Vidya Vikas Education Trust's
Universal College of Engineering
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Current Wave

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- *Tiny 350V GaN Transistor.*
- *Thermo-electric generator is 40% efficient, but only at 1,900-2,400°C.*
- *Digital pots interface directly with quadrature encoders, push buttons and MCUs.*
- *Making a 'sandwich' out of magnets and topological insulators, potential for lossless electronics.*

College Profile:

Everything you need to know about us:

Embraced by lush greenery and scenic beauty, Universal College of Engineering is a treasured place for aspiring engineers to leave their imprints on success.

As a college within the wider network frame, we are one of the fastest- growing institutions in India. Our institute has been accredited by the National Assessment and Accreditation Council(NAAC) with a B+ grade in the first cycle of accreditation. Times of India Survey Ranked No.1 in India among Top Emerging Private Engineering Institutes for 6 consecutive years 2015, 2016, 2017, 2018, 2019, and 2020 and the saga of accolades still continues.

In response to the expectations of quality technical education, our college is approved by the All-India Council for Technical Education (AICTE), New Delhi; Recognized by the Directorate of Technical Education (DTE), Government of Maharashtra; affiliated to Mumbai University. Our college is also associated with professional bodies like IEEE, IETE, ISA, and CSI to update the revolutionary technological advancements.

We offer 4 years of full-time Bachelor of Engineering in Computer Engineering, Civil Engineering, Artificial Intelligence & Machine Learning, Information Technology

The unique state-of-the-art facility of the institute has been carefully designed to accommodate the needs of the students. Laboratories are equipped with world-class facilities based on the latest technology of different sectors. Our smart classrooms are well ventilated, spacious, and equipped with overhead and LCD projectors along with the public address system. The Collegelibrary provides a rich collection of specialist library resources and services to support student's academic work and enrich their research skills.

We are obliged to equip our students to get placed in highly reputed companies by mentoring their necessary skill set for cutting-edge technologies. The core highlighted areas are helping students with their technical competency, communication skills along with career guidance andcounseling.
Universal College of Engineering has produced a large number of successful alumni who are working in reputed organizations in India and abroad and have contributed immensely to the cause of nation-building and society. We welcome all engineering aspirants to create an incredible legacy in the field of engineering.

Tiny 350V GaN transistor

The EPC2050 measures just 1.95 mm x 1.95 mm. This tiny size enables power solutions that occupy ten times less area than comparable silicon solutions.

Applications benefiting from the fast-switching speed and tiny size of the EPC2050 include DC-DC conversion from/to 120 V-160 V such as in aerospace applications, 120 V-150 V motor control for medical motors, DC-AC inverters, multi-level converters such as Totem Pole PFC and DC-DC solutions converting 400 V input to 12 V, 20 V or 48 V outputs. Additional applications include fast chargers, battery management systems, electric vehicle charging, solar power inverters, high power lidar for autonomous cars and delivery vehicles, LED lighting, RF switches, and consumer & industrial wirings like wall-mounted sockets and Class D Audio.

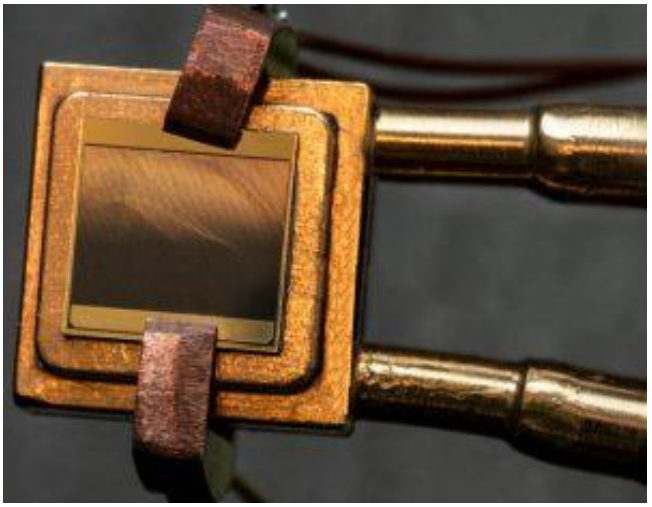
The EPC2050 is also suitable for 120 VAC-only applications. A typical power supply bus voltage is between 170 V and 250 V. This includes applications specific to the Americas market, such as power tools and in-wall powered devices, seat-back airline 120 V inverters, and commercial LED lighting.

"With the EPC2050, designers no longer have to choose between size and performance – they can have both and lower cost!" said Alex Lidow, EPC's CEO.

Development Board:

The EPC90121 development board is a 350 V maximum device voltage, 4 a maximum output current half bridge featuring the EPC2050, and the On-Semi NCP51820 gate driver. The board measures 2" x 2" and contains all critical components, and the layout supports optimal switching performance.

