1 Introduction

1.1 About the GSM/GPRS WorldTracker AVL

The GSM/GPRS WorldTracker AVL (hereafter referred to as "WorldTracker AVL") is an Automated Vehicle Locating (AVL) device that utilizes a GSM/GPRS modem and a Global Positioning Satellite (GPS) module. Working together, these technologies allow the WorldTracker AVL to simultaneously act as a stand alone GPS reporting device and wireless data retrieval unit. The WorldTracker AVL provides a flexible AVL solution with Input/Output
(I/O), six selectable National Maritime Electronics Association (NMEA) GPS data format, Trimble ASCII Interface Protocol (TAIP) GPS data format, and Security Concepts's own proprietary Binary GPS data format. The WorldTracker AVL is designed to work in a stand-alone device in an automobile. Security Concepts's WorldTracker AVL provides maximum AVL versatility in a single affordable device.

1.2 About This Manual

Contained in this manual are instructions on how to install and configure the WorldTracker AVL. Please follow the instructions herein closely to avoid damaging the WorldTracker AVL.

1.3 Contents of Basic Package

- Security Concepts WorldTracker AVL
- Mounting brackets
- Documentation CD-ROM

1.4 Available Accessories

The following accessories for the WorldTracker AVL are available directly from Security Concepts:

- Combination GPS and GSM/GPRS antenna. There are two models available; through-hole and magnetic mount.
- 12-pin serial I/O loading cable with DB-9 connector.
- 12-pin connector with pins.

1.5 System Requirements

It's necessary to have some type of terminal equipment, which includes a serial port, in order to configure the WorldTracker AVL modem. This can be a computer running a Windows Operating System with the HyperTerminal program.

1.6 WorldTracker AVL Front and Back View

Figure 1 - Security Concepts WorldTracker AVL Front View

Figure 2 - Security Concepts WorldTracker AVL Back View

1.7 Product Specifications

System Requirements

Interface:	Serial – Host DSUB 9 connector
L x W x H:	4.0 x 5.0 x 1.6 in
Housing:	One Piece, seamless Aluminum Extrusion
TX Power:	Class 4 (2W @850/900 MHz) Class 1 (1W @1800/1900 MHz)
Slot Class:	MS10(4RX/2TX, 5 MAX)

Application Interface

- Host Protocols: PPP, AT Commands, UDP, TCP/IP
- Internal Protocols: UDP, TCP/IP (future release)
- API Control/Status: AT or UDP
- Friend's IP Feature
- Auto-Registration software upon power-up
- Over the air commands for:
  - I/O Control
  - GPS TX Interval
  - Binary Reporting
  - Timed Reporting
  - Alarm Reporting
  - Status Change Reporting
  - GPS Content
  - Event Reporting
  - Distance Reporting
  - Geo-Fencing

Band Operation

GSM2218 (850/900/1800/1900)

SIM Card / Interface / I/O

- SMA Antenna Connector for 3.3 Vdc GPS 3.3
- External SIM accessible via end cap
- Audio connection
- TNC Antenna Connector for GSM
- 3 Pin I/O – 2 Input, 1 Output
  3 LED Status indicators
  1 Ignition Sense
- 1 Audio Input/Output

GPRS Packet Data

Mode:	Class B, Multislot 10 Certified
Protocol:	GPRS Release 97, SMG 31
Coding Schemes:	CS1 – CS4
Packet Channel:	PBCCH/PCCCH

Environment

Operating:	-30°C to +70°C
Spec. Compliant:	-20°C to +60°C
Storage:	-40°C to +85°C
Humidity:	Up to 95% non-condensing

GSM Functionality

Voice:	Full Rate, Enhanced full rate and half rate, AMR (GSM2218)
CS Data:	Asynchronous, transparent and non transparent up to 9.6 KB
GSM SMS:	Text, PDU, MO/MT Cell broadcast

Status Indicator

- Power ON
- Registration Status
- GPS Status
- User Defined

Certification (Pending)

GSM2218

FCC: Part 15,22,&24	Part 15
GCF: Version 3.11.0	Version 3.5.1
PTCRB: Version 2.9.1	Version 2.7.2
Industry Canada	Industry Canada
RTTE	RTTE

