BharatXtronics Pvt. Ltd.

OHM MATRIX

22-Channel Resistance Measurement System

Customer Manual | Rev 1.0 | 2026

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CHAPTER 1

Product Overview & Specifications

The **BharatX OHM MATRIX** is a professional-grade 22-channel high-accuracy resistance measurement system engineered for industrial production testing, quality control, and R&D applications. Built around Kelvin 4-Wire measurement technology, the OHM MATRIX eliminates lead and contact resistance errors, delivering highly repeatable and traceable low-resistance readings across all 22 channels simultaneously.

Wireless monitoring and configuration are supported via Bluetooth Low Energy (BLE), enabling real-time data acquisition from a mobile device without tethered connections to the measurement unit.

Figure 1.1 – BharatX OHM MATRIX unit (angled view)

1.1 Key Features

- 22 independent fully isolated measurement channels
- Kelvin 4-Wire technology – eliminates cable resistance error
- Bluetooth BLE wireless communication (range: ~10 m typical)
- External push-button inputs for Cycle Start and Data Save
- Real-time 22-channel simultaneous data output over BLE
- Internal temperature monitoring
- Configurable measurement timing, filtering and stability parameters
- DB-50 connector interface for reliable multi-channel cable management
- 19-inch rack-mount enclosure – 2U form factor

1.2 Technical Specifications

Parameter	Specification
Product Name	BharatX OHM MATRIX
Manufacturer	BharatXtronics Pvt. Ltd.
Measurement Channels	22 Independent Channels

Measurement Technology	Kelvin 4-Wire Resistance
Input Voltage	AC 220–230 V, 50 Hz
Maximum Current Draw	4.5 A Max
Current Source	1 A per channel (force leads)
Wireless Communication	Bluetooth BLE
BLE Device Name	BharatX_OHM_xxx
Connector Type	DB-50 (J1 – CC Module, J2 – VS Module)
Enclosure	19" Rack-mount, 2U Steel
Operating Temperature	0 °C to 50 °C
Power LED	RED – Rear panel power indicator
BLE Status LED	BLUE – Front panel (ON = connected)

1.3 Package Contents

- 1 × BharatX OHM MATRIX Main Unit
- 2 × DB-50 male-female extension cables (J1 and J2)
- 1 × 22-Channel Connection Box
- 1 × AC Power Cable
- 1 × Bluetooth Antenna
- 1 × Customer Manual (this document)

1.4 Manufacturer Information

Field	Details
Company	BharatXtronics Pvt. Ltd.
Address	J-181, MIDC Bhosari, Pimpri-Chinchwad, Maharashtra 411026, India
Website	www.bharatxtronics.com
Support Email	bharatxtronics@gmail.com

CHAPTER 2

Safety Precautions

Read and understand all safety instructions before operating the BharatX OHM MATRIX. Failure to follow these precautions may result in equipment damage, injury, or death.

■ ELECTRICAL SAFETY
• Operate exclusively on AC 220–230 V, 50 Hz supply.
• Ensure proper earth (ground) connection before powering on.
• Do not connect or disconnect measurement cables while the system is powered and running.
• Never exceed the specified electrical ratings.
• Do not use damaged cables, connectors, or probes.

■ GENERAL OPERATING PRECAUTIONS
• Verify Kelvin probe connections before every measurement.
• Keep the unit away from water, moisture, and excessive dust.
• Disconnect power before performing any internal servicing or maintenance.
• Only trained and authorised personnel should perform internal repairs.
• Keep all ventilation openings unobstructed during operation.
• Store and operate in a dry, temperature-controlled environment.

CHAPTER 3

Hardware Description & Front Panel Layout

The OHM MATRIX is housed in a rugged 19-inch rack-mount enclosure (2U). The front/rear panel provides all user-accessible controls, indicators, and connectors.

