342

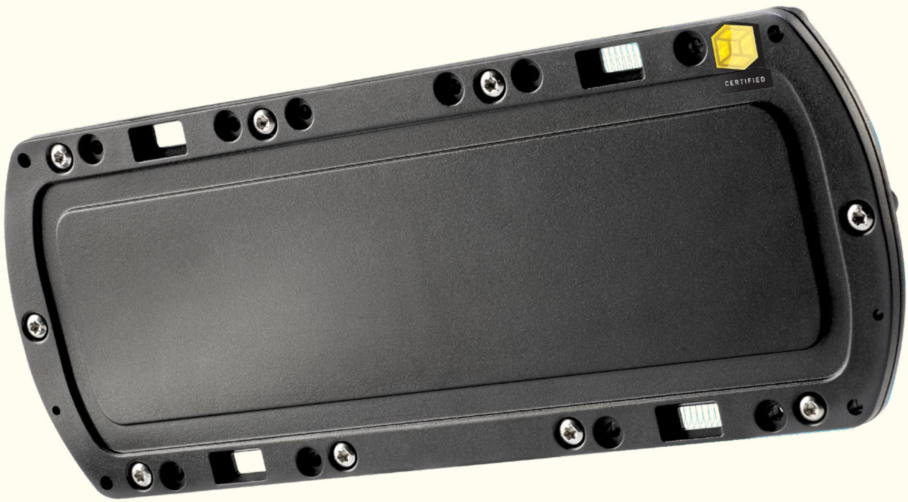
VEHICLE DETECTION

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

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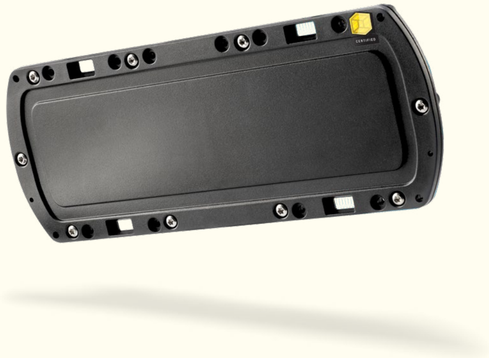
PRODUCT & TECHNOLOGY



342

The 342 has been designed specifically to measure the speed and range of passing vehicles for enforcement purposes in multiple lanes. The radar is able to track up to sixteen target signals in both approaching and receding directions simultaneously.

The radar offers fixed and mobile deployment options in conjunction with a host photographic based enforcement system.

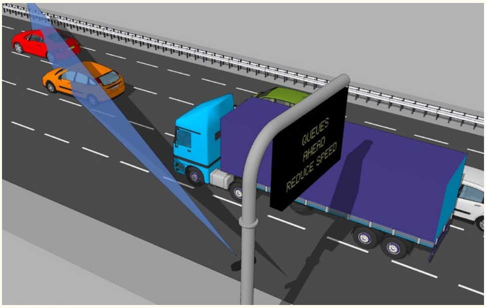
KEY FEATURES

- Radar reports speed and range to each event
- Tracks up to 16 simultaneous targets
- Speed measurement from 20kph to 320kph across multiple lanes
- Target range measurement from 2-60 metres
- Can discriminate between approaching and receding traffic
- Ease of integration to host system
- High speed RS422 serial communications to host equipment
- Hardware target simulation built into the radar
- Continuous radar self check features
- Patent applied for

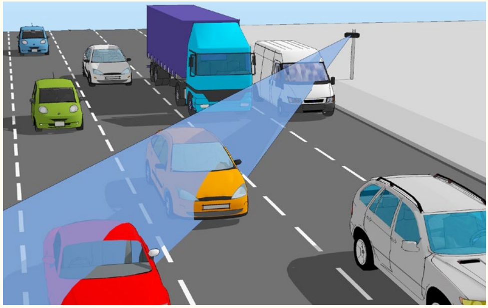
INTRODUCTION

TYPICAL APPLICATIONS

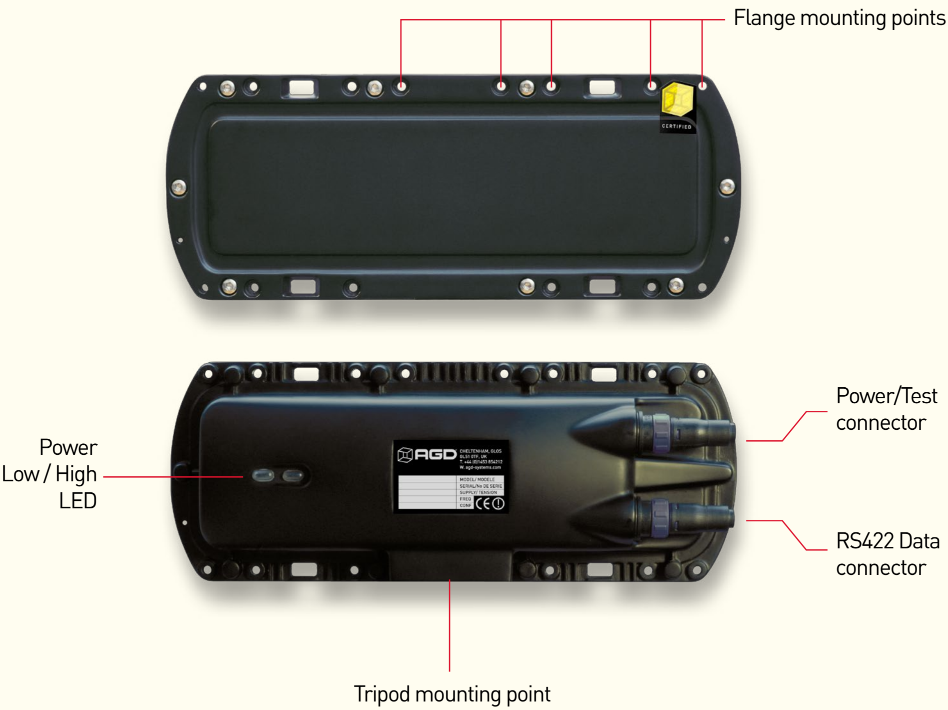
Multiple lane control from fixed infrastructure



Multiple lane control from mobile systems



PRODUCT OVERVIEW

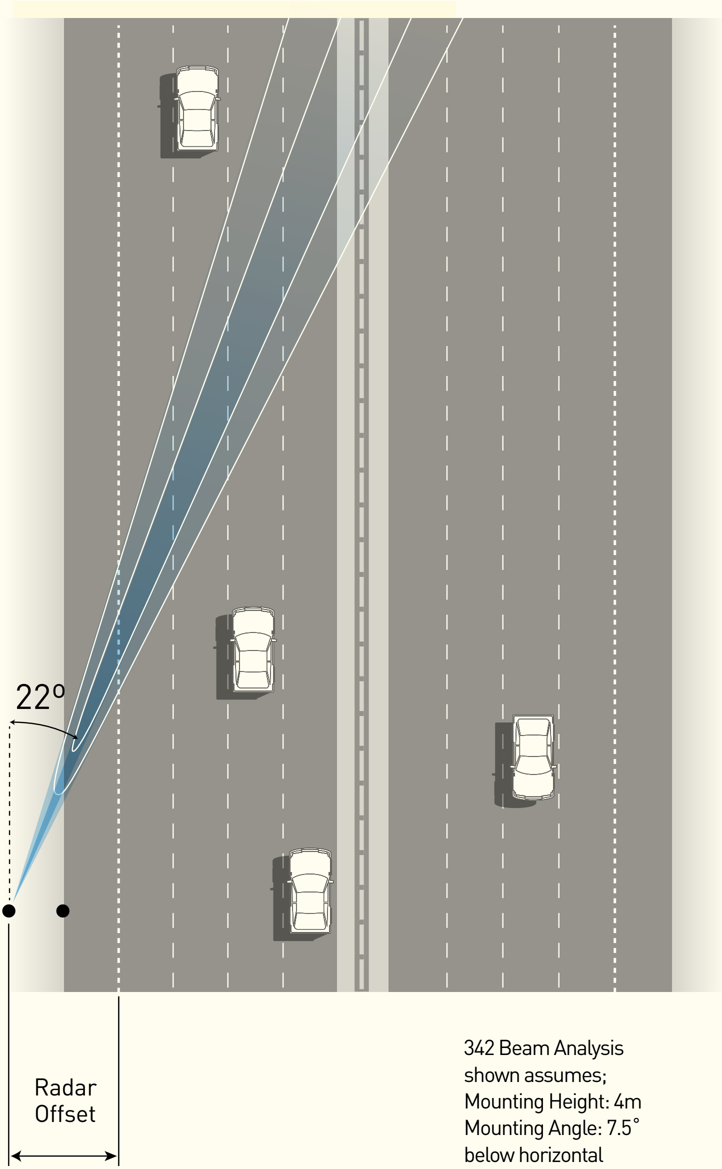


RADAR INSTALLATION

The radar is to be installed with the bore of the radar at 22° from the direction of travel of the targets in the lanes. It can be installed at a height in the range 1m to 5m with various considerations. When installed, especially if it is placed inside host equipment, it is important that the radar's radome is not covered or interrupted as this will distort the radar's beam and/or affect the sensitivity of the radar.

The typical installation for the radar is shown in the diagram.

The radar offset is the distance from the radar mounting position to the nearest lane for which detection is required. The radar offset is affected by radar mounting height.

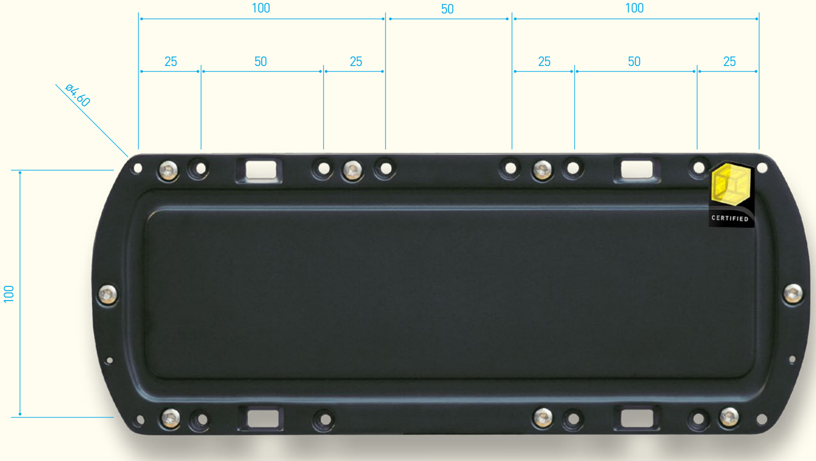


342 Beam Analysis shown assumes;
Mounting Height: 4m
Mounting Angle: 7.5° below horizontal
Targets: vehicle reflection from a height of 1m

