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Document-P/N:	FTK100-OM	

FTK100 FIELD TEST KIT

OPERATING MANUAL



Document-P/N: *FTK100-OM*


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DE	Design Engineer
HD	Head of Design Engineering
PM	Production Manager
QM	Quality Manager

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RECORD OF REVISIONS

Date	Issue	Page	Paragraph	Firmware Revision	Comments
08.01.2013	1.00	All	All		Preliminary Draft

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FIRMWARE REVISIONS

Date	Firmware Revision	Comments
08.01.2013	1.10	Firmware version initial release

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1.0 Introduction

The Aventech Research Inc. FTK100 is an integrated Field Test Kit which provides an extensive set of testing functions to verify the operational status of Aventech's line of airborne air-data, GPS and inertial system products. FTK100 test functionality includes:

- Validation and calibration of pressure channel measurements for both pitot-static and five-hole probes including barometric, pitot-static, angle-of-attack and angle-of-sideslip pressures
- Display of three-axis accelerometer and rate sensor measurements for validation of inertial subsystem
- Display of GPS receiver data for validation of GPS subsystem
- Display of three-axis magnetic sensor measurements
- Display of temperature and humidity measurements for validation of environmental / meteorological subsystem
- Reporting of IBIT status
- Reporting of CBIT status
- Firmware update capability for both the FTK100 unit itself as well as the attached instrumentation

Features of the FTK100 include:

- 3.5" Colour QVGA (320 X 240) TFT Touch-screen LCD display
- Intuitive easy-to-use menu driven operating system
- Integrated pump, plenum and valve system for provision of test pressures
- High-speed CAN AERO port for communication with the device under test
- One 15 psi pressure port for testing / calibrating barometric sensors
- Five 1 psi pressure ports for testing / calibrating pitot-static, angle-of-attack and sideslip pressures
- Integrated USB port for storage of data files and test reports which can then be easily transported to other computer systems
- Internal Real-Time Clock (RTC) for time stamping validation / calibration reports
- Integrated Lithium Ion battery providing up to 10 hours run time
- Integrated battery charging electronics with 100-240 50-60 Hz VAC plug-in wall charger
- Integrated battery gauge for reporting battery charge status

The FTK100 interfaces with a variety of air-data probe calibration fixtures and can be utilized as a standard pressure calibration device. FTK100 full functionality exists for the Aventech Research Inc. ARIM200 Air Data Probe and ARIM320 Air / Inertial / Meteorological Digital Data System.

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2.0 Quick Start

One of the first things you will want to do with your FTK100 Field Test Kit is to become familiar with its external controls and connections. We have written the exercises in this chapter to prepare your FTK100 for use and help you get familiar with some of its operations.

2.1 Verify the List of Supplied Items

The first thing you will want to do is verify that you have received the following items with your Field Test Kit. If anything is missing, please contact your approved reseller or Aventech Research Inc. directly.

- ✓ One hand-held FTK100 Field Test Kit control unit
- ✓ One Calibration Fixture
- ✓ Six lengths of plastic tubing
- ✓ One wall-mount 12.8 VDC output power supply for charging battery
- ✓ This Operating Manual

2.2 Charging the Unit

Although the unit will have been fully charged before it left our facility, it is recommended that you charge the unit before its first use.

2.3 FTK100 and Calibration Fixture External Features

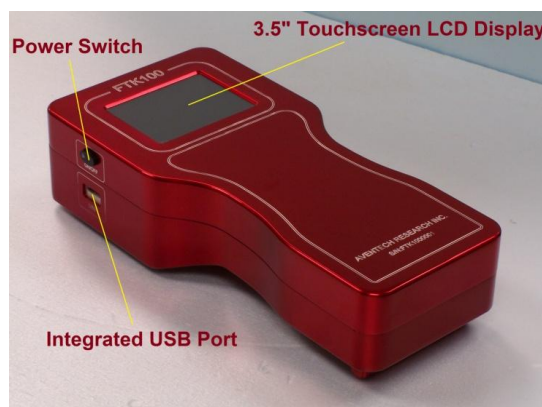


Figure 1: FTK100 Front and Left Hand Side Panel Features

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Figure 2: FTK100 Top Panel Features



