- INTRODUCTION -

The TigerTrak TM-1 and TM-1+ are highly sophisticated, fully programmable, tracking and telemetry modules. These units have been designed to meet the most stringent requirements of both the commercial and amateur user. The TM-1 employs the latest in high density "surface mount" technology, assuring high reliability and compact size.

The standard TM-1 Tracker features a single "Tracking" mode that can be configured for APRS® compatibility. The TM-1+ "MultiMode" Tracker supports the basic tracking mode of the TM-1, plus several additional modes for specialized tracking and telemetry applications. Additionally, the TM-1+ includes solid-state power switching for an external device like a GPS. This allows OEM GPS receivers like the Garmin GPS-35 to have their power controlled directly by the TigerTrak. Both TM-1 models employ the latest in "Flash" microcontroller technology, allowing additional features and functions to be added without adding additional hardware. Flash technology also allows the TM-1 to be upgraded to a TM-1+ in the event your tracking requirements change! Both models come completely assembled and tested and include an easy to use Windows configuration program.

The TM-1 and TM-1+ are easily interfaced to most base, mobile, and hand-held radios. Since power consumption is extremely low, the units can usually be powered directly from the "Aux Power" pin on the radios mic connector. For APRS® and some other tracking applications, the TM-1 is connected in parallel with the microphone. This allows you to use the radio for voice communications and tracking simultaneously. It also allows the mic PTT to trigger the tracker at the end of each voice transmission (mic encoding). Special circuitry in the TigerTrak allows it to "mute" the radios mic and control PTT operation without the need to break *any* of the mic lines!

- COMMERCIAL APPLICATIONS –

Our most fundamental goal in the design of this unit was to create a flexible and fully programmable platform on which a wide variety of other devices could be built. The TigerTrak is just the first of many products that will be built on this technology. The basic design of this unit makes it extremely easy and inexpensive to adapt to a custom application. The use of multiple Flash based processors allows us to inventory finished boards which can be programmed to become a variety of products on a moments notice. Every aspect of this devices production takes place within our own facility. We fabricate the extruded case, injection mold the covers, NC mill the openings, make artwork, silkscreens, tooling and even do the robotic assembly under one roof! All of this makes it very easy and economical for us to adapt the unit to your special needs. We are a full service quick turn solution. If you have an application that we might be able to adapt this unit to, we invite you to discuss it with our engineering staff.

- ABOUT THIS MANUAL –

Because the TigerTrak's setup varies widely with each of its operating modes, this manual will focus mainly on issues common to all modes. This includes general information on installation, operation, and specifications, as well as an overview of the TigerTraks main operating modes. Detailed information for setup of specific modes will be covered by the on-line HELP files included with the Configuration Program. Having these details in the Configuration Program allows the information to be regularly updated by downloading new help files from our web site. You can obtain HELP at any time when you are using the program by placing the cursor in the field of interest and pressing F1. Access to the entire HELP database is available from the Help Menu at the top of the screen.

- WHAT YOU WILL NEED -

In order to program the various functions of the TigerTrak you will need to connect it to an IBM compatible computer running Windows 95 or Windows 98 and the Configuration Program that we have supplied. Note that our program will not operate with earlier versions of Windows or from MSDOS. Your computer must have a free serial port in the range of COM1 to COM4. To connect the TM-1 to your computer, you will need a standard serial interface cable. Figure-1 shows the wiring of the cable. Note that only four of the nine lines are required.
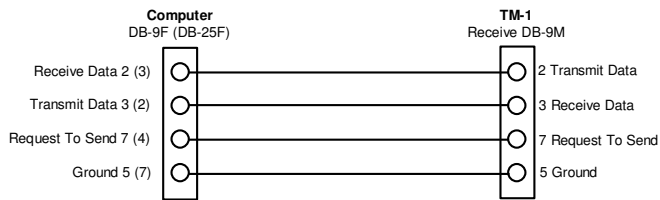
Figure-1 TM-1 to computer interface cable

The TigerTrak is supplied with a radio cable that has the connector already installed on the TM-1 end. You will need to provide whatever connectors are necessary to attach the other end to your particular radio. If you are wiring the TM-1 to a dedicated radio (no microphone), you will simply need to attach the appropriate connectors to the end of the cable. If you are using the TM-1 as a APRS® tracker and you also want to use the radio for voice communications, then you will need to attach the TM-1 lines in parallel with the existing microphone lines. Tigertronics offers an optional Mic Adapter Kit that will greatly simplify this process. Refer to the section on "Connecting Mobile & Data Radios" for additional details.

- INSTALLING THE SOFTWARE –

Before you can use the TM-1 you will need to program it using the Configuration Program that we have provided. This program may have been supplied on either floppy disks or CDROM, but the installation procedure is the same for both. The software must be installed on a computer running either Windows 95 or 98. Before installing the program you should review the README file on the installation disk. This file contains important information that you should be aware of before installing the main program.

To install the Configuration Program follow these steps:

1)   Click on the Windows "Start" Button.
2)   Click the Run Button.
3)   Click Browse and select the disk drive where the TM-1 software is located (Floppy or CDROM).
4)   Click on the program named SETUP.EXE.
5)   Press OPEN.
6)   You should now be back at the RUN menu where you simply click OK to start the installation process. Follow the directions that appear.

After installation is complete and you are using the program, you can obtain HELP at any time by placing the cursor in the field of interest and pressing F1. Access to the entire HELP database is available from the Help Menu at the top of the screen. Basic instructions on how to configure the TM-1 can also be found in the "Configuring The TM-1" section of this manual.

- CONNECTING POWER -

The TM-1 requires an unregulated source of 8 to 15VDC at approximately 45 milliamps for operation. Power can be supplied through either the "Ext Pwr" connector, or through Pin "B" (black wire) on the radio interface connector (RJ-11). Power from these two sources is handled differently inside the TM-1, so the connection you select will depend on your application. A description of each power option follows. Figure-2 will help you understand the TM-1's power routing circuitry.
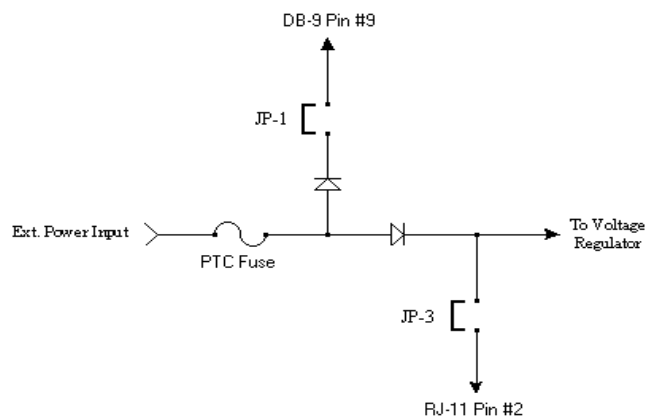

Figure-2 Power Input Circuit

WARNING: Incorrect power wiring can destroy the TM-1 and the equipment that it is connected to. ALWAYS use a fuse in the power line. Be sure to read this entire section before applying power!

