USB-LP-2

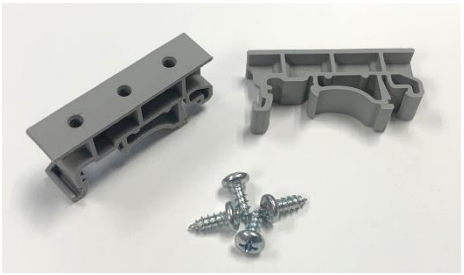
Low-Voltage Vehicle Loop Detector

With USB functionality and Two Loop Channels

The USB-LP-2 vehicle detector senses metallic objects near connected induction loops. The detector is able to simultaneously monitor two vehicle detection loops and provide vehicle presence indication for each loop separately. Each loop channel has two configurable relay outputs (four total) that can be used to transmit vehicle presence status to a gate/door operator. The USB-LP-2 also has a USB communication interface that can be used to change settings and receive vehicle detection information in real time. The detector has mounting holes to attach the provided DIN rail mounts for easy and seamless mounting.

USB-LP-2, includes:

One USB-LP-2 PCB



Two DIN mounts + 4 Screws

Specifications

Power	12-30 VDC or 12-24 VAC
Draw Current (Standby/Detect)	40mA + 30mA per active relay
Loop Frequency	4 settings (low, med-low, med-hi, high)
Loop Inductance	20-2000 µH (Q factor ≥ 5)
Surge Protection	MOVs + EMI Filters
Relay Outputs	Four Relays (Two for each channel)
Contact Rating (Resistive Load)	2 A @ 30 VDC, 0.5 A @ 125 VAC
Operating Temperature	-30° to 150°F (-34° to 65°C) 0 to 95% relative humidity
Environmental Rating	None
Connections	17 Screw Terminals
USB Connector	USB Mini-B
Dimensions (L x W x H)	145 mm (5.75”) x 83 mm (3.25”) x 34 mm (1.25”)

Wiring Connections

	Description	Screw Terminal Label
	Power Input Positive (12-30VDC or 12-24VAC)	PWR +
	Power Input Negative (12-30VDC or 12-24VAC)	PWR -
	Earth Ground Connection + Loop Shield Connection	EARTH GND
Channel 1 Outputs	Relay 1A, Normally Closed Contact	RELAY 1A - NC
	Relay 1A, Common Contact	RELAY 1A - COM
	Relay 1A, Normally Open Contact	RELAY 1A - NO
	Relay 1B, Normally Open Contact	RELAY 1B - NO
	Relay 1B, Common Contact	RELAY 1B - COM
Channel 2 Outputs	Relay 2A, Normally Closed Contact	RELAY 2A - NC
	Relay 2A, Common Contact	RELAY 2A - COM
	Relay 2A, Normally Open Contact	RELAY 2A - NO
	Relay 2B, Normally Open Contact	RELAY 2B - NO
	Relay 2B, Common Contact	RELAY 2B - COM
	Channel 1 Loop Input	LOOP1 INPUT
	Channel 1 Loop Input	LOOP1 INPUT
	Channel 2 Loop Input	LOOP2 INPUT
	Channel 2 Loop Input	LOOP2 INPUT

*Relays Outputs can be reconfigured to be normally energized using DIP switches or USB. This will flip which terminals are normally open and closed.

USB Connector

The USB-LP-2 has a single USB Mini-B connector located to the left of the screw terminals. This USB interface can be used to receive real-time detection status and reprogram settings/sensitivity. For more information on USB communication, go to page 7.

Baud Rate	Parity	Data Bits	Stop Bits
9600	Even	7	1

Controls and Indicators

1. **ULTRAMETER Display**
   This display will show how strong of a signal is being produced by metallic objects near the loop. This is normally used to help set the proper sensitivity setting, but can also be used to observe crosstalk/interference.

