

HANDHELD BOND METER

Models:
720A

Intrinsically Safe Handheld Bond Meter

Operation Manual

rev A



Manual Part Number: 720A-900, Rev. A

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NOTICES

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Safety Notice Symbols and Terms

Safety Notices denote hazards. They indicate an operating procedure, instruction, or practice that, if not correctly performed or followed, could result in damage to equipment, or injury or death to personnel. Do not proceed beyond a Safety Notice until all conditions and instructions are fully understood and complied with.

Safety Notices Symbols:



WARNING denotes an imminent hazard that *could* result in injury to personnel or death.



CAUTION denotes a hazard that *could* result in damage to the unit or other equipment.



REMINDER denotes important information about instrument functions, menus, and measurements.

TABLE OF CONTENTS

1. INSTRUMENT DESCRIPTION	1-1
1.1 Specifications	1-1
1.2 Optional Accessories and Ordering Information	1-3
1.3 TEGAM Family of Handheld Bond Meters	1-3
2. PREPARATION FOR USE	2-1
2.1 General Information	2-1
2.2 Feature Overview	2-1
2.3 Safety Notices and Information	2-2
3. ADDITIONAL SAFETY NOTICES AND INFORMATION	2-4
3.1 Unpacking and Inspection	2-5
3.2 Battery Installation and Replacement	2-5
3.3 Making Your First Resistance Measurement	2-7
4. OPERATING INSTRUCTIONS	4-1
4.1 Keypad Functions	4-1
4.2 LCD Display	4-1
4.3 Test Limit Menu	4-3
4.4 Auto-Power Off	4-3
4.5 Backlight and Backlight Timeout	4-3
4.6 Hold Function	4-3
4.7 Auto-Hold Function	4-4
4.8 Open Lead Detection	4-5
4.9 Battery Indicator	4-5
4.10 Invalid Measurement Indications	4-6
5. SERVICE INFORMATION	5-1
5.1 Inspection and Cleaning	5-1
5.2 Calibration	5-1
5.3 Troubleshooting	5-7
5.4 Diagnostic Routines and Error Codes	5-8
5.5 Preparation for Calibration or Repair Service	5-9
5.6 Expedite Repair & Calibration Form	5-10
5.7 Warranty	5-11
5.8 Warranty Limitations	5-11
5.9 Statement of Calibration	5-12
A. REQUIRED ALIGNMENT AND VERIFICATION EQUIPMENT	A-1
B. INSTRUMENT VERIFICATION DATA SHEET	B-1

1. INSTRUMENT DESCRIPTION

1.1 Specifications

GENERAL SPECIFICATIONS:		
Accuracy¹	±(0.2% Reading + 0.02% Range) -10 to 55 °C	
Resistance Ranges and Test Currents:		
Full Scale	Resolution	Test Current
10.000 mΩ	1 μΩ	100 mA
100.00 mΩ	10 μΩ	10 mA
1.0000 Ω	100 μΩ	1 mA
10.000 Ω	1 mΩ	100 μA
100.00 Ω	10 mΩ	10 μA
Connector Type	M12	
Max. Lead Resistance	500 mΩ per lead	
Display	Four and one-half (4 1/2) digit LCD, with Range, Units, Function, Battery, and Decimal Indicators	
Display Backlight	LED Backlight with 30-second timeout	
Reading Rate	3 / Second for Readings, typical	
Battery Type	3 AA (IEC LR6, ANSI 15) Alkaline	
Battery Life	100 hours standby, 50 hours in 10 mΩ range, typical ²	
Battery Indicator	Four (4) Stage Battery Charge Indicator	
Keypad	Six (6) momentary switches with audible and tactile feedback	
Power Cycle Configuration Retention	Instrument retains:	
	- Range	- Test Limit
Maximum Common Mode Voltage	30 V	
Compliance	CE (2014/30/EU) / RoHS (EU 2015/863) / EU REACH (EC) No. 1907/2006	
ESD	IEC 61000-4 2:2009, Class B	
EMC	EN 55022:2010+A1:2015, Class A; EN 61000-4 3:2006+A2:2010, 10 V/m (80 MHz to 1 GHz)	MIL-PRF-28800F, Class 2

¹ 95% confidence interval, approximately 2σ

² Factors such as range, backlight, and use of the optional display probe will affect battery life

