AXP340 MODE S TRANSPONDER INSTALLATION MANUAL

This document is applicable to the Avidyne AXP340 Mode S Transponder.

For technical support, please contact Avidyne using the following information.
888-723-7592
781-402-7592
techsupport@avidyne.com

The latest installation manuals are available to authorized dealers on the web at
www.avidyne.com.

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CONTENTS

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1. Preface

1.1 Purpose

This manual describes the physical and electrical characteristics and the installation requirements for an AXP340 Mode S Transponder.

1.2 Scope

This document applies to the installation of the AXP340 Mode S Transponder.

At the publication date of this manual the software version identifier for the AXP340 is 3.8 and the FPGA version identifier is 110613a. The software and FPGA versions are subject to change without notice.

1.3 Changes from Previous Issue

Updated section 4 to reflect the Avidyne part numbers and kit combinations

Corrected version numbering for updated documents

Added KT76C to the list of equivalent transponder trays

Added statement in 6.1.1 about automated Mode S address generation for N reg. aircraft

1.4 Document Cross-References

600-00302-000   AXP340 Mode S Transponder Pilot Guide   02

2. Introduction

2.1 AXP340 Description

The AXP340 Mode S panel mount transponder is an ED-73E and DO-181E Class 1 compliant Mode S level 2es datalink transponder, with support for extended squitter, elementary surveillance and SI codes. The AXP340 is also a DO-260B Class B1S compliant ADS-B out participant. The AXP340 meets the relevant environmental requirements of DO-160G/ED-14G, and is certified to ETSO C112d, ETSO C166b, TSO C112d and TSO C166b.

The AXP340 transmitter power output is nominally 240 watts, and the transponder runs from either 14 volt nominal or 28 volt nominal DC power supply with no configuration changes required.

The AXP340 transponder responds to both legacy Mode A/C interrogations and to Mode S interrogations from both ground radar and airborne collision avoidance systems. In all cases, the interrogations are received by the transponder on 1030MHz, and replies are transmitted on 1090MHz.

In the Mode S environment, S stands for Select, and a Mode S interrogator can selectively address a single transponder. This allows accurate position plotting with lower reply rates, which in turn reduces frequency congestion and interference. As a side benefit, power consumption by the transponder may be reduced, and simple datalink services can be supported, such as ADS-B. It is however crucial to the reliable operation of the system that each aircraft has a distinct Mode S address. The Mode S address is allocated by the registration authority for the aircraft, and must be set when the AXP340 is installed.

2.2 Interfaces

At the rear, the transponder has two Molex style connectors and a single antenna connector for blind mating with the corresponding connectors in the mounting tray.

The interfaces provide the following services:

Parallel altitude input	Connection to an external altitude encoder using parallel Gray code.
Serial altitude input	Connection to an external RS232 altitude encoder or air data computer. Using serial altitude data allows the transponder to report altitude with 25 foot resolution.
Serial altitude output	Connection to a GPS or other device needing serial altitude data – this allows the transponder to act as a repeater instead of requiring a second altitude encoder.
Ident input	External IDENT switch input.
Standby input	External standby input for dual transponder installations.
"On ground" input	Allows automatic flight/ground mode switching for aircraft with a squat switch.
Lighting bus input	Used to adjust the backlight and switch lighting intensity.
DME Suppression Input	Input to limit interference between DME interrogations and transponder replies – suppresses transponder whilst active.
Suppression bus I/O	ARINC compatible suppression bus signal used in aircraft with more sophisticated suppression needs, both an input to and output from the transponder.
Audio output	Optionally used by the altitude monitor function.
Audio mute input	Toggle function to mute the audio output.

Altitude alert output   Output used to signal altitude deviations when optional altitude monitor function is used.

GPS Input   Connection to a GPS supplying position input for ADS-B position reporting.

3. Technical Specifications

3.1 Regulatory

Specification	Characteristics
Compliance	ETSO C112d, TSO C112d; Class 1 Level 2es ETSO C166b, TSO C166b; Class B1S
FCC Identification	VZI01155
Applicable documents	EUROCAE ED-73E (RTCA DO-181E), EUROCAE ED-14G (RTCA DO-160G) , RTCA DO-260B with Corrigendum 1
Software	ED-12B (RTCA DO-178B) Level B
Power Requirements	10 – 33 Volts DC. Typical 6.3Watts @ 14Volts.
Altitude	55,000 feet
Humidity	95% @ +50C for 6 hours; 85% @ +38C for 16 hours. Tested to Category A in DO-160G
Operating Temperature	-25C to +70C
Transmitter Frequency	1090MHz ± 1MHz
Transmitter Power	240 Watts nominal; 125 Watts minimum at antenna after allowing for 0.5dB connector losses and 1.5dB cable losses.
Transmitter Modulation	6M75 V1D
Receiver Frequency	1030 MHz
Receiver Sensitivity	-74dBm ± 3dB

3.1.1 Approved Deviations

The AXP340 ADS-B function is certified to ETSO C166b which references DO-260B as the applicable standard. Since publication of DO-260B a corrigenda has been published; the AXP340 complies with the corrected DO-260B which technically is a deviation from the ETSO. This deviation has been approved by EASA.

3.2 Physical Specifications (in Tray)

Specification	Characteristics
Height	42mm (1.65")
Width	160mm (6.30")
Length	285mm (11.22")
Weight	2.8lbs. (1.35Kg)

3.3 Installation Approval

The conditions and tests required for the TSO approval of the AXP340 Mode S Transponder are minimum performance standards. It is the responsibility of those desiring to install this transponder on or within a specific type or class of aircraft to determine that the aircraft operating conditions are within the TSO standards. The transponder may be installed only if further evaluation by the user/installer documents an acceptable installation that is approved by the appropriate airworthiness authority.

3.4 TSO Failure Condition Classification

The AXP340 Mode S Transponder has been designed to the major failure condition classification as described by TSO C112d and C166b. Malfunction of the functions defined in paragraph 3.a of these TSO's are a major failure condition.

3.5 Non – TSO Functions

The AXP340 Mode S Transponder contains the following non-TSO functions:

- Stopwatch and Flight Timer. The transponder provides a simple stopwatch and flight timer function, displayed on the front panel.

- Altitude Monitor. The Altitude Monitor activates an audio annunciator or annunciator light (depending on installation) when the aircraft pressure altitude differs from the previously selected altitude by more than 200 feet.

- Altitude Repeater. This is a serial altitude output that can connect to a GPS or other device needing serial altitude data – this allows the transponder to act as a repeater for the altitude input instead of requiring a second altitude encoder.

The operation of each of these functions is described later in this manual.

The non-TSO functions defined in this section are not part of the TSO approval. The non-TSO function data included in this section is approved under 14 CFR 21.305(d).

4. Unit and Accessories supplied

4.1 AXP340 Mode S Transponder Items

Your AXP340 Mode S transponder includes the following items:

Unit Description	Qty	Manufacturer Part Number	Avidyne Part Number
AXP340 Mode S Transponder, Black ~~and~~ Kit	1		850-00219-000
AXP340 Mode S Transponder, Grey ~~and~~ Kit	1		850-00219-001
AXP340 Mounting tray, Installation kit *	1		850-00219-002

* Note 1: Optional. Contact Avidyne to determine if required.

