

# **SERVICE AND CALIBRATION MANUAL**

## **BOONTON ELECTRONICS 4530 SERIES RF PEAK POWER METER**

**MODELS 4531 AND 4532**

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# **BOONTON**

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# Section 1: 4530 Series Test Procedure

**Note:** The following procedures assume that the technician is familiar with the basic menu operation of the 4530 Series. To select menu items, press the MENU key twice to return to the top-level menu, and then use the up and down arrows to highlight the desired entry. Once highlighted, the right arrow or Enter key is used to select that entry. The ESC key aborts a menu entry, and the left arrow moves back one level in the menu hierarchy. To select a different menu item at the same menu level, simply navigate directly - it is not necessary to return to the top of the menu hierarchy. If needed, see the [4530 User's Manual](#) for more detailed instructions on menu navigation, and a complete chart of the menu tree.

## 1) TEST SETUP

- a. Remove instrument cover by removing four screws on rear and carefully sliding cover off the back of the instrument.
- b. Connect AC line cord to AC mains (90-264Vac, 47-63Hz)
- c. Turn ON rear panel power switch.
- d. If instrument turns "on" (display lights, fan runs), wait for startup to complete, then press ON/STBY key on front panel to return the unit to "standby".

## 2) TESTING the 24V UNIVERSAL SUPPLY:

- a. Locate Universal Power Supply: small (3" x 5" approx) pc board on top of chassis.
- b. Verify that supply voltage is 24.0VDC +/-0.5VDC on the output connector (P102) of the power supply:  
  
P102-4 is GND, P102-2 is +24V  
Pin 1 is near P102 reference designator on power supply board.
- c. Verify that the AC ripple voltage on the output connector is less than 250mV peak-to-peak.
- d. Press the ON/STBY switch on front panel to turn the unit "ON", and wait 15 seconds for initialization to complete.
- e. Repeat the DC output and AC ripple tests above of the universal power supply.

## 3) TESTING HOST BOARD POWER SUPPLY

- a. Locate the Host CPU Board: large "L" shaped pc board on top of chassis.
- b. Verify the main supply voltages at the following testpoints:

TP1 = +15.00VDC +/- 0.25V  
TP2 = +7.50 VDC +/-0.25V  
TP3 = -15.00 VDC +/-0.25V  
TP4 = -7.50 VDC +/-0.25V  
TP6 = +5.00 VDC +/-0.25V

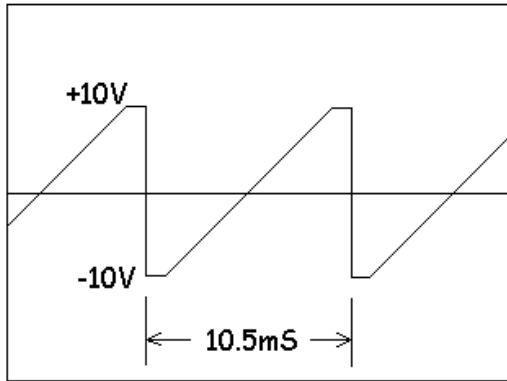
#### 4) TESTING DSP BOARD POWER SUPPLY

- a. Locate the DSP Board: large pc board on bottom of chassis
- b. Verify the main supply voltages at the following testpoints:

TP2 = +5.00VDC +/-0.25V  
TP3 = +15.00 VDC +/- 0.25V  
TP4 = +5.00 VDC +/-0.25V  
TP5 = +2.50 VDC +/-0.25V  
TP7 = -5.00 VDC +/-0.25V  
TP8 = -15.00 VDC +/-0.25V  
TP10 = +8.00 VDC +/-0.25V  
TP11 = -8.00 VDC +/-0.25V

#### 5) BASIC SYSTEM CHECK AND SETUP

- a. Press ON/STBY key on front panel to return to “standby” mode, then after a few seconds press again to turn back “on” while observing the display.
- b. The display should show a start-up screen, the BOONTON logo, and then the main menu of the 4530.
- c. Check that the fan is operating and that air flows freely through the fan and filter. The fan should blow air OUT of instrument, not in. Clean the filter or fan guard if necessary.
- d. Press and hold the ESC/Stop key while using the UP and DOWN keys to adjust the LCD contrast. Contrast should change from full dark to full light. Adjust for best display when viewed from directly in front of instrument.
- e. From front panel controls, select **Main Menu > Utilities > Backlight**, and set to “OFF”. Verify that LCD backlight turns off. Set back to “ON” and verify that backlight turns on.
- f. From front panel controls, select **Main Menu > Utilities > Key Beep**, and set to “ON”. Verify that pressing any key now causes a beep. Set to “OFF” and verify that the key beep is now disabled.
- g. From front panel controls, select **Main Menu > Utilities > Sys-Tests > Voltages**. Verify that all the voltages read correctly (no errors messages are displayed). The “Cal VDC = 0V” message is normal, since the calibrator is off. ESC ends the test.
- h. From front panel controls, select **Main Menu > Utilities > Sys-Tests > DispTest**. Observe the display test and make sure that the fill and clear patterns appear correct and that the fonts are all readable. ESC ends the test.
- i. From front panel controls, select **Main Menu > Utilities > Sys-Tests > Keypad**. Press each key. The corresponding key name on the display will go into reverse video. The ESC/Stop key ends the test so use this key last.
- j. From front panel controls, select **Main Menu > Utilities > Sys-Tests > Recorder**. Monitor the “Recorder Out” BNC connector on the rear panel using an oscilloscope to verify that the following waveform is present. Voltages should be within 500mV of values shown, and waveform should have no large steps or discontinuities. ESC ends the test.



- k. Press and hold the ON/STBY key. Verify that the instrument turns off (enters standby mode) within 0.5 seconds of key being pressed.
- l. Press ON/STBY key again to turn on.

#### 6) SENSOR DETECTION

- a. Plug in a CW power sensor into the 4530 "Sensor 1" connector and verify that the 4530 can read the sensor data (a "reading sensor..." message will be displayed). For two-channel instruments (Model 4532), repeat for the "Sensor 2" connector.
- b. Plug in a Peak power sensor into the 4530 "Sensor 2" connector and verify that the 4530 can read the sensor data (a "reading sensor..." message will be displayed). For two-channel instruments (Model 4532), repeat for the "Sensor 2" connector.

#### 7) CHANNEL 1 PEAK ACQUISITION / TRIGGER AND EXTERNAL TRIGGER TESTS

- a. Use a 4400/4500 instrument and function generator as a source for a pulsed RF signal and external trigger signal. A function generator with separate main and TTL outputs such as a BK Precision Model 3040 is required for these tests. A calibrated oscilloscope will also be needed to monitor the voltage level.
  - 1. Connect the TTL OUT signal from the function generator to the EXT PULSE input on the rear panel of the 4400/4500.
  - 2. Connect from the Main Output from the function generator to the EXT TRIGGER input on the rear panel of the 4530. Using a BNC "T" adapter, also connect this output to the oscilloscope.
  - 3. Set the function generator's frequency to 500Hz, and set its main output for a sine wave.
  - 4. Monitor the sinewave with the oscilloscope, and adjust the function generator's output level and offset so the signal has a peak amplitude of +/-4.7V (+/-100mV), and is symmetrical around 0V.

5. Set up the 4400/4500 instrument as the source for the pulsed calibrator signal as follows:

Cal Output	On
Set Level:	10.0 dBm.
Max Power:	+20.0 dBm.
Cal Mode	Pulse
Pulse Source	Ext
Polarity	+

- b. Connect and Calibrate a peak sensor on channel 1:

1. Plug in a 57518 peak power sensor into the 4530 "Sensor 1" connector.
2. From front panel controls, select **Zero/Cal > AutoCal**. Use the left-arrow key to select Sensor 1, and press Enter to begin the autocal. The instrument will take about 1.5 minutes to calibrate the sensor.

- c. Use the front panel controls to set the following menu items as needed:

Set **Main Menu > Measure** to "Run".  
Set **Main Menu > Chan 1 > MeasMode** to "PulseMode".  
Set **Main Menu > Chan 1 > Params > dB Offset** to 0.00dB.  
Set **Main Menu > Chan 1 > Params > Frequency** to 1.00GHz.  
Set **Main Menu > Chan 1 > Params > Video BW** to "High".  
Set **Main Menu > Chan 1 > Display > Vert Span** to 100dB.  
Set **Main Menu > Chan 1 > Display > Vert Cntr** to 0dBm.  
Set **Main Menu > Trig/Time > Time Span** to 5ms.  
Set **Main Menu > Trig/Time > Trig Pos** to "Middle".  
Set **Main Menu > Trig/Time > TrigDelay** to 0ms.  
Set **Main Menu > Trig/Time > TrigSlope** to "Pos (+)".  
Set **Main Menu > Trig/Time > TrigMode** to "Norm".  
Set **Main Menu > Trig/Time > TrigSrce** to "External".  
Set **Main Menu > Trig/Time > TrigLevel** to 0.0 Volts.

- d. Press the Graph key. A square wave should be displayed.
- e. Press the Graph key again to bring up the Graph Mode Edit Menu, and press the Right Arrow key until **TrigLvl** is highlighted.
- f. Press the Up key to increase the trigger level until the square wave disappears or stops updating. Verify that this occurs at a setting of +4.7 +/- 0.2 Volts.
- g. Press the Down key to decrease the trigger level until the square wave disappears or stops updating. Verify that this occurs at a setting of -4.7 +/- 0.2 Volts.
- h. Set **Main Menu > Trig/Time > TrigSrce** to "Snsr 1".
- i. Set **Main Menu > Trig/Time > TrigLevel** to 0.0 dBm, and press the Graph key again. The square wave should again be visible and triggering.
- j. Increase the frequency setting on the function generator to 100KHz.
- k. Press the Right Arrow key until **TimeSpn** is highlighted in the Graph Mode Edit Menu, then press the Up key until the Time Span is set to 50usec. A square wave with sharp edge transitions should be displayed, although the falling edge may decay slowly near the bottom.

- l. Monitor the VIDEO OUT 1 on the rear panel of the 4530 with the oscilloscope. Verify that the waveform displayed is a 100kHz squarewave with a peak-to-peak amplitude of 1.7V +/- 0.3V. It is acceptable for the falling edge to decay slowly near the bottom – similar to the waveform that displayed on the 4530.
- m. Set **Main Menu > Chan 1 > Params > Video BW** to “Low”, then press the Graph key again.
- n. Verify that now a serasoidal waveform (a highly filtered square wave with very slow rise and fall times) is displayed, which indicates that the sensor correctly switched to low bandwidth mode.

## 8) CHANNEL 2 PEAK ACQUISITION / TRIGGER TESTS (Model 4532 only)

- a. Connect and Calibrate a peak sensor on channel 2:
  - 1. Plug in a 57518 peak power sensor into the 4532 “Sensor 2” connector.
  - 2. From front panel controls, select **Zero/Cal > AutoCal**. Use the right-arrow key to select Sensor 2, and press Enter to begin the autocal. The instrument will take about 1.5 minutes to calibrate the sensor.
- b. Use the front panel controls to set the following menu items as needed:
  - Set **Main Menu > Chan 2 > MeasMode** to “PulseMode”.
  - Set **Main Menu > Chan 2 > Params > dB Offset** to 0.00dB.
  - Set **Main Menu > Chan 2 > Params > Frequency** to 1.00GHz.
  - Set **Main Menu > Chan 2 > Params > Video BW** to “High”.
  - Set **Main Menu > Chan 2 > Display > Vert Span** to 100dB.
  - Set **Main Menu > Chan 2 > Display > Vert Cntr** to 0dBm.
  - Set **Main Menu > Trig/Time > Time Span** to 5ms.
  - Set **Main Menu > Trig/Time > TrigSrce** to “Snsr 2”.
  - Set **Main Menu > Trig/Time > TrigLevel** to 0.0 dBm.
- c. Press the Graph key.
- d. Set the function generator frequency to 500Hz. A square wave should be displayed.
- e. Increase the frequency setting on the function generator to 100KHz.
- f. Press the Right Arrow key until **TimeSpn** is highlighted in the Graph Mode Edit Menu, then press the Up key until the Time Span is set to 50usec. A square wave with sharp edge transitions should be displayed, although the falling edge may decay slowly near the bottom.
- g. Monitor the VIDEO OUT 2 on the rear panel of the 4532 with the oscilloscope. Verify that the waveform displayed is a 100kHz squarewave with a peak-to-peak amplitude of 1.7V +/- 0.3V. It is acceptable for the falling edge to decay slowly near the bottom – similar to the waveform that displayed on the 4530.
- h. Set **Main Menu > Chan 2 > Params > Video BW** to “Low”, then press the Graph key again.
- i. Verify that now a serasoidal waveform (a highly filtered square wave with very slow rise and fall times) is displayed, which indicates that the sensor correctly switched to low bandwidth mode.

