FANUC

GE Fanuc Automation

Programmable Control Products

Series Six™ Redundant Processor Unit

User's Manual

GEK-25366C June, 1990

WARNINGS, CAUTIONS, AND NOTES AS USED IN THIS PUBLICATION

WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

NOTE

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

Preface

This manual provides information necessary to use a Redundant Processor Unit (RPU) in a Series Six Plus Programmable Controller system. The RPU enhances a Series Six Plus system by acting as a switch to transfer control from one Series Six Central Processor Unit (CPU) to a standby CPU if a failure of the first CPU occurs.

You should become familiar with the capabilities and hardware of the Series Six Plus before attempting to use the RPU. Information on the Series Six hardware can be found in the Series Six Plus User's Manual, GEK-96602, while programming is detailed in the Logicmaster™ 6 Programming and Documentation Software Manual, GEK-25379.

Chapter 1 is a description of the RPU hardware. It includes a general description of the features of the modules used in the RPU. Chapter 2 describes how to install and configure the RPU. A variety of RPU system configurations are shown including systems with Series Six I/O, Genius I/O, and a combination of both types of I/O.

Operator interfaces are discussed in Chapter 3. It includes Light-Emitting Diodes (LED's) and displays as well as alarm relays. Chapter 4 describes the overall function and operation of the RPU. The RPU cycle, RPU/CPU synchronization and the various RPU operating modes are also discussed. Additional information is given concerning the failure transfer sequence, power up sequence, CPU sweep time impact, I/O enable sequence and maximum CPU sweep time.

Chapter 5 provides application information. This includes a description of bumpless transfer and discusses CPU programming as it applies to the RPU. Use of the redundant I/O features, long distance I/O and analog inputs and outputs are covered. This chapter also discusses the Communications Control Module as it pertains to the RPU.

Chapter 6 describes service procedures such as CPU and I/O faults as well as faults which can occur in the RPU.

Following Chapter 6 is a collection of data sheets discussing the RPU and the modules it uses. These data sheets provide further information about the RPU not discussed in the first six chapters.

Figure

Chapter 1 Hardware Description

RPU Hardware Description

The Redundant Processor Unit (RPU) acts as a switch to transfer control from one Series Six™ Plus CPU or I/O chain to a standby Series Six Plus CPU upon failure of the first. To accomplish this, the RPU monitors the Master CPU and I/O chain for fault conditions, and when such conditions are detected, conducts an orderly transfer of control to the standby CPU. A bumpless transfer (one without loss or interjection of data) can be accomplished within milliseconds, while maintaining program and I/O continuity. Actual transfer time varies up to two CPU sweeps, depending where in the sweep cycle the fault occurs, and the amount of data to be transferred.

The RPU is contained in a stand-alone Series Six type rack and includes the following rack mounted modules. See Figure 1-1 for the location of these modules in the rack. A brief discussion of each module follows the illustration.

- Data Control Module - required
- Data Prom Module - required
- Data Storage CMOS Memory Module - required
- Device Switch Module - required
- CPU Switch Module - required
- I/O Switch Module - required
- Main Power Supply Module - required
- Auxiliary Power Supply Module - optional (recommended)
- Additional CPU and I/O Switch Modules for Auxiliary I/O - optional

The RPU modules must be connected to two Series Six CPUs and a Series Six I/O system to complete the system configuration.

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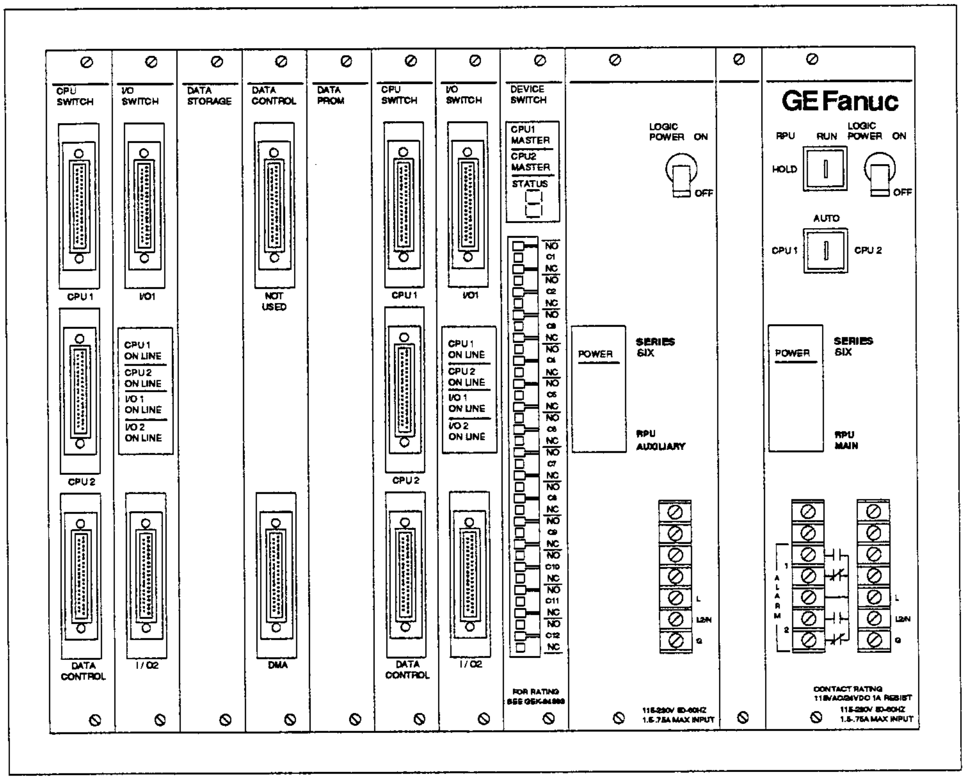


Figure 1-1. RPU Rack with Full Set of Modules

Data Control Module

The Data Control module supervises operation of the RPU, providing parallel communications between the master and standby CPUs and their I/O chains. CPU synchronization is maintained by this module, as is transfer of I/O and register data between master and standby CPUs. This is a required module.

Data Prom Module

The Data PROM module contains Programmable-Read-Only-Memory (PROM) circuits which store the internal RPU firmware. This is a required module.

Data Storage CMOS Memory Module

The Data Storage CMOS Memory module contains Random-Access Memory (RAM) for holding Central Processor Unit (CPU) memory images and for general use by the Data Control Module. These intermediate storage locations are used for input, output override, or register data read by the RPU. On every CPU scan, the RPU reads the requested data from the Master RPU and transfers it to the standby processor. The data to be transferred is selected by hardware jumpers on the Device Switch Module, or by the setting of I/O bits and registers in the CPU. Data is held by the RPU in the CMOS memory, verified using checksums, and then transferred. Actual switching of the I/O data bus cable is accomplished through interaction of the CPU and I/O switch modules. This module is required.

Device Switch Module

The RPU Device Switch module, provides logic to interface the Data Control module to the Device Switch and I/O Switch modules. It also contains twelve form C relays whose state depends upon which CPU is the Master. These are intended to be used to multiplex external devices such as Host serial link, printers, CRTs, etc., to the Master CPU. A 36-point high density connector is provided for user connection to the relays. The module also has two Light-Emitting Diodes (LEDs) and one seven-segment display which are visible through the lens on the faceplate. This module contains eight Berg jumpers, four of which are used to define the types of data transfers to be undertaken by the RPU. The other four have varied functions which we will describe later. This module is required.

CPU Switch Module

The CPU Switch module contains two I/O bus switches. One switch selects the CPU1 or CPU2 I/O bus and passes it to the I/O Switch module via the backplane. The other switch selects CPU1 or CPU2 and passes the I/O bus to the Data Control module through a front panel connector and a short cable. This module has three 37-pin D connectors and no LEDs. This module is required in the slot to the right of the Data Prom module. An additional CPU Switch module can also be used if your application requires Auxiliary I/O. (See later section on the Auxiliary I/O option).

I/O Switch Module

The I/O Switch module's main function is to select between I/O chains 1 and 2 and connect the selected one to the CPU Switch module via the backplane. This module has two 37-pin connectors and four LEDs. This module is required in the slot to the left of the Device Switch module. An additional I/O Switch module can also be used if your application requires Auxiliary I/O. (See later section on the Auxiliary I/O option).

Main Power Supply Module

The Main Power supply module contains the following:

- Switching power supply
- Redundant power supply interface circuitry
- Two form C relays for Alarm annunciation.
- Two key switches to set system operation mode.
- LED to indicate that the power supply is operational.

This module is required.

Auxiliary Power Supply Module

The Auxiliary Power supply module is similar to the Main Power Supply, except it has no relays or key switches. This supply mounts in the RPU rack and will power the RPU system in the event of failure of the main power supply. Separate power sources can be connected to each RPU power supply to assure operation in the event of loss of one or the other power source. This module is optional, but is strongly recommended for increased security.

Auxiliary I/O Option (additional CPU and I/O Switch Modules)

The Auxiliary I/O option uses an additional CPU Switch module and an I/O Switch module. This option is used only with the Series Six Plus and only when it uses the Auxiliary I/O chain function.

The RPU functions without this option. The two additonal modules are placed in the slots furthest away from the power supply. If these modules are installed, you must connect them to the corresponding CPU and I/O racks.

Installation

The RPU uses the standard size Series Six Plus PLC rack and therefore provides the same mounting dimensions and options. Cables are also standard Series Six type cables.

Power

The RPU will operate with only the Main Power Supply module installed. However, should the Main Power Supply module fail, RPU operation would also fail. The Auxiliary Power Supply module should be installed to permit the RPU to operate through the failure of either power supply.

AC power is supplied to both power supplies in the RPU rack by connection to the L1, L2 and Ground terminals on each. L1 and L2 on the two power supplies may be either paralleled or supplied from different sources - which is the preferred method, discussed in the next several paragraphs.

If you lose the Main Power Supply on the RPU, power to the RUN/HOLD keyswitch is cut off. The RPU sees this as a command to Hold and does so. This means that the RPU no longer supports CPU data transfers and cannot switch over if the Master CPU has a subsequent problem. I/O, however, is maintained from whichever CPU is Master via the CPU switch and I/O modules, provided they are still powered up (Auxiliary Power Supply operating). So, the overall system still continues to operate.

The preferred method for connecting power is:

- Using the RPU keyswitch, select CPU1 or CPU2 as the preferred Master CPU (figure 2.1 assumes CPU1 has been selected).
- Wire power to the preferred master CPU and to the RPU Auxilary Power Supply from the less reliable power source.
- Wire power to the other CPU and to the RPU Main Power Supply from the more reliable power source.

When connected in this manner, if power to the preferred Master is lost, the RPU will switch to the alternate CPU, since the Main Power Supply module is still up and running. If power to the Main Power Supply module is lost, the RPU passes the signals from the preferred Master CPU, which is still up and running, to the I/O chain(s).

If you follow this method of power hook-up, the simultaneous loss of the Master CPU and the RPU Main Power Supply is averted. Such a loss cannot be tolerated by the RPU, which automatically goes into the Hold Mode when the main power supply switches off (see Chapter 4). In the Hold Mode, the signals from the master CPU pass through the RPU to the I/O chain(s) without any intervention from the RPU. Subsequent CPU switching is not possible until the Main Power Supply module is put back on line, and the keyswitch is returned to the RUN position.

NOTE

If the RPU is running under the Auxiliary Power Supply only, the RPU provides power to all signals passing from the Master CPU to the I/O chain(s), but **does not** support any further CPU switching or data transfers from Master CPU to Backup CPU.

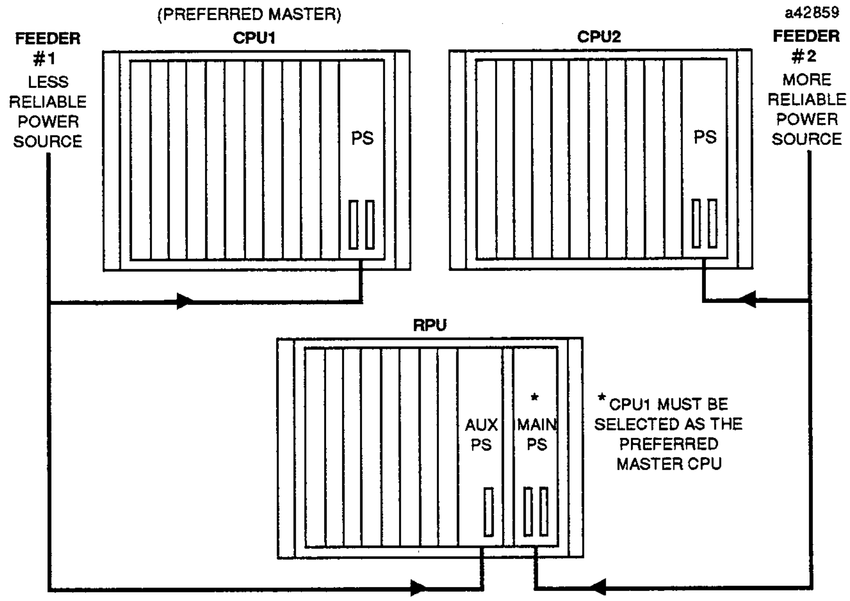


Figure 2-1. Connections for Dual Power Feeder Application of RPU

Grounding

Grounding too is critical for the RPU, as it connects several other pieces of equipment together, none of which are isolated. The preferred grounding scheme is to define a central point on the enclosure or mounting plate to which the PLC equipment (including the Workmaster® computer or PDT) will be attached and connect the ''GND'' terminals of all power supplies to that point with short, heavy conductors (No. 12 AWG. minimum wire size is suggested). These grounding recommendations are meant as a general guideline only. Common mode ground noise voltages between the RPU, CPU's and I/O racks and any other nonisolated equipment must not exceed ± 2.5 V.

The signal connections to the CPUs must be made with Series Six Plus I/O Cables (maximum cable length is 10 feet). The connections to the I/O chains are also made with I/O cables. These may be of any length as long as the total length of cable in any of the local I/O stations does not exceed 50 feet. The connections between the RPU and the CPUs and I/O chains are illustrated in Figure 2.2.

All cables should be firmly secured at both ends by using the captive screws supplied with the connectors, and should **NOT** be disturbed during normal operation.

Configuration

The I/O Switch Modules and Device Switch module contain jumpers to configure your system. The DIO jumper on the I/O Switch module configures your system for either a single I/O chain or dual I/O chains. The jumpers on the Device Switch module are set up to define the type of data which is transferred from the Master CPU to the Backup CPU each sweep, and also to determine the maximum scan time the RPU can tolerate.

I/O Chain Configuration (I/O Switch Module)

I/O Chain Selection: To configure the RPU for Dual I/O operation, the DIO jumper on either the Main or Auxiliary I/O Switch module must be in the 2-3 position for dual chain operation. These jumpers are connected through the backplane so that either one will select Dual I/O for both Main and Auxiliary I/O chains. If a single Main and Auxiliary I/O chain is used, the DIO jumper must be in the 1-2 position in the Main I/O Switch module **and** the Auxiliary I/O Switch module.

DIO Position (Main)	DIO Position (Aux)	Selection
1-2	not installed	Single I/O
2-3	not installed	Dual I/O
1-2	1-2	Single I/O
2-3	either	Dual I/O
either	2-3	Dual I/O

Auxiliary I/O Chain(s): The RPU is configured for Auxiliary I/O by installing the CPU Switch module in the left-most slot of the RPU rack and the I/O Switch module in the slot next to that. No other jumpers need be set. Auxiliary Inputs, AI0001 - AI1023, (in R0065 - R0128) will then be automatically transferred. Auxiliary Outputs, AO0001 - AO1024, (in R0001 - R0064) will be transferred if the OTT function is activated.

NOTE

If these modules are not present, the Auxiliary Input and Output Transition tables will not be transferred to the Backup CPU as described above. Since they coincide with R1 - R128 however, they may be transferred as part of the Register transfer (see explanation below).

