

Installation Guide ***Revision-a***

WatchMan

Simple Serial Bus

Intelligent 8 line DCC Current Detector

This PDF is designed to be read on screen, two pages at a time. If you want to print a copy, your PDF viewer should have an option for printing two pages on one sheet of paper, but you may need to start with page 2 to get it to print facing pages correctly. (Print this cover page separately.)

Copyright

This document is Copyright © February 2014 by **RR-CirKits, Inc.**. You may distribute it under the terms of either the GNU General Public License, version 3 or later (<http://www.gnu.org/licenses/gpl.html>), or the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0/>), version 3.0 or later.

All trademarks within this guide belong to their legitimate owners.

Authors

Dick Bronson

Feedback

Please direct any comments or suggestions about this document to:

dick@rr-cirkits.com

Contact Information

RR-CirKits, Inc.
7918 Royal Ct.
Waxhaw, NC USA 28173

<http://www.rr-cirkits.com>
sales@rr-cirkits.com
service@rr-cirkits.com
1-704-843-3769
Fax: 1-704-243-4310

Publication date and software version

Published February 2014. Based on WatchMan Rev-a.

WARNING: This product contains a chemical known to the state of California to cause cancer, birth defects or other reproductive harm. Do not ingest.

*You can download an editable version of this document from
<http://www.rr-cirkits.com/manuals/WatchMan-manual-a.odt>*

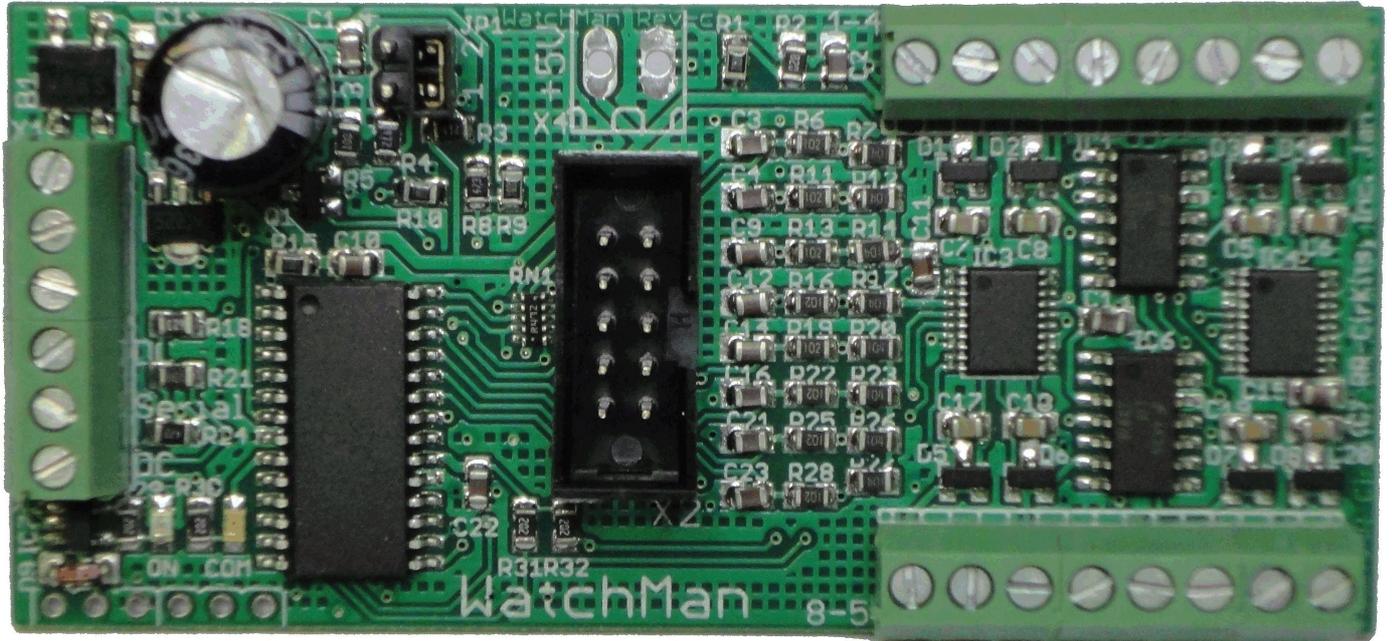
Contents

Copyright	2
Overview	4
1.0 Features	5
2.0 Getting Started	5
2.1 Create a Defult Roster Entry as a template	5
2.2 Create a New Roster Entry for each WatchMan	6
2.3 Edit the new Roster Entry	6
3.0 Power and Serial Connections	7
3.1 LocoNet® Compatible Simple Serial Bus Connector	7
3.2 Power Connections	8
3.2.1 Simple Serial Bus Gateway	8
3.2.1 Simple Serial Bus Adapter	9
3.3 Status Indicators	9
3.4 JP1 Mode Selection jumpers	9
4.0 Output Connections	10
4.1 I/O Port	10
4.1.1 Configuration.....	10
4.1.2 Input-Output mode.....	11
4.1.3 Context Sensitive Display.....	11
4.1.4 Composite Type.....	11
4.2.3 WatchMan Secondary Messages	12
4.3.1 WatchMan I/O Connector Wiring.....	13
5.0 WatchMan Detection Coil Connections	13
5.1 CT Coil Wiring	13
5.2 Auto Set	15
6.0 WatchMan Logic Statements	15
6.1 Logic Blocks	15
6.2 Variables	16
6.3 Functions	16
6.4 ABS and APB Signal examples	17
7.0 WatchMan compatible Input/Output Cards	17
7.1 BOD-8 (DCC Block Occupancy Detector - 8 block).....	17
7.2 OIB-8 (Opto Isolator Board - 8 input)	17
7.3 SCSD-8 (Single Coil Solenoid Driver)	18
7.4 4ASD-4 (4 Aspect Signal Driver - 4 head).....	19
7.5 SDB-4 (4 Aspect Searchlight Signal Driver - 4 head).....	19
7.6 SMD-8 (Stall Motor Driver - 8 line)	19
7.7 DCDB-8 (Direct Current Driver Board - 8 line)	20
7.8 RB-4 (Relay Board - 4 x SPDT)	20
7.9 FOB-A (Fan Out Board)	21
8.0 Trouble shooting	21
8.1 Sanity Test	21
8.2 Activity Test	22
8.3 Factory Reset	22
9.0 Boot Loader	23
10.0 Grounding and Isolation	24
11.0 Warranty Information	24
12.0 FCC Information	25

