STALKER
The World Leader in Speed Measurement

STALKER
Surface Velocity Radar (SVR)
Speed Sensor

Owner's Manual

Dear Valued Radar Customer:

Thank you for choosing the STALKER SVR Radar System. We sincerely appreciate you purchasing the STALKER and giving us the opportunity of serving you and your organization. You will find the STALKER to be an invaluable tool in water management. Most importantly, we care about you, our customer, and want you to be completely satisfied. Our success as a company depends upon your satisfaction and experience with the STALKER Radar.

Applied Concepts, Inc. believes that the STALKER offers more than superior performance and versatility. STALKER is backed 100% with reliable, professional, and experienced sales and service support, ready to assist you at your request. We also offer the longest warranty in the industry, with nationwide factory authorized repair centers to assure you of fast and efficient service.

We wish you the greatest success in your water management program. Please do not hesitate to let us know if there is anything we may do to add to your product satisfaction. Thanks again!

Sincerely,
Applied Concepts, Inc.

Any changes or modifications not expressly approved by Stalker Radar / Applied Concepts, Inc., could void the user's authority to operate the Stalker SVR Speed Sensor.

Not intended for Law Enforcement use.

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Introduction

Congratulations! You have purchased the most accurate SVR Sensor system available. The Stalker SVR Speed Sensor radar was designed specifically to measure the speed of water movement in rivers and streams.

The ***STALKER SVR Speed Senor*** is a Ka-band **S**urface **V**elocity **R**adar designed to allow maximum flexibility in measuring water flow.

Utilizing a state-of-the-art Digital Signal Processor (DSP), ***STALKER SVR Speed Sensor*** provides a level of performance, convenience, and accuracy previously unavailable. The DSP performs the critical filtering and timing functions required for speed measurement in its software, as opposed to hardware. This provides less unit-to-unit variation, more reliable performance, and easier maintenance. One of the unique features of the ***STALKER SVR Speed Sensor*** is that it can be upgraded in the future by simply installing new software, preventing obsolescence!

What's Included

The components included with your radar are listed below. If you are missing any parts or if you would like to upgrade your package, contact **Stalker Radar** at **1-877-782-5537**.

RS-232 SVR Speed Sensor Package	Part Number	
SVR Speed Sensor, RS-232	200-0814-00	
Radar Manual	011-0105-00	
Cable Assembly, RS-232, 12 foot	155-2223-00	
Antenna Dash/Deck Mount	200-0244-00	
Programming Interface, RS-232	200-0702-00	(on first order only)

RS-485 SVR Speed Sensor Package	Part Number	
SVR Speed Sensor, RS-485	200-0914-00	
Radar Manual	011-0105-00	
Cable Assembly, RS-485, 82 foot	155-2239-00	
Antenna Dash/Deck Mount	200-0244-00	
Programming Interface, RS-485 (Includes 82 foot cable with connector to connect to Interface Box.)	200-0730-00	(on first order only)

Detailed Instructions

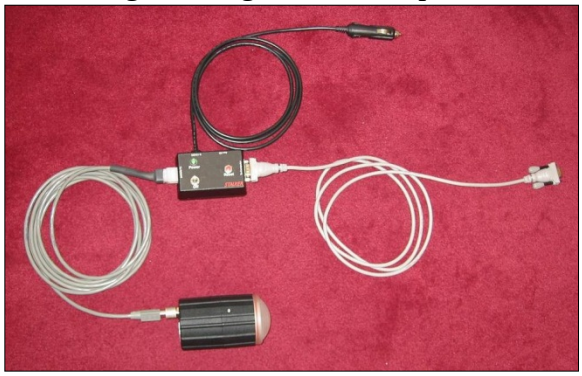
QUICK START

The easiest way to start using a Speed Sensor is to connect it to a PC using a STALKER Speed Sensor Power/Programming Box (200-0702-00 for the RS-232 sensor and 200-0730-00 for the RS-485 version). As shown in the pictures below, there are connections for a cable to the Speed Sensor (To RADAR), a cable to the PC (To Computer) and a power connector (9-12VDC).

Note: The voltage to the Programming Boxes should not exceed 12 VDC. This is a limitation of the Programming Box, not the sensor.

