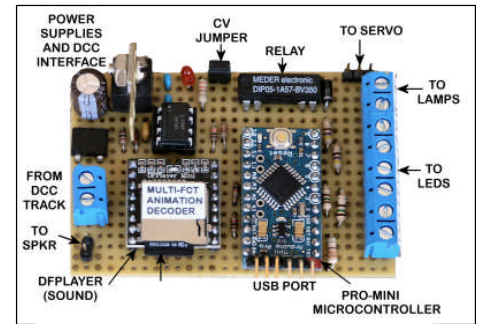OPERATING THE MULTI-FUNCTION ANIMATION DECODER (MFAD)

Previous documents described the construction and operation of the Multi-function Animation Decoder or MFAD. The DCC controlled device will processes DCC commands to animate lights, sound and motion in model railroad buildings and other layout features. Each MFAD device is assigned a DCC address just like a locomotive mobile decoder (not an accessory decoder). DCC Function commands (ON-OFF for F0 through F8) are sent to the decoder to perform assigned actions, e.g., turn lights on or off, play sounds, etc.

Multi-Function Animation Decoder

The DCC commands can be issued from DCC throttles for the applicable DCC system. If available, the computer driven JMRI system can also be used to generate the DCC function commands. JMRI scripts or buttons on Panel Pro panels could be used for this purpose.

For those modelers using the Digitrax DCC system, LocoNet commands generated from custom devices form a useful MFAD control system. The author has developed several microcontroller LocoNet capable devices to accomplish this type of control. These fall into two basic categories. The first relies on a handheld device such as an IR Remote control pad like a TV remote controller. A custom receiver is used to translate the handheld device buttons into LocoNet throttle commands.

The second category of controlling devices offers the opportunity to schedule a whole day of animated activities. This is the subject of the rest of this document.

MFAD DAY SCHEDULER

The MFAD Scheduler operates as an actual or fast clock representing the time of day on a layout. This time of day is displayed on a LCD screen in AM/PM format. Five push buttons are provided for:

- START - will start the Scheduler when first powering up, or resume after A STOP button.
- STOP -- pauses the simulated clock until START button is again pressed
- FASTER - increases the simulated clock speed up to 60X faster, (60:1)
- SLOWER - decreases the clock speed down to actual clock timing (1:1))
- RESET - resets the scheduler program to initial startup status

At startup and also when using the FASTER and SLOWER buttons, the currently set clock speed will be displayed on the LCD screen. A press of the START button begins operation at that displayed clock speed.

Selection of the Function commands (F0 - F8) for specific DCC addresses is matched in a script or schedule to the time of day. Time for activating the commands and addresses during the 24 hour period are stored on a SDHC Memory Card. The Scheduler operates from a script of time oriented commands where each command specifies a time, LocoNet address and the function ON/OFF change in status. When a LocoNet address is referenced, not previously used, the Scheduler program will acquire that address before issuing the function command. If on the other hand the address was used by the previous command the acquisition would be skipped and just the function command would be issued. The LocoNet address acquisition only takes place when a new address is referenced.

A PC program was developed to graphically create the time line and commands in the script. This PC program is described later in this document, however the script could also be developed using any PC text editing program such as

MS Notepad AS LONG AS THE PROPER FORMAT IS OBSERVED. Each line of the script must be in the form HH,MM,ADDR,F,C where HH is a two digit value for hours (in 24-hour format), MM is two digits for minutes, ADDR is a four digit LocoNet long DCC address, F is the function (0 - 8) and C is the command (1 for ON, 0 for OFF). For example 09,30,1000,3,1 would turn ON function 3 for LocoNet address 1000 at 9:30 in the morning.
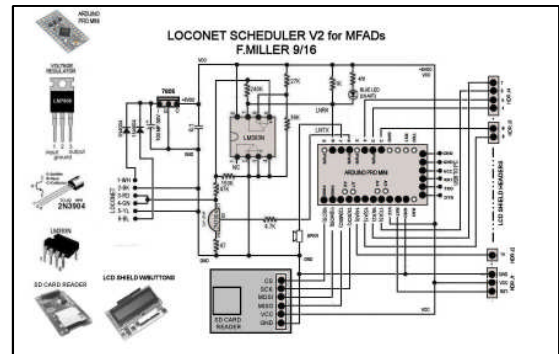
Special commands are used in the script to define the beginning and end of the day. The HH,MM,0000,0,0 command at the beginning of the script sets the beginning of the day, and the HH,MM,9999,9,9 at the end of the script sets the end of the simulated day and resets the clock (and script) back to the beginning of the day. Note that the beginning marker must be the first entry in the script and the ending marker must be the last entry. See the PC program description, below, for further script requirements.

