Tektronix

Service Procedures

Product: CFG253 3 Mhz Function Generator

Title: Performance Verification & Adjustment

Procedure #: CP1005 Revision: A

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REVISION LEVEL SUMMARY:

Revision #	Date	Initiator	Level Change From: To:	Description
A	5/16/97	Roy Lindley	n/a	Initial release

CFG253 PERFORMANCE VERIFICATION PROCEDURE

CONTENTS:

INTRODUCTION

To ensure instrument accuracy, check its performance after every 2000 hours of operation or once each year if used infrequently.

The instrument case does not have to be removed for the Performance Check procedure. All necessary controls and connectors are accessible from the outside.

Test Equipment:	Requirement:	Example:
Test Oscilloscope	5mV-5V/Div, 50nS/Div	Tek TDS210
Frequency Counter	> 3MHz, < 1 %	Tek CMC251
Distortion Analyzer	100KHz	AA501A
Coax Cable	50 ohm	P/N 012-0057-01
50 Ohm Terminator		P/N 011-0049-01

PREPARATION

Connect the instrument and test equipment to an appropriate power source and allow 20 minutes for warm up and stabilization. Set the controls as listed below during warm up.

Initial CFG253 Set-Up:

AMPLITUDE	Mid Range
DC OFFSET	Pushed In
SYMMETRY	Midrange Detent
RANGE	1K
FUNCTION	All Buttons Out
VOLTS OUT	Button Out
FREQ/10	Button Out
SWEEP	Button Out
SWEEP RATE	Midrange
SWEEP WIDTH	Midrange
FREQ DIAL	0.3

1. CHECK DC Offset

a. Pull out the DC OFFSET knob.

b. Test Scope Set-Up:

Volts/Div	2V
Time/Div	0.2 mSec

c. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator.

d. Set test scope Vert Coupling to GROUND, center the trace, then set Coupling back to DC.

e. While turning the DC OFFSET knob from CCW to CW and back, check for for > +5 V with DC OFFSET knob CW and > -5 V with the knob CCW (+/- 2.5 Div on test scope).

f. Push the DC OFFSET knob in (off).

2. CHECK MAIN OUTPUT AMPLITUDES

a. Set-Up:

AMPLITUDE	CW
DC OFFSET	Pushed In
RANGE	1K
FUNCTION	Triangle
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	3.0

b. Test Scope Set-Up:

Volts/Div	2V
Time/Div	0.2 mSec

c. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator.

d. Check the test scope display for > 5 divisions (10V).

e. Rotate the AMPLITUDE knob to nearly CCW.

f. Set test scope to 10 mV/Div. Check that the display reduces to less than 5 divisions (50mV) as the AMPLITUDE knob approaches the CCW stop.

g. Set the VOLTS OUT button in and change the test scope Volts/Div to 5mV.

h. Check for a display of < 1 division (5mV) as the knob approaches the CCW stop.

i. Set the test scope Volts/Div to 0.2 V. Rotate the AMPLITUDE knob fully CW.

j. Check the display for > 5 divisions (1V).

k. Return the VOLTS OUT button to the out position and ensure that the AMPLITUDE is CW.

l. Set the FUNCTION to Square Wave. Use the CFG253 and test scope settings in Table 1 to check the MAIN OUTPUT AMPLITUDE for the indicated settings :

TABLE 1

Function	Range	Volts Out button	Freq. Dial	Test Scope Volts/Div	Test Scope Display
Square Wave	1K	Out	3.0	2V/Div	> 5 Div
Sine Wave	1K	Out	3.0	2V/Div	> 5 Div
Sine Wave	1K	Out	0.3	2V/Div	> 5 Div
Square Wave	1K	Out	0.3	2V/Div	> 5 Div
Triangle	1K	Out	0.3	2V/Div	> 5 Div

m. Remove the 50 ohm terminator and connect the coax cable directly to the test scope input.

n. Set the test scope Time/Div to 1uSec.

