

CANBUS Protocol of High Voltage system

| Change record | | | | |
|----------------------|----------------|----------------|---|---------------|
| Date | Version | Chapter | Description | Author |
| 2016/7/19 | 1.00 | | First Version. | 邹慧兴 |
| 2016/8/15 | 1.01 | | 1、Add sleep wake up control/增加休眠唤醒控制/ 2、Add relay faulty check./ 增加继电器检测故障 | 姜炜 |
| 2016/8/17 | 1.02 | | Add charge/discharge command./ 增加充放电命令 | 姜炜 |
| 2016/11/15 | 1.03 | | Add forced charge and balance charge flag bit /增加强充、均充标志位 | 姜炜 |
| 2016/12/04 | 1.04 | | Add broadcast to get information of battery cell and module /增加广播获取单芯及模块信息 | 邹慧兴 |
| 2016/12/19 | 1.05 | | Add voltage, temperature value, alarm and protection of module /增加电池模块电压温度值及告警保护信息 告警保护信息 | 姜炜 |
| 2016/12/22 | 1.06 | | Add system equipment information/ 增加系统装备信息 Add commando of relay force to break/ 增加继电器强制断开命令 | 姜炜 |
| 2017/01/03 | 1.07 | | New composing for external PCS communication or internal BMCU communication/ 调整文本顺序，便于区分对外 PSC 通信或者内部 BMCU 模块通信 | 邹慧兴 |
| 2017/01/12 | 1.08 | | Add charge forbidden and discharge forbidden mark. 增加禁止充电，禁止放电标志 | 邹慧兴 |

| | | | | |
|------------|------|--------------|---|------|
| 2017/08/22 | 1.09 | | Add mark of connect multi-racks(pile) in parallel 增加并柜标志 | 秦威 |
| 2017/9/22 | 1.10 | | Add mark of connect multi-rack(pile) in parallel in all broadcast frames 所有广播帧中增加并柜标志 | 姜炜 |
| 2017/11/08 | 1.11 | | Add mark of "other error" 增加“其他故障”标志 | |
| 2018/03/27 | 1.12 | | 去掉并柜标志，去除无关指令，此协议只做对外通信对接使用。 Delete mark of connect multi-racks(pile) in parallel, delete irrelevant internal communication command, this protocol is for customer only. | 姜炜 |
| 2018/04/02 | 1.13 | | 增加临时屏蔽“外部通信故障”功能 Add function of keep relay on even there is no communication. | 姜炜 |
| 2018/06/12 | 1.14 | 1.2 Page8 | 系统装备信息响应数据 Revise System Device information's response data 1. 调整系统装备信息中的“硬件版本信息”和“软件版本信息” Revise the "hardware version info." and "software version info." In the system device information data 2. 系统装备信息中电池容量信息由一个字节改为 2 字节表示，原来只支持最大 255AH，改后最大 65535AH Revise the system device information's data from 1bit to 2bits, so that the battery capacity can be showed from 255Ah to 65535Ah | 邹慧兴 |
| 2018/09/25 | 1.15 | Table 2 | 增加电池损坏故障位 Add Battery cell error mark | |
| 2018/11/06 | 1.16 | Table 5 | 增加故障扩展位： 1. 增加关机电路等故障位 Add Shutdown circuit error mark 2. 增加 BIMC 故障位 Add BMIC error mark 3. 增加内部总线异常故障位 Add Internal bus error mark 4. 增加开机自检异常故障位 Add Self-test error | 姜炜 |
| 2020/09/09 | 1.17 | Page8 | 增加电池制造厂商信息 ASCII 码： Add ASCII code for battery manufacturer information: 定义 CANID:0x42F0 Define CANID: 0x42F0 Byte0~Byte7: For exzample: Dyness Byte0=' D' ;Byte1=' y' ;Byte2=' n' ;Byte3=' e' ;Byte4=' s' ;Byte5=' s' ; | Lane |

