

TOPAS

Traffic Open Products and Specifications

TOPAS 2512A

Performance Specification for Below Ground Vehicle Detection Equipment

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TOPAS 2512A

PERFORMANCE SPECIFICATION FOR BELOW GROUND VEHICLE DETECTION EQUIPMENT

CONTENTS

Section

1. Introduction
2. Functional Requirements
3. References
4. Pre Appendix – Summary of Detector Parameters

Appendix A Vehicle Actuated Traffic Signals at Junctions, Haul Routes and Pedestrian Crossings – other than for speed measurement

Appendix B Speed Measuring applications with Permanently Installed, and Temporary (including Haul Routes_) Traffic Signals

Appendix C Vehicle Counting, Occupancy and Queue Applications in UTC

Appendix D Scoot and Mova Applications

Appendix E Motorway Applications – Speed Measuring

Appendix F Motorway Applications – Occupancy

Appendix G Circuit Designations – Euro Connector

Appendix H Informative Guide

Appendix Z Technical File Content

1 INTRODUCTION

- 1.1 This specification covers the necessary requirements for below ground vehicle detection equipment for use with permanent vehicle actuated traffic signals.
- 1.2 TOPAS specifications are explicitly purchasing specifications and compliance with them is not mandatory. However Local and other Purchasing Authorities may typically require that equipment purchased complies with TOPAS specifications and is TOPAS registered.
- 1.3 Manufacturers may register products as being compliant with this specification, using the process defined in TOPAS 0600
- 1.4 TOPAS registration requires manufacturers submit a Technical File to an appropriate Technical Assessor to aid compliance verification. The content requirement for the Technical File is defined in Appendix Z of this specification.
- 1.5 Within this specification, "The Product" shall mean all components necessary to provide a complete operational unit meeting the requirements of this specification and the common requirements defined in TOPAS0600.
- 1.6 Guidance to potential users of this Product is given in Appendix H.
- 1.8 This specification will be immediately implemented from the date of issue for all new TOPAS Registrations

Glossary of Terms

- 1.9 A comprehensive glossary of terms is given in Highways Agency document TA 84 Code of Practice for Traffic Control and Information Systems for All-Purpose Roads.

Implementation

- 1.7 This specification implements requirements as originally defined in HA specification TR 2512A. Product Approvals to TR 2512A may be used to register products to this specification as defined in TOPAS 0600

2 FUNCTIONAL REQUIREMENTS

General

2.1 This Specification defines the requirements of a Product to detect the passage or presence of a vehicle by means of the change in the output state of below ground detection equipment. Applications are specified in the appendices to this specification.

2.2 This Specification covers the performance requirements of vehicle detection equipment used for following levels of integration with approved signal controllers:

- Isolated; i.e. remote detector packs;
- Serial Interface; i.e. Separate detector cards mounted within the controller cabinet, and addressable via a serial link;
- Fully Integrated within the controller.

2.3 Where inductive loops technology is used, the following requirements shall apply:

- ◆ Each detection channel shall be designed to accommodate loop inductive impedance from 50 μ H to 800 μ H;
- ◆ The Product shall have an autotune facility that shall stabilise within 5 seconds;
- ◆ The Product may have an auto-retune facility to re-stabilise the Product within 5 seconds after an inductance change of not less than +15%; *Note This facility shall be capable of being inhibited if required.*

2.4 For a multi-channel Product, the specified performance shall be achieved for each channel with all other channels operating normally.

2.5 The Product shall perform as defined by this specification with a confidence limit of not less than 90% in respect of the sensitivity and timing requirements for not less than the sooner of:

1. A period of three years after delivery to the purchaser;
2. The number of operations corresponding to 10,000,000 vehicles having been detected.

Sensitivity

2.6 The Product shall be capable of detecting any of the vehicles defined in the appendices to this Specification.

2.7 The Product shall have a minimum of three selectable sensitivity settings for each detector channel as appropriate to the requirements of this specification and the various declared loop configurations.

2.8 Where sensitivity settings and other detector parameters are selected in software the following provisions shall apply:

- the settings shall be retained in non-volatile storage for at least one year, in the event of any loss of power supply;
- when settings are being changed, the detector shall output the 'detect' condition, and revert to normal operation within 5 seconds from the completion of the change.

Drift Compensation (Tracking)

2.9 The Product shall incorporate automatic compensation to offset the effects of changes in impedance at the input terminals.

Response Time

2.10 The response time of the Product shall not be greater than 64 ms; this period is interpreted from the dynamic characteristics specified in 2.11.

2.11 The dynamic operating characteristics of the Product for any given vehicle type shall be such that the detection point on the road at which the vehicle is detected over the speed range of 40 km/h (25 mph) to 112 km/h (70 mph) shall not vary about a mean by more than ± 0.5 metres for any individual vehicle detector.

Presence Time

2.12 The Product shall maintain an unbroken vehicle detection signal for the periods specified in the appendices to this specification dependent on detector application.

2.13 Presence Time(s) may be selectable.

Turn Off Time

2.14 The Product shall return to a non-detecting state in less than 50 milliseconds following the zone of detection being vacated.

