# RR-CirKits
## Specializing in Affordable Electronics for Model Railroads

*Installation Guide*
*Revision-d*

# *Tower Controller Mark II*

## *LocoNet*
*64 line Input Output board*

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# Contents

# Overview

The Tower Controller Mark II LocoNet® interface provides a simple and easy way to connect between a LocoNet® bus and the layout. The Tower Controller Mark II may be connected at any convenient point on the LocoNet®

LocoNet® is a registered trademark of Digitrax. www.digitrax.com

*Tower Controller Mark II*
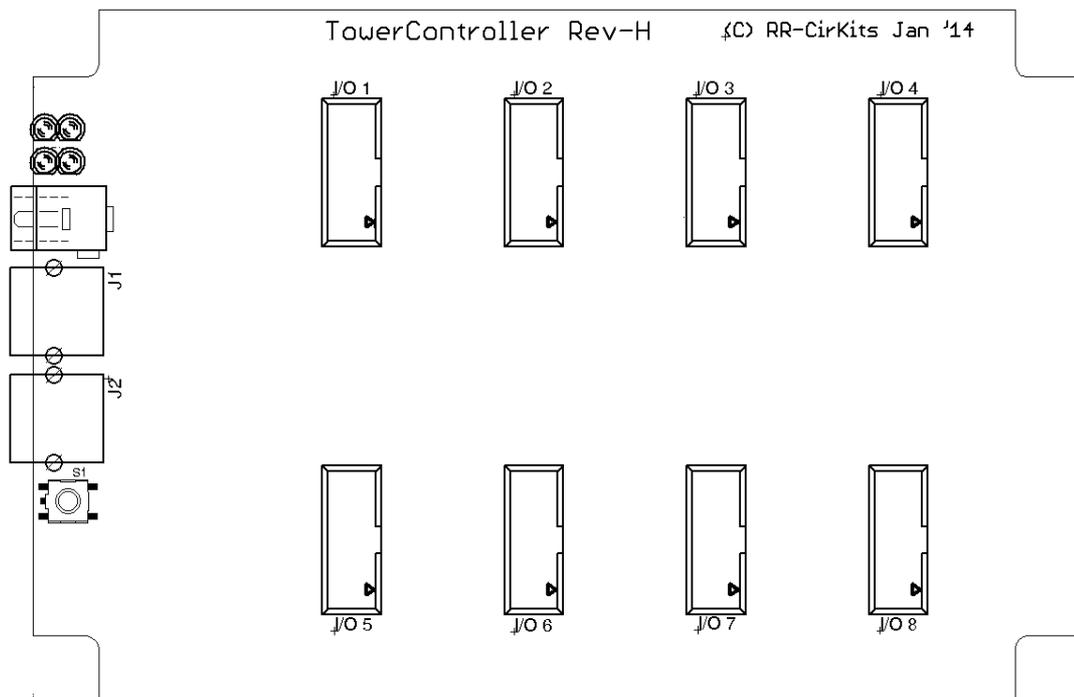
*Tower Controller Mark II Connectors*

# 1.0 Features

- Support for 64 Input/Output lines.
- Includes drive for any combination of:
- Up to 64 Input Lines.
- Up to 64 Output Lines.
- Communicates over the LocoNet® serial interface.
- Optically isolated from the LocoNet®.
- CV controlled programming via Software. (e.g. JMRI DecoderPro 3.4 or later.) Both reading and writing of CV values is supported in OPs mode over the LocoNet®.
- Lines may be configured as TC-64 compatible ports or as individual lines.
- Automatically saves input/output states during power down.
- Boot Loader allows firmware upgrades over the LocoNet®.
- Power is supplied by a coaxial jack. 9V-24V
- Efficient switcher regulated 5VDC available on port connectors to power I/O modules.

# 2.0 Getting Started

We suggest that you use a computer program such as the JMRI DecoderPro (3.10 or later) to setup the Tower Controller Mark II. The "point and click" interface will save you much time and frustration while setting the many possible options that you will need to configure.

**OPS Mode Address:** Each Tower Controller Mark II has a single address that is used for OPS mode programming on the layout. Each individual Tower Controller Mark II on your layout should have its own address.  Your Tower Controller comes pre-programmed with an address of 9999.

## 2.1 Create a Default Roster Entry as a template

Follow the following steps:

a) Open the '**OPs Mode Programmer'**
and select 'Roster' – 'Create Entry'.

b) Next Select **'RR-CirKits' - 'Tower Controller' - 'Mark II'** as the decoder type. Set the format: to 'Advanced' then Click 'Open Programmer'.
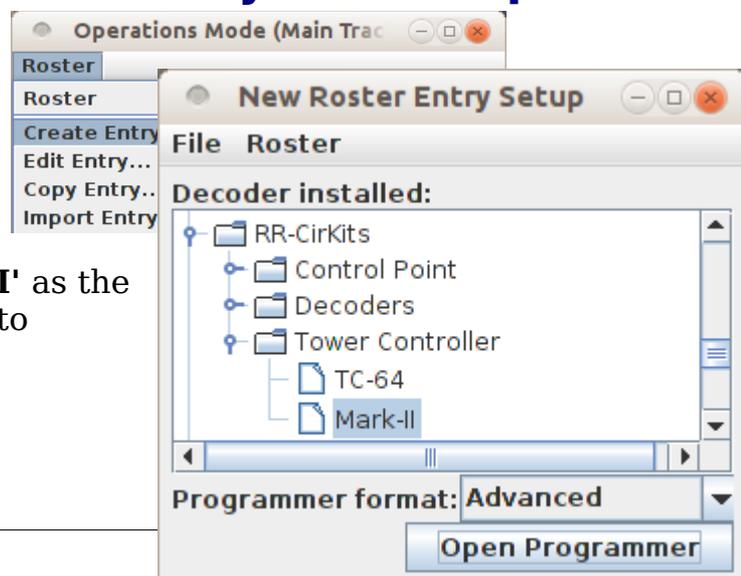
c) Once the Decoder File opens, go to the 'Basic' tab, check '4 digit addressing' and enter an address of '9999' in the 'Long Address' box.
d) Go to the 'Tower Controller Mark II' tab.
e) Set 'Master mode' as follows:
   • For use with a LocoNet® compatible command station select 'No'.
   • For use with any other, or no command station, select 'Enable'.



f) Go to the 'Roster Entry' tab, enter an ID (e.g. 'Tower Controller Mark II Default') and then click on the 'Save to Roster' button.
g) Close the new default decoder file. (template)

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**Tip**     At this point you are simply creating a default roster entry, not programming any device.