You'll need:

- A STALKER Speed Sensor
- A PC with a standard serial port. For the quickest start, we recommend a PC with a standard 9-pin D serial port connector.
- A 12 VDC power source. If you do not have a cigarette plug power source available, use the optional AC to 12VDC Power Adaptor listed with other accessories in Accessories section.
- A Programming Box/Developer's Kit.



Quick Start Steps:

- Connect the Speed Sensor to the box with the cable provided in the kit.

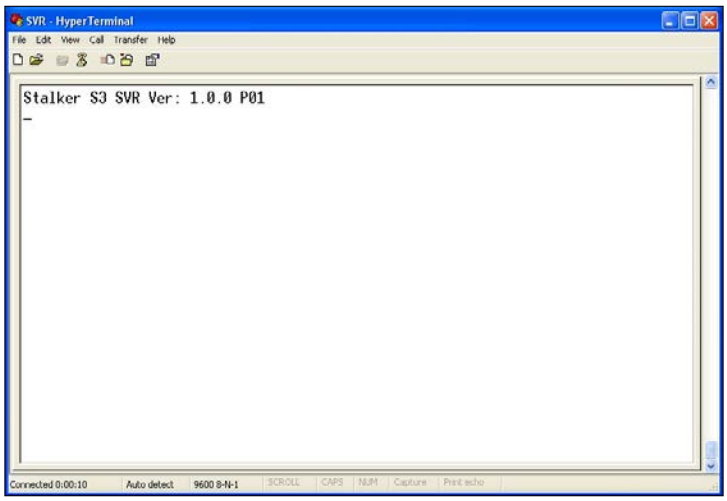
- Connect to the PC using the provided serial cable. This is a "straight-through" serial cable. Do not replace it with a "null modem" cable which will swap the transmit and receive wires.

- Connect to power by plugging the cigarette plug into a 12VDC (nominal) power supply.

- In Windows®, open the HyperTerminal[1,2] program. Open the com port on HyperTerminal that is connected to the SVR Speed Sensor. Set up HyperTerminal connection for 9600 baud, no parity, 8 data bits, 1 stop bit, no flow control.

- Turn the Speed Sensor on by flipping the On/Off switch on the Programming Box. The green LED should turn on

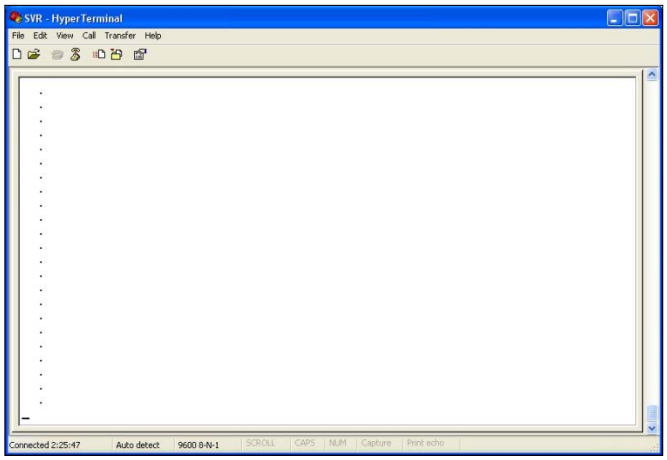
- If the com port is properly connected and opened, HyperTerminal should show the following opening screen on the sensor's power up. The version number may be different depending on the current software version at the time the sensor was purchased.



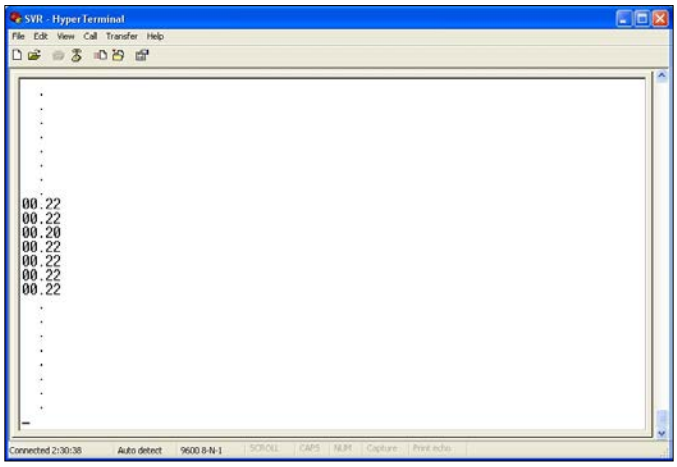
[1] HyperTerminal can usually be found under the Accessories folder in the program list.

