

Industry 4.0 Can Boost Implementation Of Semiconductor Manufacturing
— *Sunil Banwari, Advantest*



What's New In Soldering Systems

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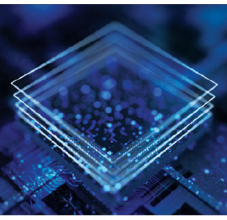
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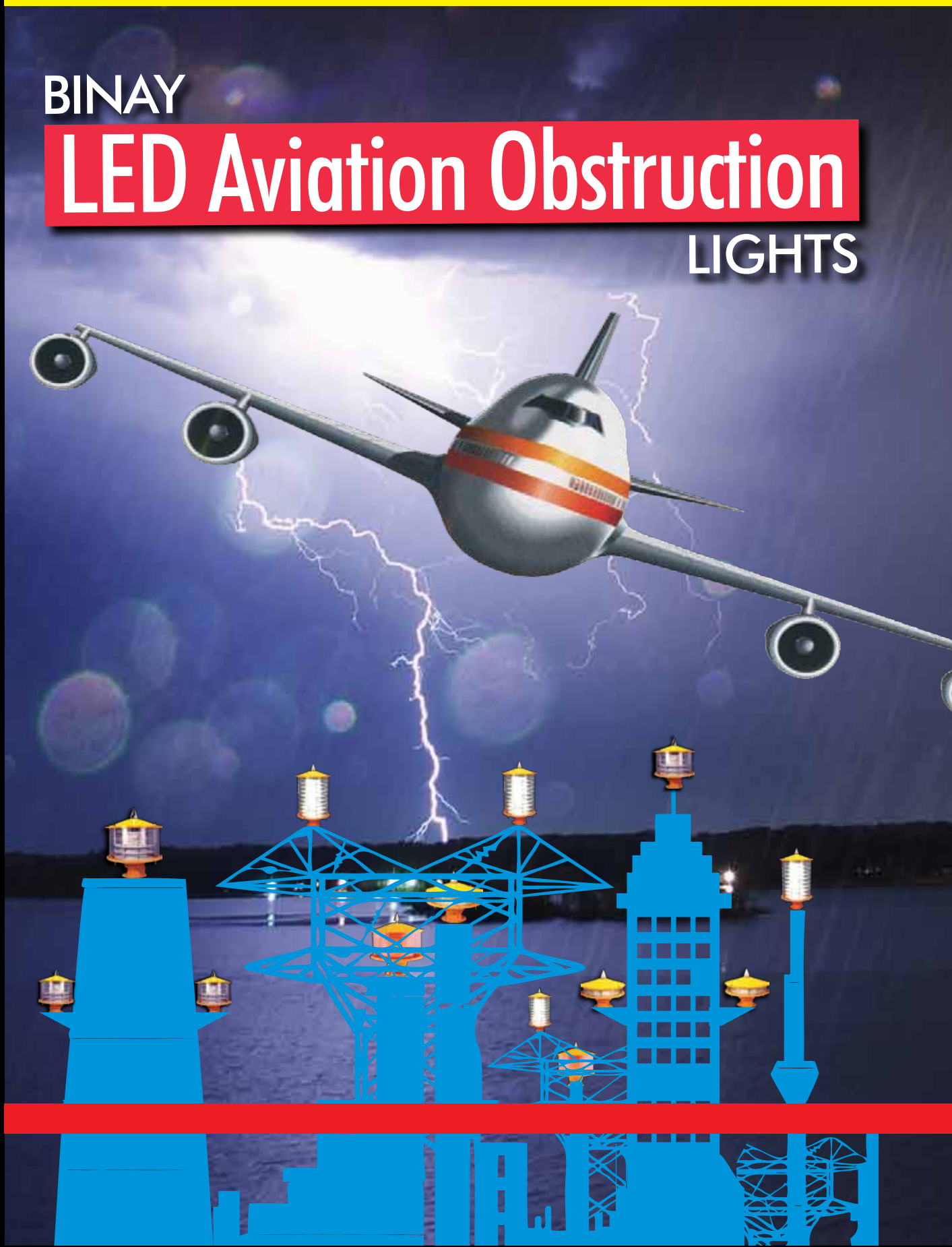


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BINAY LED-based HIGH, MEDIUM and LOW Intensity Aviation Obstruction Light Beacons

As per International Civil Aviation Organisation (ICAO) requirements
Available in Low Intensity, Medium Intensity and High Intensity versions (as per International Civil Aviation Organization guidelines), BINAY's patented LED Aviation Lights come with 5-year/3-year warranties



High Intensity
200,000 candela
(Flashing White LEDs)



Medium Intensity
20,000 candela
(Flashing White LEDs)



Medium Intensity
2,000 candela
(Flashing Red OR Fixed Red LEDs)



All BINAY Aviation Lights are based on Non-switching passive type circuitry (NO SMPS)

The circuitry incorporated inside the LED Aviation Obstruction Lights is passive electronic (solid-state) in nature, and does not use internal SMPS driver switching units to control the light unit. Internal LED current control is by non-switching electronic means only. No electrolytic capacitors are used inside the Aviation Obstruction Light unit.

The above is necessary to ensure reliability of the LED Aviation Obstruction Light. This system design effectively eliminates any active components and circuits inside the aviation light itself, and enhances the solid-state passive reliability of the LEDs (mounted in relatively inaccessible locations at the height of tall structures). This drastically reduces the possibility of component failure - and hence possibility of any maintenance requirement – in the LED Aviation Obstruction Lights themselves (which are mounted at extreme heights in the system).

The BINAY LED Aviation Obstruction Light offers the following advantages:

- Fit-and-forget maintenance-free operation
- A long life of 100,000 hours (20 years at 12 hours daily burning)
- Pays for itself within a short period of operation in the form of reduced installation, maintenance and servicing costs
- Quick Installation; Reliable operation 365 days per year
- Shock-proof and vibration-resistant
- Over-Designed Intensity to allow for natural LED intensity degradation over its operating lifetime

LED Obstruction Lighting for:

- Industrial chimneys and smokestacks
- Transmission, microwave and cellular towers
- Radio, TV and similar structural towers
- High-rise buildings and structures
- Airports and airfields

THE BINAY LED OBSTRUCTION LIGHT IS UNDER ACCEPTED PATENT, AND AS SUCH IS A PROPRIETARY PRODUCT

Binay Opto Electronics Pvt. Ltd.
(An ISO 9001:2015 Certified Company)
27, Panditia Terrace, Calcutta 700 029, India

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CONTENTS

54TH YEAR OF PUBLICATION
electronics FOR YOU
SINCE JANUARY 1969

TECHNOLOGY

20 FUTURE: The Indian Rupee Is Soon Going Digital

27 INTERVIEW: "Semicon Manufacturing Has The Potential To Generate A Huge Market For Jobs In Both Skilled And Unskilled Fields" — Chetna Mohan, President, El Camino Technologies Pvt Ltd

29 TRENDS: How To Select The Right Battery For Your e-Bike

32 TRENDS: Will 20cm SiC Wafer Be The Next Standard?

DESIGN

36 AI ML: AI Accelerators: A Long Way To Go

44 STRATEGY: The Making Of A Sturdy And Secure Autonomous e-Two-Wheeler

46 CIRCUIT: Aligning Capacitor Selection With The Latest Automotive Demands

DO-IT-YOURSELF

50 CIRCUIT IDEA: Variable Power Supply For Up To 3A Current

53 PROJECT: Make The World's Smallest Laptop For Hacking And Everything Else

58 PROJECT: Home Automation Using Apple HomeKit And ESP8266

64 CIRCUIT IDEA: Weather Station With Device Control Using Touch-Screen Display

67 PROJECT: Weather Satellite Station For Meteor M2 Reception

STRATEGY

76 
POLICY: Telecom Policy Amendment Creating Confusion: No R&D, No Value Addition Required?

82 MARKETING: How To Build A Community And Why It Matters



86 INTERVIEW: "Industry 4.0 Can Boost Implementation Of Semiconductor Manufacturing" — Sunil Banwari, Vice President, Advantest Corporation



90 MANUFACTURING: Soldering Machine Innovations Target Better Flexibility And Temperature Control



REGULARS

8 **From You:** Your Suggestions and Things You Wanted To Know!

9 **Research & Innovation Updates**

13 **Truly Innovative Electronics**

15 **New Products**

74 **Dashboard:** Key Industry Trends That Can Shape The Future Of Your Business

94 **Startups & Innovators**

98 **Industry News:** Industry Updates

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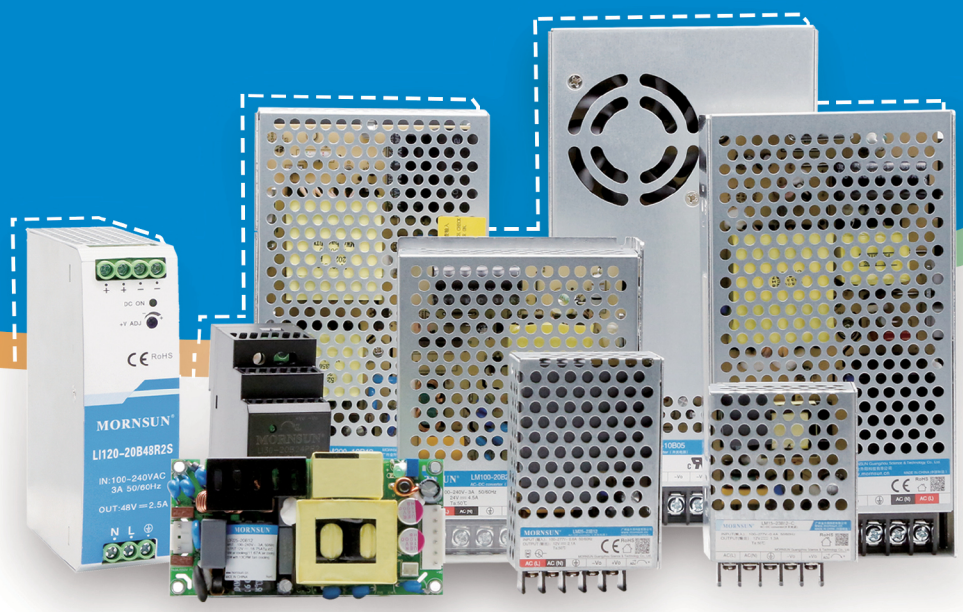
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FROM YOU

YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

NEUROMORPHIC COMPUTING

Thank you for publishing the 'Neuromorphic Computing: It's Not Sci-Fi Anymore' article in February issue. It is another revolutionary idea which might overturn our world!

Chi Tung Mak

• • •

AI CAMERA FOR TRACKING

The 'AI Camera For Tracking Suspicious Activities' DIY article published in March issue is really a very good one!

Bhuvan Vyashu

EFY. Thanks to the readers for their feedback, which keeps us going!

• • •

TOUCHLESS DOORBELL

This is regarding the 'Touchless Doorbell For The Post-Covid World' DIY article published in September 2021 issue. I am interested in building this project. It will be very helpful if you could help me by sending its PCB and component layouts in .pdf format.

Shristi

EFY. We are arranging it for you. In future, please send such requests through *support@efy.in*

HEAT-SINK

Why heat-sink details, including their dimensions, are not included in DIY articles? And how to select the heat-sinks for the ICs?

Anirvan Kule

EFY. EFY has covered several articles on heat-sinks earlier. However, some general information is being given here.

The size of a heat-sink depends not only on a particular device but also on its applications. Though heat-sink dimensions are not included in most datasheets, important parameters such as power dissipation, thermal resistance, junction temperature, and load current of a particular device or IC are mentioned in the datasheets. These parameters help decide the approximate dimensions of the heat-sinks.

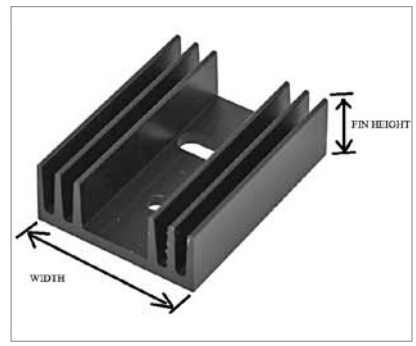


Fig. 1: A typical heat-sink for TO-220 package

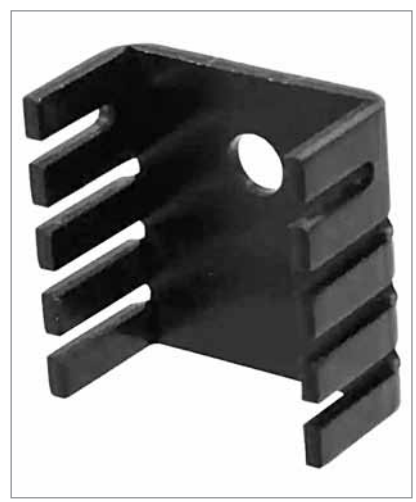


Fig. 2: A square shaped heat-sink for TO-220 package

The junction temperature in a power-handling device rises in proportion to the current consumption. The thermal resistance of the device is important because most electrical components generate heat and need to be cooled. The main goal of the heat-sink is to maintain the temperature below the specified maximum operating temperature of the device.

Selecting a heat-sink becomes simpler when you have the datasheet of the device or regulator IC. You can choose it as per the device's package, requirements, and applications. There are many readymade heat-sinks available in the market. The most common types of heat-sinks for TO-220 package regulators have natural convection cooling with or without fan.

Regulator ICs like LM317, LM78xx, LM79xx, and L200C are available in TO-220 packages. Fig.1 shows width and fin height of natural convection heat-sink for TO-220 package IC. It is an extrusion TO-220 package type heat-sink with the dimension of 35mm × 29mm × 12mm (length, width, fin height), suitable for use with a device having thermal resistance up to 15.2°C per watt.

Aluminium heat-sinks having large width rather than greater fin height are preferred. Also, if the heat-sink surface is anodised or painted, it increases heat radiation.

A commonly used heat-sink for 2.5W power dissipation at 60°C and thermal resistance up to 24°C per watt is shown in Fig. 2. It is a black anodised aluminium type heat-sink with dimensions of 19.05mm × 19.05mm × 9.65mm height. For more information on heat-sinks, you may visit following three websites:

1. *https://www.electronicspecifier.com/news/blog/how-to-specify-the-optimal-heat-sink-for-your-design*
2. *https://www.nutsvolts.com/magazine/article/how_to_intro_to_heat-sink_selection_and_installation*
3. *https://www.electronics-cooling.com/1995/06/how-to-select-a-heat-sink*

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Smartwatch that measures stress hormone

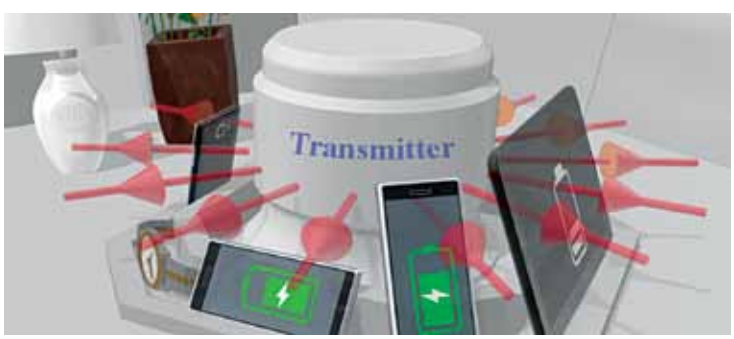
A hormone called cortisol gets produced in the human body, which is key to identifying conditions such as depression and post-traumatic stress when levels of the hormone increase. Cortisol levels traditionally have been evaluated through blood samples. While those measurements help diagnose certain diseases, they fail to capture changes in cortisol levels over time. Now, a UCLA research team has developed a smartwatch that assesses cortisol levels found in sweat—accurately, noninvasively, and in real time. In the new smartwatch, a strip of thin adhesive film collects tiny volumes of sweat. An attached sensor detects cortisol using engineered strands of DNA, called aptamers. When cortisol attaches, the aptamer changes shape in a way that alters electric fields at the surface of a transistor.



Cortisol is well-suited for measurement through wearable devices, because its concentration levels in sweat are similar to its circulating levels (Credit: https://newsroom.ucla.edu)

Wireless charging for home use

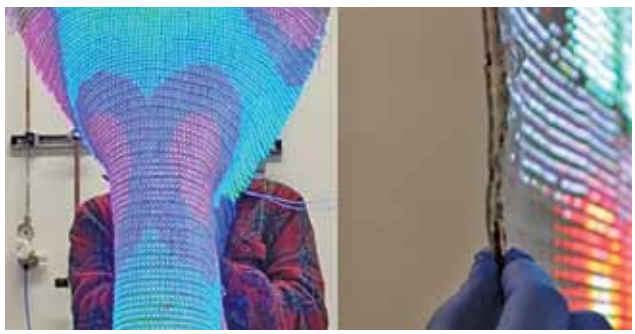
Existing wireless charging systems are known to transfer power in a specific direction or position. Now, researchers at Aalto University have developed a new wireless charging system that can charge devices placed anywhere within a certain radius around it. For this, a cylindrical power coil has been designed that has wires at the top and bottom wound in the opposite directions, with a z-shaped bridge connecting them. Current flows through these windings in opposite directions, producing complementary magnetic fields. This results in an even magnetic field around the middle of the charging coil, allowing receivers placed anywhere within that area to charge efficiently, regardless of their position or orientation. By providing a donut-shaped charging field, the new system offers a more convenient and reliable design for consumer use.



A new wireless charging technology opens the door to developing charging stations for consumer use (Credit: www.aalto.fi/en)

Fully woven display with smart sensors

An international team of scientists, led by researchers at the University of Cambridge, have produced a fully woven smart textile display that integrates active electronic sensing, energy, and photonic functions. The functions are em-



Researchers have developed a 116cm (46-inch) woven display with smart sensors, energy harvesting and storage integrated directly into the fabric (Credit: www.cam.ac.uk)

bedded directly into the fibres and yarns, which are manufactured using textile based industrial processes. Each fibre component is coated with materials that can withstand enough stretching. Some of the fibre based components are also braided to improve their reliability and durability. Finally, multiple fibre components are connected together using conductive adhesives and laser welding techniques. This approach could lead to applications such as curtains that work as TVs, energy-harvesting carpets, and interactive, self-powered clothing and fabrics.

Breakthrough for producing superior supercapacitor batteries

Existing supercapacitors are too large for many applications; they need to be about the same size as the battery they are connected to, which is an obstacle to integrating them in mobile phones or electric cars. Therefore, researchers at Chalmers University of Technology have developed a

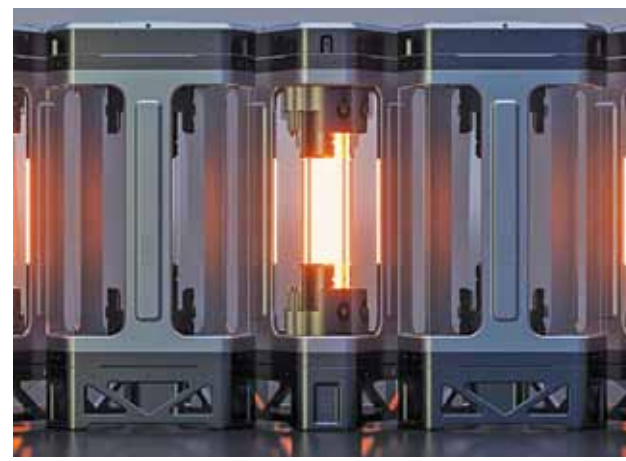


The image shows a 5cm wide silicon wafer with integrated micro supercapacitors, manufactured using the CMOS-compatible process (Credit: www.chalmers.se/en)

breakthrough method that can revolutionise how supercapacitors are produced. The proposed 'micro' supercapacitors are so small that they can fit on the system circuits that control various functions in mobile phones, computers, electric motors, and almost all electronics used today. Micro-supercapacitors of up to ten different materials can also be unified in a single manufacturing process, which means that properties can be easily tailored to suit several different end applications.

Possibility of having next-gen quantum batteries

In a key step towards making quantum batteries a reality, researchers at the University of Adelaide and their overseas partners have successfully proved the concept of superabsorption, a crucial idea underpinning quantum batteries.

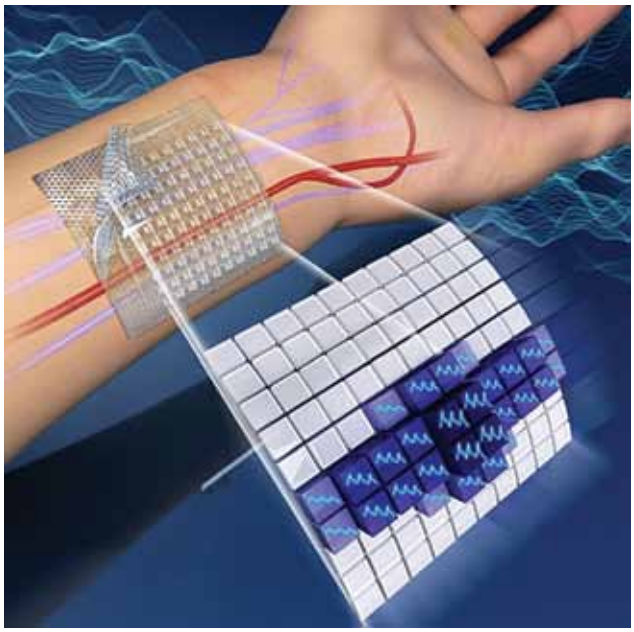


Superabsorption unlocks key to next generation quantum batteries (Credit: www.adelaide.edu.au)

For this, the team built several wafer-like microcavities of different sizes which contained different numbers of organic molecules. Each was charged using a laser. As per a researcher, it is theoretically possible that the charging power of quantum batteries increases faster than the size of the battery, which could allow new ways of speed charging. The idea of the quantum battery has the potential to significantly impact energy capture and storage in renewable energy and in miniature electronic devices.

Thin sensor patches for measuring pulse waves

Pulse wave is an important bio-signal that indicates the status of cardiovascular health. Conventional pulse wave measuring devices, such as blood-pressure measuring cuff or stiff tong-shaped sensor, measure signals only at a single location, leading to less precise measurements. So, to ease

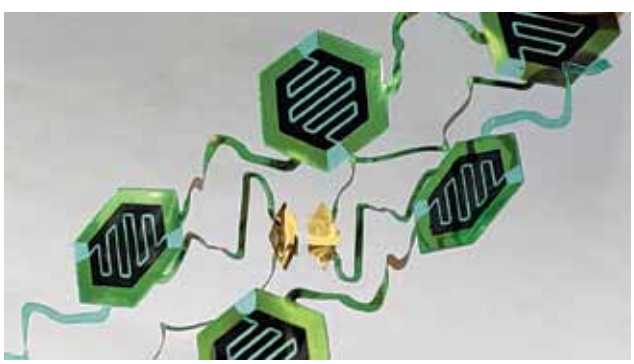


Wearable sensor patch that's thinner than a hair strand and can measure pulse wave signals with high precision (Credit: POSTECH)

the measurement and diagnosis of cardiovascular issues, a research team from the Pohang University of Science and Technology, in collaboration with the School of Energy and Chemical Engineering at Ulsan National Institute of Science and Technology, has developed a wearable sensor patch that's thinner than a hair strand. It consists of 100 sensor pixels that help in obtaining a relevant two-dimensional pressure map of the wrist.

Wearable sensor that replaces photolithography

Wearable sensors help gather medical data from patients over extended periods of time. These devices consist of flat wires as well as sensors, power sources, and antennas. To maintain full functionality, they must stretch, flex, and twist with the skin and organs they are mounted on—



A supercapacitor array made using a new fabrication technique that is faster and less expensive than photolithography (Credit: https://engineering.berkeley.edu)

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without generating strains that compromise the electronic circuitry. So, engineers at UC Berkeley have developed a new, inexpensive technique for making wearable sensors that enable medical researchers to achieve their goals much faster. The new technique replaces photolithography—an expensive, multistep process for making computer chips. To achieve low-strain flexibility, an 'island-bridge' houses rigid electronics and sensor components. The bridges link the islands to one another. Their spiral and zigzag shapes stretch like springs to accommodate large deformations.

Low-energy chip that protects personal data

Side-channel attacks aim to gather secret information by indirectly exploiting a system or its hardware. Current prevention methods are power-intensive and unfeasible for

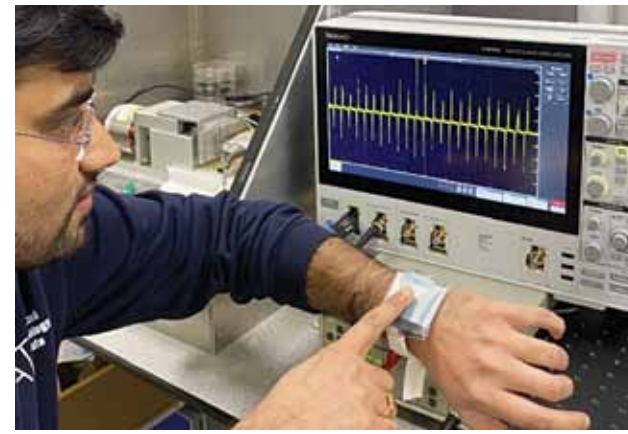


An application-specific integrated circuit chip that can be implemented on an IoT device to defend against power-based side-channel attacks (Credit: https://news.mit.edu)

low-power IoT devices like smartwatches. Now, engineers at MIT have built an integrated circuit chip that can defend against power side-channel attacks while using much less energy. The chip could be incorporated into a smartwatch, smartphone, or tablet to perform secure machine learning computations on sensor values. Rather than having a neural network operate on actual data, the chip is based on threshold computing in which the data are first split into unique, random components. The network operates on those random components individually, in a random order, before accumulating the final result.

Energy-harvesting wrist device made of discarded material

Scientists at the University of Surrey have unveiled a wrist device made from discarded paper wipes and plastic cups that runs on energy harvested by the wearer's movements. The prototype device can transmit Morse code. The device is self-powered thanks to materials that become electrically

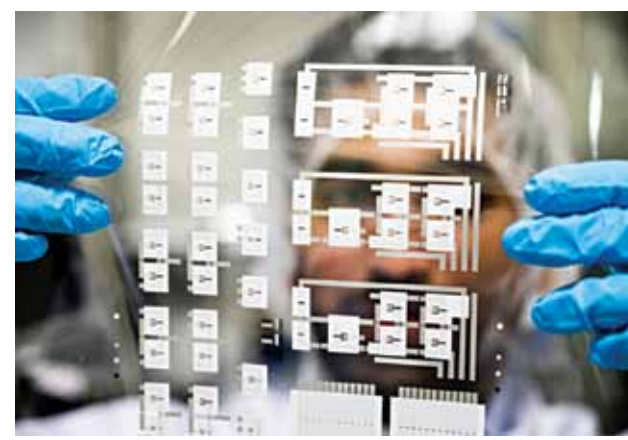


Wearable devices could soon be entirely made of recycled waste materials, and powered by human movement (Credit: www.surrey.ac.uk)

charged after they come into contact with one another. Known as triboelectric nanogenerators, they use static charge to harvest energy from movement through a process called electrostatic induction. The wearable device could be a future game-changer for the consumer, medical, and security sectors.

Printed transistors emulate neurons and synapses

In 2018 the research group at Linköping University developed complementary and printable organic electrochemical circuits, which made it possible to build printed complementary organic electrochemical transistors. The group had subsequently optimised the organic transistors, so that they



Artificial organic neurons (Credit: https://liu.se/en)

can be manufactured in printing presses on thin plastic foil. Now the group has used the printed transistors to emulate the neurons and synapses of the biological system. The hope is that artificial nerve cells can be used for sensitive human prostheses, implantable systems for relieving neurological diseases, and soft intelligent robotics.

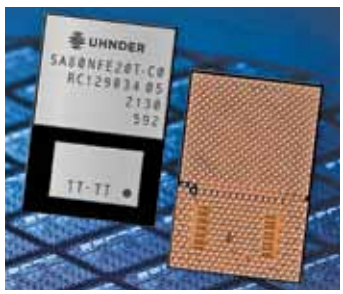
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INNOVATION UPDATES

Amongst numerous press releases of new products received by us, these are the ones we found worthy of the title *Truly Innovative Electronics*

Digital imaging radar

The 4D digital imaging radar-on-chip aims to enable next-generation advanced driver assistance systems, autonomous vehicles, and automated



mobility applications to seamlessly operate on roadways. Based on digital code modulation, the digital radar solution comes with better accuracy and power to sense moving or standing objects, large or small, at both short and long distances in all weather and lighting conditions, all while mitigating mutual interference between other radars. The digital radar can clearly identify a pedestrian crossing the road, a child entering the street from beside a parked car, or a bicyclist next to a guard rail, at levels of accuracy that legacy analogue radar systems cannot achieve.

Uhnder
www.uhnder.com

Wafer-on-wafer processor

The world's first 3D wafer-on-wafer (WoW) processor—the Bow IPU—delivers up to 40% higher performance and 16% better power efficiency for real world AI applications than its predecessors, all for the same price and requiring no changes to existing software. WoW bonds two wafers together to generate a new 3D die. The first wafer is for AI processing and is architecturally compatible with the GC200 IPU processor. It has 1472 independent IPU-core tiles



and is capable of running more than 8800 threads. The second wafer is a power delivery die and features deep trench capacitors that enable a large performance increase thanks to being located right next to the processing cores and memory.

Graphcore
www.graphcore.ai

Molecular electronics chip

The first molecular electronics chip has been developed, realising a 50-year-old

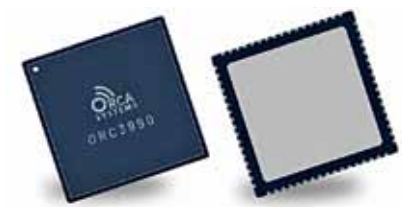


goal of integrating single molecules into circuits to achieve the ultimate scaling limits of Moore's Law. The chip uses single molecules as universal sensor elements in a circuit to create a programmable biosensor with real-time, single-molecule sensitivity, and unlimited scalability in sensor pixel density. This innovation will power advances in diverse fields that are fundamentally based on observing molecular interactions, including drug discovery, diagnostics, DNA sequencing, and proteomics.

Roswell Biotechnologies
www.roswellbiotech.com

Wireless SoC for satellite IoT

The ORC3990 is the first wireless system-on-chip (SoC) solution for the satellite Internet of Things (IoT) that meets the demands of satellite IoT connectivity. The SoC integrates all



required system functions into a single, cost-effective device in a very small 68-QFN package. An essential building block of the SoC design includes a flexible, third-generation Live Wireless RF, and digital radio subsystem. Additional function blocks integrated within the ORC3390 SoC include a low noise amplifier, a digital power amplifier, power management unit subsystem, including all analogue blocks, dual Arm Cortex-M0 + CPUs for separate network and application processing, all necessary memory (volatile and non-volatile) for the on-chip CPUs, required security functions, and key analogue and digital peripherals.

Orca Systems
www.orcasystems.com

Indoor light harvesting sensors

The ERS Eco and ERS Eco CO2 comprise a battery-free sensor line that uses Epishine's indoor light energy

harvesting solution. It is environmentally friendly and made from biodegradable materials. The ERS Eco series enables customers to have complete



control over their air quality and indoor environment. This saves money and reduces its CO_2 footprint, and its battery-free operation reduces the CO_2 footprint even further. This combination of energy harvesting from indoor light, battery-free operation, and a biodegradable enclosure makes a truly unique and ground-breaking product for IoT and building automation.
ELSYS
www.elsys.se

Accelerator in memory chip

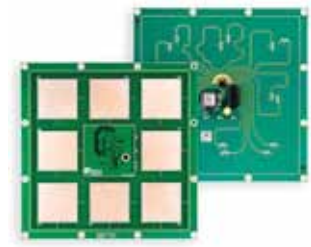
The GDDR6-AiM (accelerator in memory) adds computational functions to graphics DDR (GDDR6)



memory chips, which process data at 16Gbps. A combination of GDDR6-AiM with CPU or GPU instead of a typical DRAM makes certain computation speed 16 times faster. GDDR6-AiM can be widely adopted for machine learning, high-performance computing, and big data computation and storage. GDDR6-AiM runs on 1.25V, lower than the existing product's operating voltage of 1.35V. In addition, it reduces data movement to the CPU and GPU, reducing power consumption by 80%.
SK hynix
www.skhynix.com

Bluetooth antenna board

The u-blox ANT-B10 antenna board for Bluetooth direction finding and indoor positioning applications enables low power, high precision indoor positioning, and speeds up evaluation, testing,



and commercialisation of Bluetooth direction finding and indoor positioning solutions. ANT-B10 features an antenna array comprising eight individual patch antennas and is built around a u-blox NINA-B411 Bluetooth 5.1 module. After processing incoming RF signals emitted by mobile tracker tags in the module's radio and angle calculation processor, the solution outputs the calculated angle of arrival without requiring any additional processes.
u-blox
www.u-blox.com

Laser module for smart glasses

The Vegalas laser emitter module promises to reduce the size of the projection light engine in augmented reality (AR) and mixed reality (MR)



smart glasses by up to half, opening up the potential to develop information-rich smart glasses, which are as stylish and fashionable as the normal sunglasses. The design for the Vegalas module combines three powerful lasers at red (640nm), green (520nm), and blue (450nm) wavelengths in a robust, surface-mount package. The package is hermetically sealed to prevent contamination and degradation of the module's laser chip-on-submount emitters. It has a footprint of 7.0mm × 4.6mm and is 1.2mm high.
ams-OSRAM
www.osram.com

Camera for images on edge

The Nicla Vision is a brand new, ready-to-use, 2MP standalone camera that lets you analyse and process images on the edge for advanced machine vision and edge computing applications. Now you can add image detection, facial recogni-



tion, automated optical inspection, vehicle plate reading, gesture recognition and more to your projects. Nicla Vision has a powerful dual processor and is packed with features for applications possible in building and industrial automation, safety and security, and prototyping. Because of the small size of Nicla Vision, it can be used anywhere in a tight spot.
Arduino
www.arduino.com

Smallest energy harvesting NB-IoT module

The Autonomous NB-IoT Development Solution (ANDS) is the world's smallest energy harvesting NB-IoT module, featuring pioneering nuSIM technology. The ANDS brings together a Murata module for low-power wireless transmission with Deutsche Telekom's



integrated nuSIM technology to provide network connectivity and an advanced Nowi PMIC to power the solution with ambient light energy. The ANDS aims to encourage more widespread IoT proliferation to help customers complete their development projects quicker. With the combination of three components, the module can fit into the most space-constrained applications.
Nowi
www.nowi-energy.com

NEW PRODUCTS

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COMPONENTS

32-bit Hi-Fi DAC

The BD34352EKV digital-to-analogue converter (DAC) IC supports playback of high-resolution sound sources



in high-fidelity audio equipment. Designed to maximally extract and convert high-resolution digital audio data to analogue audio signals, audio DAC chips are one of the most important components for determining the quality in audio equipment. The BD34352EKV maintains a natural flat sound while at the same time an advanced digital filter is included. This leads to superior numerical performance (S/N ratio of 126dB, THD + N of -112dB) of the DAC chip, making it ideal for high-end audio equipment.

ROHM Semiconductor
www.rohm.com

Smallest SD card level translator

The NXS0506UP is the world's smallest secure digital (SD) card level translator IC. Housed in a 16-bump wafer-level

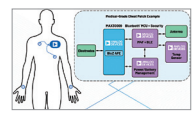


chip-scale package, the SD 3.0-compliant bi-directional dual voltage level translator features integrated auto-direction control, EMI filter, and IEC 61000-4-2 ESD protection. Designed to operate at clock frequencies of up to 208MHz and data rates of up to 104Mbps, it also features integrated pull-up and pull-down resistors to reduce the BOM cost. Devices provide direct connection to the latest host CPU/SOC ASICs and are easy to use because DATA and CMD channels are swappable without impacting functionality.

Nexperia
www.nexperia.com

Low-power BioZ analogue front-end

The MAX30009 is a low-power, high-performance bioimpedance (BioZ) analogue front-end (AFE) that reduces the size and extends the life of BioZ



remote-patient monitors. For developers of small, battery-powered, continuously wearable devices, this AFE on a chip offers clinical-grade vital sign measurements of bioimpedance analysis for patient health assessment for wellness wearables and medical-grade patches. The MAX30009 has a range of options to enable use-case power optimisation, thus extending the operational life of BioZ wearables. It reduces power consumption by 62% and has 30% smaller size than other alternatives, allowing designers to help users measure their vital signs more comfortably.

Analog Devices
www.analog.devices

High-precision pressure transmitters

The AVD series of pressure transmitters are available in three versions



for different pressure measurement ranges, including 0 to 16mbar, 0 to 100mbar, and 0 to 7bar. The series offers high precision levels for low-pressure ranges, such as ±1.75% full scale with a pressure range of 100mbar. The compact piezoresistive pressure transmitters based on MEMS technology are suitable for the pressure measurement of air and non-aggressive gases. In addition to differential pressure measurement, they can also measure over-pressure in a temperature range of -20°C to +70°C.

TDK Corporation
www.tdk.com

Crankshaft and camshaft sensor

The ATS16951 and ATS16351 are two new state-of-the-art giant magnetoresistance (GMR) crankshaft and camshaft sensors, respectively.



They provide manufacturers with a single-vendor solution that's ideal for hybrid vehicle engines, with uses extending to two-wheelers, off-road vehicles, and application designs requiring extended air gap performance. Both sensors help engine designers reduce system complexity, cost, and energy consumption, thus boosting efficiency and minimising carbon footprints. The ATS16951 combines electrical requirements and package size of legacy solutions with sensing location flexibility. The ATS16351 is highly programmable and allows manufacturers to optimise the TPOS performance across a variety of engine designs.

Allegro MicroSystems
www.allegromicro.com

Automotive Gen 4 PCIe switches

The Gen 4 automotive-qualified PCIe switches, which include Switchtec PFX, PSX, and PAX switch solutions,



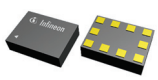
provide cutting-edge compute interconnect capabilities for advanced driver assistance systems (ADAS). Switchtec Gen 4 PCIe switches offer a high-speed interconnect that supports distributed, real-time, safety-critical data processing in ADAS architectures. PCIe is emerging as the preferred compute interconnect solution for the automotive industry.

It provides ultra-low latency and low-power bandwidth scalability to CPUs and specialised accelerator devices. Now high-speed, low-latency connectivity can be easily achieved for distributed, heterogeneous compute systems

Microchip Technology
www.microchip.com

Antenna tuners

The new range of innovative antenna tuners, including BGSA144ML10, BGSA400ML10, BGSA403ML10, and



BGSA14M2N10, are suitable for sub-7.2GHz New Radio applications, supporting both 4G and 5G in smartphones, notebooks, wearables, VR headsets, smart homes, and other cellular applications. RF engineers can now face the challenge of complex antenna design brought by increasing connected devices and introduction of 5G.

Infineon Technologies
www.infineon.com

General-purpose microprocessor

The RZ/Five general-purpose microprocessor unit (MPU) built around a 64-bit RISC-V CPU core employs the



Andes AX45MP, based on the RISC-V CPU instruction set architecture (ISA). It augments the company's previously available Arm CPU core based MPUs, expanding customer options and providing more flexibility in the product development process. RZ/Five is optimised to provide the performance and peripheral functions required of IoT endpoint devices. It comes in a small, compact package to address less complex designs more efficiently.

Renesas Electronics
www.renesas.com

Depth image sensor

VD55H1 is the first of a series of high-resolution time-of-flight sensors that bring advanced 3D depth imaging to smartphones and other devices. The sensor maps three-dimensional



surfaces by measuring the distance to over half a million points. Objects can be detected up to five metres from the sensor, and even further with patterned illumination. It addresses emerging AR/VR market use cases, including room mapping, gaming, and 3D avatars. In smartphones, the sensor enhances the performance of camera-system features, including bokeh effect, multi-camera selection, and video segmentation. Face-authentication security is also improved with higher resolution and more accurate 3D images. In robotics, the VD55H1 provides high-fidelity 3D scene mapping for all target distances.

STMicroelectronics
www.st.com

Diode for system protection

The DZDH0401DW is a diode controller for system protection against reverse discharge. Emulating an



ideal diode by driving a P-channel MOSFET, the controller provides the high-side rail isolation necessary for reverse current blocking in systems up to 40V. The compact size and high performance capabilities of this arrangement mean that it is optimised for use in cordless power tools and autonomous household/garden appliances, such as smart vacuum cleaners and smart lawnmowers. It is also well-suited for other applications, including OR-ing rectifiers used in the hot-swappable and N + 1 redundancy power supplies used in data centre servers.

DIODES Incorporated
www.diodes.com

NAND flash controllers

The new S9 family of secure digital (SD) and microSD memory card controllers provide reliable NAND flash controllers for meeting the



requirements of demanding applications with turnkey firmware. The controller's FlashXE ECC and hyReliability features guarantee extended endurance, data integrity, and power-fail safety coping with demanding applications in markets such as industrial automation, telecom, networking, and medical equipment. With the hyMap flash translation layer, the S9 achieves minimal write amplification and maximum endurance, which enables an efficient use of 3D NAND flash, resulting in lowest field failures over time.

Hyperstone
www.hyperstone.com

Gluon coprocessor for edge

The Gluon coprocessor for edge AI inference claims to deliver competitive



performance compared to Nvidia in vision workloads such as object detection. Gluon is based on an instruction set architecture (ISA) optimised for AI. The ISA refers to the instructions that a chip can process.



WE LOVE TO SHOWCASE NEW PRODUCTS!

Launched a New Product related to electronics?
Share its details with us at newproduct@efy.in
Send a photo too. We will be happy to review it, and if it matches our guidelines—we will publish it here, for FREE!

Gluon has 8 TOPS that give higher utilisation (higher performance per TOPS), resulting in higher performance. Gluon further supports PCIe and LPDDR4 interfaces. As a coprocessor targeted at the edge segment, where power is often a constraint, Gluon is aimed at vision workloads, such as classification and detection. Segments where these capabilities are applied include surveillance, industrial, retail, and smart cities.

AlphaICs
www.alphaics.ai

BOARDS & MODULES

Power supplies for LED lighting

The LCM4000HV series of configurable power supplies uses a new power system that features hot swap



functionality and simplifies installation, maintenance, and scalability of high-volume LED lighting projects, such as horticultural and commercial lighting. Rated for up to 4000W and operating with efficiencies of up to 95%, the LCM4000HV single-phase AC-DC high-voltage power modules, combined with the new LCM12K 19" 1U rack mount shelf, create a centralised current source for medium- to large-scale LED lighting installations. The modules provide a flicker-free current source from 0 to 16A at an output voltage between 100 and 300V DC. Input voltage options are 187 to 364V AC and 311 to 528V AC.

Advanced Energy
www.advancedenergy.com

High-speed digitiser cards

Two new PCIe digitiser cards, M5i.3330-x16 and the M5i.3337-x16, bring next generation performance to



PC based instrumentation. Using 16-lane, Gen 3 PCIe technology, the cards are capable of streaming acquired data over the bus at a staggering 12.8GB/s - nearly twice as fast as any other PCIe digitiser currently available. The M5i.3330-x16 is a single-channel card that can sample at rates up to 6.4GS/s while the M5i.3337-x16 is a dual-channel card that offers synchronous 3.2GS/s sampling on both channels, or the full 6.4GS/s on a single channel. Designed to handle a wide variety of signals, the cards feature fully functional front-end electronics with over 2GHz bandwidth, programmable full-scale ranges from ±200mV to ±2.5V, and variable offset.

Spectrum Instrumentation
www.spectrum-instrumentation.com

DC-DC converters

The introduction of three new parts with single outputs of 24V (21.6-26.4V), 48V (43.2-52.8V), and 54V (48.6-59.4V) that retain the wide 8:1



input range of the company's PKE8000A series suit implementation for a wide range of industrial, transportation, RFPA, and IT applications. Encapsulation of these power-dense DC-DC converters provides mechanical protection and reliable operation in environments with high shock and vibration levels or with high dust/humidity. An output power of 40W is available at high ambient temperatures with convection cooling, enabled by innovative design that maintains high conversion efficiency across the load and input voltage range. Maximum case operating temperature is 115°C with derating.

Flex Power Modules
www.flexpowermodules.com

Pulse motion controllers

The AMP-104C and AMP-304C pulse motion controller series, based on the PCI Express interface, provide high performance and exceptional



accuracy. These controllers are engineered specifically to satisfy motion control equipment requirements in numerous high-growth electronics manufacturing fields, including the semiconductor, AOI, and LED industries. The AMP-104C is an entry-level controller that enables reliable and accurate execution of basic point-to-point motion. The AMP-304C offers incredible speed and precision while coming with the DIN-304C dedicated terminal board to help simplify cable distribution. Both AMP models feature a two-in-one design that combines motion control and I/O functionality.

ADLINK Technology
www.adlinktech.com

Server-on-module families

Three new server-on-module families have been launched that come in size E and size D for accelerating the next generation of real-time microserver



workloads in rugged environments and extended temperature ranges. Up to 20 cores, up to 1TB RAM, double throughput per PCIe lanes to Gen 4 speed are included, as well as up to 100GbE connectivity and TCC/TSN support. Target applications range from industrial workload consolidation servers for automation, robotics, and medical backend imaging to outdoor servers for utilities and critical infrastructures—such as smart grids for oil, gas, and electricity as well as rail and communication networks—and include vision enabled applications, such as autonomous vehicles and video infrastructures for safety and security.

congatec
www.congatec.com

AC-DC power supplies

The TPI 300 (industrial grade) and TPP 300 (medical grade) series are a set of encapsulated AC-DC power supplies coming as open-frame and



encased versions. They feature a reinforced double I/O isolation (3000V AC) system according to latest medical or industrial safety standards, respectively. With focus on the medical market, the TPP series also has a low leakage current of < 100µA, which makes the units suitable for body floating applications. An efficiency of up to

93% allows a high power-density. The operating temperature range is -40°C to +85°C, with derating above 50°C. The TPI 300 and TPP 300 are ideal for industrial and medical devices and for demanding safety and space-critical applications.

Traco Power
www.tracopower.com

Product development solution

The nRF21540 development bundle (DB) design tools for verification and testing of applications that require



range extension or link budget improvements comprise the nRF21540 Development Kit (DK) and the nRF21540 Evaluation Kit (EK). The nRF21540 DK is ideal for application performance testing of designs. It incorporates the nRF21540 RF FEM and has two chip antennas and ports for antenna diversity and additional SWF connectors for making direct RF measurements. The nRF21540 EK is a shield incorporating the nRF21540 RF FEM and can be used for easy radio testing and development.

Nordic Semiconductor
www.nordicsemi.com

Raspberry Pi based industrial computer

The new and compact Factor 201 Raspberry Pi-powered computing device is intended for use as an industrial gateway, automation controller,



or edge computer. In addition to the Raspberry Pi CM4, the system features an operating temperature range of -20 to +60°C, options for DIN rail or wall mounting, and 12-24V power input. The device can also be powered via an Ethernet cord, utilising PoE power delivery, enabling single cable installation to provide both network access and power to the device. Multiple memory and storage options allow users to match the device to the unique demands of their project.

OnLogic
www.onlogic.com

T&M SOLUTIONS

Versatile LCR meter series

These LCR meters measure AC components of 4Hz to 10MHz for all practical applications. Part of the R&S LCX family, the LCR meter series serves



all established impedance measurements plus specialised measurements for selected component types. It provides the high accuracy required in R&D and the high speed needed in production test and quality assurance. It is suitable not only for most devices operating at conventional 50 or 60Hz domestic power frequencies, or 400Hz for aircraft, but also for everything from low-frequency seismic sensors to high-power communication circuits operating at several megahertz.

Rohde & Schwarz
www.rohde-schwarz.com

Oscilloscope for optical signals

The new 25G clock recovery range expansion option MP2110A-059 upgrades the BERTWave MP2110A sampling oscilloscope clock recovery rate required



for testing optical signals. It facilitates optical-waveform tests of fibre channel compliant 64GFC PAM4 optical modules in a clock-signal-free test environment. The upgrade helps assure the quality of 64GFC PAM4 optical modules while simplifying the production line configuration to cut costs. The all-in-one MP2110A BERTWave combines a bit-error-rate tester with a sampling oscilloscope for evaluating communications waveforms.

Anritsu Corporation
www.anritsu.com

PCI Express 6.0 test solution

The PCI Express 6.0 is an important and scalable base transmitter test solution for data-intensive markets, such as data centres, artificial intelligence/machine learning, and high-performance computing. To meet ever growing performance demands, PCIe 6.0 standard transitions to PAM4 signalling and new innovative error-correcting



techniques. The test solution includes PCIe 6.0 measurement-specific software, enhanced PAM4 DSP capabilities, and noise compensation on the oscilloscope for increased accuracy of results. It is further enhanced by industry-leading analysis tools for SNDR and uncorrelated jitter measurements, which are both mandated requirements for the PCIe 6.0 standard.

Tektronix
www.tektronix.com

100Gb/s PAM4 Ethernet test platform

The addition of a new 100GbE Layer-1 adaptor in the SierraNet M648 test platform enhances the device's ability for high-speed storage and communica-



tions while also supporting the examination and modification of Ethernet and fibre channel links that utilise both PAM4 and legacy Non-Return to Zero technologies. By adding the new SierraNet 100GbE Layer-1 adaptor, the SierraNet M648 can now capture and analyse 100GbE single lane auto-negotiation and link training.

Teledyne LeCroy
www.teledynelecroy.com

Semiconductor wafer probing system

The TESLA300 high-power semiconductor probing system has been designed specifically for IGBT and power MOSFET device measurements. The TESLA300 provides accurate data at



up to 10,000V and up to 600A current on 300mm wafers. Integrating new anti-arcing and wafer automation capabilities, the TESLA300 enables high-throughput, unattended testing over a wide thermal range to speed development and lower production cost of power devices.

FormFactor
www.formfactor.com

SOFTWARE

Single licence for T&M software bundle

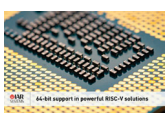
A test workflow bundle has been launched that helps engineers automate test systems through a single software licence. This subscription based bundle provides access to popular test and measurement software, including LabVIEW, TestStand, FlexLogger and DIAdem, enabling engineers working on research validation and production test applications to gain actionable insights, improve test system development, deliver more value from test data, and get products to market faster. With the ability to scale up or down as needed, users have additional control over project costs.



NI
www.ni.com

Support for 64-bit RISC-V solutions

The newly introduced support for 64-bit RISC-V cores is a complete C/C++ compiler and debugger toolchain. It has everything integrated in one single IDE, including integrated code analysis tools, ensuring code quality. It is beneficial for embedded developers to ensure their application fits the required needs and optimise the utilisation of on-board memory. In addition, symmetric multicore processing is now supported, enabling high-performance debugging of multicore RISC-V devices.



IAR Systems
www.iar.com

Monitoring software

The LIN monitoring software PLIN-View Pro version 3 helps PC interfaces with LIN connection (PCAN-USB Pro, PCAN-USB Pro FD, PLIN-USB) to script code implementations for different LIN elements in the software. Scripting is done with the programming language Microsoft C#. The data of publisher frames from the Transmit and Publish lists can be modified as well as entries of schedule tables. For different events for these elements, a C# script can be specified in each case. The new output gives the user various feedback options about loading processes of projects or LDF files, and an additional output option for C# scripts.



PEAK System
www.peak-system.com

Software development kit

With the new version 5.70, the OPC UA C++ software development kit (SDK) comes with more enhanced options. With the help of reverse connect, users can now easily establish a secure OPC UA connection with OPC UA clients across the firewall using their product's OPC UA server without opening internal binding ports. Use cases for reverse connect include company-wide, cross-domain connectivity, industrial IoT, and Industry 4.0 applications, and secure field-to-cloud OPC UA data connections. The OPC UA C++ SDK is available for Windows, Linux, and VxWorks.



Softing
www.softing.com

CHEMICALS & ADHESIVES

Liquid flip-chip flux

A new liquid flux has been developed that meets process needs for low-temperature flip-chip applications. WS-3910 is a water-soluble, halogen-free flip-chip flux that is designed for low-temperature (150°C) bismuth-tin applications. WS-3910 is chemically designed to exhibit minimal evaporation after application. Its composition also eliminates compatibility underfills by having a completely water-cleanable residue.



Indium Corporation
www.indium.com

ENTERPRISE CLASS

Data storage optimising solution

The auto-tiering function for the EonStor CS optimises read/write performances and utilises storage capacity for mass data analytics, such as in large-scale, high-performance computing (HPC). Auto-tiering utilises the high-performance of SSDs and the massive capacity of HDDs. The system automatically allocates the processing 'hot data' onto high-performance SSDs to meet the mass data read/write requirements of HPC analytics. Once the data have been finalised, they are identified as 'cold data' and moved to HDDs with PB-level capacity for archiving purposes.



Infortrend
www.infortrend.com

5G-ready embedded computing system

The ASB200-953 is a compact SBC that is powered by 11th Gen Intel Core i7-1185G7E, i5-1145G7E, and i3-1115G4E processors (formerly Tiger Lake) with a 15W TDP threshold. Aimed at smart applications in warehouse logistics management, factory automation, and the automotive industry, the fanless ASB200-953 features high performance with low power consumption. With a black colour chassis, it supports up to 64GB in two SO-DIMM slots and 12V ~ 24V wide-range DC power input. The panel is equipped with digital I/O, power button, HDD LED, DC-in terminal block, and two antenna holes that can be used with the optional Wi-Fi accessory kit



IBASE Technology
www.ibase.com.tw

The INDIAN RUPEE Is Soon GOING DIGITAL

Every other day, the lunch table conversation steers into murky waters like cryptocurrencies and central bank digital currencies. Some are for it, some are against, very few admit that it is all very confusing, while in fact, it is! Enjoy your dessert, while we give you a simple, no-tension rundown of the digital currency scene



JANANI G. VIKRAM is a freelance writer based in Chennai, who loves to write on emerging technologies and Indian culture. She believes in relishing every moment of life, as happy memories are the best savings for the future

For the past couple of years, the Reserve Bank of India (RBI) has held a firm stance against cryptocurrencies, which are volatile in nature, have the potential to cause financial instability, and enable under-the-radar transactions. There are serious discussions going on about banning them.

On the other hand, in this year's budget, Finance Minister Nirmala Sitharaman announced that India would be launching its own central bank digital currency (CBDC) in the financial year 2022-23. She also went on to announce a 30% tax on gains made from any other private digital assets like non-fungible tokens and cryptocurrencies.

Does that mean the government has regularised cryptocurrencies? To understand these developments, we need to start from the ABC, and understand cryptocurrencies, CBDCs, and everything in between.

Digital currencies, definitely desirable

"Money has changed in form throughout history. Essentially, money is a trust device between users who agree on some intrinsic value for that 'form' and then use



it as a store of value or to facilitate exchange. Anything that succeeds in gaining acceptance has the potential to become money or currency—from sea shells, pepper and gold to paper and digital. Digital, because the world is now a village, and with real-time global trade and exchanges between organisations, businesses, governments and now peer-to-peer growing exponentially, digital money is needed to facilitate these instantaneously. Digital money also serves an important purpose of compression of value (allowing for speedy movement and sometimes invisibility) that in the past art and gems have provided," says Rajesh Lalwani, CEO, Scenario Consulting Pvt Ltd, preparing the ground for a discussion on this essential financial instrument!

Digital currency is an umbrella term, which refers to currency that exists in electronic form. It is stored, managed, and transacted through computer systems, other electronic devices, and wallets. Digital currencies do not have physical attributes, like notes or coins—though they may be equivalent to or convertible to fiat currency. There is no minting, storage, transportation, or other logistical processes associated with digital currency. Digital currency transactions are inexpensive and almost instantaneous. They enable seamless transfer of value—even across borders.

If the system is based on distributed ledger technology (DLT), each transaction is linked to the previous one and the next one in a distributed ledger. So, to change one transaction, you will have to change the entire chain. This ensures that all transactions are traceable but not reversible, making them very difficult to tamper with. All transactions are encrypted between digital wallets, resulting in exact parity calculation on the ledger. This instils a sense of trust in the system, reduces the possibility of errors, and the need for extensive reconciliation processes.

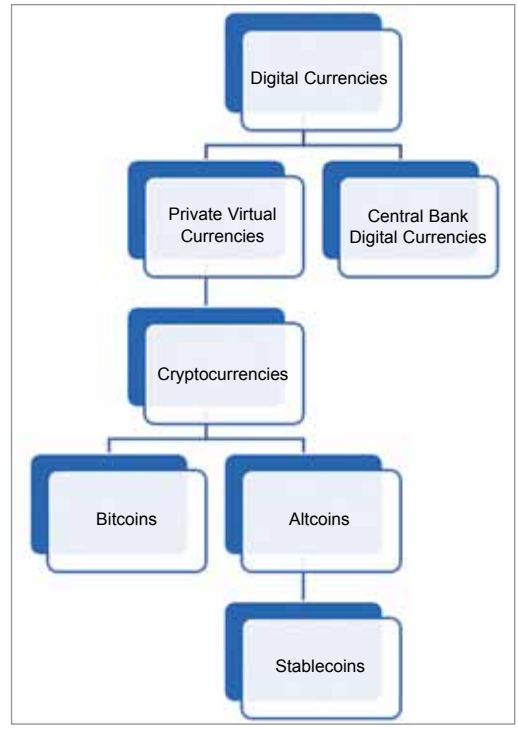


Fig. 1: Types of digital currencies

Given all the advantages, we have to remember that even the most robust and secure digital systems have fallen prey to hackers at some point of time. There have been rare cases of hackers stealing from wallets, or tampering with the protocol and making the currency unusable!

Overall, the concept of digital currency is definitely a desirable one, which can transform the world of finance. However, not all digital currencies are the same—and some can be very problematic too.

The many types of digital currency

Digital currencies can be either open or closed, regulated or unregulated, centralised or decentralised—which gives rise to different categories: private virtual currencies, cryptocurrencies, and central bank digital currencies. We must first be able to differentiate between these, to discern which is better or worse.

Private virtual currency is mostly unregulated. It is issued and controlled by a private issuer, such as the developer or founding organisation of a platform, and not by a central bank. It is usually native to a network, and has little value outside of it. It can be algorithmically controlled. Transactions are usually direct, party to party, without intermediaries. It may be centralised or decentralised, may or may not be encrypted, and may or may not be convertible to fiat currency.

Cryptocurrency is a form of private virtual currency, which uses cryptography to manage and control the creation of currency, as well as to secure and verify transactions. This makes it difficult to counterfeit or double-spend cryptocurrencies. Cryptocurrencies are decentralised virtual currencies, which depend on blockchain networks to validate transactions and instil trust in the system. The most popular cryptocurrency is the Bitcoin, which was developed in 2008 by an unknown person or group by the name of Satoshi Nakamoto. Bitcoins are basically small pieces of code, given to reward mining—a compute-intensive process that verifies Bitcoin transactions on the blockchain.

Altcoins refer to all cryptocurrencies other than Bitcoin, such as Ether, Dogecoin, etc. These use cryptography too, but may use different logic to validate transactions or include advanced features to solve the inherent problems of Bitcoin such as volatility.

Stablecoins are a type of altcoin, which peg the value of the cryptocurrency to some physical entity like fiat currency, gems, or precious

India's view of private cryptocurrencies

RBI has been advising investors against private cryptocurrencies for a long time now. In his insightful February 2022 speech, T. Rabi Shankar, Deputy Governor, RBI, explained that cryptocurrency is not actually currency, and cannot be treated as a financial asset or commodity either; cannot even call it a digital asset; just a piece of code that you are ready to buy hoping that someone else will buy it at a larger price. According to him, it serves no purpose, and simply boils down to speculation.

The government treats cryptocurrency as an asset, only CBDC is a legal tender and will be fungible with physical currency. "In the current budget, the government has clearly differentiated the digital rupee from cryptocurrency, which has been classified as a digital virtual asset, and gains from this asset class are taxed accordingly. With this, volatility and financial instability that cryptocurrency may have brought into the financial system as a payment mode has been mitigated," says Mihir Gandhi of PwC.

However, the fate of private cryptocurrencies in India remains unknown, because Finance Minister has made it clear that levying of a tax does not mean the government has endorsed or regularised cryptos. The government is still in discussion with various parties about the impact of such private currencies, and will take a decision accordingly.

metals. This will act as a reserve to redeem holders if the cryptocurrency collapses. Price fluctuations are also limited to a narrow range. Examples of stablecoins include Tether's USDT and MakerDAO's DAI.

Central bank digital currencies (CBDCs) are regulated and centralised digital currencies, issued and managed by the central bank of a country. While the fiat currency is a paper contract, the CBDC is a digital legal tender. It supplements and co-exists with traditional fiat currency, and is usually fungible with it.

Virtual currencies, real problems

According to CoinMarketCap, as of February 2022, there were 17,436 cryptocurrencies and 458 crypto exchanges. The market capitalisation of all cryptocurrencies stood at $1.98 trillion. Yet, regulators keep advising investors to beware of the risk in investing in cryptocurrencies, because they are extremely volatile in nature, and could lead to financial instability. Let us understand the risks that are inherent in cryptocurrencies.

Cryptocurrency is just a piece of code, a decentralised digital asset, which is managed through a blockchain to ensure transparency and trust. It derives its value or purchasing power from its community of users—and can be used in the network (or virtual world) that it belongs to, to pay for services or digital assets like non-fungible tokens (NFTs).

Cryptocurrency is not backed by any central agency, and does not involve any intermediaries like banks or other financial institutions. It is basically driven entirely by free market forces, and is immune to government interference. For this reason, many call it 'freedom money,' describing it as a disruptive technology and a potential social movement.

The value of cryptocurrency is extremely volatile, and tends to change by the day, even by the hour. "Cryptocurrencies are all differently envisioned based upon their designed purpose and utility. Fluctuations in their prices are a function of demand and supply (real and manipulated) and the change in future value as buyers and sellers perceive it," says Lalwani. Data from CoinMarketCap shows that the Bitcoin was valued at around $5000 in March 2020, rose to $65,000 by April 2021, and dropped to less than half that value by June 2021. This fluctuation was attributed to the novel coronavirus pandemic.

Similarly, Bitcoin valuations saw a steep fall after Russia's attack on Ukraine. However, the prices bounded back soon thereafter, as investors' risk appetite returned! In a speech delivered in February 2022, T. Rabi Shankar, Deputy Governor, RBI, explained that concentrated ownership in the hands of a few "crypto whales" makes the system prone to manipulation.

For something to be used as regular currency, its value should be reasonably stable. The highly volatile nature of cryptocurrencies means that you might not be able to use them to pay for your food, clothes, shelter, or other essentials! It is for this reason that Subash Chandra Garg, former Finance Secretary of India, commented in an interview last year that he preferred to call them just cryptos and not cryptocurrencies as they functioned only marginally as currencies, and will probably have to be recognised as another unique product or asset class in itself.

Another huge problem with cryptocurrencies is the complete privacy that it offers. In these decentralised blockchain based systems, the transactions are authorised by the participants and validated by the network without any intermediaries. A transaction remains anonymous in terms of people and purpose. A lot of misguided investors use this anonymity to evade government control and taxes. The ease of doing under-the-radar transactions also makes the crypto ecosystem an attractive playground for terrorists and money launderers.

Further, when investors put more and more money into cryptocurrencies, it could weaken a developing nation's currency, since most of today's cryptocurrencies are valued only in dollars and euros. Also, if people start doing cross-border transactions through private cryptocurrencies, a nation's foreign exchange reserve

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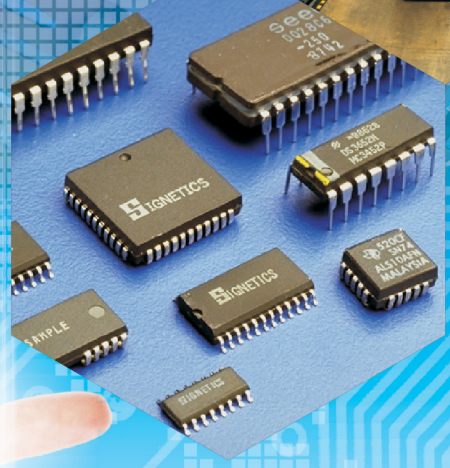
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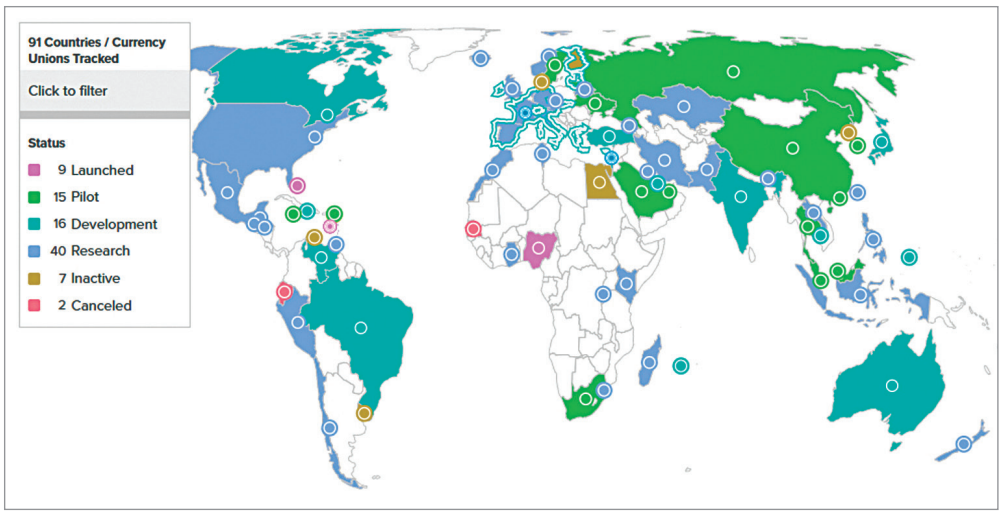


Fig. 2: Different stages of development of CBDCs (Source: Atlantic Council)

would also go down. As more money goes into private currencies, the money circulating in the economy would go down. With multiple private currencies being used simultaneously, the government would lose policy control of the economy. Their ability to control inflation would be weakened. All of this could lead to financial instability.

CBDCs overcoming the risk of crypto

While private, decentralised, and unregulated digital currencies are risky and troublesome, there is also the good side—regulated and centralised digital currencies could inject a lot of efficiency into a country's payment mechanism. For this reason, governments across the world are in the process of launching their own central bank digital currencies. CBDCs offer the benefits of cryptocurrencies, sans the risk, because the respective country's central bank would play its role as a regulatory and stabilising force.

Nine countries, including The Bahamas and Nigeria, have launched their CBDCs, while fifteen, including Russia and China, are in the pilot stage. Sixteen countries, including India, are currently developing their CBDC framework.

While announcing the upcoming digital rupee, Finance Minister said that its introduction will give a huge boost to the digital economy and will lead to a more efficient and cheaper currency management system.

"Central bank digital currencies are not to be confused with cryptocurrencies in that, while they may use encryption and may reside on the blockchain, they are backed by the respective central banks of sovereign states. They are the liability of the central bank and backed by the central bank assets just like the physical currency put into circulation by a central bank. Their unit value does not fluctuate. So, one rupee is valued at one rupee whether in cash or as a digital holding. In terms of exchange value to another central bank currency, say a dollar, that rupee's value may change based on the various dynamics of foreign exchange valuation," explains Lalwani.

Mihir Gandhi, Partner and Leader - Payments Transformation, PwC explains how CBDC could benefit a nation: "Features like trust, programmability, traceability, etc will impart additional benefits over physical form. Digital rupee will complement the existing payment modes and can make a significant impact in a few notable areas like offline payments, programmable or targeted payments (subsidies), cross border payments and remittances. Advantage is it is traceable, and lower-cost than physical currency to handle and manage, and interoperable with other digital currencies for international transactions."

Does India need a CBDC?

As soon as the announcement about the digital rupee was made,

Why CBDC?

- Creates new opportunities
- Reduces the manufacturing and logistical overheads involved in handling physical cash; very beneficial in a country with high currency to gross domestic product (GDP) ratio
- Makes digital payments and online fund transfer faster, cheaper, and more secure
- Enables instantaneous global payments at a fraction of the cost, thereby giving a fillip to international trade and economic growth
- It also helps to streamline the existing economic infrastructure and makes it easy to implement new monetary and fiscal policies
- Promotes financial inclusion; even those without bank accounts can use it
- Makes it easy to pump money into the economy
- Competes with private cryptos, and limits their usage
- Can improve enforceability of small contracts, using blockchain technologies
- Combats money laundering and financial terrorism by making cross-border transactions more secure
- Helps validate direct benefit transfers, using pre-programmed CBDC that can be used only for the specific purpose. For example, CBDC issued for LPG subsidies can be paid only into the account of LPG gas agencies

debates exploded about whether India really needs a CBDC, considering that we already have a pretty advanced digital payment system—for both wholesale and retail payments. According to a CLSA report, digital payments in India rose from $61 billion in 2016 to $300 billion in 2021. It is expected to go up further to around $1 trillion by 2026. It is quite evident that people are comfortable with digital payment systems like United Payments Interface (UPI) and Immediate Payment Service (IMPS). So, the question arises as to why we need digital currencies.