4.2 Mounting tray, Installation kit

Your optional AXP340 mounting tray and installation kit includes the following items:

Unit Description	Qty	Manufacturer Part Number	Avidyne Part Number
Mounting Tray	1	01180-00	200-00258-000
Installation Kit	1	00223-00	

The installation kit contains the following parts:

Unit Description	Qty	Part Number
12 way double sided crimp housing connector	1	00032-00
24 way double sided crimp housing connector	1	00033-00
Crimp Terminal, Female, 18-24 AWG	30	00236-00
Screw, Pozidrive, Pan Head M3x12mm lg	4	00422-00
Connector Co-axial Panel Mount Right Angle Blind Mate	1	00239-00
Circlip 7/16" External	1	00242-00
Washer 7/16" Plain, Stainless Steel	1	00241-00
Washer 7/16" Crinkle, Beryllium Copper	1	00317-00

4.3 Required Items

Additional items you will require, but which are not in the AXP340 package, include:

- Antenna and installation hardware. The AXP340 is compatible with any transponder antenna approved to ETSO C74 or C112d.

- Altitude encoder. You require an encoding altimeter or a blind encoder with either parallel Gray code or RS232 serial output. For best results, and simpler installation, an encoder with a serial output is recommended.

- Cables. You need to supply and fabricate all required cables. Guidance on cable types is given in section 5 below.

- Fixings. To secure the transponder tray to the airframe you will need at least 6 flat head screws and six self-locking nuts. If the aircraft does not have existing mounting provisions you may need to fabricate additional brackets to support the transponder tray.

To support the optional ADS-B features a GPS receiver with an appropriate serial output is required.

5. Installation

5.1 Unpacking and Inspecting Equipment

Carefully unpack the transponder and make a visual inspection of the unit for evidence of any damage incurred during shipment. If the unit is damaged, notify the shipping company to file a claim for the damage. To justify your claim, save the original shipping container and all packaging materials.

5.2 Mounting

The AXP340 Mode S transponder must be mounted rigidly in the aircraft panel. The following installation procedure should be followed, remembering to allow adequate space for installation of cables and connectors.

- Select a position in the panel that is not too close to any high external heat source. (The AXP340 is not a significant heat source itself and does not need to be kept away from other devices for this reason).

- Avoid sharp bends and placing the cables too near to the aircraft control cables.

- Secure the mounting tray (p/n 01180-00) to the instrument panel via the six (6) mounting holes in the tray. It is important that the tray is supported at the rear two mounting holes as well as the front four.

- Check that the locking mechanism is correctly oriented by unscrewing the locking screw if required.

- Slide the AXP340 transponder into the secured mounting tray.

- Lock the AXP340 transponder into the mounting tray using a 3/32" Allen key, taking care not to over tighten the locking screw.

5.3 Cooling Requirements

The AXP340 Mode S transponder meets all applicable ETSO requirements without forced air-cooling.

Attention should however be given to the incorporation of cooling provisions to limit the maximum operating temperature of each unit when the AXP340 is installed in a typical panel or rack. The reliability of equipment operating in close proximity in a rack can be degraded if adequate cooling is not provided.

5.4 Electrical Connections

The AXP340 has two Molex edge connectors, one with 24 contacts, which is the primary interface, and a second connector with 12 contacts which carries signals to support ADS-B. A single coaxial connector attaches to the antenna. In simple installations it is possible to omit wiring for the second connector altogether.

The Molex edge connector used in the AXP340 is similar to the connector used on the KT76A, KT76C and KT78A transponders, and the common signals on the primary connector use the same contact positions and are electrically compatible. The antenna connector is also compatible. Providing that the wiring is appropriately installed, it is intended that you can upgrade a KT76A, KT76C or KT78A installation to the AXP340 without any connector rewiring. Before doing that however, you MUST check that the wiring for the existing transponder is in good condition.

5.4.1 Primary Interface – Pinout

Pin	Signal	Direction
1	Ground	-
2	Lighting 14V	Input
3	Lighting 28V	Input
4	Suppress I/O *	Bi-directional
5	Squat Switch In *	Input
6	Serial Alt Out *	Output
7	Serial Alt In *	Input
8	Altitude D4	Input
9	Suppress In	Input
10	Standby Switch	Input
11	11-33V DC	-
12	11-33V DC	-
A	Ground	-
B	Altitude B4	Input
C	Altitude B2	Input
D	Altitude C1	Input
E	Altitude B1	Input
F	Ident Switch In	Input
H	Altitude C4	Input
J	Altitude A4	Input
K	Altitude A2	Input
L	Altitude C2	Input
M	Altitude A1	Input
N	Do Not Connect *	-

*: These signals are different to the KT76A/KT76C/KT78A pinout; on the KT76A, KT76C and KT78A these signals are not usually connected in the aircraft.

The following diagram shows the connector orientation as it would be fitted to the mounting tray.
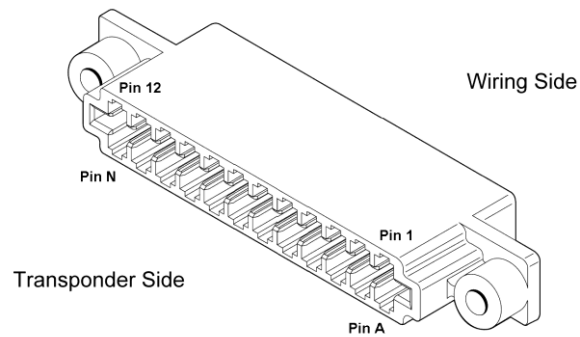
5.4.2 Secondary Interface - Pinout

Pin	Signal	Direction
1	Ground	-
2	Reserved	-
3	GPS Position In	Input
4	Reserved	-
5	Audio Mute In	Input
6	Altitude Alert	Output
A	Ground	-
B	Audio +	Output
C	Audio -	Output
D	Reserved	-
E	Reserved	-
F	Reserved	-
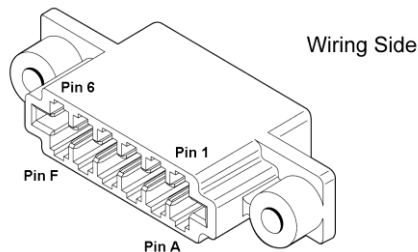
5.4.3 Orientation Diagram

To assist in connector orientation, the following example shows a typical set of connections. This diagram shows the expected connector positions when viewed from the transponder side of the tray, looking into the tray from the front. In the example shown the aircraft uses a 14 volt lighting bus, a parallel altitude encoder, a DME with simple suppression output, a GPS with serial position output, and a simple lamp for the altitude alerter. This example is representative of a simple fixed gear 14 volt aircraft.
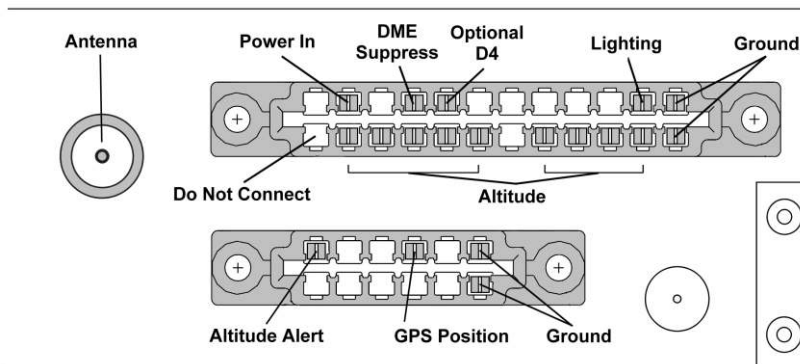
5.5 Interface Details

5.5.1 Power Input

The power supply can be 11-33 Volts DC; no voltage adjustment is required. Contacts 11 and 12 on the 24 way connector are both available as power inputs. This is for compatibility reasons only – internally the two are connected together, and in most installations only one need be connected to the power supply.

