



## FDL-978 ADS-B Equipment

### Pilot Guide/User Manual

Part Numbers  
87098-XX-XXXX



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# **FDL-978**

## **ADS-B Transmitter and Transceivers**

### ***Pilot Guide/User Manual***

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Added description of external control feature and reverse video displayed on the TC978 Controller.	2-4	June 25, 2015
Incorporated FDL-978 Lite Series equipment and configuration, along with software release 001F updates.	All pages	



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## 1 Introduction

The FreeFlight Systems (FFS) FDL-978 Automatic Dependent Surveillance – Broadcast (ADS-B) Transmitters and Universal Access Transceivers (UAT) are a 978 Megahertz (MHz) class B1/B1S and class A1H/A1S equipment designed to share aircraft position, velocity, and other flight information with other aircraft and ground station equipment.

The FDL-978 ADS-B equipment satisfy the DO-282B Minimum Operational Performance Standards (MOPS) and the TSO-C154c requirements for UAT ADS-B class B1, B1S, A1H and A1S equipment and is fully compliant with the Airborne Surveillance & Separation Assurance Processing (ASSAP) EVAcq (Class C1) requirements of TSO-C195a and RTCA/DO-317A.

The FDL-978 equipment is intended to provide an ADS-B transmitter or transceiver solution to meet the Federal Aviation Administration (FAA) mandate for ADS-B Out installation on every aircraft operating in U.S. airspace by 2020 (14 CFR §91.225, AC 90-114), while providing a solution for ADS-B In applications.

### 1.1 Description

This document contains instructions for operating the FDL-978 ADS-B equipment. Depending on the installation requirements, the FDL-978 ADS-B Equipment may use the TC978 Controller. This guide is valid for the FDL-978 ADS-B equipment Part Numbers (P/N's) 87098-XX-XXXX. The software version and Technical Standard Order (TSO) compliance data are found on the unit identification labels.

The material provided in this manual includes the following:

- Section 1 - Presents a brief introduction to the system.
- Section 2 - Describes user instructions for data entry, modes, displays, and functions using the TC978 controller.
- Section 3 - Describes the Anonymous Mode and ADS-B Annunciator when used to report failure status.
- Appendix A - Defines the acronyms and abbreviations used in this manual.
- Appendix B - Outlines the Limited Warranty details for this product.

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## 2 TC978 Controller

The FDL-978 ADS-B equipment may interface to a TC978 Controller (P/N 87349) used in-flight by the pilot to control output of ADS-B messages. The TC978 Controller receives its power from and communicates with the FDL-978 ADS-B equipment. The TC978 Controller consists of the following components:

- Monochrome Liquid Crystal Display (LCD)
- **VFR** (Visual Flight Rules) button
- **FN** button (Function)
- **CODE** knob
- **ENT** button (Enter)
- Mode Selection knob
- **IDT** button (Ident)

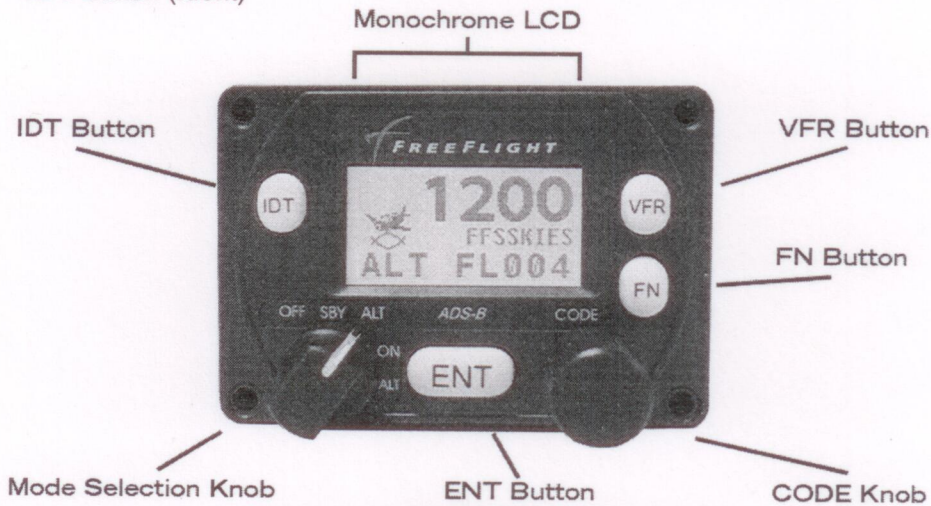


Figure 1. TC978 Components

### 2.1 Display



The wave symbol under the aircraft image traveling upward indicates that the FDL-978 equipment is receiving ADS-B messages.



