TRAKIT-20

Printings

Version 1.00: 4/01/97
Version 2.00: 9/11/97
Version 2.30: 11/04/98
Version 2.40: 6/17/99
Version 2.40A: 2/06/02
Version 2.50: 1/09/03
Version 2.51: 12/18/03

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SPECIFICATIONS

Input voltage	11VDC - 18VDC
Standby current @ 13.8VDC	125mA
with Trimble SK8 receiver and antenna	310mA
Temperature range	0 to +70 deg C
Relative humidity	90% at 50 deg C
Tx audio output impedance	600 ohms
high impedance	10k ohms
Tx audio level	0V to .77V RMS into 600 ohms
Rx audio level	30mV RMS to 2.5V RMS
Modem data	1200 baud MSK
Weight	1.1 lb.
Dimensions	5.5" x 5.5" x 1.5"

1.0 GENERAL DESCRIPTION

1.1 Description

The TrakIt-20 provides a full featured Automatic Vehicle Location (AVL) system for fleet management using the Global Positioning System (GPS). The TrakIt-20 comes in a vehicle version and a base version. The vehicle version contains a GPS receiver, a data buffer and a data modem. Location data is accumulated in the buffer and can be sent to the base through a radio link. The base version contains a data modem and connects to the AVL base computer. Location data is received by the base and passed to the AVL base computer.

The TrakIt-20 is designed for use on 450 MHz, 800 MHz, shared or dedicated, trunked or conventional radio systems. Interfaces to a number of different radios have been developed for the TrakIt-20. Various radio interface cables are available for quick and easy installation.

1.2 Capabilities and Features

- Can be used on 450 MHz, 800 MHz, shared or dedicated, trunked or conventional radio systems.
- Interface kits to many radios are available for easy installation.
- Operating and timing parameters are stored in non-volatile EEPROM and can be programmed to meet system requirements.
- Voice and data can be intermixed on the radio channel.
- Data port has numerous programmable operating modes.
- Two external inputs allow position records to be generated on external events.
- On board battery backed position buffer holds 1000+ records.
- Internally located GPS receiver board.
- Onboard 1200 baud MSK modem.

2.0 INSTALLATION AND SETUP

2.1 Inspection

Please refer to the checklist packed with the TrakIt-20 in order to become familiar with the unit and to insure that everything ordered has been received. In the event a part is missing from the checklist, please call the Customer Services Department at 1-701-280-1122.

This unit was thoroughly inspected before leaving the factory. If the outer package appears damaged, please inspect the unit for possible damage immediately. Any dents, scratches, or marks suggest rough handling in shipping. Please notify the shipper if you find any indications of mishandling. If there are any concerns about the condition of the TrakIt-20 when it is received, please don't hesitate to call the Customer Services Department.

2.2 Disassembly and Reassembly

When performing the alignment procedure or making changes to the jumpers and dip switches on the TrakIt-20, it is necessary to remove the printed circuit board from the case. This is accomplished by removing the two black screws from the front of the TrakIt-20 and removing the front panel. Remove the top cover by sliding it off the TrakIt-20. Since the printed circuit board contains sensitive circuitry, be sure to take the necessary precautions against static discharge.

To reassemble the TrakIt-20, replace the top cover and the front panel making sure the front and back panels are seated properly with the case. Replace the two black screws but do not over-tighten them.

2.3 Installation Procedure

This section describes the procedure for installing the TrakIt-20 either in a vehicle or at the base site. The first step is to perform a quick bench test on the TrakIt-20 before connecting it to a radio. The purpose of the bench test is to set up the TrakIt-20 to operate with the radio to which it will be connected. To perform the bench test, connect power and ground to the TrakIt-20. Refer to section **2.4 Radio Connection** for the power and ground connections. Connect the TrakIt-20 to the computer that the AVL Installer program is on as described in section **2.5 Data Port Connection**. Then use the AVL Installer program to edit the installer table in the TrakIt-20. Refer to section **2.10 AVL Installer Program** for information on editing the installer table. **Appendix A** lists some installer table settings that are required for certain radios.

2.3 Installation Procedure (cont.)

The next step is to connect the TrakIt-20 to the radio. Section **2.4 Radio Connection** lists the different connections that can be made to the radio. In addition, **Appendix A** contains procedures for connecting the TrakIt-20 to certain radios using factory supplied cables. The jumpers and dip switches should also be set as required. Refer to sections **2.7 Jumper Settings** and **2.8 Dip Switch Settings** for a description of the jumpers and dip switches. Be sure to program the radio's frequencies and features as required.

After the TrakIt-20 is connected to the radio, its audio levels should be adjusted by performing the alignment procedure described in section **3.0 Alignment Procedure**. After completing the alignment procedure, recheck the installer table settings and the radio programming and make any changes that may be required.

If the TrakIt-20 is a vehicle version, the TrakIt-20 along with the radio can now be installed into the vehicle. Refer to the radio's manual for instructions on installing the radio into a vehicle. The TrakIt-20 should be installed in close proximity to the radio. Be sure to allow sufficient space around the radio and TrakIt-20 for air cooling. The GPS antenna should also be installed as described in section **2.6 GPS Antenna Connection**.

If the TrakIt-20 is a base version, the TrakIt-20 along with the radio can now be installed at the base site. The TrakIt-20 and the radio should be installed to allow sufficient space for air cooling. The TrakIt-20 should be connected to the base computer that will be running the AVL base software as described in section **2.5 Data Port Connection**.

NOTE: The TrakIt-20 can key the radio at any time. Because of this, the radio should be connected to an antenna or a dummy load at all times. This will prevent damage to the radio caused by transmitting without a load.

2.4 Radio Connection

The connector J1 is used to interface the TrakIt-20 to a radio to provide the signals required for the TrakIt-20 to control the radio and send data through the radio system. Interfaces to various radios have been developed and **Appendix A** contains procedures for connecting the TrakIt-20 to certain radios using factory supplied cables. Following is a description of the function of each pin of J1.

1. This is the receive audio pin. Modem data is decoded from the audio present on this pin. For trunking or conventional systems, this pin should be connected to some point after the radio’s squelch gate so that the TrakIt-20 will only receive audio that is being sent to the radio’s speaker. This will prevent the TrakIt-20 from receiving data transmissions that are being sent to mobiles with a different ID.

2.4 Radio Connection (cont.)

For trunking systems, it is also possible to connect the receive audio pin to some point before the radio's squelch gate (such as the discriminator output) but only if the receive indicator pin is connected to a point in the radio that goes active when the radio is receiving a transmission (audio is being passed to the speaker). This is to ensure that the TrakIt-20 does not receive data transmissions that are being sent to mobiles with a different ID.

NOTE: The point in the radio where the receive audio is obtained should not be affected by the radio's volume control.

2. This is the transmit audio pin. Modem data that is to be transmitted will appear on this pin. This pin should be connected to some point in the radio that will allow the audio on this pin to be transmitted when the TrakIt-20 activates the radio's PTT. The transmit audio pin can be set up as either a low or high impedance output.

3. This is the transmit indicator pin. This pin is used to indicate to the TrakIt-20 when the radio is keyed. It should be connected to some point that goes active when the radio is keyed (such as the transmit LED). For trunking systems, it could instead be connected to a point that goes active when the system has been successfully accessed. The transmit indicator pin can be programmed as either an active high or active low input.