ENVIRONMENT:		
Certifications	UL 21 ATEX 2549 IECEX UL 21.0038 -10 °C ≤ Ta ≤ +55 °C	Ex ia IIA T4 Ga Class I, Division 1, Group D, T4 Class I, Zone 0 AEx ia IIA T4 Ga Zone 0 Ex ia IIA T4 Ga
Standards	MIL-PRF-28800F, Class 2	
Operating Temp	-10 to 55 °C	-14 to 131 °F
Humidity	5 to 95%, 10 to 30 °C	5 to 95%, 50 to 86 °F
Altitude	0 to 4600 m	0 to 15,092 ft
Vibration	Random 10 – 500 Hz, 0.03 g ² /Hz	
Shock	30g Half Sine	
Drop	4 drops from 1 m to concrete	
Storage Temp	-51 to 71 °C	-60 to 160 °F
PHYSICAL CHARACTERISTICS:		
Dimensions	193 x 84 x 28 mm	7.6 x 3.3 x 1.1 in
Weight (incl. batteries)	303.2 g	10.7 oz
CALIBRATION:		
Recommended Interval:	1 year	

1.2 Optional Accessories and Ordering Information³

PRODUCT	MODEL	DESCRIPTION
Probes	BKP-M2S	Big Kelvin Probe, 700 Series, Intrinsically Safe
	BKP-B	Pin Kit, Spear Tip, 4 Pins per Pack
	BKP-F	Pin Kit, Flat Tip, 4 Pins per Pack
	BKP-H	Pin Kit, Serrated Tip, 4 Pins per Pack
	BKP-J	Pin Kit, Round Tip, 4 Pins per Pack
	MCP-M2S	Miniature Coaxial Probe, 700 Series, Intrinsically Safe
	MCP-A	Replacement Pins for the MCP Series Probe
	MKP-M2S	Miniature Kelvin Probe, 700 Series, Intrinsically Safe
	MKP-B	Miniature Pin Kit, Spear Tip, 4 Pins per Pack
	MKP-F	Miniature Flat Tip Pin Kit, 4 Per Pack
	MKP-H	Miniature Serrated Tip Pin Kit, 4 Per Pack
	MKP-J	Miniature Round Tip Pin Kit, 4 Per Pack
	MKP-LM	Miniature Serrated Rotating Tip Pin Kit, 4 Per Pack
	KC-M2S	Kelvin Clip, 700 Series, Regular Length, Intrinsically Safe
KC-M5S	Kelvin Clip, 700 Series, Long Length, Intrinsically Safe	
Batteries	BA-109	AA Battery (3 included)
Service Options	710-CAL	Standard Calibration
	710-17025	17025 Calibration with Report

1.3 TEGAM Family of Handheld Bond Meters

Bond Meters	710A	Handheld Bond Meter
	720A	Handheld Bond Meter, Intrinsically Safe
	730A	Handheld Bond Meter, Wireless Datalogging

³ Some accessories may not be available at time of printing

2. PREPARATION FOR USE

2.1 General Information

The TEGAM 720A Intrinsically Safe Handheld Bond Meter is a high-accuracy micro-ohmmeter that provides accurate resistance readings in a wide range of manufacturing and service applications. These full-featured, durable, and versatile instruments simplify the process of resistance measurement through the intuitive user-interface.

2.2 Feature Overview

- Battery life of 100 hours in standby, 50 hours in 10 mΩ range ⁴
- Four and one-half (4½) digit LCD with LED Backlight
- Easy to clean
- Automatic and manual HOLD modes
- Programmable test limits with OK and FAIL annunciators
- OVER and UNDER annunciators
- Open lead and DUT (**D**evice **U**nder **T**est) detection
- Durable: Meets MIL-PRF-28800F, Class 2 requirements

⁴ Factors such as range, backlight, and use of the optional display probe will affect battery life

2.3 Safety Notices and Information

Read this Operation Manual and Safety Notices Manual (720A-903) thoroughly before using the instrument to become familiar with its operations and capabilities.

Visually inspect instrument before using. Do not use if unit appears damaged or with any part of the case removed.

WARNING

MAINTENANCE INSTRUCTIONS WITHIN THIS MANUAL ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. DO NOT ATTEMPT TO SERVICE THIS UNIT UNLESS YOU ARE QUALIFIED TO DO SO.

WARNING - SHOCK HAZARD

Disconnect probes from DUT and turn the unit off before removing the battery cover.

When operated in a potentially explosive atmosphere, this unit may not be used if capacitance, inductance, or other circuitry is connected to the bond or structure under test.

Always disconnect probes from DUT before opening the battery cover. Internal circuits can present a shock hazard if leads are connected to a source of elevated potential.

Do not use this instrument if the housing, probe wiring, probe, or probe handle are damaged or distorted. Housings and wire insulation are part of the personnel protection system, and if damaged could expose users to elevated potentials.

WARNING - EXPLOSION HAZARD

Never store this product with batteries installed or change batteries, in an environment where explosive or flammable vapors or dust suspensions may exist.

Do not attempt to recharge alkaline batteries.

Do not put batteries into bags designed to protect parts from electrostatic discharge (ESD). These bags are specially designed with metal shielding which can short circuit a battery.

Do not expose batteries to extreme heat or fire. Observe all regional laws and regulations when disposing batteries.