Thermo-electric generator is 40% efficient, but only at 1,900-2,400˚C



Analagous to a multi-junction photovoltaic cell, MIT's device has two stacked junctions, each picking up part of the incident spectrum. In this case, the stacked cells are lattice-mismatched AlGaInAs (1.2eV) and GaInAs (1.0eV) – mismatched to the GaAs substrate on which they are grown. There is a second design, with a matched (and therefore better quality) GaAs (1.4eV) top cell and a mismatched GaInAs (1.2eV) bottom cell. The 1.2-1.0eV cell has potential for higher power density than the 1.4-1.2eV cell because it converts a broader band of the incident spectrum, while the reduced current density of the 1.4/1.2eV combination will be more efficient (41.1% at 2.39W/cm^2, 2,400°C emitter) that the 1.2-1.0 cell (39.3% 1.8Wcm^2 2,127°C) when resistive losses are an issue, according to 'Thermo photovoltaic efficiency of 40%', a paper in Nature which describes the work. Whichever junction pait is selected, there is something that is not at all like a solar cell: proximity to the energy source. As the thermoelectric cell will be adjacent to heat source, a mirror (a gold layer in this case) applied to the back of the cell can reflect

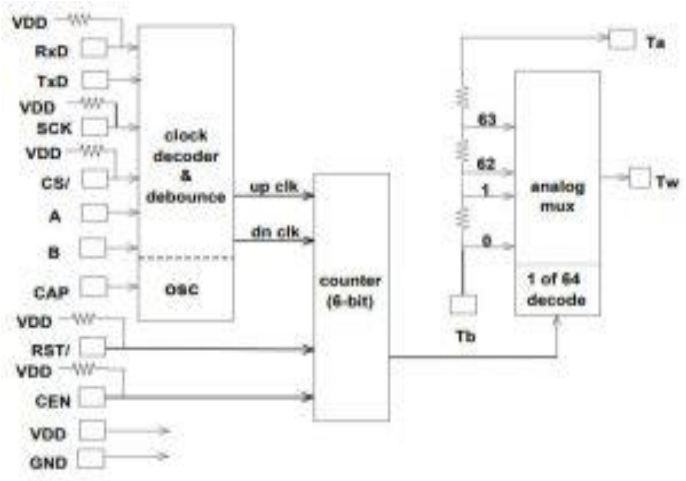
sub-bandgap (unused) thermal photons back into the heat store (93% of them in this case), reducing the amount of energy that will later be needed to heat it.

The proof-of-concept devices are 10 x 10mm and mounted on a heat sink (see image) to remove unused heat that has not been reflected back. In a practical grid-scale energy store, around 1,000m^2 of thermo voltaic array would convert radiant energy from a super-heated graphite structure, heated by spare renewable energy when it was available. 40% might not seem high as a storage efficiency for those used to the near 100% efficiency of Li-ion cells, but MIT point out that graphite as a storage medium cost little ($0.5/kg). The projected capital cost is <$10/kWh.

“Thermo photovoltaic cells were the last key step toward demonstrating that thermal batteries are a viable concept,” said MIT mechanical engineer Professor Asegun Henry. “This is an absolutely critical step on the path to proliferate renewable energy and get to a fully decarbonized grid.”

He points out that infrastructure created for making large-scale photovoltaic cells could be repurposed to make thermo-voltaic panels.

Digital pots interface directly with quadrature encoders, push buttons and MCUs



Debounce circuits are included where electromechanical switches are expected, although external pull-up resistors must be added. “The LSI/CSI digital potentiometers are used as replacements for mechanical potentiometers and for potentiometer adjustments,” according to distributor Omni Pro, which will be stocking the parts. “They can also be used for remote adjustments of instrumentation for gain, offset, time constant, line impedance matching or audio equipment volume control.”

The parts are:

- LS7190 debounced incremental encoder quadrature, and SPI
- LS7191 debounced up and down push buttons, and SPI
- LS7192 up clock and down clock from GPIO, and SPI
- LS7193 debounced incremental encoder quadrature
- LS7194 debounced up and down push buttons
- LS7195 up clock and down clock from GPIO

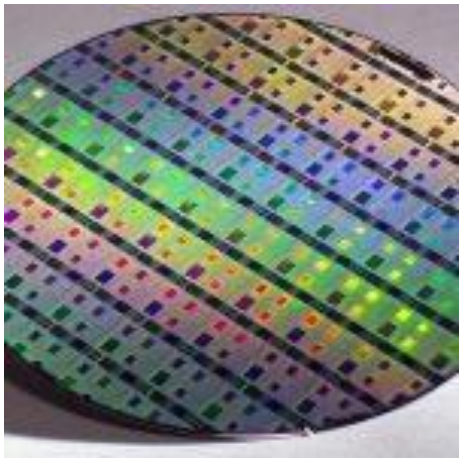
All are available in 20, 50 or 100kΩ versions – the data sheet does not appear to give a tolerance on this. At power-up, the wiper is set to ’32’ (mid-point), and SPI versions get a pin to reset the wiper to this position at any time as well as the serial bus to set in to any position without stepping through intermediate values.