External Power Connector – External power can be applied to the TM-1 through a 2.1mm coaxial power connector on the rear panel. This power input is reverse-voltage and over-current protected. A PTC self-resetting fuse limits the input current to a maximum of 300ma. The high current rating of the fuse was chosen so that this input could also be used to power a GPS or other telemetry device through Pin #9 of the DB-9 connector on the Data/Control port. See "Powering A GPS Receiver" for more information.

Radio Interface Connector - Pin "B" (black wire) on the RJ-11 radio connector provides another means of supplying power to the TM-1. Extreme caution must be used when connecting power to this input, as it is *NOT* reverse-voltage or over-current protected. Before powering the TigerTrak from the mic connector, you must check the radios documentation to be sure that it is safe to draw 45ma. You must also verify that the voltage available on the mic connector is in the range of 8 to 15 VDC. *Warning: You can cause permanent damage to your radio by overloading its Aux Power output!*

To power the TM-1 from your radio, you will need to connect the RJ-11 Radio Interface lines as follows:

Pin "A" (White) - Chassis Ground
Pin "B" (Black) - Accessory Voltage
Pin "F" (Blue) - Signal Ground

To activate the power pin on the Radio Interface you will also need to install a jumper on "JP-3" of the printed circuit board. This jumper is located near the Ext Pwr jack on the board.

Warning: Some RJ-11 cables do not have the wires arranged in the proper order or may have the connector installed backwards! Refer to Figure-3 below for the proper connector and cable layout.
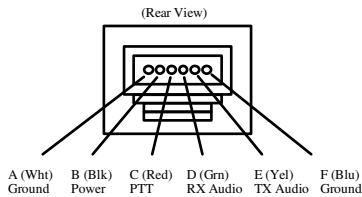

Figure-3 Radio Connector

Power During Programming – When you attach the TM-1 to your computer for programming, you will need to supply operating power. The easiest way to do this is by plugging a DC Wall Transformer into the Ext Pwr jack. Be sure that the transformer you use supplies a voltage between 8 and 15 volts. Note that some wall transformers put out excessive voltage when they are operated at lower than the rated current, so it would be wise to measure the actual voltage output before plugging it into the TM-1. If a wall transformer is not available, you can also power the unit from a 9 volt battery or bench supply.

Powering A GPS Receiver - The TM-1 can supply power to a GPS receiver or other device through Pin #9 on the Data/Control connector. In order to do this the TM-1 *must* be powered through the Ext Pwr connector (not the RJ-11) and the pc-board jumper labeled "JP-1" must be installed. This jumper is located next to the Ext Pwr jack on the pcb.

The power available on Pin #9 when JP-1 is installed is limited to about 250ma by a PTC fuse. On a TM-1 this power is available any time power is applied to the Ext Pwr jack. On a TM-1+ the power to Pin #9 is controlled by a solid-state switch. The switch is turned on any time the TM-1+ is ON. This is especially useful for controlling power to an OEM GPS receiver like the Garmin GPS-35, which has no manual controls. Using this feature, the GPS is automatically turned ON and OFF with the TigerTrak. On both the TM-1 and TM-1+ the power at Pin #9 is unregulated and is approximately 700mv lower than the power applied to the Ext Pwr jack. This voltage drop is due to the polarity protection diode on the jacks input. Before powering any device from the Data/Control connector, be sure to verify that the device can be safely powered from the voltage that you are applying to the Ext Pwr jack! The vast majority of GPS receivers can be powered from this source.

- CONNECTING MOBILE & DATA RADIOS -

The TM-1 attaches to the radio through a 6 wire RJ-11 connector on the rear of the unit. We have supplied a length of cable for this purpose with your TM-1. The cable already has the RJ-11 connector installed in accordance with Figure-3. If you intend to use a cable other than the one that we supplied, make sure it is configured *exactly* as shown in Figure-3 and read the *Warning* about these connectors. You will need to wire the unterminated end of the cable according to the documentation supplied with your radio.

Only five connections are required to attach the TM-1 to a radio. These connections are PTT (Red), Transmit Audio (Yellow), Receive Audio (Green), Chassis Ground (White) and Signal Ground (Blue). If you are powering the TM-1 from your radio, then an additional Power wire (Black) is also required. Most radios of recent manufacture will have all of these signals (including Receive Audio) available on the microphone connector. On radios that don't have Receive Audio available on the mic connector, it will be necessary to run a short jumper cable to the radios External Speaker jack.

Exactly how you connect the TM-1 to your radio will depend on your application. For dedicated telemetry and tracking applications (no microphone) you can wire the cable directly to the appropriate pins on the radio's mic/data connector as shown in Figure-4.
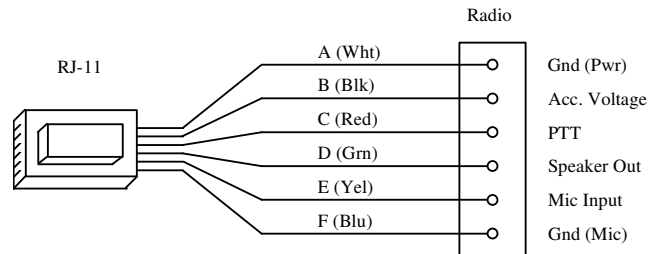

Figure-4 Wiring diagram for data-only applications

In applications where the TM-1 will be connected to a radio that is being used for both voice and tracking, the TM-1 must be connected in parallel with the microphone as shown in Figure-5.
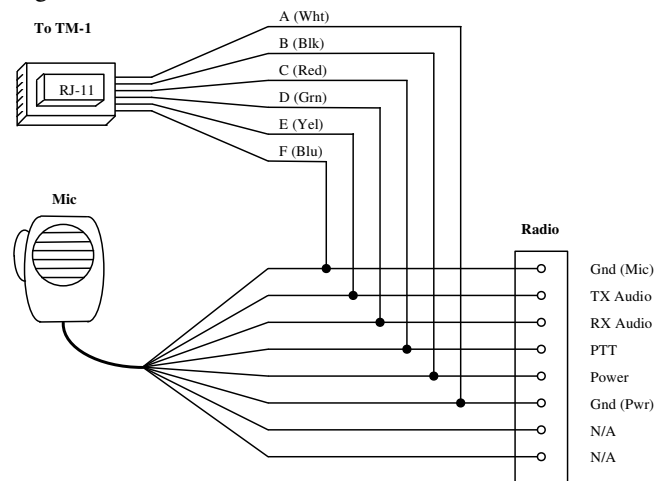
Figure 5 - Wiring diagram for data/voice applications