   While this pin is active, the TrakIt-20 will not attempt to key the radio. This is to prevent the TrakIt-20 from sending data messages while the radio's microphone is keying the radio. When the TrakIt-20 has a data message to send, it will wait for this pin to go non-active before keying the radio. After keying the radio, the TrakIt-20 will wait for this pin to go active before sending the modem data.

   This pin can also be programmed to operate as a second event input signal pin that functions the same as the event input signal pin (pin 5).

4. This is the receive indicator pin. This pin is used to indicate to the TrakIt-20 when the radio is receiving a transmission. When this pin is active, the TrakIt-20 will attempt to decode modem data from the received audio. Also, the TrakIt-20 will not attempt to key the radio while this pin is in an active state. The receive indicator pin can be programmed as either an active high or active low input.

   For trunking systems, this pin should be connected to a point in the radio that goes active when a transmission is being received by the radio but does not go active when other traffic occurs on the channel (for example, the control line that enables audio to the radio's speaker). This is to ensure that the TrakIt-20 does not receive data transmissions that are being sent to mobiles with a different ID.

   For conventional systems, this pin should be connected to a point in the radio that goes active when a carrier is detected by the radio (such as the output of the squelch detect circuit). This is to ensure that the TrakIt-20 will not attempt to transmit while the radio channel is busy with other users.

2.4 Radio Connection (cont.)

5. This is the event input signal pin. The TrakIt-20 uses this pin to determine the state of an external device. Position records can be generated by the TrakIt-20 (vehicle version only) when the state of the external device changes. The event input signal pin is de-bounced and any new input level on this pin should be held for at least 1 second. The event input signal pin can be programmed as either an active high or active low input. This pin is not used in the base version.

6,7. These two pins are used to mute the radio's microphone audio while the TrakIt-20 is sending modem data. This is necessary in some installations to prevent microphone audio from corrupting the modem data being sent. These pins can be used to enable or disable a control line that mutes the microphone audio or the microphone audio path can be broken and passed through these two pins. An audio gate is connected between these two pins in the TrakIt-20 and when enabled it will effectively connect pin 6 to pin 7. The TrakIt-20 can be programmed to mute the microphone audio by either enabling or disabling this audio gate.

8. This pin is used to supply power to the TrakIt-20. It should be connected to a point in the radio that will provide 13.8 VDC to the TrakIt-20. It is recommended that the radio's power switch control power to the TrakIt-20 as well.

9. This is the ground pin. It should be connected to the radio's ground.

10. This is the PTT output pin. The TrakIt-20 keys the radio by activating this pin. This pin should be connected to some point in the radio that will cause the radio to key up when this pin is activated. The PTT output pin can be programmed as either an active high or active low output.

11. This is the TXD pin of the TrakIt-20's external serial port. The data on this pin is at TTL levels. This pin is not currently used and should be left unconnected.

12. This is the RXD pin of the TrakIt-20's external serial port. The data on this pin is at TTL levels. This pin is not currently used and should be left unconnected.

13. This is the external output pin. The function of this pin is programmable and it should be connected to an appropriate point based upon its programmed function. The external output pin can also be programmed as either an active high or active low output. This pin does not need to be connected if none of its programmable functions are to be used.

14. This pin is not used.

15. This pin is the 5 VDC output from the TrakIt-20 and does not generally need to be connected.

2.5 Data Port Connection

The data port connector J2 is used to make a serial connection from the TrakIt-20 to a computer, a TrakIt Vehicle Terminal, or some other device. The data port on the base version of the TrakIt-20 should be connected to a computer to allow setup data to be programmed into it using the AVL Installer program or to allow the AVL base software to communicate with the base unit. If the base unit is to operate in either TrakIt IP mode or TrakIt RF/IP mode, its data port should be connected to a TrakIt IP unit. The data port on the vehicle version of the TrakIt-20 has different programmable modes of operation which determine what it should be connected to. Following is a description of each of the data port operating modes.

NMEA - In this mode, NMEA messages that are received from the GPS receiver are sent to the data port. The data port should be connected to a computer or some other appropriate device.

Supervisor/Monitor - This mode allows the AVL Supervisor/Monitor software to communicate with the TrakIt-20. The data port should be connected to the computer that will be running the AVL Supervisor/Monitor software.

ASCII In/Out - This mode allows ASCII dispatch messages to be sent and received through the data port. The data port should be connected to a computer or some other appropriate device.

Vehicle Terminal - This mode allows the TrakIt Vehicle Terminal to send and receive dispatch messages through the data port. The data port should be connected to the TrakIt Vehicle Terminal.

VDO - This mode allows the TrakIt-20 to communicate with a VDO on-board computer. The data port (at RS232 levels) should be connected to the VDO on-board computer.

Cellular - This mode allows the AVL base software to communicate with the TrakIt-20 through a cellular modem. The data port (at RS232 levels) should be connected to the cellular modem.

The AVL Installer program can be used to change the data port operating mode and to program setup data into the vehicle unit no matter what operating mode the data port is in.

2.5 Data Port Connection (cont.)

To connect the TrakIt-20 to a computer, connect the DB-9 connector on the back of the TrakIt-20 labeled "DATA PORT" to the computer's serial port using the DB-9 to DB-9 cable provided. If the computer's serial port is a DB-25, the DB-9 to DB-25 adapter should be used. In addition, the data port connector will need to be set up for RS232 levels as described in section **2.8 Dip Switch Settings**. The following table details the connections that are made between the TrakIt-20 and the computer.

TrakIt-20 DB-9	Computer DB-9	Computer DB-25
2 - TXD	2 - RXD	3 - RXD
3 - RXD	3 - TXD	2 - TXD
5 - GND	5 - GND	7 - GND
7 - CTS	7 - RTS	4 - RTS
8 - RTS	8 - CTS	5 - CTS

2.6 GPS Antenna Connection

The TrakIt-20 (vehicle version only) comes with a GPS receiver and a GPS antenna. The GPS antenna should be connected to the connector on the back of the TrakIt-20 that is labeled "GPS ANT". The GPS antenna is either magnetic mount or permanent mount and should be mounted to a flat horizontal surface that will have an unobstructed view of the sky. When installing the GPS antenna, be sure that the antenna cable is not pinched or run past sharp edges.

2.7 Jumper Settings

The following is a description of the jumpers and their settings on the TrakIt-20 board. Shorting blocks are not used with these jumpers since they can bounce off when the TrakIt-20 is installed in vehicles. Instead, staple jumpers are used on most of these jumpers. Where posts are used, the necessary connection should be made with wire wrap wire or by bending the posts together and soldering them.

JP1 - This jumper determines if the transmit audio output is low impedance or high impedance. It should be installed for low impedance and removed (or cut) for high impedance.

JP2 - This jumper is not used and should not be changed.

JP3 - This jumper is not used and should remain not installed.

JP4 - This jumper determines if the received audio will be de-emphasized. If JP4 is jumpered to A-B, the received audio will not be de-emphasized. If JP4 is jumpered to B-C, the received audio will be de-emphasized.

JP5 - This jumper is factory installed and should not be changed.