Setting Up Data Transfers (Device Switch Module)

The functions of the data transfer jumpers on the Device Switch module are explained in the table below. A more complete explanation of the meaning of these functions follows the table.

Jumpers on the Device Switch Module and Functions Selected

Jumper	Marking	Position		Equiv Output in Master CPU	Function
JP1	FT	1-2		--	Do not use in 2-3 position.
JP2	OTT	1-2	and	O1022 OFF	Disables transfer of Output and Transition Tables each sweep.
		2-3	or	O1022 ON	Enables transfer of Output and Transition Tables each sweep.
JP3	BTM	1-2	and	O1023 OFF	Disables transfer of R0254 from Backup to Master CPU each sweep.
		2-3	or	O1023 ON	Enables transfer of R0254 from Backup to Master CPU each sweep.
JP4	RT	1-2	and	O1024 OFF	Disables transfer of specified registers each sweep.
		2-3	or	O1023 ON	Enables transfer of specified registers each sweep.
JP5	BI	1-2		--	Only transfers selected by OTT, BTM, and RT are performed when a CPU first becomes a backup.
		2-3		--	A complete set of transfers are performed automatically(up to 4096 registers, and all I, O, Override, and Transition Tables) when a CPU first becomes a backup.
JP6*	--	1,2		--	I1024 used as Backup Bit (in Backup CPU).
		2-3		--	I1022 used as Backup Bit (in Backup CPU)
JP7	--	1-2		--	Do not use.
JP8**	--	1-2		--	Selects 250 ms maximum CPU sweep time
		2-3		--	Selects 150 ms maximum CPU sweep time.

* Rev E firmware or later (Dec 86)
** Rev G firmware or later (Feb 89)

CAUTION

For RPU Revision G and later, Jumper JP8 on the Device Switch Module allows you to select the maximum permitted CPU scan time. This is the scan time measured before the RPU is placed in Run mode. If you select JP8 jumpered 1-2, you must first be sure that both CPUs contain Arithmetic Logic Unit ALU3 boards. If any ALU2 boards are used, a system failure may result. To test this, turn the RUN/HOLD switch on the RPU to HOLD, and verify that both CPUs continue to run.

Output and Transition Table Transfer: Either place the OTT jumper in the 2-3 position or turn ON O1022 in Master CPU if you want the RPU to transfer the Output and Transition Tables of the Master CPU to the Backup CPU each sweep (see Chapter 5).

Backup-to-Master Transfer: Either place the BTM jumper in the 2-3 position or turn on O1023 in Master CPU if you want the RPU to transfer Register 254 from the Backup CPU to the Master CPU each sweep (see Chapter 5).

Register Transfer: Either place the RT jumper in the 2-3 position or turn on O1024 in Master CPU if you want the RPU to transfer a bank of registers from the Master CPU to the Backup CPU each sweep (see Chapter 5).

The starting register in the bank is identified by the contents of R0255 in the Master CPU. The ending register in the bank is identified by the contents of R0256 in the Master CPU.

For register transfers to execute, the contents of R0255 and R0256 in the Master CPU must be between 1 and 4096, and R0255 cannot contain a larger value than R0256. If these rules are violated, no transfer takes place.

Backup Initialization: If the BI jumper (JP5) is in the 2-3 position, the RPU will transfer the Master CPU's Registers (1-4096), Input, Output, Override, Transition tables, and time-base memory locations (scratchpad) to the backup CPU whenever a CPU is put back on-line, that is, whenever a CPU becomes a backup for the first time (it may have been the Master CPU previously, or it may have been OFF-LINE).

If the BI jumper is in the 2-3 position, only the transfers selected by other jumpers and outputs will be performed.

The Backup Initialization occurs after a switch, not before (both CPUs on-line, BI selected). When a switch is complete and the backup CPU is seen on-line, then the Backup Initialization will take place. This is not a substitute for Register Transfer (RT), and will not prepare your backup with good data just before a switch (see Chapter 4, Example No. 2).

Select Backup Bit Location: The RPU Backup Bit can conflict with I/O Xmit Status Byte, unless you set the jumper (JP6) on the Device Switch correctly. If your system uses I/O Transmitter Module I/O transmitter board(s) in channelized mode, there is a conflict at I1024 for Channel 0. You will have to set Device Switch Module switch JP6 to the 2-3 position (from the factory 1-2 position). This moves the RPU's Backup Bit from I1024 to I1022 in the Backup CPU to avoid this conflict.

Scan Time Jumper: The Device Switch Module jumper (JP8) selects the maximum PLC scan time as 150ms or 250ms. The correct selection depends on the ALU boards in PLCs in the system. JP8 is shipped in position 2-3 corresponding to 150ms (max) scan time compatible with ALU1, ALU2, and ALU3 boards. Position 1-2 corresponds to the 250ms (max) scan time compatible only with the ALU3 board. Refer to the discussion of Scan Time Compatibility to follow and the caution described there.

Other Configuration Jumpers: All other jumper locations are either reserved for future use or for factory test functions and should be set to the 1-2 position before use.

Compatibility Issues

CPU Compatibility: The RPU requires that the connected CPU1 and CPU2 versions must be 103 or later. This may be verified by connecting the Workmaster to each CPU and reading the CPU version number from the scratch pad display menu.

Scan Time Compatibility: If your application involves use of a Series Six Plus CPU with a scan time of OVER 150ms and you have a pre-Revision G RPU, you will have to install the RPU PROM upgrade kit 44A286351-G04 or later and it will only work if your Series Six Plus CPU has the ALU3 arithetic control board (IC600CB524). ALU1 and ALU2 boards will not support scan times over 150ms.

To change out these PROMS, locate the RPU Data PROM Module. Replace the PROMS at locations H3, D3, H5, D5 on the board with the quivalent EPROMS in the upgrade kit, and relabel them according to the instructions in the upgrade kit.

In summary, for scan times less than 150ms, you can use pre-Revision F RPU firmware, or Revision G firmware (or later) with RDSW JP8 set to 2-3 (150 ms). For scan times above 150ms but less than 250ms, use Revision G (or later), or upgrage your existing equipment with the Revision G (or later) kit. The Device Switch Module JP8 must be set to position 1-2 (250ms).

CAUTION

If the RPU is configured to run at 250 ms (max) and is used in conjunction with ALU1 or ALU2 boards in the CPU(s), the incompatibility may escape detection until such time as the main power supply on the RPU dies, or until the Run/Hold switch on the RPU is switched to Hold. At this point, those CPUs which contain ALU1s or ALU2s will time out. If both CPUs contain ALU1 or ALU2 boards, the I/O chains will reset. To test for compatibility, turn the Run/Hold switch on the RPU to Hold and verify that both CPUs continue to run.

Using Expanded I/O

If Series Six Expanded I/O is used in your system, you will need to transfer the Expanded I/O data from the Master to the Backup in order to maintain a sufficient system image in the Backup CPU.

To transfer this data, you will need to use the Register Transfer function, since Expanded I/O is mapped into Register space as shown in the following table.

In such a system, there are restrictions with respect to the use Expanded Channel 1. Register references R0254, R0255, and R0256 are used by the CPU for the RPU Backup-to-Master Transfer and Register Transfer functions. This can cause a conflict, because these registers are used to hold Input Table data for Channel 1 in expanded I/O systems. Inputs I01 + 0977 through I01 + 1024 cannot be used for any other purpose if these functions are required to operate in the RPU.

In particular, conventional Series Six I/O operating in Channel 1 will encounter a conflict, since the Status Byte of the I/O Transmitter Module (IC600BF900) conflicts with R256 which is required for RPU Register Transfers. A second version of the I/O Transmitter Module (IC600BF940) solves this problem by providing a jumper of the circuit board to enable or disable the Status Byte generation. If Channel 1 is required for conventional Series Six I/O in an RPU application, I/O Transmitter Module IC600BF940 must be used and must be configured to disable its status byte generation. IC600BF940 is

not advised in RPU applications with Ch1. GENIUS Bus Controllers, **can** always be used to control Channel 1, provided no conflicting I/O assignments are made.

CAUTION

RPU Backup-to-Master Register (R254) and Register Transfer Limits (R255 and R256) conflict with certain expanded channel addresses, and you must normally leave the CPU's R255 and R256 available for the RPU. In some instances, this means skipping Channel 1 altogether.

This is how I/O Channels Map into Register Banks:

R1	-	R64	Auxiliary Out (non Channelized)
R65	-	R128	Auxiliary In (non Channelized)
R129	-	R192	Expanded Ch 1 Outputs
R193	-	R256	Expanded Ch 1 Inputs

Expanded Ch 1 Outputs and Expanded Ch 1 Inputs are repeated in blocks of 128 Registers for Channels 2 through 7 and 9 through F.

Below is a list of Expanded I/O point references for each channel, and their corresponding memory locations.

Table 2-1. Memory Map for Expanded Mode I/O References

REAL I/O POINTS			INTERNAL DISCRETE REFERENCES	
REGISTER	I/O REFERENCE		REGISTER	I/O REFERENCE
R0001	AO0001 - AO1024	AUX	R2049	O0-0001 - O0-1024
R0065	AI0001 - AI1024	AUX	R2113	IO-0001 - IO-1024
R0129	O1+0001 - O1+1024	M	R2177	O1-0001 - O1-1024
R0193	I1+0001 - I1+1024	A	R2241	I1-0001 - I1-1024
R0257	O2+0001 - O2+1024	I	R2305	O2-0001 - O2-1024
R0321	I2+0001 - I2+1024	N	R2369	I2-0001 - I2-1024
R0385	O3+0001 - O3+1024		R2433	O3-0001 - O3-1024
R0449	I3+0001 - I3+1024	I	R2497	I3-0001 - I3-1024
R0513	O4+0001 - O4+102	O	R2561	O4-0001 - O4-1024
R0577	I4+0001 - I4+1024		R2625	I4-0001 - I4-1024
R0641	O5+0001 - O5+1024	C	R2689	O5-0001 - O5-1024
R0705	I5+0001 - I5+1024	H	R2753	I5-0001 - I5-1024
R0769	O6+0001 - O6+1024	A	R2817	O6-0001 - O6-1024
R0833	I6+0001 - I6+1024	I	R2881	I6-0001 - I6-1024
R0897	O7+0001 - O7+1024	N	R2945	O7-0001 - O7-1024
R0961	I7+0001 - I7+1024		R3009	I7-0001 - I7-1024
		A		
R1025	User Registers	U	R3073	O8-0001 - O8-1024
R1089	User registers	X	R3137	I8-0001 - I8-1024
R1153	O9+0001 - O9+1024	I	R3201	O9-0001 - O9-1024
R1217	I9+0001 - I9+1024	L	R3265	I9-0001 - I9-1024
R1281	OA+0001 - OA+1024	I	R3329	OA-0001 - OA-1024
R1345	IA+0001 - IA+1024	A	R3393	IA-0001 - IA-1024
R1409	OB+0001 - OB+1024	R	R3457	OB-0001 - OB-1024
R1473	IB+0001 - IB+1024	Y	R3521	IB-0001 - IB-1024
R1537	OC+0001 - OC+1024		R3585	OC-0001 - OC-1024
R1601	IC+0001 - IC+1024	I	R3649	IC-0001 - IC-1024
R1665	OD+0001 - OD+1024	O	R3713	OD-0001 - OD-1024
R1729	ID+0001 - ID+1024		R3777	ID-0001 - ID-1024
R1793	OE+0001 - OE+1024	C	R3841	OE-0001 - OE-1024
R1857	IE+0001 - IE+1024	H	R3905	IE-0001 - IE-1024
R1921	OF+0001 - OF+1024	A	R3969	OF-0001 - OF-1024
R1985	IF+0001 - IF+1024	I	R4033	IF-0001 - IF-1024
		N		

(1) Channel O real I/O is scanned on the Main I/O chain (references O0001-O1024 and I0001-I1024).
(2) Channel 8 real I/O is mapped into Registers 1 - 128 (references AO0001-AO1024 and AI0001-AI1024).
(3) References O0+0001 - O0+1024, I0+0001 - I0+1024 and O8+0001 - O8+1024, I8+0001 - I8+1024 cannot be used as real I/O references, but are available for use as discrete programming references.
(4) Channel 1 through 7 real I/O references are for the Expanded Main I/O Channels.
(5) Channel 9 through F real I/O references are for the Expanded Auxiliary I/O Channels.

Transferring Programs from the Workmaster to a CPU

Once your RPU system is debugged and operating, it is strongly recommended that the Workmaster computer be permanently installed and cabled. But, during the installation and debug stages of your system it will be necessary to transfer your application program from the Workmaster computer to the CPUs a number of times.

Follow the instructions below for transferring programs from the Workmaster to a CPU.

- Method 1: Put the RPU in HOLD, connect the Workmaster directly to CPU1, then Store to CPU1. Next, connect the Workmaster directly to CPU2, and Store to CPU2. Return the RPU to RUN.
- Method 2: Make the target CPU the Master, put the RPU in HOLD, connect the Workmaster to the target CPU, directly, or through the I/O Chain, Store, disconnect the Workmaster (optional). Then return the RPU to RUN. Repeat for the second CPU if required.

CAUTION

Connecting and disconnecting equipment such as a Workmaster with the RPU in RUN mode is not recommended. The Workmaster keyswitch must be in the OFF LINE position when connecting or disconnecting the Workmaster. Permanently installed units reduce the risk of inadvertent electrical interference, such as is caused by ungrounded or incorrectly grounded units or units being connected while not in the OFF-LINE mode..

Series Six I/O Configurations

The RPU's primary function is to provide redundancy by switching from a Master CPU to a Backup CPU in the event of a CPU failure. Additional redundancy can be obtained by maintaining a second I/O chain which can also be switched by the RPU. Each I/O combination affects the configuration of the system and connections to the RPU. Permitted Series Six I/O configurations are listed below.

- Single Main I/O Chain
- Single Main I/O Chain and Single Auxiliary I/O Chain
- Dual Main I/O Chains
- Dual Main and Auxiliary I/O Chains

The connection diagram for each of these configurations is shown in the figures that follow.

NOTE

Wiring I/O for Dual I/O Configurations. Some, if not all, loads connected to Series Six output modules will be WIRE-ORed in RPU Dual I/O configurations. This requires individual planning and risk analysis.

Some, if not all, inputs will be paralleled in RPU Dual I/O Configuration.

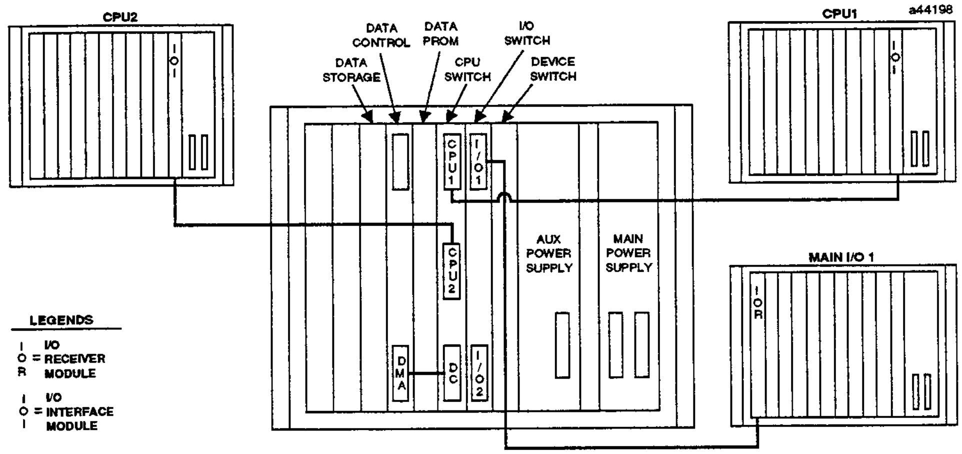


Figure 2-2. Single Main I/O Chain Configuration: Master CPU Controls I/O.