Batteries are part of the intrinsically safe system. Use only the specific battery type and manufacturers listed. Use of other batteries could impair intrinsic safety.

Safety Notices and Information continued on next page . . .

CAUTION

THREE (3) AA 1.5 V BATTERIES ARE USED WITH THE INSTRUMENT. OBSERVE THE FOLLOWING WHEN INSTALLING OR REMOVING THE BATTERIES.

	Always change the product's batteries outside Ex Hazardous areas.
	Always turn the instrument off and disconnect any input connections before replacing the batteries. Re-install the battery compartment cover before resuming use of the instrument.
	The battery compartment is sealed with a rubber gasket. Use care to not damage the gasket when removing or installing the battery compartment cover.
	Remove the batteries when storing the instrument for an extended period or in a high temperature environment to prevent battery leakage and possible damage to the instrument.
	Use only Zinc-Manganese Dioxide or Alkaline-Manganese Dioxide AA cells that have been tested by a nationally recognized laboratory to meet the requirements of UL 60079-11, Sixth Edition.

Use of any other battery will invalidate the Type Certificate and create a hazardous condition. The only batteries that TEGAM, Inc. has secured such testing, which are approved for use in the 720A, are listed on the Type Certificate. They are:

- Energizer E91
- Duracell MN1500

	Observe proper polarity when installing batteries.
--	--

Refer to *Section 3.2, Battery Installation and Replacement*, for battery installation detail.

Safety Notices and Information continued on next page . . .

3. ADDITIONAL SAFETY NOTICES AND INFORMATION

To prevent personal injury while in Ex Hazardous areas, follow the guidelines below:

- NEVER SERVICE THIS UNIT IN AN Ex HAZARDOUS AREA.
- Batteries are part of the intrinsically safe system. Use only the specific battery type and manufacturers listed in the Operation Manual. Use of other batteries could impair intrinsic safety. Do not mix batteries of different manufactures. Do not mix fresh batteries with old batteries.
- Do not take spare batteries into an Ex Hazardous area.
- To reduce the risk of ignition of a flammable or explosive atmosphere, batteries must be changed only in a location known to be Non-Hazardous.
- Never open the instrument while in an Ex Hazardous area.
- Never store the instrument with batteries installed in an Ex Hazardous area.
- Never use the instrument with the battery cover off.
- Do not put batteries into bags designed to protect parts from electrostatic discharge (ESD). These bags are specially designed with metal shielding which can short circuit a battery.
- Use only approved accessories with this product in Ex Hazardous areas.
- Use this product only as specified or protection provided by the instrument could be compromised.
- Never touch the probe(s) to a voltage source.
- Check the integrity of the case prior to using the instrument in an Ex Hazardous area. Look for any compromises like cracks or missing plastic.
- Always comply with all safety codes.

Refer to the 720A Safety Notices Manual (720A-903) for a complete list of compliances and warnings.

3.1 Unpacking and Inspection

Each instrument is electrically and mechanically inspected before shipment. Upon receiving your new TEGAM Handheld Bond Meter, unpack all items from the shipping container and check for any obvious damage that may have occurred during transit. Use the original packing materials if reshipment is necessary.

If any dents, broken, or loose parts are seen, do not use the equipment. Notify TEGAM immediately.

Check that all items are present. If any items are missing, notify TEGAM immediately.

The following items are included with every new instrument:

- One (1) Handheld Bond Meter;
- One (1) Safety Notices Booklet;
- One (1) Operation Manual;
- One (1) Quick Start Guide;
- Statement of Traceability;
- Three (3) AA, 1.5 V batteries; and
- Optional accessories (if purchased).

3.2 Battery Installation and Replacement

Three (3) AA 1.5 V batteries are supplied with the instrument, but not installed. Read the following battery replacement instructions before attempting to install or remove the batteries.



Use only Zinc-Manganese Dioxide or Alkaline-Manganese Dioxide AA cells that have been tested by a nationally recognized laboratory to meet the requirements of UL 60079-11, Sixth Edition.

Use of any other battery will invalidate the Type Certificate and create a hazardous condition. The only batteries that TEGAM, Inc. has secured such testing, which are approved for use in the 720A, are listed on the Type Certificate. They are:

- Energizer E91
- Duracell MN1500

To install or replace batteries:

Required Tools: Phillips Head Screwdriver

1. Identify the battery compartment located on the back of the instrument (see *Figure 1: Battery Installation*);
2. Remove the two (2) battery compartment retaining screws;
3. Remove the battery compartment cover;
4. If present, carefully remove old batteries being careful to not damage the battery contacts;
5. Observing proper polarity, install three (3) new, AA alkaline (IEC LR6, ANSI 15) batteries;
6. Re-install the battery cover and two (2) retaining screws;
7. At initial power on after battery replacement, allow approximately 30 seconds for instrument to stabilize.

