Document Title: Embedded Software Safety Requirements Specification of Safety Control System

Document Number: 15-Q01-000058

Project Number: SF-RD-1501

Project Number: First phase of Safety Control System Development Project

Material Number: N/A

Document Version: A.3

Classification Level: Highly secret

Document Status: CFC

Controlled Status: Under control

Prepared by: Zhu Genghua	2016-12-26
Checked by: Wen Yiming	2016-12-29
Countersigned by: Wang Dong, Li Qi, Liu Yang, Liu Yue	2016-12-29
Approved by: Ji Jun	2016-12-30

Revision History

No.	Relevant Chapter	Change Description	Date	Version Before Change	Version After Change	Prepared by	Checked by	Approved by
1		Document created	2015-5-22		A	Zhu Genghua	Wen Yiming	Ji Jun
2	3.8 3.11 3.16 3.18	3.8: Modify the description of PeerToPeer. 3.11: Add this chapter. 3.16: Delete GPS Timing. 3.18: Add the chapter 3.18.4, 3.18.5.	2015-9-16	A	A.1	Zhu Genghua	Wen Yiming	Ji Jun
3	2.2 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.9 3.10 3.12 3.15 3.16 3.18 3.19 3.21 全部	2.2: Modify the description of Communication data flow. 3.1: Modify the description of software state transition. 3.2: Modify the description of PM degradation. 3.3: Add PI points 3.4: The maximum control cycle is 500ms. 3.5: Add conditions for data power lost retention 3.6: Add synchronization of project 3.7: Add HMI write variable 3.9: Add this chapter. 3.10: Add this chapter. 3.12: Modify the description of hard SOE. 3.15: Add IP access control 3.16: Add GPS Timing; Add NTP/SNTP Master. 3.18: Add Modbus ASCII. 3.19: Modify the description of indicator. 3.21: Modify the description of log. ALL: Add requirement	2015-10-09					

		number.						
4	2.1 2.2 3.1 3.2 3.15	2.1: Modify Figure 2-1 and scope of PC software 2.2: Modify Figure 2-2 and scope of PC software 3.1: Modify the PM operation to DO and AO modules when it is in "Stop state" 3.2: Modify the description of operation time for single PM 3.15: Move the "IP access control" to 3.14 chapter.	2016-2-15	A.1	A.2	Zhu Genghua	Wen Yiming	Ji Jun
5	3.7 3.12 3.14 3.18 3.20 3.21 3.23	3.7: Delete 3.7.4 Chapter. 3.12: Modify the SOE capacity. 3.14: Modify the description of IP address setting. 3.18: Modify the description of 3.18.3. Delete 3.18.5 Chapter. 3.20: Delete the function that the system can scan the module information before the module is configured. Delete 3.20.14 Chapter 3.21: Modify the description. 3.23: Modify the description.	2016-12-26	A.2	A.3	Zhu Genghua	Wen Yiming	Ji Jun
6								
7								
8								
9								
10								
11								

Relationship between this version and old version:

文件名称：安全控制系统嵌入式软件安全需求规格书

文件编号：15-Q01-000058

项目编号：SF-RD-1501

项目名称：安全控制系统开发项目一期

物料编号：--

版本号/修改码：A.3

文件密级：机密

文件状态：CFC

受控标识：受控

拟制：朱耿华　　2016 年 12 月 26 日

审核：温宜明　　2016 年 12 月 29 日

会签：王东、李琦、刘阳、刘跃　　2016 年 12 月 29 日

批准：季俊　　2016 年 12 月 30 日

修订页

编号	章节名称	修订内容简述	修订日期	订前版本	订后版本	拟制	审核	批准
1		首次创建	2015-5-22		A	朱耿华	温宜明	季俊
2	3.8 3.11 3.16 3.18	3.8：修改站间安全通讯描述。 3.11：增加该章节。 3.16：删去 GPS 直接校时章节。 3.18：增加数据类型章节和端口权限控制章节。	2015-9-16					
3	2.2 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.9 3.10 3.12 3.13 3.16 3.18 3.19 3.21 全部	2.2：修改通讯示意图及其描述。 3.1：修改软件状态转换图及描述。 3.2：修改降级模式的描述。 3.3：增加 PI 点。 3.4：最大控制周期改为 500ms。 3.5：增加数据掉电保护条件。 3.6：增加同步工程描述。 3.7：增加 HMI 写变量 3.9：插入 3.9 异常处理章节 3.10：增加 PM 算法章节 3.12：增加从 OSP 模块读取 SOE。 3.15：增加 IP 访问控制 3.16：恢复 GPS 直接校时章节；增加支持 NTP/SNTP 主站功能。 3.18：Modbus 增加 ASCII 方式。 3.19：修改状态灯描述 3.21：修改日志的描述 全部：增加条目编号	2015-10-09	A	A.1	朱耿华	温宜明	季俊
4	2.1 2.2 3.1 3.2 3.15	2.1:修改图 2-1 和上位机软件范围 2.2:修改图 2-2 和上位机软件范围 3.1：修改”Stop state”时 PM 对 DO 和 AO 模块的操作 3.2：修改单个 PM 时关于运行时间的描述 3.15：将 IP 访问控制移动到 3.14 章节	2016-2-15	A.1	A.2	朱耿华	温宜明	季俊
5	3.7 3.12 3.14 3.18 3.20 3.21	3.7：删去 3.7.4 章节 3.12：修改 SOE 容量 3.14：修改 IP 地址设置的描述 3.18：修改 3.18.3modbus 启停的描述，删去 3.18.5 章节 3.20：删去 3.20.12 章节中未配置时	2016-12-26	A.2	A.3	朱耿华	温宜明	季俊

	3.23	支持扫描 IO 从站的功能；删去 3.20.14 章节 3.21：修改描述 3.23.2：修改描述						
6								
7								
8								
9								

本版本与旧文件（版本）的关系：

Content 目录

1 Document overview 文档概述

1.1 Introduction 综述

This document describes the PM and CM embedded software safety requirements specification of Safety Control System based on the safety requirement specification and the system safety concept design. This document is the input of PM and CM embedded software design.

本文档依据《安全控制系统安全需求规格书》和《安全控制系统总体设计说明书》，描述了安全控制系统中 PM 和 CM 嵌入式软件的需求规格，是后续 PM 和 CM 软件设计的输入。

1.2 Reference 参考文档

1.2.1 Project documents 内部参考文档

Table 1-1 Referenced project documents

表 1-1 内部参考文档

No. 序号	Document number 文档编号	Document title 名称
4	15-O05-0049	Safety requirement specification of Safety Control System 安全控制系统安全需求规格说明书
5	15-O06-0051	System safety concept of Safety Control System 安全安全控制系统总体设计说明书

1.3 Terms and abbreviations 术语和缩略语

1.3.1 Terms 术语

Table 1-2 Terms

表 1-2 术语

No. 序号	Term 术语	Description 解释
1	IP_BUS	Communication between PM and IO modules. PM 与 IO 模块之间的通讯总线。
2	CM_BUS	Communication between PM and CM. PM 与 CM 之间的通讯总线。

