Instructions Manual

Tektronix

THM420
Digital Multimeter

070-9856-01

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THM420 Digital Multimeter

The Tektronix THM420 multipurpose instrument combines the functions of a digital multimeter with the ability to display waveforms. The THM420 includes the following features:

- 3¾ digits (4000 count) LCD display with bargraph
- Waveform display with the press of a button
- A variety of measurement functions: DC/AC voltage, DC/AC current, resistance, frequency, diode testing, continuity checking
- True RMS measurements
- Autoranging for DMM and waveform display
- Measurement hold
- Input overvoltage and overcurrent warning beeper

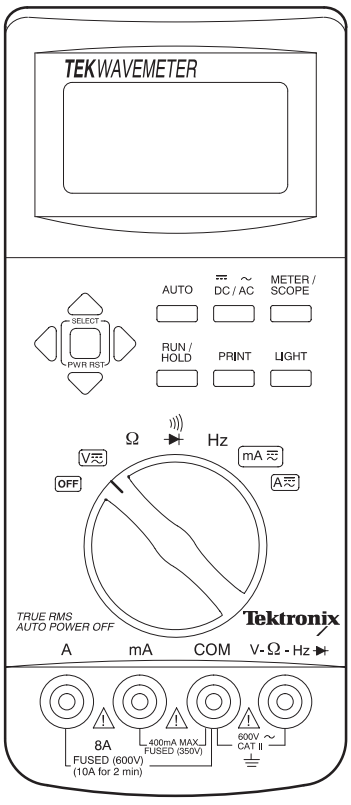

Figure 1: THM420 instrument

THM420 Specifications

The characteristics listed in this section apply under the following conditions:

- The instrument operates in an 18° to 28° C ambient environment unless otherwise noted.

NOTE. *All specifications are warranted unless marked "typical." Typical characteristics are not guaranteed but are provided for the convenience of the user.*

Table 1: General specifications

Characteristic	Description
Display	3¾ digit (4000 count) LCD
Polarity Display	Automatic
Overrange Display	OVER is displayed
Low Voltage Indicator	Battery indicator is displayed
Measurement Rate	50 ms
Automatic power-off time	Approximately 30 minutes
Power	Six AA, ANSI/NEDA 15A, or IEC LR6 batteries
Battery Life	Back light Off: typically greater than 10 hours using six alkaline batteries
Maximum Floating Voltage	600 VAC_{RMS} CAT II (or 850 VDC) between any terminal to earth and ground
Maximum Input Voltage	600 VAC_{RMS} CAT II (or 850 VDC) between V and COM
Maximum Input Current	
Between mA and COM	400 mA
Between A and COM (10 A for 2 minutes)	8 A
Maximum Open Circuit Input Voltage	
Between A and COM	600 V
Between mA and COM	350 V

Table 2: Measurement characteristics

Characteristic	Description
Volts	
DC Ranges	400 mV, 4 V, 40 V, 400 V, 850 V
AC Ranges	400 mV, 4 V, 40 V, 400 V, 600 V
DC Accuracy	±(0.3% of reading + 2 counts)
AC Accuracy	
40 to 50 Hz	±(1.5% of reading + 5 counts)
50 to 60 Hz	±(1.0% of reading + 5 counts)
60 Hz to 1 kHz	±(1.5% of reading + 5 counts)
Input Impedance	Maximum: 1 MΩ paralleled by 100 pF
Current	
DC Ranges	400 mA, 8 A
AC Ranges	400 mA, 8 A
DC Accuracy	
400 mA Range	±(0.6% of reading + 3 counts)
8 A Range	±(0.8% of reading + 4 counts)
AC Accuracy (40 to 1 kHz)	
400 mA Range	±(1.8% of reading + 5 counts)
8 A Range	±(1.8% of reading + 5 counts)
Overload protection	
⚠ mA Connector	500 mA (350 V) fast blow fuse (Tektronix part number 159-0389-00)
A Connector	15 A (600 V) fast blow fuse (Tektronix part number 159-0287-00)
Resistance	
Ranges	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ, 4 MΩ, 40 MΩ
Accuracy (By range)	
400 Ω	±(0.4% of reading + 4 counts)
4 kΩ, 40 kΩ, 400 kΩ	±(0.4% of reading + 2 counts)
4 MΩ	±(0.6% of reading + 3 counts)
40 MΩ	±(1.5% of reading + 5 counts)
Frequency	
Ranges	100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

Table 2: Measurement characteristics (cont.)

