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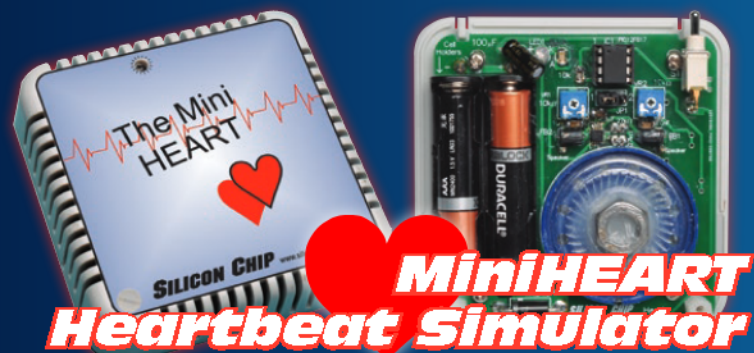
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**BASS BLACK
SUBWOOFER**



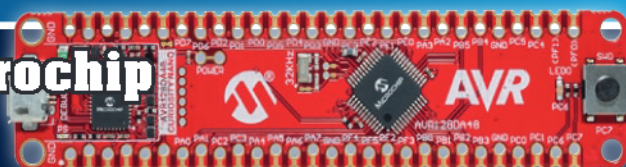
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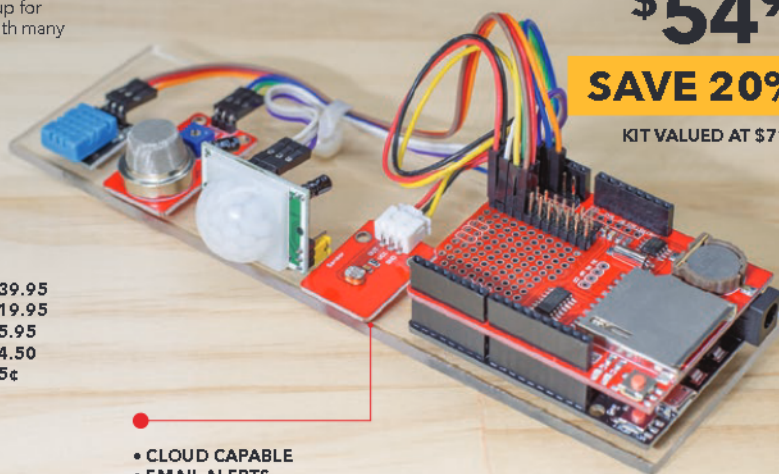
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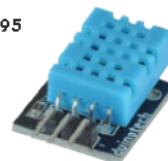
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Editorial Viewpoint



More articles than space – a good problem to have!

In the October 2020 issue, I wrote about wanting to publish a range of articles, including some of historical interest and others about the latest technology. This has created a bit of difficulty; while we have a good mixture of different articles, I am struggling to fit all this content into the magazine.

You might be wondering why I don't just print magazines with more pages. That is not as easy as it sounds.

For a start, our printing and mailing costs would go up, and given the general economic malaise caused by COVID-19, I am reluctant to increase our expenditures. Note that we have not increased the magazine cover price for more than seven years now – an unprecedented period in the magazine's history.

Another problem is that if I print magazines with more than 112 pages on our current paper stock, they might not fit into the binders that we sell. We also sometimes have problems with the centre sections tearing out in larger magazines. Printing on thinner paper would solve these problems, but result in worse print quality; something I am not keen on.

Another option is for me to reduce the number of constructional project articles in some issues.

Since taking over the magazine in August 2018, I have stuck faithfully to my predecessor's guideline of having four such articles in every issue. I think he was right that this strikes a good balance, but perhaps I should make the occasional exception and run three project articles in some months. That would allow us to include more feature articles. I think that makes sense, but I wonder what our readers would think of that.

The other option is to raise the cover price (which I am still trying to put off as long as possible) and then use the extra revenue to print larger magazines with more content. That's assuming we don't lose too many readers when the price goes up. But I still couldn't publish large issues too often, or we would run into the over-full binders problem I mentioned above.

That makes me think that perhaps dropping to three projects per issue from time to time is the best solution.

It also occurred to me that we could run some smaller, simpler projects (which I want to do anyway; again, trying to strike a balance) which will free up more space for feature articles. That's what we've done in this issue, running a clever little four-page project which allows us to have five features plus all our usual columns.

It's a good solution, but we can't always come up with shorter projects that are worth publishing and building (and what seems like a small project initially can often balloon into a major one!). One of the biggest problems with these simple projects is that often when someone has an idea, we have published something very similar before, and I don't want to keep re-ploughing the same ground.

If you have strong feelings one way or another about what I have written here, you are welcome to provide some feedback (eg, by sending an e-mail to silicon@siliconchip.com.au). That will help guide my decision-making when it comes to figuring out which articles to run in future issues, based on what our readers want.

Nicholas Vinen

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Odd GPO socket might be a phone socket

I would like to comment on the query in Ask SILICON CHIP, December 2020 on old electrical sockets, specifically, one with four flat pins (p107). I am wondering if it was actually a telephone socket, as he mentions it was in a small room (which could be a telephone room, for quietness and privacy).

There was an old plug and socket standard used for moving the telephone to another room before the more recent Telecom plugs and sockets, and the modern RJ11 modular sockets. It had two horizontal blades in the centre, with another horizontal blade below and a vertical blade on top.

I saw several of these in older homes in Adelaide in the 1950s when I started as a Trainee Technician.

Brian Dunn,
Old Noarlunga, SA.
John Hunter, the author of the Sep-

tember 2020 article on the history of GPOs, replies: That plug was used where telephones were wired as a portable service.

Usually, the phone was connected permanently via a terminal block. It was used on the Bakelite 300 and 400 series telephones, until the 1960s, when the 'modern' AWA-developed six-pin plug came into being for the new 800-series telephones.

Tiny Xmas Tree shines on 12 months later

The Tiny Xmas Trees I built from the project in last year's SILICON CHIP magazine (November 2019; siliconchip.com.au/Article/12086) are still shedding light and bringing joy to the world. The colours progressively dropped out as the battery voltage fell, but the red LEDs are still going.

Most Xmas novelties don't last till January, so my mobile of four trees is doing very well. A new set of batter-

ies and we're ready for Christmas and hopefully a better New Year!

Dave Dobeson,
Berowra Heights, NSW.

Fluke DMM repair strikes home

I have just read, with great interest, about the repair of a Fluke model 77 DMM in the Serviceman's Log, December 2020.

I own a model 75 instrument, also purchased in the early 1980s, and I had to replace the fusible resistor about 25 years ago after making a mistake using the meter. At that time, Philips was the local agent for Fluke in NZ, and I was able to buy a replacement from their trade store (Philips disappeared shortly after).

I was not even aware that the DMM also incorporated two spark gaps until I read the article; a hasty check confirmed that mine are still intact – whew!

These DMMs are a model of good design and construction and definitely precede the 'throw-away' era.

Trevor Woods,
Auckland, NZ

From crystal sets to GPS

Nicholas Vinen's editorial in the October 2020 issue struck a chord with me, and prompted a reflection on my involvement in the electronics hobby over the last 65 years or so. When the October 2020 issue of SILICON CHIP arrived in the mail, I was deeply immersed in the resuscitation of an HP5100 frequency synthesiser.

This 1964-vintage piece of test equipment is the archetypical boat anchor – one of the largest and heaviest units produced by Hewlett Packard – and is breathtakingly involved in its design and construction.

Editor's note: see Serviceman's Log starting on p61 for Rob's repair story.

The Editor pointed out that he wanted to preserve a fresh and dynamic

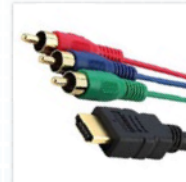


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Automotive Electronics

Part II - ECM Types

by Dr David Maddison

Last month, we provided an overview of how automotive electronic control modules (ECMs) work, described how they communicate and listed some of the many types used. We also described the operation of the engine control unit (ECU) in detail. Now we'll concentrate on the other ECM types found in modern vehicles.

There are very many electronic control modules we could describe; probably enough to fill the magazine! So we have selected the following few as representative and diverse systems.

Airbag control module (ACM)

Airbags use MEMS devices to determine if a severe impact has occurred and activate pyrotechnic devices to generate gas to fill the airbags (*Fig.28*). The ACM usually contains capacitors to store power during a crash in case vehicle power is lost.

ACMs store data about the crash that caused them to activate such as speed, throttle setting, brake application, seat belt usage and other data at the time of impact.

The ACM uses data such as seat occupancy, occupant weight and crash severity to determine whether to inflate airbags, which airbags to inflate, when to inflate them and how rapidly to inflate them.

We published an in-depth article on airbag systems in our November 2016 issue (siliconchip.com.au/Article/10424).

In the event that a car is repaired after airbag activation, the ACM has to be either replaced or reset via hardware and/or software means.

Some models can be reused a limited number of times;

others must be replaced. For details on how data can be extracted from an ACM, see the video and instructions at siliconchip.com.au/link/ab4k. Also see the video titled "KIA

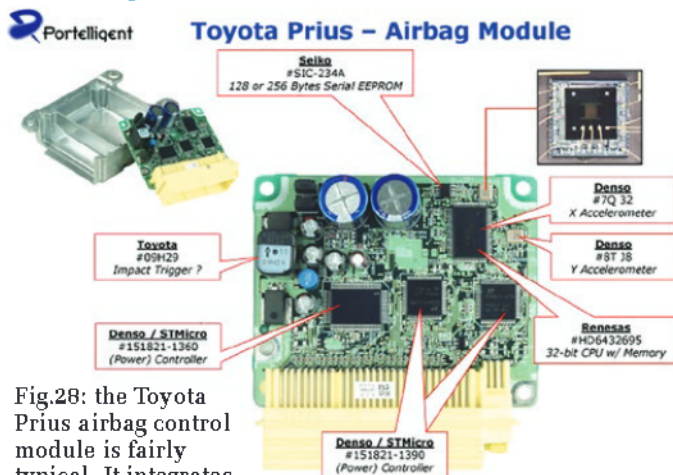


Fig.28: the Toyota Prius airbag control module is fairly typical. It integrates sensors to detect an impact with a processor to determine which airbags to fire, and components to send pulses to the airbag(s) to trigger them. The large capacitors allow it to continue operating for some time, even if the vehicle wiring or battery is damaged by the impact.

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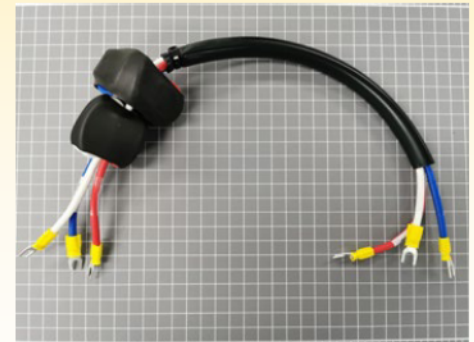
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E-Z-2-Build Digital AM/FM/SW Receiver

Our DAB+/FM/AM Radio from 2019 is very capable and has been extremely popular. But it is somewhat complicated and costly to build. Not this one, though! It uses the BK1198 digital radio chip which is cheap and readily available, and requires only a handful of discrete components to work. The resulting radio covers the AM and FM broadcast bands plus shortwave from 2.7 to 22MHz.

by Charles Kosina

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"Hands On" Review by Tim Blythman

ALTIUM 365 and *Altium*21 *Designer*



Altium Designer, which we use to design PCBs and draft circuits, can trace its history back over 30 years to the Australian-designed Protel PCB software. With design complexity increasing, collaboration is becoming even more critical, and this is what Altium 365 aims to achieve. We also have a brief overview of some new features in AD21.

As part of our review of Altium Designer 20 in December 2019 (siliconchip.com.au/Article/12176), we attended the "Altium Roadshow", which is only one of many events held for Altium subscribers. They also regularly hold 'webinars' and other online information and education sessions.

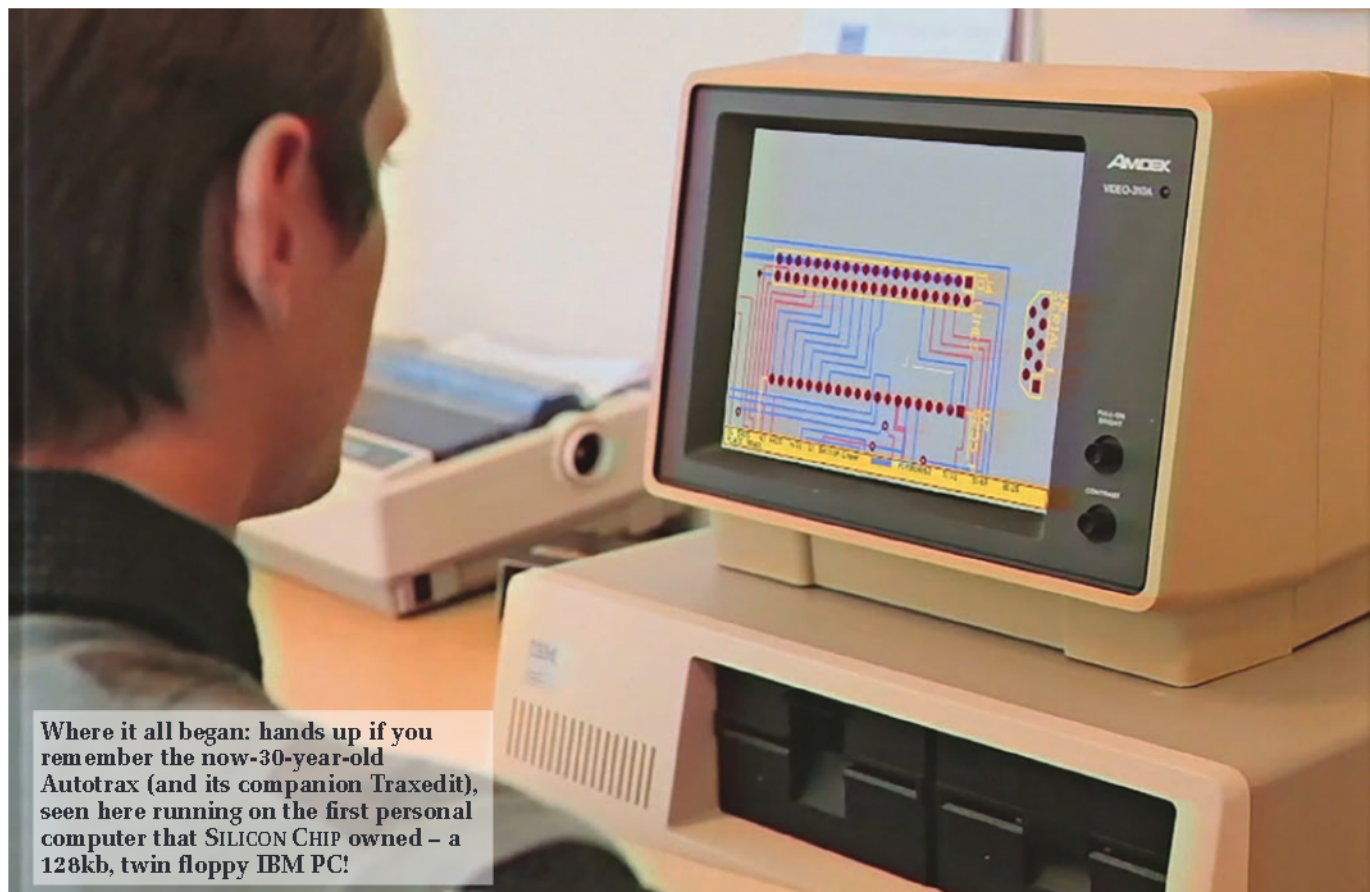
As we noted in that review, many people are still using versions of Altium Designer as old as version 14. But us-

ers who want to make full use of Altium 365 will need to run Altium Designer 20 or later.