Use a 3 Amp circuit breaker for power supply protection to the AXP340.

5.5.2 Lighting Bus Input

Two lighting bus inputs are provided on the 24 way connector to accommodate aircraft with 14 Volt or 28 Volt lighting systems. When the lighting bus operates at 28 Volts, connect the bus input to contact 3, and leave contact 2 unconnected. When the lighting bus operates at 14 Volts, connect the bus input to contact 2. In this case contact 3 can be left unconnected, but for backwards compatibility may also be grounded instead with no effect.

The operation of the lighting bus input is determined by the value of the lighting control setting in section 6.1.16.

5.5.3 Mutual Suppression

Mutual suppression allows two or more transmitters on adjacent frequencies to inhibit the other transmitters when one is active to limit the interference effects. It is commonly used between transponders and DME systems, and between transponders and collision avoidance systems.

The AXP340 provides two styles of mutual suppression interface on the 24 way connector. The Suppress input on contact 9 is typically used in aircraft with simple DME systems and no other suppression requirements. It is an input only, and is active whenever the input is greater than approximately 5 Volts.

The Suppress I/O on contact 4 is an ARINC compatible suppression bus interface, which acts as both an input and an output. The AXP340 will assert this signal when it is transmitting, and can be suppressed by other equipment that asserts the signal. The AXP340 will drive approximately 24 Volts on the output (independently of supply voltage), and will treat the input as active whenever the bus has greater than 10 Volts.

5.5.4 Altitude Inputs and Output

The AXP340 can use either a parallel Gray code altitude input, or serial RS232 altitude input. Both of these interfaces are on the 24 way connector. If the altitude encoder you are using offers both, we recommend using the RS232 serial input. Serial formats allow a higher resolution altitude representation that can be

used by Mode S interrogations, whereas parallel Gray code format can only represent altitude to the nearest 100 feet. You must choose between serial or parallel formats – you should NOT connect both. If a parallel encoder is connected the AXP340 will always use that as the altitude source even if a serial encoder is also connected.

The parallel encoder inputs are active when the voltage to ground is pulled below approximately 4 Volts. The AXP340 includes internal isolation diodes which prevent the unit from pulling the encoder lines to ground when the transponder is switched off. The AXP340 can therefore share the altitude inputs with other devices without needing external isolation.

Parallel output altitude encoders intended for operation below 30,000 feet may not have a signal connection for D4. In an aircraft with a service ceiling below 30,000 feet input D4 will never be active, and can safely be left unconnected.

The serial encoder input uses RS232 input levels. The communication should be 9600 bps, no parity. The AXP340 will correctly recognise either "Icarus/Trimble/Garmin" format altitude data, or "RMS" format altitude data. Refer to the encoder documentation to determine jumper settings as appropriate.

The AXP340 can also accept Shadin family Format G, Format S and Format Z air data protocols which supply both altitude and airspeed information. The airspeed information can be used to provide an automatic air/ground determination for an ADS-B installation.

The AXP340 includes a serial altitude output which repeats the altitude received on the encoded input (either parallel or serial) for connection to a GPS or other equipment. The serial output supplies RS232 output levels, and runs at 9600 bps, no parity. The output format is always "Icarus/Trimble/Garmin" format. If the altitude source is a parallel encoder, the serial output is reported every 0.5 seconds; if the source is a serial encoder, the output simply repeats the input reports, each report delayed by up to 10 milliseconds from the corresponding input report.

5.5.5 Squat Switch Input

The Squat switch input allows the transponder to automatically switch between Airborne and Ground modes of operation. The squat switch will also automatically start and stop the flight timer. The input will be asserted when the voltage to ground is pulled below approximately 4 Volts. The operating mode of the squat switch can be programmed during setup to allow for active low or active high logical behaviour. For aircraft with no squat switch this input should be left open circuit, and the setup mode programmed for "Not Connected".

5.5.6 Ident Switch Input

The Ident switch input, on the 24 way connector, allows the IDENT function to be selected using a remote switch. The input is active low, and will be asserted when the voltage to ground is pulled below approximately 4 Volts.

5.5.7 External Standby Input

This input, when held low, places the transponder in Standby mode. It should be used to switch between transponders in an installation with two transponders. The input is active low, and will be asserted when the voltage to ground is pulled below approximately 4 Volts.

5.5.8 Audio Output

The Audio Output is on the 12 way secondary connector. The Audio Output is a balanced (two wire) audio output that can be connected to an unswitched input on the aircraft audio panel. Audio output is up to 10 Volts peak-to-peak across the pair when driving a 600 Ohm load; actual level can be adjusted at installation

– see Section 6.

> *Note: The audio pair is not a true transformer balanced output – both pins are actively driven. If the audio panel input is single-ended, then only one of the output pins should be used, together with a local ground pin – the other audio output should be left floating.*

The Audio Output carries the traffic alert messages for the altitude audio annunciator used by the altitude monitor function.

5.5.9 Altitude Alerter Output

The AXP340 includes an altitude monitor function that can alert the pilot to altitude deviations in cruise flight. The altitude alerter output, on the 12 way secondary connector, is switched to ground when the altitude deviation is detected and can be connected to a warning light or sounder to warn the pilot. The output is an open collector transistor, and can sink up to 1 Amp DC. The switched voltage should not exceed 60 Volts.

5.5.10 GPS Position Input

The GPS position input is required to support ADS-B functionality. The GPS position input is an RS232 input to the transponder. The ADS-B features are optional – no GPS is required for normal Mode S Elementary Surveillance.

Specific GPS source and antenna, and transponder combination must be FAA approved as a system to utilize ADS-B Out functionality.

The AXP340 GPS input can recognize the following GPS position sources and protocols:

GPS Model		Protocol Used	Baud Rate
Avidyne	IFD440	Trig ADS-B	9600
	IFD540	Trig ADS-B	9600
	Release 9 IFD	Trig ADS-B	9600
Accord Technologies	NexNav Mini	Freeflt/Nexnav	19200
Avmap	2000C	NMEA 0183	9600
	EKP-IV	NMEA 0183	9600
Bendix King	AV8OR	NMEA 0183	9600
	KLN94	Aviation	9600
	SkyMap	Aviation	9600
Freeflight	1201	Freeflt/Nexnav	19200
	1204	Freeflt/Nexnav	19200
	XPLORER	Freeflt/Nexnav	19200
Funkwerk	250	NMEA 0183	9600
Garmin	GNS4x0W	Aviation	9600
	GNS4x0W	Garmin ADSB	9600
	GNS5x0W	Aviation	9600
	GNS5x0W	Garmin ADSB	9600

GPS Model		Protocol Used	Baud Rate
	96 / 96C	NMEA 0183	9600
	Aera 510/795/796	NMEA 0183	9600
	GNC 250(XL)	NMEA 0183	9600
	GNS 480	Aviation	9600
	GNS 4x0	Aviation	9600
	GNS 5x0	Aviation	9600
	GPS 150(XL)	NMEA 0183	9600
	GPS 16X	NMEA 0183	9600
	GPSMAP 295/495/496/695/696	NMEA 0183	9600
	GTN650	Aviation	9600
	GTN650	Garmin ADSB	9600
	GTN750	Aviation	9600
	GTN750	Garmin ADSB	9600

The interface speed can be selected between 4800, 9600, 19200, 38400 and 57600 bps.

