Department for **Transport**

Traffic Advisory Leaflet 16/99 December 1999



The Use of Above Ground Vehicle Detectors

Introduction

Responsive traffic signal systems are a key component in managing the safe and efficient progress of traffic. Such systems range from simple vehicle actuation where the green phase responds to approaching vehicles, to advanced algorithms that use flow and occupancy measurements taken from several different locations to set the optimum signal timings for a junction or network of junctions. All these systems rely on vehicle detection, either in the form of above ground detectors or loop detectors buried in the road surface. The former type is less susceptible to damage during road works but requires careful installation and maintenance to ensure correct operation. This leaflet aims to provide guidance to help end-users make the best use of above ground detection.

The Highways Agency specification TR 2123 describes the requirements for above ground detectors. Detectors which fully meet this specification are recommended for 'demand and extend' operations at traffic signal installations, except in the circumstances defined in this leaflet. TR2123 covers two types of above ground detector equipment:

- dynamic detection-the ability to detect all types of moving vehicles above a pre-set speed threshold (e.g. Doppler microwave detectors);
- static detection-the ability to detect all types of stationary vehicle in a defined location (e.g. certain types of infra-red detectors).

It should be noted that some of the limitations covered in this leaflet are specific to only one of these two types of vehicle detector.



A typical above ground microwave detector mounted above the traffic signal to give an unobstructed view of approaching traffic

This advice does not affect the policy set out in TD 35/91 regarding the use of MOVA at isolated trunk road traffic signal installations. Nor does it change the advice contained in TA 12/81 regarding traffic signals on high speed roads.



Stop Line detector required where slow moving traffic or traffic entering main traffic stream from side road.

Stop line detection

Studies have shown that, for certain types of approach, dynamic above ground detectors are more likely than loop detectors to fail to detect approaching vehicles. Consideration should always be given to whether the approach falls into one of these categories listed below. If so, then the use of an additional presence detector at the stop line (either a static above ground detector or an inductive loop detector) should ensure that any vehicle missed by the dynamic above ground detector will not be stranded at the stop line. If the approach does not fall into one of these categories, then it should not normally be necessary to install any additional presence detection.

Site conditions which make the need for a stop line detector more likely include:



Static stop line detector installed on an uphill approach to a junction

- where a phase consists of just one traffic stream, i.e. where there are no other approaches calling the same phase. It should be noted that for a two lane approach of this kind, adequate detection may be achieved at some sites through the use of two dynamic detectors, one on the nearside signal pole and one on the offside.
- where vehicle speeds are low, e.g. on uphill approaches;
- where side roads are lightly trafficked, particularly where the main road speeds are high;
- where traffic leaving the junction seriously masks the detector beam for approaching traffic on the same arm, e.g. on a curved approach;
- where parking on the approach is prevalent, particularly if there is a bus stop;
- where right-turning vehicles tend to block the movement of approaching traffic;
- where slow-moving vehicles join the approach from a side road close to the junction, particularly if some of these vehicles are large;
- where extreme congestion leads to blocking of the junction during peak hours, so that the forward movement of approaching traffic is too slow to be detected. (N.B. current experience suggests that this is not a common occurrence, but it has been observed under snow/ice conditions.)



Bus stop close to traffic signals, resulting in slow moving traffic in the bus lane. A stop line detector is used to ensure that the buses are detected

Consideration should always be given to using a static above ground detector (approved to TR2123) instead of a loop detector for supplementary presence detection.

For an uphill approach with slow moving traffic, detection performance may be improved by increasing the extension in the controller to 0.5 seconds. In some cases this may eliminate the need for supplementary presence detection.

Detector siting - dynamic detectors

Dynamic above ground detectors, by their very nature, respond to the motion of vehicles, so they may also show susceptibility to other moving objects in their field of view, such as receding traffic, moving tree branches, etc. Particular attention therefore needs to be paid to locating and aligning the detectors, the suitability of the mounting pole, and cutting back overhanging branches/vegetation, etc.

Detector siting - static detectors

Where a static above ground detector is installed, either of the two poles may be used. In some cases it may be preferable to use the offside pole, as the nearside pole may be occupied by a dynamic above ground detector and other detection systems, such as for Puffin or Toucan. The detector should always be sited directly beside the lane in which vehicle detection will take place.

It should be noted that TR2123 does not specify the number of lanes of coverage for a static detector. Where the width of the approach is greater than one lane, more than one static detector may be required to cover the approach (reference should be made to the manufacturers data).



An example of other detection systems mounted on the primary pole

Detector alignment - dynamic detectors

Normally, the above ground detector should be mounted on the nearside primary pole. The offside pole is less suitable because the traffic travelling in the opposite direction can interfere and cause occasional loss of detection. However a pole other than the nearside primary may be used where:

- visual obstruction exists (e.g. signs or trees);
- there are more than two lanes on the approach, in which case two above ground detectors may be required, one on the nearside pole and one on the offside pole;
- the road layout permits a better aim from an offside pole.

Above ground detectors are aimed at the approaching traffic and set at a vertical angle to detect cars in the approach lane(s) when they reach a point 40m from the stop line. When a vehicle is detected, provided it maintains a speed above the detector threshold speed, normally about 8kph (5mph), it should hold the above ground detector in the operated condition until it clears the stop line. Consequently it is only possible to set up the detector accurately when vehicles are approaching the 40m point individually and there are no vehicles moving above 8kph (5mph) between the 40m point and the stop line. Clearly these requirements can only be satisfied when there is only light traffic on the approach.



