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Foreword

Scope of this manual

This manual contains the specifications, functional description, operating instructions, schematic, parts locator and parts list for the 2017 Merlin GPS/AVL unit.

This manual is intended for use by qualified service technicians to aid them with installation, interfacing, alignment and trouble shooting of the 2017 when used with other land mobile radios.

Service manual revisions

Component changes, additions and deletions may occur in the circuit design to improve operation and will be reflected in future releases of this service manual. Specifications and circuit changes are subject to change without prior notice or obligation by Pyramid Communications.

Specifications

General:

Operation: Auto respond GPS/AVL, self test, programming
Indicators: 5 high brightness LED's
Storage: 1024 position fixes. Non-volatile E²PROM with 100 year data retention.
Interface: *Radio:* DB15M
RS-485: DB9F Bidirectional 9600 baud N81
GPS Antenna: SMA
Application: Conventional and Trunking mobiles
Adjustments: Rx Sensitivity, Tx Deviation, Squelch threshold.

Power Requirements:

DC Supply 13.6VDC negative ground $\pm 25\%$. 200 mA nominal

Physical:

Dimensions: 6.00"L x 5.275"W x 1.15"H.
Weight: 14 oz.
Case: Extruded Aluminium.

Encoder:

Format: MPT-1317¹
Speed: 1200/2400 Baud MSK
PTT Delay: .1-2.5 Sec in 100 mSec steps + smart trunking access
Tx Audio: 0-2.5 VRMS 2.2K Ohms, AC coupled

Decoder:

Format: MPT-1317¹
Speed: 1200/2400 Baud MSK
Rx Audio: Hi-Z (100k Ohm) AC coupled to discriminator
Level: 20mV - 10V RMS
CTCSS Reject: -36db @ 74 Hz

Outputs:

PTT: Active Low 2A open drain
Audio Mute: Active Low 2A open drain
Mic Mute: Active Low 2A open drain
Aux1 Out: Active Low 2A open drain
Aux2 Out: Active Low 2A open drain
Aux3 Out: Active Low 2A open drain

Mil-Std-810D/E:

501.2	Procedure II	High Temp +60°C
502.3	Procedure II	Low Temp -30°C
514.3	Procedure I Cat. 8	Vibration Ground Vehicle
516.3	Procedure I	Shock

Functional Description

The Merlin™ series AVL from Pyramid Communications is a microprocessor controlled GPS Automatic Vehicle Location device that connects to an existing conventional or trunking 2-way radio. The unit will automatically send its position information to dispatch on a pre-programmed interval. The Merlin™ AVL has 3 inputs that can be used for general purpose vehicle monitoring (doors open, shotgun removed, etc.) or can be programmed for special functions. The AVL also has 3 general purpose outputs that can be used to alert the driver when out of the vehicle or for remote control of vehicle functions. The Merlin™ AVL easily interfaces to any conventional or trunking mobile. Position updates are stored in non-volatile E²PROM memory for download and playback at a later time. The Merlin™ is capable of storing 85 hours of vehicular activity at 5 minute update intervals.

The model 2017 is PC programmable for all operating parameters through the serial interface jack on the rear panel using the FY-1 programming cable. See page 10 for programming details.

The model 2017 also has a built in self test mode for diagnostics and alignment which can be accessed through the programming port using a terminal program. All internal adjustments are accessible by removing the front display panel. See pages 8-9 for alignment procedures.

GPS Reporting: The Merlin™ AVL will automatically send its position information on a pre-programmed interval. One of the general purpose inputs can be programmed as a Code 3 input. When active, the AVL will update at a shorter interval for more accurate tracking by dispatch. Both update rates are PC programmable. Normal Rate can be programmed between 1 minute and 4 hours in one minute increments. Code 3 rate can be programmed between 5 seconds and 20 minutes in 5 second increments. The Merlin™ AVL also monitors the vehicle speed and will not send its position more than once from a stationary location.

Each position update is automatically stored in non-volatile E²PROM memory for later recall and playback. The Merlin™ is able to store 1024 position fixes including date, time, speed, heading and position fix within 50 feet. The data is stored in a circular queue with the oldest data being overwritten with each new position fix. The Merlin™ AVL can store 85 hours of vehicular activity at 5 minute update intervals. The 1024 position playback is accessible through the PC programming jack on the rear panel of the unit.

If the vehicle drives out of radio range, the Merlin™ will continue to store the position fixes on the pre-programmed interval. When the vehicle is back within range, the dispatcher may download the last 20 position fixes *over the air* from the Manning Rastrac® software.

Additionally, the dispatcher may poll the Merlin™ AVL at anytime for its position regardless of the programmed time interval or speed of the vehicle.

Programmable Inputs: The Merlin™ AVL has 3 general purpose inputs that can be used to monitor vehicle status such as door open, shotgun removed from holder, etc. Each input has a special function that can be enabled via PC programming. Input 1 can be programmed for **Emergency** transmission to alert dispatch in the event of a pending emergency. The number of emergency transmissions is programmable. Input 2 can be used for **GPS on demand** that will send a position fix when ever a switch is closed. Input 3 can be used for **Code 3** input to change the update rate between slow and fast.

Outputs: The Merlin™ AVL has 3 general purpose high current outputs that can be used to alert the driver when out of the vehicle or for remote control of vehicle functions. Each output can be independently toggled by the dispatcher and is capable of directly driving a relay coil or any load up to 2A.

