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Otis
A United Technologies Company

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CSB Monitor
Factory Test Plan

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ORIGINAL APPROVAL:

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2005-02-11	D514	Muller, S.	Kothari, P.	*Pankaj Kothari 2/11/2005*
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Description of Change	2005-02-11: Added ICT fixture schematics for AKW and AKX board to Appendix A. Updated procedure & screenshots for added "CurrentSrc OK" indication 2005-09-28: Added Pass/Fail indication screenshots and instructions for new functional test software. Removed all references to grooveless boards (ALV and ALW). 2006-04-20: Added remote temperature sensing configurations to A_A26800AKX assembly and to reflect changes in the Otis Debug Monitor software. 2011-05-24: Added "Test Switch" check to FFT procedure. Updated ODM screenshot to reflect "Test Switch" indicator. Updated test checklist. Added A_A26800AKX configurations 10-12, 110-112, and 210-212. 2013-01-29: Updated Section 2.1, Section 2.3, Section 3.1, Section 3.2, Appendix A, Appendix C, and Appendix D. Added Section 2.2. Replaced Appendix B.
Reason for Change	2005-02-11: Addition of grooved CSB Monitor boards 2005-09-28: Updated test software for mistake-proofing calibration process. 2006-04-20: Added remote temperature sensor board arrangements (CA11A-008156). To reflect changes to the test software requested by manufacturing. 2011-05-24: Test Switch implementation modified per A17.6 requirement. 2013-01-29: Corrections, updates, and additional details

Table of Contents

1 Introduction

1.1 Purpose

The purpose of this document is to describe the factory test procedure used during production of the A_A26800AKW and A_A26800AKX Coated Steel Belt (CSB) Monitor assemblies.

1.2 Overview

The CSB monitor is designed to be a low-cost, high-precision measurement system for monitoring the strength of CSBs.

1.3 Definition & Acronyms

CSB	–	Coated Steel Belt
FT	–	Functional Test
ICT	–	In-Circuit Test
ODM	–	Otis Debug Monitor
RBI	–	Resistance Based Inspection
RSL	–	Remote Serial Link (Otis proprietary communication protocol)
UUT	–	Unit Under Test

1.4 Referenced Documents

Otis Document 55721 – CSB Monitor Board Hardware Description Document
Otis Document 55869 – CSB Monitor Board CPLD Firmware Design Document
Otis Document AAA21700X_MTP_FT – CSB Monitor Functional Tester Checking Document
A_A26800AKW – Assembly Drawing – 30mm Grooved CSB Monitor
A_A26800AKX – Assembly Drawing – 60mm Grooved CSB Monitor
A_A816Q – CPLD Firmware Package – U3
A_A816R – CPLD Firmware Package – U2
A_A816AY2 – CPLD Firmware Package – U3
A_A816AY1 – CPLD Firmware Package – U2

2 Test Setup

2.1 Equipment Required

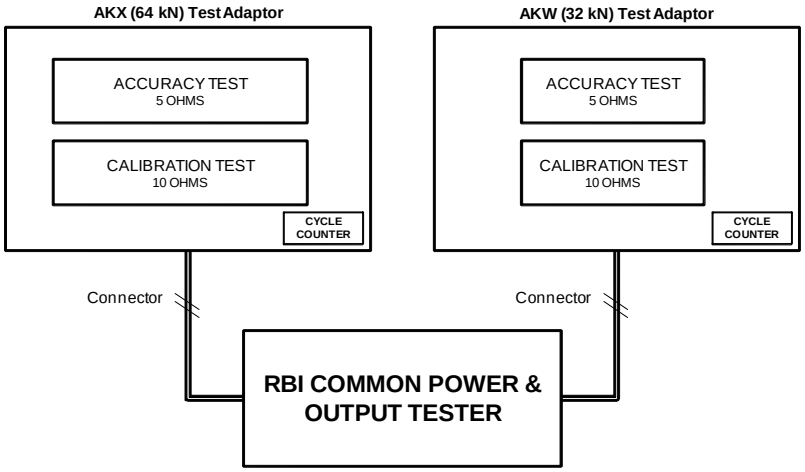
The following test equipment is required:

1. PC with the following:
    a. RS-232 serial port
    b. Otis RS-422/RS-232 converter cable – AAA639BV1, plugged into RS-232 port
    c. Parallel port, if necessary (see programming equipment below)

    CPLD programming equipment (only if CPLDs are programmed using PC and not programmed through ICT, see Section 2.2 for details):
    d. Atmel ISP software
    e. Atmel JTAG programming cable, Atmel part number ATDH1150VPC, plugged into parallel port (PC requires parallel port for compatibility with this cable). USB cable can be used as alternative, Atmel part number ATDH1150USB.
    f. Altera programming software
    g. Altera JTAG programming cable, Altera part number PL-USB-BLASTER-RCN, plugged into USB port
2. Equipment necessary for measuring ambient temperature to within 1 degree Celsius
3. An in-circuit/functional test fixture built according to schematics in Appendix A, including:
    a. Otis A1A21750J1 (VFSB2), to interpret RSL messages from RBI board (UUT) and output the result to human operator via LEDs. See Appendix B for details on the proper setup of this board in the ICT/FT.
    b. Otis GFA23550D1/2 (RS5), Remote Serial Link board.
    c. Otis 9693J2, ring terminator board.
    d. Power supply with 24V output capable of supplying at least 0.5A

2.2 Test Fixture Specifications (Full Functional Test)

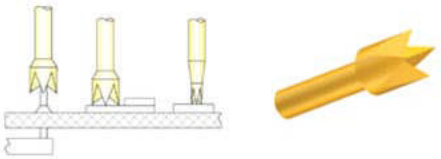
The test fixture consists of a common base tester which provides power and discrete outputs to the UUT and an individual adaptor for each board type. Only one test adaptor attaches to the base tester at a time. Each adaptor shall have a section for calibration (10 Ohms) and accuracy testing (5 Ohms) as shown in the diagram below.