Altium 365

You might have seen a glimpse of Altium 365 in our April 2020 Product Showcase (siliconchip.com.au/Article/13816).

That short piece hinted that Altium 365 is pitched at those



with no CAD tools or experience, but this is far from the full story.

Altium 365 (of which Altium 365 Viewer is only a small part) is a cloud-based companion to Altium Designer and provides tools and features which, we think, will be useful to many people.

In our review of Altium Designer 20, we noted that being such a small team, we are not sure how we would make use of the cloud features of Altium 365. Most of our PCBs are planned, designed, built and tested by one or two people.

With working from home now more common, we decided to look more closely at Altium 365's features for those occasions when feedback or collaboration are needed. It turns out that it has other features that are very useful to us too. In fact, many people who have never used Altium Designer could make good use of Altium 365.

There are four different ways of working with Altium 365.

Altium 365 Viewer

At its simplest level, Altium Viewer allows designs (circuits, PCB etc) to be viewed in a web browser by anyone – see Screen1. You don't need an Altium subscription or even an Altium Live registration.

The Viewer is found at www.altium.com/viewer/. You can go there right now, click on "View Example Project" and get a pretty good idea of what it can do.

Altium Viewer allows several CAD and CAM formats to be uploaded and viewed; not just Altium Designer files. For example, Altium Viewer supports loading and viewing EAGLE designs, and support for KiCad files is planned.



Screen1: even if you don't have an Altium Live account, you can use Altium 365's Viewer. It can handle several CAD formats and provides a similar view and interface to Altium Designer.



The Viewer is similar to the one built into Altium Designer. You can click on items to see properties and even render and navigate a 3D view of the PCB or assembly.

The Viewer can be embedded in an external webpage (for example, on your own website), with configurable features such as a variety of export

formats.

Naturally, you can't edit files using the Viewer. The Viewer also lacks the collaborative features of Altium 365.

Altium 365 Basic

To use Altium 365 Basic, you need to register on the Altium Live website. The process here is similar to most online services; your account is linked to an email address.

If you are currently using Altium Designer, then you most likely have an Altium Live registration already and use it for your Altium license.

If you have an Altium subscription, then you can also make use of the Standard version of Altium 365, which includes integration with Altium Designer.

To access these services, you need to go to <http://365.altium.com/> and log in to your Altium Live account.

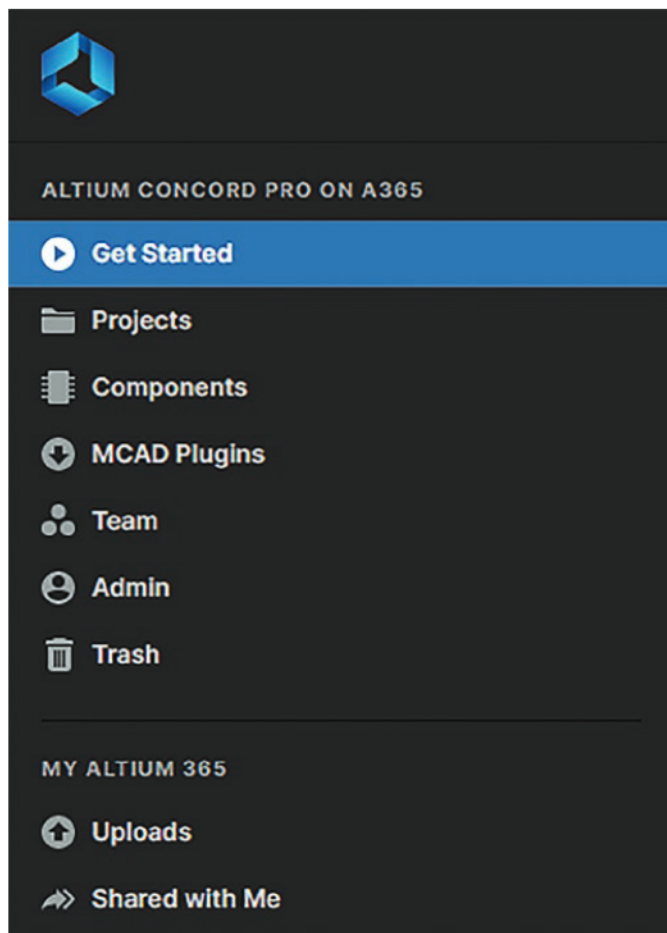
Apart from the Viewer, Altium 365 is based around the concept of "Workspaces", which are typically tied to an Altium Licence and thus a specific organisation. The easiest way of getting access to a particular Workspace (and also easily set up an Altium Live login) is to be invited by someone who has access to that Workspace.

An invitation sends an email which will also prompt for information to complete the registration process, if that has not already happened. After that, you'll be taken to the Workspace.

Altium 365 Basic is intended for those users who don't



Screen2: the Projects view in the web portal shows a preview of each project and a brief summary, including information about recent changes. Clicking on any project allows it to be viewed, with a similar interface to Altium Designer.

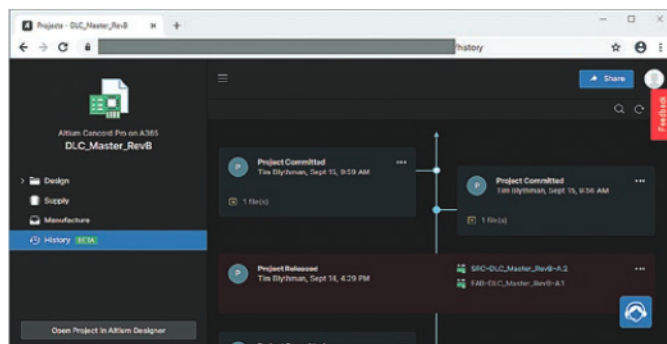


The Basic version of Altium 365 provides these menu options for managing your workspace. It's all very intuitive to navigate and work with.

have an Altium subscription and don't use Altium Designer, but work closely with those who do.

For example, inside our small organisation, the staff members who lay out our articles do not need to use Altium Designer, but could benefit from being able to view and comment on designs, or even render specific views of a PCB for publication.

One of the apparent benefits is being able to share information with those outside your organisation, such as PCB manufacturers and assemblers.



Screen3: the History feature in the web portal shows a summary of changes to a project, and is a visual guide to the version control, such as edits and releases and who made them. The three-dot buttons in the corner of each panel allow a snapshot to be downloaded or cloned.

With external parties, it is often desirable to carefully control the way that designs are shared, especially in fields where 'intellectual property' is tightly guarded.

Rather than having to import a file, the cloud nature of Altium 365 allows projects to be stored and managed online (see Screen2). Typically, a project will be uploaded by someone using Altium Designer.

Once a project is opened, the window appears very similar to the Viewer, but with more options, including a function to open it in Altium Designer.

Many different views are available in Altium 365 Basic, besides those which are available in Altium Designer. For example, Project History provides a graphical, chronological view of changes that have occurred in a project (as shown in Screen3).

Altium 365 Standard

Effectively, Altium 365 Standard is available for all Altium Designer 20 users who have a current subscription. It is well integrated into AD20. Apart from logging in to use your license, you just need to activate the Workspace within Altium Designer.

Indeed, this is probably the best way to make use of it. To start using Altium 365, click on the cloud icon at upper right and click on the Workspace, which will connect Altium Designer to the Workspace (Screen4).

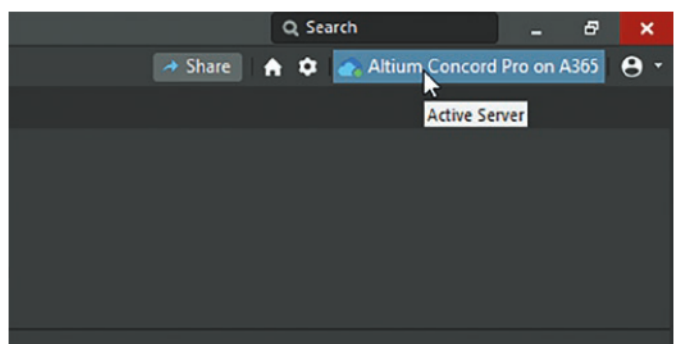
While Altium 365 Basic allows Altium Designer files to be viewed online, Altium 365 Standard also provides the option to make files available online.

Unlike other cloud solutions where the files are simply stored elsewhere, a formal version control system (based on the widely used open-source VCS Git) keeps synchronised copies (and backups) both locally and remotely.

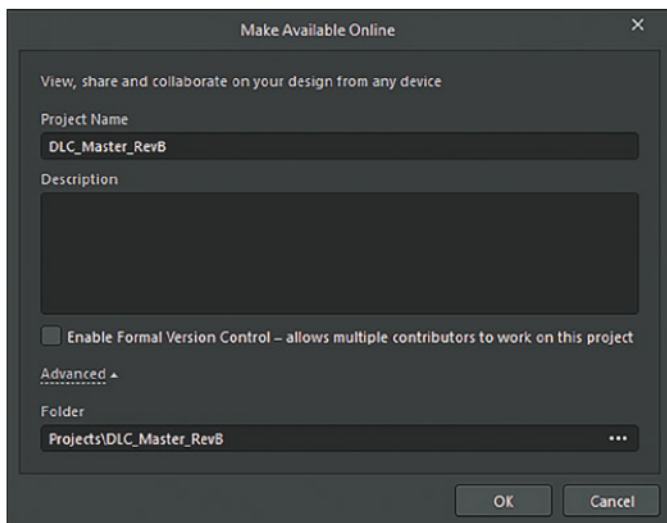
This means that, for example, others who have access to your Workspace can not only see the current version of the design but can also go back and look at how it evolved, who made what changes, and even 'undo' mistaken edits.

To use these features, from the Projects Panel, right-click the project name and click the "Make Project Available Online..." option. A dialog box appears, allowing some properties to be set (Screen5). Set the option to Enable Formal Version Control unless you have your own version control system in place.

After this, the project moves to the Altium 365 workspace. Some extra status icons appear in the Projects Panel relating to the version control. Some more menu options



Screen4: the small cloud icon in the top right corner of Altium Designer can be used to connect to your company's Workspace and thus Altium 365. Our Workspace is named Concord Pro, reflecting that Altium 365 is a progression of the older Concord platform.



Screen5: connecting Altium Designer to Workspace on Altium 365 adds the option of making projects available online and can provide version control, which is recommended unless you use your own internal version control.

relating to version control appear too (see Screen6).

Updating the 'cloud' version of your project is as simple as saving it, then using the Version Control menu to commit the file or project. If you don't save, you are prompted to do so, ensuring this happens when needed.

At this stage, the files are available in the cloud, but are not necessarily visible to other users in the Workspace. By default, they are not visible to anyone except administrators and the person who uploaded them. This aspect is carefully controlled so that you can limit who can view and edit your files.

These features are even handy for people working solo, as they now have access to cloud-backed versions of their designs. It's useful as a backup if nothing else.

Sharing projects with other people can be done with varying degrees of granularity. There are options to provide view-only or full (edit) access, as well as being able to set up groups of people to streamline this process (see Screen7). Once designs have been shared like this, users with Basic access can view the designs.

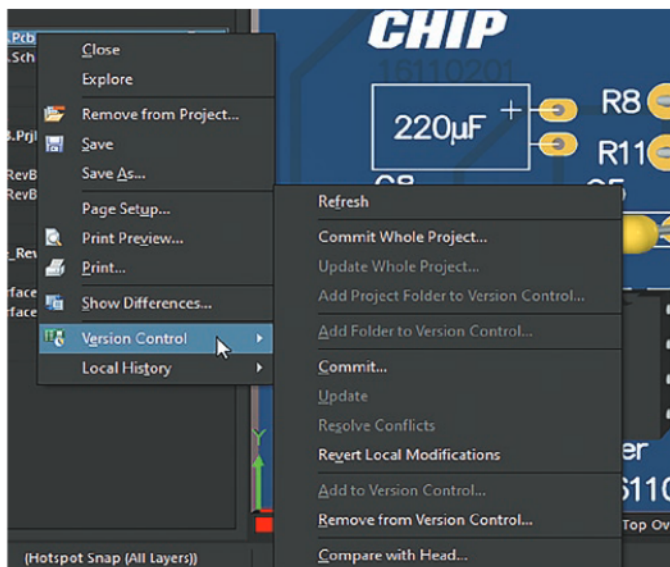
One useful collaborative feature is the ability to place comments on the designs. Comments can be applied to schematics (circuit diagrams) or PCB files, and can be viewed and edited through both Altium Designer and the Altium 365 Basic portal. This streamlines communication between those who have access to Altium Designer and those who do not.