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## 2.2 Create a New Roster Entry for each Tower Controller Mark II

Follow the following steps:

a) Open the 'OPs Mode Programmer' and select 'Roster' – 'Copy Entry...'.
b) Select 'Tower Controller Mark II Default' as the original.
c) Enter a new roster id for each new Tower Controller Mark II.
d) Close each new entry by clicking on OK.



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**Tip**     At this point you are creating a new roster entry, but still not programming any device. Do NOT actually change the address from the 9999 default at this time.

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## 2.3 Edit the new Roster Entry and address the unit

a) This Ops mode address is only used to configure the Tower Controller Mark II. It has nothing to do with the addresses that each line will use to respond to input or output commands.
b) Connect the unit's LocoNet® bus to any point on your system's bus. The yellow command indicator will light each time the Tower Controller Mark II initiates or responds to a LocoNet® command.
c) Apply Power to the Tower Controller Mark II. The green power ON status indicator should illuminate.
d) Once the Tower Controller Mark II is operating, all actual configuration, including any changes to the address, must always be done with the JMRI 'Operations Mode Programmer'.
e) When a Tower Controller Mark II is powered up for the first time it will have a default address of 9999 to match the roster entry that you have just created from the 'Tower Controller Mark II Default' template.
f) If this Tower Controller Mark II has an unknown address, press and hold the hidden 'program' switch until the COM LED flashes slowly. This places the unit into address

9999 override mode and allows you to do individual CV changes to correct the address. This always allows you to take control of any Tower Controller Mark II and correct any setup errors. See section 6.3.

g) Any changed address will only take effect after the power has been cycled on the Tower Controller Mark II.

| | |
|---|---|
| **Tip** | JMRI DecoderPro will continue to use the address that it was first opened with until you have closed the roster file. This means that after any changes to the unit address you not only need to restart the Mark II, but also to close and re-open the decoder entry. |

h) The Tower Controller Mark II decoder file is large. You must use JMRI version 3.4 or later. (3.3.6 test or later) You also must not attempt to open two different programming windows at the same time. This may exceed the JMRI internal memory allocations available to your machine.

i) It is recommended that you give the Tower Controller Mark II a long address in the range of 10000-16383 to avoid potential conflicts with locos if your command station allows it. This address must not conflict with that of any Locomotives or any other devices in use on the layout, as no distinction is made between mobile and fixed decoders in OPS mode.

j) Change any other info you want to at this time, write all changes to the Tower Controller Mark II, then save them to the roster for future use.

k) If you have changed the unit address, then power cycle the Tower Controller Mark II and close the roster entry.

l) You should now be able to interface to your Railroad from your software and make changes using its assigned address.

| | |
|---|---|
| **Tip** | Remember, to modify, or restore an unknown address, you first place the unit into address 9999 override mode, then change the address by using a roster entry with address 9999 to read or program a new address. The address override mode is only in effect while the unit is in slow flash. This is NOT an address reset. |

| | |
|---|---|
| **Warning!** | A bug in JMRI causes 'Write changes on sheet' to occasionally fail to complete. Use 'Write full sheet' or go to the 'CV' tab and select 'Write changes on sheet' for better results. |

# 3.0 Power and Serial Connections

The Tower Controller Mark II (64 Line I/O Board) has 11 connectors and four status indicators. Two of these connectors are for connections to the LocoNet® bus. One is for the power jack, and the other eight are used as connections to the I/O lines. This section covers the system connections consisting of the serial port connectors, power connections and Status indicators.

## 3.1 LocoNet® Bus Connector

The serial port connection is made to the Tower Controller Mark II via the provided LocoNet® cable connected to either of the two RJ-12 (6 pin) modular LocoNet® jacks. The LocoNet® wiring passes straight through both connectors.

LocoNet® cables are wired straight through, not reversed like phone cables.

Pin outs for the RJ-12 connector:

| Pin | Description | Color |
|-----|-------------|-------|
| 1 | Rail_Sync- | white |
| 2 | Signal Ground | black |
| 3 | LocoNet- | red |
| 4 | LocoNet+ | green |
| 5 | Signal Ground | yellow |
| 6 | Rail_Sync+ | blue |

LocoNet® pins 2 and 5, and pins 3 and 4 are connected together internally.

## 3.2 Power Connections

The Tower Controller Mark II requires an external power source of between 9 and 25 volts DC or AC supplied to the coaxial power jack, and should provide 8VA or more. Multiply the output voltage times the rated current to get VA. For example a 12V 800ma. supply would provide 9.6VA and be a good choice. A 9V 300ma, supply would only provide 2.7VA and severely limit the output drive capability of the TC Mark II.

## 3.3 Status Indicators

The Tower Controller Mark II has four status indicators located near to the LocoNet® connectors. The lower green ON status indicator shows the power status of the Tower Controller Mark II itself. The upper green ON status indicator shows the power status of the LocoNet®. The yellow Com (command) indicator normally shows all data activity addressed to, or coming from, this specific Tower Controller Mark II, and also any activity/error status during a boot loader firmware upgrade. (see section 7.0) The red Act (activity) indicator shows all data activity on the LocoNet® itself.

