QuickRefurbz Test Bench

Equipment List, Purchase Links & Setup Guide

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Equipment List

1. SCPI Multimeter — ~$493

Rigol DM3058E — 5.5-Digit Benchtop Digital Multimeter

- 5.5-digit resolution (240,000 counts), True RMS, up to 123 readings/sec
- Measures: DC/AC Voltage (1000V), DC/AC Current (10A), Resistance, Capacitance, Frequency
- Interfaces: USB Device, USB Host, RS-232 — full SCPI command support
- Compatible with Fluke and Keysight/Agilent command sets

Amazon | Saelig | DigiKey

Why: Gold standard budget SCPI benchtop multimeter. Full programmatic control via USB for automated voltage, current, and resistance measurements during refurbishment testing.

2. Smart Power Controller — $107

Shelly Pro 4PM — DIN-Rail 4-Channel Smart Switch with Power Metering

- 4 independent relay channels, 16A per channel (40A total)
- Per-channel power metering (W, kWh, voltage, current)
- Wi-Fi, LAN (Ethernet), and Bluetooth connectivity
- HTTP/REST API and MQTT for automation
- DIN-rail mountable, 1.8" color display, overpower auto-shutoff

Shelly Official | Amazon | Home Depot

Why: Programmatically turn outlets on/off and read power consumption per channel via HTTP. Turn on a refurbished appliance, measure its power draw, and auto-shut-off if anomalous. 4 channels = 4 simultaneous tests.

3. Energy Monitor (Optional) ~$300–389

IoTaWatt V6.4 — Open WiFi Electric Power Monitor (Basic Kit)

- 14 CT (current transformer) input channels
- WiFi connected, local HTTP API, open-source firmware
- Supports split-phase 120/240V (US standard)
- Outputs to InfluxDB, Emoncms — no cloud dependency

CircuitIQ | Amazon

Why: Complement to the Shelly. IoTaWatt is monitor-only with 14 channels for detailed per-circuit logging. Start with just the Shelly if budget is tight—it does both switching and metering.

4. GFCI Protected Power Strip ~$50–108

Tripp Lite TLM812GF — 8-Outlet Safety Power Strip with GFCI Plug

- 8 outlets with GFCI 5-15P plug, trips at 5mA ground fault
- All-metal industrial housing, OSHA yellow color
- 12-foot heavy-duty cord, hang holes for bench mounting
- 15A / 120V rating

Amazon | Home Depot | Lowe's

Why: Critical safety device. Refurbished appliances may have ground faults—the GFCI trips instantly to protect operators. All-metal housing survives shop environments.

5. Logic Analyzer ~$18

SparkFun USB Logic Analyzer — 24MHz/8-Channel (sigrok compatible)

- 8 digital channels, up to 24MHz sampling rate
- USB Type-C, input voltage 0V–5.25V
- Full sigrok/PulseView compatibility, 100+ protocol decoders
- Protocol decoders: UART, I2C, SPI, and more

SparkFun | Amazon | Budget Alt (~$12)

Why: Debug UART, I2C, SPI communications between test bench components. At under $20 it's disposable-cheap yet fully capable via the sigrok ecosystem.

6. Powered USB Hub — $50

Anker 7-Port USB 3.0 Data Hub with 36W Power Adapter (A7505)

- 7 USB 3.0 data ports (5Gbps per port) + 1 charging port
- 36W external power adapter — no power sag to instruments
- VIA VL812-B2 chipset — reliable Mac/PC/Linux support

Amazon | Anker Official

Why: External 36W power supply ensures the multimeter, logic analyzer, and label printer all get clean, stable power without drawing from the host computer's USB bus.

7. Current Clamp Meter — $88

KAIWEETS HT208D — 1000A AC/DC Inrush Clamp Meter

- AC/DC current up to 1000A, True RMS, 6000 counts
- Inrush current mode — critical for motor/compressor startup testing
- VFD filtering, LoZ (ghost voltage elimination), NCV detection
- Measures: Current, Voltage, Resistance, Capacitance, Frequency, Temperature

Amazon | KAIWEETS Official

Why: Inrush current mode is critical for appliance refurbishment. Captures motor startup peaks non-invasively. AC/DC capability covers mains-powered appliances and DC electronics.

8. Label Printer — $170

Brother QL-810W — Ultra-Fast Label Printer with Wi-Fi

- 110 labels/minute, 300x600 dpi resolution
- Two-color printing (black + red) — perfect for PASS/FAIL labels
- USB + Wi-Fi (802.11b/g/n), AirPrint compatible
- Automatic cutter, uses standard DK label rolls (no proprietary lock-in)

Amazon | Brother Official | Best Buy

> Avoid DYMO LabelWriter 550 series — it requires proprietary RFID-tagged label rolls, locking you into DYMO's pricing. The Brother QL-810W uses standard DK rolls with third-party availability.

Why: Two-color printing is perfect for test result labels (red for FAIL, black for PASS). Wi-Fi means the printer can be shared across the test bench. Standard label rolls keep costs low.