| | | | | |
|------------|------|-------|--|------|
| 2020/09/09 | 1.17 | Page8 | <p>增加电池序列号信息 ASCII 码:</p> <p>Add ASCII 码 code for battery serial number information:</p> <p>定义 CANID:0x42E0</p> <p>Define CANID: 0x42E0</p> <p>Byte0~Byte7:</p> <p>For exzample: 12345678 Byte0=' 1' ;Byte1=' 2' ;Byte2=' 3' ;Byte3=' 4' ;Byte4=' 5' ;Byte5=' 6' , Byte5=' 7' Byte5=' 8' ;</p> | Lane |
|------------|------|-------|--|------|

CAN 总线规格: CANBUS frame format:

采用 29 位标识符的扩展帧格式传输, 总线传输速率为 500kbps.

The 29 bits identifier is used to transfer the extended frame format, and the bus transmission rate is 500kbps.

通信方式: Communication Mode:

上位机设备发送查询或控制指令后, 电池组设备响应数据。

After the host device sends the check or control command, the battery system responds data.

Report Sending is LSB. 发送为低字节在前

Catalog

| | |
|---|----|
| 1 查询指令 Query Instruction | 4 |
| 1.1 总体信息 Ensemble information..... | 4 |
| 1.2 系统装备信息 system equipment information | 8 |
| 2 控制指令 Control Command | 9 |
| 2.1 休眠唤醒控制 Sleep / Awake Command..... | 9 |
| 2.2 充电放电命令 Charge/Discharge Command..... | 10 |
| 2.3 临时屏蔽“通信故障”指令 Temporary masking “external communication error” command ... | 11 |

1 查询指令 Query Instruction

1.1 总体信息 Ensemble information

- 上位机设备发送数据: Host device sending data:

CAN ID: 0x4200 (为广播帧) (this is Broadcast Frame)

| | | |
|-------|---------|---------------------------|
| Byte0 | 0 | Ensemble Information 总体信息 |
| Byte1 | Reserve | |
| Byte2 | Reserve | |
| Byte3 | Reserve | |
| Byte4 | Reserve | |
| Byte5 | Reserve | |
| Byte6 | Reserve | |
| Byte7 | Reserve | |

- 电池组设备响应数据: The battery pile device responds the following data:

CAN ID: 0x4210+Addr (设备地址 Addr. = 0~F, 最多 16 台设备并联通信) (Equipment Address: Addr. = 0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|-----------------------------------|---------------------------|
| Byte0 | 电池组总电压 Battery Pile Total Voltage | Resolution: 0.1V |
| Byte1 | | Offset: 0 |
| Byte2 | 电池组电流 Battery Pile Current | Resolution: 0.1A |
| Byte3 | | Offset: -3000A |
| Byte4 | 主控温度 second level BMS Temperature | Resolution: 0.1 °C |
| Byte5 | | Offset: -100 °C |
| Byte6 | SOC | Resolution: 1%, Offset: 0 |
| Byte7 | SOH | Resolution: 1%, Offset: 0 |

CAN ID: 0x4220+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|---------------------------------|------------------|
| Byte0 | 充电截止电压 Charge Cutoff Voltage | Resolution: 0.1V |
| Byte1 | | Offset: 0 |
| Byte2 | 放电截止电压 Discharge Cutoff Voltage | Resolution: 0.1V |
| Byte3 | | Offset: 0 |
| Byte4 | 最大充电电流 MAX Charge Current | Resolution: 0.1A |
| Byte5 | | Offset: -3000A |
| Byte6 | 最大放电电流 MAX Discharge Current | Resolution: 0.1A |
| Byte7 | | Offset: -3000A |