[2] Almost any Serial Comport application can be substituted for HyperTerminal

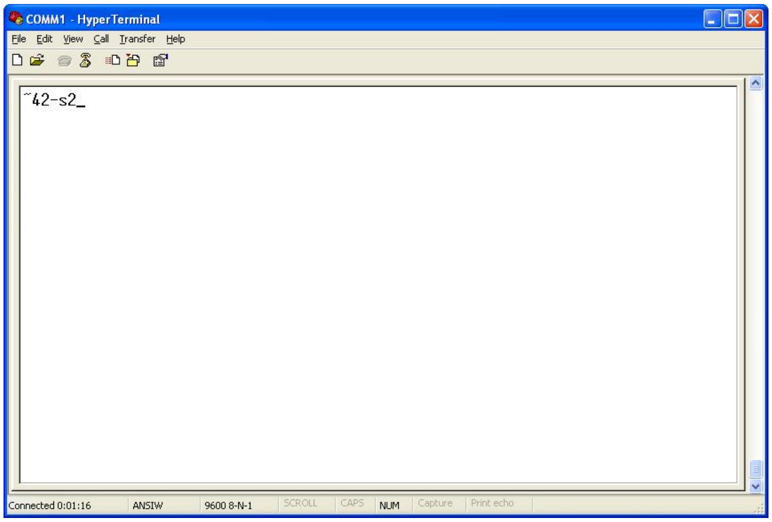
- Type “s2 (enter)” in the Hyper Terminal window to command the sensor to begin sending speed updates. The HyperTerminal should show:



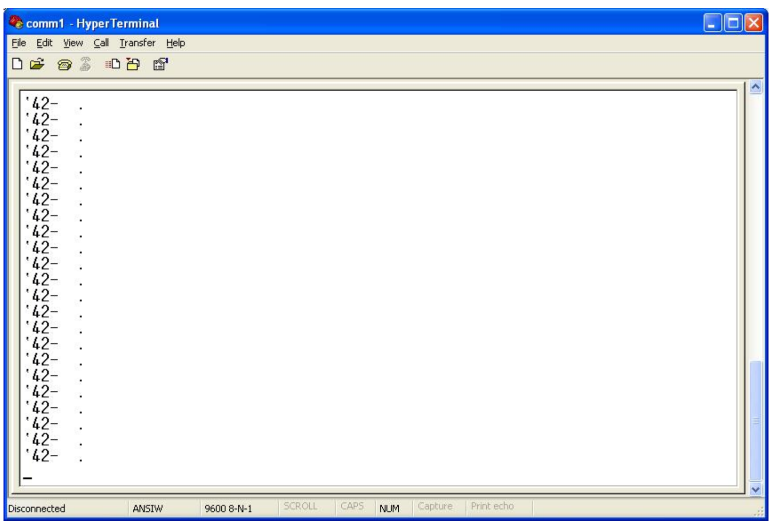
- If you move your hands <u>slowly</u> towards or away from the sensor, covering about a 3-foot distance, the terminal should show some speed updates as shown here.



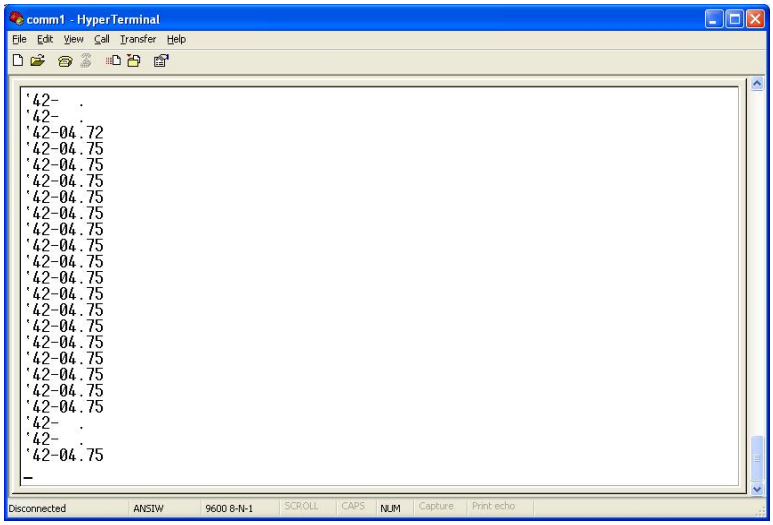
RS-485 SAMPLES



Sample Code for streaming data.