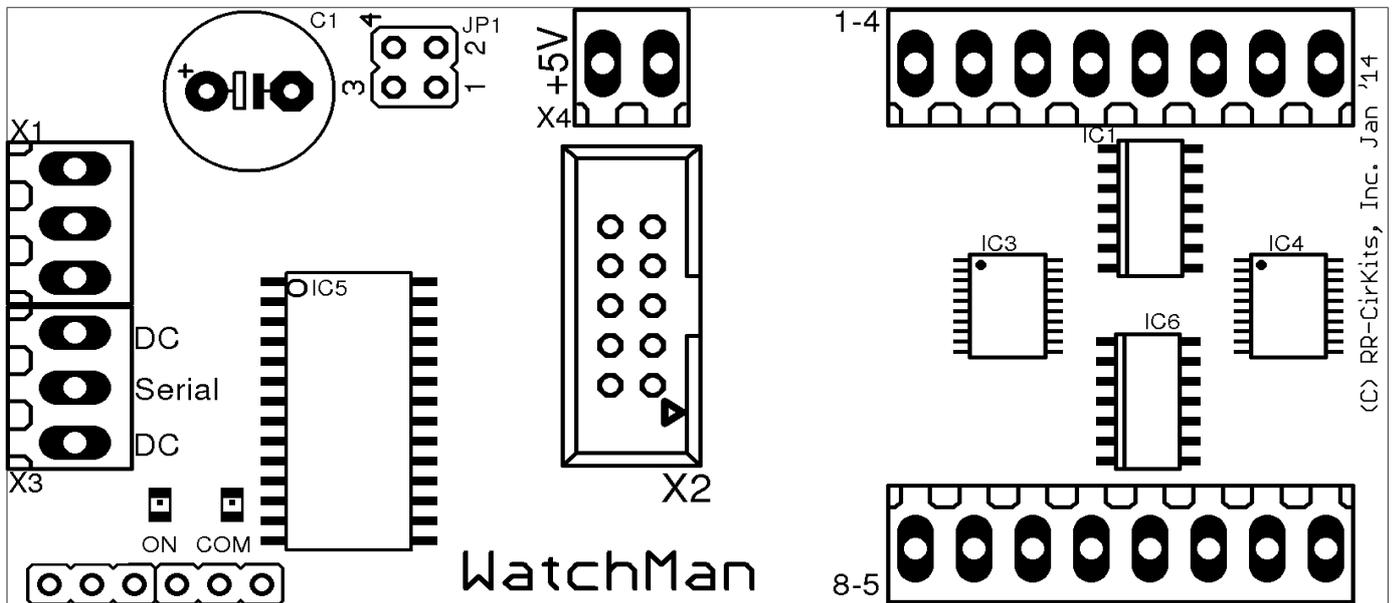
Overview

The WatchMan Simple Serial Bus interface provides a simple and easy way to connect between a LocoNet® bus and the layout. The WatchMan may be connected at any convenient point on the Simple Serial Bus.

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



WatchMan



(C) RR-CirKits, Inc. Jan '14

WatchMan Connectors

1.0 Features

- Includes 8 detector amplifiers for DCC current Detection. Coils not included.
 - Detection levels adjustable from ½ ma to 20 ma DCC. (20K ohm or less)
 - Train current maximum of 10A or more.
- Software (JMRI DecoderPro) settable sensitivity. Includes AutoSet option.
- Support for 8 auxiliary Input/Output lines.
 - Auxiliary port includes drive for any combination of:
 - Up to 8 Input Lines or 8 Output Lines.
- Internal Logic Blocks with up to 32 conditional statements.
- Communicates over the Simple Serial Bus which is a 3 wire LocoNet® compatible serial interface.
- CV controlled programming via Software. (e.g. JMRI DecoderPro 3.6 or later.) Both reading and writing of CV values is supported in OPs mode over the LocoNet® compatible Simple Serial Bus connection.
- I/O Lines may be configured as TowerController compatible ports or as individual lines.
- Automatically saves input/output states during power down.
- Boot Loader allows firmware upgrades over the LocoNet® compatible Simple Serial Bus connection.
- Power is supplied over the Simple Serial Bus.