   When the loop isn't seeing any objects or crosstalk, the display will be blank. (As shown in photo to right)

   Weak signals will be indicated by numbers closer to 9 and strong signals will be indicated by numbers closer to 0.

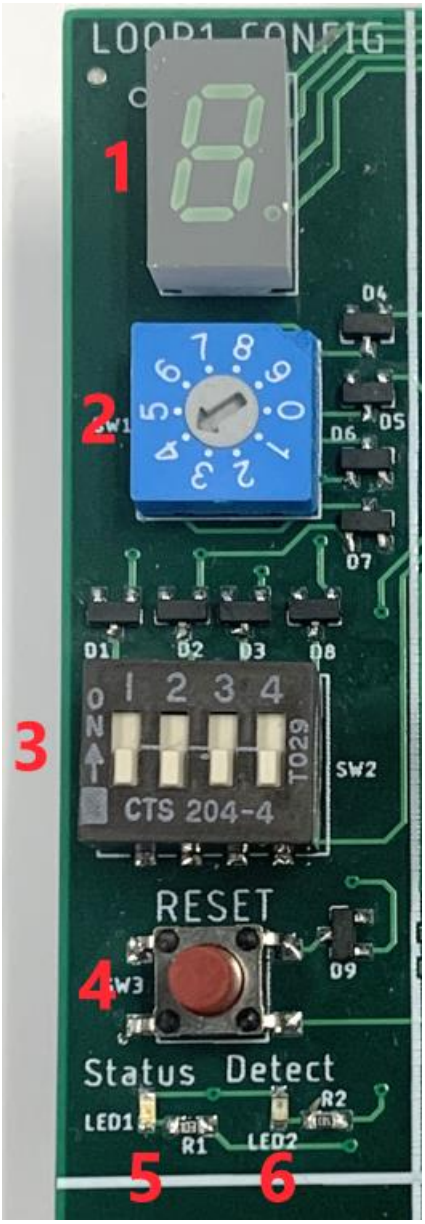
2. **Sensitivity Setting BCD Switch**
   This 10-position rotary switch allows for adjustment of the detection threshold. A setting of 0 is very low sensitivity, and a setting of 9 is very high sensitivity. Most applications require a setting of 3 or 4. The dial must be set to a one number, there are no half settings.

TIP: Most settings can also be changed via USB commands

3. **Channel Settings DIP Switch**
   The DIP switch settings are explained on the next page.

4. **Channel Reset Push Button**
   Pressing this push button makes the detector recalibrate to the loops current environment. Don't press this while there are vehicles or metallic objects near the loop that won't remain there forever. This operation is automatically performed for both loops on powerup.

Loop 1 Settings and Indicators,
*Loop 2 is identical using switches/displays under "Loop2 Config"



