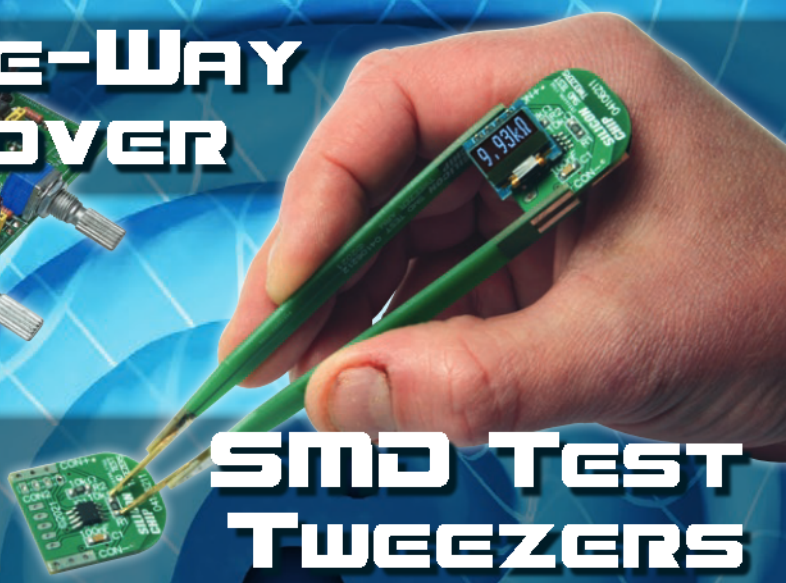
SILICON CHIP

OCTOBER 2021
ISSN 1030-2662
10
9 771030 266001
$11.50* NZ $12.90

The VERY BEST DIY Projects!

Two- or Three-Way Active Crossover



SMD Test Tweezers

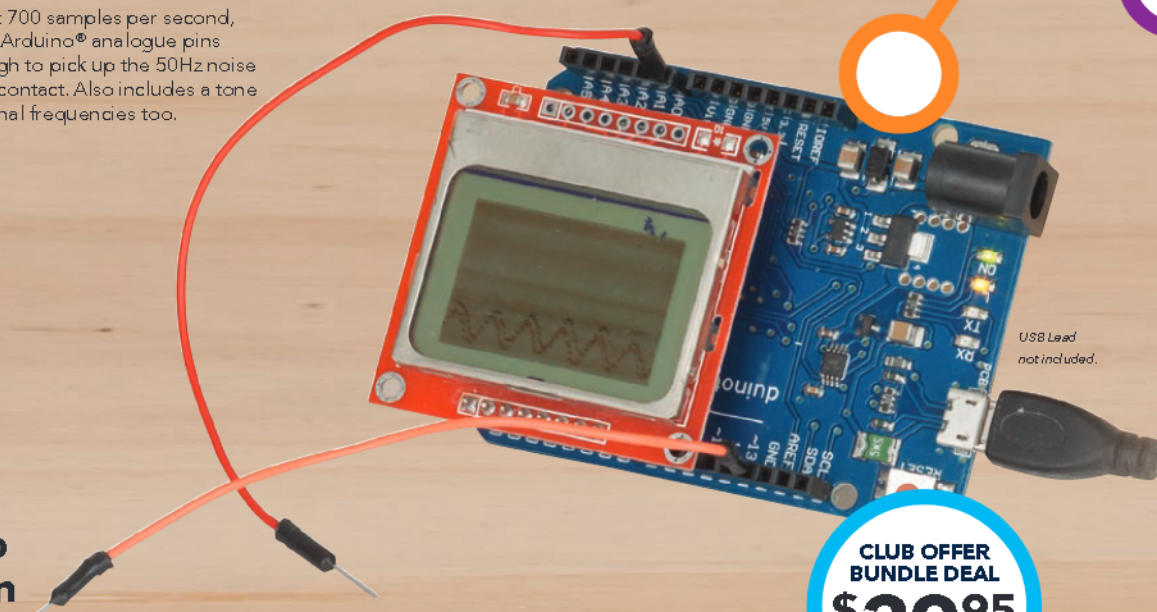
The Tele-Com Phone Intercom

Gravitational Waves how they are detected

Build your own Arduino® Compatible Oscilloscope

This little test tool is designed to be easily put together if you need a very basic scope in a hurry.
The maximum sample rate is about 700 samples per second, and it's limited to the 0-5V that the Arduino® analogue pins can handle. Still, it's sensitive enough to pick up the 50Hz noise from mains wiring without making contact. Also includes a tone generator, so you can compare signal frequencies too.

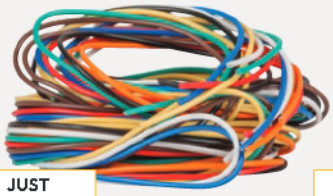
SKILL LEVEL: BEGINNER



For step-by-step instructions scan the QR code.

www.jaycar.com.au/oscilloscope
See other projects at
www.jaycar.com.au/arduino

CLUB OFFER BUNDLE DEAL
$39.95
SAVE 25%
KIT VALUED AT $55.85



JUST **$5.95**

Hook-Up Wire Pack
2 metres of 8 different colours of 13 x 0.12mm hook- up wire. 16 metres total. WH3025

FROM **$6.95**

IP65 Sealed ABS Enclosures
ABS plastic. IP65 rated. Wide range, sizes from 64Wx58Dx35Hmm to 240Wx160Dx90Hmm. HB6120-HB6134

240V Soldering Irons
Stainless steel barrel. Impact resistant handle. Electrically safety approved.
40W TS1475 **$19.95**
80W TS1485 **$24.95**

FROM **$19.95**

DON'T FORGET YOUR SOLDER!
15g, 200g, & 1kg available.
FROM $2.75

ONLY **$24.95**

Assorted LED Pack
Contains 3mm and 5mm LEDs of mixed colours. 100 pieces. ZD1694

$100 gift card

Got a great project or kit idea?

If we produce or publish your electronics, Arduino or Pi project, we'll give you a complimentary $100 gift card.
Upload your idea at projects.jaycar.com

Looking for your next build?
Silicon Chip projects:
jaycar.com.au/c/silicon-chip-kits
Kit back catalogue:
jaycar.com.au/kitbackcatalogue

Awesome projects by

On Sale 24 September to 23 October, 2021

jaycar think. possible.

1800 022 888
www.jaycar.com.au

Shop online and enjoy 1 hour click & collect or free delivery on orders over $99*
*Exclusions apply - see website for full T&Cs.

Contents

Vol.34, No.10 October 2021

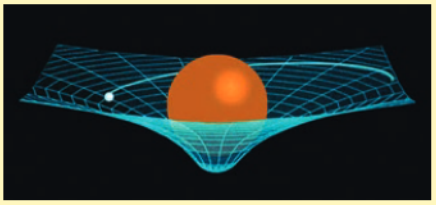
SILICON CHIP
www.siliconchip.com.au

Features & Reviews

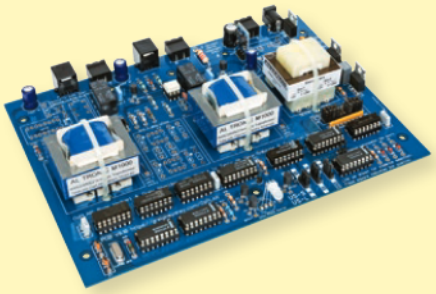
Constructional Projects

Your Favourite Columns

Everything Else



Gravitational waves are 'ripples' in spacetime that are produced by accelerating masses. Detecting them is tricky, as it requires incredibly sensitive equipment as detailed in the article – Page 14



The Tele-com intercom provides you with an easy way to connect two analog telephones. It provides all you need to make these phones functional – Page 30

This Two- or Three-Way Active Crossover can be powered by 24-30V DC, split rail DC or low-voltage AC. It has level control for all three bands, typically draws around 150mA, and has a mono or stereo output for subwoofers – Page 42

Our SMD Test Tweezers identifies resistors (10Ω to 1MΩ), capacitors (1nF to 10µF), diodes & LEDs. It runs from a single lithium coin cell with around five years of standby life – Page 64

Cover image source: www.ligo.caltech.edu/image/ligo20160615f

SILICON CHIP
www.siliconchip.com.au

Publisher/Editor
Nicholas Vinen

Technical Editor
John Clarke, B.E.(Elec.)

Technical Staff
Jim Rowe, B.A., B.Sc.
Bao Smith, B.Sc.
Tim Blythman, B.E., B.Sc.
Nicolas Hannekum, Dip. Elec. Tech.

Technical Contributor
Duraid Madina, B.Sc, M.Sc, PhD

Reader Services
Rhonda Blythman, BSc, LLB, GDLP

Advertising Enquiries
Glyn Smith
Phone (02) 9939 3295
Mobile 0431 792 293
glyn@siliconchip.com.au

Regular Contributors
Dave Thompson
David Maddison B.App.Sc. (Hons 1), PhD, Grad.Dip.Entr.Innov.
Geoff Graham
Associate Professor Graham Parslow
Ian Batty

Cartoonist
Brendan Akhurst

Founding Editor (retired)
Leo Simpson, B.Bus., FAICD

Staff (retired)
Ross Tester
Ann Morris
Greg Swain, B. Sc. (Hons.)

Subscription rates (Australia only):
12 issues (1 year): $105
24 issues (2 years): $202
For overseas rates, see our website or email silicon@siliconchip.com.au
Recommended & maximum price only.

Editorial office:
Unit 1 (up ramp), 234 Harbord Rd, Brookvale, NSW 2100.
Postal address: PO Box 139, Collaroy Beach, NSW 2097.
Phone (02) 9939 3295.

ISSN 1030-2662

Printing and Distribution:
Spotpress
24-26 Lilian Fowler Pl, Marrickville 2204

Editorial Viewpoint

The chip shortage is now a component shortage

I mentioned the severe semiconductor shortages in my June 2021 editorial. By that time, we had been having problems getting some parts for a few months, but it was clearly getting worse. Many common parts were unavailable, with long lead times.

Things have only gone downhill since then. It isn't just products like ICs and semiconductors that are becoming hard to get, but even basic components like ceramic capacitors and inductors are running out. And the situation with semiconductors like microcontrollers and Mosfets is becoming ridiculous, with whole ranges completely out of stock and astronomical lead times.

I'm not joking about that. We were trying to buy some NXP Mosfets (PSMN1R0-30YL) for one of the kits that we sell, and not only were they out of stock everywhere, but one major supplier quoted us an estimated backorder delivery date of April 25th, 2024 – over two and a half years from now!

This is a major headache for us. How can we publish constructional projects if we don't know whether readers will be able to buy the parts to build them? Even if we check and stock levels look healthy now, by the time we publish the article (which can range from a few weeks to a few months), they could all be gone and not available for a long time.

We used to keep around one month worth of parts for the kits and programmed microcontrollers we sell, perhaps 10-20 of each. Now we have to keep 6-12 months worth, often well over 100 of each, because of how quickly the suppliers run out of stock and how long it takes to replenish them. So we're paying a lot more up-front and we have to find space to store them all.

I can only imagine it's an even bigger headache for manufacturers, service centres and others who have to order in reel-size quantities and require a much more comprehensive range of parts for assembly or repair. And the fact that everyone is scrambling to get the parts they're going to need for the foreseeable future can't be helping with the shortages.

Given that the lead times for many out-of-stock components are already mid-to-late 2022, it's clear that these shortages are not going away any time soon. By the time that stock arrives next year, much of it might already have been sold, and what's left will likely be quickly snapped up.

Fundamentally, the only ways to solve a situation where demand is grossly outstripping supply is to either significantly increase supply or reduce demand. Increasing supply is not easy or quick, and I don't see the demand dropping just yet (but it will have to eventually). So we'd all better prepare for this situation to continue for some time.

ElectroneX postponed again

Given the current Australian COVID-19 situation, it comes as no surprise that ElectroneX had to be postponed again, this time until April next year. Please see the full announcement on page 29 for more details.

Exciting competition funded by Dick Smith

Also, don't miss the competition announcement on page 13 of this issue. It's an excellent opportunity for budding electronics enthusiasts to have the chance to win a substantial cash prize, and it sounds like a fun challenge. We've timed it so that entrants will have the Christmas/New Year break to work on their designs.

Depending on how many entries we get and their quality, we might also end up featuring some of them in the magazine; we'll definitely be featuring the best entry, as described in the announcement.

by Nicholas Vinen

THE TOP SUPPLIERS.
THE LATEST TECHNOLOGIES.

AUSTRALIA
DIGIKEY.COM.AU
1800 285 719

NEW ZEALAND
DIGIKEY.CO.NZ
800 449 837

1,900+ INDUSTRY-LEADING SUPPLIERS | 100% AUTHORIZED DISTRIBUTOR

*Australia: A shipping charge of $24.00 AUD will be billed on all orders of less than $60.00 AUD. A shipping charge of $20.00 USD will be billed on all orders of less than $50.00 USD. All orders are shipped via UPS, Federal Express, or DHL for delivery within 3-4 days (dependent on final destination). No handling fees. All prices are in Australian dollar or United States dollar. New Zealand: A shipping charge of $26.00 (NZD) will be billed on all orders of less than $66.00 (NZD). A shipping charge of $20.00 USD will be billed on all orders of less than $50.00 USD. All orders are shipped via UPS for delivery within 3-4 days (dependent on final destination). All prices are in New Zealand dollar or United States dollar. Digi-Key is an authorized distributor for all supplier partners. New product added daily. Digi-Key and Digi-Key Electronics are registered trademarks of Digi-Key Electronics in the U.S. and other countries.

ECIA MEMBER
Supporting The Authorized Channel

Preview only.

HARE & FORBES MACHINERYHOUSE

"Setting the standard for Quality & Value"

A family owned Australian business
Established 1930

THE INDUSTRY'S CHOICE!

CNC Machinery | Metal Working | Sheet Metal Fabrication | Wood Working | Workshop & Automotive | Lifting Handling | Cutting Tools | Machine Tool Accessories | Measuring Equipment

ACP-155 Automatic Centre Punch

- Ø6mm hardened steel centre punch
- Ergonomically shaped plastic body
- Curved end to fit into palm
- Automatic single hand operation

Order Code: P368
$23
SAVE $4.50

MADE IN TAIWAN

WHG-6 - Digital Height Gauge Wood Working

- 0 - 150mm measuring range
- Ideal for saw blades & routers
- DRO in mm, inches & fractions
- 0.01mm resolution
- Auto on & shut-off

Order Code: W643
$36
SAVE $6.90

MAGNETIC BASE

31-180 - Digital Caliper

- 150mm / 6"
- Hardened S/S mechanism
- Metric/Imperial Settings
- Four way measurement

Order Code: Q180
$91
SAVE $16.80

IP54 SPLASH PROOF

LED Rechargeable Handheld Work Light

- Max output: 400 lumens
- 3.7V 2600mAh Li-ion battery
- Rechargeable via USB
- 4 Modes: White COB, Red COB, Top Light On-Off, Spotlight On-Off
- Magnetic base & torch arm end

Order Code: T9501
$29
SAVE $6.20

3 HOURS OPERATING TIME

MKP-2 Mobile Knee Pads

- Durable high impact plastic frame
- Built-in tool storage tray
- 113kg weight capacity
- 6 x oil resistant swivel wheels

Order Code: A3615
$29
SAVE $9.50

EF-5S - Engineers Files, 5 Piece Set - Second Cut

- 200mm hardened and tempered files
- Second cut: Flat, 1/2 Round, Round, Square, Triangular
- Includes carry case

Order Code: F100
$46
SAVE $9

Imperial Hex Key Set with T-Bar Handle

- 5/64, 3/32, 1/8, 5/32, 3/16, 1/4, 5/16, 3/18"
- Chrome vanadium steel
- Adjustable 3 detent positions on T-bar handle
- Free-spinning rotating handle

Order Code: H821
$84
SAVE $15

MADE IN TAIWAN

RNB40 - Nut & Blind Riveter Set

- 130 piece kit for sheet aluminium or steel

Includes:

- Aluminium rivet nut inserts: M5, M6, M8, M10 - (10 of each size)
- Aluminium blind rivets: Ø3.2, Ø4.0, Ø4.8, Ø6.4mm (20 of each size)
- Mandrel spanner & blow mould case

Order Code: N001
$99
SAVE $22

MGP-6R Ratcheting Gear Puller Set

- 160kg load capacity
- 320-395mm height range
- 295 x 240mm platform with rubber top
- Foot lever operated

Order Code: A346
$49
SAVE $11.50

MLR-454 Hydraulic Motorcycle Lifter

- 454kg load capacity
- 200 - 770mm lift height
- Foot operated hydraulic lift
- Front wheel locking vice
- 1800 x 650mm platform

Order Code: A349
$729
SAVE $96

SB-100 - Handyman Sandblasting Cabinet

- Acrylic protective screen
- 590 x 500 x 300-360mm blast area
- Includes light, gloves, gun & ceramic nozzle

Order Code: S288
$219
SAVE $23

APW-140 - Auto Parts Washer

- 140 litre tank
- 180 litre/hr 240V pump
- Safety link on lid
- 1060 x 520 x 270mm

Order Code: A374
$259
SAVE $38

FLEXIBLE FLUID NOZZLE

cs-55 - Circular Plunge & Mitre Cut Saw

scheppach

- 160mm saw blade
- 55mm cut depth @ 90°
- 45° tilt saw head
- 1.2kW/1.6hp, 240V

Order Code: W875
$220
SAVE $33

IWB-40 - Industrial Work Bench

- 1800 x 750 x 900mm
- 1000kg load capacity
- Heavy duty steel fabricated frame
- High density laminate top

Order Code: A420
$396
SAVE $66

PACKAGE DEALS AVAILABLE

PT-2500 Hydraulic Pallet Truck

- 2500kg lift capacity
- 1220mm fork length
- 85 - 195mm lift height

Order Code: J061
$359
SAVE $48

CAST IRON PUMP DESIGN

SDC-2L - Steel Service Cart

- 705 x 370 x 835mm
- Key lockable table & drawers
- Ball bearing drawer slides
- Screwdriver holder tray
- Paper towel holder

Order Code: T751
$289
SAVE $30

Medium-Duty Pedestal Drill - Belt Drive

- 16mm drill capacity
- 2MT spindle
- 12 spindle speeds
- Swivel & tilt table
- 1hp, 240V motor

Order Code: D592
$419
SAVE $43

PROMAX 200 Auto Darken Welding Helmet

- Application: Mig & Arc & Grinding
- 9 - 13 adjustable shade
- 2 arc activation sensors
- Ultra clear vision with enhanced colour recognition
- Switching speed 0.00003 sec

Order Code: [illegible]
$88
SAVE $11

RAZOR™ 200 DIGITAL PULSE AC/DC - Multi-Function Inverter TIG/MMA (ARC) Welder

- 10 - 200amp
- 25% @ 200A duty cycle
- Includes 4M TIG torch, regulator, arc & earth leads
- 240V / 15 amp

Order Code: W1721
$1,760
GREAT VALUE!

unimig

UNIQUE PROMO CODE
SC1021
ONLINE OR INSTORE!

BECOME A MACHINERYHOUSE MATE
www.machineryhouse.com.au/signup
$70 FREE ACCOUNT VOUCHERS

COMPETITIVE FREIGHT RATES! *DELIVERED TO YOUR DOOR

Simple & Quick Online Freight Rate Check!
*Remote areas may require depot collection in your town

VIEW AND PURCHASE THESE ITEMS ONLINE AT
www.machineryhouse.com.au/SC1021

NSW (02) 9890 9111 1/2 Windsor Rd, Northmead
QLD (07) 3715 2200 625 Boundary Rd, Coopers Plains
VIC (03) 9212 4422 4 Abbotts Rd, Dandenong
WA (08) 9373 9999 11 Valentine Street Kewdale

Specifications & Prices are subject to change without notification. All prices include GST and valid until 25-11-21

07_SC_270921

SOLDER MASTER

Up to **1 MONTH**
daily use on a single charge[2]

3 HEAT MODES
plus **BOOST** Function

Model No: ESM-50WL

Under **10 seconds** to heat up

50Wh Lithium Ion Powered

CORDLESS SOLDERING IRON

Superior runtime

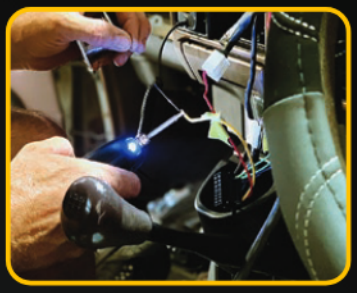
Lasts up to 270 mins on low setting[1], 160 mins on high setting, or up to 1 month[2] of daily usage out of every charge.

10 second heat up

Get in and get out - rapid flameless heat to quickly get the job done.

Boost function

Increase tip heat for 25 secs at 27W when needed before returning to preset temp.



Easy to use Modes panel

With Heat setting & Battery State of Charge LED indicators

Designed & engineered in Australia

Featuring 14.4V 50Wh protected Lithium Ion battery pack for exceptional runtime.

Suitable for use in any environment

No gas or flame means it's safer for use in confined spaces, or in high wind, wet, or potentially flammable areas.

Complete Kit

Ideal for:

- Auto electricians
- Car stereo installers
- Mechanical workshops
- Truck & taxi companies
- Security companies
- Telco industry
- Marinas and more

[1] Under 25°C ambient temperature. [2] Based on 40 solders per day for 20 working days with a solder dwell time of 20 seconds per solder.

No gas, No flames, No leaks. No worries.

www.soldermaster.com.au

For distributor enquiries contact us at (02) 9519 1200

MPLAB® Cloud Tools Ecosystem

Discover, Configure and Develop: An Ecosystem for All Your Ideas

MPLAB cloud tools ecosystem is a complete online solution for all skill-level users, to discover, configure, develop and debug embedded PIC® and AVR® microcontroller (MCU) applications.

- Intuitive entry into PIC and AVR MCU development with integrated MPLAB tools
- Quick prototyping with Microchip's PIC and AVR MCUs using Curiosity boards
- No software installation to start developing PIC and AVR MCU solutions

Designers who use PIC and AVR MCUs can visit the MPLAB Cloud Tools page and start developing based on their design phase.

- Search and Discovery: Access MPLAB Discover to find fully configured and complete source code projects
- Configure Code: Easily configure software applications with MPLAB Code Configurator
- Develop and Debug: Developing, debugging and deploying project applications directly from a preferred browser can be completed without any software installation with MPLAB Xpress IDE

MPLAB DISCOVER

MPLAB CODE CONFIGURATOR

MPLAB XPRESS IDE

Contact Information
Microchip Technology Australia
Email: aust_nz.inquiry@microchip.com
Phone: +61 (2) 9868-6733

MICROCHIP

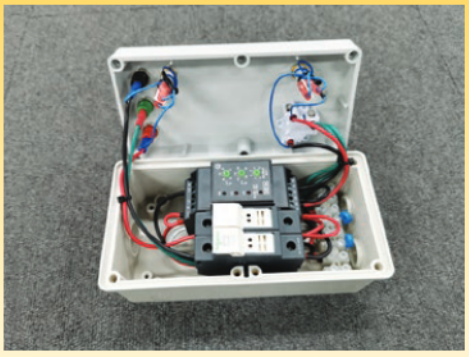
microchip.com/SC-MPLABcloudtools

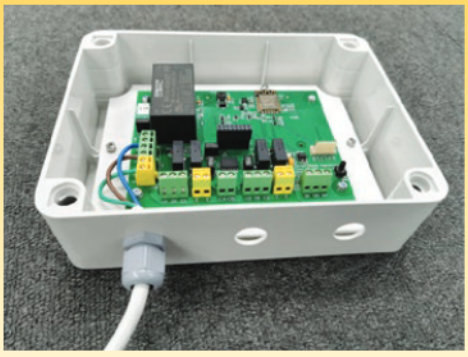
Preview only.

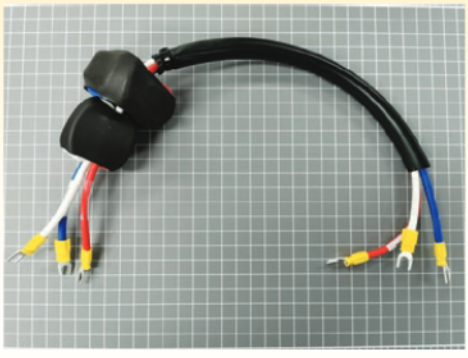
Our capabilities

CNC Machining
UV Colour Printing
Enclosure Customisation

Cable Assembly *** **Box Build** *** **System Assembly**







Ampec Technologies Pty Ltd
Tel: (02) 8741 5000
Email: sales@ampec.com.au Web: www.ampec.com.au

ampec TECHNOLOGIES

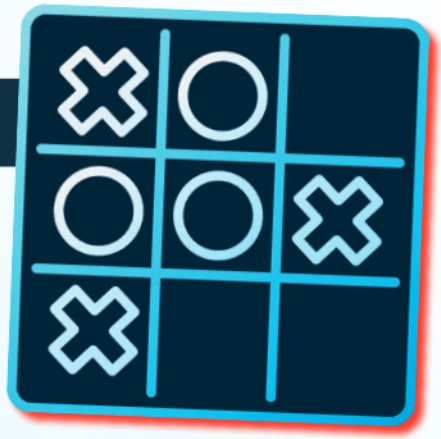
SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

Design Contest Win $500+



Dick Smith challenges you Win $500 by designing a noughts-and-crosses machine that can beat 14-year old me!

