Apollo® MX20
Multi-Function Display
Installation Manual

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UPS Aviation Technologies

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HISTORY OF REVISIONS

Part No.	Revision	Date	Description
	--	11/1/99	Initial Release.
560-1025-01	--	11/11/99	Updated installation package contents and equipment mounting information.
560-1025-02	--	1/17/00	Added the MX20 configuration procedure, expanded post installation checkout procedures, added Appendix A.
560-1025-02	a	4/3/00	Clarified unit installation position. Corrected wiring diagram. Incorporated changes for software version 1.2.
560-1025-02	b	7/25/00	Incorporated changes for software version 2.0.
560-1025-02	c	10/3/00	Added mounting tube considerations
560-1025-03	--	12/1/00	Changes for class and category in environmental qualifications and new ADS-B messages.
560-1025-04	--	7/18/01	Changes to mounting tube and environmental qualifications for helicopters.
560-1025-05	--	4/12/02	Added I/O board option and SW to support traffic and radar.
560-1025-05	a	6/12/02	Added JTSO
560-1025-06	--	11/13/02	Added landmark support for the TAWS8000
560-1025-07	--	6/18/03	Changes for SW Ver 5.0. Radar and WSI.

ORDERING INFORMATION

To receive additional copies of this publication, order part # **560-1025-07,** *Apollo MX20 Multi-Function Display Installation Manual*.

OTHER PUBLICATIONS

GX50/60 Installation Manual, P/N 560-0959
WX-500 Installation Manual, Goodrich Avionics P/N 009-11500-001
SKY899 Installation Manual, Goodrich Avionics P/N 009-11900-001
RDR2000 Installation Manual, Allied Signal P/N 006-00643-0004
9900B Installation Manual, Ryan TCAD P/N 32-2301
9900BX Installation Manual, Ryan TCAD P/N 32-2351
WSI InFlight Installation Manual, WSI P/N 305427-00
GTX330, GTX330D Transponder Manual, Garmin P/N 190-00207-02 Rev. A

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1 INTRODUCTION

1.1 ABOUT THIS MANUAL

This manual describes the installation of the Apollo MX20 Multi-Function Display. It is intended for use by persons certified by the Federal Aviation Administration (FAA) to install aircraft navigation devices. It includes installation and checkout procedures for the MX20 to standards described in 14CFR Part 43.

Section 1 Provides an **introduction** to the MX20. TSO certification information is also included in this section.

Section 2 Includes **installation** and **checkout** procedures.

Section 3 Includes complete **specifications**.

Section 4 Includes **troubleshooting** information.

Section 5 Includes **continued airworthiness instructions** requirements.

Section 6 Includes the **environmental qualification form**.

Appendix A Includes **I/O specifications.**

1.2 SYSTEM DESCRIPTION

The MX20 is a multi-function display capable of displaying moving maps, terrain awareness, obstructions, and VFR/IFR charting functions. An optional datalink provides ADS-B traffic, FIS-B and TIS-B information. Interfacing to the WX-500 provides lightning strike information on the display. Interfacing to the WSI Inflight sensor provides Nexrad images, graphic and text METARs, graphic and text TAFs, EchoTops, Sigmet, Airmet, and Temporary Flight Restriction (TFR) information.

The MX20 display is also available with an internal GPS. The internal GPS position source permits a Navigation Uncertainty Category (NUC) value to be calculated and transmitted for ADS-B broadcast.

The MX20 I/O option includes additional interface capabilities that allow connection to the ARINC 453 bus for the display of radar, ARINC 429 support for Goodrich Skywatch interfaces, RS-232 support for Ryan TCAD, Landmark TAWS, and the Honeywell KGP560. The MX20 I/O model is not available with the optional GPS engine. Interfacing to a Garmin GTX330 Mode S Transponder provides TIS-A traffic information.

The MX20 must be connected to an external GPS navigation source, such as the UPSAT Apollo GX or CNX-series, to provide route and flight plan information. The MX20 must be connected to an external serial altitude source to provide terrain awareness information.

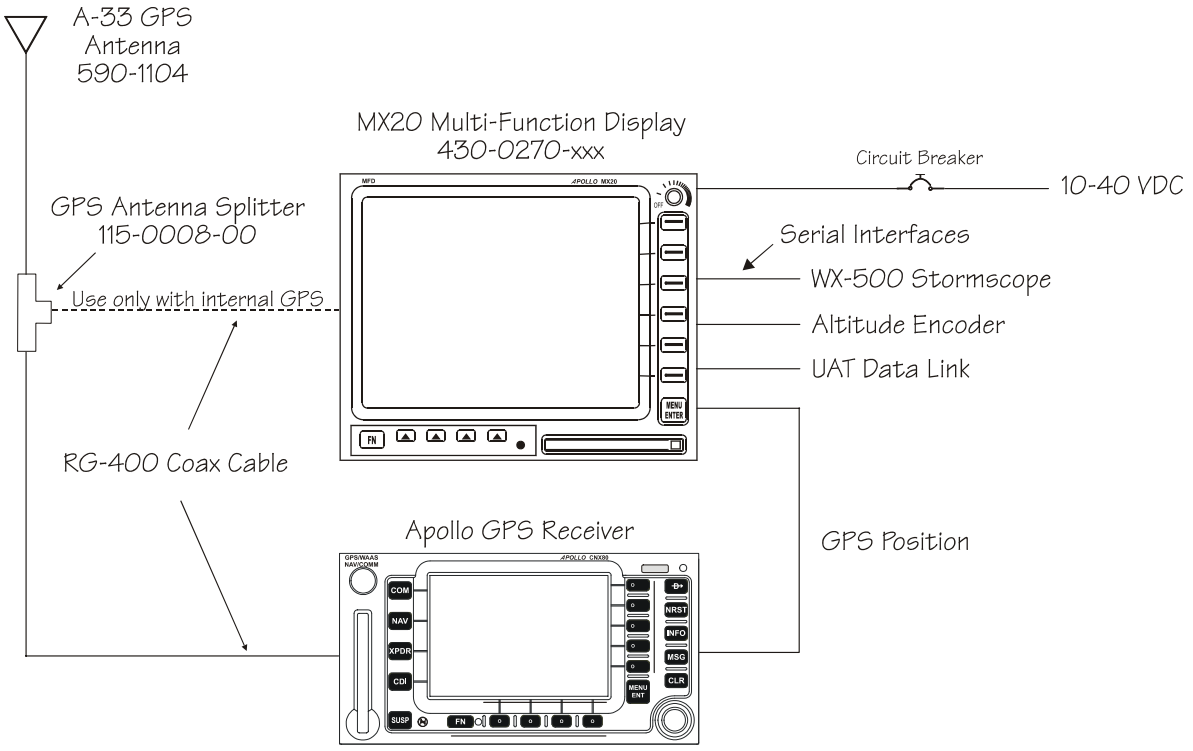
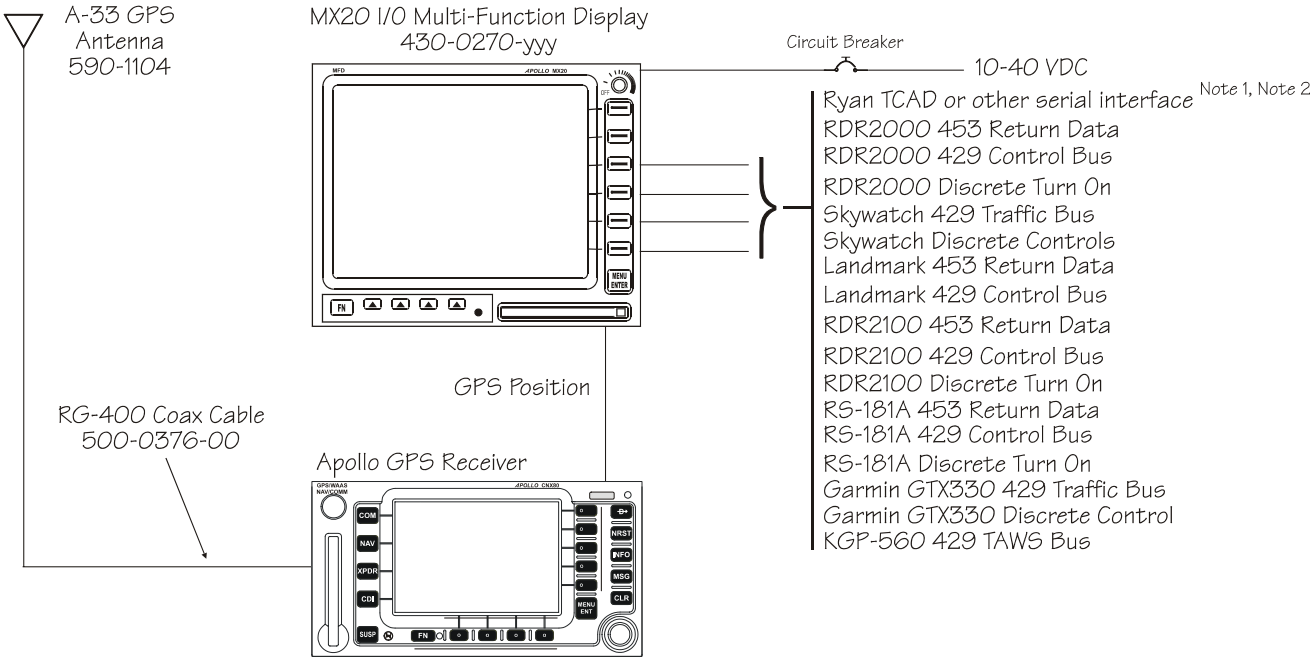


Figure 1 – MX20 System Block Diagram



Note 1: All other serial interfaces of the standard MX20 are supported, but are not shown for clarity.
Note 2: Only one traffic source may be connected to the MX20 I/O.

Figure 2 - MX20 I/O System Block Diagram

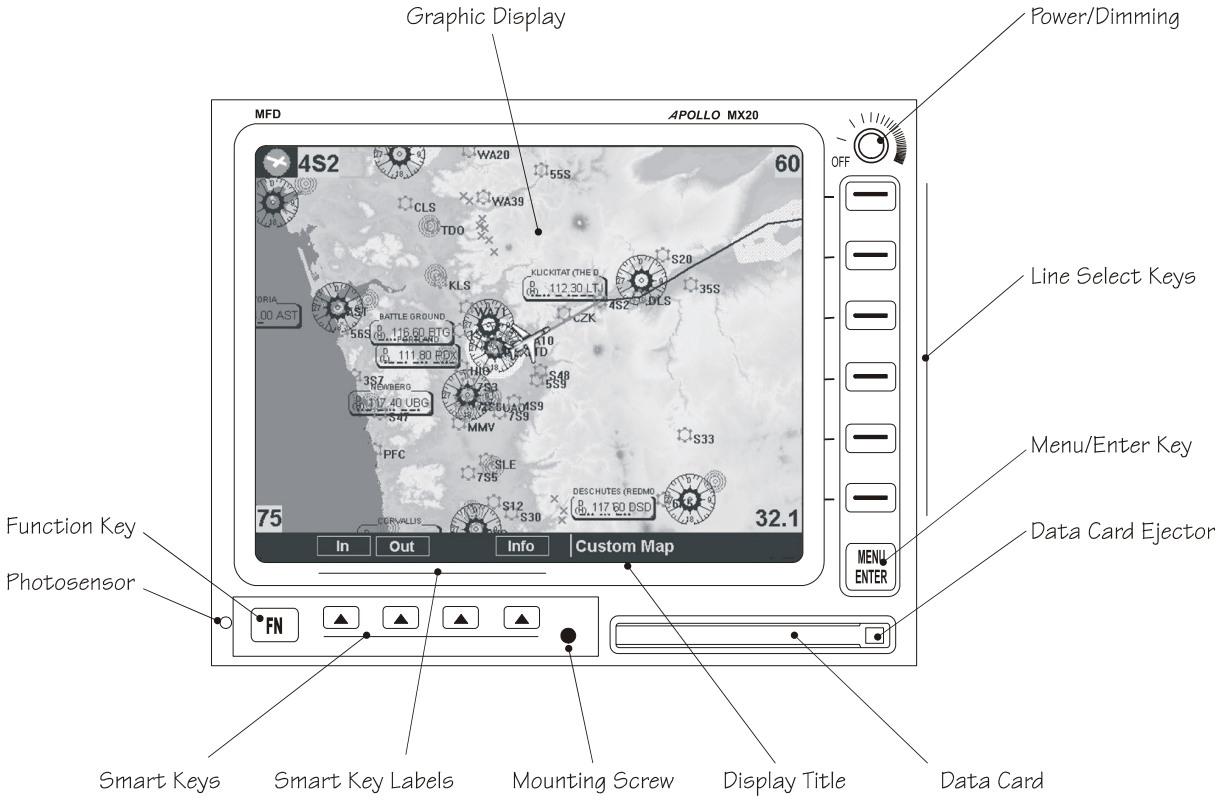


Figure 3 - MX20 Front Panel Description

1.3 REGULATORY COMPLIANCE

The MX20 is designed and tested to meet the following TSOs when connected to the appropriate equipment:

- FAA TSO-C63c/JTSO 2C63c — Airborne Weather Radar
- FAA TSO-C110a/JTSO-C110a — Passive Thunderstorm Detection (Goodrich WX500)
- FAA TSO-C113/JTSO-C113 — Multi-purpose Electronic Display
- FAA TSO-C118/JTSO-C118 — Traffic Alert and Collision Avoidance (TCAS I)
- FAA TSO-C147 — Traffic Advisory System (TAS)
- FAA TSO-C151a — Terrain Awareness and Warning System (TAWS)

The MX20 software is designed and tested to RTCA/DO-178B, levels C and D.

NOTE
Unauthorized changes or modifications to the MX20 will void the compliance to required regulatory agencies and authorization for continued equipment usage.

"The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. If not within the TSO standards, the article may be installed only if the applicant documents further evaluation for an acceptable installation and it is approved by the Administrator."

"The conditions and tests required for TSO/JTSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO/JTSO standards. The article may be installed only if the installation is performed in accordance with Part 43 or the applicable airworthiness requirements."

1.4 UNPACKING THE EQUIPMENT

Carefully unpack the equipment. Visually inspect the package contents for any evidence of shipping damage. Retain all shipping containers and packaging material in case reshipment is necessary.

1.5 PACKAGE CONTENTS

As shipped from the UPS Aviation Technologies factory, the MX20 Installation package includes most necessary items for installation other than supplies normally available at the installation shop. The items included in the package are listed in Table 1.

Table 1 - Installation Package Contents

Part #	Description	Quantity w/o GPS 424-0751	Quantity w/ GPS	Quantity w/ I/O 424-0753
Unit				
430-0270-0xx	Apollo MX20 Multifunction Display with GPS		1	
430-0270-5xx	Apollo MX20 Multifunction Display without GPS	1		
430-0270-6xx	Apollo MX20 I/O Traffic Multifunction Display			1
430-0270-7xx	Apollo MX20 I/O Traffic/Radar Multifunction Display			1
	MX20 Installation Kit			
115-0007-00	GPS 1575 MHz 2:1 splitter		1	
162-1008	Right angle coax plug		1	
162-1060	TNC Connector		3	
162-1577*	37-pin d-Sub	1	1	1
202-0001	Cable tie	4	4	4
204-0037	Edge grommet	6"	6"	6"
204-2100	Shoulder bushing		2	
220-0637	6-32 Wing nut	1	1	1
240-0615	#6 Washer	2	2	2
224-0404	4-40 x 1/4 SS flat head Phillips machine screw	2	2	2
245-0027*	Crimp contact for d-sub, 20 to 24 AWG wire	30	30	40
310-0429-xx	MFD Mounting Tube	1	1	1
998-0048	3/32" hex driver	1	1	1
	MX20 I/O Installation Kit			
160-0138	62-pin d-Sub, high density			1
245-0059	Crimp contact for high density d-sub, 22 to 30 AWG wire			20
564-0076-0xx	**Manual Kit**	1	1	1
560-1025-xx	MX20 Installation Guide	1	1	1
560-1026-xx	MX20 User's Guide	1	1	1
561-0263	MX20 Quick Reference Guide	1	1	1
564-0078-0xx	STC Kit (AFM & MDL)	1	1	1

Notes:

* Pin has a barrel over the contact. Use ITT Cannon tools.

Other Required Materials

The MX20 equipment is intended for use with standard aviation accessories. See section 1.9 for a list of compatible equipment. The following items are required for the installation:

- Compatible position locating source, such as: Apollo GX50/55/60/65 GPS receiver, or Apollo CNX-series receiver
- Compatible Serial Altitude Encoder

1.6 SPECIAL TOOLS REQUIRED

Crimp Tool

A crimp tool meeting MIL specification M22520/1-01 and a positioner/locator are required to ensure consistent, reliable crimp contact connections for the rear d-sub connectors. Examples of these tools are shown below:

For pin P/N 245-0027

ITT Cannon
1851 E. Deere Ave.
Santa Ana, CA 92705-6500

Phone (714) 261-5300
Fax (714) 575-8324

Insertion tool: ITT part # 274-7006-000 (Desc. CIET-20HD)
Regular duty Crimp tool: ITT part # 995-0001-585 (Desc. M22520/1-01)
Regular duty Locator tool: ITT part # 995-0001-244 (Desc. TH25)
Heavy duty Crimp tool: ITT part # 995-0001-584 (Desc. M22520/2-01)
Heavy duty Locator tool: ITT part # 995-0001-604 (Desc. M22520/2-08)

For pin P/N 245-0059 (High Density Connector – I/O Only)

Astro Tool Corp
21615 SW TV Highway
Beaverton, OR 97006

Phone (503) 642-9853
Fax (503) 591-7766

Crimp tool: Astro Tool part # 615708
Positioner: Astro Tool part # 616356

1.7 LICENSE REQUIREMENTS

There are no license requirements for the MX20.

1.8 OPERATING INSTRUCTIONS

1.8.1 MX20

The MX20 User's Guide, UPS Aviation Technologies P/N 560-1026-xx, covers operation and pilot interface. The MX20 Quick Reference Guide is P/N 561-0263-xx.

1.9 EXTERNAL DATA SOURCE COMPATIBILITY

External serial data sources intended for use with the MX20 should be checked for compatibility before installation. Devices from other manufacturers or unlisted models are supported if they adhere to the interface specifications provided in this manual. The list of supported devices is located in Section 3.1.10 of this manual.

2 INSTALLATION

This section describes the installation of the MX20 including mounting, wiring, connections, and software configuration. A post-installation checkout procedure is included at the end of this section.

2.1 PRE-INSTALLATION INFORMATION

Always follow good avionics installation practices per FAA Advisory Circulars (AC) 43.13-1B, 43.13-2A, and AC 20-138, or later FAA approved revisions of these documents.

Follow the installation procedure in this section as it is presented for a successful installation. Read the entire section before beginning the procedure. Prior to installation, consider the structural integrity of the MX20 installation as defined in AC 43.13.2A, Chapter 1. Perform the post installation checkout before closing the work area in case problems occur.

Complete an electrical load analysis in accordance with AC 43.13-1B, Chapter 11, on the aircraft prior to starting modification to ensure aircraft has the ability to carry the MX20 load. Refer to Section 2.5.6 for the power consumption of each MX20 mode of operation (heater on). Document the results of the electrical load analysis on FAA Form 337.

2.2 INSTALLATION OVERVIEW

A successful installation should start with careful planning including determination of mounting location for the MX20, cable routing, and other required modifications. Once the mounting location has been determined, prepare the mounting frames for installation. It may be easier to complete the wiring harness and attach the connectors to the mounting frame before installing the mounting frame.

Carefully plan which external devices are to be connected to which MX20 ports observing the special characteristics of ports 3 and 4.

2.3 INSTALLATION CONSIDERATIONS

2.3.1 EXISTING SENSORS

When the MX20 is installed with external sensors, these sensors must be installed with manufacturer's data. This manual does not provide information for the installation of specific external sensors.

2.3.2 MOUNTING CONSIDERATIONS

The MX20 is designed to mount in the avionics stack in the aircraft instrument panel within view and reach of the pilot. The MX20 must be located where the operator will have easy access to the controls and adequate viewing of the display. The preferred location would minimize pilot head movement when transitioning between looking outside of the flight deck and viewing and operating the MX20. Sample diagrams of typical cockpit front panel views of the MX20 are shown in Figure 4 and Figure 5.

The standard package includes a mounting frame for ease of mounting, connections, and service of the unit. Allow an additional one-inch clearance to the rear of the mounting frame for connectors and cables. Mounting frame details are shown in Figure 6, Figure 7, Figure 8, and Figure 9. Use of mounting tube P/N 310-0429-01, or later FAA approved revision, is recommended for all installations and is required for helicopter installations.