Power

DC Voltage: 9 - 30 V

WorldTracker AVL 2218 BAND	**MODE**	**@ 12V (mA)**	**Avg (A) @ (dBM)**	**Peak**
GSM 850& 900	1TX/1RX	390	0.600 @ 32.5	
	1RX	180		
	Idle	65		
GSM 1800& 1900	1TX/1RX	400	0.570 @ 32.0	
	1RX	190		
	Idle	55		

GPS Functionality

- SMA Antenna Connector for GPS
- Supports 3.3V Active Antenna
- GPS Protocols: NMEA, TAIP, Security Concepts binary
- Stored GPS Messages Feature

Part Number

GSM2218 850/900/1800/1900

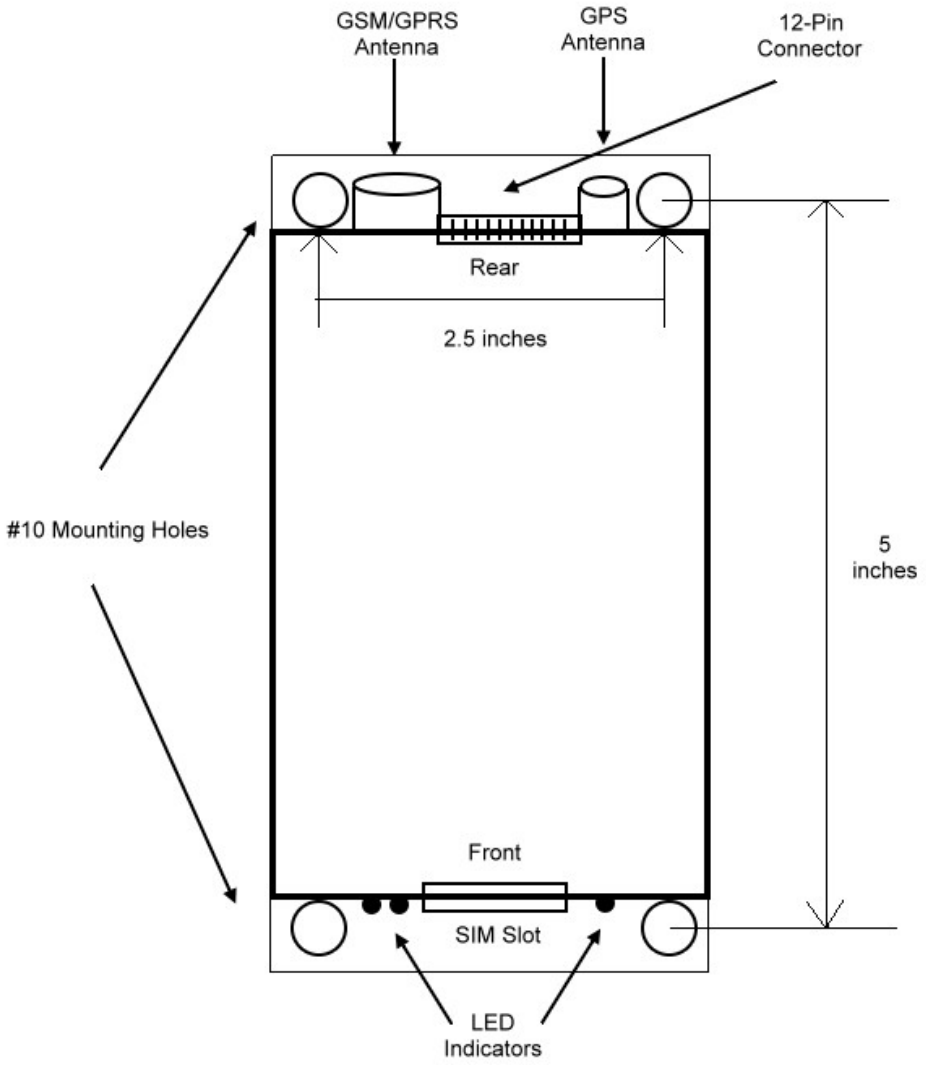
2 Installation

Instructions provided in this section describe the hardware installation of the WorldTracker AVL device. To install the WorldTracker AVL in a vehicle, follow these steps:

- Choose a convenient location in the vehicle – either in the trunk or interior of a vehicle. Avoid locations that might expose the device to excessive heat or moisture.
- Hold the WorldTracker AVL in place and mark the location for mounting screw holes
- Using the markings as a guide, drill mounting holes in those positions
- Align the WorldTracker AVL in the drilled holes and secure it with mounting screws

The WorldTracker AVL is **NOT** a waterproof or sealed device. Care must be taken to ensure the device is kept away from water or any other liquids.