The pogo pins used for the tester, manufactured by Ingun, should be as follows:

- For holes with connector lead soldering, use the tip style 14 self cleaning 4-point crown, part number GKS 100 2 14 150 A 20 00
- For through hole contact points, use the tip style 91 dagger, part number GKS 100 2 91 090 A 20 00

GKS 100 2 91 090 A 20 00
Tip Style 91 Dagger



GKS 100 2 14 150 A 20 00
Tip Style 14 Crown

Each connector pin should have a corresponding pogo pin. Resistors and wire wraps should be soldered directly to the pogo pin barrel and have a value of 10 Ohms ±0.1% for calibration and 5 Ohms ±0.1% for accuracy testing. See document AAA21700X_MTP_FT for detailed functional tester requirements and acceptable tolerances.

2.2.1 Test Fixture Maintenance

The entire test fixture must be evaluated for replacement every 80K cycles (max). All pogo pins should be replaced every 10K cycles (max). Only the pogo pin tips need to be replaced, not the barrel.

2.3 Test Software Required

The following software is to be installed on the PC listed in Section 2.1:

1. Atmel ISP software version 4.2 or later, or equivalent, for JTAG programming of the two Atmel CPLDs on the UUT. This software is not necessary if the CPLDs are programmable through the ICT.
   Note: If Altera CPLDs are used, use Quartus II Programmer version 11.0 or later, or equivalent, for JTAG programming of the two Altera CPLDs on the UUT. This software is not necessary if the CPLDs are programmable through the ICT.
2. Otis Debug Monitor software, SCN 30942 version 10.2 or later, to display serial messages from UUT to human operator for verification of functional validity. This software needs to be set up once, upon installation, as follows:
   a. Open the file OtisDbgMon.ini with any text editor (such as Notepad.exe) and verify the following items with the settings shown here, are present in the [GENERAL] section of that file:
      - AppendedChksum=True
      - UseExtendedEventRange=False
      - RbiAccuracyTestAlpha=.49
      - RbiAccuracyTestBeta=175.75
      - RbiAccuracyTestNormTemp=25
      - RbiAccuracyTestTolerance=2
      - RbiAccuracyTestResistance=5
      - RbiAccuracyTestTolerance_ARLARQ=1
      - RbiAccuracyTestResistance_ARLARQ=10
      - RbiDipswSetting_EN=0
      - RbiDipswSetting_ANSI=62
      - RbiDipswSetting_JIS=0

b. Double click on the OtisDebugMon.exe icon
c. When prompted for an Event Definition File, navigate to and select the file EventDefFile_MCS1210_ManufTester_AAA_AAN.txt or later, and click "Open"
d. In the window that appears, select Setup → Communications…
e. In the dialog box that appears, verify/set the following parameters:
    - Port: set to the COM port number of the RS-232 port into which the AAA639BV1 cable is plugged
    - Baud: set to 9600
    - Parity: set to Odd
    - Data: set to 8 bits
    - Stop: set to 1 bit
    - Handshaking: set to None
    - DTR Enable: checked
    - RTS Enable: unchecked
f. Click OK

3. Test results, including board and operator information, must be archived for each board and available upon request. This can be done through factory automation software, such as STARS, or through the Otis Debug Monitor (ODM).

3 Test Procedure

3.1 In-Circuit Test

1. In-circuit testing: In-circuit testing is to be performed on each UUT using the test pads provided on the secondary side of each board. A test pad is provided for every net on the board, to facilitate bed-of-nails testing. As some of the steps listed in the in-circuit test are necessary to prepare the UUT for the functional test, it is required that the in-circuit test be completed in its entirety prior to running the functional test.

    a. Component Verification: Perform component value verification of resistors, capacitors, etc., along with all of the active components. This test coverage should be as close to 100% as possible.

    b. Power supply voltages: Measure the following voltages to determine if they are within 5% of their nominal values:

Power Net Name	Nominal Value
8V	8 VDC
5V_MAIN	5 VDC
5V_AUX	5 VDC
5V_SVT	5 VDC
3.3V	3.3 VDC

    c. Clock frequency: Measure the output of the oscillator, U18 pin 3, to verify that it is within 0.01%, of its nominal value of 24 MHz.

    d. Pre-functional test programming: In preparation for the functional test, the following devices must be programmed by the in-circuit tester:

        i. Atmel CPLDs: The data to be programmed to U3 is archived in the A_A816Q record, and data for U2 in the A_A816R record.
        Note: If Altera CPLDs are used, the data to be programmed to U3 is archived in the A_A816AY2 record, and data for U2 is in the A_A816AY1 record.
        ii. MSC1210 microprocessor: Program and verify the Hardware Configuration Registers (HCRs) of the Texas Instruments/Burr Brown MSC1210 processor (U1). The values of the HCRs are as follows:
            - HCR1: 0xD4
            - HCR0: 0xF5
        iii. Flash memory: Program the flash memory (U16). The data to be programmed is provided as SCN 30934.

    e. Perform EEPROM (AAA616NL16) Test:
    A blank EEPROM (AAA616NL16) should be placed in socket U14 of the UUT

        i. Write 0xA5: Write with data 0xA5 to all 512 bytes locations.
        ii. Verify 0xA5: Verify that data 0xA5 to all 512 byte have been written.
        iii. Write 0xFF: Write with data 0xFF to all 512 bytes locations. (This operation can be performed by the “Erase” command).
        iv. Verify 0xFF: Verify that data 0xFF to all 512 byte have been written.