2.0 Getting Started

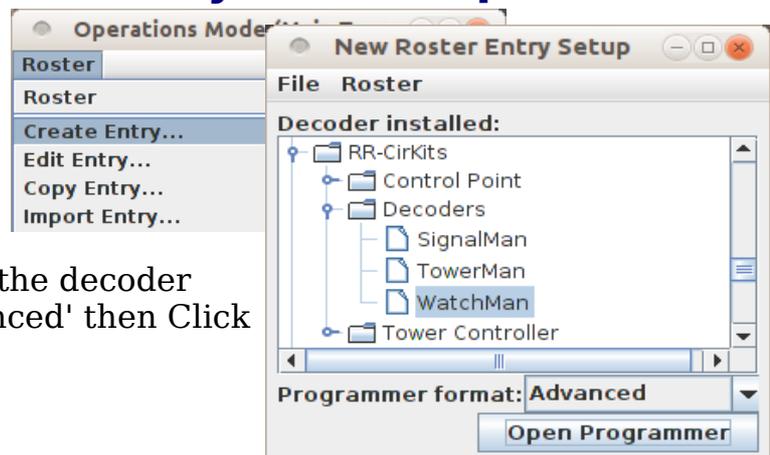
We suggest that you use a computer program such as the JMRI DecoderPro (3.6 or later) to setup the WatchMan. The "point and click" interface will save you much time and frustration while setting the many possible options that you will need to configure.

OPS Mode Address: Each WatchMan has a single address that is used for OPS mode programming on the layout. Each individual WatchMan on your layout may have its own address, (recommended) or a single WatchMan may use the jumper selectable pre-programmed default address of 9999.

2.1 Create a Defult 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**' - '**Decoders**' - '**WatchMan**' 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 'WatchMan' tab.
- e) Set 'Master mode' as follows:

Master Mode	No	▼	OPS Mode Programing	Enable	▼
-------------	----	---	---------------------	--------	---

 - For use with a LocoNet® compatible command station select 'No'.
 - For use with any other, or no command station, select 'Enabled'.
- f) Set 'OPs Mode Programming' as follows:
 - To only use the default address of 9999 with JP1 1-3 on all WatchMan units select 'No'.
 - For user defined individual addressing select 'Enable'. (recommended)
- g) Go to the 'Roster Entry' tab, enter an ID (e.g. 'WatchMan Default') and then click on the 'Save to Roster' button.


- h) Close the new default decoder file. (template)

2.2 Create a New Roster Entry for each WatchMan

Follow the following steps:

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



2.3 Edit the new Roster Entry

- a) This Ops mode address is only used to configure the WatchMan. 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® compatible Simple Serial Bus to any point on your system's bus. The yellow command indicator will light each time the WatchMan initiates or responds to a LocoNet® command.
- c) Apply Power to the WatchMan. The green power ON status indicator should illuminate.
- d) Once the WatchMan is operating, all actual configuration, including any changes to the address, must be done with the JMRI 'Operations Mode Programmer'.
- e) When a WatchMan 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 'WatchMan Default' template.
- f) If this WatchMan has an unknown address, Install the option select jumper JP1 at 1-3. The JP1 1-3 jumper will force the WatchMan into OPs mode and it will respond to both address 9999 and also what ever address was set by the CVs. This



always allows you to take control of any WatchMan and correct any setup errors. The JP1 1-3 jumper also forces the WatchMan into Master Mode Enabled for use on a stand alone bus.

- g) Any changed address will only take effect after the power has been cycled on the WatchMan.
- h) The WatchMan decoder file is large. You must use JMRI version 3.6 or later. (3.7.2 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.
- i) It is recommended that you give the WatchMan 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 information that you want to at this time, write all changes to the WatchMan, then save to the roster.
- k) Remove the JP1 1-3 jumper if it was used, then power cycle the WatchMan to activate its new address.
- l) You should now be able to interface to your Railroad from your software and make changes using its new assigned address.

Tip

Remember, to modify, or restore an unknown address, you first power up the unit, then set the program option (JP1) to 1-3 and use the default 9999 address to re-program the unit. The unit will not power up with the jumper 1-3 in place. Always power it up first, then add the jumper.

3.0 Power and Serial Connections

The WatchMan (8 Detectors & 8 Line I/O Board) has five connectors and two status indicators. Two of these terminals are for connections to the system. One connector is for the I/O lines. The other two are used as connections to the detector CT coils. This section covers the system connections consisting of the serial port connectors, power connections and Status indicators.

3.1 LocoNet® Compatible Simple Serial Bus Connector

The serial port connection is made to the WatchMan via the Simple Serial Bus (SSB) cable connected to either of the two screw terminals. (3 pin) Simple Serial Bus cables are normally wired straight through, but no harm comes from an accidental reversal. The SSB wiring passes straight through both connectors.

Pin outs for the Simple Serial Bus data connector:

Pin	Description
1	DC
2	LocoNet® Serial line
3	DC

Simple Serial Bus power is supplied on Pin 1 and Pin 3. Power can be +12V DC or greater. Serial port Pin 2 is the LocoNet® compatible Simple Serial Bus signal line.