The MX20 does not require external cooling. When mounting the MX20, leave a clearance of 1/8 to 1/4 inch between avionics to allow for air circulation.

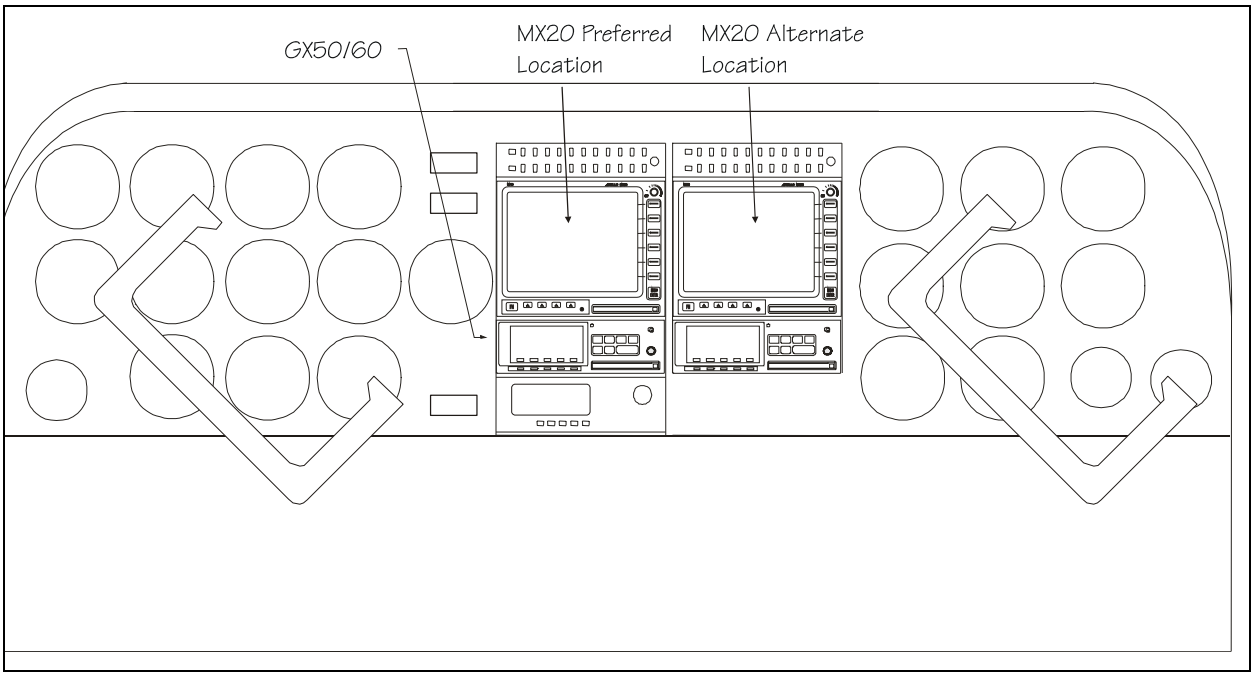


Figure 4 - Cockpit Panel Configuration for a Large Panel

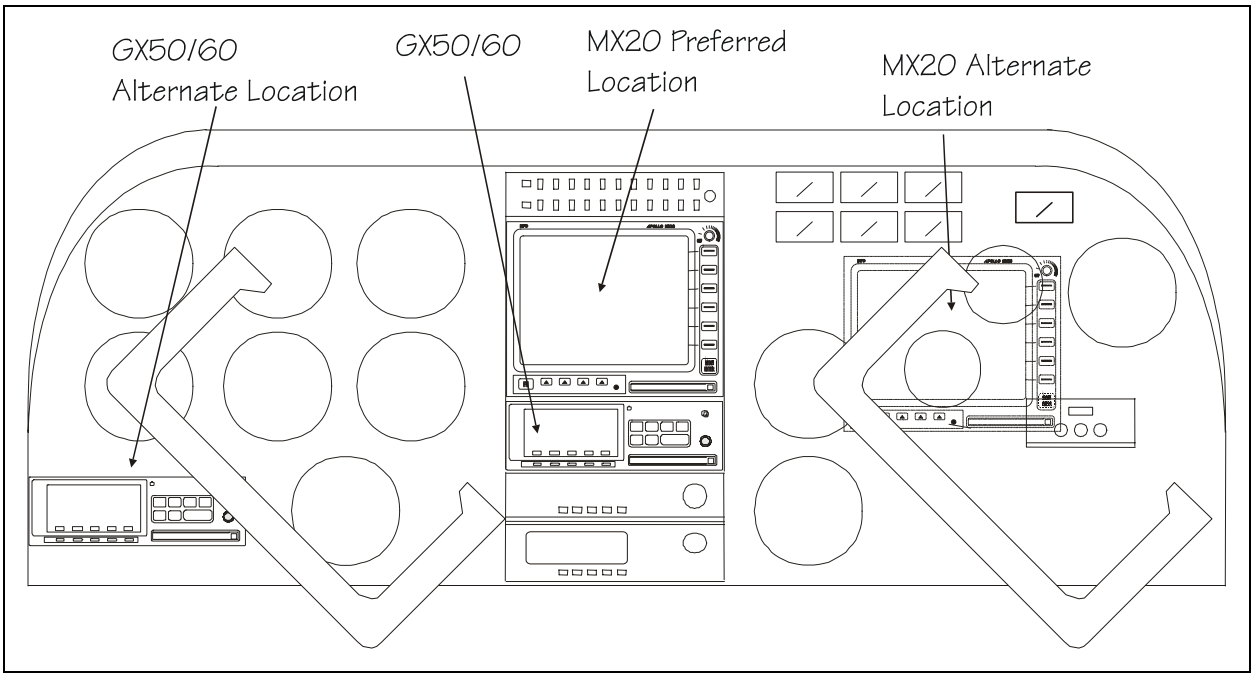


Figure 5 - Cockpit Panel Configuration for a Small Panel

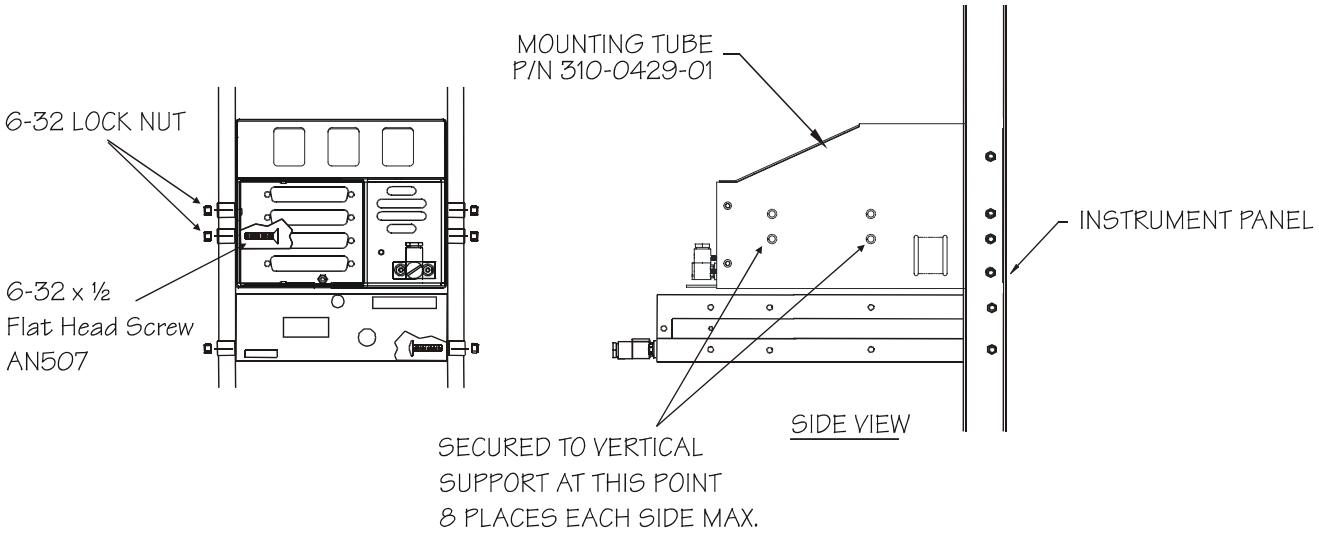


Figure 6 - Sample GX60 & MX20 Mounting

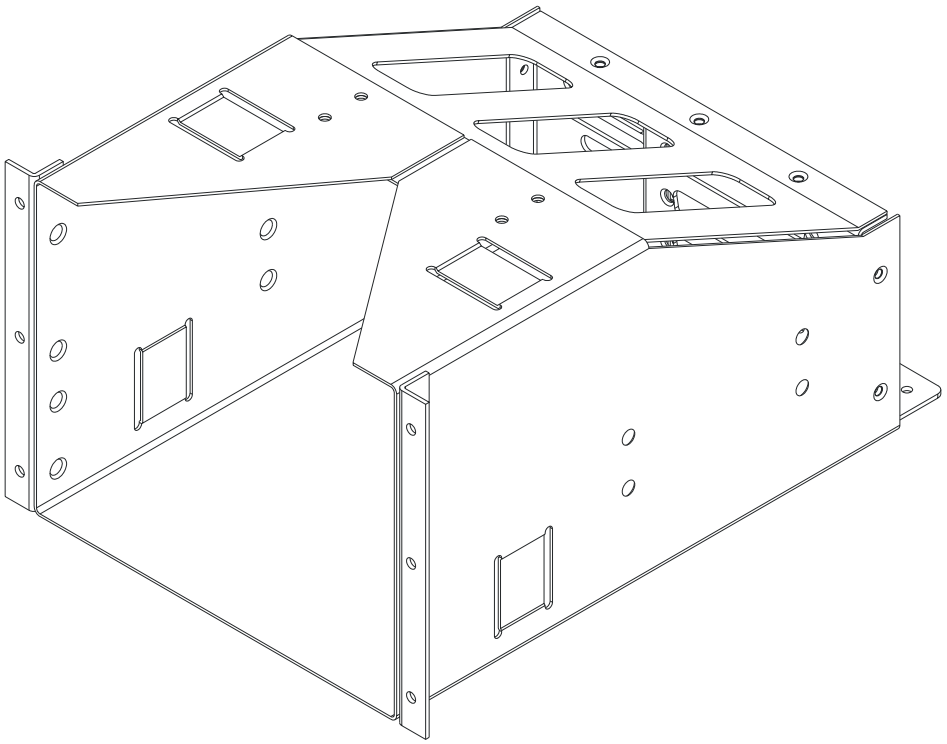


Figure 7 - Alternate MX20 Mounting Configuration

NOTE
This configuration utilizes an angle bracket along each side of the mounting tube. The installer must consider the structural integrity of the installation as defined in AC43.13.2a Chapter 1.

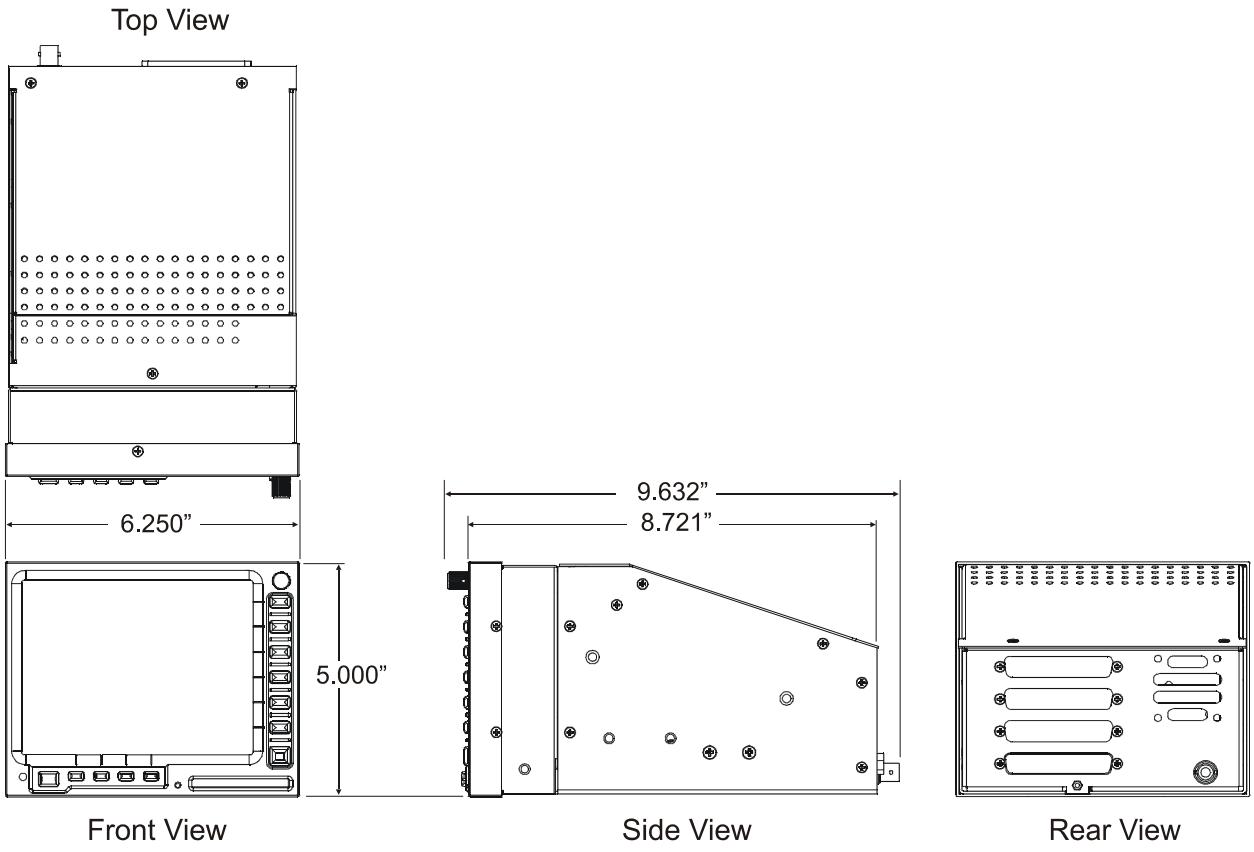


Figure 8 - MX20 Unit Dimensions

NOTE
Use of mounting tube P/N 310-0429-01, or later FAA approved revision, is recommended for all installations and is required for helicopter installations.

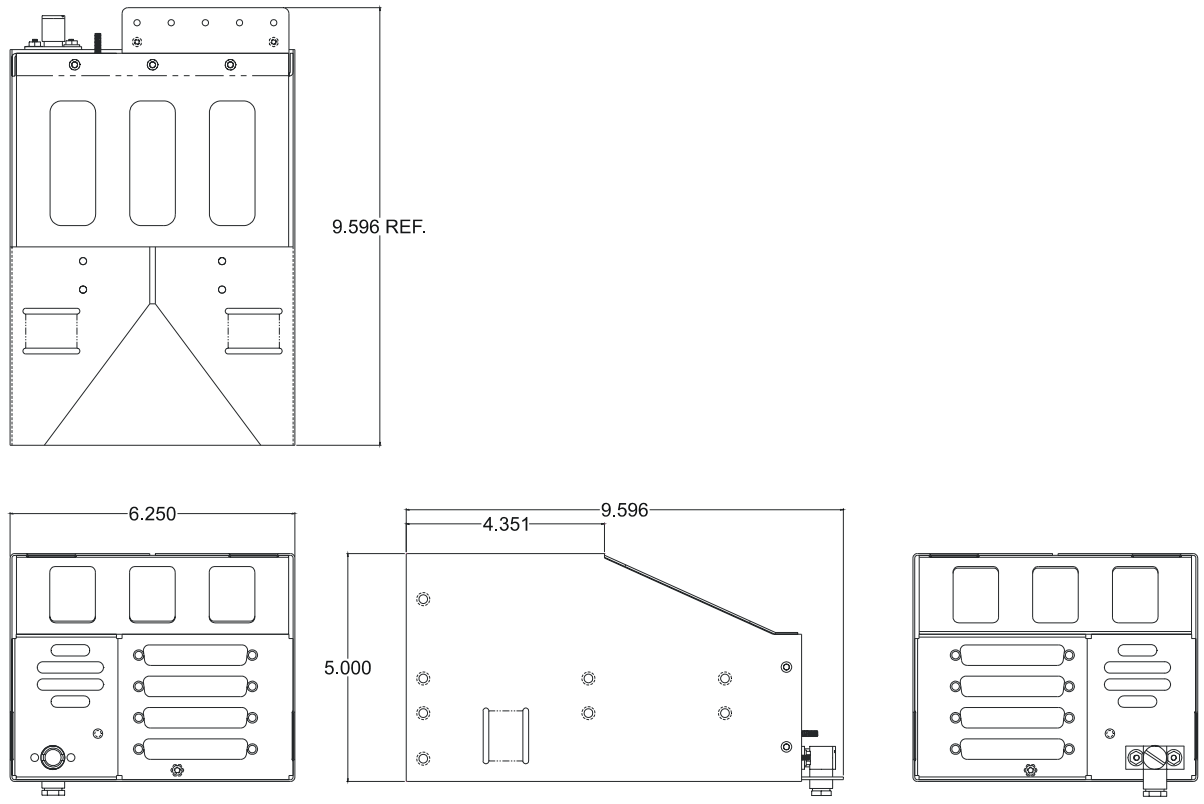


Figure 9 - MX20 Mounting Tube Assembly Dimensions

Note: Use of mounting tube P/N 310-0429-01, or later FAA approved revision, is recommended for all installations and is required for helicopter installations.

2.3.3 MINIMUM SYSTEM CONFIGURATION

The MX20 requires connections to the following equipment as a minimum, as appropriate for each unit:

- Power input
- Serial position input device (such as the Apollo GX60, Apollo CNX-series, or equivalent)
- Serial altitude encoder

The serial I/O requirements are located in Appendix A of this manual.

2.3.4 AIR CIRCULATION

No external cooling is required for the MX20. Newer units will have an internal fan installed. Previous units may be modified to include an internal fan, if desired. No special provisions are required during installation to accommodate the fan except to ensure the fan opening is not blocked.

2.3.5 COMPASS SAFE DISTANCE

After reconfiguring the avionics in the cockpit panel, if the MX20 is mounted less than seven inches from the compass, recalibrate the compass and make the necessary changes for noting correction data.

2.3.6 VIEWING ANGLE

The MX20 shall be located such that the operator will have easy access to the controls and have adequate view of the display. The MX20 may be adequately viewed from the primary pilot's position when the following minimums are met:

Up: 20 degrees off pilot's eye center line

Down: 30 degrees off pilot's eye center line
Right: 50 degrees off pilot's eye center line
Left: 50 degrees off pilot's eye center line

2.4 EQUIPMENT MOUNTING

Once the cable assemblies have been made, attach each connector to the rear connector mounting plate and the mounting tube as illustrated in Figure 10. Route the wiring bundle as appropriate.

Use tie wraps to secure the cable to the rear connector plate to provide strain relief for the cable assembly as shown in View A of Figure 10. Connect the shield grounds directly to the grounding lug.

Mounting Tube

Secure the mounting tube to the instrument panel structure using the sixteen screws. The AN507 6-32 screws have a 100° countersink head. The mating holes in the instrument panel structure must also be countersunk to accept the screw head so that the screw head is flush with the inside surface of the mounting tube.

CAUTION

Failure to properly countersink the mounting holes will result in damage to the MX20. Mounting screw heads must not protrude into the mounting tube.

The mounting tube should be flush to the instrument panel and allow sufficient clearance for the back of the bezel of the MX20 to mount flush to the mounting tube. Sufficient clearance must exist in the instrument panel opening to allow ease of insertion and removal of the MX20.

CAUTION

If the back of the MX20 bezel does not mount flush to the mounting tube, the connector may not engage fully.

An alternate mounting configuration can be accomplished using locally-fabricated *L* brackets. Make the brackets from 20-24 T3 aluminum, 0.040", and form a 90° bend. When attaching the *L* brackets to the mounting tube, screw heads must not protrude into the mounting tube.

Once the cable assemblies are complete and the connectors are attached to the mounting frame, install the mounting frame assembly in the instrument panel. Be sure to use AN507 flat head screws so the unit will slide in and out freely. Attach the front of the mounting frame to the instrument panel. Use support brackets to attach the rear of the frame to the aircraft. Cable wiring to the mounting frame is shown in Figure 10.

Slide the unit into the frame and **hand-tighten** the threaded screw shaft using the 3/32" hex driver provided in the installation package. The unit will be pulled into the frame by the shaft and the connectors will fully engage. The back of the bezel must only be flush to the mounting tube.