Output Conditions

2.15 For isolated detectors, the output conditions shall comply with the interface requirements defined in TOPAS 2523.

2.16 The Product shall provide a visual indication of the output. The indicator shall be clearly visible in all ambient light conditions.

2.17 For detectors that are connected by a serial interface or are fully integrated the output conditions shall comply with paragraph 0 0 and 0 1.

2.18 Optional, secondary outputs for non-control applications may be provided, such as secondary vehicle counting equipment.

Recovery from Sustained Actuation

2.19 Following a sustained actuation the detector shall recover to normal operation within 100 milliseconds after the zone of detection is vacated. Alternatively the recovery time for equipment incorporating the anti-locking facility; may be within 1 second of the zone of detection being vacated. This excludes equipment designed to Appendices E and F.

Loop and Feeder

2.20 Where loop technology is used these loops shall be installed to comply with MCE 0108. Loop dimensions are to be in accordance with 7th Edition Specification for Highway Works, Volume 3 Highway Construction Details Section 1, G series drawings.

2.21 The Manufacturer shall determine the shape of the installed loop.

2.22 General strategy is specified in MCE 0108 "Siting of Inductive Loops for Vehicle Detecting Equipments at Permanent Road Traffic Signal Installations"

Electrical safety

2.23 Under no conditions shall the voltage produced by the Product measured across the loop and feeder terminals, or between any such terminal and earth, exceed 70 volts peak to peak. This requirement shall apply to the voltage across the feeder cables whether the loop be connected to or disconnected from the rest of the vehicle detection equipment.

2.24 All wiring, termination, earthing bonding and labelling shall be in accordance with BS 7671.

Test Requirements

2.25 All vehicle detectors supplied to this specification shall comply, where appropriate, with the current requirement of:

2.26 ETSI EN 300 330 -1
Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz Part 2: Harmonized EN under article 3.2 of the R&TTE Directive

2.27 The vehicle detection equipment shall operate correctly, as required by this specification, when subjected to the EMC conditions, which may be met in use. Evidence of compliance with Specification EN 50293 shall demonstrate this.

2.28 Adequate precautions shall be taken in the design of the equipment to prevent mutual interference between equipment of the same type when connected to adjacent loops. These precautions shall be at least sufficient to avoid any interaction between equipment connected to a pair of loops each 2 metres square, with adjacent sides parallel to each other and spaced 0.5 metres apart throughout their length under all operating conditions at high sensitivity.

2.29 The vehicle detection equipment shall operate as required by this specification when subjected to the tests listed below, as specified in the relevant clauses of BS 7987 for;

- Change of temperature;
- Damp Heat;
- Random Vibration.

NOTE: It is not necessary to meet this requirement if the below ground detectors are installed in the vicinity of high or low current heating mats.

Construction

2.30 The general design, construction and assembly of the Product shall be based on sound proven engineering principles.

2.31 The front panel of rack mounted Products is to be fitted with a means to assist easy removal and replacement of units.

Equipment Housing

2.32 Products used with traffic signal controllers shall preferably be mounted in the controller cabinet. Where this is not possible, remote detector housings may be used.

2.33 Remote detector housings shall meet the relevant "Constructional Requirements" section of the of TR 2206 and the environmental requirements of BS 7987 for;

- Dry Heat Class AB3;
- Cold Class AE2;
- Damp Heat, Cyclic;
- Solar Radiation;
- Water Penetration;

- Random Vibration.

Euro Card Interface Vehicle Detector

2.34 The contact designations for DIN 41612 type B rear panel plug shall be in accordance with Appendix G1 for all purpose road applications (Appendices A, B, C, and D) and Appendix G2 for motorway applications (Appendices E and F).

Degree of Protection Provided by Enclosures

2.35 The equipment housing shall be to BS EN 60529 IP 55.

2.36 The equipment housings shall be manufactured from a suitable material to provide mechanical protection to IP XX9.

Failure Modes

2.37 Any open short circuit fault condition continuously presented to an input connection port of the detector for more than 30 ms shall, after an interval not exceeding 5 seconds, produce a detect signal for as long as the fault persists unless otherwise specified.

2.38 The above faulty condition shall not damage the Product or, if it a multi-channel design, affect the operation of the other channels

2.39 An interruption of the power supply to the Product shall, after an interval not exceeding 5 seconds, automatically produce a vehicle detection signal (indicating the presence of a vehicle) from the Product for so long as the interruption persists. The Product shall regain its specified operation within 5 seconds of the restoration of the power supply.

Fault Output (Required for Appendices E & F - Optional for others)

2.40 A separate fault output signal shall be provided in accordance with 2.37. In the quiescent (i.e. non-fault) condition the fault output shall be a normally closed relay or +ve solid state as indicated in Appendix G2.

2.41 The Product may also provide an additional visual indication of the fault conditions as defined in 2.37, 2.38, and 2.39 for as long as the fault exists. The Product shall provide a visual indication of the output. The indicator shall be clearly visible in all ambient light conditions. The Indicator shall be illuminated when no fault is present.

2.42 For power conservation purposes the visual indication described in 2.41 may be normally off and only brought into circuit via a readily accessible means.

