December 2023 Vol 57 No 4

MERG® Journal

Journal of the Model Electronic Railway Group

MaxDuino

Garden Railway Signalling

Gnawe Upon Toaste

Stepper Motor Turntable

Tayside AG Shuttle

N Gauge Coach Lighting

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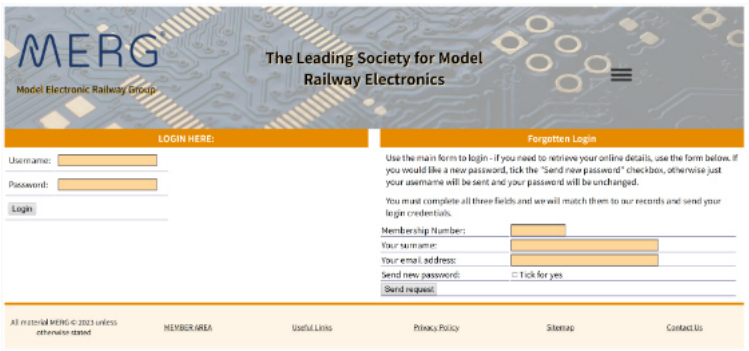

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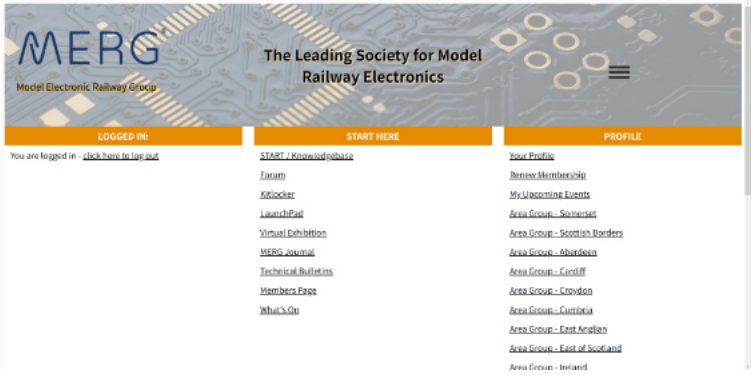

Member Area

Member Resources

MERG's website comprises several discrete parts with a completely different look and menu structure to each one. This is the legacy of how our virtual presence has expanded rapidly over the past decade.

The Home page has information about MERG and a taste of what is available to members. There are links to further details about:

- Quarterly Journal
- Technical Bulletins
- Members Forum
- Knowledgebase

Also Davy Dick's ebook "Electronics for Model Railways" - free for all to download.

Member Area

Log in via the link 'Members Area' - see left - which provides access to our resources:

START/Knowledgebase:

The portal to thousands of pages written by our members.
Forum: Want to introduce yourself, ask a question or provide a solution? This is the place.
Kitlocker: MERG's shop window, approximately 250 lines including kits, PCBs, components, PSUs, apparel and other items.
LaunchPad: A quick guide for new members.
Virtual Exhibition: Presentations and layout videos.
MERG Journal: An archive of publications from 1997 onwards in PDF format for download.
Technical Bulletins: PDFs on all things relating to model railway electronics including legacy kits.
Members Page: Where to find documents and links to key parts of our website.
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Charter and Rules:
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Committee members:
https://www.merg.org.uk/merg_pages/committee.php

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The Journal of the Model Electronic Railway Group

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Editorial

Welcome to the December edition of the Journal, somewhat delayed to include AGM news and by availability of Journal Team members. On a positive note it has enabled me to include reports of recent Area Group activities and their promotion of MERG at local exhibitions – see the 'Exhibitions' page for events in 2024.

Articles

We feature several multi-part articles: Allan Geekie & Co's next instalment of the Automatic Train Controller 2, Alan Miles describe the use of stepper motors, Colin Stephenson employs opto-electronics to good use and Alan Trevennor demonstrates touch screen technology for mimic panels.

Elaine Bentley's thought provoking 'Gnawe upon Toaste' combines an unusual layout with an important health message, whilst Dick Moger's lengthy experience of garden railways provides hard won and above all practical advice applicable to all layouts. Alan Lomax's Arduino Nano based project 'MaxDuino' provides a building block for multiple applications.

Andrew Hicks explains how to animate a crane complete with sound effects. Trevor Pocock and Torben Cox describe their design and construction of a DCC custom light bar for Dapol and Graham Farish N-gauge coaches.

Due to the size and complexity of some articles' content, the limitation of print media and our page count, the reader is occasionally referred to downloads from the Journal's Knowledgebase area and other web-based sources.

Other matters

As we go to press a new Journal Editor has yet to be appointed. It is essential that a member volunteers otherwise publication of the March 2024 issue is in jeopardy.

Duncan Greenwood has agreed to take on the post of Assistant Editor. At least one extra Assistant Editor is required also a Schematics Editor to unify the appearance of line artwork.

Finally, it is essential I pay tribute to everyone on the Journal Team – past and present – during my brief tenure. Gentlemen, thank you for your advice and work in bringing our contributor's content to MERG's 4000+ membership. I single out Graphics Editor, Phil Silver, as making a significant contribution to the Journal's new look and feel.

Emily Johnston
Journal Editor

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Garden Railway Signalling System

Dick Moger M5552

Most of what we read about in journals like this one is wonderfully thought through high tech solutions that are the epitome of logic. If this is what you are looking for then read no further – this isn't that!

My main interest is the designing and building of Gauge 1 (10mm/ft) live steam locomotives that I run on my fairly substantial garden railway and implementing an automatic signalling system was something that happened rather than was planned. I suspect that many such projects start like this and don't get written up, but since very little has been forthcoming on garden railway applications and also since lessons have been learnt here, it could prove useful for those working outdoors where different rules apply.

I will commence with a brief description of the system and the environment it is running in:

Gauge one railway tracks tend to be a fairly scarce resource and are best enjoyed in company with fellow enthusiasts. Typically, on this track, up to four trains can run at a time and they are often large, fast, heavy and expensive. They can be Live Steam, electric or even clockwork, with about half of the first two using radio control.

Crashes due to wrongly set points theoretically involve nearly one hundred times the kinetic energy of 00 scale, although in practice relatively lighter section materials are used, but obviously collisions must be avoided and so what started quite simply as a warning bell to notify drivers when the road was set against the main line, gradually evolved into a fully-fledged all the bells and whistles affair.

Figure 1 – H class steam loco to my own design passing under gantry by the top return loop. These four sections are currently controlled by MERG relay boards and a bit of my own logic to prevent sets and resets of block occupancy coming simultaneously. Note that these signals mimic the LSWR automatic signalling with pneumatic signals normally clear. The signals go to danger as the section is occupied, the stop arm clears when the first section is unoccupied and then the distant arm will clear when the stop signal ahead clears, i.e. when two sections are clear.

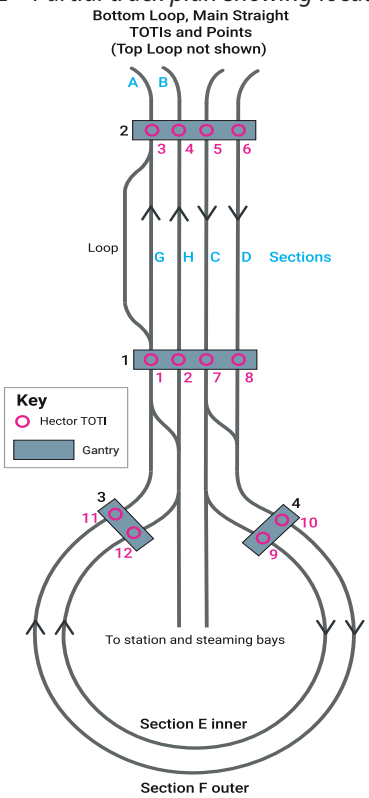
The original bell box with micro switches on the manually operated points whetted the appetite, so next came a switched control panel using Servo4 drivers to operate the points closely followed by a gantry of semaphore signals to indicate the point settings. I tried to include section occupancy but track circuiting outdoors with uncertain wheel materials and pick-up made it a non-starter. MERG relay boards were the basis of this and proved to be both reliable and good fun.

The next "while I am at it" was a second gantry that spanned all four tracks at the throat of the far return loop and used laser TOTIs combined with universal relay boards with a bit of my own logic to provide proper section notification. Obviously, you don't want sets and resets fighting each other, so use was made of the positive going TOTI outputs to block this happening via NAND circuits.

This was so much more workmanlike than the original gantry that I rebuilt the first gantry with laser TOTIs and included the up-semaphore signals as well. Finally, I realised that with a little more effort and a couple of smaller gantries I could section the whole railway. This last involved Arduinos and lots more laser TOTIs and Servo4 drivers.

Why all the gantries? Laser TOTIs are great except that outdoors the sun takes over from the laser on a bright day. If you install the lasers overhead they work with the sun and not against it. I also use a dual Hector as a sensor in a shaded part of the track, but in general the laser TOTIs do the business.

Figure 2 – Partial track plan showing location of Train on



Track Indicators (TOTIs)

Another good reason for gantries is that drivers of live steam locos can either have their hands in the cab or forget that the hand pump handle is sticking up out of the tender and any lightweight signal may go unnoticed and hence is likely to be trashed. A robustly built gantry will survive this.

The most curious of my "while I am at it" decisions is the use of Arduinos. I spent 30 years in IBM scrupulously avoiding anything to do with software and so the choice when in my eighties of programming in C++ is difficult to explain. It can hardly be described as a career move!

My original thinking was that I could find a ready-made program and simply tweak a few names and labels thus avoiding the horrors of the syntax. Not so alas, a suitable base program that employed Switch/Case instructions was found but I ended up having to do a total rewrite. I drove the Arduino website barmy with daft questions until it eventually worked and only a friend who happens to be Professor of IT was able to explain adequately what I was doing wrong.

If your subroutine uses up all the branch options you never get to the default do you? Perhaps the nuances of Switch/Case instructions are less well understood by the Arduino community than most others.

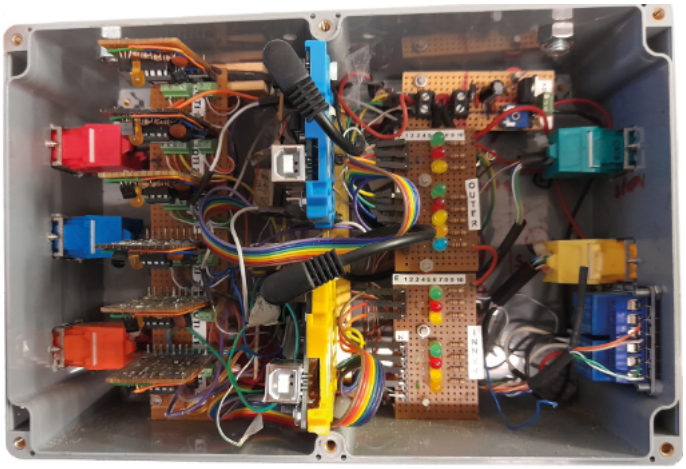


Figure 3 – Close up of the main Arduino control box. Note the six pluggable laser TOTIs at the end with RJ45 connectors (red and blue to the lasers and photo-transistors). The Arduinos are upright with an associated LED diagnostic array to the side and orange RJ45 connectors adjacent. Four sections are controlled here.

Naturally I have ended up with about a dozen cables in order to integrate the different components of the system and to this end I found that the beloved 9 pin sub-D cables and connectors were not only expensive, but they rust. I quickly moved over to Cat 5 with RJ45 connectors and immediately felt that this was so simple and low cost that I must be cheating.

The other vital component is a large manual. Because it grew rather than being planned, it has no common architecture such as EzyBus and each individual box is just that – individual. Without this the system would be unmaintainable. You will note that I have used up just about every available Arduino output with LEDs, this is a legacy of my hardware background that tries to counteract my software naivety by providing tangible status information.

The Laser TOTIs (PMP22) are mostly repackaged with LEDs and made pluggable into a motherboard so that they can be quickly eliminated in any diagnostic procedure. What may not be evident to indoor users of this kit is that because the laser is 'strobed' to reduce its power, it is unlikely to function simultaneously with an adjacent laser TOTI, however sunlight is constant and will operate all the associated photo transistors that are exposed to it regardless of the laser.

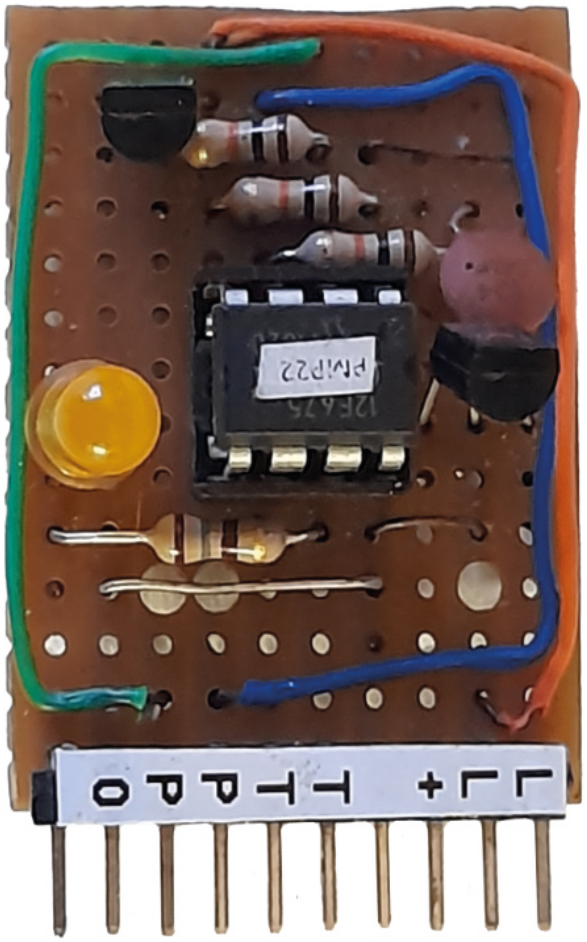


Figure 4 – I have repackaged the original kit 22 laser TOTI with an LED and made it pluggable, which is useful for diagnostic purposes.

The one MERG kit that did not work for me was the Ezypoint single servo driver, but this was largely down to the mechanics of the signal arm restricting the angular movement of the servo.

Kit 77R proved to be an excellent replacement, directly driving the loop semaphore arm when the loop entry point is operated, with the relay contacts informing the Arduino of the signal, and hence the point, status.

The entire railway was featured in an article by Stuart Hithersay in the October 2022 Garden Rail magazine and has successfully hosted many running events. Fortunately, no other "while I am at it" bright ideas have occurred of late so I have finally got round to sorting out the last remaining bugs.

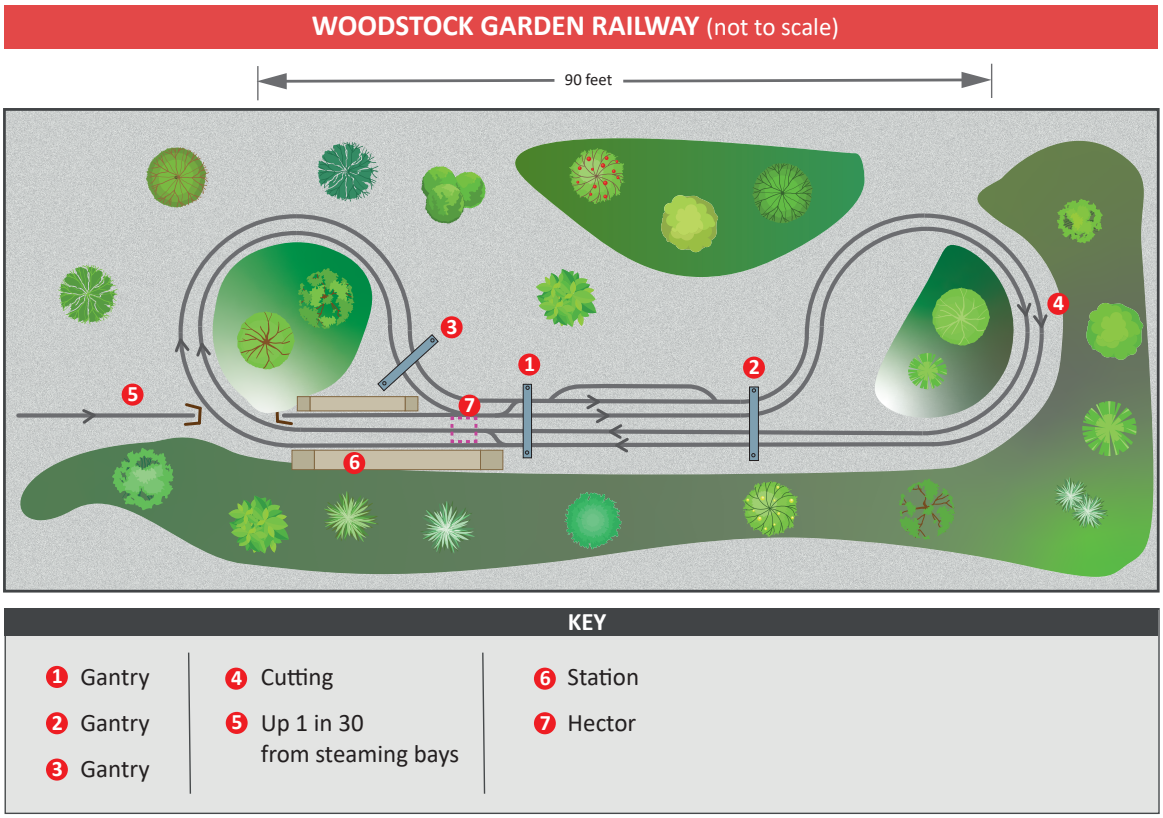


Figure 5 – Woodstock Garden Railway track plan (artwork by Phil Silver, various station and siding tracks omitted for clarity)

In conclusion, the salient points with regard to operating in the garden are as follows:

- Most MERG kits are sufficiently well designed and robust to withstand the garden environment provided that sealed ABS boxes of suitable size are employed. Plug all holes in the boxes and avoid wooden supports as otherwise the woodlice will take up residence.

- Don't use 9 pin sub-D connectors and cabling. They rust, are expensive and are difficult to make up with ageing eyesight. Cat 5 cabling with RJ45 connectors is a vast improvement. So far, no difficulties have emerged with cable distance. In some cases, as much as 3m is found between lasers, photodiodes and their associated TOTIs.

- Beware of the sun with TOTIs – work with it, not against it.

- Track circuiting is a no-no. Use relay latches or switch/case states driven by TOTIs.

- Make sure you document everything in a manual, particularly the cabling and the interfaces.

- Include as many LEDs as you can for diagnostic purposes. You will soon forget how it works without them.

- Confusion can arise with multiple lasers and photo diodes in close proximity particularly where you have multiple running lines. When the sun is out, they all work well, but the individual strobing of the lasers means you won't find if you have inadvertently swapped adjacent lasers over until the sun goes down.

My much rewritten Arduino code is available if anyone is interested and I am also in the process of rewriting this code as a simplified version with just three states, Clear, Occupied and Caution. This is just in case I need to replace the relay boards that control the far loop sections, as water has rusted a few of the tag board connectors. These differ by using three TOTIs per two sections, not four.

Finally, no matter how you do it, it will probably still work, so enjoy!

Figure 6 – A 2Bil passing under the second gantry. In fact it hasn't reached the photodiodes in this shot, but the photographer's hand has triggered the occupancy of the section.

Woodstock Garden Railway - summary of kits used:

- PMP 22/PMK22 Laser TOTI
- Kit 75 Servo 4 Driver
- Kit 72 Dual Hector
- Original item 921 Universal Relay board
- Kit 77R Single servo driver

Biography - Dick Moger

I trained in the RAF on ground radar and joined IBM in 1963 working on the early 1400 series computers. I helped in the development of an early multiplexor for NatWest that linked a 1406 to remote paper tape readers in branches, which operated successfully for quite some years. I became a hardware specialist and moved on to the 360 series specialising in optical readers.

I spent time in France as a technical writer describing the switch matrix of a computerised telephone system and returned to the UK as a systems engineer in a support group where I specialised in voice over data networks.

I retired in 1992 and ran a consultancy business. I am currently the President of G1MRA – the Gauge One Model Railway Association.

Stepping Out - Part 1

Alan Miles M8258

Introduction

These notes are a result of looking for ways to motorise an OO gauge Peco turntable. From web searches the choice of an Arduino Uno, NEMA 17 and A4988 driver chip presented itself as a recognised combination with a range of documentation available. A4988 refers to the chip itself but is used here for brevity as an abbreviation for the A4988 stepper motor driver carrier.

This article is not a step-by-step guide to building a motorised turntable; it is an introduction to the Arduino, NEMA 17 and driver board combination. Using the web sites referenced the components can be assembled and used to evaluate their limitations and capabilities. The information available on web sites can lack detail, be contradictory or wrong and can require reading across multiple sites to get a fuller picture. These notes are based on my own experiences, they fill in some of the gaps and point out areas to be aware of. I realise referencing web sites is not always a good idea as they may be taken down or changed, but the contents of other sites are similar, even identical in parts, so these notes will still have some relevance. In this article I refer to two sites "How to control a stepper motor with A4988 Driver Module and Arduino" [Ref 1] and "Control Stepper Motor with A4988 Driver Module & Arduino" [Ref 2]. Both sites are alike and representative of what is available, not perfect but they give a reasonable overview and enough information to set up a working motor. Read through these sites first then read these notes as supplementary material. Both sites have final sections on using the AccelStepper code library these are not needed to get a motor up and running.

Part 2 of this article will provide a brief note on my turntable construction and details of the controls and coding I used for turntable operation.

Why use a stepper motor

"... stepper motors offer excellent speed control, precise positioning, and repeatability of movement. Additionally, stepper motors are highly reliable since there are no contact brushes in the motor. This minimizes mechanical failure and maximizes the operation lifespan of the motor." [Ref 3]

There are some disadvantages associated with stepper motors. Possibly the main one for modellers is low efficiency. A stepper motor will draw power even when stationary as current is needed to hold a stepping position. Stepper motors can run hot, a concern raised on web forums, but it is normal for a motor to get hot when in operation. Current limiting (see below) will help prevent overheating.

NEMA 17 stepper motor

NEMA is not a trade name, it is the name of an international (American) standards committee, the National Electrical Manufacturers Association. In 1984 NEMA set out standards for motor sizes based upon the faceplate size of a motor.
17 indicates that the face plate size is approximately 1.7 inches x 1.7 inches.

As mounting hole diameters and spacings between mounting holes are part of the NEMA standards, 3rd party manufacturers are able to produce standardised accessories, such as mounting brackets. Standard dimensions allow for easy swapping out of components. Electrical specifications are not standardised so check these before making changes. It may not always be the case that motors with the same NEMA designation have the same shaft diameters and lengths. There are different styles of shaft, mine was a D type having a flat side for grub screws to lock against. Vertical heights of motors are not standardised and also vary.

I used a NEMA 17 motor, described as a "NEMA 17 Stepper Motor 26Ncm 0.4A 42x34mm 12V 4 Wires for 3D Printer Extruder". Motors are unipolar or bipolar. Bipolar stepper motors have four leads whilst unipolar motors typically have five, six, or eight leads (unipolar motors can be converted to work as bipolar motors). The motor description does not include the term "bipolar", but it is important to check before making a selection. The A4988 driver is designed to work with a bipolar, 4 wire stepper motor. The NEMA 17 used has two set of coils, known as phases, with two wires to each hence four leads.

Wiring colours are not standardised but usually follow one of two patterns or occasionally a third [Refs 4 & 5]. Buying a motor with a plug already attached will make life easier, mine came with a plug and wires that followed one of the common colour arrangements. [Ref 1] has a section on determining the correct motor wiring if it has bare wires. In that section, the author says "spin the shaft freely", this is unlikely to happen, the motor will give resistance with a notched feel if rotated.

Remember if you are connecting/disconnecting motor wires always power the system down first or risk blown components.

0.4A is the rated current for the motor. In data sheets it will be quoted as current per phase. NEMA 17 motors mostly range between 0.3A and 2A. In general more current gives more torque. A knowledge of the rated current is needed to be able to set the current limit on the driver. This is an important part of the setup and must be done, see below.

Motor torque is listed "26Ncm". I gave no consideration to torque requirements.

The NEMA 17 has a step angle of 1.8° equating to 200 steps for a full revolution (1.8° x 200 = 360°). The term microstepping refers to the ability electronically increase the number of steps per revolution to produce a smoother rotation and finer control, suitable for driving a turntable. If microstepping in quarter steps, a full revolution will take 800 microsteps. The A4988 driver board is capable of microstepping the motor down to sixteenths.

A4988 driver carrier

It is possible to control a motor without using a driver. The advantage of a dedicated driver is that much of the heavy lifting is done for you, simplifying both circuitry and coding requirements. With the A4988 driver an Arduino board can control a stepper motor through just two pins, STEP and DIR. A series of pulses to STEP will be translated into steps and direction of movement is controlled through change of level to DIR. The stepper motor has two sets of interleaved coils and the A4988 controls the currents through each set to drive the motor.

A motor connects to a A4988 driver module through the pins marked 2B, 2A, 1A & 1B. The wiring colours shown are for my motor. Power for motor is fed in through VMOT and GND. Plug is reversible, if reversed then directions of travel will be swapped.

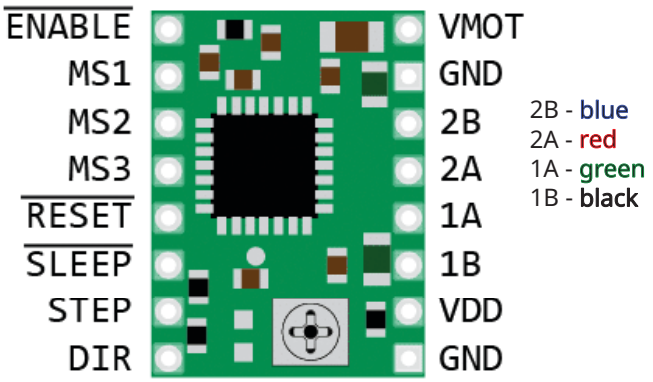


Figure 1 – A4988 drive pinouts

Current limiting

This is not optional. Current limiting caps the maximum amount of current that is allowed to flow through the stepper coils thereby ensuring that the motor's rated current is not exceeded. [Ref 1]. Be careful when referring to the web, some sites do not always emphasis that current limiting should be the first thing done before setting up a stepper motor and driver. Current limiting should be done before any other steps are taken.

Setting the limit - Vref

Vref is a Voltage Reference that corresponds to the maximum current that will flow from the driver board to the stepper motor. It is essential that Vref is set correctly to ensure the driver board and/or the motors are not damaged by excessive current. Vref on the A4988 is adjusted by turning the small potentiometer found at the bottom of the board – see Figure 1

There are two methods to determine and set the current limit. One is to use a multimeter to physically measure the current flowing through an energised coil and to adjust Vref to obtain the desired current.

The second method is to calculate what Vref should be, and then adjust, the reference voltage on the driver. This second method does not require the motor to be connected to the driver board or powered on. This second method is the easier of the two methods and is the method discussed below. Use the instructions in [Ref 1], it is the only method this reference describes and states "you don't need to connect the stepper motor to the driver when setting the current limit".

Calculating the required Vref

To calculate the correct Vref, we first need to know the value of the current sensing resistance (Rcs) on the board. The Rcs installed on the A4988 are small surface mount resistors and their values can be difficult to read. Their markings are in the form R050, R100, R200 etc. standing for 0.05Ω, 0.1Ω, 0.2Ω. My A4988 driver board has 0.1Ω resistors. [Ref 1] has a photo to show where the resistor (in fact either of 2 resistors) is situated on the board. [Ref 7] and other sites show a third resistor that can be used.

As stated earlier, Vref determines the maximum current allowed on the board. Sites may offer different calculations for current limiting, Vref is the value to be found.

[Ref 1] uses the formula Current Limit = Vref ÷ (8 x Rcs), where Rcs is the current sense resistance and Current Limit is the rated current for the motor in use.

[Ref 2] uses the formula Current Limit = Vref x 2.5.

This second formula is commonly seen on sites. It is the same as the [Ref 1] formula but assumes a resistance value of 0.05Ω for the board. Not all boards are the same, determine your Rcs value first then use the appropriate formula.

Adjusting Vref

Once you have determined the value of Vref required for your board and motor combination it is time to go ahead and adjust the value of Vref. Remember, this must be done before connecting a motor to the driver board and energising the motor.

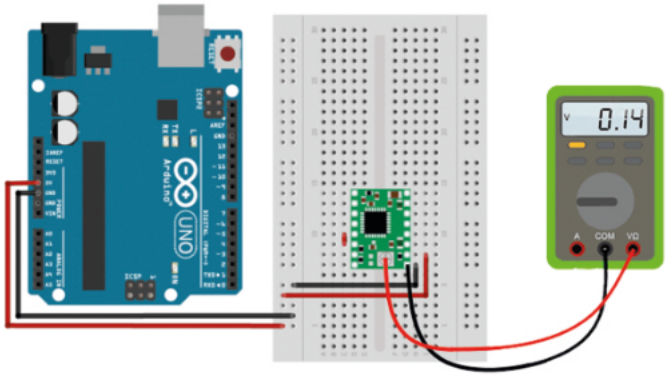


Figure 2 – Wiring for current limiting

First off, connect the Arduino to the A4988 as shown in Figure 2. Note: there is no stepper motor in this circuit.

Also, please note that one of the diagrams in [Ref 1] shows the multimeter connected to the A4988 driver with the driver out of circuit. The A4988 driver board must be in circuit with the Arduino or breadboard supplying the necessary 5v.

Do not forget the jumper between the SLEEP and RESET pins; RESET pin is floating, connecting it to the SLEEP pin will bring it high and enable the board.

Using a small cross head screwdriver, adjust the potentiometer in very small increments until the desired Vref value is displayed on the meter.

