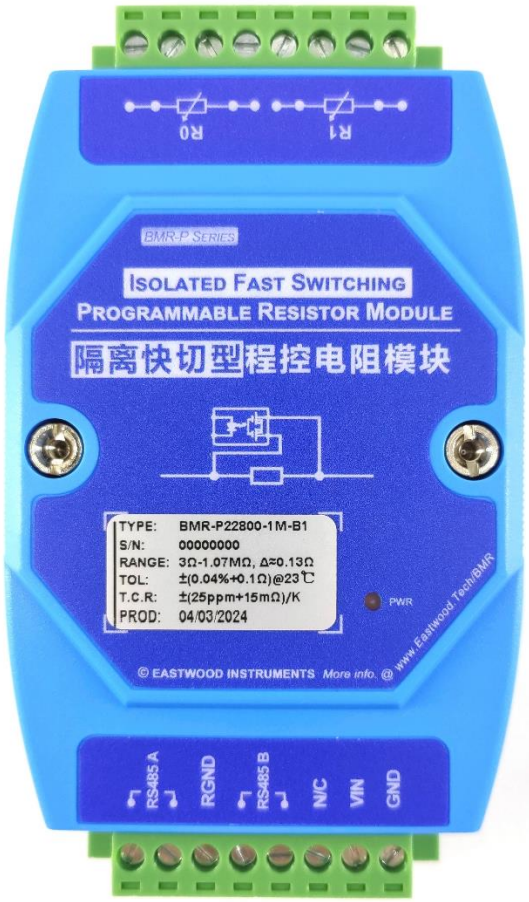
BMR-P Series Isolated Fast-Switching Programmable Resistor Module

Specification & Manual



The BMR-P series programmable resistor modules utilize Photocoupler relays as switches for the resistor network. The drive circuit is isolated from the output resistor and is capable of switching within 1 ms. The semiconductor switches feature a long service life and operate without oscillation during switching, making BMR-P suitable for applications requiring frequent switching actions and high switching speed.

The BMR-P series covers an output range from 3Ω to 1.1MΩ, featuring a step resolution as high as **0.01Ω** and a maximum rated power of 0.5W (maximum voltage 60V). In terms of accuracy, this series overcomes the drawback of high on-resistance in Photocoupler. **Class A** achieves an initial accuracy of **±(0.025% or 0.1Ω)**@Tcal across the entire output range.

The BMR-P Series supports 2-channel output, with channels capable of "synchronous output" of independent resistance values. This enables the convenient configuration of a high-performance digital potentiometer with freely adjustable gain and output impedance.

The BMR-P series supports a wide voltage supply range of 6 to 24V and offers a variety of communication interfaces (isolated RS485, RS232, and CAN). The RS485 interface supports networking with up to 256 nodes.

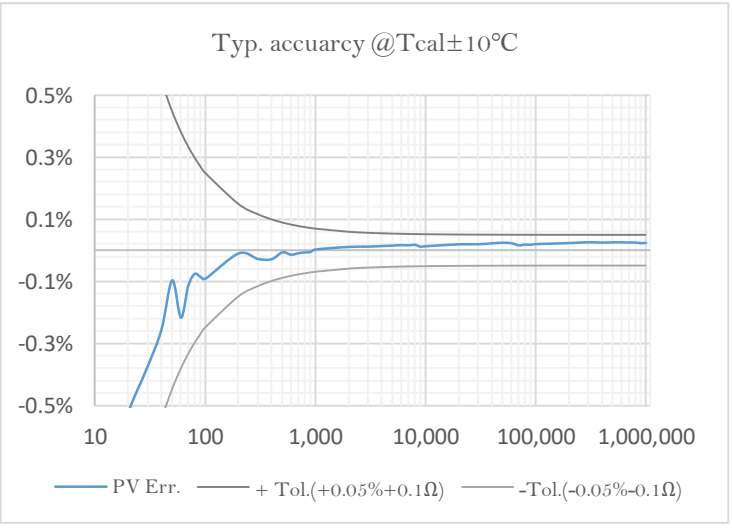
Additionally, the module housing is designed for industrial applications and supports standard DIN rail mounting.

Features Overview

- True resistance generated by "optocoupler relay-resistor network," passive output friendly to small signals
- Dual-channel output, also supports module networking
- Fast response:
  Typical output switching time <1ms
- Smooth relay group switching with no oscillation
- Wide output range:
  3Ω - 1.1MΩ (approx. 0.1Ω steps)
- High accuracy(@Tcal±1℃):
  Class B: ±(0.04%+0.1Ω)
  Class A: ±(0.0025% or 0.1Ω)
- User-configurable output floor value
- Optional communication interfaces with user-defined baud rate:
  - Isolated RS232 (for local interference resistance)
  - Isolated RS485 (for remote module networking)
  - Isolated CAN (suitable for automotive industrial networking)
- Support both **standard Modbus RTU protocol** and self-defined AT command set
- Standard 35mm DIN rail mounting
- Compact dimensions:
  12.2 (L) × 7.2 (W) × 3.5 (H) cm

Application

- Industrial automation (testing)
- Sensor simulation
- Sensor calibration
- High-performance programmable potentiometer (dual-channel combination)
- Other applications replacing traditional resistance boxes
- .....



Ordering Code (to be continued)

Ordering Code *	Description[1,2]
BMR-P22800-1M-B☐	Class B, dual-ch, 3Ω-1.1MΩ range, aprox. 0.1Ω steps, initial accuracy ±(0.04%+0.1Ω)@T_{cal}±1°C, T.C ±(25ppm+15mΩ/K), rated power 0.25W-0.5W (max 60V)
BMR-P22200-M1-B☐	Class B, dual-ch, 3Ω-120kΩ range, aprox. 0.1Ω steps, initial accuracy ±(0.04%+0.1Ω)@T_{cal}±1°C, T.C ±(25ppm+15mΩ/K), rated power 0.25W-0.5W (max 60V)
BMR-P22808-1M-A☐	Class A, dual-ch, 3Ω-1.1MΩ range, 0.01Ω steps, initial accuracy ±(0.025% or 0.1Ω, whichever is greater)@T_{cal}±1°C, T.C ±(25ppm+5mΩ/K), rated power 0.25W-0.5W (max 60V)
BMR-P22208-M1-A☐	Class A, dual-ch, 3Ω-120kΩ range, 0.01Ω steps, initial accuracy ±(0.025% or 0.1Ω, whichever is greater)@T_{cal}±1°C, T.C ±(25ppm+5mΩ/K), rated power 0.25W-0.5W (max 60V)
*In ordering code,☐=0:RS-232 port; ☐=1:RS-485 port; ☐=2：CAN BUS *Custom non-standard parameters including range, precision, temperature drift and max voltage are available upon request.*	

1 For specific definitions of accuracy, temperature drift, and other parameters, refer to the detailed specifications below.
2 The precise output range varies by machine and batch. The minimum output range is typically around 3Ω, with the maximum not exceeding 10Ω.

