



Houston Radar LLC

Installation and User Manual For

K-Band Doppler Radar DR600 (-BOM2) version
(Applies to both DR600S and DR600C versions, DR600S shown below)



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This device conforms to the CE mark and conforms to the requirements of the applicable European Directives as follows:

EN 60950-1
ETSI EN 300 440-1 V1.4.1
ETSI EN 300 440-2 V1.2.1
ETSI EN 301 489-1 V1.7.1
EN 55022 Class B
EN 61000-4-2 8 kV/4 kV
EN 61000-4-3 3 V/m

FCC ID: TIADR600

This device meets the FCC requirements for RF exposure in public or uncontrolled environments.

This device complies with FCC part 15 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.

Changes or modifications not approved by Houston Radar could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



In order to comply with FCC/ISED Canada/MIC RF Exposure requirements, this device must be installed to provide at least 20 cm separation from the human body at all times.

Pour être conforme aux exigences de la FCC / ISED Canada / MIC RF Exposure, cet appareil doit être installé pour assurer une séparation d'au moins 20 cm du corps humain en tout temps.

IC: 21838-DR600

This device meets the IC requirements for RF exposure in public or uncontrolled environments.

Cet appareil est conforme aux conditions de la IC en matière de RF dans des environnements publics ou incontrôlée.

IC Warning

This device complies with ISED Canada license exempt RSS standard(s). Operation is subject to the following two conditions: 1. this device may not cause interference, and 2. this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme avec ISED Canada RSS standard exempts de licence (s). Son utilisation est soumise à Les deux conditions suivantes: 1. cet appareil ne peut pas provoquer d'interférences et 2. cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.



The DR600C open frame radar is sensitive to electrostatic discharge. Please observe handling precautions.

Note: Specifications may change without notice.
Note: Not liable for typographical errors or omissions.



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INTRODUCTION

Congratulations on your purchase of the Houston Radar LLC's directional Doppler speed radar DR600 (available in weatherproof DR600S or open frame DR600C options). This state of the art K-band microwave Doppler speed radar is specifically designed for the license free, battery operated speed radar market, for use in speed awareness trailers, school zones and other speed restricted traffic zone speed awareness uses.

Utilizing the latest in high performance, ultra low power DSP (Digital Signal Processing) technology, you will find that this high quality product meets your exacting standards for performance and reliability.

Some of the highlights of this product include:

- ✓ FCC approved and with **CE mark**† for your convenience and peace of mind
- ✓ Advanced DSP based performance yields consistent performance and speed detection
- ✓ Up to 3300 feet (1000 m) of pickup distance for incoming vehicles on open and level road
- ✓ Standard serial port hookup and data format allows hassle free use in existing systems
 - Use in place of existing products
 - Interface to your message displays
 - Use in your speed trailers
 - Use in school zones
- ✓ 2nd True serial port. Connect to different devices simultaneously
- ✓ Only 0.2 W power usage is up to 4X lower vs. competing solutions and allows use of smaller batteries and solar panels- saving you money
- ✓ Rugged weatherproof enclosure features side mounts and short depth (DR600S only)
- ✓ Built in clock/calendar keeps time even with DC power removed
- ✓ Radar internal software is “bootloader” flash upgradeable in the field
- ✓ Optional bluetooth control allows you to change/set radar parameters including:
 - Min/Max speed limit of detection
 - Speed limit setting for flashing display digits
 - Sensitivity setting for changing detection range
 - Internal clock/calendar
 - Serial port settings
 - Radar built in self test

Now Featuring Optional Integrated “Advanced In-Radar” Traffic Statistics Package with:

- Multi-vehicle/multi-lane tracking allows better accuracy over competing units
- 2 months of speed as well as count statistics saved in internal memory
- Real time clock keeps stats with date/time
- Unmatched Windows™ based “Stats Analyzer” software to download, manage, analyze and plot your stats information from all your DR-500S radars available as option
- Stats saved in mph or kph units per display option

INSTALLATION

Mounting:

The DR600S is supplied in a weatherproof enclosure and may be conveniently mounted via the side-mounting bosses, outside the speed trailer enclosure to facilitate pointing it into the oncoming traffic.