Characteristic	Description
Accuracy (By range)	
100 Hz, 1 kHz, 10 kHz, 100 kHz	±(0.1% of reading + 4 counts)
1 MHz	±(0.5% of reading + 4 counts)
Sensitivity	
100 Hz, 1 kHz, 10 kHz	40 mV_{RMS}
100 kHz, 1 MHz	400 mV_{RMS}
Lowest Measurable Frequency	10 Hz
Continuity	
Threshold	Beeper sounds when resistance is approximately 30 Ω or less
Diode Test	
Test Current	1.0 mA
Test Voltage	5 V maximum

Table 3: Waveform display characteristics

Characteristic	Description
Display Region	8 Horizontal divisions and 4 vertical divisions (16 dots/division)
Vertical	
Voltage Input Bandwidth	
20 mV to 1 V/div	DC to 5 MHz
2 V to 200 V/div	DC to 3 MHz
Current Inputs Rise Time Limits	
400 mA Connector	>500 ns
8 A Connector	>5 µs
Voltage Ranges	20 mV/div to 200 V/div
Current Ranges	
mA	2 to 500 mA/div
A	200 mA/div to 10 A/div
Sample Rate	16 MS/s
Resolution	6 bits
Coupling	DC and AC (–3 dB at 15 Hz)
Input Impedance	1 MΩ

Table 3: Waveform display characteristics (cont.)

Characteristic	Description
DC Accuracy	±(3.5% + 2 pixels)
Horizontal	
Sweep Time	100 ns/div to 10 s/div Using roll mode: 0.2 s/div to 10 s/div
Position Settings	Left edge: 8 divisions shown after the trigger point Center screen: 4 divisions shown before and after trigger point Right edge: 8 divisions shown after the trigger point
Trigger	
Trigger Mode	Auto
Coupling	DC
Slope	Positive or negative

Table 4: Physical characteristics

Characteristic	Description
Height	6.5 cm (2.56 inch)
Width	9 cm (3.54 inch)
Depth	20.8 cm (8.19 inch)
Weight	With batteries: approximately 640 g (22.6 oz.)

Table 5: Environmental characteristics

Characteristic	Description
Temperature	
Operating	0° to 50° C
Nonoperating (Storage)	–20° to +70° C
Humidity (Operating)	0° to 40° C: ≤80% 41° to 50° C: ≤60%
Altitude	
Operating	2,222 m (7290 ft)
Nonoperating	12,300 m (40354 ft)

Table 5: Environmental characteristics (cont.)

Characteristic	Description
Vibration	
Operating	5 to 500 Hz, 3 axes (10 minutes each): 2.66 g_{RMS}
Nonoperating	5 to 500 Hz, 3 axes (10 minutes each): 3.48 g_{RMs}

Table 6: Optical interface characteristics

Characteristic	Description
Infrared Wavelength	945 nm
Carrier Wavelength	38 kHz
Reception Range	Approximately 1 meter

Table 7: Certifications

Characteristic	Description
Certifications	Listed UL3111-1 and CSA C22.2 No. 1010.1

THM420 Performance Verification

This section contains procedures to verify that the THM420 performs as warranted. If your instrument fails any of the checks, it needs adjustment and or repair.

The performance verification procedures provide a valid confirmation of instrument electrical characteristics and function under the following conditions:

- The instrument operates in an 18° to 28° C environment with a relative humidity of less than 80%.
- The instrument remains fully assembled (do not remove the bottom cover).

The THM420 performance verification consists of the checks listed in Table 8.

Table 8: Performance verification checks

DC Voltage
AC Voltage
Resistance
Diode and Continuity
Frequency
DC Amperes
AC Amperes
Trace Shift
Trace Slope
Printer
Back Light

The performance verification procedure should be performed annually or after every 2000 hours of operation if used infrequently.

Test Equipment

The performance verification procedures use external traceable test equipment to directly check warranted characteristics. The following procedures use either the Wavetek 9100 Universal Calibration System with Oscilloscope Calibration Module (Option 250) or the Fluke 5500A Multi-product Calibrator with Oscilloscope Calibration Option 5500A-SC.

Alternative test equipment must meet or exceed the intended minimum requirements. If you substitute equipment, you may need to modify the performance verification procedures.

NOTE. *Before beginning the performance verification procedures, warm up the test equipment according to the manufacturer's recommendations.*

Verification Procedure

WARNING. *The following tests use hazardous voltages. If you use standard banana plugs to apply test signals to the THM420 instrument, do not touch the exposed conductors.*

NOTE. *For the following series of tests, set the METER/SCOPE button to the METER mode.*

To verify the performance of your THM420 instrument, perform the following checks in sequential order.

