Single Channel Loop Detector

The LD120T is a series of single channel inductive loop detectors. The use of microprocessor and surface mount technology enables a large number of functions to be incorporated into a small package. The LD120T is compatible with most single channel detectors on the market and is easy to set-up and install. All configurations are done through the RS485 communications port.

The LD120T consists of an inductive loop detector with an integral RS485 communications port. The unit has been developed to enable remote monitoring and control of the loop detector over a RS485 network. The communications allows access to internal setup parameters such as sensitivity, timers, as well as counters. The LD120T can be multi-dropped on the RS485 network with other detectors and logic units, or linked to a PC running software for configuration and monitoring of the parking system. Non volatile memory is used to store all configuration parameters.

Applications

Typical applications in the parking and access control environments are safety loops for barriers or gates, arming loops for activating card dispensers, entry or exit loops and vehicle counting.

Typical applications in the traffic environment are traffic control (traffic lights), toll systems and vehicle counting.

Features

RS485 Communications Port. The RS485 communications port enables up to 127 detectors to be networked on a single twisted pair cable. The LD120T communicates using the Modbus protocol in Binary mode. All configuration data is held in Modbus registers and can be setup by a PC or PLC on the network.

Loop Fail Diagnostics. Provides an indication of shorted loops and open circuit loops.

Automatic Tuning. This results in the detector re-tuning the sensing loop and becoming ready for vehicle detection. Also includes continuous environmental monitoring and tracking for optimal performance.

Vehicle Counter. Counts vehicles as they move over the loop. The counter has a maximum value of 32 bits.

Loop Protection. Uses a loop isolation transformer with zener diodes and gas discharge tube.

Programmable Features

- Selectable Detect Sensitivity
- Selectable UnDetect Sensitivity
- Filter Timer & Extend Timer
- Selectable Pulse Time
- Relay Mode – Pulse on detect, pulse on undetect, presence or Loop fault
- Presence Mode –Limited or Unlimited.
- Baud Rate

Indicators

Power Indicator. This LED Indicator illuminates when power is present.

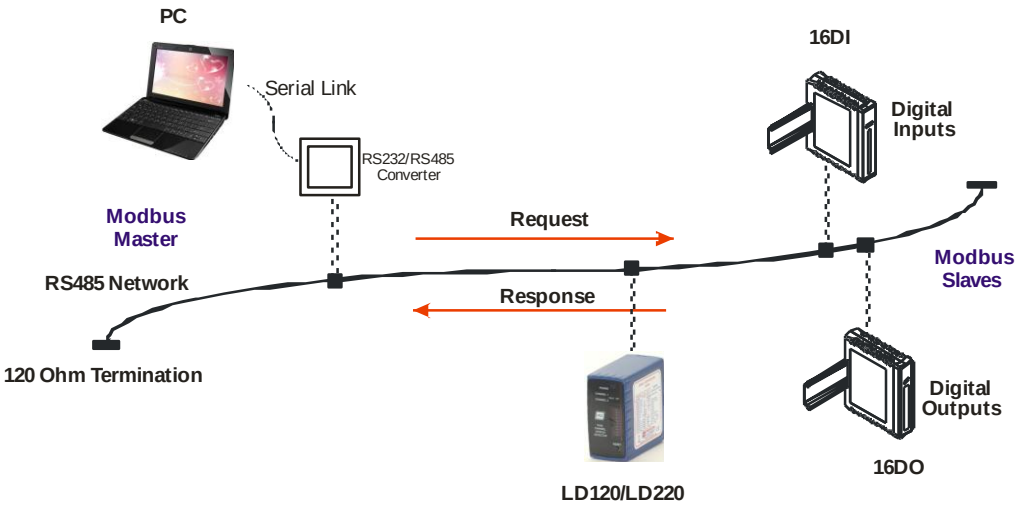
Detect Indicator. This LED Indicator is illuminated when there is a vehicle over the loop or the loop is faulty. This LED can also be used to determine the loop frequency. On reset, count the number of times the LED flashes. Multiply this number by 10KHz.For example: if the LED flashes 6 times, then the loop frequency is between 60KHz and 70KHz.