3.2 Functional Test

The functional test is performed directly after the ICT, utilizing the functional tester. The RS-422/RS-232 converter cable (Otis PN AAA639BV1), is connected from the UUT's J1 connector, through the ICT/FT, to the RS-232 port on the PC.

3.2.1 Test Setup

Before testing begins (and with power off to the UUT), the Otis Debug Monitor software must be launched on the PC. When testing several CSB Monitor boards in succession, it is not necessary to launch the software for each UUT. Following the testing of the first UUT, the Debug Monitor software can be prepared for the next UUT by clicking the "ClearRx" button on the main Debug Monitor screen, prior to powering on each new UUT.

The Debug Monitor program is set up as follows:

For the first UUT in a testing session:

1. Double click on the OtisDebugMon.exe icon
2. When prompted for an Event Definition File, navigate to and select the file EventDefFile_MCS1210_ManufTester_AAA_AAN.txt or later, and click "Open"
3. Open the Setup menu and click the "RBI Factory Test Mode" option. The "Perform RBI Calibration" button should then be visible on the menu bar.
4. In the main Debug Monitor window, click the "Port Open" button

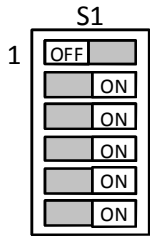
An example screenshot of the Otis Debug Monitor is included in Appendix C as a reference.

For subsequent UUTs in a testing session:

a. Click the "Clear Rx" button prior to powering up the next UUT

Before powering on the UUT, and before testing begins, the UUT must be set up as follows:

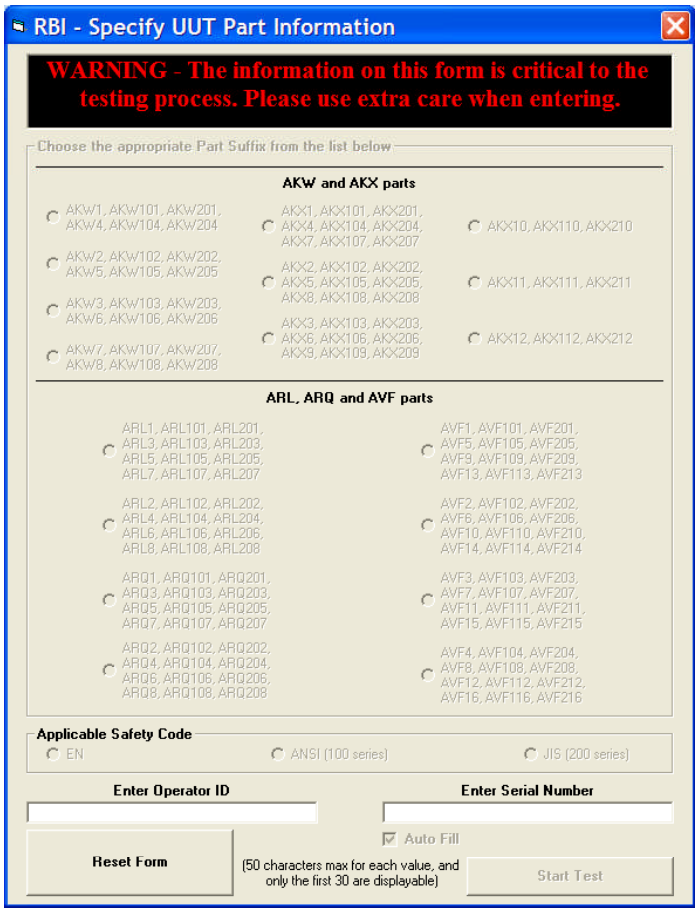
5. The RSL Address dipswitch, S1, should have all six switches set as shown below. (0x3E or 62).



6. Attach remote sensor cable assembly AAA21600CB1 to header P24 for A_A26800AKX board, version 7, 8, 9, 107, 108, 109, 207, 208, and 209 only
7. Attach remote sensor cable assembly AAA21600CB3 to header P24 for A_A26800AKX board, version 10, 11, 12, 110, 111, 112, 210, 211, and 212 only

3.2.2 Test Procedure

1. Once the UUT is set up as described above, click the "Perform RBI Calibration" button in the Otis Debug Monitor program. The following window will appear:



2. The operator is to enter their “Operator ID” (only needs to be done the first time). The board serial number is scanned and the part number and “Applicable Safety Code” will automatically be selected.

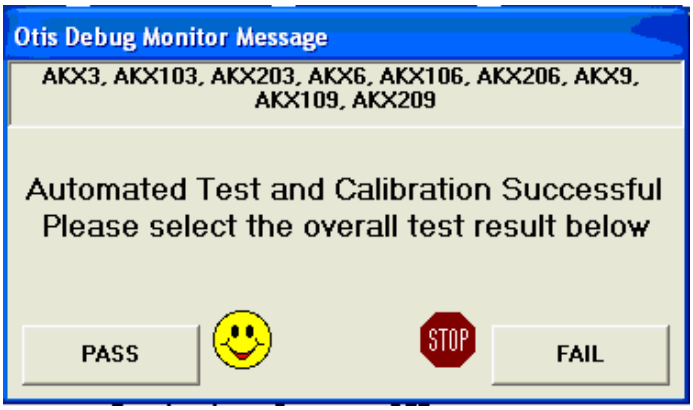
   Note: The “Auto Fill” box must be checked for automatic selection to occur.