If for some reason the LocoNet commands cannot be honored, the Scheduler device will emit an audible BEEP and the command will not executed. This might occur if LocoNet traffic is high. Note that if this happens while acquiring a LocoNet address (first command for that address) then this and all subsequent commands for this address will also be ignored and the device will beep for each.

BUILDING THE DAY SCHEDULER DEVICE

The Scheduler device is driven by a Mini Pro micro-controller which in turn uses


Day Scheduler Circuit Schematic

1. A SD Reader module to read the Schedule Script on the Micro SDHC card.
2. A LCD Display Shield to display the clock for time-of-day and the five push buttons referenced above to control the operation.
3. A LocoNet interface circuit to read and write LocoNet commands.

As is my usual procedure, the circuit (and program) for the device was first tested on a breadboard to ensure the design for the device was correct. An Arduino UNO board with Breadboard shield was used for most of the initial program development and testing. The program was then transferred to the Mini Pro on a breadboard for subsequent testing. The circuit was then transferred to a "building aid" drawing which laid out the actual components and their wiring connections. Using this "building aid" the actual circuit was built on a perf board and wired as defined by the flipped version of the "aid. It should be noted that the LCD Display shield 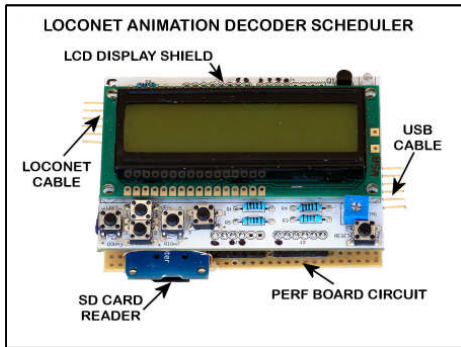has the usual Arduino style pin arrangements, so headers were added to the perf board to facilitate plugging the shield above the other perf
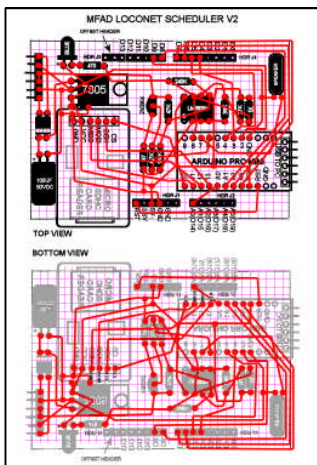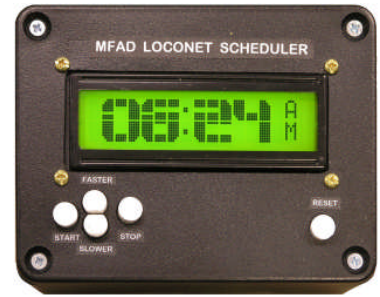

Wiring Aid
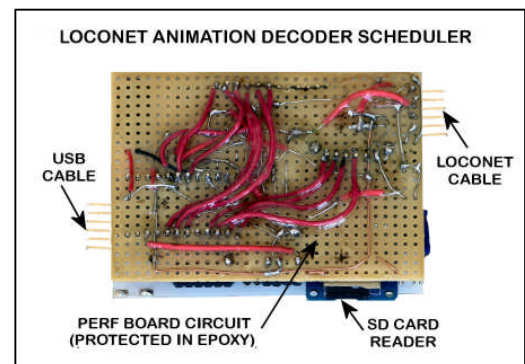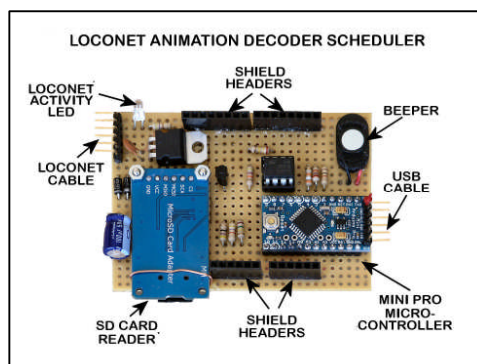
board circuitry.

After testing the assembled circuit board to confirm that the circuit was working as did the breadboard test version, a project box was prepared to house the circuit. The LocoNet cable plugs into the circuit board through an access hole in the box. Changing the SDHC card requires removal of the circuit from the box. Use of the USB programming connection (to modify the program) also requires removal from the box.

