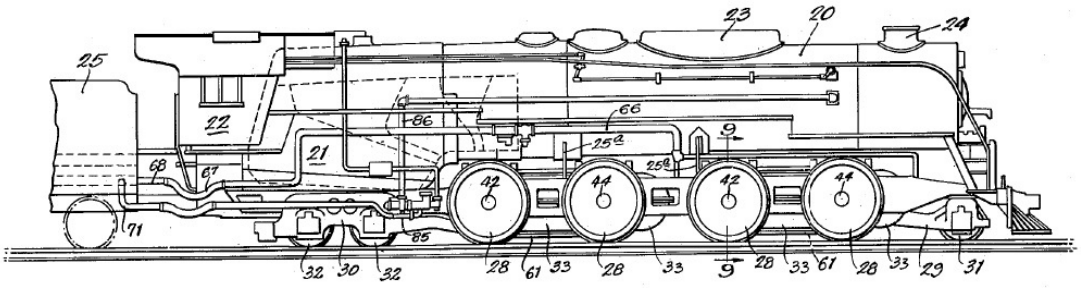
Mountain View Rail Road



Discrete Crossing Light Controller

Rev c

A redacted copy of the latest version of this document is available at

MtViewRR.com

Made in the USA - now and forever!

Table of Contents

Package contents:

1) Printed circuit board
2) Components package
3) User's manual & building instructions

General

Features:

User's manual written in US English

Reed switch actuation

Four crossing light drivers

Crossing bar driver

Track power (DCC or CAB power) or optional external DC power

Operational or kit

Description

The Discrete Crossing Light Controller provides automatic alternate flashing light signals and crossing bar driver for model railroads. There are four LED crossing lights drivers, one for each side, and an actuation signal for a crossing gate(s). The board is controlled by a magnet placed on the locomotive (most forward) car of the train. The train is sensed by reed switches in or on the track.

As a train approaches the lights are off and crossing bar is in the raised position. As the locomotive crosses over the first reed switch the lights begin flashing. At the same time the crossing bar signal is actuated. As the train crosses over the second reed switch the lights are disabled and the crossing bar signal is deactivated.

Power for the board, lights and crossing bar can be provided either the AC output of a CAB, track power from a DCC train track power system or an external power supply. If an external DC power supply is used it may be between 12 Volts and 18 Volts DC. If an AC supply external supply is used it may be between 9 Volts and 18 Volts AC. The maximum crossbar current draw is 100 milliAmps unless an optional external relay is used for crossbar actuation.

Inputs:

- Reed switches
- CAB power, DCC power, External AC or external DC power

Outputs:

- Four alternating crossing light signals for driving LEDs.
- One 100 milliAmp crossbar signal.

Configuration

The product can be shipped in a number of configurations depending on customer needs. For

accessories ordered in the initial shipment no additional handling charges will be charged.[1] The basic configurations are the combinations of assembled or kit, DCC power option, on-board connectors, mating connectors, mating connectors with pigtails (18” length power and 12” signal lengths standard) and conformal coating.

Conformal coating provides moisture resistance in areas where condensation can be expected as would be the case in areas of high humidity such as near large bodies of water or tropical environments.

Crossing Lights

There are two outputs for crossing lights. Each pair of crossing lights requires two sensors two on each side of a crossing. The light drivers have on-board current limit resistors that are optimized to deliver 15 to 20 milliAmps per LED at at 8 to 12 Volts input voltage.

Crossing Bar

The crossing bar circuit can provide up to 200 milliAmps total (100 milliAmps to each side) current. The crossing bar circuit can be powered either by the internal 9 Volt DC or the external rectified power.

Power Supply

If an external DC power supply is used it may be DC or AC. If an external DC power supply is used it may be between 12 Volts and 18 Volts DC. If an AC supply external supply is used it may be between 9 Volts and 18 Volts AC.

Connector option

Assembled boards always include terminal block type connectors.