3. REFERENCES

3.1 Where undated references are listed, the latest edition of the publication applies.

British Standards

3.2 The British Standards Institution, London, publishes British Standards.

BS 7671	Requirements for electrical installations (The IEE wiring regulations)
BS 7987	Road Traffic Signal Systems
ETSI EN 300 220-1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz Part 2: Harmonized EN under article 3.2 of the R&TTE Directive
BS EN 50293	Electromagnetic Compatibility - Road Traffic Signal Systems
BS EN 60529	Specifications for degrees of protection by enclosures (IP Code)

Specifications

3.3 TOPAS Limited Specifications are available from www.topasgroup.org.uk

MCE 0108	Siting of Inductive loops for Vehicle Detecting Equipments at Permanent Road Traffic Signal installations
MCH 1352	Technical Guide to SCOOT Loop Siting
MCH 1542	Installation Guide for MOVA
MCH 1932	Vehicle Detection Techniques
TR 2029	Inductive Loop Cable for Vehicle Detection Systems
TR 2031	Armoured Feeder Cable for Inductive Loops Systems
TR 2130	Environmental Tests for Motorway Communications Equipment and Portable and Permanent Traffic Control Equipment
TOPAS 2500	Traffic Signal Controller
TR 2501	Performance Specification for Traffic Signal Control Equipment for use at Haul Route Crossings
TOPAS 2503	Performance Specification for Pedestrian Facilities at Temporary Stand-alone Traffic Signals
TOPAS 2523	Traffic Control Systems Interfacing Specification
TOPAS 0600	Statutory Approval of Equipments for the Control of Vehicular and Pedestrian Traffic on Roads

Other Publications

3.4 Other publications can be obtained from the Stationary Office:

Specification for Highway Works	Department of Transport 7 th Edition of the Specification for Highway Works, Volumes 1 – Series 1200 & 1500, Volume 2 – Notes for Guidance NG1200 & NG1500 and Volume 3 – Highway Construction Details (HCD) G series drawings.
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4. PRE APPENDIX - SUMMARY OF DETECTOR PARAMETERS

Parameters \ Appendices	A	B	C	D	E	F
Lower entry speed into zone of detection			4.8 km/h	4.8 km/h		4.8 km/h
Higher entry speed into zone of detection			113 km/h			
Lower working Speed	4.8 km/h	40 km/h	4.8 km/h	4.8 km/h	4.8 km/h	
Upper working Speed	129 km/h	129 km/h	129 km/h	129 km/h	193 km/h	193 km/h
Cycle lower working speed	4.8 km/h					
Cycle upper working speed	32 km/h					
Failure acceptance (multiple vehicle detection)	20%					
Single unbroken coverage with % covered			25%			
Detector must work with % of loop covered	50%	50%	50%	50%	50%	50%
(a) Normal presence time	4 min	3.5 sec	4 min	4 min	35 min	35 min
Time variation + or - (a)	1 min	0.5 sec	1 min	1 min	5 min	5 min

Parameters \ Appendices	A	B	C	D	E	F
(b) Alternative Presence time	3.5 sec	4 min	35 min		4 min	4 min
Time variation + or - (b)	0.5 sec	1 min	5 min		1 min	1 min
Variation of detection point at 40 km/h		0.2m			0.2m	
Variation of detection point at 97 km/h		0.2m				
Variation of detection point at 105 km/h					0.2m	
Tolerance of accuracy 16 km/h to 40 km/h					< = 3km/h	
Tolerance of accuracy 105 km/h to 145 km/h					< = 7%	
Tolerance of accuracy 146 km/h to 193 km/h					< = 10%	
Zone of detection Max distance from loop edge			200 mm			
Ignore inductance change					< = 0.01%	< = 0.01%

Summary of Detector Parameters

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APPENDIX A VEHICLE-ACTUATED TRAFFIC SIGNALS AT JUNCTIONS, HAUL ROUTES AND PEDESTRIAN CROSSINGS – OTHER THAN FOR SPEED MEASUREMENT

Performance Requirements

- A1 Vehicle detection equipment used to provide vehicle demands and extensions, in accordance with equipment complying with Specification TOPAS 2500, shall comply with the following performance requirements with whatever loop and feeder configuration the manufacturer specifies.
- A2 The vehicle detection equipment shall respond to any vehicles, including pedal cycles, travelling at any speed between 4.8 km/h (3 mph) and 129 km/h (80 mph) (pedal cycles 4.8 km/h (3 mph) to 32 km/h (20 mph), but is not precluded from detecting vehicles at speeds outside this range. The vehicle detection equipment shall preferably give a single unbroken vehicle detection signal for all types of vehicles. If multiple vehicle detection signals are produced, due to varying chassis height, then they shall not occur for more than 20% of all vehicles normally encountered on public roads with 3 or more road wheels.
- A3 In the event of any type of motor driven vehicle with 3 or more road wheels coming to rest over a below ground detector, after having entered the zone of detection at a speed of not less than 4.8 km/h (3mph), the presence time shall normally be 4 minutes \pm 1 minute. An alternative presence time of 3.5 seconds \pm 0.5 seconds may also be provided.
- A4 The vehicle detection equipment shall respond to any target object after the presence time has expired.
- NOTE: A4 is required primarily for those conditions where a single detector is connected in series with other detector configurations to the same Product (parallel configurations may not be used). It is to ensure that if, during saturated traffic conditions, the detector presence time expires, then the movement of vehicles off and onto any detector boundary in the detection system, whilst the other detectors are occupied, again produces a vehicle presence condition giving an extension to hold the green for that stage.
- A5 The output signal to indicate the presence of a vehicle may be either high or low impedance condition.