RS485 Communications Indicators. There is a RS485 Rx and Tx LED which illuminate during communications.

RS485 Network Layout

The diagram below shows how the LD120T may be connected to a Modbus network. The LD120T can be placed on the network with other I/O products such as the popular **PROMUX** from Procon Electronics.

A typical application is where a **PC** (Personal Computer) is connected to the Network. Many SCADA software packages support the MODBUS Master Protocol and can hence retrieve data from the LD120T as well as Input Modules or send data to Output Modules. The **serial port** of the PC is connected to an **RS232/RS485 Converter** which in turn is connected to the Network.



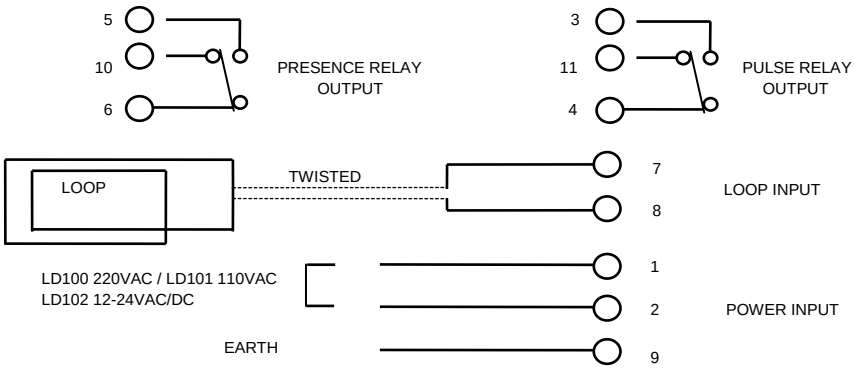
Technical Specifications

Power supply	**LD120T** 200 - 260VAC 50Hz 1.5VA
	LD121T 100 - 120VAC 60Hz 1.5VA
	LD122T 11 - 26VAC/DC 50/60Hz 90mA max.
Presence Relay Mode	0.5A/220VAC (Fail Safe – normally energized)
Pulse Relay Mode	0.5A/220VAC(Non Fail Safe–normally denergised)
Response time	Default approximately 120ms after vehicle enters loop. Adjustable 50ms to 10.00 seconds
Indicators	LED indicators show: Detect state & Rs485 communications.
Detector tuning range	15 - 1500uH
Loop Frequency	Approx. 23 – 130KHz
Environmental tracking	Automatic Compensation
Protection	Loop isolation transformer with zener diodes and gas discharge tube.
Connector	11 Pin Connector on rear of unit.
Dimensions	80mm (height) X 40mm (width) X 79mm (Depth excl. connector).
Operating Temperature	-20°C to +70°C
Storage Temperature	-40°C to +85°C

Relay Functionality

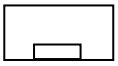
RELAYS		**VEHICLE PRESENT**	**NO VEHICLE**	**LOOP FAULTY**	**NO POWER**
PRESENCE RELAY	**N/O**	**CLOSED**	**OPEN**	**CLOSED**	**CLOSED**
	N/C	**OPEN**	**CLOSED**	**OPEN**	**OPEN**
PULSE RELAY	**N/O**	**PULSE CLOSED**	**OPEN**	**OPEN**	**OPEN**
	N/C	**PULSE OPEN**	**CLOSED**	**CLOSED**	**CLOSED**

Wiring Diagram



Comms (RJ45) – RS485 (LD120T)

Pin	Name	Function
1	N/C	Not used (no connect)
2	485	+ Line of 485 Comms
3	485	- Line of 485 Comms
4	GND	RS485 Gnd

