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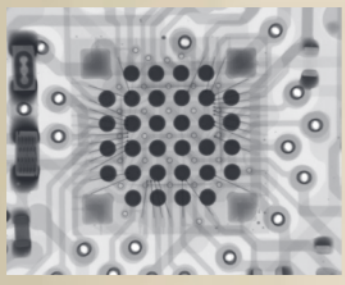

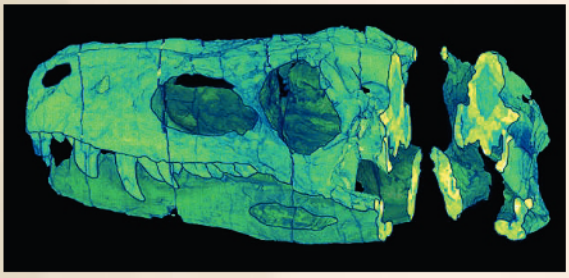

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Non-Medical Uses – Security, Archaeology & Biometrics

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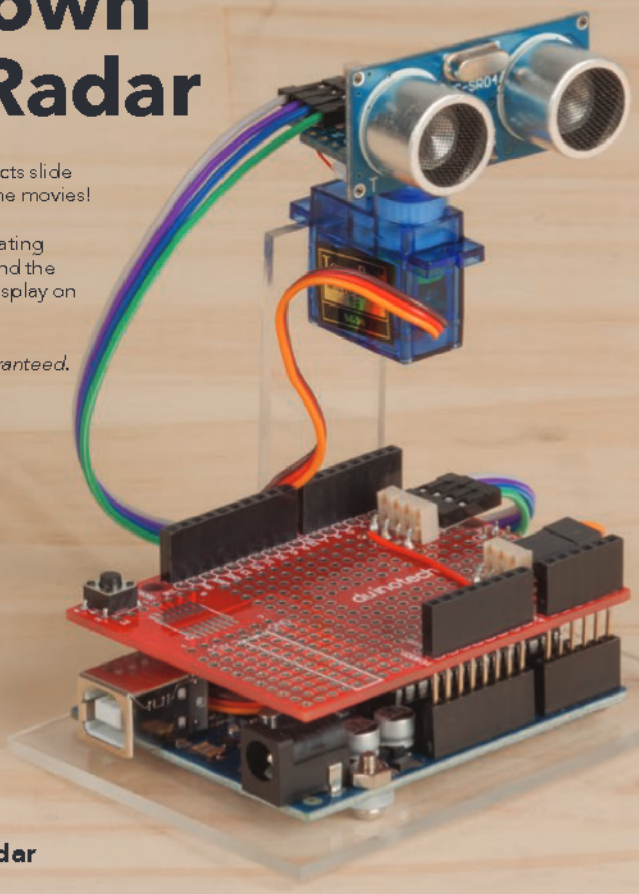

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Contents

Vol.34, No.9 September 2021

SILICON CHIP
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Features & Reviews

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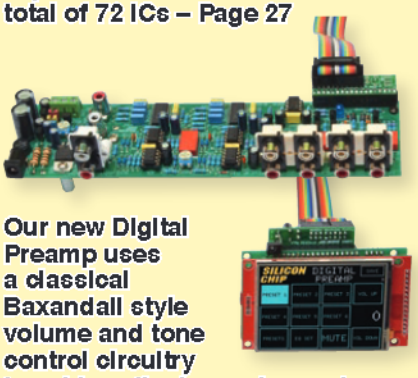
Your Favourite Columns

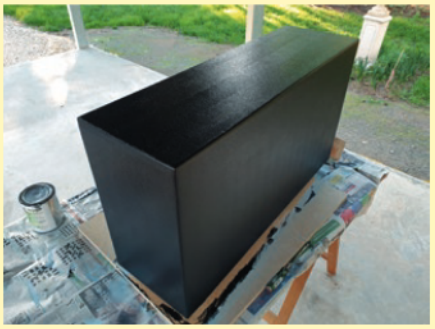
Everything Else

The Cromemco Dazzler was the first colour graphics card for the S-100 bus computer. It was released in 1976, and came as two separate S-100 boards which had a total of 72 ICs – Page 27



Our new Digital Preamp uses a classical Baxandall style volume and tone control circuitry to achieve the low noise and distortion expected of an analog design. It can be controlled via a colour touchscreen or an infrared remote – Page 38

The IOT Cricket is a tiny, ultra low-power ESP8266-based WIFI module – Page 48



This Tapped Horn Subwoofer is built into a modestly-sized cabinet which measures 50 x 90cm with a width of 28.2cm. You don't need much more than a hand-held circular saw, drill and clamps to assemble it – Page 66

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Editorial Viewpoint

Upcoming price changes

As discussed previously in the magazine, the SILICON CHIP cover and subscription prices have not changed since mid-2013. I have been holding off increasing what we charge as long as possible, despite most issues of SILICON CHIP now having 112 pages rather than 96 or 104 (and considerably more content as a consequence).

To keep up with inflation, the magazine cover price will change to $11.50, starting with the next issue (October). The New Zealand cover price will not change. Domestic and online subscription rates will increase by roughly the same amount (15%) – see below. You can extend your subscription now for up to two years to lock in the current rate.

Unfortunately, we must increase international subscription costs by an even higher percentage because the cost of mailing magazines overseas has increased so much. The company we were using before went out of business due to the impacts of COVID-19. This has resulted in our international mailing costs roughly doubling.

Affected customers could consider switching to an online subscription if they cannot afford the new rates, at least until international mailing goes back to normal.

These changes should mean that we can afford to stay in business for a while yet, and continue to produce a world-class magazine with a considerable amount of exclusive content.

Our new pricing in Australian dollars as of October 31st 2021 will be:

Subscription Type	6 Months	12 Months	24 Months
Online Subscription (Worldwide)	$50	$95	$185
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Print + Online (Combined)	$110	$215	$415

A note about cheques

Due to COVID-19 related restrictions, it is becoming difficult to deposit cheques and money orders. We will continue to accept them, but there could be delays in processing orders paid by these methods. We recommend making payments via EFT, credit card or PayPal as those payments can be processed without leaving our premises, and such orders are typically processed within one business day.

ElectroneX 2021 delayed

The ElectroneX 2021 trade show and associated SMCBA conference has been pushed back to the 10th & 11th of November – see the ad on p7 for more details.

by Nicholas Vinen

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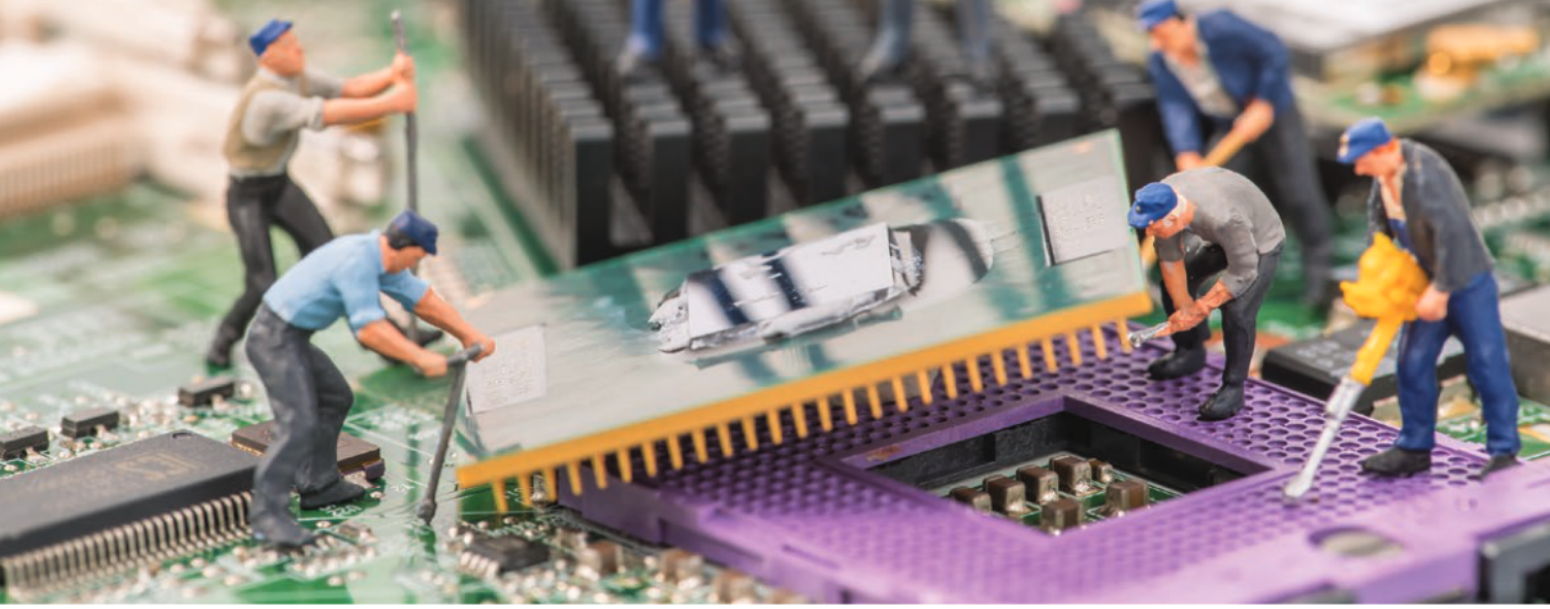

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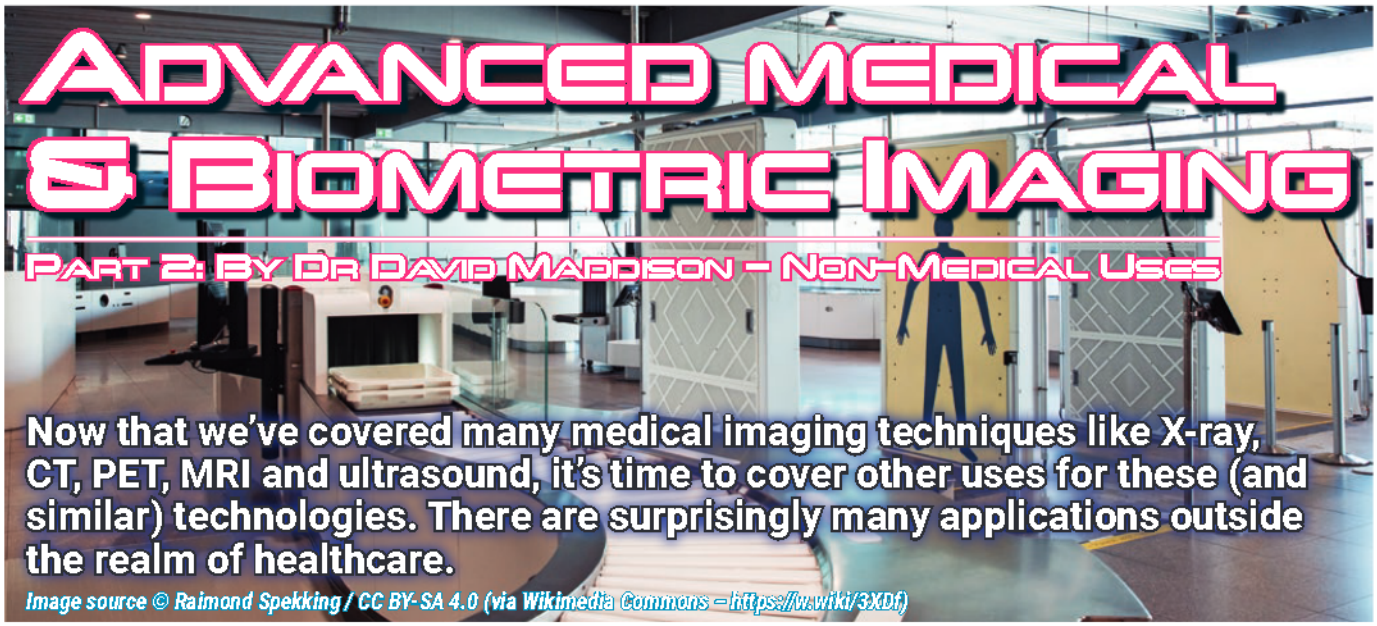
Advanced Medical & Biometric Imaging

Part 2: By Dr David Maddison – Non-Medical Uses



Now that we've covered many medical imaging techniques like X-ray, CT, PET, MRI and ultrasound, it's time to cover other uses for these (and similar) technologies. There are surprisingly many applications outside the realm of healthcare.