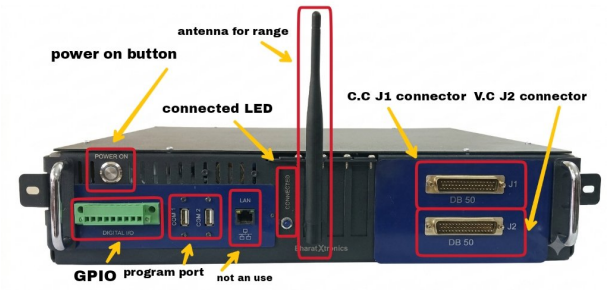


Figure 3.1 – Annotated front panel layout

3.1 Panel Elements Description

Label	Component	Description
POWER ON	Power Switch	Momentary push-button to power on the system after AC supply is connected.
Antenna	BLE Antenna	External Bluetooth antenna for maximum wireless range (~10 m line-of-sight).
CONNECTED	Blue LED	Illuminates when a BLE device is actively connected. OFF = no connection.
DIGITAL I/O	GPIO Terminal	Green screw-terminal block for external push-button inputs (COMM, X1, X2).
COM 1	Program Port	USB port used for firmware programming and diagnostics.
COM 2	USB Port	Additional USB communication port.
LAN	Ethernet Port	Not used in standard operation.
J1 DB-50	CC Module Connector	DB-50 connector carrying the Current Source (Force) lines for all 22 channels.
J2 DB-50	VS Module Connector	DB-50 connector carrying the Voltage Sense lines for all 22 channels.
RED LED (rear)	Power Indicator	Illuminates when AC power is present and the unit is energised.

3.2 System Module Overview

The OHM MATRIX integrates two core measurement modules connected via DB-50 cables to the 22-channel connection box:

Module	Connector	Function
CC Module (Current Controller)	J1 – DB-50	Generates and routes the 1 A constant current source through Force+ and Force– leads to each DUT channel.
VS Module (Voltage Sense)	J2 – DB-50	Captures the precision voltage differential at Sense+ and Sense– terminals directly across each DUT for R = V/I calculation.

Figure 3.2 – OHM MATRIX with DB-50 cables connected

CHAPTER 4

Installation & Power-Up Sequence

Follow the steps below in order to correctly install and power up the OHM MATRIX for the first time. Do not skip any step.

Step	Action	Verify
1	Mount the unit in a 19" rack or place on a stable bench. Ensure ventilation clearance ≥ 50 mm on all sides.	Unit is stable and ventilated.
2	Connect the earth (ground) terminal on the rear panel to a reliable protective earth.	Earth lead secured.
3	Connect the AC 220–230 V power cable to the IEC inlet on the rear panel.	Rear RED Power LED illuminates.
4	Attach the Bluetooth antenna to the SMA connector on the front panel.	Antenna is finger-tight.
5	Connect the J1 DB-50 cable (CC Module) and J2 DB-50 cable (VS Module) to the connection box.	Both connector thumbscrews are secure.
6	Press the POWER ON button on the front panel.	System initialises. Wait ~5 s.
7	Verify Bluetooth status: Blue LED ON = BLE active and advertising.	Blue LED is ON.
8	Connect DUT cables to the connection box according to channel mapping.	All Kelvin probes are secure.

■ **Never connect or disconnect DUT cables while a measurement cycle is active.**

■ *If the rear RED LED does not illuminate, check the AC supply and fuse.*

CHAPTER 5

Bluetooth Configuration & Pairing

The OHM MATRIX communicates wirelessly via Bluetooth Low Energy (BLE). A free Android application called **Serial Bluetooth Terminal** is used to connect and send commands.

5.1 Required Application

- App Name: Serial Bluetooth Terminal
- Platform: Android (available on Google Play Store)
- Developer: Kai Morich
- Cost: Free

5.2 Pairing Steps

Step	Action
1	Install **Serial Bluetooth Terminal** from the Google Play Store.
2	Power on the OHM MATRIX. Ensure the Blue CONNECTED LED is lit (BLE advertising).
3	Open the app and tap the Devices icon. Scan for BLE devices.
4	Select the device named **BharatX_OHM_xxx** from the list.
5	In app Settings → Terminal, set: **Mode = Text**, **New Line = LF**.
6	Tap Connect. The Blue LED on the unit should turn ON steady.
7	The terminal is now ready to send commands and receive measurement data.

5.3 BLE Status LED Reference

LED State	Meaning	Action
BLUE – ON (steady)	BLE device connected. Communication active.	System ready for commands.
BLUE – OFF	No BLE connection. Device advertising.	Open app and connect.