A parts list for the Scheduler Device is included in the appendix of this document.

SCRIPT DEVELOPMENT PROGRAM

A PC based program was developed to aid in the development of the Schedule scripts which are then loaded onto a SDHC flash memory card and subsequently read by the program in the Scheduler device. This PC program makes use of MS Excel software to graphically display the time and LocoNet function commands in a spreadsheet. (The PC running the Schedule development program MUST have MS Excel installed.)
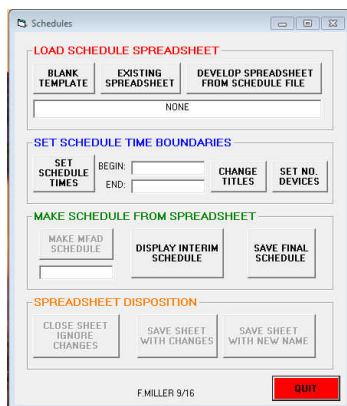
The PC program offers commands to (1) load a blank script template complete with time line and function columns for several LocoNet addresses, (2) find and load a previously developed Spreadsheet script, (3) Convert a previously developed script (in final SDHC card format) into a graphic representation in a spreadsheet.

A program command will enable setting the beginning and ending times for the script and show these on the graphic display. Additional commands are provided to change the titles for the devices and functions (which are for informational purposes only). When a script is loaded and displayed in the MS Excel spreadsheet, additional LocoNet script commands can be drawn on the display scale. A paste command into any of the cells (in the proper function and address column) will place a marker at that location. This marks the function ON TIME. An Excel copy-drag action down will fill in the period of time that that function will remain ON, and the last position of this "bar" marks the time for the function OFF command. Standard MS Excel commands can be used to erase or copy/move cell contents.

Note when using the blank script template, the LocoNet address for the applicable set of function columns must be entered into the cell immediately above the F0 column. The row of cells at the top of the sheet above the function row can be used to show the meaning of the function, e.g., "store lights". These entries are only for descriptive purposes and are not carried forward in the final SDHC format script.

An additional button labeled [SET NO. DEVICES] will modify the spreadsheet to only contain the specified number of devices. The size of the spreadsheet will be appropriately modified.
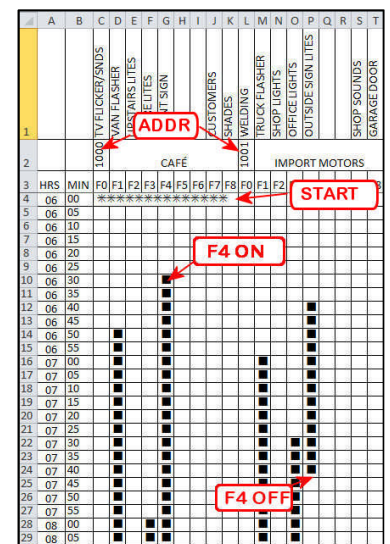
Sample Schedule in Graphic Form

As noted above, the program button labeled [CHANGE TITLES] provides the capability to change the LocoNet address, device name, and purpose of each function. These changes could be made directly on the spreadsheet but this program function makes it easier.

Clicking on the [MAKE SCHEDULE] program button will start an analysis of the graphically displayed script. There are several LocoNet timing considerations which must be observed and will be noted during the PC program error checking. Most significant errors deal with LocoNet commands (Function ON/OFF) placed too close to other commands. At least one empty clock tick (5 minutes shown in the graph) must be honored between LocoNet commands.

If the program completes a successful analysis and displays an "AVAILABLE" message, the script has now been converted into an INTERIM script format. Clicking on the [DISPLAY INTERIM SCHEDULE] program button will display the created script along with accompanying interpretative comments. This display can also be printed for future reference.
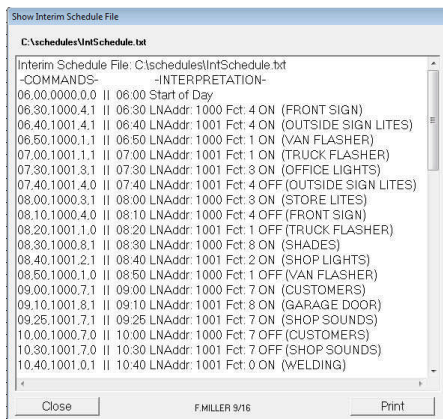

A click on the [SAVE FINAL SCHEDULE] provides the opportunity to save the schedule in final format to the SDHC card drive, or a folder of choice.