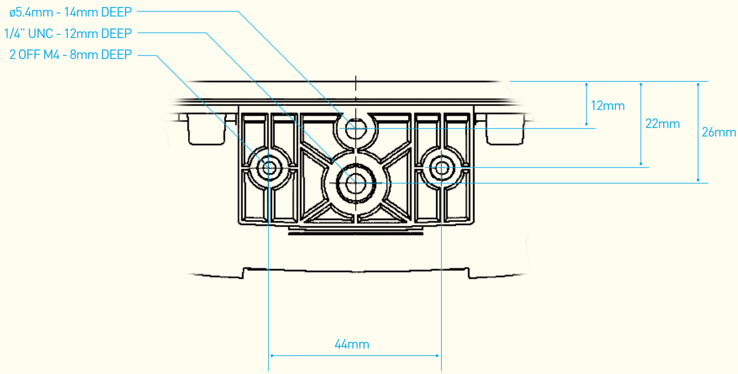
INSTALLATION

RADAR MOUNTING

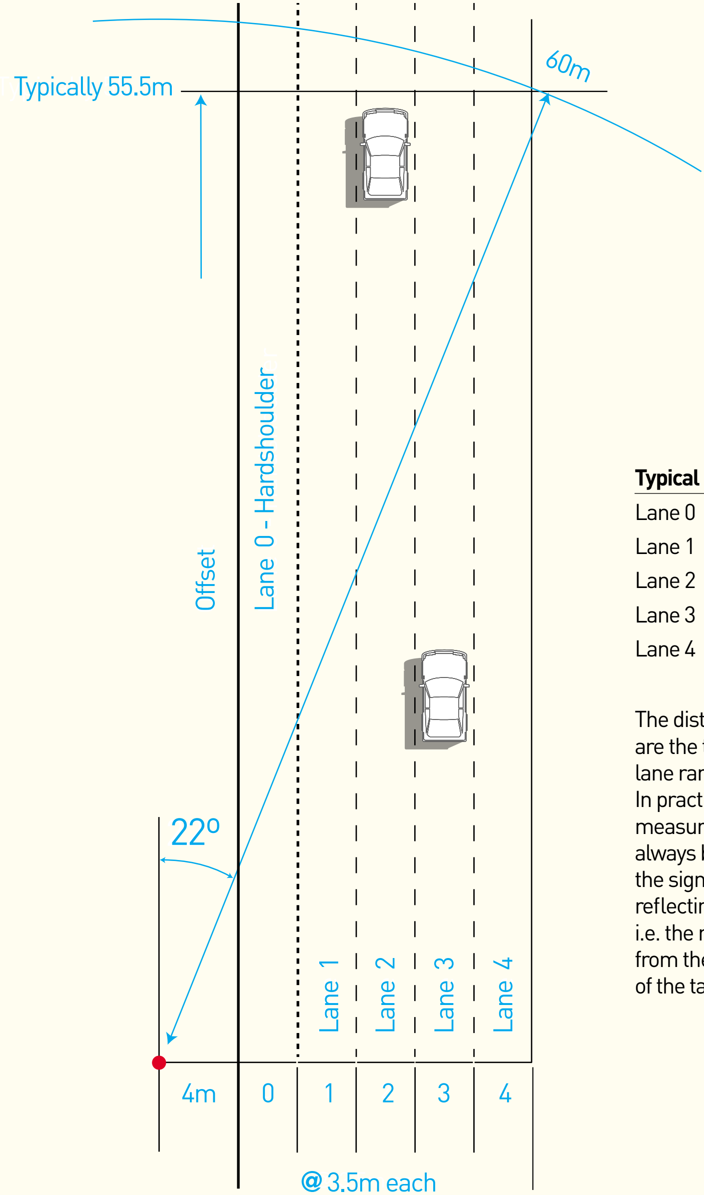
The radar mounting features are shown below:



All above dimensions in mm



RADAR LANE COVERAGE



Typical Distance (metres)	
Lane 0	10.6 - < 20.0
Lane 1	20.0 - < 29.4
Lane 2	29.4 - < 38.7
Lane 3	38.7 - < 48.1
Lane 4	48.1 - < 57.4

The distances shown above are the typical geometric lane range distances.
In practice, the range measured by the radar will always be less owing to the signal coming from the reflecting surface of the car, i.e. the returned signal is not from the approximate centre of the target.

RADAR MOUNTING HEIGHT

The radar can be installed at different heights but operation is best in the height range 1m to 3.5m. The radar can be mounted up to a height of 5m but it is important to understand that at these higher mounting heights the vertical cosine will affect the speed reading of the radar to progressively under-read for increasing heights for lanes that are too close to the radar.

It is therefore recommended that a minimum off-set, that is, a minimum perpendicular distance from the mounting position to the nearest enforceable lane is adopted as shown in the following table.

Mounting Height	Minimum Offset	Radar Declination Angle	Comment
1-2m	2m	0º	
3m	3m	0º	
4m	4m	7.5º	TBC
5m	6m	7.5º	TBC

SELECTING A SUITABLE SITE

When choosing to deploy the radar on a site the following is a non-exhaustive list of considerations which should be taken into account;

- Do the lane(s) have a measurable radius which cause the vehicles to travel on an arc around the radar?
- Does the roads surface slope in a direction excessively which means deployment is not possible or needs to be accounted for in the set-up/alignment process of the radar.
- Is the nearest lane to be covered greater than the specified offset given the proposed deployment height for the radar?
- Are there any large reflecting surfaces directly in front or behind the radar mounting position?

RADAR MESSAGES IN NORMAL OPERATION

When the radar is installed and aligned correctly it will perform to specification.

RADAR SPEED ACCURACY

Simulated target up to 300km/hr	±0.3Km/Hr
Real target typical accuracy	±1.6km/Hr*

*The accuracy of the speed measurement on a true target can be influenced by a number of factors that include:

- Radar mounting height
- When the radar is mounted higher than vehicles being monitored the speeds reported by the radar will be lower than the actual speed of the target. Please see minimum offset/height requirements.
- Radar mounted angle to vehicle direction. It is important that the 22 degrees installation angle is deployed as accurately as possible.
- The radar is normally programmed to make a cosine adjustment of the speeds it measures. Typically the radar will compensate for a mounting angle of 22 degrees to the road. If the radar is mounted at a lesser angle then speed readings will be higher and if the angle is greater the speed readings will be lower.

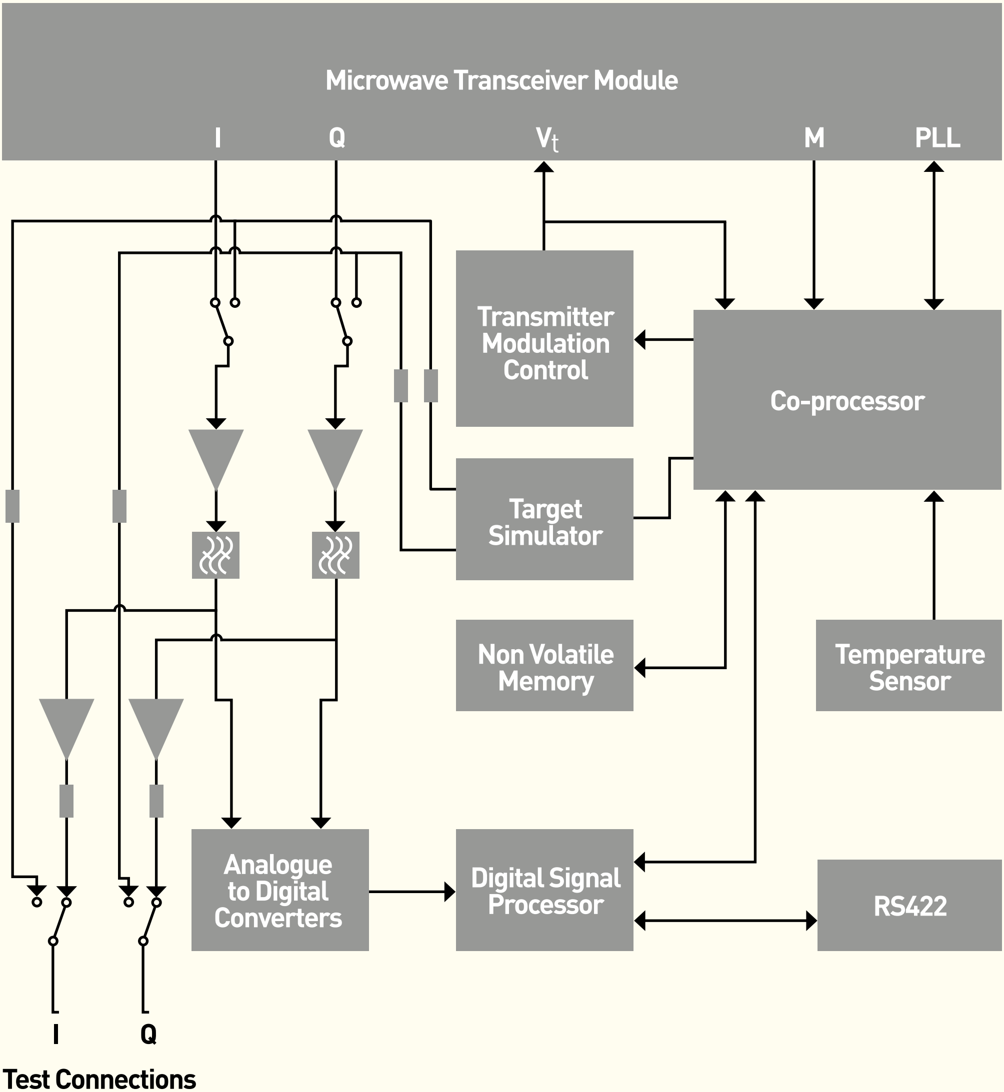
RADAR RANGE ACCURACY

Range readout resolution	0.1m
Simulated target absolute accuracy	±2m for up to a range of 60m
Range noise	< 1.3m

Range accuracy is dependent on a number of factors. Targets usually consist of a number of reflection points and when these signals add together in the radar a range measurement is made that is somewhere between the reflection points. To measure range a reasonable amount of signal level is required. The radar cross section of a target influences the accuracy of the range measurement. Typically range measurements for a motorcycle are less accurate than for a car and the greater the range of the target the lower the range accuracy.

Please note that owing to radar deployment, in recede mode, the range measurement for Event Start (ES) will be less than the range measurement for Event End (EE) and vice versa.

SYSTEM HARDWARE OVERVIEW



SYSTEM HARDWARE OVERVIEW

RS422 SERIAL INTERFACE

A UART interface is provided that uses RS422 voltage levels on the communications connector. The default baud rate for this interface is 115200. This however maybe changed using the *BAUD command to speeds of up to 926000. The *BAUD command must be followed by a *PUS command to store the new value to non-volatile memory. This new value will be used next time the radar reboots.

The serial interface default setup during normal operation is shown in table below.

DEFAULT UART SETTINGS	
Parameter	**Value**
Baud rate	115200
Data bits	8
Parity bits	odd
Stop bits	1
Flow control	None

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

The communications connector is a Bulgin PXO412/08P connector, mating type PX0410/08S/6065.
The pin out of the connector is shown in the table below.

RS422 CONNECTOR CONNECTIONS		
Pin No	**Signal**	**Description**
1	A (RX+)	RS422 Signals
2	B (RX-)	RS422 Signals
3	Y (TX+)	RS422 Signals
4	Z (TX-)	RS422 Signals
5	Not connected	
6	Not connected	
7	GND	Ground or 0V
8	Not connected	

TEMPERATURE SENSOR

A temperature sensor has been installed in the radar. The temperature of the radar may be requested using the *TEMP command.

POWER SUPPLY

The radar is powered using a DC voltage in the range of 10 to 16 Volts. This is supplied on the power and test connector. This connector is a Bulgin PX0412/06P mating type PX0410/06S/4550.

Reverse polarity protection is included in the design. The radar can take a large current during power up that is of the order of amps which only lasts for ~1ms and as such should not affect most applications.

A thermal fuse with a 750mA rating has been installed to protect against electrical short circuit fault conditions.