Dick Smith has described in his new autobiography how one of the turning points in his life, at age 14, was succesfully building a 'noughts-and-crosses machine' (also known as tic-tac-toe) that could play the game as well as anyone. Keep in mind that this was in 1958, when nobody had computers; it was a purely electromechanical device.

Email Design to Enter

Design your own noughts-and-crosses circuit and send your submission to compo@siliconchip.com.au including:

a) Your name and address
b) Phone number or email address (ideally both)
c) A circuit or wiring diagram which clearly shows how the device works
d) Evidence that your device can always play a perfect game (it never loses)
e) A video and/or supply images and text describing it
f) Entries requiring software must include source code

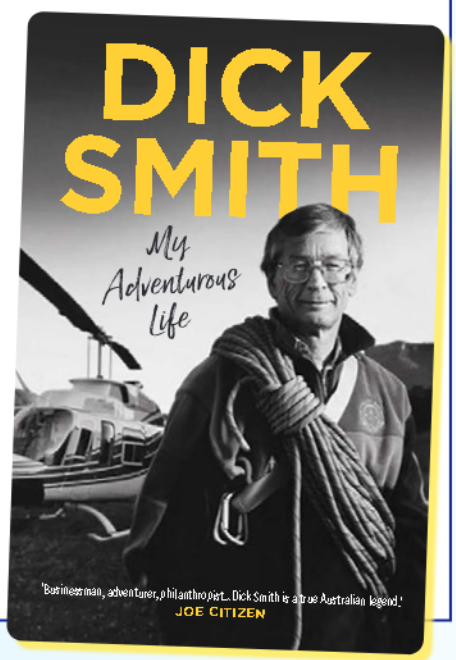
The deadline for submissions is the 31st of January 2022.

Win $500 + Signed Copy of Dick Smith's Autobiography

Four winners to be decided, one each for the following categories:

1. The simplest noughts-and-crosses playing machine
2. The most ingenious noughts-and-crosses playing machine
3. The youngest constructor to build a working noughts-and-crosses playing machine
4. The most clever noughts-and-crosses playing machine not using any kind of integrated processor

The entry we judge overall to be the best will also be featured in our Circuit Notebook column and receive an additional $200.



Conditions of entry

1) You must be a resident of Australia or New Zealand
2) One entry per family (Silicon Chip staff and their families are not eligible)
3) Submissions will be confirmed within 7 days. If you do not receive a confirmation of your submission, contact us to verify that we have received it
4) Chance plays no part in determining the winner
5) The judges' decision is final
6) The winners will be decided by the 3rd of February 2022 and will be notified immediately

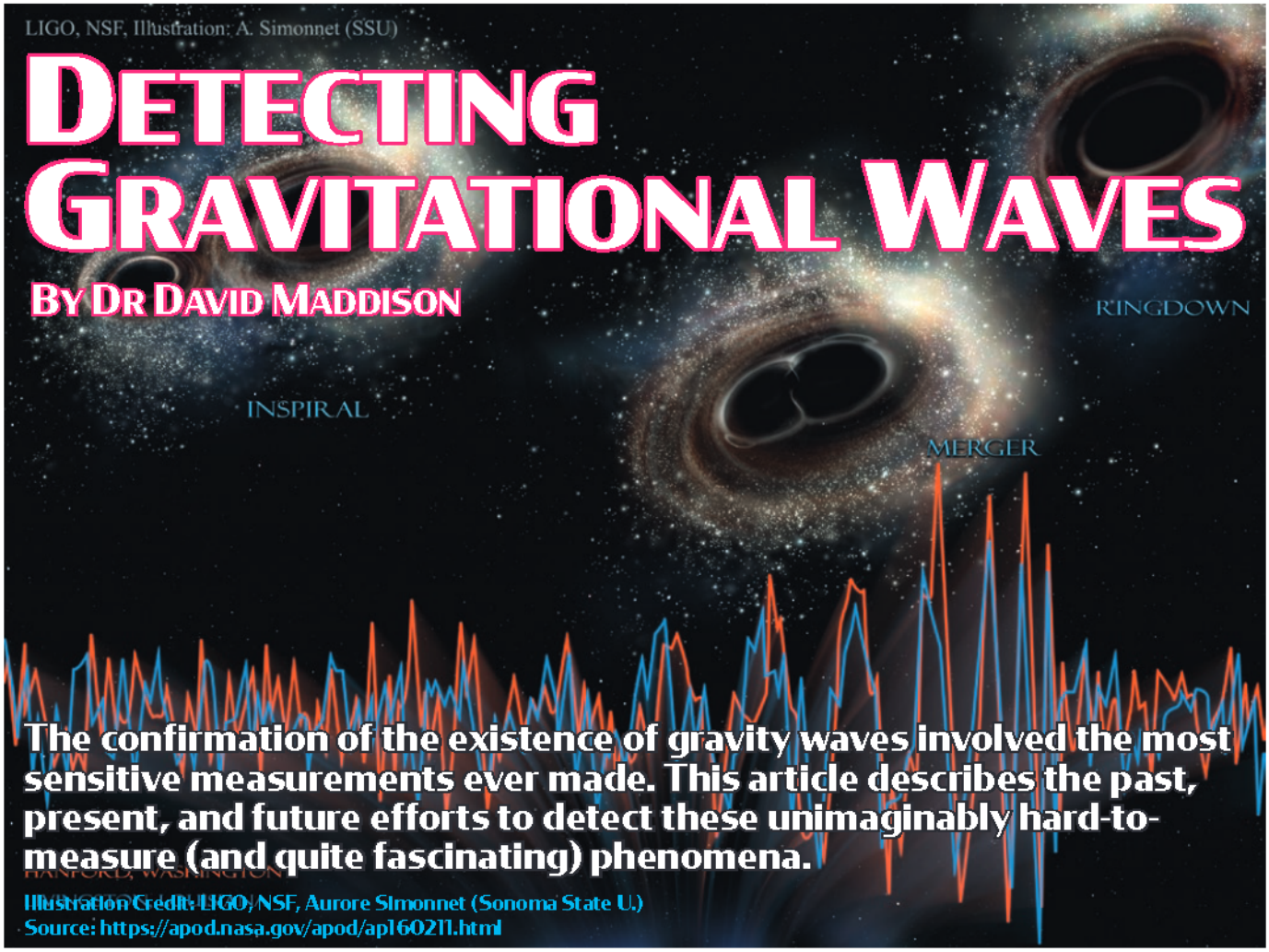
Dick Smith writes

By 1958 I'd advanced from building crystal radio sets to designing and building what I called a noughts and crosses machine. It really was an early computer. I used second-hand parts from a telephone exchange to build it. It would play noughts and crosses against anyone and no one could beat it.

This was a great boost to me, because while I was no good at rote learning and theory, I was fine at practical things. The fact that my mind was capable of working out how to build this complex machine gave me confidence as I left school. Now I just had to find a job.

Because this was such a turning point in his life and he's so enthusiastic about youngsters learning electronics, he's putting up $2000 of his own money to award to people who can come up with a modern version of his noughts-and-crosses machine. Silicon Chip will judge the entries.

Winners will be announced in the March 2022 issue of Silicon Chip magazine and will also be contacted directly for payment information.



DETECTING GRAVITATIONAL WAVES

BY DR DAVID MADDISON

The confirmation of the existence of gravity waves involved the most sensitive measurements ever made. This article describes the past, present, and future efforts to detect these unimaginably hard-to-measure (and quite fascinating) phenomena.

Illustration Credit: LIGO, NSF, Aurore Simonnet (Sonoma State U.)
Source: https://apod.nasa.gov/apod/ap160211.html

One of Einstein's many predictions that has been proven correct was the existence of gravitational waves, predicted by Einstein in 1916 and first directly observed on the 14th of September 2015.

The idea of gravity as mass distorting space-time was described in Einstein's General Theory of Relativity, first presented to the Prussian Academy of Sciences in 1915. This theory includes refinements to Newton's Law of Universal Gravitation.

General Relativity is the currently accepted explanation of gravitation, describing gravity as a geometric property of space and time (space-time) in four dimensions – three of space and one of time.

There had previously been other attempts to describe gravitational waves, but Einstein was the first to get the concept right.

Einstein thought his prediction of the existence of gravity waves was of academic interest only, as he did not believe they could ever be detected due to being so slight. In 1935, he had second thoughts about the existence of gravitational waves. But the journal he presented his paper to, Physical Review, refused to publish it due to an error.

Then in 1957, Richard Feynman said they must be real based on the theory and used his "sticky bead" argument to convince others that they were real.

For details on this, see the website at siliconchip.com.au/link/ab9f

Explanation of gravity waves

Unlike Newton, Einstein did not describe gravity as a force. In General Relativity, space-time is 'flat' without matter, but the presence of matter causes space-time to curve, and this distortion is manifest as gravity. It is relatively easy to visualise this by considering a heavy ball placed on a taut rubber sheet or trampoline (see Fig.1).

Suppose another ball is in the vicinity of the distortion caused by this object. In that case, it will either rotate

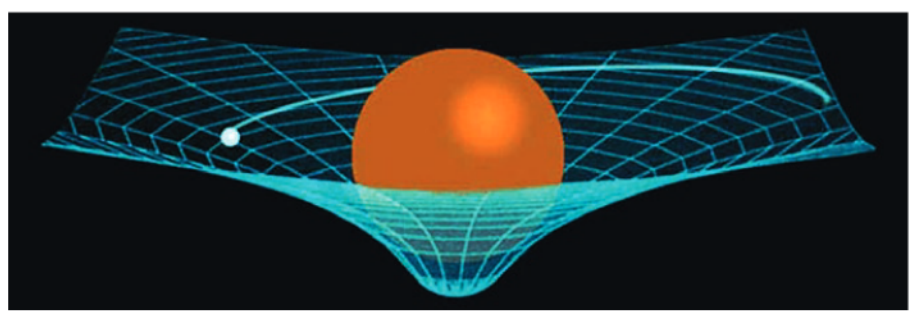


Fig.1: a massive object distorts the surrounding space-time, represented by the grid, creating a 'gravity well' to which other objects are attracted. They may orbit, bypass or fall into the other object depending on their velocity.

around (orbit), bypass or fall into the "gravity well" created by the first ball (plus make one of its own), depending upon its velocity.

This means that any mass accelerating through space-time also generates gravitational waves analogous to waves on a pond (see Fig.2), with the waves being distortions in space-time.

An orbiting object is under constant acceleration in the physics sense, although that does not necessarily mean a change in its speed. Technically, the velocity of an object in a stable orbit is constantly changing while its speed is constant, because the direction of the vector is continually varying, even though its magnitude remains essentially constant.

Examples of two bodies under acceleration that generate gravity waves include two massive objects, such as black holes orbiting each other, or massive objects merging such as a black hole or neutron star (see Fig.3, the panel below and siliconchip.com.au/link/ab9t).

A stationary (non-accelerating) object does not emit gravitational waves. All accelerating objects with mass, no matter how tiny the mass, emit gravitational waves, but the effect is so small as to not be measurable in any realistic sense. Thus, the observation of gravitational waves is only possible when supermassive objects like black holes and neutron stars orbit or merge.

Even the orbit of Jupiter about the Sun does not emit realistically measurable gravitational waves, even though Jupiter is 318 times as massive as Earth.

A gravitational wave causes physical dimensions to change as it passes through space, by either stretching or compressing the distance between objects, but the effect is unimaginably tiny.

Relevant video and audio links

In 2016, University of Western Australia Emeritus Professor David Blair spoke to the ABC about the first discovery of gravitational waves in 2015. You can listen to that program at siliconchip.com.au/link/ab9h

Also see the video titled "OzGrav: A new wave of discovery" at https://youtu.be/jMwHppyQiZw

Read articles about gravitational waves written by Professor David Blair at https://theconversation.com/profiles/david-blair-4285/articles

There is an Australian initiative to explain Einsteinian physics to children, The Einstein-First Project: www.einsteinianphysics.com

Fig.2: waves on a pond are a familiar analogy for gravitational waves, although they are (essentially) two-dimensional while gravity waves are three-dimensional. *Source:* www.pexels.com/photo/water-drop-photo-220213/

Even the gravitational waves formed by the collision of two black holes might alter the distance between Earth and the nearest star system Alpha Centauri, 41,343,000,000,000km (4.37 light years) away, by about one part in 10^{20} or 0.041mm, depending upon how far away the black hole is. That is less than the thickness of human hair.

Another way to look at it is that in the LIGO detector we will discuss, the length change is one-thousandth of the width of a proton (subatomic particle). No matter how near or far a black hole might be, the effect is incredibly small.

The creation of gravitational waves involves the loss of energy from the originating system, such as by orbital decay ('inspiral'), merger and 'ring-down' (as the union is consolidated) of massive objects like white dwarfs, neutron stars or black holes.

Like electromagnetic radiation, such as light or radio waves, the energy carried by gravitational waves follows the inverse square law with distance. That is, if you double the distance, the signal strength is $1 \div 4$ ($1 \div 2^2$); if you triple the distance, the strength is $1 \div 9$ ($1 \div 3^2$) etc.

However, also like electromagnetic radiation, the amplitude of the waves

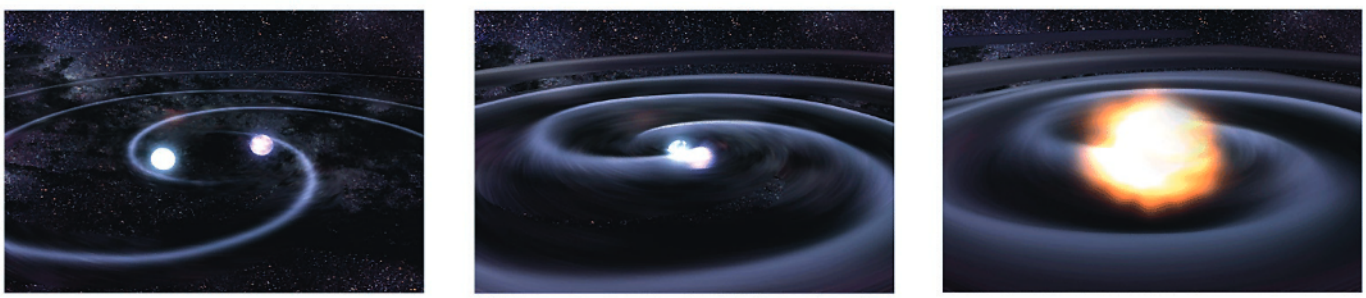


Fig.3: the orbit of two massive objects (in this case, white dwarf stars), leading to the emission of gravitational waves as their orbits decay toward a final merger. This might end in a supernova explosion, as shown in the third panel. These types of gravitational waves would be detectable with a space-borne instrument such as LISA. *Source: NASA.*

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

ALTRONICS

Build It Yourself Electronics Centres®

Maker SAVERS!

Get creating this October.

Hurry, sale prices end October 31st.

Inspect A Gadget

$109

X 4201 5 Dioptre
X 4200 3 Dioptre

SAVE $20

No more eye strain!

Ultra-bright long life LED for fantastic clarity (plus no need to change a globe - EVER!). Let "gadget" be your eyes. Identify those impossible to read miniature parts without straining your eyes. Great for collectors, model makers, jewellers etc.

SAVE $70

$399

Ideal for small, precise prints!

Creality® LD-002R Resin 3D Printer

Affordable entry level resin printer for fast, strong & smooth prints.

Resin based 3D printers are rapidly becoming the go to tool for high resolution 3D prints. They offer a faster print process with excellent accuracy and a stronger finished product thanks to UV curing on each layer. The LD-002R can print objects up to 120 x 65 x 165mm. It is capable of printing up 20-30mm per hour, making it much faster than traditional FDM 3D filament printers. K 8620

Creality Resin 500ml
- ■ K 8497 Black
- ■ K 8498 Grey
- □ K 8499 White

SAVE 20%

$34

Durable all metal chassis

T 2444A

SAVE $50

$199

Whisk away smelly soldering fumes while you work.

Popular choice for schools! This 60W soldering station has a powerful in-built fume exhaust fan which sucks away the smoke when soldering. The active filter helps to reduce airborne pollutants. Replaceable filters T 1291 $7.50, 3 pack.

D 0890

Handy kit to get started in online content creation!

SAVE $50

$189

All-In-One Mini Audio Studio For Creators

The MaonoCaster Lite provides everything you need to get started in podcasting, live streaming, YouTube & Twitch. Get top quality audio from the included XLR cardioid pick up condenser mic, control all your device levels, effects and music using the mixer buttons. Includes mic, mixer console, USB C cable, tripod, windsock, 3 x TRRS jack cables and monitor earphones.

NEW!

Desk mount microphone arm to suit.

$35.95 C 0506

SAVE $21

$99 X 0103A

Also great for cleaning jewellery!

Clean & Revive Small Parts

This 60W ultrasonic cleaner uses water and household detergent, coupled with ultrasonic waves to clean jewellery, small parts, DVDs etc, without damage - no solvents required. Stainless steel 18x8x6cm tank.

SAVE UP TO 40%

SAVE $59	SAVE $60	SAVE $51
$90	$85	$69
Z 6516 7" 1024x600	Z 6514 7" 800x600	Z 6513 5" 800x480

Large Touchscreens For Raspberry Pi®

• Great for integrated projects, game consoles, information stands, mini PCs etc • Works with raspbian & ubuntu • HDMI connection.

SAVE 50%

$99

Arduino based. Program it your way!

Z 6453

HURRY, LIMITED STOCKS!

Smart Turtle Tracking Robot

Easy to program 2 wheel, Arduino based, obstacle avoidance and line tracking robot. Features a 5x5 LED panel which can display icons, text and symbols. It is controlled via your programming, Bluetooth on your tablet or IR remote. Requires 2x18650 lithium cells (S 4736 $18.50ea).

Upgrade the workbench.

Normal RRP value of tools $67.90

SAVE 25%
$30
T 2162

'Getting Started' Electronics Kit

Great for enthusiasts and students. Includes pliers, cutters, 30W iron, solder sucker & carry case. All you need to get soldering!

SAVE $70
$399
K 8600

The worlds best selling 3D printer!
Over 800,000 sold worldwide.

Creality® 'Ender 3' Desktop 3D Printer

Creality's top selling 3D printer! The Ender 3 is a compact 3D printer offering excellent print quality with a build volume of 22Wx22Dx25Hcm and is compatible with ABS, PLA and TPU filaments. Supplied mostly assembled and can be up and running within an hour.

Premium Autoranging True RMS Multimeter

Our first multimeter with wireless USB charging in-built! No more changing batteries. Includes top spec features such as illuminated sockets, LED torch, desk stand, True RMS, non contact voltage detection, frequency meter and relative mode.

NEW!
$99
Q 1073A

Amazing value under $100

SAVE 13%
$10
T 1490A

Must have for any tool kit

Handy Scissor Snips

Multi-purpose snippers made from SK4 carbon steel. Spring loaded with comfort grip. 160mm.

Sizes down to 4mm!

SAVE 23%
$22

Precision Spanner Set

Includes hard to find 4, 4.5, 5, 5.5, 6, 7, 8, 9, 10mm ring & open end sizes. 10pcs. T 2166

Iroda® 3 Nozzle Blow Torch Kit

Ideal for trades requiring both precision brazing and high output wide spread flame jobs. Supplied in handy carry case with stable safety stand. 120 mins run time at mid setting. Includes carry case.

Trade quality!

T 2457

SAVE $76
$149

SAVE 15%
2 For $30
T 3097A

Air Duster Cans

The servicing essential, blows out dust and keyboard crumbs. 284g. Flammable.

T 1422
SAVE 22%
$35

Precision Tap & Die Set

A precision machined tap and die set for creating & cleaning metric thread holes and bolts. M3 to M12 sizes.

T 2865A Side Cutter
T 2870A Lng Nose Plier
T 2860A Bull Nose Plier

SAVE 16%
$22ea

1000V Rated Electrical Tools

VDE 1000V rated electrical hand tools constructed from quality drop forged steel with comfort grip insulated handles.

SAVE 20%
$22
T 2198B

11 Pc Screwdriver Set

Quality set of flat blade and phillips screwdrivers for general repairs. Chrome vanadium.

Bench Power Savings.

M 8254
SAVE $40
$145

Fixed 13.8V 20A Bench Power Supply

A fixed voltage output power supply designed for powering automotive, marine and comms equipment. Low noise and ripple design (<100mV) offers excellent efficiency and performance.

SAVE $80
$309
M 8205

5A 30V Linear Lab Power Supply

Fully adjustable with LCD meters for precision adjustments. Great for R&D and workshops. • Precision linear toroidal design for lower noise • Fixed 12V & 5V output rails • Fully regulated • Short circuit & overload protection.

Compact 30V Lab Power Supply

Great for servicing, repair and design of electronics. Low noise switchmode design. Fine & coarse voltage and current controls. 3A max. Size: 85Wx160Hx205Dmm.

SAVE $40
$119
M 8303

Order online @ altronics.com.au | **Sale pricing ends October 31st.**

Save on Audio Visual.

SAVE $40

$199

C 5064

Demo in store!

Opus One® Bluetooth Bookshelf System

Want top notch sound for your games, hi-fi listening or home theatre? These new active bookshelf speakers need no amplifier, just plug them in and connect via Bluetooth, digital S/PDIF or stereo RCA. Amazing sound for their price with a sleek oak grain finish - looks great with grilles on or off! Size: 146 x 164 x 240mm.

Opus One® 140W Soundbar Wireless Subwoofer

Our new premium finish soundbar offers rich, clear sound from it's 6 high performance speaker drivers, plus a 8" subwoofer which can be placed anywhere in your lounge room thanks to wireless connectivity. Offers bluetooth audio streaming from your favourite devices, plus S/PDIF digital audio input for connection to your TV (cable included).

$299 SAVE $90

Soundbar: 97 x 8 x 7.5cm,
Subwoofer: 30 x 25 x 30cm

C 5050

C 9021A

SAVE $30

$109

FANTASTIC VALUE AT $109! Why pay $300 or more?

Super Quiet Noise Cancelling Bluetooth® Headphones

No outside interference with world class noise reduction technology. Designed & engineered in Silicon Valley, USA. • Block out distractions while you work • Superb active noise cancelling • Bluetooth wireless • 12hrs of listening time. • USB rechargeable (includes cable) • Carry pouch. Amazing sound. You be the judge - try a pair in store!

SAVE $120 C 7115

$249

A PA system in the palm of your hand.

Be heard without raising your voice! The Micker-Pro is an all-in-one microphone PA with in-built speakers. Ideal for demonstrations, tour groups, classrooms and club meetings. Easy USB recharging with up to 6 hours use per charge.

SAVE $25

$135 A 3216A

Long Distance HDMI Sender

As used by hundreds of commercial AV installs! Send 1080p from a HDMI source up to 50m over Cat5e/6 UTP. Includes TX, RX & plugpacks. Great way to extend signals around the house.

$39.95 or 2 for $70

C 0520A

Amazingly Tight!

Compact Speaker Stands

Study folding design. Ideal for use with the stage speakers & portable PAs. Adjustable 1-2m. Max 40kg

Instant, powerful PA sound!

An all in one portable PA sound system with amplifier that sets up in just seconds - no expertise required. Just plug into 240V power, switch it on and connect a mic. USB playback makes it easy to play your favourite tunes. Great for clubs, sports events, fetes, carnivals and bingo nights - **any crowd up to 500 people!**

SAVE 25%

$199 C 0991A 8" 140W

$255 C 0993A 10" 180W

Professional grade UHF true diversity for crisp, clear vocals

C 8367C 1 x Handheld Mic
C 8368C 1 x Beltpack Mic

SAVE $80

$299

16 Channel Wireless Microphone Systems

A complete wireless microphone system with your choice of handheld or beltpack mic. Offers wireless freedom when on stage. Plugs into existing PA systems for easy connection. Ideal for clubs, & places of worship. Up to 70m range.

