QR-10 Series *R-Can*:

General-Purpose Pocket Programmable Resistance Substitution Box

User Manual

Warranty

The manufacturer warrants this instrument is free from defects in material and workmanship under normal use and service for the period of one / two years from date of purchase. This warranty extends only to the original purchaser.
This warranty shall not apply to fuses, single-use batteries or any product that has been subject to misuse, neglect, accident, or abnormal conditions of operation. Changes in this product not approved by the manufacture or application of voltages or currents greater than those allowed by the specifications shall void this warranty.

In the event of failure of a product covered by this warranty, the manufacturer will repair the instrument when it is returned by the purchaser, freight prepaid, to an authorized Service Facility within the applicable warranty period, provided manufacturer's examination discloses to its satisfaction that the product was defective. The manufacturer may, at its option, replace the product in lieu of repair.

With regard to any covered product returned within the applicable warranty period, repairs or replacement will be made without charge and with return freight paid by the manufacturer, unless the failure was caused by misuse, neglect, accident, or abnormal conditions of operation or storage, in which case repairs will be billed at a reasonable cost. In such a case, an estimate will be submitted before work is started, if requested.

The foregoing warranty is in lieu of all other warranties, expressed or implied. The manufacturer shall not be liable for any special, incidental or consequential damages, whether in contract, tort, or otherwise.

⚠ WARNING:
CONNECT TO PROTECTIVE EARTH BEFORE USING!
Safety ground can via the screw at the front panel where following symbol is indicated.

WHENEVER HAZARDOUS VOLTAGES (> 36 V) ARE USED, TAKE ALL MEASURES TO AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS AND TERMINALS.

Isolated AC voltage as application power supply is recommended.

Use USB-Serial COM to control the instrument is recommended when applied for high –voltage circuits, and if possible, add an USB isolator (USB to USB isolation module) between the host device and this instrument.

The instrument output is passive component (pure resistor), it has well isolated with driver circuits that powered by Li-Polymer. There will be no high power voltage generated or stored by the instrument itself.

⚠ CAUTION
DO NOT APPLY ANY VOLTAGES TO THE TERMINALS OF THIS INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS, ELSE ACCURACY MAY BE AFFECTED OR HAVE IT DAMAGED PERMINIENTLY.
SET OUTPUT LIMIT IN ADVANCE TO AVIOD "SHORT CUT" DANGER DURING OPERATION.
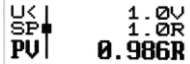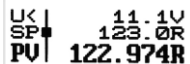
Introduction

As a candidate of replacing/upgrading conventional resistance decade box[1], QR10 has as good as, if not better than, top class of the latter on accuracy, range, resolution/step, repeatbility and T.C.R. It provides "better operation experience[2]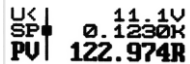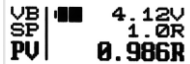" on user interface, and, much higher rated power and much smaller dimensions[3]. More importantly, it's just a "programmable" resistance substitution box the way it should be - user can either set desired output value by integrated keypad or remotly control it via USB-Serial COM port. The COM port mentioned makes it suitable for advanced applications such as data acquisition and auto-tests, for example, sensor simulation and sensor auto calibration.

What's more, thanks to the design solution and approach chosen, QR10 can use standard key components to improve quality and reduce cost; And, allowing user calibration makes it easy for maintainance and keeps long-term accuacy as well.

This manual is mainly divided into two parts, which respectively introduce *the key operation* and *the proprietary AT command set* used in USB-to-serial communication. In addition, we also list self-check codes and instrument maintenance suggestions. By the way, *please remind that should always pay attention to danger especially for high voltage application.*
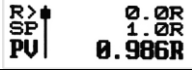
Key operation
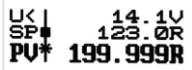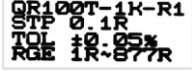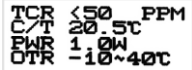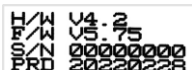
Item	Function/Display	Operation	Note/Example
1	Boot up (ON)	Press and hold the red button ⭕ until you see the startup screen	
2	Shutdown (OFF)	Press and hold the red button ⭕ until the screen dims or shuts off	
3	**Page 0**	If there is no other operation after booting, the screen that displays "U</SP/PV" is page 0.	U< 1.0V / SP 1.0R / PV 0.986R
3.1	Set SP	On page 0: Number key 0~9 / the black button ⭕(decimal point) + the red button ⭕(enter/ok)	Note: The first digit of the set value cannot be a decimal point. Screen demo. of "SP=123.0 R": U< 11.1V / SP 123.0R / PV 122.974R
3.2	Cancel SP setting	During 3.1 editing (before click the red button) double click the black button ⭕ to cancal editing.	The system will return to page 0
3.3	Change SP unit	On page 0: Double click the red button ⭕, SP unit changes in the order of "R(Ω)" → "K(kΩ)" → "M(MΩ)"	Screen demo. of SP unit change from "R" to "K" (SP=123.0 R): U< 11.1V / SP 0.1230K / PV 122.974R
3.4	Rated power	On page 0: The first line "U<" indicates the rated voltage of the current PV	After each update of SP, the corresponding rated voltage value also refreshed.
3.5	Output value (PV)	View it on page 0/1/2 (row 3)	Definition of the accuracy is based on PV and its corresponding reference value.
4	**Page 1**	On page 0, click the black button ⭕ to switch to page 1	VB 4.12V / SP 1.0R / PV 0.986R
4.1	Battery voltage (VB)	Refer to page 1 (row 1)	Cannot boot up if VB<3.6 V
4.2	Back to page 0	On page 1, click the red button ⭕	

