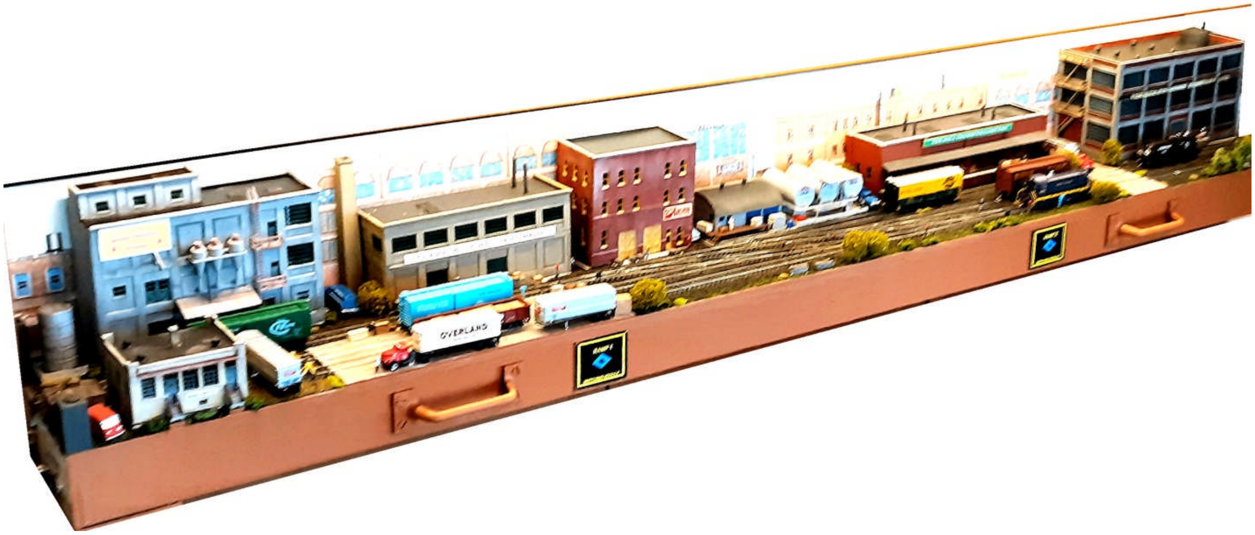
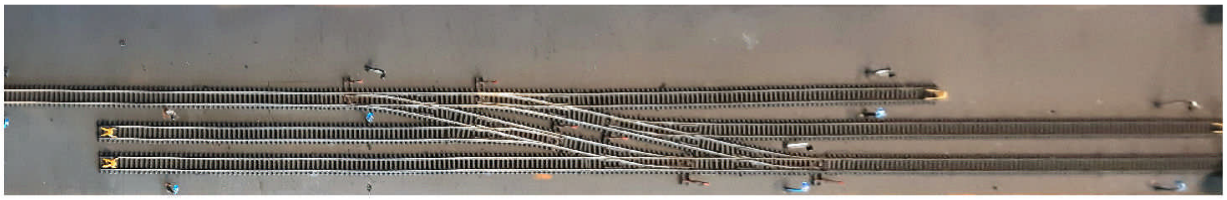
N-SCALE SWITCHING LAYOUT ANIMATION

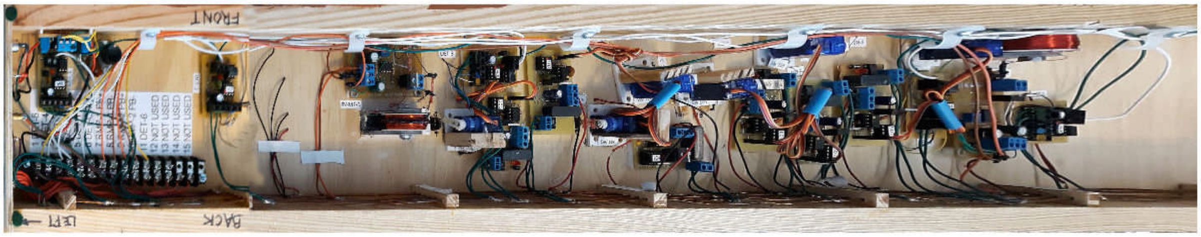
By F. Miller, MMR

The FOX HILL SWITCHING LAYOUT in N-Scale was developed as a fun project to demonstrate the capabilities of Arduino micro-controllers in animating Model Railroads. The layout is a complex of spurs suitable for a switching challenge not unlike the famous John Allen switching puzzle. This project, however, makes use of micro-controllers to actually operate the layout and switching activities. In fact, in total (2) Arduino Megas, (4) Arduino ProMinis and (15) AT-TINY85s are used to complete the automation.