Two #8-32 size screws are provided for side boss mounting.

The DR600C is provided in an open frame format with 4x corner holes on the PCB for mounting. Please request an outline drawing from Houston Radar for mounting details. If a battery is installed in the radar, you must ensure that this Lithium backup battery does not short to the frame or battery ground.

Direction Pointing:

The DR-500 is directional in nature. It rejects traffic moving away from it and only measures oncoming traffic.



If the optional stats analyzer feature is purchased with the unit, stats will only be collected for incoming traffic. This allows you to position the unit in a median without worry of picking up traffic on the outgoing lane.

For optimal performance:

- ✓ Radar should be mounted with the mounting bosses horizontal to the road.
- ✓ Radar should be pointed into the direction of the oncoming traffic.
- ✓ Radar should be placed along the size of the road to minimize the angle of the oncoming traffic to the radar.
 - If radar cannot be placed right along the side of the road, it should be pointed at least 200-300 feet up the road into oncoming traffic.
- ✓ The radar may pickup rotating fans. Avoid pointing it at fans or compressors.
- ✓ Radar should be mounted at least 3 feet high from the road for optimal performance and at least 5 feet off the ground for pickup distance of 1500+ feet.



Hookup:

Power Input:

The DR600 radar should be powered from a nominal 12V DC battery and features industry leading nominal operational power consumption of less than 16mA. This is up to 4X lower than competing products.

This operational power translates directly into a longer battery life or gives you an option to power the unit from smaller batteries that would also require smaller solar panels.

Serial Connection:

The DR600 has a standard 3 wire (RX, TX and Ground) RS232 port to output speeds and accept configuration settings.

Speed data is output serially in mph (or Kph if set via the remote) as three ASCII digits in the following format:

```
nnn\r\n
```

where:

nnn : The three digit ASCII speed digits in mph/kph

\r\n : A new line followed by a carriage return character

When no further vehicles are detected, the radar outputs:
000\r\n or ?000\r\n (once or repeating depending on configuration)

This format is compatible with other industry formats including a standard RS232 serial port on a PC, message boards and speed displays.

Note: Optionally, the radar may be set to output the display speed in +nnn\r format. Please see serial port config settings table later section.

Setting Detection Sensitivity via the ASCII Interface:

In addition through the optional IR interface, the radar also allows programmatic sensitivity setting (and many other parameters in an industry compatible manner- contact us for details).

Over the serial interface, send in ASCII the following commands:

```
Sensitivity:nn\n and  
Sensitivity?\n
```

In the 1st case it sets the detection sensitivity to "nn" where nn is from 10 to 99 and is a %



of the max detection distance (typically about 1500 feet but can vary with installation effects and size of the target).

If the sensitivity is set ok, it replies with

OK\n

Log/Statistics Storage:

The DR600 radar has capacity to store traffic statistics in user programmable time bin intervals (default is 5 minute bins which yields 60 days of storage) and features a clock/calendar that retains time even when external power is removed. The clock is used to time stamp the collected statistics.

Stats are stored in mph or kph units. This depends on the display units of the stats. See the IR remote programming section to change the display units of the radar.

This feature is an add-on software option. Please contact Houston Radar LLC for purchase of this option.

Detecting traffic statistics inside the radar has tremendous advantages:

- Radar tracks multiple vehicles at different speeds simultaneously and hence does not miss vehicles visible to it
- Radar access to all return signal parameters of the target vehicles processed by proprietary software inside radar makes full use of every bit of information present in reflected signal and dramatically improves counting accuracy
- No add-on boards keeps total system power usage down and reliability up
- Advanced Statistics are software “key enabled” allowing turn-on in the field or after the radars have shipped to the sign manufacturer
- Easy Bluetooth wireless access using standard Bluetooth modules you buy from your source or optional on board Bluetooth. Now enable statistics collection wirelessly!

Please see a white paper on this topic on our web site for further discussion on this topic including some actual field test results.