Some of the protocols listed above may not contain all the required data for a compliant ADS-B message, depending on the intended airspace regulations. For further information refer to Section 11 (ADS-B Compliance) of this manual.

5.6 Molex Crimp Terminals

The Molex connector contacts should be wired with wire of 18-24 AWG. The contacts are compatible with a wide range of crimp tools. Ensure that the contact has been crimped using both the conductor crimp and the insulator crimp.
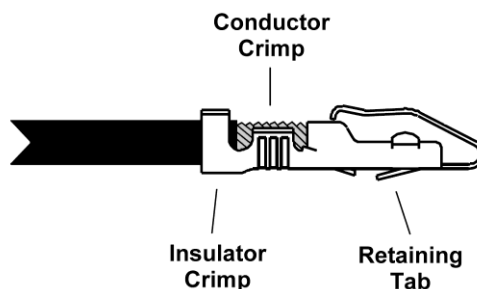
Once crimped, the contacts should be slotted into the rear of the connector shell. Push the contact in until the retaining tab clicks into place. Tug gently to confirm the contact is locked in place.

The contacts can be easily removed using the Molex removal tool, or equivalent. This is pushed gently into the connector shell from the side opposite from the wire entry, and lifts the retaining tab from the stop, allowing the contact to be eased out by pulling on the wire.

5.7 Antenna Installation

The antenna should be installed according to the manufacturer's instructions.

The following considerations should be taken into account when siting the Antenna.

- The antenna should be well removed from any projections, the engine(s) and propeller(s). It should also be well removed from landing gear doors, access doors or others openings which will break the ground plane for the antenna.

- The antenna should be mounted on the bottom surface of the aircraft and in a vertical position when the aircraft is in level flight.

- Avoid mounting the antenna within 3 feet of the ADF sense antenna or any COMM antenna and 6 feet from the transponder to the DME antenna.

- Where practical, plan the antenna location to keep the cable lengths as short as possible and avoid sharp bends in the cable to minimise the VSWR.

- To prevent RF interference, the antenna must be physically mounted a minimum distance of 3 feet from the AXP340 Mode S transponder.

Electrical connection to the antenna should be protected to avoid loss of efficiency as a result of the presence of liquids or moisture. All antenna feeders shall be installed in such a way that a minimum of RF energy is radiated inside the aircraft.

5.7.1 Antenna Cable

The AXP340 is designed to meet Class 1 requirements with an allowance of 2 dB for loss in the connectors and cable used to connect it to the antenna. Excessive loss will degrade both transmitter output power and receiver sensitivity.

Allowing 0.25dB loss for the connector at each end of the antenna cable assembly leaves an allowance of 1.5dB maximum loss for the cable itself.

An acceptable cable:

- Has less than 1.5dB loss for the run length needed

- Has a characteristic impedance of 50 Ohms

- Has double braid screens or has a foil and braid screen

Once the cable run length is known, a cable type with low enough loss per metre that meets the above requirements can be chosen. Longer runs require lower loss cable.

NOTE: Low loss cable typically uses foamed or cellular dielectrics and foil screens. These make such cables especially prone to damage from too-tight bends or from momentary kinking during installation. Once kinked, these cables do not return to full performance when straightened.

The following table is a guide to the maximum usable lengths of some common cable types. Actual cable loss varies between manufacturers, there are many variants, and the table is therefore based on typical data. Use it as a guide only and refer to the manufacturer's data sheet for your specific chosen cable for accurate values.

Max Length in Metres	Max Length in Feet	Insertion Loss dB/metre at 1090MHz	MIL-C-17 Cables	Electronic Cable Specialists Type
2.54	8' 4"	0.59	M17/128 (RG400)	
3.16	10' 4"	0.47		3C142B

3.81	12' 6"	0.39	M17/112 (RG304)	
5.25	17' 3"	0.29	M17/127 (RG393)	311601
6.42	21' 1"	0.23		311501
8.22	26' 11"	0.18		311201
12.59	41' 3"	0.12		310801

Contact Carlisle Interconnect Technologies on +1 414 421 5300 or www.carlisleit.com for their data sheets.

When routing the cable, ensure that you:

- Route the cable away from sources of heat.

- Route the cable away from potential interference sources such as ignition wiring, 400Hz generators, fluorescent lighting and electric motors.

- Allow a minimum separation of 300mm (12 inches) from an ADF antenna cable

- Keep the cable run as short as possible

- Avoid routing the cable round tight bends.

- Avoid kinking the cable even temporarily during installation.

- Secure the cable so that it cannot interfere with other systems

5.7.2 BNC Connector

This section describes the technique for attaching the antenna cable to the supplied blind-mate BNC connector.

If a low-loss cable is needed that has too large a dielectric diameter to fit the supplied blind-mate BNC connector, a short length (up to 150mm or 6 inches) of smaller cable may be used with suitable mating connectors to adapt to the transponder connector.

- Strip back the coax cable to the dimensions in the table, as shown in the diagram below. Slide 25 mm (1 inch) of heat shrink tubing over the cable.
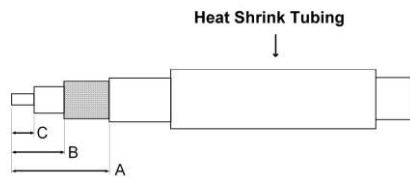
Dimension	Cut size (mm)	Cut size (inches)
A	12.7	0.5
B	6.4	0.25
C	3.2	0.125

- Insert the cable into the connector – the inner conductor should align with the centre contact, the inner shield should be inside the body of the connector and the outer shield should be outside the body.
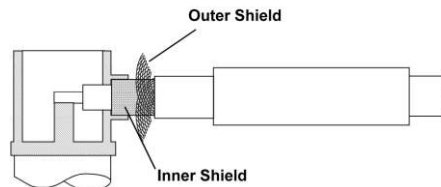
- Solder the centre conductor to the centre contact, aligning the conductor with the slot in the contact. Avoid excess solder heat on the centre BNC conductor pin.

- Solder the inner shield to the inside of the connector body by applying a soldering iron to the body and running solder into the gap. Try to avoid excess solder heat on the connector body.

- Solder the outer shield to the outside of the connector body. Avoid excess solder heat on the connector body.
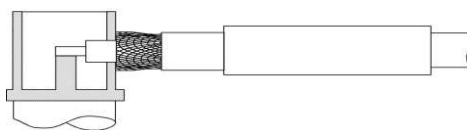
- Slide heat shrink tubing forward (flush to connector) and heat to shrink the tubing.