Make sure to use only small movements to adjust the potentiometer. The potentiometers used are not robust and have a limited range of travel.

Some sites suggest connecting the meter lead to an insulated screwdriver with an alligator clip, this does make the setting process much easier.

The potentiometer is designed to take a cross head screwdriver but the video demonstrating current limiting on the Pololu (suppliers of A4988s) website [Ref 6] suggests a flat head is better suited.

A question sometimes asked on web forums is "the current limit given on the data sheet is listed as current per phase, my motor has two phases do I need to double the Vref value (or current limit)?". Answer given is no.

Web site observations

The voltage adjustment instructions given in Method 1 [Ref 2], have the motor connected and powered. Posts on forums warn against this, pointing out that boards may not all be designed the same way. In addition, the circuit shown is wrong, it shows the meter leads set up to measure current.

[Ref 1] offers an adjustment to the calculation if the driver is to be used in full-step mode. Unlikely with a model turntable.

Motor setup

With Vref set it is safe to attach the stepper motor and other components as detailed in [Ref 1], see Figure 3.

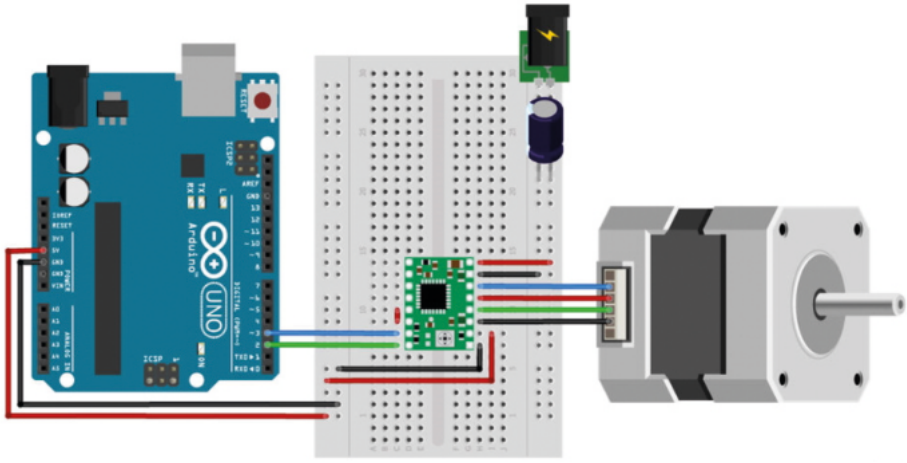


Figure 3 – Wiring for A4988 stepper motor driver

Make sure the heat sink (which should come with driver) is attached to the A4988 IC.

Uno and driver both need 12v feeds. The 12v feed does not run directly to the motor but passes through the A4988 board. The Uno is capable of outputting 12v but cannot provide sufficient power to run the stepper motor.

The 100µF decoupling capacitor on the motor power feed to the A4988 is essential.

Remember do not disconnect motor or make changes to circuit without first powering down.

Controlling the motor via the Arduino

Both [Ref 1] and [Ref 2] provide code to test run stepper motors. At the most basic level, all it takes to control a stepper motor using the A4988 driver board is to input a pulse, HIGH then LOW, on the STEP input to drive the motor one step and a HIGH or LOW sent to the DIR input to set the direction.

The code provided on the referenced web sites comes with and without, included libraries, these notes are for code without included libraries.

Problem with sample code provided

The code in [Ref 1] and [Ref 2] is set for full stepping. I did try the code given in [Ref 1] using the circuit shown in Figure 3. In common with other sample code given on the internet it uses the function delayMicroseconds() to control rotational speed by putting a delay between driving the STEP pin LOW then HIGH i.e. the end of one pulse and the start of next. This function times in millionths of a second and values as low as 500 are used, this creates a gap of 0.0005 seconds between pulses. The rotational speeds generated were beyond the capabilities of my setup (which outwardly was the same as that given in [Ref 1] and [Ref 2]), there were erratic or limited movements and a squealing motor (often indicative of too high a step rate). I did not continue with this for fear of doing damage.

Changes to the sample code

Reading from the Arduino Reference site [Ref 8]: "delayMicroseconds(). Currently, the largest value that will produce an accurate delay is 16383". The longest gap this allows is 0.016 seconds.

In my test code, I replaced delayMicroseconds() with delay(), which measures in milliseconds. The code shown below uses delay(24) which gives 0.024 seconds between pulses.

Example code, as in [Ref 1], often includes an additional delay between STEP HIGH and STEP LOW, this is there to ensure the generated pulse is long enough to be recognised by the driver. As others have noted, the inherent delay in the digitalWrite() function can render the need for this additional delay redundant. This was the case, but the delay function was left in the test code given below to allow experimentation with differing pulse lengths. Commented out in code below, remove // to enable the instruction.

Coding libraries

Coding for the turntable does not need any additional libraries to be loaded. However, there are stepper motor libraries available.

The library you are most likely to come across is AccelStepper.h (capitalisation is important).

I did not use a library. I did try AccelStepper but with the slow speeds of a turntable, and sometimes short distances moved, it did not add anything significant.

If you try AccelStepper, note that it uses both relative and absolute positioning. The instruction moveto(50) will move the motor 50 steps, follow this with moveto(54) and the motor only moves 4 steps as it is already at position 50 (absolute positioning). The instruction move(50) will move the motor 50 steps, follow this with move(54) and motor will move an additional 54 steps (relative positioning). For AccelStepper the start point (position 0) is arbitrary, zero is the position the motor is in when it starts up.

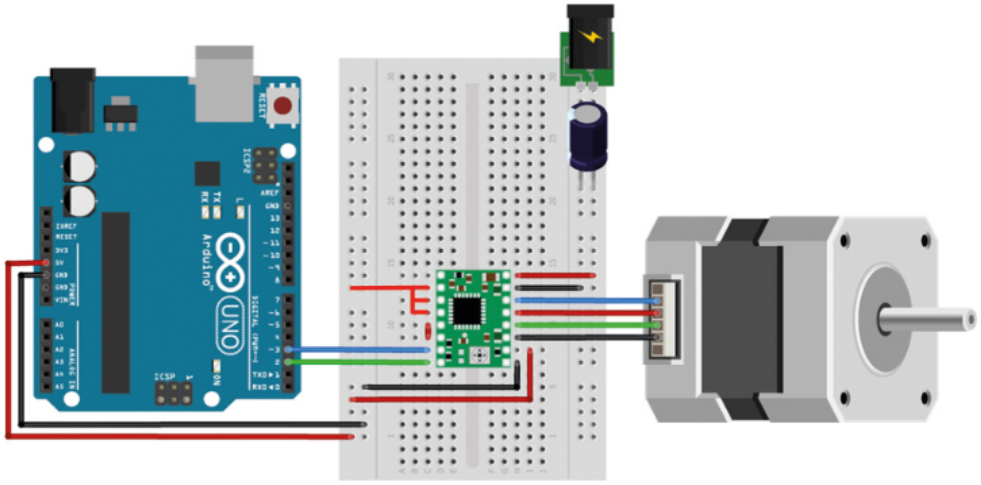


Figure 4 – Wiring for microstepping

The Stepper.h library, driving A4988s, is used in code examples given on some web sites. Other sites say that this library is not designed to work with drivers like the A4988, one reason given is that the library is designed to do what the A4988 does anyway. Out of interest I did try it and my setup was not happy, I think the driver/code library combination was trying to divide microsteps into smaller microsteps.

Microstepping

Table 1 gives necessary settings for driver pins MS1, MS2 and MS3 to achieve various microstepping resolutions.

MS1	MS2	MS3	Microstep resolution	Full revolution
Low	Low	Low	Full step	200
High	Low	Low	1/2 step	400
Low	High	Low	1/4 step	800
High	High	Low	1/8 step	1600
High	High	High	1/16 step	3200

Table 1 – Microstepping settings

Microstepping resolution can be set by making the appropriate connections in the circuit. Pins can be set HIGH by connecting to the 5v line. In Figure 4 pins MS1, MS2 and MS3 are set HIGH by connecting to the 5v line so microstepping will be set to step in sixteenths.

Test code for circuit in Figure 4

This is the test code that worked for me after the problems encountered with the example code given in the referenced web pages. With no switches in circuit the code will run continuously. Main code is in void loop() and gives a repeating sequence of a half revolution followed by a full revolution in the opposite direction. The code is for the circuit shown in Figure 4 which is set to use microstepping in sixteenths, 3200 steps for a full revolution. Turntable speed can be controlled by changing the value of milliseconds between Steps.

If you use the example code from [Ref 1] or [Ref 2], the turntable speed can be controlled by changing the delayMicroseconds() values that come after the digitalWrite(stepPin, LOW) lines. Remember the code is for full stepping so use the circuit as shown in Figure 3 that has no connections to MS1, 2 or 3.

The motor can exhibit random or juddering movements due to floating pins. [Ref 6] says "the STEP and DIR pins are not pulled to any particular voltage internally so you should not leave them floating in your application". This did happen and lines were added to the code in setup() to pull both pins LOW, this resolved the problem.

```
//defines Uno pin numbers
byte DIR_pin = 2;
byte STEP_pin = 3;
//pulse width time between step HIGH and step
LOW, microseconds
int pulseWidthMicros = 20;
//number of milliseconds between step pulses
will control speed
int millisbetweenSteps = 24; //bigger the
value the slower the speed
void setup(){
  //sets pins as outputs
    pinMode(DIR_pin,OUTPUT);
    pinMode(STEP_pin,OUTPUT);
  //ties pins low
    digitalWrite(DIR_pin, LOW);
    digitalWrite(STEP_pin, LOW);
}
void loop() {
  digitalWrite(DIR_pin,LOW); //set direction
  //1600 pulses for one half rotation
    for (int x = 0; x < 1600; x++) {
    digitalWrite(STEP_pin,HIGH);
  //delayMicroseconds(pulseWidthMicros);
    digitalWrite(STEP_pin,LOW);
    delay(millisbetweenSteps);
  }
  delay(1000); //one second delay
  digitalWrite(DIR_pin,HIGH); //set direction
  //3200 pulses for one full rotation
    for (int x = 0; x < 3200; x++) {
    digitalWrite(STEP_pin,HIGH);

  //delayMicroseconds(pulseWidthMicros);
    digitalWrite(STEP_pin,LOW);
    delay(millisbetweenSteps);
  }
  delay(1000);
  }
```

In the testing phase attaching a turntable deck or taping a ruler to the motor will make observing the speed and movement of the motor much easier, particularly for any small or erratic movements. Clamping the motor to something firm is advisable. A turntable deck will allow a load to be carried whilst testing.

The motor will probably jerk suddenly on power up, this is normal and a consequence of the way a motor is constructed. There will be more on this in Part 2.

Remember a USB cable has a power supply so disconnect Uno from circuit before uploading a sketch.

Additional

I do not have a lot of knowledge of or experience with electronic devices but, compared to the few other components I have used, the A4988 boards do seem to be electronically fragile. Personal experience suggests that buying more than one A4988 driver board at a time is a good idea. For me mistakes through tiredness/impatience and stray wires touching boards led to dead A4988s. I would advise having a spare to hand or be more careful than me.

Conclusion

The web has enough information to set up a working NEMA 17 but, be prepared to question what sites say, any problems you encounter may not be of your own making. With these notes and the given references, a basic working system can be assembled, an understanding of the code and microstepping resolutions will allow differing combinations of speeds, step sizes and stepping to be tried.

References

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Using Opto-electronics – Part 1

Colin Stevenson M5147

Introduction

I found it fascinating that in the June 2023 MERG Journal there appeared to be a confluence of interest in opto-electronics and the different ways of using them:

- Davy Dick's explanation of what they do is a great place to start
- Julian Coles application for data transmission is much more sophisticated
- Andrew Hick's use of an infrared motion detector is closer to my level.

I have been using opto-electronics for a while to detect point position and have developed other uses from there. What follows are a couple of real working examples of using opto-electronics on my layout.

Point Position Detection and Switching (PPDS)

I described my development of this application in full in the September 2020 Journal. [1] At that time I was using 0603 SMD infrared LEDs and matching phototransistors, wired individually.

In the intervening time, I discovered photo-interrupters and have been making use of them exactly as Davy Dick describes. I found that VISHAY TCST1230 photo-interrupters were like for like replacements for my 0603 SMD components and can be used with the same circuits and component values I had previously arrived at. They are just 9.2 x 4.8 x 5.4mm in size with a 2.8mm gap and an aperture of 0.5mm. These sensor heads are interchangeable with my home brewed stripboard ones and are ideal in the fiddle yard where hiding them is not so important.

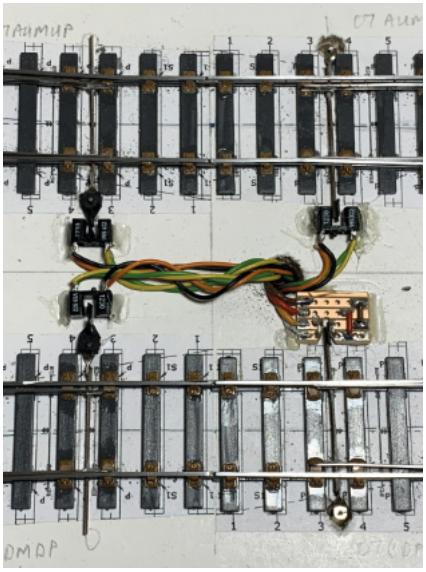


Figure 1 - A cluster of sensors at one end of the Fiddle Yard.

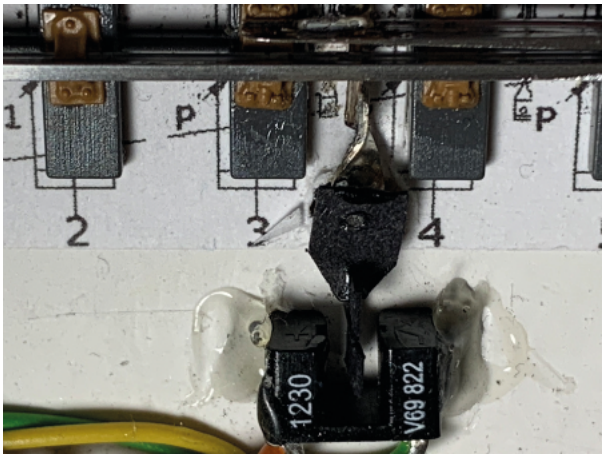


Figure 2 - Close up of a VISHAY TCST1230 Photo-interrupter.

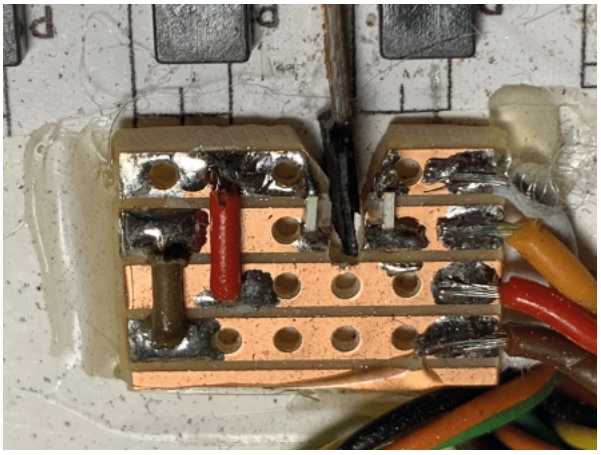


Figure 3 - Close up of a fabricated photo-interrupter, 0603 components mounted on their side.

I find it is better to arrange for the light path to be blocked when the point direction is for the normal or main line, so that moving the point to the branch or secondary direction opens the light path and activates the sensor. In my case, this switches on the relay to change the track power to the point frog or crossing vee, as well as providing an input to CBUS. Choosing this default allows operation of track power through the main line even when the auxiliary 12V DC supply is not switched on, else track power short circuits result.

It is straightforward to arrange for the light blocker todo this whichever direction of movement in required.

Figure 4 - Light blocking arrangements

My practice is to set up the appropriate black card light blocker on the point stretcher bar or tie-bar, then set the point movement (I use servos) before carefully positioning the photo-interrupter sensor head so that the light path is just reliably blocked with the point in the chosen position. I have blown a few of the phototransistors with an inadvertent slip of a metal tool while making position adjustments, so care is needed. As can be seen in the photos, I hot glue mine in place, so that re-application of heat allows adjustment or replacement.

With the detectors on the top of the layout (in my fiddle yard, under a window), false detection due to sunlight has occurred, but some more black card is a straightforward solution, and can be made to look like a boarded over facing point lock if required.

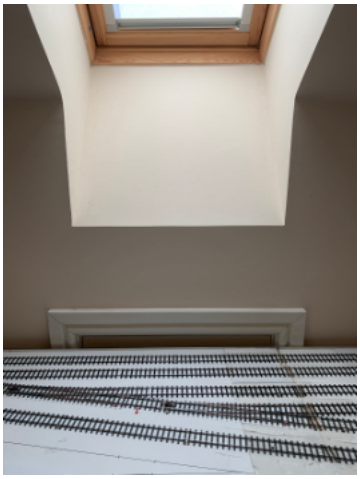


Figure 5 - Sensors under a window

Figure 6 - Light shield over sensor

Sadly, not all photo-interrupters are so easily used. The data sheet for the slightly smaller Sharp GP1S094HCZ0F led me to believe that they could also be used with my circuits, but in fact the sensitivity is markedly lower, and would need a re-optimisation of component values to give reliable detection. Rather than do that, I think I prefer to keep to my "standard" circuit so that an interchangeable spare can be available if necessary.

Carriage Lighting Switch

Next time I will describe how I use a fixed LED in the track to switch on lighting in a passing vehicle.

Reference

1. *https://www.merg.org.uk/merg_journal/dev/journal/2020-3/index.html*

For Colin's biography please see MERG Journal Vol 54 No 3 September 2020 p55

MaxDuino

Alan Lomax M8640

Abstract

This article describes an Arduino based printed circuit board for use on a variety of layouts. The circuit design is flexible enough for use in many applications such as animations, signals, lighting, sound effects, switching, and many more. It is also very useful as a software development platform enabling many different features to be explored with minimal fuss.

Background

My railway club is embarking on a new club layout which is to be modular in nature. I already had several PCB designs for animation effects however this represented a perfect opportunity to press the 'reset' button and remedy many of the identified shortcomings existing on those that came before. One of the identified shortcomings was how several of my Arduino implementations were cobbled together using a lot of point-to-point wiring and add on modules for things like power conditioning, sensor inputs, sound, RS485 communications, and NeoPixel implementation. With his in mind, it was resolved to design a custom 'carrier' PCB to implement all of these features in a compact design I have now called the MaxDuino. The heart of the design is a basic standard Arduino NANO and the circuit design allows the various subsystems to be included or not according to the desired features.

The Design Process

My design process started with a block diagram (Figure 1) indicating the desired features and what I/O pins I planned to use for that feature. From this, a schematic was created using KiCad design software [Ref 1]. I went through a several design iterations making incremental improvements along the way. Most of the improvements were optimizations of PCB real estate, such as selecting smaller footprints for capacitors which in turn allowed extra features to be added e.g. dedicated 5 volt screw terminals and the NeoPixel were late additions. While the early PCBs were being manufactured at JLCPCB [Ref 2] I developed the Arduino software test suite of sketches. These were then used to validate the operation of various features as the PCB was built up. The most recent version (v1.4) has had all features tested and it has functionally 'passed' the full test suite and has updated some silkscreen text items that were noted during the preparation of this article.

The 3D view of the board is shown in Figure 2 below. Onto the 3D view I have added callouts showing the major functional areas that generally match the block diagram shown previously. As is self-evident there is not a lot of free space available on this board but in the little that was left over I included a white square of silkscreen which with the use of a sharpie marker is handy for keeping track of specific boards and what software is loaded.

The test software and how it was iteratively developed eventually led me to include a standard function in each of my test sketches to output a software 'fingerprint' to the serial monitor at bootup. As long as I remember I used 19200 as a standard speed. It will on power up send out some pertinent information, chiefly what source code file was used, what version I have assigned to it, and when it was actually compiled. Additional serial outputs are of course possible and will vary by sketch and application.

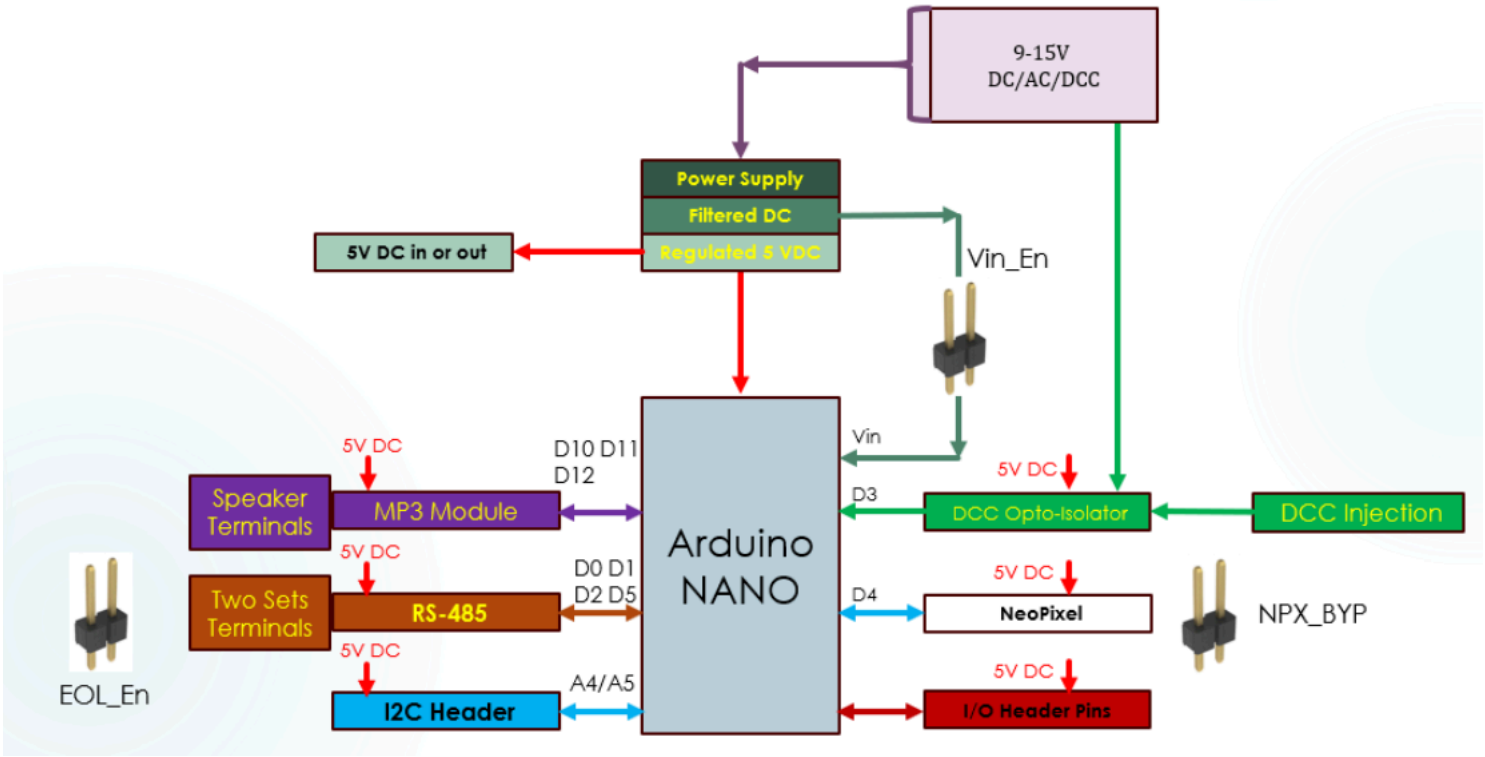


Figure 1 – MaxDuino Block Diagram

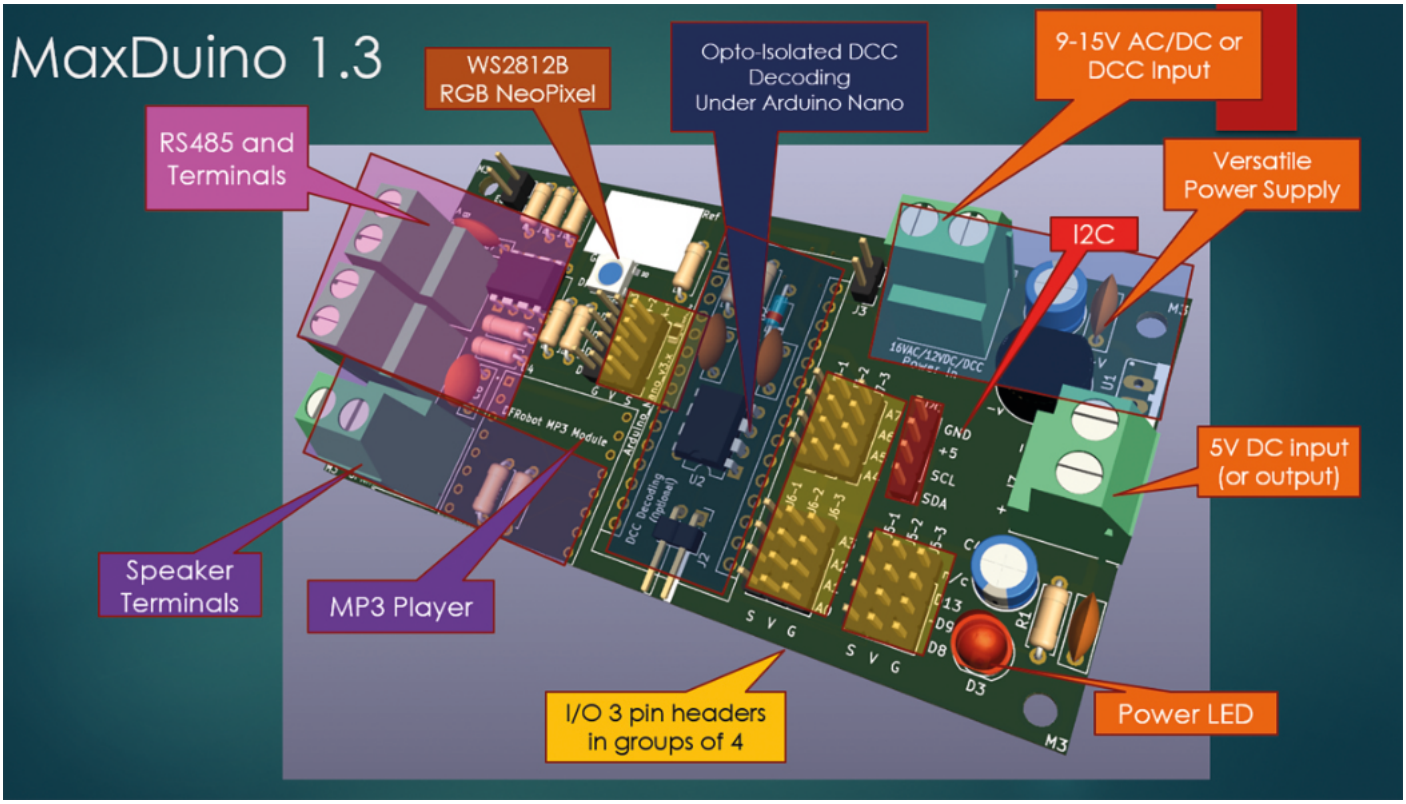


Figure 2 – MaxDuino 3D View

Key Features List

On any given build of the MaxDuino PCB not all sections need be present. This gives considerable flexibility depending on the intended application. If the full PCB is built up it represents a standard building block of functionality and can provide many Arduino features that can be implemented over time. This provides a platform to grow and is consistent with a phased modular club layout approach.

The following sections describe the main functional areas of the board and what they contribute to the overall operation.

Power Input

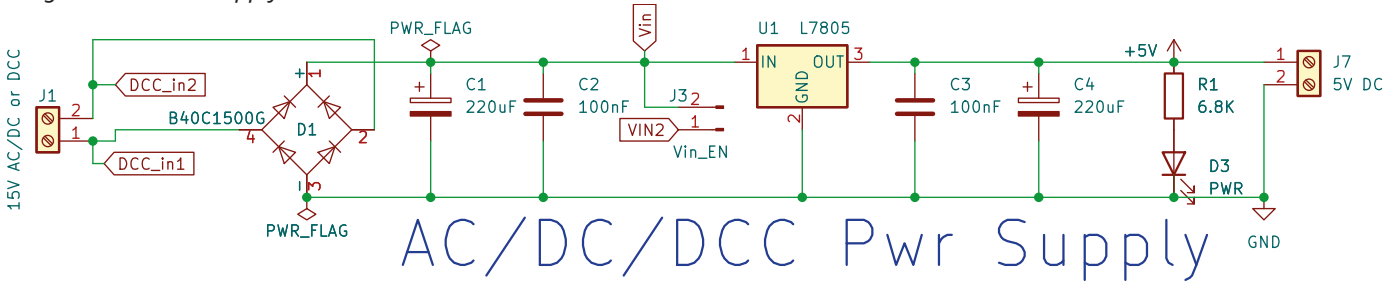
From the outset it was my self-imposed choice to make it a design requirement to have a very flexible power supply system. The root of this was my own home layout has a 12V DC auxiliary bus available but there are other club members that only have a 5V DC bus running on their layout. The club layout was tending toward a 12V auxiliary power system but this was not cast in stone at the time. Not wanting to paint myself into a corner the power supply needed to be flexible.