CAN ID: 0x4230+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|--|--------------------|
| Byte0 | 最高单体电池电压 | Resolution: 0.001V |
| Byte1 | MAX Single Battery Cell Voltage | Offset: 0 |
| Byte2 | 最低单体电池电压 | Resolution: 0.001V |
| Byte3 | MIN Single Battery Cell Voltage | Offset: 0 |
| Byte4 | 最高单体电池电压编号 | Resolution: 1 |
| Byte5 | MAX Single Battery Cell Voltage Number | Offset: 0 |
| Byte6 | 最低单体电池电压编号 | Resolution: 1 |
| Byte7 | MIN Single Battery Cell Voltage Number | Offset: 0 |

CAN ID: 0x4240+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|-------------------------------------|--------------------|
| Byte0 | 最高单体电池温度 | Resolution: 0.1°C |
| Byte1 | MAX Single Battery Cell Temperature | Offset: -100 |
| Byte2 | 最低单体电池温度 | Resolution: 0.1 °C |
| Byte3 | MIN Single Battery Cell Temperature | Offset: -100 |
| Byte4 | 最高单体电池温度编号 MAX Single | Resolution: 1 |
| Byte5 | Battery Cell Temperature Number | Offset: 0 |
| Byte6 | 最低单体电池温度编号 MIN Single Battery | Resolution: 1 |
| Byte7 | Cell Temperature Number | Offset: 0 |

CAN ID: 0x4250+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|-------------------|--------------------------------|
| Byte0 | 基本状态 Basic Status | 详见附表一 See Table 1 for details. |
| Byte1 | 循环周期 Cycle Period | |
| Byte2 | | |
| Byte3 | 故障 Error | 详见附表二 See Table 2 for details. |
| Byte4 | 告警 Alarm | 详见附表三 See Table 3 for details. |
| Byte5 | | |
| Byte6 | 保护 Protection | 详见附表四 See Table 4 for details. |

Byte7

➤ Table 1: Basic Status

| | |
|------|--|
| Bit7 | Reverse |
| Bit6 | Reverse |
| Bit5 | Reverse |
| Bit4 | 0: Null; 1: 请求均充/Balance charge request |
| Bit3 | 0: Null; 1: 请求强充/Forced charge request |
| Bit2 | 0: Sleep, 1: Charge, 2: Discharge, 3: Idle, 4~7: Reserve |
| Bit1 | |
| Bit0 | |

➤ Table 2: Fault

| | |
|------|--|
| Bit7 | Other error 其他故障（具体见故障扩展） |
| Bit6 | 电池损坏故障（电池过放等原因导致）/ Battery cell error |
| Bit5 | RELAY_ERR/ 继电器检测故障 Relay Check Error |
| Bit4 | RV_ERR/ 输入反接故障 Input transposition Error |
| Bit3 | DCOV_ERR/ 输入过压故障 Input Over Voltage Error |
| Bit2 | IN_COMM_ERR/ 内部通信故障 Internal Communication Error |
| Bit1 | TMPR_ERR/ 温度传感器故障 Temperature Sensor Error |
| Bit0 | VOLT_ERR/ 电压传感器故障 Voltage Sensor Error |

➤ Table 3: Alarm

| | |
|-------|---|
| Bit15 | Reserve |
| Bit14 | Reserve |
| Bit13 | Reserve |
| Bit12 | Reserve |
| Bit11 | MHV: 电池模块高压告警 Module High Voltage Alarm |
| Bit10 | MLV: 电池模块低压告警 Module Low Voltage Alarm |
| Bit9 | DOCA: 电池组放电过流告警 Discharge Over Current Alarm |
| Bit8 | COCA: 电池组充电过流告警 Charge Over Current Alarm |
| Bit7 | DHT: 放电高温告警 Discharge Cell High Temperature Alarm |
| Bit6 | DLT: 放电低温告警 Discharge Cell Low Temperature Alarm |
| Bit5 | CHT: 充电高温告警 Charge Cell High Temperature Alarm |
| Bit4 | CLT: 充电低温告警 Charge Cell Low Temperature Alarm |
| Bit3 | PHV: 电池组充电高压告警 Charge system High Voltage Alarm |
| Bit2 | PLV: 电池组放电低压告警 Discharge system Low Voltage Alarm |
| Bit1 | BHV: 电池单体高压告警 Single Cell High Voltage Alarm |
| Bit0 | BLV: 电池单体低压告警 Single Cell Low Voltage Alarm |