## 9) CHANNEL 1 CW ACQUISITION TESTS

- a. Select internal calibrator and turn on at 0dBm:

Display the **Main Menu > Calibratr** menu to determine which calibrator is currently selected.

If the bottom line indicates "SelectInt", then highlight that line and press Enter to select the internal calibrator. If the bottom line indicates "SelectExt", then the internal calibrator is already selected.

Set **Main Menu > Calibratr > Int Level** to 0.0dBm.  
Set **Main Menu > Calibratr > Int Signal** to "On".

- b. Plug in the CW sensor cable into the 4530 Sensor 1 connector and connect a model 51075 CW sensor to the 4530 Calibrator.

Set **Main Menu > Chan 1 > MeasMode** to "CW".  
Set **Main Menu > Chan 1 > Params > dB Offset** to 0.00dB.  
Set **Main Menu > Chan 1 > Params > Frequency** to 0.05GHz.  
Set **Main Menu > Chan 1 > Params > Filter** to "Auto".  
Set **Main Menu > Chan 1 > Params > Range** to "Auto".

- c. Zero the sensor:

Press the Zero/CAL key, and press Enter.  
Select "Zero Chan". Press Enter.  
The 4530 will perform a sensor fine zero adjustment operation.  
Check for any error messages.

- d. Perform a Fixed Calibration:

Press the Zero/CAL key.  
Select "Fixed Cal", and press Enter.  
The 4530 will perform a fixed 0dBm calibration.  
Check for any error messages, then press the Text key.  
Channel 1 should display 0.000 dBm +/-0.002dBm.

- e. Perform an Auto Calibration:

Press the Zero/CAL key.  
Select "Auto Cal". Press Enter.  
The 4530 will perform an automatic sensor power sweep calibration.  
Check for any error messages, then press the Text key.  
Channel 1 should display 0.000 dBm +/-0.002dBm.

## 10) CHANNEL 2 CW ACQUISITION TESTS (Model 4532 only)

- a. Select internal calibrator and turn on at 0dBm:

Display the **Main Menu > Calibratr** menu to determine which calibrator is currently selected.

If the bottom line indicates "SelectInt", then highlight that line and press Enter to select the internal calibrator. If the bottom line indicates "SelectExt", then the internal calibrator is already selected.

Set **Main Menu > Calibratr > Int Level** to 0.0dBm.  
Set **Main Menu > Calibratr > Int Signal** to "On".



- b. Plug in the CW sensor cable into the 4530 Sensor 2 connector and connect a model 51075 CW sensor to the 4530 Calibrator.
  - Set **Main Menu > Chan 2 > MeasMode** to "CW".
  - Set **Main Menu > Chan 2 > Params > dB Offset** to 0.00dB.
  - Set **Main Menu > Chan 2 > Params > Frequency** to 0.05GHz.
  - Set **Main Menu > Chan 2 > Params > Filter** to "Auto".
  - Set **Main Menu > Chan 1 > Params > Range** to "Auto".
- c. Zero the sensor:
  - Press the Zero/CAL key.
  - Select "Zero Chan". Press Enter.
  - The 4530 will perform a sensor fine zero adjustment operation.
  - Check for any error messages.
- d. Perform a Fixed Calibration:
  - Press the Zero/CAL key.
  - Select "Fixed Cal", and press Enter.
  - The 4530 will perform a fixed 0dBm calibration.
  - Check for any error messages, then press the Text key.
  - Channel 2 should display 0.000 dBm +/-0.002dBm.
- e. Perform an Auto Calibration:
  - Press the Zero/CAL key.
  - Select "Auto Cal". Press Enter.
  - The 4530 will perform an automatic sensor power sweep calibration.
  - Check for any error messages, then press the Text key.
  - Channel 2 should display 0.000 dBm +/-0.002dBm.

## 11) CHANNEL 1 PEAK ACQUISITION TESTS

- a. Select internal calibrator and turn on at 0dBm:
 

Display the **Main Menu > Calibratr** menu to determine which calibrator is currently selected.

If the bottom line indicates "SelectInt", then highlight that line and press Enter to select the internal calibrator. If the bottom line indicates "SelectExt", then the internal calibrator is already selected.

  - Set **Main Menu > Calibratr > Int Level** to 0.0dBm.
  - Set **Main Menu > Calibratr > Int Signal** to "On".
- b. Connect a model 57318, 57518, 56218 to the 4530 "Sensor 1" connector using a peak sensor cable, and connect the sensor to the instrument's 50MHz calibrator connector.
  - Set **Main Menu > Chan 1 > MeasMode** to "Modulated".
  - Set **Main Menu > Chan 1 > Params > dB Offset** to 0.00dB.
  - Set **Main Menu > Chan 2 > Params > Video BW** to "Low".
  - Set **Main Menu > Chan 1 > Params > Frequency** to 0.05GHz.
  - Set **Main Menu > Chan 1 > Params > Filter** to "Auto".
- c. Perform an Auto Calibration:
  - Press the Zero/CAL key.
  - Select "Auto Cal". Press Enter.
  - The 4530 will perform an automatic sensor power sweep calibration.
  - Check for any error messages, then press the Text key.
  - Channel 1 should display 0.000 dBm +/-0.005dBm.

## 12) CHANNEL 2 PEAK ACQUISITION TESTS (Model 4532 only)

- a. Select internal calibrator and turn on at 0dBm:

Display the **Main Menu > Calibratr** menu to determine which calibrator is currently selected.

If the bottom line indicates "SelectInt", then highlight that line and press Enter to select the internal calibrator. If the bottom line indicates "SelectExt", then the internal calibrator is already selected.

Set **Main Menu > Calibratr > Int Level** to 0.0dBm.

Set **Main Menu > Calibratr > Int Signal** to "On".

- b. Connect a model 57318, 57518, 56218 to the 4530 "Sensor 2" connector using a peak sensor cable, and connect the sensor to the instrument's 50MHz calibrator connector.

Set **Main Menu > Chan 2 > MeasMode** to "Modulated".

Set **Main Menu > Chan 2 > Params > dB Offset** to 0.00dB.

Set **Main Menu > Chan 2 > Params > Video BW** to "Low".

Set **Main Menu > Chan 2 > Params > Frequency** to 0.05GHz.

Set **Main Menu > Chan 2 > Params > Filter** to "Auto".

- c. Perform an Auto Calibration:

Press the Zero/CAL key.

Select "Auto Cal". Press Enter.

The 4530 will perform an automatic sensor power sweep calibration.

Check for any error messages, then press the Text key.

Channel 2 should display 0.000 dBm +/-0.005dBm.

## Section 2: 4530 Series Calibration Procedure

**Note:** The following procedures assume that the technician is familiar with the basic menu operation of the 4530 Series. To select menu items, press the MENU key twice to return to the top-level menu, and then use the up and down arrows to highlight the desired entry. Once highlighted, the right arrow or Enter key is used to select that entry. The ESC key aborts a menu entry, and the left arrow moves back one level in the menu hierarchy. To select a different menu item at the same menu level, simply navigate directly - it is not necessary to return to the top of the menu hierarchy. If needed, see the [4530 User's Manual](#) for more detailed instructions on menu navigation, and a complete chart of the menu tree.

Required Test Equipment:

BOONTON Model 2520 RF Calibrator.  
BOONTON Model 2510 DC Range Calibrator.  
BOONTON Model 4530 RF Power Meter.  
BOONTON Model 51075 CW Power Sensor and its Data Adapter.  
Murata Eire TZBX Special Trim Cap tool or equivalent (0.047" Square Ceramic Tip)  
Jewelers Screw driver for pots R81, R82 (0.125" blade)  
HP8761A RF coaxial Switch  
4 90 degree Male to Female Type N adapters  
2 Straight Male to Male Type N adapters  
DC power supply (12-15vdc) and switch control of your own design.  
Oscilloscope with 1 Megohm (min) input impedance  
Spectrum Analyzer with 50 ohm input impedance  
50 ohm, 1 Watt precision termination (dummy load)

**NOTE: When removing or inserting a sensor or data adapter into the 4530, you will notice that the instrument reacts to these events. Pause a moment to allow the 4530 time to perform its house keeping. This will prevent some unpredictable behavior. In the unlikely event that unpredictable or improper behavior is noticed, the instrument should be restarted by cycling AC power.**

## 1) BASIC SYSTEM CHECK AND SETUP

- a. Turn ON rear panel power switch
- b. Press **ON/STBY** key on front panel.
- c. The display should show a start-up screen, the BOONTON logo, and then the main menu of the 4530. Check that the fan is operating. If the menu is not shown, press the **Menu** key.
- d. Press and hold the **ESC/Stop** key while using the **UP** and **DOWN** keys to adjust the display contrast.
- e. Select *Main Menu > Utilities > SystemInf.* Note the software version date. This is useful when contacting Boonton Engineering. Software update instructions are available at <http://www.boonton.com/upgrade.htm>

- f. Verify proper operation of the following:

Select *Main Menu > Utilities > Backlight* – backlight should turn on or off

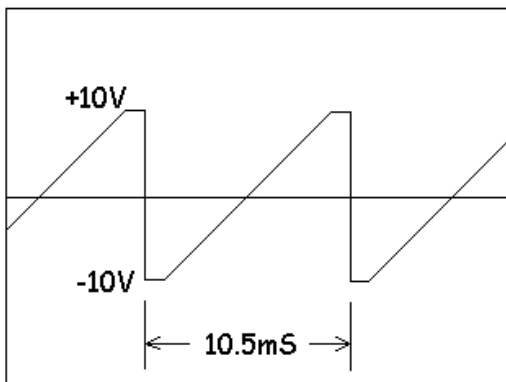
Select *Main Menu > Utilities > Key Beep* – key beep should be audible or silent

Select *Main Menu > Utilities > Sys-Tests > Voltages* – all voltages should be within 0.5V of nominal.

Select *Main Menu > Utilities > Sys-Tests > Disp Test* – check for abnormal pixels or bad display

Select *Main Menu > Utilities > Sys-Tests > Keypad* – check for response from each key; ESC ends test.

- g. Select *Main Menu > Utilities > Sys-Tests > Recorder* and monitor the signal on the **Recorder Out** BNC connector on the rear panel using an oscilloscope. The waveform should be approximately as shown below:



- h. Press and hold the **ON/STBY** key. The instrument should turn off.

## 2) Calibrator Signal Check

- a. Press **ON/STBY** key on front panel. The instrument should power up with the calibrator off.
- b. With the calibrator output still off, connect a spectrum analyzer with a 50 ohm input impedance to the **Calibrator** connector. Scan from 1MHz to 1GHz for any signals above  $-80\text{dBm}$ .
- c. Set the spectrum analyzer input to accept a signal of  $+20\text{dBm}$  without overloading, then turn on calibrator and set for a  $20\text{dBm}$  output level using the following key sequence:

Select *Main Menu > Calibrator > IntSignal*      ON.  
Select *Main Menu > Calibrator > Int Level*       $+20\text{dBm}$

(Once the current level is highlighted, press **>** key to position an edit cursor on the desired digit, then use the **UP** and **DOWN** keys to set for  $20\text{dBm}$ . Press **Enter** to set level.)

- d. With the spectrum analyzer, scan for carrier harmonics from  $49.5\text{MHz}$  to  $1\text{GHz}$ . The main carrier should be at approximately  $20\text{dBm}$  at  $50\text{MHz}$ , and all harmonics must be at least  $60\text{dB}$  below the carrier ( $-60\text{dBc}$ , or  $-40\text{dBm}$ ).
- e. Set the analyzer for a narrow bandwidth, and perform a very slow scan the calibrator's output from  $49.5$  to  $50.5\text{MHz}$ . Look for low frequency components being mixed with the  $50\text{MHz}$  signal. These components must be at least  $60\text{dB}$  below the  $50\text{MHz}$  signal ( $-60\text{dBc}$ , or  $-40\text{dBm}$ ).
- f. Select *Main Menu > Calibrator > IntStatus* to view the calibrator's internal AGC signal. The A-to-D value should be fairly stable between 100 and 210 counts, and the bargraph should move no more than 1 pixel.
- g. Turn off the calibrator with the following key sequence:

Select *Main Menu > Calibrator > IntSignal*      OFF.

- h. If any of the preceding steps fail, the following RF alignment should be attempted on the calibrator. If this alignment cannot bring the calibrator back into spec, the entire instrument should be returned for service. There is no need to perform RF alignment if all the above steps were completed successfully.

### 3) 50MHz Calibrator RF Alignment

Note: The calibrator alignment adjustment is sealed at the factory during initial calibration, and should not require routine adjustment. This procedure should only be performed if a new calibrator has been installed in the instrument or if the output or AGC tests in the previous section failed.