1 . Refers to the conventional resistance substitution box using mechanical or other types of switches that need to be manually operated.

2 . Based on a questionnaire. Operating experience is subjective and varies from person to person.

3 . According to incomplete statistics, the rated power of ordinary wire-wound resistance boxes is mostly 0.2 W ~ 0.5 W. The QR10 series offers a 1.0 W power rating.

Key operation(continued)

5	**Page 2**	On page1, click the black button ⭕ to switch to page 2	`R>` `0.0R` `SP` `1.0R` `PV` `0.986R`
5.1	Output min. limit (R>)	Refer to the first row of page 2	"R>"default value is "0", i.e. any SP that greater than "0" is allowed
5.2	Set output min. limit (R>)	On page 2: Number key 0~9 / the black button ⭕(decimal point) + the red button 🔴(enter/ok)	If current SP < limit value, Output (PV) will be forced to be the latter and with a mark "*" on display near "PV". Screen demo. of SP=123.0 R and "R>" = 200.0 R: `U<` `14.1V` `SP` `123.0R` `PV*` `199.999R`
5.3	Set output min. limit (R>) unit	On page 2: Double click the red button 🔴, "R>" unit changes in the order of "R(Ω)" → "K(kΩ)" → "M(MΩ)"	The weight of number key changes according to "unit".
5.4	Back to page 0	In editing mode (item 5.2), will return to page 0 when finished editing; Else click the black button ⭕ to switch to page 0.	
6	**Device info. (1/3)**	On page 0: Use combination keys "the red button 🔴 + number key ①" to view device info. (1/3): - Device Type / order code - Step (STP) - Tolerance (TOL) - Output range (RGE)	*Note: When device info. is displaying, some AT commands cannot be executed in real time.* Screen demo of device info. (1/3): `QR100T-1K-R1` `STP 0.1R` `TOL ±0.05%` `RGE 1R~877R`
6.1	Device info. (2/3)	In the state of item 6: Click the red button 🔴: - T.C.R(TCR) - Calibration temperature (C/T) - Rated power (PWR) - Operating Temperature Range (OTR)	Screen demo of device info. (2/3): `TCR <50 PPM` `C/T 20.5℃` `PWR 1.0W` `OTR -10~40℃`
6.2	Device info. (3/3)	In the state of item 6.1: Click the red button 🔴: - Hardware version (H/W) - Firmware version (H/W) - Serial Number (S/N) - Production date (PRD), yyyymmdd	Screen demo of device info. (3/3): `H/W V4.2` `F/W V5.75` `S/N 00000000` `PRD 20220228`
6.3	Back to page 0	In the state of item 6.2: Click the red button 🔴 or wait about 30s	
7	**Display auto turn off**	The screen turns off automatically after 1 minute of inactivity. Press any key to wake up the screen.	USB-Serial COM still working properly under this condition
8	**Auto shutdown**	The system will shut down automatically after 1 hour of inactivity (activity includes key operation, USB-serial communication and battery charging)	Currently, users cannot disable this function. To keep "working state", please refer to the AT instructions table to find how to "delay auto shutdown"

Proprietary AT Command Set

User can remotely control the instrument, do user calibration and check device information via serial COM software (there're many such kind of freewares available).

Configuration		
Driver IC	WCH CH340	*WIN driver link* *MAC driver link*
Driver installation	Turn on the instrument, and connect it to PC via USB type-C cable. Select the driver to install manually or let PC do auto-scanning for installation.	After successful installation, following information can be found through Device Manager (Windows): ∨ 🖥 Ports (COM & LPT) 　🖳 USB-SERIAL CH340 (COM28)
Baudrate & settings	115,200 bps, 8 byte, none checksum, 1 bit stop	
End mark (EOT)	\r or \n	Necessary for each command.