5. Channel Status Indicator

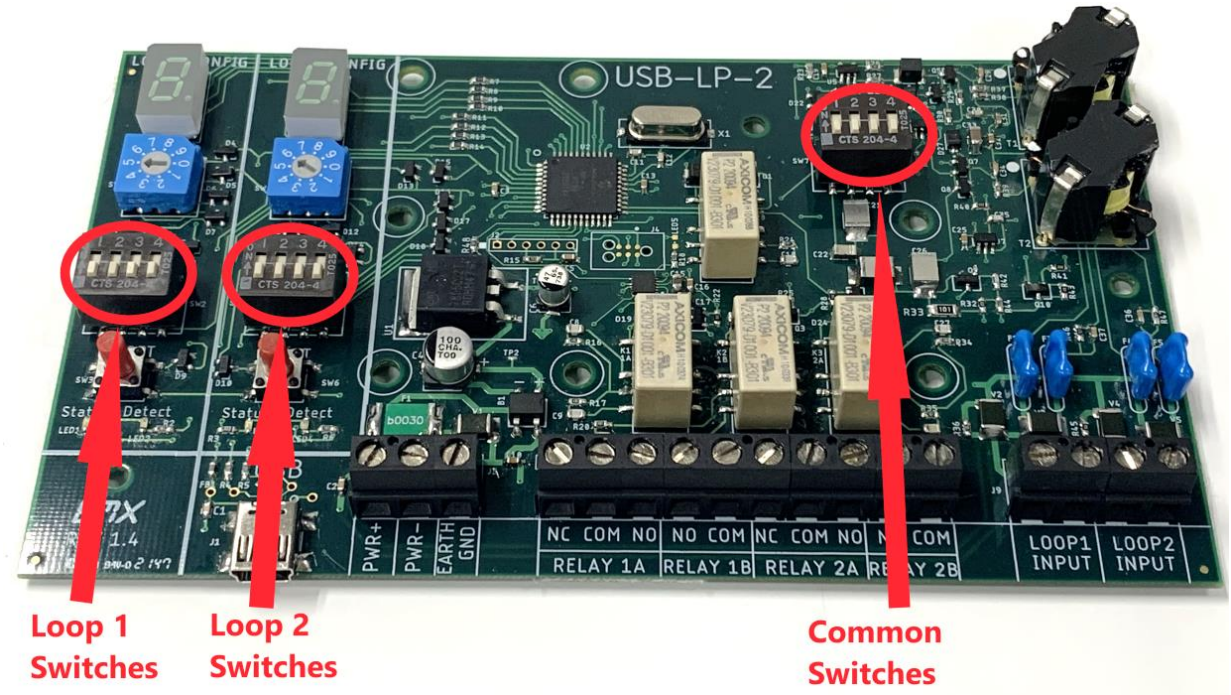
Healthy Loop	Solid Green
Current Loop Fault	Constant Flashing
Previous Loop Fault	Intermittent Flashing

6. Channel Detect Indicator

Presence Detected	Solid Red
No Presence	Off

DIP Switch Settings

Use the image below for help in finding where the switches are located



1. Loop 1 and Loop 2 DIP Switches

Each channel has its own settings DIP switch, but the functions tied to each position are identical. These DIP switches can be found in the corresponding "LOOP CONFIG" area of the PCB.

DIP Switch 1 – Relay A Normally Un-energized (OFF) or Normally Energized (ON)
This DIP switch determines whether relay A of the channel is energized by default or not. This can be used to make the board fail-safe or fail-secure in power-loss scenarios. The relay contacts are labeled as if the relays are normally un-energized. Turning this DIP switch on will cause the relay contacts to be backwards. For example, with DIP1 set to ON, the R1,NO contact will be closed until a vehicle detection occurs.

DIP Switch 2 – Relay B Normally Un-energized (OFF) or Normally Energized (ON)
DIP switch 2 behaves identical to DIP switch 1 as described above but will apply to Relay B of the corresponding channel.

DIP Switch 3 – Relay B same as A (OFF) or Relay B pulse on Entry (ON)
If DIP switch 3 is set to OFF, relay B will activate whenever relay A activates. If this switch is ON, relay B will pulse on for about 400ms. This pulse duration is configurable via USB.

DIP Switch 4 – No Detect-On-Stop (OFF) or Detect-On-Stop (ON)
Turns Detect-On-Stop On or Off for the corresponding channel. Detect-On-Stop will require the detecting object to come to a complete stop for about two seconds before the detector activates.

2. Common DIP Switches

These DIP switches apply to both loops simultaneously. The switches can be found in the top right of the PCB near the label "FREQUENCY ADJUST". Refer to the image on the previous page.

DIP Switch 1 and 2 – Frequency Control

DIP 1 and 2 allow for changing of the loops operating frequency. This is useful if you have multiple detectors in a single location as loops operating on similar frequencies have a potential to crosstalk and cause false detections. The actual operating frequency of a loop is dependent upon the quality and size of the actual loop wire. Use the chart below for changing between different frequencies.