APPENDIX B SPEED MEASURING APPLICATIONS WITH PERMANENTLY INSTALLED, AND TEMPORARY (INCLUDING HAUL ROUTES) TRAFFIC SIGNALS

Performance Requirements

- B1 Vehicle detection equipment used in conjunction with equipment complying with Specification TOPAS 2500 or other approved equipment shall comply with the following performance requirements whatever loop and feeder configuration the manufacturer specifies.
- B2 The vehicle detection equipment shall respond to any vehicle with 3 or more road wheels, travelling at any speed between 40 km/h (25 mph) and 129 km/h (80 mph), but is not precluded from detecting such vehicles outside this speed range.
- B3 In the event of any vehicle with 3 or more road wheels coming to rest over a below ground detector, after having entered the zone of detection at a speed of not less than 4.8 km/h (3 mph), the presence time shall normally be 3.5 seconds \pm 0.5 second. An alternative presence time of 4 minutes \pm 1 minute shall also be provided.
- B4 The detection point variation between the dynamic operating characteristic of any pair of vehicle detectors of the same type, or associated channel of a Product shall be such that, the difference between the points at which they each detect the same vehicle at 40 km/h (25 mph) shall not exceed 0.2 metres, and the difference between the points at which they each detect the same vehicle at 97 km/h (60 mph) shall not exceed 0.2 metres. The manufacturer shall specify the sensitivity setting(s), which may be used for correct operation in this application.
- NOTE:** Tests for compliance with this clause shall be carried out with all detectors and feeders in an essentially identical environment.
- B5 The vehicle detection signal to indicate the presence of a vehicle may be either the high or low impedance condition.

APPENDIX C VEHICLE COUNTING, OCCUPANCY AND QUEUE APPLICATIONS IN UTC

Performance Requirements

- C1 Vehicle detection equipments used in accordance with equipment complying with Specification MCH 1932 shall comply with the following performance requirements:
- C2 The zone of detection of a vehicle detection equipment shall not be less than the physical area of the detection zone and not greater than an area whose sides are parallel to the physical sides of the detection zone and not further than 200 mm from these sides for any vehicle with 3 or more road wheels, travelling within the speed range 4.8 km/h (3 mph) to 113 km/h (70 mph). The manufacturer shall specify the sensitivity setting(s) that may be used for correct operation in this application.
- C3 The vehicle detection equipment shall respond to any vehicle with 3 or more road wheels travelling at any speed between 4.8 km/h (3 mph) and 129 km/h (80 mph) but is not precluded from detecting vehicles at speeds outside this range. If the associated equipment is a vehicle counter, the vehicle detection equipment shall give a single unbroken vehicle detection signal for all motor-driven vehicles with 3 or more road wheels. An exception can be made for special classes of vehicles such as those having a ground clearance greater than 0.5 metres. For the purpose of the single unbroken vehicle detection signal, the vehicle shall traverse the detection zone in such a way that at least 25% of the detection zone area is covered by the vehicle.
- C4 In the event of any type of motor driven vehicle with 3 or more road wheels coming to rest over a boundary of detection, after having entered the zone of detection at a speed of not less than 4.8 km/h (3mph), such that it is positioned midway between the point at which it was first detected on entering the detection zone and the point at which it would just cease to be detected on leaving the detection zone, with the whole width of the vehicle within the detection zone, or with the vehicle occupying at least 50% of the detection zone area, whichever is the lesser, the presence time shall be switch selectable to 4 minutes \pm 1 minute for counting and occupancy, and 35 minutes \pm 5 minutes for counting and queue.
- C5 The vehicle detection signal to indicate the presence of a vehicle may be either the high or low impedance condition.

APPENDIX D SCOOT AND MOVA APPLICATIONS

Performance Requirements

- D1 Vehicle detection equipment used to provide occupancy information for the SCOOT and MOVA traffic responsive strategy of traffic control, shall comply with the following performance requirements:
- D2 The vehicle detection equipment shall respond to any vehicle with 3 or more road wheels, travelling at any speed between 4.8 km/h (3 mph) and 129 km/h (80 mph), but is not precluded from detecting vehicles at speeds outside this range. The equipment shall preferably give a single unbroken vehicle detection signal for all types of vehicles.
- D3 In the event of any vehicle with 3 or more road wheels coming to rest over a below ground detector, after having entered the zone of detection at a speed of not less than 4.8 km/h (3 mph), the presence time shall be 4 minutes \pm 1 minute for any vehicle. The value of the presence time shall preferably not be adjustable from the front panel.
- D4 The 'presence' output signal shall be produced when a vehicle occupies the zone of detection, the output to hold as long as the occupation by the vehicle continues (subject to the limitations of D3).
- D5 The vehicle detection signal duration shall be within 30 milliseconds of the time for which a vehicle is over its zone of detection.
- D6 The value of input sensitivity shall be set to accord with requirements of D2 with preferably no manual adjustment accessible from the front.