Once the issue has been resolved, the comment can be marked as such and it disappears, so as not to clutter the display.

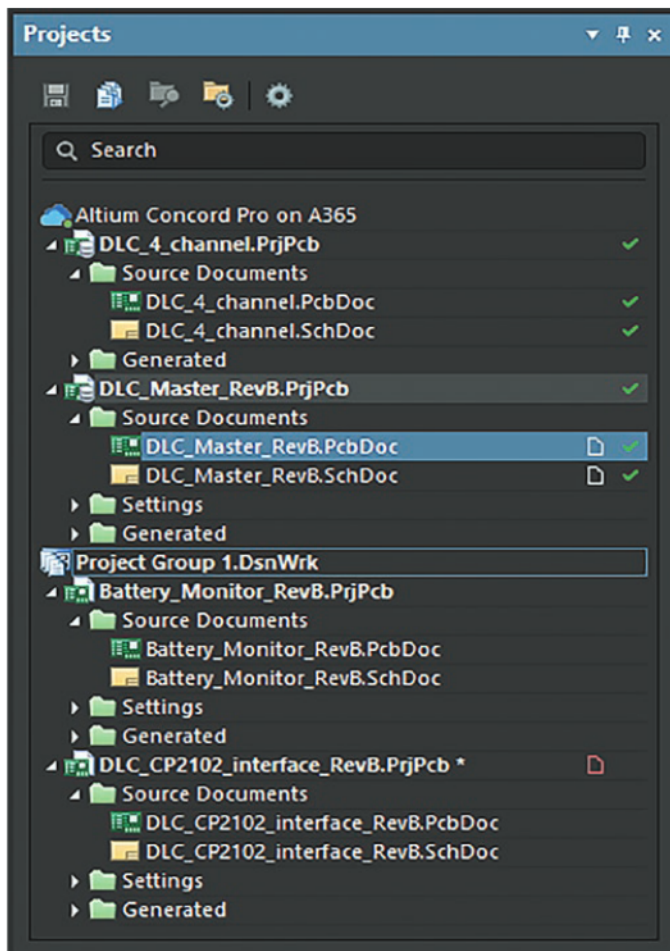
Once a PCB design is complete, the design goes through a 'release' process, which produces an output job (for example, creating Gerber files). After this, the Manufacture section is populated with the output files, which can also be viewed through the web portal.

Sharing

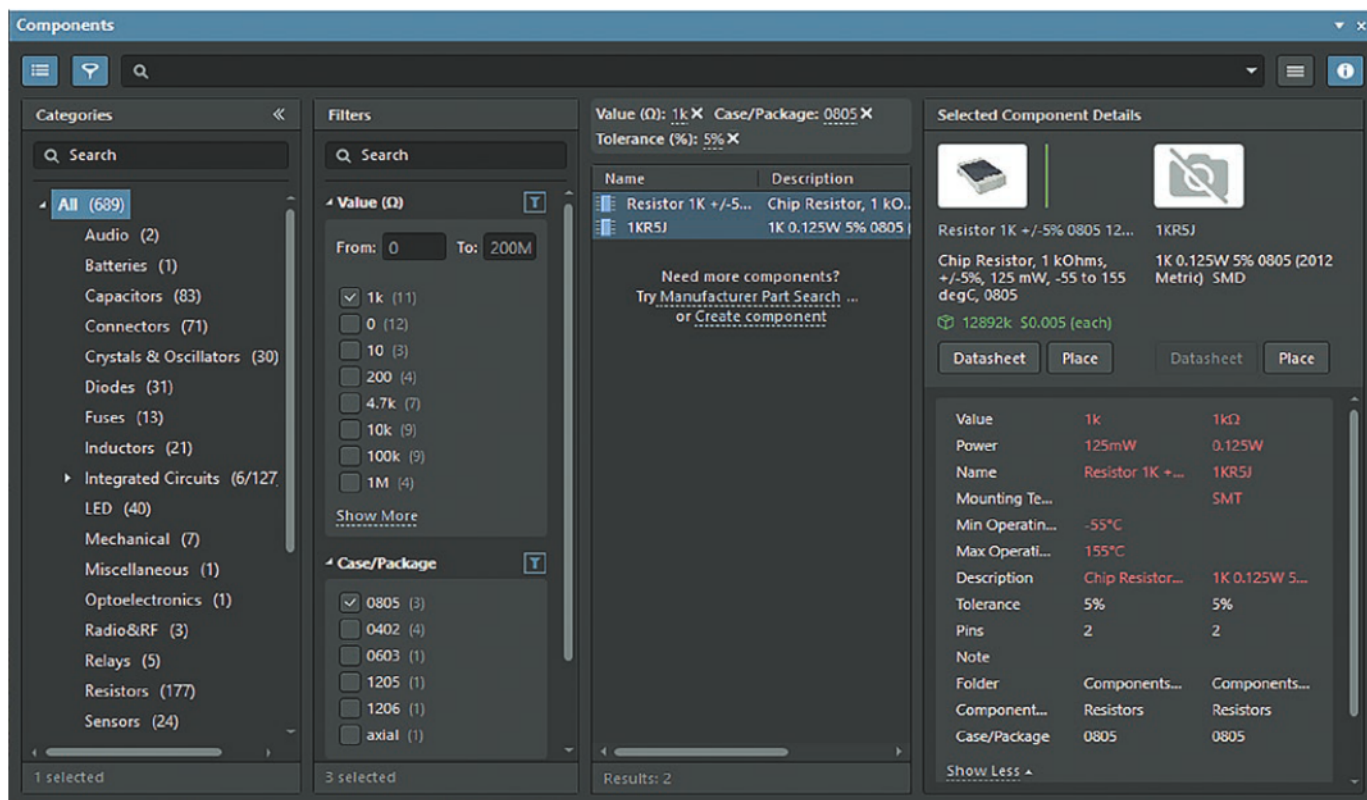
As well as integrating with those people who are working



Screen6: joining a workspace and enabling version control adds numerous options to the Projects panel. Simply committing the project will prompt for any other actions that need to be done before the project is synchronised and up to date.



Screen7: when connected to a workspace, new icons appear that reflect the state of the project, including whether it is correctly synchronised with the online version control. Pushing changes into shared projects is as simple as right-clicking and choosing the correct option; you will be prompted to save if necessary.



Screen8: the component search window provides many fields, including some optimised for specific component types. Parts can be compared, including live information like supplier stock levels and prices.

on files using Altium 365 Basic, it's also possible to share designs with people who don't. In this case, the recipient is sent a link, and the file is made available through the Altium 365 Viewer interface.

Either a generic link can be generated (making the file available to anyone who has the link), or the link can be sent directly to a specific person, which also makes it possible for that person to comment. The links expire after 48 hours.

Components

Managing component and part libraries is also integrated into Altium 365. This makes it easy to monitor component designs, check that they are consistent and current, and manage their life cycle.

Once logged in to the Altium 365 workspace in Altium Designer, you have access to the Workspace's shared component library (see Screen8). This is accessible through the web portal (Altium 365 Basic) too. The Library Migrator menu item under File menu can be used to import a local library into Altium 365.

This shared component library is one of the most useful features for us, so once one member of the team has created a component symbol and footprint, anyone can use it from then on.

Mechanical integration

Altium 365 Standard also offers tools relating to managing workflows. The MCAD Plugins option offers interfaces to Solidworks, Autodesk Inventor and PTC Creo. More similar options might become available in the future. This allows people working on aspects of the mechanical design or even marketing to be involved without requiring a full Altium license.

Our review of Altium Designer 20 covered some of the handy mechanical design features that are now available. Beyond being able to view and import mechanical designs in, say, Solidworks, it's possible to make edits to the mechanical design and push those changes back to Altium Designer.

Changes need to be effected within Altium Designer and saved back into the cloud; these changes can then be checked from within Solidworks. Unfortunately, we don't use any of these tools, so we weren't able to test these features out.

Altium 365 Pro

The kind folks at Altium also allowed us to try an evaluation version of Altium 365 Pro. This works similarly to Altium 365 Standard, integrating Altium Designer 20 with the cloud portal, but offers more features.

If you have used Altium Concord Pro or Vault, then you might be familiar with some of the features of Altium 365 Pro.

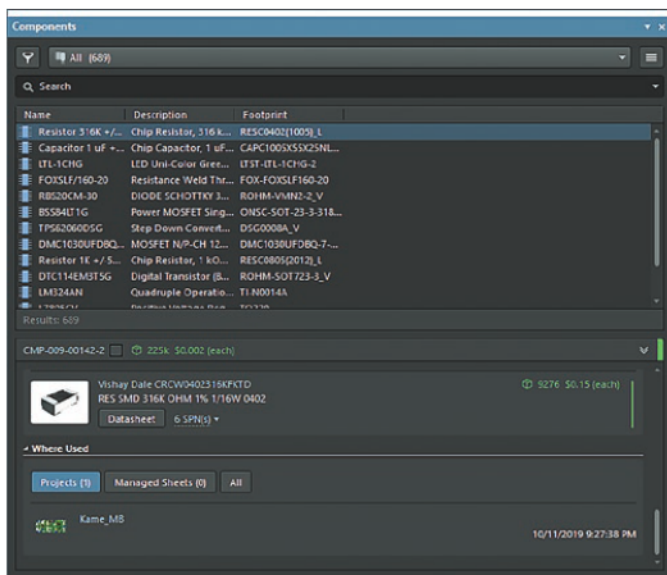
Component management

A significant feature of Altium 365 Pro is component management, which goes beyond what is available in the Standard version.

These features are available through the Properties panel and the Components panel.

Much of what Altium 365 can do with components is drawn from the Octopart database (<https://octopart.com/>) which is operated by Altium.

Octopart aggregates supplier and manufacturer data, which is accessed seamlessly through Altium 365. Altium 365 Pro can also draw on other supply chain information



Screen9: the Components panel now shows (at the bottom) information about which projects appears (Where Used). This can help streamline component changes and replacements by flagging which projects might need to be changed as a consequence of a component change.

providers, such as IHS Markit. There's even the option of customising the progression of the component lifecycle through its various transitions. This can be viewed through the web portal, but can only be set through Altium Designer 20, once it has connected with an Altium 365 Pro workspace.

With all libraries and projects connected through the cloud platform, other features become possible. For example, the Component Panel now features a "Where Used" section (Screen9).

When a part is selected, this section displays the projects which use a given component.

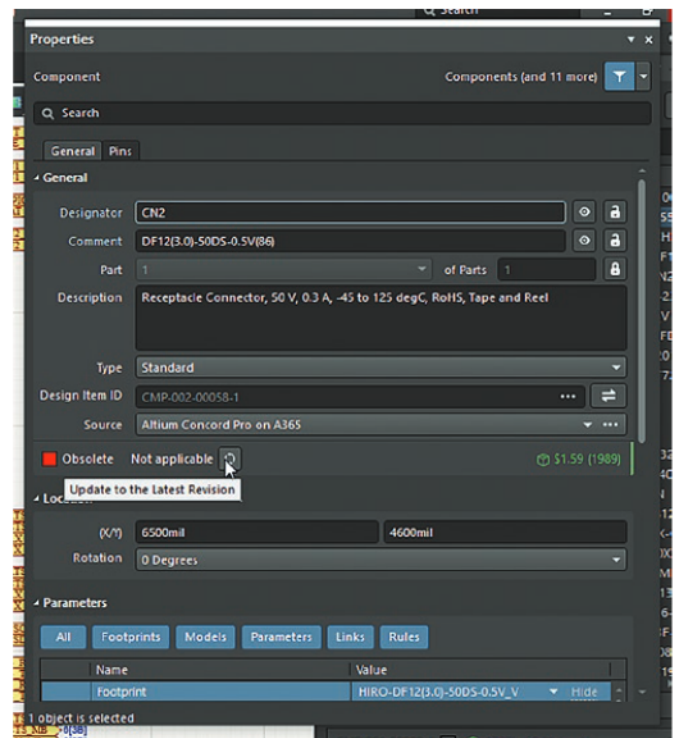
This provides an easy way to deal with part obsolescence or manufacturing problems with a particular component. When a part needs to be replaced or altered, Where Used can quickly identify the affected projects and allow them to be adjusted as necessary (Screen10).

This might involve creating a new version of the part, perhaps with a different footprint to correct a manufacturing issue. Or a new part can be substituted once an old part is unavailable. Changes to projects can be tagged with the reason for the change under version control, providing traceability.

Component templates

Another feature that Altium 365 Pro includes is Component Templates, which are templates for common components such as resistors. The principle is that a circuit can be laid out using template components, which have only the minimum necessary information attached (for example, resistance).

This prevents the schematic design from being bogged down with needing information that is not necessary at that stage. The other parameters can be configured later.



Screen10: Altium 365's component management makes it easier to deal with obsolete parts by flagging the component state and allowing parts to be updated as needed.

For example, a resistor can be set to require composition, current rating, diameter or lead pitch (amongst others) or none of these at all. Default values can be set too.

Templates are set up with sample data in the Altium 365 Pro workspace, so these can be used immediately.

Like some of the other Pro features, this appears to be aimed at larger teams, where one team member might be responsible for drawing the circuit, and another can work independently on choosing the correct parts to use.

Parts Requests

Another feature which is handy for larger teams, especially those that may have dedicated staff for maintaining component libraries, is Parts Request. As the name suggests, a user can request a part to be created and added to the Library.

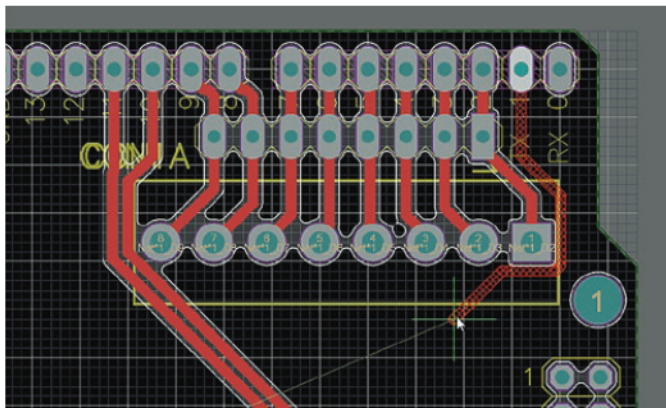
There are fields for manufacturer part number, request state, component type, date required and room to add attachments (for example, data sheets) and notes.