- Complete the assembly by installing the bushing over the centre contact, and fitting the cap. Solder the cap in place in at least two places.
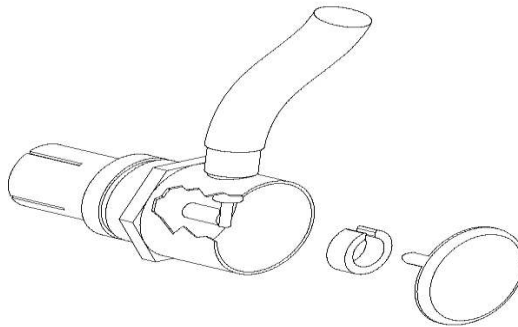
5.8 Tray / BNC Connector Assembly
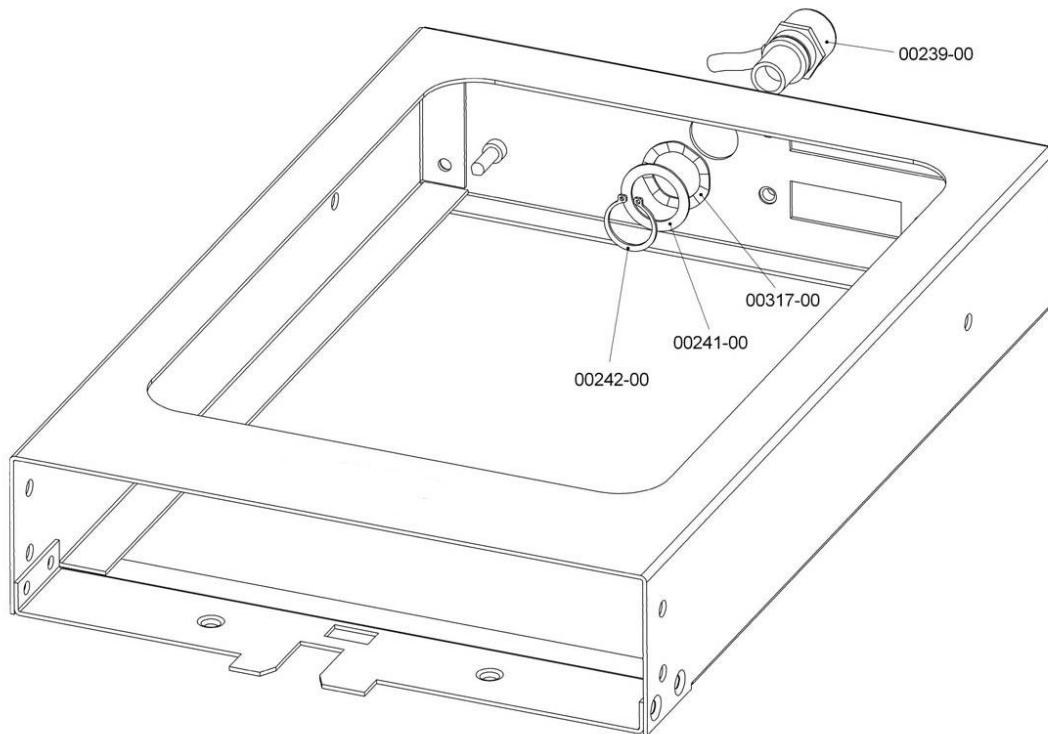
When the BNC is prepared, feed it through the AXP340 mounting tray and attach the washer combination in the following order:

- Wave washer (p/n 00317-00).

- Plain washer (p/n 00241-00).

- Circlip washer (p/n 00242-00).

The Circlip washer should be fitted with a set of Circlip pliers.

The two Molex connectors should be passed through the openings in the rear of the tray, and then mounted firmly to the tray from the inside using the four M3 screws supplied.

6. Installation Setup and Test

The AXP340 uses a simple setup system to program important system parameters, including the Mode S address. In the original factory configuration, the setup screen is the first thing that runs when you switch on the transponder. If the transponder has already been configured, and you want to access the setup screen again, simply press the FUNC button while switching on the transponder and the setup system will run.

The script will prompt for the following configuration items:

- Aircraft Registration

- Mode S Address

- VFR Squawk Code

- Aircraft Maximum Airspeed

- Aircraft Category

- Squat switch source, if fitted

- GPS position source, if fitted, and ADS-B parameters

- Audio Output Volume

- Pressure Altitude Units

- Lighting Control and LCD Dimming Settings

It will then run some simple installation diagnostics, including an external interface check, a check of the altitude encoder interface, and a check of the lighting bus input.

All the programming is accomplished using the rotary selector knob, numeric, CLR and FUNC buttons. Pressing the selector knob accepts the current input. Pressing the CLR (back) button allows you to change something you have already entered. Rotating the selector knob moves up and down through the menu options. Pressing the select tor knob or FUNC button accepts the selection and moves to the next screen.

6.1 Configuration Items

6.1.1 Aircraft Registration

Enter the aircraft registration using the numeric keys and selector knob. When the correct character is shown in the flight ID section of the screen, press the selector knob to accept and advance to the next digit.

Note that the aircraft registration is loaded as letters and numbers only. There are no dashes or other punctuation marks, and no spaces can be inserted. When you enter a space it finishes the data entry and moves to the next item.

The aircraft registration is used as the transponder default Flight ID.

For N registered aircraft, the Aircraft Registration may be used to generate the Mode S Address.

6.1.2 Aircraft Address Programming

The Mode S Address is a 24 bit number issued to the aircraft by the registration authority for the aircraft. These addresses are usually written as a 6 digit hexadecimal number, although you may also encounter one written as an 8 digit octal number. The AXP340 only understands the hexadecimal format, so you must first convert an octal number to hexadecimal.

Enter the 6 digit aircraft address using the numeric buttons or selector knob and confirm selection by pressing the selector knob.

For N registered aircraft, this address may be pre-populated based on the registration number.

Press FUNC to move to the next menu item.

6.1.3 VFR Squawk Code

When the pilot presses the VFR button, a pre-programmed code will replace the current squawk code. The code is set up next; the choice of code will depend on the normal location of the aircraft. In the USA, the VFR squawk code is 1200. In most parts of Europe, the VFR squawk code should be set to 7000.

Enter the 4 digit squawk code using the numeric buttons.

Press selector knob to move to the next menu item.

6.1.4 Airspeed Category

Mode S transponders can transmit their maximum airspeed characteristics to aircraft equipped with TCAS. This information is used to help identify threats and to plan avoiding action by the TCAS equipped aircraft. The airspeeds are grouped in ranges; rotate the selector knob to choose the range that corresponds to the aircraft. Press the selector knob to accept and move to the next menu item.

6.1.5 Aircraft Category

To assist ATC tracking of aircraft, an aircraft category can be transmitted by Mode S transponders. Using the selector knob, choose the aircraft category that most closely matches the aircraft in which the transponder is installed. Press selector knob to accept and move to the next menu item.

6.1.6 Squat Switch Source

The Squat switch input allows the transponder to automatically switch between Airborne and Ground modes, and to automatically start and stop the flight timer. The sense of the squat switch input can be selected using the selector knob. Press selector knob to accept and move to the next menu item.

If the squat switch input is not connected the "Not Connected" option must be selected.

6.1.7 GPS Input

If a GPS is connected for ADS-B position reporting, select the appropriate interface protocol using the selector knob. Press selector knob to accept and move to the next menu item.

6.1.8 GPS Line Speed

If a GPS input has been configured, you should select the appropriate line speed using the selector knob. Press selector knob to accept and move to the next menu item.

The Avidyne IFD440 and IFD540 use the Trig ADS-B protocol at 38400 bps. GPS receivers using the Garmin protocol run at 9600 bps. Panel mount GPS units with Aviation format outputs generally also run at 9600 bps. NMEA GPS units generally run at 4800 bps. Freeflight 1201 and NexNav 3101 GPS receivers generally run at 19200 bps.

