THE DISPATCHER

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April Division Meet to Be Held Online Once Again

On Saturday, April 10, 2021 the Philadelphia Division will be meeting online using the Zoom conference program as we have done for all of the meets in the past year. Login will begin at 8:30am with the program starting at 9:00am.

If you plan to attend and would like to be able to be seen by others, you would need a webcam. These are typically integrated into most laptops and pads. If you don't have one, they can be purchased online or from any computer, electronics, or office supply retailer. Smart phones have the capability built in. If you just want to attend and don't care about being seen, you will be provided with links to download the application onto your device and to join the meeting online to view the proceedings. Phone numbers will be supplied to call in so that you can receive the audio and participate verbally if you desire (calling in is not required if you have webcam capability). An email will be sent in advance with all the pertinent information and instructions.

The program will consist of two clinics. First up **Barry Rosier**, our good friend from across the river, will present a clinic titled "***Printable Textures for Scratchbuilding.***" He'll look at the wealth of printable texture sheets available on the internet. From brick to concrete to door and windows, there are a number of printable sheets available for immediate usage. Some are free while others require a modest fee for unlimited printing. Join Barry for this informative clinic and learn how printable textures can be used on your train display.

Barry is an accomplished model railroader who has a passion for sharing this great hobby with everyone. He is a member of Model Railroading University and a Model Railroading Team Live Member. He has presented several clinics in the past for the Philly Division together with colleague and friend Mike Dettinger. Barry has served as the webmaster for the Strasburg Model Railroad Club and a producer of the YouTube Model Builders Shows. He primarily models HO and American Flyer S-scale. He is currently working on restoring American Flyer trains collected during his boyhood, as well as creating a 1950s transition-era layout featuring the PRR and LV.

Next on the docket will be a clinic titled ***"Farmer Mike's Corny Adventure."*** The Philly Division's own Mike Dettinger will be taking a look at agriculture. His clinic will look at cornfields, home gardens, and even tulips. Mike looks at different model agricultural products and discusses some strategies for planting your own crops.

- A small vegetable garden would look great in a back yard and tell a story about the residents.
- A community garden would provide a much needed bit of green space in an urban setting.
- And, of course, the corn is as high as an elephant's eye. Mike not only discusses corn in rows, but crop circles and corn mazes.

The railroads literally move tons of plant based materials, so it is always nice to see the raw materials on display, too. Who better than the corniest guy in the division to bring us such a program. You won't want to miss it.

Mike is what you might call a "fringe" modeler. If it's odd or obscure, he'll model it and put a decoder in it and/or animate it. He has authored numerous articles on his projects, most recently a log cabin made from toothpicks. His latest preoccupation is with N-scale T-TRAK modules, having recently presented a clinic on a Japanese powered N-scale railcar with cab-view camera mounted inside.

The remainder of the morning's program will consist of show and tell where attendees can discuss what they've been working on. Please check online at phillynmra.org for any further updates. In addition, an email blast will be sent in advance to members with further details.

(Division news continues on page 3)

Form 19

From the Super…

Spring has started to make an appearance after a very snowy second half of the winter. I've spent some time working on a couple different projects, mostly small in nature at this point in time including some experimentations on DCC++. If you've been working on something, we'd love to include some coverage of it in ***The Dispatcher***. It doesn't have to be a full length article, just a couple pictures with descriptions would be welcome so that everyone can show off their progress until we get back to layout visits.

Thanks go out to the New Jersey Division for the joint meet in January that they hosted. The joint meets involving our two divisions always result in a good time, and I'm glad I was able to attend this one.

Our next meet will be held via Zoom again on Saturday April 10th, starting at 9am with the Zoom meeting opening around 8:30 am for people to join. More details about the clinicians we've been able to get for the meet can be found on page 1. If you have any interest in giving a clinic, either virtually or back in front of the division once we get back to live meets, let us know.

Our yearly elections for board members will be held starting in April and announced during the June meet. We are always looking for people interested in being a board member, so if you have any interest still feel free to reach out to myself or any of other current board members.

At this time we are still targeting our September meeting as the next one to be held live, but things have changed and may continue to change so watch for more details in the future issues of ***The Dispatcher***.