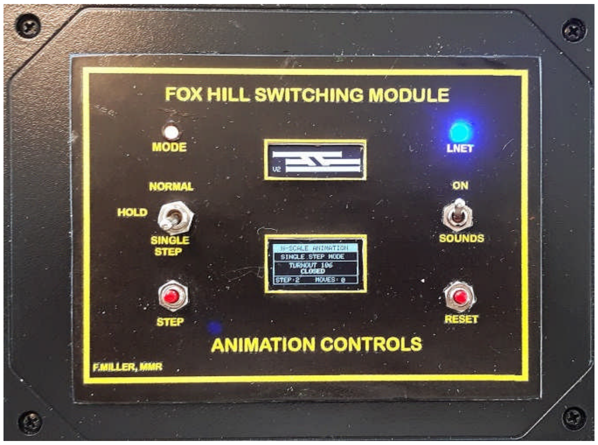
The layout is powered by DCC delivered through a DCC++ Base Unit (Arduino Mega). The turn-outs are controlled by DCC Command Activated Servo Switch Machines (ATTINY 85 Micro-Controller). Two electric Uncoupling Ramps are activated with ATTINY85 Micros & MOSFET Transistors. Six IR Detection circuits are activated with ATTINY 85 Micro-Controllers.





Separate articles describe the Turnout, Powered Uncoupling, IR Detection and DCC++ Command Station electronics. See References.

Animation Controls

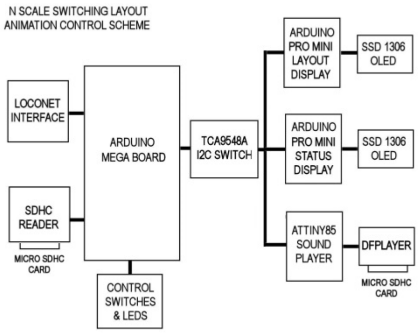


The Animation Controls use 'scripts' or schedules stored on a SDHC card. The script steps activate various activities. For example:

- Set Turnout positions to THROW or CLOSED
- Run a Locomotive Eastbound or Westbound at a selected speed.
- Stop the locomotive at a specific detection point
- Stop the locomotive after running for a specific time
- Run past detection points by a specified number of cars
- Perform an uncoupling action at specified Uncoupling Ramp
- Pause the script for a specified time delay.
- Repeat the script from the beginning.

The Animation Controls can operate each of the Script steps automatically in sequence, or do a single (next) step as commanded by a push-button.

The animation functions for the Switching Layout are performed by an Arduino Mega microcontroller and various other supporting toggle switches, pushbuttons, displays and other devices. A two color LED shows the operating mode (Hold/Normal/SingleStep) and one Display shows turnout positions and active detectors. Another display shows the Script Step, Number of 'moves' and details of the current animation step underway.



The Animation Controls box also has provision for audible narration of the current Script step, mimicking the text displayed.

The Animation Controls box is connecting to the DCC++ Base Station through a LocoNet cable. Control signals are received or passed to the layout through a DB15 cable.

The primary controls on the Animation Controls box include toggles for selecting an operating Mode and enabling Loco decoder sounds. Push buttons are used for Single Step cycling through the schedule and resetting the controls back to power up status. Display panels show the current turnout positions and the operating status and schedule steps underway. LEDs show operating Mode status and

Loconet activity. In addition voice narration indicates current schedule activity. A control knob is provided for setting the narration volume.

The 3-position Mode Select toggle determines the operational mode.