   After updating the board selection, place the board onto the test fixture and perform the following functional test procedure. A checklist is provided in Appendix D to aid in determining Pass/Fail of the functional test.

3. Power on the UUT
4. Press the “Start Test” button on the Debug Monitor screen.
5. Acknowledge that the unit is in the proper work center by pressing “Yes”. This starts the calibration process.
6. Verify the following:
   a. “DIPSW” indicator on the Debug Monitor is displaying 0x3E
   b. “xT” indicator on the Debug Monitor is displaying a temperature within 2º Celsius of the actual ambient temperature

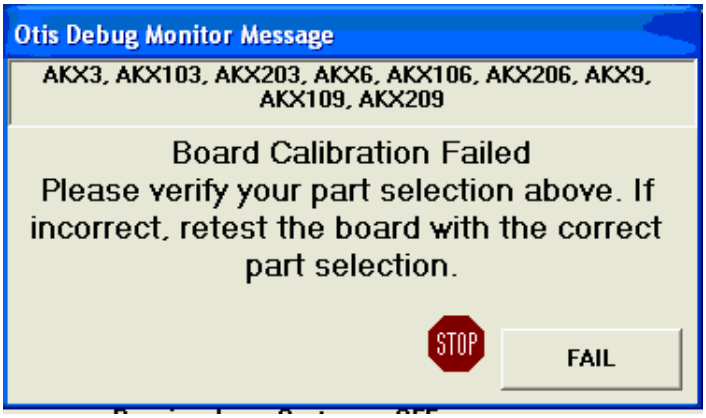
7. Verify that the red LEDs on the UUT are blinking in a chasing pattern. That is, each LED will take its turn being OFF while the other four are ON. This pattern will persist for the duration of the calibration cycle. At the end of the calibration cycle, all five red LEDs on the UUT will stay solidly ON. The Debug Monitor screen will show one of two indications.

   If the UUT passed the calibration process, the following screen will be shown:



This indicates that the calibration was successful, the operator is asked to acknowledge that the board passed and to proceed to step 8 of this procedure.

If the UUT failed the calibration process, the following screen will be shown:



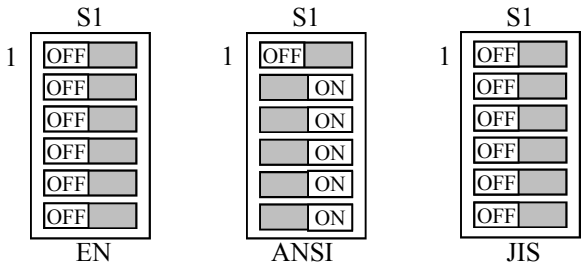
If the part number selection matches the UUT, and the calibration has failed, repeat the calibration procedure from Step 1. If the UUT continues to fail, the UUT will likely require rework.

8. When the calibration process is finished, verify the following:
   a. All three “Calibration” indicators on the Debug Monitor screen are GREEN and state “Calib Data OK”, “CalibWrite OK”, and “CalibrationDone”
   b. “E2P Test” indicator on the Debug Monitor screen is GREEN and states “E2P Test Pass”
   c. Tester and ODM indicators match the table below:

Tester Indicator	Expected Response	ODM Indicator	Expected Response
"Relay Alarm"	ON	"Alarm Relay"	GREEN
"Discrete Alert"	Flashing	"Discrete Alert"	Flashing
"Discrete Alarm"	Flashing	"Discrete Alarm"	Flashing
"RSL Alarm"	OFF	"RSL Alarm"	GREEN
"RSL Alert"	OFF	"RSL Alert"	GREEN
"RSL Board Health"	OFF	"RSL BoardFault"	GREEN
"RSL Heartbeat"	Flashing	On-board LEDs (UUT)	LEDs solid ON

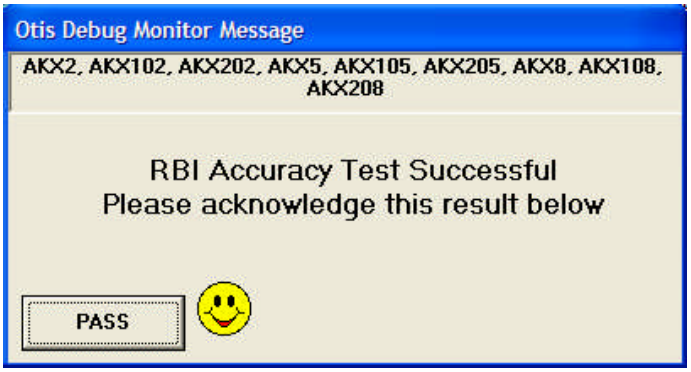
9. Once verification is complete, power off the UUT

10. Move the UUT to the "Accuracy Test" fixture (5-Ohms) of the functional tester and make the appropriate selections to the dip switch (S1) as follows (RSL address based on Safety Code Parameter):



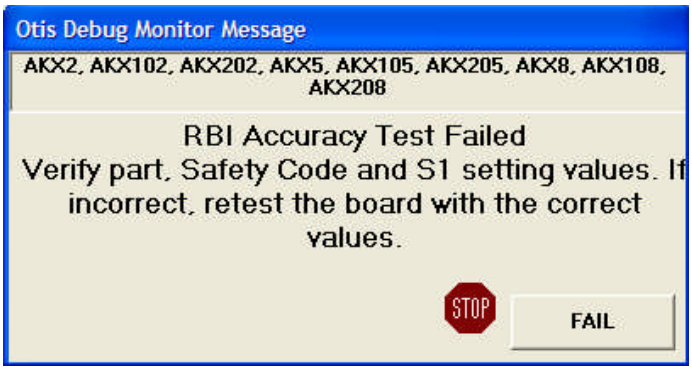
Board Arrangements	Safety Code Parameter Value
A_A26800___1-12	EN
A_A26800___101-112	ANSI
A_A26800___201-212	JIS