Looking towards the fall, we have the MER Convention currently scheduled for Thursday October 21st through Sunday October 24th. The convention is being hosted by the Chesapeake Division and being held in Hunt Valley, Maryland, which is off of I-83 just a couple miles north from Timonium. I plan to be there, and I hope to see a lot of the division members there, as well.

As always stay safe and hope to see everyone in person sooner than later.

Rob

From the Editor…

Welcome to our winter edition of ***The Dispatcher.*** I don't know if we've ever featured an article on electronics, but there may be no member more qualified than Earl Hackett to provide such a piece. In the past he has presented clinics and shown off his amazing signals, and this month he provides us with some practical electronics that may come in useful for many model railroad projects

In the online section, our second feature continues to explore Rick Melcher's retirement facility's model railroads. Also featured are our regular columnists for whose continuing contributions we are always grateful. Clerk Mark Wallace with the January meet recap; Bill Fagan as the dashing Video Vigilante relates his further adventures videoing more interesting layouts. MMR Joe Walters discusses a favorite topic of many modelers, the long, lost caboose. Chip Stevens takes us on another plunge into the world of computers, and, of course, Kevin Feeney, pumping that handcar to his further adventures at train shows.

In response to my pleas, I have received some new articles for which I am very grateful, but I need more, so I encourage everyone to keep writing on whatever you know or love about model and prototype railroading.

Howard

THE DISPATCHER

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Submissions: THE DISPATCHER welcomes any model railroad- or railroad-related material. Members are encouraged to send in articles, letters to the editor, reviews, etc. The editors reserve the right to, when necessary, paraphrase portions of the text in order to fit the space available.

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Call for Nominations

Every spring, the Philadelphia Division holds its annual election for board of directors. There are seven total board positions, four (4) of which are open for election or re-election this year. The term is for two (2) years. The board then elects officers from among the directors. This is your chance to take an active role in the operation and direction of the division.

Board members are expected to attend board meetings (once every two months) and all meets–or at least aim to. Candidates must be Philadelphia Division members (residing in within the division boundaries) in good standing. If interested, please send bio and photo to the editor, Howard Kaplan. If elected office is too big a step, consider volunteering to chair or work on a committee. Any participation counts as credit toward your AP Volunteer.

In Memoriam

Alden Smith: The Philadelphia Division is sad to announce the passing of Alden Smith in January of 2021. After retirement his wife suggested he engage in a hobby to keep himself busy and he wound up in model railroading. In addition to being a division member, Alden was a talented modeler who excelled in scratch-built structures and was happy to share his expertise in both clinics and written articles. He was also proud to have traced his lineage back to the Mayflower as was indicated in his email address.

Alden's Cumberland Division of the Western Maryland was nothing less than a masterpiece of craftsmanship, and was viewed no doubt by hundreds of visitors throughout the years. He was a friend to many and a wonderful person to know. He will be sorely missed.

Jerry Powell: We are saddened to announce the loss of Jerry Powell. In the past Jerry had been a division member, but his most notable claim to fame was as the person responsible for the establishment of the Schuylkill Valley Model Railroad Club, which spent the majority of its existence in Phoenixville, PA. Over the years Jerry had also graciously opened his own personal impressive layout to the division members following meets. The model railroad community will feel his loss.

New Member Profile

Stephen Koffel: I'm Steve and I reside in Horsham, PA. I'm an under-30 modeler with a wife, young son, and a daughter on the way. While I've always been an avid hobbyist, no other hobby has captivated my imagination and maintained my interest like model railroading. For many years I modeled in N scale and constructed several Free-mo N modules. When the pandemic started I transitioned to HO scale and have enjoyed it immensely. I'm currently reading up on prototypical operations in order to begin running ops sessions on my new layout.