Getting connected in parallel with the mic connector is generally not as simple as it sounds! The easiest solution is to make some sort of "Y" cable that splices into the appropriate lines. Unfortunately, this solution tends to be both cumbersome and unreliable. A better choice is to provide a junction box with connectors for all the various devices and a terminal block to allow selection of the lines

going to the TM-1. Tigertronics now offers an optional Mic Adapter Kit for this purpose. The kit includes all the necessary cables and connectors for both 8-Pin round and 8-Pin RJ-45 type mic connectors. Additional details about the kit are available on our web site. A picture of the Mic Adapter pc-board is shown in Figure-6.
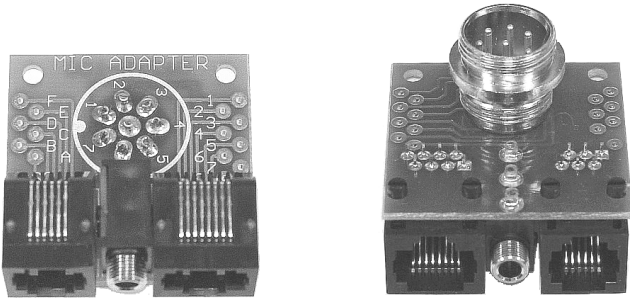

Figure-6 Mic Adapter PC Board

- CONNECTING A HAND-HELD RADIO -

If you are using the TM-1 with a hand-held radio, you may find that there is no separate PTT line available. Many of these radios key the PTT by grounding the microphone input line through a resistor. If this is the case with your radio, you can activate the TM-1's internal PTT keying resistor (2.7K) by installing jumper "HT" on the pc-board. This jumper is located near the RJ-11 connector on the rear of the unit. Note that all radios will work with the keying resistor value we have provided, including those from manufacturers that suggest a higher value. If you select the keying resistor option, be sure you do not attach anything to the PTT (Red) line on the interface cable. On radios that have a separate PTT line (ie: Kenwood, etc.) be sure that the "HT" jumper is *not* installed. NOTE: Because the antenna on most hand-held radios is only a fraction of an inch from where the cables plug in, we recommend using an external antenna if at all possible. This will prevent excessive RF levels from interfering with the operation of the TM-1 and GPS receiver.

- THE DATA/CONTROL INTERFACE -

The Data/Control connector on the rear of the TM-1 can be used to connect a variety of external data sources including GPS receivers, Programmable Logic Controllers, Weather Instruments, and Security Systems. The interface can accept both RS-232 and CMOS logic levels. Input baud rate can be programmed to 1200, 2400, 4800 or 9600 baud. The data format is configured for eight data bits, no parity, and one (or more) stop bits. Figure 7 shows how to connect the TM-1 to various types of serial devices.
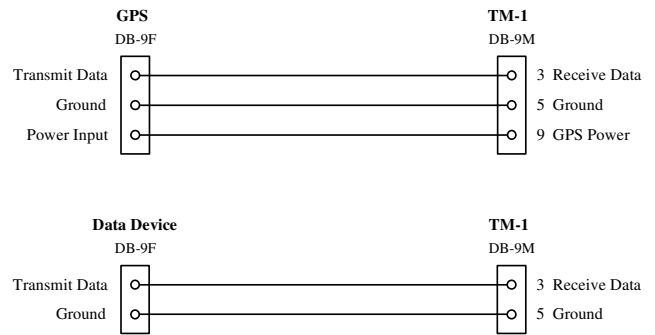

Figure-7 Connecting the TM-1 to various devices.

- TEST MODE OPERATION -

The TigerTrak's Test Mode has two main functions. First, it can be used to generate nearly continuous packets for testing or calibration of deviation. The test message consists of the station call sign followed by a very long string containing all printable ASCII characters. Once started, the string is transmitted continuously until power is turned OFF or PC MODE is invoked. PC MODE is the mode that the TM-1 uses to communicate with the PC during configuration and setup. Anytime the TM-1 is running in Test Mode it is also looking for a PC running the Configuration Program. When the PC is detected on the Data/Control port, it drops out of Test Mode and enters PC Mode automatically.

To start Test Mode you must simply be pressing the Mode Switch when you turn on the Power Switch. As soon as the Power LED lights, you can release the Mode Switch. You will notice from the PTT light activity that you have started sending the Test Mode beacons. If you subsequently attach a computer running the Configuration Program, the TM-1 will automatically detect it and enter PC Mode. The green "Lock" light will illuminate to indicate that PC Mode is active. The only way to exit PC Mode is to turn OFF the unit. This happens automatically when you press Disconnect" from within the Configuration Program or when you EXIT the program. Never disconnect power to turn OFF the TM-1 when it is running in PC Mode.

- CALIBRATION -

All critical functions within the TM-1 are controlled by a precision crystal and will never require calibration. Normally, the only adjustment that may be required by the user is the "LEVEL" adjust on the front panel which sets transmitter deviation. While the level has been factory adjusted to the correct setting for most radios, there may be instances where further adjustment is necessary. In such cases, the level should be set to provide a transmitter deviation of 3.5 to 4.0 KHz. In most cases, the lower deviation is better. Note that this is less deviation than would be appropriate for voice communications. The lower deviation provides superior phase distortion characteristics for data transmission and minimizes data errors. To calibrate the modulation level you will find it helpful to place the TM-1 in Test Mode.

4

- CONFIGURATION PROGRAM OVERVIEW -

Getting Connected - To configure the TM-1 for operation you must attach it to your PC and a power source as mentioned in earlier sections. Before you start, disconnect the TM-1 from your radio so that it does not transmit when you enter Test Mode. Start the Configuration Program on the PC and then place the TM-1 in Test Mode. This is done by holding down the Mode button when the Power button is turned ON. You should see the "Disconnected" button in the program switch to "Connected" after a few seconds. The green "Lock" light on the TM-1 will also illuminate to indicate that it has entered PC Mode and is ready for programming. The type of unit (TM-1/TM-1+) and current firmware revision will be displayed at the top of the screen after connecting.

Reading and Writing - The Configuration Program is capable of both reading and writing to the data memory of the TM-1. Once you have established communication and the program displays "Connected" you can read the TM-1's current mode and configuration details by pressing the "Read" button. After you have changed the configuration, you can write it back to the TM-1 by pressing the "Write" button. It is important that you never disconnect power while the unit is communicating with your PC!

If you have connected to the TM-1 just to verify it's configuration and do not plan to program (Write) new data, then you should press the "Disconnect" Button to turn OFF the TM-1 before disconnecting any cables.

The File Menu – The File menu of the Configuration Program allows you to manage the various configurations that you create for the TM-1. The first three selections allow you to Create, Retrieve, and Save all your configuration data to a disk file.

The Memorize Defaults button writes the most commonly used parameters in the program to an initialization file which loads automatically when the program starts the next time. After you have created your first configuration you should click the Memorize Defaults button so that the program will remember all of your basic defaults like My Call, Serial Port, Baud Rates, etc.

The last selections in the File Menu allow you to print a handy Pocket Guide to help you remember your settings in NMEA and Tracking Modes. These modes are very complex and contain may Profile settings. You will find this feature a valuable tool to manage your unit in the field.