Frequency Settings	DIP Switch	
	1	2
Low	on	on
Medium Low	off	on
Medium High	on	off
High	off	off

DIP Switch 3 – No Automatic Sensitivity Boost (Off) or Automatic Sensitivity Boost (ON)

When this switch is on, the detector will perform an automatic sensitivity boost after an initial detection. This feature is useful to prevent detection drop-outs on high-bed vehicles. After the detected vehicle is longer seen by the loop, the detection sensitivity returns to the users setting.

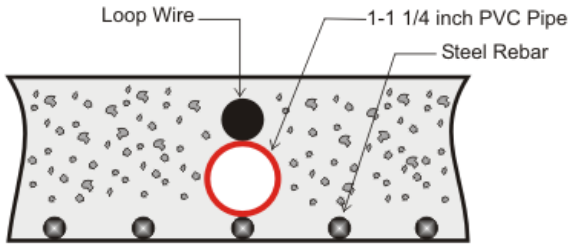
DIP Switch 4 – No AB logic (OFF) or Loops use AB logic (ON)

This mode can be used if it is important to determine the direction of travel of a vehicle that is passing over both loops. When AB logic is turned on, channel 1 will activate if a vehicle first enters loop1 and then proceeds to loop2. Channel 2 will activate if a vehicle first enters loop2 and then proceeds to loop1.

Loop Installation

NEW SLAB POUR

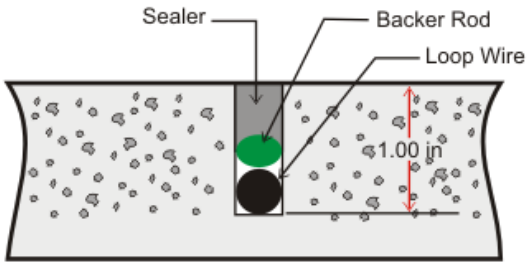
Ty-wrap 1-1/4" PVC pipe to the top of the rebar in the size and configuration of the loop (ex. 4' x 8'). Then ty-wrap the loop to the top of the PVC frame. This stabilizes the loop during the pour and separates it from the rebar.



Concrete Slab Cross View

SAW CUT EXISTING SURFACE

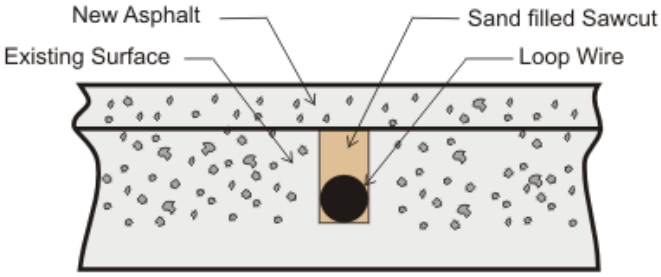
Cut 1" deep into the existing surface, place a 45° cut at the corners to prevent sharp edges from damaging the loop wire. Notch out for the "T" connection where the lead wire connects to the loop. Remove all debris from the finished cut with compressed air. Place the loop into the saw cut. Place backer material into the saw cut over the loop wire and pack tightly. Place a high-quality sealer over the saw cut to seal the surface.



Concrete Slab Cross View

RESURFACE ASPHALT

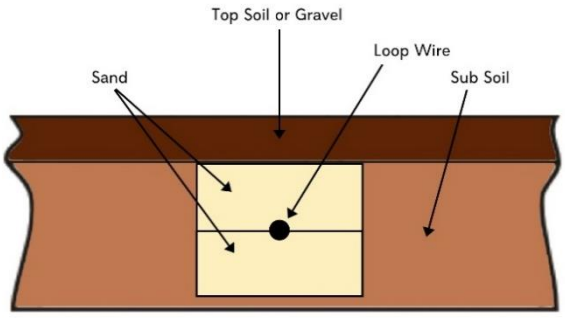
Saw cut the existing surface ¾" deep and place a 45° cut at the corners to prevent sharp edges from damaging the loop wire. Remove all debris from the finished cut with compressed air. Place sand over the loop wire to the surface and pack tightly. Lay new asphalt.