11. Click the "Perform RBI Accuracy Test" button in the Otis Debug Monitor program. A window will appear, similar to the one shown in Step 1 of this section.
12. After the board serial number is scanned, power on the UUT and press the "Start Test" button to initiate the automated accuracy test.
13. Acknowledge that the unit is in the proper work center by pressing "Yes". This starts the accuracy process.
14. If the UUT passed the RBI Accuracy Test, the following screen will be shown:



This indicates that the accuracy test was successful, the operator is asked to acknowledge that the board passed and to proceed to step 15 of this procedure.

If the UUT failed the RBI Accuracy Test, the following screen will be shown:



This indicates that the accuracy test was unsuccessful. Double check the UUT assembly part number against the numbers listed along the top of the screen shown above. If they do not match, return to step 10 of this procedure, and re-run the accuracy test, making sure to properly set the dipswitch (S1) to the correct address.

15. When the RBI accuracy test is finished, verify the following:
    a. "MeasSystem" indicator on the Debug Monitor screen is GREEN and states "MeasSystem OK"
    b. "CurrentSrc" indicator on the Debug Monitor is GREEN and states "CurrentSrc OK". "I=" indicator is displaying a current value within the limits shown in following table for the given assembly number being tested

Assembly Number	Minimum Current	Maximum Current
A_A26800AKW	9.546mA	21.186mA
A_A26800AKX (10,11 &12)		
A_A26800AKX	6.654mA	13.736mA

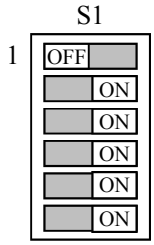
    c. Tester and ODM indicators match the table below:

Tester Indicator	Expected Response	ODM Indicator	Expected Response
"Relay Alarm"	OFF	"Alarm Relay"	RED
"Discrete Alert"	Flashing	"Discrete Alert"	Flashing
"Discrete Alarm"	Flashing	"Discrete Alarm"	Flashing
"RSL Alarm"	OFF	"RSL Alarm"	GREEN
"RSL Alert"	OFF	"RSL Alert"	GREEN
"RSL Board Health"	OFF	"RSL BoardFault"	GREEN
"RSL Heartbeat"	See Note 1	On-board LEDs (UUT)	Flashing (15 times)

Note 1: If safety code setting is EN or JIS, expected response is "OFF". If safety code setting is ANSI, expected response is "Flashing". See Step 10 for safety code settings.

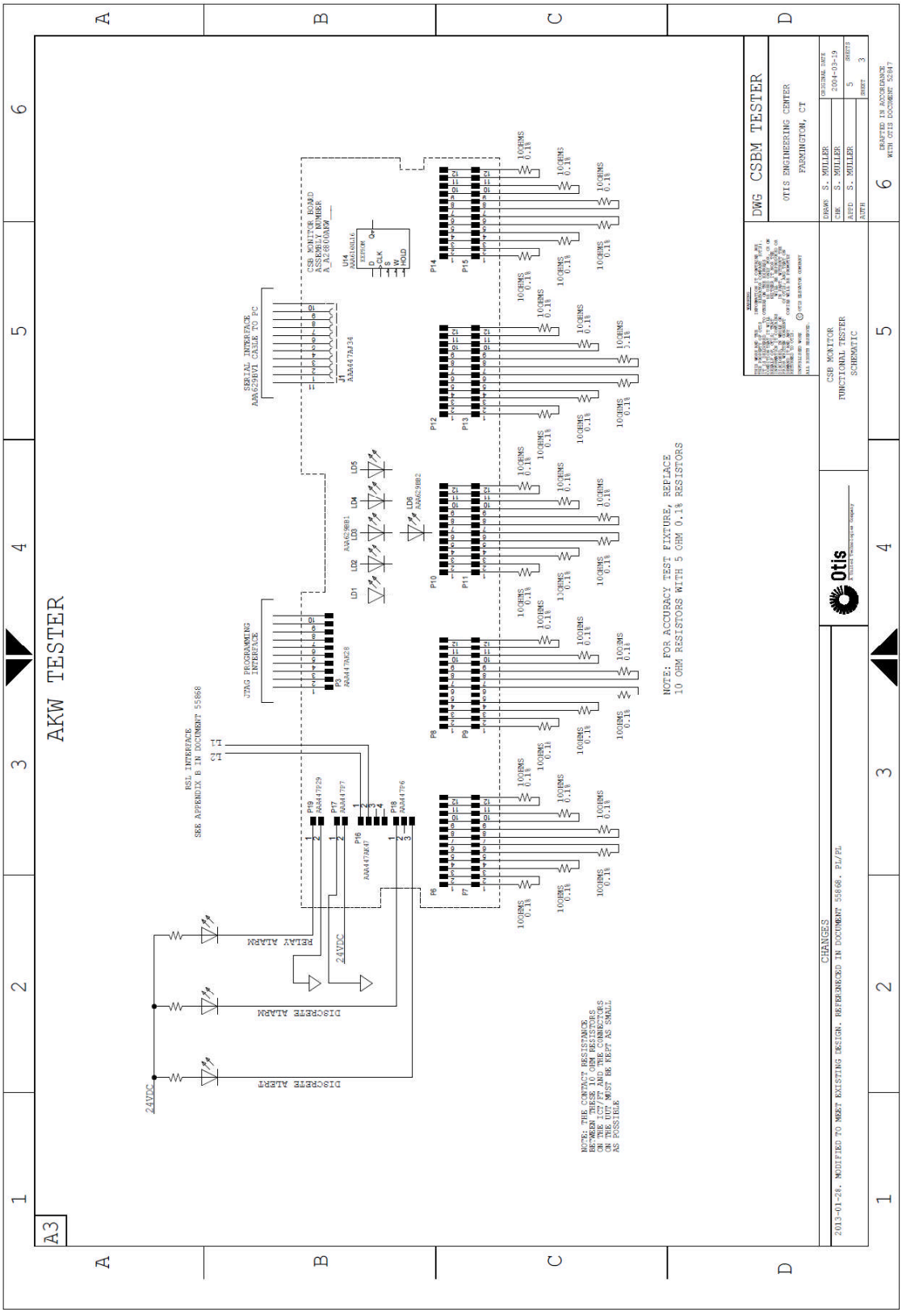
16. Check the functionality of the Test Switch by pressing the "TEST" button on the UUT, with reference designator "SW3", and verify that the "TEST Switch" indicator in the upper right corner of the Debug Monitor screen is GREEN while the "TEST" button is pressed. The "TEST Switch" indicator should return to RED when the "TEST" button is no longer being pressed.
17. Check the functionality of the Reset Switch by pressing the "RESET" button on the UUT, with reference designator "SW2", and verify that the UUT is reset. The LEDs on the UUT will stop blinking when the "RESET" button is pressed and will start blinking again when the "RESET" button is released.
18. Verify that all five red LEDs on the UUT are blinking 15 times, followed by a pause, repeatedly. If any other behavior is observed (i.e. a different number of flashes), the board is faulty, and will need to be reworked.

