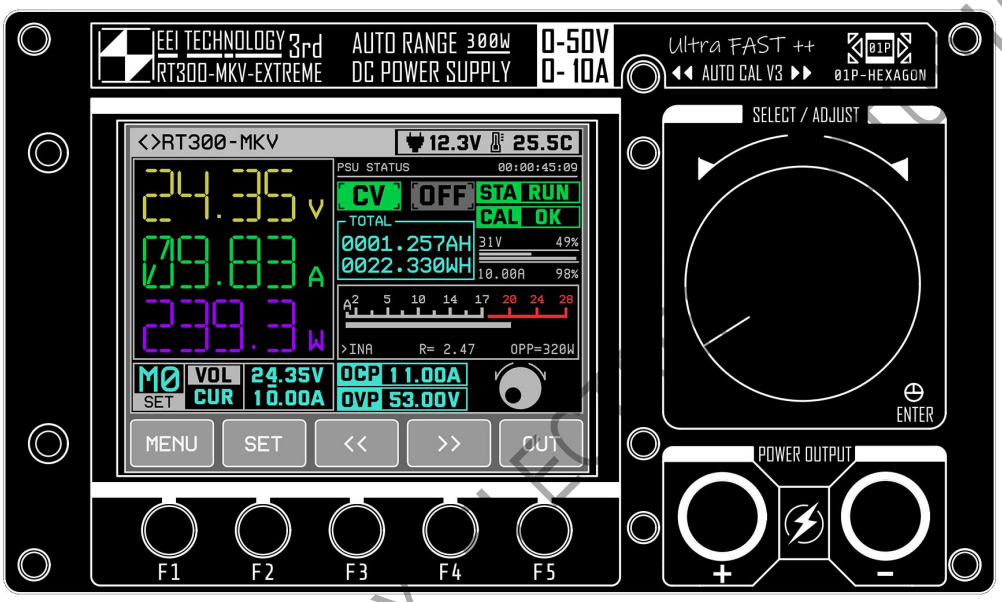
EEI TECHNOLOGY ElecStudio

01P-HEXAGON

RT300-MKV EXTREME

HEXAGON-3rd Series DC POWER SUPPLY

USER MANUAL



产品概要：

■ RT300-MKV-EXTREME 自动范围数控升降压可调直流电源，具有恒压，恒流，多重保护功能。

■采用同步整流混合功率级方案以保证高转换效率的同时，实现超宽的输出电压以及高速动态响应。

■输入端可承受 30A 的输入电流，即便是最低电压输入，也可以实现 300W 的全功率输出。

■优秀的负载调整率并且具有极低的输出电压纹波。

■高侧电流取样方案使得负载可以与输入电源共地而不影响电流测量。

■同步整流逻辑具有过零检测，有效防止输出端电流倒灌而导致设备损坏。

■采用高精度 DAC 与 ADC 配合 AUTO CAL 自校准算法保证设备的全范围测量误差小于±0.2%。

■10 组独立的掉电数据存储（电压电流设定值，保护设置）空间。

■具有电气隔离的 RS485 扩展接口，并支持 Modbus-RTU 协议。

Features(1-2)：

■RT300-MKV-EXTREME automatic range digital control step-up and step-down adjustable DC power supply, with constant voltage, constant current, and multiple protection functions.

■The synchronous rectification hybrid power stage scheme is adopted to ensure high conversion efficiency while achieving ultra-wide output voltage and high-speed dynamic response.

■The input terminal can withstand an input current of 30A, and even with the lowest voltage input, a full power output of 300W can be achieved.

■Excellent load regulation and extremely low output voltage ripple.

■The high-side current sampling scheme allows the load to be grounded to the input supply without affecting the current measurement.

Features(2-2):

■Adopt high-precision DAC and ADC combined with AUTO CAL self-calibration algorithm to make the full-range measurement error less than ±0.2%.

■10 independent groups of power-down data storage (voltage and current setting values, protection settings) space.

■It has an electrically isolated RS485 expansion interface and supports Modbus-RTU protocol.

安全说明：

* 使用本产品之前请阅读以下注意事项，以避免人身伤害以及防止损坏本产品或与本产品连接的负载。
■ 请使用合适的电源线以及保险丝，避免火灾或人身伤害。
■ 使用开关电源对本产品供电时，请保证开关电源接地良好。
■ 为了防止本产品工作时发生过热，请勿阻挡本产品尾部的出风口或进风口。
■ 请勿在通电时打开本产品的机壳。
■ 请勿在潮湿以及易燃易爆的环境下使用本产品。
■ 当怀疑产品出现故障时，请勿进行操作。

Safety instructions:

* Please read the following precautions before using this product to avoid personal injury and prevent damage to this product or the load connected to this product.
■ Please use appropriate power cords and fuses to avoid fire or personal injury.
■ When using a switching power supply to power this product, please ensure that the switching power supply is well grounded.
■ To prevent overheating when this product is working, do not block the air outlet or air inlet at the rear of the product.
■ Do not open the case while this product is working.
■ Do not use this product in humid or flammable and explosive environments.
■ Do not operate the product if you suspect it is malfunctioning.

配件列表 Accessories list

名称 NAME	备注 REMARK	数量 QUANTITY
电源主机 Power supply	RT300-MKV EXTREME	1
输入电源线 Input power cord	XT60 延长线 12AWG 硅胶线 长度 1m XT60 extension cord 12AWG silicone insulation, length 1m	1
输出电源线 Output power cord	鳄鱼夹测试线 14AWG 硅胶线 长度 1m Alligator clip test lead 14AWG silicone insulation layer length 1m	1
输入保险丝 Input fuse	插片式保险丝 30A 20A 15A Blade fuse 30A 20A 15A	1
RS485 扩展（选配） RS485 Extension (optional)	USB 开发套件 USB development kit	--
	VFD2002 开发套件 VFD2002 development kit	
	VFD253X63 开发套件 VFD253X63 development kit	

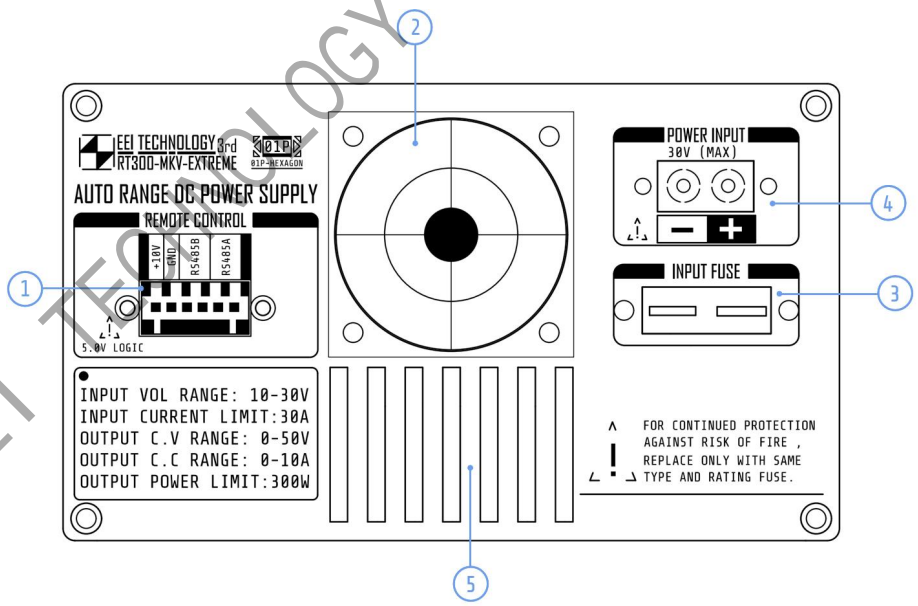
产品规格 Product specifications (1-2)