SAVE 25%

$22

D 0932

3.5mm Lapel Mic

Ideal for audio recording on smartphones, laptops, vlogging cameras. 3.5mm TRRS or TRS connection. 2m lead. Condenser type.

D 0934 SAVE 28%

$35

Electret Lapel Mic

Need to record high quality audio for YouTube or live demos? This 6m electret mic offers excellent audio clarity and 3.5mm TRRS or 6.35mm TS connections.

With muting button

NEW!

$75

D 0935

USB Conference Microphone

Top quality audio for group communications or one-on-one meetings. USB C connection. Diecast case with rubber feet for excellent noise isolation. 2m USB cable.

Order online @ altronics.com.au | **Sale pricing ends October 31st.**

Gear to keep you creating.

Creality® Premium PLA Filament

We're now stocking Creality's premium 1.75mm PLA designed for use in many brands of 3D printer on the market. Creality have focused on making top quality non toxic filaments with a tolerance of just 0.02mm. Each filament is 100% bubble free and offers excellent tensile strength & fluidity. This all adds up to more reliable prints and less waste!

- K 8387A Silver
- K 8388A Gold
- K 8389A Pink
- K 8391A Orange
- K 8392A Green
- K 8393A Yellow
- K 8394A Purple
- K 8395A Blue
- K 8396A Red
- K 8397A Black
- K 8398A Grey
- K 8399A White

World Famous DeoxIT® Sprays

The gold standard in electronic servicing sprays. Deoxidises, cleans, preserves contacts & joins (Fader F5 even works on conductive plastic faders controls!). A must have for servicing and restoration. 142g.

$44.95 T 3063 Deoxit D5

$56 T 3062 Fader F5

Freezer Spray

Non-flammable freezing spray. Useful for rapid detection of temperature dependent circuit faults, testing thermal sensors etc. 300g.

T 3084A $20.95

T 3133

Bare Conductive® Paint Jar

Paint real circuits on almost any surface! Great for repairs or experimenting. 50ml jar.

T 2980A 5mm T 2982A 50mm

Single Sided Copper Tape

A multitude of electronic uses - create low-profile component traces, RF-shielding, antennas etc. Also great for stick on circuits. 0.07mm thick. 15m length.

Model	Width	NOW
T 2971A	8mm	$9.75
T 2972A	12mm	$12
T 2973A	16mm	$13.50
T 2974A	19mm	$15
T 2975A	24mm	$17
T 2976A	36mm	$25

High Temperature Polyimide Tape

Great for 3D printing, leaves no residue in high temperature masking applications.

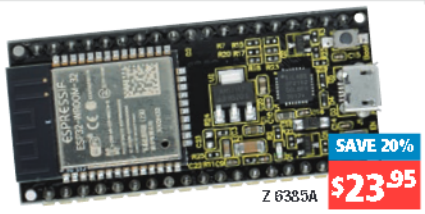
H 8950 Dual Fan

Red Raspberry Pi® 4 Aluminium Cases

Available in dual fan cooled or passive cooled versions. These cases provide protection and thermal dissipation for your Pi 4.

Arduino Starter Platform Kit

A handy starter kit for educators or Arduino newbies. Includes an Arduino UNO compatible board, blue acrylic base, 5V 2A power supply, USB lead, breadboard, 65pcs of jumper leads & hardware.



Z 6385A

ESP32 Wi-Fi & Bluetooth Dev Board

A development board integrating 802.11b/g/n WiFi, Bluetooth 4.2 and BLE. Fully Arduino compatible and perfect for wireless projects. Offers more GPIOs than the ESP8266 board in the same compact, breadboard friendly package.

Computer Hardware Kit

$22.95 D 0010

A handy 228pc set of common computer for hard drives, motherboard standoffs and cooling fans.

Z 0003

LED Assortment Pack

3mm and 5mm LEDs in green, red, blue, yellow and white. 300pcs.

K 9642

Jumper Header Kit

A huge assortment of single row header connectors. Includes male & female pin headers, plus 2.54mm housings.

K 9643

Plug & Header Connection Kit

Straight boxed 2.54mm PCB connectors and plugs in 2, 3, 4 and 5 way. Plus crimp pins to suit plug housings. 150pcs total.

ALTRONICS

Build It Yourself Electronics Centres

Sale Ends October 31st 2021

Phone: 1300 797 007 Fax: 1300 789 777

Mail Orders: mailorder@altronics.com.au

Western Australia

» Perth: 174 Roe St 08 9428 2188
» Joondalup: 2/182 Winton Rd 08 9428 2166
» Balcatta: 7/58 Erindale Rd 08 9428 2167
» Cannington: 5/1326 Albany Hwy 08 9428 2168
» Midland: 1/212 Gt Eastern Hwy 08 9428 2169
» Myaree: 5A/116 N Lake Rd 08 9428 2170

Victoria

» Springvale: 891 Princes Hwy 03 9549 2188
» Airport West: 5 Dromana Ave 03 9549 2121

New South Wales

» Auburn: 15 Short St 02 8748 5388

Queensland

» Virginia: 1870 Sandgate Rd 07 3441 2810

South Australia

» Prospect: 316 Main Nth Rd 08 8164 3466

Find a local reseller at: altronics.com.au/storelocations/dealers/

Please Note: Resellers have to pay the cost of freight & insurance. Therefore the range of stocked products & prices charged by individual resellers may vary from our catalogue.

B 0091

PRODUCT SHOWCASE

ElectroneX rescheduled to April 2022

Following the ongoing situation with COVID-19 in NSW and other states, a decision has been made to reschedule ElectroneX – the Electronics Design & Assembly Expo at Rosehill Gardens from 5-6 April 2022.

Noel Gray, Managing Director of show organiser AEE said:

We were hopeful that we would be able to stage the show in November but it has become apparent that until the vaccination rates reach a high level and states and business can open up again, we had no choice but to move the event to 2022.

Whilst there may be a relaxing of restrictions and travel by November, for the safety and wellbeing of our exhibitors, visitors and staff we consider it was better to take a cautious approach and move the Expo and SMCBA conference to next year. The majority of other Expos in NSW have also had to reschedule to 2022 and it has been a challenging time for the exhibition and event Industry.

Last held in Sydney in 2018, the Expo was almost sold out and exhibitors have been very supportive of the move to April next year.

ElectroneX is Australia's major dedicated high-tech event that showcases new technologies, components, contract manufacturing services, manufacturing equipment and supplies and solutions for the electronics and manufacturing industries. Alternating between Melbourne and Sydney, over 1000 senior decision makers attend including design engineers, electronic and general engineers, technical engineers and management that are involved in design, service or utilise electronics in manufacturing.

Visitors can register for free to attend the Expo in April next year at www.electronex.com.au

Australasian Exhibitions and Events Pty Ltd
Suite 11, Pier 35-263 Lorimer St
Port Melbourne VIC 3207
Tel: (03) 9676 2133
mail: ngray@auexhibitions.com.au
Web: www.auexhibitions.com.au

Easy-PC PCB design suite version 25 released

NumberOne Systems has announced the release of Easy-PC version 25, with over 25 new technology features based on user requests from professional PCB designers.

Easy-PC is packed with time saving features providing everything required to easily create schematics, PCB layout, and manufacturing outputs, making the task of PCB design much quicker. A set of libraries is also included, as is a component search engine with over 15 million parts available to download and use for free.

A few of the new enhancements found in version 25 of Easy-PC include:

- Differential Pairs with length matching are now supported in Easy-PC.
- Vias can be specified as 'tented'. A tented via is one that is covered with solder resist during the manufacturing stage.
- New Design Rule Checks have been added to enhance the checking of the design so that errors can be rectified at an earlier stage.
- Resize Shape enables shapes to be replicated and resized. The resizing can be both larger and smaller than the original shape selected.

For the additional 25+ Easy-PC enhancements found in version 25, go to https://www.numberone.com/latest-version

Easy-PC with integrated schematic capture and PCB Layout starts at $457.

Number One Systems
https://numberone.com/
sales@numberone.com

Rugged silicon carbide power solutions now available at 1700V

Microchip has expanded its silicon carbide portfolio with a family of high-efficiency, high-reliability 1700V silicon carbide Mosfets and power modules.

Microchip's 1700V silicon carbide technology is an alternative to silicon IGBTs. This new silicon carbide product family allows engineers to move beyond IGBTs. It uses two-level topologies with reduced part counts, greater efficiency and simpler control schemes. Without switching limitations, power converters can be significantly reduced in size and weight, freeing up space, or extending the range and operating time of battery-powered commercial vehicles – all at reduced overall system cost.

Features include gate oxide stability, excellent avalanche ruggedness and parametric stability. A degradation-free body diode eliminates the need for an external diode with the silicon carbide Mosfet. A short-circuit withstand capability comparable to IGBTs allows them to survive harmful electrical transients. A flatter RDS_{ON} curve over junction temperature from 0 to 175°C enables the power system to operate at greater stability than other silicon carbide Mosfets that exhibit more sensitivity to temperature.

Other Microchip silicon carbide products include schottky barrier diodes at 700V and 1200V, available in bare die and a variety of discrete and power module packages.

Microchip Technology Inc.
Unit 32, 41 Rawson Street
Epping 2121 NSW
www.microchip.com

The Tele-com

an intercom using analog phones

by Greig Sheridan & Ross Herbert

Put your old analog telephones to use and build an intercom! Perhaps you have a classic or retro telephone like this red "batphone", or one of the other Bakelite phones with a real bell that generates a fantastic ring sound. Now you can not only hear it again but actually speak to someone at the other end!

Technically, the Tele-com is a 'private line automatic ringdown unit', known in the industry as a PLAR. That means that it allows two PSTN telephones to be automatically connected by simply lifting one handset. Colloquially, though, most people would just call it an intercom.

Because of this, the device which allows the Tele-com to operate is referred to as the OzPLAR.

If you need two-way communication between two nearby locations such as a house and a shed, or a granny flat, or just two rooms in a home, it doesn't get much more convenient than this. Pick up the phone and the other end rings, then when the other person picks up, you can have a conversation.

While the NBN supports analog telephones, we suspect that many people (like us) simply haven't bothered plugging them in, and now have a box of spare phones. Rather than throw them away, now you can put them to good use.

The central OzPLAR unit to which both telephones are connected (described in this article) performs the following functions;

- Provides power to the phones ('transmission battery feed').
- Detects when a phone is picked up ('off-hook detection').
- Automatic ringing of an electromagnetic or electronic AC bell.
- Ringing uses standard PSTN cadence – Australia/NZ/UK/EU/USA (long & short) selectable.
- The caller hears a ringtone while the called telephone is ringing.
- Upon answer, ringing ceases and a speech path is established between the two telephones.
- Both telephones must be replaced on-hook after a call before a new connection can be established.
- Ring-trip (stopping the ring signal) occurs during either the silent or ringing period, when the called telephone is taken off-hook.

The design is based entirely on discrete components and logic ICs and has been designed with flexibility in mind. The PCB accommodates various alternative parts for the battery feed and the ringing generator. See the features panel for more information.

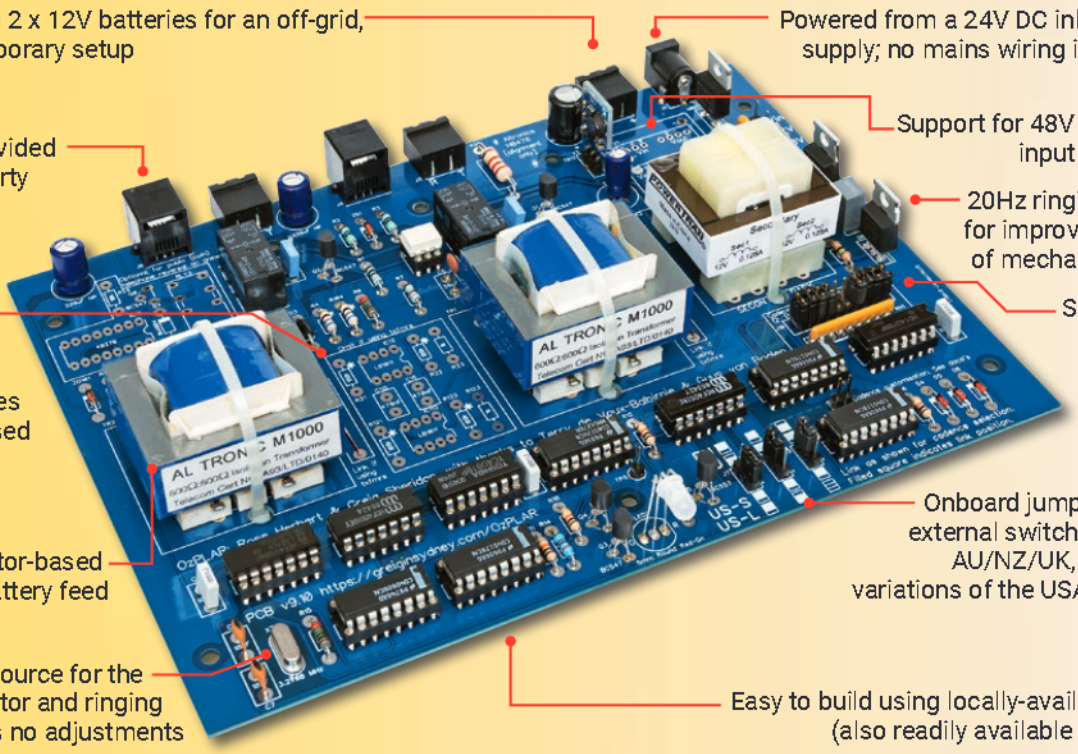
Circuit details

The complete circuit of the Tele-com is shown in Figs.1 & 2, with Fig.2 having the ring related circuitry (including cadence generation), and Fig.1 the rest. The overall circuit has a few basic jobs:

1. Power the telephones
2. Detect when one is picked up
3. When a call is initiated, cause the called phone to ring and send a ringtone to the calling phone
4. When the other phone is picked up, stop the ringtone and establish voice communications
5. Reset the system when both phones are restored on-hook

To achieve this, it consists of multiple interconnected circuit blocks. The left-hand section in Fig.1 is the 'battery feed' and loop detect/ring trip circuit, whilst the middle section is the logic engine which detects line status

Features of the Tele-com



(off-hook/on-hook) and ensures that ringing output occurs only when the first telephone goes off-hook.

The far-right section in Fig.1 includes the components required to add an optional polarity reversal on answer ("ROA") to the calling telephone. Public telephones (PT) connected to Step-by-Step and ARF crossbar switching systems in the now discontinued PSTN used the reversal of the line polarity as the signal to deposit the caller's money in the coin tin. This option requires 48V operation to work.

Off-hook detection & ring trip

When a telephone is taken off-hook, current passes through the optocoupler LED associated with the calling telephone (OPTO1 for the one plugged into CON3/4 or OPTO2 for CON5/6). Its output transistor therefore conducts and initiates a series of events to ring the other telephone.

The voltage across each optocoupler LED is limited by zener diodes ZD1 & ZD2. At the same time, a low-pass filter

This "batphone" is an example of an old analog telephone that could be used with the Tele-com. It's important to note that not all analog telephones have rotary dials, some have push-button keypads instead; both types will work.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

PART 1:
BY PHIL PROSSER

Low-cost Two- or Three-Way Active Crossover

We are frequently asked for active crossover designs because they can provide significant benefits for driving loudspeakers compared to passive crossovers. They allow you to use a separate amplifier for each driver, avoid the need for large power-carrying inductors and capacitors and provide much closer to ideal performance. This Crossover also suits the Tapped Horn Subwoofer we presented last month.

When building a really serious speaker system, an active crossover and independent amplifiers for bass, mid and high frequencies should be front and centre in your consideration. The general configuration of a three-way loudspeaker system with an active crossover is shown in Fig.1.

While excellent results can be achieved with a conventional passively crossed-over system, passive crossovers significantly limit your driver choices and cabinet design. A versatile, active solution is the best way to get the most out of those expensive drivers.

One major advantage of active crossovers is that even when the subwoofer or woofer is driven into clipping, which they often are, the mid and high channels remain unclipped and clean.

Another benefit is the ability to use a 24dB per octave crossover on the mid-range driver, reducing the amount of low-frequency signal it must handle below the crossover point, consequently minimising mid-range cone excursion. This is often observable by the mid-range sounding 'cleaner'.

We have published several active crossovers in the past, both simple and complicated. There is often a trade-off between cost and versatility, which this project seeks to address. This project makes no compromise with sound quality and includes new features such as turn-on muting to de-thump the output and a subsonic filter to protect your expensive subwoofer.

Our last two published designs are a 3-Way Active Crossover in the September & October 2017 issues (siliconchip.com.au/Series/318) and a DSP Active Crossover and Parametric Equaliser in the May-July 2019 issues (siliconchip.com.au/Series/335). Both are excellent designs but cost significantly more to build than this one, and the DSP version is also quite a bit trickier to build.

This version eschews the adjustability of those two designs to keep the cost and complexity down. You can still set the crossover points where you need them, but that's done by selecting resistor and capacitor values, so you can't change them on the fly.

In a domestic setting, a typical subwoofer, mid-range driver and tweeter configuration might use crossover frequencies at say 90Hz and 3kHz. This system might use a subwoofer amplifier of 100W plus mid-range and high-frequency amplifiers of 50W each (per channel). Many readers would have these amplifiers already. Of course, using higher power amplifiers is fine.

The mid-range and tweeter channels will be delivering only a few watts of continuous power, but having the headroom of a 50W or 100W amplifier means that massive dynamics can be delivered.

We plan to follow this article up with a compact, low-cost amplifier of which you can build five or six into a single housing along with a shared

heatsink and power supply. So if you don't already have the amplifiers but want to build a system with an active crossover, keep an eye out over the next couple of issues!

Features

The outstanding features of this design are:

A multi-way active crossover

Because every project is different, you can use the same board to make a two-way or three-way crossover by fitting the parts required and setting a few jumpers.

Versatile power supply

Excellent results can be achieved using low-cost class-D amplifiers available on the internet, but these mostly require a single DC supply rail. A higher-power Class-AB amplifier can be used for the best results, such as our Ultra-LD series, which provides split rails (±15V DC) for the preamplifier. This Active Crossover can run from either supply type, again by varying a few components and two jumper selections.

Crossover frequencies set by passive parts

To make the crossover frequency adjustable using a potentiometer would require four-ganged potentiometers, which are expensive and results in a much larger PCB. Using fixed resistors and capacitors reduces cost significantly and avoids the potential of someone turning a dial that they really should not touch!

Mono/stereo subwoofer output

This gives you a fair bit of flexibility. Even if you have two subwoofer channels, if your crossover frequency is set below 100Hz, you might want to use the mono option (ie, drive both with the same signal).

Subsonic Filtering

Many subwoofer/bass enclosures use vented, bandpass and sometimes horn-loaded arrangements. These systems require frequencies below their range of operation to be filtered out. Failure to do this can lead to over-excursion and/or overheating and failure of the driver. All professional sound systems include this.

Turn-on/off delay

An active crossover is connected directly to a power amplifier and your expensive speaker drivers. Especially when operating from a single-rail, the crossover must not generate a 'thump'

Features & Specifications

- Two-way or three-way stereo active crossover
- Can be powered from 24-30V DC, split rail DC (±12-15V) or low-voltage AC (9-12V or 18-24V CT)
- Muting to eliminate switch-on and switch-off transients
- Subsonic filter to protect vented subwoofers and remove unneeded subsonic signals
- Low noise and low distortion; <0.0022% THD+N, 20Hz-20kHz
- Low-cost design using available parts; cheaper than building pairs of passive crossovers.
- Mono or stereo subwoofer output.
- Level controls for all three bands.
- Modest power demands; typically draws around 150mA.

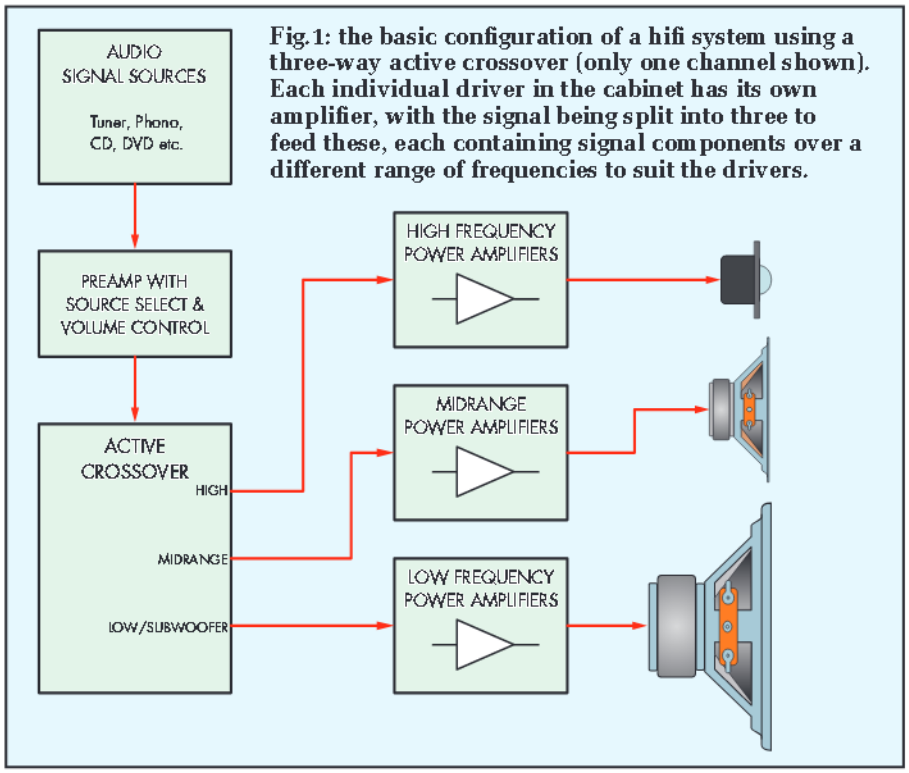


Fig.1: the basic configuration of a hifi system using a three-way active crossover (only one channel shown). Each individual driver in the cabinet has its own amplifier, with the signal being split into three to feed these, each containing signal components over a different range of frequencies to suit the drivers.

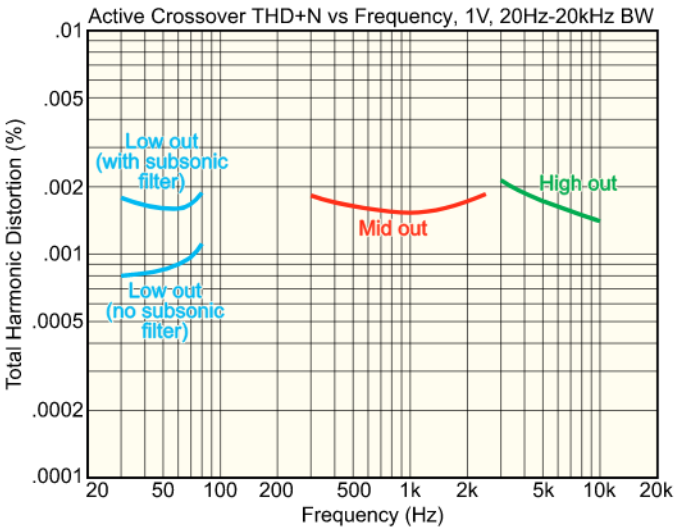


Fig.2: plots of total harmonic distortion plus noise against frequency for each output, with the test frequencies chosen to be well within the bandpass of each. The actual harmonic distortion is extremely low, virtually unmeasurable with our equipment. These readings are basically noise; the subsonic filter adds more noise, hence higher readings with it enabled (note that LF noise is not very audible).

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

Price Changes For SILICON CHIP Magazine

From **October 31st 2021**, the price of SILICON CHIP Subscriptions will change as follows:

Online (Worldwide)	Current Price	New Price
6 Months	$45	$50
12 Months	$85	$95
24 Months	$164	$185
Print Only (AUS)	**Current Price**	**New Price**
6 Months	$57	$65
12 Months	$105	$120
24 Months	$202	$230
Print + Online (AUS)	**Current Price**	**New Price**
6 Months	$69	$75
12 Months	$125	$140
24 Months	$240	$265
Print Only (NZ)	**Current Price**	**New Price**
6 Months	$61	$80
12 Months	$109	$145
24 Months	$215	$275
Print + Online (NZ)	**Current Price**	**New Price**
6 Months	$73	$90
12 Months	$129	$165
24 Months	$253	$310
Print Only (RoW)	**Current Price**	**New Price**
6 Months	$90	$100
12 Months	$160	$195
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

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

40th Birthday Celebration

On Sale
24 September to 23 October, 2021

jaycar
think. possible.