The program command buttons in the category "Spreadsheet Disposition" provide:

1. Close the spreadsheet without saving any changes
2. Close the spreadsheet and save with the same name but with changes made.
3. Close the spreadsheet and save with a new spreadsheet name (and location).

Summary

Multi-Function Animation Decoders (MFAD) are DCC devices used to operate lights, sounds and motion in model railroad buildings and other scenery features on a model railroad layout. The Scheduler Device is used to send LocoNet commands to operate the MFADs in a time-of-day schedule. A PC program is used as an aid to build the schedules which are loaded on a SDHC memory card for use by the Scheduler Device.

APPENDIX
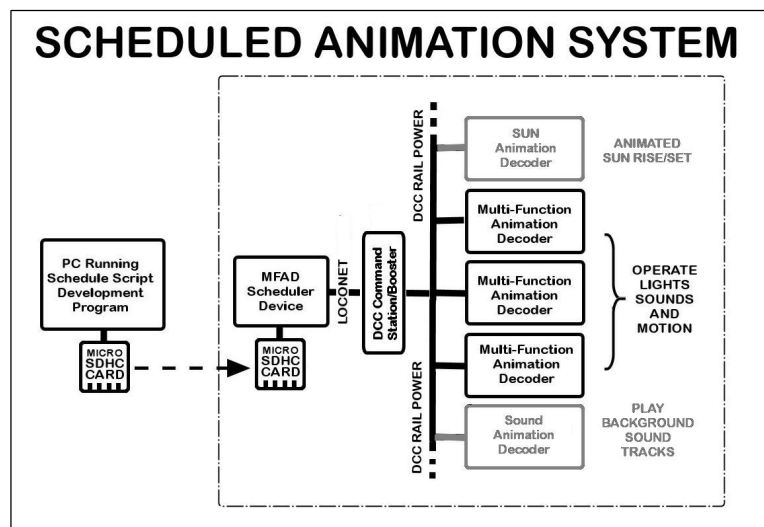
QTY	DESCRIPTION	SOURCE	PART #	COST	
	MFAD LOCONET SCHEDULER V2 - PARTS LIST				
2	1N4001 DIODE	JAMECO.COM	35975	$ 0.10	
1	7805 5V REGULATOR	JAMECO.COM	51262	$ 0.29	
1	T1 3MM BLUE LED	JAMECO.COM	2168421	$ 0.29	
1	240K OHM RESISTOR	JAMECO.COM	690718	$ 0.10	PKG 10
1	39K OHM RESISTOR	JAMECO.COM	691243	$ 0.10	PKG 10
1	1K OHM RESISTOR	JAMECO.COM	690865	$ 0.10	PKG 10
1	27K OHM RESISTOR	JAMECO.COM	691201	$ 0.10	PKG 10
1	470 OHM RESISTOR	JAMECO.COM	690785	$ 0.10	PKG 10
1	150K OHM RESISTOR	JAMECO.COM	691382	$ 0.10	PKG 10
1	47K OHM RESISTOR	JAMECO.COM	691260	$ 0.10	PKG 10
1	4.7K OHM RESISTOR	JAMECO.COM	691024	$ 0.10	PKG 10
1	47 OHM RESISTOR	JAMECO.COM	690540	$ 0.10	PKG 10
1	100UF 50V CAPACITOR	JAMECO.COM	10913	$ 0.85	
1	0.1 UF 25V DISK CAPACITOR	JAMECO.COM	151118	$ 0.15	PKG 10
1	8-PIN IC SOCKET	JAMECO.COM	112206	$ 0.25	
1	LM393	JAMECO.COM	2120647	$ 0.35	
1	2N3904	JAMECO	38359	$ 0.08	
1	PRO-MINI MICROCONTROLLER	ALIEXPRESSS.COM	-	$ 1.32	
1	16x2 LCD KEYPAD SHIELD	CUTEDIGI.COM	-	$ 8.60	
1	6 POS MALE HEAD	JAMECO	103393	$ 0.08	STRIP 10
1	SET SHIELD HEADERS	JAMECO	2137756	$ 1.95	
1	MICRO SD CARD READER	ALIEXPRESSS.COM	-	$ 0.79	
1	MISCELANEOUS HARDWARE AND LENGTH 6-POS LOCONET WIRE W/PLUG				
			TOTAL	$ 15.32	

The sketch (program) which runs in the Mini Pro micro-controller of the Scheduler device as well as the PC program used to create schedules using a graphic display, are each available from the author (tractionfan@aol.com) just for the asking and at no charge.