2.8 Dip Switch Settings

The following describes the function of the individual switches of dip switch SW1. Changes should be made to the switches only after power has been removed from the TrakIt-20.

1,2. These switches are used to set the operating mode of the TrakIt-20 as follows:

1	2	Mode
OFF	OFF	Normal
OFF	ON	Test
ON	OFF	TrakIt IP
ON	ON	TrakIt RF/IP

Normal - This is the normal operating mode. The TrakIt-20 should always be in this mode except when it is necessary to have the unit in one of the other modes.

Test - This is the test mode. When put into this mode, the TrakIt-20 will key the radio and start generating a modem test tone. This will allow the audio levels to be adjusted. Refer to section **3.0 Alignment Procedure** for more information on adjusting the audio levels. If the TrakIt-20 does not key up the radio when put into test mode, check the radio connections and the installer table settings.

TrakIt IP - This is the TrakIt IP mode. It is available only on the base unit. This mode allows the TrakIt-20 base unit to provide the required features for TrakIt IP operation. NOTE: When in this mode, the base unit cannot communicate with the AVL installer program.

TrakIt RF/IP - This is the TrakIt RF/IP mode. This mode allows the TrakIt-20 to provide the required features for TrakIt RF/IP operation. NOTE: When in this mode, the base unit cannot communicate with the AVL installer program.

3-10. These switches determine the routing and signal levels of the TrakIt-20's external serial port as follows:

3,4	5,6	7-10	Routing
ON	OFF	OFF	Data port @ TTL levels
OFF	ON	OFF	Radio port @ TTL levels
OFF	OFF	ON	Data port @ RS232 levels

Data port @ TTL levels - The serial port is routed to the data port connector at TTL levels. This setting is not currently used.

Radio port @ TTL levels - The serial port is routed to the radio port connector at TTL levels. This setting is not currently used.

Data port @ RS232 levels - The serial port is routed to the data port connector at RS232 levels. This setting is used when the data port is connected to the serial port of a computer, the TrakIt Vehicle Terminal, or some other RS232 device.

2.9 Adjustment Potentiometers

The functions of the adjustment potentiometers are described below. Refer to section **3.0 Alignment Procedure** for step-by-step instructions on adjusting these pots.

Receive Audio Level - The potentiometer R3 is used to adjust the receive audio level that is applied to the modem IC.

Transmit Audio Level - The potentiometer R2 is used to adjust the level of audio from the modem IC that is sent to the radio for transmission.

DTMF Audio Level - The potentiometer R1 is used to adjust the level of DTMF tones that are sent to the radio for transmission. This pot is not currently used.

2.10 AVL Installer Program

The AVL Installer program is used only by the installer and allows the many different programmable parameters of the TrakIt-20 to be tailored to the selected radio and system on which it will operate. The AVL Installer program contains an installer table and an operator table. The parameters contained in the installer table determine how the TrakIt-20 will operate with the selected radio and system and can be changed only by the installer using the AVL Installer program. The parameters contained in the operator table determine how the TrakIt-20 handles position records and can be changed by the installer using the AVL Installer program or by the operator using over the air programming. The AVL Installer program cannot communicate with a TrakIt-20 base unit if it is in either TrakIt IP or TrakIt RF/IP operating mode. The base unit should be switched to normal mode to allow it to communicate with the AVL Installer program.

To change the installer table settings, the installer should use the AVL Installer program to edit the installer table and then upload the installer table to the TrakIt-20. The installer does not normally need to edit and upload the operator table since the operator can change the operator table settings using over the air programming. In addition, the installer does not need to initialize the unit ID of the vehicle unit since the automated initialization feature will allow the operator to initialize the unit ID after the TrakIt-20 has been installed in a vehicle. If a TrakIt-20 vehicle unit is in TrakIt RF/IP operating mode, its unit ID is pre-configured and cannot be changed.

The different parameters that are available in the installer table are described below. Before changing any parameter, its function should be completely understood since the full effect of any change may not be immediately noticeable.

Vehicle Name - Vehicle name helps the system operator identify which vehicle is connected when the automated initialization feature is being utilized. Use an identifier that the operator will equate to the vehicle (for example, "Red truck" or "Truck 112").

Event input signal active - If the event input signal at J1-5 is active high, this should be set to high. If the event input signal is active low, this should be set to low. The TrakIt-20 (vehicle version) can use the event input signal to generate position records. If the TrakIt-20 is a base version, this setting is ignored.

2.10 AVL Installer Program (cont.)

Transmit indicator active/Event input 2 signal active - If the transmit indicator line (J1-3) is active high, this should be set to high. If the transmit indicator line is active low, this should be set to low. If the transmit indicator pin is programmed to operate as a second event input signal pin, this setting reflects the active level of the second event input signal.

Receive indicator active - If the receive indicator line (J1-4) is active high, this should be set to high. If the receive indicator line is active low, this should be set to low.

PTT output active - If the PTT output (J1-10) needs to be at a high level to key the radio, set this to high. If the PTT output needs to be at a low level to key the radio, set this to low.

External output active - If the external output (J1-13) needs to be active high, set this to high. If the external output needs to be active low, set this to low.

Enable mic mute gate on transmit - The TrakIt-20 uses the mic mute audio gate to mute the microphone audio while it is transmitting a data message. If the radio's microphone audio will be muted with the mic mute audio gate enabled, this should be set to yes. If the radio's microphone audio will be muted with the mic mute audio gate disabled, this should be set to no.

Transmit while receive indicator active - When this is set to no, the TrakIt-20 will not attempt to key the radio to send a data message while the receive indicator line is active. This prevents the TrakIt-20 from trying to key the radio while the radio is receiving a transmission. Setting this to yes allows the TrakIt-20 to key the radio while the receive indicator line is active (unless modem data is currently being detected). Normally, this should be set to no.

Transmit while transmit indicator active - When this is set to no, the TrakIt-20 will not attempt to key the radio to send a data message while the transmit indicator line is active. This prevents the TrakIt-20 from trying to key the radio and send a data message while the microphone is being used for voice communications. Setting this to yes allows the TrakIt-20 to key the radio and send a data message while the transmit indicator line is active. Normally, this should be set to no.

Number of key up attempts - This is the maximum number of times the TrakIt-20 will attempt to key the radio when it has a data message to send. If the radio does not successfully key up within this number of attempts, the data message will not be sent.

Key up delay after receive - When the TrakIt-20 has a data message to send, it will not activate the PTT output to key the radio until a minimum of this amount of time has passed since the receive indicator line was last active (if *transmit while receive indicator active* is set to no) or since modem data was last detected (if *transmit while receive indicator active* is set to yes).

2.10 AVL Installer Program (cont.)

Key up delay after transmit - When the TrakIt-20 has a data message to send, it will not activate the PTT output to key the radio until a minimum of this amount of time has passed since the transmit indicator line was last active. If *transmit while transmit indicator active* is set to yes, this time will be ignored.

Transmit considered active time - After activating the PTT output, the TrakIt-20 will monitor the transmit indicator line to determine when the radio has keyed and accessed the system. Only after the transmit indicator line has been continuously active for this amount of time will the TrakIt-20 assume that the radio has successfully keyed up and the modem data can be sent.

