Quadrature Outputs

The quadrature outputs are 5V logic levels that indicate the occupancy of the sensors. The output levels are driven by an isolated input voltage and are clamped to protect against voltage leaking into connected equipment.

The quadrature outputs can also be used to drive a load of up to 50mA or up to 5A with an isolated high current circuit.

Each WCU module terminates two sensors and has four quadrature outputs. Each output is used to indicate occupancy of coil 1 and coil 2 of each sensor.

Figure 1 below shows the quadrature output from coil 1 and coil 2 of a sensor generated in response to the detection of a wheel. Four phase detection is used to determine direction and count wheels. Overlap results where coil 1 and coil 2 both produce an output when a wheel is in the center of the sensor and both coils are activated.

See the Quadrature Wiring section for details on how to configure these outputs

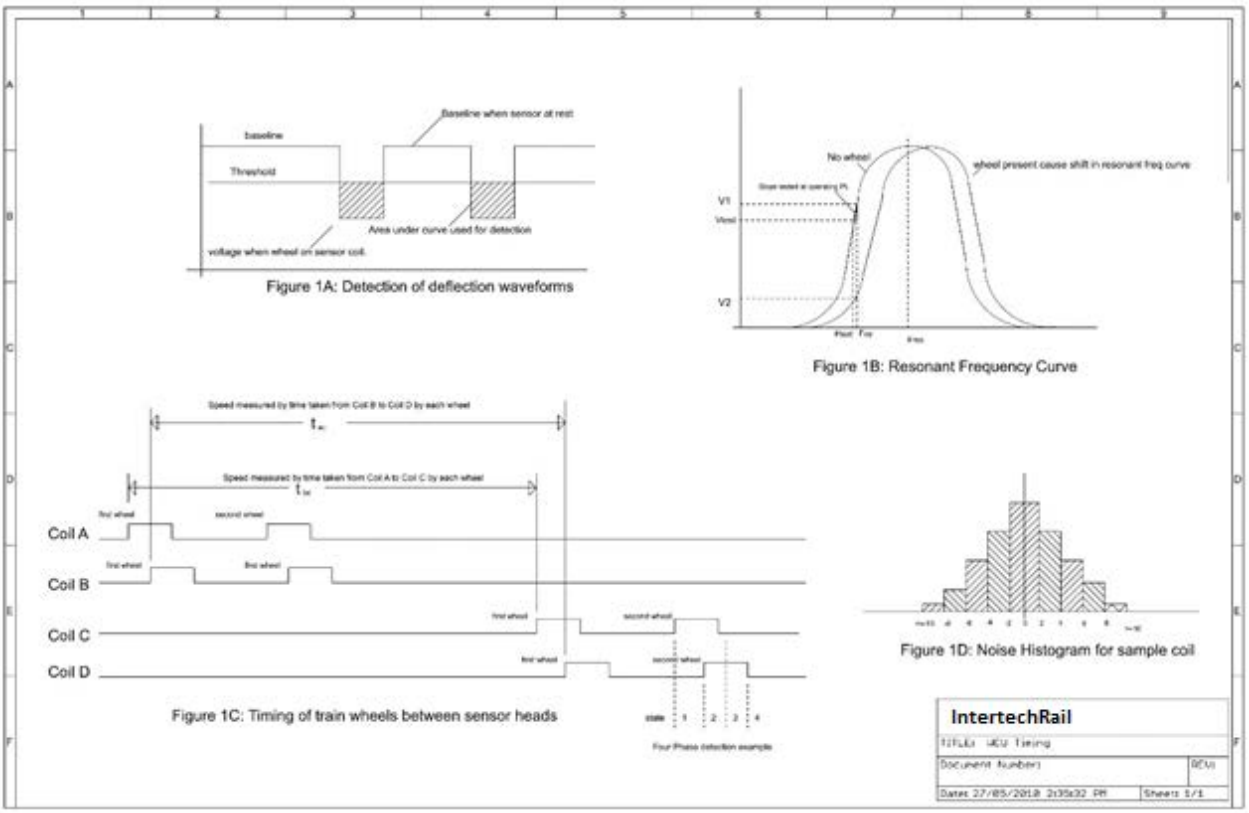


Figure 1 Quadrature outputs from the sensors

Digital Wheel Sensors

The digital wheel sensor mounts to the rail and detects the flange of each wheel as it passes over the sensor.