Image source © Raimond Spekking / CC BY-SA 4.0 (via Wikimedia Commons – https://w.wiki/3XDf)

You will be aware that X-rays are used for security purposes, such as at airports to check baggage and passengers for contraband and weapons. But these days, it isn't just X-rays being used, and many of these imaging techniques are being used for other purposes, like archaeology, as we shall now describe.

X-ray inspection

When Röntgen discovered X-rays in 1895, he mentioned one possible use as detecting flaws in materials such as steam pressure vessels. They are still used for that purpose to this day – see Fig.49.

One important electronics-related use of X-rays is the inspection of PCBs and solder joints, especially when solder joints are hidden, such as with BGA and LGA packages. X-ray inspection is a critical part of quality control for advanced electronics which make extensive use of BGA/LGA package devices – see Fig.50.

Defects that can be detected by X-ray include breaks in tracks, voids in solder joints and missing or incorrectly-sized solder balls.

Airport baggage and cargo

Airport passenger luggage (and indeed all aircraft cargo) is always X-rayed to detect explosives or weapons (see Fig.51). X-ray machines have traditionally been of the planar type, with a single X-ray beam passing through the luggage.

To give you some idea of the advances in security X-ray technology, the machine shown in Fig.51 offers optional proprietary iCMORE software algorithms to detect lithium batteries, as well as other hazardous or dangerous cargo such as flammable liquids or solids, and liquefied or compressed gases.

We have probably all noticed the images on the security screener monitors as we have gone through X-ray security checkpoints at airports. But what do the colours mean? X-rays do not yield colour information, but they do provide information about the average atomic weight and thickness of the materials they pass through.

Most X-rays will pass through materials with a low average atomic weight, such as plastics which include some combination of two or more atoms of carbon, hydrogen, nitrogen and oxygen. Materials that have much higher atomic weight metals such as steel and aluminium will comparatively absorb many X-rays.

Similarly, the thicker or more dense something is, the more X-rays are absorbed and the lower the X-ray count through the material.

With security X-ray machines, the X-ray image is artificially coloured according to a material's overall atomic weight average (and density), which initially appears as grey levels. The software colourises the grey-scale X-ray image, as the human eye can more readily distinguish colours

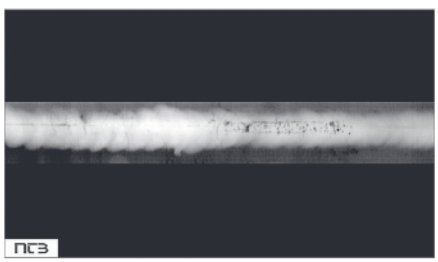


Fig.49: X-ray inspection of a weld showing defects.
Source: NTB (https://ntbxray.com).

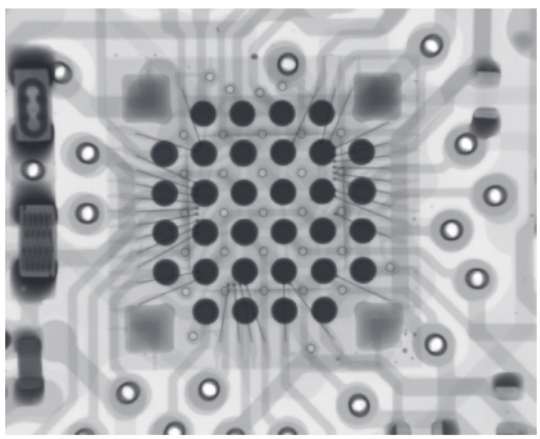


Fig.50: an X-ray of an assembled printed circuit board (PCB) with a ball-grid array (BGA) package IC at the centre, and vias and passive devices surrounding it. Not only can you see the PCB tracks, IC bond wires and BGA solder balls adhering to the lands and pads, but also the copper plating in the vias and the internal structure of the components to the left, which appear to be a resistor and possibly a fuse.

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A 35x26cm heat resistant silicon work mat, plus a 25x20cm magnetic mat to keep screws and materials organised while you work.

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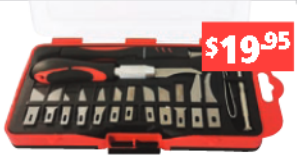

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Housed in a rugged aluminium extrusion, this new range delivers robust reliability and unwavering performance - even under severe operating conditions. For peace of mind all models have been certified to Australian Standard AS/NZS 4763.2011. Ideal for tricky loads, such as laptops, & game consoles. Perfect for 4WDs, campers, caravans & trade vans.

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Fitted with secure lid clips & colourful LED voltmeter

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Don't get caught with a flat battery! Know your power usage.

M 8636A

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Includes 10m cable & mounting hardware

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Ideal for DIY DC power wiring

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Great for added security around the house, back shed or garage. PIR models activate when motion is detected & have adjustable sensitivity, on time and dusk settings. Fitted with 240V 3 pin mains plug. Fully approved. Natural white. Rust free stainless steel brackets and hardware.

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X 2314C 20W	X 2315C 20W
$39.95	$59.95
X 2312C 10W	X 2340C 10W

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S 9901J

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Affordable 5 Megapixel CCTV Surveillance System.

Simple to install with instructions supplied. Cameras can be remote viewed on iOS/Android. Each pack includes: • Hybrid digital video recorder (IP camera ready!) • Pro grade 5MP resolution weatherproof cameras • 20m connection leads • Power supply

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Build a camera into anything!

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S 9844

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S 9846

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Wi-Fi HD Camera Clock

• 1080p HD footage. • Real alarm clock function. • Two-way audio (mic & speaker). • Motion detect recording • USB or battery powered (S 4736 x 2 $18.50ea)

*Note: We encourage this item be used responsibly for legitimate CCTV use.

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S 9850

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B 0092

THE CROMEMCO DAZZLER

The Cromemco Dazzler was probably the first 'reasonable' computer graphics device capable of producing a colour image. It generated an NTSC composite video signal that could be fed to a monitor or TV. As they are now quite rare, I built a copy of the device and in doing so, discovered some quirks.

By Dr Hugo Holden

Computer graphics were coming of age in the mid-to-late 1970s, and efforts were being made to provide home computer enthusiasts with graphics accessory cards. These were typically designed to be used in early S-100 computers such as the Altair and others.

Matrox was on the front line then, with monochrome graphics cards such as the ALT-256 and the ALT-512 (as described in our October and November 2020 issues; see siliconchip.com.au/Series/352).

Three Matrox monochrome cards could be deployed to make an RGB colour system, but it was a very expensive purchase.

Other companies such as Godbout Electronics offered the "Spectrum" board by 1980, which was advanced enough to support colour and have onboard video RAM. But before that, the Cromemco company offered the "Dazzler" board set in 1976.

Dazzler history

The Cromemco Dazzler was pivotal in the development of computer graphics cards. It was the first colour graphics card for S-100 bus computers, having an NTSC colour composite video output.

The idea behind it was born in 1975 when Roger Melon and Harry Garland created the first solid-state video camera. Their idea was to use a 1k x 1 bit MOS dynamic RAM IC with its top cut off, acting as an optical sensor (transistors are photosensitive). This led to the creation of the "Cyclops" solid-state video camera (Fig.1), and the founding of Cromemco.

The camera controller board put the camera's pixel data into general RAM in the host computer. The Dazzler board could read that RAM and create a standard (or close to standard) NTSC composite video signal to feed a colour video monitor or a domestic TV set via an RF modulator.

But the Dazzler board set became an entity of its own. It was presented as a

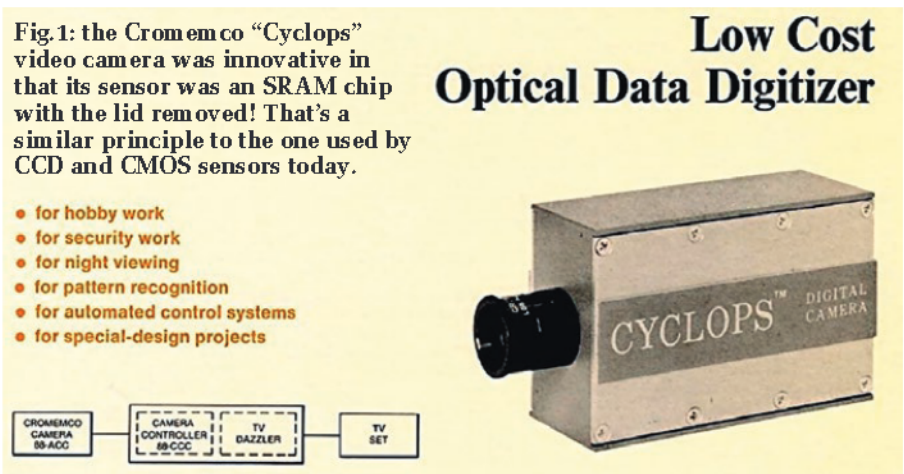

Fig.1: the Cromemco "Cyclops" video camera was innovative in that its sensor was an SRAM chip with the lid removed! That's a similar principle to the one used by CCD and CMOS sensors today.

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12 Months	$125	$140
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24 Months	$253	$310
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24 Months	$300	$380
Print + Online (RoW)	**Current Price**	**New Price**
6 Months	$100	$110
12 Months	$180	$215
24 Months	$330	$415

All prices are in Australian Dollars

The cover price of the October issue onwards will be $11.50 in Australia. The New Zealand cover price will remain the same at $12.90.

SILICON CHIP

Part 1: by Nicholas Vinen & Tim Blythman

Touchscreen & Remote Digital Preamp with Tone Controls

This preamp has the best of both worlds: the benefits of digital control such as an intuitive touchscreen interface, presets and remote control, along with the low noise and distortion of an analog design. It achieves that by using classic Baxandall style volume and tone control circuitry with op amps, incorporating high-quality digital potentiometers to provide the adjustments.

Most of our remote-controlled preamplifiers to date have used motorised potentiometers. While these have many benefits, such as low noise and distortion, and the ability to simply turn the knob if you are close to the preamp, they are quite expensive and can be hard to obtain. They also can fail and wear out.

Digital volume control ICs are an attractive alternative, but there have only been a few of these with performance that we would call hifi, and most of those have been discontinued. They also can be pretty expensive and difficult to obtain.

And since they only adjust the audio level, we need separate arrangements for input switching (as any self-respecting preamp needs at least a few pairs of inputs) and tone controls. Those are a frequently requested feature for preamps, and we agree that they can be handy. For example, they can compensate for loudspeaker shortcomings, such as a lack of bass or treble, or too much treble.

So any digital preamp we came up with would have to tick the following boxes:

1) Decently low distortion and noise (at least CD quality, and ideally better)
2) Tone controls (ideally with at least three bands for flexibility)
3) A wide volume control range operating in a logarithmic manner
4) Adjustable gain to suit a wide range of signal sources
5) Infrared remote control
6) Input switching
7) Ideally, an intuitive and attractive colour touchscreen interface for direct control

We achieved 1) through 4) by using two quad Analog Devices AD8403ARZ10 digital potentiometer ICs. While these are not especially cheap at around $10 each, they are still quite reasonably priced compared to hifi-quality volume control chips. The eight potentiometers they include let us adjust the volume, bass, mid and treble levels in both channels using just two chips.

