Generic Frequency/Timer Counter Calibration Procedure for the PM6681 and the Agilent 53131A

Introduction:

Ask any Electrical Calibration laboratory what their main workload is and they'll probably list DMMs, Oscilloscopes and Frequency/Timer counters as their top three items. The first two items, DMMs and Oscilloscopes, are calibrated quite efficiently by a variety of calibration products from Fluke. Frequency/Timer counter calibration has not been as straightforward, until now. What is required in calibrating these devices depends on whether it is a routine calibration or a more comprehensive calibration following a repair.

This document reviews calibration/test procedures from a sample of Frequency/Timer Counter manufacturers including Fluke and Agilent. Although many of the tests are common, the equipment required often stretches beyond that of a Frequency Standard.

Frequency/Timer Counter calibration/test parameters for consideration include;

1. Timebase frequency calibration
2. Timebase frequency adjustment (if needed)
3. Channel Input impedance (to find damaged input termination)
4. Frequency accuracy and sensitivity verification
5. Time Interval systematic uncertainty (input channel mismatch)
6. Period, Pulse width and trigger slope test
7. Channel Vp-p calibration
8. Channel Vdc calibration

Not all models will require all parameters to be calibrated, for example parameter 4 is only called for timer/counters, and parameters 7 and 8 are only required for counters with voltage measurement capabilities. However in all cases basic practices begin with instrument warm-up time.

Equipment Requirements Preparation & Set-up

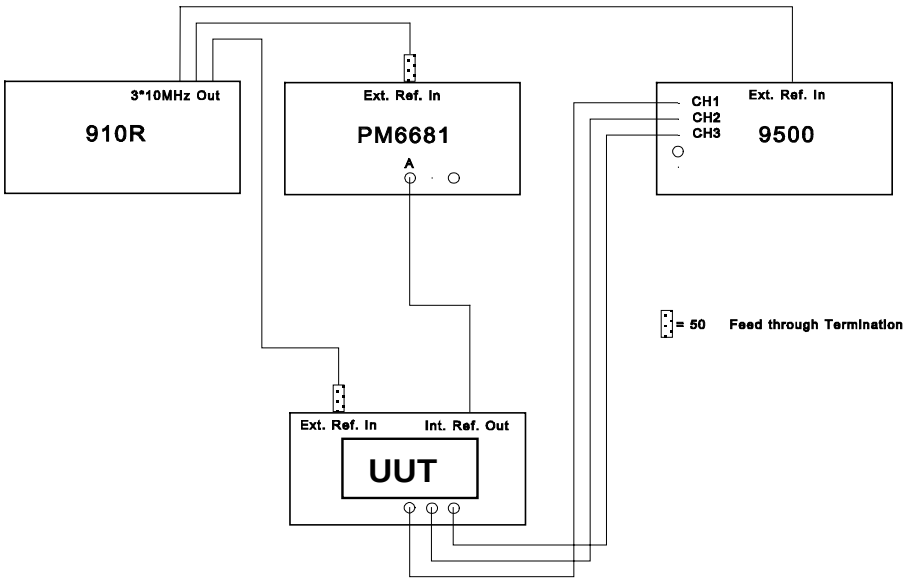
This generic Frequency/timer counter calibration procedure uses the following example test equipment:

- Fluke 910R GPS locked Rubidium Frequency Standard
- Fluke PM6681 Timer Counter
- Fluke 9500 3.2GHz Calibrator & two 9530 Active Heads
- 50Ohm terminators
- RG58 BNC cables

Connect the equipment as shown in the following diagram, use RG58 cables between 9500 and UUT.

Connect 9530 Active heads as close as possible to the UUT's inputs. If the spacing between input connectors is less than the width of an Active Head, use suitable right angle BNC-adapters.

This preparation & set-up is used for each of the following tests.



Calibration procedures are available for MET/CAL software to help automate the process.

