NORTHEAST N-TRAK

February 2009 NEWSLETTER

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President's Message
Mark Ferracane

Well, its here......WINTERFEST!!!

I look forward to attending each year. The only thing that compares to it is the N-Scale Collector Conventions. Winterfest allows us to see friends we have not seen in a while. It also allows us to have a compitition on our skills in building and designing. The one great thing is that we have the banquet on Saturday night and get to show off our skils to others of building and painting. Then we have a great guest speaker and a report from the various manufacturers on what is in the works for the next year. The one thing I do not understand is why people wait until the last minute to sign up to attend. If you signed up by January 1st, you would save $5.00. $5.00 may not be much, but its more money in your pocket.

On January 8th, a member of our club was severely injured in a apartment fire. Christopher Spampinato is in the burn ward at Mass General Hospital. He has burns over 85-90% of his body. Dan and I are going to try to visit him and see how he is doing. We will keep everyone informed. Let's all pray fo him and hope he makes it.
Till next Month, Mark

Show Schedule for 2008 – 2009

Jan 23 to 25, 2009, WINTERFEST 2009, West Springfield, MA
Big "E" Exposition Center, West Springfield, MA
Set-up Fri noon to 5pm & Sat 7am
Show Sat 9am to 5pm - Sun 10am to 5pm
Coordinator: John Dunne - 508-697-7635
Winterfest Coordinator: Bob Pawlak - 781-862-2485

Feb 14 & 15, 2009 Museum of National Heritage, Lexington,MA
Set-up Sat 7:30am Show Sat 10am to 5pm - Sun noon to 5pm
Coordinator: Bob Pawlak - 781-862-2485

Mar 28 & 29, 2009 Great Train Expo, Wilmington, MA
Shriners Auditorium, Wilmington, MA
Set up Sat 7:30AM Show Sat 10AM to 4PM - Sun 10PM to 4PM
Coordinator: Dan Pawling - 617-244-5261

Apr ??, 2009, Billerica Train Show,
NEW SHOW
Set-up 8am Show 10am to 4pm
Coordinator: Peter Matthews - 978-667-7906

Apr ??, 2009, Hooksett Lyons Club, Hooksett, NH
Cawley Middle School, Hooksett, NH
Set-up 8am Show 10am to 4pm
Coordinator: ????

Looked For Action and Found It
Story and Pix by both Dan Pawling's

Following some family business late on the afternoon of December 26th, we stopped by the CSX's North Yard in Framingham, MA. We found the action.

The North Yard is reached by a wye and is immediately north of the CSX (formerly Boston & Albany RR) mainline and the AMTRK and MBTA passenger station in Framingham. From a public street where the east and west legs of the wye converge to form the south throat of the yard we photoed the Yard Office, a Russell-type snow plow and MOW car still in Conrail color and reporting marks, and a hi-rail truck with trailer, and the sand tower. We had just missed a train backing north into the yard, but could still see the headlight.

With high hopes for activity we hung out in spite of the increasing chill and darkness. Soon the train moved toward us with CSX locos 6226 and 6233 leading a block of cars into the wye's west leg. Because of the quick passage and the low light the photos are fuzzy (*see photos left)*. The final photo shows the cut on the west leg of the wye with the brakeman mounting the last car. The train then moved north into the yard on a different track and disappeared into the night. So did we, for home. We had been looking for action, were most happy to have found it and to be able to share it with you.

Lights and Speedometers for Bridges Canyon
(*Part 2 of 2 Parts)*
by Bob Pawlak

In a previous Newsletter, I described how the new control panel lights, wayside signal lights, and speedometer display unit on my Bridges Canyon Ntrak module appear to the public. This article will attempt to describe the design, construction, and testing of the electronics and software involved in making these items work.

Bridges Canyon has 3 separate spaghetti loops of track below the mainline. Each loop is about 42' long and has 7 blocks. Each loop is separately powered through Digitrax PM42 circuit cards and Digitrax BDL16 circuit cards are used to provide **block occupancy detection** in each of these 21 blocks, the passing sidings for each loop, and other blocks in the transition track connecting the loops to the Mountain Division level.