January Meet with the NJ Division – Back to the Garden

by Mark Wallace, Clerk

. For many years lasting a decade now, the Philadelphia Division has shared the November and January meets with our friends across the Delaware River in the New Jersey Division. We've discovered that not only clinicians could be shared to lighten the load, but also we get to visit even more layouts beyond what is local to our territory. We've gone for many years hosting the November meet in Wilmington Delaware while the Jersey Division hosts the January meet at a location of their choosing. For these last three years, NJ has been meeting at Grace Episcopal Church's auditorium in Merchantville, NJ. Like everything else this pandemic has affected, our long-standing traditions of meeting on a Saturday morning—complete with coffee, donuts, swap tables, a model contest, and some great model railroading fellowship—has had to be revised to the safety of the virtual "Zoom-from-the-Train-Room" format.

With Superintendent Bill Grosse as host, we began just past 9am with a few announcements followed by our first clinic presented as a team effort by New Jersey Division members **Tom Neukirchen** and **Jim Shepard** titled, ***"Garden Railroading: Trials and Tribulations, Continual Evolution, and Fun."*** Jim is a professional gardener and model railroader. Tom continues work on his garden railroad, solving many challenges of working in or with "mother-nature." Yes, the NMRA extends its extensive umbrella to all types of model railroading and that certainly includes garden model railroading.

Tom and Jim each presented their respective outdoor layouts which, like most "legitimate" model railroads, includes a track plan with a network of towns, locations, features, and destinations to and from which trains move. Typically garden railroading is constructed and modeled with G Scale or the large-scale variants that allow for models to operate on anything from O-gauge track (analagous to gauges used for On30 or HOn30 in smaller scales) up to G-gauge track. Typically 1/32" gauge (1:12) 16 mm scale, and 1/32 Scale (1:32) are some of the possible sizes encountered in this neck of the hobby. Several structures built at

these larger scale sizes featured some superb model detailing. While the trains can run for show or continuously in a loop, they could also be "operated" depending on the track plan for switching, car forwarding, or performing special moves. While there is no benchwork to build or layout room to prepare, the modeler still has to plan and construct the layout upon the ground almost exactly like the 1:1 railroads do. The chief challenge after construction of the layout is maintenance. Again, just as with the prototype, with vegetation and plants being the main scenicked feature of the layout, the track and structures nestled between them are all subject to annual growth spurts along with the freeze-thaws that contort the ground. Occasionally wildlife can show up, too. But even with seasonal weather events, these layouts are fairly durable if they can be maintained.

Slightly off topic but of an historical note of interest, garden model railroading got its start right here in our Philadelphia region. It is perhaps the oldest type of legitimate model railroading or "prototype" model railroading with respect to how its track plans portray how the train travels from one destination to another through features of hills, tunnels, bridges or structures that imitate real life locales. In the late 19th or very early 20th century, the owners of large estates who also held interests in prototype railroads that extended nationally beyond the Philadelphia area, would have miniature railroads built in their gardens or on their grounds as a diversion for guests to enjoy. Folks could stroll about with the track and trains being a means for networking or attracting investors to help finance the owner's real railroad. The tracks could be set up to represent towns or city destinations with small handcrafted locomotives (usually steam driven) with small consists running along the track.

Such a garden railroad display continues to the present at the **Morris Arboretum** in nearby Chestnut Hill. However, time has certainly progressed with electricity, better motors, manufacturing techniques, track design, and so forth that enable anyone with some outdoor space, time, energy, and patience the opportunity to construct a garden model railway.

Getting back to Tom and Jim's presentation, they enthusiastically demonstrated their modeling efforts, complete with questions and answers, lasting over an enjoyable hour. Their two layouts will be good ones to visit when we eventually return normal socializing.

After a short intermission, the meet continued with our second clinic by Philly's own Clinic Director**, Mike Dettinger** titled, ***"Live Streaming Video from Inside an N-scale Train Car."*** Mike continues a long and deep emotional yearning that permeates the hobby for the thrill of riding inside of the trains we run—the "cab view." For some of us, that feeling has never gone away. Our friend and colleague Bill Fagan has devoted his efforts as the Video Vigilante presenting videos of layouts as if viewed from within the cab. Mike explained that short of using a sci-fi-type "shrink-ray" the only way to get a view from inside a train is to settle for letting the camera do the view capturing. His clinic summarized the history and milestones in model train filming or video since the early 1940s up through miniature cameras streaming video signal using Bluetooth technology over home wifi networks. Ah, the marvels of technology!