Response with no speeds read.

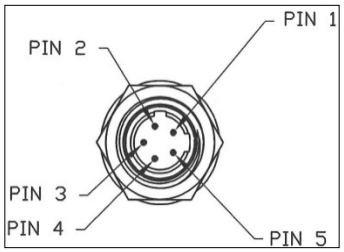


Response with speed readings.

CONNECTING THE SPEED SENSOR

As recommended above in the Quick Start section, the fastest and easiest way to get a Speed Sensor connected and running is by using a Developer's Kit Programming Box. In this section the simple box cabling is described in more detail along with alternative custom solutions for connections to the unit. Cables referenced below are listed in Appendix F with other optional accessories.

The Speed Sensor has a single connector used to provide it power, to control and configure it, and to monitor speed information. Its pinout is shown below as viewed from outside the unit. Pin 1 is between the polarizing slots, and pins 2 through 5 are numbered in a counter-clockwise direction.



Pin 1 – RX – Receive Data – toward the Speed Sensor (COMM+ for RS-485 units)
Pin 2 – PWR – 12VDC (nominal)
Pin 3 – AUX – Auxiliary Input/Output
Pin 4 – TX – Transmit Data – from the Speed Sensor (COMM- for RS-485 units)
Pin 5 – GND – Ground

Connecting to Power

Using the Programming Box, the power connection is made from the cigarette plug, through the box, and to pins 2 and 5 of the Speed Sensor over the 155-2223-00 / 155-2239-02 Speed Sensor and Power I/O Cable. If the RS-232 Speed Sensor needs to be mounted farther from the Programming Box, the optional 155-2290-00 Extension Cable is available for an extra 15 feet.

For custom user cabling, connect pin 2 to a DC voltage source in the range from 9 to 24 volts. Connect pin 5 to the source's ground return. The Speed Sensor draws less than .5 A of current at a nominal 12 VDC.

Connecting to an RS-232 Controller

Using the RS-232 version of the Developer's Kit, 200-0702-00, the connection between the Speed Sensor and the RS-232 PC controller runs over the 155-2223-00 Speed Sensor Power and I/O Cable, through the box, and to the controller's 9-pin D serial port over the 155-2130-00 RS-232 Straight-Through Cable. Do not replace this RS-232 cable with a "null modem" cable which will swap the transmit and receive wires.

Some PCs are not configured with the recommended 9-pin D serial ports and have USB ports instead. In these cases, acquire a USB-to-serial-port adapter to perform the necessary conversion. These products vary and may or may not work well. In some cases they provide undesirable buffering and delay, and a different brand should be used.

For custom user cabling, the serial connection uses pins 1, 4, and 5 of the Speed Sensor connector. Pin 1 is the Receive Data pin for data transmitted from the controller toward the Speed Sensor. Pin 4, Transmit Data, is for data transmitted from the Speed Sensor toward the controller. Pin 5 is the common ground.

Speed Sensors are configured for 10-bit asynchronous serial communications with 1 start bit, 8 data bits, 1 stop bit and no parity (8N1). This is standard for PC serial ports, but a custom controller may need to be modified to match these settings.

To assist with custom cable development, the 155-2227-00 Power I/O User Cable Parts Kit can be used to interface the 155-2223-00 Power and I/O Cable to custom connections.

Connecting to an RS-485 Controller

Using the RS-485 version of the Developer's Kit, 200-0730-00, the connection between the Speed Sensor and the RS-232 PC controller runs over the 155-2239-02 Speed Sensor Power and I/O Cable, through the box, and to the controller's 9-pin D serial port over the 155-2130-00 RS-232 Straight-Through Cable. Do not replace this RS-232 cable with a "null modem" cable which will swap the transmit and receive wires.

Some PCs are not configured with the recommended 9-pin D serial ports and have USB ports instead. In these cases, acquire a USB-to-serial-port adapter to perform the necessary conversion. These products vary and may or may not work well. In some cases they provide undesirable buffering and delay, and a different brand should be used.

For custom user cabling, the serial connection uses pins 1, 4, and 5 of the Speed Sensor connector. Pin 1 is the Comm+ pin and Pin 4 is ther Comm- pin. Pin 5 is the common ground.