LocoNet Power

Command

Power Jack            LocoNet Jacks

LocoNet Activity

TC Mark II Power
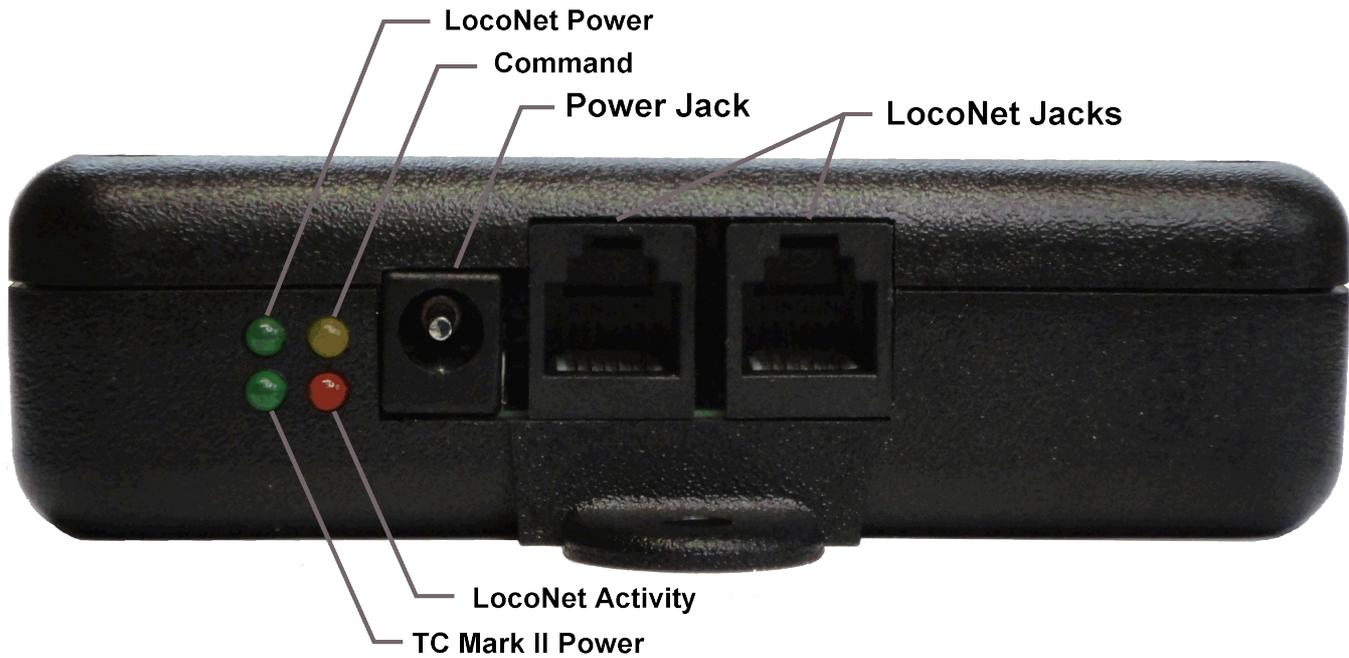
## 3.4 S1 Mode Selection Switch

The Tower Controller Mark II has an internal switch to place it into address override mode or program mode. Configuration is always done in OPs mode. (Programming on the main) Address 9999 override mode is used to allow you to change the units address if the current address is unknown. Hold the switch activated for more than 3 seconds. The yellow Com LED will start flashing slowly to indicate that the unit is in address 9999 mode. The units address may then be read out or changed by using a roster entry with address 9999.

If the button is held for more than 10 seconds then the yellow Com LED will come on steadily which indicates that the unit is ready to accept a firmware upgrade. See section 8.0 Boot Loader.

Press the button again or power cycle the unit to exit either mode.

# 4.0 Output Connections

We suggest that the user take advantage of JMRI DecoderPro or a similar program to set the Tower Controller Mark II configuration values, rather than attempting to use a hand held controller due to the large number of items to set, and the inability of a hand held to access 5 digit addresses. Current versions of DP also have the capability of setting groups of values with one selection.

## 4.1 I/O Ports

The Tower Controller Mark II has eight Input / Output ports for a total of 64 lines. The ports are normally configured as either all Inputs or all Outputs to be

compatible with the various RR-CirKits I/O modules. However each line may be individually set as either input or output for special purposes.

Any special effects may be applied differently for each line. E.g. one line may be held steady while another sends a pulse or is blinking.

## 4.2 Configuration

The following examples are using JMRI DecoderPro files for the Tower Controller Mark II.

To prevent any confusion the Tower Controller Mark II decoder file presents all input and output events in their common formats. For example LS9 is simply entered as 'Sensor Message 9' not 'unit #2, AuxA' or some such board oriented notation. This allows assigning any desired event to any line, no matter which board it is connected to.

