Clearview Intelligence
making journeys work

Design Guide

M100 wireless vehicle detection system

The M100 wireless vehicle detection system uses embedded in-road sensors to detect the presence and movement of vehicles.The system provides a more reliable, affordable and easier to install alternative to traditional inductive loops. The M100 Sensor is used in many applications including traffic signal control, ramp metering, MIDAS, route safety schemes, bicycle detection and queue protection.

Cost effective vehicle detection system

Wireless magnetometer sensors transmit vehicle detection to a traffic junction / MIDAS outstation. Designed as a direct replacement for traditional inductive loops, the M100 wireless detection system offers lower total cost of ownership over its lifetime due to a reduced level of maintenance and repair work. No ducting or cabling is required between the in-ground sensors and access point, saving on both cost and installation time.

The M100 Sensors and M115 Repeaters are battery powered providing up to 10 years operational life. The M100 Access Points, Repeaters, Sensors and Interface Cards are all provided with a five-year warranty.

Reduced installation time and improved safety

The M100 wireless detection system has a rapid installation time. A typical sensor installation takes approximately 10-15 minutes when deployed just below the road surface, significantly less than the installation time for inductive loops.

Road worker safety is improved by minimising the time spent in-road; reduced level of on-site machinery and removing the need to access mains power.

Each sensor is independently installed in the centre of a lane, removing the need to close all lanes at once. This lowers the amount of traffic management required, keeping full road closures and traffic disruption to a minimum which further reduces road worker exposure, driver stress and frustration.

Key Benefits

- Reduced installation costs versus traditional loop technology
- Rapid installation and deployment reduces road closures, road worker exposure and traffic disruption
- More reliable and cost effective than inductive loops
- Reduces junction maintenance costs
- Centre lane installation maintains road surface integrity
- Depth of installation eliminates need for removal during future resurfacing work

Key Features

- Wireless sensor system to detect vehicle presence
- Ultra-low power communications protocol with reliable two-way communications
- 10-year sensor and repeater battery life
- Standard contact closure card output replicates traditional loop inputs
- Fast and simple installation with no wires, ducting or trenching

M100 wireless detection system components

The M100 Sensors use magnetometer technology to wirelessly transmit detection data in real-time via low power secure radio technology to a nearby M110 Access Point. For larger more complex junctions, or where greater distances are involved, the Access Point may be supplemented by multiple M115 Repeater Units to expand coverage. The M110 Access Point connects to a variety of interface cards dependent on the type of application. M100 Sensors and M115 Repeaters are battery powered providing up to 10 years operational system life.

M100 Sensor

M100 Sensors are sensitive magnetometers equipped with a low power secure radio transmitter suitable for in-road mounting. Sensors can be installed just below the road surface at 65mm or to a depth of 165mm enabling future road resurfacing to take place without the need to remove and redeploy the sensor. Installation requires a cored hole with a width of 100mm due to the compact size of the sensor and takes approximately 10-15 minutes per installation. Low powered detection signal technology combined with a high-quality internal 3.6v lithium thionyl chloride battery ensures an operational life of 10 years.

The M100 uses 3-axis magnetic field sensing, with each sensor providing a detection zone of 2m in length by 1.3m width. Sensors must be deployed within 35m of an access point or repeater and communicates vehicle presence within 125 milliseconds allowing for real-time operation.

M110 Access Point

The M110 Access Point maintains two-way communications with M100 Sensors and M115 Repeaters. It receives and processes detection data from M100 Sensors, forwarding this onto the controller unit whilst transmitting a message acknowledgment back to the sensor.

The access point uses a wired connection to relay the sensor detection data via a:

- M120 Interface Card to a roadside traffic signal controller
- M150 Interface Card into a MIDAS outstation
- M160 Interface Card to a Vehicle Activated Sign (VAS)

The access point can be mounted on any roadside column or signal head at a recommended height of between 4.5 and 6m to provide good signal coverage to sensors or repeaters.

M115 Repeater

In cases where one or more M100 Sensors are installed out of the range of the nearest access point (over 35 metres), M115 Repeaters can be used to provide a two-way relay, extending the range and coverage between the sensors and the access point. Repeater units have a maximum range of 200m from the M110 Access Point. Up to a maximum of three repeater units can be used in tandem to further extend the network.