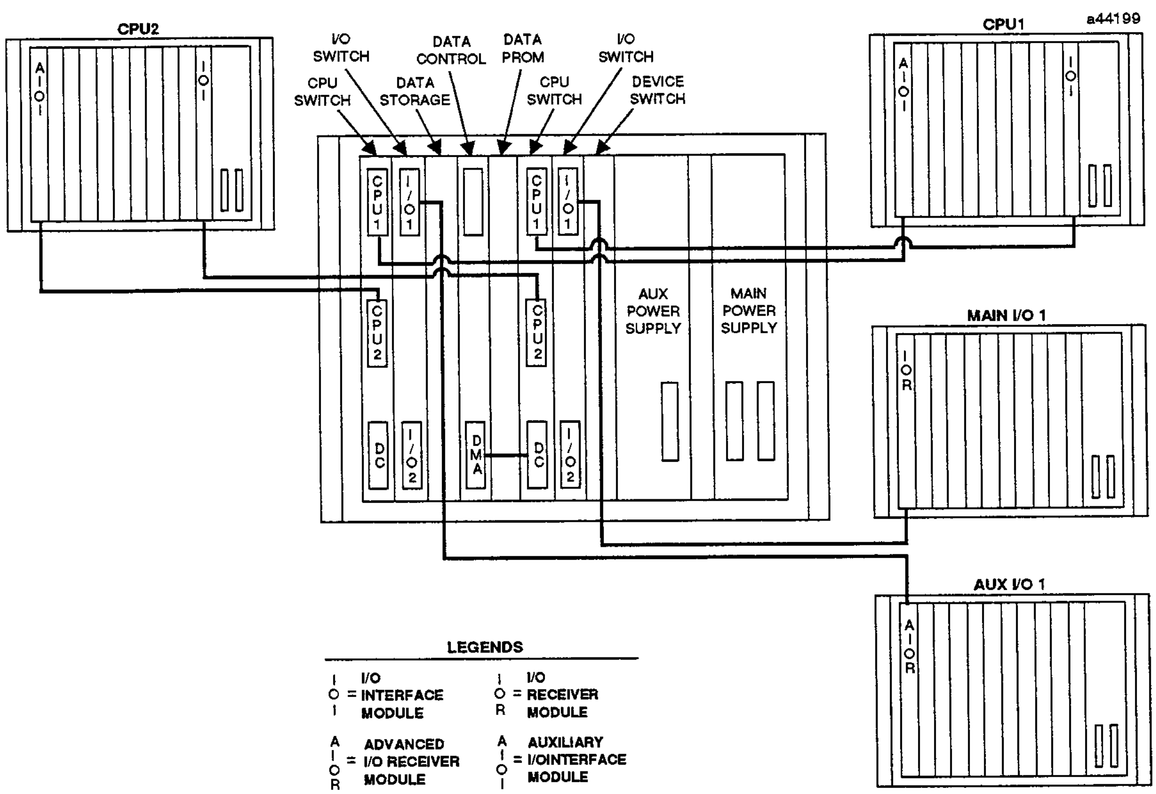


Figure 2-3. Single Main I/O Chain and Single Auxiliary I/O Chain Configuration: Master CPU Controls Main and Auxiliary I/O Chains.

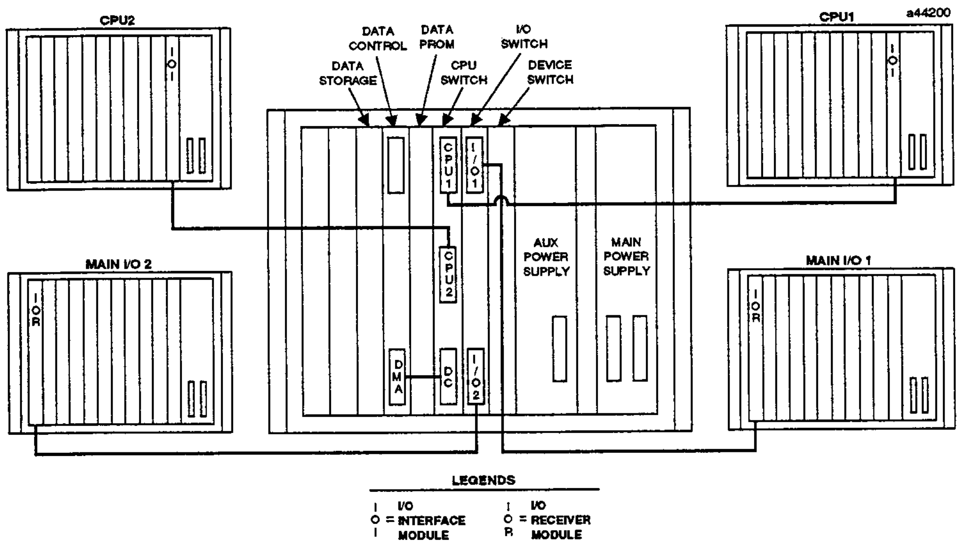


Figure 2-4. Dual Main I/O Chain Configuration: Master CPU Controls Both Chains. (CPU1 cannot be Master CPU without Main Chain l.) (CPU2 cannot be Master CPU without Main Chain 2.)

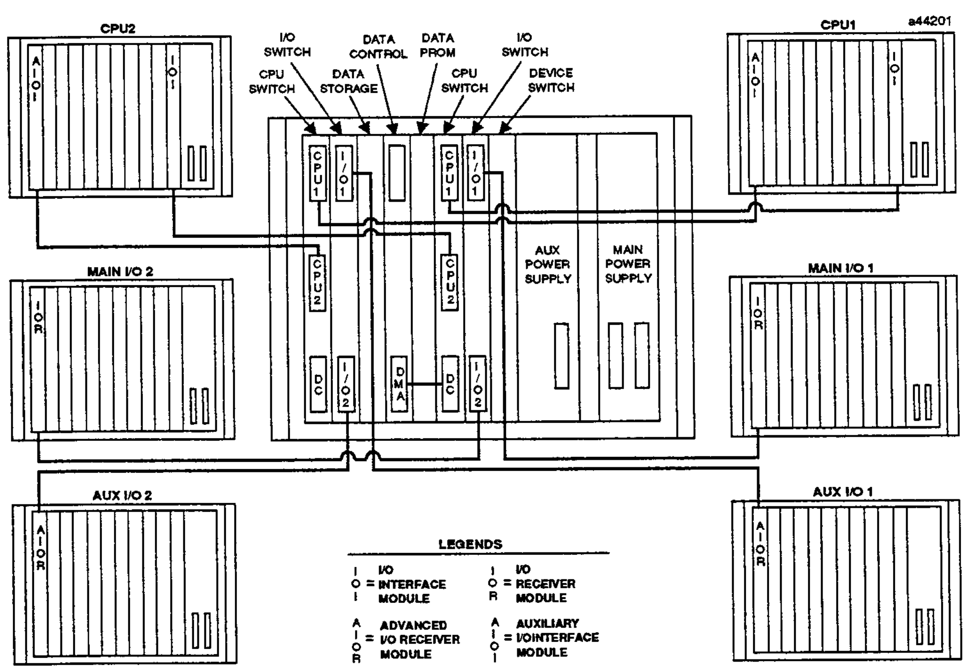


Figure 2-5. Dual Main I/O and Auxiliary I/O Chain Configuration: Master CPU Controls All I/O Chains. (CPU1 cannot be Master CPU without both Main 1 and Auxiliary 1 Chains.) (CPU2 cannot be Master CPU without both Main 2 and Auxiliary 2 Chains.)

Genius™ I/O Configurations

Genius I/O is designed with its own capabilities for redundancy. However, in many redundant GENIUS systems, the addition of an RPU provides a high degree of utility, making it unnecessary to figure out ''workarounds'' for resuming system operation following the return of any CPU to on-line status. For instance, the RPU can automatically update seal circuits, latches, data from ASCII/BASIC modules, and CCM modules, which otherwise would require significant system planning and special ladder diagram programming to accomplish a similar ''trouble-free'' restart.

The RPU is also used with Genius I/O to maintain synchronization between the CPUs.

Using the redundancy features of Genius I/O in combination with the RPU, there are numerous system configurations which can be developed. The system design considerations associated with these configurations are extremely important in determining the level of protection offered by a particular configuration.

The sections below include typical examples of configurations using Genius I/O. But the eventual selection of a system configuration is highly dependent on the specific parameters within the process being controlled and the equipment used in the application. Therefore, it is recommended that more complex configurations such as those requiring a combination of Genius I/O and RPUs be reviewed with a GE Fanuc Application Engineer.

Genius I/O Compatibility with the RPU

If the RPU will be used in a PLC system that includes Genius™ I/O, the following upgrade kits might be required for your application:

Kit #44A286355-G04 for Bus Controller IC660CBB902 (with diagnostics)
Kit #44A286356-G04 for Bus Controller IC660CBB903 (without diagnostics)

These kits contain EPROMS and labels to upgrade the Series Six Genius Bus Controller to firmware version 1.7; they are available at no charge.

Use of Bus Controllers containing firmware version 1.7 (or later) is especially important if the CPU sweep time is expected to exceed 100 ms (measured with the RPU in Hold mode).

If a Bus Controller is already installed, its version can be determined using a Genius Hand-held Monitor. On the HHM's Bus Controller status display, version number 1.7 (or later) should appear.

These Bus Controllers may also be identified by the following labels:

	IC660CBB902G	IC660CBB903G
EPROM (U39) label	371-025A	371-003C
EPROM (U53) label	371-026A	371-004C
EPROM (U8) label	355-016A	355-016A

NOTE

For Genius I/O redundancy to operate as stated in the Genius I/O System User's Manual, GEK-90486B, do **not** place Genius I/O in a Series Six I/O chain connected to the RPU I/O Switch module. Instead, configure your Genius I/O system as shown in Figures 2-6 or 2-7 so that the Genius I/O are connected through bus controllers to the CPUs. The CPUs are connected to the RPU, as in Series Six I/O configurations, through the CPU Switch module. These configurations use the redundancy designed into the Genius I/O system and the RPU acts to synchronize the CPUs.

Single and Dual Genius I/O Bus Configurations

The configurations shown below (single bus and dual bus) are the most effective way to make use of the Genius I/O redundancy features and to maintain synchronization of the two CPUs.

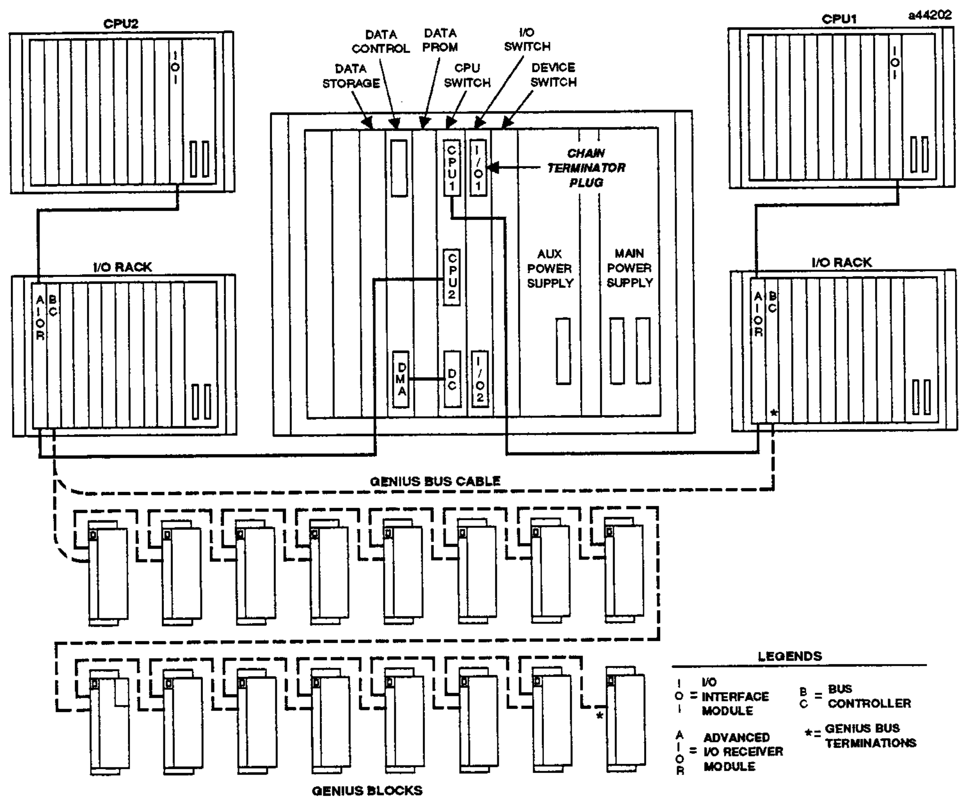


Figure 2-6. Single Genius I/O Bus Configuration with Redundant Bus Controllers -- Operating with the RPU in Single I/O Chain Mode (Main Chain Only)

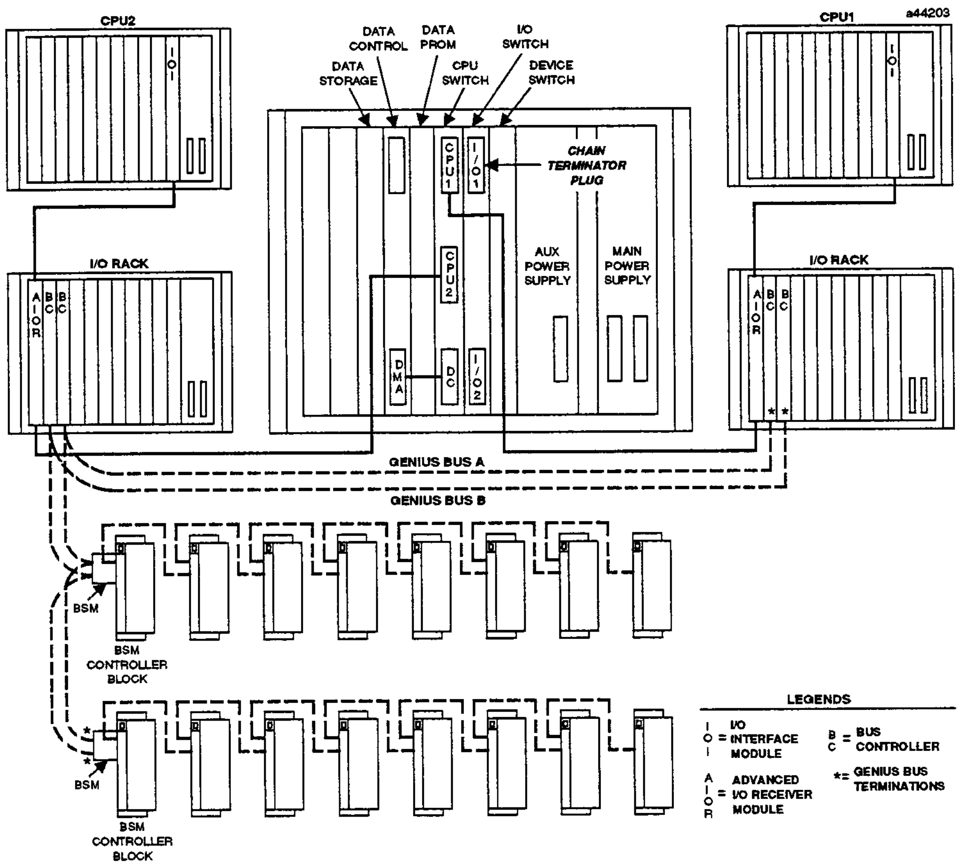


Figure 2-7. Dual Genius I/O Bus Configuration with Redundant Genius Bus Controllers and Redundant Genius Busses -- Operating with the RPU in Single I/O Chain Mode (Main Chain Only)

Guidelines for Setting Up Configurations

NOTE

Connections of CPU1 and CPU2 to the RPU are arbitrary; they may be reversed. In the guidelines below:

- CPU1 is the preferred Master = Primary CPU -- all Bus Controllers must be set to SBA 31.
- CPU2 = Secondary CPU -- all Bus Controllers must be set to SBA 30.

All Genius I/O Blocks must be type Phase B. All bus controllers in CPU1 will use the same references as those in CPU2. There is no change in the application program with respect to the Genius I/O.