Trunking Operation: When the Merlin™ AVL is connected to a trunking radio, it can be programmed for voice channel acquisition before a message is sent. When a GPS update is sent, the unit will key the radio for 200mS; it then monitors the radio's transmitter for an on-air condition. If it does not see the radio transmit at all (system is busy), it will retry every 4 seconds until successful or time out (60 seconds). When it detects that the radio is transmitting, it will continue to monitor the on-air line until the transmitter remains keyed for at least 400 mS to ensure that the radio is not handshaking or retrying. After successful acquisition of a voice channel, it will send its GPS data to the base,

Notes:

Installation

The model 2017 can be configured for use with conventional or trunking systems. The minimum interface required is 5 wires for conventional operation and 6 wires for trunking. There are also a number of optional connections that allow for features such as microphone muting, and tone stripping (audio muting during the reception of messages) and busy channel lockout.

P1 (DB15-M) Radio Connector

Pin 1: Ground. Connect to the radio ground
(Shield/Black)

Pin 2: Transmit Audio Out. This is the MSK encode line to the radio. It is approximately 2.2K Ohms, AC coupled and should be connected to the input of the microphone bandpass filtering *before pre-emphasis and limiting*. If connected too close to the microphone input, it may reduce the amount of mic audio; if connected too far into the transmit audio circuitry, you may not be able to achieve enough modulation. *It is important that the transmitted signal does not get distorted*. Excessive distortion will affect the reliability of the received signal and may be responsible for retries and failed status requests. J1 selects the output adjustment range for RV3; if J1 is installed, RV3 adjusts the output between 0-200mV, if removed, RV3 adjusts the output between 0-5V.

Pin 3: On-Air detect input. In trunking applications, this line should be connected to radio logic level that indicates that the radio is transmitting. *This is not the same as mic PTT*. On trunking logic boards, this line would be radio PTT, or connect directly to the Tx LED. The line can be either active high or active low. Program "On Air Polarity" to "Low" if the line goes to ground during transmit, to "High" if the line goes positive during transmit. ***Do not install J2 for trunking applications.***

In conventional applications, this line is used to detect when the driver has keyed the mic to prevent data from being sent on top of voice and can be connected to mic PTT.

Pin 4: PTT output. This is an open collector output to the radio and should be connected to the mic PTT line.
(Green)

Pin 5: Switched 13.6VDC from the radio. This line *must* go off when the radio is switched off, since the 2017 does not have a power switch. It should be capable of supplying at least 200mA.
(Red)

Pin 6: Receive audio input. Connect this line *directly to the output of the radio's discriminator*. Do not connect to any point after filtering or de-emphasis. It is a high impedance input (100KOhms) and AC coupled.
(Yellow)

Pin 7: Busy Channel Input. This line is connected to the logic level output that indicates that the radio is receiving and audio is unmuted. The COR polarity can be programmed to be active high or active low. Adjust RV2 for a DC voltage at TP2 that is midway between the muted and unmuted levels on the violet wire. Example: If the violet wire goes from 0 volts (muted) to 5V (unmuted) adjust RV2 (TP2) for 2.5VDC and program mobile COR as active high. If the violet wire goes from 3.5V (muted) to 0.7V (unmuted), adjust RV2 (TP2) for 2.1 VDC and program mobile COR as active low.
(Violet)

Pin 8: Audio mute output. Whenever the 2017 is receiving a signal, this line will pull to ground to mute the receiver audio. When not receiving, it is open collector. If you wish to use tone stripping, connect this line to an *active low* audio mute input to the radio, or more generally, to the high side of the volume control.
(Brown)

Pin 9: *Mic mute:* This line goes *active low* every time the 2017 sends it's message and may be used to mute the microphone audio to prevent interference with the tone signal. It can also be programmed for channel change with 3 different methods: *Continuous* will pull this line to ground and hold it until the acknowledgment is received from the base. *Pulse* will pulse the line low once before the message is sent and again after the acknowledgment is received. *EFJ* will allow channel changing on an EF Johnson 8600 series mobile and requires hardware modifications.
(Grey)

Pin 10: Aux input 3. General purpose status input with programmable function for *Code 3* update rate.
(Black/White)

Pin 11: Aux input 2. General purpose status input with programmable function for *GPS on Demand*.
(Teal)

Pin 12: Aux input 1. General purpose status input with programmable function for *Emergency* input.
(Coral)

Pin 13: Aux output 3. General purpose output 2A open drain.
(Red/White)

Pin 14: Aux output 2. General purpose output 2A open drain.
(Brown/White)

Pin 15: Aux output 1. General purpose output 2A open drain.
(Orange)

P2 (DB9-F) Connector RS-485 data bus

Pin 1: Ground. Connect to the ground reference of the auxiliary device.

Pin 2: RS-485 "-" lead.

Pin 3: RS485 "+" lead.

Pin 5: Switched B+ output, 2A fused, to supply auxiliary device.

Alignment

Before aligning the 2017, ensure that the base radio is aligned per the manufacturer's service procedure; Ensure that the 2017 is properly programmed. In order to properly align the 2017, you will need a service monitor and the mobile radio that the 2017 will be installed with.

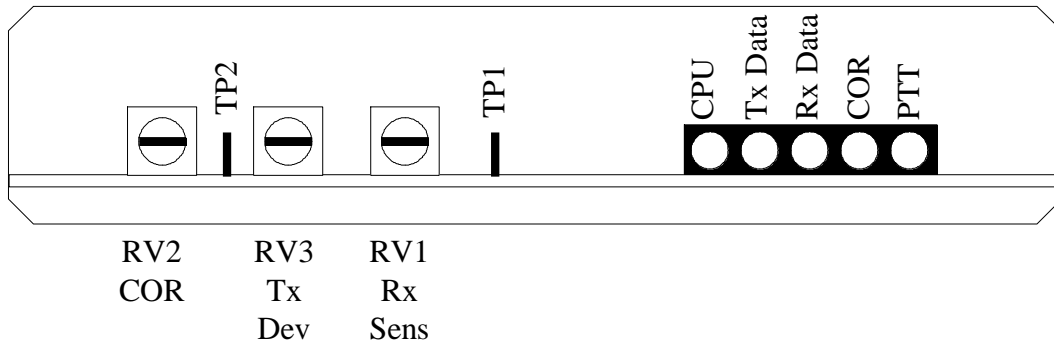
Dis-assemble the Merlin™ by removing the two cap screws on the rear panel. Carefully slide the entire assembly out of the housing. Connect the service monitor to the mobile radio antenna jack. Connect the cable from the mobile radio to the 2017.