These devices have impressive specifications, borne out by our testing, with a rated THD+N figure of 0.003% at 1V RMS/1kHz (they tested considerably better than that), a -3dB bandwidth of 600kHz and an impressively low noise level of 9nV per $\sqrt{Hz}$. So they are well suited to audio signal processing tasks.

Because each chip has all four potentiometers needed for a channel, the digital pot and its associated op amps are laid out all in one area, simplifying the PCB design and minimising crosstalk between channels.

The input switching is handled by three telecom style relays, which has worked well for us in the past, as these mechanical devices have minimal impact on signal quality.

Finally, the control interface is handled by a Micromite LCD BackPack with either a 2.8-inch, 320x240 or 3.5-inch, 480x320 colour touchscreen. This provides many benefits such as a nice clear volume readout when you adjust it via the remote, the ability to show the actual frequency response for any given tone control setting, loading/saving presets – the whole nine yards.

It's just the go for a modern preamplifier or amplifier, without compromising the sound quality.

Besides the BackPack, which would generally mount on the unit's front panel (along with the IR receiver), all this circuitry is packed onto a modestly-sized PCB at 206 x 53mm. It has four pairs of onboard RCA inputs, so that it can be mounted at the back of the unit.

It can be powered from a separate AC or split DC supply or an internal transformer with suitable windings. That includes transformers with high-voltage windings to power amplifier modules, and low-voltage secondaries for preamps like this one.

For standalone use, the power input can be an onboard socket on the

back, near the inputs, along with the optional rear panel pre-outs. These are in parallel with a pair of internal RCA sockets, which can feed the preamp's output signals to a couple of internal amplifier modules, making a complete preamp/amplifier combination.

Performance

The performance of the preamp is summarised in Figs.1-4. Fig.1 shows a plot of total harmonic distortion plus noise (THD+N) against frequency for an input signal level of 1.5V RMS and an output level of 3V RMS. As the final stage has a gain of two times, this means that the volume control section is set for unity gain.

The 20Hz-22kHz bandwidth plot (in cyan) gives the best indication of audible performance. This shows a total harmonic distortion level of less than 0.001% from around 35Hz up to 2.3kHz. The distortion level rises above 1kHz, with the dashed line showing how the curve would look if the harmonics weren't rolled off at the upper end by the bandpass filter.

As a good CD player is generally expected to have a THD+N figure of less than 0.0018% at 1kHz, we'd say that this preamp exceeds CD quality. That's also indicated by its signal-to-noise ratio of over 100dB, with CDs being limited to 96dB by their 16-bit sampling resolution.

Fig.2 shows how THD+N varies with signal level for some typical gain settings. The rise in distortion at the low end is due to noise being a larger component of the signal for small signals, while the rapid rise at the upper end is where the preamp has run out of headroom and has started clipping.

The best performance is around 2V RMS, a typical level for many playback systems such as CD, DVD & Blu-ray players.

Fig.3 shows how the channel separation varies with frequency. We consider this an excellent result, with worst-case crosstalk of -75dB at 20kHz.

Fig.4 shows the preamp's frequency response with the controls set flat, which only varies by about 0.5dB across the whole audio spectrum, rolling off slightly towards the 20Hz end.

It also shows plots with the bass/mid/treble controls set to their extremes individually. This should give you an idea of the adjustment range that the preamp permits. Of course, you would usually not use the

Features

- Four input stereo preamp with a colour touchscreen and remote control
- Bass, mid & treble adjustments with presets, plus volume control
- Better than CD quality
- Four external stereo inputs (one active at any time)
- Two stereo outputs, one internal and one external
- Optional loudness control automatically adjusts tone with volume

Specifications

- THD+N: typically less than 0.001%; see Fig.1
- Signal-to-noise ratio: typically around 104dB with respect to 2V RMS input
- Frequency response: 20Hz-20kHz +0,-0.5dB
- Channel separation: >75dB, 20Hz-20kHz
- Signal handling: 0.1-2.5V RMS
- Volume control range: approximately 78dB
- Gain range: -50dB to +27.6dB (0.003 times to 24 times)
- Input impedance: 100kΩ || 470pF
- Bass tone control: ±12.5dB centred around 20Hz (±11.5dB @ 50Hz, ±8.5dB @ 100Hz)
- Midrange tone control: ±11dB centred around 440Hz (±7.5dB @ 200Hz & 1kHz)
- Treble tone control: ±11.5dB centred around about 20kHz (±10.5dB @ 10kHz, ±9dB @ 5kHz)
- Power supply: 12-15V AC, 24-30V AC CT or ±15V DC
- Current draw: typically around 200mA with touchscreen on and <50mA with it off

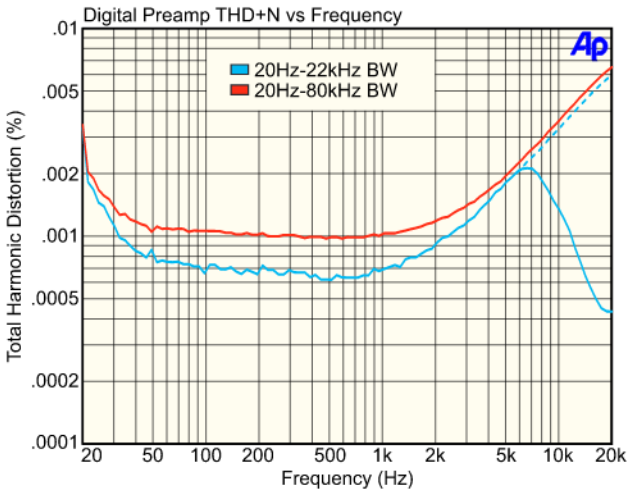

Fig.1: harmonic distortion plus noise plotted against frequency for two different analyser bandwidths. The blue plot with the dashed line is the most realistic representation of the performance, which we think is meritable. 1.5V RMS gives the best performance, but it's still pretty good at around 1V RMS full-scale, and the unit can handle over 2.5V RMS at its inputs before clipping.

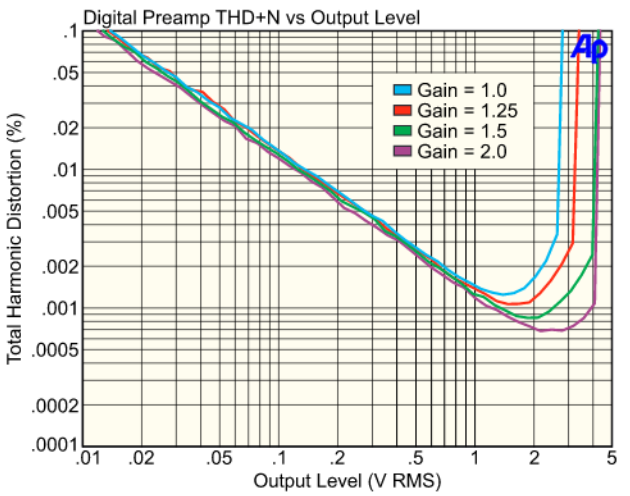

Fig.2: a plot of distortion versus signal level for a 1kHz tone, confirming that distortion rises at lower signal levels due to noise. This also shows the onset of clipping for high signal levels, but note that there are two reasons for clipping; either the input signal rises above 2.5V RMS (as is the case with lower gain settings), or the output runs into clipping at about 4V RMS (higher gain settings).

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The IOT Cricket is a small, ultra-low-power WiFi module designed for makers, scientists and hobbyists. It can run for years from a pair of AA cells. We were sent a sample to test and review.

Review: IOT Cricket

by Tim Blythman

The IOT Cricket was created by a UK company, Things On Edge, based in Cambridge.

The IOT Cricket (IOT stands for 'internet of things') appears to be their only product at this stage, but, as they suggest, it is a versatile module. Things On Edge also provides an online platform for the IOT Cricket to connect to.

At the time of writing, it is listed at £16, which equates to about AU$29. Free shipping is offered when purchasing three or more modules.

What makes the IOT Cricket different?

The IOT Cricket is different to other WiFi modules we've seen.

It's designed to be used with sensors to report their state but it requires virtually no programming. Most other devices (typically) need to be programmed with high-level software such as Python. However, with this one there's not much more to it than plugging it in and away it goes.

This makes it an ideal add-on to a wide variety of applications and especially suits the "maker" market – though we believe it will also find ready acceptance amongst designers and manufacturers, due to its simplicity.

It's housed on a small PCB module measuring 37.2mm by 16.4mm, and most of its top surface is covered by a folded metal shield, meaning the unit is around 4mm thick.

According to the Things On Edge website, it includes an ESP8266 processor running at 160MHz.

A notch in one corner of the shield provides access to a minuscule tactile switch and LED.

At one edge is a 6-way set of full (through-hole) and castellated pads. The reverse has 13 surface test pads, six of which are arranged in a 2x3 grid, which we suspect is a programming header.

At the opposite end of the board is a PCB antenna, similar to the antenna seen on other ESP8266 modules.

Probably the most interesting aspect of the IOT Cricket is the fact that it can run for long periods on battery power; the website claims years on a pair of AA cells.

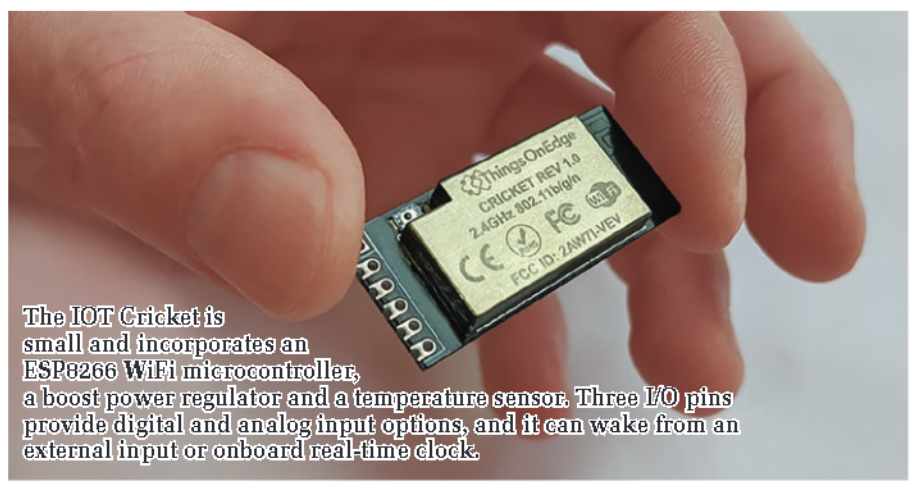
We haven't had the time to test that statement, but it certainly appears feasible with aggressive power saving features.

Those who have worked with the ESP8266 would know that it is not a very battery-friendly chip. So they have used some tricks to achieve low power consumption. Although Things On Edge did not share the schematics with us, the general operating concept is straightforward.

The six-way edge header provides connections for a battery, the negative of which is also circuit ground.

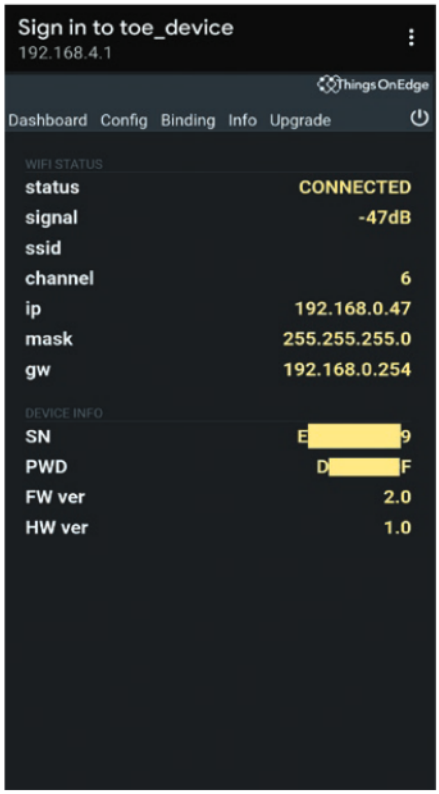
One terminal provides a nominal 3.3V output when the device is 'awake', while the remaining pins are digital inputs, with one capable of measuring analog voltages.