POWER / TEST CONNECTOR CONNECTIONS

Pin No	Signal	Description
1	REF	Reference frequency RS422 voltage levels
2	REF	
3	I	Do not connect. I and Q port connections for directly measuring received signal or for simulated signal injection
4	Q	
5	VIN	Supply voltage 10 to 16Vdc
6	GND	Supply ground

Power-Up Sequence

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

AGD SYSTEMS LTD AGD342 RANGING ENFORCEMENT RADAR
Firmware Version MI-146-2-P2
Firmware Compile Time 10:21:21 Dec 5 2012
Co-Processor Firmware MI-147-1,Nov 12 2012
....
HB,00000000*FD

Whilst the radar is carrying out its self-test functions a series of decimal points will appear. When finished the radar will report a Heartbeat (HB) message to indicate the radar has successfully initialised and is normally operating. The host system should not send the radar any messages whilst it is initialising. Messages should be sent to the radar after the HB is received. The radar will always send an initial HB message after initialising following power-up even when the HB message is turned off.

Power Supply Tolerance

The radar power supply is specified between 10 and 16Vdc. These are the limits applied on test and calibration. The radar will operate outside this range but its operation is not specified. At 12V dc the current is 250mA.

When V_{SUPPLY} < 10Vdc (but enough to power the radar) the LED will permanently Illuminated.

When V_{SUPPLY} > 16Vdc (but below fuse limit) the LED will flash.

RADAR CHARACTERISTICS

GENERAL

The radar has been designed to have a specific set of functional characteristics which make it suitable for speed measurements for enforcement applications.

Radar Antenna

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

Parameter	Specified	Notes
Horizontal Beam-width	4.5°	-3dB (HPBW)
Vertical Beam-width	15°	-3dB (HPBW)
Side-lobe Suppression	>15dB	
E-Field	Horizontal	Plane Polarised

Operating Frequency Band and Power

The transmitter is a Phase Locked Loop (PLL) controlled MMIC based oscillator. The design confidence means that the nominal centre frequency of the transmission shall remain within a 10MHz window for the required 7 years for a radar functioning normally.

The change in frequency with temperature is measured to be ≤ ±1.21MHz over the operating temperature range -20°C to +60°C.

The radar frequency and power is as follows;

Parameter	Specified	Notes
Operating Frequency Band	24.075 – 24.125 GHz	
Frequency Modulation (FM)	9.4MHz	
Power	<100mW eirp	
Field Strength	Typically 450mV/m	At 3m
ITU Code	9M4FXN	

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
24.100GHz	IE, UK, BE, DK, ES, FI, EL, IT, NL, PT, SE, NO,	CH, TW, TR, QT, AU, NZ, US, ZA, KR, VN	-

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

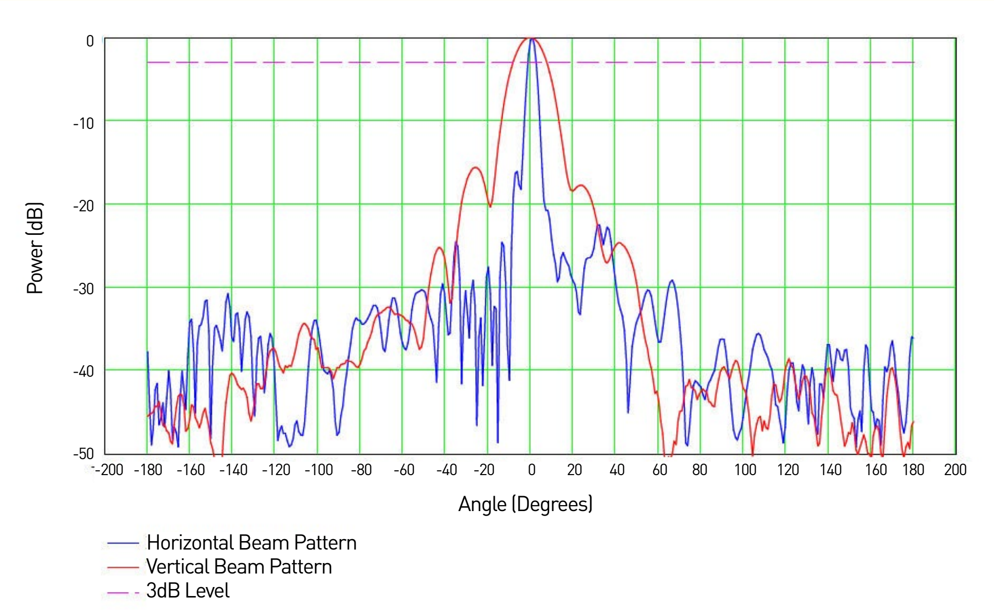
These products may not be used in the following geographic regions;

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)

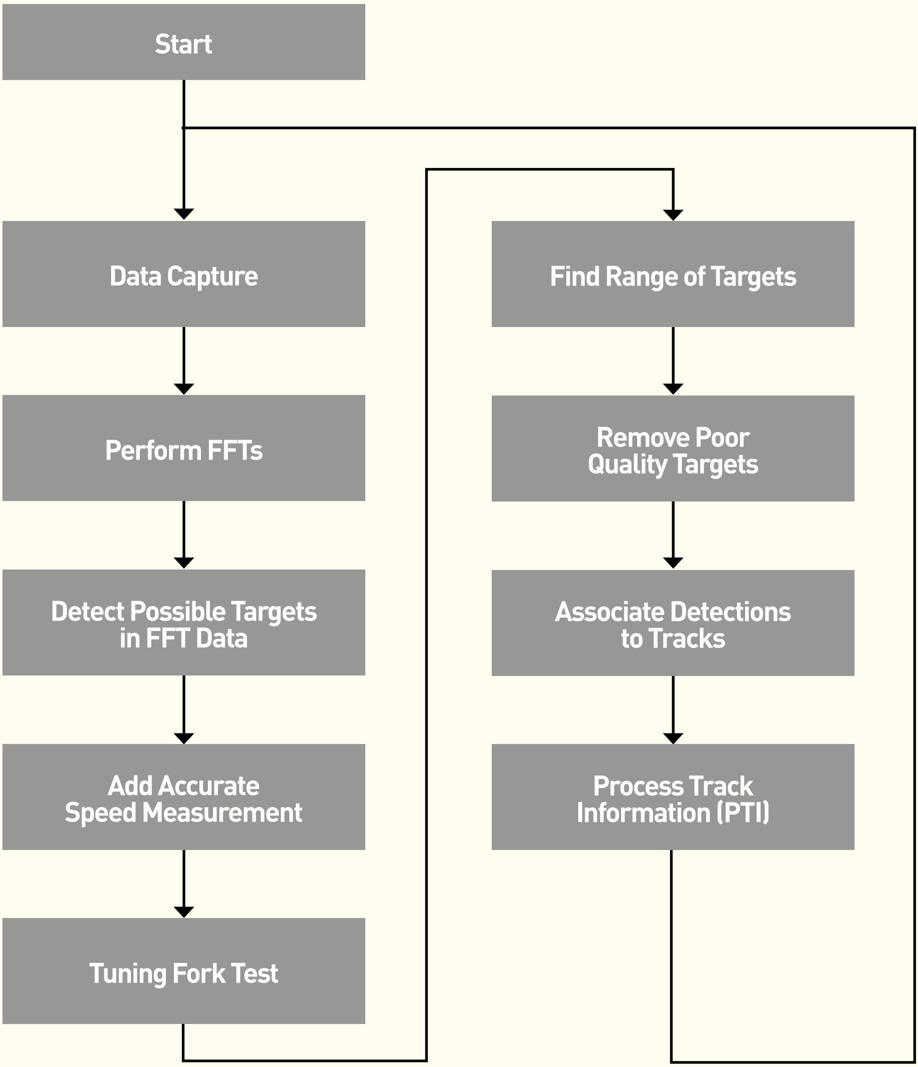
ANTENNA PLOTS



SOFTWARE FUNCTIONALITY

OVERVIEW

The 342 radar uses a real time operating system that continuously samples the input. The radar is continuously performing a number of tasks simultaneously using a time multiplexing method. The main data capture and processing task flow diagram is shown below.



RADAR COMMAND OVERVIEW

Commands are used to control the operation of the radar. These are sent over the RS422 UART link.

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

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

Command Operators

Where a command is used to enquire or set a radar parameter the radar will respond in a set way. The radar will respond with a hash, #, followed by the command name, operator used and then the value of parameter or parameters.

For example

*LS=50<CR>	Radar responds with #LS=50km/Hr<CR>
*LS?<CR>	Radar responds with #LS?50km/Hr<CR>
*FSN?<CR>	Radar responds with #FSN?11111111,22222222,3333333,4444444<CR>

Where a function requires to provide more feed back than can fit on a single line the radar will prefix each line with a # followed by the command name. An example of this is the MOTOROLA-FLASH command.

Communications Command Interpreter Error message

If the user enters incorrect syntax or tries to set a parameter out of range this will be reported as an error. The radar will return #ERROR followed by a description of the error.

RADAR COMMANDS

RADAR COMMAND LIST

Command	Function	Units, Resolution or Values
*BAUD	Used to enquire/set baud rate of radar	*BAUD=115200<CR> *BAUD?<CR> Programmed baud rate is used the next time the radar is rebooted (Default 115200) Range: 115200 - 921600
*CD	Set/enquire calibration date and certificate number	
*CRC32	Reports the CRC for the currently installed program in the Flash	*CRC?<CR>
*DEFAULTS	Sets the default values for the radar	*DEFAULTS!<CR>
*DIR	Used to enquire/set radar direction detection mode	*DIR=A<CR> (Default=R) A = advance R = recede D = dual direction
*ESD	Used to enquire/set the event start distance. This is the distance a target has to travel before an event start message is sent, in metres.	*ESD=1.0<CR> *ESD?<CR> (Default 2.0m) Range: 1-5m
*FSN	Reports the security serial numbers of the radar's flash memories	*FSN?<CR> Enquire Flash serial number values
*HBP	Enquire/set the heart beat period that is measured in frames. Setting this to zero turns off the heart beat	*HBP?<CR> Enquire value (default 60) *HBP=5<CR> Set heart beat period to 5 seconds Range: 0 - 86400 seconds
*IQPORT	Enquire/set the IQ port configuration as input or output. Not Implemented	*IQPORT=0<CR> set to output (default) *IQPORT= I<CR> set to input
*LS	Used to enquire/set the low speed threshold speed	*LS?<CR> Enquire what threshold speed is *LS=50<CR> Set threshold to 50 of current speed units (Default 20kph) Range: 20kph - 160kph
*PUS	Program current user parameters into flash memory	*PUS!<CR>
*REBOOT	Used to force a hardware reset of the radar	*REBOOT!<CR>
*SN	Normally used to enquire about radar serial number	*SN?<CR> Enquire about radar's serial number
*SR	Used to enquire the radars measured sample rate	*SR?<CR>
*SU	Used to enquire / set the speed units type	*SU=K<CR> Set speed units to kph *SU=M<CR> Set speed units to Mph *SU?<CR> Enquire what speed units are being used (Default M)
*TEMP	Reports the temperature measured inside the radar	*TEMP?<CR>
*TS	Self-Test; used to simulate a target	*TS=1,A<CR>
*VS	This command is used to enquire about the radars power supplies voltage levels	*VS?<CR>
AGD	Provides radar software version	AGD<CR>
LIST	This command lists the available commands	LIST!<CR>
HELP	Lists all commands along with command help information	HELP<CR>
MOTOROLA_FLASH	Used to reprogram the radars firmware	The new program is in a modified motorola hex format
*EED	Used to enquire/set the event exit distance. This is the distance, in metres, a target has to travel after its last detection before a event exit message is sent.	*EED=2<CR> Set EED distance to 2m (Default 1.2m) Range: 1-5m
*VER	This command is used to enquire the versions of the firmware of the main and co-processors	*VER?<CR>
*TFM	This command is used to enable or disable tuning fork messages	*TFM=1<CR> Enable tuning fork messages *TFM=0<CR> Disable tuning fork messages (Default 0)
STATUS	Used to enquire radar configuration and status	STATUS!<CR>

*TS COMMAND & HARDWARE SELF-TEST

The radar has a built in hardware based target simulator. This command is used to perform a self-test using this built in target simulation hardware. There are twelve targets that maybe simulated in either receding or approaching directions

The format of the command is:

***TS=<Target Number>,<Direction><CR>**

The target parameters for each target are shown in the table below.