Terminology and Definitions

T_{cal}	Module internal temperature during calibration (the reading from the built-in temperature sensor shall prevail), typically between 23°C to 25°C
Calibration conditions	Ambient temperature fluctuation range: Tcal ±1°C Ambient relative humidity: 75% R.H. Supply voltage: 12 VDC Power supply ripple: Vpp approximately 15 mV
Accuracy (R.D)	Reading accuracy, which is calculated based on the error between the return value (PV) and the actual measured value plus the uncertainty of the reference meter itself.
Initial accuracy	Indicates the accuracy measured at the factory without considering long-term aging factors of Photocoupler Relay and base resistors, under conditions of low load power (<0.05 W) at the output resistance.
SP	SetPoint
PV	Process Value (Indicated value). Within the output range, the error typically falls within one step of the corresponding setpoint (SP).
ΔT	The difference between the internal module temperature (is read by the module's built-in temperature sensor) and T_{cal}.
R.H	Relative Humidity
Ri	For dual-ch module, R0 represents the output resistance of channel 0, R1 represents the output resistance of channel 1.
T.C	Temperature Coefficient

Specification

Items	Spec.		Remarks
Output resistance			
Class	Class A	Class B	*@ Calibration conditions
Initial Accuracy	±0.025% R.D or ±0.1Ω, whichever is greater	±(0.04% R.D +0.1Ω)@T_{cal}±1 ℃	
T.C	±(25ppm+0.005Ω/K)	±(25ppm+0.015Ω/K)	
Maximum Range	3Ω-1.2MΩ, custom high-range (10M) available		
Steps resolution	Approx. 0.1Ω/1Ω (Class B), **0.01Ω (Class A)**		
SP and PV difference	Typical value < 0.5 steps		@within output range
Max. Voltage	60V, custom 100V version available		
Max. Current	0.8A		
Rated power	0.25~0.5 W (varies on output, up to 60 VDC)		For details, refer to Communication port return data
Open output	>100MΩ		
Relay type	Photocoupler		
Relay life	Unaffected by frequent switching operations, typical service life > 100,000 hours		
Switching time	<1 ms, typical <0.5 ms; no oscillation		
Recommended Max. Switching Frequency	10Hz (new value set every 0.1s)		
Self-heating caused by Photocoupler	<4℃		
Output terminal	2-wire/4-wire output via plug-in terminal		
Communication Interface			
Power supply	6V~24VDC, 1W+		Recommended Low-Ripple Power Supply
Power supply terminal	Plug-in terminal		
Communication Interface	Optional isolated RS485, RS232, or CAN		
RS485/RS232 default configuration	115200 bps, 8, N, 1		
RS485/RS232 baudrate range	9600-115200 bps		
RS485 max nodes	247(Modbus RTU)		
CAN BUS baudrate	3k-1M bps (default 1Mbps)		
CAN BUS	Standard frame format		
Communication protocol	**Modbus RTU standard protocol (FW v2.22 and above)** Private AT instruction set (details below)		

Specifications (Continued)

Additional Functions		
Built-in temperature sensor	Typ. Accuracy ±0.1℃	
General spec.		
Operating temperature	-10 ℃ to 55 ℃	
Operating relative humidity	To 80 % R.H non-condensing	Can still be used in high humidity without condensation, but accuracy cannot be guaranteed then.
Storage temperature	-20 ℃ to75 ℃	
Dimensions	12.2 (L) × 7.2 (W) × 3.5 (H) cm	
Installation	Std. DIN 35mm	
Weight	117 g (including external terminals)	
Warranty	1-year	

Typical characteristics *

* Unless otherwise specified, all tests are based on sample data measured at room temperature and 75% relative humidity. The accuracy values in the table represent relative accuracy relative to the reference meter reading. The accuracy of the reference meter used is better than ±0.01% within the 1MΩ range. **When calculating absolute accuracy, the uncertainty of this reference meter should be taken into account.**

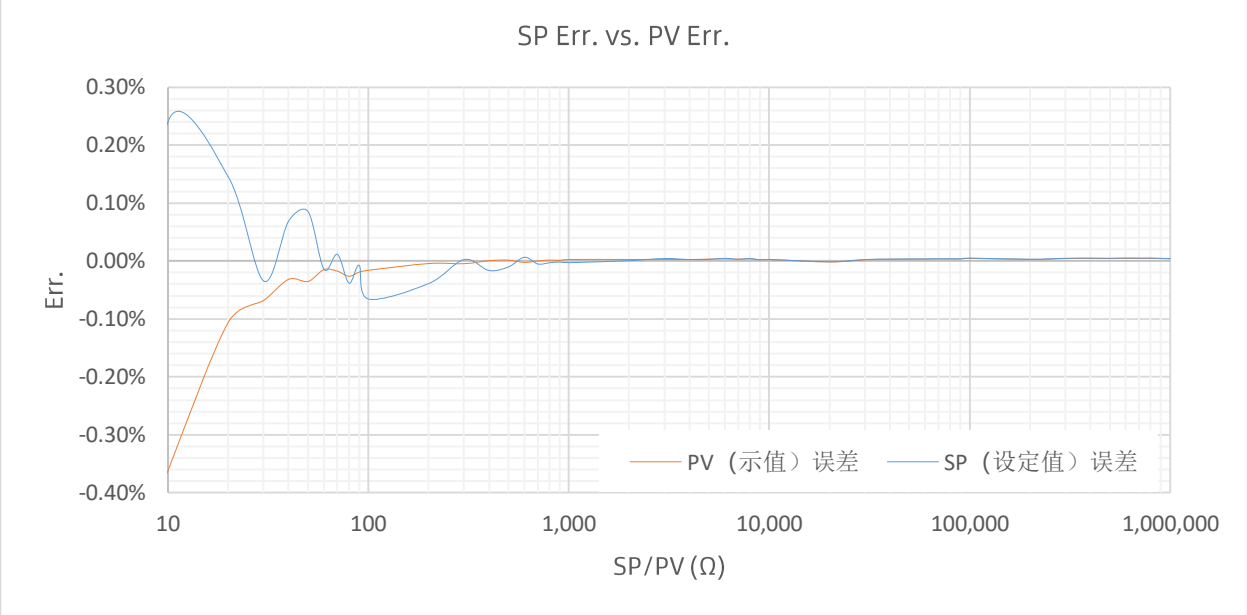


Figure above: Output errors calculated based on SP (Setpoint) and PV (Process Value) respectively. Outputs below 1kΩ show that PV provides a more objective description of actual output resistance; differences between the two become negligible above 1kΩ.