Figure 3: Integrated Stylus for use with LCD Touchscreen

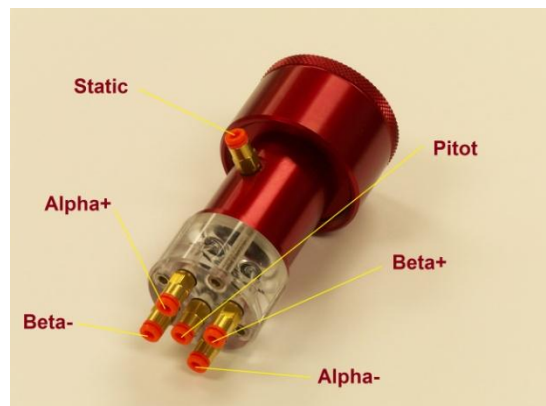


Figure 4: Typical Calibration Fixture Tubing Connections (ARI320 Version Shown)

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2.4 Connecting the Calibration Fixture to the FTK100

This section describes how to connect the calibration fixture to the FTK100 control module.

The FTK100 supports calibration fixtures designed to test pressures on standard pitot-static probes and five-hole probes. A calibration fixture designed to test the five-hole probe integrated into the ARIM320 is shown in Figure 4. For testing the more common pitot-static probes, tubing is only required to be connected between the pitot tubing connector on the forward face of the calibration fixture, and the static tubing connector furthest aft on the side of the calibration fixture. If a five-hole probe is being tested, as shown in Figure 4, tubing must also be connected to the angle-of-attack (alpha) connectors in the vertical plane and sideslip connectors in the horizontal plane. Please note that the calibration five-hole probe calibration fixtures are typically designed so that the static connector is on the same side as the Alpha+ connector. This allows the user to orient the calibration fixture correctly when installing it on the probe.

Both the FTK100 control module and Aventech Research Inc. calibration fixtures utilize 1/8" OD quick connect / disconnect fittings to interface to the interconnecting pressure tubing. To install the tubing simply insert it as far as possible into the fitting and it will lock in place. To disconnect, push down on the orange collar on the fitting and pull the tubing out.

Six lengths of 1/8" OD tubing will have been provided with your field test kit which should be installed between the pressure connections show on the calibration fixture in Figure 4 and the labeled input ports on the FTK100 shown in Figure 2.

2.5 Installing the Calibration Fixture

For pitot-static probes, orientation of the calibration fixture is not important however, for five-hole probes it is critical. As described in Section 2.5, the static pressure fitting is typically located on the same side as the alpha+ pressure fitting.

Install the calibration fitting onto the measurement boom by sliding it over the boom while insuring the static pressure fitting is pointing straight up. This will insure that the remaining pressure fittings are oriented correctly relative to the pressure ports on the measurement boom. Slide the fixture as far as it will go onto the boom and then apply a small amount of longitudinal force to the fixture to compress the O-rings against the nose of the boom and seal off the pressure ports to the calibration fixture. While applying this force, rotate the collar located at the rear of the calibration fixture clockwise, when looking at the front of the fixture, gently to lock the fixture onto the probe boom.

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Some calibration fixtures will be manufactured with a clear acrylic front to allow the user to observe that the pressure inputs in the calibration fixture are correctly oriented with the pressure ports on the probe.

2.6 Installing the Interface Cable

Install the CAN Interface cable between the FTK100 and Device Under Test (DUT).

2.7 Turning the Unit On

To begin a test both the DUT and the FTK100 have to be turned on in that order. To power the FTK100 depress and release the power switch shown in Figure 1.

As the unit boots up and runs its internal self-tests the splash screen shown in Figure 5 below will appear showing the unit's current firmware version and build number, manufacturing date and calibration date.



Figure 5: FTK100 Splash Screen

At completion of the start-up procedure the main FTK100 operating system menu window will appear as shown in Figure 6 below.

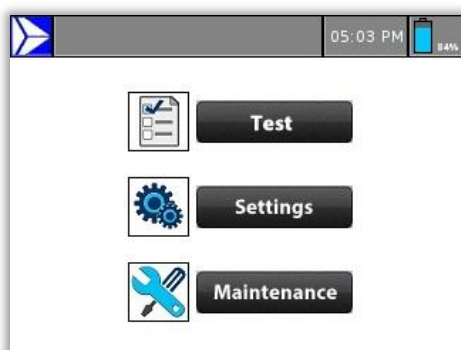


Figure 6: FTK100 Operating System Main Menu Window

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The FTK100 operating system windows consists of a status bar and display area with menu buttons to access and run various test, settings, and maintenance functions programmed into the unit.