All repeater units are battery powered and require no external power supply or cabling. There are two variants of M115 Repeater; the solar powered variant has a battery life over 10 years and is non-replaceable whilst the battery variant has a replaceable lithium thionyl chloride battery offering a seven year life.

Repeater units must be mounted on a convenient pole or other structure between 4.5 and 6m height with a direct line of sight to both sensors and an access point. Repeaters can be mounted on the same pole or mast as another repeater or access point that is pointed in the opposite direction as to communicate with sensors located within a different view.

Both access point and repeater units provide a 120° field of vision providing flexibility when planning and installing the system.

M115 Repeater Antennas

Antennas are available to extend the range of the M115 Solar Repeater to cover a greater field of vision. Available as short and long range, use of an antenna provides additional flexibility for applications such as MIDAS, queue protection or complicated junction layout. Short range antennas have a range of 200m back to an access point or repeater with a 35m range to in-ground sensors. In comparison, a long range antenna has a 400m range back to an access point or repeater alongside a 35m range to in-ground sensors.

M100BR Bicycle 'Radar' Sensor

For areas where cyclist traffic is prevalent, M100BR Sensors can be added to the system ensuring visibility and inclusion of cycling demand into the traffic signal control. With a battery life of up to eight years the BR (bicycle radar) Sensors have been designed to uniquely detect the presence of a bicycle within a defined zone of up to 3m installed at a shallow depth to the road surface.

Installed in-ground, BR Sensors emit RF pulses to detect presence at a bicycle approach lane or stop line. High frequency RF pulses are transmitted, bounced off a target object, and the return pulses are measured by a time-gated RF mixer. RF reflections are analysed to produce presence, distance and motion measurements. When a detection is acknowledged, the sensor sends a signal wirelessly to an M110 Access Point which feeds detection information directly into the traffic controller through a wired connection.

Integrating bicycle detection as part of an M100 wireless solution can give bicycles their own traffic light 'phase', separate from other traffic to improve road safety at junctions.
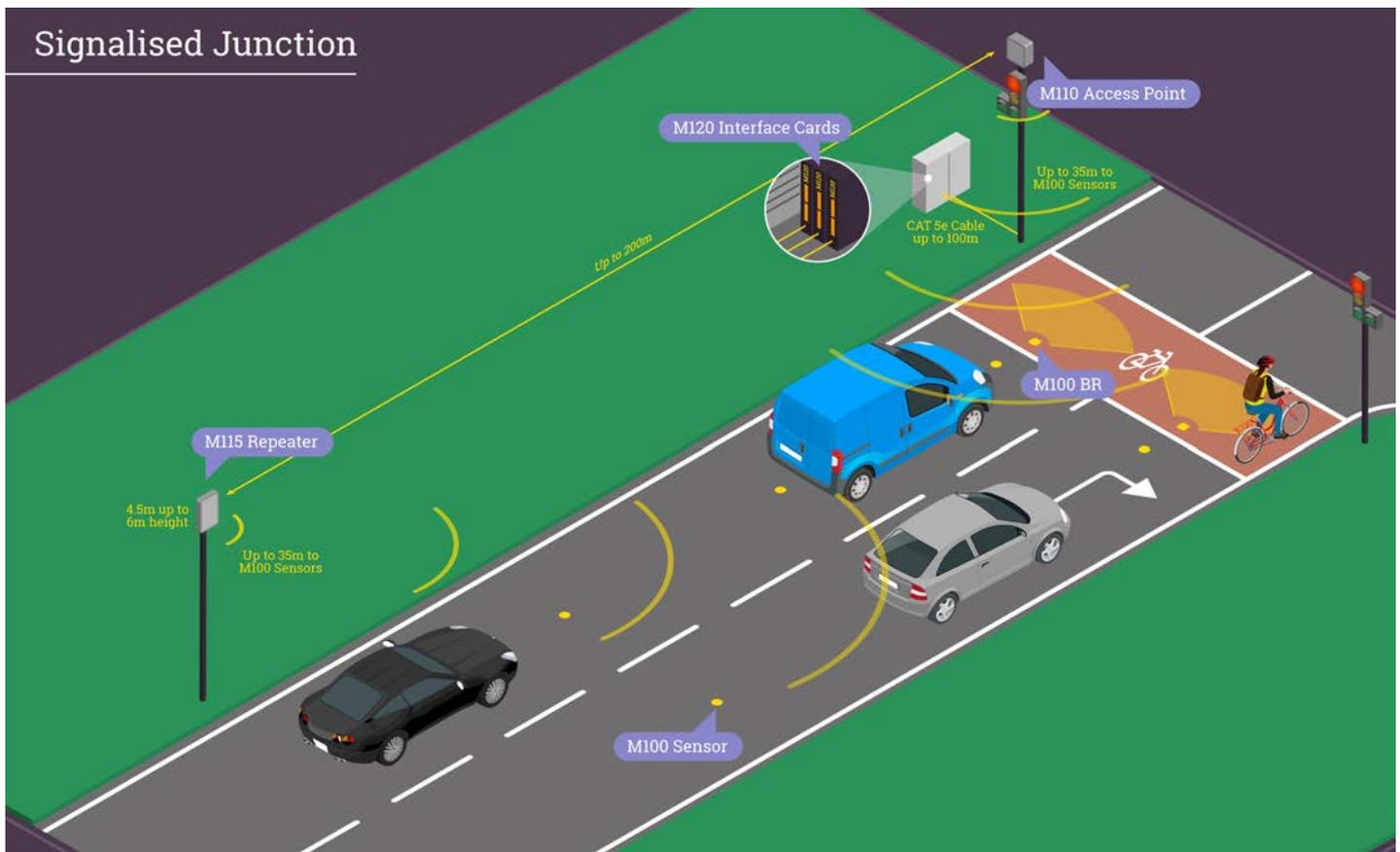
Traffic light control and bicycle detection