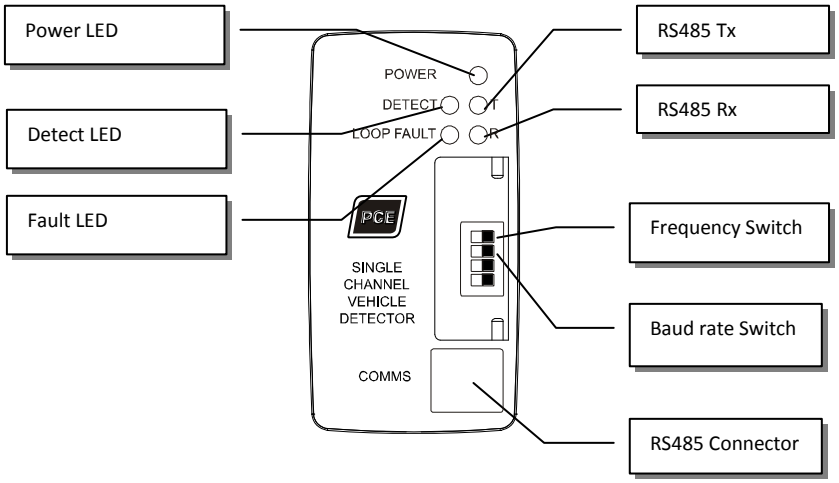


1 2 3 4

View From Cable side of connector (Looking ‘into’ hole)

Front Panel Controls

Front Panel Display and Controls. The drawing below shows the features on the front panel.



Power LED. Illuminates when the power is on.

Detect LED. Illuminates when a vehicle is on the loop.

Fault LED. Illuminates when there is a loop fault.

RS485 Rx LED. On when the units receives a message.

RS485 Tx LED. On when the units has received a valid message and sends a reply.

Frequency Switch (SW4). Used to change the loop frequency. Switch On = Low frequency and switch Off = High frequency.

Baud Rate Switch (SW3). When the switch is Off the baud rate is the default. (9600, 8, 1, N) When the switch is On the baud rate and communication settings will be according to the baud rate registers.

RS485 Connector. Refer to the wiring diagram for connections to the RS485.

Switch Settings

LD120T Switch Settings			
Switch No.	**Function**	**ON**	**OFF**
4	Frequency	Low	High
3	Baud Rate	Programmed	9600
2	Not Used	-	-
1	Not Used	-	-

Modbus Register Descriptions

Module Type / Software Version (30001)

This register is used to show the software version and the Module type. Every product manufactured by Procon Electronics has a unique module type number that is used to identify the product on the network.

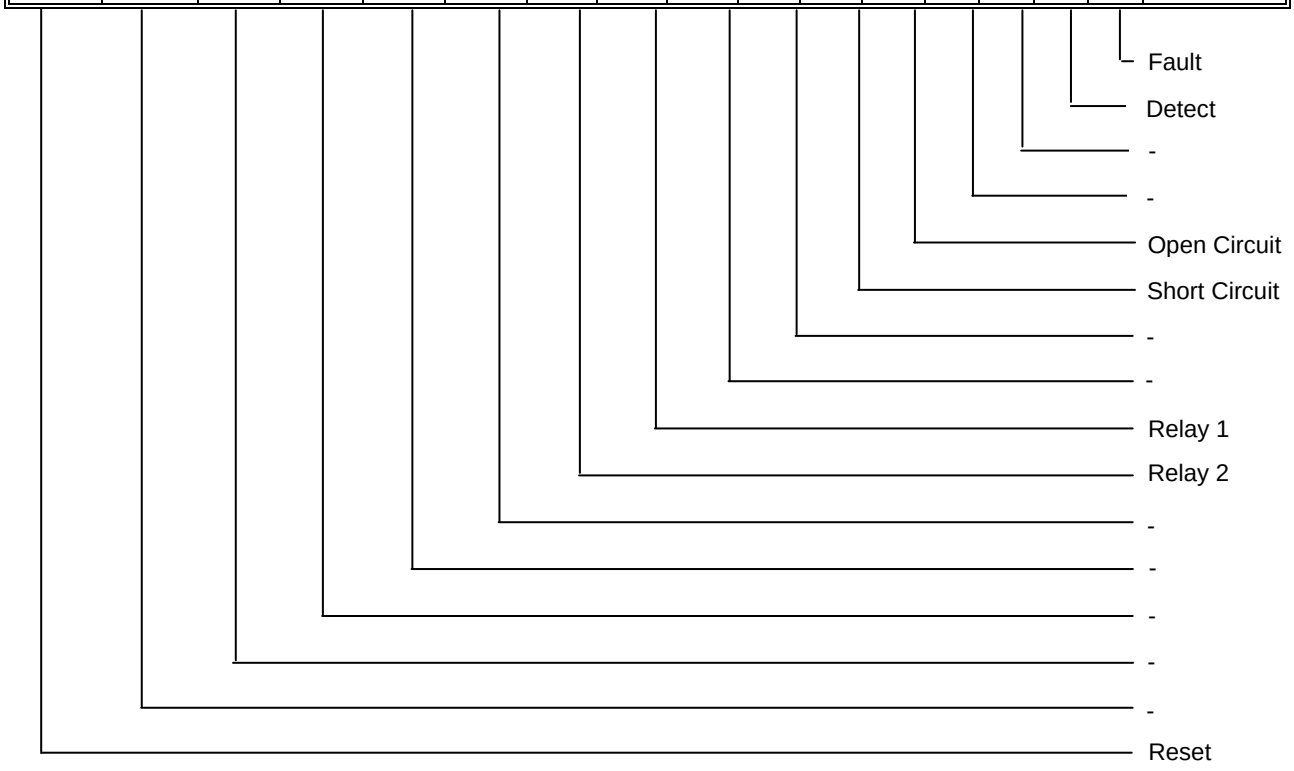
MSB								SOFTWARE VERSION / MODULE TYPE							LSB	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	ADDRESS
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30001