This is the standard size Sensor Head Unit. It is designed to fit most modern rail profiles.

Figure 2 Sensor in the correct, upright, positive orientation

The compact Sensor Head Unit is designed for lower profile rail such as the ASCE75 or 90 ARA-A profiles.

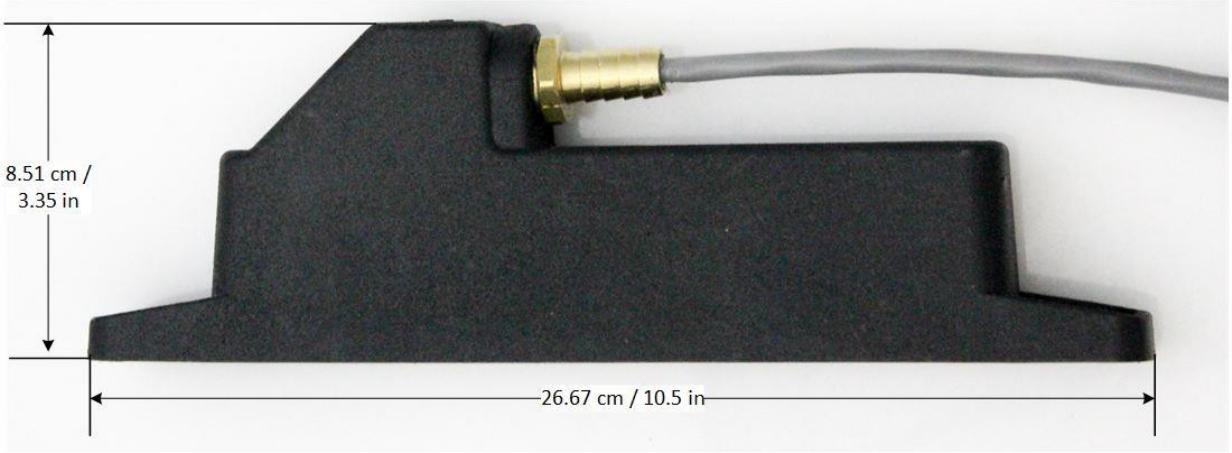


Figure 3 top view

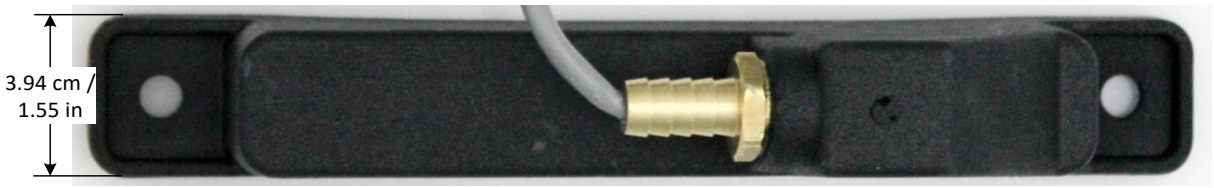


Figure 4 side view

Wheel Sensor Mounting

The Sensor Head Unit interfaces with the rail without making electrical contact. There is no modification to the track or ballast required. There is no need to modify any existing signal or track switches to accommodate any part of the system.

The wheel sensor cable must be protected in conduit or by other means of protection from the elements as it is not intended for direct burial. A length of flexible 1/2" ID hose (such as is shown below) must be attached to the barbed fitting to protect the cable from the elements and the SHU housing from stress from the weight and vibration of the cable.

In an ideal installation, the 50' cable supplied with the sensor head is sufficient to be routed directly to the WCU Terminator. If this is not possible, care must be made to ensure a robust and element-proof connection of the cabling to ensure the proper operation of the wheel sensor.