CAN PRINT LARGER MODELS 3 X FASTER PRINTING SPEEDS THAN EARLIER MODELS

4K HIGH RESOLUTION FOR HIGHLY DETAILED PRINTS

NEW

JUST $1149

Anycubic 4K Resin 3D Printer

Larger build volume of 192Lx120Wx245Hmm. 8.9" 4K LCD. Fast printing speed (3 x faster than previous models). More detailed prints compared to filament-type printers. Uses Anycubic App to remotely control print operations, monitor printing progress etc. TL4421

Anycubic Wash & Cure Plus Machine
Rotating curing platform with full 360° curing operation. 405nm UV light. TL4423

JUST $499

Anycubic 500ml Resin
Wide range of resin available in 5 colours.

Black	TL4425
Grey	TL4426
Clear	TL4427
Blue	TL4428
Green	TL4429

JUST $39.95 EA

BUY BOTH FOR $1549
SAVE $99
VALUED AT $1648

NOW $59.95
SAVE $20

VIEW SPECS jaycar.com.au

Arduino® Compatible Learning Kit

Includes UNO board, breadboard, plenty of prototying hardware, modules, components and instruction booklet to get you started. XC3900

NEW

2.4" LCD

JUST $59.95

ODB-II Engine Code Reader
Accurately identify car problems. Displays data from engine system, reads & remove fault codes, retrieves vehicle information, & more. Suits 12V systems with OBD-II port.
130Lx85Wx25Dmm. PP2147

NEW

2.5" LCD

JUST $69.95

1080p HD DVR Event Camera
Automatic recording on impact, wide 170° angle lens. G-sensor function. Records to microSD (sold separately). QV3872
16GB microSD Card XC4989 **$19.95**

4X CLEARER THAN 1080P!

NEW

JUST $749

GET IT ON Google play
Available on the App Store

VIEW SPECS jaycar.com.au

4K UHD | 2 YEAR WARRANTY | 1TB HDD

Concord 4 Channel 4K DVR & Camera Kit
Smartphone viewing & notification. Built-in infrared LEDs for night vision up to 20m & Thermal Detect Technology to help prevent false triggers. Includes 4K UHD DVR, 4 x 4K UHD bullet cameras, power & video cables, adaptor, USB mouse, network & HDMI leads. QV5150 Due Mid October

40TH BIRTHDAY SPECIALS

NOW $11.95
SAVE 40%

Board not included.

Desktop PCB Holder
Hold PCBs of up to 200 x 140mm. Adjustable angle. TH1980

NOW $109
SAVE $40

N300 Wi-Fi Ethernet Over Power Kit
Extend wireless network using your existing mains wiring. Integrated power socket. Fast 300Mbps data speed. YN8359

NOW $209
SAVE $40

2 x 120WRMS Stereo Amplifier
Provides crisp rich sound ideal for powering speakers in your home, office or shop. RCA input. 6.5mm output. Remote control included. AA0520

Shop the catalogue online!

Free delivery on online orders over $99*
*Exclusions apply - see website for full T&Cs.

www.jaycar.com.au 1800 022 888

Bluetooth® Connectivity

AMAZING SOUND
GREAT FOR ZOOM CALLS

Bluetooth® 5.0
TWS Wireless Earbuds
Features True Wireless Stereo (TWS) to provide amazing sound. Built-in microphone for handsfree calls. USB rechargeable charging case included. AA2147

NOW $59.95
SAVE $10

Bluetooth® 5.0

Long Range Transmitter & Receiver

Dual Bluetooth® streaming up to 50m range without the need for running cables. Includes USB mains power adaptor & 3.5mm lead, TOSLINK cable, & 3.5mm socket to RCA adaptor. AA2114

NOW $99
SAVE $20

Bluetooth®4.1

Transmitter & Receiver

Add Bluetooth® connectivity to your audio player, speaker or headphones to transmit or receive wireless stereo audio. AA2104

JUST $69.95

Bluetooth® Rechargeable Headset with Mic
Features anti-noise technology for crystal clear conversation, voice command, last number re-dial, call rejection, and adjustable volume. AA2080

NOW $39.95
SAVE $10

HDMI 4K & 8K Connectivity

NOW $64.95
SAVE $15

4K Wi-Fi HDMI Miracast Dongle

Stream HD content from your Smartphone, Tablet or PC to your TV. Plugs into the HDMI port. Supports Miracast, AirPlay® and EZMira. 2.4GHz/5GHz Dual Band Wi-Fi. AR1924

NOW $69.95
SAVE $20

Concord 2-Way 4K HDMI Splitter
Simultaneously split to two HDMI displays from one HDMI source. Up to 4K x 2K video resolution. High-Dynamic-Range (HDR) video support. Mains adaptor included. AC5000

48GBPS BANDWIDTH

FROM $34.95

Concord 8K HDMI Cables
High quality HDMI 2.1 leads, support up to 48Gbps, 8K High Dynamic Range signal in Dolby Vision & HDR10. Backwards compatible. 1.5m & 3.0m available. WQ7920-WQ7922

JUST $42.95

3 Way HDMI Switcher
Switch HDMI signals from multiple sources to a single output. Supports 3D video. Remote control included. AC1705

JUST $29.95

4K Mini DisplayPort to HDMI Adaptor
Allows you to view your DisplayPort equipped device on any HDMI monitor. Supports output resolutions up to 4K @ 60Hz for high quality viewing. 155mm long. WQ7420

40TH BIRTHDAY SPECIALS

NOW $29.95
SAVE 40%

Turntable USB Recording Digitiser
Record your vinyl tracks to USB. Digitises tracks using PC or Mac™. Power via USB or power supply (not supplied). AC1593

IPX5 WATER RESISTANT

NOW $89
SAVE 40%

Portable Boom Box Speaker
Take this powerful 22W water resistant speaker anywhere. True Wireless Stereo (TWS). Built-in radio. Rechargeable battery. CS2499

Portable Wireless UHF PA System
Streams music or backing tracks via Bluetooth® or audio cable. Rechargeable. 30WRMS. Includes wireless microphone & self-contained amplifier/ controller. AM4095

NOW $159
SAVE $40

More ways to pay: eftpos mastercard VISA AMERICAN EXPRESS PayPal humm zip

1 hour click & collect

FAST WI-FI TO EVERY CORNER OF THE HOUSE

Dual Band Wi-Fi

AC1200 Wi-Fi Mesh Network & Satellite Kit

NOW $199
SAVE $50

Provide seamless Wi-Fi to all areas of your home with a combined speed of up to 1200Mbps (5GHz 867Mbps + 2.4GHz 300Mbps). Easy to set up & expandable with additional satellite modules. YN8564
Extra Satellite Module YN8566
NOW $99 SAVE $30

JUST $39.95

AC600 USB Dual Band Wi-Fi Dongle
Equip your old PC or laptop with ultra fast Wi-Fi. Combined speed of up to 600Mbps (5GHz 433Mbps + 2.4GHz 150Mbps). Compact size. YN8334

NOW $149
SAVE $20

AC2100 Dual Band Wi-Fi Router

Incredibly fast with a combined Wi-Fi speed of up to 2100Mbps (5GHz 1733Mbps + 2.4GHz 300Mbps). Dual band mode avoids signal congestion. 6 antennas to help boost signal. YN8394
ALSO AVAILABLE:
Tri-Band Wi-Fi Router YN8396 **NOW $199 SAVE $30**

JUST $99.95

AC1200 High Power Dual Band Extender

Quickly eliminate dead-spots, enhance Wi-Fi signal or provide an access point on your existing wired network. Plugs into power point. 1200Mbps capable. YN8374

2-in-1 Network Cable Tester & Digital Multimeter
Easily check cable integrity or measure AC & DC voltage up to 600V, AC/DC current up to 200mA, resistance, etc. CAT III, 2000 count.
XC5078

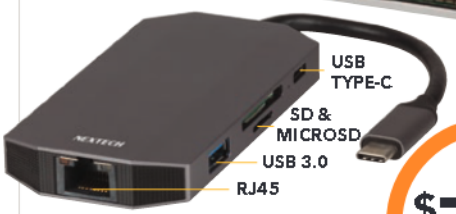
NOW $79.95
SAVE $10

NOW FROM $99
SAVE UP TO $40

YN8074

Power Over Ethernet (PoE) Network Switches
Simplifies installation for IP cameras, phones, routers, & other networking equipment, reducing the need for mains power.
5 Port 10/100Mbps YN8074 **NOW $99 SAVE $20**
10 Port Gigabit YN8049 **NOW $199 SAVE $40**

XC4938



XC4975

NOW $79.95 EA
SAVE $20

JUST $34.95

Cat5e Solid Network Cable - 30m
Designed for reliable high-speed network installations. Solid core. Polywrapped roll.
WB2023

JUST $22.95

6P / 8P Modular Crimping Tool
Will crimp the following lugs: 6P2C, 6P4C - RJ11 6P6C - RJ12 8P - RJ45. It also cuts & strips the cable. TH1935

Expand Your Laptop or MacBook®

Expand the number of ports and connect just about anything to your MacBook® or latest laptop. Suitable for devices with Type-C / Thunderbolt™ 3 connections.
MacBook® 4-in-1 Thunderbolt™ XC4938
9-in-1 Multifunction Type-C Hub XC4975

19" Rack Mount Cabinets

6U to 12U in Swing or Fixed frame. Ideal for IT or phone system installations, PA systems, etc. Solid steel powder coated to provide high strength & rigidity.

6U Flat Packed	HB5170	**NOW $109 SAVE $80**
6U Assembled	HB5171	**NOW $129 SAVE $90**
12U Flat Packet	HB5174	**NOW $149 SAVE $100**
6U Swing Frame	HB5180	**NOW $164 SAVE $115**
12U Swing Frame	HB5182	**NOW $199 SAVE $150**

NOW FROM $109
SAVE UP TO $150

NOW FROM $29.95
SAVE UP TO $40

Desktop Power Supplies

Highly reliable, single output adaptors with average operating efficiency up to 90%. Low no load power consumption (less than 0.075W).

60W 12V 5A	MP3252	**NOW $29.95 SAVE $20**
60W 24V 2.5A	MP3254	**NOW $29.95 SAVE $20**
60W 48V 1.25A	MP3256	**NOW $29.95 SAVE $20**
120W 12V 8.5A	MP3258	**NOW $59.95 SAVE $40**

40% OFF BIRTHDAY SPECIALS

Looking for more product information?
Visit your local store or our website jaycar.com.au

We reward our industry professionals

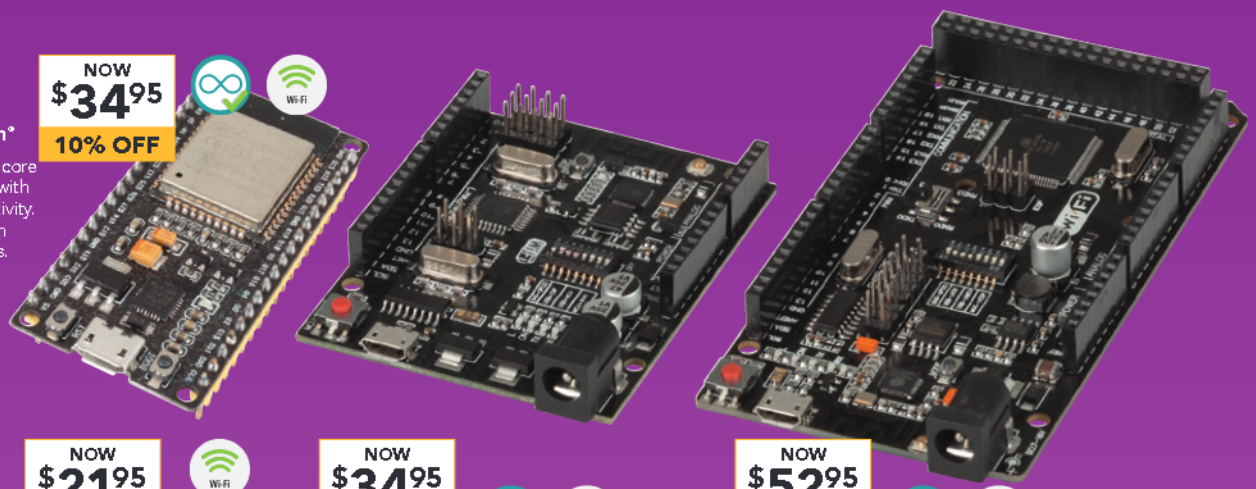
trade card jaycar

10% OFF DEVELOPMENT BOARDS WITH WI-FI

ESP32
Development Board with Wi-Fi & Bluetooth®

NOW $34.95
10% OFF

Arduino® compatible. Dual core microcontroller equipped with Wi-Fi & Bluetooth® connectivity. 512kB of RAM, 4MB of flash memory & heaps of IO pins. 3.3V. XC3800



Wi-Fi Mini ESP8266
Development Board

NOW $21.95
10% OFF

Arduino® compatible. Perfect compact solution to your IoT sensor node problem. 80MHz microcontroller with Wi-Fi into a board. 4MB flash memory. 11 digital IO pins. 3.3V. XC3802

UNO With Wi-Fi
Development Board

NOW $34.95
10% OFF

Arduino® compatible. Stackable design. Includes integrated ESP8266 chip to connect your projects to the cloud without the need for additional shields. Powered by DC or USB. XC4411

MEGA with Wi-Fi
Development Board

NOW $52.95
10% OFF

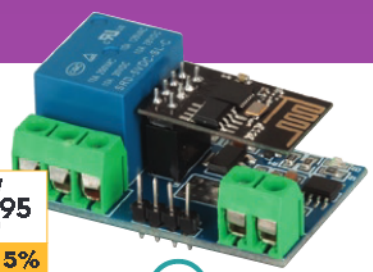
Arduino® compatible. Stackable design & features more I/O pins, memory, PWM outputs & serial ports than the standard UNO board. Integrated ESP8266 chip connects your projects to the cloud without the need for additional shields. Powered by DC or USB. XC4421

Make your project wireless

NOW $59.95
SAVE $10

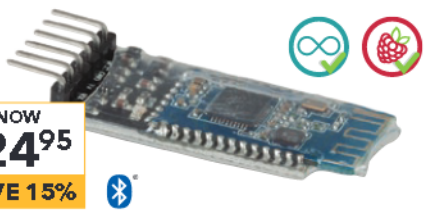
YUN Wi-Fi Shield

Allows you to easily program & operate your Arduino® project over Wi-Fi & allow it to access the Internet. Contains a tiny Linux computer with Wi-Fi, ethernet & USB. XC4388



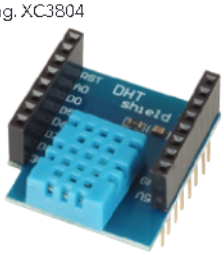
NOW $14.95
SAVE 15%

Smart Wi-Fi Relay Kit
A Wi-Fi controlled SPDT relay that you can trigger with an App from anywhere in the world. Ideal for home automation, IoT, lighting control projects, & much more. 10A @ 250VAC contact rating. XC3804



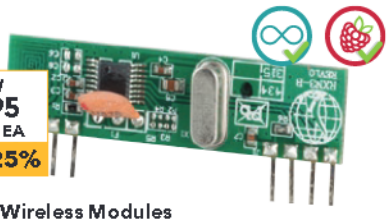
NOW $24.95
SAVE 15%

Bluetooth® V4.0 BLE Module
Brings Bluetooth 4.0 standards to your Arduino® project. Configurable as master or slave. Provides a serial communication channel. 5V IO & power. XC4382



NOW $7.95
SAVE 20%

DHT11 Shield for Wi-Fi Mini
Create a tiny environmental sensor node. Uses pin D4 for DHT11 interface. Suitable to plug into breadboard for prototyping. XC3856



NOW $9.95 EA
SAVE 25%

433MHz Wireless Modules
Pre-built 433MHz wireless transmitter/receiver modules. Feature ASK encoding. Ideal for devices using short data bursts such as remote controls, trigger pulses etc.
Transmitter ZW3100 **Receiver** ZW3102 (Shown)

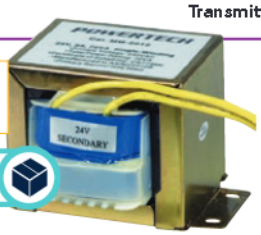
40 YEARS
HERE'S A SELECTION OF THE MANY ELECTRONICS PRODUCTS WE'VE BEEN SELLING FOR DECADES!

JUST $17.95 EA

Panel Meters MU45
Moving coil type. 44mm hole. 0-1mA to 0-30V available. QP5010-QP5022

VIEW RANGE jaycar.com.au

JUST $29.95



VIEW RANGE jaycar.com.au

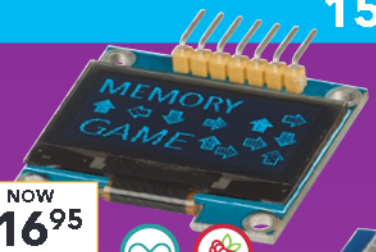
72VA EI Core Transformer
24V 72VA 3A single winding type 2158 with 200mm flylead connection. MM2012

JUST $29.95

120mm 240VAC Axial Fan
Suitable for computers, office machinery etc. Solder lugs connection. YX2514

Not sure what to build next? Here's some inspiration:
jaycar.com.au/projects

15% OFF DISPLAY MODULES



NOW $16.95
15% OFF

1.3" 128 x 64 OLED Monochrome Display Module
For projects that don't require full colour. Wide viewing angle to eliminate eye strain. 39Lx36Wx6Dmm. XC3728

NOW $24.95
15% OFF

2.5" 240 x 320 LCD Touch Screen
Large, colourful touch display shield which piggybacks straight onto your UNO or MEGA. Fast parallel interface. microSD card slot. Resistive touch interface. 77Lx52Wx19Hmm. XC4630

BUILT-IN HDMI PORT

NOW $84.95
15% OFF

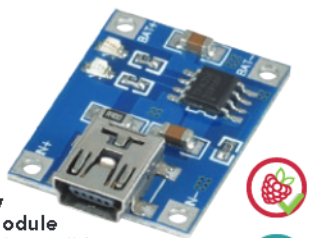
5" 800 x 480 LCD Touch Screen
Connect directly to your Pi. Resistive touch interface via GPIO only. HDMI and USB ports. 121Wx78Hmm. XC9024

NOW $6.50
15% OFF

8 x 8 LED Dot Matrix Display Module
Display custom characters, or use multiple modules together to make a scrolling display. 62Wx32Hx14Dmm. XC4499

2.8" $29.95
XC9022

15% OFF USB MODULES FOR MICROCONTROLLERS



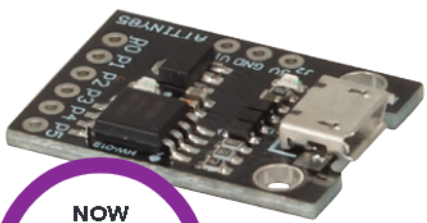
NOW $4.20
15% OFF

Lithium Battery USB Charger Module
Charges a single lithium cell from a 5V supply. Output via solder tabs, input is either via solder tabs or a mini-USB port. XC4502

NOW $10.95
15% OFF

3 PACK

USB Mini LED Touch Module
Touch control - ON/OFF (quick touch), Dimming (continuous). Double USB design. Compatible with all standard USB devices such as power banks, mobile chargers, etc. ZD1688

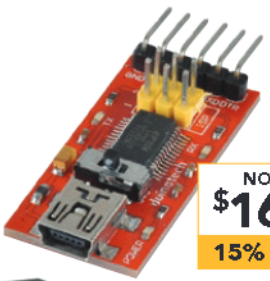


NOW $11.50
15% OFF

ATtiny85 Micro USB Development Board
Features an ATtiny85 8-bit microcontroller that you can program using the Arduino® IDE. 8K Flash memory. 6 x I/O connections. Integrated 5V regulator. XC3940

NOW $16.95
15% OFF

USB Interface for Joystick & Buttons
Suitable for arcade games, flight simulators or anything that works with a USB joystick. XC9046



NOW $16.95
15% OFF

USB to Serial Adaptor Module
This mini-USB to 6-pin serial port module uses FT232 chip with power, sending & receiving indicators to communicate with Arduino® boards & modules. XC4464

Panel Mount Fuse Holder
Low voltage. 10A 250V. Accepts 3AG fuses. SZ2020

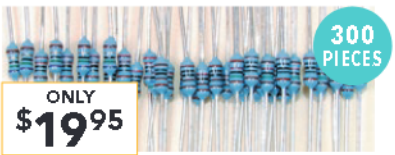
JUST $2.25

FROM $3.45

Jiffy boxes
ABS plastic. Industry standard sizes from 83x54x31 to 197x113x63mm available. HB6005-HB6025

Cigarette Lighter Double Adaptor
150mm cable. Two inline sockets. PP2006

JUST $9.95



ONLY $19.95

Mini Size Metal Film Resistors
Contains 5 of each value from 10Ω to 1MΩ. Total 60 values - 300 resistors. RR0680

ARDUINO® COMPATIBLE
This icon indicates that the product will work in your Arduino® based project.

RASPBERRY PI COMPATIBLE
This icon indicates that the product will work in your Raspberry Pi project.

3D Printing & Accessories

CLEARANCE
$699
HALF PRICE

3X FILAMENT COLOUR MIXING TECHNOLOGY

GET IN QUICK WHILE STOCKS LAST

VIEW SPECS jaycar.com.au

NOW
$849
SAVE $50

BUILT-IN CAMERA

DUAL COLOUR PRINTING

VIEW SPECS jaycar.com.au

NOW
$1199
SAVE $100

CREALITY

4.3" COLOUR TOUCH SCREEN

DOBOT MOOZ-3Z Triple Filament 3D Printer

Equipped with a three-color print head for colour mix print. Easy-to-use controller & mobile app. Featured with 3.5" LCD touch pad, Wi-Fi or USB connectivity, magnetic heat bed & more. Prints up to 100Hx100(Dia.)mm. TL4412

Flashforge Adventurer 3 3D Printer

Control print jobs via the cloud. Removable print bed, detachable nozzle, & automatic filament feeding. Prints up to 150Lx150W x150Hmm. TL4256

Creality Dual Filament 3D Printer CR-X

Create amazing high-quality prints with two colours or materials. Dual cooling fans. SD memory card slot. Prints up to: 300Lx300Wx400Hmm. TL4410

3-in-1

3D Printer, CNC & Laser Etcher

NOW
$1249
SAVE $100

3D print, engrave & laser cut with a single machine. Easy swap & interchangeable modules. Includes easy to use software. Prints up to 125Lx 125Wx125Hmm. TL4400

3.5" TOUCH SCREEN

VIEW SPECS jaycar.com.au

Flashforge Guider II 3D Printer

Stable print performance & durable. Producing large format objects. Features assisted levelling, filament-run-out detection, file preview & more. Prints up to 280x250x300mm. TL4240

*SPECIAL ORDER ONLY. Not stocked in all stores but definitely we can get one for you.

- 5" TOUCH SCREEN
- WI-FI, USB & ETHERNET CONNECT

JUST
$2499

BUY ANY 3 AND SAVE

ANY 3 FOR
$40
SAVE $19.85

1.75mm 250g Roll Filament
PLA or PET options in various style & colours. TL4124-TL4156 **$19.95EA**

Help protect your filament

Mini Auto Vacuum Pump
Keeps unused filament dry to ensure a better build quality of your prints. 6 reusable bags. Battery powered. TL4390
Spare Vacuum Bags 6pcs TL4392 **$9.95**
4 x AA Batteries SB2425 **$3.25**

NEW

JUST
$34.95

eBox Filament Storage Dry Box
A storage box that actively heats up to keep the filament dry. 80°C max heat temp. Sealed protection. TL4430
Due early October.