Software version | Module Type

Digital I/O Status (40002)

This register can also be accessed as individual bits using the Modbus functions 1, 2 and 5.

MSB								DIGITAL INPUT/OUTPUT STATUS							LSB	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	ADDRESS
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40002



Fault. This bit will be set when there is a fault on the loop.
Detect. This bit will be set when there is a vehicle on the loop.
Open circuit. This bit will be set when there is a fault on the loop. (The loop is open circuit or too large)
Short circuit. This bit will be set when there is a fault on the loop. (The loop is short circuit or too small)
Relay 1 & 2. This bit can be written to, and will control the relay directly. This function is enabled by setting the Modbus Mode in register 40022, (Relay1/2 (1=modbus,0=detector)).
Reset Detector. The detector can be reset by writing to this bit.

Counter (40003/40004)

The vehicle counter counts vehicles as they move over the loop. The counter is a 32 bit value which uses two 16 bit Modbus registers.

Loop Frequency (30005/30006)

The loop frequency (Khz) is used to determine how close the loop detector is operating to the upper and lower limits of the working range (23 – 130 Khz). The loop frequency is also useful to determine how close in frequency the loop is operating to an adjacent loop to prevent problems with crosstalk. The loop frequency is a 32 bit value which uses two 16 bit Modbus registers.

Delta (30007)

Change in Loop Inductance. The Delta register displays the inductance change of the loop as the vehicle travels over the loop. This value is expressed as a percentage change in loop inductance. When no vehicle is present, the value will toggle about 0%. When a vehicle enters the loop area the value will increase until it reaches a maximum value determined by the size, shape and height of the vehicle. As the vehicle continues to pass over the loop the value will fluctuate as the loop senses different parts of the vehicle. When the vehicle leaves the loop the value will drop back to zero.
When a vehicle enters the loop the value increases. As soon as the value is greater than the sensitivity setting, the detector presence output will give a detect output. This reading gives a good indication of the performance of the loop and assists with decision making in setting the sensitivity of the detector.

Delta Min (30008)

Minimum change in inductance from the tuned value. This value is recorded as a vehicle passes over the loop and is displayed as the vehicle leaves the loop. This value is useful in determining the minimum change in inductance caused by vehicles over a period of time. This value is updated as each vehicle passes over the loop. If the change in inductance caused by a vehicle was greater than the previous vehicle, then the reading is not changed. If the change in inductance is smaller than the previous vehicle, then the reading is updated with the latest reading. Again this value is useful in determining the optimum sensitivity setting.

Delta Max (30009)

Maximum change in inductance from the tuned value. This value is reset after the vehicle passes the loop. Whilst over the loop the detector records the peak change in inductance caused by the vehicle.