项目 Item	测试条件 Test conditions	Min	Typ	Max	Unit
操作环境 Operating environment					
海拔 Altitude		--	--	2000	m
环境温度 Ambient temperature		-10	--	+45	℃
相对湿度 Relative humidity		--	--	80	%
储存环境 Storage environment					
环境温度 Ambient temperature		-10	--	+80	℃
相对湿度 Relative humidity		--	--	80	%
电源输入 Power input					
输入电压范围 Input voltage range		11.0	--	30.0	V
最大输入电流 Maxim input current		--	--	30.0	A
电源输出 Power output					
输出电压范围 Output voltage range		0.2	--	50.0	V
输出电流范围 Output current range	V_{out} <= 30V	0	--	10.0	A
	V_{out} > 30V	0	--	300/V_{out}	A
电压设定分辨率 Voltage setting resolution		--	0.01	--	V
电压测量分辨率 Voltage measurement resolution					
电流设定分辨率 Current setting resolution		--	0.01	--	A
电流测量分辨率 Current measurement resolution					
电压测量误差 Voltage measurement error	操作温度范围内 operating temperature range	±0.2%+0.02			--
电流测量误差 Current measurement error					
输出电压动态加载偏移 Output voltage dynamic load offset	V_{in} = 11.5V V_{out} = 24V I_{out}A=0.1A I_{out}B=8A I_{Δ}=3A/us I_{freq}=50Hz	-200	--	+200	mV
输出电压动态加载恢复时间 Output voltage dynamic load recovery time		190	--	210	us
输出电压纹波 Output voltage ripple	V_{in} = 11.5V V_{out} = 24V I_{out} = 9.8A	15.5	16.0	17.0	mV_{p-p}
	V_{in} = 11.5V V_{out} = 50V I_{out} = 5.9A	16.5	17.0	19.0	mV_{p-p}
输出电压负载调整率 Output voltage load regulation	V_{in} = 11.5V V_{out} = 5.0V I_{out} = 0.1->9.9A	0.02	--	--	%
	V_{in} = 11.5V V_{out} = 50V I_{out} = 0.1->5.9A				%
转换效率（不含线损和自身耗电） Conversion efficiency(Excluding line loss and own power consumption)	V_{in} = 11.5V V_{out} = 5.0V I_{out} = 9.8A	--	91	--	%
	V_{in} = 11.5V V_{out} = 50V I_{out} = 5.9A	--	92	--	%

产品规格 Product specifications (2-2)

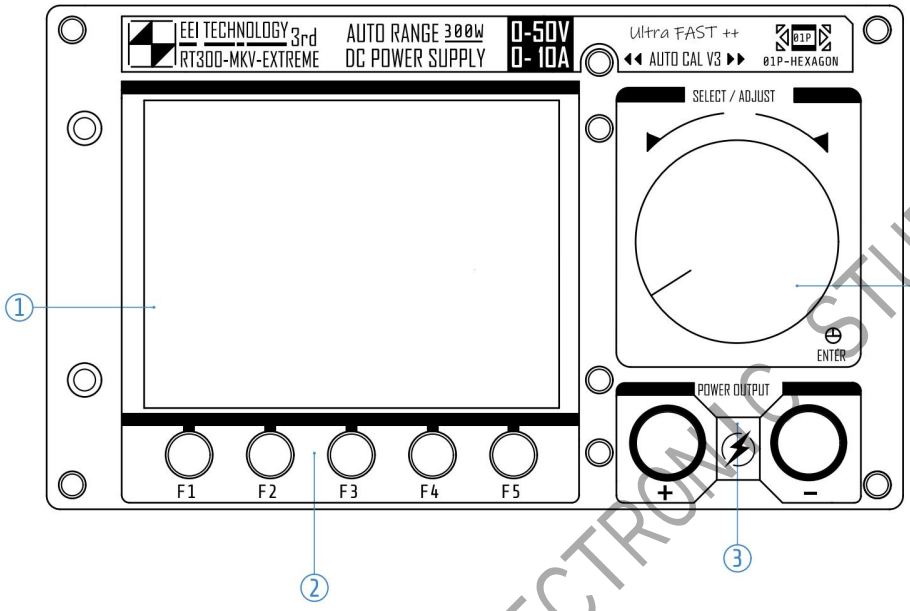
项目 Item	测试条件 Test conditions	Min	Typ	Max	Unit
扩展接口 Extension ports					
波特率 Baud rate		--	19200	--	bps
RS485 接收器输入阻抗 RS485 receiver input impedance	RS485A - RS485B	96K	--	--	Ω
RS485 逻辑高电压 logic high voltage		--	-110	-50	mV
RS485 逻辑低电压 logic low voltage		-20	-140	--	mV
RS485 驱动器输出电压 RS485 Driver output voltage	RL = Open RS485A - RS485B	--	2.9	--	V
	RL = 54Ω RS485A - RS485B	--	2.0	--	V
RS485 总线共模电压 RS485 Bus common mode voltage	RS485A RS485B - GND	-5	--	+5	V
RS485 电气隔离强度 RS485 Electrical isolation strength	PGND(Power input) - GND	1000	--	--	V_{DC}
产品外形 Product appearance					
尺寸	不含突出 Does not include protruding parts	127(L)*154(W)*75(H)			mm
重量 Weight	不含配件 No accessories included	0.81			kg

后面板图示 Rear panel diagram



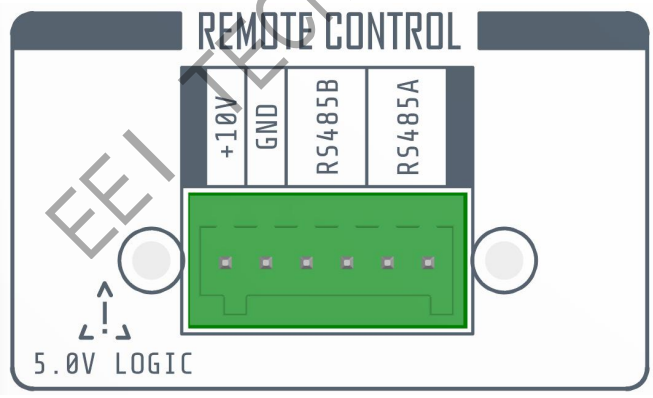
序号 NO.	说明 Description
1	扩展接口 Extension ports
2	散热进风口 Cooling air inlet
3	输入保险丝 input fuse
4	输入电源接口 Input power interface
5	散热出风口 Heat dissipation vent

前面板图示 Front panel diagram



序号 NO.	说明 Description
1	液晶显示屏 IPS LCD
2	多功能按键 Multi-function button
3	电源输出接口 Power output interface
4	多功能旋钮 Multi-functional knob

扩展接口图示 Extension ports diagram



序号 NO.	说明 Description
1	预留 Reserve
2	信号地 Signal ground
3	RS485 信号 B
4	RS-485 signal B
5	RS485 信号 A
6	RS-485 signal A

EDGKD-2.5-6P

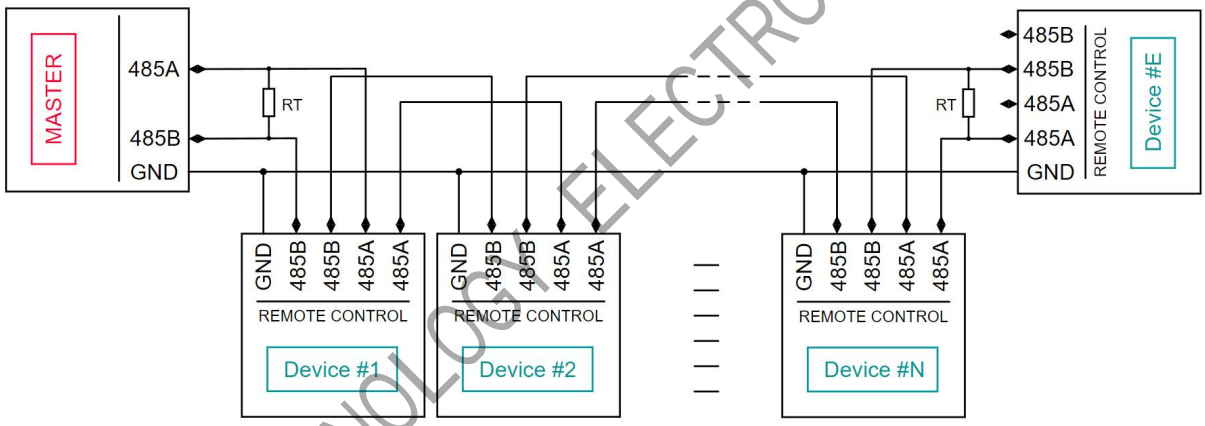
* 请勿热插拔该接口。Do not hot plug this interface.