Thousands of sensors have been deployed in the UK and worldwide as part of modern traffic signal systems including over 1,000 junctions deployed by Transport for London. The solution is traffic controller manufacturer independent and suitable for all Urban Traffic Control (UTC) systems including System D, MOVA and SCOOT.

As with inductive loops, M100 wireless sensors can be located exactly where measurements are required whether it is at a specific through-lane, turn lanes or entrance and exit ramps.

Each M100 Sensor is typically installed in the middle of a traffic lane where it will detect the presence and passage of vehicles in that lane. Rapid installation of M100 Sensors takes less than 1/5 of the time to install compared with a standard loop installation. By installing via a cored hole, installation of sensors eliminates the need for expensive and time-consuming slot cutting, trenching / ducting. Two or more sensors can be used and configured to replicate extended loops if required.

Once installed, M100 Sensors detect vehicle presence on the approach to each leg of a junction and feed this information to an M110 Access Point. The access point is connected to a M120 Interface Card in a traffic light controller.

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M120 Interface Card

The M120 Interface Card is traffic signal controller independent to ensure compatibility, sending vehicle detection information directly to the traffic junction controller. The card requires a hardwired connection to an M110 Access Point and translates vehicle detection data from the M100 Sensors via the access point.

The interface card provides four detection channels each compromising of an optically isolated contact closure relay for maximum reliability in both normally closed (n/c) and normally open (n/o) configurations. An additional master fault relay (n/c and n/o) is also provided. If sensors require more than four channels, up to 16 interface cards can be daisy-chained together via the front panel connectors. Multiple cards may also be used if the traffic controller detector rack has pre-defined functions or phases for each slot.