o. Check the test scope display for each setting in Table 2:

TABLE 2

Function	Range	Volts Out	Freq. Dial	Volts/Div	Display
Triangle	1M	Out	3.0	5V/Div	> 4 Div
SquareWave	1M	Out	3.0	5V/Div	> 4 Div
Sine Wave	1M	Out	3.0	5V/Div	> 4 Div

p. Press the VOLTS OUT button in. Check the test scope display for the settings in Table 3:

TABLE 3

Function	Range	Volts Out	Freq. Dial	Volts/Div	Display
Sine Wave	1M	In	3.0	0.5V/Div	> 4 Div
Square Wave	1M	In	3.0	0.5V/Div	> 4 Div
Triangle	1M	In	3.0	0.5V/Div	> 4 Div

q. Rotate the AMPLITUDE knob nearly CCW.

r. Set the test scope Volts/Div to 5mV.

s. Check the display for < 2 divisions (10mV) as the knob nears the CCW stop.

3. Square Wave Rise Time and Fall Time

a. Test Scope Set-Up:

Volts/Div	5V
Time/Div	0.5 uSec
Trig Slope	+

b. Set-Up:

AMPLITUDE	CW
DC OFFSET	Pushed In
RANGE	100K
FUNCTION	Square Wave
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	3.0

c. Connect MAIN OUTPUT to test scope vertical input via coax cable WITHOUT the 50 ohm terminator.

d. Adjust AMPLITUDE knob for a 4 division display on the test scope.

e. Set Time/Div to 50 nSec/Div. Adjust Trig Level control as necessary to display the rising edge of the Square Wave.

f. Check risetime between the 10% and 90% points for < 100 nSec (2 Div).

g. Set test scope Trig Slope to - (negative). Adjust Trig Level to view the Falling edge of Square Wave.

h. Check the Fall Time between the 10% and 90% points for < 100 nSec (2 Div).

4. Check Square Wave Duty Cycles

a. Set-Up:

AMPLITUDE	Midrange
RANGE	1K
FUNCTION	Square Wave
FREQ/10	Button In
FREQ DIAL	3.0

b. Test Scope Set-Up:

Volts/Div	1V
AC/GND/DC	DC
Time/Div	0.2 mSec
Trig Slope	+

c. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator. Adjust Trig Level as necessary for a stable display.

d. Use test scope variable Time/Div control to set the display for 1 complete cycle over 10 divisions.

e. Check for nearly equal positive and negative half cycles (50 % duty cycle). Readjust the variable Time/Div as necessary to maintain 1 complete cycle over 10 divisions.

f. Set FREQ/10 button out.

g. Check that the frequency increases by a factor of 10 as shown by a display of approximately 1 cycle per division on the test scope.

h. Set the FREQ/10 button in. Rotate the SYMMETRY knob CCW and use the Time/Div variable to set the first half cycle to 1 division. Rotate the SYMMETRY knob CW and check for the same half cycle to increase to 5 divisions or greater (a duty cycle change of 5:1).

i. Return the SYMMETRY knob to the center detent position and the test scope Time/Div variable to the detent position.

j. Repeat steps d and e to verify the 50 % duty cycles for the settings in Table 4.

Table 4

RANGE	FREQ. DIAL	FREQ/10	TIME/DIV	RESULT
1K	3.0	OUT	20uSec	50 % Duty Cycle
1K	0.3	OUT	0.2mSec	50 % Duty Cycle
1K	0.3	IN	2 MSec	50 % Duty Cycle
100K	0.3	OUT	2 uSec	50 % Duty Cycle
1M	0.3	IN	2 uSec	50 % Duty Cycle

5. SYNC (TTL) OUTPUT

a. Set-Up:

AMPLITUDE	CW
RANGE	1K
FUNCTION	Triangle
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	3.0

b. Test Scope Set-Up:

Volts/Div	1 V
Time/Div	0.2 mSec

c. Connect SYNC/TTL OUTPUT directly to the test scope vertical input via a coax cable (without the 50 ohm terminator).

d. Check the test scope for a display of approximately 4 volts (4 divisions).

e. Repeat step d with the FUNCTION set to Square Wave and Sine Wave.