You may download it from the following URL:

<http://houston-radar.com/downloads/HoustonRadarAdvancedStatisticsWhitePaper.pdf>

Wire Signal Descriptions:

DB9 Pin #	Signal Name	Direction (wrt Radar)	Description
1	+12V DC	Input	Radar + Power Supply. Connect to battery + 9.5VDC to +18VDC
2	PRI RS 232 TX	Output	Primary RS232 transmit output from Radar
3	PRI RS 232 RX	Input	Primary RS232 receive input. Required only if connected to PC to download stats from unit or setting sensitivity parameter
4	AUX RS232 RX	Input	Auxiliary RS232 RX
5	GND	Input	System Ground. Connect to battery -
6	AUX RS232 TX	Output	Auxiliary RS232 TX
7	Trigger 1	Output	“Open Drain Output”. See Note 1.
8	Trigger 2	N/A	“Open Drain Output”. See Note 1.
9	GND	Input	System Ground. Connected to wire #5.

Note 1: The DR600 features an output that can wake up an external display panel(s) to bring it out of power saving mode when a vehicle is detected above a user set threshold. If the panels you hook to the radar do not feature such an input, this wire should remain unconnected.

Normally this pin is pulled up to +12VDC by ~18KOhm resistor. When a vehicle is detected, this pin is pulled down to GND and held down to GND as long as a vehicle is detected. This pin is released to +12VDC as soon as the radar detects no further traffic.

You must ensure that no more than 500 mA of current flows into this terminal when it is pulled low.





USE

Turn on the power to the DR600 to make it operational. No other action is required. The radar will output data over the serial port(s) whenever it detects a vehicle that is above the programmed lower speed limit and below the programmed high limit. The default limits are set at 5mph (kph) and 99mph (kph) at the factory (but may be different for a particular user. Please consult the factory test report that is included with the radar).

Using the serial interface, program the high limit to blank out the speed display above this limit. This will prevent “racing against the radar” by denying a speed feedback display of excessive speeds as determined by you.

On initial power up, the radar counts up from 000 to 010 to provide a quick visual check that it is operational.

Collecting and Analyzing In-Radar Traffic Statistics

The DR600 Radar supports optional “In-Radar” advanced traffic statistics collection. This feature is sold separately. If your radar has this feature enabled you may collect the stored statistics by using the provided Houston Radar Advanced Statistics Analyzer Windows program.

This program must be installed on a MS Windows 2000, XP or Vista PC and allows the retrieval of stored statistics from the radar by using a PC serial port. It also has features to generate traffic reports, plot interactive graphs and export the raw data to a MS Excel file.

Please refer to the on line help functionality of the program after you install it on your computer for detailed instructions on how to use its functionality.

Real Time Traffic Statistics In the Radar:

The DR600 In-Radar stats software now features “real time” histogram statistics. These are updated as soon as a vehicle is detected and may be read out as a speed bin count “histogram”. Thus no historical records need be read out and parsed to read statistics. This feature requires a host program to be on-line to read the live statistics. Please contact Houston Radar for more information if you are interested in acquiring live statistics from the radar.



CONFIGURING THE RADAR

Setting the following internal parameters configures the DR600 radar. All parameters are 16 bits wide (two bytes) and can accept values from 0 to 65535 (although not all possible values are valid for the all parameters).

The unit's internal parameters are configured via the radar's RS232 port connected to a PC's RS232 serial port and using the Houston Radar Advanced Stats Analyzer program's configuration screen as described here. Alternatively, you may use the provided Houston Radar Configuration tool.

The following internal "variables" may be set. Their functions are described below:

Radar Configuration Variable Name	Description
RS	Sets the primary RS232 serial port's baud rate and speed output format. Do not change this value unless you understand the implications.
RA	Sets the auxiliary RS232 serial port's baud rate. The output format is the same as the primary serial port (set by the RS variable above).
UN	Lower Byte: Sets the internal speed units of the radar. All LO, SP, HI, SI speeds are interpreted to be in this units. 0 = MPH 2=FPS (Feet per second) 1 = KPH 3=MPS (Meters per second) Upper Byte: Sets number of digits after decimal point. <i>See note 1.</i>
LO	Low speed cutoff. Vehicle speeds are not output below this speed. You may set this to 0, but the radar will only measure and output speed based on its minimum speed specification. Should value be set to be less than HI.
HI	High-speed cutoff. Vehicles speeds are not output above this speed. Should be set higher than LO speed.
SP	'Flashing' speed limit. Any speed higher than this value 'flashes' the ASCII output at 2/3 duty cycle, 1Hz. Sending out 000 between nnn speed values interrupts the speed output to signal "flashing". The trigger output is NOT de-asserted during flashing. It is up to the device connected to the radar to interpret this as 'flashing' and take appropriate action to flash the display. Set this to a value higher than HI to disable this feature.
ST	Target detection sensitivity. Valid values are from 10 to 99 and are a percentage of max range. So a value of 50 would yield about 750 feet detection. Note: This is not range setting but detection sensitivity. Thus if large vehicles are being detected at 2000 feet, a value of 50 will make them detect at approx 1000 feet etc.
SF	1 = Select Fastest Target for speed output 0 = Select Strongest Target for speed output
BN	Set from 1 to 60 minutes of binning interval for stats collection.