2.1 Mounting Dimensions



The bracket should be used as a template to mark screw holes for installation. See Figure 4 - WorldTracker AVL Mounting Brackets. The mounting holes are designed for a number 10 screw. Once mounting holes have been located for placement, the mounting plate can be easily broken into two parts as demonstrated in Figure 5 - WorldTracker AVL Mounting Bracket (separated). The mounting bracket must be separated in order to affix it to the WorldTracker AVL. The two pieces will easily slide into the grooves on the modem.

2.2 Installing Cables

During installation, the following precautions will help ensure proper operation of the WorldTracker AVL

- Remove power from the WorldTracker AVL.
- Do not create loops, sharp bends or crimps in the cables
- All cables should be attached to the vehicle and equipment in such a way to reduce stress or wear caused by vibration generated by moving vehicles.
- Use proper terminations on all power cables

2.2.1 12 pin Connector

The user can purchase the optional 12-pin external I/O connector for the Security Concepts WorldTracker AVL that can be used to interface with other devices. Security Concepts can provide an optional cable and connector. The user also has the option of building his/her own cable. Table 1 describes the pin functionality for this 12 pin I/O connector. Pins that are not planned for usage can be left open without anything connected to them.

Pin Number	Functionality
Pin – 1	Serial Data Out
Pin – 2	Serial Data In
Pin – 3	Audio – Ear Speaker Out (-)
Pin – 4	Audio – Ear Speaker Out (+)
Pin – 5	Audio – Mic Input (+)
Pin – 6	Audio – Mic Input (-)
Pin – 7	User Controlled Output
Pin – 8	User Controlled I/O
Pin – 9	User Controlled I/O
Pin – 10	Switched Power (Ignition)
Pin – 11	Unswitched Power (Battery)
Pin – 12	Ground

Table 1 - 12 pin I/O Connector Interface

Figure 8 - I/O Connector

2.2.2 WorldTracker AVL Serial Adapter (Optional)

Security Concepts P/N can be used to provide a standard serial interface for the WorldTracker AVL. This adapter provides a standard DB9 serial interface and power to the unit. The adapter would be used for loading new software onto the WorldTracker AVL. The customer may choose to connect directly to the 12-pin connector serial interface pins, or order this convenient adapter from Security Concepts.

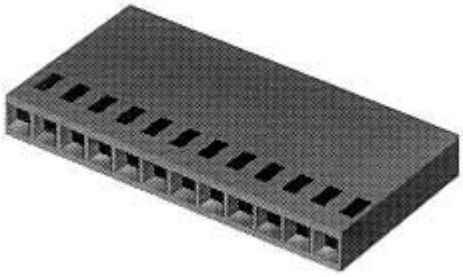
Note: Only three of the pins are used; ground, serial in and serial out.

See Figure 9 - 12-Pin Connection.

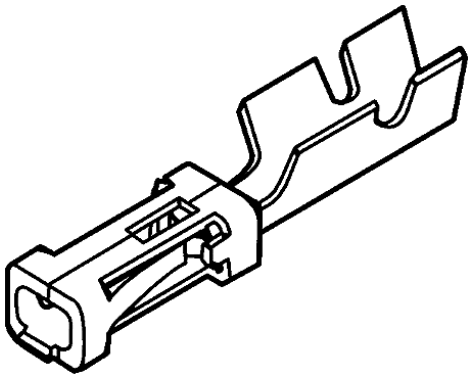
Figure 9 - 12-Pin Connection

The customer can also build their own cable, if they choose. The following information contains photographs and the manufacturer's (AMP/Tyco) part numbers for the parts needed to build the cable. Security Concepts recommends using 20-gauge wire when building the connector.