- Normal Ops (cycling through all steps of the schedule) – LED- mode indicator shows steady GREEN
- Hold Status (no schedule activity) - mode indicator shows alternate RED/GREEN blinking
- Single Step(each schedule step is activated, one at a time for each button press - mode indicator shows steady AMBER

The Single Step push button can also be used (when in Hold mode) to advance through the 'schedule' without executing the steps.

Once a 'schedule' is read from the micro SDHC card and activated the animation will step through each action and then repeat the schedule, unless the Mode switch is set back to Hold, in which case the schedule will terminate before restarting at the first step. If the Mode switch is set to Single Step, a press of the STEP pushbutton is required to move to each step in the schedule. The Mode LED will switch from AMBER to RED when a step has been completed and the controls are ready for another step (push button).

The Schedule

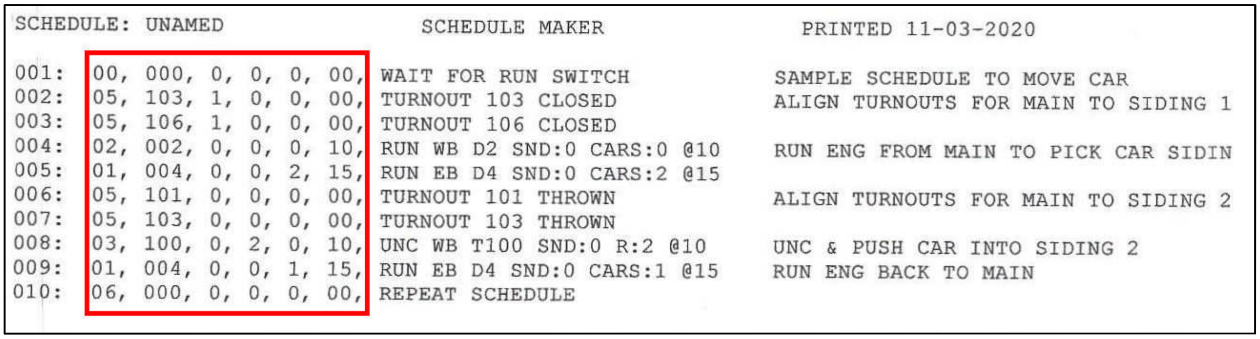
The schedule, stored on a micro SDHC memory card, makes use of five 'activities' and three additional control commands. The activities are:

- Run Loco Eastbound at specified speed to a specified IR Detector, or for a specified time.
- Run Loco Westbound at specified speed to a specified IR Detector, or for a specified time.
- Run Loco Eastbound as above, but performing an uncoupling action at uncoupling ramp 1
- Run Loco Westbound as above, but performing an uncoupling action at uncoupling ramp 2
- Set a specified Turnout to either THROW or CLOSE position.

The additional control commands are:

- Wait for the Mode switch to be set to Normal or Single Step. This is usually the first operating command of a Schedule.
- Repeat the Schedule. This is usually the last command in a schedule
- Pause operations for s specified amount of time.

A sample Schedule to move a car from Siding 3 the Siding 2 is shown below. The example contains lots of commentary but only the data shown within the RED box is actually stored on the MICRO SDHC card. Each line of the schedule contains the command code followed by 5 parameters



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SCHEDULE: UNAMED                  SCHEDULE MAKER                  PRINTED 11-03-2020