Target Number	Speed(MPH)	Range (Metres)	Distance Travelled in Beam (Metres)
1	50	16	25
2	80	16	10
3	120	16	10
4	190	16	10
5	50	32	25
6	80	32	10
7	120	32	10
8	190	32	10
9	50	64	25
10	80	64	10
11	120	64	10
12	190	64	10

For example

*TS=1,A<CR>

Radar Response;

<STX>ES,000018F7,00000003,X,050.0,M,016.0*16<ETX><CR>
#TS:COMPLETE<CR>
<STX>EE,000019CD,00000003,X,050.0,M,016.0,025.2,022.0*DA<ETX><CR>
<STX>QM,000019CD,00000003,X,050.0,00.00,M,104.4,100,100*7A<ETX><CR>

*TS COMMAND & HARDWARE SELF-TEST (CONTINUED)

It is recommended that the system uses the following pass/fail criteria for acceptance to specification for a radar self-test. It is also recommended that after power-up of the radar, the host system calls the radar self-test function to simulate at least one approaching and one receding target. When in Bi-Directional mode the radar will report both advancing and receding simulated targets.

When in Advance Mode the radar will only accept and report simulated targets that are advancing. If a recede simulated target is requested the radar processing will reject the target as 'wrong direction' and only

    #TS:COMPLETE<CR>

message will be sent as confirmation that the simulation has been completed. When in Recede mode vice versa.

Parameter	Criteria For Event Start Message	Criteria For Event End Message	Criteria For Quality Message
Speed	≤ ± 0.2 (mph or Km/h)	≤ ± 0.2 (mph or Km/h)	N/A
Distance	≤ ± 0.5 m	≤ ± 0.5 m	N/A
Event Length	N/A	≤ ± 0.5 m	N/A
Direction	100% correct	100% correct	N/A
Checksum	100% correct	100% correct	100% correct
Peak Power Speed (PPS)	N/A	N/A	≤ ± 0.2 (mph or Km/h)
PPS Standard Deviation	N/A	N/A	< 0.1
Event Peak Power (EPP)	N/A	N/A	100.0<EPP<110.0
% Speed readings	N/A	N/A	>95%
% Range Readings	N/A	N/A	>95%

The hardware target simulator is fully independent of the radar measurement system. This is used to verify the operation of the radars measurement circuitry. The self-test does NOT operate automatically on power-up of the radar. During simulation the microwave front end is disconnected from the ADC to avoid any possible interference with the simulation.

The radar self-test function can be called at any time using the *TS command.

The *TS command calls a pre-loaded simulated test target condition. There is a selection of pre-loaded test target conditions as set out.

As the test targets are a true simulation of a real target the respective event messages from the radar will occur at differing times dependant on the simulation called. i.e the time between the Event Start Message and the Event End Message will be significantly longer if a simulation is for a slow long target than if a simulation for a fast short target is selected.

To distinguish real targets from simulated targets the radar inserts an X or a Y in the direction fields of all related messages produced.

*SR COMMAND & THE 50KHZ REFERENCE CLOCK

The *SR command is used to enquire about the radars measured sample rate. This is an additional self-test feature to confirm correct operation of the radar to specification.

For example

*SR?<CR>

Radar Response

#SR?50002.21<CR>

There is no pass/fail criteria for the host system for this response as the radar periodically performs this test against pre-set criteria.

The radar uses an analogue to digital converter, ADC, to digitise the received signals. The ADC clock source is derived from a crystal on the digitiser board. The crystal used has a frequency of 12.0MHz. This clock is divided down by 240 to give a reference clock frequency of 50.0KHz.

The reference clock is provided on balanced line outputs compatible with RS422 signal levels.

The radar constantly monitors the sampling frequency by comparing how long the radar takes to collect data samples by using the processors crystal as a reference, which is independent from the ADC clock source. Measurements are compared approximately every five seconds and if measurements show a large enough error then the radar will send an error message 06. The last measurement of the ADC clock frequency can be accessed at any time by using the *SR command.

*IQ PORT COMMAND

This command is used to enquire or set the IQ port configuration as input or output. The IQ port is default set to an output.

For example

*IQPORT?<CR>

Radar response

#IQPORT?0

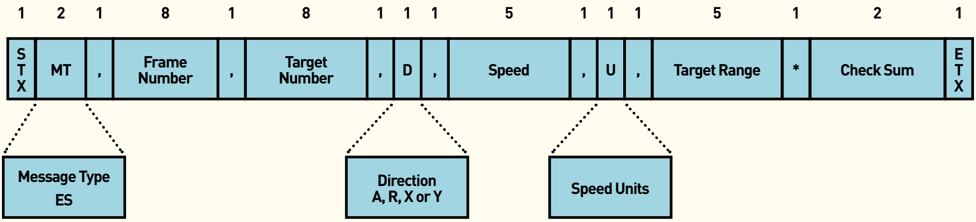
The IQ port provides connections that may be used to observe or inject IQ signals for independent test house measurement performance verification. When the IQ port is configured as an input the radar will disconnect from the microwave module and connect its baseband circuitry to the IQ port pins. The radar will measure injected events in the normal way and the radar will mark detected targets with a direction field of X or Y depending on the direction of the target indicating the test condition.

It should also be noted that the IQ Port can be configured as an input.

RADAR EVENT MESSAGES

Event Start message

This message is sent after the radar has established that a vehicle has entered the radar's beam.
The numbers above the boxes in the diagram below indicate how many bytes are used for each field.



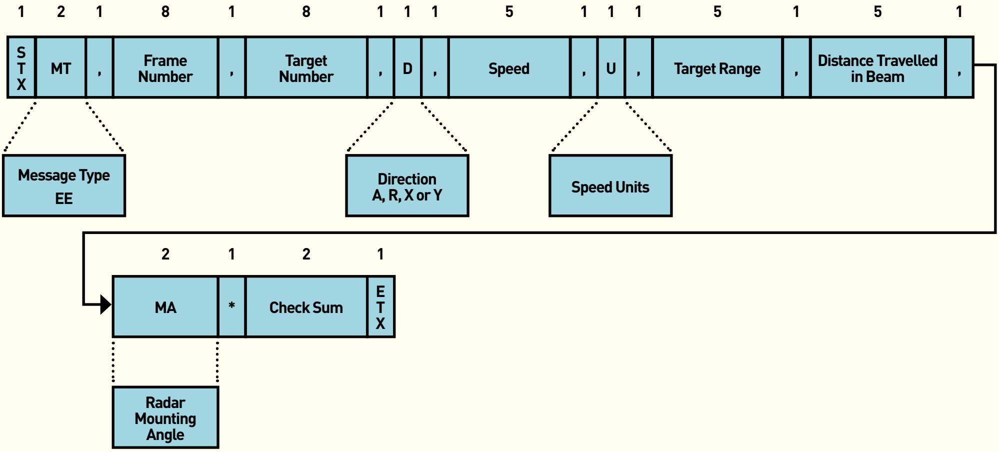
Event Start message format

Name	Size / Bytes	Value	Notes
STX	1	2	Start of message byte
MT	2	'ES' = Event Start	Message type
,	1	','	Comma
Frame Number	8	XXXXXXXX	Frame number in hexadecimal format
,	1	','	Comma
Target Number	8	XXXXXXXX	Target identification number in hexadecimal format
,	1	','	Comma
Direction	1	'A' = Approaching Target 'R' = Receding Target 'X' = Simulated approaching target '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	1	'M'=mph 'K'= kph	The speed units used for the measurement
,	1	','	Comma
Target Range	5	'DDD.D'	Target range in metres
*	1	'*'	Asterisk
Check Sum	2	'XX'	Check sum in hexadecimal format
ETX	1	3	End of message byte

RADAR EVENT MESSAGES

Event End Message

This message is sent once a target has been detected for a significant amount of time. This message can be used by a host system to trigger a camera to capture images for a receding target enforcement system.



RADAR EVENT MESSAGES

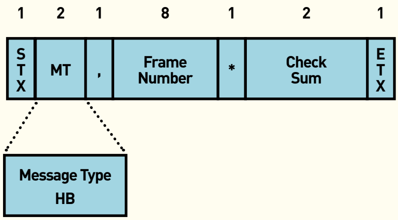
Event End message format

Name	Size / Bytes	Value	Notes
STX	1	2	Start of message byte
MT	2	'EE' = Event End	Message type
,	1	','	Comma
Frame Number	8	XXXXXXXX	Frame number in hexadecimal format
,	1	','	Comma
Target Number	8	XXXXXXXX	Target identification number in hexadecimal format
,	1	','	Comma
Direction	1	'A' = Approaching Target 'R' = Receding Target 'X' = Simulated approaching target '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	1	'M'= mph 'K'= kph	The speed units used for the measurement
,	1	','	Comma
Target Range	5	'DDD.D'	Target range in metres
,	1	','	Comma
Distance Travelled in beam	5	'DDD.D'	The distance a target has travelled while in the beam of the radar.
,	1	','	
MA	2	'DD'	Radar mounting angle in degrees. This is the angle the radar uses to calculate the speed of a target
*	1	'*'	Asterisk
Check Sum	2	'XX'	Check sum in hexadecimal format
ETX	1	3	End of message byte

RADAR EVENT MESSAGES

Heart Beat message

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
Frame Number	8	XXXXXXXX	Frame number in hexadecimal format
*	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.

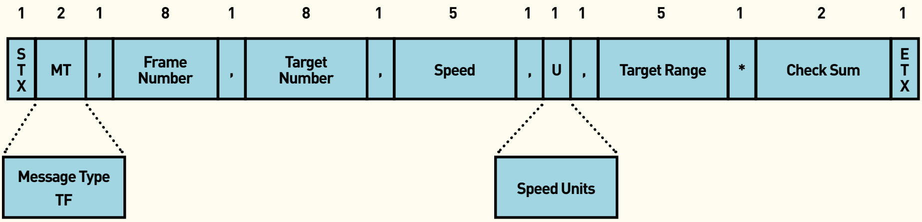
A heartbeat message will always be produced after the radar initialises even if the heartbeat is turned off. The host system should not send messages to the radar after power-up until this initial heartbeat message is received.

MESSAGE FORMATS

RADAR EVENT MESSAGES

Tuning Fork message

This message is sent when a tuning fork target has been detected. This message is sent after a event end message is sent.