In a November 2021 media interview, Garg explained that though more than 95% of payments by value are digital payments, there is about ₹30,000 billion of currency floating in the country, and it is believed that more than 90% of payments by volume are still physical payments. It is this segment of small-value currency transactions that needs CBDC the most.

"CBDC's advantage is envisioned in terms of creating frictionless, accessible, and affordable payment mechanisms. While we have digital payment systems today, including immediate settlements through IMPS, UPI, etc, they are not universal and sometimes carry high fees or transaction costs (particularly cross-border). CBDCs will allow cross-border payments at fractional costs and deliver unprecedented impact," says Lalwani.

Although the digital rupee is likely to advent in a very simple form, it will incorporate more features as time goes by.

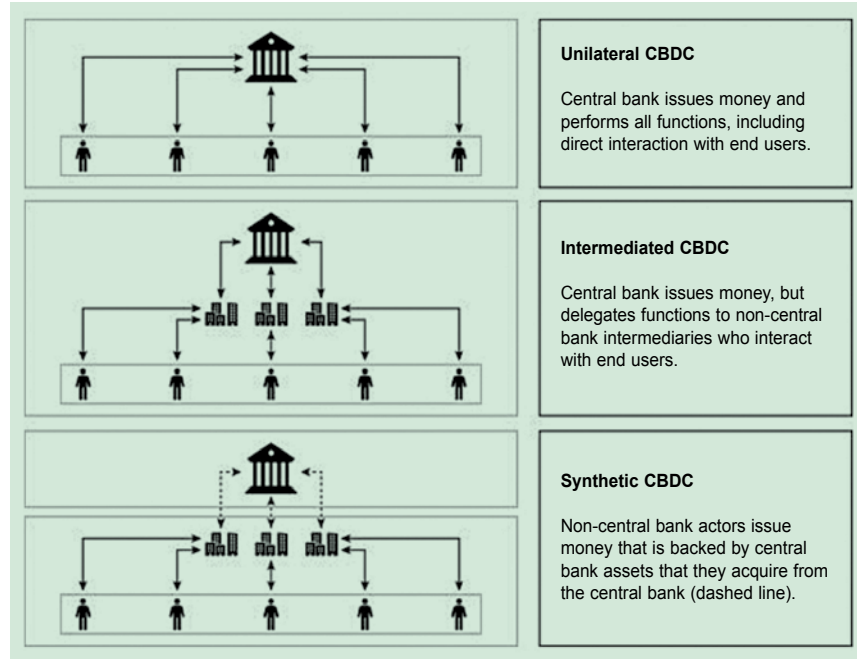


Fig. 3: Three conceptual CBDC operating models (Source: International Monetary Fund)

Understanding retail and wholesale CBDCs

India is likely to introduce both retail and wholesale CBDCs.

Wholesale CBDC is for use by banks and other financial institutions. Wholesale payment systems in India are already digital and pretty well-evolved, so CBDC might not be visibly disruptive but will definitely introduce efficiencies using the blockchain. Wholesale CBDC will enable settlement on net basis. Settlements will be validated using smart contracts. It will be used for interbank, cross-border, capital, and security market settlements. It is rumoured that work on wholesale CBDCs is more advanced in India than retail CBDC.

Retail CBDC is, understandably, more complex because it involves a larger population. It will be used by the general public for conducting day-to-day transactions, usually small-value ones. There are different conceptual operating models (refer Fig. 3), which decide how

What are smart contracts?

A smart contract is a piece of self-executing code, stored on a blockchain, which gets executed when certain predetermined conditions are met. The terms and conditions are directly coded, and exist across a distributed blockchain network. Hence, smart contracts make transactions traceable and trackable but irreversible.

Smart contract can be used to automate the execution of an agreement so that all parties are immediately aware of the outcome without any delay or intermediaries. It can also be used to automate a workflow, triggering actions one after the other as conditions are met. The actions could be like releasing funds, registering properties, or levying fines! The blockchain is updated as soon as the transaction is completed, so it cannot be tampered with.

Smart contracts…

- Are digital and automated, involve no paperwork and reconciliation; hence errors and delays are avoided, and cost is also low
- Do away with third parties; hence no trust issues
- Are secure, because blockchain records are encrypted and hard to hack
- Cannot be tampered with, because each record is linked to the previous and next, and whole chain has to be altered to change a single record

Smart contracts can be used for international trade, retailer-supplier partnerships, medicine or food supply chains, and more. They can help a country to improve enforceability of small contracts.

the CBDCs would flow through the economy, and what role banking and financial institutions, payment services, and application providers play in the ecosystem.



"Digital rupee will complement the existing payment modes and can make a significant impact in a few notable areas like offline payments, programmable or targeted payments (subsidies), cross border payments and remittances." — ***Mihir Gandhi, Partner and Leader - Payments Transformation, PricewaterhouseCoopers Pvt Ltd (PwC)***

"While we have digital payment systems today, including immediate settlements through IMPS, UPI, etc, they are not universal and sometimes carry high fees or transaction costs (particularly cross-border). CBDCs will allow cross-border payments at fractional costs and deliver unprecedented impact." — ***Rajesh Lalwani, CEO, Scenario Consulting Pvt Ltd***



Blockchain and other technologies

India's CBDC is likely to use DLT, most likely a private blockchain handled by the government. This would enable RBI to have good control over the blockchain. Sankar explained in his speech that a blockchain can be maintained without native currency, if transactions are authenticated centrally. It is possible to maintain accounts and reward work with legal tender currency too, making the DLT useful for several purposes without any private currency.

The iSPIRT Foundation earlier launched the Bharat Distributed Ledger (BADAL) for establishing trust for Indian B2B commerce. The BADAL protocol uses a private-public ledger (PPL) substrate, which might be useful for the RBI to launch CBDC.

Garg suggested in another media interview that it would be much easier, convenient, and cost-effective to dematerialise the physical currency on the lines of how equity, bonds, and other securities have been dematerialised, and use it to usher in digital currency in India.

According to Eswar Prasad, Professor at Cornell University, retail CBDC could take two forms—value based or token based. In a Bloomberg Quint interview, he said, "One could be a prepaid card, except it would be an account with a prepaid balance that you would have on your phone. A second form is where a CBDC essentially functions as a token in a payment system. This would take the form of a digital wallet where one could hold CBDCs, which would essentially be like accounts, but non-interest-bearing accounts."

"Blockchain is one of the many distributed ledger technologies available for launching a CBDC, however not the only technology available. We will need to evaluate available technologies on multiple criteria like accessibility, privacy, scalability, performance, resiliency, finality etc. Decision needs to be taken based on the model selected, if there should be a centralised technology or decentralised technology," concludes Gandhi.

Pitfalls to be avoided

While designing its CBDC framework, India must take into consideration some potential problems, and try to design the solutions into the system right in the beginning:

Potential bank run. A bulk shift from commercial to central banks might lead to a kind of financial crisis. To avoid this, central banks must limit the amount of money that can be held in CBDC accounts, and make sure digital wallets are maintained by commercial banks.

Strain on the central bank. Full control in the hands of central banks might lead to a strain on their network infrastructure and make the central bank vulnerable to security threats.

Private innovation. Reduced role of commercial banks might kill private innovation in the banking sector. To avoid this, countries like Sweden and China are trying out a two-tier CBDC, where the central bank provides the payment infrastructure in the backend. In the front-end, commercial banks innovate and provide effective payment mechanisms to users.

Policy making challenges. CBDC, with the direct nature of its transactions, will have a dynamic impact on the economy, and macroeconomic policymaking will be more challenging than ever before!

Energy consumption. Blockchain based cryptographic networks require immense computing power, and many of them, including the Bitcoin network, have come under heavy criticism for their socially wasteful energy usage. However, high energy consumption is not intrinsic to all blockchain network architectures. The amount of energy consumed by a blockchain network depends on its consensus mechanism, that is, what information is added to the network ledger. India must optimise this, such that it does not have a deep environmental impact.

India is in for a very interesting ride, which involves not only designing and developing the infrastructure, and rolling out the digital currency in a phased manner, but also clearing misconceptions and creating awareness about digital currencies—what is accepted and what is not. We might see wholesale CBDC in action first, followed by retail CBDC in a simple form, with more features being added as we go along. EFY

Career

"SEMICON MANUFACTURING Has The Potential To Generate A Huge Market For Jobs In Both Skilled And Unskilled Fields"

As part of being Atmanirbhar Bharat, India is working towards setting up semiconductor manufacturing facilities and is receiving proposals from big players like Vedanta, Foxconn, IGSS, and ISMC. Chetna Mohan, President, El Camino Technologies Pvt Ltd, spoke to Abbinaya Kuzhanthaivel of EFY about the career opportunities that this opens up for graduates in electronics and electricals, physics, applied physics, material sciences, chemical, and mechanical disciplines, and the skillsets they need to build



CHETNA MOHAN
PRESIDENT, EL CAMINO TECHNOLOGIES PVT LTD

How do you see the semicon manufacturing space evolving in India?

I would categorise semicon manufacturing into different sectors for ease of understanding, and each one is an individual unit on its own. These are:

- Design houses
- Wafer fabs (including raw wafer manufacturing and crystal growth)
- Assembly lines that include assembly, testing, marking, and packaging (ATMP)
- Failure analysis and reliability analysis (FA and RA) labs

India is a hub of the semiconductor design industry having well-established R&D and design centres for VLSI design, board design, and embedded software companies. Major players across the world have their R&D and design centres in India. However, raw wafer manufacturing and crystal growth are yet to be established. For fabs, the investment is huge and return on investment (ROI) takes a long time, whereas packaging lines are more flexible and easier to set up as compared to fabs. To be self-reliant, India will need wafer manufacturing, assembly, and testing facilities.

What do you think about the type of jobs and skillsets that will be in demand if semicon manufacturing picks up?

Semiconductor manufacturing needs a wide range of skillsets when we see at a macro level. It has the potential to generate a huge market for jobs in both skilled and unskilled fields. It could target youth from rural areas to scientists, designers, researchers, process developers, quality control, utilities, and facilities experts. The industry needs different levels of workforce for production, including shop-floor assistants, helpers, warehouse management, security, etc.

Apart from the production related skills, there are other add-ons and supporting clusters of industries which grow when any other production unit grows, such as suppliers of raw materials, chemicals, high purity gases, gas handling systems, water handling equipment, electricity, cleanrooms, related furniture, pollution control, disposal systems, chemical treatment plants, environment controlled facilities, certification bodies, which will require both Indian and overseas products and expertise.

Do we have courses or curriculum that gives on-hand training before getting to the job?

As I understand, we do not find a defined curriculum, particularly on microelectronics, including semiconductor technology in detail, at undergraduate levels in most universities. Premier institutes, such as IITs and IISc, have well-established labs where students have exposure. Some of the labs at premier institutes include labs for basic electronics, microelectromechanical (MEMS) systems, microelectronics, VLSI engineering, MEMS and microsystems, microwave and millimeter-wave circuits, nanofabrication, nanophotonics, nanoscale optoelectronics, semiconductor devices and circuits, which gives the students preliminary understanding of the subjects.

We do see a few chapters on VLSI designing and semiconductor devices, but complete process and know-how of semiconductor manufacturing and fabrication are not available at graduation levels. As I have seen in my experience in this area, most of the training is on-the-job. Since this is a high-tech industry, it takes six to nine months before an

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engineer can understand the processes and can speak about them.

Any advice for institutions wanting to prepare themselves, including their faculty, curriculum, and students for this industry?

There is a widening gap between the nature of jobs and active candidates with the skills. There is always a need for skilled and talented early-career professionals. Being in a high-end technology area, my suggestion for institutions would be to consider setting up small labs where institutions can have in-house facilities with manual or semi-automatic systems for students to have practical experience. The upcoming manufacturing units will need nine to twelve months of facility readiness; by this time the candidates can be prepared as per the requirement by giving them on-the-job training, which will help the industry and candidates both.

Consider experts from the industry for guest lectures, seminars, conferences, and workshops. We have a 'gold mine' of these from premier institutes in India. The institutes can have curriculum to develop skills that are in high demand from the semiconductor industry. They can be at graduation, masters, and doctorate levels with PhDs and also non-thesis programmes.

Independent institutes can have a dedicated certification course, which will benefit by bringing both candidates and companies closer to each other. The companies can find the right candidates and candidates can learn what the companies require.

For the final years, we can look for something like 'Enthusiastic Fresh Resources' available with incentives in form of scholarships to increase their ability to understand the subject and take it to the industry. The industry can thus save time by having a quick induction programme.

Another important point I would like to touch upon is the curriculum. It should be designed with the help of industry experts to streamline the subjects of study, which will benefit these industries. Exposure to basic knowledge and practical training from the start to the end of the fabrication process will help both students and the industry. Additionally, faculty development programmes can be conducted by industry experts. Some universities and industries can look at special awards and recognition for the professors' efforts to help address pressing engineering and supply-chain challenges as well as attract and retain top local talent.

In recent times, we do see many academic institutes and industries coming together to bridge this gap and tying up with the industry so that students can have practical training and are industry-ready. This is a good starting point for India as we move forward in semiconductor manufacturing. We need several more to bridge this gap. EFY

How To Select The RIGHT BATTERY FOR Your E-BIKE

The concept of an e-bike revolves around a battery, where you have to select between performance, mileage, and cost. Here's an attempt to help you make that choice





SIDDHARTH CHATTERJEE, Senior Manager and Mentor, DIYguru

Electric bikes, also known as e-bikes, are bringing a revolution in the automotive industry. The whole concept of e-bike revolves around the battery that it uses. With battery technologies evolving rapidly, choosing the right battery is quite challenging. While the primary factors depend on speed, range, and battery capacity, other factors like battery type and cell construction are also important. Let us look at the parameters to be considered.

The requirement of a battery depends on whether the e-bike is an electric cycle,

Key specifications

- Cost
- Specific energy density (Wh/kg)
- Volume energy density (Wh/litre)
- Life cycle
- Capacity and Depth of Discharge
- C-rate usable
- Safety and Disposal

TABLE 1
CHARACTERISTICS OF COMMONLY USED RECHARGEABLE BATTERIES

Specifications	Lead Acid	Ni-Cd	Ni-MH	Li-ion		
				Cobalt	Manganese	Phosphate
Specific energy (Wh/kg)	30-50	45-80	60-120	150-250	100-150	90-120
Internal resistance	Very low	Very low	Low	Moderate	Low	Very low
Cycle life (80% DoD)	200-300	1,000	300-500	500-1,000	500-1,000	1,000-2,000
Charge time	8-16h	1-2h	2-4h	2-4h	1-2h	1-2h
Overcharge tolerance	High	Moderate	Low	Low. No trickle charge		
Self-discharge/month (room temperature)	5%	20%	30%	<5% Protection circuit consumes 3%/month		
Cell voltage (nominal)	2V	1.2V	1.2V	3.6V	3.7V	3.2-3.3V
Charge cutoff voltage (V/cell)	2.40 float 2.25	Full charge detection by voltage signature		4.20 typical; Some go to higher V		3.60
Discharge cutoff voltage (V/cell, 1C)	1.75V	1.00V		2.50-3.00V		2.50V
Peak load current Best result	5C 0.2C	20C 1C	5C 0.5C	2C <1C	>30C <10C	>30C <10C
Charge temperature	-20 to 50°C (-4 to 122°F)	0 to 45°C (32 to 113°F)		0 to 45°C (32 to 113°F)		
Discharge temperature	-20 to 50°C (-4 to 122°F)	-20 to 65°C (-4 to 149°F)		-20 to 60°C (-4 to 140°F)		
Maintenance requirement	3-6 months (topping chg.)	Full discharge every 90 days when in full use		Maintenance-free		
Safety requirements	Thermally stable	Thermally stable, fuse protection		Protection circuit mandatory		
In use since	Late 1800s	1950	1990	1991	1996	1999
Toxicity	Very high	Very high	Low	Low		
Coulombic efficiency	~90%	~70% slow charge ~90% fast charge		99%		
Cost	Low	Moderate		High		

(Source: batteryuniversity.com)

scooter, or motorcycle. Each of them needs a battery with different chemistry and a capacity of 12V, 24V, or 36V depending on the range and speed required.

The first factor to consider, of course, is cost, which may also decide the quality. The other important metric is specific energy density that tells the amount of energy contained per kg unit of the battery. For instance, a lightweight vehicle requires a battery with high specific energy density of about 1,000Wh/kg.

Volume energy density is the metric that needs attention for fixing a battery in a small space. While retrofitting a 4-wheeler or some other vehicle, there might be space constraint to replace the engine and associated components with motor controller and power electron. Here opting for battery cells with high volume energy density helps. For example, if one litre (or 0.01m³) volume can hold more energy, it means that much lesser space is needed.

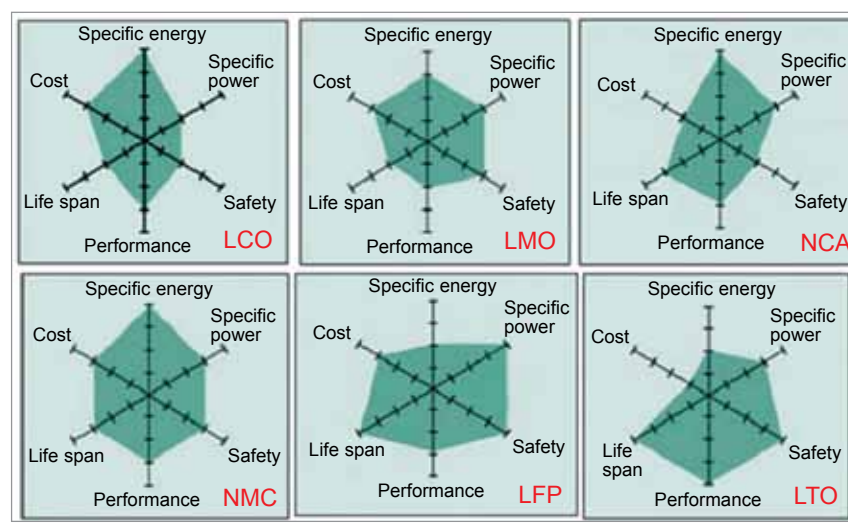


Fig. 1: Spider diagram for six most relevant Li-ion battery technologies (Source: Boltta Battery Technologies)



Fig. 2: Cell types for Li-ion batteries: pouch, cylindrical, and prismatic

The life cycle of a battery, when it discharges from 100 to almost 0%, is vital too. Usually Li-ion batteries have around 2,000 life cycles. If battery life is of core concern, the math can be done to ascertain how long the battery would last.

The capacity of a battery in ampere hours shows the energy rating of the battery. Higher capacity means more range, the distance travelled in one charge. A mandatory factor to consider here is the depth of discharge (DoD). The entire charge in the battery cannot be utilised. For instance, if a 100-ampere hour Li-ion battery has DoD of 0.85, it means only up to 85-ampere hour charge can be used.

Charging rate (C-rate) is as important as battery life cycle. It is the amount of current used to charge the battery for an hour. Fast charging by increasing the amount of current can reduce the battery's life.

Battery's safety and disposability should be ensured by looking at the battery management system, casing, lab certification, and other universally acceptable standards.

Battery characteristics

e-bikes accept different battery chemistries like lead-acid or lithium-ion. From an economic point of view, manufacturers use lead-acid batteries as well in scooters. In cycles, only Li-ion batteries are used because of their light weight and the fact that they suit long-distance commutation. Lead-acid is usually very toxic due to the presence of diluted sulphuric acid as the electrolyte.

Li-ion batteries are usually preferred for e-bikes, even though lead-acid batteries are significantly cheaper. For example, for a golf-cart the cost of a lead-acid battery would be about ₹36,000 and that of a Li-ion battery ₹150,000. However, Li-ion batteries need good thermal management as a temperature range of 25 to 50°C needs to be maintained.

Li-ion batteries have several types of cell chemistry like Nickel Manganese Cobalt (NMC), Lithium Cobalt Oxide (LCO), Lithium Nickel-Cobalt-Aluminium Oxide (NCA), Lithium Manganese Oxide (LMO), Lithium Iron Phosphate (LFP), and Lithium Titanate Oxide (LTO). However, specific energy, power, life span, cost, and safety are the five important metrics that have to be checked before selecting a cell chemistry.

Apart from cell construction, the battery pack is also a vital factor to check and select. Battery packs are made of individual battery cells, whose construction may be cylindrical, prismatic, or pouch shaped. Each class of battery is manufactured with a variety of form-factors; the most commonly used is 18650 or 21700 for cylindrical construction, which is low-priced and available in abundance.

When compared to cylindrical cells, prismatic construction is expensive and has low energy density as well as poor thermal management. The pouch cells, extensively used in electric 4-wheelers, come with high packing efficiency but have likelihood of swelling.

Deciding your own battery pack

If you are planning to use an electric bike, first calculate the battery rating. This would help in figuring out what battery pack would suit your EV.

As an example, let us try to select battery pack for an e-bike with motor rating of 48V, 1kW, with top speed being 40kmph, and the required range of 100km. Assuming DoD for Li-ion battery to be 0.85:

$$\frac{(\text{Range}\times\text{Motor Rating} \div \text{Depth of Discharge})}{\text{Speed}}$$

$$= \frac{\frac{100\times1000}{0.85}}{40} = 2.95\text{kWh (approx.)}$$

Battery rating = Kilowatt hr/48V = 61Ah

So, you would need a 48V, 61Ah battery for the vehicle. Similarly, you can decide a battery pack for motorcycles or scooters.

With all this discussion, which battery should you take, you may still ask? NMCs, or Nickel Manganese Cobalt batteries, are outstanding, yet there is no one single solution to fit all applications. There are so many parameters as discussed above to consider before deciding what kind of battery is best suitable.

It is advised to have a budget and use case in mind before selecting the right battery. The question is, do you prefer high specific energy or power for your application? EFY

The article has been compiled by Abbinaya Kuzhanthaivel, a Technology Enthusiast, from a tech talk session at E-bike Show 2021 by Siddharth Chatterjee, Senior Manager and Mentor, DIYguru.

Will 20cm SiC WAFER Be The Next Standard?

Silicon carbide (SiC) has a lot of potential to replace silicon in many applications, a significant one being in the automotive industry, especially for battery-operated electric vehicles. To reduce the cost of producing SiC devices, which is quite high, SiC fabs are moving from 15cm (6-inch) to 20cm (8-inch) wafers



Porsche Carrera GT uses carbon-fibre-reinforced silicon carbide (C/SiC) ceramic composite braking system

AARYAA PADHYEGURJAR

The semiconductor silicon carbide (SiC), commonly known as carborundum, occurs in nature as the mineral moissanite. It is actually abundantly found in space in the form of stardust but occurs very rarely in nature. Nonetheless, since 1893, SiC is being mass-produced for use as an abrasive or in manufacture of light emitting diodes (LEDs) and radio detectors. Today, the ceramics made with SiC, being durable and having high thermal shock resistance, are widely used in automotive brakes and clutches.

Why have we not been using SiC instead of silicon for making semiconductor devices? Earlier, the main problem with SiC crystals was that they had some defects that prevented them from being used widely in electrical applications. Hence, silicon became the standard. However, with technological advancements in production processes, 15cm SiC wafers are now giving a good yield. Particularly in the automotive industry, using SiC instead

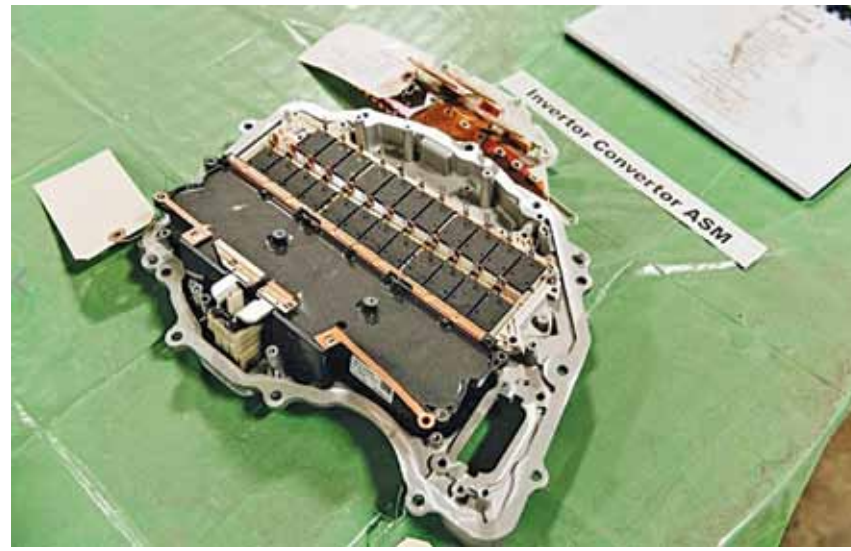
of silicon can increase the driving range per charge, speed up charging time, and increase efficiency by delivering the same range with lesser battery capacity and weight.

Importance of SiC in automobiles

Today, the electric vehicle (EV) sector is growing rapidly and governments all over the world are taking initiatives for the preservation of the environment. Moreover, petrol prices and CO_2 emissions are a matter of great concern. This is why we can see large-scale investments in EVs. Within the next decade, EVs might very well dominate the vehicle market.

But it is important to note that EVs still cannot compete with conventional vehicles in terms of cost—they are significantly expensive. Hence, EV designers and researchers are looking to increase EV efficiency as that will translate to lower costs. Exploring SiCs has pushed EVs towards this goal.

The very properties that SiC has enable it to be used in devices operating at high temperatures and/or high voltages. Automobiles, especially EVs and hybrid EVs, contain many high-voltage systems like the high-voltage battery and its charging sub-systems. This makes SiC a good choice for use in such applications. With SiC technology incorporated in MOSFETs and diodes, the whole system can be made smaller, lighter, and more efficient.



Model 3 main inverter featuring 24 SiC MOSFET modules from ST Microelectronics

Electrical systems in EVs, such as battery management systems (BMS) and onboard chargers (OBC), are crucial since the battery is a fundamental feature of EVs. Typically, the OBC is used to charge the battery using AC mains when the car is parked. This is generally a unidirectional process—from mains to the battery. But OBCs can be used the other way round too, for example, when you want to power your home using the energy stored in your EV battery. By using SiCs in such bidirectional chargers, more efficient bidirectionality can be obtained.

Reasons for the success of SiC

According to BusinessWire, "Global SiC market was valued at US$850.6 million in 2020, and is estimated to reach US$2670.25 million in 2007".

Here are some reasons for its success.

- Its on-state resistance and switching losses are considerably lower
- High thermal conductivity compared to silicon, and hence lesser cooling requirements
- Allows faster heat dissipation from components
- Provides high power density, and hence better efficiency
- Wide bandgap
- Efficient even in harsh environments due to exceptional hardness and strength
- Ability to switch at three to five times higher system frequencies
- High thermal shock resistance and low thermal expansion
- Chemical inertness because chemical bonds in SiC are stronger

The 15cm to 20cm transition

Many companies have already adopted SiC technology in conjunction with traditional silicon. Tesla, in 2018, added SiC MOSFETs from STMicroelectronics in its inverter for Model 3, due to which the weight of the inverter was reduced by half as compared to other models. The industry believes that although SiC production is not easy on our pockets, the huge demand in the

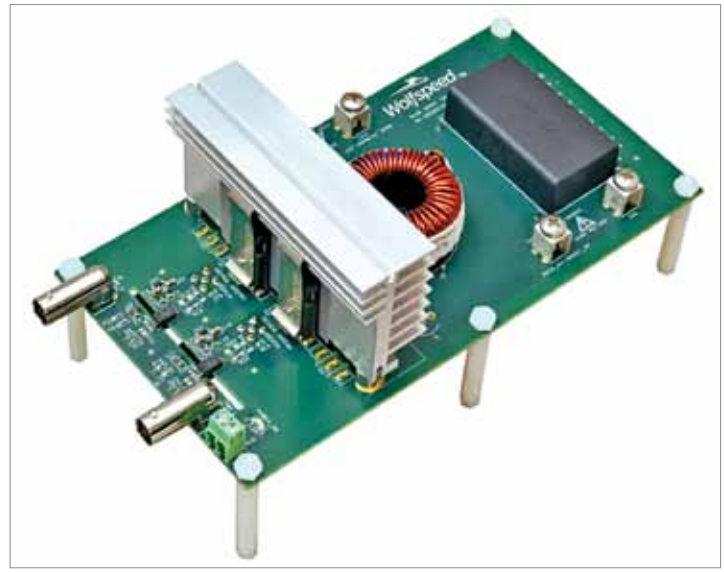
SiC and the BFOM Equation (Baliga's Figure of Merit)

In the 1980s, Dr Jayant Baliga, an electrical engineer, professor, and inventor of IGBTs suggested replacing silicon with wide bandgap semiconductors to enhance the performance of power devices. "In the latter half of the 1980s, the technology for the growth of silicon carbide was developed with the culmination of commercial availability of wafers from CREE Research Corporation," says Baliga in his book titled Silicon Carbide Power Devices.

Dr Baliga's famous equation, commonly referred to as Baliga's Figure of Merit (BFOM), predicts that SiC would be much more efficient than silicon. Baliga was well aware that SiC devices could replace his own invention—the IGBT. "It has been my privilege to assist in the establishment of national programs to fund research on silicon carbide technology in the United States, Japan, and Switzerland-Sweden," he says.

automotive industry will help in decreasing the cost through the economies of scale.

Today, the SiC market is dominated by 10cm and 15cm wafers. Both of these are in high demand, but most of the growth is happening in the 15cm domain, where the aspect ratio of the wafer is 6 to 1. While the industry is looking to improve the methods of processing for 15cm wafers, companies are paying close attention to the development of 20cm SiC wafers at the same time.



Buck-boost evaluation board for 650V SiC C3M MOSFET (Image source: Wolfspeed)

The main reason for this transition is to reduce the application cost of SiC. A larger wafer size directly reduces the cost of production. But moving to a larger wafer size is not that easy and establishing mass production infrastructure takes time. Once the mass production of 20cm SiC is established, and the market is no longer dominated by just six to seven companies, the cost of SiC production will drop.

Advantages of 20cm SiC wafers

Ability to produce more SiC devices. 20cm wafers can significantly increase the production capacity of SiC devices since a larger area can be used for manufacturing. This will ensure that more devices can be produced using a single wafer of 20cm SiC. Compared to its 15cm counterpart, 20cm wafers will almost double the output of chip production.

Better wafer quality. Approximately twelve wafers are obtained in the batch production of 15cm and 10cm wafers. This number is quite less for 20cm wafers, which is why it is much easier to follow the single-wafer production approach instead of batch production. This enables us to have better control over each wafer, in turn increasing the quality of production.

Electrification. As 20cm wafers become a norm and production capacity increases in the coming years, we can expect major growth in the electrification of systems and products, not just in the automotive sector. The industry might slowly start remaking some fabs that currently run on silicon with SiC technology.

Disadvantages of 20cm SiC wafers

Need for independent processes and increased investment costs. The production process, as well as the development process of 20cm wafers is fundamentally different from 15cm wafers. Hence, fabrication companies will have to establish independent process plants for the 20cm technology, and this will add to their costs. Not to mention, SiC production itself is more expensive than silicon.

Risk of damages. SiC wafers are already pretty delicate. Developing a wafer of a larger area increases the risk of damaging the wafer during the substrate cutting process. Problems like cutting stress and warpage are evident as the substrate size increases.

Achieving a good tradeoff. Using 20cm SiC will make sense only if the benefits outweigh the challenges, most importantly in terms of cost. For example, the efficiency of the resulting device built on 20cm SiC should compensate for the higher SiC cost as well as the increased costs of 20cm wafer production.

World's Leading SiC Wafer manufacturers

Many semiconductor companies are gearing up for the transition from 15cm to 20cm wafers. Here is a list of a few of the key players:

- STMicroelectronics
- Cree (Now Wolfspeed)
- II-IV Incorporated
- SiCrystal (A ROHM Semiconductor Company)
- Infineon
- ON Semiconductor
- Bosch

Current trends in SiC industry

Mentioned below are some trends that are being witnessed currently in the silicon carbide industry:

More and more SiC products. So far, several SiC devices have been produced and many have reached maturity as well. For example, many companies, including ROHM Semiconductor, STMicroelectronics, and Infineon, have already launched several SiC based devices like MOSFETs, Schottky diodes, power modules, and hybrid devices. Also, many companies are offering commercially available evaluation kits that feature modules based on SiC.

20cm SiC wafers produced. Due to the cost benefits that the mass production of 20cm SiC will offer,

many companies have started the fabrication process of 20cm wafers. Some have already demonstrated 20cm SiC samples. These include Cree (now Wolfspeed), II-VI, SiCrystal (a subsidiary of ROHM Group), and STMicroelectronics.

In July 2021, STMicroelectronics announced that it has manufactured the first 20cm SiC bulk wafers for prototyping next-generation power devices. "The transition to 200mm SiC wafers will bring substantial advantages to our automotive and industrial customers as they accelerate the transition towards electrification of their systems and products," says Marco Monti, President Automotive and Discrete Group, STMicroelectronics.



ST's 20cm SiC wafer

5G and SiC. Due to the advent of 5G, there will be demand for high-frequency RF power amplifiers. This is another potential application industry for SiC devices apart from the automotive sector, since GaN (gallium nitride) on SiC is a key technology for 5G power amplifiers. II-IV announced in 2019 that it has introduced prototype 20cm diameter semi-insulating SiC substrates for RF power amplifiers in 5G wireless base-station antennas and other high-performance RF applications.

In-house production. The demand for 20cm SiC is growing and many companies would prefer to produce it in-house. This is why they are expanding their fabrication facilities for the mass production of 20cm wafers. A few years down the line, we can expect several key players in the semiconductor business to have 20cm wafer production facilities.

Bosch aims to become a global leader in the production of SiC chips for electromobility and plans to develop SiC devices on 20cm wafers instead of standard 15cm ones. The company has expanded its wafer fab facilities and is expanding even further for complete in-house production of SiC based devices.

Infineon has been involved in SiC technology for a long time and by 2023 aims to start mass production of 20cm SiC. Cree (Wolfspeed) plans to use existing facilities and install refurbished tools to produce 20cm SiCs in a fiscally responsible manner.

Investments. Another important trend in this industry is the increase in investments in SiC technology. In 2019, Cree (Wolfspeed) announced their largest-ever investment of $1 billion to expand SiC capacity. Moreover, collaborations and acquisitions among semiconductor companies have also become noticeable. Multiple players from all over the world are joining the SiC race and helping the technology become mainstream.

Exciting collaborations. Many semiconductor companies have collaborated, started joint ventures and partnerships in the SiC domain. On 1st February 2022, II-VI Incorporated announced that it has expanded its relationship with GE by signing a three-year technology access agreement (TAA) with GE Research. In November 2021, Japanese power electronics company ROHM and a China based firm known as Zhenghai Group announced a new joint venture that focuses on developing SiC power modules for automotive applications. Many key players in this business have invested in such partnerships with each other.

The future of SiC technology

The competition in the production of 20cm SiC is expected to grow, since the demand for SiC is slowly growing more than the supply. As the automobile industry pushes SiC into the mainstream, most challenges related to 20cm wafers mentioned in this article can be eliminated. However, this will take time, and 15cm wafers might dominate the market for a few more years, after which the 20cm tech will take over. And when this happens, device prices will decrease considerably compared to 15cm SiC.

In a 2005 IEEE paper titled Silicon Carbide Power Devices - Current Developments and Potential Applications, authors Peter Friedrichsi and Roland Rupp mention the following about SiC: "The final market penetration will be somehow related to the fantasy and degree of innovation in circuit design groups, since the simple replacement of silicon by SiC alone cannot justify the cost position resulting from the implementation of SiC."

Today, not only are SiC devices already in the market, we also have justifiable reasons as to why 20cm SiC wafer might very well become as mainstream in the coming years as 20cm silicon wafer is today. EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast with a keen interest in innovation and research.

AI ACCELERATORS: A Long Way To Go

We are witnessing the AI revolution. In order to make smart decisions, the devices equipped with AI need lots and lots of data. And making sense of that data needs power and speed. This is where AI accelerators come into the picture

AARYAA PADHYEGURJAR

As IoT systems are getting more and more efficient, data acquisition is getting easier. This has increased the demand for AI and ML applications in all smart systems. AI based tasks are data-intensive, power-hungry, and call for higher speeds. Therefore, dedicated hardware systems called AI accelerators are used to process AI workloads in a faster and more efficient manner.

Co-processors like graphics processing units (GPUs) and digital signal processors (DSPs) are common in computing systems. Even Intel's 8086 microprocessor can be interfaced with a math co-processor, 8087. These are task-driven additions that were introduced because CPUs alone cannot perform their functions. Similarly, CPUs alone cannot efficiently take care of deep learning and artificial intelligence workloads. Hence, AI accelerators are adopted in such applications. Their designs revolve around multi-core processing, enabling parallel processing that is much faster than the traditional computing systems.

At the heart of ML is the multiply-accumulate (MAC) operation. Deep learning is primarily composed of a large number of such operations. And these need to happen parallelly. AI accelerators have the capacity to significantly reduce the time it takes to perform these MAC operations as well as to train and execute AI models. In fact, Intel's head of architecture, Raja Koduri, noted that one day every chip will be a neural net processor. This year, Intel plans to release its Ponte Vecchio HPC graphics card (accelerator), which, Intel claims, is going to be a game-changer in this arena.

AI in Smartphones

- Apple's iPhone 13 series comes with A15 bionic chips that contain dedicated neural network hardware
- OnePlus 9 Pro and other phones featuring Qualcomm's Snapdragon 888 processor have AI capabilities in their cameras thanks to Qualcomm artificial intelligence (AI) engine
- Samsung Galaxy S20 series includes an AI-powered camera
- Google's Pixel 6's processor has features powered by AI and ML

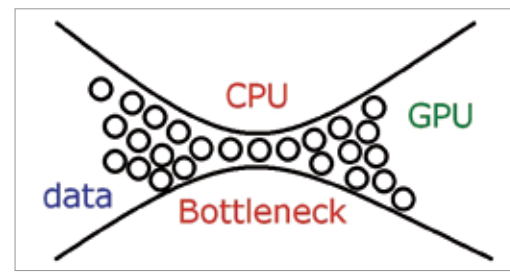


Fig. 1: CPU bottleneck

User-to-hardware expressiveness

'User-to-hardware expressiveness' is a term coined by Adi Fuchs, an AI acceleration architect in a world-leading AI platforms startup. Previously, he has worked at Apple, Mellanox (now NVIDIA), and Philips. According to Fuchs, we are still unable to automatically get the best out of our hardware for a brand new AI model without any manual tweaking of the compiler or software stack. This means we have not yet effectively reached a reasonable user-to-hardware expressiveness.

It is surprising how even slight familiarity with processor architecture and the hardware counterpart of AI can help in improving the performance of our training models. It can help us understand the various bottlenecks that can cause the performance of our models to decrease. By understanding processors, and AI accelerators in particular, we can bridge the gap between writing code and having it implemented on the hardware.

Bottleneck in AI processing

As we add multiple cores and accelerators to our computing engines to boost performance,

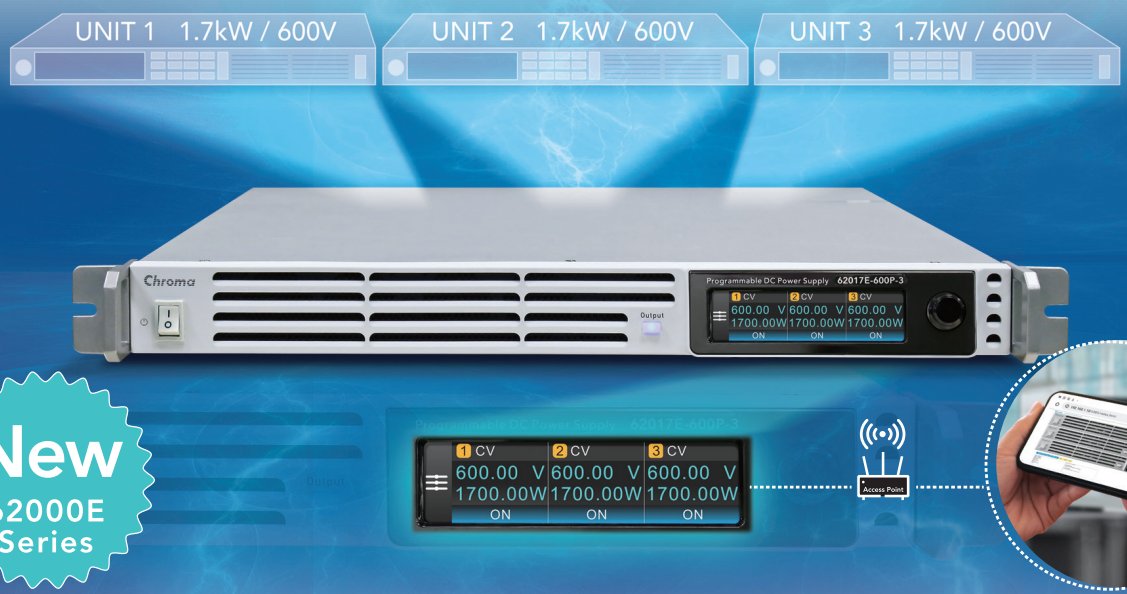
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Fig. 2: AlexNet's most probable labels on ImageNet images, with five labels considered most probable for each. The probability assigned to each label is also shown by the bars (Credit: Alex Krizhevsky, Ilya Sutskever, and Geoffrey Hinton)



Fig. 3: Xilinx' Alveo U50 data centre accelerator card that comes with the Zebra software (Credit: Xilinx)

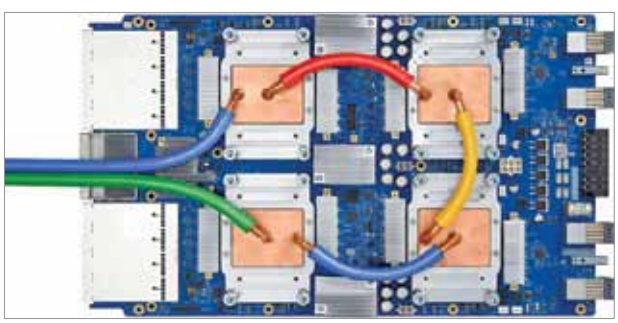


Fig. 4: Cloud TPU v3 (Credit: Google)

we must keep in mind that each of them has a different speed. When all these processors work together, the slowest one creates a bottleneck. If you use your PC for gaming, you would probably have experienced this problem. It does not matter how fast your GPU is if your CPU is slow.

Similarly, it would not matter how fast hardware accelerators are if the read/write data transfer is slow between RAM storage and the processor. Hence, it is crucial for designers to select the right hardware for all components to be in sync.

Popular AI accelerator architectures

Here are some popular AI architectures:

Graphics processing unit (GPU). Well, GPUs were not originally designed for ML and AI. When AI and deep learning were gaining popularity, GPUs were already in the market and were used as specialised processors for computer graphics. Now we have programmable ones too, called general-purpose GPU (GPGPU). Their ability to handle computer graphics and image processing makes them a good choice for usage as an AI accelerator. In fact, GPU manufacturers are now modifying their architectures for use in AI or ML.

In 2012, Alex Krizhevsky, Ilya Sutskever, and Geoffrey Hinton from the University of Toronto presented a paper on AlexNet, a deep neural network. It was trained on readily available, programmable consumer GPUs by NVIDIA (NVIDIA GTX 580 3GB GPU). It is basically a GPU implementation of a CNN (convolutional neural network). AlexNet won the 2012 ImageNet Large Scale Visual Recognition Challenge (ILSVRC).

FPGAs and ASICs. FPGAs are semiconductor devices that, as the name suggests, are field programmable. Their internal circuitry is not mapped when you buy them; you have to program them right on the field using hardware description languages (HDLs) like VHDL and Verilog. This means that your code is converted into a circuit that is specific to your application. The fact that they can be customised gives them a natural advantage over GPUs.

Xilinx and an AI startup called Mipsology are working together to enable FPGAs to replace GPUs in AI accelerator applications, just using a single command. Mipsology's software Zebra converts GPU code to run on Mipsology's AI compute engine on an FPGA, without any code changes.

FPGAs are cheaper, reprogrammable, and use less power to accomplish the same work. However, this comes at the cost of speed. ASICs, on the other hand, can achieve higher speeds and consume low power. Moreover, if ASICs are to be manufactured in bulk, the costs are not that high. But they cannot be reprogrammed on the field.

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Tensor processing unit (TPU). Tensor processing unit is an AI accelerator built by Google specifically for neural network machine learning. Initially, it was used by Google only, but since 2018, Google has made it available for third-party use. It supports TensorFlow code and allows you to run your own programs on the TPU on Google Cloud. The documentation provided by Google is comprehensive and includes several user guides. The TPU is specifically designed for vector-by-matrix multiplication, an operation that happens multiple times in any ML application.



Fig. 5: Coral Dev Board (Credit: Coral)

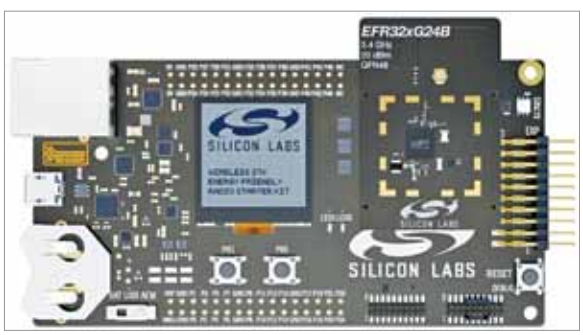


Fig. 6: The complete Pro Kit for the new BG24 and MG24 SoCs with all the necessary hardware and software for developing high-volume, scalable 2.4GHz wireless IoT solutions (Credit: Silicon Labs)



Fig. 7: Evaluation Kit for the MAX78000 (Credit: Maxim Integrated)

On-edge computing and AI

On-edge computing gives an engine the power to compute or process locally with low latency. This leads to faster decision-making due to faster response time. However, the biggest advantage would be the ability to send just the processed data to the cloud. Hence, with edge computing, we will no longer be as dependent on the cloud as we are today. This means that lesser cloud storage space is required, and hence lower energy usage and lower costs.

The power consumed by AI and ML applications is no joke. So, deploying AI or machine learning on edge has disadvantages in terms of performance and energy that may outweigh the benefits. With the help of on-edge AI accelerators, developers can leverage the flexibility of edge computing, mitigate privacy concerns, and deploy their AI applications on edge.

Boards that use AI accelerator

As more and more companies make a mark in the field of AI accelerators, we will slowly witness a seamless integration of AI into IoT on edge. Companies like NVIDIA are, in fact, known for their GPU accelerators. Given below are a few examples of boards that feature AI accelerators or were created specifically for AI applications.

Benefits of Edge Computing

- Flexible
- Decreased latency, faster computation
- Decreased bandwidth
- Improved security features
- Real-time decision making

Google's Coral Dev Board. Google's Coral Dev Board is a single-board computer (SBC) featuring an edge TPU. As mentioned before, TPUs are a type of AI accelerator developed by Google. The edge TPU in the Coral Dev Board is responsible for providing high-performance ML inferencing with a low power cost.

The Coral Dev Board supports TensorFlow Lite and AutoML Vision Edge. It is suitable for prototyping IoT applications that require ML on edge. After successful prototype development, you can even scale it to production level using the onboard Coral system-on-module (SoM) combined with your custom PCB. Coral Dev Board Mini is Coral Dev Board's successor with a smaller form factor and lower price.

BG24/MG24 SoCs from Silicon Labs. In January 2022, Silicon Labs announced the BG24 and MG24 families of 2.4GHz wireless SoCs with built-in AI accelerators and a new software toolkit. This new co-optimised hardware and software platform will help bring AI/ML applications and wireless high performance to battery-powered edge devices. These devices have a dedicated security core called Secure Vault, which makes them suitable for data-sensitive IoT applications.

The accelerator is designed to handle complex calculations quickly and efficiently. And because the ML calculations are happening on the

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Fig. 8: Kria KV260 Vision AI Starter Kit (Credit: Xilinx)



Fig. 9: Gluon Evaluation Board (Credit: AlphaICs)



Fig. 10: Intel NCS2 (Credit: Intel)

local device rather than in the cloud, network latency is eliminated. This also means that the CPU need not do that kind of processing, which, in turn, saves power. Its software toolkit supports some of the most popular tool suites like TensorFlow.

"The BG24 and MG24 wireless SoCs represent an awesome combination of industry capabilities, including broad wireless multiprotocol support, battery life, machine learning, and security for IoT edge applications," says Matt Johnson, CEO of Silicon Labs. These SoCs will be available for purchase in the second half of 2022.

MAX78000 Development Board by Maxim Integrated. The MAX78000 is an AI microcontroller built to enable neural networks to execute at ultra-low power. It has a hardware based convolutional neural network (CNN) accelerator, which enables battery-powered applications to execute AI inferences.

Its CNN engine has a weight storage memory of 442kB and can support 1-, 2-, 4-, and 8-bit weights. Being SRAM based, the CNN memory enables AI network updates to happen on the fly. The CNN architecture is very flexible, allowing networks to be trained in conventional toolsets like PyTorch and TensorFlow.

Kria KV260 Vision AI Starter Kit by Xilinx. This is a development platform for Xilinx's K26 system on module (SOM), which specifically targets vision AI applications in smart cities and smart factories. These SOMs are tailored to enable rapid deployment in edge based applications.

Because it is based on an FPGA, the programmable logic allows users to implement custom accelerators for vision and ML functions. "With Kria, our initial focus was Vision AI in smart cities and, to some extent, in medical applications. One of the things that we are focused on now and moving forward is expanding into robotics and other factory applications," says Chetan Khona, Director of Industrial, Vision, Healthcare & Sciences markets at Xilinx.

Gluon AI co-processor by AlphaICs. The Gluon AI accelerator is optimised for vision applications and provides maximum throughput with minimum latency and low power. It comes with an SDK that ensures easy deployment of neural networks.

AlphaICs is currently sampling this accelerator for early customers. It is engineered for OEMs and solution providers targeting vision market segments, such as surveillance, industrial, retail, industrial IoT, and edge gateway manufacturers. The company also offers an evaluation board that can be used to prototype and develop AI hardware.

Intel's Neural Compute Stick 2 (Intel NCS2). Intel's NCS2 looks like a USB pen drive but actually brings AI and computer vision to edge devices in a very easy manner. It contains a dedicated hardware accelerator for deep neural network interfaces and is built on the Movidius Myriad X Vision processing unit (VPU).

Apart from using the NCS2 for their PC applications, designers can even use it with edge devices like Raspberry Pi 3. This will make prototyping very easy and will enhance applications like drones, smart cameras, and robots. Setting up and configuring its software environment is not complex, and detailed tutorials and instructions on various projects are provided by Intel.

A long way to go

The field of AI accelerators is still niche, and there is still a lot of room for innovation. "Many great ideas were implemented in the past five years, but even those are a fraction of the staggering number of AI accelerator designs and ideas in academic papers. There are still many ideas that can trickle-down from the academic world to industry practitioners," says Fuchs. EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast with a keen interest in innovation and research

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The Making Of A Sturdy And Secure AUTONOMOUS E-TWO-WHEELER

For a country like India, where more than half of the population is dependent on two-wheelers, enhancing these vehicles will be nothing short of achieving the dream of implementing autonomy on a wider scale



DR RAHUL KALA is Assistant Professor at the Centre of Intelligent Robotics, IIIT Allahabad

Two-wheelers have been an integral part of the Indian lifestyle for many years. While the public can smoothly go about its business, tourists can easily traverse the length and breadth of this vast country with these vehicles. Even Bollywood has been hugely influenced by it, so much so that many key scenes have involved a two-wheeler in action.

The idea of developing an autonomous two-wheeler amongst the current excitement around autonomous cars may be seen as silly by some. But the fact is that the idea of having an autonomous e-two-wheeler has been there since the early 2010s. So, is the idea of having an autonomous e-two-wheeler relevant more than a decade later? The answer is a full-fledged yes. If it could be thought of back then, it surely is possible now when technology has taken great strides.

Lane splitting

A common road phenomenon observed in the USA and the UK is 'lane splitting' wherein two-wheelers travel between adequately spaced rows of four-wheelers. And because two-wheelers are extremely agile, in case of a traffic jam, they can easily navigate their way ahead. So, for an efficient transportation system, lane splitting is the way to go in countries with a greater number of smaller vehicles.



Lane splitting at a traffic light in New York (Credit: Unsplash)

The need

In America and Europe, self-driven cars are quite popular, and you see very few two-wheelers on the road. The two-wheelers are used there mainly for leisure and sports. In India, two-wheelers are the lifeline of our transportation system. They are much less expensive here, so more people buy them.

But maintaining a smooth traffic flow due to the huge variety of vehicles on the Indian roads is a challenge for the authorities. Building more lanes and flyovers helps, but for a country like India their construction remains slow due to monetary constraints.

Two-wheelers occupy lesser space compared to four-wheelers, so more people can utilise each lane. Thus, there is lesser requirement for new lanes and flyovers. Therefore, in the future, when the traffic is not likely to reduce, the situation can be better tackled by using two-wheelers instead of cars.

The technology

Standard autonomous mobile robot models, for which a lot of research has been done over the last several decades, include the unicycle model, the bicycle model, the differential wheel type model, the tricycle

model (e-rickshaw or auto-rickshaw), and the dual bicycle model (car).

The two most prominent models for on-road self-driving mechanism are autonomous cars and autonomous two-wheelers. The software tech stack remains largely unchanged irrespective of the robot model used. Effectively, every self-driving vehicle looks at the surroundings through its eyes, which include onboard cameras and lidars. Whatever is seen gets converted to a digital map. All the captured information gets interpreted using an onboard computer vision that controls the associated orientation and speed mechanisms.

Finally, everything translates into decision making regarding lane changing, lane overtaking, stopping, slowing down, or accelerating. So, by tracking static objects and computing how much you moved, your current location can be determined.

Decision making is also regarding the control system that determines the conversion of linear and angular velocity in different motors. The control system is specific to the type of mechanical model, whether it is a bicycle model, dual-bicycle model, or tricycle model. Everything else, including the tech stack, remains the same.

The peculiarity

As per the laws of physics, if any stationary object subjected to a dynamic disturbance destabilises, it is called an unstable system; but if it comes back to its stable condition, it is called a stable system. If you push a glass near the edge of a table, or exert force on an upright pole standing on the ground, it would naturally fall down. The same does not apply to four- and three-wheelers, which, when disturbed, do not topple under normal circumstances.

A four-wheeler and a three-wheeler are stable systems when these are standing as well as when they are moving. But in case of two-wheelers, the same is not true. A two-wheeler is stable as long as it is moving. The moment it stops, it becomes unstable and tends to fall down.

In situations such as traffic stops, riders tend to place their foot on the ground to stabilise a two-wheeler. That is exactly what autonomous two-wheelers would need to do, but automatically. For that, a small leg hidden inside the vehicle's body gets deployed as soon as the vehicle speed slows down and is not good enough to maintain stability.

The cost of converting a normal two-wheeler EV into an autonomous two-wheeler EV is not much. Level 5 autonomy is quite expensive and there is no chance it will happen soon. But level 2 and 3 autonomies are comparatively easy. For it, an ultrasonic technology, or a high-speed depth camera, both costing 10,000 rupees or less, are available.

The electronics

A level-5 autonomous vehicle includes many lidars, radars, ultrasonic devices, IMUs, GPUs, battery systems, etc. This leads to its rear bonnet getting jam packed with computing devices and batteries, while the front bonnet is filled with sensors. Due to lack of space, any further expansion/addition to the system becomes difficult. On top of that, the comfort factor of the rider also needs to be kept in mind. You don't want any electronics or mechanics interfering with the rider's space.

The solution to this problem lies in removing a lot of onboard hi-tech equipment. Autonomy for two-wheelers does not require a lot of GPUs and lidars. A camera system and a lidar system will suffice. You can do many things with such systems. In fact, several hi-tech sensors are not at all required.

Safety

Safety standards for autonomous two-wheelers require rigorous testing for a lot of scenarios. The testing involves a vulnerable road user, such as a child, who can suddenly come up in front of a vehicle.

Segway e-scooter, with its ability to stand upright on its own, is an exception. A complex arrangement of gyroscopes, coupled with several microprocessors, measures its angular velocity, which directs the control mechanism to take appropriate action to remain stable.

An interesting thing is that two-wheelers themselves come under the category of vulnerable vehicles for road users. Autonomous four-wheeler cars are trained to detect vulnerable road users and take necessary action. The presence of a large number of two-wheelers on the road significantly increases the accident threat (owing to their vulnerable status). So, all possible efforts are required to make e-two-wheelers safe, which requires extensive research.

Final thoughts

Currently, there is a rule: One lane, one vehicle. That is how a lot of accidents are prevented. The moment there are too many hybrid vehicles on the road, you are talking of traffic risks never dealt with before. A self-driving car makes decisions based on the behaviour of other vehicles, for which a lot of behaviour analysis takes place inside the autonomous vehicle. The same needs to be implemented for autonomous two-wheelers as well.

And finally, for all vehicles to communicate with each other using digital signals, you do not need high-profile onboard sensing. Everything can come from a global map of network channels. This way, there is a lot of scope to enhance the communication protocols.

The two-wheeler has its own set of unique challenges concerning safety and operation. So, let us make the two-wheeler brand unique to India and help it shine globally with our R&D. EFY

The article is based on a talk by Dr Rahul Kala, Assistant Professor at the Centre of Intelligent Robotics, IIIT Allahabad. It has been transcribed and curated by Vinay Prabhakar Minj, an IoT and audio electronics enthusiast.

ALIGNING CAPACITOR SELECTION With The Latest Automotive Demands

Capacitors are common passive elements in all electronic devices, including vehicles. The usage of capacitors in vehicles is expected to increase in the coming years as electric vehicles (EVs) gain popularity. It is important to select capacitors wisely in order to combat common issues that occur in vehicular circuitry

TECHNICAL CONTENT TEAM, TME, AND AARYAA PADHYEGURJAR, EFY

Vehicular systems today have become vastly advanced. Smart cars, self-driving cars, electric vehicles, etc are rapidly gaining popularity not only among the wealthy but also among the middle-class society. Thanks to the huge boom of innovation in this field, there is a need for better and more durable electronic components, both passive and active.

Capacitors are widely used in the automotive industry. In fact, they are crucial to the functioning of a vehicle. They provide stability and are used in the management of current in the vehicle's circuitry. They are also used to ensure that the design is free from interference. Capacitors play a major role in braking systems, window wipers, seat aligners, airbag controllers, and many other important applications inside a vehicle.

Capacitors in EVs

Driven by concerns about petrol prices, government environmental initiatives, and large-scale public and private investment in the supporting charging infrastructure, the electric vehicle (EV) sector is undergoing a period of substantial growth. Over the course of the next decade, the automotive market is set to transition from being dominated by internal combustion engine (ICE) vehicles to one where EVs make up the majority of new vehicle sales.

ICE vehicles have relied on 12V and 24V powertrain architectures, with hybrids often being based on 48V systems. EVs, however, have powertrains that are placed at far higher voltages. Further, in order to accelerate charge times and increase conversion efficiencies, the voltages are being pushed even higher. The new EV models that are just starting to appear on the market have 800V powertrain ratings!

For the first time, worldwide EV annual sales surpassed 6 million units in 2021. Predictions made by the International Energy Agency (IEA) suggest that this is just the beginning. It forecasts that sales will have reached 15 million by 2025 and 25 million by 2030. The powertrains of EVs need to support higher voltage levels compared to their ICE counterparts, and this will have major implications when it comes to specifying constituent passive components.

Even for 48V hybrid systems, the motors will be located on the powertrain itself. This does, however, mean that the accompanying electronics will be exposed to more intense vibrations and thermal

Supercapacitors in EV batteries

Capacitors and batteries are both methods of energy storage. Unlike lithium-ion batteries, supercapacitors do not rely on a chemical reaction. They are electrochemical in nature and store energy electrostatically. Since lithium-ion batteries are expensive and slow to charge, supercapacitors can be considered as a viable alternative for EV batteries.

Some common capacitors used in vehicles

- Tantalum electrolytic capacitors
- Aluminium electrolytic capacitors
- Film capacitors
- Ceramic capacitors

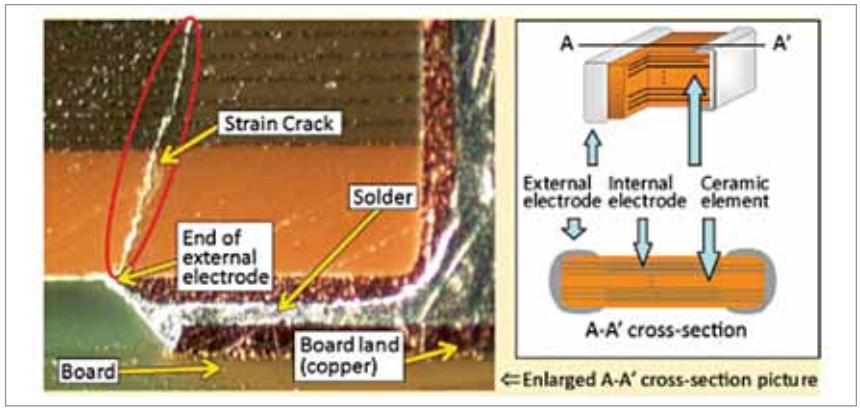


Fig. 1: A typical strain crack (Credit: Murata Manufacturing)

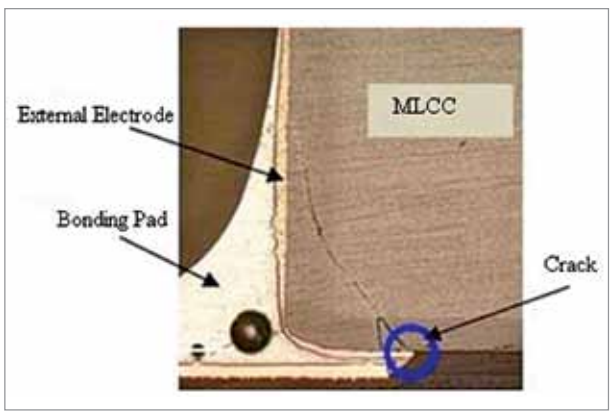


Fig. 2: MLCC crack due to vibration (Credit: AIRI Tech)



Fig. 3: A taller base with dummy terminals (Credit: Kemet Engineering Center)

cycling. Factors like vibrations, shock, and stress have clear effects on the passive components present in the system. Therefore, automotive engineers must look at the effects this will have on component reliability.

ESR: An important parameter

A key performance parameter for any DC-Link capacitor will be its equivalent series resistance (ESR) value. The lower the ESR of a capacitor, the greater its ability to smooth out high-frequency voltage disturbances passing through the powertrain. If the ESR values that these capacitors present within the electrical circuitry increase due to some form of damage, the whole powertrain operation could potentially be jeopardised.

While selecting capacitors that conform to these factors, vehicle manufacturers must keep the overall bill-of-materials expense as low as possible, so the chosen capacitors have to be cost-effective. There is, therefore, a constant tradeoff between efficiency and cost, and engineers need to maintain both sides of the equation for the vehicle to be optimal.

Effect of vehicle vibrations and stress

The adoption of high voltage levels in EVs and the location of motors away from the protection of the engine compartment in a few hybrid systems will have implications for the DC-Link capacitors incorporated into EV and hybrid powertrains. Situated between the battery and the traction inverter, these passive components are used to smooth out the voltage and prevent unwanted transient spikes from occurring. If they are to be effective, a high degree of robustness is needed. This will allow them to cope with the challenging application environment that automotive deployment represents.

Standard multilayer ceramic capacitors (MLCCs) are not well suited to automotive usage, as they are not able to cope with the acute mechanical stresses involved. If the PCB on which they are mounted flexes, due to either vibration or thermal cycling, the solder joints will be placed under considerable strain. This can lead to cracks appearing within the ceramic substrate. These cracks can result in moisture ingress arising which will, in turn, impact the capacitor performance. If these components are located close to the edge of the PCB, the stresses that they are subjected to are likely to be even greater.

Combating vibration-related issues

The vibrations witnessed in an automobile can come from a variety of sources and be at a wide range of different frequencies. Though these issues are intrinsic in automobile design, they can be mitigated in a number of ways as follows:

Specify polymer capacitors instead of MLCCs. Unlike normal

Important considerations for engineers

- Low ESR value
- High operational temperature range
- Resilience to ongoing vibrations
- High degrees of robustness
- Small physical dimensions

COMPARISON: ALIGNING CAPACITOR SELECTION WITH THE LATEST AUTOMOTIVE DEMANDS

Name of Company	Name of Series	Type	Capacitance Range	Operational Temperature	ESR Value (mΩ)	Notable Features	Key Application	Compliance and Qualification
KEMET	A768	Solid Polymer Aluminum Capacitor	18μF up to 1000μF	−55°C to +125°C	15 to 54 (@ 100kHz, 20°C)	Taller base and extra terminals for physical support	Vehicular electrical subsystems, engine control units, and automotive DC/DC converters	RoHS, REACH, AEC-Q200
KEMET	FT-CAP	MLCC	180pF to 22μF	−55°C to +125°C	N/A	Conductive silver epoxy layer situated between the base metal and nickel barrier layers	Critical timing, tuning, circuits requiring low loss, circuits with pulse, circuits subject to high levels of board flexure or temperature cycling	RoHS, REACH, AEC-Q200
KYOCERA AVX	TCQ	Polymer	2.2μF to 470μF	-55 to +125°C	25 to 150 (@ 100kHz)	Conductive Polymer Electrode and a Benign Failure Mode Under Recommended Use Conditions	DC/DC converters, Telecommunication (coupling/decoupling), Automotive (body electronics, cabin controls, infotainment, comfort, after market etc)	RoHS, AEC-Q200
KYOCERA AVX	TCO	Polymer	10μF to 33μF	-55 to +150°C	100 to 150 (@ 100kHz)	Conductive Polymer Electrode and a Benign Failure Mode Under Recommended Use Conditions. Suited for higher temperature applications	DC/DC converters, Telecommunication (coupling/decoupling), Automotive (body electronics, cabin controls, infotainment, comfort, after market etc)	RoHS, AEC-Q200
KYOCERA AVX	Flexiterm Products	MLCC	220pF to 100nF	-55°C to +125°C	N/A	The nickel-plated copper terminations are supplemented by a proprietary layer that absorbs incident mechanical stresses	High Flexure Stress Circuit Boards, All kinds of engine sensors, Variable Temperature Applications	RoHS, AEC-Q200
Panasonic	EEH-ZS	Hybrid	47μF to 470μF	-55°C to +125°C	20mΩ to 100mΩ (@ 100kHz)	Auxiliary side terminals. Vibration Variants Can Withstand Shocks Of As Much As 30G	DC/DC Converters, AC/DC Converter, Under-The-Hood Applications (125°C)	RoHS, REACH, AEC-Q200

capacitors whose electrolyte is actually a liquid—a conductive solution—polymer capacitors have a solid electrolyte that's made up of conductive polymers. They are therefore more compact and there is no chance of leakage or the capacitor drying out. These components will have lower ESR values than MLCCs, with better performance across a wide range of operating conditions. However, there are increased costs involved.

A great example for this category would be Kemet's solid polymer aluminium capacitor. It is the solid polymer that makes these capacitors vibration-resistant. In their A768 series of solid polymer capacitors, a few design changes were made to increase their vibration tolerance even further. They were provided with a taller base



Fig. 4: TCQ automotive conductive polymer chip capacitor (Credit: AVX)

for better physical support. What's interesting about these capacitors is that they have extra terminals that do not provide electrical conductivity but are actually used to give the capacitor a stable connection to the PCB.