### 4.2.1 Input-Output mode

The first selection seen on each line is its direction. Select the appropriate one. Normally a complete port will be assigned as either input or output lines, but this not required if your application allows. One example may be direct driving LEDs (with external resistors) and monitoring contacts in a control panel.
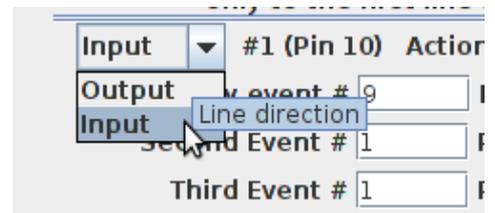
### 4.2.2 Context Sensitive Display

The Tower Controller Mark II decoder file attempts to show a context sensitive display of the options presented.
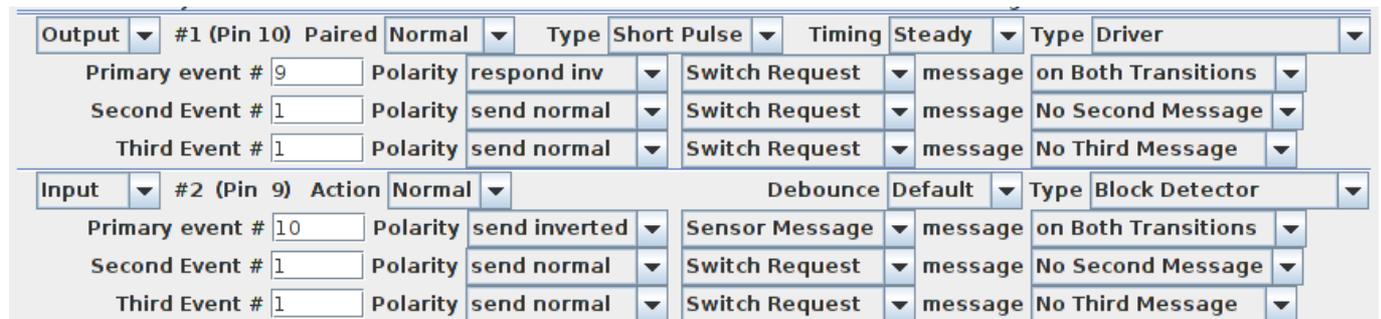
For example in the above snapshot I have selected line #1 as a 'Driver' and line #2 as a 'Block Detector'. (Note the '**Type**' selection box at the end of each row) The items displayed for the output line include its type (Pulse, Blink) and its timing values. A 'Short Pulse' with 'Steady' length is interpreted as a continuous output, not a pulse. In the same location in the 'Input' line we find the contact 'De-bounce' timing value. For example if your block detectors do not include built in noise suppression for dirty track you might use a long value here to compensate for that. Note that the default value is sufficient to de-bounce noisy mechanical contacts. The Tower Controller Mark II would not normally be used to drive signals, so the Signal mode is not made context sensitive.

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## 4.2.3 Composite Type
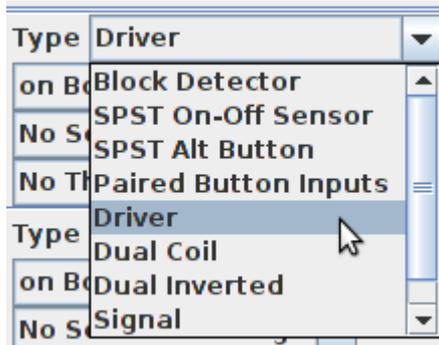
JMRI decoder files include the option of a combo box that presets multiple options at one time. In this example we see some of these pre-configured types available. If you make changes to individual settings then the 'Type' box may change to 'Custom' indicating that JMRI does not recognize the new configuration. 'Custom' does not mean that your configuration will not work for your purposes. For example using a longer pulse timing for a stubborn dual coil switch machines will work, but it will show as 'Custom' to serve as a warning against possible coil over heating.

- **Block Detector** – Many block detectors have a low output when occupied. The 'Block Detector' setting compensates for this by sending an inverted response.
- **SPST On-Off Sensor** – Sensors may be of either polarity, so this setting allows you to set either 'send normal' or 'send inverted' as the message type. If your block sensors do not have an inverted output, then use this option.
- **SPST Alt Button** – Sometimes a single button can be used to send alternating commands. One example would be when controlling a local turnout from the fascia. The operator can easily see the position, and press the button if it needs to be changed. To do this set the 'SPST Alt Button' option, which customizes the Tower Controller Mark II to send a 'Switch Request' Message'. This option only sends as the button is closed.
- **Paired Button Inputs** – When you need two buttons that send paired events, then this setting does the job. It reserves two lines and uses the event ID that you assign to the first line. Each button only sends when it is closed. One sends normal and the other sends inverted outputs. It may be customized to send 'Switch Request' messages to directly control turnouts.
- **Driver** – This option is used with simple outputs such as stall motor drivers, relays, or direct drive lamps. It normally responds to 'Switch Request' messages. It may be customized to respond to sensors, for example to light occupancy lamps that follow block sensors. It also may respond to either the normal or inverted commands.
- **Dual Coil** – This specialized output option pairs lines and sends a short pulse as an output, closed on one, and thrown on the other. Of course the Tower Controller Mark II does not have enough power to drive the coils of a turnout motor, so a board such as the SCSD-8 needs to be used to actually power the coils. As in other paired options, just the event ID entered in the first option box is used. Any event entered in the second line of the pair is ignored.
- **Dual Inverted** – This is simply an easy way to reverse the direction of the Dual Coil option without crawling under the layout.
- **Signal** – The signal option also pairs output lines. It also changes the interpretation of the two primary events to emulate the Digitrax SE8c behavior. For most users the better option would be to use a SignalMan. However for driving 4ASD-4 or SDB-4 boards this option does the job. Also it is possible to connect the SMD-8 board with TAB-3 options to drive Semaphore signals with Tortoise actuators.

## 4.3 Tower Controller Mark II Secondary Messages

In these examples there are no second or third messages being sent. However additional messages may be sent if desired, for example to activate a 'Next' turnout whenever the 'first' is sent in order to sequence a yard ladder. These additional messages, if enabled, are sent whenever the primary event occurs. Another simple example would be to allow two or even three different messages to be sent when a single button is pressed. A bit more complex use would be to send one message when a button or sensor is activated, and to send a different message when it is released. If a secondary message is configured as 'respond norm' or 'respond inv' then the selected event will control the output just as the primary event does. For example a single event could be master reset for many turnouts.