With the typical supply being a pair of AA cells, the regulator is of the boost variety. The IOT Cricket claims an input of 1V to 3.5V. Most of the

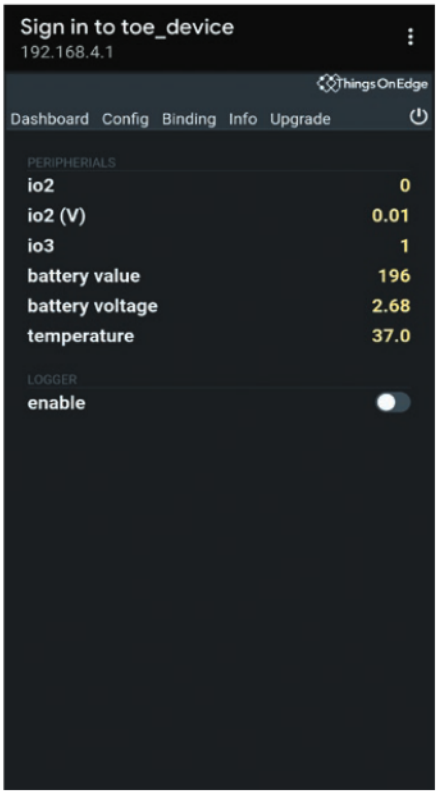


The IOT Cricket is small and incorporates an ESP8266 WiFi microcontroller, a boost power regulator and a temperature sensor. Three I/O pins provide digital and analog input options, and it can wake from an external input or onboard real-time clock.

Screen1: the captive web portal provides the ability to set up the WiFi network. Once connected to the internet, the IOT Cricket can upload data and receive configuration and firmware updates.



Screen2: the Info tab indicates that the WiFi has been correctly configured, and lists the unique serial number and password needed to make use of the Things On Edge MQTT (Message Queuing Telemetry Transport) broker.



Screen3: the I/O port status can also be monitored via the web portal; this is handy for prototyping and troubleshooting.

time, the ESP8266 on the IOT Cricket is powered off. An RTC chip can be configured to wake up the boost regulator at set intervals.

One of the I/O pins can also be configured to wake up the IOT Cricket, and it also includes a temperature sensor.

This scheme is probably the best way to get the most battery life out of a circuit utilising an ESP8266, with the proviso that it won't be operating most of the time.

It has a web configurator which can be used to change WiFi settings. Unlike many other ESP8266-based devices, this one is not intended to be programmed by the end-user in a low-level or high-level language.

Instead, the web configuration is used to set how often the IOT Cricket wakes up, what information it reports and how it reports it.

It's a very different philosophy from other ESP8266-based products. Still, Things On Edge also provides a web portal which can work with MQTT (Message Queuing Telemetry Transport) data, which means that it is straightforward to set up something that 'just works', without having to worry about programming specifics.

As such, it's well-suited as a sensor node, reporting data, status or user inputs back to another device as part of a larger system.

Setup process

The small button is used to enter the configuration modes; a five second press is used for initial configuration. After holding the button for five seconds, the LED flashes at around 5Hz and a 'toe_device' WiFi network appears.

Connecting to this WiFi network takes you to the captive portal webpage (at IP address 192.168.4.1) to enter the necessary information. The first thing to configure is the IOT Cricket's connection to your WiFi network, using the Binding tab as seen in Screen1, which shows 'CONNECTED' if this is successful.

The Info tab shows WiFi and device information (seen in Screen2). In particular, you will need to note down the serial number and password (SN and PWD) to configure other things to work with the IOT Cricket.

The Dashboard tab (Screen3) shows the current sensor status. This could be handy during the testing phase, to check that your sensors are working correctly.

The Config tab (Screen4) is used to set up what inputs are monitored and

Features & specifications

Connectivity:	WiFi (b/g/n)
Supply voltage:	1-3.5V (boost regulator onboard)
Protocols:	HTTP and MQTT (free MQTT broker provided)
Configuration:	web portal
Inputs:	two digital, one analog (shared with digital pin), one wake-up, temperature sensor
Processor:	ESP8266 running at 160MHz
Wake-up:	real-time clock (RTC) or digital input

where they are reported. These settings will also be most critical to getting the best battery life from the IOT Cricket. We enabled most of the reports to run some tests, and set the connectivity to MQTT_TOE, which is Things On Edge's MQTT broker.

There are also options for a custom MQTT broker (which could be on the internet or a local network) or communicating using HTTP GET or POST methods, again connecting to either a remote or local HTTP server.

Clicking the power icon at top right exits configuration and starts the IOT Cricket running with its current application settings.

We enabled all sensors for our initial tests and set the RTC to wake the IOT Cricket up every 10 seconds. These settings are certainly not optimal for power consumption, but made it easy to check that everything was working correctly.

MQTT

MQTT stands for Message Queuing Telemetry Transport and is a protocol that is well-suited to allowing small IoT-type devices to communicate. Devices publish messages to so-called 'topics' to a broker, and other devices can subscribe to specific topics. The broker sends these messages when they are received.

It is a fairly simple and lightweight protocol, but supports authentication via username/password combinations and security using TLS encryption. The client and broker model also means that many small devices can share information via a single broker.

Something like a PC or even a single-board computer like a Raspberry Pi is typically used as a broker, meaning that a microcontroller can implement the lightweight clients. Since one broker can manage many clients, this is not hard to set up and allows many clients to send, receive and share data.

Several open-source home automation projects can use MQTT, and there are also mobile phone apps that can be configured with custom dashboards to send and receive messages. So MQTT is a good choice for integrating with these sort of home-made projects.

We set up mosquitto (https://mosquitto.org/), an open-source, cross-platform MQTT broker and client to test out the setup on our Windows computer, although this should also work for Mac and Linux (including Raspberry Pi).

Running the command shown in Screen5, we were able to monitor the status updates from the IOT Cricket. Note that the Things On Edge broker (at mqtt.thingsonedge.com) uses the IOT Cricket's serial number as its username and password, and passes all messages to a topic named for that serial number and the property (after the -t option).

Table1 is a good summary of what sort of information the IOT Cricket can capture and report. Note that the configuration will need to be set to allow the necessary topics to be reported, and those not used should be switched off to minimise power consumption.

Using Things On Edge's MQTT broker and an MQTT dashboard app could be a simple way to monitor a remote sensor using not much more hardware than the IOT Cricket itself.

Screen5: this command, issued after installing the 'mosquitto' software, allows the IOT Cricket's messages to be checked and monitored. The 'batt' topic name can be replaced with any of the others that are supported, or the '#' MQTT wildcard to see all messages.

HTTP

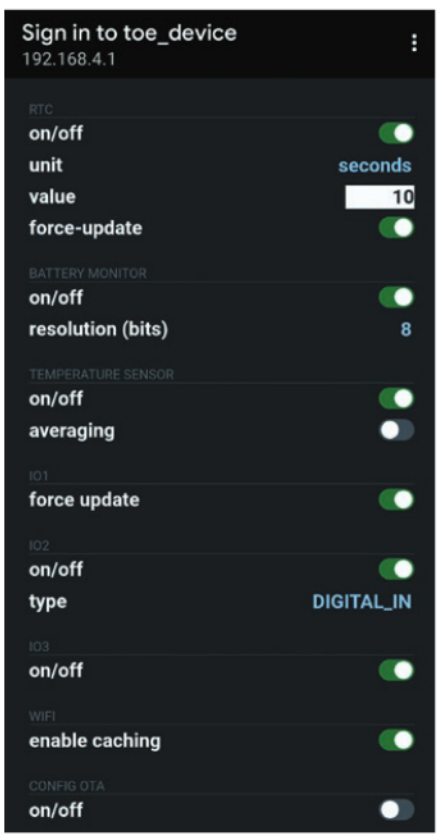
The IOT Cricket can also communicate with a web server via HTTP POST or GET methods. In either case, the data is passed by tags which correspond to the topics listed above, but preceded by a '#'. The IOT Cricket then replaces the tag (eg, '#batt') with its value when the data is sent.

In the case of a POST, the payload can be set to a specific string, which can contain a combination of text and tags. A GET method includes these at the end of a URL, typically in the form of parameters like "?battery=#batt".

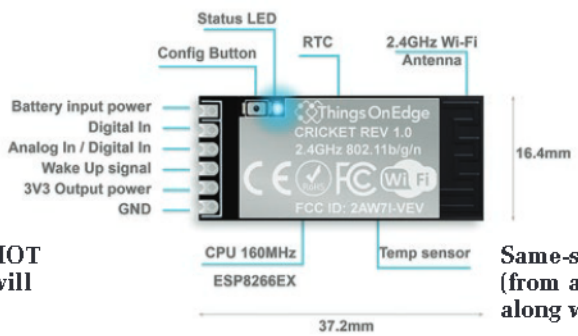
This allows custom content to be created and passed to an existing server. When the HTTP server receives a request, it can process the payload or URL to decode the data. The HTTP protocol is quite simple, but it is limited to one endpoint (the HTTP server).

Testing

We tried a few things out to put



Screen4: configuring what and when the IOT Cricket reports data is critical to how it will operate and how much power it will use.



Same-size illustration of the Cricket (from above) showing its I/O pins along with the main features.

temp	Temperature in °C to one decimal place
batt	Battery voltage as raw ADC value (up to 8 bits)
io2	Pin state as digital (0-1) or analog (0-255) value
io3	Pin state as digital (0-1) value
io1_wake_up	Digital value (0-1) if IOT Cricket was woken by pin
rtc_wake_up	Digital value (0-1) if IOT Cricket was woken by RTC
hwc_wake_up	Count of wake-up events
hwc_wifi_enabled	Count of WiFi connections
device_sn	Device serial number (string)
device_name	Device custom name (string)

Table1: these topics are available, and all MQTT data is communicated as strings of ASCII characters.

the IOT Cricket through its paces. We found that running it from breadboard wiring was not always successful, especially from a single 1.5V cell, but we had no problem after we had soldered it directly to the battery holder.

The hardware notes for the IOT Cricket indicate that the power supply should be able to supply bursts up to 0.5A with a 3.3V supply, and 100mA continuously.

We ran some tests with a small 0.1Ω current shunt resistor and an oscilloscope. With a pair of AAA cells providing around 3V, we noted a current spike of 600mA at start-up, causing the battery voltage to sag near 2.5V; see Scope1.

The nature of the boost module means that a lower supply voltage will necessarily require a higher current; a 1V supply might need to supply peaks of around 2A at start-up, possibly causing the battery voltage to sag even further.

So while the specifications indicate that the IOT Cricket should be able to run from a 1V supply, users should be aware that this would be measured at the unit itself and they should leave some headroom for sagging due to high current bursts. One option could be to fit an external capacitor to help with this.

Despite this, we found operation on a pair of AAA cells to be flawless. Given that two AAA cells are not much larger than a single AA cell, we would be inclined to power the unit in this fashion. Average current consumption while active was around 40mA, and the typical uptime was six seconds.

This means that each update consumes around 67µAh and a 1000mAh capacity battery (at 3V nominal) can provide about 15,000 updates, assuming the quiescent power consumption is negligible.

With this in mind, it is clear that the IOT Cricket's ability to operate for long periods on battery power is dependent on spending most of its time in the low-power state, where presumably, only the RTC is running. Current in this state was under 1µA, according to our multimeter.

The boost regulator inherently limits the upper voltage that can be supplied to the IOT Cricket, since it cannot regulate down. The notes clearly state that 3.5V is the upper battery voltage, which aligns with the 3.6V upper limit for the ESP8266.

This rules out rechargeable options such as LiPo or even LiFePO cells without an external regulator, as they can peak up to 4.2V when fully charged. A pair of NiMH cells would be the logical alternative (giving around 2.4V to 2.8V), although we haven't tested that.

