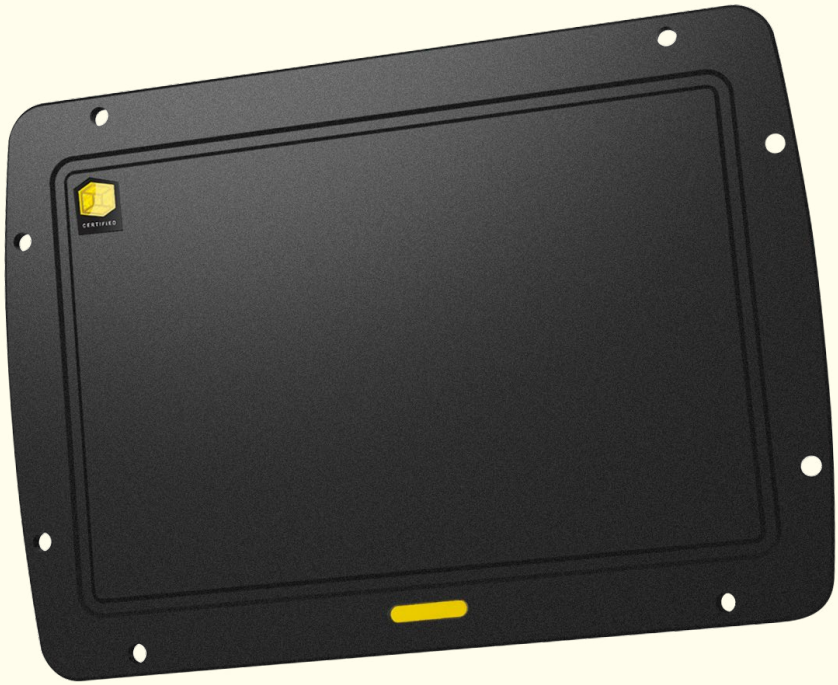
# 350

VEHICLE DETECTION

Enforcement Radar Traffic Detector

AGD CERTIFIED
INTELLIGENT DETECTION SYSTEM

# PRODUCT MANUAL



AGD®

ISO 9001 Registered Quality Management
UKAS MANAGEMENT SYSTEMS 015

ISO 14001 Registered Environmental Management
UKAS MANAGEMENT SYSTEMS 015

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2011

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# INTRODUCTION

## PRODUCT & TECHNOLOGY

AGD CERTIFIED
INTELLIGENT DETECTION SYSTEM

# 350

The 350 is specifically designed for O.E.M integration into photo enforcement systems to measure the position, speed and range of passing vehicles. Operating in the K-band at 24GHz, the radar offers market leading performance for demanding applications such as red light (&speed) and yellow box violations at signalised intersections.

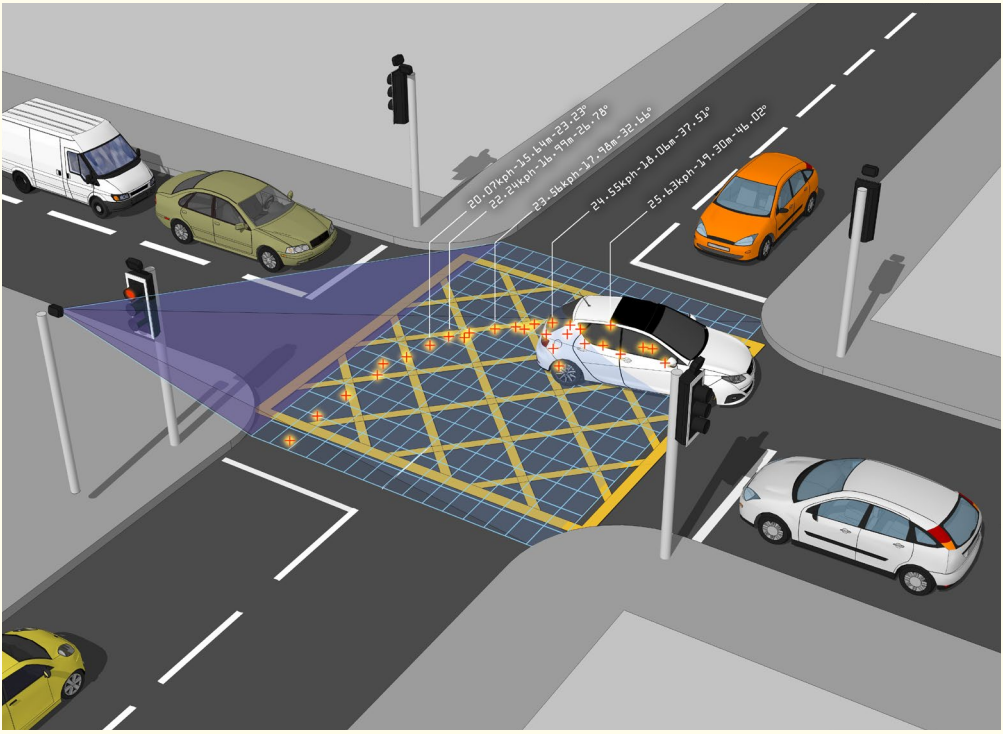
Positioned in front of (or optionally behind) an intersection stop line, the 350 will track up to thirty two targets simultaneously and allows the setting of two precise trigger points for data output to the host system when a violation occurs.

## KEY FEATURES

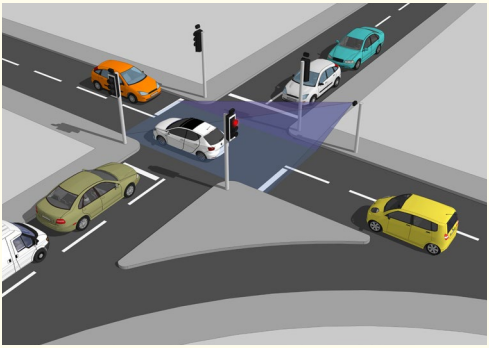
- Radar reports speed, range and positional data to each event
- Tracks up to 32 simultaneous targets
- Speed measurement from 10kph - 250kph
- Target range 4m - 85m
- 40º field of view
- Suitable for advancing or receding traffic flow
- Dual user selectable virtual trigger points
- High speed RS422 serial communications
- Optional Ethernet interface
- Continuous radar self-check features
- Self calibrating bandwidth control

## TYPICAL APPLICATIONS

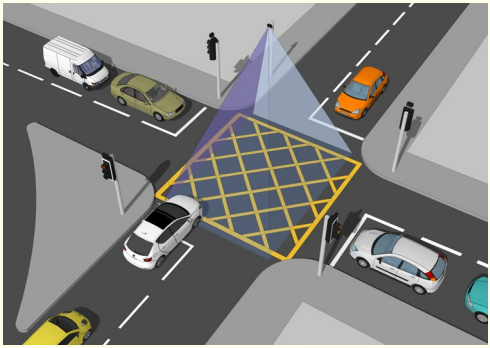
Vehicle speed, distance and angle is captured through the detected zone