Pin Housing (2-87499-1)



Pins (8523-6)

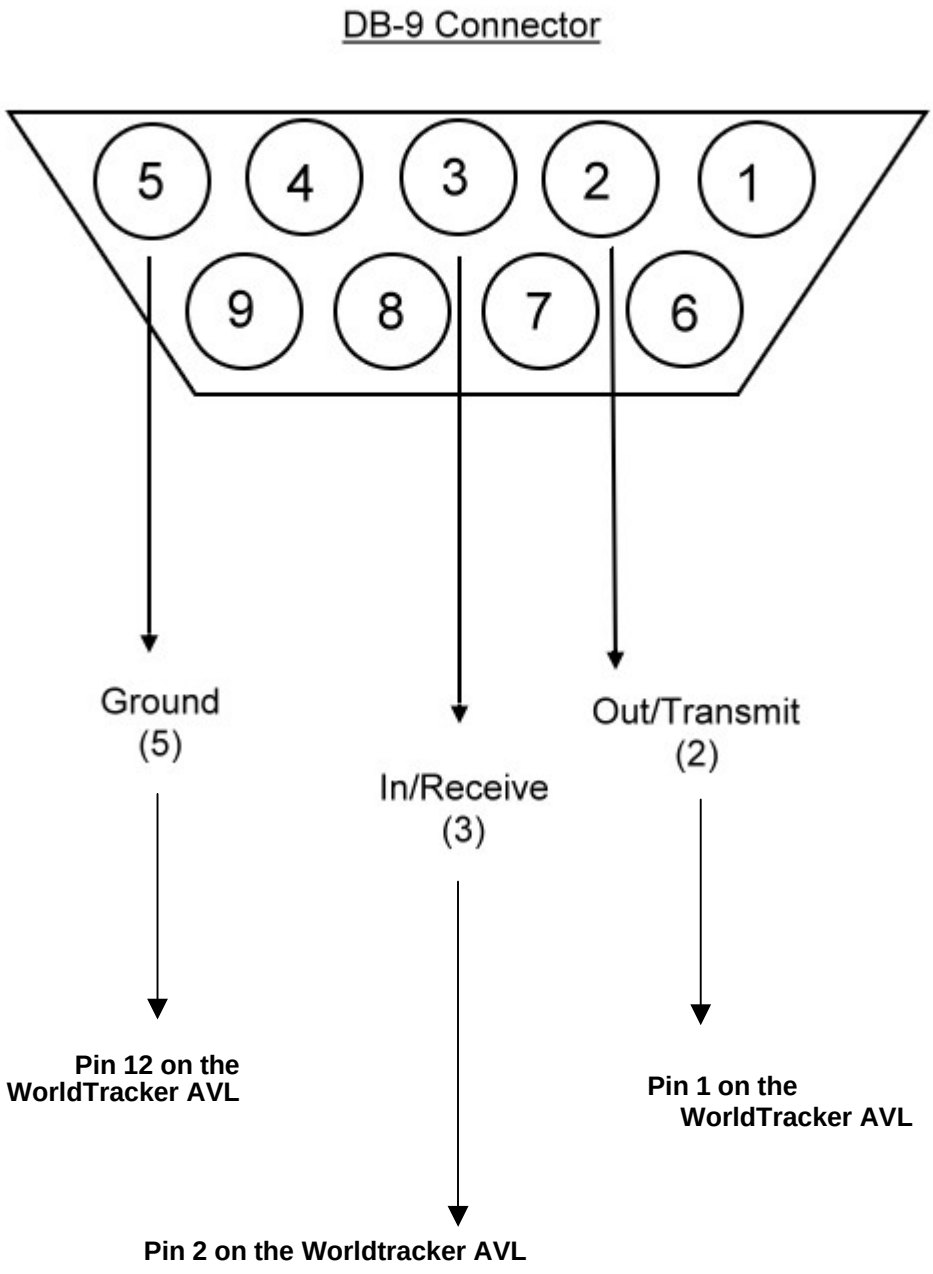


NOTE: Instead of using the previous two parts, you can build the cable using the Wago 733-112 connector. This connector is keyed, so the user won't be able to insert the connector into the WorldTracker AVL the wrong way.

DB-9 Pinout

There are three pins that are used to connect to the serial port of your computer. These are for transmit (out), receive (in) and ground.

The following diagram displays the serial end of the interface cable.



2.3 Installing Subscriber Identity Module (SIM) Card

The SIM, an integral part of any GSM terminal device, is a “smart card” that is programmed with subscriber information. The user information consists of an International Mobile Subscriber Identity (IMSI) number which is registered with the GSM/GPRS service provider and an encryption Ki (pronounced “key”). This information consists of a microprocessor and memory installed on a plastic card. A SIM card can be installed by simply inserting the SIM card in the SIM slot provided in the front of the device. See Figure 10 - Inserting a SIM below.