	<p>Traffic data binned (see below) and is accumulated for this duration in the bins and then a time stamped record made in stats memory in the radar.</p> <p>Speed bins are factory set and cannot be changed. They are: 5 MPH bins for MPH units (20 bins in total from 0 to 105 MPH) 10 KPH bins for KPH units (17 in total from 0 to 170 KPH)</p>
MO	<p>Radar mode bit mask. The bits controls different functionality as described below:</p> <p>Bit set (1) = enable functionality. Clear (0) = disable functionality, unless otherwise noted.</p> <p>Bit 0: SI3 compatibility mode for ASCII command to set and read sensitivity. Contact us for more details.</p> <p>Bit 1: ASCII output on primary serial port</p> <p>Bit 2: ASCII output on auxiliary serial port</p> <p>Bit 3 – 4: Reserved. Do not set.</p> <p>Bit 5: Fast updates. Sends ~8 updates/sec when enabled. DO NOT SET if using True Average Speed or In-Radar traffic stats else stats functionality will be adversely affected.</p> <p>Bit 6 – 9: Reserved. Do not set.</p> <p>Bit 10: Extra filtering for slow (<20mph) targets. Increases the internal validation time for slow targets before they are accepted as valid. Enable this bit if radar is seeing some fleeting spurious speed output below 20 mph (32 kph). (<i>See note 2</i>).</p> <p>Bit 11: “True Average Speed” mode. Requires purchase of in-radar traffic statistics collection option. Radar will send out average speed of all detected traffic over period set in TA variable. (<i>See note 3</i>).</p> <p>Bit 12: Outgoing detection. When set, radar will reject incoming targets and only report speeds of outgoing targets. (<i>See note 4</i>).</p> <p>Bit 13: Tuning fork mode. When set, disables directional selectivity for 30 seconds after power up. This allows the radar to pickup and display speed associated with tuning forks much easier than when in direction selective mode. (<i>See note #5</i>).</p>
TA	<p>Average Speed time period in seconds. If “True Average Speed” mode bit is set in the MO variable and in-radar traffic stats option is enabled, radar enters true average speed mode. In this mode, radar accurately averages the count-weighted speed of all targets and sends the average out on the serial port. It no longer outputs real-time speed of targets.</p>
KY	<p>Reserved. Do not set unless value provided by Houston Radar.</p>

Some features described above (and identified with a “see note”) were implemented in later firmware versions of the radar. The radar firmware may be updated in the field via the serial port. If you wish to use a feature not implemented in your firmware version, please request an updated firmware from Houston Radar by contacting us at contact@houston-radar.com.



The firmware in the radar is displayed with the “VER=” tag when connecting to the radar via the Windows software provided with the radar. Alternatively, it may be queried via the “info” command via a command line terminal program like Hyperterminal or “Teraterm Pro”. It is also printed on the factory test report that accompanies all radars.

Note 1: Decimal output and ft/s and m/s units requires firmware version #416 and later.

Note 2: Extra filtering for slow targets requires firmware version #411 and later.

Note 3: True average speed requires firmware version #424 and later. It also requires the optional “In-Radar traffic statistics” feature to be purchased and enabled. This may be done via software “key” set via the serial port in the field.

