Unit Test PCB1 THD Analyzer

Bob Cordell's article (part 3) describes this as CP1 bench-testing. The PCB itself is tested slightly different from Bob's bench-test. This is because we use the µC board (PCB4) to control all the switches.

Date test conducted:	
PCB1 hardware version:	V0.30
PCB4 firmware version:	
End-result Test	OK / NOK

PCB1 signal-generator: Unit-Test

Nr.	Description			
0	**Entry-criteria:** - PCB1 board ready for testing, all components are mounted. - Oscilloscope, true-RMS multimeter and frequency-counter are available. - a tested and working µC control-board (PCB4). - A host PC with USB-to-serial adapter is connected to **CON6 (RS232.5V)** of the µC control-board (GND-GND, RXD-TX, TXD-RX). - Communication settings are set to **57600,N,8,1**. Give the **s0** command, a response with version info is returned.			OK/NOK
1	Connect ±15 V and GND to **+15 V**, **GND** and **-15 V**.			
2	Measure the following DC voltages at the test-pins:	+15.0 V +12.0 V +5.0 V -15.0 V		OK/NOK
3	Connect a flatcable from PCB4 **CON10** to PCB1 **CON3 (UC_IO)**. Give the UART command **f10** or use the joystick buttons on PCB4 to select a frequency.	Some PCB1 relays are switched.		OK/NOK
4	This step tests relays **K1 – K10**. Use the following procedure to check if a relay on PCB3 is switched: - A relay is **ON** when the voltage level on pin 8 of the relay is equal to approx. **0 Volts** (DC). - A relay is **OFF** when the voltage level on pin 8 of the relay is equal to approx. **12 Volts** (DC). - Use the joystick-buttons on PCB4 to select a **Frequency** and use that to check the relays. - When a relay is **NOT** mentioned under expected test-results, it should be **OFF**! Test this as well.	20 Hz – all relays off 25 Hz – K1 is on 30 Hz – K2 is on 40 Hz – K3 is on 50 Hz – K4 is on 65 Hz – K5 is on 80 Hz – K6 is on 100 Hz – K7 is on 130 Hz – K8 is on 160 Hz – K9 is on 200 Hz – K10 is on		OK/NOK
5	Use the same procedure to check relays **K11 – K13** and **K17 – K20**.	200 Hz – K11 & K17 are on 250 Hz – K12 & K18 are on 2.5 kHz – K13 & K19 are on 25 kHz – K20 is on		OK/NOK
6	Use the same procedure to check relays **K14 & K21 – K24**, but now select **Output-level** instead of **Frequency**.	**Output-level**: - **OFF** – K21 is on - **0.15V** – K22 is on - **0.5V** – K23 is on - **1.5V** – K24 is on - **5V** – K14 & K24 are on		OK/NOK

PCB1 signal-generator: Unit-Test

Nr.	Description	Result		OK?
		Expected	Measured	
10	- Center trim pot **R24**. - Select a **frequency** of **2 kHz**. - Connect a scope to **E5**.	**4.5 V_{pp}** sine-wave of approx. **2 kHz**.		OK/NOK
11	Measure the following DC voltages:	IC1-6: +2.9 mV IC2-6: +0.8 mV IC3-3: +0.1 mV IC3-6: -4.3 mV IC4-6: +1.0 mV IC5-6: -4.6 mV BQ3: +602 mV EQ3: +2.2 V E7 : +2.2 V IC6-6: +13 mV E8 : -2.5 V GQ1 : -2.5 V		OK/NOK
12	- Set **output-level** to **1.5V**. - Connect scope channel A to **E5** and channel B to **E9**. - Measure the amplitude with a true-RMS multimeter of both **V_{E11}** and **V_{E5}**. - Set **output-level** to **5V**. - Measure both amplitudes again.	**V_{E11}** / **V_{E5}** ≈ 1.0 X **V_{E11}** / **V_{E5}** ≈ 3.0 X	V_{E11}: V_{E5}: $\frac{V_{E11}}{V_{E5}} =$ V_{E11}: V_{E5}: $\frac{V_{E11}}{V_{E5}} =$	OK/NOK
13	- Select a **frequency** of **200 Hz**. - Connect scope channel A to test-pin **IC6.6**. Adjust **R24** for perfect symmetry: adjacent peaks are of equal level.	- 4.5 Vpp sine-wave of approx. **200 Hz**. - Signal is full-wave rectified		OK/NOK
14	Select a frequency of **20 Hz** on PCB4. Adjust **R24** if necessary.	- 4.5 Vpp sine-wave of approx. **20 Hz**. - Stable level within 15 seconds		OK/NOK
15[1]	- Connect a scope to **E9** and select frequency measurement on the scope (or use a frequency-counter). - Select a frequency of **650 Hz** and adjust frequency trimmer **R2** for a source frequency of exactly 650 Hz. - Select a frequency of **65 Hz** and adjust frequency trimmer **R1** for a source frequency of exactly 65 Hz. - Select a frequency of **6.5 kHz** and adjust frequency trimmer **R3** for a source frequency of exactly 6.5 kHz. - Select a frequency of **65 kHz** and adjust frequency trimmer **R4** for a source frequency of exactly 65 kHz.	 - frequency = 650 Hz - frequency = 65 Hz - frequency = 6.5 kHz - frequency = 65 kHz		
16	- Use the µC control-board and select every possible frequency. - Connect a scope to **E9** and check for a stable sine-wave. Measure the actual frequency. - Connect a multimeter to **E8** and measure the DC-voltage.	Fill in table 1 with actual measured frequency and **E8** DC voltage. - Frequency within 10% - 0.5V ≤ **-E8** ≤ 8V		OK/NOK

[1] Test-step 15 is taken from Bob's "Test and Calibration" paragraph, since it felt more appropriate here as a Unit-Test.

Frequency	Measured	E8 (V_{DC})	Frequency	Measured	E8 (V_{DC})
20 Hz					
25 Hz			2.5 kHz		
30 Hz			3.0 kHz		
40 Hz			4.0 kHz		
50 Hz			5.0 kHz		
65 Hz			6.5 kHz		
80 Hz			8.0 kHz		
100 Hz			10 kHz		
130 Hz			13 kHz		
160 Hz			16 kHz		
200 Hz			20 kHz		
250 Hz			25 kHz		
300 Hz			30 kHz		
400 Hz			40 kHz		
500 Hz			50 kHz		
650 Hz			65 kHz		
800 Hz			80 kHz		
1.0 kHz			100 kHz		
1.3 kHz			130 kHz		
1.6 kHz			160 kHz		
2.0 kHz			200 kHz		

Table 1: results from test-step 15