3	PM_BUS	Communication between PMs. PM 之间的通讯总线。
4	System Net	Communication between control station and PC. 控制站与上位机之间的通讯网络。
5	Safety Net	Safe communication between control stations. 控制站之间的安全通讯。
6	Control station 控制站	A set of triple redundant control system, which includes triple redundant PMs and IO modules under control. 一套三冗余的控制系统，包含三冗余 PM 和 PM 控制的各种 IO 模块。
7	System response time 系统响应时间	Time interval from the moment that transition of demand signal generated at input ETP to the moment that transition of response signal generated at output ETP. 从系统输入端子板上产生需求信号跳变的时刻到输出端子板上产生相应的响应信号跳变之间的时间。
8	Control cycle 控制周期	Time interval between adjacent two runs of user program execution. PM 两次执行用户程序间隔时间。
9	Project 工程	Files which contain configuration information for control station and generated by IEC 61131 configuration software. These files contain all the information required by control station to implement control, including user control program (binaries) to be loaded and executed as well as configuration information of task, CM, PM and IO modules. IEC 61131 组态软件在完成编译后，为控制站生成的组态信息文件，该文件包含可加载执行的用户控制程序（二进制程序）、任务配置信息、CM 配置信息、PM 配置信息和 IO 模块配置信息等各种控制站完成控制所需的信息。
10	Source project 源工程文件	The original project file before compiling. 工程在编译前的原始文件。
11	User program	Part of project which contain user control program (binaries) to be loaded and

	用户程序	executed and configuration information of task. 工程中的一部分：可加载执行的用户控制程序（二进制程序）和任务配置信息。

1.3.2 Abbreviations 缩略语

Table 1-3 Abbreviations

表 1-3 缩略语

No. 序号	Abbreviation 缩略语	English description 英文	Chinese description 中文
1	PM	Processor Module	主处理器模块
2	CM	Communication Module	通讯模块
3	AI	Analog Input Module	模拟量输入模块
4	AO	Analog Output Module	模拟量输出模块
5	DI	Digital Input Module	数字量输入模块
6	DO	Digital Output Module	数字量输出模块
7	OSP	Over Speed Protect Module	超速保护模块
8	SOE	Sequence Of Events	SOE 事件
9	SIL	Safety Integrity Level	安全完整等级
10	PW	Power Module	电源模块
11	OPC	OLE for Process Control	用于过程控制的对象链接与嵌入式技术

2 Software general description 软件总体描述

2.1 Function overview 功能概述

SWSRS_SafR_NSecR_B_067

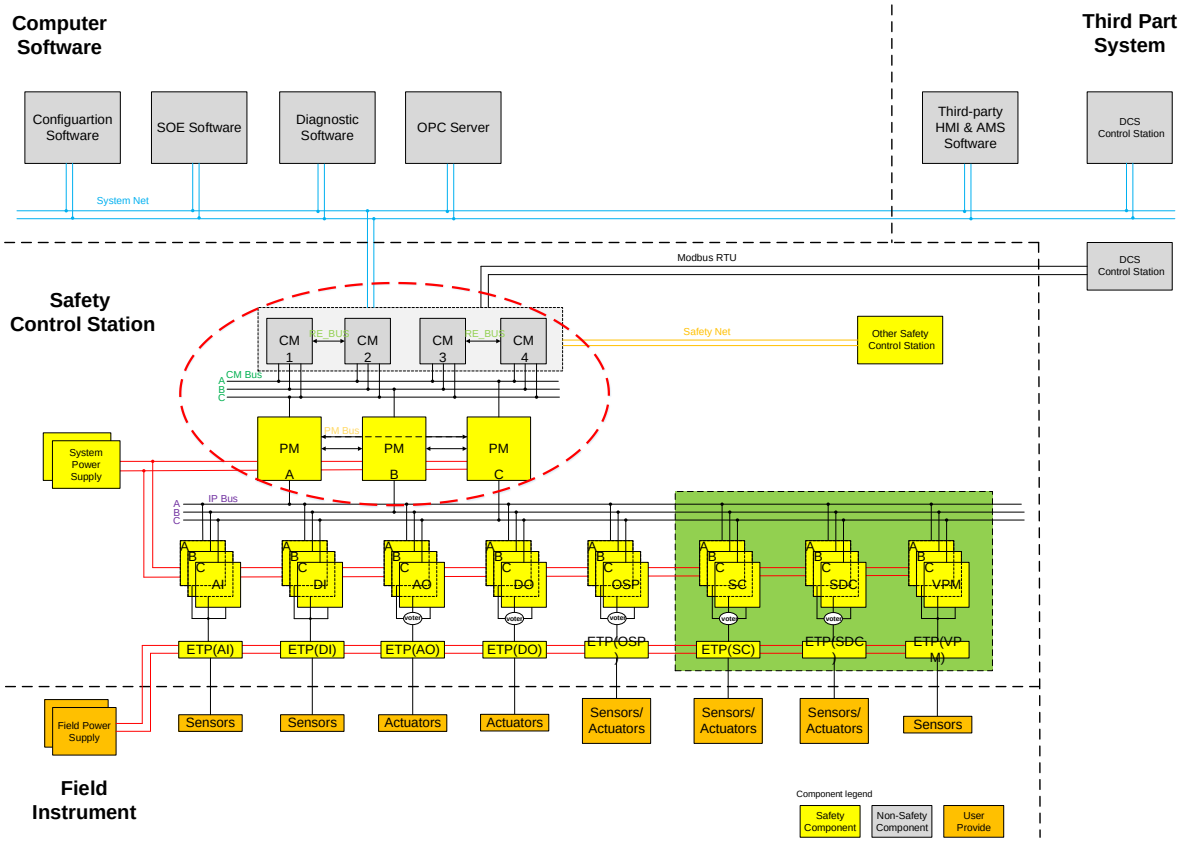

Figure 2-1 System logical architecture diagram

图 2-1 系统逻辑架构图

System logical architecture is shown in Figure 2-1, the part in the red dashed box is PM and CM. Embedded software includes the firmware in the PM, the firmware in the CM and the OS in the CM.

系统逻辑架构如图 2-1 所示，其中红色虚线框内部分为本文涉及的 PM、CM。嵌入式软件指的是 PM 中的固件以及 CM 中的固件和 OS。

2.2 Communication data flow 通讯数据流

SWSRS_SafR_NSecR_B_068

The system data flow are illustrated in Figure 2-2. IP_BUS is the communication link between the PM and the IO modules; System Net is used for communication between the control station and PC software; Modbus RTU/TCP is used for communication between the control station and the third-party device; Safety Net is used for the safety data exchange between control stations.

数据流如图 2-2 所示，其中 IP_BUS 用于 PM 与 IO 模块进行通讯；System Net 用于控制站与各个上位机软件进行通讯；Modbus RTU/TCP 用于控制站和第三方设备进行通讯；Safety Net 用于控制站与其他控制站进行通讯。

CM_BUS is used for communication between CM and PM; PM_BUS is used for data exchange

between PMs.