The Setup Menu – This menu allows you to select the various communications parameters for the program. You must select the Serial Port that the TigerTrak will be connected to during configuration. There are selections for COM1 thru COM4. You will need to consult your computers documentation to determine which port is available for use. Our factory default is COM2.

You will need to select an Input Baudrate from this menu also. This is the baud rate for the data that will be received by the TM-1's Data/Control port. For GPS receivers this baudrate is usually 4800 baud. Baudrates of 1200, 2400, 4800, and 9600 are available to interface to a wide variety of telemetry and data equipment.

You will also need to select an Output Baudrate from the menu. The TM-1 is capable of generating both 300 and 1200 baud packets. The 300 baud selection should generally be selected for HF operation, while the 1200 baud selection is normally used for VHF and UHF. Note that there is some 1200 baud packet activity on the 10 meter HF band. Commercial users will almost always require 1200 baud.

The Help Menu – Selecting the Help Menu provides you with access to the entire HELP database. It allows you to Search, Browse, and Print the available information. Note that you can also get help for a specific field at any time by placing the cursor in that field and pressing the F1 key.

Detailed Mode Settings – Detailed information concerning the various entry fields within each mode is available from the online HELP menu. We will make every attempt to keep expanding the scope of the HELP file and make it available for download on our web site at: www.gpstracker.com . The TigerTrak is a very complex product and the user is expected to have a working knowledge of his application. For example: We make no attempt to explain the application or intricacies of APRS®, although the TigerTrak supports this type of operation. It is the users responsibility to determine his objectives and the proper protocols for operation. In some cases a user unfamiliar with a particular application may need to seek the assistance of a more experienced associate or even a professional. Our Technical Support is available to answer questions related to the hardware and configuration software, but is not available to provide extensive support for any application, except on a consulting basis.

- MODES OF OPERATION -

The TM-1+ currently has five different "Modes" of operation, while the TM-1 is limited to operation in Tracking Mode only. Note that the TigerTrak can only operate in one mode at a time! An overview of each mode follows:

Telemetry Mode - This mode is best suited for applications in which the data to be transmitted arrives in bursts. As each data burst is received it is stored in memory for transmission when the burst is complete. By buffering the data in this manner, the unit can accommodate data that is arriving at baud rates both faster and slower than the transmission rate. The end of the burst is detected by the reception of a "termination character". This is a user specified character that is known to be at the end of the data stream. Typically this character is a Carriage Return or Line Feed. But it can be any character that you select between 00 and FF hex. The only requirement is that the character can never exist anywhere in the data string except the point at which transmission should be triggered. The transmit buffer can

hold as many as 105 characters. If the buffer overflows, data storage will stop and transmission will be suspended until the termination character is received. A transmit timer is provided in this mode so that data can be transmitted at a user-defined interval. The interval can be set to any value between 1 second and 68 minutes. Multiple paths are supported. These paths can be used to route the transmission through a repeater network or to identify the sending device with ID Codes.

Beacon Mode – This mode is used in applications where a fixed message must be transmitted at regular intervals. The interval can be set to any value between 1 second and 68 minutes. The length of the "Beacon Text" is limited to 76 characters. This mode is ideally suited for transmitting an APRS® string from a fixed (base) location, so it will appear on local APRS® maps. It is also useful for transmitting announcements like severe weather warnings, meetings, etc.

NMEA Mode - This mode was designed primarily for GPS tracking applications, where entire NMEA sentences need to be sent. However, this mode can also be used in any application where the desired data is identified by a known preamble (header). In operation the incoming data is searched for a predefined string (Data Header). When the string is received, the unit starts storing data in its buffer. It continues to store data until a user specified termination character is received or until the buffer overflows. The buffer length is 105 characters. This is sufficiently long to store any NMEA string. The user can program up to three Data Headers to search for. A header can be up to six characters long. The unit searches for and transmits each header in sequence. A transmit timer is provided in this mode so that data can be transmitted at any user-defined interval between 1 second and 68 minutes. NMEA Mode allows the user to configure up to ten different "Profiles", each with it's own SSID, Digi Path, Transmit Timer Interval, TX Delay and Tail Delay.

Tracking Mode - This mode was designed especially for tracking applications where shorter packets are desirable. This mode is flexible in its format and can be configured to transmit APRS® compatible strings. In operation the serial input receives $GPRMC NMEA strings from a gps receiver and parses out the latitude and longitude data needed to construct the packet. The user can specify several parameters that are included in the packet including a "comment" to be attached to the end of the packet. Transmission of the packet can be triggered by release of the microphone's Push-To-Talk button (mic encoding/manual mode) or by an automatic transmit timer (auto mode). The timer interval can be set to any value between 1 second and 68 minutes. This mode allows the user to configure up to ten different "Profiles", each with it's own SSID, Digi Path, Symbol, Transmit Timer Interval, TX Delay and Tail Delay.

Alarm Mode - This mode allows the remote monitoring of up to four alarm conditions. In this mode the TM-1 continuously compares the state of the alarm inputs to a user programmed "image". If the state (High/Low) of any input deviates from the "image", then the alarm is activated.

Alarm activation causes a user-defined packet to be sent identifying the alarm condition. If multiple alarms have triggered, then multiple messages will be sent. Alarm packets are sent a specified number of times and at a programmed interval. After all transmissions are completed, the TM-1 will reset the alarm status ("image") based on the current state of the inputs. If the condition that initiated the alarm still persists, then the alarm will still be reset using the current set of conditions (i.e.: the alarm will not be triggered again unless the door that was opened later closes!). The alarm messages are programmed by the user. The message for Alarm #1 can be up to 25 characters long. The remaining three messages are limited to 15 characters.

- ABOUT PROFILES -

Both the NMEA and Tracking modes allow up to ten separate "Profiles" to be programmed into the TM-1. Each profile has it's own SSID, Digi-Path, Transmit Interval, TX Delay and Tail Delay. The other information used by these modes (MyCall, ToCall, etc.) is shared among all of the profiles. Each profile can be selected by the user in the field, without the need for a computer. This is useful in situations where the operator is driving from one area to another, and needs to switch the Digi path from a local path to a more generic one. It is also a convenient way to change timer intervals for changing situations, like when you are no longer moving.

A profile can be selected by simply pressing the "Mode" button a number of times that is equal to the profile number that you want to use. For example, if you want to select Profile #5 you would press the Mode button five times. After selecting a profile, the TM-1 will verify your selection by flashing the "PTT" light a number of times equal to the profile number selected. The current profile is always saved to memory when the TM-1 is powered off. Upon power up, the current profile is loaded from memory and the PTT light is flashed to indicate the profile number currently selected. Turning the unit On/Off is a handy way to readout the current mode. Profiles are one of the most powerful features of the TigerTrak. They allow you to overcome many common problems that plague other tracking devices.

- FIRMWARE UPGRADES -

Tigertronics may from time to time offer firmware or hardware upgrades to enhance the features and functions of the TigerTrak. These upgrades will be announced on our web site. If you are interested in a particular upgrade, you should contact our Technical Support Department to determine the cost and proper return procedures. Generally upgrades do not involve hardware changes, so they are very simple and inexpensive.