Note: The SIM card is not provided with the WorldTracker AVL device. The SIM must be obtained from the GSM/GPRS service provider and must be provisioned by the operator for data and/or voice. Always take care to protect the SIM. WorldTracker AVL’s GSM/GPRS related functionality will not operate without the SIM installed.

Ensure the power to the WorldTracker AVL is disconnected before inserting the SIM card. Failure to do so might result in unusable WorldTracker AVL or a damaged SIM card.

Insert the SIM into the SIM Slot with the notch going into the slot first, and facing toward the left side of the modem.

Figure 10 - Inserting a SIM

2.4 Audio In/Audio Out

The only way of connecting the microphone/speaker is via pins 3 - 6 of the 12-pin connector.

Please follow the specifications as listed in the table below. Security Concepts is not liable for damage to the WorldTracker AVL due to user error.

Ear – Speaker Output:

Parameter	Conditions	MIN	TYP	MAX	UNIT
Maximum Input Range – Mic(+) to Mic(-)	Inputs 3 dBm0 (Max. digital sample amplitude when PGA gain set to 0 dB)		**32.5**		**mVrms**
Nominal Ref. Level – Mic(+) to Mic(-)			**-10**		**dBm0**
Differential Input Resistance – Mic(+) to Mic(-)			**100**		**kΩ**
Microphone Pre-Amplifier Gain			**25.6**		**dB**
Bias Voltage on Mic(+)	2.0 or 2.5 V	**2.0**		**2.5**	**Vdc**
Mic Bias Current Capability		**0**		**0.5**	**mA**

Handset Speaker Output

Parameter	Conditions	MIN	TYP	MAX	UNIT
Maximum Swing – Ear(+) to Ear(-)	R_L = 32 Ω & 5% distortion	**1.2**	**1.5**		**V_{pp}**
Maximum Capacitive Load – Ear(+) to Ear(-)				**100**	**pF**
Amplifier Gain			**1**		**dB**
Amplifier State in Power Down	High Z				

Table 2 - Audio Settings

2.5 Connecting GSM/GPRS modem Antenna

The user must supply the GSM/GPRS antenna. The antenna must have a nominal impedance of 50 Ohms. The VSWR must be less than 2.0:1. System antenna gain should be 0 – 2 dB for optimum performance.

The antenna connector on the GSM/GPRS WorldTracker AVL model is a TNC female connector.

The antenna has to be connected to the connector labeled “MODEM ANT”. See Figure 11 - GSM/GPRS Antenna Connection.