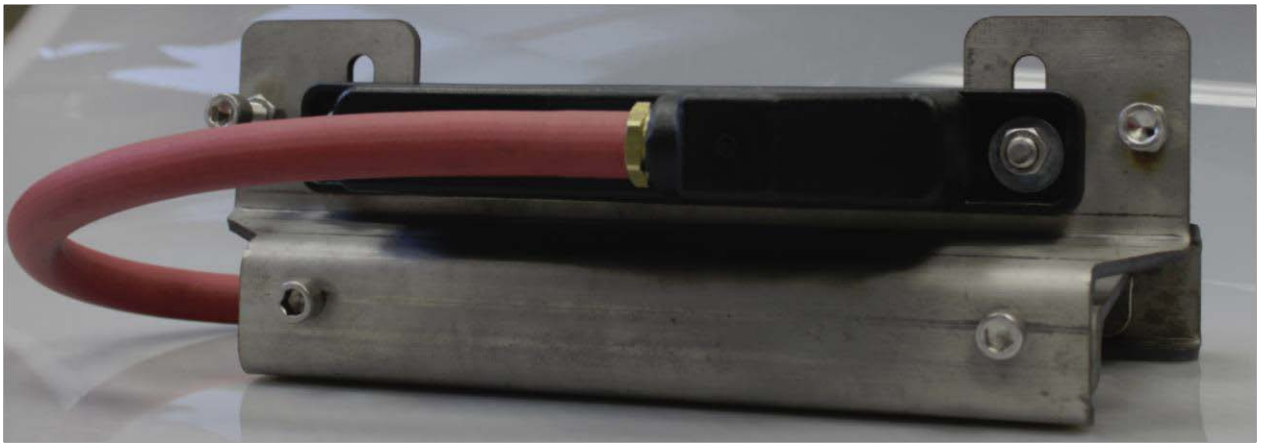


Figure 5 Sensor on bracket with the correct, right-side up orientation

Parts

Brackets are provided with the required hardware shown below. You may received nylon locking nuts in place of lock washers for the long bolts.

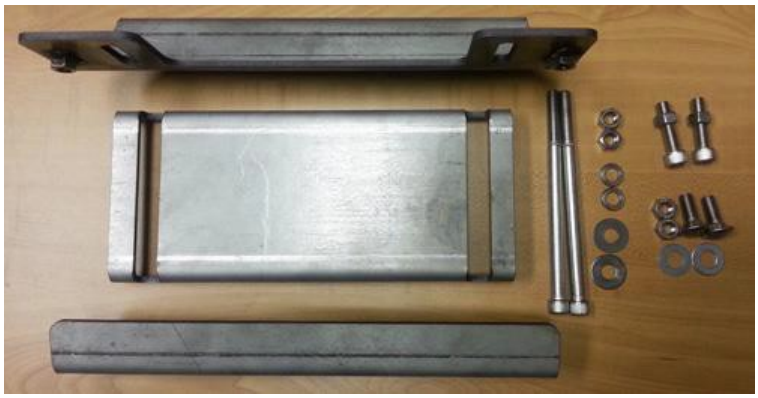


Figure 6 Bracket Parts

Tools

You will need an 8 mm hex/Allen key and a 14mm wrench or socket.

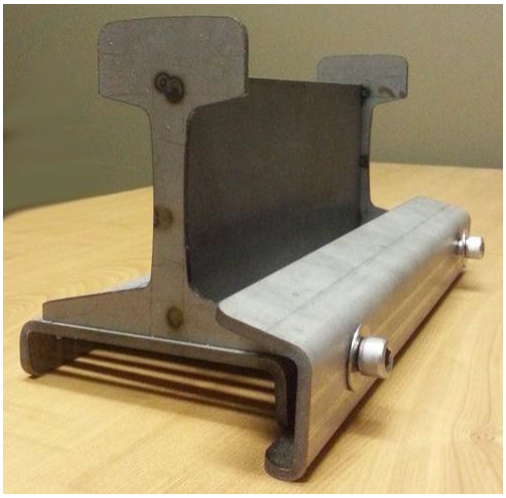
Step 1

Put the large washers or lock washers on the long bolts and place them through the holes on the small side plate. Rest the bolts in the slots of the bottom plate as shown below. The top of the side plate is the larger surface which angles upwards. This angled surface clamps onto the base of the rail.