The status bar appears in each menu window providing any necessary status information, the current time from the real-time clock just to the right of centre-screen and the battery charge status in the right-hand corner. Home button at the top left corner can be used to navigate to the main window from any other windows.

2.8 Resetting the Device

The device can be reset at any point by pressing and holding the on/off button for more than five seconds and releasing it once the touch screen shuts down.

Note: All test results will be erased once the device is reset.

2.9 Turning the Device Off

To shut down the device, the on/off push button should be pressed and held for one to two seconds and released.

Note: The device cannot be turned off while it is in the test mode. In order to turn it off, you have to exit from the test mode and make sure the screen is showing either the home/main page or any other subpages such as test, settings, or maintenance.

3.0 Menu Features and Functions

3.1 Test

After pressing the Test button on the main menu, the FTK100 will immediately connect with the DUT, download and subsequently display the CAN AERO Node ID number, serial number and firmware version of the DUT.

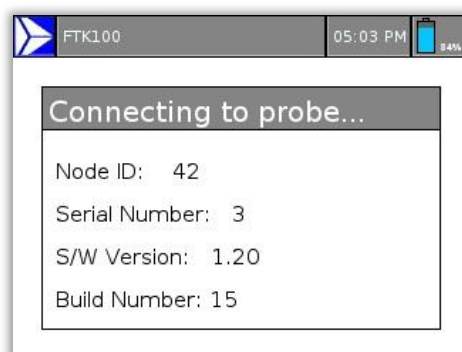


Figure 7: Connecting to DUT and Obtaining Probe Information

The DUT Node ID, Serial number and software ID data are displayed for three seconds, after which the Test Menu is displayed:

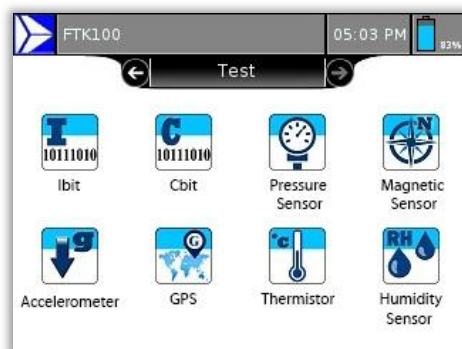


Figure 8: Test Window

3.1.1 IBIT

The FTK100 will send an IBIT request to the DUT and the 32-bit status word sent in reply from the DUT will be displayed in hexadecimal format. To assist interpretation, the output includes text descriptions of each non-zero bit occurring in the status word, each representing a particular error condition.

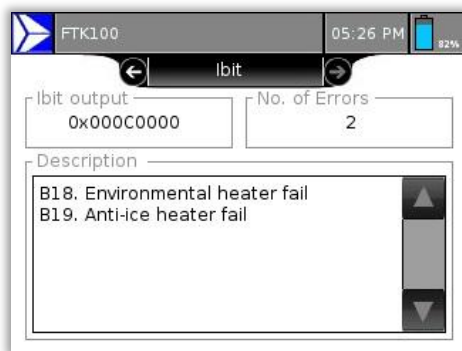


Figure 9: Ibit Test

3.1.2 CBIT

CBIT data is continuously generated by the DUT under normal operation. The FTK100 sends a request at 1Hz to continuously receive and monitor the latest CBIT values being generated by the system. Two different CBIT values will be output along with text-based descriptions of all non-zero bits denoting various error conditions.

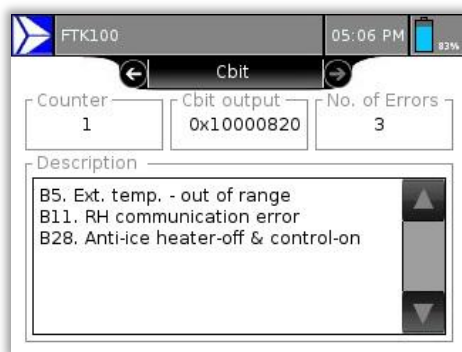
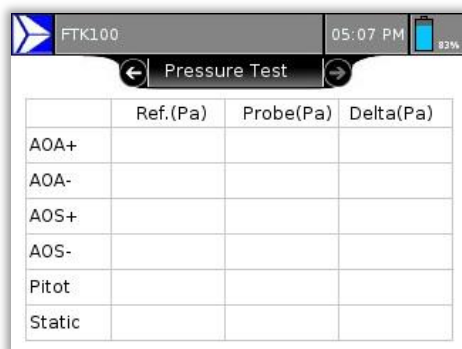