PM 和 CM 之间通过 CM_BUS 通讯，PM 与 PM 之间通过 PM_BUS 进行通讯。

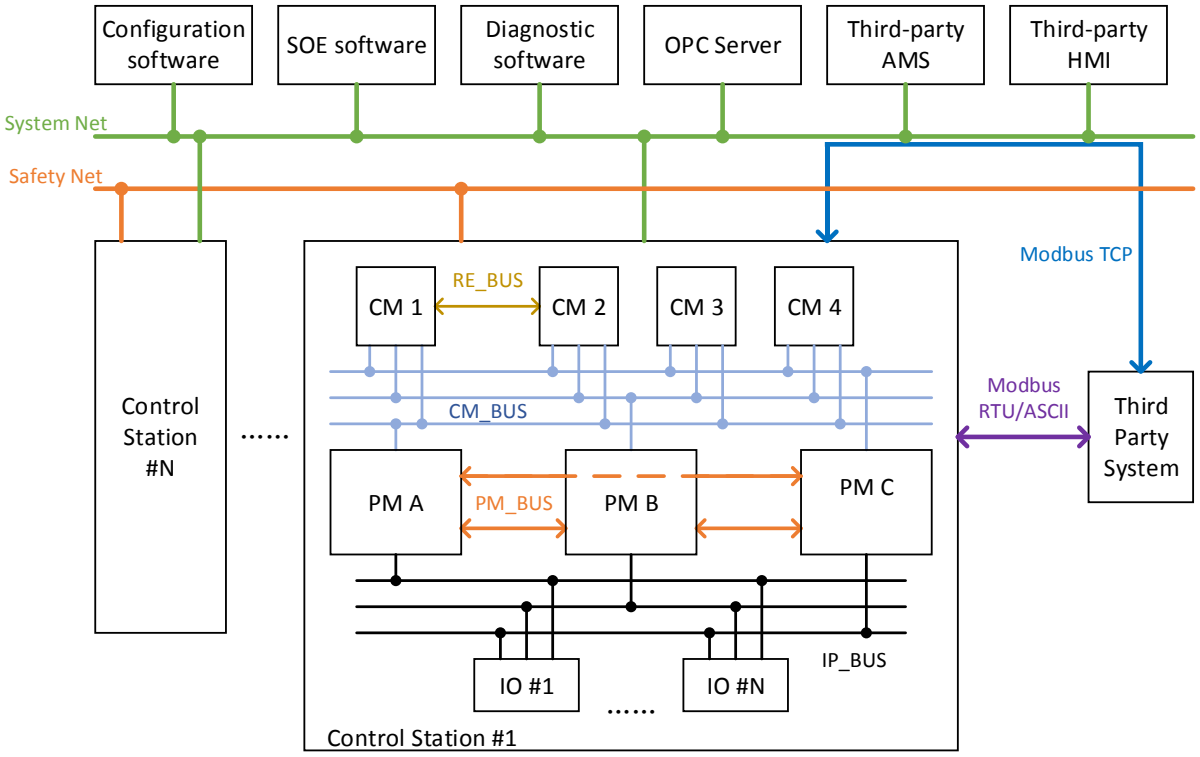

Figure 2-2 Control station communication data flow

图 2-2 控制站通讯示意图

3 Software requirement specification 软件需求规格

3.1 Software state transition 软件状态转换

SWSRS_SafR_NSecR_C_001

CM is mainly used for communications, which is not affected by the state of the system. The software states of PM and state transition conditions are shown in the following figure:

CM 主要用于通讯，不受系统状态的影响。PM 软件状态的状态描述以及状态转换条件如下图所示：

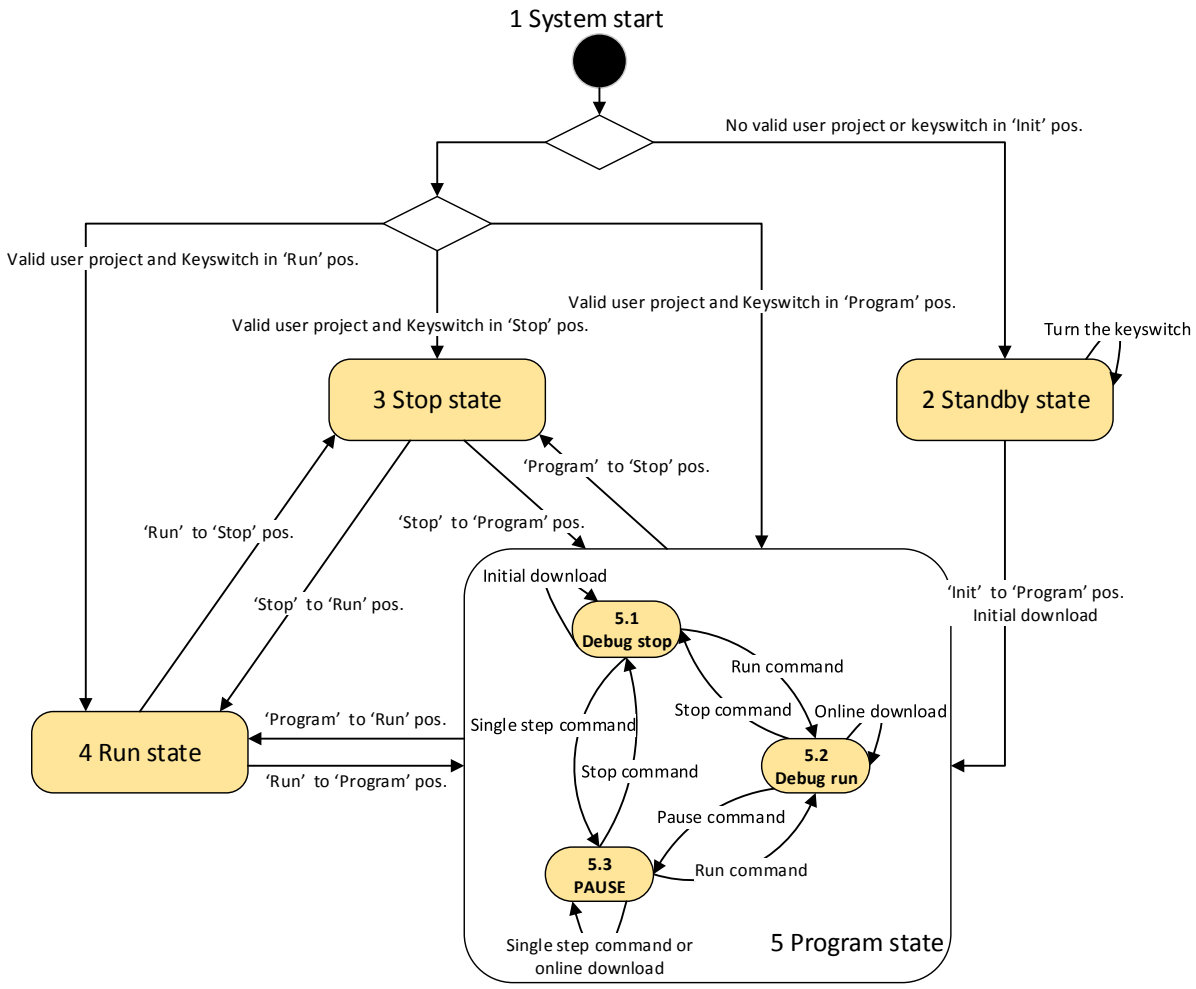

Figure 3-1 Transition of software states

图 3-1 软件状态转换图

When the PM has a valid project, the Stop, Run, Program states of PM software are consistent with the 'Stop', 'Run', 'Prog' position of the key switch, and also correspond to the system states. The 'Init'position means the project and configuration information in PM will be purged after power on.

当 PM 中有有效工程时，PM 软件的 Stop、Run、Program 状态和钥匙开关的 STOP、RUN、PROG 三个档位一一对应，也和系统的三个状态一一对应。钥匙开关中的 init 档位代表上电时清空工程及配置信息。

Detailed descriptions of the states are as follows:

状态具体描述如下：

- System start：System start into a different state according to the validity of project and the positon of key switch. When the project is valid and the key switch in the 'Prog' position, the software enters into Debug run state.

系统启动，根据工程的有效性及钥匙开关的档位进入不同的状态。当工程有效，并且钥

匙开关在 PROG 档位时，软件进入 Debug run 状态。

- Stop state：In this state, PM has a project, but neither execute the user program, nor support user debug operation. PM set the DO and AO modules in this channel into safe state. In this state, if the key switch turn from ‘Stop’ to ‘Prog’ position, the software enters into Debug stop state.

PM 有用户工程，但不执行用户程序，也不支持用户进行调试操作。PM 置对应系的 DO 和 AO 模块为安全状态。在此状态下，钥匙开关从 STOP 到 PROG 档位，软件进入 Debug stop 状态。

- Run state：In this state, PM executes user program and exchanges data with IO modules, but does not support user debug operation. In this state, if the key switch turn from ‘Run’ to ‘Prog’ position, the software enters into Debug run state.