The RPU key switch is set to CPU1 as the preferred master. All Genius I/O blocks are configured for "hot stand-by" redundancy mode (uses data from secondary bus controller only if primary bus controller is not available). Bus controllers in CPU1 are set to SBA 31 (primary). Bus controllers in CPU2 are set to SBA 30 (secondary).

DIP Switch U3, position 1, on the bus controllers is set to STOP CPU if there is a failure. This causes the RPU to switch masters based on the Genius I/O bus controller fault.

Do not turn on the Self Fault Bit (O1017) in either CPU. This avoids split control by the two CPUs.

If the master CPU (CPU1) is down and the I/O is under control of the backup CPU (CPU2), power up the master CPU in STOP mode. This allows the bus controllers to log in all blocks and start sending outputs when the CPU goes to the RUN mode. Wait at least 15 seconds after power up before going to the RUN mode to allow enough time for the log-in to occur. The log-in time will vary according to the program size and the number of I/O blocks, but 15 seconds is normally sufficient. This process keeps all I/O on backup until the master CPU is fully reinitialized.

If the RPU and the Master CPU (CPU1) are both down, the RPU must be restored to the RUN mode before CPU1 goes into RUN mode. This prevents CPU1 from running with old data.

Disable the outputs of the bus controllers in CPU1 for 10 scans on first start. This can be done in a number of ways in the ladder program by setting the Disable Outputs bit for each bus controller (Output #1 of the outputs assigned to the bus controller.) See the example below.

The reason the outputs need to be disabled has to do with the differences in starting up times between the RPU and Master CPU and the Backup CPU. When a CPU goes to the RUN mode, it performs two CPU sweeps, updating I/O and solving ladder logic, with the Reset line held low. This forces the real outputs to remain off. This is done to make sure the Output table is current on the first sweep the outputs are enabled. The reset line is then released and the CPU is completely on line.

The bus controller monitors the Reset line to determine when it should send outputs to the blocks. The RPU also monitors this line to see if the CPU is enabled. The RPU will consider the CPU unavailable until the Reset line is released. The RPU and current Master have longer sweep times than the Backup coming on line, because of the RPU data transfer to the Master CPU. The difference in sweep times depends on the ratio of sweep time with and without the RPU. The two CPUs at this time are asynchronous and the Backup CPU coming on line can run for one or more sweeps with outputs enabled before the RPU has a chance to update the Backup CPU with current data.

The following example program shows how to disable outputs from bus controller 31 upon startup. In this example the bus controller is at address 513. R8000 is the scan counter (must be above R4096 so that it is not in the RPU transfer). Output OF-100 can be any unused output and it may be within the bounds of the RPU transfer. This program can be resident in both the Master and the Backup CPUs.

```
|00999   const      R8000
|-|/|---| A   MOVE   B  |--------------------------( )
         10

|00513   R8000      const R8000                 OF-100
|-| |---| A   SUBX   B  =  C  |--------------------( )
                     1

|00999                                           00513
|-|/|-------------------------------------|LATCH|-( L)
                                                  ( )
|OF-100                                           ( )
|-| |---------------------------------------------(UL)
|
.
.
.
|                                                00999
|-|NOOP|------------------------------------------( )
|
|-|ENDSW|
```

Combined Genius I/O and Series Six I/O Configuration

The figure below shows how to connect both Genius I/O and Series Six I/O in the same RPU configuration.

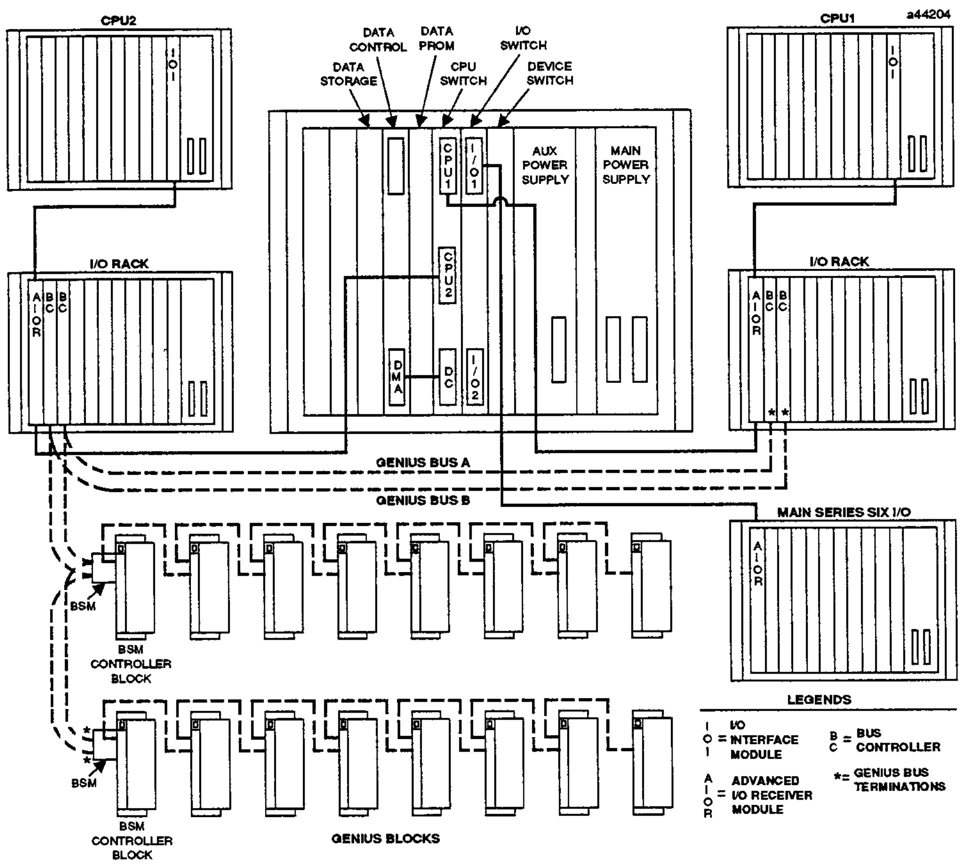


Figure 2-8. Genius I/O and Series Six I/O Configuration with Redundant Genius Bus Controllers and Redundant Genius Busses -- Operating with RPU in Single I/O Chain Mode (Main Chain Only)

Guidelines for Setting Up the Configuration

Guidelines for this configuration are basically the same as for the previous configuration (Figure 2-7), as far as the Genius I/O is concerned. However, the presence of the down-stream Series Six I/O rack requires you to determine how your system will operate in the event that a failure in the RPU's Main I/O Chain causes a single-point failure for the system. To avoid this, you will need to block the Fault In signal by properly configuring the Advanced I/O Receiver modules. (Refer to GEK-90771.) In some installations, a failure in the Main I/O Chain could cause a complete shutdown, while in others the system may function quite well with only the Genius I/O operating.

Note that chain faults from Genius Bus Controller racks **must** still pass through to the CPU in this system.

LEDS and Displays

I/O Switch Modules

The LED indicators on the Main and Auxiliary I/O Switch modules have identical meanings.

- CPU1 ON LINE will be on if the RPU deems CPU1 to be operable (see Chapter 4 for a definition of On-Line).
- CPU2 ON LINE will be on if the RPU deems CPU2 to be operable.
- I/01 ON LINE will be on if I/O Chain No. 1 is not reset.
- I/02 ON LINE will be on if I/O Chain No. 2 is not reset.

Device Switch Module

CPU1 MASTER will be on if CPU1 is the Master CPU.

CPU2 MASTER will be on if CPU2 is the Master CPU.

RPU Status 7 - Segment Display

0	=	Single I/O - No Aux. I/O
1	=	Redundant I/O - No Aux I/O
2	=	Single I/O and Aux I/O
3	=	Redundant I/O and Aux I/O
4	=	Hung I/O Bus
5	=	Data Storage Card Failure
6	=	Data PROM Card Failure
7	=	Data Control Card Failure
8	=	Device Switch Card Failure
9	=	CPU Switch Card Failure

Codes 0 through 3 are normal operation indications. Code 4 indicates an I/O bus could not be cleared when the RPU tried to change masters. The RPU continues to function for codes 0 through 4, unless the digit is flashing, which indicates the RPU's watchdog timer has timed out due to RPU failure or the Run/Hold Switch being set in ''Hold'' position.

Codes 5 through 9 indicate RPU failures. The RPU halts itself and enters Hold Mode when these codes are displayed and flashing. When in Hold Mode, whatever CPU was Master stays running and I/O outputs do not shut off, but no further RPU operations will occur.

Whenever the display is flashing, the RPU will permit the master CPU to control the I/O Chain(s). The signals required to do this are bussed through the RPU via the Device Switch and I/O Switch Modules. In this mode, the RPU does not communicate with the CPUs and provides no switchover capability. The CPU-ON-LINE LEDs may not be correct when the watchdog timer is timed out (and the RPU has halted, that is, is in Hold Mode). The Master CPU LEDs are correct, however, as long as the I/O chain is not subsequently disturbed, causing an I/O Chain reset.

Key Switches

CPU1-AUTO-CPU2 Switch

This switch can be used to select a preferred Master CPU. Of course, if the preferred Master goes off-line, the RPU will automatically switch over to the backup.

- Auto position causes the RPU to have no preference for either CPU.
- CPU1 position causes the RPU to select CPU1 as the master CPU whenever it is on-line.
- CPU2 position causes the RPU to select CPU2 as the master CPU whenever it is on-line.

RUN-HOLD Switch

A RUN/HOLD key for the RPU. The HOLD position holds the RPU on the present master CPU. NO FUNCTIONS OPERATE (that is, no transfers, no switchovers, I/O Chain driven by Master only). This allows the replacement of some of the RPU modules without powering down the RPU (exceptions - Device Switch Module, CPU Switch Module, I/O Switch Module).

The RUN position restarts the RPU for normal operation (transfers, switchovers).

When in RUN Mode, the 7 Segment LED should normally show 0 - 3 and will not be flashing. In HOLD Mode, the LEDs will start to flash, and the notes about flashing on the previous page apply.

Alarm Relays

The alarm relays are form C relays rated at 5 Amps (resistive) at 125 Vac. The alarm contacts are located on the main power supply.

Major Fault ALARM NO. 1 - The relay is de-energized if the I/O chain (Single I/O) or I/O chains (Dual I/O) are shut down.

System Fault ALARM NO. 2 - the relay is de-energized upon detection of any Series Six Plus CPU or RPU faults. If a CPU or I/O chain that the RPU has been programmed to expect is off line, or if the RPU detects an internal fault, this relay will be off.

Device Switch Relays

Device Switch Relays are used to switch external devices (e.g. printer) between the two CPUs, so that they are controlled by the Master CPU. The alarm contacts are located on the high density connector in the device switch board faceplate.

Overall Function

The main function of the RPU is to increase the availability of a Series Six PLC System to your equipment. To accomplish this, the RPU monitors the CPU and I/O chain controlling it. When the RPU detects a failure of the CPU or I/O, it switches to a backup CPU and (optionally) to a backup I/O chain.

The block diagram below shows how RPU modules interact with external CPUs and I/O chains.

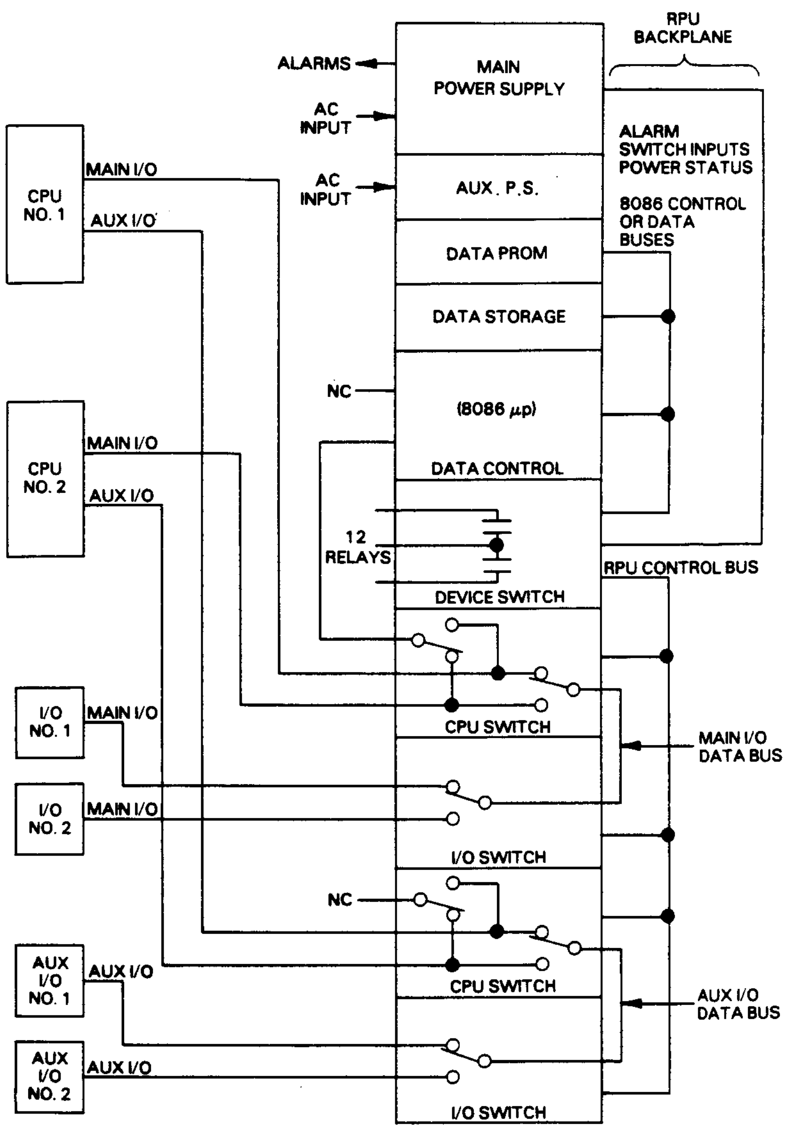


Figure 4-1. RPU System Block Diagram

Figure 4-2 shows where the modules described in the block diagram are placed in the RPU rack.

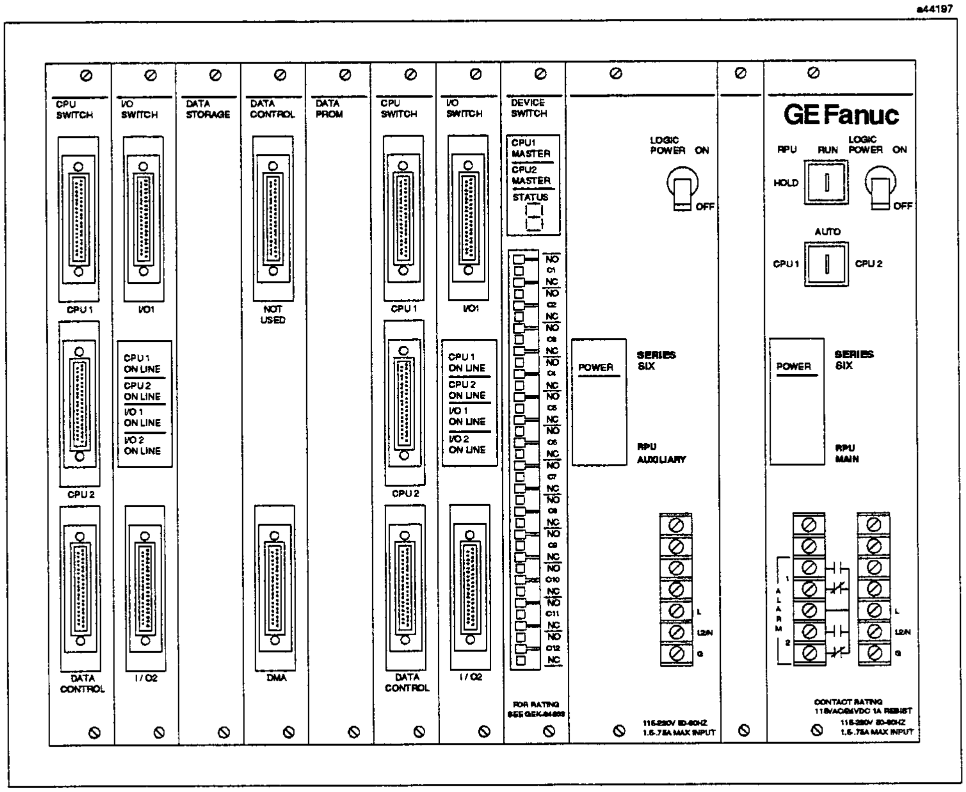


Figure 4-2. RPU Rack with Full Set of Modules

In addition to switching-in backup systems, the RPU must minimize the disturbance to user equipment caused by this switching. As we said in Chapter 1, this is accomplished by maintaining a hot standby backup CPU (the backup CPU will be in RUN mode). Again, to maintain synchronization between the CPUs, the RPU reads the selected Master CPU's tables and transfers them to the backup each sweep.