The wave symbol under the aircraft image traveling downward indicates that the FDL-978 equipment is transmitting ADS-B messages.



The wave symbol under the aircraft image traveling upward and downward indicates the FDL-978 equipment is transmitting and receiving ADS-B messages. The FDL-978 ADS-B Transceiver equipment receives ADS-B transmissions regardless of the transmission mode.



The pressure altitude is displayed as a Flight Level in hundreds of feet. The Flight Level shown may not match the indicated altitude on the altimeter due to non-standard atmospheric conditions.

Figure 2 shows the ALT Mode display of the FDL-978 ADS-B Transceiver equipment:

- Squawk Code
- Call Sign/Flight ID
- Reported pressure altitude in hundreds of feet

Figure 2 also shows the FDL-978 ADS-B Transceiver equipment powered on in Airborne Transmission mode with a pressure altitude of flight level 400 feet being displayed, as defined in Table 1.

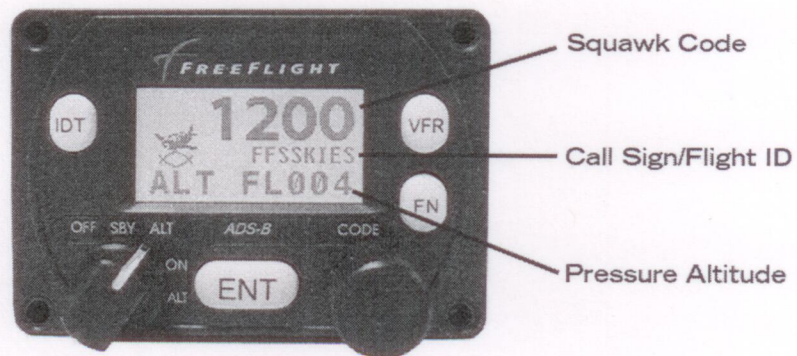


Figure 2. ALT Mode Display (Typical)

## 2.2 Mode Selection Knob

The Mode Selection knob controls power to the FDL-978 ADS-B equipment and operating modes. The knob rotates between the different operating modes, as defined in Table 1.

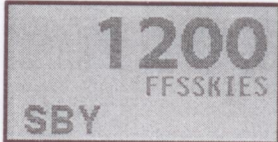

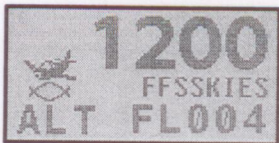

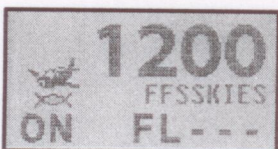
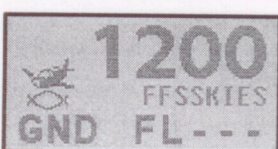


Figure 3. Mode Selection Knob



There is no functional difference between the two ALT positions.