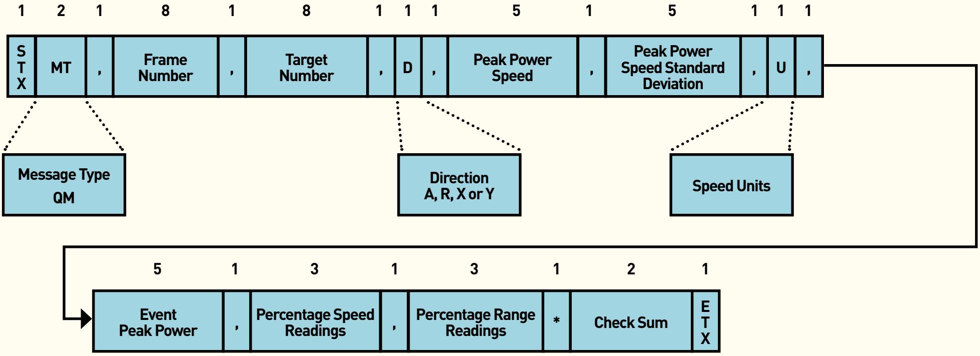
Tuning Fork message format

Name	Size / Bytes	Value	Notes
STX	1	2	Start of message byte
MT	2	‘TF’ = Tuning Fork	Message type
,	1	‘,’	Comma
Frame Number	8	XXXXXXXX	Frame number in hexadecimal format
,	1	‘,’	Comma
Target Number	8	XXXXXXXX	Target number in hexadecimal format
,	1	‘,’	Comma
Speed	5	‘DDD.D’	
,	1	‘,’	Comma
Speed Units	1	‘M’= mph ‘K’= kph	The speed units used for the measurement
,	1	‘,’	Comma
Target Range	5	‘DDD.D’	Target range in metres
*	1	‘*’	Asterisk
Check Sum	2	‘XX’	Check sum in hexadecimal format
ETX	1	3	End of message byte

RADAR EVENT MESSAGES

Event Quality message

Once an event end message is sent, the measurements relating to the event are analysed. These various elements of the event are reported in the Event Quality Message.



RADAR EVENT MESSAGES

Event Quality message format

Name	Size / Bytes	Value	Notes
STX	1	2	Start of message byte
MT	2	‘QM’ = Quality Message	Message type
,	1	‘,’	Comma
Frame Number	8	XXXXXXXX	Frame number in hexadecimal format
,	1	‘,’	Comma
Target Number	8	XXXXXXXX	Target number in hexadecimal format
,	1	‘,’	Comma
Direction	1	‘A’ = Approaching Target ‘R’ = Receding Target ‘X’ = Simulated approaching target ‘Y’ = Simulated receding target	Direction the target is travelling.
Peak Power Speed	5	‘DDD.D’	
,	1	‘,’	Comma
Peak Power Speed Standard Deviation	5	‘DDD.D’	
,	1	‘,’	Comma
Speed Units	1	‘M’= mph ‘K’= kph	The speed units used for the measurement
,	1	‘,’	Comma
Event Peak Power	5	‘DDD.D’	
,	1	‘,’	Comma
Percentage Speed Readings	3	‘DDD’	The value of actual speed readings taken as a function of the total possible expressed as a percentage
,	1	‘,’	Comma
Percentage Range Readings	3	‘DDD’	The value of actual range readings taken as a function of the total possible expressed as a percentage
*	1	‘*’	Asterisk
Check Sum	2	‘XX’	Check sum in hexadecimal format
ETX	1	3	End of message byte

RADAR MESSAGES IN NORMAL OPERATION

Example data from radar set in Bi-Directional Mode and the Heartbeat set to 5 seconds.

```
HB,00003560*68
HB,00003930*40
ES,00003B15,00000014,R,029.3,M,017.1*2A
EE,00003B87,00000014,R,029.5,M,023.2,009.5,022.0*DE
QM,00003B87,00000014,R,029.5,00.93,M,095.1,081,081*84
HB,00003D00*31
HB,000040D0*BE
HB,000044A0*26
HB,00004870*D4
ES,00004988,00000015,R,029.1,M,017.4*46
EE,00004A0A,00000015,R,029.7,M,022.2,010.7,022.0*78
QM,00004A0A,00000015,R,029.7,00.67,M,092.8,087,083*7E
ES,00004AE6,00000016,R,031.0,M,018.1*20
EE,00004B4D,00000016,R,031.5,M,021.7,009.5,022.0*9C
QM,00004B4D,00000016,R,031.5,00.52,M,093.4,086,085*E2
ES,00004B55,00000017,A,030.1,M,030.5*F4
EE,00004BAA,00000017,A,029.2,M,029.0,006.8,022.0*86
QM,00004BAA,00000017,A,029.2,00.82,M,080.3,070,065*9C
HB,00004C40*D1
ES,00004D86,00000018,A,033.1,M,030.2*CE
EE,00004DCE,00000018,A,032.9,M,027.9,006.7,022.0*7C
QM,00004DCE,00000018,A,032.9,00.63,M,084.4,073,071*75
ES,00004F7D,00000019,A,040.1,M,032.2*9D
EE,00004FC9,00000019,A,039.7,M,030.2,007.8,022.0*6A
QM,00004FC9,00000019,A,039.7,00.64,M,085.9,085,081*25
HB,00005010*7B
HB,000053E0*8D
```

EXPLANATORY NOTES FOR RADAR EVENT & QUALITY MESSAGES

The Event Start (ES) message contains both initial target speed and range information. The radar will have tracked the vehicle for a short distance before this message is sent. As only a relatively small amount of target information is available to the radar at this stage, the range and speed of the target are not fully evaluated by the radar and are provided for the system to make some initial decisions about whether to be interested in the target. The initial speed and range readings in the ES message will have been qualified by the radar against a series of checks to ensure that the event information is of sufficient quality to proceed with a target track. The physical position on the road of the target corresponding to the sending of the ES message can be moved by altering the Event Start Distance (*ESD). A longer ESD will improve the quality of the ES speed and distance measurement and make the ES message occur later. Reducing the ESD will have the opposite effect. Making the ESD too small may lead to premature ES messages.

When the vehicle can no longer be tracked by the radar an Event End (EE) message is generated. This message contains the speed of the vehicle which should be used for the Event as all possible speeds would have been processed during the event. The range of the target in the EE message will generally be different from that of the ES message because the target will have moved along the carriageway during the event. Generally, the ES range will be less than the EE range for receding target and vice versa. The distance the target travels after the track is lost to when the EE message is sent is set by the Event End Distance (*EED) message. Making the EED too small may result in multiple events being generated for a single target.

In the Event End message, the distance travelled in the beam by the target (Event Length) is reported in metres. This measurement is directly proportional to the length of the target in the event. Depending on the range this measurement will be approximately 8m for a saloon car and approximately 20m for a truck. Generally, a larger event length can result in a larger difference in the range measurements reported in the ES and EE messages.

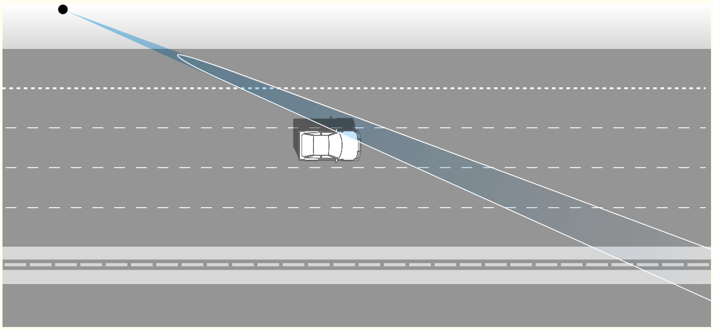
The Quality Message (QM) always immediately follows the EE message. The reported Peak Power Speed in the QM is the same as that used in EE speed reading. The radar processes 195 readings per second and the standard deviation of all those readings for the associated event are reported as a standard deviation in the QM. The peak power reading is the maximum signal strength seen for the event. The peak power for a given target will be reduced at increasing range. Generally, for a given range, cars produce a lower peak power reading than for trucks.

Whilst the radar processes 195 range and speed readings per second not all these readings pass the radars quality check for a given reading. Say, 100 speed readings are collected for an event (that's an event which lasts approx. 513mS) but the radar rejects 12 of the readings, the QM field Percentage Speed Readings will report 088. That is, 88 good readings from the possible 100 taken is reported as 88%.

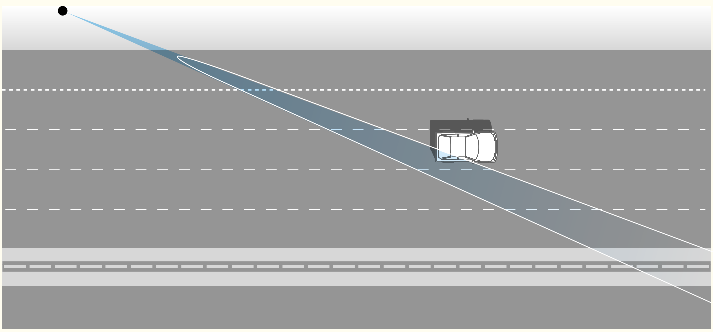
Firstly, the speed reading is assessed and then the corresponding range reading for that speed is then assessed. If a speed reading is rejected, the corresponding range reading is automatically rejected. Continuing with the example, there will be 88 ranges corresponding to the accepted speeds. Each range is then quality checked to a given tolerance and rejected or passed. If they all pass the range quality check the Percentage Range Readings will report 088. The Percentage Range Readings field is always less than or equal to the Percentage Speed Readings. Finally, if the radar had rejected 14 of the available range measurements the reported Percentage Range Reading would be 074.

EXPLANATORY NOTES FOR RADAR RANGE MEASUREMENT

The 342 radar has a beam with a finite width for a given target range etc. The range to the target will be different owing to the geometry of the application. This is shown by way of a typical example as follows;



Vehicle in lane two enters zone of measurement and creates an Event Start message. The ES message at this position would typically indicate a range reading of approximately 29m.



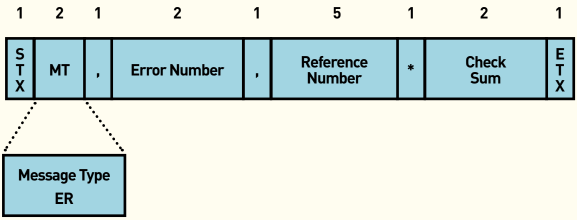
As the vehicle exits the zone an Event End message is sent. The EE message at this position would typically indicate a range reading of approximately 32m. The 32m range measurement is derived from the range readings significant before the vehicle exits in the beam.

If your application requires greater density of target range data please contact AGD as there are additional target range features within the radar.

RADAR ERROR MESSAGES

Operational Error message

The operational error message is an unsolicited message used to report degrees of variance of the radar from normal operation.



Operational Error message format

Name	Size / Bytes	Value	Notes
STX	1	2	Start of message byte
MT	2	'ER' = Error Message	Message type
,	1	','	Comma
Error Number	2	DD	Error number in decimal format - see table on next page for details
,	1	','	Comma
Reference Number	5	DDDDD	Reference number used to help isolate error source. This can change between software versions and should not be used by the host system.
,	1	'*'	Asterisk
Check Sum	2	'XX'	Check sum in hexadecimal format
ETX	1	3	End of message byte

RADAR ERROR MESSAGES

Error Number table

Error Number	Description	Response	Actions
01	Corruption of User Configuration Data	Radar will attempt to restore Factory Default Data configuration set	User will need to reset individual configuration variances from default set
02	Corruption of Factory Default Data Configuration set	Radar operation will automatically shut down as operation to specification cannot be assured	Return radar to AGD for repair and/or recalibration
03	Corruption of Critical Configuration Data	Radar operation will automatically shut down as operation to specification is not possible	Return radar to AGD for repair and/or recalibration
04	Internal communication error. Communication between radar processors has failed.	Radar operation will automatically shut down	Return radar to AGD for repair and/or calibration
05	General error	Radar has internal code tags to indicate resource usage and levels of processing load	User should ignore if infrequent. Repeated occurrence suggests radar nearing specification limits and should be shut down by the user. It should be noted that repeated occurrence of this message may be owing to the specific site at which it is deployed and or the associated targets making the radar work close to its operational processing limits.
06	Sampling Frequency Error	The radar will continue to operate.	If the sampling Frequency Error is persistent ie more than one message every 10 secs, then the radar operation to specification cannot be assured and should be shut down by the host system. The radar should be returned to AGD for repair and/or recalibration

CRC8 C CODE WORKED EXAMPLE

CRC8 C CODE

CRC8 checksums are used on the standard radar messages. The checksum calculation is performed on all bytes, up to and including the asterisk character. These checksums are calculated using the following C code.