The base plate should be positioned such that the bends on the sides are facing downwards. The bend in the base plate nestles under the bend on the side plate.

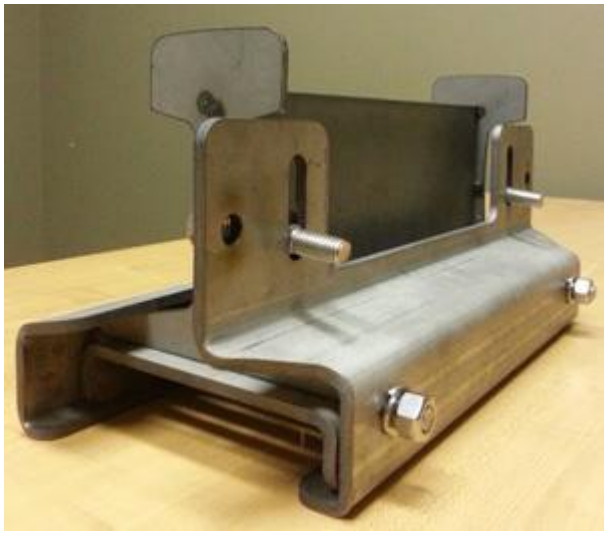
Step 2

Clear space under the rail and slide the bottom plate under holding the bottom plate and side plate together. The small side plate goes on the outside of the rail so that the bolts are pointing toward the other rail.



Step 3

Place carriage bolts in the slots on the large side plate so that the bolts are pointing away from the rail you are mounting to. Position large side plate so that the bottom bend tucks under the base plate. Position long bolts through the holes on the large side place and fasten with lock washers and nuts or locking nuts using the 8mm hex key or 14mm wrench on one side and the 14mm wrench or socket on the other.



Step 4

Place the carriage bolts through the holes on each side of the sensor. Fasten with the large washers or lock washers and nuts using the 14mm wrench or socket. For the sensor showing below, the cable should be coming out to the left when you are facing the rail to ensure that the sensor is right-side up.

Step 5

Place the vibration supressing bolts in the holes to either side of the sensor. These should be tightened until they make contact with the rail. Tighten the nut against the bracket to hold these bolts firmly in place.

Step 6

Adjust the height of the sensor by sliding it up and down within the slots in the large side plate. The sensor should be raised such that the top of the sensor is 40 – 45mm from the ball of the rail head and the nuts tightened down against the mounting tabs of the sensor.

Sensor Mounting

To mount the sensor right-side up, the cable should be coming out to the left when you are facing the rail. The correct orientation is shown in Figure 1.

Sensor Direction

The direction of the wheel sensor is critical to the correct operation of the system. The direction of wheel strikes must be counted consistently (e.g. all wheel sensors register a given direction as positive and negative in the opposing direction) and in the correct orientation for the application to function. As such, it may be necessary to install the sensor in one physical orientation, but then reverse the polarity.

This can be accomplished by a wiring change at the WCU and is outlined in the WCU Terminator section of this manual.