6. SINE WAVE DISTORTION

a. Set-Up:

RANGE	100K
FUNCTION	Sine Wave
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	1.0

b. Connect MAIN OUTPUT to Distortion Analyzer via coax cable and 50 ohm terminator.

c. Set the Distortion Analyzer INPUT RANGE to Auto Range, and the FUNCTION settings to Volts, Auto Range and THD+N.

d. CHECK- For less than 1% distortion for the frequencies listed in Table 5:

Table 5

RANGE	FREQ DIAL	PER CENT DISTORTION
100K	1.0	< 1 %
10K	1.8	< 1 %
1K	1.8	< 1 %
100	1.8	< 1 %
10	1.0	< 1 %

7. FREQUENCY DIAL ACCURACY

a. Set-Up:

AMPLITUDE	CW
RANGE	1K
FUNCTION	Triangle
VOLTS OUT	Button In
FREQ/10	Button Out
FREQ DIAL	3.0

b. Connect the CFG253 MAIN OUTPUT to the input of a Frequency Counter. Check the frequency reading for each set-up listed in Table 6:

Table 6

RANGE	FREQ DIAL	COUNTER READING
1 M	3.0	2.85 MHz - 3.15 MHz
1 M	0.3	150 KHz - 450 KHz *
100 K	3.0	285 KHz - 315 KHz
10 K	3.0	28.5KHz - 31.5KHz
1 K	3.0	2.85KHz - 3.15KHz
100	3.0	285 Hz - 315 Hz
10	3.0	28.5 Hz - 31.5 Hz
1	3.0	2.85 Hz - 3.15 Hz

* The Frequency reading accuracy is 5% of full scale. 5% of 3 MHz is 150 KHz

c. Disconnect cable from the Counter and CFG253.

CFG253 ADJUSTMENT PROCEDURE

NOTE:

The Adjustment procedure should be performed only by qualified service technicians.

CONTENTS:

PREPARATION FOR ADJUSTMENT

This procedure should be accomplished at an ambient temperature of 21 to 25 degrees C and a relative humidity of 75% or less.

It is necessary to remove the bottom cover from the instrument to gain access to the adjustments used in this procedure.

Turn off the POWER switch, disconnect the power cord and place the CFG253 upside down on its top.

Remove the 2 screws in the rear feet and the 2 screws BESIDE the front feet.

Carefully lift the bottom cover off the unit, remove the handle and set these aside along with the screws for later reassembly.

Reconnect the power cord from an appropriate AC power source and allow the instrument a 20 minute warm up period.

Test Equipment requirements

The test equipment listed in the Table on Page 2 is a list of the equipment needed for this performance check. All test equipment is assumed to be operating within tolerance. Detailed operating instructions for test equipment are not given in this procedure. If operating information is needed, refer to the appropriate test equipment instruction manual.

Initial CFG253 Set-Up:

AMPLITUDE	CCW
DC OFFSET	Pushed In
SYMMETRY	Midrange Detent
RANGE	1K
FUNCTION	All Buttons Out
VOLTS OUT	Button Out
FREQ/10	Button Out
SWEEP	Button Out
SWEEP RATE	Midrange
SWEEP WIDTH	Midrange
FREQ DIAL	0.3

1. Set U1 Input Voltage

a. Set digital multimeter to DC mV range

b. Connect multimeter test leads to pins 2 and 3 of Integrated Circuit U1.

Note: Alternate Test Points

Locate R8 and R9 at the front left edge of the Main circuit board. Pin 2 is connected to the end of R8 nearest the board edge. Pin 3 is connected to the end of R9 furthest from the board edge.

c. Adjust R10 for approximately 0 mV.