Red light violation

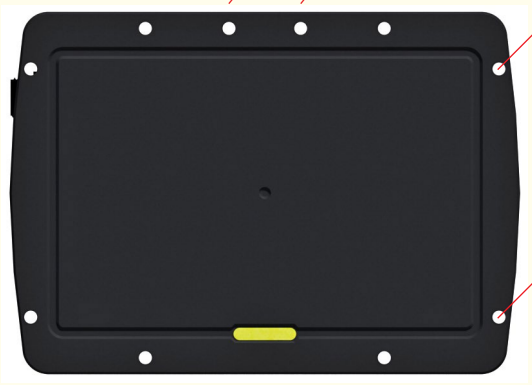


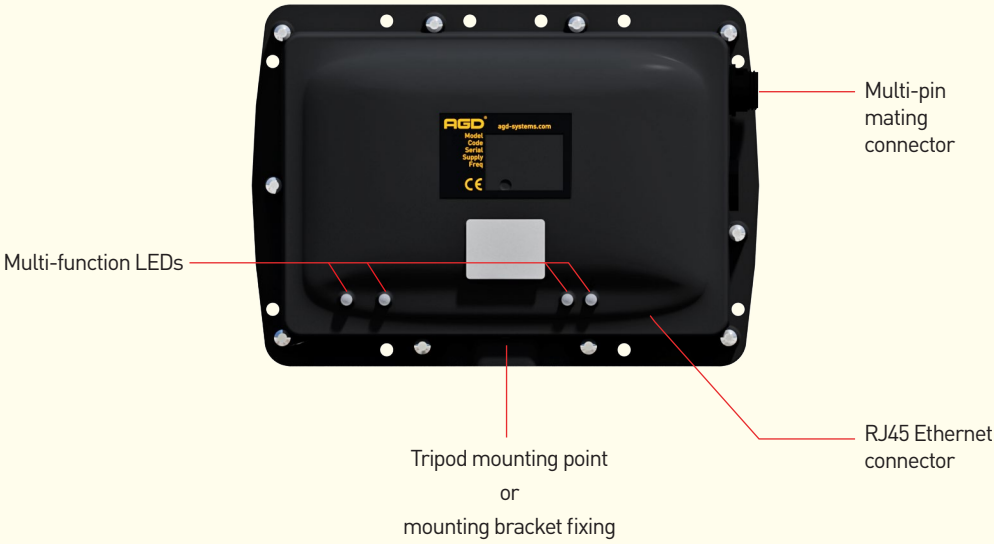
Yellow box violation



# INTRODUCTION

## PRODUCT OVERVIEW

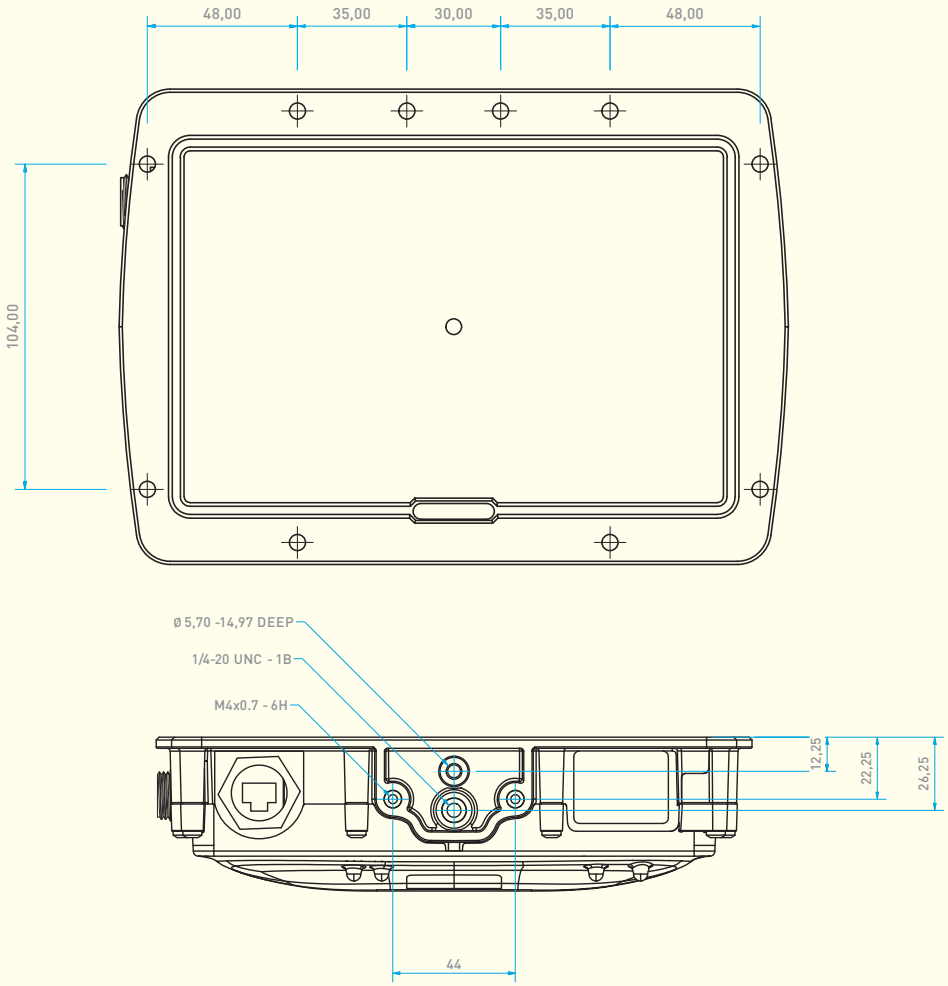


# INSTALLATION

## RADAR MOUNTING

The radar mounting features and dimensions are shown below.



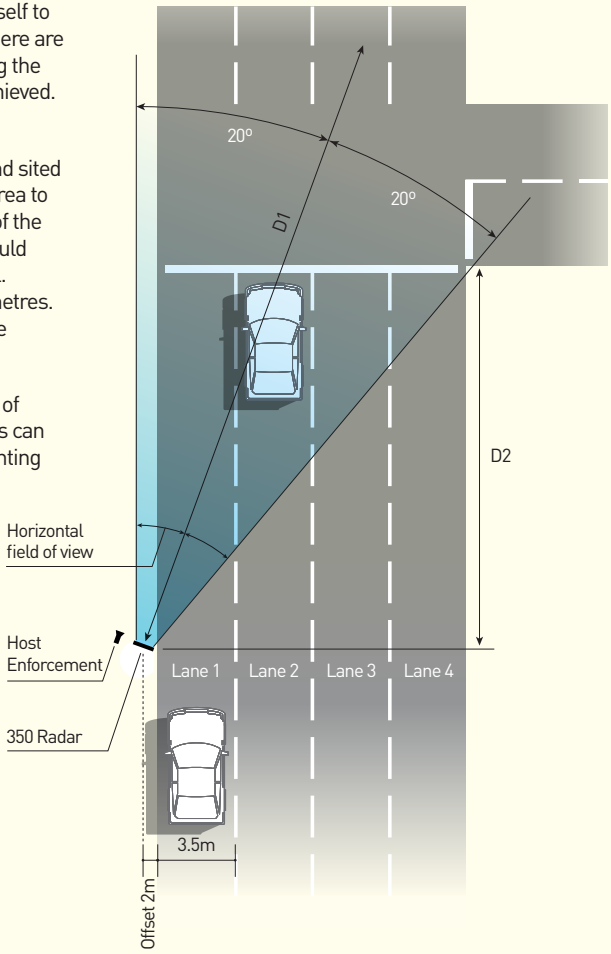
## RADAR INSTALLATION - RED LIGHT ENFORCEMENT (RECEDING FLOW)

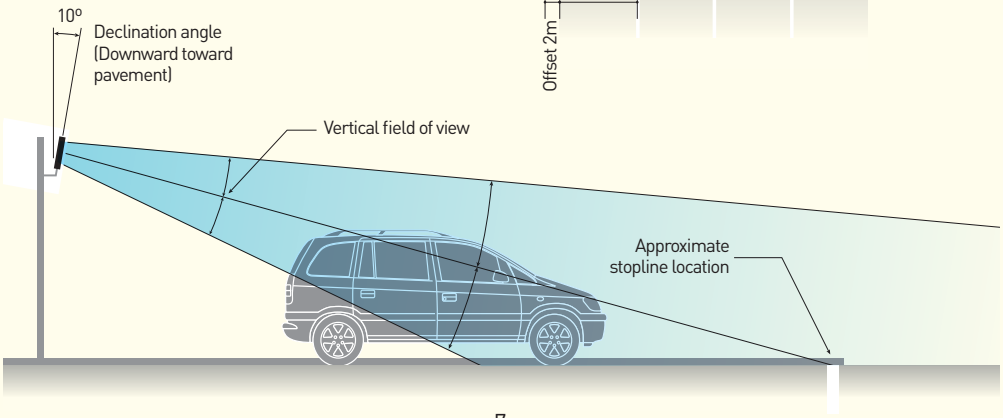
The nature of the design of the radar lends itself to versatility in its mounting on the roadway. There are however, factors to be considered when siting the radar to ensure optimum performance is achieved.

The radar should be installed at an angle of approximately 20º from the pavement line and sited toward the centre of the junction area. The area to be enforced should be within the 'D1' range of the radar (85 metres max). Mounting height should be approximately 3 metres from ground level. Offset (setback) should be approximately 2 metres. Declination angle of the radar head should be approximately 10º.

Care should be taken to ensure that the area of interest is covered by the 40º field of view, this can be affected by mounting height, correct mounting angle to the road, correct declination angle and the radar offset.

| 350 Radar Installation Approximation |
|---|
| D1 - Maximum range at centre of radar bore (85m) |
| D2 - approximate distance from the stopline (20m) |
| Offset - approximate setback from lane 1 (2m) |
| Horizontal field of view - approximately ±20º from centre bore of radar |
| Vertical field of view - approximately ±10º from centre bore of radar |