PM 执行用户程序，实时输出，不支持用户进行调试操作。在此状态下，钥匙开关从 RUN 到 PROG 档位，软件进入 Debug run 状态。

- Standby state：There is no valid project in PM.

PM 中无用户工程。

- Program state：In this state, PM has a project and supports user debug operation.

PM 有用户工程，支持用户进行调试操作。

- Pause：PM has a user project, but does not execute the user program. PM exchanges data with IO modules but the outputs is the last execution result before the pause operation. If the user program has not been executed before the pause operation, the output is the initial value.

PM 有用户工程，但不执行用户程序。保持和 IO 模块交换数据，输出为暂停前最后一次运算的结果，如暂停前没有经过一次运算，输出为初始值。

- Debug run：In this state, PM executes user program, exchanges data with IO modules, and supports user debug operation.

PM 执行用户程序，实时输出，可进行其他调试操作。

- Debug stop：In this state, PM has a project, but does not execute the user program, does not exchange data with IO modules, but supports user debug operation.

PM 有用户工程，但不执行用户程序，停止和 IO 模块交换数据，可进行其他调试操作。

System shall support start-up to normal operation when only one PM or two PMs exist.

系统支持仅存在一系 PM 或两系 PM 时上电启动。

3.2 PM degradation mode PM 降级模式

SWSRS_SafR_NSecR_C_002

The PM supports degradation mode of 3-2-1-0, 2-1-0, as shown in follow:

PM 降级模式为 3-2-1-0，2-1-0，如下图所示。

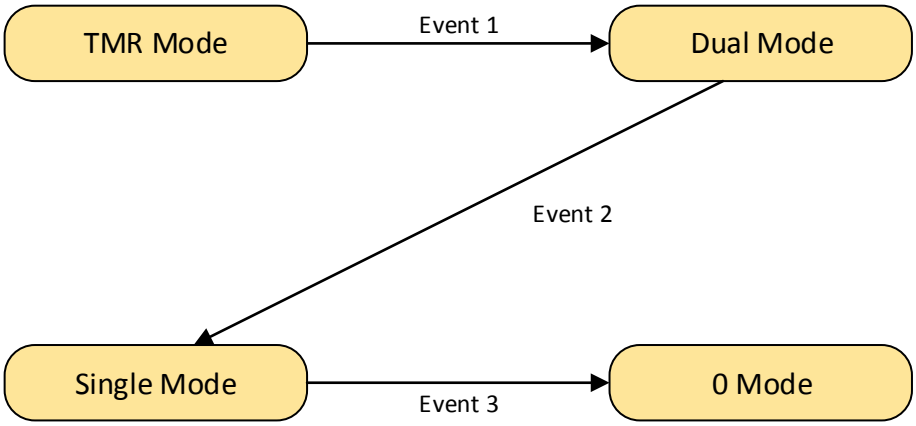

Figure 3-2 PM degradation mode

图 3-2 PM 降级模式示意图

Detailed description of the states as follows:

图中状态及事件具体描述如下：

- TMR Mode: Three channels work normally.
- Dual Mode: Only two channels work normally. When a task is configured as “Control” property, the task can be configured as 1oo2 or 2oo2 voting. When a task is configured as “Safety” property, only 1oo2 voting can be configured. The property can be set in the configuration software for each task.
- Single Mode: Only one channel works normally. When the operation time exceeded the MRT used in PFH/PFD calculation for SIL3, the calculation results are not valid anymore.
- Event 1: One PM has a fault, the system occurs 3-2 degradation.
- Event 2: One of the remaining PMs has a fault, therefore the system occurs 2-1 degradation.
- Event 3: The last PM has a fault.
- TMR Mode：三系正常运行。
- Dual Mode：两系正常运行。用户配置成 control 应用时，可选择按照 1oo2 或者 2oo2 方式表决；配置成 safety 应用时，只能按照 1oo2 方式表决。control 应用、safety 应用的选择在组态软件中配置，可基于每个任务配置。
- Single Mode：单系运行。Single Mode 下，运行时间超过用于计算 SIL3 PFH/PFD 使用的 MRT 时，计算结果不再有效。
- Event 1：一系 PM 出现故障，发生 3-2 降级。

- Event 2：一系 PM 出现故障后，又有一系 PM 出现故障，发生 2-1 降级。
- Event 3：单系 PM 运行，剩余该系 PM 出现故障。

3.3 Scale of single control station 单站规模

SWSRS_SafR_NSecR_B_003

The system shall support a maximum scale of 3680 digital points or 1248 analog points (including PI point) in a single control station.

单控制站硬件测点规模：开关量点最大支持 3680 点，模拟量点(含 PI 点)最大支持 1248 点。

3.4 Control cycle configuration 控制周期设置

3.4.1 Control cycle 控制周期

SWSRS_SafR_NSecR_A_004

For a typical 300 point configuration case, the control cycle is 10ms. If the number of IO points is 1000, i.e. 500 digital points and 500 analogue points (16 pairs of DI/DO, 10 pairs of AI, 12 pairs of AO), the minimum control cycle can be less than 100ms.

单用户程序情况下，如系统规模中硬件测点小于 300 点，控制周期至少可设置为 10ms；如系统规模中硬件测点小于 1000 点，其中开关量 500 点，模拟量 500 点，控制周期至少可设置为 100ms。

3.4.2 Multitasking 多用户程序

SWSRS_SafR_NSecR_A_005

It allows users to configure two user programs (tasks), and set to different control cycles separately.

支持用户组态两个用户程序（任务），并设置为不同的控制周期。

3.4.3 Control cycle ladder 控制周期设置阶梯

SWSRS_SafR_NSecR_B_006

The control cycle can be set by configuration software, and the range is 5ms~500ms, the ladder is 5ms.

控制周期最小为 5ms，最大为 500ms，设置阶梯为 5ms。

3.5 Power lost retention 掉电保持

3.5.1 Data retention 数据掉电保持

SWSRS_SafR_NSecR_B_007

When module re-power on after power off, a part of data can be resumed to the result of the last normal calculation. These variables will be defined by the user in configuration software, and its total size is 1kByte. If the key switch is in 'Init' when power on, the retained data will be cleared. If the module has been pulled out, the retained data is lost.

模块掉电后再次上电，部分数据能够恢复成最后一次正常运算后的结果。变量由使用者通过组态软件指定，总大小为 1kByte。如果上电时钥匙开关在 init 档位，上电后保持的数据无效。模块拔插后掉电保护数据无效。

3.5.2 Project retention 工程掉电保持

SWSRS_SafR_NSecR_A_008

When module re-power on after power off, the project retain valid. If the key switch is in 'Init' when power on, the project will be cleared.

模块掉电后再次上电，工程保持有效。如果上电时钥匙开关在 init 档位，上电后工程无效。

3.6 PM online replacement PM 在线更换

SWSRS_SafR_NSecR_B_009

Online replacement of PM shall be supported, the new-inserted PM will synchronize project, real time data and running states from other running PMs automatically, and the new-inserted PM will be automatically running after the synchronization. The user program execution will be delayed due to real time data synchronization, the delayed time is related to the number of real time data, but the maxmum delayed time is no more than 3 control cycles.

支持在线更换 PM，更换后的 PM 会自动从其他工作 PM 上同步工程、运行数据及运行状态，同步完成后新 PM 自动运行，不需要人工干涉。同步实时数据会使得用户程序执行有一次延后，延后时间和实时数据量有关，不大于 3 个控制周期。

It is not allowed to install two or more PMs at the same time during the system running. It is not allowed to install the next PM module until the current PM module is running normally.

系统运行过程中不允许同时安装两个或多个 PM，需等待前一个被安装的模块正常运行后方可安装下一个模块。

3.7 Configuration and debug operation 组态及调试

3.7.1 Download 下装

SWSRS_NSafR_NSecR_A_010

Downloading and online downloading to the control station shall be supported in Program state by configuration software.