Side view of a dynamic detector mounted on the primary signal pole



Two above ground detectors used to cover a wider approach

Some setting up can be done where there is moderate traffic with individual vehicles joining the back of a stationary queue during a part of the signal cycle, but this technique can give detection at a reduced distance, especially if there are tall vehicles near the front of the queue. Therefore, the final setting should always be checked with an individual vehicle approaching the junction. It is essential that these requirements are met during setting up. It is not possible to set up detectors effectively under busy traffic conditions.

The aiming process usually consists of looking along the top of the detector body and adjusting the angle until the required distance of detection is obtained. For good results it is worth taking care over the correct setting distance, erring below 40m rather than above.



Detectors should not be mounted behind the backing board or other physical obstructions

Vehicles turning off an approach into a side road close to the junction may be detected unnecessarily. Where these vehicles make up a significant proportion of traffic on the approach, it may be possible to set up the detector so that its detection zone does not extend to the side road. If this is not practical, inductive loop detection should be used.

A traffic cone or a similar marking device should be placed on the footway at the 40m position and a test box with a buzzer, as recommended by the manufacturer, should be connected to the detector to indicate when detection occurs. Where there are two lanes on the approach, the detection distance must be checked in both lanes and, if necessary, the detector must be rotated horizontally until cars in both lanes are detected at approximately the same distance.

The extension time in the controller should be reduced to 0.2 seconds, or to the value nearest to 0.2 seconds to which the controller can be set. Theoretically, since the detector stays in the detect condition until the vehicle reaches the stop line, the extension could be set to zero. However, there may be a tendency to gap-out (controller moves to the next stage) under congested traffic condition and a small extension in the controller helps to reduce this effect. Note that an extension time of 0.5 second is built into TR2123 approved dynamic above ground detectors. There are some circumstances where a slightly longer extension time in the controller (up to 0.5s) may improve detection performance. These include the detection of buses in a bus priority system, and vehicle detection on uphill approaches with slowmoving traffic.

Situations where above ground detectors are not recommended

Above ground detectors are not recommended for the following scenarios:

To control any approach at a junction which is controlled by MOVA

MOVA timings vary widely in response to traffic conditions. The system uses accurate presence and count information on a lane-by-lane basis to ensure that queues are discharged from each approach with maximum efficiency. Cost benefit analysis suggests that it is not possible to use above ground detectors for MOVA at present because of the large number of detectors needed to cover the detection zones, additional mounting and in some cases ducting requirements.

Loops and above ground detectors should not be used together to extend the vehicle phase on the same approach

However, above ground detectors may be used at sites other than MOVA as part of a hybrid

detection system, where some approaches have loop detectors and others have above ground detectors.

To replace the normal System D detection on approaches which are also fitted with speed discrimination (SD) or speed assessment (SA) equipment.

High speed roads represent a significant number of sites where above ground detectors could potentially be used. There is a specific set of conditions (although it is unlikely to occur very often) under which the detectors on a high speed road, if used in conjunction with SA/SD equipment loops, will cause a stage to run to a maximum more often than System D. However, there are potential benefits in using above ground detectors for approach detection, and a low probability of an increase in risk to drivers. As a result, further work is planned to investigate the impact of the use of detectors on high speed roads. In particular, this will compare the relative number of maximum changes resulting from loop detection, with hybrid systems using above ground detector approach detection. It is intended to quantify these effects under controlled conditions. When sufficient experience has been gained, further guidance will be published on this topic.



Lane discrimination requires independent vehicle detection for each stream

On an approach where the control strategy requires separate lane detection, e.g. separately signalled turning movements.

Applications that require two or more separately signalled traffic streams require independent vehicle detection for each stream. Careful detector siting and alignment procedures are therefore necessary to ensure proper detection. With loopbased detection, this can be implemented relatively easily. However, achieving lane discrimination with above ground detectors requires special consideration, and may not be possible at all sites. There are currently no standards covering detection functionality for approach detection with lane discrimination. TR2123 (for dynamic detectors) covers a sub-set of the necessary functionality but specifies that a detector must cover a two lane approach, which is not appropriate for lane discrimination applications. So far only two technologies have been trialled to provide lane discrimination and the results are encouraging.

Equipment approval

The following applications cannot be implemented using above ground detectors because there is no approved equipment:

- presence detection for controllers incorporating the MOVA strategy
- approach detection with lane discrimination
- approach detection with call-cancel
- speed discrimination and speed assessment

However, an investigation into the use of above ground detectors in these applications is currently underway. Further advice will be issued when the suitability of above ground detectors for these applications has been determined. The specification for above ground detector is being revised to include narrow beam devices, which are more suited to discriminate vehicles in individual lanes.

Reference

TR2123 - Above Ground Vehicle Detector Systems for use at Permanent Traffic Signals Installations (Highways Agency)

Design Manual for Roads and Bridges, Volume 8, Section 1, TD 35/91- All Purpose Trunk Roads MOVA System of Traffic Control at Signals

Traffic Advisory Leaflet 3/97 the MOVA Signal Control System

Design Manual for Roads and Bridges, Volume 8, Section 1, TA 12/81- Traffic Signals on High Speed Roads. Enquiries on the use of above ground detectors should be addressed to:

Department for Transport Traffic Management Zone 2/06 Great Minster House 76 Marsham Street London SW1P 4DR Tel: 020 7944 2974

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