## 4.4 Port Electrical

The maximum current draw by user devices such as LEDs should not exceed 15ma. at 5VDC per output line. The maximum current draw from any individual port, including data lines and the 5V supply line is 200ma. The total current per Tower Controller Mark II is limited to 1 amp. The Tower Controller Mark II includes an internal 1A switching power supply and internal auto reset fuses to protect against long term overloads that exceed these values. **If you need to drive more voltage and/or current, then you will need to use an external I/O module powered from its own source.**

### 4.4.1 Tower Controller Mark II I/O Connector Wiring

The two port connector's wiring is as follows. Note that the pin numbers and I/O line numbers are NOT the same, and actually run opposite to each other.

| Pin number | Connection name |
|:----------:|:---------------:|
| 1 | line 8 |
| 2 | line 7 |
| 3 | line 6 |
| 4 | line 5 |
| 5 | Ground |
| 6 | +5VDC |
| 7 | line 4 |
| 8 | line 3 |
| 9 | line 2 |
| 10 | line 1 |
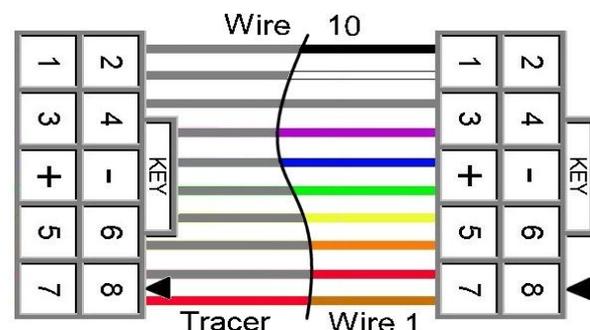


10 position IDC cable

## 5.0 Tower Controller Mark II compatible Input/Output Cards

The RR-CirKits Tower Controller Mark II and its compatible I/O modules are designed to be clipped into Tyco 3-1/4" Snap-Track® mounted to the bench work. (Snap-Track®  is a plastic channel designed to mount PC cards to a chassis, not something to run trains on.)

Each I/O module is equipped with two connectors to facilitate these connections. A single Tower Controller Mark II or compatible I/O module fits into the 3TK2-1

(single) mounting track. Other widths are available for compact installations using multiple boards.

## 5.1 BOD-8 (DCC Block Occupancy Detector - 8 block)
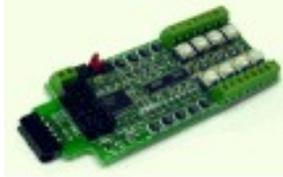
The BOD-8 does not expect you to re-wire your layout to bring track feeders to the detector cards. The small CT (Current Transformer) detection coils are placed directly on the track feeders where they belong. Simple lengths of Cat-5 cable are the usual way to run the signals back to the detector boards.  Use of CT coils means that there are no track voltage losses associated with the detectors. Normal detection levels are 1ma. but may be adjusted to higher levels with on board pots.

During a DCC bus power failure the Power-Lok input on the BOD-8 instantly locks the current state of each block detector. I.e. the state of the layout does NOT change during a DCC power outage, neither to all occupied, nor to all vacant. It just suspends sending any occupancy changes until after power is restored and things have stabilized again. If you do not want the feature there is a jumper to disable it.

The BOD-8 outputs are low during detection so the Tower Controller Mark II should be configured as "Block Detector" for each line of a port that is connected to a BOD-8. This inverts the input lines to match the BOD-8 and most types of detector outputs.

| Input ▾ | #1 (Pin 10) Action Normal ▾ | Debounce Default ▾ | Type Block Detector ▾ |
|---|---|---|---|
| Primary event # 201 | Polarity send inverted ▾ | Sensor Message ▾ | message on Both Transitions ▾ |

## 5.2 OIB-8 (Opto Isolator Board - 8 input)

This 8 input board is used when a non-isolated source of voltage needs to be monitored and input to the Tower Controller Mark II. One example would be to monitor the DCC voltage on a set of points to determine the position of a turnout without using auxiliary contacts.

This board may be configured to monitor the absence or presence of an AC or DC signal. It may also be configured to monitor the polarity of a DC signal. This board requires 10ma. for reliable operation and includes pads for the customer supplied dropping resistors.

The line 'Type' should be set to 'SPST On-Off Sensor' and may be either polarity.

| Input ▾ | #1 (Pin 10) Action Normal ▾ | Debounce Default ▾ | Type SPST On-Off Sensor ▾ |
|---|---|---|---|
| Primary event # 201 | Polarity send normal ▾ | Sensor Message ▾ | message on Both Transitions ▾ |

## 5.3 SCSD-8 (Single Coil Solenoid Driver)

The SCSD-8 Output Module is designed to drive individual solenoid coils or other high voltage high power devices. Normally the input voltage should not exceed 35VDC. The SCSD-8 board is optically isolated from the driving circuitry to protect the Tower Controller Mark II or other control device from the high power outputs. When driving single coils or high power loads configure the 'Type' as 'Driver'.

| Output ▼ | #1 (Pin 10) Paired | Normal ▼ | Type | Short Pulse ▼ | Timing | Steady ▼ | Type | Driver | ▼ |
|---|---|---|---|---|---|---|---|---|---|
| Primary event # | 9 | Polarity | respond inv | ▼ | Switch Request | ▼ | message | on Both Transitions | ▼ |

By using the proper options on the Tower Controller Mark II the SCSD-8 may also be used to control dual coil momentary switch machines. In 'Dual Coil' mode the output lines are paired such that the lines requires just single addresses. Setting the Port 'Direction' to 'Output' and the Port 'Toggle' bit to 'Paired' places the port into paired mode. Each line of a pair normally responds to either 'Closed' or 'Thrown' with the output action selected for each line. This action will normally be a 0.1 second pulse when driving solenoids.