APPENDIX E MOTORWAY APPLICATIONS – SPEED MEASURING

Performance Requirements

- E1 Vehicle detection equipment shall comply with the following performance requirements using motorway loop configurations as detailed in the 7th Edition Specification for Highway Works, with the maximum feeder length specified of 200 metres.
- E2 The vehicle detection equipment shall respond to any vehicle with 3 or more road wheels normally encountered on motorways, travelling at any speed between 4.8 km/h (3 mph) and 193 km/h (120 mph), but is not precluded from detecting such vehicles outside this speed range.
- E3 In the event of any vehicle with 3 or more road wheels coming to rest over a below ground detector, after having entered the zone of detection at a speed of not less than 4.8 km/h (3 mph), the presence time shall be 35 minutes \pm 5 minutes. An alternative presence time of 4 minutes \pm 1 minute may also be provided, if specified.
- E4 The detection point variation between the dynamic operating characteristics of any pair of vehicle detectors of the same type, or associated channels of a vehicle detector, shall be such that, the difference between the points at which they each detect the same vehicle at 40 km/h (25 mph) shall not exceed 0.2 metres, and the difference between the points at which they each detect the same vehicle at 105 km/h (65 mph) shall not exceed 0.2 metres. This represents a speed measurement error of less than 5%. The manufacturer shall specify the sensitivity setting(s) that may be used for correct operation in this application.
- E5 The tolerance for speed measuring accuracy of the same vehicle travelling over the speed range of 16 km/h (10 mph) to 40 km/h (25 mph) shall be less than or equal to 3 km/h (2 mph).
- E6 The tolerance for speed measuring accuracy of the same vehicle travelling over the speed range 105 km/h (65 mph) to 145 km/h (90 mph) shall be less than or equal to 7% and for speeds from 145 km/h (90 mph) to 193 km/h (120 mph) the tolerance shall be less than or equal to 10%.
- E7 The Product shall not respond to any positive inductance change greater than 0.01% of the unoccupied detector, lasting for 0.7 seconds or less (or recovery from such), in such a way as to cause a vehicle detect signal to be created.
- E8 Recovery time from a sustained actuation shall not be greater than 10 seconds for an applied recovery actuation signal of 2% dL/L.
- E9 Each channel of a detector unit shall have a normally closed, isolated fault output in accordance with 2.40 and 2.42.
- E10 Under failure conditions persisting for a period of not less than 1 minute the vehicle detection and fault signals shall latch and remain latched until a power or reset condition is applied, as required. The latched facility may be achieved by insertion of a link or other approved means.
- E11 A label shall be affixed to the unit "Latched Fail Safe - For Motorway Use Only".

- E12 The vehicle detection signal to indicate the presence of a vehicle may be either the high or low impedance condition.

APPENDIX F MOTORWAY APPLICATIONS - OCCUPANCY

Performance Requirements

- F1 Vehicle detection equipment shall comply with the following performance requirements using motorway loop configurations as detailed in the 7th Edition Specification for Highway Works, with the maximum feeder length specified of 200 metres.
- F2 The vehicle detection equipment shall respond to any vehicle with 3 or more road wheels normally encountered on motorways, travelling at any speed up to 193 km/h (120 mph). Detection of vehicles outside this range is not precluded.
- F3 In the event of any vehicle with 3 or more road wheels coming to rest over a below ground detector, after having entered the zone of detection at a speed of not less than 4.8 km/h (3 mph), the presence time shall be 35 minutes \pm 5 minutes. An alternative presence time of 4 minutes \pm 1 minute may also be provided, if specified.
- F4 The Product shall not respond to any positive inductance change greater than 0.01% of the unoccupied detector, lasting for 0.7 seconds or less (or recovery from such), in such a way as to cause a vehicle detect signal to be created.
- F5 Recovery time from a sustained actuation shall not be greater than 10 seconds for an applied recovery actuation signal of 2% dL/L.
- F6 Each channel of a detector unit shall have a normally closed, isolated fault output in accordance with 2.40 and 2.42.
- F7 Under failure conditions persisting for a period of not less than 1 minute, the vehicle detection and fault signals shall latch and remain latched until a power or reset condition is applied, as required. The latched facility may be achieved by insertion of a link or other approved means.
- F8 The vehicle detection signal to indicate the presence of a vehicle shall be the low impedance condition. A high impedance output condition may also be given to indicate the presence of a vehicle.
- F9 A label shall be affixed to the unit "Latched Fail Safe - For Motorway Use Only".