Typical characteristics (continued)

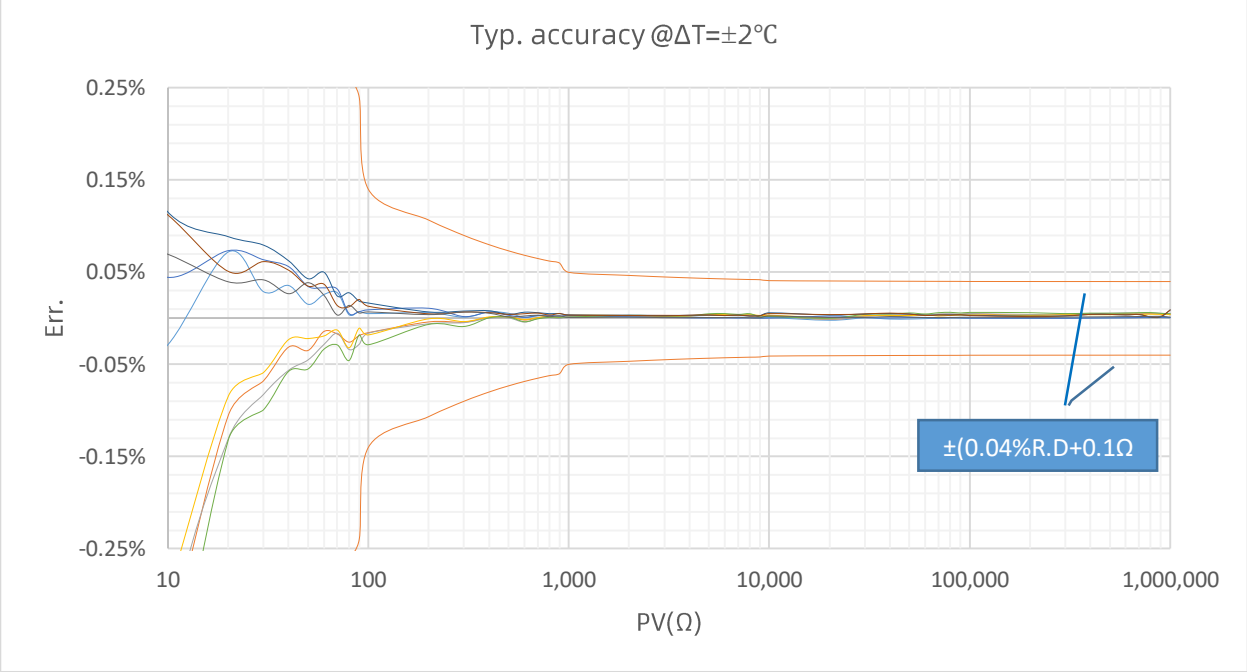


Figure above: Accuracy is based on the aggregated results of testing multiple samples (channels) within a constant-temperature chamber (temperature variation range: Tcal-2°C to Tcal+2°C).

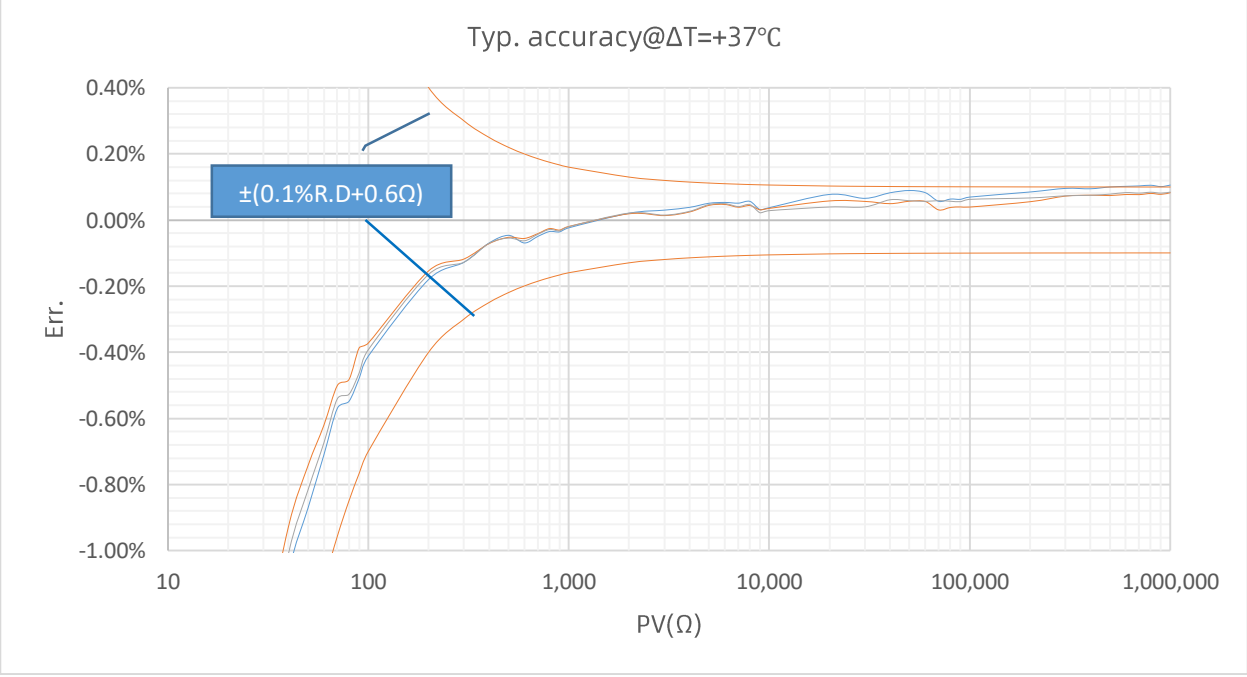
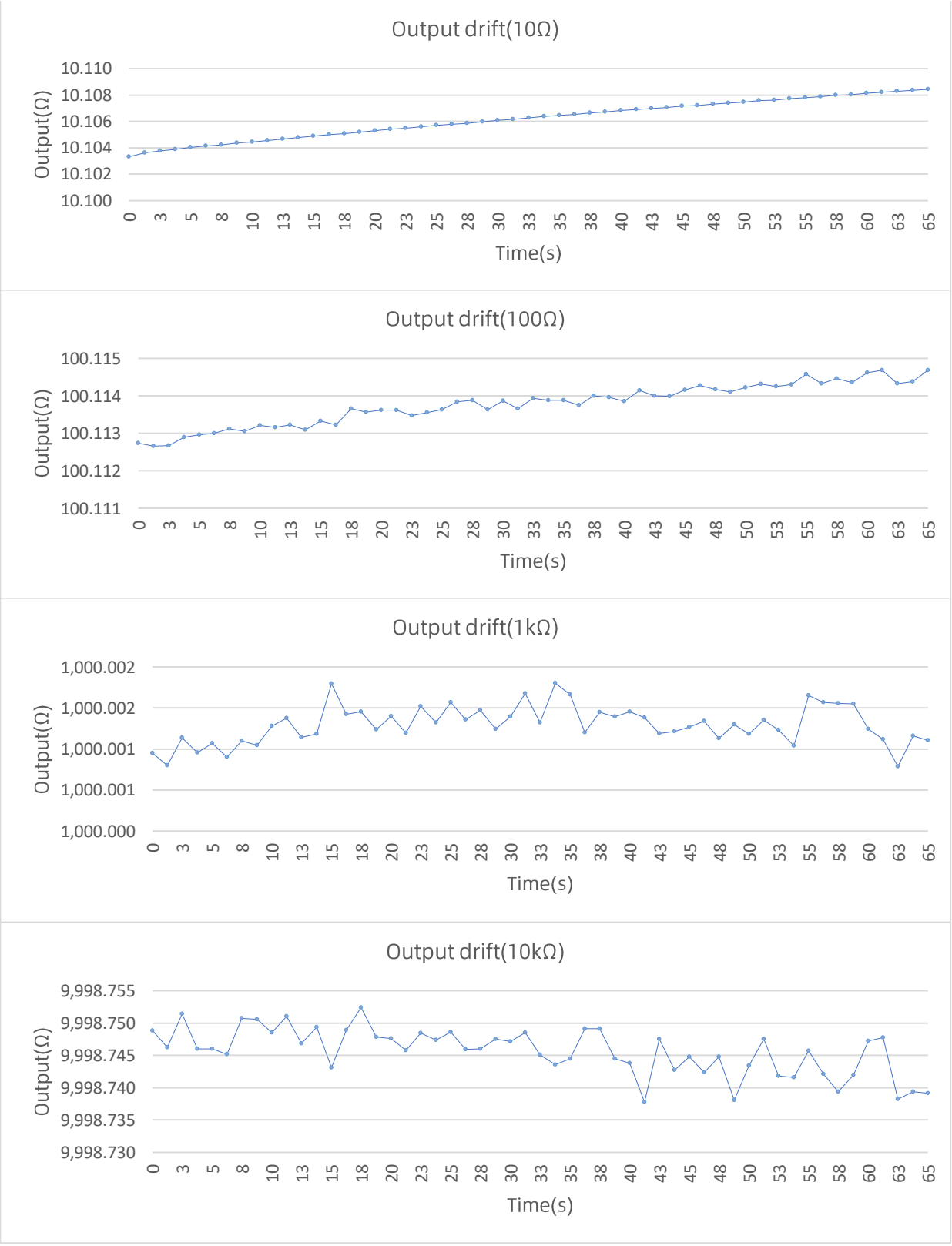
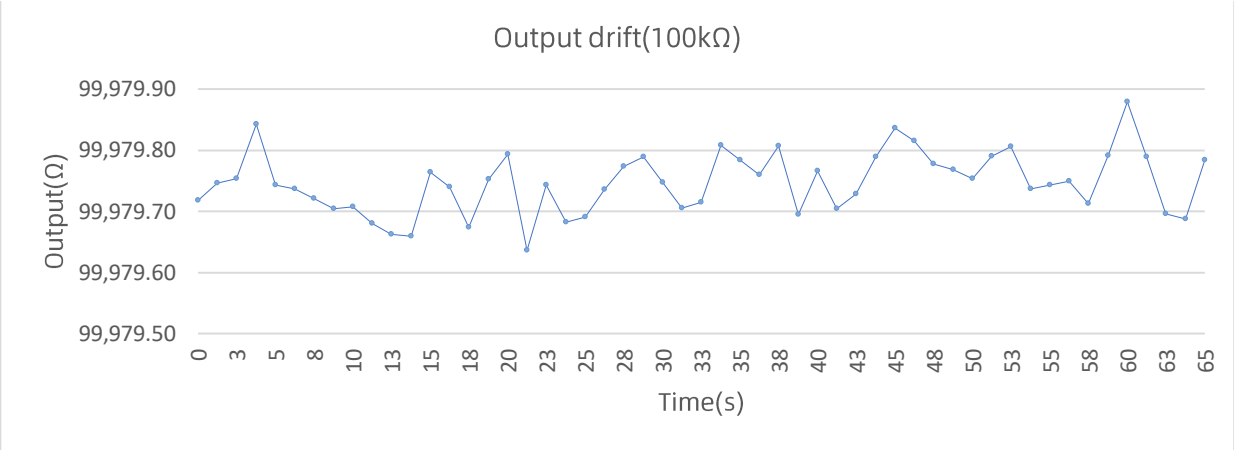