Enable Tx indicator as event 2 - When this is set to no, the transmit indicator line will be used to determine when the radio is keyed. On conventional systems, this may not be required in which case setting this to yes will allow the transmit indicator pin to be used as a second event input signal. When this is set to yes, *transmit while transmit indicator active*, *number of key up attempts*, *key up delay after transmit*, *transmit considered active time*, *key up failure time*, and *key up failure delay time* will be ignored.

Key up failure time - After activating the PTT output, this is the maximum amount of time the TrakIt-20 will wait for the radio to successfully key up. (The radio has successfully keyed up when the transmit indicator line has been continuously active for *transmit considered active time*). If the radio does not successfully key up within this amount of time, the TrakIt-20 will consider this key up attempt to have failed and will de-activate the PTT output.

Key up failure delay time - After a failed key up attempt, the TrakIt-20 will de-activate the PTT output and then delay this amount of time before it attempts to re-key the radio (provided that the *number of key up attempts* has not been exceeded).

Delay before data send - After the radio has been successfully keyed up, the TrakIt-20 will delay this amount of time before sending the modem data. This will allow time for the radios that are to receive the data to decode the radio ID and open their audio paths and/or to trunk to the channel being used.

After send delay before unkey - After the TrakIt-20 has sent the modem data, it will delay this amount of time before de-activating the PTT output to unkey the radio.

Minimum time between sends - After the TrakIt-20 has sent a message and de-activated the PTT output, it will wait a minimum of this amount of time before activating the PTT output to send another message.

External output active time - If the *external output mode* is set to speaker mute, the TrakIt-20 will activate the external output while receiving a data message and keep it active for this amount of time after receiving the data message or until the receive indicator line is no longer active. If the *external output mode* is set to second PTT, the TrakIt-20 will activate the external output this amount of time before the PTT output is activated and deactivate the external output this amount of time after the PTT output is deactivated. The *external output active time* is not used when the *external output mode* is set to user output.

2.10 AVL Installer Program (cont.)

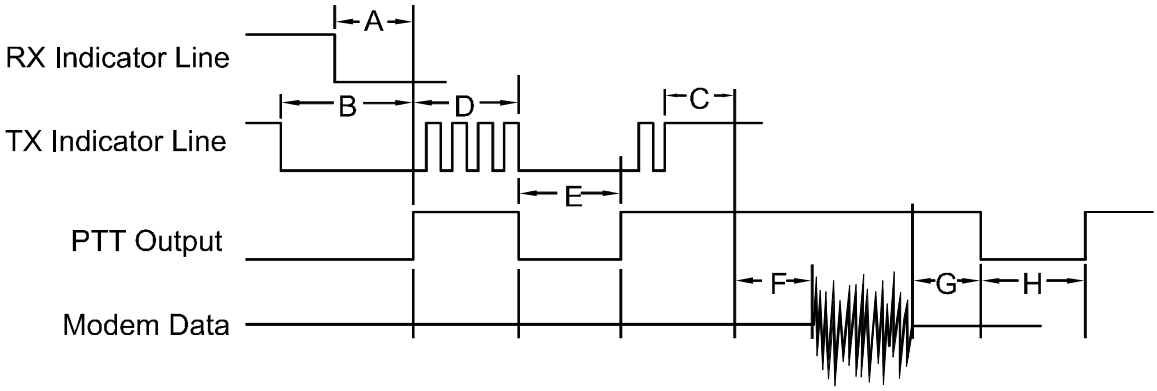
External output mode - This setting determines the operating mode for the external output. Following is a description of the different operating modes of the external output.

Speaker mute - In this mode, the TrakIt-20 will activate the external output while receiving a data message to mute the radio's speaker audio to prevent the modem data tones from being heard through the radio's speaker.

Second PTT - In this mode, the external output will provide a second PTT signal that goes active before the PTT output is activated and is deactivated after the PTT output is deactivated. This second PTT signal can be used on some radios to change the radio to a data channel before the radio is keyed.

User output - In this mode, the state of the external output is controlled by the operator using the AVL base software. This allows a device in the vehicle to be enabled and disabled from the base site. This mode is not available in the base version of the TrakIt-20.

The following diagram shows the relationship between the different programmable times and the different input and output signals. For illustration purposes, this diagram assumes the inputs and outputs are all active high.



The letters used in the diagram correspond to the programmable times as follows:

A. Key up delay after receive
B. Key up delay after transmit
C. Transmit considered active time
D. Key up failure time
E. Key up failure delay time
F. Delay before data send
G. After send delay before unkey
H. Minimum time between sends

3.0 ALIGNMENT PROCEDURE

The alignment procedure requires two TrakIt-20 units connected to the radios that they are to operate with. The two TrakIt-20 units will be aligned at the same time.

1. Connect the TrakIt-20 units to the radios, set the switches and jumpers as required, and program the required installer data into the TrakIt-20 units using the AVL Installer program.

2. Put the first TrakIt-20 into test mode (SW1-1 OFF, SW1-2 ON) and the second TrakIt-20 into normal mode (SW1-1 OFF, SW1-2 OFF). Monitor the first radio's transmit frequency with a communications monitor and adjust R2 on the first TrakIt-20 for 3 kHz deviation.

3. On the second TrakIt-20, measure the voltage level at TP2 using an AC voltmeter. Adjust R3 to obtain a level of 440mV RMS.

4. Put the second TrakIt-20 into test mode (SW1-1 OFF, SW1-2 ON) and the first TrakIt-20 into normal mode (SW1-1 OFF, SW1-2 OFF). Monitor the second radio's transmit frequency with a communications monitor and adjust R2 on the second TrakIt-20 for 3 kHz deviation.

5. On the first TrakIt-20, measure the voltage level at TP2 using an AC voltmeter. Adjust R3 to obtain a level of 440mV RMS.

6. On both units, turn R1 completely counter-clockwise since R1 is not currently used.

7. Make sure both TrakIt-20 units are in normal mode and not in test mode before reassembling the TrakIt-20 units in their cases.

APPENDIX A - RADIO INTERFACES

This appendix contains instructions for interfacing the TrakIt-20 to a few select radios. If modifications to a radio are required, the steps necessary to perform the modification to the radio are given. Any required installer table settings and jumper settings are also listed. Interface cables for each radio are available from the factory. Refer to the TrakIt Radio Interface Manual for interface instructions to many additional radios.

Kenwood TK-840/940/941 Interface

The following items are included in the Kenwood TK-840/940/941 interface kit:

1. TK-840/940/941 interface cable assembly.
2. 3 short pieces of wire.
3. 3 short pieces of heat shrink tubing.
4. Instruction sheet.

The following steps outline the procedure for interfacing the Kenwood TK-840/940/941 radio to the TrakIt-20. The Kenwood TK-840/940/941 radio can operate in either trunking or conventional mode but the interface will depend upon the mode selected as detailed in the following steps.

1. Set the TrakIt-20 up for a bench test and use the AVL Installer program to set the following operating constants in the installer table to the indicated value:

Trunking	
Transmit indicator active:	Low
Receive indicator active:	High
PTT output active:	Low
Enable mic mute gate on transmit:	Yes
Enable Tx indicator as event 2:	No
External output active:	Low
External output mode:	Speaker mute

Conventional	
Transmit indicator active:	High
Receive indicator active:	High
PTT output active:	Low
Enable mic mute gate on transmit:	Yes
Enable Tx indicator as event 2:	No
External output active:	Low
External output mode:	Speaker mute

2. Configure the following jumpers as indicated:

Trunking	
JP1	Installed
JP4	B-C

Conventional	
JP1	Installed
JP4	A-B

Kenwood TK-840/940/941 Interface (cont.)

