

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

Overview

The current document describes the Predistortion and Detector Offset calibration procedure via GPIB commands, following the procedure specified in the HP8648 Operating and Service Guide Manual.

This test adjusts the Output Section Predistortion, Frequency Extension Predistortion and Frequency Extension Detector Offset.

Only one module, Output A6 or Frequency Extension A10, may have potentiometers. If this is the case, when doing the detector offset and output module predistortion adjustments, adjust the available potentiometer to optimize both adjustments.

Reference Instructions

* User Manual errata: 1.5MHz instead of 1.5GHz.

Predistortion and Detector Offset (8648B/C/D Only)

(Some versions of hardware do not have the following potentiometers. Do not run this adjustment if the potentiometers are not present.)

Description

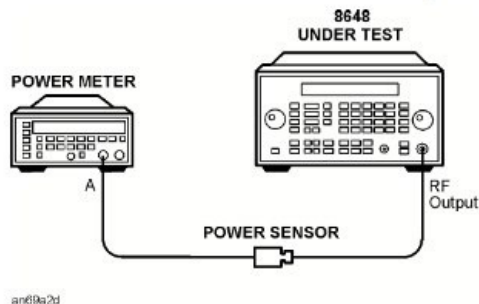
This adjustment sets up the Detector Offset potentiometer on the A10 frequency extension board and the Predistortion potentiometer on the A6 output board while measuring the power at the RF Output connector. With the DUT set to 100 MHz, the Detector Offset potentiometer is adjusted for –10 dBm reading at the RF output. Then, the Predistortion potentiometer is adjusted for –17.5 dBm at the RF output. These two adjustments are iterated between until both power levels are within 0.1 dBm of their respective power levels. The DUT is set to 1.5 MHz and the predistortion potentiometer is adjusted for –17.0 dBm.

Required Test Equipment

- Power Meter
- Power Sensor

Procedure

Figure 7-17. Predistortion and Detector Offset Test Setup



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they are displayed on the PC.

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

GPIB sequence according to Agilent Service Support Software

```

*RST
IP
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
POWER:AMPL 10.0000000000
OUTPUT 1
AE
LG
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
LG
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
FREQ 1500.0000000000 MHZ
KB95.000000EN
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H666
TR2
CS@18
+12.620E+00
TR2
+12.620E+00
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H4bb
TR2
CS@18
+9.9300E+00
TR2
+9.9300E+00
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H4c5
TR2
CS@18
+10.010E+00
TR2
+10.010E+00
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H4c4
TR2
CS@18
+10.000E+00
TR2
+10.000E+00
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
FREQ 100.0000000000 MHZ
KB95.000000EN
DIAG:LATCH:SELECT "out_carrier_level_DAC"

```

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

```

DIAG:LATCH:VAL #H4c4
TR2
CS@18
+11.340E+00
TR2
+11.340E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H57c
TR2
CS@18
+12.550E+00
TR2
+12.550E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H416
TR2
CS@18
+9.9800E+00
TR2
+9.9700E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H41a
TR2
CS@18
+10.000E+00
TR2
+10.000E+00
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
FREQ 100.0000000000 MHZ
KB95.000000EN
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H69
TR3
CS@18
+9.4800E+00
TR3
CS@18
-9.9900E+00
TR3
-9.9900E+00
TR3
-9.9900E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H2e
TR3
CS@18
-9.9900E+00
TR3
-10.090E+00
TR3

```

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

```

CS@18
-16.490E+00
TR3
CS@18
-17.440E+00
TR3
-17.440E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H69
TR3
CS@18
-17.450E+00
TR3
-15.630E+00
TR3
-11.360E+00
TR3
-10.000E+00
TR3
CS@18
-9.9900E+00
TR3
-9.9900E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H2e
TR3
CS@18
-9.9900E+00
TR3
-10.060E+00
TR3
CS@18
-16.330E+00
TR3
CS@18
-17.440E+00
TR3
-17.440E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H2e
TR2
CS@18
-17.440E+00
TR2
-17.450E+00
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H69
TR2
CS@18
-9.9900E+00
TR2

```

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

```

-9.9900E+00
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
FREQ 1500.0000000000 MHZ
KB95.000000EN
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H36
TR3
CS@18
+9.5600E+00
TR3
-15.410E+00
TR3
CS@18
-17.000E+00
TR3
-17.000E+00
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H36
TR2
CS@18
-17.000E+00
TR2
-17.000E+00
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
*RST
IP

```

Procedure Overview

1. Initial Hookup Summary

Calibrate the HP438A power meter. Connect the power sensor to HP8648 output. Set power meter via GPIB to logarithmic mode, calibration factor @1.5GHz (or 100MHz) and read actual output power by triggering:

```

AE          //set A channel as input
LG          //Log (dBm)
KB95.000000EN //Cal Factor
TR2         //Trigger with Delay
CS@18       //Clear status byte
+12.620E+00

```

Set the HP8648 generator to 1.5GHz, CW, RF output ON, +10.0 dBm:

```

*RST
POWER:AMPL 10.0000000000
OUTPUT 1
FREQ 1500.0000000000 MHZ

```

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

Set internal value of "freq_ext_level_DAC" register to #H666 (2000 decimal):

```
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H666
```

This value will be the reference to estimate the slope required to find Frequency Extension DAC value for +10.0 dBm. Then DAC value is fine adjusted, for example FE DAC value found #H4c4.