We found that the temperature reported by the IOT Cricket was slightly higher than expected, although we were testing with a fairly frequent update rate, so the unit may have been suffering from self-heating. We expect that less frequent updates would ameliorate this issue.

Power saving

Apart from enabling and disabling individual inputs, there's also the option only to report changes if the input changes; this is the "force update" option seen in Screen3.

When this option is switched off, the input states are only reported when a change occurs.

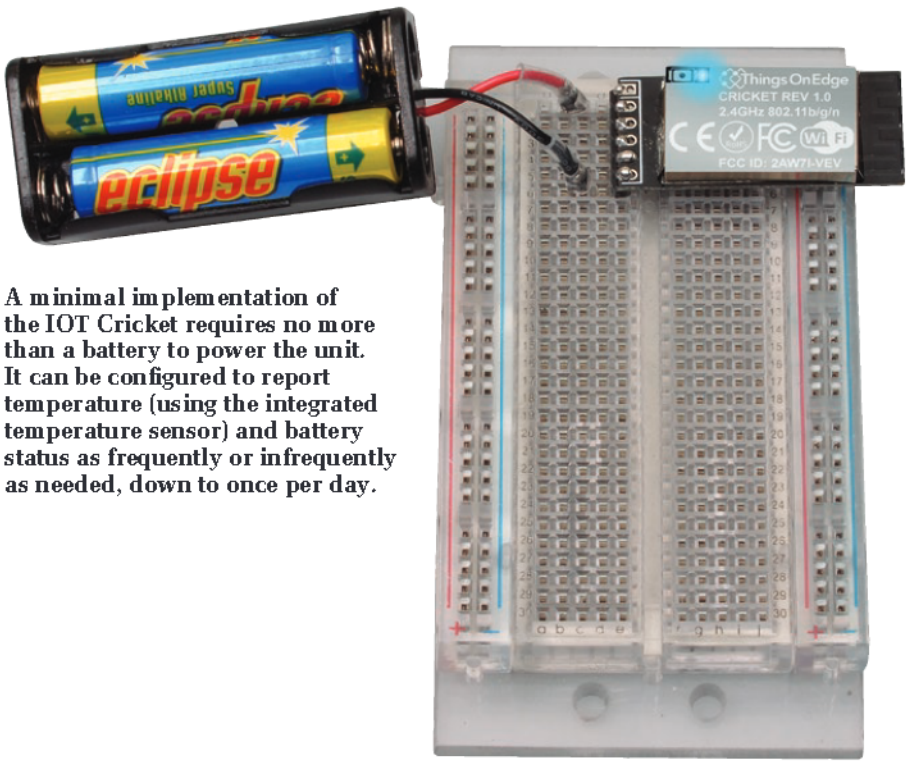
If no data needs to be reported, then the IOT Cricket can skip the power-hungry process of connecting to a WiFi network and sending that data, saving even more power.

Of course, this means that it's more difficult to tell when the IOT Cricket is working correctly.

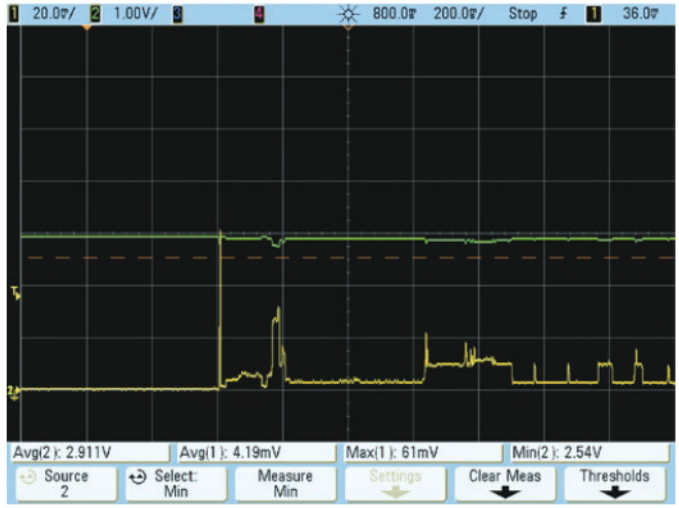
Resources

An online brochure, quick-start guide and in-depth IOT Developer Guide are available at www.thingsonedge.com/documentation, while sample projects and other articles are referenced from the blog page at www.thingsonedge.com/blog

The IOT Developer Guide also lists several compatible sensors, including buttons, light sensors, motion sensors and even a microphone.



A minimal implementation of the IOT Cricket requires no more than a battery to power the unit. It can be configured to report temperature (using the integrated temperature sensor) and battery status as frequently or infrequently as needed, down to once per day.



Scope1: the green trace shows battery voltage while the yellow trace is the voltage across a 0.1Ω current shunt when the IOT Cricket is powering up. The 61mV spike on the yellow trace is notable; it corresponds to 610mA of current draw, while the battery voltage sags to 2.54V.

With the 3.3V output, it's possible to power external sensors only when needed. However, they will need to have modest current consumption to allow the boost regulator to work correctly and prolong battery life.

We suggest reading the IOT Developer Guide to get the most out of the IOT Cricket.

The IOT Cricket can also upgrade its own firmware from the Things On Edge server. These options are available from the captive web portal under the Upgrade tab.

There is also an option to load configuration settings from the Things On Edge server. Enabling this feature could be a good idea for a unit that has been remotely deployed.

Conclusion

The IOT Cricket has a very different philosophy to many other similar devices we have seen, requiring practically no programming and only some minimal setup, at the expense of the greater options available with a more programmable alternative.

It appears to be well thought out and provides an interesting addition to the spectrum of IoT and remote-sensing modules on the market.

The ESP8266 is a power-hungry part, and as expected, the way the IOT Cricket gets around this is by shutting down for long periods, although the option of RTC and I/O pins for wake-up should cover most uses for this device.

It requires fairly high currents when it is starting and awake, so careful design is needed to ensure that there are no high-resistance paths in the battery circuit, as these will be a major point of inefficiency. A supply closer to 3.5V will provide headway above the minimum operating voltage, reducing the current needed for operation.

The provision of an internet connected MQTT broker to complement the IOT Cricket is a handy feature, meaning that its data can be accessed from just about anywhere by multiple clients.

We don't expect that the IOT Cricket will be useful for all battery sensor applications, especially those that require fast and frequent updates. But it is versatile, compact and easy to use with many common sensors. The IOT Cricket is available for purchase from www.thingsonedge.com

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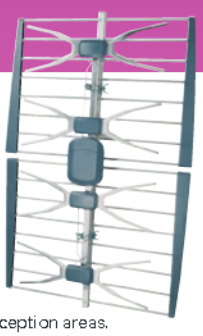

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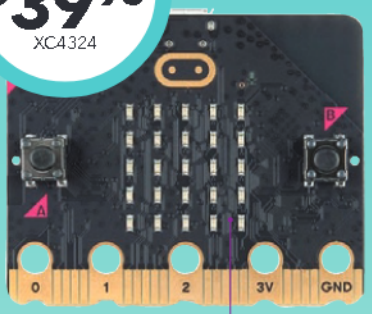

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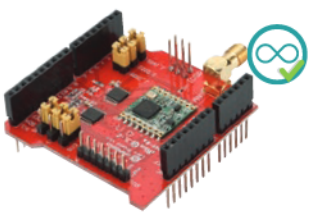

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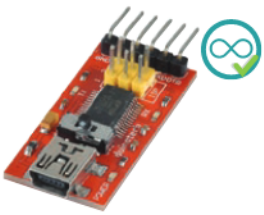

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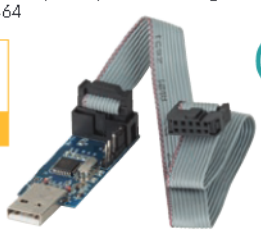

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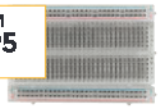

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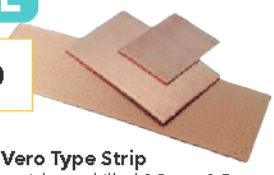

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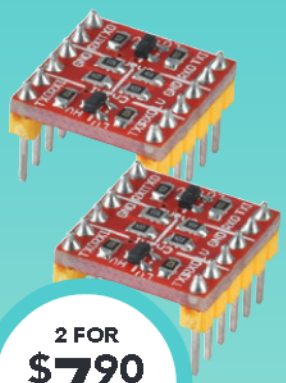

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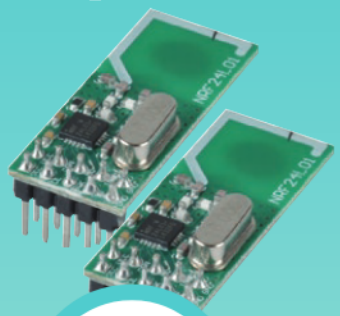

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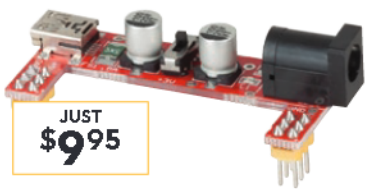

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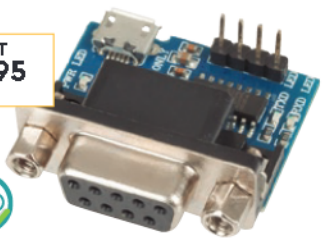

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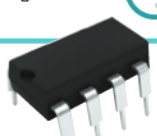

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Second-Generation Colour Maximite 2

This new CMM2 computer is compatible with the original described in mid-2020 and adds several great new features. These include more memory, higher-resolution video modes, 24-bit 'true colour', more controller inputs, better keyboard and mouse support and some new optional components like a super-accurate real-time clock.

PART 2: ASSEMBLY & USE

WORDS AND MMBASIC BY GEOFF GRAHAM
DESIGN AND FIRMWARE BY PETER MATHER

Ditching the use of a microcontroller module like in the original CMM2 means there are more SMDs onboard, but overall it has simplified the design. Since many vendors are now supplying boards with the vast majority of the SMDs already soldered, the cost has been kept low and assembly is quick and easy. So we'll get stuck into that before we describe some ways you can use it.

Construction

Fig.4 shows the PCB overlay for the CMM2 Gen2 board. You can use this as a guide during construction, but it is also helpful for debugging, testing or planning hardware expansion (eg, developing an add-on board for the computer).

If you're building your CMM2 Gen2 from scratch (including soldering all the SMDs), we'll assume that you know what you are doing and just give some general pointers. Firstly, make sure that you have IC3 & IC4 orientated correctly before you solder more than a few pins. Even experienced constructors can sometimes mount ICs with pin 1 in the wrong location, and fixing it is a lot of work!

After soldering IC3 and IC4, clean up the board and scrutinise the solder joints to ensure they're all good and there are no bridges. You can mount the remaining SMDs in pretty much any order. Do check the orientation of the remaining ICs and oscillator modules before and after tacking them down.

Once you have all the ICs, resistors, capacitors, oscillators and reset switch in place, give the board another clean, and you're at the same point as someone who is starting assembly from one of the partially pre-assembled kits.

Finishing your computer

Even if you have a partially assembled second-generation Colour Maximite 2, you still need to complete it by soldering the connectors and larger components, a few of which are surface-mounted. This is reasonably straightforward; only a couple of items need to be treated with care.

The first is the SD card socket, which should be soldered first so that you have easy access with the soldering iron. This is a surface-mounting connector, and it has two small pins on its underside which match two holes in the PCB. These help locate the connector in the correct position while you solder the pins.

The best approach in soldering this socket is to apply plenty of liquid flux on the pins and carry the solder to the joint on a fine-tipped, temperature-controlled soldering iron. You could also use fine-gauge rosin cored soldering wire and solder the joints directly, but this has the risk of adding too much solder causing shorts etc.

Note that the socket must be held firm to the PCB while soldering, as any gap between it and the PCB will prevent an inserted SD card from making reliable contact with the connector pins.