■ *If Blue LED does not turn ON after connecting in the app, restart the app and retry.*

CHAPTER 6

Connector Pinout – J1 & J2 DB-50

The OHM MATRIX uses two DB-50 connectors on its front panel. **J1** carries the Current Controller (CC Module) signals — the force/drive leads. **J2** carries the Voltage Sense (VS Module) signals — the Kelvin sense leads. Both connectors are wired 1-to-1 to the corresponding inputs on the 22-channel connection box using the supplied 50-pin male-female harness cables.

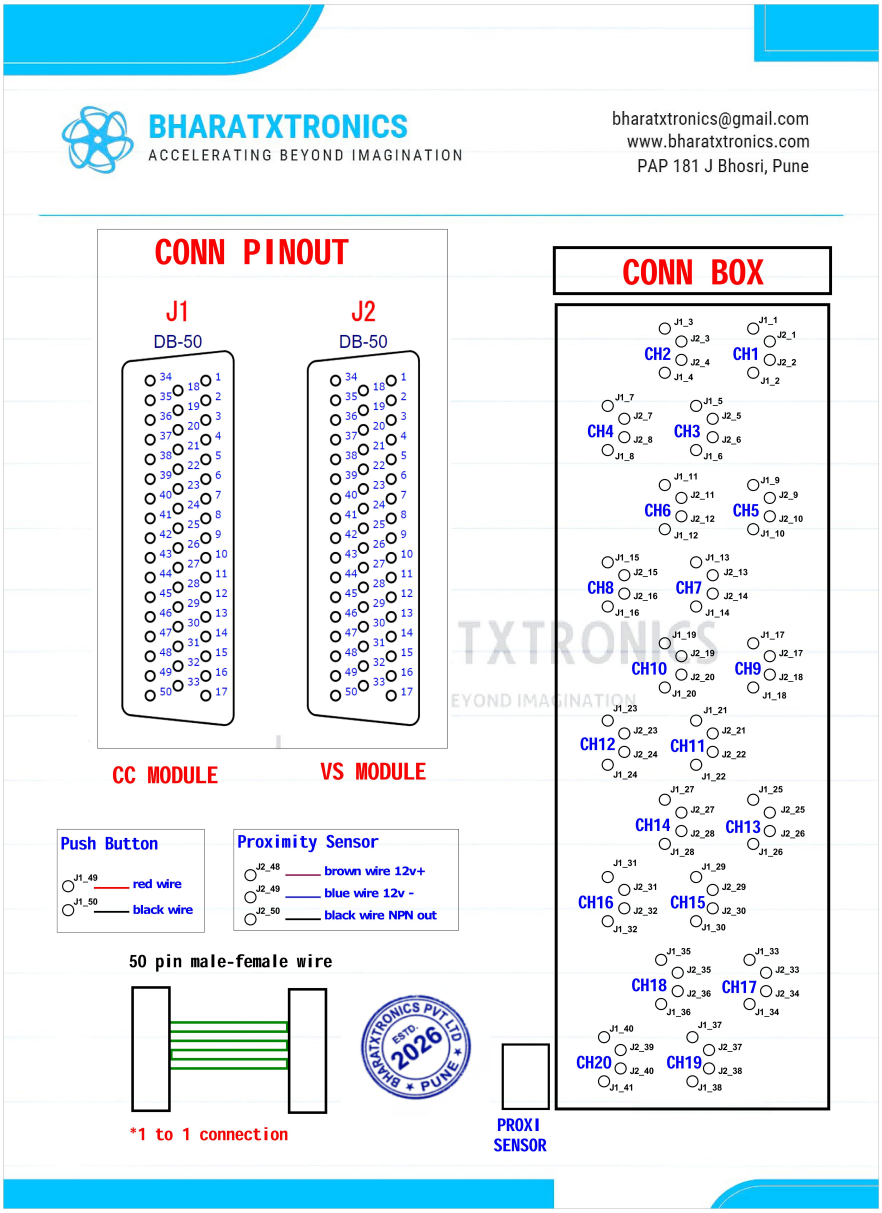


Figure 6.1 – DB-50 connector pinout and connection box channel mapping

6.1 Channel-to-Pin Mapping (J1 – CC Module)

Each measurement channel uses 2 pins on J1 (Force+ and Force–):