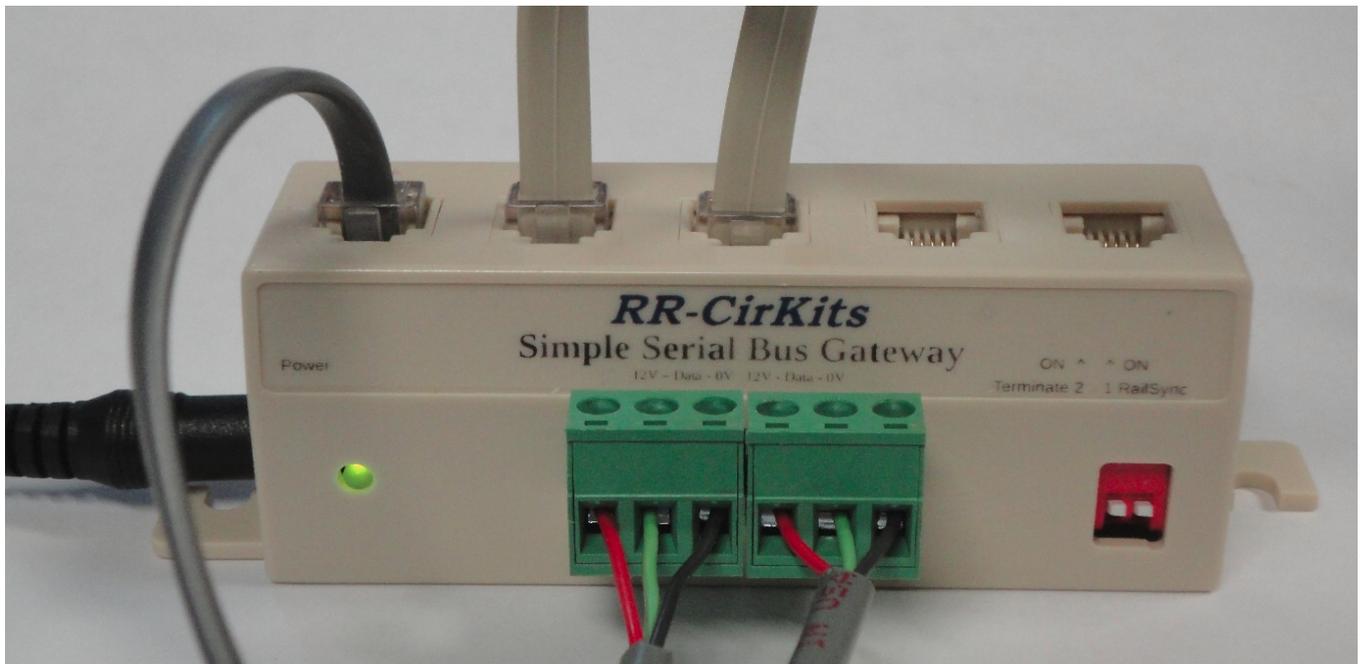
The Simple Serial Bus connectors will accept wire from 16 AWG to 22 AWG. For larger wire sizes simply attach a tail of smaller gauge wire to extend from the main bus wires to the WatchMan connectors. It may help to tin stranded conductors to prevent any stray strands from causing short circuits.

3.2 Power Connections

The WatchMan requires an external power source of between 12 and 18 volts DC supplied on the Simple Serial Bus. Polarity is not important.

3.2.1 Simple Serial Bus Gateway

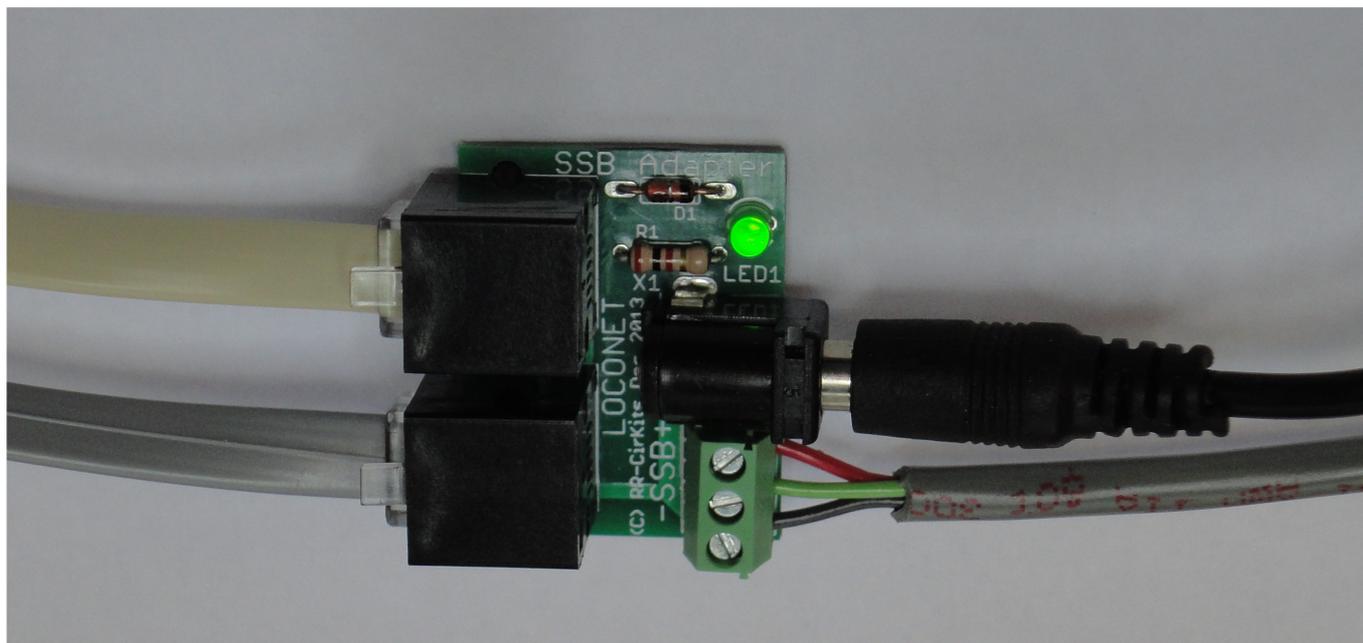
The **Simple Serial Bus Gateway** unit is a convenient way to supply the required power to the WatchMan and other Simple Serial Bus boards over single or dual 3 wire cables. It also includes both a LocoNet® terminator and power to the RailSync lines as options for stand alone LocoNet® users. In addition it provides an easy point to connect up to 5 LocoNet® cables for compatible devices such as the LocoBuffer-USB computer interface



Simple Serial Bus Gateway

3.2.1 Simple Serial Bus Adapter

For Digitrax users and other users with an existing LocoNet a simpler connection and power option is the **SSB Adapter**. The SSB Adapter may also be used to supply additional power to a SSB Gateway based network if required.