Electronic Modules

The WCU Module

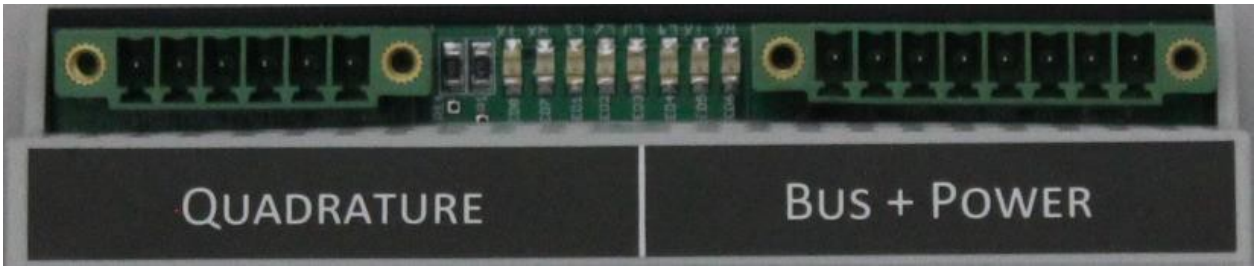
The Terminator module terminates the cables from the sensors and connects to any digital module. Each Terminator can operate 2 wheel sensors. Each wheel sensor is addressable individually so they appear as two separate systems.

An 8 conductor cable of up to 60 m (200 feet) in length is used to connect the wheel sensor to the Terminator, as shown in the table below. 15m (50 feet) of cable is supplied with each sensor.

Identifying Revisions

Revision 1.1 has 8 LEDs adjacent to the quadratre output connector. The additional LEDs are used as status indication for the second RS-485 bus on Pins 7&8.

WCU LEDs

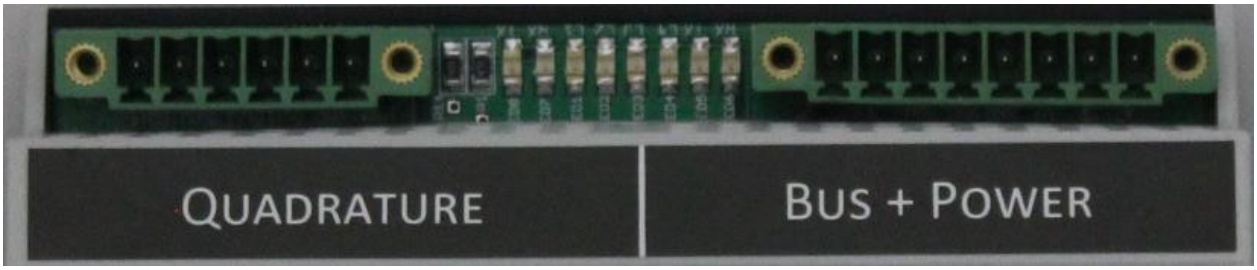


The following table describes the WCU-RS (wired terminator) LEDs from left to right, assuming Sensor A and Sensor B are on opposing rails. See the wiring for opposing rails in the WCU Wiring section below.

LED Label	Function	Notes
TX	RS485 transmit	Flashes when data transmitted over wired bus

RX	RS485 receive	Flashes when data received over wired bus
L1	Sensor B Coil 2 Occupied	On when coil occupied, otherwise off Quadrature Out 1 High, otherwise Low
L2	Sensor B Coil 1 Occupied	On when coil occupied, otherwise off Quadrature Out 2 High, otherwise Low
L3	Sensor A Coil 1 Occupied	On when coil occupied, otherwise off Quadrature Out 3 High, otherwise Low
L4	Sensor A Coil 2 Occupied	On when coil occupied, otherwise off Quadrature Out 4 High, otherwise Low
TX	Log bus transmit	Flashes when data transmitted (only if log bus is used)
RX	Log bus receive	Flashes when data transmitted (only if log bus is used)

WCU LEDs



The following table describes the WCU-SW (wireless terminator) LEDs from left to right, assuming Sensor A and Sensor B are on opposing rails. See the wiring for opposing rails below.