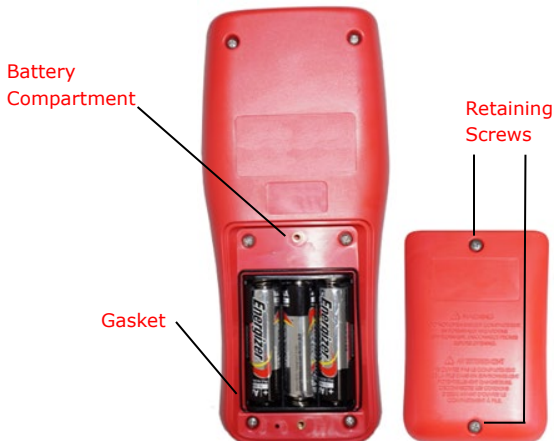





Figure 1: Battery Installation

3.3 Making Your First Resistance Measurement

TEGAM's 700 Series Handheld Bond Meters are designed for easy operation, while still providing a feature-rich experience via the intuitive user interface.

To get started making resistance measurements right away, follow these steps:

1. Perform *Section 3.2, Battery Installation and Replacement*;
2. Connect probes to unit. Be sure to check the orientation of the connector as it is installed. Once the connector is lined up with the plug, push the plug into the connector and twist the outer ring of the connector clockwise.
3. Press  to turn unit on;
4. The unit will light all segments of the display as it performs a power on self-test;
5. The instrument will display a resistance if connected to a device or "----" if not connected. If kelvin clips are connected and closed, "nodut" will be displayed;
6. Press   to change ranges or to put unit in Auto-Range mode.

Congratulations! You're now ready to make accurate and reliable resistance measurements, wherever and whenever you may need to.

We know you are eager to begin using your new bond meter, but this overview is just the beginning. Please take a moment to familiarize yourself with this Operation Manual to learn about all the features and benefits of your new TEGAM Handheld Bond Meter.

4. OPERATING INSTRUCTIONS

4.1 Keypad Functions

The instrument keypad is a six (6) key, sealed membrane keypad. Each key provides audible and tactile user feedback when pressed. Key functions are described in *Figure 2* below.

		Power instrument ON or OFF
		Disable auto-power OFF while instrument is on.
		Enter Test Limit Menu (See <i>Section 4.3</i>)
		While in Test Limit Menu, save current value and advance to next parameter
		Toggle display backlight
		Disable backlight 30-second timeout
		Hold currently displayed measurement and OK/FAIL result
		Enter/Exit Auto Hold mode (See <i>Section 4.7</i>)
	Increment/Decrement through ranges, including AUTO	
	While in Test Limit Menu, advance or reverse selected parameter	

Figure 2: Keypad Button Functional Description

The , , , and keys have multiple functions which can be accessed by momentarily pressing the key, or alternatively, by pressing and holding the key for approximately 1.5 seconds. Throughout this Operation Manual, the press and hold sequence is indicated by the key designator followed by the subscript (1.5s). For instance, indicates that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

4.2 LCD Display

The display is a large, easy to read, LCD display, with an LED backlight for clear viewing in low-light conditions. It can simultaneously display the resistance reading, range, PASS/FAIL status, open lead detection, over/under indication and the battery level.

See Figure 3 below for further description of each display indicator.





<p>The diagram shows an LCD display with various indicators. At the top, there are six status indicators labeled 1 through 6: OVER, UNDER, HOLD, OPEN, 12, and a battery icon. The main display shows '1888.88'. Below the main display, there is an 'AUTO RANGE' indicator (8) and a '100 μmΩ' measurement (9). At the bottom, there are four more indicators labeled 10 through 13: OK, FAIL, a square wave icon, and a Bluetooth icon.</p>	1	Measurement is overrange
	2	Measurement is 10% or less of range
	3	Solid: Hold function is active Flashing: Auto Hold function is active
	4	One or both probes are not electrically connected (See Section 4.8, Open Lead Detection)
	5	If a probe is not electrically connected, the open channel is indicated (See Section 4.8, Open Lead Detection)
	6	Remaining battery life
	7	Resistance measurement
	8	AUTO range is active
9	Currently selected range	
10	The measurement is less than the test limit	
11	The measurement is greater than the test limit	
12	Reserved for future use	
13	Reserved for future use	


Figure 3: LCD Display Description


4.3 Test Limit Menu



Key designators followed by (1.5s), e.g. , indicate that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

Test limits are available for the user to easily identify if a measurement is above or below a resistance value with an OK/FAIL indication. Press  to access the Test Limit Menu. From within the Test Limit Menu, press  to step through the digits, decimal point, and resistance range. Press the   keys to advance or reverse the selected value for the active parameter. The active parameter value will flash on the display.