Although both the Master and the Backup CPUs solve their ladder program and update their own Output tables, only the Master CPU receives Inputs from actual input devices and only the Master CPU sends outputs to output devices. The Backup CPU solves it's logic based on the inputs received through the RPU.

RPU Cycle

The RPU, during normal operation, goes through three phases in a repetitive sequence. This sequence alternates between the two CPUs. The data tables are read in from the Master CPU, the transfer is validated by the RPU, then written out to the Backup CPU. CPU reading/writing is performed at the end of each CPU's Workmaster window. The figure below illustrates this sequence.

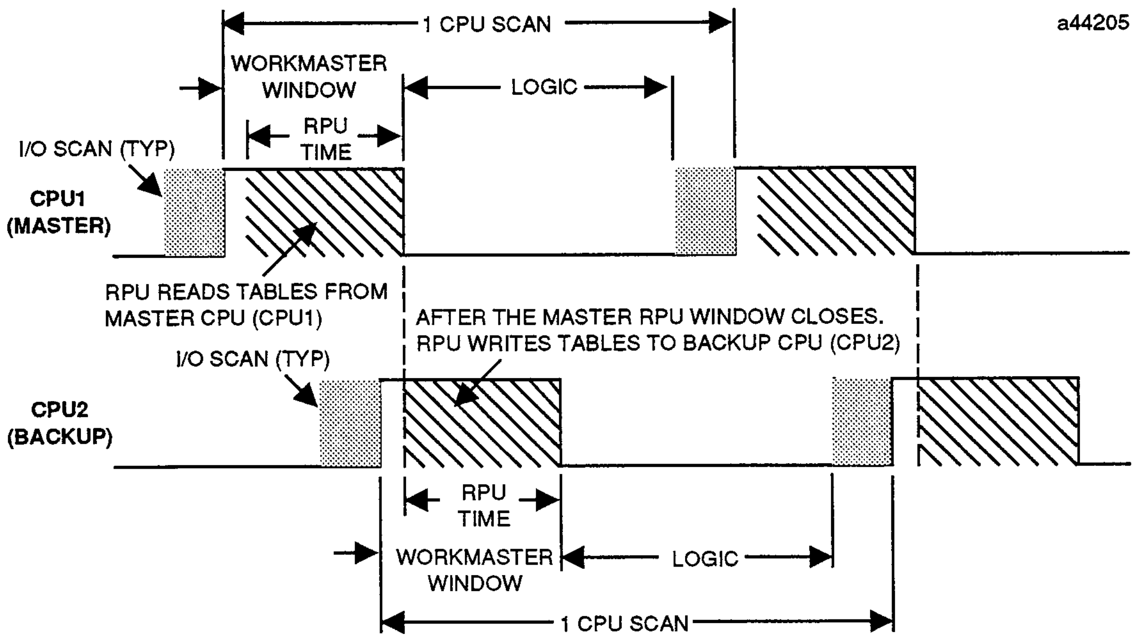


Figure 4-3. Sequence for Transferring Data From Master CPU to Backup CPU Each Sweep

CPU Window

The RPU determines from the jumper selections (or equivalent Master CPU outputs 1022 - 1024), Auxiliary I/O modules and the CPU's status (Master/Backup, On- or Off-Line), the required data transfers to and from the CPU. The Input Table, Override Table and internal time base data to be read from the master and written to the backup are performed automatically without regard to any jumper selections. The optional transfers are defined in Chapter 5. When the CPU opens its window to the Workmaster and the Workmaster (if there is one on-line) is finished, the RPU performs the required transfers then closes the window. A Workmaster is not required to be connected.

System Status Check

The RPU examines the status of the CPUs and I/O chains and determines which CPU should be Master and which I/O chains to reset.

RPU Self Test

The RPU tests a different portion of its RAM, PROM, Device Switch and Processor Cards each sweep. If a failure is detected, a corresponding code is displayed on the Device Switch Module 7 segment LED, and the firmware goes into Hold mode. The LED flashes, and the I/O Chain is controlled by the master CPU at the time of shutdown.

Operations Safeguards

Here are some basic cautions for you to observe to help minimize disturbance:

- Workmaster computers attached to RPU systems **must** be at the same ground potential. Since this is not always easy to determine, it is strongly recommended that the Workmaster computers in RPU systems be permanently installed and cabled up.
- Do not plug or unplug the Workmaster Computer Cable when it is On-line or in Monitor Mode. There is a good chance you could cause a CPU switch or shut off the I/O chain.
- Use Caution when making on-line program changes. It is possible to get a condition where the Workmaster computer displays equal to an unequal CPU if ladder programs are different. On-line changes performed in this mode can stop the CPU, or rewrite logic in an unpredicable manner. You can avoid this by making sure that jumper settings are correct for your application, and that the same program is loaded in both CPUs.
- The Suspend I/O time when using a program store to CPU is much longer when using an RPU. How much longer depends on how much data the RPU is transferring each scan. Worst case could have I/O suspended for about 15 seconds. The Workmaster does not know this, and the Suspend I/O prompt on the Program Store screen does not reflect this increase in time. Storing the program to the backup CPU does not suspend real I/O at all. When storing programs from a Workmaster to a CPU, follow the procedure outlined in Chapter 2 in the section on Genius I/O Configurations.
- The Advanced I/O Receiver module detects an output parity error under some conditions when the RPU switches. This creates no system disturbance, but an LED on the module is turned off. This can be cleared from the program or by pressing the Reset button on the module.

RPU - CPU Synchronization

The RPU maintains synchronization between the two CPU's sweeps. The CPU/Workmaster windows are the mechanisms used to maintain this synchronization. The RPU will wait up to 150 ms (250 ms if selected, using ALU3 board RPU/Rev G or later) from the close of one CPU's window to the opening of that same CPU's next window. The CPUs will also wait up to 150 ms (250 ms if permitted) for the RPU to respond to the opening of a window. If the RPU does not respond, the CPU will give up, close the window, and perform its normal logic solving and I/O Chain service. Workmaster windows will time out after only 560µs on subsequent sweeps, until the RPU again responds and synchronism is re-established.

RPU Definition of CPU Operating Modes

From the RPU's perspective, the CPUs connected to it can be in one of seven modes:

Reset

Standard Series Six outputs are essentially latches. When the CPU disables, it issues a signal to the I/O system to reset these latches, turning off all outputs. This signal is called ''Reset''.

If the Reset input to the RPU is on, the CPU will be considered Reset and cannot be the Master CPU. Normally, this is due to the CPU being Disabled, but could also be due to a bad cable or board.

Some of the reasons for Reset from the CPU are I/O Parity Error, I/O Fault, failed or disconnected cable, Memory Parity, CPU watchdog timer time-out, CPU power off or power supply failed, or CPU in STOP or RUN/DISABLED mode.

Self Fault

If the RPU finds output 1017 ON during a window to a CPU, that CPU is self faulted and cannot be the master CPU. This bit is user-controlled and must be accounted for in every CPU program used with a RPU. It can be used to force a transfer for user defined faults (e.g.Serial Link or ASCII Basic failure).

Direct Memory Access (DMA) Fault

If the RPU finds that a window transfer to or from a CPU has failed for any reason, that CPU has a DMA fault and cannot be the Master CPU. Any data received by the RPU during that window will be discarded, and the CPU will be marked Off-Line.

Timed Out

If the RPU fails to start communications with a CPU within the selected Max CPU time, the RPU will consider that CPU to be unavailable. Besides a hardware failure, a possible reason may be that the user program logic has caused the CPU sweep to exceed the specified maximum time.

On-Line

If a CPU has none of the above conditions it will be considered on-line and may be made the Master CPU. The RPU continuously monitors both CPUs. If a CPU's fault is corrected, it regains on-line status automatically. The RPU will update the memory of this newly available CPU as indicated by the jumper settings discussed in Chapter 2.

Bus-Hung

The RPU tests the I/O bus before switching masters. If the bus fails the test, the corresponding CPU cannot be made master, and the I/O chain(s) will be reset.

Backup I/O Parity Error

In dual I/O mode, if the RPU detects an output parity error in the backup I/O chain, that chain will be reset and the corresponding CPU cannot be given master status until the parity error is removed.

Failure Transfer Sequence

Switchover Sequence

Assume a failure of the Master CPU (CPU1) occurs while the Backup CPU (CPU2) is on line (single I/O system). In this example, the failure occurred during the Workmaster window following a successful RPU transfer. Then, the Reset input from the CPU went high, the RPU latched and held all of the Data and Control lines to the I/O chain. Reset was not passed through to the I/O chains, so they were ''frozen'' in their last state.

The hardware in the RPU permits it to change Master CPUs only at the end of the backup CPU's window. Therefore, no action can be taken until the CPU No. 2 status check. The System Status Check recognizes the failure of CPU1 and sets the RPU up to switch to CPU2 at the end of the CPU2 window.

During this CPU2 window, the data read from CPU1 during the last *successful* RPU window is transferred to CPU2. At the end of the CPU2 window, CPU2 is made the Master and is put in control of the I/O chain(s).

During the first I/O scan after CPU2 becomes the Master CPU, the I/O chains will receive data that is the same as that last sent out by CPU1, the previous Master. Providing the user programs are the same with respect to I/O handling, subsequent I/O scans will be identical to those which would have resulted from the original Master CPU. See Chapter 5 for an explanation of the sources of differences between these two sets of I/O data.

Restoring the Backup (Backup Initilization)

When CPU1 is returned to an On-Line condition, the RPU behaviour depends on the Backup Initialization (BI) jumper selection.

If Backup Initialization is selected, the RPU, recognizing that a new Backup CPU is now available, will automatically read in from the Master CPU all of the transferrable tables: (R0001-R4096, Input Table, Output Table, Override Table, Transition Tables and the Internal timer-based data from the Scratchpad). And the RPU will then pass all of these tables to the new Backup CPU (CPU1) in the next window. Thus, both CPU's have the same operational status (database) at that time.

After this Backup Initialization phase, the transfers will resume as defined by the Jumpers/Outputs described in the section on Data Transfer Setup in Chapter 2.

If Backup Initialization is not selected, the RPU will do nothing special for its new Backup CPU (CPU1). Only the normal data transfers, as defined by the Jumper/Output selections (see Chapter 2) will take place.

Power Up Sequence

When the RPU powers up, the hardware selects CPU1 as the Master CPU and passes CPU1's I/O data and control signals to and from I/O system 1. The Reset signal is also passed through, so that when CPU1 completes its powerup cycle, it will enable the I/O chains.

Within 5 seconds, the RPU will complete its self-check and initialization and begin normal operation. Until that time, CPU1 is the Master regardless of the state of either CPU or the key switch. Also no RPU/CPU communications will occur until the RPU begins normal operation.

Hold

When the RPU is in the HOLD mode for any reason, the presently-selected Master CPU is retained as the Master CPU and controls the I/O Chain(s). The RPU does **not** communicate with the CPUs and provides **no transfer capability** while in HOLD.

Hold-To-Run

When switched from Hold to Run, the RPU detects which CPU is physically controlling the I/O Chain. If the I/O Chain is operational and the physical Master CPU is not in Reset, the I/O scan will continue undisturbed (no I/O Chain Reset).

If the physical Master CPU is unavailable, an I/O Chain Reset will already be present. However, if the physical Master is available but has Output O1017 ON (self fault), an I/O Chain Reset will result.

The I/O Chain Reset (if active) will be removed as soon as the RPU finds an operational CPU and determines that the I/O bus is also operational.

CPU Sweep Time Impact

Table 4.1 shows the amount of time the RPU requires to transfer data to and from the CPUs under normal operating condition. This is the actual transfer time, not including the time either the RPU or CPU spends waiting for the other device to begin the transfer.

The length of the status check phase is 2.0 ms maximum. The RPU self-check is 1.0 ms maximum.

Therefore, the CPU's total sweep times are the greater of:

1. The CPU's total sweep time without the RPU, plus the window time from Table 1, plus the self-check.
2. The total of both CPU's window times plus both self-checks. Number 1 must be calculated for both CPUs and the greater of the two values compared with No. 2.

The previous calculations apply for normal RPU operation with both CPUs on line. If either CPU is reset, its window length will be the status-check time. It should be noted that if Backup Initialization is selected, the sweep length will increase for one sweep following a change of masters or a backup coming back on line. In these cases, the maximum values from Table 4.1 should be used for calculating the length of that sweep.

NOTE

The Workmaster and the RPU both use the CPU's PDT (Workmaster) window to transfer data from Workmaster to CPU and CPU to CPU by way of RPU. So, your PDT window will be extended.

Table 4-1. RPU Transfer Times

RPU window calculations.	
Default transfers only (256 byes Override Table, 5 bytes Scratchpad,128 bytes Input Table)	= 11.48ms. (a)
Auxiliary I/O options adds (no OTT)	= 2.64ms.
Backup to Master option adds	= 0.22ms. (d)
Output and Trans. Table option adds	= 2.53ms. (b)
OTT with Aux I/O selected adds	= 4.73ms.
Registers add	= 0.56 + 0.0186 ms/Register. (c)
(Registers already covered in OTT or Auxiliary options should not be counted in the .0186/Register adder.)	
To figure maximum window times, use the above calculations as follows: (a) + (b) + (c), where (a) = 11.48, (b) = 4.73, and (c) varies:	
If maximum registers = 1024* then (c) = 35.82 ms;	
If maximum registers = 4096** then (c) = 92.96 ms.	
* RPUs up to Rev D.	
** RPUs Rev E or later.	

I/O Enable Sequence

Whenever the RPU senses that both CPUs are off line, it will reset the I/O chains. When either CPU recovers to online status and is made the Master CPU, the RPU will maintain the I/O chains in Reset until two windows to that CPU have been received. It will then enable the master I/O chain.

This sequence allows the Master CPU to receive inputs, solve its logic and supply valid data to the outputs once before the outputs are enabled.

Maximum CPU Sweep Time

Some versions of the RPU permit the maximum sweep time to be selected at either 150 ms or 250 ms. (See Chapter 2). Prior to Rev. G RPUs, the maximum sweep time was fixed at 150 ms.

If either CPU sweep time (excluding RPU window transfer time) exceeds the maximum sweep time permitted, the RPU considers that CPU to be offline.

Application Information

Bumpless Transfer of Masters

The RPU, except for certain configurations listed below, provides a bumpless transfer. A bumpless transfer of Masters is defined as one in which the output to the I/O chains, in the first I/O scan after the switchover, is either a repeat of the previous scan from the old Master CPU or is identical to what the old Master CPU's next scan would have been. The outputs are frozen in their last state while the RPU is switching Masters.

A bumpless transfer can be expected if the following conditions are met:

- CPU memory must not be modified asynchronously by any Series Six option (DPREQ, SCREQ, Window) capable of doing so (.e.g CCM, ABM, Genius Bus Controller). Each of these devices may alter the Master CPU Tables. Should the Master fail before the RPU transfers any modified table locations to the backup, the backup would become the Master with no knowledge of the modified data. Genius Bus Controllers performing I/O only are not included.
- Interrupts, and Do I/O-Suspend I/O instructions are used with care.
- Identical logic programs and override status (the programs must not use register 254 and outputs 1017 through 1024 in any way that may affect the output status) in the Backup and Master CPU.