To remove the unit from the mounting frame, unscrew the screw shaft. The unit will be loosened and then may be pulled from the frame. No special extraction tools are required.

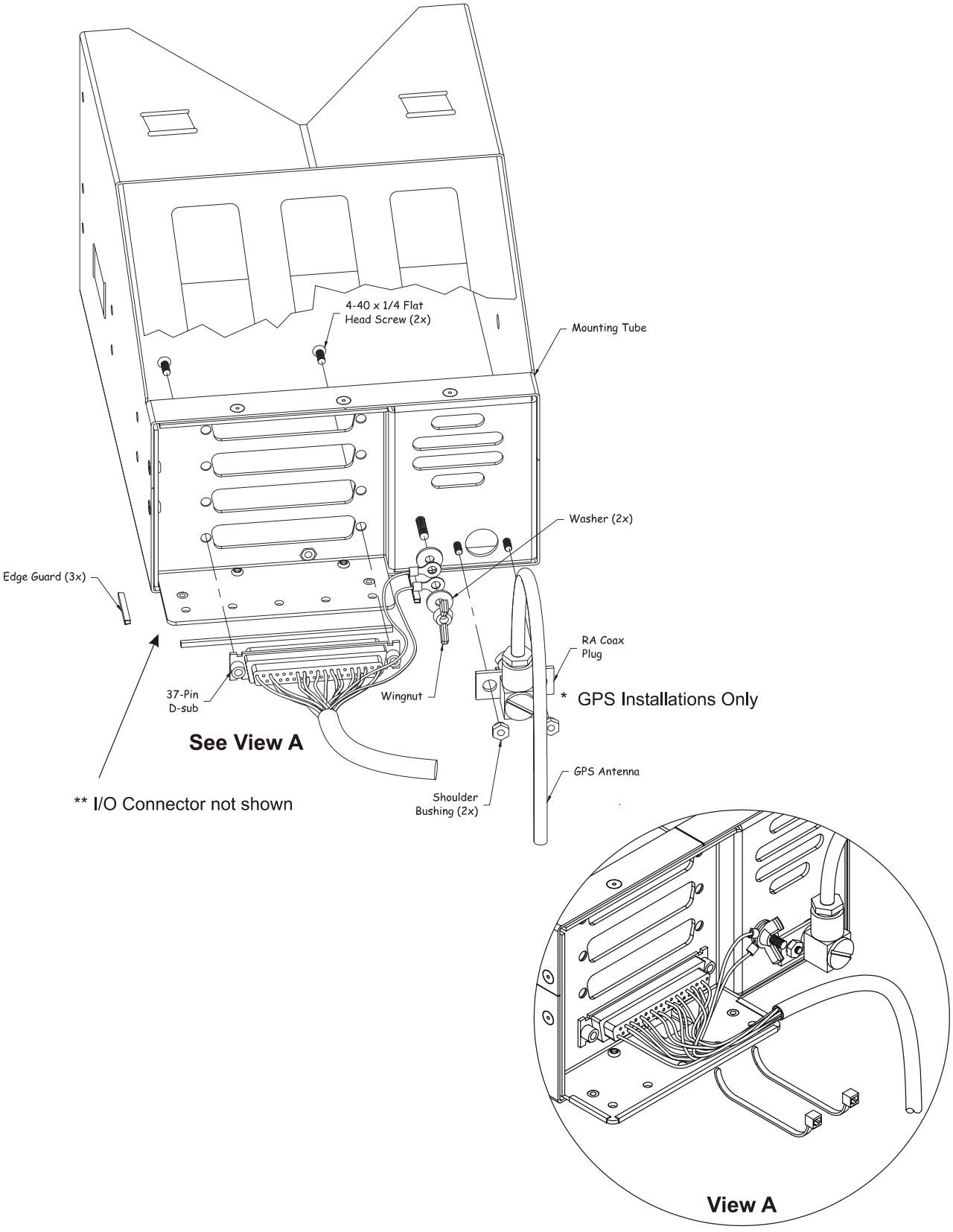


Figure 10 - MX20 Typical Rear Panel Wiring Connections

2.5 ELECTRICAL CONNECTIONS

The MX20 installation kit includes connectors and crimp contacts. Make the crimp connections with a crimp tool as specified in the Special Tools Required section on page 6. Wires should be 20 to 24 AWG for the 37-pin connector and 22-30 AWG for the 62-pin connector, unless otherwise specified. Power and ground wires should be 20 AWG. Shield grounds should be as short as possible and connected to the grounding lug on the back of the chassis with wire of three inches, or less.

- Wiring shall be in accordance with AC 43.13-1B.
- All RS-422 or RS-232 connections should be made with twisted pair shielded cable.
- All ARINC 453/708 connections should be made with 70 ohm, constant impedance, twisted pair shielded cable.
- All ARINC 429 connections should be made with twisted pair shielded cable.

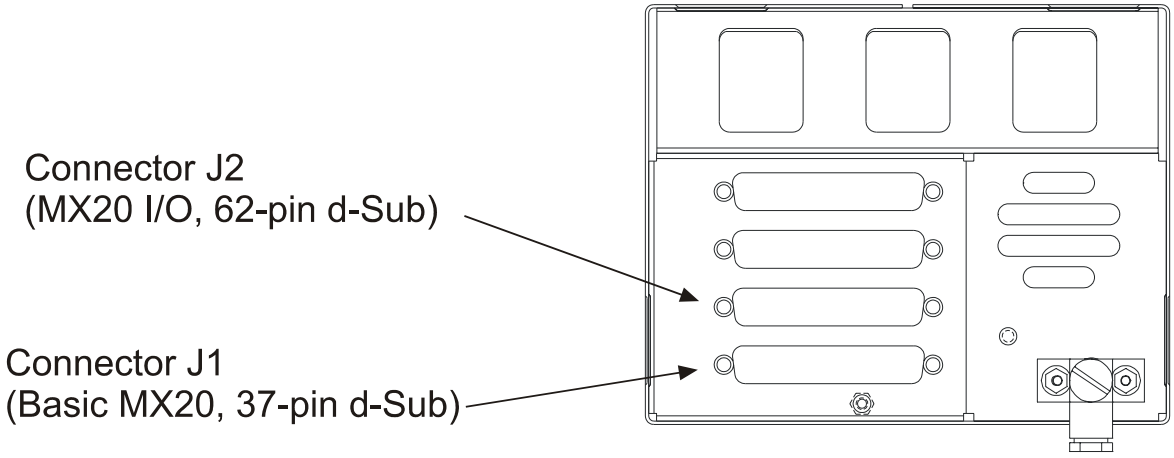


Figure 11 - Data Port Location

2.5.1 MX20 BASIC DATA PORT CONFIGURATION

The basic MX20 supports four I/O ports on connector J1. Three of the ports are RS232 and one is RS422. The usage of each port is assigned during the configuration procedure (see section 2.7). The diagram below provides an example of a configuration for the data ports. Samples of typical wiring configurations are shown in section 2.5.7.

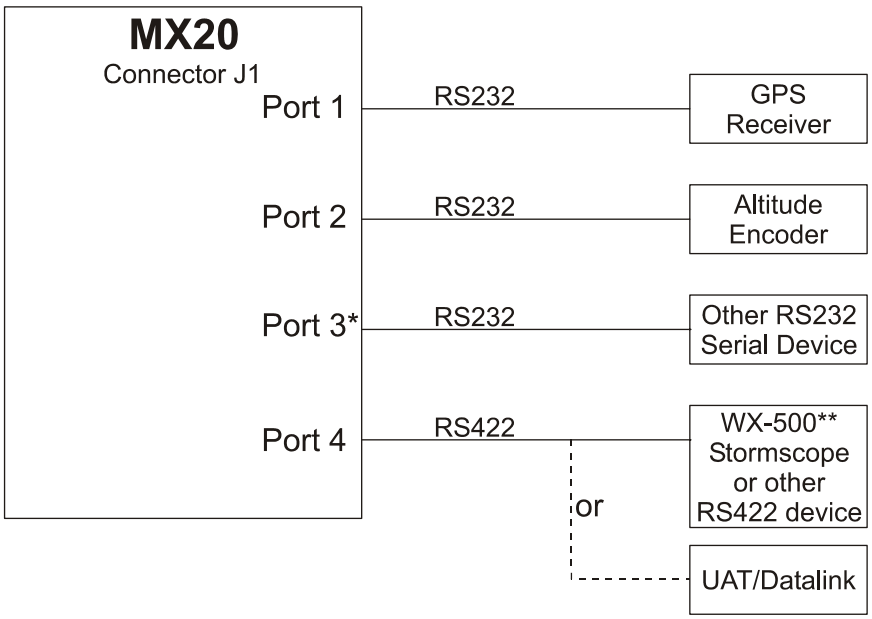
The following table shows the suggested port usage, however note that the software must be configured to match the installed MX20 wiring configuration. Note that only one traffic source may be connected to the MX20 I/O at one time.

Table 2 - Preferred Data Port Configurations

		MX20 With GPS	MX20 Without GPS
PORT 1	RS232	GX50/60* or equivalent	GX50/60* or equivalent
PORT 2	RS232	Altitude Encoder* or option	Altitude encoder* or option
PORT 3	RS232	Internal GPS**	SL30, or option
PORT 4	RS422	UAT Datalink Radio or option	WX-500 or option

* A GX-series unit running software version 3.2 or higher and enabled for extended mode and a CNX-series unit is capable of receiving altitude data from the altitude encoder and passing the data to the MX20. This configuration opens up an MX20 port for other options.

** If the MX20 is configured with an internal GPS engine, Port 3 is not available for external connections.



*If an internal GPS engine is present, Port 3 will be unavailable for external use.
**The WX-500 can be connected via RS232 or RS422, but is shown here in RS422. The Northstar M3 must be connected to Port 4, as it is an RS422 device.

Figure 12 – Preferred Data Port Description

2.5.2 MX20 I/O DATA PORT CONFIGURATION

The I/O product variation of the MX20 supports an array of additional I/O capabilities on connector J2 as shown below. Note that the hardware connected to the MX20 I/O ports must be connected as shown in Table 3, as reconfiguration by software is not available. See the sample wiring diagrams and connector pinouts in section 2.5.7 for detailed connections. One possible configuration is shown in Figure 13.

Table 3 – MX20 I/O Data Port Configurations

Port Type (Count)	Direction	Data	Allocation
ARINC 453 (1)	Input	Weather Radar Display	ART2000 Radar, ART2100, RS-181A
ARINC 429 (1)	Output	Weather Radar Control	ART2000 Radar, ART2100, RS-181A
Discrete (1)	Output	Weather Radar Power	ART2000 Radar, ART2100, RS-181A
ARINC 429 (1)	Input	Traffic Data	Goodrich SKY497,SKY899, GTX330
Discrete (2)	Output	Skywatch Mode Control	Goodrich SKY497, SKY899, GTX330
J1 RS232	Input	Ryan TCAD	Ryan 9900B/BX
ARINC 453 (1)	Input	Terrain Data	Landmark, KGP560 TAWS
ARINC 429 (1)	Output	Terrain Control	Landmark, KGP560 TAWS
ARINC 429 (1)	Input	Terrain Status	Landmark TAWS, KGP560

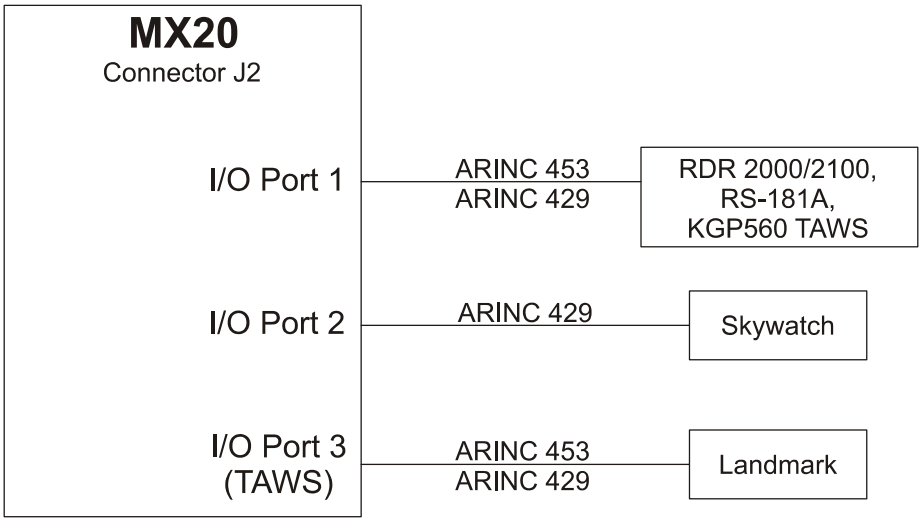


Figure 13 –Data I/O Port Description

2.5.3 DATA CARD

The data card is a Compact Flash™ card that contains the NAV database, operating software, and other information. The data card is required for MX20 operation.

CAUTION
Do not remove the data card with power on.

2.5.4 PLACARD

The aircraft will have a placard identifying the MFD circuit breaker. The placard will be placed directly adjacent to the respective breaker.

2.5.5 POWER

The power and fuse requirements for each external sensor are described in their respective installation manuals. The MX20 will operate on voltages between 10 and 40 VDC. Install a five amp circuit breaker for a 14 VDC aircraft and a three amp circuit breaker for a 28 VDC aircraft. Use separate wires for the heater and CPU power inputs; one wire to each pin. Power and ground wires should be 20 AWG.

2.5.6 ELECTRICAL LOAD ANALYSIS

An electrical load analysis should be completed on each aircraft prior to installation in accordance with AC 43.13-1B, Chapter 11. Use the following values for computation:

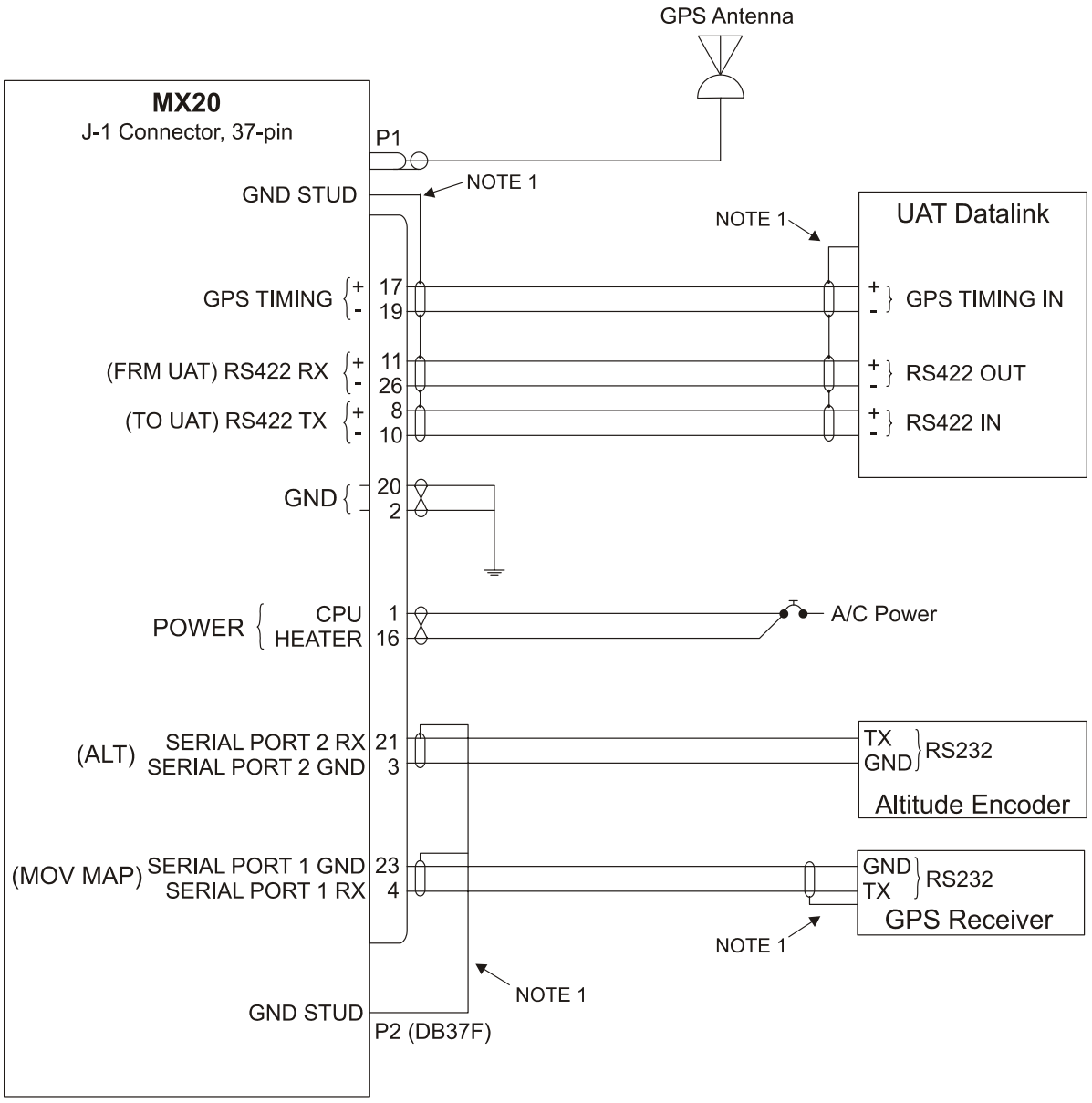
Table 4 – Unit Power Loads

Unit	14 VDC		28 VDC	
	Typical	Max	Typical	Max
MX20	2.0 A	3.0 A	1 A	1.5 A
MX20 with heater (1)	3.0 A	4.0 A	1.5 A	2.0 A
MX20 I/O	2.5 A	3.5 A	1.25 A	1.75 A
MX20 I/O with heater (1)	3.5 A	4.5 A	1.75 A	2.25 A

Notes:
1. Heater element turns on below approximately 30°C.