The RS-485 Programming Box converts the half-duplex RS-485 signals into 10-bit asynchronous serial communications with 1 start bit, 8 data bits, 1 stop bit and no parity (8N1). This is standard for PC serial ports, but a custom controller may need to be modified to match these settings.

Surface Velocity Radar (SVR) S3 Command Set

The SVR Speed Sensors provide a serial command protocol based on the ASCII characters. Each command is represented by a single character. Some commands require an option selection which will be a single digit number. These commands and their options are described in the tables below.

Command Summary:

Command	Description
I	Get or set ID
F	Set format of speed output
G	Get most recent speed data
S	Streaming output on/off
D	Set direction mode
R	Set range
H	Set horizontal angle
V	Set vertical angle
U	Set units
C	Dump configuration
W	Set length of averaging window
Z	Reset sensor

Command Syntax Details:

Syntax	Description
i*[aannnnnn]*<*cr*>	Get or set ID *aannnnnn*: *ID (2-alpha + 6-numeric = 8-digit ASCII string)* Notes: 1. When ID is not specified or incorrect length, current ID is output. 2. When ID is specified, new ID is set to *aannnnnn*. 3. The ID is destroyed during firmware upgrade and will have to be reconfigured. Example: **i**<*cr*> **SD004001**<*cr*> **iSD004007**<*cr*> **i**<*cr*> **SD004007**<*cr*>

Syntax	Description
f*n*<*cr*>	Set format of speed output *n*: **0**=*current (instantaneous) speed* **1**=*ID-strength-avgTime-currSpeed-currAvgSpeed-prevAvgSpeed* **2**=*ID-strength-currSpeed-currWindowAvgSpeed* Notes: 1. *ID* is as specified by the **i** command. 2. *currSpeed* is the current (instantaneous) speed. *3.* *currAvgSpeed* is the running average from 0.0 seconds until *avgTime.* 4. *currWindowAvgSpeed* is the average of all valid speed readings from the last n seconds. (n set by W command) 5. *prevAvgSpeed* is the average over the previous measurement period. 6. *strength* is 0 to 9, where 0 means no speed. 7. *avgTime* resolution is tenths of a second and is in the range 00.0 to 99.9 seconds. 8. Speed resolution is in hundredths (xx.xx) Example: See **g** or **s** command example.
g<*cr*>	Get most recent speed output data Example: **f1**<*cr*> **g**<*cr*> SD004001-7-02.4-11.32-11.32-11.14<*cr*> **g**<*cr*> SD004001-8-16.2-11.95-11.43-11.14<*cr*> **g**<*cr*> SD004001-7-37.1-11.63-11.51-11.14<*cr*> **f2**<*cr*> **g**<*cr*> SD004001-8-11.32-11.44<*cr*> **f0**<*cr*> **g**<cr> 11.87<*cr*> **g**<cr> 11.92<*cr*> Notes: 1. If a streaming output mode (**s1,s2**) is selected, then this

Syntax	Description
	command is ignored.
s*n*<*cr*>	Streaming output mode *n*: **0**=*off* **1**=*every averaging period* **2**=*every measurement period* <u>Notes:</u> 1. Averaging period is fixed at 100 seconds. 2. Measurement period is approximately 213.3 ms. <u>Example:</u> **f1**<*cr*> **s1**<*cr*> SD004001-7-00.0-11.88-11.79-11.16<*cr*> SD004001-8-00.0-11.89-11.80-11.16<*cr*> SD004001-7-00.0-11.90-11.80-11.16<*cr*> **s2**<*cr*> SD004001-7-32.1-11.88-11.79-11.16<*cr*> SD004001-8-32.3-11.87-11.80-11.16<*cr*> SD004001-7-32.5-11.90-11.81-11.16<*cr*> SD004001-7-32.8-11.89-11.79-11.16<*cr*> SD004001-8-33.0-11.87-11.80-11.16<*cr*> SD004001-7-33.2-11.92-11.81-11.16<*cr*> **s0**<*cr*>
d*n*<*cr*>	Set direction mode *n*: **0**=auto-detect **1**=inbound **2**=outbound Note: When auto-detect is selected, an “i” for inbound or an “o” for outbound is appended to the average speeds in the streaming output.
r*n*<*cr*>	Set range *n*: **1-4** Note: 4 is most sensitive setting (farthest range), 1 is the least sensitive setting.