Figure 10: Cbit Test (change the image)

3.1.3 Pressure Test

This feature will perform a pressure test of all five pressure ports on the tip of the air-data probe and the ring of static-pressure ports around its circumference. This test can be performed only if the appropriate probe adapter is firmly secured to the DUT and is connected to the FTK using the supplied tubing.

Immediately after the Pressure Test is selected, the internal pump will begin to pressurize the system to approximately 3000Pa. If any leaks are present, as would occur if the probe adapter is not properly in place, the pump will continue to run until a timeout error is generated if the target pressure is not reached within 6 seconds. If the no leaks occur, the pump will bring the system up to test pressure in approximately 1 second. The following window will then be displayed:



	Ref.(Pa)	Probe(Pa)	Delta(Pa)
AOA+			
AOA-			
AOS+			
AOS-			
Pitot			
Static			

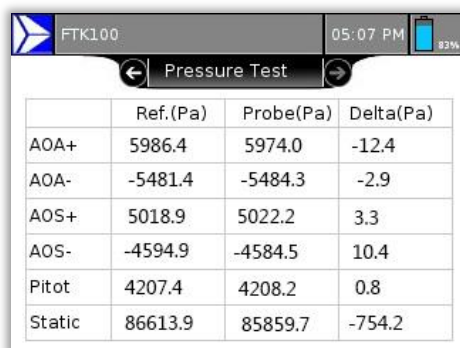
Figure 11: Pressure Test Layout

After a 5 second settling period, valves will be activated to introduce the test pressure to the AOA+ (ALPHA+) pressure port. The FTK100 will read the pressure data sensed by the DUT across the CAN AERO connection and record data from its own internal reference pressure sensor for a period of five seconds. After this sampling period, the valves are switched to disconnect the AOA+ port and return it to ambient atmospheric pressure, and simultaneously connect the internal pressure plenum to the AOA- (ALPHA-) port. During the following 5 second settling period, the pump is given ability to re-engage and recharge the plenum if necessary. If this occurs, a further 5s settling period is introduced before data is collected from both the DUT and reference pressure sensor. This process continues through all pressure ports in the following order: AOA+, AOA-, AOS+ (BETA+), AOS- (BETA-), Pitot-Static. After data has been collected for the pitot-static test, the valves switch to change the direction of air-flow between the pump and internal plenum so as to generate a vacuum. The pump runs and takes the plenum pressure down to approximately 90kPa. The static pressure

port is then activated and now the internal reference barometric sensor is sampled concurrently with data from the DUT access across the CAN AERO network connection.

The status bar will display status information as the test progresses through all stages.

Once the test is complete, mean values are computed from the approximately 150 data points sampled during each stage of the test. Mean values from the reference sensors, the DUT and the differences between them are displayed in a tabular format:



	Ref.(Pa)	Probe(Pa)	Delta(Pa)
AOA+	5986.4	5974.0	-12.4
AOA-	-5481.4	-5484.3	-2.9
AOS+	5018.9	5022.2	3.3
AOS-	-4594.9	-4584.5	10.4
Pitot	4207.4	4208.2	0.8
Static	86613.9	85859.7	-754.2

Figure 12: Sample Pressure Test Results **(change the image – static is wrong)**

3.1.4 Magnetic Sensor

Magnetic sensor test results will show the magnetic coordinates which are generated by the magnetic sensor at 1 Hz frequency. A compass on the screen will indicate the approximate heading direction of the DUT.