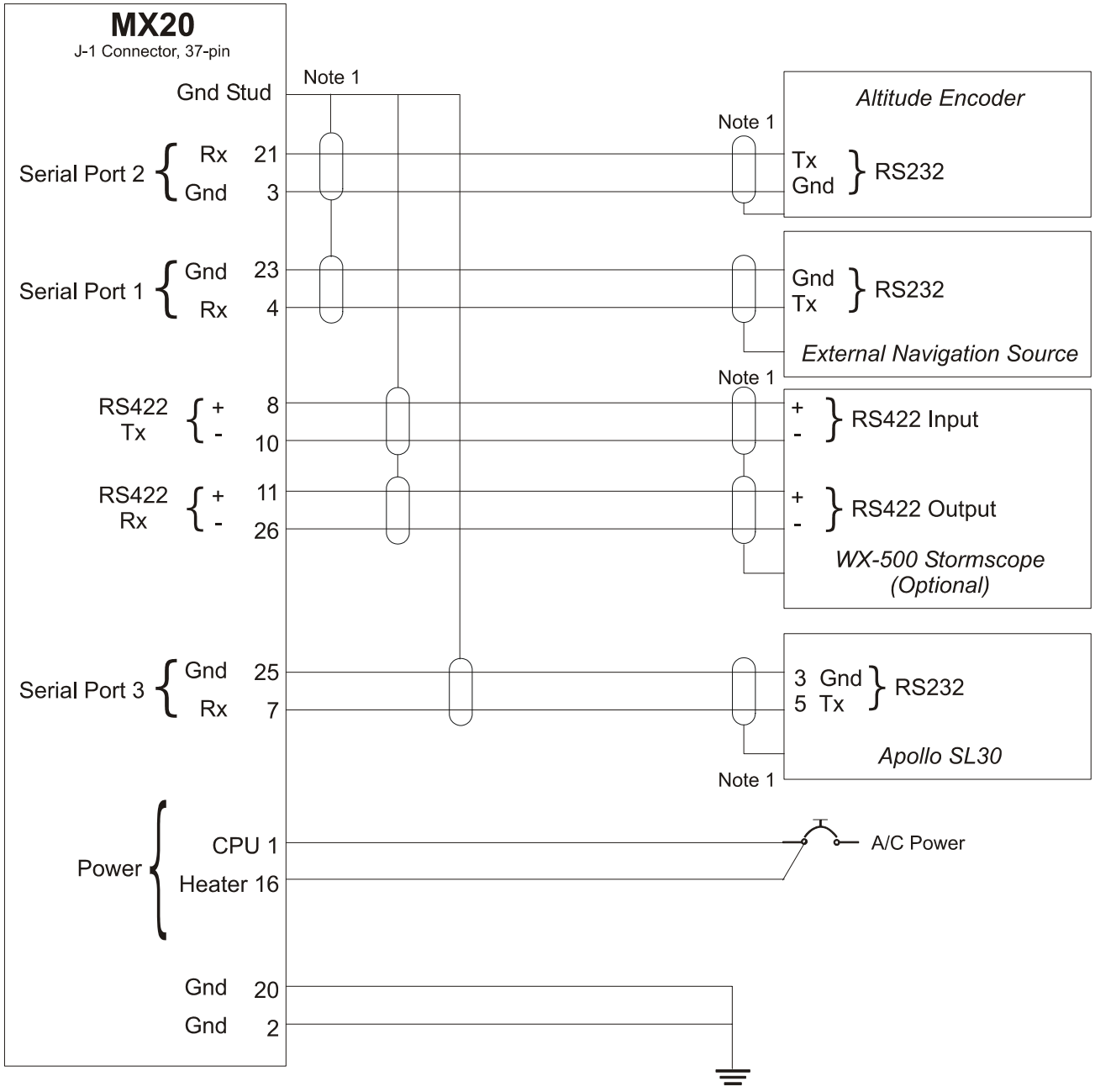
Note: *Circuits should be protected in accordance with guidelines in AC 43.13-1B, chapter 11, section 2, paragraph 429. Power inputs should be across a minimum of all four specified input pins.*

2.5.7 SAMPLE WIRING DIAGRAMS



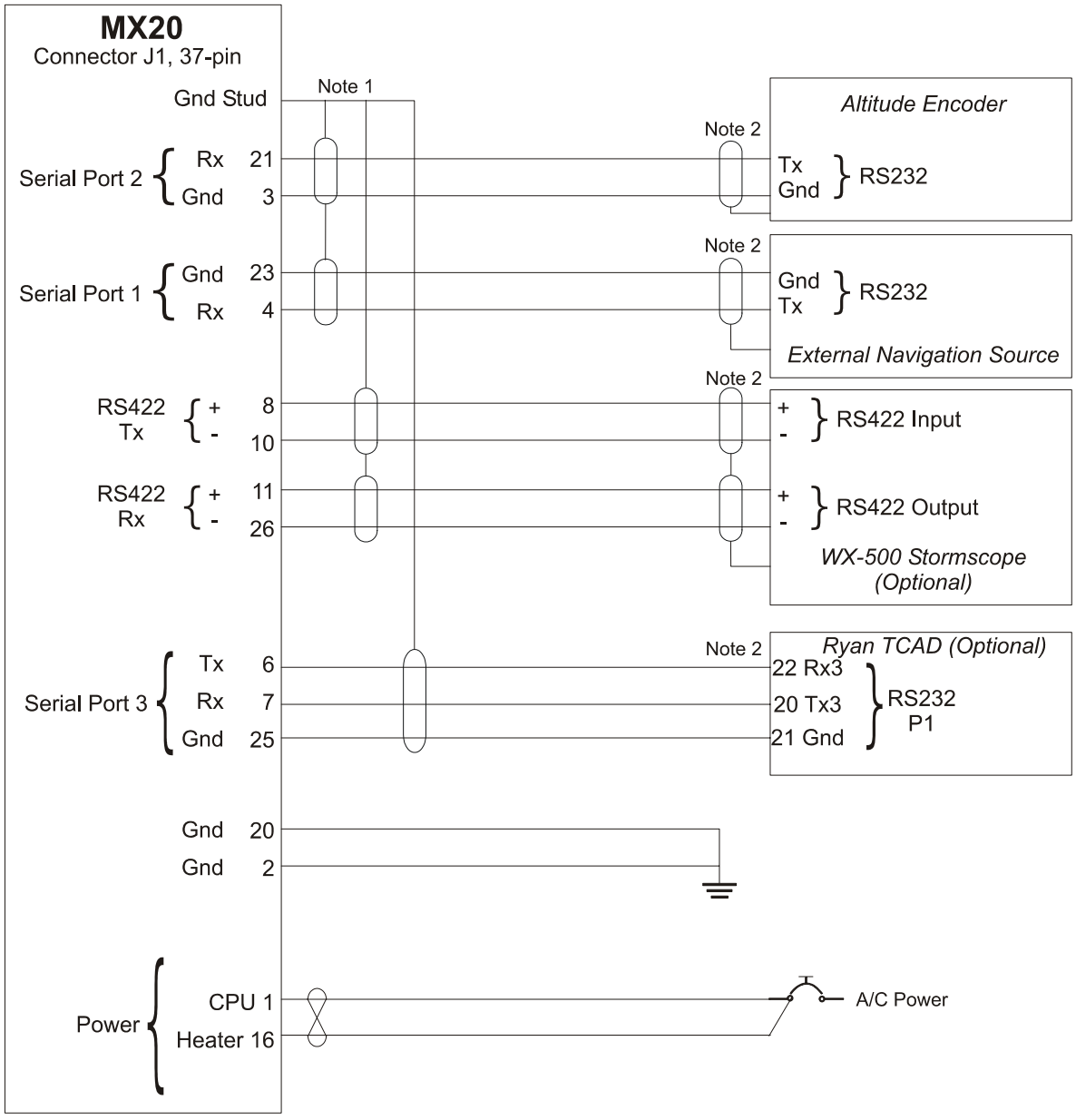
Note 1. Terminate shield to within 2” of connector. Grounding shields must be grounded to the mounting tube/tray. Pigtail 3” maximum length. Minimize pigtail length as much as possible.

Figure 14 - Sample System Wiring Diagram (Internal GPS Version) with UAT



Note 1. Terminate shield to within 2" of connector. Grounding shields must be grounded to the mounting tube/tray. Pigtail 3" maximum length. Minimize pigtail length as much as possible.

Figure 15 - Sample System Wiring Diagram (No Internal GPS Version) with WX500



Note 1. Terminate shield to within 2" of connector. Grounding shields must be grounded to the mounting tube/tray. Pigtail 3" maximum length. Minimize pigtail length as much as possible.

Note 2. Terminate shield as detailed by the manufacturer's installation instructions. Note that only one traffic source may be connected to the MX20 I/O at one time.

Figure 16 - Sample System Wiring Diagram for TCAD and Stormscope

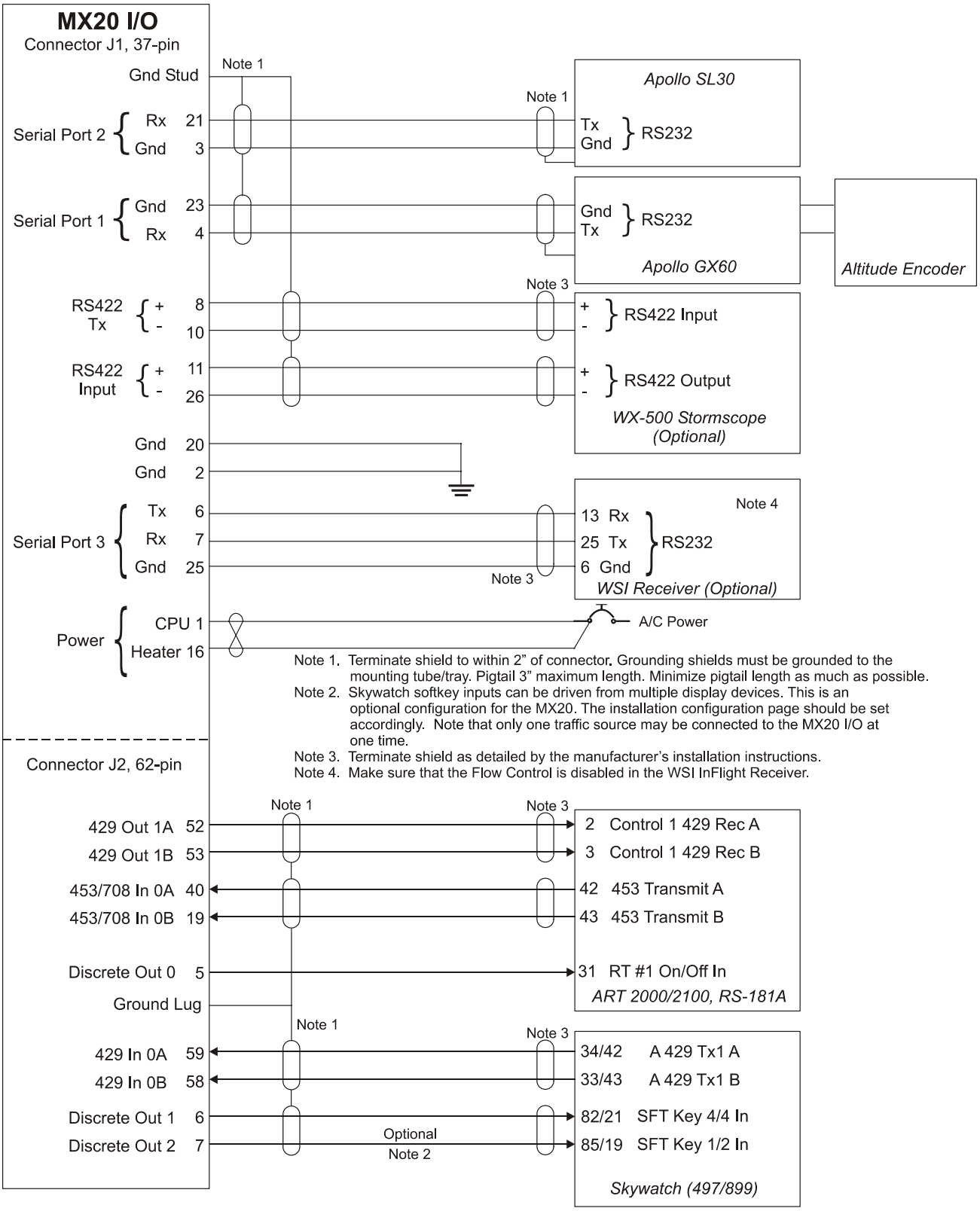
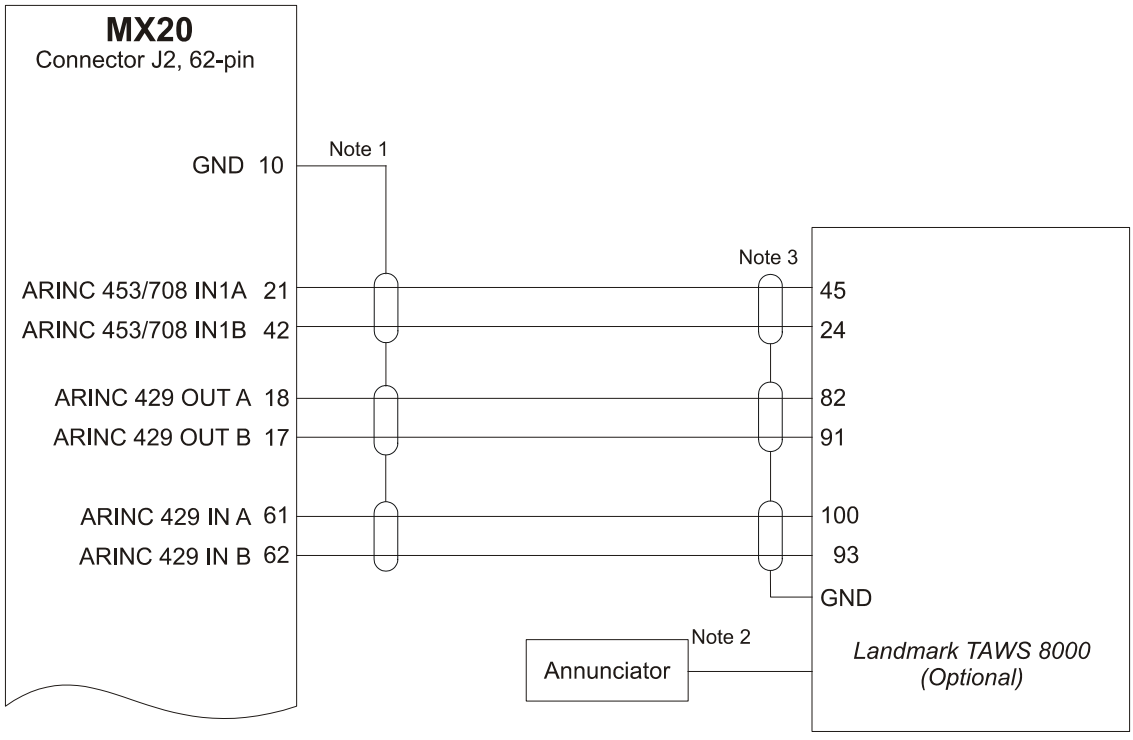
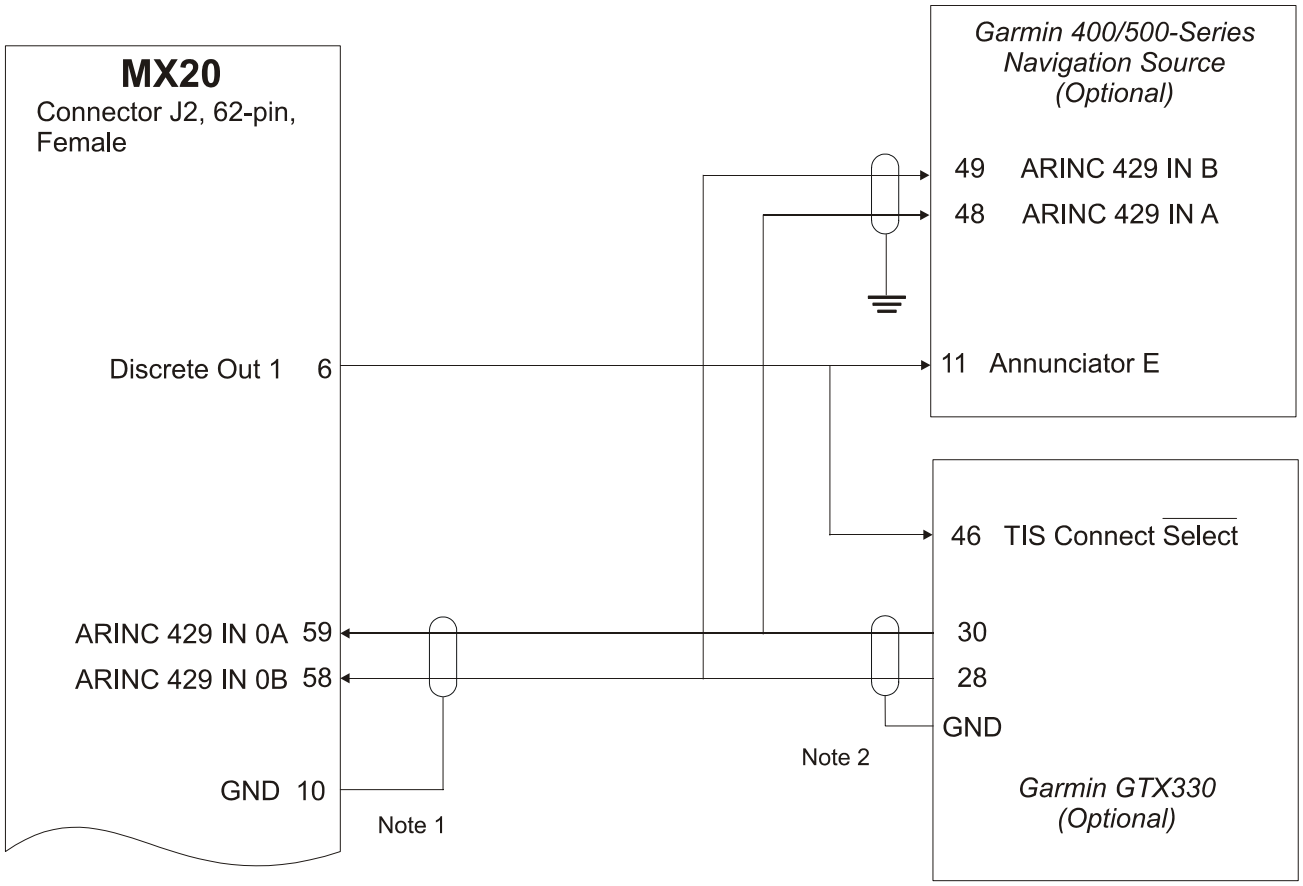


Figure 17 - Sample System Wiring Diagram I/O model with Radar, Goodrich Skywatch, and WSI InFlight Receiver



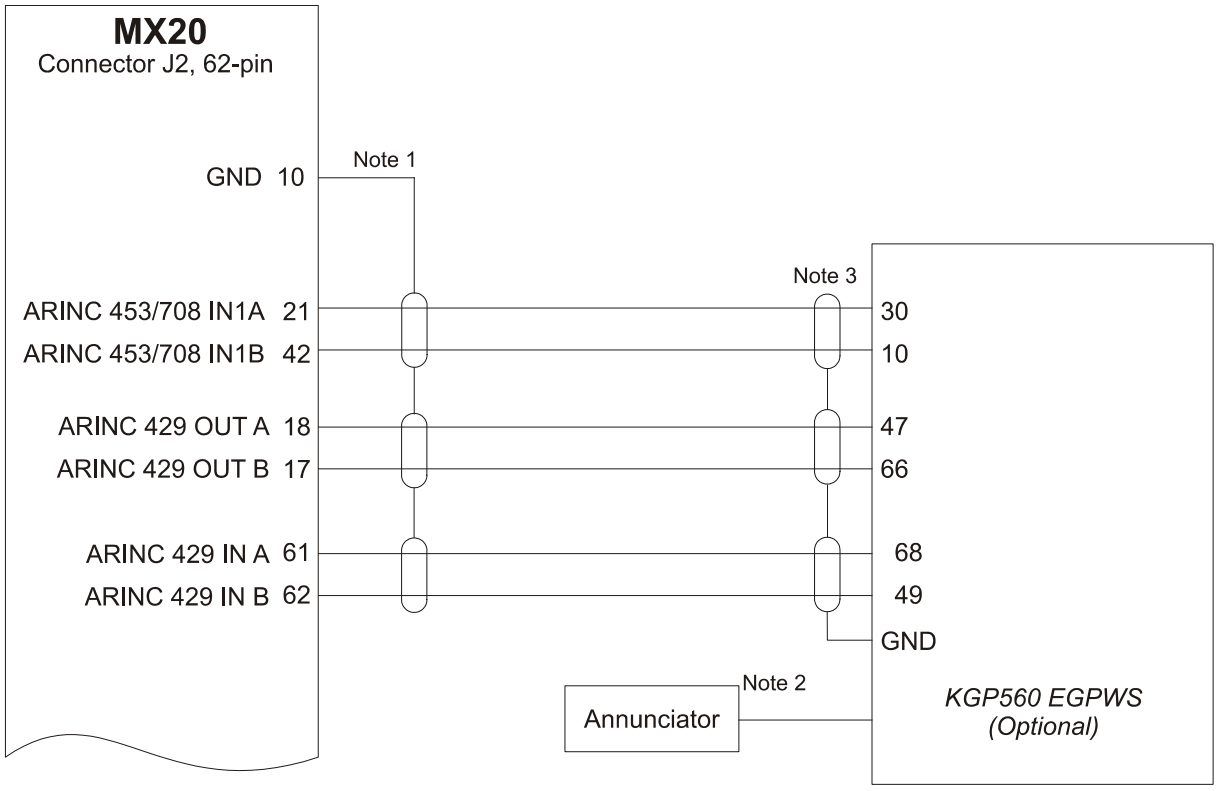
Note 1. Terminate shield to within 2" of connector. Grounding shields must be grounded to the mounting tube/tray. Pigtail 3" maximum length. Minimize pigtail as much as possible.
Note 2. An external annunciator must be installed for terrain caution and warning lamps.
Note 3. Terminate shield as detailed by the manufacturer's installation instructions.

Figure 18 - Sample System Wiring Diagram of MX20 I/O with Landmark TAWS



Note 1. Terminate shield to within 2" of connector. Grounding shields must be grounded to the mounting tube/tray. Pigtail 3" maximum length. Minimize pigtail length as much as possible.
Note 2. Terminate shield as detailed by the manufacturer's installation instructions.

Figure 19 - Sample System Wiring Diagram of MX20 I/O with Garmin GTX330



Note 1. Terminate shield to within 2" of connector. Grounding shields must be grounded to the mounting tube/tray. Pigtail 3" maximum length. Minimize pigtail length as much as possible.
Note 2. An external annunciator must be installed for terrain caution and warning lamps.
Note 3. Terminate shield as detailed by the manufacturer's installation instructions.