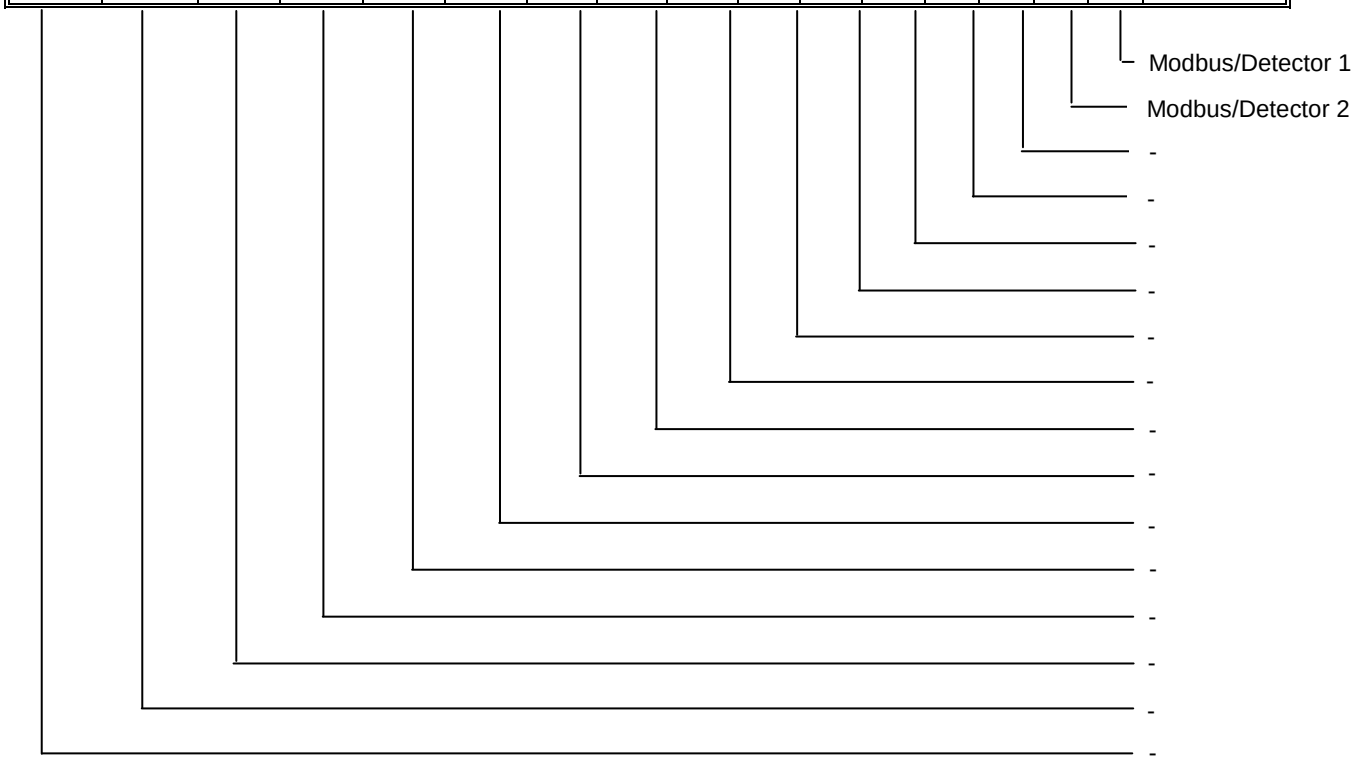
Node ID (40021)

The node ID is the Modbus address on the network. Every module on the RS485 network must have a unique ID number. The default ID that the module will always respond to is 254. To use this ID there must only be one module on the network.

Mode (40022)

The mode register is used to determine the functionality of the relays.

MSB						MODE REGISTER									LSB	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	ADDRESS
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40022



Modbus/Detector Mode. When this bit is set the relays will be connected to the Modbus register 40002. Relay 1 = bit 8, relay 2 = bit 9. When the bit is cleared then the relays will be connected to the detector.

Baud Rate (40023)

The baud rate value is programmed directly into the baud rate register.