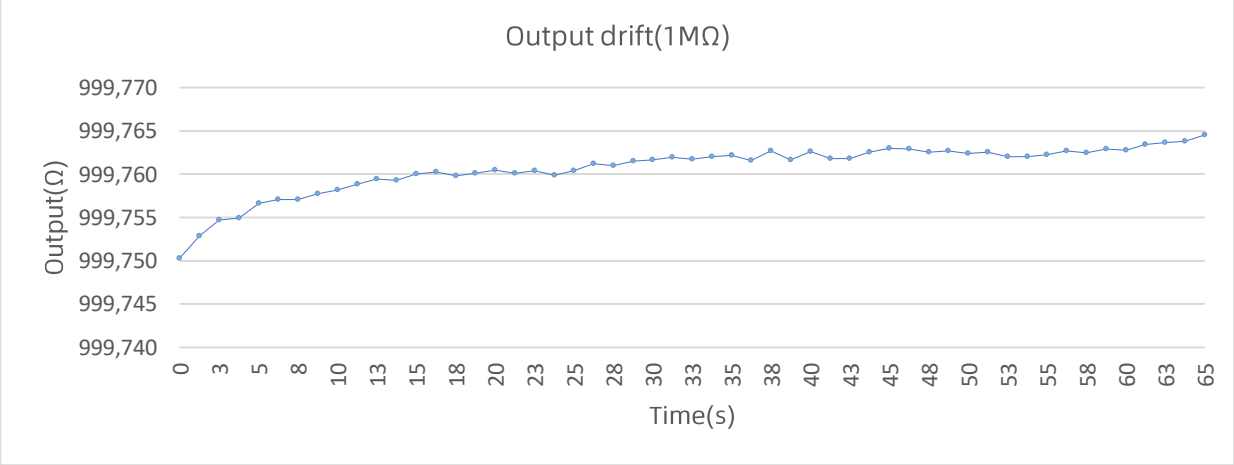
Figure above: Accuracy is based on the aggregated results of testing multiple samples (channels) under Tcal+37°C (60°C) conditions.

Typical characteristics (continued)



Typical characteristics (continued)





Output drift: Due to factors such as optocoupler temperature rise, parasitic capacitance/inductance, measurement instruments, or measurement methods, the measured output resistance typically requires a period to stabilize, which may last several seconds to minutes. This should be considered in high-precision or long-term fixed-value applications (the BMR-L series is recommended for higher-standard applications, as its relays do not generate heat). The test method involves initiating measurement at the instant the new output value appears (t=0) and recording data for approximately 1 minute.