Asphalt Re-surface

GRAVEL OR SOIL INSTALLATION

While this is not a recommended installation for most loops, it has been used successfully with proper preparation. Remove gravel or top soil until reaching a stable base. Dig ~ 6-8" deep by ~ 6-8" wide. Fill halfway with sand and pack tightly. Place the loop into the trench and finish filling to level with sand. Pack tightly and replace gravel or soil over top.



GENERAL INSTALLATION GUIDELINES

- Use EMX lite preformed loops for quick, reliable installations.
- It is not recommended to install a loop near power lines (overhead or underground) or low voltage lighting. If necessary near these power sources, place at a 45° angle. Make the loop shape a diamond, not a square.
- Never install a loop near inductive heaters.
- If using a non-preformed loop, lead-in wire (wire from loop to detector) must be twisted a minimum of 6 turns per foot to avoid the effects of noise or other interference.
- Detection height is approximately 70% of the shortest side of the loop.
  For example: detection height for a 4' x 8' loop = 48" x .7 = 33.6"

USB Communications

1. This section defines the communications between the USB-LP-2, termed the "Sensor", and a computer or other entity to which it is connected, termed the "Host". The sensor is intended to engage in two-way communications only.

2. All communications are in 7-bit ASCII and are in the form of either a packet or of a two-character negative acknowledgment (?<cr>) termed a "Nak". The communication parameters are 9600,E,7,1, meaning 9600 baud, even parity, 7 data bits, and one stop bit (ten bits per character).

3. There are three types of packets: "Commands", "Responses", and "Notifications". All packets end with a <cr> character. All three packet types may contain "Data Items". Each Data Item is always preceded by a comma and consists of one or more hexadecimal digits with letters always uppercase. Every Command, Response, and Notification specific to the ULT-LP2-USB Sensor is defined and detailed later in this document.

3.1. Commands are sent only by the Host to the Sensor. Each Command begins with a '!' character followed by a single "Command Character", followed by zero or more Data Items depending upon the specific Command. Each Command Character is a letter; both cases are used. Commands may be missing certain Data Items, depending upon the Command. Whenever a Data Item is missing the comma that would have preceded it is always sent.

3.1.1. The Sensor has limited processing capability, and it must be recognized that once the Host sends a Command it should wait for the Sensor's Response (or Nak) before further transmission. Otherwise characters the Host sends may be lost, and this will generally cause the Sensor to enter an error state regarding character reception (§4 and §4.1).

3.1.2. If a Command results in an Error Response (§3.2.1) the Sensor does not process it beyond sending the Error Response.

3.2. Responses are sent only by the Sensor to the Host. The Sensor sends a Response to every Command. Each Response begins with a '!' character followed by the Command Character of the Command to which it is responding. If the Sensor understood the Command then the Response's Command Character is followed by the Data Items requested by the Command, if any.

3.2.1. If the Sensor receives a Command that is correct in form but which it nevertheless does not understand, then it returns an "Error Response" with an 'e' immediately following the Command Character and a single hexadecimal digit (uppercase if a letter) following that. The digit, an "Error Code", specifies the nature of the error the Sensor perceived. An Error Code of '0' means that the there is no valid Command associated with the Command Character. An Error Code of '1' means that the number of Data Items, whether or not missing (§3.1), is incorrect for the Command (i.e., wrong number of commas). Other Error Codes are specified for the individual Commands. If there are multiple errors in a Command then the Sensor returns the Error Code of the first error it discovers.

3.3. Notifications are sent only by the Sensor to the Host. Each advises the Host that one or more events concerning the Sensor has taken place. Each Notification begins with an '@' character followed by a single "Notification Character", followed by zero or more Data Items depending upon the specific Notification. Each Notification Character is a letter; both cases are used. No Response from the Host to any Notification is specified.