**Table 1. Mode Descriptions**

<b>OFF</b>	Power is removed from the FDL-978 ADS-B equipment.
<b>SBY</b>	<p>The FDL-978 ADS-B equipment is on and will not transmit any ADS-B messages, but will still receive ADS-B messages if the ADS-B equipment has receive capabilities.</p> <div data-bbox="727 615 1003 756" style="text-align: center; border: 1px solid black; padding: 5px;">  </div>
<b>ALT</b>	<p> When airborne, the control should always be set to either of the two ALT positions unless otherwise directed by ATC.</p> <p>The FDL-978 ADS-B equipment is placed in Transmission Mode with pressure altitude reported in transmitted messages (applies to both ALT positions).</p> <p>The FDL-978 equipment automatically switches between Airborne and Ground Mode. In Airborne Mode <b>ALT</b> is displayed below the aircraft image and in Ground Mode <b>GND</b> is displayed below the aircraft image.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="430 1060 820 1102" style="text-align: center;"> <p><b>Airborne Transmission Mode</b></p> <div data-bbox="483 1108 760 1249" style="text-align: center; border: 1px solid black; padding: 5px;">  </div> </div> <div data-bbox="917 1060 1307 1102" style="text-align: center;"> <p><b>Ground Transmission Mode</b></p> <div data-bbox="958 1108 1234 1249" style="text-align: center; border: 1px solid black; padding: 5px;">  </div> </div> </div>
<b>ON</b>	<p>The FDL-978 ADS-B equipment is placed in Transmission Mode with <i>no</i> pressure altitude reported in transmitted messages.</p> <p>The FDL-978 equipment automatically switches between Airborne and Ground Transmission Mode. In Airborne Mode <b>ON</b> is displayed below the aircraft image and in Ground Mode <b>GND</b> is displayed below the aircraft image.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="430 1459 820 1501" style="text-align: center;"> <p><b>Airborne Transmission Mode</b></p> <div data-bbox="479 1507 755 1654" style="text-align: center; border: 1px solid black; padding: 5px;">  </div> </div> <div data-bbox="917 1459 1307 1501" style="text-align: center;"> <p><b>Ground Transmission Mode</b></p> <div data-bbox="954 1507 1230 1654" style="text-align: center; border: 1px solid black; padding: 5px;">  </div> </div> </div> <p style="text-align: center;">Suppression of pressure altitude reporting is indicated by <b>FL---</b>.</p>



### 2.3 CODE Knob

The **CODE** knob is used to set Squawk Codes and the Call Sign/Flight ID. Press the **FN** button until either the Squawk Code or Call Sign/Flight ID is highlighted at the top of the display. Turning the **CODE** knob will highlight the first digit on the display, then the digit can be modified as required by rotating the **CODE** knob. Press the **ENT** button to advance to the next digit and repeat until the Flight ID entry is complete. When the **ENT** button is pressed on the last digit, the new Squawk Code or Call Sign/Flight ID will replace the previous value. If the code entry is not completed within 7 seconds the changes are ignored and the previous code is restored.

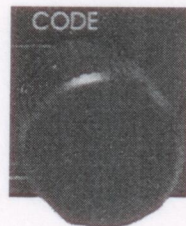


Figure 4. CODE Knob

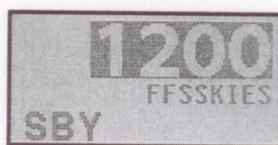
Table 2. Common VFR Squawk Codes

1200	VFR code in the USA
7500	Hijack Code
7600	Loss of communications
7700	Emergency Code

The Call Sign/Flight ID should correspond to the Aircraft Identification entered on the flight plan. The aircraft registration should be used as the Call Sign/Flight ID unless a company designator and flight number is available. Use only letters and digits. If the Call Sign/Flight ID is less than eight characters long entering a blank character will end new entry.

### 2.4 External Control and Reverse Video

The TC978 provides control to the FDL-978 ADS-B equipment or the FDL-978 system can be configured for external control. External control inputs, such as Squawk Codes, Call Sign/Flight ID, and mode control (IDENT, Altitude Inhibit, transmit Standby), are needed by the FDL-978 ADS-B equipment. If an external controller is configured and functional with the TC978 installed the TC978 displays status, but locks out user control inputs. Mode control is always provided by the external controller, so the position of the Mode Selection Knob only serves to turn on power to the ADS-B system. When in external control mode the TC978 will display the Squawk Code and/or Call Sign/Flight ID in reverse video, as shown below.



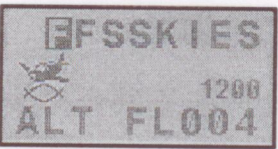
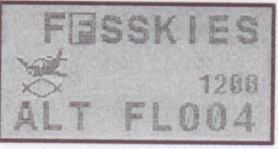
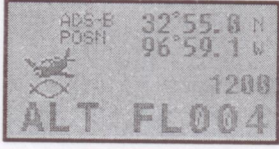




## 2.5 Push Buttons



The TC978 control inputs, such as Squawk Codes, Call Sign/Flight ID, and mode control (IDENT, Altitude Inhibit, transmit Standby) are configurable by the TC978 only when external controls are not being used.

