User Manual

Black Cat
030057 Loop Detector
Issue 0.6

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1 Contents

2 Document History

2.1 Document Release

Issue	Date	Comments
0.1	22/04/2014	Draft
0.2	16/07/2014	Comments added section 4 and 8
0.3	17/07/2014	Various changes (Updated correct version)
0.4	28/7/2014	Removed commercially sensitive content
0.5	4/8/2014	Corrections
0.6	3/9/2014	Loop detail added

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3   Description

The 030057 is an eight channel inductive loop detector, designed to be integrated into CA Traffics "Black CAT" family of traffic monitoring units only.
The function of the loop detector card is to detect road vehicles using inductive loops which are buried typically 75mm below the road surface.

Under normal operation the loop detector is controlled by the Black CAT host. The user has the ability to indirectly alter loop detector parameters when using the Black CAT via the "Collect Black" user interface program
Refer to 080004 – CA001-501 Black CAT User manual for details.

4   Physical

Size	225 x 125 x 26 mm (overall including front panel and handle
Weight	200g
Temperature range	-30º C to +80º C
Input voltage	Supplied by the Black Cat (nominally 12VDC)
Operating current	10mA typ
Sensor Inputs	Up to 8 inductive road loops (80 - 350uH)
Outputs	8 x Sensor status LEDs and 1 x Alarm LED
I/O	SPI bus
Operating frequency	60 - 85kHz
Detection sensitivity	0.05%dL/L
Scan duty cycle	2ms transmitter on, 8ms transmitter off
ITU Class of Emission as defined in the ITU Radio Regulations Article 4 Appendix 6.	1k0N0N

Alarm Indicator
> This illuminates when the detector card is unable to communicate with the host CPU card.

A – F Indicators (sensor status leds)
> These indicators indicate the status of each loop
>> **On** indicates that a loop presence is detected (something over the loop)
>> **Slow Flashing** indicates 'Open Circuit' loop fault has been detected
>> **Fast Flashing** indicates 'Short Circuit' loop fault has been detected.

4.1 Connectors and Pinouts

Two connectors are provided on the Loop Detector as follows:

Black Cat (Host CPU) Interface = 36way edge

Pin assignments

Pin No	Signal	Description
A1	GND	Power supply: common ground (0V).
A2	VBAT	Power supply Input: +VOLTS
A3	TP5	Not used
A4	DETSEL_2	Used by CPU board to select card
A5	DETSEL_1	Used by CPU board to select card
A6	DETSEL_0	Used by CPU board to select card
A7	SSEL0	I/P, asserted by CPU board during the SPI transfer
A8	SCK0	Clock input, from CPU board.
A9	MISO	Data output, to external CPU.
A10	MOSI	Data input, from external CPU board
A11	DET_SYNC	Temporarily assert to reset the time-tag.
A12	SYS_32K	32768Hz clock from CPU (logic level)
A13	DET_ENAB	Temporarily assert to cold boot (reset) the PCB.
A14	DETREQ	o/p, assert to request attention
A15	IDENT_2	Leave open circuit or connect to ground. Slot ID
A16	IDENT_1	Leave open circuit or connect to ground. Slot ID
A17	IDENT_0	Leave open circuit or connect to ground. Slot ID
A18	GND	Power supply: common ground (0V).
B1	GND	Power supply: common ground (0V).
B2	VBAT	Power supply Input: +VOLTS
B3	RUN	Raised to logic 1 to power up the PCB.
B4	RUN	Raised to logic 1 to power up the PCB.
B5	LEDS_ON	Asserted to allow the on-board LEDs to operate.
B6	GND	Power supply: common ground (0V).
B7	GND	Power supply: common ground (0V).
B8	GND	Power supply: common ground (0V).
B9	GND	Power supply: common ground (0V).
B10	GND	Power supply: common ground (0V).
B11	GND	Power supply: common ground (0V).
B12	GND	Power supply: common ground (0V).
B13	TP7	Not used
B14	TP6	Not used
B15	IDENT_2	Leave open circuit or connect to ground. Slot ID
B16	IDENT_1	Leave open circuit or connect to ground. Slot ID
B17	IDENT_0	Leave open circuit or connect to ground. Slot ID
B18	GND	Power supply: common ground (0V).

All signals connected to the detector are listed below.
All signals are CMOS logic level (0 to +3V3) unless otherwise specified.
Logic 1 = 3V3: an asserted signal is at logic 1, a negated signal is at ground.

