SWS™ TRANSMITTER USER'S GUIDE

Revision 4/19/99

for

VEHICLE MOUNTED MOBILE TRANSMITTERS

by

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PRODUCT DESCRIPTION:

Your transmitter is commercial grade electronic equipment intended for mobile operation. It contains a state-of-the-art Digital Signal Processor and microwave hardware equivalent to that found in modern police radar units. It has a tough UV protected moisture sealed polycarbonate radome, a weather tight power connector, and a corrosion resistant aluminum base. It will operate in an ambient temperature of -35 to +65 Celsius. It can be powered from the unconditioned battery voltage (11 - 16 VDC, negative ground). Typically it will be mounted external to the passenger compartment of the vehicle, in a light bar for instance, and will be active when powered. It does not require operator controls and is normally powered only when the light bar is active (normally when it would be used). Installation of the transmitter can be done by personnel qualified to install electrical equipment on emergency vehicles (i.e. radios, light bars, sirens, etc.).

The transmitter is being licensed under Part 90 of the FCC regulations. It may be mounted on a law enforcement vehicle (federal, state, local), a utility vehicle (light, water, phone, etc.), a road maintenance vehicle (paint stripe, road patch, etc.), an emergency vehicle (fire, ambulance, etc.), school bus, or road hazard vehicle (wrecker, wide load, slow moving vehicle, etc.). The transmitters are preprogrammed at the factory with one of the 64 message codes. The message codes for moving or stationary mode may be reprogrammed in the field with an optional programming cable. Return the transmitter to the factory for repairs. There are no user serviceable parts inside.

When powered, the transmitter will transmit a message to a motorist's SWS™ receiver, alerting the driver of some traffic situation as described in the "Radar Safety Warning Transmitter/Receiver Standard " published by the Georgia Tech Research Institute. A signal proportional to the moving speed is available on the tachometer output of the transmitter when it is powered and the transmitter's internal software determines that it is moving. The vehicle speed can be displayed on an optional display that will be available in the near future. Following is a message subset of the transmitter standard, which is used for some specific applications:

POLICE:
When the transmitter establishes that it is moving at a speed over 15 MPH it will transmit a "Police in Pursuit" message code 62. When stationary or moving at a speed less than 15 MPH, it will transmit a "Stationary Police Vehicle Ahead" message code 13. The alarm function is not active in this mode of operation.

EMERGENCY:
When the transmitter establishes that it is moving at a speed over 15 MPH, it will transmit an "Emergency Vehicle In Transit" message code 61. When stationary or moving at a speed less than 15 MPH, it will transmit a "Stationary Emergency Vehicle Ahead" message code 31. The alarm function is not active in this mode of operation.

SCHOOL BUS:

The school bus application does not have a moving mode and does not display vehicle speed on the tachometer output. It is powered when the loading/unloading bus lights are activated and transmits the "School Bus Loading/Unloading" message code 28 regardless of bus velocity. The alarm option may be enabled in this application to warn the driver of fast approaching targets (it assumes the bus is stationary and all detected movement is a target). The receive sensitivity and alarm speed threshold may be adjusted to optimize the alarm for specific installations on future units.

WORK ZONE:

When the transmitter establishes that it is moving at a speed over 10 MPH, it will transmit a "Slow Moving Vehicle" message 64. When stationary or moving at a speed less than 10 MPH, it will transmit a "Work Zone Ahead" message code 1..

Mobile transmitter applications not listed above can be accommodated (i.e. utility, etc.) but have not been established at the time of this publication. Transmitter functions for additional applications will be added in future publications of this guide.

In addition to field configuration, future features include user settable parameters. The transmitter has a built in digital signal processing radar that is tracking targets or the moving speed during the interval between transmit messages. One of the future features of the transmitter is to activate an alarm output if a target moving over the settable threshold is detected. This alarm could give road maintenance crews or school bus driver a "heads up" warning of a speeding motorist for example.