#### **Warning**

***Extreme caution should be used when handling the 4530 with the cover removed. High voltages are present at the Power supply. Components inside are ESD Sensitive.***

- a. Turn off the 4530 and disconnect power from the instrument. Remove the instrument's cover by removing the 4 screws in the rear. Place the 4530 upside down on the bench and reconnect power. Turn on the instrument and wait for it to boot up.

***Do not open the calibrator.*** *The calibrator has an adjustment hole in its cover. This hole must be covered with copper tape during normal operation. If you do not have copper tape to replace this seal, do not break it. Likewise, if you do not have a Murata Eire TZBX Special Trim Cap tool or equivalent (0.047" Square Ceramic Tip) do not break this seal or attempt to adjust C16.*

- b. Connect a 1 Watt 50 ohm termination to the calibrator's output connector.
- c. Connect the 4530 instrument ("UUT") to a terminal or host computer using the serial port or GPIB interface, and verify proper communication. See 4530 Instruction Manual for details on communication interfacing.
- d. Send "SYSTEM:LANG BOON" to the UUT.
- e. Send "SYSTEM:LANG BOON" to the UUT.
- f. Send "\$CAL:DAC 40000; \$CAL:ATTEN 0" to the UUT.
- g. Select *Main Menu > Calibrator > IntStatus* to view the calibrator's AGC signal and record the starting D/A count, (typically 110 to 200):     **Starting D-to-A count:** \_\_\_\_\_
- h. Remove the copper foil seal from the adjustment hole on the calibrator's cover.
- i. With a Murata Eire TZBX or equivalent Trim Cap tool (0.047" Square Ceramic Tip). Adjust C16 through the hole in the calibrator's cover for the minimum A/D count on the 4530 display (IntStatus). This adjustment is very touchy. You will notice peaks and valleys in the A/D count as the cap is adjusted. *Since there are no stops on the trimming capacitor (C16), it can rotate continuously. This should be avoided, as it will eventually damage the capacitor.*
- j. Once a null has been found, carefully remove the tool and replace copper foil seal over the hole. If the reading goes up significantly as the tool is removed, try making the adjustment again.
- k. Record the new D/A count (typically 110 to 200):     **Adjusted D-to-A count:** \_\_\_\_\_
- l. Send "\$CAL:DAC 50000; \$CAL:ATTEN 0" to the UUT.
- m. Remove the dummy load and connect an RF powermeter to the calibrator's output.
- n. Verify that the calibrator output is between 20.5 and 21.4 dBm
- o. Send "OUTPUT:INTERNAL:SIGNAL OFF" to the UUT.
- p. Remove power from the 4530, and reinstall the cover.

#### 4) CW Channel Input Current Offset Adjustment

**Warning**

**Extreme care should be used when handling the 4532 with the cover removed. High voltages are present at the Power supply. Components inside are ESD Sensitive.**

- a. Turn off the 4530 and disconnect power from the instrument. Remove the instrument's cover by removing the 4 screws in the rear. Place the 4530 upside down on the bench and reconnect power. Turn on the instrument and allow several minutes warmup time.
- b. Set the Boonton Model 2510 DC RANGE CALIBRATOR Output to OFF and its Source Resistance to 1800 ohms.
- c. Connect the 2510 to the 4530's Sensor 1 (or 2) input using a CW SENSOR DATA ADAPTER.
- d. Zero the channel as follows:  
Pressing the **Zero/CAL** key.  
Select the appropriate channel by pressing < or >.  
Select *Zero Chan* and press **Enter**, and wait for the zeroing process to complete.
- e. Display the reading with the following key sequence:  
Select *Main Menu > Channel 1 > Meas Mode* CW  
Select *Main Menu > Display > Units* Lin-Watts  
Press **Enter** to start the measurement.  
Press the **Text** key to show the reading.
- f. Set the 2510 Source Resistance to 500K.
- g. Adjust R81 (R82 for channel 2) until the 4530 displays a power reading of 0.00nW +/- 1.00nW. This is an extremely sensitive adjustment.
- h. Repeat steps (b) through (g) for channel 2 if the instrument is a 4532 (2 channel unit).
- i. Disconnect the 2510, remove power from the 4530, and reinstall the cover.

#### 5) CW Channel Gain Calibration

**Warning**

**Extreme care should be used when handling the 4532 with the cover removed. High voltages are present at the Power supply. Components inside are ESD Sensitive.**

- a. Turn off the 4530 and disconnect power from the instrument. Remove the instrument's cover by removing the 4 screws in the rear. Place the 4530 upside down on the bench and reconnect power. Turn on the instrument and allow several minutes warmup time.
- b. Connect the 4530 instrument ("UUT") to a terminal or host computer using the serial port or GPIB interface, and verify proper communication. See 4530 Instruction Manual for details on communication interfacing.
- c. Send "SYSTEM:LANG BOON" to the UUT.
- d. Set the Boonton Model 2510 DC RANGE CALIBRATOR Output to OFF and its Source Resistance to

500K.

- e. Connect the 2510 output to the 4530's Sensor 1 (or 2) input using a CW SENSOR DATA ADAPTER.
- f. Zero the channel as follows:
  - Pressing the **Zero/CAL** key.
  - Select the appropriate channel by pressing < or >.
  - Select *Zero Chan* and press **Enter**, and wait for the zeroing process to complete.
- g. Set the 2510 Range to 6B and set its Output to ON.
- h. Send "\$DCCAL:R1:C1" to the 4530, ("...C2" for channel 2). Look for any error messages on the 4530.
- i. Set the 2510 Range to 4.
- j. Send "\$DCCAL:R0:C1" to the 4530, ("...C2" for channel 2). Look for any error messages on the 4530.
- k. Repeat steps (d) through (j) for channel 2 if the instrument is a 4532 (2 channel unit).
- l. Send "\$DCCAL:SAVE" to the 4530 to save the new gain calibration coefficients for both channels.
- m. Disconnect the 2510, remove power from the 4530, and reinstall the cover.

## 6) 50MHz Calibrator Calibration

It is recommended that the 4530 be returned annually to Boonton Electronics for calibration. If that is not possible, the calibration accuracy of the 4530's calibrator should be checked annually by performing the checkout at the end of this procedure, or by an equivalent method traceable to NIST standards. If calibration errors are noted, or if the calibrator has been replaced, the following procedure should be used to store new coefficients into the 4530's calibration memory. This procedure should be attempted only by personnel with a strong knowledge of interconnecting bus communications and RF Power Measurements, and only after carefully reading this entire procedure. DC Gain Calibration and Input Offset adjustment procedures must be completed prior to this procedure. The 4530 should have its cover installed and be at a stable operating temperature (within one degree Celsius) for a minimum of 30 minutes before this calibration is performed.

This procedure may require communication with two or more instruments. If RS232 is used, it will be necessary to use separate ports, or alternatively to enter commands manually from the keyboard on the reference powermeter. Both the bus commands and the menu keystrokes are shown below.

### Overview

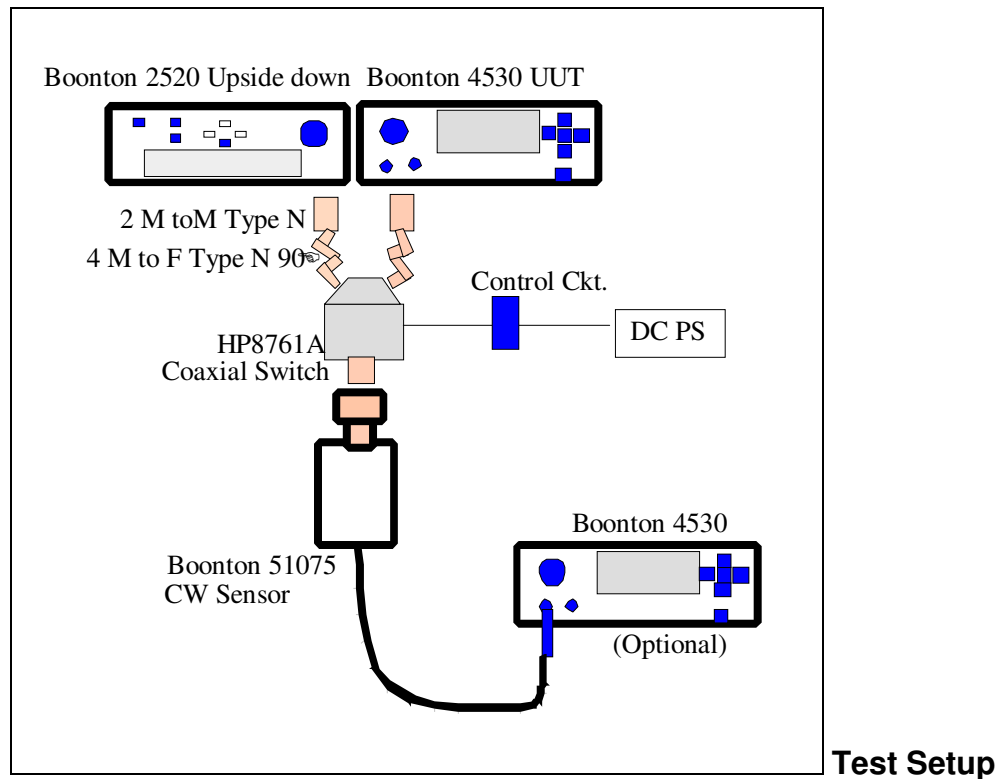
This calibration technique uses a reference calibrator to generate precise power levels and a reference powermeter operating in relative (ratiometric) mode to resolve the difference in power between the reference calibrator's output and the UUT at each calibration point. A coaxial switch is used to switch a single RF power sensor between the two sources, and the reference powermeter is used to first measure the reference signal, then the test signal, and display the difference in dBr. Once the output error in the UUT is known, a new gain coefficient may be calculated. This process is repeated iteratively until the test level is exactly equal to the reference level. In this manner, the calibration of the reference calibrator (which should be NIST traceable) can be transferred to the UUT.

### Test Setup



Construct the calibration setup as shown below. The use of a second 4530 (“reference powermeter”) to make the calibration measurements is the preferred method, but is not strictly necessary. Since all readings are relative to the test calibrator’s output, there is no requirement that the reference powermeter have high absolute measurement accuracy.

When reference powermeter is operated in relative mode, sensor and powermeter calibration uncertainties cancel out, and the only significant uncertainty with this method is the difference between the two paths through the switch. Every effort should be taken to ensure that the two paths from the switch to the calibrator outputs are the electrically identical. This differences between the two paths can be easily measured (S21) and can usually be kept very small (>0.01dB) at 50MHz.



The switch should be wired so the output of the reference calibrator (Boonton Model 2520) is routed through an adapter to input “A” of the HP8761A Coaxial Switch, and the output of the UUT’s calibrator is routed through an identical adapter to input “B” of the switch. The reference powermeter’s sensor is connected to the switch common.

It is possible to connect the HP8761A Switch and a sensor to the same UUT at the same time by orientating the adapters and instruments such that the sensor port is not obstructed. RF cables (electrically identical and short in length) can be used in place of the adapters.

Covers should be installed on all instruments, and the temperature of the test area should be stable to within one degree Celsius for the duration of the procedure.

### Test Terminology

Since the reference 4530 is optional, The term **UUT** will be used here to refer to the 4530 containing the calibrator being calibrated, and **Meas4530** will refer to the reference powermeter making the measurement. If the same instrument that contains the calibrator being calibrated is also used to measure the power ratios, all commands are sent to that instrument.

**[Select UUT]** means set the coaxial switch to the test calibrator’s output, and **[Select 2520]** means set the coaxial switch to the output of the reference 2520 calibrator

**[Set Ref]** means to place Meas4530 into reference (ratiometric) mode and load the current power level as a reference. This process is detailed in step (j) below, and all other steps should use the same procedure.

### Procedure Summary

The transfer calibration is performed in two steps. First, the variable output oscillator is calibrated. The inherent linearity of the oscillator is quite good, so a two-point calibration is performed at a “full-scale” point, and a “down-scale” point exactly 10dB below full-scale, which is the normal range switch point. Then the step attenuator is calibrated with the oscillator at its full-scale level for each 10dB step. Each point is calibrated using the reference transfer method, so final accuracy should be within several thousandths of a dB for all but the lowest levels.

- a. Connect the instruments as shown above, and allow 30 minutes warm up time with the cover installed for the 4530 Unit Under Test (**UUT**), the 2520 and the optional reference 4530. All calibrator outputs should be off.
- b. Connect the test 4530 (**UUT**) and reference powermeter (**Meas4530**) to a terminal or host computer using the serial port or GPIB interface, and verify proper communication. See 4530 Instruction Manual for details on communication interfacing.
- c. If a separate 4530 is used for the reference powermeter, AutoCal its 51075 CW sensor as follows:

Remove the sensor from the coaxial switch and connect it to the reference powermeter’s calibrator output.

Pressing the **Zero/CAL** key.