BUILT-IN HEATER

NEW

JUST
$99.95

40% OFF BIRTHDAY SPECIALS

REPAIR JUST ABOUT ANYTHING

Silicon Tuff Tape
Hundreds of uses including emergency radiator hose repair. 25mm x 3m. NA2832-NA2834

NOW
$8.95 EA
SAVE $6

NOW
$19.95
SAVE $15

60 PIECES

Glue Lined Pre-cut Heatshrink Tubing
Includes 6 common sizes (4.0mm, 6.0mm, 8.0mm, 12mm, 16mm & 19mm) in a handy storage box. WH5521

NOW
$29.95
SAVE $20

5m Roll Carpet Cable Cover
Conceal unsightly cords & eliminate trip hazards. Use on any nylon based carpet. 5m long x 100mm wide. HP2004

Workbench Essentials

BUILT-IN RECHARGEABLE LI-ION BATTERY

NOW $79.95
SAVE $20

Rechargeable Soldering Iron Set
Temp range up to 300°C. Comes with 30W/12W tips, hot knife, solder & sponge. LED light for Illumination. Charge via USB. TS1545
Tips to suit TS1546-TS1548 **NOW $7.50EA** SAVE 40%

NOW $119
SAVE $26

portasol

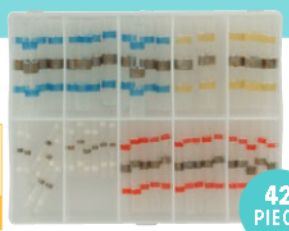
Portasol Pro Piezo Gas Soldering Tool Kit

Quality pro piezo iron. Includes tips, cleaning sponge/tray & storage case. Temp range up to 480°C. Piezo ignition. 75W equivalent electrical power. Gas powered. TS1318
Butane Gas NA1020 **$4.95**

NOW $129
SAVE $30

60W ESD Safe Soldering Station
Powerful 60W heating element. 160-480°C temperature range. Celsius or Fahrenheit temperature display. Mains powered. TS1640
Tips to suit TS1642-TS1644 **NOW $5.95EA** SAVE 40%

HIGH TEMP STABILITY



NOW $29.95
SAVE $10

42 PIECE

Assorted Solder Splice Heatshrink Pack
Quickly create sealed soldered joint in one go. Includes assorted colours and sizes to suit various cable size.
WH5668

NOW $39.95
SAVE $10

LED Magnifying Lamp with Third Hand
Perfect for PCB assembly & soldering. 3x Magnification. Powered by 4 x AA batteries (sold separately). TH1989
4pk AA Batteries SB2425 **$3.25**

IP67 WATERPROOF CASE

NOW $149
SAVE $40

NOW $39.95
SAVE $10

73 PIECE

73 Piece Screwdriver Set
Open all kinds of electronic devices. S2 Steel precision bits. Storage case. TD2136

NOW $179
SAVE $40

Variable Laboratory Autotransfomer (Variac)
Heavy-duty steel housing case. 500VA (fused) rated power handling. 0~260VAC @ 50Hz output voltage.
MP3080

True RMS Digital Multimeter with Bluetooth®

Full autoranging & math functions. 6000 display count. Cat III 1000V/Cat IV 600V. Bluetooth® connectivity, duty cycle, capacitance, datalogger & more. QM1578

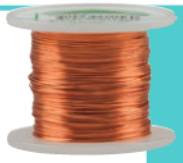
NOW $22.95
SAVE $17

Ratchet Crimping Tool For Insulated Terminals
Heavy duty. Suitable for crimping insulated terminals from 0.5mm to 6.0mm in size.
TH1829

0-15V Analogue Bench Voltmeter
3V & 15V scales. Zero offset adjustment. Analogue dial & banana plug connections.
QP5040

NOW $11.95
SAVE $8

NOW $9.50 EA
SAVE 40%



100g Enamelled Copper Wire
For winding chokes, crossover coils, etc. Supplied on its own plastic reel. 0.5mm-1.25mm available.
WW4016-WW4024 **$15.95EA**

40% OFF BIRTHDAY SPECIALS

Looking for more product information?
Visit your local store or our website jaycar.com.au

We reward our industry professionals

trade card jaycar

40th Birthday Specials

NOW FROM $89
SAVE $40

WATCH LIVE OR RECORDED VIDEO ON YOUR SMARTPHONE

NOW $129
SAVE 40%

CLEARANCE $299
SAVE 40%

GET IN QUICK WHILE STOCKS LAST

High Definition Web Cameras

Clear crisp sound & HD video for Skype, Zoom, or other video conferencing applications. Easy installation.

5MP QC3207 **NOW $89**
4K QC3209 **NOW $159**

720p Wi-Fi Camera with Flood Lights

All-in-one security camera designed to be mounted outdoors to deter or record any intruders. Records to an internal 16GB microSD card. Supplied with solar panel, mounting brackets, and hardware. QC8047

Flashforge Finder Lite 3D Printer

Easy to use advanced hobbyist 3D printer. Fully assembled. Features a slide-in build plate, assisted levelling & SD card slot.
Build size 140(H) x 140(W) x 140(L)mm. TL4222

ALL THESE $40 EACH

Indoor Flat Panel Digital TV Antenna
Clear signal technology, capable of picking up UHF/ VHF & DAB+ radio signals. Adjustable gain amplifier.
LT3156

NOW $40
SAVE $4.95

NOW $40
SAVE $9.95

USB Inspection Camera
Ideal for finding dropped screws/ bolts or locating objects in tight spaces. Includes hook, magnet & 45° mirror.
QC3373

4-Channel Universal Battery Charger
Fast charge any combination of Ni-MH, Ni-CD, Li-ion, or LiFePO4 cells using Pulse Width Modulation (PWM) at the same time.
MB3703

NOW $40
SAVE $9.95

Non-Contact Thermometer
Safely measure temperature in hot, hazardous, or hard to reach places.
-50°C~+500°C temp.
12:1 distance to spot ratio.
QM7410

NOW $40
SAVE $9.95

VIEW SPECS jaycar.com.au

MULTI-BUYS FOR $40

3 FOR $40
SAVE $19.85

BUY 3 AND SAVE
RGB Underwater Light
Select up to 12 different colours & 3 different light patterns. IP65 rated with a max depth of 2m. Battery powered. SL3933 **$19.95EA**
4 x AAA Batteries SB2413 **$3.25**

VIEW RANGE jaycar.com.au

2 FOR $40
SAVE $9.90

BUY 2 AND SAVE
4" Woofer/Midrange Speaker
Produces clean bass sound output. Excellent replacement or for new speaker design construction. Coated paper cone. CW2190 **$24.95EA**

2 FOR $40
SAVE $19.90

BUY 2 AND SAVE
6 Way Powerboard with Surge Overload Protection
Individually switched power sockets. Protect against surges or energy spikes. 1m lead.
MS4063 **$29.95EA**

Got a great project or kit idea?
If we produce or publish your electronics, arduino or pi project, we'll give you a complementary $100 gift card.
projects.jaycar.com

1800 022 888
www.jaycar.com.au

Over 100 stores & 130 resellers nationwide

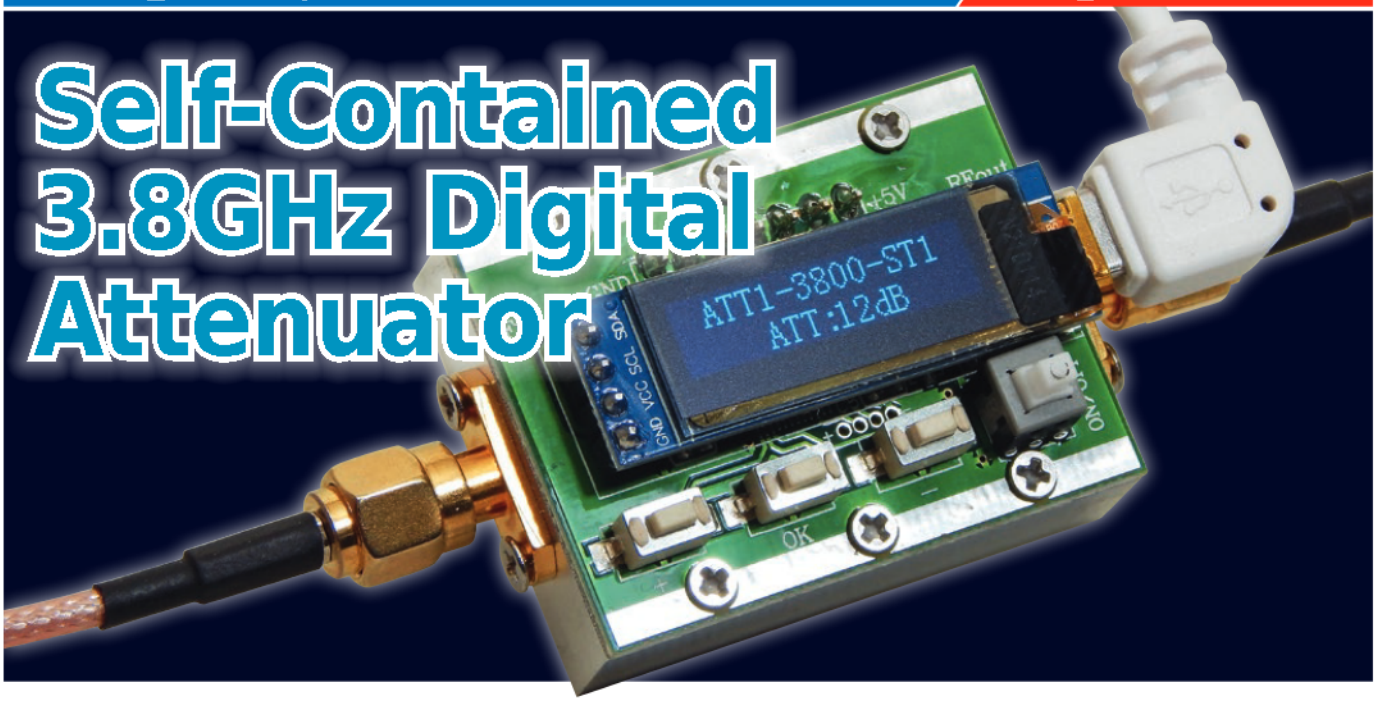
jaycar think. possible.

HEAD OFFICE
320 Victoria Road,
Rydalmere NSW 2116
Ph: (02) 8832 3100
Fax: (02) 8832 3169

ONLINE ORDERS
www.jaycar.com.au
techstore@jaycar.com.au

By Jim Rowe

Self-Contained 3.8GHz Digital Attenuator



This digitally programmable RF attenuator module can attenuate RF signals from 1MHz to 3.8GHz by 0-31dB in 1dB steps. It doesn't need to be controlled by an external microcontroller; it has one built in. You control it using four small pushbutton switches, while a tiny OLED screen shows the current setting.

I **reviewed one** of the simpler digitally programmable RF attenuator modules back in the June 2018 issue (siliconchip.com.au/Article/11090). It could be configured either by a separate microcontroller unit (MCU) like a Micromite or Arduino, or a six-way DIP switch.

It was based on the Peregrine Semiconductor PE4302 attenuator IC, mounted in the centre of a 33 x 24.5mm PCB without any shielding. Despite that, it turned out to have quite respectable performance up to about 1.5GHz. Above that, attenuation errors tended to grow, but the module was still quite practical for many applications.

I recently noticed this new digitally programmed step attenuator for sale. It is only a little larger, but has a built-in MCU with a tiny OLED and some small pushbutton switches for easy attenuation adjustment. I ordered one from Banggood (ID number 1769385; siliconchip.com.au/link/ab8p).

At the time of writing, it is priced at about $30.00 plus $6.70 for shipping to Australia. I haven't been able to find any information regarding its manufacturer, but like most of these modules, it is almost certainly made in China.

This module measures 42 x 32 x 22mm overall, not counting the SMA connectors at each end for RF input and output. The digital attenuator section is on a 33 x 22.5mm PCB inside a 42 x 32 x 10mm CNC machined aluminium block which forms the 'case'.

Most of the control section is mounted on a second PCB measuring 42 x 32mm, which forms the top of the case. The 26mm diagonal (38 x 12.5mm) OLED is mounted on top of the second PCB.

The PE4302 digital attenuator chip used in the earlier attenuator module was made obsolete in 2018 and is no longer available. This new module uses the HMC472 from Hittite Microwave Corporation, a company acquired by Analog Devices in 2014.

The HMC472 is similar to the PE4302 in many ways. It is described as a 6-bit digital step attenuator using GaAs MMIC technology, and can provide attenuation from 0dB to 31.5dB in 0.5dB steps for DC to 3.8GHz signals. It comes in a 24-lead Lead Frame SMD package measuring 4 x 4mm. Unlike the PE4302, it runs from 5V DC rather than 3.3V.

The insertion loss at the 0dB setting is rated at 1.1-1.2dB below 350MHz, 1.5dB at 2GHz and 1.9dB at 4GHz.

I wasn't able to find a complete circuit for the new module, but I worked out a basic block diagram for it, shown in Fig.1. The HMC472's RF1 input pin is coupled to the SMA connector via a 1nF capacitor, with its RF2 output pin configured similarly. Apart from various bypass capacitors, that is the whole attenuator section.

The control section is based on an STM32F103C8T6 microcontroller. You may have noticed that it controls only five of the six programming lines of the HMC472: V1 to V5. The unused V6 line is the one that controls the 0.5dB attenuator stage inside the HMC472, which explains why this module only provides 1dB steps.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SMD Test Tweezers

By Tim Blythman

This clever little device is made from just 11 components. Yet it can measure the values of many SMD resistors and capacitors, plus show diode and LED orientations and measure their forward voltages. It's quick and easy to use, and is powered by an onboard button cell, with a high-contrast OLED screen to show the readings.

Working with SMD parts can be tricky. Reading component markings can be a strain on the eyes, if the component is even marked! Devices like SMD capacitors are totally anonymous and, once removed from their packaging, almost impossible to tell apart. These SMD Test Tweezers make it easier by telling you all about a component by simply picking it up.

In some cases, these Tweezers can also measure the properties of a component once it has been soldered to a board (although, depending on the circuit configuration, sometimes the readings will not be accurate).

As time passes, fewer electronic parts are available in through-hole variants and increasingly manufacturers are building products mostly or entirely from SMDs. They are smaller and cheaper than through-hole parts, can be mounted on both sides of a board (often with internal traces running underneath) and are also less sensitive to shock and vibration.

Of course, while parts being smaller can be advantageous, it also presents problems when working with them. Certain tools, such as tweezers and a magnifier, are indispensable.

Once you've had a chance to try out our SMD Test Tweezers, we think you will be adding them to your bag of SMD tricks!

The tweezers

SMD parts are very awkward to read with a multimeter. On many occasions, we've been pressing multimeter probes into the ends of an SMD part, trying to get a reading, only for it to fly off and never be found again. Tweezers provide a much more natural way to do this, and as you don't need to apply much pressure, there is less chance of the part taking flight.

Even better, since tweezers are a convenient way to pick up and handle such parts, if we incorporate the measuring tool into the tweezers, it can tell you what part you are handling while you are in the process of placing it on the board.

The SMD Test Tweezers measure whatever component is present between its tips, so there are no extra fiddly movements to make. You pick up the part, and the screen displays its assessment. The Tweezers automatically detect the difference between resistors, capacitors and diodes, including many LEDs. With a maximum applied current of 0.3mA at 3V, there's virtually no chance of causing damage.

The Tweezers can measure resistances from around 10Ω to 1MΩ and capacitances from 1nF to 10µF. These ranges are slightly limited, but increasing them would significantly complicate the design, and a large percentage of SMD components fall within those ranges.

Features & Specifications

- Identifies and measures resistors, capacitors, diodes & LEDs
- Compact OLED display readout
- Runs from a single lithium coin cell, around five years of standby life
- Auto power on and off
- Displays own cell voltage when no component is connected
- Can measure components in-circuit under some circumstances
- Can perform thousands of measurements before the cell is exhausted
- Resistance measurements: 10Ω to 1MΩ
- Diode measurements: polarity and forward voltage, up to about 3V
- Capacitance measurements: 1nF to 10µF

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

Review by Tim Blythman

PicoScope 6426E USB Oscilloscope

The PicoScope 6426E USB Oscilloscope is a high-performance software-driven oscilloscope. As most of our experience is with standalone/benchtop type 'scopes, we were interested in trying it out when Emona Instruments offered to loan us an evaluation unit.

In February this year, we purchased a BitScope Micro PC-based oscilloscope to build a low-cost Virtual Electronics Workbench (siliconchip.com.au/Article/14751). While the concept is similar – both scopes lack screens and buttons, connecting to a computer instead for display and control – Pico Technology's 6000E series of PC-based oscilloscopes is in an entirely different league.

The unit we received for testing is the 6426E four-channel, 1GHz bandwidth scope with a maximum 5GS/s (gigasamples per second) sampling rate. But there is much more to the scope than these basic specs imply.

The 6426E has the so-called FlexRes feature, which means that it can sample voltages with a resolution of eight bits (256 steps), 10 bits (1024 steps) or 12 bits (4096 steps). This is 12 bits of true hardware resolution, not achieved by averaging multiple samples of lower resolution.

If the full 1GHz sampling rate is not needed, then the 6426E can also perform oversampling and software enhancement to provide an effective resolution of up to 16 bits.

This extra resolution can be handy in audio work or anywhere that a high dynamic range is needed. It can only sustain the 5GS/s sampling rate with the vertical sampling resolution set to eight bits, reducing to 1.25GS/s when using two channels at 12 bits due to hardware bandwidth limitations.

Given that you'd typically need the higher vertical resolution when looking at lower-frequency signals like audio, that doesn't seem like a significant problem.

The scope feature that we found most interesting is the sheer volume of sample data that the unit can capture, up to four gigasamples. That means that the 6426E can sustain its maximum 5GS/s sampling rate (on one channel) for up to 800ms.

There are great benefits to having long capture times. Once you have sampled an event, it will be a great boon to be able to look over the surrounding times to see the complete circumstances.

For example, there is nothing more frustrating than debugging digital communication and only capturing a fraction of the transaction, especially if it's a rare event. This long sample size potentially allows many seconds or even minutes of data (at lower sampling rates) to be captured and analysed after the fact.

These high sampling depth and rate capabilities also mean that FFT (spectral) analysis can be more detailed; the spectrum view can be accessed by a single click in the user interface.

Range of scopes

The 6426E that Emona supplied us for review is just one of Pico Technology's 6000E series of scopes, and it is pretty well top-of-the-range.

There are nine units with different feature combinations listed at the time of writing. The range starts with a 300MHz bandwidth unit that lacks the FlexRes feature, limited to eight

PicoScope 6426E Features & Specifications

- Voltage resolution: eight bits (256 steps) to 12 bits (4096 steps)
- Channels: 4 x 1GHz analog, plus 16 x digital with optional MSO pods fitted
- Sampling rate: 5GS/s maximum
- Capture memory: 4GS
- Waveform generator: 50MHz, 200MS/s, 14-bit
- Update rate: 300,000 waveforms per second
- Software: PicoScope 6 and PicoSDK (free)
- Other features include: serial decoding, mask limit testing, high-resolution waveform timestamping

bits (256 steps) of vertical resolution. Also, this basic unit (the 6403E) only has 1GS of storage.

There are also eight-channel units, although these are only available with 500MHz bandwidth: the 6804E (eight-bit resolution only) and 6824E (with FlexRes).

These scopes can also be fitted with one or two optional mixed-signal oscilloscope (MSO) pods. These provide eight digital signal inputs each; our review unit was not supplied with these. But this doesn't stop the scope from being useful for digital work.

There is an online tool for configuring and viewing the scope options at: **www.picotech.com/oscilloscope/6000/picoscope-6000-overview**

Software

Even before we received the unit to test, we made sure to download the necessary software.

In a very refreshing change from much software these days, the PicoScope 6 software does not need a login or e-mail address to use or download. PicoScope Version 6.14.44 is the latest release and the first version to support the 6000E series scopes.

On Windows, the software is around 210MB to download and around 230MB installed. The installation process was straightforward and included the necessary drivers. It's a good sign when things like this just work.

There are also beta (pre-release) versions of PicoScope 6 for macOS and Linux. Early versions of PicoScope 7 are also available. The notes indicate that this version will eventually support all current and many discontinued PicoScope models, so ongoing support looks good.

Hands-on testing

The scope comes in a padded clamshell case and with all the basics needed to use it, including four 500MHz 10:1 passive probes. Active probes are also available as an option at the time of purchase.

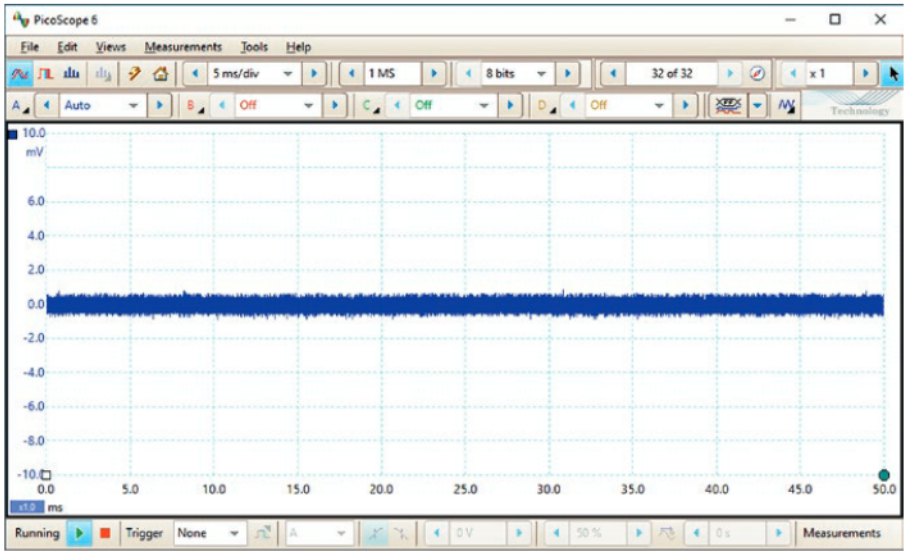
The front panel features the four BNC socket inputs plus a pair of test points for Earth and a square-wave output.

The rear is dominated by a fan grille with USB and power connections on one side and three BNC sockets on the other. These sockets are for the auxiliary trigger input, 10MHz timebase

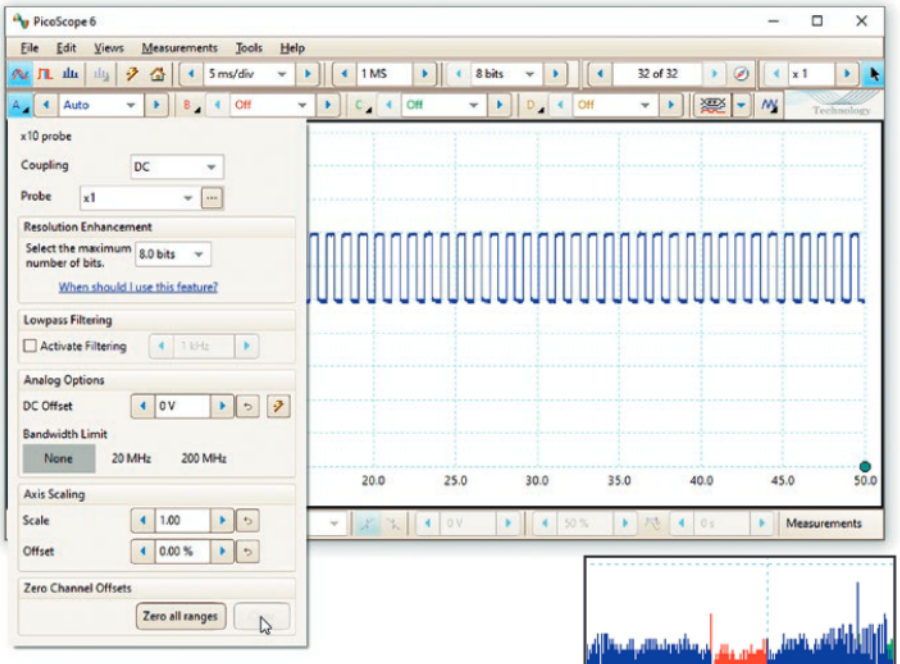
The PicoScope 6426E accepts Pico Technology's intelligent probes as well as standard passive probes on the front panel. Optional mixed-signal oscilloscope (MSO) pods for digital signals can be plugged in at lower right.

Up to two MSO (mixed signal oscilloscope) pods can be plugged into the front of the 6000 series 'scopes. These are optional extras and were not included with the unit we tested.

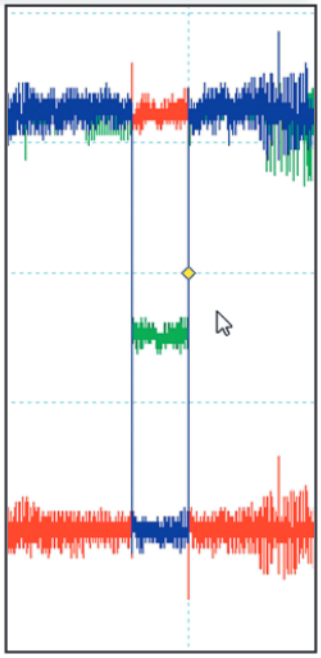
Standard inclusions are four passive 10:1 500MHz probes. The probes also come with a variety of useful accessories, including spring tip, ground spring and colour coding rings. Active probes are also available.



Screen 1: when the PicoScope application is started, connected probes are automatically detected and the trace is displayed. Common settings are above and below the main trace window.