INSTALLATION:

Mounting

Mounting of the transmitter is accomplished by securing the transmitter base (as outlined in figure 1) to a horizontal surface on the vehicle with #6 screws through the four mounting holes. The transmitter can be mounted upside down or right side up, but should be oriented so that the transmitter beams, as indicated by the directional arrows on the label, are broadcasting to the front and rear of the vehicle. It should also be mounted as high upon the vehicle as possible and in a place that metal obstacles (emergency lights, sirens, etc.) are not directly in the path of the beams. If possible, the base should be mounted to a metal heat sinking frame (such as the light bar frame) to help maintain the base at a constant temperature.

Heat Sinking Considerations:

The thermal resistance of a transmitter to still air is 2.8° Celsius/Watt (without a heat sink). The power consumption of the transmitter is about 10 Watts so that the temperature rise of the transmitter would be typically 28° Celsius above the surrounding air. If the transmitter is mounted on stand-offs or non-heat sinking surfaces, care should be taken to insure that the transmitter temperature does not exceed +65° Celsius during

operation. For example: Still air inside a light bar might go as high as 45° Celsius in direct sunlight on a hot summer day. If the transmitter were operated without a heat sink for a long period of time, it would reach a temperature of 28 + 45° Celsius or 73° Celsius, which would be outside the operating limits. On the other hand, if the transmitter was mounted where the ambient air never exceeded 37° Celsius, it could be mounted without a heat sink. Since the transmitter will operate down to -35° Celsius and will generate its own heat while in operation, the cold temperature environment should not pose a mounting problem, except in the extremely cold climates.

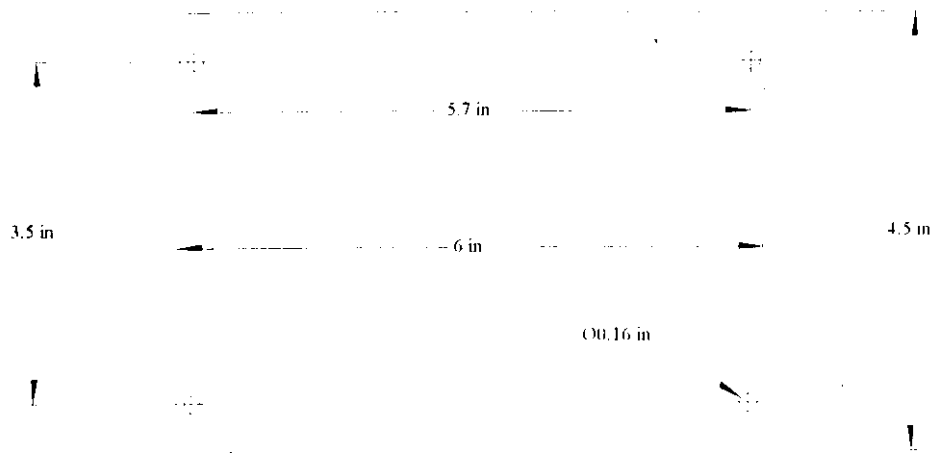
Power Connection/Cable Installation

The transmitter is supplied with a power cable that comes in 6 ft, 12 ft, 15 ft, and 20 ft lengths. One end of the cable has a connector that connects to the transmitter, and the other end is wired into the vehicle's wiring harness. The red wire is the positive (+) power lead and goes to a switched +12V source such as the voltage supplying the emergency lights, the transmitter being active when power is applied. The black wire connects to the battery negative (-) terminal (frame ground). The transmitter base is also connected to the black lead, so care should be taken to insure that the vehicle frame is negative ground if the transmitter base is mounted on the vehicle frame. REVERSING THE POWER LEADS WILL CAUSE FAILURE UPON APPLICATION OF THE VOLTAGE. The transmitter draws approximately 0.75 amps when in operation and has an internal non-replaceable 2A slow blow fuse for wiring harness protection in case of a short or the application of reverse polarity.

The green and white wires are used for a tachometer differential output and are used with an optional display not supplied with the units. The green wire is the tach. (+) signal, the white wire is the tach. (-) signal. These are high impedance signals that should only be used with the display designed specifically for them.

The alarm output wire is blue. It is an open collector optoisolator type of output that has a high impedance to frame ground when inactive and will sink up to 100 mA to frame ground when the alarm is active. Typically, the alarm signal would drive a 12 VDC power relay to operate a warning light or buzzer to alert the driver. When using an inductive load on the alarm output (such as a relay coil) a protection diode of sufficient current rating should be installed reversed biased across the coil. This is done to protect the optoisolator output transistor from the inductive "kick" voltage when the power is removed.