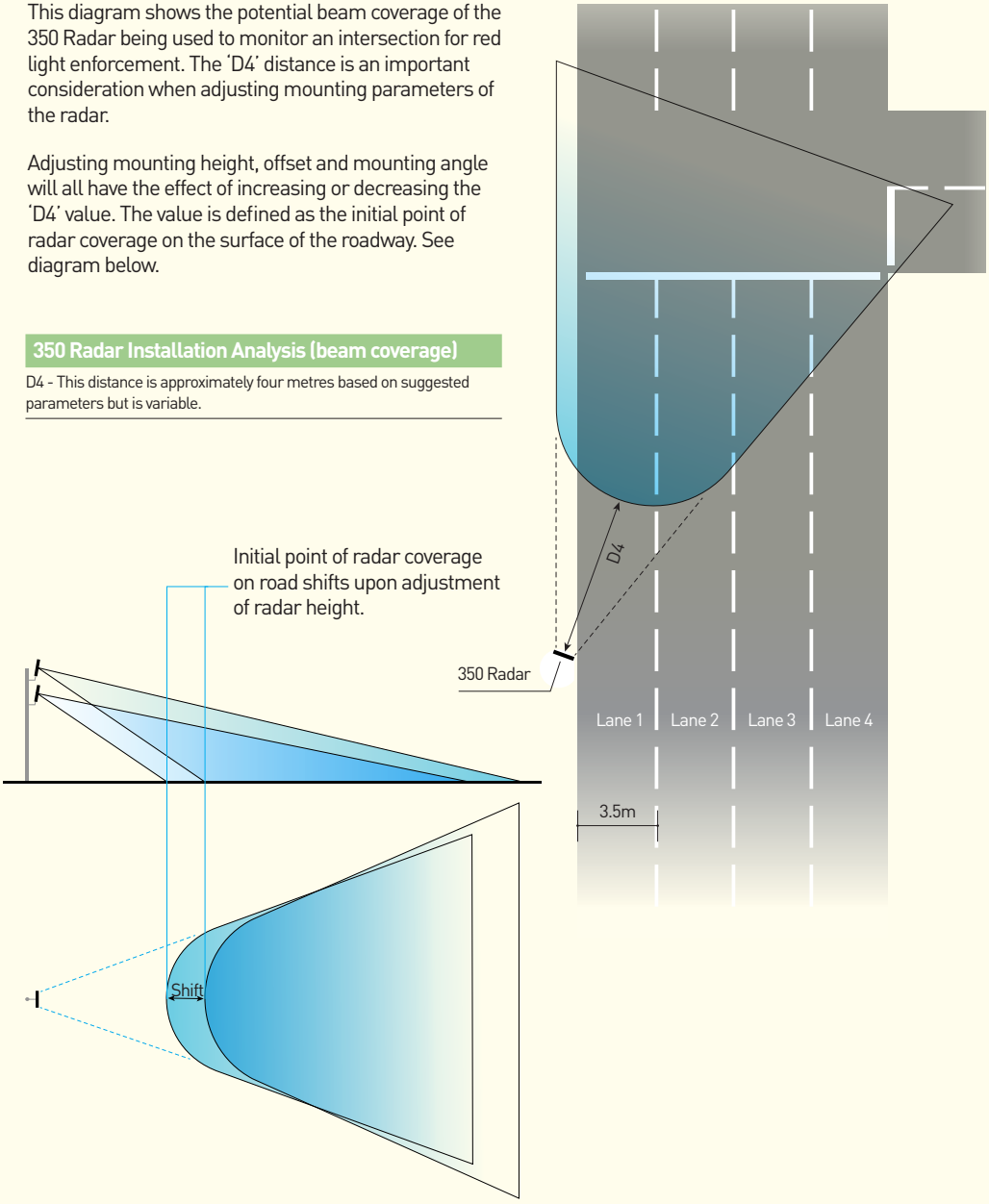
## RADAR INSTALLATION - RED LIGHT ENFORCEMENT (RECEDING FLOW)

This diagram shows the potential beam coverage of the 350 Radar being used to monitor an intersection for red light enforcement. The 'D4' distance is an important consideration when adjusting mounting parameters of the radar.

Adjusting mounting height, offset and mounting angle will all have the effect of increasing or decreasing the 'D4' value. The value is defined as the initial point of radar coverage on the surface of the roadway. See diagram below.

**350 Radar Installation Analysis (beam coverage)**

D4 - This distance is approximately four metres based on suggested parameters but is variable.



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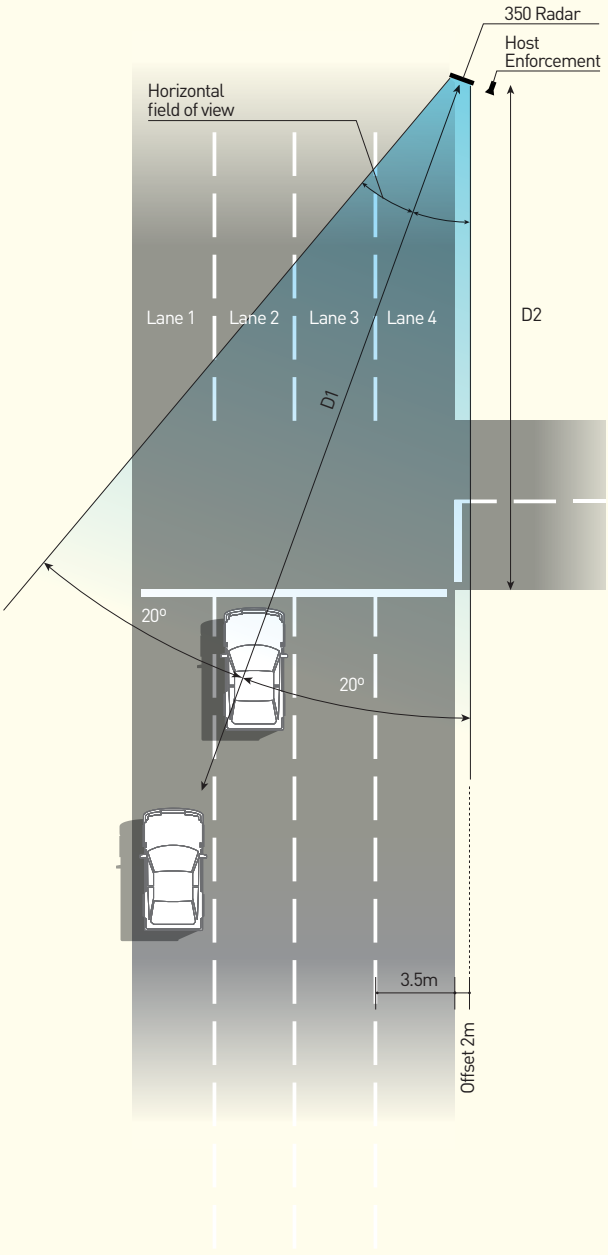

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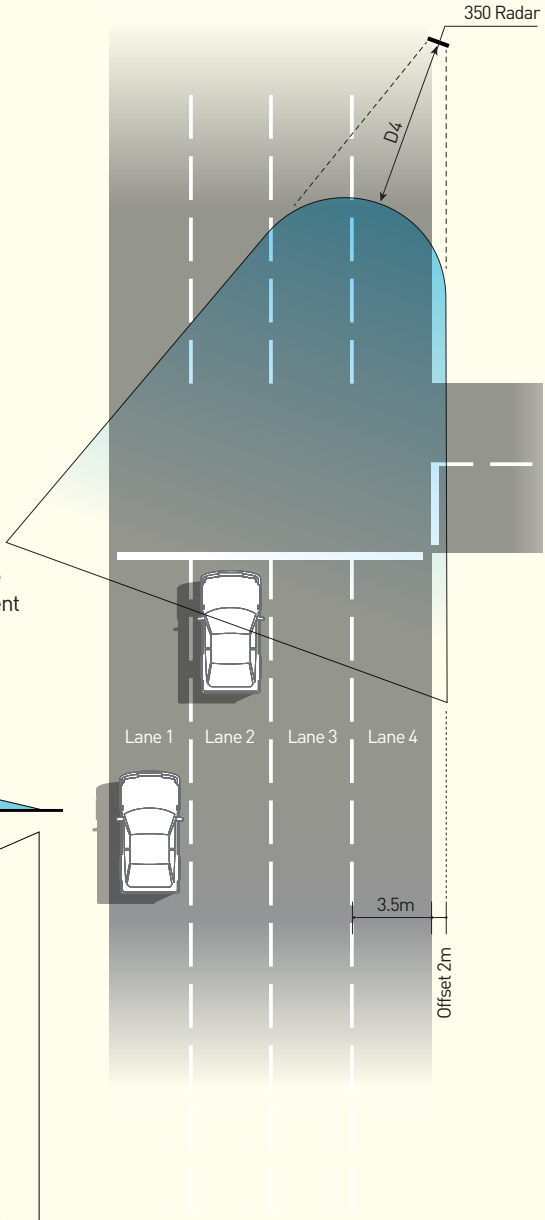
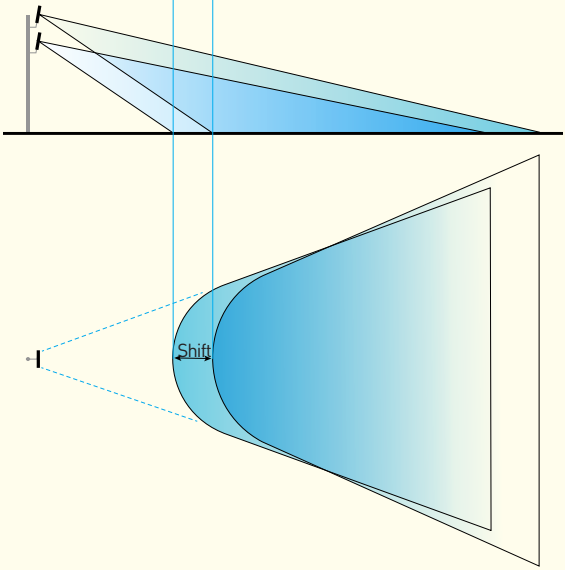



Initial point of radar coverage on road shifts upon adjustment of radar height.



