

|                                  |               |               |
|----------------------------------|---------------|---------------|
| <b>Adjustment: Time Base DAC</b> | HP8648A/B/C/D | YO4HFU – v1.0 |
|----------------------------------|---------------|---------------|

## Overview

This document describes the procedure for adjusting the Time Base DAC of the HP8648 series signal generators by GPIB, following the procedure specified in the HP8648 Operating and Service Guide Manual.

## Reference Instructions

### Time Base DAC (All 8648A/B/C/D)

**NOTE** A manual adjustment is available. This automated adjustment can be replaced by performing the manual Internal Reference Oscillator Adjustment instead.

#### Description

This adjustment determines the proper DAC setting to achieve a frequency reading of 1 GHz  $\pm$  1 Hz. The DAC settings are then stored away.

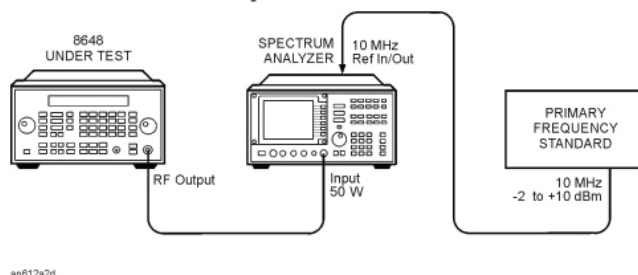
This program determines the proper DAC setting to achieve a frequency reading of 1 GHz  $\pm$  1 Hz. The DAC setting is then stored away.

#### Required Test Equipment

- Spectrum Analyzer
- Primary Frequency Standard

#### Procedure

**Figure 7-22. Time Base DAC 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.

## GPIB sequence according to Agilent Service Support Software

```

IP
*RST
SERV:PRODUCTION:PUP
RL 10 DBM
SP 0.000000 HZ
SNGLS
MKFC ON;
MKFCR 1.000000 HZ;
*IDN?

```

|                                  |                      |                      |
|----------------------------------|----------------------|----------------------|
| <b>Adjustment: Time Base DAC</b> | <b>HP8648A/B/C/D</b> | <b>YO4HFU – v1.0</b> |
|----------------------------------|----------------------|----------------------|

```

Hewlett-Packard, 8648B, 3847A02762, B.04.09
FREQ 100.0000000000 MHZ
POWER:ATT:AUTO 1
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
POWER:AMPL -136.0000000000
AM:STATE 0
FM:STATE 0
PM:STATE 0
OUTPUT 1
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
POWER:AMPL 0.0000000000
DIAG:LATCH:SELECT "refs_tbase_select"
DIAG:LATCH:VAL #H00
FREF EXT
*IDN?
Hewlett-Packard, 8648B, 3847A02762, B.04.09
FREQ 1000.0000000000 MHZ
OUTPUT 1
CF 1000.000000 MZ
TS;DONE?
1
MKCF;
DIAG:LATCH:SELECT "refs_DAC_fine"
DIAG:LATCH:VAL #H80
DIAG:LATCH:SELECT "refs_DAC_coarse"
DIAG:LATCH:VAL #Hff
TS;DONE?
1
MKCF;
MKPK;
MKF?
1.014500000000E9
DIAG:LATCH:SELECT "refs_DAC_coarse"
DIAG:LATCH:VAL #Heb
TS;DONE?
1
MKPK;
MKF?
1.000000000000E9
DIAG:LATCH:SELECT "refs_DAC_fine"
DIAG:LATCH:VAL #Hff
TS;DONE?
1
MKPK;
MKF?
1.000000000000E9
DIAG:LATCH:SELECT "refs_DAC_fine"
DIAG:LATCH:VAL #H00
TS;DONE?
1
MKPK;
MKF?