Mike then previewed and demonstrated his recent acquisition, an N-scale car—available only in Japan—into which can be mounted such a miniature camera capable of digital transmission. Mike shared video taken from his Kato #5595 in N scale that was truly impressive as he ran it over his layout of T-track constructed modules. And as is typical of model railroading serving as an umbrella for many other hobbies, in this case "home-computing," Mike demonstrated another recent Internet phenomenon: translating foreign tech notes or brochures into legible English. Mike walked us through the techniques of making quick translations from Kato's instruction manual or specs authored in one of the conventions of technical Japanese into English. With this technical aid, Mike could apply the adjustments and properly setup the items necessary to run his "camera car" over his layout. Some good question and answer dialog followed suggesting more than a few of us still yearn for a way "to see from the cab."

To wrap up, Superintendent Bill Grosse announced the winner of the NJ Division's virtual contest for November, Bill Howard. There followed a general discussion from various members on what I continue to call, "modeling while flattening the curve." Again, there were some exciting examples of cars, structures, and scenery that members had been working on along with some good back and forth that all ended about 11:30am. Our thanks to Bill, Jersey Assistant Super and Clinic Director John Gallagher, clinicians Tom Neukirchen, Jim Shepard, and our own Mike Dettinger for all of their efforts in contributing to another successful New Jersey-Philly Division meet.

Tracks ahead: Your division board has been meeting and continues to plan the division's various programs through the coming year. On Saturday morning April 10, 2021, we are looking forward to another virtual meet for clinics and some extended fellowship in model railroading. Hopefully many of you are getting or are soon to get your vaccines that will allow for safer and relaxed meeting as a way of resuming the enjoyment of our hobby of model railroading. Until we can be assured of obtaining the type of venues where we've been used to meeting, we will continue virtually, but hopefully not for long. Our patient hope and persistent goal is to resume doing face-to-face meets by mid-year or the fall, all going well, of course. Stay safe and see you next time!

An Arduino Interface for a Model Railroad

by Earl T. Hackett, Jr.

Electronics

This section describes basic digital circuit and board design concepts, and circuit board assembly. More detailed information can be found in the following:

References

"Build Your Own Universal Computer Interface," Second Edition, Bruce Chubb, McGraw-Hill, 1997, ISBN 0-07-912639-1

"Designing with TTL Integrated Circuits," Texas Instruments, 1971, Library of Congress Card Number 77-150465

Circuits Useful to Model Railroaders

Rob Paisley has a very helpful page of model railroad circuits including many for the 555. Many of my circuits are based on his designs. Many have all proven to be very simple and reliable. Some need improvement. Breadboard a circuit before making a bunch of them.

http://www.circuitous.ca/CircuitIndex.html (This is not the original URL of this page but is current as of January 2021.)

Digital Circuit Families

There are many families of digital integrated circuits. For simple circuits used in model railroading, only three are necessary, all using the standard 5VDC (regulated) power supply. All can sink 20mA, but a few have higher current capacity.

Transistor **T**ransistor **L**ogic (**TTL**) has been around for decades. It is fast, but because it uses bipolar transistors, it is power hungry. About the only TTL ICs that are really needed today are the open cathode versions. These permit the 5VDC logic to drive real world components running on voltages up to 30VDC.

Low power **S**chottky (**LS**) was an early replacement for TTL. It has slightly slower speed (unimportant for modelers), but uses far less power than TTL.

High speed **C**MOS **T**TL (**HCT**) was intended as a direct drop in for LS ICs. It has a high speed CMOS core with peripheral circuitry that allows it to operate on 5VDC. Some functionality is available in LS while other functions are available in HCT. They can be mixed without interface concerns. Use LS and HCT whenever possible with open collector TTL ICs as an interface to higher voltage and inductive loads.

Types of Digital Integrated Circuits

Gates, comparators, flip-flops, and latches are of most interest to modelers. Timers are not exactly digital devices, but are extremely useful in driving digital circuits or providing a clock signal. Specific ICs will be discussed where they are used in a circuit.