6.1.9 GPS System Certification Level

An important metric for ADS-B ground system behaviour is the SDA or System Design Assurance level. It is intended to reflect the probability that the GPS position source is providing erroneous information, and is

based on the certification standard that was used by the GPS vendor. This will be indicated in the form of a letter code (A to D) on the data plate or installation documentation for the GPS in accordance with the standards DO-178B and DO-254, for example "DO-178B level C". If both standards are reported but at different levels, use the lower standard (higher letter).

6.1.10 GPS NACv

Another metric that the ADS-B ground system uses to help it track the aircraft is NACv. NACv is the Navigational Accuracy Category for velocity, and is a design feature of the GPS receiver. It represents the error bound for velocity that the GPS may report in acceleration/deceleration or turning manoeuvres. You can find this information from your GPS installation manual.

6.1.11 Aircraft Length and Width

On the ground, ADS-B transmits encoded aircraft size information which is used by ATC to identify taxiing routes and potential conflicts. When configured for ADS-B, the AXP340 will ask for the aircraft length and width (wingspan), in metres, and will calculate the appropriate size code for transmission.

6.1.12 GPS Antenna Offset

The GPS antenna offset is used together with the aircraft length and width to manage taxiway conflicts. A typical GPS installation does not report the geographic position of the centre of the aircraft, or even the tip of the nose of the aircraft; instead it usually reports the location of the actual GPS antenna (not the GPS receiver). In normal flight operations this distinction is of no practical importance at all, but if ADS-B is used to manage taxiway conflicts, a significant offset in antenna position could mean that the aircraft is not in the same place as the ADS-B reported position. Although primarily intended for position correction on large transport aircraft, General Aviation aircraft can also have a significant offset. For example, if the aircraft has a long tail boom and the GPS antenna is on the top of the tail, the GPS position could be 15 feet or more from the nose of the aircraft.

Enter the position of the GPS antenna relative to the nose of the aircraft. The position is stored and transmitted to the nearest 2 metres; great accuracy in measurement is not required.

6.1.13 ADS-B Receiver Options

In the USA there are two ADS-B channels, 1090ES and UAT, and there is an ADS-B based traffic information service called TIS-B. The ADS-B ground stations relay this information between the two channels so that suitably equipped aircraft can receive traffic information. To limit channel congestion these services are only provided to aircraft equipped to receive them.

The transponder reports what receivers are installed in a periodic status message; enter the receiver status here.

6.1.14 Audio Volume

The altitude alert function includes an audio alert. This configuration item lets you adjust the audio volume output from the transponder using the selector knob. Whilst you are turning the volume control, the transponder will periodically output a test signal to verify the settings.

Press the selector knob to accept and move to the next menu item.

6.1.15 Pressure Altitude Units

This configuration setting lets you select the units of the pressure altitude displayed on some transponder

screens. You may select Flight level (100's of feet), feet or meters.

6.1.16 Lighting Control

The AXP340 has an integrated ambient light sensor in addition to an external input connection from the aircraft lighting bus (if available). This configuration setting selects the way in which the integrated light sensor and the lighting bus input control the brightness of the LCD and the bezel.

Selected Method	Description of lighting control
Normal mode	The display brightness/backlighting is controlled from the ambient light sensor and the bezel is controlled by the lighting bus.
Bus Only	The lighting bus is used to control the bezel and the display brightness/backlighting.
Sensor Only	The ambient light sensor is used to control the bezel and the display brightness/backlighting.

6.1.17 LCD Dim Point

Depending on the amount of light spill in the cockpit, and the brightness of other adjacent avionics displays, it may be necessary to adjust the darkest setting of the backlight to best match other equipment and to improve the cockpit appearance.

Note – it is only practical to do this in pitch darkness, since that is the in-flight environment that you are trying to reproduce. If you are working in a hangar with any other lighting it may be better to leave the setting in the mid-range.

6.1.18 LCD Brightness

The actual maximum brightness of the LCD cannot be increased with this control. What it controls is the rate at which the lighting increases in brightness as detected by the ambient light sensor. This allows the brightness to be matched to other avionics displays during light level changes as far as possible.

6.2 Test items

6.2.1 Interface Check

The Interface Check screen displays the current state of the external IDENT, external STANDBY and external GROUND inputs. Exercise these inputs to confirm the correct behaviour.

6.2.2 Altitude Check

The Altitude check displays the current state of the altitude inputs. Individual Gray code lines are shown to assist in fault tracing.

6.2.3 Lighting Bus

The lighting bus check displays the voltage on the lighting bus to assist in verifying the correct operation of the lighting bus.

6.2.4 Temperature

The internal temperature of the transponder may be accessed only in maintenance mode. This is for information only and does not provide any diagnostic value. Display is in degrees Celsius.

6.2.5 GPS Interface

The GPS interface check provides a simple confidence check that the transponder is receiving data on the RS232 input. Note that this check does not attempt to decode the received data; it is intended only to provide a quick wiring check in the hangar. To assure that the interface is fully operable the aircraft should be tested with the transponder in normal operating mode, with the GPS receiver operating correctly, and a ramp test of the transmitted parameters completed.

7. Post Installation Checks

Post installation checks should be carried out in accordance with your certification requirements. These checks should include:

- Mode S interrogations to verify correct address programming.

- Verification of the reported altitude using a static tester. For aircraft using parallel Gray code encoders, the test should include a range of altitudes up to 6,800 feet, 14,800 feet or 30,800 feet, depending on the service ceiling of the aircraft – these altitudes correspond to code changes which are not otherwise tested at lower altitudes.

- Where installed, verification of correct squat switch ground/airborne indications. In an aircraft with a squat switch, setting the Mode switch to ALT when the aircraft is on the ground should leave the transponder in GND mode; when the aircraft becomes airborne, the mode should switch automatically to ALT.

- Interrogations to verify the receiver sensitivity. A Mode S transponder should have a minimum triggering level (MTL) of between -77 dBm and -71 dBm. Failure to meet this requirement usually indicates antenna or coaxial cable problems.

- Interrogations to verify the transmitted power. A Class 1 installation should have no less than 125 Watts at the antenna (and no more than 500 Watts). Failure to meet this requirement is also generally due to antenna or wiring issues.

- Where installed, verification of the GPS position source and ADS-B outputs. In an aircraft with a configured GPS, pressing the FUNC button on the transponder front panel in normal operation will display the ADS position monitor. With the aircraft outside the hangar (for good GPS reception) the aircraft position should be displayed on the transponder. If the position indications are all dashes then either the GPS position is not valid or the GPS interface is not correctly configured. Whenever a valid position is received by the transponder and the transponder is in any mode other than Standby, ADS-B Extended Squitters should be observed on the transponder test set.
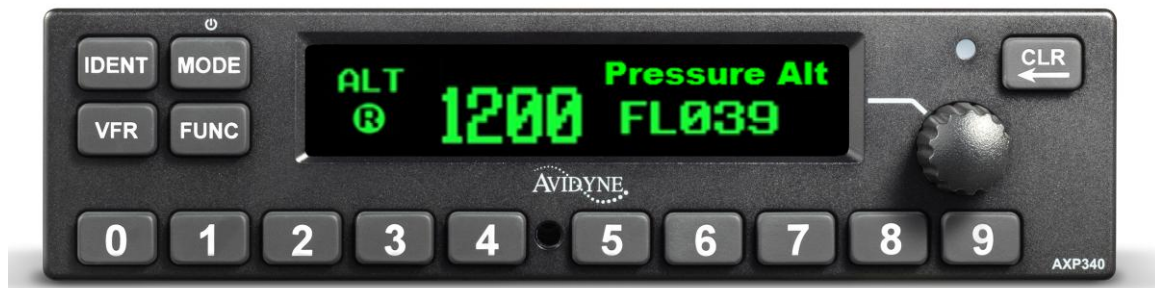
8. Normal Operation

8.1 Overview

On the front panel is a green backlit LCD display flanked buttons for IDENT, VFR squawk code, Mode selection (MODE) and user function selection (FUNC) on the left side and a rotary selector knob plus a CLR / backspace button on the right side of the front panel. A row of numeric buttons lie below the display.