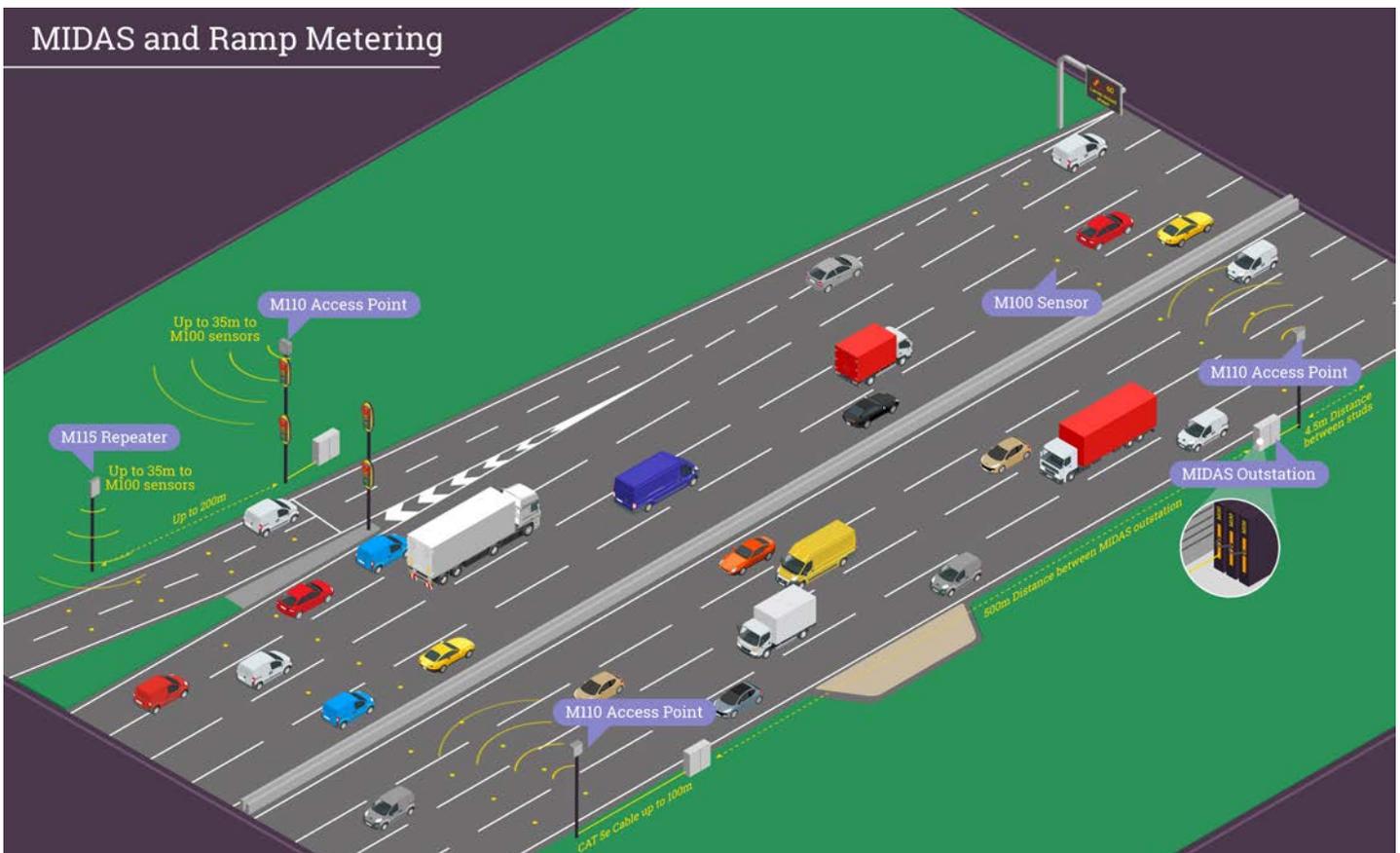
Each M100 Sensor can be mapped to its own individual channel or up to 15 sensors can be mapped to a single channel to effectively 'OR' the sensor signals together. This way, if any sensor detects a vehicle, the contact closure relay will close. This means the system can be easily configured to replicate the way traditional inductive loops interface with the traffic controller.

MIDAS and Ramp Metering

A traditional MIDAS system utilises two 2m inductive loops in each lane spaced 4.5m apart, coupled to a Highways England Specification MIDAS outstation. The M100 Sensor simply replaces the two inductive loops per lane with two M100 Sensors installed 4.5m apart (as per the spacing of traditional inductive loops). The M100 Sensor detection zone is 2m long by 1.3m wide, matching the traditional 2m inductive loop length and its width, ensuring no cross detection between adjacent lanes.

Vehicle detection information is transmitted via wireless radio communications to the M110 Access Point mounted on a roadside pole, hardwired into an M150 Interface Card located within the MIDAS outstation. The M150 Interface Card translates detection information from the sensors via the M110 Access Point.

As there is no requirement to slot cut when installing M100 Sensors as opposed to loops, road surface life is prolonged, reducing remedial work on MIDAS detection equipment. Installation time is significantly improved (each sensor installed within 10-15 minutes) and, as sensors are installed in the centre of each lane, can be installed one lane at a time, minimising the amount of road closures or disruption on key route networks.

MIDAS and Ramp Metering

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Ramp Metering

With ever increasing levels of traffic on motorways, careful management of vehicle flow is essential for maintaining safety and avoiding congestion. Ramp metering is part of the answer: injecting traffic onto the motorways in a controlled manner that optimises capacity and integrates smoothly with the main carriageway.