Communications Settings with Switch 3 Off (Default)

BAUD RATE	9600
DATA BITS	8
PARITY	NONE
STOP BITS	1

Communications Settings with Switch 3 On (Programmed Baud Rate)

BAUD RATE	2400, 4800, 9600, 19200, 38400
DATA BITS	8
PARITY	None
STOP BITS	1

Detector Sensitivity (40025)

The detect sensitivity is the minimum change in inductance required to produce a detect output when the vehicle enters the loop. (%ΔL/L). (Value x 0.01%)

Detector Undetect Sensitivity (40026)

This is the level that the detector will use to go out of detect when the vehicle leaves the loop. (Value x 0.01%)

Filter (40027)

This timer is used to provide a delay between detection of the vehicle and switching of the output relay. This delay is normally used to prevent false detection of small or fast moving objects. (Value x 5ms)

Extend – Undetect Time (40028)

This feature extends the presence output relay after the vehicle has left the loop. (Value x 5ms)

Pulse Time (40029)

This feature sets the length of time that the pulse relay will be energized. (Value x 5ms)

Presence Mode (40030)

The presence time can be configured for an unlimited time depending on the value of the %ΔL/L, or a limited time. The limited time presence is normally used in traffic applications. 0 = Unlimited Presence, 1 = Permanent Presence, 2 = 1 Hour, 3 = 10 Minutes, 4 = 3 Minutes, 5 = 1 Second presence (Passage mode).

Relay 2 Mode (40031)

The mode of Relay 2 is configured by entering the value as follows: 0 = Pulse on detect, 1 = Pulse on Undetect, 2 = Presence, 3 = Loop Fault Relay.

Communications Settings

The data in the modules is stored in 16 bit registers. These registers are accessed over the network using the MODBUS **RTU** communication protocol.

Communications Settings with DIP Switch 3 Off (Default)

BAUD RATE	9600
DATA BITS	8
PARITY	NONE
STOP BITS	1

Modbus Registers

There are 4 types of variables which can be accessed from the module. Each module has one or more of these data variables.

Type	Start Address	Variable	Access
1	00001	Digital Outputs	Read & Write
2	10001	Digital Inputs	Read Only
3	30001	Input registers (Analog)	Read Only
4	40001	Output registers (Analog)	Read & Write

Modbus Functions

The PROMUX modules will respond to the following Modbus functions:

Function 1 – Read I/O status (Digital Inputs and Outputs)
Function 2 – Read I/O status (Digital Inputs and Outputs)
Function 3 – Read Register (Analog Inputs and Outputs)
Function 4 – Read Register (Analog Inputs and Outputs)
Function 5 – Write Single Digital Output (Digital Outputs)
Function 6 – Write Single Register (Analog Outputs)
Function 15 – Write Multiple Digital Outputs (Digital Outputs)
Function 16 – Write Multiple Registers (Analog Outputs)

LD120T - Single Channel Detector (MODULE TYPE = 38)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
10001	Digital Input 1	0	1	R	Loop Fault Status.
10002	Digital Input 2	0	1	R	Loop Detect Status.
10005	Digital Input 5	0	1	R	Loop Error – Open circuit.
10006	Digital Input 6	0	1	R	Loop Error – Short circuit.
00009	Digital Output 1	0	1	R/W	Relay 1
00010	Digital Output 2	0	1	R/W	Relay 2
00016	Reset Detector	0	1	R/W	When this bit is set to 1 the detector will reset.
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 38
40002	Digital I/O	N/A	N/A	R	Reset Detector bit 15 0, bit 14 0, bit 13 0, bit 12 0, bit 11 0, bit 10 Relay 2 bit 9 Relay 1 bit 8 Loop Error – Short circuit bit 5 Loop Error – Open circuit bit 4 Loop Detect Status bit 1 Loop Fault Status bit 0
40003	Counter LSB	0	65535	R/W	Counter MSB and LSB combine to give a
40004	Counter MSB	0	65535	R/W	32 bit Counter (max value 4294967295)
30005	Loop Freq.MSB	0	65535	R/W	Frequency MSB and LSB combine to give
30006	Loop Freq. LSB	0	65535	R/W	a 32 bit value.
30007	Delta	0	65535	R/W	Change in loop inductance.
30008	Delta Min	0	65535	R/W	Min. change in loop inductance.
30009	Delta Max	0	65535	R/W	Max. change in loop inductance.
40021	Node ID	0	253	R/W	Network ID (default = 254)
40022	Mode	0	65535	R/W	0, bit 7 0, bit 6 0, bit 5 0, bit 4 0, bit 3 0, bit 2 Relay2 (1=modbus,0=detector) bit 1 Relay1 (1=modbus,0=detector) bit 0
40023	Baud Rate	2400	38400	R/W	2400, 4800, 9600, 19200 or 38400