➤ Table 4: Protection

| | |
|-------|---------|
| Bit15 | Reserve |
| Bit14 | Reverse |
| Bit13 | Reverse |
| Bit12 | Reverse |

| | |
|-------|---|
| Bit11 | MOV: 电池模块过压保护 Module Over Voltage Protect |
| Bit10 | MUV: 电池模块欠压保护 Module Under Voltage Protect |
| Bit9 | DOC: 电池组放电过流保护 Discharge Over Current Protect |
| Bit8 | COC: 电池组充电过流保护 Charge Over Current Protect |
| Bit7 | DOT: 放电高温保护 Discharge Cell Over Temperature Protect |
| Bit6 | DUT: 放电低温保护 Discharge Cell Under Temperature Protect |
| Bit5 | COT: 充电高温保护 Charge Cell Over Temperature Protect |
| Bit4 | CUT: 充电低温保护 Charge Cell Under Temperature Protect |
| Bit3 | POV: 电池组充电高压保护 Charge system Over Voltage Protect |
| Bit2 | PUV: 电池组放电低压保护 Discharge system Under Voltage Protect |
| Bit1 | BOV: 电池单体高压保护 Single Cell Over Voltage Protect |
| Bit0 | BUV: 电池单体低压保护 Single Cell Under Voltage Protect |

CAN ID: 0x4260+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|------------------------------|--------------------|
| Byte0 | Module Max. Voltage 最高电池模块电压 | Resolution: 0.001V |
| Byte1 | | Offset: 0 |
| Byte2 | Module Min. Voltage 最低电池模块电压 | Resolution: 0.001V |
| Byte3 | | Offset: 0 |
| Byte4 | Module Max. Voltage Number | Resolution: 1 |
| Byte5 | 最高电池模块电压编号 | Offset: 0 |
| Byte6 | Module Min. Voltage Number | Resolution: 1 |
| Byte7 | 最低电池模块电压编号 | Offset: 0 |

CAN ID: 0x4270+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|----------------------------------|--------------------|
| Byte0 | Module Max. Temperature 最高电池模块温度 | Resolution: 0.1°C |
| Byte1 | | Offset: -100 |
| Byte2 | Module Min. Temperature 最低电池模块温度 | Resolution: 0.1°Ce |
| Byte3 | | Offset: -100 |
| Byte4 | Module Max. Temperature Number | Resolution: 1 |
| Byte5 | 最高电池模块温度编号 | Offset: 0 |
| Byte6 | Module Min. Temperature Number | Resolution: 1 |
| Byte7 | 最低电池模块温度编号 | Offset: 0 |

CAN ID: 0x4280+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|---------------------------------|---|
| Byte0 | Charge forbidden mark 禁止充电标志 | 0xAA 有效, 其它值无效 0xAA: effect; other value: NULL |
| Byte1 | Discharge forbidden mark 禁止放电标志 | 0xAA 有效, 其它值无效 0xAA: effect; other value: NULL |
| Byte2 | Reserve | |
| Byte3 | Reserve | |
| Byte4 | Reserve | |

| | | |
|-------|---------|--|
| Byte5 | Reserve | |
| Byte6 | Reserve | |
| Byte7 | Reserve | |

CAN ID: 0x4290+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|---------|--------------------------------|
| Byte0 | 故障扩展 1 | 详见附表五 See Table 5 for details. |
| Byte1 | Reserve | |
| Byte2 | Reserve | |
| Byte3 | Reserve | |
| Byte4 | Reserve | |
| Byte5 | Reserve | |
| Byte6 | Reserve | |
| Byte7 | Reserve | |