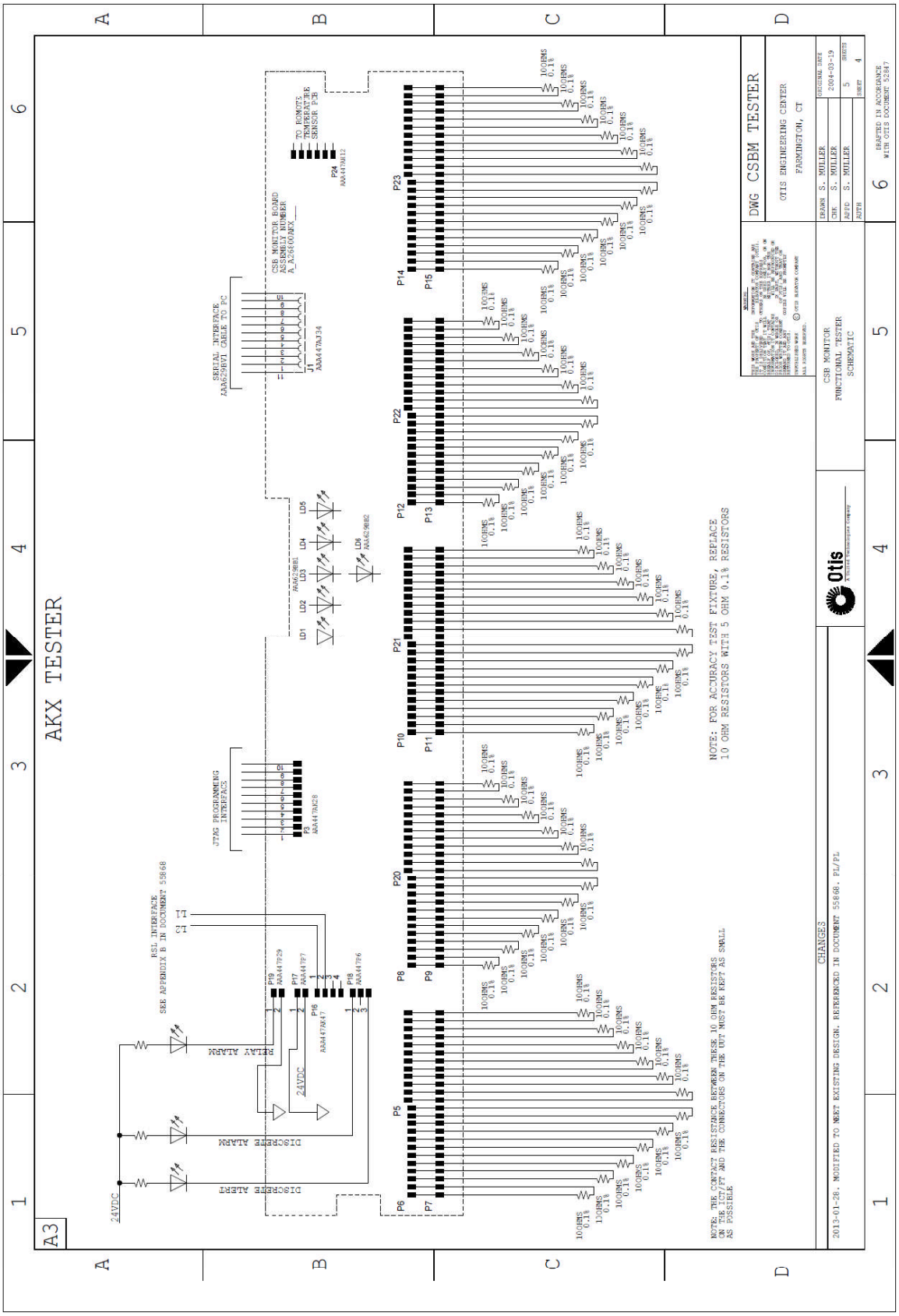
19. Power off the functional tester, and remove the UUT
20. Verify the RSL Address dipswitch (S1) is set up as follows:
    - For arrangement numbers A_A26800___1-12 and A_A26800___201-212, set all six positions of S1 to the OFF position (RSL Address 0x00)
    - For arrangement numbers A_A26800___101-112, the RSL Address dipswitch (S1) should be set according to the following diagram (RSL Address 0x3E):