Kyocera AVX has two special series of automotive polymer capacitors: the TCQ series and the TCO series. TCQ is used for standard



Fig. 5: Panasonic EEH-ZK hybrid capacitor (Credit: Panasonic)

temperature conditions while TCO is used for applications that demand higher temperatures. Both of these meet all the 'AEC-Q200 Stress Test Qualification for Passive Components' requirements and are reliable for a wide range of temperatures. They are robust and provide stable

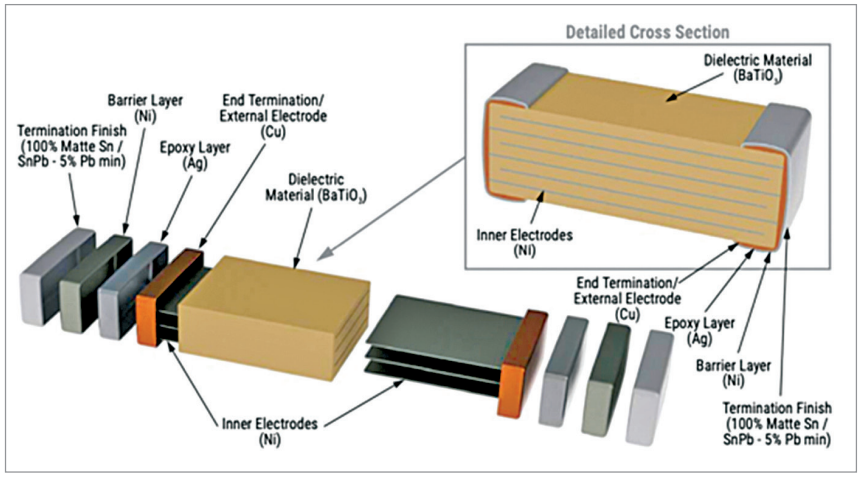


Fig. 6: Construction of FT-CAP MLCC (Credit: Kemet)

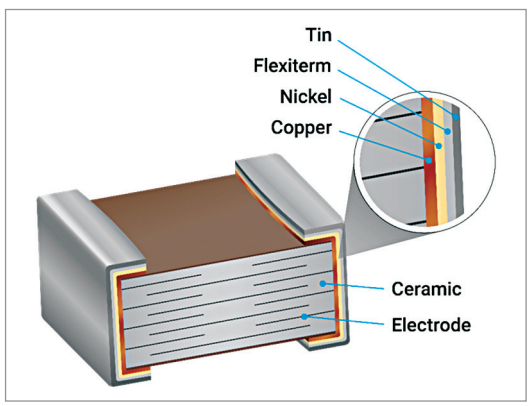


Fig. 7: The additional layer of a Flexiterm MLCC (Credit: AVX)

performance with a low ESR.

Using hybrid capacitors. These comprise an anode with a liquid and conductive polymer construction, alongside a cathode made from aluminium. The large surface area of the liquid enables elevated capacitance values to be achieved in a compact form factor. Like the previous option, this comes with added costs.

The EEH-ZS hybrid series of capacitors from Panasonic particularly target automotive applications and have vibration-resistant properties. These have auxiliary side terminals that enhance their vibration resistance. This is why these capacitors can withstand shocks with vibration acceleration up to 30G. Further, the side terminals make soldering easier. While using these capacitors, designers may choose not to deploy external anti-vibration techniques. These are also RoHS/REACH compliant and qualify the requirements set by AEC-Q200.

Using vibration-resilient MLCCs. In MLCCs, it is possible to make certain enhancements to the methods via which the capacitor body and its terminations are interconnected with one another so that the vibrational forces experienced are dampened. In this way, additional costs of using polymer or hybrid capacitors can be avoided. This enables greater mechanical robustness to be attained, while still benefiting from the cost advantages of MLCCs.

To address the need for capacitors that are able to resist vibrational forces, Kemet developed its FT-CAP series. These MLCCs have an innovative termination arrangement that helps to lower the strain imparted from the PCB when it is flexed. A conductive silver epoxy layer is included in the termination structure (situated between the base metal and nickel barrier layers). This enables terminal strength to be upheld but provides the cushioning necessary to prevent any cracks from appearing. The capacitor's continued performance is thus assured.

Kyocera AVX is also tackling the vibration issues previously outlined through its Flexiterm low ESR MLCC products. These also have flexible terminations fitted to them for added elasticity. Here nickel-plated copper terminations are supplemented by a proprietary layer that absorbs incident mechanical stresses. The manufacturer has successfully managed to do this without there being any major increase in the costs involved. They support an -55°C to +125°C operational temperature range and 5mm flexes can be comfortably handled by them (compared to the 2mm that MLCCs are normally rated for).

A comparison of the capacitors mentioned above is given in the Table.

There are many capacitor series developed by other manufacturers to combat specific issues, not only vibration. They leverage engineering advances that provide enhanced levels of ruggedness. For example, the PCZ series introduced by Nichicon Corp. has a great degree of heat resistance.

The automotive industry places exacting demands on the electronic hardware employed in vehicle designs, and the next generation of vehicle models (particularly those that are EV or hybrid) will only exacerbate this. High voltage levels will call for capacitors that have superior performance characteristics. These components will need to withstand heavy vibrations, for instance, as they are now being placed into more difficult surroundings. This means that automotive engineers need to select their components wisely to be assured of long-term reliability even under the harshest of working conditions. EFY

This feature is inspired by an article authored by the technical content team at TME. The co-author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast with a keen interest in innovation and research.

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VARIABLE POWER SUPPLY
For Up To 3A Current

S.C. DWIVEDI

The circuit presented here can provide up to three amperes of current for a 5V, 6V, 8V, or 9V supply. It uses the popular adjustable voltage regulator LM317, which is inexpensive and is used generally for variable power supplies with up to 1.5 ampere current.

With the addition of PNP transistor TIP127 in the circuit, we get a 5V to 9V variable power supply with 3A current rating. However, suitable heatsinks for LM317, TIP127, LM7809 and an exhaust fan for cooling the TIP127 are required.

The author's prototype is shown in Fig. 1. The block diagram of the variable power supply is shown in Fig. 2 and its circuit diagram in Fig. 3.

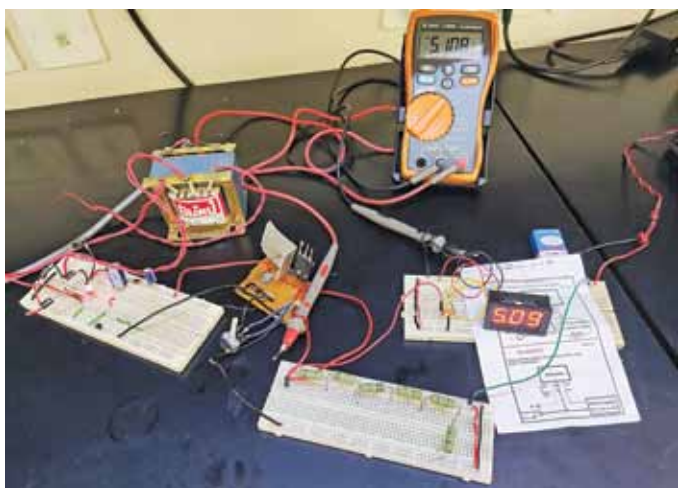


Fig. 1: Author's prototype

Circuit and working

The variable power supply is built around step-down transformer X1, four 1N5408 rectifier diodes D1 through D4, an LED, TIP127 transistor T1, LM317 adjustable voltage regulator IC1, 9V voltage regulator IC2, and a DC digital panel meter (DPM). A 22-ohm, 2-watt resistor (R1) is connected between the base and emitter of T1 to control the current. Pot VR1 is used to control the output voltage. The output voltage can be seen on the DPM.

The output voltage can be set to 9V and the current drawn is around 3A. The voltage across resistor R1 makes transistor T1 to conduct and most of the current is drawn from

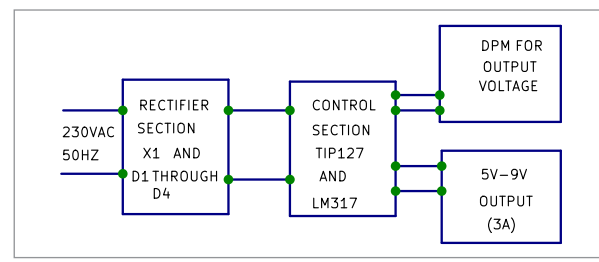


Fig. 2: Block diagram

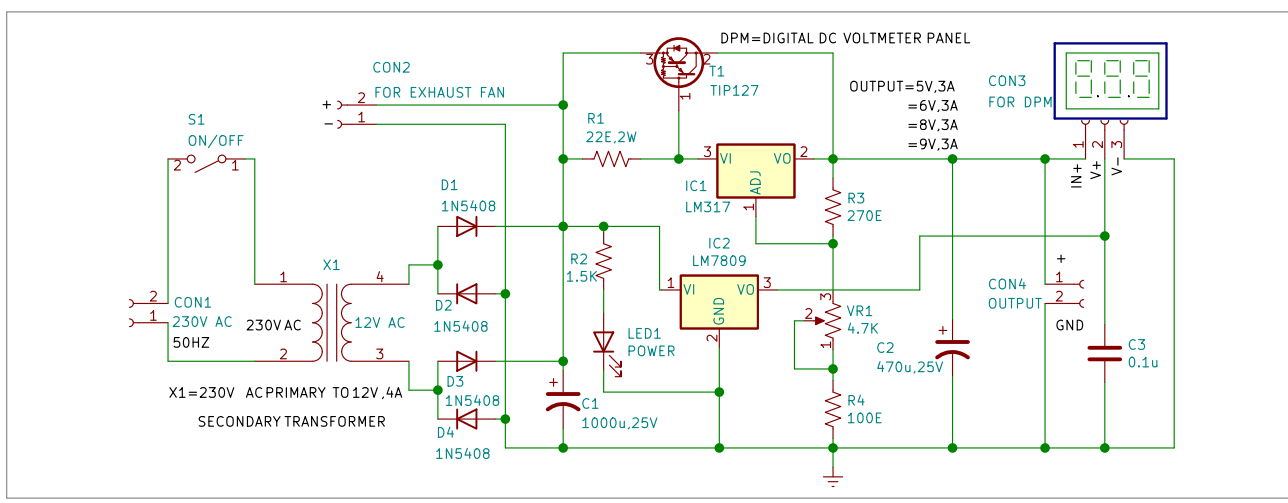


Fig. 3: Circuit diagram

emitter to collector of T1. As lesser current passes through LM317 and most of the current flows through T1, heatsink of IC1 is less warm as compared to the heat sink of transistor T1 heat sink. So the heat sink for T1 needs to be bigger than the heat sink for IC2 and IC3. Use of exhaust fan helps in proper dissipation of

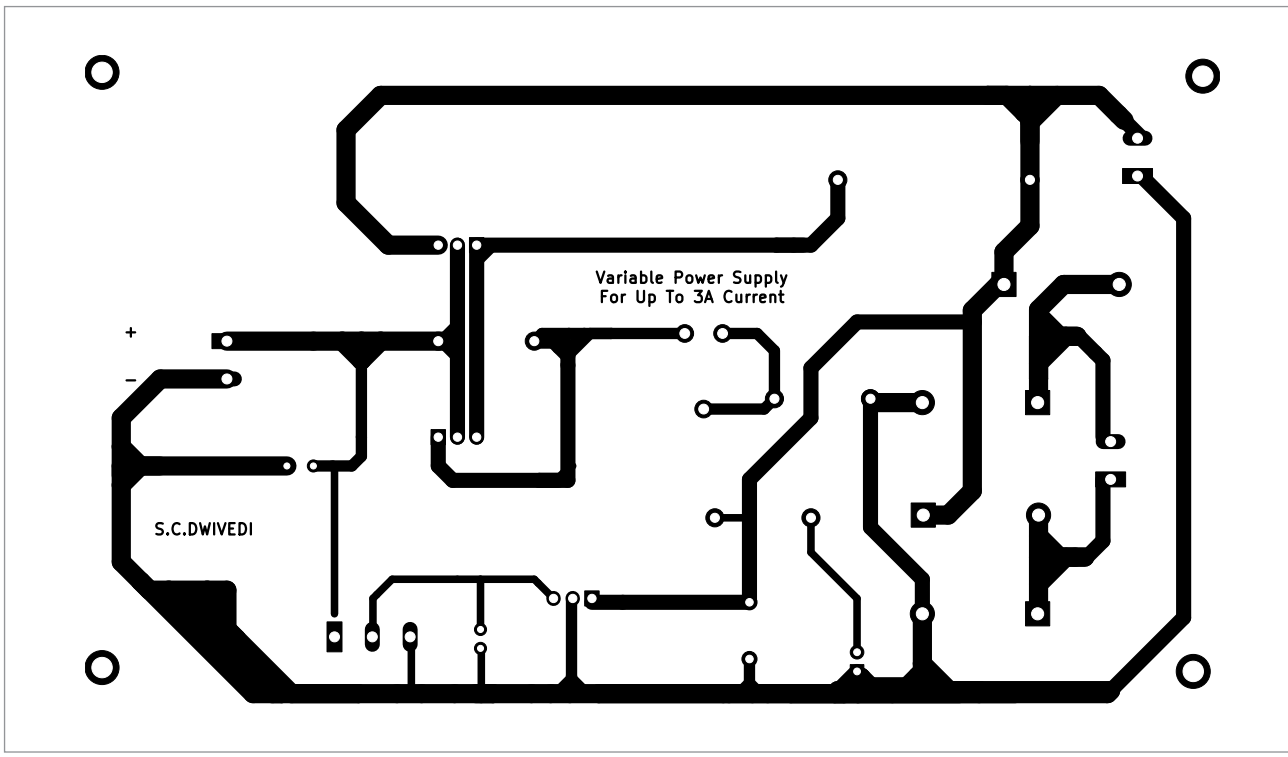


Fig. 4: Actual-size single-side PCB layout

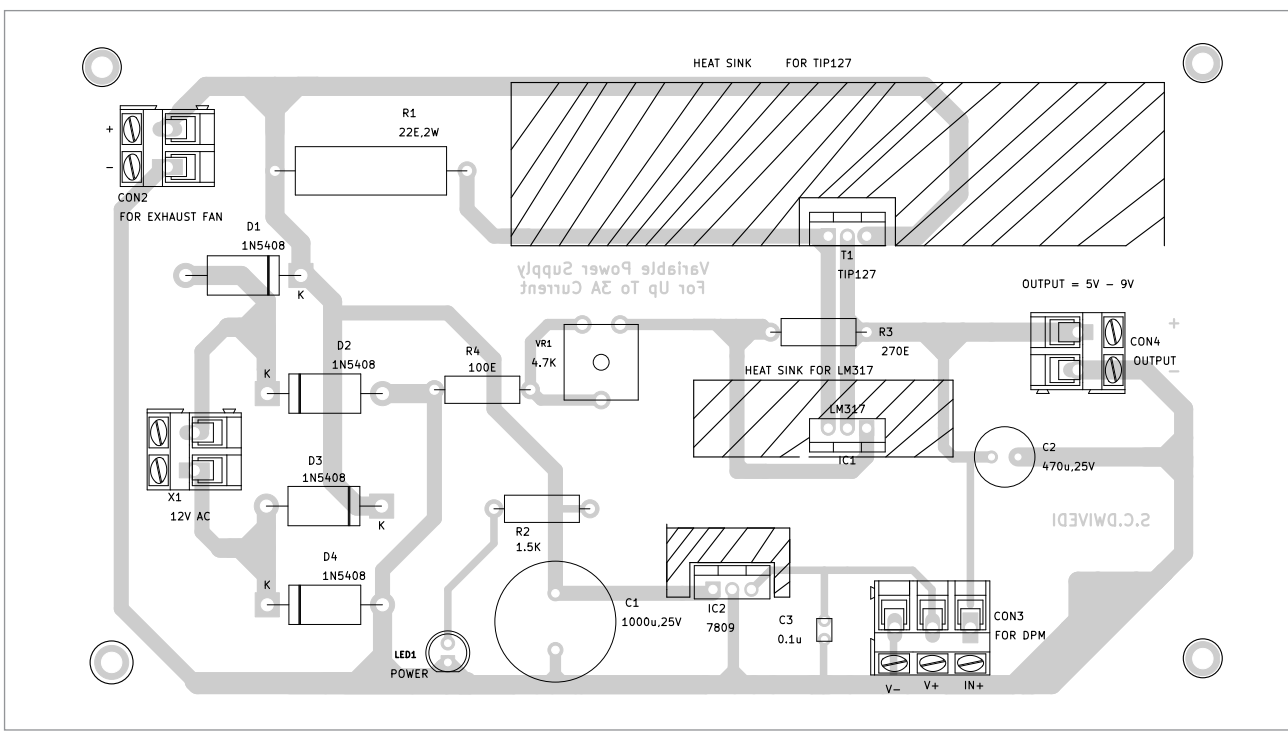


Fig. 5: Component layout

the heat. With more current needed by the load, transistor T1 conducts more and the current bypasses the LM317.

LED1 glows when 230V AC supply is on. VR1 is used to vary the output voltages according to your requirement. The voltage is shown on DPM.

Construction and testing

An actual-size, single-side PCB for the 3A variable power supply is shown in Fig. 4 and its component layout in Fig. 5. After assembling the circuit on PCB, enclose it in a suitable cabinet. Do not forget to use suitable heat-sinks for transistors TIP127, IC LM317 and IC LM7809.

Connect +12V power supply to exhaust fan from CON2 provided in the PCB. Also connect VR1 and LED1 via 2-pin wires from PCB to front panel.

PARTS LIST

Semiconductors:

IC1	- LM317 adjustable voltage regulator
IC2	- LM7809
T1	- TIP127 PNP power transistor
LED1	- 5mm LED
D1-D4	- 1N5408 rectifier diode

Resistors (all 1/4-watt, ±5% carbon), unless stated otherwise:

R1	- 22-ohm, 2-watt
R2	- 1.5-kilo-ohm
R3	- 270-ohm
R4	- 100-ohm
VR1	- 4.7-kilo-ohm pot (potentiometer)

Capacitors:

C1	- 1000µF, 25V electrolytic
C2	- 470µF, 25V electrolytic
C3	- 0.1µF ceramic disc

Miscellaneous:

X1	- 230V AC primary to 12V-0-12V, 4A secondary transformer
S1	- On/off switch
CON1 (for X1), CON2, CON4	- 2-pin terminal connector
CON3	- 3-pin terminal connector
DPM	- Digital DC voltmeter
	- 12V small exhaust fan
	- Heat-sink for TIP127 (big size)
	- Heat-sinks for LM317 and LM7809

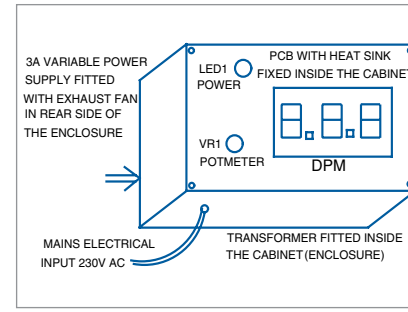


Fig. 6: Proposed layout of the parts in cabinet

Fix a small exhaust fan just behind the heat sink of TIP127 to get proper output. Also provide a window on the rear side of the cabinet for the exhaust fan's air outlet. Fix LED1, pot VR1, and DPM on the front side, and CON1 and CON2 at rear side of the cabinet. A placement of the parts in the cabinet is shown in Fig. 6. EFY

S.C. Dwivedi is an electronics enthusiast, circuit designer and technical article writer



EFY TESTED
Ashwini K. Sinha

Make THE WORLD'S SMALLEST LAPTOP For HACKING And Everything Else

ASHWINI KUMAR SINHA

Carrying a machine everywhere, which is capable of doing ethical hacking without getting noticed, is important in some hacking related tasks for which you may not like to carry a big laptop. For this we need a smart device to test the exploitation and network penetration and injection of malware and viruses. Ethical hacking requires small-size machine that is as capable as a full-specs laptop but small enough to be hidden and carried anywhere. So, here is how you can make the world's smallest hacking device that has a full touch keyboard.

To begin with, we have to decide some exciting specs for the laptop, so that we can select the hardware parts and operating system (OS) for the hacking machine accordingly. The following are some features we want in our laptop for hacking:

- As small as our finger, portable, and easy to hide and carry for hacking anywhere
- Built-in full multi-touch keyboard
- Multi-touch display for working as a hacking tablet
- Equipped with Wi-Fi, BLE, and Bluetooth connectivity for wireless and network based exploitation and penetration testing and hacking

Linux is considered to be the best operating system (OS) for ethical hacking and Kali is one of the best Linux flavoured OS because it comes with pre setup of various ex-



Fig. 1: Author's prototype

TABLE 1
MATERIALS

Component name	Quantity	Description
Raspberry Pi 4	1	2GB/4GB/8GB
8.9cm touch LCD display	1	HDMI/SPI LCD display
5.43cm touch e-ink display	1	Touch e-ink display
5V battery+charging IC	1	5V battery Lithium thin
Laptop 3D printed parts	1	ABS/PLA 3D printed
Wires	30	Thin wire



Fig. 2: The hacking laptop with touch keypad



Fig. 3: The laptop running Linux



Fig. 4: Laptop size compared to finger

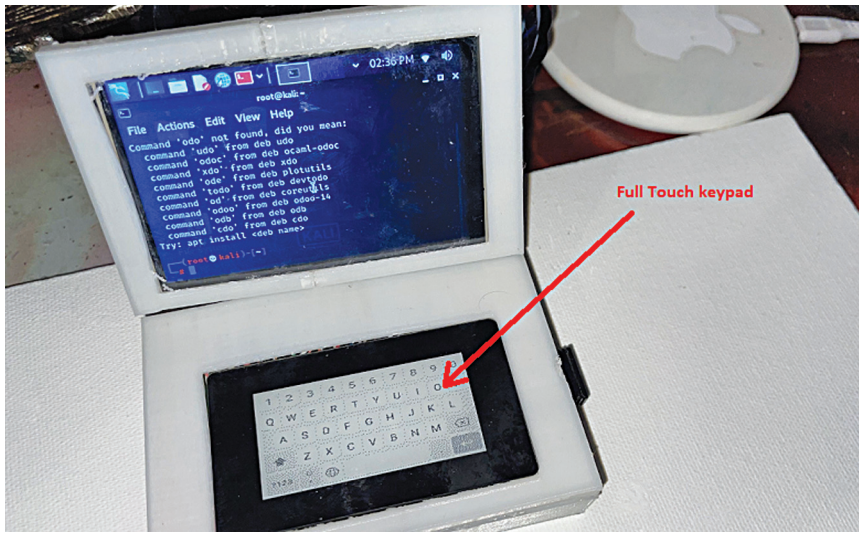


Fig. 5: The laptop's touch keyboard



Fig. 8: LCD panel

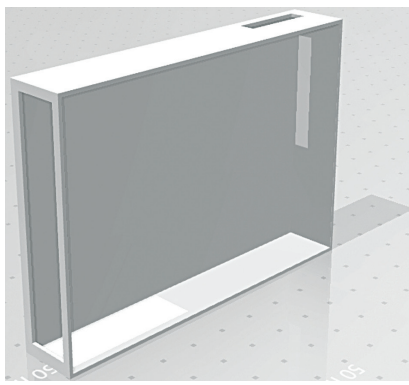


Fig. 6: The laptop's base

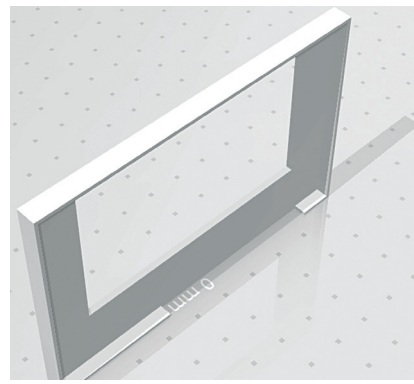


Fig. 7: Base cover to hold the keyboard

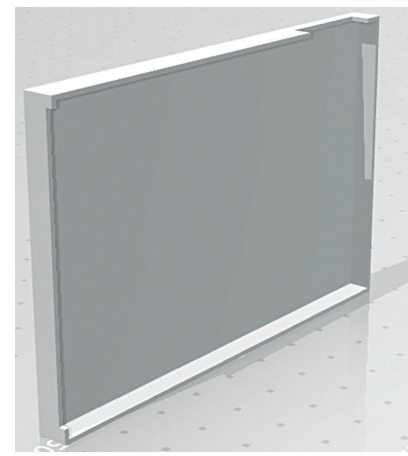


Fig. 9: LCD panel's back cover

ploitation tools for penetration hacking and testing, such as Metasploit, Aircrack-ng, and Wireshark.

Designing the laptop

After collecting the components listed in the Bill of Materials, we need to design the case or body of the laptop that is to hold the hardware inside it safely. We may design the laptop body in three parts. First, the base part where we keep the main hardware, viz, Raspberry Pi, battery, and charging system. In the base we make two cuts: one in front for the Ethernet and USB and the other for power and charging of the battery.

Next, we design the top cover of the base to hold a touch e-paper based keyboard. We make a cut in the top cover to fix the touch panel keyboard inside it, as shown in Fig. 7.

Next, we design the LCD panel's support for the laptop. For that we make the enclosure in the same size as the display and keep the thickness same as well.

After designing the laptop body, we can 3D print its parts.

Prerequisite

Before proceeding further, we need to prepare the Raspberry Pi board with Kali Linux. For that, go to Kali Linux official website and download its latest version for an ARM based device like Raspberry Pi. Next, download the Raspberry Pi disk imager and install it. Insert the SD card in USB drive and prepare it with Kali Linux OS using Raspberry Pi disk imager by choosing Kali Linux OS image file in Raspberry Pi disk imager.

Preparing OS for SPI display

For our laptop we can choose any display for Raspberry Pi that is up to 8.9cm (3.5-inch) in size. An HDMI based touch display is recommended as we are using a touch e-ink display for the keyboard panel, which is an SPI, and two SPI displays can cause conflict in communication. However, the SPI touch e-ink display used for keyboard uses only its touch function that is I2C based, so the SPI of other displays does not cause that much of a problem.

An SPI based display was used in the prototype because it had already been bought, but use of 8.9cm HDMI touch display is recommended in-

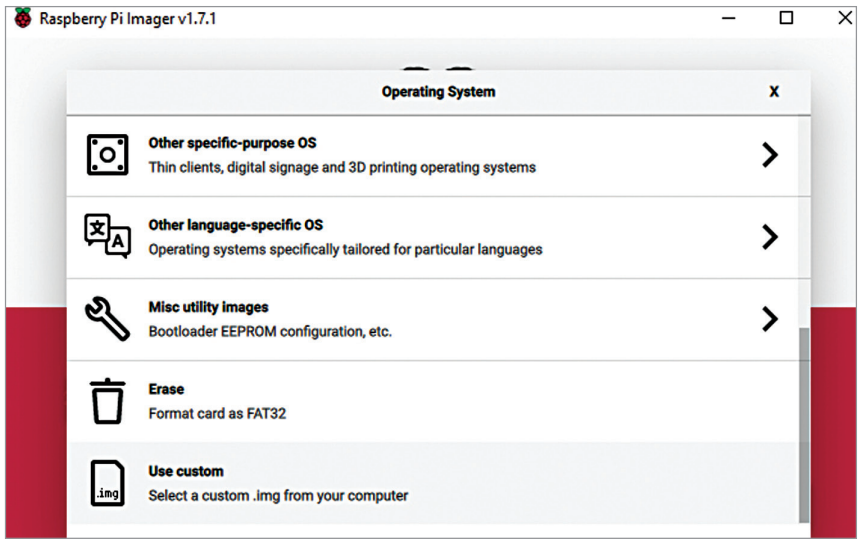


Fig. 10: Preparing SD card with Kali Linux OS

After installing the driver, connect the SPI display, as shown in Fig. 11, and solder the pins to Raspberry Pi as per Table 2.

Preparing the touch keyboard

We need to prepare the keypad system for the laptop for giving input to the laptop. As we wish to make a full touch keyboard panel, we are using the touch e-ink display as the touch based keypad, but we need software to use it as keyboard.

For making the touch keyboard, we need to display the keys on the e-ink display. So, download a vector image having the keys on the keyboard. Resize the image to the size

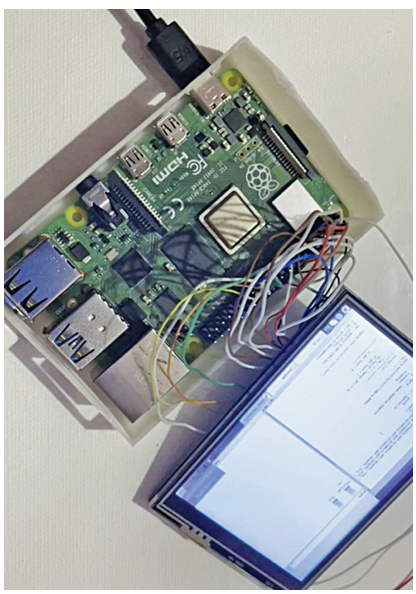


Fig. 11: Connecting SPI display with Raspberry Pi



Fig. 12: Keyboard layout on e-ink display

stead. By using the HDMI display, you can skip the following steps (required for SPI display) and go straight to the keyboard preparation section.

To use the SPI display, we need to install the drivers and setup the SPI touch display. So, open the terminal and run the following command in Linux terminal to install the driver and setup the display for Raspberry Pi:

```
git clone https://github.com/goodtft/
LCD-show.git
chmod -R 755 LCD-show
cd LCD-show/
sudo ./LCD35-show
```

TABLE 2
SPI DISPLAY CONNECTIONS

Pin No.	Symbol	Description
1, 17	3.3V	Power positive (3.3V power input)
2, 4	5V	Power positive (5V power input)
3, 5, 7, 8, 10, 12, 13, 15, 16	NC	NC
6, 9, 14, 20, 25	GND	Ground
11	TP_IRQ	Touch panel interrupt; low level while the touch panel detects touching
18	LCD_RS	Instruction/data register selection
19	LCD_SI / TP_SI	SPI data input of LCD/touch panel
21	TP_SO	SPI data output of touch panel
22	RST	Reset
23	LCD_SCK / TP_SCK	SPI clock of LCD/touch panel
24	LCD_CS	LCD chip selection, low active
26	TP_CS	Touch panel chip selection, low active

```
#!/usr/bin/python
# -*- coding:utf-8 -*-
import sys
import os
libdir = os.path.join(os.path.dirname(os.path.
dirname(os.path.realpath(__file__))), 'lib')
if os.path.exists(libdir):
    sys.path.append(libdir)

from TP_lib import gt1151
from TP_lib import epd2in13_V2
import time
import logging
import traceback
import threading
from pynput.keyboard import Key, Controller

logging.basicConfig(level=logging.DEBUG)
flag_t = 1
keyboard = Controller()

def pthread_irq() :
    print("pthread running")
    while flag_t == 1 :
        if(gt.digital_read(gt.INT) == 0) :
            GT_Dev.Touch = 1
        else :
            GT_Dev.Touch = 0
    print("thread:exit")


try:
    logging.info("epd2in13_V2 Touch Demo")
```

Fig. 13: Code for keyboard input

```
#uncomment to overclock the arm. 700 MHz is the default.
#arm_freq=800

# Uncomment some or all of these to enable the optional hardware interfaces
dtparam=i2c_arm=on
#dtparam=i2s=on
dtparam=spi=on
enable_uart=1
dtoverlay=spi1-3cs,cs0_pin=05,cs1_pin=06,cs2_pin=16

# Uncomment this to enable the lirc-rpi module
#dtoverlay=lirc-rpi

# Additional overlays and parameters are documented /boot/overlays/README

# Enable audio (loads snd_bcm2835)
dtparam=audio=on
dtoverlay=waveshare35a

^G Get Help  ^O Write Out ^W Where Is  ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit      ^R Read File ^\ Replace   ^U Uncut Text^T To Spell  ^_ Go To Line
```

Fig. 16: Enabling other SPI on Raspberry Pi

```
File  Edit  Format  Run  Options  Window  Help
    t = threading.Thread(target = pthread_irq)
    t.setDaemon(True)
    t.start()
    while(1):

        gt.GT_Scan(GT_Dev, GT_Old)
        if(GT_Old.X[0] == GT_Dev.X[0] and GT_Old.Y[0] == GT_Dev.Y[0] and GT_Old.S[0] == GT_Dev.S[0]):
            continue
        if(GT_Dev.X[0] > 100 and GT_Dev.X[0] <114 and GT_Dev.Y[0] > 2 and GT_Dev.Y[0] < 37):
            keyboard.type('1')
            print("1")
        if(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 38 and GT_Dev.Y[0] < 51):
            print("2")
            keyboard.type('2')

        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 52 and GT_Dev.Y[0] < 71):
            print("3")
            keyboard.type('3')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 73 and GT_Dev.Y[0] < 100):
            print("4")
            keyboard.type('4')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 101 and GT_Dev.Y[0] < 123):
            print("5")
            keyboard.type('5')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 125 and GT_Dev.Y[0] < 149):
            print("6")
            keyboard.type('6')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 150 and GT_Dev.Y[0] < 172):
            print("7")
            keyboard.type('7')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 175 and GT_Dev.Y[0] < 197):
            print("8")
            keyboard.type('8')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 199 and GT_Dev.Y[0] < 223):
            print("9")
            keyboard.type('9')
        elif(GT_Dev.X[0] > 100 and GT_Dev.X[0] < 114 and GT_Dev.Y[0] > 225 and GT_Dev.Y[0] < 248):
```

Fig. 14: Code checking touchpoints and converting into keyboard input

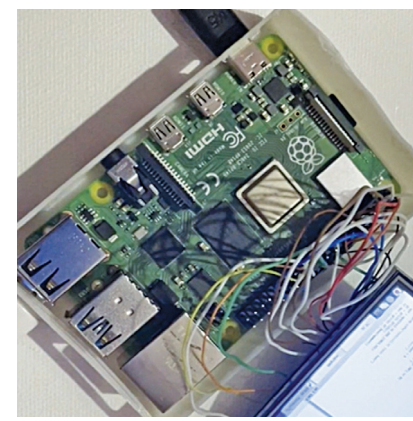


Fig. 17: Raspberry Pi fitted in the case

```
    #

    import RPi.GPIO as GPIO
    import time
    from smbus import SMBus
    import spidev
    import ctypes
    import logging

    # e-Paper
    EPD_RST_PIN     = 17
    EPD_DC_PIN      = 25
    EPD_CS_PIN      = 8
    EPD_BUSY_PIN    = 24

    # TP
    TRST    = 22
    INT     = 27

    spi     = spidev.SpiDev(1, 0)
    address = 0x0
    # address = 0x14
    # address = 0x48
    bus     = SMBus(1)
```

Fig. 15: Changing the SPI number in code

TABLE 3
CONNECTION OF E-INK DISPLAY TO RASPBERRY PI

E-ink paper pins	BCM pin numbering	Board pin number
VCC	3.3V	3.3V
GND	GND	GND
INT	27	13
SCL	SCL1	5
SDA	SDA1	3
TRST	22	15



Fig. 18: Touch keyboard on the top of laptop base

of e-ink display, then download the library for touch e-ink display. Here we are using the waveshare touch e-ink display, so open Linux and run the following command to get the library and driver for the e-ink display:

```
sudo pip3 install gpiozero
wget http://www.airspayce.com/mikem/
bcm2835/bcm2835-1.68.tar.gz
tar zxvf bcm2835-1.68.tar.gz
cd bcm2835-1.68/
sudo ./configure && sudo make && sudo make
check && sudo make install
sudo apt-get install wiringpi
sudo apt-get update
sudo apt-get install python3-pip
sudo apt-get install python3-pil
sudo apt-get install python3-numpy
sudo pip3 install RPi.GPIO
 sudo pip3 install spidev
cd ~
git clone https://github.com/waveshare/
Touch_e-Paper_HAT
```



Fig. 19: Touch keyboard fixed



Fig. 20: The display fixed



Fig. 21: Laptop running Kali Linux

Go to Example and run the code to show the image on e-ink display. In that code change 'pic' to keyboard layout vector image and run the code (Note: Attach the e-ink touch display with Raspberry on its GPIO pins before running the code) and then turn off the Raspberry. The display will remain with the same image even after power is disconnected, until you refresh the display. E-ink display uses a special technology where the ink molecules that are activated electrically remain on the display, like the printed ink on paper.

Next, create the code that will identify the touch points on the touch e-ink display that we touch and convert those keyboard signals to inputs for Kali Linux in Raspberry Pi. To input signals of mouse and keyboard virtually, without actually connecting any mouse or keyboard, we have many Python libraries. In prototype we used pynput Python library module to give a virtual keyboard input to Raspberry Pi. So, open the Linux terminal and run the following command to install pynput:

```
sudo pip3 install pynput
```

Next, prepare the code that will check the touch points and convert them into key input for each key that we touch on the keyboard.

Import the library and pynput modules for virtual input to Raspberry Pi, as shown in Fig. 13, and check the touch points on display where we will be touching the e-ink display that is being used as a keyboard. Next, create a while loop and define the function to use pynput for the keyboard inputs to Raspberry Pi, as shown in Fig. 14.

Now we need to change the SPI(0,0) of the Raspberry Pi SPI port to a second SPI. Open the lib folder and make a change in the code file of e-ink touch display by changing to SPI(1,0) in every file where SPI(0,0) is written and save that. Next, enable the second SPI port of Raspberry Pi by adding the line marked by arrow in Fig. 15 in config.txt file of Raspberry Pi in boot folder in root of Raspberry Pi.

Connect the e-ink display to Raspberry Pi pins as shown in Table 2. As we are using only touch part, and touch controller is I2C based, we are connecting the pins of touch controller of e-ink display only to Raspberry Pi.

Preparing the laptop

After setting up everything in the library and modules, and connecting the components and soldering, fix all the hardware in the 3D-printed laptop case that we made earlier. Fix the components as shown in Fig. 17 through Fig. 20. Fit the battery and charging system inside the case, leaving Raspberry Pi 5V pin and GND pin outside.

Testing

Congratulations! The world's smallest hacking laptop is ready to show its magic. Power the laptop and run the keyboard code. You are now ready to use it as a hacking machine that is as powerful as a commercially available hacking laptop, in spite of its tiny size.

You can carry the laptop anywhere for penetration testing, securing network, and then testing the network security. You can also use it, of course, like any other laptop for normal working, playing games, watching videos, or browsing the internet. Whatever you do on your regular laptop, this smallest laptop is capable of doing the same. EFY

Ashwini Kumar Sinha is
a technology enthusiast

EFY TESTED Sani Theo

HOME AUTOMATION
Using Apple HomeKit And ESP8266

ROHAN BARNWAL AND RAHUL BARNWAL

It is an IoT based project through which you can control four home appliances using Apple HomeKit, Hey Siri app, and ESP8266 Wi-Fi module. The author's prototype is shown in Fig. 1.

A few months ago we were thinking of building a home automation system. After searching on the internet we found that such projects were mainly based on Google Assistant and Alexa. From there we got the idea to make a home automation system that could be controlled using Apple's assistant, the Hey Siri feature.

We searched this topic but most of the articles written required Apple's laptop and Homebridge app. We wanted to make the project without using these tools. Then we came across an amazing library that could make it possible, though it had an example to control only one relay. Here is the home automation project through which you can control four appliances through four relays.

Following hardware is required to make the project:

- 5V relay module
- NodeMCU board
- Jumper wires
- Bulb holder (for 230V AC)
- 60W/100W bulb
- iPhone SE or any iPhone that supports Apple HomeKit application

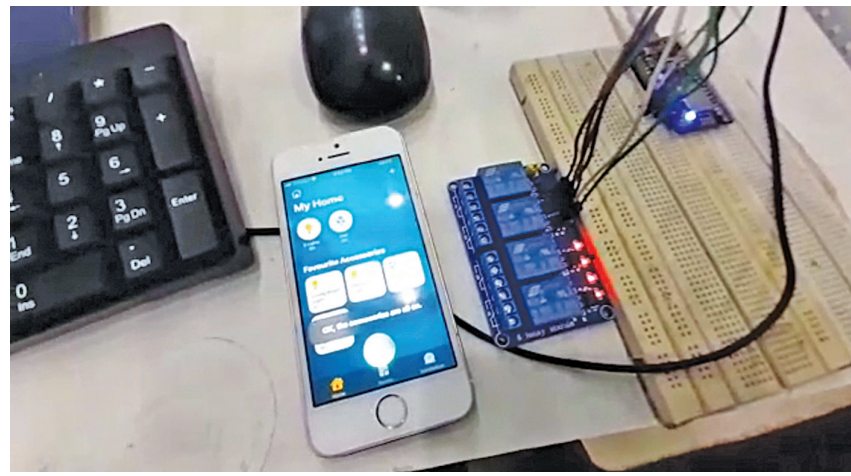


Fig. 1: Author's protoype

Circuit

Circuit connections are very simple. The Table shows connections between relay module and NodeMCU. The complete connection diagram for controlling a bulb through a relay module is shown in Fig. 6. You

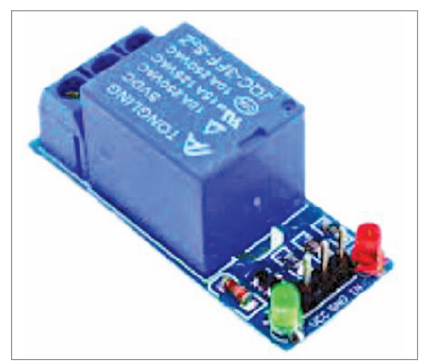


Fig. 2: Relay module

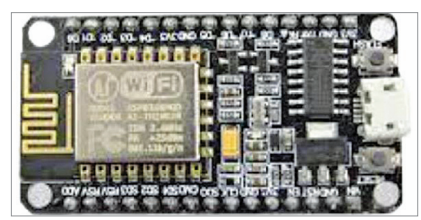


Fig. 3: NodeMCU board

CIRCUIT CONNECTIONS

Pin on Relay	To NodeMCU
IN	D4
GND	G
VCC	VIN



Fig. 4: Bulb and holder



Fig. 5: Jumper wires

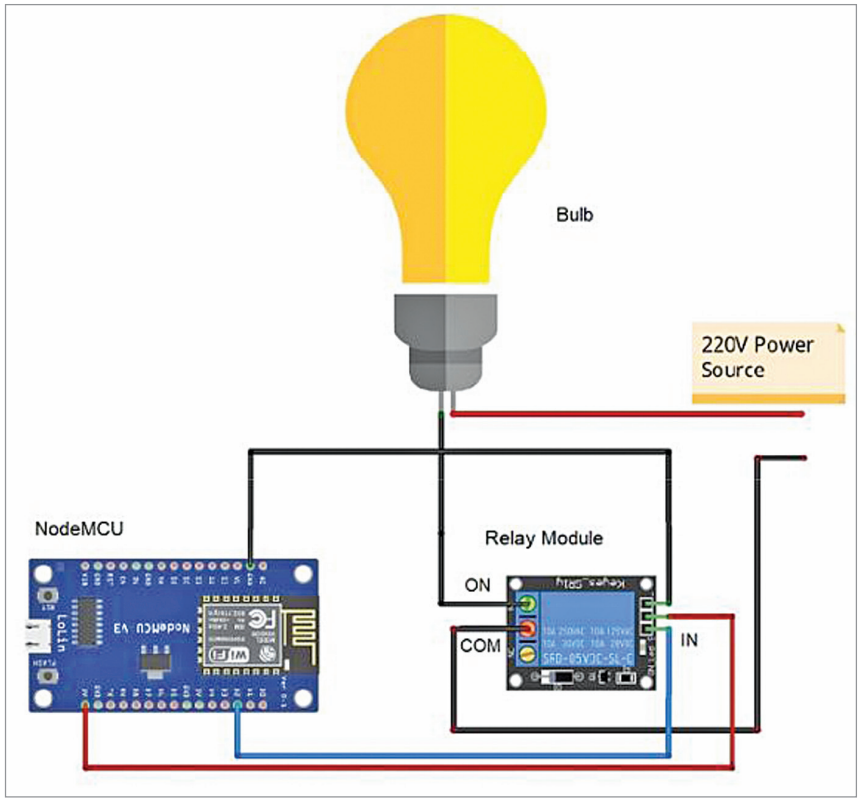


Fig. 6: Circuit connections

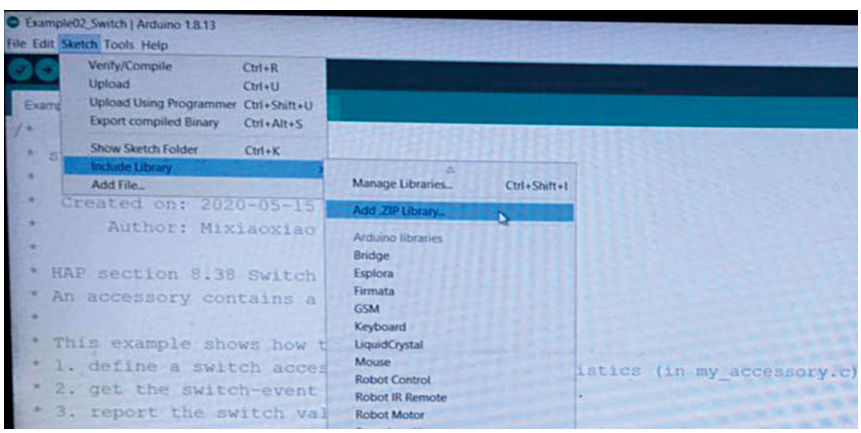


Fig. 7: Adding .Zip Library to Arduino IDE

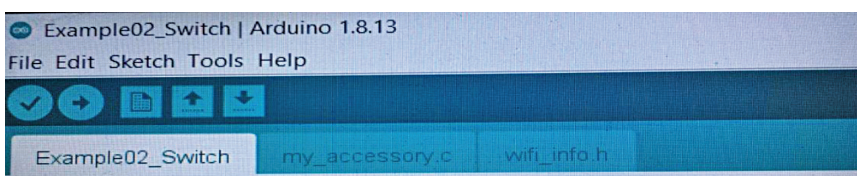


Fig. 8: Example02_Switch

```
const char *ssid = "your-ssid";
const char *password = "your-password";
```

Fig. 9: Setting SSID and password

can connect the circuit in a similar way to control the remaining three electrical appliances.

There are two wires in the bulb holder, as shown in Fig. 6. Cut one of the wires in the middle and connect one of the cut ends to COM pin and the other to NO terminal of the relay module. Connect pin D2 of NodeMCU to IN pin of the relay module.

Software

Download Arduino-HomeKit library from the link https://github.com/Mixiaoxiao/Arduino-HomeKit-ESP8266

After downloading, open Arduino IDE and follow the steps given below.

1. From the Arduino IDE, click on Sketch and then Include Library option, as shown in Fig. 7. Next click on Add .Zip Library and select Home-Kit-ESP8266 library. The three files Example02_Switch, my_accessory.c, and wifi_info.h will be included in the Arduino IDE.

2. Open Example02_Switch file, as shown in Fig. 8. The original 'Example02_Switch.ino' code includes only one relay module. For adding multiple (four) relays, you need to make some changes in the code, as explained in the next section.

3. In Wifi_info.h file (Fig. 9), mention your own SSID and password.

4. First make some changes in 'my_accesory.c' code. To add many devices, copy and paste the highlighted part in Fig.10 as many times as the number of devices to be added in the project.

After adding multiple times, change the 'id' in the line "HOMEKIT_ACCESSORY (.id = 1, .category = homekit_accessory_category_switch, .services = (homekit_service_t*[])" as shown in Fig. 11.

Change .id = 1 to .id = 2. If you have added the third device, change it to .id = 3. So every time you copy and paste the highlighted part, increase the .id number.

```
// format: string; HAP section 9.62; max length 64
homekit_characteristic_t cha_name = HOMEKIT_CHARACTERISTIC_(NAME, "Switch");

homekit_accessory_t *accessories[] = {
    HOMEKIT_ACCESSORY(.id=1, .category=homekit_accessory_category_switch, .services=(homekit_service_t*[]) {
        HOMEKIT_SERVICE(ACCESSORY_INFORMATION, .characteristics=(homekit_characteristic_t*[]) {
            HOMEKIT_CHARACTERISTIC(NAME, "Switch"),
            HOMEKIT_CHARACTERISTIC(MANUFACTURER, "Arduino HomeKit"),
            HOMEKIT_CHARACTERISTIC(SERIAL_NUMBER, "0123456"),
            HOMEKIT_CHARACTERISTIC(MODEL, "ESP8266/ESP32"),
            HOMEKIT_CHARACTERISTIC(FIRMWARE_REVISION, "1.0"),
            HOMEKIT_CHARACTERISTIC(IDENTIFY, my_accessory_identify),
            NULL
        }),
    HOMEKIT_SERVICE(SWITCH, .primary=true, .characteristics=(homekit_characteristic_t*[]){
      &cha_switch_on,
      &cha_name,
      NULL
    }),
        NULL
    }),
    NULL
};
```

Fig. 10: The highlighted code to be copied and pasted

```
_characteristic_t cha_name = HOMEKIT_CHARACTERISTIC_(NAME, "Switch");

t accessory_t *accessories[] = {
MEKIT_ACCESSORY(.id=1, .category=homekit_accessory_category_switch,
  HOMEKIT_SERVICE(ACCESSORY_INFORMATION, .characteristics=(homekit_ch
      HOMEKIT_CHARACTERISTIC(NAME, "Switch"),
      HOMEKIT_CHARACTERISTIC(MANUFACTURER, "Arduino HomeKit"),
      HOMEKIT_CHARACTERISTIC(SERIAL_NUMBER, "0123456"),
      HOMEKIT_CHARACTERISTIC(MODEL, "ESP8266/ESP32"),
      HOMEKIT_CHARACTERISTIC(FIRMWARE_REVISION, "1.0"),
      HOMEKIT_CHARACTERISTIC(IDENTIFY, my_accessory_identify),
```

Fig. 11: Changing the id

```
HOMEKIT_CHARACTERISTIC(FI
HOMEKIT_CHARACTERISTIC(ID
NULL
}),
HOMEKIT_SERVICE(SWITCH, .primary=
&cha_switch_on,
&cha_name,
NULL
}),
rduino Version: 1.8.13
```

```
HOMEKIT_CHARACTERISTIC(SER
HOMEKIT_CHARACTERISTIC(MOD
HOMEKIT_CHARACTERISTIC(FIR
HOMEKIT_CHARACTERISTIC(IDE
NULL
}),
HOMEKIT_SERVICE(SWITCH, .primary=t
&cha_switch_on2,
&cha_name,
NULL
}),
```

Fig. 12: Changing the channel switch number

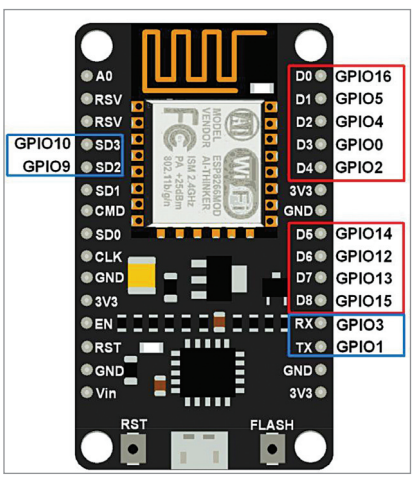


Fig. 13: GPIO pins on NodeMCU board

```
#define PIN_SWITCH 2
#define PIN_SWITCH2 16
#define PIN_SWITCH3 4
#define PIN_SWITCH4 5
```

Fig. 14: GPIO pins defined in the code

```
cha_switch_on.setter = cha_switch_on_setter;
  cha_switch_on2.setter = cha_switch_on_setter2;
    cha_switch_on3.setter = cha_switch_on_setter3;
      cha_switch_on4.setter = cha_switch_on_setter4;
```

Fig. 15: Changing the switch_on and setter in the code

In the highlighted part you will find "&cha_switch_on" line, as shown in Fig. 12. This is default code for channel switch number. If you added a new highlighted part, change it to "&cha_switch_on2". You need to increase the switch number every time you add a new highlighted part.

Next, you will find "homekit_characteristic_t cha_switch_on = HOMEKIT_CHARACTERISTIC_(ON, false);" in the same code. Here too, you need to add this line as many times as you have added the devices and also add the switch_on number. For example, if you added two devices, the line of code will be as follows:

homekit_characteristic_t cha_switch_on = HOMEKIT_CHARACTERISTIC_(ON, false);

homekit_characteristic_t cha_switch_on2 = HOMEKIT_CHARACTERISTIC_(ON, false);

5. Now make some changes in Example02_Switch code. Here, you will find the line

"extern "C" homekit_characteristic_t cha_switch_on;" You need to add this line every time you add a device and also, as before, you have to change switch_on to switch_on2, switch_on3, etc.

Next, you will find a "#define PIN_SWITCH 2" line of code. Copy this line and add as many times as you have added new devices and also change each pin number. This pin actually defines the pin of NodeMCU board where the device is connected through the relay module.

Note that the pin 2 defined here is not the physical pin D2 of NodeMCU; it is GPIO pin 2. The GPIO pins are marked on NodeMCU board, as

shown in Fig. 13. The GPIO pins defined in this project for switching the four relays are shown in Fig. 14.

To control four appliances, the author used GPIO2, GPIO16, GPIO4, and GPIO5 pins of NodeMCU. Each GPIO pin should be connected to corresponding relay module, as shown in connection diagram of Fig. 6.

Next is "cha_switch_on.setter = cha_switch_on_setter;" line of code. Copy this one too and add it as many times as the number of devices to be added in the project. For adding four new devices, change the switch_on and setter, as shown in Fig. 15.

Next is "void my_homekit_setup()" line. Inside that you will find "pinMode(PIN_SWITCH, OUTPUT); digitalWrite(PIN_SWITCH, HIGH);" You have to add these lines as many times as you have added new devices. For four devices, you need to change the variables, as shown in Fig. 16.

After this select following lines: "void cha_switch_on_setter

```
void my_homekit_setup() {
  pinMode(PIN_SWITCH, OUTPUT);
  digitalWrite(PIN_SWITCH, HIGH);

  pinMode(PIN_SWITCH2, OUTPUT);
  digitalWrite(PIN_SWITCH2, HIGH);

    pinMode(PIN_SWITCH3, OUTPUT);
  digitalWrite(PIN_SWITCH3, HIGH);

    pinMode(PIN_SWITCH4, OUTPUT);
  digitalWrite(PIN_SWITCH4, HIGH);
```

Fig. 16: PinMode variables

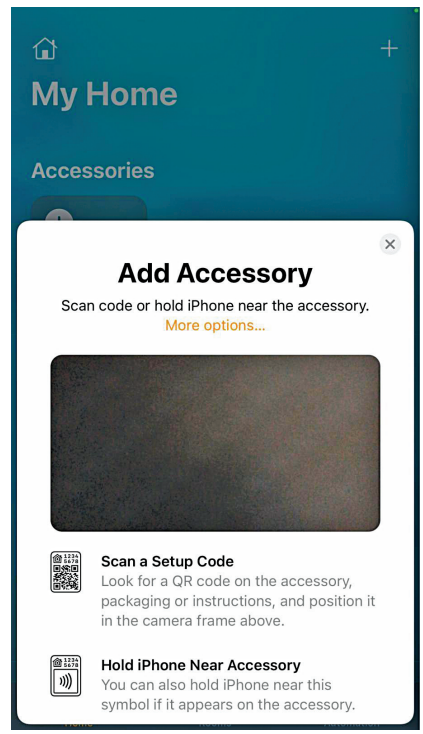


Fig. 18: Add Accessary window

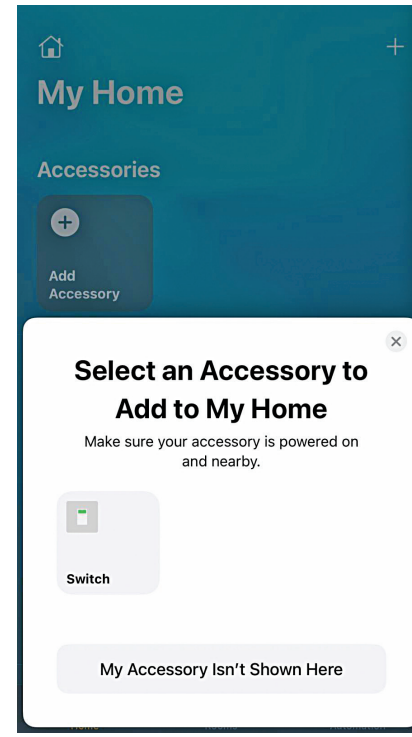


Fig. 19: Add To My Home window

```
void cha_switch_on_setter(const homekit_value_t value) {
  bool on = value.bool_value;
  cha_switch_on.value.bool_value = on;  //sync the value
  LOG_D("Switch: %s", on ? "ON" : "OFF");
  digitalWrite(PIN_SWITCH, on ? LOW : HIGH);
}

void cha_switch_on_setter2(const homekit_value_t value) {
  bool on = value.bool_value;
  cha_switch_on2.value.bool_value = on;  //sync the value
  LOG_D("Switch: %s", on ? "ON" : "OFF");
  digitalWrite(PIN_SWITCH2, on ? LOW : HIGH);
}

void cha_switch_on_setter3(const homekit_value_t value) {
  bool on = value.bool_value;
  cha_switch_on3.value.bool_value = on;  //sync the value
  LOG_D("Switch: %s", on ? "ON" : "OFF");
  digitalWrite(PIN_SWITCH3, on ? LOW : HIGH);
}

void cha_switch_on_setter4(const homekit_value_t value) {
  bool on = value.bool_value;
  cha_switch_on4.value.bool_value = on;  //sync the value
  LOG_D("Switch: %s", on ? "ON" : "OFF");
  digitalWrite(PIN_SWITCH4, on ? LOW : HIGH);
}
```

Fig. 17: The .setter function to get the switch-events

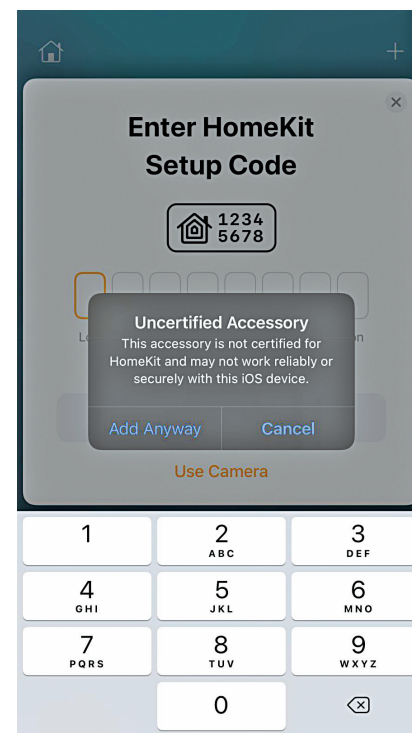


Fig. 20: Setup warning message

(const homekit_value_t value) {
bool on = value.bool_value;
cha_switch_on.value.bool_value = on; //sync the value
LOG_D("Switch: %s", on ? "ON" : "OFF");

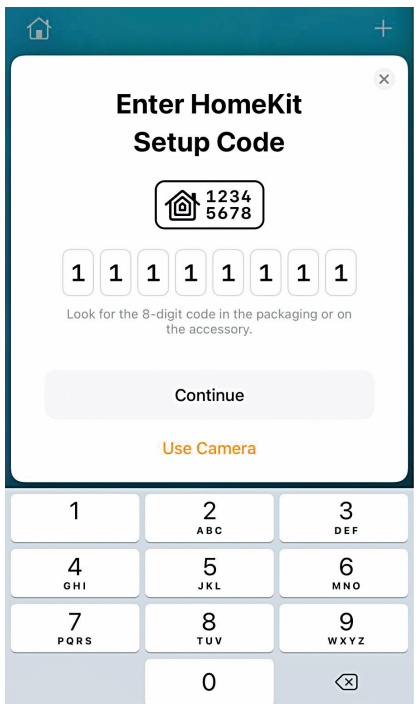


Fig. 21: Adding setup code

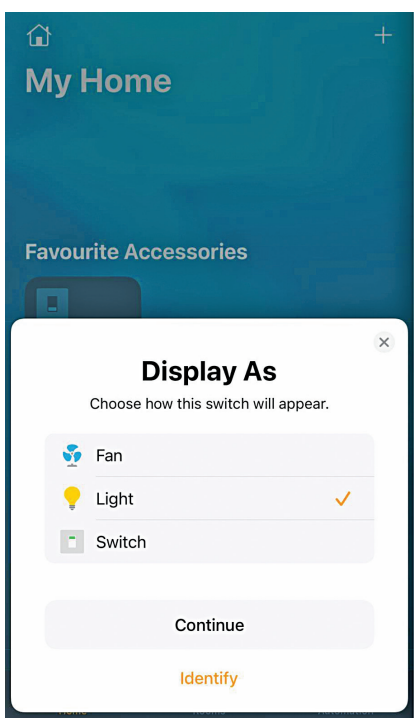


Fig. 22: Display As window

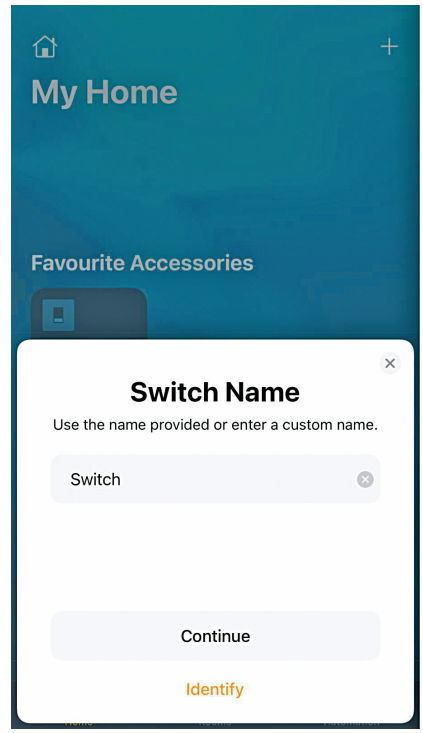


Fig. 23: Switch name

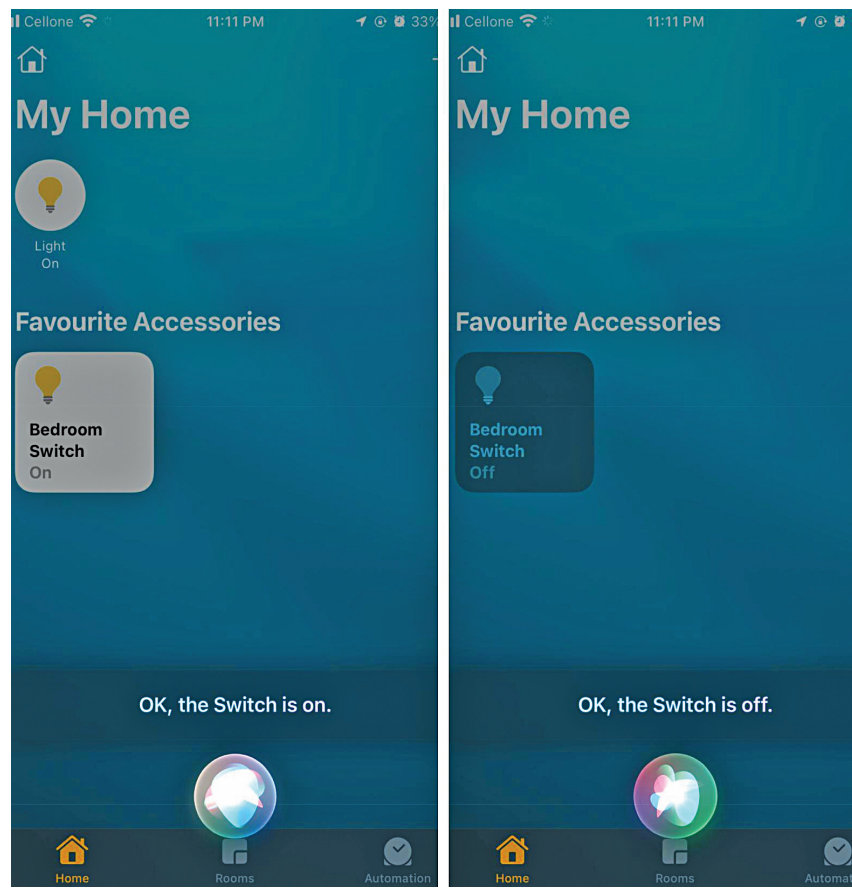


Fig. 24: Responses from iPhone app

digitalWrite(PIN_SWITCH, on ? LOW : HIGH); }"

Copy these lines and add as many times as you have added new devices. Then change the setter, PIN_SWITCH and cha_switch_on in the code, as shown in Fig. 17. This is basically the .setter function to get the switch-event sent from Apple's iOS device.

Now, upload the code to NodeMCU board. Next, set up the Apple HomeKit app.

Setting up Apple HomeKit

Follow the steps given below to set up the Apple HomeKit app using Apple's iPhone SE device.

Step 1. Download the HomeKit from App Store.

Step 2. On the top right corner, click on the plus (+) button. Select Add Accessory. You will see a pop-up window, as shown in Fig. 18.

Select More options... to continue.

Step 3. Next another pop-up window appears, as shown in Fig. 19. Here you will find your "Switch" device. Click on the Switch.

Step 4. You will see a warning message popping up. Just click on Add Anyway option, as shown in Fig. 20.

Step 5. You need to add 8-digit setup code. Here, 11111111 is the default setup code, as shown in Fig. 21.

Step 6. Now it will ask for switch location. You can choose as per your setup. Here Bedroom switch is used. Click Continue to proceed with the steps.

Step 7. Next the Display As window pops up, as shown in Fig. 22. You can choose any of the devices listed, including fan or light, or switch, if they are connected. Then click Continue.

Step 8. Now it will ask for Switch name, as shown in Fig. 23. This feature gives you the ability to set any custom name for your switch. Then click Continue

Step 9. Lastly, a window pops up showing that switch has been added to your home. Click Done.

Now you can manually control all the four appliances from your iPhone device by pressing the respective buttons or through voice commands. The Hey Siri feature lets you control the appliances using your own voice commands.

For example, to turn on the bedroom light, just say "Hey Siri, turn on the bedroom light." Immediately, the app will respond with voice "Ok, the switch is on" along with the text displayed on the app, as shown in Fig. 24. At the same time, the bedroom light will turn on.

Similarly, to turn it off, say "Hey Siri, turn off the bedroom light." The app will give "Ok, the switch is off" voice response along with the text on the app. At the same time, the bedroom light will be turned off.

Similarly, you can control other appliances that are already connected to NodeMCU and programmed in the app.

Note. After uploading the code to NodeMCU, in case you want to make some changes in the code, first make sure to erase the flash memory of your NodeMCU. Then only you can upload the modified code into the NodeMCU. Otherwise, the app may give "Not available" error message. EFY

EFY Note
The source code of this project is available for free download at *source.efymag.com*

Rohan Barnwal (left) is an electronics hobbyist and Youtuber. Rahul Barnwal (right), a B.Tech from Indian Institute of Information Technology, Kottayam is a physics and electronics enthusiast



EFY TESTED S.C. Dwivedi

WEATHER STATION With DEVICE CONTROL Using Touch-Screen Display

SANI THEO

This weather station provides such information as temperature and humidity at a place on a colourful touch-screen display. It can also control the temperature through the touch-screen user interface when it exceeds the set threshold level. The project can be easily converted to a personal weather station by adding more sensors to measure weather conditions outdoors or indoors.

The digital console provides easy readouts of the data collected by the sensor. The touch-screen has a microSD card memory slot. So, it can be connected to a personal computer where data can be displayed, stored, and uploaded to websites, or used for data ingestion or distribution systems. The author's prototype is shown in Fig. 1.

Components required for this project are mentioned in the Table.