Select the appropriate channel by pressing < or >.

Select *AutoCal* and press **Enter**, and wait for the calibration sweep to complete.

Reconnect the sensor back to the output of the coaxial switch.

**OR**

Send “CAL1:INTERNAL:AUTOCAL” to the **Meas4530** instead of the using the above keystrokes.

- d. Configure the measurement and display settings on the **Meas4530**:

Select <i>Main Menu &gt; Channel 1 &gt; Parameters &gt; Filter time</i>	4 secs
Select <i>Main Menu &gt; Channel 1 &gt; Parameters &gt; Frequency</i>	0.05GHz
Select <i>Main Menu &gt; Channel 1 &gt; Display &gt; Units</i>	Log-dBm
Select <i>Main Menu &gt; Channel 1 &gt; Display &gt; Display Source</i>	Sensor1

**OR**

Send “SENSE1:FILTER:TIME 4; CALC1:UNITS DBM” to the **Meas4530**

Send “SENSE1:CORR:FREQ 0.05; CALC1:MODE CW; CALC1:MATH CH1” to the **Meas4530**

- e. Display the current power reading (probably underrange) on Meas4530 as follows: Press the **Text** key.

**OR**

Send “DISP:TXTB 1” to **Meas4530**.

- f. Send “SYSTEM:LANG BOON” to the **UUT**.

- g. **[Select UUT]** (select the Coaxial Switch Position for the UUT’s output).

- h. Send “\$CAL:DAC 50000; \$CAL:ATTEN 0” to the **UUT**. **Meas4530** should display the output level of the UUT’s calibrator between 20.2 and 21.6 dBm. If no output is detected, the connections or one of the configuration settings is most likely incorrect. Cycle power on the UUT and Meas4530 and begin the procedure again. If there is output, but it is not within this range, the calibrator may require RF alignment (see section above) or could be defective.

- i. Set the 2520’s RF output to 0.0dBm & “**ON**”

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- j. **[Set Ref]:** First **[Select 2520]**, and then once the reading has settled, place **Meas4530** in reference mode and load a reference level corresponding to the current output level of the 2520. The reading should indicate 0.000 dBr once the reference is loaded. Loading the reference is done as follows:

Press the **Text** key twice. This displays a menu at the top of the display. Scroll left or right until *Ld/ClrR* is selected then press the **UP** arrow key to load the current reading as a reference. (Down arrow clears the reference mode, and returns the display to absolute power).

**OR**

Send "CALC1:REF:COLLECT" to the **Meas4530**.

- k. **[Select UUT]** and send "\$CAL:DAC 50000; \$CAL:ATTEN 20" to the **UUT** to generate a level of approximately 0dBm from the **UUT**. **Meas4530** should now display the ratio (error) between the reference 2520 and the **UUT** at 0dBm.
- l. Observe the error in the UUT's output level and adjust the D to A Converter (DAC) count value up or down to drive the output to **0.000 dBr** using the following formula to estimate a new DAC value. This may take several iterations:

DtoAold is the current DAC count (Starting with 50000).

$$\underline{DtoAnew} = DtoAold / (10^{(Error\_In\_dBr / -20)})$$

Send "\$CAL:DAC DtoAnew" to the **UUT**

- m. When you have the DAC value that represents 0dBm, store that value:

Send "\$CAL:DTOA:1 [DtoA1]" to the **UUT** *Typically 437XX* [DtoA1]=\_\_\_\_\_

To verify, send "\$CAL:DTOA:1?" The 4530 should reply with your [DtoA1] value.

- n. **[Select 2520]** and set the 2520's RF output to -10.0 dBm.
- o. **[Set Ref]** (load the reference level from the 2520 at -10dBm. See step (j) for procedure.)
- p. **[Select UUT]** and send "\$CAL:DAC [DtoA1 \* 0.3162]; \$CAL:ATTEN 20" to the **UUT** to generate a level of approximately -10dBm from the **UUT**. **Meas4530** should now display the ratio (error) between the reference 2520 and the **UUT** at -10.0dBm.
- q. Observe the error in the UUT's output level and adjust the D to A Converter (DAC) count value up or down to drive the output to **0.000 dBr** using the following formula to estimate a new DAC value. This may take several iterations:

DtoAold is the current DAC count (Starting with DtoA1 \* 0.3162).

$$\underline{DtoAnew} = DtoAold / (10^{(Error\_In\_dBr / -20)})$$

Send "\$CAL:DAC DtoAnew" to the **UUT**

- r. When you have the DAC value that represents -10dBm, store that value:

Send "\$CAL:DTOA:0 [DtoA0]" to the **UUT** *Typically 437XX* [DtoA0]=\_\_\_\_\_

To verify, send "\$CAL:DTOA:0?" The 4530 should reply with your [DtoA0] value.

- s. **[Select 2520]** and set the 2520's RF output "OFF", then wait at least 30 seconds to allow the sensor dissipate any thermal noise from the previous higher level measurements.

- t. On the **Meas4530**, zero the sensor as follows:

Press the **Zero/CAL** key.

Select the appropriate channel by pressing < or >.

Select *Zero Chan* and press **Enter**, and wait for the zeroing process to complete.

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**OR**

Send "CAL1:INT:ZERO" to the **Meas4530**, and wait for the zeroing process to complete.

- u. Send "\$CAL:DAC [DtoA1]; \$CAL:ATTEN [attenuator\_step]" to the **UUT**, where the first [attenuator\_step] is 70. This sets the calibrator's oscillator to the full scale power level (approximately +20dBm) with the step attenuator set for 70dB attenuation, for an output of -50dBm.
- v. Set the 2520's RF output to the current step's calibrator output level (-50dBm for the first step), and turn "**ON**"
- w. After waiting for the reading to settle, [**Set Ref**].
- x. [**Select UUT**] and record the full scale error for the 70dB attenuator step (-50dBm output power). The Attenuator Step Correction Coefficient is the inverse of this ratio, or the value in dB negated.
- y. Send "\$CAL:COEF:[attenuator\_step] [correction\_factor]" to the **UUT** where [attenuator\_step] is the current attenuation setting from step "u" (70 to 0 in 10dB steps), and [correction\_factor] is (-1.0 \* Reading\_in\_dBr). This stores the correction coefficient for the current attenuator step. Record this correction factor below.
- z. Repeat steps (u) through (y), and fill in the following chart for each attenuator step:

<u>Atten Step</u>	<u>Output Lev</u>	<u>Corr Factor</u>	
70 dB	-50 dBm_____ dB		(performed first time through the preceding steps)
60 dB	-40 dBm_____ dB		
50 dB	-30 dBm_____ dB		
40 dB	-20 dBm_____ dB		
30 dB	-10 dBm_____ dB		
20 dB	0 dBm_____ dB		(should be 0.000 +/- 0.010)
10 dB	10 dBm_____ dB		
0 dB	20 dBm_____ dB		

Note: All correction factors should be less than 1dB.

- aa. Set the 2520's RF output to -60dBm & "**OFF**", then [**select 2520**].
- bb. Send "\$CAL:SAVE" to the **UUT**. This saves the new D-to-A and attenuator coefficients to the UUT's calibration memory. If this step is omitted, the calibration will be lost when the instrument is restarted.

## 7. Calibration Verification

This verification procedure should always be performed immediately after completion of calibrator calibration, and it can also be performed independently. The test setup and terminology is identical to that described above in **50MHz Calibrator Calibration**.

- a. If not already hooked up, connect the instruments as shown above and cycle the AC power on the UUT.
- b. Verify bus communications, and allow all equipment to warm up for at least 10 minutes. All calibrator outputs should be off.
- c. Wait at least one minute to allow the power sensor to cool from recent service at or above 0dBm.
- d. Set the 2520's RF output to -60dBm & "**OFF**", then [**select 2520**].

e. Zero the reference powermeter as follows:

Pressing the **Zero/CAL** key.

Select the appropriate channel by pressing < or >.

Select *Zero Chan* and press **Enter**, and wait for the zero process to complete.

**OR**

Send “CAL1:INTERNAL:ZERO” to the **Meas4530**.

f. Configure the measurement and display settings on the **Meas4530**:

Select <i>Main Menu &gt; Channel 1 &gt; Parameters &gt; Filter time</i>	4 secs
Select <i>Main Menu &gt; Channel 1 &gt; Parameters &gt; Frequency</i>	0.05GHz
Select <i>Main Menu &gt; Channel 1 &gt; Display &gt; Units</i>	Log-dBm
Select <i>Main Menu &gt; Channel 1 &gt; Display &gt; Display Source</i>	Sensor1

**OR**

Send “SENSE1:FILTER:TIME 4; CALC1:UNITS DBM” to the **Meas4530**

Send “SENSE1:CORR:FREQ 0.05; CALC1:MODE CW; CALC1:MATH CH1” to the **Meas4530**

g. Set the 2520’s RF output to the first power step (-60dBm) with the RF output “**ON**”.

h. **[Set Ref]** to load the 2520’s current output as a reference level.

i. **[Select UUT]** and send “OUTPUT:INT:LEVEL -60; OUTPUT:INT:SIGNAL ON” to the **UUT**.

j. Measure and record the error between the reference calibrator’s level and the output of the UUT in the appropriate row of the table below.

k. Repeat steps (g) through (j) for each power level in the following table.

<u>Level</u>	<u>Error</u>	<u>+/- Limit</u>
-60.0 dBm	_____dBr	0.300
-59.9 dBm	_____dBr	0.300
-50.0 dBm	_____dBr	0.100
-49.9 dBm	_____dBr	0.100
-40.0 dBm	_____dBr	0.015
-39.9 dBm	_____dBr	0.015
-30.0 dBm	_____dBr	0.015
-29.9 dBm	_____dBr	0.015
-20.0 dBm	_____dBr	0.015
-19.9 dBm	_____dBr	0.015
-10.0 dBm	_____dBr	0.015
-9.9 dBm	_____dBr	0.015
0.0 dBm	_____dBr	0.015
0.1 dBm	_____dBr	0.015
10.0 dBm	_____dBr	0.015
10.1 dBm	_____dBr	0.015
20.0 dBm	_____dBr	0.015

Differences in the error between adjacent 0.1dB steps indicate the incremental error associated with each 10dB range change. Errors in the fullscale and downscale D/A coefficients may show here.

l. Remove the coaxial switch and adapters, and connect the sensor directly to the UUT’s calibrator.

m. Clear the reference and go back to measuring absolute power as follows:

Press the **Text** key twice. This displays a menu at the top of the display. Scroll left or right until *Ld/ClrR* is selected then press the **DN** arrow key.

**OR**

Send "CALC1:MATH CH1" to the **UUT**.

- n. Perform an AutoCal on the sensor using the UUT's new calibration:

Pressing the **Zero/CAL** key.

Select the appropriate channel by pressing < or >.

Select *AutoCal* and press **Enter**, and wait for the AutoCal process to complete.

**OR**

Send "CAL1:INTERNAL:AUTOCAL" to the **UUT**.