My flexible input power supply section schematic is shown in Figure 3 below and was based on several reference circuit designs for the L7805 chip. One of the better references on the L7805 chip itself can be found here. [Ref 3]

Power comes in from the left and can be anything from 9-15V AC/DC, or even a DCC feed. This goes through the full wave bridge rectifier D1 and smoothing capacitor C1 and filter capacitor C2. This filtered DC voltage is the input to the 5 volt regulator chip L7805 which is capable of providing 1.5 amps and is also internally protected against short circuits. The use of a TO-220 heat sink on the voltage regulator is recommended, especially at higher input voltages like when using DCC for a power source. The 5 volt regulated output is filtered with C3 and C4 to improve transient response and this produces a rock steady 5 volt supply and is suitable for significant Arduino projects.

A pair of pins is provided as J3 which, if a jumper were installed there, would route this power to the V_{in} pin on the Arduino. Care must be observed when J3 (Vin_EN) is used to ensure V_{in} is 12V DC or less. The Arduino's on-board regulator is not rated beyond this and so could be damaged. The full wave rectifier does offer a safety margin in this regard.

Figure 3 – Power Supply Schematic



On the right-hand side I have provided a second set of screw terminals which can be used as a 5 volt output (to supply other circuits), or optionally this can be used as a 5 volt input (in which case the L7805 regulator and everything to the left of it is not required.

Finally, a simple LED with a relatively high 6.8K current limiting resistor is used to indicate the presence of 5 volts. This LED works even without an Arduino present and it does not care where the 5 volts is coming from.

Power Supply Notes:

When using DCC as the power input there is some support for the position that fast-acting diodes should be used to avoid the possibility of distorting the DCC waveform. In my testing distortion was not seen however the use of fast acting diodes will not hurt. If you know DCC will be your power source then constructing a bridge from 4 discrete fast acting diodes (eg: 1N4148) would be erring on the more conservative side.

This circuit utilizes what might be considered a robust amount of capacitance, however as the power leads could be relatively long on the club layout, and the operating environment is uncertain, I do anticipate them having significant electrical noise. Similarly, the 5 volt output could potentially also be supplying (or at the receiving end) of a long run. The capacitors can of course be left out or other values used, however if no space were provided on the PCB at all then they would be difficult to retrofit after the fact.

On the left-hand side of the schematic the flags are indicating that these power inputs are also routed over to the DCC opto-isolator circuit (more on DCC Decoding below).

Arduino

The Arduino portion of the schematic (Figure 4) is not particularly remarkable other than showing that the majority of pins are used. Indeed, the only pins not used are the 3V3 output, the analog reference A_{ref}, and the two Reset pins.

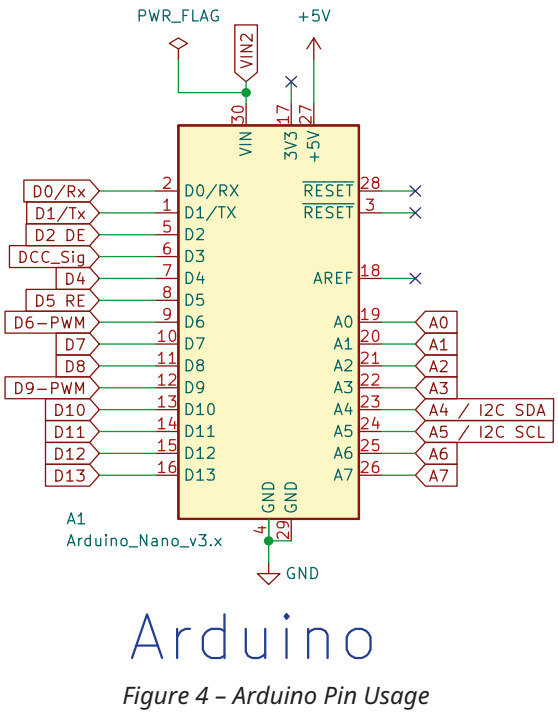


Figure 4 – Arduino Pin Usage

Physically during PCB assembly, the Nano is mounted using female header pins to standoff from the MaxDuino PCB as the space under the Arduino is used for the DCC decoding circuitry.

DCC Decoding

For my own layout I wanted the option to implement an Arduino based stationary decoder. This turned out to be one of the more challenging aspects with the main factor being some poor component choices on the initial circuit I found on the internet [Ref 4]. I eventually found a good in-depth analysis [Ref 5] of that original circuit which suggested some significantly different component values in the same fundamental circuit design. I experimented with these using a solderless breadboard before settling on the values now shown in Figure 5 below. Referring to the schematic, the DCC signal comes from the power circuit on the left as DCC_in1 and DCC_in2. These signals are routed through two marked isolation points (Implemented as thin traces on the underside of the PCB that can be scratched open if needed). The DCC signal then goes through the 2K2 current limiting resistor R2 and then through the optoisolator U2. D3 provides reverse polarity protection for the opto-isolator diode. C5 (in conjunction with R2) provide transient noise rejection. The output of the opto-isolator goes to Arduino pin D3 and is pulled high by a relatively low value R4 which is specifically selected to significantly improve the rise time of the outgoing square wave (this is quite different than the normal use of pullup resistors). Pins 1, 4 and 7 are not used. The original source showed a pull up resistor on pin 7 but this was not actually required as the opto-isolator has internal pullups.

During board assembly these components should be amongst the first to be installed if the DCC decoding functionality is desired. This is purely for access reasons, as after the Arduino header pins are installed they will restrict PCB access in this area.

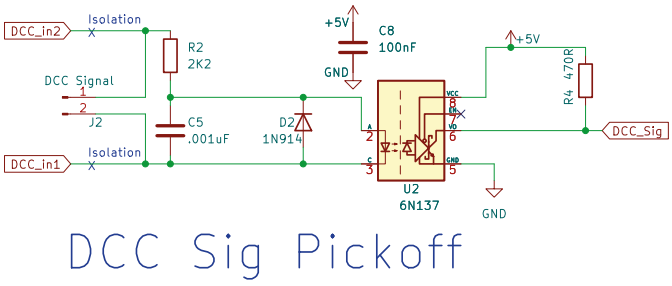


Figure 5 – DCC Decoding

DCC Decoder Notes

As mentioned, a number of issues were encountered when implementing this portion of the schematic. What I first bserved was that nothing was being decoded although the sketch was running fine. Reviewing the code, I saw that decoding zeroes and ones depended upon some precise timing triggered by interrupts. It turned out that as the DCC signal is being produced by an H bridge type circuit there occurs at the zero crossover a point where two MOSFETs will stop conducting just as two others start. If these components are mismatched in any way a transient signal (glitch) can occur at each and every zero crossing in the DCC waveform. Unless filtered out these transient glitches can be significant enough to trigger the opto-isolator which causes a software interrupt on the Arduino pin.

Since bit decoding depends on the length of the pulse it follows that resetting the timing on every ZERO crossing results in nothing getting properly decoded. The nefarious aspect of this is that the magnitude of the glitch depends on the magnitude of the DCC voltage. For the original author it might not have been an issue but for me (and obviously others) using 14V DC for DCC did cause issues. Some motor shields are likely better than others with regards to the zero-crossing glitch phenomenon and this is also a consideration.

If DCC is not used as the MaxDuino power supply, the two power inputs DCC_In1 and DCC_In2 will of course have full input power on them whatever the source is. This will not normally be an issue because of the high value of R2 but of course no DCC decoding can happen unless some changes are made as indicated below.

To decode DCC where DCC is not the input power the following steps must be taken:

First the two DCC isolation traces must be made open circuit. These traces are clearly marked on the bottom of the MaxDuino PCB (X marks the spot). Opening these two traces where indicated disconnects the 'power supply' from the 'DCC decoder'. Once these traces are opened then the PCB power source is completely independent of DCC signal decoding. A DCC signal can now be input via J2 which is implemented as a pair of 90 degree header pins located on the PCB under the Arduino.

MP3 Player

The DFRobot MP3 player (Figure 6) is a powerful and inexpensive module that can read and play MP3 files from an SD card. It has a low-level audio signal outputs and also an 8-ohm speaker output driven by a low power audio amplifier.

Commands are sent to the module, and results fed back from this module using standard serial messaging (Transmit = Tx and Receive = Rx). It is only necessary to connect these to the Arduino and send out appropriate commands like "Play Track 1" that is encoded by the DFPlayer library into the required format for transmission.

The MP3 module operates at 5 volts but is noted for clicking whenever commands are sent at this voltage. I have implemented a simple voltage divider to drop the Arduino's sent commands down to about 3 volts to solve this.

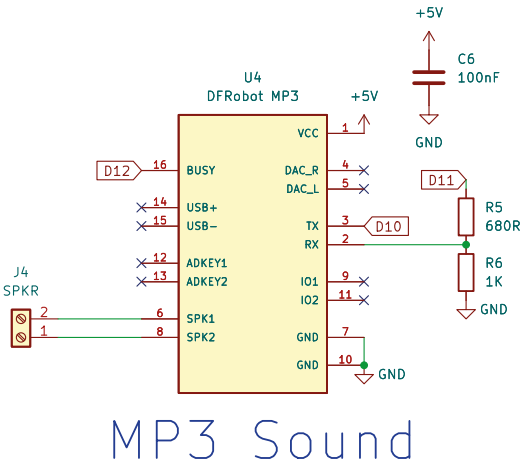


Figure 6 – MP3 Player

I did read on the manufacturers page [Ref 6] that a simple 1K resistor in series does the same thing but I had trouble coming to grips with how this worked electrically so I stuck with what I knew. This option remains available if you prefer by leaving out the lower leg of the voltage divider resistors and using the 1k resistor for R5.

I did have some issues initially getting the MP3 player to work but it turned out there are two different parts for very similar MP3 modules and I had them jumbled up in my parts box. The now recommended one is branded as a DFRobot MP3 player whereas the one that gave me issues was branded as mp3-tf-16p. The symptoms manifested as an inability to change the volume (it started loud and stayed that way). Other commands like changing tracks or play/pause all worked fine. I now believe the issue might be attributed to a library incompatibility but once I found a working combination, I purged the offending parts and stuck with what worked for me.

NeoPixel

This is a very simple circuit (Figure 7) and uses a single bare NeoPixel chip generically called a WS2812B. In the MaxDuino implementation I use the physical space of one LED but now I have the opportunity to display many colour coded feedback signals such as green for running, red for error or similar. There are thousands of colour combinations possible [Ref 7].

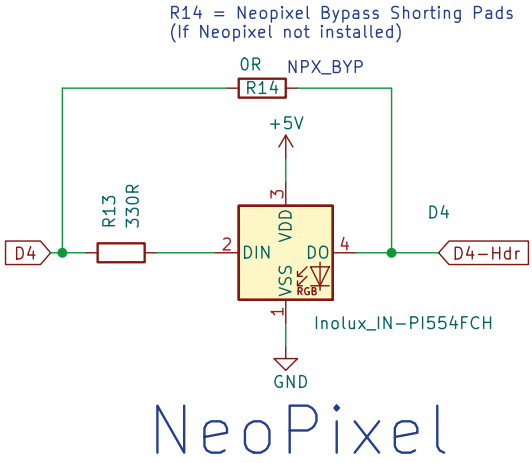


Figure 7 – NeoPixel

For those not familiar with the chip it is about 5mm to a side and consists of 3 LEDs (Red, Green and Blue) plus a "single bit wide shift register that is 24 bits deep" all contained within the one tiny surface-mount package as shown in Figure 8.

Figure 8 – The NeoPixel WS2812B chip

The data stream consists of the desired RGB values (0-255 or 8 bits if you prefer) and is sent to the chip via the D_{in} pin. The first 24 bits in the data steam are acted on by this NeoPixel and only the remainder of the data is repeated out the Data Output pin to the next chip in the chain. This process is repeated until all data is 'used up' 24 bits at a time. At that point nothing is forwarded out the DO pin, even if other NeoPixels might physically be present.

You can see how, when arranged as a strip, these are commonly referred to as addressable LED strips even though no actual addresses are used on the wire. In software, the library code frequently uses arrays and the index of those array is commonly referred to as the address of the NeoPixel.

On the MaxDuino PCB the on-board NeoPixel is always address 0 (first in line out from the Arduino pin) however its data output pin is routed on to a header so that external strings of NeoPixels can easily be added and used. The external NeoPixels will start at address 1 and continue up according to how many are installed. The heavy-duty power supply of the MaxDuino ensures up to 25 LEDs (at full brightness and all on) can be accommodated. For more than this number I recommend a review of the power requirements considering how many will be on at the same time and at what brightness levels. (and yes external 5 volt supplies can work with Neopixels: just ensure the common "Zero" voltages are all tied together.)

A good reference for these clever little devices is here [Ref 8]

RS-485

It is frequently the case where it is desired for an Arduino to operate in conjunction with some external controller, or in coordination with other Arduinos. This implies some sort of communication mechanism which in this case is RS-485. This standard is more of an electrical standard than a full-blown protocol but it does have some compelling features - namely it is robust and it is inexpensive. The downside of it is it is relatively slow and lacks error checking. I have used it previously in industrial settings covering many hundreds of metres and I can say it works as advertised in spite of the harsh environment and less than ideal wiring practices employed.

The network consists of two wires that daisy chain from device to device. At each end of the network a 120 ohm 'end of line' resistor is used to prevent voltage reflections causing issues.

In the MaxDuino implementation I used the same circuit found on the inexpensive external modules (Figure 9) available from China, but I have ensured the EOL resistor was only enabled if a jumper was installed at the JR7 location.

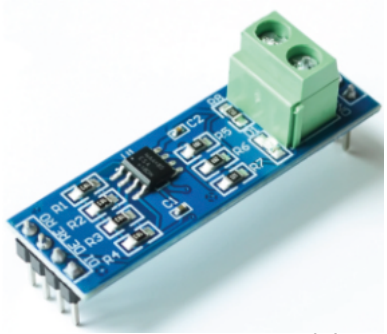


Figure 9 – RS-485 Module

JMRI

For those who use JMRI there is within it the ability to define an interface called the Chubb Computer/Model Railroad Interface better known as CMRI. Originally CMRI nodes were hardware I/O boards for the JMRI software to talk to but now CMRI more commonly refers to software emulations of that original hardware. Most relevant for MaxDuino is that there is an Arduino library that allows the Arduino to emulate one or more of these CMRI nodes. The bottom line here is that JMRI can send on/off type commands to the CMRI emulator and the Arduino can act on them (Figure 10).

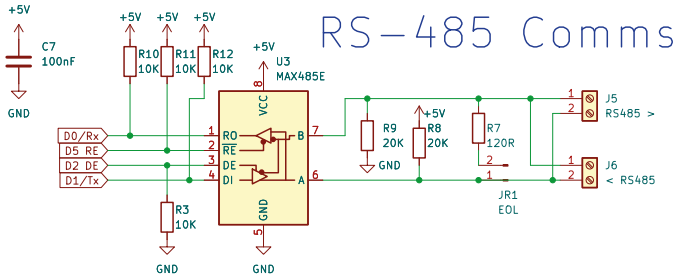


Figure 10 – RS-485

I/O Headers including I2C

It is well worth noting that a few of the header pins are utilized elsewhere on the PCB and this has the potential to catch you out if you are not aware of it.

For example, Arduino digital output 4 goes first to the onboard NeoPixel and only then to the header pin marked D4. If the D4 header pins are used for an external NeoPixel string it will form one continuous logical string with the on board NeoPixel being at index 0. (If the NeoPixel is not installed then an option at build time is provided to bypass the on board NeoPixel circuitry)

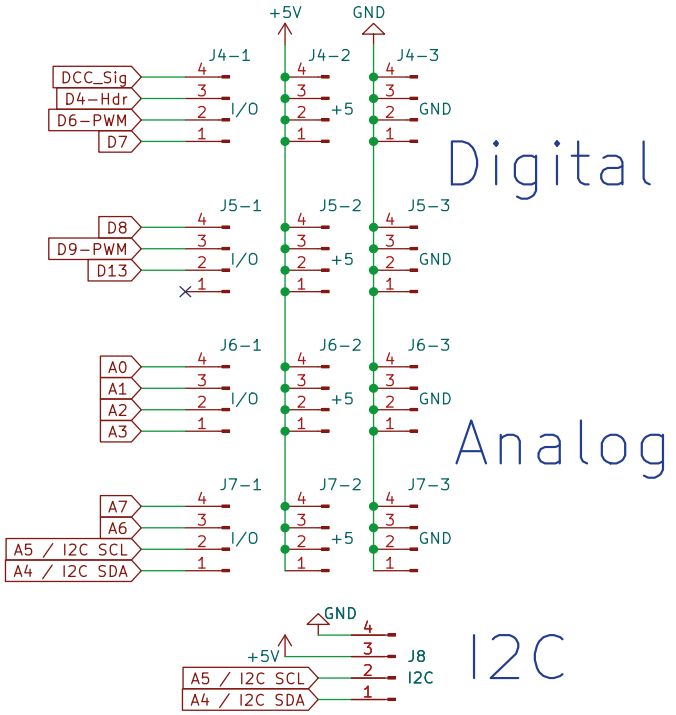


Figure 11 – Headers

Similarly, DCC decoding goes to the D3 input on the Arduino, and is available on the header pins. The note here is that this pin has a very strong external pullup resistor. If DCC decoding is left out this would be of no concern.

Finally header pins A4 and A5 are also dual purposed with SDA and SCL on the I2C header strip.

Full Schematic

The complete schematic as produced in KiCad due to its size, is available from the Knowledgebase [Ref 9]. Each sub section has been discussed in detail previously [Ref 10].

Project Status

In October of 2023, my supposed 'final' batch (grin) of Rev 1.3 PCBs arrived. These are shown as designed in Figure 13 and also as manufactured in Figure 14.

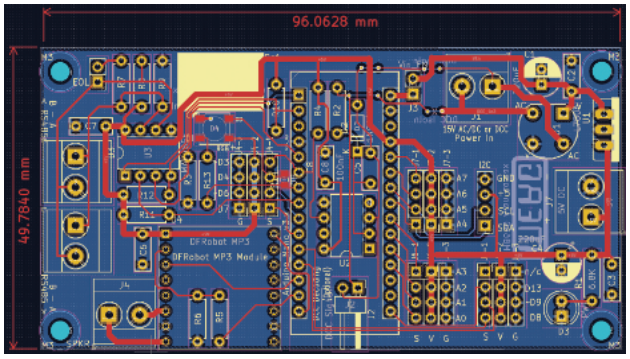


Figure 12 – PCB as Designed

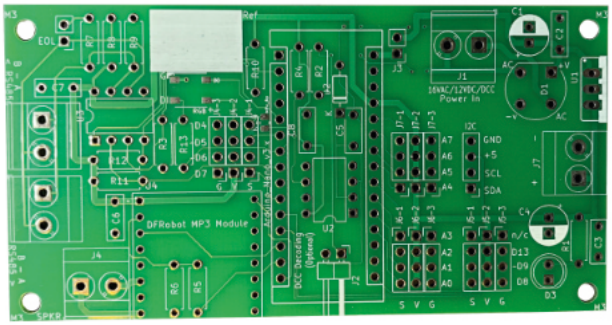


Figure 13 – PCB as Manufactured

At the first opportunity these were carefully inspected and naturally within seconds I found minor silkscreen errors. Fortunately, that was the extent of it and the actual PCB was correct. I built one up and proceeded to run a complete battery of tests on it. The test code that was developed on the earlier iteration test boards made fairly quick work of verifying that everything was working as expected. The flexibility of this board still meant it took some hours to complete and perform the tests and of course I could not leave well enough alone. I did go back and clean up the code a little bit, improving the documentation and removing some of the dead code from previous troubleshooting efforts. The silkscreen corrections have been made and are fully reflected in the R1.4 Gerbers.

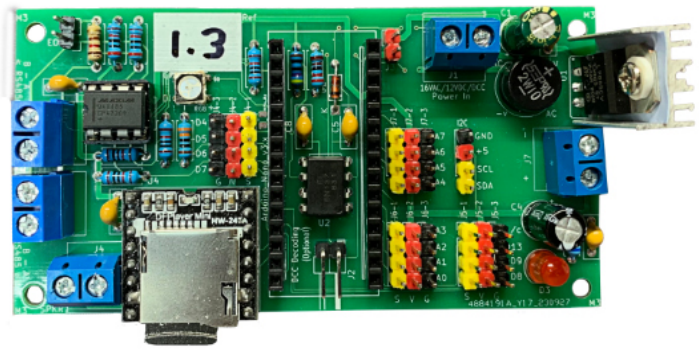


Figure 14 -The final built up PCB

Testing Details

This is a brief overview of the testing that was carried out. Should anyone choose to build a MaxDuino they can repeat these tests on their build using the test sketches provided. All sketches output to the serial monitor at 19.2K with program status updates regarding the test process.

Power Supply

Hardware: Partially built PCB. Nano not required at this stage.
Software: None needed
Checks Performed: Visual, Verify proper voltage, Check for overheating.

NeoPixel

Hardware: Partially built PCB, Arduino Nano.
Software: NeoPixel Test sketch (uses FastLed library)
Checks Performed: NeoPixel cycles through some colours. (This is then used in future tests)

I/O Header

Hardware: Continuing with the partially built PCB with Arduino Nano
Software: I/O Test sketch
Checks Performed: Sensor plugged into header. NeoPixel changes colour when activated. External NeoPixels can be checked.

Mp3 Player

Hardware: Continuing with the partially built PCB with Arduino Nano. SD card with MP3 folder and contents.
Software: MP3 Player Test sketch. (uses the DF-Robot MP3 library) Checks Performed: Sounds are played (With no conditions or logical dependencies)

RS-485

Hardware: Fully built PCB with Arduino Nano. External computer running JMRI. USB-RS485 interface.
Software: RS-485 Test sketch, JMRI. JMRI and CMRI are configured. (uses a RS-485 decoding library)
Checks Performed: Within the Arduino digital bits received are echoed back to JMRI as one to one sensor inputs thus performing a full loopback test. Any lights turned on from JMRI will also cause NeoPixel colour changes. (Note: after the RS-485 is initialized legible text output is not practical but the data stream activity is still visible.)

DCC Decoding

Hardware: Fully built PCB with Arduino Nano. DCC Controller with accessory command ability. (Turnout control) software: DCC Decoding Test sketch (uses a DCC decoding library)

Checks Performed: Within the Arduino any DCC accessory commands within a wide range of addresses (1-400) are decoded and a diagnostic message is echoed out to the serial monitor indicating the command and address involved.

Potential Applications

From the outset, the MaxDuino was intended as a 'platform' PCB upon which many and varied applications could be built. For an electronic hobbyist, such as most MERG members, I think it would also be a good electronics assembly project that can be completed in bite sized pieces. Once completed it could be used standalone as an Arduino learning tool without the need for any additional hardware.

With the addition of a few simple plug in modules or sensors (MERG or otherwise) this could be the heart of a significant automation effort around any layout.

It is my plan to use several of these as standalone units using sensors (MERG TOTIs for example) to activate animations on my layout, mainly in the form of sound and lighting effects. I do envisage some servo activated motion items. Beyond that I will borrow some ideas from my technology demonstrator where sensors on several Arduinos are used for block occupancy and keep the JMRI track plan updated. Simultaneously this could initiate effects on other Arduinos using the RS485 communications capability.

Within my railway club other members have expressed an interest in using this PCB for their own and also for the club layout but only time will tell how that all works out.

Next Steps

In preparing this article a few minor stencil improvements were noted and these will be corrected in Rev 1.4. (no different electrically when compared to 1.3). This will be posted to Github and thus be available for downloading. I will of course be building up several examples of the MaxDuino and developing code for some specific applications and deployments on my layout. I think something like platform announcements and sound effects would be a good first case.

GitHub, Gerbers, and Test Sketches

The KiCad files, along with the complete panelised gerbers, are available on my GitHub at:

https://github.com/Alan-Lomax/MaxDuino
and in the MERG Knowledgebase at:
https://merg.org.uk/s/maxduino

You will also find the complete build instructions, the test code I used, and some of my 'under construction' photos in both locations.

References

1. KiCad PCB design software: kicad.org/
2. My preferred PCB Manufacturer: JLCPCB: jlcpcb.com/
3. About the 7805 Regulator:
   https://www.electronicsforu.com/technology-trends/learn-electronics/7805-ic-voltage-regulator
4. Rudy's Model Railway DCC Decoder:
   https://rudysmodelrailway.wordpress.com/software/
5. In depth analysis of DCC Decoding circuit:
   https://wakwak2popo.wordpress.com/2020/12/11/dcc-sniffer/
6. DFRobot MP3 player module:
   https://wiki.dfrobot.com/DFPlayer_Mini_SKU_DFR0299
7. RGB Colour Picker:
   https://www.rapidtables.com/web/color/RGB_Color.html
8. Circuit Geeks article on NeoPixels:
   https://www.circuitgeeks.com/ws2812b-addressable-rgb-led-strip-with-arduino/
9. Complete schematic:
   https://www.merg.org.uk/merg_wiki/doku.php?id=journal_additional_content:start
10. *https://merg.org.uk/s/maxduino*

Alan Lomax was born in Widnes, Cheshire and moved to Canada at the age of 7 with his family. His early years involved exploring techniques of percussive disassembly (aka hitting things with hammers). His formal education followed a technical path with a bachelor's degree in Electrical Engineering and a master's degree in Management Science both from the University of Waterloo. His working life started off with sensors, control valves, and low voltage electrical power circuits. His middle career work centred around chemical plant automation and control systems and this took him and his family on assignments around the world. This culminated in Alan being the lead technical manager for a large control system replacement project. In retirement Alan has rediscovered his passion for model railways and how it integrates many of the things he dealt with while working. Within MERG Alan is a contributing member to the Arduino SIG and the RFID SIG. Alan and his wife Dawn are happily retired and live in Sarnia, Ontario, Canada.

An animated crane for Abingdon

Andrew Hicks M6962

Abstract

This article describes how to animate any model railway small goods yard crane using a 3D printed mechanism with servos to give an automated sequence of movements with matching sound effects. It uses a combination of MERG kits including the PMP26 Event Sequencer, PMP12 Random Light Generator and Servo-4, as well as a cheap DY-Player board [Ref 1]. It is suitable for intermediate level skills, requires physical assembly, and reprogramming PIC chips using Just Another Language (JAL) code and a Pickit-3 [Ref 2]. It is described here within the context of a CBUS layout control system, but is equally applicable to other control busses, or even just a manual switch control to start it.

Introduction

One of my contributions to the Ealing Road layout was an animated dock crane at the front of the layout and two animated derrick cranes on the large freighter in the dock [Ref 3]. These were animated using small N20 geared motors driving pulleys and were operated using 5V DC batteries driven from a small control box at the corner of the layout via lengths of ribbon cable [Ref 4]. Actually, it was pretty 'low-tech', but the crowds loved it.

The point about animation is that it draws the eye. If something moves, people will instinctively look at it. That also means the eye is not focused on other things, which then become 'background'. The animation serves as a distraction from people noticing the flaws in the model and they can then momentarily experience that cognitive dissonance when part of the brain thinks "this looks real", while other parts know it to be a model. It is those moments of optical trickery that so delight people at exhibitions and create the magic of the hobby. In my experience the more animation a layout has, the more it will draw peoples' attention and the longer it will hold them enthralled.

When we took Ealing Road on its tour round the UK exhibitions in 2019 my usual job was to be front of house, talking to members of the public, while discreetly operating the cranes with one hand behind my back. It was a particular pleasure to watch for the whoops from small children watching the trains through the legs of the crane when it suddenly and unexpectedly sprang into life. However, after a while it became something of a chore, manually driving the crane through a set sequence of movements and I wondered if that, too, could be automated. It was around that time that I joined MERG.

Ealing Road, regrettably, is now history – though well recorded in a dozen or so articles in the model railway press, including several cover features. But the idea has stuck with me and has niggled ever since, as good ideas do. After putting Ealing Road to bed, just before lockdown, I was invited to start a new project and install a 'full-fat' CBUS system on Abingdon, including automation and animations. Fool that I am – I said yes [Ref 5].

Three years later the project is still ongoing. We now have CBUS fully operational with route-setting buttons triggering interlocked point and signal sequences, and TOTI train detectors lighting up the control panel like a small Christmas Tree. Now that the layout has an operational communications bus, with any part of it able to send digital messages in two-way communication with any other part, we can start adding the sexy stuff. Now we can add the animations because we can automate thenm

The Crane

Pretty much bang in the middle of Abingdon are two yard cranes. The larger is a 6-ton crane for unloading heavy goods from wagons in Goods Siding 2. The smaller is an exquisite platform crane just outside the goods shed. Both are just begging to be animated. Neither offers any scope for hiding a mechanism. This calls for something really cunning.

When I did Randolph's Yard with the boys at Summer Fields School [Ref 6], I used that as an opportunity to experiment. Their layout had a goods shed with a standard off-the-shelf Ratio Yard Crane as its centre-piece and, as a gift to the school, I animated it.

The trick is to design in 3D CAD and then 3D print an entire mechanism that fits underneath the baseboard. The crane itself has a central vertical column around which it rotates. I substituted a brass tube for the plastic column that came with the kit and then the fine chain for lifting the load, after looping round the spool, simply disappears down the inside of the tube to be hooked onto a pulley underneath the layout. The pulley is driven by a servo, to raise or lower the load.