➤ Table 5: 故障扩展 1

| | |
|------|--------------------------------|
| Bit7 | Reserve |
| Bit6 | Reserve |
| Bit5 | Reserve |
| Bit4 | Reserve |
| Bit3 | 开机自检异常/ Self-test error |
| Bit2 | 内部总线异常/ Internal bus error |
| Bit1 | BMIC 异常/BMIC error |
| Bit0 | 关机电路异常/ Shutdown circuit error |

CAN ID: 0x42E0+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|---------------------|--|
| Byte0 | Series-Number-ASCII | |
| Byte1 | | |
| Byte2 | | |
| Byte3 | | |
| Byte4 | | |
| Byte5 | | |
| Byte6 | | |
| Byte7 | | |

CAN ID: 0x42F0+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|-------------------------|--|
| Byte0 | Manufacturer-Name-ASCII | |
| Byte1 | | |
| Byte2 | | |
| Byte3 | | |
| Byte4 | | |
| Byte5 | | |
| Byte6 | | |
| Byte7 | | |

1.2 系统装备信息 system equipment information

- The host device sends the data: 上位机设备发送数据:

CAN ID: 0x4200 (is broadcast frame) (为广播帧)

| | | |
|-------|---------|--|
| Byte0 | 2 | 2 is system equipment information 系统装备信息 |
| Byte1 | Reserve | |
| Byte2 | Reserve | |
| Byte3 | Reserve | |
| Byte4 | Reserve | |
| Byte5 | Reserve | |
| Byte6 | Reserve | |
| Byte7 | Reserve | |

- Battery System Response Data: 电池组设备响应数据:

CAN ID : 0x7310+Addr (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.) (设备地址 Addr=0~F, 最多 16 台设备并联通信)

Hardware Version: such as V2.1

Software Version: such as V1.2

| | | |
|-------|---------------------------------------|---|
| Byte0 | Hardware Version 硬件版本 | 0: Null; 1: ver. A; 2: ver. B; Others: Reserve. 0:无效; 1:A 版本; 2:B 版本 ; 其他:预留 |
| Byte1 | reserve | |
| Byte2 | Hardware Version-V 硬件版本-V | -0x02 |
| Byte3 | Hardware Version-R 硬件版本-R | 0x01 |
| Byte4 | Software Version-V 软件版本-V (主版本 Major) | -0x01 |
| Byte5 | Software Version-V 软件版本-V (子版本 Minor) | 0x02 |
| Byte6 | Software Version-开发主版本 | |
| Byte7 | Software Version 开发子版本 | |

CAN ID : 0x7320+Addr (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.) (设备地址 Addr=0~F, 最多 16 台设备并联通信)

| | | |
|-------|---|---------------------------|
| Byte0 | Battery Module Qty. | |
| Byte1 | 电池总数 | |
| Byte2 | Battery Module in series Qty. 串联电池模块个数 | |
| Byte3 | Cell Qty. in battery module 模块中电池个数 | |
| Byte4 | Voltage Level | Resolution: 1V |
| Byte5 | 电压平台 | Offset: 0 |
| Byte6 | AH number AH 数 | Resolution: 1AH Offset: 0 |
| Byte7 | | |

2 控制指令 Control Command

2.1 休眠唤醒控制 Sleep / Awake Command

不支持广播 Broadcast not supported

上位机设备发送数据: Host device send data:

CAN ID: 0x8200+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|-------------------------------|--|
| Byte0 | 休眠唤醒控制 Sleep Awake Control | 0x55: 控制设备进入休眠状态 Control device enter sleep status; 0xAA: 控制设备退出休眠状态 Control device quit sleep status; Others: Null 其他: 无效 |
| Byte1 | Reserve | 0 |

| | | |
|-------|---------|---|
| Byte2 | Reserve | 0 |
| Byte3 | Reserve | 0 |
| Byte4 | Reserve | 0 |
| Byte5 | Reserve | 0 |
| Byte6 | Reserve | 0 |
| Byte7 | Reserve | 0 |

电池组无回复 No response from battery.