SSB Adapter

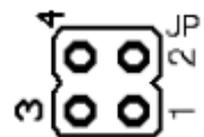
3.3 Status Indicators

The WatchMan has two status indicators located near to the Simple Serial Bus connectors. The green ON status indicator shows the power status of the WatchMan itself. The yellow COM (command) indicator normally shows all data activity addressed to, or coming from, this specific WatchMan, and also any activity/error status during a boot loader firmware upgrade. (see section 8.0) The COM indicator also warns of a low voltage condition by flashing slowly until the voltage is restored to normal.

3.4 JP1 Mode Selection jumpers

The WatchMan has a single Mode Jumper, JP1. This selects the mode and options. JP1 has 4 valid positions:

- None** = Serial mode. (LocoNet® data) Simple Serial Bus mode. (use with JP2 1-2) Read only at power up.
- 1 - 3** = OPs Mode Programming. Read after power up.



Note The **1-3** jumper is not allowed during power up. It causes a rapid flash error warning if it is in place at power up.

- 3 - 4** = Boot Loader mode. Serial Mode only. Read only at power up.

Warning

For proper Boot Loader error status reporting be sure to remove Boot Loader jumper **3 - 4** after power up. The Boot Loader status is maintained until power is cycled or the boot process has completed.

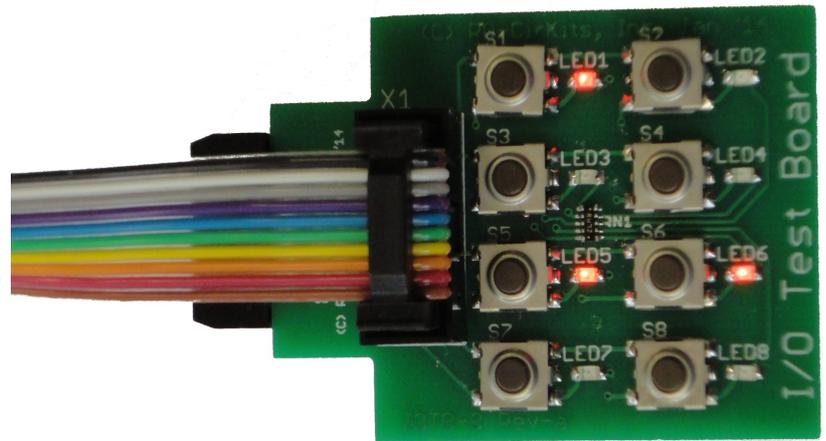
d) **2 - 4** = Test Mode. Input states are connected directly to the Auxiliary port.

Note

The **2-4** Test Mode jumper may also be used to create a stand alone detector board with simple logic level outputs.

The use of an **I/O Test Board** and the 2-4 test mode jumper makes it easy to see the current status of each detection channel during trouble shooting or AutoSet without changing the normal Auxiliary connector's configuration.

The use of a ribbon cable extension allows viewing the WatchMan board's status from any convenient location.



I/O Test Board

4.0 Output Connections

We suggest that the user take advantage of JMRI DecoderPro or a similar program to set the WatchMan 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 Port

The WatchMan has one Input / Output port for a total of 8 lines. The port is 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 a crossing signal.

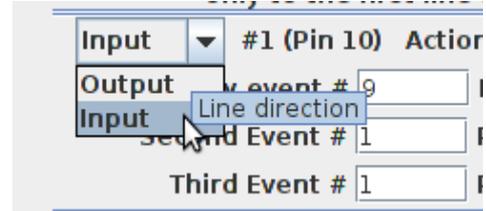
4.1.1 Configuration

The following examples are using JMRI DecoderPro files for the WatchMan.

To prevent any confusion the WatchMan 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. It may cause an issue with RR&Co that does not allow selections by the actual event numbers. You may need to convert to 'BDL' speak to set the expected numbers.

4.1.2 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 (using external resistors) and monitoring push button contacts in a local fascia control panel.



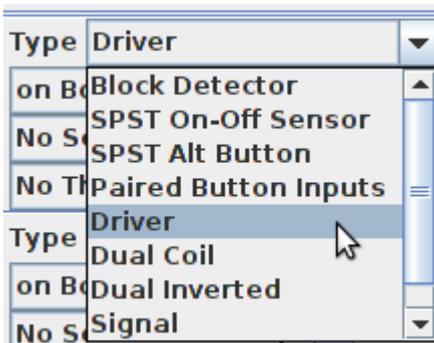
4.1.3 Context Sensitive Display

The WatchMan decoder file attempts to show a context sensitive display of the options presented.

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			
Second Event #	1	Polarity	send normal	Switch Request	message	No Second Message			
Third Event #	1	Polarity	send normal	Switch Request	message	No Third Message			
Input	#2 (Pin 9)	Action	Normal	Debounce	Default	Type	Block Detector		
Primary event #	10	Polarity	send inverted	Sensor Message	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			

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 external '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 WatchMan would not normally be used to drive signals, so the Signal mode is not made context sensitive.

4.1.4 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

machine will work, but it will show as 'Custom' to serve as a warning against possible coil over heating.

- **Block Detector** - Many external block detectors (such as the BOD-8) 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 WatchMan 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 WatchMan does not have enough power to drive the coils of a turnout motor directly, 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.