AT Command Set Table

No.	Description	Instruction	Default Unit	Example (communication log.)
1	Get SP	AT+USER.SP?	Ω	TX: AT+USER.SP? RX: +USER.SP=1.0000
2	Set SP	AT+USER.SP=*<float string>*	Ω	TX: AT+USER.SP=1.0 RX: SP(R)=1.000 PV(R)=0.993 UMax(V)=1.0 RLimit(R)=0.000
3	Set SP (Increasingly)	AT+USER.SP+=*<float string>*	Ω	Initial status: SP=1.0 TX: AT+USER.SP+=1 RX: +OK. RX: SP(R)=2.000 PV(R)=1.998 UMax(V)=1.4 RLimit(R)=0.000
4	Set SP (Decreasingly)	AT+USER.SP-=*<float string>*	Ω	Initial status: SP=2.0 TX: AT+USER.SP-=1 RX: +OK. RX: SP(R)=1.000 PV(R)=0.993 UMax(V)=1.0 RLimit(R)=0.000
5	Get min. output limit	AT+USER.RLIMIT?	Ω	TX: AT+USER.RLIMIT? RX: +USER.RLIMIT=0.0000
6	Set min. output limit	AT+USER.RLIMIT=*<float string>*	Ω	TX: AT+USER.RLIMIT=10.0 RX: +OK. RX: SP(R)=1.000 PV(R)=10.041 UMax(V)=3.2 RLimit(R)=10.000
7	Restore factory calibration data	AT+UCAL.RESTORE		TX: AT+UCAL.RESTORE RX: +OK.

8	Start user calibration	AT+UCAL.START		TX: AT+UCAL.START RX: Step 0/26: Send "AT+UCAL.REF=(Amb.Temp.)" to continue.
9	Save reference value during user calibration[1]	AT+UCAL.REF=*<float string>*	Ω	TX: AT+UCAL.REF=25.0 RX: +OK. Step 1/26: Send "AT+UCAL.REF=(Ref.Value)" to continue. ... *The last step:* TX: AT+UCAL.REF=300000 RX: +OK. Calibration done.
10	Get rated power	AT+DEV.PWR?	W	
11	Get max. voltage	AT+DEV.MAXU?	V	
12	Get T.C.R	AT+DEV.TCR?	ppm	
13	Get device type	AT+DEV.TYPE?		
14	Get production date	AT+DEV.PROD?		
15	Get serial number	AT+DEV.SN?		
16	Get HW version	AT+DEV.HW?		
17	Get FW version	AT+DEV.FW?		
18	To delay auto shutdown	*(Any data[2])*		

1. Please follow the instructions to store ambient temperature or reference values via this command. Wait until the output settled down can improve accuracy.

2. Any data appeared at USB-Serial bus can reset the counterdown timer for another 1 h before the instrument auto-shutdown. But still use defined "get" instruments is recommended.

Self-check

| Item	Display message	Action
1	Show "VB<*V" when powered up	Refuse working if battery voltage <3.6 V. Should recharge it soon. "*" represents current battery voltage.
2	ERR.01	Click the red button to shut down. Please contact the manufacture for solution.
3	ERR.02	Click the red button to shut down. Please contact the manufacture for solution.

Maintenance

Do not overload.
Do not use it in moisture conditions and avoid water getting in.
Keep the surface clean (stains may erode the painting surface of the brass housing)
Recharge it every 8 month if in store (battery shelf-life is around 10 month).
An annual calibration is recommended due to the (more or less) change of relay contact resistance.
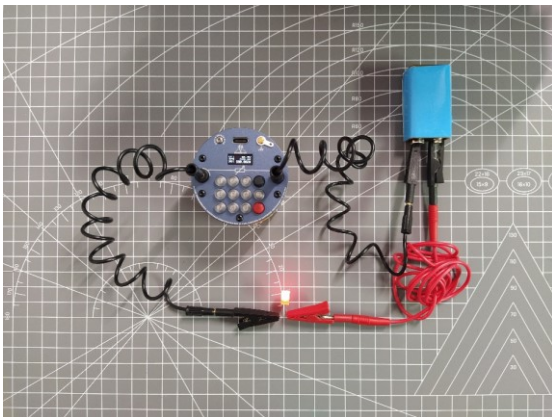
Eastwood Instruments
<mark>*- Always do better.*</mark>

For more information:
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ZL202122003046.7
ZL202130497759.6

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