<b>IDT</b>	Press the <b>IDT</b> button when ATC instructs you to "Ident" or "Squawk Ident."  
<b>FN</b>	Pressing the <b>FN</b> button provides access to changing the Call Sign/Flight ID.   <p>You may either directly rotate the <b>CODE</b> knob or press the <b>ENT</b> button and the first character of the Call Sign/Flight ID will be highlighted. Use the rotary <b>CODE</b> knob to select your choice of alpha-numeric characters. Press the <b>ENT</b> button again and the cursor moves to the next character. You must press the <b>ENT</b> button each time, all the way through the eight characters, to save your Call Sign/Flight ID change.</p>   <p>Pressing the <b>FN</b> button again allows the user to view the present Global Positioning System (GPS) position being transmitted.</p> 

<p><b>FN</b></p>	<p>Pressing the <b>FN</b> button a third time allows the user to adjust the brightness level of the screen. Turning the <b>CODE</b> knob to the right will make the screen brighter. Turning the <b>CODE</b> knob to the left will decrease the brightness. When the desired brightness is reached, press the <b>FN</b> button to lock the brightness setting.</p> <div data-bbox="701 499 977 646" data-label="Image"> </div> <p>If there are any errors, the fourth press of the <b>FN</b> button allows user to view the FDL-978 ADS-B equipment WARNINGS.</p> <div data-bbox="701 743 977 890" data-label="Image"> </div> <p>The next <b>FN</b> button press returns to the main Squawk Code view.</p>
<p><b>VFR</b></p>	<p>Pressing the <b>VFR</b> button sets the ADS-B to the pre-programmed Squawk Code or <b>VFR</b> Call Sign/Flight ID. Pressing the <b>VFR</b> button again restores the previous Squawk Code or Call Sign/Flight ID. To toggle the Squawk Code the display must be in the Squawk Code view. To toggle Call Sign/Flight ID the display must be in the Call Sign/Flight ID view.</p> <div data-bbox="701 1155 977 1302" data-label="Image"> </div>
<p><b>ENT</b></p>	<p>The <b>ENT</b> button enters a digit in the code selector.</p>

## 2.6 Warning Messages

If the FDL-978 ADS-B equipment detects a malfunction, the **MSG** icon appears in the center of the display to indicate that warning messages are present. The **MSG** icon will remain as long as the malfunction is present. Depending on the nature of the malfunction, the FDL-978 ADS-B equipment may not transmit ADS-B messages.





Cycle power on the FDL-978 ADS-B equipment. If the problem persists, contact an Authorized Service Center.

**Table 3. Warning Messages**

Message	Potential Cause
Synth Unlock	Transceiver can't lock to carrier frequency.
TX Fault	Generic Transceiver Fault – POST, transmit, address, broadcast, or nominal rate failure.
Tx Power Low	Transceiver power too low.
Tx PSU High	Transceiver power supply voltage too high.
Tx PSU Low	Transceiver power supply voltage too low.
Squitter Fail	Transceiver modulation fault.
Remote Hot	FDL-978 ADS-B equipment internal temperature too high.
No ADS-B Pos	The unit is not receiving digital serial communication from the GPS.
GPS Fault	GPS has reported unavailable position or a fault.
Top Ant Fault	Top antenna disconnected.
Bot Ant Fault	Bottom antenna disconnected.
PSU Fail	Internal DC Power Supply failure.
ADC Fault	ADC or Altitude encoder fault or not responding.