To enter the Test Limit Menu, press . The active parameter value will flash on the display.

Press  to save a setting and step to the next parameter. If no key is pressed for 10 seconds, the current configuration is saved and the instrument will exit the Test Limit Menu.

4.4 Auto-Power Off






Key designators followed by (1.5s), e.g. , indicate that the key should be pressed and held for 1.5 seconds, then released to access the desired function.

To conserve battery life, the instrument automatically turns off if no key is pressed for 20 minutes. To disable this feature, press  (1.5s). The remaining battery life indicator will flash once, indicating auto-power off is disabled.



Auto-power off will remain disabled until instrument power is cycled. At next power on, auto-power off returns to the default enabled condition.

4.5 Backlight and Backlight Timeout


The instrument includes an LED backlight feature to ensure measurement data can be easily read in low-light conditions. To activate the backlight, press .

Once the backlight is activated, it will automatically turn off to preserve battery life if no key is pressed within 30 seconds. To disable the backlight timeout feature, press  (1.5s). The backlight will flash to indicate the timeout feature has been disabled. To re-enable the backlight timeout feature, turn the backlight off then on by pressing  twice.


4.6 Hold Function

Press  to hold the current reading. **HOLD** is displayed at the top-center of the LCD display. New measurements are not displayed while the hold function is active. If test limits are active, the OK or FAIL annunciators will also be held. To disable the hold function and resume normal operation, press  again.


4.7 Auto-Hold Function



The Auto Hold function allows the user to take a measurement, have the unit determine a stable reading, and hold that value. Once the user is ready to make the next measurement,  is pressed momentarily to clear the last reading from the display and re-initiate Auto-Hold mode.

To use the Auto-Hold Function:

1. Press  to initiate Auto-Hold mode.



The unit will not initiate Auto-Hold mode if it is already in Hold mode. If the **HOLD** indicator is solid, simply press  to exit Hold mode and try initiating Auto-Hold mode again.

2. The **HOLD** indicator will begin to flash.
3. If the unit is not connected to a Device Under Test (DUT):
 - a. "----" will appear on the display.
 - b. Connect leads to DUT.
4. When the unit detects a connection, the display of the unit will go blank, then begin to cycle. The cycling animation on the display indicates that the unit is taking measurements of the DUT.
5. Once a stable value has been determined and the measurement is completed, the unit will display the reading of the DUT along with PASS/FAIL status (if enabled).
6. The determined reading and status are temporarily saved and will stay displayed unless  is pressed or the unit is power-cycled.
7. Press  to re-activate Auto-Hold mode.
8. The **HOLD** indicator will begin to flash.
9. If the unit has been disconnected from the DUT, "----" will appear on the display.
10. The unit is ready to take another measurement.



To exit Auto-Hold mode, press . The **HOLD** annunciator will turn off. The unit is now in normal operating mode.



For best results, put unit in Auto-Range when using Auto-Hold.

4.8 Open Lead Detection

The 700 Series Handheld Bond Meters feature open lead detection for all ranges. This feature monitors the test current across the leads on each channel. A small current is sourced between the Kelvin connection of each channel’s test leads. This detection is independent of whether a DUT is or is not connected.

If the unit detects an open circuit in either channel it will illuminate the OPEN annunciator along with the channel(s) the unit has detected an open circuit in.



When using the unit with MKP, BKP, and MCP probes, the OPEN and channel annunciators will be illuminated when not connected to a DUT.

4.9 Battery Indicator

The battery voltage indicator provides a visual representation of approximate remaining battery life. It is located at the top-right of the display.

The battery voltage indicator uses three bars to represent remaining battery life. *Figure 4* shows the approximate battery life for each bar.

At zero (0) bars, the instrument will momentarily display **Lo bATT** and initiate a shutdown sequence. To prevent disruption of the measurement process, the batteries should be replaced before the battery voltage indicator reaches zero (0) bars. See *Section 3.2, Battery Installation and Replacement*.

BARS	APPROX. BATTERY LIFE
3	100% - 50%
2	50% - 20%
1	20% - 5%
0	0% - Shutdown Initiated

Figure 4: Battery Voltage Indicator

4.10 Invalid Measurement Indications

The LCD display indicates when a measurement is invalid, as shown in *Figure 5* below.

INDICATION	DESCRIPTION
-----	The device is auto ranging.
OVER and -----	Reading is 110% of full scale or higher. If possible, switch to a higher range.
UNDER	Reading is 10% of full scale or less. If possible, switch to a lower range.
OPEN, 1, 2	If the leads become electrically disconnected, the OPEN segment will illuminate along with segment 1, 2, or both to indicate the disconnected channel.
"nodut"	The device does not detect a DUT. (no device under test) This message will appear when Kelvin Clips are connected and closed. This message does not appear in Auto-Hold Mode.