Frequency is switched to 100MHz. Output module DAC is set using last value found for Frequency Extension DAC:

```
FREQ 100.0000000000 MHZ
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H4c4
```

Output level is read as reference to estimate the slope required to find Output DAC value for +10.0 dBm. Then DAC value is fine adjusted, for example Output DAC value found #H41a.

Summary DAC values for +10.0 dBm:

"A10 Frequency Extension – 1.5GHz" DAC = #H4c4

"A6 Output – 100MHz" DAC = #H41a

New target DAC value can be found:

$$DAC_{target} = DAC_{ref} * 10^{[P_{target} - P_{ref}]/20}$$

2. Predistorsion and Offset Ajustment

Select "**Freq. Ext Det. Offs**" or "**Predistorsion**" option for adjusting the potentiometers. Adjusting one of the potentiometer may affect the adjustment of the other. Therefore, alternate between the two adjustments until the respective power levels are within 0.1 dB of the desired power levels.

Set frequency to 100MHz: FREQ 100.0000000000 MHZ

"DETECTOR OFFSET" POTENTIOMETER ADJUSTMENT

Set A6 Output DAC to obtain -20dB less than previously value found for +10 dBm (#H41a, 1050 dec).

$$DAC_{target} = 1050 * 10^{[-10 - (+10)]/20} = 105 \text{ (0x69 hex, #H69)}$$

```
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H69
```

Adjust the Detector Offset potentiometer on the A10 Frequency Extension module (middle potentiometer until the power meter reads between -10.1 and -9.9 dBm (desired power level is -10dBm). If the FE module does not have this adjustment, adjust the Output module Predistorsion potentiometer to optimize both adjustments.

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

"PREDISTORSION" POTENTIOMETER ADJUSTMENT

Set Output DAC to obtain -27.5dB less than previously value found for +10dBm (#H41a, 1050 dec).

$DAC_{target} = 1050 * 10^{[-17.5 - (+10)]/20} = 44$ (0x2c hex, #H2c), close to Agilent Service Software result 0x2e (46 dec).

```
DIAG:LATCH:SELECT "out_carrier_level_DAC"
DIAG:LATCH:VAL #H2e
```

Adjust Predistorsion potentiometer on the A6 Output module (potentiometer towards the back of the instrument) until the power meter reads between -17.4 and -17.6 dBm (desired power level is -17.5 dBm). If the Output module does not have this adjustment, adjust FE module detector potentiometer to optimize both adjustments.

3. Frequency Extension Module Predistorsion Adjustment

Set frequency to 1.5GHz: `FREQ 1500.0000000000 MHZ`

Set Frequency Extension DAC to obtain -27dB less than previously value found for +10 dBm (#H4c4, 1220 dec).

Previously DAC "reference" value found #H4c4 (1220 dec).

$DAC_{target} = 1220 * 10^{[-17 - (+10)]/20} = 54$ (0x36 hex, #H36)

```
DIAG:LATCH:SELECT "freq_ext_level_DAC"
DIAG:LATCH:VAL #H36
```

If the A10 Frequency Extension board has a Predistorsion potentiometer adjust it (the potentiometer nearest to front of the instrument) until the power meter reads between -17.1 and -16.9 dBm (desired power level is -17.0 dBm). If there is no potentiometer, just abort this adjustment.

4. Reset instrument

Reset HP8648: `*RST`

Calibration DONE!

Remarks

The Agilent Service Software algorithm looks quite complicated but can be replaced with a simpler one and controlled manually or via a Python script.

Adjustment: Predistortion and Detector Offset	HP8648B/C/D	YO4HFU – v1.0
--	-------------	---------------

Predistorsion and Offset Ajustment of A6 Output module

1. Set Frequency to 100MHz. Adjust up/down Output DAC until +10.0dBm is obtained. Save Output DAC value as a reference for further use.
2. Calculate DAC target value for Output module -10dBm and -17.5dBm using previously reference, see above formula.
3. Set Output DAC to -10dBm ("out_carrier_level_DAC"). Do not adjust DAC value, just use the calculated value.

Adjust the Detector Offset potentiometer on the A10 Frequency Extension module (middle potentiometer until the power meter reads between -10.1 and -9.9 dBm (desired power level is -10dBm). If the FE module does not have this adjustment, adjust the Output module Predistorsion potentiometer to optimize both adjustments.

4. Set Output DAC to -17.5dBm ("out_carrier_level_DAC"). Do not adjust DAC value, just use the calculated value.

Adjust Predistorsion potentiometer on the A6 Output module (potentiometer towards the back of the instrument) until the power meter reads between -17.4 and -17.6 dBm (desired power level is -17.5 dBm). If the Output module does not have this adjustment, adjust FE module detector potentiometer to optimize both adjustments.

Note: Adjusting one of the potentiometer may affect the adjustment of the other. Therefore, alternate between the two adjustments until the respective power levels are within 0.1 dB of the desired power levels.

Predistorsion Adjustment of A10 Frequency Extension module

1. Set Frequency to 1.5GHz. Adjust up/down FE DAC until +10.0dBm is obtained. Save FE DAC value as a reference for further use.
2. Calculate DAC target value for FE module to obtain -17dBm using previously reference, see above formula.
3. Set FE DAC to -17dBm ("freq_ext_level_DAC"). Do not adjust DAC value, just use the calculated value.

If the A10 Frequency Extension board has a Predistorsion potentiometer adjust it (the potentiometer nearest to front of the instrument) until the power meter reads between -17.1 and -16.9 dBm (desired power level is -17.0 dBm). If there is no potentiometer, just abort this adjustment.

73's de Robert YO4HFU