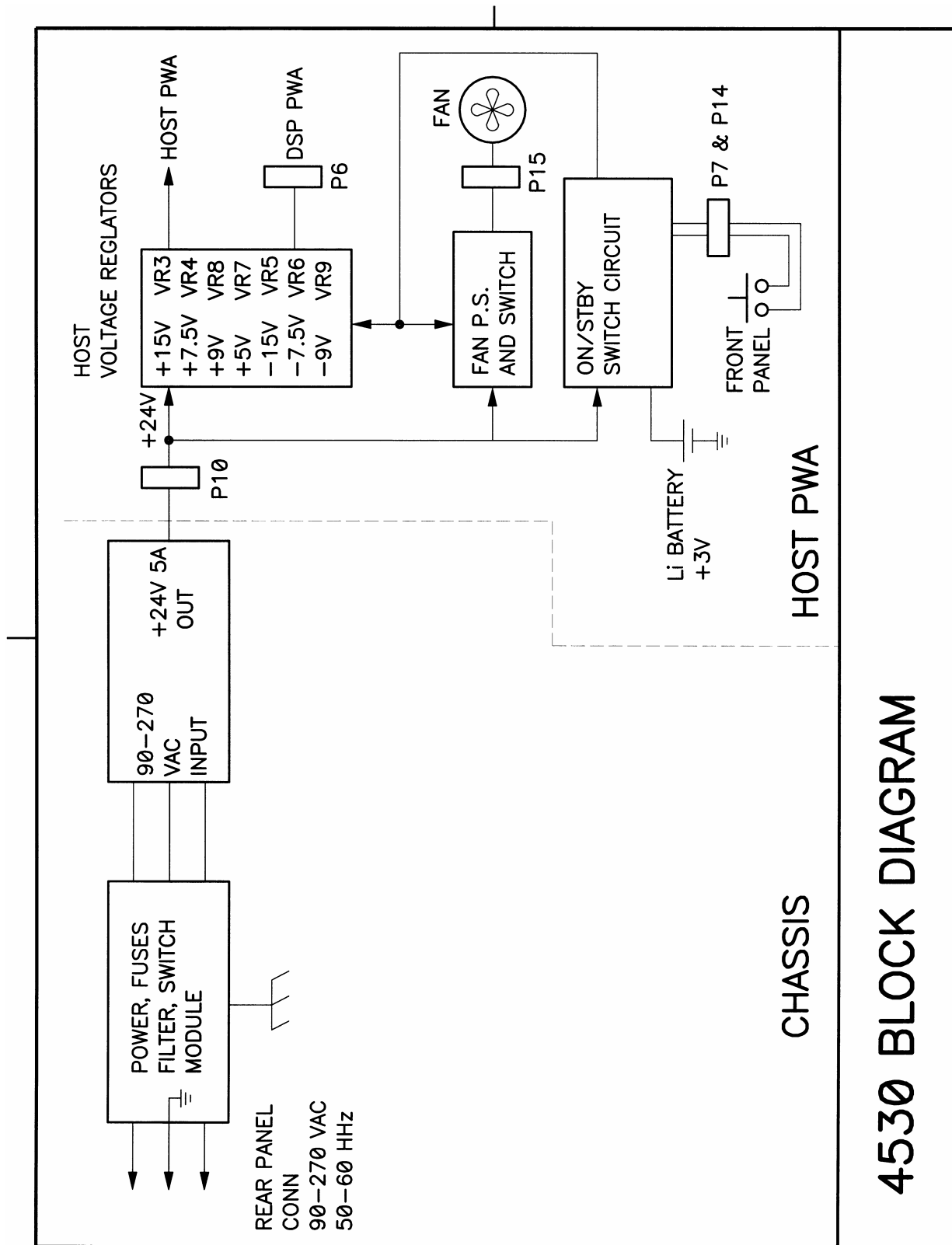
- o. Set the 2520's RF output to -60dBm & "**OFF**", and then connect the sensor to the 2520.
- p. Set the 2520's RF output to -60dBm & "**ON**", and record the power reading at each of the following signal levels. Calculate the error as the difference between the actual reading and 2520 level and check against the limits for that level. This process verifies the power measurement accuracy of the sensor after it has been step calibrated using the UUT's calibrator.

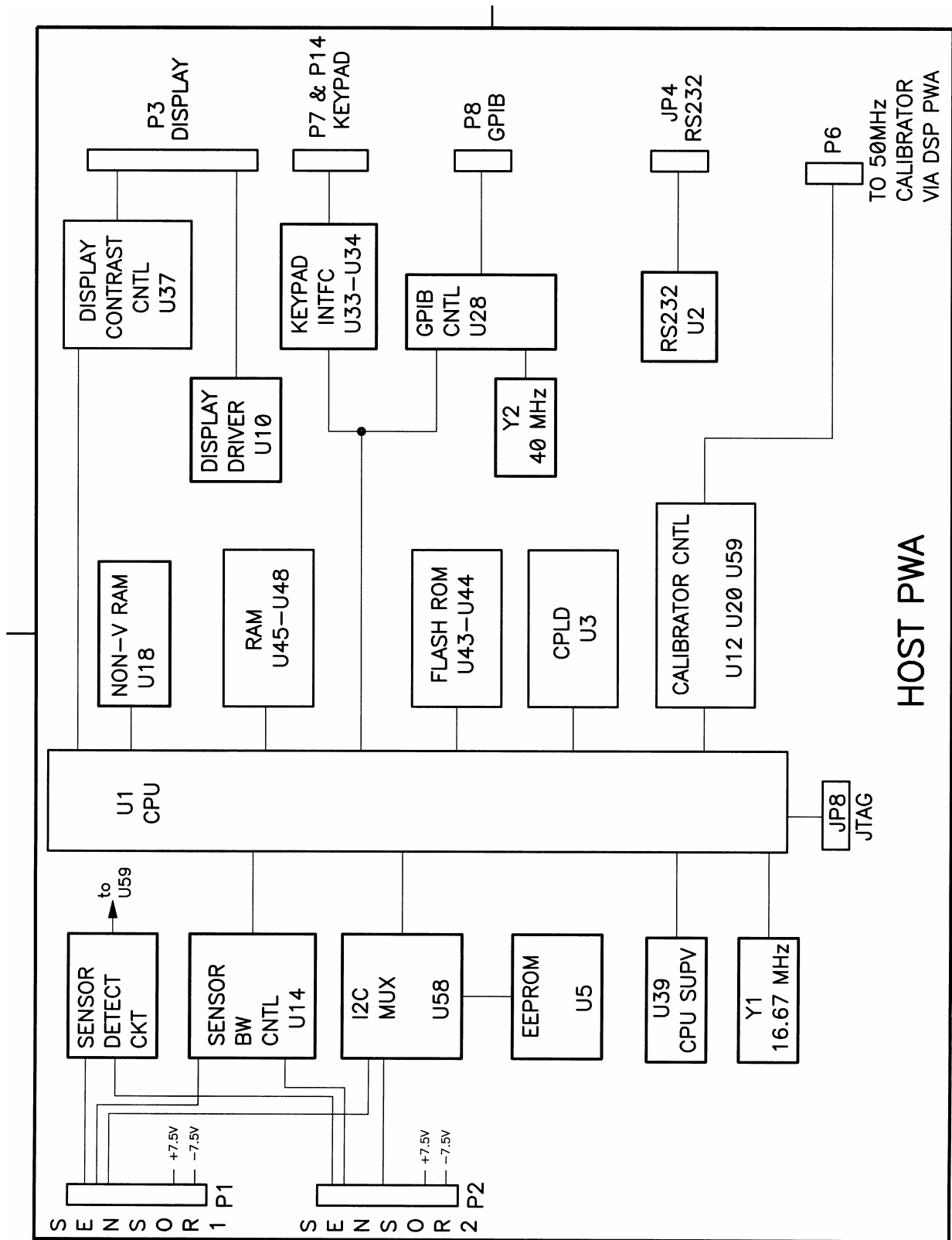
Note: if difficulty is experienced at extremely low power levels (<-40dBm), be extremely careful about thermal drift of the diode sensor. It may help to wrap the sensor with an insulator such as bubble-wrap, and to thermally isolate the sensor's RF connector with an airline, adapter or short section of coax from the warm connectors on the calibrators. It may be necessary to re-zero or AutoCal the sensor before checking at the lowest settings.

<u>2520 Level</u>	<u>Reading</u>	<u>Error</u>	<u>+/- Limit</u>
-60 dBm	_____	_____	0.300
-55 dBm	_____	_____	0.150
-50 dBm	_____	_____	0.080
-45 dBm	_____	_____	0.080
-40 dBm	_____	_____	0.050
-35 dBm	_____	_____	0.050
-30 dBm	_____	_____	0.050
-25 dBm	_____	_____	0.050
-20 dBm	_____	_____	0.050
-15 dBm	_____	_____	0.050
-10 dBm	_____	_____	0.030
-5 dBm	_____	_____	0.030
0 dBm	_____	_____	0.020
5 dBm	_____	_____	0.030
10 dBm	_____	_____	0.030
15 dBm	_____	_____	0.030
20 dBm	_____	_____	0.030

- q. Set the 2520's RF output to -60dBm & "**OFF**" and disconnect the sensor.

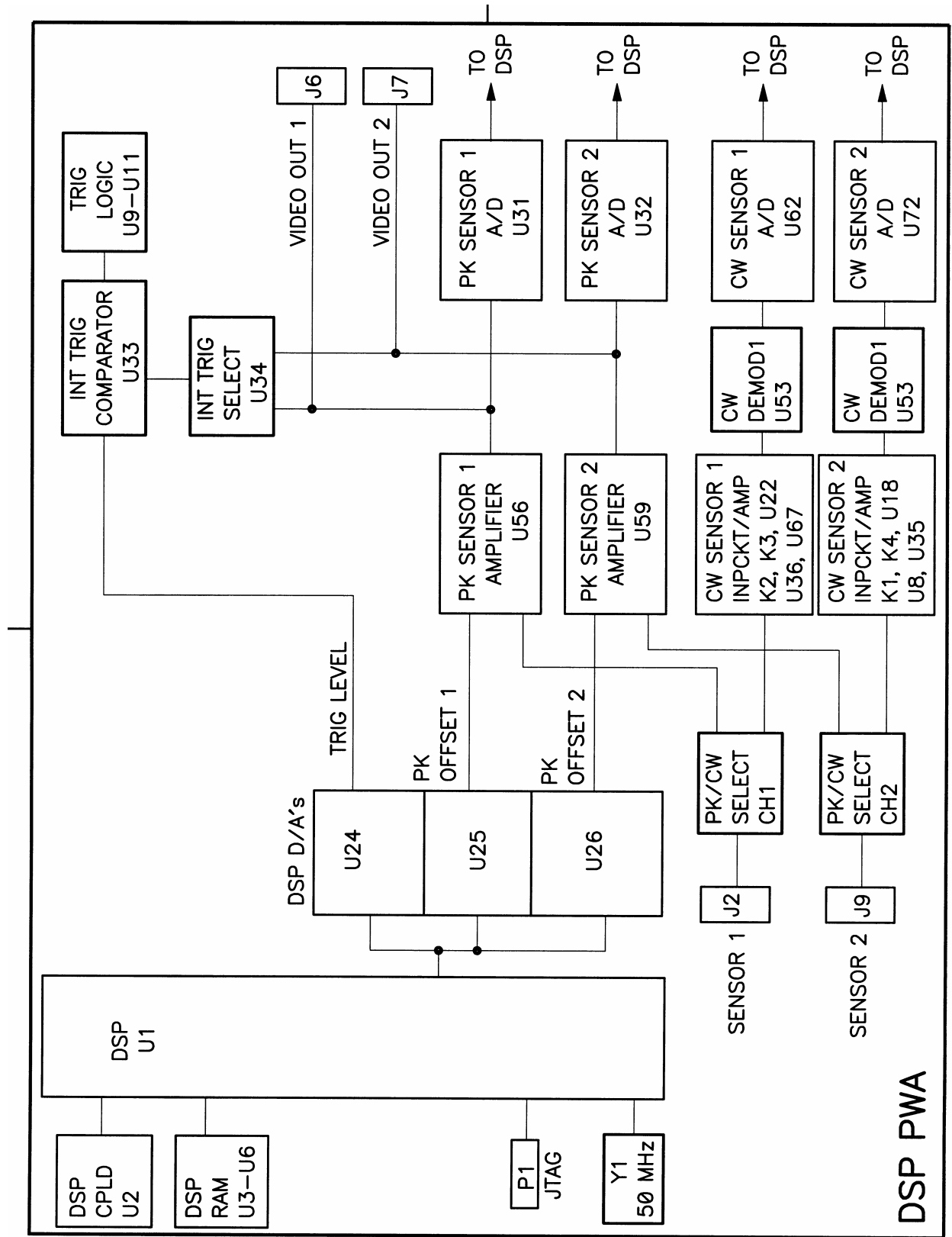
### Section 3: 4530 Series Block Diagrams