4.2.3 WatchMan Secondary Messages

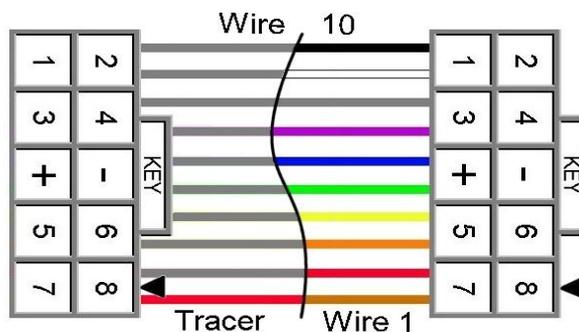
In these examples there are no second or third messages being sent. However additional messages may be sent if desired, for example to activate a 'Next' turnout whenever the 'first' is sent in order to sequence a yard ladder. These additional messages, if enabled, are sent whenever the primary event 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.

4.3.1 WatchMan I/O Connector Wiring

The auxiliary port connector's wiring is as follows. Note that the pin numbers and I/O line numbers are NOT the same, and actually run in opposite order from 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 WatchMan Detection Coil Connections

The small CT (Current Transformer) detection coils are placed directly on the track feeders where they belong. The WatchMan uses 100:1 Current Transformer (CT) coils to measure the DCC current flowing in any wire.

The use of CT coils means that there are no track voltage losses associated with the detectors. Normal DCC detection levels are 1ma. but may be adjusted from 1/2 ma to higher levels with the on board digital pots set by sliders in DecoderPro.

CT coils do not work for detection on pure DC power, but many modern power supplies use pulsed outputs which may allow detection with the WatchMan. Other control systems may provide AC to the rails at all times and also be detectable.

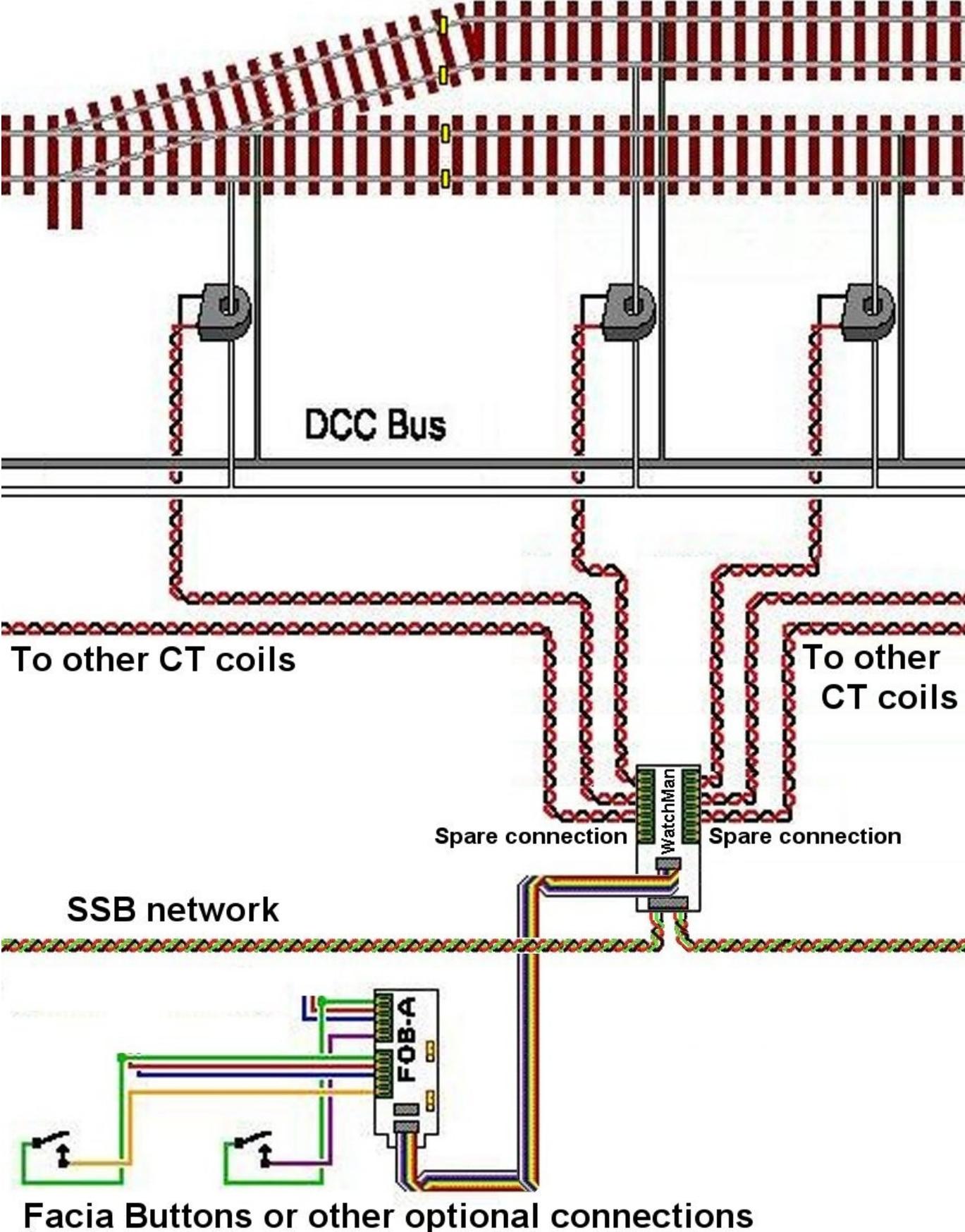
5.1 CT Coil Wiring

Simple lengths of the commonly available CAT-5 or similar cables may be used to connect up to 4 CT coils, one coil for each pair. Each coil should be connected to its input terminals with its own twisted pair wire. Do not connect any CT coil or its wiring to any other coils or wiring.