| Output ▼ | #1 (Pin 10) Paired | Paired ▼ | Type | Short Pulse ▼ | Timing | 0.1 sec ▼ | Type | Dual Coil | ▼ |
|---|---|---|---|---|---|---|---|---|---|
| Primary event # | 9 | Polarity | respond norm ▼ | | Switch Request | ▼ | message | on Both Transitions | ▼ |
| Second Event # | 1 | Polarity | send normal ▼ | | Switch Request | ▼ | message | No Second Message | ▼ |
| Third Event # | 1 | Polarity | send normal ▼ | | Switch Request | ▼ | message | No Third Message | ▼ |
| Output ▼ | #2 (Pin 9) Paired | Paired ▼ | Type | Short Pulse ▼ | Timing | 0.1 sec ▼ | Type | Dual Coil | ▼ |
| Primary event # | 10 | Polarity | respond inv ▼ | | Switch Request | ▼ | message | on Both Transitions | ▼ |
| Second Event # | 1 | Polarity | send normal ▼ | | Switch Request | ▼ | message | No Second Message | ▼ |
| Third Event # | 1 | Polarity | send normal ▼ | | Switch Request | ▼ | message | No Third Message | ▼ |

The lines are paired and only the primary event of the first line of each pair will be used. In this example 'LT9 closed' and 'LT9 Thrown' will be used. LT10 is ignored.

Dual coil operation should not be attempted if the switch machine power supply is not of the capacitive discharge type that will limit the long term current to a low value in case of hardware or configuration errors.

**Failure to observe this precaution may result in destruction of equipment and be a fire hazard!**

## 5.4 4ASD-4 (4 Aspect Signal Driver - 4 head)
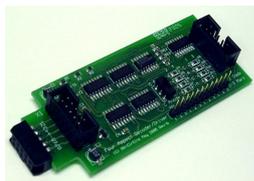
This output board drives up to 4 four aspect signal heads with 9VDC. The outputs are multiplexed to allow 4 heads on a single 10 wire flat ribbon cable. LED current dropping resistors are included on the board allowing the signals to be directly attached to the cables without purchasing any extra hardware for each signal. To control the fourth aspect two CV's are required and "signal" mode must be enabled:

1st, 3rd, 5th and 7th lines: this 'Timing' byte controls the timing of the flashing aspect;

2nd, 4th, 6th and 8th lines: this 'Timing' byte selects the two alternating aspect colors.

| Output ▼ | #5 (Pin 4) Paired | Signal ▼ | Type | Short Blink ▼ | Timing | Steady ▼ | Type | Signal | ▼ |
|---|---|---|---|---|---|---|---|---|---|
| Primary event # | 5 | Polarity | respond inv ▼ | Switch Request | ▼ | message | on Both Transitions | ▼ |
| Second Event # | 1 | Polarity | send normal ▼ | Switch Request | ▼ | message | No Second Message | ▼ |
| Third Event # | 1 | Polarity | send normal ▼ | Switch Request | ▼ | message | No Third Message | ▼ |
| Output ▼ | #6 (Pin 3) Paired | Signal ▼ | Type | Short Blink ▼ | Timing | 8 sec ▼ | Type | Signal | ▼ |
| Primary event # | 6 | Polarity | respond inv ▼ | Switch Request | ▼ | message | on Both Transitions | ▼ |
| Second Event # | 1 | Polarity | send normal ▼ | Switch Request | ▼ | message | No Second Message | ▼ |
| Third Event # | 1 | Polarity | send normal ▼ | Switch Request | ▼ | message | No Third Message | ▼ |

Normally the 4th aspect will be set to 'dark' and the JMRI software will blink the signal if a flashing mode is required by sending alternate 'dark' and 'color' commands. Select 'SE8c 4 Aspect' as the JMRI signal type for this application. It is also possible to allow the Tower Controller Mark II to directly flash the signals in the 4th aspect selection. The selection of 'LDT LS-DEC' as the signal type will make this easier to configure.

The user should consider the use of the newer SignalMan instead of the 4ASD-4 because it includes superior options at a similar per head cost.

## 5.5 SDB-4 (4 Aspect Searchlight Signal Driver - 4 head)

The user should consider the use of the newer SignalMan instead of the SDB-4 because it has improved options and a better per head cost.

## 5.6 SMD-8 (Stall Motor Driver – 8 line)

The SMD-8 board contains 8 individual, optically isolated, H-Bridge drivers. This allows the board to be powered from any supply between 9 Volts and 18 Volts. It is primarily designed to drive stall motor turnout machines such as those found in Tortoise® and Switchcraft® machines . Do not exceed 15VAC or 24VDC at the power input.

This board includes an adjustable regulator to allow you to control the speed of your switch machine motors. This regulator will draw 100ma. plus your load current, and the board normally runs warm even with no load.

| Output ▼ | #7 (Pin 2) Paired | Normal ▼ | Type | Short Pulse ▼ | Timing | Steady ▼ | Type | Driver | ▼ |
|---|---|---|---|---|---|---|---|---|---|
| Primary event # | 7 | Polarity | respond inv ▼ | Switch Request | ▼ | message | on Both Transitions | ▼ |

'Driver' is the proper option for this board. It may be set to 'respond normal' or 'respond inverted' to control the direction of the turnout in relation to 'closed' and 'thrown'.

## 5.7 DCDB-8 (Direct Current Driver Board - 8 line)

The DCDB-8 driver board contains 8 individual, optically isolated, H-Bridge drivers. This allows the board outputs to be powered from any supply between 8 Volts and 28Volts. It is primarily designed to drive small DC motors. Do not exceed 24VAC or 36VDC at the power input. This board includes an on-board 5V switching regulator to allow safe operation at high voltages. The regulator will draw 50-100ma. plus your load current, and normally runs warm even with no load.