Typical characteristics (continued)

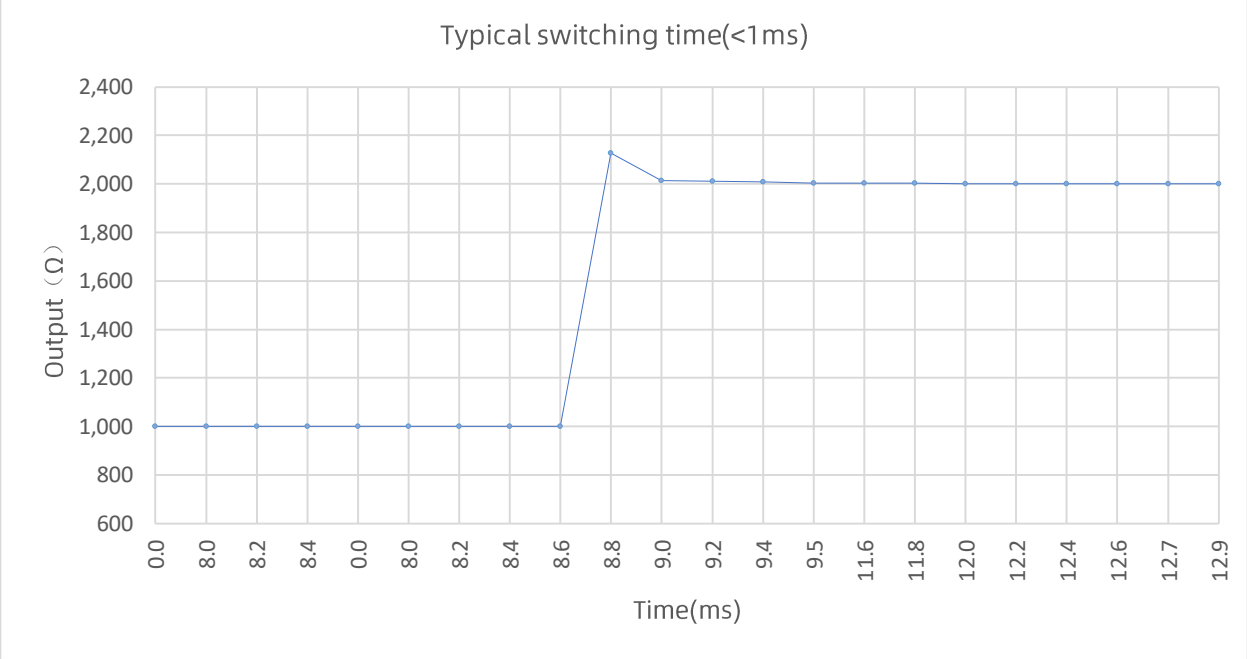
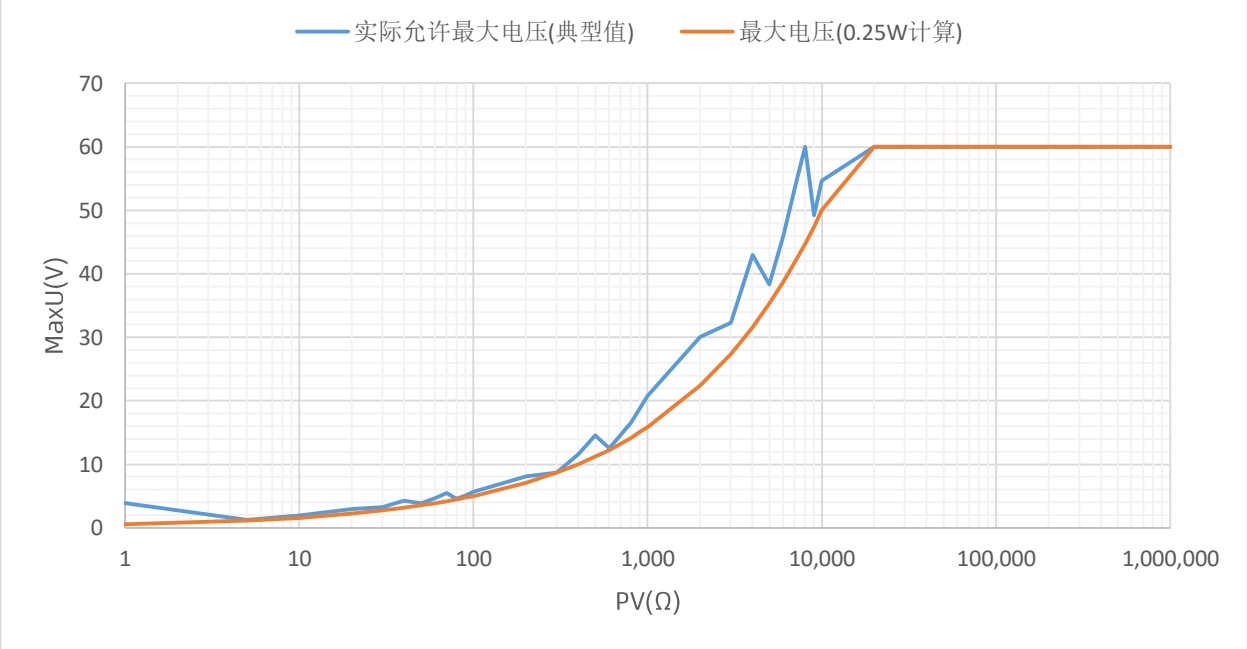
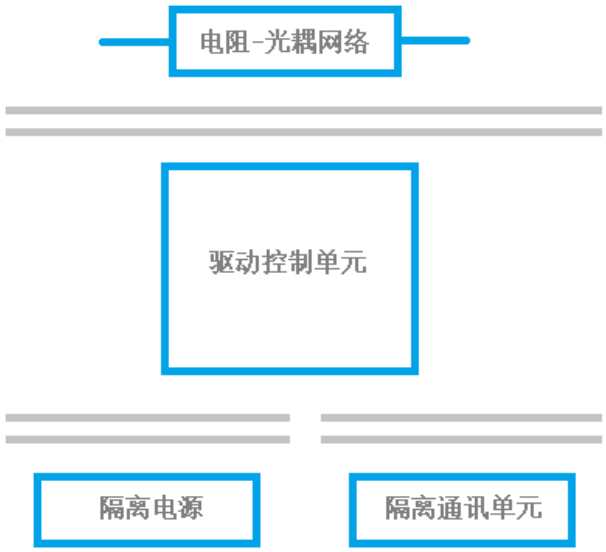


Figure: Output typical switching time (1kΩ to 2kΩ)



Above: The rated power of the BMR-P base resistor is 0.25W. However, for the vast majority of output values (PV), the actual rated power typically ranges between 0.25W and 0.5W. Users may operate based on the actual MaxU value returned via the serial port. For simplicity, the rated voltage can also be uniformly calculated using the formula MaxU = √(PV × 0.25). Note that the maximum voltage applied across the output resistor must not exceed 60V.

