Flexible Fast Clock (FFC)

Installation Guide

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LOGIC RAIL ™
TECHNOLOGIES

PMB #287 21175 Tomball Parkway Houston, TX 77070
Voice/Fax: (281) 251-5813
email: info@logicrailtech.com
http://www.logicrailtech.com

TABLE OF CONTENTS

Thank you for purchasing a Logic Rail Technologies product! Please read all instructions prior to Installing this board. CAUTION: The FFC master controller contains CMOS circuits that are very sensitive to electrostatic discharge. Store the FFC master controller board in its static protective bag until you are ready to install it. Avoid a build-up of static electricity and handle the board by its edges to minimize potential damage.

1 CONNECTION OVERVIEW

The FFC connections are summarized below:

AC	Power input (6.3V - 18V AC or DC)
G	Ground
RUN	Run/Stop input
FSET	Fast Set input
SSET	Slow Set input
RST	Reset input
SPD3	Speed up bit 3 alternate input
SPD2	Speed up bit 2 alternate input
SPD1	Speed up bit 1 alternate input
SPD0	Speed up bit 0 alternate input
EVENT 1	1-4 Event outputs

2 THEORY OF OPERATION

The Flexible Fast Clock master controller makes use of an intelligent microcontroller to keep precise fast time and provide control of external accessories at user-defined times (hereafter referred to as "events"). The master controller transmits time information to the Fast Clock Display Modules (FDMs) using a serial interface. Three signals from the master controller provide all the information for the FDMs. The serial interface makes use of differential wiring to allow for extremely long cable runs between the master controller and the FDMs (i.e. provides for very remote displays). Differential wiring means that there are two wires for each of the three serial interface signals. The other two wires in the 8 conductor modular cable carry the power for the FDM.

3 LOCATING AND MOUNTING THE FFC

The FFC is predrilled for mounting with #4 screws. Do NOT enlarge the holes; damage to the board will result. The FFC can be located in any convenient spot. If you think you will be adjusting the fast clock speedup using the dipswitch on the master controller board then you should locate the FFC in an easily accessible place. On the other hand you can use external switches (not provided) to control the speedup and thus locate the master controller anywhere (well almost anywhere - we do not recommend you locate it underwater or underground!).

4 POWER SUPPLY REQUIREMENTS

The FFC master controller has its own on-board rectifier, filter, and voltage regulator. Power (AC or DC) should be connected to the two screw-type terminals labelled AC. The two terminals are interchangeable (i.e. no polarity). The input voltage can range from 6.3V to 18V. Possible sources of power are the accessory terminals on your power pack, a plug-in wall transformer (e.g. Radio Shack #273-1652), or a surplus computer power supply. If you choose to use a wall transformer you should clip off the plug and strip the leads. These connections are illustrated in Figure 1. The required capacity of the power source can be determined by calculating the current draw of the master controller plus the current draw of the FDMs plus the current draw of any other connected

accessories. The master controller draws 85mA and each FDM draws 325mA. For example, a 1200 mA supply can handle the master controller and 3 FDMs (85mA + 3 x 325mA = 1060mA). Don't forget to factor in any other accessories you may be powering from the same power source. CAUTION: the master controller's voltage regulator (tall component with black heat sink) can get hot - try to avoid touching it! Our warranty does not cover burnt fingers!!!

5 CONNECTION TO THE FDMs

Nothing could be simpler! Just plug-in one end of the modular cable (included with each FDM) to either of the mating sockets on the back of the FDM board (labeled J4 & J5 on the front of the board). Plug the other end of the modular cable into any one of the mating sockets on the master controller. That's it! You're done!!! Refer to the FDM Installation instructions for details on using multiple FDMs.