DC Voltage

The following check verifies DC voltage measurement accuracy.

1. Turn the THM420 rotary switch to V≂.
2. Set the DC/AC button to **DCV**.
3. Connect the voltage source output to the THM420 COM and the V Ω Hz ⊣◀ inputs.
4. Configure the voltage source to output **DC**.
5. Set the controls of the THM420 and the voltage source to each of the values listed in Table 9; then verify that the THM420 readout remains within the readout limits.

Table 9: DC voltage accuracy

THM420 range	DC voltage source	Readout limits	
		Minimum	Maximum
400m V	300.0 mV	298.9 mV	301.1 mV
4 V	3.000 V	2.989 V	3.011 V
40 V	30.00 V	29.89 V	30.11 V
400 V	300.0 V	298.9 V	301.1 V
850 V	450 V	447 V	453 V

6. Disable the voltage source output.
7. Do not disconnect the test setup.

AC Voltage

The following check verifies AC voltage measurement accuracy.

1. Set the THM420 DC/AC button to **ACV**.
2. Configure the voltage source to output **AC**.
3. Set the controls of the THM420 and the voltage source to each of the values listed in Table 10; then verify that the THM420 readout remains within the readout limits.

Table 10: AC voltage accuracy

THM420 range	AC voltage source		Readout limits	
	Voltage	Frequency	Minimum	Maximum
400 mV	300.0 mV	1 kHz	295.0 mV	305.0 mV
4 V	3.000 V	50 Hz	2.965 V	3.035 V
40 V	30.00 V	1 kHz	29.50 V	30.50 V
400 V	300.0 V	1 kHz	295.0 V	305.0 V
600 V	450 V	1 kHz	438 V	462 V

4. Disable the voltage source output.
5. Disconnect the test setup.

Resistance

The following check verifies resistance measurement accuracy.

1. Turn the THM420 rotary switch to **Ω**.
2. Connect the resistance source output to the THM420 COM and the V Ω Hz ⊣◀ input connectors.
3. Set the controls of the THM420 and the resistance source to each of the values listed in Table 11; then verify that the THM420 readout remains within the readout limits.

Table 11: Ohms accuracy

THM420 range	Resistance source	Readout limits	
		Minimum	Maximum
400 Ω	100.0 Ω	99.2 Ω	100.8 Ω
400 kΩ	100.0 kΩ	99.4 kΩ	100.6 kΩ
40 MΩ	10.00 MΩ	9.80 MΩ	10.20 MΩ

4. Disconnect the test setup.

Diode and Continuity

The following check verifies diode and continuity measurement accuracy.

1. Turn the THM420 rotary switch to ⊣◀ and))).
2. Connect the THM420 COM input to the V Ω Hz ⊣◀ input with a shorting strap.
3. Verify that the THM420 readout indicates approximately **0.000V** and the beeper sounds.
4. Disconnect the test setup.

Frequency

The following check verifies frequency measurement accuracy.

1. Turn the THM420 rotary switch to **Hz**.
2. Connect the frequency source output to the THM420 COM and the V Ω Hz ⊣◀ input connectors.
3. Set the controls of the THM420 and the frequency source to each of the values listed in Table 12; then verify that the THM420 readout remains within the readout limits.

Table 12: Frequency accuracy

	Frequency source		Readout limits	
THM420 range	Voltage	Frequency	Minimum	Maximum
100 kHz	1.000 V	50 kHz	49.91 kHz	50.09 kHz

4. Disconnect the test setup.

DC Amperes

The following check verifies DC ampere measurement accuracy.

1. Turn the THM420 rotary switch to mA≂ for the first verification; turn the THM420 rotary switch to A≂ for the second verification.
2. Set the THM420 DC/AC button to **DCA**.
3. Set the current source to output **DC**.
4. Connect the current source output to the THM420 COM and the V Ω Hz →|– input connectors.
5. Set the controls of the THM420 and the current source to each of the values listed in Table 13; then verify that the THM420 readout remains within the readout limits.

Table 13: DC amperes accuracy

THM420 rotary switch	DC current source	Readout limits	
		Minimum	Maximum
mA	200.0 mA	198.5 mA	201.5 mA
A	2.000 A	1.94 A	2.06 A

6. Do not disconnect the test setup.

AC Amperes

The following check verifies AC ampere measurement accuracy.