The act of assigning the task triggers an email to the necessary person to initiate the process. This is done through the web portal, so can be initiated by anyone with an Altium Live login.

Teams

Altium 365 Pro also offers the option to customise and tailor people's roles (and their capabilities) via team management. Larger organisations might need to create fine-grained permissions, especially if there are similar roles within different projects, requiring differing policies.

A simplified version of the Teams option exists within the Standard version of Altium 365 Standard, with a limited number of roles available.



Screen11: this feature was already available in Altium Designer 20, but we only just found out about it! A keypress (CTRL-W) will show you clearance outlines during interactive routing. Note how the gaps between the pins at lower-right are completely pinched off (but might open up if a narrower track is chosen). No more guessing whether or not a track will fit!

Cost

Altium has a simple price model for Altium 365 Pro. It is \$500 per year for each 'seat' that you have for Altium Designer. It can only be applied to all seats within a given license.

Note that you could have more people than seats; the seat number sets the maximum number of people that can use the software simultaneously.

There are servers located around the globe. Currently, Australian clients connect to a server in Singapore, although that might change in the future.

We think that most Altium users could benefit from using Altium 365 Pro, but those who will get the most out of it will be larger organisations, who have the most to gain from the Pro features.

Working from home

Now with many people working from home (indeed, I'm writing this at home), a state of affairs that could continue for a while (or perhaps indefinitely), using tools like Altium 365 to keep teams working smoothly together makes a lot of sense.

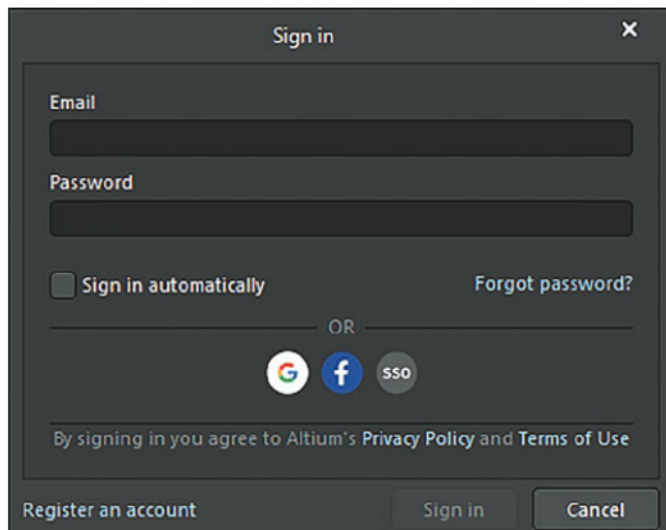
Even in our small team, we found that using Altium 365 was quicker and easier than trying to package and email projects or use a shared drive; the web interface works as intuitively as Altium Designer and the integration between the two is excellent.

We are in the process of moving our library into the shared library in our Altium 365 workspace. That will allow us to synchronise added parts more smoothly than when we were working in the same office!

Altium Designer 21

Many of the changes in Altium Designer 20 were intended to smooth the way for new features to appear in future releases. Some of these new features make an appearance in Altium Designer 21.

One such feature is dynamic polygons. Instead of having to repour polygons (large copper areas) manually, the PCB editor will do it as needed.



Screen12: another new feature of Altium Designer 21 is single sign-on (SSO) support to streamline users logging in. This allows people to use their usual company credentials to log in to an existing Altium Live account (giving access to the company license to use the software)

This might sound like a minor feature, but it will certainly make working on large PCBs with ground and power planes less of a hassle.

Interactive routing will also check for signal integrity whilst routing is occurring. This is handy for those working with differential pairs and other high-speed designs. Around 50% of Altium users work on designs operating at or above 1GHz, and they stand to benefit the most from this feature.

Also, length tuning options now include trombone and sawtooth patterns.

Altium Designer 20 introduced an improved simulation engine, and AD21 makes better use of it. There is now a Simulation Dashboard which operates somewhat like a software wizard, stepping through the stages needed to set up and run simulations. AD21 also has a generic simulator library for many standard component types.

Design Rules

AD21 can define design rules on a per-object basis, and objects have rules as characteristics. This is in addition to the existing Design Rules window and can be found by switching to Document view or by adding a Design Rule to a selected object.

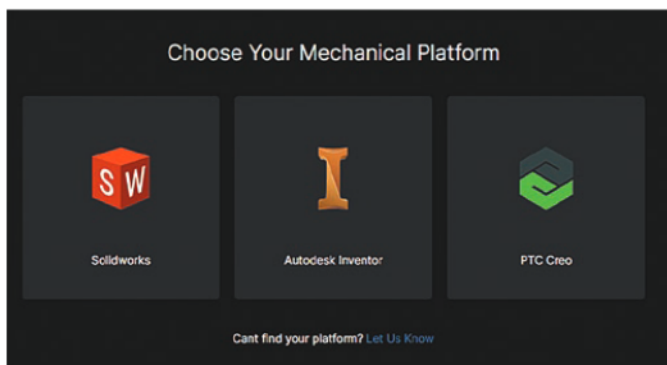
Flex PCBs

Support for flexible (and mixed rigid/flex) PCBs continues to improve. It's still a bit more expensive to get these made than standard, rigid fibreglass PCBs, but Altium and many manufacturers are embracing the possibilities.

With AD21, it is possible to add more complex bends to flexible PCB designs and then animate these in the 3D view (using the '5' key shortcut).

This is a great aid to visualising that flexible designs are correct. These different views can be captured and used in the Draftsman drawing creator to help others to understand the intended product.

As we've heard Altium say before, this continuous improvement is necessary for them to stay competitive. We



Altium 365 currently integrates with three different mechanical CAD platforms. Changes can be made in MCAD and pushed back to Altium, for example if the mechanical team need to make changes to the board shape or mounting holes.

look forward to using these new features.

Another useful feature

While investigating AD21, we also discovered some useful features introduced in AD20 that we didn't know about. During interactive routing, it is possible to display clearance boundaries (CTRL-W key shortcut or as an option while routing is paused with TAB) – see Screen11.

Summary

Altium 365 strikes a good balance for a cloud platform. The usual criticism is of losing control of one's files, but Altium's version control ensures that both local and cloud copies are synchronised and backed up. Indeed, simply having an automatic online backup of your local files is a handy feature.

Many of the useful cloud features are available for free with the Viewer and Basic platforms, or at no extra cost (beyond licensing Altium Designer) for the Standard platform.

For securely sharing (and keeping copies) of files and projects, the experience is quite seamless.

We'll definitely make good use of the shared component library, as this is one aspect of PCB design that can quickly become fragmented even within a small team. A single, shared library will be much easier to maintain, and will ensure that a consistent style is maintained between our designs.

It will also mean that if one of us discovers an error and fixes it, it will be fixed for us all.

With it becoming easier to import components from online sources, we expect to spend less time creating and managing components in the future.

For those who don't have an Altium licence, it's now possible to try out many of its features at no cost with Altium 365 Viewer.

We definitely recommend that anyone that uses Altium Designer have a look at Altium 365, given that they can take advantage of the features of the Standard version at no additional cost.

A good way to start is to join one of the frequent webinars that are available to Altium license holders. For more information, visit <http://365.altium.com/>

Thanks to Altium for providing us with a trial of Altium 365 Pro for our review.

SC



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Easy to use wind speed sensor up 60m/sec with 0 to 10VDC signal output and 1.5 meter cable.

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THE MiniHEART:

A Miniature Heartbeat Simulator

Give a favourite soft toy a beating heart! With both soft sound and a real beat, it could relax a baby, puppy or kitten for sleeping, or even help you sleep better yourself. All are possible with the SILICON CHIP MiniHEART!

Many newborns – human babies as well as pets – are unsettled when left alone to sleep. They miss their mum, and it's lonely and frightening for them. Just being able to cuddle up to the sound of a heartbeat can help with their anxiety.

The MiniHeart is a small gizmo that produces a low-level soothing heartbeat sound, mimicking that of a real heart.

The beat rate can be adjusted so that it more accurately matches the rate of the heart it is to emulate, while a timer will shut off the heartbeat after a set time.

The unit is switched on and off with a toggle switch with the actuating lever only protruding slightly outside the box. This is to prevent any injury to a baby. It is fully enclosed into a

plastic case that clips together, and we have added extra screw supports to make sure it stays shut. That way, the two internal AAA cells will not be easily accessed to cause a choking hazard.

We recommend enclosing the device into a cloth bag that is sewn or zippered shut. That provides an extra margin of choke hazard safety which is necessary when used with a baby.

We should point out that the simulated heartbeat is not a loud sound – it is not meant to be.

It is more like the subtle sound of a real beating heart; it needs to be placed close to the ear, and is felt more than heard. Think of it as a tiny heart, but in a rounded rectangular prism shape.

A loud heartbeat sound would require a large loudspeaker properly baffled to produce bass along with an amplifier with a reasonable amount of power.

Neither of these are a feature of the MiniHeart (but could be added externally).

Heart sounds

When listening to a heartbeat, you will hear two distinct, separate sounds, often called a “lub” and a “dub”.

These two sounds are produced by the closing of heart valves required to pump blood efficiently.

You've almost certainly seen the classic heartbeat waveform as shown on an electrocardiogram (ECG).

These are the electrical signals sent to the heart muscles, and when monitored with electrodes on the skin, are

useful for diagnosing heart problems.

Electrode readings do not represent the sounds and vibrations made by the heart; heartbeat sounds are heard using a stethoscope.



By
**John
Clarke**

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AUSTRALIA'S OWN MICROMITE TOUCHSCREEN BACKPACK



Since its introduction in February 2016, Geoff Graham's mighty Micromite Backpack has proved to be one of the most versatile, most economical and easiest-to-use systems available – not only here in Australia but around the world! Now there's the V3 Backpack – it can be plugged straight into a computer USB for easy programming or re-programming – YES, you can use the Micromite over and over again, for published projects, or for you to develop your own masterpiece!

The Micromite's Backpack colour touchscreen can be programmed for any of the following SILICON CHIP projects:



Many of the HARD-TO-GET PARTS for these projects are available from the SILICON CHIP Online Shop (siliconchip.com.au/shop)

- Poor Air Quality Monitor (Feb20 – siliconchip.com.au/Article/12337)
- GPS-Synched Frequency Reference (Oct18 – siliconchip.com.au/Series/326)
- Tariff Super Clock (Jul18 – siliconchip.com.au/Article/11137)
- Altimeter & Weather Station (Dec17 – siliconchip.com.au/Article/10898)
- Radio IF Alignment (Sep17 – siliconchip.com.au/Article/10799)
- Deluxe eFuse (Jul17 – siliconchip.com.au/Series/315)
- DDS Signal Generator (Apr17 – siliconchip.com.au/Article/10616)
- Voltage/Current Reference (Oct16 – siliconchip.com.au/Series/305)
- Energy Meter (Aug16 – siliconchip.com.au/Series/302)
- Super Clock (Jul16 – siliconchip.com.au/Article/9887)
- Boat Computer (Apr16 – siliconchip.com.au/Article/9977)
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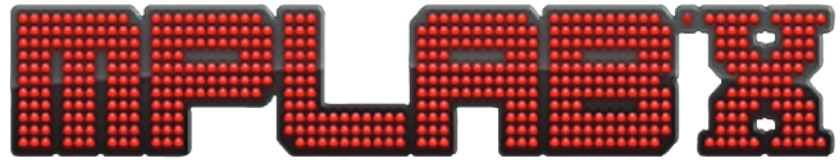
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Installing and using



While Arduino software and hardware have made microcontroller projects accessible, many advanced users prefer to use MPLAB X, especially for PIC devices. Like the Arduino IDE, it is a free download. This article will step you through the process of creating your first MPLAB X project.

Those who have been dabbling with microprocessors and microcontrollers for a long time may remember a time when writing a program required intimate knowledge of instruction sets and memory maps. You had to hand-write assembly language or even machine code which would then have to be loaded into an EPROM.

Our early microprocessor projects, such as the 1989 Printer Buffer (siliconchip.com.au/Article/7380) or LED Message Board (siliconchip.com.au/Series/255), also from 1989, used a Z80 microprocessor with separate RAM chips and an EPROM chip.

About the same time came the first PIC microcontrollers, with integrated program EPROM and in the next decade, flash memory. These were typically programmed in assembly language, with the machine code created by an assembler program.

Flash-based devices such as the PIC16F84 meant it was finally possible to quickly and easily update code without having to manually erase an EEPROM under a UV lamp (or sunlight, if you didn't have a UV lamp).

It was over ten years ago, in July 2010, that we last gave an in-depth 'howto' on programming PIC microcontrollers (siliconchip.com.au/Article/208). That article introduced the PICKit 3 programmer/debugger from Microchip and their MPLAB software.

MPLAB is a complete IDE (integrated development environment). It's integrated because it includes the ability to write programs in a high-level language (typically C) and then compile, upload and even debug these programs.

The PICKit 3 is still a handy device; we haven't come across many PIC devices that it can't program. But you will probably have to switch to a PICKit 4 or Snap programmer if you want to work with the latest

AVR parts (as described starting on page 88 of this issue).

MPLAB has evolved into MPLAB X, which is now Java-based, and therefore runs on all major operating systems; Windows, Mac and Linux.

For a long time, we've used this software and PICKit programmers to program microcontrollers for our projects, and we see no reason to change that, especially with MPLAB X now supporting AVR parts.



There may be some out there for whom microcontroller programming remains a mystery; perhaps you're happy just buying pre-programmed parts from the SILICON CHIP ONLINE SHOP, or you just don't have the need. But you may be interested in the process nonetheless. Or you might like to jump into the world of microcontrollers.

Rest assured that the process only continues to get easier. In this article, we'll introduce and review the latest version of Microchip's MPLAB X IDE.

Once you've read through it, you might also like to read the separate article on the new AVR DA family of microcontrollers

which are supported by MPLAB X.

MPLAB X is not tied to that particular chip or development board, but can be used with many Microchip microcontrollers, including virtually all PICs and many AVR MCUs.

