

TOPAS

Traffic Open Products and Specifications

TOPAS 2500B

Specification for Traffic Signal Controller

Revision	Date	Scope	Authorised by
B	29/06/21	Final	Board
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TOPAS 2500B

SPECIFICATION FOR TRAFFIC SIGNAL CONTROLLER

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CHANGE LOG

There are significant changes in this specification compared to TOPAS 2500A. When seeking Registration / Re-Registration Manufacturers are advised to review the whole specification and not rely solely on this change log for details.

The following outlines significant changes to this specification, from its previous issue which do not impact on currently Registered products:

- a. General document tidy-up, textual corrections, clarifications and minor reformatting.
- b. Specification now refers to the latest versions of TSRGD, EN12675 and EN 50556.
- c. The section 'National Requirements' has been re-titled as 'Essential Requirements'.
- d. Reference to the Zebra, Pelican and Puffin Crossing Regulations and General Directions 1997 have been removed (section 3.3).
- e. The start-up time limits have been relaxed to allow up to 120 seconds before the signals are required to be illuminated. (section 3.5 onwards).
- f. Some material from Appendix A which is applicable to all modes and not just fixed time (e.g intergreens and parallel stage streaming) have been moved to the main body of the specification.
- g. Appendix A (Fixed-Time) has been modified to recognise that phases may be demand dependent in Fixed-Time and that the Fixed-Time periods may be either directly configured or be the currently selected maximum times for VA mode.
- h. The requirement for the provision of minimum intergreen times which cannot be changed on-site has been clarified. (section 3.11).
- i. The use of phase demands (as well as stage demands) to initiate a Hurry Call is now explicitly allowed (section E4).

- j. The definition of the cableless linking Cycle Time” has been clarified (section C7).
- k. Appendix F has been renamed as ‘External Control Strategies’ (was ‘UTC and MOVA’) and has been updated to allow other strategies to be specified by the purchaser.
- l. The provision of Integral UTC facilities has been clarified to note that the network device (e.g. router) is not part of the integral UTC facility (section F6).
- m. Appendix H (Warden Control) has been re-organised and updated to aid clarity.
- n. The approval for use of push-button or biased key switches for Warden Control Boxes now rests with the customer (was previously the Approval Authority) (section H5).
- o. Appendix I has been renamed ‘Selected Vehicle Priority’ (was ‘PSV Priority’) and has been clarified in several areas.
- p. The need to have a defined key type for manual access has been clarified (section K14).
- q. The vehicle red/red standing man period in part (d) of section K16 has been clarified as the vehicle to pedestrian intergreen.
- r. The specification for the serial handset device has been clarified (section K19).
- s. Provision of additional access facilities (for example a web browser interface) is now explicitly permitted. (Section K20).
- t. The All-Off period defined in the Start-up timings section of Appendix K Table 2, has been clarified as being the period following manual switch on by the signals on-off switch.
- u. The designations of Puffin and Pedestrian timings in Appendix K table 3 have been changed to nearside and farside to better align with the text.
- v. Appendix K table 4 has been deleted as it is a duplicate of material contained in other tables in this appendix.
- w. The classes of performance required against BS EN50556 have been rationalised to align with the classes now available in that specification and also required by TSRGD.

- x. The original protection class for the enclosure protection (V4) has been withdrawn so has been replaced with the nearest equivalent in BS EN 50556 (V2, IP54), however it is noted that for Registration, products must still comply with TOPAS 2130 which requires IP55.

The following outlines significant changes to this specification, from its previous issue which may impact on currently Registered products.

- a. The option to provide alternative solutions in each appendix has been removed. (As TOPAS specifications are Purchasing Specifications they aim to give Purchasers reasonable certainty over what they are purchasing and the deleted clauses are not consistent with that aim).
- b. The requirement to provide fault log facilities has been clarified with respect to dealing with many fault / notification events potentially created by Operating System based software. (section 3.22).
- c. The requirement for the controller to explicitly provide dimming facilities has been added. (section 3.29).
- d. The specification now includes basic cyber security requirements. (section 3.32).
- e. The ability of DFM to be able to set a detector input active, inactive or to continue to operate whilst simply logging the fault, is now required (section B32).
- f. The access protection requirements when changing Traffic Safety Data and Controller Operating Programs have been tightened. (sections K9 and K11 and also B5).
- g. Appendix C (CLF) has been enhanced to specify more clearly how CLF should operate in multi-stream controllers and clarified with respect to influences required for junction and pedestrian operation.
- h. Appendix D (Part-Time), now clarifies that in a multi-stream controller each stream shall independently be able to be operated in Part-Time mode.

- i. The red lamp monitoring class of EN12675 when part time signals are implemented has now been clarified as CC1, with two red signals now explicitly specified. Also the requirement to perform feeder failure and monitoring of the RLM facility has been restored to this specification, as originally outlined in TR2210 and the proposed (unpublished) TR2500B. (section D10).
- j. The response times for red lamp monitoring have been clarified (section D11).
- k. Appendix E (Hurry Calls) now explicitly defines the operation of Hurry Calls in a multi-stream controller and clarifies how the priority of competing hurry calls are to be treated.
- l. Appendix J has been re-named Non-Motorised Crossing Facilities and includes significant clarifications and updates to operational features, including closer alignment with the intentions of the (unpublished) TR2500B proposals. Some timing sequence designators have also been changed to align more closely with Chapter 6 of the Traffic Signs Manual.
- m. Appendix K, table 3 has been corrected to ensure the timing range for the farside pedestrian VA minimum vehicle green time, aligns with the text in section J62 (6-15 seconds).
- n. The access level requirements for vehicle extensions and fixed vehicle period timings have been reduced to access level 2 (from 3) in Appendix K tables 1 and 3.
- o. Appendix L (Speed Measurement) now explicitly defines that loop detection technology is to be used for the sensing of vehicle speed. Also, it is not now permitted to implement alternative algorithms to deliver the SDE / SA functionality.
- p. Appendix M (Informative Guide) has been deleted, but labelling requirements have been moved to the main body of the specification. (section 3.34).
- q. Appendix Z (3) has been updated to require details of relevant CE and CA marking material.

The requirements for re-registration of existing products are defined in section 1.7.

Corrigendum 6/12/24

Inclusion of Clause J92 before Clause 100 as it should have appeared in both sections.

1 INTRODUCTION

1.1 This specification covers the requirements for traffic signal controller equipment for use on roads other than motorways.

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.

Implementation

1.6 This specification will be immediately implemented from the date of issue for all new TOPAS Registrations.

1.7 For Products previously Registered against TOPAS 2500A, manufacturers are simply required to confirm in writing that the Products remain compliant with this amended specification. Once confirmed Product Registration information will be migrated on the TOPAS website.

Glossary of Terms, Abbreviations and Application Guidance

1.8 A comprehensive glossary of terms and abbreviations may be found in the Institute of Highway Engineers guidance note "Traffic Control and Information systems".

TOPAS Terms are defined in TOPAS 0600 and TOPAS 0601.

1.9 The DfT Traffic Signs Manual provides guidance on the application of traffic signals in the United Kingdom.

2 EUROPEAN HARMONISED STANDARDS

2.1 Controllers shall meet the requirements of BS EN 50556, BS EN 12675 and BS EN 50293.

2.2 Where these documents provide alternatives for variations to requirements by the definition of different classes, the controller shall meet the requirements of the classes set out in The Traffic Signs and General Directions (TSRGD) and set out in the following tables.

BS EN 50556

Electrical Supply	Overvoltage	D0
Safety	Leakage current	T2
	Enclosure	V2 ¹
	Terminations	H0
	Requirements of Signalling Intensity for Safety	AF5
	Requirements for signal states	AG5
	Requirements for signal states	X1
	Location of Monitoring Elements for signals	N0

Note1 For TOPAS Registration TOPAS 2130 requires the enclosure protection to exceed the requirements of EN 50556. (TOPAS 2130 maintains the historical requirement for enclosures to be IP55 rated, which is considered necessary in the UK environment).

Test of Impedance	Fault Loop Impedance test	AA1
Maintenance	Maintenance Testing Procedures	Y1
Environmental	Dry heat	AB3
	Cold	AE2
	Damp heat, cyclic	AK2
	Solar radiation	AH0
	Random vibration (operational)	AL2
	Random vibration (transportation) ²	AM2

Note2 Not required if supplier takes full responsibility for installation or defines full installation and commissioning procedures.

BS EN 12675

Fault	Class
Green – Green conflict	AA1
Green – Yellow conflict	AB1
Yellow – Yellow conflict	AC0
Green – Red/Yellow conflict	AD1
Green – Green/Yellow conflict	AE0
Absence of any conflicting Red signal	AF0
Absence for conflicting Red on specified signal heads	AG0
Absence of the last conflicting red signal	AH0
Absent Red/ absent Red	AJ0
National signal regulations (infringement)	BA0
Absence of a Red signal on a specified signal group	CA1
Absence of the last Red signal	CB1

Fault	Class
Absence of a number of Red signals	CC1
Absence of specified Red signals	CD0
Absent signal groups, Yellow or Green signals	CE0
Compliance checking	DA1
Stored values of timings	FA1
Time base frequency	FB0
Minimum values of time settings	FC0
Maximum settings of time settings	FD0
Duration of timings	FE0
National signal sequences (infringement)	GA0
Specified signal group Green to signal group Green movements	GB0
Specified signal start up sequence signal group movements	GC0
Faults of external inputs	HA1

3 ESSENTIAL REQUIREMENTS

3.1 Controllers Registered to this specification shall meet all the requirements set out in the main body of the specification (sections 1 to 4) and one or more of the Appendices (A to L).

3.2 The appendices to which the controller is Registered shall be clearly identified in its documentation and on its individual product label. (see section 3.34).

Signal Sequences

3.3 Regulations require that traffic signalling equipment must be designed to present to the road user only those signals and signal sequences defined in the current version of the Traffic Signs Regulations and General Directions.

Controller Start-up Sequence

General

3.4 Where junction, junction linked pedestrian and stand-alone Pelican, Puffin and/or Toucan facilities are provided within the same controller, then each facility shall function independently of the other with regard to start up requirements.

3.5 On restoration of the mains supply to the controller the period of time that no signals are shown shall not exceed 120 seconds.

3.6 The start-up sequence shall always include an 'all off' period of 7 seconds where no signals shall be shown. This period may be included within the overall start-up period defined in clause 3.5.

Note The intention is that the signals are lit as quickly as possible, subject to the minimum 'all-off' timings above.

Junction Control

3.7 After the expiry of the 'all off' period, defined in clauses 3.5 and 3.6 the controller shall recommence operation with the establishment of the stage pattern subject to the following constraints:

- a) vehicular phases which in Stage 1, or any other nominated 'start-up' stage, shall commence with an amber signal for a period of 3 seconds followed by red;
- b) during the amber period the signals for vehicular phases which will eventually show green, or green arrow during stage 1, shall show the all signals off condition. They shall then show a full green signal at the end of a timed period known as the starting intergreen period. This period shall start at the commencement of the red signals of (a). It shall be possible to pre-set the starting intergreen period; all pedestrian and cycle signals shall be set to show red at the start of the amber in (a);
- c) on restoration of the mains supply to the controller, demands shall be inserted (in appropriate modes of operation) for all phases to ensure that no vehicles are trapped against a phase red signal.

Pelican Control

3.8 After the expiry of the 'all off' period, defined in clauses 3.5 and 3.6, the controller shall recommence operation at the start of the flashing amber to vehicles/flashing green period to pedestrians with a stored pedestrian demand.

Note: TSRGD 2016 no longer permits the installation of new Pelican Crossings in England, Scotland, or Wales. The full definition of Pelican requirements are retained to allow controllers to be replaced at existing sites, for example as the result of a controller 'knockdown', and for use in Northern Ireland, where new Pelican Crossings are still permitted.

Puffin/Toucan/Equestrian Control

3.9 After the expiry of the 'all off' period, defined in clauses 3.5 and 3.6 the controller shall recommence operation in accordance with the following sequence:

- a) the pedestrian (or cyclist or equestrian) signals shall be set to show the red signal.
- b) at the end of a timed period, the starting intergreen, a full green signal shall be shown to vehicles. A stored demand for pedestrians/cyclists/equestrian shall be inserted.

Traffic Regulatory Signs

3.10 Where required by the Works Specification, regulatory signs mounted within a signal head may be switched on or off at specific times, usually under part time control. This action may, (if required), also be delayed until the appearance of specified phase green signals or alternatively the appearance of a specified stage.

Intergreen provision

3.11 It shall be possible to define minimum intergreen timings between any pair of conflicting phases which may not be amended manually on-site or by external control signals. This may be either via:

- a) A fixed minimum intergreen table or,
- b) A fixed minimum handset limit which applies to all intergreen timings.

Priority Structure

3.12 Where the controller provides different modes of control related to different Appendices of this specification, they shall operate in the following priority structure unless an alternative priority structure is specified in the Works Specification.

3.13 The mode operated by the Controller shall be the highest priority mode for which a request exists, and which is currently available:

- 1) Hurry Call (Highest Priority);
- 2) Manual Control;
- 3) Vehicle Priority (e.g. Selected Vehicle Priority);
- 4) Urban Traffic Control (UTC, SCOOT, MOVA);
- 5) Manually selected other modes (e.g. VA, fixed time);
- 6) Cableless Linking Facility (CLF);
- 7) VA or Fixed Time (Lowest Priority).

3.14 Any changes in the method of control shall eliminate the risk of vehicles and pedestrians being excessively delayed or trapped due to lost demands or extensions. This shall be performed on every control method change by either inserting demands on all non-running phases or by continuously assessing demands and extensions against the associated greens and inserting the outstanding demands and extensions.