Channel	J2 – Sense Pins (VS Module / Kelvin Sense)	J1 – Force Pins (CC Module / Current Drive)
CH 1	J2_1 / J2_2	J1_1 / J1_2
CH 2	J2_3 / J2_4	J1_3 / J1_4
CH 3	J2_5 / J2_6	J1_5 / J1_6
CH 4	J2_7 / J2_8	J1_7 / J1_8
CH 5	J2_9 / J2_10	J1_9 / J1_10
CH 6	J2_11 / J2_12	J1_11 / J1_12
CH 7	J2_13 / J2_14	J1_13 / J1_14
CH 8	J2_15 / J2_16	J1_15 / J1_16
CH 9	J2_17 / J2_18	J1_17 / J1_18
CH 10	J2_19 / J2_20	J1_19 / J1_20
CH 11	J2_21 / J2_22	J1_21 / J1_22
CH 12	J2_23 / J2_24	J1_23 / J1_24
CH 13	J2_25 / J2_26	J1_25 / J1_26
CH 14	J2_27 / J2_28	J1_27 / J1_28
CH 15	J2_29 / J2_30	J1_29 / J1_30
CH 16	J2_31 / J2_32	J1_31 / J1_32
CH 17	J2_33 / J2_34	J1_33 / J1_34
CH 18	J2_35 / J2_36	J1_35 / J1_36
CH 19	J2_37 / J2_38	J1_37 / J1_38
CH 20	J2_39 / J2_40	J1_39 / J1_40
CH 21	J2_41 / J2_42	J1_41 / J1_42
CH 22	J2_43 / J2_44	J1_43 / J1_44

■ *Refer to Figure 6.1 for the complete CONN BOX layout showing physical wire labels.*

6.2 Special Pins

Pin	Connector	Function
J1_49	J1	Push Button – Red wire (COMM)
J1_50	J1	Push Button – Black wire (GND)
J2_48	J2	Proximity Sensor – Brown wire (12 V+)

J2_49	J2	Proximity Sensor – Blue wire (12 V–)
J2_50	J2	Proximity Sensor – Black wire (NPN output)

CHAPTER 7

DUT Wiring & Kelvin 4-Wire Connection

Each measurement channel uses four conductors in a Kelvin configuration: two Force leads that carry the 1 A measurement current, and two Sense leads that measure the voltage drop directly across the Device Under Test (DUT). This arrangement completely eliminates the resistance of the wiring from the measurement result.