2. Set Q5 Gate Voltage

a. Connect common lead of multimeter to ground and the positive lead to the wire loop test point near gate of Q5. (on the Main board under rear edge of the elevated Switch board).

b. Adjust R33 for approximately 0 mV.

3. Adjust Square Wave Duty Cycles

a. Set-Up:

AMPLITUDE	Midrange
RANGE	1K
FUNCTION	Square Wave
FREQ/10	Button In
FREQ DIAL	3.0

b. Test Scope Set-Up:

Volts/Div	1V
AC/GND/DC	DC
Time/Div	0.2 mSec

c. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator. Adjust Trig Level as necessary for a stable display.

d. Use test scope variable Time/Div control to set the display for 1 complete cycle over 10 divisions.

e. Adjust R67 for equal positive and negative half cycles (50 % duty cycle). Readjust the variable Time/Div as necessary to maintain 1 complete cycle over 10 divisions.

f. Set FREQ/10 button out.

g. Adjust R126 for 1 cycle per division on the test scope.

h. Repeat steps d and e to set the 50 % duty cycles for the settings and adjustments in Table 1.

Table 1

RANGE	FREQ. DIAL	FREQ/10	TIME/DIV	ADJUST	RESULT
1K	3.0	OUT	20uSec	R127	50 % Duty Cycle
1K	0.3	OUT	0.2mSec	R18	50 % Duty Cycle
1K	0.3	IN	2 MSec	R16	50 % Duty Cycle
100K	0.3	OUT	2 uSec	R132	50 % Duty Cycle
1M	0.3	IN	2 uSec	R128	50 % Duty Cycle

4. Set DC Offset

a. Set-Up:

DC OFFSET	Pulled Out
RANGE	1K
FUNCTION	All Buttons Out
VOLTS OUT	Button Out
FREQ/10	Button Out

b. Test Scope Set-Up:

Volts/Div	2V
Time/Div	0.2 mSec
Var Time/Div	Cal

c. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator.

d. Set test scope Vert Coupling to GROUND, center the trace, then set Coupling back to DC.

e. While turning the DC OFFSET knob from CCW to CW and back, adjust R117 for equal voltage swings positive and negative on the test scope.

f. Adjust R129 for 5.1 V with DC OFFSET knob CW and -5.1 V with the knob CCW (2.55 Div on test scope). Repeat step e, if necessary.

g. Push the DC OFFSET knob in (off).

h. Set the test scope to 10 mV/Div.

i. Set test scope Vert Coupling to GROUND, center the trace, then set Coupling back to DC.

j. Slowly adjust R82 to recenter the trace, set to within 1 division of center (+/- 10 mV).

5. Square Wave Overshoot, Rise Time and Fall Time

a. Test Scope Set-Up:

Volts/Div	5V
Time/Div	0.5 uSec
Trig Slope	+

b. Set-Up:

AMPLITUDE	CW
DC OFFSET	Pushed In
RANGE	100K
FUNCTION	Square Wave
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	3.0

c. Connect MAIN OUTPUT to test scope vertical input via coax cable WITHOUT the 50 ohm terminator.

d. Adjust AMPLITUDE knob for a 4 division display on the test scope.

e. Adjust C31 for minimum overshoot (will not be completely flat).

f. Set Time/Div to 50 nSec/Div. Adjust Trig Level control as necessary to display the rising edge of the Square Wave.

g. Check risetime between the 10% and 90% points for < 100 nSec (2 Div).

h. Set test scope Trig Slope to - (negative). Adjust Trig Level to view the Falling edge of Square Wave.

i. Check the Fall Time between the 10% and 90% points for < 100 nSec (2 Div).