* 注意静电防护。 Attention to static protection.

多设备组网 Multi-device networking

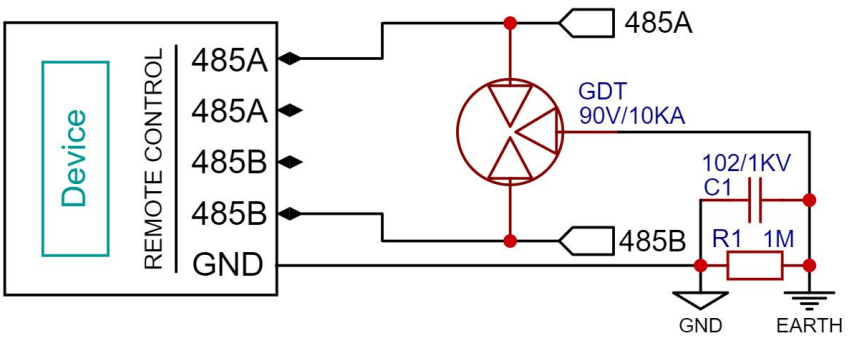
* 建议使用菊花链总线方式连接多个设备。
* 当总线通信距较远(>300m)时，主站和最远的从站应当在 485A-485B 两端并联终端电阻 RT 以避免信号反射干扰。
* 本设备 RS485 接收器阻抗为 96KΩ，即 1/8 单位负载，因此一条总线理论上最多可挂载 256 台设备(包括主站)。
* 一条总线上只允许存在一个主站。
* It is recommended to use daisy chain bus to connect multiple devices.
* When the bus communication distance is far (>300m), the master station and the farthest slave station should connect terminal resistors RT in parallel at both ends of 485A-485B to avoid signal reflection interference.
* The RS485 receiver impedance of this device is 96KΩ, which is 1/8 unit load, so a bus can theoretically carry up to 256 devices (including the master station).
* Only one master station is allowed on a bus.

简化示意图 Simplified schematic diagram



雷击和高压防护 Lightning and high voltage protection

* 设备内部自带 ESD 防护电路，因此在良好的应用环境下，不需要增加额外保护措施。
* 如应用环境恶劣(高压电，雷击)，则需要额外增加保护电路，如下图所示。
* The device has its own ESD protection circuit, so in a good application environment, no additional protection measures are required.
* If the application environment is harsh (high voltage, lightning strike), additional protection circuits are required, as shown in the figure below.



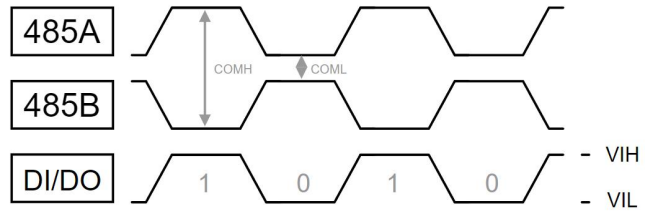
串行通信协议 Serial Communication Protocol

* 本设备采用 Modbus-RTU 通信协议，以 RS-485 作为通信介质。

* This device uses Modbus-RTU communication protocol and RS-485 as the communication medium.

下图展示了 RS-485 与串行数据输入/输出的逻辑关系。

The following figure shows the logical relationship between RS-485 and serial data input/output.



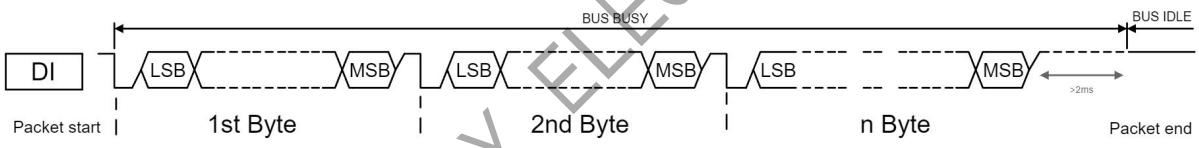
注：该设备的信号地应当与总线上其他设备的信号地良好连接，否则可能会导致通信异常或者设备损坏。

Note: The signal ground of this device should be well connected with the signal ground of other devices on the bus, otherwise it may cause communication abnormality or device damage.

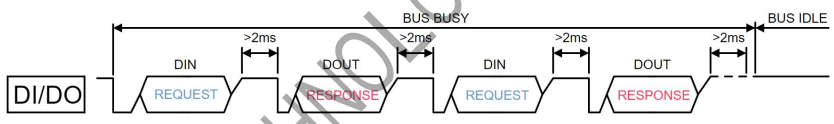
* 串行传输时序 Serial transmission timing

一个字节 One byte

一帧 RTU 报文 One RTU Message



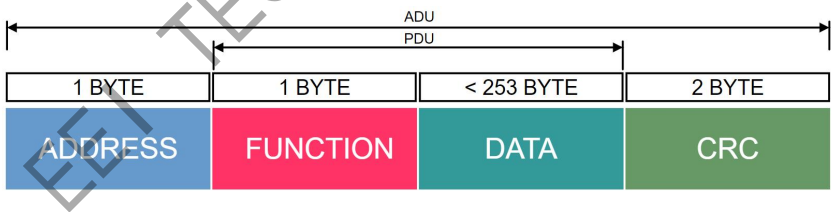
主站请求和从站响应 Master station request and slave station response



注：主站向设备发送 RTU 报文之后，需要等待设备解析数据并回应，在此之前总线都处于忙状态，任何发向从站的数据都视为无效。

Note: After the master station sends an RTU message to the device, it needs to wait for the device to parse the data and respond. Before that, the bus is in a busy state, and any data sent to the slave station is considered invalid.

Modbus-RTU 报文格式 Message format



* Modbus-RTU 功能列表 Function list

功能码 Function code (Hex)	说明 Description	备注 Remark
0x01	读取线圈状态 Read coils	该功能仅支持单播 This function only supports unicast
0x02	读取离散输入状态 Read Discrete Input	
0x03	读取寄存器 Read Registers	
0x05	写单个线圈 Write Single Coil	该功能支持广播写入 This function supports broadcast writing
0x06	写单个寄存器 Write Single Register	
0x10	写多个寄存器 Write Multiple Register	