Module System Block Diagram



Working Principle

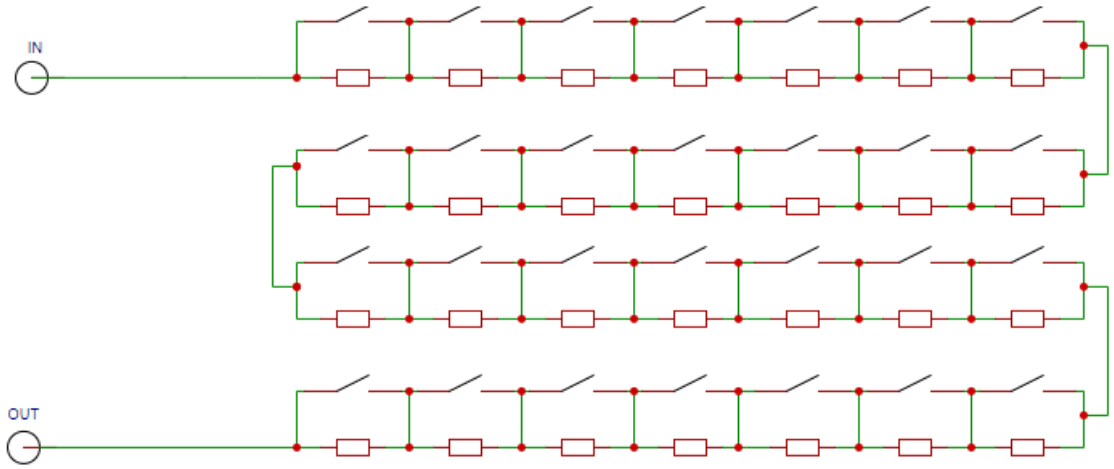


Figure: Relay-Based Resistor Array Principle.
Activating or deactivating specific switch combinations outputs a resistance value close to the set value (switches are open by default during power loss and module startup).

Port Signal Distribution

Above: RS-485 Interface Label

Items	Signal definition	Function
1	RS485 A*	RS-485 differential signal A
2	RGND	RS-485 GND (optional)
3	RS485 B*	RS-485 differential signal B
4	N/C	No connection
5	VIN	Power Supply (Positive), 6-24 VDC
6	GND	Power Supply (Negative)

* The extra pair of RS485 ports can be terminated with 120Ω resistors or connected to the next module for networking.

Above: RS-232 Interface Label

Items	Signal definition	Function
1	RS232 TXD	RS-232 TXD
2	RGND	RS-232 GND
3	RS232 RXD	RS-232 RXD
4	N/C	No connection
5	VIN	Power Supply (Positive), 6-24 VDC
6	GND	Power Supply (Negative)

Above: CAN Interface Label

Items	Signal definition	Function
1	CAN_H*	CAN H
2	RGND	CAN GND (optional)
3	CAN_L*	CAN L
4	N/C	No connection
5	VIN	Power Supply (Positive), 6-24 VDC
6	GND	Power Supply (Negative)

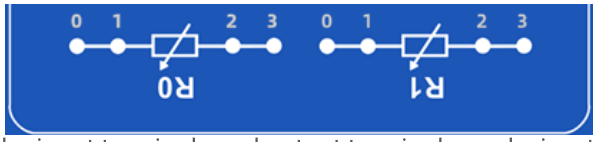
* The extra pair of CAN_H and CAN_L pins can be connected to the next module to form a network.

Important Notice for Use

Warning: Electric Shock Hazard!
This product's resistor output terminals support voltages up to 60V DC/AC. When operating above the 36V safety voltage threshold, ensure proper protective measures are in place. Do not touch the output terminals to prevent injury to personnel or damage to equipment.

Operating Temperature and Humidity
Use within the recommended temperature and humidity ranges. Excessive temperatures may cause abnormal operation or damage to this module, as well as reduce the rated power of the output resistor. High humidity or condensation may affect the accuracy of the output resistor and shorten the module's service life.

Wiring



Please correctly distinguish the input terminals and output terminals, and wire strictly in accordance with the pin information on the label. For two-wire connection, **prioritize the combination marked 0 and 3** in the figure above. You may also short-circuit 0/1 and 2/3 to further reduce contact resistance.
To prevent contact resistance drift caused by frequent plugging and unplugging, the resistance output terminal are fixed at factory. **Do not disassemble it**.

Installation
The BMR-P supports DIN 35mm rails.

Power Supply
Supply this module with a 6-24VDC power source rated at 1W or higher. The module incorporates internal reverse polarity protection. Although the module employs a power supply IC with high PSRR, it is recommended to use a low-ripple power supply to minimize output resistance noise.

Testing
During power loss or after power-up, the module defaults to outputting its maximum value.

The four-wire (Kelvin) connection method is recommended for verifying module output accuracy; two-wire connections typically introduce an offset value, requiring users to compensate for external wire resistance in their applications.

During operation, the optocoupler generates heat. Single-channel use causes a worst-case temperature rise of approximately 2°C, while simultaneous dual-channel operation causes a worst-case rise of approximately 4°C. For short-term measurements, temperature rise is the primary cause of output resistance drift, but initial accuracy already accounts for this factor.

Networking
This module with **firmware version V2.22 and above supports the standard Modbus RTU protocol**, enabling users to implement networked control directly via PLC and other systems.

The AT command set of this module enables the host to communicate individually with any module on the bus. Both RS-485 and CAN communication interfaces support networking. A maximum of 256 nodes can be connected to a single RS-485 bus.

Typically, RS-232 can only control a single module. If required, after networking modules via RS-485, users may add RS-232-to-RS-485 converters to enable RS-232 control of multiple modules. If the host does not require module feedback, all modules' RXD pins can be connected to the host's TXD pin for RS-232 networking.

Feature Highlights

Users can define a "minimum output limit value" (e.g., using "AT+RES.RLIMIT=100\" to clamp R0's minimum output to 100Ω) to prevent accidental configuration below this threshold, which could cause output resistor overload. Setting this threshold to 0 disables output limiting.

Multi-channel can "Synchronized Output", i.e. Modules allow control of all channels to output identical or different resistance values in "synchronized" mode via corresponding commands. This proves particularly useful in scenarios such as connecting two channels in series to form a high-performance potentiometer.

AT Command Set

Configuration		
Default setting	115,200 bps, Data bits 8, Parity bit None, Stop bits 1	
Command ending sign	'\r'(CR) or '\n'(LF) or char '/' or char '\'	**Note: Each command must end with a command ending sign to be considered a complete command.**

AT Command Set Introduction

The AT command set for this module is categorized into several types: "R0 Basic Commands," "Multi-Channel Extension Commands," "User-Defined Configuration Commands," "Module Information Query Commands," and "Networking Extension Commands."