1. Turn the THM420 rotary switch to mA≂.
2. Set the THM420 DC/AC button to **ACA**.
3. Reconfigure the current source to output **AC**.
4. Set the controls of the THM420 and the current source to each of the values listed in Table 14; then verify that the THM420 readout remains within the readout limits.

Table 14: AC Amperes accuracy

THM420 rotary switch	AC current source		Readout limits	
	Current	Frequency	Minimum	Maximum
mA	200.0 mA	50 Hz	195.9 mA	204.1 mA

5. Set the METER/SCOPE button to **SCOPE** mode.
6. Verify that the current measurement is displayed.
7. Disconnect the test setup.

***NOTE**. For the following series of tests, the METER/SCOPE button must remain in the SCOPE mode.*

Trace Shift

The following check verifies trace shift accuracy.

1. Turn the THM420 rotary switch to V≂.
2. Connect the THM420 COM input to the V Ω Hz ⊣◀ input with a shorting strap.
3. Verify that there is no trace shift while using the ▲ ▼ buttons to switch between SCALE settings (vertical volts/division).
4. Disconnect the test setup.

Trace Slope

The following check verifies trace slope accuracy.

1. Turn the THM420 rotary switch to V≂.
2. Set the DC/AC button to **AC(V)**.
3. Set the SCALE to **200 V** with the ▲ ▼ buttons.
4. Set the horizontal time-per-division to **100 µs** with the ◀ ▶ buttons.
5. Connect the voltage source to the THM420 COM and the V Ω Hz ⊣◀ input connectors.
6. Set up the voltage source to output an AC voltage of **200 V** at **1 kHz**.
7. Set the THM420 trigger slope to ⎍ and verify that the waveform display starts on the rising edge.

8. Set the THM420 trigger slope to ⌞ and verify that the waveform display starts on the falling edge.
9. Disable the voltage source output.
10. Disconnect the test setup.

Printer

The following check verifies printer operation.

1. Press and hold the THM420 **PRINT** button for two seconds. Verify that the P icon appears in the upper-right corner of the display.

Back Light

The following check verifies that the display back light operates properly.

1. Press the THM420 **LIGHT** button and verify that the back light is on.

THM420 Adjustment Procedures

This section contains procedures to adjust the THM420. If your instrument fails a performance requirement, use these procedures to return it to factory specifications.

In this section you will find the following information:

- Instructions on how to prepare the instrument for adjustment
- Step-by-step adjustment procedures

The procedures in this section do not verify performance. To confirm that your instrument meets factory specifications, perform the procedures in the *THM420 Performance Verification* section.

Preparation for Adjustment

The following guidelines apply to all instrument adjustments:

- Perform all adjustments in a 20° to 30° C (68° to 86° F) ambient environment.
- Before making any adjustment, warm up the instrument for at least 20 minutes.
- Do not alter any setting without reading the entire adjustment procedure first.
- Do not alter a setting unless a performance characteristic cannot be met at the current setting.
- Read the *Safety Summary* at the beginning of this manual.

Remove the Bottom Cover

You must remove the bottom cover to gain access to the internal adjustments. To remove the cover, refer to Figure 2 while performing the following steps.

1. Remove the battery pack.
2. Lay the instrument face down on a flat work surface.
3. Remove the four cover screws with a Phillips-head screwdriver.
4. Carefully lift the bottom cover off of the instrument.
5. Replace the battery pack (the instrument must be powered for the adjustment procedures that follow).

To reinstall the bottom cover following the adjustments, perform steps 1 and 4 above in reverse order.