序号 NO.	命令 Command	Byte	MSB B7	B6	B5	B4	B3	B2	B1	LSB B0	Hex	说明 Description
支持广播和单播 Support broadcast and unicast												
1	写单个线圈 Write Single Coil	1st	0	0	0	0	0	1	0	1	0x05	功能码 Function code
		2nd	A15	A14	A13	A12	A11	A10	A9	A8	--	寄存器地址 Register address
		3rd	A7	A6	A5	A4	A3	A2	A1	A0	--	
		4th	D15	D14	D13	D12	D11	D10	D9	D8	--	寄存器数据 Register data
		5th	D7	D6	D5	D4	D3	D2	D1	D0	--	
2	写单个寄存器 Write Single Register	1st	0	0	0	0	0	1	1	0	0x06	功能码 Function code
		2nd	A15	A14	A13	A12	A11	A10	A9	A8	--	寄存器地址 Register address
		3rd	A7	A6	A5	A4	A3	A2	A1	A0	--	
		4th	D15	D14	D13	D12	D11	D10	D9	D8	--	寄存器数据 Register data
		5th	D7	D6	D5	D4	D3	D2	D1	D0	--	
3	写多个寄存器 Write Multiple Register	1st	0	0	0	1	0	0	0	0	0x10	功能码 Function code
		2nd	A15	A14	A13	A12	A11	A10	A9	A8	--	寄存器起始地址 Register start address
		3rd	A7	A6	A5	A4	A3	A2	A1	A0	--	
		4th	C15	C14	C13	C12	C11	C10	C9	C8	--	寄存器数量 Register quantity
		5th	C7	C6	C5	C4	C3	C2	C1	C0	--	
		6th	P7	P6	P5	P4	P3	P2	P1	P0	--	数据字节数量 Number of data bytes
		7th	D15	D14	D13	D12	D11	D10	D9	D8	--	寄存器数据 1 Register data1
		8th	D7	D6	D5	D4	D3	D2	D1	D0	--	
		--	--	--	--	--	--	--	--	--	--	--
		n	D15	D14	D13	D12	D11	D10	D9	D8	--	寄存器数据 n Register data n
		n	D7	D6	D5	D4	D3	D2	D1	D0	--	
仅支持单播 Only supports unicast												
4	读取线圈状态 Read coils	1st	0	0	0	0	0	0	0	1	0x01	功能码 Function code
		2nd	A15	A14	A13	A12	A11	A10	A9	A8	--	寄存器起始地址 Register start address
		3rd	A7	A6	A5	A4	A3	A2	A1	A0	--	
		4th	C15	C14	C13	C12	C11	C10	C9	C8	--	寄存器数量 Register quantity
		5th	C7	C6	C5	C4	C3	C2	C1	C0	--	
5	读取离散输入状态 Read Discrete Input	1st	0	0	0	0	0	0	1	0	0x02	功能码 Function code
		2nd	A15	A14	A13	A12	A11	A10	A9	A8	--	寄存器起始地址 Register start address
		3rd	A7	A6	A5	A4	A3	A2	A1	A0	--	
		4th	C15	C14	C13	C12	C11	C10	C9	C8	--	寄存器数量 Register quantity
		5th	C7	C6	C5	C4	C3	C2	C1	C0	--	
5	读取寄存器 Read Registers	1st	0	0	0	0	0	0	1	1	0x03	功能码 Function code
		2nd	A15	A14	A13	A12	A11	A10	A9	A8	--	寄存器起始地址 Register start address
		3rd	A7	A6	A5	A4	A3	A2	A1	A0	--	
		4th	C15	C14	C13	C12	C11	C10	C9	C8	--	寄存器数量 Register quantity
		5th	C7	C6	C5	C4	C3	C2	C1	C0	--	

Modbus-RTU 指令概要 Command summary

0x05	写单个线圈 Write Single Coil								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
功能码 Function code	0	0	0	0	0	1	0	1	0x05
寄存器地址	A15	A14	A13	A12	A11	A10	A9	A8	--
Register address	A7	A6	A5	A4	A3	A2	A1	A0	--
寄存器数据	D15	D14	D13	D12	D11	D10	D9	D8	--
Register data	D7	D6	D5	D4	D3	D2	D1	D0	--

说明
Description

(1) 该命令用于写入开关量。
(2) D[15:0] = 0xFF00 表示开启，D[15:0] = 0x0000 表示关闭
(3) 该命令支持广播写入，广播写入后，设备不会发送应答帧。
(4) 该命令设定的参数将在设备重启之后恢复默认。
(5) 下图展示了寄存器地址和功能的关系。

(1) This command is used to write the switch value.
(2)D[15:0] = 0xFF00 means on, D[15:0] = 0x0000 means off
(3) This command supports broadcast writing. After broadcast writing, the device will not send a response frame.
(4) The parameters set by this command will be restored to default after the device is restarted.
(5) The following figure shows the relationship between register address and function.

地址 Address	功能 Function
0x0000	电源输出使能 Power supply output enable
0x0001	蜂鸣器使能 Buzzer Enable
0x0002	屏幕背光控制 Display backlight control
0x0003	面板锁定控制 Panel lock control
0x0004	清空能量计数 Clear energy count
0x0005	预留 Reserve
0x0006	
0x0007	
0x0008	
0x0009	
0x000A	
0x000B	
0x000C	
0x000D	
0x000E	
0x000F	

0x06	写单个寄存器 Write Single Register								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
功能码 Function code	0	0	0	0	0	1	1	0	0x06
寄存器地址	A15	A14	A13	A12	A11	A10	A9	A8	--
Register address	A7	A6	A5	A4	A3	A2	A1	A0	--
寄存器数据	D15	D14	D13	D12	D11	D10	D9	D8	--
Register data	D7	D6	D5	D4	D3	D2	D1	D0	--
说明 Description	(1) 该命令用于写入寄存器，一次只能写入一个。 (2) 该命令支持广播写入，广播写入后，设备不会发送应答帧。 (3) 该命令写入的参数会被保存。 (1) This command is used to write registers. Only one register can be written at a time. (2) This command supports broadcast writing. After broadcast writing, the device will not send a response frame. (3) The parameters written by this command will be saved.								

0x10	写多个寄存器 Write Single Register								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
功能码 Function code	0	0	0	1	0	0	0	0	0x10
寄存器地址	A15	A14	A13	A12	A11	A10	A9	A8	--
Register address	A7	A6	A5	A4	A3	A2	A1	A0	--
寄存器数量	C15	C14	C13	C12	C11	C10	C9	C8	--
Register quantity	C7	C6	C5	C4	C3	C2	C1	C0	--
数据字节数量 Number of data bytes	P7	P6	P5	P4	P3	P2	P1	P0	--
寄存器数据 1	D15	D14	D13	D12	D11	D10	D9	D8	--
Register data1	D7	D6	D5	D4	D3	D2	D1	D0	--
--	--	--	--	--	--	--	--	--	--
寄存器数据 n	D15	D14	D13	D12	D11	D10	D9	D8	--
Register data n	D7	D6	D5	D4	D3	D2	D1	D0	--
说明 Description	(1) 该命令用于写入寄存器，一次可以写入多个寄存器。 (2) 该命令支持广播写入，广播写入后，设备不会发送应答帧。 (3) 该命令写入的参数会被保存。 (4) C[15:0]表示需要写入寄存器的数量,P[7:0]表示需要写入寄存器数据的字节总数。 (1) This command is used to write registers. Multiple registers can be written at one time. (2) This command supports broadcast writing. After broadcast writing, the device will not send a response frame. (3) The parameters written by this command will be saved. (4)C[15:0] indicates the number of registers to be written, and [P7:0] indicates the total number of bytes of register data to be written.								

0x01	读取线圈状态 Read coils								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
功能码 Function code	0	0	0	0	0	0	0	1	0x01
寄存器起始地址	A15	A14	A13	A12	A11	A10	A9	A8	--
Register start address	A7	A6	A5	A4	A3	A2	A1	A0	--
寄存器数量	D15	D14	D13	D12	D11	D10	D9	D8	--
Register quantity	D7	D6	D5	D4	D3	D2	D1	D0	--
说明 Description	(1) 该命令用于读取开关量。 (2) 该命令一个地址或数量对应 1bit 数据。 (3) 该命令仅支持单播。 (4) 寄存器地址和功能的映射表参考"写单个线圈"。 (1) This command is used to read the switch value. (2)In this command, one address or quantity corresponds to 1 bit of data. (3) This command only supports unicast. (4) For the mapping table of register address and function, refer to "Write Single Coil"								

0x02	读取离散输入状态 Read Discrete Input								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
功能码 Function code	0	0	0	0	0	0	1	0	0x02
寄存器起始地址	A15	A14	A13	A12	A11	A10	A9	A8	--
Register start address	A7	A6	A5	A4	A3	A2	A1	A0	--
寄存器数量	D15	D14	D13	D12	D11	D10	D9	D8	--
Register quantity	D7	D6	D5	D4	D3	D2	D1	D0	--
说明 Description	(1) 该命令用于读取设备状态信息。 (2) 该命令仅支持单播。 (1) This command is used to read device status information. (2) This command only supports unicast.								

0x03	读取寄存器 Read Registers								
Bit	B7	B6	B5	B4	B3	B2	B1	B0	Hex
功能码 Function code	0	0	0	0	0	0	1	1	0x02
寄存器起始地址	A15	A14	A13	A12	A11	A10	A9	A8	--
Register start address	A7	A6	A5	A4	A3	A2	A1	A0	--
寄存器数量	D15	D14	D13	D12	D11	D10	D9	D8	--
Register quantity	D7	D6	D5	D4	D3	D2	D1	D0	--
说明 Description	(1) 该命令用于读取设备寄存器数据。 (2) 该命令仅支持单播。 (1) This command is used to read the device register data. (2) This command only supports unicast.								