Loop Input Connector = Tyco 050372

Pin assignments (PL3)

Pin No	Signal	Description
1	LOOP_H2	Loop input H
9	LOOP_H1	Loop input H
2	LOOP_G2	Loop input G
10	LOOP_G1	Loop input G
3	LOOP_F2	Loop input F
11	LOOP_F1	Loop input F
4	LOOP_E2	Loop input E
12	LOOP_E1	Loop input E
5	LOOP_D2	Loop input D
13	LOOP_D1	Loop input D
6	LOOP_C2	Loop input C
14	LOOP_C1	Loop input C
7	LOOP_B2	Loop input B
15	LOOP_B1	Loop input B
8	LOOP_A2	Loop input A
16	LOOP_A1	Loop input A

5   Installation into a Black CAT Host

Be sure to take appropriate precautions to avoid ESD when handling, and installing the 030057 Loop detector module into a Black CAT host.

Use the appropriate assembly drawing to ascertain which peripheral slot the Loop detector module is to be installed.
Ensure the slot guide rails are clean and clear of any foreign material.
Insert the Loop detector module into the guides and slide in until its front panel is in contact with the Black CAT.
Insert 2 off M3x8 screws through the Black CAT rear panel into the rear bracket of the Loop Detector module, do not tighten as this point.
Insert 2 off M3x10 screws through the Loop detector modules front panel into the Black CAT top and bottom panels then tighten all four screws.

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6 Detection Loops / Antennas

The 030057 Loop Detector is designed to monitor up to eight detection loops.

A detection loop is generally 2m x 2m (6' x 6') square and comprises of either 3 or 4 turns of cable buried in a slot cut into the road surface then covered and back filled with epoxy resin and/or hot pour bitumen (sealant/grout).

The cable is a single core multi-strand flexible cable. We recommend using a XHHN Cross-linked, polyethylene-insulated wire rated at 90 C in dry locations.

Road Loop Location

A traffic monitoring site should ideally be located on a long flat straight section of road which is clear from junctions or any other features which may cause vehicles to accelerate or decelerate.

The road surface should be in good condition, free from cracks, potholes and bumps

A road loop should be at least 1 metre clear from any manhole, grate or any other type of metal street furniture

A minimum clearance of 50mm should be maintained between any reinforcement in the road and the road loop.

Road loop Installation

A road loop is installed by firstly marking out the location of the loop on the road surface. Typically 2m x 2m square.

A slot typically 10mm wide and between 50-80mm deep is cut into the road surface. Cross cuts are then made at 45 degrees across each corner, this prevents the formation of tight 90 degree bends. A slot is then cut from the loop slot to the edge of the road/draw pit or cabinet to route the loop feeder.

The slot is then cleaned and dried. Run the loop wire from the roadside cabinet/equipment housing along the feed slot to the loop slot, form 3 or 4 turns of wire in the loop slot then return to the cabinet equipment housing.

It is advisable to check the loop inductance and resistance at this point.

Check the loop wire is lying flat in the bottom of the slots then completely fill with sealant/grout

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Checking

Check the loop inductance agrees with the theoretical value.
Check the series resistance (across the loop feeder wires) is <10R
Check the resistance to ground is >100 M ohms measured at 500V
Check the loop inductance agrees with the value below:
3 turn loop (2m x 2m) = 85uH + (0.6 x length of feeder (m))
4 turn loop (2m x 2m) = 150uH + (0.6 x length of feeder (m))
Allow a tolerance of +/-15 % in the measurement.

Refer to the following for further information on detector loops, installation etc

FHWA Traffic Detector handbook third edition volume II chapter 5

The 030057 Loop Detector is designed to operate with road loops that have been constructed and installed into the road surface as above, whose overall inductance is within the range 80uH to 350uH

Termination

Road loops are normally terminated in the roadside cabinet via a terminal/barrier strip, they are then connected to the Loop Detector module using a connecting cable as shown below:

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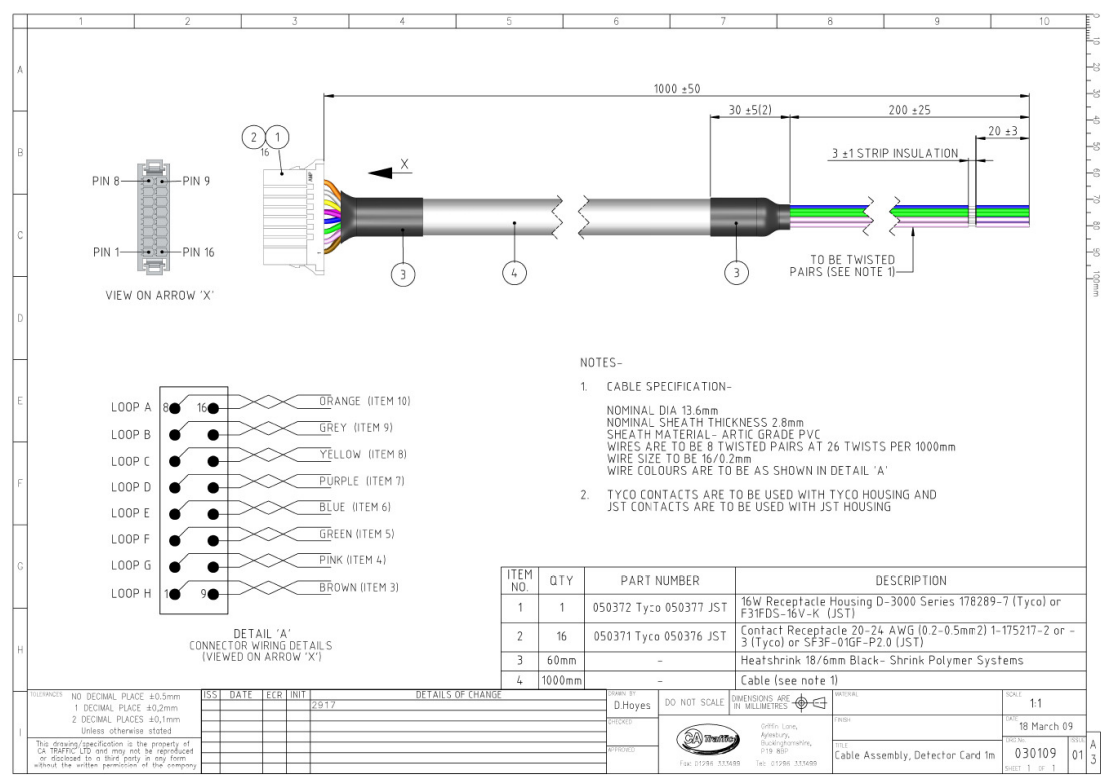
7 Agency Statements

FCC Statements

Compliance statement (Part 15.19)

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.

Warning (Part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the users authority to operate the equipment.

Industry Canada Statements

Section 7.1.2 of RSS-GEN

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or less) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be chosen that the equivalent isotropic radiated power (e.i.r.p) is not more than that necessary for successful communication.

Section 7.1.3 of RSS-GEN

This Device complies with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions: 1) this device may not cause interference, and 2) this device must accept and interference, including interference that may cause undesired operation of the device.

Industrie Canada declarations

Section 7.1.2 du RSS-GEN

Aux termes des réglements de l'industrie du Canada, cet émetteut radio peut fonctionner à l'aide d'une antenne d'un type et un maximum (ou moins) de gain approuvé pour l'emetteur par Industrie Canada. Pour réduire le risqué d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisis afin que la puissance isotrop rayonnée équivalente (e.i.r.p) ne dépasse pas ce qui est nécessaire pour une communication réussie.

Section 7.1.3 du RSS-GEN

Cet appareil ect conforme avec Industrie Canada norme exempt de licence RSS (s). Son fonctionnement est soumis aux deux conditions suivantes: 1) cette appareil peut ne pas causer l'interférence et 2) cet appareil doit accepter toute interference, y compris les interferences qui peuvent causer un mauvais fonctionnement de l'appareil.

Responsibilities to comply with FCC and Industry Canada Regulations

The 030057 Loop detector module, has been granted *Limited Modular Approval* for integration into Black CAT host products by approved members of CA staff under the following conditions:

1. The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter.
2. Integration is only permitted in Black CAT host products which are suitably shielded.

CA Traffic ltd is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE: In the event that these conditions cannot be met (for certain configurations or co-located with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID and IC Certification Number cannot be used on the final product. In these circumstances, CA Traffic ltd will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC and Industry Canada authorization.

End Product Labelling

The 030057 Loop Detector module is labelled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labelled in a visible area with the following:

"Contains Transmitter Module FCC ID: 2AB86-030057"
"Contains Transmitter IC: 11965A-030057"
or
"Contains FCC ID: 2AB86-030057"
"Contains IC: 11965A-030057"

The 030057 Loop detector Module must only use approved antenna(s) which have been certified with this module.

CA Traffic ltd has to be aware not to provide information to the end user regarding how to change RF related parameters in the user manual of the end product.