## RADAR MOUNTING

As highlighted on the previous page(s). There is a certain amount of flexibility in the position of where the RADAR is mounted. The offset, height, distance from stop line, even orientation in relation to the stop line can be altered, however when selecting a mounting position, all parameters should be reviewed to ensure that sufficient RADAR beam coverage of the area of interest, can be achieved at the chosen mounting location.

**Selecting a Suitable Site**

When choosing to deploy the radar at a location, the following is a non-exhaustive list of considerations which should be taken into account.

- Does the proposed mounting position give sufficient beam coverage to 'view' the enforceable area ?
- Are there any large reflecting surfaces directly in front or behind the RADAR mounting position ?

**Radar Speed Accuracy**

| | |
|---|---|
| Simulated target up to 262km/hr | ±.....Km/hr |
| Real target typical accuracy | ±.....Km/hr |
| Radar speed resolution readout | 0.1 Km/hr |

**Radar Range Accuracy**

| | |
|---|---|
| Simulated range up to 70m | ±.....m |
| Real target range accuracy | ±2m for a range up to 70m |
| Range readout resolution | 0.1m |

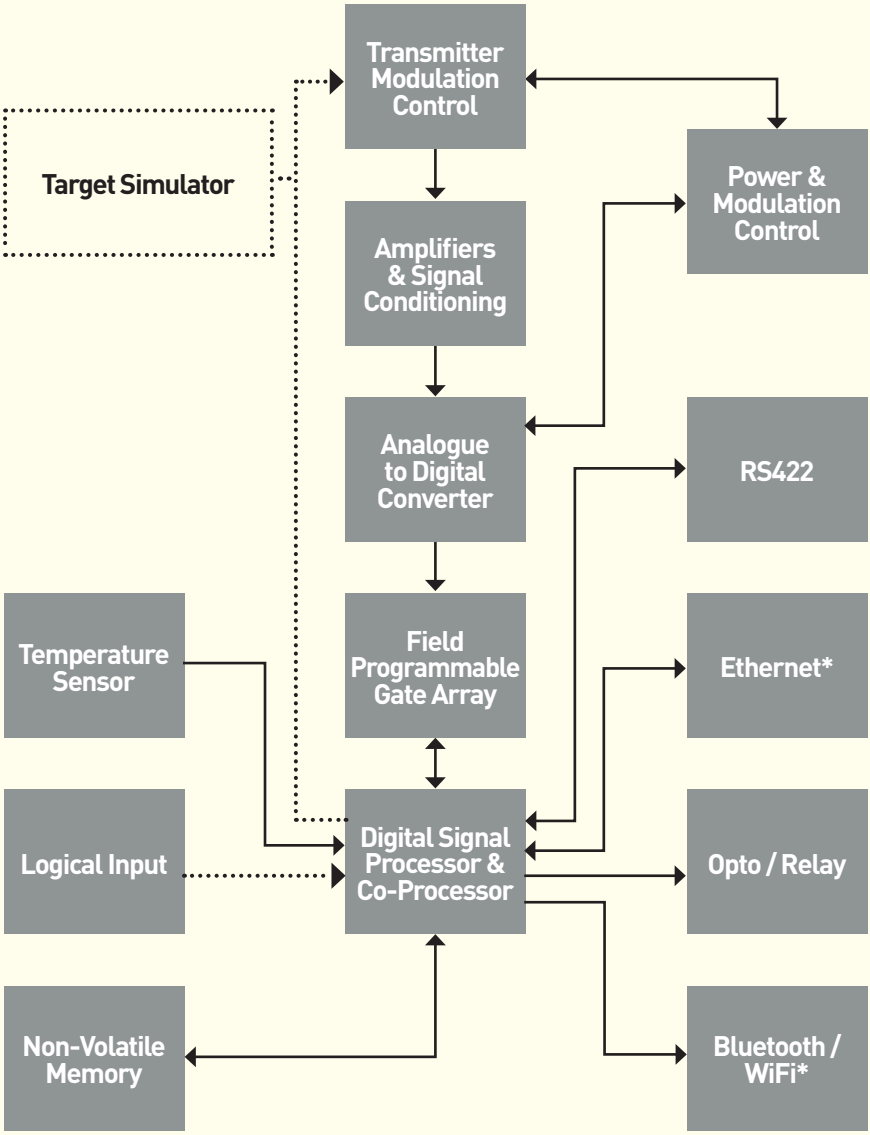
**Radar Angular Accuracy**

| | |
|---|---|
| Simulated angle | ±.....º |
| Real target angular accuracy | ±.....º |
| Angular readout resolution | 0.1 º |

**Radar Angle and Range Modes**

The radar has two modes when reporting range and angle. This can be set to a distance based range and angular approach of the target vehicle, or alternatively, the position of the vehicle can be expressed as an 'X, Y' co-ordinate (polar or cartesian).

## SYSTEM HARDWARE OVERVIEW




*Note: not all functions currently active

## RS422 SERIAL INTERFACE

A UART interface is provided that uses RS422 voltage levels on the multi-pin mating connector.
The default baud rate for this interface is 921600.

The serial interface default set-up, during normal operation is shown in the table below.

| DEFAULT UART SETTINGS | |
|---|---|
| **Parameter** | **Value** |
| Baud rate | 921600 |
| Data bits | 8 |
| Parity bits | odd |
| Flow control | None |

The RS422 provides the primary output of the radar in the form of ASCII messages

**Interface connector details are as follows:**

BULGIN - PX0410/12S/6065 - SOCKET, FREE, 12WAY (IP67 mated)

BULGIN - SA3179/1 - CONTACT, SOCKET, 26-24 AWG, SOLDER [12 off required]

The above connector will mate with the product mounted chassis plug, detailed as:

BULGIN 400 Series Buccaneer - PX0412/12P - PLUG, CHASSIS MOUNT, 12WAY

(IP67 mated) Power supply

## ETHERNET INTERFACE

An optional Cat 6 Ethernet interface is provided on product connector 2. The 350 radar requires it be connected to a network and be able to obtain an IP address through a DHCP server.

A Cat 6 interface cable is not provided for use with the product, but should it be fitted, it should be of the type: Overall braid screened, shielded twisted pair (S/FTP). This is to ensure EMC compliance.

**Connector Details:**

Product Connector: RJ45 Bulkhead Connector - Amphenol P/No RCP-5SPFFH-TCU7001

The following connectors are supplied with the 350 radar:

**Option 1** – Amphenol RCP-00AMMA-SLM7001

Connector needs to be assembled prior to the fitting of the RJ45 connector. Recommended cable OD range = 4.5mm to 6.5mm

**Option 2** – Amphenol RCP-00BMMS-SLM7001 (Field installable)

Prior assembled RJ45 Ethernet cable can be fitted into this housing (RJ45 connectors fit through and into this connector). Recommended cable OD range = 5.0mm to 6.5mm.

**NOTE:**

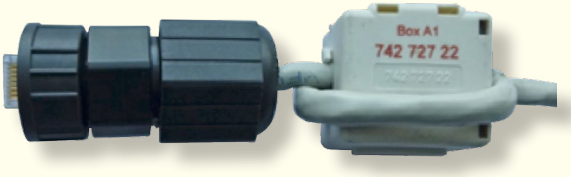
**a)** The RJ45 at the 350 end **MUST NOT** have any sort of boot fitted - to enable it to fit correctly into this connector.

**b)** The Ethernet braid shield of the external cable, at the customer equipment end, must be connected to a good ground earth point in order to comply with EMC requirements.

**c)** Whichever Ethernet connector is used, the snap on ferrite (CP-07-015) which is supplied with the 350 must be fitted to the 350 end of the Ethernet cable (with 2 turns) as shown below in order to comply with EMC requirements.

**CP-07-015 Positioning**

POSITION SNAP ON FERRITE 20MM (-0MM/+3MM) FROM THE CABLE END TO ENSURE COMPLIANCE WITH EMC REQUIREMENTS




2 TURNS APPLIED TO THE CABLE AS SHOWN

NOTE THE CONNECTOR MAY DIFFER BUT THE 70MM (-0MM / 3MM) DISTANCE IS REQUIRED AS ARE THE 2 TURNS

## POWER SUPPLY

The radar is powered using a DC voltage in the range of 10-16 Volts. The power is applied to the radar using the multi-pin mating connector.

Reverse polarity protection is included in the design. The radar takes approximately 1A for a period of 5ms.

The radar consumes 500mA at 12vDC. Power consumption is approximately 6 Watts.

A thermal fuse with a 1.25A rating has been installed to protect against electrical short circuit fault conditions.