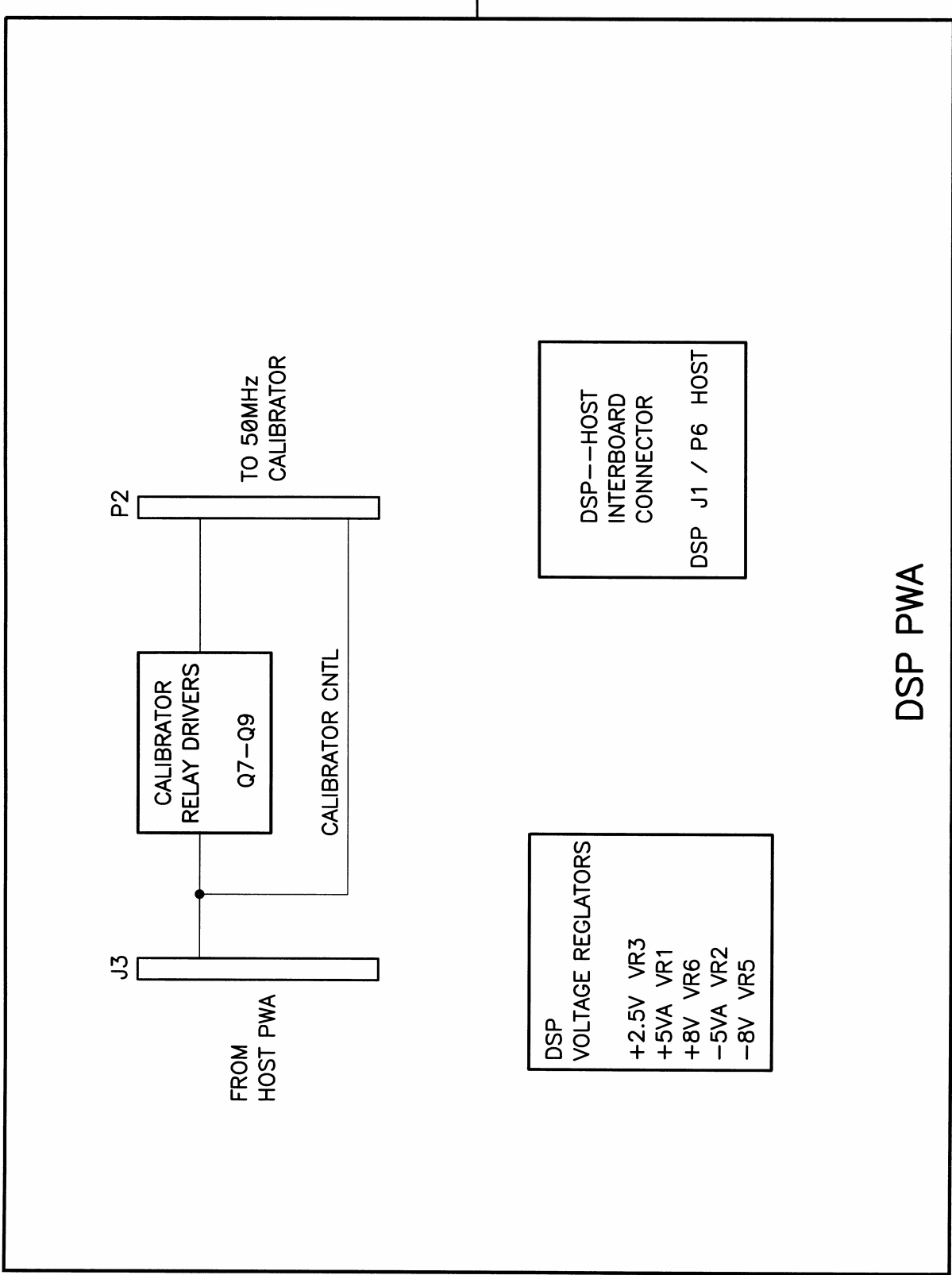




HOST PWA

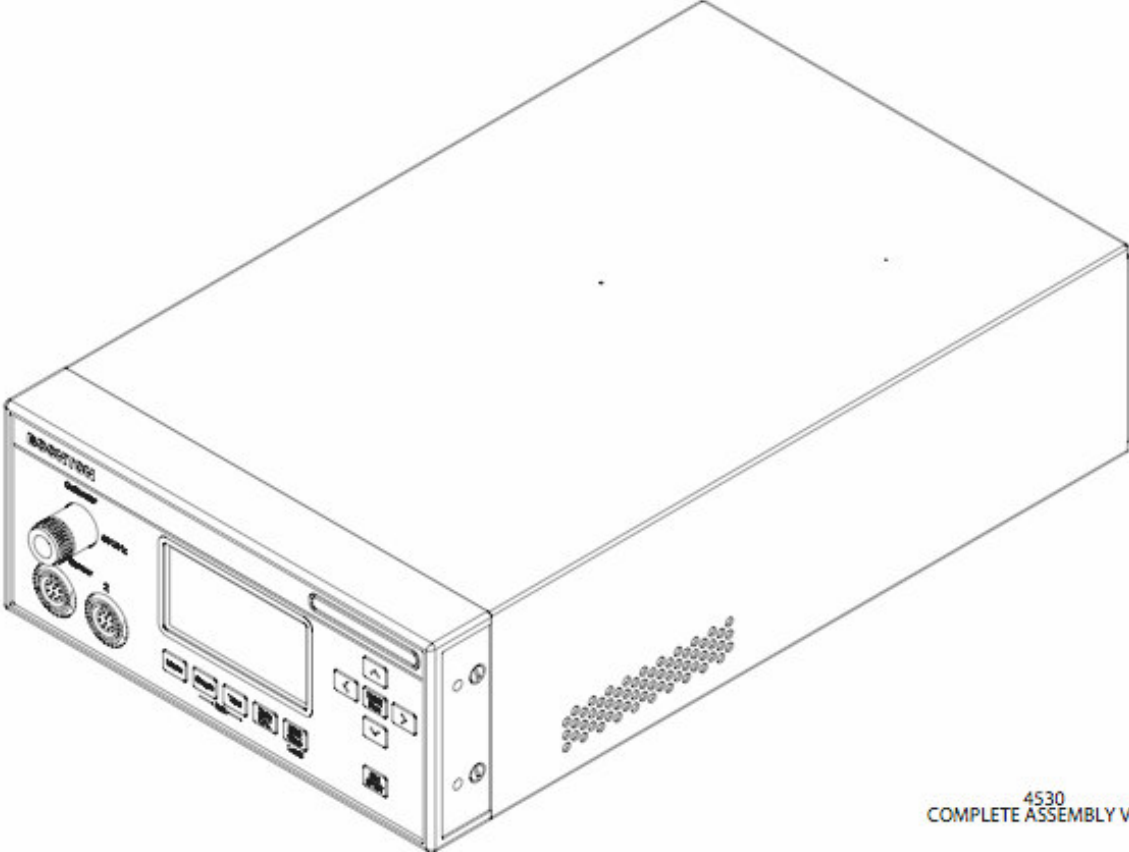




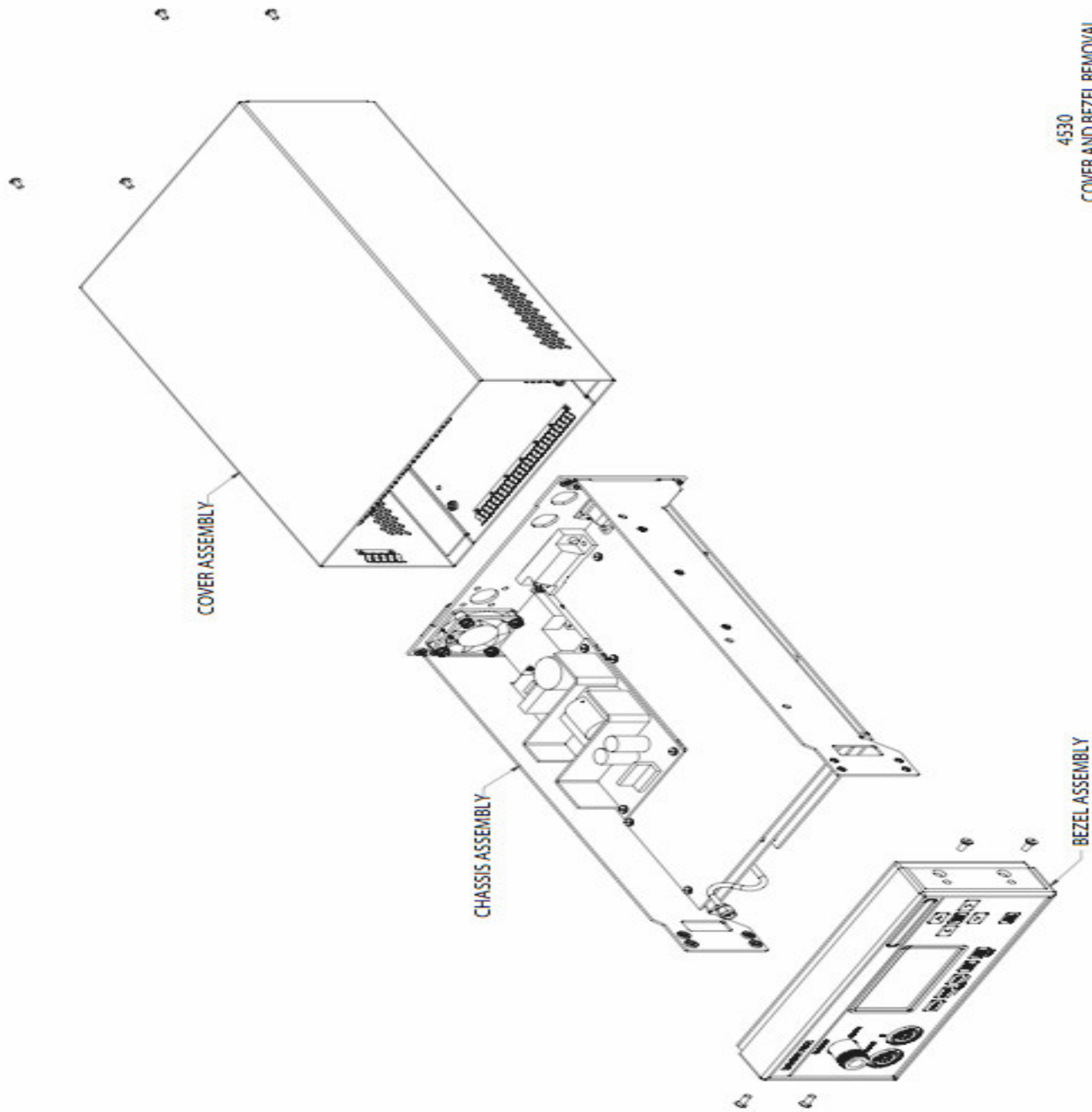


DSP PWA

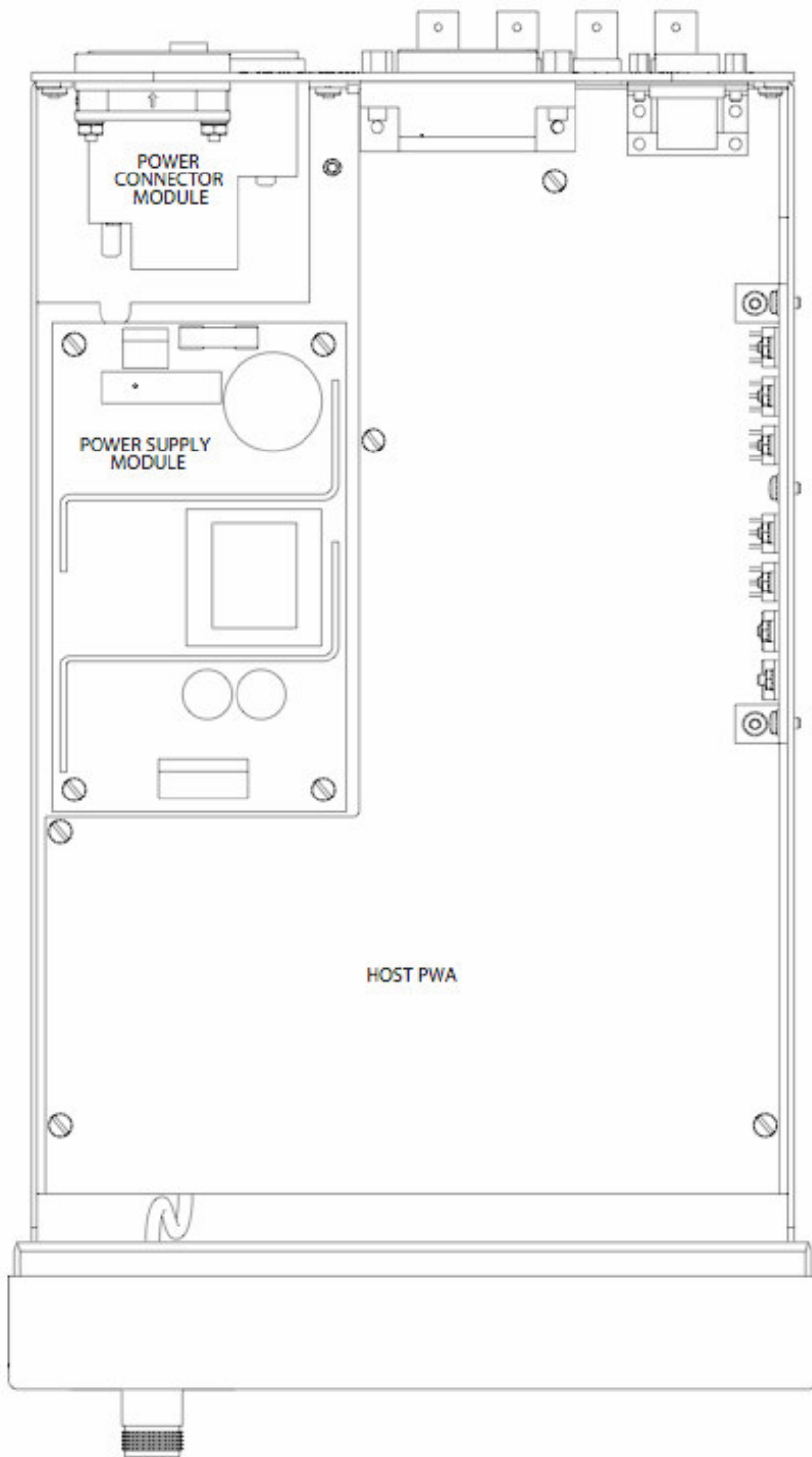
**Section 4: 4530 Series  
Drawings**



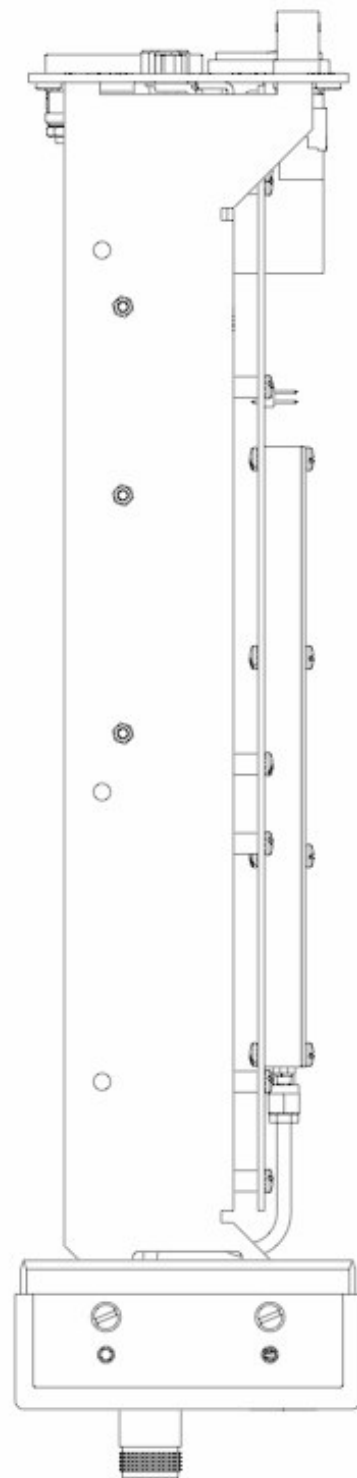
4530  
COMPLETE ASSEMBLY VIEW



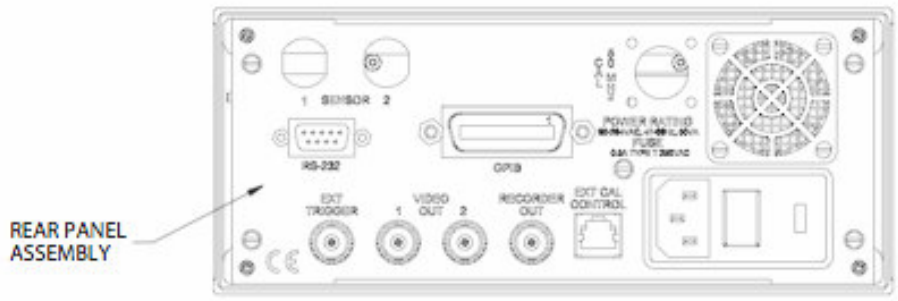
4530  
COVER AND BEZEL REMOVAL  
EXPLODED VIEW