Instrument warm up time:

Calibration temperature:	23°C ± 3°C.
Frequency Reference:	910R, at least 72 hours for best performance.
Timer/Counter:	PM6681 ~30 minutes.
Calibrator:	9500/3200 ~20 minutes.
UUT:	Depends on UUT internal time base accuracy. Consult UUT's calibration specifications for recommended warm-up time.

Calibration Procedure

Section 1
Time Base Accuracy Tests

Requires internal reference output from UUT (Unit Under Test).

Instrument set-up:

Fluke PM6681:
- Pre-set.
- Measurement time: 1s, or for calibrating Rubidium time base, 10s. (See appendix A).
- Input A
    - 50Ω.
- Math. ON
    - Math constant L = -10 000 000

UUT:
- Internal reference output ON

If the UUT fulfils the calibration table, skip section 2 and continue with section 3.

Section 2
Time Base Adjustment

Use the same instruments, and instruments set-up, as defined in section 1. Time Base accuracy tests.

a) Manual adjustment

Remove the UUT's covers to expose the internal oscillator adjustment. Adjust the internal oscillator until the reading on the PM6681 is within the values specified in table two. Replace the UUT covers. Wait until the temperature within the UUT has stabilised (typical 30 minutes) and repeat section 1.

b) Electronic Adjustment

Electronic Adjustments are specific to the instrument manufacturer and model. Consult the UUT-Operators manual.

Section 3
Input Resistance tests

Note: If the UUT has an internal 50Ω input termination, it's important that this termination is functioning within specification and has not been subjected to excessive input voltages before continuing with the calibration process.

UUT:
- Preset/Default
- Ratio A/B
- Input A, DC
- Input B, DC
- Input A, 50Ω
- Input B, 50Ω

9500:
- AUX.
- Load Resistance
- Signal Channel 1
- Load 50Ω
- Output ON
- Other settings see respective UUT's calibration procedure.

Calibrate as specified in the table, for the UUT.

Section 4
Frequency Accuracy and Sensitivity Test

UUT:
- Preset/Default (Frequency 1).
- Input A, 50Ω
- Input A, DC
- Input B, 50Ω
- Input B, DC
- Ext. Ref. ON

- Measure/Gate Time, 1s
- Other settings, see respective UUT's calibration table procedure.

9500
- Ext. ref in ON
- Leveled Sine
- Signal Channel 1
- Load 50Ω
- Frequency, 10 Hz
- Amplitude, 56 mVp-p
- Output ON
- Other settings, see respective UUT:s calibration table procedure.

Repeat all the steps for UUT:s input channels, as indicated in the calibration table 4

Section 5
Absolute Time Interval Error test
For Timer/Counters only

UUT:
- Preset/Default.
- Time Int A-B or TI 1 TO 2
- Input A, 50Ω
- Input B, 50Ω
- Input A, DC
- Input B, DC
- Other settings, see respective UUT's calibration table procedure.

9500:
- Ext. Ref in ON
- AUX
- Skew
- Signal Channels 1 and 2.
- Frequency, 10 kHz.
- Output ON

Section 6
Pulse Width and Slope Test

UUT:
- Preset/Default.
- Ext. Ref ON
- Period A or Period 1.
- Input A, 50Ω
- Input A, DC
- Other settings, see respective UUT's calibration table procedure.

9500:
- Ext. Ref in ON
- Square Wave
- Polarity: symmetrical about ground.
- Amplitude 500mVp-p
- Signal Channel 1
- Load 50Ω
- Output ON

Section 7
Peak Voltage Tests

UUT:
- Preset/Default
- Voltage A Max/Min or Volt Peaks 1
- Input A or 1, 1 MΩ
- Input B or 2, 1 MΩ
- Input A or 1, DC
- Input B or 2, DC
- Other settings, see respective UUT's calibration table procedure.

9500:
- Ext. Ref. in ON
- Square Wave
- Polarity: symmetrical about ground
- Frequency, 100 Hz
- Amplitude 1.000 Vp-p
- Load 1 MΩ
- Signal Channel 1
- Output ON

- Other settings, see respective UUT's calibration table procedure.