Figure 5: Invalid Measurement Indications

5. SERVICE INFORMATION





5.1 Inspection and Cleaning




To extend the life of the instrument, inspect and clean the instrument regularly. Inspect the instrument for any significant abrasions, cuts, cracks, dents, or other signs of damage on the case, keypad, and display lens. Inspect the connectors for breaks, dirt, or corrosion. Ensure all screws are securely fastened, and if equipped, that the tilt stand/magnet/hanger is in good condition and locks into position properly.

With all screws securely fastened and the battery compartment cover in place, use a damp cloth or towel to wipe down the instrument. Use care to avoid scratching the display lens. Mild, non-abrasive detergents may be used providing the instrument is then wiped down with a clean damp cloth or towel.

5.2 Calibration

5.2.1 Verification Procedure

1. This procedure shall be performed within environmental conditions of 23 ± 3 °C and 5% to 95% RH.
2. The unit under test ("UUT") shall be acclimated to the controlled environment for a minimum of four (4) hours.
3. Power on the 720A for a minimum of ten (10) minutes. To disable Auto-Power Off, press  (1.5s).
4. The equipment listed in *Appendix A* is required to fully verify the UUT.
5. Refer to *Appendix B* for standard measurement points and tolerances for each 720A resistance range.
6. Record standard resistance values on the Instrument Verification Data Sheet in *Appendix B*.
7. Calculate high and low limits using tolerances noted in *Appendix B*.
8. If not already, connect the M12 connectors of the bond meter probes.
9. Press  until UUT is in 100 Ω range. If UUT is in AUTORANGE, press  once.
10. Connect the UUT leads to the 100 Ω resistance standard.
11. Note value in "Reading" column of *Appendix B*.
12. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
13. Staying in the 100 Ω range, connect UUT leads to 10 Ω standard and record value.
14. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
15. Press the  to put UUT into 10 Ω range and record value.

16. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
17. Staying in the 10 Ω range, connect UUT leads to 1 Ω standard and record value.
18. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
19. Press  to put UUT into 1 Ω range and record value.
20. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
21. Staying in the 1 Ω range, connect UUT leads to 100 m Ω standard and record value.
22. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
23. Press  to put UUT into 100 m Ω range and record value.
24. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
25. Staying in the 100 m Ω range, connect UUT leads to 10 m Ω standard and record value.
26. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
27. Press  to put UUT into 10 m Ω range and record value.
28. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
29. Staying in the 10 m Ω range, connect UUT leads to 1 m Ω standard and record value.
30. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
31. Connect UUT leads to 100 $\mu\Omega$ standard and record value.
32. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.
33. Short the leads of the unit in the following order: +I to -I, -I to +E, and +E to -E. The unit should display 0.000 (± 0.002)
34. Indicate if the value exceeds the high limit or low limit calculated in Step 6 using "Pass/Fail" column of *Appendix B*.


5.2.2 Alignment Procedure

Preparation

CAUTION

Servicing and calibration must be done by qualified service personnel.

1. This procedure shall be performed within environmental conditions of $23 \pm 3 \text{ }^\circ\text{C}$ and 5% to 95% RH.
2. The unit under test ("UUT") shall be acclimated to the controlled environment for a minimum of four (4) hours.
3. Remove the UUT battery door housing to expose the alignment access hole.

4. Press  to turn the UUT on.
5. Leave the 720A powered on for a minimum of ten (10) minutes. To disable Auto-Power Off, press






6. Press  until unit is in 10 mΩ range.
7. Short the leads of the unit in the following order: +I to -I, -I to +E, and +E to -E. (See *Figure 6*) The unit should display 0.000 (± 0.002).



Figure 6: Kelvin Clip Short Orientation



If the unit displays $\approx 0.300 \text{ m}\Omega$ (± 0.050), check that the connection of the shorted leads are in the correct order

8. With the leads still shorted together, insert a rigid wire through the alignment access hole and gently press the calibration enable switch located on the circuit board. See *Figure 7* for location.
9. The UUT display will indicate as follows:
 - a. "1"
 - b. Line 1: ----
 - c. Line 2: 10 mΩ
10. Press  for 2 sec to display stored value of short.
11. Press  to select 0.000.

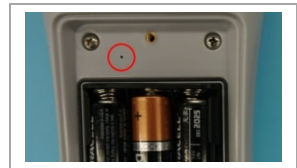

































Figure 7: Alignment Access Hole Location




When using   to adjust the value displayed, the value will change slowly with each keypress, but will accelerate if the key is held down.