Do not run the twisted pairs in close proximity to severe electrical noise sources such as unshielded florescent lamps with electronic ballasts.

Do not use straight wiring. The twisted pair wiring serves to cancel out most electrical noise in the sensitive circuits.

SSB WatchMan Wiring



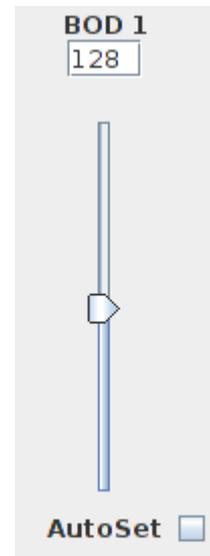
5.2 Auto Set

For most conditions using 10KΩ wheel sets, the default mid setting (128) of the digital sensitivity potentiometers will suffice. However if you are using 20KΩ wheel sets, or have unusually long blocks you may desire to change these settings. In the case of the 20KΩ wheel sets you will need to increase the sensitivity. In the case of long blocks or complex wiring you may need to reduce the sensitivity.

To aid in this process we have included an automated sensitivity setting process called AutoSet that lets you fine tune your settings.

The detectors are each shown on the 'Sensitivity' pane in the order that they appear on the WatchMan's connectors. Sensitivity Values range from 1-255. To manually adjust the sensitivity simply move the slider and then click on 'Write changes on sheet' to store the new value.

To AutoSet a detector channel be sure that track power is on. Clip a single wheel set or matching resistor to the track to maintain a good connection. Check the 'AutoSet' box, and then 'Write changes on sheet'. To read back the present setting of the sensitivity, do 'Read full sheet'. Note: The 'AutoSet' process may take some time to complete for each channel. When the 'AutoSet' box has been automatically un-checked, then the slider shows the new found sensitivity value.



The AutoSet process rapidly changes the sensitivity up or down until it detects the resistor or wheel set. It then moves the sensitivity more slowly until the resistor is detected again. It then adds the value selected by the 'Margin' slider to the actual auto detected sensitivity to allow for any changes during normal operations.



Of course you may override any sensitivity by setting a new value on the slider and then 'Write changes on sheet'. Any number of channels may be AutoSet at one time. Just be sure that each has a resistor connected.

If you do the AutoSet process with no occupancy resistor attached to the rails, then the sensitivity will be set to the maximum allowed by stray noise plus the margin. This could mean that the block remains 'occupied' at all times. In that case manually reduce the sensitivity by at least double the margin value.

6.0 WatchMan Logic Statements

In addition to the optional secondary messages, the WatchMan contains 32 logic statements. Each statement may be used to create a new command based on one or two conditionals.

6.1 Logic Blocks

A logic 'block' consists of several statements all related to a single group. To calculate this logic, each logic block is treated as a group of statements

independent of any other groups. The logic in any group will only be evaluated when some variable contained in that block changes state. This logic is event driven, not state driven. The logic blocks are used to do signaling logic or other animations such as controlling grade crossings. Each statement of this table consists of an identifier and two memory locations that remember the last command given for any items they are 'watching'. These memory locations remember the event information from the last seen commands to allow decision making. Any changes to these memory locations that cause a block to become 'true' will generate a new evaluation of the logic block, possibly sending out a new command.

Logic block statements for signals are required to be grouped together from the most restrictive aspect to the least restrictive aspect. The last entry of every block is marked by checking the 'End Logic Block' check box. Each entry that is to be evaluated must have its 'Enable' box checked. Each individual block evaluation is done from top down in the list, and all evaluation for that block is terminated with the first matching statement or when the "End Logic Block" check box is reached. If no enabled Mast-Aspect evaluates to 'true' then no Mast-Aspect message is sent, and evaluation ceases until some watched variable in that block changes again.

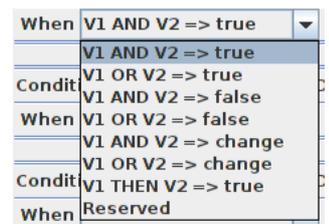


6.2 Variables

Each statement contains zero to two variables for identifying the required sensor, turnout, and/or following signal's aspect information in order to do simple signal interlocking. Any logic statement evaluates to true only if its function and variables are true. A blank variable entry is considered to be true. Thus a blank entry at the end of a logic block will cause a default message to be sent if no previous statement with the same group number has been evaluated to 'true'.



The state of all variables is remembered internally in order to compare them. A change in either variable's state will trigger a new comparison. This dual variable capability makes it easy to calculate a signal aspect or train direction based on turnout position and occupancy.



6.3 Functions

The 'Function' column has options for **AND**, and **OR** statements. The 'When' selection entry expands this capability. Especially note the '**V1 THEN V2**' option. This allows you to only trigger on V2 if V1 was previously true. This makes it easy to determine train direction simply by using two occupancy sensors.

A statement may optionally send an event when true. To send an event define the event to be sent and check the 'Enable' check box. Events sent may be LocoNet sensor, switch, or switch feedback messages. Events may also be NMRA DCC Signal Mast commands. (a mast number plus its aspect)

6.4 ABS and APB Signal examples

For examples of using logic to control signals see the SignalMan manual. The WatchMan logic may be used to expand a SignalMan's logic table if more statements are required.

7.0 WatchMan compatible Input/Output Cards

The RR-CirKits WatchMan 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 WatchMan or compatible I/O module fits into the 3TK2-1 (single) mounting track. Other widths are available for compact installations using multiple boards.