Microchip Technology

Microchip Technology is the company that makes PIC microcontrollers. In 2016, they bought out Atmel, the makers of 8-bit AVR microcontrollers (which are at the heart of early Arduino boards such as the Uno). Atmel also made a range of 32-bit ARM-based

By Tim Blythman

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 See website for details.

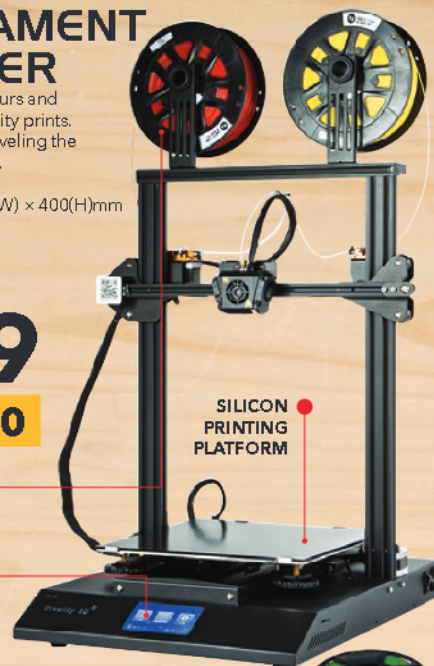
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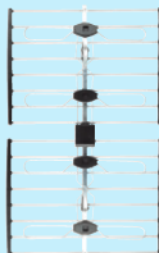


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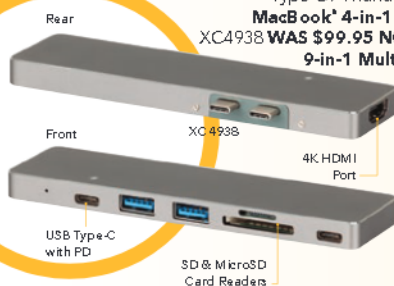
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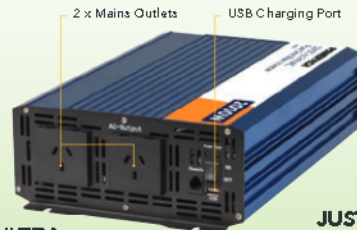
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JUST
\$19⁹⁵

12V TO 5VDC CONVERTER WIRING KIT

Get rid of unsightly power cables floating around car dash that powers GPS, Dash Cam or mobile device.

• 2.5A continuous current
• Cable length 1.3m MP3675



More ways to pay:



jaycar

keep the kids ENTERTAINED

...at home

AMAZING SELF-FLYING DRONE!

LASER GUN & DRONE SET

Launch this amazing 'obstacle avoidance & self-flying drone and watch it fly, then pull out the gun, take aim - shoot! Hit the drone and it shudders, strike it 3 times and it falls safely to ground. Warning - The drone shoots back. Full colour lighting and multiple sound effects. Add up to 3 drones. Ages 8+. GT4082 See website or in-store for details.

Additional Drone to Suit GT4082 GT4084 \$24.95

Due early January.



JUST \$49⁹⁵



REMOTE CONTROLLED 2-IN-1 TANK CONSTRUCTION KIT

Assembled into two different tanks. Drive around on caterpillar tracks and raise/lower the turret. Equipped with gunfire sounds. 759 pieces. Ages 6+. Requires 3 x AAA and 6 x AA batteries (sold separately). KR9242

4 PK AAA Batteries SB2413 \$3.25

12 PK AA Batteries SB2333 \$7.95

NEW JUST \$99⁹⁵

REMOTE CONTROLLED 2-IN-1 ROCK & DIRT CRAWLER

Interchangeable 4WD tyres for speed and caterpillar tracks for rough terrain. Speeds up to 10km/h. 2.4GHz remote requires 2 x AA batteries (sold separately). Ages 8+. GT4247

2 PK AA Batteries SB2424 \$1.95

NEW \$19⁹⁵

SAVE \$3

ANYWHERE TABLE TENNIS

- Collapsible net
- Spring-damp net support posts
- Includes 2 x paddles & 2 x ball

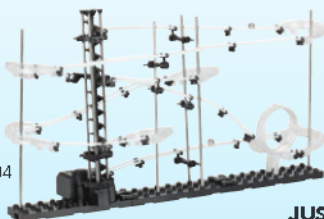
GH1162 WAS \$22.95



SPACE RAIL CONSTRUCTION KIT

Build your own 'marble' roller coaster. The spiral "elevator" lifts the marbles to the top of the rail, and gravity takes care of the rest. 170 piece. Requires 1 x C battery (sold separately). Ages 15+. KJ9004

2 PK C Batteries SB2416 \$4.50



JUST \$29⁹⁵

TOBBIE THE ROBOT - HEXAPOD KIT

A 6-legged robot that you can build. Walks and spins in any direction and will beep and flash its eyes. Ages 8+. KJ9031

JUST \$49⁹⁵



JUST \$12⁹⁵

POTATO CLOCK KIT

Runs on potatoes or with tomatoes, lemons, apples, even soft drink or beer! Safe and highly educational. Ages 10+. KJ8937



HYDRAULIC CYBORG HAND KIT

Simulates the movements of human hand/fingers, using hydraulic power. It allows every finger joint to adjust at different angles for close-fist/or open-palm precisely. Ages 10+. KR9266



JUST \$49⁹⁵

SNAP-ON ELECTRONIC KITS

All in bright coloured pieces. Parts simply snap together without any screws or soldering. Ages 6+. KJ8970-KJ8985

Full range available in store or online.



FROM \$9⁹⁵

NOW \$14⁹⁵

SAVE \$2

MAKE YOUR OWN: CLOCK KIT

Easy to assemble. No batteries required. 31 pieces. Ages 6+. KJ8996 WAS \$16.95



WEARABLE BADGES & ELECTRONIC DICE KITS

These kits are a great way for your kids and grand kids to start soldering and pick up some electronics on the way. They will also learn about how various components work including LEDs, transistors, integrated circuits and more. Each kit requires a CR2032 battery (SB2522 \$3.25 sold separately). \$19.95 EA

6 DIFFERENT KITS AVAILABLE:

1. Skull Badge with Alternating Flashing LEDs KM1090
2. Owl Badge with Touch Sensitive LEDs KM1092
3. Rocket Badge with Flashing LEDs KM1094
4. Pirate Badge with Flashing LED Eye KM1096
5. Robot Badge with Touch Sensitive LEDs & Buzzer KM1098
6. Electronic Dice with Flashing LEDs KM1099

ANY 3 KITS FOR \$40
SAVE \$19.85



80W 240V Soldering Iron TS1485 \$24.95



RETRO STYLE HANDHELD GAME CONSOLE WITH 256 GAMES

Hours of entertainment to keep you and the kids entertained.

Features a 2.8" colour screen, built in speaker and a 3.5mm to RCA and USB recharge cable. Available in Black or Red. Ages 15+. GT4280

Due early January.



CONNECT IT TO YOUR TV

NEW ONLY \$29⁹⁵

In the Car

JUST \$129

7" TFT LCD WIDESCREEN COLOUR MONITOR WITH IR REMOTE

Suitable for in-car and home entertainment, use it to watch video from any composite source such as a DVD player or game console. QM3752



Wireless Headphones AA2047 RRP \$39.95

bonus free gift



JUST \$39⁹⁵

WIRELESS INFRARED STEREO HEADPHONES

Add these wireless headphones to the monitor on the left and enjoy automotive bliss! Soft cushioned pads. AA2047



CLEARANCE

ORDER ONLINE, COLLECT IN STORE

Listed below are a number of discontinued (but still good) items that we can no longer afford to hold stock.
Please ring your local store or search our website to check stock. At these prices we won't be able to transfer from store to store.
STOCK IS LIMITED. ACT NOW TO AVOID DISAPPOINTMENT. Sorry NO RAINCHECKS.

AUDIO & VISUAL

	Cat. No	WAS	NOW	SAVE
150m 1080p HDMI Cat5e/6 Extender with Infrared	HOT PRICE AC1746	\$219	\$169	\$50
2 Channel Mixer with Microphone Preamp	HOT PRICE AM4201	\$69.95	\$39.95	\$30
2 Way DisplayPort Splitter	AC1755	\$49.95	\$39.95	\$10
2 Way DisplayPort Switcher	AC1757	\$49.95	\$39.95	\$10
2 x 15 WRMS Portable Stereo Amplifier	AA0504	\$69.95	\$49.95	\$20
2 x HDMI to VGA/Component & Analogue/Digital Audio Converter	AC1721	\$119	\$99	\$20
3.5mm Plug to Socket Cable with Microphone and Volume Control - 0.5m	WA7120	\$14.95	\$9.95	\$5
4 Way Digital Audio Switcher	AC1723	\$39.95	\$34.95	\$5
6 Way Speaker Selector with Internal Protection	AC1683	\$129	\$99	\$30
6.5" Rechargeable Cube Speaker with Bluetooth® Technology	CS2489	\$119	\$89	\$30
Concord 50m 4K HDMI Fibre Optic Cable	HOT PRICE WQ7496	\$299	\$249	\$50
Economy UHF/VHF Masthead Amplifier	LT3276	\$49.95	\$34.95	\$15
HDMI 4K Repeater	AC1717	\$34.95	\$24.95	\$10
Portable 5.8GHz Wireless 1080p HDMI AV Sender	HOT PRICE AR1901	\$229	\$179	\$50

SECURITY

	Cat. No	WAS	NOW	SAVE
1080p AHD Dome Camera with IR	HOT PRICE QC8687	\$129	\$89	\$40
1080p Wi-Fi IP Camera with Pan/Tilt	QC3858	\$89.95	\$69.95	\$20
12V AC/DC Door Strike release	LA5078	\$49.95	\$29.95	\$20
15m CCD Camera Extension Cable	WQ7277	\$49.95	\$39.95	\$10
4 Door RFID Access Controller	HOT PRICE LA5359	\$199	\$149	\$50
720p AHD Dome Camera with IR	QC8639	\$99.95	\$69.95	\$30
720p AHD Wireless Receiver & Camera Kit	QC8663	\$99	\$89	\$10
720p Outdoor Trail Camera	QC8041	\$149	\$129	\$20
Ceiling Mount Alarm with Remote Control	LA5215	\$34.95	\$24.95	\$10
Concord 8 Ch. 4K DVR Package - 4x5MP Cameras	HOT PRICE QV5100	\$799	\$699	\$100
Concord 8 Ch. 4K NVR Package - 6x5MP Cameras	HOT PRICE QV5602	\$1,299	\$1,099	\$200
Motion Sensor Camera recorder with 3.8 IR LEDs	QC8027	\$89	\$79	\$10
Non-Contact Infrared Door Exit Switch	LA5187	\$74.95	\$49.95	\$25
Rechargeable Solar Sensor Light	SL3239	\$69.95	\$54.95	\$15

POWER

	Cat. No	WAS	NOW	SAVE
125A Dual Battery Isolator (VSR)	MB3687	\$49.95	\$39.95	\$10
12V 8.5A Desktop Power Supply	HOT PRICE MP3258	\$99.95	\$69.95	\$30
18W USB Type-C Mains Power Adaptor with Power Delivery	MP3410	\$24.95	\$19.95	\$5
240VAC Aluminium 48 LED Light Strip with Switch	ST3946	\$59.95	\$49.95	\$10
240VAC Aluminium 72 LED Light Strip with Switch	ST3948	\$69.95	\$59.95	\$10
2500 Lumen Rechargeable LED Torch	HOT PRICE ST3499	\$129	\$99	\$30
2600mAh Metallic Power Bank Rose Gold	MB3794	\$14.95	\$9.95	\$5
2600mAh Metallic Power Bank Silver	MB3792	\$14.95	\$9.95	\$5
2600mAh Metallic Power Bank Space Gray	MB3793	\$14.95	\$9.95	\$5
3 x Oscon Osram LED Torch	1/2 PRICE! ST3487	\$9.95	\$4.95	\$5
30W 5V 6A Encapsulated Mini Power Supply	MP3301	\$42.95	\$29.95	\$13
5VDC 1A USB Mains Adaptor with Micro-B Cable	MP3544	\$19.95	\$14.95	\$5
6300 Lumen 6.5 Inch Solid LED Driving Light	SL3920	\$149	\$129	\$20

IT & COMMS

	Cat. No	WAS	NOW	SAVE
0.5W 80 Ch UHF Transceivers	DC1027	\$69	\$59	\$10
3W UHF CB Radio Tradies Pack - Pair	HOT PRICE DC1076	\$329	\$229	\$100
5W UHF CB Radio Tradies Pack IP67	HOT PRICE DC1069	\$449	\$349	\$100
Advanced 2 Watt 80 Channel UHF Transceiver with CTCSS	DC1049	\$69.95	\$59.95	\$10
Ethernet Over Power N300 Wi-Fi Access Point	YN8357	\$149	\$129	\$20
Ethernet-Over-Power Kit	YN8355	\$99.95	\$89.95	\$10
VGA To Composite & S-Video Converter	XC4907	\$49.95	\$39.95	\$10
Waterproof Floating 80 Channel 3W UHF CB Transceiver	DC1074	\$129	\$99	\$30

AUTO & OUTDOORS

	Cat. No	WAS	NOW	SAVE
1080p Wi-Fi Dash Camera with GPS	QV3865	\$189	\$169	\$20
3G GPS Vehicle Tracker	HOT PRICE LA9026	\$199	\$149	\$50
Bluetooth® In-Car Earpieces with USB Charger	AR3135	\$19.95	\$14.95	\$5
FM Transmitter with USB & SD Playback	AR3136	\$14.95	\$9.95	\$5