APPENDIX G CIRCUIT DESIGNATIONS - EURO CONNECTOR

G1 Euro Connector DIN 41612 type B (Appendices A, B, C & D)

PIN	Circuit Designation (Optional 8 Channel Connector)	1 Channel	2 Channel	4 Channel	8 Channel
1a	Output Channel 1 relay N/C or +ve solid state	√	√	√	√
2a	Detector Channel 5				√
3a	Output Channel 1 relay N/O or +ve solid state	√	√	√	√
*4a	Reserved see note 2				√
5a	Detector Channel 1	√	√	√	√
*6a	Reserved see note 2	√	√	√	√
7a	Master fault output relay N/O or +ve solid state	√	√	√	√
8a	Detector Channel 6				√
9a	Output Channel 2 relay common or -ve solid state		√	√	√
10a	Output Channel 5 relay N/C or +ve solid state				√
*11a	Master fault output relay common or -ve solid state	√	√	√	√
12a	Output Channel 5 relay N/O or +ve solid state				√
13a	Detector Channel 2		√	√	√
14a	Output Channel 6 relay common or -ve solid state				√
15a	Output Channel 3 relay N/C or +ve solid state			√	√
16a	Detector Channel 7				√
17a	Output Channel 3 relay N/O or +ve solid state			√	√
18a	Output Channel 7 relay N/C or +ve solid state				√

PIN	Circuit Designation (Optional 8 Channel Connector)	1 Channel	2 Channel	4 Channel	8 Channel
19a	Detector Channel 3			√	√
20a	Output Channel 7 relay N/O or +ve solid state				√
*21a	24V ac supply	√	√	√	√
22a	Detector Channel 8				√
23a	Output Channel 4 relay common or -ve solid state			√	√
24a	Output Channel 8 relay N/C or +ve solid state				√
*25a	Serial communications bus transmit data RS 232 TX (TXD+)	√	√	√	√
*26a	RS 232 RTS	√	√	√	√
27a	Detector Channel 4			√	√
*28a	RS 232 RS 232 DSR (RXD-)	√	√	√	√
*29a	Reset input	√	√	√	√
*30a	Reserved see note 3	√	√	√	√
31a	Output Channel 8 relay N/O or +ve solid state				√
*32a	Reserved see note 3	√	√	√	√
1b	Output Channel 8 relay N/O or -ve solid state				√
2b	Output Channel 1 relay common or -ve solid state	√	√	√	√
3b	Detector Channel 5				√
*4b	Master fault output relay N/C or +ve solid state	√	√	√	√
*5b	Reserved see note 2	√	√	√	√
6b	Detector Channel 1	√	√	√	√
*7b	Reserved see note 2	√	√	√	√

PIN	Circuit Designation (Optional 8 Channel Connector)	1 Channel	2 Channel	4 Channel	8 Channel
8b	Output Channel 2 relay N/C or +ve solid state		√	√	√
9b	Detector Channel 6				√
10b	Output Channel 2 relay N/O or +ve solid state		√	√	√
11b	Output Channel 5 relay common or -ve solid state				√
12b	Detector Channel 2		√	√	√
13b	Output Channel 6 relay N/O or +ve solid state				√
14b	Chassis ground	√	√	√	√
15b	Output Channel 6 relay N/C or +ve solid state				√
16b	Output Channel 3 relay common or -ve solid state			√	√
17b	Detector Channel 7				√
*18b	24V ac supply	√	√	√	√
19b	Output Channel 7 relay common or -ve solid state				√
20b	Detector Channel 3			√	√
*21b	Reserved see note 3	√	√	√	√
22b	Output Channel 4 relay N/C or +ve solid state			√	√
23b	Detector Channel 8				√
24b	Output Channel 4 relay N/O or +ve solid state			√	√
*25b	RS 232 TXD- RS 232 DTR (TXD-)	√	√	√	√
26b	Detector Channel 4			√	√
*27b	RS 232 CTS	√	√	√	√
*28b	Serial communications bus receive data RS 232 RX (RXD+)	√	√	√	√

PIN	Circuit Designation (Optional 8 Channel Connector)	1 Channel	2 Channel	4 Channel	8 Channel
*29b	Reserved see note 3	√	√	√	√
30b	+24 V d.c. supply	√	√	√	√
*31b	Reserved see note 3	√	√	√	√
32b	0 volt d.c. supply and common connection	√	√	√	√

NOTES:

1. * Indicates optional facility. Refer to Table 2 for communications connections. (RS 485 connections shown in brackets)
2. Reserved for loop frequency selection as defined below

PIN	Signal name	Function
*4a	Frequency selection bit 1	Least significant frequency selection bit
*5b	Frequency selection bit 2	
*6a	Frequency selection bit 3	
*7b	Frequency selection bit 4	Most significant frequency selection bit

Table.G.1
Frequency Selection (Option)

These signals duplicate the functions of the frequency selection switches on the Product and shall affect all detection channels within the vehicle detector

Interface: Logical '1' is defined as floating or connection to +ve rail.

Logical '0' is defined as connection to 0v common.

Signal Function: The combined functions of these signals shall be:

'1111' Selects the highest available loop frequency

'1110' Selects the next highest available frequency

;; ;; ;; ;; ;;

'0001' Selects the next lowest available frequency

'0000' Selects the lowest available loop frequency

Where fewer than 16 available loop frequencies are available, these bits shall be implemented most significant first. Non-implemented combinations of bit patterns shall not cause the detector to malfunction and may be interpreted as either 'Detector off' or as operation at one of the valid frequencies.