Fig. 1: Author's prototype

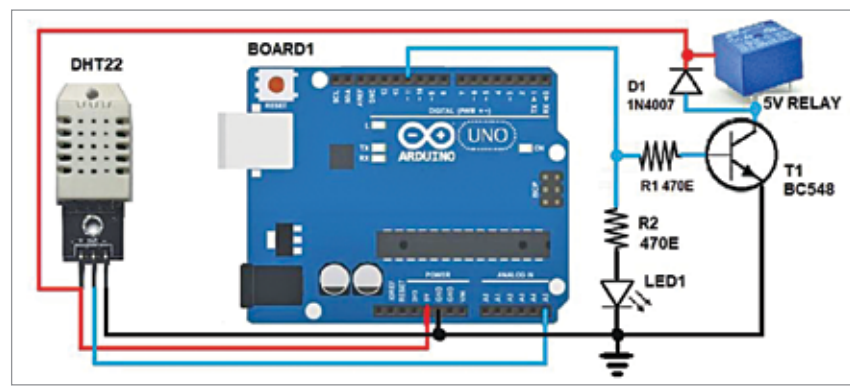


Fig. 2: Circuit diagram

COMPONENTS REQUIRED

Components	Quantity	Purpose
Arduino Uno	1	Computing
6cm TFT LCD touch screen shield	1	Data display
DHT22	1	Temperature and humidity sensor
BC548	1	NPN transistor amplifier for driving relay
Resistor (470-ohm)	2	Current limiter
1N4007	1	Rectifier diode used as freewheeling diode
Relay	1	5V SPDT relay for switching the device
LED	1	5mm LED for relay status indicator
Jumper wires	9	Connections
PCB	1	10x3cm Veroboard

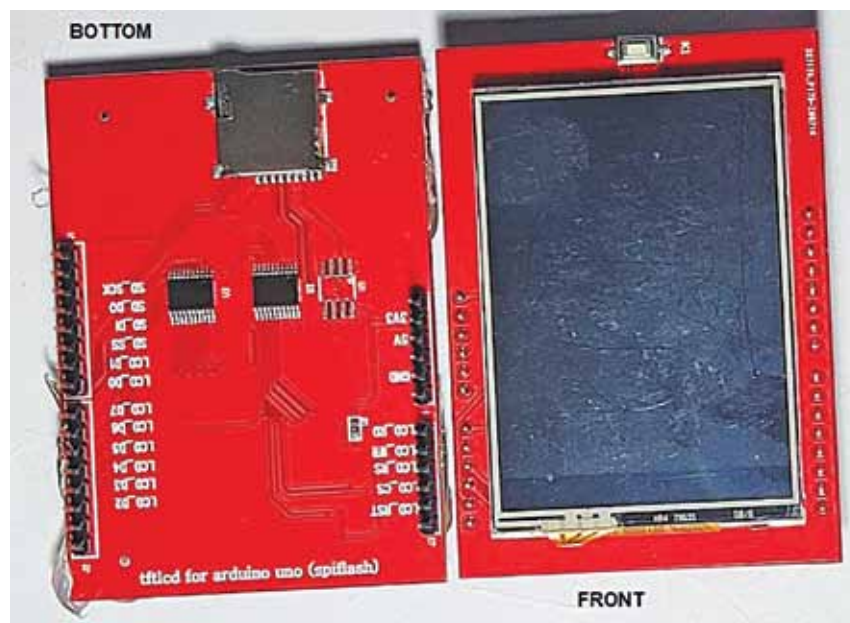


Fig. 3: TFT touch-screen display

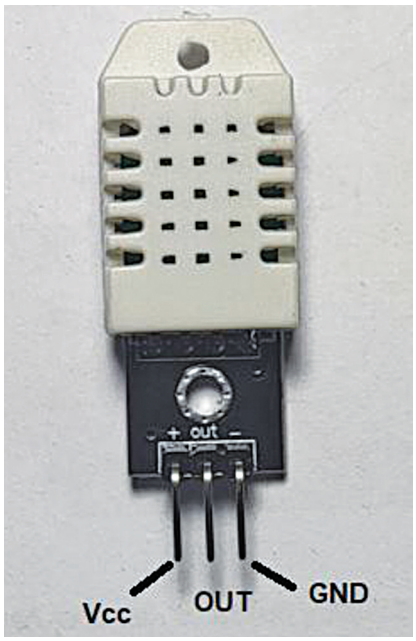


Fig. 4: Pin details of DHT22 module

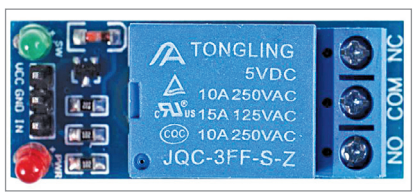


Fig. 5: Relay module

Circuit and working

The circuit diagram of weather station with device control is shown in Fig. 2. It comprises Arduino Uno Board1, DHT22 temperature and humidity sensor, BC548 transistor T1, a 5V single changeover relay, light-emitting diode LED1, and resistors R1 and R2. The 6cm TFT touch-screen display to be mounted on top of the Arduino board is shown in Fig. 3.

A 9V-12V DC power supply is used to power the Arduino board. The touch-screen, DHT22 sensor, and BC548 device driver sections are powered by the 5V supply from Arduino board.

Arduino Uno. It is the heart of the project. Temperature and humidity data, TFT touch input display, and device control inputs are processed through Arduino programming.

TFT touch-screen. The 6cm TFT touch-screen display TS1 is basically an Arduino shield, which can be mounted on top of the Arduino Uno board. This is one of the advantages of this display because you don't need any external wires to interface with Arduino.

```
File  Edit  Sketch  Tools  Help
Weather_light_control.ino §
#define WHITE       0xFFFF
#define ORANGE      0xFD20
#define DARKORANGE  0xFB60
#define MAROON      0x7800
#define BLACKM      0x18E3

//----------------- Calibrated values for touch points

#define TS_MINX 500
#define TS_MINY 125
#define TS_MAXX 887
#define TS_MAXY 855

//------------------Variable for detecting touch screen when touched
#define MINPRESSURE 10
#define MAXPRESSURE 1000

//---------------Defines the pin to drive the device
#define DEVICE 11

//-------------------Button location at point x and y
int BtnGreenX = 30;
int BtnGreenY = 30;
int BtnRedX = 200;
int BtnRedY = 30;
```

Fig. 6: The calibrated values for x and y coordinates

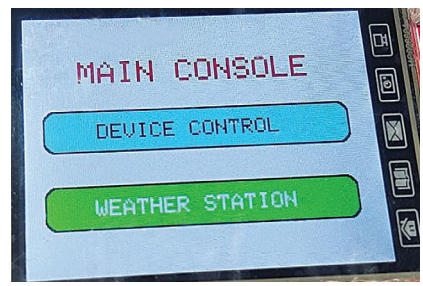


Fig. 7: Main console

DHT22. This temperature and humidity sensor gives more accurate readings as compared to the popular DHT11 sensor. With this sensor, you can easily program to get humidity in %, temperature in °C and °F units. In this project, its output pin is connected to pin 11 of Arduino board.

DHT22 sensor can either be purchased as a sensor or as a module. The sensor comes as a 4-pin package out of which only three pins are used. The module comes as a 3-pin package, as shown in Fig. 4. The module has a filtering capacitor and pull-up resistor inbuilt, but for the sensor you must use them externally, if required. Otherwise, performance of both is same. The sensor is also factory calibrated and hence easy to interface with microcontrollers. It can measure temperature from -40°C to +80°C and humidity from 0% to 100%.

BC548. This popular bipolar NPN transistor is used as driver for switching the electrical appliance connected across the relay module.

Relay module. This is an electromechanical sugar-cube, single-channel relay used to switch on/off the electrical device connected across its COM and NO terminals. You can use readily available single-channel relay module. In that case you can connect digital pin 11 of Arduino to IN pin of relay module. The pin details of relay module are shown in Fig. 5.

The working of the circuit is simple. After uploading the code to Arduino Uno board and connecting all the components, as shown in the circuit, switch on the circuit. You will see the main panel on the TFT touch-screen, as shown in Fig. 7. Touch the Device Control option, using stylus or your fingertip, to turn on or turn off the appliance/device such as tube-light or air-conditioner. Otherwise, touch on the Weather Station option to check the current temperature and humidity.

Software

The software (weather_light_control.ino) for this project is written in Arduino programming language. The project requires specific libraries for DHT22 and touch-screen display, such as DHT.h, SPFD5408_Adafruit_GFX.h, SPFD5408_Adafruit_TFTLCD.h and SPFD5408_

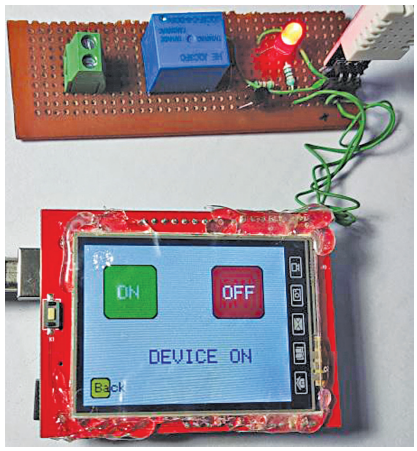


Fig. 8: Device on

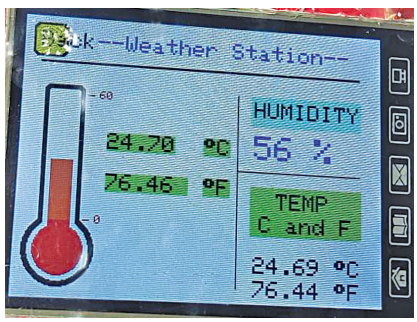


Fig. 9: Temperature and humidity readings

TouchScreen.h

One of the challenges in the project is calibrating the touch points in the touch-screen display.

Depending on the model and size of the touch-screen display, you need to calibrate x and y coordinates. The calibrated values in the code used by the author are shown in Fig. 6.

After uploading the code to Arduino Uno board, mount the TFT touch-screen on top of the Arduino board through the header pins already provided on Arduino board. You can carefully place it with a slight push on the touch-screen from top. Ensure the correct positions of the male header pins from touch-screen display are inserted into the corresponding female pins on the Arduino board.

Now you can connect the board to USB port of your PC/laptop or use a 9V-12V DC supply.

As soon as the power is on, the touch-screen display will turn on and you can see the main console panel on the TFT touch-screen, as shown in Fig. 7.

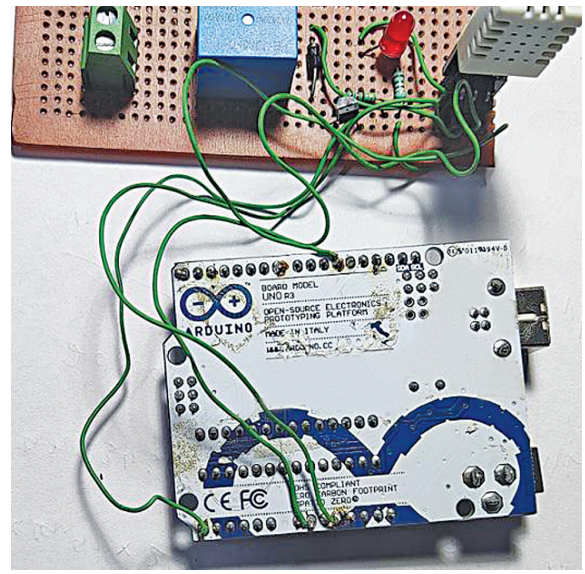


Fig. 10: Soldered connections

To control the device, such as light or air-conditioner connected across the relay, touch the 'Device Control' option. There are on and off buttons in Device Control section, as shown in Fig. 8. When you touch 'on' button, the LED will glow and at the same time the electrical device/appliance connected across the relay will turn on. Touch the 'off' button to turn it off.

If you touch the 'Weather Station' option, it will take you to another screen, as shown in Fig. 9. Here, you can see the current humidity and temperature values captured by the DHT22 sensor. The humidity here is basically the relative humidity expressed in percentage, which represents the amount of water vapour in the air at a given temperature compared with the maximum possible water vapour at that same temperature. Here the temperature values are read in both °C and °F units. So, no conversion is required.

Construction and testing

The circuit can be assembled on a bread-board or Veroboard. The author used a 10x3cm size Veroboard to mount the relay, sensor, transistor, LED, 2-pin terminal connector (optional), and the two resistors.

Since most of the Arduino pins are used by the TFT touch-screen display, you need external wires to solder at digital pin 11 of Arduino for the relay driver and analogue pin A5 for the DHT22, as shown in Fig. 10. You also need to solder 5V and GND pins of Arduino for power supply to the Veroboard. If you are using DHT22 sensor instead of the module, make sure you connect a 5-kilo-ohm pull-up resistor at its output pin, otherwise you may not get correct temperature and humidity readings.

Also note that some 6cm TFT touch-screen displays may not work. So, it is recommended to use the model shown in Fig. 3. If you want to control an appliance like cooler or AC, you need to replace the sugar-cube relay with a high-power relay having contact ratings above 16A.

Though you can power the circuit by connecting it to USB port of your PC, you can also power it with external power supply through the DC jack on the Arduino board. The author used a 9V DC power adaptor to power the Arduino board. When power is connected to the circuit you will get the main console screen, as shown in Fig. 7. EFY

EFY Note
The source code of this project is available for free download at *source.efymag.com*

Sani Theo is an electronics enthusiast, circuit designer, and technical editor

EFY TESTED Sani Theo

WEATHER SATELLITE STATION
For Meteor M2 Reception

PRASANNA WAICHAL

The basic setup needed to receive the weather satellites was covered in 'Set Up Your Own Weather Satellite Receiving Station' article published in January issue. The antenna setup, the receivers, and decoding software were discussed in detail in that article. By this time, the author hopes that many readers would have their receiving stations up and running.

In this article, we shall look at the imaging systems of these satellites and how the automatic picture transmission (APT) protocol works. Later we shall see how to decode the digital QPSK transmission from the Russian Meteor M2 satellite and produce even higher resolution earth imagery.

It should be noted that the APT transmission is being phased out and the currently operational satellites, such as NOAA-15, NOAA-18, and NOAA-19, are the last ones to carry such analogue transmission payload. But why discuss this phased out system when digital transmission, such as Meteor, is readily available?

Many universities and academic institutions all over the world are building nano satellites (Cube Sats). Therefore, one can think of how meaningful and scientific imaging data can still be transmitted using such narrow-band protocol. May be some groups active with the nano satellites can work towards such an experiment in the future Cube Sat missions!

The present scope of discussion is:

- Basic imaging process onboard NOAA satellites
- The high-resolution picture transmission (HRPT) and low-resolution analogue APT transmission protocol
- Receiving and decoding weather images from Russian Meteor M2 satellite

TABLE 1
SPECTRAL BANDS AND THEIR APPLICATIONS

Channel No.	Wavelength range	Spectral band	Applications
1	580nm – 680nm	Visible light	Day-time reflected sunlight from earth's surface
2	725nm – 1000nm	Near IR	Reflected infrared energy from earth, used for contrasting land/ocean
3A	1580nm – 1640nm	Near IR	Contrast for snow/ice
3B	3.55μm – 3.93μm	Thermal	Reflected as well as thermal infrared generated from forest fire
4	10.20μm – 11.30μm	Thermal	Sea-surface temperature, night-time cloud mapping
5	11.5μm – 12.5μm	Thermal	SST and night-time cloud mapping

Source: Users Guide Building Receiving Station – NOAA, 2009

Basic imaging process

The images that we receive from these earth imaging satellites are generally a result of what is called scanning radio meter, an instrument that produces the output to the corresponding intensity of the spectral components through scanning. It utilises a mirror that rotates at angular speed of 360rpm and reflects the energy received from various lenses to the spectral sensors.

As the satellite progresses through its orbital path, the reflected energy received perpendicular to the satellite's trajectory is used to construct each line of the image. Thus, a complete two-dimensional image of the area over which the satellite passes is constructed.

As the mirror rotates during each scan, the sensors look at the earth using the mirror and lens arrangement. These sensors are calibrated on-the-fly during each line with respect to emission from the Deep Sky and Black-Body radiation on board the spacecraft as a reference. This entire instrumentation is called very high resolution radio meter (VHRR).

Table 1 summarises the various spectral bands and their primary applications.

As the energy/emission falls on these sensors, electrical signal is produced, which is further digitised by an analogue-to-digital converter (ADC) with a resolution of 10 bits, thereby producing an equivalent of 1024 grey-scale levels.

The transmission protocols

HRPT transmission. With a high-resolution picture transmission (HRPT) protocol, this image data is transmitted at 360 lines per minute and each of the scan line produces 2048 pixels per line. Since this is a very huge data, the signal is trans-

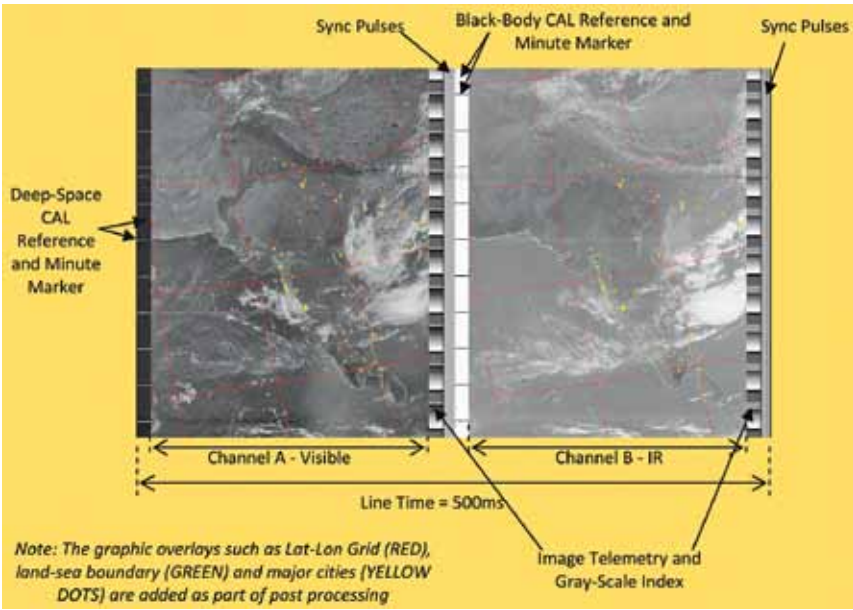


Fig. 1: The image components of the analogue APT

mitted digitally at a 665kbps rate with PSK modulation at main carrier frequencies of 1698MHz, 1708MHz, or 1702.5MHz. Therefore, the ground-receiving station becomes complex for an individual or amateur experimenter to construct. Each line has a pixel resolution of 1.1km and the HRPT image is transmitted using all the above five channels.

APT analogue transmission. The automatic picture transmission (APT) protocol is the one we are currently using to receive images from the NOAA satellites. However, only two channels from the above five sensors are used for APT transmission, which are decided by the ground command-and-control of the satellite and thus are not user-selectable.

From the 10-bit ADC, the APT uses 8-bit MSB data to produce the 8-bit grey-scale levels for the analogue APT transmission. It uses a 2.4kHz audio tone and its amplitude is modulated as a function of the intensity level (grey-scale level) of the picture information. Also, the HRPT produces 360 lines per minute from which only two lines from the spectral channels are used for producing the APT data. Therefore, the resulting line resolution gets reduced to 120 lines per minute.

Thus, with 120 lines per minute, we get two lines per second, or each line has a 0.5-second (500ms) duration. Let us now see how these 500ms get distributed between various signal components, as shown in Fig. 1.

1. The sync pulses. The sync pulses are transmitted in the form of square wave pulses for each set of the image component, that is, the Visible channel and the IR channel. Each set consists of seven pulses. For the Visible image channel, 1040Hz square wave pulses are used. While for the IR channel, 832Hz square wave pulses are used. These sync pulses appear as vertical lines in the primary raw image data received from the satellite and can be seen in Fig. 1 at the middle and right hand side of the image.

2. CAL references and time markers. The scanner uses two references while scanning the earth. It uses the Deep Space as a reference for the channel A visible imagery, and it appears as a vertical black strip at the beginning of the Visible channel, as can be seen at the left hand side of the image. Also, horizontal white lines are overlaid for time reference as 1-Minute Marker.

For the channel B IR imagery, the Black-Body is used as the thermal reference and appears as vertical white strip at the beginning of the IR channel. Similarly, the time markers are overlaid as 1-Minute Marker but appear as black horizontal lines, as can be seen in the mid-right part of Fig. 1.

3. Telemetry data and grey-scale indices. For each of the Visible and IR channel, the image brightness data is transmitted as varying grey-scale levels and appear as horizontal strips called Wedges. It is used for temperature calibration of the image data in the respective image channel.

4. Channel A (Visible sensor) image. The channel A image section appears for 250ms of the scan-line from the Visible sensor of the satellite. Besides the CAL reference and the telemetry data, the major part contains the image data. During the earth scan, the visible light reflected from the earth's surface is used to construct this image. It therefore contains the oceans appearing as black, the clouds appearing as white, and the land as various levels of grey scale.

During night-time, this channel sends image data from another IR channel and has a clear and distinct image difference as compared to channel B's IR image data. The ground control decides the channel to be used during night-time pass of the satellite.

5. Channel B (IR sensor) image. Similarly, the channel B image section appears for the remaining of the 250ms and sends data from the IR sensor. Apart from the sync and telemetry data, the remainder of the time is used to send the sensor data from earth scan. Warmer objects appear as black or darker grey shades while colder objects appear white or lighter shades.

With the present scope of the

article and space limitation, it is not possible to entirely cover the APT image format, but when receiving these images, it is equally important to understand the image data properly. Therefore, this section has been limited to the basic information only. Readers are advised to refer to the NOAA website for further information.

Receiving and decoding weather images

The APT offers us a resolution of 4km/pixel. Also, there is the Meteor M2 satellite from Russia that transmits the earth imagery in the same 137MHz weather band, currently at 137.1MHz but in digital format at 72kbps QPSK. It offers even higher resolution of 1km/pixel in stunning three spectral bands as against only two channels from the NOAA APT.

Therefore, the decoding software WXtoImg used in the first article is unsuitable for this satellite. We require both the QPSK demodulator and the image extractor from the demodulated data.

The imager in Meteor is called MSU-MR or MultiSpectral Scanner for meteorological purposes. Table 2 summarises the spectral bands comparison of NOAA and Meteor M2 satellites.

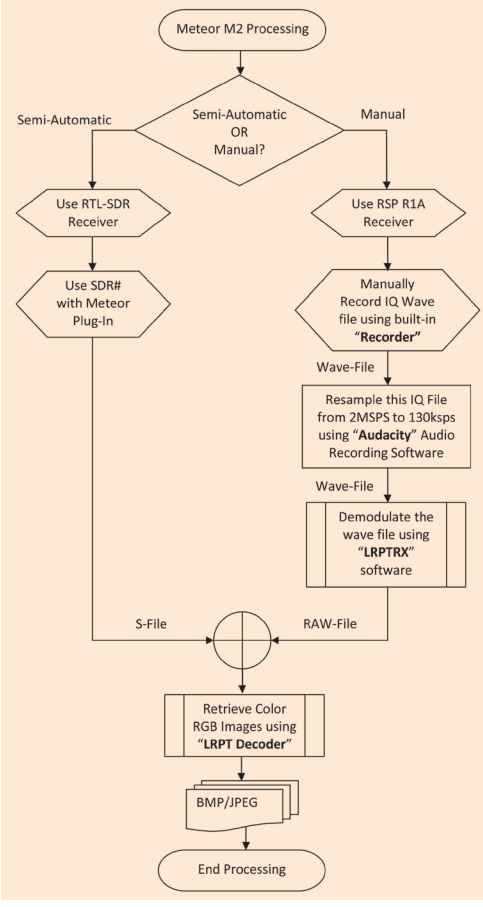


Fig. 2: The flow-chart showing the demodulation and image retrieval process

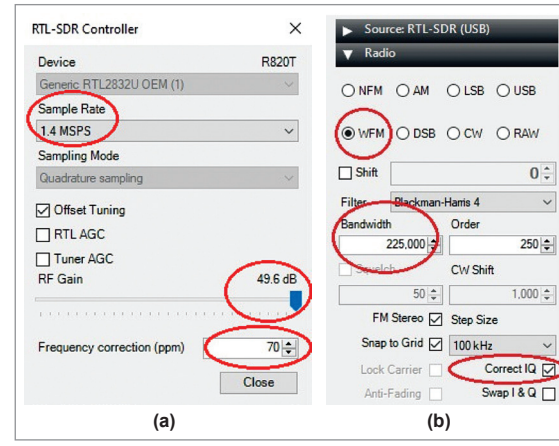


Fig. 3: (a) SDR settings, (b) Receiver settings

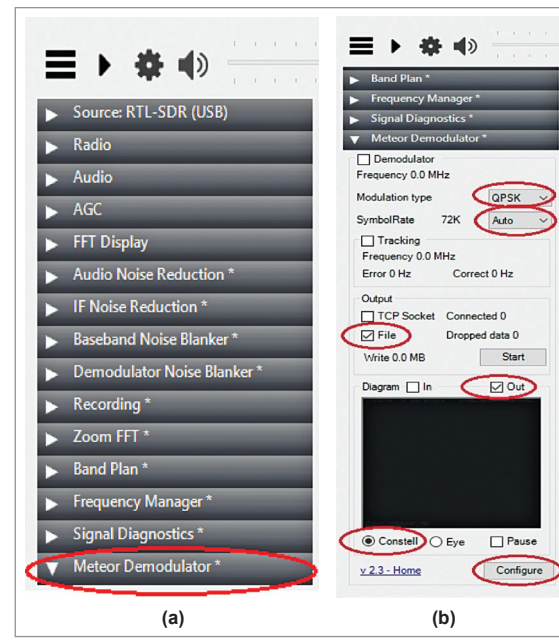


Fig. 4: (a) Properly installed plug-in, (b) Demodulator settings

TABLE 2
SPECTRAL BANDS COMPARISON OF NOAA AND METEOR M2 SATELLITES

NOAA-1x Polar Satellites		Russian Meteor M2 Satellite	
Channel No.	**Wavelength range**	**Channel No.**	**Wavelength range**
1	580nm – 680nm	1	500nm – 700nm
2	725nm – 1000nm	2	700nm – 1100nm
3A	1580nm – 1640nm	3	1600nm – 800nm
3B	3.55μm – 3.93μm	4	3.5μm – 4.1μm
4	10.20 μm – 11.30μm	5	10.5μm – 11.5μm
5	11.5 μm – 12.5μm	6	11.5μm – 12.5μm

Note: *The Meteor M2 spectral information was obtained from the website of Planeta (Scientific Research Center for Space HydroMeteorology, Russia)*

Software options

Since this satellite offers higher resolution of 1km/pixel, let us now see how to demodulate the signal and obtain the earth imagery.

There are two options, and both require manual processing or file handling. Nothing gets automatically processed like the analogue APT software that we use for NOAA satellites. The options are:

Option 1: SDR# software with built-in Meteor M2 demodulator

Option 2: Manually recording the SDR I/Q data in a file and then processing it

Both these options give a demodulated output file, which needs to be processed manually to get the RGB colour/spectral images from the

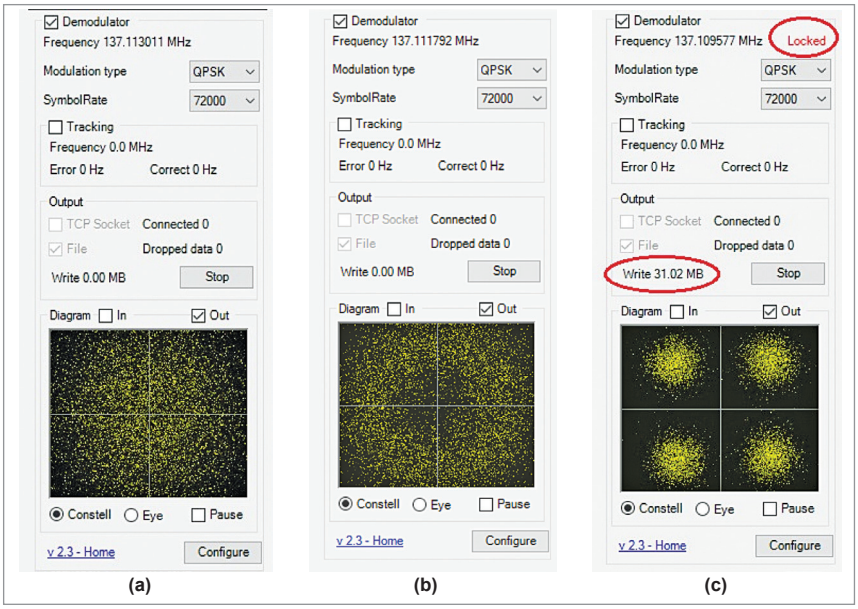


Fig. 5: (a) No signal, (b) Weak signal, and (c) Carrier locked signal



Fig. 6(a): SDRUno recorder

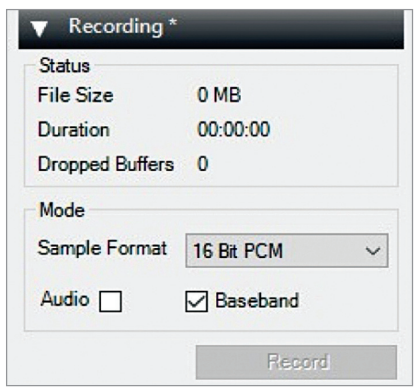


Fig. 6(b): RTL-SDR recorder with SDR#

demodulated data. Fig. 2 illustrates a flow-chart for both these options.

The RTL-SDR with SDR# software and Meteor plug-in. The readers should familiarise themselves with the installation and usage of the SDR# software from AirSpy for use with the RTL-SDR receiver and, more importantly, the Meteor plug-in. One can download the SDR# software and add the plug-in later or download the latest version of the software from www.airspy.com. The Meteor M2 demodulator plug-in can be found at http://happysat.nl/meteor_2.3.zip

The author is grateful to Alex of the HappySatl.nl website and Les Hamilton of the UK. Their articles are very useful for setting up the Meteor satellite demodulation and processing software properly. The off-line Meteor LRPT analyser can also be found at https://lesham-ilton.co.uk/soft/Meteor-LRPT-Suite.1.8.1.zip

Given below are the steps to set up the software to receive the satellite signals:

Step 1: Receiver preparation and settings. The Meteor demodulator is a QPSK soft demodulator. Also, the software defined radio is nothing but an ADC sampling the RF signal at some high rates of > 1MSPS (mega samples per second).

Therefore, we need some settings at the SDR sampling rate as well for the demodulator to work properly. After studying various published information, we had set the RTL-SDR sampling rate at 1.4MSPS, somewhere in between 1MSPS and 2MSPS. This can be achieved by clicking the Configure Source button on the SDR# main menu at the top. A dialogue box appears, as shown in Fig. 3(a). Maintain settings accordingly with the RTL AGC box unticked and Tuner AGC RF Gain set to the maximum. The oscillator frequency correction needs to be set around 70ppm, or the value specified by the manufacturer, for better frequency stability.

Next, set the radio receiver in wide-band FM (WFM) with a bandwidth of around 225kHz and tick the Correct I/Q check box, as shown in Fig. 3(b).

Step 2: The Meteor demodulator settings. Setup the demodulator plug-in. If your demodulator plug-in is successfully installed, it appears in your list as shown in Fig. 4(a). When you click on it, you should see the demodulator settings, as shown in Fig. 4(b).

As shown in Fig. 4(b), set the modulation as QPSK and the symbol rate to either 72k or auto. Uncheck the Demodulator and Tracking boxes at this stage. The tracking option is utilised when the Doppler shifts in frequency or in conjunction with an automatic antenna tracker. The demodulator check-box enables or disables the demodulator and can be used at the time of receiving the satellite.

For output settings, check the File check-box, so that the demodulator writes the demodulated data as a file. The folder or location where this file will be stored is set using the Configure settings at the bottom-right of the diagram. When the demodulator starts writing data to the file, it will show the data size being written to the file. For a successful satellite file this data can range from 36MB to all the way up

to 70MB large data files!

The demodulator is an excellent diagnostic tool, which can be found very useful when a satellite signal is being received. In the Diagram option, we can choose the input side or output side signal quality as the Constellation or Eye diagrams. The Constellation diagram is an easy diagnostic tool, as can be seen later when actual signal is received, as it shows the four phases (Quadrature Phase Modulation!) and magnitudes in each of the four quadrants.

Step 3: Recording a satellite pass. The final step in the first approach is to record the actual satellite pass. For this, we know the Meteor M2 satellite transmits at 137.100MHz. Find the satellite pass from your Prediction software, tune the receiver to this frequency, and start the demodulator by checking the Demodulator check-box, as shown in Fig. 5(a). As the satellite rises above horizon, the signal strength increases, and you shall see that the Constellation diagram starts changing from random dots to a circular 'O' ring and then finally stabilises with four dots indicating that the 72kHz QPSK signal is being received.

At the same time two important developments take place. First, the demodulator shows a 'Locked' status in red colour and the File Write shows the data being written to the file. Refer Fig. 5(b) and Fig. 5(c). When the satellite leaves your horizon or field of view, the demodulator also loses lock onto the carrier and any data write also ceases. For a good and successful satellite pass, one can expect a file size in excess of 60MB, although smaller file sizes of 35MB are also possible and would result in useful earth imagery.

Once your satellite pass is complete, stop the demodulator and uncheck the Demodulator check-box. The demodulated data file is saved with a '.S' extension in the folder you chose while configuring the demodulator.

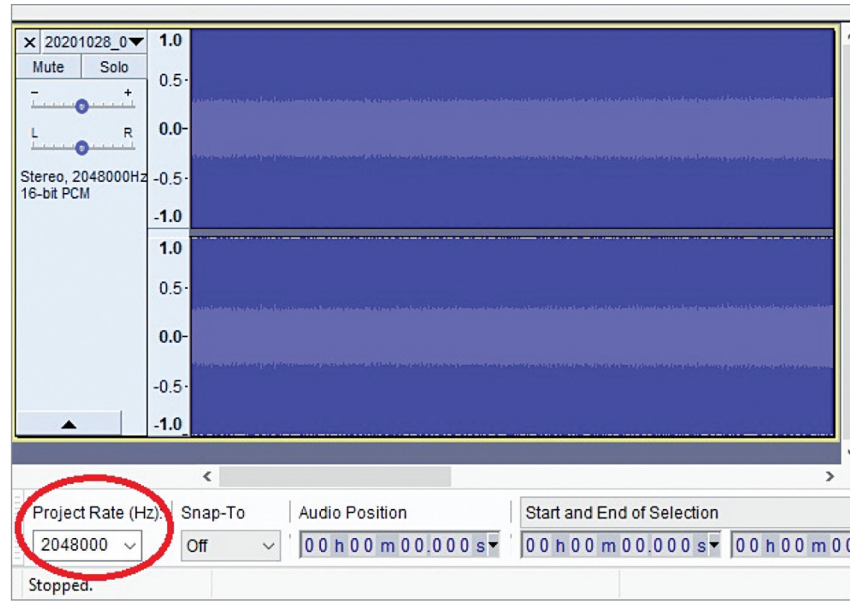


Fig. 7: Resampling the I-Q Wave file using Audacity

Since the image extraction process is common to both approaches, we shall see this process at a later point in the text.

Manual recording using IQ wave file. The other method is to manually record the IQ signal in the form of a .wave file and then demodulate it as part of the post processing. Although this is a very cumbersome and time consuming process, sometimes it proves advantageous.

Step 1: Recording the satellite pass using the I-Q wave file. Whether you are using the RTL-SDR with the SDR# or the RSP1A receiver with SDRUno software, both these receiver GUIs offer you a facility to record the sound or the baseband I-Q (Quadrature Modulation) data as a wave file. Refer Fig. 6 for this. Kindly note that this wave file is the actual RF signal recorded and not a demodulated output.

Step 2: Processing the wave file using Audacity. The next step is to resample the recorded RF signal at a lower sampling rate. This is necessary for the demodulation process in the next step. For this, open the satellite wave file (I-Q data) in Audacity software.

The file might be large, several GB in size! And you can notice the sampling rate at which the SDR recorded this wave file in the bottom left corner of the Audacity GUI. Refer Fig. 7 for details.

Next, change this sampling to 130ksps. For example, if your sampling rate is shown as 2048000, change it to 130000. Then, select the entire waveform/signal and save the File/data as (Save as…) wave file. Once saved properly, you would notice that the file size has reduced from GBs to a few hundred MBs. You can delete the larger files to save space on the hard disk as these are not needed any more.

Step 3: Manually demodulating the wave file. The next step is to demodulate this wave file using the LrptRx Demodulator software, which the author found from the websites mentioned above. The link is: *https://www.dropbox.com/s/qq1fjyitpa3j14o/software.zip*

The dashboard of LRPTRX, as shown in Fig. 8(a), is very complex but we do not have to worry about that. We just need to enter the Input and Output filenames and their

locations. Then hit the Run button highlighted in Fig. 8(a). Kindly note that the output file is a .RAW, while the Meteor demodulator plug-in produces a .S file as the output file.

However, as shown in the flow-chart in Fig. 2, both these files are acceptable for this project.

It should be noted that this is a long process, which takes almost double the time the satellite pass takes. While the demodulator processes the data files, it shows the carrier demodulation process and, if the satellite has been received prop-

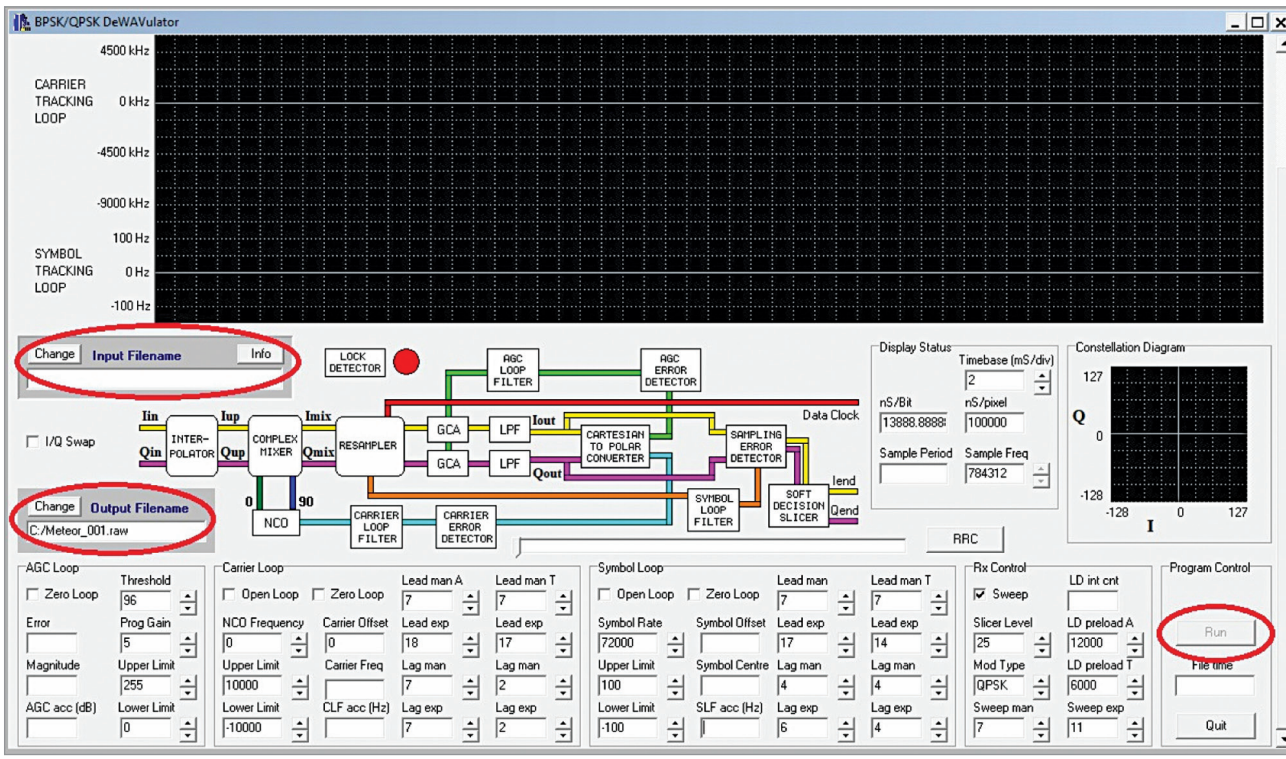


Fig. 8(a): The LRPTRX demodulator software Dashboard

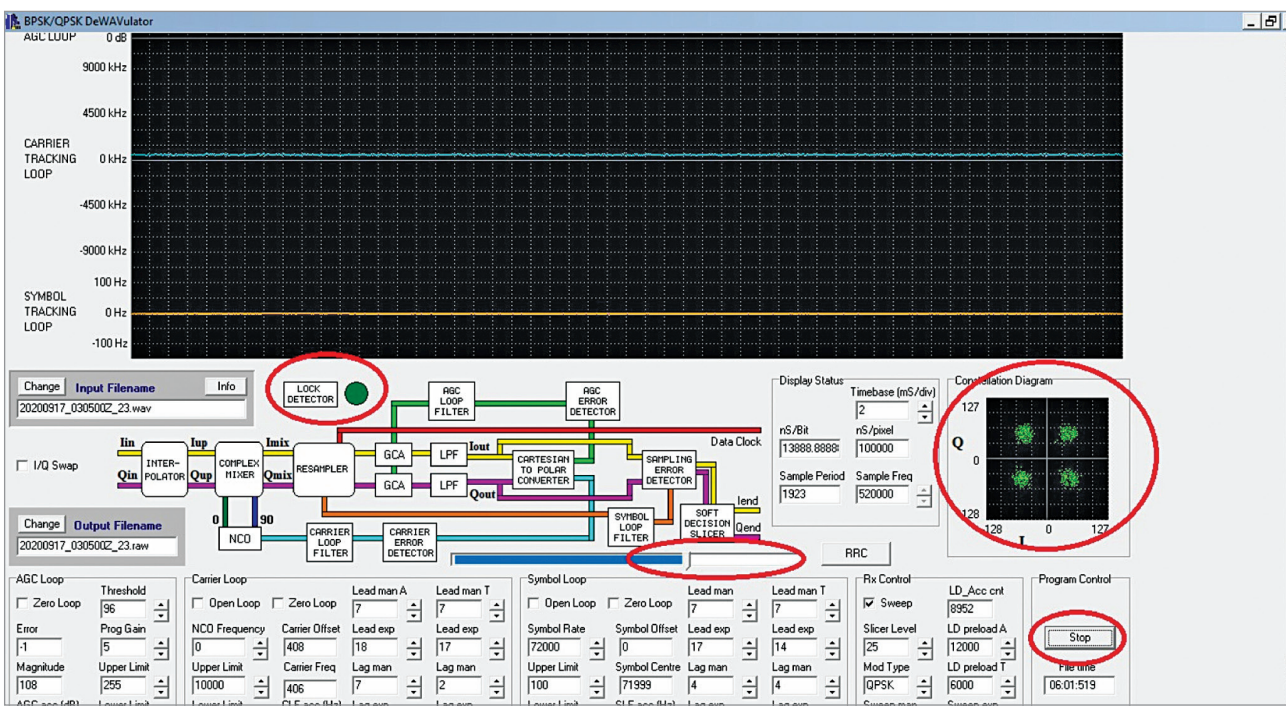


Fig. 8(b): LRPTRX demodulation in progress (Note the fine dots in the constellation diagram)

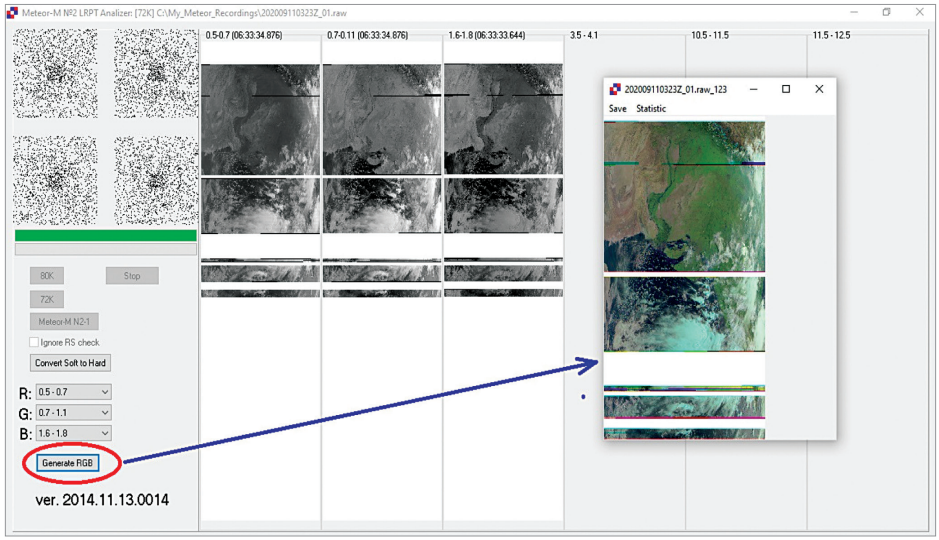


Fig. 9(a): Image extraction from LRPT Analyser software with three visible channels and the generated image

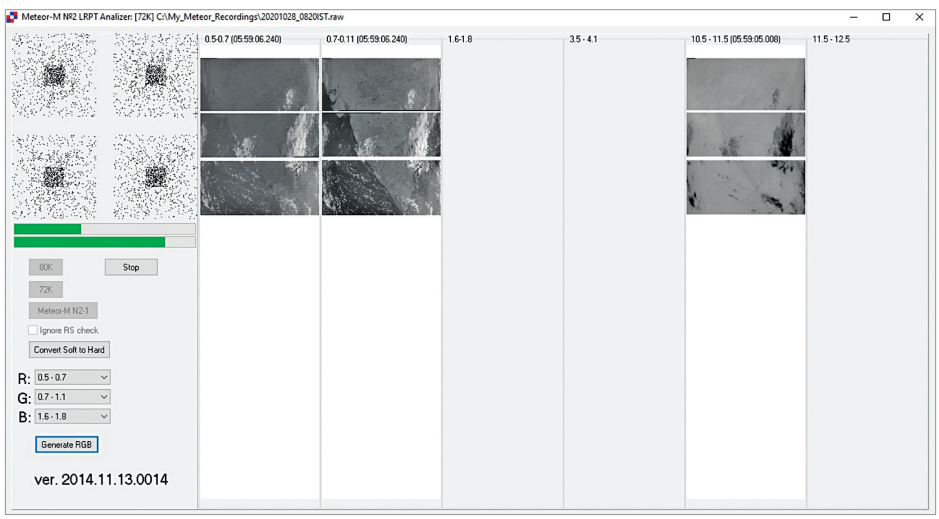


Fig. 9(b): Seasonal change in the Meteor M2 spectral bands with five channels

erly, the Lock Detector (red dot in Fig. 8(a)) turns green and also the Constellation Diagram towards the right starts showing the four phase-amplitude dots of the QPSK signal, as illustrated in Fig. 8(b).

As the demodulation progresses, the status/progress bar also slides towards right. The only problem with this software is that it does not stop automatically, even after all the file data has been processed. You need to press the Stop button to stop it and then quit the program.

This completes the manual demodulation processes. Next, we shall see the final step that is applicable to both the approaches, that is, to extract the actual image file(s) from this demodulated data.

Image extraction, the final step

This is the final step in our effort to demodulate the earth imagery from the Meteor satellite data. From the above discussions, either through the plug-in or through the manual demodulation, we get the .S or the .RAW file. At this stage, we shall require the Off-line Meteor LRPT Analyser software, as mentioned earlier in this article.

Click on the 72k button in LRPT Analyser/Decoder software and the file selection dialogue box opens. Choose either S file or RAW file. The software starts and shows the constellation diagram. If it finds the data properly, you shall see the grey-scale images displayed from the three active bands as sent by the Meteor satellite. Out of these three, there will be two in the visible/near-IR region. The third channel is switched depending upon the season to monitor the snow in the higher latitude countries during winter-time.

Once the decryption process is completed, you can click on the Generate RGB button and the image will be produced. Refer Fig. 9(a) and Fig. 9(b).

Conclusion

Images from each of these satellites, the NOAA satellites with Analogue APT weather imagery and the high resolution images from the Meteor M2, are quite useful for understanding the weather, cloud patterns, and cyclones. The author has also been experimenting with various antennas, impedance matching, and the antenna pre-amplifier for making this reception better in the best possible way and within acceptable budgets! For a successful reception, a proper antenna and good cabling system is equally important. EFY

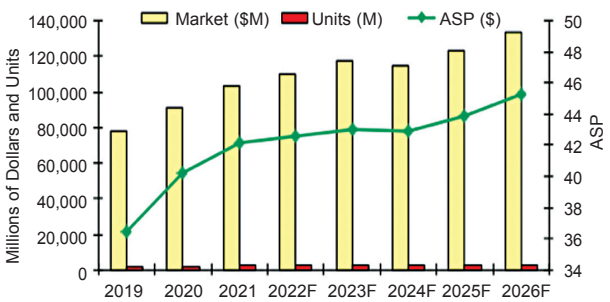
Prasanna Waichal holds a master's degree in electronics and has more than 25 years of work experience in industrial R&D for design and development of specialised and strategic electronics systems and academic teaching and research at post-graduate levels, both in India and abroad. His passions include radio reception and studying solar activities and their effect on ionosphere on earth. He is also a licensed amateur radio operator with call-sign VU3OOI. He claims to have discovered a method to predict earthquakes using very-low-frequency (VLF) multipath-multi-frequency propagation technique



THE DASHBOARD

Microprocessor Growth Will Slow in 2022 After Cellphone MPU Surge

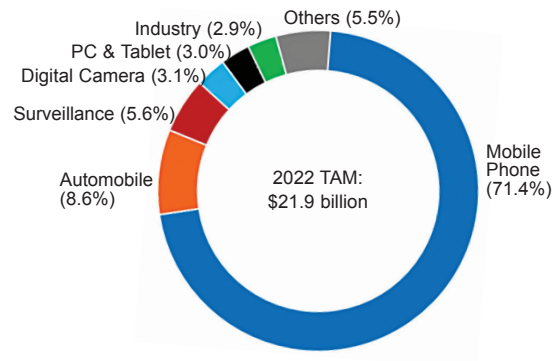
Total microprocessor sales in 2021 maintained strength, growing 14% to a record-high $102.9 billion after climbing 16% in 2020. Worldwide sales growth in total microprocessors is expected to slide back in 2022 to an increase of 7%, which will lift the MPU market to another record high of $110.4 billion, with unit shipments rising 6% to 2.6 billion processors.



(Source: IC Insights)

Global CIS Market Revenue to Reach $21.9 Billion in 2022

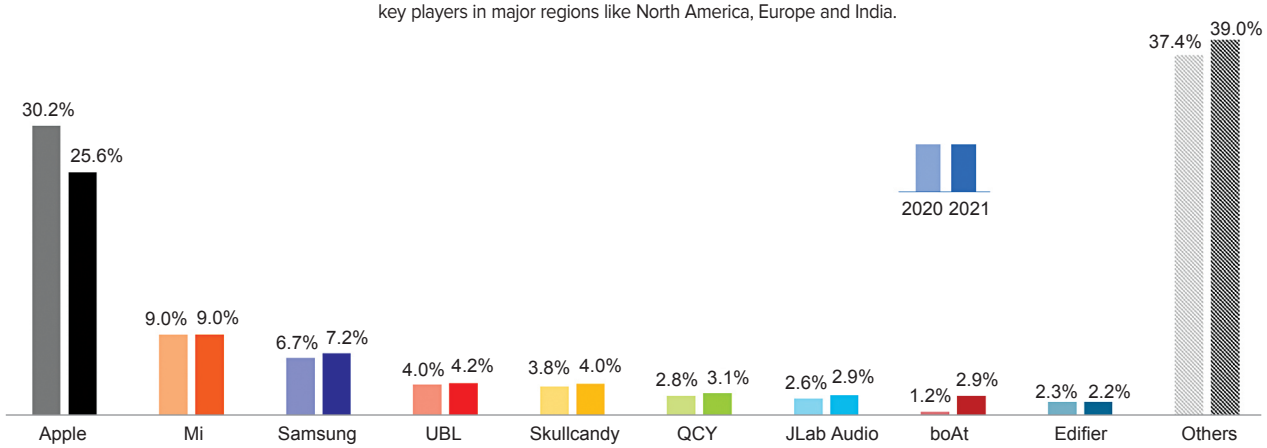
The global camera images sensor (CIS) market revenue is expected to grow 7% in 2022 to reach $21.9 billion, largely driven by increasing demand from the smartphone, automotive, industrial and other applications. Sony is expected to capture a 39.1% revenue share in 2022, followed by Samsung (24.9%) and OmniVision (12.9%).



(Source: Counterpoint Research)

Global TWS Shipments Reach 300 Million in 2021

The global TWS hearables market shipments in 2021 grew 24% YoY in unit sales and 25% in terms of value. TWS market leader Apple saw a slight increase of 5% YoY in its unit sales but its market share fell to 25.6%. Skullcandy and boAt showed noticeable growth, as they became key players in major regions like North America, Europe and India.



(Source: Counterpoint Research)

Worldwide Silicon Wafer Shipments and Revenue Set New Records in 2021

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Area Shipments (MSI)	9,043	9,031	9,067	10,098	10,434	10,738	11,810	12,732	11,810	12,407	14,165
Revenues ($ bn)	9.9	8.7	7.5	7.6	7.2	7.2	8.7	11.4	11.2	11.2	12.6

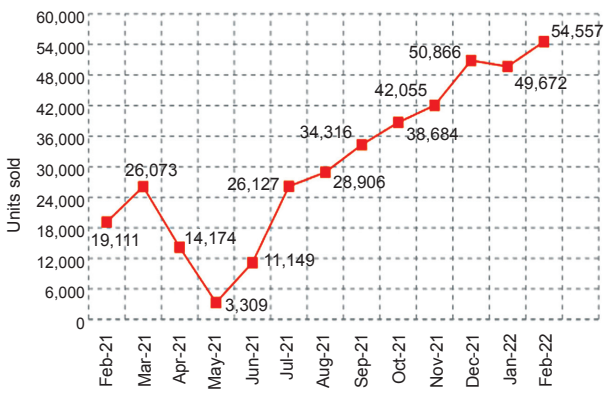
Worldwide silicon wafer area shipments in 2021 increased 14% while wafer revenue rose 13% compared to 2020, topping $12 billion, to reach new all-time highs. Silicon shipments totaled 14,165 million square inches (MSI) compared to 12,407 MSI shipped in 2020 to meet surging broad-based demand for semiconductor devices and a wide variety of applications. Wafer revenue reached $12,617 million, surpassing the previous record of $12,129 million set in 2007.

(Source: www.semi.org)

At-a-glance view of key industry trends that can shape the future of your business…

EV Sales Pick Up Pace in India

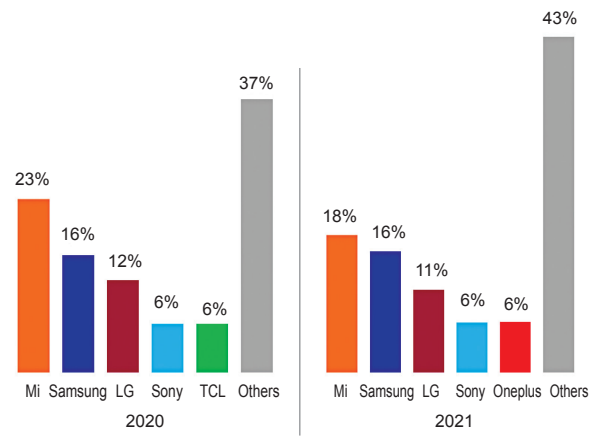
The overall EV sales in February 2022 bounced back to its growth trajectory, clocking 54,557 units. This signifies a month-over-month rise of 10% and a YoY jump of 185%. EV registrations in February 2022 were driven by electric two-wheelers and passenger-type electric three-wheelers, which together accounted for 89.75% of total registrations in the month.



(Source: JMK Research)

India Smart TV Market Records Highest Ever Shipments in 2021

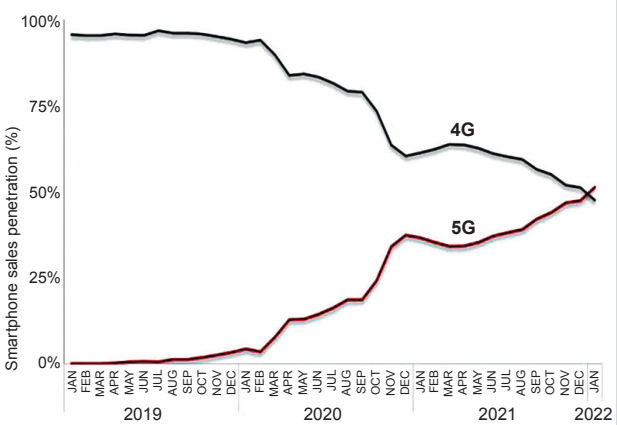
India's TV shipments grew 48% YoY in Q4 2021 (December quarter) and 24% YoY in 2021. The smart TV market grew even faster at 55% YoY in 2021 and 65% YoY in Q4 2021 to reach its highest ever shipments for a calendar year. Xiaomi continued to lead the smart TV segment in 2021 with an 18% market share.



(Source: Counterpoint Research)

Global 5G Smartphone Sales Penetration Surpassed 4G for First Time in January 2022

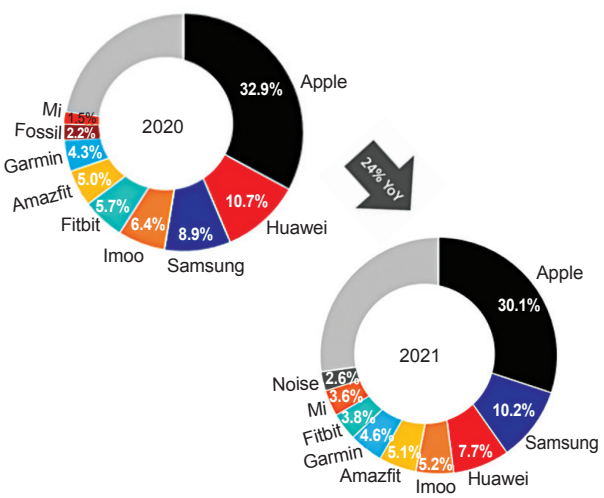
Sales penetration of 5G-capable smartphones reached 51% globally in January 2022. China, North America and Western Europe were the biggest drivers of this growth. China had the highest 5G penetration in the world at 84% in January.



(Source: Counterpoint Research)

Global Smartwatch Market Grows 24% YoY in 2021

The global smartwatch market shipments hardly grew in 2020 due to COVID-19, but they recorded a healthy 24% YoY growth in 2021. The fourth quarter alone saw shipments of more than 40 million units, the highest quarterly shipments ever. Samsung was one of the most successful smartwatch OEMs in 2021.



(Source: Counterpoint Research)

Telecom Policy Amendment Creating Confusion: **NO R&D, NO VALUE ADDITION REQUIRED?**



PROF. N.K. GOYAL,
Chairman Emeritus, Telecom Equipment Manufacturers Association of India (TEMA)

Should the manufacturers of telecom products in India, and those planning to start their manufacture, invest in setting up a local manufacturing ecosystem or just import the components and stick to assembling only with no value addition or local content. The Department of Telecommunication (DoT) seems to be encouraging imports through recent amendments to its DPIIT Notified Public Procurement Policy 2017, which may hit domestic manufacture of the telecom components and parts!

It seems, national and international companies in India can now just assemble imported parts and components and the entire cost of imports plus local assembly would be considered as local manufacture cost. The companies would thus become eligible as Class I manufacturers and qualify for preference for public procurements and get all the benefits under PPP MII.

This would also eliminate the need of the Indian specifications notified by DoT themselves through Telecommunication Engineering Centre (TEC). On the other hand, there are PLI schemes offering incentives for promoting electronics manufacture within the country. Is the new amendment against the dream and vision of India's Prime Minister Narendra Modi?

Given below are the views of Prof. N.K. Goyal, Chairman Emeritus, Telecom Equipment Manufacturers Association of India (TEMA) as told to Mukul Yudhveer Singh, Business Editor at EFY



India, during the last two years, has emerged as one of the most ambitious countries of the world. The Covid-19 outbreak, which caused havoc all over the world, continues to be one of the prime reasons fueling the dreams of achieving self-sufficiency (*AtmaNirbhar Bharat*) for the country. During the last eighteen months or so, the country has announced production linked incentive (PLI) schemes one after another, and electronics is being given great importance for self-sufficiency. The amount promised as incentives for the electronics sector is north of 900 billion rupees (₹90,000 crore).

However, with the recent amendments made to the Public Procurement Policy 2017, we seem to be taking a step back. The Telecom Equipment Manufacturers Association of India (TEMA) is of the view that the new notification dated 31st August 2021 issued by DoT in supersession of the notification dated 29th August 2018 is beyond the scope of mother policy notification issued by DPIIT, known as Public Procurement (Preference to Make in India) Order 2017, or PPP MII, and is not in harmony with the Prime Minister's dream of *AtmaNirbhar Bharat*.

The issue of reducing the number of products from 36 to 25 in the amendment is understandable, as more than a year was invested by DoT on this, but the logic behind allowing 100% import of components to qualify for PPP MII is not clear. Likewise, the issues of R&D, Indian design, and local content have always been supported by the authorities. In its order of August 2018 DoT had certified that the 36 products "have sufficient local capacity and local competition." The list is now reduced to 25, which means either the earlier list was wrong or the present list is non exhaustive.

The latest amendment notes that all telecom equipment will count as local content, even if they constitute 100% imported components. Surprisingly, this also applies to 25 products listed in the order for which DoT declared that they have sufficient local capacity and local competition.

The notification also eliminates the requirement to follow DoT's own specifications of telecom equipment as notified by TEC, thus enabling procurement with any specifications, which could be restrictive or foreign based. The notification enables public procurement of such goods for even Defence, Smart Cities, Metros, Police, Railways, BSNL, etc with 100% imported components, which would be considered as local products for these public projects.

TEMA considers this to be a retrograde step that has permitted 100% import from China and other countries and made them eligible for PPP-MII, by simple assembling without even having 0.1% of local components and without any emphasis on local R&D, designing, or IPR.

It may be noted that as per Clause 5 of DoT notification dated 29th August 2018, "the local supplier has to manufacture equipment from components level in India and also develop local vendors for procurement of raw materials, components and parts for increasing local content." Further, local content was specified as "Minimum Local Content as a percentage of total bill of material (Cost of production) to qualify as Make in India Telecom products, services or works." Both these provisions now stand superseded. The moot question raised here is, for whose benefit these conditions have been removed ?

While the list of 25 telecom products that can be made from the imported components includes satellite phones, broadband equipment, optical fibre cable, modems, routers, core network routers, broadband equipment, mobile antennas, and more, there is also a PLI scheme for telecom products running which aims to promote local manufacturing of the same.

The amendment for several years

Though the amendment made to the policy has drawn flak from various associations and individuals, the DoT in its notification has clarified that the same will be reviewed once a semiconductor fab is operational in India. It might simply mean that the amendment will be in place for next three to five years at least given that India is chasing fabs for last several years.

A semiconductor fab, to be set up, tested, and operational, gener-

Amendment to the Public Procurement Policy 2017

What's the amendment? All telecom products where companies assembling them here in India with zero local value add are eligible for supplying these as local products to public projects falling under organisations such as Indian Defence, Railways, or BSNL.

What's the concern? 1. India might earn the tag of a country famous for offering assembling services for telecom products. All the hard work of design, R&D, innovations done by the industry—including the likes of Tejas Networks, Coral Telecom, Vihaan Telecom Limited, Sterlite, Paramount, and more—goes into vain.

2. The statement "to be reviewed once FAB in India is operational." A semiconductor fab takes a minimum of three to five years to be set up, tested and become operational. Till that happens, anyone can assemble in India and supply to government agencies. This is a guarantee that 100% import of components will be allowed almost in perpetuity.

3. National security is at stake. India, in the past, has permanently banned more than 50 Chinese apps for national security. The new amendment makes importing and selling from China, even to government agencies, 100% legal.

4. Several local companies have given in writing that they have successfully reached more than 50% local value add in products. This is not needed now and they can revert back to imports.

ally takes at least three to five years and millions of dollars' worth of investment. It is good to know that the authorities of the country have requested expression of interest for setting up such fabs in the country, but it has been more than nine months since work on that front has also stalled due to reasons only known to the government of India.

As a matter of fact, Israel based Tower Semiconductor had recently written to Prime Minister Narendra Modi, requesting intervention on fast tracking their EOI (expression of interest). The company had expressed concerns over the delay in the project and said that it might be unable to stay active for the semiconductor project in India. On the better side, ISEA has noted that more than 20 countries had shown interest in setting up a semiconductor fab in the country. Specifically mentioning that review will be done when a fab in India is operational is a commitment to allow 100% imports for several years due to uncertainties of fab.

The progress of any country depends upon its local manufacturing power. That is why the likes of China, the USA, South Korea, Finland, Sweden, Japan, France, etc are way ahead of other nations as their imports are way less than the exports due to their local manufacturing capacity.

These countries have progressed due to support by their governments to the local companies. That is why these countries are large net exporters of electronic goods and components.

Assembly or manufacturing

While there is no rocket science in understanding the fact that every nation imports electronic components for fulfilling its needs, it takes a little brain exercise to gauge that despite these imports such countries manage to stay on top of the table because their export revenue is much bigger than their import. Besides, a lot of the government agencies working in such countries make it mandatory to procure goods from local companies for establishing public projects.

For instance, China imported electrical equipment and machinery worth US$548.7 billion in 2020. It exported electronic equipment worth US$710.12 billion during the same year. India, in FY 2020, imported electronic products valued at over ₹3.7 trillion. These included telecom instruments, electronics components, consumer electronics, and a lot of other things. The country, in the same year, exported electronics goods worth over ₹829 billion only.

THIS POLICY IS COMPLETELY AGAINST DOMESTIC INDUSTRY, ANTI-ATMANIRBHAR BHARAT, AND AGAINST THE WELL-KNOWN POLICIES OF PRIME MINISTER MODI. SO TEMA REQUESTS THAT DoT SHOULD TAKE NOTE OF THIS AND RECALL IT IMMEDIATELY.

The difference between the exports and import figures of the two countries is mainly due to the local value addition factor. In simple words, countries like China are doing much more than mere assembly of products.

Now, the new amendment to the policy states that if printed circuit board assembly (PCBA) and testing of imported/domestically manufactured parts and components using surface mount technology (SMT) process is done in India, then imported/domestically manufactured parts and components will be qualified for the purpose of Local Content. If the basic components of the assembly are 100% imported but assembled here locally, then by virtue of the above clause it would be considered as locally manufactured product duly qualified for PPP-MII.

Notifications like these will surely suppress the zeal and motivation of local companies to put in efforts to add more value than mere assembly and packaging. TEMA is of the view that the new amendment will lead to India's domestic add (local value add) reducing to zero. And India will be seen as a country for low-cost assembling where the assembling cost is paid by the government through different PLI schemes. This is despite the fact that many companies in India have the capabilities and capacities to manufacture in India with much less foreign imports.

This policy encourages CKD assembly with 100% imported components (irrespective of country of import, including China) as an Indian product qualified for all government purchases as a Class 1 Domestic Manufacturer. This is because there is no requirement or percentage prescribed for domestic components. It has done away with any need of domestic IPR, or Indian technology, or even design requirements, for which industry has fought tooth and nail for the last several years. So, now India will graduate from being an importer to CKD assembler where the assembly charges are paid by the government, if eligible for PLI.

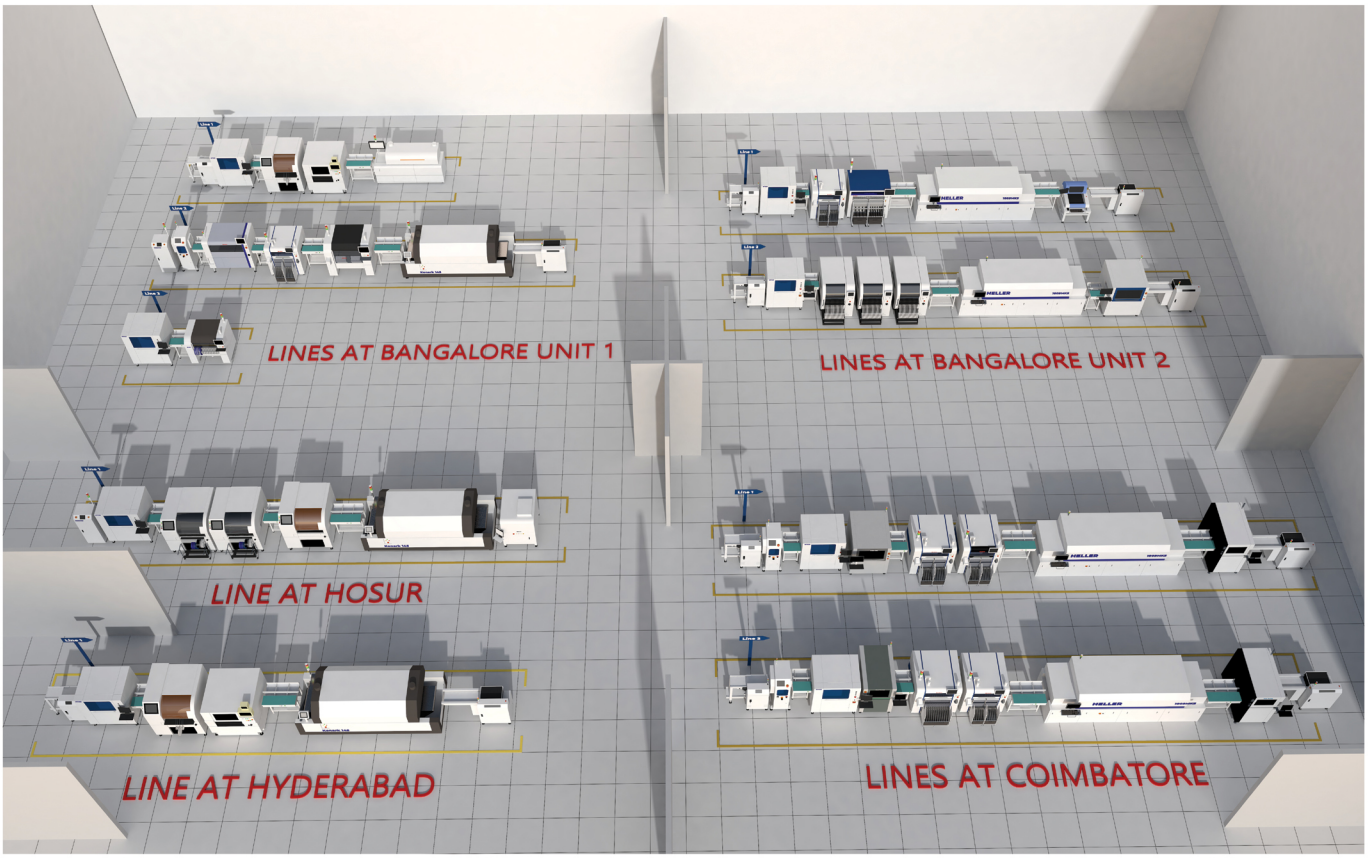
Without naming any telecom products manufacturing company, TEMA clarifies that several of them have already confirmed that they have successfully managed to achieve over 50% domestic content. In high technology telecom products, active imported components constitute about 30% of the cost. Hence, more than 50% domestic value addition is achievable by these Indian companies.