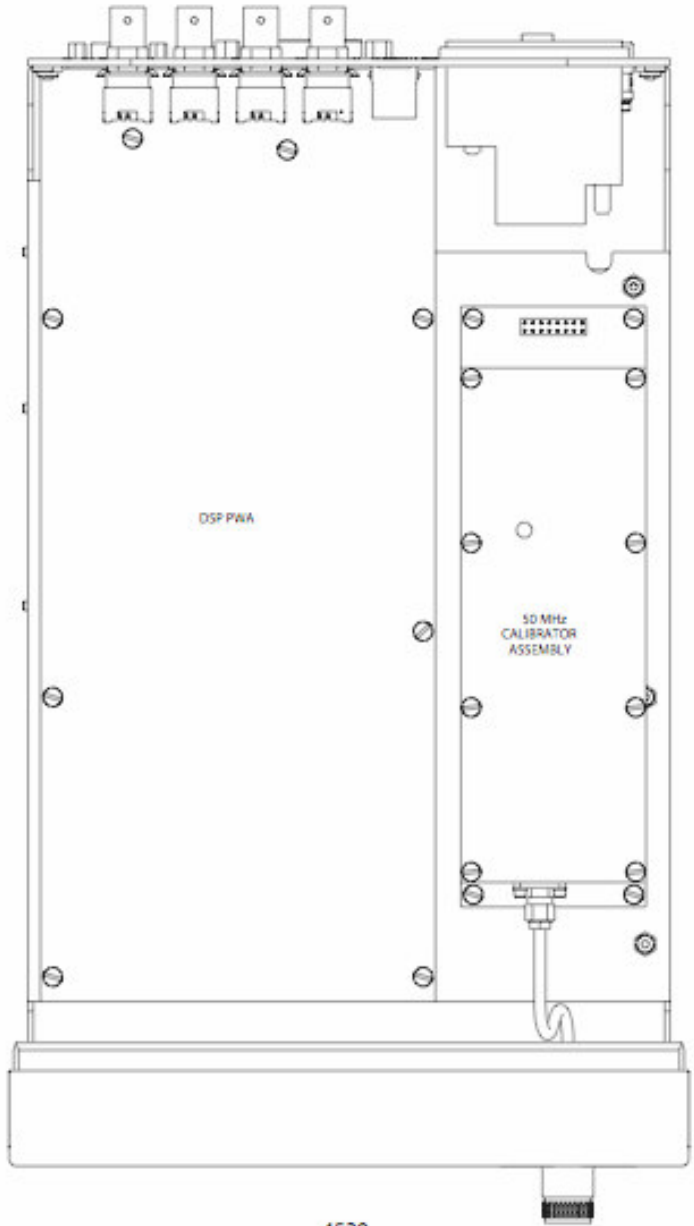
4530  
CHASSIS ASSEMBLY TOP VIEW



4530  
CHASSIS ASSEMBLY SIDE VIEW

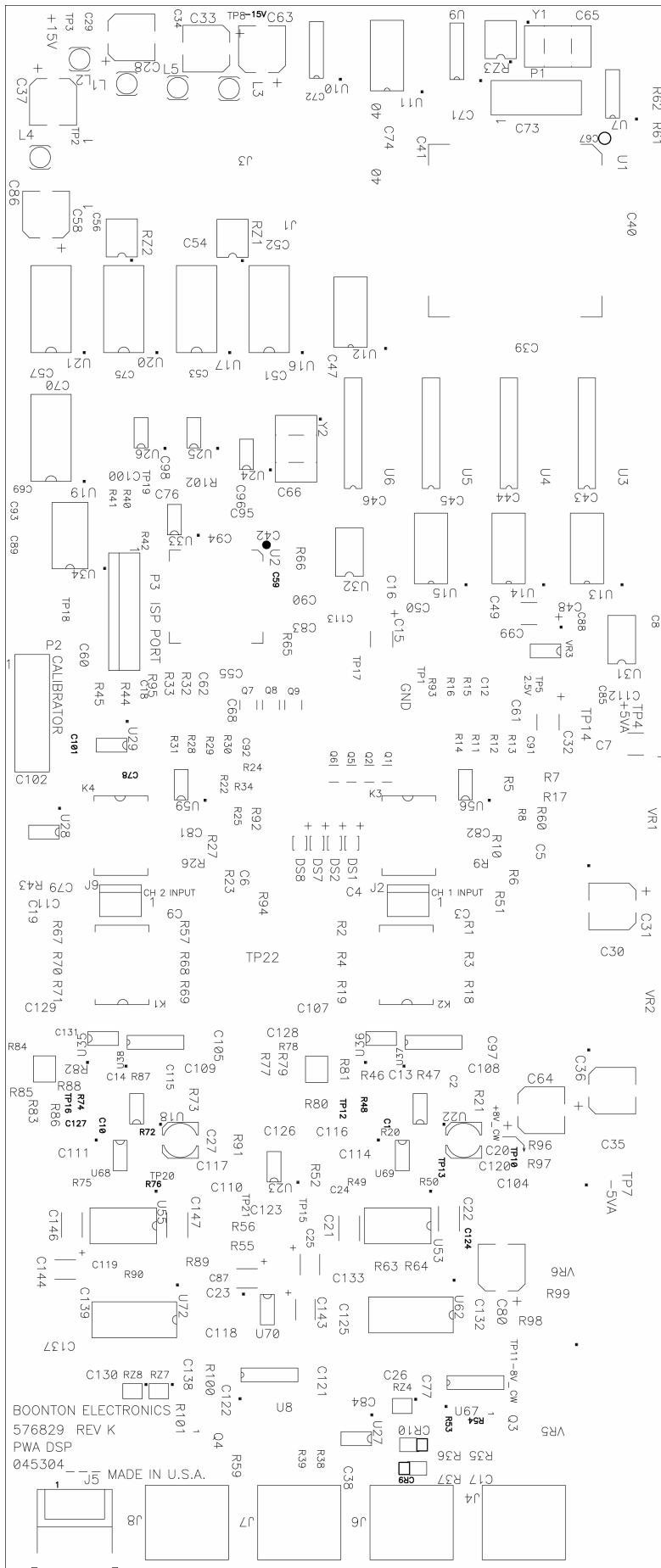


4530  
CHASSIS ASSEMBLY REAR VIEW



4530  
CHASSIS ASSEMBLY BOTTOM VIEW

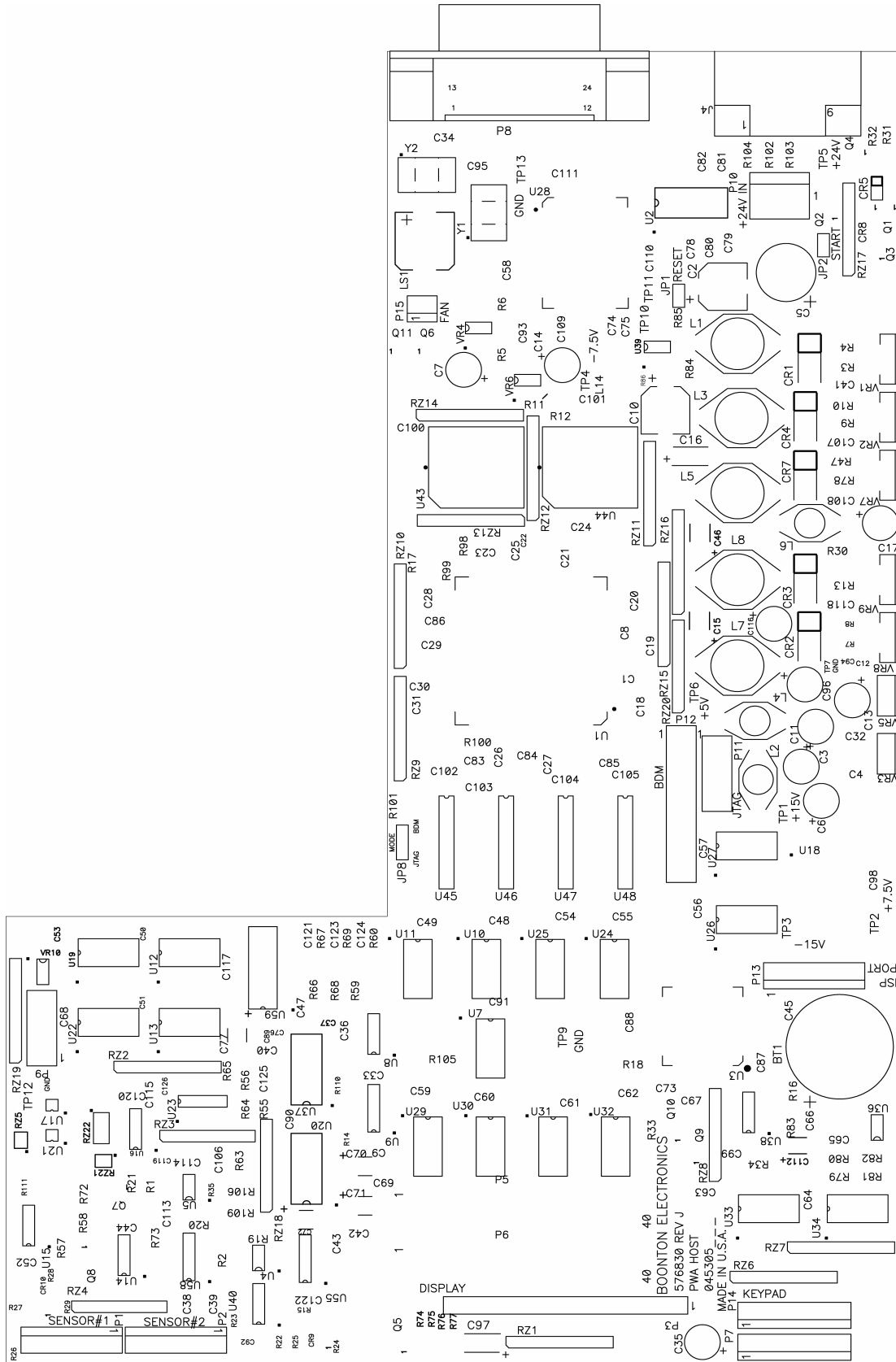
4530  
CHASSIS ASSEMBLY VIEWS  
WITH COVER REMOVED



BOONTON ELECTRONICS  
 576829 REV K  
 PWA DSP  
 045304

MADE IN U.S.A.