Kits have the option of terminal blocks or the user may solder wires directly to the board.

1 For accessories ordered in the initial shipment no additional handling charges will be charged. Accessories that are available at initial shipping time will be included with no additional shipping charges. Accessories that are shipped separately will incur shipping and handling charges.

Connector Configurations

Input description

J1 Power

Train power or an external power supply may be connected here. If train power is used this input can be connected either directly at the controller or between the track rails. In a non-DCC system is used the CAB AC output may be connected here.

J3 and J4 Reed Switch

A magnet on the train must pass over the reed switches closely enough for actuation. Correct location for the reed switch will have to be determined by trial and error. A permanent magnet on the train actuates the reed switch. The reed switch is mounted such that it is close enough to be actuated by the train's magnet without touching as the train passes over the reed switch.

Many factors can affect reed switch location including near by metal objects, the train's composition, track composition, available clearance and so forth. Be careful that no part of the train contacts the reed switches while keeping the reed switch high enough to be actuated by the magnet.

If a greater actuation distance is desired the magnetic field multiple magnets may be used.

SH2 Crossing Bar Power Selection Shunt

The crossing bar actuation circuit has a three pin header for selection of power source for the crossing bar. If on-board regulated power (9 Volts) is being used to drive the crossing bar a shunt should placed to connect pins 2 and 3 of the header. If rectified input power is being used to drive the crossing bar then the shunt should be connected between pins 1 and 2 of the header. If an external relay is used to switch power to the crossing bar actuator it should be connected between pins 2 and 3. An external relay board is available from MVRR.

OUTPUT

TB4 Crossing bar

The output connector provides power for the crossing bar on Pin 1 (positive) and the switched signal on pin 2 (negative.) This is designed to operate a circuit that lowers the bar when actuated and raises the bar when deactivated.

If more than 100 milliAmps current is required for crossing bar actuation an external relay and power supply may be used.

If a bipolar signal is required as might be the case for a DC motor that spins in one direction to raise the bar and the other direction to lower the bar an external relay is suggested. An external

relay is available as an option.

TB5 & TB6 Crossing Lights

LEDs for the crossing lights are on terminals 1 and 3. Pin 2 is the common pin. The LEDs must be connected with the anodes (positive pin) on pin 2 and the cathodes (negative pins) 1 and 3.

LED current is set to approximately 17 milliAmps per output. If two LEDs are connected to a single output a total of 16 milliAmps.

Note: LED's of different colors have very different forward voltage drops. If colors are mixed on a single output then it is possible that one LED will illuminate and the other LED will not.

The current may be changed by changing the resistor indicated in the table below. The table below lists which resistor controls the current of a particular led as indicated by the connector pin number.

The terminal blocks are for different sides of the crossing.

Terminal Block Number	Resistor Number	Side
TB5 p1	R7	A
TB5 p3	R8	A
TB6 p1	R5	B
TB6 P3	R6	B

LED current is approximately 8.5 / R where R the resistor value. For example, as supplied (470 ohm resistor) the current would be approximately 17 milliAmps.

BLINKING RATE

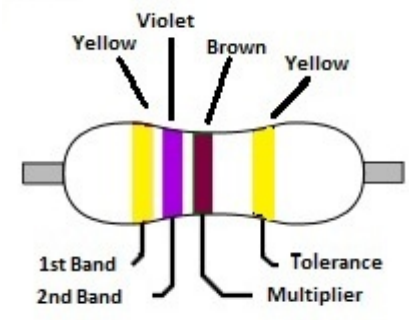
The blinking rate is set by C1,C3, R2, R3 and R4. The blinking frequency is adjusted by means of R4.