3. Install the KCT-19 accessory connection cable into the TK-840/940/941 radio by following the instructions in the TK-840/940/941 service manual. The cable connectors should be connected to the TX-RX unit as follows:

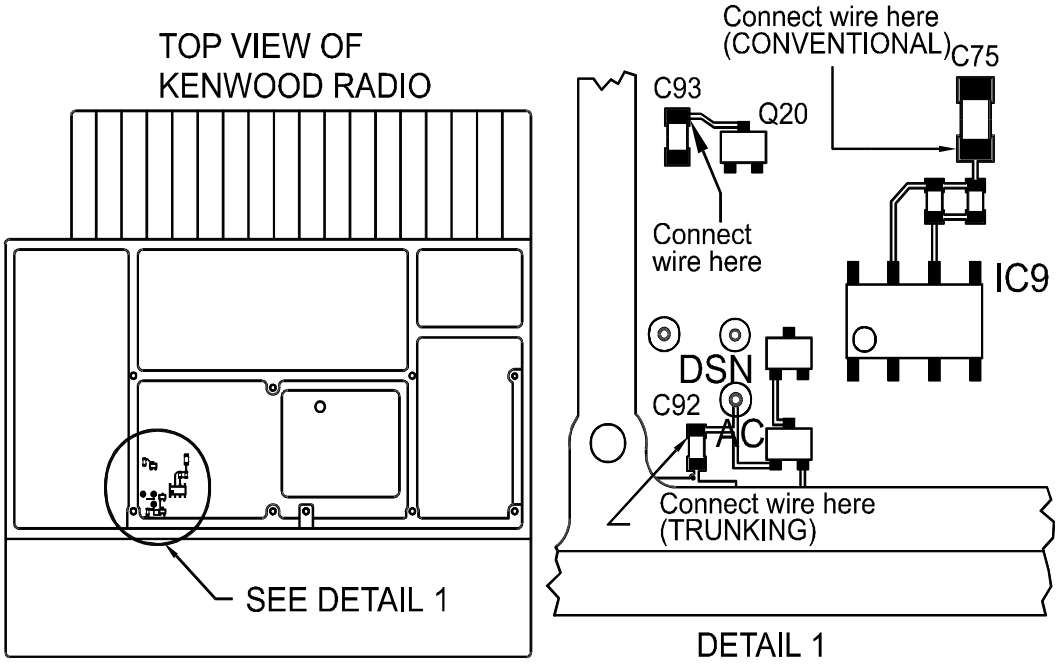
Cable	TX-RX unit
B	CN4
C	No connection
D	CN1
E	CN2

4. Place the speaker and speaker holder off to the side and remove the shield cover located beneath the speaker.

5. Locate capacitor C93 and solder a piece of wire to the side of C93 that is connected to Q20 as shown in the following diagram.

6. **Trunking only**: Locate capacitor C92 and solder a piece of wire to the side of C92 that is connected to the hole labeled "AC" as shown in the following diagram.

Conventional only: Locate capacitor C75 and solder a piece of wire to the side of C75 that is connected to pin 7 of IC9 as shown in the following diagram.



Kenwood TK-840/940/941 Interface (cont.)

7. Cut the brown wire going to pin 1 of connector B (the larger 3 position connector) on the KCT-19 cable. Place a piece of heat shrink tubing on this wire and solder this wire to the wire that was soldered to C93.

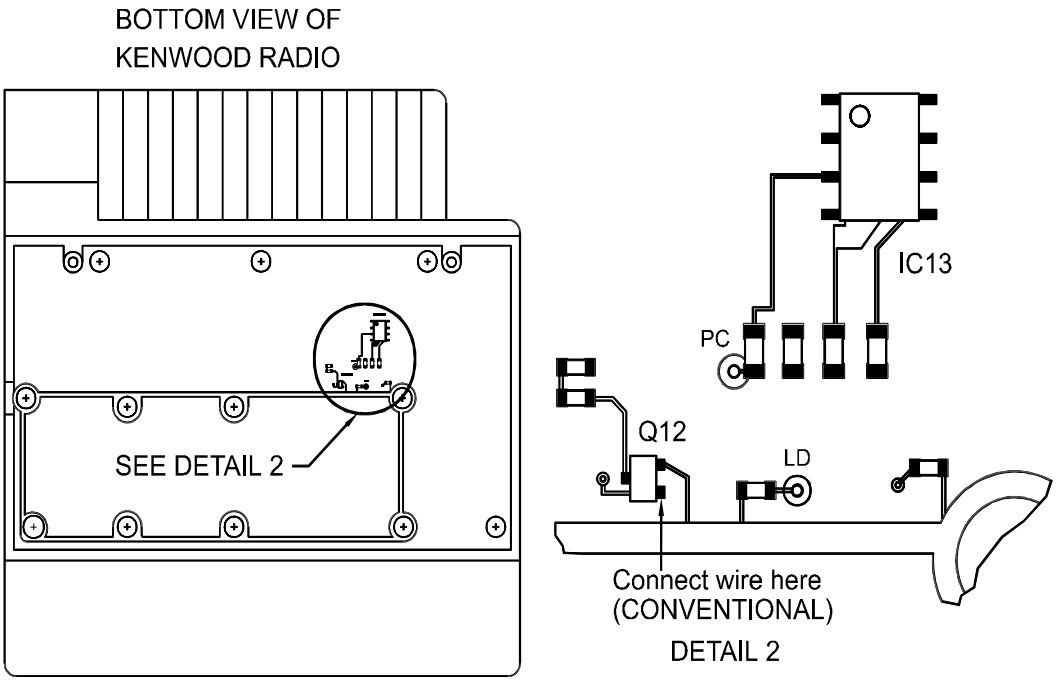
8. **Trunking only**: Cut the gray wire going to pin 8 of connector D (the 8 position connector) on the KCT-19 cable. Place a piece of heat shrink tubing on this wire and solder this wire to the wire that was soldered to C92.

Conventional only: Cut the brown wire going to pin 1 of connector D (the 8 position connector) on the KCT-19 cable. Place a piece of heat shrink tubing on this wire and solder this wire to the wire that was soldered to C75.

9. Move the heat shrink tubing into place and shrink it.

10. Replace the shield cover making sure the wires pass through slots in the cover without being pinched.

11. **Conventional only**: On the bottom side of the radio, locate transistor Q12 and solder a piece of wire to Q12 as indicated in the following diagram. Pass this wire through a hole in the PC board to the top side of the radio.



12. **Conventional only**: Cut the white wire going to pin 1 of connector E (the smaller 3 position connector) on the KCT-19 cable. Place a piece of heat shrink tubing on this wire and solder this wire to the wire that was soldered to Q12 in the previous step. Move the heat shrink tubing into place and shrink it.

Kenwood TK-840/940/941 Interface (cont.)