Gates are the most basic digital circuits. There are six basic types:

NAND, 74nn00: (Negative AND) If all inputs are high, the output is low.
NOR, 74nn02: If any input is high, the output is low.
AND, 74nn08: If all inputs are high, the output is high.
OR, 74nn32: If any input is high, the output is high.
NOT, 74nn04: Inverts the input high to low or low to high.
XOR, 74nn86: The exclusive OR gate. The output is high if ONLY one input is high.

Buffers/Inverters: These have one input and one output. Both serve as a current and/or voltage amplifier. The inverter inverts the input signal and is often referred to as a NOT gate. Some of these gates can have a **Schmitt trigger** on the inputs. This will convert a slow rising signal to a fast digital transition.

Comparators are ICs that compare two inputs, usually four or eight bit. If the inputs match, the output is set either high or low. Some have both positive and negative outputs so they will fit any logic design.

Flip-flops and Latches are basic memory circuits. They remember the last state of the input. There is usually a clock input that makes the circuit active, meaning it will accept a new input.

Timers have only one IC of interest to modelers, the 555. The 556 is simply two 555 timers in a single package.

Decoders/Encoders convert a multibit input to a digital numeric (power of 2) output (decoder) or a digital numeric input to a multibit output (encoder). The most common are 2 inputs to 1-of-4 and 3 inputs to 1-of-8. This is the truth table for a 74HCT139 which could be used to drive a color light signal.

2 Line Input	4 Line Output	Using leftmost 3 bits
00	1110	Dark
01	1101	Red
10	1011	Yellow
11	0111	Green

This would reduce the signal lines for a three light signal head from 3 to 2. This doesn't sound like much, but a small interlocking can easily have 8 signal heads so this reduces the lines from 24 to 16 allowing a single local memory card to handle the whole interlocking. Personally, I don't think it's worth the cost of the extra circuit boards.

These are the most useful types for the model railroader. There are other types of ICs and literally hundreds of designs available. Datasheets are readily found on most component suppliers' websites.

The Arduino Mega

All the board designs mentioned here are intended for use with an Arduino Mega. This little microprocessor has amazing capabilities. There are 32 digital ports that can be configured for either input or output, 8 analog lines that can supply up to 5VDC, along with analog inputs and communication ports. I use 16 digital ports for input and the other 16 for output. The analog ports are set to deliver either 5 or 0 VDC and are used to drive the address bus and the load data (strobe) line. Its capability is comparable to an IBM AT, running at 16 MHz with 256 Kb memory. Copies are available for $25 or less.

If there is interest I'll write up an article on the use of the Arduino. This would include details of setting up the programming environment, the C language (it isn't as complex as professional programmers would have you think), and the basics of program logic to make your code easy to write and later to understand.

Digital Circuit Design Logisim

http://www.cburch.com/logisim/

Logisim is a simplified digital signal simulator free for download. It was designed by Carl Burch at Hendrix College for teaching digital circuit design. Through the use of subcircuits you can duplicate any digital IC by copying the logic diagram in its datasheet. It has limitations, most of which are related to timing of the signal through the device, but at the speed our circuits run, this is of no importance. It cannot handle analog circuits. Development has been taken over by some Swiss universities and is available as Logisim Evolution which has some useful upgrades.

Breadboard Testing

Once you have a circuit design you should build a test version just to verify that it works as you expect. The term "breadboard" comes from the very early days when a circuit would be constructed on a piece of wood with nails as attachment points. Today test circuits are built on circuit board material perforated in a 0.1" x 0.1" pattern. It is available in a variety of formats.

Single-hole-per-pad is the most common format. You can pack a lot of components into a small space. Connections can be made by creating a solder bridge between pads or soldering a small wire in the hole along with the component lead.

Multiple-holes-per-pad typically provides 3 holes per pad allowing two connecting wires to be easily added to each node.

Stripboard has strips of copper connecting whole rows of holes. Most circuitry can be completed by just cutting the copper strips. One off circuits can be easily constructed on this material. I also use it for back planes to carry the address and data bus.

Sources for Components

Mouser and Digikey are my favorite general purpose suppliers. Good service, fair prices, and I've never had a problem. Their search engine usually shows many thousands of parts that you have to winnow down using various filters. This can be frustrating if you don't know exactly what you are looking for. Pricing becomes reasonable when ordering 50 or more parts. If you just want one or two parts, Jameco may have better prices.