Online downloading supports the following operations: add variables; modification logic; add

or remove IO modules; modification IO parameters; add or remove chasises.

在 Program 状态下，支持组态软件对控制站进行全下装操作、在线下装操作。

在线下装包括在线增减变量；在线修改逻辑；在线增减 IO 模块或修改 IO 模块参数；在线增减机架。

3.7.2 Write variables 写变量

SWSRS_NSafR_NSecR_B_011

Writing variables to the control station shall be supported in Program state by configuration software, OPC software and HMI software.

在 Program 状态下，支持组态软件对控制站进行写变量操作支持 OPC 软件或 HMI 软件对控制站进行写变量操作。

3.7.3 Enable/disable 使能/释放使能

SWSRS_NSafR_NSecR_A_012

Enable or disable variables operation of the control station shall be supported in Program state by configuration software. If the key switch has been switched from ‘Prog’ to the other positions, there shall be no effect on enabled/disabled status of the variables.

在调试模式下，支持组态软件对控制站进行使能变量/释放使能操作。钥匙开关从 PROG 档位切换到其他档位不会影响使能状态。

~~### 3.7.4 Parameters read back 参数回读~~

~~SWSRS_NSafR_NSecR_A_013~~

~~Parameters read back operation shall be supported in Program state by configuration software, the parameters which want to be readed back shall be assigned by user using configuration software.~~

~~在调试模式下，支持组态软件对控制站进行持参数回读，需要回读的参数变量由使用者通过组态软件指定。~~

3.7.5 Pause 暂停

SWSRS_NSafR_NSecR_A_014

Pause operation shall be supported in Program state by configuration software. User program is not executed when pause operation happened, and the output hold the last calculation result. This operation can be used by single user program.在调试模式下，支持组态软件对控制站进行暂停操作。暂停时，控制站不执行用户程序，输出保持暂停前最后一次运算的结果。该操作可以针对单个用户程序。

3.7.6 Single step 单步运行

SWSRS_NSafR_NSecR_A_015

Single step operation shall be supported in Program state by configuration software. The user program is executed only once in this condition, and the output hold the current calculation result. This operation can be used by single user program.

在调试模式下，支持组态软件对控制站进行单步运行操作。此时，控制站只执行一次用户程序，后续输出保持该次运算的结果。该操作可以针对单个用户程序。

3.8 Safety communication 安全通讯

3.8.1 Safety communicaton between control stations 安全站间通讯

SWSRS_NSafR_NSecR_B_016

Safty communication between control stations (Peer to Peer) can be used between several control stations, the communication start or stop of each control station can be controlled independently. The cycle of the communication between control stations can be configured. When the cycle is less than the actual interval (the actual interval is the time between send requests and receive the responsed), the actural interval will replace the set cycle.

There is an independent ID for each control station, which is configured by the configuration software.

支持多个控制站之间的安全数据通讯（Peer to Peer），可单独控制每一个控制站的通讯启停。站间通讯周期可配置，当配置的通讯周期小于实际的数据发送间隔（从数据发送到接收到对方控制器的应答）时，按实际的数据发送间隔发送数据。

每个控制站有各自的站号，通过组态软件配置。

3.8.2 Safety IO protocol 安全IO协议

SWSRS_NSafR_NSecR_A_017

The safety IO communication protocol will be used betwwen PM and IO modules, the safety layer which belonged to the master of IP_BUS is implemented by PM software.

PM 和 IO 模块之间采用安全通讯协议，IP_BUS 主站端的安全层由 PM 软件实现。

3.9 Exception handling 异常处理

3.9.1 IP_BUS failure recovery IP_BUS故障恢复

SWSRS_NSafR_NSecR_A_018

The communication re-connection between PM and IO can be configured to require confirmation by user, when the communication failure has happened. This property is configured by

the user via the configuration software, if the choice is not need to be confirmed, the re-connection will be established automatically after the failure recovery. Otherwise, the re-connection will not be established until the user confirmed.

PM 和 IO 通讯中断后，再次建立连接是否需要用户确认为可配的。该属性由使用者通过组态软件配置，如配置为不需确认，PM 和 IO 之间故障排除后，会自动建立连接；如配置为需确认，在用户确认前，PM 和 IO 之间保持通讯中断。

3.9.2 User program execution timeout 执行用户程序超时

SWSRS_SafR_NSecR_A_019

The user program can be configured as both stopped and alarmed or just alarmed when executing timeout. This property is configured by the user via configuration software for each user program. When safety application is selected by the user, this property can be only configured to ‘stop executing the user program and alarm’; when control application is selected by the user, both “stop executing the user program and alarm” and “only alarm” can be configured.

当执行用户任务超时时，可配置停止执行此用户程序并报警或仅报警。该属性由使用者通过组态软件基于每个任务配置。用户选择 safety 应用时，该属性只能配置为停止执行此用户程序并报警；用户选择 control 应用时，都可以配置。

3.9.3 Calculation exception 运算异常

SWSRS_SafR_NSecR_A_020

The enable of “Divided-by-zero error protection, array bounds exceeded error protection and exception handling” can be selected by user. This property can be configured via configuration software for each user program. The property must be configured to enabled, when user selects the safty application mode; the property can be configured to enabled or disabled, when user selects the control application mode.

用户可选择是否开启“除零和数组越界的错误保护及异常处理”， 该属性由使用者通过组态软件基于每个任务配置。用户选择 safety 应用时，该属性只能配置为开启；用户选择 control 应用时，都可以配置。

3.10 PM Algorithm PM 算法

SWSRS_SafR_NSecR_B_069

PM provides standard functions such as ABS, provides standard function blocks such as TON, and provides system function blocks such as UP_STATUS which is used for reading UP status.

PM 提供 ABS 等标准函数•；提供 TON 等标准功能块；以及提供读取 UP 状态等系统库。

3.11 Communication protocol type 通讯协议类型

SWSRS_NSafR_SecR_B_023

The communication protocol and the corresponding Ethernet port or serial port which CM supported is shown in Table 4-1, and the "-" means not supported. CM can identify different PC software, and can be configured as a redundant network interface.

CM 支持的通讯协议类型及相应的以太网口或串口如下表所示，其中“—”表示不支持。CM 能够识别不同的上位机软件，并可配置为冗余网口。

Table 4-1 CM communication protocal type

表 4-1 CM 通讯协议类型

No. 序号	Protocl or device 协议或设备	Ethernet port 支持的以太网口	serial port 支持的串口
1	CS1131	NET1，NET2	—
2	OPC Server	NET1，NET2	—
3	HMI	NET1，NET2	—
4	diagnostic software 诊断软件	NET1，NET2	Port 5（USB 转串口）
5	SOE software SOE 软件	NET1，NET2	—
6	AMS	NET1，NET2	—
7	Peer-to-Peer	NET1，NET2	—
8	Modbus Slave (RTU/ASCII)	—	Port 1-4
9	Modbus Master (RTU/ASCII)	—	Port 1-4
10	Modbus Master or Slave	NET1，NET2	—
11	NTP/SNTP timing NTP/SNTP 校时	NET2	—

12	GPS timing GPS 校时	—	Port 4

3.12 SOE function SOE 功能

3.12.1 Hard SOE record 硬SOE记录

SWSRS_NSafR_SecR_A_024

Support to collect SOE records from DI module、AI module、OSP module，and provide SOE record to SOE software.

支持从 DI 模块、AI 模块、OSP 模块收集 SOE 记录，并能将 SOE 记录提供给上位机 SOE 软件。

3.12.2 Soft SOE record 软SOE记录

SWSRS_NSafR_SecR_A_025

Support to record SOE from the change of the BOOL variables，and provide SOE record to SOE software.