13. Replace the speaker holder, speaker, and the radio covers.

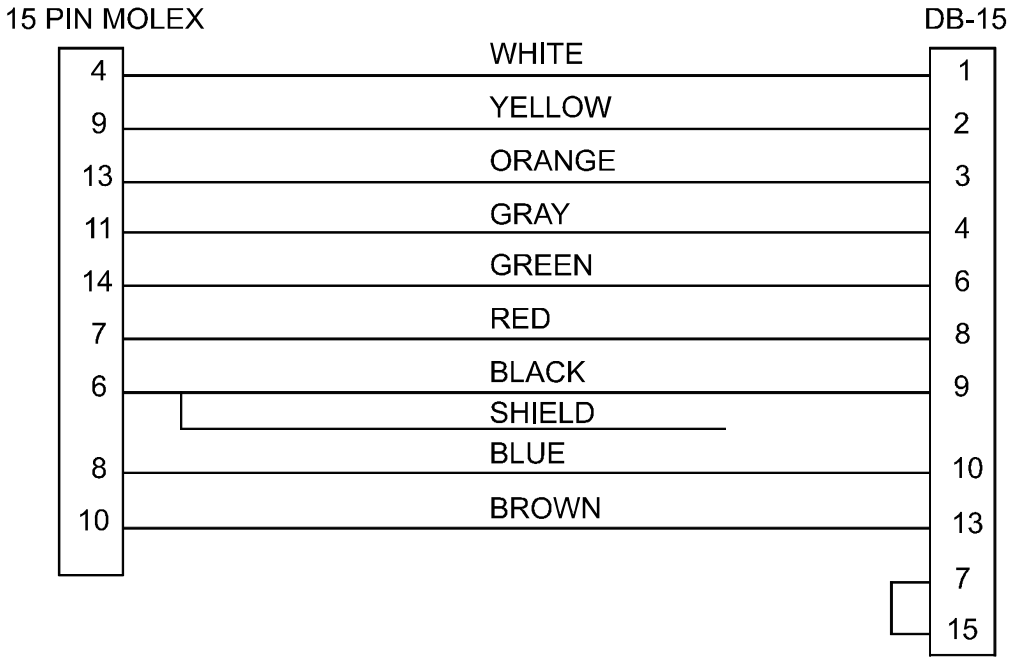
14. Connect the DB-15 end of the TK-840/940/941 interface cable to the DB-15 connector on the back of the TrakIt-20.

15. Connect the Molex plug end of the TK-840/940/941 interface cable to the KCT-19 cable.

16. Check the TrakIt-20's audio levels by performing the alignment procedure described in this manual.

NOTE: When programming the TK-840/940/941 radio, be sure to set "Access logic sig" in the Feature Option screen to continuous if the radio is being used in trunking mode. This will allow the TrakIt-20 to detect when the TK-840/940/941 radio is transmitting. If the radio is being used in conventional mode, set "Off hook decode" in the Feature Option screen to enabled. This will prevent the TrakIt-20 from receiving data transmissions that are being sent to mobiles with a different ID. Also, for either mode, if there will not be any voice transmissions, set "Minimum volume" to 0 in the Feature Option screen.

TK-840/940/941 Interface Cable



Uniden SMU 4525KT/SMH 1525DT Interface

The following items are included in the Uniden SMU 4525KT/SMH 1525DT interface kit:

1. SMU 4525KT/SMH 1525DT interface cable assembly.
2. 7 lengths of wire with Molex pins.
3. 2 short pieces of heat shrink tubing.
4. 2M ohm resistor.
5. Instruction sheet.

The following steps outline the procedure for interfacing the Uniden SMU 4525KT/SMH 1525DT to the TrakIt-20.

1. Set the TrakIt-20 up for a bench test and use the AVL Installer program to set the following operating constants in the installer table to the indicated value:

Transmit indicator active:	High
Receive indicator active:	Low
PTT output active:	Low
Enable mic mute gate on transmit:	No
Enable Tx indicator as event 2:	No
Delay before data send: (if using a repeater)	1 sec.

2. Configure the following jumper as indicated:

JP4 B-C

3. On the TrakIt-20 board, remove JP1 and replace it with a 2M ohm resistor. Remove R49 and remove C25.

4. Remove top and bottom covers of the radio and un-snap the faceplate from the main body of the radio.

5. Remove the radio's power connector from the rear of the radio for easier access to the accessory jack. Re-install the power connector when all connections to the accessory jack are complete.

Uniden SMU 4525KT/SMH 1525DT Interface (cont.)

6. Install the wires with Molex pins into the accessory connector from the inside of the radio as follows:

Pin #	Wire
4	Red
5	Blue
6	Brown
7	Orange
8	Yellow
9	White
10	Gray

7. Locate the wire connected to pin 4 of J401 which is labeled as “MIC”. Cut this wire at the center of its length.

8. Place a piece of heat shrink tubing onto both the yellow and gray wires that were installed into the accessory connector.

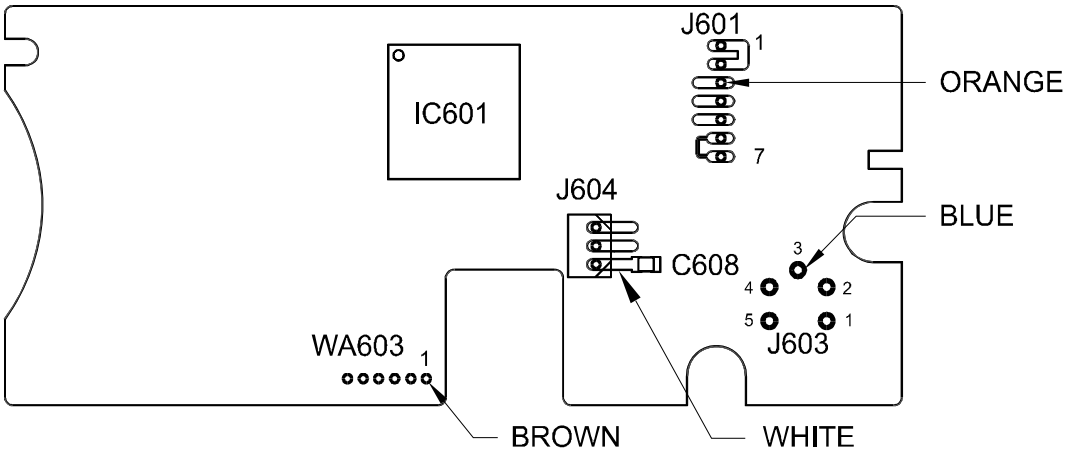
9. Solder the yellow wire to the side of the cut wire that goes to the main board and solder the gray wire to the side of the cut wire that goes to the faceplate.

10. Move the heat shrink tubing into place on both wires and shrink it.

11. Connect the remaining wires that were installed into the accessory connector to the following points in the radio as shown in the diagram that follows:

Red	positive side of C405 (on main board)
Blue	J603 pin 3
Brown	WA603 pin 1
Orange	J601 pin 3
White	J604 pin 3

LOGIC BOARD LOCATOR (BOTTOM VIEW)



Uniden SMU 4525KT/SMH 1525DT Interface (cont.)