Resistor color code

Color	Digit	Multiplier	Tolerance Temp Co
Black	0	0	1.00%
Brown	1	10	2.00%
Red	2	100	
Orange	3	1,000	
Yellow	4	10,000	5.00%
Green	5	100,000	0.50%
Blue	6	1,000,000	0.25%
Violet	7	10,000,000	0.10%
Gray	8	100,000,000	0.05%
White	9	1,000,000,000	
Gold		0.10	5.00%
Silver		0.01	10.00%

5% Resistor color band layout

For a 5% resistor there are three value bands and an optional tolerance band. The three value bands will be grouped together near the end of the resistor. The band closest to the end of the resistor is the most significant digit of the value. If the tolerance band is not present the resistor value is assumed to be +/- 20 % of the indicated value. The resistor below is a 470 ohm 5% resistor.

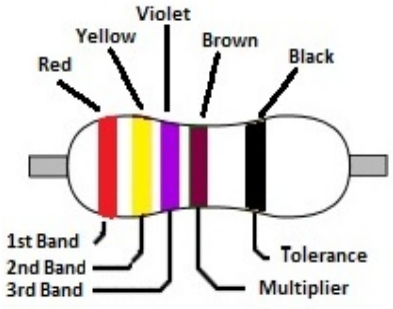


Note: Either yellow and Gold will denote 5% resistor tolerance when used as the tolerance band.

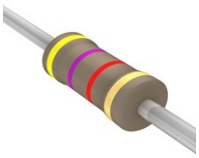
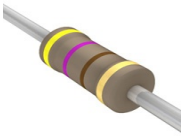
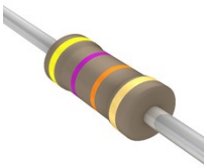
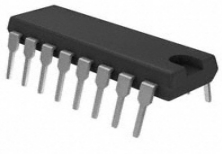
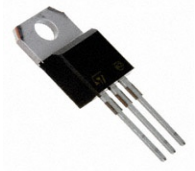
1% Resistor color band layout

Four bands grouped together in addition to the tolerance band imply a 1% resistor. For a 1%

resistor there are four value bands and a tolerance band. The four value bands will be grouped together near the end of the resistor. The band closest to the end of the resistor is the most significant digit of the value. The resistor below is indicated as a 2470 ohm 1% resistor.



Reference	Name	Qty	
C1 C3	Capacitor 47uF 35V	2	
C2	Capacitor 100 uF 16V	1	
Nut 6X32 Nut C4	Capacitor 100uF 25V	1	
D1	Bridge Rectifier	1	
D2	LED (color may vary)	1	
TB1 TB2 TB3 TB4	Terminal Block 2pin	1 (not included in all kits)	
TB5 TB6	Terminal Block 3pin	2 (not included in all kits)	
Q1 Q2 Q3 Q4	2N3904	4	

R1 R2 R3 R11	Resistor 4.7K ¼ Watt 5% Color bands yel, violet, red with yellow tolerance	3	
R4	Resistor, adjustable, 50K	1	
R6 R7 R8	Resistor 470 ohm ¼ watt 5% Value bands yel, violet, black with yellow tolerance	3	
R9 R10	Resistor 47K ohm ¼ watt 5% Value bands yel, violet, orange with yellow tolerance	2	
U1	4027 CMOS Flip Flop	1	
U2	Positive Linear regulator 9Volts TO220	1	

Assembly Instructions

General – Refer to the Silkscreen with component values drawing above. When components are hand soldered to a board the component is installed on one side of the board and the board is turned over for soldering. For this reason component leads are often bent out immediately after installation to prevent the component falling out after installation and before soldering.

Another method is install components of the same height and used a piece of foam that is about the same size as the board to retain the components when the board is turned over. The foam may be held in place with a rubber band.