离散输入寄存器映射表 Discrete Input Register Mapping Table

地址 Address	功能 Function
0x0001	当前调节目标 Current adjustment target 0 = CV, 1 = CC
0x0002	当前调节倍数 Current adjustment multiple (0x0002=M0, 0x0003=M1)
0x0003	M[1:0]=0x00,1X M[1:0]=0x01, 0.1X M[1:0]=0x02, 0.01X
0x0004	当前输出模式 Current output mode 0 = CV, 1 = CC
0x0005	设备运行状态 Device status (0x0005=C0, 0x0006=C1, 0x0007=C2)
0x0006	C[2:0]=0x00, Normal C[2:0]=0x01, OCP C[2:0]=0x02, OVP C[2:0]=0x03, OPP
0x0007	C[2:0]=0x04, UVP
0x0008-0x000F	预留 Reserve
备注 Remark	
一个地址对应 1bit One address corresponds to 1 bit	

保持寄存器映射表 Holding Register Mapping Table

地址 Address	功能 Function	类型 Type	范围 Range	倍数 Multiple
0x0001	输出电压 Output voltage	R	0-5000	0.01
0x0002	输出电流 Output current	R	0-10000	0.001
0x0003	输出功率 Output power	R	0-30000	0.01
0x0004	输入电压 Input voltage	R	0-3500	0.01
0x0005	内部温度 Internal temperature	R	0-1000	0.01
0x0007-0x0007	累计能量计数 Total energy count mAH	R	0-9999999	0.001
0x0008-0x0009	累计能量计数 Total energy count mWH	R	0-9999999	0.001
0x000A-0x000C	设备序列号 Device serial number	R	--	--
0x000D	数据存储组 Data storage group	R/W	0-9	1
0x000E	过功率保护设定 Setting OPP	R/W	0-320	1
0x000F	欠压保护设定 Setting UVP	R/W	1000-2800	0.01
0x0010-0x0019	设定电压 Setting voltage M0-M9	R/W	0-5000	0.01
0x001A-0x0023	设定电流 Setting current M0-M9	R/W	0-10000	0.001
0x0024-0x002D	过压保护设定 Setting OVP M0-M9	R/W	0-5300	0.01
0x002E-0x0037	过流保护设定 Setting OCP M0-M9	R/W	0-1000	0.01
0x0038-0x003F	预留 Reserve			

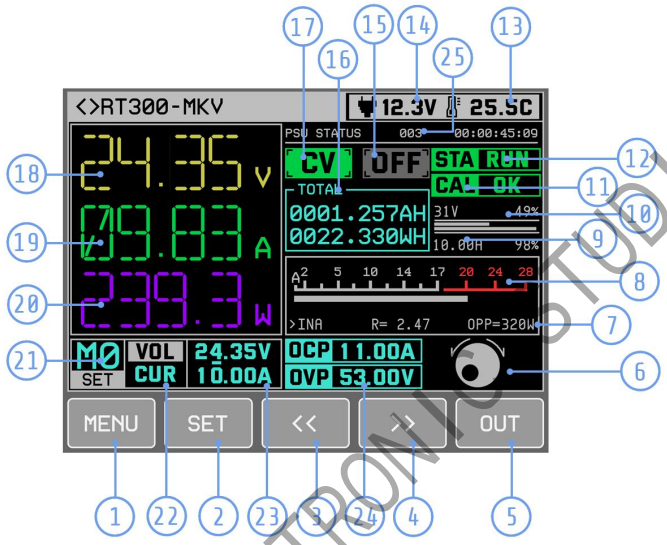
Modbus-RTU 异常码 Abnormal code

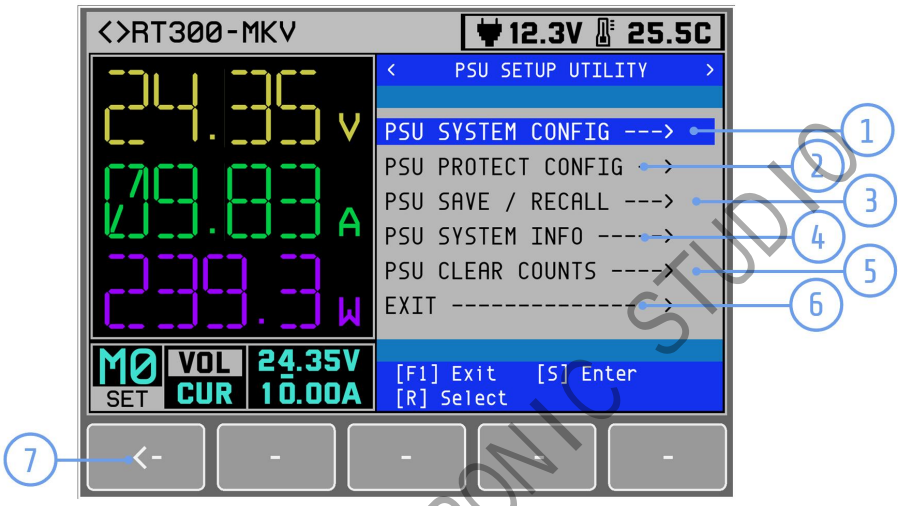
异常码 Abnormal code	说明 Description
0x01	设备不支持请求的功能码 The device does not support the requested function code
0x02	请求的数据地址不存在 The requested data address does not exist
0x03	写入的数据值超出了范围 The data value written is out of range
0x04	设备故障，无法处理请求 The device failed and cannot process the request.
0x05	设备收到了请求，但需要较长时间处理 The device received the request, but it took a long time to process
0x06	设备正在处理其他指令 The device is processing other instructions
0x08	CRC 校验错误 CRC check error