### Power-Up Sequence

Upon initialisation from power-up or *REBOOT the radar will respond with the following message;

AGD SYSTEMS LTD AGD350
350-000-000
ARM Software version MI-164-2
DSP Software version MI-159-2
Common Platform version REL-13
FPGA version 15E000E

### Power Supply Tolerance

The radar power supply is specified between 10 and 16vDC. The radar will operate outside of these parameters but its operation is not specified. At 12vDC the current consumed is 500mA.

**MATING CONNECTOR PIN OUT CONNECTIONS**

| Pin No. | Signal | Function | Host Equipment Connection |
|---|---|---|---|
| 1 | Input + | Digital input for Future Expansion | |
| 2 | Input - | Digital input for Future Expansion | |
| 3 | N/C Contact --- | Contacts for single opto output | |
| 4 | N/O Contact --- | | |
| 5 | Common --- | | |
| 6 | GND (RS422) | RS422 ground | Ground or 0V |
| 7 | VIN | Supply Voltage 10 – 16vDC | |
| 8 | GND | Supply Ground | |
| 9 | RS422 Y (TX+) | RS422 Signal | RS422 A (RX+) |
| 10 | RS422 Z (TX-) | RS422 Signal | RS422 B (RX-) |
| 11 | RS422 B (RX-) | RS422 Signal | RS422 Z (TX-) |
| 12 | RS422 A (RX+) | RS422 Signal | RS422 Y (TX+) |

# RADAR CHARACTERISTICS

## GENERAL

### Radar Antenna

The antenna design is a planar patch array with the following performance;

| Parameter | Specified | Notes |
|---|---|---|
| Horizontal Beam-width | 40° approx | -3dB |
| Vertical Beam-width | 20° approx | -3dB |
| Side-lobe Suppression | | |
| E-Field | Vertical | Plane Polarised |

### Operating Frequency Band and Power

The radar frequency and power is as follows;

| Parameter | Specified | Notes |
|---|---|---|
| Centre Frequency (channel 1) | 24.077GHz* | |
| Centre Frequency (channel 2) | 24.125GHz* | |
| Centre Frequency (channel 3) | 24.175GHz* | |
| Centre Frequency (channel 4) | 24.223GHz* | |
| Frequency Modulation (FM) | 44 MHz | |
| Power | <100mW eirp | |
| Field Strength | | |
| ITU Code | 44M0FXN | |

*Proposed channels for U.S, channel 1 - 24.102GHz, channel 2 - 24.148GHz.

# RADAR CHARACTERISTICS

## FREQUENCY VARIANTS

Several versions of this product are available at frequency options which are for use in different geographic regions related to the radio requirements of that specific jurisdiction as follows;

| Frequency Variant | EU Country of Use | Other Countries | Notes |
|---|---|---|---|
| 24.050GHz to 24.250GHz* | | | *For U.S special build variant required.<br><br>Proposed U.S channels<br><br>channel 1 - 24.102GHz<br><br>channel 1 - 24.148Ghz |

This table is periodically updated: if the required country is not shown please enquire on availability.

These products may not be used in the following geographic regions;

| Restriction Type | EU Country | Other Countries |
|---|---|---|
| Relevant 24GHz Band not allocated | | |
| Licence Required for Use | none currently identified | |
| Frequency Allocated but EIRP too high | | |

It is important to note that this table is updated from time to time. Please contact AGD for latest information if your intended country of use is not currently represented.

(Note: Countries are listed by their ISO 3166 2 letter code)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. such that the module should not be installed in equipment intended to be used within 20cm of the body.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Changes or modifications not expressly approved by the party responsible for
compliance could void the user's authority to operate the equipment

# RADAR CHARACTERISTICS

## ANTENNA PLOTS

# RADAR COMMANDS

## RADAR COMMAND OVERVIEW

Commands are used to control the operation of radar. These can be sent over the RS422 UART Link.

(Ethernet available at a later date)

Commands are immediately followed by an operator that indicates the required action. Not all the operators are supported for all commands. Where an operator is used and it is not supported the radar will respond with warning message. The table shows the commands used by the radar.

| Operator | Operation |
|---|---|
| = | Set a parameter to a value e.g. *LS=50<CR> |
| ? | Respond with value or values |
| ^ | Set default value for parameter |
| $ | Provide help on the command |
| ! | Do something e.g. *REBOOT! Reboots the radar |

## RADAR COMMAND LIST

| Command | Type | Function | Default Value | Min Value | Max Value | Units, Resolution or Values |
|---|---|---|---|---|---|---|
| AGD | | Displays the product information and firmware / software revisions | n/a | n/a | n/a | Text Display |
| *BAUD | ?/= | Enquire / Set the baud rate of the radar. The program is stored in non-volatile memory and is used the next time the radar is powered on. *BAUD =<baud>, <flow control>, <parity>, <number of data bits><br>e.g.*baud=115200,0,NONE,8 | 921600<br>Flow Control 0<br>Parity ODD<br>Number of data bits 8 | 2400 | 921600 | Baud Rate Values: 2400, 4800, 9600, 19200, 38400, 57600,115200, 230400, 460800, 921600<br>Flow Control: 0=no control 1=flow control<br>Number of data bits 7,8 |
| *CD | ? | Enquire the calibration date | | | | DD,MM,YYYY |
| *CRC32 | ? | Calculates and verifies the 32 bit CRC code and data checksums | | | | |
| *CHAN | ?/= | Enquire / Set the transmit channel | 3 | 1 | 4 | 1-4<br>1-24.075<br>2-24.175<br>3-24.125<br>4-24.225<br>(4 channel variant) |
| *CT | ?/= | Enquire / Set the co-ordinate type used in the target detection messages | P | P | C | P = Polar<br>C = Cartesian |
| *DIR | ?/= | Enquire / Set the radar direction mode | A | A | R | A= Advancing<br>R= Receding<br>B= Bi-Directional<br>N= No Detection |
| *ETPn (n=1 or 2) | ?/= /^ | Enquire / Set an Event Trigger Point at a defined range | 20 | 6 (0 = off) | 84 | 1 metre |
| *ETPnLST (n=1 or 2) | ?/= /^ | Enquire / Set the optional Event Trigger Point Low Speed Threshold | 10 | 10 | 249 | KPH<br>units change depending on speed units (see *SU) |
| *ETPnHST (n=1 or 2) | ?/= /^ | Enquire / Set the optional Event Trigger Point High Speed Threshold | 250 | 11 | 250 | KPH<br>units change depending on speed units (see *SU) |
| *ETPnDIR (n=1 or 2) | ?/= /^ | Enquire / Set the optional Event Trigger Point Direction.<br>NOTE: The *DIR command must also be set to allow the required Event Trigger Point direction otherwise the event will not be triggered. | B | A | R | A = Approaching<br>R = Receding<br>B = Bi-directional |
| *ETPnLPT (n=1 or 2) | ?/= /^ | Enquire / Set the optional Event Trigger Point Low Threshold Power (target amplitude) | 65 | 55 | 109 | dB<br>(ref Target amplitude values in Target Detect message) |
| *ETPnHPT (n=1 or 2) | ?/= /^ | Enquire / Set the optional Event Trigger Point High Power Threshold (target amplitude) | 110 | 56 | 110 | dB<br>(ref Target amplitude values in Target Detect message) |
| *HBP | ?/= | Enquire / Set the heartbeat period | 60 | 0 (off) | 86400 | 1 second |
| *HELP | | Lists all commands along with command help information | | | | |
| *HOLD | ? / = /^ | Enquire / set the hold time of the opto output. Opto output is triggered on ETP1 | 0.5 | 0.1 | 10 | seconds |
| *HR | ? / = /^ | Enquire / set the High Range threshold | 85 | 20 | 85 | metres |
| *HS | ? / = /^ | Enquire / set the High Speed Threshold | 250 | 40 | 250 | KPH<br>(Units change depending on speed units (see *SU) |
| *HS | ? / = /^ | Enquire / set the High Speed Threshold | 250 | 40 | 250 | KPH<br>(Units change depending on speed units (see *SU) |