001: 00, 000, 0, 0, 0, 00, WAIT FOR RUN SWITCH             SAMPLE SCHEDULE TO MOVE CAR
002: 05, 103, 1, 0, 0, 00, TURNOUT 103 CLOSED              ALIGN TURNOUTS FOR MAIN TO SIDING 1
003: 05, 106, 1, 0, 0, 00, TURNOUT 106 CLOSED
004: 02, 002, 0, 0, 0, 10, RUN WB D2 SND:0 CARS:0 @10      RUN ENG FROM MAIN TO PICK CAR SIDIN
005: 01, 004, 0, 0, 2, 15, RUN EB D4 SND:0 CARS:2 @15
006: 05, 101, 0, 0, 0, 00, TURNOUT 101 THROWN              ALIGN TURNOUTS FOR MAIN TO SIDING 2
007: 05, 103, 0, 0, 0, 00, TURNOUT 103 THROWN
008: 03, 100, 0, 2, 0, 10, UNC WB T100 SND:0 R:2 @10       UNC & PUSH CAR INTO SIDING 2
009: 01, 004, 0, 0, 1, 15, RUN EB D4 SND:0 CARS:1 @15      RUN ENG BACK TO MAIN
010: 06, 000, 0, 0, 0, 00, REPEAT SCHEDULE
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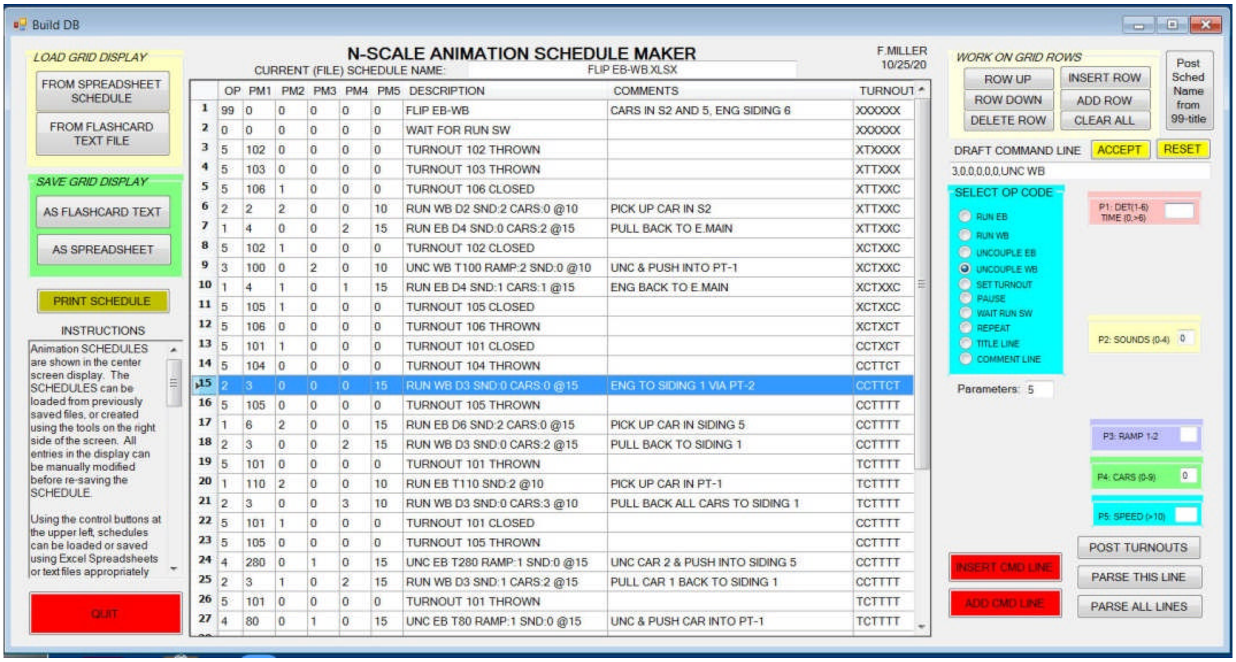
The script or schedule is a text formatted file with 16 characters per line. It could be developed with a simple PC program such as Notepad, but to make the process easier a custom PC program was written to develop schedules. It provides for easy insertion of schedule action steps with applicable parameters. The actions are automatically parsed for accuracy and narrative comments are added. The program also saves the step commands on a micro SDHC.



N-SCALE ANIMATION SCHEDULE MAKER

CURRENT (FILE) SCHEDULE NAME: FLIP EB-WB.XLSX

INSTRUCTIONS

Animation SCHEDULES are shown in the center screen display. The SCHEDULES can be loaded from previously saved files, or created using the tools on the right side of the screen. All entries in the display can be manually modified before re-saving the SCHEDULE.