Cost Summary

#	Item	Product	Price
1	SCPI Multimeter	Rigol DM3058E	$493
2	Smart Power Controller	Shelly Pro 4PM	$107
3	Energy Monitor (optional)	IoTaWatt V6.4 Basic	$300–389
4	GFCI Power Strip	Tripp Lite TLM812GF	$50–108
5	Logic Analyzer	SparkFun 24MHz/8CH	$18
6	Powered USB Hub	Anker 7-Port A7505	$50
7	Current Clamp Meter	KAIWEETS HT208D	$88
8	Label Printer	Brother QL-810W	$170
	Estimated Total (with IoTaWatt)		**$1,275–1,425**
	Estimated Total (without IoTaWatt)		**$975–1,035**

> **Budget tip:** Start with items 1, 2, 4, 6, and 8 (~$870). These are the core test bench components. Add the current clamp (#7), logic analyzer (#5), and IoTaWatt (#3) as you scale up.

Setup Instructions

Phase 1: Physical Setup

1. **Mount the GFCI power strip** to your test bench using the hang holes. All test devices plug into this strip. Test the GFCI by pressing the TEST button—it should trip immediately.
2. **Install the Shelly Pro 4PM** in a DIN-rail enclosure near the bench. Wire it between the GFCI strip and 4 dedicated test outlets. Each channel controls one outlet. Follow Shelly's wiring guide for your electrical configuration (have an electrician verify if needed).

3. **Connect the Shelly to your network** via Ethernet (recommended) or Wi-Fi. Open the Shelly app or navigate to its IP address to configure. Note the IP—you'll need it for QuickRefurbz.

4. **Set up the USB hub** on the bench near your computer. Plug in the 36W power adapter. Connect the multimeter, logic analyzer, and label printer via USB.

5. **Connect the Rigol DM3058E** via the USB Device port on the rear panel. The instrument should appear as a serial device (e.g., `/dev/ttyUSB0` on Linux/Mac).

Phase 2: Software Setup

1. **Clone and build QuickRefurbz:**

```
git clone https://github.com/Quicklotz/QuickRefurbz.git
cd QuickRefurbz
npm install
npm run build
```

2. **Initialize the database:**

```
node dist/enhanced-cli.js init
```

3. **Scan for connected instruments:**

```
node dist/enhanced-cli.js scan
```

This should detect the Rigol DM3058E on its USB serial port.

4. **Register the multimeter:**

```
node dist/enhanced-cli.js instrument add
```

Follow the interactive prompts. Select "SCPI Multimeter", enter the connection path from the scan output.

5. **Verify communication:**

```
node dist/enhanced-cli.js measure <instrumentId> "*IDN?"
```

Should return the instrument's identity string (manufacturer, model, serial, firmware).

6. **Install sigrok-cli** (for the logic analyzer):

```
# macOS
brew install sigrok-cli

# Ubuntu/Debian
sudo apt install sigrok-cli
```

7. **Install Brother printer drivers** from brother-usa.com/support/ql810w. The QL-810W works over USB or Wi-Fi.

Phase 3: Create a Test Station

1. **Create a station** via the QuickTestz API or web UI. Set:
   - **Name:** "Bench 1" (or whatever you call it)
   - **Controller Type:** SHELLY_GEN2_HTTP
   - **Controller Base URL:** http://<shelly-ip> (e.g., http://192.168.1.100)
   - **Safety Flags:** GFCI Present = true, Acknowledged By = your name
2. **Add outlets** to the station (one per Shelly channel):
   - Channel 0: "Outlet A", Max Amps: 15, On/Off: Yes, Metering: Yes
   - Channel 1: "Outlet B", etc.
3. **Verify the station:**

```
node dist/enhanced-cli.js station list
node dist/enhanced-cli.js station health <stationId>
```

Phase 4: Run Your First Integrated Test

1. **Check the overview dashboard:**

```
node dist/enhanced-cli.js overview
```

Verify your station, instruments, and any active runs are displayed.

2. **Run an integrated test** (hardware-diag + QuickTestz):

```
node dist/enhanced-cli.js test start QLID000001 \
  -c VACUUM \
  --station <stationId>
```

This will: energize the outlet via Shelly, run the SCPI test plan, record all readings, compute a PASS/FAIL score, and de-energize.

3 **Review results:**

```
node dist/enhanced-cli.js testrun list
node dist/enhanced-cli.js testrun readings <runId>
node dist/enhanced-cli.js test result QLID000001
```

Architecture Diagram

Data Flow:
1. CLI sends HTTP to Shelly -> energize outlet -> appliance powers on
2. Shelly polls power (W/V/A) -> recorded as test_readings
3. Rigol measures via SCPI -> recorded as hardware_test_step_results
4. SCPI results also mapped -> additional test_readings
5. Safety monitor watches for spikes -> auto-shutdown if threshold exceeded
6. Test completes -> PASS/FAIL computed -> label printed

Key CLI Commands Reference

Command	Description
`qr-enhanced scan`	Scan USB/serial ports for instruments
`qr-enhanced instrument add`	Register a new instrument (interactive)
`qr-enhanced instrument list`	List all registered instruments

`qr-enhanced station list`	List test stations with outlets
`qr-enhanced station health <id>`	Health-check a station's controller
`qr-enhanced overview`	Unified dashboard of everything
`qr-enhanced test start <qlid> -c VACUUM --station <id>`	Run integrated test
`qr-enhanced testrun list`	List recent test runs
`qr-enhanced testrun status <id>`	Show run status + readings
`qr-enhanced testrun readings <id>`	Show readings table