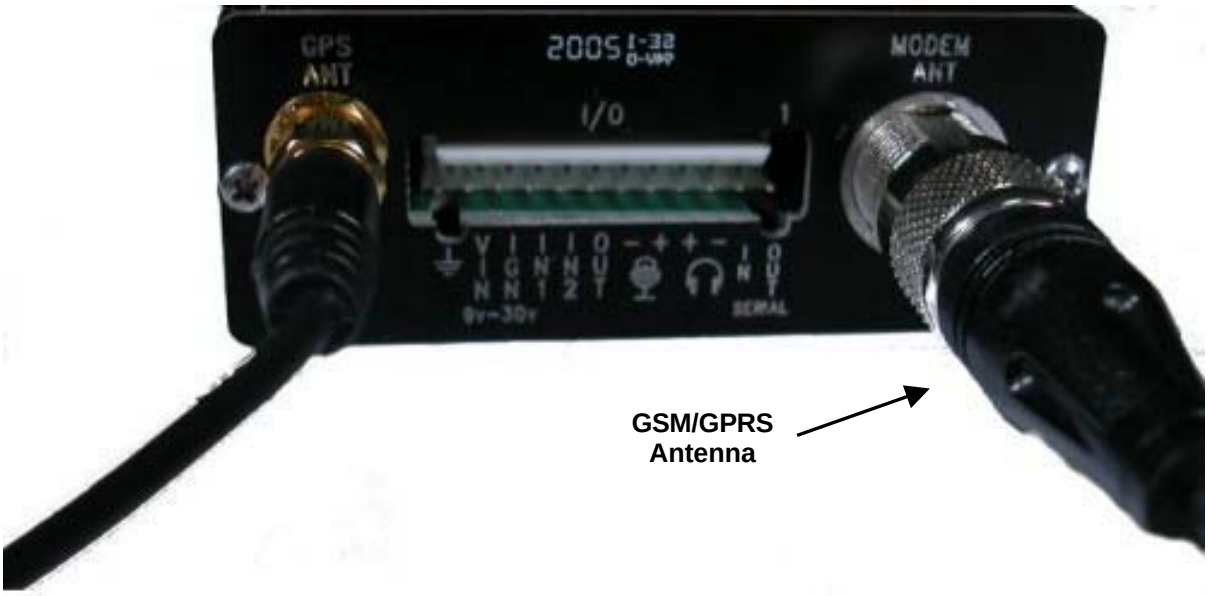


Figure 11 - GSM/GPRS Antenna Connection

2.6 Connecting GPS Antenna

The user must supply the GPS antenna. The GPS receiver inside the WorldTracker AVL powers the pre-amplifier in the GPS antenna (Active-style) by applying a power of 3.3 Volts to the center conductor of the RF input to the GPS receiver. If a passive-style GPS antenna must be used, please verify that it has a DC block installed in order to prevent shorting to ground. GPS antenna connector on the WorldTracker AVL model is a SMA female connector. The GPS antenna must be placed in an area where it can have direct view of the sky.

The GPS antenna must be connected to the connector labeled “GPS ANT”. See Figure 12 - GPS Antenna Connection.

User must disconnect power before connecting the GPS antenna

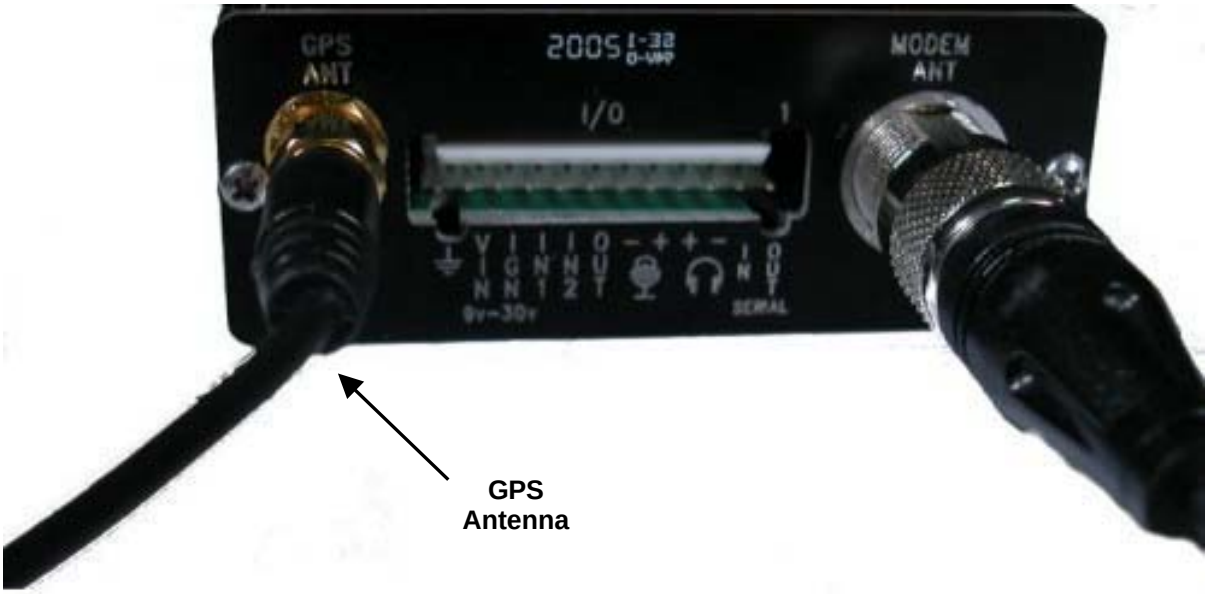


Figure 12 - GPS Antenna Connection

2.7 Connecting the Power Source

The GSM/GPRS WorldTracker AVL has an input voltage range of 9 – 30 V DC. (See Table 3 and Table 4). The power and ignition pins can support 9 – 30 V DC input voltage. The user has an option to connect these wires depending on the desired functionality. Described below are the desired functionality and their associated wire connecting procedure:

Use of the device outside of the specified voltage range may result in damage to the device and/or undesirable results.