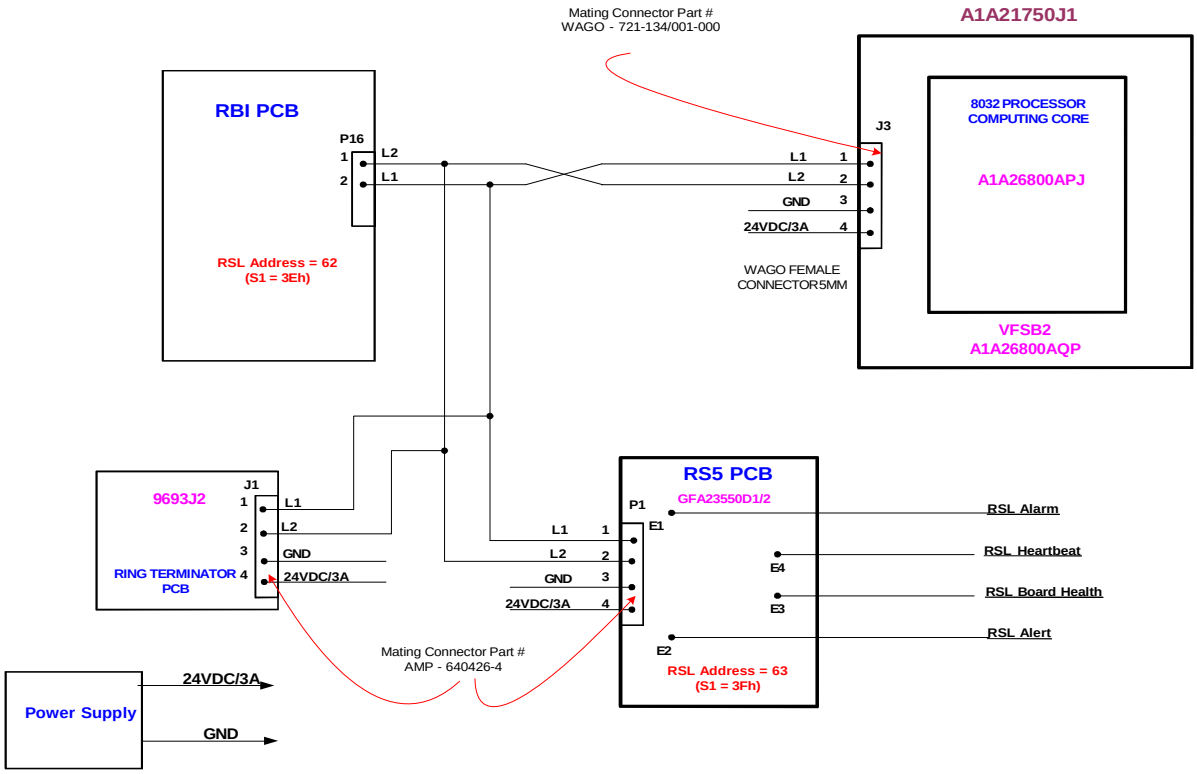
21. To prepare the Debug Monitor for testing the next UUT, click the “ClearRx” button at the bottom of the Debug Monitor screen.