To start, solder the two tabs on the right-hand side of the socket (viewed from the front) and the five on the left-hand side. Some are close to the socket shield, so take care not to cause a solder bridge there. You can then solder the nine pins at the rear. If you get a solder bridge, don't worry and carry on with the other pins.

Finally, examine your soldering carefully and clean up any solder bridges using solder wick. Be careful here as solder wick can suck up all the solder (although generally, it will

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BY PHIL PROSSER

Tapped Horn Subwoofer

This subwoofer uses just one 8-inch (200mm) driver, yet its response extends below 30Hz and it's capable of delivering over 100dB SPL! That's despite a modestly-sized cabinet that's less than 30cm wide, making it relatively easy to hide. So how does it achieve this? Read on to find out.

This subwoofer is relatively inexpensive to build and not all that hard either, thanks to its clever design. If you already have most of the tools, it will probably end up costing around $200 in total (depending on where you get your hardware). You can get away with using a relatively small amplifier to drive it too, given its high efficiency, although you will need an active bandpass filter (to be described next month).

Being a "Tapped horn" subwoofer means that its sole driver is placed inside a horn. This type of subwoofer was made famous by Thomas Danley of Danley Sound Labs. They are often used in sound reinforcement; visit siliconchip.com.au/link/ab9q for a few examples.

If you want to see the ultimate manifestation of the tapped horn subwoofer, check out the video at https://youtu.be/Zbf3bzpgml8

The term "tapped horn" does not sit easily with the engineer in me, as it is not actually horn-loaded. Instead, it would probably be more accurate to call the alignment a re-entrant resonant pipe. But let's set semantics aside and use the common name.

After reading a few articles on this approach to making a sub, I decided to see how they work. The aim was to present a tapped horn design that fits into a domestic setting, allowing readers to explore this concept in an approachable manner. So, if you have ever wondered about this sort of sub, here is your chance to spend a weekend and find out for yourself how they work!

This subwoofer is more than enough for a living room, study or bedroom – it has been kept to a modest scale and cost. The design presented has been simplified to avoid odd cut angles, and I have taken out non-essential corner fillets to keep the assembly as simple as possible. I have even sized the box so that you can use standard sheets of MDF with minimal cuts.

In loudspeaker design, the designer needs to juggle several parameters, notably: the size of the box, how loud it will go (SPL), its low- and high-frequency extension (bandwidth), and its efficiency (how much power it takes to drive to a particular sound level).

A tapped horn can push the efficiency, low frequency extension and SPL well beyond that offered by a conventional sealed or vented enclosure. It achieves this by placing the driver inside the acoustic path and folding that path around, so that the output from the back of the driver adds to the output of the front of the driver.

But there ain't no such thing as a free lunch, so you pay the price in complexity.

As shown in Fig.1, one side of a loudspeaker drives the horn close to its end, and the other side of a loudspeaker drives it close to its output. If the two drivers are fed with the same signal, they deliver out-of-phase

signals into the horn since they face opposite directions. This gives the simulated response shown in Fig.2; note the extended bass response.

But the same driver can't exist in two different places, so to get the driver to fire into both the front and back ends of the horn, the enclosure is folded over on itself – see Fig.3. This single-fold design is still really long and not that convenient. It is possible to fold these up further in several ways. The configuration we have chosen is shown in Fig.4.

Ideally, it would be made from conically expanding sections, but those are really fiddly to cut. You will note that we have cheated on this and made the sections straight. Our tests show that the impact is not enough to worry about.

Remember that a conventional sealed enclosure is there to absorb the rearward output from a driver. By juggling the length and area of the path from the back of the driver to the mouth, we achieve constructive interference of the sound over a set bandwidth. This increases the efficiency and allows us to push the low-frequency extension further down.

Of course, this comes with compromises. A tapped horn only works over a limited bandwidth, after which the output becomes a series of peaks and dips. Therefore, we need to set the crossover frequency low enough to cut out all the unwanted frequencies. Also, below the low-frequency cutoff, cone excursion becomes uncontrolled, similar to a vented enclosure.

The solution is to drive the subwoofer with an active crossover that filters out high frequencies and provides a subsonic filter to remove unwanted low frequencies.

Every professional sound system includes subsonic filtering for their subs. This protects the drivers from over-excursion and avoids the amplifiers wasting power by driving the speakers with signals they cannot generate.

This article presents only the subwoofer. It should be driven with a signal that's been through a 20Hz subsonic filter (high-pass) of 24dB/octave and a low-pass filter of -24dB/octave with a -3dB point of 80Hz.

We will present an active crossover design to provide this next month. Still, you can probably drive it from the subwoofer output on many home

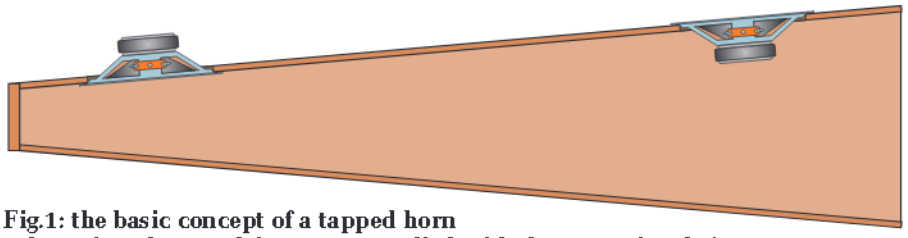

Fig.1: the basic concept of a tapped horn subwoofer. The two drivers are supplied with the same signal. As they are mounted rotated 180° compared to each other, the signals they generate within the horn are out-of-phase. But it takes time for sound to travel down the horn, so over a certain range of frequencies, the sound reaching the outer driver is in-phase, resulting in constructive interference and reinforcement.

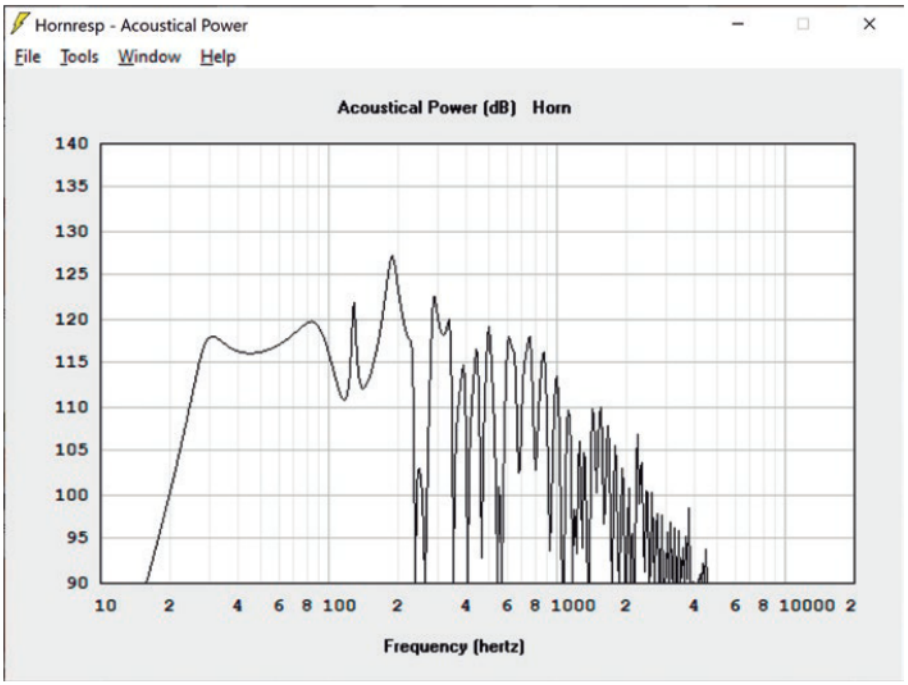

Fig.2: the simulated response of a folded horn. It gives a nice broad plateau over the range from just below 30Hz up to about 100Hz plus a series of peaks and troughs at higher frequencies, as the sound waves constructively or destructively interfere depending on the specific frequency. So we need a low-pass filter to eliminate signals above 100Hz for it to sound good.

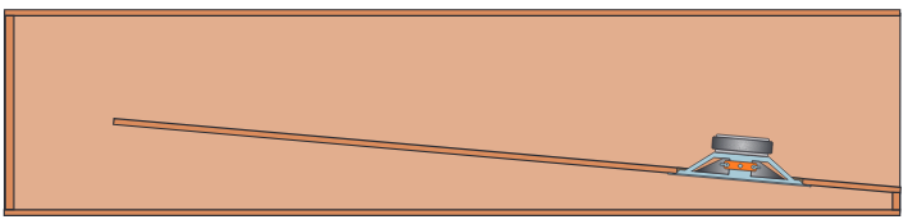

Fig.3: this rearrangement of the tapped horn shown in Fig.1 is more practical to build since it is both shorter and uses just one driver instead of two, but it achieves the same result.

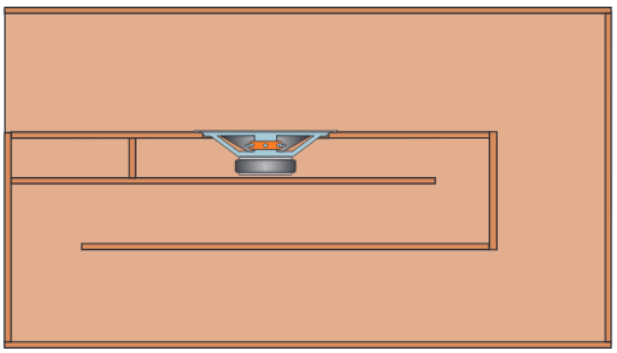

Fig.4: more folding of the horn (and a bit of creativity regarding how it tapers) allows us to create an even more compact enclosure without sacrificing much in the way of performance.

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SERVICEMAN'S LOG

'Playing' with fire


Dave Thompson

I always hesitate to 'help' repairers or installers do work in my home. While I presume that my talents would come in handy (even if I'm just acting as a third hand), I know how frustrating it can be when someone who is not an expert is hovering over you. Sometimes, a 'helper' is actually a hindrance. In this case, I think the guy appreciated assistance from someone with decent electronics knowledge.

A little while ago, I was sitting in my workshop doing something-or-other when suddenly there was a huge **boom**! The earth shook, dust fell from the light fittings, and everything on the bench was rearranged slightly. This didn't overly disturb me, as earthquakes are a dime a dozen here these days.

I'll admit that my heart did race a little, as it always does with quakes, though I did think it a bit unusual at the time. Most 'quakes don't have the sharp shock and loud audio soundtrack this one had, tending instead to be rolling, rumbling affairs lasting perhaps 30 seconds or more. This one was very short and sharp, and quite loud, but I thought nothing more of it at the time.

I know, great story, right? However, this will all become relevant later, I promise!

Keeping the 'cave' comfortable

Increasingly, our news reports seem to be chock full of extreme weather events. If it isn't droughts, it's floods, and if it isn't wildfires, it is plunging temperatures from seemingly endless polar blasts. Sometimes both of these will happen in the same place, just a few months apart.

While being so far away from the hottest places on the planet does help us here in New Zealand a little, being so close to very cold places does have its drawbacks. Anyone who has visited Christchurch (or anywhere further south of here) in the middle of winter will know what I'm talking about.

This year, we have record-breaking 'cold snaps', which sound vaguely appealing, like something my grandma would have baked. But to those of us living here, they are anything but. When the mercury drops to -7°C of a morning, for example, one really appreciates having a well-insulated, well-heated double-glazed home.

The rub is that most homes built here before, say, the 1980s are mainly uninsulated (apart from some having fibreglass insulating batts retrofitted into the roof over the living areas if you were posh).

They typically have single-glazed windows, making them increasingly inappropriate for the temperature extremes we are now seeing in the summer and winter months.

My parents' ex-home, which we have just sold due to them not being here any longer, is a classic example. Mum and dad added insulation and better windows to their 1959-built house, where practical, while they lived there.