- TECHNICAL SUPPORT -

If you read this manual and the Help Files in the Configuration Program thoroughly, it is unlikely that you will need additional support. You can also find answers to many common questions on our Internet web site at:

www.gpstracker.com. If you do encounter a problem that you cannot resolve, you are welcome to call our Technical Support Hotline at (541) 862-2639. **This line is available each Monday, Wednesday, and Friday between 1:00 PM and 5:00 PM Pacific Time**. Be sure to have your equipment available for testing when you call. Please DO NOT mail, email, or fax your technical questions to us. We realize that calling is a little more expensive, but more can be accomplished in a few interactive minutes on the phone than can be accomplished in hours of writing! We simply are not able to respond to written inquiries involving technical problems.

- VISIT OUR WEB SITES -

If you have Internet access, please be sure to visit our tracker web site at: www.gpstracker.com and our main web site at: www.tigertronics.com These websites contain the latest news about Tigertronics products as well as a wealth of information including Software Updates, Application Notes, Frequently Asked Questions, and other technical issues.

- YOUR COMMENTS WELCOME -

Tigertronics has made every effort to make the TigerTrak the best product possible. We believe it represents a major technological breakthrough and hope we have anticipated your every need in using it. We welcome any comments or suggestions that you would like to make. Please drop us a note to let us know about your experiences, tips you would like to share with other users, or how we might do a better job for you.

- LIMITED WARRANTY -

Tigertronics warrants the TM-1 to be free of defects in material and workmanship for a period of 90 days from the date of shipment. Tigertronics will repair or replace, at its option, any parts found to be defective during the warranty period. This warranty does not include any unit which has been subject to misuse, neglect, improper installation or operation. This warranty is in lieu of all others, express or implied, and no person or representative is authorized to assume for Tigertronics any other liability in connection with the sale or use of this product. Tigertronics will not be responsible for any expense or loss of revenue or property incurred by the user due to operation or malfunction of this equipment. Tigertronics reserves the right to make circuit or component changes, or to incorporate new features, at any time, without obligation.

- RETURN POLICY -

A Return Material Authorization Number (RMA#) must be obtained from the factory before any product will be accepted for return or repair. Items received at the factory without an RMA# clearly marked on the OUTSIDE of the package WILL NOT BE ACCEPTED. Items being returned must be sent prepaid. Returned items should have a tag attached showing the RMA#, customer name, return address, phone number, and action requested. Units being returned for warranty repair must be accompanied by a copy of the original sales invoice showing the date of purchase.

Customers wishing to return a product for refund, for ANY reason, must receive an RMA# within 15 days from the shipping date shown on the original sales invoice. Customers returning products for refund will be charged a Restocking Fee equal to 20% of the purchase price, to cover the cost of re-testing and re-stocking. Products which have been damaged or modified in any way, may not be returned. Contact our Technical Support department for the RMA#.

- FCC STATEMENT -
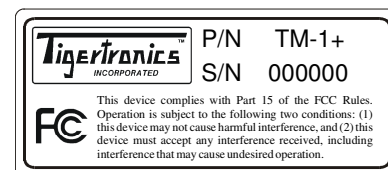
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate 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 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.

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the users authority to operate the equipment. To meet FCC requirements, shielded cables are required to connect this device to a personal computer or other Class B certified device.

- TECHNICAL INFORMATION -

- THE RADIO INTERFACE -

The radio interface is terminated with standard 6-wire RJ-11 connector. Note that we have identified the various lines with letters rather than the customary pin numbers to be consistent with the identifiers used on our Mic Adapter board. Figure-3 shows both the pin letter designations and the corresponding wire colors. The signals on this interface function as follows:

Pin "A" (White) – Power Ground   This is the ground return line for TM-1 power. It should be connected to the radios power or chassis ground pin on the mic connector.

Pin "B" (Black) - Accessory Voltage Input   This line can be used to power the TM-1 from the "Auxiliary Voltage" available on the mic connector of most radios. The voltage on this input must be between 8 and 15 VDC. Approximately 45ma is needed to power the TM-1. See the "Connecting Power" section of this manual for further information on the jumpering required and precautions.

Pin "C" (Red) – PTT   This line is used to "key" the transmitter. The TM-1 switches this line to ground with a FET transistor during transmit. The transistor can "sink" currents as high as 50ma @ 12 volts. When interfacing older radios that use mechanical switches (relays) in the PTT circuit, precautions must be taken to insure that voltage and current limits are not exceeded. If your radio needs some other kind of keying arrangement (not likely) you will need to provide it. If your radio is an older model with high voltage or high current on the PTT line, you will need to install a small relay to do the keying (very low current 12v relay). Special provisions have been made to key the PTT of some "hand-held" radios. See the "Connecting Hand-Held Radios" section for details.

Pin "D" (Green) - Rx Audio   This is the receive audio input to the TM-1. This line is used to detect channel activity prior to transmitting. This line is normally connected to speaker audio and has a nominal input level of 250mv p-p. This input can be optionally configured to detect a DC level for use on some data radios. Refer to the "Option Jumpers" section for further details.

Pin "E" (Yellow) - Mic Audio   This is the transmit audio output from the TM-1. The output is capacitively coupled and should be connected to the microphone input of the radio. The level on this output can be adjusted by the "LEVEL" control on the front of the TM-1. The level is adjustable from zero to 80mv p-p (Hi Z). Note that the level has already been factory adjusted to be compatible with most radios. You should not attempt to re-adjust the level without the proper test equipment. Deviation should be set to 3.5KHz for most applications.

Pin "F" (Blue) – Signal Ground   This is the microphone ground from the radio. It should be a separate ground from the power ground.

Radio Interface Notes:

1) Keep the lines between the radio and the TM-1 as short as possible to prevent unwanted noise from entering the mic circuit.
2) If you are using a radio cable that was not supplied by Tigertronics, be sure to verify that the connector orientation is correct using Figure-3. It is extremely common for the connector to be installed backwards!
3) Be sure that the cable you use has a high quality gold plated connector that has been installed with a certified crimping tool. Lesser quality cables, available from many retail outlets may not provide reliable operation!

Connection Summary:

Pin "A" (White)	-	Power Ground
Pin "B" (Black)	-	Accessory Voltage Input
Pin "C" (Red)	-	PTT
Pin "D" (Green)	-	Rx Audio
Pin "E" (Yellow)	-	Mic Audio
Pin "F" (Blue)	-	Signal Ground

- THE DATA INTERFACE -

The data interface to the TM-1 is a standard DB-9S (female) connector. The signals on this connector function as follows:

Pin "1" – Alarm Input #1   This alarm input is high impedance and CMOS level compatible. It is internally biased to the high (+5v) state and is low-pass filtered to prevent false triggering. Applying logic levels or simply grounding this input will activate the alarm.

Pin "2" - Transmit Data   This line is the serial data output from the TM-1. It is used exclusively by the computer during programming of the unit. It should not be connected for other applications. Output levels are RS-232 compatible.