Syntax	Description
h*nn*<*cr*>	Set horizontal angle *nn*: **00-70** (0° - 70°) Notes: 1. *nn* must be a 2-digit numeric.
v*nn*<*cr*>	Set vertical angle *nn*: **00-70** (0° - 70°) Notes: 1. *nn* must be a 2-digit numeric.
u*n*<*cr*>	Set units *n*: **0**=mph **1**=km/h **2**=m/s **3**=ft/s
w*nn*<*cr*>	Set window size for moving window averaging *nn*: **00-60**=window size in seconds Notes: 1. *nn* must be a 2-digit number. 2. Applies to speed format 2 (*f*2)only.
c<*cr*>	Dump configuration Output: **i***aannnnnn*<*sp*>**f***n*<*sp*>**s***n*<*sp*>**d***n*<*sp*>**r***n*<*sp*>**h***n* <*sp*>**v***n*<*sp*>**u***n*<*sp*>**w***nn*<*cr*> Notes: 1. All values of *n* are defined by the parameter values for each respective input command. Example: **c**<*cr*> **iSD004007 f1 s0 d1 r1 h00 v30 u1 w40**<*cr*> **u2**<*cr*> **c**<*cr*> **iSD004007 f1 s0 d1 r1 h00 v30 u2 w40**<*cr*>

z<*cr*>	Reset sensor Notes: 1. Resets the sensor as if it has been powered off and back on. 2. Sensor sends out its version after reset. Example: **z**<*cr*> **Stalker S3 SVR Ver: 2.1.0**<*cr*>

Syntax Notes:

<*cr*> is carriage return character (ASCII=13 decimal).
<*sp*> is space character (ASCII=32 decimal).
All input commands are delimited with <cr>.
All output responses are delimited with <cr>.
Optional parameters are enclosed in square brackets [..].
All input commands may be upper or lower case.

Operational Notes:

1. Transmitter will always be enabled.
2. Serial communication is set at 9600/N/8/1 (9600 baud, no parity, 8 data bits, 1 stop bit) and cannot be changed.
3. Commands can be issued at anytime and do not affect streaming output.
4. Averaging period is fixed at 100 seconds.
5. No commands will be echoed back (half-duplex operation).

RS-485 Extensions:

For units equipped with RS-485 multi-drop serial ports, a prefix must be included with all commands and will be included with every response. The command prefix consists of a tilde character "~" (ASCII=126 decimal) followed by the destination device's address and a dash "-" (ASCII=45 decimal). The address is a two-digit number represented as an ASCII string equal to the last two digits of the device ID (as set by the "i" command). A broadcast address is also defined to which all devices will respond, regardless of ID. This is useful for initial configuration where only one device is attached to the PC master. The broadcast address is "A" (must be upper-case). Certain restrictions are imposed on the use of the broadcast address to prevent erroneous input from producing an unrecoverable state. Streaming cannot be enabled with a broadcast command. Also, the unit's ID cannot be set this way. To set the ID without knowing the old one, send the set ID command as though the unit were equipped with RS-232 (that is, send a command like **iSD004007**<*cr*>).

The response prefix is similar to command prefix except that the first character is a back tick "`" (ASCII=96 decimal). The address of the device is sent here also. This time, it is a message source address rather than a destination address.

Example:

command: ~38-i<cr>	effect: query ID on unit with ID ending in “38”
response: <none>	
command: ~96-g<cr>	effect: request speed from unit with ID ending “96”
response: `96-12.34<cr>	meaning: speed from unit with ID ending “96” is 12.34
command: ~A-g<cr>	effect: request most recent speed from all connected units
response: `65-23.45<cr>	meaning: most recent speed from all units, in this case, only unit with ID ending in “65” is attached and has speed 23.45

Streaming in Multi-Drop Systems:

Streaming may be enabled only on one unit at a time. A unit with streaming enabled will pause output when it reads a “~” on the serial port between transmissions. This enables it to receive a command from the master on the half-duplex bus. Tilde “~” characters may be sent repeatedly until the streaming unit is interrupted. If the command that follows is addressed to the streaming unit, it will cancel streaming mode and respond to the command. If the command is invalid or addressed elsewhere, streaming mode will resume on receipt of a carriage return <cr> character and after a short delay.