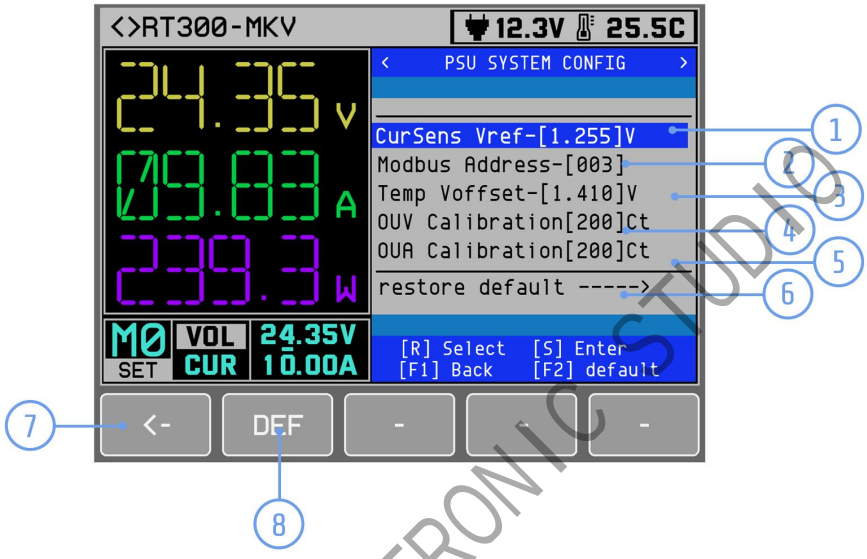
Modbus-RTU 设备响应 Device response

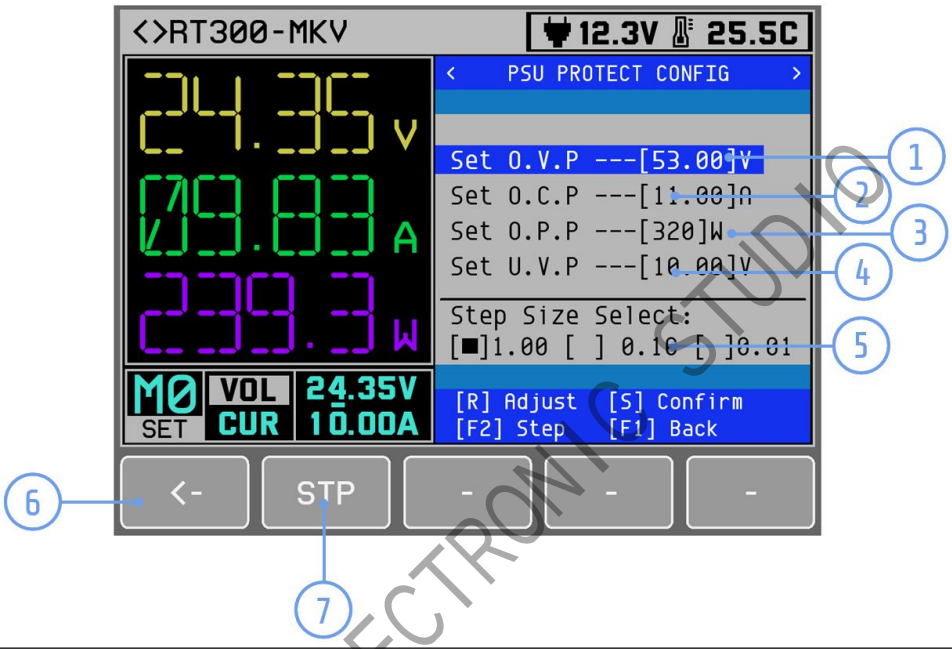
正常响应 Normal response		
功能 Function	字节 Byte	说明 Description
所有读取操作 All read operations	1st	从站地址 Slave Address
	2nd	功能码 Function code
	3rd	数据字节数 Returns the number of bytes of data
	4th	寄存器数据 1 高字节 Register data 1 MSB
	5th	寄存器数据 1 低字节 Register data 1 LSB
	--	--
	N	寄存器数据 N 高字节 Register data N MSB
	N+1	寄存器数据 N 低字节 Register data N LSB
	N+2	CRC 校验高字节 CRC Check MSB
	N+3	CRC 校验低字节 CRC Check LSB
写单个线圈,寄存器 Write Single Coil, Register	1st	从站地址 Slave Address
	2nd	功能码 Function code
	3rd	寄存器地址高字节 Register address MSB
	4th	寄存器地址低字节 Register address LSB
	5th	寄存器数据高字节 Register data 1 MSB
	6th	寄存器数据低字节 Register data 1 LSB
	7th	CRC 校验高字节 CRC Check MSB
	8th	CRC 校验低字节 CRC Check LSB
写多个寄存器 Write Multiple Register	1st	从站地址 Slave Address
	2nd	功能码 Function code
	3rd	寄存器地址高字节 Register address MSB
	4th	寄存器地址低字节 Register address LSB
	5th	寄存器数量高字节 Register quantity MSB
	6th	寄存器数量低字节 Register quantity LSB
	7th	数据字节数 Returns the number of bytes of data
	8th	CRC 校验高字节 CRC Check MSB
	9th	CRC 校验低字节 CRC Check LSB
异常响应 Abnormal response		
非法操作,通信,设备异常 Illegal operation, communication, device abnormality	1st	从站地址 Slave Address
	2nd	差错码=功能码+128 Error code = function code + 128
	3rd	异常码 Abnormal code
	4th	CRC 校验高字节 CRC Check MSB
	5th	CRC 校验低字节 CRC Check LSB

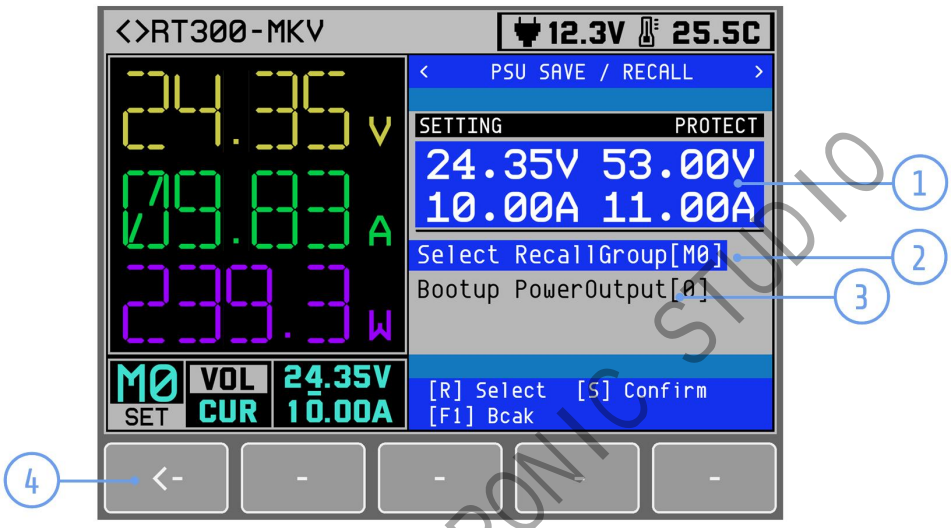
功能说明 Function Description

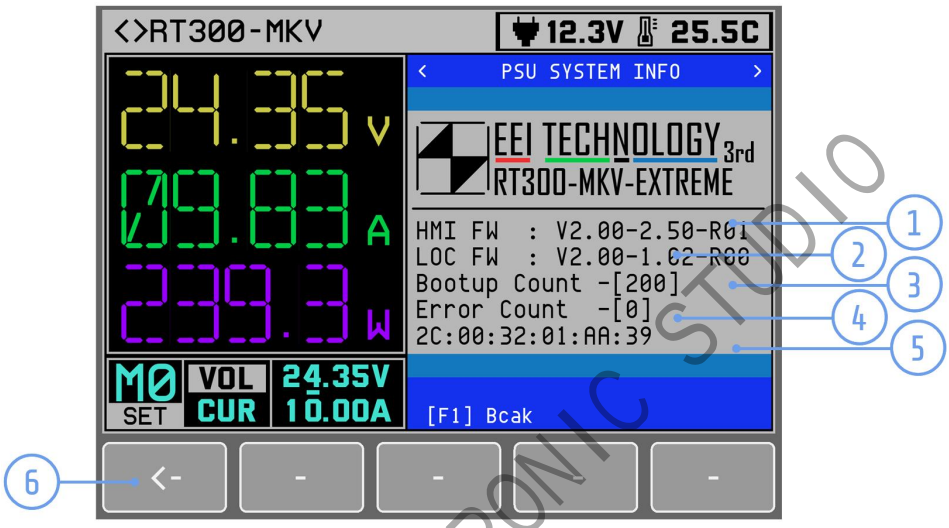
主界面显示说明 Main page display instructions	
显示图例 Display diagram	
说明 Description	1.打开菜单页面。Open the menu page. 2.切换调节目标。Switch the adjustment target. 3.增加 10 倍调节倍率。Increase the adjustment multiple by 10 times. 4.减小 10 倍调节倍率。Reduce the adjustment multiple by 10 times. 5.打开/关闭电源输出。Turn power output on/off. 6.操作锁定/解锁状态显示。Operation lock/unlock status display. 7.输出负载等效电阻估算和过功率保护设定值。Output load equivalent resistance estimation and over-power protection setting value. 8.输入电流估算。Input current estimate. 9.输出电流上限以及当前输出百分比。Output current upper limit and current output percentage. 10.预升压设定值以及输出电压百分比。Pre-boost setting value and output voltage percentage. 11.校准状态指示。Calibration status indication. 12.设备状态指示。Device status indication. 13.当前设备温度。Current device temperature. 14.当前输入电压。Current input voltage. 15.输出开关状态指示。Output switch status indication. 16.累计能量计数。Cumulative energy count. 17.电源输出模式指示。Power output mode indication. 18.当前输出电压。output voltage. 19.当前输出电流。Output current. 20.当前输出功率。Output Power. 21.当前数据存储组。Current data storage group 22.调节目标指示。Adjust target indication. 23.当前电压/电流设定值。Voltage/current setting value. 24.当前过压/过流保护设定值。Overvoltage/overcurrent protection setting value. 25.Modbus 设备地址。Modbus Device address. 注： 在此界面下转动多功能旋钮以调节电压/电流，短按多功能旋钮打开/关闭蜂鸣器，长按锁定/解锁设备。 Note: In this page, turn the multi-function knob to adjust voltage/current, short press the multi-function knob to turn on/off the buzzer, and long press to lock/unlock the device.