Transmit Deviation: Using the Merlin™ PC software, select the *Data Menu, Test Mode*.

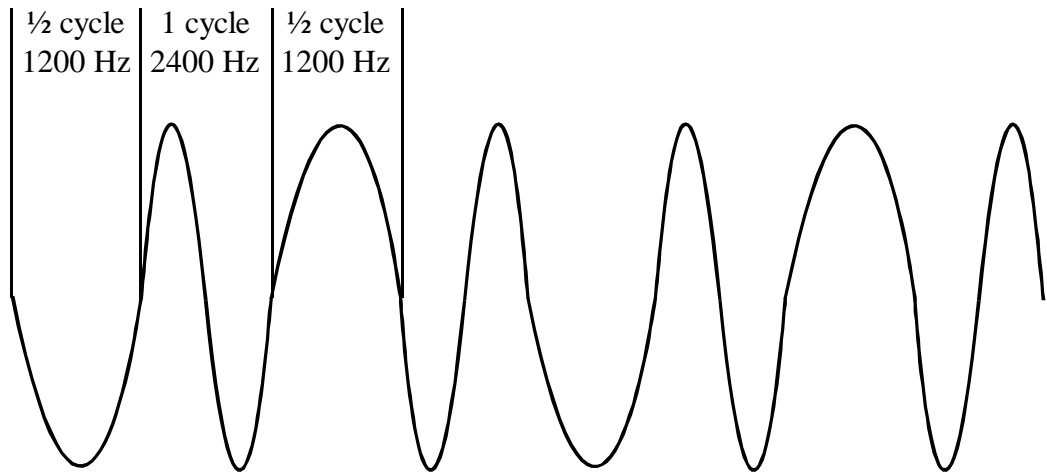
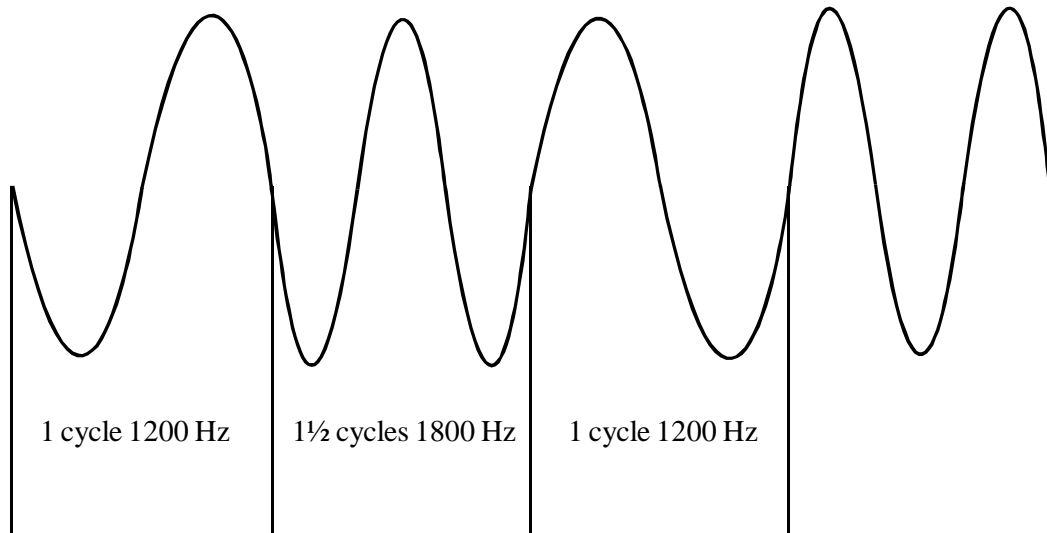
Select *Send MSK*; the 2017 will send alternating 1's and 0's until the <Esc> key is pressed. Adjust **RV3** for 60% of rated system deviation. Compare the service monitor display with the waveforms on page 9; the transmitted signal should resemble the sine waves as shown. If excessive distortion is occurring, you may need to find a different tx audio input to the radio.

Receive Sensitivity: Set the service monitor signal generator for the mobile's receive frequency, with 60% deviation of a 1kHz tone. Connect an oscilloscope or AC voltmeter to **TP1** and adjust **RV1** for 1VPP as read on the scope, or 375mVrms on the meter.

Squelch Threshold: Measure and record the voltage on the violet wire when the mobile is receiving and when it is squelched. Adjust RV2 for the mid-way point between the two voltages just recorded, with a voltmeter on TP2. The yellow LED (COR) will light to indicate a busy channel. If the COR LED is on when the channel is idle and off when busy, the COR polarity is programmed backwards. If the COR LED is always on or always off, RV2 is improperly set or the violet wire is not connected to a point that indicates receive unmute.



1200 Baud Test Waveform



2400 Baud Test Waveform

Programming

Note to DOS 6.0 and higher users: The memory manager automatically installed by DOS 6.0 and greater, defaults to a configuration that does not allow access to extended memory. The Merlin™ program needs access to extended memory and will not run if your computer disallows it. If you receive the error message:

"Program too big to fit into memory" or "not enough memory"

You must edit your autoexec.bat file. Add the following line:

```
SET CLIPPER=F50;E000
```

Save the file and reboot your computer.