The new amendment, as TEMA

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debates, has put an end to all the efforts made by the Indian companies by eliminating requirements of local value addition. The amendment also seems to have overridden the DPIIT policy where Class 1/Class 2 supplier is mandated to offer products with a minimum of 50/20% local value add in terms of domestic content, as under the new amendment no amount of domestic content is needed

This indicates that somehow the decision has been misled by some officers in DoT for some pecuniary benefits and vested interests. This new policy puts fully imported products assembled in India at par with Indian designed and manufactured products, thus giving a severe blow to the Prime Minister's vision of creating AtmaNirbhar Bharat. Now the Indian design and manufacturing industry will die a natural death.

The new amendment might result in a lot of local players losing business in terms of procurement orders for government projects. Reason being, international players—especially from China—can now easily offer at much lower prices than their Indian counterparts even those telecom products in the list for which sufficient local capacity and local companies exist. They have a developed ecosystem of building such products back in their country, whereas such an ecosystem has only recently started opening its wings in India.

It is worth mentioning here that the likes of Cisco, Nokia, and Ericsson have demanded to be treated at par with their Indian counterparts in the past. TEMA welcomes that as government allows 100% FDI in telecom sector and clarifies that all government orders apply equally to Indian and foreign manufacturers in India. BSNL, the state-run telecommunications company, had earlier notified that it will be testing the quality of telecom equipment manufactured by Indian companies before letting them participate in the upcoming 4G tender.

National security

The USA became the first nation to set an example when it comes to doing technology business and setting the expectations straight when it comes to national security. There are several China based firms that have been barred from doing any type of business with the companies and authorities based in the USA. Not only that, the USA mandated organisations to take prior approval of the Pentagon if any kind of technology transfer is scheduled or required with China, and the USA openly promotes Made in America.

India, on the other hand, has now made it possible for companies to sell telecom products assembled entirely from components sourced from China. Such companies will also be eligible to supply to Indian authorities for public projects as a domestic product. This is despite the fact that the government of India has permanently banned more than 55 Chinese apps and has notified restrictions to procure equipment from border countries under General Financial Rules Rule 144 xi. So, in a way, the DoT notification even overrides GFR. These apps were banned as they were seen as "prejudicial" to India's sovereignty, integrity, and national security. And the GFR Rule 144 xi was introduced on 23rd July 2020 on grounds of defence of India, or "matters directly or indirectly related thereto including national security."

All talks of need for domestically designed products for national security will now get sidelined. It is now possible to import all the components from China or other foreign countries and just assemble them in India in a contract manufacturing EMS company and become eligible for Make in India PPP MII. Of course, in case of procurement by TSPs, the National Directive on Security in Telecom will be applied, but for non-TSPs, the field is wide open.

Moreover, the compulsory specifications in TEC's clause have also been removed in the new amendment. TEC was also mandated to implement testing under Indian Telegraph Amendment Rules, 2017. This paves way for the procurement to be made based on any standard and specifications prepared by self or by anybody of any nature. Of course, foreign specifications are barred in DPIIT PPP MII.

No consultation with associations

DoT did not consult with the likes of TEMA or TEPC, or any other such organisation before announcing this mandate. These associations represent the likes of Tejas Networks, Coral Telecom, Vihaan Telecom Limited, Sterlite, Paramount, Fibcom, and more when it comes to policy making or interacting with the government on behalf of the industry. The general practice has been to consult such associations, as it enables the local industry to give their suggestions to the government.

Surprisingly, the 100% import of components not only has been allowed but has also been ensured at least for next four to five years by putting a statement in Clause 5 of the policy, which states, "This shall be reviewed when the semiconductor FAB in India is operational." We all know the availability of fab in India has been under discussion for the last ten years. Of course, it has received more emphasis now, but it is a mirage because of several international ramifications.

This policy is completely against domestic industry, anti-AtmaNirbhar Bharat, and against the well-known policies of Prime Minister Modi. So TEMA requests that DoT should take note of this and recall it immediately, and remove the anomalies to support Indian companies. EFY

The views expressed here are entirely of Prof. Goyal, Chairman Emiritus, TEMA.

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How To BUILD A COMMUNITY And WHY It MATTERS

Building a community and keeping it thriving is certainly not a bed of roses. Janardan Revuru, Community Leader, JavaScript Meetup, talks from his experience the constant questions he receives and few important steps that many larger communities have followed





JANARDAN REVURU,
Community Leader,
JavaScript Meetup

The demand for communities is growing. Even if its start is small, the returns are quite compounding. I would compare it to an adventure in the deep woods. You can start with a lot of preparation but it's better to be prepared to face the unknown. Technology and tools still continue to evolve, so you cannot rely on them completely. On your journey, you will find other fellow travelers who support. Be ready to deal with surprises yourself.

Many times, people fall into the trap of thinking a community is needed for problems to be addressed, or for support that people need. Even if these reasons are correct, the main core to build a thriving community entirely depends on you as a leader. Once this is clear, it is good to know the common mental blocks for people to start or join a community.

Four blockers

Why. It is a major question that people come up with as they see it as a contribution with no returns.

Awareness. There are a lot of communities that need a supporting hand and the lack of awareness among people to hit in the right direction remains.

Where to start. There are many who do not know where to start, despite having inclining thoughts and awareness.

How to start. People are unsure of what role they can play and where their contributions can be helpful.

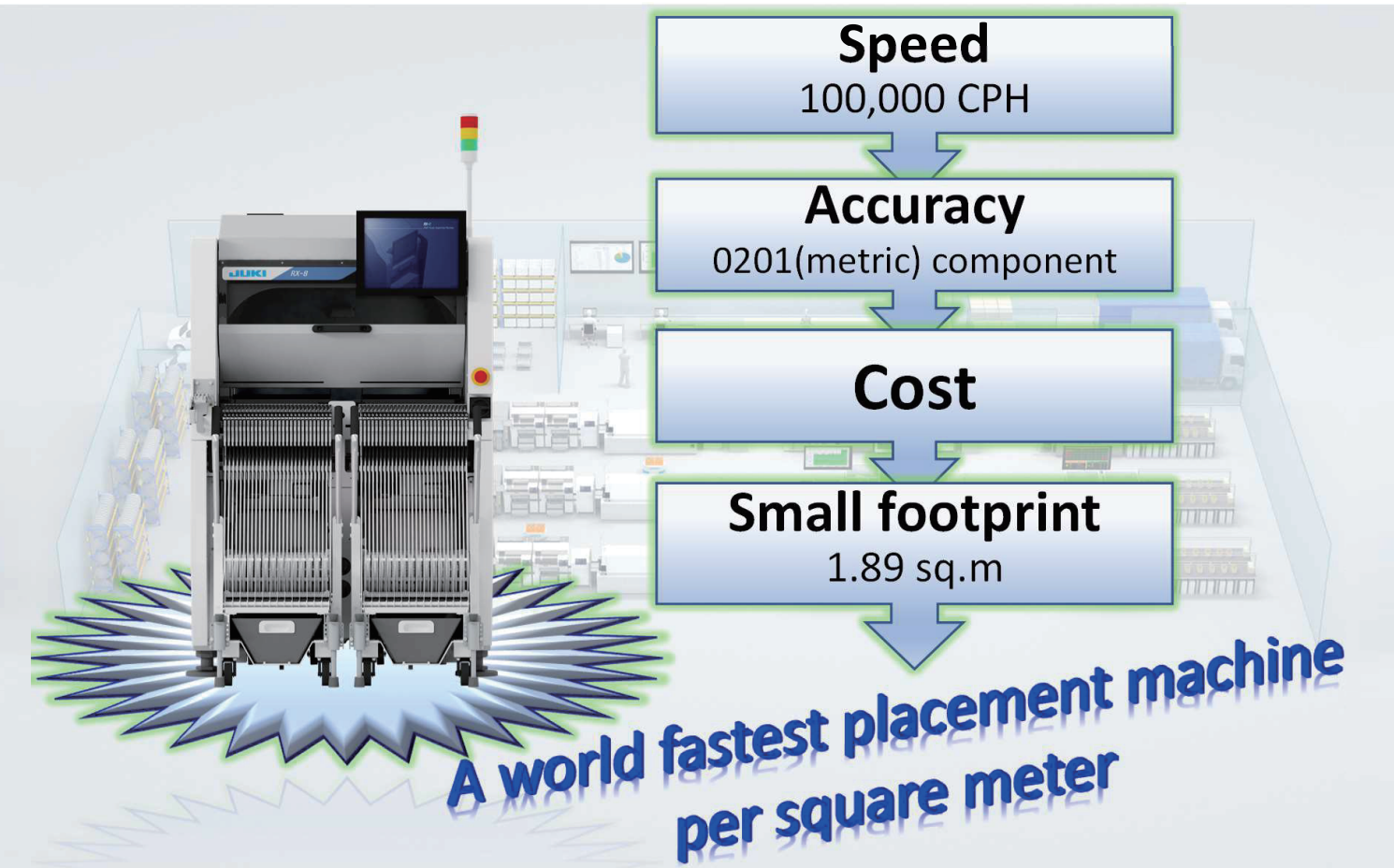
A straight answer to these blockers is knowing the wide range of valuable skills that can be gained from technology, communication, influence, strategic thinking, and so on. It will be helpful to start discussions with the organisers as volunteers, note down your purpose, explore opportunities, connect with fellow teammates, contribute, and grow in your community.

Five steps to start and build a community

1. Research for a common interest. The very first thing to do is research, which can be done in a day, week, or maximum a month, without much time being spent on it. Think of it as a need for a group to be formed—be it technical or non-technical. You can visit two places to figure out whether it would be valuable to start or not. Meetup.com, where there are many communities worldwide, not just limited to location or technology. The second

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place would be Discord. Even though it initially started for gamers, it is vibrant for non-gamers also.

2. Start small. Do not stop after the analysis. You could start a meet up with a little group. Be aware, for instance, that your first event registration may fall somewhere between 50 and 100, but the actual turnout would be 10 people. You might be disappointed with the turnout being less, even if there is a lot of interest in the forum. It is a pattern we see all through the ratios at different points of time. We have seen a ratio of one out of three people registered for an event turning up. Hence, do not judge too early. Conduct the sessions at least a couple of times before you decide on whether it is working or not. The net take away is putting thought in action and not just having an intention to build.

3. Communicate for impact, participate for feedback. It is important to develop the skill of communication and participation. A good communicator will create an impact that leads to action. For instance, let's say, you are writing an email for people to register; a lengthy email on the benefits of the topic and a small link for registration may not help. The start itself should be a big popup containing the link for registration, along with an agenda repeating the process. Also, when these emails are being sent, note the time of the day and day of the week that help you fetch more registrations. Though it does not guarantee people coming in, you will learn to be concise in your communications over a period of time.

Participation is yet another important thing. For example, in the first week, I asked people about the topics they would like to hear in the next three sessions. Even if there were a lot of ideas pouring in, in the next session we did not have the same set of people. People give feedback because you asked for it; it does not mean they are committed to being a part of it. As time passes, you will slowly see some regular people, assuring that probably 5-10% of them are more committed to the group.

4. Adapt to evolve. A big lesson where you have to be nimble and adaptive. When the pandemic hit, we were forced to shift from offline sessions to remote interactions. We looked at options like Zoom, Slack, and some other affordable options to sail through. So, it is important for you to keep an eye on where your set of community members spend most of their time. We may have a lot of social media platforms, but then you have to keep on adapting and trying. With trials on apps like WhatsApp, Facebook, and Telegram for our community, we figured our meet up.com gained us approximately 9,500 registrations spanning across fifteen cities and eight countries. Similarly, in terms of adapting to groups, WhatsApp group is the most active after Discord. We have around 1,800 members where the maximum interaction happens.

5. Grow and expand for win-win. This is how you start thinking like an entrepreneur. You get an entry as a member of a credible community and run multiple meetups consistently every single month, say for three to five years. Then people start taking it seriously. Not only the community members, you may even have a good number of fans following and a great set of volunteers, which may get you sponsorship. Credibility comes with numbers and fetches you sponsors. That's when you may get people who want to talk about hiring. Hence build and boost your numbers for others to talk about it.

If you want to expand your community beyond a certain range, you can think about spot leaders. As mentioned, you will see a few regular members attending your meetups and being active in various forums. It would be beneficial to make those volunteers the leaders, which helps when you cannot involve or dedicate to your role as a community leader. These spot leaders can help in events and keep the community thriving. Remember, the willingness of the person and volunteering is more important than their skill or expertise.

When you are gaining sponsors, you can think about the purpose of the community to decide on tie-ups. For example, in JavaSript we are tying with Reactindia. We have a couple of other groups to open up for hosting events. Such tie-up strategies would help you grow at a different scale, as long as your intentions are matching with the alliances. Hence, if you are building a community and have plans to expand, you should also imbibe skills of entrepreneurship. Understand your market, identify more places where you can attract people, boost your numbers, sell what you are doing, and create win-win scenarios.

What to expect as community leader

Community leaders are followed not only by the communities but also the corporates. Corporates like Microsoft, Google, and Amazon are seeking community leaders for new positions and roles to influence their communities. You could either be directly associated with them as an employer or contractor, or have a tie-up to get sponsorships for your events. I see this scenario increasing in the next five to ten years, making it a reason to focus on full-time.

One simple thing to remember is that expectations may be different. I suggest not to think of only benefits, but how it can make us better in terms of strategic thinking and adapting to different situations. In spite of the highs and lows you may go through, you will have the backing of a community of, say, around 10,000 people.

There is no single route in the journey to community leadership as you would find things a little scattered and may have wrong assumptions. But remember, when you take action you are taking steps forward. EFY

The article was compiled from a talk by Janardan Revuru, Community Leader, JavaScript Meetup in Open Source India 2021 Edition conducted by EFY. Speech transcribed and authored by Abbinaya Kuzhanthaivel

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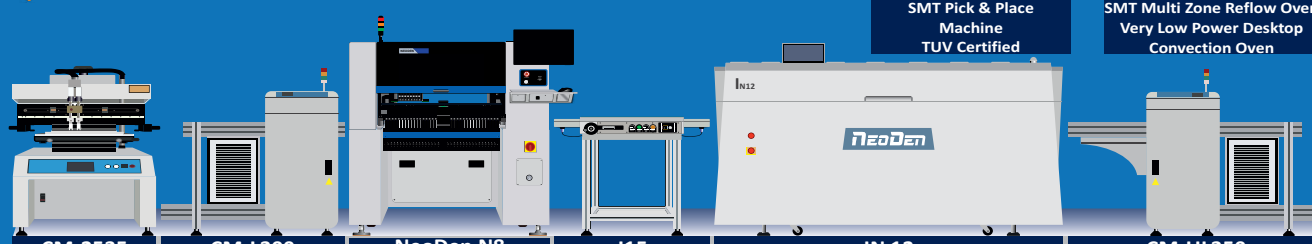
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Automation

Sunil Banwari: INDUSTRY 4.0 Can BOOST Implementation Of SEMICONDUCTOR MANUFACTURING



Manufacturing semiconductors is a vital aspect of electronics empowerment that has not yet harvested the potential of Industry 4.0. Can they complement each other and help answer the crisis of semiconductor shortage the world is facing? Sunil Banwari, Vice President, Advantest Corporation, in an interaction with EFY's Mukul Yudhveer Singh believes that this can create more jobs in the industry

Can implementing Industry 4.0 help us meet the demand for semiconductors, especially with the chip shortage in the world today?

Definitely! Many factors are associated with the shortage of semiconductors. For example, in the automotive industry, companies like Toyota have done really well while others have not. What worked for Toyota is the good visibility in the semiconductor supply chain. The automotive manufacturers usually buy modules from Tier 1 organisations, which are usually similar to electronics manufacturing services (EMS) families.

SUNIL BANWARI
VICE PRESIDENT,
ADVANTEST CORPORATION

The semiconductors and components are bought from suppliers who are two levels below. Which means, the automotive manufacturers are not usually aware of what's happening in the supply chain until it hits them too late. In such a complex scenario, Industry 4.0 can make a major difference by adopting the semiconductor industry. Even with semiconductors being the driving force behind technologies like artificial intelligence (AI) and machine learning (ML), the semiconductor industry in itself has not seen much of Industry 4.0.

To summarise, semiconductor test solution providers are looking to change this in a way where the semiconductor industry itself is benefitted. It might be important to note that Advantest generates the most amount of data in the semiconductor industry across all players. We are using this data to take the industry to the next level in terms of digital transformation.

Would better visibility in the supply chain be of help?

Yes, and that is one of the essential things being worked on today. As an industry, we are trying to build solutions over the cloud that will allow any manufacturer to calculate what's happening in the supply chain well ahead of time. The solutions will tell manufacturers about problems that can arise in the future, giving them enough time to react and come up with a resolution.

The cloud is one function that we are most excited about. When talking about increasing the yield through a fab, it would take at least a year. But when it comes to establishing a new fab, it could take around two to three years of time. However, with Industry 4.0 in the picture, we can guarantee improved yield starting today. Yet these are just some functions of the Industry 4.0 value chain.

How Industry 4.0 can complement semiconductor industry

1. Elements of Industry 4.0 can be used to validate semiconductor design from the very first step.
2. Design engineers do not need to wait for 2.5 months to gauge the effectiveness of the die they are working on.
3. A semiconductor travels more than 48,000 kilometres (30,000 miles) before reaching the consumer. Industry 4.0 can be used to collect data from all the points of distance it covers.
4. There is better visibility of the supply chain, both for the creators as well as users of the semiconductors.

Is it expensive?

Any transformation requires investment. The focus, however, is mostly on the return on investment (ROI), and early use cases have already proven an impressive ROI. Adding to it, cases that come online would only increase ROI further. The best way to test waters for semiconductor companies is by signing up for subscription models instead of making all investments before the value is understood. If the results are satisfactory, such companies can fine tune their investments.

Will it reduce jobs?

As a matter of fact, Industry 4.0 creates more jobs. The need of the hour for professionals working in the semiconductor industry is to up-skill and re-skill themselves. Almost every semiconductor industry needs data scientists, and this explains the magnitude of jobs that can evolve.

What are the other possible areas where Industry 4.0 can be used in the semiconductor industry?

The complexity of the semiconductor manufacturing process requires high levels of visibility, analytics, and awareness. Analytics in the past was mostly manual. Let me explain this through an analogy.

Just like how a multiple-use residential/commercial skyscraper consists of many layers—structures with interdependencies—similarly, a semiconductor device process is like a skyscraper that has many floors or processing layers, as we call them in the industry. It takes 2 to 2.5 months to put these layers onto a device for a typical semiconductor company.

A lot can go wrong in this process. The smallest mistakes can affect the time of the semiconductor to market by weeks, or in some cases months. This in turn affects the overall image of a semiconductor company. What makes the process more challenging is that different layers of the device are being worked upon in different parts of the world. A typical semiconductor travels no less than 48,000 kilometres.

Now all the places a semiconductor goes, tremendous amounts of data is generated. Sometimes it is collected manually as well. The data acquired is in multiple languages, and one of the biggest challenges that we as an industry face is to bring this data under one machine in one language to gauge what's going right and what's not.

Industry 4.0 provides the analytics of this data and improves the yields that directly improve the cost. It can also help in answering the questions that are related to the tests of semiconductors. Issues of over testing or under testing can be answered with the help of Industry 4.0. Though there are many more advantages that it offers, the target of most companies is to decrease the time to market for the semiconductors.

What all stages of semiconductor manufacturing can benefit from Industry 4.0?

A term often referred to in the semiconductor industry is the

Sunil Banwari, during his 28+ years of working in the electronics industry, has been associated with the likes of Intel Corporation, Anadigics, Natel EMS, Smiths Group, ON Semiconductor, and AT&S India

Advantest Corporation is a leading manufacturer of automatic test equipment for the semiconductor industry, and a manufacturer of measuring instruments used in the design, production, and maintenance of electronic systems including fibre-optic and wireless communication equipment and digital consumer products. It recorded over $3 billion in annual revenue in fiscal 2020.

Product Life Cycle. It is also sometimes referred to as the Technology Life Cycle. Industry 4.0 can benefit semiconductor manufacturing at every stage of the product or technology life cycle as it gives us an opportunity to do things in a smarter way.

Smart Manufacturing, when used as a synonym to Industry 4.0, includes smart design capabilities too. Designing a product today requires going through different iterations of the same. These different iterations go on until you hit the right spot and can meet all the expectations from the design. Typically, it takes multiple iterations to get one design right.

Industry 4.0 reduces the number of iterations dramatically. AI and ML being the biggest contributors play a big role here. The best example of the same is the recent announcement made by Google.

When you do a layout of a chip it requires a lot of designing, and the layout engineers have to ensure that the circuit is placed in a way that optimises the efficiency of a chip. Thankfully, Google has introduced a tool which can do the same using AI instead of humans.

According to Google, the tool decreases the time to market and helps bring down the cost by decreasing the amount of time and number of iterations required in the process. This was just an announcement by



Google and, personally, I do not think it has been adopted widely in the semiconductor industry. However, we should not forget that Google is designing its own chips.

There is a tool that we at Advantest offer that can decrease the time of validation of silicon. This tool is also based on Industry 4.0 and basically allows one to do a proper validation with every iteration and hence improve performance with every new iteration. It can even suggest design options on its own.

Any other elements where Industry 4.0 can be beneficial to the semiconductor industry?

Consider the example of an OSAT or an ATMP that manufactures chips for others but does not have its own design, say someone like the Taiwan Semiconductor Manufacturing Company (TSMC). The opportunity that Industry 4.0 provides to them helps improve the yield and capacity. Typically, the margins of such companies are lower than those that design the chips.

Industry 4.0 can provide the reasons behind losses in terms of capacity at each step for OSATs and ATMPs. It can also reduce the idle time caused by different reasons (including equipment not working) by suggesting what to do based on data it has collected in the past.

With much of the process being manual, it takes weeks to improve yield because the data is read, the equipment is reset and tested, before the final steps are taken. Industry 4.0 can automate the process, saving valuable time as the data is available with you at every point of time and process, and it does not need to be analysed manually.

What about the yield part?

As mentioned earlier, the usual process of semiconductor manufacturing, which used to be about two-and-a-half months long in the past, made it difficult as we had to wait to find out whether the die being used was good or not. It involved a lot of guesswork with the usual question being, "What percentage of what was started would be good

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after two-and-a-half months?"

Imagine working on a cake for two-and-a-half months and then finding out that the customer is not happy with the cake. You will either have to start the whole process again or leave it for a new cake. Considering the same in the world of semiconductors, Industry 4.0, on the other hand, has the capability of signal corrections that are needed to be made at each stage during these two-and-a-half months. This opportunity Industry 4.0 provides can help dramatically improve die yield.

But isn't implementing Industry 4.0 expensive for the already expensive semiconductor industry?

Investment is indeed a big and core topic for everyone. The best way to predict the prospects of the investment is to start with the subscription services. That way you can easily set short-term goals, track results, and determine the ROI, which will guide and justify additional investments. As a matter of fact, at Advantest we advise our smaller customers to start with the subscription model first. This way it becomes part of the operating expense (OPEX) for a company.

I think the best way to find out if something is expensive or not is by calculating the amount of investment in terms of return on investment (ROI). There's always a payback period involved. It varies from company to company but typically, if the ROI stretches over decades, you can conclude that it isn't a good investment.

Would the subscription services require the provider to go to the client locations physically?

One of the key benefits of Industry 4.0 lies in providing services virtually. A lot of the things can be done virtually. At the end of the day, it is the clients who know their machines best. Advantest encourages customers to come up with their own set of applications, and the required training would definitely be looked into.

The semiconductor market is highly competitive, and survival clearly goes to the fittest. Our data shows that companies that are technologically ahead are also ahead in time to market, when compared to their competitors. Though, there is no standard on the adoption of Industry 4.0, it all depends on the maturity of the company as well. Some companies are lagging and have not adopted even the Industry 3.0 features, which places them at a competitive disadvantage.

The decision of adopting Industry 4.0 must come from the executive level. The ROIs are not related to one business aspect but affect multiple businesses throughout the entire company. It is good to know that almost all leading companies in the semiconductor industry have taken initiative in Industry 4.0 domain and this was done at the executive level.

Would implementation of Industry 4.0 in the semiconductor industry result in shrinkage of jobs?

That fear, in my opinion, is very overrated. Every country and every company is trying to improve its better living index. For every job that is being replaced there are multiple jobs being created by the same industry. The biggest example of this is the number of data scientists required in the industry. The designation data scientist did not even exist a few years ago.

Industry 4.0 generates big data and at Advantest we are still in the process of gathering data in terms of gigabytes per die. Much of this data was not being looked at in the past, and there can be instances where important data is not even collected. Industry 4.0, in terms of the semiconductor industry, is creating more jobs. EFY



SOLDERING MACHINE INNOVATIONS
Target Better Flexibility And Temperature Control

Are you planning to buy a new soldering system, equipment, or robot for printed circuit board assembly in your manufacturing unit? Here is a quick look at recent features—just what you want to know before investing

ABBINAYA KUZHANTHAIVEL

The electronics industry is advancing rapidly in technology, and automation is taking the lead in manufacturing spaces. Automating the soldering process is found to be a more efficient alternative to hand soldering, with the latest technologies and soldering accessories in place. However, there are significant applications that still need hand soldering, and hand soldering stations are not going to go out anytime soon. So, you need to consider the best-in-the-class in both automated and hand soldering, before making the right choice to help you save costs, improve quality and productivity, and ensure standard safety practices.

Trendy features in recent launches

The recent machines and soldering stations have undergone incremental improvements from the previous generation models with more focus to provide manufacturers with efficient temperature and power control, and motion flexibility.



Pillarhouse Orissa Synchrodex Pro (Credit: www.pillarhouse.co.uk)

Capability to handle large PCBs. The industry is handling large printed circuit boards (PCBs) that are used in supercomputers and servers with complex miniature components. Hence the recent launches have more focus on the maximum size of printed circuit boards that can be soldered in the machine.

According to Bittele Electronics, a PCB assembly house headquartered in Canada, the largest panel size available is 14.50 × 1.37 metres, which can be fabricated for two-layer boards. The company can fabricate four-layer boards with maximum size of 0.55 × 1.35 metres. Manufacturers say that there will be additional fabrication cost for PCBs that have sides longer than 50.8 centimetres. For example, Pillarhouse Orissa Synchrodex Pro is a selective soldering system that can process PCBs up to 114.3 × 60.96 centimetres when using the XL frame size.

Combined systems. The most popular and best soldering equipment comes in integrated packages that are either fully or semi-automatic. Fully automatic are those with soldering modules or soldering robots, safety covers, conveyors, loaders, and unloaders, while semi-automatic are the soldering modules or robots which can be retrofitted into automatic packages to reduce the number of steps and make the process quick and eliminate the need for expensive carriers used in processes like wave soldering.

The REECO Soldering Robot is an example in which two or more robots can form cooperative assemblies and, for example, can work with other equipment, loader, and unloader stations. The robot uses programmable logic controller (PLC) system to control all auxiliary equipment, such as transport, soldering generator, wire feeder, and tip cleaning station.

Temperature and wattage control. Temperature control is one of the most important factors in soldering systems to avoid faulty soldering. Wattage is a parameter to indicate how rapidly the heating element can raise the tip temperature.

An iron rated at 25 watts may take over a minute to bring the tip temperature up to 660°F (about 349 degrees centigrade) from room temperature and the one rated at 130 watts will get there in a couple of seconds. Moreover, when the hot tip transfers heat to the cooler PCB pad and component leads, it can become colder. Hence the heating element is used to maintain tip temperature. Lower wattage soldering irons cannot replenish the heat lost and may lead to defective soldering. So, it is advisable to select stations equipped with minimum 60 watts heating power.

In contrast to the popular belief,



QUICK ET9484E soldering robot



REECO Soldering Robot (Credit: www.renex.pl/en)



Ersa VERSAFLOW ONE

the high-wattage iron will not destroy delicate components. A temperature-controlled soldering iron is designed to switch off the heater when the tip reaches a preset temperature. A powerful heating system will only ensure quick thermal recovery during soldering. The soldering station with 130 watts of heating power will not be of much use if the tip is allowed to get cold before the heating element kicks in.

So, remember to choose stations with closed-loop temperature control. A digital closed-loop temperature control system comes with a heating element, temperature sensor, and also a microprocessor control unit. It is a common feature to prevent both temperature undershoot and overshoot while soldering.

The Hakko FX-951 is a relatively more modern station with direct heat soldering technology that not only allows it to react faster to thermal changes but also maintain tip temperature. The tip in such stations is a composite design available as a unified package with heating element and thermocouple to avoid thermal drift.

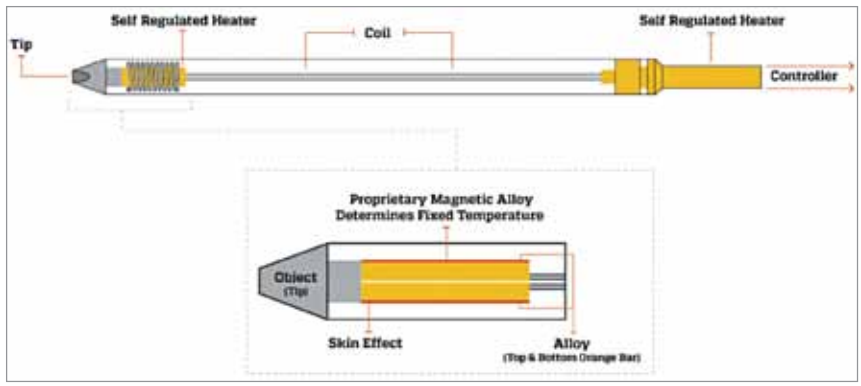
In the automated lines, QUICK ET9484E Soldering Robot is a new launch that features a robust hot iron system with a superior closed-loop temperature sensing feedback. Two fine-toothed gears work to pull solder from the solder spool. It then perforates the solder wire, allowing better out gassing of flux core, resulting in less solder ball and flux splatter defects.

Ersa's VERSAFLOW ONE is another model with improved heating in the cross profile, which significantly reduces machine's power requirements.

Heat technology. Induction soldering is a process where two or more metals are joined together by melting and flowing a filler metal (solder) into the joint interface. It does not involve melting of the joints. This often gives a bit weaker joint compared to a brazed one but is a desirable result for many sensitive electronics or small components. Curie Heat Technology is where the iron tips respond to the thermal demands of each solder joint by adjusting the power instantaneously, thereby meeting the exact requirements of the substrate component and solder material.

One of the most critical aspects in soldering is choosing the right solder tip, which helps to achieve uniform heating of component leads and pads on the PCB. Some soldering solutions, such as Metcal's SmartHeat Technology, can be used with the necessary tips and cartridges to ensure proper soldering. The cartridge in here is made of a heater of proprietary design and has a non-heating copper core and an outer heating layer of magnetic alloy. The composition of the alloy predetermines the tip temperature, and it can self-regulate maintaining constant temperature (±1.1°C).

More axes. Traditional robotic sol-



Metcal SmartHeat Technology



TMT R9900S Inline Robot Soldering System (Credit: www.thermaltronics.com)

dering machines that feature linear motion in 3-axis and 4-axis type soldering robots are currently available in the market. In 3-axis, the soldering tip moves in 3 directions—X, Y and Z, with Z as the movement of the base plate. Similarly, in 4-axis type the tip moves in 3 directions—X,Y and Z, and in an angular momentum of the soldering tip. Here, the soldering tip can change its angle to match any angular surface on a PCB.

The 6-axis soldering works a bit differently from the 3-axis and 4-axis types. Conventionally, a solder wire is fed to the soldering tip to perform a solder joint on a PCB. However, as per the IPC soldering standards, the solder wire must be fed to the joint and not to the soldering tip. This type came up as a solution to comply with IPC standards where the robot has two independent mechanisms—one to feed the soldering wire to the joint directly and the other to solder on to the PCB.

The latest upgrade is the 8-axis soldering that works slightly differently from the other types, giving 360 degrees of freedom. This increases the capabilities of the robot to perform operations in fewer setups. Considering that each setup requires additional power, material, and time, fewer setups translate into cost-savings. Thermaltronics Inc's TMT RS0099S is a model with 8-axis capability and 360° independent fixture rotation.

Laser soldering. Laser soldering is a non-contact process that eliminates the risk of marring or damaging sensitive components. This technique gives flexibility and is found to be suitable for mass production. As the system has a completely closed structure, it is free of pollution and ensures safety. It also provides process enhancements and zero consumable expenses.

The recent launches have various techniques that use different laser beam shapes like ring type or square type. It gives flexibility for manufacturers to choose the shape considering their board pattern and components to avoid burning sensitive parts. A few machines have also come up with beam-splitting technology providing twin-spot lasers to simultaneously solder two joints. Japan Unix Laser Soldering Equipment is among the recent launches featuring various patented laser beam shapes suitable for micro-soldering applications.



Japan Unix Soldering Equipment

Micro-soldering. Some components used in a PCB board are smaller than the size of a grain and micro-soldering uses smaller tools to solder them. One can connect even small wires that are nine microns in size. Laser soldering systems are found to be effective for micro-soldering.

"A laser's parameter is much smaller than even the finest soldering tip. It can reach spaces that are too narrow or inaccessible for an iron tip. As electronic parts become smaller and more intricate, this is becoming more relevant," says Shailendra Mathur, business head at Maxim SMT Technologies.

Advanced software. CAD/CAM software has become increasingly democratised, more affordable, and accessible. The recent software systems allow robots to be set up with minimal programming in a few steps. These software can be easily integrated with real-time analysis, model based definition (MBD) software, and 3D viewing systems, thereby enabling quality improvements with reduced chances of user errors.

Apollo Seiko's L-CAT NEO-N is one of the soldering robots that allows reduction in cycle time and makes programming and setup much simpler. Robot teaching can be performed by the touch panel teaching pendant, a computer, or a tablet.

Dual port operating



Apollo Seiko L-CAT NEO-N (Credit: www.apolloseiko.com)



HAKKO FM-203 (Credit: https://hakkousa.com)

solder station. Since PCBs have different components, there is a need to use soldering tips of different shapes, sizes, and temperatures depending on the application. Even using a cartridge type tip may not be easy as it needs to be replaced to continue the soldering process. With recent advancements in technology, soldering stations give the convenience of getting two different tasks done with one station.

The dual port soldering station HAKKO FM-203 comes with another handpiece connected to the other port/channel which has temperature settings and tip shape installed.

IoT solder station. The Internet of things (IoT) soldering station represents the latest evolution of the soldering station connected to the company network that enables full traceability for manual soldering. As soon as the soldering station is integrated into a company network, all mobile devices in the company network can access and communicate with the soldering stations via web browser. The server based communication concept makes it easier to manage individual soldering stations and makes the process documentable.

For instance, the i-CON TRACE is claimed to be the world's first fully networkable soldering station with integrated wireless local area network (WLAN), Bluetooth, and network card.

The way forward: automation

Soldering becomes more precise and error-free when automated, and is ideal for soldering complex components onto PCBs for a variety of applications in the fields, including automotive, aviation, and telecommunications. The equipment comes as hi-tech integrated packages, while robots come with various features with sturdy construction design to give optimum performance. Both have similar features like high-resolution cameras to support soldering with real-time view, vision alignment, great temperature control, superior thermal feedback system, nitrogen systems, and many more for most challenging solders. Therefore, industry experts believe both robots and soldering equipment are ideal for the soldering process.

"Choosing a soldering equipment or robot is an application-driven query. There are different needs for PCBs coming to the manufacturers. For instance, if a board has more thermal demands, we look for machines with more pre-heating technologies, and if something has more small components, we look for the availability of micronozzle features. It is also important to consider the size of the mother boards, and selective soldering is a great solution to solder larger boards. However, manual soldering may not be advisable for miniatures used in IoT devices or auto-ancillary equipment," says Arvind Gopal Joshi, director at Accurex Solutions, a sales and support provider of capital equipment used for pcba.



i-CON TRACE (Credit: www.kurtzersa.com)

Joshi suggests looking at specific standards while planning automation. "The automated equipment launched in recent times are designed to meet standards like the IPC 2591 connected factory exchange (CFX)," he says.

According to the IPC global trade association, the IPC 2591 is the open industry standard that supports IPC-CFX. The standard applies to communication between all executable processes in the manufacture of printed board assemblies—automated, semiautomated, and manual—and is applicable to related mechanical assembly and transactional processes.

Despite the high initial expense in setting up both equipment or robots, over time automated soldering proves cost-effective compared to soldering by hand. By using automated machines, both the cost of labour and costs associated with the training and re-training of soldering experts is reduced. Additionally, the increased precision afforded by these machines can ensure better quality work that eliminates the need for rework. Investing in good quality parts and accessories further reduces costs over time.

The automated systems will be more prevalent in the future while they would still be working along with humans, assisting the experts to do their job more efficiently and effectively. EFY

The author, Abbinaya Kuzhanthaivel, is a technology enthusiast

STARTUPS & INNOVATORS

1 DaveAI: The Self-Learning Digital Avatar
2 Convert Your Bicycle to e-Bike with Easykit
3 VFLYX Drone at Your Service

1 DaveAI: THE SELF-LEARNING DIGITAL AVATAR

Imagine a digital bot in a showroom or bank who understands your preferences and helps you make the right pick. DaveAI, a Bengaluru based startup takes customer experience to an all-new level with such interactive bots. The firm, powered by the Intel Startup Program, works in retail, automobile, and banking, financial services, and insurance (BFSI)



Meet Katelyn, a state-of-art AI avatar with vision, speech, and a sales brain

In a store, you have salespeople who introduce the products or services the firm has to offer and influence you. This is missing in a virtual sales experience. In product segments like auto, banking, or lifestyle retail, such product introduction has moved online first but enterprises still rely on traditional e-commerce, which is not designed for complex product segments.

DaveAI is a digital human avatar that can assist customers with everything that is done in an offline store. It can demo products, showcase products in 3D, help visualise various configurations, and also nudge customers with relevant recommendations. The avatar can talk to customers in different languages and can be deployed on any preferred channel such as kiosks, websites, or immersive environments like the metaverse.

With Intel's backing, DaveAI is delivering this experience at the edge. In retail, these are in-store kiosks, and in banks these are AI Micro branches. AI Micro branch offering replaces a physical branch and enables users to interact with an AI avatar in a language of their choice to conduct banking transactions.

"DaveAI avatars are powered by vision, speech, visualisation, and an AI sales brain. It's a complete package and not just a good looking digital persona," says Sriram PH, one of the co-founders of DaveAI.

The avatars can learn on the go based on customer interactions, unlike traditional business intelligence or analytics systems. In some cases, the avatar is set up with very minimal data for the system to learn and improve as more and more customers interact. DaveAI uses a multi-dimensional affinity engine that creates an affinity graph in real time to map customer preferences vs product attributes. The online learning algorithm adapts these affinity scores based on real-time interactions.

With all intelligence combining physical and digital spaces, Sriram says that delivering high perfor-

mance and impactful experiences on low graphic processing unit (GPU) is a big challenge, which they are solving with the help of a proprietary technology. "The avatar for every interaction leverages compute and graphic-heavy AI workloads, such as computer vision, speech and NLP, 3D visualisation, and a flexible data model. To create a low latency and realistic experience at each touch point is a technology challenge that we solve. It is a constantly evolving space that requires to stay ahead in the innovation curve as the ecosystem evolves," he adds.



Ashok (left), Co-founder & Domain Lead; Sriram PH (centre), Co-founder & CEO; and Dr Ananth (right), Co-founder & CTO

All of these workloads are running at edge right now and allow the system to learn in real time, which means it needs to be a high-power compute. How to optimise these complex workloads at the edge is an ongoing challenge. With the open alliance partnership with Intel, the firm is working on joint research projects to improve these experiences.

Currently, DaveAI is a full-stack platform, which is available as a subscription model for customers.

The platform is also available on a perpetual license model in case the enterprise mandates deployment on their cloud or premises. Their partner model allows partners to leverage the platform subscription and further deploy the same to customers with required customisation and configuration. The firm plans to expand and is open for partnerships with system integrators and services partners and those with experience in global markets as implementation partners and value added resellers.

2 CONVERT YOUR BICYCLE TO E-BIKE WITH EASYKIT

Domestic startups are taking advantage of the emerging interest in electric vehicles. Strictly Electric is a Mumbai based startup founded in May 2019, which is working on micro-mobility solutions by developing conversion kits

Many e-bikes available in the market are standardised specifically in two or three formats with the battery box attached to the frame. With the powertrain construction taking up most of the manufacturing cost, the attractive frames and other manufacturing components shoot up the final price.

"As most of the users in India already have a bicycle at home, we decided to just upgrade them to electric with Easykit. It can convert any bicycle to an e-bike in around 20 minutes," says Durgesh Garud, co-founder of Strictly Electric.



Easykit is a universal DIY front-



Founders—Mihir Pawar (left), CTO, and Durgesh Garud (right), CEO

wheel conversion kit with a 250W front-wheel motor, a 209Wh Li-ion battery, a compact charger, easy-to-attach pedal-assist sensor, controller box, throttle, wiring harness, and e-brakes. In contrast to the conventional e-cycles, the battery box is not attached to the frame but sits atop the handle, making it suitable for any model cycle. Any cycle can be turned electric in a few steps like swapping the front tyre with the one provided in the kit, attaching the top assembly consisting of battery and controller, attaching the pedal-assist sensor on the crankset, and by fixing e-brakes and throttle. The user can do all this with the help of an instruction manual.

"Since it is a universal kit, one can just use the same kit on different bicycles. It offers a range of around 25km and can charge up to 70% in an hour. The battery box is compact and detachable, enabling the user to charge the battery anytime and anywhere. Therefore, it eliminates range anxiety with the compact charger," Garud explains.

Speaking about the challenges, Garud says that designing the front-wheel conversion was among the major constraints. "It was not easy to get the motor fixed in the front wheel, especially in India. Since we did not want to source it from other countries, thinking about the cost, we developed it with a manufacturing partner in Pune," he says.

Garud elaborates, "The placement of the battery is fixed in a comfortable position to give the rider a great handling experience. Designing and developing this was another task, which took a lot of research and development. Finally, the battery has to be charged up to 70% in an hour, which was also customised, developed, and is being sourced from a partner in India itself."

While Garud appreciates the government's Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) scheme, he also points out the terms that limit the scheme to those vehicles offering a minimum range of 80km and a minimum speed of 40kmph. He suggests that including low-speed micro-mobility vehicles in this scheme will be a great boost to the market and mass adoption of electric vehicles.

As a startup founder, Garud says patience and perseverance are his best lessons in the journey. He advises the others, "Focus on sustainable growth. Don't compromise on building a great foundation for your startup just for short-term financial gratification. It is really important to get the foundation correct and make sure the product or service you offer adds value to your consumers."

Currently, the firm is operating on direct to consumer (D2C) model, allowing customisation with customer requirements for initial orders. The firm is planning to conduct the next round of funding and is also open to welcome like-minded partnerships. "We have plans to get launched on various e-commerce platforms and in a few retail stores. We also have bigger goals to step into the UAE market soon," he says.

3 VFLYX DRONE AT YOUR SERVICE

With India focusing entry in drone manufacturing with its own drone portals, regulations, and licenses, VFLYX—a Bangalore based startup—is already into manufacturing customised UAVs/drones using in-house hardware and on-board flight software

The parent firm, Xboom, started in 2015 with focus on addressing safety and security products. It eventually started exploring the next level into surveillance using drones. Introducing VFLYX in 2021, the firm has now ventured exclusively into drone sales and operations to cater

to applications such as land surveys, analysis, and inspections. Xboom recently announced three million dollar funding for VFLYX to improvise the manufacturing and testing facility in India.

One of their latest launches is an agri drone that can fly up to eighteen minutes with larger spray coverage area compared to what is available in the current Indian market.



VFLYX drones are capable of giving a well-balanced performance matrix with flight time of up to fifty minutes, maintaining high speed with utmost stability. "This was achieved by improving the design factor, reducing the overall weight of the drone by 20% to 1.55kg and using the battery of high charge capacity of 13,000mAh," says Vishal Saurav, CEO & Co-founder of VFLYX.

With one of his clients enquiring drones operating indoors for inventory management, his team took up the challenge. "Our drones weren't fit for inside operation with respect to GPS signal requirements for navigation. We overcame this challenge by implementing an inertial measurement unit to get the position and direction of the drone, eventually turning it into a successful project," Saurav adds.

However, Saurav feels India has too many strict regulations for registering and licensing drones. He says, "The number of steps in formalities are high and even the permission to fly is very limited. Though it is being revised largely now, it was one of the major challenges. With expansions and more firms coming into play, I believe India would relax several restrictions and promote easy operations."

Currently operating on a dual model, the firm sells drones and also renders drones as a service (DAAS).

Saurav says this learning came after they realised that many companies were hesitant to indulge in hefty one-time investment on drones. "We turned to providing drones as a service on a rental basis, be it monthly or a plug-n-play model for those who are not looking at upfront high investments. We still cater to those who are open to investing in drones. We found the new model taking off with a speed and increasing our revenues, giving us a deeper penetration into the market," he elaborates.



Vishal Saurav, CEO & Founder, VFLYX India

Sauvrav expects wireless charging drones and drone pods to be the next big thing for drone technology. "It's very important to upgrade your skills and keep pace with the trends and expectations of customers, if you want to be in the game. We are working towards creating economic payload drones for logistics to foster medical and e-commerce growth in near future," he adds.

With the funds from Xboom, the firm has plans to import the essential components to ensure a smoother supply chain. VFLYX, the bootstrapped company, is now planning to expand their talent pool, with focus towards hiring well-trained drone pilots on a large scale. It is also looking for channel partners in around fifteen states in India. EFY

—Abbinaya Kuzhanthaivel

Government waiting for global semiconductor companies to submit their proposals

Five companies have proposed to invest more than ₹1,530 billion to set up display and semiconductor fabs in India. One of these is Vedanta Foxconn Joint Venture, ISMC and IGSS Ventures, who have proposed $13.6 billion investment. Syrma Technology, SPEL, Valenkani, and HCL are the other four who have shown interest in semiconductor packaging. Ruttonsha International Rectifier has registered for compound semiconductors. Curie Microelectronics, Terminus Circuits, and Trispace Technologies have registered for the design linked semiconductor scheme.

The window for submitting the applications for the ₹760 billion incentive package is now being extended by the Centre to enable some top global semiconductor majors to also submit their proposals. The government expects to receive bids from the likes of Intel, Samsung, TSMC, Micron, and Infineon for setting up semiconductor chip fabrication plants in the second round of the programme.

Government announces strategy on 3D printing for 5% global market share

Additive manufacturing, or 3D printing, is the next industry that the government is eyeing to capitalise on. Union Minister Ashwini Vaishnaw has shared that they are looking to capture 5% of the global market share. Under the National Strategy on Additive Manufacturing, the government plans to create 50 India-specific technologies for material, machine, process, and software to make India a 3D-printed design and manufacturing hub. The strategy aims to create 100 new start-ups, 500 additive manufacturing products, and 50 Indian additive manufacturing technologies on material, machine, process, and software.

PEOPLE (on the move)

MeitY gives additional responsibility to K. Rajaraman



The Ministry of Electronics & Information technology (MeitY) has given additional responsibility to Telecom Secretary K. Rajaraman, following the retirement of Ajay Prakash Sawhney. Rajaraman earlier worked as Additional Secretary in the Department of Economic Affairs.

Applied Materials ropes in ex-Xilinx executive as CFO

US based Applied Materials has announced the appointment of Brice Hill as the company's Senior Vice President and Chief Financial Officer. Hill was Executive Vice President and CFO of Xilinx through its acquisition by Advanced Micro Devices, Inc. He previously served at Intel Corporation as Chief Financial Officer and Chief Operating Officer of the Technology, Systems and Core Engineering Group responsible for Intel's manufacturing, R&D, and product engineering.



Sun Mobility hires Anant Badjatya as CEO



EV infrastruture provider Sun Mobility has appointed Anant Badjatya as the CEO for its India business. Anant is an engineer from NIT Durgapur and an alumnus of INSTEAD, France. In his last role, Anant served as Group Chief Executive Officer with Stallion Group.

Vikram Solar appoints Rajendra Kumar Parakh as COO of EPC Division

Solar module manufacturer Vikram Solar has appointed Rajendra Kumar Parakh as the Chief Operating Officer for its Engineering, Procurement and Construction (EPC) Division. Parakh has been associated with Vikram solar since 2017 as Chief Financial Officer (CFO).



CORPORATE news

Reliance entering electronics manufacturing sector through JV and acquisition

Mukesh Ambani-led Reliance Industries is looking to further expand its empire to include electronics manufacturing as it mulls an investment of up to $221 million in forming a JV with electronics firm Sanmina. Manufacturing will initially take place at Sanmina's 100-acre campus in Chennai, with the ability for site expansion to support future growth opportunities as well as to potentially expand to new manufacturing sites in India over time based on business needs.

The conglomerate is also to acquire the assets of cobalt-free lithium battery technology and manufacturing company Lithium Werks for $61 million. The acquisition will include Lithium Werks' entire patent portfolio, manufacturing facility in China, key business contracts, and hiring of existing employees as a going concern.

Samsung to manufacture refrigerator components in Tamil Nadu

Samsung is planning to invest around ₹15.88 billion in making refrigerator compressor units in Tamil Nadu. An MoU to set up the manufacturing plant was recently inked between Samsung and Tamil Nadu government. Though Samsung has two plants that manufacture a wide range of electronics, this move is to set up a dedicated unit for manufacturing components for refrigerators. The state government also touched base with Samsung asking it to make use of the PLI scheme rolled out by the Centre to manufacture chips in the country.

Exide joins hands with China's SVOLT for Li-ion battery manufacture in India

Striking a multi-year deal, Exide Industries has partnered with China's SVOLT Energy Technology Co. Ltd for lithium-ion (Li-ion) battery manufacturing in India. As part of the agreement, Exide will receive an irrevocable right and license to use, exploit, and commercialise necessary technology and know-how owned by SVOLT for lithium-ion cell manufacturing in India. SVOLT will also provide the support required for setting up of a green field manufacturing plant on a turnkey basis.

Ather Energy partners with Bharat FIH to manufacture parts for its E2Ws

Ather Energy has joined hands with Taiwanese Foxconn's Indian subsidiary Bharat FIH to develop and manufacture key components for Ather's scooters. Bharat FIH will offer a host of manufacturing services that include printed circuit board (PCB) assemblies for battery management systems, dashboard assembly, peripheral controlling units, and drive control modules. These products will be manufactured on a turnkey model, including managing the supply-chain logistics and raw material procurement for Ather Energy.

Oppo, Xiaomi, Vivo eyeing to locally manufacture phones for exports

Chinese smartphone giants Xiaomi, Oppo, and Vivo are reportedly in the process of holding talks with Indian manufacturers to locally make smartphones for exports. The firms are looking to rope in manufacturers like Lava International and Dixon Technologies to assemble the phones and begin exporting from their plants as early as this year. Oppo and Vivo have begun discussions with Lava while Xiaomi is courting Dixon. Both groups are eyeing to utilise the IT hardware PLI scheme put in place by the Indian government last year.

VVDN and Blue Star to collaborate on AC components, Wi-Fi 6e, and Wi-Fi 7

VVDN Technologies and Blue Star have formed a strategic alliance to co-develop and manufacture new-generation controllers for residential and commercial AC segments. VVDN specialises in PCB layout and design of power controllers. VVDN has also begun working on the next generation technologies in the networking and Wi-Fi space. VVDN does end-to-end product development and continues to build these products based on the next-generation technologies like Wi-Fi 5, Wi-Fi 6/6e, and wireless mesh. It has also started doing design work related to Wi-Fi 7 for its customers.

SNIPPETS

- IdeaForge onboards ICT distributor Savex Technology as its new distributor to strengthen its presence in the Indian market
- Yulu looking to raise $100 million to expand fleet to 100,000 units by 2022 end
- Hero Electric partners with Sun Mobility to integrate its smart-swappable battery technology into Hero's two-wheelers
- Lam Research India signs MoU with CeNSE and IISc, Bengaluru to offer a sponsored fellowship programme for second-year M.Tech students
- Zypp Electric to train 3000 women as delivery partners by 2022 end
- Pinnacle Mobility forms JV with VDL Group to invest ₹20 billion to enter EV market
- Drone Federation of India signs MoU with Fukushima Robot Test Field (RTF) to accelerate drone technology, business, and areas of common interest
- Astra Microwave Products joins hands with Steradian Semiconductors to produce radar modules for traffic management systems

RattanIndia Enterprises to launch consumer micro drones across India

RattanIndia Enterprises has announced its plans to develop and launch consumer micro drones across India through its subsidiary NeoSky India Ltd. NeoSky is aiming to be the first Indian company to achieve this milestone. These drones will be widely used at weddings, for sports coverage, broadcasting, amateur travel vlogs, surveillance, and warehouse management.

Vedanta surveying Pune to set up chip manufacturing plant

Vedanta Group has sent a team to Pune to survey the feasibility of setting up its electronic chip plant in the district. Vedanta has plans to initially make 28-nanometre electronic chips that can be widely used in mobiles, power, and automotive products.

STL partners with Analog Devices to develop 5G O-RAN radio units

Mumbai based digital networks integrator Sterlite Technologies (STL) is collaborating with chip maker Analog Devices to develop 5G Open RAN radio units (O-RU). As a part of this collaboration, STL and Analog Devices will work closely with other ecosystem providers, including leading power amplifier vendors, to expand the range of STL's Garuda O-RU indoor small cell offerings. STL will integrate Analog Devices' transceivers into Garuda to create power-efficient, high-performance radios.

Hero MotoCorp to enter EV space through Vida brand

Domestic two-wheeler giant Hero MotoCorp has announced a new brand, Vida, through which it will enter the electric vehicle market in July. All the company's upcoming EV initiatives and launches will be made through the Vida brand. Customer deliveries of the first product will start later this year. The company will manufacture the electric vehicles at a factory in Chittoor, Andhra Pradesh.

UK's Volex buys majority stake in EDMS company InYantra

UK based integrated manufacturing-services and power products company Volex plc has acquired a majority stake in Indian EDMS firm inYantra Technologies Pvt Ltd for $13 million (around one billion rupees).It will strengthen focus on two high-growth Indian sectors of medical electronics and electric vehicles for inYantra Technologies. As part of the transaction, the two partners will undertake joint development of complex cable assembly capability through low-cost production for both domestic and export markets, as Volex expands the capabilities at the Pune site by building a new medical and complex industrial technology cable assembly facility.

Tata Elxsi and Renesas collaborate to build EV design centre in Bengaluru

Tata Group's design and technology services subsidiary Tata Elxsi has signed a pact with Japanese semiconductor company Renesas Electronics Corporation to build a design centre in Bengaluru that will develop targeted solutions for electric vehicles. Tata Elxsi and Renesas will bring together their deep domain expertise, intellectual property, and assets to the Centre and collaborate to create reference designs and solution accelerators for critical EV subsystems like battery management systems and motor control units, among others.

Suzuki and Toyota looking to make EVs in Suzuki's Gujarat plant

Automaker Maruti Suzuki and Toyota are likely to use the former's Gujarat plant to manufacture electric cars (EVs) for both the entities, as per information revealed by Maruti MD & CEO Kenichi Ayukawa. Ayukawa said that discussions on this matter are still on by Suzuki Japan and anything is yet to be finalised. Toyota and Suzuki are already in a business alliance as well as a product-development and model-sharing relationship.

Elin Electronics receives SEBI approval for IPO

Delhi based electronics manufacturer Elin Electronics Limited (EEL) has received SEBI's approval for its ₹7.6 billion initial public offering (IPO). Elin's IPO offers equity shares with a face value of ₹5 each, comprising a fresh issue of up to ₹1.75 billion and an offer for sale of up to ₹5.85 billion. Elin filed preliminary papers with SEBI last year in November.

Omega Seiki partners with Israel based startup to develop e-motors in India

Omega Seiki Mobility (OSM) has announced a strategic alliance with Israel based startup EVR Motors to produce compact e-motors in India. The e-motors will be based on a new TSRF technology and will be used for OSM's existing and future vehicle models. It will be produced at OSM's Faridabad facility and its group company Omega Bright Steel and Components' facility.

Crompton Greaves acquires majority stake in Butterfly Gandhimathi Appliances

Crompton Greaves Consumer Electricals is acquiring up to 55% stake of domestic appliances maker Butterfly Gandhimathi Appliances. The deal is valued at ₹1,403 per equity share, aggregating up to about ₹13.8 billion. It will also acquire certain Butterfly trademarks in allied and cognate classes from promoter group entities for a consideration of ₹303.8 million.

Jupiter International raises money from Edelweiss

Solar PV cell manufacturer Jupiter International has raised ₹1.7 billion from Edelweiss Alternative Asset Advisors (EAAA). The Kolkata based maker will utilise the funds as growth capital to enhance its manufacturing capacity as it plans to set up a new greenfield capacity of 2000-megawatt integrated cell plus module line. The fresh capital was raised through a combination of debt and convertible-to-equity instruments.

Drone PLI: Centre invites applications

The Ministry of Civil Aviation has invited applications from the drone industry for the production linked incentive (PLI) scheme for drone manufacturing. More than one company within a group of companies can file separate applications under this PLI scheme and the same shall be evaluated independently. The PLI scheme provides a total incentive of ₹1.2 billion spread over three financial years, which is nearly double the combined turnover of all domestic drone manufacturers in FY 2020-21. The PLI rate is 20% of the value addition, one of the highest among PLI schemes.

White goods PLI: Centre reopens application window

The application window for production linked incentive scheme (PLI) for white goods, including air-conditioners and LED lights, has been reopened by the Centre. The application window for the scheme shall remain open from 10th March to 25th April, 2022 on the same online portal. The incentive shall be available only for the remaining tenure of the scheme. The move is aimed to give a second chance to prospective investors to take benefit of the scheme.

DGFT revises import restrictions on components for TVs, smartphones

The Directorate General of Foreign Trade (DGFT) has revised the status for the import of specific components, including flat panel displays and camera modules, to 'Free' from 'Restricted' with immediate effect. This move is expected to bring relief to smartphone makers who had feared large scale disruption to local manufacturing.

Battery swapping policy to be announced in 3-4 months

India's battery swapping policy is likely to be rolled out by Niti Aayog in the next three to four months. The policy will introduce disruptive business models, such as battery as a service (BaaS), and leasing, etc. Niti Aayog chief Kant said the focus in the initial phase will be to cater to light electric vehicles, where it is easy to plug and play batteries from the vehicles to the battery swapping stations.

EDSM companies submit LoI for operation in Karnataka

Eighteen electronics, system, design, and manufacturing (ESDM) companies have submitted their letter of intent (LoI) to set up operations in Karnataka. Some of the companies who have shown their interest include Proxelera Pvt Ltd, Wuerth Electronic India Pvt Ltd, Virtulive Technologies Pvt Ltd, Gopalan Aerospace Pvt Ltd, Teccheren Batteries, Kaynes Technology, Rapture Innovation Labs, Physics Motors, Astr Defence, nanoPix Integrated Solutions Pvt Ltd, and SLN Technologies.

INTERNATIONAL news

Chipmakers to form coalition to establish universal chipset standard

Companies like Intel, Qualcomm, AMD, Arm, Samsung, Taiwan Semiconductor Manufacturing Company (TSMC), along with software companies like Meta, Microsoft, and Google Cloud have begun operations to form a coalition to establish a universal chiplet interconnect express (UCIe) standard. The UCIe 1.0 specification has been ratified to provide a complete standardised die-to-die interconnect with physical layer, protocol stack, software model, and compliance testing to enable end users to easily mix and match chiplet components from a multi-vendor ecosystem for system-on-chip (SoC) construction, including customised SoCs.

Japan imposes chip export sanctions, Samsung suspends shipments to Russia

Considering the ongoing Russia-Ukraine war, Japan has announced that it will impose sanctions on Russia that revolve around semiconductor chip exports and financial institutions. Japan will also impose sanctions on exports to Russian military-related organisations, items on restricted lists based on international agreements, and exports of semiconductors and other general-purpose products to Russia. In similar fashion, Samsung has suspended product shipments to Russia citing "current geopolitical developments." The products that have been suspended include smartphones, semiconductors, and consumer electronics.

LG pulls the plug on solar panel business

LG Electronics has decided to close their solar panel business. The decision comes as uncertainties in the global solar panel business continue to increase due to a variety of contributing factors, including the intensification of price competition and the rising cost of raw materials. LG's Business Solutions (BS) Company, which operates the solar panel business, will reorganise its portfolio around the key pillars: information technology (IT) and information sisplay (ID).

UMC to invest $5 billion to build new 22nm chip fab in Singapore

Taiwanese chipmaker United Microelectronics is expanding its manufacturing base as it plans to invest US$5 billion in a new manufacturing facility in Singapore to make 22-nanometer chips. The first phase of the investment would add 30,000 wafers of 30cm (12-inch) dia per month to UMC's capacity, with production expected to start in 2024.

Arm to reduce workforce following its acquisition deal with Nvidia

Following the fallout of its acquisition deal with Nvidia, UK based chip company Arm Ltd has revealed that it is looking to cut 12 to 15% of its workforce. Most of the job losses would be in the UK and the USA.

Panasonic starts production of new Li-ion battery for Tesla

Panasonic Corp intends to begin mass production of a new lithium-ion battery for Tesla Inc. before the end of March at a plant in Japan. The company will establish a production facility at its Wakayama factory in western Japan to manufacture the new '4680' lithium-ion batteries. Two additional production lines as well as utility facilities will be established at the factory, and productivity verification and mass production are set to begin in the fiscal year ending in March 2024.

Nothing locks $70 million in Series B funding round

Carl Pei-led consumer tech brand Nothing has raised $70 million in a Series B fundraise round. The funding will be used to create new product categories in partnership with Qualcomm Technologies and its Snapdragon platform, and grow operations at its new London Design Hub, led by ex-Dyson Head of Design, Adam Bates.

Analog Devices to invest 100 million euros in Europe operations

Analog Devices will invest 100 million euros over the next three years in ADI Catalyst, a 1000 square metre custom-built facility for innovation and collaboration located at its campus in the Raheen Business Park in Limerick, Ireland. ADI Catalyst is an accelerator where ecosystems of customers, business partners, and suppliers engage with ADI to develop industry-leading solutions.

Kioxia to acquire Chubu Toshiba Engineering

Japanese computer memory maker Kioxia Holdings Corporation has entered into a definitive agreement with Toshiba Digital Solutions Corporation to acquire all the outstanding shares of its subsidiary, Chubu Toshiba Engineering (CTE) Corporation. This acquisition will help Kioxia strengthen its technology development capabilities. CTE is involved in semiconductor manufacturing technologies, specialising in semiconductor related hardware and software design, prototyping and evaluation, covering areas from development to mass production.

Altair expands electronic system design technology

Altair has acquired Powersim, a provider of simulation and design tools for power electronics. This acquisition expands Altair's electronic system design technology into the domain of power electronics. This acquisition includes PSIM, Powersim's flagship product for design and simulation of power electronics and motor drives.

Menlo Micro raises money in Series C funding

US based Menlo Micro has raised $150 million in Series C funding from Vertical Venture Partners and Tony Fadell's Future Shape. Microelectromechanical system switches maker Menlo Micro will use the funding to expand domestic manufacturing and supplychain for the Ideal switch.

Electronics goods exports grew by 88% between 2013-21

India's electronics goods exports grew by almost 88% from $6600 million in 2013-14 to $12,400 million in 2021-22, as per data released by the Ministry of Commerce and Industry. Mobile phones, IT hardware including laptops and tablets, consumer electronics such as televisions and audio, industrial electronics, and auto electronics are the key drivers of this growth. Electronics goods exports grew 49% in April-December 2021 at $11 billion over $7.4 billion during the same period last year with the US and the UAE being the top two destinations.

US to fund manufacture of solar panels in India

The US is funding $500 million to help American companies manufacture solar panels in India, the White House announced. This comes after the White House said that the Quad leaders have renewed their commitment to promote a free, open, rules based order in the Indo-Pacific region.