But with no wall insulation, minimal roof insulation and originally just two back-to-back fireplaces to heat the whole house (eventually replaced with stand-alone electric heaters, then heat pumps), the home was very susceptible to heat and cold. It was sweltering in the summer and impossible to warm up in the winter.

These days, it is increasingly important that houses be properly built and well-insulated. Not only is it a nicer place to be, but it is also a lot less expensive to heat or cool, especially given that costs of energy – whether electricity, gas or wood – are all going through the roof (pun intended!).

Time for an upgrade

Recently, the 35-plus-year-old Masport LPG gas fire we inherited when we bought this house five years ago started playing up.

The Masport range is well-known and seems to include pretty decent products. However, the model in our lounge was deprecated years ago and finding information on it turned out to be a challenge.

The 'modern' Masport company has nothing relating to it on their website, not even giving it a listing in its 'old bangers' section. I eventually found, through a helpful forum post, a PDF service manual for it. With that, I could finally plumb the depths of what is still available for it parts-wise, which, as you can probably guess, is 5/8ths of less than nothing.

So, the weather was getting colder, and our gas fire often wouldn't start properly (which entails opening a valve to the 'light' position and pushing a piezo striker button repeatedly until it decides to work). When it did light, it performed poorly.

Items Covered This Month

- 'Playing' with fire
- TV remote control repair
- Surround sound system repair
- RS-485 network with intermittent faults
- Philips AE5230 radio repair
- Repairing two laptops that wouldn't POST

Dave Thompson runs PC Anytime in Christchurch, NZ.

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Email: dave@pcanytime.co.nz

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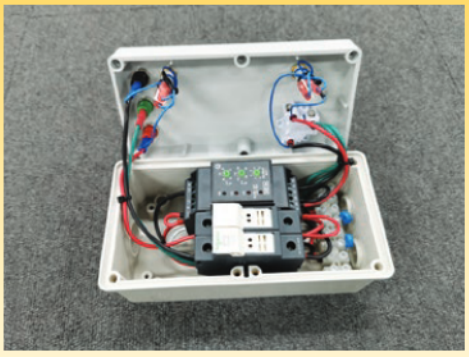

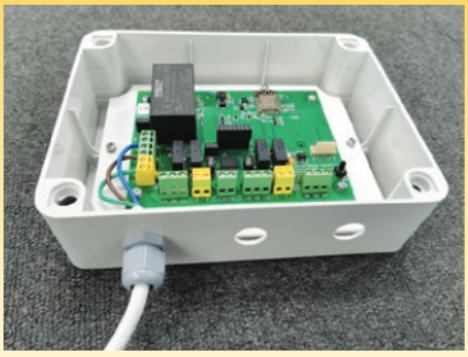

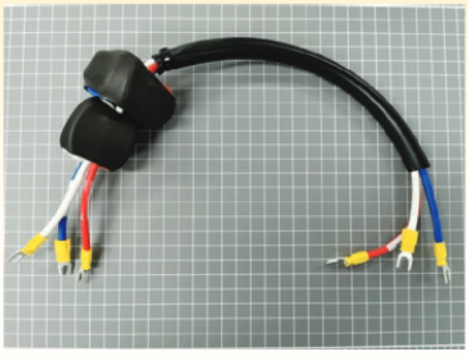

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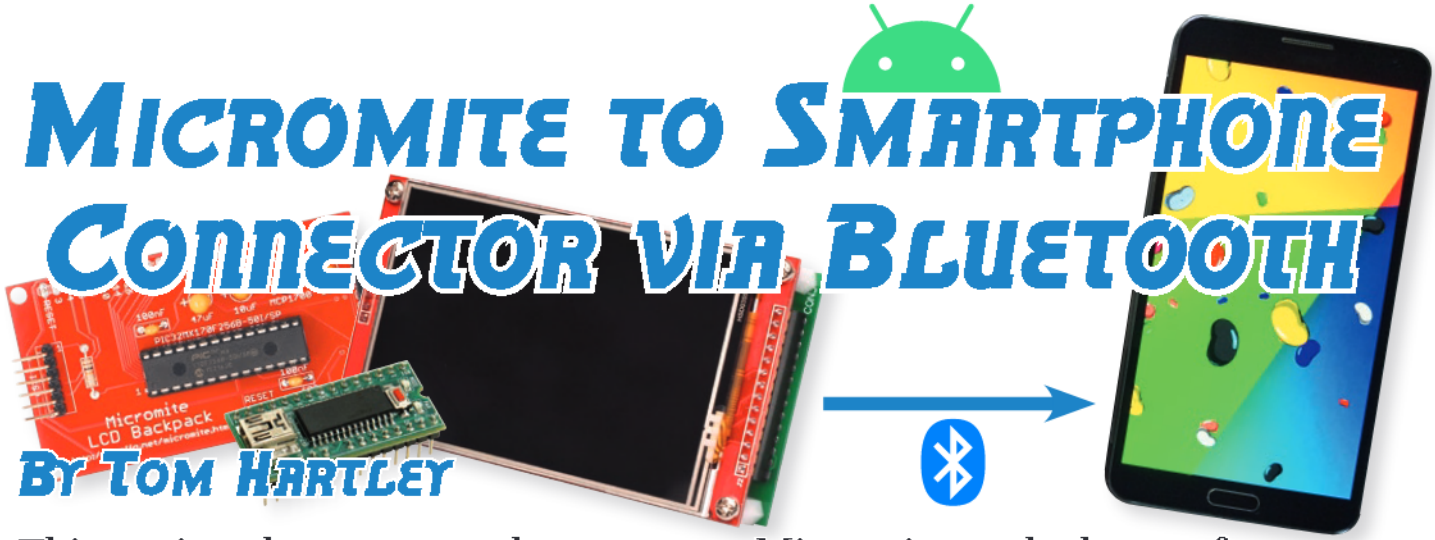
Micromite to Smartphone Connector via Bluetooth



By Tom Hartley

This project demonstrates how to use a Micromite as the heart of an IoT (Internet of Things) device. But there are many other reasons you might wish to connect a Micromite to your Android smartphone, such as making it easy to monitor what your device is doing without going to the trouble or expense of fitting it with an LCD screen. It also makes it really easy to control the software running on the Micromite.

Phone Image Source: Android Open Source project

The Micromite Mk2 (January 2015; siliconchip.com.au/Article/8243) is a great way to get into programming microcontrollers, because you need so little to get it up and running, and the BASIC language it uses is easy to learn. But to make the most of it, you really need some sort of screen.

That's why the Micromite LCD BackPack series (starting in February 2016) has been so popular. It combines the Micromite with a colour touchscreen, giving you an easy way to interact with the device and display information. But that arrangement is considerably more expensive and complex, and a separate screen isn't always required.

The Circuit Notebook section of the May 2015 issue (siliconchip.com.au/Article/8395) showed how low-cost Bluetooth modules could be used to allow two Micromites to communicate without wires. But what about using such a module to interface with a smartphone?

That way, the phone becomes the user interface to the Micromite, so you can get away with a much simpler and cheaper arrangement – assuming you already have a suitable phone.

And since smartphones generally have a connection to the internet, the Micromite can become an IoT (internet of things) device and easily share data with other devices.

This article explains how to connect a bare Micromite chip to an Android mobile phone to communicate and display data without using a screen. You can even communicate with the Micromite's terminal output data stream using an Android app, sending it BASIC commands and so on.

Basic arrangement

After programming a 28-pin Micromite chip via the conventional PC USB connection, I was able to disconnect it from the PC and transmit the Micromite's terminal output data stream over Bluetooth to an Android App, running on an inexpensive mobile phone.

The design requires very few components:

1) A smartphone running some version of the Android operating system.
2) A 28-pin Micromite PIC chip loaded with MMBasic, and a tantalum or ceramic capacitor for the V_{CAP} pin, as recommended by Geoff Graham.
3) An HC-05 Bluetooth module, preferably one with an Enable pushbutton key.
4) A USB to TTL converter (eg, one based on the ubiquitous CP2102 chip).
5) A short USB extension cable.
6) A BMP180 atmospheric pressure sensor (for this particular demonstration application).
7) A four-AA battery holder modified by tapping the output voltages at 3V and 4.5V. The fourth cell is not needed, so that position can be left empty.
8) A small piece of Veroboard.
9) Some hook-up wire.

Bluetooth module setup

The first job is to configure the Bluetooth module as required by this

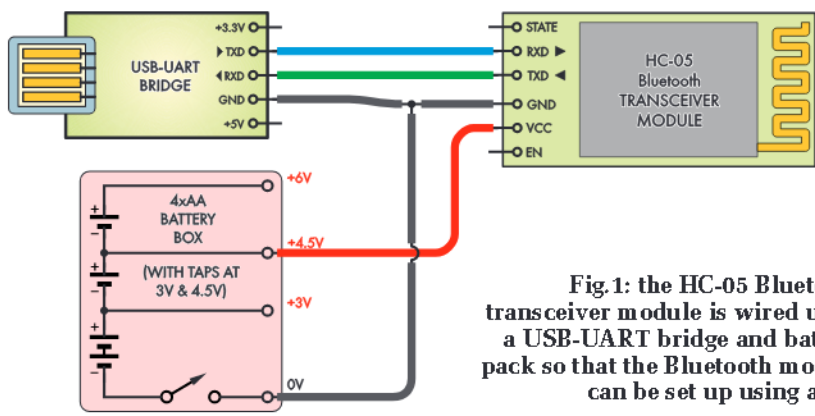


Fig.1: the HC-05 Bluetooth transceiver module is wired up to a USB-UART bridge and battery pack so that the Bluetooth module can be set up using a PC.

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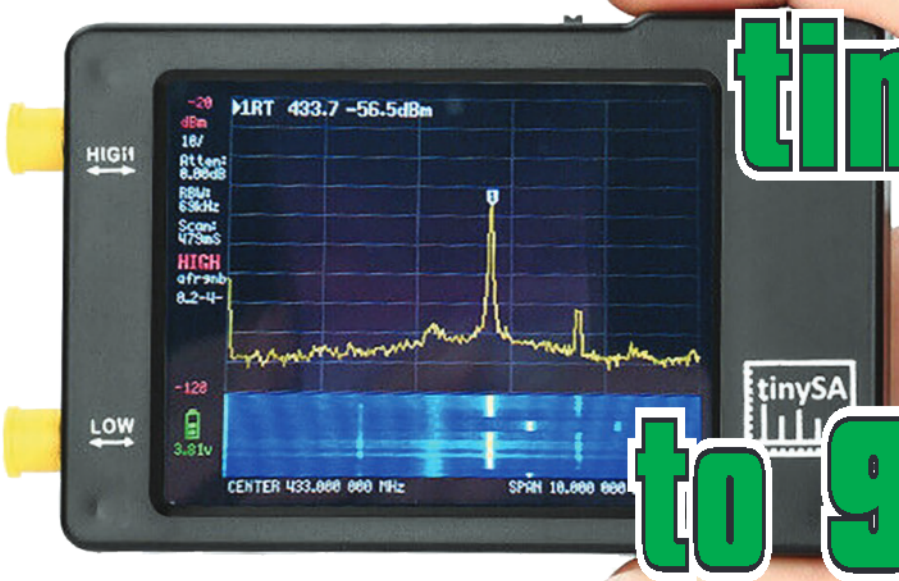
Preview only.

Allan Linton-Smith reviews an $80 ebay "bargain"

tinySA: a 0.1MHz to 960MHz Spectrum Analyser



I bought this "tinySA" spectrum analyser/signal generator on ebay for just $80 including delivery! It is a standalone device which can be connected to a computer for recharging and reprogramming.

While oscilloscopes are used to measure and view signal amplitude (voltage) vs time, a spectrum analyser is used to measure and view a signal amplitude vs frequency.

Like oscilloscopes, over time, cheaper and smaller spectrum analysers are becoming available.

When I spotted the tinySA for sale, I had to get one as I use spectrum analysers often, and I wanted to know if a device this cheap was any good.