LED Label	**Function**	**Notes**
TX	Wireless transmit	Flashes when data transmitted over wireless bus
RX	Wireless receive	Flashes when data received over wireless bus
L1	Sensor B Coil 2 Occupied	On when coil occupied, otherwise off Quadrature Out 1 High, otherwise Low
L2	Sensor B Coil 1 Occupied	On when coil occupied, otherwise off Quadrature Out 2 High, otherwise Low
L3	Sensor A Coil 1 Occupied	On when coil occupied, otherwise off Quadrature Out 3 High, otherwise Low
L4	Sensor A Coil 2 Occupied	On when coil occupied, otherwise off Quadrature Out 4 High, otherwise Low
TX	Log bus transmit	Flashes when data transmitted (only if log bus is used)
RX	Log bus receive	Flashes when data transmitted (only if log bus is used)

WCU Quadrature Modes

The WCU has four modes of operation for the quadrature outputs. The modes are selected using dip switches 3 and 4. To access the dip switches, pop open the lid of the module by grasping it from the top of the logo and hinging open downwards.

To enable a new mode, you must select the appropriate settings for switches 3 and 4 and then hold down both of the red buttons while you apply the power. The buttons can be released after 1-2 seconds to retain the new setting.

Real Time Mode (Factory Default)

The factory default setting for the Quadrature outputs is real time mode. Both switch 3 and 4 are ON and do not need to be changed. In this mode, the quadrature outputs will go high in real time as a wheel passes over the sensor coils. See the tables in the LED sections above to determine which LED corresponds with which output.

Motion Detection Mode

To enable motion detection mode, unplug the power and move switch 3 to the OFF position and switch 4 to the ON position. Hold down both red buttons when you apply the power and hold them for 1-2 seconds.

When in motion detection mode, each of the quadrature outputs will stay high for approximately 10 seconds following the detection of motion over the sensor and coil that corresponds with each output.

For example, if you apply metal to Coil 1 of Sensor A, L3 and Quadrature Out 3 will stay high for 10 seconds.

Long Pulse Mode

To enable long pulse mode, unplug the power and move switch 3 to the ON position and switch 4 to the OFF position. Hold down both red buttons when you apply the power and hold them for 1-2 seconds.

When in long pulse mode, L1 and Quadrature Out 1 will go high when metal passes over Sensor A and will stay high until metal passes over Sensor B. Going the other direction, L2 and Quadrature Out 2 will go high when metal passes over Sensor B and stay high until metal passes over Sensor A.

Long pulse mode can be used to calculate speed by recording the time that the pulse is high for and dividing that time by the distance between the sensors.

Short Pulse Mode

To enable short pulse mode, unplug the power and move switch 3 to the OFF position and switch 4 to the OFF position. Hold down both red buttons when you apply the power and hold them for 1-2 seconds.

When in short pulse mode, L1 and Quadrature Out 1 will go high when metal passes over Sensor A Coil 1 and will go low when metal passes over Sensor A Coil 2. Going the other direction, L2 will go high when metal passes over Sensor A Coil 2 and go low when metal passes over Sensor A Coil 1.

Short pulse mode can be used to calculate speed with a signal sensor with accuracy up to about 30 mph / 50 kph by recording the time that the pulse is high for and dividing that time by 4 ¼ inches / 10.8 cm which is the distance between the two coils.

WCU Wiring

Wheel Sensor Head to Terminator Wiring (Sensor A and Sensor B)

If sensors are placed on opposite rails, both sensor connectors are wired the same as shown in column 3 below. If the sensors are placed on the same rail, the polarity of sensor B must be reversed for the direction to work properly. This wiring is shown in column 4.

Sensor Signal	Wire Color	Sensor A/B (Opposing Rails)	Sensor B (Same Rail)
COIL B	WHT w/ BLK	1	**2**
COIL A	GRN	2	**1**
NC		3 (Empty)	3 (Empty)
OSC B	BLU	4	4
OSC A	RED w/ BLK	5	5
TEST B	WHT	6	**7**
TEST A	ORN	7	**6**
POWER	RED	8	8
GND + SHIELD	BLK	9	9

BUS+POWER Wiring

SIGNAL	PIN
LOG BUS A	1
LOG BUS B	2
POWER	3
GND	4
GND	5
GND	6
SYSTEM BUS A	7
SYSTEM BUS B	8

Quadrature Wiring – Terminal Block

The wiring below assumes that sensors are positioned such that wheel counts are positive when activating from left to right and the sensors are right side up.