Parallel Stage Streaming

3.15 Parallel stage streams allow a controller to function as two or more smaller controllers.

3.16 The controller may be Registered as providing either:

- c) A single stage stream or,
- d) Parallel stage streams (2 or more).

3.17 Where parallel stage streaming facilities are provided it shall be possible to define in the Works Specification the allocation of the available stages to a minimum of two stage streams. Any split in the number of stages allocated to each stage stream shall be possible, and the streams shall be capable of operating independently of one another at all times during the signal cycle

Stage Stream Restrictions

3.18 It shall be possible to restrict the independent operation of stage streams in one or both of the following ways:

- a) by direct influences between stage streams. It shall be possible for one stage stream to have its stage changes conditioned by the state of another stage stream, and/or;
- b) by declaring conflicts (and phase intergreens) between selected phases in the different stage streams.

Fault recording

3.19 Fault recording facilities shall be provided in the controller in accordance with BS EN 12675:2017 5.4 Storage of Faults.

3.20 The fault log shall record the date and time of fault clearances.

3.21 The fault log shall have, as a minimum, the capacity to record 255 events.

3.22 The requirement (in BS EN 12675) not to overwrite major fault entries until they have been manually cleared may be met by the provision of a current fault log of uncleared faults with a minimum capacity of 64 fault entries together with an historic record (minimum 255 entries capacity) containing all faults and recorded events which is overwritten when full.

Note. Where an Operating System or other software architectures are likely to give rise to many 'internal' software notifications or faults, a means to separate these from controller operational faults and events shall be provided. The fault log capacity shall be such that 'internal' software notifications or faults do not affect the ability to store operational events as defined in 3.21 and 3.22.

3.23 All fault data shall be preserved in the event of a power supply failure for a minimum of 30 days.

3.24 The fault recording system shall have the capability of detecting and recording faults from external inputs (such as detectors) as required by BS EN 12675 class HA1.

3.25 Major Faults (requiring the controller to enter Failure Mode) are defined in TSRGD as those described in the following classes of BS EN 12675.

AA1; AB1; AD1; DA1.

3.26 The controller manufacturer or the Works Specification may specify certain additional faults to cause the controller to enter failure mode.

3.27 All other faults are defined as minor faults.

Failure mode

3.28 In the event of a Major Fault, the Failure Mode shall be "all signals off" including non-operation of "wait" and demand indicators and tactile and audible devices.

Signal Dimming

3.29 The controller shall provide a Solar Cell interface and be capable of dimming all signals as defined in TOPAS 2523. Where required, signal dimming shall only actually be implemented if required by the Works Specification.

Environmental and EMC performance.

3.30 The controller shall be tested and meet the Environmental and EMC performance requirements defined in TOPAS 2130.

Reliability

3.31 The controller shall be designed to have a minimum in-service life of 15 years with suitable maintenance.

Cyber Security

3.32 Where controllers are capable of being connected to an IP network of any kind, for example a UTC system, monitoring system or have local wireless access, it shall not be possible for the IP link to be used (intentionally or maliciously) to create an unsafe condition on the street.

3.33 The controller device and the deployment of the controller should be subject to a nationally recognised process** to manage security risks, protect against cyberattack, and detect cyber security events, to ensure the impact of cyber security incidents are minimised.

** For example, the NCSC Cyber Assessment Framework (<https://www.ncsc.gov.uk/collection/caf>).

Marking, labelling and packaging

3.34 Each Controller shall clearly marked with a unique serial number and the Appendices of TOPAS 2500 to which it is Registered.

Note: If the controller is Registered to all appendices in this specification it is simply sufficient to state "Registered to TOPAS 2500B."

Note: Where a controller is Registered to appendix F and does not support both integral and free standing facilities, the label shall explicitly identify which sub-category(s), defined in section F6, it complies with.

Note: Where a controller is Registered to Appendix J and does not provide the all crossing sub-categories specified, the label shall explicitly identify which sub-categories, defined in section J3, it complies with.

3.35 The controller shall also be clearly marked with its power supply requirements and power consumption figures.

Note: It is not necessary to include power consumption figures for ancillary equipment such as routers or the overall site power.

3.36 Where there is flexibility within the specification, such as the maximum number of phases/stages supported, these shall be clearly detailed in the controller documentation.

4 REFERENCES

4.1 Where undated references and standards are listed, the latest issue of the publication applies.

British Standards

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

BS EN 50556	Road Traffic Signal Systems
BS EN 50293	Electromagnetic Compatibility Road Traffic Signal Systems Product Standard
BS EN 12675	Traffic Signal Controllers – functional safety requirements

Specifications

4.3 TOPAS Limited specifications are available at www.topasgroup.org.uk

TOPAS 0600	TOPAS Registration Process
TOPAS 2505	Performance Specification for Above Ground Vehicle Detector Systems for use at Permanent Traffic Signal Installations
TOPAS 2506	Performance Specification for Above Ground On-Crossing Pedestrian Detection Systems
TOPAS 2507	Performance Specification for Kerbside Detection Systems for use with Nearside Signals and Demand Units
TOPAS 2508	Performance Specification for Tactile Equipment for use at Pedestrian Crossings
TOPAS 2509	Performance Specification for Audible Equipment for use at Pedestrian Crossings
TOPAS 2512	Performance Specification for Below Ground Vehicle Detection Equipment
TOPAS 2523	Traffic Control Equipment Interfacing Specification
TOPAS 2130	Environmental Tests for Road Traffic Control Equipment
MCE 0360	Urban Traffic Control - Functional Specification
MCE 0361	High Capacity data transmission system for use in UTC

Other publications

TSRGD	Traffic Signs Regulations and General Directions:
TSM	The Traffic Signs Manual – specifically chapter 6 (Traffic Control)
DMRB	The Highways England Design Manual for Roads and Bridges
	Institute of Highway Engineers guidance note “Traffic Control and Information systems”

APPENDIX A FIXED-TIME

A1 This appendix sets out the requirements for a traffic signal controller to be Registered for use in Fixed-Time mode.

A2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Functional Requirements

A3 Junction controllers shall provide, as a minimum, four phases and four stages.

A4 In Fixed-Time mode, the stages shall appear in a specified order (the 'Stage Sequence') for pre-set Fixed-Time periods. The Fixed-Time periods may:

- a) Be fixed periods as set by the controller configuration or,
- b) If the controller is also designed for Vehicle Actuated control, the fixed periods may be the same as the currently active stage maximum periods, (Referred to as Fixed-Time to Current Maximums).

Either or both options may be provided as defined by the Manufacturer.

A5 In Fixed-Time mode Input signals from detection systems, normally used to extend phases or stages shall be ignored.

A6 On controllers with other modes of control, Fixed-Time mode may be introduced by a switch or push button on an accessible position on the controller (on the Manual Control Panel if provided) or by timetable or remote command from a UTC or other remote system.

A7 Any phases which may run conditionally within stages, in the Vehicle Actuated mode shall either:

- a) Always run if the appropriate stage appears in the Fixed-Time mode or,
- b) Be able to be configured as demand dependent and only run when demanded.

Either or both options may be provided as defined by the Manufacturer.

A8 If the controller is switched to Fixed-Time, then it shall continue to work in the Fixed-Time mode following a power failure, after power is restored.

APPENDIX B VEHICLE ACTUATION

B1 This Appendix sets out the requirements for a traffic signal controller to be Registered for use in Vehicle Actuated mode. Any controller Registered for use in Vehicle Actuated mode must also meet the requirements for Registration for use in Fixed-Time mode as set out in Appendix A of this specification.

B2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Functional Requirements

B3 The requirements contained in this Appendix are for a controller which is able to have a variable stage order, and able to omit stages when permitted and when there is no demand registered for that stage. It also has the ability to select stages according to the demands received.

B4 This requires the ability to receive demands for stages or for individual phases. It also has the ability to overlap extensions for the same phase so that, with multiple detectors for the same traffic stream, the total extension thus granted for an individual vehicle may, in effect, be varied according to the speed of the vehicle.

Note. It is not required to measure the vehicle speed in VA mode.

B5 It shall be possible to designate which stage-to-stage movements are permitted and which are not permitted. It shall not be possible to change these designations except by a change to the controller configuration requiring a controller restart (see also section K9)..

B6 Any alternative method of operating in a Vehicle actuated mode offered for Registration must provide the same basic facilities including:

- Variable stage order
- Stages may be omitted if not demanded
- Phase and stage demands
- Overlapping green extensions

B7 The controller shall systematically give green (right-of-way) to demanded vehicular or pedestrian phases. Once a phase has been given right-of-way, this right-of-way shall continue for a preset minimum period – the minimum green period. Vehicular phases greens may be extended by requests from 'on street' detection; each such request shall cause the controller to give the associated phase its preset green extension time.

B8 If a conflicting, or opposing, phase demand exists, the running phase green may be extended up to the expiry of the phase maximum green time (as detailed in clause B17), at which time the controller shall attempt to serve one, or more, of the conflicting, or opposing, demanded phases, by calling a new stage.

Extension of Vehicle Phase Green

B9 The passage of a vehicle through a detection zone as indicated by a detector unit which normally demands a phase may, during the green period of that phase, cause a green extension to be generated for that phase.

B10 The continued output from the detector or detectors associated with a phase shall hold, subject to the maximum green running period, that phase green signal. The cessation of the output from the detector shall normally terminate the green extension request after a fixed extension period, subject to the cessation of extensions from other associated detectors. (See Figure B1). Vehicle detector outputs of a shorter duration than the response time of the controller are ignored.

B11 If at the end of the extension time the stage is held by extensions associated with another phase, further extension requests shall be permitted (subject to the maximum green running period).

B12 It shall be possible to arrange that selected detector input(s) do not extend a phase during a single selected stage.

B13 It shall not be possible for the relevant phase green periods to be terminated before extension inputs that have been accepted are actioned or are legitimately overridden (by the maximum green time or a UTC force bit, for example).

B14 It shall be possible to designate a detector input as a Call/Cancel demand. In this case, the demand shall not be stored but shall only persist until the detector output ceases. In addition, it shall be possible to arrange that the demand from the detector does not take effect until it has persisted for a preset period – the Call Delay, and/or to prolong the effect when it ceases for a preset period – the Cancel Delay.

B15 It shall also be possible to cancel a demand for a pedestrian phase where call/cancel facilities are provided for pedestrian demands.

B16 It shall be possible to insert a revertive demand such that if a phase green is terminated with the extension timer running, a demand for a return to that phase shall normally be inserted. Where required the demand may alternatively be inserted for another specified phase.

Termination of Vehicle Phase Green

B17 A gap change of stage shall occur when the following conditions are satisfied:

- a) a demand for right-of-way for a conflicting phase exists;
- b) the minimum green running periods of phases which will lose right-of-way have expired; and
- c) the vehicle green extension timers have expired on all phases which will lose right-of-way upon the change to the next stage.

B18 The maximum green running period shall be provided for each vehicle-actuated phase such that when a phase obtains right-of-way, the maximum green running period shall start to time off immediately if there is a demand for any conflicting or opposing phase. Alternatively, if there is no conflicting or opposing demand present, it shall start to time off upon the receipt of a subsequent demand for any conflicting or opposing phase.

B19 It shall also be possible to set the operation of the controller so that the maximum green running period shall start to time off immediately a phase obtains right of way. In this case, if a demand for any conflicting or opposing phase is received during the maximum green period, the phase green shall be terminated at the end of the maximum green running period. If no demand for a conflicting or opposing phase has been received by the end of the maximum green running period the phase will remain on green until a demand for a conflicting or opposing phase is received whereupon the running phase shall terminate immediately.

B20 The maximum duration of a particular stage green shall be governed by the termination of the green period of the last associated phase if more than one phase green is to be terminated by the stage change and if the maxima for these phase greens are different.

B21 Alternative values of maximum running periods shall be available and selectable by time of day and day of week.

B22 After the termination of the last phase maximum green for phases not served by the next stage to be introduced, a stage change shall occur to serve the conflicting demanded phase(s). This change may take place irrespective of whether the maximum or minimum green periods for the phase(s) also served by the new stage have expired.

All-Red stage

B23 It shall be possible to designate any stage as an all-red stage where all signals display a red signal (or a stop indication in the case of tram signals). An all-red stage may be demanded and extended by detectors between a maximum and minimum time as with other stages.

Quiescent Signal State

B24 In the absence of all demands and extensions, the signals may move to the All-Red or other nominated stage as required in the Works Specification.

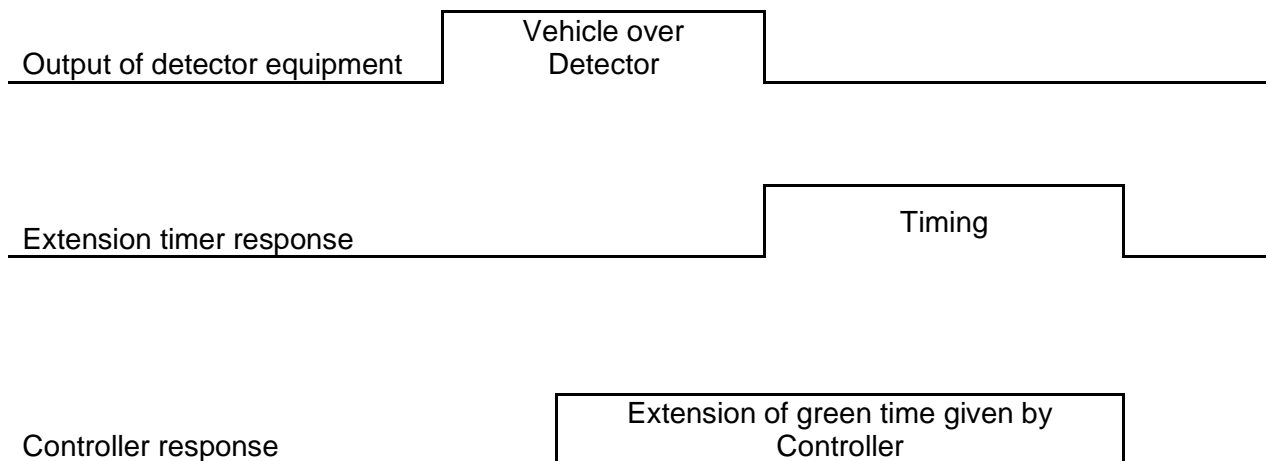


Figure B1 - Detector Logic

Detector Monitoring

B25 The input signals from the detector equipment shall be monitored by the controller. Pedestrian push buttons may, when required, be treated as vehicle detectors for fault monitoring purposes.