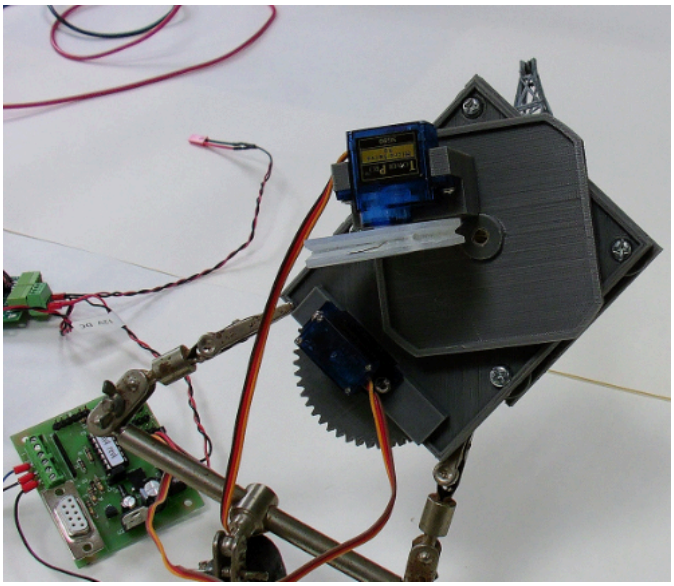


Figure 1 – Showing the pulley which will be underneath the layout

It is not quite that simple. The crane must also rotate. A load picked up from one location must be put down somewhere else. A vehicle must be 'being loaded or unloaded'. It is not practical for the crane to be loading a railway wagon because the load must stay permanently attached to the chain, just to keep it pulled tight, so instead I move something that has previously been unloaded from the train onto the back of a lorry. Then, when peoples' attention has moved on, I unload it.

So, the movement is not just up-down, it is a more complicated sequence of up-rotate-down – pause - up-rotate back-down – stop. The rotation is managed by having a turntable platform under the layout, to which the

pulley servo is attached. When the crane rotates, the platform rotates with it, mirroring the movement above. A second servo, driving a large gear, rotates the platform and central column.

That is the theory. The engineering challenge is to get this to work without friction gumming up the works. Part of the solution is to have a really good 3D printer and, as I have found, to print the parts in extruded Fused Deposition Modelling (FDM), rather than resin [Ref 7]. Another requirement is to have a second brass tube as a sleeve bearing within which the central column can rotate smoothly. A third requirement is to be able to remove either the crane top or the mechanism below, each without disturbing the alignment of the other, such that they can be reassembled and mate perfectly every time.

This led to a three-part construction. First, there is the crane itself and its base – the central brass column and its sleeve bearing. Second there is the baseboard mount, which is permanently fixed to the baseboard and to which the other parts attach. This is basically a flat plate underneath the baseboard with a 22mm diameter cylinder that sticks up through a hole in the baseboard into which the crane is mounted. The cylinder has a square profile hole in its top, while the crane bearing is shaped as a square peg that tightly fits in this hole. So, when the crane is dropped into place, its base is held firmly and does not move when the crane rotates.

The third part is the mechanism that is attached to the mounting plate below the baseboard with four M4 bolts. The drive gear in the mechanism also has a small square hole set in its top centre and a circular hole below that for the column to feed down to the pulley below. The central column, below its sleeve, has a small square block tightly glued around it. When the crane is dropped into its base mount the small block slots into the square hole in the gear, so, when the gear rotates, the crane above rotates with it.

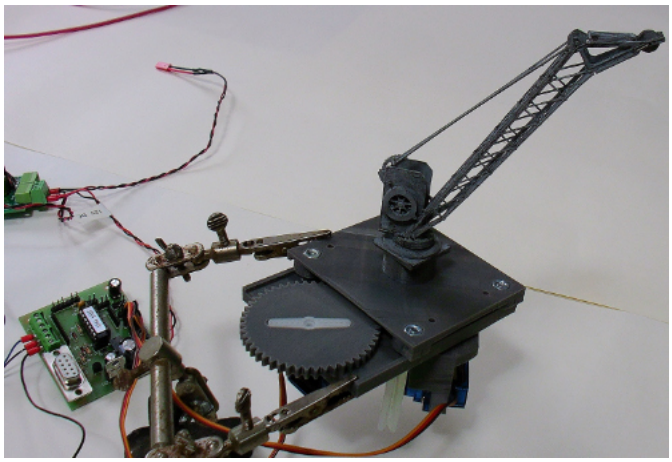


Figure 2 – Showing the mounting plate and the M4 bolts

It has taken three years and countless test prototypes to get this perfected. I plan to sell these mechanisms as part of a small hobby business. They can be adapted to pretty much any yard crane. Having prototyped it with a Ratio kit, I moved on to the larger of the yard cranes at Abingdon. No-one does kits for the small platform crane, so that will have to be scratch-built in Computer-Aided Design (CAD) and 3D printed. Fortunately, there is a kit for a 6T Great Western Railway (GWR) yard crane by Osborn's Models [Ref 8]. Unfortunately, it is laser-cut and fragile. However, it fitted perfectly to the mechanism and runs quite smoothly, despite having wooden pulleys threaded on pins.

I use fine chain from Scale Model Scenery [Ref 9] and the wire to tie it to the load is simply from ordinary layout electrical cable, stripped down to single strand (which is thin enough to pass through the chain links). We had a choice of loads for the crane, taken from the Langley Miniature Models white-metal kit range – a plough, concrete mixer or portable generator. We went for the generator, being the largest and heaviest of the three [Ref 10]. Suitably weathered and mounted on a Peco plastic pallet it works perfectly.

The Control System

That is the hardware part. The next question is how to control it, which is where the electronics comes in. Driving the servos is easy – I use a MERG Servo-4 kit [Ref 11]. This allows me to program the start and end positions and to set the speed, so each movement is slow and takes about eight seconds. I figured two outputs for the 6T crane leaves two spare for the platform crane in future. Next question – how to drive the Servo-4? Plus, I also wanted to include sound effects when the cranes move, using a DY-Player. So that had to be operated simultaneously. Cue the MERG Pocket Money Project #26 – The Event Sequencer [Ref 12].

Let's be clear, PMP26 is a fantastic little kit. I regard it as Davy Dick's masterpiece, even taking Ezybus into account [Ref 13]. It is simple and yet perfect. It has a trigger input, so it starts running when the trigger is pulled low (connected to 0V). This starts a sequence of five outputs (numbered A through E), each turning on, one after the other, separated by pauses. When the trigger is released (pulled high to 5V), then the sequence runs in reverse, with each of the outputs turning off from E to A with the same pauses. There are five separate pauses identified in the system; these are set by one of five links being connected and then a small potentiometer to dial the range for anything up to one minute each. When the link is removed, whatever value the potentiometer is at gets saved for that pause. For sheer elegance and simplicity, it is beautiful, but unfortunately, it didn't do what I needed.

I did not need five outputs going low one after the other and then going high again. I needed a more complex sequence. However, reprogramming the Event Sequencer is an easy task and a great learning exercise for anybody. I decided to use Output A as a logical signal that would be fed back into CBUS as an input to a CANVOUT [Ref 14] to be used as a 'crane busy' indicator on the Abingdon Fiddle Yard Control Panel. What this means in practice is Output A simply acts as a switch input to the CANVOUT, which sends an event that is read by the control panel CANPAN to light a Light Emitting Diode (LED) [Ref 15]. I want Output A to go on immediately the crane is triggered and remain on until the crane has finished its sequence, regardless of what the trigger does.

The system has to start with the trigger and then ignore it until after it has finished. The reverse sequence happens automatically after one of the longer pauses (Pause #4). Pause #1 is after the trigger and until the load lifts. Pause #2 is between the crane lifting and it rotating. Pause #3 is after the rotation before it lowers (this needs to be longer, so the load isn't swinging). Pause #5 is the 'wait' period at the end, just to stop the whole sequence being triggered again immediately.

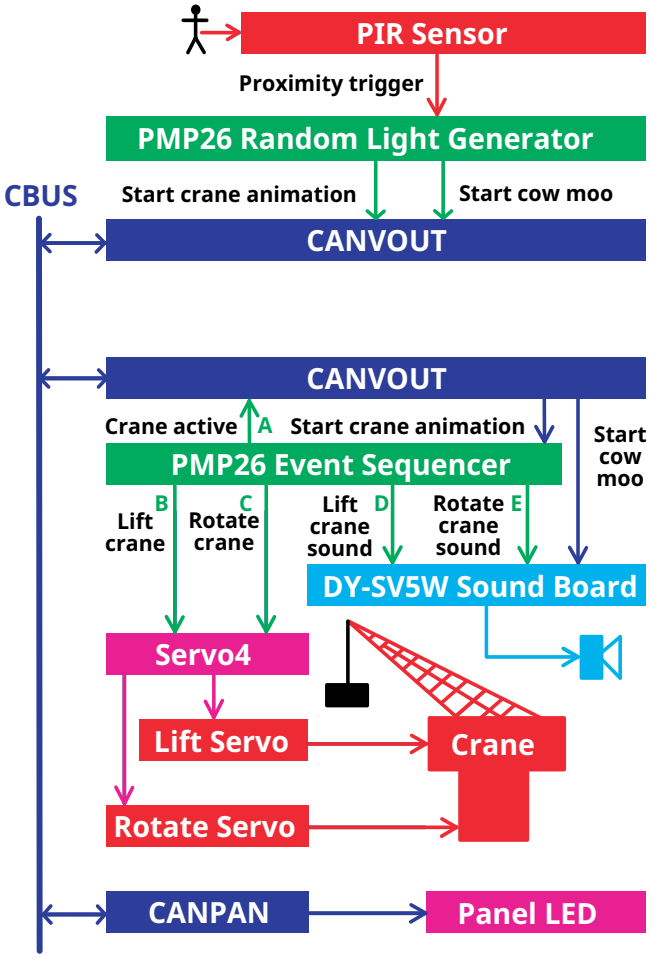


Figure 3 – System configuration (Artwork by Emily Johnston from an original sketch by Rob Holgate)

Output B drives the crane up-down pulley. Output C drives the crane rotation. So outputs B and C go through a ballet of ons and offs, separated by various pauses, following the sequence outlined earlier.

For the sound board I use a DY-SV8F sound board with 64Mbit (8 MB) on-board flash storage (£4.56 at the time of writing, on eBay from China). This can comfortably fit half a dozen small MP3 sound files, but not many more than that. (There is another version of the same board, the DY-SV5W with a slot for a 32 GB micro-SD card as memory – enough for thousands of different sound files.) This has several different modes to operate it in different ways. I use it in "I/O Independent Mode 0" (DIP switches 1 and 3) which makes it play 8 specific files triggered by any of the 8 input pins being pulled low, and once started it will continue playing that track until it ends.

These little sound players are cheap and versatile. The DY-SV5W can be operated through the Universal Asynchronous Receiver-Transmitter (UART) serial bus directly from an Arduino [Ref 16]. I have done this in another project and can in theory address over 65,000 different sound files. However, for most purposes such as ambient sounds on a layout, I would use the more basic DY-SV8F with just a few sounds on it specific to that area of the layout. Typically, I would trigger whichever sound is to play, either using a CANVOUT directly to the specific pin of the DY-SV8F or using a single output of a CANVOUT as trigger for a PMP12 Random Light Generator, with a sound file trigger program loaded onto it instead of the usual firmware. Where the standard code turns lights on or off at random, the sound version simply sends a brief pulse of 0V to one of the outputs – which could then be used to trigger any pin of the DY-Player.

The sound files have to be named as numbers, to be associated with specific inputs in the DY-Player. Sound file #1 must be named 00001.MP3, file #2 00002.MP3, etc. I searched the BBC Sound Archive [Ref 17] (this is a fantastic treasure trove for sound modellers, and royalty free as well) for a "crane" sound and eventually found something suitable from a recording of a water mill operating - lots of clanking, chains rattling, joints creaking and un-oiled bearings scraping. I edited these using the (free) Audacity program [Ref 18] on my PC to create two short 8-second output files - one for the crane winding (lots of chain rattle) and the other for it rotating (lots of creaking and screeching bearings). These are loaded as files #1 and #2. For good measure I also created a one-minute sound file of cattle mooing that is loaded as file #3, since the 6T crane is right next to the cattle dock, which is full of cattle, so the same DY-Player can be used separately for both purposes - crane and cattle. This cattle sound will be operated directly by a CANVOUT output.

With the DY-Player hooked up to a 5V power supply (any more than that will cause the chip to burn out – guess how I learnt that?) and any old second hand two-wire speaker (old radios or tape decks are a great source of these), all that is needed is to connect the two pins with the sound files to the Event Sequencer and it will play those sounds. I connected it to Event Sequencer outputs D and E respectively as sounds #1 and #2.

That means that whenever output B goes either high or low, output D should be triggered by being pulled low briefly (just long enough to start the sound file playing). Similarly, whenever the crane rotates in either direction by output C going high or low, then output E should also be triggered.

The code for PMP26 is posted in the MERG Knowledgebase [Ref 19]. It is quite short and simple and written in JAL which is a 'BASIC' style language modelled on Pascal, it is very intuitive and easy to learn. MERG also has a JAL SIG which can help with such modification projects. It turned out to be surprisingly easy to re-jig the JAL code so the five outputs turn on and off in the order I wanted. I also made some other changes, so when the unit is first powered up and doesn't know what position it is in it goes through a controlled, slow sequence of moves to get to its starting position, rather than swinging its generator load around like a conker fight on steroids.

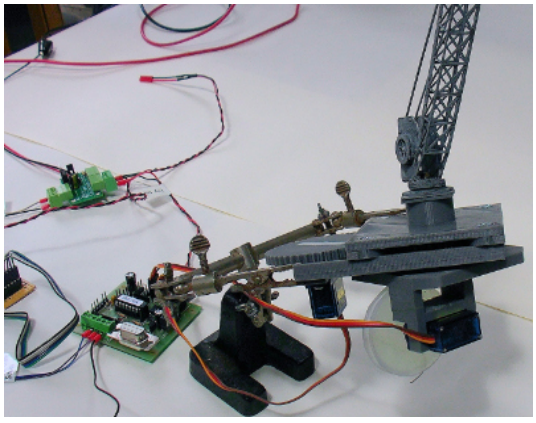


Figure 4 – Showing the mechanism in the crocodile clip stand for testing

I have explained how to compile JAL code and load it onto the PIC chip using a Pickit-3 device in a previous article [Ref 20], so won't repeat that here. I then hooked up the whole system, with the crane mount held in a crocodile clip stand to lift it off the table and tested it, before fitting it all to Abingdon.

We end up with a fully operational 6T Yard Crane – and cattle dock with sound effects – triggered by two outputs from a CANVOUT and with one input to the CANVOUT as busy indicator. Only it does not stop there. The CANVOUT can be operated by buttons on the Abingdon control panel, but that is not the intention for its general use. Instead, we have fitted, on another baseboard at the front of the layout, a PIR sensor (as described previously). This has its output connected to a PMP12 Random Light Generator [Ref 21].

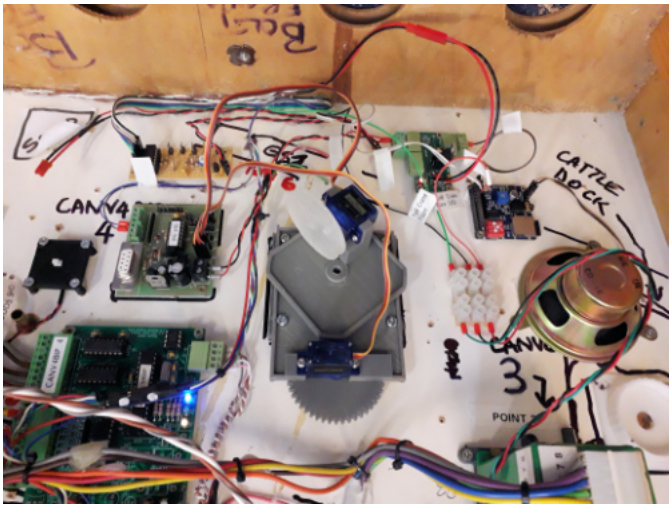


Figure 5 – Showing the underside of the baseboard, with the crane in position

The PMP12 has ten outputs. Two of these will be connected to special effect animations on that same board. The other eight are all connected as inputs to a CANVOUT to operate remote animations. Because the layout now has a CBUS network, these eight inputs can be used to trigger special effects anywhere on the entire layout. I use the "sound player" version of PMP12 code, which sends only a brief pulse to any of the output triggers.

One of those outputs will be to trigger the 6T yard crane to do its thing. Another of those outputs will set the cattle mooing. Whenever somebody comes into view in front of the PIR that will cause it to trigger one or other of ten animation/special effects somewhere on the layout (subject to a short lockout period, to give the layout time to catch its breath after each animation). The operators, who are placed in front of the layout for good reason, can then choose to divide their attention between running trains and interacting with the viewing public, while the magic happens around them automatically.

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For Andrew's biography, please see MERG Journal, Vol 56, No 3, September 2022, page 6.

Figure 6 – Showing the crane in position on the layout

Mimic Dreams and Nightmares – Part 1

Alan Trevennor M8864

Abstract

This multi-part article looks at the possibilities and practicalities of incorporating a touch screen mimic control panel into a layout that uses DCC only for loco control but does everything else via a network of Wi-Fi equipped microcontrollers. Advantages over conventional "switch and LED" mimic panels are enumerated and then different graphical touch screen approaches are discussed. Part 1 concludes with an outline of the chosen solution and part 2 looks at it in more detail.

Mimic Spaghetti

I think most modellers feel that the larger a model railway layout becomes, the more essential it becomes to have a central control panel – or a mimic diagram – which allows control of all layout essentials such as signals and points.

However essential such a facility is, most people find that implementing it is a real chore. Accounts of mimic diagram implementations frequently feature the phrase "spaghetti wiring nightmare" and a great many of them end with a phrase like "a better re-implementation is high on the 'to do' list".

I am in the fortunate position of starting a completely new test layout – and of having some experience with microcontrollers, electronics and programming. For my test layout, I have decided that, although I will use DCC for loco control and power distribution, I will try to do everything else using wireless command and control. The centre of this scheme is to use a mimic control panel, based on a touch screen. Since that is the central part in my plan, that is the first thing I am working on. The reader may wonder why I have elected not to use already available facilities in JMRI or to use things like a Raspberry Pi with a touch screen. The answer is that – for my test layout at least – I am intending to use a network of Wi-Fi capable microcontrollers for all non-DCC command and control. Therefore, using one of those same microcontrollers to run the mimic panel minimises possible system integration issues by keeping the technology set small and all within my direct control. Also of course, there is the fun technical challenge of making it all work as it should.

These articles (part two next time) describe the thought processes and technology selections for my first version.

Why Mimic?

The value of a mimic panel comes from three main functions:

- Overview: a diagrammatic view of your layout
- Control: the ability to control signals and track elements on the layout
- Indication: providing a visual representation (i.e. a mimic) of the status of layout elements.

The conventional build of a mimic board requires that the power feed to any controlled object (for example a point/turnout, a signal motor, or a light) be wired back to the mimic panel. Each power feed must be connected to some kind of switch or stud connector.

Where a panel has indicators, these are often indicating the controlling switch's state rather than the true state of the controlled object.

More complex mimics may also incorporate additional features like lights to show whether a track section is occupied now, and some more recent designs even incorporate small OLED displays to allow the panel to show what train is occupying a section. But on a conventional mimic build, all these things increase the amount of wiring and connections needed behind the panel and when layout changes happen, then corresponding changes to the mimic board can get complicated and disruptive.

The details of any mimic panel implementation are clearly going to depend in large degree on the control system used across the layout. A layout using DC control is going to need a different approach to one that's controlling a DCC layout. For example, on a layout using a lot of train automation, the mimic panel needs some integration to allow a mix of automated and manual control – and so on.

Are we there yet?

As a self-confessed tech-head I decided that I would try out different technology approaches before I built any proper layout (beyond the usual test oval for trying out individual items). For better or worse it seemed to me that the control system was going to be the key aspect to begin from, and that the mimic panel should sit at the centre of that. So at the time of writing, that is my focus and my small prototype panel is very well progressed – though not yet 100% complete. This multi-part article describes the journey so far.

My Test Layout Plan

Before anything else, I had to have a layout plan. Using the free application SCARM (Simple Computer Aided Railway Modeller) I eventually arrived at a plan for my test layout which, with a complete lack of imagination, I have called "Westside-Eastside". This test layout is intended to fit in a fairly small space – a table sized at about 1700mm by 1300mm – and to provide:

- a platform for trying out command and control ideas – not for scenic modelling. Almost all the features (stations, lineside buildings) except the track and signalling will be imaginary
- end to end running (mainly single-track) between two terminal stations: a small two track station called "Eastside" and a larger five track station called "Westside"
- as much running length as possible, using a spiral track arrangement
- a passing loop
- a small branch line
- running for short trains (perhaps maximum two vehicle trains) with short block sections

The idea is to try out as many different ideas as possible before committing to a larger, properly scenic build. The track diagram for the layout is shown in Figure 1.The SCARM model says I can largely build this layout from Peco Set Track.

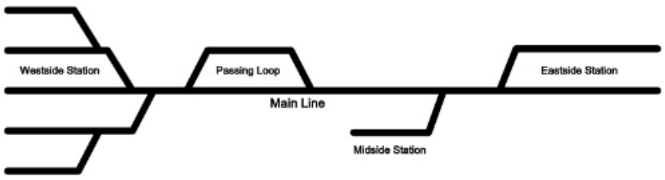


Figure 1– The track plan for Westside-Eastside

Although – as the diagram shows – this test layout runs from end to end, it is in fact constructed in a spiral fashion so that the mainline between the two termini loops round a couple of times. Westside station is actually in the middle of the layout.

A Touch of Glass

I am far from the first person to look at the idea of using an LCD touch panel screen for a mimic diagram. However, I want my eventual implementation to deliver a few specific things:

- to diagrammatically show the layout in whole, or in part
- to allow control of points and signal devices
- to indicate the true state of those devices
- to dynamically show section occupation but also to show what train is on what section
- to easily accommodate and reflect changes to the layout
- to allow multiple Mimic instances – so that two operators could see the same display on two different touch screen devices. Not needed for my little test layout, but a nice option to have in the back pocket if the design is ever scaled up for use on something bigger.

Touch Choices – Tough Choices

So, faced with the requirements listed above, the next step was to select an implementation approach and choose what software and hardware to use. I considered several approaches to implementing the touch screen mimic and these are described below.

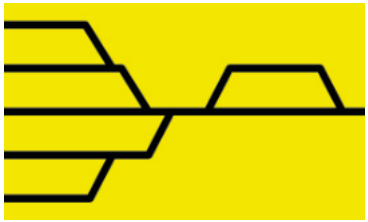
The JPEG Plus Overlays Approach

On the face of it, the simplest approach is to draw your layout diagram as a single image using your preferred drawing package and use that as the background to your mimic diagram page display. You'd need to make sure to size the image to the exact same pixel sizes as your target touch screen. The diagram would show all the track connections and use some kind of markers at rail junctions to represent points and perhaps have trackside markers for signals. When completed, you would save your drawing twice:

1. As an uncompressed editable original. This would allow you to come back to it and make modifications without losing any image quality.
2. As a JPEG file with minimal compression level, which you would use as the touch panel page background image.

I started with this method and as part of it I drew up the track diagram for the Westside part of the layout – see Figure 2. This shows the five platform tracks and associated point work and the passing loop and a track going off to the right, which leads to Eastside.

Figure 2 – Westside track diagram



Having got a diagram like this, you might then incorporate that image – at full screen size – into an HTML5 page which sets up screen hotspots (and callback functions for when they are pressed) for each of the actionable touch points of the image. The touch screen sends touch coordinates into the browser and the callback routine takes some action – in my scheme it would send a command via network (Wi-Fi or Bluetooth) to the actual device controller (e.g. a point motor driver) on the layout. The controller takes the action and sends back a completion acknowledgement.

The single image approach is intuitive, and it serves the overview (diagram) and control (hotspot) purposes of a mimic panel very well. But implementing the indication function I had in mind could need an extra set of more complex overlays – for example to change the colour of individual set routes or occupied track sections on the diagram might be quite complex or impossible to do.

Touch Tiles

Rather than using a complete single image of the layout, another approach I looked at was to draw the overview diagram as a single image – as before – but then decompose it into some number of individual image tiles. I also looked at rendering multiple versions of each of the tiles in different track colours (black for not set, blue for set, red for occupied) to make it easier to indicate how points are set and each section status. The command line image processing toolset Imagemagick (hereinafter IM) [Ref 1] allowed me to generate a matrix of tiles from the Westside track diagram (which we saw in in Figure 2). For each tile location I generated three geometrically identical versions, but with the track lines in different colours – thumbnails of the resulting set of files are shown in Figure 3.

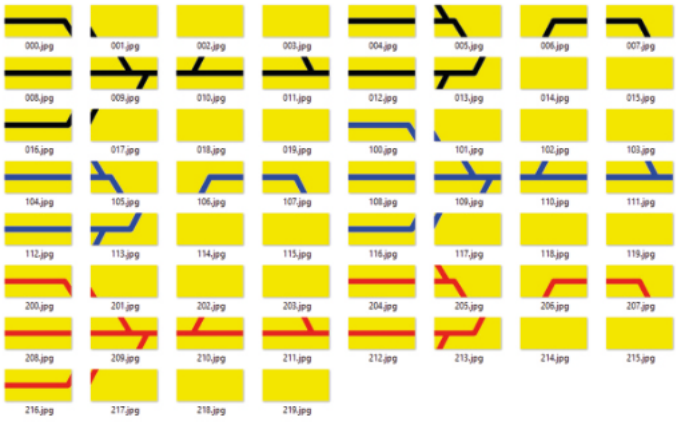


Figure 3 – Tile set generated using Imagemagick.

By making up an HTML5 page containing a matrix of image objects, we could build up our mimic, filling each image with a tile from the set – and then using some means (JavaScript, Python etc) we could dynamically load different tiles (from a black version to a red version for example) to meet our need to indicate layout item statuses.

The problem with this approach is that each of the tile sizes would need to be identical, but the junctions between the individual items on a mimic diagram are highly unlikely to occur at identical intervals. That means that this approach can't really work exactly how we would like. Very often you would be changing tiles which span two sections, and you could end up with confusing displays like the one shown in Figure 4 which were made up from tiles 001, 002, 204 and 205 using the IM command:

```
magick montage -border 0% -geometry +0+0
 .\000.jpg .\001.jpg .\204.jpg .\205.jpg
          overlap_example.png
```

As you can see here, the intention is to make the lower track red to show section occupation, but due to tile overlap, part of the upper track is also made red.

Figure 4 – Showing the tile overlap problem.

Depending on the granularity of the tiling, this problem might not be too hard to live with, but I decided that I would keep looking to see if there was a better approach – and I think maybe I discovered that there was.

Smart Touch Panels

Over a period of years, I have carried out many DIY home automation projects – mainly info and lighting control systems. Through all those projects I progressed from using control systems consisting of simple panel mounted switches wired out to controlled devices to using small touch panels connected to the house Wi-Fi to wirelessly send commands to various electronically controlled systems and devices.

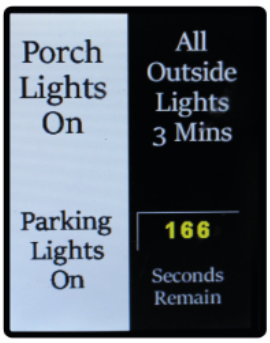


Figure 5 Touch panel 1

Figure6 Touch Panel 2

If my later projects have used what are known as "Intelligent touch screens". These are a colour LCD screen with a touch overlay, but they also have a complete miniature graphics system built-in, which can display a variety of things such as JPEG images, buttons, sliders, checkboxes, meters etc. The photos in Figures 5 and 6 show a couple of the control panels we use in our house made using small 3.5" versions of this kind of panel.
The panels were built using Nextion's free PC-based design tool which allows you to design your screens using a wide variety of gadgets (buttons, pictures, sliders, etc.) and you can test your design before you upload the final thing into your Nextion panel. Sadly, though we will use it a little bit later on, this design environment is not hugely useful here where we don't really need many bitmapped objects.

There are a few companies making this kind of Human Machine Interface (HMI) product now, but the ones I have used are marketed by a company called Nextion [Ref 2]. These panels (currently available up to 10" size) talk to the outside world via a TTL level serial interface (operating at serial baud rates up to 921.6k, though for most purposes 38.4k seems to suffice). The communication is two way and by hooking up a microcontroller to the panel you can command the panel to update the display and receive touch events and other information from it. Where you use a Wi-Fi enabled Microcontroller, this essentially givesyou a dedicated graphics-capable networked human-machine interface. Yes, you can do the same with a tablet computer but in a general-purpose machine like that you can't really help but have a lot of other things running all the time as well as your graphics application – so a tablet might be an attractive alternative in some ways, but not others.

For the purposes of the current article, the most interesting feature of Nextion's products is that they can be sent instructions to display text at specific screen locations, to draw lines, circles and arcs in specified colours – and any of these can be updated (text changed, colour changed, hidden or revealed etc) at will. This means that you can develop a set of coordinate points on your layout to represent where lines intersect and draw lines between them – and redraw them in different colours to show "live" or "not live" sections or to represent occupancy or not. You can also put text labels next to sections of line to indicate things like what train is occupying them and you can put representations of signals beside the lines to show signal states. You can touch the screen at intersections to cause point change commands to be sent, but you will also get visual confirmation when the connecting lines change colour that those commands have been successfully carried out.

Wiring – is that all there is?

All these capabilities are possible using this approach but there is a lot of programming and data design involved – so yes, it's a journey! But let's start simple and see how, using just a simple Arduino Uno, we can command one of these panels to do very basic drawings for us. I'll have to assume that you are reasonably familiar with using Arduinos and the Arduino Interactive Development Environment (IDE) – and you may find it useful to refer to the Nextion instruction set page [Ref 3] when considering these examples.

The size and type of Nextion panel that you might use will depend on you. If you want to just try out the panels, by all means use one of the smaller, cheaper ones. If you want one that will be useful as a Mimic you'll probably need the 7" or the 10" products which cost rather more. The connections to the panel – whatever its size – don't seem to vary at all – though the power requirements do change a bit as you go up the range. In the following I'm just using a spare 3" panel for purposes of explanation.