General vehicle electrical equipment safety installation practices should be observed. Cable wires not used in the installation should be taped so that they do not short out against each other or ground. The +12 VDC supplying the transmitter should be adequately fused to protect the transmitter cable from overheating in the event it gets shorted to the frame.



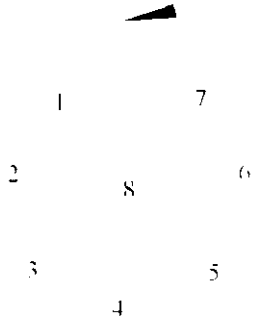
SWS TRANSMITTER FOOTPRINT

FOOTPRNT.TCW
db 3.3.97

FIGURE 1

TRANSMITTER CONNECTOR PIN DEFINITION

Guide Key



PIN DESIGNATION

1 = FUTURE USE
2 = SIG. GND.
3 = ALARM OUT
4 = FUTURE USE
5 = TACH (+)
6 = TACH (-)
7 = PWR. GND.
8 = PWR. (+12VDC)

FIGURE 2

FIELD PROGRAMMABILITY:

The SWS transmitter can send any of the 64 preset messages listed in this document and as defined in the "Radar Safety Warning Transmitter/Receiver Standard Version 3.0". The safety messages are categorized into moving or stationary types and have a number assigned to them (1-64). In operation, the transmitter senses whether it is moving or stationary and sends the appropriate message. The transmitter comes programmed with a pair of messages for moving and stationary operation, but can be reprogrammed in the field by the user, if desired. Once the messages are set by programming they are permanently changed and will remain until they are reprogrammed (no default setting). The switching parameters (speed at which it switches, etc.) are preset at the factory and cannot be reprogrammed in the field at present. This feature and other programmable features such as the alarm will be released at a future date.

INPUT TERMINAL:

A special cable adapter assembly is required to interface the SWS transmitter with an "RS232" type of terminal for programming. The adapter assembly has a female 9 pin "D-Sub" connector with the following pin signal definitions: Pin 3: RS232 output signal, Pin 5: Signal ground, Pins 1, 2, 4, 6-9: no connection. The adapter assembly also has a "cigarette lighter" +12 volt DC input power connector that is used to power the SWS transmitter and its adapter box, as well as a connector for the SWS transmitter.

The terminal may be free standing or terminal emulation software can be used on a PC with a programmable serial interface, etc. The SWS transmitter does not have to be removed from its vehicle mount to be reprogrammed. A battery powered terminal or "laptop" can be taken to the vehicle in which the transmitter is mounted and used with the cable adapter to reprogram the transmitter. The cable adapter is temporarily attached to the transmitter in place of its power cable. While programming, the transmitter is powered through the adapter (which is connected to the vehicle's cigarette lighter plug). After programming the transmitter power cable is reconnected.

The terminal should be configured with local echo so that the programmer can see what characters have been sent to the transmitter. In most cases the terminal should be configured to output each character as it is entered and output only the character that is entered (watch out for automatic line feed with carriage returns). The terminal can be used in a "block" mode, that is send out a line or block of characters that has been entered upon the execution of a carriage return or other command, however, command sequences (terminated with an enter key) should not be entered faster than once a second.

The required terminal communications configuration is defined below.

TERMINAL COMMUNICATIONS CONFIGURATION:

RS232 ASCII output (input is not used), 9600 baud, 8 bits, 1 stop bit, no parity, no hardware handshake

PROGRAMMING MESSAGES:

With a terminal connected as described above, the transmitter moving and stationary messages can be programmed. Other programmable transmitter options will be available in the future, but at this point have not been implemented. Programming is done by entering a three-character command with its parameter enclosed in rectangular brackets. The command characters are not case sensitive (doesn't matter if they are capitalized). The carriage return character (enter key) is used to enter a command. A series of carriage return characters can be used to set the transmitter in the programming mode initially or to reset it in the programming mode if an error was made while programming. No provision has been made for backspace or error correction. The "STO" command is used to store the programming into the nonvolatile memory and place the transmitter back into normal operation.