- **R0 Basic Commands**
  For the configuration of the R0 (Channel 0) output resistor
- **Multi-channel extension command:**
  Append the channel number after the "AT+RES" command. For example, "AT+RES1" applies settings to R1 (Channel 1). Additionally, the "AT+RESX" command enables "synchronous configuration" of both R0 and R1.
- **User-defined configuration commands**
  These commands apply to the entire module, modifying communication baud rates, user-defined US/N settings, etc.
- **Module Information Query Command**
  Module Electronic Tag. *Firmware version V2.22 and above adds query commands for Modbus RTU configuration to facilitate user debugging.*
- **Network Expansion Command**
  In networked applications, the module's own S/N serves as its ID for communication with the host. The host can add "@<S/N>" at the end of any command to control a specific module individually. The mechanism is as follows: If <S/N> matches the module's actual serial number, the command is executed and acknowledged; otherwise, the command is ignored. Commands without "@<S/N>" are always executed and acknowledged by the module, enabling broadcast functionality. Additionally, users may define a custom serial number (User S/N, or US/N) to replace the default S/N as the module ID.

AT Command Table

No.	Function	CMD/Solution	Default Unit	Example/Remarks
	① R0 Basic Commands			
1	Set output	AT+RES.SP=<*float string*>	Ω	TX：AT+RES.SP=100/ RX：+OK. +R0 .SP(Ohm)=100.00 .PV(Ohm)=99.99 .UMax(V)=5.7 .RLimit(Ohm)=0.00 +Temp(C)=33.9
2	Set output(INC)	AT+RES.SP+=<*float string*>	Ω	TX：AT+RES.SP+=100/ RX：+OK. +R0 .SP(Ohm)=200.00 .PV(Ohm)=199.94 …
3	Set output(DEC)	AT+RES.SP-=<*float string*>	Ω	TX：AT+RES.SP-=100/ RX：+OK. +R0 .SP(Ohm)=100.00 .PV(Ohm)=99.99 …
4	Get minimum output limit value	AT+RES.RLIMIT?	Ω	TX：AT+RES.RLIMIT?/ RX：+RES.RLIMIT=0.0
5	Set minimum output limit value	AT+RES.RLIMIT=<*float string*>	Ω	TX：AT+RES.RLIMIT=500/ RX：+OK. +R0 .SP(Ohm)=100.00 .PV(Ohm)=500.00 .UMax(V)=14.5 .RLimit(Ohm)=500.00 +Temp(C)=34.6 Note: The above command sets the minimum output RLIMIT to 500. At this point, even though SP=100, PV now follows RLIMIT.
6	Get built-in temperature sensor value	AT+RES.TEMP?	℃	TX：AT+ RES.TEMP?/ RX：+ RES.TEMP=34.1
7	Get detailed information about the output resistance	AT+RES.INFO?		TX：AT+RES.INFO?/ RX：：+R0.INFO: .SP(Ohm)=100.00 .PV(Ohm)=500.00 .UMax(V)=14.5 .RLimit(Ohm)=500.00 .Temp(C)=34.8 .TCal(C)=24.3

	②Multi-Channel Extension Commands			
8	Extend above basic commands to Ri (channel i)	AT+RES<ch> *Where <ch>=0,1*		TX：AT+RES1.SP=123.4?/ RX：+OK. +R1 .SP(Ohm)=123.40 .PV(Ohm)=123.41 … *The above command assigns a value to R1 (Channel 1). The same applies to other channels.*
9	Simultaneously assign values to all channels, with each channel outputting "synchronously."	AT+RESX.SP=<a>,<b> *Where <a> or <b> may be omitted (for example, "AT+RESX.SP=,<b>"), in which case the default channel retains its original output.*	Ω	TX：AT+RESX.SP=123,456/ RX：+OK. +R0 .SP(Ohm)=123.00 .PV(Ohm)=122.97 … +R1 .SP(Ohm)=456.00 .PV(Ohm)=455.99 …
	④User-defined configuration commands			
10	Set baudrate	AT+DEV.BAUDRATE=*<baud>* *<baud> valid range is：9600~115200 (9600, 14400, 19200, 38400, 43000, 57600, 76800 and 115200)*	bps	TX：AT+DEV.BAUDRATE=9600/ RX：+ok *Setup take effect immediately*
11	Set User-Defined Serial Number (US/N)	AT+DEV.USN=*<string>* <string> is 8 Byte string		TX：AT+DEV.USN=00000001/ RX：+ok
12	Get USN.EN status (Enabled/Disabled)	AT+DEV.USN.EN?		TX：AT+DEV.USN.EN?/ RX：+DEV.USN.EN=0
13	Enable U/SN to replace SN	AT+DEV.USN.EN=*1*		Replace S/N with US/N as the ID for network communication.
14	Disable U/SN to replace SN	AT+DEV.USN.EN=*0*		Restore S/N as the ID for network communication
	CAN BUS configuration	(TBD)		
	⑤Module Information Query Command			
15	Get device info.	AT+DEV.INFO?		TX：AT+DEV.INFO?/ RX：+DEV.INFO: .SN=00000000 .USN(EN=0)=00000001 .TYPE=BMR-P22800-1M-B1 …
16	Get Modbus RTU config. (FW v2.22+)	AT+DEV.MODBUS.INFO?		TX：AT+DEV.MODBUS.INFO?/ RX：+MODBUS.INFO: .SlaveAddr = 1 .baud(bps) = 115200 .FFC = 0: 8,N,1 .delay(ms) = 0 .muteSP = OFF

⑥Network Expansion Command				
17	In networked applications, to control a specific device by S/N	When USN.EN=0, append "@<S/N>" to the end of the above commands to control the corresponding module.		TX：AT+DEV.USN.EN?/ RX：+DEV.USN.EN=0 TX：AT+DEV.SN?/ RX：+DEV.SN=00000000 TX：AT+RES1.SP=789@00000000/ RX：+OK.@00000000 +R1 .SP(Ohm)=789.00 .PV(Ohm)=788.93 …
18	In networked applications, to control a specific device by US/N	When USN.EN=1, append "@<US/N>" to the end of the above commands to control the corresponding module.		TX：AT+DEV.USN=12345678/ RX：+OK. TX：AT+DEV.USN.EN=1/ RX：+OK. TX：AT+RES1.SP=123@12345678/ RX：+OK.@ 12345678 +R1 .SP(Ohm)=123.00 .PV(Ohm)=123.03 …

Modbus RTU registers table(FW v2.22+)

Holding Registers					
FC: 0x03(RD)/0x06(WR)/0x10(nWR); Byte order：ABCD					
Offset Addr.	**Register definition**	**Type**	**Length**	**Legal value & Default Value**	**Unit**
0 1	R0 Setpoint, SP0	float	2	IEEE 754 float, 0x7F800000 (OPEN) Default(after boot up): OPEN	Ω
2 3	R1 Setpoint, SP1	float	2	IEEE 754 float, 0x7F800000 (OPEN) Default(after boot up): OPEN	Ω
4 5	R0 Floor Value	float	2	IEEE 754 float, Default:0.0	Ω
6 7	R1 Floor Value	float	2	IEEE 754 float, Default:0.0	Ω
8 9	Serial baudrate	long	2	9600,14400,19200,38400, 43000,57600,76800,115200 Default:115200	bps
10	Slave address	int	1	1-247 Default:1	
11	Slave response delay *	int	1	0-1000 Default:0	ms
12	Serial Frame Format Code (FFC)	int	1	0-5: 8N1,8E1,8O1,8N2,8E2,8O2 Default:0（8N1）	

*Slave Response Delay Function: To prevent excessive fast responses from slaves. Design purposes is to: 1. Adapt to low-speed masters. 2. Allow masters to send continuous commands to more slaves, avoiding bus data interference caused by rapid slave replies.