EDUCATIONAL KITS & GADGETS

	Cat. No	WAS	NOW	SAVE
Circuit Scribe Maker Kit	KJ9310	\$89	\$69	\$20
Crookes Radiometer	GG2108	\$59.95	\$39.95	\$20
Draw Circuits Circuit Scribe Basic Kit	KJ9340	\$69.95	\$59.95	\$10
Draw Circuits Circuit Scribe Ultimate Kit	HOT PRICE KJ9300	\$149	\$109	\$40
Makeblock mBot Blue Robot Kit	KR9200	\$199	\$169	\$30
MakeBlock Neuron Inventor Kit	KJ9190	\$99	\$79	\$20
Meet Edison Robot Kit	KR9210	\$99.95	\$79.95	\$20
Motion Drone	GT4224	\$34.95	\$24.95	\$10
Portable 14L 12V Cooler / Warmer	GH1373	\$119	\$89	\$30
Puppy Go AI Smart Dog	HOT PRICE KR9234	\$169	\$129	\$40
Space Rail Construction Kit - Glow in the Dark	KJ9001	\$49.95	\$39.95	\$10
Squishy Circuits Deluxe Kit	KJ9352	\$129	\$99	\$30
Vinyl Record Carry Case	GE4101	\$39.95	\$29.95	\$10

HARDCORE

	Cat. No	WAS	NOW	SAVE
30 Piece Tool Kit with Case	TD2166	\$29.95	\$19.95	\$10
3000A True RMS AC High Current Clamp Meter	QM1568	\$49.95	\$39.95	\$10
300W Hot Air SMD Rework Station	HOT PRICE TS1645	\$159	\$129	\$30
8 Piece 1000v VDE Set	TD2031	\$59.95	\$39.95	\$20
Bendtop 16-Bin Storage Organiser	HB6341	\$49.95	\$34.95	\$15
2 Bay USB 3.0 SATA HDD RAID Enclosure	XC4688	\$99	\$89	\$10
Arduino Compatible 16x16 LED Dot Matrix Module	XC4607	\$24.95	\$19.95	\$5
Arduino Compatible 3W 200 Lumen LED Module	XC4468	\$10.95	\$6.95	\$4
Arduino Compatible Ultraviolet Sensor Module	XC4518	\$29.95	\$24.95	\$5
Long Range LoRa IP Gateway	XC4394	\$99	\$79	\$20
USB Port Voltage Checker Kit	KC5522	\$33.95	\$19.95	\$14

More ways to pay:



jaycar

HOT OFFERS:

SAVE \$200

DESKTOP 3D SCANNER V2 WITH SOFTWARE

Watch real life objects become digitized before your eyes. Scans up to 250 x 180mm. Sleek, foldable design for workspace storage. Comes packed with MFStudio software with +Quickscan.

• Scans up to 250(H) x 180(D)mm
TL4420 **WAS \$1499**

See website for details.

NOW

\$1299

SAVE \$200

- CAPTURES GEOMETRY IN AS FAST AS 1 MINUTE!
- SCAN OBJECTS WITH AN ACCURACY WITHIN +/- 0.1MM RESOLUTION.



MOOZ-3Z TRIPLE FILAMENT 3D PRINTER

- Equipped with a three-color print head for colour mixing
- Easy-to-use controller and mobile app
- Featured with 3.5" LCD touch pad, Wi-Fi USB connectivity, magnetic heat bed and more
- Supplied with a roll each of cyan, magenta and yellow filament to get you started.
- Prints up to: 100(H) x 100(Dia.)mm

TL4412 **WAS \$1499**

See website for details.

THREE FILAMENT 3D PRINTER

COLOUR MIXING TECHNOLOGY



NOW

\$1299

SAVE \$200

LOTS OF FILAMENT COLOURS & STYLES
AVAILABLE PRICE FROM \$19.95

PORTABLE BOOM BOX SPEAKER

Stream music from your Smartphone or Tablet via Bluetooth* in true stereo, or connect via 3.5mm Aux input.

- IPX5 Water resistant
- Bluetooth* Wireless Technology
- True Wireless Stereo (TWS)
- Google Assistant & Siri* Support

CS2499 **WAS \$149**

NOW

\$119

SAVE \$30



5 PORT USB CHARGING STATION WITH STORAGE COMPARTMENT

- Charge up to 5 USB devices at the same!
- Maximum power output of 2.4A per port.
- Includes 6 dividers and a 12VDC, 4A power supply.

WC7766 **WAS \$59.95**

NOW

\$39.95

SAVE \$20



7" LCD WIRELESS 2.4GHZ VIDEO DOORPHONE

Modern touch sensitive monitor with clear vision to identify visitors. Provides electronic door strike and gate control, as well as full talk-back to the outdoor unit. QC3884 **WAS \$399**

- 2-way audio intercom
- Various melodies
- IP44 rated

NOW

\$329

SAVE \$70



2 FOR **\$70**
SAVE \$49.90

15,000MAH PORTABLE POWER BANK

- 4 x LEDs show charge status
- Dual USB Type-A ports & 1 x USB Type-C port
- Up to 3A total power output

MB3806 **\$59.95 EA.**

WIRELESS TWS SPORT EARPHONES WITH BLUETOOTH*

Fits comfortably and pairs very easily. Up to 3hrs play/talk time.

- Bluetooth* 5.0
- True Wireless Stereo (TWS)
- Built-in Microphone

AA2147 **WAS \$69.95**

NOW

\$59.95

SAVE \$10



WI-FI IP CAMERAS WITH INFRARED LEDS

Suitable for night time use.

720P QC3849 **WAS \$69.95**

NOW \$49.95 (Shown)

1080P QC3862 **WAS \$79.95**

NOW \$59.95

NOW FROM

\$49.95

SAVE \$20



R/C MOTORISED ROBOT ARM KIT

Ideal for anyone interested in robotic construction. 100g lift capacity. Supplied as a kit of parts with detailed instructions. Requires 4xD batteries (SB2321 **\$8.95** sold separately). Ages 12+.

KJ8995 **WAS \$139**

NOW

\$99

SAVE \$40



TERMS AND CONDITIONS: REWARDS / CLUB MEMBERS FREE GIFT, % SAVING DEALS, & MEMBERS OFFERS requires ACTIVE Jaycar Rewards / membership at time of purchase. Refer to website for Rewards / membership T&Cs. IN-STORE ONLY refers to company owned stores and not available to Resellers. Page 1: 10% OFF Flashforge Filament applies to all colours and sizes. FREE GIFT: Buy DashCam (QV3589) and get 32GB microSD card (XC24992) FREE. 1% OFF TV Mounting Brackets apply to CW2805, CW2811, CW2819, CW2834, CW2840, CW2851, CW2859, CW2864, CW2875, CW2880, CW2885, CW2890, CW2895, CW2900, CW2905, CW2910, CW2915, CW2920, CW2925, CW2930, CW2935, CW2940, CW2945, CW2950, CW2955, CW2960, CW2965, CW2970, CW2975, CW2980, CW2985, CW2990, CW2995, CW3000, CW3005, CW3010, CW3015, CW3020, CW3025, CW3030, CW3035, CW3040, CW3045, CW3050, CW3055, CW3060, CW3065, CW3070, CW3075, CW3080, CW3085, CW3090, CW3095, CW3100, CW3105, CW3110, CW3115, CW3120, CW3125, CW3130, CW3135, CW3140, CW3145, CW3150, CW3155, CW3160, CW3165, CW3170, CW3175, CW3180, CW3185, CW3190, CW3195, CW3200, CW3205, CW3210, CW3215, CW3220, CW3225, CW3230, CW3235, CW3240, CW3245, CW3250, CW3255, CW3260, CW3265, CW3270, CW3275, CW3280, CW3285, CW3290, CW3295, CW3300, CW3305, CW3310, CW3315, CW3320, CW3325, CW3330, CW3335, CW3340, CW3345, CW3350, CW3355, CW3360, CW3365, CW3370, CW3375, CW3380, CW3385, 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SERVICEMAN'S LOG



Dave Thompson

One good turn deserves another

A client turned up at the workshop the other day with what I would consider the perfect job for me. This bloke is a known audio 'nut' in my old circle of friends. Although I hadn't heard from him for many years, he had tracked me down because he finally decided to fix up a few of the 'vintage' items in his vast collection of 70s and 80s audio gear.

I say 'my circle of friends', but I didn't really know him; I had met him briefly, and knew of him by reputation back when I was a young jobbing musician. He played bass guitar in one of the many bands I used to cross paths with while grinding out gigs on the local pub circuit.

He was known for being right into his audio gear, so in lieu of any real information available to us at the time (no internet in those days), we often bowed to his supposedly superior knowledge in subjects related to sound reinforcement and instrument amplification. For better or worse, he was a fount of knowledge at the time; I had to learn this stuff somewhere, right?

For those intent on writing off my experiences, put those burning torches and pitchforks down; I admit I was never a 'rock star' but I did play in touring bands for many years, and one picks up pertinent knowledge along the way.

While I might not know what amplifier and speaker combination works best in your man-cave/lounge room, I could suggest what sound reinforcement hardware you would choose if you wanted to sonically light up a 500-seat theatre!

My point is that we all knew this bloke as an audio purist, and while we somewhat blundered on with our typically low-fi stage gear, he was the one who was really into the specifications and minutiae of the speakers and amplification that were being used back then. While I hesitate to label anyone I've ever known as an 'audiophile', he was probably as close as I ever came to meeting one.

Not that he was in any way one of

these guys who proclaims that those \$500-per-metre, plutonium-enriched gold and copper alloy speaker cables as the only thing to use for a home stereo setup. Or that one had to have thousands of dollars' worth of audio hardware to have a good sound; he was just really into his audio hardware.

Many of us likely know (or have known) someone like this, to varying degrees. I've met guys over the years who insist that speaker cabinets need to be mounted on Kryptonium-alloy

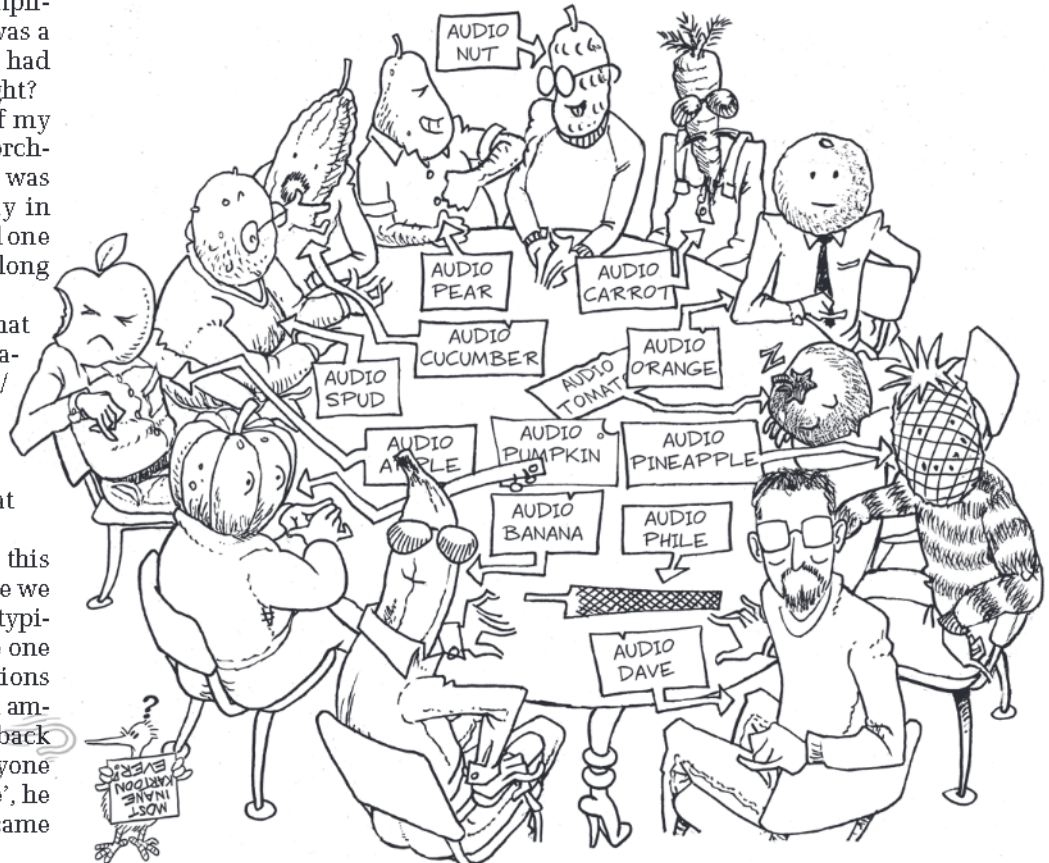
Items Covered This Month

- Acoustic research turntables
- PA system repair
- HP5100 frequency synthesiser repair

**Dave Thompson runs PC Anytime in Christchurch, NZ.*

Website: www.pcan anytime.co.nz

Email: dave@pcanytime.co.nz



THIS BLOKE IS A KNOWN AUDIO NUT IN MY OLD CIRCLE OF FRIENDS

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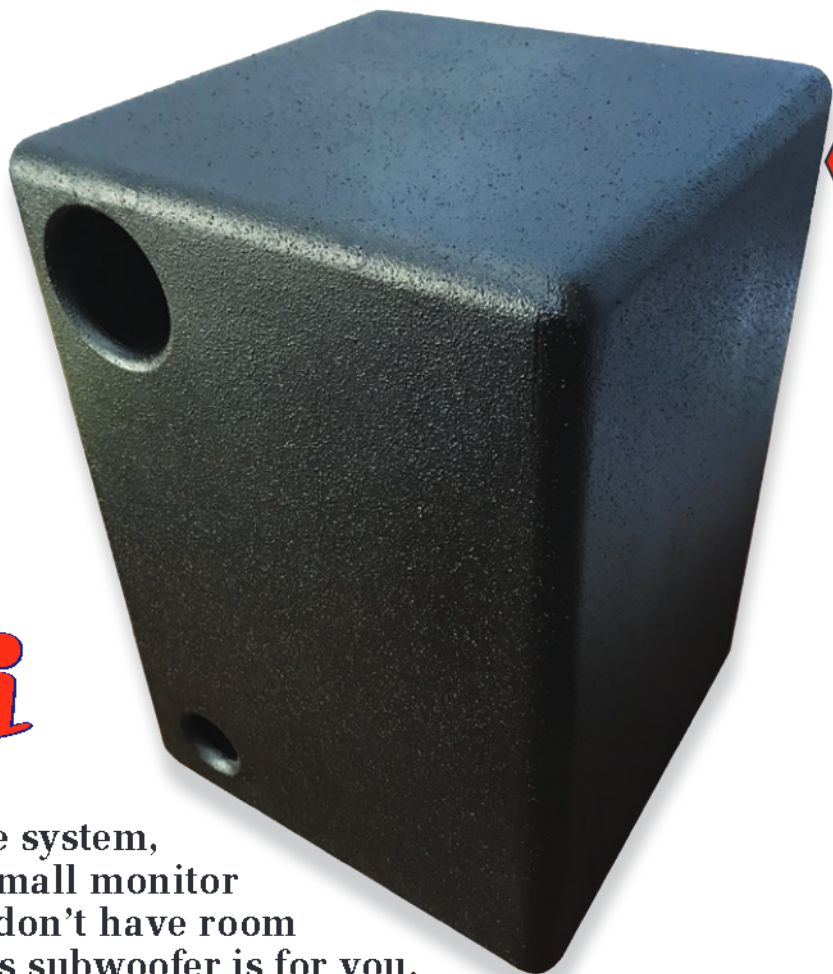
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*A 2021 variation
on an old theme . . .*

The Bass Block



If you're building a home theatre system, or want to listen to music with small monitor or tower speakers (because you don't have room for huge ones, perhaps), then this subwoofer is for you. It's compact and easy to build, but it pumps out plenty of bass to fill in the gaps left by smaller speaker systems. Virtually all music and movies can benefit from a healthy dollop of low-end sound!