# RADAR COMMANDS

## RADAR COMMAND LIST

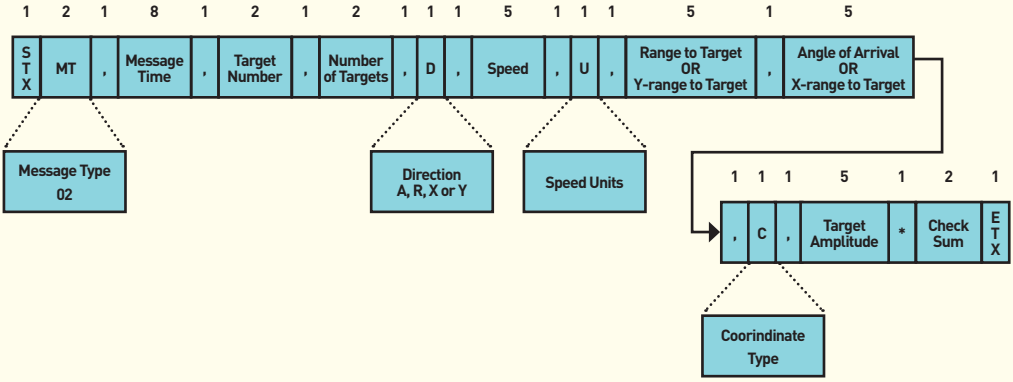
| Command | Type | Function | Default Value | Min Value | Max Value | Units, Resolution or Values |
|---|---|---|---|---|---|---|
| *IP | ?/=/^ | Not Currently Enabled | | | | |
| *LR | ? / = /^ | Enquire / set the Low Range Threshold | 4 | 4 | 40 | metres |
| *LS | ? / = /^ | Enquire / set the Low Speed Threshold | 10 | 10 | 160 | KPH<br>(Units change depending on speed units (see *SU) |
| *MSG | ?/= /^ | Enquire / Set the message type displayed on the output | 2 | 2 | 4 | 2 = Target Detect Message<br>3 = Event Trigger Point Message (only)<br>4 = Tracked Target Messages (and event trigger point message if event trigger point enabled) |
| *REBOOT | ! | Force a reboot of the radar | | | | |
| *SN | ? | Read the serial number of the radar | | | | |
| *TEXT | ?/= | Read / Write free form text to non-volatile memory | | | | |
| *TEMP | ? | Reports the temperature measured inside the radar | | | | ºC |
| *VER | ? | Provides the product number, firmware version and date | | | | |
| *SU | ? / = | Enquire / set the speed units used in the messages. | K | K | M | K = KPH<br>M = MPH |
| *THRESHOLD | ? / = /^ | Enquire / set the detection power threshold.<br>Caution: setting this value too high may make the radar deaf. Setting it too low may make the radar very noisy | 85 | 55 | 120 | dB |

## RADAR EVENT MESSAGES

### Detect Message / 02 Message

The detect message outputs the raw data for targets as identified by the radar. Each valid target is output as a message conforming to the structure below.

This message output is activated using the *MSG=02 command.



# MESSAGE FORMATS

## RADAR EVENT MESSAGES

**Detect Message / 02 Message Format**

| Name | Size / Bytes | Value | Notes |
|---|---|---|---|
| STX | 1 | 2 | Start of message byte |
| MT | 2 | 02 | Message Type |
| , | 1 | ',' | Comma |
| Message Time | 8 | DDDDD.DD | Time of message in seconds.<br>0 to 86400.00 seconds |
| , | 1 | ',' | Comma |
| Target Number | 2 | XX | Target number |
| , | 1 | ',' | Comma |
| Number of Targets | 2 | XX | Total number of targets detected in the current frame. |
| , | 1 | ',' | Comma |
| Direction 'D' | 1 | 'A' = Approaching Target<br>'R' = Receding Target<br>'X' = Simulated approaching target<br>'Y' = Simulated receding target | Direction the target is travelling. |
| , | 1 | ',' | Comma |
| Speed | 5 | 'DDD.D' | Target speed to one decimal place in decimal format |
| , | 1 | ',' | |
| Speed Units 'U' | 1 | 'M' = MPH<br>'K' = KPH | The speed units used for the measurement |
| , | 1 | ',' | Comma |
| Range to Target OR Y-range to Target | 5 | 'DDD.D' | Target range in metres OR<br>Y-range to target in metres<br>(depending on Coordinate Type) |
| , | 1 | ',' | Comma |
| Angle of Arrival OR X-range to Target | 5 | '±DD.D' | Angle of Arrival in degrees OR<br>X-range to target in metres<br>(depending on Coordinate Type) |
| , | 1 | ',' | Comma |
| Coordinate Type 'C' | 1 | 'P'= Polar<br>'C'= Cartesian | Coordinate Type used for positional information |
| , | 1 | ',' | Comma |
| Target Amplitude | 5 | 'DDD.D' | Target Power Amplitude in dB |
| * | 1 | '*' | Asterisk |
| Check Sum | 2 | 'XX' | Check sum in hexadecimal format |
| ETX | 1 | 3 | End of message byte |

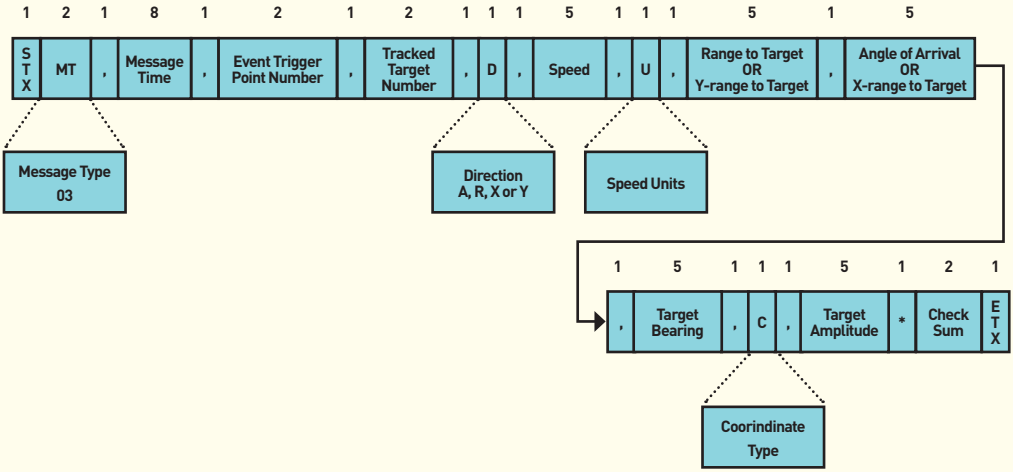
## RADAR EVENT MESSAGES

### Event Trigger Point Message / 03 Message

The event trigger point message is output from the radar when a user defined trigger point in the radars field of view has been set by the user and is activated by a target.

An Event Trigger Point can be configured using the '*ETPn' message and further qualified with the optional messages (e.g. '*ETPn_LST').

This message output is activated using the *MSG=03 command.



## RADAR EVENT MESSAGES

### Event Trigger Point Message / 03 Message Format

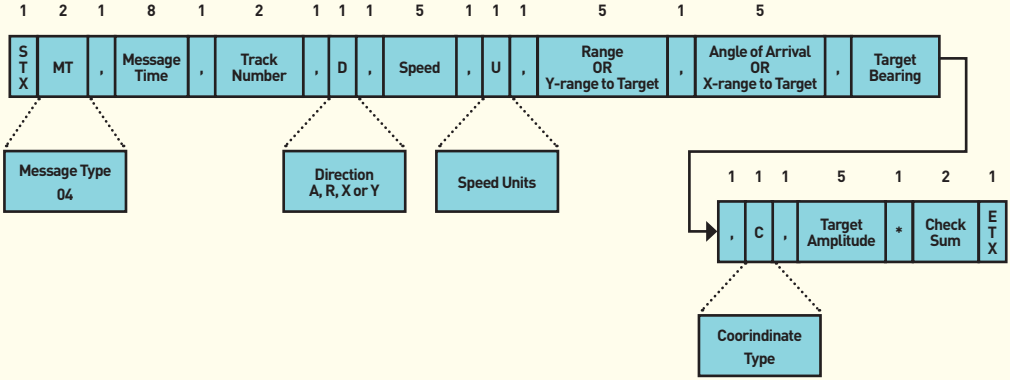
| Name | Size / Bytes | Value | Notes |
|---|---|---|---|
| STX | 1 | 2 | Start of message byte |
| MT | 2 | 03 | Message Type |
| , | 1 | ',' | Comma |
| Message Time | 8 | DDDDD.DD | Time of message in seconds.<br>0 to 86400.00 seconds |
| , | 1 | ',' | Comma |
| Event Trigger Point Number | 1 | XX | The Event Trigger Point Number |
| , | 1 | ',' | Comma |
| Tracked Target Number | 2 | 1 or 2 | The identity of the tracked target |
| , | 1 | ',' | Comma |
| Direction 'D' | 1 | 'A' = Approaching Target<br>'R' = Receding Target<br>'X' = Simulated approaching target<br>'Y' = Simulated receding target | Direction the target is travelling. |
| , | 1 | ',' | Comma |
| Speed | 5 | 'DDD.D' | Target speed to one decimal place in decimal format |
| , | 1 | ',' | |
| Speed Units 'U' | 1 | 'M' = MPH<br>'K' = KPH | The speed units used for the measurement |
| , | 1 | ',' | Comma |
| Range to Target OR Y-range to Target | 5 | 'DDD.D' | Target range in metres OR Y-range to target in metres (depending on Coordinate Type) |
| , | 1 | ',' | Comma |
| Angle of Arrival OR X-range to Target | 5 | '±DD.D' | Angle of Arrival in degrees OR X-range to target in metres (depending on Coordinate Type) |
| , | 1 | ',' | Comma |
| Target Bearing | 5 | DDD.D | The bearing of the target in degrees relative to the radar.<br>0° is a target travelling directly away from the radar<br>90° is a target travelling from left to right across the radar<br>180° is a target travelling directly towards the radar<br>270° is a target travelling from right to left across the radar |
| , | 1 | ',' | Comma |
| Coordinate Type 'C' | 1 | 'P'= Polar<br>'C'= Cartesian | Coordinate Type used for positional information |
| , | 1 | ',' | Comma |
| Target Amplitude | 5 | 'DDD.D' | Target Power Amplitude in dB |
| * | 1 | '*' | Asterisk |
| Check Sum | 2 | 'XX' | Check sum in hexadecimal format |
| ETX | 1 | 3 | End of message byte |

## RADAR EVENT MESSAGES

### Tracked Target Message / 04 Message

This function creates the Tracked Target message type. The raw target data is filtered so that only tracked target data is output.