It is a standalone device and is connected to a computer or USB charger. It can be programmed using tinySA software from www.tinysa.org/wiki/

It arrived neatly packed in a cardboard box with a lid and included two SMA cables, an SMA female-female converter, a small 10-30cm telescopic antenna and a USB Type-C charging cable.

It comes in a nice little pocket-sized black enclosure and has two SMA connectors; one is the high-frequency input or output (260-960MHz), while the other is the input or output for lower frequency signals, down to 100kHz.

It does not have a tracking generator; it is merely switched between analysis mode or generator mode. However, it can be used for plotting RF frequency response using the "max hold" setting and an external sweep generator.

It worked straight out of the box. It's remarkably accurate too, and we didn't even have to charge it straight away.

RF Spectrum Analysers are usually very expensive devices, often costing thousands of dollars (even old preloved ones).

So for $80, this seems like an excellent deal. And while some cheap modules we've tried either didn't work at all or instantly self-destructed, this one gave useful readings immediately.

Using it

If you have ever used a "real" benchtop spectrum analyser, you will know that they may need a significant warm-up time and a lot of setting up.

But this one required almost no adjustment. The resolution bandwidth (RBW) and reference level were set automatically, and the instrument discovered a signal immediately!

Spectrum analysers definitely require a bit more 'tuning' than an Oscilloscope, but this little device makes life easy.

Except for RF enthusiasts, most of us don't really need an RF spectrum analyser all that often. But when you need one, you need it. So it makes sense to not spend heaps on a benchtop unit which will just be gathering dust for 99.9% of the time.

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PIC10F202-E/OT	Ultrabrite LED Driver (with free TC6502P095VCT IC, Sep19)
PIC12F1572-I/SN	LED Christmas Ornaments (Nov20; specify variant) Nano TV Pong (Aug21)
PIC12F617-I/P	Car Radio Dimmer (Aug19), MiniHeart Heartbeat Simulator (Jan21) Refined Full-Wave Universal Motor Speed Controller (Apr21) Model Railway Level Crossing (two required – $15/pair) (Jul21)
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PIC12F675-I/SN	Tiny LED Xmas Tree (Nov19)
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PIC16F1455-I/SL	Ol' Timer II (Jul20), Battery Multi Logger (Feb21)
PIC16F1459-I/P	5-Way LCD Panel Meter (Nov19), IR Remote Control Assistant (Jul20) Ultrasonic Cleaner (Sep20), Electronic Wind Chime (Feb21) 20A DC Motor Speed Controller (Jul21)
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PIC32MX170F256D-501P/T	44-pin Micromite Mk2 (Aug14), 4DoF Simulation Seat (Sep19)
PIC32MX170F256B-50I/SP	Micromite LCD BackPack V1-V3 (Feb16 / May17 / Aug19) Micromite DDS for IF Alignment (Sep17), Tariff Clock (Jul18) GPS-Synched Frequency Reference (Nov18), Air Quality Monitor (Feb20) RCL Box (Jun20), Digital Lighting Controller Micromite Master (Nov20) Advanced GPS Computer (Jun21) **Touchscreen Digital Preamp (2.8in/3.5in version) (Sep21)**
PIC32MX170F256B-I/SO	Battery Multi Logger (Feb21), Battery Manager BackPack (Aug21)
PIC32MX270F256B-50I/SP	ASCII Video Terminal (Jul14), USB M&K Adaptor (Feb19)
PIC32MX795F512H-80I/PT	Maximite (Mar11), miniMaximite (Nov11), Colour Maximite (Sep12), Touchscreen Audio Recorder (Jun14)

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dsPIC33FJ128GP802-I/SP	Ultra-LD Preamp (Nov11), LED Musicolour (Oct12)
PIC32MX470F512H-I/PT	Stereo Echo/Reverb (Feb 14), Digital Effects Unit (Oct14)
PIC32MX470F512H-120/PT	Micromite Explore 64 (Aug 16), Micromite Plus (Nov16)
PIC32MX470F512L-120/PT	Micromite Explore 100 (Sep16)

$30 MICROS

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- DS3231(M) real-time clock SMD IC (Battery Multi Logger, Feb21) **$3.00**
- Pair of CSD18534 transistors (Electronic Wind Chimes, Feb21) **$6.00**
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VINTAGE TELEVISION

Sanyo's 8-P2 TV (1962) and horizontal linearity

By Dr Hugo Holden

The early 1960s was a boom time in the television industry, as semiconductor-based compact and portable TV sets were gaining in popularity. Many of these could be powered by either onboard batteries or an external 12V supply. Valve TVs were rapidly becoming obsolete, and transistors started to fill the role of valves in demanding applications.

One of the most demanding roles in a semiconductor-based TV set is that of the horizontal scan transistor.

It must have a very low saturation voltage drop during the horizontal scan time, be able to withstand very high peak collector voltages during flyback and have a short storage time, so it can switch off rapidly to allow a fast flyback. Some of these features were difficult to achieve for a germanium device in the early 1960s.

In the Sony Micro 5-303E TV, also released in 1962 (to be described in an upcoming article), they were well ahead of the game in transistor design. Sony had already moved to silicon transistors for the horizontal and vertical scan and video output stages. Not all companies were this advanced, but the germanium transistor technology was still up to the task.

One of the most acclaimed early transistor-based TVs was Sony's 8-301W, said to be one of the world's first nearly all transistor-based miniature TV sets (it had valve EHT rectifiers). However, it was just beaten to the market by the Philco Safari in the USA.

But there is little talk of the Sanyo 8-P2 of the same vintage. Despite it being the same size as the Sony 8-301W and the same age as the Sony 5-303E, it does not contain a single silicon transistor.

The Sanyo 8-P2 TV educated me on transistor television design. It was given to me by an elderly retired TV technician in 1975 or thereabouts, when I was around 17. He was valve TV trained and never warmed to the notion of transistors, even though he was very smart and had built a number of his own valve TV sets.

Faults

This particular set was faulty. The horizontal output transistor, which had been replaced, just sat there heating up with no EHT and no horizontal

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PRODUCT SHOWCASE

ElectroneX returns to Sydney this year on November 10th

Following the delay of ElectroneX this year – The Electronics Design & Assembly Expo and Conference will be hosted in Sydney on the 10-11th of November 2021 at Rosehill Gardens (10am-6pm on the 10th, and 9am-4pm on the 11th).

Reflecting the growth of high-tech niche manufacturing in Australia, at the 2019 Expo more than 87% of visitors said that they had met new companies and 81% discovered new products and technology they were not aware of, reinforcing the important role of exhibitions in showcasing new technology.

The 33rd Surface Mount & Circuit Board Association (SMCBA) Electronics Design & Manufacture Conference will also be held over the 9-11th of November at Rydges Parramatta.

The speaker program for the conference is currently being finalised; visit www.smcba.asn.au for further information.

Registration for ElectroneX is free, as is on-site parking. To register online, go to the following link: siliconchip.com.au/link/abae

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Electrolube launch new range of versatile thermal gap fillers

Electrolube has launched the GF400, a two-part, liquid-silicone-based gap filler. It can either be cured at room temperature or accelerated with heat. Once cured, GF400 forms a low modulus elastomer that prevents the 'pump-out phenomenon', ensuring minimal degradation of effective heat dissipation.

Thermal gap fillers are widely used for mobile and touchscreen applications. However, the GF400 range is extremely adaptable and can be used in a multitude of applications from PCB assembly and housing automotive electronics discretely, including HEV, NEV and batteries, power electronics, LEDs and fibre optic telecoms equipment.

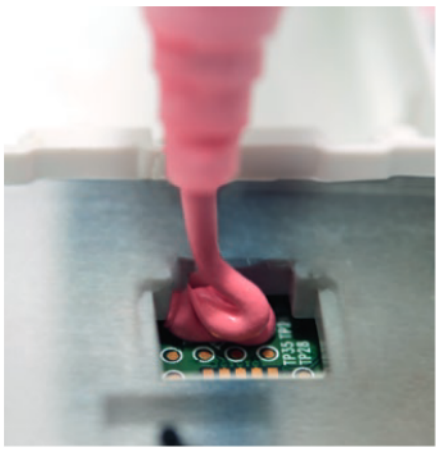
GF400 is soft and compliant, making it ideal for low stress applications, and provides a wide operating temperature range between -50 to +200°C. It's also low viscosity, enabling easier dispensing, and provides high thermal conductivity of 4W/mK.

The GF400 has a straightforward mix ratio of 1:1 and a fast cure time of 20 minutes at 100°C, vastly increasing throughput. Alternatively, the gap filler can be cured at 25°C for 12 hours or 90 minutes at 60°C.

The new thermal gap filler is UL94 V-O approved and has an excellent dielectric strength of 9kV/mm.

There's also a 50mL version of the GF400 in development. We will officially pre-launch the GF400 at ElectroneX on the 10-11th November in Sydney, alongside our new range of UV Cure conformal coatings.

Electrolube would like to extend a warm welcome to all visitors at their booth A20 during the two day event. For further information, please visit www.electrolube.com



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MPLAB tools – now on the Cloud

Microcontroller (MCU) design is easier than ever with the new MPLAB cloud tools ecosystem available now for PIC and AVR devices from Microchip Technology.

The enhanced MPLAB Xpress IDE delivers a powerful, scalable cloud infrastructure for development and debugging along with community collaboration tools using secure GitHub repository interface controls.

The free, all-in-one cloud platform combines easy, integrated search and discovery of example code, graphical configuration of projects and code debugging in a collaborative environment. This environment enables enterprise-scale rapid development while simplifying software design for users at all skill levels with an intuitive browser-based interface and cloud connectivity.

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For more information, visit: www.microchip.com/MPLABCloudTools

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Advertising Index

Notes & Errata

Programmable Hybrid Lab Supply with WiFi, May & June 2021: the footprints for transistors Q3 and Q4 on the PCB are incorrect, with the base & emitter pins (pins 1 & 2) swapped. There are two possible solutions to this: either gently bend the pins of these transistors up so that they can be soldered in place upside-down, or trim the leads of two NPN TO-92 package transistors to reach the appropriate pads. Also, there is an error in the parts list; the 150Ω axial resistor should be 68Ω, and the 68Ω SMD resistor should be 150Ω 0.5W (M2012/0805 size). This error also affects Fig.6 in the June 2021 issue; the 150Ω through-hole resistor below REG2 should be 68Ω, and the 68Ω SMD resistor to the right of REG1 should be 150Ω 0.5W.

High-Current Four Battery/Cell Balancer, March & April 2021: The UM6KM34N and UM6K31N transistor types have been swapped throughout both parts of this article. Q7 should have been specified as UM6KM34N, while Q8, Q13, Q18, Q19 and Q24 should have been UM6K31N. This is not critical unless the total battery 'stack' voltage can exceed 50V. In that case, you should replace Q8 and Q18 with the 60V-tolerant UM6KM34N. Finally, in the second article (April), at the start of page 82 where it refers to dividing a reading by 3.3V, it should instead be divided by 1.65V (ie, half the 3.3V rail, which is the ADC reference voltage).

Speedo Corrector Mk.3, September 2013: the BC857 is incorrectly listed for Q3 & Q6 in the parts list, it should be for Q4 & Q6. The circuit and overlay diagram are correct.

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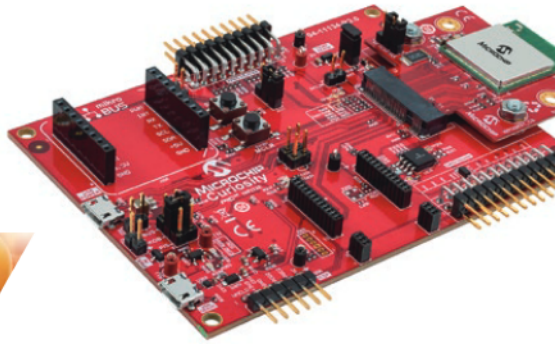

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