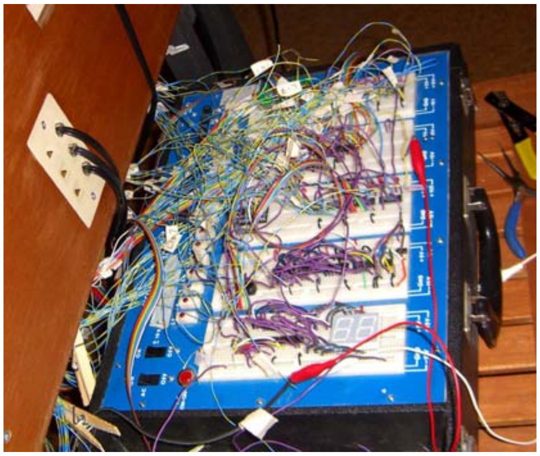
There is a Tortoise switch machine used to power each of the 24 turnouts on the module. 16 of them operate though Digitrax DS54 quad stationary decoder cards so they can be operated from a tethered throttle or with a push button on the control panel. Those with push buttons use blue LEDs to indicate the thrown direction. The rest use toggle switches with the toggle handle used to indicate turnout direction. Each Tortoise has 2 sets of single-pole-double-throw (SPDT) switch contacts. I use one set for power-routing the turnout frog. I put ground and +5 volts DC on the other set of contacts so that the center-tap of the switch gives an **electronic indication of turnout position**. +5V DC is a logic 1 and zero volts (ground) is a logic 0.

The original plan was to bring the block occupancy and turnout position indication wire "inputs" to a "Basic Stamp 2sx" microprocessor module (www.parallax.com) and have it decide which wayside signal light and control panel light "outputs" to light depending on turnout positions and the location of trains on the 3 loops and other private track of the module. I sized a printed circuit board (PCB), built a frame for it, and hung it in place under the module near all the wires coming from the wayside signal and control panel lights. All I had left to do in December, 2004, was to populate the PCB with the proper electronic components, write the software for the microprocessor, and connect about 165 dangling wires to the PCB. I discovered this to be a daunting task which I continued to put off until I could focus on it over a period of several months. Meanwhile, the wayside signal and control panel lights remained dark except for the 16 blue turnout indicator LEDs.

I got a new personal computer (PC) for a Christmas present last December. I eventually got it running in April, 2008, and downloaded the free Parallax software I needed to help me develop the software for the Stamp microprocessor. I borrowed a circuit bread boarding kit from my son-in-law who bought it while studying to be an electrical engineer. I was able to wire several electronic chips together on the breadboard tester, connect the microprocessor to my PC and the breadboard tester, type a program on the PC, and download it to the microprocessor. I used 7 toggle switches on the tester to indicate block occupancy or not and 14 LEDs on the tester to see if they lit in proper order as I simulated the motion of a train going around a loop using the toggle switches. I used this approach to develop the software and test it for one loop of position indicator lights and wayside signal lights at a time. Although there are many similarities between the 3 independent loops, all the variable names for the blocks and turnouts are different and there are sidings, crossovers, and other differences which affect the software for each loop.

Software development for the project turned out to be much more difficult than anticipated. The Basic Stamp 2sx microprocessor is quite capable but is designed to be programmed in 8 separate "blocks". Each block has limitations on the number of variables, the number of instructions, the number of input/output pins that can be used, etc. I kept bumping into these various constraints and had to work hard, devise tricks, and divide the total problem up into 6 separate blocks. Each block was almost exceeding one limitation or another in order to squeeze everything in.

Photo top of next page shows the breadboard tester, the microprocessor module, enough chips for the lower loop inputs and outputs, 14 green LEDs to simulate the control panel lights, and the speedometer display for the lower loop. The mess is up against the back of the module getting occupancy inputs with a loco running on the lower loop. This is how I tested the hardware and



and software for the lower loop. I then made changes to the breadboard and tested the hardware and software for the middle and upper loops in a similar way. The next step was to populate and wire the PCB exactly the same as the breadboard tester so that the electronics would become an integral part of the portable module.