B26 If Puffin or other facilities involving on-crossing detection are provided at a junction, on-crossing detector monitoring as specified in Appendix J shall be provided if so required by the Works Specification.

Detector Failure Conditions

B27 Each detector input shall be individually monitored. A detector failure shall be registered if the timeout value for either a permanent detect state and for a permanent non-detect state is exceeded.

B28 The permanent detect state timeout value shall be pre-settable to a maximum of at least 60 minutes with a maximum incremental step of 1 minute.

B29 The permanent non-detect state timeout value shall be pre-settable to a maximum of at least 72 hours with a maximum incremental step of one hour.

B30 It shall be possible to allocate detectors timeout values to at least two different groups. Each group shall be capable of having a different fault reporting time.

B31 It shall be possible to designate a group as being non-monitoring, thereby providing for unmonitored detectors. The timeout values of each group should be switchable to a minimum of one alternative set by time switch.

Detector Failure Action

B32 If a detector failure occurs the controller shall be able to be configured to take any one of the following actions (for each failed detector);

- a) Insert an artificial demand for that detector.
- b) Set that detector input to an inactive state.
- c) Log the failure but continue to use the detector input state (as if no fault had been detected).

B33 If a detector failure occurs a fault flag shall be set and an indication of which detector has failed shall be stored in the fault log. If a detector fault monitor (DFM) indicator is provided it shall be lit when the fault flag is set.

B34 Once the fault flag has been set and the DFM indicator (if provided) has been lit, they shall be reset only by operator intervention.

APPENDIX C CABLELESS LINKING

C1 This Appendix sets out the requirements for a traffic signal controller to be Registered for use in cableless linked mode. Registration for use in cableless linked mode will only be granted if the controller is also Registered for use in vehicle actuated mode (Appendix B).

C2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Functional Requirements

C3 The requirements contained in this Appendix are for a controller which is able to maintain coordination with other similarly equipped controllers without communication between them or individual communication with another control source (other than a publicly available time reference source). The cableless linking facility shall provide at least four timing plans switched by time of day and day of week, special conditioning, or manual introduction via the manual panel).

Cableless Linking

C4 The cableless linking facility (CLF) allows a method of linking traffic signals along a route and/or in an area using timing information derived from internal clocks in each controller which are kept in synchronism with each other by being locked to the frequency of the mains electricity supply or other means which effectively eliminates drift between them.

C5 In this way a variety of signal linking can be achieved, ranging from simple co-ordination between streams in the same controller, simple linking between two separate controllers through to a fully co-ordinated multi-controller system, or to act as a standby system in a Computer Controlled Urban Traffic Control System.

C6 All signal controllers in a linked system are related to a common cycle time for any particular traffic plan. The cableless linking facility provides instructions to the controller to change from one traffic plan to another and during the plan when to exert specific influences (e.g. to move from one nominated stage to another).

Plan Facilities

Timing Periods

C7 The necessary timing signals for the execution of a specific plan shall be derived from the group timer using the following periods:

- Offset Time – The offset time shall relate the start of the timing cycle on the individual controller to reference time. Alternatively offset times can be derived by varying the times of introduction of particular plans on linked controllers;
- Cycle Time – The repeating fixed period of the traffic plan, within which all the Group Influences are actioned.;
- Group Start Time – Group start time shall be the time that each group commences from the start of the cycle time.

Group Influences

C8 The function of each group and the number of groups within a cycle shall be programmable within the individual plan to exert one of the following influences at a time upon junction streams in the controller.

- Immediate – An immediate move to the specified stage, subject to the constraints imposed by safety timings and stage to stage movement restrictions.

- Demand Dependent – That is an immediate move to a specified stage if demanded by street demands.
- Isolate stream – Allow unrestricted local Vehicle Actuated method of traffic control to operate. Phase maximum periods shall have no effect.
- Hold stream – The hold influence shall not allow any stage-to-stage changes to occur.
- Prevent – The prevent influence shall prevent all moves except to a specified stage, providing a demand exists for a phase within that stage and providing no extensions exist for terminating phases in the current stage..

C9 For Pedestrian streams (as part of a junction controller or stand-alone) it shall be possible to arrange the influences to emulate the PV functionality as defined in J33, J50 and J66.

C10 The plan may also allow stages to be introduced or deleted, within the constraints of the basic stage/ phase definitions. Hence, phases may be allowed to run or be prevented from running. The stage structure changes made by a plan (by including or deleting stages) shall only apply whilst the controller is operating the Cableless Linking method of control.

Changes to mode and Plan Changes

C11 If the mode is to change to CLF, implementation of the 'new' stage may be delayed until the start of the next group timing period. This delay shall also apply if a plan change occurs whilst operating the CLF method of control.

C12 It shall be possible to modify the timings of a plan that is currently in operation.

CLF Control of Parallel Stage Streams

C13 It shall be possible to allocate the groups of the group timer to the stages of different stage streams. For each stage it shall be possible to specify the particular group influence which shall apply.

C14 It shall be possible for the group timings for any stage stream to be independently adjusted from those of other stage streams.

C15 It shall be possible for CLF Mode to run independently for Individual Streams e.g. Implement CLF Mode only if Group Influences are declared in the current operational CLF Plan for said Stream(s).

APPENDIX D PART-TIME OPERATION

D1 This Appendix sets out the requirements for a traffic signal controller to be Registered for use for Part-Time operation.

D2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified..

D3 The requirements of the Functional Specification contained in this Appendix are for a controller provided with a means to switch signals in and out of operation by time of day and day of week. Additionally, the controller shall have a provision for the signals to be brought into and out of service by special conditioning, local manual command and by remote command (when the controller is connected to a remote control system).

D4 Where the traffic signal controller offers parallel stage streaming each stream shall be able to be operated independently as defined in this Appendix.

Functional requirements

D5 Part-Time traffic signals may be brought in and out of service at specific times or for specific tasks or reasons. Switch-on of signals shall be as that defined for power restoration in Section 3.

D6 The controller shall be provided with a means to switch signals in and out of operation by at least:

- a) Time of day and day of week.
- b) Special conditioning commands (e.g. to implement queue control).
- c) When under UTC or other remote control system, by remote command.

D7 The signals shall be switched off under part-time control during a nominated stage provided that all minimum running periods have expired. Red Lamp Monitoring shall be provided.

D8 The controller shall also be provided with a manual means to override part time operation. When part-time operation is selected or terminated manually the controller shall follow the same switch on and switch off procedures as specified for clock, special conditioning, or remote commands.

D9 When part-time signals are non-operational, all signal displays (including "wait" and demand indicators, tactile and audible devices) shall be switched off.

Red Lamp Monitoring

D10 Upon the confirmation of the failure to illuminate two or more red lamps in the signals of a vehicle approach phase (EN 12675 Class CC1), all red lamps on a vehicle approach phase (a feeder failure), or the failure of the red lamp monitor facility, all the signals shall be extinguished.

D11 Confirmation of the failure must occur within 500ms of the fault, unless the failure occurs before or within 500 ms of the start of the monitored vehicle red. In this circumstance, action shall be taken within 1 second of the start of the red

D12 Other junction or stand-alone stage streams shall continue operation or be extinguished as specified in the Works Specification.

D13 Following the shut down of a part-time junction / stream due to red lamp monitoring actions, operation shall not be restored until the fault has been rectified and the controller manually reset. The signals shall then go through a controlled start-up sequence as defined in section 3.

APPENDIX E HURRY CALL

E1 This appendix sets out the requirements for a traffic signal controller to be approved for use with Hurry Call facilities.

E2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Use of Hurry Calls

E3 The purpose of the Hurry Call is to enter a priority demand for a particular stage to ensure that a green signal is given to certain vehicles. For example, Hurry Calls may be used at junctions, or stand-alone signals near to fire or ambulance stations, to ensure that certain vehicles are given right-of-way, or in conjunction with queue detectors to prevent blocking of a junction. This Specification enables stand-alone pedestrian facilities to reside on All-Red signals which may also be influenced by Hurry Call demands subject to protection of safety timings.

Functional Requirements

Request for Hurry Call

E4 The Hurry Call request for a stage shall normally be generated from special on-site detectors or from a remote push-button. Other Hurry Call sources such as UTC bits or special conditioning shall also be possible. Where more than one request exists, it shall be possible to prioritise the requests.

Note. The Hurry Call facility is intended to be Stage based, however as an additional facility it is also permitted for Hurry Call stages to be called by selecting individual phase within them.

E5 On receipt of a Hurry Call request the controller shall go into the Hurry Call mode after a preset delay, (the Hurry Call Delay Period), providing the controller is not in a higher priority mode.

E6 On expiry of the Hurry Call Delay Period, the controller shall move immediately to the requested stage, provided that the intergreen timings and minimum green timings associated with any phases losing right-of-way in the currently running stage have expired. Extensions for running phases shall be ignored (but see also section E14).

E7 If the requested move to the Hurry Call stage is not permitted directly, the controller shall move via the All-Red stage or other specified permitted stage movements to the Hurry Call stage. If the move is accomplished via intervening stage(s) these stage(s) shall terminate when their phase minimum running periods have expired.

Hurry Call Hold

E8 Once the Hurry Call stage has been reached, it shall be possible for the equipment to hold the stage for a preset period – the Hurry Call Hold Period.

E9 No stage change shall take place until the preset Hold Period has expired even though phase minimum green, maximum and extension timings will not be reset or held during the Hold Period. After the Hold Period the equipment shall revert to the next requested lower priority mode.

Cancelling Hurry Call Mode

E10 An input shall be provided to cancel the effect of the Hurry Call and return the controller to the next requested mode in priority order.

E11 The Hurry Call shall be prevented from being recalled for a preset period, known as the Hurry Call Prevent Period.

E12 The controller shall remain in the current mode during this period unless other higher priority control modes(s) are requested.

E13 Hurry Call requests input during the Hurry Call Prevent Period shall be invalid. The Hurry Call Prevent period will commence timing when the Hurry Call stage is reached during Hurry Call mode. The cancel signal shall cause the Hurry Call Prevent and Hold Periods to be cancelled.

E14 It shall be possible to insert a revertive demand such that if a phase green is terminated with the extension timer running, a demand for a return to that phase shall normally be inserted. Where required the demand may alternatively be inserted for another specified phase.

Parallel Stage Streaming

E15 Where only a single stream is provided the controller shall be capable of providing at least two Hurry Call facilities which may be allocated to any of the controller stages.

E16 Where the controller provides more than one stream, sufficient Hurry Call facilities shall be provided to enable at least one Hurry Call to operate in each stream.

Note. Where the number of Hurry Call facilities provided is sufficient to allow only one to be allocated per stream, Hurry Call facilities not used in one stream shall be able to be allocated to another stream, as required by the Works Specification.

E17 Hurry Calls which are allocated to stages in different stream shall be actioned and operate independently from one another.

Hurry Call Priority

E18 Where two (or more) Hurry Calls are allocated to different stages but in the same stream they shall be actioned on the bases of a defined priority. The interaction of their respective delay and hold periods shall be as follows:

- a) If a request for a lower priority Hurry Call occurs while the delay period of a higher priority hurry call is running, the request for the lower priority Hurry Call shall be rejected (and not latched by the controller).
- b) If a request for a higher priority Hurry Call occurs while the delay or hold period of a lower priority Hurry Call is running, the request for the lower priority Hurry Call shall be interrupted and the controller shall serve the higher priority Hurry Call. After serving the higher priority Hurry Call the controller shall return to the stage requested by the lower priority Hurry Call, unless its hold period has already elapsed.

Interface

E19 A suitable parallel input interface as defined by TOPAS 2523 shall be provided for connection to the Hurry Call request and cancel inputs. Condition '1' on the Hurry Call or Cancel inputs shall cause the controller to action the Call or Cancel within 250 milliseconds of the '0' to '1' transition.

E20 When requested in the Works Specification, an indicator (typically on the manual panel) shall be provided to indicate the period from when a valid Hurry Call is received until the Hurry Call Delay and Hold Periods have elapsed and the controller has resumed normal operations.

APPENDIX F EXTERNAL CONTROL STRATEGIES

F1 This appendix covers facilities which allow a traffic signal controller to be taken over by an external device or logic which can determine the selection and duration of stages. “External” in this context refers to the logic of the strategy being external to the core logic of the controller, even though it may be physically integrated into the controller software.

F2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

F3 This appendix allows for a variety of external control strategies to be implemented.

F4 The major UK strategies are Fixed Time Urban Traffic Control (UTC), the central adaptive control strategy SCOOT, and the local optimised vehicle actuation system, MOVA. Other forms of area control and local optimisation may also be implemented.