Angle Errors

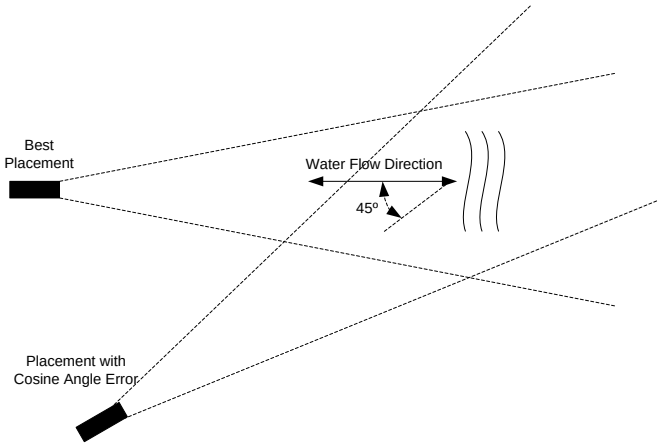
The most common mistake made with all radar guns is trying to measure targets at an angle relative to the direction of travel of the target.

All radar guns work on the Doppler principle and need to measure objects moving directly at or away from the gun. Measuring at an angle with a radar gun results in angle error, and the gun displays a speed that is LOWER than the actual speed.

Cosine Angle Error Chart

	0 Degrees	5 Degrees	10 Degrees	15 Degrees	30 Degrees	45 Degrees	90 Degrees
True Speed	0% Error	0.4% Error	1.5% Error	3.4% Error	13.4% Error	29.3% Error	100% Error
25.0 mph	25.0 mph	24.9 mph	24.6 mph	24.1 mph	21.7 mph	17.7 mph	0 mph
50.0 mph	50.0 mph	49.8 mph	49.2 mph	48.3 mph	43.3 mph	35.4 mph	0 mph
75.0 mph	75.0 mph	74.7 mph	73.9 mph	72.4 mph	65.0 mph	53.0 mph	0 mph
100.0 mph	100.0 mph	99.6 mph	98.5 mph	96.6 mph	86.6 mph	70.7 mph	0 mph
125.0 mph	125.0 mph	124.5 mph	123.1 mph	120.7 mph	108.3 mph	88.4 mph	0 mph
150.0 mph	150.0 mph	149.4 mph	147.7 mph	144.9 mph	129.9 mph	106.1 mph	0 mph

Radar Gun Placement



For accurate readings, the radar gun must be placed in the line of travel of the water. At slight angles, the error is very small; however, at larger angles, the error becomes substantial.

NOTE: The SVR Speed Sensor can automatically adjust for angle error by changing the Cosine Angle settings in the Operator MENU.

Calculating Angle Errors

If you know the angle at which you are pointing, you can calculate the actual velocity by taking the radar reading and dividing by the cosine of the angle.

For example: if you are pointing at 30 degrees relative to the water's flow, and the gun displays 0.5 meters per second take 0.5 and divide by the cosine of 30 degrees (0.866) to get a true speed of 0.577 m/s.

Interference Problems

Interference Frequencies

The ***STALKER*** SVR Speed Sensor radar transmits at a frequency of 34.7 GHz (34,700,000,000 Hz), using a Ka-Band Transmitter. The receiver is designed to read the Doppler frequency (the change in frequency) between 20 Hz and 15,500 Hz. There are very few devices other than another radar gun that could cause interference in a radar gun's transmission frequency range. However, there are a number of devices that could interfere with a radar gun in the receiver's frequency range.

What Does Interference Do?

Interference can cause a radar gun to read random readings, or make it harder for the radar gun to "see" the intended target.

A variety of sources, both natural and man-made, can cause misleading indications or poor performance. The operator should note the sources described below, and take steps to avoid the problem, or ignore the misleading indications.

Sources of Interference

Terrain
Radar signals will not pass through most solid objects, including tree foliage. Make certain the path between the radar and target is unobstructed.
Rain

Rain absorbs and scatters the radar signal. This reduces the range and increases the possibility of obtaining readings from the speed of the raindrops.

Electrical Noise

Electrical noise sources include neon signs, radio transmitters, power lines, and transformers. These influences may cause reduced range or intermittent readings.

FCC Requirements

The United States Federal Communications Commission requires that all transmitting equipment carry a Grant of Type Acceptance. The **STALKER** SVR Speed Sensor is Type Accepted by the FCC under Type Acceptance number IBQACMI002. The FCC also requires that an operating license be obtained by the user of the equipment.