3. Reserved for detector identification selection as defined below:

PIN	Signal Name	Function
*21b	Detector Identification selection bit 1	Least significant Detector Identification selection bit
*29b	Detector Identification selection bit 2	
*30a	Detector Identification selection bit 3	
*31b	Detector Identification selection bit 4	
*32a	Detector Identification selection bit 5	Most significant Detector Identification selection bit

Table G.2
Detector Identification (Option)

These signals set the Product identification for use within large serial bus connected detector systems.

Interface: Logical '1' is defined as floating or connection to +ve rail.

Logical '0' is defined as connection to 0v common.

Signal function: The combined functions of these signals shall be

'11111' Selects the highest Detector Identification

'11110' Selects the next highest Identification

;; ;;

'00001' Selects the next lowest Identification

'00000' Selects the lowest Detector Identification

G2 Euro Connector (Appendices E & F)

PIN	Circuit Designation (Appendices E & F)
1a	Output channel 1 relay N/C or +ve solid state
2a	Not used
3a	Output channel 1 relay N/O or +ve solid state
*4a	Reserved see note 2
5a	Detector channel 1
*6a	Reserved see note 2
*7a	Master fault output relay N/O or +ve solid state
8a	Isolated fault output channel 2 N/C or +ve solid state
9a	Output channel 2 relay common or -ve solid state
10a	Isolated fault output channel 2 common or -ve solid state
*11a	Master fault output relay common or -ve solid state
12a	Not used
13a	Detector channel 2
14a	Not used
15a	Output channel 3 relay N/C or +ve solid state
16a	Not used
17a	Output channel 3 relay N/O or +ve solid state
18a	Not used
19a	Detector channel 3
20a	Not used
*21a	24V ac supply
22a	Isolated fault output channel 4 N/C or +ve solid state
23a	Output channel 4 relay common or -ve solid state
24a	Isolated fault output channel 4 common or -ve solid state
*25a	Serial communications bus transmit data RS 232 TX (TXD+)
*26a	RS 232 RTS
27a	Detector channel 4
*28a	RS 232 RS 232 DSR (RXD-)
*29a	Reset input
*30a	Reserved see note 3
*31a	Reserved see note 3
*32a	Reserved see note 3

NOTES:

1. * Indicates optional facility. Refer to Table 2 for communications connections. (RS 485 connections shown in brackets)
2. Reserved for loop frequency selection as defined below

PIN	Signal Name	Function
*4a	Frequency selection bit 1	Least significant frequency selection bit
*5b	Frequency selection bit 2	
*6a	Frequency selection bit 3	
*7b	Frequency selection bit 4	Most significant frequency selection bit

Table G.3

Frequency Selection (Option)

These signals duplicate the functions of the frequency selection switches on the Product and shall affect all detection channels within the vehicle detector

Interface: Logical '1' is defined as floating or connection to +ve rail.

Logical '0' is defined as connection to 0v common.

Signal Function: The combined functions of these signals shall be:

'1111' Selects the highest available loop frequency

'1110' Selects the next highest available frequency

;; ;;

'0001' Selects the next lowest available frequency

'0000' Selects the lowest available loop frequency

Where fewer than 16 available loop frequencies are available, these bits shall be implemented most significant first. Non implemented combinations of bit patterns shall not cause the detector to malfunction and may be interpreted as either 'Detector off' or as operation at one of the valid frequencies.

3. Reserved for detector identification selection as defined below:

PIN	Signal Name	Function
*21b	Detector Identification selection bit 1	Least significant Detector Identification selection bit
*29b	Detector Identification selection bit 2	
*30a	Detector Identification selection bit 3	
*31b	Detector Identification selection bit 4	
*32a	Detector Identification selection bit 5	Most significant Detector Identification selection bit

Table G.4

Detector Identification (Option)

These signals set the Product identification for use within large serial bus connected detector systems.

Interface: Logical '1' is defined as floating or connection to +ve rail.

Logical '0' is defined as connection to 0v common.

Signal function: The combined functions of these signals shall be

'11111' Selects the highest Detector Identification

'11110' Selects the next highest Identification

;; ;;

'00001' Selects the next lowest Identification

'00000' Selects the lowest Detector Identification

Where fewer than 32 detector identities are available, these bits shall be implemented most significant first. Non-implemented combinations of bit patterns shall not cause the detector to malfunction.

APPENDIX H INFORMATIVE GUIDE

General

This Annex is an informative guide to Highways Authorities who wish to purchase / hirer and use Below Ground Vehicle Detection Equipment, for use with Portable Traffic Signal Controllers, that has been declared conformant to this specification. Prospective purchasers/hirers should ensure that the procurement contract address the following issues.