F5 This appendix should be read in conjunction with TOPAS 2523 which specifies standard interfaces where these are required for compatibility purposes.

Note; Where compatibility with UTC, SCOOT or MOVA is required, Purchasers should explicitly require Registration against one or more of the sub-categories defined in section F6.

UTC, SCOOT and MOVA strategies

F6 Where controllers offer compatibility with UTC, SCOOT or MOVA they shall be Registered under one or more of the following sub-categories.

- a. UTC/MOVA interface. A controller Registered to **Appendix F (a)** will have an interface which will allow, where required by the Works Specification, either a standard UTC Outstation Transmission Unit (OTU) or a separate MOVA unit to be connected.
- b. Integrated UTC. A controller Registered to **Appendix F (b)** will, where required by the Works Specification, incorporate an integrated OTU and IP connectivity enabling it to be connected to a UTC system (via a suitable external network device such as a router).
- c. Integrated MOVA. A controller Registered to **Appendix F (c)** will, where required by the Works Specification, incorporate an integrated MOVA unit.

Functional Requirements

F7 This section details the operation and facilities of the controller to be compatible with existing UTC systems under remote computer control and with existing MOVA equipment under local control.

F8 A single Mode (e.g. UTC) or separate modes (e.g. for UTC mode and MOVA mode) may be provided as defined by the Manufacturer.

F9 In these modes, the controller is controlled either by a remote computer, via a data transmission system, or by a MOVA unit, which may be either integral to the controller or installed as an ancillary item. More details on UTC, including SCOOT (**S**plit, **C**ycle and **O**ffset **O**ptimisation **T**echnique) can be found in MCE 0360. MCH 1542 provides more details on MOVA (**M**icroprocessor **O**ptimised **V**ehicle **A**ctuation).

F10 The facilities described in this section shall be available in any combination, as required by the Works Specification. The controller shall operate as indicated by this section when used in a UTC system to MCE 0360.

F11 When operating under Urban Traffic Control, the Controller shall operate in a stage-based manner, whereby it is necessary to allocate phases to stages, such allocations being conditioned by the traffic requirements and safety constraints.

F12 Commonly used designations of control/reply signals are defined in TOPAS 2523. Others may be used where a need is identified.

F13 MOVA may be used as a fall-back mode for UTC.

OTU / MOVA Unit Controller Interface

F14 Where the OTU or MOVA unit is external to the Controller, control and reply information between them and the Traffic Signal Controller shall be presented at the equipment / Controller interface.

F15 The electrical and physical requirements of the interface are specified in TOPAS 2523 Traffic Control Equipment Interfacing Specification.

F16 Where the OTU or MOVA unit is integrated with the Traffic Signal Controller, control and reply information between them and the Traffic Signal Controller may use the defined control and reply designations defined in TOPAS 2523 or other designations as defined by the manufacturer.

APPENDIX G MANUAL CONTROL

G1 This appendix sets out the requirements for a traffic signal controller to be Registered for use in manual control mode.

G2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Functional Requirements

General

G3 In Manual control mode the normal influence of the detectors shall be suspended and any existing demands ignored. The selection of manual control shall not cause any extended intergreen period introduced by Warden Control, Selected Vehicle priority or SA/SDE to be omitted or reduced. Stages shall be served as requested by the operator. In Manual control mode any detector whose operation would normally prevent the appearance of a stage shall be inhibited.

Manual Control Facilities

G4 A manual panel shall be incorporated in the controller to provide access to one of three sets of facilities as required by the Works Specification.

Access to the manual facilities shall be as defined in Appendix K

G5 The manual control facilities sets 1, 2 and 3 shall, unless stated, be operationally latched (including under power failure conditions) until the status of that facility is changed by an alternative command.

G6 The facilities of clauses G9 (c) and (d) shall be rendered inoperative if a higher priority method of control is selected.

Set No. 1

G7 A switch shall be provided to immediately remove the signal light source supply and audible/tactile supplies without interfering with the supply to the controller operating circuits. When the signals are switched on again the controller shall operate in the start-up sequence described in Section 3 of this specification.

Set No. 2

G8 The following facilities shall be provided:

- a) a switch as specified in clause G7 above.
- b) switches to select the following individual methods of traffic control:
 - i) normal;
 - ii) fixed time; and
 - iii) manual.
- c) a facility to switch from stage to stage in sequence, called during manual conditions, but having regard to any stage-stage restrictions configured in the controller. Stage switching shall be achieved without interference to any preset clearance periods (such as intergreens or pedestrian clearance periods). Stage requests shall not be stored.
- d) a facility to call an All-Red condition shall be provided. When this condition is called, the controller shall switch to All-Red immediately subject to outstanding minimum green and intergreen periods and shall be terminated by the selection of another stage to which it shall switch via the red/amber period for the new stage and subject to intergreen timings. All-Red condition requests shall not be stored. It shall be possible to select and hold the All-Red condition indefinitely.

G9 The functions of the switches in clause G8(c) and (d) shall not be latched.

Set No. 3 (Part Time Signals Only)

G10 The following facilities shall be provided:

- a) a switch as specified in clause G7.
- b) switches as specified in clause G8 (b).
- c) stage call switches as specified in clause G8 (c).
- d) the facility to call an All-Red condition as specified in clause G8 (d).
- e) a switch to override normal part time operation as follows:
 - “on” – signals permanently on;
 - “off” – normal operation where the signals follow the requests for part-time operation.

G11 A facility shall be provided which will inhibit the selection of manual facilities set no 2 and set no 3, with the exception of the signals on/off switch and the Part Time Override switch (e). If requested by the Works Specification, the all-red call switch (in G8 d), should still function while this inhibit is active. An indicator shall be provided to show that the stage switch facilities are not available when this facility is active, as required by G21.

Manual Control of Parallel Stage Streams

G12 Where manual control is provided, it shall be possible to operate all stage streams by a single manual control panel to provide ‘manual conditions’ plus an All-Red condition. The ‘manual conditions’ shall constitute combinations of specified stages provided within the controller.

Automatic Reversion from the Manual Method of Control to Normal Working

G13 Closure of the manual panel door shall cause the controller to revert from manual operation to normal working, (i.e. as if the selection switch had been returned to the Normal position).

G14 Closure of the manual panel door under conditions of power failure shall cause the controller to start up in the normal working mode when power is restored.

Note. It is permitted for the controller to always exit Manual Mode and start up in the normal working mode irrespective of the state of the manual panel door.

Indicators

G15 A test facility shall be provided for the operator to manually verify the satisfactory operation of all manual facility indicators.

G16 In manual control mode facilities sets 2 and 3, indicators shall be provided to show the current operational status of each control facility (with the exception of the signals on/off switch) that can be accessed.

G17 Upon selection of manual control mode, indication shall be given that the controller is ready to accept commands from the manual control facility (where applicable).

G18 The indication shall be removed when either: the controller is executing a valid request, or a higher priority method of traffic control is requested.

G19 The indication shall not be given when the ‘stage switch’ facility is not available.

G20 An indication shall be given when a request for a prohibited stage-to-stage movement is made. The indication shall continue to be given until either:

- a) a request for a permitted stage-to-stage movement is requested; or
- b) a higher priority method of control is requested.

G21 An indication shall be given to show that the stage switch facilities are not available.

G22 Manual conditions in clause G8(c) and G10(c) may either be separately indicated or displayed on a common numerical indicator. Under all methods of traffic control except manual, stage indication may be switched off.

G23 All indicators shall be located in a position on the manual control facility (where applicable) such that they are readily visible with the access door open. The visual indicators shall have a high brightness light source appropriate to the application.

Safety Conditions

G24 It shall not be possible for a stage to be terminated under manual control until the minimum times of all currently running phases have expired. It shall not be possible to override the prohibited stage movements specified for the Manual method of traffic control.

G25 In the event of a prohibited move being requested, an indication that the selection is prohibited shall be given and the movement shall not take place. The operator may accomplish this move via permitted stage routes which may include the All-Red stage.

APPENDIX H WARDEN CONTROL

H1 This appendix sets out the requirements for a traffic signal controller to be approved for use with Warden control.

H2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Functional requirements

H3 The Warden control feature shall allow a school crossing warden to extend a nominated intergreen period by means of an input device which does not enable or require access to any other controller functions.

H4 The input device shall provide a non-latching input.

H5 The input device, when operated, shall cause an intergreen period to be extended for school crossing patrol use. The extended intergreen shall appear after a nominated stage, and shall effectively provide an extended All Red period. The facility may be provided by introducing an All-Red stage.

H6 When the input device is not operated, any running intergreen extensions shall be terminated or cancelled. If an All-Red stage is used this shall be terminated and the next programmed stage shall run.

Where a remote Warden box is used it shall incorporate:

- a) an input device as defined in H4.
- b) a white indicator, which may be integral with item (a) and shall be illuminated when a demand for the extended intergreen period has been registered; and,
- c) a green indicator, which shall be illuminated for the duration of the All-Red period. The white indicator shall extinguish at the start of this period.

H7 The input device and may be mounted within or on the remote Warden box and shall be protected so as to prevent unauthorised use, utilising either,

- d) a push button together with the white and green indicators mounted behind a locked door in the remote box, or,
- e) a key operated switch together with the white and green indicators mounted on the outside of the box.

H8 The design of the box and input device shall be agreed, prior to manufacture, with the Purchaser.

H9 The green indicator shall be subject to the green/green conflict monitoring requirements.

H10 It shall not be possible for the green indicator to be illuminated if either the indicator's supply has been turned off or the indicator's supply fuse (if provided) has blown or the controller has shut down due to a fault.

H11 Any voltages present in the remote box shall be ELV as defined in BS 7671.

APPENDIX I SELECTED VEHICLE PRIORITY

I1 This appendix sets out the requirements for a traffic signal controller with Selected Vehicle Priority facilities.

I2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

I3 The principal of operation is that a detector system configured to detect one or more 'selected vehicle types' is used to bring one or more priority phases to Right of Way as soon as safely possible. Depending on configuration the facility may also 'compensate' other approaches which may have been disadvantaged by the priority request, by giving them additional green time on subsequent controller cycles.

Functional requirements

I4 Under no circumstances shall the introduction or cancellation of priority facilities override the minimum green period, intergreen periods (including pedestrian blackout periods), or any enforced stage sequences specified for safety or other reasons. A priority demand shall result in each fixed phase of any enforced stages running for its minimum period.

I5 An operation of the selected vehicle detection equipment whilst the priority phase does not have right of way shall, in addition to registering as a priority demand, register as a normal demand. For a phase normally called via a call/cancel facility, a latching demand shall be registered if so required by the Works Specification.

I6 Provision shall be made for the full range of priority facilities. It shall be possible to include or exclude facilities and adjust timings via the user interface specified in appendix K.

I7 The minimum facilities to be adjusted are priority extensions and priority maximum running period. To this may be added a priority change, an inhibit period and one or more compensation periods.

I8 Priority facilities shall be able to be provided on a minimum of eight phases.

I9 It shall be possible to introduce or delete each priority change facility and adjust each priority maximum, inhibit and compensation period by means of timetable entries.

Servicing of Priority Facilities

I10 The presence of an output from a selected vehicle detector shall, while the priority phase is running, hold the green signal. The cessation of the output shall initiate a priority extension period. A priority demand, for a phase other than those which are running, which is received whilst a priority extension and/or priority maximum period is running, shall be stored and serviced when the priority extension or priority maximum period expires, when no inhibit period is operational.

I11 Should two or more priority demands be stored at the termination of a minimum running period, then the priority demands shall be serviced in the normal cyclic order, and not necessarily in order of receipt.

I12 When a priority extension runs a phase beyond its normal maximum running period then a normal demand shall be entered when the phase loses right-of-way during, or at the end of, the priority maximum running period. This demand insertion may be omitted only if, by monitoring the normal detectors, it is established that no vehicles or vehicle extensions are present.

I13 If a phase green is terminated with an unexpired priority extension present (Typically because the priority maximum time has expired), then a revertive priority demand may be automatically entered if the priority demand facility is operational. Optionally, a facility may be specified to enable this reversion to be included or excluded.

The inhibit period

I14 The inhibit period is a period following a priority change during which priority changes to the same priority phase or up to at least three other specified priority phases shall not occur, but priority extensions may still be served.

I15 When the inhibit period is not operational, then, irrespective of the normal cyclic stage sequence, priority demands which are received after the commencement of a priority change, shall be serviced immediately (subject to normal safety periods) after the initial priority demand and after any priority extensions (subject to the priority maximum running period) are satisfied.

I16 An inhibit period shall only be introduced when a priority change has led to a phase green being prematurely terminated or a demanded phase not being run and will normally commence from the end of the terminated phase green or the point where the phase demand would otherwise have been actioned.

Note: Where, following a priority demand, more than one stage change is required to reach the priority stage, it may be necessary to start the inhibit timer later to prevent the final stage change to the priority stage itself being inhibited.

I17 The receipt of a priority extension request, during an inhibit period, for a running priority phase shall result in a priority extension and priority maximum running period being introduced

I18 The inhibit period shall be terminated either after a preselected period has elapsed, or by right-of-way being granted to the phase to which the original priority change was made, whichever occurs first.

I19 A priority demand stored during the inhibit period shall be cancelled if the demanded phase is served during the inhibit period by the normal cyclic operation of the controller (irrespective of controller mode) (this may also cancel the inhibit period).

The compensation period

I20 A preselected extension (the compensation period) to the normal maximum running period shall, when specified, be given to nominated phases the first time they gain right-of-way following a priority change, if their running periods were curtailed or they were caused not to run by the priority change. The compensation period shall be selected individually for each phase for which compensation is specified. Different phases may be compensated as a result of priority changes to each priority phase.