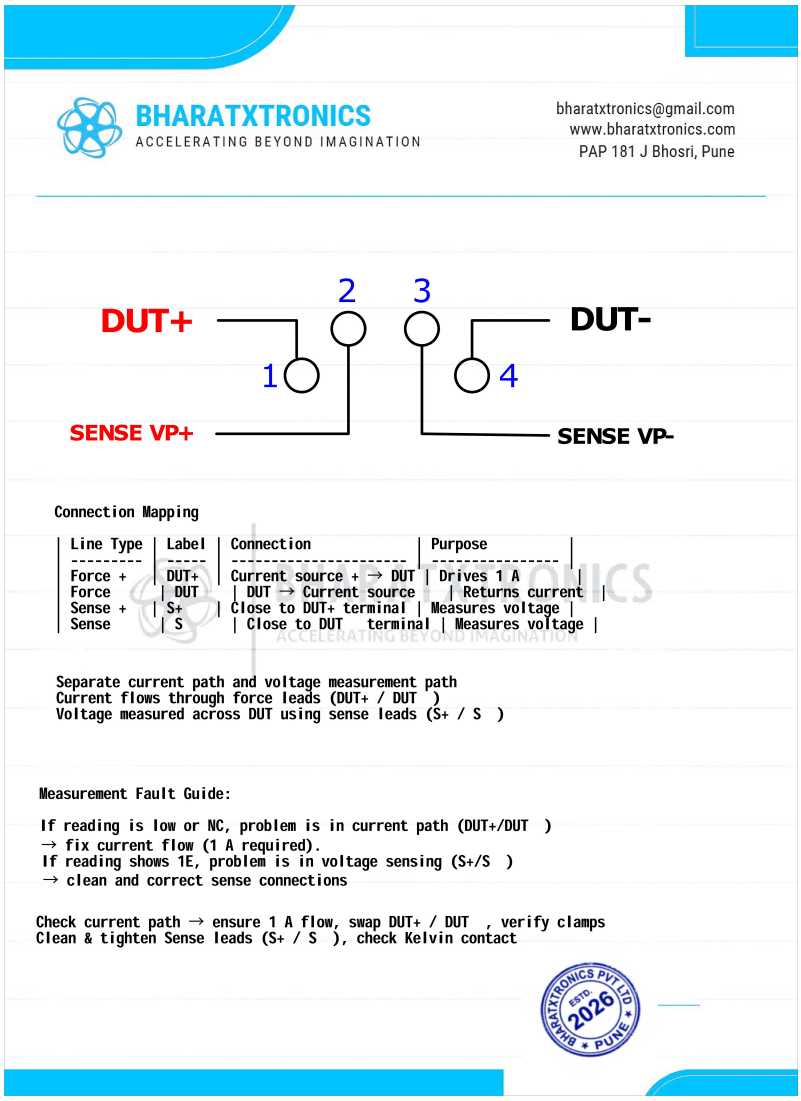


Figure 7.1 – Kelvin 4-Wire DUT wiring diagram with connection mapping

7.1 4-Wire Terminal Assignments

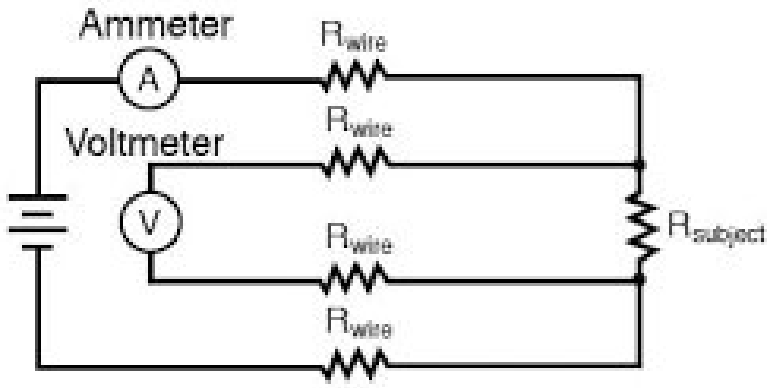
Terminal	Label	Connection Point	Purpose
Force +	DUT+	Current source (+) → DUT terminal A	Drives 1 A into the DUT
Force –	DUT–	DUT terminal B → Current return	Returns measurement current
Sense +	S+ (VP+)	Placed close to DUT terminal A	Measures voltage (+)
Sense –	S– (VP–)	Placed close to DUT terminal B	Measures voltage (–)

7.2 Connection Box Terminal Layout

The 22-channel connection box presents 4 terminals per channel (numbered 1–4 per channel): terminals 1 (DUT+) and 4 (DUT–) carry the Force current, while terminals 2 (Sense VP+) and 3 (Sense VP–) carry the voltage measurement.

7.3 Why Kelvin 4-Wire?

In a standard 2-wire measurement, the resistance of the test cables is included in the reading, introducing significant error especially for low-value resistances (below 1 Ω). The Kelvin 4-Wire method bypasses this error:



$$R_{subject} = \frac{\text{Voltmeter indication}}{\text{Ammeter indication}}$$

Figure 7.2 – Classic Kelvin 4-Wire measurement principle

Since the voltage-sense leads carry negligible current (high-impedance input), the voltage reading V across Sense+ / Sense– equals exactly the drop across the DUT. Combined with the precisely known 1 A force current: **R = V / I = V / 1 = V** (resistance in ohms equals measured voltage in volts).

CHAPTER 8

External I/O Terminal

The green screw-terminal block labelled **DIGITAL I/O** on the front panel provides external push-button inputs for hands-free operation of the measurement system.

Terminal	Label	Function
COMM	Common	Shared common reference for external push-button circuits. Connect one side of each button to COMM.
X1	Cycle Start	Connects to the Cycle Start push button. Pressing closes X1–COMM and initiates a complete 22-channel measurement cycle.
X2	Data Save	Connects to the Data Save push button. Pressing closes X2–COMM and saves the most recent measurement results.

8.1 Push Button Wiring

- Use normally-open (NO) momentary push buttons (rated ≥ 12 V / 100 mA).
- Wire one terminal of each button to COMM.
- Wire the other terminal of the Cycle Start button to X1.
- Wire the other terminal of the Data Save button to X2.
- Cables should not exceed 5 m in length to avoid interference.

