2541 Redundant Processor Manager Module

Definitions

Active PLC: the PLC which is actually controlling the remote I/O.

Standby PLC: the backup PLC which is not in control of the I/O but receives a mirror image of the I/O inputs from the RPM module.

Bumpless Transfer: switching control of remote I/O to a standby PLC without affecting the process

Warm backup: transfer of remote I/O control to a standby PLC running asynchronously within the timeout period of the PLC or remote base controller (typically <100ms).

Hot back-up: synchronous program execution and seamless data transfer between two PLCs with instantaneous, bumpless transfer of control. The RPM module does not support this level of backup.

Switchover: transfer of remote I/O control from active PLC to standby PLC.

Critical data: user-defined data that must be transferred every scan to maintain control of the process in the event of a switchover.

Non-critical Data: data which must be transferred to the backup PLC, but which does not potentially change every scan.

Virtual base: a remote I/O base that exists within the RPM module; it appears as real (physical) I/O to the PLCs but is created through emulation of the remote I/O data stream.

Home Base: the first virtual base which is created by the RPM; it contains the control and status bits which can be used for PLC program control of the switchover.

Task Codes: messages which can read and write values in PLC memory.

Specifications

Environmental
Operating Temperature: 0° to 60° C (32° to 140°F)
Storage Temperature: -40° to 85°C (-40° to 185°F)
Relative Humidity: 5 to 95% (non-condensing)

Backplane Power Consumption
6.0 watts at 5V DC

Module Size
Double wide

Configuration Port
Male DB9, RS-232
1500 V isolation channel to PLC
9600 baud
No parity, 1 stop bit, 8 data bits

Switched I/O Ports
Front Access Connector
Compliant with RS485 Remote I/O Communications Specification.

Switched Communications/Aux Ports
Front Access Connector
Maximum Voltage: 24V AC/DC
Maximum Current: 0.5 amp
Resistive load only

Switchover Characteristics
PLC Timeout Value: 25 - 450ms (user defined)
RPM Switchover Time: <50ms
Maximum RBC Switchover Re-connect Time: <50ms

Agency Approvals (pending)

UL, UL for Canada

FM Class I, Div 2

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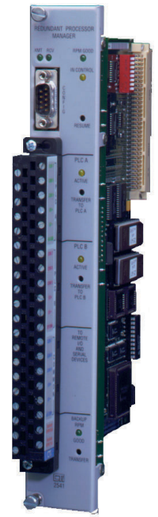
2500 Series PLC System
Product Bulletin

2541 Redundant Processor Manager



Features

- Automatically transfers control to standby PLC upon loss of I/O scan or “heartbeat” pulse from the active PLC.
- Switches both remote I/O and serially attached operator interface devices.
- Enables PLC logic to monitor status and control switchover, if desired.
- Allows optional manual switchover capability.
- Uses high-reliability relays to directly connect the active PLC and remote I/O without intervening electronics.
- Defaults to a user-defined switched position on power loss or hardware failure.
- Provides LEDs to visually indicate status of control.
- Transfers up to 4096 words of critical data between active and standby PLCs every scan.

Description

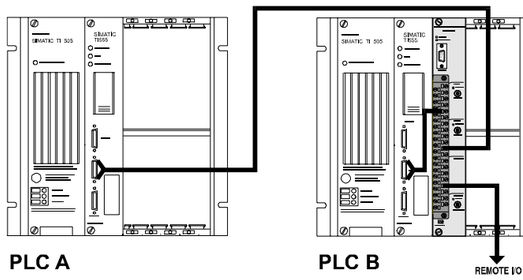
The CTI 2541 Redundant Processor Manager (RPM) provides a warm backup solution for CTI 2500 Series or Simatic® 505 PLCs. If the active PLC fails, the RPM will automatically switch the remote I/O to the standby PLC. All I/O updates are mirrored to the standby PLC to facilitate bumpless transfer. In addition, up to 4096 words of user-defined critical data can be transferred from the active PLC to the standby PLC every scan. Other non-critical data can be transferred over several scans. The RPM can also switch up to two serially attached operator interface devices.

Front bezel LEDs indicate the control and module status. Protected front panel pushbuttons can be used to exercise manual control. A serial port provides access for module configuration. The RPM uses the standard front-access connector for ease in terminating I/O and operator interface connections.

A complete system can be configured using two bases, two power supplies, two PLCs, one RPM module, and one or more racks of remote I/O. Only one RPM module is required to provide warm backup.

System Configuration

PLC A is the PLC which will be active under normal conditions; PLC B is the PLC which will be in standby mode under normal conditions. The RPM module may be inserted into the local base of either PLC or into a separate base.



The remote I/O port of PLC A and PLC B are both connected to the appropriate terminals on the RPM. The cable from the remote I/O is connected to the module. Three sets of nine additional terminals are provided for switching the connections between operator interface devices and the PLC communication ports. These connections are not shown in the figure above. See wiring diagram on back page for details.