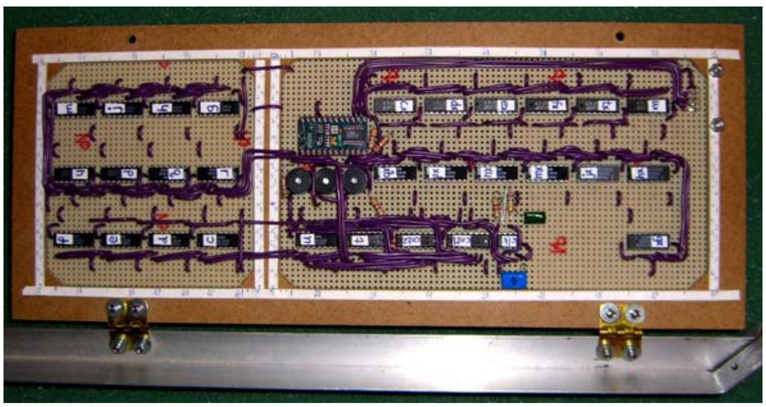


Photo above shows the PCB populated with components with each connected to +5V DC and ground (short wires). The microprocessor is one small chip on the large module in the middle of the PCB. The module plugs into a special adapter soldered to the board. This allows me to remove the module, plug it into a similar adapter which interfaces with my PC, and download a revision of the software to the microprocessor. The 3 round components are the automatic breakaway detection beepers. The half-size chip (lower right) with resistors and capacitors around it is a “555 timer” wired to produce a square wave. Each pulse of the square wave goes to the 8-bit counter chip (74HC590) next to the timer which then overflows into the adjoining 8-bit counter chip to form a 16-bit measure of time needed for speed computations. The next two chips in the sequence are 8-bit parallel input shift registers (74HC165) that are used to read the counters and send the information to the microprocessor. About 1/3 of the rest of the chips on the PCB are also 8-bit **input shift registers** to gather track occupancy and turnout position data. All the rest of the chips on the board are 8-bit **output**

Shift registers (74HC595) which will be connected to the control panel lights and wayside signal lights. When any output pin changes from logic 1 (+5 V DC) to logic 0 (ground), an LED lights somewhere on the module. Most of the longer wires on the board chain two groups of input shift registers and two groups of output shift registers together and to the microprocessor module. The 9-pin connector at the end of the board accepts the cable feeding output data to the speedometer unit.

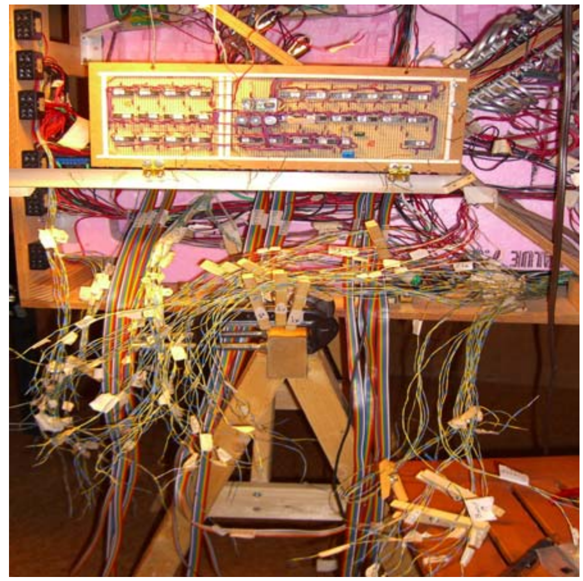


Photo above shows the PCB hung temporarily near the tangle of about 56 input wires and about 109 output wires ready to be trimmed and connected (soldered) to either the input or output shift registers. The module is on its back lying across two saw horses. The PCB is vertical so I can push wires through the holes in the board. The PCB is then rotated to a horizontal position to facilitate soldering the wires to the board.

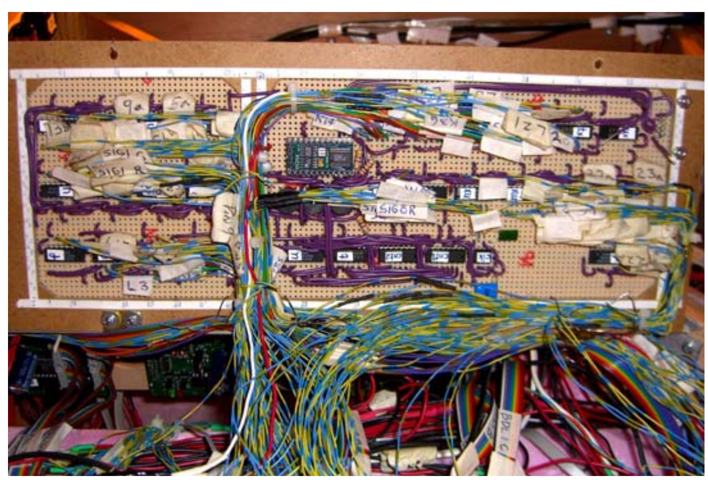


Photo above shows all the input and output wires connected to the PCB. Tlhe PCB is on its hinged support and screwed to the module. The result looks messy because each wire has a masking tape label, there are lots of wires, and the wires are slack in order to flex as the board hinges into place under the module.