Pin "3" - Receive Data   This is the serial data input to the TM-1. Data from a GPS or other telemetry device should be connected to this pin. The input will accommodate either standard RS-232 levels (+/- 12v) or CMOS logic levels (0/+5v). This input is high impedance.

Pin "4" – Alarm Input #4   This alarm input is high impedance and CMOS level compatible. It is internally biased to the high (+5v) state and is low-pass filtered to

prevent false triggering. Applying logic levels or simply grounding this input will activate the alarm.

Pin "5" – Ground   This pin is used for both power and signal ground.

Pin "6" – Alarm Input #2   This alarm input is high impedance and CMOS level compatible. It is internally biased to the high (+5v) state and is low-pass filtered to prevent false triggering. Applying logic levels or simply grounding this input will activate the alarm.

Pin "7" – Programming Supply   This line is used to supply negative voltage to the RS-232 driver during programming of the TM-1 by the computer. It is not connected for any other application.

Pin "8" – Alarm Input #3   This alarm input is high impedance and CMOS level compatible. It is internally biased to the high (+5v) state and is low-pass filtered to prevent false triggering. Applying logic levels or simply grounding this input will activate the alarm.

Pin "9" - GPS Power   This optional output can be used to supply power to a telemetry device or GPS receiver. See the "Connecting Power" and "Option Jumpers" section of this manual for further information on the jumpering required and for some important precautions.

Data Interface Notes:

1) Some devices that generate high levels of electrical noise may not be suitable for connection to GPS Power line (Pin #9). The noise spikes generated by such devices may cause ground currents that generate noise in the transmitted signal.

Connection Summary:

Pin "1"	-	Alarm Input #1
Pin "2"	-	Transmit Data
Pin "3"	-	Receive Data
Pin "4"	-	Alarm Input #4
Pin "5"	-	Ground
Pin "6"	-	Alarm Input #2
Pin "7"	-	Program Supply
Pin "8"	-	Alarm Input #3
Pin "9"	-	GPS Power

- OPTION JUMPERS -

- CAUTION - CAUTION - CAUTION - CAUTION -

Circuit board jumpers must be used with GREAT CAUTION. Incorrect jumper settings can result in IMPROPER OPERATION or DAMAGE to both the TM-1 and the equipment it is connected to!

The TM-1 has several jumpers on the pc board for accommodating special hardware requirements. To activate the function associated with a particular jumper, you must short the jumper pins together using a 2mm "Shunt". Several shunts were supplied with the TM-1 for this purpose. If you require additional shunts, you can obtain them from most electronic and computer suppliers, such as Mouser or DigiKey. Tigertronics DOES NOT supply additional or replacement shunts! With the exception of JP4, the factory default for all jumpers is "open". The jumpers are numbered JP1 through JP5 and function as follows:

JP1 - *WARNING:* Be sure to REMOVE JP1 before you connect the TM-1 to any device that might be damaged by voltage on DB-9 Pin #9 (computers, etc.)!

This jumper connects power from the External Power jack to Pin #9 of the DB-9 connector. This jumper can be useful for powering an external device such as a GPS or telemetry encoder. Note that in the TM-1+ the power to JP1 is controlled internally by a solid state switch (Power FET). This allows the power at Pin #9 to be switched ON automatically anytime the TM-1+ is turned ON. In the TM-1 the power is not switched and is always applied to Pin #9 if JP1 is installed. Consequently, any device powered from Pin #9 on a TM-1 must have its own power switch. In both the TM-1 and TM-1+ the power to Pin #9 must be limited to 250ma (Max). Any device powered through this jumper MUST be fused (250ma or less).

JP2 - This jumper is used to bypass the power switch. Installing JP2 will cause the TM-1 to begin operating immediately when the power is applied. This may be useful in installations where power is controlled by another device. For example: If the TM-1 is used as a Mobile Tracker, power could be supplied from the ignition switch so that the TM-1 is activated anytime the vehicle is in use.

JP3 - This jumper connects the input of the TM-1's internal voltage regulator to Pin "B" of the RJ-11 connector. This jumper can be utilized in two different ways. First, it can be used to allow power from the radio interface (RJ-11) to power the TM-1. Secondly, because JP3 is at the input of the TM-1's power regulator, voltage applied to the External Power jack will also be supplied to RJ-11 Pin "B" if JP3 is installed. Note that a diode between JP3 and the External Power Jack prevents power from RJ-11 Pin "B" from feeding back to either DB-9 Pin #9 (via JP1) or the External Power jack. Power supplied to RJ-11 Pin "B" should be limited to 100ma because of the limited power rating of the RJ-11 connector itself. Note that power supplied through JP3 is not switched in either the TM-1 or TM-1+. Refer to Figure-2 for a better understanding of the power control circuitry.

JP4 - This jumper determines what kind of signal is expected on the "Busy" line from the radio (RJ-11 Pin "D"). The "Busy" line is tested by the TM-1 prior to transmitting. If the "Busy" line is active, the TM-1 will wait to transmit until the channel is clear. This avoids collisions with other signals that might be on the channel. The default setting for

JP4 is a jumper between pins 2-3. In this configuration the input (RJ-11 Pin "D") is terminated with 100 ohms and an audio level of at least 150mv p-p is expected when the channel is busy. This is the correct setting for JP4 when "Busy" is connected to the speaker output of a radio. The alternate setup for JP4 is to connect pins 1-2. This setting allows the input to sense a dc level. The dc threshold for "Busy" will be about 2.5 volts and the input impedance is increased to 5k ohms. This option allows the "squelch output" from most "data radio" ports to be used. This is an important capability since the audio from most "data ports" is not controlled by the squelch circuit.

JP5 - This is the "HT" jumper. Many handheld (HT) radios control the PTT function of the external microphone input by drawing a small amount of dc current through the audio (mic) input. This is generally accomplished by connecting a resistor between the mic input and the PTT switch. The other side of the switch is connected to ground so that a small current flows through the mic circuit when the PTT is activated. This current causes the radio to transmit. Jumper JP5 connects a 2.7k resistor between the PTT circuit of the TM-1 (RJ-11 Pin "C") and the mic audio line (RJ-11 Pin "E"). This resistor value is suitable for all radios. Note that some handheld radios are NOT switched in this manner (i.e.: Kenwood, etc.). Be sure to consult your radios documentation before installing JP5!