I21 If a compensation period is curtailed by a priority change, the compensation period shall be reapplied on the next cycle, if required in the Works Specification.

I22 If compensation periods are required for a phase as a result of two separate priority changes, these compensation periods should run concurrently.

Note: This may limit the compensation periods to VA mode of operation only.

I23 Each phase caused not to run or whose running period was curtailed by a priority change shall always be serviced in the normal cyclic order following a priority change.

A compensation period shall only be introduced on a particular running phase if there is an outstanding vehicle extension present at the expiry of the normal maximum period for that phase. Gap changes may occur during a compensation period.

I24 When a priority change results in a VA extension being curtailed, then a demand shall be entered for the phase losing right-of-way.

SVD detection performance

I25 In the event of a selected vehicle detector giving a permanent output for a time adjustable in the range 0–600 seconds in 30 second steps then the output of the detector shall, have no further effect on the operation of the controller.

I26 This condition may be either manually or automatically reset. Automatic reset shall only occur after at least 15 operations of the detector output.

Changes from VA to Selected Vehicle Priority mode

I27 The priority structure for modes of control are defined in section 3.12.

Other change of mode

I28 If a controller is ‘taken over’ by an External Control Strategy (such as UTC) while a priority level is running, any ‘Takeover’ command (such as the presence of UTC force bits) shall have no effect until all vehicle extensions at the priority level have been satisfied. Subsequently, response to the ‘Takeover’ shall comply with the requirements of Appendix F, unless further priority demands and/or extensions are received, and unless compensation periods are specified.

Indicators

I29 A suitable means shall be provided to display the status of all priority vehicle detection inputs, inhibit periods and compensation period(s).

I30 It shall be possible to observe all detection inputs of one priority level simultaneously. These shall preferably be indicated by either a suitable indicator behind the manual panel door of the controller, or an indication via the User Interface specified in Appendix K.

APPENDIX J NON-MOTORISED CROSSING FACILITIES

J1 This appendix sets out the requirements for a traffic signal controller to be Registered for use with various pedestrian, cyclist and equestrian facilities.

J2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

J3 Equipment may be Registered under this appendix in one or more of the following subcategories:

- a) Junction pedestrian facility (sequence as shown in Fig J2 or J3).
- b) Pelicans (sequence as shown in Fig J1).
- c) Standalone nearside Puffin/Toucan/Equestrian (sequence as shown in Fig J2).
- d) Standalone farside (Pedestrian/Toucan/Equestrian) sequence as shown in Fig J3.

Sequences

J4 There are three basic sequences for non-motorised facilities. Some allow for more than one class of road user. A Toucan crossing is a shared facility for pedestrians and cyclists. An Equestrian crossing may have a pedestrian facility working in parallel.

Pelican Crossing

J5 The Pelican sequence is characterised by the use of a flashing green indication to pedestrians combined with a flashing amber indication to vehicles to indicate that pedestrians have priority for a period following the steady pedestrian green indication.

J6 The pelican sequence is shown in Figure J1.

Note: TSRGD 2016 no longer permits the installation of new Pelican Crossings in England, Scotland, or Wales. The full definition of Pelican requirements are retained to allow controllers to be replaced at existing sites, for example as a result of a controller 'knockdown' and for use in Northern Ireland where new Pelican Crossings are still permitted.

Nearside Crossing

J7 The nearside sequence uses nearside signals and may have a combination of call/cancel pedestrian detection, pedestrian clearance extension using on-crossing pedestrian detectors and a standard vehicle signal sequence (red – red/amber – green – amber – red).

J8 Because it uses the standard vehicle signal sequence it is suitable for use at junctions as well as standalone crossings. It can also be used for a shared facility between pedestrians and cyclists (Toucan crossing) or for horse riders (Equestrian crossing), with or without a parallel pedestrian facility.

J9 The nearside sequence is shown in Figure J2.

J10 Where a crossing uses nearside indicators and has a central refuge which has pushbuttons and indicators mounted on it, it shall be possible for the indicators mounted on the central refuge to display a blackout period after pedestrian green, as defined in J55.

Farside Crossing

J11 This is the original sequence for pedestrian facilities at junctions using farside signals with the facility to provide a blackout period between the green and the red pedestrian indications. Blackout extensions using on-crossing detectors and call/cancel crossing demand facilities may be incorporated.

J12 The farside (non-Pelican) sequence may be used for junction and standalone Toucan and Equestrian crossings and at stand-alone pedestrian-only traffic signals (referred to in chapter 6 of the Traffic Signs Manual as pedex crossings)..

J13 The farside (non-Pelican) sequence is shown in Figure J3.

Timings

J14 The timing requirements for all three crossing facility sequences are shown in Appendix K Table 3.

J15 Equestrian crossings with nearside indicators require the same sequence and timing ranges as Puffin Crossings. Equestrian crossings with farside signals require the same sequence and timing ranges as farside Toucan Crossings

Functional Requirements

J16 The controller shall be capable of controlling a facility in accordance with the periods, times and sequences required for that facility.

J17 For a stand-alone facility, the controller may be a dedicated stand-alone controller or a junction controller capable of additionally operating the stand-alone facility by using a parallel stage stream.

J18 Requirements include the ability to operate both audible and tactile indicators on any pedestrian phase and to receive and act on the input from vehicle detectors, pushbuttons, pedestrian presence detectors and on-crossing detectors as required to operate the facility.

J19 The controller shall provide all the interlocks between the signals and other indicators needed to ensure safe operation as defined in TOPAS 2523.

Note. Where audible or tactile indicators are operated directly by pedestrian indicators, for example in distributed control systems, the overall system must provide interlocking at least meeting the requirements defined in the “Audible and Tactile supplies” clauses of TOPAS 2523.

J20 The maximum vehicle green time may start at the beginning of vehicle green or on the receipt of a pedestrian or cyclist demand. It shall be possible to select either of these modes by timetable if so required in the works specification.

J21 Any one or a combination of the junction, pedestrian and Toucan facilities may be provided, as called for in the Works Specification. If more than one facility is provided, then each facility must operate independently and shall be catered for within the manual panel.

J22 Where a facility is provided with on-crossing detection it shall be possible, subject to the Works Specification, to operate the crossing without on-crossing detection. In this case the variable All-Red or black out periods 6 and vi respectively, may be pre-set at a value within the range of time allocated to the same period.

Pelican Crossing

J23 This facility is a stand-alone pedestrian crossing which has far-sided crossing signals but does not have pedestrian demand cancelling or on-crossing pedestrian detection. Pedestrian demands shall be in accordance with the requirements of clauses J80 to J85. The method of control of the facility shall be selectable to be fixed vehicle period, vehicle actuated or linked.

J24 Figure J1 provides an overview of the Pelican signal sequence and facilities.

Vehicle Phase – Period A

J25 This period is the quiescent state in which the signals shall normally display vehicle green and pedestrian red, but may alternatively reside on All-Red, if called for in the Works Specification (clause J34). In each operating mode the period shall function in accordance with the following requirements.

Fixed Vehicle Period Method of Control

J26 The vehicle phase green shall terminate on expiry of the vehicle maximum green time, with a pedestrian demand present. This time shall be preset at a value in the range between 20 and 60 seconds, and adjustable in incremental steps no greater than four seconds.

J27 Following the expiry of the vehicle maximum green time, any subsequent pedestrian demand shall be served after a configurable delay period of either 1, 2 or 3 seconds before period 'B' commences.

Vehicle Actuated Method of Control

J28 The vehicle phase green shall be terminated by either a forced change, with a pedestrian demand present, or a gap change.

J29 The minimum green time shall be preset at a value in the range between 6 and 15 seconds, and adjustable in incremental steps no greater than 1 second. This period will be timed from the start of the vehicle green.

J30 The maximum green time shall be preset at a value in the range between 10 and 60 seconds, and adjustable in incremental steps of a maximum of 10 seconds. This period will be timed from either:

- a) the receipt of a demand i.e. to extend; or
- b) the start of the minimum green i.e. pre-timed maximum.

J31 The extension timer shall be preset at a value in the range between 0.2 and 5 seconds, and adjustable in incremental steps no greater than 0.2 seconds.

J32 Following the expiry of the pre-timed maximum green period, any subsequent pedestrian demand shall be served after a configurable delay period of either 1, 2 or 3 seconds, before period B commences.

Linked Method of Control

J33 The vehicle phase green shall be prevented from terminating if a hold vehicle (PV) signal is present. On removal of this signal the vehicle period shall terminate immediately provided the minimum vehicle, or fixed, green period has terminated and a pedestrian demand is present.

All-Red quiescent state

J34 In absence of vehicle and pedestrian demands the signals may be held on a pedestrian and vehicle All Red state i.e. period C. On receipt of one of the following demands the signals shall:

- a) for a vehicle demand only, respond as in clause J25 (period A) via period G (clause J38); or
- b) for a pedestrian demand only, the signals shall respond as in clause J36 (period D) after a configurable delay of 0, 1 or 2 seconds, as required in the Works Specification.

Vehicle to Pedestrian Phase Intergreen – Periods B and C

J35 These periods immediately follow the vehicle phase green and shall comprise:

Period B – A fixed period of three seconds during which the signals shall display vehicle amber and pedestrian red.

Period C – A period during which the signals shall display vehicle red and pedestrian red. The duration shall be dependent upon the highest of the following criteria applying at the time:

- a) fixed at 1, 2 or 3 seconds for a gap change in vehicle actuated operation;
- b) preset at either 1, 2 or 3 seconds for fixed vehicle period operation, linked operation, a forced change in vehicle actuated operation or if a vehicle detector fault has been registered on the conflicting vehicle phase;
- c) fixed at 3 seconds when speed measuring equipment is fitted.

Invitation to Cross Period – Period D

J36 This period during which the signals shall display vehicle red and pedestrian green shall immediately follow the vehicle to pedestrian phase intergreen, and shall be preset at a value in the range between 4 and 9 seconds, and adjustable in incremental steps no greater than one second.

J37 If audible and/or tactile signals are provided they may be activated during this period in accordance with the requirements of clause J86.

Pedestrian to Vehicle Phase Intergreen – Periods E, F and G

J38 These periods shall immediately follow the ‘Invitation to Cross’ period and shall comprise the following:

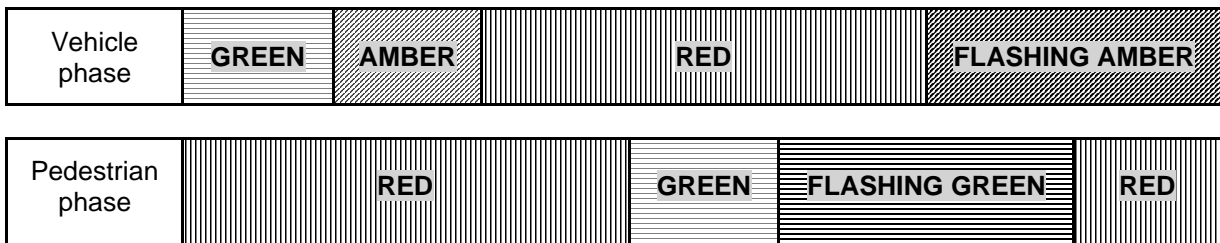
Period E – Operation with either the inclusion or exclusion of a period of 2 seconds during which the signals shall display vehicle red and flashing pedestrian green.

Period F – A period during which the signals shall display flashing vehicle amber and flashing pedestrian green. This period shall be preset at a value in the range between 6 and 18 seconds, and adjustable in incremental steps no greater than 1 second.

Period G – A period during which the signals shall display flashing vehicle amber and pedestrian red. If this period follows period F then this period shall be preset at a value of either 1 or 2 seconds. If this period follows period C then this period will be preset at a value of 3, 4 or 5 seconds. Upon termination the signals shall immediately go to the vehicle phase green (period A).

Vehicle Amber and Pedestrian Green Flash Rate

J39 The flashing rate of the flashing vehicle amber and the flashing pedestrian green signals shall be not less than 70 nor more than 90 flashes per minute. The on/off period of both signals shall be equal and synchronous.



References:

	Period A	Period B	Period C	Period D	Period E	Period F	Period G
Clause	J25	J35	J35	J36	J38	J38	J38

Facilities supported:

Farside Signals, No Call Cancel, No Crossing Extension, Latching Push Button Demand Audible and Tactile

Figure J1 – Pelican Sequence and Facilities

Nearside Crossing

J40 This facility is a pedestrian crossing which has nearside crossing signals with call/cancel crossing demand and on-crossing pedestrian detection. Pedestrian demands shall be in accordance with the requirements of clauses J80 to J85.

Note: The facility must accommodate call / cancel crossing demands and on-crossing pedestrian detection as defined in this specification, but their use is optional as requested by the Works Specification.

J41 Figure J2 provides an overview of the Nearside signal sequence and facilities.

Vehicle Phase – Period 1

J42 During period 1:

- a) The signals shall ordinarily display vehicle green and pedestrian red.
- b) For Nearside crossings at Junctions this period is controlled by the phase minimum period (3-30 seconds) and phase maximum period (0 to 120 seconds) defined in Appendix K (table 2).
- c) For Standalone crossings this period is the quiescent state in which the signals shall normally display vehicle green and pedestrian red, but alternatively may reside on All-Red, if called for in the Works Specification (clause J51). In each operating mode the period shall function in accordance with the following requirements.

Fixed Vehicle Period Method of Control

J43 The vehicle phase green shall terminate on expiry of the vehicle maximum green time, with a pedestrian demand present. This time shall be preset at a value in the range between 20 and 60 seconds, and adjustable in incremental steps no greater than 4 seconds.