4. Whenever the Sensor receives a communication that is not a Nak and is not in the form of a Command as described above, or that otherwise appears to have been corrupted in transmission, it responds with a Nak. Normally the Host resends its last Command upon receipt of a Nak.

4.1. Whenever the Sensor receives a character that is invalid with respect to the form of a Command or Nak, or that otherwise appears to be corrupted in transmission, it enters an error state regarding its reception of characters. Only the subsequent receipt of a valid <cr> character clears this error state and causes the Sensor to send the corresponding Nak.

5. Whenever the Sensor receives a Nak it resends the last Notification that it transmitted completely. Any Data Items in this resent Notification are current, i.e. they may have changed since it was sent previously.

6. The Sensor accepts and ignores, but does not require, a single <lf> character following every valid <cr> character it receives.

7. In accordance with the above, the only characters that are communicated are as follows (note that whitespace is specifically not allowed):

a. A '!' or '@' to begin every packet.
b. Letters 'A' through 'Z' and 'a' through 'z' as Command Characters and Notification Characters.
c. A ',' to precede every Data Item, whether or not missing.
d. Numbers '0' through '9' and letters 'A' through 'Z' for Data Items and Error Codes.
e. An 'e' to designate an error.
f. A '?' for every Nak.
g. A <cr> to end every packet and Nak.
h. A single optional <lf> sent to the Sensor immediately following a <cr> sent to it.

USB Commands and Responses

8. Commands and Responses.

8.1. Read frequencies.

Purpose: Returns the acquisition target frequencies of both loops.
Command: !f,<cr>
Responses: !f,aa,bb<cr>
Where aa = frequency for loop-1 in kHz
bb = frequency for loop-2 in kHz
!fe1<cr> = Incorrect number of data items
Note: For the current loop frequency or frequencies use !R before this command

8.2. Reset loop(s).

Purpose: Resets frequency acquisition from one or both loops
Command: !R,a<cr>
Where a = Which loop or loops (1 through 3).
1 = Loop-1.
2 = Loop-2.
3 = Both Loop-1 and Loop-2.
Responses: !R<cr> = Command accepted and processed.
!Re1<cr> = Incorrect number of Data Items.
!Re2<cr> = Invalid Data Item.
Note: Also clears past loop faults for the specified loop or loops.

8.3. Read relays.

Purpose: Gets the status of all four relays.
Command: !r<cr>
Responses: !r,a<cr>
Where a = Relays status (0 through Fh).
bit 0 (1/0) = Loop-1 relay A energized/de-energized.
bit 1 (1/0) = Loop-1 relay B energized/de-energized.
bit 2 (1/0) = Loop-2 relay A energized/de-energized.
bit 3 (1/0) = Loop-2 relay B energized/de-energized.
!re1<cr> = Incorrect number of Data Items

USB Commands and Responses (Continued)

8.4. Read settings.

Purpose: Gets current Settings from Sensor
Command: !s<cr>
Responses: !s,a,b,c,d,e<cr>
Where a = Loop-1 sensitivity (0 through 9).
b = Loop-1 settings (0 through Fh).
bit 0 (1/0) = Relay A normally closed/open.
bit 1 (1/0) = Relay B normally closed/open.
bits 3,2 = Relay B function.
00 = Presence.
01 = Pulse on entry (detect).
10 = Pulse on exit (undetect).
11 = Loop fault.
c = Loop-2 sensitivity (0 through 9).
d = Loop-2 settings (0 through Fh).
bit 0 (1/0) = Relay A normally closed/open.
bit 1 (1/0) = Relay B normally closed/open.
bits 3,2 = Relay B function.
00 = Presence.
01 = Pulse on entry (detect).
10 = Pulse on exit (undetect).
11 = Loop fault.
e = Detect-On-Stop and global settings (0 through Fh).
bit 0 (1/0) = Loop-1 Detect-On-Stop on/off.
bit 1 (1/0) = Loop-2 Detect-On-Stop on/off.
bit 2 (1/0) = Automatic Sensitivity Boost on/off.
bit 3 (1/0) = AB Logic on/off.
!se1<cr> = Incorrect number of Data Items.