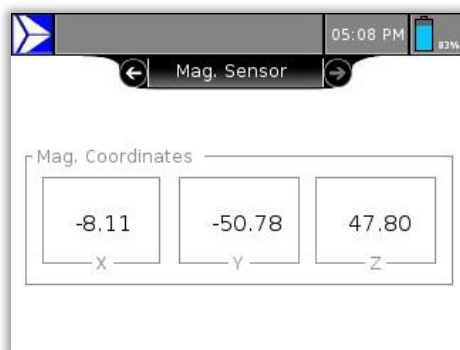


Figure 13: Magnetic Sensor Test Results [\(change the image\)](#)

3.1.5 Accelerometer

Accelerometer test results will show the raw data from roll (x), pitch (y), and yaw (z) accelerometers. A 3D animation of each axis will also be displayed on the screen to compare the results with DUT's orientation.

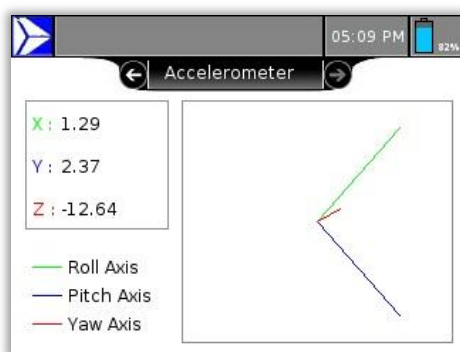


Figure 14: Accelerometer Test Results [\(change the image\)](#)

3.1.6 GPS

GPS test results show the location of the device under test such as latitude, longitude, and altitude. In addition, it also provides number of satellites that are used to obtain the results, position type, and solution status.

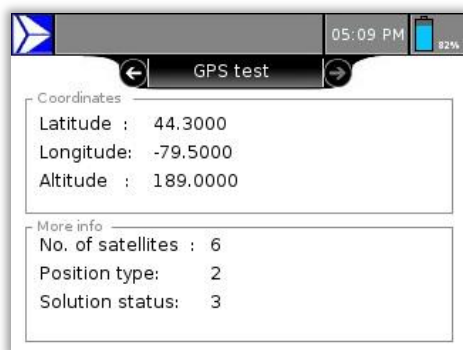


Figure 15: GPS Test Results

Position type and description are shown in the following table:

Table 1: Position Type and Description

Position Type	Description
0	No solution
1	Position has been fixed by FIX POSITION command
2	Position has been fixed by the FIX HEIGHT/AUTO command
8	Velocity computed using instantaneous Doppler
16	Single point position
17	Pseudorange differential solution
18	Solution calculated using corrections from an SBAS
19	Propagated by a Kalman filter without new observations
20	OmniSTAR VBS position
32	Floating L1 ambiguity solution
33	Floating ionospheric-free ambiguity solution
34	Floating narrow-lane ambiguity solution
48	Integer L1 ambiguity solution
49	Integer wide-lane ambiguity solution
50	Integer narrow-lane ambiguity solution
51	RTK status where the RTK filter is directly initialized from the INS filter
52	INS calculated position corrected from the antenna
53	INS pseudorange single point solution – no DGPS corrections
54	INS pseudorange differential solution
55	INS RTK floating point ambiguities solution
56	INS RTK fixed ambiguities solution
64	OmniSTAR HP/XP position
65	OmniSTAR XP position
66	Position solution using CDDPS correction

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Solution status is broadcasted by GPS to indicate the status and errors found. Following table describes the status and descriptions.

Table 2: Solution Status and Description

Solution Status	Description
0	Solution computed
1	Insufficient observations
2	No convergence
3	Singularity at parameters matrix
4	Covariance trace exceeds maximum(trace > 1000m)
5	Test distance exceeded(maximum of 3 rejections if distance>10km)
6	Not yet converged from cold start
7	Height or velocity limits exceeded
8	Variance exceeds limits
9	Residuals are too large
10	Delta position is too large
11	Negative variance
12	Reserved
13	Large residuals make position unreliable
14-17	INS solution status values
18	When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid
19	The fixed position, entered using the FIX POSITION command, is not valid
20	Position type is unauthorized - HP or XP on a receiver not authorized for it

3.1.7 Thermistor

In this test mode, the temperature readings from the thermistor and built-in temperature sensor in the RH sensor will be compared. The difference between these two temperatures and average temperature will also be displayed with comments (if any).