All holding registers except SP0 and SP1 are saved after power-off upon modification. **Note that the entire address range of the register must be overwritten in a single write operation.**

If serial port configuration information is forgotten, use the AT command **AT+DEV.MODBUS.INFO?/** for quick inquiry.

Example (using default slave address, send in hexadecimal):

- **Read SP0:**
  01 03 00 00 00 02 C4 0B
- **Set R0 outputs 12.345Ω (SP0 = 12.345Ω):**
  01 10 00 00 00 02 04 41 45 85 1F D5 1E
- **Set R0 = 1234Ω、R1=5678Ω simultaneously (R0 and R1 output at the same time)**
  01 10 00 00 00 04 08 44 9A 40 00 45 B1 70 00 E7 9B

Input Registers					
FC: 0x04(RD) ; Byte order: ABCD					
Offset Addr.	**Register definition**	**Type**	**Length**	**Legal value & Default Value**	**Unit**
0 1	R0 Indicated value, PV0	float	2	IEEE 754 float, 0x7F800000 (OPEN) Default(after boot up): OPEN	Ω
2 3	R1 Indicated value, PV1	float	2	IEEE 754 float, 0x7F800000 (OPEN) Default(after boot up): OPEN	Ω
4 5	R0 rated volatge	float	2	IEEE 754 float	V
6 7	R1 rated volatge	float	2	IEEE 754 float	V
8 9	Internal temperature	float	2	IEEE 754 float	℃

Example (using default slave address, send in hexadecimal):

- **Read PV0:**
  01 04 00 00 00 02 71 CB
- **Read internal temperature:**
  01 04 00 08 00 02 F0 09

Coils				
FC: 0x01(RD)/0x05(WR)				
Offset Addr.	**Coils definition**	**Type**	**Legal value**	**Remarks**
0	Restore factory settings	boolen	ON(RD/WR), OFF(RO) Default: OFF	After setting to ON successfully, all holding registers related to serial port configuration will be restored to default values, and this coil will be automatically set to OFF afterwards.
1	SP Mute*	boolen	ON, OFF Default: OFF	After being set to ON successfully, the slave will no longer respond to Modbus commands for setting SP0 and SP1. This setting is not retained after power-off.

The application of the *SP Mute function scenario is: when a single channel needs to continuously switch resistance values at the fastest speed (e.g., within 10 ms), or multi-channel resistors require high-speed scanning, disabling SP reply after configuration prevents slave device response data from interfering with the bus, thus shortening the command interval of the master device. Users can later verify the configuration result by querying PV values or directly checking the output resistance.

- Example (**SP Mute = ON**):

  01 05 00 01 FF 00 DD FA

Application Examples (AT commands set)

Example 1. Config single-device output

- Connect host device to slave device (the BMR-P module)
- Send "**AT+RES.SP=123.4/**" or "**AT+RES0.SP=123.4/**" to set the output of R0 (Channel 0) to 123.4Ω.
- Send "**AT+RES1.SP=432.1/**" to set the output of R1 (Channel 1) to 432.1Ω.
- Send "**AT+RESX.SP=111.1,222.2/"** to set the R0 and R1 outputs to 111.1Ω and 222.2Ω respectively; both channels will switch synchronously.

Example 2. Using S/N as IDs for RS-485 Networking

- Connect host device to slave devices (the BMR-P modules) via RS-485
- Send "**AT+DEV.USN.EN=0/"** to enable all slave devices to use the default S/N for network communication.
- Send "**AT+RES.SP=123.4@00000001/"**, #00000001's R0 output 123.4Ω and acknowledge.
- Send "**AT+RES1.SP=432.1@00000002/",** #00000002's R1 output 432.1Ω and acknowledge.
- Send "**AT+RES1.SP=100@002/".** Due to an invalid serial number (the leading "0" cannot be omitted), no slave device responded.
- Send "**AT+RESX.SP=100,200/**" to set all slave devices' R0 to 100Ω and R1 to 200Ω; all slaves should respond (though this causes garbled response data).

Example 3. Using US/N as IDs for RS-485 Networking

- Connect to Slave 1 individually. Send **"AT+DEV.USN=12345678/"** to set its US/N to 12345678. Send "**AT+DEV.USN.EN=1/**" to enable US/N to replace the factory default S/N for this slave.
- Connect to slave device 2 individually. Send **"AT+DEV.USN=87654321/"** to set its US/N to 87654321. Send "**AT+DEV.USN.EN=1/**" to enable the US/N to replace the slave's factory default S/N.
- Refer to Example 2 for network communication using new US/N codes (12345678 and 8765432) for individual control.

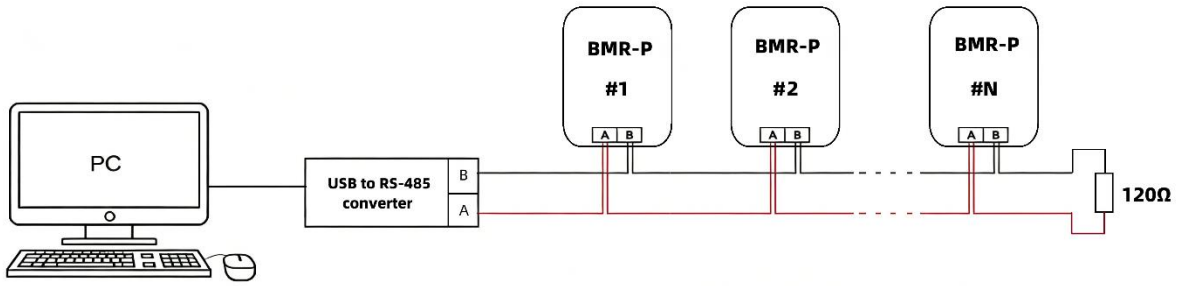
Example 4. Control via Python

```
import serial

#Typically, a USB-to-RS232/485 module is used for debugging with the module. The USB adapter module maps to a COM port on the computer, here we assume it's COM6

ser = serial.Serial('COM6',115200,timeout=1,parity=serial.PARITY_NONE)

#Config COM port

ser.write(b'AT+RES.SP=10\r\n')

# Write the AT command, here setting the resistance value to 10.

response=ser.readall().decode()

print(response)

ser.close()

#Close COM6
```

Example 5. CAN Bus User Guide

- (TBD)

Networking Test Diagram (RS-485 Version)



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