7.1 BOD-8 (DCC Block Occupancy Detector - 8 block)



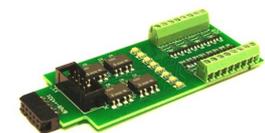
Like the WatchMan, the BOD-8 does not expect you to re-wire your layout to bring track feeders to the detector cards. The small CT (Current Transformer) detection coils are placed directly on the track feeders where they belong. Simple lengths of Cat-5 cable are the usual way to run the signals back 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. This board may be used to extend the WatchMan to 16 blocks of detection.

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 WatchMan 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	

7.2 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 WatchMan. 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	

7.3 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 WatchMan 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 WatchMan 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			

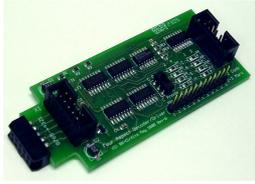
The lines are paired and only the primary event of the first line of each pair will be used. In this example 'LT9 closed' and 'LT9 Thrown' will be used. LT10 is ignored.

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!

7.4 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 WatchMan 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.

7.5 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.

7.6 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.

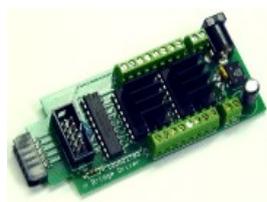
This board includes an adjustable regulator to allow you to control the speed of

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'.

7.7 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 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 WatchMan 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 WatchMan setup or by reversing the DCDB-8 output lines.

7.8 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 WatchMan, 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 WatchMan, or other driver.



The RB-4 input lines are active low so all lines on this WatchMan 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 WatchMan setup or by reversing the RB-4 output contacts.

7.9 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.



'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 WatchMan will be damaged.



'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'.

8.0 Trouble shooting

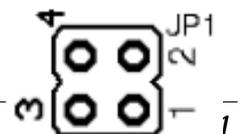
8.1 Sanity Test

To perform a very basic WatchMan sanity test perform the following steps:

- Power up the WatchMan by plugging it into the power supply.
- The green power LED should come on.
- The previous output states should be automatically be restored.

Or

- Apply the JP1 1 - 3 option jumper.



- Power up the WatchMan by plugging it into the power supply.
- This causes an error and the COM LED should flash rapidly if the unit is operational.

If the green power LED does not light, be sure that a power supply is connected to the Simple Serial Bus, and provides at least 11V to the WatchMan. The WatchMan 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. A slow flash of the yellow LED indicates a low voltage condition has occurred.

- If a volt meter is not available you can do a quick test by removing the power, applying the JP1 1-3 option jumper, then restoring the jumper. If the COM LED flashes rapidly, then the power up sequencing has completed OK. Be sure to restore the jumper to its normal position after the test.

8.2 Activity Test

The WatchMan'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 WatchMan. The command should appear in the LocoNet® monitor window and the WatchMan 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 WatchMan 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 WatchMan. 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.

8.3 Factory Reset

If the WatchMan's address settings get lost, restore the address as shown in section 2.0. The factory default address with JP1 1-3 in place is 9999. The WatchMan is also forced into Master Mode by the JP1 1-3 jumper, so it may be re-programmed on a stand alone bus.

Steps:

- 1) Power the unit.
- 2) Apply jumper at JP1 1-3

- 3) Use the WatchMan Default roster entry to restore the proper address for this unit in the "Basic" tab, then switch to the "CVs" tab and write just CV17 and CV18 to the WatchMan.
- 4) Remove the JP1 1-3 jumper
- 5) Remove then restore power to return the WatchMan back to its normal operating mode at the new address.

9.0 Boot Loader

If an update to your WatchMan firmware is needed, a program such as "Download Firmware" in JMRI version 2.4 or later is required.

To enter Boot loader mode:

- 1) Remove power from the WatchMan.
- 2) Add a jumper at JP1 3-4.
- 3) Apply power to the WatchMan. The yellow COM light should light.
- 4) Remove the JP1 3-4 jumper.
- 5) The yellow COM LED will continue to light steadily indicating that the boot loader is now ready to accept messages from the JMRI Downloader.
- 6) Start JMRI and select "LocoNet" then "Download Firmware".
- 7) Select the latest WatchMan upgrade and click "Read file" then "Download".
- 8) The COM LED will blink each time it receives a data packet from the JMRI down loader.
- 9) When programming is successful, the yellow COM LED will completely extinguish automatically, and normal operation will resume.

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 WatchMan, add the jumper at JP1 3-4, apply power again, then remove the jumper as before. Correct the error, and then re-run the JMRI program.

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.

10.0 Grounding and Isolation

Unlike the LocoBuffer-USB and the Tower Controller, the WatchMan is not optically isolated from the Simple Serial Bus. This allows for possible ground loop problems between the LocoNet® and your layout power supplies, so be sure to keep the ground connection to the Terminator unit, either isolated, or else in common with your booster's power source.

Normally all WatchMan connections originate or reference to the WatchMan board itself, so there is no danger of ground loops. RR-CirKits High power output boards are opto isolated from the WatchMan port and use their own power sources.

If you are building your own I/O boards or using third party units be sure to observe the common/isolated ground rules, and never exceed 5V on any pin.

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 where necessary.

11.0 Warranty Information

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

12.0 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 WatchMan 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.

RR-CirKits, Inc.
7918 Royal Ct.
Waxhaw, NC USA 28173

<http://www.rr-cirkits.com>
sales@rr-cirkits.com
service@rr-cirkits.com
1-704-843-3769
Fax: 1-704-243-4310