Why Testing is Important

In order to ensure continued compliance with FCC rules, meet legal requirements for admissibility of radar speed measurements, and verify full operating performance, the following test procedures are recommended. If the unit fails any of the tests, it should be removed from service until the cause of the problem is corrected.

Periodic Calibration

We recommend that the following performance characteristics should be verified on a regular basis:

Transmitter frequency is within specification of licensed operating frequency.

Unit indicates correct speed (±0.1 m/s) when reading a target of known speed.

SVR Speed Sensor Accessories

The STALKER SVR Speed Sensor radar has a host of optional accessories. For current pricing and availability, contact sales at **1-888-STALKER.**

Accessories

(See the latest Stalker radar Parts and Accessories Catalog of a full listing of available accessories)

RS-232 SVR Sensors:

- 155-2290-00 Extension Cable
- 200-0702-00 Programming Interface for RS-232

RS-485 SVR Sensors:

- 200-0730-00 Programming Interface for RS-485
- 155-2239-10 10ft. Power I/O cable for RS-485

Common Accessories:

- 015-0025-00, Deluxe Tripod
- 015-0026-00 Heavy Duty Tripod
- 019-7031-00 120VAC/12VDC converter
- 200-0525-00 Universal Cycle Mount

Service Information

A Checklist Before Servicing the SVR Speed Sensor Radar

Check the Settings - If you are having a problem with your SVR Speed Sensor, first make sure that the settings are correct for your application.

Call Customer Service - If the problem is not rectified with these steps, call Customer Service at 1- 877-STALKER for help. A service representative will determine if the gun needs to be sent to the factory.

Factory Service Center Address

Applied Concepts, Inc.
Attn. Repair Department
2609 Technology Drive
Plano, TX 75074
1-877-STALKER Toll Free
Phone: (972) 801-4807
Fax: (972) 398-3781

Warranty Information

The SVR Speed Sensor radar is covered for Two (2) Full Years, Parts and Labor, against defects in workmanship, parts, or materials, and is guaranteed to operate within specifications for that period.

STALKER Radar will repair or replace, at their option, any component or system found to be defective. The customer is responsible for shipping the defective product to the factory (freight prepaid), and **STALKER** Radar will pay for the return shipping via UPS ground service back to the customer. Any expedited air shipping charges are to be paid by the customer.

This full warranty does not cover damage due to dropping, salt, improper voltage, fire, attempted repairs or modifications by an unauthorized service agent, or any other unusual treatment.

STALKER SVR Speed Sensor

Specifications

PERFORMANCE SPECIFICATIONS

Speed Range	.2 – 18.0 meters per second
Accuracy	± 0.03 meters per second

MICROWAVE SPECIFICATIONS

Operating Frequency	34.7 GHz (Ka-Band) ± 50 MHz
Polarization	Circular Polarization
3 db Beam width	12 Degrees Nominal (± 1°)
Microwave Source	Gunn-Effect Diode
Receive Type	Schottky Barrier Mixer Diode
Power Output	20 Milliwatts Minimum
	25 Milliwatts Nominal
	50 Milliwatts Maximum

The STALKER SVR Speed Sensor Complies with Part 90 of the FCC rules.
FCC ID #IBQACMI002.

GENERAL SPECIFICATIONS

Product Type	Stationary Doppler Radar
Computer Processor	Digital Signal Processor
Operating Temperatures	-30°C to +70°C (-22°F to +158°F)
Storage Temperatures	-40°C to +85°C (-40°F to +185°F)

ELECTRICAL SPECIFICATIONS

Voltage Range	9 to 24 volts, 12 Volts Nominal
Current Requirements (At 12 Volts DC)	0.45 Amps

PHYSICAL SPECIFICATIONS

Weight	1.15 lbs. (0.52 kg)
Diameter	2.6 in (6.7 cm)
Length	4.7 in. (11.8 cm)
Housing Material	Aluminum Die Cast

The STALKER SVR Speed Sensor Radar
is Manufactured by Applied Concepts, Inc.

STALKER RADAR
2609 Technology Drive
Plano, TX 75074
1-888-STALKER
(972) 398-3780 Sales
(972) 398-3781 Fax
www.stalkerradar.com

Made in U.S.A.

011-0105-00 Rev E