Step	Completed	Instructions
1		The component bag contains the components that will be installed on the printed circuit board. Using the Components Bag Contents list above assure all components are in the component bag.
2		The Printed Circuit Board (PCB) is marked top and bot. Components are mounted on the top side of the board and soldered on the bottom side (bot.) When mounting components the silkscreen is consistently oriented for reading left to right for all north-south mounted components and north-south for all north-south components.
3		Select R1, R2, R3 and R11 (4.7K ohms -yellow, violet, red) from component bag and solder to the PCB.
4		Clip the leads for R1, R2, R3 and R11.
5		Select R5, R6, R7 and R8 (470 ohms -yellow, violet, brown) from component bag and solder to the PCB.
6		Clip the leads for R5, R6, R7 and R8.
7		Select R4 a rotary potentiometer with and adjusting knob f from the bag and solder to the PCB.
8		Select R9 and R10 (47K ohms -yellow, violet, orange) from component bag and solder to the PCB.
9		Clip the leads for R9 and R10.
10		Select Q1, Q2, Q3 and Q4 from component bag and install the transistors with the flat of the transistor facing U1 and solder them to the PCB.
11		Clip the leads for Q1, Q2, Q3 and Q4.
12		NOTE: The following components are polarized which means they can only be installed in one direction. Improper installation will result in the circuit not operating and possible component failure.
13		Select U1 from the component bag and determine pin 1. Pin 1 must be installed on the end with the U1 marking on the board's silkscreen. Pin 1

Step	Completed	Instructions
		is usually denoted by an embossed dot at the end of the IC or by an indentation at the short edge of the IC. Install U1.
14		Solder U1
15		Select C1 and C3 (47uF 35V) from the component bag. These are electrolytic capacitors. Electrolytic capacitors are usually marked in two ways. The body of an aluminum electrolytic capacitor denotes the negative leg of the capacitor with an arrow. This is convenient for visual inspection. The positive leg of the capacitor is longer. This is usually used for construction. The board's silkscreen is marked for the positive leg with a + symbol. Install the capacitor with the longer leg of the capacitor in the hole that marked +.
16		Select C2 (100 uF 16V) from the component bag. This is an electrolytic capacitors. Electrolytic capacitors are usually marked in two ways. The body of an aluminum electrolytic capacitor denotes the negative leg of the capacitor with an arrow. This is convenient for visual inspection. The positive leg of the capacitor is longer. This is usually used for construction. The board's silkscreen is marked for the positive leg with a + symbol. Install the capacitor with the longer leg of the capacitor in the hole that marked +.
17		Select C4 (100 uF 25V) from the component bag. This is an electrolytic capacitors. Electrolytic capacitors are usually marked in two ways. The body of an aluminum electrolytic capacitor denotes the negative leg of the capacitor with an arrow. This is convenient for visual inspection. The positive leg of the capacitor is longer. This is usually used for construction. The board's silkscreen is marked for the positive leg with a + symbol. Install the capacitor with the longer leg of the capacitor in the hole that marked +.
18		Select D1 from the component bag. This is a bridge rectifier. This series of bridge rectifiers may be denoted in one of two ways. If the rectifier has a flat then when looking at the part with the legs facing away pin 1 is the leg on the clockwise portion of the flat as denoted on the silk screen. If one leg is longer then it goes into pin 1 on the pcb. Most of these parts also have pin 1 printed on the top of the part. Install and solder D1.
19		Select U2 from the bag. U2 is installed with the metal portion of the package toward the outside of the board. Install and solder D1.
20		The terminal blocks are optional. Select the terminal blocks from the bag. The terminal blocks are installed such that the wire openings face the outside of the board. Install the two terminal terminal blocks into TB1, TB2, TB3 and TB4. Install the three terminal terminal blocks into TB5 and TB6. Solder the terminal blocks.

Testing

Referring to the schematic and silk screen connect a power supply of between 11 and 18 volts to PB1. The power supply may be either AC or DC.

Connect two LED to either of TB5 or TB4 with the anode of each connected together to the center connector and the cathodes connected.

Short the terminals of TB2 to simulate the closing of a reed relay. If the LEDs were flashing they should stop flashing. If the LEDs were not flashing they should start flashing.

Short the terminals of TB1 to simulate the closing of a reed relay. If the LEDs were flashing they should stop flashing. If the LEDs were not flashing they should start flashing.