The connections between our touch panel and the Arduino are very simple. The Nextion panel has just four connecting wires:

+5V DC power supply.
Ground
Send data (TX)
Receive data (RX)

It would be nice to power the Nextion panel from the Arduino's built-in regulator (its +5V pin) and for some of the smaller Nextion panels you might get away with that – but there is a risk. The Nextion website is very clear that providing insufficient current to a panel may damage it, so try it at your own risk! The safe way to do it is to provide the Nextion with a dedicated +5V supply (a 5V DC supply that can supply 500ma should do the job) and be sure to link the ground of that supply to an Arduino UNO ground pin as shown in Figure 7. The interconnections we need for our get-started sketch are shown in Figure 7. Very simple, just power and TX and RX serial lines.

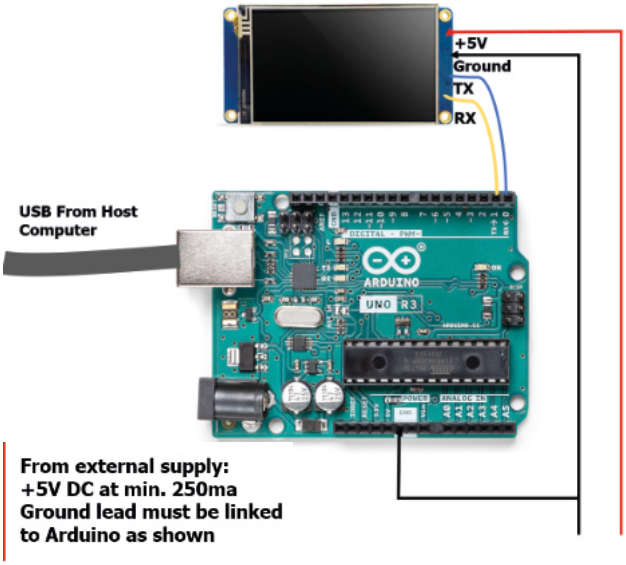


Figure 7 – Basic Arduino UNO to Nextion panel connections

So now with the hardware for our first foray into programming a panel all set, let's get started on some software.

The Line Must be Drawn Here

The Nextion instruction set consists of text commands sent over the serial line. Commands such as "page" (which selects among different display pages – that's right, a single panel can have multiple display pages and you can command it to flip between them).

The length (number of characters) in the commands that we send varies quite a lot. Therefore, the end of every command must be signalled to Nextion by sending three bytes, each containing the Hexadecimal value 0xff (or decimal 255). Every command that we send to the panel must have this added on the end or it won't be carried out. So, we use a dedicated function called sendEnd() to do that.

Aside from sendEnd() our first sketch consists only of the familiar setup() and loop() functions. The code for lineDraw1 is shown below and the following is a commentary on it.

IMPORTANT NOTE: keep the TX and RX leads from the Nextion panel disconnected until the upload is complete, or the upload will fail. In order to keep this first example simple, the USB and the panel are using the same serial channel. We'll address this in subsequent examples

```
// LineDraw1: Arduino to Nextion 01

void setup() {
 // Open serial communication
 Serial.begin(9600);
 delay(100);
 Serial.write("cls YELLOW");
 sendEnd();
}

void loop() {
 // Draw the line
 Serial.write("line 0,0,200,200,BLACK");
 sendEnd();
 delay(1000);

 // Draw red circle
 Serial.write("cirs 200,200,30,RED");
 sendEnd();
 delay(1000);

 // Redraw circle in blue.
 Serial.write("cirs 200,200,30,BLUE");
 sendEnd();
 delay(1000);

 // Clear screen before we loop() over
    again.
 Serial.write("cls YELLOW");
 sendEnd();
 delay(2000);
}

void sendEnd()
{
 Serial.write(0xff);
 Serial.write(0xff);
 Serial.write(0xff);
}
```

The setup section is very simple – we just initialise the Serial channel to run at 9600 Baud (which is what Nextion panels default to out of the box) and then we wait for 100ms as – at power up – the Nextion panel needs a moment to complete its own initialisations. To end the setup section, we send the panel the first command which is a "cls" (Clear screen) command to clear the screen and set the page background to yellow then, of course we complete the command with a call to the sendEnd() function.

Now we get into the main loop which will run repeatedly until we stop it.

All Nextion graphics commands use x and y coordinates (x being how many pixels from the left-hand side and y how many pixels down from the top). So, a coordinate of "0,0" means top left, while "200,200" means a point which is 200 pixels from the left-hand side and 200 pixels from the top.

We begin by sending a line draw command, which takes two sets of x and y coordinates – the first pair specify where the line starts and the second pair where the line ends. Here those pairs of numbers are 0,0 and 200,200 and we also add a colour name "BLACK" (colours must be in upper case).

At the top of the loop() function we use Serial.write to send this command to the Nextion display and of course we follow that with sendEnd().

We wait for one second (1000ms) and then we send another command which is a "cirs" command. This command draws a colour filled circle, centred on the x and y coordinates 200,200 and we tell the command that the circle radius is to be 30 pixels and the fill colour is to be RED. Then of course we need sendEnd() again as we always do – so I won't keep mentioning it.

After another one second pause, we draw another identical circle but in BLUE – this has the effect of changing the colour of the circle on screen from RED to BLUE. Again, we wait for one second and finally we use a "CLS" command to clear the screen to yellow again, ready for the next loop to do it all over again after we wait for 2 seconds to recover from the excitement.

Upon successful execution of this program the screen should look something like the snapshot shown in Figure 8.

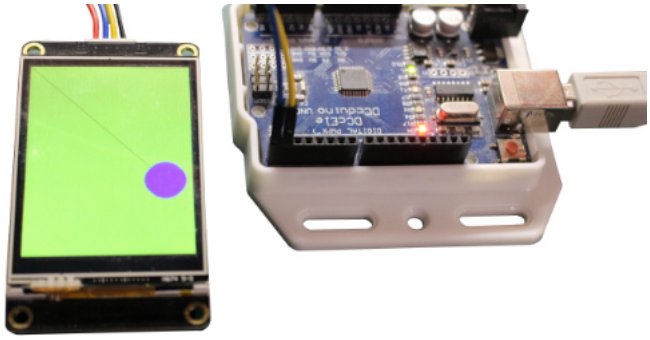


Figure 8 – Arduino UNO and Nextion Panel Running Linedraw1

So that's a very simple example of sending drawing instructions, you can also draw rectangles and fill them with colour and you can draw much thicker lines than we've seen here.

What Next?

In the next instalment we'll look at how we build on the simple capabilities we just sampled and how we build a data model to describe the lines and features of the Westside-Eastside layout and look at code that turns that data model into drawing instructions. We'll also see how we handle touch events from the panel and how the software can turn those into commands out to device controllers to make things happen in the real world. We'll also see how an overall system based on these ideas could have multiple control stations and look at accommodating layout changes.

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Biography - Alan Trevennor

Alan lives in North Cornwall with his wife and son. Now retired, he most recently worked for a medical software company in Bodmin. Before that he worked as a digital media technical consultant with Hewlett Packard (HP) in Bristol and London. Previously to that, he worked for Compaq and DEC. He is the author of several books – most recently "Practical AVR Microcontrollers" which was published in various editions between 2012 and 2015. He is working on a new book at present. He only recently returned to the Model Railway hobby after the usual mid-life absence, although he has always loved trains. His main interest is applying modern tech to heighten and enhance layout operation and realism.

Gnawe Upon Toaste

Elaine Bentley M7366

Ooh, that's different!

That phrase was repeated often when I first exhibited a layout at a model railway show. Well, it did feature a castle made from fabric, ballast using tiny seed beads and dragons! My OO gauge layout had a circle of track over a u-shaped loop for a shuttle. Steam engines are fire-breathing dragons, after all. Pesky humans were trying to steal the dragon's treasure of gold and jewels. It was appreciated particularly by women and children who attended the shows. More conventionally I then contributed to our group layout of Scarborough trams. In my case it was a model, entirely scratch built, of the Scarborough Grand Hotel (the seafront facing part of it). That was more than enough prototypical modelling for me.

Whilst teaching the basics of human biology to adults I liked to use visual aids. I had made a 3D model of the digestive system from fabric to show the different organs and length. This was useful for anatomical purposes, but didn't show how it functions. That was something I thought a model railway could contribute to. After all, there is a journey involved with plenty of interest along the way and the location certainly exists. Hence the concept of my layout 'Gnawe Upon Toaste' or G.U.T. for short: a tube train.

Gnawe Upon Toaste

G.U.T. does not realistically emulate gut anatomy – way too many curves. Instead, the aim is to highlight the functions at different stages. I designed a layout that is essentially an oval but with extra length from two helices. It is a single-track N-gauge, one-way system with no points. There are 'stations' which represent the different parts of the gut, for example, stomach and colon. The loops of the gut tube depict the gross anatomy, whilst the stations depict some of the microscopic anatomy as this is where nutrients are absorbed across the gut wall into the blood stream. Each station has different lights and sound to highlight function. For example, lights at the stomach indicate acid and enzyme production. The backscene displays information about fluid use, nutrients and has a more anatomical map of the gut to show the train position. Other body organs are depicted inside the helices, though again, not in anatomical positions. One helix has the liver, pancreas and gall bladder which are particularly involved in digestion. The other helix has organs which are using nutrients. Overall, the layout is 75 x120cm. As I did not want actual engines going round G.U.T., I found the cheapest, shortest ones I could customise. Kato, Es-1 Electric locomotives fitted the bill [Ref 1]. The tops were removed then they were customised to look like food: one peas, the other sweetcorn as shown in Figure 2.

There are four picture frames on the backscene: menu, fluid chart, nutrients and body map. The menu cycles through three menus, one for each pass around the system. My original intention was to try and show the nutrient content of each meal but that was just several steps too far. The fluid chart lights up as it goes through each gut section to show fluid in and out, as digestion uses a surprising amount of fluid (hence the serious danger of dehydration with diarrhoea, when the fluid is not reabsorbed). The nutrient chart just has three lights for carbohydrates, fats and proteins. It lights up as the engine reaches the small intestine.

Food is broken down into nutrients so we can absorb it. The body map shows the gut organs in a more anatomical position. Organs light up in turn as the engine passes along the track.

Figure 1 – Gnawe upon Toaste, showing the open jaw, waiting for its next meal, at the far left. Also visible are the four picture frames.

Figure 2 – Peas and Corn locomotives

Electronics

My ambition was to have a fully automated layout. I knew what I wanted to achieve but I wasn't exactly starting from a strong knowledge position. I hadn't even wired my dragon layout myself. I'd come across MERG at a model railway show in Doncaster and thought the CBUS idea was potentially useful. Thus starting a very, very steep learning curve, with the word 'eventually' really needing to be added to each stage. The layout was first made in cardboard to work out the position of the various elements and where the electronics could go. There are two boards with a helix on each. I decided to use the centre of each helical loop to contain the electronic modules, as shown in Figures 3 and 4. They are accessible from the top of the baseboard rather than underneath, though the track power wires run underneath. The lights for the organs in the domes link by ribbon cable to a connector board so the domes can be removed. I built my layout using laser cut plywood for the helices as these would carry the track, with scratch built made supports. The rest is mostly card, paper and papier maché; all scratch built as obviously no kits exist for this type of location.

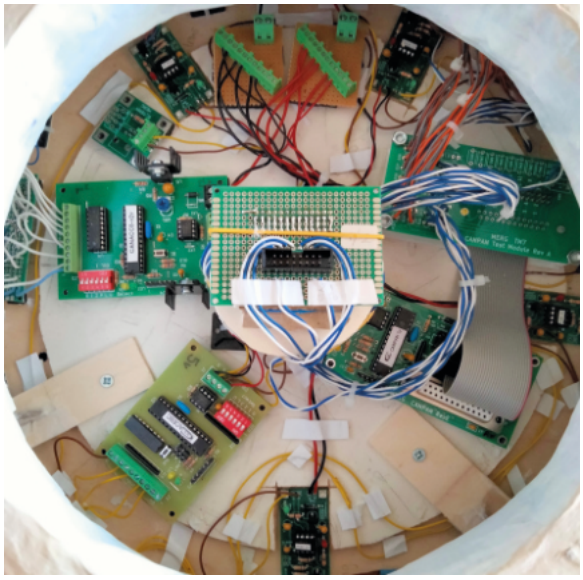

Figure 3 – Modules under dome 1

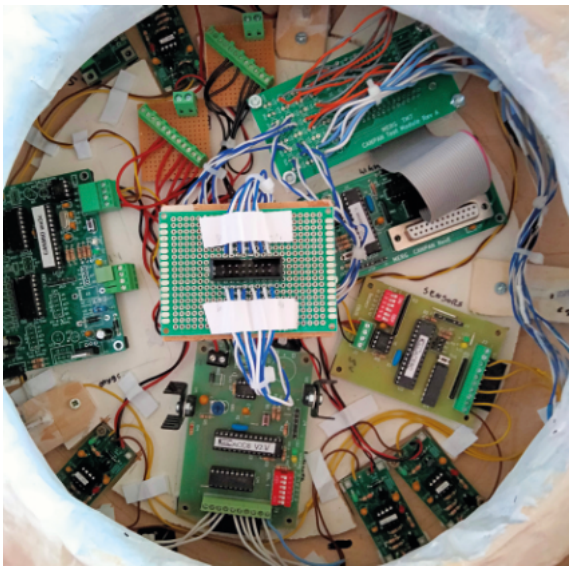

Figure 4 – Modules under dome 2

I had never soldered before, so I first tried making up two of the Laser detector PMK22s. To my surprise, they worked, so I moved onto the beginner CBUS kits. FCU software was successfully downloaded and the modules talked to each other. These were then used for the layout. I also made up various other MERG modules including CANPANs. I was doing quite well with soldering until then. SMDs might be great for experts but are nasty little things. I intended to have only the CBUS and power wires going between the boards, so each board had modules to receive information from the sensors and to communicate with the lights.

Overall, I ended up using the following MERG kits and modules:

- CANUSB (Kit80A)
- CANACC8 (Kit88)
- CANACE8C (Kit89)
- CANPAN (Kit97)
- CANMIO (Kit13)
- Laser Train Detection (PMK 22)
- Train Detector with LDR (PMP2)
- Speed Controller (PMK10).

Train detection

I needed to detect the train position for my concept to work. Sensors would trigger different actions at each station so that as the train goes round, the food journey is illustrated. The PMK laser detectors were chosen. They work but were quite difficult to position and hide as I needed some of them on the top level of the helix. With more confidence I would have chosen more discrete ones.

Lights

G.U.T. is accessory rich. There are trackside lights in the stations and lights in each of the organs. The backscene displays also use lights. Seventy in total in a variety of colours. They don't come on all at once. For example, in the duodenum trackside lights show bile, enzyme and pancreatic juice. The sensor also triggers lights to come on in the liver, pancreas and on the anatomical diagram. They are turned off further along the journey.

Whilst the CBUS system does indeed reduce the number of long wires going across boards, I still had to do lots of wiring for the LEDS. I also had to do a lot of head scratching as to how exactly to wire them to the modules. As a beginner I found it difficult to work out how to wire 8 lights with 16 wires to a CANACC for example, when there are only 8 outputs. This is probably obvious to experts but I would have appreciated this information added to the build instructions. Because of the number of lights, I thought a CANPAN module would be appropriate. But I really struggled to know the best way of dealing with the CANPAN light matrix. Initially I used a blank PCB to give me rows and columns, but after meeting someone who knows about MERG at a show, he suggested using the CANPAN test PCB. This was neater but only marginally easier.

Sound

Sound adds to the interest and also can be fun. For G.U.T I didn't need train noises, but background ones to help complement the different areas of the gut. I thought this might be one of the more straightforward aspects. Silly me. I could get sound bites from the internet as several sites offer free sounds. Also, I had some family members contribute. Getting sound was relatively straightforward, as was using the free programme, Audacity, which does save files in a suitable format, once I'd worked out what was needed [Ref 2].

Many years ago, I had played with an Arduino, though not progressed very far or used it for a practical application, but thought that would help here. To do so seemed to need a sound shield. I found an Adafruit's Waveshield kit [Ref 3] and duly soldered the components – see Figure 5. It made sense to try one of the examples but it refused to compile. Hence a dive into the darkness of Arduino error messages. It took me a long time to work out that an error message required a tweak to the Wave library. Who knew one could (or want) to alter an Arduino library! Further error messages related to the type of file. Eventually I found the right parts of Audacity programme and saved the files correctly. Finally the example (dap.hc) worked.

Connecting Arduino to CBUS

I wanted the sensors which were attached to CBUS to trigger sounds as well as lights. So down a rabbit hole attempting to make the Arduino UNO talk to CBUS. Naively, bearing in mind that I am beginner in all this, I thought this would be straightforward. Silly me. I tried. I really did. First of all, the Waveshield was using the pins that CBUS wanted. Maybe an Arduino mega would help? It has lots of pins.

But no, because the shield was not designed for it. Even without considering sound, I spent hours trying to get communication going between the systems. I encountered error messages when the CBUS library examples wouldn't compile. Yet another library tweak required, I gather sorted now. Then I managed to silence an Arduino somehow by repeatedly trying to sort out communication. It wasn't the main removable chip but something wrong with the serial communication. Yet another rabbit hole seeing if the Arduino could be rebooted, but it wasn't to be. This became all too complicated, so I gave up in frustration. But then I realised that all was not totally lost as CBUS gives a digital output which could be accepted as a digital input by an Arduino. Not full communication but maybe of use. One CANMIO output is used to trigger the sounds. Each sensor does talk to the CANMIO so I could select sensor events ON then OFF so that the pin receiving this could detect a change of state as the engine passes along the track. The Arduino coding was sorted out for this – eventually!

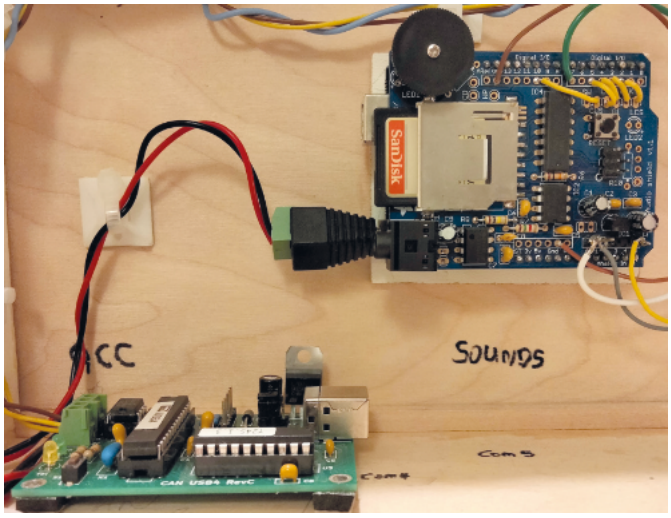

Figure 5 – Waveshield and CANUSB4

Servo and stepper motors

I have two motors on my layout, one servo, one stepper. A servo motor opens and closes the mouth, just a jaw really. This is controlled by CBUS via the servo outputs from the CANMIO module. This all singing, all dancing module is probably great for experts who wish to use as few modules as possible. For beginners like me it was one big headache. Having assembled one, it transpired it only moved servos, though I wanted outputs as well – something I should have realised had I understood all the documentation. I did have a go at downloading the universal firmware but later bought a replacement chip with it already installed. Only then did the options for setting up outputs appear, though it seemed a complex procedure with look-up tables. There was a lot to understand.

The stepper motor moves a wheel – see Figure 1 extreme right and Figure 7 to the left of the MERG Journal. The wheel shows the Bristol Stool Chart [Ref 4], so has sections with 3D models of poo as depicted in the chart. It moves round with the appropriate trigger. The stepper is controlled by another Arduino, once the coding was worked out. The silent Arduino did in the end find a use as it provides a separate 5V DC supply for the stepper motor. Initially I had an output from the CANMIO triggering the wheel, but later changed this to use the light dependent resistor (LDR) which is positioned behind the backscene. The engine stops here, wheel turns, then after a short delay sets off round G.U.T. again. The downside of this rather bodge Arduino/CBUS job is that I do have extra wires running between the two boards now as I only wanted one CANMIO. The nutrient chart is triggered by CANMIO output.

Track control

For my single-track, one way, no points, one engine running at a time, layout, it seemed sensible to use DC. However, I did want it to be automated. After all, the liver is actually the fat controller! There seems to be little information about this as I guess most railway modellers do want to control their trains. A colleague who knows way more about electronics and coding than I do, helped devise a means of doing this. The Arduino, which also controls the stepper, uses an adaptation of an Arduino sketch with a pulse width modulation (PWM) pin to 'fade' the output voltage up and down. A MERG PMK Kit 10 voltage regulator gives me some control over the speed. I did want the engine to stop at the stations for a short time, primarily to give time for the sounds to play. Initially, I tried using the delay() function which did achieve appropriate stopping, but also stopped any other actions whilst the delay was in progress. Not very helpful. Plan B was to try using the millis() function. All the help for understanding this relates to the 'BlinkWithDelay' Arduino sketch, which didn't really help me at all.

Coding for me is not intuitive. I did get quite good at getting coding to compile, which unfortunately is not the same as working the way I wanted it too. I kept thinking I had sorted out the logic, only to find that some aspect still did not work. Gradually I worked out how to write code into function blocks, then organise them together so my final void loop code is actually quite short. It does work, more or less. My engines run round the layout, stopping at stations, triggering lights, sound and movement, all without me having to press any buttons or switches.

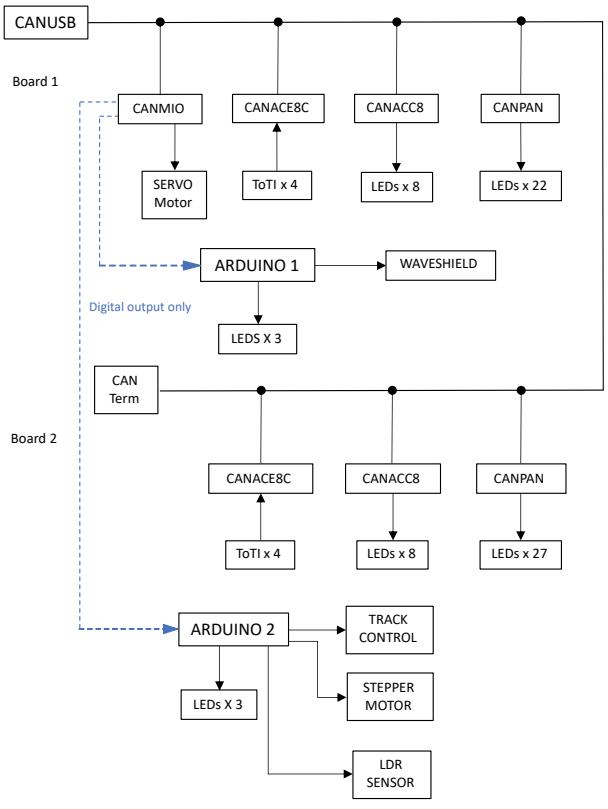

Figure 6 – Wiring connections

I just plug in power. Quite amazing given my initial level of electronics knowledge, but of course, I would like it to be more robust and behave well at all times. It does get out of sync sometimes so that, for example, the sounds aren't always appropriate, so Arduino resets are required.

Exhibitions

G.U.T. had a couple of initial outings, with not a lot working, but viewers were certainly interested in the concept. "Ooh, that's different" was often heard and people were happy to talk to me about their bowel experiences! Many, often frustrating, weeks have followed tweaking all the elements. Now the layout is ready for its next outings.

Figure 7 – G.U.T. at Scarborough, July 2023

Figure 8 – G.U.T. at Harrogate, August 2023

As well as using some MERG kits for G.U.T. I've used some others: Lighthouse Simulator (PMP13), Simple Shuttle (PMP4) and Versatile Timer (PMP20) to contribute to a group layout aimed particularly at children. It is full of wacky scenes. My lighthouse stands guard over a village pond. A short shuttle features a plant crossing. Well, the engine is doctored to look like a mad plant!

Figure 9 – Plant crossing

It is quite fascinating to attend model railway shows. They generally cater to a very particular demographic. There is definitely no queue for the ladies' loo! For me, the most appealing layouts are those which provide rich varied scenery with interest around the layout. I like those with height too and of course moving trains bringing the scene to life. I can totally appreciate that the vast majority of railway modellers get a lot of satisfaction from making their layouts look as authentic as possible and that running trains is an essential part of the hobby. However, it would be wonderful to see a little bit more fun and imagination injected into this domain. Surely, the model railway world can accommodate this and maybe widen the appeal? MERG modules and kits used in fun ways perhaps?

Whilst I still do not enjoy soldering and struggle with electronic concepts, I will try another layout, no doubt using some MERG modules. It will probably still be N-gauge but will not be a model of a railway and will certainly be 'different'!

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4. *https://www.nice.org.uk/guidance/cg99/resources/bristol-stool-chart-pdf-245459773*

Biography - Elaine Bentley

An 'A' level in physics gave me my first and last introduction to electronics. It was not an area that I enjoyed. Biology and chemistry were more preferable. Hence a degree in physiology. Work life has included health services research and teaching medical students. My main hobby is creative embroidery and making textile art. After retirement I joined Scarborough u3a and led a human biology group. I also joined a u3a modelling group which had a particular focus on model railways.

DCC Light Bar for N-gauge Coaches with Stay-Alive

Trevor Pocock M7058 and Torben Cox M6165

Abstract

The article demonstrates an effective collaboration for a simple project between members of a MERG Area Group where needs, knowledge, skills and opportunities came together at the right time – real serendipity. We describe the design and construction of a DCC custom light bar for Dapol and Graham Farish N-gauge coaches which includes a stay-alive capacitor to eliminate flickering. Nothing that is new or sophisticated but neat and very satisfactory.

Background

One thing leads to another. At our 3 Counties Area Group meetings we are encouraged to share what we have been up to on our own layouts. At one meeting Trevor Pocock was showing an early version of his homemade two-aspect signals [ref. 1] and enthusing about learning KiCad, getting PCBs made and how straightforward he found it using SMD components. Torben Cox, a keen N-gauge modeller, commented on how he could see the same approach improving the lighting bars he had made for his Dapol GWR Collett coaches using card, 2 mm axial LEDs wired in parallel and a through hole resistor. A series of conversations followed. Although the Dapol coaches came pre-fitted with wheel pickups and ready-wired with a JST 1.25 socket for their own proprietary light bar, Torben had the problem of flickering of the light bars even with scrupulously clean track and wheels; and the pucker Dapol bars don't come with capacitors as standard to provide any stay-alive function. Trevor mentioned how he had solved this problem in OO-gauge coaches and brake vans based on a modification of an earlier journal article 'Automatic Coach Lighting for DCC' [ref. 2] and using the accompanying PCB design [ref. 3] but Torben reminded him of how little space there was in an N-gauge coach. We swiftly agreed to collaborate on a little project, sharing our knowledge and skills and ideas to come up with a solution.

Design

The design criteria for the Dapol coaches were pretty self-evident (and helped of course by the fact that they had factory-fitted wheel pickups and a socket to plug into the track supply and that the roof and compartment moulding were designed with space for a light bar):

- All components on one PCB that fitted in the roof between the two moulded ridges
- One SMD LED positioned above each compartment wired in parallel with a single current-limiting resistor to adjust the brightness
- Space to fit a stay-alive capacitor to eliminate flickering caused by poor track connection
- DCC-compatible
- Full-wave rectification

It did not matter that the lighting was on all the time so there was no need to include circuitry to switch off after a period of inactivity.

Opting for full-wave rectification may raise eyebrows in some quarters who might say it's unnecessary especially as there are no PICs or components that need a DC supply. We realised that the LEDs would work satisfactorily with a single diode on one side of the supply with a current-limiting resistor but there are suggestions that when using that approach it is wise to share the load between the two sides of the DCC supply (see [ref. 4] for details). However, for the sake of fitting two small Dual Schottky diodes we just went for it.

The big question was where to fit the capacitor? In the toilet of course, where it can't be seen! This not only fixed where it had to be on the PCB but also determined case size and therefore to some extent its capacity. After assessing a range of capacitors on the bench with a mock-up of eight warm-white 0805 SMD LEDs, a 470uF capacitor was found to be perfect to eliminate flickering and a 470uF 16V 7343 Case Type E tantalum capacitor looked like it fitted the bill (and the toilet compartment!).

Circuit and PCB

The circuit is very straightforward, see figure 1, and very much influenced by the above-mentioned article. The two SMD BAT54S dual Schottky diodes give 14V from a nominal 15V DCC supply. The 1k5 resistor R1 limits the initial charging current to the capacitor. The solder pads for the current-limiting resistor R2 for the LEDs were deliberately made large to allow a conventional resistor to be 'surface mounted' if required. The reason was that we thought most folk would have a wider range of conventional resistors to choose a suitable value for their required level of brightness; it could then be replaced with the smaller SMD resistor of the correct value if desired. Torben found a 2k resistor to be ideal.

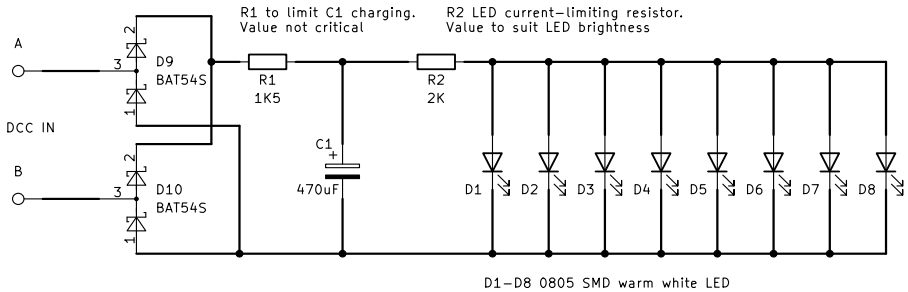


Figure 1 – Schematic for lighting bar with stay-alive.

Armed with our selected components, the dimensions of the roof and the distance between compartments for the LED spacing, a PCB was designed with KiCad. It was fortunate that a 100 mm long board fitted perfectly because at that time 100 mm square seemed to be the default panel size for economical (i.e. lowest price) PCB production.