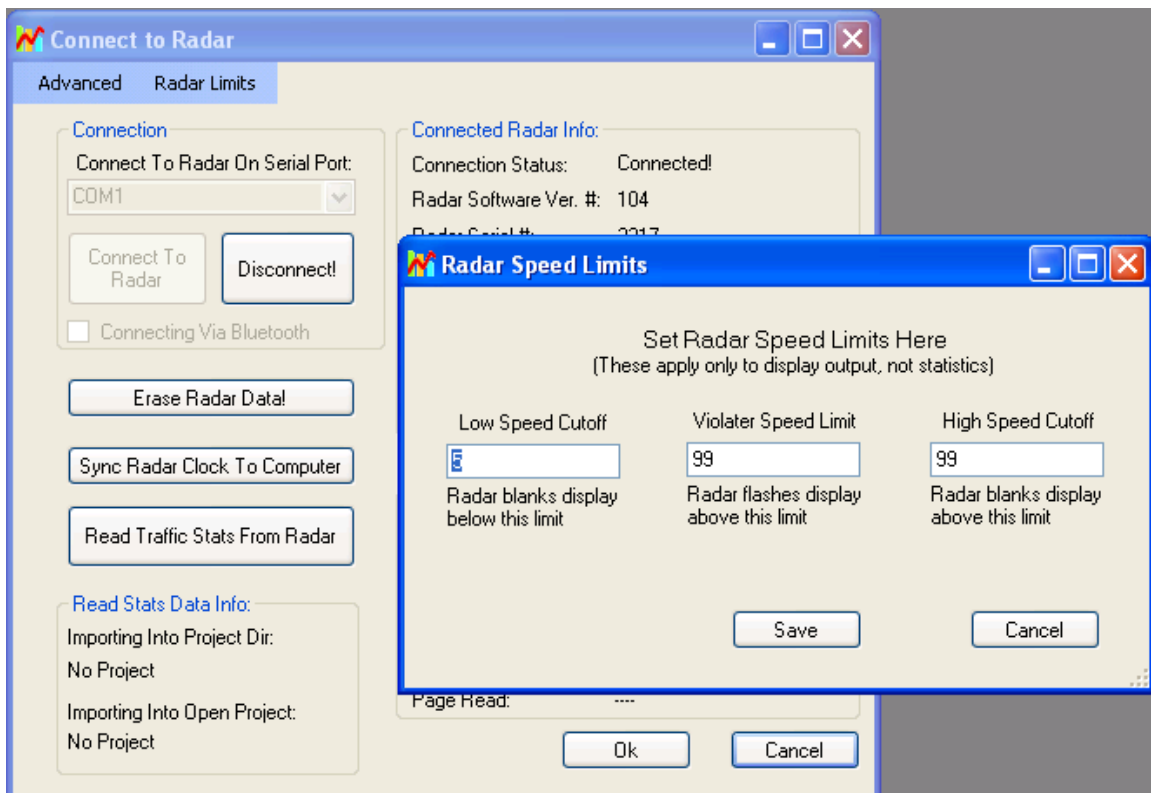
Note 4: Outgoing detection feature requires firmware version #422 and later.

Note 5: Tuning fork mode requires firmware version #427 and later.

Setting Configuration Variables in the Radar:

Setting variables via the provided Windows Graphical User Interface program:

1. Install the provide Houston Radar Advanced Stats Analyzer Windows program on a Windows 2000, XP or Vista computer. Alternatively you may use the provided Houston Radar Configuration tool.
2. Connect the radar RS232 port to the PC's RS232 serial port. If the PC does not have a serial port you may buy a USB serial converter dongle (from BestBuy, Radioshack or any Internet store).
3. Power up the radar from an external power supply or alternatively use the USB to serial port and power adapter available from us (our part #: 900-0016).
4. Start the Houston Radar Stats Analyzer program on the computer (Start->All Programs->Houston Radar->Houston Radar Stats Analyzer)
5. In the program window, click on Start->Connect to Radar...
6. Click on "Connect" button.
7. Ensure you see a "Radar found on COM" message. The COM # will depend on your computer .
8. Click on OK. Now you are ready to configure the radar.
9. To configure the LO, SP & HI limits, click on "Radar Limits" menu bar item. The three fields show the current values of the three variables. Change the variables to the desired values and click on "Save".
10. To configure any other variable, click on "Advanced->Radar Configuration". In the window that comes up, enter the two letter variable name in the "Variable" field (from the table on previous page). Enter its value in the "Value" field and click on "Set Variable" button.