Figure 20 - Sample System Wiring Diagram of MX20 I/O with KGP-560

2.6 WEIGHT AND BALANCE

Weight and balance computation is required after the installation of the MX20. Follow the guidelines as established in AC 43.13-1B, Chapter 10, section 2. Make appropriate entries in the equipment list indicating items added, removed, or relocated along with the date accomplished. Include your name and certificate number in the aircraft records. The following table identifies the weight of the new MX20 equipment.

Table 5 - Unit Weights

Unit	Weight	
MX20 only, with GPS	4.08 lb.	(1.85 kg)
MX20 only, without GPS	3.92 lb.	(1.78 kg)
MX20 only, with I/O Option	4.07 lb.	(1.85 kg)
MX20 mounting tray only	0.73 lb.	(0.33 kg)

2.7 CONFIGURING THE MX20 & MX20 I/O

1. Turn on power to the MX20.
2. Immediately after the self-test is complete, press line select keys 1, 4, and 6 in sequence before pressing any other keys (where 1 is the top line select key, 4 is the fourth key down, and 6 is the lower most line select key). If other keys are pressed before or during this sequence, the MX20 will be in the normal operational mode. To enter the install mode, turn off the MX20 and start again at step 1.

3. Press the function key until the INSTL function is present. If INSTL function is not found, restart the unit. Carefully press line select keys 1, 4, and 6 in sequence. Do not press any other buttons before pressing the 1, 4, 6 line select key sequence.
4. Select the INSTL function by pressing the smart key directly below the INSTL label. The Enable/Disable Functions will be the first screen to appear.

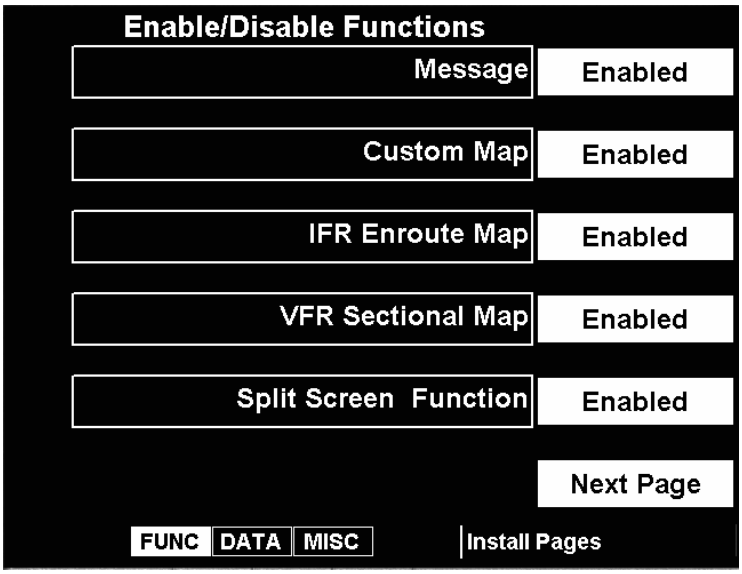
NOTE

MX20 power must be cycled before configuration changes will take affect.

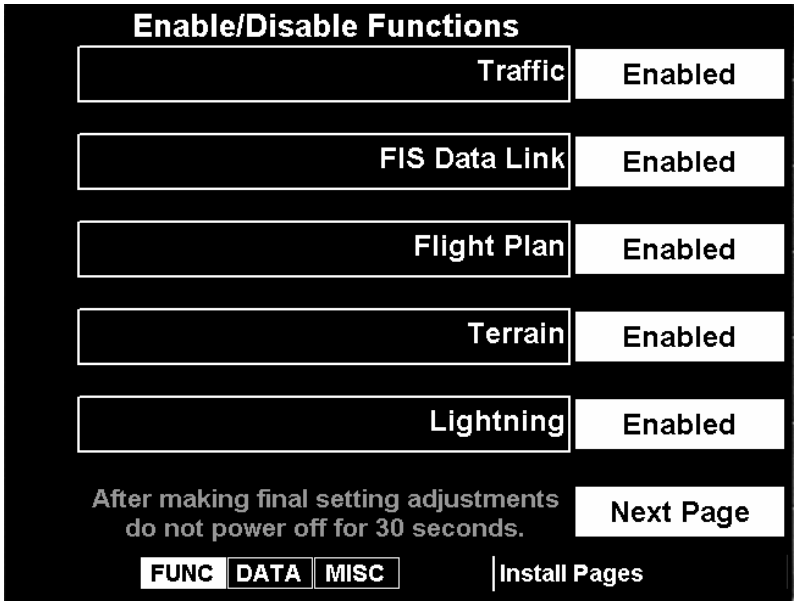
After a configuration change, a message will appear on the screen telling you to wait 30 seconds before turning off power. You may continue to make configuration changes without pausing; however, do not turn off power to the MX20 until waiting 30 seconds after the last configuration/ setting change. The message will disappear when it is safe to cycle power.

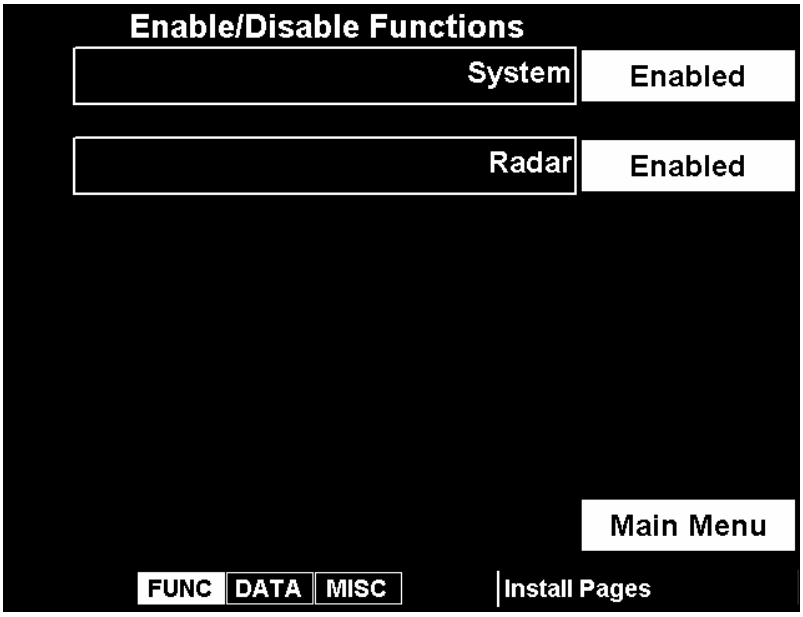
2.7.1 ENABLE/DISABLE FUNCTIONS

This menu allows the activation or deactivation of MX20 functions.



1. Ensure the Enable/Disable Functions page of the MX20 has the desired configuration. Modifications can be made using the line select keys.
   a. Enable Message to allow viewing of system messages.
   b. Enable Custom Map to allow viewing of the Custom Map function.
   c. Enable IFR En Route Map to allow viewing of the IFR Map function.
   d. Enable VFR Sectional Map to allow viewing of the VFR Map function.
   e. Enable the Split Screen function to allow viewing of two functions side by side.
2. Press the Next Page line select key to view additional functions.
   a. Enable Traffic only if UAT, Skywatch, or GTX330 are installed.
   b. Enable FIS Data Link only if a UAT or WSI InFlight system is installed.
   c. Enable Flight Plan to allow viewing of flight plan route lines on the display.
   d. Enable Terrain only if an altitude encoder is installed, either directly or through a navigation source, or if a TAWS sensor is installed.
   e. Enable Lightning only if WX-500 is installed.
3. Press the Next Page line select key to view additional functions.
   a. Enable the System function to allow viewing of the System function.
   b. Enable Radar only if a unit is an I/O model and interfaced to a radar unit.





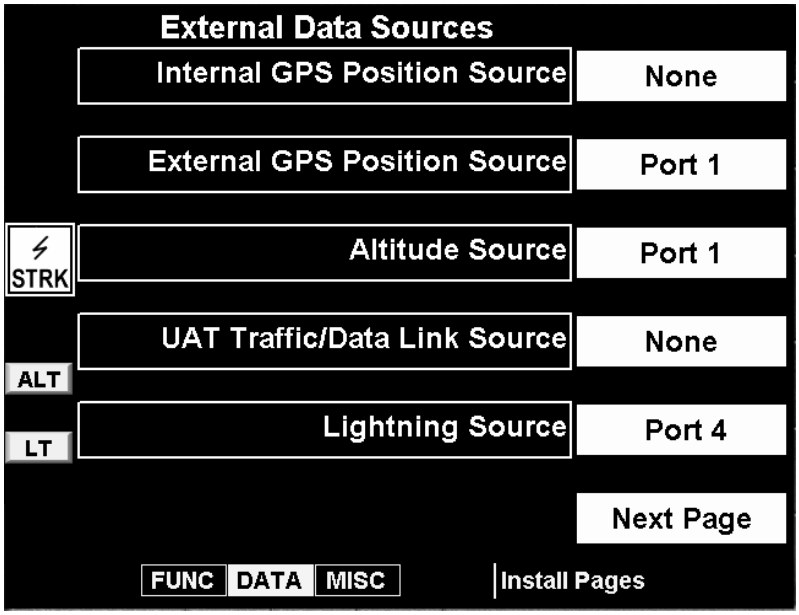
4. A typical installation will have all functions enabled except those noted above based on what hardware is installed in the aircraft.

2.7.2 EXTERNAL DATA SOURCE

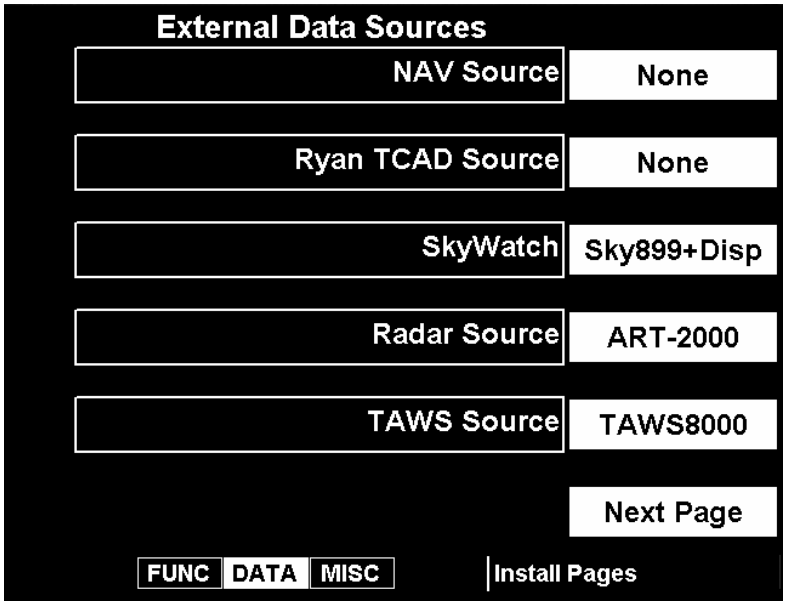
This menu allows the software to assign ports to the installed sensors.

1. Press the DATA smart key while still in the INSTL function.
2. Ensure the External Data Sources pages of the MX20 have the desired configuration. Modifications can be made using the line select keys. Port allocations must match how the system is wired. Set port source to None if the hardware is not installed. The Internal GPS Position Source, when present, must always be configured to Port 3. If the altitude data is supplied from the GX model unit, the Altitude

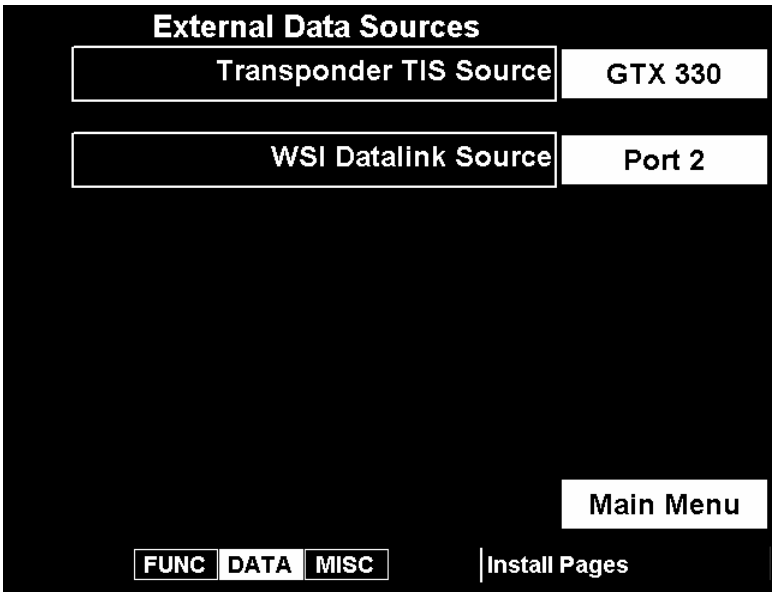
Source port must be set to the same port number that the GX model unit is connected to (such as Port 1 in the example shown below).



Main Menu



Next Page



2.7.3 EXTERNAL DATA SOURCE FOR THE MX20 I/O

The MX20 I/O allocates fixed data source ports for interface to the radar, TAWS, and traffic sensors. Software configuration is not required for Skywatch, GTX330, or TCAD traffic sensors. The I/O version of the MX20 adds traffic and radar functionality. These data sources are configured in a similar manner as the basic MX20 external sensors. Note that only one traffic source may be connected to the MX20 I/O at one time.

2.7.3.1 RYAN TCAD SOURCE

Select the RS-232 port 1-4 where the TCAD unit is connected.

2.7.3.2 SKYWATCH

Select the configuration which matches the physical installation. The two model options are SKY497 and SKY899. Additionally, if the MX20 is not wired to drive the discrete inputs (when an additional display such as the WX1000 is being used), select the + DISP option. If the MX20 is wired to drive the Skywatch discrete inputs, select just the basic SKY model without the + DISP option. Using the +DISP option indicates that an external display is responsible for driving the discrete inputs and the corresponding MX20 controls will be disabled on the MX20 Traffic page.

2.7.3.3 RADAR

Select the model of the Radar connected. Currently the ART-2000 and the RS-181A are supported. The ART-2100 is supported if it is configured as an ART-2000.

2.7.3.4 TAWS

Select the model of the TAWS sensor connected in the system. Currently only the L-3 (Goodrich) Landmark TAWS 8000 and KGP560 are supported. Select TAWS8000 for the Landmark 8000 and EGPWS for the KGP560.

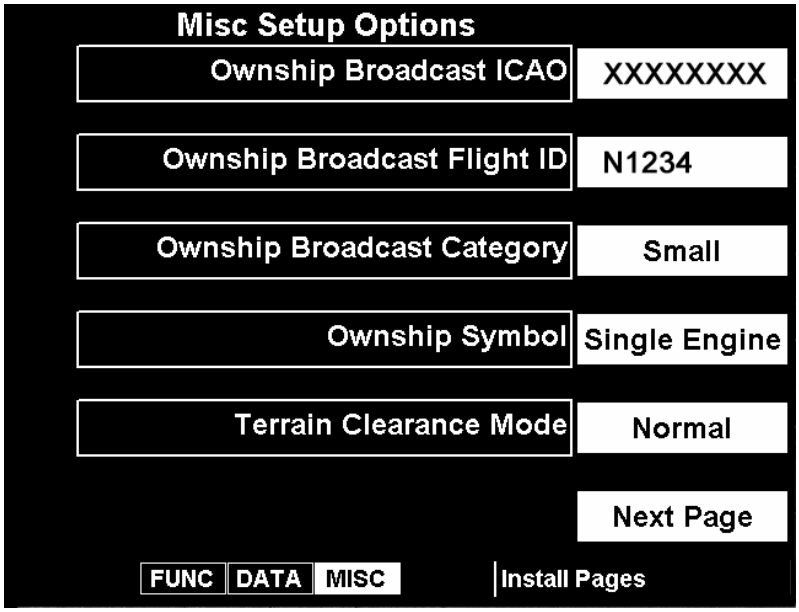
2.7.3.5 TRANSPONDER TIS

Select the model of the TIS data source selected. Currently, only the Garmin GTX330 is supported.

2.7.4 MISCELLANEOUS SETUP OPTIONS

1. Press the MISC smart key while still in the INSTL function.

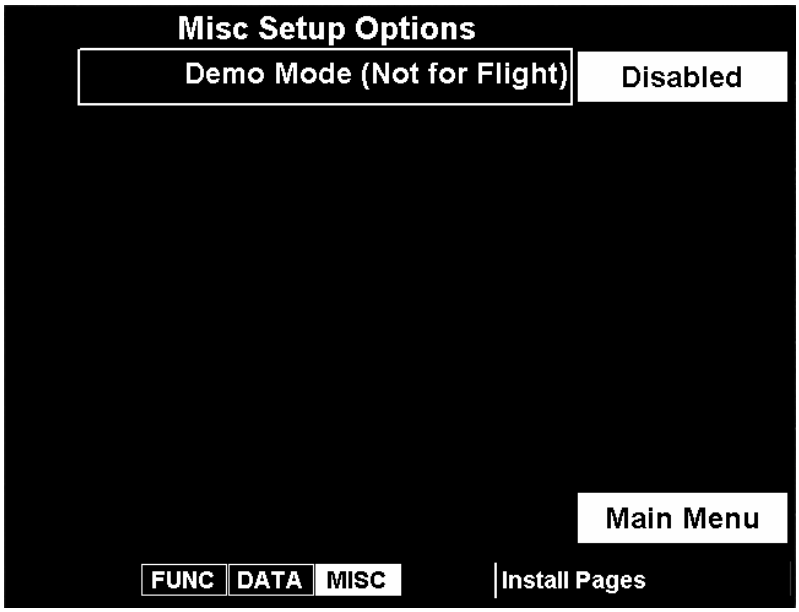
2. Ensure the Misc Setup Options pages of the MX20 are configured with respect to the aircraft it is being installed in. Modifications can be made using the line select keys.



See Step 3

See Step 4

See Step 5



3. Obtain ICAO address of the aircraft from the FAA only if the UAT/ADS-B system is installed. The ICAO address is a unique eight number code assigned to each aircraft. For U.S. registered aircraft, it will be necessary to have a specific address code assigned. These address codes are presently issued by:

   Federal Aviation Administration
   FAA Aircraft Registry
   P.O. Box 25504
   Oklahoma City, OK 73125
   Tel: (405) 954-3116
   Fax: (405) 954-3548

   If the aircraft is registered in a country other than the United States, please contact the local aviation authority of the country in which the aircraft is registered.

4. Enter in Flight ID. (Required if UAT/ADS-B system is installed.)
5. Enter Category Code. (Required if UAT/ADS-B system is installed.)

Category Code	**Aircraft Weight**
Small	< 15,500 lbs.
Medium	15,500 to 75,000 lbs.
Large	75,000 to 190,000 lbs.
Extra Large	190,000 to 300,000 lbs.
Heavy	> 300,000 lbs.
High Performance	> 5g acceleration and > 400 kts

6. Enter in Ownship Symbol (Single Engine, Twin, or Jet).
7. Set the Terrain Clearance Mode to Normal for **all** operations.
8. Demo Mode must be disabled for **all** aircraft installations.
9. Press Enter/Menu to confirm all settings.
10. After the 30-second waiting period, turn the MX20 power off **to apply all configuration settings**.

NOTE

MX20 power must be cycled before configuration changes will take affect.

After a configuration change, a message will appear on the screen telling you to wait 30 seconds before turning off power. You may continue to make configuration changes without pausing; however, do not turn off power to the MX20 until waiting 30 seconds after the last configuration/ setting change. The message will disappear when it is safe to cycle power.

2.8 MX20 POST INSTALLATION CHECKOUT

Once the unit is installed, complete the checkout procedure to verify proper operation. Refer to the MX20 Multi-Function Display User's Guide, 560-1026-xx, for operating instructions.

2.8.1 MOUNTING / WIRING CHECK

Verify that all cables are properly secured and shields are connected to the rear of the mounting frame. Check the movement of the flight and engine controls to verify that there is no interference. Ensure wiring is installed in accordance with AC 43.13-1B, Chapter 11.