Using the Software

The Merlin™ personalization software is used to program the 2017 for all of the operating parameters and options. The software is menu driven and on-line help is available at any time by pressing F1.

To install the software on your computer type the following at the DOS prompt:

```
A:INSTALL or B:INSTALL
```

The install program will install the software onto your hard drive in a directory called Merlin. To run the program, type:

```
MERLIN
```

The main menu bar will appear at the top of the screen, with the highlight on 'FILE'. Press <ENTER> or the first letter of any of the main menu bar items to activate a drop down menu of choices (clicking the left mouse button on any of the main menu bar items will have the same effect). When the drop down menus are displayed, any of the sub-menu items may be selected in the same way: by pressing the first letter of the item, by moving the highlight with the up/down arrow keys and pressing <ENTER> or by clicking the left mouse button on the desired item.

There is on-line help available at any time by pressing F1, or by clicking the left mouse button on the [HELP] icon in the upper right corner of the screen. Use the up/down arrow keys, pgup/pgdn keys or home/end keys to move through the help text. Pressing <ESC> or the right mouse button returns to normal program execution.

Important Note:

Before attempting to program the Merlin™ start the software and ensure the FY-1 programming cable is plugged into the correct serial port. The com port may be selected under the 'FILE' menu. Plug the FY-1 programming cable into P4 on the rear panel of the Merlin™.

Menu selections

File

Load: Allows you to load a previously saved file from disk. Enter the file name or press F2 for a directory of Merlin™ files. Only files with the .MLN extension and legal DOS names will be loaded.

Save: Allows you to save the current configuration to disk. Enter the file name to save or press F2 for a directory of Merlin™ files. The file name entered under the common data menu is automatically inserted for file name to save. This name is also stored in the E²PROM of the 2017 during write operations and will be the inserted file name if the radio data has just been uploaded. The program will prompt you before overwriting an existing file.

Com1/2: Allows you to change the com port setting for uploads and downloads to the radio. This setting is remembered by the program for the next session.

Print: Sends the current configuration to LPT1. Make sure the printer is on line and paper is loaded before executing this command.

Quit: Returns to DOS. You will be asked to confirm before exiting the program. The software will also prompt you if the configuration has changed since program start up and data has not been saved to disk.

Data

Format: The signalling format can be either 1200/2400 Baud MSK or CDPD. The Centry® modem is required if signalling format is set to CDPD.

System Data: The data that pertains to the vehicle addressing, type of mobile used as well as specific parameters used with different manufacturers of mobile radios.

Vehicle #:	This is the vehicle number in the fleet. Range is 1-65534.
Base #:	This is the base console the mobile is assigned to. The mobile will send its GPS data to, and receive base messages from, only this console. Range is 1-15. This number MUST match the 2016 programming for base number.
PTT Delay (.1-2.5 Sec)	The delay from when the transmitter is keyed until the first digit is sent is based upon this timer. In trunking mode, this time is added to the voice channel acquisition time.
Trunking Mobile: Yes/No	If programmed for trunking operation, the 2017 will acquire a voice channel before sending its data. Uses on-air detect line (blue wire) for determination.
On Air Polarity: Low/High	Determines whether the blue wire (pin 3) is active high or low. On conventional radios, this may be the same as mic PTT and is used for ANI trigger. On trunking radios, this line must be attached to a point that actually indicates the mobile is transmitting (TX B+ or similar).
COR Polarity: Low/High	Determines whether the violet wire (pin 7 mobile COR detect) is active high or active low. RV2 is used to set the COR threshold. See page 8 for alignment instructions.
Data Validate w/COR: Yes/No	If enabled, data will only be decoded if COR input is active. If disabled, any data that meets the correct format will be decoded. Used to prevent interference from different Merlin™ systems on the same repeater or trunking systems if the audio input is connected to the discriminator.
ANI on mobile PTT: Yes/No	If enabled, the 2017 will send an ANI burst whenever the mobile is keyed by the operator. ANI allows the dispatcher to identify who is transmitting in the fleet at any given time. Also useful for logging transmissions.

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GPS after PTT	If enabled the Merlin™ will send a GPS position fix 10 seconds after the last local PTT indication is detected.
I/O Pin 9	The gray wire (pin 9 main connector) can be programmed for mic mute or channel select. If programmed for mic mute, pin 9 will go low only while the 2017 is sending tones. If programmed for channel select, pin 9 will go low at the beginning of each message and remain low until an acknowledgment is received, the user presses RESET, or the number of retries expires. This can be used to send the status messages on a separate data channel.
Method	If channel change function is selected for I/O pin 9, this determines if the output is held active for duration of the status request or pulsed once at the beginning of the request and again at the conclusion.
Emergency Input	Input #1 can be programmed for Emergency input. When this line is brought low, the 2017 will send an Emergency message to the base with retries if no acknowledgment is received.
Retries (0-9):	Number of additional attempts the 2017 will go through if no acknowledgment is received for Emergency messages only. GPS Messages are not acknowledged. Excessive retries may indicate mis-alignment of the 2017, the 2016 modem or the radios they are connect to.
GPS on Demand	Input #2 can be programmed for GPS on demand . When this line is brought low, the 2017 will send its GPS position once.
±Bipolar	If enabled, GPS on demand will also be sent when input #2 is brought high. If disabled, only grounding input #2 causes transmission.
GPS Dual Rate	Input #3 can be programmed for Code 3 input. When this line is brought low, the 2017 will report it's GPS position using the fast interval.
GPS Slow Interval	If Input #3 is high, or is not programmed for Dual Rate, the 2017 will report it's position based on this interval. Range is 1-255 minutes.
GPS Fast Interval	If Input #3 is low and is programmed for Dual Rate, the 2017 will report it's position based on this interval. Range is 10-990 seconds in 5 second increments.
Queue GPS Data	If enabled, Merlin™ will not send the GPS position on the programmed interval, but will store them until the queue is full (see next item) and send as a batch transmission to reduce air time and possible collisions.
Length of Queue	If GPS queue is enabled (above), this parameter determines the number of GPS positions the Merlin™ will store before sending a batch transmission. Range is 5 to 100.
Unque Length	Determines how many GPS position fixes will be sent when the queue is full. This number MUST be less than or equal to the queue length. Examples (assume 1 minute GPS intervals): Queue length and Unque length=20. Merlin™ will queue calls for 20 minutes then send a batch of 20 position fixes as one transmission. Queue length=20, Unque length=1: Merlin™ will store a position fix every minute, but will only send the most recent position fix every 20 minutes. Queue length=20, Unque length=0. Merlin™ will store a position fix every minute, and never send the data over the air (unless polled or history is requested). Merlin™ is acting as a "black box" recorder in this mode.
History Length	The dispatcher can request an over-the-air history of GPS positions using the Street Smarts® software. The length of the history queue is determined by this parameter. This feature is useful if the vehicle has driven out of radio range as Merlin™ continues to log the GPS positions in internal memory even though it is not able to transmit over the radio. Range is 5-100.