Marking and Labelling

The Vehicle Detection Equipment is fitted with a label displaying the Following:

1. The unique Product Identity and serial number
2. The Technical Requirements Specification against which it has been declared compliant.
3. The electrical supply requirements of the equipment;

Method of Connection

Where alternative interfaces are permitted in the appendices hereto, in order to be compatible with existing UK signal control equipment, they would need to comply with the following connection types, tables and configurations:

Connector Device RJ45 (Optional Front Panel Connector).

Pin	Signal	Input/Output
1	RTS	Output
2	DTR (TXD-)	Output (TX)
3	TX (TXD+)	Output (TX)
4	0V	Common
5	0V	Common
6	RX (RXD+)	Input (RX)
7	DSR (RXD-)	Input (RX)
8	CTS	Input

Table 5

RJ 45 Pin Connections

TERMINAL INTERFACE. The interface shall conform to RS 232 or RS 485.

(RS 485 connections shown in brackets)

BAUD RATE. The Baud Rate must be capable at 9600 Bd or higher rates. Operation at 9600 Bd is recommended.

CHARACTER SET. The Character Set shall be ISO Alphabet No 5 (ASCII).

User Terminal. The manufacturer shall specify an appropriate P.C. terminal device and required software.

1. Connector Device – Rear Terminations on Euro-Connector

Pin	Signal	Input/Output
26a	RTS	Output
25b	DTR (TXD-)	Output (TX)
25a	TX (TXD+)	Output (TX)
32b	0V	Common
28b	RX (RXD+)	Input (RX)
28a	DSR (RXD-)	Input (RX)
27b	CTS	Input

Table 2

Connections to Euro-Connector

TERMINAL INTERFACE. The interface shall conform to RS 232 or RS 485.

(RS 485 connections shown in brackets).

BAUD RATE. The Baud Rate must be capable at 9600 bd or higher rates. Operation at 115.2 KBd is recommended.

CHARACTER SET. The Character Set shall be ISO Alphabet No 5 (ASCII).

The manufacturer shall specify an appropriate personal computer terminal device and required software.

Integrated Detector Link

Where detectors are fully integrated on the controller circuit board, the detector/controller interface can be manufacturer specific. .

Reset Input (Optional - Required for App: E & F)

Where required the product shall provide a reset facility.

Vehicle Detection Equipment Protection

It shall not be possible for any vehicle, or combination of vehicles, to produce input conditions that either damage the Product or render it non-operational.

The equipment shall not suffer damage if any loop and/or feeder is short circuited or disconnected.

An external fault applied to the input or output of one channel shall not affect the operation of any other channel(s).

Power Supplies

In order to be compatible with existing UK controller equipment the Product would need to be powered from one of the following supplies:

Extra Low Voltage AC

The Product shall operate as required by this specification when the Extra Low Voltage varies between +13% and -10% of its nominal voltage of 24V AC or 40V AC and over the range $\pm 4\%$ of its nominal frequency.

Extra Low Voltage DC

The Product shall operate as required by this specification when the nominal 24V DC supply voltage varies over the range $\pm 20\%$ of its nominal value.

APPENDIX Z - TECHNICAL FILE CONTENT

This appendix defines the necessary content for a Technical File Pack (a collection of relevant documents) which must be reviewed by an appropriate Technical Assessor as part of the TOPAS Registration process (See TOPAS 0600).

Only the 'ticked' items are required to be present in a Technical File Pack used to support TOPAS Registration against TOPAS 2512A.

Ref	Item	Description	Required
1	Technical File overview document.	A summary document outlining the product, specifying which TOPAS and other relevant specification(s) the product has been designed to comply with, together with a detailed table of contents for the Technical File Pack. Where copies of external certificates or documents are referred to these may be included within the Technical File overview document or supplied separately as part of the Technical File Pack.	✓
2	QA accreditation certificate(s).	A copy of the Quality Management Registration Certificates for the organisation applying for TOPAS Product Registration.	✓
3	Details of all CE markings that apply to the product.	A list of all directives complied with and how achieved. Typically this would be references to explicit CE Technical Files and certificate's, copies of which would be included in the Technical File Pack.	✓
4	A functional design description of the product.	A reference to the overall System Design Documentation for the product (by document part number and issue).	✓
5	Product part numbers	A list of top level assembly part numbers and their issue states including all firmware / software part numbers and issues.	✓
6	Statement of compliance	A clause by clause statement of compliance against TOPAS 2512A confirming compliance and/or listing caveats or deviations.	✓

7	Test procedures and results	A reference to all test schedules and test result documents (by document part number and issue).	✓
8	EMC test results	A reference to EMC test performance requirements. Copies of the results of EMC testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	✓
9	Optical test results	A reference to Optical tests performance requirements. Copies of the results of Optical testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	N/A
10	Environmental test results	A reference to Environmental tests performance requirements. Copies of the results of the Environmental testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	✓
11	Radio Agency test results	A reference to Radio Agency tests performance requirements. Copies of the results of Radio Agency testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	✓
12	Primary Safety Test results	For Traffic Control equipment specifically a reference to the Primary Safety Test schedule and test results by part number and issue. A copy of the test results should be included as part of the Technical File Pack.	N/A
13	Failure Mode Analysis	A reference to the product failure mode analysis requirements and results by document part number and issue.	N/A