In some cases, the above conditions may be circumvented and still achieve a bumpless transfer. The following sections show some ways to minimize the magnitude of the bump when the above rules are violated.

CAUTION

Be sure to read carefully the Configuration section in Chapter 2 before attempting CPU programming, as differences in equipment will dictate bit and switch settings.

CPU Programming

For normal operations the RPU uses Registers R0254, R0255, and R0256, Inputs I1017-I1024, and Outputs O1017-O1024. These should therefore be avoided.

Register Transfers

Normally, the registers in the Master and Backup CPUs should remain in synchronization. Certain Series Six options (CCM, ASCII/BASIC, Interrupt modules) may alter Register memory requiring special programming to keep the two CPUs synchronized. See sections later in this chapter. A method is provided for users who expect such situations, or wish to have extra protection against data errors, to transfer some of the Master CPU's registers to the Backup CPU on command or by jumper selection.

This command is initiated by setting output 1024 to a "1" in the Master CPU or by selecting the RT jumper on the Device Switch Module in the Master CPU. The RPU will then transfer the group of registers beginning at the register indicated by the value in Master CPU register R255 and ending at the register indicated by the value in register R256. These register values may range from 1 to 4096.

Register R255 must contain a value less than or equal to the value contained in register R256. If these limits are violated, no registers will be transferred. To minimize RPU window time, the registers used in a program should be grouped together so that unused registers need not be transferred. Only one block of registers may be transferred on any one scan.

This function adds approximately 18.6 µs per register transferred to the CPU's RPU window time. Note too that if a system includes 8 or 16k registers, only the first 4k can be transferred.

Output and Transition Table Transfers

Output and Transition Table transfers should only be required under the same conditions outlined above for registers. This transfer is selected by the OTT jumper on the device switch board, or by setting output bit 1022 in the Master CPU. All outputs from 1 through 1016 are transferred each window, as well as Transition Table addresses 0 through 7FH.

If the Auxiliary I/O option is installed, Register 1 - 64 and Transition table addresses 80H - FFH will also be tranferred each sweep.

With the Auxiliary I/O Option, this feature adds 4.73 ms to the CPU's RPU window. Without the Auxiliary I/O option, this feature adds only 2.5 ms to the CPU's RPU window.

Note that 01017 - 01024 are not transferred, since these are used to determine the CPU "self fault" status and the transfer options you want - RT(1024), BTM(1023), OTT(1022).

Backup to Master Transfer

If the BTM jumper is selected on the Device Switch module, or output bit 1023 in the Master CPU is set, register 254 will be transferred from the Backup CPU to the Master CPU on each sweep where both CPUs are on line. If the Backup is not on line, register 254 of the Master CPU is set to zero by the RPU.

This feature allows the Backup CPU to inform the Master of the completion of Communication Control module tasks. This allows some synchronization to be maintained between the Master and Backup CPUs and Communication Control modules. This may be as simple as passing task-complete flags to the Master CPU. It is suggested that the Backup CPU's program maintain register 254 in a non-zero state. Then, if the word is found to be '0' in the Master CPU, the Backup CPU can be assumed to be off line.

Backup CPU Bit

If a Backup CPU is on line, the RPU will set the backup bit in the Input Table to '1' during each window. We recommend that the user's program clear this bit and then examine it after each RPU window. Then, the presence of a '1' in the backup bit indicates that the CPU is in the Backup CPU. Likewise, a '0' in the backup bit indicates that the CPU is either the Master CPU or is off line.

The default backup bit is normally I1024. If you are using I/O Transmitter Module boards in the system, the backup bit should be moved to I1022. This is done by changing JP6 on the Device Switch Module. The 2,3 position selects I1024, while the 1,2 position selects I1022.

Because the RPU only sets the bit to the Backup CPU, it does not always clear the bit at the Master.

Determination of Master CPU

If a CPU is found to be not the Backup CPU as outlined above, the BTOM transfer can be used to determine whether the CPU is off line or is the Master CPU. Figure 5.1 illustrates a simple CPU program that will determine a CPU's status (assuming both CPUs have this same program segment running).

CPU Self Fault

If, for any reason, your program determines that the CPU should not be the Master CPU, it should set the output bit 1017 to '1'. This instructs the RPU to prevent this CPU from being the Master. For example, a user with a dual I/O system could program an I/O test by checking on some intputs. If the test detected a failure, it could set output 1017, which would force the RPU to switch to the other CPU I/O system.

Dual I/O Chains

To use the Dual I/O features of the RPU, the entire I/O system (modules, racks and cables, the Main I/O and Auxiliary I/O chains if used) must be duplicated. Each digital input and output should be wired in parallel to the corresponding I/O point in the other I/O system. However, this does not pertain to Genius I/O. See Chapter 2 for more information on Genius I/O configurations.

The power source for any output module must be the same as the corresponding module in the other I/O system. Power supply voltage differences and AC phase differences between outputs that are paralleled will result in blown fuses and improper operation.

NOTE

The Workmaster computer will accurately reflect the status of the system only if connected to the I/O Chain linked to the Master CPU. If linked directly to the Backup CPU, confusion as to what is going on may result. In a dual I/O system, the Workmaster computer will operate correctly on the I/O Chain corresponding to the Master CPU. Of course, these Workmaster computers may always be directly hooked to either CPU.

CAUTION

Workmasters plugged into an RPU system must use the same power source or be at the same ground potential as the RPU system. Failure to comply with this requirement may cause improper operation and/or damage to the equipment.

See the restrictions on ASCII BASIC modules (and similar WINDOW type modules) discussed in the section on the ASCII BASIC module later in the chapter.

```
  I1024
                                                                         00001
+--] [--+-------+-------+-------+-------+-------+-------+--------+-(   )-+
|
|
+
|
| 00001   CONST                              R0253  R0253  R0254          00002
+--]/[--+[  A     MOVE                         B  ]+[  A   :   B  ]+--------+(    )-+
          -00001
|
|
+
|
| 00001   CONST                              R0252  R0252  R0254          00003
+--]/[--+[  A     MOVE                         B  ]+[  A   :   B  ]+--------+(    )-+
          +00001
|
|
+
|
| 00001   CONST                              R0254
+--] [--+[  A     MOVE                         B  ]+
          +00001
|
|
+
|
| 00001   CONST                              R0254
+--] [--+[  A     MOVE                         B  ]+
          -00001
|
|
+
|
|         CONST                              I1009
+[NOOP]-+[  A     MOVE                         B  ]+
          +00000
```

```
00001, 00002 and 00003 all off: This CPU is Master - other CPU off-line
00001 on:   - This CPU is Backup
00002 on:   - This CPU is off-line
00003 on:   - This CPU is Master - other CPU is on-line.
```

Figure 5-1. CPU Program

Analog I/O with Redundant I/O Systems

Analog Inputs

Analog inputs from the two I/O systems may be paralleled for voltage input. For 4 to 20 mA current input, the inputs must be placed in series. This requires the current source be capable of 10 volts output.

The two input modules connected together are unlikely to be synchronized regarding which input is to be read in on the next I/O scan. Therefore, your program may need to detect the transfer of master CPUs and take appropriate action concerning the analog inputs.

Analog Outputs

Analog output points may not be paralleled since their outputs are always active. Analog outputs near the RPU may be multiplexed to the load through the form C relays on the Device Switch module. Analog outputs at a distance from the RPU can be multiplexed by connecting a reed relay module output in series with the Analog output before connecting it to the load. Figure 5.2 illustrates these connections.

The switchover between I/O systems will not be bumpless as far as analog outputs are concerned. At the time of switchover, the relays involved will inject delays and contact bounce.

94.TMP.5

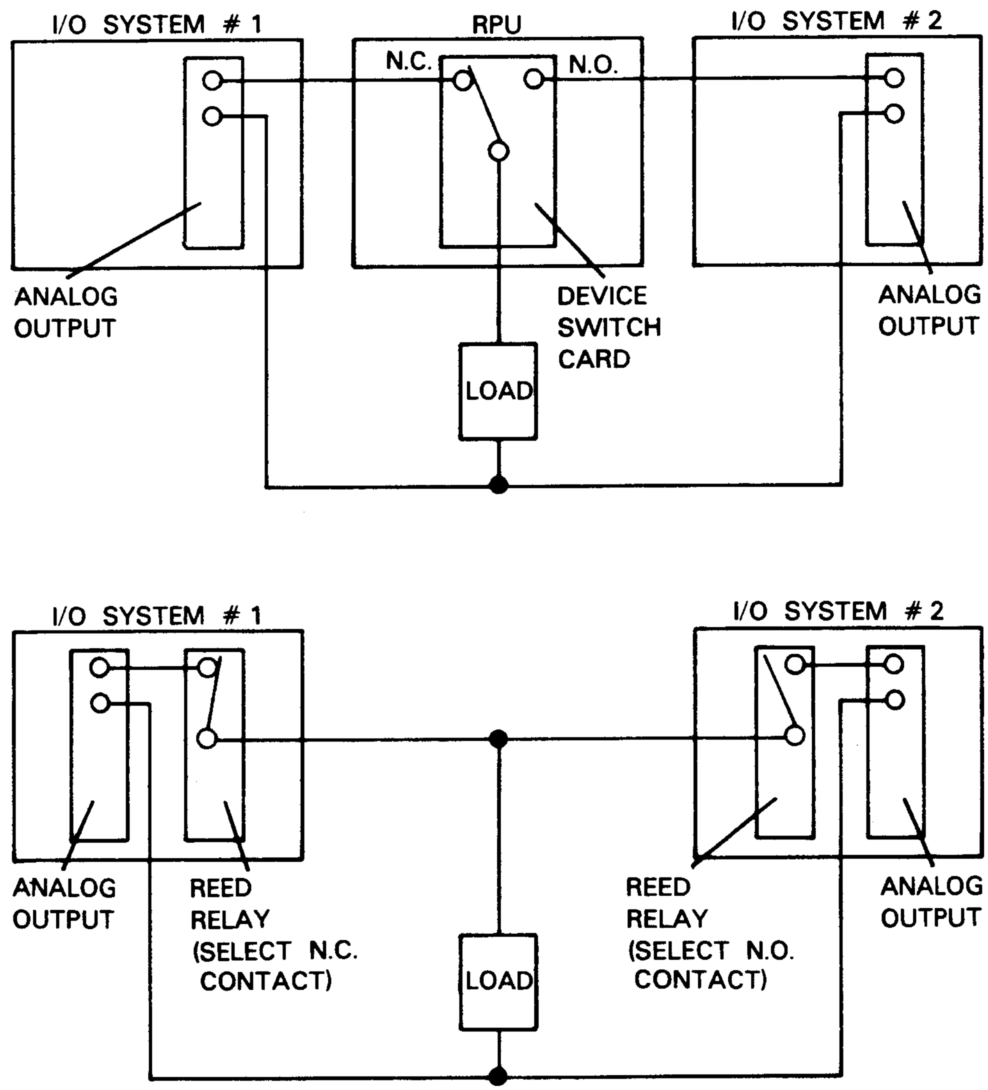


Figure 5-2. Typical Analog Output Connections

NOTE

To use the reed relays to connect Analog outputs, two different output bits must be used for the relays. The CPU programs must also be slightly different. The program in CPU1 should turn on the relay in I/O system No. 1 and turn off the relay in I/O No. 2. CPU2's program should do just the opposite. This way, only the Master CPU's I/O will be connected to the load.

Remote I/O

Series Six REMOTE I/O (LDR/LDL) may be used with Redundant systems if a couple of precautions are observed. First, on later releases of Remote I/O software, the LDL (local) module will provide a Heartbeat the CPU can read. Its intent is to signal when output data is sent to the remote and new input data is received at the local module. On Master switchover, one I/O scan may be repeated, and therefore, a Heartbeat transition may be missed. Your program must take this into account.

In systems with dual I/O, since the heartbeat and handshake bits from the backup Remote I/O cannot be read into the CPU, you cannot determine for sure that any given output data reached the backups output points.

Data Processor (Obsolete)

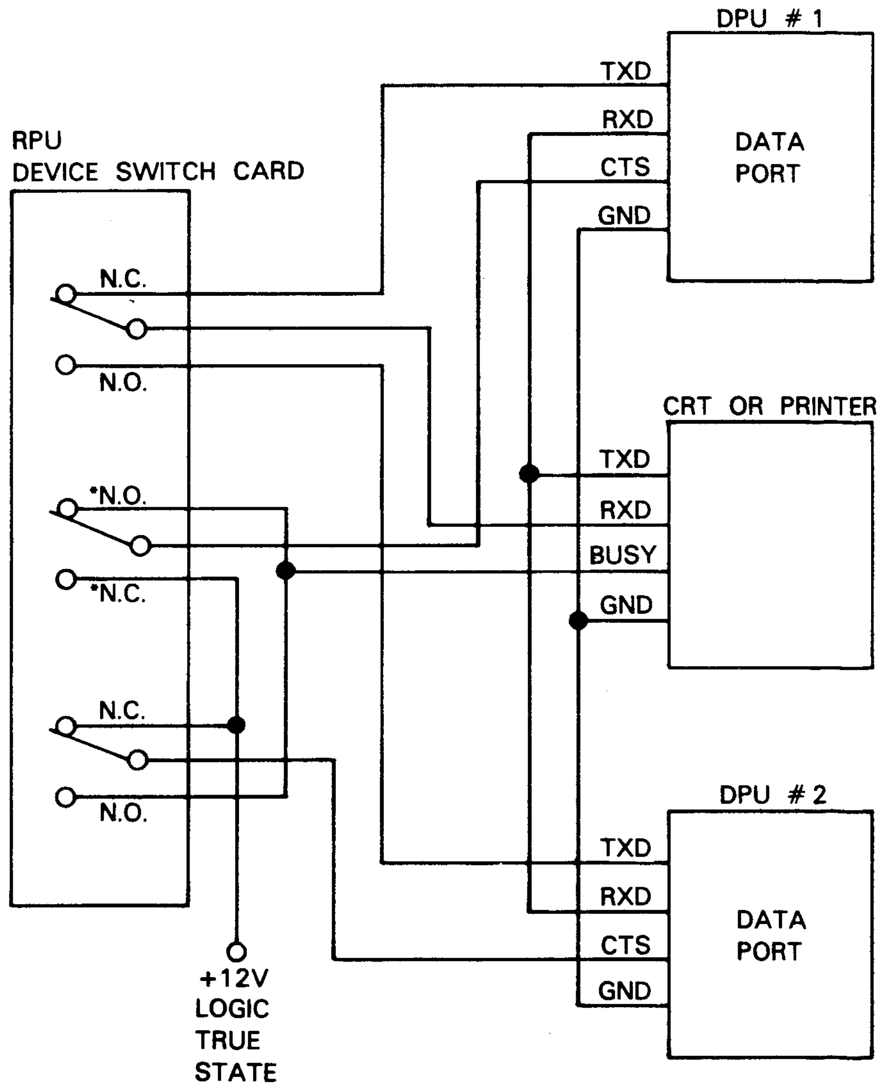
Although Data Processor Units (DPUs) are obsolete systems, they may still be used with Redundant CPU systems. They are connected to the CPUs and programmed in exactly the same manner as in single CPU systems. The items of special concern with DPUs in Redundant systems are shared serial I/O devices, and program synchronization.

Shared serial devices may be multiplexed to two DPUs with the relays on the Device Switch module. Figure 5.3 illustrates one way in which a peripheral device may be connected to two DPUs.

The DPU MOVE command and Serial Port Read and Write commands are asynchronous with respect to the CPU's sweeps. Therefore, if the RPU changes Master CPUs while one or more of these commands are in progress, the results will be indeterminate.