Section 8
Voltage DC Tests

UUT:
- Voltage A Max/Min or Volt Peaks 1.
- Other settings, see respective UUT's calibration table procedure.

9500:
- DC Voltage
- Ground (0V)
- Load 1 MΩ
- Other settings, see respective UUT's calibration table procedure.

UUT: PM6680, without or with options PM9621 or PM9624

1 and 2 **Time Base Accuracy Test**

(For 01-oscillator, standard)
(After warm up time, 30 minutes)

Test no.	Function tested	Measure values	Out of tolerance	Calibration tolerance
1.	Time Base			±70 Hz
2.	Time Base Adjustment	10 MHz		±10 Hz

(For 05-oscillator, PM9691)
(After warm up time, 24 hours continuous operation)

Test no.	Function tested	Measure values	Out of tolerance	Calibration tolerance
1.	Time Base			±1 Hz
2.	Time Base Adjustment	10 MHz		±0.2 Hz

(For 06-oscillator, PM9692)
(After warm up time, 24 hours continuous operation)

Test no.	Function tested	Measure values	Out of tolerance	Calibration tolerance
1.	Time Base			±0.25 Hz
2.	Time Base Adjustment	10 MHz		±0.05Hz

3. **Input Resistance:**

Test	Function tested /	Measure	Out of	Calibration tolerance

no.	New Settings	values	tolerance	
	Input A			
3.1	50 Ω			45 to 55 Ω
	9500: - Signal Channel 2			
	Input B			
3.2	50 Ω			45 to 55 Ω

4. Frequency Accuracy and Sensitivity tests:

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
	Input A			
	PM6680: - Auto Trig OFF			
4.1	10 Hz @ 56 mV p-p			10 ±0.02 Hz
	PM6680: - Auto Trig On 9500: - Frequency, 1 kHz.			
4.2	1 kHz @ 56 mV p-p			1000 ±0.05 Hz
	9500: - Frequency, 1 MHz.			
4.3	1 MHz @ 56 mV p-p			1 MHz ±0.25 Hz
	9500: - Frequency, 100 MHz.			
4.4	100 MHz @ 56 mV p-p			100 MHz ±25 Hz
	9500: - Frequency, 200 MHz. - Amplitude, 85 mV p-p			
4.5	200 MHz @ 85 mV p-p			200 MHz ±50 Hz
	9500: - Frequency, 225 MHz. - Amplitude, 113 mV p-p			
4.6	225 MHz @ 113 mV p-p			225 MHz ±57 Hz

	Input B			
	PM6680: - Swap - Auto Trig Off 9500: - Signal Channel 2 - Frequency, 10 Hz - Amplitude, 56mVp-p			
4.7	10 Hz @ 56 mVp-p			10 ±0.02 Hz
	PM6680: - Auto Trig On 9500: - Frequency, 1 kHz.			
4.8	1 kHz @ 56 mV p-p			1000 ± 0.05 Hz
	9500: - Frequency, 1 MHz.			
4.9	1 MHz @ 56 mV p-p			1 MHz ±0.25 Hz
	9500: - Frequency, 100 MHz.			
4.10	100 MHz @ 56 mV p-p			100 MHz ±25 Hz
	Input C (Option PM9621)			
	PM6680: - Frequency C 9500: - Signal Channel 3 - Frequency, 70 MHz - Amplitude, 28 mV p-p			
4.11	70 MHz @ 28 mV p-p			70 MHz ±18 Hz
	9500: - Frequency, 900 MHz.			
4.12	900 MHz @ 28 mVp-p			900 MHz ±226 Hz
	9500: - Frequency, 1.1 GHz. - Amplitude, 42 mV p-p			