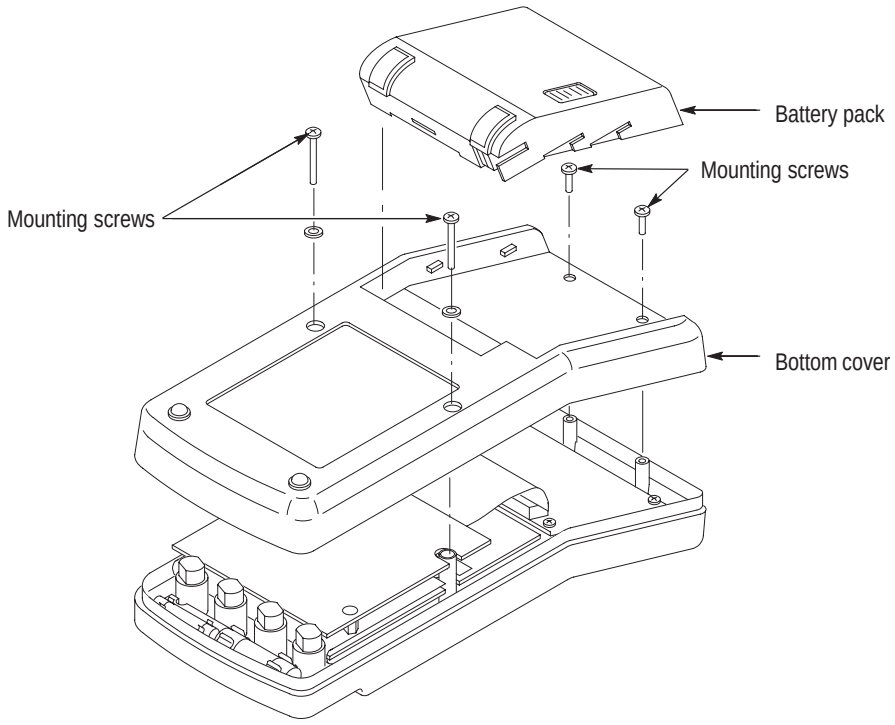

Figure 2: Removing the bottom cover

Access the Main Circuit Board

You must access the main circuit board to make adjustments. To expose the board, refer to Figure 3 while performing the following steps.

1. Remove the two circuit board mounting screws with a Phillips-head screwdriver.
2. Lift the top circuit board up and position it to the side. Do not disconnect any cables.
3. Fold back the insulating shield that separates the top circuit board from the bottom circuit board.

To reinstall the top circuit board following the adjustments, perform steps 1 through 3 above in reverse order.

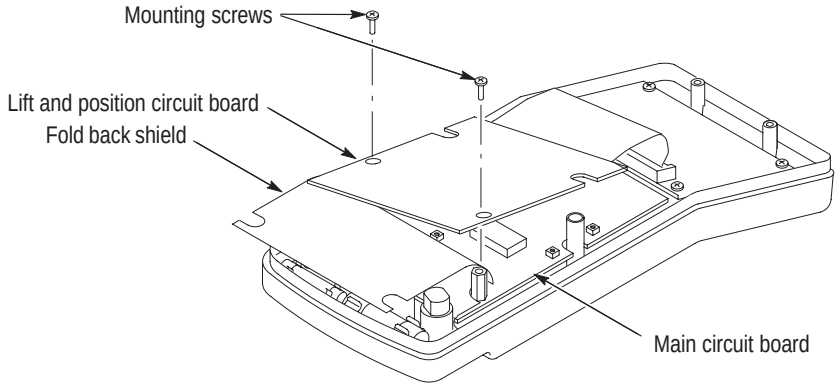

Figure 3: Exposing the Main circuit board

Adjustment Procedure

To return your instrument to factory calibration, perform the following procedure.

1. Turn the THM420 rotary switch to V≂.
2. Press the METER/SCOPE button to select **SCOPE** mode.
3. Set the AC/DC button to **DC**.
4. Connect the COM input to the V Ω Hz →|– input with a shorting strap.
5. Set the vertical offset (POS) to **0 mV**.
6. Set the vertical SCALE to **200 V**.
7. Adjust R80 to align the trace to the display center line. See Figure 4 for the adjustment location.
8. Set the vertical scale to **20 mV**.
9. Adjust R84 to align the trace to the display center.
10. If necessary, repeat steps 5 through 9 above to achieve a fine adjustment.

11. Turn the rotary switch to mA≂.

12. Press the METER/SCOPE button to select **SCOPE** mode.

13. Set the AC/DC button to **DC**.

14. Set the vertical offset (POS) to **0 mA**.

15. Set the vertical SCALE to **2 mA**.

16. Adjust R86 to align the trace to the display center.

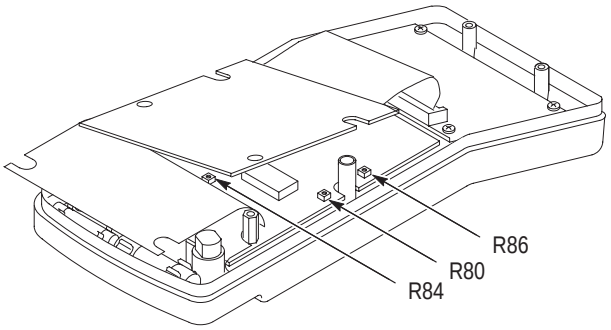

Figure 4: Adjustment locations