J44 Following the expiry of the vehicle maximum green time, any subsequent pedestrian demand shall be served after a configurable delay period of either 1, 2 or 3 seconds before period 2 commences.

Vehicle Actuated Method of Control

J45 The vehicle phase green shall be terminated by either a force change with a pedestrian demand present, or a gap change.

J46 The minimum green time shall be preset at a value in the range between 6 and 15 seconds, and adjustable in incremental steps no greater than 1 second. This period will be timed from the start of the vehicle green.

J47 The maximum green time shall be preset at a value in the range between 10 and 60 seconds, and adjustable in incremental steps of 10 seconds. This period will be timed from either:

- d) the receipt of a demand; or
- e) the start of the minimum green i.e. Pre-timed maximum.

J48 The extension timer shall be preset at a value in the range between 0.2 and 5 seconds, and adjustable in incremental steps no greater than 0.2 seconds.

J49 Following the expiry of the pre-timed maximum green period, any subsequent pedestrian demand shall be served after a configurable delay period of either 1, 2 or 3 seconds before period 2 commences.

Linked Method of Control

J50 The vehicle phase green shall be prevented from terminating if a hold vehicle (PV) signal is present. On removal of this signal the vehicle period shall be terminated provided the minimum vehicle green period or fixed, green period has terminated and a pedestrian demand is present.

All-Red quiescent state

J51 In the absence of vehicle and pedestrian demands the signals may be held on a pedestrian and vehicle All Red state i.e. period 3. On receipt of one of the following demands the signals shall:

- a) for a vehicle demand only, respond as in clause J42 (period 1) via period 7 (clause J55); or
- b) for a pedestrian demand only, the signals shall respond as in clause J53 (period 4) after a configurable delay of 0, 1 or 2 seconds, as required in the Works Specification.

Vehicle to Pedestrian Phase Intergreen – Periods 2 and 3

J52 These periods shall immediately follow the vehicle phase green and shall comprise:

Period 2 – A fixed period of 3 seconds during which the signals shall display vehicle amber and pedestrian red.

Period 3 – A period during which the signals shall display vehicle red and pedestrian red. The duration shall be dependent upon the highest of the following criteria applying at the time:

- a) fixed at 1, 2 or 3 seconds for a gap change in vehicle actuated operation;
- b) preset at either 1, 2 or 3 seconds for fixed vehicle period operation, linked operation, a forced change in vehicle actuated or if a vehicle detector fault has been registered on the conflicting vehicle phase;
- c) fixed at 3 seconds when speed measuring equipment is fitted.
- d) Where a nearside crossing is used as part of a Junction this period is controlled by the conflicting vehicle to pedestrian phase intergreen which may be set in the range 0-30 seconds as defined in Table 2 of Appendix K.

Invitation to Cross Period – Period 4

J53 This period during which the signals shall display vehicle red and pedestrian green shall immediately follow the vehicle to pedestrian phase intergreen, clause J52, and shall be preset at a value in the range between 4 and 12 seconds, and adjustable in incremental steps no greater than 1 second.

J54 If audible and/or tactile signals are provided they may be activated during this period in accordance with the requirements of clause J86.

Pedestrian to Vehicle Phase Intergreen – Periods 5 to 9

J55 This period shall immediately follow the 'Invitation to Cross' (period 4), and shall comprise the following periods.

Periods 5 to 8 shall normally display vehicle and pedestrian red signals.

Period 5 – The minimum All-Red time shall be preset at a value in the range between 1 and 5 seconds, and adjustable in incremental steps no greater than 1 second.

Period 6 – This period shall be extended by pedestrian detection, similar to the principle of vehicle actuation, and shall be terminated by either a gap or forced change.

The maximum extendable All-Red time shall be preset at a value in the range between 0 and 30 seconds, and adjustable in incremental steps no greater than 1 second. The extendable All-Red timer shall start at the end of the minimum red period.

The extension timer shall be preset at a value in the range between 0.4 and 5 seconds, and adjustable in incremental steps no greater than 0.2 seconds.

If an associated on-crossing detector has not given a demand during the period as defined in clause J77, then an artificial demand will extend this period to the maximum red time followed by the forced change period defined at period 6(a).

Where on-crossing detection is not provided this period shall be pre-set at a value between the range 0 - 30 seconds, adjustable in 1 second steps and must run even though there are no extensions present.

For crossings with a central refuge the indicators on the refuge shall display a blackout during periods 5 and 6.

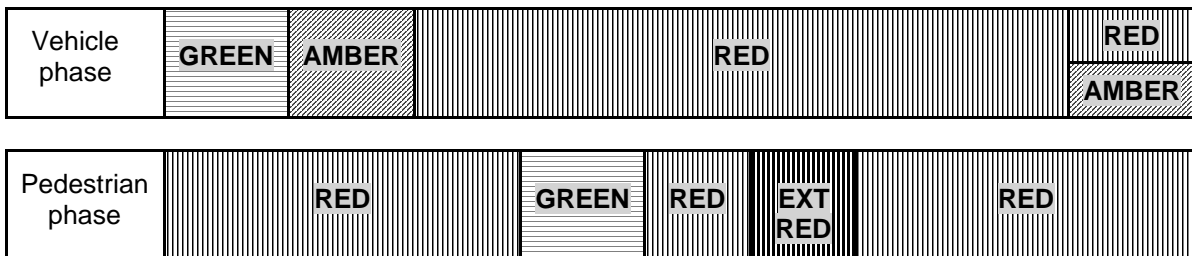
Note: The maximum All-Red time is the sum of periods 5, 6, 6(a) or 6(b).

Note: Following period 6 will be periods 6a or 6b, not 6(a) and 6(b).

Period 6(a) This period only appears if period 6 runs to a maximum. This time shall be preset at a value in the range between 0 and 3 seconds, and adjustable in incremental steps no greater than one second.

Period 6(b) – If preceded by a gap change, this time shall be preset at a value in the range between 0 and 3 seconds, and adjustable in incremental steps no greater than one second.

Period 7 – A fixed period of 2 seconds during which the signals shall display vehicle red and amber and pedestrian red. Upon termination the signals shall immediately go the Vehicle Phase green (period 1).



References

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 6(a)	Period 6(b)	Period 7
Clause	J42	J52	J52	J53	J55	J55	J55	J55	J55

Facilities supported

- Nearside Signals
- On-Crossing Extension.
- Audible and Tactile.
- Pedestrian demand Call Cancel

Figure J2 – Nearside Sequence and Facilities

Far-sided Crossing Signals

J56 This facility is crossing which has far-sided pedestrian/cyclist or equestrian crossing signals and may use on-crossing and kerbside call / cancel detection. Crossing demands shall be in accordance with the requirements of clauses J80 to J85..

Note: The facility must accommodate call / cancel crossing demands and on-crossing pedestrian detection as defined in this specification, but their use is optional as requested by the Works Specification.

Note The use of on-crossing pedestrian detection to extend the pedestrian blackout period will prevent the use of PCATS facilities which rely on fixed crossing times.

J57 Figure J3 provides an overview of the sequence and facilities for farside signals). Several methods of control are permitted as defined in the following clauses.

Vehicle Phase – Period I

J58 During period I:

- a) The signals shall ordinarily display vehicle green and pedestrian red.
- b) For Farside crossings at Junctions this period is controlled by the phase minimum period (3-30 seconds) and phase maximum period (0 to 120 seconds) defined in Appendix K (table 2).
- c) For Standalone crossings this period is the quiescent state in which the signals shall normally display vehicle green and pedestrian red, but alternatively may reside on All-Red, if called for in the Works Specification (clause J67). In each operating mode the period shall function in accordance with the following requirements.

Fixed Vehicle Period Method of Control

J59 The vehicle phase green shall appear for at least a fixed period determined by the vehicle maximum green time and shall only terminate on expiry of the maximum green time, when a pedestrian and/or cyclist/equestrian demand present. The maximum green time shall be preset at a value in the range between 20 and 60 seconds, and adjustable in incremental steps no greater than 4 seconds.

J60 Following the expiry of the vehicle maximum green time, any subsequent pedestrian demand shall be served after a configurable delay period of 1, 2 or 3 seconds before period ii commences.

Vehicle Actuated Method of Control

J61 The vehicle phase shall rest on green until a pedestrian and/or cyclist demand is present. The vehicle green shall then be terminated by either:

- a) the expiry of the maximum green time (section J63) when vehicle extensions are present,
- b) a gap change when vehicle demands are not present.

J62 The minimum green time shall be preset at a value in the range between 6 and 15 seconds, and adjustable in incremental steps no greater than 1 second. This period will be timed from the start of the vehicle green.

J63 The maximum green time shall be preset at a value in the range between 10 and 60 seconds, and adjustable in incremental steps of not more than 10 seconds. This period will be timed from either:

- a) the receipt of a pedestrian and/or cyclist/equestrian demand or,
- b) the start of the minimum green, called a pre-timed maximum.

J64 The extension timer shall be preset at a value in the range between 0.2 and 5 seconds, and adjustable in incremental steps no greater than 0.2 seconds.

J65 Following the expiry of the pre-timed maximum green period, any subsequent pedestrian/cyclist/equestrian demand shall be served after a configurable delay period of either 1, 2 or 3 seconds, before period ii commences.

Linked Method of Control

J66 The vehicle phase green shall be prevented from terminating if a hold vehicle (PV) signal is present. On removal of this signal the vehicle period shall terminate provided the minimum vehicle, or fixed, green period has terminated and a pedestrian demand is present.

All-Red Quiescent State

J67 In the absence of vehicle and pedestrians/cyclist/equestrians demands the signals may be held on pedestrian/cyclist/equestrian and vehicle All Red state i.e. period III. On receipt of one of the following demands the signals shall:

- a) for a vehicle demand only, respond as in period I (clause J58) via period VIII (clause J71); or
- b) for a pedestrian demand only, the signals shall respond as in clause J69(period IV) after a configurable delay of 0, 1 or 2 seconds, as required in the Works Specification;

Vehicle to Pedestrian/Cyclist/Equestrian Phase Intergreen – Periods II and III

J68 This period shall immediately follow the vehicle phase green and shall comprise:

Period II – A fixed period of 3 seconds during which the signals shall display vehicle amber and pedestrian/cyclist/equestrian red;

Period III – A period during which the signals shall display vehicle red and pedestrian/cyclist/equestrian red. The duration shall be dependent upon the highest of the following criteria applying at the time:

- a) fixed at 1, 2 or 3 seconds for a gap change in vehicle actuated operation;
- b) preset at either 1, 2 or 3 seconds for fixed vehicle period operation, linked operation, a forced change in vehicle actuated operation or if a vehicle detector fault has been registered on the conflicting vehicle phase.;
- c) fixed at 3 seconds when speed measuring equipment is fitted.
- d) Where a Farside crossing is used as part of a Junction this period is controlled by the conflicting vehicle to pedestrian phase intergreen which may be set in the range 0-30 seconds as defined in Table 2 of Appendix K.

Invitation to Cross Period – Period IV

J69 This period during which the signals shall display vehicle red and pedestrian/cyclist/equestrian green shall immediately follow the vehicle to pedestrian/ cyclist/equestrian phase intergreen (clause J68), and shall be preset at a value in the range between 4 and 12 seconds for standalone crossings and 4–99 seconds for junctions, both adjustable in incremental steps no greater than 1 second.

J70 If audible and/or tactile signals are provided they may be activated during this period in accordance with the requirements of clauses J86 to J89.

Pedestrian/Cyclist/Equestrian to Vehicle Phase Intergreen – Periods V to VIII

Note: Periods V, VI, and VI(a) shall display vehicle red and pedestrian/cyclist/equestrian blackout signals;

J71 This period shall immediately follow the 'Invitation to Cross' period iv and shall comprise the following periods:

Period V – the minimum blackout time shall be preset at a value in the range between 1 and 5 seconds for standalone crossings and 3–15 seconds for junctions and for crossings where blackout extensions are not used, both adjustable in incremental steps no greater than 1 second;

Period VI – this period may be extended by pedestrian/cyclist/equestrian detection, similar to the principle of vehicle actuation, and shall be terminated by either a gap or forced change.

Period VI(a) – This period only applies when blackout extensions are used and only appears if period VI runs to a maximum.. This time shall be preset at a value in the range between 1 and 3 seconds, and adjustable in incremental steps no greater than 1 second.

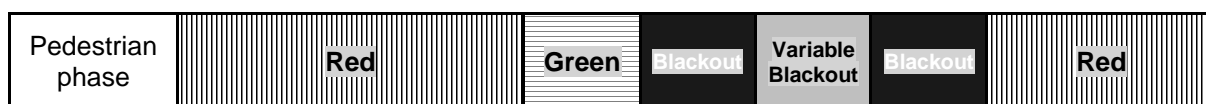
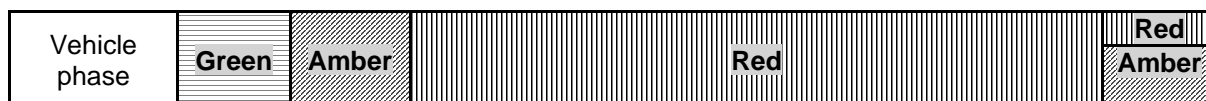
Period VII – which shall display red vehicle and pedestrian/cyclist/equestrian red signals. This time shall be preset at a value in the range between 1 and 3 seconds, and adjustable in incremental steps no greater than 1 second.

Period VIII– A fixed period of 2 seconds during which shall display vehicle red and amber and pedestrian/cyclist/equestrian red signals. Upon termination the signals shall immediately to the Vehicle Phase green (period i).