菜单界面说明 Menu page description	
显示图例 Display diagram	
说明 Description	1.打开系统设置界面。Open the system settings page. 2.打开保护设置界面。Open the protection settings page.. 3.打开数据存储/读取界面。Open the data save/recall page. 4.打开系统信息界面。Open the system information page. 5.清空能量计数。Clear energy count. 6.退出，返回主界面。Exit and return to the main page. 7.退出，返回主界面。Exit and return to the main page.
	在此界面下转动多功能旋钮移动光标到所选项目，短按多功能旋钮确定选择。 In this page, turn the multi-function knob to move the cursor to the selected item, and press the multi-function knob briefly to confirm the selection.

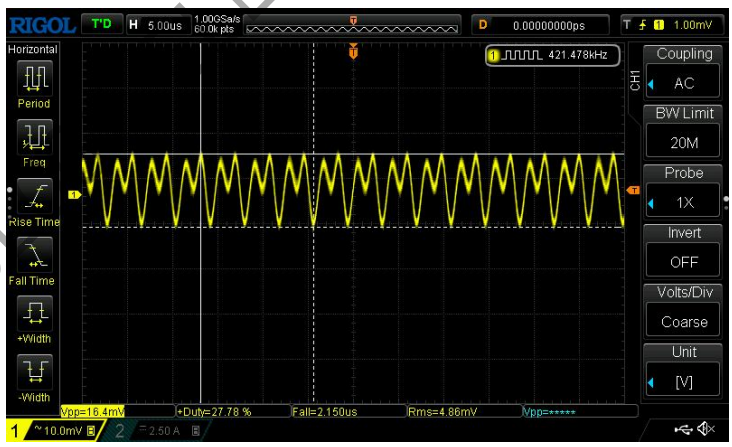
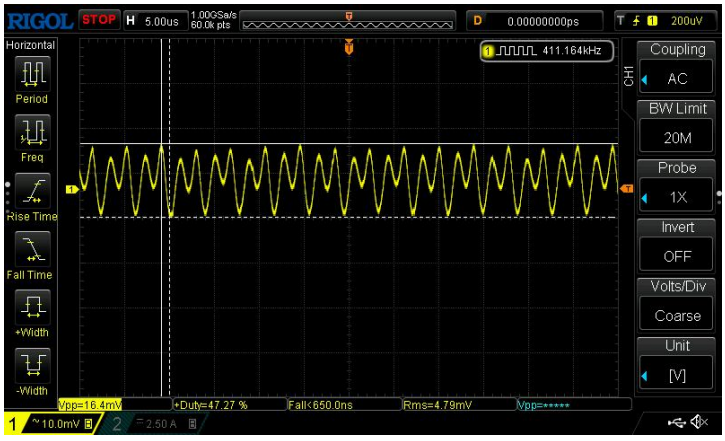
系统设置界面说明 System config page description	
显示图例 Display diagram	
说明 Description	1.电流传感器偏置电压。Current sensor bias voltage. 2.Modbus 设备地址设定。 Modbus Device address setting. 3.温度传感器中点温度电压。Temperature sensor midpoint temperature voltage. 4.输出电压校准。Output voltage calibration. 5.输出电流校准。Output current calibration. 6.恢复默认设置。Restore the default settings. 7.退出，返回主菜单。Exit and return to the main menu. 8.恢复默认设置，按下后光标跳转到①位置， 此时短按多功能旋钮恢复默认。 Restore the default settings, and press the cursor to jump to the① position, At this time, the multi -function knob is restored to the default.
	在此界面下转动多功能旋钮移动光标到所选项目，短按多功能旋钮确定选择。 In this page, turn the multi-function knob to move the cursor to the selected item, and press the multi-function knob briefly to confirm the selection. 确认选择后，转动多功能旋钮增加/减小调节数值。 After confirming the selection, turn the multi-function knob to increase/decrease the adjustment value.

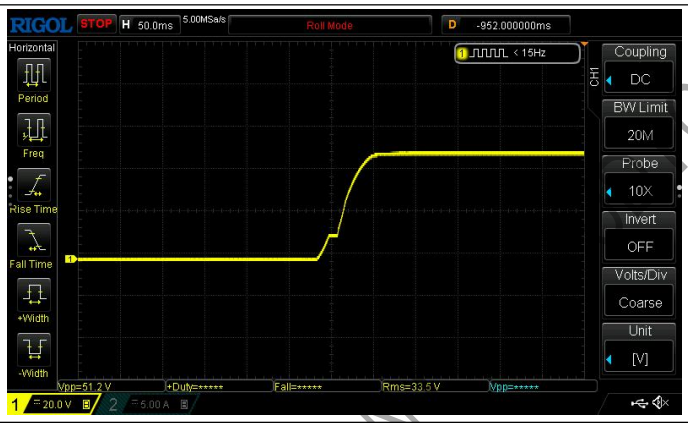
保护设置界面说明 Protection page description	
显示图例 Display diagram	
说明 Description	1.输出过压保护设定。Output overvoltage protection setting. 2.输出过流保护设定。Output overcurrent protection setting. 3.输出过功率保护设定。Output over-power protection setting. 4.输入欠压保护设定。Input undervoltage protection setting. 5.调节倍数指示。 Adjust multiple indication. 6.退出，返回主菜单。Exit and return to the main menu. 7.调节倍数切换。Adjustment multiple switching.
	在此界面下转动多功能旋钮移动光标到所选项目，短按多功能旋钮确定选择。 In this page, turn the multi-function knob to move the cursor to the selected item, and press the multi-function knob briefly to confirm the selection. 确认选择后，转动多功能旋钮增加/减小调节数值。 After confirming the selection, turn the multi-function knob to increase/decrease the adjustment value. 短按“STP”切换调节倍率。 Short press "STP" to switch the adjustment multiple. 当打开该界面时，输出会被强制关闭。 when the page is opened, the output will be forced to close.

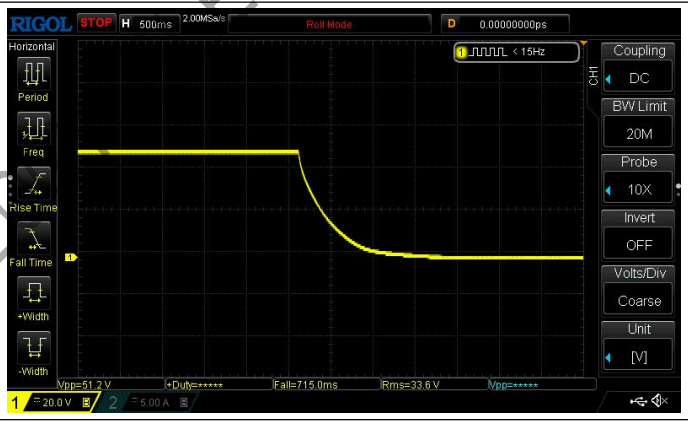
数据保存/读取界面说明 Data save/recall page description	
显示图例 Display diagram	
说明 Description	1.数据预览窗口，输出设定值和保护设定值。 Data preview window, output settings and protection settings. 2.选择数据存储组。Select the data storage group. 3.开机默认输出打开/关闭。Open the default output to open/close. 4.退出，返回主菜单。Exit and return to the main menu. 在此界面下转动多功能旋钮移动光标到所选项目，短按多功能旋钮确定选择。 In this page, turn the multi-function knob to move the cursor to the selected item, and press the multi-function knob briefly to confirm the selection. 确认选择后，转动多功能旋钮增加/减小调节数值。 After confirming the selection, turn the multi-function knob to increase/decrease the adjustment value. 电源的设定数据（输出电压，电流，过压，过流保护）会被存储在所选择的数据存储组内。 The setting data (output voltage, current, overvoltage, overcurrent protection) of the power supply will be stored in the selected data storage group. 为了防止操作切换存储组时导致负载损坏，当打开该界面时，输出会被强制关闭。 In order to prevent the load damage during the change of the group, when the page is opened, the output will be forced to close.