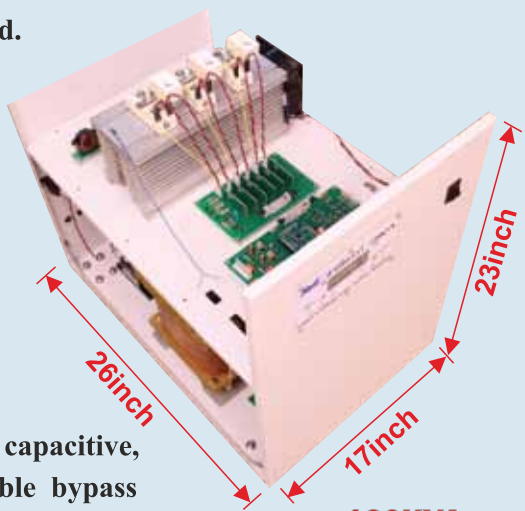
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- Imbalanced load can also be connected. • Three phase input 400V ±20%(320V to 480V) output will be 400V ±1%.
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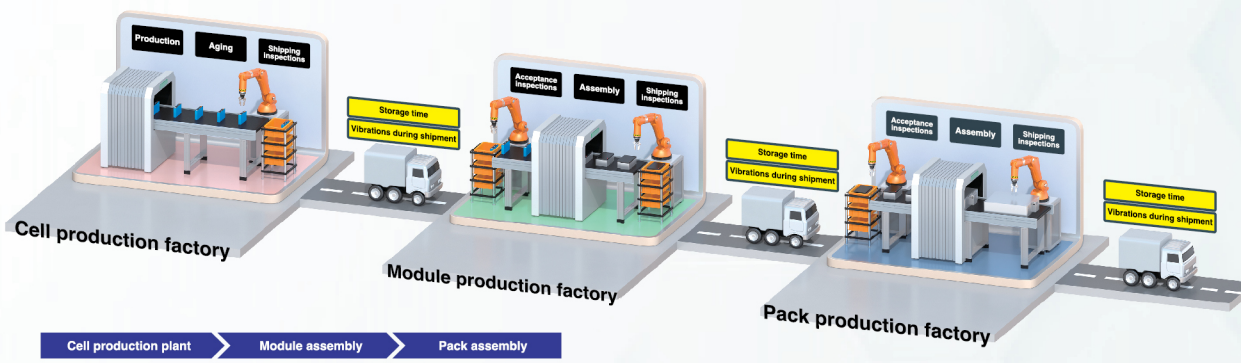
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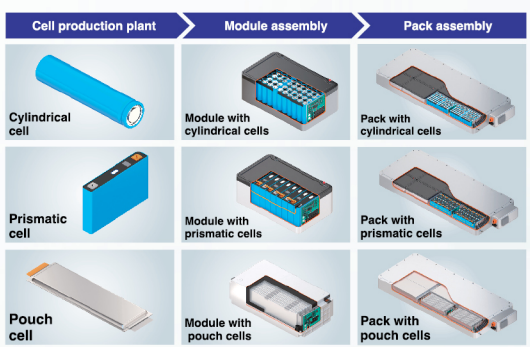


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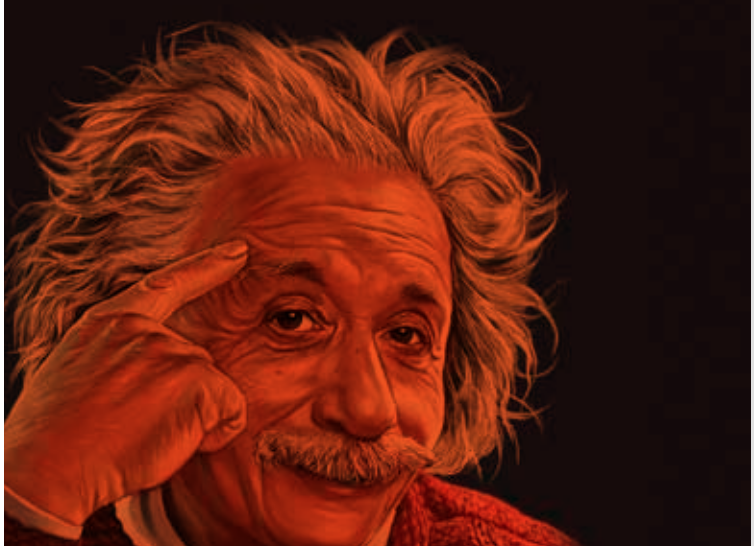
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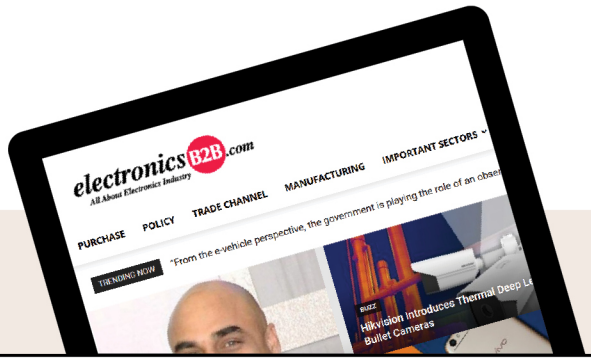


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Client name	Page No.
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ADexpo Korea Co., Ltd (www.adexpokorea.com)	110
Analog Devices International Inc (www.analog.com)	5
Binay Opto Electronics Pvt Ltd (www.binayLED.com)	Gatefold
CHIPMAX DESIGNS PVT LTD (chipmax.in)	85
Digi-Key Electronics (www.digikey.in)	4
EFY Certified Skill Center (https://efy.in/esdcfaq)	28
EFY Group of Publications: Subscription Scheme (subscribe.efy.in)	43
element14 India Pvt Ltd (in.element14.com)	Front Cover
GSAS Microsystem (https://gsasindia.com)	106
HIOKI INDIA PRIVATE LIMITED (https://www.hioki.com/global)	103
I.T. Solutions India Pvt Ltd (www.itsipl.com)	109
Innodisk Taiwan (https://www.innodisk.com)	89
IPC India (https://www.ipcindia.org.in/iemi-website)	41
Juki India Pvt Ltd (http://www.smtjukiindia.com)	83
kitsNspares.com	105
LWI Electronics Inc. (www.livewireinfo.com)	23
Martins Electronic Devices & Instruments (www.medielectronics.com)	102
MORNSUN GUANGZHOU SCIENCE & TECHNOLOGY CO., LTD (www.mornsun-power.com)	7
National Controlling & Equipments (www.nacei.com)	107
Premier Industries (www.solderwire.co.in)	104
Quantel Technologies India Private Limited (https://quantel-global.com)	37
Sakthi Accumulators Private Ltd (https://sakthipower.com)	107
Tescom (www.tescom.co.in)	79
TME SLOVAKIA (www.tme.com)	11

ADVERTISERS' PRODUCT CATEGORIES INDEX

Products	Page No.
Automation & Robotics	
CHIPMAX DESIGNS PVT LTD	85
Juki India Pvt Ltd	83
Batteries & Power Supplies	
Martins Electronic Devices & Instruments	102
MORNSUN GUANGZHOU SCIENCE & TECHNOLOGY CO., LTD	7
National Controlling & Equipments	107
Sakthi Accumulators Private Ltd	107
Components (Including Active & Passive)	
Analog Devices International Inc.	5
Digi-Key Electronics	4
element14 India Pvt Ltd	Front Cover
LWI Electronics Inc.	23
TME SLOVAKIA	11
Industrial & Manufacturing Equipment	
CHIPMAX DESIGNS PVT LTD	85
Juki India Pvt Ltd	83
IT Products	
Ability Components India Private Limited	107
Innodisk Taiwan	89
Materials (Including Chemicals & Consumables)	
Premier Industries	104
Optics & Optoelectronics	
Binay Opto Electronics Pvt Ltd.	Gatefold
PCBs, Assemblies & Sub Assemblies	
Tescom	79
Reseller and Distributors	
Digi-Key Electronics	4
element14 India Pvt Ltd	Front Cover
LWI Electronics Inc.	23
TME SLOVAKIA	11
Services	
Tescom	79
Switches & Relays	
Ability Components India Private Limited	107
Test & Measurement Equipment (Including Indicators & Monitors)	
HIOKI INDIA PRIVATE LIMITED	103
Quantel Technologies India Private Limited	37



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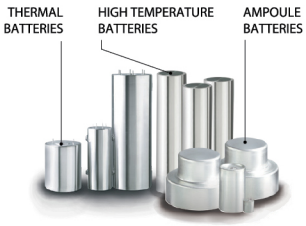
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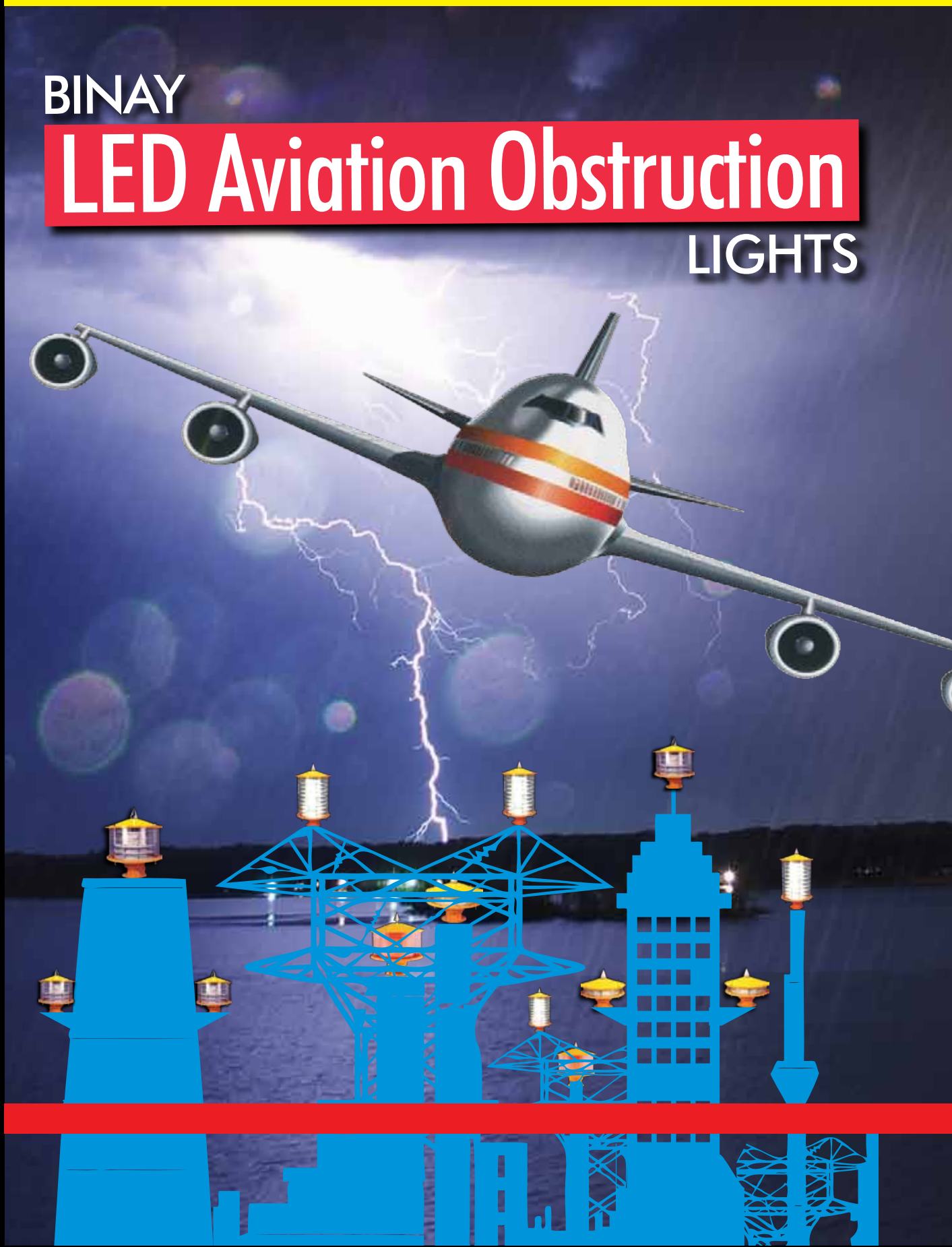
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(Flashing Red OR Fixed Red LEDs)



All BINAY Aviation Lights are based on Non-switching passive type circuitry (NO SMPS)

The circuitry incorporated inside the LED Aviation Obstruction Lights is passive electronic (solid-state) in nature, and does not use internal SMPS driver switching units to control the light unit. Internal LED current control is by non-switching electronic means only. No electrolytic capacitors are used inside the Aviation Obstruction Light unit.

The above is necessary to ensure reliability of the LED Aviation Obstruction Light. This system design effectively eliminates any active components and circuits inside the aviation light itself, and enhances the solid-state passive reliability of the LEDs (mounted in relatively inaccessible locations at the height of tall structures). This drastically reduces the possibility of component failure - and hence possibility of any maintenance requirement – in the LED Aviation Obstruction Lights themselves (which are mounted at extreme heights in the system).

The BINAY LED Aviation Obstruction Light offers the following advantages:

- Fit-and-forget maintenance-free operation
- A long life of 100,000 hours (20 years at 12 hours daily burning)
- Pays for itself within a short period of operation in the form of reduced installation, maintenance and servicing costs
- Quick Installation; Reliable operation 365 days per year
- Shock-proof and vibration-resistant
- Over-Designed Intensity to allow for natural LED intensity degradation over its operating lifetime

LED Obstruction Lighting for:

- Industrial chimneys and smokestacks
- Transmission, microwave and cellular towers
- Radio, TV and similar structural towers
- High-rise buildings and structures
- Airports and airfields

THE BINAY LED OBSTRUCTION LIGHT IS UNDER ACCEPTED PATENT, AND AS SUCH IS A PROPRIETARY PRODUCT

Binay Opto Electronics Pvt. Ltd.
(An ISO 9001:2015 Certified Company)
27, Panditia Terrace, Calcutta 700 029, India

Ph.:+91 (33) 4006 9875, 2475 0062, 2475 0030
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CONTENTS

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TECHNOLOGY

20 INTERVIEW: "Semicon Manufacturing Has The Potential To Generate A Huge Market For Jobs In Both Skilled And Unskilled Fields" — Chetna Mohan, President, El Camino Technologies Pvt Ltd

22 TRENDS: Will 20cm SiC Wafer Be The Next Standard?

DESIGN

28 STRATEGY: The Making Of A Sturdy And Secure Autonomous e-Two-Wheeler

DO-IT-YOURSELF

32 CIRCUIT IDEA: Weather Station With Device Control Using Touch-Screen Display

37 CIRCUIT IDEA: Variable Power Supply For Up To 3A Current

STRATEGY

42 MANUFACTURING: Soldering Machine Innovations Target Better Flexibility And Temperature Control

58 INTERVIEW: "Industry 4.0 Can Boost Implementation Of Semiconductor Manufacturing" — Sunil Banwari, Vice President, Advantest Corporation

64 MARKETING: How To Build A Community And Why It Matters

REGULARS

8 **From You:** Your Suggestions and Things You Wanted To Know!

9 **Research & Innovation Updates**

13 **Truly Innovative Electronics**

15 **New Products**

40 **Dashboard:** Key Industry Trends That Can Shape The Future Of Your Business

50 **Startups & Innovators**

68 **Industry News:** Industry Updates

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to Electronics For You (e-zine or print) to Access These Additional Stories…



TECHNOLOGY

20 FUTURE: The Indian Rupee Is Soon Going Digital

29 TRENDS: How To Select The Right Battery For Your e-Bike

DESIGN

36 AI ML: AI Accelerators: A Long Way To Go

46 CIRCUIT: Aligning Capacitor Selection With The Latest Automotive Demands

DO-IT-YOURSELF

53 PROJECT: Make The World's Smallest Laptop For Hacking And Everything Else

58 PROJECT: Home Automation Using Apple HomeKit And ESP8266

67 PROJECT: Weather Satellite Station For Meteor M2 Reception

STRATEGY

76 POLICY: Telecom Policy Amendment Creating Confusion: No R&D, No Value Addition Required?



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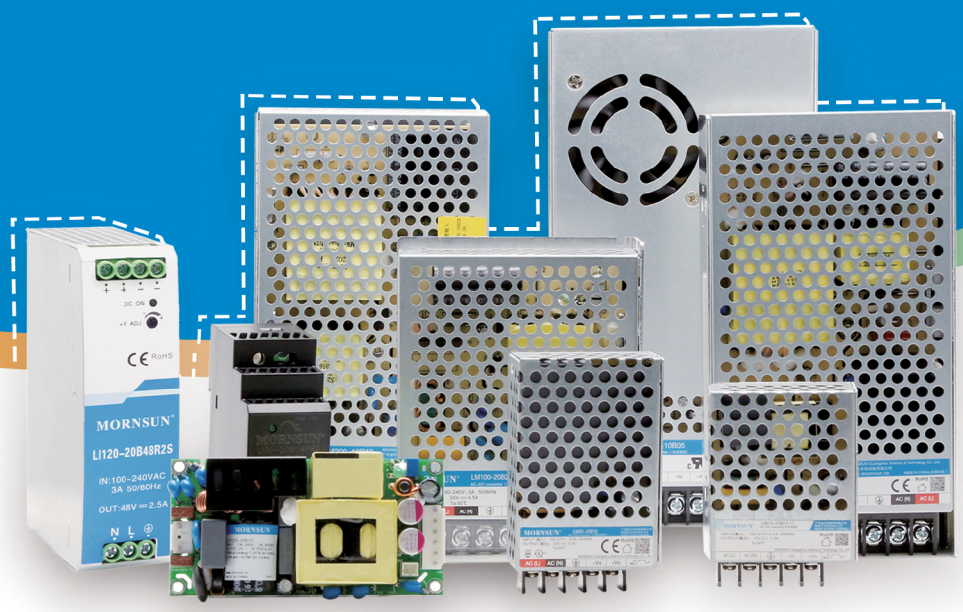
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YOUR SUGGESTIONS AND THINGS YOU WANTED TO KNOW!

NEUROMORPHIC COMPUTING

Thank you for publishing the 'Neuromorphic Computing: It's Not Sci-Fi Anymore' article in February issue. It is another revolutionary idea which might overturn our world!

Chi Tung Mak

• • •

AI CAMERA FOR TRACKING

The 'AI Camera For Tracking Suspicious Activities' DIY article published in March issue is really a very good one!

Bhuvan Vyashu

EFY. Thanks to the readers for their feedback, which keeps us going!

• • •

TOUCHLESS DOORBELL

This is regarding the 'Touchless Doorbell For The Post-Covid World' DIY article published in September 2021 issue. I am interested in building this project. It will be very helpful if you could help me by sending its PCB and component layouts in .pdf format.

Shristi

EFY. We are arranging it for you. In future, please send such requests through *support@efy.in*

HEAT-SINK

Why heat-sink details, including their dimensions, are not included in DIY articles? And how to select the heat-sinks for the ICs?

Anirvan Kule

EFY. EFY has covered several articles on heat-sinks earlier. However, some general information is being given here.

The size of a heat-sink depends not only on a particular device but also on its applications. Though heat-sink dimensions are not included in most datasheets, important parameters such as power dissipation, thermal resistance, junction temperature, and load current of a particular device or IC are mentioned in the datasheets. These parameters help decide the approximate dimensions of the heat-sinks.

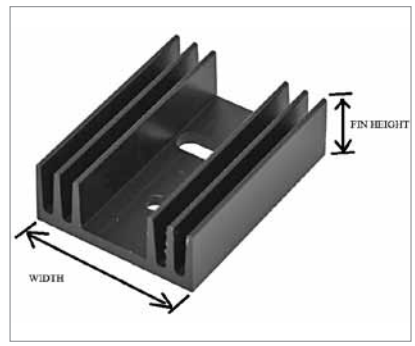


Fig. 1: A typical heat-sink for TO-220 package

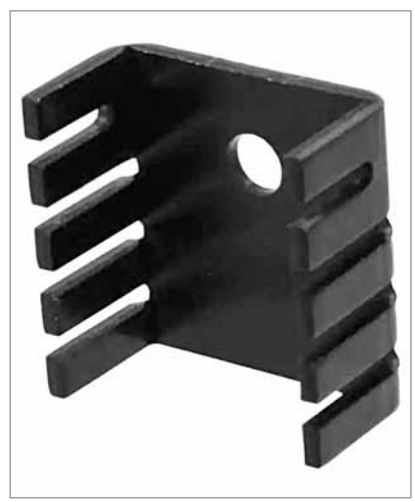


Fig. 2: A square shaped heat-sink for TO-220 package

The junction temperature in a power-handling device rises in proportion to the current consumption. The thermal resistance of the device is important because most electrical components generate heat and need to be cooled. The main goal of the heat-sink is to maintain the temperature below the specified maximum operating temperature of the device.

Selecting a heat-sink becomes simpler when you have the datasheet of the device or regulator IC. You can choose it as per the device's package, requirements, and applications. There are many readymade heat-sinks available in the market. The most common types of heat-sinks for TO-220 package regulators have natural convection cooling with or without fan.

Regulator ICs like LM317, LM78xx, LM79xx, and L200C are available in TO-220 packages. Fig.1 shows width and fin height of natural convection heat-sink for TO-220 package IC. It is an extrusion TO-220 package type heat-sink with the dimension of 35mm × 29mm × 12mm (length, width, fin height), suitable for use with a device having thermal resistance up to 15.2°C per watt.

Aluminium heat-sinks having large width rather than greater fin height are preferred. Also, if the heat-sink surface is anodised or painted, it increases heat radiation.

A commonly used heat-sink for 2.5W power dissipation at 60°C and thermal resistance up to 24°C per watt is shown in Fig. 2. It is a black anodised aluminium type heat-sink with dimensions of 19.05mm × 19.05mm × 9.65mm height. For more information on heat-sinks, you may visit following three websites:

1. *https://www.electronicspecifier.com/news/blog/how-to-specify-the-optimal-heat-sink-for-your-design*
2. *https://www.nutsvolts.com/magazine/article/how_to_intro_to_heat-sink_selection_and_installation*
3. *https://www.electronics-cooling.com/1995/06/how-to-select-a-heat-sink*

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Smartwatch that measures stress hormone

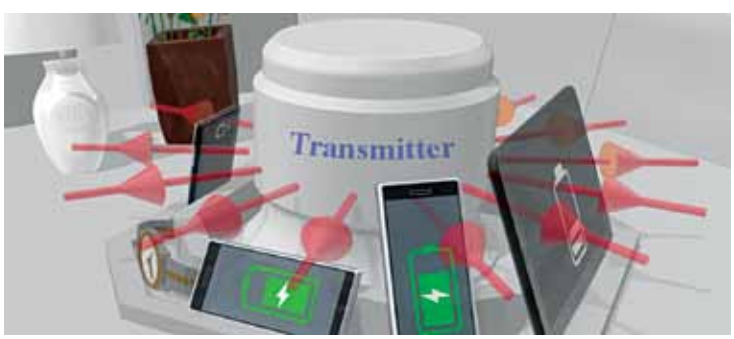
A hormone called cortisol gets produced in the human body, which is key to identifying conditions such as depression and post-traumatic stress when levels of the hormone increase. Cortisol levels traditionally have been evaluated through blood samples. While those measurements help diagnose certain diseases, they fail to capture changes in cortisol levels over time. Now, a UCLA research team has developed a smartwatch that assesses cortisol levels found in sweat—accurately, noninvasively, and in real time. In the new smartwatch, a strip of thin adhesive film collects tiny volumes of sweat. An attached sensor detects cortisol using engineered strands of DNA, called aptamers. When cortisol attaches, the aptamer changes shape in a way that alters electric fields at the surface of a transistor.



Cortisol is well-suited for measurement through wearable devices, because its concentration levels in sweat are similar to its circulating levels (Credit: https://newsroom.ucla.edu)

Wireless charging for home use

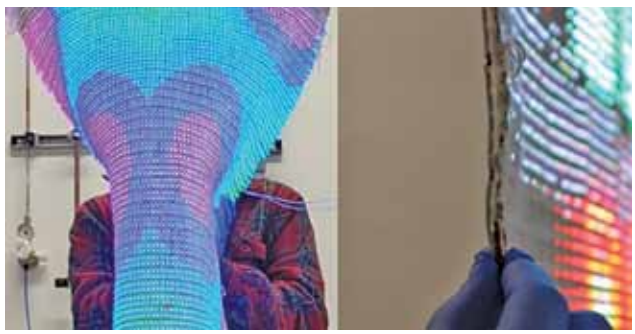
Existing wireless charging systems are known to transfer power in a specific direction or position. Now, researchers at Aalto University have developed a new wireless charging system that can charge devices placed anywhere within a certain radius around it. For this, a cylindrical power coil has been designed that has wires at the top and bottom wound in the opposite directions, with a z-shaped bridge connecting them. Current flows through these windings in opposite directions, producing complementary magnetic fields. This results in an even magnetic field around the middle of the charging coil, allowing receivers placed anywhere within that area to charge efficiently, regardless of their position or orientation. By providing a donut-shaped charging field, the new system offers a more convenient and reliable design for consumer use.



A new wireless charging technology opens the door to developing charging stations for consumer use (Credit: www.aalto.fi/en)

Fully woven display with smart sensors

An international team of scientists, led by researchers at the University of Cambridge, have produced a fully woven smart textile display that integrates active electronic sensing, energy, and photonic functions. The functions are em-



Researchers have developed a 116cm (46-inch) woven display with smart sensors, energy harvesting and storage integrated directly into the fabric (Credit: www.cam.ac.uk)

bedded directly into the fibres and yarns, which are manufactured using textile based industrial processes. Each fibre component is coated with materials that can withstand enough stretching. Some of the fibre based components are also braided to improve their reliability and durability. Finally, multiple fibre components are connected together using conductive adhesives and laser welding techniques. This approach could lead to applications such as curtains that work as TVs, energy-harvesting carpets, and interactive, self-powered clothing and fabrics.

Breakthrough for producing superior supercapacitor batteries

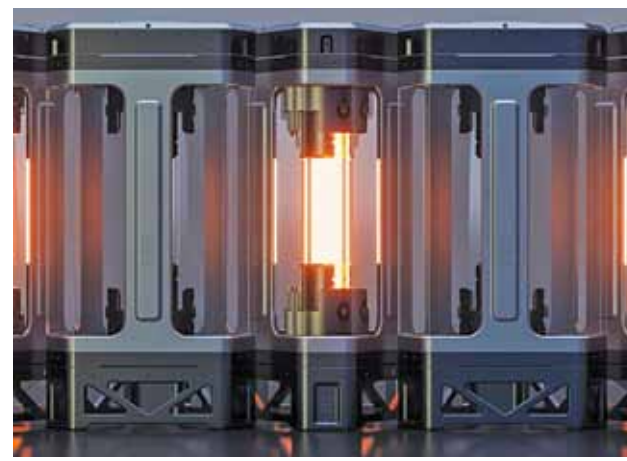
Existing supercapacitors are too large for many applications; they need to be about the same size as the battery they are connected to, which is an obstacle to integrating them in mobile phones or electric cars. Therefore, researchers at Chalmers University of Technology have developed a breakthrough method that can revolutionise how supercapacitors are produced. The proposed 'micro' supercapacitors are so small that they can fit on the system circuits that control various functions in mobile phones, computers, electric motors, and almost all electronics used today. Micro-supercapacitors of up to ten different materials can also be unified in a single manufacturing process, which means that properties can be easily tailored to suit several different end applications.



The image shows a 5cm wide silicon wafer with integrated micro supercapacitors, manufactured using the CMOS-compatible process (Credit: www.chalmers.se/en)

Possibility of having next-gen quantum batteries

In a key step towards making quantum batteries a reality, researchers at the University of Adelaide and their overseas partners have successfully proved the concept of superabsorption, a crucial idea underpinning quantum batteries.

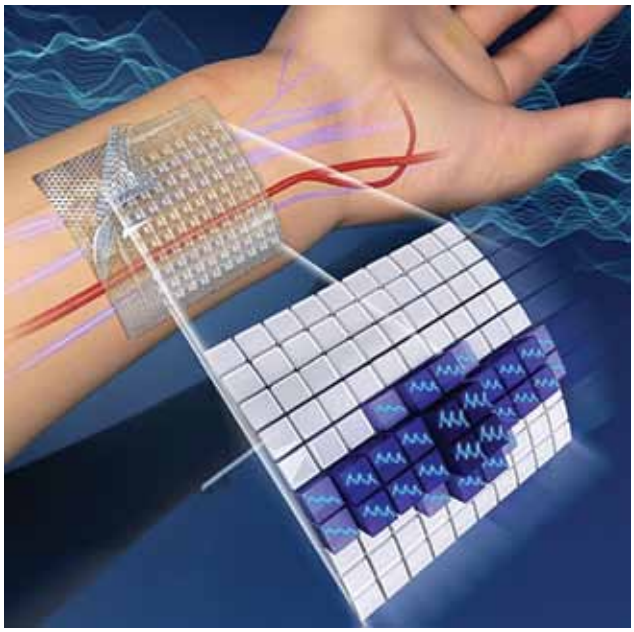


Superabsorption unlocks key to next generation quantum batteries (Credit: www.adelaide.edu.au)

For this, the team built several wafer-like microcavities of different sizes which contained different numbers of organic molecules. Each was charged using a laser. As per a researcher, it is theoretically possible that the charging power of quantum batteries increases faster than the size of the battery, which could allow new ways of speed charging. The idea of the quantum battery has the potential to significantly impact energy capture and storage in renewable energy and in miniature electronic devices.

Thin sensor patches for measuring pulse waves

Pulse wave is an important bio-signal that indicates the status of cardiovascular health. Conventional pulse wave measuring devices, such as blood-pressure measuring cuff or stiff tong-shaped sensor, measure signals only at a single location, leading to less precise measurements. So, to ease

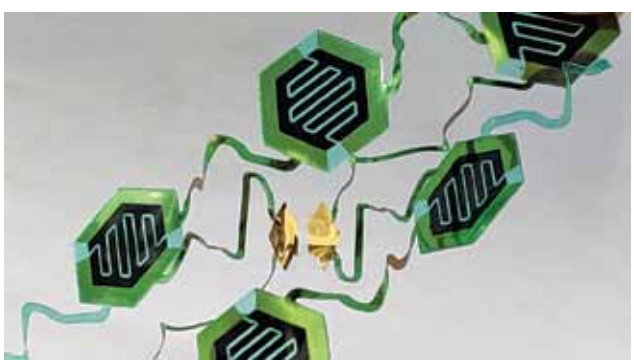


Wearable sensor patch that's thinner than a hair strand and can measure pulse wave signals with high precision (Credit: POSTECH)

the measurement and diagnosis of cardiovascular issues, a research team from the Pohang University of Science and Technology, in collaboration with the School of Energy and Chemical Engineering at Ulsan National Institute of Science and Technology, has developed a wearable sensor patch that's thinner than a hair strand. It consists of 100 sensor pixels that help in obtaining a relevant two-dimensional pressure map of the wrist.

Wearable sensor that replaces photolithography

Wearable sensors help gather medical data from patients over extended periods of time. These devices consist of flat wires as well as sensors, power sources, and antennas. To maintain full functionality, they must stretch, flex, and twist with the skin and organs they are mounted on—



A supercapacitor array made using a new fabrication technique that is faster and less expensive than photolithography (Credit: https://engineering.berkeley.edu)

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without generating strains that compromise the electronic circuitry. So, engineers at UC Berkeley have developed a new, inexpensive technique for making wearable sensors that enable medical researchers to achieve their goals much faster. The new technique replaces photolithography—an expensive, multistep process for making computer chips. To achieve low-strain flexibility, an 'island-bridge' houses rigid electronics and sensor components. The bridges link the islands to one another. Their spiral and zigzag shapes stretch like springs to accommodate large deformations.

Low-energy chip that protects personal data

Side-channel attacks aim to gather secret information by indirectly exploiting a system or its hardware. Current prevention methods are power-intensive and unfeasible for

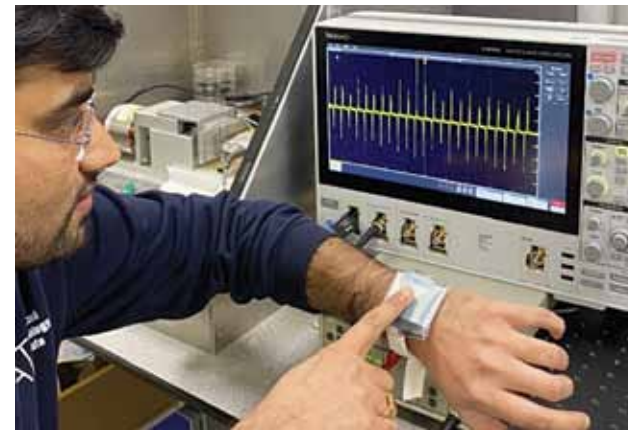


An application-specific integrated circuit chip that can be implemented on an IoT device to defend against power-based side-channel attacks (Credit: https://news.mit.edu)

low-power IoT devices like smartwatches. Now, engineers at MIT have built an integrated circuit chip that can defend against power side-channel attacks while using much less energy. The chip could be incorporated into a smartwatch, smartphone, or tablet to perform secure machine learning computations on sensor values. Rather than having a neural network operate on actual data, the chip is based on threshold computing in which the data are first split into unique, random components. The network operates on those random components individually, in a random order, before accumulating the final result.

Energy-harvesting wrist device made of discarded material

Scientists at the University of Surrey have unveiled a wrist device made from discarded paper wipes and plastic cups that runs on energy harvested by the wearer's movements. The prototype device can transmit Morse code. The device is self-powered thanks to materials that become electrically

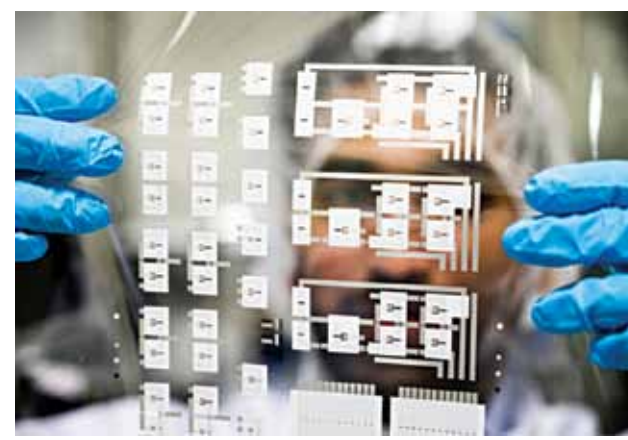


Wearable devices could soon be entirely made of recycled waste materials, and powered by human movement (Credit: www.surrey.ac.uk)

charged after they come into contact with one another. Known as triboelectric nanogenerators, they use static charge to harvest energy from movement through a process called electrostatic induction. The wearable device could be a future game-changer for the consumer, medical, and security sectors.

Printed transistors emulate neurons and synapses

In 2018 the research group at Linköping University developed complementary and printable organic electrochemical circuits, which made it possible to build printed complementary organic electrochemical transistors. The group had subsequently optimised the organic transistors, so that they



Artificial organic neurons (Credit: https://liu.se/en)

can be manufactured in printing presses on thin plastic foil. Now the group has used the printed transistors to emulate the neurons and synapses of the biological system. The hope is that artificial nerve cells can be used for sensitive human prostheses, implantable systems for relieving neurological diseases, and soft intelligent robotics.

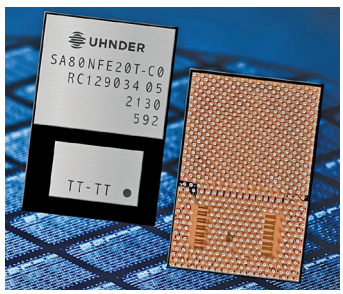
TRULY INNOVATIVE ELECTRONICS

INNOVATION UPDATES

Amongst numerous press releases of new products received by us, these are the ones we found worthy of the title *Truly Innovative Electronics*

Digital imaging radar

The 4D digital imaging radar-on-chip aims to enable next-generation advanced driver assistance systems, autonomous vehicles, and automated



mobility applications to seamlessly operate on roadways. Based on digital code modulation, the digital radar solution comes with better accuracy and power to sense moving or standing objects, large or small, at both short and long distances in all weather and lighting conditions, all while mitigating mutual interference between other radars. The digital radar can clearly identify a pedestrian crossing the road, a child entering the street from beside a parked car, or a bicyclist next to a guard rail, at levels of accuracy that legacy analogue radar systems cannot achieve.

Uhnder
www.uhnder.com

Wafer-on-wafer processor

The world's first 3D wafer-on-wafer (WoW) processor—the Bow IPU—delivers up to 40% higher performance and 16% better power efficiency for real world AI applications than its predecessors, all for the same price and requiring no changes to existing software. WoW bonds two wafers together to generate a new 3D die. The first wafer is for AI processing and is architecturally compatible with the GC200 IPU processor. It has 1472 independent IPU-core tiles

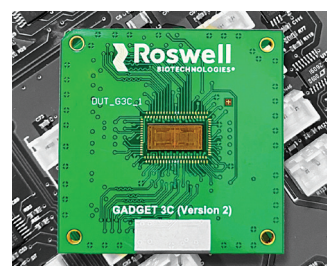


and is capable of running more than 8800 threads. The second wafer is a power delivery die and features deep trench capacitors that enable a large performance increase thanks to being located right next to the processing cores and memory.

Graphcore
www.graphcore.ai

Molecular electronics chip

The first molecular electronics chip has been developed, realising a 50-year-old

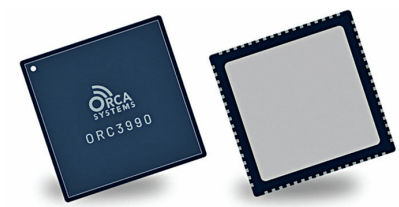


goal of integrating single molecules into circuits to achieve the ultimate scaling limits of Moore's Law. The chip uses single molecules as universal sensor elements in a circuit to create a programmable biosensor with real-time, single-molecule sensitivity, and unlimited scalability in sensor pixel density. This innovation will power advances in diverse fields that are fundamentally based on observing molecular interactions, including drug discovery, diagnostics, DNA sequencing, and proteomics.

Roswell Biotechnologies
www.roswellbiotech.com

Wireless SoC for satellite IoT

The ORC3990 is the first wireless system-on-chip (SoC) solution for the satellite Internet of Things (IoT) that meets the demands of satellite IoT connectivity. The SoC integrates all



required system functions into a single, cost-effective device in a very small 68-QFN package. An essential building block of the SoC design includes a flexible, third-generation Live Wireless RF, and digital radio subsystem. Additional function blocks integrated within the ORC3390 SoC include a low noise amplifier, a digital power amplifier, power management unit subsystem, including all analogue blocks, dual Arm Cortex-M0 + CPUs for separate network and application processing, all necessary memory (volatile and non-volatile) for the on-chip CPUs, required security functions, and key analogue and digital peripherals.

Orca Systems
www.orcasystems.com

Indoor light harvesting sensors

The ERS Eco and ERS Eco CO2 comprise a battery-free sensor line that uses Epishine's indoor light energy

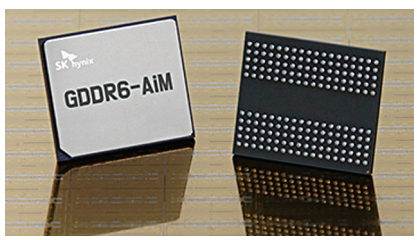
harvesting solution. It is environmentally friendly and made from biodegradable materials. The ERS Eco series enables customers to have complete



control over their air quality and indoor environment. This saves money and reduces its CO_2 footprint, and its battery-free operation reduces the CO_2 footprint even further. This combination of energy harvesting from indoor light, battery-free operation, and a biodegradable enclosure makes a truly unique and ground-breaking product for IoT and building automation.
ELSYS
www.elsys.se

Accelerator in memory chip

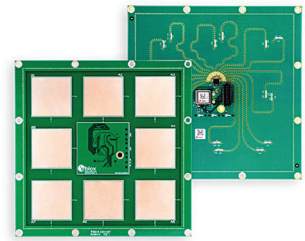
The GDDR6-AiM (accelerator in memory) adds computational functions to graphics DDR (GDDR6)



memory chips, which process data at 16Gbps. A combination of GDDR6-AiM with CPU or GPU instead of a typical DRAM makes certain computation speed 16 times faster. GDDR6-AiM can be widely adopted for machine learning, high-performance computing, and big data computation and storage. GDDR6-AiM runs on 1.25V, lower than the existing product's operating voltage of 1.35V. In addition, it reduces data movement to the CPU and GPU, reducing power consumption by 80%.
SK hynix
www.skhynix.com

Bluetooth antenna board

The u-blox ANT-B10 antenna board for Bluetooth direction finding and indoor positioning applications enables low power, high precision indoor positioning, and speeds up evaluation, testing,



and commercialisation of Bluetooth direction finding and indoor positioning solutions. ANT-B10 features an antenna array comprising eight individual patch antennas and is built around a u-blox NINA-B411 Bluetooth 5.1 module. After processing incoming RF signals emitted by mobile tracker tags in the module's radio and angle calculation processor, the solution outputs the calculated angle of arrival without requiring any additional processes.
u-blox
www.u-blox.com

Laser module for smart glasses

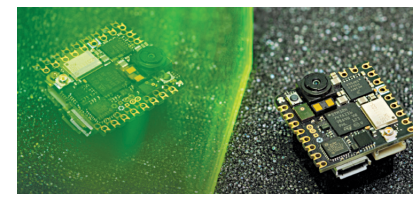
The Vegalas laser emitter module promises to reduce the size of the projection light engine in augmented reality (AR) and mixed reality (MR)



smart glasses by up to half, opening up the potential to develop information-rich smart glasses, which are as stylish and fashionable as the normal sunglasses. The design for the Vegalas module combines three powerful lasers at red (640nm), green (520nm), and blue (450nm) wavelengths in a robust, surface-mount package. The package is hermetically sealed to prevent contamination and degradation of the module's laser chip-on-submount emitters. It has a footprint of 7.0mm × 4.6mm and is 1.2mm high.
ams-OSRAM
www.osram.com

Camera for images on edge

The Nicla Vision is a brand new, ready-to-use, 2MP standalone camera that lets you analyse and process images on the edge for advanced machine vision and edge computing applications. Now you can add image detection, facial recogni-



tion, automated optical inspection, vehicle plate reading, gesture recognition and more to your projects. Nicla Vision has a powerful dual processor and is packed with features for applications possible in building and industrial automation, safety and security, and prototyping. Because of the small size of Nicla Vision, it can be used anywhere in a tight spot.
Arduino
www.arduino.com

Smallest energy harvesting NB-IoT module

The Autonomous NB-IoT Development Solution (ANDS) is the world's smallest energy harvesting NB-IoT module, featuring pioneering nuSIM technology. The ANDS brings together a Murata module for low-power wireless transmission with Deutsche Telekom's



integrated nuSIM technology to provide network connectivity and an advanced Nowi PMIC to power the solution with ambient light energy. The ANDS aims to encourage more widespread IoT proliferation to help customers complete their development projects quicker. With the combination of three components, the module can fit into the most space-constrained applications.
Nowi
www.nowi-energy.com

NEW PRODUCTS

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COMPONENTS

32-bit Hi-Fi DAC

The BD34352EKV digital-to-analogue converter (DAC) IC supports playback of high-resolution sound sources



in high-fidelity audio equipment. Designed to maximally extract and convert high-resolution digital audio data to analogue audio signals, audio DAC chips are one of the most important components for determining the quality in audio equipment. The BD34352EKV maintains a natural flat sound while at the same time an advanced digital filter is included. This leads to superior numerical performance (S/N ratio of 126dB, THD + N of -112dB) of the DAC chip, making it ideal for high-end audio equipment.

ROHM Semiconductor
www.rohm.com

Smallest SD card level translator

The NXS0506UP is the world's smallest secure digital (SD) card level translator IC. Housed in a 16-bump wafer-level

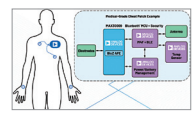


chip-scale package, the SD 3.0-compliant bi-directional dual voltage level translator features integrated auto-direction control, EMI filter, and IEC 61000-4-2 ESD protection. Designed to operate at clock frequencies of up to 208MHz and data rates of up to 104Mbps, it also features integrated pull-up and pull-down resistors to reduce the BOM cost. Devices provide direct connection to the latest host CPU/SOC ASICs and are easy to use because DATA and CMD channels are swappable without impacting functionality.

Nexperia
www.nexperia.com

Low-power BioZ analogue front-end

The MAX30009 is a low-power, high-performance bioimpedance (BioZ) analogue front-end (AFE) that reduces the size and extends the life of BioZ



remote-patient monitors. For developers of small, battery-powered, continuously wearable devices, this AFE on a chip offers clinical-grade vital sign measurements of bioimpedance analysis for patient health assessment for wellness wearables and medical-grade patches. The MAX30009 has a range of options to enable use-case power optimisation, thus extending the operational life of BioZ wearables. It reduces power consumption by 62% and has 30% smaller size than other alternatives, allowing designers to help users measure their vital signs more comfortably.

Analog Devices
www.analog.devices

High-precision pressure transmitters

The AVD series of pressure transmitters are available in three versions



for different pressure measurement ranges, including 0 to 16mbar, 0 to 100mbar, and 0 to 7bar. The series offers high precision levels for low-pressure ranges, such as ±1.75% full scale with a pressure range of 100mbar. The compact piezoresistive pressure transmitters based on MEMS technology are suitable for the pressure measurement of air and non-aggressive gases. In addition to differential pressure measurement, they can also measure over-pressure in a temperature range of -20°C to +70°C.

TDK Corporation
www.tdk.com

Crankshaft and camshaft sensor

The ATS16951 and ATS16351 are two new state-of-the-art giant magnetoresistance (GMR) crankshaft and camshaft sensors, respectively.



They provide manufacturers with a single-vendor solution that's ideal for hybrid vehicle engines, with uses extending to two-wheelers, off-road vehicles, and application designs requiring extended air gap performance. Both sensors help engine designers reduce system complexity, cost, and energy consumption, thus boosting efficiency and minimising carbon footprints. The ATS16951 combines electrical requirements and package size of legacy solutions with sensing location flexibility. The ATS16351 is highly programmable and allows manufacturers to optimise the TPOS performance across a variety of engine designs.

Allegro MicroSystems
www.allegromicro.com

Automotive Gen 4 PCIe switches

The Gen 4 automotive-qualified PCIe switches, which include Switchtec PFX, PSX, and PAX switch solutions,



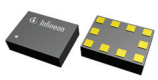
provide cutting-edge compute interconnect capabilities for advanced driver assistance systems (ADAS). Switchtec Gen 4 PCIe switches offer a high-speed interconnect that supports distributed, real-time, safety-critical data processing in ADAS architectures. PCIe is emerging as the preferred compute interconnect solution for the automotive industry.

It provides ultra-low latency and low-power bandwidth scalability to CPUs and specialised accelerator devices. Now high-speed, low-latency connectivity can be easily achieved for distributed, heterogeneous compute systems

Microchip Technology
www.microchip.com

Antenna tuners

The new range of innovative antenna tuners, including BGSA144ML10, BGSA400ML10, BGSA403ML10, and



BGSA14M2N10, are suitable for sub-7.2GHz New Radio applications, supporting both 4G and 5G in smartphones, notebooks, wearables, VR headsets, smart homes, and other cellular applications. RF engineers can now face the challenge of complex antenna design brought by increasing connected devices and introduction of 5G.

Infineon Technologies
www.infineon.com

General-purpose microprocessor

The RZ/Five general-purpose microprocessor unit (MPU) built around a 64-bit RISC-V CPU core employs the



Andes AX45MP, based on the RISC-V CPU instruction set architecture (ISA). It augments the company's previously available Arm CPU core based MPUs, expanding customer options and providing more flexibility in the product development process. RZ/Five is optimised to provide the performance and peripheral functions required of IoT endpoint devices. It comes in a small, compact package to address less complex designs more efficiently.

Renesas Electronics
www.renesas.com

Depth image sensor

VD55H1 is the first of a series of high-resolution time-of-flight sensors that bring advanced 3D depth imaging to smartphones and other devices. The sensor maps three-dimensional



surfaces by measuring the distance to over half a million points. Objects can be detected up to five metres from the sensor, and even further with patterned illumination. It addresses emerging AR/VR market use cases, including room mapping, gaming, and 3D avatars. In smartphones, the sensor enhances the performance of camera-system features, including bokeh effect, multi-camera selection, and video segmentation. Face-authentication security is also improved with higher resolution and more accurate 3D images. In robotics, the VD55H1 provides high-fidelity 3D scene mapping for all target distances.

STMicroelectronics
www.st.com

Diode for system protection

The DZDH0401DW is a diode controller for system protection against reverse discharge. Emulating an



ideal diode by driving a P-channel MOSFET, the controller provides the high-side rail isolation necessary for reverse current blocking in systems up to 40V. The compact size and high performance capabilities of this arrangement mean that it is optimised for use in cordless power tools and autonomous household/garden appliances, such as smart vacuum cleaners and smart lawnmowers. It is also well-suited for other applications, including OR-ing rectifiers used in the hot-swappable and N + 1 redundancy power supplies used in data centre servers.

DIODES Incorporated
www.diodes.com

NAND flash controllers

The new S9 family of secure digital (SD) and microSD memory card controllers provide reliable NAND flash controllers for meeting the



requirements of demanding applications with turnkey firmware. The controller's FlashXE ECC and hyReliability features guarantee extended endurance, data integrity, and power-fail safety coping with demanding applications in markets such as industrial automation, telecom, networking, and medical equipment. With the hyMap flash translation layer, the S9 achieves minimal write amplification and maximum endurance, which enables an efficient use of 3D NAND flash, resulting in lowest field failures over time.

Hyperstone
www.hyperstone.com

Gluon coprocessor for edge

The Gluon coprocessor for edge AI inference claims to deliver competitive



performance compared to Nvidia in vision workloads such as object detection. Gluon is based on an instruction set architecture (ISA) optimised for AI. The ISA refers to the instructions that a chip can process.



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Share its details with us at newproduct@efy.in
Send a photo too. We will be happy to review it, and if it matches our guidelines—we will publish it here, for FREE!

Gluon has 8 TOPS that give higher utilisation (higher performance per TOPS), resulting in higher performance. Gluon further supports PCIe and LPDDR4 interfaces. As a coprocessor targeted at the edge segment, where power is often a constraint, Gluon is aimed at vision workloads, such as classification and detection. Segments where these capabilities are applied include surveillance, industrial, retail, and smart cities.

AlphaICs
www.alphaics.ai

BOARDS & MODULES

Power supplies for LED lighting

The LCM4000HV series of configurable power supplies uses a new power system that features hot swap



functionality and simplifies installation, maintenance, and scalability of high-volume LED lighting projects, such as horticultural and commercial lighting. Rated for up to 4000W and operating with efficiencies of up to 95%, the LCM4000HV single-phase AC-DC high-voltage power modules, combined with the new LCM12K 19" 1U rack mount shelf, create a centralised current source for medium- to large-scale LED lighting installations. The modules provide a flicker-free current source from 0 to 16A at an output voltage between 100 and 300V DC. Input voltage options are 187 to 364V AC and 311 to 528V AC.

Advanced Energy
www.advancedenergy.com

High-speed digitiser cards

Two new PCIe digitiser cards, M5i.3330-x16 and the M5i.3337-x16, bring next generation performance to



PC based instrumentation. Using 16-lane, Gen 3 PCIe technology, the cards are capable of streaming acquired data over the bus at a staggering 12.8GB/s - nearly twice as fast as any other PCIe digitiser currently available. The M5i.3330-x16 is a single-channel card that can sample at rates up to 6.4GS/s while the M5i.3337-x16 is a dual-channel card that offers synchronous 3.2GS/s sampling on both channels, or the full 6.4GS/s on a single channel. Designed to handle a wide variety of signals, the cards feature fully functional front-end electronics with over 2GHz bandwidth, programmable full-scale ranges from ±200mV to ±2.5V, and variable offset.

Spectrum Instrumentation
www.spectrum-instrumentation.com

DC-DC converters

The introduction of three new parts with single outputs of 24V (21.6-26.4V), 48V (43.2-52.8V), and 54V (48.6-59.4V) that retain the wide 8:1



input range of the company's PKE8000A series suit implementation for a wide range of industrial, transportation, RFPA, and IT applications. Encapsulation of these power-dense DC-DC converters provides mechanical protection and reliable operation in environments with high shock and vibration levels or with high dust/humidity. An output power of 40W is available at high ambient temperatures with convection cooling, enabled by innovative design that maintains high conversion efficiency across the load and input voltage range. Maximum case operating temperature is 115°C with derating.

Flex Power Modules
www.flexpowermodules.com

Pulse motion controllers

The AMP-104C and AMP-304C pulse motion controller series, based on the PCI Express interface, provide high performance and exceptional



accuracy. These controllers are engineered specifically to satisfy motion control equipment requirements in numerous high-growth electronics manufacturing fields, including the semiconductor, AOI, and LED industries. The AMP-104C is an entry-level controller that enables reliable and accurate execution of basic point-to-point motion. The AMP-304C offers incredible speed and precision while coming with the DIN-304C dedicated terminal board to help simplify cable distribution. Both AMP models feature a two-in-one design that combines motion control and I/O functionality.

ADLINK Technology
www.adlinktech.com

Server-on-module families

Three new server-on-module families have been launched that come in size E and size D for accelerating the next generation of real-time microserver



workloads in rugged environments and extended temperature ranges. Up to 20 cores, up to 1TB RAM, double throughput per PCIe lanes to Gen 4 speed are included, as well as up to 100GbE connectivity and TCC/TSN support. Target applications range from industrial workload consolidation servers for automation, robotics, and medical backend imaging to outdoor servers for utilities and critical infrastructures—such as smart grids for oil, gas, and electricity as well as rail and communication networks—and include vision enabled applications, such as autonomous vehicles and video infrastructures for safety and security.

congatec
www.congatec.com

AC-DC power supplies

The TPI 300 (industrial grade) and TPP 300 (medical grade) series are a set of encapsulated AC-DC power supplies coming as open-frame and



encased versions. They feature a reinforced double I/O isolation (3000V AC) system according to latest medical or industrial safety standards, respectively. With focus on the medical market, the TPP series also has a low leakage current of < 100µA, which makes the units suitable for body floating applications. An efficiency of up to

93% allows a high power-density. The operating temperature range is -40°C to +85°C, with derating above 50°C. The TPI 300 and TPP 300 are ideal for industrial and medical devices and for demanding safety and space-critical applications.

Traco Power
www.tracopower.com

Product development solution

The nRF21540 development bundle (DB) design tools for verification and testing of applications that require



range extension or link budget improvements comprise the nRF21540 Development Kit (DK) and the nRF21540 Evaluation Kit (EK). The nRF21540 DK is ideal for application performance testing of designs. It incorporates the nRF21540 RF FEM and has two chip antennas and ports for antenna diversity and additional SWF connectors for making direct RF measurements. The nRF21540 EK is a shield incorporating the nRF21540 RF FEM and can be used for easy radio testing and development.

Nordic Semiconductor
www.nordicsemi.com

Raspberry Pi based industrial computer

The new and compact Factor 201 Raspberry Pi-powered computing device is intended for use as an industrial gateway, automation controller,



or edge computer. In addition to the Raspberry Pi CM4, the system features an operating temperature range of -20 to +60°C, options for DIN rail or wall mounting, and 12-24V power input. The device can also be powered via an Ethernet cord, utilising PoE power delivery, enabling single cable installation to provide both network access and power to the device. Multiple memory and storage options allow users to match the device to the unique demands of their project.

OnLogic
www.onlogic.com

T&M SOLUTIONS

Versatile LCR meter series

These LCR meters measure AC components of 4Hz to 10MHz for all practical applications. Part of the R&S LCX family, the LCR meter series serves



all established impedance measurements plus specialised measurements for selected component types. It provides the high accuracy required in R&D and the high speed needed in production test and quality assurance. It is suitable not only for most devices operating at conventional 50 or 60Hz domestic power frequencies, or 400Hz for aircraft, but also for everything from low-frequency seismic sensors to high-power communication circuits operating at several megahertz.

Rohde & Schwarz
www.rohde-schwarz.com

Oscilloscope for optical signals

The new 25G clock recovery range expansion option MP2110A-059 upgrades the BERTWave MP2110A sampling oscilloscope clock recovery rate required



for testing optical signals. It facilitates optical-waveform tests of fibre channel compliant 64GFC PAM4 optical modules in a clock-signal-free test environment. The upgrade helps assure the quality of 64GFC PAM4 optical modules while simplifying the production line configuration to cut costs. The all-in-one MP2110A BERTWave combines a bit-error-rate tester with a sampling oscilloscope for evaluating communications waveforms.

Anritsu Corporation
www.anritsu.com

PCI Express 6.0 test solution

The PCI Express 6.0 is an important and scalable base transmitter test solution for data-intensive markets, such as data centres, artificial intelligence/machine learning, and high-performance computing. To meet ever growing performance demands, PCIe 6.0 standard transitions to PAM4 signalling and new innovative error-correcting



techniques. The test solution includes PCIe 6.0 measurement-specific software, enhanced PAM4 DSP capabilities, and noise compensation on the oscilloscope for increased accuracy of results. It is further enhanced by industry-leading analysis tools for SNDR and uncorrelated jitter measurements, which are both mandated requirements for the PCIe 6.0 standard.

Tektronix
www.tektronix.com

100Gb/s PAM4 Ethernet test platform

The addition of a new 100GbE Layer-1 adaptor in the SierraNet M648 test platform enhances the device's ability for high-speed storage and communica-



tions while also supporting the examination and modification of Ethernet and fibre channel links that utilise both PAM4 and legacy Non-Return to Zero technologies. By adding the new SierraNet 100GbE Layer-1 adaptor, the SierraNet M648 can now capture and analyse 100GbE single lane auto-negotiation and link training.

Teledyne LeCroy
www.teledynelecroy.com

Semiconductor wafer probing system

The TESLA300 high-power semiconductor probing system has been designed specifically for IGBT and power MOSFET device measurements. The TESLA300 provides accurate data at



up to 10,000V and up to 600A current on 300mm wafers. Integrating new anti-arcing and wafer automation capabilities, the TESLA300 enables high-throughput, unattended testing over a wide thermal range to speed development and lower production cost of power devices.

FormFactor
www.formfactor.com

SOFTWARE

Single licence for T&M software bundle

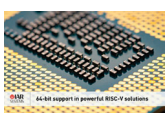
A test workflow bundle has been launched that helps engineers automate test systems through a single software licence. This subscription based bundle provides access to popular test and measurement software, including LabVIEW, TestStand, FlexLogger and DIAdem, enabling engineers working on research validation and production test applications to gain actionable insights, improve test system development, deliver more value from test data, and get products to market faster. With the ability to scale up or down as needed, users have additional control over project costs.



NI
www.ni.com

Support for 64-bit RISC-V solutions

The newly introduced support for 64-bit RISC-V cores is a complete C/C++ compiler and debugger toolchain. It has everything integrated in one single IDE, including integrated code analysis tools, ensuring code quality. It is beneficial for embedded developers to ensure their application fits the required needs and optimise the utilisation of on-board memory. In addition, symmetric multicore processing is now supported, enabling high-performance debugging of multicore RISC-V devices.



IAR Systems
www.iar.com

Monitoring software

The LIN monitoring software PLIN-View Pro version 3 helps PC interfaces with LIN connection (PCAN-USB Pro, PCAN-USB Pro FD, PLIN-USB) to script code implementations for different LIN elements in the software. Scripting is done with the programming language Microsoft C#. The data of publisher frames from the Transmit and Publish lists can be modified as well as entries of schedule tables. For different events for these elements, a C# script can be specified in each case. The new output gives the user various feedback options about loading processes of projects or LDF files, and an additional output option for C# scripts.



PEAK System
www.peak-system.com

Software development kit

With the new version 5.70, the OPC UA C++ software development kit (SDK) comes with more enhanced options. With the help of reverse connect, users can now easily establish a secure OPC UA connection with OPC UA clients across the firewall using their product's OPC UA server without opening internal binding ports. Use cases for reverse connect include company-wide, cross-domain connectivity, industrial IoT, and Industry 4.0 applications, and secure field-to-cloud OPC UA data connections. The OPC UA C++ SDK is available for Windows, Linux, and VxWorks.



Softing
www.softing.com

CHEMICALS & ADHESIVES

Liquid flip-chip flux

A new liquid flux has been developed that meets process needs for low-temperature flip-chip applications. WS-3910 is a water-soluble, halogen-free flip-chip flux that is designed for low-temperature (150°C) bismuth-tin applications. WS-3910 is chemically designed to exhibit minimal evaporation after application. Its composition also eliminates compatibility underfills by having a completely water-cleanable residue.



Indium Corporation
www.indium.com

ENTERPRISE CLASS

Data storage optimising solution

The auto-tiering function for the EonStor CS optimises read/write performances and utilises storage capacity for mass data analytics, such as in large-scale, high-performance computing (HPC). Auto-tiering utilises the high-performance of SSDs and the massive capacity of HDDs. The system automatically allocates the processing 'hot data' onto high-performance SSDs to meet the mass data read/write requirements of HPC analytics. Once the data have been finalised, they are identified as 'cold data' and moved to HDDs with PB-level capacity for archiving purposes.



Infortrend
www.infortrend.com

5G-ready embedded computing system

The ASB200-953 is a compact SBC that is powered by 11th Gen Intel Core i7-1185G7E, i5-1145G7E, and i3-1115G4E processors (formerly Tiger Lake) with a 15W TDP threshold. Aimed at smart applications in warehouse logistics management, factory automation, and the automotive industry, the fanless ASB200-953 features high performance with low power consumption. With a black colour chassis, it supports up to 64GB in two SO-DIMM slots and 12V ~ 24V wide-range DC power input. The panel is equipped with digital I/O, power button, HDD LED, DC-in terminal block, and two antenna holes that can be used with the optional Wi-Fi accessory kit



IBASE Technology
www.ibase.com.tw

Career

"SEMICON MANUFACTURING Has The Potential To Generate A Huge Market For Jobs In Both Skilled And Unskilled Fields"

As part of being Atmanirbhar Bharat, India is working towards setting up semiconductor manufacturing facilities and is receiving proposals from big players like Vedanta, Foxconn, IGSS, and ISMC. Chetna Mohan, President, El Camino Technologies Pvt Ltd, spoke to Abbinaya Kuzhanthaivel of EFY about the career opportunities that this opens up for graduates in electronics and electricals, physics, applied physics, material sciences, chemical, and mechanical disciplines, and the skillsets they need to build



CHETNA MOHAN
PRESIDENT, EL CAMINO TECHNOLOGIES PVT LTD

How do you see the semicon manufacturing space evolving in India?

I would categorise semicon manufacturing into different sectors for ease of understanding, and each one is an individual unit on its own. These are:

- Design houses
- Wafer fabs (including raw wafer manufacturing and crystal growth)
- Assembly lines that include assembly, testing, marking, and packaging (ATMP)
- Failure analysis and reliability analysis (FA and RA) labs

India is a hub of the semiconductor design industry having well-established R&D and design centres for VLSI design, board design, and embedded software companies. Major players across the world have their R&D and design centres in India. However, raw wafer manufacturing and crystal growth are yet to be established. For fabs, the investment is huge and return on investment (ROI) takes a long time, whereas packaging lines are more flexible and easier to set up as compared to fabs. To be self-reliant, India will need wafer manufacturing, assembly, and testing facilities.

What do you think about the type of jobs and skillsets that will be in demand if semicon manufacturing picks up?

Semiconductor manufacturing needs a wide range of skillsets when we see at a macro level. It has the potential to generate a huge market for jobs in both skilled and unskilled fields. It could target youth from rural areas to scientists, designers, researchers, process developers, quality control, utilities, and facilities experts. The industry needs different levels of workforce for production, including shop-floor assistants, helpers, warehouse management, security, etc.

Apart from the production related skills, there are other add-ons and supporting clusters of industries which grow when any other production unit grows, such as suppliers of raw materials, chemicals, high purity gases, gas handling systems, water handling equipment, electricity, cleanrooms, related furniture, pollution control, disposal systems, chemical treatment plants, environment controlled facilities, certification bodies, which will require both Indian and overseas products and expertise.

Do we have courses or curriculum that gives on-hand training before getting to the job?

As I understand, we do not find a defined curriculum, particularly on microelectronics, including semiconductor technology in detail, at undergraduate levels in most universities. Premier institutes, such as IITs and IISc, have well-established labs where students have exposure. Some of the labs at premier institutes include labs for basic electronics, microelectromechanical (MEMS) systems, microelectronics, VLSI engineering, MEMS and microsystems, microwave and millimeter-wave circuits, nanofabrication, nanophotonics, nanoscale optoelectronics, semiconductor devices and circuits, which gives the students preliminary understanding of the subjects.

We do see a few chapters on VLSI designing and semiconductor devices, but complete process and know-how of semiconductor manufacturing and fabrication are not available at graduation levels. As I have seen in my experience in this area, most of the training is on-the-job. Since this is a high-tech industry, it takes six to nine months before an

engineer can understand the processes and can speak about them.

Any advice for institutions wanting to prepare themselves, including their faculty, curriculum, and students for this industry?

There is a widening gap between the nature of jobs and active candidates with the skills. There is always a need for skilled and talented early-career professionals. Being in a high-end technology area, my suggestion for institutions would be to consider setting up small labs where institutions can have in-house facilities with manual or semi-automatic systems for students to have practical experience. The upcoming manufacturing units will need nine to twelve months of facility readiness; by this time the candidates can be prepared as per the requirement by giving them on-the-job training, which will help the industry and candidates both.

Consider experts from the industry for guest lectures, seminars, conferences, and workshops. We have a 'gold mine' of these from premier institutes in India. The institutes can have curriculum to develop skills that are in high demand from the semiconductor industry. They can be at graduation, masters, and doctorate levels with PhDs and also non-thesis programmes.

Independent institutes can have a dedicated certification course, which will benefit by bringing both candidates and companies closer to each other. The companies can find the right candidates and candidates can learn what the companies require.

For the final years, we can look for something like 'Enthusiastic Fresh Resources' available with incentives in form of scholarships to increase their ability to understand the subject and take it to the industry. The industry can thus save time by having a quick induction programme.

Another important point I would like to touch upon is the curriculum. It should be designed with the help of industry experts to streamline the subjects of study, which will benefit these industries. Exposure to basic knowledge and practical training from the start to the end of the fabrication process will help both students and the industry. Additionally, faculty development programmes can be conducted by industry experts. Some universities and industries can look at special awards and recognition for the professors' efforts to help address pressing engineering and supply-chain challenges as well as attract and retain top local talent.

In recent times, we do see many academic institutes and industries coming together to bridge this gap and tying up with the industry so that students can have practical training and are industry-ready. This is a good starting point for India as we move forward in semiconductor manufacturing. We need several more to bridge this gap. EFY

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EFY-CERTIFIED
Skill DEVELOPMENT CENTRE

Referred to as ESDC, the Centre will help students improve their hands-on skills, make exciting projects of their own and understand the latest technologies

For more details, please call: Shyam (+91-8800100761)
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Will 20cm SiC WAFER Be The Next Standard?

Silicon carbide (SiC) has a lot of potential to replace silicon in many applications, a significant one being in the automotive industry, especially for battery-operated electric vehicles. To reduce the cost of producing SiC devices, which is quite high, SiC fabs are moving from 15cm (6-inch) to 20cm (8-inch) wafers



Porsche Carrera GT uses carbon-fibre-reinforced silicon carbide (C/SiC) ceramic composite braking system

AARYAA PADHYEGURJAR

The semiconductor silicon carbide (SiC), commonly known as carborundum, occurs in nature as the mineral moissanite. It is actually abundantly found in space in the form of stardust but occurs very rarely in nature. Nonetheless, since 1893, SiC is being mass-produced for use as an abrasive or in manufacture of light emitting diodes (LEDs) and radio detectors. Today, the ceramics made with SiC, being durable and having high thermal shock resistance, are widely used in automotive brakes and clutches.

Why have we not been using SiC instead of silicon for making semiconductor devices? Earlier, the main problem with SiC crystals was that they had some defects that prevented them from being used widely in electrical applications. Hence, silicon became the standard. However, with technological advancements in production processes, 15cm SiC wafers are now giving a good yield. Particularly in the automotive industry, using SiC instead

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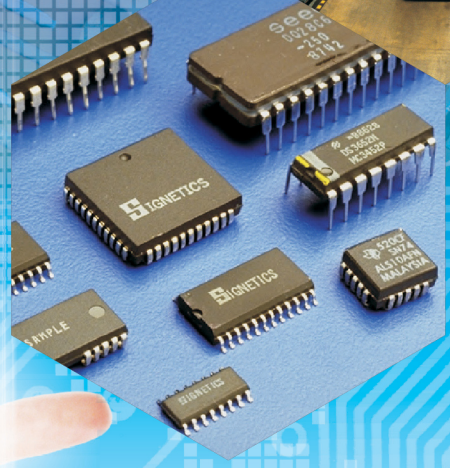
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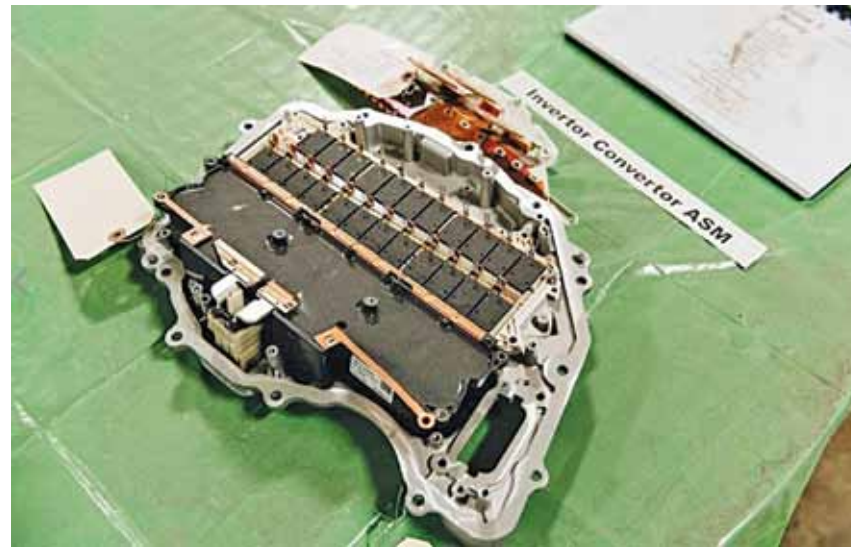
of silicon can increase the driving range per charge, speed up charging time, and increase efficiency by delivering the same range with lesser battery capacity and weight.

Importance of SiC in automobiles

Today, the electric vehicle (EV) sector is growing rapidly and governments all over the world are taking initiatives for the preservation of the environment. Moreover, petrol prices and CO_2 emissions are a matter of great concern. This is why we can see large-scale investments in EVs. Within the next decade, EVs might very well dominate the vehicle market.

But it is important to note that EVs still cannot compete with conventional vehicles in terms of cost—they are significantly expensive. Hence, EV designers and researchers are looking to increase EV efficiency as that will translate to lower costs. Exploring SiCs has pushed EVs towards this goal.

The very properties that SiC has enable it to be used in devices operating at high temperatures and/or high voltages. Automobiles, especially EVs and hybrid EVs, contain many high-voltage systems like the high-voltage battery and its charging sub-systems. This makes SiC a good choice for use in such applications. With SiC technology incorporated in MOSFETs and diodes, the whole system can be made smaller, lighter, and more efficient.



Model 3 main inverter featuring 24 SiC MOSFET modules from ST Microelectronics

Electrical systems in EVs, such as battery management systems (BMS) and onboard chargers (OBC), are crucial since the battery is a fundamental feature of EVs. Typically, the OBC is used to charge the battery using AC mains when the car is parked. This is generally a unidirectional process—from mains to the battery. But OBCs can be used the other way round too, for example, when you want to power your home using the energy stored in your EV battery. By using SiCs in such bidirectional chargers, more efficient bidirectionality can be obtained.

Reasons for the success of SiC

According to BusinessWire, "Global SiC market was valued at US$850.6 million in 2020, and is estimated to reach US$2670.25 million in 2007".

Here are some reasons for its success.

- Its on-state resistance and switching losses are considerably lower
- High thermal conductivity compared to silicon, and hence lesser cooling requirements
- Allows faster heat dissipation from components
- Provides high power density, and hence better efficiency
- Wide bandgap
- Efficient even in harsh environments due to exceptional hardness and strength
- Ability to switch at three to five times higher system frequencies
- High thermal shock resistance and low thermal expansion
- Chemical inertness because chemical bonds in SiC are stronger

The 15cm to 20cm transition

Many companies have already adopted SiC technology in conjunction with traditional silicon. Tesla, in 2018, added SiC MOSFETs from STMicroelectronics in its inverter for Model 3, due to which the weight of the inverter was reduced by half as compared to other models. The industry believes that although SiC production is not easy on our pockets, the huge demand in the

SiC and the BFOM Equation (Baliga's Figure of Merit)

In the 1980s, Dr Jayant Baliga, an electrical engineer, professor, and inventor of IGBTs suggested replacing silicon with wide bandgap semiconductors to enhance the performance of power devices. "In the latter half of the 1980s, the technology for the growth of silicon carbide was developed with the culmination of commercial availability of wafers from CREE Research Corporation," says Baliga in his book titled Silicon Carbide Power Devices.