Setting variables from an ASCII Terminal program via ASCII commands:

Starting from firmware version #415 all the radar variables can also be set and queried via a simple ASCII command set over the serial port.

ASCII commands may be issued via an ASCII terminal program like Hyperterminal or Teraterm Pro. Alternatively, you may issue these commands from an attached microcontroller.

The ASCII commands are:

get (to get a config variable)

set (set set a config variable to a supplied value)

reset (resets the radar. Required after changing variables MO, MD and RS, RA(for DR series radars only). LO, HI, SP, ST, SF, UN do not require a reset).

info (print out some info about the radar. Info is in the format of <tag>=<value>). New tags may be added in the future. Order of tags may be moved around.

e.g.

To set a variable (variables are documented in the user manual):

set: <case sensitive var name> <value>[Enter]

e.g.

set:LO 5

alt format:

set:LO=5

sets the low speed cutoff to 5 etc.

Variables are case sensitive. Commands are not.

Success is indicated by an "OK".

Failure is indicated by either:

"ERROR" - Command was recognized but some other error occurred (variable not present, format not correct etc.)

<nothing returned> - Command was not recognized. Entire line was silently discarded.

This ensures that spurious things like enters or other ASCII chars do not generate "ERROR" when you are not expecting them.

To get a variable:

get:<case sensitive var name>[ENTER]

e.g.

get:LO

returns

LO=5 (if value is presently set to 5).



DR600 SPECIFICATIONS

General

Operating Band	K-Band
Frequency	24.125 GHz ±25Mhz
Power Output	5mW
Antenna Gain	18 dB
Polarization	Linear
Supply Voltage	5V DC to 30V DC
Reverse Battery	Protected
Detection Range	Typically 1500+ feet on open & level road w/ radar mounted 5 feet above road. 3000ft boost mode
Nominal Current Draw approx	16 mA (+/-1ma,) (@+12V DC)
Operating Temp.	-22°F to +175°F (-30°C to +80°C)
Weatherproof	Yes (IP68) (only DR600S package option)
IR Remote Programmable	Yes (optional)

Approvals

Approvals	FCC Part 15
CE (DR600S only)	European R&TTE directive (1999/5/EC) EN 60950-1 ETSI EN 300 440-1 V1.4.1 ETSI EN 300 440-2 V1.2.1 ETSI EN 301 489-1 V1.7.1 EN 55022 Class B EN 61000-4-2 8 kV/4 kV EN 61000-4-3 3 V/m

Data Interfaces

Serial Communication	2x RS232 with independently programmable baud rates
Data Rate	Baud Rates from 1200 to 115200 baud
Data Format	Selectable via serial port or factory set. (Please refer to user manual or contact Houston Radar)
Data & Pwr Connector	DB9 Male (DR600S) wired as DCE, DB9 Male on DR600C Note: Not all pins are RS232 signal compatible.

Mechanical

Weight	approx 1.2lb/0.5Kg (DR600S enclosure option).
Length	1.2 inches
Cable Exit	Bottom (DR600S)
Mounting	Two side bosses using 2X #8-32 screws (provided) (DR600S)
Width	4" inches @mounting bosses (DR600S)

Performance

Accuracy	±0.1 mph internal rounded to 1mph external output over ASCII
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Speed Range 3 mph to 205 mph (5 to 105mph recommended)
(5 Kmph to 300 Kmph)

Detection Range Typically 1500+ feet detecting compact car, further with larger vehicles. *Can vary with installation & road conditions* and target radar cross section. Boost mode to +3000ft

Advanced Statistics

Storage Last 60 days in 5 min bins & 20 (5 mph) speed bins mph mode
Last 60 days in 5 minute bins & 17 (10 kph) bins in kph mode

Multi-vehicle capable Yes (in multiple lanes for approaching traffic)

Internal Clock Battery Life At least 5+ years on the shelf with radar un-powered. 10+ years under normal radar operation in the field.

Note: Advanced Statistics is sold as an option in the radar.