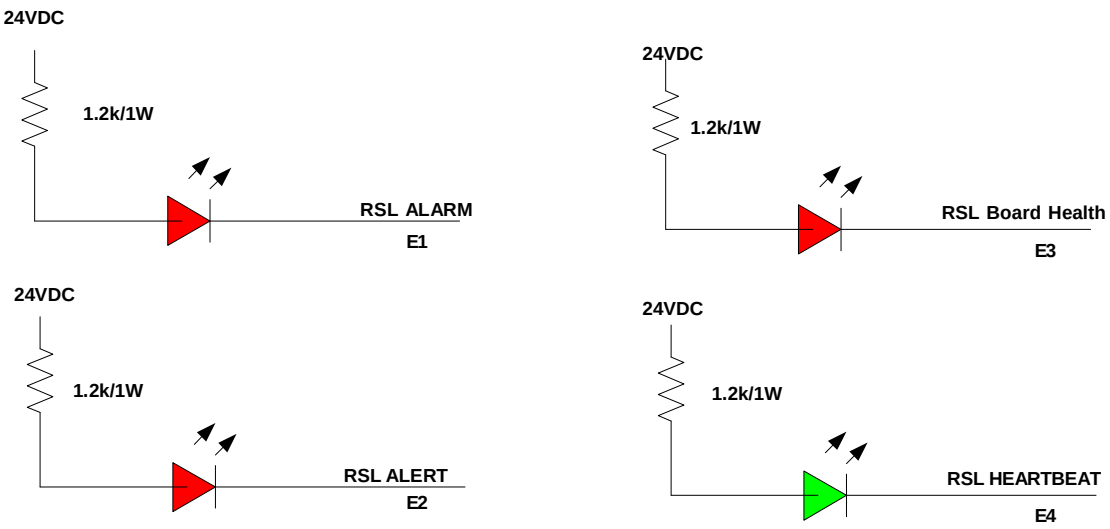
Appendix A – Test Fixture Schematics



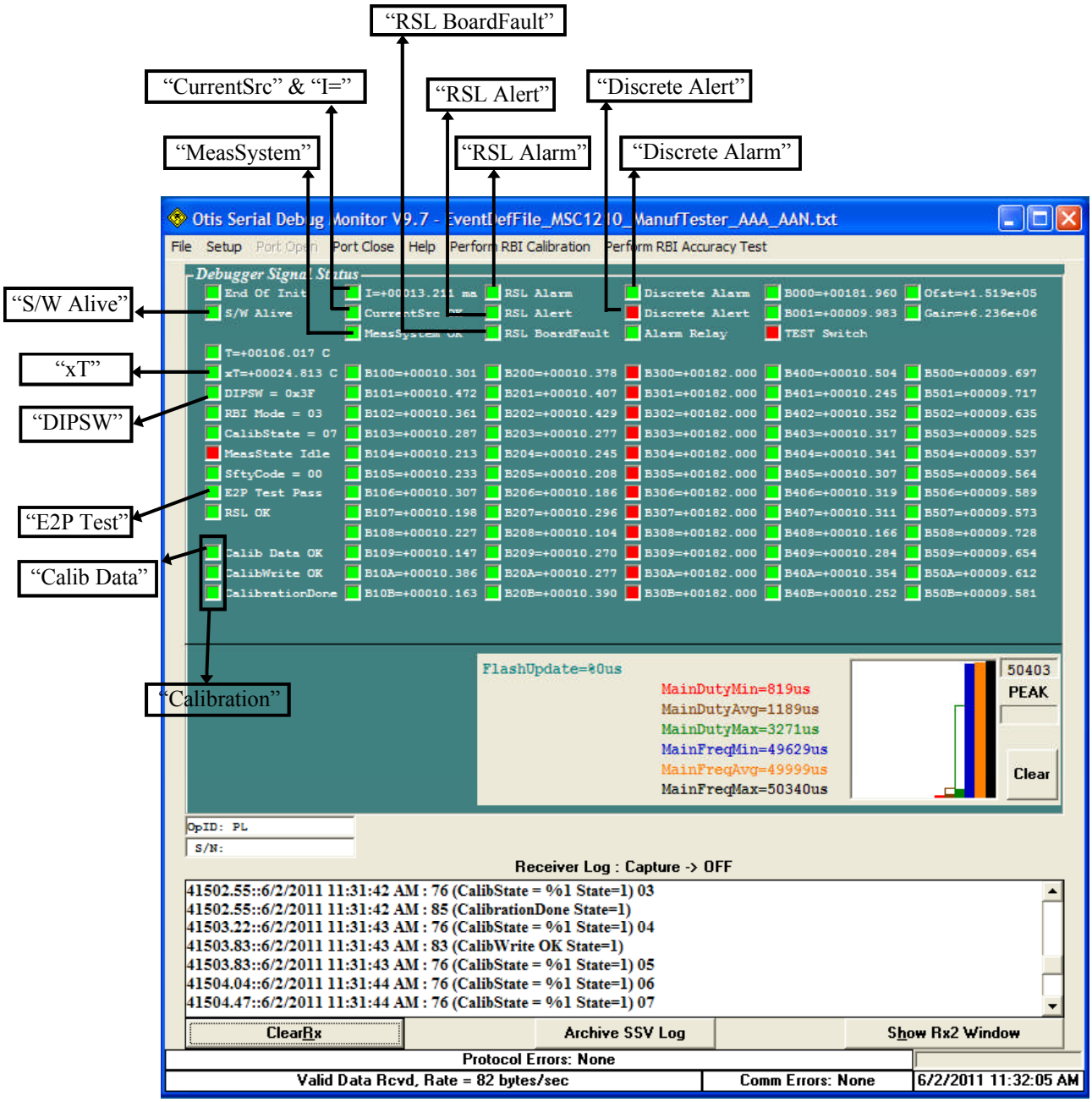


Appendix B – RSL Setup for ICT/FT





Appendix C – Otis Debug Monitor (ODM) Screenshot



Appendix D – Test Checklist

FT Step	Expected Result	Pass	Fail
6a	"DIPSW" on ODM is reading "0x3E"		
6b	"xT" on ODM is reading within 2°C of measured ambient temperature Note if remote cable or internal sensor is being used		
7	UUT LEDs blinking in chasing pattern, followed by all UUT LEDs solid ON and "PASS" indication on ODM		
8a	Three "Calibration" indicators on ODM are GREEN		
8b	"E2P Test" on ODM is GREEN and states "Pass"		
8c	Functional Tester indicators match the expected response provided in the table		
	ODM indicators match the expected response provided in the table		
14	RBI Accuracy Test Successful and shows "Pass" indication on ODM		
15a	"MeasSystem" on ODM is GREEN and states "OK"		
15b	"CurrentSrc" on ODM is GREEN and stating "OK"		
	"I=" on ODM is reading an acceptable current value		
15c	Functional Tester indicators match the expected response provided in the table		
	ODM indicators match the expected response provided in the table		
16	"TEST Switch" on ODM is GREEN while "TEST" button is pressed		
	"TEST Switch" on ODM is RED when "TEST" button is not being pressed		
17	"RESET Switch" is functional		
18	UUT LEDs blinking 15 times, followed by pause, repeatedly		