The M100 wireless vehicle detection solution integrates into a ramp metering scheme with sensor detection points on both the ramp and the motorway network. Sensors measure the level of demand for traffic to join the motorway from the ramp and marries it up with data from the MIDAS network to "inject" traffic into the motorway flow with minimum disruption to improve driver journey time and experience.

M150 MIDAS Outstation Interface Card

The M150 MIDAS Interface Card is manufacturer agnostic and installed within the MIDAS outstation to translate sensor detection data from an M110 Access Point.

The M150 MIDAS Interface Card provides four detection channels suitable for two lanes. Each card comprises of an optically isolated contact closure relay for maximum reliability in both normally closed (n/c) and normally open (n/o) configuration. It is switchable between different manufacturers of MIDAS outstations to give compatibility via a single interface card. Up to 16 interface cards can be daisy-chained together via the front panel connectors to support more sensors across multiple lanes.

M100 Sensors are installed two per lane at 4.5m spacing and mapped to their own individual channel so that upon vehicle detection the contact closure relay will close. The M100 wireless vehicle detection system can therefore be easily configured to replicate the way traditional inductive loops interface with a MIDAS outstation.

Route safety and queue detection

Route safety solutions positively influence driver behaviour to reduce the likelihood of accidents occurring. Wireless vehicle detection gives a complete picture of junction demand and allows network operators to respond quickly to traffic build-up, helping to minimise disruption and keep road users safe.

Identifying vehicles turning

M100 systems have the functionality to alert drivers of an impending junction where a vehicle is turning from a side road with the potential to act as a hazard to vehicles travelling at speed. M100 Sensors read vehicle occupancy at the entrance from the side road and activate a VAS sign via a smart junction controller to upcoming traffic, warning drivers of the potential hazard ahead. This increases driver awareness and encourages them to take precautionary action, ultimately reducing the likelihood and/or severity of an incident.

Encouraging speed compliance

Encouraging drivers not to break speed limits through enforcement is only effective to a level and can create the 'kangaroo' effect of drivers slowing at certain points, rather than the whole route. With two M100 Sensors located in advance of the stop line at a set of traffic lights, speed data can be processed within 125m/s and fed back to the M110 Access Point connected to the traffic junction controller. If speed restrictions have been broken, the traffic signal controller issues a red light to bring the speeding vehicle to a standstill, prompting users to alter their behaviour over time and adjust to the correct speed for the area. Drivers will learn over time that driving in accordance with the restrictions is more likely to result in them having a smoother journey through the area and less chance of being stopped by a red light.
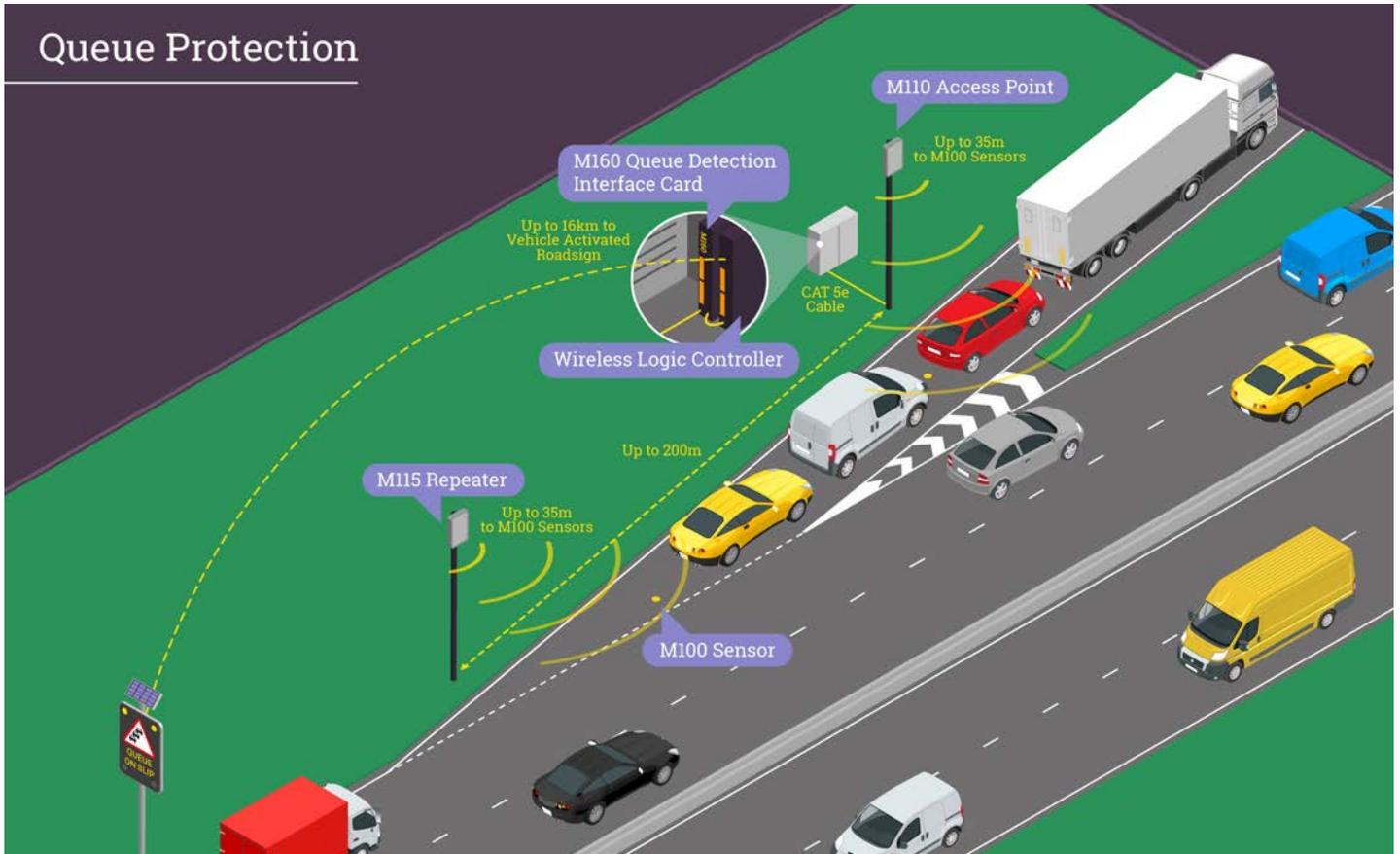
Queue protection