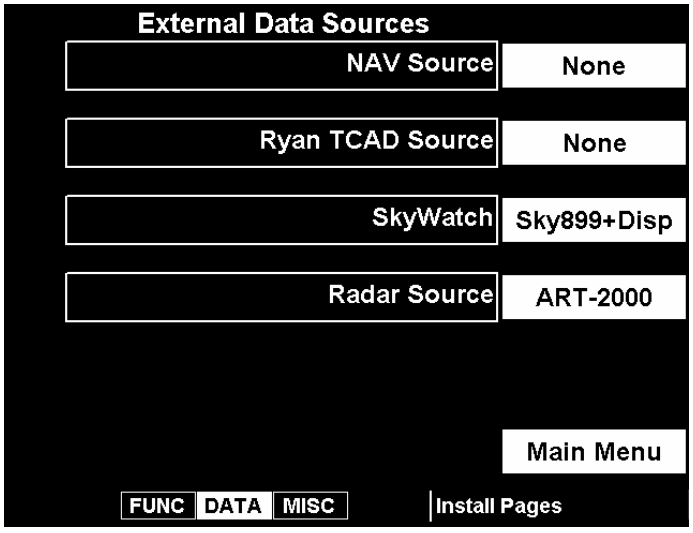
2.8.2 SOFTWARE AND DATABASE TEST

1. Turn on power to the MX20.
2. Verify all self-tests pass on the main startup screen.
3. Verify the expiration on the NavData database.
4. Verify the Terrain and Geography databases are applicable to the area of intended flight (CONUS, Alaska, etc.).
5. Press the MSG smart key and verify that "Unit configured for Special Terrain Mode" is **NOT** displayed.

2.8.3 EXTERNAL DATA SOURCE TESTS

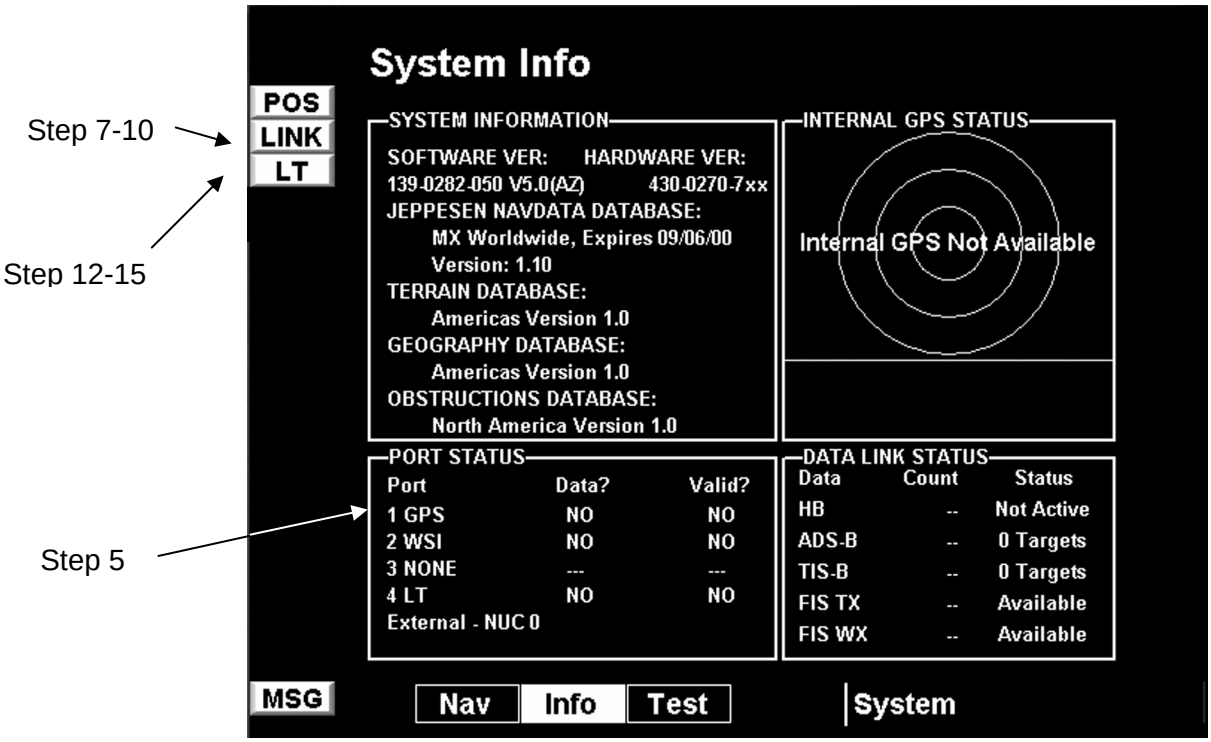
Verify that all external data sources are connected. See section 3.1.13 to check the compatibility of the external devices for use with the MX20.

1. Turn on power to the MX20 and the external data sources. Activate the Installation Mode (see section 2.7).
2. Verify that the MX20 data ports are configured properly. See sections 2.5.1 and 2.5.2 for details on the data port configuration. See section 2.7 for information on configuring the MX20 in Installation Mode.



3. Recycle power to the MX20 to reinitialize it with any changes made in the Install function settings.

4. Verify that the external data sources are properly configured to output the proper data to the MX20, i.e., the Apollo GX should be configured to output Moving Map data. If the altitude data is supplied from a GX model unit, it must have extended mode enabled.



5. Check the System Info page on the MX20 to verify that the data is available to each port and that it is being processed properly.
6. Verify ALT data flag is not displayed in the lower left portion of the MX20 display.
7. With external navigation source off, the POS and RTE data flags should be present.

NOTE

- The external navigation source may need to be properly configured prior to this step.
- Direct To sequence may need to be entered for external navigation source to output POS and RTE.
- If an internal GPS exists, it can also provide a valid position to the MX20.

8. Turn the external navigation source power on. Verify that the navigation source acquires a position.
9. Create/activate a flight plan on the external navigation source.
10. Verify the RTE and POS data flags are not displayed.
11. Flight plan will be displayed on the MX20 on the FPL page.
12. Turn the traffic source power on. Verify the SKWY, TCAD, XPDR, or TRAF data flags are not displayed.
13. With the Lightning sensor turned off, verify that the LT data flag is displayed.
14. Turn the Lightning sensor power on. Verify that the LT data flag is not displayed.
15. With the WSI InFlight sensor, if installed, turned off, verify that the Link data flag is displayed.

16. Turn the WSI InFlight sensor on. Verify that the Link data flag is not displayed.

2.8.4 EMI/RFI TEST

This test validates that interference does not exist between the MX20 and other systems on the aircraft. Turn off the power to all avionics devices.

2.8.4.1 TEST WITHOUT MX20

1. Start the aircraft engine(s) and switch to engine power, as appropriate.
2. Turn on power to the external GPS navigation source. Clear visibility to satellites is required.
3. Load a flight plan on the external GPS navigation source.
4. Test the function and/or observe for operation of each of the following if installed, or other appropriate systems.

    ____ Transponder (if equipped)
    ____ NAV/VOR/ILS unit and tune to a local frequency (VOR/DME)
    ____ Any other navigation source
    ____ Radio Altimeter
    ____ DME
    ____ ADF
    ____ VHF Comm Transceiver
    ____ Encoding Altimeter
    ____ Flight Director
    ____ Marker Beacon Receiver
    ____ Weather Radar
    ____ Ground Proximity Warning System
    ____ Autopilot
    ____ Directional Gyro/HSI
    ____ RMI
    ____ WSI InFlight Weather Sensor. Visibility to the southern sky is required. The aircraft must be far enough from buildings to avoid multipath effects. Note if the InFlight sensor causes interference to other equipment. The MX20 must be turned on to see any effects on the WSI InFlight sensor by other equipment.
    ____ Garmin GTX330 TIS-A Traffic Sensor. TIS-A is available only in areas with a Terminal Approach Radar.
    ____ TAWS Sensor
5. Turn the power off to each of the avionics systems.

2.8.4.2 TEST WITH MX20

While performing the following tests, observe the MX20, external GPS navigation source (signal reception), and the system under test for interference or abnormal operation.

1. Turn on power to the MX20.
2. Turn on the power to each avionics system. Observe for proper operation of the MX20 and the other avionics systems.

    ____ Transponder (if equipped)
    ____ NAV/VOR/ILS unit and tune to a local frequency (VOR/DME)
    ____ Any other navigation source
    ____ Radio Altimeter

____ DME
____ ADF
____ VHF Comm Transceiver
____ Encoding Altimeter
____ Flight Director
____ Marker Beacon Receiver
____ Weather Radar
____ Ground Proximity Warning System or Enhanced Ground Proximity Warning System (EGPWS)
____ Autopilot
____ Directional Gyro/HSI
____ RMI
____ TIS-A Sensor
____ WSI InFlight Weather Sensor
____ TAWS Sensor

2.8.5 ALTITUDE TEST

1. Perform the installation and calibration tests in accordance with the altitude source manufacturer's installation manual.
2. Perform a flight check against the aircraft altimeter. Verify readings at ground level and at three additional altitude points.
3. The altitude will be displayed on the bottom right-hand corner of the MFD terrain page.

2.8.6 COMPASS TEST

If the MX20 is located within seven inches of any compass, the compass will require a compass calibration.

2.8.7 STORMSCOPE INTERFACE TEST

If a Goodrich WX-500 Stormscope® sensor has been connected to the MX20, the interface should be verified in the LT function on the MX20. Four standard Stormscope test screens are available to support system checkout. Refer to the WX-500 Stormscope Installation Manual, P/N 009-11500-001. These test screens are System Data, Self-Test, Noise Monitor, and Strike Test.

2.8.8 SKYWATCH INTERFACE TEST

If a Goodrich SKY497 or SKY899 Skywatch® sensor has been connected to the MX20 I/O, the interface should be verified under the TRAF function on the MX20.

1. Turn power on to the MX20 I/O and Skywatch Unit. After the MX20 I/O self-tests have completed, enter the Traffic Function by pressing the FN key until the TRAF menu option is available and press the corresponding traffic smart key.
2. (If the TRAF function is not available, verify that the MX20 is an I/O model and that the traffic function has been enabled as described in previous sections.)
3. From the traffic function, verify in the lower right corner of the screen that status of the Skywatch unit. The unit should be either in the TAS Standby mode or no status should be presented. If a Data Timeout error is presented, re-check the wiring.
4. From any function, verify that no amber SKYW annunciator is present in the upper left corner of the display. If this is present, re-check the wiring.

5. From the traffic function, or from the SKY1000 display if connected, command a Skywatch Self Test. The status presented in the lower left of the display should change to a white 'TAS Test' and clear after several moments.
6. From the Message function, verify that no error messages have been posted from the Skywatch system.

2.8.9 RYAN TCAD INTERFACE TEST

If a Ryan TCAD 9900B or 9900BX sensor has been connected to the MX20 I/O, the interface should be verified under the TRAF function on the MX20.

1. Turn power on to the MX20 I/O and TCAD unit. After the MX20 I/O self-tests have completed, enter the Traffic Function by pressing the FN key until the TRAF menu option is available and press the corresponding traffic smart key.
2. If the TRAF function is not available, verify that the MX20 is an I/O model and that the traffic function has been enabled as described in previous sections.
3. Ensure that power is applied to the TCAD unit.
4. From the traffic function, verify that no amber TCAD Annunciator is present.
5. Perform additional checkout procedures in accordance to the TCAD installation manual.

2.8.10 RADAR CONFIGURATION & CHECKOUT PROCEDURES

The following steps are performed to verify the interface between the RADAR sensor and the MX20 I/O. The radome should NOT be installed during these tests as visual verification of antenna movement is required.

Note that the Antenna Receiver/Transmitter should be installed and calibrated in accordance to the manufacturer's specifications. This manual does not cover the installation or calibration of the actual ART unit.

WARNING

Configuration procedures include steps that require the radar antenna to be powered on. Please observe all safety precautions during these steps including: Do not perform in the vicinity of refueling operations; Do not perform while personnel are in the vicinity (approximately 20 feet) of the radar sweep area.

NOTE

See FAA AC20-68B "Recommended Radiation Safety Precautions For Airborne Weather Radar" for safety precautions to be taken by personnel when operating airborne weather radar on the ground.

2.8.10.1 ART 2000 CONFIGURATION AND CALIBRATION

2.8.10.1.1 Configuring the MX20

First configure the MX20 for the ART2000 option. Do this in the normal way by entering the install key sequence (1, 4, 6) on the menu keys after boot-up is complete. Enable "RADAR" under the "FUNC" menu-set, then select the "DATA" menu-set and select the "ART2000" choice. After selection, wait 30 seconds then turn the power off and on again. Note that the MX20 is compatible with the ART2100 when the ART2100 is programmed to emulate the ART2000.

2.8.10.1.2 Calibration Procedures

Refer to the Bendix/King RDR 2000 Color Weather Radar System Installation Manual, Revision 4 or later. Follow the instructions in "Stabilization calibration with Radar Indicator" or its equivalent.

Skip the description in the RDR 2000 manual on how to enter calibration mode. The MX20 allows a single button push to enter calibration mode. The MX20 MUST be in Install mode to calibrate the radar head. Follow the instructions below.

1. Turn the MX20 on.
2. After boot-up is complete, key-in the install sequence 1, 4, 6, on the menu keys.
3. Press the FN key until one of the options is RADAR. If the RADAR option is not available, see the section on "Configuring Radar".
4. Press the "smart key" corresponding to the RADAR option. You will now switch to the Radar page.
5. Press the STBY key to put the radar unit into standby mode. This may take up to twenty seconds.
6. Once the MX2O is in standby mode, one of the menu options will be "Test". Press the TEST key.
7. Once the MX20 is in Test mode, press the ENTER key to switch to the "Setup" page.
8. On the "Setup" page, press the key labeled CALB to enter calibration mode. This will take a couple of seconds.
9. The MX20 will flash all faults briefly to indicate calibration mode has been entered. If this fails, turn power off and try again.

At this point, follow directions in the RDR 2000 Installation Manual starting with "400 Hz Ref Gain" section. Selection of calibration parameters is done by adjusting the gain setting according to the values in the RDR 2000 Installation Manual. On the MX20, the "smart keys" labeled "Gain" are used to adjust the gain setting and select the parameter to be calibrated. Follow the RDR 2000 Installation Manual instructions for calibrating the selected parameters.

2.8.10.2 RS-181A CONFIGURATION AND CALIBRATION

2.8.10.2.1 RS-181A Calibration

First configure the MX20 for the RS181 option. Do this in the normal way by entering the install key sequence (1, 4, 6) on the menu keys after boot-up is complete. Enable “RADAR” under the “FUNC” menu-set, then select the “DATA” menu-set and select the “RS181” choice. After selection, wait 30 seconds then turn the power off and on again.

2.8.10.2.2 RS-181A calibration and Roll/Trim

1. Turn the MX20 on and wait until the startup page is completely drawn. When the green labels on the smart keys (buttons at bottom) appear, it’s complete.

2. Press menu keys 1, 4, 6 to enable install mode. (buttons on right-hand side numbering from top to bottom)

3. Next press the “FN” key until the “RADAR” label appears, then press that key. This will cause a switch to the “RADAR” page.

4. Press the “STBY/ON” button (top right) on the RADAR page.

5. Wait until the unit has powered-up. 15 to 30 seconds.

6. Three choices should appear on the menu keys: ON, TEST, OFF. Select TEST.

7. A test pattern should appear within a few seconds.

8. Now press the “MENU/ENTER” key (bottom right) to get to the R/T Calibration SETUP page.

9. To enter calibration mode, press the “CALB” menu key. The “CALB” label should turn green and the text near the bottom of the display should read “Calibration Enabled.”

10. From here you may follow the manufacturer’s calibration instructions and procedure or set the roll/trim parameter. Remember that the antenna is radiating during the setting of roll/trim.

11. To return to test mode and the test-pattern display, press the “MENU/ENTER” key. Once you return to test mode, calibration mode is disabled.

12. So each time you return to test mode and the test pattern, and then return to the R/T Calibration SETUP page (by pressing the “MENU/ENTER” key, you will need to press the “CALB” key again to enter calibration mode.

2.8.10.2.3 Setting Roll/Trim

When setting roll trim, after returning to r/t calibration (setup) page, it is important to wait 30 seconds then power-off. Do not attempt to re-enter calibration mode or use the unit without cycling the power.

2.8.10.3 GROUND BASED CHECKOUT PROCEDURES

2.8.10.3.1 Radar Test Mode Checkout

Turn power on to the MX20 I/O and radar antenna assembly. After the MX20 I/O self-tests are completed, enter the Radar Function by pressing the FN key until the RADAR menu option is available. Then, press the corresponding RADAR "smart key."

(If the Radar Function is not available, verify that the MX20 is an I/O model and that the radar function has been enabled as described in previous sections).

The RADAR should remain in the off state with no scanning occurring when the Radar Function is entered for the first time.

2.8.10.3.2 Test Pattern

Press the ON/STBY line item and allow approximately twenty seconds for the radar to power up. Verify at this point that the RADAR powers up and performs the antenna clearance test. Once the unit is powered-up, the radar will be in standby mode.

Press the TEST line item to place the unit in Test mode.

Verify that the test pattern is displayed. Press the range UP/DOWN keys if necessary until the test pattern can be seen.

2.8.10.3.3 Tilt Test

Press the TILT line item and verify that the tilt can be adjusted from +15 degrees up, to –15 degrees down: Pressing and holding the key will auto increment the value. Verify that both the RADAR antenna mechanically follows the commands and that the display tilt indicator value on the MX20 I/O screen corresponds to the actual angle of the antenna.

2.8.10.3.4 Vertical Test - ART 2000 ONLY

Press the VERT line item and verify that the antenna scan changes from the horizontal profile to the vertical profile.

2.8.10.3.5 Radar On Mode Checkout

WARNING

When in ON mode, the radar antenna will be radiating.

If the MX20 radar function is not in standby mode, place it in standby mode by pressing the STBY line item. Once in standby, press the ON line item (same key as STBY). The unit is now in "WX" mode. Verify that the mode can be changed to MAP mode by pressing the MAP line item. Now verify that the unit can be placed in vertical profile by pressing the HORZ/VERT line item (ART 2000 ONLY). The display should change to a vertical profile scan.

1. Press the Brg "smart keys" and verify that the bearing can be changed from 45 L to 45 R. ART 2000 ONLY.
2. Press the TILT/BRG line item to select the TILT on mode. ART 2000 ONLY
3. Press the Tilt "smart keys" and verify that the tilt angle can be changed from 15 DN to 15 UP.

The Radar Function should still be in MAP mode. If not in MAP mode, press the MAP line item. In map mode the bottom line item will have a second option: GAIN. Press the GAIN line item. A bar-gauge should appear in the bottom left of the display. Verify that the gain can be adjusted from minimum to maximum by pressing the Gain "smart keys." At minimum, the green bar in the gauge will not be present. At maximum, the green bar fills the entire gauge.

2.8.10.4 FINAL RADAR CHECKOUT

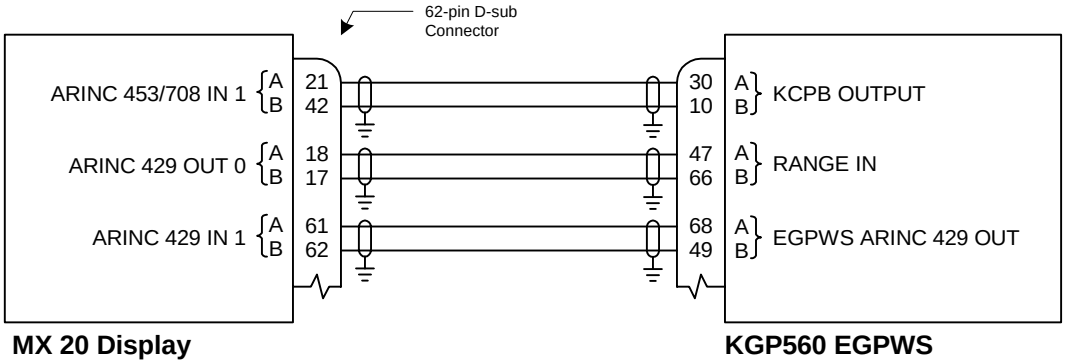
Ensure all ground checkout procedures are completed and verified prior to "open air" checkout.
With stabilization on, during takeoff or prolonged aircraft maneuvers, the displayed radar returns may not be accurate. Point the aircraft radar sensor across the airport and paint buildings and terrain.

2.8.11 LANDMARK TAWS8000 AND KGP560 CHECKOUT PROCEDURE

2.8.11.1 KGP560 CONFIGURATION

The MX20 with I/O option and version 5.0 (or later) software is required in order to display terrain from the KGP-560 EGPWS. External terrain caution and warning annunciator lamps are also required.

The figure below shows the connections between the MX20 display and the KGP560 EGPWS.



To interface with the MX20, the KGP560 must be configured as follows:
- Category 4: Terrain Display ID = 4

- Category 5: I/O Discrete ID = 1
- Category 9: Terrain Display Popup ID = 0

The remainder of the KGP560 configuration items is installation-specific and consequently not specified.