8.2 Front Panel

8.3 Display

The display shows the operating mode of the transponder, the reported pressure altitude, and the current squawk code and Flight ID. The reply indicator is active when the transponder replies to interrogations.

The pressure altitude is displayed as Flight level (100's of feet), feet or meters, depending on the installation configuration of pressure altitude units. When non-standard atmospheric conditions apply, this may not match the altimeter indicated altitude, but will be correctly displayed by the ATC radar.

8.4 POWER ON/OFF

Press the MODE button to turn on the transponder.

Hold the MODE button for at least 3 seconds to turn off the transponder. A count down is displayed on the left side of the screen. When the counter reaches zero and the screen turns off, release the MODE button.

8.5 MODE CONTROL

The MODE button also controls the operation mode of the transponder.

The possible states are as follows:

ALT   The transponder will respond to all interrogations.

ON   The transponder will respond to all interrogations, but altitude reporting is suppressed.

GND   The transponder will respond to Mode S ground interrogations from surface movement radar. This mode is only available in installations that send a ground/air discrete signal to transponder.

SBY   The transponder is on, but will not reply to any interrogations.

When airborne, the transponder should always be set to ALT unless otherwise directed by Air Traffic Control.

Aircraft installations that include a ground/air state input (such as a gear squat switch) will automatically select GND on landing or while taxiing and will automatically select ALT when airborne. In these installations, the pilot selectable states are ALT-ON-SBY when in-air and GND-SBY when on-ground.

8.6 IDENT

Press the IDENT button when ATC instructs you to "Ident" or "Squawk Ident". This activates the SPI pulse in the transponder replies for 18 seconds. IDENT will appear in the display.

8.7 VFR

Pressing the VFR button sets the transponder to the pre-programmed conspicuity code. Pressing the button again restores the previous squawk code.

Pressing the VFR button whilst in Flight ID edit changes the Flight ID to the pre-programmed VFR Flight ID set up during configuration of the transponder.

8.8 FUNC

Pressing the FUNC button provides access to the flight timer, stopwatch, Flight ID editing, ADS-B monitor (depending on installation), altitude monitor and front panel dimming.

8.9 Selector Knob

The selector knob on the right side of the front panel is used to select data such as characters for Flight ID or move through the menu options. Pressing the selector knob confirms the selection or selection of the options presented. A label on the right side of the display describes the action when the selector knob is pressed.

8.10 Numeric Buttons

The numeric buttons are used to select a new Squawk code or flight ID numbers. Pressing buttons 0 through 7 will immediately edit the current squawk code if not already in flight ID edit.

8.11 CLR

Press the CLR button to return to original settings or back space through partially complete data entry or reverse through a menu.

8.12 Squawk code entry

Press any of the numeric buttons (0 through 7) to start modifying the squawk code.   A new squawk code is set when the fourth digit is entered. If the code entry is not completed within 7 seconds, the changes are ignored and the previous code restored.

Some standard squawk codes are listed below

1200   VFR code in the USA

7000   VFR code commonly used in Europe

7500   Hijack code

7600   Loss of communications

7700   Emergency code

8.13 Flight Timer

The Flight Timer records the time for which the transponder has been powered on and operating in flight mode – either ON or ALT. Press the FUNC button to display the Flight Timer.

Pressing the CLR button resets the flight time counter. Pressing the selector knob starts or stops the flight timer. Pressing the FUNC button moves to the next screen and leaves the flight timer in the current state.

8.14 Stopwatch

The stopwatch can be used as a convenient timer. Press the FUNC button to display the stopwatch. Pressing the selector knob starts and stops the timer. Pressing the CLR button resets the timer.

8.15 Flight ID entry

Select the Flight ID edit screen using the FUNC button. The display shows the alpha numeric characters selected via the rotary selector knob or numeric buttons. When the correct character is shown in the flight ID section of the screen, press the selector knob to accept and advance to the next digit. When the selector knob is pressed on the last digit or a space, the new Flight ID will replace the previous value. If a button is not pressed for 7 seconds, the changes are ignored and the previous code restored.

The Flight ID should correspond to the aircraft call sign entered on your flight plan. If no flight plan is active, the aircraft registration should be used as your Flight ID. Use only letters and digits. If the Flight ID is less than 8 characters long, entering a blank character will end it.

8.16 Altitude Monitor

The Altitude Monitor activates an audio annunciator or annunciator light (depending on installation) when the aircraft pressure altitude differs from the selected altitude by more than 200 feet. Press the FUNC button to display the altitude monitor enable screen. Pressing selector knob toggles the altitude monitor at the current altitude.

When altitude monitoring is in use, "ABOVE or "BELOW" is displayed adjacent to the altitude display on the transponder. The Altitude Monitor will automatically be disabled when the deviation exceeds 999 feet or 300 meters. When disabled, "OFF" is displayed.

8.17 ADS-B Monitor

The ADS-B Monitor is only available on installations that include an ADS-B position source. The ADS-B Monitor provides a display of the position information that is being transmitted in ADS-B position reports. This can provide confirmation that the correct information is being transmitted, particularly where the GPS source is remote from the transponder.

In the event that valid position information is NOT available from the GPS, the latitude and longitude display will be replaced by dashes; if no valid latitude and longitude is shown then ADS-B position information is NOT being transmitted.

Loss of ADS-B position information will also result in a WARNING message being displayed.

8.18 Alert Messages

If the transponder detects a problem, the screen will indicate WARNING and a brief statement of the problem. Depending on the nature of the problem, your transponder may not be replying to interrogations. Note the message on the screen and pass that information to your avionics maintenance organisation. The WARNING message should clear when the event has cleared. Press CLR to clear the message at any time;

if the problem is still present the message may reappear.

8.19 Fault Annunciation

If the transponder detects an internal failure, the screen will indicate FAULT and a brief statement of the problem. No replies will be made to interrogations when a fault is detected.

Some FAULT indications can be recovered by switching the transponder off and back on again, although in all cases a FAULT code implies that there is a fault with the transponder or the installation. Note the FAULT message at the bottom of the screen and pass that information to your avionics maintenance organisation.

8.20 Low Temperature Operation

The AXP340 is certified to operate correctly down to -25C, but at low temperatures the display may be impaired. On a cold day you may need to wait for the cockpit to warm up to ensure normal operation.