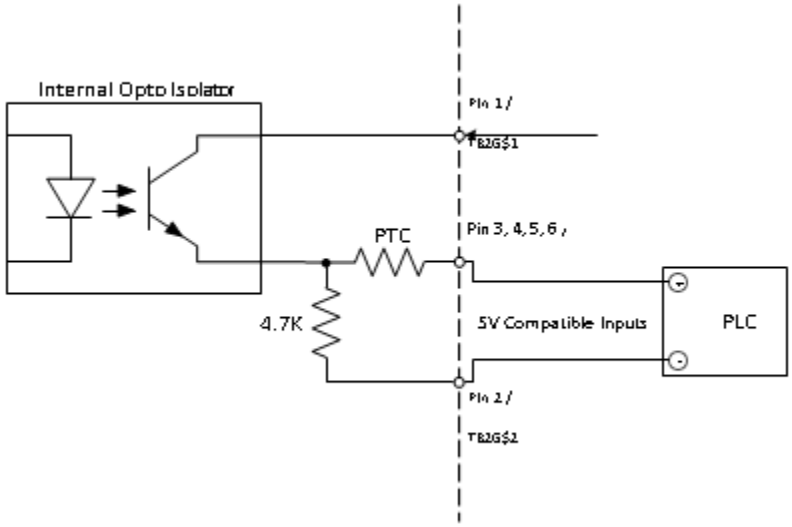
For the correct orientation of the sensor, the cable should be coming out to the right if you are facing the rail it is mounted on (see Figure 2).

For the correct orientation of the SHU-C, the sensor cable should be coming out to the left if you are facing the rail it is mounted on (see Figure 5).

SIGNAL	PIN
POWER	1
GND	2
Sensor B Coil 1	3
Sensor B Coil 2	4
Sensor A Coil 1	5
Sensor A Coil 2	6

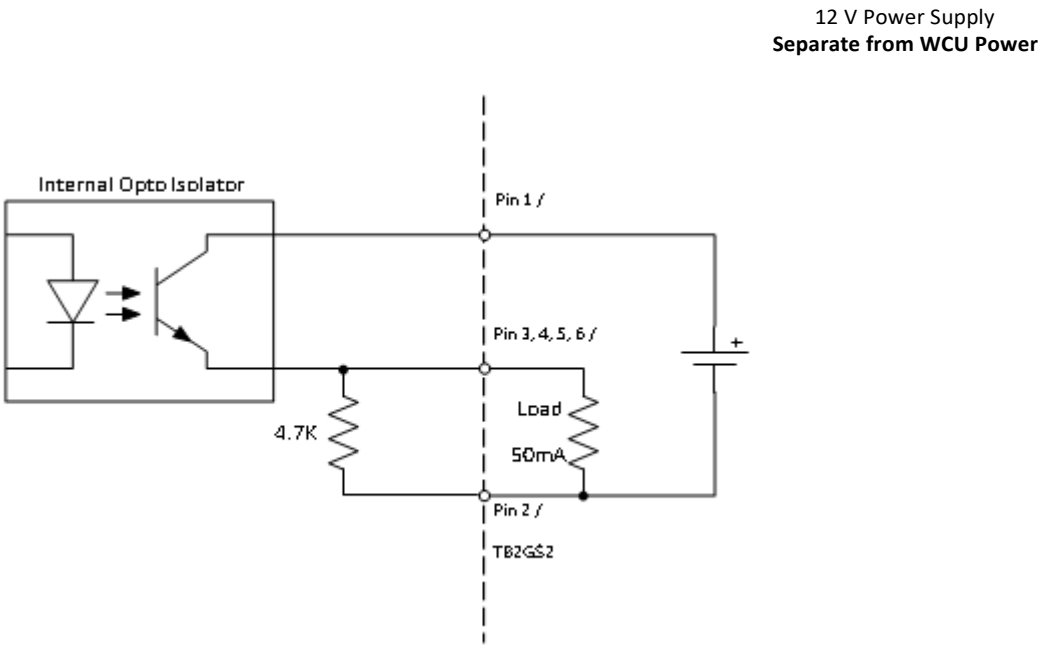
Quadrature Wiring – Voltage Mode CMOS Output

This mode is used to interface with a PLC or other logic controller.