8.5. Send settings.

Purpose: Sends settings to the sensor.
Command: **!S**,a,b,c,d,e<cr>
where the five Data Items are the same as those returned by the **!s** command
Note: Any but not all of the Data Items may be missing.
Responses: !S<cr> = Command accepted and processed
!Se1<cr> = Incorrect number of Data Items.
!Se2<cr> = Invalid Data Item.
!Se3<cr> = All five Data Items missing.

8.6. Read pulse time.

Purpose: Returns the pulse duration for Relay-B pulse on entry (detect) or on exit (undetect)
Command: **!t**<cr>
Responses: **!t**,aa<cr>
Where aa = the pulse duration in deciseconds from ½ second through 10 seconds (05 through 64h).
!te1<cr> = Incorrect number of data items.

8.7. Send pulse time.

Purpose: Sends the Sensor the pulse duration for Relay-B pulse on entry (detect) or on exit (undetect).
Command: **!T**,aa<cr>
where the data item is the same as that returned by the **!t** command.
Responses: **!T**<cr> = Command accepted and processed.
!Te1<cr> = Incorrect number of data items.
!Te2<cr> = Invalid data item.

8.8. Read faults.

Purpose: Returns current and past faults of both loops.
Command: **!u**<cr>
Responses: **!u,**a,b<cr>
Where a = Loop-1 faults (0 through Fh).
bits 1,0 = Current fault.
00 = No fault.
01 = Frequency out of target range.
10 = Frequency < 20kHz.
11 = Frequency > 150kHz.
bits 3,2 = Past fault; same encoding as current fault.
b = Loop-2 faults (0 through Fh); same encoding as loop-1 faults.
!ue1<cr> = Incorrect number of Data Items.

USB Notifications

9. Notifications

9.1. Loop-1 entry (detection) output.

Purpose: Informs the host that the Loop-1 output has just been activated
Notification: @a<cr>

9.2. Loop-2 entry (detection) output.

Purpose: Informs the host that the Loop-2 output has just been activated
Notification: @b<cr>

9.3. Powerup

Purpose: Informs the Host that the Sensor has just been powered.
Notification: @p<cr>

9.4. Settings change.

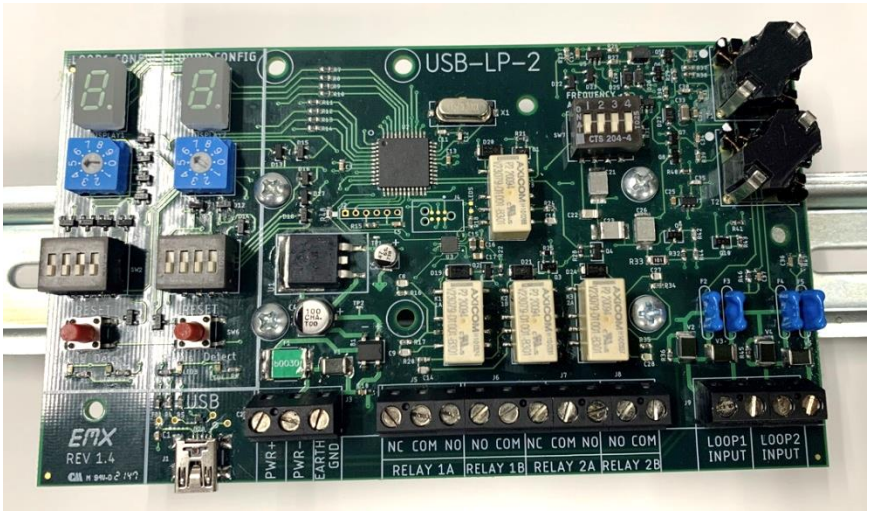
Purpose: Informs the Host of one or more manual setting changes.
Notification: @s,a,b,c,d,e<cr>
Where the five Data Items are the same as those returned by the !s Command.