9. Continued Airworthiness

Other than for periodic functional checks required by the regulations, the AXP340 Mode S transponder has been designed and manufactured to allow "on condition maintenance". This means that there are no periodic service requirements necessary to maintain continued airworthiness, and no maintenance is required until the equipment does not properly perform its intended function. When service is required, a complete performance test should be accomplished following any repair action. Repairs should only be carried out in accordance with the manufacturer's service procedures.

10. Environmental Qualification Form

Nomenclature	AXP340 Mode S Transponder		
Part Number:	01155-00-(XX)	ETSO:	C112d, C166b
Manufacturer	Trig Avionics Limited		
Address	Heriot Watt Research Park, Riccarton, Currie, Scotland, EH14 4AP		
Conditions	**DO-160G Section**	**Description of Conducted Tests**	
Temperature and Altitude	4.0	Equipment tested to Categories A4, C4	
Low temperature ground survival	4.5.1	-55°C	
Low temperature operating	4.5.1	-25°C	
High temperature operating	4.5.3	+70°C	
High temperature short-time operating	4.5.2	+70°C	
High temperature ground survival	4.5.2	+85°C	
Loss of Cooling	4.5.4	Cooling air not required (+70°C operating without cooling air)	
Altitude	4.6.1	55,000 feet	
Decompression	4.6.2	8,000 to 55,000 feet in 15 seconds	
Overpressure	4.6.3	-15000 feet	
Temperature Variation	5.0	Equipment tested to Category C	
Humidity	6.0	Equipment tested to Category A	
Operational Shocks	7.2	Equipment tested to Category B	
Crash Safety	7.3	Equipment tested to Category B	
Vibration	8.0	Aircraft zone 2; type 3, 4, 5 to category S level M Equipment also tested to aircraft zone 2; type 1 (Helicopters) to category U level G	
Explosion	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	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 tested to Category Z	
Power Input	16.0	Equipment tested to Category BX	
Voltage Spike	17.0	Equipment tested to Category B	
Audio frequency conducted susceptibility	18.0	Equipment tested to Category B	
Induced signal susceptibility	19.0	Equipment tested to Category AC	
Radio frequency susceptibility	20.0	Equipment tested to Category TT	
Radio frequency emission	21.0	Equipment tested to Category B	
Lightning induced transient susceptibility	22.0	Equipment tested to Category B2H2L2	
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
Flammability	26.0	Equipment tested to Category C

11. ADS-B Compliance

AXP340 transponders with software version 3.6 and above include support for Extended Squitter ADS-B out which is compliant with DO-260B with corrigendum 1. The AXP340 is a B1S ADS-B transmitter.

Specific GPS source and antenna, and transponder combination must be FAA approved as a system to utilize ADS-B Out functionality.

11.1 ADS-B Parameters Supported

The following table lists the ADS-B parameters that are transmitted by the AXP340 transponder when connected to an appropriate GPS receiver.

Parameter		BDS Register
SPI		0,5
Emergency Indicator		0,5
Barometric Altitude		0,5
Quality Indicator (NIC)		0,5
Airborne Position	Latitude	0,5
	Longitude	0,5
Quality Indicator (NIC)		0,6
Surface Position	Latitude	0,6
	Longitude	0,6
Surface Ground Speed		0,6
Surface Ground Track		0,6
Aircraft Identification		0,8
Airborne Ground Velocity		0,9
Geometric to Barometric Altitude Difference		0.9
Geometric Vertical Speed		0.9
Squawk Code		6,1
Emergency Status		6,1
Quality Indicator (NACp, NACv and GVA)		6,5
Quality Indicator (SIL and SDA)		6,5
Version Indicator		6,5
Surface Length/Width		6,5
Surface Antenna Offset		6,5

In all cases, uncompensated latency due to the transponder is less than 10 milliseconds. Analysis of the system latency should add this to the latency of the GPS system and the transmission time of the position data from the GPS to the transponder to determine the overall latency.
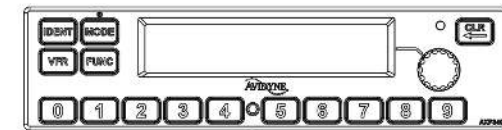
12. Installation Drawings

All dimensions in millimetres

13. Basic Interconnect Diagram

AXP340 MODE S TRANSPONDER

Pin	Signal
1	Ground
2	Lighting 14V
3	Lighting 28V
4	Suppress I/O
5	Squat Switch
6	Serial Alt Out
7	Serial Alt In
9	Suppress In
10	Ext Standby
11	11-33V DC
12	11-33V DC
A	Ground
F	Ext Ident
8	Alt D4
B	Alt B4
C	Alt B2
D	Alt C1
E	Alt B1
H	Alt C4
J	Alt A4
K	Alt A2
L	Alt C2
M	Alt A1
N	Test

MUTUAL SUPPRESSION BUS

GPS POSITION SOURCE

SERIAL ALTITUDE ENCODER or ADC

DME

PARALLEL ALTITUDE ENCODER

OTHER TRANSPONDER

3A CIRCUIT BREAKER 11 – 33V

Pin	Signal
1	Ground
2	Reserved
3	GPS Input
4	Reserved
5	Audio Mute
6	Alt Alert
A	Ground
B	Audio +
C	Audio –
D	Reserved
E	Reserved
F	Reserved
RF	Coax

LAMP

1A CIRCUIT BREAKER 11 – 33V

AUDIO PANEL

NOTES:
1. ALL WIRES SHOULD BE 18 – 24 AWG

1. ONLY CONNECT ONE ALTITUDE DATA SOURCE, EITHER A SERIAL ENCODER, PARALLEL ENCODER OR ADC.

2. WHEN USING DATA FROM AN ADC, IT SHOULD BE CONNECTED TO THE "SERIAL ALT IN", AS SHOWN.

3. CONNECT ONLY ONE INPUT TO THE LIGHTING BUS, DEPENDING ON LINE VOLTAGE

4. LAMP SHOWN AS EXAMPLE OF POSSIBLE ALERTER INSTALLATION. OTHER OPTIONS ARE POSSIBLE.

14. AVIDYNE EXCLUSIVE LIMITED WARRANTY and LIMITATIONS ON LIABILITY

Avidyne warrants the Product manufactured by it against defects in material and workmanship for a period of twenty-four (24) months from delivery. If Avidyne's Product fails to conform to this warranty, Avidyne, in its sole discretion, will either repair or replace the Product or provide a refund of the purchase price paid for the Product. This warranty is made upon the express conditions that:

    a)   Avidyne is given prompt written notice of any claimed non-conformity in the Product with a reasonable explanation thereof;

    b)   The Product is returned to Avidyne or to an Avidyne authorized service facility;

    c)   The Product has not been altered in any manner other than as previously authorized by Avidyne in writing; and

    d)   Repairs to the Product have not been made by anyone other than Avidyne or an Avidyne authorized service facility.

This warranty does not apply to any Product which is not installed, maintained and operated in accordance with Avidyne's written instructions or which is otherwise misused, including, without limitation, to any Product which is damaged due to improper installation, maintenance or operation, tampering, alteration of serial numbers or other manufacturers data, lightning or other electrical source, or otherwise.

If warranty protection is applicable to the Product, Avidyne will use reasonable efforts to repair or replace Product within ten (10) business days of its receipt of the Product.

Any Product that has been repaired by Avidyne or replaced by Avidyne under this warranty will be subject to remainder of the original warranty term applicable to the repaired or replaced Product or will be warranted under the warranty terms above for ninety days from the date of repair or replacement, whichever period is longer.

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