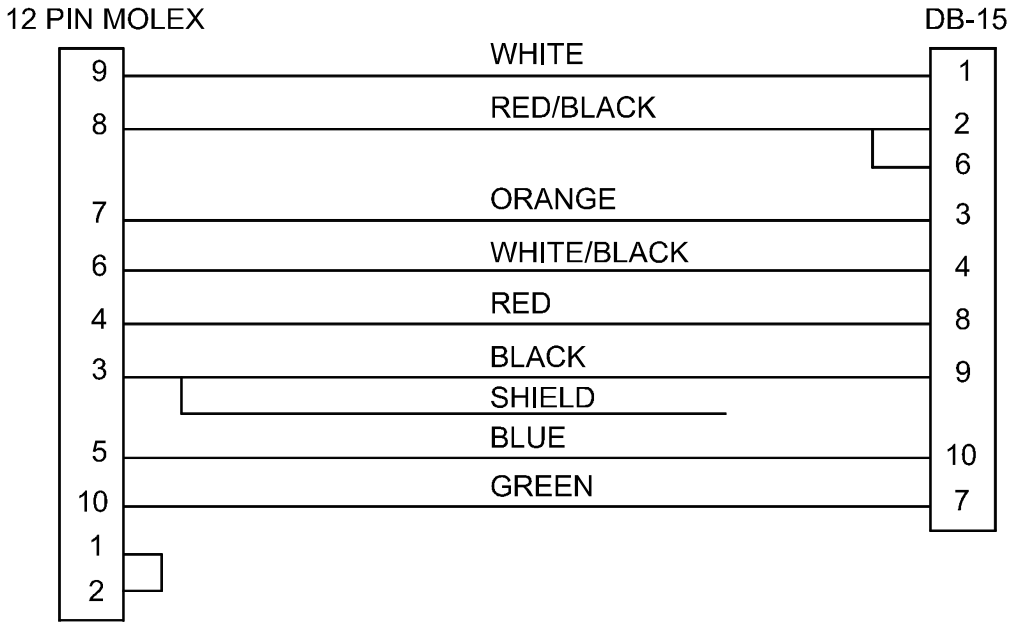
12. Position the wires through the slot with the existing wires and replace the faceplate and the radio covers.

13. Connect the Molex plug end of the SMU 4525KT/SMH 1525DT interface cable to the 12 pin accessory jack on the back of the radio.

14. Connect the DB-15 end of the SMU 4525KT/SMH 1525DT interface cable to the DB-15 connector on the back of the TrakIt-20.

15. Check the TrakIt-20's audio levels by performing the alignment procedure described in this manual.

SMU 4525KT/SMH 1525DT Interface Cable



PARTS LIST

TRAKIT-20V PCB BOARD
101-0268

Item	Reference	Description	Part No.	Qty.
1	B1	3V BATTERY	399-0008	1
2	B1	3V BATTERY HOLDER	399-0009	1
3	C1	2.2uF ELEC. NP CAP	361-0002	1
4	C2,3	1uF ELEC. CAP	360-0001	2
5	C4,5,6	10uF ELEC. CAP	360-0004	3
6	C7,8,9,10	22uF ELEC. CAP	360-0002	4
7	C11	220uF ELEC. CAP	360-0007	1
8	C12,13,14,15,16,19, 20,21,22,23*,24,26,29, 30*,31,32,35*,37*,40, 41,42,43*,44,45,46, 47*,48	.1uF 10% X7R CAP	372-5104	27
9	C17,18,27,28	18pF 5% NPO CAP	372-5180	4
10	C25,36*,49,50,51,52, 53,54,55,56,57,58,59, 60,61,62	.01uF 10% X7R CAP	372-5103	16
11	C33,34	33pF 5% NPO CAP	372-5330	2
12	C38*,39*	.001uF 5% NPO CAP	372-5102	2
13	D1,2,4	1N914 DIODE	110-0001	3
14	D3	1N4003 DIODE	110-0002	1
15	D5,6	1N5232 5.6V ZENER DIODE	111-0018	2
16	F1	1 AMP PC MOUNT FUSE	290-0008	1
17	J1	DB15 FEMALE CONN R/A	231-0031	1
18	J2	DB9 FEMALE CONN R/A	231-0026	1
19	J1,2	HEX NUT 4-40	199-0010	4
20	J1,2	WASHER, STAR #4	199-2001	4
21	J1,2	SCREW, 4-40 x 3/8 PHLP	200-0305	4
22	JP1,2*,5	STAPLE JUMPER	265-0016	3
23	JP3	NOT INSTALLED	000-0002	1
24	JP4	3 POS JUMPER POST	231-1040	1
25	JP4	SHORTING JUMPER	234-0046	1
26	P1	8 POS DIP CONN	234-0022	1
27	Q1,2,3,4,5	MPS8098 TRANSISTOR	180-0009	5
28	R1*,2,3	50K 1 TURN POT	351-0010	3
29	R4,28	1M 5% 1/8 W RES	321-1105	2
30	R5,8,9,11,12,13,14,16, 18,19,20,21,23,24,25, 26,27,31*,32*,38,39, 40,41,42,43*,44,45,49, 52	10K 5% 1/8 W RES	321-1103	29
31	R6,7	100ohm 5% 1/8 W RES	321-1101	1
32	R10,15,17,34*,35*	220K 5% 1/8 W RES	321-1224	5

33	R22,29*,46*,48,51	100K 5% 1/8 W RES	321-1104	5
34	R30*	390K 5% 1/8 W RES	321-1394	1
35	R33*	39K 5% 1/8 W RES	321-1393	1
36	R36*	68K 5% 1/8 W RES	321-1683	1
37	R37*	2M 5% 1/8 W RES	321-1205	1
38	R47	1K 5% 1/8 W RES	321-1102	1
39	R50	470ohm 5% 1/8 W RES	321-1471	1
40	SW1	10 POS DIP SWITCH	613-0022	1
41	TP1,2	PC MOUNT TEST POINT	200-0013	2
42	U1	LM2940-10 TO-220 IC	130-0277	1
43	U2	80C32 IC	131-3005	1
44	U3	UA7805 TO-220 IC	131-0022	1
45	U4	27C512 IC	130-0319	1
46	U5,13*	74HCT00 IC	131-1026	2
47	U6	74HCT245 IC	131-1023	1
48	U7	74HC373 IC	131-1022	1
49	U8	MAX232 IC	131-1019	1
50	U9	24LC04 IC	131-1029	1
51	U10	60L256 IC	131-1024	1
52	U11	74HC244 IC	131-1022	1
53	U12	74HC138 IC	131-1020	1
54	U14	88C681 IC	131-3004	1
55	U15*	8888 IC	131-1027	1
56	U16*	TL082 IC	131-1007	1
57	U17	TL084 IC	131-1001	1
58	U18	4066 IC	131-1028	1
59	U19	7407 IC	131-1025	1
60	U20	MX429 IC	131-3003	1
61	U21	695 IC	131-1018	1
62	U2	44 PIN PLCC SOCKET	220-0011	1
63	U3	T0220 INSULATOR	210-0103	1
64	U4	28 PIN DIP SOCKET	220-0008	1
65	X1	4MHz CRYSTAL	305-0007	1
66	X2	3.579545MHZ CRYSTAL	305-0001	1
67	X3	11.0592MHz CRYSTAL	305-0012	1
68		SPACER, 4-40 x 3/8	200-0305	4
69		PC BOARD TRAKIT-20	900-0268	1