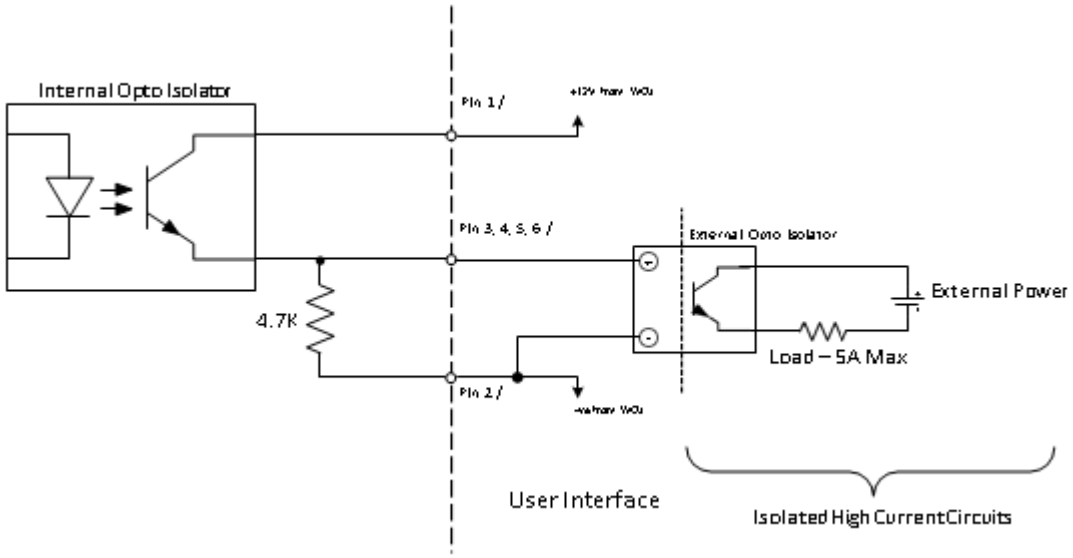
Quadrature Wiring – Current Mode

This mode is used to drive a low current relay. The power supply for the output circuit should be separate from the WCU power supply.



Quadrature Wiring – External High Current Driver

This mode is used to drive a higher current relay. If the WCU is powered from a battery, all of the 12V sources in the diagram below can use the same battery.



WCU Address Configuration

Terminator Address Configuration (Rev. 1.0)

Address	SW6	SW7
A B	OFF	OFF
C D	OFF	ON
E F	ON	OFF
G H	ON	ON

Terminator Address Configuration (Rev 1.1)

Address	SW5	SW6	SW7	SW8
A B	ON	ON	ON	ON
C D	ON	ON	ON	OFF
E F	ON	ON	OFF	ON
G H	ON	ON	OFF	OFF
I J	ON	OFF	ON	ON
K L	ON	OFF	ON	OFF
M N	ON	OFF	OFF	ON
O P	ON	OFF	OFF	OFF

WCU Programming Enable Mode (Revision 1.1 and above)

Both buttons must be depressed at power on and then released within the first 3 seconds of power up, SW1 and SW3 must be in the OFF position (LEDs off) to enable programming**.** When the address is set, the address is saved permanently to flash. The rocker switch is therefore ignored unless the above sequence is observed.

WCU Connectors

Connector	Part Number	Details
Quadrature	Phoenix Contact 1748011	6 POS 3.81mm
Bus+Power	Phoenix Contact 1748419	4 POS 3.81mm
Sensor A	Phoenix Contact 1748422	9 POS 3.81mm
Sensor B	Phoenix Contact 1748422	9 POS 3.81mm