4.13	1.1 GHz @ 42 mVp-p			1.1 GHz ±276 Hz
	9500: - Frequency, 1.3 GHz. - Amplitude, 113 mVp-p			
4.14	1.3 GHz @ 113 mVp-p			1.3 GHz ±325 Hz
	Input C (Option PM9624)			
	PM6680: - Frequency C 9500: - Signal Channel 3 - Frequency, 100 MHz - Amplitude, 56 mV p-p			
4.11	100 MHz @ 56 mV p-p			100 MHz ±25 Hz
	9500: - Frequency, 300 MHz - Amplitude, 28 mV p-p			
4.12	300 MHz @ 28 mV p-p			300 MHz ±76 Hz
	9500: - Frequency, 1 GHz			
4.13	1 GHz @ 28 mV p-p			1 GHz ±251 Hz
	9500: - Frequency, 1.8 GHz			
4.14	1.8 GHz @ 28 mV p-p			1.8 GHz ±451 Hz
	9500: - Frequency, 2.5 GHz			
4.15	2.5 GHz @ 28 mVp-p			2.5 GHz ±626 Hz
	9500: - Frequency, 2.7 GHz - Amplitude, 56 mVp-p			
4.16	2.7 GHz @ 56 mVp-p			2.7 GHz ±676 Hz

5. Absolute Time Interval Error Test

Test	Function tested /	Measure	Out of	Calibration tolerance

no.	New Settings	values	tolerance	
5.1	Time Int A - B			±1 ns
	PM6680: - Slope A, A-A - Slope B, A-A			
5.2	Time Int A - B			±1 ns

6. Pulse Width and Slope test

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
6.1	Period A			1.000 000 ms ±5 ns
	PM6680: - Pulse Width A			
6.2	Positive Pulse Width			500.0 µs ±0.5 µs
	PM6680: - Input A, Slope A-A			
6.3	Negative Pulse Width			500.0 µs ±0.5 µs
6.4	Sum of 6.2 and 6.3			1.000 000 ms ±10 ns

7. Peak Voltage tests

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
	9500: - Amplitude, 1.0 Vp-p - Output On			
7.1.a	Voltage A Max.			0.50 V ±85 mV
7.1.b	Voltage A Min.			- 0.50 V ±85 mV
	PM6680: - Swap 9500: - Signal Channel 2			
7.2.a	Voltage B Max.			0.50 V ±85 mV
7.2.b	Voltage B Min			- 0.50 V ±85 mV
	9500: - Amplitude 12.0 Vp-p			
7.3.a	Voltage B Max			6.0 V ±1.02 V
7.3.b	Voltage B Min			- 6.0 V ±1.02 V
	PM6680: - Swap 9500: - Signal Channel 1.			
7.4.a	Voltage A Max			6.0 V ±1.02 V
7.4.b	Voltage A Min			- 6.0 V ±1.02 V
	9500: - Frequency, 100 kHz			
7.5.a	Voltage A Max.			6.0 V ±1.02 V
7.5.b	Voltage A Min.			- 6.0 V ±1.02 V
	PM6680: - Swap 9500:			

	- Signal Channel 2.			
7.6.a	Voltage B Max.			6.0 V ±1.02 V
7.6.b	Voltage B Min.			- 6.0 V ±1.02 V
	9500: - Amplitude 1.0 V p-p			
7.7.a	Voltage B Max			0.50 V ± 85 mV
7.7.b	Voltage B Min			- 0.50 V ±85 mV
	PM6680: - Swap 9500: - Signal Channel 1.			
7.8.a	Voltage A Max.			0.50 V ±85 mV
7.8.b	Voltage A Min.			- 0.50 V ±85 mV
	PM6680: - Input A, 50 Ω - Input B, 50 Ω 9500: - Leveled Sine: - Frequency, 50 MHz - Amplitude, 3 Vp-p - Load 50 Ω - Output On			
7.9.a	Voltage A Max			1.5 V ±0.21 V
7.9.b	Voltage A Min			- 1.5 V ±0.21 V
	PM6680: - Swap 9500: - Signal Channel 2			
7.10.a	Voltage B Max.			1.5 V ±0.21 V
7.10.b	Voltage B Min.			- 1.5 V ±0.21 V