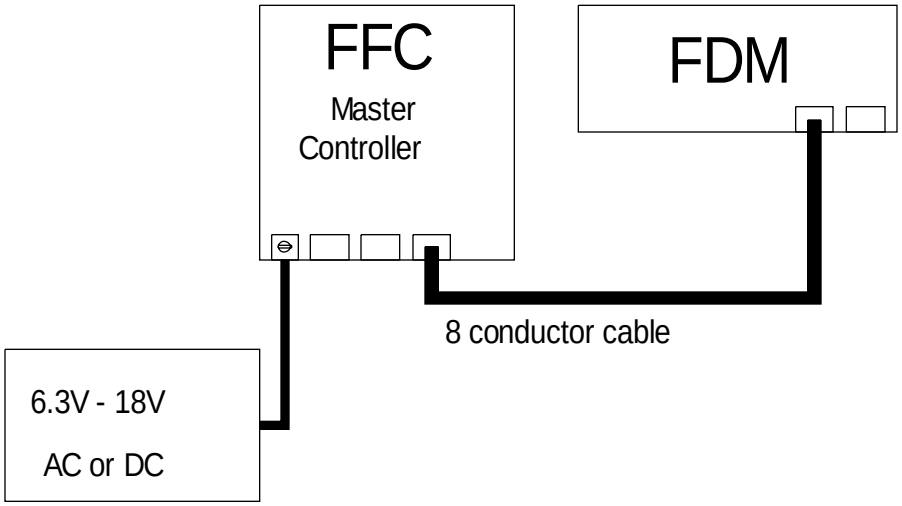

Figure 1

6 CONNECTION TO EXTERNAL CONTROLS

A minimum one external switch (not provided) is required to operate the FFC. This switch controls the Run/Stop function of the fast clock. We recommend using an SPST switch (toggle or slide) for this. If desired you can add switches for the Fast Set, Slow Set, and Reset functions. We recommend SPST momentary (normally open) switches for those functions. These switches are necessary if you want to change the time or utilize the program mode of the master controller to set the initial (power-up) time and the event control times. You may also add four SPST switches (non-momentary) for alternate control of the speedup. If you choose to do this, then you will need to have the on-board speedup switches in the off position. Figure 2 illustrates how the switches are wired to the FFC master controller.

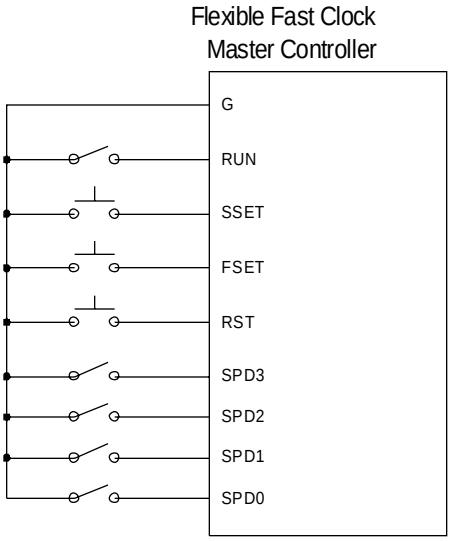

Figure 2

7 OPERATION

The first step in controlling the Fast Clock is to determine which speedup value you wish to operate with. There is no right or wrong fast clock speedup to use. It can vary from scale to scale and user to user. If you actually want to operate your railroad "by the clock", some points to keep in mind are:

1. the distance between stations or towns; the longer the distance, the lower the speedup can be.
2. switching time; it doesn't make sense to choose a high speedup if your switching crew is totally overwhelmed by the clock and they can't enjoy their work!
3. train speeds; the faster you run your trains, the faster you'll need to run the clock in order to make distances appear longer.
4. average operating session length; if you expect to complete an entire day's work in a three hour operating session, then you'd better choose a speedup of around 8.

For a detailed discussion of fast clocks and their usage consult the book How to Operate Your Model Railroad by Bruce A. Chubb. You may want to try operating your layout a few times with different speedups to assess which is most fitting.