Connect an indicator device (such as an LED in series with a 10K resistor) with the negative (cathode) to pin 2. When the lights are flashing the indicator should be continuously on.

Troubleshooting table

Assumes power supplied between pins 1 and 2 of TB1 and LEDs connected to either TB5 or TB6. High is Vss +/- 2 Volts Low is Vdd +.2 Volts.

	TB3 pins 1 and 2 shorted to each other	TB3 pins 1 and 2 shorted to each other
TB2 pin 2	High	Low
TB3 pin 2	Low	High
Q3 base	High	Low
Q3 emitter	High	Low
Q4 base	High	Low
Q4 emitter	High	Low
TB5 pin 2	High	High

Q1 and Q2 are cross connected to provide an asynchronous multivibrator(oscillator.) As Q1 is turning on Capacitor C1 is being charged keeping the base of Q2 at a low voltage. When C1 gets full charged R2 pulls the base of Q1 positive turning Q2 on. This charges C3 turning Q1 off while C3 charges. When C3 is charged Q1 will again turn on, turning off Q1 …. and so forth.

The collectors of Q1 and Q2 are connected to TB5 and TB6 through resistors R7 and R8 and R5 and R6 respectively limiting the current flow to those outputs. It is intended that LED will be connected to these connectors with the cathodes connect to pins 1 and 3 and the anodes connected to pin 2.

NOTE: A load must be connected to TB5 or TB6 or both for the multivibrator to operate. A pair of 270 ohm to 1.5K ohm resistors will be adequate for troubleshooting the circuit.

Operation

This board provides automatic operation of crossing lights and a crossing bar in one direction.

First a direction of travel must be determined. Let's say the direction of travel is counter-clockwise for a particular layout. In this case the train will be moving left to right if you are standing outside the layout.

If you are facing the train layout the reed switch for starting the light will be mounted to your left and must be connected to TB2. When the train's magnet closes the TB2 reed switch the lights will begin flashing. The lights will continue to flash until the TB3 reed switch closes.