PRELIMINARY TABLES

Security Concepts MT-G (@ 12 Volts)				Average Current (mAmps)	Peak Current (Amps)
GSM 850 & 900	**GSM**	1TX/1RX 1RX Idle	390 mA 180 mA 65	0.600@32.5	
DCS 1800 & PCS 1900	**GSM**	1TX/1RX 1RX Idle	400 mA 190 mA 55 mA	0.570@32.0	

Table 3 - GSM Operating Power

Security Concepts MT-G (@ 12 Volts)				Average Current (mAmps)	Peak Current (Amps)
GSM 850 & 900	**GPRS**	TBD1TX/1RX 1RX Idle	400 mA 190 mA 55 mA	0.590@32.0	
DCS 1800 & PCS 1900	**GPRS**	TBD	400 mA 200 mA 55 mA	0.560@31.5	

Table 4 - GPRS Operating Power

- WorldTracker AVL
Always ON
  - Connect the power and ground wires of the WorldTracker AVL to the battery leads. The WorldTracker AVL will always remain ON as long as the battery lasts.
  - The WorldTracker AVL will be non-operational when the input voltage and current requirements are not met (battery drains).
  - The Ignition wire has to be left open (not connected).

- WorldTracker AVL Turns Off when Ignition Turned Off
  - Connect the power line of the WorldTracker AVL to an auxiliary power source, i.e. ignition.
  - Connect the ground wire to the chassis or negative terminal of the battery
  - The Ignition wire has to be left open (not connected).

- Device in Low Power Mode when Ignition Turned Off
    - Connect the power and ground wires of the WorldTracker AVL to the battery.
    - Connect the ignition wire of the WorldTracker AVL to an auxiliary power source, i.e. ignition.
    - Device enters low power mode when ignition line goes low. This feature has to be enabled via the software configuration (see AT$PWRSAV command for more details).
    - Device enters normal power consumption mode when auxiliary power is supplied.
    - Device goes through a reset upon ignition on.

2.8 LED Operation

The WorldTracker AVL has three LED's on its front panel.

PWR:	Indicates power to the modem. LED is on when power is turned on and the modem is operational. LED is off when power is removed or when the modem enters low power mode.
User LED 1:	This LED can be configured to display registration; GPS fix status, or other user functions. By default, this LED indicates GSM/GPRS registration status. LED state of OFF indicates that the device is not attempting to register to the network. Blinking LED indicates that the device is trying to connect to the network. LED always ON indicates that the device is attached to the network.
User LED 2:	This LED can be configured to display registration; GPS fix status, or other user functions. By default, this LED indicates GPS fix status. The LED remains in OFF state when invalid GPS data is received. The LED remains ON when valid GPS data is received.

3 Additional Software Features

The following software features are included in version 0.6.0 and greater:

A user can send AT commands, via SMS, to the MTG in the following format:

>RSP=[T/F];ID=[modem id];[at command]<

- [T/F] field has to be set to either T or F. Setting of T indicates that the response to an AT command will be sent back to the originator. Setting of F indicates that the response to an AT command will be discarded
- [modem id] field has to be the same value as AT$MDMID command setting. This field is case-sensitive
- [at command] field has to be set to an AT command from the below list:

  - AT$ACKTM
  - AT$ACTIVE
  - AT$APIPWD
  - AT$AREG
  - AT$CONNTO
  - AT$EVDEL
  - AT$EVDELA
  - AT$EVENT
  - AT$EVTIM
  - AT $FRIEND
  - AT$GPSRD
  - AT$IDLETO
  - AT$MDMID
  - AT$MSGLOGEN
  - AT$MSGLOGRD
  - AT$MSGSND
  - AT$PADBLK
  - AT$PADBS
  - AT$PADDST
  - AT$PADSRC
  - AT$PADTO
  - AT$PKG
  - AT$SMSDA
  - AT$UDPAPI
  - AT$WAKEUP
  - AT+CGDCONT
  - AT&W

Note: Please refer to the MT-G AT Command Set Document (GSM2000PB001MAN) for detailed information on AT Command execution.

Please note the following information regarding sending AT commands via SMS:

- AT commands sent via SMS have to originate from an address listed in the AT$SMSDA command;
- An incorrectly formatted SMS message will be processed as a regular SMS message;
- Not having the originating address of the SMS message listed in AT$SMSDA command will result in the SMS message being treated as a regular SMS message;
- Query of an AT command setting that returns more than 160 bytes will result in data being truncated to a maximum of 160 bytes.