8. Voltage DC:

8.1.a	Voltage A Max			0 V ±0.03 V
8.1.b	Voltage A Min			0 V ±0.03 V
	PM6680: - Swap			
8.2.a	Voltage B Max			0 V ±0.03 V
8.2.b	Voltage B Min			0 V ±0.03 V
	9500: - A- 5 V@			
8.3.a	Voltage B Max			- 5 V ±0.08 V
8.3.b	Voltage B Min			- 5 V ±0.08 V
	PM6680: - Swap			
8.4.a	Voltage A Max			- 5 V ±0.08 V
8.4.b	Voltage A Min			- 5 V ±0.08 V
	9500: - A- 50 V@			
8.5.a	Voltage A Max			- 50 V ±1.03 V
8.5.b	Voltage A Min			- 50 V ±1.03 V
	PM6680 - Swap			
8.6.a	Voltage B Max			- 50 V ±1.03 V
8.6.b	Voltage B Min			- 50 V ±1.03 V
	9500: - A+ 50 V@			
8.7.a	Voltage B Max			50 V ±1.03 V
8.7.b	Voltage B Min			50 V ±1.03 V
	PM6680 - Swap			

8.8.a	Voltage A Max			50 V ±1.03 V
8.8.b	Voltage A Min			50 V ±1.03 V
	9500: - A+ 5 V@			
8.9.a	Voltage A Max			5 V ±0.08 V
8.9.b	Voltage A Min			5 V ±0.08 V
	PM6680 - Swap			
8.10.a	Voltage B Max			5 V ±0.08 V
8.10.b	Voltage B Min			5 V ±0.08 V

UUT: HP 53131A, with or without Option Input 3 (0.1 to 3.0 GHz).

1 and 2 **Time Base Accuracy test:**

(For standard oscillator)
(After warm up time, 30 minutes)

Test no.	Function tested	Measure values	Out of tolerance	Calibration tolerance
1.	Time Base			±36 Hz
2.	Time Base Adjustment	10 MHz		±5 Hz

(For Medium Stability Oven oscillator, Option 001)
(After warm up time, 24 hours continuous operation)

Test no.	Function tested	Measure values	Out of tolerance	Calibration tolerance
1.	Time Base			± 24 Hz
2.	Time Base Adjustment	10 MHz		Electronic

(For High Stability Oven oscillator, Option 010)
(After warm up time, 24 hours continuous operation)

Test no.	Function tested	Measure values	Out of tolerance	Calibration tolerance
1.	Time Base			±1.8 Hz
2.	Time Base Adjustment	10 MHz		Electronic

3. Input Resistance

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
	Input 1			
3.1	50 Ω			45 to 55 Ω
	9500: - Signal Channel 2			
	Input 2			
3.2	50 Ω			45 to 55 Ω

4. Frequency Accuracy and Sensitivity tests

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
	Input 1			
	HP 53131A: - Auto Trig OFF			
4.1	10 Hz @ 56 mVp-p			10 ±0.02 Hz
	HP 53131A: - Auto Trig ON 9500: - Frequency, 1 kHz.			
4.2	1 kHz @ 56 mVp-p			1000 ±0.005 Hz
	9500: - Frequency, 1 MHz.			
4.3	1 MHz @ 56 mVp-p			1 MHz ±0.25 Hz
	9500: - Frequency, 100 MHz.			
4.4	100 MHz @ 56 mVp-p			100 MHz ±25 Hz
	9500: - Frequency, 200 MHz. - Amplitude, 85 mVp-p			
4.5	200 MHz @ 85 mVp-p			200 MHz ±50 Hz
	9500: - Frequency, 225 MHz. - Amplitude, 113 mVp-p			
4.6	225 MHz @ 113 mVp-p			225 MHz ±57 Hz