Test Mode

Send/Cancel MSK: Causes the Merlin™ AVL to send a continuous stream of alternating 1's and 0's in order to set transmit deviation.

Transfer

Send: Downloads the current configuration to the Merlin™. The program will prompt you to make the FY-1 connection and press the <SPACE> bar to begin downloading.

Receive: Uploads the current data from the Merlin™. The program will prompt you to make the FY-1 connection and press the <SPACE> bar to begin uploading.

GPS Data: To upload the 1024 GPS position fixes from the Merlin™, select Playback; the program will ask you for the file name to save the data to, with today's date as the default. After selecting the file name, the program will prompt you to make the connection to the programming jack on the rear panel of the unit and press <Enter> to begin uploading. Transfer takes approximately 2 minutes. You can abort the process by pressing <Esc> at any time.

Manning: The Manning Rastrac® software cannot directly import the Merlin™ playback files. Use this menu selection to send the uploaded playback file from one computer to the next. A *null modem* cable is required to connect the two computers together. Unplug the 2016 modem from the Rastrac® computer and connect the playback computer's serial port to the Rastrac® computer's serial port using the null modem cable. The data will be interpreted as if it were coming from the 2016.

Help

There are two help menu items: **General** explains how to use the mouse and menu system as well as general program information. **About** contains Pyramid's address and phone number for problems that may arise. Help is also available at any time by pressing F1 or clicking the left mouse button on the [HELP] icon in the upper right hand part of the screen.

Notes

Theory of Operation

General

All of the functions of the 2017 are under control of the microprocessor U11 which also contains the firmware operating system and interfaces to the rest of the hardware. Non-volatile data storage is contained in U13 for the Merlin™ personality data and in U6-U9 for GPS position recording.

MSK signaling

U10 provides the MSK encoding/decoding as well as signal filtering. The microprocessor communicates with U10 on pins 4 and 5. MSK tones generated by U10 are output on pin 23 then amplified by U4A. Level control is achieved with RV3. After amplification the audio is routed to the mobile radio for modulation.

Audio processing

Audio enters the 2017 on pin 6 of P1 and is high pass filtered by U5A which has a cut off frequency of 300 Hz and a slope of 12db/octave. U5B and U5C are a 4 pole low pass filter with a cut off frequency of 2500 Hz and a slope of 24db/octave. The filtered audio goes into U10 pin 13 an op-amp inverter with a gain of 0-20db as determined by RV1. U10 pin 14 is the output which goes to its internal MSK decoder. Transmit audio comes from U10 pin 23, is amplified by U4A and output on pin 2 of P1. RV3 sets the level and J1 selects the adjustment range; In:0-200mV Out: 0-5V.

LED Display

The μ P controls the Yellow COR LED directly and will depend on the programming of the COR polarity. The Yellow LED is also used to indicate busy lock out from the driver pressing PTT. If the Yellow LED is flashing, it indicates the mobile is keyed and the Merlin™ is prevented from transmitting. The CPU LED should flash at a constant 1 Hz rate. The Tx Data and Rx Data LEDs are driven by the hardware and can indicate if the μ P is communicating with the GPS receiver or the PC. PTT LED should be on when ever the Merlin™ is keying the mobile radio.

RS-485

The Merlin™ can communicate with other peripherals via the high speed bi-directional data bus connected through P2. U15 provides the RS-485 to TTL level translation.

Memory Retention

U13 E²PROM provides data retention of programming information. The E²PROM has a data retention of up to 100 years without power applied. U13 communicates with the microprocessor on lines DATA IN and DATA OUT and CHIP ENABLE.

U6-U9 provide the non-volatile storage for the GPS position data. The microprocessor communicates with the serial E²PROMs via a two wire interface SDA and SCL.

Logic and control: U11 is an Atmel 89C52 microprocessor with flash E²PROM memory. The microprocessor provides all of the logic and control functions for the 2017, interface to the rest of the hardware and communications with the PC for programming.