```

|                                  |                      |                      |
|----------------------------------|----------------------|----------------------|
| <b>Adjustment: Time Base DAC</b> | <b>HP8648A/B/C/D</b> | <b>YO4HFU – v1.0</b> |
|----------------------------------|----------------------|----------------------|

```

9.99999833000E8
DIAG:LATCH:SELECT "refs_DAC_fine"
DIAG:LATCH:VAL #Hff
TS;DONE?
1
MKPK;
MKF?
1.00000000000E9
DIAG:LATCH:SELECT "refs_DAC_coarse"
DIAG:LATCH:VAL?
+235
DIAG:LATCH:SELECT "refs_DAC_fine"
DIAG:LATCH:VAL?
+255
SERV:PRODUCTION:CAL:BEGIN
SERV:PRODUCTION:CAL timebase,0,235.0000000000
SERV:PRODUCTION:CAL timebase,1,255.0000000000
SERV:PRODUCTION:CAL:END
SERV:PRODUCTION:CAL:STORE timebase
SERV:PRODUCTION:PUP

```

## Procedure Overview

### 1. Initial Hookup Summary

Set the HP8648 generator to 1000 MHz, no modulation, RF output ON, 0 dBm.  
Configure the spectrum analyzer: center frequency 1000 MHz, zero span, single sweep,  
reference +10dBm, marker frequency 1Hz resolution, 10MHz external reference input.

### 2. Coarse and Fine DAC Adjustment

Set the "refs\_tbase\_select" latch to state 0.  
DIAG:LATCH:SELECT "refs\_tbase\_select"  
DIAG:LATCH:VALUE #H00

Select the coarse DAC ("refs\_DAC\_coarse") and set an initial value of #H80 (decimal 128).  
DIAG:LATCH:SELECT "refs\_DAC\_fine"  
DIAG:LATCH:VAL #H80

Select the fine DAC ("refs\_DAC\_fine") and set an initial value of #Hff (decimal 255).  
DIAG:LATCH:SELECT "refs\_DAC\_coarse"  
DIAG:LATCH:VAL #Hff

Adjust both DACs incrementally until the output frequency reads exactly 1.0000000000E+9 Hz  
on the spectrum analyzer ( $\pm 1$  Hz tolerance).

|                                  |               |               |
|----------------------------------|---------------|---------------|
| <b>Adjustment: Time Base DAC</b> | HP8648A/B/C/D | YO4HFU – v1.0 |
|----------------------------------|---------------|---------------|

### 3. Record the Final DAC Values

Query the DAC registers:

```
DIAG:LATCH:SELECT "refs_DAC_coarse"
```

```
DIAG:LATCH:VAL?
```

```
→ +235
```

```
DIAG:LATCH:SELECT "refs_DAC_fine"
```

```
DIAG:LATCH:VAL?
```

```
→ +255
```

### 4. Calibration Storage Sequence

Begin calibration:

```
SERV:PRODUCTION:CAL:BEGIN
```

Store the coarse and fine DAC values:

```
SERV:PRODUCTION:CAL timebase,0,235.0000000000
```

```
SERV:PRODUCTION:CAL timebase,1,255.0000000000
```

End calibration and save values to EEPROM (A4 Reference Module):

```
SERV:PRODUCTION:CAL:END
```

```
SERV:PRODUCTION:CAL:STORE timebase
```

Reboot HP8648:

```
SERV:PRODUCTION:PUP
```

## Remarks

The purpose of this document is to explain how the time base adjustment is performed using SCPI commands via GPIB and the corresponding algorithm.

Since not everyone has access to a spectrum analyzer, it can be replaced with a frequency counter capable of measuring 1 GHz with 1 Hz resolution or better, disciplined by a stable and precise reference (e.g., a GPSDO).

The algorithm can be fully implemented in a Python script, with the operator manually adjusting the coarse and fine DACs (up/down) until the output frequency reaches 1000 MHz  $\pm$ 1 Hz. The resulting calibration values can then be automatically saved to the EEPROM.

The Python script can be much more sophisticated—for example, it could query a frequency counter or a spectrum analyzer via GPIB and perform the entire calibration automatically. The advantage over Agilent Service Software is the flexibility to use a variety of instruments available in the laboratory, without being limited by drivers that only support specific devices. For instance, Agilent software only supports HP8560E/8563E analyzers or models with similar SCPI command sets.

|                                  |               |               |
|----------------------------------|---------------|---------------|
| <b>Adjustment: Time Base DAC</b> | HP8648A/B/C/D | YO4HFU – v1.0 |
|----------------------------------|---------------|---------------|

It should be noted that the time base adjustment can also be performed from front panel, without using GPIB control, by toggling “Timebase Adjust” DIP switch on the back of the HP8648. For details, refer to the Operating and Service Guide Manual – Internal Reference Oscillator Adjustment, page 7-5.

73's de Robert YO4HFU