12. Press 
 - a. "-----" will flash periodically
13. The UUT display will then indicate as follows:
 - a. "2"
 - b. Line 1: -----
 - c. Line 2: 10 mΩ
14. Connect the probes to the 10 mΩ resistance standard.
15. A value will be displayed, press   to select the correct value of the 10 mΩ standard.
16. Press 
 - a. "-----" will flash periodically.
17. The UUT display will indicate as follows:
 - a. "1"
 - b. Line 1: -----
 - c. Line 2: 100 mΩ
18. Short the leads of the unit as described in *Step 6*.
19. Press   to select 0.00.
20. Press 
 - a. "-----" will flash periodically
21. The UUT display will then indicate as follows:
 - a. "2"
 - b. Line 1: -----
 - c. Line 2: 100 mΩ
22. Connect the probes to the 100 mΩ resistance standard
23. A value will be displayed, press   to select the correct value of the 100 mΩ standard.
24. Press 
 - a. "-----" will flash periodically

25. The UUT display will indicate as follows:
 - a. "1"
 - b. Line 1: -----
 - c. Line 2: 1 Ω
26. Short the leads of the unit as described in *Step 6*.
27. Press the   to select 0.000
28. Press 
 - a. "-----" will flash periodically.
29. The UUT display will then indicate as follows:
 - a. "2"
 - b. Line 1: -----
 - c. Line 2: 1 Ω
30. Connect the probes to the 1 Ω resistance standard.
31. A value will be displayed, press the   to select the correct value of the 1 Ω standard.
32. Press 
 - a. "-----" will flash periodically
33. The UUT display will indicate as follows:
 - a. "1"
 - b. Line 1: -----
 - c. Line 2: 10 Ω
34. Short the leads of the unit as described in *Step 6*.
35. Press   to select 0.000.
36. Press 
 - a. "-----" will flash periodically
37. The UUT display will then indicate as follows:
 - a. "2"
 - b. Line 1: -----
 - c. Line 2: 10 Ω
38. Connect the probes to the 10 Ω resistance standard

39. A value will be displayed, press   to select the correct value of the 10 Ω standard.
40. Press 
 - a. "-----" will flash periodically
41. Short the leads of the unit as described in *Step 6*.
42. Press the   to select 0.00.
43. Press 
 - a. "-----" will flash periodically
44. The UUT display will then indicate as follows:
 - a. "2"
 - b. Line 1: -----
 - c. Line 2: 100 Ω
45. Connect the probes to the 100 Ω resistance standard
46. A value will be displayed, press   to select the correct value of the 100 Ω standard.
47. Press 
 - a. "-----" will flash periodically
48. "ERROR" will begin flashing. Hold  for 3 seconds to store the alignment.



If the unit is powered off during the alignment process or  is not held for 3 seconds at the end of the alignment process, the calibration factors will not be saved.

5.3 Troubleshooting

TEGAM's handheld bond meters are designed and built to provide years of uninterrupted use. In the event the instrument malfunctions or does not perform as expected, helpful troubleshooting tips are provided below. *Figure 8* below lists some of the more common issues and their resolutions.



SYMPTOM	DESCRIPTION	RESOLUTION
Unexpected or Erroneous Measurement	Display is all zeroes	Check range of unit, if UNDER annunciator is active, press  to select a lower range. If already in lowest range, measurement is under 1 $\mu\Omega$.
	Auto-Hold never completes	Check range of unit.
Unresponsive	Hold Mode is active	Press  , and verify that the HOLD indicator is not active (see <i>Section 4.6, Hold Function</i>)
Shuts down unexpectedly or will not power on	Batteries are low or depleted	Replace batteries (see <i>Section 3.2, Battery Installation and Replacement</i>)

Figure 8: Common Troubleshooting Issues

5.4 Diagnostic Routines and Error Codes

The instrument momentarily activates all display annunciators and segments during startup to allow for visual inspection of the LCD. Observe the LCD and verify all segments activate.

Internal diagnostic routines are also executed during startup. If any diagnostic routine detects a malfunction, an error will be displayed as shown in *Figure 9* below.

ERROR CODE	DESCRIPTION
Err ADC	Analog to digital converter error
Err FLSH	Flash memory error
Err InP	Stuck key or other keypad error
noCAL	Instrument has no calibration data

Figure 9: Diagnostic Routine Error Codes

If the unit displays one of these codes, power cycle the unit. If the code continues to be displayed, see *Section 5.5, Preparation for Calibration or Repair Service*.

5.5 Preparation for Calibration or Repair Service

Once you have verified that the cause of the malfunction cannot be solved in the field and the need for repair and calibration service arises, contact TEGAM customer service to obtain an RMA (Returned Material Authorization) number. You can contact TEGAM customer service via the TEGAM website, www.tegam.com or by calling 440-466-6100 (*All Locations*) or 800-666-1010 (*United States Only*).

The RMA number is unique to your instrument and will help us identify your instrument and to address the particular service request by you which is assigned to that RMA number.