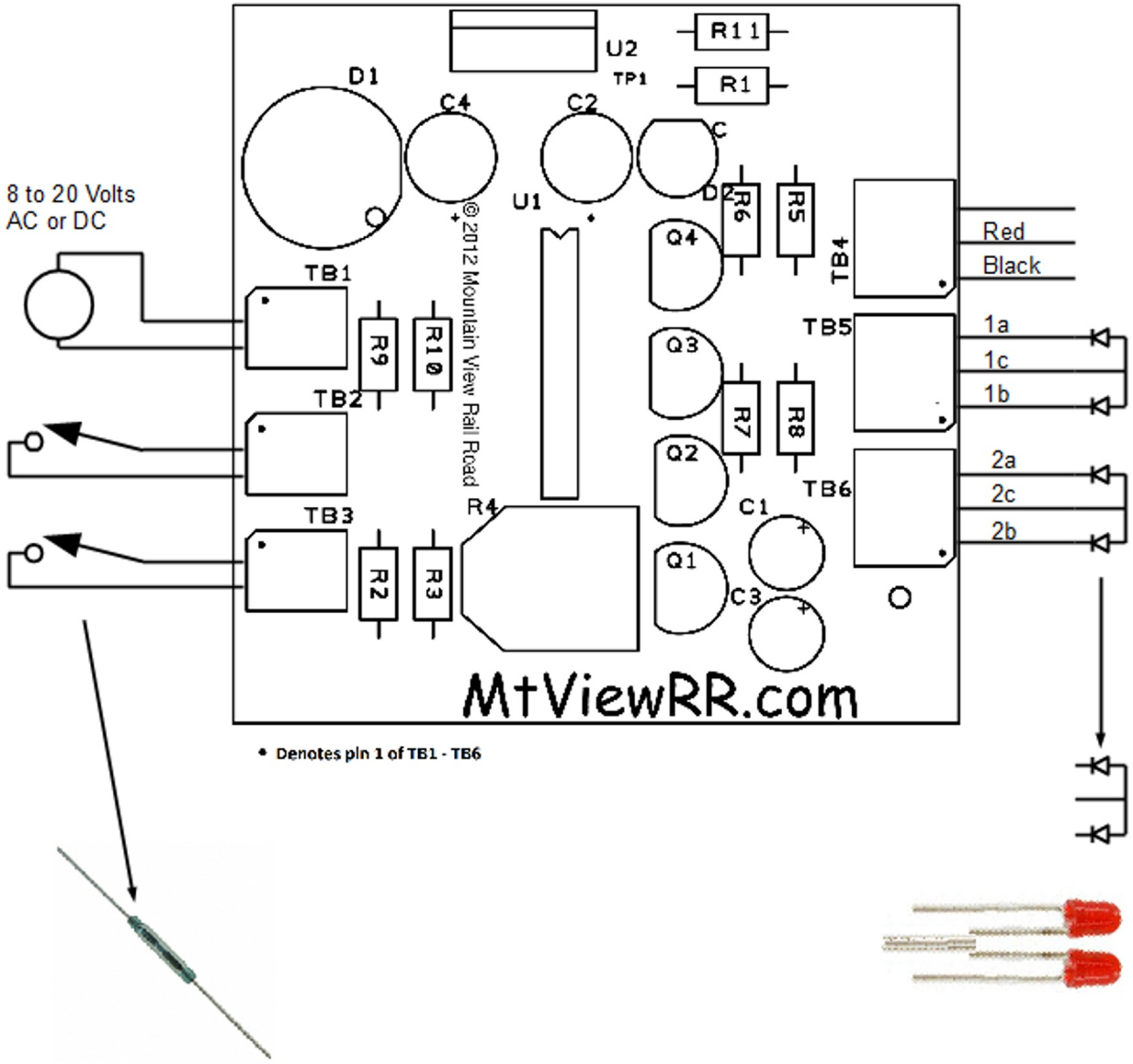
HINT: To keep the lights flashing the right hand (TB3) reed switch must be further away from the crossing than the length of the longest train you will run.

The crossbar signal is an 8.5 Volt DC signal with pin 1 of TB4 being the positive signal output and pin 2 of TB4 being the negative output. Or, as some engineers would say it “pin 1 is sourcing current and pin 2 is sinking the current with pin2 being an active low.” The maximum current through this circuit should be 100 milliAmps if the shunt is connected between SH2 pins 1 and 2.

If the shunt is connected between pins 2 and 3 the output current can be 200ma. And the output voltage will be the input voltage at TB1 – 1.7 Volts.PCB Component List

Reference Designator	Description	Quantity
C1 C3	CAP ALUM 47UF 35V 20% RADIAL	2
C2	CAP ALUM 100UF 16V 20% RADIAL	1
C4	CAP ALUM 100UF 25V 20% RADIAL	1
D1	RECTIFIER BRIDGE 1.5A 1000V WOG	1
D2	LED 5MM OVAL AMBER 591NM	1
Q1 Q2 Q3 Q4	IC TRANS NPN SS GP 200MA TO-92	4
R1 R2 R3 R11	RES 4.7K OHM 1/4W 5% CARBON FILM	4
R4	TRIMMER 50K OHM 0.2W PC PIN	1
R5 R6 R7 R8	RES 470 OHM 1/4W 5% CARBON FILM	4
R9 R10	RES 47K OHM 1/4W 5% CARBON FILM	2
TB1 TB2 TB3	TERM BLOCK 2POS SIDE ENT 2.54MM	3
TB4 TB5 TB6	TERM BLOCK 3POS SIDE ENT 2.54MM	3
U2	IC REG LDO 5V .5A TO220AB	1

Board Wiring Diagram



Notes:

The connection to TB1 can be any DC, AC or battery source. The board was designed to be powered by either the auxiliary power from a standard train or rail power from a DCC train.