Subwoofers have become commonplace in recent decades. There are several reasons for this: One is the popularity of home theatre systems with 5.1 surround sound (where the .1 refers to the subwoofer). Another is the increasing trend towards small speakers which are less obtrusive in a home setting.

Compact speaker systems (and many larger ones) tend to have a bottom end roll-off in the region of 50Hz. While much of the satisfying bass components of music is in the 50-60Hz range, there is still plenty below this level. For example, the bottom A on an 88-key piano with modern tuning has a fundamental frequency of 27.5Hz.

For speakers with a -3dB point of 50Hz, at least half an entire octave will be severely diminished, and the fundamental of the bottom note perhaps not heard at all; only the overtones and harmonics.

It isn't just classical or piano music either; other types of music which have a lot of content in the 20-50Hz range include reggae, hip-hop, rap, rock and pop. And action movies make good use of the lowest octave, to reproduce sounds like explosions and

Features & specifications

Frequency response:	40-100Hz, ± 3 dB; 25-150Hz, ± 5 dB
Impedance:	nominally 4 Ω
Dimensions:	240 x 272 x 396mm
Material:	16mm thick MDF

collisions. So ideally, you want a sound system which doesn't just die off below 50Hz.

Traditional speaker designs (whether sealed or bass reflex boxes, or more exotic designs like horn-loaded or transmission lines) all have similar difficulty

in reproducing this bottom octave without large drivers and enclosures. This is especially true where high sound pressure levels (SPL) are needed.

Speaker manufacturers have responded by developing drivers with extremely long excursions to "move more air". Unfortunately, these drivers still tend to be large and expensive.

In recent decades, mathematicians and audio/acoustic engineers have developed new speaker enclosure configurations which enable these bass frequencies to be reproduced in much smaller physical volumes.

One such design, implemented by Julian Edgar, was the "Bass Barrel", presented in the August 1997 issue of SILICON CHIP – (see siliconchip.com.au/Article/4846).

It used a "Compound Isobaric 6th Order (A) Bandpass Double Vent" enclosure. This type of cabinet employs two drivers mounted face-to-

By Nicholas Dunand

Behold the Bass Block, in all of its blocky magnificence! It is made from MDF, which you could just leave "natural", but if you rout the edges and corners and paint it like this one, it looks a whole lot better. You could also glue speaker carpet to the outside (as was done with ye olde Bass Barrel). Read on for more details on how I achieved the finish **shown**.

Preview only.

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For those times when
you DON'T want to
be interrupted . . .

**I'm
busy.
Go
away!**



OK, it's a bit tongue-in-cheek . . . but it could have other, more serious, uses. The Busy Dunny Door Warning flashes a bright LED light on the door when you, ahem, don't want someone barging in. When you leave and open the door the light goes out! It's a simple idea with a real simple circuit – but it makes a superb beginner's project . . .

The idea for this little project came about when avid SILICON CHIP reader John Chappell was sitting, reading his latest copy . . . and the dunny door burst open, with obvious embarrassment all around.

So maybe he had taken a bit longer than normal; maybe he was so engrossed in the magazine that he didn't hear anyone yelling out . . . but it started him thinking how to avoid the delicate situation in the future.

One problem was that the door lock, umm, didn't.

So without replacing the lock, how

to let others know that the best seat in the house was, umm, occupied – without the embarrassment!

Light bulb LED moment

Of course, that was the answer: a bright, flashing LED that would let others know not to barge in.

If it was made somewhat automatic – ie, it turned off when the outhouse door opened to let him out, so much the better. And this really simple circuit is the outcome.

Original by John Chappell

When the pushbutton (S1) is pressed, both the LED mounted on the door and the internal LED start flashing.

Why two LEDs? One is the ultrabright warning LED mounted on (or through) the dunny door to warn others that it is occupied. The second (internal) LED merely confirms that the circuit is operating.

Overkill? Perhaps - but at the cost of a 10c LED and a 5c resistor, it doesn't add much cost to the project.

When the dunny door is opened, a magnetic reed switch resets the circuit

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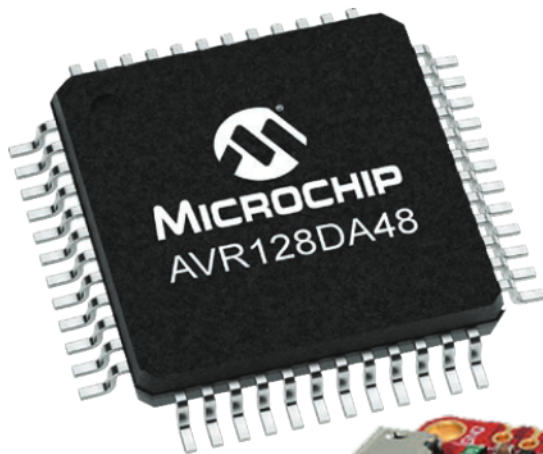
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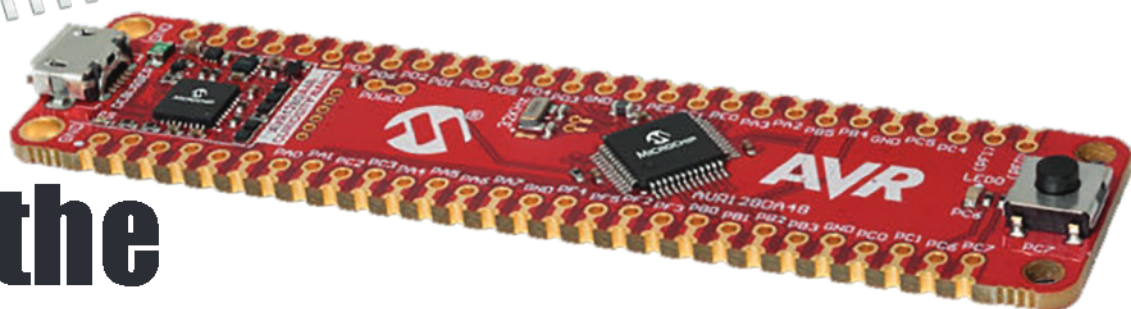
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The



AVR128DA48



and the Curiosity Nano evaluation board

By
Tim Blythman

The AVR DA Curiosity Nano Evaluation Kit demonstrates Microchip's new range of AVR128DA microcontrollers. These have several very significant advantages over commonly used AVRs, such as much more flash memory and RAM, a higher operating speed, 12-bit ADC channels and a 10-bit DAC. Despite all this, they actually cost less than the ATmega328P!

When we saw that the new AVR DA family AVR chips were available, we had to try them out. They cost around \$2.50 even in single quantities, slightly less than an ATmega328P.

But they have four times the flash memory, eight times the RAM and greatly enhanced peripherals. If you're designing a new circuit around an AVR, it would be silly not to use one of these.

While some micros have cryptic part numbers, the AVR-128DA series is quite straightforward. The "AVR" means that it is an AVR processor (originally from Atmel, now part of Microchip). The "128" means that it has 128kB of program (flash) memory and the "DA" refers to this particular AVR family. There are also AVR32DA and AVR64DA parts with 32kB and 64kB of flash memory, respectively.

The two digits following the "DA" are simply the number of pins that the part has. The parts in this series are AVR-

128DA28, AVR128DA32, AVR128DA48 and AVR128DA64. These are available in various packages and footprints, which are described by further suffixes.

When we looked at the ATtiny816 in January 2019 (siliconchip.com.au/Article/11372), we thought it looked like a fair competitor to the ATmega328 (as found in the Arduino Uno board). In fact, with more ADC (analog-to-digital converter) channels, it was an tinyAVR series chip that could put its bigger (megaAVR) sibling to shame. The AVR DA family is even more impressive – see Table 1.

Like the ATtiny816, the AVR128DA series has Event System and Configurable Custom Logic (CCL) hardware. These two peripherals handle in hardware what would have previously been done with software, freeing up processor time. The comparators and 10-bit DAC allow arbitrary trigger voltage thresholds to be set for external signals.

One example of the benefits of the Event System is that,

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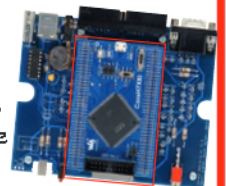
ALL-NEW COLOUR MAXIMITE 2

See the articles in
SILICON CHIP
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processor; 9MB of
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H 8853

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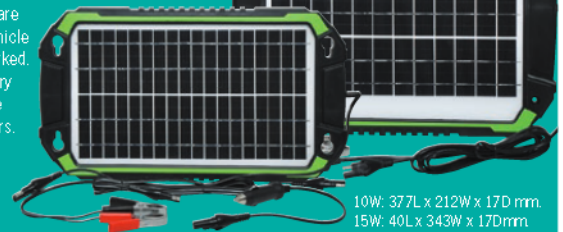
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A handy 4" stainless steel bowl with magnetic base to keep screws from straying while you work



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T 1927

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Chemtools® No Clean Flux Pen

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Smaller sizes than most 1000V rated driver sets. Ideal for servicing AC equipment. 3 flat blade (2.0, 2.5 & 3mm) and 3 phillips (#000, #00, #0). T 2188

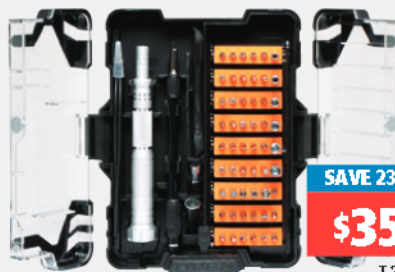


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Perfect for lighting inside cabinets, under shelves, wardrobes etc. Utilises high efficiency SMD 4014 chip LEDs - 4W per strip. Use at home or in cars, caravans and 4WDs. 39Wx8Hx300Lmm. Join up to 5 strips together using joiners. 12V input, 500mA per strip.

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Create Amazing LED Light Effects!

1.3m length of addressable RGB 5050 LED strip - this means you can program the colour of every individual LED using an Arduino/Raspberry Pi. 60 LEDs per m. WS2812B chip on board. 10mm width, adhesive backed. 5V, 3.6A/m (max).



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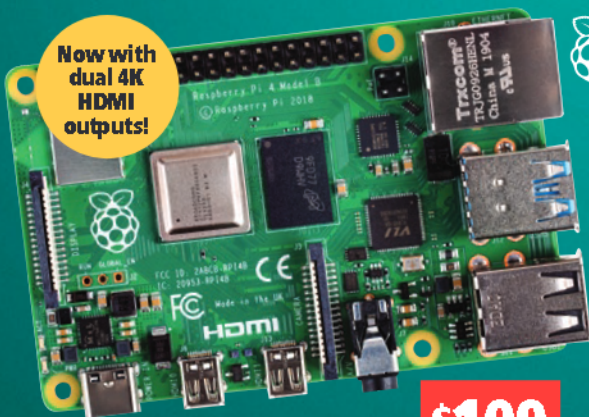
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Project Parts 'a' Plenty

Now with dual 4K HDMI outputs!



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A great Pi media centre case!



NEW!

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H 2930

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Build a network music player!



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H 2932

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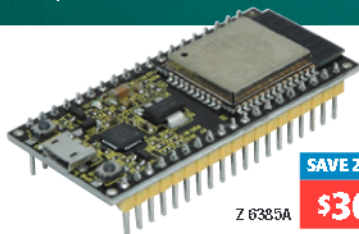
Red Armor Pi Case

Aluminium passive cooled design.
*Pi not included.



H 2954

\$29.95



SAVE 25%

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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.



SAVE 25%

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Z 6432

LoRa Arduino Shield

Allows long range communication with an Arduino without the need for a GSM 4G network - even over distances of up to several kilometres! 3.3/5V input.



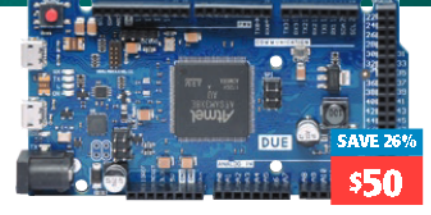
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Z 6426

CAN-BUS Arduino Shield

Allows you to interface Arduino's with CAN-BUS control systems found in automotive electronics. Use an Arduino to build your own vehicle monitors.



SAVE 26%

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The first Arduino board based on a 32 bit ARM core micro-controller for added power. Ideal for projects that need higher speed processing. 54 digital in/outs, 12 analog inputs & 4 UARTs. 3.3V shield/sensor compatible.



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NEW!

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X 1010A

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64 bright RGB LEDs are contained in a 60x60mm housing.



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Z 0877



NEW!

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K 9643

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



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H 2946

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A huge assortment of single row header connectors for making your own custom length wiring. Includes male & female pin headers, plus 2.54mm housings.

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K 9640



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PRODUCT SHOWCASE

New microcontrollers from Microchip help with analog system design

Sensor-based Internet of Things (IoT) applications rely on a combination of analog functionality and digital control capability to meet a list of requirements including cost, size, performance and power usage.