J72 The extendable blackout time shall be preset at a maximum value in the range between 0 and 30 seconds, and adjustable in incremental steps no greater than 1 second. The extendable blackout timer shall start at the end of the minimum blackout period.

J73 The extension timer shall be preset at a value in the range between 0.4 and 5 seconds, and adjustable in incremental steps no greater than 0.2 seconds.

J74 If an associated on–crossing detector has not given a demand during the period as defined in clause J77, then an artificial demand will extend period VI to the maximum blackout time followed by the forced change period defined at period VI(a).



References

	Period I	Period II	Period III	Period IV	Period V	Period VI	Period VI(a)	Period VII	Period VIII
Clause	J58	J68	J68	Error! Reference source not found.	J71	J71	J71	J71	J71

Facilities supported

Farside Signals, On-Crossing Extension, Audible and Tactile, Pedestrian demand Call Cancel

Figure J3– Farside Sequence and Facilities

Detector Monitoring

J75 The input signals from the detector equipment shall be monitored by the controller. Pedestrian push buttons shall, when required, be treated as vehicle detectors for fault monitoring purposes..

Detector Fault Conditions

J76 Each detector input shall be individually monitored and fault logged as described in B27 to B34, including the timing of permanent detect and permanent non-detect states.

J77 In addition, individual on-crossing pedestrian detectors shall be checked as follows:

- i) If a signal has not been received from an on-crossing detector in the period between the end of the preceding clearance period (period 6 etc.) and the end of the current pedestrian green period (period 4 etc.), then a temporary artificial extension shall be inserted, being reset at the end of each clearance period.
- ii) The artificial extension shall extend the clearance period (period 6 etc.) to its maximum.
- iii) A fault does not need to be recorded when this occurs, but if one is, it must be automatically cleared when a signal is subsequently received from the on-crossing detector.

Manual Facilities

J78 The following control facilities shall be provided in a stand-alone controller, access to all of which shall be secured (by key operation or otherwise) and not require the opening of the controller door:

- a) a facility by means of which the signal lamps, pedestrian or pedestrian/cyclist/equestrian indicators and audible alarms can be switched off;

- b) a facility by means of which the following can be applied to the pedestrian or pedestrian/cyclist/equestrian stage:
 - i) a continuous artificial pedestrian or pedestrian/cyclist/equestrian demand for a facility with far-sided crossing signals;
 - ii) a continuous artificial pedestrian or pedestrian/cyclist/equestrian demand and clearance extensions for a facility with nearside crossing signals;
- c) a facility by means of which the controller may be switched to operate in the fixed vehicle period or vehicle actuated method of control. When set to the fixed vehicle period method of control the controller shall operate as specified in clauses J26, J43, and J59. Where vehicle detection equipment is not fitted, the controller shall operate in the fixed vehicle period method of traffic control regardless of the state of this facility;
- d) a facility by means of which a continuous extension can be applied to the vehicle stage. The timers controlling the 'Maximum Vehicle Period' shall continue to time out and shall not be held or reset whilst this facility is operated.

J79 Facilities (b), (c) and (d) are optional on the manual panel. Where more than one facility is required e.g. a duplicate crossing, then the extra manual facilities must be catered for within the manual panel.

Pedestrian Demands

J80 Appropriate means shall be provided so that the pedestrian phase can be demanded. Demands shall be registered at any time other than during the pedestrian phase green and shall be removed on commencement of the pedestrian phase green. A registered demand from detection equipment shall be in accordance with the following requirements as applicable.

Push Button only Demand

J81 The registered demand shall be latching and shall be removed on commencement of the pedestrian phase green.

Push Button Demand and Kerbside Cancel

J82 Where kerbside detection is provided, pedestrian/cyclist/equestrian demands shall be registered and removed as follows:

- a) when both a push button box and its associated kerb side detector demand exist simultaneously an unlatched demand shall be registered. Once registered, the demand shall remain registered while any kerb side demand persists for the phase, irrespective of the state of the push– button demand. The registered demand shall be removed either upon expiry of all kerb side detector activations and then the registered demand extension (section J83) or on commencement of the pedestrian phase green; or
- b) when a push button box demand exists but a demand from its associated kerb side detector does not exist, a latched demand shall be registered. Once registered the demand shall remain registered and shall be removed on commencement of the pedestrian phase green.

J83 Each registered demand (push button or kerbside) shall have an extension (which shall commence when the button is released) and which shall be preset at a value in the range between 0 and 5 seconds, and adjustable in incremental steps of no more than 0.2 seconds.

On–crossing Extension Demands

J84 The controller shall receive inputs from the on–crossing detection system and provide the variable clearance period of the crossing to vehicle phase intergreen.

Demand Indicators

J85 The crossing Demand Accepted indicator shall be illuminated to indicate that a demand exists for the crossing phase. All indicators associated with the same phase shall be displayed concurrently.

Audible/Tactile Signals

General

J86 The controller shall be designed to provide audible and tactile supplies as defined in TOPAS 2523 to allow operation with audible and tactile drive signals meeting the requirements of TOPAS 2508 and TOPAS 2509. Audible and/or tactile signals may be provided to indicate the steady pedestrian green period. Audible signals shall not be used unless the red signals displayed are such that all non-pedestrian movements are signalled to stop. Tactile signals may be used where the red signals are such that all conflicting non-pedestrian movements are signalled to stop.

Note: Standalone pedestrian controllers shall always provide audible and tactile drive capabilities. junction controllers shall provide such capabilities as required by the works specification.

J87 Where required by the Works Specification the audible and/or tactile signals may operate for a reduced period at the start of the steady pedestrian green period.

J88 Where required by the Works Specification the audible signals shall be operative for only part of the day or switched to a lower audible level. The tactile signals in this case shall be fully operative.

Safety of Audible and Tactile Signals

J89 The output, to audible/tactile drives, shall be interlocked as defined in clause J19.

Red Lamp Monitoring for Pedestrian Facilities at Junctions

J90 Red lamp monitoring shall be provided if called for in the Works Specification. Red Lamp Monitoring is always a requirement where audible and/or tactile equipment is used.

Response

J91 Confirmation of the failure must occur within 500ms of the fault, unless the failure occurs before or within 500 ms of the start of the monitored vehicle red. In this circumstance, action shall be taken within 1 second of the start of the red

Single Vehicle Red Lamp Failure

J92 A single vehicle red lamp failure, shall, within one signal cycle of the failure, cause the All-Red period of the relevant intergreens to be extended up to a value of 5 seconds, unless it is already 5 seconds or greater when no action will be taken.

Second or Total Vehicle Red Lamp Failure

J93 Upon the event of a second vehicle red lamp failure on the same phase, vehicle red lamp feed failure or failure of the vehicle red lamp monitor, the following actions shall be taken:

- a) for conflicting exclusive pedestrian stages, subsequent pedestrian stages shall be omitted. All pedestrian demands shall be disabled and all pedestrian red signals and demand indicators shall be illuminated;

- b) for other stages, these shall run normally, except that any pedestrian phase which conflicts with a vehicle phase having failed vehicle reds, shall remain at pedestrian red with their demand indicators permanently illuminated;
- c) stand-alone pedestrian streams where conflicting vehicle phases are affected, shall be completely extinguished.

J94 If the failure occurs during the pedestrian blackout period, the blackout shall terminate at the end of its period

J95 If the failure occurs during the pedestrian stage, the stage shall terminate unless it is within the minimum green period when it shall terminate at the end of the minimum green period.

Restoration of Facilities

J96 Facilities shall not be restored until the fault has been rectified. The fault may be manually or automatically cleared as called for in the Works Specification. Manual clearance of the fault may initiate the controlled start-up sequence in order to allow the resumption of the pedestrian facilities.

J97 Automatic clearance of the fault shall only occur following confirmation of the replacement of the failed red lamps. Pedestrian facilities shall be resumed at the next appropriate time as required by the normal operation of the controller without invoking a start-up sequence

Red Lamp Monitoring for Stand-alone Pedestrian Facilities

J98 The requirements of this section shall apply equally to pedestrian facilities provided by junction controllers as separate stage streams

J99 The controller shall provide a minimum of four red lamp monitors which will monitor for red lamp and red lamp supply failure.

Operation of Red Lamp Monitor

NOTE: A single vehicle red lamp failure, shall, within one signal cycle of the failure, cause the All-Red period of the relevant intergreens to be extended up to a value of 5 seconds, unless it is already 5 seconds or greater when no action will be taken.

J100 On the event of all red lamps failing on a monitor, two red lamps on a monitor failing or a failure of the red lamp monitor being detected then all signals and pedestrian indicators shall switch off.

Restoration of Facilities

J101 Facilities shall not be restored until the fault has been rectified. The controller shall require a manual reset.

APPENDIX K USER INTERFACE

K1 This appendix details the various controls and indications that are to be provided to enable:

- a) operation in manual method of control by authorised personnel; and
- b) adjustment of programming; and
- c) verification of the operational integrity of the controller.

K2 This Appendix should be read in conjunction with TOPAS 2523 Traffic Control Equipment Interfacing Specification.

K3 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

Functional Requirements

Access Levels

K4 To ensure operational safety various levels of access shall be provided. These access levels will be appropriate to the needs and skills of the authorised personnel.

K5 The levels of access to the controller are:

Level 1

K6 Access to the facilities associated with manual control.

Level 2

K7 Access for modifying non safety data and timings as defined in tables 1-4 which can be modified either by local handset or remote access. With level 2 access it shall be possible to monitor, but not modify, facilities restricted to level 3 and level 4 access.

Level 3

K8 Access for modifying safety data and timings as defined in tables 1-4.

Level 4

K9 Level 4 Traffic Safety Data and timings shall not be changeable on-site via levels 1, 2 or 3.

K10 Changes to Traffic Safety Data and timings in tables 1-4 as well as conflict data, phase type data and permitted / prohibited stage movements, may only be accomplished by the complete replacement of the site configuration data, requiring the signals to be extinguished and restarted. To ensure personnel are on-street to confirm that safety configuration data is performing as required such changes shall not be possible remotely.

Level 5

K11 Access to changes to the operating program(s) of the controller.

K12 Changes to the operating programs of the controller may only be accomplished by the complete replacement of the programs, requiring the signals to be extinguished and restarted. To ensure personnel are on-street to confirm that operating program updates have been implemented successfully and the system is operating safely, such changes shall not be possible remotely.

Note. Level 5 changes may affect TOPAS Registration – see TOPAS 0600 for details.

Admittance to Access Levels

Level 1

K13 Admittance shall be by means of a locked door and/or key operated switch, which in order to provide compatibility within Local Authorities, shall be a Yale Key, 10½ Section, change 900. Access to level 1 facilities shall be gained without opening the main controller door(s).

All other levels

K14 Admittance to all other access levels shall have security protection before write access is available and shall be provided via either the main controller door(s) or the manual panel access. Admittance shall be in the form of either the operation of a key or the entry of a security code.

Where a specified key type is required this should be identified in the Works Specification.

Level 3

K15 Access shall only be by an operator who must be required to confirm their presence on site i.e. at the controller, for example by pressing a 'level 3 access button'. Level 3 data is detailed in tables 1-4.

Adjustment of safety timings

K16 It shall be possible, without access to level 4, only to adjust controller parameters subject to the following constraints.

- a) A phase minimum running period shall not be set below a configured minimum green limit value.
- b) A phase intergreen shall not be set below a configured intergreen limit value.
- c) The standalone vehicle minimum running period shall not be set below 6 seconds.
- d) The all red period during the vehicle to pedestrian intergreen of stand-alone crossings shall not be set below 1 second.

If an attempt is made to modify any timing to a value that conflicts with the timing constraints specified, no change shall be made to the timing. A suitable indication that the timing change has not been made shall be given.

Serial Handset Interface

K17 The handset device will normally be associated with the display and modification of data concerned with the parameters listed in tables 1-4. Other parameters and viewable data may be provided and these shall be allocated to either Level 2, 3 or 4 as defined by the Manufacturer.

K18 The handset device should have a display capable of simultaneously displaying at least 1 line of information containing the specified parameter and the instruction.

K19 The specification for the serial handset device is defined in TOPAS 2523.

Other Display facilities

K20 Additional access facilities, for example using a web browser interface may also be provided. Where such facilities are provided the access level controls described in sections K4 to K15 are to apply.

K21 Visual indicators may be provided to display controller status as defined by the manufacturer.

Timing Tolerance and range sizes

K22 The total timing tolerance of the controller can be considered in various categories, these categories are related to the various parameters by means of the timing charts.

Category

- A – Tolerance \pm 250 milliseconds
- B – Tolerance \pm one second
- C – Tolerance \pm 1 minute
- D – Mains Sync \pm one second in 30 days or Crystal Clock \pm one second in 24 hours
- E – Tolerance \pm 10 minutes

K23 For the parameters in Table 2 the timing tolerance shall be as specified in that table. All parameters in Tables 3 and 4 shall have tolerance category A.

Note. Where a tolerance potentially takes a timing value below zero, an absolute minimum timing value of zero shall be used.

K24 The value range and step sizes in table 2 to 4 and elsewhere in this specification represent the minimum facilities which are acceptable. Manufacturers, at their discretion, may provide wider value ranges and smaller step sizes.

Engineer's Control Facilities

K25 Control facilities located inside the controller case shall be incorporated as manual switches and/or as part of the handset interface or web browser interface (if provided).