	Input 2			
	HP 53131A: - Frequency 2 - Auto Trig OFF 9500: - Signal Channel 2 - Frequency, 10 Hz - Amplitude, 56mVp-p			
4.7	10 Hz @ 56 mVp-p			10 ±0.02 Hz
	HP 53131A: - Auto Trig ON 9500: - Frequency, 1 kHz.			
4.8	1 kHz @ 56 mV p-p			1000 ±0.005 Hz
	9500: - Frequency, 1 MHz.			
4.9	1 MHz @ 56 mVp-p			1 MHz ±0.25 Hz
	9500: - Frequency, 100 MHz.			
4.10	100 MHz @ 56 mVp-p			100 MHz ±25 Hz
	9500: - Frequency, 200 MHz. - Amplitude, 85 mVp-p			
4.11	200 MHz @ 85 mVp-p			200 MHz ±50 Hz
	9500: - Frequency, 225 MHz. - Amplitude, 113 mVp-p			
4.12	225 MHz @ 113 mVp-p			225 MHz ±57 Hz
	Input 3 (Option)			
	HP 53131A: - Frequency 3 9500: - Signal Channel 3 - Frequency, 100 MHz - Amplitude, 28 mVp-p			

4.13	100 MHz @ 28 mVp-p			100 MHz ±25 Hz
	9500: - Frequency, 900 MHz - Amplitude, 28 mVp-p			
4.14	900 MHz @ 28 mVp-p			900 MHz ±251 Hz
	9500: - Frequency, 1.8 GHz			
4.15	1.8 GHz @ 28 mVp-p			1.8 GHz ±451 Hz
	9500: - Frequency, 2.7 GHz			
4.16	2.7 GHz @ 28 mVp-p			2.7 GHz ±676 Hz
	9500: - Frequency, 3.0 GHz - Amplitude, 56 mVp-p			
4.17	3.0 GHz @ 56 mVp-p			3.0 GHz ±751 Hz

5. Absolute Time Interval Error test:

Test no.	**Function tested / New Settings**	**Measure values**	**Out of tolerance**	**Calibration tolerance**
5.1	Time Internal A - B			±1.5 ns
	HP 53131A: - Input 1, NEG - Input 2, NEG			
5.2	Time Int A - B			±1.5 ns

6. Pulse Width and Slope test:

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
6.1	Period 1			1.000 000 ms ±5 ns
	HP 53131A: - Pos Width 1			
6.2	Pos Width 1			500.0 µs
	HP 53131A: - Neg Width 1			
6.3	Neg Width 1			500.0 µs
6.4	Sum of 6.2 and 6.3			1.000 000 ms ±10 ns

7. Peak Voltage tests:

Test no.	Function tested / New Settings	Measure values	Out of tolerance	Calibration tolerance
	9500: - Amplitude, 1.0 Vp-p - Output On			
7.1.a	Volt Peaks 1 Max			0.50 V ±75 mV
7.1.b	Volt Peaks 1 Min			- 0.50 V ±75 mV
	HP 53131A: - Volt Peaks 2 9500: - Signal Channel 2.			
7.2.a	Volt Peaks 2 Max			0.50 V ±75 mV
7.2.b	Volt Peaks 2 Min			- 0.50 V ±75 mV
	HP 53131A: - Input 1, X10 - Input 2, X10 9500: - Amplitude 12.0 Vp-p			
7.3.a	Volt Peaks 2 Max			6.0 V ±0.85 V
7.3.b	Volt Peaks 2 Min			- 6.0 V ±0.85 V
	HP 53131A: - Volt Peaks 1 9500: - Signal Channel 1.			
7.4.a	Volt Peaks 1 Max			6.0 V ±0.85 V
7.4.b	Volt Peaks 1 Min			- 6.0 V ±0.85 V
	9500: - Frequency, 100 kHz			
7.5.a	Volt Peaks 1 Max			6.0 V ±0.85 V
7.5.b	Volt Peaks 1 Min			- 6.0 V ±0.85 V
	HP 53131A:			