* Indicates parts not populated

TRAKIT-20B PCB BOARD
101-0268

Item	Reference	Description	Part No.	Qty.
1	B1	JUMPER WIRE	265-0013	1
2	C1	2.2uF ELEC. NP CAP	361-0002	1
3	C2,3	1uF ELEC. CAP	360-0001	2
4	C4,5,6	10uF ELEC. CAP	360-0004	3
5	C7,8,9,10	22uF ELEC. CAP	360-0002	4
6	C11	220uF ELEC. CAP	360-0007	1
7	C12,13,14,15,16,19, 20,21,22,23*,24,26,29, 30*,31,32,35*,37*,40, 41,42,43*,44,45,46, 47*,48	.1uF 10% X7R CAP	372-5104	27
8	C17,18,27,28	18pF 5% NPO CAP	372-5180	4
9	C25,36*,49,50,51,52, 53,54,55,56,57,58,59, 60,61,62	.01uF 10% X7R CAP	372-5103	16
10	C33,34	33pF 5% NPO CAP	372-5330	2
11	C38*,39*	.001uF 5% NPO CAP	372-5102	2
12	D1,2,4	1N914 DIODE	110-0001	3
13	D3	1N4003 DIODE	110-0002	1
14	D5,6	1N5232 5.6V ZENER DIODE	111-0018	2
15	F1	1 AMP PC MOUNT FUSE	290-0008	1
16	J1	DB15 FEMALE CONN R/A	231-0031	1
17	J2	DB9 FEMALE CONN R/A	231-0026	1
18	J1,2	HEX NUT 4-40	199-0010	4
19	J1,2	WASHER, STAR #4	199-2001	4
20	J1,2	SCREW, 4-40 x 3/8 PHLP	200-0305	4
21	JP1,2*,5	STAPLE JUMPER	265-0016	3
22	JP3	NOT INSTALLED	000-0002	1
23	JP4	3 POS JUMPER POST	231-1040	1
24	JP4	SHORTING JUMPER	234-0046	1
25	P1	NOT INSTALLED	000-0002	1
26	Q1,2,3,4,5	MPS8098 TRANSISTOR	180-0009	5
27	R1*,2,3	50K 1 TURN POT	351-0010	3
28	R4,28	1M 5% 1/8 W RES	321-1105	2
29	R5,8,9,11,12,13,14,16, 18,19,20,21,23,24,25, 26,27,31*,32*,38,39, 40,41,42,43*,44,45,49, 52	10K 5% 1/8 W RES	321-1103	29
30	R6,7	100ohm 5% 1/8 W RES	321-1101	1
31	R10,15,17,34*,35*	220K 5% 1/8 W RES	321-1224	5
32	R22,29*,46*,48,51	100K 5% 1/8 W RES	321-1104	5
33	R30*	390K 5% 1/8 W RES	321-1394	1
34	R33*	39K 5% 1/8 W RES	321-1393	1

35	R36*	68K 5% 1/8 W RES	321-1683	1
36	R37*	2M 5% 1/8 W RES	321-1205	1
37	R47	1K 5% 1/8 W RES	321-1102	1
38	R50	470ohm 5% 1/8 W RES	321-1471	1
39	SW1	10 POS DIP SWITCH	613-0022	1
40	TP1,2	PC MOUNT TEST POINT	200-0013	2
41	U1	LM2940-10 TO-220 IC	130-0277	1
42	U2	80C32 IC	131-3005	1
43	U3	UA7805 TO-220 IC	131-0022	1
44	U4	27C512 IC	130-0319	1
45	U5,13*	74HCT00 IC	131-1026	2
46	U6	74HCT245 IC	131-1023	1
47	U7	74HC373 IC	131-1022	1
48	U8	MAX232 IC	131-1019	1
49	U9	24LC04 IC	131-1029	1
50	U10	60L256 IC	131-1024	1
51	U11	74HC244 IC	131-1022	1
52	U12	74HC138 IC	131-1020	1
53	U14	88C681 IC	131-3004	1
54	U15*	8888 IC	131-1027	1
55	U16*	TL082 IC	131-1007	1
56	U17	TL084 IC	131-1001	1
57	U18	4066 IC	131-1028	1
58	U19	7407 IC	131-1025	1
59	U20	MX429 IC	131-3003	1
60	U21	695 IC	131-1018	1
61	U2	44 PIN PLCC SOCKET	220-0011	1
62	U3	T0220 INSULATOR	210-0103	1
63	U4	28 PIN DIP SOCKET	220-0008	1
64	X1	4MHz CRYSTAL	305-0007	1
65	X2	3.579545MHZ CRYSTAL	305-0001	1
66	X3	11.0592MHz CRYSTAL	305-0012	1
67		PC BOARD TRAKIT-20	900-0268	1

* Indicates parts not populated

TRAKIT-20V CABINET
103-0268

Item	Description	Part No.	Qty.
1	NUT, HEX, 4-40	199-0010	1
2	WASHER, STAR #4	199-2001	1
3	SCW, 4-40 X 1/4 SLOT	199-3055	1
4	S/N LBL IDA PRODUCT	199-6009	1
5	NUT, PEM 6-32 FLUSH	200-0056	4
6	BACKPLATE, TRAKIT	900-6062A	1
7	CABINET, TRAKIT	900-6071	1
8	FACEPLATE, TRAKIT	900-6072S	1

TRAKIT-20B CABINET
103-0268

Item	Description	Part No.	Qty.
1	NUT, HEX, 4-40	199-0010	1
2	WASHER, STAR #4	199-2001	1
3	SCW, 4-40 X 1/4 SLOT	199-3055	1
4	S/N LBL IDA PRODUCT	199-6009	1
5	NUT, PEM 6-32 FLUSH	200-0056	4
6	HOLE PLUG .187 BLACK	203-1157	1
7	REARPLATE, TRAKIT	900-6062A	1
8	CABINET, TRAKIT	900-6071	1
9	FACEPLATE, TRAKIT	900-6072S	1

TRAKIT-20 TRIMBLE SK-8 RECEIVER KIT
105-0268

Item	Description	Part No.	Qty.
1	NUT, HEX 10 X 32	199-0046	1
2	SCW, #4-40 X 1/4 SLOT	199-3055	4
3	GPS RECEIVER BD.	902-0006	1

TRIMBLE MAGNETIC ANTENNA

Item	Description	Part No.	Qty.
1	GPS MAGNETIC ANTENNA	902-0007	1

TRIMBLE PERMANENT ANTENNA

Item	Description	Part No.	Qty.
1	GPS PERMANENT ANT.	902-0011	1

TRAKIT-20 CABINET BRACKET KIT
103-5025

Item	Description	Part No.	Qty.
1	SCW, #10 X 3/4 SHEET MET.	199-1009	4
2	SCW, #6-32 X 3/16 PHILLIPS	199-3068	4
3	WASHER, STAR #6	199-2002	4
4	BRACKET, TRAKIT ANOD.	900-5025A	1

TRAKIT-20 BASE CABLE KIT
800-2081

Item	Description	Part No.	Qty.
1	SERIAL XT ADAPTER	231-0065	1
2	SERIAL CABLE ASSY. DB9	800-2081	1

SCHEMATICS