Addressing this through a focus on increased microcontroller (MCU) integration, Microchip Technology announced the PIC18-Q41 and AVR DB MCU families (as seen on page 82 of this issue). These are the first to com-

bine advanced analog peripherals and multi-voltage operation with inter-peripheral connections for increased system integration and reduced signal acquisition times.

To address the need for signal conditioning in space-constrained sensing and measuring applications (such as IoT end nodes and industrial, medical devices, wearables, automotive and lighting systems), the PIC18-Q41 MCU has a configurable operational ampli-

fier, analog-to-digital (ADC) & digital-to-analog converters (DAC).

It is particularly well-suited for IoT and large-scale artificial intelligence (AI), including predictive maintenance edge nodes in a smart factory. Offered in compact 14- and 20-pin packages, the PIC18-Q41 MCU also makes a good companion to Microchip's 32-bit MCUs and other controllers that require analog integration.

Mixed-signal IoT systems often include multiple power domains, and the AVR DB MCU simplifies these designs while reducing cost by integrating true bi-directional level shifters. This feature lowers cost in a wide range of applications such as automotive, HVAC and liquid measurement.

The addition of three independent and highly configurable op amps, a 12-bit differential ADC, 10-bit DAC, three zero cross detectors and core independent peripherals (CIPs) makes the AVR DB MCU ideal for virtually any application involving analog signal conditioning and processing functions.



Microchip Technology Inc.

Unit 32, 41 Rawson Street
Epping 2121 NSW
Tel: (02) 9868 6733
www.microchip.com

New NP400 low-cost pressure sensors from Ocean Controls

Novus NP400 two-wire pressure sensors break the \$100 barrier. These compact sensors are ideal for air and water applications. They feature a wide power supply range of 11-33V DC, $\pm 0.5\%$ accuracy, an overpressure range (twice the maximum range) and rupture pressure (triple the pressure range upper value).

Process connections: external thread $\frac{1}{4}$ NPT, $\frac{1}{4}$ G, $\frac{1}{2}$ NPT or $\frac{1}{2}$ BSP.



Digi-Key releases 1.5 million SnapEDA CAD models

Digi-Key Electronics announced its collaboration with SnapEDA, providing over 1.5 million high-quality symbols, footprints, and 3D models for Digi-Key parts. These can now be downloaded from digikey.com

With this collaboration, engineers can access SnapEDA's high-quality CAD models directly on Digi-Key's website, further streamlining their design flow.

To start downloading EDA and CAD parts from Digi-Key, go to a part detail page, look for the row labelled "EDA / CAD Models" and click on Download from SnapEDA. Supported formats include Altium, Eagle, KiCad, OrCad, Allegro, PADS, and DXDesigner.

SnapEDA adds millions of parts to its library each year, aided by its computer vision technology such as InstaBuild, and other automation tools.

Supported suppliers on SnapEDA include Recom, CUI, Samtec, TE Connectivity, I-PEX, GCT, CUI Devices, Bel Fuse, Murata, Texas Instruments, ECS, Triad Magnetics, Quectel, Infineon and many more.

SnapEDA is on a mission to help engineers innovate faster by removing barriers. They help over one million engineers find CAD models for their electronics designs each year. Their community of professional engineers are making everything from medical devices to electric airplanes.

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VINTAGE RADIO

Philips 1963 “Musicmaker” MM1 mantel radio

By Associate Professor Graham Parslow

Philips valve radios from the 1960s had excellent sound, came in a variety of interesting colours and were quite affordable at the time. This article covers three different models: the model 224, MM1 and MM1/01, as they look similar. Their performance is indistinguishable because they all use the same circuit and components.

The design of valve-based superhets was fully mature by the 1960s. By then, they were pretty much all using tried and tested components and circuitry. The competing Kriesler range of valve mantels were comparable and sold in greater numbers, as judged by the number of remaining units held by collectors.

The Philips radios had a more conservative style, and that may have been advantageous for a kitchen radio where function was the prime consideration. Philips also made other valve radios in the 1960s, notably the mantel model 172 using inductive (permeability) tuning, as well as valve radiograms.

But the biggest competitors to these radios were the then-new transistor types. Philips made a good range of transistor sets, both for battery and mains operation, at prices comparable to the valve radios.

Their transistor models included the Philadelphia model MM2, the Metropolitan model MT7 and the Leisuremate model RB290, all are pictured at the end of the article.

The downside to these transistor radios was an audio output of only about 300mW before distortion became severe.

Australian Philips valve and transistor radios were manufactured at Hendon in South Australia. Local production ceased in the early 1970s when tariff protection was lifted and imported radios took the market. Those imported radios usually cost less than just the local cost of the components!

Three similar models

The model 224 was introduced in 1961 at £27, and was marketed with the title “Futura Five”. It came in one of six colours: ember red, flamingo, charcoal, turquoise, grey and primrose.

The escutcheon at the sides of the dial had a two-tone colour scheme, with one section usually being metallic chrome or gold. The other section was usually black, but sometimes colour-matched to the case.

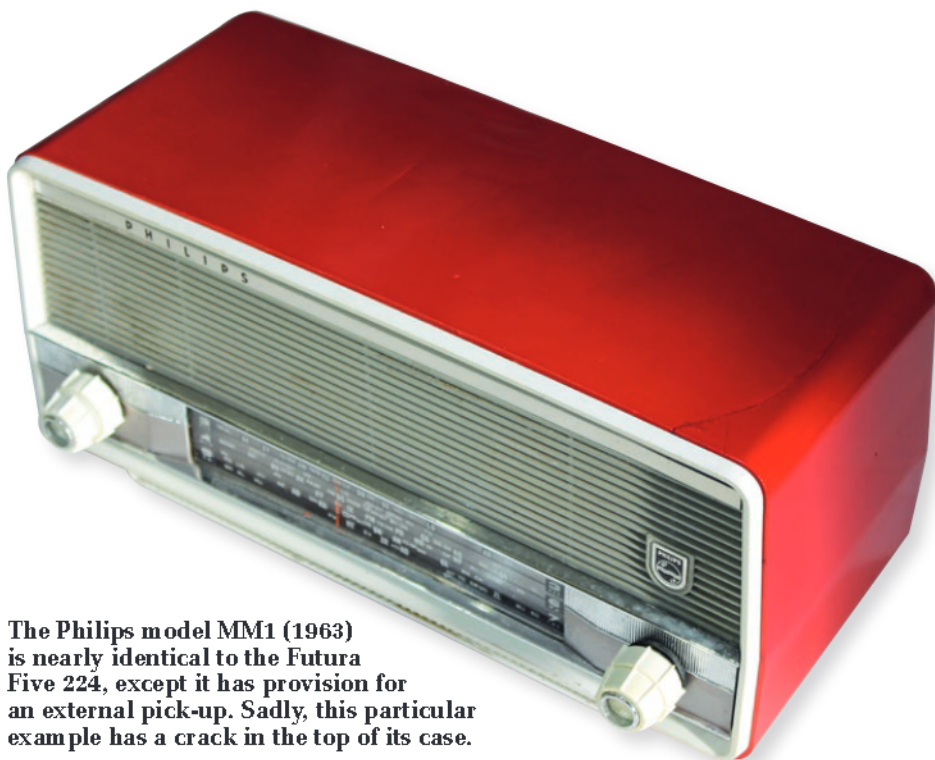
The knobs were cream with eight raised flutes. The volume and tone knobs at the left drove concentric pots,

with a DPDT on/off switch linked to the tone control.

The tuning knob used the same two segments to duplicate the appearance of the left-hand knob, but it was mounted onto a single shaft with stepped diameters to lock the sections together.

The easiest way to identify the model is to look at the paper label pasted under the case. However, these labels are easily damaged and sometimes missing. An example of the label from an MM1 radio is shown at the end of the article.

The model MM1, marketed as the



The Philips model MM1 (1963) is nearly identical to the Futura Five 224, except it has provision for an external pick-up. Sadly, this particular example has a crack in the top of its case.

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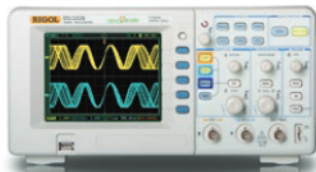
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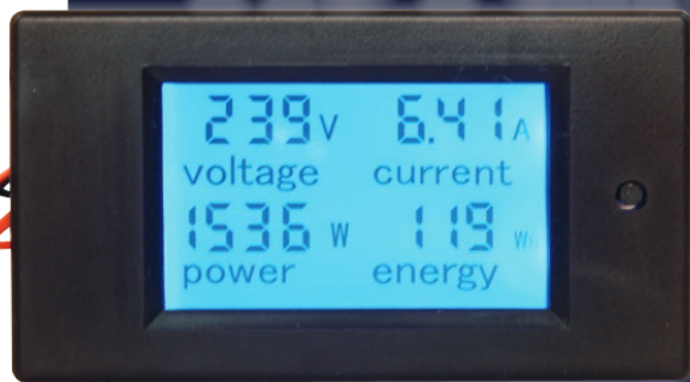
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Mini Digital AC Panel Meters



In this follow-up article on low-cost digital panel meters, we're looking at meters designed to measure AC voltages and currents. Some of them can even calculate and display power, energy consumption and frequency. As usual, we'll give you an idea of how they work, how they perform and how easy they are to use.

As promised last month, this second article describes some small meters designed to measure AC voltages and currents. The AC models are even more interesting than those we described last time. For a start, they vary more significantly in both size and price.

Like the DC meters we looked at in the first article, these AC meters are all designed to be powered from the same source used for voltage measurements. So no separate power source is needed.

It's important to make sure all connections are properly insulated when taking measurements.

As explained last month, DC meters measure currents by measuring the voltage drop across a very low resistance current shunt. In contrast, AC meters typically measure currents by using a special kind of transformer: a current transformer or 'CT'. This steps down the current to a much lower level, as well as providing galvanic isolation for improved safety.

Current transformer basics

One of the big advantages of AC

compared with DC, as Nikola Tesla and George Westinghouse stressed over 120 years ago, is that with AC you can use transformers to step the voltage up or down to whatever level best suits your purposes.

This means that AC power can be stepped up to hundreds of thousands of volts to reduce losses when conveyed over long distances, then stepped down to much lower voltages like 230V or 115V, for somewhat more safe use in houses, factories and offices.

Of course, when a transformer steps up the voltage, it also steps down the current, and vice versa. This is due

to the conservation of energy (ie, the product of voltage and current at the output must be similar to that at the input). So if the voltage is stepped up by a factor N , the current is stepped down by the same factor, and if the voltage is stepped down by N , the current is stepped up by the same factor.

This is much harder to do with DC; generally, this means converting the DC voltage to AC, stepping it up or down, then rectifying and filtering it to turn it back into DC. That is not easy to do efficiently!

The current transformer works on the same principle, as shown in Fig.1. It consists of a toroidal magnetic core,

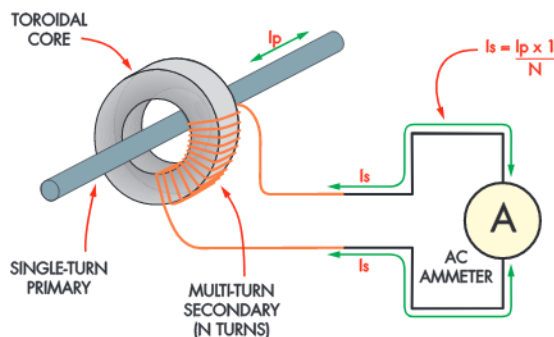


Fig.1: how the current transformer (CT) operates. The CT secondary should be terminated with a low impedance, otherwise it will generate a very high voltage if any significant AC current is flowing in the primary. Make sure to connect the secondary leads of the CT to the panel meter before any current is allowed to flow through the primary.

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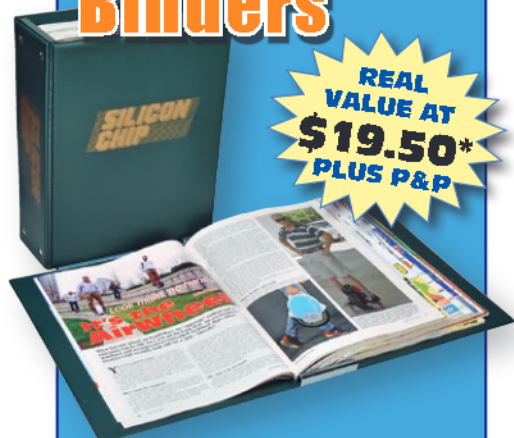
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Notes & Errata

Balanced Input Attenuator for the USB SuperCodec, November-December 2020: the photo shown halfway down the left-hand column on page 71 of the December 2020 issue, showing the wiring to the power connector, is incorrect. The positive (red) wire should be shown going to the bottom-most pin in the socket, with the black (negative) wire to the top. Also, in the circuit diagram on pages 50 & 51 of the November 2020 issue, the centre (ground) pin of CON3 at upper right should only be connected to the junction of the two zener diodes, the negative end of the 100 μ F capacitor next to switch S1 and the negative ends of all relay coils. The junction between this ground and the other grounds in the circuit is on the main SuperCodec board.

Two LED Christmas Stars, November 2020: in the parts lists on page 41, there is no such part as a 75HC595. It should read 74HC595 instead.

D1 Mini LCD BackPack with WiFi, October 2020: in the circuit diagram (Fig.1), the connections to pins 7 & 8 on the LCD module via CON1 are swapped. The drain of Q1 should go to pin 8 (LED) while pin 7 is the display SCK line and also connects to pin 10 on the LCD module and on to the D5 pin of MOD1.

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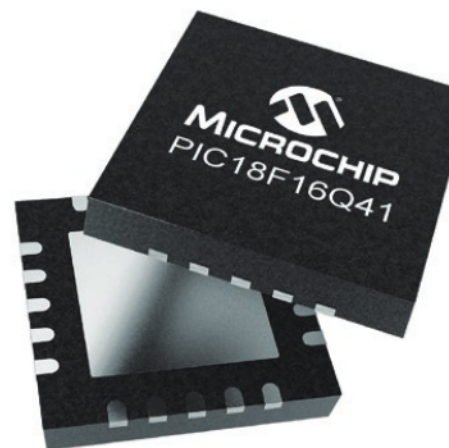
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