The DCDB-8 drivers include clamp diodes and may be used to directly drive inductive loads such as relay or solenoid coils if desired. The outputs are wired in an "H" bridge configuration but may be used single ended. Both positive and negative common return points are provided for single ended operation.

The DCDB-8 outputs are rated at 600ma. per line, not to exceed 1.2A peak for 100µs non repetitive. The board includes an auto reset fuse that will prevent extended operation in excess of 1A total continuous output current per board, but it will NOT protect it from from direct short circuit currents. Short circuits on any output line may destroy the board, so be careful with your wiring.

| Output ▼ | #7 (Pin 2) Paired | Normal ▼ | Type | Short Pulse ▼ | Timing | Steady ▼ | Type | Driver ▼ |
|---|---|---|---|---|---|---|---|---|
| Primary event # | 7 | Polarity | respond inv ▼ | Switch Request ▼ | message | on Both Transitions ▼ | | |

The DCDB-8 input lines  are active low so all lines on this Tower Controller Mark II port should be configured as "Driver". This inverted input mode matches most types of driver outputs, and the drive polarity may be easily switched either in the Tower Controller Mark II setup or by reversing the DCDB-8 output lines.

## 5.8 RB-4 (Relay Board - 4 x SPDT)

Relay Board - 4 is a Quad 10A SPDT relay board with logic level drivers. It is suitable for use with Tower Controller Mark II, TC-64, LNCP, or other logic output devices. It requires 12V auxiliary power to drive the relay coils. Auxiliary power is optically isolated from the logic inputs for double isolation. LED indicators for each relay make it easy to monitor activity.

In some cases it may be suitable to use the 12V SSB power to supply the RB-2 relays, but be sure that you do not exceed the available current on the SSB line. Each RB-4 may draw up to 150ma. at 12VDC.

Includes dual ribbon connectors with offset lines to allow easy connection as output 1-4, or output 5-8, of the Tower Controller Mark II, or other driver.

| Output ▼ | #7 (Pin 2) Paired | Normal ▼ | Type | Short Pulse ▼ | Timing | Steady ▼ | Type | Driver ▼ |
|---|---|---|---|---|---|---|---|---|
| Primary event # | 7 | Polarity | respond inv ▼ | Switch Request ▼ | message | on Both Transitions ▼ | | |
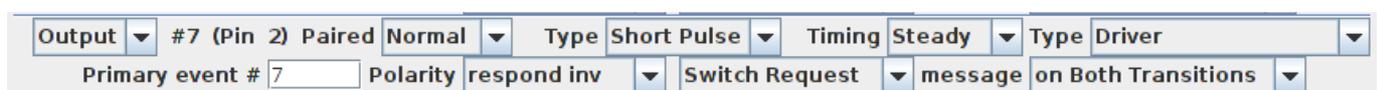
The RB-4 input lines  are active low so all lines on this Tower Controller Mark II

port should be configured as "Driver". This inverted input mode matches most types of driver outputs, and the drive polarity may be easily switched either in the Tower Controller Mark II setup or by reversing the RB-4 output contacts.

## 5.9 FOB-A (Fan Out Board)
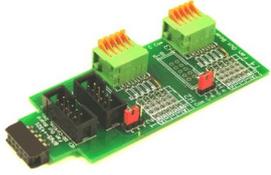
This board is a convenient way to convert from 10 pin ribbon cable to compression terminals. It may be used for inputs or outputs, and includes pads for mounting resistors such as required for connecting LEDs used for direct drive signals or panels.



| Input ▼ | #1 (Pin 10) Action Normal ▼ | Debounce Default ▼ | Type SPST On-Off Sensor ▼ |
| Primary event # 201 | Polarity send normal ▼ | Sensor Message ▼ | message on Both Transitions ▼ |

'SPST On-Off Sensor' is the usual setting for the FOB-A used for input lines. For input lines jumper wires will need to be installed for each line. Do not exceed 5V on any input or the Tower Controller Mark II will be damaged.

| Output ▼ | #7 (Pin 2) Paired Normal ▼ | Type Short Pulse ▼ | Timing Steady ▼ | Type Driver ▼ |
| Primary event # 7 | Polarity respond inv ▼ | Switch Request ▼ | message on Both Transitions ▼ |

'Driver' is the proper output option for this board. It may be set to 'respond normal' or 'respond inverted' to control the polarity of the output in relation to 'closed' and 'thrown'.

## 5.10 I/O Test (Input Output Test Board)

This board is a convenient way to test a port. It may be used for testing inputs or outputs, and includes 8 LEDs and 8 push buttons. The LEDs light when each output is low. The push buttons pull the inputs low. Both male and female I/O connectors make it easy to add in series with another cable.



# 6.0 Trouble shooting

## 6.1 Sanity Test

To perform a very basic Tower Controller Mark II sanity test perform the following steps:

1. Power up the Tower Controller by plugging it into the computer.
2. The lower green power LED should come on.
3. Plug in the LocoNet® cable. The upper green power LED should light.
4. Unplug the LocoNet® cable. The red activity light should blink briefly as the

cable is removed.

5. Using a paper clip, press the "Program" switch located under the small hole labeled "Program" for 3 seconds. The yellow "Command" LED should begin to flash indicating that the Tower Controller Mark II has entered Service Mode and is waiting for an address change. Press the switch again briefly and the LED should extinguish.

If the green power LED does not light, be sure that a power supply is connected to the power jack, and provides at least 11V to the Tower Controller Mark II. The Tower Controller Mark II includes internal power monitoring circuits, and will not restart operation until the supply voltage stabilizes at higher than 10VDC. The green power LED will initially light at much lower voltages, so it is not a reliable indicator of suitable power.