In many cases, reissuing the command that was in progress during the switchover is a sufficient recovery technique. As stated in Chapter 5, the Backup to Master transfer word, register 254, may be used to inform the Master CPU of the completion of tasks by the Backup CPU's DPU. You must either avoid the use of the CPU's command stack or keep careful track of which commands are still pending in it, if you want to be able to determine which command was in progress during a switchover, you must either avoid the use of the DPU command stack, or keep careful track of which commands are still pending in the stack.

94.TMP.6



*REQUIRED ONLY IF FLOW CONTROL IS USED.

Figure 5-3. Typical DPU Serial Port Connections

Communication Control Modules

CCM2 and CCM3

Communications Control Modules in Redundant Systems may be multiplexed to the external serial devices through the Device Switch module's relays. Since the serial handshaking is in software, the backup CCM will be idle. Any information sent to the Master CPU via the CCM should be copied to the Backup with the RPU's Register and Output Table move functions. When a Master switchover occurs during a transmission, indicated by a serial line timeout, that transmission should be repeated. Transmissions received by the CCM, but not yet transferred to the CPU when switchover occurred are not recoverable.

Communications Control Module Type 3 (CCM3)

The above paragraph applies for the Communications Contol module type 3 also, but with an additional problem. The disconnected Communications Control module type 3 in the Backup CPU will be either busy or port-errored after each SCREQ commanded from the CPU.

If the configurations of the external devices permit, a more useful solution would be to provide a separate port to the Communications Control module type 3 in each CPU. Then, all Communications Control module type 3 transactions can be duplicated, and the effects of a Master switchover minimized.

GENIUS I/O Bus

Using the redundancy features of Genius I/O in combination with the RPU, there are numerous system configurations which can be developed. The system design considerations associated with these configurations are extremely important in determining the level of protection offered by a particular configuration. The eventual selection of a system configuration is highly dependent on the specific parameters within the process being controlled and the equipment used in the application. Therefore, we recommend that more complex configurations such as those requiring a combination of Genius I/O and RPUs be reviewed with a GE Fanuc Application Engineer. Please contact your GE Fanuc sales representative for further information.

ASCII BASIC Module (and other WINDOW type modules)

DPREQ (or Window) instructions to the ASCII Basic Module may be initiated by the Master CPU only. In the Backup CPU, these windows will fail due to the presence of the RPU. Therefore, the Backup CPU should receive this data by way of a register transfer. Modules requiring Windows occupy both Main and Auxiliary I/O Chain references assigned, and no duplication is allowed. Furthermore, in Dual I/O Chain systems, these modules cannot use the same references in both chains.

Any information sent to the Master CPU via the ASCII BASIC module (or other WINDOW module) should be copied to the Backup with the RPU's Register and Output Table move functions. When a Master switchover occurs during a transmission, indicated by a serial line timeout, that transmission should be repeated. Transmissions received by the ASCII BASIC module (or other WINDOW module) but not yet transferred to the CPU when switchover occurred are not recoverable.

It may be useful to use the Backup to Master function (BTM) to detect the switchover at the RPU.

CPU and I/O Faults

When the RPU detects an I/O or CPU fault, it turns on Alarm No. 2 and sets that CPU's status to off-line. When a failure has occurred, the LEDs on the CPU Switch module will indicate which CPU is off line, and which I/O Chain(s) are reset. The LEDs on that CPU should be consulted next. Their meanings are the same as in single CPU systems.

Memory and I/O Parity addresses may be read from CPU Scratch Pad Memory as in single CPU systems. (The Workmaster computer must be connected directly to the CPU and not after the RPU in the I/O chain.) Depending upon the cause of the I/O parity error, the RPU may clear the Parity LEDs in the I/O chain, leaving the address in the Scratch Pad as the only way to tell where the error occurred. I/O faults may be traced through the failed I/O chain as in single CPU systems.

If the RPU indicates that a CPU is off line but the CPU is in run mode, either the CPU has output 1017 set, or it is having communications failures with the RPU. A Workmaster connected to that CPU will indicate whether or not output 1017 is causing a CPU Self-Fault. If not, and the Workmaster can communicate with the CPU, the CPU Switch or I/O Switch modules may be at fault. If the Workmaster cannot communicate with the CPU, normal CPU troubleshooting techniques should be used to locate the failed CPU board.

RPU Faults

The RPU performs a self-check during each RPU sweep and upon initialization. This test can detect some failures of the RPU Device Switch, Data PROM, Data Storage, Data Control, and Device Switch modules. The RPU watchdog timer also protects against certain types of processor errors. Errors in the above areas should result in a digit on the display of the Device Switch module indicative of the error type (see Chapter 3).

Each power supply contains circuitry which monitors that supply and turns off the POWER LED indicator if the power supply's outputs are out of tolerance. All of the above error conditions also result in Alarm No. 2 being turned on.

Module Replacement Under Power

When a faulty Power Supply Module (Main or Auxiliary), Data PROM, Data Storage, or Data Control module has been diagnosed, it may be replaced without powering down the RPU or stopping the system being controlled. First, the keyswitch should be set to HOLD. Then the faulty module can be carefully removed and replaced. (Care should be taken not to short any module printed-circuit runs with the extraction/insertion tool.) Finally, the keyswitch should be turned back to RUN. The RPU should go through its self-check and a 0 through 3 should appear on the Device Switch module indicating the RPU is OK.

If the RPU fault was from the RPU's watchdog timer (blinking Device Switch module display, 0-3 codes), the failure may be from any one of the above modules. They should be swapped for known good modules one at a time until the problem is corrected.

If the failure was in a power supply, it also may be replaced without stopping the system. The replacement procedure is as follows:

1. Switch the keyswitch to HOLD.
2. Remove external power to the failed power supply and to the Alarm relays on the failed power supply.
3. Disconnect the wiring to the AC and Alarm terminals.
4. Release quarter-turn fasteners and slide the power supply out to expose the connectors located behind faceplate.
5. Disconnect the two connectors (4 wires from the terminal block) and the signal-cable clamp.
6. Remove the failed power supply from the rack.
7. Reverse the above procedure to install the replacement power supply.

Module Replacement Requiring Power-Down

Failure of the Device Switch, CPU Switch or I/O Switch module(s) requires that the system be stopped and the RPU powered down before the modules can be replaced. Some faults on the CPU Switch and I/O Switch modules will appear to be I/O failures, since the I/O bus passes through them. If the RPU detects a failure in a CPU and I/O chain which work properly without the RPU, then the CPU Switch and I/O Switch modules should be swapped for known good modules one at a time to locate the faulty module.

The I/O Switch and CPU Switch Modules provide the physical connection between the master CPU and the I/O Chain. Neither can be replaced without causing an I/O Chain reset. This applies to I/O Switch and CPU Switch Modules used in the Auxiliary I/O Chain as well as those used in the Main I/O Chain.

A

B

C

D

E

F

G

H

I

W

GE Fanuc Automation North America, Inc., Charlottesville, Virginia

DATA SHEETS

GE FANUC

Series Six™
Programmable Controllers

GEK-84860B
March 1989

Redundant Processor Unit

General Description

The Redundant Processor Unit (RPU) acts as a switch to transfer control from one Series Six Plus Central Processor Unit (CPU) or I/O chain to a standby upon failure of the first. To accomplish this, the RPU monitors the CPU and I/O chain for fault conditions, and when detected, conducts an orderly transfer of control to the standby CPU. A bumpless transfer, one without loss or interjection of data, is accomplished within a few milliseconds, while maintaining program and I/O continuity. Actual transfer time varies up to 2 CPU sweeps, depending upon where in the sweep cycle the fault occurs and the amount of data to be transferred.

The RPU includes a Data Control module, Data PROM and Storage modules, and CPU, I/O, and Device Switch modules, connected to a common power supply and backplane, all enclosed within a mountable rack. The RPU system is designed to directly interface with CPU Extended Software Revision 103 or above. Earlier releases can be upgraded to this level. The features and benefits of the RPU are summarized in Table 1, while Table 2 provides module specifications. Figure 1 illustrates the standard rack configuration and cable connections to CPUs and I/O chains.

The Data Control module, which contains an Intel 8086 microprocessor, is used to control parallel communications between the master and standby CPUs and their I/O chains. CPU synchronization is maintained by this module, as is transfer of I/O and register data between master and standby CPUs.

The DATA PROM module contains the executive program which controls the RPU, while memory contained on the Data Storage module is used as intermediate storage locations for input, output override, or register data read by the RPU. On every CPU scan, the RPU reads the requested data from the master CPU and transfers it to the standby processor. Transfer data is selected by hardware jumpers on the Device Switch module, or by the setting of I/O bits and registers in the master CPU.

Actual switching of the I/O data bus cable is accomplished through interaction of the CPU and I/O Switch modules.

The CPU Switch selects either the CPU1 or CPU2 I/O Bus, whichever is determined to be Master by the Data Control module, and connects this bus to the I/O Switch module through the backplane. The main function of the I/O Switch module is to select between I/O chains 1 or 2 and connect the selected chain to the master CPU I/O bus. If Auxiliary I/O chains are being used, a second pair of CPU and I/O Switch modules are inserted in the RPU rack for connection to these devices. Each of these modules contain 37-pin, D-type connectors for termination of the standard multi-conductor I/O bus cables.

The Device Switch module contains logic for interfacing the various modules and provides system status information. Additionally, 12 form C relays, whose state is dependent upon which CPU is master, are mounted on this module. A 36 point terminal connector is provided for connection to external devices such as CRTs and printers. By use of these low level contacts, external devices can be switched between master CPUs.

The Main Power Supply provides the +5 and +12 volts required for proper RPU operation. It also contains a RUN/HOLD keyswitch for selecting the state of operation, and another keyswitch whose function is to select which CPU is to be master or allow the RPU to automatically select the master. Two form C relay contacts are also available for user connection. One contact (Alarm No. 2) will annunciate if there is a problem within the RPU, CPU, or I/O system which requires attention, although the total system is still operational. The other contact (Alarm No. 1) is used to annunciate a major fault which causes the total system to shut down.

For those applications that require maximum redundancy, an Auxiliary Power Supply is available for the RPU. This supply mounts in the RPU rack and will power the RPU system in the event of failure of the main power supply. Separate power sources can be connected to each RPU power supply to assure operation in the event of loss of one or the other power source.

Table 1. Features and Benefits

FEATURES	BENEFITS
Dual I/O chains	Additional Redundancy Capability
Dual RPU power supplies	Additional Reliability
Device Switch card	Permits Transfer of Peripheral Devices
Automatic update when CPU returned to on-line status	Increased Performance
No Special Programming Required	Easy Installation
RPU Fault Tolerant Operation	CPU System Operation Maintained for most RPU Failures
Digital Fault Annunciation	Simplifies Troubleshooting
Alarm Contacts	Separate Annunciation for major or minor faults

Table 2. Specifications

Dimensions:	Rack Mount: 19.0 x 14.0 x 10.3 (Inches) 483 x 356 x 261 (mm) Panel Mount: 20.0 x 14.0 x 10.3 (Inches) 508 x 356 x 261 (mm)
Weight (with modules):	37 lbs (17Kg)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 55° C (at the outside of the rack)
Humidity:	5% - 95% (non-condensing)
Power Requirements:	95 V to 260 V ac, 125 V A maximum. Frequency: 47-63hz

INSTALLATION NOTES

Verify with the Workmaster™ Computer that each CPU is equipped with Extended Software Revision 103 or later. CPU I/O Control modules (IC600CB503) and Auxiliary I/O Control modules (IC600CB513) produced after January, 1984 (CPU Serial Number C188-8405-0000 and later), contain enhanced filter circuits. Because of the RPU's ability to monitor and sense externally induced disturbances, these enhanced modules should be in CPUs being used in conjunction with an RPU system to improve the reliability of the total system. Inspection of CPU systems used with an RPU system should be made to make sure the proper enhanced modules are contained within the CPUs used.

The appropriate modules are identified as follows: I/O Control module IC600CB503 should be labeled Assembly Version R07 or later. Looking at the component side of the module, oriented with the backplane pins to the right, the assembly version label is a white affixed label at the bottom right hand edge of the module. Auxiliary I/O Control module (IC600CB513) should be labeled Assembly Version R03 or later. Location of the Assembly Version label is approximately the same as the IC600CB503 module above.

Scan Time >150ms, use ALU3 board or RPU Rev K kit, or > Rev G.

If any questions arise concerning the module assembly versions or the extended software version of the CPU, contact PC Product Service at (804) 978-5747.

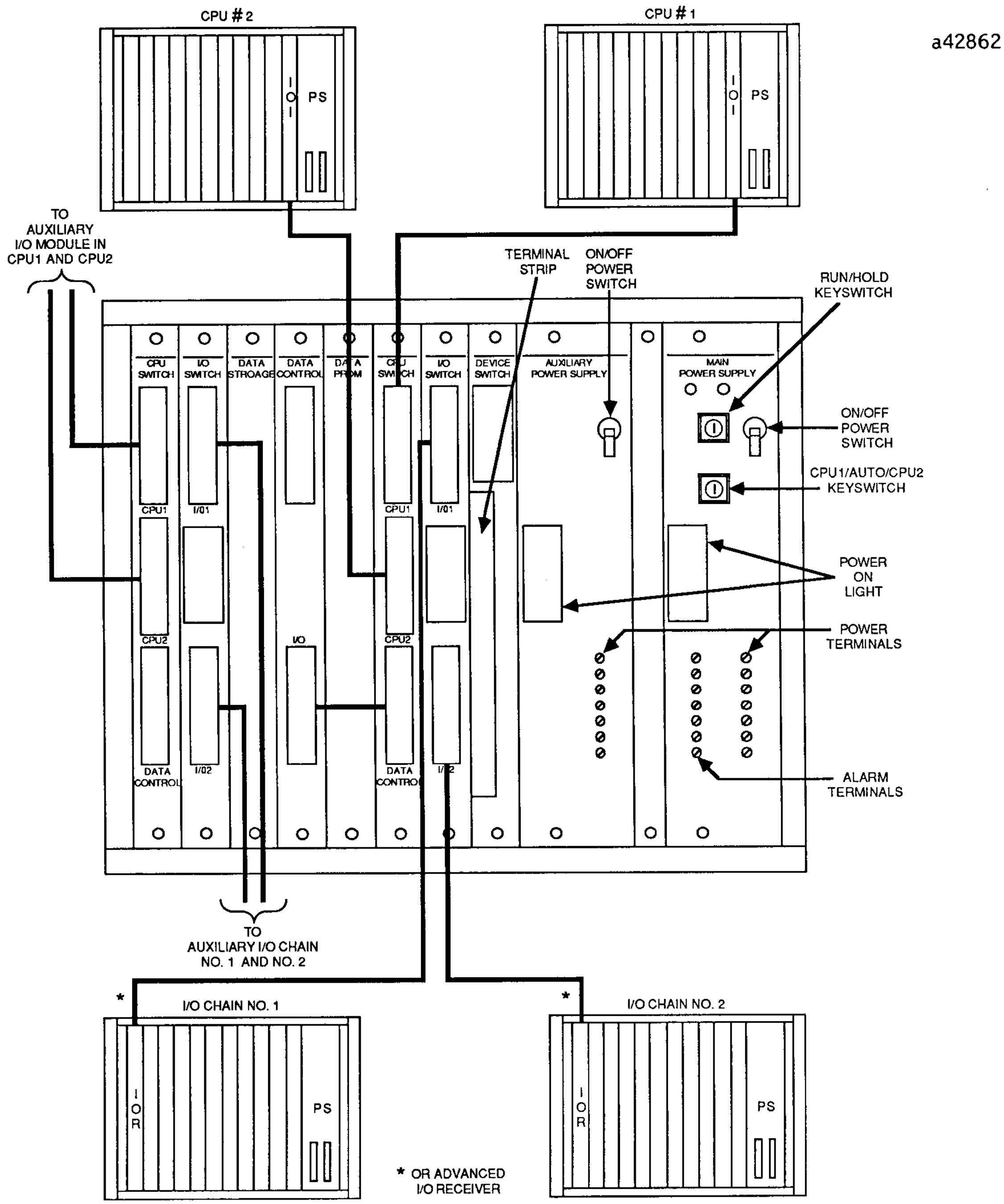


Figure 1. RPU Rack Configuration

Installation

This section provides a summary of the procedures described in the Installation section for the various RPU modules. Do not attempt to install the Redundant Processor Unit (RPU) without first reading this material.