Screen 2: a comprehensive set of probe settings are available via a drop-down for each connected probe. It's handy to have all these settings in one place.



Screen 3: when the trigger is activated, it appears as a yellow diamond that can be moved around to set both the trigger threshold and delay. A separate window is used to modify more advanced trigger settings.

input and AWG (arbitrary waveform generator) output.

The body is extruded aluminium with rubber bumpered corners. It feels solid and comes with a 12V power brick of the type that would typically accompany a laptop computer, and a sturdy USB 3.0 (A-B) cable, as well as the necessary manuals.

While we scanned the Quick Start Guide, getting started was as simple as connecting the power brick, connecting the unit to the computer with the USB cable and starting the PicoScope software.

Connected probes are automatically detected and displayed. Screen 1 shows the initial display on launching the software with the scope connected.

User interface

While PC-based scopes are necessarily different to the alternative, they also tend to offer more options. The trick is learning where all the settings and selections are hidden. We found the PicoScope software to be laid out in a fairly intuitive manner.

An A3 poster guide is available, briefly explaining the main features and where their controls are located.

Within the main window, there are three main rows of controls (plus the standard window menus). The first row has the timebase and sample settings, the second the channel ranges.

Interestingly, the vertical channel ranges aren't set per division but for the entire vertical scan. It's not what we're used to, but it makes sense to do it this way, as you typically know the range of signals to expect and can simply set the vertical range to match.

Screen 2 shows the settings that are available for each probe (channel).

A third row below the trace window has the trigger settings, so the most commonly used features are suitably grouped and easy to find.

The PicoScope software makes excellent use of the PC interface — the method of setting Triggers is both remarkable and straightforward. Once the trigger is enabled, a yellow diamond appears on the screen and can simply be dragged around to set the trigger point.

The vertical position of the trigger determines the threshold, while the horizontal position determines the delay (or amount of pre-sample and post-sample). This is shown in Screen 3.

As well as the basic trigger options, there are advanced options such as window, interval, level, runt pulse and digital boolean logic trigger conditions, including those dependent on multiple signals.

With the zoom tool selected, a region of the trace can be selected for closer inspection. As well as the zoomed window, an overview panel is shown, allowing the zoomed section to be panned around and inspected. This is seen in Screen 4.

Features

In the course of working on some of our current projects, we tried out some of the different features of the 6426E. Of particular interest to us is the serial decoding feature.

Several protocols can be decoded, and these are accessed from the Tools → Serial Decoding menu item. The dialog box with its options is seen in Screen 5. We used an I^2C decoder to monitor signals being sent to an I^2C OLED display. Screen 6 shows the data being correctly detected, packetised and decoded.

While this looks like quite a bit of data, what is being displayed is only a fraction of what the PicoScope has stored. Up to 32 separate captures are also kept and can be examined using the 'buffer overview' feature.

This makes it easier to examine longer sequences, and different captures can be compared and viewed, including any decoded serial data associated with the raw scope waveforms. Screen 7 shows the small window that provides the waveform overview and allows easy selection of captures to view.

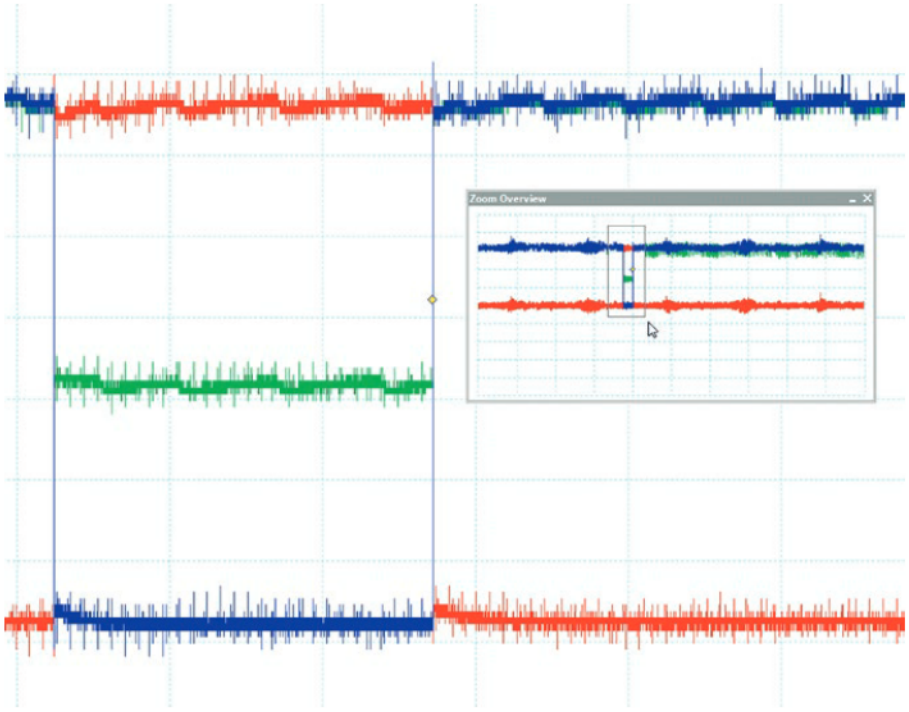
Menus

We cannot cover all the features of the 6426E, but we will highlight some that we thought were of particular interest.

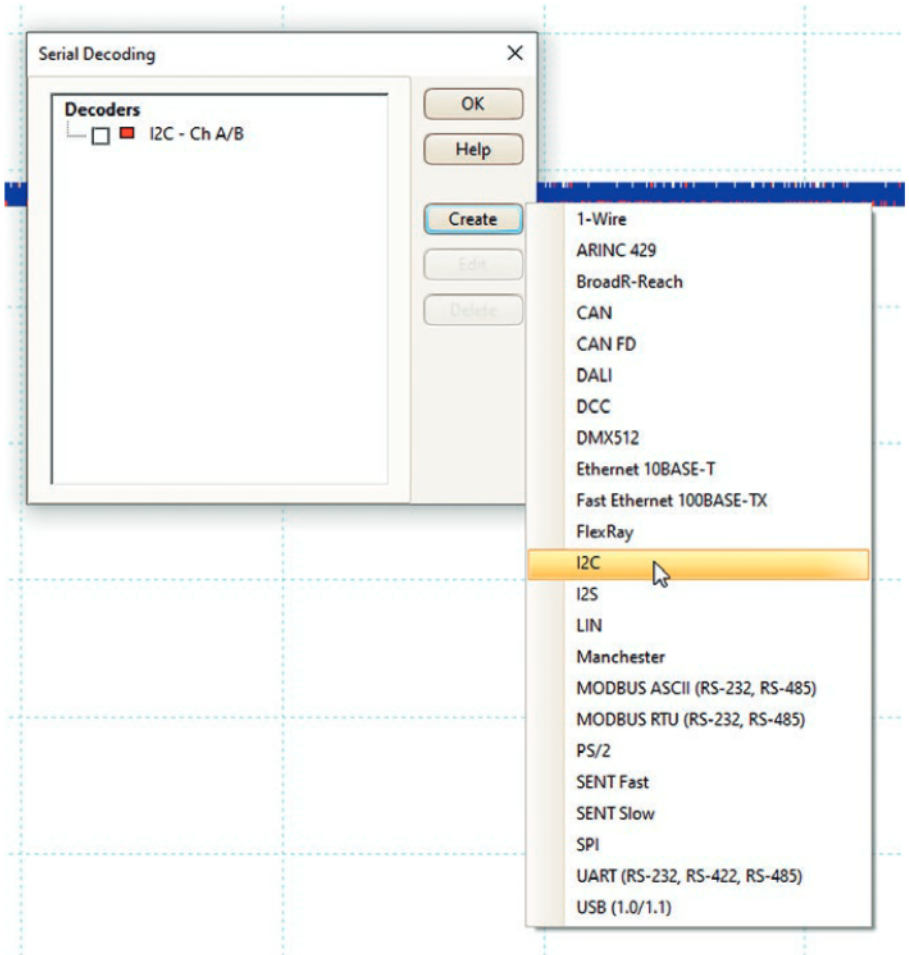
Taking a screenshot is as simple as using the Edit → Copy as Image menu item. There is also a "Copy as Text" option to allow easy pasting of data into a spreadsheet application.

Various measurements can be applied to a trace, allowing easy assessment of things like frequency, duty cycle, RMS value and even digital aspects such as the number of edges.

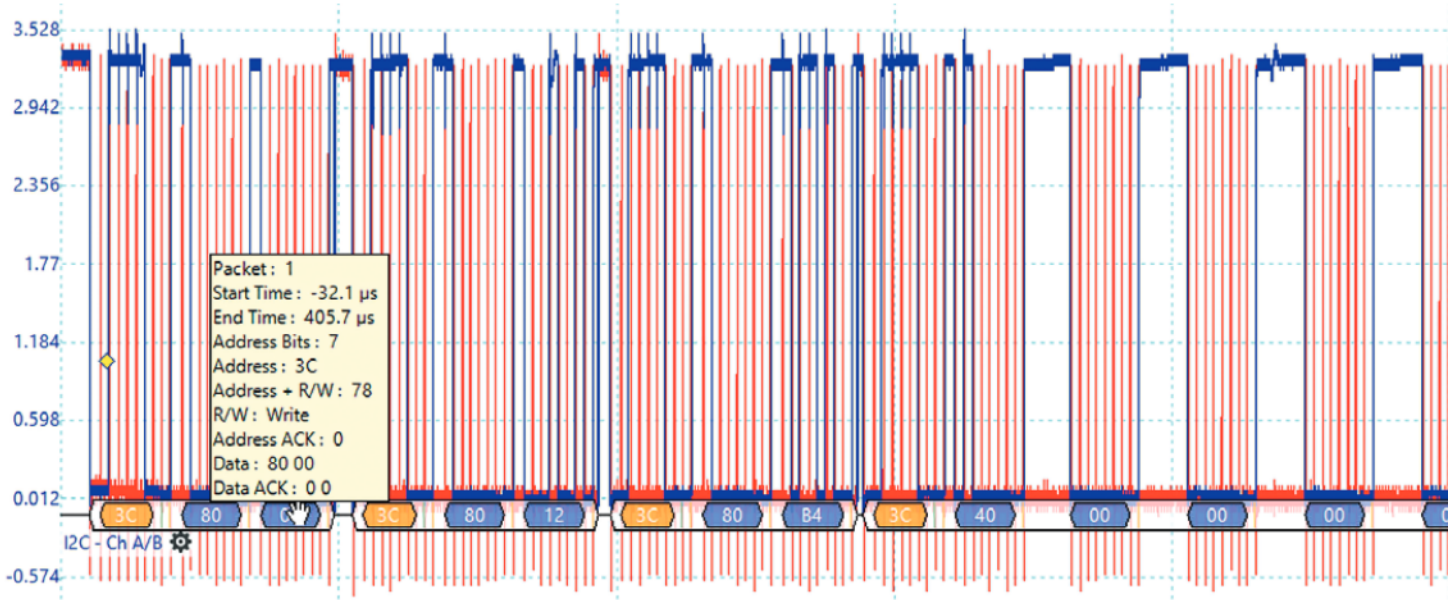
These can be applied to the entire screen display or between manually set rulers on the screen; the rulers can



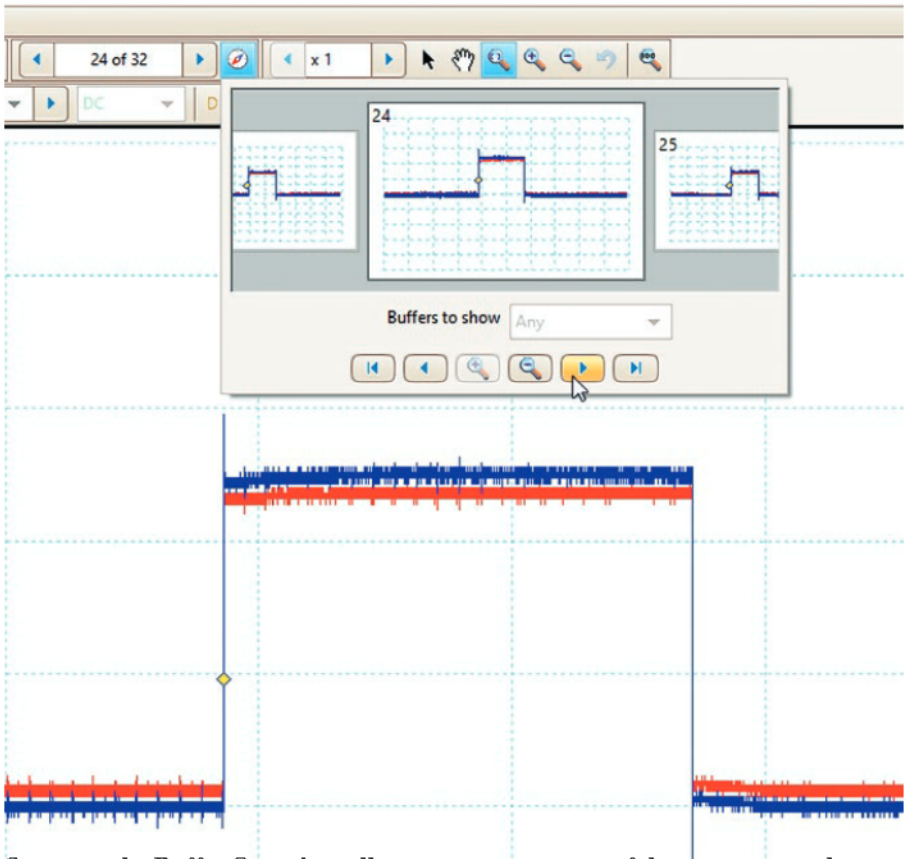
Screen 4: the zoom tools are simple and intuitive. The Zoom Overview allows the zoomed region to be panned around.



Screen 5: a comprehensive range of serial protocol decoders are available. We were impressed to see that the DCC digital command protocol for model railways is present.



Screen 6: we tested the I²C decoder and found that the PicoScope had no trouble detecting data packets that matched what we expected.



Screen 7: the Buffer Overview allows up to 32 screens of data captures to be viewed and compared. Any applicable decoding is also made available below the window shown.

simply be dragged and dropped like the trigger marker. Screen 8 shows the available measurements.

As well as serial decoding, the Tools menu allows 'Math Channels' to be added. There are simple (sum, difference, product) channels available directly from the menu, but you can also enter custom equations. The interface for entering equations looks a lot like a scientific calculator.

There are also Tools menu options for masks, alarms and reference waveforms.

Within the Preferences settings are a comprehensive range of functions to which keyboard shortcuts can be allocated. While it is easy enough to use the mouse for most features, we think that being able to set up shortcut keys for frequently used actions will be very handy for people who use the scope a lot.

Waveform generator

The waveform generator output is available from one of the BNC sockets at the rear of the scope. It can produce square waves and sinewaves up to 50MHz, and other waveforms at lower frequencies.

Arbitrary waveforms can be taken from either a CSV file or an existing scope trace. Digital bitstreams can be entered as binary or hexadecimal data.

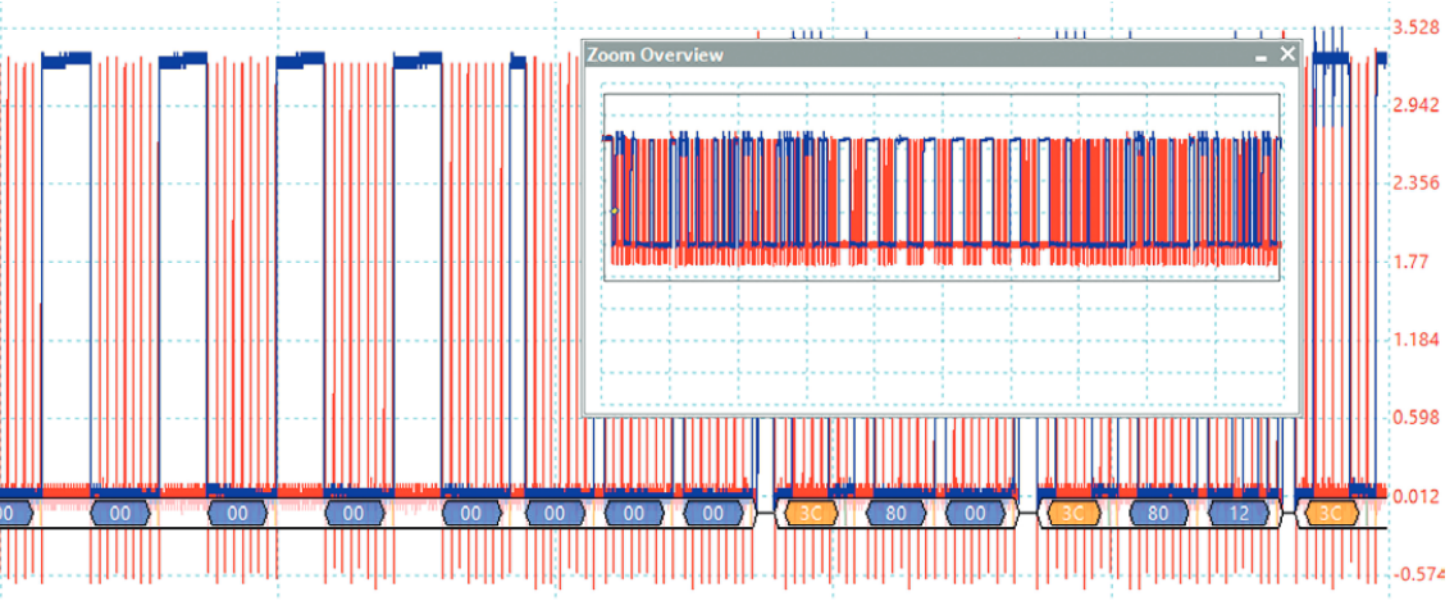
Conclusion

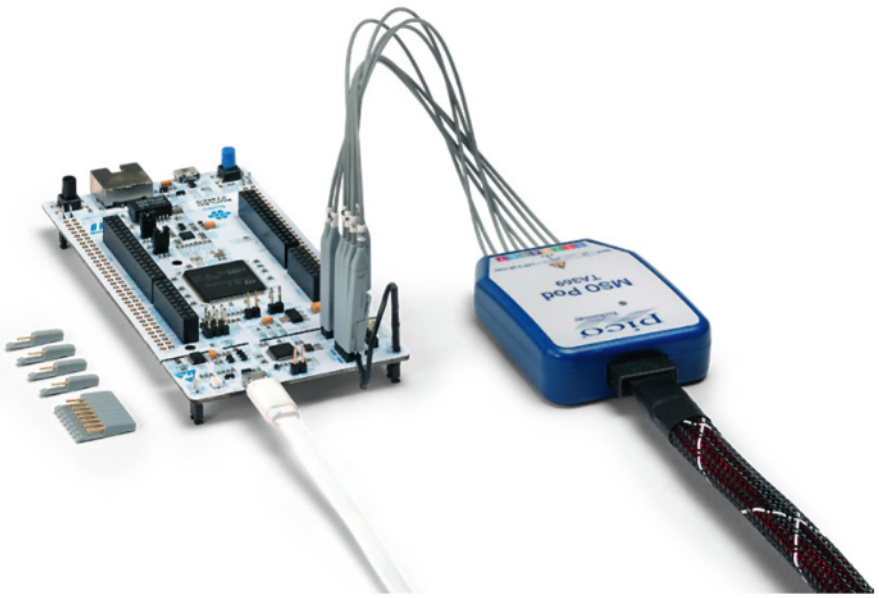
The 6426E is an impressive machine with a comprehensive set of features. We did not find it wanting in any of the tests we threw at it. In fact, we struggled to get it anywhere near its limits.

It is a handy tool for working with digital electronics through the numerous decoders, even though it has impressive specifications in the analog domain.

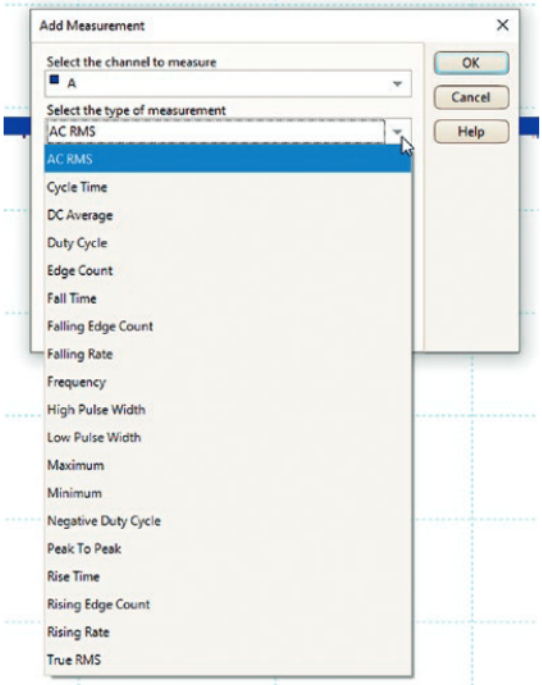
The 6000E range of ultra-deep-memory oscilloscopes is available from Emona Instruments. Ring them on 1800 632 953 or e-mail testinst@emona.com.au

Visit siliconchip.com.au/link/ab9j for a list of all the PicoScope products they sell or refer to their advertisement on the inner back cover. SC





Each optional MSO pod provides eight digital channels and includes a number of adapters, ground clips and test hooks to connect to the circuit under test.



Screen 8: the measurements listed here can be applied over the entire span of a buffer, or limited to specific ranges using adjustable rulers.

The A3136 1.3GHz Active probes are an optional extra, but are necessary for working at frequencies higher than passive probes can support. The Intelligent Probe Interface powers the probe from the scope and facilitates automatic probe detection and unit scaling.

Part 2: by Nicholas Vinen & Tim Blythman

Touchscreen & Remote Digital Preamp with Tone Controls

Our new Digital Preamplifier, introduced last month, combines high audio fidelity with convenience. It provides input switching, volume adjustment, bass/mid/treble controls via remote control and a colour touchscreen. It can be built as a standalone unit or integrated into a power amplifier. Having explained how it works, now we'll go through the construction and testing procedures.

This Preamp brings analog & digital circuitry together, giving the best aspects of both. It's a relatively simple design with excellent audio quality thanks to its analog roots, but it avoids the complexity of the multiple, expensive ICs that would be needed for a purely digital design. It also avoids using mechanical parts that can wear out, like a mostly analog design using a motorised potentiometer.

It has a good range of features including a colour touchscreen interface, infrared remote support, a three-band tone control, a wide gain range and four stereo inputs.

Last month's article explained how all of this is achieved using a Micromite LCD BackPack, two quad low-distortion digital potentiometers and a handful of op amps. That article also had all the relevant performance data. Now that we've explained how it all works, let's start on the assembly procedure.

Construction

The main PCB overlay for the Digital Preamp is shown in Fig.7. This board is coded 01103191 and measures 206 x 53mm (shown rotated).

As mentioned last month, we don't think the bypass relay (RLY4) and its associated components are necessary, so we have shown them greyed out. Instead, we recommend that you fit two wire links, shown in red. These let the signal pass to the output without RLY4 being fitted.

Assembly is pretty straightforward, with just two SMDs on the board (IC6 & IC7). Those parts are quite large, similar in size to a 14-pin DIP IC, and with widely spaced pins are not hard to solder.

Start with those two parts. Find their pin 1 markings and make sure they are orientated correctly, then apply flux paste to all the pads, rest the IC on top and tack one pin down. Check that all the pins are correctly aligned over their pads, then solder them. With enough good-quality flux paste on the pads, you can just load your iron with solder and drag it across the pins, and good joints will form.

Clean off the flux residue and carefully inspect the joins to ensure they have all formed properly (with the fillet touching both the pins and the pads) and that there are no bridges between adjacent pins. If you find bridges, apply more flux paste and use some solder wick and a fair bit of heat to remove the excess solder. Repeat the cleaning and inspection process to verify all is OK.

Now move on to the resistors, but leave off the larger 1W resistors for now. Note that two of the 100Ω resistors need ferrite beads slipped onto their leads before soldering – see Fig.7. Check each batch with a DMM set to resistance mode before fitting them to the board, and you can then fit those two wire links shown in red using resistor lead off-cuts.