TB2 and TB3 are the position inputs and are designed for reed relays such as the Standex-Meder ORD325-1015. Sensitivity is rated in AT units which is a function of the number of turns and current in a coil wrapped around the relay. However, we will be using magnets. The sensitivity is determined by the strength of the permanent magnet(s) placed on the train and how closely the magnet approaches the reed relay.

Connection between TB4 and the crossing bar servo(s) is by means of a standardized connector. Nearly all the available servos have red and black wires to aid in determination of the servo's

polarity. The third wire can be any color, but blue and yellow seem to be common.

There are connectors for two pairs of LEDs. Each pair of LEDS has a common line and two signal lines. The common (middle) lines connect to the long legs of the LEDs and the other lines connect to the short legs of the LEDs.

Other MtViewRR.com Electronic Products

Crossing Light Controller (CLC)

The discreet Crossing Light Controller (CLC) is an economy entry level product that may be purchased as a completed board or a Do It Yourself kit. The arrival of a train is sensed by means of sensors placed by the customer. The alternating lights and a signal for a crossing bar is generated. The lights are turned disabled and the crossing bar is raised after the train has passed. The actuation point is determined by sensor placement. The flashing rate is adjustable by a potentiometer on the board.

Digital Servo Controller (DSC)

The Digital Servo Control converts a digital signal into servo control signals to control scale devices such as crossing arms and rail switches. The rate of servo actuation can be set by means of an optional Digital Command Controller Interface (DCCI.) When used with a CLC the DSC may be powered by the CLC. When used in a standalone application the board may be powered by a 5 Volt power supply or a Mountain View Net Controller.

Mountain View Net Controller (MVNC)

The MVNC provides efficient power distribution and digital communication to electronic boards. Distributed power of 10 to 24 Volts is connected between boards by means of convenient modular connectors. The high voltage low current distributed voltage is converted to low voltage high current power required by various boards. When connected to a digital controller such as the MtViewRR DCC the Mountain View Net controller provides single point control and reporting of train activity to and from a central location.

Digital Crossing Signal Controller (DCSC)

The Digital Crossing Signal Controller provides alternating crossing lights, servo control signals, bell actuation and MtViewNet and traffic red light control that can be operated stand alone, in conjunction with MtView Net or DCC power.

Digital Command Controller (DCC)

The MtViewRR Digital Command Controller DCC provides full DCC operation to existing rolling stock and peripherals, but additionally provides power and a wired interface for items such as crossing controllers and track switches and other peripherals. MtViewRR digital components are designed to work with other manufacturers equipment, or in the enhanced MVNet modes.

Digital Command Controller Pendant (DCCP)

The MtViewRR Digital Command Controller Pendant (DCCP) is a DCC accessory that provides

operator interface for the MtView DCC.

Digital Command Controller Interface (DCCI)

The MtViewRR Digital Command Controller Interface (DCCI) is a DCC accessory that provides an operator interface by means of a USB computer such as a local tablet or laptop. This product may also be used to program MtViewRR products such as the DCSC or DCC including setting operational parameters or downloading firmware updates.

Digital Command Controller (WiFi)

The MtViewRR Digital Command Controller Interface (DCCI) is a DCC accessory that provides an operator interface by means of a WiFi connection. This provides connection between the DCC and a network device such as a handheld tablet or laptop.

Digital Command Controller Interface (DCCI)