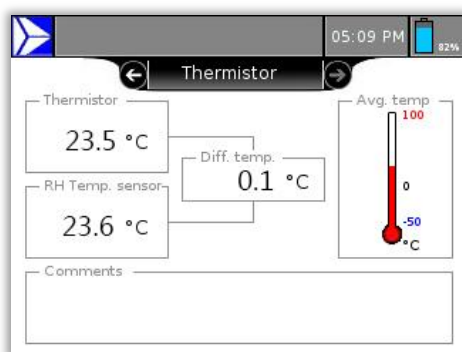


Figure 16: Thermistor Test Results **(change the image)**

3.1.8 Humidity Sensor

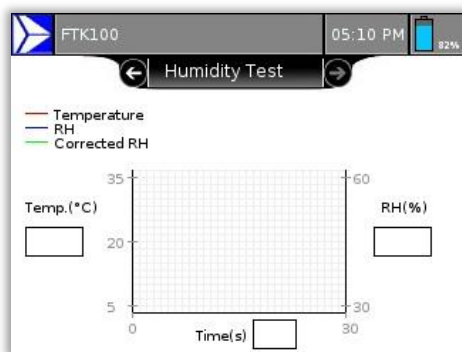


Figure 17: Humidity Sensor Test Results **(change the image)**

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Storing Data on USB

When exiting from the test mode, a dialog box will give an option to store the test results on a USB.



Figure 18: Dialog Box Confirms To Store the Data on USB

The user can enter a file name to store the data using the keyboard that can be accessed by pressing the 'Yes' button in the above dialog box. The file name must contain less than nine characters. The device will create a folder and name it as 'FTK100' (if the folder already exists, then it will select that folder) to store all the test results. Once the confirmation message is appeared, the USB can be removed from the port.

Note: Removing the USB while storing data might create a corrupted file or cause problems with opening the files.

Note: All the test results will be erased if the 'No' button is clicked in the above dialog box.

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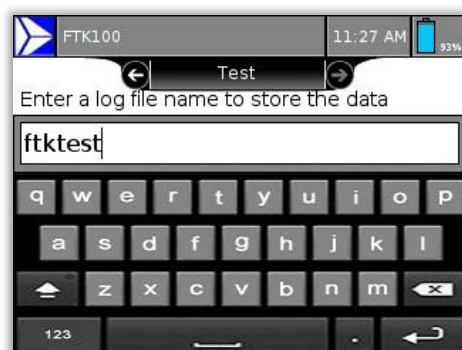


Figure 19: Keyboard to Enter Log File Name

3.2 Settings

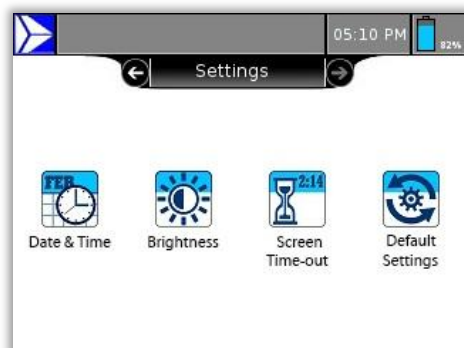


Figure 20: Settings Window

3.2.1 Date and Time

Sets the system date and time.

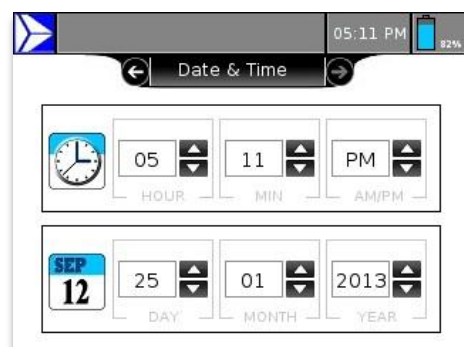


Figure 21: Date and Time

3.2.2 Brightness

Sets the screen brightness.

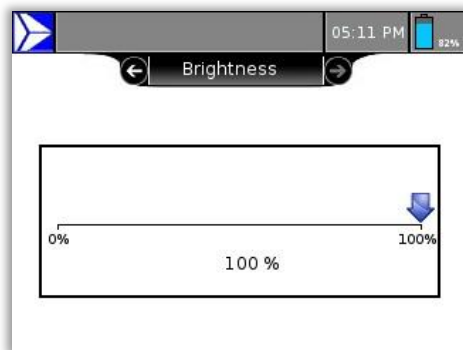


Figure 22: Brightness

3.2.3 Screen Timeout

Sets screen timeout (30 seconds to 30 minutes).