This message output is activated using the *MSG=04 command.



# MESSAGE FORMATS

## RADAR EVENT MESSAGES

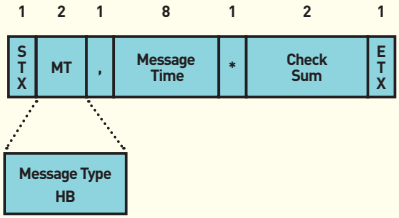
### Tracked Target Message / 04 Message Format

| Name | Size / Bytes | Value | Notes |
|---|---|---|---|
| STX | 1 | 2 | Start of message byte |
| MT | 2 | 04 | Message Type |
| , | 1 | ',' | Comma |
| Message Time | 8 | DDDDD.DD | Time of message in seconds.<br>0 to 86400.00 seconds |
| , | 1 | ',' | Comma |
| Track Number | 1 | XX | Track Number |
| , | 1 | ',' | Comma |
| Direction<br>'D' | 1 | 'A' = Approaching Target<br>'R' = Receding Target<br>'X' = Simulated approaching target<br>'Y' = Simulated receding target | Direction the target is travelling. |
| , | 1 | ',' | Comma |
| Speed | 5 | 'DDD.D' | Target speed to one decimal place in decimal format |
| , | 1 | ',' | |
| Speed Units<br>'U' | 1 | 'M' = MPH<br>'K' = KPH | The speed units used for the measurement |
| , | 1 | ',' | Comma |
| Range to Target<br>OR<br>Y-range to Target | 5 | 'DDD.D' | Target range in metres OR<br>Y-range to target in metres<br>(depending on Coordinate Type) |
| , | 1 | ',' | Comma |
| Angle of Arrival<br>OR<br>X-range to Target | 5 | '±DD.D' | Angle of Arrival in degrees OR<br>X-range to target in metres<br>(depending on Coordinate Type) |
| , | 1 | ',' | Comma |
| Target Bearing | 5 | DDD.D | The bearing of the target in degrees relative to the radar.<br>0° is a target travelling directly away from the radar<br>90° is a target travelling from left to right across the radar<br>180° is a target travelling directly towards the radar<br>270° is a target travelling from right to left across the radar |
| , | 1 | ',' | Comma |
| Coordinate Type 'C' | 1 | 'P'= Polar<br>'C'= Cartesian | Coordinate Type used for positional information |
| , | 1 | ',' | Comma |
| Target Amplitude | 5 | 'DDD.D' | Target Power Amplitude in dB |
| * | 1 | '*' | Asterisk |
| Check Sum | 2 | 'XX' | Check sum in hexadecimal format |
| ETX | 1 | 3 | End of message byte |

## RADAR EVENT MESSAGES

### Heart Beat Message / 'HB'

This message is sent each time the heart beat period expires. The heart beat message period is controlled using the *HBP command. The heart beat period is measured in frames.



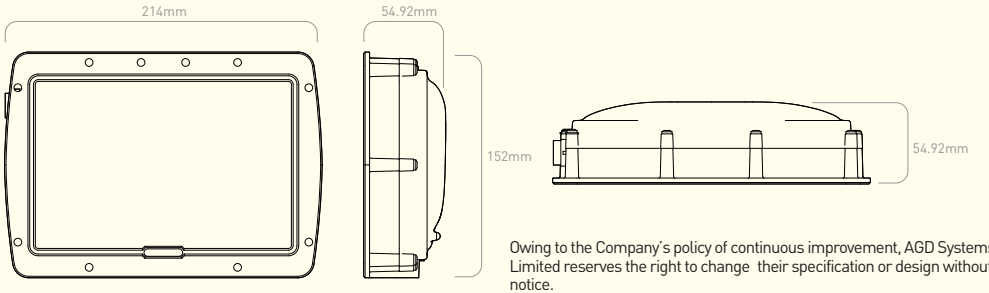

### Heart Beat Message Format

| Name | Size / Bytes | Value | Notes |
|---|---|---|---|
| STX | 1 | 2 | Start of message byte |
| MT | 2 | 'HB' = Heart Beat | Message type |
| , | 1 | ',' | Comma |
| Message Time | 8 | DDDDD.DD | Time of message in seconds.<br>0 to 86400.00 seconds |
| * | 1 | '*' | Asterisk |
| Check Sum | 2 | 'XX' | Check sum in hexadecimal format |
| ETX | 1 | 3 | End of message byte |

### Notes to Heart Beat Message

The heartbeat period is set in seconds using the *HBP command. Setting the hearbeat period to 0 secs will turn the hearbeat off. The maximum setting for the heartbeat period is 86400 secs.

# TECHNICAL SPECIFICATIONS




Owing to the Company's policy of continuous improvement, AGD Systems Limited reserves the right to change their specification or design without notice.

## SPECIFICATIONS

| | |
|---|---|
| **Technology** | Phase Mono-Pulse FMCW |
| **Radiated Power** | <100mW EIRP (<20dBm) |
| **Transmit Frequency** | 24.050 – 24.250GHz |
| **Transmit Bandwidth** | 44MHz |
| **Range** | 4 to 85m |
| **Mounting** | Flange fixings, tripod mount or optional foot bracket (MS-205) |
| **Mounting Height** | 3 - 5.5m nominal |
| **Speed Range** | 10 to 250 kph |
| **Horizontal Field of View** | ±20º from centre bore of radar |
| **Vertical Field of View** | ±10º from centre bore of radar |
| **Measurement Frame Rate** | 100 frames per second |
| **Weight** | TBC |
| **Housing Material** | Black Polycarbonate |
| **Housing Finish** | Self coated black |
| **Sealing** | IP66 |
| **Operating Temperature** | -30°C to +70°C |
| **Power** | Nominal 6W (Typically 500mA @ 12Vdc) |
| **Power Supply** | 10 -16Vdc |
| **Radar Output** | RS422 (Ethernet provision for future) |
| **MTBF** | 20 years |
| **EMC Specification** | ETSI EN 301 489 / BS EN 50293 |
| **Radio Specification** | ETSI 300.440, FCC CFR47 Part 15.245 |
| **Patent No.** | Patent applied for |

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. such that the module should not be installed in equipment intended to be used within 20cm of the body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

RoHS COMPLIANT
Restriction on Hazardous Substances

# MANUFACTURING TEST PROCESS

| | | |
|---|---|---|
| TEST EQUIPMENT: | ARIEL™ | AGD INTELLIGENT DETECTION SYSTEMS |
| PRODUCT TEST: | 350 | ARIEL was designed and developed by AGD Systems |
| TEST FUNCTION: | • True range simulation of target • Radar target processing optimisation<br>• Test cycle time 9 minutes • Verification of communication protocols | |

**Ariel**™ is a bespoke set of test equipment designed and developed by AGD Systems. It is dedicated to the testing of the AGD portfolio of 'ranging' FMCW vehicle radars. 100% of the 350 units manufactured at AGD are Certified by Ariel.


AGD CERTIFIED
INTELLIGENT DETECTION SYSTEM

# FULL RANGE

Ariel is dedicated to the testing of the AGD portfolio of 'ranging' FMCW vehicle radars. It provides true range simulation and both target speed and direction simulation at a given range

The key test functions performed by Ariel to Certify the premium performance of your Intelligent Detection System are:

- True range simulation of target
- Target speed and direction simulation at a given range
- Radar target processing optimisation
- Transmitted radar frequency modulation measurement
- Verification of interface and communication protocols
- Test cycle time of 9 minutes

The radar test sequences performed by Ariel on the radar under test provides a thorough examination of the performance of the 350 radar and specifically the ranging measurement capability provided by the FMCW technology deployed. This gives full control of simulated targets' signal size, speed, direction and range.

Optimisation of frequency signals on Ariel ensures full compatibility with country requirements within the 24GHz radar operating band.