Dr Baliga's famous equation, commonly referred to as Baliga's Figure of Merit (BFOM), predicts that SiC would be much more efficient than silicon. Baliga was well aware that SiC devices could replace his own invention—the IGBT. "It has been my privilege to assist in the establishment of national programs to fund research on silicon carbide technology in the United States, Japan, and Switzerland-Sweden," he says.

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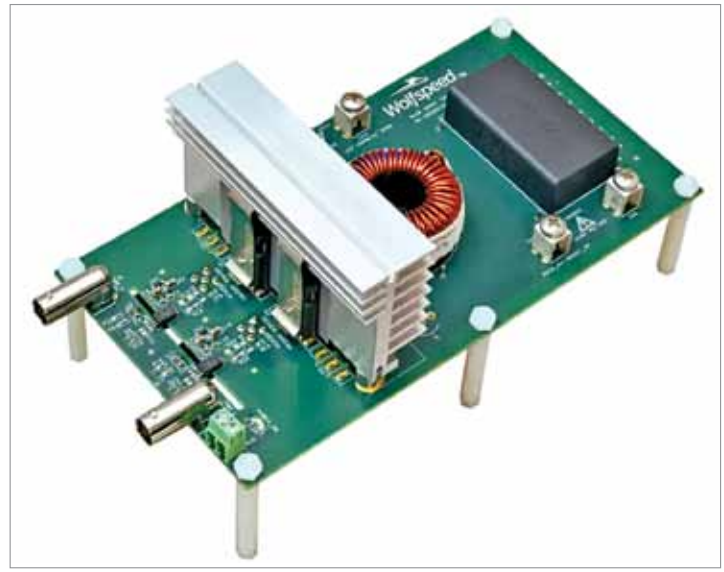
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automotive industry will help in decreasing the cost through the economies of scale.

Today, the SiC market is dominated by 10cm and 15cm wafers. Both of these are in high demand, but most of the growth is happening in the 15cm domain, where the aspect ratio of the wafer is 6 to 1. While the industry is looking to improve the methods of processing for 15cm wafers, companies are paying close attention to the development of 20cm SiC wafers at the same time.



Buck-boost evaluation board for 650V SiC C3M MOSFET (Image source: Wolfspeed)

The main reason for this transition is to reduce the application cost of SiC. A larger wafer size directly reduces the cost of production. But moving to a larger wafer size is not that easy and establishing mass production infrastructure takes time. Once the mass production of 20cm SiC is established, and the market is no longer dominated by just six to seven companies, the cost of SiC production will drop.

Advantages of 20cm SiC wafers

Ability to produce more SiC devices. 20cm wafers can significantly increase the production capacity of SiC devices since a larger area can be used for manufacturing. This will ensure that more devices can be produced using a single wafer of 20cm SiC. Compared to its 15cm counterpart, 20cm wafers will almost double the output of chip production.

Better wafer quality. Approximately twelve wafers are obtained in the batch production of 15cm and 10cm wafers. This number is quite less for 20cm wafers, which is why it is much easier to follow the single-wafer production approach instead of batch production. This enables us to have better control over each wafer, in turn increasing the quality of production.

Electrification. As 20cm wafers become a norm and production capacity increases in the coming years, we can expect major growth in the electrification of systems and products, not just in the automotive sector. The industry might slowly start remaking some fabs that currently run on silicon with SiC technology.

Disadvantages of 20cm SiC wafers

Need for independent processes and increased investment costs. The production process, as well as the development process of 20cm wafers is fundamentally different from 15cm wafers. Hence, fabrication companies will have to establish independent process plants for the 20cm technology, and this will add to their costs. Not to mention, SiC production itself is more expensive than silicon.

Risk of damages. SiC wafers are already pretty delicate. Developing a wafer of a larger area increases the risk of damaging the wafer during the substrate cutting process. Problems like cutting stress and warpage are evident as the substrate size increases.

Achieving a good tradeoff. Using 20cm SiC will make sense only if the benefits outweigh the challenges, most importantly in terms of cost. For example, the efficiency of the resulting device built on 20cm SiC should compensate for the higher SiC cost as well as the increased costs of 20cm wafer production.

World's Leading SiC Wafer manufacturers

Many semiconductor companies are gearing up for the transition from 15cm to 20cm wafers. Here is a list of a few of the key players:

- STMicroelectronics
- Cree (Now Wolfspeed)
- II-IV Incorporated
- SiCrystal (A ROHM Semiconductor Company)
- Infineon
- ON Semiconductor
- Bosch

Current trends in SiC industry

Mentioned below are some trends that are being witnessed currently in the silicon carbide industry:

More and more SiC products. So far, several SiC devices have been produced and many have reached maturity as well. For example, many companies, including ROHM Semiconductor, STMicroelectronics, and Infineon, have already launched several SiC based devices like MOSFETs, Schottky diodes, power modules, and hybrid devices. Also, many companies are offering commercially available evaluation kits that feature modules based on SiC.

20cm SiC wafers produced. Due to the cost benefits that the mass production of 20cm SiC will offer,

many companies have started the fabrication process of 20cm wafers. Some have already demonstrated 20cm SiC samples. These include Cree (now Wolfspeed), II-VI, SiCrystal (a subsidiary of ROHM Group), and STMicroelectronics.

In July 2021, STMicroelectronics announced that it has manufactured the first 20cm SiC bulk wafers for prototyping next-generation power devices. "The transition to 200mm SiC wafers will bring substantial advantages to our automotive and industrial customers as they accelerate the transition towards electrification of their systems and products," says Marco Monti, President Automotive and Discrete Group, STMicroelectronics.



ST's 20cm SiC wafer

5G and SiC. Due to the advent of 5G, there will be demand for high-frequency RF power amplifiers. This is another potential application industry for SiC devices apart from the automotive sector, since GaN (gallium nitride) on SiC is a key technology for 5G power amplifiers. II-IV announced in 2019 that it has introduced prototype 20cm diameter semi-insulating SiC substrates for RF power amplifiers in 5G wireless base-station antennas and other high-performance RF applications.

In-house production. The demand for 20cm SiC is growing and many companies would prefer to produce it in-house. This is why they are expanding their fabrication facilities for the mass production of 20cm wafers. A few years down the line, we can expect several key players in the semiconductor business to have 20cm wafer production facilities.

Bosch aims to become a global leader in the production of SiC chips for electromobility and plans to develop SiC devices on 20cm wafers instead of standard 15cm ones. The company has expanded its wafer fab facilities and is expanding even further for complete in-house production of SiC based devices.

Infineon has been involved in SiC technology for a long time and by 2023 aims to start mass production of 20cm SiC. Cree (Wolfspeed) plans to use existing facilities and install refurbished tools to produce 20cm SiCs in a fiscally responsible manner.

Investments. Another important trend in this industry is the increase in investments in SiC technology. In 2019, Cree (Wolfspeed) announced their largest-ever investment of $1 billion to expand SiC capacity. Moreover, collaborations and acquisitions among semiconductor companies have also become noticeable. Multiple players from all over the world are joining the SiC race and helping the technology become mainstream.

Exciting collaborations. Many semiconductor companies have collaborated, started joint ventures and partnerships in the SiC domain. On 1st February 2022, II-VI Incorporated announced that it has expanded its relationship with GE by signing a three-year technology access agreement (TAA) with GE Research. In November 2021, Japanese power electronics company ROHM and a China based firm known as Zhenghai Group announced a new joint venture that focuses on developing SiC power modules for automotive applications. Many key players in this business have invested in such partnerships with each other.

The future of SiC technology

The competition in the production of 20cm SiC is expected to grow, since the demand for SiC is slowly growing more than the supply. As the automobile industry pushes SiC into the mainstream, most challenges related to 20cm wafers mentioned in this article can be eliminated. However, this will take time, and 15cm wafers might dominate the market for a few more years, after which the 20cm tech will take over. And when this happens, device prices will decrease considerably compared to 15cm SiC.

In a 2005 IEEE paper titled Silicon Carbide Power Devices - Current Developments and Potential Applications, authors Peter Friedrichsi and Roland Rupp mention the following about SiC: "The final market penetration will be somehow related to the fantasy and degree of innovation in circuit design groups, since the simple replacement of silicon by SiC alone cannot justify the cost position resulting from the implementation of SiC."

Today, not only are SiC devices already in the market, we also have justifiable reasons as to why 20cm SiC wafer might very well become as mainstream in the coming years as 20cm silicon wafer is today. EFY

The author, Aaryaa Padhyegurjar, is an Industry 4.0 enthusiast with a keen interest in innovation and research.

The Making Of A Sturdy And Secure AUTONOMOUS E-TWO-WHEELER

For a country like India, where more than half of the population is dependent on two-wheelers, enhancing these vehicles will be nothing short of achieving the dream of implementing autonomy on a wider scale



DR RAHUL KALA is Assistant Professor at the Centre of Intelligent Robotics, IIIT Allahabad

Two-wheelers have been an integral part of the Indian lifestyle for many years. While the public can smoothly go about its business, tourists can easily traverse the length and breadth of this vast country with these vehicles. Even Bollywood has been hugely influenced by it, so much so that many key scenes have involved a two-wheeler in action.

The idea of developing an autonomous two-wheeler amongst the current excitement around autonomous cars may be seen as silly by some. But the fact is that the idea of having an autonomous e-two-wheeler has been there since the early 2010s. So, is the idea of having an autonomous e-two-wheeler relevant more than a decade later? The answer is a full-fledged yes. If it could be thought of back then, it surely is possible now when technology has taken great strides.

Lane splitting

A common road phenomenon observed in the USA and the UK is 'lane splitting' wherein two-wheelers travel between adequately spaced rows of four-wheelers. And because two-wheelers are extremely agile, in case of a traffic jam, they can easily navigate their way ahead. So, for an efficient transportation system, lane splitting is the way to go in countries with a greater number of smaller vehicles.



Lane splitting at a traffic light in New York (Credit: Unsplash)

The need

In America and Europe, self-driven cars are quite popular, and you see very few two-wheelers on the road. The two-wheelers are used there mainly for leisure and sports. In India, two-wheelers are the lifeline of our transportation system. They are much less expensive here, so more people buy them.

But maintaining a smooth traffic flow due to the huge variety of vehicles on the Indian roads is a challenge for the authorities. Building more lanes and flyovers helps, but for a country like India their construction remains slow due to monetary constraints.

Two-wheelers occupy lesser space compared to four-wheelers, so more people can utilise each lane. Thus, there is lesser requirement for new lanes and flyovers. Therefore, in the future, when the traffic is not likely to reduce, the situation can be better tackled by using two-wheelers instead of cars.

The technology

Standard autonomous mobile robot models, for which a lot of research has been done over the last several decades, include the unicycle model, the bicycle model, the differential wheel type model, the tricycle

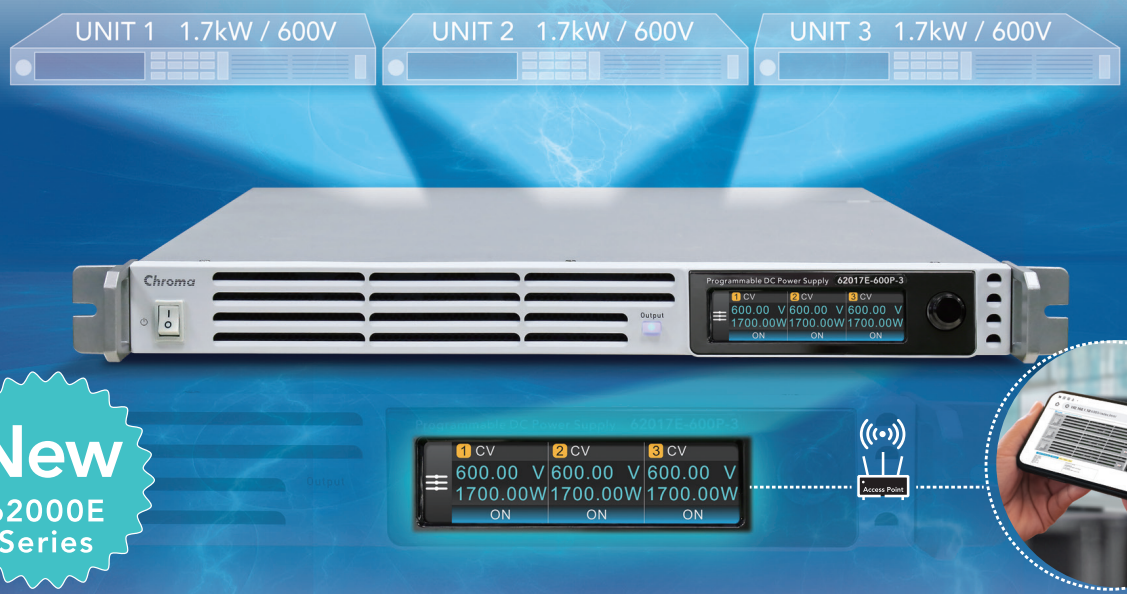
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model (e-rickshaw or auto-rickshaw), and the dual bicycle model (car).

The two most prominent models for on-road self-driving mechanism are autonomous cars and autonomous two-wheelers. The software tech stack remains largely unchanged irrespective of the robot model used. Effectively, every self-driving vehicle looks at the surroundings through its eyes, which include onboard cameras and lidars. Whatever is seen gets converted to a digital map. All the captured information gets interpreted using an onboard computer vision that controls the associated orientation and speed mechanisms.

Finally, everything translates into decision making regarding lane changing, lane overtaking, stopping, slowing down, or accelerating. So, by tracking static objects and computing how much you moved, your current location can be determined.

Decision making is also regarding the control system that determines the conversion of linear and angular velocity in different motors. The control system is specific to the type of mechanical model, whether it is a bicycle model, dual-bicycle model, or tricycle model. Everything else, including the tech stack, remains the same.

The peculiarity

As per the laws of physics, if any stationary object subjected to a dynamic disturbance destabilises, it is called an unstable system; but if it comes back to its stable condition, it is called a stable system. If you push a glass near the edge of a table, or exert force on an upright pole standing on the ground, it would naturally fall down. The same does not apply to four- and three-wheelers, which, when disturbed, do not topple under normal circumstances.

> The cost of converting a normal two-wheeler EV into an autonomous two-wheeler EV is not much. Level 5 autonomy is quite expensive and there is no chance it will happen soon. But level 2 and 3 autonomies are comparatively easy. For it, an ultrasonic technology, or a high-speed depth camera, both costing 10,000 rupees or less, are available.

A four-wheeler and a three-wheeler are stable systems when these are standing as well as when they are moving. But in case of two-wheelers, the same is not true. A two-wheeler is stable as long as it is moving. The moment it stops, it becomes unstable and tends to fall down.

In situations such as traffic stops, riders tend to place their foot on the ground to stabilise a two-wheeler. That is exactly what autonomous two-wheelers would need to do, but automatically. For that, a small leg hidden inside the vehicle's body gets deployed as soon as the vehicle speed slows down and is not good enough to maintain stability.

The electronics

A level-5 autonomous vehicle includes many lidars, radars, ultrasonic devices, IMUs, GPUs, battery systems, etc. This leads to its rear bonnet getting jam packed with computing devices and batteries, while the front bonnet is filled with sensors. Due to lack of space, any further expansion/addition to the system becomes difficult. On top of that, the comfort factor of the rider also needs to be kept in mind. You don't want any electronics or mechanics interfering with the rider's space.

The solution to this problem lies in removing a lot of onboard hi-tech equipment. Autonomy for two-wheelers does not require a lot of GPUs and lidars. A camera system and a lidar system will suffice. You can do many things with such systems. In fact, several hi-tech sensors are not at all required.

Safety

Safety standards for autonomous two-wheelers require rigorous testing for a lot of scenarios. The testing involves a vulnerable road user, such as a child, who can suddenly come up in front of a vehicle.

> Segway e-scooter, with its ability to stand upright on its own, is an exception. A complex arrangement of gyroscopes, coupled with several microprocessors, measures its angular velocity, which directs the control mechanism to take appropriate action to remain stable.

An interesting thing is that two-wheelers themselves come under the category of vulnerable vehicles for road users. Autonomous four-wheeler cars are trained to detect vulnerable road users and take necessary action. The presence of a large number of two-wheelers on the road significantly increases the accident threat (owing to their vulnerable status). So, all possible efforts are required to make e-two-wheelers safe, which requires extensive research.

Final thoughts

Currently, there is a rule: One lane, one vehicle. That is how a lot of accidents are prevented. The moment there are too many hybrid vehicles on the road, you are talking of traffic risks never dealt with before. A self-driving car makes decisions based on the behaviour of other vehicles, for which a lot of behaviour analysis takes place inside the autonomous vehicle. The same needs to be implemented for autonomous two-wheelers as well.

And finally, for all vehicles to communicate with each other using digital signals, you do not need high-profile onboard sensing. Everything can come from a global map of network channels. This way, there is a lot of scope to enhance the communication protocols.

The two-wheeler has its own set of unique challenges concerning safety and operation. So, let us make the two-wheeler brand unique to India and help it shine globally with our R&D. EFY

The article is based on a talk by Dr Rahul Kala, Assistant Professor at the Centre of Intelligent Robotics, IIIT Allahabad. It has been transcribed and curated by Vinay Prabhakar Minj, an IoT and audio electronics enthusiast.

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WEATHER STATION With DEVICE CONTROL Using Touch-Screen Display

SANI THEO

This weather station provides such information as temperature and humidity at a place on a colourful touch-screen display. It can also control the temperature through the touch-screen user interface when it exceeds the set threshold level. The project can be easily converted to a personal weather station by adding more sensors to measure weather conditions outdoors or indoors.

The digital console provides easy readouts of the data collected by the sensor. The touch-screen has a microSD card memory slot. So, it can be connected to a personal computer where data can be displayed, stored, and uploaded to websites, or used for data ingestion or distribution systems. The author's prototype is shown in Fig. 1.

Components required for this project are mentioned in the Table.

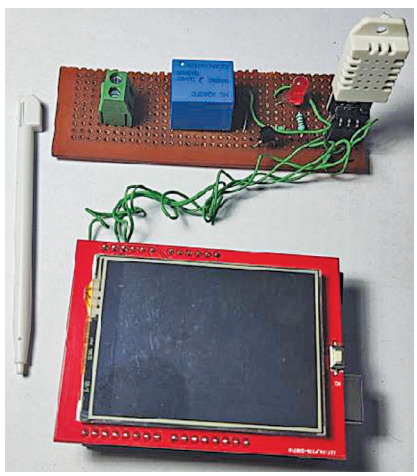


Fig. 1: Author's prototype

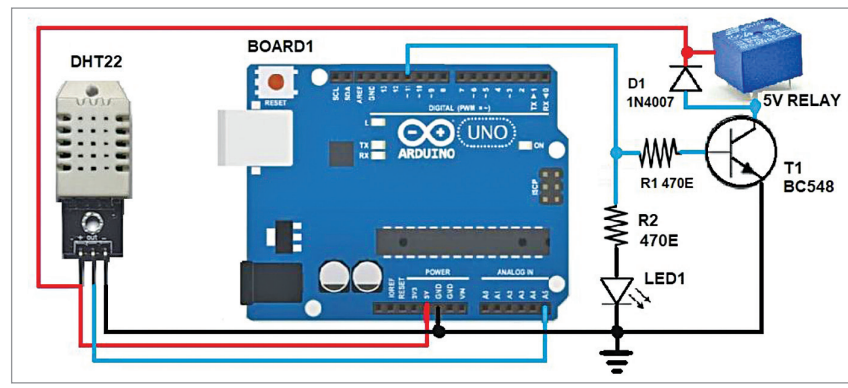


Fig. 2: Circuit diagram

COMPONENTS REQUIRED

Components	Quantity	Purpose
Arduino Uno	1	Computing
6cm TFT LCD touch screen shield	1	Data display
DHT22	1	Temperature and humidity sensor
BC548	1	NPN transistor amplifier for driving relay
Resistor (470-ohm)	2	Current limiter
1N4007	1	Rectifier diode used as freewheeling diode
Relay	1	5V SPDT relay for switching the device
LED	1	5mm LED for relay status indicator
Jumper wires	9	Connections
PCB	1	10x3cm Veroboard

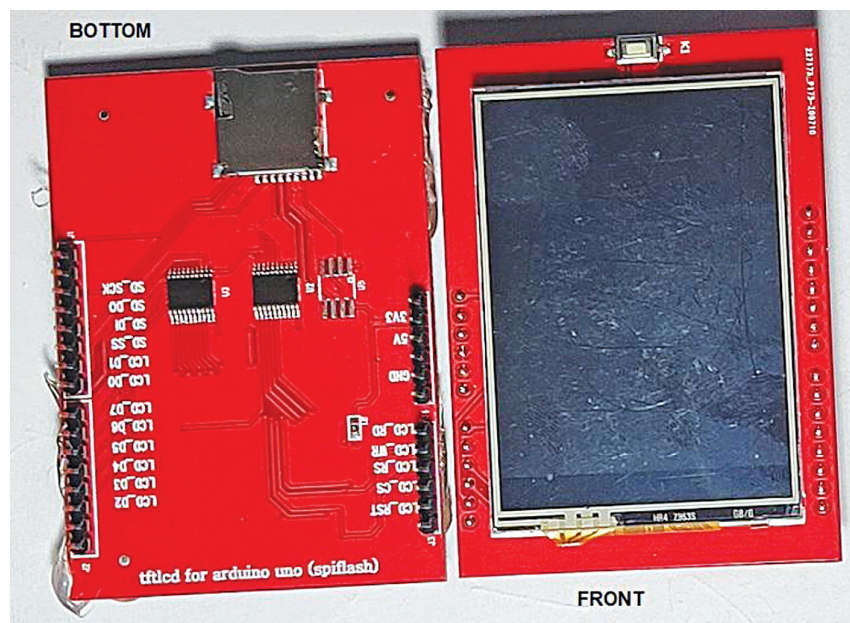


Fig. 3: TFT touch-screen display

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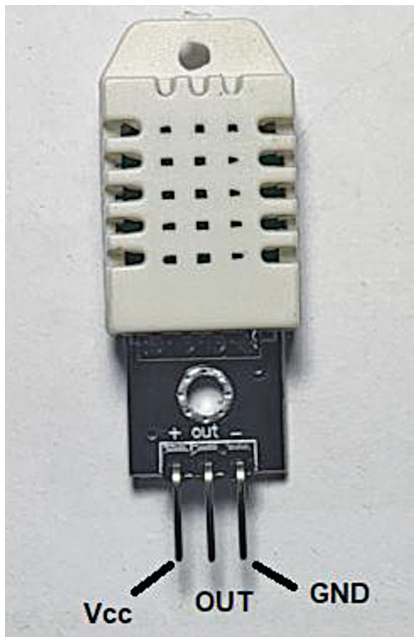


Fig. 4: Pin details of DHT22 module

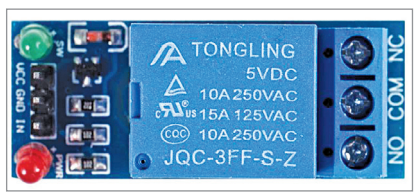


Fig. 5: Relay module

Circuit and working

The circuit diagram of weather station with device control is shown in Fig. 2. It comprises Arduino Uno Board1, DHT22 temperature and humidity sensor, BC548 transistor T1, a 5V single changeover relay, light-emitting diode LED1, and resistors R1 and R2. The 6cm TFT touch-screen display to be mounted on top of the Arduino board is shown in Fig. 3.

A 9V-12V DC power supply is used to power the Arduino board. The touch-screen, DHT22 sensor, and BC548 device driver sections are powered by the 5V supply from Arduino board.

Arduino Uno. It is the heart of the project. Temperature and humidity data, TFT touch input display, and device control inputs are processed through Arduino programming.

TFT touch-screen. The 6cm TFT touch-screen display TS1 is basically an Arduino shield, which can be mounted on top of the Arduino Uno board. This is one of the advantages of this display because you don't need any external wires to interface with Arduino.

```
File  Edit  Sketch  Tools  Help
Weather_light_control.ino §
#define WHITE       0xFFFF
#define ORANGE      0xFD20
#define DARKORANGE  0xFB60
#define MAROON      0x7800
#define BLACKM      0x18E3

//----------------- Calibrated values for touch points

#define TS_MINX 500
#define TS_MINY 125
#define TS_MAXX 887
#define TS_MAXY 855

//-------------------Variable for detecting touch screen when touched
#define MINPRESSURE 10
#define MAXPRESSURE 1000

//---------------Defines the pin to drive the device
#define DEVICE 11

//--------------------Button location at point x and y
int BtnGreenX = 30;
int BtnGreenY = 30;
int BtnRedX = 200;
int BtnRedY = 30;
```

Fig. 6: The calibrated values for x and y coordinates

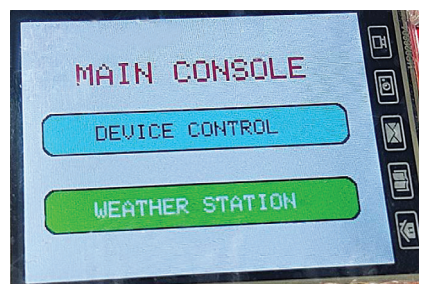


Fig. 7: Main console

DHT22. This temperature and humidity sensor gives more accurate readings as compared to the popular DHT11 sensor. With this sensor, you can easily program to get humidity in %, temperature in °C and °F units. In this project, its output pin is connected to pin 11 of Arduino board.

DHT22 sensor can either be purchased as a sensor or as a module. The sensor comes as a 4-pin package out of which only three pins are used. The module comes as a 3-pin package, as shown in Fig. 4. The module has a filtering capacitor and pull-up resistor inbuilt, but for the sensor you must use them externally, if required. Otherwise, performance of both is same. The sensor is also factory calibrated and hence easy to interface with microcontrollers. It can measure temperature from -40°C to +80°C and humidity from 0% to 100%.

BC548. This popular bipolar NPN transistor is used as driver for switching the electrical appliance connected across the relay module.

Relay module. This is an electromechanical sugar-cube, single-channel relay used to switch on/off the electrical device connected across its COM and NO terminals. You can use readily available single-channel relay module. In that case you can connect digital pin 11 of Arduino to IN pin of relay module. The pin details of relay module are shown in Fig. 5.

The working of the circuit is simple. After uploading the code to Arduino Uno board and connecting all the components, as shown in the circuit, switch on the circuit. You will see the main panel on the TFT touch-screen, as shown in Fig. 7. Touch the Device Control option, using stylus or your fingertip, to turn on or turn off the appliance/device such as tube-light or air-conditioner. Otherwise, touch on the Weather Station option to check the current temperature and humidity.

Software

The software (weather_light_control.ino) for this project is written in Arduino programming language. The project requires specific libraries for DHT22 and touch-screen display, such as DHT.h, SPFD5408_Adafruit_GFX.h, SPFD5408_Adafruit_TFTLCD.h and SPFD5408_

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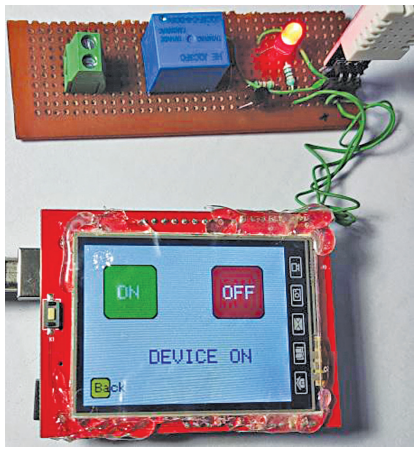


Fig. 8: Device on

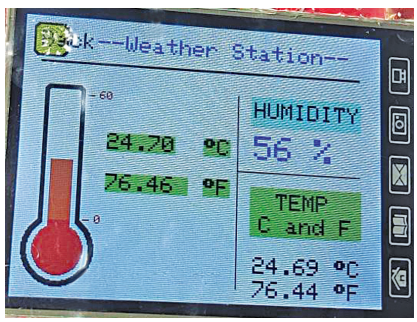


Fig. 9: Temperature and humidity readings

TouchScreen.h

One of the challenges in the project is calibrating the touch points in the touch-screen display.

Depending on the model and size of the touch-screen display, you need to calibrate x and y coordinates. The calibrated values in the code used by the author are shown in Fig. 6.

After uploading the code to Arduino Uno board, mount the TFT touch-screen on top of the Arduino board through the header pins already provided on Arduino board. You can carefully place it with a slight push on the touch-screen from top. Ensure the correct positions of the male header pins from touch-screen display are inserted into the corresponding female pins on the Arduino board.

Now you can connect the board to USB port of your PC/laptop or use a 9V-12V DC supply.

As soon as the power is on, the touch-screen display will turn on and you can see the main console panel on the TFT touch-screen, as shown in Fig. 7.

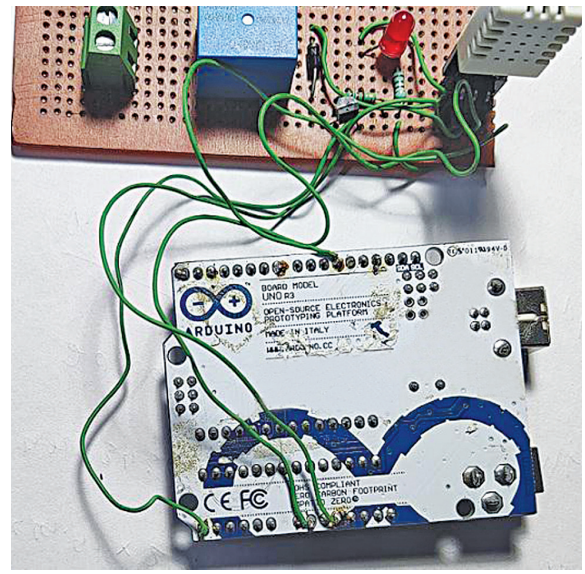


Fig. 10: Soldered connections

To control the device, such as light or air-conditioner connected across the relay, touch the 'Device Control' option. There are on and off buttons in Device Control section, as shown in Fig. 8. When you touch 'on' button, the LED will glow and at the same time the electrical device/appliance connected across the relay will turn on. Touch the 'off' button to turn it off.

If you touch the 'Weather Station' option, it will take you to another screen, as shown in Fig. 9. Here, you can see the current humidity and temperature values captured by the DHT22 sensor. The humidity here is basically the relative humidity expressed in percentage, which represents the amount of water vapour in the air at a given temperature compared with the maximum possible water vapour at that same temperature. Here the temperature values are read in both °C and °F units. So, no conversion is required.

Construction and testing

The circuit can be assembled on a bread-board or Veroboard. The author used a 10x3cm size Veroboard to mount the relay, sensor, transistor, LED, 2-pin terminal connector (optional), and the two resistors.

Since most of the Arduino pins are used by the TFT touch-screen display, you need external wires to solder at digital pin 11 of Arduino for the relay driver and analogue pin A5 for the DHT22, as shown in Fig. 10. You also need to solder 5V and GND pins of Arduino for power supply to the Veroboard. If you are using DHT22 sensor instead of the module, make sure you connect a 5-kilo-ohm pull-up resistor at its output pin, otherwise you may not get correct temperature and humidity readings.

Also note that some 6cm TFT touch-screen displays may not work. So, it is recommended to use the model shown in Fig. 3. If you want to control an appliance like cooler or AC, you need to replace the sugar-cube relay with a high-power relay having contact ratings above 16A.

Though you can power the circuit by connecting it to USB port of your PC, you can also power it with external power supply through the DC jack on the Arduino board. The author used a 9V DC power adaptor to power the Arduino board. When power is connected to the circuit you will get the main console screen, as shown in Fig. 7. EFY

EFY Note
The source code of this project is available for free download at *source.efymag.com*

Sani Theo is an electronics enthusiast, circuit designer, and technical editor

EFY TESTED Sani Theo

VARIABLE POWER SUPPLY
For Up To 3A Current

S.C. DWIVEDI

The circuit presented here can provide up to three amperes of current for a 5V, 6V, 8V, or 9V supply. It uses the popular adjustable voltage regulator LM317, which is inexpensive and is used generally for variable power supplies with up to 1.5 ampere current.

With the addition of PNP transistor TIP127 in the circuit, we get a 5V to 9V variable power supply with 3A current rating. However, suitable heatsinks for LM317, TIP127, LM7809 and an exhaust fan for cooling the TIP127 are required.

The author's prototype is shown in Fig. 1. The block diagram of the variable power supply is shown in Fig. 2 and its circuit diagram in Fig. 3.

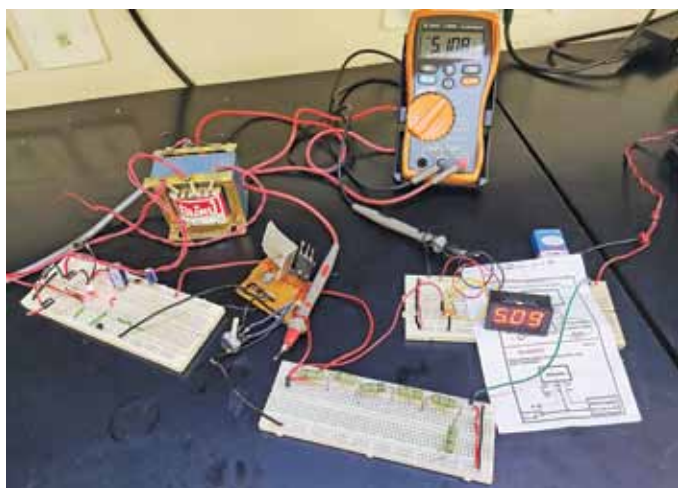


Fig. 1: Author's prototype

Circuit and working

The variable power supply is built around step-down transformer X1, four 1N5408 rectifier diodes D1 through D4, an LED, TIP127 transistor T1, LM317 adjustable voltage regulator IC1, 9V voltage regulator IC2, and a DC digital panel meter (DPM). A 22-ohm, 2-watt resistor (R1) is connected between the base and emitter of T1 to control the current. Pot VR1 is used to control the output voltage. The output voltage can be seen on the DPM.

The output voltage can be set to 9V and the current drawn is around 3A. The voltage across resistor R1 makes transistor T1 to conduct and most of the current is drawn from

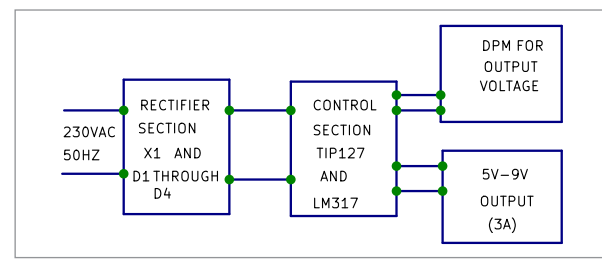


Fig. 2: Block diagram

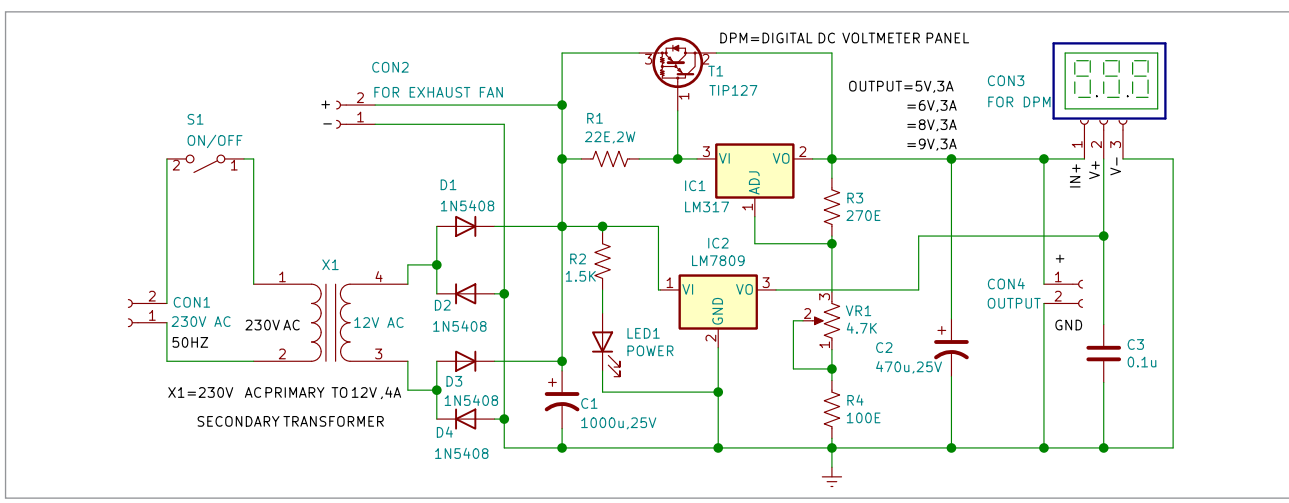


Fig. 3: Circuit diagram

emitter to collector of T1. As lesser current passes through LM317 and most of the current flows through T1, heatsink of IC1 is less warm as compared to the heat sink of transistor T1 heat sink. So the heat sink for T1 needs to be bigger than the heat sink for IC2 and IC3. Use of exhaust fan helps in proper dissipation of

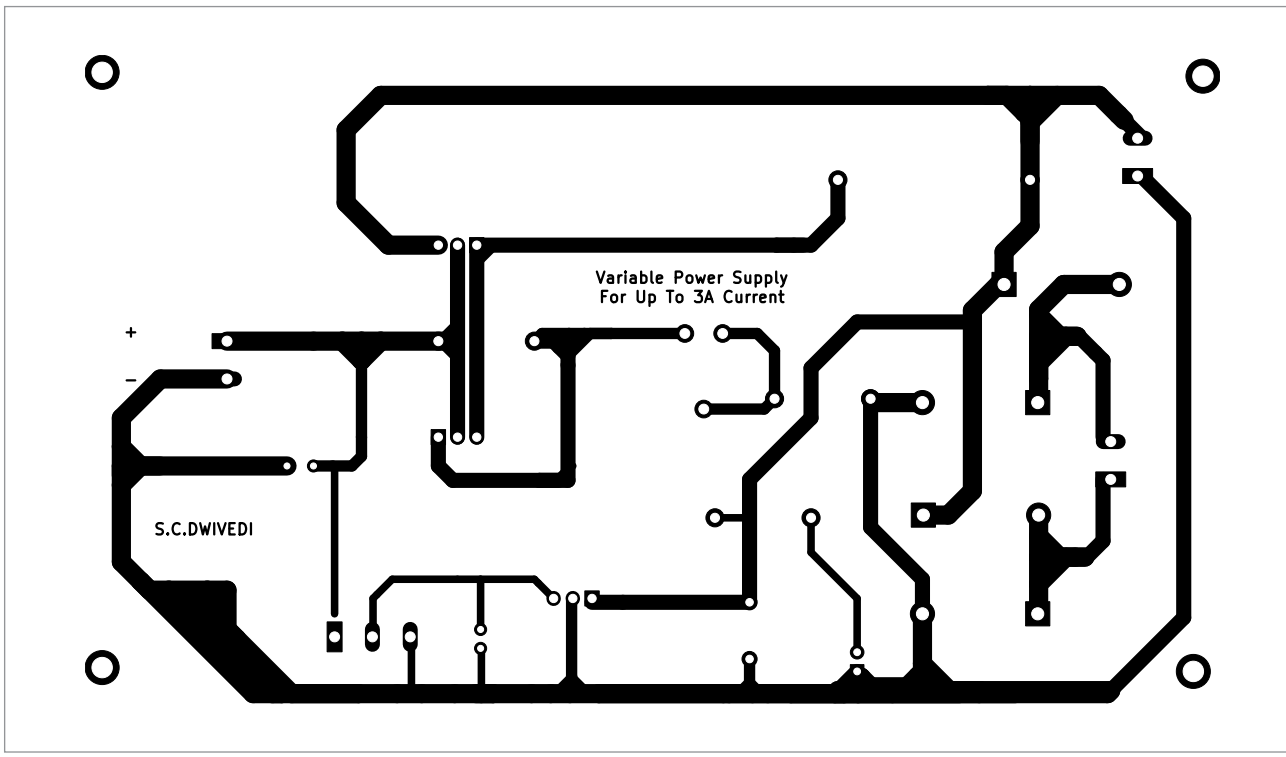


Fig. 4: Actual-size single-side PCB layout

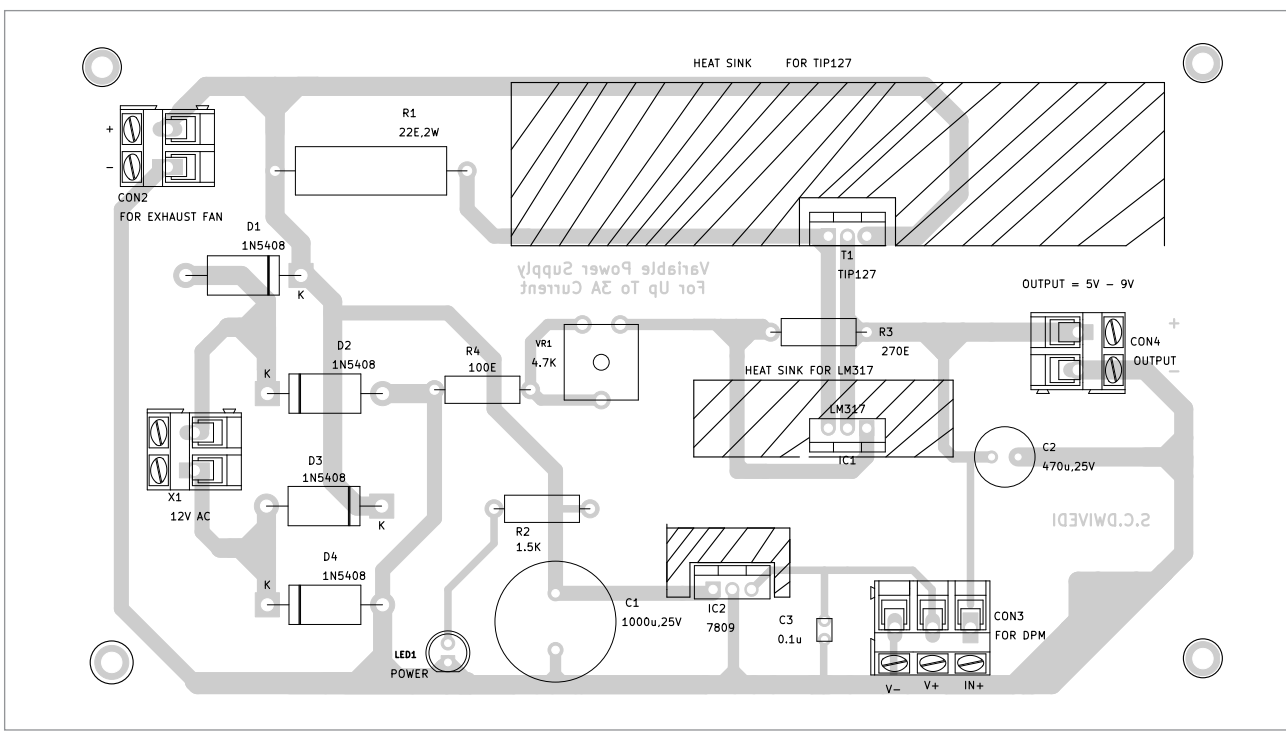


Fig. 5: Component layout

the heat. With more current needed by the load, transistor T1 conducts more and the current bypasses the LM317.

LED1 glows when 230V AC supply is on. VR1 is used to vary the output voltages according to your requirement. The voltage is shown on DPM.

Construction and testing

An actual-size, single-side PCB for the 3A variable power supply is shown in Fig. 4 and its component layout in Fig. 5. After assembling the circuit on PCB, enclose it in a suitable cabinet. Do not forget to use suitable heat-sinks for transistors TIP127, IC LM317 and IC LM7809.

Connect +12V power supply to exhaust fan from CON2 provided in the PCB. Also connect VR1 and LED1 via 2-pin wires from PCB to front panel.

PARTS LIST

Semiconductors:

IC1	- LM317 adjustable voltage regulator
IC2	- LM7809
T1	- TIP127 PNP power transistor
LED1	- 5mm LED
D1-D4	- 1N5408 rectifier diode

Resistors (all 1/4-watt, ±5% carbon), unless stated otherwise:

R1	- 22-ohm, 2-watt
R2	- 1.5-kilo-ohm
R3	- 270-ohm
R4	- 100-ohm
VR1	- 4.7-kilo-ohm pot (potentiometer)

Capacitors:

C1	- 1000µF, 25V electrolytic
C2	- 470µF, 25V electrolytic
C3	- 0.1µF ceramic disc

Miscellaneous:

X1	- 230V AC primary to 12V-0-12V, 4A secondary transformer
S1	- On/off switch
CON1 (for X1), CON2, CON4	- 2-pin terminal connector
CON3	- 3-pin terminal connector
DPM	- Digital DC voltmeter
	- 12V small exhaust fan
	- Heat-sink for TIP127 (big size)
	- Heat-sinks for LM317 and LM7809

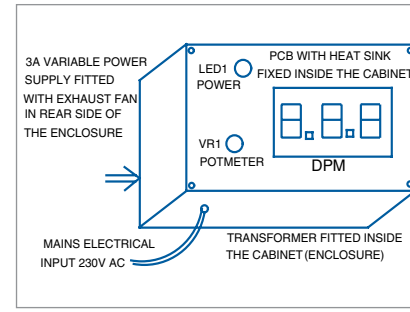


Fig. 6: Proposed layout of the parts in cabinet

Fix a small exhaust fan just behind the heat sink of TIP127 to get proper output. Also provide a window on the rear side of the cabinet for the exhaust fan's air outlet. Fix LED1, pot VR1, and DPM on the front side, and CON1 and CON2 at rear side of the cabinet. A placement of the parts in the cabinet is shown in Fig. 6. EFY

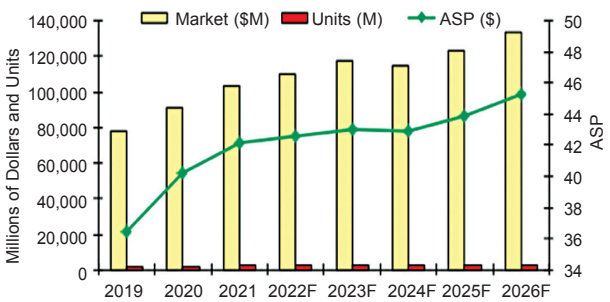
S.C. Dwivedi is an electronics enthusiast, circuit designer and technical article writer



THE DASHBOARD

Microprocessor Growth Will Slow in 2022 After Cellphone MPU Surge

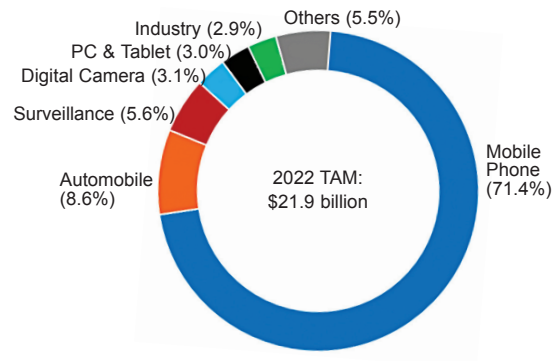
Total microprocessor sales in 2021 maintained strength, growing 14% to a record-high $102.9 billion after climbing 16% in 2020. Worldwide sales growth in total microprocessors is expected to slide back in 2022 to an increase of 7%, which will lift the MPU market to another record high of $110.4 billion, with unit shipments rising 6% to 2.6 billion processors.



(Source: IC Insights)

Global CIS Market Revenue to Reach $21.9 Billion in 2022

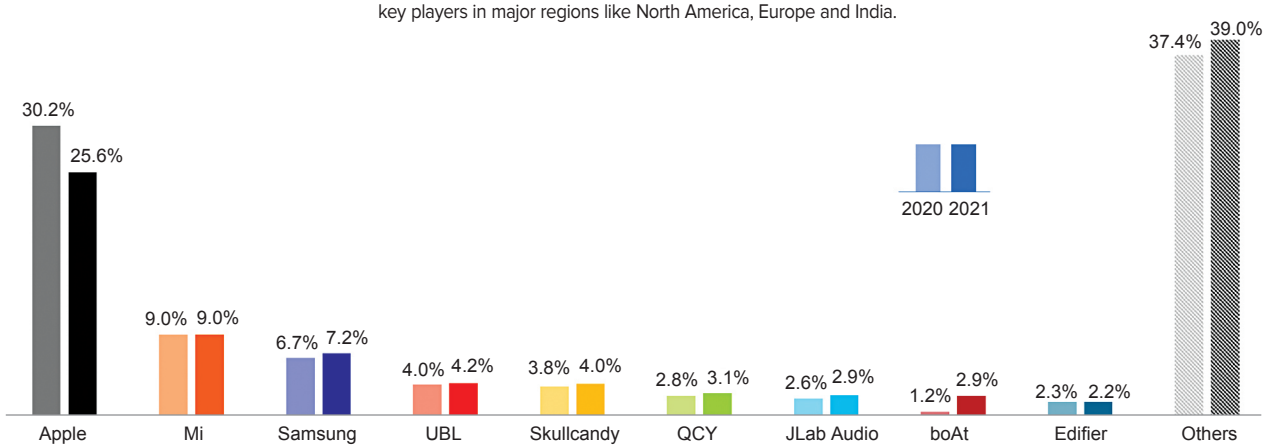
The global camera images sensor (CIS) market revenue is expected to grow 7% in 2022 to reach $21.9 billion, largely driven by increasing demand from the smartphone, automotive, industrial and other applications. Sony is expected to capture a 39.1% revenue share in 2022, followed by Samsung (24.9%) and OmniVision (12.9%).



(Source: Counterpoint Research)

Global TWS Shipments Reach 300 Million in 2021

The global TWS hearables market shipments in 2021 grew 24% YoY in unit sales and 25% in terms of value. TWS market leader Apple saw a slight increase of 5% YoY in its unit sales but its market share fell to 25.6%. Skullcandy and boAt showed noticeable growth, as they became key players in major regions like North America, Europe and India.



(Source: Counterpoint Research)

Worldwide Silicon Wafer Shipments and Revenue Set New Records in 2021

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Area Shipments (MSI)	9,043	9,031	9,067	10,098	10,434	10,738	11,810	12,732	11,810	12,407	14,165
Revenues ($ bn)	9.9	8.7	7.5	7.6	7.2	7.2	8.7	11.4	11.2	11.2	12.6

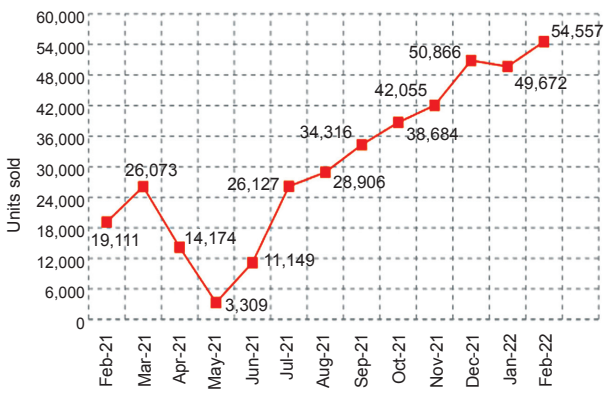
Worldwide silicon wafer area shipments in 2021 increased 14% while wafer revenue rose 13% compared to 2020, topping $12 billion, to reach new all-time highs. Silicon shipments totaled 14,165 million square inches (MSI) compared to 12,407 MSI shipped in 2020 to meet surging broad-based demand for semiconductor devices and a wide variety of applications. Wafer revenue reached $12,617 million, surpassing the previous record of $12,129 million set in 2007.

(Source: www.semi.org)

At-a-glance view of key industry trends that can shape the future of your business…

EV Sales Pick Up Pace in India

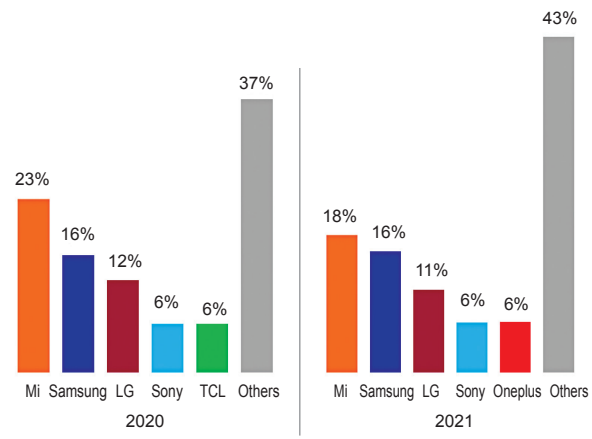
The overall EV sales in February 2022 bounced back to its growth trajectory, clocking 54,557 units. This signifies a month-over-month rise of 10% and a YoY jump of 185%. EV registrations in February 2022 were driven by electric two-wheelers and passenger-type electric three-wheelers, which together accounted for 89.75% of total registrations in the month.



(Source: JMK Research)

India Smart TV Market Records Highest Ever Shipments in 2021

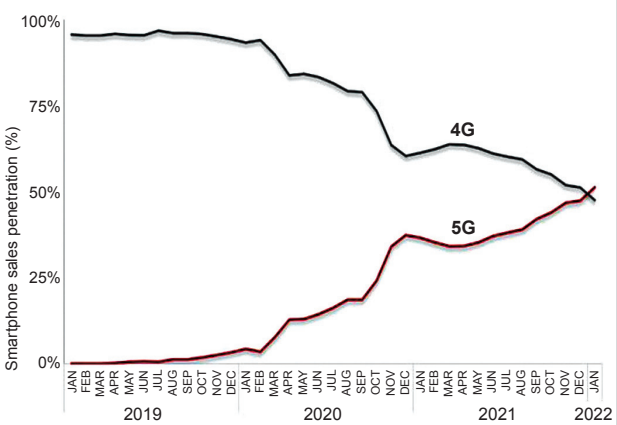
India's TV shipments grew 48% YoY in Q4 2021 (December quarter) and 24% YoY in 2021. The smart TV market grew even faster at 55% YoY in 2021 and 65% YoY in Q4 2021 to reach its highest ever shipments for a calendar year. Xiaomi continued to lead the smart TV segment in 2021 with an 18% market share.



(Source: Counterpoint Research)

Global 5G Smartphone Sales Penetration Surpassed 4G for First Time in January 2022

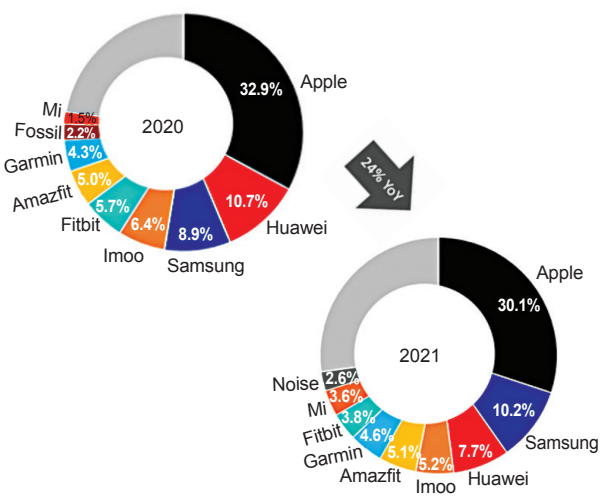
Sales penetration of 5G-capable smartphones reached 51% globally in January 2022. China, North America and Western Europe were the biggest drivers of this growth. China had the highest 5G penetration in the world at 84% in January.



(Source: Counterpoint Research)

Global Smartwatch Market Grows 24% YoY in 2021

The global smartwatch market shipments hardly grew in 2020 due to COVID-19, but they recorded a healthy 24% YoY growth in 2021. The fourth quarter alone saw shipments of more than 40 million units, the highest quarterly shipments ever. Samsung was one of the most successful smartwatch OEMs in 2021.



(Source: Counterpoint Research)

SOLDERING MACHINE INNOVATIONS
Target Better Flexibility And Temperature Control

Are you planning to buy a new soldering system, equipment, or robot for printed circuit board assembly in your manufacturing unit? Here is a quick look at recent features—just what you want to know before investing

ABBINAYA KUZHANTHAIVEL

The electronics industry is advancing rapidly in technology, and automation is taking the lead in manufacturing spaces. Automating the soldering process is found to be a more efficient alternative to hand soldering, with the latest technologies and soldering accessories in place. However, there are significant applications that still need hand soldering, and hand soldering stations are not going to go out anytime soon. So, you need to consider the best-in-the-class in both automated and hand soldering, before making the right choice to help you save costs, improve quality and productivity, and ensure standard safety practices.

Trendy features in recent launches

The recent machines and soldering stations have undergone incremental improvements from the previous generation models with more focus to provide manufacturers with efficient temperature and power control, and motion flexibility.



Pillarhouse Orissa Synchrodex Pro (Credit: www.pillarhouse.co.uk)

Capability to handle large PCBs. The industry is handling large printed circuit boards (PCBs) that are used in supercomputers and servers with complex miniature components. Hence the recent launches have more focus on the maximum size of printed circuit boards that can be soldered in the machine.

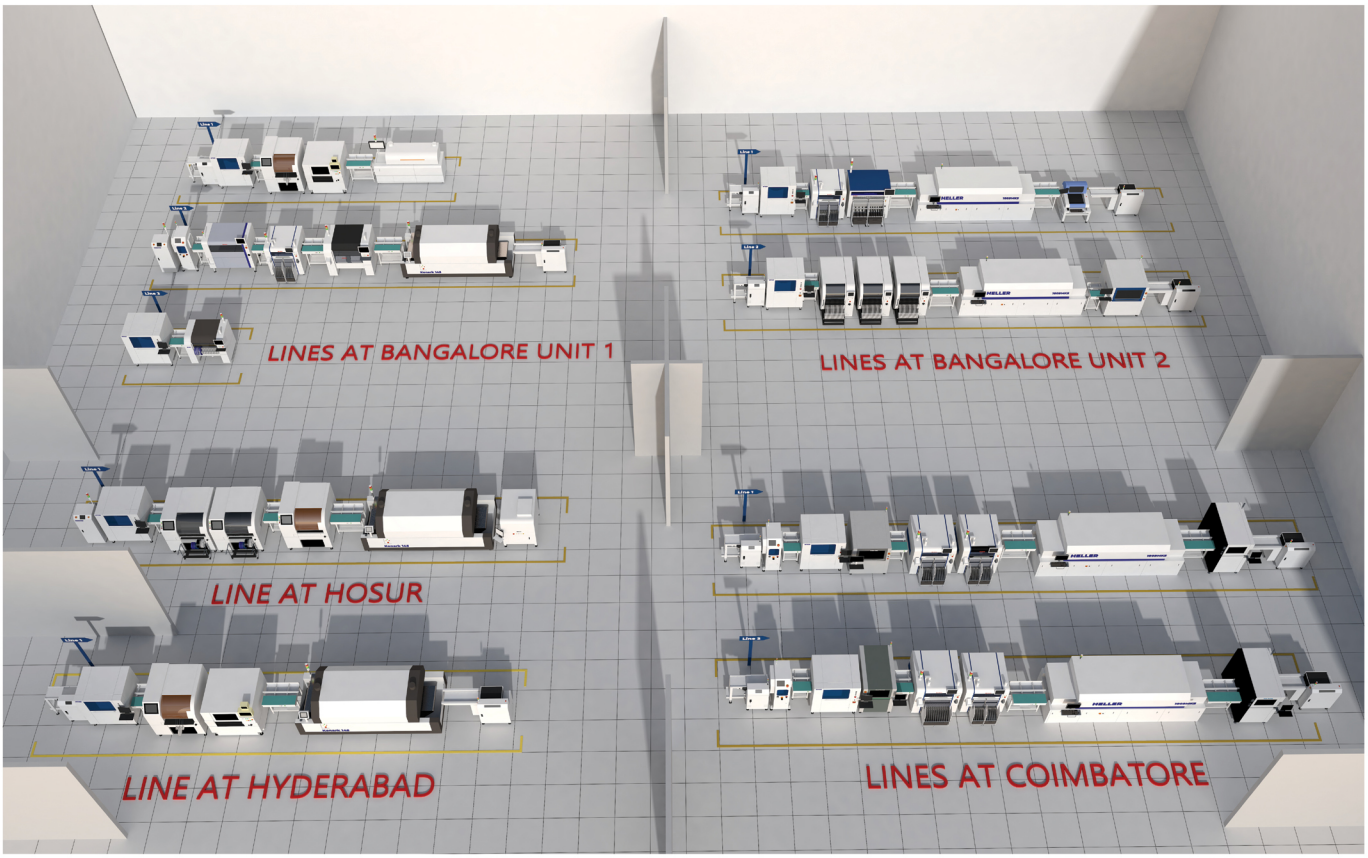
According to Bittele Electronics, a PCB assembly house headquartered in Canada, the largest panel size available is 14.50 × 1.37 metres, which can be fabricated for two-layer boards. The company can fabricate four-layer boards with maximum size of 0.55 × 1.35 metres. Manufacturers say that there will be additional fabrication cost for PCBs that have sides longer than 50.8 centimetres. For example, Pillarhouse Orissa Synchrodex Pro is a selective soldering system that can process PCBs up to 114.3 × 60.96 centimetres when using the XL frame size.

Combined systems. The most popular and best soldering equipment comes in integrated packages that are either fully or semi-automatic. Fully automatic are those with soldering modules or soldering robots, safety covers, conveyors, loaders, and unloaders, while semi-automatic are the soldering modules or robots which can be retrofitted into automatic packages to reduce the number of steps and make the process quick and eliminate the need for expensive carriers used in processes like wave soldering.

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The REECO Soldering Robot is an example in which two or more robots can form cooperative assemblies and, for example, can work with other equipment, loader, and unloader stations. The robot uses programmable logic controller (PLC) system to control all auxiliary equipment, such as transport, soldering generator, wire feeder, and tip cleaning station.

Temperature and wattage control. Temperature control is one of the most important factors in soldering systems to avoid faulty soldering. Wattage is a parameter to indicate how rapidly the heating element can raise the tip temperature.

An iron rated at 25 watts may take over a minute to bring the tip temperature up to 660°F (about 349 degrees centigrade) from room temperature and the one rated at 130 watts will get there in a couple of seconds. Moreover, when the hot tip transfers heat to the cooler PCB pad and component leads, it can become colder. Hence the heating element is used to maintain tip temperature. Lower wattage soldering irons cannot replenish the heat lost and may lead to defective soldering. So, it is advisable to select stations equipped with minimum 60 watts heating power.

In contrast to the popular belief,



QUICK ET9484E soldering robot



REECO Soldering Robot (Credit: www.renex.pl/en)



Ersa VERSAFLOW ONE

the high-wattage iron will not destroy delicate components. A temperature-controlled soldering iron is designed to switch off the heater when the tip reaches a preset temperature. A powerful heating system will only ensure quick thermal recovery during soldering. The soldering station with 130 watts of heating power will not be of much use if the tip is allowed to get cold before the heating element kicks in.

So, remember to choose stations with closed-loop temperature control. A digital closed-loop temperature control system comes with a heating element, temperature sensor, and also a microprocessor control unit. It is a common feature to prevent both temperature undershoot and overshoot while soldering.

The Hakko FX-951 is a relatively more modern station with direct heat soldering technology that not only allows it to react faster to thermal changes but also maintain tip temperature. The tip in such stations is a composite design available as a unified package with heating element and thermocouple to avoid thermal drift.

In the automated lines, QUICK ET9484E Soldering Robot is a new launch that features a robust hot iron system with a superior closed-loop temperature sensing feedback. Two fine-toothed gears work to pull solder from the solder spool. It then perforates the solder wire, allowing better out gassing of flux core, resulting in less solder ball and flux splatter defects.

Ersa's VERSAFLOW ONE is another model with improved heating in the cross profile, which significantly reduces machine's power requirements.

Heat technology. Induction soldering is a process where two or more metals are joined together by melting and flowing a filler metal (solder) into the joint interface. It does not involve melting of the joints. This often gives a bit weaker joint compared to a brazed one but is a desirable result for many sensitive electronics or small components. Curie Heat Technology is where the iron tips respond to the thermal demands of each solder joint by adjusting the power instantaneously, thereby meeting the exact requirements of the substrate component and solder material.

One of the most critical aspects in soldering is choosing the right solder tip, which helps to achieve uniform heating of component leads and pads on the PCB. Some soldering solutions, such as Metcal's SmartHeat Technology, can be used with the necessary tips and cartridges to ensure proper soldering. The cartridge in here is made of a heater of proprietary design and has a non-heating copper core and an outer heating layer of magnetic alloy. The composition of the alloy predetermines the tip temperature, and it can self-regulate maintaining constant temperature (±1.1°C).

More axes. Traditional robotic sol-

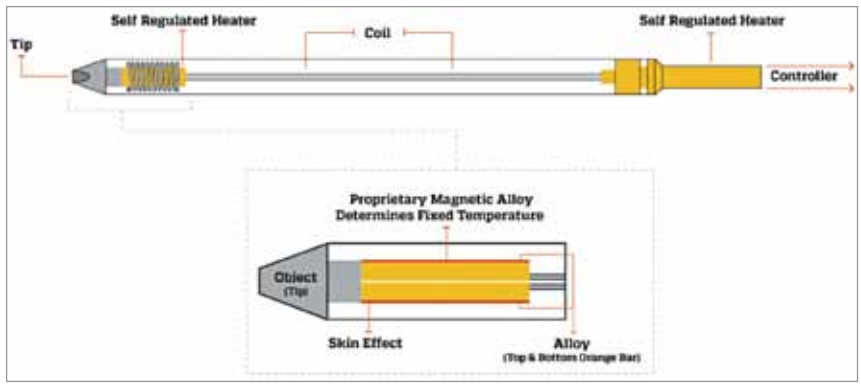
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Metcal SmartHeat Technology



TMT R9900S Inline Robot Soldering System (Credit: www.thermaltronics.com)

dering machines that feature linear motion in 3-axis and 4-axis type soldering robots are currently available in the market. In 3-axis, the soldering tip moves in 3 directions—X, Y and Z, with Z as the movement of the base plate. Similarly, in 4-axis type the tip moves in 3 directions—X,Y and Z, and in an angular momentum of the soldering tip. Here, the soldering tip can change its angle to match any angular surface on a PCB.

The 6-axis soldering works a bit differently from the 3-axis and 4-axis types. Conventionally, a solder wire is fed to the soldering tip to perform a solder joint on a PCB. However, as per the IPC soldering standards, the solder wire must be fed to the joint and not to the soldering tip. This type came up as a solution to comply with IPC standards where the robot has two independent mechanisms—one to feed the soldering wire to the joint directly and the other to solder on to the PCB.

The latest upgrade is the 8-axis soldering that works slightly differently from the other types, giving 360 degrees of freedom. This increases the capabilities of the robot to perform operations in fewer setups. Considering that each setup requires additional power, material, and time, fewer setups translate into cost-savings. Thermaltronics Inc's TMT RS0099S is a model with 8-axis capability and 360° independent fixture rotation.

Laser soldering. Laser soldering is a non-contact process that eliminates the risk of marring or damaging sensitive components. This technique gives flexibility and is found to be suitable for mass production. As the system has a completely closed structure, it is free of pollution and ensures safety. It also provides process enhancements and zero consumable expenses.

The recent launches have various techniques that use different laser beam shapes like ring type or square type. It gives flexibility for manufacturers to choose the shape considering their board pattern and components to avoid burning sensitive parts. A few machines have also come up with beam-splitting technology providing twin-spot lasers to simultaneously solder two joints. Japan Unix Laser Soldering Equipment is among the recent launches featuring various patented laser beam shapes suitable for micro-soldering applications.



Japan Unix Soldering Equipment

Micro-soldering. Some components used in a PCB board are smaller than the size of a grain and micro-soldering uses smaller tools to solder them. One can connect even small wires that are nine microns in size. Laser soldering systems are found to be effective for micro-soldering.

"A laser's parameter is much smaller than even the finest soldering tip. It can reach spaces that are too narrow or inaccessible for an iron tip. As electronic parts become smaller and more intricate, this is becoming more relevant," says Shailendra Mathur, business head at Maxim SMT Technologies.