Using the control buttons at the upper left, schedules can be loaded or saved using Excel Spreadsheets or text files appropriately

	OP	PM1	PM2	PM3	PM4	PM5	DESCRIPTION	COMMENTS	TURNOUT
1	99	0	0	0	0	0	FLIP EB-WB	CARS IN S2 AND 5, ENG SIDING 6	XXXXXX
2	0	0	0	0	0	0	WAIT FOR RUN SW		XXXXXX
3	5	102	0	0	0	0	TURNOUT 102 THROWN		XTXXXX
4	5	103	0	0	0	0	TURNOUT 103 THROWN		XTTXXX
5	5	106	1	0	0	0	TURNOUT 106 CLOSED		XTTXXC
6	2	2	2	0	0	10	RUN WB D2 SND:2 CARS:0 @10	PICK UP CAR IN S2	XTTXXC
7	1	4	0	0	2	15	RUN EB D4 SND:0 CARS:2 @15	PULL BACK TO E.MAIN	XTTXXC
8	5	102	1	0	0	0	TURNOUT 102 CLOSED		XCTXXC
9	3	100	0	2	0	10	UNC WB T100 RAMP:2 SND:0 @10	UNC & PUSH INTO PT-1	XCTXXC
10	1	4	1	0	1	15	RUN EB D4 SND:1 CARS:1 @15	ENG BACK TO E.MAIN	XCTXXC
11	5	105	1	0	0	0	TURNOUT 105 CLOSED		XCTXCC
12	5	106	0	0	0	0	TURNOUT 106 THROWN		XCTXCT
13	5	101	1	0	0	0	TURNOUT 101 CLOSED		CCTXCT
14	5	104	0	0	0	0	TURNOUT 104 THROWN		CCTTCT
15	2	3	0	0	0	15	RUN WB D3 SND:0 CARS:0 @15	ENG TO SIDING 1 VIA PT-2	CCTTCT
16	5	105	0	0	0	0	TURNOUT 105 THROWN		CCTTTT
17	1	6	2	0	0	15	RUN EB D6 SND:2 CARS:0 @15	PICK UP CAR IN SIDING 5	CCTTTT
18	2	3	0	0	2	15	RUN WB D3 SND:0 CARS:2 @15	PULL BACK TO SIDING 1	CCTTTT
19	5	101	0	0	0	0	TURNOUT 101 THROWN		TCTTTT
20	1	110	2	0	0	10	RUN EB T110 SND:2 @10	PICK UP CAR IN PT-1	TCTTTT
21	2	3	0	0	3	10	RUN WB D3 SND:0 CARS:3 @10	PULL BACK ALL CARS TO SIDING 1	TCTTTT
22	5	101	1	0	0	0	TURNOUT 101 CLOSED		CCTTTT
23	5	105	0	0	0	0	TURNOUT 105 THROWN		CCTTTT
24	4	280	0	1	0	15	UNC EB T280 RAMP:1 SND:0 @15	UNC CAR 2 & PUSH INTO SIDING 5	CCTTTT
25	2	3	1	0	2	15	RUN WB D3 SND:1 CARS:2 @15	PULL CAR 1 BACK TO SIDING 1	CCTTTT
26	5	101	0	0	0	0	TURNOUT 101 THROWN		TCTTTT
27	4	80	0	1	0	15	UNC EB T80 RAMP:1 SND:0 @15	UNC & PUSH CAR INTO PT-1	TCTTTT

DRAFT COMMAND LINE: 3,0,0,0,0,0,UNC WB

SELECT OP CODE
○ RUN EB
○ RUN WB
○ UNCOUPLE EB
● UNCOUPLE WB
○ SET TURNOUT
○ PAUSE
○ WAIT RUN SW
○ REPEAT
○ TITLE LINE
○ COMMENT LINE

Parameters: 5

P1: DET(1-6) TIME (0,>6):

P2: SOUNDS (0-4): 0

P3: RAMP 1-2:

P4: CARS (0-9): 0

P5: SPEED (>10):

<u>References</u>:

GITHUB Article/Code Repository:
https://github.com/tractionfan/ModelRailroadElectronics

YouTube Animation videos:
https://www.youtube.com/channel/UCIv51lCSYIGrCWe9xwvfAJg

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