■ *The push buttons can also be replaced by PLC dry-contact relay outputs for automated testing.*

CHAPTER 9

Measurement Workflow

Follow the workflow below for a standard resistance measurement cycle. Each step may be triggered either by the physical push buttons or by the corresponding BLE command.

Step	Action	Expected Result
1	Connect AC Supply	Rear RED LED illuminates.
2	Press POWER ON	System initialises (~5 s).
3	Verify BLE ready	Blue LED is ON.
4	Connect via Serial BT Terminal app	Blue LED ON + steady.
5	Connect DUT to connection box	All Kelvin probes secure.
6	Press X1 (Cycle Start) or send "cycle start" BLE command	Terminal shows: USER START
7	ADC acquisition begins internally	System processing…
8	22-channel measurement completes	Terminal shows: CYCLE DONE
9	Results transmitted over BLE	ALL | ch1, ch2, … ch22
10	Press X2 (Data Save) if required	Data saved to internal log.
11	System ready for next cycle	Repeat from Step 5.

CHAPTER 10

BLE Command Reference

All commands are sent as plain text via the Serial Bluetooth Terminal. Commands are **case-sensitive**. Send with LF (Line Feed) line ending. To **read** a parameter, send the command keyword alone (no value). To **set** a parameter, append the numeric value immediately after the keyword.

10.1 Timing Commands

Command Syntax	Parameter	Example	Description
cyc	Cycle Duration (ms)	cyc1000	Sets the total cycle duration to 1000 ms.
out	Live Output Interval (ms)	out500	Sets live BLE output interval to 500 ms.
stbo	Start Button Debounce (ms)	stbo100	Sets Start button debounce to 100 ms.
rebo	Retest Button Debounce (ms)	rebo100	Sets Retest button debounce to 100 ms.

10.2 Measurement Stability Commands

Command Syntax	Parameter	Example	Description
fialp	Filter Alpha (0.0–1.0)	fialp0.75	IIR low-pass filter coefficient. Higher = smoother, slower.
minsavg	Min Averaging Samples	minsavg20	Minimum number of ADC samples used for averaging.
stabhol	Stability Threshold	stabhol50	ADC counts that define measurement stability window.
maxall	Max Allowed Jitter	maxall200	Maximum peak-to-peak jitter before measurement is flagged.

10.3 System Commands

Command	Action	Response
cycle start	Initiates a complete 22-channel measurement cycle (same as pressing X1).	USER START → ... → CYCLE DONE
fail	Triggers the hardware error buzzer (test/diagnostic).	Buzzer activates.
temp	Returns the current internal temperature reading.	e.g. 34.5 C

10.4 Reading Current Configuration

Send the command keyword alone (without a value) to query the current setting:

Command	Returns
cyc	Current cycle time (ms)
out	Current output interval (ms)
stbo	Current Start button debounce (ms)
rebo	Current Retest button debounce (ms)
fialp	Current filter alpha value
minsavg	Current minimum averaging samples
stabhol	Current stability threshold
maxall	Current maximum jitter setting

10.5 BLE Status Messages

Message	Meaning
USER START	Physical Cycle Start button was pressed.
RETEST	A retest has been triggered.
CYCLE DONE	22-channel measurement cycle has completed.
ALL | ...	22-channel measurement output data (comma-separated values).
ADC1 FAIL	ADC Block 1 hardware failure detected.
ADC2 FAIL	ADC Block 2 hardware failure detected.
ADC3 FAIL	ADC Block 3 hardware failure detected.
ADC4 FAIL	ADC Block 4 hardware failure detected.

CHAPTER 11

Data Output Format

After each successful measurement cycle, the OHM MATRIX transmits all 22 channel results over BLE in the following format:

Output Format:

```
ALL | CH1_VAL, CH2_VAL, CH3_VAL, CH4_VAL, CH5_VAL, CH6_VAL, CH7_VAL,
      CH8_VAL, CH9_VAL, CH10_VAL, CH11_VAL, CH12_VAL, CH13_VAL, CH14_VAL,
      CH15_VAL, CH16_VAL, CH17_VAL, CH18_VAL, CH19_VAL, CH20_VAL,
      CH21_VAL, CH22_VAL
```

Example Output:

```
ALL |
12.52, 13.10, 11.89, 14.02, 15.31, 10.98, 13.45, 11.24, 14.78, 12.61,
13.80, 11.92, 15.06, 12.33, 13.74, 11.55, 14.40, 13.28, 12.81, 14.91,
11.67, 13.52
```

Values are expressed in **milliohms (mΩ)** or **ohms (Ω)** depending on system calibration. Values are always listed in channel order from CH1 to CH22 inclusive.