Of even greater importance, a detailed written description of the problem should be attached to the instrument. Many times repair turnaround is unnecessarily delayed due to a lack of repair instructions or a detailed description of the problem.

This description should include information such as measurement range and other instrument settings at the time of the malfunction, type of components being tested, frequency of the symptoms (intermittent or continuous), conditions that may cause the symptoms, changes to the test setup or operating environment that may affect the instrument, etc. Any detailed information provided to our technicians will assist them in identifying and correcting the problem in the quickest possible manner. Use a copy of the Repair and Calibration Service form provided on the next page.

Once this information is prepared and sent with the instrument to our service department, we will do our part to make sure that you receive the best possible customer service and turnaround time possible.

5.6 Expedite Repair & Calibration Form

Use this form to provide additional repair information and service instructions. The completion of this form and including it with your instrument will expedite the processing and repair process.

RMA#:		Instrument Model #:	
Serial Number:		Company:	
Technical Contact:		Phone Number:	
Additional Contact Info:			

Service Instructions:

- Evaluation Calibration Only Repair Only
 Repair & Calibration ISO 17025 Calibration with Data

Detailed Symptoms:

Include information such as measurement range, instrument settings, type of components being tested, is the problem intermittent? When is the problem most frequent?, has anything changed with the application since the last time the instrument was used?, etc.

5.7 Warranty

TEGAM, Inc. warrants this product to be free from defects in material and workmanship for a period of three (3) years from the date of shipment. During this warranty period, if a product proves to be defective, TEGAM Inc., at its option, will either repair the defective product without charge for parts and labor, or exchange any product that proves to be defective.

In order to exercise this warranty, TEGAM, Inc., must be notified of the defective product before the expiration of the warranty period. The customer shall be responsible for packaging and shipping the product to the designated TEGAM service center with shipping charges prepaid. TEGAM Inc. shall pay for the return of the product to the customer if the shipment is to a location within the country in which the TEGAM service center is located. The customer shall be responsible for paying all shipping, duties, taxes, and additional costs if the product is transported to any other locations. Repaired products are warranted for the remaining balance of the original warranty, or 90 days, whichever is greater.

5.8 Warranty Limitations

The TEGAM, Inc. warranty does not apply to defects resulting from unauthorized modification or misuse of the product or any part. This warranty does not apply to fuses, batteries, or damage to the instrument caused by battery leakage.

The foregoing warranty of TEGAM is in lieu of all other warranties, expressed or implied. TEGAM specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. In no event will TEGAM be liable for special or consequential damages. Purchaser's sole and exclusive remedy in the event any item fails to comply with the foregoing express warranty of TEGAM shall be to return the item to TEGAM; shipping charges prepaid and at the option of TEGAM obtain a replacement item or a refund of the purchase price.

5.9 Statement of Calibration

This instrument has been inspected and tested in accordance with specifications published by TEGAM, Inc.

TEGAM, Inc. certifies the above listed instrument has been inspected and calibrated and meets or exceeds all published specifications and has been calibrated using standards whose accuracies are traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other recognized National Metrology Institutes.

A. REQUIRED ALIGNMENT AND VERIFICATION EQUIPMENT

EQUIPMENT	NOMINAL VALUE	TOLERANCE
Resistance Standards	100 Ω	$\pm 10\%$ Nominal ⁵
	10 Ω	
	1 Ω	
	100 m Ω	
	10 m Ω	
	1 m Ω	
	100 $\mu\Omega$	
Rigid Wire	Required to access the calibration enable switch. Any rigid wire, approximately 0.8 mm in diameter, may be used.	

⁵ The resistance standards' total contribution to the calculated calibration uncertainty is the responsibility of the calibrating laboratory.

B. INSTRUMENT VERIFICATION DATA SHEET

RANGE	NOMINAL VALUE	STANDARD VALUE	READING	TOLERANCE	LOW LIMIT	HIGH LIMIT	PASS/FAIL
100 Ω	100 Ω			$\pm 0.220 \Omega$			
	10 Ω			$\pm 0.040 \Omega$			
10 Ω	10 Ω			$\pm 0.0220 \Omega$			
	1 Ω			$\pm 0.0040 \Omega$			
1 Ω	1 Ω			$\pm 0.00220 \Omega$			
	100 m Ω			$\pm 0.00040 \Omega$			
100 m Ω	100 m Ω			$\pm 0.220 \text{ m}\Omega$			
	10 m Ω			$\pm 0.040 \text{ m}\Omega$			
10 m Ω	10 m Ω			$\pm 0.0220 \text{ m}\Omega$			
	1 m Ω			$\pm 0.0040 \text{ m}\Omega$			
	100 $\mu\Omega$			$\pm 0.0020 \text{ m}\Omega$			
	0 Ω			$\pm 0.0020 \text{ m}\Omega$			

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