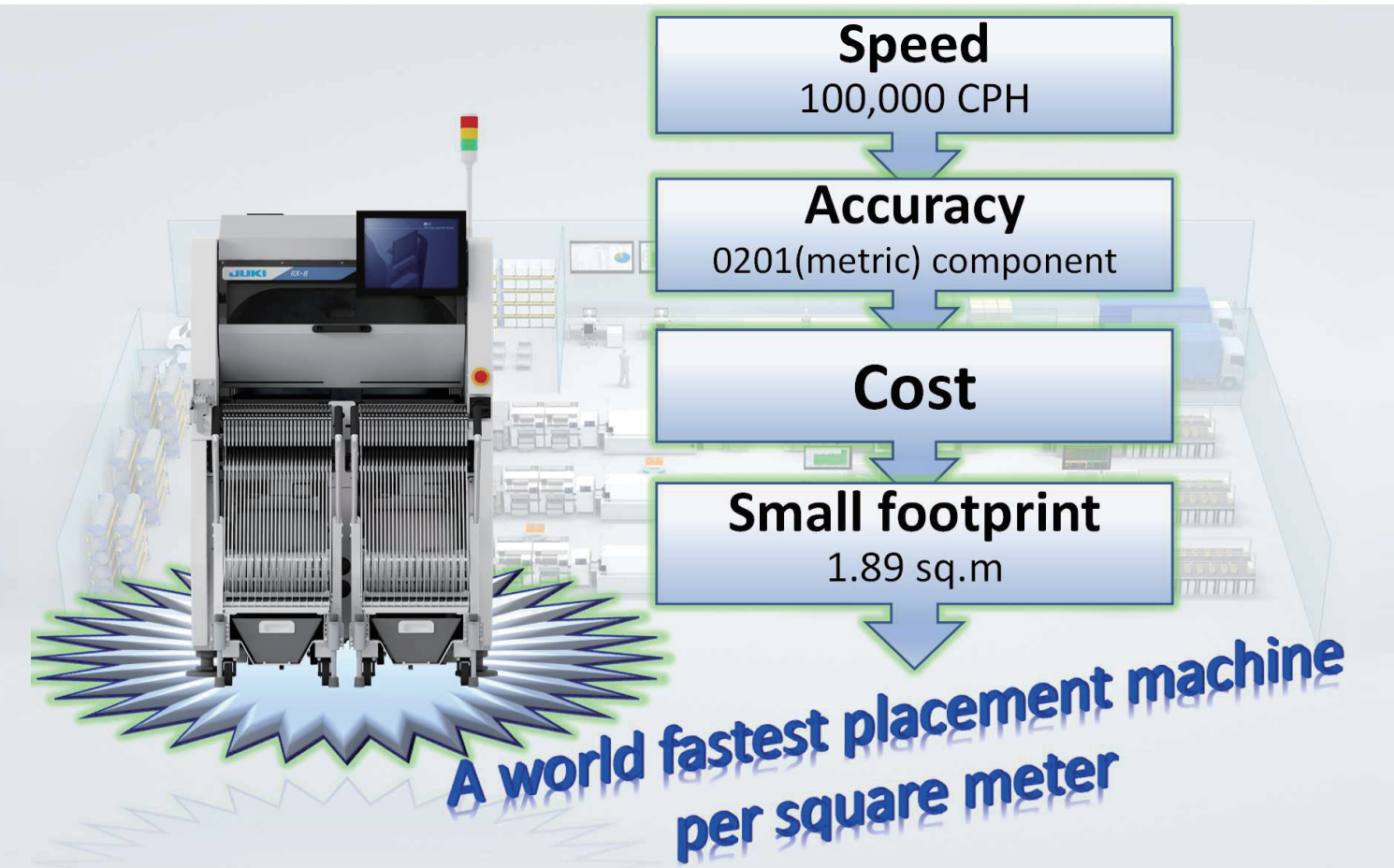
Advanced software. CAD/CAM software has become increasingly democratised, more affordable, and accessible. The recent software systems allow robots to be set up with minimal programming in a few steps. These software can be easily integrated with real-time analysis, model based definition (MBD) software, and 3D viewing systems, thereby enabling quality improvements with reduced chances of user errors.

Apollo Seiko's L-CAT NEO-N is one of the soldering robots that allows reduction in cycle time and makes programming and setup much simpler. Robot teaching can be performed by the touch panel teaching pendant, a computer, or a tablet.

Dual port operating

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Apollo Seiko L-CAT NEO-N (Credit: www.apolloseiko.com)



HAKKO FM-203 (Credit: https://hakkousa.com)

solder station. Since PCBs have different components, there is a need to use soldering tips of different shapes, sizes, and temperatures depending on the application. Even using a cartridge type tip may not be easy as it needs to be replaced to continue the soldering process. With recent advancements in technology, soldering stations give the convenience of getting two different tasks done with one station.

The dual port soldering station HAKKO FM-203 comes with another handpiece connected to the other port/channel which has temperature settings and tip shape installed.

IoT solder station. The Internet of things (IoT) soldering station represents the latest evolution of the soldering station connected to the company network that enables full traceability for manual soldering. As soon as the soldering station is integrated into a company network, all mobile devices in the company network can access and communicate with the soldering stations via web browser. The server based communication concept makes it easier to manage individual soldering stations and makes the process documentable.

For instance, the i-CON TRACE is claimed to be the world's first fully networkable soldering station with integrated wireless local area network (WLAN), Bluetooth, and network card.

The way forward: automation

Soldering becomes more precise and error-free when automated, and is ideal for soldering complex components onto PCBs for a variety of applications in the fields, including automotive, aviation, and telecommunications. The equipment comes as hi-tech integrated packages, while robots come with various features with sturdy construction design to give optimum performance. Both have similar features like high-resolution cameras to support soldering with real-time view, vision alignment, great temperature control, superior thermal feedback system, nitrogen systems, and many more for most challenging solders. Therefore, industry experts believe both robots and soldering equipment are ideal for the soldering process.

"Choosing a soldering equipment or robot is an application-driven query. There are different needs for PCBs coming to the manufacturers. For instance, if a board has more thermal demands, we look for machines with more pre-heating technologies, and if something has more small components, we look for the availability of micronozzle features. It is also important to consider the size of the mother boards, and selective soldering is a great solution to solder larger boards. However, manual soldering may not be advisable for miniatures used in IoT devices or auto-ancillary equipment," says Arvind Gopal Joshi, director at Accurex Solutions, a sales and support provider of capital equipment used for pcba.



i-CON TRACE (Credit: www.kurtzersa.com)

Joshi suggests looking at specific standards while planning automation. "The automated equipment launched in recent times are designed to meet standards like the IPC 2591 connected factory exchange (CFX)," he says.

According to the IPC global trade association, the IPC 2591 is the open industry standard that supports IPC-CFX. The standard applies to communication between all executable processes in the manufacture of printed board assemblies—automated, semiautomated, and manual—and is applicable to related mechanical assembly and transactional processes.

Despite the high initial expense in setting up both equipment or robots, over time automated soldering proves cost-effective compared to soldering by hand. By using automated machines, both the cost of labour and costs associated with the training and re-training of soldering experts is reduced. Additionally, the increased precision afforded by these machines can ensure better quality work that eliminates the need for rework. Investing in good quality parts and accessories further reduces costs over time.

The automated systems will be more prevalent in the future while they would still be working along with humans, assisting the experts to do their job more efficiently and effectively. EFY

The author, Abbinaya Kuzhanthaivel, is a technology enthusiast

NeoDen Auto SMT Pick and Place Assembly Line



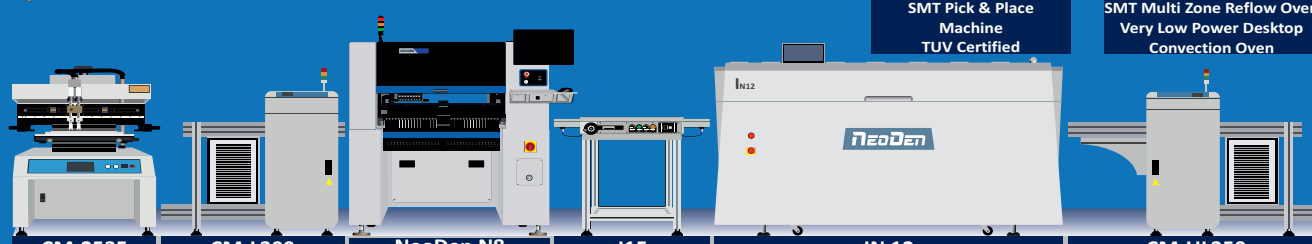
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STARTUPS & INNOVATORS

1 DaveAI: The Self-Learning Digital Avatar
2 Convert Your Bicycle to e-Bike with Easykit
3 VFLYX Drone at Your Service

1 DaveAI: THE SELF-LEARNING DIGITAL AVATAR

Imagine a digital bot in a showroom or bank who understands your preferences and helps you make the right pick. DaveAI, a Bengaluru based startup takes customer experience to an all-new level with such interactive bots. The firm, powered by the Intel Startup Program, works in retail, automobile, and banking, financial services, and insurance (BFSI)



Meet Katelyn, a state-of-art AI avatar with vision, speech, and a sales brain

In a store, you have salespeople who introduce the products or services the firm has to offer and influence you. This is missing in a virtual sales experience. In product segments like auto, banking, or lifestyle retail, such product introduction has moved online first but enterprises still rely on traditional e-commerce, which is not designed for complex product segments.

DaveAI is a digital human avatar that can assist customers with everything that is done in an offline store. It can demo products, showcase products in 3D, help visualise various configurations, and also nudge customers with relevant recommendations. The avatar can talk to customers in different languages and can be deployed on any preferred channel such as kiosks, websites, or immersive environments like the metaverse.

With Intel's backing, DaveAI is delivering this experience at the edge. In retail, these are in-store kiosks, and in banks these are AI Micro branches. AI Micro branch offering replaces a physical branch and enables users to interact with an AI avatar in a language of their choice to conduct banking transactions.

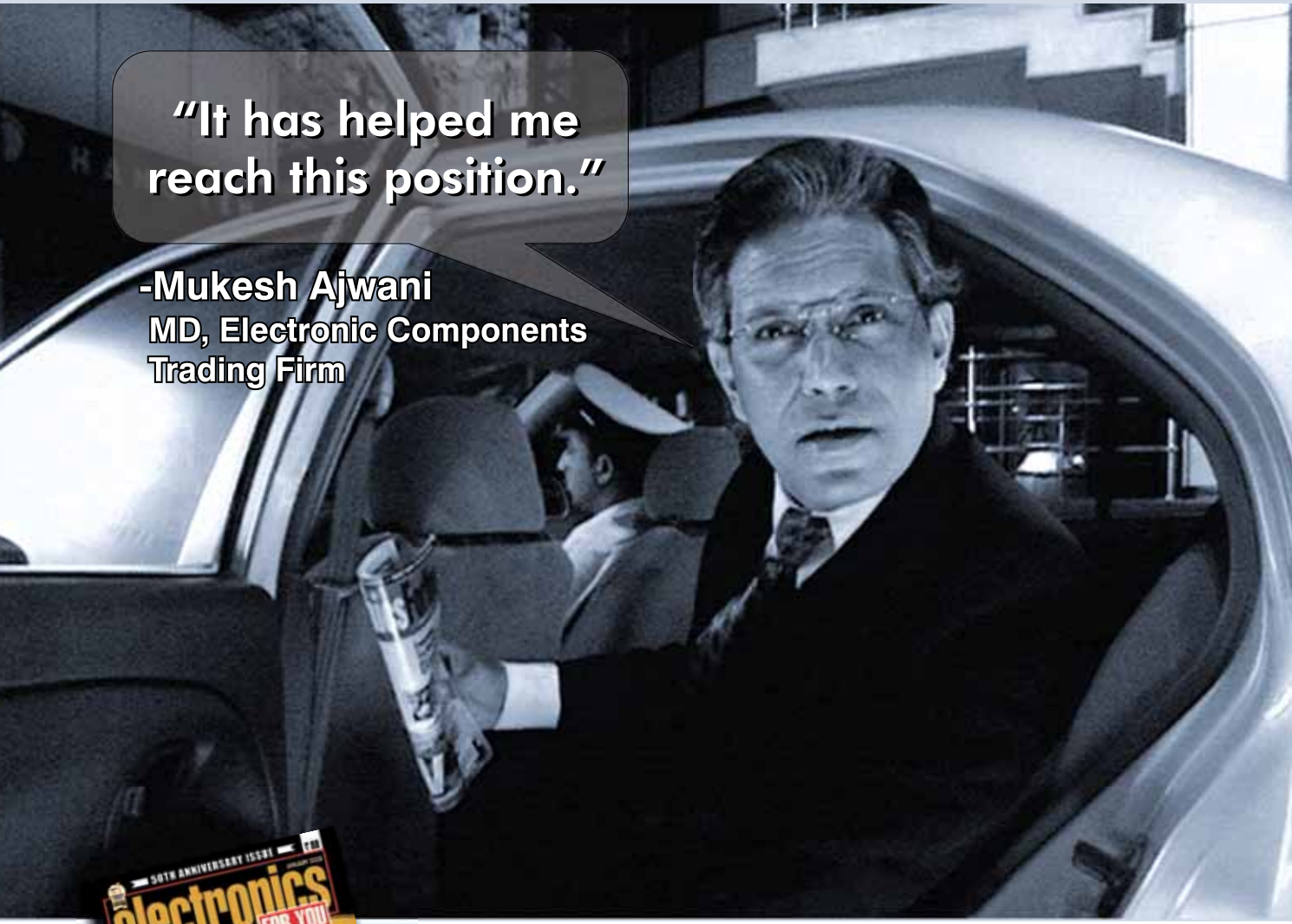
"DaveAI avatars are powered by vision, speech, visualisation, and an AI sales brain. It's a complete package and not just a good looking digital persona," says Sriram PH, one of the co-founders of DaveAI.

The avatars can learn on the go based on customer interactions, unlike traditional business intelligence or analytics systems. In some cases, the avatar is set up with very minimal data for the system to learn and improve as more and more customers interact. DaveAI uses a multi-dimensional affinity engine that creates an affinity graph in real time to map customer preferences vs product attributes. The online learning algorithm adapts these affinity scores based on real-time interactions.

With all intelligence combining physical and digital spaces, Sriram says that delivering high perfor-

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mance and impactful experiences on low graphic processing unit (GPU) is a big challenge, which they are solving with the help of a proprietary technology. "The avatar for every interaction leverages compute and graphic-heavy AI workloads, such as computer vision, speech and NLP, 3D visualisation, and a flexible data model. To create a low latency and realistic experience at each touch point is a technology challenge that we solve. It is a constantly evolving space that requires to stay ahead in the innovation curve as the ecosystem evolves," he adds.



Ashok (left), Co-founder & Domain Lead; Sriram PH (centre), Co-founder & CEO; and Dr Ananth (right), Co-founder & CTO

All of these workloads are running at edge right now and allow the system to learn in real time, which means it needs to be a high-power compute. How to optimise these complex workloads at the edge is an ongoing challenge. With the open alliance partnership with Intel, the firm is working on joint research projects to improve these experiences.

Currently, DaveAI is a full-stack platform, which is available as a subscription model for customers.

The platform is also available on a perpetual license model in case the enterprise mandates deployment on their cloud or premises. Their partner model allows partners to leverage the platform subscription and further deploy the same to customers with required customisation and configuration. The firm plans to expand and is open for partnerships with system integrators and services partners and those with experience in global markets as implementation partners and value added resellers.

2 CONVERT YOUR BICYCLE TO E-BIKE WITH EASYKIT

Domestic startups are taking advantage of the emerging interest in electric vehicles. Strictly Electric is a Mumbai based startup founded in May 2019, which is working on micro-mobility solutions by developing conversion kits

Many e-bikes available in the market are standardised specifically in two or three formats with the battery box attached to the frame. With the powertrain construction taking up most of the manufacturing cost, the attractive frames and other manufacturing components shoot up the final price.

"As most of the users in India already have a bicycle at home, we decided to just upgrade them to electric with Easykit. It can convert any bicycle to an e-bike in around 20 minutes," says Durgesh Garud, co-founder of Strictly Electric.



Easykit is a universal DIY front-



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Founders—Mihir Pawar (left), CTO, and Durgesh Garud (right), CEO

wheel conversion kit with a 250W front-wheel motor, a 209Wh Li-ion battery, a compact charger, easy-to-attach pedal-assist sensor, controller box, throttle, wiring harness, and e-brakes. In contrast to the conventional e-cycles, the battery box is not attached to the frame but sits atop the handle, making it suitable for any model cycle. Any cycle can be turned electric in a few steps like swapping the front tyre with the one provided in the kit, attaching the top assembly consisting of battery and controller, attaching the pedal-assist sensor on the crankset, and by fixing e-brakes and throttle. The user can do all this with the help of an instruction manual.

"Since it is a universal kit, one can just use the same kit on different bicycles. It offers a range of around 25km and can charge up to 70% in an hour. The battery box is compact and detachable, enabling the user to charge the battery anytime and anywhere. Therefore, it eliminates range anxiety with the compact charger," Garud explains.

Speaking about the challenges, Garud says that designing the front-wheel conversion was among the major constraints. "It was not easy to get the motor fixed in the front wheel, especially in India. Since we did not want to source it from other countries, thinking about the cost, we developed it with a manufacturing partner in Pune," he says.

Garud elaborates, "The placement of the battery is fixed in a comfortable position to give the rider a great handling experience. Designing and developing this was another task, which took a lot of research and development. Finally, the battery has to be charged up to 70% in an hour, which was also customised, developed, and is being sourced from a partner in India itself."

While Garud appreciates the government's Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) scheme, he also points out the terms that limit the scheme to those vehicles offering a minimum range of 80km and a minimum speed of 40kmph. He suggests that including low-speed micro-mobility vehicles in this scheme will be a great boost to the market and mass adoption of electric vehicles.

As a startup founder, Garud says patience and perseverance are his best lessons in the journey. He advises the others, "Focus on sustainable growth. Don't compromise on building a great foundation for your startup just for short-term financial gratification. It is really important to get the foundation correct and make sure the product or service you offer adds value to your consumers."

Currently, the firm is operating on direct to consumer (D2C) model, allowing customisation with customer requirements for initial orders. The firm is planning to conduct the next round of funding and is also open to welcome like-minded partnerships. "We have plans to get launched on various e-commerce platforms and in a few retail stores. We also have bigger goals to step into the UAE market soon," he says.

3 VFLYX DRONE AT YOUR SERVICE

With India focusing entry in drone manufacturing with its own drone portals, regulations, and licenses, VFLYX—a Bangalore based startup—is already into manufacturing customised UAVs/drones using in-house hardware and on-board flight software

The parent firm, Xboom, started in 2015 with focus on addressing safety and security products. It eventually started exploring the next level into surveillance using drones. Introducing VFLYX in 2021, the firm has now ventured exclusively into drone sales and operations to cater

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to applications such as land surveys, analysis, and inspections. Xboom recently announced three million dollar funding for VFLYX to improvise the manufacturing and testing facility in India.

One of their latest launches is an agri drone that can fly up to eighteen minutes with larger spray coverage area compared to what is available in the current Indian market.



VFLYX drones are capable of giving a well-balanced performance matrix with flight time of up to fifty minutes, maintaining high speed with utmost stability. "This was achieved by improving the design factor, reducing the overall weight of the drone by 20% to 1.55kg and using the battery of high charge capacity of 13,000mAh," says Vishal Saurav, CEO & Co-founder of VFLYX.

With one of his clients enquiring drones operating indoors for inventory management, his team took up the challenge. "Our drones weren't fit for inside operation with respect to GPS signal requirements for navigation. We overcame this challenge by implementing an inertial measurement unit to get the position and direction of the drone, eventually turning it into a successful project," Saurav adds.

However, Saurav feels India has too many strict regulations for registering and licensing drones. He says, "The number of steps in formalities are high and even the permission to fly is very limited. Though it is being revised largely now, it was one of the major challenges. With expansions and more firms coming into play, I believe India would relax several restrictions and promote easy operations."

Currently operating on a dual model, the firm sells drones and also renders drones as a service (DAAS).

Saurav says this learning came after they realised that many companies were hesitant to indulge in hefty one-time investment on drones. "We turned to providing drones as a service on a rental basis, be it monthly or a plug-n-play model for those who are not looking at upfront high investments. We still cater to those who are open to investing in drones. We found the new model taking off with a speed and increasing our revenues, giving us a deeper penetration into the market," he elaborates.



Vishal Saurav, CEO & Founder, VFLYX India

Sauvrav expects wireless charging drones and drone pods to be the next big thing for drone technology. "It's very important to upgrade your skills and keep pace with the trends and expectations of customers, if you want to be in the game. We are working towards creating economic payload drones for logistics to foster medical and e-commerce growth in near future," he adds.

With the funds from Xboom, the firm has plans to import the essential components to ensure a smoother supply chain. VFLYX, the bootstrapped company, is now planning to expand their talent pool, with focus towards hiring well-trained drone pilots on a large scale. It is also looking for channel partners in around fifteen states in India. EFY

—Abbinaya Kuzhanthaivel

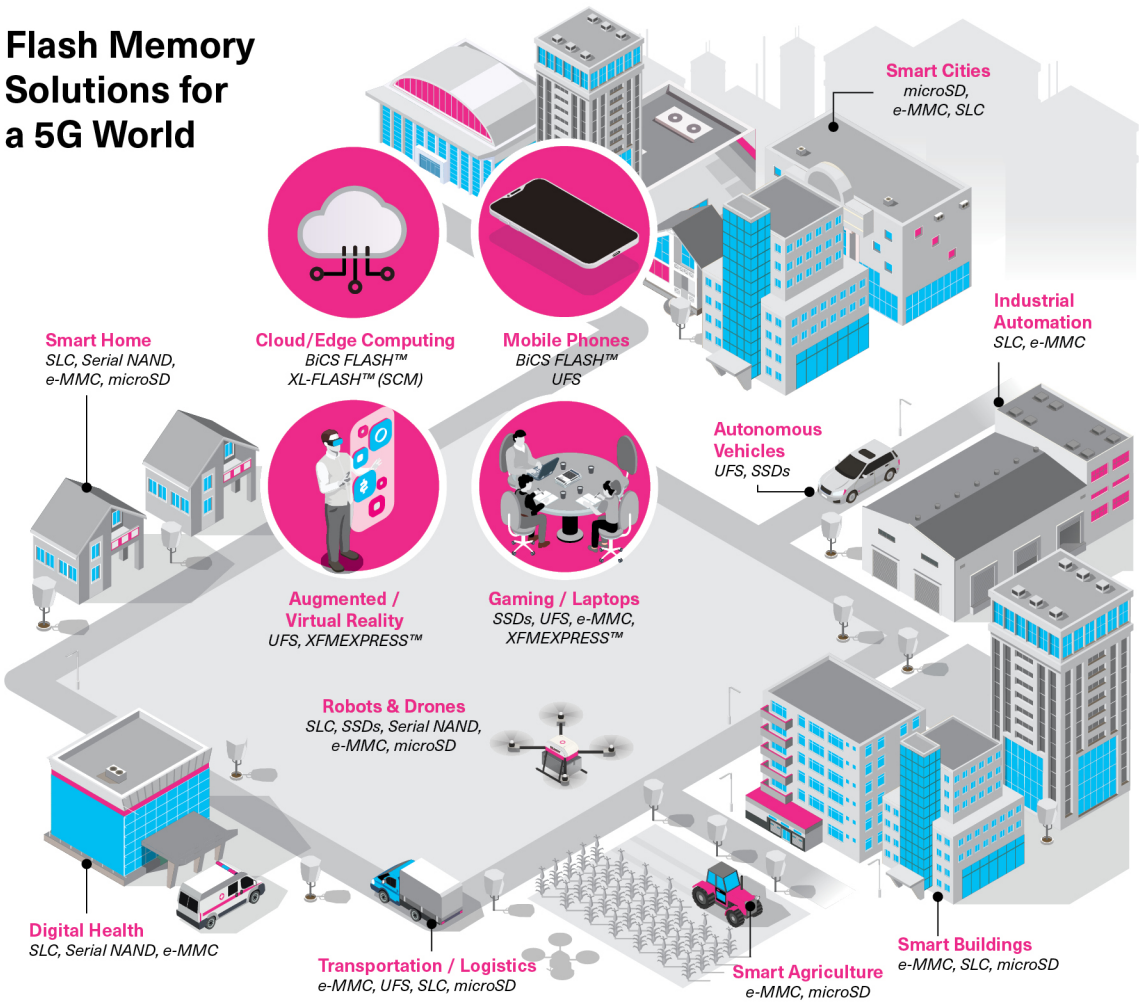
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Automation

Sunil Banwari: INDUSTRY 4.0 Can BOOST Implementation Of SEMICONDUCTOR MANUFACTURING



Manufacturing semiconductors is a vital aspect of electronics empowerment that has not yet harvested the potential of Industry 4.0. Can they complement each other and help answer the crisis of semiconductor shortage the world is facing? Sunil Banwari, Vice President, Advantest Corporation, in an interaction with EFY's Mukul Yudhveer Singh believes that this can create more jobs in the industry

Can implementing Industry 4.0 help us meet the demand for semiconductors, especially with the chip shortage in the world today?

Definitely! Many factors are associated with the shortage of semiconductors. For example, in the automotive industry, companies like Toyota have done really well while others have not. What worked for Toyota is the good visibility in the semiconductor supply chain. The automotive manufacturers usually buy modules from Tier 1 organisations, which are usually similar to electronics manufacturing services (EMS) families.

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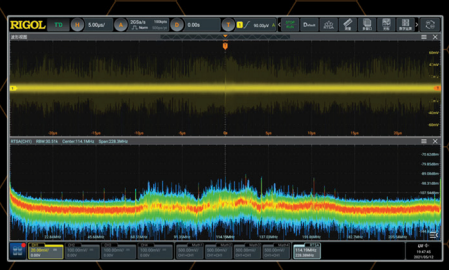
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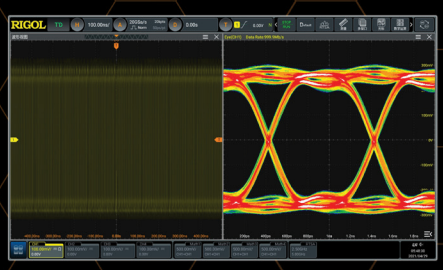


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Real time Spectrum Analysis



Eye Diagram Analysis



Jitter Test



Serial Bus Analysis

The semiconductors and components are bought from suppliers who are two levels below. Which means, the automotive manufacturers are not usually aware of what's happening in the supply chain until it hits them too late. In such a complex scenario, Industry 4.0 can make a major difference by adopting the semiconductor industry. Even with semiconductors being the driving force behind technologies like artificial intelligence (AI) and machine learning (ML), the semiconductor industry in itself has not seen much of Industry 4.0.

To summarise, semiconductor test solution providers are looking to change this in a way where the semiconductor industry itself is benefitted. It might be important to note that Advantest generates the most amount of data in the semiconductor industry across all players. We are using this data to take the industry to the next level in terms of digital transformation.

Would better visibility in the supply chain be of help?

Yes, and that is one of the essential things being worked on today. As an industry, we are trying to build solutions over the cloud that will allow any manufacturer to calculate what's happening in the supply chain well ahead of time. The solutions will tell manufacturers about problems that can arise in the future, giving them enough time to react and come up with a resolution.

The cloud is one function that we are most excited about. When talking about increasing the yield through a fab, it would take at least a year. But when it comes to establishing a new fab, it could take around two to three years of time. However, with Industry 4.0 in the picture, we can guarantee improved yield starting today. Yet these are just some functions of the Industry 4.0 value chain.

How Industry 4.0 can complement semiconductor industry

1. Elements of Industry 4.0 can be used to validate semiconductor design from the very first step.
2. Design engineers do not need to wait for 2.5 months to gauge the effectiveness of the die they are working on.
3. A semiconductor travels more than 48,000 kilometres (30,000 miles) before reaching the consumer. Industry 4.0 can be used to collect data from all the points of distance it covers.
4. There is better visibility of the supply chain, both for the creators as well as users of the semiconductors.

Is it expensive?

Any transformation requires investment. The focus, however, is mostly on the return on investment (ROI), and early use cases have already proven an impressive ROI. Adding to it, cases that come online would only increase ROI further. The best way to test waters for semiconductor companies is by signing up for subscription models instead of making all investments before the value is understood. If the results are satisfactory, such companies can fine tune their investments.

Will it reduce jobs?

As a matter of fact, Industry 4.0 creates more jobs. The need of the hour for professionals working in the semiconductor industry is to up-skill and re-skill themselves. Almost every semiconductor industry needs data scientists, and this explains the magnitude of jobs that can evolve.

What are the other possible areas where Industry 4.0 can be used in the semiconductor industry?

The complexity of the semiconductor manufacturing process requires high levels of visibility, analytics, and awareness. Analytics in the past was mostly manual. Let me explain this through an analogy.

Just like how a multiple-use residential/commercial skyscraper consists of many layers—structures with interdependencies—similarly, a semiconductor device process is like a skyscraper that has many floors or processing layers, as we call them in the industry. It takes 2 to 2.5 months to put these layers onto a device for a typical semiconductor company.

A lot can go wrong in this process. The smallest mistakes can affect the time of the semiconductor to market by weeks, or in some cases months. This in turn affects the overall image of a semiconductor company. What makes the process more challenging is that different layers of the device are being worked upon in different parts of the world. A typical semiconductor travels no less than 48,000 kilometres.

Now all the places a semiconductor goes, tremendous amounts of data is generated. Sometimes it is collected manually as well. The data acquired is in multiple languages, and one of the biggest challenges that we as an industry face is to bring this data under one machine in one language to gauge what's going right and what's not.

Industry 4.0 provides the analytics of this data and improves the yields that directly improve the cost. It can also help in answering the questions that are related to the tests of semiconductors. Issues of over testing or under testing can be answered with the help of Industry 4.0. Though there are many more advantages that it offers, the target of most companies is to decrease the time to market for the semiconductors.

What all stages of semiconductor manufacturing can benefit from Industry 4.0?

A term often referred to in the semiconductor industry is the

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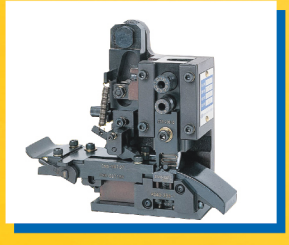




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Sunil Banwari, during his 28+ years of working in the electronics industry, has been associated with the likes of Intel Corporation, Anadigics, Natel EMS, Smiths Group, ON Semiconductor, and AT&S India

Advantest Corporation is a leading manufacturer of automatic test equipment for the semiconductor industry, and a manufacturer of measuring instruments used in the design, production, and maintenance of electronic systems including fibre-optic and wireless communication equipment and digital consumer products. It recorded over $3 billion in annual revenue in fiscal 2020.

Product Life Cycle. It is also sometimes referred to as the Technology Life Cycle. Industry 4.0 can benefit semiconductor manufacturing at every stage of the product or technology life cycle as it gives us an opportunity to do things in a smarter way.

Smart Manufacturing, when used as a synonym to Industry 4.0, includes smart design capabilities too. Designing a product today requires going through different iterations of the same. These different iterations go on until you hit the right spot and can meet all the expectations from the design. Typically, it takes multiple iterations to get one design right.

Industry 4.0 reduces the number of iterations dramatically. AI and ML being the biggest contributors play a big role here. The best example of the same is the recent announcement made by Google.

When you do a layout of a chip it requires a lot of designing, and the layout engineers have to ensure that the circuit is placed in a way that optimises the efficiency of a chip. Thankfully, Google has introduced a tool which can do the same using AI instead of humans.

According to Google, the tool decreases the time to market and helps bring down the cost by decreasing the amount of time and number of iterations required in the process. This was just an announcement by



Google and, personally, I do not think it has been adopted widely in the semiconductor industry. However, we should not forget that Google is designing its own chips.

There is a tool that we at Advantest offer that can decrease the time of validation of silicon. This tool is also based on Industry 4.0 and basically allows one to do a proper validation with every iteration and hence improve performance with every new iteration. It can even suggest design options on its own.

Any other elements where Industry 4.0 can be beneficial to the semiconductor industry?

Consider the example of an OSAT or an ATMP that manufactures chips for others but does not have its own design, say someone like the Taiwan Semiconductor Manufacturing Company (TSMC). The opportunity that Industry 4.0 provides to them helps improve the yield and capacity. Typically, the margins of such companies are lower than those that design the chips.

Industry 4.0 can provide the reasons behind losses in terms of capacity at each step for OSATs and ATMPs. It can also reduce the idle time caused by different reasons (including equipment not working) by suggesting what to do based on data it has collected in the past.

With much of the process being manual, it takes weeks to improve yield because the data is read, the equipment is reset and tested, before the final steps are taken. Industry 4.0 can automate the process, saving valuable time as the data is available with you at every point of time and process, and it does not need to be analysed manually.

What about the yield part?

As mentioned earlier, the usual process of semiconductor manufacturing, which used to be about two-and-a-half months long in the past, made it difficult as we had to wait to find out whether the die being used was good or not. It involved a lot of guesswork with the usual question being, "What percentage of what was started would be good

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after two-and-a-half months?"

Imagine working on a cake for two-and-a-half months and then finding out that the customer is not happy with the cake. You will either have to start the whole process again or leave it for a new cake. Considering the same in the world of semiconductors, Industry 4.0, on the other hand, has the capability of signal corrections that are needed to be made at each stage during these two-and-a-half months. This opportunity Industry 4.0 provides can help dramatically improve die yield.

But isn't implementing Industry 4.0 expensive for the already expensive semiconductor industry?

Investment is indeed a big and core topic for everyone. The best way to predict the prospects of the investment is to start with the subscription services. That way you can easily set short-term goals, track results, and determine the ROI, which will guide and justify additional investments. As a matter of fact, at Advantest we advise our smaller customers to start with the subscription model first. This way it becomes part of the operating expense (OPEX) for a company.

I think the best way to find out if something is expensive or not is by calculating the amount of investment in terms of return on investment (ROI). There's always a payback period involved. It varies from company to company but typically, if the ROI stretches over decades, you can conclude that it isn't a good investment.

Would the subscription services require the provider to go to the client locations physically?

One of the key benefits of Industry 4.0 lies in providing services virtually. A lot of the things can be done virtually. At the end of the day, it is the clients who know their machines best. Advantest encourages customers to come up with their own set of applications, and the required training would definitely be looked into.

The semiconductor market is highly competitive, and survival clearly goes to the fittest. Our data shows that companies that are technologically ahead are also ahead in time to market, when compared to their competitors. Though, there is no standard on the adoption of Industry 4.0, it all depends on the maturity of the company as well. Some companies are lagging and have not adopted even the Industry 3.0 features, which places them at a competitive disadvantage.

The decision of adopting Industry 4.0 must come from the executive level. The ROIs are not related to one business aspect but affect multiple businesses throughout the entire company. It is good to know that almost all leading companies in the semiconductor industry have taken initiative in Industry 4.0 domain and this was done at the executive level.

Would implementation of Industry 4.0 in the semiconductor industry result in shrinkage of jobs?

That fear, in my opinion, is very overrated. Every country and every company is trying to improve its better living index. For every job that is being replaced there are multiple jobs being created by the same industry. The biggest example of this is the number of data scientists required in the industry. The designation data scientist did not even exist a few years ago.

Industry 4.0 generates big data and at Advantest we are still in the process of gathering data in terms of gigabytes per die. Much of this data was not being looked at in the past, and there can be instances where important data is not even collected. Industry 4.0, in terms of the semiconductor industry, is creating more jobs. EFY



How To BUILD A COMMUNITY And WHY It MATTERS

Building a community and keeping it thriving is certainly not a bed of roses. Janardan Revuru, Community Leader, JavaScript Meetup, talks from his experience the constant questions he receives and few important steps that many larger communities have followed





JANARDAN REVURU,
Community Leader,
JavaScript Meetup

The demand for communities is growing. Even if its start is small, the returns are quite compounding. I would compare it to an adventure in the deep woods. You can start with a lot of preparation but it's better to be prepared to face the unknown. Technology and tools still continue to evolve, so you cannot rely on them completely. On your journey, you will find other fellow travelers who support. Be ready to deal with surprises yourself.

Many times, people fall into the trap of thinking a community is needed for problems to be addressed, or for support that people need. Even if these reasons are correct, the main core to build a thriving community entirely depends on you as a leader. Once this is clear, it is good to know the common mental blocks for people to start or join a community.

Four blockers

Why. It is a major question that people come up with as they see it as a contribution with no returns.

Awareness. There are a lot of communities that need a supporting hand and the lack of awareness among people to hit in the right direction remains.

Where to start. There are many who do not know where to start, despite having inclining thoughts and awareness.

How to start. People are unsure of what role they can play and where their contributions can be helpful.

A straight answer to these blockers is knowing the wide range of valuable skills that can be gained from technology, communication, influence, strategic thinking, and so on. It will be helpful to start discussions with the organisers as volunteers, note down your purpose, explore opportunities, connect with fellow teammates, contribute, and grow in your community.

Five steps to start and build a community

1. Research for a common interest. The very first thing to do is research, which can be done in a day, week, or maximum a month, without much time being spent on it. Think of it as a need for a group to be formed—be it technical or non-technical. You can visit two places to figure out whether it would be valuable to start or not. Meetup.com, where there are many communities worldwide, not just limited to location or technology. The second

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place would be Discord. Even though it initially started for gamers, it is vibrant for non-gamers also.

2. Start small. Do not stop after the analysis. You could start a meet up with a little group. Be aware, for instance, that your first event registration may fall somewhere between 50 and 100, but the actual turnout would be 10 people. You might be disappointed with the turnout being less, even if there is a lot of interest in the forum. It is a pattern we see all through the ratios at different points of time. We have seen a ratio of one out of three people registered for an event turning up. Hence, do not judge too early. Conduct the sessions at least a couple of times before you decide on whether it is working or not. The net take away is putting thought in action and not just having an intention to build.

3. Communicate for impact, participate for feedback. It is important to develop the skill of communication and participation. A good communicator will create an impact that leads to action. For instance, let's say, you are writing an email for people to register; a lengthy email on the benefits of the topic and a small link for registration may not help. The start itself should be a big popup containing the link for registration, along with an agenda repeating the process. Also, when these emails are being sent, note the time of the day and day of the week that help you fetch more registrations. Though it does not guarantee people coming in, you will learn to be concise in your communications over a period of time.

Participation is yet another important thing. For example, in the first week, I asked people about the topics they would like to hear in the next three sessions. Even if there were a lot of ideas pouring in, in the next session we did not have the same set of people. People give feedback because you asked for it; it does not mean they are committed to being a part of it. As time passes, you will slowly see some regular people, assuring that probably 5-10% of them are more committed to the group.

4. Adapt to evolve. A big lesson where you have to be nimble and adaptive. When the pandemic hit, we were forced to shift from offline sessions to remote interactions. We looked at options like Zoom, Slack, and some other affordable options to sail through. So, it is important for you to keep an eye on where your set of community members spend most of their time. We may have a lot of social media platforms, but then you have to keep on adapting and trying. With trials on apps like WhatsApp, Facebook, and Telegram for our community, we figured our meet up.com gained us approximately 9,500 registrations spanning across fifteen cities and eight countries. Similarly, in terms of adapting to groups, WhatsApp group is the most active after Discord. We have around 1,800 members where the maximum interaction happens.

5. Grow and expand for win-win. This is how you start thinking like an entrepreneur. You get an entry as a member of a credible community and run multiple meetups consistently every single month, say for three to five years. Then people start taking it seriously. Not only the community members, you may even have a good number of fans following and a great set of volunteers, which may get you sponsorship. Credibility comes with numbers and fetches you sponsors. That's when you may get people who want to talk about hiring. Hence build and boost your numbers for others to talk about it.

If you want to expand your community beyond a certain range, you can think about spot leaders. As mentioned, you will see a few regular members attending your meetups and being active in various forums. It would be beneficial to make those volunteers the leaders, which helps when you cannot involve or dedicate to your role as a community leader. These spot leaders can help in events and keep the community thriving. Remember, the willingness of the person and volunteering is more important than their skill or expertise.

When you are gaining sponsors, you can think about the purpose of the community to decide on tie-ups. For example, in JavaSript we are tying with Reactindia. We have a couple of other groups to open up for hosting events. Such tie-up strategies would help you grow at a different scale, as long as your intentions are matching with the alliances. Hence, if you are building a community and have plans to expand, you should also imbibe skills of entrepreneurship. Understand your market, identify more places where you can attract people, boost your numbers, sell what you are doing, and create win-win scenarios.

What to expect as community leader

Community leaders are followed not only by the communities but also the corporates. Corporates like Microsoft, Google, and Amazon are seeking community leaders for new positions and roles to influence their communities. You could either be directly associated with them as an employer or contractor, or have a tie-up to get sponsorships for your events. I see this scenario increasing in the next five to ten years, making it a reason to focus on full-time.

One simple thing to remember is that expectations may be different. I suggest not to think of only benefits, but how it can make us better in terms of strategic thinking and adapting to different situations. In spite of the highs and lows you may go through, you will have the backing of a community of, say, around 10,000 people.

There is no single route in the journey to community leadership as you would find things a little scattered and may have wrong assumptions. But remember, when you take action you are taking steps forward. EFY

The article was compiled from a talk by Janardan Revuru, Community Leader, JavaScript Meetup in Open Source India 2021 Edition conducted by EFY. Speech transcribed and authored by Abbinaya Kuzhanthaivel



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Government waiting for global semiconductor companies to submit their proposals

Five companies have proposed to invest more than ₹1,530 billion to set up display and semiconductor fabs in India. One of these is Vedanta Foxconn Joint Venture, ISMC and IGSS Ventures, who have proposed $13.6 billion investment. Syrma Technology, SPEL, Valenkani, and HCL are the other four who have shown interest in semiconductor packaging. Ruttonsha International Rectifier has registered for compound semiconductors. Curie Microelectronics, Terminus Circuits, and Trispace Technologies have registered for the design linked semiconductor scheme.

The window for submitting the applications for the ₹760 billion incentive package is now being extended by the Centre to enable some top global semiconductor majors to also submit their proposals. The government expects to receive bids from the likes of Intel, Samsung, TSMC, Micron, and Infineon for setting up semiconductor chip fabrication plants in the second round of the programme.

Government announces strategy on 3D printing for 5% global market share

Additive manufacturing, or 3D printing, is the next industry that the government is eyeing to capitalise on. Union Minister Ashwini Vaishnaw has shared that they are looking to capture 5% of the global market share. Under the National Strategy on Additive Manufacturing, the government plans to create 50 India-specific technologies for material, machine, process, and software to make India a 3D-printed design and manufacturing hub. The strategy aims to create 100 new start-ups, 500 additive manufacturing products, and 50 Indian additive manufacturing technologies on material, machine, process, and software.

PEOPLE (on the move)

MeitY gives additional responsibility to K. Rajaraman



The Ministry of Electronics & Information technology (MeitY) has given additional responsibility to Telecom Secretary K. Rajaraman, following the retirement of Ajay Prakash Sawhney. Rajaraman earlier worked as Additional Secretary in the Department of Economic Affairs.

Applied Materials ropes in ex-Xilinx executive as CFO

US based Applied Materials has announced the appointment of Brice Hill as the company's Senior Vice President and Chief Financial Officer. Hill was Executive Vice President and CFO of Xilinx through its acquisition by Advanced Micro Devices, Inc. He previously served at Intel Corporation as Chief Financial Officer and Chief Operating Officer of the Technology, Systems and Core Engineering Group responsible for Intel's manufacturing, R&D, and product engineering.



Sun Mobility hires Anant Badjatya as CEO



EV infrastruture provider Sun Mobility has appointed Anant Badjatya as the CEO for its India business. Anant is an engineer from NIT Durgapur and an alumnus of INSTEAD, France. In his last role, Anant served as Group Chief Executive Officer with Stallion Group.

Vikram Solar appoints Rajendra Kumar Parakh as COO of EPC Division

Solar module manufacturer Vikram Solar has appointed Rajendra Kumar Parakh as the Chief Operating Officer for its Engineering, Procurement and Construction (EPC) Division. Parakh has been associated with Vikram solar since 2017 as Chief Financial Officer (CFO).



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CORPORATE news

Reliance entering electronics manufacturing sector through JV and acquisition

Mukesh Ambani-led Reliance Industries is looking to further expand its empire to include electronics manufacturing as it mulls an investment of up to $221 million in forming a JV with electronics firm Sanmina. Manufacturing will initially take place at Sanmina's 100-acre campus in Chennai, with the ability for site expansion to support future growth opportunities as well as to potentially expand to new manufacturing sites in India over time based on business needs.

The conglomerate is also to acquire the assets of cobalt-free lithium battery technology and manufacturing company Lithium Werks for $61 million. The acquisition will include Lithium Werks' entire patent portfolio, manufacturing facility in China, key business contracts, and hiring of existing employees as a going concern.

Samsung to manufacture refrigerator components in Tamil Nadu

Samsung is planning to invest around ₹15.88 billion in making refrigerator compressor units in Tamil Nadu. An MoU to set up the manufacturing plant was recently inked between Samsung and Tamil Nadu government. Though Samsung has two plants that manufacture a wide range of electronics, this move is to set up a dedicated unit for manufacturing components for refrigerators. The state government also touched base with Samsung asking it to make use of the PLI scheme rolled out by the Centre to manufacture chips in the country.

Exide joins hands with China's SVOLT for Li-ion battery manufacture in India

Striking a multi-year deal, Exide Industries has partnered with China's SVOLT Energy Technology Co. Ltd for lithium-ion (Li-ion) battery manufacturing in India. As part of the agreement, Exide will receive an irrevocable right and license to use, exploit, and commercialise necessary technology and know-how owned by SVOLT for lithium-ion cell manufacturing in India. SVOLT will also provide the support required for setting up of a green field manufacturing plant on a turnkey basis.

Ather Energy partners with Bharat FIH to manufacture parts for its E2Ws

Ather Energy has joined hands with Taiwanese Foxconn's Indian subsidiary Bharat FIH to develop and manufacture key components for Ather's scooters. Bharat FIH will offer a host of manufacturing services that include printed circuit board (PCB) assemblies for battery management systems, dashboard assembly, peripheral controlling units, and drive control modules. These products will be manufactured on a turnkey model, including managing the supply-chain logistics and raw material procurement for Ather Energy.

Oppo, Xiaomi, Vivo eyeing to locally manufacture phones for exports

Chinese smartphone giants Xiaomi, Oppo, and Vivo are reportedly in the process of holding talks with Indian manufacturers to locally make smartphones for exports. The firms are looking to rope in manufacturers like Lava International and Dixon Technologies to assemble the phones and begin exporting from their plants as early as this year. Oppo and Vivo have begun discussions with Lava while Xiaomi is courting Dixon. Both groups are eyeing to utilise the IT hardware PLI scheme put in place by the Indian government last year.

VVDN and Blue Star to collaborate on AC components, Wi-Fi 6e, and Wi-Fi 7

VVDN Technologies and Blue Star have formed a strategic alliance to co-develop and manufacture new-generation controllers for residential and commercial AC segments. VVDN specialises in PCB layout and design of power controllers. VVDN has also begun working on the next generation technologies in the networking and Wi-Fi space. VVDN does end-to-end product development and continues to build these products based on the next-generation technologies like Wi-Fi 5, Wi-Fi 6/6e, and wireless mesh. It has also started doing design work related to Wi-Fi 7 for its customers.

SNIPPETS

- IdeaForge onboards ICT distributor Savex Technology as its new distributor to strengthen its presence in the Indian market
- Yulu looking to raise $100 million to expand fleet to 100,000 units by 2022 end
- Hero Electric partners with Sun Mobility to integrate its smart-swappable battery technology into Hero's two-wheelers
- Lam Research India signs MoU with CeNSE and IISc, Bengaluru to offer a sponsored fellowship programme for second-year M.Tech students
- Zypp Electric to train 3000 women as delivery partners by 2022 end
- Pinnacle Mobility forms JV with VDL Group to invest ₹20 billion to enter EV market
- Drone Federation of India signs MoU with Fukushima Robot Test Field (RTF) to accelerate drone technology, business, and areas of common interest
- Astra Microwave Products joins hands with Steradian Semiconductors to produce radar modules for traffic management systems

RattanIndia Enterprises to launch consumer micro drones across India

RattanIndia Enterprises has announced its plans to develop and launch consumer micro drones across India through its subsidiary NeoSky India Ltd. NeoSky is aiming to be the first Indian company to achieve this milestone. These drones will be widely used at weddings, for sports coverage, broadcasting, amateur travel vlogs, surveillance, and warehouse management.

Vedanta surveying Pune to set up chip manufacturing plant

Vedanta Group has sent a team to Pune to survey the feasibility of setting up its electronic chip plant in the district. Vedanta has plans to initially make 28-nanometre electronic chips that can be widely used in mobiles, power, and automotive products.

STL partners with Analog Devices to develop 5G O-RAN radio units

Mumbai based digital networks integrator Sterlite Technologies (STL) is collaborating with chip maker Analog Devices to develop 5G Open RAN radio units (O-RU). As a part of this collaboration, STL and Analog Devices will work closely with other ecosystem providers, including leading power amplifier vendors, to expand the range of STL's Garuda O-RU indoor small cell offerings. STL will integrate Analog Devices' transceivers into Garuda to create power-efficient, high-performance radios.

Hero MotoCorp to enter EV space through Vida brand

Domestic two-wheeler giant Hero MotoCorp has announced a new brand, Vida, through which it will enter the electric vehicle market in July. All the company's upcoming EV initiatives and launches will be made through the Vida brand. Customer deliveries of the first product will start later this year. The company will manufacture the electric vehicles at a factory in Chittoor, Andhra Pradesh.

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UK's Volex buys majority stake in EDMS company InYantra

UK based integrated manufacturing-services and power products company Volex plc has acquired a majority stake in Indian EDMS firm inYantra Technologies Pvt Ltd for $13 million (around one billion rupees).It will strengthen focus on two high-growth Indian sectors of medical electronics and electric vehicles for inYantra Technologies. As part of the transaction, the two partners will undertake joint development of complex cable assembly capability through low-cost production for both domestic and export markets, as Volex expands the capabilities at the Pune site by building a new medical and complex industrial technology cable assembly facility.

Tata Elxsi and Renesas collaborate to build EV design centre in Bengaluru

Tata Group's design and technology services subsidiary Tata Elxsi has signed a pact with Japanese semiconductor company Renesas Electronics Corporation to build a design centre in Bengaluru that will develop targeted solutions for electric vehicles. Tata Elxsi and Renesas will bring together their deep domain expertise, intellectual property, and assets to the Centre and collaborate to create reference designs and solution accelerators for critical EV subsystems like battery management systems and motor control units, among others.

Suzuki and Toyota looking to make EVs in Suzuki's Gujarat plant

Automaker Maruti Suzuki and Toyota are likely to use the former's Gujarat plant to manufacture electric cars (EVs) for both the entities, as per information revealed by Maruti MD & CEO Kenichi Ayukawa. Ayukawa said that discussions on this matter are still on by Suzuki Japan and anything is yet to be finalised. Toyota and Suzuki are already in a business alliance as well as a product-development and model-sharing relationship.

Elin Electronics receives SEBI approval for IPO

Delhi based electronics manufacturer Elin Electronics Limited (EEL) has received SEBI's approval for its ₹7.6 billion initial public offering (IPO). Elin's IPO offers equity shares with a face value of ₹5 each, comprising a fresh issue of up to ₹1.75 billion and an offer for sale of up to ₹5.85 billion. Elin filed preliminary papers with SEBI last year in November.

Omega Seiki partners with Israel based startup to develop e-motors in India

Omega Seiki Mobility (OSM) has announced a strategic alliance with Israel based startup EVR Motors to produce compact e-motors in India. The e-motors will be based on a new TSRF technology and will be used for OSM's existing and future vehicle models. It will be produced at OSM's Faridabad facility and its group company Omega Bright Steel and Components' facility.

Crompton Greaves acquires majority stake in Butterfly Gandhimathi Appliances

Crompton Greaves Consumer Electricals is acquiring up to 55% stake of domestic appliances maker Butterfly Gandhimathi Appliances. The deal is valued at ₹1,403 per equity share, aggregating up to about ₹13.8 billion. It will also acquire certain Butterfly trademarks in allied and cognate classes from promoter group entities for a consideration of ₹303.8 million.

Jupiter International raises money from Edelweiss

Solar PV cell manufacturer Jupiter International has raised ₹1.7 billion from Edelweiss Alternative Asset Advisors (EAAA). The Kolkata based maker will utilise the funds as growth capital to enhance its manufacturing capacity as it plans to set up a new greenfield capacity of 2000-megawatt integrated cell plus module line. The fresh capital was raised through a combination of debt and convertible-to-equity instruments.

Drone PLI: Centre invites applications

The Ministry of Civil Aviation has invited applications from the drone industry for the production linked incentive (PLI) scheme for drone manufacturing. More than one company within a group of companies can file separate applications under this PLI scheme and the same shall be evaluated independently. The PLI scheme provides a total incentive of ₹1.2 billion spread over three financial years, which is nearly double the combined turnover of all domestic drone manufacturers in FY 2020-21. The PLI rate is 20% of the value addition, one of the highest among PLI schemes.

White goods PLI: Centre reopens application window

The application window for production linked incentive scheme (PLI) for white goods, including air-conditioners and LED lights, has been reopened by the Centre. The application window for the scheme shall remain open from 10th March to 25th April, 2022 on the same online portal. The incentive shall be available only for the remaining tenure of the scheme. The move is aimed to give a second chance to prospective investors to take benefit of the scheme.

DGFT revises import restrictions on components for TVs, smartphones

The Directorate General of Foreign Trade (DGFT) has revised the status for the import of specific components, including flat panel displays and camera modules, to 'Free' from 'Restricted' with immediate effect. This move is expected to bring relief to smartphone makers who had feared large scale disruption to local manufacturing.

Battery swapping policy to be announced in 3-4 months

India's battery swapping policy is likely to be rolled out by Niti Aayog in the next three to four months. The policy will introduce disruptive business models, such as battery as a service (BaaS), and leasing, etc. Niti Aayog chief Kant said the focus in the initial phase will be to cater to light electric vehicles, where it is easy to plug and play batteries from the vehicles to the battery swapping stations.

EDSM companies submit LoI for operation in Karnataka

Eighteen electronics, system, design, and manufacturing (ESDM) companies have submitted their letter of intent (LoI) to set up operations in Karnataka. Some of the companies who have shown their interest include Proxelera Pvt Ltd, Wuerth Electronic India Pvt Ltd, Virtulive Technologies Pvt Ltd, Gopalan Aerospace Pvt Ltd, Teccheren Batteries, Kaynes Technology, Rapture Innovation Labs, Physics Motors, Astr Defence, nanoPix Integrated Solutions Pvt Ltd, and SLN Technologies.

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INTERNATIONAL news

Chipmakers to form coalition to establish universal chipset standard

Companies like Intel, Qualcomm, AMD, Arm, Samsung, Taiwan Semiconductor Manufacturing Company (TSMC), along with software companies like Meta, Microsoft, and Google Cloud have begun operations to form a coalition to establish a universal chiplet interconnect express (UCIe) standard. The UCIe 1.0 specification has been ratified to provide a complete standardised die-to-die interconnect with physical layer, protocol stack, software model, and compliance testing to enable end users to easily mix and match chiplet components from a multi-vendor ecosystem for system-on-chip (SoC) construction, including customised SoCs.

Japan imposes chip export sanctions, Samsung suspends shipments to Russia

Considering the ongoing Russia-Ukraine war, Japan has announced that it will impose sanctions on Russia that revolve around semiconductor chip exports and financial institutions. Japan will also impose sanctions on exports to Russian military-related organisations, items on restricted lists based on international agreements, and exports of semiconductors and other general-purpose products to Russia. In similar fashion, Samsung has suspended product shipments to Russia citing "current geopolitical developments." The products that have been suspended include smartphones, semiconductors, and consumer electronics.

LG pulls the plug on solar panel business

LG Electronics has decided to close their solar panel business. The decision comes as uncertainties in the global solar panel business continue to increase due to a variety of contributing factors, including the intensification of price competition and the rising cost of raw materials. LG's Business Solutions (BS) Company, which operates the solar panel business, will reorganise its portfolio around the key pillars: information technology (IT) and information sisplay (ID).

UMC to invest $5 billion to build new 22nm chip fab in Singapore

Taiwanese chipmaker United Microelectronics is expanding its manufacturing base as it plans to invest US$5 billion in a new manufacturing facility in Singapore to make 22-nanometer chips. The first phase of the investment would add 30,000 wafers of 30cm (12-inch) dia per month to UMC's capacity, with production expected to start in 2024.

Arm to reduce workforce following its acquisition deal with Nvidia

Following the fallout of its acquisition deal with Nvidia, UK based chip company Arm Ltd has revealed that it is looking to cut 12 to 15% of its workforce. Most of the job losses would be in the UK and the USA.

Panasonic starts production of new Li-ion battery for Tesla

Panasonic Corp intends to begin mass production of a new lithium-ion battery for Tesla Inc. before the end of March at a plant in Japan. The company will establish a production facility at its Wakayama factory in western Japan to manufacture the new '4680' lithium-ion batteries. Two additional production lines as well as utility facilities will be established at the factory, and productivity verification and mass production are set to begin in the fiscal year ending in March 2024.

Nothing locks $70 million in Series B funding round

Carl Pei-led consumer tech brand Nothing has raised $70 million in a Series B fundraise round. The funding will be used to create new product categories in partnership with Qualcomm Technologies and its Snapdragon platform, and grow operations at its new London Design Hub, led by ex-Dyson Head of Design, Adam Bates.

Analog Devices to invest 100 million euros in Europe operations

Analog Devices will invest 100 million euros over the next three years in ADI Catalyst, a 1000 square metre custom-built facility for innovation and collaboration located at its campus in the Raheen Business Park in Limerick, Ireland. ADI Catalyst is an accelerator where ecosystems of customers, business partners, and suppliers engage with ADI to develop industry-leading solutions.

Kioxia to acquire Chubu Toshiba Engineering

Japanese computer memory maker Kioxia Holdings Corporation has entered into a definitive agreement with Toshiba Digital Solutions Corporation to acquire all the outstanding shares of its subsidiary, Chubu Toshiba Engineering (CTE) Corporation. This acquisition will help Kioxia strengthen its technology development capabilities. CTE is involved in semiconductor manufacturing technologies, specialising in semiconductor related hardware and software design, prototyping and evaluation, covering areas from development to mass production.

Altair expands electronic system design technology

Altair has acquired Powersim, a provider of simulation and design tools for power electronics. This acquisition expands Altair's electronic system design technology into the domain of power electronics. This acquisition includes PSIM, Powersim's flagship product for design and simulation of power electronics and motor drives.

Menlo Micro raises money in Series C funding

US based Menlo Micro has raised $150 million in Series C funding from Vertical Venture Partners and Tony Fadell's Future Shape. Microelectromechanical system switches maker Menlo Micro will use the funding to expand domestic manufacturing and supplychain for the Ideal switch.

Electronics goods exports grew by 88% between 2013-21

India's electronics goods exports grew by almost 88% from $6600 million in 2013-14 to $12,400 million in 2021-22, as per data released by the Ministry of Commerce and Industry. Mobile phones, IT hardware including laptops and tablets, consumer electronics such as televisions and audio, industrial electronics, and auto electronics are the key drivers of this growth. Electronics goods exports grew 49% in April-December 2021 at $11 billion over $7.4 billion during the same period last year with the US and the UAE being the top two destinations.

US to fund manufacture of solar panels in India

The US is funding $500 million to help American companies manufacture solar panels in India, the White House announced. This comes after the White House said that the Quad leaders have renewed their commitment to promote a free, open, rules based order in the Indo-Pacific region.

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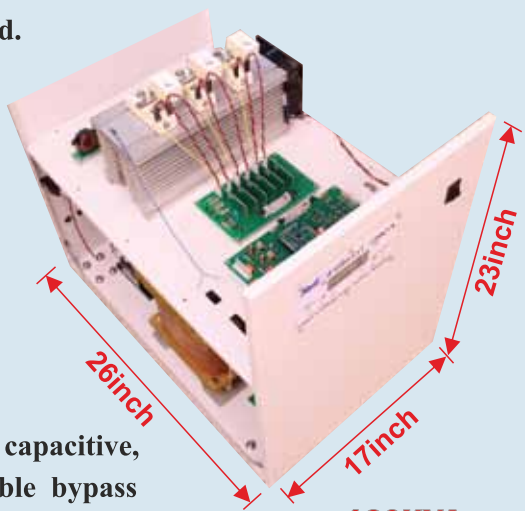
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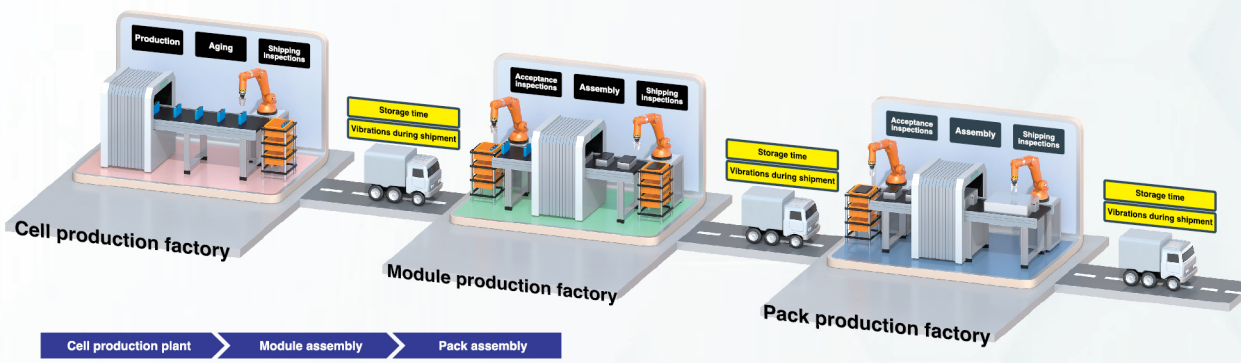
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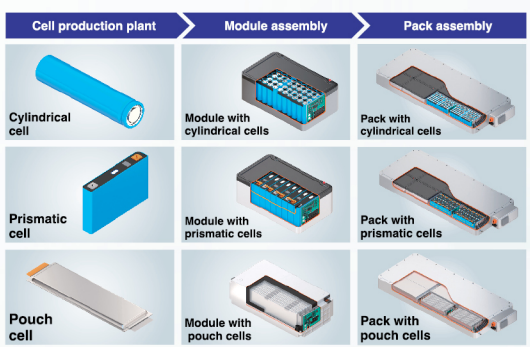


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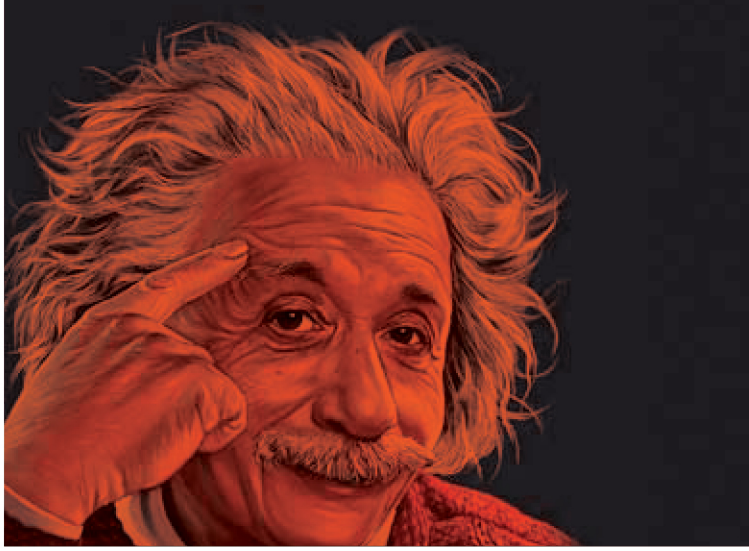
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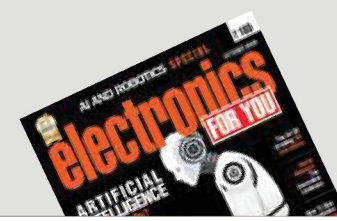
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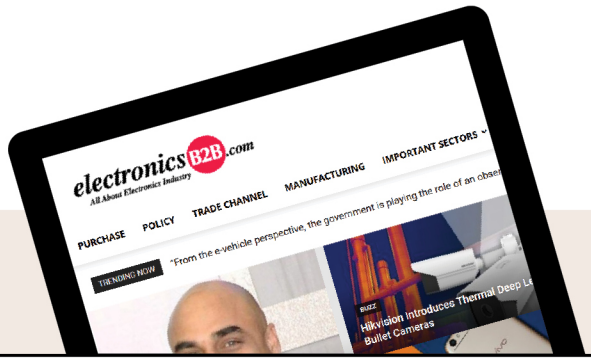


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ADVERTISERS' INDEX

Client name	Page No.
Ability Components India Private Limited (www.advancetech-india.com)	81
ADexpo Korea Co., Ltd (www.adexpokorea.com)	84
Analog Devices International Inc (www.analog.com)	5
Anritsu (https://www.anritsu.com/en-in/test-measurement/products/mg362x1a)	69
Binay Opto Electronics Pvt Ltd (www.binayLED.com)	Gatefold
CHIPMAX DESIGNS PVT LTD (chipmax.in)	49
Digi-Key Electronics (www.digikey.in)	4
EFY Certified Skill Center (https://efy.in/esdcfaq)	21
EFY Group of Publications: Subscription Scheme (subscribe.efy.in)	35
element14 India Pvt Ltd (in.element14.com)	Front Cover
GSAS Microsystem (https://gsasindia.com)	80
HIOKI INDIA PRIVATE LIMITED (https://www.hioki.com/global)	77
I.T. Solutions India Pvt Ltd (www.itsipl.com)	83
Innodisk Taiwan (https://www.innodisk.com)	63
IPC India (https://www.ipcindia.org.in/iemi-website)	33
Juki India Pvt Ltd (http://www.smtjukiindia.com)	47
Kioxia Singapore Pte. Ltd (https://www.kioxia.com)	57
kitsNspares.com	79

Client name	Page No.
LWI Electronics Inc. (www.livewireinfo.com)	23
Makerdemy (Azure Micro Degree) (https://makerdemy1.teachable.com/p/azure-micro-degree)	71
Makerdemy (IoT Micro Degree) (https://makerdemy1.teachable.com/p/iot-micro-degree)	73
Martins Electronic Devices & Instruments (www.medielectronics.com)	76
Maxim SMT Technologies Pvt Ltd (https://www.maximsmt.com)	61
MORNSUN GUANGZHOU SCIENCE & TECHNOLOGY CO., LTD (www.mornsun-power.com)	7
National Controlling & Equipments (www.nacei.com)	81
OSRAM Opto Semiconductors (Malaysia) (ams-osram.com)	53
Premier Industries (www.solderwire.co.in)	78
Quantel Technologies India Private Limited (https://quantel-global.com)	29
RECOM Asia Pte Ltd (https://recom-power.com/en/index.html?2)	67
Rigol (http://int.rigol.com)	59
Sakthi Accumulators Private Ltd (https://sakthipower.com)	81
Spur DTDS Microwave Pvt Ltd (www.pasternack.com)	55
Tescom (www.tescom.co.in)	43
TME SLOVAKIA (www.tme.com)	11
U&C Batteries Pvt Ltd (www.ucbatteries.com)	65

ADVERTISERS' PRODUCT CATEGORIES INDEX

Products	Page No.
Automation & Robotics	
CHIPMAX DESIGNS PVT LTD	49
Juki India Pvt Ltd	47
Batteries & Power Supplies	
Martins Electronic Devices & Instruments	76
MORNSUN GUANGZHOU SCIENCE & TECHNOLOGY CO., LTD	7
National Controlling & Equipments	81
Sakthi Accumulators Private Ltd	81
Components (Including Active & Passive)	
Analog Devices International Inc.	5
Digi-Key Electronics	4
element14 India Pvt Ltd	Front Cover
LWI Electronics Inc.	23

Products	Page No.
TME SLOVAKIA	11
Industrial & Manufacturing Equipment	
CHIPMAX DESIGNS PVT LTD	49
Juki India Pvt Ltd	47
IT Products	
Ability Components India Private Limited	81
Innodisk Taiwan	63
Materials (Including Chemicals & Consumables)	
Premier Industries	78
Optics & Optoelectronics	
Binay Opto Electronics Pvt Ltd.	Gatefold
PCBs, Assemblies & Sub Assemblies	
Tescom	43

Products	Page No.
Reseller and Distributors	
Digi-Key Electronics	4
element14 India Pvt Ltd	Front Cover
LWI Electronics Inc.	23
TME SLOVAKIA	11
Services	
Tescom	43
Switches & Relays	
Ability Components India Private Limited	81
Test & Measurement Equipment (Including Indicators & Monitors)	
HIOKI INDIA PRIVATE LIMITED	77
Quantel Technologies India Private Limited	29



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