The best source for electronic connectors I've found is Phoenix Enterprises, now PE Connectors. They have every connector imaginable and more, all at very good prices.

Magnet and bus wire can be found at Remington Industries. Their "solderable" magnet wire is indeed solderable, but at 700F. Many electronic soldering irons operate at 450F. To get a reliable solder joint it must be tinned first. I dip it in a small solder pot or use my Weller soldering gun to tin it before attaching to a component or board.

Circuit Board Design

I use an old copy of Eagle for both schematic and board design. Even if you intend to breadboard a one off design, it's a good idea to have a proper schematic as a record of what you built. When I got my copy of Eagle it was owned by CadSoft, a German company. As with most European software suppliers they offered a free version that had some limitations, but was perfect for the hobbyist. Unfortunately, AutoCAD purchased Eagle and the free feature has been eliminated. There are several free/open source PCB design software packages available, but I have no experience with them. Some are tied to a particular board manufacturer so you can't shop around for the best price.

Custom Board Suppliers

I've tried several including some from the Far East. Boards I purchased from China or India had variable quality—some were unusable. I finally settled on Accutrace. In 50-piece quantities their prices are comparable to those from China, but the quality is consistently top notch. A good offshore supplier is PcbCart. Just watch out for those air freight shipping charges—they can be more than the cost of the boards.

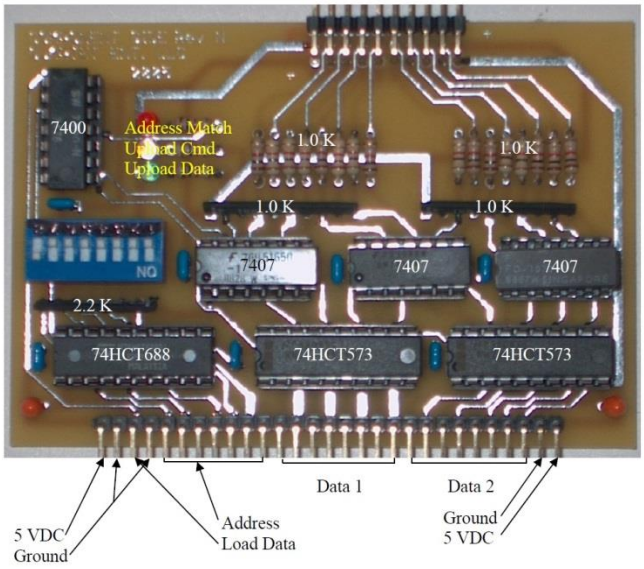
Arduino Interface Boards

1. Output Board

The Arduino Mega has a lot of output lines, but not nearly enough to operate signals on even a small layout. Additional output lines are needed.

Description

This board is designed to read and store data from the microprocessor (µP) and deliver it to the layout. Signal aspects and any other digital information you want to send goes through this board. Each board can handle 16 bits of information. Each board has an address that can be set with the DIP switch or with jumpers. I have a few boards with switches so I can troubleshoot the system, the rest have jumpers for a permanent address. I didn't apply solder mask because I was concerned about possible errors in the design.



The fully loaded board has the following ICs:

74HCT688: an 8-bit comparator. The Output Enable (OE) pin is held at ground so it is always active. When all input pairs match, the output of this IC goes low.

74HCT573: 8-bit transparent D latches with 3 state outputs. This is the IC that holds the data for the layout. It has two control inputs, Output Enable (OE) and Load Enable (LE). When OE is low, data is available on the outputs. When OE is high, the outputs go to high impedance and neither sink for source current. As an output board, OE is held low for continuous output. LE is normally held low so it locks the previous input data in the output register. When high LE allows transfer of data from the inputs to the output register. For the 688 to control the transfer of data from the bus to the output register, we have to invert its output, thus the 7400 IC in the upper left corner. A 74HCT00 would work fine, too.

7400/74HCT00: Quad, 2-input NAND gate. I wired both of the inputs of one gate to the output of the 688 to invert the signal. I had some gates left over so I added some LEDs to indicate operational events.