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Switchover

The I/O port of the active PLC is directly connected to the remote I/O through a switching relay in the module. The module continually monitors the I/O traffic between the active PLC and the remote I/O bases. Data from the remote bases is mirrored to the standby PLC every scan so that the standby PLC operates as if it were actually controlling the process.

Provided the standby PLC is operational, the RPM will automatically switch the remote I/O to the standby PLC when one of the following conditions is encountered:

- A "heartbeat" pulse, generated by user PLC logic, is not received from the active PLC within a user specified time period.
- A remote I/O update from the active PLC is not received within a user-specified time period.

Switchover can also be requested using PLC logic or through the front bezel pushbuttons. All switchover options can be disabled by the user using the RPM configuration program. Switchover will be inhibited if:

- The RPM module determines a failure in the standby PLC
- The standby PLC does not attempt to scan the I/O within a user -specified time period

Switchover can be optionally inhibited it:

- The standby PLC does not generate a "heartbeat pulse" within a user-specified period
- The L (ladder program) memory checksums in the two PLCs do not match.

The RPM will switch to a user defined default position if any of the following occurs:

- Early Power Fail signal is detected. This signal, which indicates an imminent power failure, is generated by the rack power supply when power drops into a brownout condition.
- Power to the rack is lost.
- The RPM module itself fails.

Data Transfer

Besides data from the I/O, many applications will require that certain data, local to the active PLC, be transferred to the backup PLC. This local data may include V memory values, timer/counter values, and control relay states. Critical data, which changes rapidly, can be transferred by the RPM every scan. Non-critical data, which does not change as often, can be transferred by the RPM over several scans.

Critical data is transferred every scan via the image register of the PLCs. The RPM accomplishes this transfer by emulating one or more remote bases (called virtual bases). The first virtual base (called the home base) provides 448 words of I/O (WX/WY); additional virtual bases provide up to 512 words each. The maximum number of virtual bases is determined by subtracting the number of real I/O bases from 15 (the maximum number of I/O bases allowed). The total number of words that can be transferred using virtual bases will be limited by the PLC minus the number of words transferred for other uses. It requires two words (one WX and one WY) to transfer a single word value. User generated program logic in the active PLC maps the critical data into the output WY image register. Similar logic in the standby PLC copies the corresponding WX image register contents back to the appropriate PLC memory locations.

Non-critical data is transferred via task code requests. This operation may take several scans. To accomplish this transfer, the RPM inserts task code requests into the remote I/O data stream to read and write PLC memory. No additional user programming is required. About 100 words of Non-critical data can be transferred per second (throughput will vary depending upon PLC scan times and configuration). Should higher performance of non-critical data transfer be required, a pair of CTI 2572 Ethernet TCP/IP modules can be used.

Programming Considerations

Most applications will require some additional user written PLC logic to optimize the use of the RPM module. The function of this logic may include monitoring and controlling the RPM module, generating a heartbeat pulse, and transferring critical data.

The first virtual base created by the RPM (the home base) logs in as 32X, 32Y, and up to 448 WX or WY locations. The discrete X and Y points can be used by the PLC program to monitor and control the RPM, if desired.

By observing certain X points, each PLC can determine whether it is the active or the standby controller and whether the other PLC is available for transfer of control. If a dual-RPM architecture is used, the status of the backup RPM module can also be monitored. Y control points can be used to request a switchover to the other PLC, or to the backup RPM (if present).

Interruption of a heartbeat pulse is one event the RPM can use to automatically switch over to the standby PLC. The module can also use this pulse to determine whether the backup PLC is available for switchover. PLC logic generates a heartbeat pulse by toggling a specific Y location in the RPM home base.

The RPM virtual bases equate the WY outputs of the active PLC to the WX inputs of the standby PLC. For transferring critical data, the user written PLC logic in the active PLC must map internal variables into word output (WY) image registers and the standby PLC must map the corresponding WX locations back into internal variables. Since both PLCs must contain identical mapping logic, the RPM controls a bit which indicates to each PLC whether it is active or standby. This bit can be used to conditionally control the direction of the data mapping.

Operator Interface Considerations

Transferring control to the standby PLC is likely to result in a brief interruption in serial communications because switchover may occur in the middle of a message. Fortunately, the message protocol used by the PLC provides a way to ensure that a valid complete message is received. Thus, most Operator Interface or Man Machine Interface (MMI) devices can detect and recover from these communications interruptions.

Rather than use serially connected MMI, a TCP/IP Ethernet network with CTI 2572 modules may be used. If you choose to install a 2572 module in a remote base, switchover will follow the I/O control. If you need the higher performance of local rack communications, you could install two modules, one in each local base and have the MMI application select to communicate with the module in the rack with the active PLC. In this instance, the MMI application has the added advantage of being able to query the standby PLC at any time, a function not possible when using serial communications or installing in a remote base.

Wiring Diagram