We could afford to be fairly relaxed about our first version of the PCB because it was fitted into spare space on the edge of a large square panel of smaller mixed boards that Trevor was getting made by JLCPCB [ref. 5] (perfect collaboration) so we were not committing ourselves to a large number of potential duffs. In the end it all worked out well and apart from very minor adjustments to the LED spacing the biggest snag was that the capacitor was too tight a fit in the toilet compartment when mounted horizontally. It did not take long for two brains to realise that it would fit with plenty of space if the anode end was soldered vertically onto the PCB and the cathode attached with a thin lead to a pad on the PCB. The final PCB design is shown in figure 2 and we got the single 100 mm x 5.25 mm board panelised by JLCPCB giving 18 boards on a 100 mm x 95 mm panel.

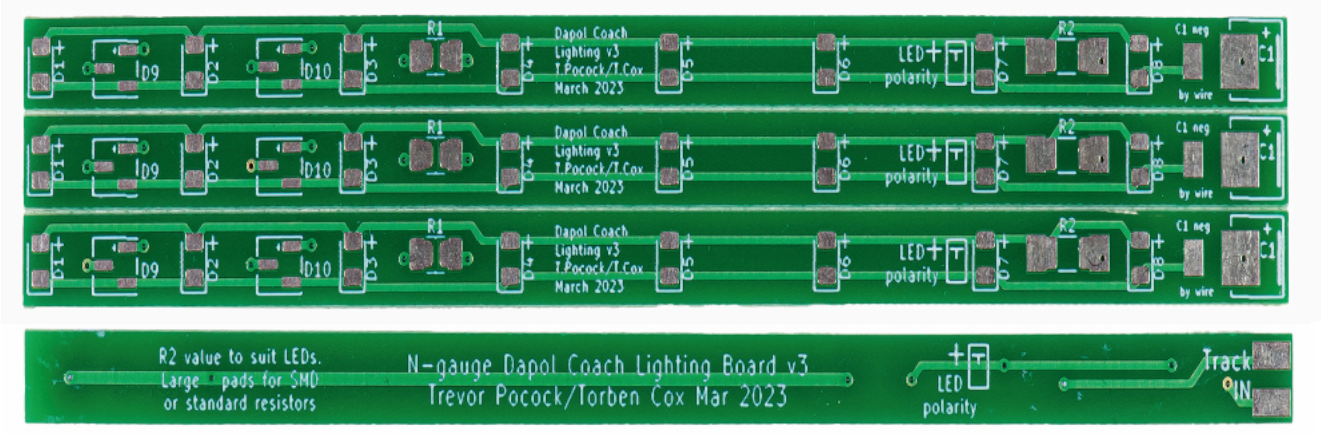


Figure 2 – Front and back of the PCBs showing panelisation.

Fitting the relatively few SMD components onto an uncrowded PCB was not as onerous as many people seem to fear; it just needs a little practice and encouragement as Torben can testify. We have both used a third-hand SMD soldering aid (available for 3-D printing on Thingiverse [ref 6]). There are other methods that members use and there are some guidance notes on the MERG website [ref 7]. The best method is the one that works for you. The Schottky diodes only fit one way but the LEDs must be fitted with the anode at the top of the board (indicated by a 'T' symbol or similar on the back of the LED pointing to the anode). It is also very important to fit the tantalum capacitor the right way with the anode (positive, marked with a bar) soldered edgeways on the PCB solder pad at the end of the board and the cathode (negative) connected by a thin wire to the PCB. The light bar sits neatly in the roof between the ridges secured with Black Tack (figure 3), with the stay-alive capacitor slotting comfortably into the toilet compartment with space to spare (figure 4).

Figure 3 – Constructed PCB fitting neatly in roof.

Figure 4 – PCB showing accurate alignment of components to coach interior.

Figure 5 - The comparison between a lit and unlit Dapol coach is striking (figure 5).

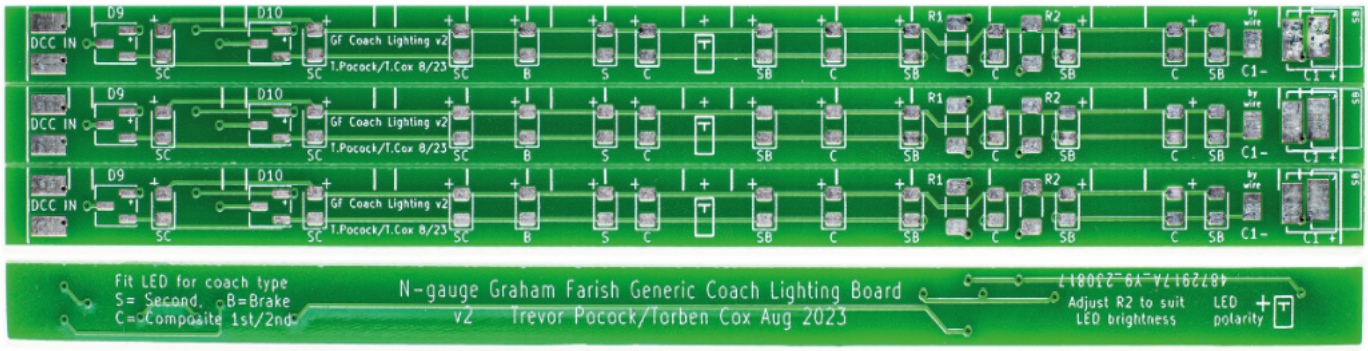
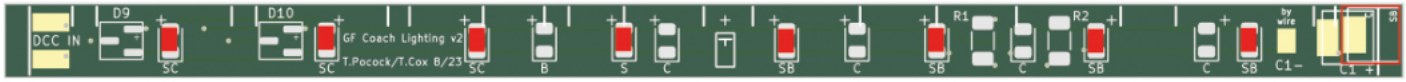


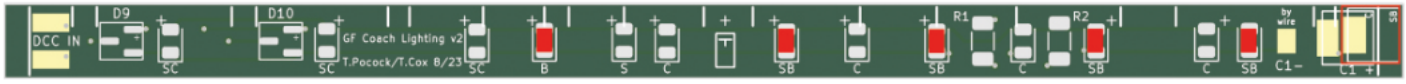
Figure 6 – Front and back of the Hawksworth PCBs showing panelisation.

Position of LEDs and stay-alive capacitor for each Hawksworth coach type

Second – 8 LEDs, capacitor at position SB



Brake – 5 LEDs, capacitor at position SB



Composite First/Second – 7 LEDs, capacitor at position C

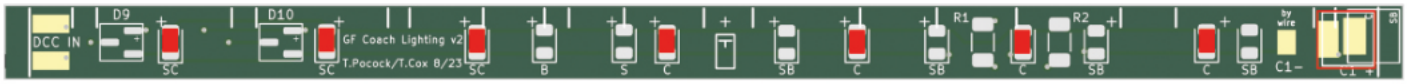


Figure 7 – Location of components for each coach type on GF PCB.

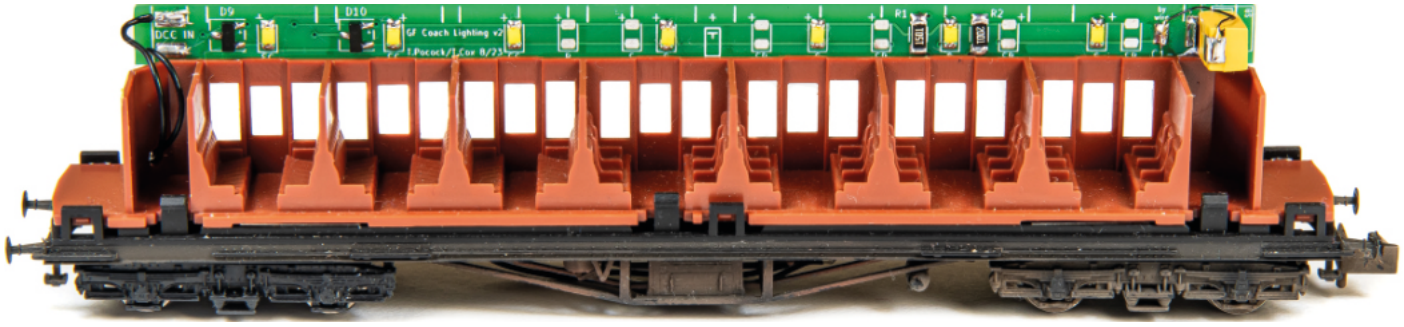


Figure 8 shows the completed light bar ready to be fitted into a composite coach with the final result in clear view in figure 9!

Figure 9 – Comparing a lit and unlit Hawksworth coach.

The Real Challenge

Creating and installing the light bar for Dapol coaches that were designed for them was a relatively straightforward task. Could we achieve the same for three rakes of Graham Farish (GF) Hawksworth coaches which were not manufactured to accommodate internal lighting? Specifically:

- Could we design a single board for the different coach types (Second class compartment, Brake Second and Composite First/Second) with a stay-alive capacitor?
  Answer: Yes – if there were multiple positions for the LEDs and we accepted that not all LEDs would be dead-centre. At least the toilet compartment is big enough for the stay-alive capacitor and in the right place!

- Would the board fit into the roof space without major surgery to the compartment moulding?
  Answer: Yes – with a thinner PCB, with all components on one side of the board and if we made sure that all active components avoided the compartment partitions.

- Can we fit reliable wheel pickups and connect to the board?
  Answer: Yes probably – but this is the greatest challenge, one obstacle being that the NEM coupling arm blocks the obvious route up from the bogie. There is much discussion and several solutions 'out there' but they are beyond the scope of this article.

Although the third consideration is very much work in progress, we have made a PCB that accommodates all coach types and fits in the available space with a 1.2 mm thick board. We kept the original circuit and design criteria and there were just three minor changes: increase the board length to 114 mm, remove the extended solder pads for resistor R2, include two positions for the capacitor. Both sides of the PCBs for the GF coaches are shown in figure 6 and, although it may look crowded and that some LEDs appear on a partition, remember that there are redundant LED positions depending on which coach the board is made up for.

The location of the LEDs and capacitor for each coach type are shown more clearly in figure 7.

There is a Project Page in the MERG Knowledge Base to accompany this article which has a list of components and the Gerber files for the PCBs together with details of a limited supply of spare PCBs [ref 8].

All photos by Torben Cox

Summary

We achieved our initial aim to create a neat and effective DCC light bar with stay-alive for both the Dapol and Graham Farish coaches at an affordable price (~£3 each). The Dapol design has already been used by another MERG member to his satisfaction in Dapol Mk3 coaches (TSO Trailer Second Open and FO First Open). Even though this was a straightforward project we both found it satisfying and rewarding working together to achieve our aim – although only one of us has the benefit of using the final product on his (N-gauge) layout! It is an example of what is surely happening through many areas of MERG: collaboration between like-minded folk to create an effective and workable solution for an idea or requirement which may be mundane or novel, simple or sophisticated, obvious or really ingenious.

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Biographies Torben Cox

As a child I had a Trix 3 rail layout attached to a board that hinged down over my bed. Then as a parent I built a small layout for my son, and quickly realised that N gauge was the way to go for a limited space. After retiring from a career in technical sales management, I set about building the layout I had drawn out in my 'Time Manager' many years before, and that too is on a hinged board of 8' x 4' to allow other uses for the room. However, my dream of an automated layout was really only made possible when I discovered JMRI and MERG, at the time when the CANMIO was just being launched.

Having taught myself the basics of JMRI, I went on a couple of Pete Brownlow's excellent courses to learn how to use JMRI's Dispatcher for full automation. I have some knowledge of electronics but the advice, tips and other help from MERG members and folk in the JMRI support forum have been utterly invaluable in answering questions and solving problems!

Trevor Pocock's biography is given in MERG Journal, September 2023, Vol 57, No 3, page 9.

Automatic Train Controller Kits – Part 4

Michael Collins M2563, Barry Mason M3426, Paul Howes M1925 and Allan Geekie M5173

Abstract

The Automatic Train Controller consists of a suite of four kits to automate a DC layout. They will be available in MERG's Kit Locker as:

ATC2-CORE (Kit 145)
ATC2-ENDS (Kit 146)
ATC2-PROFILES-PANEL (Kit 147)
ATC2-MPS (Kit 148)

This article provides a description of how train movements may be defined by using an Excel spreadsheet uploaded to an ATC2-CORE module. This approach is a prerequisite to using the ATC-PROFILES-PANEL and ATC2-MPS modules.

Introduction

The deployment of an ATC2-CORE module and an ATC2-ENDS module provides significantly better variety over simple shuttle circuits. However, the successful operation of multiple locomotives can be problematic if there are differences in the performance characteristics of different locomotives. Also the in-built firmware provides a variety of options for controlling up to four ENDs but, what of larger configurations?

Additional modules can be deployed to increase the number of ENDS available and to provide different performance profiles to improve control of multiple locomotives. However, these modules require train movements to be manually defined, on a spreadsheet, and downloaded to the ATC2-CORE module. In order to make this work, an USB interface module is required to connect a Windows PC to the ATC2-CORE and a folder of files needs to be downloaded from the MERG KnowledgeBase.

Microsoft Excel is required to define the train movements in a simple table and save them to disk. A free downloadable utility called TeraTerm is then used to transfer the file of train movements to the ATC2-CORE module.

Train Movement for a Simple End to End Shuttle

Step by step instructions for downloading a simple shuttle sequence are available as a Spreadsheet Quick Start Guide [Ref 1]. These include the steps necessary to download and use the specific spreadsheet version used in the examples in this article. The two train movements required are simply defined by specifying three mandatory columns for each train movement:

Start END number
Finish END number
Direction (East or West)

Optionally, comments can be added to the last two columns to remind yourself of what you intended.

The ATC2-CORE module can control a servo to move a semaphore platform start signal. The white cell on the top right can be used to specify the END that is next to the platform. Figure 1 below.

After the yellow Create button has been pressed (see Figure 1) to generate the file to be downloaded to the ATC2-CORE, a utility called TeraTerm is used to transfer the file to the ATC2-CORE microprocessor.

After selecting the user defined configuration (ON – ON – OFF – ON – OFF) using the red CONFIGURATION switch, and powering on the ATC2-CORE-PANEL, the locomotive will start moving. After it has completed the two movements, it will automatically start the sequence again.

Multiple ATC2-ENDs Modules

Up to four ATC2-ENDS modules may be added using Cascade cables as shown in Figure 2 below.

Whereas the first ATC2-ENDS module could be used using the built-in firmware, the second to fourth modules can only be accessed using train operations defined in the spreadsheet.

ATC2 System - Automated User Sequence Table Hex File Generator V1_3_2 4 x ATC2-ENDS																	Create Train Movements File	
Enter Sequence Data Here																	Enter Signal Location Here >	1
V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V		
Start End	Finish End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Dir E/W	Comments 1	Comments 2
1	2															E	DMU	left to right
2	1															W	DMU	right to left

Figure 1 – Simple Shuttle Train Movements

Figure 2 – Multiple ATC2-ENDS Modules

ATC2 System - Automated User Sequence Table Hex File Generator V1_3_2 4 x ATC2-ENDS																	Create Train Movements File	
Enter Sequence Data Here																	Enter Signal Location Here >	1
V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V		
Start End	Finish End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Dir E/W	Comments 1	Comments 2
1	5																E	Local Goods	left to right
5	1																W	Local Goods	right to left

Figure 3 – Accessing the Second ATC2-ENDS Module

Figure 3 shows how the the second module can be accessed. In this instance the train moves between ENDS, controlled by different ATC2-ENDS modules. The ATC2-CORE module accesses the ATC2-ENDS modules using the END numbers in Table 1.

ENDS Module	ENDS Range
1st	1 to 4
2nd	5 to 8
3rd	9 to 12
4th	13 to 16

Table 1 – ATC2-ENDS Module Addressing

Multiple ENDs using Via

The configurations described so far have always had ENDs separated by an INTERMEDIATE section.

The INTERMEDIATE section is essential for the correct operation of the track power logic. However, it is possible to add one or more END sections to the existing sections at each end. This configuration is shown in Figure 4.

Figure 4 – Sequential END Sections

ATC2 System - Automated User Sequence Table Hex File Generator V1_3_2 4 x ATC2-ENDS																	Create Train Movements File	
Enter Sequence Data Here																	Enter Signal Location Here >	1
V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V		
Start End	Finish End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Dir E/W	Comments 1	Comments 2
1	3	2															E	Long Goods	trailing loco
3	1	2															W	Long Goods	leading loco

Figure 5 – Controlling Sequential END Sections

The advantage of this arrangement is that a long loco can be made to move across END2 and then commence deceleration as it enters END3. The effect of a Via is to extend the INTERMEDIATE section into END2 / Via2.

This capability enables longer train sets to use both sections, whereas a shorter set might only stop at END2 and not travel further into END3. The way that this is specified is by making use of the Via columns of the spreadsheet. A 'Via' indicates a non-stopping train at that END number.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	ATC2 System - Automated User Sequence Table Hex File Generator V1_3_2 4 x ATC2-ENDS																	Create Train Movements File	
2	Enter Sequence Data Here																	Enter Signal Location Here >	1
3	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V		
4	Start End	Finish End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Via End	Dir E/W	Comments 1	Comments 2
5	1	3	2														E	Long Goods	trailing loco
6	3	1	5														W	Long Goods	leading loco

CORE + 4 x ENDS | CORE + 1 x MPS + 4 x ENDS

Figure 6 – Using Tabs to Select Hardware Configuration

For example the movement definition shown in Figure 5 will result in the locomotive accelerating in END1, progressing at full speed through INTERMEDIATE and END2 and then commence deceleration in END3. Up to 14 'Vias' may be specified.

Locomotive Profiles

This spreadsheet mechanism is also used to select the appropriate performance profiles for the ATC2-PROFILES and ATC2-MPS modules.

There are differences in the signals that are sent along the cascade cable, depending on which module is used to define the locomotive performance profiles.
There are two tabs at the bottom of the spreadsheet to enable the selection to be made. In the case of ATC-PROFILES [modified ATC2-ENDS (kit 146) plus ATC2-PROFILES Panel (kit 147)], the first tab is used as shown in Figure 6. If the ATC2-MPS module is to be used, then the second spreadsheet tab is selected.

Reference

1. *https://merg.org.uk/merg_wiki/doku.php?id=projects:atc2:atc_central:spreadsheet_quick_start_guide*

Michael Collins and Barry Mason's biographies are given in MERG Journal, 57 No 2, 5
Paul Howes's biography is given in MERG Journal, 54 No 3, 28
Allan Geekie's biography is given in MERG Journal, 55 No 2, 21

Area Group Reports

3 Counties Area Group

The Group finished the Double Decker Demonstration track in time for the Tring Model Railway Club exhibition. The track worked well and created a lot of interest in MERG. The top track had a DCC auto shuttle working flawlessly directly from the CANCMD command station using two CAN-DTC4 to detect the position of the locomotive. However, this needs to be made more interesting and have 2, maybe 3, locos running in an automated sequence.

The lower deck was running under JMRI with a screen showing the track layout and the position of the train/tram and featured working 2 Aspect signals with feathers. These were built by Trevor Pocock and were described in the last Journal.

Figure 1 – The AG's Double Deck Demonstration track with Trevor Pocock and Jim Douglas.

Geoff Latham also showed his "Van Rides" layout featuring MERG kits. It is amazing what you can get into a Really Useful Storage box. Figure 2 below.

Figure 3 - Prototype Block Instrument.

Figure 4 - Raspberry Pi connected to CBUS.

Previously, the group had discussed the problem of layouts with more than one operator needing to communicate to send and receive trains to/from each other. The outcome was the desire for a block instrument offering/accepting trains sending/receiving data over CBUS. Duncan Greenwood, a visitor from Cambridge, came to our clubroom and gave a fascinating presentation on his work on this subject complete with a working demonstration of his system of 2 block instruments talking to each other via CBUS.

We continue with the format of one club night, one Zoom meeting and one Saturday workshop every quarter. This has proved successful, and anyone living in the area is more than welcome to visit us to see what an active group is like.

Christopher Langdon M336

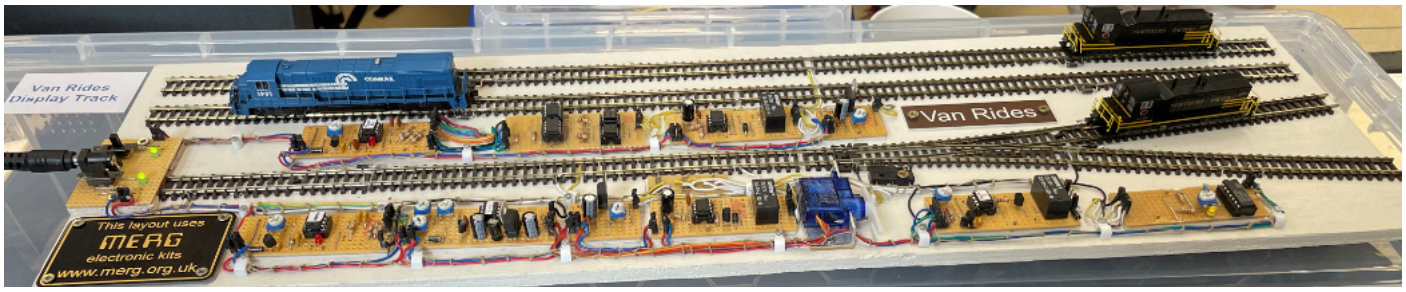


Figure 2 – Geoff Latham's Van Rides layout

Croydon Area Group

The group continues to meet on the second Friday of each month at the Croydon Model Railway Society clubhouse in South Croydon. Two meeting were hands-on workshop events and the third was a presentation / discussion / demonstration of the new Automatic Train Controller (ATC) kits which should now be available in the Kit Locker.

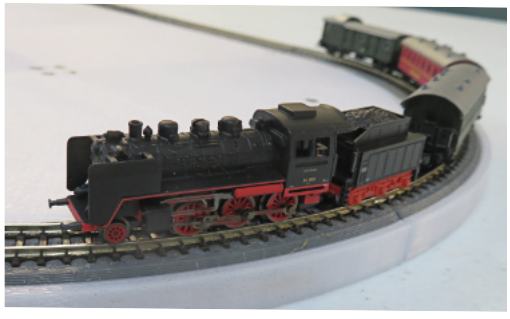


Photo by Allan Geekie

A small Z-Scale (1:220) test track was used to demonstrate the capability of the kits. The track is mounted on a 3D printed 'baseboard'.

Although the ATC is normally considered to be an end-to-end controller, Allan Geekie demonstrated how the kits could be used to run a train on an oval layout by making use of a spreadsheet to define the train movements.

An initial programme has been defined for Winter and Spring as follows:
8th December – Mince Pies, Show and Tell where members will be encouraged to share the projects that they are working on at home be it on a layout, shelf, or plank.
12th January – Adventures with CBUS – John will talk about his own personal ups and downs in deploying CBUS on his layout.
9th February – Hands on Workshop
8th March – CBUS Meets JMRI – Allan will describe two alternative approaches that can be taken to get CBUS and JMRI to work together.

Allan Geekie

Irish Area Group

Our monthly Zoom meetings are attracting participants from Ireland and overseas. We cover events in Ireland and what is happening within MERG. We share progress and problems on our layouts or projects and help each other with suggestions, tips about kits and commercial products to use. Several of us use CBUS so we talk about recent developments of the FCU and how to best to use various CBUS kits. The benefits and problems with CANMIO-Universal firmware comes up now and then. FREMO modules also come up where Pekka Siiskonen and Sven Rosvall talk about meetings where massive layouts are put together. This raises a lot of questions and discussions about how to control such big layouts.

We had a physical meeting in October in Dublin that covered many advanced features of DCC. Most participants already use DCC at various levels. We started with the DCC waveform that provides both power to the locomotive and commands to the decoder. Participants had brought their own command stations and we discussed the pros and cons with each. It was interesting to see cheap alternatives such as Arduino based DCC++Ex. One notable product is the Sprog which is a simple command station with a computer interface. Many use a Sprog with a programming track to reprogram locomotive decoders from a computer.

There are a huge range of decoders at varying prices. We talked about our favourites and agreed that the saying "you get what you pay for" holds true. The big names like Lenz and ESU were recommended but also Doehler & Hass for their capable but very small controllers.

Many had heard about JMRI DecoderPro before but never used it. This was a good time to use DecoderPro to program the decoders, then to demonstrate the changes in locomotive behaviour on a small circle of N-gauge track such as acceleration, deceleration and mapping function keys. DecoderPro provides a graphical interface with descriptive texts for each configuration instead of having to learn what each CV is used for.

Sven had prepared a module to provide Automatic Brake Control (ABC) to the circular track. ABC has been described in the Journal several times, notably by Julian Coles. Here we could see ABC in action, its set up in DecoderPro and how it behaves on the track.

There are two methods for consisting. Some command stations such as the Z21 allow users to define a consist and add locomotives. The user then controls all the locomotives in the consist with one knob. This is called classic consist. There is also a method called advanced consist where the decoder is set up with a consist address. When several locomotives are set up with the same consist address they can then all be operated with a single throttle that is set for the consist address. MERG CANCAB was used to demonstrate this. The CANCAB has a "consist" button that sets up the consist address for the decoders one by one. We used DecoderPro to see what settings were changed when the consist was setup. Using DecoderPro we could also see how each locomotive could be adjusted, for example running backwards and ensuring that the front lights on the second locomotive are not lit.

Members took the opportunity to check some problematic locos. It was easy to identify the decoder with DecoderPro and bring up the setting screens for each locomotive. One locomotive had very low sound. Here we could see that the decoder didn't just have one setting for volume, but 15, one for each kind of sound. Now we could adjust each of these sound levels to the satisfaction of the owner.

We covered a lot of things but everyone went home having learnt something new about DCC control of locos on a model railway. Some of the myths and complexities of Function mapping and the use of Auxiliary outputs were discussed and might form the topic for a deep dive into DCC at a future date.

Sven Rosvall

Most of the participants at the October meeting around a collection of DCC equipment. left to right: Steve Burroughs, Nicolas Merton, Lorcan O'Toole, Sven Rosvall, Tim Odlum. Photographer is Derek Russel-Hill.

North East Area Group

In late October, Nigel Anderson and I attended the EM Gauge Society's North East & Borders Area Group WorkshopWise 2023 event at Stannington, Northumberland. Nigel brought one-sixteenth of the Newcastle & District MRC's new layout – in the early stages of being built – to demonstrate the practical use of the Servo-4 kit. The ice cream tub shown is merely a lash-up and the board was clamped to the table's edge. Also seen is another servo-controlled point.

Nigel Anderson promotes MERG at the EMGS WorkshopWise 2023 event. Photo by Emily Johnston.

During the show I had time to commence the revival of the North East AG. The Group's activities came to a sudden halt in 2021 when our Chairman, the late Colin Begg, stepped down. With the assistance and encouragement of MERG's Group Liaison, John Fletcher and Secretary Francis Pritchard I contacted 110 members in the Group's postal area, half of whom were on the NE AG list. I proposed holding an initial meeting via Zoom to gauge enthusiasm and organise support on the MERG stand at local exhibitions. By the time the Journal is printed we will have met. Please see the NE AG section of the Forum for latest news.

In parallel, realising that our stand was rather lacking in both visual appeal and things to exhibit – some items had been seen many times before and were showing their age – I designed a set, sourced display items, fabric, printed assorted media. I borrowed some MERG kits from Paul Tompkins, MERG's Kit Sales Manager and arranged with Nigel the loan of items from MERG member Peter Grant in time for our next exhibition. Alas it was all in vain. The Tyneside 2023 Model Railway Exhibition was cancelled at short notice due to storm damage at the venue. Our next scheduled outing will be the Birtley Model Railway Engineers Annual Exhibition 2nd and 3rd March 2024.

Emily Johnston

Scottish Borders Area Group

The Scottish Borders Area Group was asked in a roundabout way if we could put a stand on at the Railex show held at the Aln Valley Railway, Lionheart Station just outside Alnwick, Northumberland on the 2nd and 3rd September. With only about four weeks notice we had to work hard to get our demo layout in a fit state to show. At that time we only had the track laid, so with a few more Zoom calls and face to face meeting to work on the layout we got the rear track running as an auto shuttle and the front track running as a visitor operated track.

Figure 1 – Our demo layout, a work in progress. Photo by Keith Torrington.

We also got a box made to show some of the PMPs kits that MERG sells. Right from the start of the layout build we had decided to use the PMP kits and keep away from the bus operated systems, so people could see what could be achieved with simple kits. Figure 2 below.

On the Friday afternoon Martin Pearson and myself set off in his camper-van to Alnwick to set up; this done we retired to his camper-van for the night. Saturday morning saw us having breakfast on a pleasant morning before manning our Layout. Myles Wheatley and Emily Johnston joined us for the day which was very busy with a good number of people attending. Martin and myself stayed over another night,

Richard Gaddas and Emily joined us for the Sunday show which was a bit quieter. Our layout worked well all weekend but one of the engines had to be taken off as it was showing signs of being overworked.

Keith Torrington

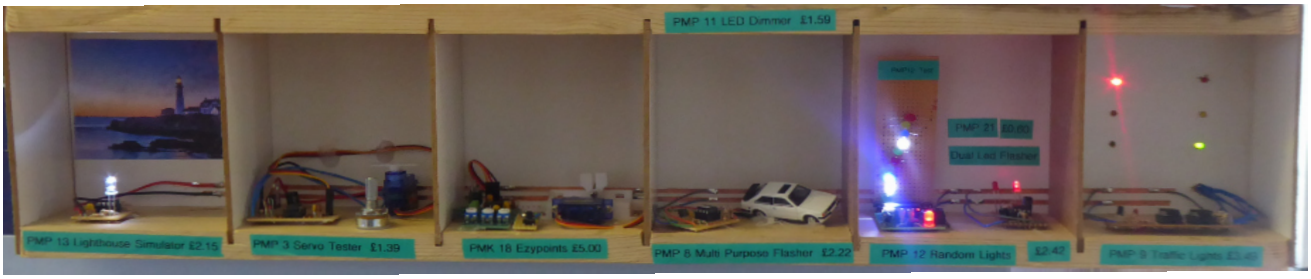


Figure 2 – Our PMP display. Photo by Emily Johnston.