- GENERAL SPECIFICATIONS -

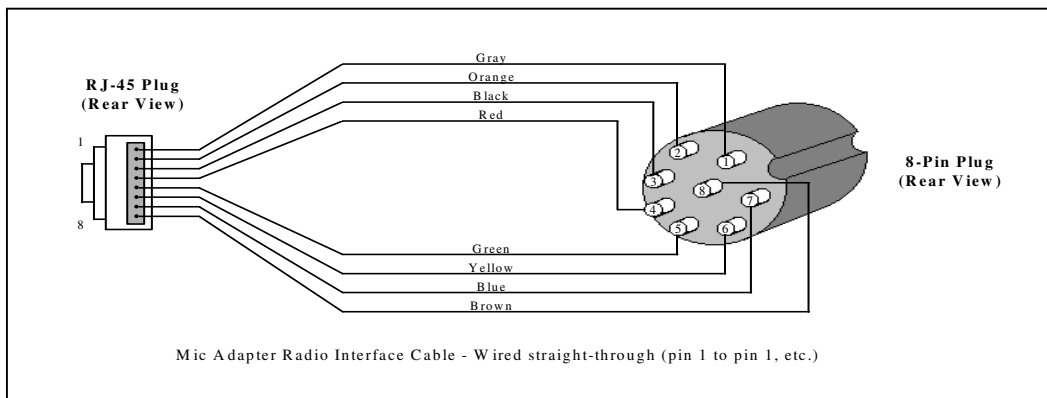|	
Levels (Radio):	Mic Audio - 80mv max (Hi-Z)
	Receive Audio - 250mv (nom)
	PTT - 15v @ 50ma (max)
Levels (Data):	RS232 (+/- 3v min)
	CMOS (2.5v min / 5v max)
Power Supply:	+8 – 15 vdc @ 45ma (max)
Operating Mode:	Programmable
Compatibility:	Input: RS-232 / CMOS
	Output: AX-25 Packet
Connectors:	Data: DB-9S
	Radio: RJ-11 (6)
	Power: 2.1mm
Dimensions:	1.1" x 2.7" x 3.0"
Operating Temp:	-30C to +60C

Instructions For Optional Mic Adapter
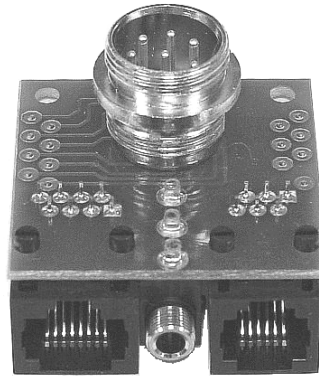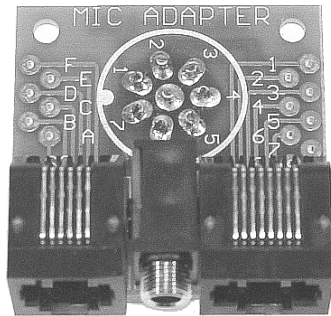
Introduction: The TM-1 Mic Adapter Kit was created to simplify attaching the TigerTrak to a mobile radio for tracking applications. The adapter provides a convenient way to connect to the various mic lines without the need to cut or splice any existing wiring. The Mic Adapter is simply inserted in-line between the radio and the microphone. Inside the adapter there are a series of jumper terminals that allow you to bridge the appropriate mic lines over to the TM-1 connector. Although this process is simple in theory, it is extremely easy to make an error that could have disastrous consequences! These instructions include a worksheet to guide you through the process. It is important that you read this document thoroughly before beginning and then follow the instructions exactly to insure success. These instructions will take you through the following steps:

1. Assemble the Mic Adapter printed circuit board.
2. Verify the radio's microphone connector pin-out using a multimeter.
3. Make a table showing the *correct* pin-out of the microphone connector.
4. Complete the jumper wire diagram showing how to install the jumpers.
5. Install the appropriate jumpers on the Mic Adapter circuit board.

WARNING: Incorrect wiring could destroy both the TM-1 and your radio equipment! If after reviewing this document, you are not absolutely certain that you are technically qualified to proceed, we recommend that you obtain the assistance of an experienced technician. Tigertronics assumes no responsibility for the use or misuse of this adapter. This document is intended only to provide basic guidelines to a qualified technician. It is the sole responsibility of the user to insure proper wiring.

Assembling The PCB: Assembly and soldering of the Mic Adapter circuit board is very straightforward. It is a simple matter of inserting the parts into the board as shown in the pictures and then carefully soldering all the pins. The only caution we might make is to be sure that each component is held tight against the board before you solder. It might be a good idea to solder just one or two pins and then double check the positioning of the part before soldering the remainder. It is *extremely difficult* to reposition a part after it is completely soldered, so take your time and double check your work! Be sure to index the round connector correctly. Check the connector pin numbers and index notch against the pin numbers and index printed on the board.

Interface Cable: The next step in assembling the Mic Adapter Kit is the wiring of the Interface Cable. This is the cable that connects your radio to the Mic Adapter board. The reason that we want to wire this first is that it provides a useful tool for figuring out the microphone wiring in the steps that follow. We have provided a short length of eight conductor cable in the kit. The cable already has the RJ-45 connector installed on one end, so you will only need to install the 8-pin round connector on the other. It is best to make this cable as short as possible, so trim it's length appropriately for the distance that you plan to locate the Mic Adapter from your radio. In wiring the connector, Pin #8 (center pin) is always the most difficult to solder, so we would recommend that you wire the connector pins in sequence starting with Pin #8 (reverse order). Be very careful not to fray any wires as they can cause pins to short when the cable is flexed. It would be best to use "heat shrink" or insulating tubing on the pins, if it is available. Wire the connector according to the wire colors as shown in the diagram below.

RJ-45 Plug
(Rear View)

1

8

Gray
Orange
Black
Red

Green
Yellow
Blue
Brown

8-Pin Plug
(Rear View)

Mic Adapter Radio Interface Cable - Wired straight-through (pin 1 to pin 1, etc.)

Mic Connector: The next step is to determine *for certain* the function of each pin on the mic connector. If your radio has a round 8-pin connector the process is very straight forward, but if your radio uses a RJ-45 (telephone like) connector, the process can be a little tricky! To wire either connector you *must* have the Users Manual for your radio available for reference.

To minimize the possibility of making a wiring mistake, we have provided a wiring table for you to complete in the Jumper Wire Diagram. As the correct signal is determined for each microphone pin, you should record it in the table. You might want to use a pencil for this process, in case you need to make a change or use the table for a different radio later.

If your radio uses the 8-pin round connector, you should be able to copy the signal names and their associated pin numbers directly from the radio manual into the appropriate lines of the Jumper Wire Diagram. When copying this information, be sure that you refer to the actual pin numbers given. Do not attempt to determine the pin number from any illustration of the connector. When you are finished, it would be a good idea to double check the accuracy of your information by testing continuity between chassis ground and the pin that is supposed to be Ground on the connector.