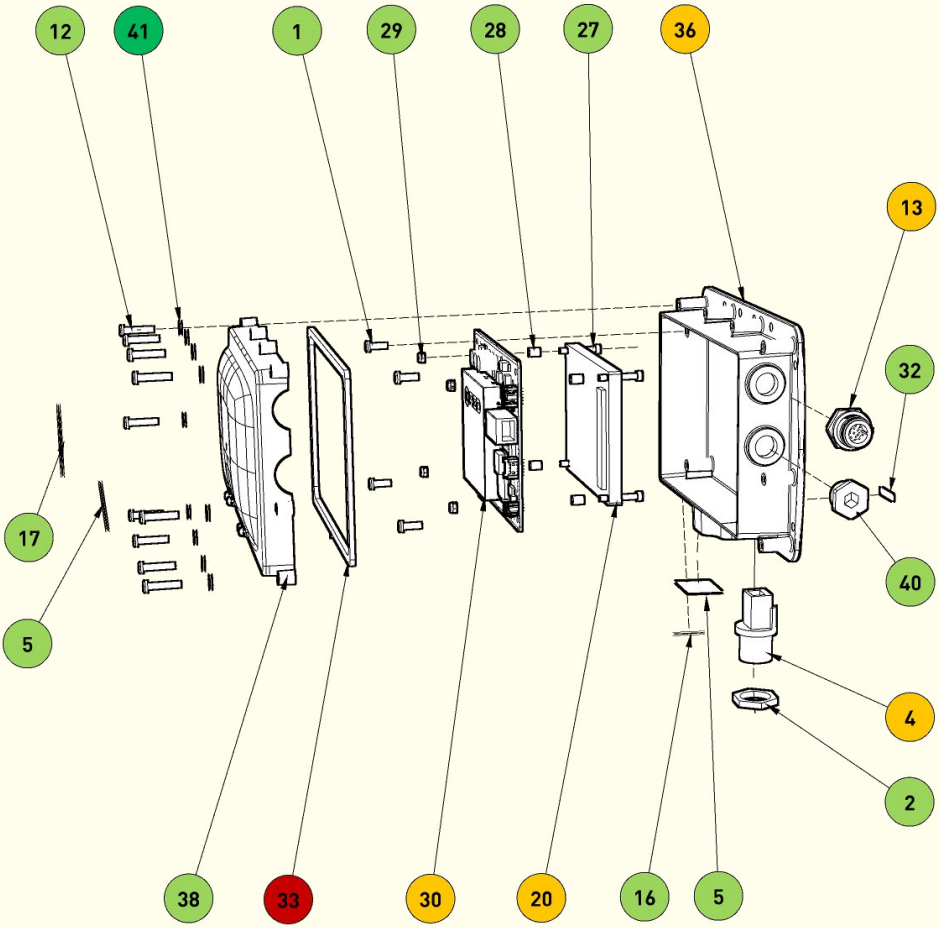
## LIFETIME PRODUCT TRACEABILITY

There are clearly defined pass and fail criteria at all stages within the Ariel test process. The test results in association with the product build revision are recorded on a product serial number basis. The full suite of test measurements is instantly sent to the dedicated product database within the AGD secure server facility, providing full traceability during the product lifetime.

The AGD Certified symbol is your mark of assured performance.

# END OF LIFE – DISPOSAL INSTRUCTIONS (EOL)

## AGD350 RADAR TRAFFIC DETECTOR




| Item | Qty | Material |
|---|---|---|
| 1 | 4 | Stainless steel |
| 5 | 2 | Polyester |
| 12 | 10 | Steel |
| 13 | 1 | Cable Assembly |
| 15 | 2 | Polyester |
| 17 | 1 | Generic |
| 20 | 1 | Zinc/PCB Assembly |

| Item | Qty | Material |
|---|---|---|
| 27 | 4 | Stainless Steel |
| 28 | 4 | Aluminum |
| 29 | 4 | Stainless Steel |
| 30 | 1 | PCB Assembly |
| 33 | 1 | Neoprene - Closed Cell |
| 36 | 1 | Polycarbonate/Brass |
| 38 | 1 | Polycarbonate |

| Item | Qty | Material |
|---|---|---|
| 40 | 1 | Nylon 6 |
| 4 | 1 | Nylon 6 / Metal |
| 2 | 1 | Nylon 6 |
| 32 | 1 | Polyester |
| 41 | 10 | Cellulose Fill |
| | | |
| | | |

- Reuse / Recycle
- Separate & Recycle
- Downcycle
- Hazardous Recovery
- Non- Recyclable

This document serves as a guideline only for EOL procedures and further guidance may need to be sought from the appropriate authority or agency.

# IMPORTANT

## SAFETY PRECAUTIONS

All work must be performed in accordance with company working practices, in-line with adequate risk assessments. Only skilled and instructed persons should carry out work with the product. Experience and safety procedures in the following areas may be relevant:

- Working with mains power
- Working with modern electronic/electrical equipment
- Working at height
- Working at the roadside or highways

1. This product is compliant to the Restriction of Hazardous Substances (RoHS - European Union directive 2011/65/EU).

2. Should the product feature user-accessible switches, an access port will be provided. Only the specified access port should be used to access switches. Only non-conductive tools are to be used when operating switches.

3. The product must be correctly connected to the specified power supply. All connections must be made whilst the power supply is off or suitably isolated. Safety must take always take precedence and power must only be applied when deemed safe to do so.

4. No user-maintainable parts are contained within the product. Removing or opening the outer casing is deemed dangerous and will void all warranties.

5. Under no circumstances should a product suspected of damage be powered on. Internal damage may be suggested by unusual behaviour, an unusual odour or damage to the outer casing. Please contact AGD for further advice.

6. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

## IMPORTANT INFORMATION

**Low Power Non-Ionising Radio Transmission and Safety**

Concern has been expressed in some quarters that low power radio frequency transmission may constitute a health hazard. The transmission characteristics of low power radio devices is a highly regulated environment for the assurance of safe use.

There are strict limits on continuous emission power levels and these are reflected in the testing specifications that the products are approved to. These type approval limits are reflected in the product specifications required for a typical geographic area such as those for the EU (ETS300:440), for the USA (FCC part 15c) and for Australia/ New Zealand (AS/NZS 4268). The limits adopted in these specifications are typically replicated in many other localized specifications.

The level of safe human exposure to radio transmission is given by the generally accepted guidelines issued by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This body has issued guidance for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz) which are quoted below.

| | Radar and ICNIRP limit comparison | | | Typical Informative Limits for Radar Transmission Approval | | |
|---|---|---|---|---|---|---|
| | Radar Transmitted Level (Note 4) | ICNIRP Limit (Table 6) | Exposure Margin | ETS300:440 | FCC (part15c) | AS/NZS 4268 |
| Power (mW EIRP) | <100mW (<20dBm) | N/A | N/A | 100mW (20dBm) | 1875mW (Note 1) | 100mW (20dBm) |
| Max Power Density (mW/cm2) | 3.18µW/cm2 at 50cm (Note 3) | <50W/m2 (5mW/cm2) (Note 2) | 0.064% | N/A | N/A | N/A |
| Field Strength (V/m) at 3m | <0.58V/m (5.8mV/cm) (Note 1) | <137V/m (1370mV/cm) | 0.42% | 0.58V/m (5.8mV/cm) (Note 1) | 2500mV/m (25mV/cm) | 0.58V/m (5.8mV/cm) (Note 1) |

*Note 1 Values are calculated conversions for comparison purposes.*

*Note 2 Other equivalent limits include; Medical Research Council Limit of 10mW/cm$^2$, IACP limit of 5mW/cm$^2$ (at 5cm) and UK CAST limit of 5mW/cm$^2$ . Power density at the radome typically 4µW/cm$^2$ .*

*Note 3 Calculation is made on the assumption antenna is a point source therefore the actual value is likely to be significantly less than that quoted. Note that a theoretical max level at a 5cm distance (which gives 0.318mW/cm$^2$) is at a point in the field where the radar beam is not properly formed.*

*Note 4 Comparison for product model 350 operating in the band typically 24.050GHz to 24.250GHz*

From the table it can be seen that it is extremely unlikely that a potentially hazardous situation could occur owing to the use of such low power devices.

It is considered to be good practice not to subject humans to radiation levels higher than is necessary. In a works environment where multiple equipment on soak test are to be encountered then it is considered good practice to contain the equipment in an appropriate enclosure lined with radar absorbing material.

# NOTES

# NOTES

# DISCLAIMER

While we (AGD Systems) endeavour to keep the information in this manual correct at the time of print, we make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the information, products, services, or related graphics contained herein for any purpose.

Any reliance you place on such information is therefore strictly at your own risk. In no event will we be liable for any loss or damage including without limitation, indirect or consequential loss or damage, or any loss or damage whatsoever arising from loss of data or profits arising out of, or in connection with, the use of this manual.

## WARRANTY

All AGD products are covered by a 12 month return to factory warranty. Products falling outside this period may be returned to AGD Systems for evaluation, repair, update or re-calibration, any of which may be chargeable.

**AGD Systems Limited**

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