The ability to store event data in memory, upon event trigger occurrence, and transmit data when desired.

- The user can configure the WorldTracker AVL to store event-generated data, to be sent over the air to a remote server, in its internal memory. This feature can be enabled or disabled using the AT$MSGLOGEN command.

- "Total Number of Unread Messages" is decremented if an unread message is read via the AT$MSGLOGRD command.

  Example: Assume there are 50 unread messages in the GPRS queue and the total number of messages in GPRS queue is 100. This means that the first 50 messages have been read while the last 50 messages have not been read. If a user sends AT$GPSLOGRD=0,1,51 then the total number of unread messages drops down to 49 after successful transmission of that message. However, if a user sends AT$GPSLOGRD=0,1,99 then the total number of unread messages still remains at 50 – that message is transmitted to the remote server.

- A user can also read a message that has already been read from the memory by passing in the appropriate starting index number.

Synchronize RTC time with GPS time

- RTC time is synched with GPS time automatically
- RTC time is synched with GPS time every time the device is powered up and the device acquires valid GPS data
- RTC time is synched with GPS time every time the GPS time rolls over from 23:59:59 to 00:00:01

Allow a user to append RTC date and time at the end of event data

- Bit-21 for Parm2, for output message types 40 – 42 & 45 (in AT$EVENT command), has been added to allow users to send RTC time along with event data
- The RTC date and time contains Year, Month, Day, Hour, Minute, and Second fields
- 6 bytes of information is appended in Binary format when bit-21 is enabled. Each byte represents an individual field
- 12 ASCII character (12-bytes) representing RTC date and time is appended in ASCII format when bit-21 is enabled. Two bytes (or two ASCII characters) represents an individual field

4 Appendix 1 – Cable Wiring Diagrams

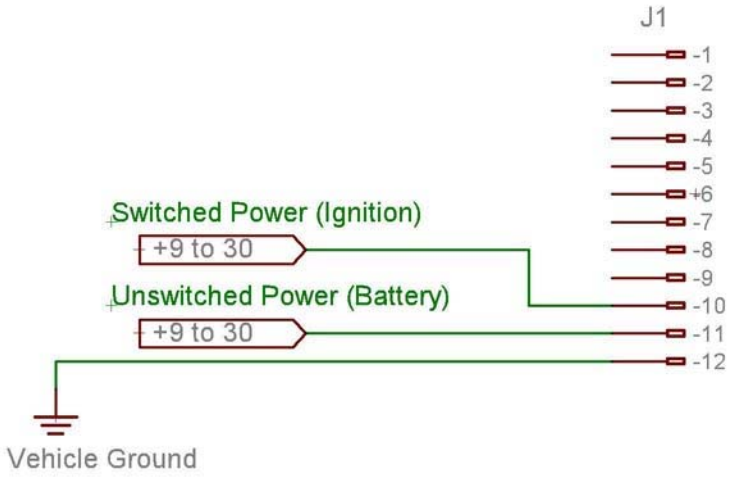


Figure 13 – Wiring for Power Only

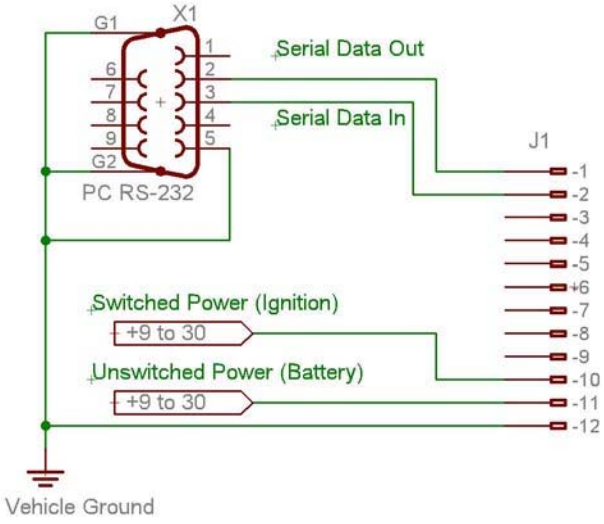


Figure 14 – Wire for Programming Cable