40025	Det Sensitivity	0	65535	R/W	(X0.01%)
40026	UnDet Sens	0	65535	R/W	(X0.01%)
40027	Filter	0	65535	R/W	(X5ms)
40028	UnDet Time	0	65535	R/W	(X5ms)
40029	Pulse Time	0	65535	R/W	(X5ms)
40030	Presence Mode	0	5	R/W	0 = Unlimited Presence 1 = Permanent Presence 2 = 1 Hour presence time 3 = 10 Minutes presence time 4 = 3 Minutes presence 5 = 1 Second presence (Passage mode)
40031	Relay 2 Mode	0	3	R/W	0 = Pulse on undetect 1 = Pulse on detect 2 = Presence Relay 3 = Loop Fault Relay

Diagnostics

SYMPTOM	POSSIBLE CAUSE	SOLUTION
The POWER LED is not on.	No power supply voltage on the input.	Check that the power supply is correctly wired to the detector. (PINS 1 and 2)
The DETECT LED flashes erratically.	There may be a poor connection in the loop or loop feeder. The detector may be experiencing crosstalk with the loop of an adjacent detector.	Check all wiring. Tighten screw terminals. Check for broken wires. Try changing frequencies using the frequency switch. Put the detector with the larger loop onto low frequency and the detector with the smaller loop onto high frequency.
The DETECT LED randomly stays on.	Faulty loop or loop feeder wiring. Movement of the loop in the ground.	Check the wiring. Tighten screw terminals. Check for pinched or bent wires. Is the feeder wire twisted? Check for cracks in the road surface near the loop.
The LOOP FAULT LED is flashing.	The loop inductance is too small or the loop is short circuit.	Check that there is no short circuit on the loop feeder wiring or the loop. If there is no short circuit then the inductance is to small and more turns of wire should be added to the loop.
The LOOP FAULT LED is permanently illuminated.	The loop inductance is too large or the loop is open circuit.	Check that there is electrical continuity on the loop. This can be done using a multimeter on the ohms range (< 5 Ω). If the loop inductance is too large then try reducing the number of turns.

Loop Installation Guide

1. The detector should be installed in a waterproof housing as close to the loop as possible.
2. The loop and feeder should be made from insulated copper wire with a minimum cross-sectional area of 1.5mm^2. The feeder should be twisted with at least 20 turns per metre. Joints in the wire are not recommended and must be soldered and made waterproof. Faulty joints could lead to incorrect operation of the detector. Feeders which may pick up electrical noise should use screened cable, with the screen earthed at the detector.
3. The loop should be either square or rectangular in shape with a minimum distance of 1 metre between opposite sides. Normally 3 turns of wire are used in the loop. Large loops with a circumference of greater than 10 metres should use 2 turns while small loops with a circumference of less than 6 metres should use 4 turns. When two loops are used in close proximity to each other it is recommended that 3 turns are used in one and 4 turns in the other to prevent cross-talk.
4. Cross-talk is a term used to describe the interference between two adjacent loops. To avoid incorrect operation of the detector, the loops should be at least 2 metres apart and on different frequency settings.
5. For loop installation, slots should be cut in the road using a masonry cutting tool. A 45^o cut should be made across the corners to prevent damage to the wire on the corners. The slot should be about 4mm wide and 30mm to 50mm deep. Remember to extend the slot from one of the corners to the road-side to accommodate the feeder.
6. Best results are obtained when a single length of wire is used with no joints. This may be achieved by running the wire from the detector to the loop, around the loop for 3 turns and then back to the detector. The feeder portion of the wire is then twisted. Remember that twisting the feeder will shorten its length, so ensure a long enough feeder wire is used.
7. After the loop and feeder wires have been placed in the slot, the slot is filled with epoxy compound or bitumen filler.