The 89C52 has four 8 bit ports that interface with the rest of the hardware on board; a brief description of each port follows:

P0.0	Serial data output to the personality E ² PROM.
P0.1	Serial Clock output to the personality E ² PROM.
P0.2	Audio mute output (tone stripping) active low.
P0.3	Aux 1 output active low.
P0.4	Aux 2 output active low.
P0.5	Aux 3 output active low.
P0.6	Mic Mute output active low.
P0.7	PTT output active low.
P1.0	Chip select output to U13 E ² PROM
P1.1	Serial Data input from U13 E ² PROM
P1.2	Chip select for U10 MX829
P1.3	Serial data in from U10 MX829
P1.4	Serial data out to U10 MX829
P1.5	Serial clock out to U10 MX829
P1.6	Mobile COR input. Polarity is determined by programming.
P1.7	Test jumper. Not used Do not install.
P2.0-1	Not used
P2.2	Serial Data to and from U6-U9 GPS E ² PROMs
P2.3	Serial Clock for U6-U9 GPS E ² PROMs
P2.4	Aux 2 input.
P2.5	Aux 1 input.
P2.6	Aux 3 input.
P2.7	RS-485 Request line; bi-directional
RD	RS-485 data direction control
RXD	Serial Data port Rx Data
TXD	Serial Data port Tx Data
INT0	Interrupt Request from MX829
INT1	On Air detect input. Polarity determined by programming
T0	CPU LED output active low
T1	COR LED output active low Steady On: COR busy Flashing: On-Air Busy

MSK Signalling

The 2017 transmits and receives data packets at 1200/2400 baud and conforms to the MPT-1317 protocol for over-the-air signalling. A brief description of the MPT-1317 protocol and the 2017 data messages follows:

MPT-1317

The MPT-1317 protocol consists of a data packet made up of preamble (bit reversals for receiver synchronization), a 16 bit sync word, a 6 byte address code word and 16 bits of CRC error correction data. If data bytes are attached, they are preceded by the same 16 bit synch word (preamble is sent only once), and followed by 16 bits of CRC:

Preamble	sync	address code word	16 bit crc	sync	data bytes	crc
16 bits	16 bits	48 bits	16 bits	16 bits	up to 128 bytes	16 bits

The minimum message length is 96 bits; at 1200 baud, transmission takes 80mS, at 2400 baud, 40mS.

2017

The 2017 sends 2 types of messages that conform with the MPT-1317 data protocol. Emergency messages contain preamble, sync, address code word, and CRC. GPS messages contain the same, plus add another 16 bits of sync, 64 bytes of data and 16 more bits of crc for a total of 640 bits. At 1200 baud, transmission takes 533mS, at 2400 baud, 266mS.

Address Code words

The address code word defines the message type and what action is to be taken by the 2017. The address code word is 6 bytes of hexi-decimal data and conform to the following format:

Address Code word 6 bytes 48 bits:

- Bit 0 Always 1
- Bits 1-3 System Flags
- Bits 4-7 Console ID
- Bits 8-23 Mobile ID
- Bits 24-31 Function Code
- Bits 32-39 Time Stamp
- Bits 40-47 Number of data bytes to follow

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Flags:

Bit 1	Retry: Cleared for normal operation, set if message is a retry
Bit 2	2017 Identifier always "1"
Bit 3	General Purpose 2

Console ID:

Bits 4-7	Console # 1-15 Source address for 2016 message, destination address for 2017
----------	--

Mobile ID:

Bits 8-23	Mobile # 1-65534 (65535=group call) Destination address for 2016 messages Source address for 2017 messages
-----------	---

Function code:

	Merlin™	Base
	2017	2016
Bits 24-27	0 Reserved	Acknowledge
	1 Emergency	Negative Acknowledge
	2 Acknowledge	Interrogate
	3 Negative Acknowledge	Reserved
	4 ANI	Reserved
	5 GPS message	Set Individual Output
	6 Reserved	Clear Individual Output
	7 Reserved	Output Mask (Change all outputs)
	8 Reserved	Reserved
	9 Reserved	Request GPS position
	A Reserved	GPS Interval Change (OTAR)
	B Reserved	GPS History
	C-F Reserved	Reserved

Bits 28-31	Input Status Bit 28 always 0 Bit 29: Input 1 Bit 30: Input 2 Bit 31: Input 3	RS485 destination address 0-15
------------	---	--------------------------------

Bits 32-39	Time Stamp Pack BCD 00-99	GPS Interval 0-255 Bit 37: Output 3 Bit 38: Output 2 Bit 39: Output 1
------------	---------------------------	--

Data bytes:

Bits 40-47	Number of data bytes to follow 0-255
------------	--------------------------------------

Examples:

Emergency message from 2017 unit #512 (Input #1: Emergency) to 2016 #1: A1 02 00 14 00 00
2016 response: 81 02 00 00 00 00

2016 #3 requests 2017 #12345 to send its GPS position: 83 30 39 90 00 00

2017 #12345 response (All Inputs open): A3 30 39 50 00 40 + sync, 64 bytes GPS data & CRC