The BOOL type variable is labeled as ‘SOE variable’ in the configuration software by user. PM records SOE of the states change of these variables, and the accuracy of soft SOE is 1 control cycle.

支持对内部 BOOL 类型变量做 SOE 记录，并能将 SOE 记录提供给上位机 SOE 软件。

使用者在组态软件上配置 BOOL 类型变量是否为 SOE 点，PM 将这些变量的跳变信息记录为 SOE，精度为一个控制周期。

3.12.3 The capacity of SOE SOE容量

SWSRS_NSafR_SecR_B_026

The SOE record is rolling recorded, and the maximum number in each PM is ~~60000~~ 120000. The latest ~~5000~~ 20000 records can be maintained after power-off.

三系各自保存 SOE 记录，每系的记录总数为 ~~6~~12 万条，其中，掉电保持的条数为 ~~5000~~20000 条。

3.12.4 SOE group SOE分组

SWSRS_NSafR_SecR_A_027

SOE records can be grouped by configuration software, and each group can be set individually for the capacity, recording method and whether need to be maintained after power-off. Hard SOE and soft SOE cannot be in one group.

组态软件可以对 SOE 记录的来源进行分组，并设置每组的记录容量、记录方式及是否掉电保护；硬 SOE 和软 SOE 不能设置在一个组内。

3.12.5 SOE read SOE读取

SWSRS_NSafR_SecR_A_028

SOE software can read SOE records from one PM or three PMs.

上位机 SOE 软件可读取一系或者三系的 SOE 记录。

3.13 Source project backup 源文件备份

SWSRS_NSafR_SecR_A_029

The configuration software can download, upload and clear the source project.

The CM stores the source project in FLASH, to ensure that the source project is maintained after power-off.

This function is independent of the key switch position, it means the source project files will not be cleared if the key switch is in the 'Init' position when the system power on.

组态软件可下载、上传、清除源工程文件。

CM 中的 FLASH 保存组态软件下载的源工程文件，不会因为模块掉电丢失。

钥匙开关的 init 档位和源文件备份功能无关，即上电时钥匙开关在 init 档位不会导致源工程文件丢失。

3.14 IP configuration IP 配置

3.14.1 IP address setting IP地址配置

SWSRS_NSafR_SecR_B_030

The default IP address of Ethernet port 1 in CM is 192.168.1.0, and the default IP address of Ethernet 2 is 192.168.1.1. These address can be configured with the configuration software ~~or diagnostic software~~ by user, and can be read with the configuration software.

The default IP address will be recovered after power on if the key switch is in the 'Init' position.

CM 上以太网口 1 的 IP 地址默认为 192.168.1.0，以太网口 2 的 IP 地址默认为 192.168.1.1，工程人员可通过组态软件~~或者诊断软件~~对 IP 地址进行配置，可通过诊断软件读取目前的 IP 地址。

如果上电时钥匙开关在 init 档位，上电后恢复默认 IP 地址。

3.14.2 IP Access Control IP访问控制

SWSRS_NSafR_SecR_B_032

Support IP access control, and user can configure read/write authority and communication protocol for each IP address.

支持 IP 访问控制，可以为每个 IP 配置读写权限及可使用的通讯协议。

3.15 Network Storm Protect 防网络风暴

SWSRS_NSafR_SecR_A_031

When network storm occurs, all the functions of the PM and CM except system net communication shall be remain normal. System net communication shall be recovered after the network storm.

当网络风暴发生时，除系统网通讯功能外，PM、CM 的其他功能不受影响。网络风暴结束后系统网通讯功能恢复工作。

3.16 Timing 校时

3.16.1 Timing Function Block 功能块校时

SWSRS_NSafR_SecR_A_033

Support timing function block, and source of the block can be DI, Modbus input or user debug command.

提供校时功能块，校时使能源可以来自于 DI 输入、Modbus 输入或者用户的调试命令。

3.16.2 NTP/SNTP Timing NTP/SNTP校时

SWSRS_NSafR_SecR_B_034

CM can be slave station of the NTP/SNTP, so it can accept timing command of the NTP/SNTP timing master.

CM can be master station of the NTP/SNTP, so it can send timing command to other control stations as a timing source.

CM 可作为 NTP/SNTP 的从站，接受 NTP/SNTP 校时源的校时命令。

CM 可作为 NTP/SNTP 的主站，作为校时源给其他控制站校时。

3.16.3 GPS Timing GPS直接校时

SWSRS_NSafR_SecR_A_035

CM support GPS timing through serial port.

CM 支持 GPS 通过串口校时。

3.17 Variables On-line Monitor 变量在线监视

3.17.1 Variables Monitor by Configuration Software 组态软件变量监视

SWSRS_NSafR_NSecR_A_036

Control station will upload variables value cyclicly, which was assigned by the configuration software.

控制站根据组态软件指定需求监视的变量，周期性上传监视数据。

3.17.2 Oscilloscope 示波器

SWSRS_NSafR_NSecR_A_037

PM record variables value in every control cycle or in several control cycles, and the user can assign variables which need to be recorded and its record interval. The recorded information can be displayed by the configuration software.

PM 按单个控制周期间隔或者多个控制周期间隔记录部分变量的值，变量的指定、记录间隔的设置由使用者通过组态软件配置，记录信息可提供给组态软件显示。

3.17.3 Variables Monitor by OPC Software OPC软件变量监视

SWSRS_NSafR_NSecR_A_038

Control station will upload variables value cyclicly, which was assigned by the OPC software.

控制站根据 OPC 软件指定需求监视的变量，周期性上传监视数据。

3.18 Modbus

3.18.1 Modbus Protocol Modbus协议

SWSRS_NSafR_NSecR_B_039

Modbus protocol will be used to realize the communication between the control station and the third party systems.

- Support Modbus RTU Master and Slave.
- Support Modbus ASCII Master and Slave.
- Support Modbus TCP Client/Server.

Modbus 协议用于实现控制站与第三方系统间的通讯。

- 支持 Modbus RTU 主从。
- 支持 Modbus ASCII 主从。
- 支持 Modbus TCP Client/Server。

3.18.2 Modbus Application Modbus应用

SWSRS_NSafR_NSecR_A_040

Modbus input variable can be used to calculate in the PM user program or only displayed by the PC software.

Modbus 输入变量可参与 PM 用户程序运算，或者只用于上位机显示。

3.18.3 Modbus Start/Stop Modbus启停

SWSRS_NSafR_SecR_B_041

As a Modbus master/Modbus TCP Server, the access of every slave station can be started or stopped independently. As a ~~Modbus slave~~Modbus TCP Client, whether it can be accessed by the ~~master~~Server can be controlled.

作为 Modbus 主站或者 Modbus TCP Server 时，对每个从站的访问可单独控制启停。作为 ~~Modbus 从站~~ Modbus TCP Client 时，可控制能否被~~主站~~ Server 访问。

3.18.4 Data Type 数据类型

SWSRS_NSafR_NSecR_A_042

The protocal support Bool, Word, Real and Long Real type, and the byte order of Real and Long Real type can be set using configuration software. As a Modbus master, the total communication data size for all its modbus slave stations is 4k.

支持 Bool、Word、Real、Long Real 类型，其中 Real、Long Real 类型的字节顺序可通过组态软件配置。作为 Modbus 主站时，和从站通讯的变量总大小为 4k。

~~**3.18.5 Port access control 端口权限控制**~~

~~SWSRS_NSafR_SecR_A_043~~

~~As a Modbus slave, the port authority (read only or read/write) can be configured using the Configuration software.~~

~~作为 Modbus 从站时，可通过组态软件配置为只读或者读写。~~

3.19 Indicators 指示灯

3.19.1 CM Indicators CM指示灯

SWSRS_NSafR_NSecR_B_044

CM's indicators are described as below, and the indicators as PASS, FAULT, ACTIVE, CM_BUS are controlled by the embedded software.