# 4530 Host Printed Wiring Assembly





# Appendix: Entering Data into Boonton Peak and CW Sensors

*The information supplied in this document is not for general distribution. It should only be used by qualified calibration and metrology personnel. Boonton Electronics is not responsible for measurement errors or operability problems caused by the improper programming of sensors.*

This application note describes the procedures to be used to enter calibration data into the EEPROM memory of BOONTON Peak Power Sensors and the Sensor Data Adapter of BOONTON CW Power Sensors for use with BOONTON Power Meters.

NOTE: Utmost care must be exercised when changing any of the factory-installed data. Corrupted sensor data can cause instrument malfunction.

Data loading is accomplished through the IEEE-488 Bus and Model 4400, 4500, 4400A, 4500A, 4500B or 4530 series Power Meter. Data cannot be loaded into the sensor if it is not connected to a BOONTON Peak Power Meter. It is NOT possible to change one item in a data string without reloading the entire data string.

The memory of a 56000/57000 series Peak Power Sensor is divided into four data pages:

1. Sensor Data
2. Calibration Factors for Low Bandwidth Mode
3. Calibration Factors for High Bandwidth Mode
4. Sensor Message

CW and Voltage sensor data adapters add an additional page:

5. Shaping (gain) coefficients for each range

These five areas with instructions for loading data are discussed separately below.

## SETUP FOR DATA INPUT

To change the data in the sensor EEPROM or sensor data adapter, turn on instrument power and insert the sensor into channel 1. Connect a GPIB terminal to the rear of the powermeter and verify communication by sending \*IDN? to the instrument followed by a carriage-return (CR) and line-feed (LF).

When addressed to talk, the instrument should respond with an identification string including its model and serial number.

If a 4530 series meter is being used, set to BOONTON language by issuing the bus command:

```
SYS:LANG BOON(CR)(LF)
```

Set the instrument's active channel to channel 1 by issuing the bus command:

```
CH1(CR)(LF)
```

## SENSOR DATA

This is the data about the sensor that the Power Meter uses to set various operating parameters. Most of this information is displayed on the screen when the sensor report for a specific channel is called.

This data may be recalled from the sensor by using the Talk Mode Bus Mnemonic `TKSDATA`. The string returned from the instrument will have the following format.

Format type, sensor type, month of manufacture, day of manufacture, year of manufacture, serial number, month of calibration, day of calibration, year of calibration, attenuation, impedance, pulse power bottom of range, pulse power top of range, CW power bottom of range, CW power top of range.

Except for month, day, and year of calibration there should be NO changes made to the factory programmed data.

The Bus Mnemonic to load Sensor Data into the sensor is `RD-S-DATA` followed by an ASCII space followed by the data string. Commas separate the various elements of the data string and the year of manufacture and year of calibration are represented by the number (year-1990). The mnemonic and data string cannot contain any embedded terminators (carriage return (CR) or line feed (LF)) before the end.

The following is a properly composed string to be sent to a sensor:

```
RD-S-DATA 1,56218,9,19,1,121,2,28,7,0,50,-20.00,20.00,-30.00,20.00 (CR) (LF)
```

After the string has been sent to the instrument, wait at least two seconds for the data to be written to the EEPROM before sending any other data over the GPIB.

## **NOTE ON CALIBRATION FACTORS**

Different calibration frequencies are often used for the Low and High Bandwidth modes. For some older sensor models the same frequencies and cal factors may be loaded for both modes. In all cases the sensor **MUST** contain a valid set of calibration frequencies and cal factors for both modes. Otherwise, the sensor will not function correctly in the instrument.

## **CALIBRATION FACTORS FOR LOW BANDWIDTH MODE**

This data is the frequency and associated calibration factors that the Peak Power Meter uses when in the Low Bandwidth Mode.

This data may be recalled from the sensor by using the Talk Mode Bus Mnemonic `TKSSLOW`. The string returned from the instrument will have the following format:

```
Count, Bottom of Frequency Range, Top of Frequency Range, Freq0, CF0,  
Freq1, CF1, ... Freq(n), CF(n)
```

The count is the total number of data elements in the string following the count, which include the bottom and top of the frequency range, a Frequency of 0 with a associated Calibration Factor of 0, and each Frequency and Calibration Factor separately. The maximum count is 124 numbers or 60 frequency points.

The Frequencies **MUST** be entered in order from the lowest to the highest. The instrument will not tolerate a frequency out of order or out of range and will terminate data entry.

Frequencies are valid if they are within the specified frequency range and have a format of `##.##` with the implied units of GHz. Calibration Factors are valid if they are in the range of `+/- 3.00` with the implied units of dB.

The Bus Mnemonic to load Calibration Factors for Low Bandwidth into the sensor is `RD-S-SLOW` followed by an ASCII space (SP) followed by the data string. Commas separate the various elements of the data string. The mnemonic and data string cannot contain any embedded terminators (carriage return (CR) and line feed (LF)) before the end.

The following is a properly composed string to be sent to a sensor:

```
RD-S-SLOW 2,0.50,18.00,0.00,0.00,0.50,0.15,1.00,0.00,2.00,0.23,3.00,0.34,4.00,
0.45,5.00,0.73,6.00,0.60,7.00,0.65,8.00,0.68,9.00,0.73,10.00,0.70,11.00,0.79,
12.00,0.99,13.00,1.20,14.00,1.44,15.00,1.59,16.00,1.46,17.00,1.24,18.00,0.78
(CR) (LF)
```

After the string has been sent to the instrument, wait at least two seconds for the data to be written to the EEPROM before sending any other data over the GPIB.

## **CALIBRATION FACTORS FOR HIGH BANDWIDTH MODE**

This data is the frequency and associated calibration factors that the Peak Power Meter uses when in the High Bandwidth Mode.

This data may be recalled from the sensor by using the Talk Mode Bus Mnemonic `TKSFAST`. The string returned from the instrument will have the following format:

```
Count, Bottom of Frequency Range, Top of Frequency Range, Freq0, CF0, Freq1,
CF1, ... Freq(n), CF(n)
```

The count is the total number of data elements in the string following the count, which include the bottom and top of the frequency range, a Frequency of 0 with a associated Calibration Factor of 0, and each Frequency and Calibration Factor separately. The maximum count is 124 numbers or 60 frequency points.

The Frequencies **MUST** be entered in order from the lowest to the highest. The instrument will not tolerate a frequency out of order or out of range and will terminate data entry.

Frequencies are valid if they are within the specified frequency range and have a format of `##.##` with the implied units of GHz. Calibration Factors are valid if they are in the range of `+/- 3.00` with the implied units of dB.

The Bus Mnemonic to load Calibration Factors for Low Bandwidth into the sensor is `RD-S-FAST` followed by an ASCII space (SP) followed by the data string. Commas separate the various elements of the data string. The mnemonic and data string cannot contain any embedded terminators (carriage return (CR) and line feed (LF)) before the end.

The following is a properly composed string to be sent to a sensor:

```
RD-S-FAST 42,0.50,18.00,0.00,0.00,0.50,-0.15,1.00,0.00,2.00,0.23,3.00,0.34,
4.00,0.45,5.00,0.73,6.00,0.60,7.00,0.65,8.00,0.68,9.00,0.73,10.00,0.70,11.00,
0.79,12.00,0.99,13.00,1.20,14.00,1.44,15.00,1.59,16.00,1.46,17.00,1.24, 18.00,
0.78(CR) (LF)
```

After the string has been sent to the instrument, wait at least two seconds for the data to be written to the EEPROM before sending any other data over the GPIB.

## **ADJUSTING CAL FACTORS**

The easiest way to modify existing calibration factors is to use `TKSSLOW` to read the existing string into a buffer, modify the cal factors with a text editor, then send the modified string back to the sensor by prefixing the command `RD-S-SLOW`. Repeat the same process for `TKSFAST/RD-S-FAST`, or transmit the edited "slow" string to replace the "fast" data as well.

## **SENSOR MESSAGE**

This is the message that displays on the bottom of the screen when the sensor report for a specific channel is called. The factory default for this message is "BOONTON ELECTRONICS a Wireless Telecom Group Company". This message may be recalled from the sensor by using the Talk Mode Bus Mnemonic TKSMMSG. The string returned from the instrument will be up to 253 characters long terminated by a (CR) and (LF).

The Bus Mnemonic to load a new message into the sensor message page is RD-S-SMSG followed by an ASCII space (SP) followed by the message terminated by a carriage return (CR) and line feed (LF). This will destroy the previous message. The maximum message length is 253 characters.

The following is a properly composed message to be sent to a sensor:

```
RD-S-SMSG BOONTON ELECTRONICS a Wireless Telecom Group Company(CR) (LF)
```

After the string has been sent to the instrument, wait at least two seconds for the data to be written to the EEPROM before sending any other data over the GPIB.

## **CW GAIN COEFFICIENTS**

The CW gain coefficients are used only on CW sensors and voltage sensors. These contain two or three correction coefficients for each range that are used to fine-tune the default shaping equations the instrument uses for that sensor model. Power sensors use 7 ranges, each with an upscale and a downscale coefficient, while voltage sensors use 8 ranges, each with an upscale, midscale and downscale coefficient. These coefficients may be read with the Talk Mode Bus Mnemonic TKSCWRG, and the data string will have the following format:

(power sensor)

```
R0-up, R0-dn, R1-up, R1-dn, R2-up, R2-dn, R3-up, R4-dn, R4-up, R4-dn, R5-up, R5-dn, R6-up, R6-dn
```

(voltage sensor)

```
R0-up, R0-dn, R1-up, R1-dn, R2-up, R2-dn, R3-up, R4-dn, R4-up, R4-dn, R5-up, R5-dn, R6-up, R6-dn,  
R7-up, R7-dn, R0-mid, R1-mid, R2-mid, R3-mid, R4-mid, R5-mid, R6-mid, R7-mid
```

Upscale and midscale coefficients are integers that adjust the gain at the top and middle of each range, with a nominal value of 5000 for default shaping. Downscale coefficients are integers that adjust the offset at the bottom of each range, with a nominal value of 0 for default shaping.

The Bus Mnemonic to load new range coefficients into the sensor is RD-S-CWRG followed by an ASCII space (SP) followed by the data string. Commas separate the various elements of the data string. The mnemonic and data string cannot contain any embedded terminators (carriage return (CR) and line feed (LF)) before the end.

The following is a properly composed string to be sent to a sensor:

```
RD-S-CWRG 5021, 6, 5003, -2, 4996, 5, 4967, -12, 5001, 0, 4988, 11, 4914, 9 (CR) (LF)
```

After the string has been sent to the instrument, wait at least two seconds for the data to be written to the EEPROM before sending any other data over the GPIB.

## **EFFECT OF CHANGES TO SENSOR DATA**

All BOONTON peak power meters will read and write data to the EEPROM of any peak sensor connected to an input. It is not necessary for the sensor in question to be auto-calibrated to perform the above data operations. If the sensor in question has been auto-calibrated, BOONTON peak power meters have preserved a copy of the current sensor EEPROM data and calibration data in non-volatile memory. In

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normal operation, this feature provides for power-up without repeating the Auto-calibration procedure. When changing sensor EEPROM data this feature may cause confusion.

When the RD-S-XXXX commands are used to write new data into a sensor's EEPROM, any sensor data stored in the instruments non-volatile memory is NOT disturbed. Therefore, a previously auto-calibrated sensor will continue to use the old data until the instrument reads the EEPROM again.

Models 4400 and 4500 will not update the **Calibration Factor** tables in memory unless the Calibration Date or the serial number in the EEPROM has changed and the sensor has been un-plugged and plugged back in or until a different sensor has been plugged in.

Models 4400A and 4500A with software versions prior to 20020511 operate as above.

Models 4400A and 4500A with software versions 20020511 or later update non-volatile memory when auto-calibration is performed successfully. In addition, the sensor auto-cal file may be deleted from memory by choosing the Util > Disk > Flash Disk menu. Select the sensor auto-cal file by serial number and channel and use the Delete Start key to delete it from memory. After the sensor is unplugged or power-down occurs, the sensor will no longer be recognized.

Models 4531 and 4532 will not update the calibration factor tables in RAM until the sensor is unplugged and plugged back in or until a power OFF/ON cycle occurs. These models update immediately any changes made with the manual sensor data editor. This sensor data editor is available only from the front panel controls.

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