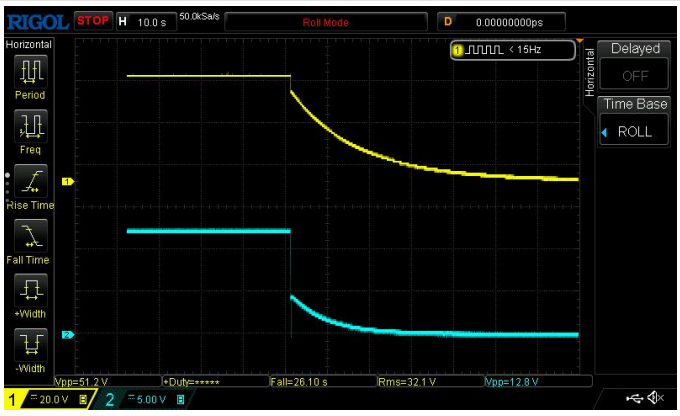
系统信息界面说明 System information page description	
显示图例 Display diagram	
说明 Description	1.显示模块固件版本。HMI module firmware versions 2.电源模块固件版本。Power module firmware versions 3.累计开机次数。Cumulative number of boot up. 4.累计错误次数。Cumulative number of errors. 5.设备序列号。Device serial number. 6.退出，返回主菜单。Exit and return to the main menu.

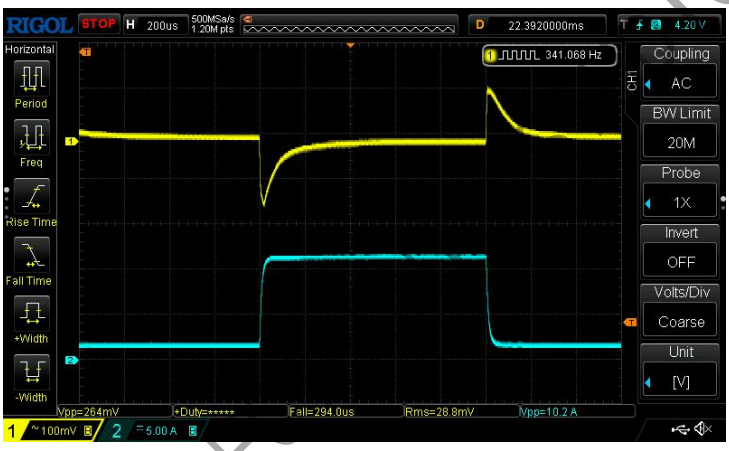
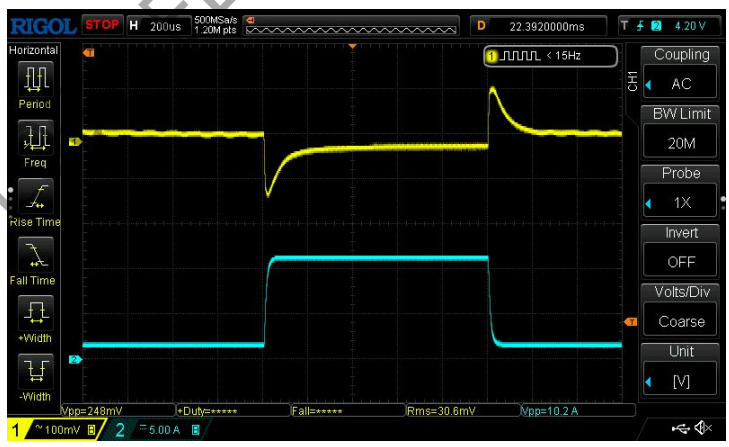
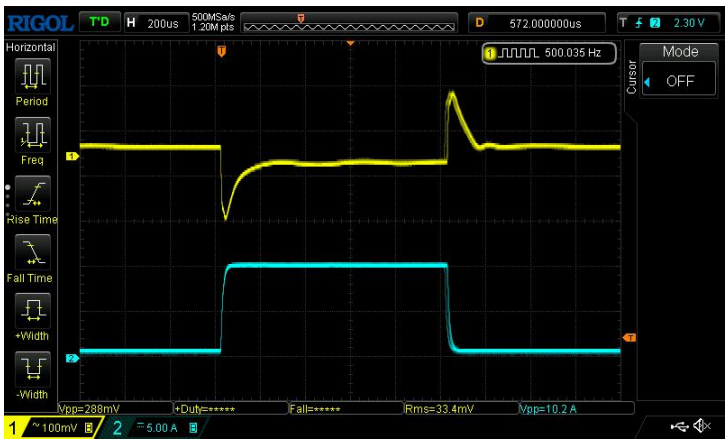
测试报告 Testing report

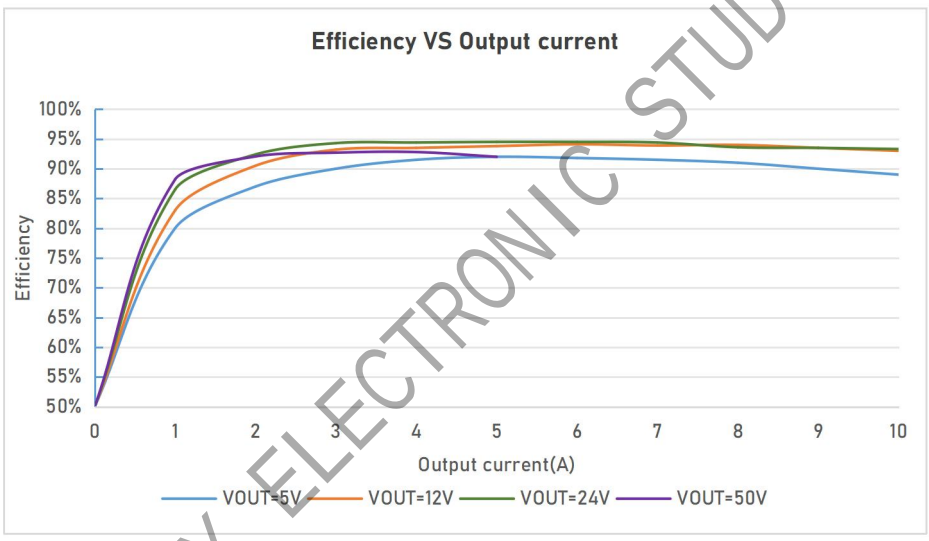
输出电压纹波 Output voltage ripple	
备注 Remark	在输出端子测得 Measured at the output terminal
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 5.0V I_{out} = 9.8A BW=20MHz
波形图 Waveform graph	
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 24V I_{out} = 9.8A BW=20MHz
波形图 Waveform graph	
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 50V I_{out} = 5.9A BW=20MHz
波形图 Waveform graph	

输出电压建立 Output voltage builds	
备注 Remark	在输出端子测得 Measured at the output terminal
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 50V no load BW=20MHz CH1=VOUT
波形图 Waveform graph	

输出关闭 Output off	
备注 Remark	在输出端子测得 Measured at the output terminal
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 50V no load BW=20MHz CH1=VOUT
波形图 Waveform graph	

输入关闭 Input off	
备注 Remark	在输出端子测得 Measured at the output terminal
测试条件 Test Conditions	V_{in} = 11.5V->0V V_{out} = 50V no load BW=20MHz CH1=VOUT CH2=VIN
波形图 Waveform graph	

负载瞬态响应 Load Transient Response	
备注 Remark	在输出端子测得 Measured at the output terminal
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 24V I_{out} = 0.8A->9.9A->0.8A I_{Δ}=3A/us BW=20MHz CH1=VOUT CH2=IOUT
波形图 Waveform graph	
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 12V I_{out} = 0.8A->9.9A->0.8A I_{Δ}=3A/us BW=20MHz CH1=VOUT CH2=IOUT
波形图 Waveform graph	
测试条件 Test Conditions	V_{in} = 11.5V V_{out} = 5.0V I_{out} = 0.8A->9.9A->0.8A I_{Δ}=3A/us BW=20MHz CH1=VOUT CH2=IOUT
波形图 Waveform graph	

电源转换效率 Power conversion efficiency	
备注 Remark	输入端测试点位于输入电感前。 The input test point is located in front of the input inductor. 不包含线损和自身耗电。 Excludes line loss and own power consumption.
测试条件 Test Conditions	V_{in} = 11.5V T_A = 25°C
图表 graph	

安全操作范围 safe operating range	
备注 Remark	
测试条件 Test Conditions	相对湿度 < 80% Relative humidity < 80%
图表 graph