Southeast Queensland Area Group

This report covers from May to the end of September. We again attended the Brisbane Train Show; that was quite successful in promoting MERG to our model train community and also a time for members and prospective/ new members to talk to us.

Our June and July meetings focused on some basics: What is layout control? Including Ezybus and CBUS. Which electronic component is which? Also how to use a Multimeter.

Our August meeting was a general workshop. During September we looked at surface mounted devices (SMD) and how to use an induction cooktop with a metal plate to melt the solder paste. We also had a MERG display at the British Railway Modellers of Australia's Annual Convention. This provided an opportunity to meet other MERG members from other states who were also BRMA members.

Figure 1 Stephen Sherwood at the Brisbane Train Show 2022 with a display board. Photo by Ian Renshaw.

The rest of the 2023 year's program will be advertised through the usual emails. If you have ideas for 2024, please email me through our SEQLD email below.

Our SE QLD Area Group generally meets on the first Saturday of every month at the Banyo branch of the Brisbane City Council Library. The meeting consists of two parts with the first session starting at 10.30 am, being hands-on working on a project.

The afternoon session from 12.30 pm will either be a continuation of the morning session, a short relevant local presentation or a demonstration. More general presentations will usually be offered during the virtual Australia and New Zealand Area Group (ANZ AG) meetings – subscribe to this group through your MERG member profile page.

Figure 2 – British Model Railway of Australia Convention 2023 in Brisbane. Guest Tom Clunes in the foreground is looking at the display of PMP/PMK kits, Stephen Sherwood in MERG apparel. Photo by Paul Skehan.

Also remember there is a CBUS ANZ Special Interest Group conducted by Greg Palmer during the Australian/NZ time zone. If you are interested, go to your MERG member profile page and add CBUS ANZ SIG to your subscriptions. New or returning members are always welcome and with the number of different projects we have available you will hopefully find something of interest. If you have a topic of interest for our monthly meeting, please let me know.

If you are not registered with SE Queensland Area Group (see Your Profile) you will not receive any emails advising of the topics with confirmation of time and date. If you are not sure if you are registered, please contact me via: sequeensland@merg.org.uk

Stephen Sherwood

Australian and New Zealand Area Group

The Australian and New Zealand (ANZ) Area Group is a virtual group with regular members from both countries. Everyone is welcome to join us as this will be a permanent virtual meeting group. Over the last few months Mike McHugh in the ACT and Tim Morrow from Victoria have hosted our meetings. Thank you for hosting these meetings. Anyone can host or conduct a presentation.

In September, we had a presentation on a variation of the PMP2 LDR detector and integrating this with a PMP 16 Turnout Position Sensor to act a link between the PMP2 and a CBUS input which led to a discussion on further variations and the use of InfraRed which will be a presentation for another month.

Once finalised the agenda for each meeting will be advised by email, so watch out for the emails to the group on the next topic. If you wish to join this group you must subscribe to the ANZ Area Group through 'Your Profile' page otherwise you will not receive any notifications.

Also remember there is a CBUS ANZ Special Interest Group conducted by Greg Palmer during the Australian/NZ time zone. If you are interested, go to your MERG member profile page and add CBUS ANZ SIG to your subscriptions.

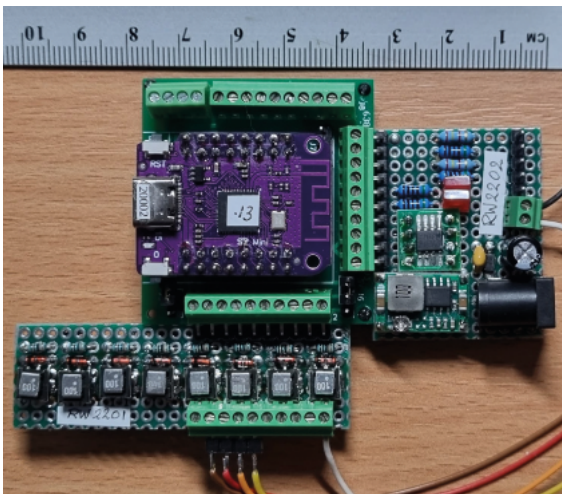
If you are unsure if you are registered, please contact me via: anz@merg.org.uk

Stephen Sherwood
On behalf of the SE QLD, ACT and VIC Area Group coordinators.

Tayside Area Group

We have continued to meet via Zoom on the first Wednesday of each month and face to face for our workshops at The Friary, Tullideph Road, Dundee on the third Saturday of the month. As usual, the Zoom sessions have covered a wide range of topics. Our most recent session allowed one member to get advice about a Java problem with JMRI and another to ask a wide range of questions as he starts down the road of DCC and CBUS. Starting in January, we are changing to having our face to face workshops on the first Saturday of the month and our Zoom sessions on the third Wednesday. This change will save us having to move our workshop sessions as there are no local shows at the beginning of the month.

Thanks to the efforts of Alex Hunter, our EzyBus demo board is now complete and had its debut at the Aberdeen Model Railway Exhibition at the end of October. It is displayed mounted above my CBUS layout so that a direct comparison can be made between the two layout control buses (LCB). Readers may be wondering why the Tayside group was running a MERG stand at Aberdeen when there is an Aberdeen area group. The simple reason is that the members of the Aberdeen area group are also members of the Aberdeen Model Railway Club so are fully involved with running the show and operating their layout. Our efforts were not in vain as one new member joined before we met for dinner together on Saturday evening, another joined before midnight on Saturday and another the following Wednesday. Colin Stevenson, the Aberdeen AG leader was very pleased with the outcomes from the event, at what was a new venue.



Prior to the Aberdeen exhibition we had stands at shows in Cupar in July and St Andrews in August. We have been delighted with the interest shown by members of the public in our offering at all the shows. To round off 2023, we will again be promoting MERG at the Falkirk show in November. I'd like to thank David Duff, Alex Hunter, Jim Lynch, Ron Murray, Graham Overton and Anthony Vogelaar for their contributions to our effort. Sadly, Gordon Stevenson, who was a regular member of the team, passed away in July. He is greatly missed.

Anthony Vogelaar has made a significant contribution to our offering at the shows that we have attended by demonstrating his progress in designing a concept for advanced control of model railways. It is built around a Layout Control Bus that carries data and power through single standard available cables with a high data throughput and capable of bridging sufficient distance (up to 30 metres per section), the well-known USB bus, named UBUS. The control specialisation is done in software rather than hardware, using micro-controllers like the Esp32 with an on-board hard-disk and a WiFi transmitter, available for just a few pounds. It fits well in the master – multi slave paradigm. No compiler is required and it has an on-chip editor, file system and a Python script interpreter running at 240 MHz. At the Aberdeen show youngsters especially were very attracted by the system, as Python programming, considered as easy to learn, is taught at school.

The picture above, shows the general micro controller, a screw-in octal TOTI board and a screw-in board for signals, power regulator and a PWM 1 Amp output. Photo by Anthony Vogelaar.

At the show it controlled an OO scale shuttle (Class 153) DC train (not DCC, but DCC compatible) with speed and direction control, position detection (TOTI), timers and signals, independent from other computers on 12V DC only. It will be further developed and in due course articles about this will be published in our MERG Journal.

Fraser Smith

Warwickshire, North Oxfordshire Area Group

Since the last Journal there have been two meetings of the Warwickshire and North Oxfordshire AG (WNOAG), on 22nd July and 30th September, both of which were well attended. The July meeting covered a range of topics from a discussion on Layout Control Buses, demonstration of a Hornby TXS DCC/Bluetooth decoder followed by a reminder and demonstration on how to configure CANMIO Universal for inputs, on/off outputs and servos and some of the extra functionality the Universal firmware offers. At our September meeting, Andy Cumming showed the basic steps of using DesignSpark PCB to produce a PCB, starting with drawing a schematic diagram and then going through the stages of turning this into a PCB design. Everybody picked up some new tips and tricks in using this PCB design software. We then had a talk and demonstration on what an oscilloscope does and how it can help with certain aspects of electronic design and fault finding. Both meetings also provided detailed discussion of the talks and troubleshooting of any MERG modules, PIC re-programming, etc.

The WNOAG meet at the clubrooms of the Leamington and Warwick Model Railway Society. Many of the layouts make use of MERG electronics and can be used to illustrate how to implement various techniques.

The last WNO meeting of 2023 is planned for the 18th November – keep an eye on the Area Group pages for details:

https://merg.org.uk/merg_wiki/doku.php?id=areagroups:general:area_groups_start

Simon West

Thames Valley Area Group

4th July 2023 Grazeley Memorial Hall
New member Michael O'Flanagan showed a plan for his proposed N gauge layout based on Tynemouth station (Fig 1). He wanted ideas for control, eventually leading to full automation. There was much discussion concerning which MERG kits he could/should use. His plan was made from Templot, and he intends to use Finetrax for the pointwork, with one complicated junction made for him by a fellow ex-club member now in the USA.

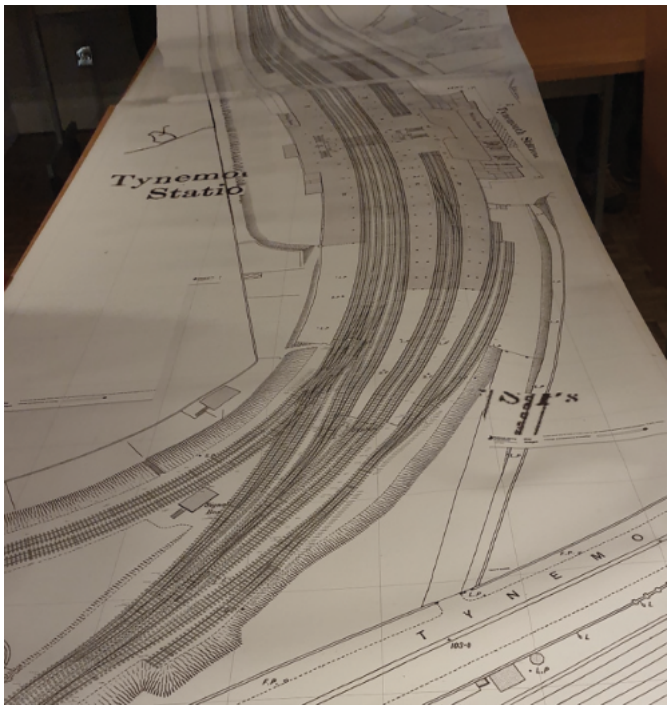


Figure 1 – Templot printout of Tynemouth Station. Photo by Howard Watkins.

We reviewed our three demo layouts to decide on future work. This will include better labelling and getting the RPi working.

1st August 2023 Grazeley Memorial Hall
The focus of this meeting was to continue to develop the three TVAG demonstration boards. Since the July meeting Greig Callaghan had investigated the challenges associated with the complex full fat JMRI demo board. Together with Alan Whitmore he been able to get WiFi operational but with the limitation that it could only be used from a laptop/iPad to control throttles/points. Greig identified that it was not possible to use Jython scripts in JMRI with the CANPiCAP. (JMRI has developed such that it can be used over WiFi to control throttles, points and scripts). An article by Steve Todds "JMRI RaspberryPi as Access Point" provides an up-to-date RPi image and a post by Mike Bolton (Sat May 28 2022 CANPiCAP Background and Re: Wireless CANCAB) supported Greig's work.

To test the JMRI demo board, having installed the more recent SD card, Greig used a static motor and DCC decoder and a Loco Ident display (Fig 2).

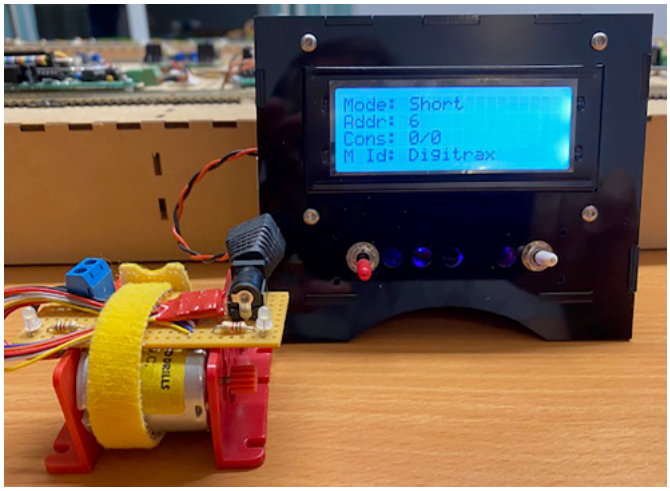


Figure 2 – static motor and display. Photo by Paul Miller.

Alan Whitmore reviewed the basic DC demo board and changed one of the servos that had become damaged.

4th September 2023 Grazeley Memorial Hall
The focus of this meeting was to continue to develop the three TVAG demonstration boards ahead of a potential first outing at the Oxford show. With the CBUS wires of the CANPiCAP disconnected, the RPi was powered using just the 5V connection of the CANPiCAP. The JMRI Demo board was tested. Amongst other tests, double heading (consist) was demonstrated and the WiFi throttle was tested.

Paul Miller and Howard Watkins

Cleveland Show

Peter Denton, Emily Johnston and Ian Macdonald. Photo supplied by Emily Johnston.

In August Peter Denton, Ian Macdonald (Events & Exhibitions Manager) and Emily Johnston staffed the MERG stand at Cleveland Model Railway Club's show held in Redcar. Footfall on Saturday was less than anticipated due to heavy rain overnight and localised flooding. Despite brilliant sunshine on Sunday the footfall did not recover. We occupied a prime spot in the foyer near the entrance where I intercepted those entering, offered our flyers and encouraged them to visit our stand. Ian and Peter demonstrated the benefits of MERG kits and answered all manner of technical queries. Visitors had the rare opportunity at a model railway exhibition to control the trains – a source of amusement and delight for children and some older visitors. Our thanks to Cleveland MRC for being our hosts and sponsoring our stand.

Emily Johnston

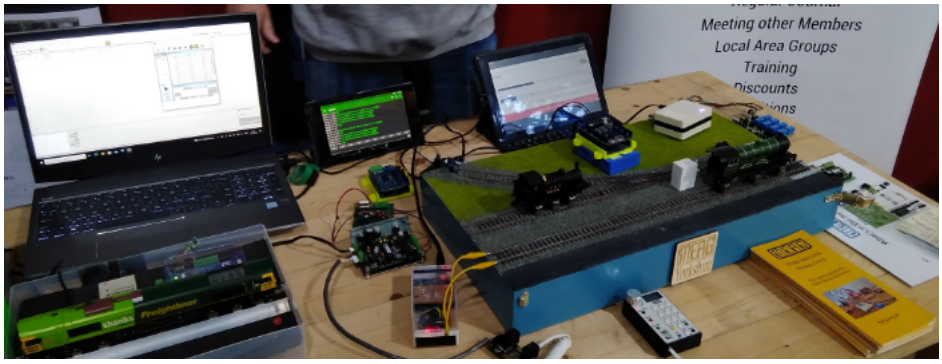
Hull Show

Hull Model Railway Show took place across the weekend of 11th and 12th November. Bob Shanks and Peter Denton, who host the Yorkshire AG, staffed the show. Business was brisk all day on both days. The most common things encountered were: "I know nothing, where do I start?" Other questions seemed to be: "Do you do radio control or sounds?" The younger generation loved the 'fingers on' approach for twiddly bits in PMPs and several made their parents come back.

It was good to see a number of 'couples' where both were finding something from the hobby, or were assisting where fingers could not be as deft as maybe they once were. But definitely interested. One day on I know of at least one couple who have joined and two others who had their fears allayed and are looking to their first foray into electrical and electronic projects.

The stand displayed a host of Pocket Money Projects doing simple things and a separate board showed wired and remote DCC, alongside Hornby remote Bluetooth control of DC, with sounds. DCC track signal analysing so you can see what the decoder is being sent, a wedge of gadgetry of other projects and kit ideas.

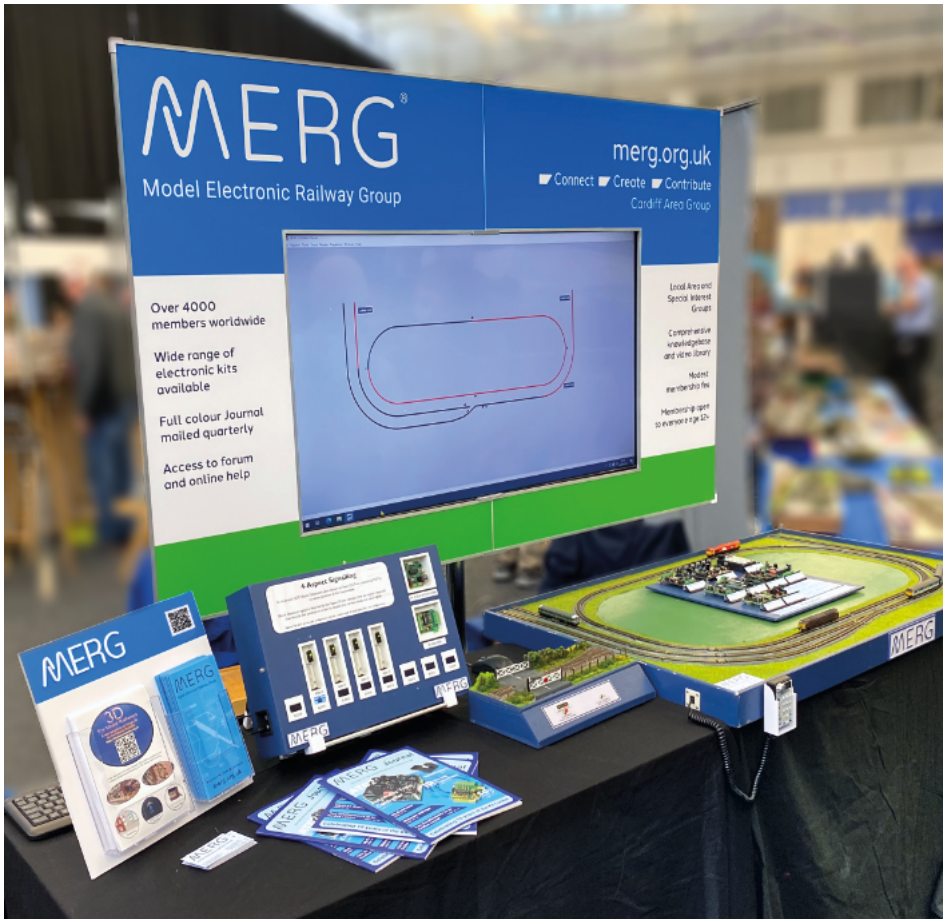
Bob Shanks prior to the doors opening. Photo by Peter Denton.



A DCC control with the DCC signal analyser and the Hornby control running DC loco. Photo by Peter Denton.

Peter Denton

Cardiff Area Group



We continue with our monthly zoom presentation evenings accompanied by the usual question and answer session. These are supplemented with a Saturday Workshop when required.

Over the summer we have provided a MERG presence at Penarth, Swansea and more recently Cardiff Model Railway Shows.

Cardiff was a chance to present our new demonstration stand, this comprised a new surround to the display monitor sporting the new logo, colours and a more distinctive look.

In addition we also displayed our new 4 Aspect Signal Simulation Display Unit along with our demo layoutrunning an end to end shuttle circuit and an inner loop demonstrating TOTI (Train on Track Indicator) control. Both tracks being shown on the large display monitor through the use of MERG kits and JMRI software.

Alongside this was our Basic Kits display and our faithful crossing gate unit with Arduino controlled servos operating the gates and flashing lights

Russ Davies

Special Interest Groups

Raspberry Pi SIG

Abstract
The Pi SIG has remained exceptionally active over the past year, yet there have been no recent updates shared in the Journal. I believe it's crucial to address this issue in order to better promote the informative Zoom talks we've been conducting to the entire MERG membership. Presently, the Pi SIG boasts a membership of 135 individuals.

Additionally, I'm pleased to inform you that the knowledge-base has undergone updates.

These improvements aim to enhance the accessibility of various topics, making it notably easier to locate the information you're seeking.
This report encapsulates the developments of the first half of 2023, ensuring that members can catch up on our recent endeavours. Please note that the cut-off date for this report is October 1st, implying that certain sections will provide a glimpse into our upcoming plans beyond that date.

Benoit Bouchez M8718
In January, Benoit delivered a presentation about his ongoing project – the Pi Pico Decoder. This session provided an overview of his accomplishments up to that point, He also showed a DCC Packet sniffer implemented using a Pi Pico which helped him to see what was being seen at the track. Building on this, Benoit provided us with an update on his advancements in April. Subsequently, in September, he shared yet another progress update that showcased substantial developments in this project. Comprehensive information regarding both projects has been documented on the Knowledgebase, accessible through the following links:
DCC Decoder:
https://merg.org.uk/merg_wiki/doku.php?id=sig:pisig:benoit_pico_decoder
DCC Packet Sniffer:
https://www.merg.org.uk/merg_wiki/doku.php?id=sig:pisig:benoit_dcc_packet_sniffer


Figure 1 – QR code linking to the video

Duncan Greenwood M5767
Also in January Duncan Greenwood gave us a talk "MicroPython & CBUS on a Pico". This talk was prompted because he has ported his C++ CBUS library over to MicroPython. This presentation can be found on this page of the Knowledgebase:


Figure 2 – QR code linking to the video

In August Duncan gave another talk "Using the Pi Pico" in which he showed a number of examples that he had been working on with other members. This presentation can be found on this page of the Knowledgebase :
https://merg.org.uk/merg_wiki/doku.php?id=sig:pisig:duncan_using_the_pi_pico


Figure 3 – QR code linking to the video

More talks are planned by Duncan, and these can be found in the sidebar of the Pi SIG home page.

David Jones M9042
David Jones has given a number of talks to the SIG covering MicroPython to assist beginners wanting to learn how to use MicroPython and Thonny to program either a Pi Pico or a Pi Pico W. There are nine videos in the series so far, with more planned for the future. The presentation can be found on this page of the Knowledgebase:
https://merg.org.uk/merg_wiki/doku.php?id=sig:pisig:david_pico_micropython


Figure 4 – QR code linking to the video

Ian Hart M546
Ian gave the group a talk in May about a number of Pi Pico form factor boards he has designed. A further progress update is planned for the near future. The video presentation can be found on the PiSIG TV Channel:
https://merg.org.uk/merg_wiki/doku.php?id=subjects:pisig_tv


Figure 5 – QR code linking to the video

If you have anything you would like to share with the SIG, please get in contact via the following email pi@merg.org.uk so I can arrange a meeting around a time that is suitable with you.

John Holmes

A New Look for MERG Kits

Martin Perry, Kit Management Team

By now many of you will be aware that the MERG brand is undergoing a restyling to take us further into the 21st Century. We have a new MERG logo and moves are afoot to abandon the venerable Justov font that looked so good 20 years ago. Much of this work is being done by our Publicity Officer Phil Silver.

The Kit Management Team (KMT) discussed these moves and agreed that the kit appearance should be included, not having changed since forever. Once upon a time all we had was a monochrome printer and a range of coloured cards upon which to print. That gave us some variety and a basic way to ascribe colours to kit ranges. The 1st generation CBUS kit frontages were all on deep red card for instance. But as the range of kits expanded, the colour plan went out of the window. Now the card colour for new kits became whatever the kit crafter had left on the shelf.

It was time to restyle the kits and the packaging so Phil was approached to make some suggestions. After all, many of we engineers did not even get Art at O-Level. Phil was sent some examples of the present kit look and general format to aid an appreciation of the text and sizing of information to be displayed. Here is what was suggested as starters for 10.

Figure 1- Serv4-F Driver Card

Figure 2- EzyPoints Card

Now that we can take advantage of colour printing, more variety beckons and enables the kit elves to stock only inexpensive white card instead of multiple packs of coloured cards, some of which never got used. QR codes on the kit front label would lead the user to the Knowledgebase entries for the kit depicted.

Coincident with this, the KMT discussed moving the CBUS kit ranges from 1st Generation (not really used any more) and 2nd Generation, into groups that include the potential for module development with Single Board Computer (SBCs) such as the Raspberry Pi and Arduino. Hence the Basic, Advanced and Explorer groups and their proposed logos were born after consultation with Phil.

Figures 3–5 – CBUS group logos

With the proposed restyling reaching general approval in the KMT, it was time to try it out on a kit. The main objective being to showcase the new look amongst members for comment, prior to finalising it.

Only then would we undertake a lot of work restyling the entire kit range.

An upcoming opportunity was the new ARDUINO CAN Shield kit 110, designed by Martin Da Costa and being processed for 'kitdom' by me. This is the first kit in the Explorer range to underscore the newness and forward thinking of future CBUS modules.

This kit is now in the Kit Locker and available for purchase, see:

https://www.merg.org.uk/merg_kitlocker/section.php?id=35

Overview and Build Instructions here:

https://www.merg.org.uk/merg_wiki/doku.php?id=kits:110

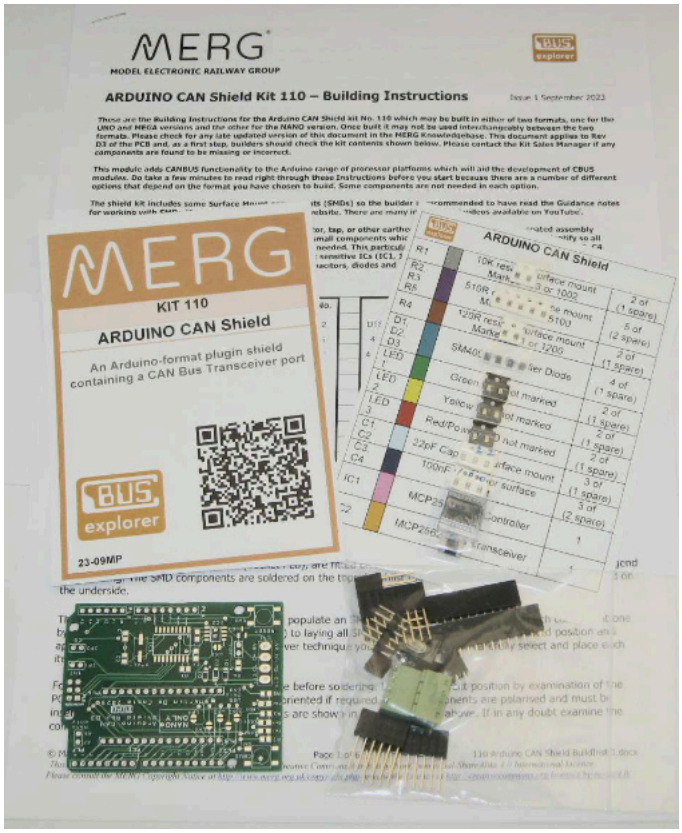


Figure 6 – Arduino CAN Shield Kit 110 contents.

Assuming the restyling meets with general approval, work will proceed to upgrade existing kits along with new items in the pipeline.

Martin Perry

Supporting MERG Groups, SIGs, Education &Training

John Fletcher

Introduction
Emily invited me to write something about my role on the MERG Committee. I joined the MERG Committee in 2021 with a remit for Education and Training. I took on the support of Area Groups and Special Interest Groups (SIGs) in 2022. That is not long so I need to go back rather further to explain what I am attempting to do. I have been interested in railways for longer than I can remember and in model railways for not much less than that. My father bought some surplus cam switches which we adapted to do cab control on our Triang layout when I was a boy. I soldered up the control box. At the same time we had holidays in North Wales and I saw both the narrow gauge and main line railways. I moved to Birmingham in 1972 to an academic post in chemical engineering at Aston University. I retired from there in 2014. In that time I used each of the generations of computers which came my way. I have been programming one way and another since about 1967. I bring to MERG my experience in education and also deep interests in railways and computer programming.

The Experience of joining MERG
I joined MERG in 2018 and appreciated very much the support I received from members of the West Midlands Area Group. I experienced some confusion in understanding what was available in MERG and began to print off documentation. I have a pile of lever files of paper as a result. I have summed up a lot of my experience in a page on Education on the Knowledgebase, see: *https://www.merg.org.uk/merg_wiki/doku.php?id=education:start*. The idea as far as I am concerned is to recognise that each MERG member is starting from different understanding and experience. Each will be experienced in some areas and a beginner in others and the needs are different. Very few will wish to become experts and the experts in each area may need help to explain things so that the less experienced can make use of their knowledge. This is why I responded to the invitation in 2021 for someone to take on Education and Training on the Committee.

Area Groups and SIGs.
Area Groups have been a part of MERG for much longer than I have been a member. I have enjoyed the support of a number of them, not only local ones. I went on a short course run by the Somerset Group not long after I joined MERG.

I was encouraged to start the Arduino SIG in 2020 during the Covid lockdown when it was not possible to have meetings. I have learned a lot from the use of Zoom meetings. The SIGs provide a way for members to share across geographical barriers and time zones. We can also share skills and I worked with a group of Arduino members to achieve things we could not have done individually. I have contributed my programming skills and others have made PCBs and 3D printed items, some of which are here on my desk as I write this.