The speedup is set by using the dipswitches on the master controller board or by using four external SPST switches as described above. The speedup switches will hereafter be referred to as SPD3 - SPD0. Speedup is set as shown in the following table. The Fast Clock must be in STOP mode (RUN input not connected to ground) to change the speedup. The speedup switches are also used to enter program mode.

Speedup	SPD3	SPD2	SPD1	SPD0
Program Mode	OFF	OFF	OFF	OFF
1:1	OFF	OFF	OFF	ON
2:1	OFF	OFF	ON	OFF
3:1	OFF	OFF	ON	ON
4:1	OFF	ON	OFF	OFF
5:1	OFF	ON	OFF	ON
6:1	OFF	ON	ON	OFF
7:1	OFF	ON	ON	ON
8:1	ON	OFF	OFF	OFF
9:1	ON	OFF	OFF	ON
10:1	ON	OFF	ON	OFF
11:1	ON	OFF	ON	ON
12:1	ON	ON	OFF	OFF
13:1	ON	ON	OFF	ON
14:1	ON	ON	ON	OFF
15:1	ON	ON	ON	ON

The following steps should be taken to set the clock. The example assumes you want to set the time to 8:30am.

1. Place the clock in STOP mode (disconnects the RUN input from ground)
2. Push down the FSET switch (grounds the FSET input)
3. Place the clock in RUN mode (grounds the RUN input); the time will rapidly change
4. Release the FSET switch (disconnects the FSET input from ground)
5. When the displayed time hits 8:00am, place the clock in STOP mode
6. Push down the SSET switch (grounds the SSET input)
7. Place the clock in RUN mode; the time will change slowly
8. Release the SSET switch (disconnects the SSET input from ground)
9. When the displayed time hits 8:30am, place the clock in STOP mode
10. Set the speedup to the desired value
11. Place the clock in RUN mode when ready!

The time can be reset to its programmed initial time (factory set at 12:00AM) at any time by momentarily connecting the RST input to ground. It is NOT necessary to be in STOP mode to reset the time.

8 EVENT CONTROL

One of the neat features of the FFC is Event Control. The master controller provides four event control outputs. Each output can be programmed for one of two modes. The first mode is to activate the output from a start time until an end time. This would most likely be used to control building or street lights on your layout. The second mode will activate the output for 2 seconds (real time) beginning at a start time. This would most likely be used to control an annunciator (bell, alarm, etc). Electrically these controls are open collector outputs capable of sinking up to 150mA each. An active event output will be about 0.8V. When inactive the output will act like an open circuit.

Figure 3 illustrates a variety of uses for the Event Control outputs. Each item controlled by the Event Control outputs will be referred to as a "load". As you can see from Figure 3 the loads can be LEDs, Grain-of-Wheat (GOW) lamps, relays, or even logic interfaces to other digital circuits. Each load must have it's own DC power supply (voltage rating dictated by the load). The ground of the load's power supply must be connected to the G terminal on the master controller as shown in Figure 3. IMPORTANT NOTE: do NOT use the same power supply to power the loads and the master controller/FDMs; damage to the circuits could result. If you choose to use a variety of load types (e.g. GOW lamps + relay + digital logic) simply tie all of the grounds from the power supplies together at a single point with the G terminal on the master controller. When using LEDs as loads you must use a current limiting resistor. For a 12VDC power supply we recommend a 470 ohm 1/2W resistor. You can use multiple loads (e.g. several GOW lamps) wired in parallel as shown as long as you do not exceed the 150mA limitation of the Event Control output. If the load you're using exceeds the 150mA capability of the Event Control output you will have to attach a relay to the Event Control output. The relay contacts should be rated such that it can handle the load you wish to control. GOW lamps typically draw upwards of 40mA, so you will most likely need to use a relay (e.g. Radio Shack #275-233, 12VDC power, 1 amp contacts) when controlling building or street lights. Don't forget to use the diode (1N4001 or Radio Shack #276-1101) when controlling relays. The diode prevents damage to the Event Control output when the relay switches.