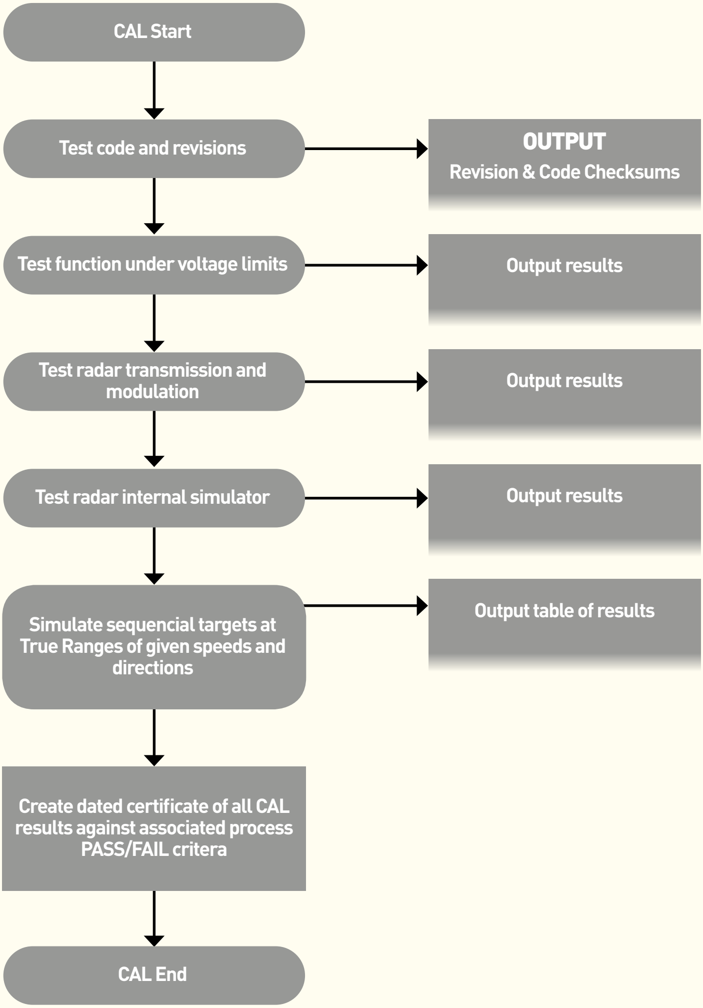
```
//Lookup table for CRC8 calculation
//Needs to be initialised with InitCRC8
U8 crc8_table[256];
/*******************************MemCRC8*****************************
This function calculates the CRC8 of a data array pointed to by data
and of length length.
Uses polynomial x^8 + x^2 + x + 1. Lookup table used by function is initialised
by the InitCRC8 function.
*/
unsigned char MemCRC8(void *data, unsigned int length)
{
unsigned char crc8;
unsigned char i;
unsigned char *dptr;
    dptr = (unsigned char*)data;
    crc8 = 0;             //Start with a value of 0
    for(i = 0; i < length; i++)
    {
        crc8 = crc8_table[crc8 ^ *dptr];
        ++dptr;
    }
    return crc8;
}

#define GP  0x107   /* x^8 + x^2 + x + 1 */
#define DI  0x07
/***************************InitCRC8****************************
Initialises the lookup table for the MemCRC8 function
Uses polynomial x^8 + x^2 + x + 1
*/
void InitCRC8(void)
{
int i,j;
unsigned char crc;
    for (i=0; i<256; i++)
    {
        crc = i;
    for (j=0; j<8; j++)
        {
            crc = (crc << 1) ^ ((crc & 0x80) ? DI : 0);
        }
    crc8_table[i] = crc & 0xFF;
    }
}
```

342 CALIBRATION PROCESS

The 342 is calibrated at manufacture to the process referenced on the calibration certificate supplied with the radar.

An overview of the process is as follows:



The process is conducted using calibrated test equipment(s) whose readings are traceable to a national standard.

FREQUENTLY ASKED QUESTIONS - FAQ'S

i) Can you supply a Type Approval Certificate for the 342 radar certifying its compliance for enforcement applications?

As the 342 is not a stand-alone hand-held radar but part of a system which is designed to be fixed or portable so the radar does not have Type Approval in its own right. Type Approval is usually only granted for the complete system. The 342 is used in complete systems that have been granted Type Approval for speed enforcement applications.

ii) What is the maximum lane coverage of the radar?

The number of lanes is not part of the specification for the radar. The range capability is specified as 2 to 60 metres. Dependant on the perpendicular offset, whether the hard-shoulder is included as a lane and the width of the lanes themselves are all functions of the maximum number of lanes which can be covered. By way of example, if the radar is mounted with an offset of 4m and the lanes (including the hard-shoulder) are 3.5m width then the radar will cover 4 active lanes (numbered 1 to 4) (with the hard-shoulder being lane 0).

A diagram depicting this is shown earlier in the manual.

iii) If a vehicle straddles lanes how does the 342 handle these events?

The radar measures range in metres. The system will determine the lane allocation from the range information contained within the ES and EE messages. It is expected that if the range to the target is not within the specified band in metres as determined by the system for each lane then the target could be a car straddling lanes. There is some merit in the system assigning special status to 'straddling events' which could be expressed by the system as either 2+ or 2-3 as a lane determined output if the range measurement was in between the centres for those bands specified for lane 2 or lane 3. There is significantly more conversation for this from a system perspective if a lane learning algorithm is deployed by the host system but may still require the setting option of an enforceable hard-shoulder for example.

iv) How does the 342 deal with vehicle tail-gating?

Tail-gating in the same lane if the separation of targets is less than the radar beam-width and the target speed difference is less than 5km/hr is un-detectable as these events are identical in radar terms to a vehicle and trailer. For reliable detection of two vehicles, the vehicles should be separated by at least 9m for the shorter ranges.

v) Is 60m the maximum range of the radar?

The radar has an instrumented range of 160m and can therefore report targets beyond the 60m range if signals levels are large enough. The quoted performance for the radar is given for targets up to a range of 60m. Measurements beyond 60m cannot be guaranteed to be inside measurement specification limits.

FREQUENTLY ASKED QUESTIONS - FAQ'S

vi) How long is the radar "Self-Test" time?

The duration of the self-test is dependent on the selection of the target number selected for the self-test. The target numbers with the longest duration self-test time will be the longest targets travelling at the slowest speeds (Target Numbers 1, 5 and 9 from relevant section of the manual.) This is because the self-test performs a simulation that is representative of a true target.

For these events the duration of the self-test is less than 2secs.

An important point to note is that when the self-test is called all real targets being tracked and reported by the radar are flushed, which means an EE message will be sent for any targets that an ES message has been sent.

Violations cannot be captured while the radar is performing self-test.

vii) Is the radar a so-called 2D or 3D technology radar?

2D and 3D are not a helpful way of describing the radar technology and is generally misleading at best. The 342 is an FMCW radar which measures speed and range to each target. In spacial terms only, this is strictly 1-dimensional measurement which is the range (r) to the target. Some so-called 2D and 3D radars are using the radar's velocity measurement as one of the extra dimensions.

vii) Is the radar 'Self-Test' function a manual or an automatic function?

The Self-Test function is a manual function and can be called at any time by the host system.

ix) What is the mounting specification for the 342?

The 342 should be mounted with an uninterrupted front radome. No secondary plastic screens or invasive metalwork which may distort the radars beam should be introduced across or near the plain, flat centre of the front radome. (see installation/mounting pages of the manual).

x) Can the 342 radar classify vehicles?

The radar does not classify vehicles but provides measurements such that the host system can.

The 'Distance travelled in Beam' field in the EE message is the output of the radar that should be used for classification. The distance reported is dependent on a number of factors including target range, length and width. This can still be used though to give a course vehicle classification such as motorbike, car and lorry. In addition, the event peak power field in the QM message can be used as a quality marker for the classification as generally it is larger for bigger (longer) targets for a given range.

xi) How does the radar deal with 'overlapping' targets?

The radar is capable of measuring the speed and range of multiple vehicles when they have speeds that differ by more than 5Km/Hr.

When the radar detects a new potential target that is at a distance greater than a presently tracked target the target will not be reported. When the radar detects a new potential target that is at a distance less than a presently tracked target the target will be reported. This is to ensure that only the closest targets to the radar are reported avoiding potential false detections due to reflected signals.

FREQUENTLY ASKED QUESTIONS - FAQ'S

xii) Can the measurement readings of the radar get corrupted by interference?

All the messages of the radar to the hosts system carry a Checksum. The host system should check the received message contents against the provided checksum to ensure that the information received by the host system is indeed that which was sent by the radar to ensure no corruption has occurred.

xiii) How does the radar accurately identify the lane of the vehicle?

The range to targets is provided by the radar in the ES and EE messages. For each site the system will learn or prescribe a range of measured distances for each lane (or indeed both). The reported range for each event from the radar can then be ascribed a lane (or a straddle.)

xiv) How does the radar identify between long vehicles and two normal vehicles travelling very close to each other?

This depends on the range to the targets, the leading vehicle width and the event end distance setting of the radar. Typically vehicles travelling at virtually the same speed in the same lane need to be separated by 9 metres, depending on which lane they are in, to be reliably detected as two vehicles.

xv) What is the response time of the radar?

The radar has a measurement interval of 5.12mS. The distance a target travels, since first detected, before the radar generates an Event Start (ES) message is set by the Event Start Distance (ESD). This is typically set in the range 1.8 to 2.5m. By using distance instead of time the radar gives good repeatability in target position when an ES message is generated.

xvi) Does the radar have any special event diagnostic features?

Yes, there are many hidden functions that are present within the radar.

You may need to contact AGD for access to these features depending on your specific system application.

xvii) How does the radar perform if there are strong reflectors or parked cars in the field of view for the radar?

The radar performs best when installed in line with the guidelines laid out in the product manual. The introduction of undesirable reflectors in the view of the radar such as parked vehicles is more likely to result in the radar having to process out more unwanted signal reflections. This is likely to add to the radar processing load. This can be determined by the system as the radar will report Error Message 05 (see error messages earlier in the product manual). Whilst this is not totally deterministic and in most instances can be ignored it could represent difficulties presented by the condition of the particular site at which the radar is deployed. This does not affect the accuracy of the speed reading obtained if the pass criteria for the Quality Message parameters are met.

FREQUENTLY ASKED QUESTIONS - FAQ'S

xviii) What features are available for the radar to be able to detect inaccuracy in the measurement mechanism?

In order for the radar to determine whether the speed measurement system of the radar is accurate several separate strategies are deployed;

The radar has its own built-in target simulator. This can be called by the host system at any point required to ensure the radar is measuring accurately. The simulated target output can be checked by the host system against pre-defined pass criteria. (see relevant Manual section). Failure to meet these requirements will result in suspension of the radar operation by the host system.