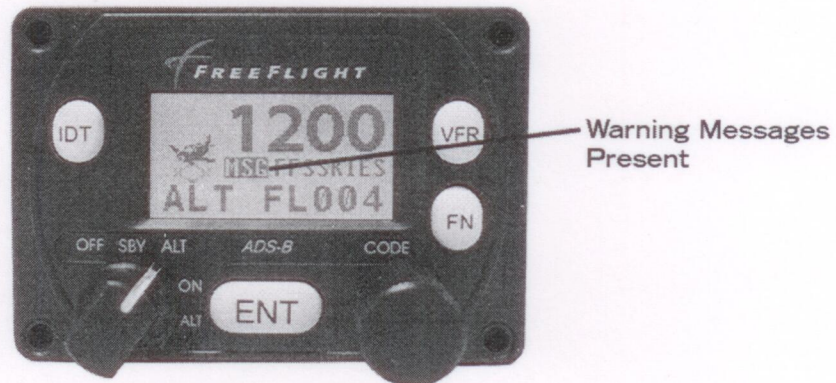


Figure 5. Warning MSG Icon

To enter the Warning View mode, press the **FN** button four times and WARNING will be displayed top center along with a brief description of the fault. In this mode, the Controller continually requests the active warning messages from the FDL-978 ADS-B equipment and displays them on the Controller. Press the **FN** button again to exit this mode and return to normal operation.



Warning/Troubleshooting messages are described in Section 3.

## 2.7 No Remote Link

If the FDL-978 ADS-B equipment loses communication with the TC978 after power-up, the TC978 display will be as shown below.



If the FDL-978 ADS-B equipment loses communication with the TC978 before power-up, the TC978 display will be as shown below.



## 2.8 Fault Annunciation

If the FDL-978 ADS-B equipment detects a catastrophic internal failure the screen will indicate FAULT with a brief statement of the problem. No ADS-B messages will be transmitted when a fault has been detected.



### 3 Miscellaneous

#### 3.1 Anonymous Mode

ADS-B Out messages broadcast the registered ICAO address and call sign to identify the aircraft for the purpose of utilizing ATC services. The FDL-978 systems have an Anonymous Mode feature that will broadcast a random, temporary, ICAO address and no call sign when enabled. This feature can only be enabled through a dedicated pilot interface.

When Anonymous Mode is enabled the previous call sign will continue to be displayed in the TC978, but will not be broadcast. When Anonymous Mode is disabled, the FDL-978 resumes broadcasting the registered ICAO address and Call Sign. Anonymous Mode can be disabled by the pilot, or whenever the squawk code is changed from 1200.

Anonymous Mode is not available in aircraft with a Mode S transponder.



The Anonymous Mode can only be enabled when the squawk code is set to 1200, no flight plan is filed, and ATC services are not requested.



The FDL-978 equipment defaults to the registered aircraft ICAO address and call sign when initially powered on. Anonymous Mode will not be enabled within the first 90 seconds after the FDL-978 is powered on.



The FDL-978 equipment will automatically revert back to the default ICAO address and call sign when the squawk code is changed from 1200.



In Anonymous Mode you're unable to receive Instrument Flight Rule (IFR) or Visual Flight Rule (VFR) separation services. Also potential loss of enhanced search and rescue benefits, and potential negative impacts to ADS-B IN applications could occur.

#### 3.2 ADS-B Annunciator

If the aircraft is not equipped with a TC978, or MFD capable of displaying failure conditions, a separate ADS-B annunciator will be installed as shown in the following figure. The annunciator is required to identify two types of failure conditions – an ADS-B Device Failure and a Position Source Failure.



Cycle power on the FDL-978 ADS-B equipment. If the problem persists, contact an Authorized Service Center.



Figure 6. Fault Annunciator Light

	Normal Operation	ADS-B Device Failure (TX Fault)	ADS-B Position Source Failure (GPS Fault)
Light Status	Off	Steady ON	Flashing

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**APPENDIX A      Acronyms and Abbreviations**

Item	Description
ADS-B	Automatic Dependent Surveillance – Broadcast
ASSAP	Airborne Surveillance & Separation Assurance Processing
ATC	Air Traffic Control
FAA	Federal Aviation Administration
FFS	FreeFlight Systems
GPS	Global Positioning System
IFR	Instrument Flight Rule
LCD	Liquid Crystal Display
MHz	Megahertz
MOPS	Minimum Operational Performance Standards
P/N	Part Number
TSO	Technical Standard Order
UAT	Universal Access Transceiver
VFR	Visual Flight Rules

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## APPENDIX B Limited Warranty

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