11.1 Special Output Values

Output Value	Meaning
Numeric (e.g. 12.52)	Valid resistance measurement.
NC	No Connection — open circuit detected on this channel.
1E	Error in voltage sense path for this channel.
LOW	Reading below threshold — possible current path issue.

CHAPTER 12

Kelvin 4-Wire Measurement Principle

Understanding how Kelvin 4-Wire measurement works is essential for correct probe placement and interpreting measurement results.

12.1 The Problem with 2-Wire Measurement

In a standard 2-wire resistance measurement, the same conductors carry both the measurement current and the voltage sense signal. At low resistance values (typically below 1 Ω), the voltage drop across the cable resistance Rwire can be comparable to or greater than the voltage across the DUT itself, producing significant measurement error.

12.2 How Kelvin Eliminates Cable Error

In the 4-wire configuration, the current path (Force+/Force–) and the voltage measurement path (Sense+/Sense–) are physically separate conductors:

Path	Conductors	What Flows	Effect on Measurement
Current Path	Force+ → DUT → Force–	1 A measurement current	Voltage drop on these leads is irrelevant — voltage is measured elsewhere.
Voltage Path	Sense+ → DUT → Sense–	Negligible current (μA)	Drop across Sense leads ≈ 0 V. Voltage measured is purely across the DUT.

Result: **$R_{DUT} = V_{sense} / I_{force} = V_{sense} / 1\ A$** — the measured voltage equals the resistance in ohms. Cable resistance has zero effect.

CHAPTER 13

Fault Diagnosis & Troubleshooting

Use the following guide to diagnose and resolve common measurement faults and system errors. Always resolve connection issues before suspecting hardware failure.

13.1 Measurement Reading Faults

Reading	Fault Type	Root Cause	Corrective Action
Low (unexpectedly low Ω)	Current path problem	Partial contact or poor clamp on DUT+/DUT–. Insufficient 1 A current flow.	• Check DUT+ and DUT– connections. • Verify 1 A current is flowing. • Inspect clamp contact and cable continuity.
NC (No Connection)	Open circuit	Current path completely broken. No connection to DUT.	• Verify current source output. • Check all cable connections. • Confirm connector is fully seated. • Test clamp contact with continuity meter.
1E (Sense Error)	Voltage sensing problem	Sense+ or Sense– lead is disconnected or has poor Kelvin contact.	• Check Sense+ (S+) and Sense– (S–) wires. • Tighten Kelvin probe at DUT terminals. • Inspect sense wire for damage. • Clean DUT contact points.

13.2 ADC Hardware Faults

Error	Affected Channels	Cause	Action
ADC1 FAIL	CH 1–6 (approx.)	ADC Block 1 IC damage, PCB fault, power issue, or internal comm failure.	Restart system. Inspect PCB. Contact support.
ADC2 FAIL	CH 7–12 (approx.)	ADC Block 2 IC damage, PCB fault, power issue, or internal comm failure.	Restart system. Inspect PCB. Contact support.
ADC3 FAIL	CH 13–18 (approx.)	ADC Block 3 IC damage, PCB fault, power issue, or internal comm failure.	Restart system. Inspect PCB. Contact support.
ADC4 FAIL	CH 19–22 (approx.)	ADC Block 4 IC damage, PCB fault, power issue, or internal comm failure.	Restart system. Inspect PCB. Contact support.

13.3 System & Connectivity Faults

Symptom	Probable Cause	Solution
Rear RED LED not ON	No AC supply or blown fuse.	Check AC cable, wall outlet and rear-panel fuse.
Blue LED stays OFF	No BLE device connected.	Open Serial BT Terminal app and connect to BharatX_OHM_xxx.
BLE not discoverable	Antenna not attached, or unit not powered.	Attach antenna, power cycle system.
No data output after cycle	BLE disconnected during cycle.	Reconnect BLE and restart cycle.
All channels read 0 or NC	DB-50 cables not seated.	Reseat J1 and J2 DB-50 connectors on unit and connection box.
Cycle Start not responding	X1 terminal not wired or debounce too high.	Check X1/COMM wiring. Reduce stbo value.