The radar deploys a speed tracking system for target locking in line with the requirements of the OIML standard.

The radar constantly monitors its own measurement sample rate. The frequency source of the ADC and that of the system measurement crystal are effectively compared to ensure conformity to specification (see relevant manual section). Failure of this test will result in Error Message 06 (Manual error messages).

For each measured Event the radar associates a Quality Message (QM). To assure the provision of specified accuracy, pass criteria are applied to the fields of the Event QM by the system. By way of trivial example, if 'Percentage Speed Readings' was 5%, that is, only 5% of all readings from a specific event passed the radars individual speed reading quality check then the speed reading for the event will be considered below that as specified as rejected as a reading. (see relevant manual section)

xix) What checks are put in place during maintenance to ensure that the detection mechanism is working as intended and is accurate?

When the radar is taken out of service for scheduled maintenance the radar is re-certified to a series of rigorous tests with precise pass/fail criteria. This is performed on dedicated simulation test equipment to a prescribed procedure to given pass/fail criteria as described in earlier parts of the Manual.

A test certificate for this process is provided with each product calibration.

Finally, each radar has a unique 128bit security ID which is indelible in the electronic hardware of the radar. This ID features on the certificate and ensures that each radar is uniquely referenced from tampering of labels, external identification or swapping of hardware between enclosures.

xx) A typical vehicle is 5 to 20m long to which point on the vehicle is the range measured?

A typical vehicle in radar terms will have multiple reflection points each of which produces a signal that will add by superposition to form a kind of average signal within the radar. There will therefore not be any specific point on a vehicle the radar measures the range to. Not all of a vehicle will necessarily be in the beam when being detected which means as the vehicle travels through the beam the distance will naturally vary.

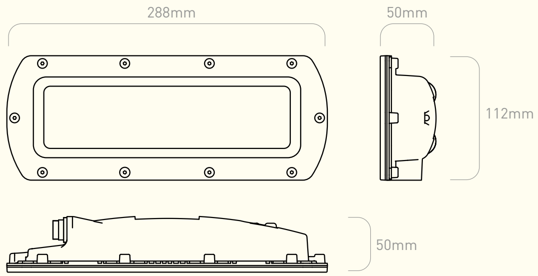
xxi) Is it possible for the customer to do this calibration rather than return the radar to AGD?

We are currently working on making a cut-down version of our certification equipment available for customers to buy. Please contact AGD for current availability.

xxii) What kind of test equipment and other sort of tools are available to test the radar?

See separate information available on the 932 target simulator.

TECHNICAL SPECIFICATIONS



SPECIFICATIONS

Technology	FMCW Radar
Radiated Power	<100mW EIRP (<20dBm)
Transmit Frequency	In the band 24.075 to 24.125GHz
Transmit Bandwidth	9.4MHz
Range	2 to 60m
Mounting	Flange fixings or tripod mount
Mounting Height	1 - 3.5m nominal
Speed Range	20 to 320 kph
Weight	0.8 Kg nominal
Housing Material	Polycarbonate (UL94 V-2)
Housing Finish	Self coated black
Sealing	IP66
Operating Temperature	-20°C to +60°C
Power	2.9 - 3.3W (Typically 280mA @ 12Vdc)
Power Supply	10-16Vdc
Radar Output	RS422
MTBF	Based on a similar product for which we have field data from 1000 units installed over 4 years we are able to provide with a 90% confidence that the AGD 342 will achieve an MTBF of greater than 20 years. This statement assumes that the product is returned for recertification and calibration annually.
EMC Specification	ETSI EN 301 489 / BS EN 50293
Radio Specification	ETSI 300.440, FCC CFR47 Part 15.245
Patent No.	Patent applied for

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

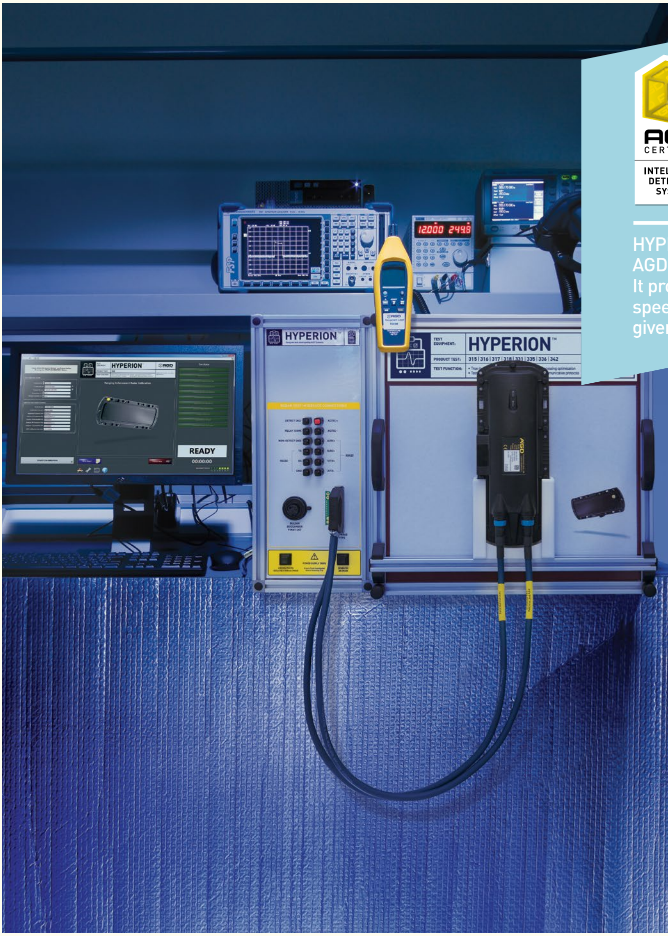
RoHS COMPLIANT
Restriction on Hazardous Substances

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. See 47 CFR Sec. 15. 19

A separation distance of at least 20 centimetres should normally be maintained between this product and the body of users or nearby persons. Changes or modifications to this equipment, not expressly approved by AGD Systems Ltd, may void the user's authority to operate this equipment.

MANUFACTURING TEST PROCESS

TEST EQUIPMENT:	HYPERION™	AGD INTELLIGENT DETECTION SYSTEMS
PRODUCT TEST:	315 | 316 | 317 | 318 | 331 | 335 | 336 | 342	HYPERION was designed and developed by AGD Systems
TEST FUNCTION:	• True range simulation of target • Test cycle time 9 minutes • Radar target processing optimisation • Verification of communication protocols	



Hyperion™ 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 342 units manufactured at AGD are Certified by Hyperion.

AGD CERTIFIED
INTELLIGENT DETECTION SYSTEM

FULL RANGE

HYPERION 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 Hyperion 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 Hyperion on the radar under test provides a thorough examination of the performance of the 342 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 Hyperion ensures full compatibility with country requirements within the 24GHz radar operating band.

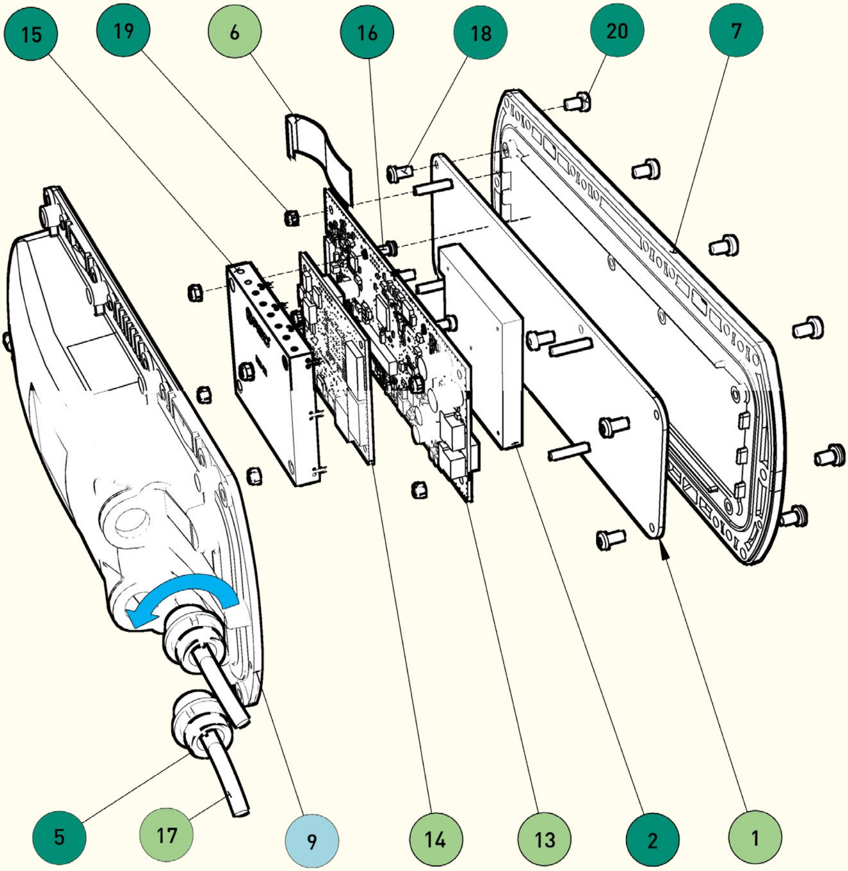
LIFETIME PRODUCT TRACEABILITY

There are clearly defined pass and fail criteria at all stages within the Hyperion 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)

AGD342 RADAR TRAFFIC DETECTOR



Item	Qty	Material
1	1	PCB Assembly
2	1	Zinc Alloy
5	2	ABS
6	1	Mixed Metal & PVC
7	1	Polycarbonate
9	1	PC, Brass
13	1	PCB Assembly

Item	Qty	Material
14	1	PCB Assembly
15	1	Nickel Silver
16	4	Steel
17	2	Mixed Metal & PVC
18	6	Steel
19	8	Steel
20	10	Steel

- 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. See 47 CFR Sec. 15. 19

   A separation distance of at least 20 centimetres should normally be maintained between this product and the body of users or nearby persons.

   Changes or modifications to this equipment, not expressly approved by AGD Systems Ltd, may void the user's authority to operate this equipment.

IMPORTANT

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 $4\mu W/cm^2$.

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 342 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.