6. Set OUTPUT Levels

a. Set-Up:

AMPLITUDE	CW
DC OFFSET	Pushed In
RANGE	1K
FUNCTION	Triangle
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	3.0

b. Test Scope Set-Up:

Volts/Div	2V
Time/Div	0.2 mSec
Trig Slope	+

c. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator.

d. Adjust R130 for approximately 10.5 V p-p output display on test scope (5.25 Div).

e. Set RANGE to 1M and FREQ DIAL to 0.3.

f. Note the test scope display amplitude.

g. Observe the display amplitude for > 10 V while turning the FREQ DIAL from 0.3 to 3.0.

h. Set the FREQ DIAL to 3.0. Adjust C55 for the same amplitude as observed in step f.

i. Repeat steps a thru h for the Sine Wave function. In step d, adjust R74 for 10.8 V. In step h, use C26.

j. Set FUNCTION to Square Wave, RANGE to 1K and FREQ DIAL to 3.0.

k. Adjust R56 for approximately 10.8 V on the test scope display (5.4 Div).

7. Sine Wave Distortion

a. Set-Up:

RANGE	100K
FUNCTION	Sine Wave
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	1.0

b. Connect the MAIN OUTPUT to the Distortion Analyzer via a coax cable and a 50 ohm terminator.

c. Set the Distortion Analyzer INPUT RANGE to Auto Range and the FUNCTION settings to Volts, Auto Range and THD+N.

d. Adjust R43 and R46 for a minimum distortion reading on the Distortion Analyzer. Repeat the two adjustments as necessary to obtain the optimum results.

e. Disconnect the cable from the Distortion Analyzer.

***** Alternate Procedure *****

(If Distortion Analyzer is not available)

f. Test Scope Set-Up:

Volts/Div	2V
Time/Div	1 uSec

g. Connect MAIN OUTPUT to test scope vertical input via coax cable and 50 ohm terminator.

h. Adjust R46 for minimum distortion at top of sinewave and R43 for minimum distortion at the bottom.

7. FREQUENCY DIAL ACCURACY

a. Set-Up:

AMPLITUDE	CW
RANGE	1K
FUNCTION	Triangle
VOLTS OUT	Button In
FREQ/10	Button Out
FREQ DIAL	3.0

b. Connect the MAIN OUTPUT to the input of a Frequency Counter.

NOTE:

If a Frequency Counter is not a available, see alternate procedure on next page.

c. Adjust R6 for a reading of 3.0 KHz on the Frequency Counter.

d. Set the RANGE to 1M and adjust C8 for a reading of 3.0 MHz on the Frequency Counter.

e. Check the Frequency Counter readout while changing the CFG253 FUNCTION between Sine Wave and Square Wave. Adjust R76 for approximately 3.0 MHz, setting for the best compromise between Sine Wave and Square Wave.

***** Alternate Procedure *****

(If a Frequency Counter is not available)

f. Set-Up:

AMPLITUDE	CW
RANGE	1K
FUNCTION	Triangle
VOLTS OUT	Button Out
FREQ/10	Button Out
FREQ DIAL	3.0

g. Test Scope Set-Up:

Volts/Div	0.5 V
Time/Div	0.2 mSec

h. Connect SYNC/TTL OUTPUT to test scope vertical input via coax cable and 50 ohm terminator.

i. Adjust R6 for a display of 6 cycles in 10 Divisions on the test scope. (3KHz)

j. Set RANGE to 1M and the test scope Time/Div to 0.2 uSec.

k. Adjust C8 for a display of 6 cycles in 10 Divisions on the test scope. (3MHz)

l. Check display while changing the FUNCTION between Sine Wave and Square Wave. Adjust R76 for 6 cycles in 10 Divisions, setting for the best compromise between Sine Wave and Square Wave frequencies.

REASSEMBLY

1. Disconnect any cables connected to the CFG253, turn off the POWER switch and remove the power cord.

2. With the unit setting upside down on its top, place the handle upside down in its opening in the case top and carefully slide the case bottom onto the unit. Be sure that the front and back grooves line up and slip over the front and rear panels.

3. Reinstall the two rear feet and screws plus the two front screws.