2016 #3 sends 2017 #12345 Turn on Output #1: 83 30 39 50 01 00

2017 #12345 response (All Inputs open): A3 30 39 20 00 00

Parts List

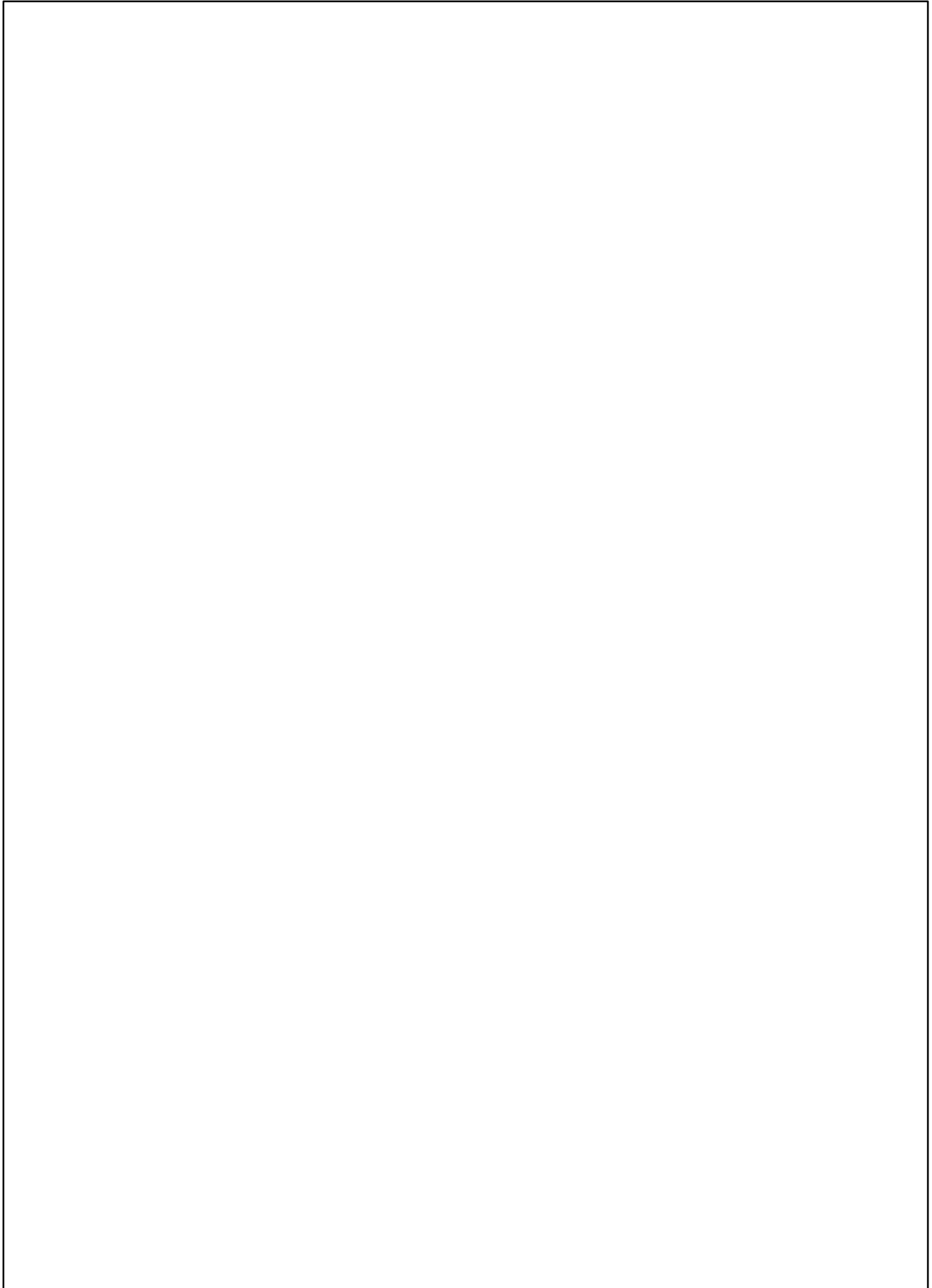
Reference	Description	Part #
C1	2200 pfd 0805 chip cap	1010-03-5222
C18-C21	10 pfd 0805 chip cap	1010-03-5100
C4-C7	.47 μ fd 1206 tantalum chip cap	1610-04-5474
C9,C12,C22,C23	0.1 μ fd 0805 chip cap	1010-03-5104
C10,C17,C24,C25	2.2 μ fd 1206 tantalum chip cap	1610-04-5225
C11	1000 pfd 0805 chip cap	1010-03-5102
C13,C14	.01 μ fd 0805 chip cap	1010-03-5103
C15	3300 pfd 0805 chip cap	1010-03-5332
C16	6800 pfd 0805 chip cap	1010-03-5682
C26,C27	100 μ fd SMT electrolytic	1410-09-6107
C28	1 μ fd 1206 tantalum chip cap	1610-04-5105
C29	0.22 Farad electrolytic	1481-18-5229
DS1,DS4,DS5	Red LED	4001-01-2501
DS2	Yellow LED	4001-01-2503
DS3	Green LED	4001-01-2502
D1-D4,D6-D9	BAV99 Dual diode sot-23	3110-01-0099
D5	1N4001 1A silicon	3110-11-4001
F1,F2	Fuse, 2A	2610-04-0020
P1	DB15-M Connector	7401-00-0012
P2	DB9-F Connector	7409-00-0011
P3	2mm 8pin GPS connector	7200-12-0108
P4	2.5mm Jack	7401-02-0050
Q1, Q2	2N4403 pnp sot-23	3010-01-4403
Q3-Q8	IRLMS1902 MOSFET	3310-01-1902
Q9, Q10	2N4401 npn sot-23	3010-01-4401
RN1	2.2 K Resistor network	2002-07-5222
RV1, RV2	Potentiometer, 20K	2060-08-5203
RV3	Potentiometer, 100K	2060-08-5104
R29,R30,R33-R35,R40,R41,R43,R49	10K 0805 chip resistor	2010-03-5103
R11,R12,R19-R24,R39,R50,R53,R59	22K 0805 chip resistor	2010-03-5223
R13-R17	330 Ohm 0805 chip resistor	2010-03-5331
R26-R28, R55-R57	1K 0805 chip resistor	2010-03-5102
R44,R45	1M 0805 chip resistor	2010-03-5105
R31,R32,R36,R37	24K 0805 chip resistor	2010-03-5243
R38,R46	47K 0805 chip resistor	2010-03-5473
R42,R48,R51	100K 0805 chip resistor	2010-03-5104
R47,R52,R54, R58	2.2K 0805 chip resistor	2010-03-5222
TP1,TP2	Test Point	7300-13-0001
U1	74C14 Hex Inverter	3510-01-7414
U2	LM7805 1A 5V regulator	3400-08-7805
U3	LM7808 100 mA 8V regulator	3410-10-7808
U4	LM2904 Dual op-amp	3410-01-2904
U5	MC3403 Quad op-amp	3410-01-3403
U6-U9	Serial E ² PROM 24C128	3610-01-4128
U10	MX829 MSK Processor	3710-01-0829
U11	AT89C52 Microprocessor	3610-02-8952
U12	MCP101 Reset controller	3410-11-0450