CERTIFICATION

TRaC
testing regulatory and compliance

Certificate of Testing

N°: TRA011405CC01A
Page 1 of 15 Pages

Issue Date: 14th February 2013
Our Ref: TRA-011405-00
Client's Order Number: 45345
Date(s) of Test: 7th January 2013 – 22nd January 2013

AGD Systems Ltd
White Lion House
Gloucester Road
Staverton
Cheltenham
Gloucestershire
GL51 0TF

Attn.: Mr Rob Fyfe

Specimen(s):

1 Off	AGD342 Radar (Complete Unit)
Part Number:	AGD342-100-000
Serial Number:	34374-00002
TRaC Stores Number:	TRA11405S5
Receipt Date:	7th January 2013
1 Off	AGD342 Radar (Outer case only)
Part Number:	AGD342-100-000
Serial Number:	N/A
TRaC Stores Number:	TRA11405S6
Receipt Date:	7th January 2013

Specification:

Cold Storage Test
Tested in accordance with BS EN 50556:2011 and PSDB 7.1.2

Temperature	-25 ºC
Duration	3 Hours
Ramp Rate	1ºC / Minute
Stabilization Period	30 Minutes

Hot Storage Test
Tested in accordance with BS EN 50556:2011 and PSDB 7.1.2

Temperature	70ºC
Duration	3 Hours
Ramp Rate	1ºC / Minute
Stabilization Period	30 Minutes

Test Engineer — Ashley Yorke Junior Test Engineer
Approval — S.J. Brown Direc

Certified that the specimens detailed hereon have been subjected to the tests as required by the order unless otherwise stated above competence and quality control arrangements are in accordance with the conditions of our UKAS accreditation. No representation or warranty Tests performed under the terms of Contract constitute, in themselves, a sufficient programme for the Customer's purpose, nor that the Custo is suitable for any particular purpose. The contents of this Certificate shall not be reproduced, except in full, without the written approval of TRa

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TRaC
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Certificate of Test

CERTIFICATE No:	TRA-011405-36-03A
ISSUE No:	1
COPY No:	PDF
DATE:	28th January 2013

PURPOSE OF TEST:	EMC EMISSIONS AND IMMUNITY
TRaC PROJECT ID:	TRA-011405
TEST SPECIFICATION(S):	EN50293:2001, EN50293:2012*, EN301489-3 V1.4.1 (EN301489-1 V1.9.2) COMPRISING OF THE FOLLOWING TESTS: RADIATED RF EMISSIONS (CLASS B) 30MHz – 6GHz CONDUCTED RF EMISSIONS (CLASS B) 150kHz -30MHz, RADIATED RF IMMUNITY (10V/m) 80MHz – 1GHz, 900MHz, 1890MHz, RADIATED RF IMMUNITY (3V/m) 1.4GHz – 2.7GHz CONDUCTED RF IMMUNITY (10Vrms) 150kHz – 80MHz, ELECTRICAL FAST TRANSIENTS (1kV) ESD IMMUNITY, CONTACT DISCHARGE (4kV) ESD IMMUNITY, AIR DISCHARGE (8kV)
DEVIATIONS FROM SPECIFICATION(S):	NONE
EQUIPMENT UNDER TEST (EUT):	AGD342
DESCRIPTION OF EUT:	SPEED AND RANGING RADAR
MODEL / TYPE / VERSION No:	AGD342-100-000
BUILD LEVEL:	PRODUCTION
EQUIPMENT SERIAL No:	34374-00001
TEST RESULT:	MEASURED AS COMPLIANT IN BOTH DETECT AND STANDBY MODES (Measurement uncertainty as per RF109 current issue)
MANUFACTURER / AGENT:	AGD SYSTEMS LTD WHITE LION HOUSE GLOUCESTER ROAD STAVERTON CHELTENHAM GLOUCESTERSHIRE GL51 0TF
ORDER No / CLIENT REFERENCE:	45345 (AGD TEST REFERENCE 009)
DATE OF TEST:	14TH – 21ST JANUARY 2013

TESTED BY: Digitally signed by Simon Copeland DN: CN = Simon Copeland, C = GB Reason: I am the author of this document Date: 2013.01.28 16:36:37 Z — S COPELAND

APPROVED BY: Digitally signed by Neil Roche Reason: I am approving this document Date: 2013.01.30 10:41:41 Z — N ROCHE
EMC PRODUCT MANAGER, TRaC Global Ltd

The results herein relate only to the sample tested. Full results are contained in the relevant works order file.

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Page 1 of 1

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CERTIFICATION

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Certificate of Test

CERTIFICATE No:	TRA-011405-36-05A
ISSUE No:	1
COPY No:	PDF
DATE:	30th January 2013

PURPOSE OF TEST:	EMC IMMUNITY
TRaC PROJECT ID:	TRA-011405
TEST SPECIFICATION(S):	THE SPEEDMETER HANDBOOK (FOURTH EDITION), PUBLICATION 15/05. COMPRISING OF THE FOLLOWING TESTS: RADIATED RF IMMUNITY (10V/m) 80MHz – 2GHz CONDUCTED RF IMMUNITY (10Vrms) 27MHz – 100MHz ESD IMMUNITY, CONTACT DISCHARGE (4kV) ESD IMMUNITY, AIR DISCHARGE (4kV)
DEVIATIONS FROM SPECIFICATION(S):	NONE
EQUIPMENT UNDER TEST (EUT):	AGD342
DESCRIPTION OF EUT:	SPEED AND RANGING RADAR
MODEL / TYPE / VERSION No:	AGD342-100-000
BUILD LEVEL:	PRODUCTION
EQUIPMENT SERIAL No:	34374-00001
TEST RESULT:	MEASURED AS COMPLIANT IN BOTH DETECT AND STANDBY MODES (Measurement uncertainty as per RF109 current issue)
MANUFACTURER / AGENT:	AGD SYSTEMS LTD WHITE LION HOUSE GLOUCESTER ROAD STAVERTON CHELTENHAM GLOUCESTERSHIRE GL51 0TF
ORDER No / CLIENT REFERENCE:	45345 (AGD TEST REFERENCE 009)
DATE OF TEST:	14TH – 21ST JANUARY 2013

TESTED BY: Digitally signed by Simon Copeland DN: CN = Simon Copeland, C = GB Reason: I am the author of this document Date: 2013.01.30 14:38:11 Z S COPELAN

APPROVED BY: Digitally signed by Neil Roche Reason: I am approving this document Date: 2013.02.01 14:35:01 Z N ROCHE
EMC PRODUCT MANAGER, TRaC Global Ltd

The results herein relate only to the sample tested. Full results are contained in the relevant works order file.

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Certificate of Test

CERTIFICATE No:	TRA-011405-47-00-A
ISSUE No:	1
COPY No:	PDF
DATE:	31st January 2013

PURPOSE OF TEST:	RADIO PERFORMANCE TESTING
TRaC PROJECT ID:	TRA-011405
TEST SPECIFICATION(S):	ETSI EN300 440-2
DEVIATIONS FROM SPECIFICATION(S):	EXTENDED TEMPERATURE RANGE (-30°C - +60 °C)
EQUIPMENT UNDER TEST (EUT):	AGD342-100-XXX
DESCRIPTION OF EUT:	PORTABLE NON HANDHELD SPEED ENFORCEMENT RADAR
MODEL / TYPE / VERSION No:	FIELD DISTURBANCE SENSOR
CATALOGUE / SAMPLE No:	S03
EQUIPMENT SERIAL No:	34374-00002
TEST RESULT:	MEASURED AS COMPLIANT
TRANSMITTER Pnom:	17.68mW
ANTENNA TYPE:	PATCH ANTENNA
BAND(s) OF OPERATION:	24.00 GHz – 24.25 GHz
CHANNEL SPACING:	WIDEBAND
NUMBER OF CHANNELS:	1
MODULATION METHOD:	DOPPLER [ ] FMCW [X] OTHER [ ]
RECEIVER CLASS:	Class 2

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Certificate of Test

CERTIFICATE No:	TRA-011405-47-01-A
ISSUE No:	1
COPY No:	PDF
DATE:	31st January 2013

PURPOSE OF TEST:	RADIO PERFORMANCE TESTING
TRaC PROJECT ID:	TRA-011405
TEST SPECIFICATION(S):	AS/NZS 4268:2012
DEVIATIONS FROM SPECIFICATION(S):	EXTENDED TEMPERATURE RANGE (-30°C - +60°C)
EQUIPMENT UNDER TEST (EUT):	AGD342-100-XXX
DESCRIPTION OF EUT:	PORTABLE NON HANDHELD SPEED ENFORCEMENT RADAR
MODEL / TYPE / VERSION No:	FIELD DISTURBANCE SENSOR
CATALOGUE / SAMPLE No:	S03
EQUIPMENT SERIAL No:	34374-00002
TEST RESULT:	MEASURED AS COMPLIANT
TRANSMITTER Pnom:	17.68mW
ANTENNA TYPE:	PATCH ANTENNA
BAND(s) OF OPERATION:	24.00 GHz – 24.25 GHz
CHANNEL SPACING:	WIDEBAND
NUMBER OF CHANNELS:	1
MODULATION METHOD:	DOPPLER [ ] FMCW [X] OT

Full results can be found the TRaC test report TRA-011405-W-AS-NZ-1

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Certificate of Test

CERTIFICATE No:	TRA-011405-47-02-A
ISSUE No:	1
COPY No:	PDF
DATE:	31st January 2013

FCC IDENTITY:	WH3342100
TRaC PROJECT ID:	TRA-011405
TEST SPECIFICATION(S):	CFR 47 Part 15C
DEVIATIONS FROM SPECIFICATION(S):	EXTENDED TEMPERATURE RANGE (-30°C - +60°C)
EQUIPMENT UNDER TEST (EUT):	AGD342-100-XXX
DESCRIPTION OF EUT:	PORTABLE NON HANDHELD SPEED ENFORCEMENT RADAR
MODEL / TYPE / VERSION No:	FIELD DISTURBANCE SENSOR
CATALOGUE / SAMPLE No:	S03
EQUIPMENT SERIAL No:	34374-00002
TEST RESULT:	MEASURED AS COMPLIANT
TRANSMITTER Pnom:	442.08 mV/m @ 3m
ANTENNA TYPE:	PATCH ANTENNA
BAND(s) OF OPERATION:	24.00 GHz – 24.25 GHz
CHANNEL SPACING:	WIDEBAND
NUMBER OF CHANNELS:	1
MODULATION METHOD:	DOPPLER [ ] FMCW [X] OTHER [ ]

Full results can be found the TRaC test report TRA-011405-W-US-1

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Page 1 of 2

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AGD®

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Declaration of Conformity

Certificate No: CE-062 Issue: 1

We AGD SYSTEMS LTD
White Lion House
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Gloucestershire
GL51 0TF
UNITED KINGDOM

as manufacturer hereby declare that the following product(s)

Equipment Model Type(s): AGD342-100-000 (UK/EU/AS/NZS/USA)
Equipment Description: Speed Enforcement and Ranging Radar - Traffic Detector

conform with the provisions of the following EC Directive(s), including all amendments, and with national legislation implementing this / these directive(s):

1999/5/EC relating to Radio & Telecommunications Terminal Equipment, 2004/108/EC relating to Electromagnetic Compatibility and 2006/95/EC relating to Low Voltage Directive (Safety)

Standards Applied:

EN300 440-1 V1.6.1, EN300 440-2 V1.4.1, EN301 489-1 V1.9.2, EN301 489-3 V1.4.1, EN60950-1:2006/A1:2010

AS/NZS4268:2012	Radio Equipment and systems - Short Range Devices - Limits and methods of measurement
FCC CFR47 Part15, 2010-10	Title 47 of the Code of Federal Regulations; Chapter I Part 15 - Radio frequency devices

The radiated power of the radar antenna module is up to a maximum of 100mW (20dBm) eirp and the frequency of operation is 24.075GHz to 24.125GHz. (ITU Code 9M4FXN)

and where specified below the product(s) also conform with the National and / or International standards and specifications shown

BSEN50293: 2001	Electromagnetic Compatibility – Road Traffic Signal Systems
BSEN50293: 2012	Road Traffic Signal Systems – Electromagnetic Compatibility
The Speed meter Handbook (4TH Edition)	Publication No. 15/05 including amendments 1, 2 & 3. [covering EMC sections, contact AGD for further information]

Signed Dated: 6/2/13

For and on behalf of AGD Systems Ltd
P M Hutchinson
Managing Director

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2011

nqa ISO 9001 Registered Quality Management — UKAS MANAGEMENT SYSTEMS 015

nqa ISO 14001 Registered Environmental Management — UKAS MANAGEMENT SYSTEMS 015

Registered in England and Wales
Number 2666988

NOTES

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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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