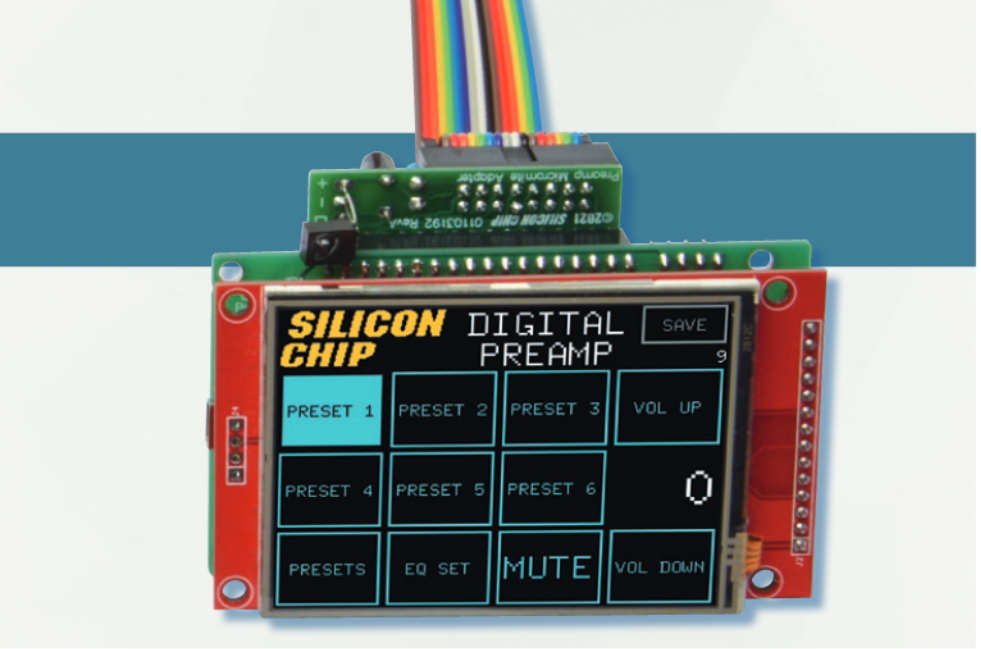
Next, mount the diodes. All diodes are polarised, so check their cathode stripes against Fig.7 and the PCB silkscreen before soldering them in place. D1-D12 are all BAT42 schottky types, while D13-D15 are standard 1N4148 signal diodes. Follow with zener diode ZD1.

Bend REG4's leads down by 90° about 6mm from its body, insert them into the PCB and then attach its tab to the mounting hole securely using a short machine screw, washer and nut. Once it's solidly attached and square, solder and trim its leads.

Now you can solder op amps IC1-IC5 to the board, ensuring they are orientated correctly. You can instead solder sockets if you prefer; they make swapping op amps easier but can lead to reliability problems long-term. Follow with bridge rectifier BR1, ensuring its + lead (usually longer) goes into the marked hole.

Install the two trimpots (both 500Ω) and then the three relays in a row, RLY1-RLY3. Ensure the stripes on the relays are positioned as shown, as it is possible to install them backwards.

Next, mount all the TO-92 package devices. These are transistors Q1-Q3



and Q5-Q7 plus regulators REG1-REG3. As there are five different device types in similar packages, be careful to check the markings so that you don't get them mixed up.

Now is a good time to fit all the ceramic capacitors (two different values) and MKT capacitors (five different values). Refer to Fig.7 and the PCB to ensure the right ones go in the correct locations.

Then fit the headers for links LK1-LK3 but do not insert the shorting blocks yet. Follow with the DC socket (if you plan to use it) and the 18-pin header, plus the 3-way terminal block, with its wire entry holes facing the outside of the board.

If you are going to fit LED1 onboard, do it now, with its longer anode lead soldered to the pad marked "A". Otherwise, you could mount a header in its place, or solder a twin lead later.

Also install the two 10Ω 1W resistors now. Bend their leads so that they are suspended a few millimetres above the PCB surface to allow air to circulate, as they get pretty hot. As mentioned last month, you could opt to use 2W resistors, or perhaps four 4.7Ω 1W resistors arranged in pairs and mounted vertically to spread out the heat load.

Then fit all the electrolytic capacitors, with their longer positive leads to the pads marked with a + symbol. Note that the two 47µF caps need to have their leads splayed out to fit the pads provided.

That just leaves the RCA sockets. The right-angle sockets will have plastic tabs that clip into the holes drilled into the PCB. Once you have pushed them down fully so they are flat on the PCB, solder their leads. You should also push the vertical connectors down fully before soldering the two tabs and central pin on each.

Building the BackPack

You have the option of using the Micromite BackPack V2 with a 2.8-inch colour touchscreen (May 2017; **siliconchip.com.au/Article/10652**) or the Micromite BackPack V3 with a higher-resolution 3.5-inch touchscreen (August 2019; **siliconchip.com.au/Article/11764**).

The main advantages of the 2.8-inch version are lower power consumption and the fact that it will more easily fit into a slimmer case. The 2.8-inch screen module is 38.5mm tall, while the 3.5-inch screen is 56.5mm tall. A 1RU case is 44.5mm tall, so it would be difficult to fit the 2.8-inch version into one, while fitting the 3.5-inch version would be impossible. A 2RU case would fit either.

Regardless, it's up to you; build the one you prefer based on the instructions published in those previous issues. Assembly is pretty straightforward, especially if you're making it from a kit, so if you're an experienced constructor, you probably don't need instructions.

We can supply a kit for either version with the microcontroller pre-programmed with the appropriate software. The 2.8-inch version is available at **siliconchip.com.au/Shop/20/4237** while the 3.5-inch version is at **siliconchip.com.au/Shop/20/5082**

Whichever version you purchase,

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

Review by Tim Blythman

Solder Master ESM-50WL Cordless Soldering Iron

Battery-powered soldering irons are becoming the preferred choice when soldering needs to be done away from mains power or in tight spaces. The Solder Master ESM-50WL from Master Instruments is the latest contender.

Like the Wagner SI50HSK cordless soldering iron we reviewed in the April 2021 issue (siliconchip.com.au/Article/14828), the ESM-50WL is being marketed as a replacement for butane (gas) powered soldering irons. However, there are some significant differences between them.

We received a test unit from Master Instruments, a company prominent in the battery engineering space. They have had substantial input into this Australian-designed product.

The ESM-50WL Cordless Iron comes as a complete kit in a padded clamshell case. It includes the Iron, two tips, a protective heat-resistant silicone tip cover, both 12V (vehicle accessory socket) and universal (100V-240V) mains chargers, and a small tube of lead-free solder.

The kit is ideal for keeping in the toolbox for those who know they might need to use a soldering iron anytime. The two chargers mean it can be kept charged no matter where you are.

As you might expect from Master Instruments, the Iron does not skimp on batteries. The battery is rated at 14.4V 3.45Ah (50Wh) and comprises four Panasonic cells. The chargers are rated at 1A, so the battery will charge from flat in a few hours, although generally you'll only need to top it off, taking less than an hour.

The nominal continuous running time is up to 270 minutes on 'low mode'. We found that we never came close to running it down in our tests. Master Instruments reckon it's the longest-lasting battery on the market.

In use

The ESM-50WL Cordless Iron is a powerful unit. We used it to assemble a project PCB, however, we found that it was overpowered for such a small task, as even on the lowest setting (480°C), it put out quite a bit of heat.

We then tried using it to solder heavy-duty wires onto some 70W LED panels on a thick aluminium-core PCB. For this job, it excelled. There is no doubt that this is a serious tool for heavy-duty work. It also handled splicing together some thick copper wires with ease.

The power button for the Solder Master ESM-50WL is located on the left-hand side. The yellow indicators on the top of the device show how hot the tip will become, while the blue lights indicate the battery charge left in 25% steps.

For those that want even more heat, its boost mode can provide 27W for up to 25 seconds.

The controls and LEDs are clear and visible on the top of the Iron, and it is well-balanced. The shape lends itself well to being placed flat on a work surface between uses, without fear of melting anything.

An included silicone tip cover can be fitted while the Iron is hot and allows it to be packed away safely. The Iron also has a white LED which is aimed towards the tip for illumination of the work. This lights up the work area nicely, but as it's only lit while holding down the heat button, it isn't that useful for positioning the tip before soldering.

Some of the suggested users include automotive and marine engineers, telecommunication techs and HVAC (heat, ventilation & air conditioning) installers. Those sound like the sort of jobs that will make good use of the portability, power and long running time that this Iron provides.

Construction & servicability

The shell is fire retardant polycarbonate and ABS, and the Iron also appears made to be serviced, with a full range of spare parts available. The DC jack, for example, seems to be a standard barrel type and the tip holder is a silicone-lined gland, both of which are well-suited to straightforward user servicing and repair.

Conclusion

The Solder Master ESM-50WL Cordless Iron is a powerful unit and would be well-suited as a gas iron replacement for those involved in heavy-duty work, in difficult situations. The kit provides a small but complete and versatile set of accessories to accompany the Iron.

While more expensive than a comparable gas iron, we think it has significant advantages, including having several charging options and being usable in places where an open flame is not safe.

The Solder Master ESM-50WL Cordless Iron retails for $369.95 and is available from resellers like Wagner Electronics Super Store (siliconchip.com.au/link/abau). For more information on this and related products, see www.soldermaster.com.au/ and www.master-instruments.com.au/category/Solder_Master/2263 SC

The soldering iron comes in a padded clamshell case. The case contains the iron with protective cover, two tips, a universal mains charger, a car charger and a tube of lead-free solder.

This 3D internal view of the soldering iron showing the battery pack is from the YouTube video: https://youtu.be/[illegible]. This same YouTube video also has a 3D external view of the soldering iron.

SERVICEMAN'S LOG

Life on the 'bleeding edge'

Dave Thompson

When new technology comes along, I prefer to sit back and watch what happens before I take the plunge down that particular rabbit hole. This is a different philosophy than many people I know, including family members, who simply must have the very latest widget, gadget and toy available.

Some people seem to need the latest gadgets. Control your home lights, entertainment system and air conditioner with your phone or home PC? Check. Have the latest electric car? Check. Own the latest drone with an 8K stabilised camera? Check. Ask Siri, Cortana or Alexa to order washing-up powder for you? Check.

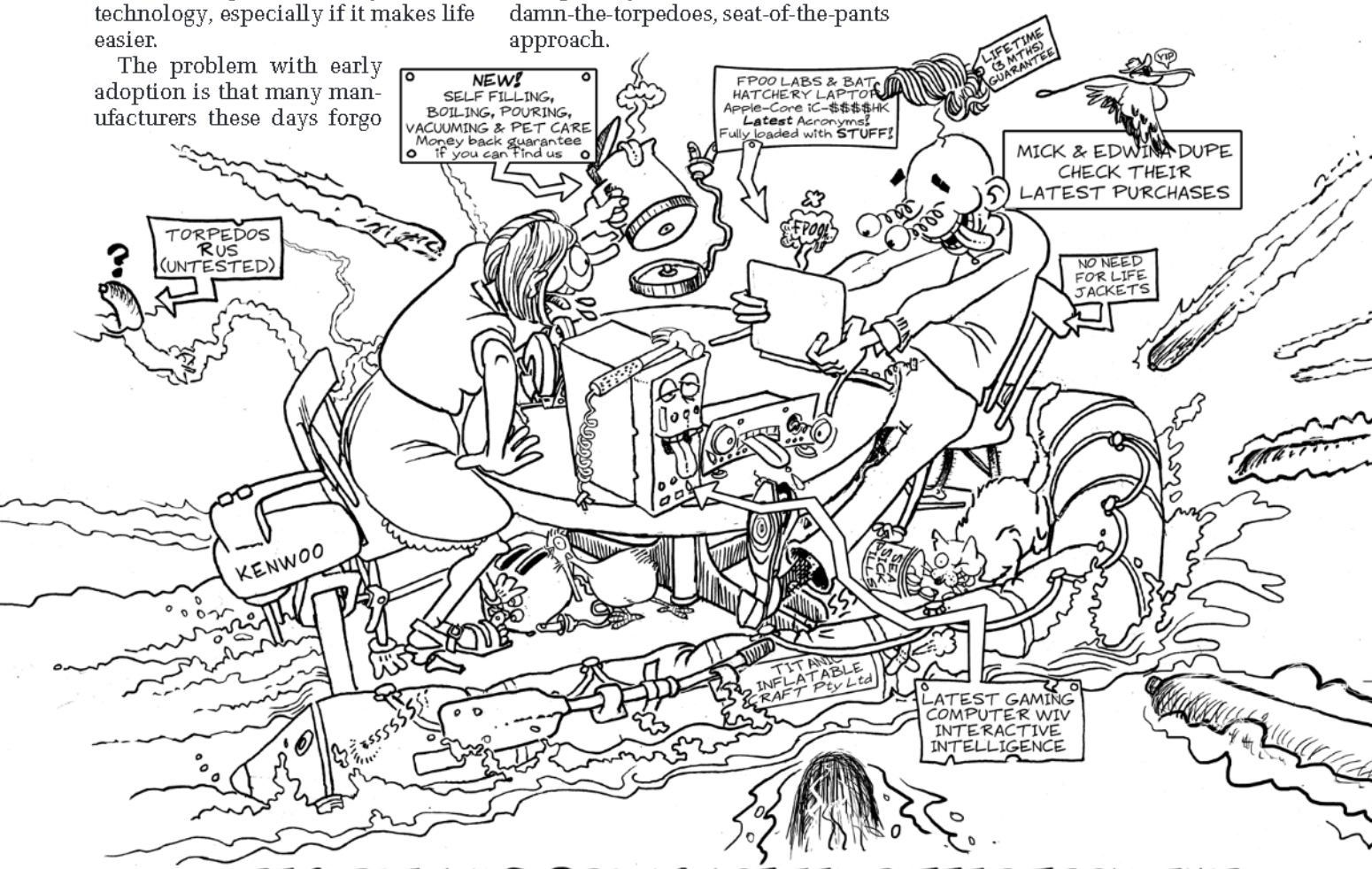
Don't get me wrong; I'm not averse to these things and usually embrace technology, especially if it makes life easier.

The problem with early adoption is that many manufacturers these days forgo stringent product testing and simply let their customers do it all for them, attempting to resolve any problems that crop up on the fly, in the hope that product sales will cover the costs of finishing the development (or recalling it in worst-case scenarios).

Gone are the days of focus groups, mass testing and in-depth trials. The problem is that consumer security and privacy often suffer from this damn-the-torpedoes, seat-of-the-pants approach.

This is a tried-and-true business strategy, though. Japanese companies have done this for years. As a non-technical example, say a manufacturer wants to try a different flavour of ice cream.

In Japan, they simply make it and release it into the market. If it takes off, they reap the rewards. If no one buys it, they quietly withdraw it and move on to another flavour.



SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

Preview only.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

And now . . .

THE UT-P 2016 MEMS WOOFER!

by Allan Linton-Smith

Back in May 2020 we told you about the amazing, minuscule UT-P 2017 MEMS Tweeter from USound. We mentioned that it had a "big" brother (if big is the right word!) – the UT-P 2016 "woofer" or midrange driver. This tiny device can provide full range reproduction down to 20Hz and all our tests proved that it also has a great deal of potential.

Austrian developer USound launched the UT-P 2016 at the same time as the UT-P 2017. Both are MEMS or Micro Electrical-Mechanical Systems.

Identical in size, the main difference between the two is that the UT-P 2016 is intended for wide-range speaker roles while the UT-P 2017 is designed as a tweeter.

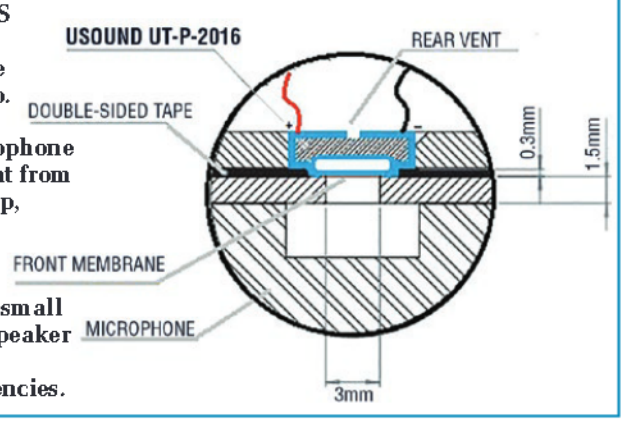
These devices have the potential to be very cheap because they can be manufactured using integrated circuit (IC) fabrication and device packaging processes. And from a manufacturing viewpoint, they are also easy to mount because they can be soldered in place by reflow soldering techniques, which is how most SMD components are incorporated into commercial applications. These MEMs speakers are in fact SMD speakers!

These little speakers can be made far more easily than conventional moving-coil miniature speakers. It has been estimated that MEMS speakers will require around one thousand times less manufacturing time to produce!

USound woofer performance

Listening tests with the woofer were encouraging. A variety of music was auditioned including jazz, piano, classical and hard rock and the tiny MEMS speakers performed admirably with all genres.

Our Test Bed: the MEMS speaker was mounted on a small PCB with the recommended 3mm gap. This feeds directly into our Bruel & Kjaer microphone but it is slightly different from the manufacturer's setup, accounting for slight differences in the specifications. The back pressure from the small port in the rear of the speaker allows it to "breathe", especially at low frequencies.



SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

Reinartz "4-valve" reaction radio

By Fred Lever

I built this simple battery-powered AM radio set using the "Reinartz" tuning principal and early 1930s to 1940s components (well, mostly; I cheated in a couple of places). I did this for a few reasons. One is that it was a learning exercise; I knew that it was possible to build a radio set like this, but I didn't fully understand all the details. Now I do. I also succeeded in turning a load of old junk into a working radio!

Reinartz tuning is also known as reaction tuning, and I was keen to build a radio using this principle. I wanted to build it such that it would appear to be a radio designed and built in the 30s. So I drew up the circuit shown in Fig.1.

I initially toyed with the idea of using battery triodes such as the type 30 or mains-powered tetrodes such as type 24A. But I ended up using two type 57 amplifier pentodes and a type 47 pentode output valve driving the loudspeaker.

I could have used a type 80 rectifier but instead, I used a silicon bridge rectifier hidden in a defunct 5V4. This allowed me to wind the HT secondary on the transformer as a single winding. I also wound on 2.5V heater windings, with centre taps for bias and grounding.

To get to this arrangement, I had to do lots of prototyping different circuits, fabricating of parts and re-thinking and re-designing when my tests failed. This article presents the receiver in its finished state, with a lot of the development detail left out.

Circuit details

Valve V1 is a type 57 pentode which works as a three-grid stage, with tuning, feedback, gain control and AM detection. Each grid of the type 57 has some level of DC bias or signal applied. The combination of the tapped antenna coil and tuning capacitor selects the desired AM signal frequency and this signal is applied, via a grid-leak resistor and capacitor, to the control grid (top cap).

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

SILICON CHIP .com.au/shop ONLINESHOP

HOW TO ORDER

VISA mastercard PayPal

INTERNET (24/7)	PAYPAL (24/7)	eMAIL (24/7)	MAIL (24/7)	PHONE - (9-5:00 AET, Mon-Fri)
siliconchip.com.au/Shop	silicon@siliconchip.com.au	silicon@siliconchip.com.au	PO Box 139, COLLAROY, NSW 2097	(02) 9939 3295, +612 for international

You can also pay by cheque/money order (Orders by mail only) or bank transfer. Make cheques payable to Silicon Chip.

10/21

YES! You can also order or renew your Silicon Chip subscription via any of these methods as well! The best benefit, apart from the magazine? Subscribers get a 10% discount on all orders for parts.

PRE-PROGRAMMED MICROS

For a complete list, go to siliconchip.com.au/Shop/9

$10 MICROS

24LC32A-I/SN	Digital FX Unit (Apr21)
ATmega328P	RF Signal Generator (Jun19), Si473x FM/AM/SW Digital Radio (Jul21)
ATmega328P-AUR	RGB Stackable LED Christmas Star (Nov20)
ATtiny85V-10PU	Shirt Pocket Audio Oscillator (Sep20)
ATtiny816	ATtiny816 Development/Breakout Board (Jan19)
PIC10F202-E/OT	Ultrabrite LED Driver (with free TC6502P095VCT IC, Sep19)
PIC12F1572-I/SN	LED Christmas Ornaments (Nov20; specify variant) Nano TV Pong (Aug21), **SMD Test Tweezers (Oct21)**
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)
PIC12F675-I/P	Motor Speed Controller (Mar18), Heater Controller (Apr18) Useless Box IC3 (Dec18)
PIC12F675-I/SN	Tiny LED Xmas Tree (Nov19)
PIC16F1455-I/P	Microbridge (May17), USB Flexitimer (June18) Digital Interface Module (Nov18), GPS Finesaver (Jun19) Digital Lighting Controller LED Slave (Dec20)
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)
PIC16F1705-I/P	Flexible Digital Lighting Controller Slave (Oct20)
PIC16F88-E/P	Automotive Sensor Modifier (Dec16)
PIC16F88-I/P	Remote-controlled Preamp with Tone Control (Mar19) UHF Repeater (May19), Six Input Audio Selector (Sep19) Universal Battery Charge Controller (Dec19)

$15 MICROS

ATSAML10E16A-AUT	High-Current Battery Balancer (Mar21)
PIC16F1459-I/SO	Four-Channel DC Fan & Pump Controller (Dec18)
PIC32MM0256GPM028-I/SS	Super Digital Sound Effects (Aug18)
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)

$20 MICROS

dsPIC33FJ64MC802-E/SP	1.5kW Induction Motor Speed Controller (Aug13)
dsPIC33FJ128GP306-I/PT	CLASSiC DAC (Feb13)
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

PIC32MX695F512L-80I/PF	Colour MaxiMite (Sep12)
PIC32MZ2048EFH064-I/PT	DSP Crossover/Equaliser (May19), Low-Distortion DDS (Feb20) DIY Reflow Oven Controller (Apr20)

KITS, SPECIALISED COMPONENTS ETC

siliconchip.com.au/Shop/

SMD TEST TWEEZERS KIT (CAT SC5934) *(OCT 21)* — **$35.00**
PCBs, micro, other onboard parts and heatshrink (no cell or brass tips)

NANO TV PONG SHORT FORM KIT (CAT SC5885) *(AUG 21)* — **$17.50**
PCB and all onboard parts only (does not include controllers)

MODEL RAILWAY LEVEL CROSSING *(JUL 21)*
- Pair of programmed PIC12F617-I/Ps — **$15.00**
- ISD1820P-based audio recording and playback module — **$5.00**

MINI ISOLATED SERIAL LINK COMPLETE KIT (CAT SC5750) *(MAR 21)* — **$10.00**
All parts required to build the project including the PCB

AM/FM/SW RADIO *(JAN 21)*
- PCB-mount right-angle SMA socket (SC4918) — **$2.50**
- Pulse-type rotary encoder with integral pushbutton (SC5601) — **$3.00**
- 16x2 LCD module (does not use I^2C module) (SC4198) — **$7.50**

LED CHRISTMAS ORNAMENTS (CAT SC5579) *(NOV 20)* — **$14.00**
Complete kit including micro but no coin cell (specify PCB shape & colour)

RGB STACKABLE LED CHRISTMAS STAR (CAT SC5525) *(NOV 20)* — **$38.50**
Complete kit including PCB, micro, diffused RGB LEDs and other parts

MICROMITE LCD BACKPACK V3 KIT (CAT SC5082) *(AUG 19)* — **$75.00**
Includes PCB, programmed micros, 3.5in touchscreen LCD, UB3 lid, mounting hardware, Mosfets for PWM backlight control and all other **mandatory** on-board parts

Separate/Optional Components:
- **3.5-inch TFT LCD touchscreen (Cat SC5062)** — **$35.00**
- DHT22 temp/humidity sensor (Cat SC4150) — **$7.50**
- BMP180 (Cat SC4343) **OR** BMP280 (Cat SC4595) temp/pressure sensor — **$5.00**
- BME280 temperature/pressure/humidity sensor (Cat SC4608) — **$10.00**
- **DS3231 real-time clock SOIC-16 IC (Cat SC5103)** — **$4.00**
- 23LC1024 1MB RAM (SOIC-8) (Cat SC5104) — **$5.00**
- AT25SF041 512KB flash (SOIC-8) (Cat SC5105) — **$1.50**
- 10µF 16V X7R through-hole capacitor (Cat SC5106) — **$2.00**

VARIOUS MODULES & PARTS
- **64x32 pixel white 0.49in OLED (SMD Test Tweezers, Oct21)** — **$10.00**
- **pair of AD8403ARZ10 (Touchscreen Digital Preamp, Sep21)** — **$35.00**
- **Si4732 radio IC (Si473x FM/AM/SW Radio, Jul21)** — **$15.00**
- EA2-5NU relay (PIC Programming Helper, Jun21) — **$3.00**
- VK2828U7G5LF GPS module (Advanced GPS Computer, Jun21) — **$25.00**
- MCP4251-502E/P (Advanced GPS Computer, Jun21) — **$3.00**
- pair of Signetics NE555Ns (Arcade Pong, Jun21) — **$12.50**
- **2.8-inch touchscreen LCD module (Lab Supply, May21)** — **$25.00**
- Spin FV-1 digital effects IC (Digital FX Unit, Apr21) — **$40.00**
- 15mΩ 3W SMD resistor (Battery Multi Logger / Arduino PSU, Feb21) — **$2.50**
- DS3231(M) real-time clock SMD IC (Battery Multi Logger, Feb21) — **$3.00**
- Pair of CSD18534 transistors (Electronic Wind Chimes, Feb21) — **$6.00**
- IPP80P03P4L04 (Dual Battery Lifesaver / Vintage Radio Supply, Dec20) — **$5.00**
- 16x2 LCD module (Digital RF Power Meter, Aug20) — **$7.50**
- WS2812 8x8 RGB LED matrix module (Ol' Timer II, Jul20) — **$15.00**
- MAX038 function generator IC (H-Field Transanalyser, May20) — **$25.00**
- MC1496P double-balanced mixer IC (H-Field Transanalyser, May20) — **$2.50**
- **AD8495 thermocouple interface (DIY Reflow Oven Controller, Apr20)** — **$12.50**
- Si8751AB 2.5kV isolated Mosfet driver IC (Charge Controller, Dec19) — **$5.00**
- I/O expander modules (Nov19):
  PCA9685 – **$6.00** ; PCF8574 – **$3.00** ; MCP23017 – **$3.00**
- SMD 1206 LEDs, packets of 10 unless stated otherwise (Xmas Ornaments, Nov20):
  yellow – **$0.70** ; amber – **$0.70** ; blue – **$0.70** ; cyan – **$1.00** ; pink (1 only) – **$0.20**
- ISD1820-based voice recorder / playback module (Junk Mail, Aug19) — **$4.00**
- 23LCV1024-I/P SRAM & MCP73831T (UHF Repeater, May19) — **$11.50**
- MCP1700 3.3V LDO regulator (suitable for USB M&K Adapator, Feb19) — **$1.50**
- 1nF 1% MKP (5mm) or ceramic capacitor (LC Meter, Jun18) — **$2.50**
- ESP-01 WiFi Module (El Cheapo Modules, Apr18) — **$5.00**
- WiFi Antennas with U.FL/IPX connectors (Water Tank Level Meter with WiFi, Feb18):
  5dBi – **$12.50** ; 2dBi (omnidirectional) – **$10.00**
- NRF24L01+PA+NA transceiver, SNA connector & antenna (El Cheapo, Jan18) — **$5.00**
- ERA-2SM+ MMIC & ADCH-80A+ choke (6GHz+ Frequency Counter, Oct17) — **$15.00**
- VS1053 Geeetech Arduino MP3 shield (Arduino Music Player, Jul17) — **$20.00**
- MAX7219 red LED controller boards (El Cheapo Modules, Jun17):
  8x8 SMD/DIP matrix display – **$5.00** ; 8-digit 7-segment display – **$7.50**
- AD9833 DDS modules (Apr17):
  gain control (DDS Signal Generator) – **$25.00** ; no gain control – **$15.00**
- microSD card adaptor (El Cheapo Modules, Jan17) — **$2.50**
- **DS3231 real-time clock module with mounting hardware** — **$7.50**
- CP2102 USB-UART bridge — **$5.00**

*Prices valid for month of magazine issue only. All prices in Australian dollars and include GST where applicable. # P&P prices are within Australia. Overseas? Place an order on our website for a quote.