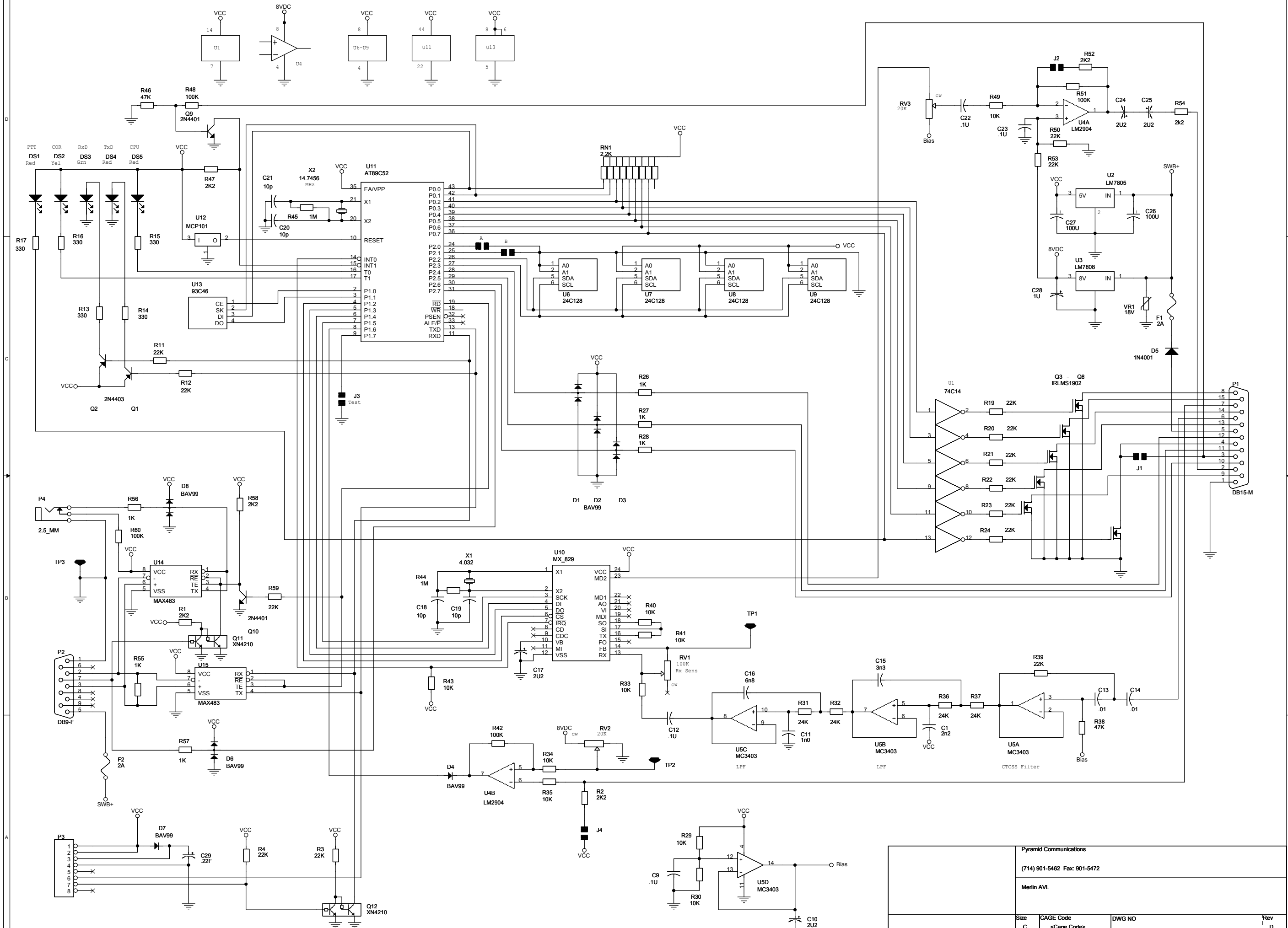
Model 2017 Service Manual

U13	93C46 E ² PROM	3610-01-9346
U14,U15	MAX483 RS485 Driver	3410-01-0483
VR1	MOV Surge protector 18V	2580-02-0018
X1	4.032 MHz Crystal	6010-01-4032
X2	14.7456 MHz Crystal	6010-01-1474

Mechanical Assembly

Ashtech G8 GPS Receiver	9205-09-0088
SMA Right Angle Connector	7401-01-0003
4" GPS antenna cable	7504-04-0016
Extruded aluminium case	8100-01-5010
Aluminium end panel	8200-04-2017
ABS Face Plate	8200-03-2502
Trunion Mount Bracket	9600-05-0001
10ft. radio cable with DB-15F conn. .	7500-10-1301
8-32 x 1/4" SS philips	8000-24-8324
4-40 x 3/8" SS cap screw	8000-34-4406
4-40 SS nut	8000-54-4400
4-40 x 1/4" SS philips	8000-24-4404
2-56 x 1/4" Standoff	8000-65-2564
2-56 x 3/16" SS philips	8000-24-2563





Pyramid Communications			
(714) 901-5462 Fax: 901-5472			
Merlin AVL			
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