7407: 6-bit open collector buffer. When controlling anything other than an LED, this IC buffers/protects the 573 ICs from current and voltage spikes. I do not use the open collector for higher voltage control; that is done with an external booster.

The output header at the top of the board is intended to connect to a ribbon cable with an insulation displacement connector (IDC). The two outer lines on each edge carry 5VDC and ground to power low power components such as an LED. Ribbon cable has 28AWG wires, so if more than a 100 milliamps are required, a separate power and ground line should be run.

On the image above you will notice that the fourth pin from the left is a second ground pin. When all these boards are placed on the ground plane, it is very difficult to see the socket to insure it is plugged in properly. I cut that pin off and put the cut off bit into the socket so the board will fit only in the proper position. The two grounds are connected on the back plane.

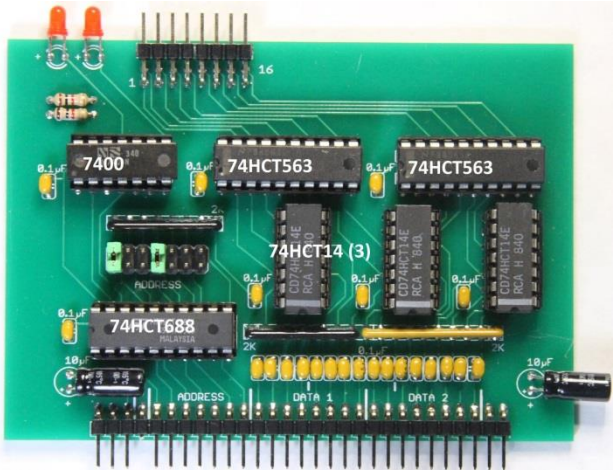
Operation

The 688 monitors 8 bits on the address bus. Seven of those bits are the address, the eighth Load Data or Strobe line is normally low and is controlled by the microprocessor. When the address and data lines have been set up, Load Data is set high for a millisecond to allow data to be uploaded from the data bus to the outputs of the 573. The 573 has transparent latches so as long as the Load Data line is high any changes on the data bus will be immediately transmitted to the outputs, causing lots of flashing lights and motors going nuts so you want to keep the Load Data line low except to upload data.

2. Input Board

Additional input lines are also needed. The output board can be modified to operate as an input board with some minor circuit changes, but where the input is noisy or slow to change, it will not function properly. To correct this problem I added circuitry to support optional filters (the two resistor networks and row of 0.1µF catacitors) and Schmitt triggers. The Schmitt triggers are inverting gates, so I used a 74HCT563 inverting D latch rather than the 573 on the input boards.

This board was produced by PCBCart. I was pretty confident I had this design right so I had solder mask applied. The input filter electrolytic capacitors are bent over to gain more clearance to make it easier to insert it into the back plane.



Description

The address design is identical to the output board, but rather than DIP switches I just used a double pin header and jumpers. Data lines share space with track power, so data enters through an RC filter to remove any stray pulses generated by the DCC signal. It then goes to three 74HCT14 hex inverters with Schmitt triggers. To get the correct output a 74HCT563 inverting latch is used in place of the 74HCT573 on the input board.

Operation

The 688 monitors the address bus and behaves as described above, however its output will be used a bit differently. Since there will be more than one of these boards supplying data to the Arduino, all the outputs will be connected to a single ribbon cable. Each board has a 16-pin socket to receive data from the layout (switch position, block occupancy, etc.). LE is held high so the latches are transparent and data is uploaded as received. The output from the 688 is used to control the OE line without being inverted by the 7400. Normally the 688 output is high, making the 563 chips go to their high impedance state. In this state they neither supply nor drain current from the bus. When the address on the bus matches the board's address, the 688 output goes low and the 563 ICs supply their data to the ribbon cable bus for the Arduino to read. Each board has a unique address so only one board can be connected to the bus.

Problems with the Original Output Board

The biggest problem is the address format. We normally position numbers of increasing value from left to right, like the pin numbers on the Arduino. In the digital world, bits increase in value from right to left. This can get confusing, so for the address I just assign a bit pattern to a constant and duplicate it with jumpers on the two row header or DIP switch.