If your radio uses an RJ-45 mic connector, you cannot assume that the pin numbers in the manual are listed correctly. If the manufacturer has not followed the industry standard numbering conventions, the lines will be in the correct sequence, but in reverse order (Pin #1 = Pin #8)! Unfortunately this is not at all uncommon. On a number of occasions we have even found disagreement in the numbering system between radio models from the *same* manufacturer! You should *never* assume the position of Pin #1 on any RJ type connector, based on the diagram in the manual. Since these lines often times have Accessory Voltage on them, wiring the connector incorrectly can have catastrophic results!
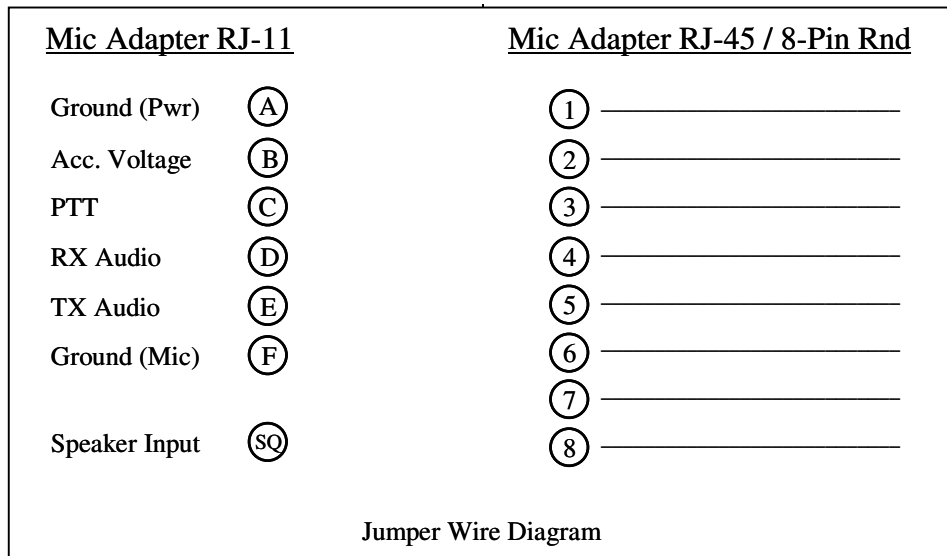
The best way to insure you have the correct wiring order is to verify with a multimeter where the Ground and PTT pins actually are on the connector. Because the RJ-45 pins are dangerously close together and very fragile, we will use the Interface Cable and Mic Adapter board to help make these tests. Since the adapters RJ-45 and 8-pin round connectors

are wired in parallel (Pin #1 = Pin #1), you can use the pins on the back of the boards round connector for testing. These pins are much easier to probe than an RJ-45 pin and are very clearly numbered on the pc board. Turn the radio OFF and attach the Mic Adapter board to your radio using the Interface Cable.

Start the identification process by checking for continuity between the radios chassis and the connector pin number that is listed as Chassis Ground in your radio manual. For example: If the manual says that Pin #3 is Ground, then check continuity between the radio chassis and the third pin (Pin #3) on the round connector. When making this measurement, remember that you are looking for "Zero Ohms". There will no doubt be some amount of continuity between several other pins, but remember that the one you are testing for is a "short" to ground! If you don't find continuity on the pin that you tested, then the pin numbers must be reversed in the radio manual. You can verify this by testing the third pin from the other end (in our example Pin #6). You should find continuity on that pin if the order is in fact reversed.

If you would like to up your confidence even further, you can turn your radio ON and test the PTT line. Your radio should be attached to an antenna or dummy load for this test, since you will be transmitting briefly. In this test you will be manually keying the transmitter by briefly shorting the PTT line to Ground. If one is available, use a small value resistor (a few hundred ohms) to short the PTT line to Chassis Ground (chassis - not the ground pin). The resistor is not really necessary, but a good idea just in case you are shorting the wrong pin! If the radio transmits, you can be absolutely certain that you have the pin numbering correct.

Once you have established whether or not the pins in the manual are listed in reverse order, you should enter the signal names into the appropriate lines of the Jumper Wire Diagram. If the lines were not reversed, then you can enter the signals exactly as they are numbered in your radio manual. If the connector numbers were reversed, then enter the signals into Jumper Wire Diagram in the reverse order.

Mic Adapter RJ-11   Mic Adapter RJ-45 / 8-Pin Rnd

Ground (Pwr)   Ⓐ   ①————————

Acc. Voltage   Ⓑ   ②————————

PTT   Ⓒ   ③————————

RX Audio   Ⓓ   ④————————

TX Audio   Ⓔ   ⑤————————

Ground (Mic)   Ⓕ   ⑥————————

     ⑦————————

Speaker Input   ⓈⓆ   ⑧————————

Jumper Wire Diagram

This means that the signal listed in the radio manual as Pin #8 should be entered into the Jumper Wire Diagram next to Pin #1. The signal listed in the manual as Pin #7 should be entered into the Jumper Wire Diagram as Pin #2 and so on, until all entries are complete.

Jumper Wire Diagram: Now that you have completed the entries in the Jumper Wire Diagram, you are ready to draw in the Jumpers that need to be installed on the Mic Adapter pc board. This is simply a matter of matching the TM-1 signals in the left column with the corresponding radio signals in the right column and then drawing a line between them representing the jumper that you need to install. You may find that some of the signal names taken from the radio manual are not as descriptive as you might like, but generally the manual will also contain a brief description of each line that will help you understand the function well enough to make the match.

On occasion you may find a radio that does not provide a separate Mic Ground and Chassis (Pwr) Ground. In this case you can simply jumper TM-1 pins "A" and "F" together and then connect them to the single radio ground. The TM-1 uses speaker audio (Pin "D") to determine if the channel is busy before it transmits. If your radio does not provide speaker audio on the mic connector, you can deal with the problem in several ways. First, if you are technically inclined, you could run the radios speaker audio to an unused (or unnecessary) pin on the mic connector. This is a nice solution but sometimes rather difficult to accomplish. The second solution is to run speaker audio from the radios Aux Spkr jack to the 3.5mm miniature phone jack on the Mic Adapter board. This jack is connected to the terminal point on the board marked "SQ". The "SQ" terminal can then be jumpered to the RX Audio pin to the TM-1 (Pin "D"). The drawback to this solution is that plugging into the Aux Spkr jack of most radios will disable the radios internal speaker. If you are also using the radio for voice communications, this is a problem.

About the only solution to that problem is to use an external speaker or modify the radios Aux Spkr jack so that it does not cut the internal speaker off. NOTE: Pin "B" (Acc. Voltage) going to the TM-1 is not required and should not be connected under normal circumstances. Refer to the TM-1 Installation Manual for details about this pin.

Installing Jumpers: Using short lengths of the hookup wire provided with the adapter kit, install jumpers on the pc board according to the diagram that you created above. These wires should be installed on the top side of the pc board, so that the jumpers can be checked or changed at a later date without removing the board from the enclosure.

Packaging the Mic Adapter: Tigertronics currently does not supply a housing for the Mic Adapter board. It is up to the ingenuity of the user to find an appropriate package suitable for his purpose. For those who would like to package the board in a small plastic case, we would suggest looking at the Radio Shack case #270-1801. We have found this case to work very well for "under dash" installations. To use this case, you will need to drill down or cut off the four standoffs on the floor to provide clearance for the pc board. You will of course also need to make the necessary holes and cutouts in the case for the Mic Adapter. The pc board should be mounted to the floor of the case using two #4 screws and short standoffs.