A list of programming commands and the parameters for each of them can be found in table 1. Note that the message commands are the only ones available at present. Table 2 contains a numerical ordered list of the messages that can be programmed into the transmitter.

Following are some example programming sequences. Characters contained in the "< >" characters designate a key entry, for example <CR> means a carriage return keystroke. The < > symbols themselves are not entered.

EXAMPLE 1:

<CR><CR>
SMC[24]<CR>
MMC[25]<CR>
STO<CR>

When the transmitter is first powered, it comes up in the normal transmit mode. Two carriage returns (<CR>) must be entered to get the attention of the device, causing it to stop transmitting and go into the programming mode. In the above example after entering the programming mode, the stationary message code number 24 was set with the SMC[24] command and the moving message code number 25 was set with the SMC[25] command. The settings were saved into permanent eeprom memory with the STO command and the transmitter resumed normal operation (goes out of the programming mode).

EXAMPLE 2:

<CR><CR>
MMC[25]<CR>
STO<CR>

In the above example, the moving message code was set to 25. The stationary message code was unchanged and remains the same as before programming. The transmitter resumed normal operation after the STO command.

TABLE 1 (Program Commands & Parameters):

Programmable Feature	Command	Parameter	Default
Stationary message code	SMC	1 to 64	None
Moving message code	MMC	1 to 64	None
Stationary message text	SMT*	up to 64 characters	not used
Moving message text	MMT*	up to 64 characters	not used
Moving message algorithm	MMA*	1 to ?	?
Moving message speed	MMS*	20 to 80	?
Units	UNI*	KPH or MPH	MPH
Store eeprom (end prog)	STO	none	n/a

* unimplemented at this point

TABLE 2 (Message Codes and Categories):

Category 1 {Highway Construction or Maintenance}

1) Work Zone Ahead
2) Road Closed Ahead/Follow Detour
3) Bridge Closed Ahead/Follow Detour
4) Highway Work Crews Ahead
5) Utility Work Crews Ahead
6) All Traffic Follow Detour Ahead
7) All Trucks Follow Detour Ahead
8) All Traffic Exit Ahead
9) Right Lane Closed Ahead
10) Center Lane Closed Ahead
11) Left Lane Closed Ahead
12) *future use*
13) Stationary Police Vehicle Ahead

Category 2 {Highway Hazard Zone Advisory}

14) Train Approaching/At Crossing
15) Low Overpass Ahead
Gear
16) Draw Bridge Up
17) Observe Bridge Weight Limit
18) Rock Slide Area Ahead
19) School Zone Ahead
20) Road Narrows Ahead
21) Sharp Curve Ahead
22) Pedestrian Crossing Ahead
23) Deer/Moose Crossing
24) Blind/Deaf Child Area
25) Steep Grade Ahead/Truck Use Low
26) Accident Ahead
27) Poor Road Surface Ahead
28) School Bus Loading/Unloading
29) No Passing Zone
30) Dangerous Intersection Ahead
31) Stationary Emergency Vehicle Ahead
32) *future use*

Category 3 {Weather Related Hazards}

33) High Wind Ahead
34) Severe Weather Ahead
35) Heavy Fog Ahead
36) High Water/Flooding Ahead
37) Ice On Bridge Ahead
38) Ice On Road Ahead
39) Blowing Dust Ahead
40) Blowing Sand Ahead
41) Blowing Snow Whiteout Ahead
42) *future use*

Category 4 {Travel Information/Convenience}

43) Rest Area Ahead
44) Rest Area With Service Ahead
45) 24 Hour Fuel Service Ahead
46) Inspection Station Open
47) Inspection Station Closed
48) Reduced Speed Area Ahead
49) Speed Limit Enforced
50) Hazardous Materials Exit Ahead
51) Congestion Ahead/Expect Delay
52) Expect 10 Minute Delay
53) Expect 20 Minute Delay
54) Expect 30 Minute Delay
55) Expect 1 Hour Delay
56) Traffic Alert/Tune AM Radio
57) Pay Toll Ahead
58) Trucks Exit Right
59) Trucks Exit Left
60) *future use*

Category 5 {Fast/Slow Moving Vehicles}

61) Emergency Vehicle In Transit
62) Police In Pursuit
63) Oversize Vehicle In Transit
64) Slow Moving Vehicle