CM 的状态灯描述如下，其中 PASS、FAULT、ACTIVE、CM_BUS 由嵌入式软件控制灯的状态：

Table 4-2 Communication Module indicators

表 4-2 通讯模块指示灯定义

Name 名称	Color 颜色	Status 状态	Meaning 含义
POWER	Green 绿色	On 亮	The module is powered on. 模块上电
		Off 灭	The module is powered off. 模块掉电
		Flash 闪	Undefined. 未定义
PASS	Green 绿色	On 亮	The module self-test passed. 模块自检通过
		Off 灭	The module self-test failed. 模块自检失败
		Flash 闪	Undefined. 未定义
FAULT	Red 红色	On 亮	The module has detected faults. 模块故障
		Off 灭	The module has not detected faults. 模块无故障
		Flash 闪	Network upgrade. 在线升级
ACTIVE	Yellow 黄色	On 亮	The module has a project. 有工程，正常运行
		Off 灭	The module does not have a project. 无工程
		Flash 闪	Undefined. 未定义
CM_BUS	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication on CM_BUS. 无通讯
		Flash 闪	CM_BUS communication in processing. 通讯过程中
PULSE	Yellow 黄色	On 亮	Timing pulse is normal. 校时脉冲正常
		Off 灭	No timing pulse or timing pulse is abnormal. 无校时脉冲或校时脉冲不正常
		Flash 闪	Undefined. 未定义
NET1	Yellow	On	Link is normal, and no data

TX RX	黄色	亮	exchange. 链接正常，无数据交换
		Off 灭	No link. 无链接
		Flash 闪	Data exchange in processing. 有数据交换
NET2 TX RX	Yellow 黄色	On 亮	Link is normal, and no data exchange. 链接正常，无数据交换
		Off 灭	No link. 无链接
		Flash 闪	Data exchange in processing. 有数据交换
COM1 TX RX	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication. 无通讯
		Flash 闪	TX1：Send data；RX1：Receive data TX1：发送数据；RX1：接收数据
COM2 TX RX	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication. 无通讯
		Flash 闪	TX2：Send data；RX2：Receive data TX2：发送数据；RX2：接收数据
COM3 TX RX	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication. 无通讯
		Flash 闪	TX3：Send data；RX3：Receive data TX3：发送数据；RX3：接收数据
COM4 TX RX	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication. 无通讯
		Flash 闪	TX4：Send data；RX4：Receive data TX4：发送数据；RX4：接收数据
DEBUG TX，RX 5	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication. 无通讯
		Flash 闪	TX5：Send data；RX5：Receive data TX5：发送数据；RX5：接收数据

3.19.2 PM Indicators PM指示灯

SWSRS_NSafR_NSecR_B_045

PM's indicators are described as below, and the indicators as PASS、FAULT、ACTIVE、SYNC、FORCE、INIT、RUN、PROG、STOP、CM_BUS、PM_BUS are controlled by the embedded software.

PM 的状态灯描述如下，其中 PASS、FAULT、ACTIVE、SYNC、FORCE、INIT、RUN、PROG、STOP、CM_BUS、PM_BUS 由嵌入式软件控制灯的状态：

Table 4-3 PM indicators
表 4-3 主处理器指示灯

Name 名称	Color 颜色	Status 状态	Meaning 含义
POWER	Green 绿色	On 亮	The module is powered on. 模块上电
		Off 灭	The module is powered off. 模块掉电
		Flash 闪	Undefined. 未定义
PASS	Green 绿色	On 亮	The module self-test passed. 模块自检通过
		Off 灭	The module self-test failed. 模块自检失败
		Flash 闪	Undefined. 未定义
FAULT	Red 红色	On 亮	The module has detected faults. 模块故障
		Off 灭	The module has not detected faults. 模块无故障
		Flash 闪	Network upgrade 在线升级
ACTIVE	Yellow 黄色	On 亮	The module has a project, and is executing user program. 有工程，正常运行
		Off 灭	The module does not have a project. 无工程
		Flash 闪	The module has a project, but has stopped executing user program. 有工程，停止运行
SYNC	Yellow 黄色	On 亮	Synchronization is completed. 同步完成
		Off 灭	Synchronization has not started. 同步尚未开始

		Flash 闪	Synchronization is in progress. 同步进行中
FORCE	Yellow 黄色	On 亮	A variable has been disabled. 有变量被强制
		Off 灭	No variable has been disabled. 无变量被强制
		Flash 闪	Undefined. 未定义
INIT	Yellow 黄色	On 亮	The keyswitch is in the 'Init' position. 钥匙开关在 Init 状态
		Off 灭	The keyswitch is not in the 'Init' position. 钥匙开关未在 Init 状态
		Flash 闪	Undefined. 无定义
RUN	Yellow 黄色	On 亮	The keyswitch is in the 'Run' position. 钥匙开关在 Run 状态
		Off 灭	The keyswitch is not in the 'Run' position. 钥匙开关未在 Run 状态
		Flash 闪	Undefined. 无定义
PROG	Yellow 黄色	On 亮	The keyswitch is in the 'Prog' position. 钥匙开关在 Prog 状态
		Off 灭	The keyswitch is not in the 'Prog' position. 钥匙开关未在 Prog 状态
		Flash 闪	Undefined. 无定义
STOP	Yellow 黄色	On 亮	The keyswitch is in the 'Stop' position. 钥匙开关在 Stop 状态
		Off 灭	The keyswitch is not in the 'Stop' position. 钥匙开关未在 Stop 状态
		Flash 闪	Undefined. 无定义
IP_BUS	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication on IP_BUS. 无通讯
		Flash	IP_BUS communication is in

		闪	processing. 通讯过程中
CM_BUS	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication on CM_BUS. 无通讯
		Flash 闪	CM_BUS communication is in processing. 通讯过程中
PM_BUS	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication on PM_BUS, or the bus has detected a fault. 无通讯，或存在 PM_BUS 故障
		Flash 闪	PM_BUS has not detected a fault in communication process. 通讯过程中，两条 PM_BUS 正常
TX1，RX1	Yellow 黄色	On 亮	Undefined. 未定义
		Off 灭	No communication. 无通讯
		Flash 闪	TX1：Send data；RX1：Receive data TX1：发送数据；RX1：接收数据

3.20 Diagnostic function 诊断功能

3.20.1 Debug interface 调试接口

SWSRS_NSafR_SecR_A_046

The debug interface is mainly used for reading internal fault information and internal log information of CM and PM. This debug interface only can be used by developers.

The interface uses serial port as a medium.

私有调试接口主要用于对 CM、PM 的内部调试以及读取内部故障信息和内部日志，这些信息并不开放给用户。

私有调试接口采用串口作为介质。

3.20.2 Memory usage diagnostic 内存使用率诊断

SWSRS_NSafR_SecR_A_047

The control station monitors memory usage in real-time, and this information can be provided to the diagnostic software.

实时检测内存使用率，该信息能够提供给诊断软件。

3.20.3 CPU load diagnostic CPU负荷诊断

SWSRS_NSafR_SecR_A_048

The control station monitors CPU load in real-time, and this information can be provided to the diagnostic software.

实时检测 CPU 负荷，该信息能够提供给诊断软件。

3.20.4 System Net load diagnostic System Net网络负荷诊断

SWSRS_NSafR_SecR_A_049

The control station monitors the load of System Net in real-time, and this information can be provided to the diagnostic software.