NOTE
The MX20 will automatically range to 10 nmi if a terrain pop-up occurs.

NOTE
With Terrain Display ID 4 the peaks data will be embedded in the terrain sweep. A future version of the MX20 will support Terrain Display ID 6 and display peaks data outside the terrain sweep area.

2.8.11.2 GOODRICH LANDMARK TAWS AND HONEYWELL KGP560 TAWS CHECKOUT

If a Goodrich Landmark TAWS or Honeywell KGP560 TAWS system has been connected to the MX20 I/O, the interface should be verified under the TER (Terrain) function on the MX20.

1. Turn power on to the MX20 I/O and the TAWS system. After the MX20 I/O tests have completed, enter the Terrain Function by pressing the FN key until the TER menu option is available and press the corresponding terrain smart key.

2. If the TER function is not available, verify that the MX20 is an I/O model and that the terrain function has been enabled as described in previous sections.

3. After the TAWS has completed its self-tests, verify that an amber TAWS data-fail annunciator is not present on the left side of the screen. Other annunciators may be present.

4. From the TAWS control panel, execute a self-test. The MX20 display should present the TAWS8000 generated test pattern.

5. After the self-test has completed, verify that the MX20 range up and range down keys change the corresponding range being presented by the TAWS.

2.8.12 GARMIN GTX330 CHECKOUT PROCEDURE

First, perform the Post-Installation Checkout Procedure in Section 3.3 of the GTX330D Transponder Installation Manual. Once completed successfully, turn on the MX20. After the MX20 self-tests are completed, enter the Traffic (TRAF) function by pressing the FN key until the TRAF menu option is available. Then, press the corresponding TRAF “smart” key, followed by the Menu/Enter key. Press the “Operate” Line Selection key. Verify that “TIS Standby” is displayed in the lower right corner. Press the “Standby” Line Selection key. Verify that “TIS Operating” or “TIS Unavailable” are displayed in the lower right corner of the display.

2.8.13 WSI INFLIGHT CHECKOUT PROCEDURE

The checkout procedure involves checking that the satellite signal is acquired and being tracked. Turn on the power to the MX20 and WSI InFlight receiver. After the MX20 performs its self-tests, enter the FIS function by pressing the FN key until the FIS menu option is available. Then, press the corresponding FIS “smart key” followed by the Menu/Enter key, and finally the “Status” Line Selection key. The top three lines indicate signal reception quality. Perform the Post-Installation Checkout Procedure as described in Section 4 of the WSI InFlight AV-120/200 Installation Manual.

NOTES

3 SPECIFICATIONS

This section includes detailed electrical, physical, environmental, and performance specifications for the MX20.

3.1 MX20 FEATURES

3.1.1 DISPLAY

6" Diagonal, Color AMLCD Display
640x480 Resolution (921,600 RGB Dots)
65,535 Simultaneous Colors
Direct Sunlight Readable
Auto/Manual Dimming

3.1.2 USER INTERFACE

Back-lit, high tactile buttons
Six general purpose "line select keys"
Four general purpose "smart keys"
Dedicated Function and Menu/Enter keys
Front Panel Data-Card Access
Open Software Architecture
Field-Upgradeable Code

3.1.3 EXPANSION/INTERNAL ARCHITECTURE

Open software architecture
Field-Upgradeable software
PC-104/PC-104L expansion bus
Four external high-speed serial I/O ports
Four general purpose input flags

3.1.4 POSITION SOURCE

Primary - External GPS or Loran via RS-232 serial input
Optional internal GPS

3.1.5 ELECTRICAL

Table 6 – Unit Power Loads

Unit	14 VDC		28 VDC	
	Typical	Max	Typical	Max
MX20	2.0 A	3.0 A	1 A	1.5 A
MX20 with heater (1)	3.0 A	4.0 A	1.5 A	2.0 A
MX20 I/O	2.5 A	3.5 A	1.25 A	1.75 A
MX20 I/O with heater (1)	3.5 A	4.5 A	1.75 A	2.25 A
Notes: Heater element turns on below approximately 30°C.				

Note: *Circuits should be protected in accordance with guidelines in AC 43.13-1B, chapter 11, section 2, paragraph 429. Power inputs should be across a minimum of all four specified input pins.*

3.1.6 AVIONICS OUTPUTS

Serial Ports	3 High Speed RS232
	1 High Speed RS422

3.1.7 AVIONICS INPUTS

Serial Ports	3 High Speed RS232
	1 High Speed RS422
Discrete Inputs	4 General Purpose

3.1.8 AVIONICS OUTPUTS (I/O MODEL)

Serial Ports	2 ARINC 429 High/Low
Discrete Outputs	3 General Purpose

3.1.9 AVIONICS INPUTS (I/O MODEL)

Serial Ports	2 ARINC 429 High/Low
	2 ARINC 453/708 Radar

3.1.10 SERIAL INTERFACE DATA SOURCES

Position Source	Apollo GX50/55/60/65, Apollo CNX-series, or internal GPS
	Apollo SL50/60
	Trimble 2000, 2000 Approach, 2000 Approach Plus, 2101, 2101 I/O, 2101 I/O Plus
	Garmin GNC 250 XL, GNC 430/530, and equivalent
	Bendix/King KLN 90B TSO and equivalent
	Northstar Avionics M3 GPS Approach
Nav Source	Apollo SL30, Apollo CNX-series
Altitude Source	Apollo SL70
	Apollo CNX-series,
	Apollo GX50/55/60/65 (with extended data enabled)
	Trans-Cal SSD120-(XX)(x)-RS232-(XX)
	ICARUS U3000
	Sandia Aerospace Model SAE5-35
Traffic Source	Apollo UAT
(only one traffic source may be connected to the MX20)	L-3 (Goodrich) SKY497 (MX20 I/O Model Only)
	L-3 (Goodrich) SKY899 (MX20 I/O Model Only)
	Ryan TCAD 9900B (MX20 I/O Model Only)
	Ryan TCAD 9900BX (MX20 I/O Model Only)
	Garmin GTX330 (MX20 I/O Model Only)
Weather Source	Apollo UAT
	Bendix/King RDR2000 Radar (MX20 I/O Model Only)
	RDR2100 (MX20 I/O Model Only)
	Allied Signal RS-181A (MX20 I/O Model Only)
	L-3 (Goodrich) WX500
	WSI InFlight (MX20 will communicate at 38,400 baud)
Terrain TAWS Source	L-3 (Goodrich) Landmark TAWS 8000
	Honeywell KGP-560 EGPWS

3.1.11 PHYSICAL SPECIFICATIONS

Height	5.00 inches (12.7 cm)

Width.....6.25 inches (15.88 cm)
Depth.....8.00 inches (20.3 cm)

Table 7 - Unit Weights		
Unit	Weight	
MX20 only, with GPS	4.08 lb.	(1.85 kg)
MX20 only, without GPS	3.92 lb.	(1.78 kg)
MX20 only, with I/O Option	4.07 lb.	(1.85 kg)
MX20 mounting tray only	0.73 lb.	(0.33 kg)

3.1.12 ENVIRONMENTAL SPECIFICATIONS

Operating Temperature .....-20°C to +55°C
Storage Temperature .....-55°C to +85°C
Temperature Variation .....2°C per minute
Humidity .....95% at 50°C
Maximum altitude .....35,000 ft
Cooling.....Not Required

3.1.13 TSO AUTHORIZATIONS

The MX20 meets the following TSO authorizations when connected to the following units:

JTSO	TSO	Manufacturer and Model	Part Number
JTSO 2C63c	TSO C63c	Bendix King ART2000	071-01519-0101
JTSO C110a	TSO C110a	L-3 (Goodrich) WX 500 Stormscope L-3 (Goodrich) NY-163 Stormscope Antenna L-3 (Goodrich) NY-163 Stormscope Antenna	805-11500-001 805-10930-001 (White) 805-10930-001 (Black)
JTSO C113	TSO C113	All Configurations	
JTSO C118 (TCAS)	TSO C118 (TCAS)	L-3 (Goodrich) NY-156 Antenna L-3 (Goodrich) Skywatch HP SKY899A or L-3 (Goodrich) Skywatch HP SKY899 (non-JTSO)	805-10003-001 805-11900-002 805-11900-001
	TSO C147 (TAS)	L-3 (Goodrich) Skywatch SKY497 (SW Version 1.6, or later) L-3 (Goodrich) Skywatch HP SKY899 L-3 (Goodrich) NY-156 Antenna L-3 (Goodrich) NY-164 Antenna RYAN TCAD Model 9900B RYAN TCAD Model 9900BX RYAN Antenna set (top and bottom mount)	805-10800-001 805-11900-001 805-10003-001 805-10800-001 70-2400 70-2420 70-2410

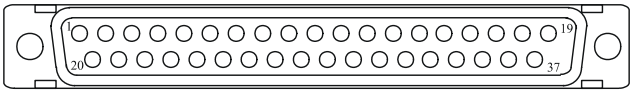
3.1.14 INTERNAL GPS RECEIVER PERFORMANCE

Number of channels	8
Frequency	1575.42 MHz L1, C/A code
Sensitivity (acquisition)	-135 dBm
Sensitivity (drop lock)	-142 dBm
Dynamic range	> 20 dB
Lat/Lon position accuracy	15 meters RMS typical 25 meters, SEP, without SA 100 meters 2DRMS with SA
Velocity	1000 knots maximum
Acceleration	4G maximum
TTFF (time to first fix)	25 seconds typical with current almanac, position, time, and ephemeris 55 seconds typical with current almanac, position, and time
Reacquisition	2.5 seconds typical
Position update interval	1 second typical
Datum	WGS-84

3.2 REAR CONNECTOR PINOUTS

Table 8 - MX20 Rear Panel Connector Pinout (J1)

Pin #	I/O	Name	Comment
1	I	Power +	Main Aircraft Power Input (+10 to +30 VDC)
2	I	Power ground	Main Aircraft Power Ground
3	I	Port 2 GND	RS-232
4	I	Port 1 IN	RS-232
5	O	Port 1 OUT	RS-232
6	O	Port 3 OUT	RS-232
7	I	Port 3 IN	RS-232
8	O	Port 4 OUT +	RS-422
9	-	NC	Reserved
10	O	Port 4 OUT -	RS-422
11	I	Port 4 IN +	RS-422
12	I	Power ground	
13	-	NC	Reserved
14	I	Input Flag 1	Discrete Input (Internally Pulled Up)
15	I	Input Flag 3	Discrete Input (Internally Pulled Up)
16	I	Heater Power +	Auxiliary Heater Input (+10 to +30 VDC)
17	O	1 PPS OUT +	1 Pulse Per Second Output (RS422 Level). GPS timing is referenced to the falling edge of +.
18	-	NC	Reserved
19	O	1 PPS OUT -	1 Pulse Per Second Output (RS422 Level). GPS timing is referenced to the rising edge of -.
20	I	Power ground	
21	I	Port 2 IN	Port 2 RS-232 RxD
22	O	Port 2 OUT	Port 2 RS-232 TxD
23	I	Port 1 GND	RS-232
24	O	Reserved (Power)	NC In Aircraft Install
25	I	Port 3 GND	RS-232
26	I	Port 4 IN -	Port 4 RS-422 RxD -
27	I	Reserved (Ground)	NC In Aircraft Install
28	I	Reserved (Data)	NC In Aircraft Install
29	I	Reserved (Clock)	NC In Aircraft Install
30	-	NC	Reserved
31	-	NC	Reserved
32	-	NC	Reserved
33	I	Input Flag 2	Discrete Input (Internally Pulled Up)
34	I	Input Flag 4	Discrete Input (Internally Pulled Up)
35	-	NC	Reserved
36	I	External Power Switch	External Power Switch (Gnd to Turn On)
37	-	NC	Reserved

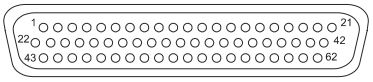


Viewed from rear of unit

Table 9 - MX20 I/O Connector Pinout (J2)
Some features listed are not supported at this time

Pin	Name	I/O	Description
1	SYNCHRO_0_X	I	Reserved
2	SYNCHRO_0_Z	I	
3	SYNCHRO_0/1_REF_LO	I	
4	SYNCHRO_1_X	I	
5	DISCRETE_OUT_0	O	Discrete Output number 0
6	DISCRETE_OUT_1	O	Discrete Output number 1
7	DISCRETE_OUT_2	O	Discrete Output number 2
8	DISCRETE_IN_8	I	Reserved
9	+12V	O	
10	GND	I	
11	SHIFT_REG_S/L	O	
12	561_DATA_IN_B	I	
13	429_IN_6B	I	
14	429_IN_5A	I	
15	429_IN_4A	I	
16	429_IN_2A	I	
17	429_OUT_0B	O	
18	429_OUT_0A	O	
19	453/708_IN_0B	I	ARINC 453/708 Input port 0B
20	5VAC	I	Reserved
21	453/708_IN_1A	I	
22	SYNCHRO_2_REF_HI	I	
23	SYNCHRO_0_Y	I	
24	SYNCHRO_0/1_REF_HI	I	
25	SYNCHRO_1_Y	I	
26	SYNCHRO_1_Z	I	
27	DISCRETE_IN_2	I	
28	DISCRETE_IN_4	I	
29	DISCRETE_IN_6	I	
30	DISCRETE_IN_5	I	
31	SHIFT_REG_DATA_OUT	I	
32	SHIFT_REG_CLK	O	
33	VREF_8V2_REARINT	I	
34	561_DATA_IN_A	I	
35	429_IN_6A	I	
36	429_IN_5B	I	
37	429_IN_4B	I	
38	429_IN_2B	I	
39	429_IN_3A	I	
40	453/708_IN_0A	I	ARINC 453/708 Input port 0A
41	5VAC	I	Reserved
42	453/708_IN_1B	I	
43	SYNCHRO_2_REF_LO	I	
44	SYNCHRO_2_X	I	
45	SYNCHRO_2_Y	I	
46	SYNCHRO_2_Z	I	
47	DISCRETE_IN_0	I	
48	DISCRETE_IN_3	I	
49	DISCRETE_IN_7	I	
50	DISCRETE_IN_1	I	

51	+28V	I	
52	429_OUT_1A	O	ARINC 429 Output port 1A
53	429_OUT_1B	O	ARINC 429 Output port 1B
54	561_CLK_IN_B	I	Reserved
55	561_CLK_IN_A	I	↓
56	561_SYNC_IN_B	I	
57	561_SYNC_IN_A	I	
58	429_IN_0B	I	ARINC 429 Input port 0B
59	429_IN_0A	I	ARINC 429 Input port 0A
60	429_IN_3B	I	Reserved
61	429_IN_1A	I	↓
62	429_IN_1B	I	



View from rear of unit

NOTES

4 TROUBLESHOOTING

This section provides information to assist troubleshooting if problems occur after completing the installation. Use Table 10 to assist in troubleshooting.

4.1 TROUBLESHOOTING GUIDE

Table 10 - Troubleshooting Guide

Problem	Cause	Solution
Unit does not power up – blank screen.	1. Improper wiring; circuit breaker open. 2. Unit intensity turned down. 3. Unit is cold. 4. Data card improperly installed.	1. Ensure power is properly wired to the MX20 and the circuit breaker is closed. 2. Ensure that unit is not in manual intensity control mode with the intensity turned down. 3. If ambient temperature is below 10°C, allow unit to preheat for up to 60 seconds. 4. Ensure that the data card is fully inserted in the front bezel (It should be flush with the ejector button).
Unit fails during power-on self-test (POST).	Data card improperly installed.	Ensure that the data card is fully inserted in the front bezel (It should be flush with the ejector button).
INST function not shown in install mode.	1. Improper key sequence entered. 2. Too many keys pressed in key sequence. 3. Cycle through functions not completed.	1. Ensure that the proper installation key sequence is carefully entered after the power on self-test is complete. 2. Ensure that no other keys are pressed prior to entering the sequence. 3. Cycle through the available functions by pressing the FN key – INST function is on last available function page.
Unit shows POS data flag.	1. Data port information not correct. 2. Antenna cables improperly installed. 3. Antenna is improperly installed. 4. Waypoint not selected as the current destination.	1. Ensure that the data port configuration is correct and matches how the unit is wired for the position source. 2. Ensure that the GPS antenna cables are correctly installed on the external GPS and the internal GPS (if equipped). 3. Ensure that the GPS antenna is correctly installed on top of aircraft and aircraft is clear of hangers, buildings and trees. 4. If a GX/SL series is used as the position source, ensure that a waypoint is selected as the current destination (Nav Flagged

Table 10 - Troubleshooting Guide

Problem	Cause	Solution
		is not shown on primary nav page).
	5. Position source not configured on appropriate port.	5. If a GX/SL series is used as the position source, ensure that it is configured to output serial data (MOV MAP) on the appropriate port.
	6. External GPS not properly configured.	6. If other compatible external GPS is used, ensure it is configured to output serial position data on the appropriate lines.
	7. RF interference.	7. Ensure no RF interference at 1575 MHz from VHF Comm antenna – add 1575 MHz notch filter in Comm coax; Fix or replace Comm; Disconnect the ELT antenna coax to check.
Unit shows RTE data flag.	External position source does not have active route engaged.	Ensure that the external position source has an active route engaged.
Unit shows ALT data flag.	1. Data port configuration incorrect.	1. Ensure that the data port configuration is correct and matches how the unit is wired for the serial altitude source.
	2. Serial altitude encoder not powered up; not functioning properly.	2. Ensure that serial altitude encoder is powered up and functioning properly.
	3. System is configured to use GX unit as source for altitude data and GX is not turned on.	3. Ensure GX is turned on, shows a valid altitude, and has acquired position and valid waypoint.
	4. System is configured to use GX unit as source for altitude data and GX not configured properly.	4. Verify that GX has extended data output enabled.
Unit shows TER data flag.	1. Terrain database incorrect.	1. Ensure the unit has the appropriate terrain database loaded for the area of operation. The terrain database is indicated on the power-up and system status pages of the MX20.
	2. Invalid altitude supplied to unit.	2. Ensure that valid altitude is being supplied to the unit (an ALT data flag should not be present).
SL30 information is not displayed.	1. Data port configuration incorrect.	1. Ensure that the data port configuration is correct and matches how the unit is wired for the SL30.
	2. SL30 is not powered up.	2. Ensure the SL30 has power applied.
	3. Wiring connections are incorrect.	3. Check wiring.
Unit shows DEMO data flag.	Demo mode enabled.	Ensure that demo mode is not

Table 10 - Troubleshooting Guide		
Problem	**Cause**	**Solution**
		enabled in the install pages.
Unit posts message indicating 'Special' terrain clearance mode after power-up.	Incorrect terrain clearance mode improperly set.	1. This is normal for special 'Capstone' support. 2. General aviation usage should have the terrain mode set to 'Normal' in the install pages.
TCAD	1. Unit is not Traffic capable. 2. Data port configuration incorrect. 3. Traffic function not enabled. 4. TCAD unit not powered up; not functioning properly. 5. Wiring connections are incorrect.	1. Ensure that the model MX20 is traffic capable. 2. Ensure that the data port configuration is correct and matches how the unit is wired for the serial interface. 3. Ensure that the traffic function is enabled. 4. Ensure that the TCAD unit has power applied and is functional. 5. Verify serial wiring and pin connections.
SKWY	1. Unit is not Traffic capable. 2. Data port configuration incorrect. 3. Traffic function not enabled. 4. Skywatch unit not powered up; not functioning properly. 5. Wiring connections are incorrect.	1. Ensure that the model MX20 is traffic capable. 2. Ensure that the data port configuration is correct and matches the model/unit that is wired for the 429 interface. 3. Ensure that the traffic function is enabled. 4. Ensure that the Skywatch unit has power applied and is functional. 5. Verify 429 wiring and pin connections.
RDR (Amber)	1. Unit is not radar capable. 2. Data port configuration incorrect. 3. Radar function not enabled. 4. Radar unit not powered up; not functioning properly. 5. Wiring connects are incorrect.	1. Ensure that the model MX20 is radar capable. 2. Ensure that the data port configuration is correct and the model radar head is set correctly. 3. Ensure that the radar function is enabled. 4. Ensure that the radar unit has power applied and is functional. 5. Verify 453/708, 429 and discrete wiring and pin connections.