## 6.2 Activity Test

The Tower Controller Mark II's input circuit and code sends data directly to the unit's processor, so if you send any command to the unit it should immediately be seen on the command (COM) LED. This test uses the free software available from the JMRI project to watch the test commands. (www.jmri.org)

Steps:

• Open the JMRI LocoNet® Monitor window. Using the turnout control send a command to any output line on this Tower Controller Mark II. The command should appear in the LocoNet® monitor window and the Tower Controller Mark II command (Y) LED should blink.

• The connected output should respond.

If there is activity at the LocoBuffer-USB red LED, but no activity light at the Tower Controller Mark II when switch commands are sent, check the Simple Serial Bus wiring. If the command is seen in the LocoNet® monitor, but not in the command light, be sure that the command you are sending is addressed to respond on this Tower Controller Mark II. If there is no activity shown in the LocoNet® monitor window, check that you have the correct interface selected in the JMRI preferences, and that you have the correct COM port selected.

## 6.3 Address Override

If the Tower Controller Mark II's address settings are forgotten, the unit may be temporarily returned to its factory default address of 9999 by depressing the 'Program' switch for 3 seconds. The unit will flash the yellow Com light while it is in this address override mode. You may then read or change settings to correct any problems using a roster with address 9999.

Steps:

1. Using a paper clip, press the "Program" switch located under the small hole labeled "Program" for 3 seconds. The yellow "Command" LED should begin to flash indicating that the Tower Controller Mark is temporarily in Address override Mode.

2. Open DecoderPro (3.10 or later) and select 'Ops Mode'. (main track) Select

RR-CirKits – Tower Controller Mark II as the decoder and be sure it is addressed at 9999, or else use the TC Mark II default roster entry from your initial setup.

3. Read out and/or Restore the proper address for this unit using the "Basic" tab, then switch to the "CVs" tab and write just CV17 and CV18 if you have changed it.
4. Simply close the roster entry without saving it if it is your 9999 default entry.
5. If you did change the address, then be sure to save it to a new roster entry, close the new roster entry, and then open it again to have the new address active in the programmer.
6. Press the "Program" switch again to return the Tower Controller Mark II to its normal operating mode.
7. If you changed the unit address, then power cycle the Mark II unit to activate the new address.
8. Open the roster entry that contains the correct address and check for proper operation.

# 7.0 Boot Loader

If an update to your Tower Controller Mark II firmware is needed, a program such as "Download Firmware" in JMRI version 3.10 or later is required. Do NOT use JMRI version 3.8 because it will brick the unit and require you to return it to the factory for repair!

To enter Boot loader mode:

1) To enter Boot loader mode, make a tool from a bent paper clip to depress the internal switch located under the small hole in the top of the Tower Controller Mark II labelled "Program".
2) Depress the switch for 10 seconds, until the Command light starts to blink, then lights steadily, and then release it.
3) The yellow COM LED will continue to light steadily indicating that the boot loader is now ready to accept messages from the JMRI Downloader.
4) Start JMRI and select "LocoNet" then "Download Firmware".
5) Select the latest Tower Controller Mark II upgrade and click "Read file" then "Download".
6) The COM LED will blink each time it receives a data packet from the JMRI down loader.
7) When programming is successful, the yellow COM LED will completely extinguish automatically, and normal operation will resume automatically.

Error codes:

During boot loading, several possible error codes are shown by the yellow LED:

– 1 blink: manufacturer code or product code mismatch; - Be sure that you have chosen the proper file to upload.
– 2 blinks: hardware version mismatch; - You may need to select "Accept later hardware versions".

- – 3 blinks: hex file software version equal or lower; - You may need to select "Don't check software version".
- – 4 blinks: unused (no LocoNet® data).
- – 5 blinks: internal programming error detected. - The operation has failed, see below.

Each of the above errors will halt the boot loader process. To recover from these error types, remove power from the Tower Controller Mark II, then, while holding the program switch depressed, plug in the power again. This will place the unit directly into program mode and allow you to resend the upgrade. (the yellow command light will light steadily)

To recover from the last error type, it must be assumed that the firmware is in an undefined state, most probably damaged or incomplete. If the process is interrupted for any reason you will also end up with corrupted firmware which must be reloaded. The boot loader code itself is protected against being written over.

# 8.0 Grounding and Isolation

The Tower Controller Mark II provides complete electrical isolation between the layout and the LocoNet®. This prevents possible ground loop problems between the LocoNet® and your layout power supplies. For example, many systems are installed without properly grounding the booster to power ground, but use grounded power supplies for accessories.

Some devices such as our WorkMan series boards connect the LocoNet® ground directly to the interface boards. This provides a ground path from the local power supplies to the LocoNet® and then to the booster. At best this indirect grounding causes electrical noise. At worst it could create a fault path via the small gage LocoNet® wiring to ground. These devices require an isolated power source for proper operation.

Properly ground your boosters, your power supplies, and your desktop computer through a 3 wire cable, and isolate them from each other via isolated equipment.

# 9.0 Warranty Information

We offer a one year warranty on the Tower Controller Mark II. This device contains no user serviceable parts. If a defect occurs, please contact RR-CirKits at: service@rr-cirkits.com for a replacement.

# 10.0 FCC Information

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
--Reorient or relocate the receiving antenna.
--Increase the separation between the equipment and receiver.
--Connect the equipment into an outlet on a circuit different from that to
 which the receiver is connected.
--Consult the dealer or an experienced radio/TV technician for help.

Any modifications to this device voids the user's authority to operate under and be in compliance with these regulations. The actual measured radiation from the Tower Controller Mark II is much lower than the maximum that is permitted by the FCC Rules, so it is unlikely that this device will cause any RFI problems.