Vehicle congestion on motorway junctions and key exits or A-roads can cause delays and a build-up of traffic. This can act as a stationary hazard to the fast-moving traffic behind and generate major journey time disruption at peak commuting times. Sharing information is key to giving motorists as much notice as possible of any upcoming delays or standstill traffic to increase driver awareness and ultimately, improve route safety. The combination of queue detection with M100 Sensors and the use of VAS highlights the upcoming hazard to drivers approaching the area and gives them the opportunity to react earlier to traffic congestion on either an upcomming exit slip road or the road ahead.

M160 Queue Detection Card

A M160 Queue Detection Card translates vehicle detections from M100 Sensors sent to it via the M110 Access Point into contact closure events which can be used to trigger actions such as activating VAS. Triggering contact closure events is the result of a pattern of vehicle detections matching defined programmable logic criteria set by the operator to determine what constitutes queuing or stationary traffic. This can be a mix of data points such as breach of speed, traffic volume or occupancy thresholds or around length of time for which traffic appears to be slow or stationary.

This means the criteria and threshold parameters can be uniquely tailored to the specific conditions of an individual scheme and makes the card a truly versatile solution to suit every location.

For use in areas where instances of queuing or slowing traffic is frequent, an M160 Interface Card can monitor the status of queuing traffic for up to four lanes and be used to operate VAS to alert drivers and notify of potential hazards ahead, improving route safety and minimising road user risk.

Queue Protection

- M160 Queue Detection Interface Card
- Up to 16km to Vehicle Activated Roadsign
- Wireless Logic Controller
- M110 Access Point
- Up to 35m to M100 Sensors
- CAT 5e Cable
- M115 Repeater
- Up to 35m to M100 Sensors
- Up to 200m
- M100 Sensor

Compliance and compatibility

CE Marked

Type approved to TR2512A and approved to Highways England standard MCH1529

Meets electrical safety requirement EN 60950

Elexon code: 83 9000 5000 10

Designed to meet mechanical and temperature requirements of TR2130C and European specification HD638

Electromagnetic Compatibility (EMC) tested to EN 50293

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