Finally I only kept the LED that tells me the address is a match (it was the only one that proved useful) and put it at the top of the board where it can be seen.

3. Occupancy Detector Board

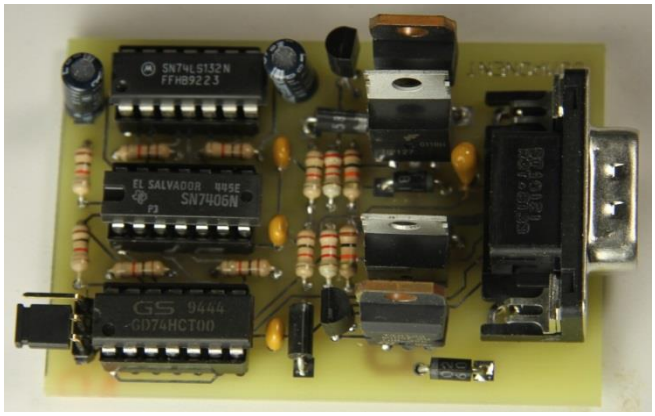
I tried transformer detection but had problems with leakage current generating false occupancy signals. So I continue to use diode drop detectors, which don't appear to have such problems. These detectors are no longer made, but a description, schematic, and board layout are available at http://www.rr-cirkits.com/detector.html.

4. Switch Driver Board

I wanted to get rid of the twin-coil machines, but my experience with stall motor machines was not very satisfactory. Sometimes those machines were so slow that I'd wonder if they were working at all. The tower operator cannot see the switch points and has no way to tell if the movement has been completed. I wanted them to move closer to the speed of the prototype, about half a second.

This circuit drives a MicroMark Switch Tender gear head motor. The motor is connected to a full size toggle switch. One pole controls the frog power, the other pole supplies the board with the switch position information. If it is running a crossover, a 3- or 4-pole toggle is used to control power to both frogs. Frog power extends to the clearance point of the turnout so if the switch is not aligned properly the resulting short turns the booster off and avoids a derailment.

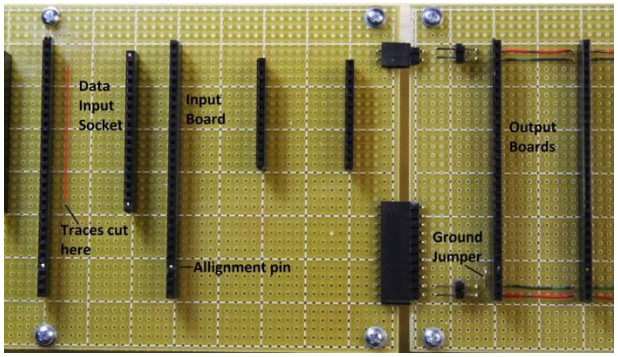
The input to the board is a single line that is set high or



low. If the input from the control line and the switch position match, the motor does nothing. If they do not match, the motor will run in the direction to make the switch position match the input command. The motor will run until the opposing contact is made so a center off toggle can be used as well. There is an RC delay circuit located in the center of the schematic that runs the motor for 20ms after the switch signals it is thrown, just to make sure it doesn't stop early due to a switch bounce. A D-subconnector was selected for this board as it will be carrying some current, and the contacts are rated for 3 to 5A. The three-pin header has a jumper on it that can change the apparent lever position. Manual switches use the same toggle switch arrangement but have a simple push rod extending to the layout facia.

5. Backplane

The backplane ties everything together. It's made from



inexpensive stripboard. I beef up the power and ground circuits for the output boards because there can be a lot of LEDs that draw more current than the stripboard traces are intended to carry. Pins are added to provide a convenient power supply for a logic probe. On the bottom of the board traces are cut to isolate the various data input lines. The address lines serve both input and output boards.

CIRCUIT LAYOUTS & SCHEMATICS IN ONLINE EDITION

ABOUT THE AUTHOR... *Earl Hackett is a long-time division member, well-known for his use of technology such as casting, milling, and 3D printing to develop unique systems of creating modeling parts, most recently working signals and a working mechanical interlocking lever machine for his model C&O.*

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