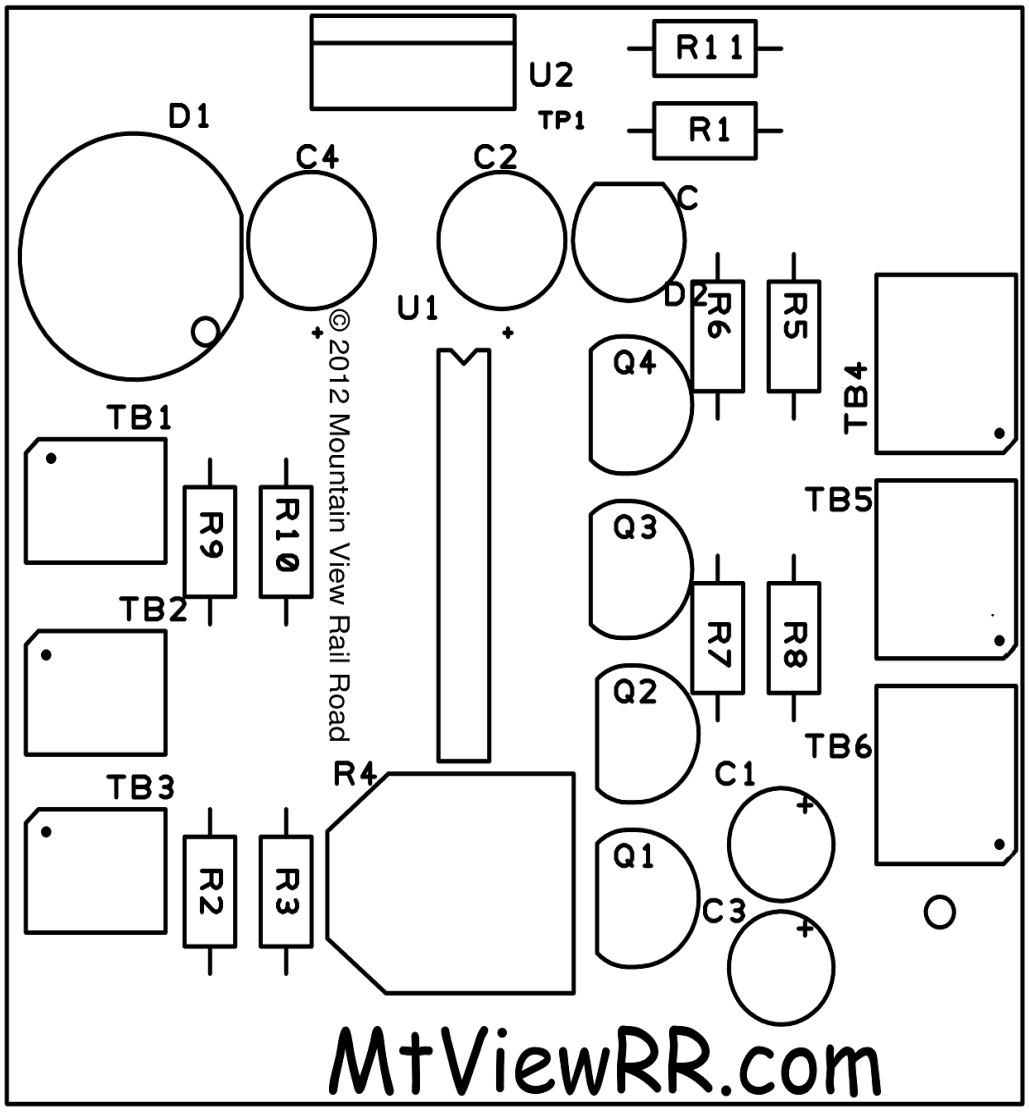
The MtViewRR Digital Command Controller Interface (DCCI) is a DCC accessory that provides an operator interface by means of a USB computer such as a handheld tablet or laptop.

MtViewNet

Communication between on-track train components is being handled efficiently by the present DCC components. In our opinion, off-track components can be handled in a more efficient manner. Mountain View Railroad products is pursuing a philosophy of dual communication channels. Our answer for off-track components is the MtViewNet communications system.

MtViewNet components communicate at up to 400 Khz rates and can support up to 1,000 devices. Connection between components is by means of two wire, bi directional communication. Our MtViewNet boards utilize a four or six conductor and modular connectors similar to telephone or Ethernet connectors to provide communications between a controller such as our DCC controller and peripherals such as our Digital Crossing Signal Controller.

Silk screen



• Denotes pin 1 of TB1 - TB6