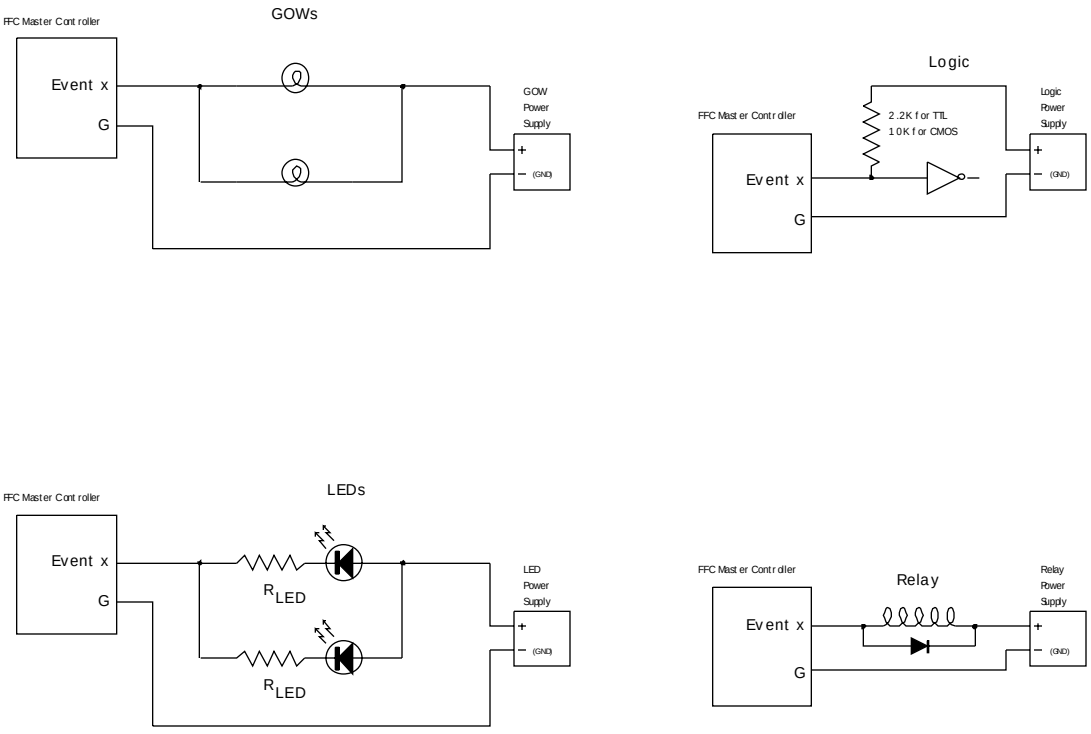

Figure 3

9 PROGRAMMING THE INITIAL TIME AND EVENT TIMES

The FFC master controller contains a special memory chip that retains it contents even when power is removed. This allows the master controller to remember the initial time (used when FFC powers up or when RST switch is activated) and the Event Control times. The factory default settings are as follows:

Initial Time:	12:00AM		
Event 1 Start Time:	12:00AM	Event 1 End Time:	6:00AM
Event 2 Start Time:	6:00AM	Event 2 End Time:	12:00PM
Event 3 Start Time:	12:00PM	Event 3 End Time:	12:00PM
Event 4 Start Time:	6:00PM	Event 4 End Time:	12:00AM

With this default setup the FFC will begin the "day" at 12:00AM with Event 1 turned on until 6:00AM. At 6:00AM Event 1 will turn off and Event 2 will turn on. At 12:00PM Event 2 will turn off and Event 3 will be pulsed for 2 seconds (real time!) since the Start and End times are the same. At 6:00PM Event 4 will turn on. At midnight Event 4 will turn off and Event 1 will turn on and the day will have begun again! If RST is activated at any point the time will reset to 12:00AM and all events will be turned off (in this example Event 1 will then immediately turn on). It's simple to change any of these times. First, you must put the master controller into program mode. Do this by first putting it in RUN mode. Then turn off all of the Speedup switches (SPD3 - SPD0). Then put the master controller in STOP mode. You will now see the letter "P" displayed on the FDM. You're now in program mode! In this mode the RST switch takes on new meaning. It functions as an "Enter" or "Accept" switch. When activated it means that you are done with the current parameter and are ready to proceed to the next one. The FDM will show the parameters in the following order:

1.	P :	program mode
2.	1 2 : 0 0	initial time (e.g. 12:00AM)
3.	S : 1	event 1 start time is next
4.	1.2 : 0 0	event 1 start time (e.g. 12:00AM)
5.	E : 1	event 1 end time is next
6.	.6 : 0 0	event 1 end time (e.g. 6:00AM)
7.	S : 2	event 2 start time is next
8.	6.: 0 0	event 2 start time (e.g. 6:00AM)
9.	E : 2	event 2 end time is next
10.	·1 2.: 0 0	event 2 end time (e.g. 12:00PM)
11.	S : 3	event 3 start time is next
12.	·1 2 : 0.0	event 3 start time (e.g. 12:00PM)
13.	E : 3	event 3 end time is next
14.	·1 2 : 0.0	event 3 end time (e.g. 12:00PM)
15.	S : 4	event 4 start time is next
16.	· 6 : 0 0.	event 4 start time (e.g. 6:00PM)
17.	E : 4	event 4 end time is next
18.	1 2 : 0 0.	event 4 end time (e.g. 12:00AM)

Each time the RST input is momentarily activated (pushed and released) the next parameter will be displayed. When programming the event start and end times you will notice that one of the decimal points is lit. That is a reminder as to which event you're programming (#1 is far left, #4 is far right). Each of the times (initial, event start, or event end) is set as described in the

OPERATION section above (steps 1 - 9). When you're satisfied with one time (whether you changed it or not) just momentarily activate the RST switch. The next item will then be displayed. There is nothing to change when you see " S : 1", etc. That just indicates which event time you're about to see. When you've finished programming all the events turn on any of the speedup switches in STOP mode and then activate the RST switch. You can also do this if you wish to exit program mode prior to stepping through all of the parameters.

10 COMPUTER INTERFACE

The FFC can be interfaced to an IBM-compatible personal computer (PC) using our FFC Programmer's Kit. This kit consists of a cable to connect the FFC to your PC's RS-232 serial port, user-friendly menu driven software, and a user's manual. While connected to the PC you can remotely control the FFC's speedup, run/stop mode, and time. You can also program the initial time and event times using the menu driven interface instead of the switches previously described. It is important to note that the PC is NOT required to operate your FFC. It merely provides another method of controlling and programming the FFC. Please refer to the FFC Programmer's Kit documentation for more details.

11 QUESTIONS

Please direct any questions about the use of this product in writing to Logic Rail Technologies. Include as much detail as possible about your usage (e.g. power supply voltage and current rating, number of FDMs, length of modular cables, loads controlled by the Event Control outputs). Comments and suggestions are always welcome.

12 LIMITED WARRANTY

This product is warranted to be free from defects in materials or workmanship for a period of one year from the date of purchase. Logic Rail Technologies reserves the right to repair or replace a defective product. The product must be returned to Logic Rail Technologies in satisfactory condition. This warranty covers all defects incurred during normal use of this product. This warranty is void under the following conditions:

1) If damage to the product results from mishandling or abuse.
2) If the product has been altered in any way (e.g. soldering).
3) If the current or voltage limitations of the product have been exceeded.

Requests for warranty service must include a dated proof of purchase, a written description of the problem, and return shipping and handling ($6.00 inside U.S./$10.00 outside U.S. - U.S. funds only). Except as written above, no other warranty or guarantee, either expressed or implied by any other person, firm or corporation, applies to this product.