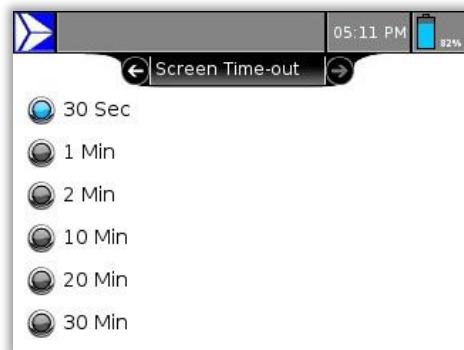


Figure 23: Screen Timeout

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3.2.4 Default Settings

Restores system default settings.



Figure 24: Dialog box to confirm the changes in settings

3.3 Maintenance

Maintenance window is used to update FTK100 and DUT firmware through a FLASH memory drive.



Figure 25: Maintenance Window

3.3.1 Device Under Test (DUT) Firmware Update

Icons with DUT name, such as M320, update the DUT firmware from a FLASH memory drive that is in the USB port.

For example, to update the M320 firmware, the firmware file has to be placed in the root (not in any folders) of USB drive. When 'M320 FW Update' icon is pressed, a dialog box will give an option to soft-start the DUT boot loader. The DUT boot loader can be triggered to start firmware updating process by pressing the 'Yes' button in the dialog box. Alternatively, the firmware updating process can be done by pressing 'No' and manually turning the DUT power off and on.

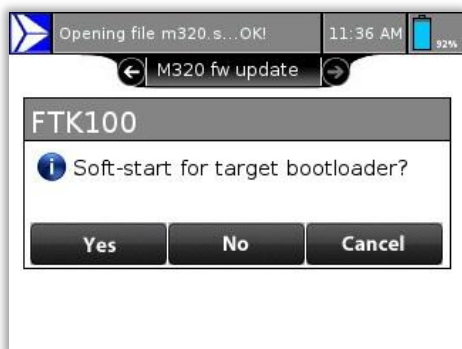


Figure 26: Dialog box to Start Firmware Update

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Following progress bar will appear on the screen to show the status of the firmware updating process. Once the updating process is done, a confirmation message will ensure that the firmware is successfully updated.

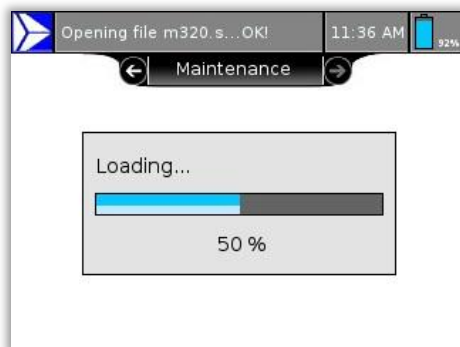


Figure 27: Progress Bar Showing the Status of Firmware Update Process

Note: Do not change the name of the firmware file.

3.3.2 FTK100 Firmware Update

Updates the FTK100 firmware from a FLASH memory drive inserted in the USB port.

4.0 Error Messages and Troubleshooting

FTK100 displays error messages when it has communication problems with other devices such as USB drive and device under test. Following table summarizes the errors and how to troubleshoot the problems.

Table 3: Troubleshooting Tips for the Error Messages Generated By FTK100

Error Messages	Troubleshooting
No reply / No response	Check if the CAN cable between DUT and FTK100 is connected properly. Make sure the DUT is connected to the power supply. If the problem continues, restart FTK100 and the DUT.
Time-out error	This error occurs if the test results are not obtained within a certain time limit. Ensure proper CAN connection between DUT and FTK100. If there is any leakage inside the calibration fixture, time-out error will be displayed during the pressure test as the device can't obtain the pressure results within the time limit. Gently push the calibration fixture further until all the O-rings in the fixture are fully engaged with the boom.
Error in detecting USB	Insert the USB if it is not already in the port. If the device generates this error messages while USB is in the port, then remove and reinsert the USB. If the problem continues, reboot FTK100 and try again. Note: Do NOT insert the USB while FTK100 is starting. Insert before pressing the ON/OFF button or after the main window comes up.
Invalid file name	This error occurs when the user enters file name that contains invalid characters to store the data. The valid file name must contain uppercase letters, lowercase letters, numbers and one of the following characters: \$ % ' - _ @ ~ ! () { } ^ # &

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5.0 Mechanical Drawing