	- Volt Peaks 2 <u>9500:</u> - Signal Channel 2.			
7.6.a	Volt Peaks 2 Max			6.0 V ±0.85 V
7.6.b	Volt Peaks 2 Min			- 6.0 V ±0.85 V
	<u>9500:</u> - Amplitude 1.0 Vp-p			
7.7.a	Volt Peaks 2 Max			0.50 V ±75 mV
7.7.b	Volt Peaks 2 Min			- 0.50 V ±75 mV
	<u>HP 53131A:</u> - Volt Peaks 1 - Input 1, X1 - Input 2, X1 <u>9500:</u> - Signal Channel 1.			
7.8.a	Volt Peaks 1 Max			0.50 V ±75 mV
7.8.b	Volt Peaks 1 Min			- 0.50 V ±75 mV
	<u>HP 53131A:</u> - Input 1, 50 Ω - Input 2, 50 Ω <u>9500:</u> - Leveled Sine: - Frequency, 30 MHz - Amplitude, 3 Vp-p - Load 50 Ω - Output On			
7.9.a	Volt Peaks 1 Max			1.5 V ±0.175 V
7.9.b	Volt Peaks 1 Min			- 1.5 V ±0.175 V
	<u>HP 53131A:</u> - Volt Peaks 2 <u>9500:</u> - Signal Channel 2			
7.10.a	Volt Peaks 2 Max			1.5 V ±0.175 V
7.10.b	Volt Peaks 2 Min			- 1.5 V ±0.175 V

8. Voltage DC:

8.1.a	Volt Peaks 1 Max			0 V ±0.025 V
8.1.b	Volt Peaks 1 Min			0 V ±0.025 V
	HP 53131A: - Volt Peaks 2 9500: - Signal Channel 2			
8.2.a	Volt Peaks 2 Max			0 V ±0.025 V
8.2.b	Volt Peaks 2 Min			0 V ±0.025 V
	9500: - A- 5 V@			
8.3.a	Volt Peaks 2 Max			- 5 V ±0.125 V
8.3.b	Volt Peaks 2 Min			- 5 V ±0.125 V
	HP 53131A: - Volt Peaks 1 9500: - Signal Channel 1			
8.4.a	Volt Peaks 1 Max			- 5 V ±0.125 V
8.4.b	Volt Peaks 1 Min			- 5 V ±0.125 V
	HP 53131A: - Input 1, X10 - Input 2, X10 9500: - A- 50 V@			
8.5.a	Volt Peaks 1 Max			- 50 V ±1.25 V
8.5.b	Volt Peaks 1 Min			- 50 V ±1.25 V
	HP 53131A: - Volt Peaks 2 9500: - Signal Channel 2			
8.6.a	Volt Peaks 2 Max			- 50 V ±1.25 V
8.6.b	Volt Peaks 2 Min			- 50 V ±1.25 V

	9500: - A+ 50 V@			
8.7.a	Volt Peaks 2 Max			50 V ±1.25 V
8.7.b	Volt Peaks 2 Min			50 V ±1.25 V
	HP 53131A: - Volt Peaks 1 9500: - Signal Channel 1			
8.8.a	Volt Peaks 1 Max			50 V ±1.25 V
8.8.b	Volt Peaks 1 Min			50 V ±1.25 V
	HP 53131A: - Input 1, X10 - Input 2, X10 9500: - A+ 5 V@			
8.9.a	Volt Peaks 1 Max			5 V ±0.125 V
8.9.b	Volt Peaks 1 Min			5 V ±0.125 V
	HP 53131A: - Volt Peaks 2 9500: - Signal Channel 2			
8.10.a	Volt Peaks 2 Max			5 V ±0.125 V
8.10.b	Volt Peaks 2 Min			5 V ±0.125 V

Appendix A:

Calculating UUT maximum time base uncertainty

If specification are in Hz:

Uncertainty* 10.000.000 = Hz

For example Uncertainty = $1*10^{-5}$ <> $1*10^{-5}$ * 10.000.000 = 100 Hz.

If specifications are in ppm:

For example uncertainty = 10 ppm <> 10.000.000 / 1.000.000 * 10 = 100 Hz.

After calculation, you have the maximum readings of PM6681.

Measure time for PM6681 versus measurement resolution:

Measure time [s]	Measurement resolution [mHz]
0.1	1
1	0.1
10	0.01