2.2 充电放电命令 Charge/Discharge Command

不支持广播 Broadcast not supported

上位机设备发送数据: Host device send data:

CAN ID: 0x8210+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|------------------------|---------------------------------------|
| Byte0 | 充电命令 Charge Command | 0xAA: effect; Others: Null (* Note 1) |
| Byte1 | 放电命令 Discharge Command | 0xAA: effect; Others: Null (* Note 2) |
| Byte2 | Reserve | |
| Byte3 | Reserve | |
| Byte4 | Reserve | |
| Byte5 | Reserve | |
| Byte6 | Reserve | |
| Byte7 | Reserve | |

电池组无回复 No response from battery.

*Note:

1. 充电命令: 当电池处于欠压保护状态时, 继电器断开, 当 EMS 或 PCS 确定要对电池进行充电时可以发送此命令, 电池会闭合主继电器。若电池已休眠, 则需先唤醒。

Charge Command: When the battery is in under-voltage protection, the relay is open. When EMS or PCS is going to charge the battery, send this command, then the battery will close the main relay. If the battery is in sleep status, wake up first then use this command.

2. 放电命令: 当电池处于过压保护状态时, 继电器断开, 此时 EMS 或 PCS 确定要对电池进行放电时, 可发送此命令, 电池会闭合主继电器。若电池已休眠, 则需先唤醒。

Discharge Command: When the battery is in over-voltage protection, the relay is open. When EMS or PCS is going to discharge the battery, send this command, then the battery will close the main relay. If the battery is in sleep status, wake up first then use this command.

2.3 临时屏蔽“通信故障”指令 Temporary masking “external communication error” command

CAN ID: 0x8240+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信) (Equipment Address: Addr=0~F, MAX 16 equipments can be parallel communicated.)

| | | |
|-------|--|----------------------------|
| Byte0 | BMS masking “external communication error” 下发“屏蔽外部通信故障”指令 | 0xAA: effect; Others: Null |
| Byte1 | Reserve | 0 |
| Byte2 | Reserve | 0 |
| Byte3 | Reserve | 0 |
| Byte4 | Reserve | 0 |
| Byte5 | Reserve | 0 |
| Byte6 | Reserve | 0 |
| Byte7 | Reserve | 0 |

电池组回复 Response from battery:

CAN ID: 0x8250+Addr (设备地址 Addr=0~F, 最多 16 台设备并联通信)

| | | |
|-------|---|---|
| Byte0 | System condition able to act this command or not 系统状态是否符合执行此命令条件 | 0xAA: 符合, 立即执行; OK, will act this command immediately Others: 不执行此命令; won't act this command |
| Byte1 | Reserve | 0 |
| Byte2 | Reserve | 0 |
| Byte3 | Reserve | 0 |
| Byte4 | Reserve | 0 |
| Byte5 | Reserve | 0 |
| Byte6 | Reserve | 0 |
| Byte7 | Reserve | 0 |

Danger: High Safety Risk from improper use

警示: 不正当使用会造成系统严重安全风险。

Note:

After receive this command, BMS will estimate the condition and give reply.

If meet the condition, in 5 minutes, BMS will ignore the “external communication fail” alarm, which means relay will keep ON while no communication between BMS and EMS/PCS.

In this 5 minutes, if there is a protection alarm, BMS will cut off the relay as normal.

当外部设备发起请求时, 如电池系统允许执行此动作, 则返回正常报文, 并且系统将屏蔽 5 分钟“外部通讯故障”功能。在 5 分钟内, 继电器将保持闭合。但, 当 5 分钟内发生保护时, 系统将正常执行保护功能。