K26 As part of the manual control facilities (level 1 access), a physical switch shall be provided to immediately extinguish all signals and disable all audible and tactile devices without interfering with the supply to the controller operating circuits. When the signals are switched on again the controller shall immediately operate in the appropriate start-up sequence described in section 3 of this specification, ensuring a minimum 7 second 'all-off' period is achieved.

K27 A facility shall be provided to switch individual phase signal aspects and Pedestrian confirm indicators on and off (for testing purposes). This facility shall only be available via Level 3 access of the User Interface and may only be enabled with the signals switched off using the switch described in section K26. During the accessing of this facility all signals shall be off but all normal safety monitoring facilities shall remain enabled.

1. British Summer Time advance/retard.
2. Control facilities
 - insertion of demand for phase;
 - insertion of demand for phase green extension;
 - detector inhibit.
3. Fault logs.
4. Detector fault monitor.
5. Current controller mode.

Table 1: Parameters Accessed via User's Terminal

Parameter	Range	Maximum Step Size	Tolerance	Access Level	Fixed / Alterable
Mandatory Signal Timings (as defined in TSRGD)					
Red/amber	2 sec	–	A	4	Fixed
Amber	3 sec	–	A	4	Fixed
Signal Timings - Working Values					
Phase Min Green	3–30 sec	1 sec	A	3	ALT
Vehicle extension	0.2–5 sec	0.2 sec	A	2	ALT
Phase green Maximum	0–120 sec	1 sec	A	2	ALT
Phase Intergreen	0–30 sec	1 sec	A	3	ALT
Pedestrian Blackout (preset)	3–30 sec	1 sec	A	3	ALT
Detector Function					
Call Delay	0–60 sec	1 sec	A	2	ALT
Cancel Delay	0–60 sec	1 sec	A	2	ALT

Table 2: Timing Parameters

Parameter	Range	Maximum Step Size	Tolerance	Access Level	Fixed / Alterable
Detector Fault Monitoring					
Permanent detect state timeout	0–60 min	1 min	C	2	ALT
Permanent non-detect state timeout	0–72 hrs	1 hr	E	2	ALT
Start up timings					
'All Off' period following power up	7 - 120 sec	–	N/A	4	Fixed
'All Off' period following manual switch on by the signals on-off switch (K26)	7 sec	–	N/A	4	Fixed
Starting intergreen	0–30 sec	1 sec	A	3/4	ALT/Fixed
CLF plans definition					
Plans Cycle Time	0–200 sec	1 sec	D	2	ALT
Offset	0–200 sec	1 sec	D	2	ALT
Group	0–100 sec	1 sec	D	2	ALT
Speed measurement SA/SDE					
SDE					
Double extension	3 sec	–	A	4	Fixed
Triple extension	3.5 sec	–	A	4	Fixed
SA	5 sec + delay period	–	A	4	Fixed
Vehicle priority					
Priority Extension	0–30 sec	1 sec	B	2	ALT
Priority Maximum	0–31 sec	1 sec	B	2	ALT
Compensation Period	0–30 sec	2 sec	B	2	ALT
Inhibit Period	0–150 sec	10 sec	B	2	ALT
Hurry Call					
Hurry Call Delay	0-99 sec	1 sec	B	2	ALT
Hurry Call Hold	0-99 sec	1 sec	B	2	ALT
Hurry Call Prevent	0-199 sec	1 sec	B	2	ALT

Table 2: Timing Parameters (cont)

Parameter	Facility Type	Range	Maximum Step Size	Access Level	Fixed/ Alterable
Vehicle phase Pelican, Puffin, and Ped/Junction					
Fixed vehicle period	ALL	20 – 60	4	2	ALT
VA vehicle minimum	ALL	6 – 15	1	3	ALT
VA vehicle maximum	ALL	10 – 60	10	2	ALT
Vehicle extension	ALL	0.2 – 5	0.2	2	ALT
Vehicle to pedestrian phase Intergreen					
Vehicle amber/ped red	ALL	3	–	4	Fixed
Red/red					
- gap change	ALL	1 – 3	1	3	ALT
- forced change	ALL	1 – 3	1	3	ALT
Pedestrian phase					
Vehicle red/ped green					
Stand-alone (Period D)	Pe Ns	4 – 12	1	3	ALT
(Period 4)					
(Period IV)					
Junction	Fs	4 – 99	1	3	ALT
Pedestrian to vehicle phase intergreen					
<u>Pelican</u>					
Veh red/FGM (Period E)	Pe	0 or 2	2	3	ALT
FA/FGM (Period F)	Pe	6 – 18	1	3	ALT
FA/ped red (Period G)	Pe	1 – 2	1	3	ALT
Nearside crossing					
Red/Red					
- Minimum (Period 5)	Ns	1 – 5	1	3	ALT
- Maximum (Period 6)	Ns	0 – 30	1	3	ALT
- Force Change (Period 6(a))	Ns	0 – 3	1	3	ALT
- Gap Change (Period 6(b))	Ns	0 – 3	1	3	ALT
On-crossing Extension (Period 6)	NS	0.4 – 5	0.2	3	ALT

<u>Farside crossing</u>					
Red/Blackout					
- Minimum (Period V)	Fs	1 – 15	1	3	ALT
- Maximum (Period VI)	Fs	0 – 30	1	3	ALT
- Force Change (Period VI(a))	Fs	1 – 3	1	3	ALT
Red/Red (Period VII)	Fs	1 – 3	1	3	ALT
On-crossing Extension (Period VI)	Fs	0.4 – 5	0.2	3	ALT
Push-button demand with kerbside cancel					
Hold demand after:					
- Push button operation	ALL	1 – 5 secs	0.2	2	ALT
- End of kerb side detection	ALL	1 – 5 secs	0.2	2	ALT
- Other registered demand	ALL	1 – 5 secs	0.2	2	ALT

Table 3: Timing Parameters for Pedestrian Facilities

Key: Fs – Farside crossing Ns - Nearside crossing Pe – Pelican

APPENDIX L SPEED MEASUREMENT

L1 This appendix sets out the requirements for a traffic signal controller to be approved for use with Speed Discrimination Equipment or Speed Assessment facilities for use on High Speed Roads (defined as roads with an 85 percentile approach speed equal to or greater than 35mph).

L2 Registration to this appendix requires the Design Authority to self-certify that the Product meets the requirements specified.

High Speed Road Strategies

L3 This strategies section is provided to explain the background to high speed road strategies and the reason for and application of Speed Assessment and Speed Discrimination facilities. It does not form part of the specification.

L4 The amber signal at traffic signals requires drivers to stop if it is safe to do so. Drivers are not permitted to cross the stop line when the red signal is showing. If the amber appears when a vehicle is so close to the stop line that it is not possible to stop safely, the driver will be able to clear the stop line before the red signal appears.

L5 At further distances from the stop line there is an area (often referred to as the "dilemma zone") where drivers confronted by a change to amber have to choose between stopping at the stop line or, by continuing at the same speed, to cross the stop line before the onset of red. One of the purposes of System D detection is to extend green periods so that drivers are less likely to be confronted by a change to amber while in the dilemma zone.

L6 The location of the dilemma zone depends on the speed of the vehicle. At speeds up to 30mph, the dilemma zone is within the area covered by System D detection: vehicles which have not reached the X detector before the change to amber will be able to stop safely at the stop line. At higher speeds the dilemma zone is located further back from the stop line. Speed discrimination/speed assessment is designed to ensure as far as possible that signal changes for vehicles travelling in excess of 30mph do not occur within the dilemma zone.

L7 Speed discrimination provides either one (double vehicle extension) or two (triple vehicle extension) additional pairs of detectors which operate only when a specific speed threshold is exceeded. These detectors provide sufficient extensions for a vehicle continuing at the same speed to reach the System D detection and prevent the green "gapping out" before the vehicle reaches the stop line.

L8 Speed assessment works on a different principle. The speed assessment detectors introduce a delay dependent on the vehicle speed after which a fixed extension is introduced. The delay is calculated to expire when the vehicle is just over 5 seconds travel time from the stop line. If amber appears during the delay period the vehicle will still be able to stop safely at the stop line. The green signal is therefore permitted to "gap out" during the delay period. At the end of the delay period, if the signals have not yet changed to amber, a 5 second extension is introduced so that the green is prevented from gapping out until the vehicle is very close to the stop line, beyond the dilemma zone.

Functional Requirements

Speed Measuring Detectors

L9 The use of Speed Discrimination and Speed Assessment requires loop detectors installed in pairs with the correct spacing (typically 12' (3.66m) between leading edges). The speed is measured from the time interval between the operation of the two detectors as a vehicle passes. The logic for this may be incorporated within the controller.

Note. All timings specified in this appendix assume typical loop pair spacings as above.

L10 The strategy for the implementation of speed measuring detectors is described in TAL2/03 (Signal-control at Junctions on High-speed Roads).

Speed Discrimination

L11 Where Speed Discrimination (Double Vehicle Extension) is required, if a difference in signal between the inputs from the speed measuring loops of 275 milliseconds or less exists, the phase green shall be extended for a fixed period of 3.0 seconds, subject to the maximum running period.

L12 Where Speed Discrimination (Triple Vehicle Extension) is required, if a difference in signal between the inputs from the outer speed measuring loops of 183 milliseconds or less exists, or from the inner speed measuring loops of 235 milliseconds or less exists, the phase green shall be extended for a fixed period of 3.5 seconds, subject to the maximum running period.

Speed Assessment

L13 Where Speed Assessment (Double Vehicle Extension) is used, if a difference in signal between the inputs from the speed measuring loops indicates a speed of 45 km/h (28 mph) or more, the phase green shall be extended by a fixed period of 5.0 seconds following a delay period given by the formula:

$$\text{Delay} = (140 - 5v) / v \text{ Seconds}$$

where v is the measured vehicle speed in metres/second. Above 100 km/h (62 mph), where the above expression is negative, the delay shall be zero.

L14 A gap change shall be permitted during the speed dependent delay period.

L15 The overall period comprising the fixed extension and the speed dependent delay period shall be subject to the maximum running period.

Extra Clearance Period

L16 A two second extension to the 'All-Red' period shall be automatically added following the running of any phase which is provided with speed assessment or speed discrimination equipment, if any one of the following circumstances occur:

- a) any speed extension is curtailed;
- b) any VA extension is curtailed;
- c) a speed discrimination or speed assessment extension occurs during the amber signal;
- d) during the phase green period, any vehicle detector connected to speed measurement equipment associated with that phase is not operated.

Speed Discrimination/Assessment Test Facility

L17 A means of testing the SDE/SA facility on site shall be provided. The test method shall be capable of access via the handset or another appropriate test facility. Access shall be level 3 i.e. access only available on-site.

L18 When in the test mode the controller shall either continue to operate normally and just provide a monitoring facility or inhibit normal operation by disconnecting the links between the detector outputs and the corresponding discriminator/assessor inputs.

L19 If the test mode inhibits normal operation or in any way prevents the detection of high-speed vehicles then an extra clearance period as defined in L16 shall be introduced following the termination of any phases that may be affected by the test.

L20 Exiting the test mode shall generate an extension to cover any high speed vehicles which may not have been detected. Typical values are approximately 4 seconds for SDE or 10 seconds for speed assessment.

APPENDIX Z TECHNICAL FILE CONTENT

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

The 'ticked' items are required to be present in a Technical File used to support TOPAS Registration against TOPAS 2500B. **Please read the description criteria carefully.**

<i>Ref</i>	<i>Item</i>	<i>Description</i>	Required
1	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. Where external certificates or documents are referred to these shall be included either: (a) within this overview document; or (b) supplied separately as part of this Technical File.	✓
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 required standards and regulations including CE/CA requirements that apply to the Product	A list of all standards to be complied with. Including explicit CE/CA declarations of performance/conformity for those standards, including all certificates, shall be included in this Technical File.	✓
4	A functional design description of the product	Title, document number, version and date of the overall System Design Document for the Product.	✓
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 2500B confirming compliance or non-compliance and referencing supporting evidence. (An example template can be found on the TOPAS website)	✓

7	Functional test procedures and results	A list of all functional test schedules and test result documents (by document number and issue) that substantiate the Statement of Compliance.	✓
8	BS EN 50293 EMC test procedures and results	(a) Title, document number, version and date of the EMC test performance requirement document. Copies of the results of EMC testing undertaken by an appropriately qualified independent approved test house <u>must</u> be included in the Technical File.	✓
9	Optical test procedures and results required by this specification	For all products which have any defined optical performance requirements (a) Title, document number, version and date of the optical test performance requirement document. Copies of the results of optical testing undertaken by an appropriately qualified independent approved test house <u>must</u> be included in the Technical File.	N/A
10	Environmental test results	(a) A list of relevant Environmental tests performance requirements defined in TOPAS 2130. Copies of the results of the Environmental testing undertaken by an appropriately qualified independent approved test house <u>must</u> be included in the Technical File.	✓
11	Radio Equipment Regulations test results	For all products which include any transmitting and/or receiving radio equipment (a) A copy of the RER Declaration Of Conformity (b) Reference to the RER Technical Documentation for the product (by title, document number and version). (c) Copies of the results of radio testing, undertaken by an appropriately qualified independent approved test house <u>must</u> be included in the Technical File. The test results should be those identified in the RER Technical Documentation and should cover any specific IR2030 requirements for the type of radio used. A copy of the Type Examination Certificate for radio equipment not covered by a Designated EN standard.	N/A

12	Primary Safety Test procedure and results	For Traffic signal Control equipment only: (a) The title, document number, version and date of the Primary Safety Test schedule. (b) A copy of the test results must be included as part of the Technical File.	✓
13	Failure Mode Analysis	For Traffic signal Control equipment only Title, document number, version and date of the product failure mode analysis requirements and results.	✓