Education and Training
This also has been a feature of MERG for many years. I recently visited Missenden Abbey and appreciate the work which has gone on there. A lot of the work of education is done on line through the sharing of ideas on the Forum and the Knowledgebase. Both of these have their difficulties which I am well aware of and currently I am working to improve the indexing of the Knowledgebase. At the same time there is a wealth of knowledge and experience available to the enquiring mind. When I search on some topic on the Forum I quite often come across a question I asked in previous years. I then did not always understand the answers. Now I find I know the people who answered me. In some cases the answers have lead on to a lot of activity. So my work in Education and Training is focussed on helping those who are searching find what they need. This means that there must be multiple pathways to the knowledge, often different ones from what the originator thought of. The resources which we have are the result of the contributions of volunteers. If MERG were a library they are putting books onto shelves where they think best. I am working as a librarian would to find the pattern and move the books into related groups, with labels on the shelves. The Arduino SIG, among others, has built up now a large number of videos of our meetings and many of them provide valuable resources for learning new skills. More is needed to help members find what they need.

Physical Meetings
The Area Groups provide physical meetings to share knowledge and friendship. There are also opportunities for training courses and gatherings such as the meeting in Oxford, now planned for 2024. MERG members have a stall at many model railway exhibitions and are members of model railway clubs. There are gaps in the area group structure even in England and there is a need to offer encouragement and support for members who would like to form new local groups. I planned when I took on the support of groups to go and visit some not local to me. I have not been able to do that in 2023. It is my plan to do more in 2024.

Communication Training
One of the needs for MERG is for us all to learn how best to communicate. This covers a lot of areas: articles for the Journal, speaking at a Zoom meeting, putting together a video, designing a good poster or contribution on an external web site. We need to share what works and what did not go so well.

Changing Technology
What is available to us has changed a lot even since I joined MERG in 2018. The change in my working lifetime is enormous. How many of us remember decks of punch cards? At the same time there is a need to keep compatibility with what has gone before. Many members have old kits still working on their layouts.

Building Community
I think I can sum up my task as being about helping MERG members build the community we already are, through sharing our time and experience with each other, through the different structures. My challenge is recognise that I cannot do this on my own and ask others to join me in doing it. There are areas I don't know much about e.g. DCC and I still need to provide a structure in those areas. I hope that by writing this I have encouraged you all. I thank the many members of MERG who have encouraged and supported me. They will know who they are. Never hide your natural enthusiasm.

The Role of the Publicity Officer

Phil Silver

I joined MERG in 2011 and was co-opted onto the Committee in Oct 2022 as Publicity Officer. Additionally, since 2020 I have shared the Cardiff Area Group co-ordinator role. Although an electronics engineer by training, I have worked as the Director of a successful multimedia design and print company for over 40 years; working with the broadcast sector, examination boards, blue chip companies and local government departments.

The role of Publicity Officer is challenging but also fun. Part of the job is about building relationships within MERG and with our external print suppliers and magazine advertising departments. The practical elements of the post fall into two main areas: internal, within our MERG community and external, dealing with public facing dealing with non-members and advertisers.

Using my professional experience I have begun the process of refreshing and updating MERG's image, initially through the design and roll-out of our new logo. Additionally, the MERG flyer, used for hand-outs at exhibitions, has been redesigned and will be printed and rolled out early next year. Along with my colleagues on the Kit Locker team, we are considering ways of updating the design of the Kit Font Labels which are included in the build kits. I am also part of the Journal team, with responsibility for checking the suitability and quality of the images submitted for inclusion in the Journal. Additionally, I ensure that all final files are to the specification required by the printer.

My external role focuses on placing updated and rebranded MERG advertisements in relevant Model Railway magazines; currently Railway Modeller, Hornby Magazine and Model Rail. By using one of my business printing contacts I have been able to half the cost of printing the quarterly Journal, and we now have additional copies of the each Journal availably for publicity use.

Over the next year my main aim is to unify our identity across all public-facing aspects of MERG and consolidate our current advertising campaigns, ensuring optimum value for money.

Facebook Admin

Required to regularly update and monitor MERG's Facebook Page

For further details please contact the Publicity Office - *publicity@merg.org.uk*

Committee News

Summary of Committee meeting 16th September 2023

Introduction
The Managing Committee met for an emergency meeting via Zoom with nine members present. Apologies were offered by Martin Da Costa and Phil Silver. Chairman John Gowers welcomed everyone stating that a decision had to be made as to whether the 'Oxford Event' was to be held in its advertised form.

Discussion
John Gowers revealed that MERG's finances were not in good shape and the financial year commenced without a budget. He took responsibility for these facts apologising for his oversight, hence the reason for calling an emergency meeting.

The costs associated with holding the exhibition included pre-payment for the venue of £1000, also estimates of travelling expenses and accommodation at £4000. At the start of the year there was a £13000 deficit, in part due to an unexpected £10000 bill for Kit Locker expenditure.

Journal Editor Emily Johnston gave a summary of likely costs associated with producing December's Journal, including news that Royal Mail were to increase their postage charges for mailing the Journal from 1st October by 10%, which would further impact on MERG's reserves.

Following a recent site visit to the West Oxford Community Centre (WOCC) by Treasurer James Cunningham and input over several weeks from members of the Committee with expertise in event planning, audio-visual and IT support, it was apparent that postponement of the exhibition, presentations and workshops would be advisable.

Ian Macdonald pledged his support to organise a future event. Area Groups Liaison John Fletcher offered to support Ian Macdonald and perform site visits, also to explain the decision to those Area Groups who had been approached about providing layouts. James Cunningham stated he would check with WOCC about alternative dates and any penalty for cancellation.

Committee members were unanimous in deciding to postpone the event and hold the AGM via Zoom only. John Gowers suggested an e-mail be sent to all members about this decision with a reminder about the AGM, requesting Emily Johnston to provide a draft for comment. Secretary Francis Pritchard was delegated to arrange circulation with Webmaster Andy Woolass.

Rules and Motions Committee
The need for nominees for the Rules and Motions Committee was discussed. A maximum of five are required: a liaison from the Managing Committee – Web Content Editor Keith Norgrove agreed to undertake this position – two full members and a Chair.

Area Groups, SIGs, Education and Training Report September 2023

Introduction
Since the MERG AGM I have continued a wider responsibility for liaison with the Area Groups and SIGs as well as work on Education and Training. My subscription to most of the groups and SIGs has given me a good idea of what is going on. I have been looking into where group activity is not at its previous level or where an old group is no longer active.

Area Groups
The 27 active Area Groups all have a steady membership. They vary a lot in size. Some of them are developing a lot of specialist knowledge in different areas. They provide a combination of physical meetings and Zoom meetings. They cover many areas of the U.K. and some elsewhere. Some members travel a long way to attend the meetings. New ideas for Area Groups are welcome to extend the coverage to more members. Most groups have more than one coordinator and I am keen to encourage members to share this work. I am particularly interested to help the North West Group have new leadership and work to re-establish groups in Bristol and the North East.

The Virtual Area Group (VAG) was established some years ago to provide Zoom meetings for members who do not have an Area Group. It has been relaunched by Huw Griffiths (vag@merg.org.uk) and there have now been some meetings. The aim is for this to provide a platform for talks which have a wide interest for members and can bring different groups into contact.

Special Interest Groups (SIGs)
The total membership of the 13 SIGs is over 1700, although some members belong to several SIG. There is a new SIG for RailCom. Most of the SIGs have continued to meet by Zoom and provide a way for members to share ideas and work together, often from across the world. There are emerging topics of interest which could be covered by more than one interest group, which leads to discussion to avoid duplication. This is particularly the case where new hardware is becoming available, which is happening all the time. I am promoting dialogue between the SIGs to sort this out.

Education Resources
One result of all the group and SIG activity is a lot of videos. I want to thank the members who have edited and indexed the videos to make them available. There is a need for more volunteers to help with the editing of the videos. The amount of information may be confusing for new members and we need to be thinking of ways to provide guidance. We are also thinking of other ways of helping members get the understanding they need, through short courses and other ways.

Knowledgebase Resources
I am aware of the problems members have finding things on the Knowledgebase. I have been attempting to improve the situation by adding links and indexes. There are also whole areas where there has been little information from the past and I have been working to grow these, including a section on programming which did not exist before.

I would be glad of suggestions where information is either hard to find or missing. Also please contact me if you are interested in helping with this. There are locations for

members to provide information about the project work they are doing.

Conclusion
I want to thank all the members who are active in this area, including committee members, area group organisers and SIG convenors. We are continually educating each other, sharing our different skills. I am sharing this report with the Education SIG which I expect will lead to more ideas. One of the effects of all this is that I see more and more familiar faces on the Zoom meetings I attend. MERG is a place where friendships grow as knowledge is shared. Best wishes to all.

John Fletcher,
Area and Group Liaison, Education & Training Manager

Summary of Committee meeting 23rd September 2023

Introduction
The Managing Committee met at Keen House, London with nine members present and Emily Johnston joining via Zoom, Martin Da Costa offered apologies. Chairman John Gowers welcomed everyone. The minutes of the meeting on 17th June were approved.

Chairman's Business
Expectations of Being a Committee Member – John Gowers stated that members of the Committee must commit to attending meetings in person, excluding extenuating circumstances and agree to the collective view.

How We Communicate Vacancies – a lengthy debate ensued about recruiting members to fill key posts, the need for mentoring, stating the time each post requires and further moves to team working to ensure no one becomes overloaded.

MERG User Guide – John Fletcher offered to check the Knowledgebase and videos.

Secretary's Business
Francis Pritchard outlined the arrangements for the AGM – as the Oxford Event was cancelled the AGM will be held via Zoom.

Questions & Answers session for candidates and proposers of motions on 15th October via Zoom – arrangements to be finalised and details circulated to members. Martin Perry to be approached to act as host.Bank Mandate – this regular, administrative formality was approved.

Review of ORG Files (which describe Managing Committee functions) – held over.

Content Editor's Report
Keith Norgrove presented his comprehensive report on issues encountered with the website and remedial action taken. Many related to correcting out of date information. Also queries from members, past and present and the public.

Membership
Francis presented current and historical data which demonstrated the continuing trend of members leaving MERG. Being unable to quiz leavers as to their motivation, it was speculated that mortality amongst our ageing membership was the driver.

Renewal Questionnaire
Emily Johnston stated that her suggested review of the questionnaire would be progressed when time permitted, probably after the December Journal was completed. Francis to add this item for discussion during the yearly review.

IT Performance and Development & IT Subgroup Report
Due to Andrew Hicks and Martin Da Costa having to step down, the mooted IT Renewal project has halted. Following the report from Paul Howes, leader of the current IT Subgroup It was agreed that a more cautious, considered path be taken after establishing exactly what MERG needs now and in the medium to long term future. Phil Silver queried how this change was to be handled given the publicity build-up IT Renewal had received.

Groups
John Fletcher highlighted the difficulties in finding members to lead AGs and SIG, listing those Groups were assistance was required and others no longer active. A new SIG covering Railcom is to be set up and an AG for the Bristol area too.

Education and Training
John Fletcher summarised his report – reproduced above.

Events & Exhibitions
Ian Macdonald reported that 1500 of the old flyers are left and his desire for a new exhibition stand back screen. John Gowers queried which events should be supported, the cost and where to store banners, etc. Ian responded with a breakdown of fees charged to societies such as MERG, how some shows were no longer an economic prospect – more so when travel and hotel costs were factored in – and the lack of support from Area Groups to staff the MERG stand.

Phil Silver stated that a MERG stand at local shows in Wales were free of charge and the need to present MERG as a professional organisation – resourcing Area Groups with corporate branding, display materials, etc., – to aid recruitment. The new batch of 10000 flyers will cost £550.

Kit Sales and Technical Support
Paul Tompkins reported that kit sales were buoyant. The use of Tracked Mail saw a big improvement with fewer losses. With James he was examining the financial issues associated with the levels of stock held, the cost of launching a kit and the payback timescale. James stated that he was aware of what Paul stocked but not that held by Kit Packers.

Phil Silver felt that a sufficient margin was not being charged on kit sales, that every kit should be bar coded and that the MERG model relied too heavily on new members purchasing kits to generate sales. Long standing members did not make repeat orders. Emily Johnston stated that old stock should be promoted advertised in the Journal and sold off to reduce inventory.

Paul reported that the long awaited Automatic Train Controller (ATC2) range of kits were nearly ready for release, which should have been launched in spring. Three months had been spent on writing the Build Instructions. Also the lead time for the new booster kit was long.

Paul reported his progress in identifying a commercial distributor to relieve him of an onerous workload. The mechanics of kit delivery, invoicing, monitoring stock levels and the technical requirements to map our data to comply with their system were discussed.

Journal
Emily Johnston reported that the cost of printing and distribution was higher for September than June due to inclusion of the AGM papers and an extra eight pages of Journal content. From the 1st October 2023, Royal Mail are increasing their postage rates. Inland postage will rise 10% adding £1650 pa to the distribution bill, assuming no change in the UK membership roll. At present there is no alternative to Royal Mail for UK distribution as the volume we send is below the threshold for bulk mail distribution companies.

Phil Silver offered to investigate bulk delivery of Journals to Australia, New Zealand and the USA, employing local distributors to cut costs.

Publicity
Judi Rastall, who administers MERG's Facebook account suggested it be shut down. Phil Silver reported that a lack of metrics for model railway magazines to determine cost/benefit and possibilities for gaining useful data. A code might be added to each advert, to be quoted on joining. John Gowers agreed that a budget for external advertising must be agreed.

Communications and PR
Corporate Video or Slideshow – Emily Johnston suggested that the MERG website host a short promotional video and that a longer one be made available to Area Groups for use at exhibitions. Both to present a corporate presence. Phil Silver felt it would have to be done to a high standard as he had seen many poor attempts at exhibitions. He would seek advice from a Cardiff AG member. Emily Johnston agreed to pass on her slideshow.

Finance
John Gowers introduced this item, apologising for the poor state of MERG's finances. James gave a lengthy and detailed summary of his work referring to his report previously circulated:

- Kit Locker expenditure was high
  At the time James' report was written, MERG had £15000 cash in hand. In the interim this figure had risen to £18000, though bills of £3000 were pending. Journal expenditure for September's edition including the AGM Notice was £13000 (print and distribution) therefore care was required when authorising any spending.
- Having two deputies to assist was a boon, spreading his considerable workload.
- He was uncomfortable with the old method of calculating VAT using spreadsheets, now that it was dealt with in Sage (an accounting package) he was happier.
- Stock management needed to be tackled though not easy to do.
- MERG has an exemption from corporation tax – to be examined – though not a major concern.
- Avoiding any unnecessary spend was vital, a change to our payments to supplier Rapid was helping with cash flow.

Consideration of the Action Points
Held over until next meeting.

Date and Venue for 2024 Strategy Meeting
Committee members expressed a desire to hold a Strategy Weekend in early 2024. Potential venues and costs were discussed for future investigation and availability.

Any Other Business
In light of the decision to hold this year's AGM via Zoom, it was agreed to proceed with Motion 2 which would – if passed – permit the holding of hybrid AGMs in the future.

John Gowers enquired who intended to stand for election to the 2023-2024 Committee.

Dates of Next Meetings (all at Keen House except where otherwise stated)
AGM online: 28th October, next meeting of the Managing Committee: 18th November 2023.

Emily Johnston

Summary of pre-AGM Q&A session 15th October 2023

At the Q&A session we had only seven members log on, three at the very beginning and then in ones up to about 17.00. Most of those that logged on were supportive of what the MERG Managing Committee were doing. The four Officers stayed on line for most of the four hours and John Fletcher, Ian Macdonald, Paul Tomkins, Keith Norgrove and Phil Silvers also joined us. During the course of the four hours we talked about many MERG related subjects to fill the time, whilst waiting for Members to log on.

John Gowers

Summary of the AGM 28th October 2023

The AGM was held via Zoom, 40 members attended with John Gowers presiding.

1. Apologies for Absence – apologies were received from Martin Da Costa, Roger Edwards and Brian Golding.

2. Minutes of the AGM held on 29th October 2022 – the minutes were approved by the meeting.

3. Matters Arising from the Minutes – there were no matters arising from the minutes.

4. The Chair's Report – the Report was approved by the membership. John Gowers stated that since it was written three members of the Managing Committee were not standing for 2023-2024.

5. The Treasurer's Report and Approval of the Accounts – the Report and the Accounts as amended were approved by the membership

6. Appointment of the Examiner – Sue Kowszun, the Independent Examiner was reappointed for 2023-2024.

7. Election of Officers: Chair, Vice Chair, Secretary and Treasurer. The following nominations were submitted in advance of the meeting: Chair: John Gowers; Vice Chair: Paul Howes; Secretary: Francis Pritchard; Treasurer: James Cunningham. All Officers nominated were elected unopposed.

8. Election of Eight Committee Members. The following committee-member nominations were submitted in advance of the meeting: John Fletcher, Ian MacDonald, Keith Norgrove, Phil Silver and Paul Tompkins. All Committee members nominated were elected unopposed. The IT Manager and Journal Editor posts remain unfilled also one non-portfolio position. Martin Da Costa, Andrew Hicks and Emily Johnston were thanked for their service during 2022-2023 by the Chairman and he urged those present to seek replacements to serve during 2023-2024.

9. Results of Online and Postal Voting

Resolution 1: Rule 8. Annual General Meeting (AGM). To replace "The meeting shall be held on-line to allow as many members as practicable to participate" with "The meeting shall be held online or in hybrid form (online and in-person) to allow as many members as practicable to participate." For 125, Against 2, Abstain 2.

Resolution 2: "To appoint Sue Kowszun as the Independent Examiner for 2023-2024." For 128, Against 0 Abstain 1.

Independent Monitor Nigel Phillips confirmed the accuracy of votes cast.

10. Date of next AGM – agreed to be held on a date to be advised.

11. Any Other Business:

John Fletcher reported his recent work on improving the searchability of the Knowledgebase and compiling a history of MERG, requesting that long standing members contact him with information pre-dating the Journal Archive (1999).

John Fogerty raised the fact that MERG has little presence on social media and that the word 'MERG' was already claimed on YouTube. John Gowers pointed out the considerable time and effort it takes to update such channels and the lack of a volunteer to oversee this function. MERG is listed as 'MERG TV' although no content is listed.

Phil Silver advised that MERG had a team looking at producing a promotional video. Further – in response to requests for a supply of flyers for forthcoming exhibitions – that when stocks of the current flyer are exhausted a print run will be initiated of the blue new-look flyer for distribution to Area Groups. Ian Macdonald stated he has a stock of 1200 copies of the current flyer.

Chris Langdon highlighted the work of his team presenting courses at Missenden Abbey, detailing forthcoming and planned events. He asked that members contact him with suggestion for future courses. John Fletcher stated that he would visit next weekend, look at courses content elsewhere and contemplate external communications. Chris thanked Emily Johnston for her work in improving the Journal's presentation.

John Gowers informed the meeting that the Oxford Event would now take place on 24th September 2024. Ian Macdonald and his team were working on ways to realise the event.

Jim Hardie asked for the support at Scottish Area Groups of specialist speakers. John Fletcher stated that he would speak to Jim after the meeting and John Gowers highlighted that MERG was trying to ensure far-flung parts of the UK were visited but the cost of accommodation was high. That could be negated by a member providing accommodation.

12. John Fletcher moved a formal vote of thanks to outgoing Committee members Martin Da Costa, Andrew Hicks and Emily Johnston. John Gowers stated that he would write to all three thanking them for their service.

Emily Johnston

Vacancies - Journal Team

Journal Editor

The post of Journal Editor, which includes a seat on the Managing Committee, remains vacant at the time of writing

The Journal Editor manages and is assisted by a team of 24 volunteers who edit and proof content, QC check imagery and layout content. The post holder's responsibilities include commissioning new content and overseeing the production of four issues each year. It is vitally important that a member volunteers to take on this challenging role, otherwise publication of the March 2024 issue of the Journal will be in jeopardy

Assistant Editor

An additional Assistant Editor is required. We welcome applications from members with editorial and management experience within the publishing industry, academia or engineering.

Schematics Editor

A Schematics Editor is required to create from scratch author's schematics and block diagrams where necessary. Experience in a professional environment would be an advantage.

Please contact the Journal Editor for further details via: *journaleditor@merg.org.uk*

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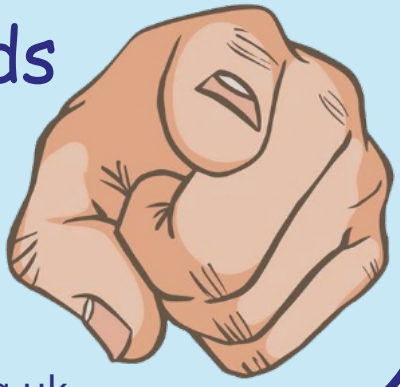
Without Production Staff and Articles there would be no Journal

Your Journal needs

YOU !!



Contact: journaleditor@merg.org.uk

Area Group Leaders

The contact details for MERG Group Leaders may be found in the lists below. John Fletcher (agliaison@merg.org.uk) represents all Groups on the MERG committee. Members in a geographical area that does not presently have an Area Group are encouraged to make contact with others in that area with a view to forming a new Area Group. Email John to ask for assistance with this. Davy Dick and Pete Brownlow are willing to give advice on AG practicalities.

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Ian Hogg M5144
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Judi Rastall M3086 - *KMT Chair plus New Kit Production*
Martin Perry M1481 - *Document Control & Admin*
Paul Tompkins M5231 - *Kit Sales Manager*
Phil Wheeler M3645 - *Inventory Manager*
Simon West M2542 - *Tech Support*
Timothy Calnun-Pratt M7133
CBUS Production Manager

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MERG at Missenden Abbey

Spring 2024 Weekend

8th to10thMarch
7mm Loco Construction
4mm Loco Construction
DCC Sound & Lights
Painting & Lining
Scenery & Back scenes
Structure Modelling
Weathering
Booking now open

August 2024 Summer Retreat

28th July 28th to 3rd August

A week of uninterrupted modelling.
Plenty of time and space to really progress that project of yours.

October 2024 Autumn Weekend

4rth to 6th October
Usually with several MERG tutors – suggestions for new topics are welcome.
Dates subject to confirmation.

For further details see: *https://www.missendenrailwaymodellers.org.uk/*

Christopher Langdon

Meetings - Zoom and Face to Face

Please see the Events page at merg.org.uk/content/events for details of any face to face AG meetings or Zoom based AG or SIG meetings being held. Remember that you can join any AG or SIG: especially useful if they are presenting something that is of interest to you. You do need to sign up to that group via *merg.org.uk/membership* to get their Zoom joining details.

Details of Zoom meetings for AGs or SIGs that you are signed up to can be seen by clicking the "My Upcoming Events" link on the Start page or at merg.org.uk/s/myevents. Planned video calls for the next 10 days can be accessed from the Upcoming Video Calls link at the top of the Start page under NEWS.

The following groups hold regular Zoom only meetings
(Times are UK time unless noted otherwise)

Australia and New Zealand VAG
3rd Saturday of the month from 12:30 to 14:00 AEST.

Cumbria AG
every other Friday at 14:00 and

North Wales AG
the alternate Friday at 14:00

Ireland AG
3rd Sunday of the month at 19:00.

North America AG
4th Monday of the month at 19:30 central time

Three Counties AG
1st Wednesday of the month at 19:30.

Virtual AG
2nd Tuesday of the month at 09:30 GMT, 08:30 UTC

West of Scotland AG
1st and 3rd Sunday of the month at 14:00

Arduino SIG
2nd and 4th Tuesdays of the month (except Dec.) at 19:30

CBUS ANZ SIG
2nd and 4th Sunday of the month from 12:15 AEST [GMT+10]

Electronic Guidance Group SIG
last Tuesday of the month at 19:30

Electronics 101 SIG
1st and 3rd Mondays of the month at 19:30

Just Another Language (JAL) SIG
2nd (technical) and 4th (beginners) Mondays at 19:30

New subscription rates from 1st July 2023

UK - £24, EU - £26, Rest of the World - £30.

All per annum plus a one-off joining fee of £5.

The option to subscribe for multiple years has been withdrawn.

Exhibitions with a MERG presence

January

Southampton Model Railway Society Annual Exhibition
Barton Peveril College, Chestnut Avenue,
Eastleigh, SO50 5ZA
27th-28th January
Saturday: 10:00-17:00, Sunday: 10:00-16:30
https://southamptonmodelrailwaysociety.wordpress.com

March

Birtley Model Railway Engineers Annual Exhibition
Birtley Community Centre, Ravensworth Road, Birtley, Tyne and Wear DH3 1EN
2nd-3rd March
Saturday & Sunday: 10:00-16:00
https://www.facebook.com/groups/737079663164996/

North Down MRS
Bangor Grammar School, 84 Gransha Road,
Bangor, BT19 7QU
23rd-24th March
Saturday: 10:00-17:00, Sunday: 12:00-17:00
http://www.ndmrs.org.uk/

May

Glenrothes Model Railway Exhibition
The Lomond Centre, Woodside Way,
Glenrothes, KY7 5RA
11th-12th May
Saturday: 10:00-16:00, Sunday 10:30-16:00
https://www.glenrothesmrc.org.uk/

1st Bangor MRC
1st Bangor Presbyterian Church Hall,
Main Street, Bangor, BT20 4AG
24th-25th May
Friday: 19:00-21:30, Saturday 10:00-16:30
http://www.firstbangormrc.co.uk/

June

Perth Model Railway Exhibition
Dewars Centre, Glover
St, Perth, PH2 0TH
29th-30th June
Saturday: 10:00-17:00, Sunday: 10:00-17:00
https://smet.org.uk/show/

July

Cupar Model Rail 2024
The Corn Exchange, Cupar,
Fife, KY15 4BT
20th-21st July
Saturday & Sunday: 10:00-16:30
https://cuparmrc.wixsite.com/beta/post/cupar-model-rail-2024

August

East Neuk Model Railway Club
St Andrews Model Railway Exhibition
St Andrews Town Hall, Queen's Gardens,
St Andrews, KY16 9TA
17th-18th August
Saturday: 10:00-17:30, Sunday: 10:30-17:00
http://www.eastneukmrc.co.uk/

Ulster MRC
Methodist College Sports Hall,
Belfast, BT9 6BY
24th-25th August
http://www.ulstermodelrailwayclub.co.uk/

September

Ernle Model Railway Club Annual Exhibition
St Macartin's Church Hall,
Enniskillen BT74 7DR
21st September
https://www.facebook.com/people/Erne-Model-Railway-club/100063617825000/

Stafford Railway Circle Annual Model Railway Exhibition
Stafford County Showground in Bingley Hall, ST18 0BD
28th-29th September
Saturday: 10.00–17.00, Sunday: 10.00–16.30
https://www.staffordrailwaycircle.org.uk/exhibition-september-28-29-2024/

October

Aberdeen Model Railway Club Exhibition
https://www.facebook.com/AberdeenModelRailwayClub/

November

Falkirk Model Railway Exhibition
Grangemouth Athletic Stadium, Kersiebank Avenue,
Grangemouth, FK3 0EE
16th-17th November
https://falkirkmrc.com/

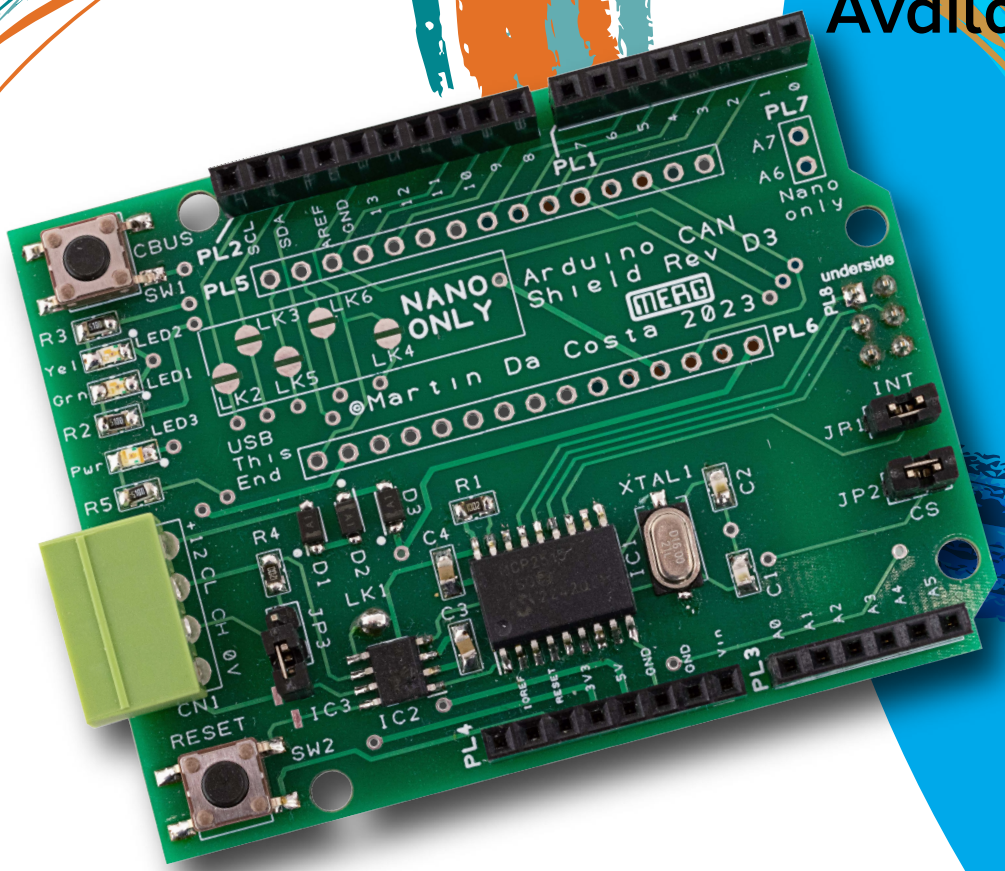
Start Your Adventure

BUS explorer

Kit 110

Arduino CAN Shield

Available from the Kitlocker



- Compatible with Arduino UNO R3, MEGA, NANO
- Provides standard MERG CAN Bus port
- CBUS interface

MERG