A setting of ‘0’ takes the wiper all the way to the ‘T b’ end of the potentiometer (see diagram), while ’63’ takes it one resistor short of the ‘Ta’ end of the potentiometer. The serial bus also allows a host microcontroller to read the wiper position, allowing it to know where the electromechanical controls have set it, for instance to save a setting at power-down.

Quadrature parts count only on the rising edge of the A input – so pick your encoder with this in mind.

Counting in LS7193 and LS7194 is enabled all the time, while the other devices have an (internally pulled-up) enable pin to allow adjustment to be inhibited. Where debounce is provided, its timing is set by a single external capacitor. Power can be anywhere from 3.0 to 5.0V (7V abs max), and the three potentiometer connections can be made at potentials anywhere within the power rails. Operation is over -40°C to +125°C.

IC unit growth returns to normal



IC Insights' *May 2Q Update* to *The McClean Report 2022* forecasts that worldwide IC unit shipments will increase 9.2% this year to 427.7 billion units and resume tracking with the long-term IC unit CAGR of 9.4%. The 9.2% gain anticipated this year follows the large, 22% increase experienced during the economic recovery of 2021—the largest increase in IC unit growth since the boom year of 2010.

Figure 1 shows IC unit shipments in 2022 are forecast to reach a record-high level of 427.7 billion, almost 5x more units than were shipped in the year 2000 and nearly 44x more than were shipped in 1980.

The figure shows there was a falloff in shipments in 2019, which was only the fifth time in the history of the IC market that there was a year-over-year decline in IC unit volume. The previous four years with a drop in units were 1985, 2001, 2009, and 2012. *Never have there been two consecutive years with a decline in IC unit shipments.*

Of the 33 major IC product categories defined by the World Semiconductor Trade Statistics (WSTS) organization, 30 are forecast to show positive unit growth in 2022 and three (SRAM, DSP, and Gate Array) are forecast to have unit shipment declines. Twelve product segments are forecast to match or grow more than the expected 9.2% growth rate for total IC units this year.

From 2021-2026, IC Insights forecasts the IC unit CAGR will be 7%. Ignoring the 5-year CAGR time periods with abnormally high or low endpoints, IC Insights believes that the long-term CAGR for IC unit growth will be 7%-8%, moderately lower than the historical 42-year rate of 9.4%.

Making a 'sandwich' out of magnets and topological insulators, potential for lossless electronics

Making the Right Kind of Sandwich

Yet, inducing sufficient magnetic order to open a sizable gap via magnetic proximity effects is challenging due to the undesired influence of the abrupt interface potential that arises due to lattice mismatch between the magnetic materials and topological insulator.

"To minimise the interface potential when inducing magnetic order via proximity, we needed to find a 2D ferromagnet that possessed similar chemical and structural properties to the 3D topological insulator" says Qile Li, who is also a PhD student with the Australian Research Council Centre for Excellence in Future Low-Energy Electronic Technologies (FLEET).

"This way, instead of an abrupt interface potential, there is a magnetic extension of the topological surface state into the magnetic layer. This strong interaction results in a significant exchange splitting in the topological surface state of the thin film and opens a large gap," says Li.

A single-septuple layer of the intrinsic magnetic topological insulator $MnBi_2Te_4$ is particularly promising, as it is a ferromagnetic insulator with a Curie temperature of 20 K.

"More importantly, this setup is structurally very similar to the well-known 3D topological insulator Bi_2Te_3, with a lattice mismatch of only 1%" says Dr Mark Edmonds, who is an associate investigator in FLEET.

The research team travelled to the Advanced Light Source part of the Lawrence Berkeley National Laboratory in Berkeley, USA, where they grew the ferromagnet/topological/ferromagnet heterostructures and investigated their electronic band structure in collaboration with beam line staff scientist Dr Sung-Kwan Mo.

"Although we cannot directly observe the QAH effect using angle-resolved photoemission spectroscopy (ARPES), we could use this technique to probe the size of the bandgap opening, and then confirm it is magnetic in origin," says Dr Edmonds.

"By using angle-resolved photoemission we could also probe the hexagonal warping in the surface state. It turns out, the strength of the warping in the Dirac fermions in our heterostructure is almost twice as large as in Bi_2Te_3" says Dr Edmonds

The research team was also able to confirm the electronic structure, gap size and the temperature at which this $MnBi_2Te_4/Bi_2Te_3/MnBi_2Te_4$ heterostructure is likely to support the QHE effect by combining experimental ARPES observations with magnetic measurements to determine the Curie temperature (performed by FLEET associate investigator Dr David Cortie at the University of Wollongong) and first-principles density functional theory calculations performed by the group of Dr Shengyuan Yang (Singapore University of Technology and Design).

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