Table 10 - Troubleshooting Guide

Problem	Cause	Solution
LINK	1. Unit is not WSI sensor capable. 2. Data port configuration incorrect. 3. WSI Inflight sensor function not enabled. 4. WSI Inflight sensor not powered up; not functioning properly. 5. Wiring connects are incorrect.	1. Ensure that the model MX20 is WSI sensor capable. 2. Ensure that the data port configuration is correct and the WSI sensor is set correctly. 3. Ensure that the WSI sensor function is enabled. 4. Ensure that the WSI sensor has power applied and is functional. 5. Verify wiring and pin connections.
MX20 runs hot.	Arrangement of avionics and installation area does not provide sufficient airflow.	1. If an internal fan is present, verify that it is operational and that the opening is clear of obstructions. The fans should turn on when the unit's internal temperature is approximately 95-100ºF. 2. If an internal fan is not present, one may be installed by the factory. Contact factory.
XPDR	1. Unit is not GTX330 capable. 2. Data port configured incorrectly. 3. Traffic function not enabled. 4. GTX330 not powered up or not functioning properly. 5. Wiring connection are incorrect.	1. Ensure that the model MX20 is GTX330 capable. 2. Ensure that the data port configuration is correct and the GTX330 is set correctly. 3. Ensure that the GTX330 function is enabled. 4. Ensure that the GTX330 has power applied and is functional. 5. Verify wiring and pin connections
Split Screen function does not appear.	Split Screen function is not enabled.	Enable Split Screen function in INSTL mode function page.

4.2 INTEGRATION TROUBLESHOOTING PROCEDURE

Use this procedure to check the integration of external data sources with the MX20.

1. Remove power to all external data sources and power on just the MX20.
2. Verify the correct power up sequence and access to the different functions of the MX20.
3. Verify that amber data flags are presented and own-ship is ‘X’d, indicating that external data sources are not available. Allow the system to operate for several minutes to verify correct basic operation.
4. Apply power to each external data source one at a time. Verify that the corresponding amber data flag extinguishes with each data source.
5. Verify that system operates correctly with the new data source by switching between different functions and allowing the system to operate for several minutes. Repeat with the next data source.

Note that the external GPS may need to acquire and set a destination waypoint before the ALT, POS, and RTE flags clear.

6. If a given external data source causes a system error, verify compatibility and wiring. Re-verify port assignments.

4.3 CONTACTING THE FACTORY FOR ASSISTANCE

If the MX20 fails to operate despite troubleshooting efforts, contact the UPS Aviation Technologies factory for assistance.

UPS Aviation Technologies, Inc.
2345 Turner Rd. SE
Salem, Oregon 97302
USA

Phone (503) 581-8101 or 1-800-525-6726

http://www.upsat.com

Be prepared to offer the following information about the installation:

- Installation configuration (accessories, antenna, ...)
- Model number, part number with mod levels, and serial number
- Software version
- Description of problem
- Efforts made to isolate the problem

5 CONTINUED AIRWORTHINESS INSTRUCTIONS

The MX20 is designed to not require any regular maintenance except as included in this section:

5.1 EQUIPMENT CALIBRATION

The MX20 design requires no adjustments or calibration to be made.

5.2 CLEANING THE FRONT PANEL

The front bezel, keypad, and display can be cleaned with a soft cotton cloth dampened with clean water. DO NOT use any chemical-cleaning agents. Care should be taken to avoid scratching the surface of the display.

5.3 DISPLAY BACKLIGHT

The display backlight lamps are rated by the manufacturer as having a usable life of 10,000 hours. This life may be more or less than the rated time depending on the operating conditions of the MX20. Over time, the backlight lamps will dim and the display will not perform as well in direct sunlight conditions. The user must determine by observation when the display brightness is not suitable for its intended use. Contact UPS Aviation Technologies when the backlight lamps require service.

5.4 LITHIUM BATTERY REPLACEMENT

The internal keep-alive battery will require replacement after 5 years of service. The Li battery is only included in MX units with internal GPS 430-0270-0xx. The effect of battery failure is a loss of the real time clock in the GPS receiver. The unit will still work with loss of battery power; however, GPS acquisition may take considerably longer time (20 minutes). There is no hazard associated with such a failure.

To replace the battery, the MX20 must be removed from the aircraft and serviced by an appropriately rated UPS AT service center. If the aircraft is to fly without the unit installed, placard the aircraft accordingly.

Note: The battery is to be replaced ONLY with UPS AT part number 148-0052-00, or a UPS AT approved equivalent.

CAUTION
The battery may explode if mistreated. Risk of fire, explosion, and burns. Do not recharge, disassemble, heat above 100°C, or incinerate.

5.5 ALTITUDE ENCODER

In this VFR non-essential system, it is recommended that the altitude encoder be calibrated every 24 months. Refer to the manufacturer's installation and calibration manual.

5.6 MANUALS

Incorporate operational test and troubleshooting guides into Aircraft Maintenance manuals. Update the wiring diagram manual and equipment list as necessary. Add each component to the reliability program as necessary.

NOTES

6 ENVIRONMENTAL QUALIFICATIONS

The MX20 has been tested to the following environmental categories per procedures defined in RTCA/DO-160D.

Environmental Qualification Form						
Part No: TSO/- JTSO No:	430-0270-000 C110a C113	430-0270-500 C110a C113	430-0270-600 C110a C113 C118 C147	430-0270-700 C63c/2C63c C110a C113 C118 C147	430-0270-800 C110a C113 C118 C147	430-0270-900 C63c/2C63c C110a C113 C118 C147
Manufacturer: UPS Aviation Technologies, Inc. 2345 Turner Road SE Salem, Oregon 97302						

Conditions	Section	Description of Conducted Tests
Temperature and Altitude Operating Temp Short Time High Temperature Ground Survival Temperature	4.0	Equipment tested to Category A1 and C1 with -20°C to +55°C + 70°C -55°C to +85°C
In-flight Loss of Cooling	4.5.4	No cooling required
Altitude	4.6.1	Equipment tested to 35,000 feet
Decompression	4.6.2	Equipment tested 8K to 35K in < 15 seconds
Overpressure	4.6.3	Equipment tested for overpressure
Temperature Variation	5.0	Equipment tested to Category C, 2°C/minute
Humidity	6.0	Equipment tested to Category A, standard humidity environment
Operational Shocks and Crash Safety	7	Equipment tested to Category B5R for both operational and crash safety shocks. (Equipment operated normally after the crash safety shocks.)
Vibration	8.0	Standard vibration category S (curves M and B) Robust Helicopter Vibration Category U (curves F and F1)
Explosion Proofness	9.0	Equipment identified as Category X, no test required
Waterproofness	10.0	Equipment identified as Category X, no test required
Fluids Susceptibility	11.0	Equipment identified as Category X, no test required
Sand and Dust	12.0	Equipment identified as Category X, no test required
Fungus Resistance	13.0	Equipment identified as Category X, no test required
Salt Spray	14.0	Equipment identified as Category X, no test required
Magnetic Effect	15.0	Equipment is Class Z, < 0.3 meters
Power Input	16.0	Equipment tested to Category B for 14 and 28 VDC
Voltage Spike	17.0	Equipment tested to Category A
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	Equipment tested to Category B
Induced Signal Susceptibility	19.0	Equipment tested to Category C, Z
Radio Frequency Susceptibility (Radiated and Conducted)	20	Equipment tested to Category V (Conducted) Equipment tested to Category V (Radiated)
Emission of Radio Frequency Energy	21	Equipment tested to Category M
Lightning Induced Transient Susceptibility	22.0	Equipment tested to Category A3 and B2
Lightning Direct Effects	23.0	Equipment identified as Category X, no test required
Icing	24.0	Equipment identified as Category X, no test required
Electrostatic Discharge	25.0	Equipment tested to Category A
Remarks:		

NOTES

APPENDIX A – I/O SPECIFICATIONS

This appendix includes the RS-232 serial port interface specifications.

6.1 MOVING MAP INPUT

The format of the moving map data output is as follows. Definitions of the input data is included in Table 11 and Table 13. A sample output message is included in Figure 21.

Baud rate: 9600
Data bits: 8
Stop bits: 1
Parity: ..... none
Output rate: ..... approx. 1 seconds
Message length: ..... variable, approx. 83 to 484 characters

The serial output messages are in the following format.

<STX><id><data><it><id><data><it>...<id><data><it><ETX>

<STX> ..... ASCII "start of text" character (1 byte, 02h)
<id> ..... item designator (1 byte, from following table)
<data> ..... item data (format listed in following table)
<it> ..... item terminator (1 byte, 0Dh)
<ETX> ..... ASCII "end of text" character (1 byte, 03h)

Table 11 - Moving Map ASCII Navigation Data

ID	Data Format	Length	Description
A	sddmmhh	9	Present latitude s =sign: N for north, S for south dd = degrees mm = minutes hh = hundredths of minutes
B	sdddmmhh	10	Present longitude s = sign: E for east, W for west ddd = degrees mm = minutes hh = hundredths of minutes
C	ddd	3	Track (magnetic): ddd = degrees
D	ddd	3	Ground speed: ddd = knots
E	ddddd	5	Distance to active waypoint: ddddd = nm x 10
G	sdddd	5	Cross track error: s = sign: R for right, L for left of course dddd = distance off course, hundredths of nm
I	dddd	4	Desired track (magnetic): dddd = degrees x 10
K	ddd[dd]	3 to 5	Active waypoint identifier: ddd[dd] = ASCII waypoint identifier
L	dddd	4	Bearing to active waypoint (magnetic): dddd = degrees x 10
Q	sddd	4	Magnetic variation:

Table 11 - Moving Map ASCII Navigation Data			
ID	**Data Format**	**Length**	**Description**
			s = sign: E for east, W for west ddd = degrees x 10
T	---A-----	9	Warnings: The 4th character will be an "A" when the navigation data is flagged, otherwise, all characters will be dashed. All other navigation data will be dashed when it is flagged.

6.2 BINARY NEAREST LIST DATA (WHEN EXTENDED DATA IS ENABLED ONLY)

The nearest waypoints lists are sent one waypoint per data transmission set. The lists are sent in the following order:

- LFAC
- VOR
- NDB
- INT
- User

There is a maximum of twenty waypoints per type. The waypoints are a maximum of 600 nm from the current position. The waypoints are order by distance from current position nearest to farthest. The maximum time to send all lists is 100 second. Each list is updated just prior to the first waypoint in the list being sent. If a list is empty a shorter record will be sent with the List Item Number set to 0xFF.

Table 12 - Nearest Waypoint List Data		
Byte	**Format**	**Description**
1	Z	'Z' **Item Designator**
2	sddddddd	**List Item Number:** Packed, unsigned binary values s = 1 End of list, 0 all other ddddddd = 1 – 20 list waypoint index sddddddd = 0xFF List Type is EMPTY **(BYTE *4* terminate Item)**
3	t	**Waypoint Type**: t = {a (airport) || v (VOR) || n (NDB) || i (INT) || u (USER)}
4	Cr	'\r' **Item Terminator** <0x0d> **(ONLY IF BYTE 3 = OxFF)**
4-8	ddddd	**ASCII Waypoint Identifier**
9 10 11	sddddddd xxmmmmmm xhhhhhhh	**Latitude of waypoint.** Packed, unsigned binary values for degrees, minutes and hundredths of minutes. s = 0 North latitude, 1 South latitude x = undefined ddddddd = Latitude degrees mmmmmm = Latitude minutes hhhhhhh = Latitude hundredths of minutes
12 13 14 15	sxxxxxxx ddddddd xxmmmmmm xhhhhhhh	**Longitude of waypoint.** Packed, unsigned binary values for degrees, minutes and hundredths of minutes. s = 0 East longitude, 1 West longitude

Table 12 - Nearest Waypoint List Data		
Byte	**Format**	**Description**
		x = undefined ddddddd = Longitude degrees mmmmmm = Longitude minutes hhhhhhh = Longitude hundredths of minutes
16	Cr	'\r' **Item Terminator** <0x0d>

Table 13 - Moving Map Binary Route Data		
Byte	**Data Format**	**Description**
1	w	Item designator
2-3	dd	Current waypoint number in ASCII (01h to 20h)
4	xiannnnn	Sequence number x = undefined i = 1 if last waypoint a = 1 if active waypoint nnnnn = unsigned binary waypoint number
5-9	ddddd	ASCII waypoint identifier
10 11 12	sddddddd xxmmmmmm xhhhhhhh	Waypoint latitude - packed, unsigned binary s = sign: 0 for north, 1 for south ddddddd = degrees mmmmmm = minutes hhhhhhh = hundredths of minutes x = undefined
13 14 15 16	sxxxxxxx sddddddd xxmmmmmm xhhhhhhh	Waypoint longitude s = sign: 0 for east, 1 for west ddddddd = degrees mmmmmm = minutes hhhhhhh = hundredths of minutes x = undefined
17 18	nnnnnnnn nnnnnnnn	Magnetic variation at waypoint LS byte (msbit...lsbit) MS byte (msbit...lsbit) Two's complement binary in sixteenths of degrees, easterly variation is positive.
19	<CR>	ASCII carriage return (0Dh)

6.3 FLIGHT PLAN WAYPOINT TYPES (WHEN EXTENDED DATA IS ENABLED ONLY)

The following data is only transmitted when preceded by flight plan data. There is one character per flight plan waypoint transmitted.

Table 14 - Flight Plan Waypoint Type

Id	Item Format	Len	Description
t	nnn…	1-21	n = { a (airport) || v (VOR) || n (NDB) || i (intersection) || u (user) || p (parallel track) || d (direct to) || F (FAF) || I (IAF) || H (MAHP) || A (IFAF) || P (undefined approach waypoint type) }

Example Moving Map Data Output (Extended Data Disabled)

`AN 34 1570`	34°15.70’ latitude
`BW 118 4390`	118°43.90’ longitude
`C306`	306° track angle
`D210`	210 knots
`E02682`	268.2nm to waypoint
`GR0006`	0.6nm right of course
`I3059`	305.9° desired track
`KSFO`	SFO waypoint ident
`L3058`	305.8° bearing to waypoint
`QE140`	14.0° east magnetic variation
`T---------`	No alarms, data not flagged
`<binary data>`	From Table 9

Figure 21 - Moving Map Data Output (Extended Data Disabled)

Example Moving Map Data Output (Extended Data Enabled)

`AN 34 1570`	34°15.70’ latitude
`BW 118 4390`	118°43.90’ longitude
`C306`	306° track angle
`D210`	210 knots
`E02682`	268.2nm to waypoint
`GR0006`	0.6nm right of course
`I3059`	305.9° desired track
`KSFO`	SFO waypoint ident
`L3058`	305.8° bearing to waypoint
`QE140`	14.0° east magnetic variation
`T---------`	No alarms, data not flagged
`<binary data>`	From Table 7
`a–O--F`	Approach Enabled Off, Active Off, Message On, Parallel Track Off, Hold Off, and From/To is FROM
`cvR001`	CDI Valid, Needle Right, Deflection 001°
`vC000`	VDI Valid, Needle Centered, Deflection is 000°
`<binary data>`	From Table 13
`tda`	Flight Plan Waypoint Type data, direct-to, airport type

Figure 22 - Moving Map Data Output (Extended Data Enabled)

6.4 ALTITUDE ENCODER/CONVERTER INPUT

The format of the altitude input is as follows. Definition of the input message is included in Table 15. Several sample messages are illustrated in Figure 23**Error! Reference source not found.**.

Baud rate: 1200
Data bits: 8
Stop bits: 1
Parity: .....none
Expected input rate: .....approx. 1 second
Message length: .....17 characters

Table 15 - Altitude Input Data

Byte	Data Format	Description
1	"#"	ASCII "#" (023h)
2	"A"	ASCII "A" (041h)
3	"L"	ASCII "L" (04Ch)
4	" "	ASCII space (020h)
5	"+" or "-"	Altitude sign: ASCII "+" or "-" (02Bh or 02Dh)
6-10	ddddd	Altitude in feet, right justified with leading zeros
11	"T"	ASCII "T" (054h)
12	"+" or "-"	Temperature sign: ASCII "+" or "-" (02Bh or 02Dh)
13-14	dd	Internal altimeter temperature
15-16	dd	Checksum of bytes 1 through 14, computed in hex, output in ASCII format (i.e., "FA" hex)
17	<CR>	ASCII carriage return (0Dh)

The altitude input can decode several status or error codes. These codes would be in place of the altitude data in characters 5 - 10 as follows.

"-09980".....Heater not ready: expected during encoder warm-up or if there is a loss of signal from the encoder.

"-09981".....Possible hardware problem: expected from encoder indicating a temperature greater than 55°C or if data is invalid.

"-09982".....Altitude out of range: expected from the encoder indicating that the altitude is outside specified range of the encoder.

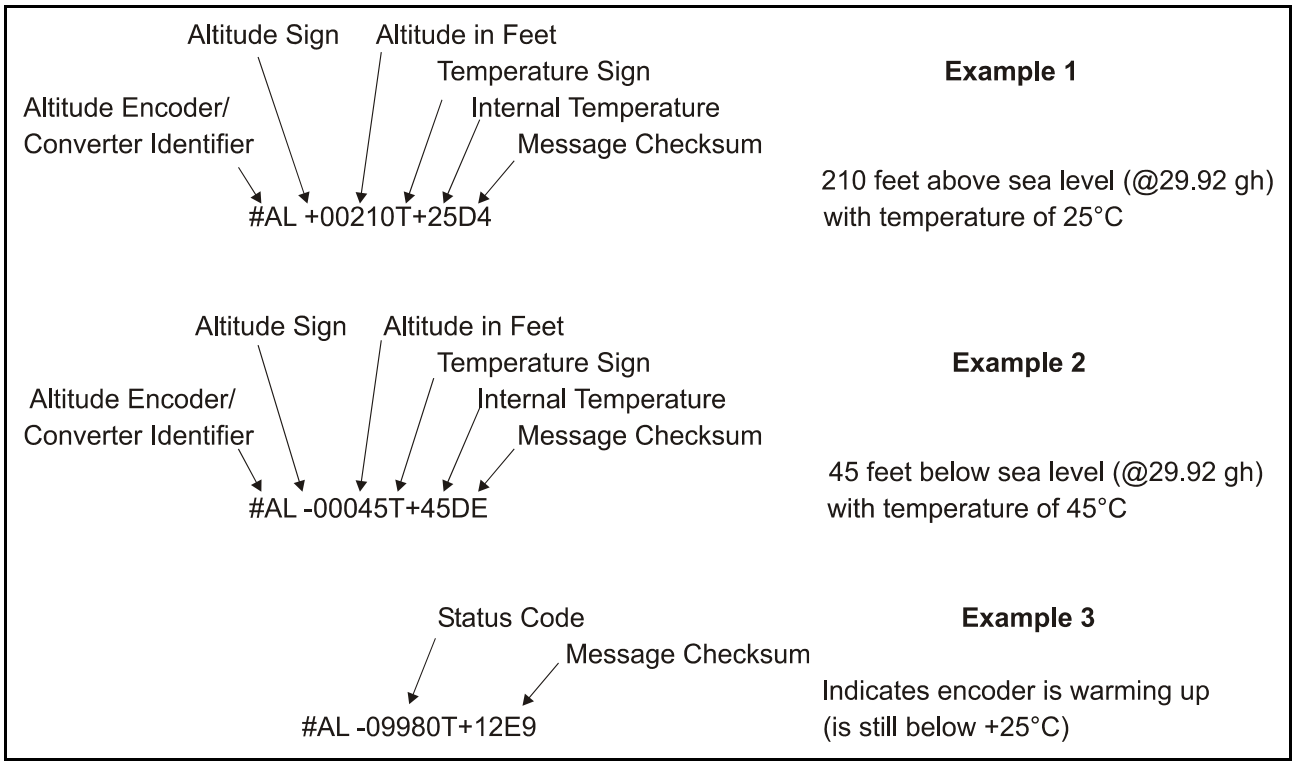


Figure 23 - Altitude Data Input

6.5 STORMSCOPE INPUTS

The WX-500 is the only stormscope that the MX20 MFD interfaces with. It can be connected to RS-422 or RS-232.

RS-232		
Connection	TX	J3-20
	RX	J3-8
	RS-232_GND	J2-5
Cable	Twisted shielded triad 24 AWG wire	
Voltage	Logic 0 (space) Min: +5V, Max: +15V	
	Logic 1 (mark) Min: -15V, Max: -5V	
Baud Rate	9600	
Load Impedance	3KΩ Min.	
RS-422		
Connection	TX+	J3-25, TX- J3-13
	RX+	J3-24, RX- J3-12
	GND	CASE_GND
Cable	Twisted shielded pair 22 AWG	
Voltage	Logic 0 (space) Min (A-B): +2V, Max (A-B): +6V	
	Logic 1 (mark) Min (A-B): -6V, Max (A-B): -2V	
Baud Rate	9600	
Load Impedance	3KΩ Min.	

NOTES

UPS Aviation Technologies