Above photo shows the PCB hinged and locked in place. All the wires and components are hidden. All you can see is the back side of the board with about 1,180 solder connections.

Speedometers

As I was working on the lights, it occurred to me that I might be able to compute and display the speed of the trains on the 3 loops. I first envisioned 3, 2-digit (seven segment LED) displays, on a small panel hung on the sky board. The upper display was to be labeled “Upper MPH”, the middle one was to be labeled “Middle MPH”, and the lower “Lower MPH”. I decided it wouldn’t take people long to figure out what the displays meant. The digits had to be big and bright enough to be read by the public at a distance of about 6’.

I first developed the software to limit the display to read 99 MPH but decided I would need a third digit to display up to 199 MPH. I found that when track cleaning and at other times, the trains can easily exceed 99 scale miles per hour. Then I also realized that I wanted to know what the public was seeing in order to control the trains so I would need an identical set of 3, 3-digit displays on the back side of the sky board. The resulting design has the electronics on the larger, back side of the display with a simple set of wires to duplicate the same result on the smaller front side of the display.

I only use 5 wires of a 9-wire cable to connect the speedometer unit hanging on the sky board to the PCB under the layout. The 5 wires carry +5V DC, ground, and connection to 3 pins of the microprocessor to control the flow of serial data to the output shift registers feeding the displays. I first bought two digit display components and later bought single digit components. The double and single digit displays were from the same manufacturer and had the same color and digit height but had different digit width, package height, and pin placement. I had to notch the single units with my table saw and glue them to the double units to form the three digit displays.

Speed (MPH) = distance/time. In theory I know the distances between block boundaries of a given loop of track within about 1/8”. I needed a “555” timer chip to make a “clock” that would send a pulse to a 16 bit counter about 80 times a second. This gave me a relatively precise measure of time. After calibrating the clock, I could scale the stored block length values to have the answer come out close to proper scale miles per hour.

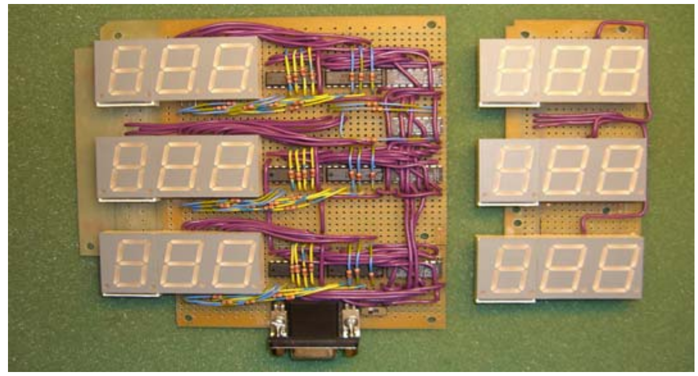


Photo above shows the back side of the speedometer unit with the 3, 3-digit displays and the electronics needed to drive them. It also shows the smaller front side which is driven from the same electronics. Three chips are needed for each 3-digit display and a single chip (alone in a fourth row of chips) is shared by the 3 displays. An 8-bit output shift register gets a 4-bit binary number for the ones digit and another 4-bit binary number for the tens digit of a given display. These two binary numbers each feed a separate decoder chip (74HC7447) which decides which of the 7 segments of the display must be lit to form the corresponding digit. The hundreds digit can only be a “1” or a “blank” so it can be controlled by a single bit which comes from the shared chip mentioned earlier. Each segment is a separate LED and requires its own load resistor which complicates the wiring.

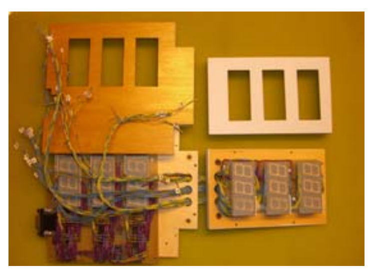


Photo above left shows about 45 wires already connected to the front set of displays and fed through the mounting block ready to be connected to the back side of the display with the electronics. The design of a proper sequence of mechanical assembly and wiring was an interesting puzzle to say the least.

Photo above right shows the back side of the completed unit with the covers in place. The slot between the two sides allows the unit to hang on the sky board. The front is painted sky blue so the unit will bend into the sky board. The back cover has two coats of polyurethane to match the back of the module. The only evidence of the electronics and wiring crammed inside is the 9-pin connector sticking out of the bottom of the unit.