实时检测 System Net 网络负荷，该信息能够提供给诊断软件。

3.20.5 CM_BUS status diagnostic CM_BUS故障诊断

SWSRS_NSafR_SecR_A_050

The control station monitors the status of CM_BUS in real-time, and this information can be provided to the diagnostic software.

实时检测 CM_BUS 网络状况，该信息能够提供给诊断软件。

3.20.6 PM_BUS status diagnostic PM_BUS故障诊断

SWSRS_NSafR_SecR_A_051

The control station monitors the status of PM_BUS in real-time, and this information can be provided to the diagnostic software.

实时检测 PM_BUS 网络状况，该信息能够提供给诊断软件。

3.20.7 Safety Net status diagnostic Safety Net故障诊断

SWSRS_NSafR_SecR_A_052

The control station monitors the status of Safety Net in real-time, and this information can be provided to the diagnostic software.

实时检测 Safety Net 网络状况，该信息能够提供给诊断软件。

3.20.8 IP_BUS status diagnostic IP_BUS故障诊断

SWSRS_NSafR_SecR_A_053

The control station monitors the status of IP_BUS in real-time, and this information can be provided to the diagnostic software.

实时收集 IP_BUS 网络状况，该信息能够提供给诊断软件。

3.20.9 CM status diagnostic CM状况诊断

SWSRS_NSafR_SecR_A_054

The control station monitors the status of CM in real-time, and this information can be provided to the diagnostic software.

实时检测 CM 运行状况，该信息能够提供给诊断软件。

3.20.10 PM status diagnostic PM状况诊断

SWSRS_NSafR_SecR_A_055

The control station monitors the status of PM in real-time, and this information can be provided to the diagnostic software.

实时检测 PM 运行状况，该信息能够提供给诊断软件。

3.20.11 PW status diagnostic PW状况诊断

SWSRS_NSafR_SecR_A_056

The control station monitors the status of PW in real-time, and this information can be provided to the diagnostic software.

实时读取 PW 的运行状况，该信息能够提供给诊断软件。

3.20.12 IO module status diagnostic IO状况诊断

SWSRS_NSafR_SecR_B_057

The control station ~~can scan the module information before the module is configured, and~~ monitors the status of IO module in real-time after the module is configured, and this information can be provided to the diagnostic software.

~~上电后系统未做硬件配置时支持对本系统内所安装模块的扫描识别，~~系统完成硬件配置后实时收集 IO 模块运行状况，该信息能够提供给诊断软件。

3.20.13 Diagnostic information clear 诊断清除

SWSRS_NSafR_NSecR_A_021

The system supports the user to clear the diagnostic information using diagnostic software.

支持用户对部分诊断信息进行清除处理。

~~3.20.14 Safety parameters information 安全参数信息~~

~~SWSRS_NSafR_NSecR_A_022~~

~~The information as IO module status, IO module fault record (with time stamp), UP running information (with time stamp) which is related with safety parameters can be provided to the~~

~~configuration software.~~

~~This information can be used by configuration software to calculate the safety parameters.~~

~~上报 PM 及 IO 模块的状态及故障信息（带时间戳）、UP 的运行状态及变化信息（带时间戳）给组态软件，可用于组态软件进行安全参数计算。~~

3.21 Log 日志

3.21.1 Log capacity 日志容量

SWSRS_NSafR_SecR_B_058

~~Each PM, CM can save the lateset 10000 log records.~~

~~PM、CM 各自保存最近的 10000 条日志记录。~~

PM can save the lateset 30000 log records. CM can save the lateset 10000 log records.

PM 保存最近的 30000 条日志记录，CM 保存最近的 10000 条日志记录。

3.21.2 Log content 日志内容

SWSRS_NSafR_SecR_A_059

The important operation information and all kinds of exception information need to be recorded in the log, include: power on records, fault records, download records and debug records, etc.

日志中需要记录关键运行信息和各种异常信息，主要包括：上电记录、故障记录、组态下装及调试记录等。

3.21.3 Power lost retention 日志掉电保持

SWSRS_NSafR_SecR_C_060

The ~~latest 1000 important~~ log will not be lost after PM power off. The important log include power on records, fault records, access control (entry and exit), download and debugging records, etc. If the module has been pulled out, the retained log is lost.

日志记录~~中最近的 1000 条关键日志~~具有掉电保持功能，不会因为模块掉电而丢失。上电记录、故障记录、访问控制（登录和退出）、组态下装和调试记录等为关键日志。模块拔插后日志不保持。

3.21.4 Log read 日志读取

SWSRS_NSafR_SecR_B_061

User can read log from each PM or CM by diagnostic software. When the space which is used for storing log is less than the threshold value, an alarm will be provided to the user. The threshold is 5%.

The log can not be modify by diagnostic software, but can be cleared by diagnostic software.

使用上位机诊断软件，可读取指定 PM 或 CM 的日志记录。当有未被读取的日志将要被最新日志覆盖时，产生报警，该预警门限为 5%。

不支持诊断软件对日志的修改；支持诊断软件清除日志。

3.22 Performance 性能

3.22.1 The scale of control station 控制站规模

SWSRS_SafR_NSecR_A_062

One control station supports a maximum of 16 PCs (includes engineer station, operator station, SOE station and diagnostic station). System supports a maximum of 64 control station.

系统中最多支持 16 个上位机（包括工程师站、操作员站、SOE 站、诊断站、AMS 站），最多支持 64 个控制站。

3.22.2 System network load 系统网负荷

SWSRS_NSafR_NSecR_A_063

In the case of 100Mbps Ethernet, the load of system network is less than 40% when system is in normal running. System normal running does not include the status as download process, system restart process, etc.

在采用 100Mbps 以太网情况下，系统正常运行过程中，系统网负荷小于 40%。系统正常运行过程不包括组态软件下装、系统重启过程等。

3.22.3 Power-on time 上电时间

SWSRS_NSafR_NSecR_A_064

The power on time of PM is less than 2 minutes, and the power on time of CM is less than 2 minutes. Power-on time is the interval between the module power-on completed to the module self-check completed.

CM、PM 的上电时间应不大于 2min。上电时间是指从模块电源端口上电完成到模块自检完成之间的时间。

3.23 Upgrade via network 现场升级

3.23.1 Upgrade software via network 软件网络升级

SWSRS_NSafR_NSecR_A_065

Firmware, OS, FPGA of CM/PM can be upgraded by diagnostic software via System Net. The new firmware will be checked while upgrading. The new firmware will not take effect immediately until the system power-on again. Before this, the system keeps using the original firmware.

PM can receive the upgrade data of IO module from diagnostic software and send it to IO modules.

上位机诊断软件通过 System Net 升级 CM、PM 中的 FW、OS、FPGA，升级时需进行数据校验。升级后的版本在系统重新上电后才会加载生效，在此之前，系统继续使用原来的软件运行。

PM 将上位机诊断软件下发的 IO 模块升级数据发送给对应 IO 模块，用于该模块的网络升级。

3.23.2 Version record 版本记录

SWSRS_NSafR_SecR_B_066

CM and PM record the version of firmware, OS, FPGA~~, CPLD and hardware~~ and Power_MCU information. These information can be provided to the ~~configuration software and~~ diagnostic software.

PM can get the version of firmware, FPGA, CPLD and hardware information from IO modules, and provided it to the ~~configuration software and~~ diagnostic software.

CM、PM 记录本模块上的 FW、OS、FPGA~~、CPLD~~和 Power_MCU 的版本号，该信息能够提供给~~组态软件及~~诊断软件。

支持从 IO 模块读取模块固件、FPGA、CPLD、硬件的版本号，并提供给~~组态软件及~~诊断软件。

——以下无正文

The last requirement number is SWSRS_NSafR_NSecR_A_069

本文档最后一个需求编号为 SWSRS_NSafR_NSecR_A_069