CHAPTER 14

Maintenance & Care

Regular maintenance ensures long-term reliability and measurement accuracy of the OHM MATRIX. Follow the schedule below.

Frequency	Task
Before each use	Verify all DB-50 cable connectors are fully seated and thumbscrews are secure.
Before each use	Inspect Kelvin probe tips for corrosion, damage or contamination. Clean if necessary.
Before each use	Verify Bluetooth connectivity before starting a measurement run.
Weekly	Inspect push-button wiring at the DIGITAL I/O screw terminal for loose connections.
Weekly	Clean external enclosure surfaces with a dry lint-free cloth.
Monthly	Inspect the DB-50 cables for kinks, abrasion, or damaged insulation.
Monthly	Verify all channel readings against a known reference resistor.
Monthly	Check Bluetooth antenna connection (SMA connector should be finger-tight).
As needed	Clean connector pins with electrical contact cleaner if resistance readings drift.
As needed	Update firmware as advised by BharatXtronics support.

14.1 Storage Guidelines

- Store in a dry, clean environment (relative humidity < 80%, non-condensing).
- Temperature range for storage: –10 °C to 60 °C.
- Cover connectors with protective caps when not in use.
- Coil DB-50 cables loosely — do not bend sharply or tightly wind.
- Do not use solvents, abrasives or chemical cleaners on any surface.

CHAPTER 15

Technical Specifications

Specification	Value	Notes
Measurement Channels	22	All channels measured simultaneously per cycle
Measurement Method	Kelvin 4-Wire	Force + Sense lead separation
Current Source	1 A constant	Per channel, regulated
Resistance Range	< 1 mΩ to > 1 kΩ	Calibration-dependent
ADC Resolution	High-resolution ADC × 4 blocks	4 independent ADC ICs
Input Voltage	AC 220–230 V, 50 Hz	IEC inlet, rear panel
Max Current Draw	4.5 A	At full load
Wireless	Bluetooth BLE 4.0+	SMA external antenna
BLE Range	~10 m (line of sight)	With antenna attached
BLE Name	BharatX_OHM_xxx	xxx = unit serial suffix
Connector – CC	DB-50 (J1)	Force / current source lines
Connector – VS	DB-50 (J2)	Sense / voltage measurement lines
Digital I/O	3-terminal screw block	COMM, X1 (Cycle Start), X2 (Data Save)
Status LEDs	RED (rear), BLUE (front)	Power and BLE connected indicators
Enclosure	19" rack-mount, 2U	Steel with panel handles
Operating Temp.	0 °C to +50 °C	Non-condensing
Storage Temp.	–10 °C to +60 °C	
Humidity	≤ 80% RH	Non-condensing
Internal Temp. Monitor	Yes (BLE command: temp)	Reports °C via BLE

CHAPTER 16

Support & Warranty

16.1 Technical Support

BharatXtronics Pvt. Ltd. provides full technical support for all OHM MATRIX units. Before contacting support, please have the following information available: unit serial number, firmware version, description of the issue, and any error messages observed.

Contact	Details
Company	BharatXtronics Pvt. Ltd.
Address	J-181, MIDC Bhosari, Pimpri-Chinchwad, Maharashtra 411026, India
Website	www.bharatxtronics.com
Email	bharatxtronics@gmail.com
Support Hours	Monday to Saturday, 9:00 AM – 6:00 PM IST

16.2 Warranty Terms

BharatXtronics Pvt. Ltd. warrants the OHM MATRIX against defects in materials and workmanship for a period of **12 months** from the date of original purchase, under normal use and service conditions.

- Warranty covers manufacturing defects in the main unit and internal electronics.
- Warranty does NOT cover damage from improper use, incorrect power supply, physical damage, or unauthorised modification.
- Consumable items (probes, cables, connectors) are not covered under warranty.
- To claim warranty, contact bharatxtronics@gmail.com with proof of purchase.

16.3 Disclaimer

BharatXtronics Pvt. Ltd. reserves the right to change product specifications without prior notice as part of its continuous improvement program. All measurements are dependent on correct installation, calibration, and use as described in this manual.