PRINTED CIRCUIT BOARDS & CASE PIECES

For a complete list, go to siliconchip.com.au/Shop/8

PRINTED CIRCUIT BOARD TO SUIT PROJECT	DATE	PCB CODE	Price
DCC PROGRAMMER (INC. HEADERS)	OCT18	SC4716	$7.50
↳ WITHOUT HEADERS	OCT18	09107181	$5.00
GPS-SYNCHED FREQUENCY REFERENCE	NOV18	04107181	$7.50
LED CHRISTMAS TREE	NOV18	16107181	$5.00
DIGITAL INTERFACE MODULE	NOV18	16107182	$2.50
TINNITUS/INSOMNIA KILLER (JAYCAR VERSION)	NOV18	01110181	$5.00
↳ ALTRONICS VERSION	NOV18	01110182	$5.00
HIGH-SENSITIVITY MAGNETOMETER	DEC18	04101011	$12.50
USELESS BOX	DEC18	08111181	$7.50
FOUR-CHANNEL DC FAN & PUMP CONTROLLER	DEC18	05108181	$5.00
ATtiny816 DEVELOPMENT/BREAKOUT PCB	JAN19	24110181	$5.00
ISOLATED SERIAL LINK	JAN19	24107181	$5.00
DAB+/FM/AM RADIO	JAN19	06112181	$15.00
↳ CASE PIECES (CLEAR)	JAN19	SC4849	$.00
REMOTE CONTROL DIMMER MAIN PCB	FEB19	10111191	$10.00
↳ MOUNTING PLATE	FEB19	10111192	$10.00
↳ EXTENSION PCB	FEB19	10111193	$10.00
MOTION SENSING SWITCH (SMD) PCB	FEB19	05102191	$2.50
USB MOUSE AND KEYBOARD ADAPTOR PCB	FEB19	24311181	$5.00
LOW-NOISE STEREO PREAMP MAIN PCB	MAR19	01111119	$25.00
↳ INPUT SELECTOR PCB	MAR19	01111112	$15.00
↳ PUSHBUTTON PCB	MAR19	01111113	$5.00
DIODE CURVE PLOTTER	MAR19	04112181	$7.50
↳ UB3 LID (MATTE BLACK)	MAR19	SC4927	$5.00
FLIP-DOT (SET OF ALL FOUR PCBs)	APR19	SC4950	$17.50
↳ COIL PCB	APR19	19111181	$5.00
↳ PIXEL PCB (16 PIXELS)	APR19	19111182	$5.00
↳ FRAME PCB (8 FRAMES)	APR19	19111183	$5.00
↳ DRIVER PCB	APR19	19111184	$5.00
iCESTICK VGA ADAPTOR	APR19	02103191	$2.50
UHF DATA REPEATER	MAY19	15004191	$10.00
AMPLIFIER BRIDGE ADAPTOR	MAY19	01105191	$5.00
3.5-INCH LCD ADAPTOR FOR ARDUINO	MAY19	24111181	$5.00
DSP CROSSOVER (ALL PCBs – TWO DACs)	MAY19	SC5023	$40.00
↳ ADC PCB	MAY19	01106191	$7.50
↳ DAC PCB	MAY19	01106192	$7.50
↳ CPU PCB	MAY19	01106193	$5.00
↳ PSU PCB	MAY19	01106194	$7.50
↳ CONTROL PCB	MAY19	01106195	$5.00
↳ LCD ADAPTOR	MAY19	01106196	$2.50
STEERING WHEEL CONTROL IR ADAPTOR	JUN19	05105191	$5.00
GPS SPEEDO/CLOCK/VOLUME CONTROL	JUN19	01104191	$7.50
↳ CASE PIECES (MATTE BLACK)	JUN19	SC4987	$10.00
RF SIGNAL GENERATOR	JUN19	04106191	$15.00
RASPBERRY PI SPEECH SYNTHESIS/AUDIO	JUL19	01106191	$5.00
BATTERY ISOLATOR CONTROL PCB	JUL19	05106191	$7.50
↳ MOSFET PCB (2oz)	JUL19	05106192	$10.00
MICROMITE LCD BACKPACK V3	AUG19	07106191	$7.50
CAR RADIO DIMMER ADAPTOR	AUG19	05107191	$5.00
PSEUDO-RANDOM NUMBER GENERATOR	AUG19	16106191	$5.00
4DoF SIMULATION SEAT CONTROLLER PCB	SEP19	11109191	$7.50
↳ HIGH-CURRENT H-BRIDGE MOTOR DRIVER	SEP19	11109192	$2.50
MICROMITE EXPLORE-28 (4-LAYERS)	SEP19	07108191	$5.00
SIX INPUT AUDIO SELECTOR MAIN PCB	SEP19	01110191	$7.50
↳ PUSHBUTTON PCB	SEP19	01110192	$5.00
ULTRABRITE LED DRIVER	SEP19	16109191	$2.50
HIGH RESOLUTION AUDIO MILLIVOLTMETER	OCT19	04108191	$10.00
PRECISION AUDIO SIGNAL AMPLIFIER	OCT19	04107191	$5.00
SUPER-9 FM RADIO PCB SET	NOV19	06109181-5	$25.00
↳ CASE PIECES & DIAL	NOV19	SC5166	$25.00
TINY LED XMAS TREE (GREEN/RED/WHITE)	NOV19	16111191	$2.50
HIGH POWER LINEAR BENCH SUPPLY	NOV19	18111181	$10.00
↳ HEATSINK SPACER (BLACK)	NOV19	SC5168	$5.00
DIGITAL PANEL METER / USB DISPLAY	NOV19	18111182	$2.50
↳ ACRYLIC BEZEL (BLACK)	NOV19	SC5167	$2.50
UNIVERSAL BATTERY CHARGE CONTROLLER	DEC19	14107191	$10.00
BOOKSHELF SPEAKER PASSIVE CROSSOVER	JAN20	01101201	$10.00
↳ SUBWOOFER ACTIVE CROSSOVER	JAN20	01101202	$7.50
ARDUINO DCC BASE STATION	JAN20	09207181	$5.00
NUTUBE VALVE PREAMPLIFIER	JAN20	01112191	$10.00
TUNEABLE HF PREAMPLIFIER	JAN20	06110191	$2.50
4G REMOTE MONITORING STATION	FEB20	27111191	$5.00
LOW-DISTORTION DDS (SET OF 5 BOARDS)	FEB20	01106192-6	$20.00

PRINTED CIRCUIT BOARD TO SUIT PROJECT	DATE	PCB CODE	Price
NUTUBE GUITAR DISTORTION / OVERDRIVE PEDAL	MAR20	01102201	$7.50
THERMAL REGULATOR INTERFACE SHIELD	MAR20	21109181	$5.00
↳ PELTIER DRIVER SHIELD	MAR20	21109182	$5.00
DIY REFLOW OVEN CONTROLLER (SET OF 3 PCBS)	APR20	01106193/5/6	$12.50
7-BAND MONO EQUALISER	APR20	01104201	$7.50
↳ STEREO EQUALISER	APR20	01104202	$7.50
REFERENCE SIGNAL DISTRIBUTOR	APR20	CSE200103	$7.50
H-FIELD TRANSANALYSER	MAY20	06102201	$10.00
CAR ALTIMETER	MAY20	05105201	$5.00
RCL BOX RESISTOR BOARD	JUN20	04104201	$7.50
↳ CAPACITOR / INDUCTOR BOARD	JUN20	04104202	$7.50
ROADIES' TEST GENERATOR SMD VERSION	JUN20	01005201	$2.50
↳ THROUGH-HOLE VERSION	JUN20	01005202	$5.00
COLOUR MAXIMITE 2 PCB (BLUE)	JUL20	07107201	$10.00
↳ FRONT & REAR PANELS (BLACK)	JUL20	SC5500	$10.00
OL' TIMER II PCB (RED, BLUE OR BLACK)	JUL20	19104201	$5.00
↳ ACRYLIC CASE PIECES / SPACER (BLACK)	JUL20	SC5448	$7.50
IR REMOTE CONTROL ASSISTANT PCB (JAYCAR)	JUL20	15005201	$5.00
↳ ALTRONICS VERSION	JUL20	15005202	$5.00
USB SUPERCODEC	AUG20	01106201	$12.50
↳ BALANCED ATTENUATOR	NOV20	01106202	$7.50
SWITCHMODE 78XX REPLACEMENT	AUG20	18105201	$2.50
WIDEBAND DIGITAL RF POWER METER	AUG20	04106201	$5.00
ULTRASONIC CLEANER MAIN PCB	SEP20	04105201	$7.50
↳ FRONT PANEL	SEP20	04105202	$5.00
NIGHT KEEPER LIGHTHOUSE	SEP20	08110201	$5.00
SHIRT POCKET AUDIO OSCILLATOR	SEP20	01110201	$2.50
↳ 8-PIN ATtiny PROGRAMMING ADAPTOR	SEP20	01110202	$1.50
D1 MINI LCD WIFI BACKPACK	OCT20	24106121	$5.00
FLEXIBLE DIGITAL LIGHTING CONTROLLER SLAVE	OCT20	16110202	$20.00
↳ FRONT PANEL (BLACK)	OCT20	16110203	$20.00
LED XMAS ORNAMENTS	NOV20	16111191-9	$3.00
30 LED STACKABLE STAR	NOV20	16109201	$12.50
↳ RGB VERSION (BLACK)	NOV20	16109202	$12.50
DIGITAL LIGHTING MICROMITE MASTER	NOV20	16110201	$5.00
↳ CP2102 ADAPTOR	NOV20	16110204	$2.50
BATTERY VINTAGE RADIO POWER SUPPLY	DEC20	11111201	$7.50
DUAL BATTERY LIFESAVER	DEC20	11111202	$2.50
DIGITAL LIGHTING CONTROLLER LED SLAVE	DEC20	16110205	$5.00
BK1198 AM/FM/SW RADIO	JAN21	CSE200902A	$10.00
MINIHEART HEARTBEAT SIMULATOR	JAN21	01109201	$5.00
I'M BUSY GO AWAY (DOOR WARNING)	JAN21	16112201	$2.50
BATTERY MULTI LOGGER	FEB21	11106201	$5.00
ELECTRONIC WIND CHIMES	FEB21	23011201	$10.00
ARDUINO 0-14V POWER SUPPLY SHIELD	FEB21	18106201	$5.00
HIGH-CURRENT BATTERY BALANCER (4-LAYERS)	MAR21	14102211	$12.50
MINI ISOLATED SERIAL LINK	MAR21	24102211	$2.50
REFINED FULL-WAVE MOTOR SPEED CONTROLLER	APR21	10102211	$7.50
DIGITAL FX UNIT PCB (POTENTIOMETER-BASED)	APR21	01102211	$7.50
↳ SWITCH-BASED	APR21	01102212	$7.50
ARDUINO MIDI SHIELD	APR21	23101211	$5.00
↳ 8X8 TACTILE PUSHBUTTON SWITCH MATRIX	APR21	23101212	$10.00
HYBRID LAB POWER SUPPLY CONTROL PCB	MAY21	18104211	$10.00
↳ REGULATOR PCB	MAY21	18104212	$7.50
VARIAC MAINS VOLTAGE REGULATION	MAY21	10103211	$7.50
ADVANCED GPS COMPUTER	JUN21	05102211	$7.50
PIC PROGRAMMING HELPER 8-PIN PCB	JUN21	24106211	$5.00
↳ 8/14/20-PIN PCB	JUN21	24106212	$7.50
ARCADE MINI PONG	JUN21	08105211	$35.00
Si473x FM/AM/SW DIGITAL RADIO	JUL21	CSE210301C	$7.50
20A DC MOTOR SPEED CONTROLLER	JUL21	11006211	$7.50
MODEL RAILWAY LEVEL CROSSING	JUL21	09106211	$5.00
COLOUR MAXIMITE 2 GEN2 (4 LAYERS)	AUG21	07108211	$15.00
BATTERY MANAGER SWITCH MODULE	AUG21	11104211	$5.00
↳ I/O EXPANDER	AUG21	11104212	$2.50
NANO TV PONG	AUG21	08105212	$2.50
LINEAR MIDI KEYBOARD (8 KEYS)	AUG21	23101213	$5.00
TOUCHSCREEN DIGITAL PREAMP	SEP21	01103191	$12.50
↳ RIBBON CABLE / IR ADAPTOR	SEP21	01103192	$2.50
NEW PCBs			
2-/3-WAY ACTIVE CROSSOVER	**OCT21**	**01109211**	**$15.00**
TELE-COM INTERCOM	**OCT21**	**12110121**	**$30.00**
SMD TEST TWEEZERS (3 PCB SET)	**OCT21**	**04106211/2**	**$10.00**

We also sell an A2 Reactance Wallchart, RTV&H DVD, Vintage Radio DVD plus various books at siliconchip.com.au/Shop/3

SILICON CHIP

This is a preview of the October 2021 issue of SILICON CHIP.

For access to the full 112 pages of content in the magazine, purchase the issue at our website: **www.siliconchip.com.au**

Or take out an online subscription for access to the latest issues.

MARKET CENTRE

Advertise your product or services here in SILICON CHIP

FOR SALE

PMD Way

PMD WAY offers (almost) everything for the electronics enthusiast – with full warranty, technical support and free delivery worldwide.
Visit pmdway.com to get started.

Lazer Security
For Quality That Counts...

QUALITY LED PRODUCTS + MORE
Massive parts clearance sale, limited stock. Go to lazer.com.au

ASSORTED BOOKS FOR $5 EACH
Electronics and other related subjects – condition varies. Some books may have already been sold. Bulk discount available. All books can be viewed at: siliconchip.com.au/link/aawx

Email for a postage quote, quote photo numbers when referring to a book: silicon@siliconchip.com.au

FOR SALE

LEDsales
LEDs and accessories for the DIY enthusiast

LEDs, BRAND NAME AND GENERIC LEDs. Heatsinks, LED drivers, power supplies, LED ribbon, kits, components, hardware – www.ledsales.com.au

tronixlabs

TRONIXLABS PTY LTD would like to thank all of our customers for their support and feedback. For any enquiries or customer technical support, please email support@tronixlabs.com

PCB PRODUCTION

PCB MANUFACTURE: single to multi-layer. Bare board tested. One-offs to any quantity. 48 hour service. Artwork design. Excellent prices. Check out our specials: www.ldelectronics.com.au

KIT ASSEMBLY & REPAIR

VINTAGE RADIO REPAIRS: electrical mechanical fitter with 36 years experience and extensive knowledge of valve and transistor radios. Professional and reliable repairs. All workmanship guaranteed.
$17 inspection fee plus charges for parts and labour as required. Labour fees $38 p/h. Pensioner discounts available on application.
Contact Alan, VK2FALW on 0425 122 415 or email bigalradioshack@gmail.com

DAVE THOMPSON (the Serviceman from SILICON CHIP) is available to help you with kit assembly, project troubleshooting, general electronics and custom design work. No job too small. Based in Christchurch, NZ but service available Australia/NZ wide.
Email dave@davethompson.co.nz

KEITH RIPPON KIT ASSEMBLY & REPAIR:
* Australia & New Zealand;
* Small production runs.
Phone Keith: 0409 662 794
keith.rippon@gmail.com

ADVERTISING IN MARKET CENTRE

Classified Ad Rates: $32.00 for up to 20 words (punctuation not charged) plus $1.20 for each additional word. Display ads in Market Centre (minimum 2cm deep, maximum 10cm deep): $82.50 per column centimetre per insertion. All prices include GST. Closing date: 5 weeks prior to month of sale. To book, email the text to silicon@siliconchip.com.au and include your name, address & credit card details, or phone Glyn (02) 9939 3295 or 0431 792 293.

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles.

When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine.

Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

Advertisers are warned that they are responsible for the content of all advertisements and that they must conform to the Competition & Consumer Act 2010 or as subsequently amended and to any governmental regulations which are applicable.

Notes & Errata

Tapped Horn Subwoofer, September 2021: the Altronics C3088 driver specified for this design has been discontinued. Wagner Electronics (www.wagneronline.com.au) sell suitable alternatives: the SB Acoustics SB20PFC30-8 ($55) and SB20PFCR30-8 ($56.50). These cost less than the originally specified driver and give very similar performance. The only design change required is to increase the diameter of the driver hole from 180mm to 187mm.

Touchscreen Digital Preamplifier, September 2021: in the circuit diagram (Fig.6) on pages 42 & 43, the V_{DD} pins of IC6 and IC7 are incorrectly shown connected to +12V. They actually connect to +5.5V.

Battery Manager, August 2021: in Fig.3 on page 72, Q2 has been incorrectly drawn with a P-channel Mosfet symbol. It is an N-channel Mosfet, like Q1 and Q3. The gate, drain and source pins are marked correctly.

Bush VTR103 AM/FM radio, Vintage Radio, August 2021: in the circuit diagram (Fig.2) on pages 102 & 103, capacitor C11 should have been shown in series with L5, not L6. This means that C11 and L6 form a parallel resonant network, not series resonant as stated in the text. Also, the right-most label in the photo at the bottom of p100 is wrong. It is the VHF RF amplifier load coil, not the VHF antenna coil.

Single-Chip Silicon Labs FM/AM/SW Digital Radio Receiver, July 2021: the specified 3.3V regulator for REG2 (LM2936-3.3) has swapped input & output pins compared to the footprint on the PCB. So if you use this regulator, install it facing the opposite direction to that shown in Fig.5 on page 68, or mount it on the opposite side of the PCB but with the flat side facing as shown. Also note that its part code is incorrectly written as LP2936-3.3 in the circuit diagram, Fig.3, on page 67.

7-Band Stereo Equaliser, April 2020: an error has been found in the 7-Band Stereo Equaliser PCB (01104202 RevB). There is a missing track between the 10nF and 2.2nF capacitors above IC7 – they should be in parallel, but only one side of the pair is connected. This causes the second-highest band to operate at the wrong frequency. If you have a PCB with this error, solder a short length of wire (eg, a component lead off-cut) between those two pads. This error will be fixed with the RevC PCB.

CLASSiC DAC, February-May 2013: revised firmware for the DAC (0110213B.HEX) is available for download from our website. This fixes pushbutton debouncing problems and includes changes to the IR reception code to better reject noise. Also, some people have complained that one or more TOSLINK input LEDs light up when there is no signal present. This is usually fixed by adding 30pF ceramic capacitors across the empty pairs of pads near the TOSLINK receivers.

The November 2021 issue is due on sale in newsagents by Monday, October 25th. Expect postal delivery of subscription copies in Australia between October 25th and November 12th.

Advertising Index

"Rigol Offer Australia's Best Value Test Instruments"

Oscilloscopes

RIGOL DS-1000E Series

- 50MHz & 100MHz, 2 Ch
- 1GS/s Real Time Sampling
- USB Device, USB Host & PictBridge

FROM $429 ex GST

RIGOL DS-1000Z/E - FREE OPTIONS

- 50MHz to 100MHz, 4 Ch; 200MHz, 2CH
- 1GS/s Real Time Sampling
- 24Mpts Standard Memory Depth

FROM $649 ex GST

RIGOL MSO-5000 Series

- 70MHz to 350MHz, 2 Ch & 4Ch
- 8GS/s Real Time Sampling
- Up to 200Mpts Memory Depth

FROM $1,569 ex GST

Function/Arbitrary Function Generators

RIGOL DG-800 Series

- 10MHz to 35MHz
- 1 & 2 Output Channels
- 16Bit, 125MS/s, 2M Memory Depth

FROM $479 ex GST

RIGOL DG-1000Z Series

- 25MHz, 30MHz & 60MHz
- 2 Output Channels
- 160 In-Built Waveforms

FROM $725 ex GST

Multimeters

RIGOL DM-3058E

- 5 1/2 Digit
- 9 Functions
- USB & RS232

ONLY $789 ex GST

Power Supplies

RIGOL DP-832

- Triple Output 30V/3A & 5V/3A
- Large 3.5 inch TFT Display
- USB Device, USB Host, LAN & RS232

ONLY $749 ex GST

Spectrum Analysers

RIGOL DSA Series

- 500MHz to 7.5GHz
- RBW settable down to 10 Hz
- Optional Tracking Generator

FROM $1,321 ex GST

Real-Time Analysers

RIGOL RSA Series

- 1.5GHz to 6.5GHz
- Modes: Real Time, Swept, VSA & EMI
- Optional Tracking Generator

FROM $3,210 ex GST

Buy on-line at www.emona.com.au/rigol

Sydney
Tel 02 9519 3933
Fax 02 9550 1378

Melbourne
Tel 03 9889 0427
Fax 03 9889 0715

Brisbane
Tel 07 3392 7170
Fax 07 3848 9046

Adelaide
Tel 08 8363 5733
Fax 08 83635799

Perth
Tel 08 9361 4200
Fax 08 9361 4300

EMONA

email testinst@emona.com.au

web www.emona.com.au

WHAT IF THE WORLD'S DATA CONSUMPTION DIDN'T ALSO CONSUME MOST OF THE WORLD'S POWER?

Today's data centers can require as much power as a small city. And that demand limits what businesses and industries can achieve. But what if power were unlimited? ADI breakthroughs in power efficiency are helping unlock a future without limits to computing power.

Analog Devices. Where what if becomes what is.
See What If: analog.com/WhatIf

ANALOG DEVICES