9.5. Fault change.

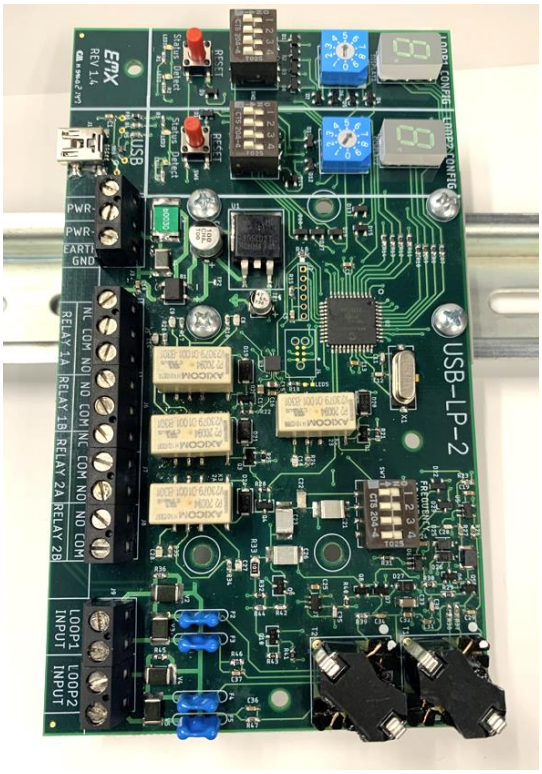
Purpose: Informs the Host that the fault status of one or both loops has changed.
Notification: **@u**,a,b<cr>
Where the two Data Items are the same as those returned by the !u Command.

Mounting

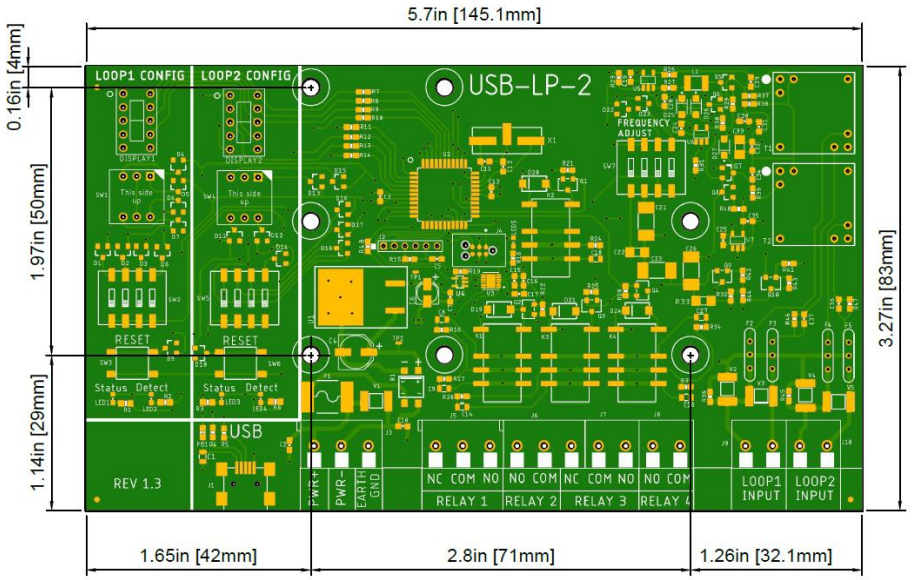
The USB-LP-2 is provided with two plastic DIN rail mounts that can be attached to the board in two different orientations. See the images below.



Horizontal Mounting Style



Vertical Mounting Style



Warranty

EMX Industries, Inc. products have a warranty against defects in materials and workmanship for a period of two years from date of sale to our customer.