1. The RPU can be rack, panel or wall mounted, depending on the orientation of the mounting brackets.
2. If Auxiliary I/O is to be used, insert the second pair of CPU and I/O Switch modules. Use the extraction/insertion tool supplied with the CPU to install these modules in the first and second (respectively) slots from the left.
3. Set jumper on I/O Switch modules for either single or dual I/O chains.
4. Set jumpers on Device Switch module for data to be transferred and other functions.

5. If the Auxiliary Power Supply is to be used, connect the appropriate cables and wires and insert the power supply into the slot adjacent to the Main Supply.
6. Connect the multi-conductor cables from CPU1 and CPU2 I/O Control modules to the appropriate 37-pin connectors on the CPU Switch module.
7. Connect the multi-conductor cable from the I/O Receiver (or Advanced I/O Receiver) module of the I/O chain to the 37 pin connector marked I/O1 on the I/O Switch module.
8. If Redundant I/O or Auxiliary I/O is used, make similar connections to I/O Chain 2 and Auxiliary I/O chains.
9. Connect the short multi-conductor cable supplied with the RPU between the bottom 37-pin connectors of the Data Control and CPU Switch modules.
10. If peripheral devices are to be switched between CPUs, make the appropriate connections to the 36 point terminal strip on the Device Switch module.
11. Make the following connections to the terminal blocks on the RPU Main and Auxiliary Power Supplies:
    - 3-wire (grounding) AC power cord.
    - Alarm-relay contacts (on Main Supply only).
12. Verify that the software version is correct as described in the Installation Notes on page 2.

Table 3. Ordering Information

Equipment	Catalog Number
RPU System	IC600RP551
* Rack and Power Supply	IC600RR551
* Data Control	IC600RB753
* Data Storage	IC600RM715
* Data PROM	IC600RM716
* I/O Switch	IC600RB750
* CPU Switch	IC600RB751
* Device Switch	IC600RB752
* Cable, Data Control to CPU Switch	IC600WJ001
**Cable 2 feet	IC600WH002
**Cable 5 feet	IC600WH005
**Cable 10 feet	IC600WH010
Main Power Supply	IC600PM507
Auxiliary Power Supply	IC600PM508

* Items marked are combined and sold as a basic RPU system under catalog number IC600RP551.

** These cables are used to connect the RPU to CPU No. 2 only. The RPU to CPU No. 1 cable is the standard I/O chain cable IC600WD002 (2 ft), IC600WD005 (5 ft) or IC600WD010 (10 ft). RPU to I/O chain cables are also standard I/O chain cables.

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc. (UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

Series Six™
Programmable Controllers

GEK-84863B

Redundant Processor Unit
Device Switch Module

March 1989

General Description

The Device Switch module used in the Redundant Processor Unit (RPU) includes 12 Form C reed relays to allow external peripherals such as CRTs, printers, etc., to be shared between CPUs connected to the RPU. A 36-point connector at the front of the module provides access to these relays. This module isolates the CPU and I/O Switch modules from and interfaces them to the Data Control Module and its memory in the RPU. A watchdog timer function and various status displays are also provided for external error indication. On-board jumpers allow the selection of various options, including data transfer requirements. The features and benefits of the Device Switch module are summarized in Table 1, while Table 2 provides module specifications.

Table 1. Features and Benefits

FEATURES	BENEFITS
12 Form C reed relays	Allows peripheral sharing between CPU's or DPU's
Seven segment display	Indicates system configuration and error status
Jumpers	Facilitates selection of data transfer options

Table 2. Specifications

Dimensions:	Circuit Board: 8.15 x 11.0 x 1.1 (inches) 208 x 280 x 28 (mm) Faceplate: 12.46 x 1.175 (inches) 317 x 30 (mm)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 60° C (Outside of rack)
Power Requirements:	5 V dc, 1.5 A (Supplied by RPU power supply)
Relay Contact Ratings:	Maximum current 250 mA Maximum voltage 25 Volts dc or ac Switch bounce 5 milliseconds maximum Resistive loads only
Humidity:	5% - 95% (non-condensing)

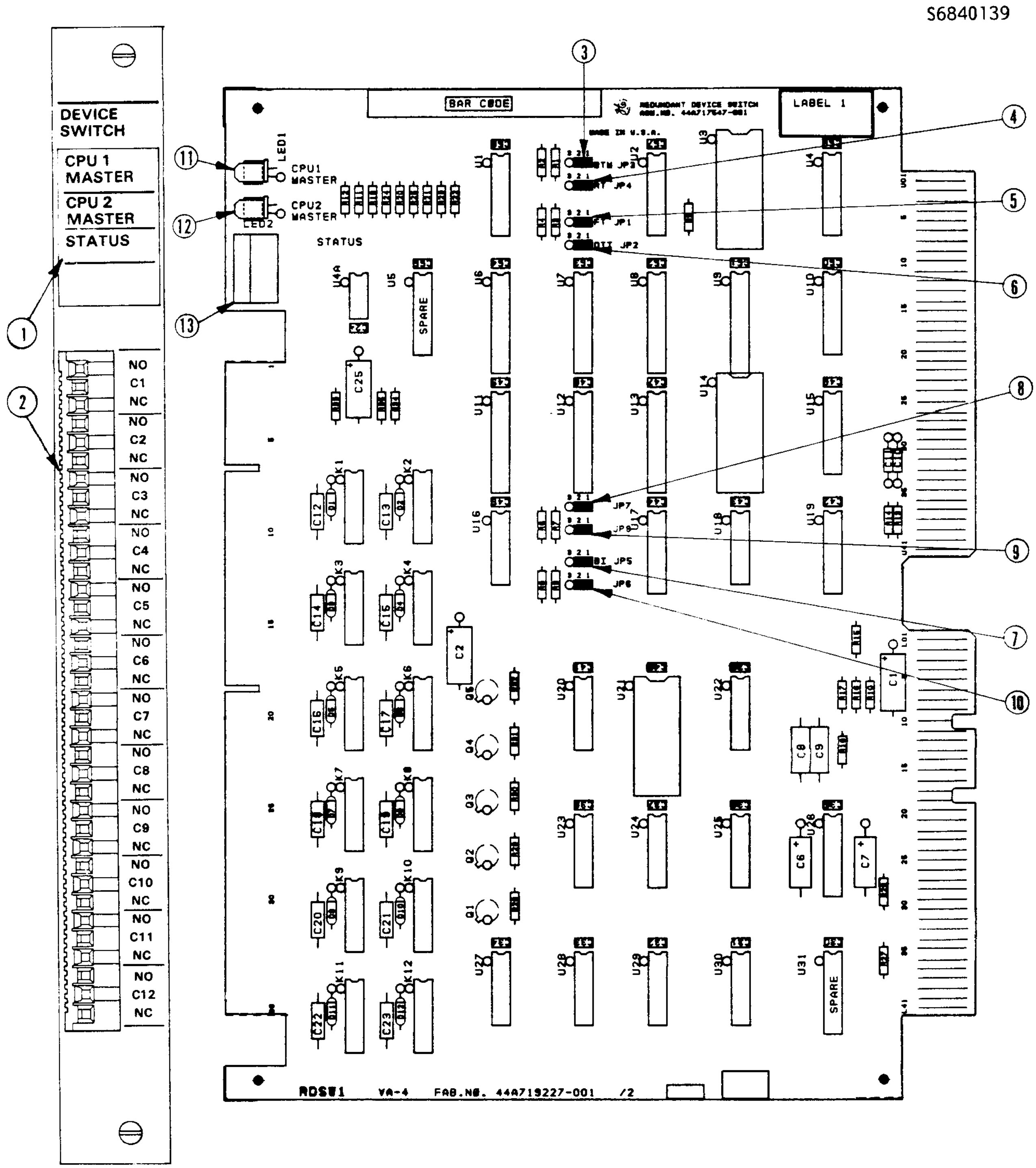


Figure 1. User Items

1. Faceplate
2. 36-point Connector
3. Jumper BT 3 2 1 (3 2 1 not active)

   Register 254 will be transferred from the Backup to the Master CPU each sweep.
4. Jumper RT 3 2 1 (3 2 1 not active)

   Allows specified registers to be transferred from the Master CPU to the Backup CPU each sweep. Start register value in R255, end register value in R256 of Master CPU.
5. Jumper FT 3 2 1

   Set at factory. Do not alter.
6. Jumper OTT 3 2 1 (3 2 1 not active)

   Output status table (Main I/O chain) and transition table will be transferred from the Master to Backup CPU each sweep.
7. Jumper BI 3 2 1

   The RPU will transfer up to 4096 registers, and all inputs, outputs, override and transition tables from the Master CPU to the Backup CPU whenever a CPU becomes a Backup. (From either off-line or Master status.)

   3 2 1

   The RPU will transfer only the data specified by the BTM, RT and OTT jumpers, in addition to the default transfers.
8. Jumper JP6

   3 2 1

   Enables I1024 to be used as Backup Bit in Backup CPU.

   3 2 1

   If your system uses PT4 I/O transmitter board(s), you will have to set RDSW board switch JP6 to the 1,2 position from the factory 2,3 position to move the Backup Bit to I1022.
9. Jumper JP7 Not used
10. Jumper JP8

    3 2 1

    Selects 150ms maximum scan time. Compatible with ALU2 and ALU3 CPU Arithmetic Logic Units.

    3 2 1

    Selects 250ms maximum scan time. Compatible only with ALU3 boards in both CPUs.

NOTE

These data transfer options may also be selected by certain Master CPU table bits. Input status table and timer time base values are always transferred from Master CPU to backup CPU each sweep. Data transfer options selected will impact Master and Backup CPU sweep time.

11. Status Display LED CPU1

    When on, indicates that CPU1 is selected to be the Master CPU.
12. Status Display LED CPU2

    When on, indicates that CPU2 is selected to be the Master CPU.

    STATUS, seven segment LED display

0	- Single I/O - No Aux. I/O	NORMAL OPERATION
1	- Redundant I/O - No Aux. I/O	
2	- Single I/O and Aux. I/O	
3	- Redundant I/O and Aux. I/O	
4	- Hung I/O Bus	RPU ERRORS
5	- Data Storage Card Failure	
6	- Data PROM Card Failure	
7	- Data Control Card Failure	
8	- Device Switch Card Failure	
9	- CPU Switch Card Failure	

NOTE

A flashing display indicates that the watchdog timer has timed out. (RUN/HOLD switch in "HOLD" position, processor failure, or any of errors 5-9 displayed).

Figure 1. User Items (Cont'd)

Installation

Set the option jumpers as described in Figure 2. Install the Device Switch Module in the eighth slot from the left of the RPU, using the extraction/insertion tool supplied with the RPU to seat it firmly in place.

CAUTION

The module may be installed or removed under power, but the RPU RUN/HOLD switch on the Main Power Supply must be in the HOLD position, or damage to the equipment may result. Replacement of the Device Switch under power almost always results in system shut down, even in Hold Mode.

Before installing the faceplate, make any required connections to the 36 point connector attached to the faceplate. Connections include, but are not limited to:

- Sharing a CRT or printer between a Master or Backup CPU (see Figure 2).
- Sharing a communications line set up to an external Host computer, or modem between a Master and Backup CPU Communications Control Module.
- Sharing an external analog device between two D/A or A/D cards located in the Master and Backup I/O chains.

The 12 device relays are Form C. The NO (normally open), NC (normally closed), and C (common) contacts for each relay are labeled on the faceplate. For example, relay 1 is labeled as NO, NC and C1, relay 2 is labeled NO, NC and C2, and so on.

The C contact of each relay is made to its NC contact whenever the RPU bus position is CPU1. Conversely, the C contact of each relay is made to its NO contact whenever the RPU bus position is CPU2. See Table 2 for the relay contact specifications.

After all required connections have been made, guide the faceplate into position on the module, then secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

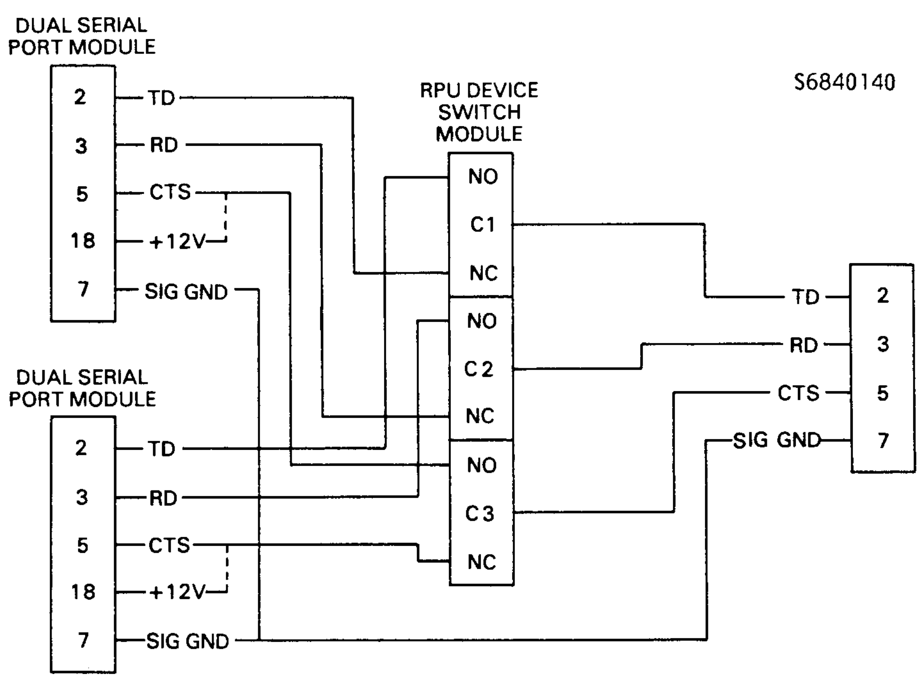


Figure 2. Peripheral Connections

Printer, CRT, etc. Connections

*Serial port CTS must be jumped to +12 V if the user device does not provide a CTS signal.

Table 3. Ordering Information

Circuit Board	Circuit Board and Faceplate	Faceplate
IC600RB752	IC600BF752	IC600FP752

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc. (UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

FANUC

Series Six™
Programmable Controllers

GEK-84864B

Redundant Processor Unit
I/O Switch Module

March 1989

General Description

The I/O Switch Module is used in the Redundant Processor Unit (RPU) to interface to and select one of two parallel I/O chains as the Master I/O chain.

Both I/O chains connect to the I/O Switch Module through two 37-pin D connectors located at the top and bottom positions on the front of the module.

The module transfers the selected I/O chain bus to the RPU backplane bus for use by the CPU Switch Module.

Two I/O Switch Modules can be used in an RPU; one for the Main I/O chain, and an optional module for the Auxiliary I/O chain.

A jumper is provided on the module to allow operation with a second I/O chain. Four LED indicators are provided to show CPU and I/O chain status. The features and benefits of the I/O Switch module are summarized in Table 1, while Table 2 provides module specifications.

Table 1. Features and Benefits

FEATURES	BENEFITS
Two parallel bus connectors	Provides RPU link for one or two I/O chains
Solid state bus switch	Provides bumpless transfer of I/O chain control
Status display	Shows CPU and I/O chain status

Table 2. Specifications

Dimensions:	Circuit Board: 8.15 x 11.0 x 1.10 (inches) 208 x 280 x 28 (mm) Faceplate: 12.46 x 1.175 (inches) 317 x 30 (mm)
Power Requirements:	5 V dc, 2.0 A (Supplied by RPU power supply)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 60° C (Outside of rack)
Humidity:	5% - 95% (non-condensing)

GEK-84864B

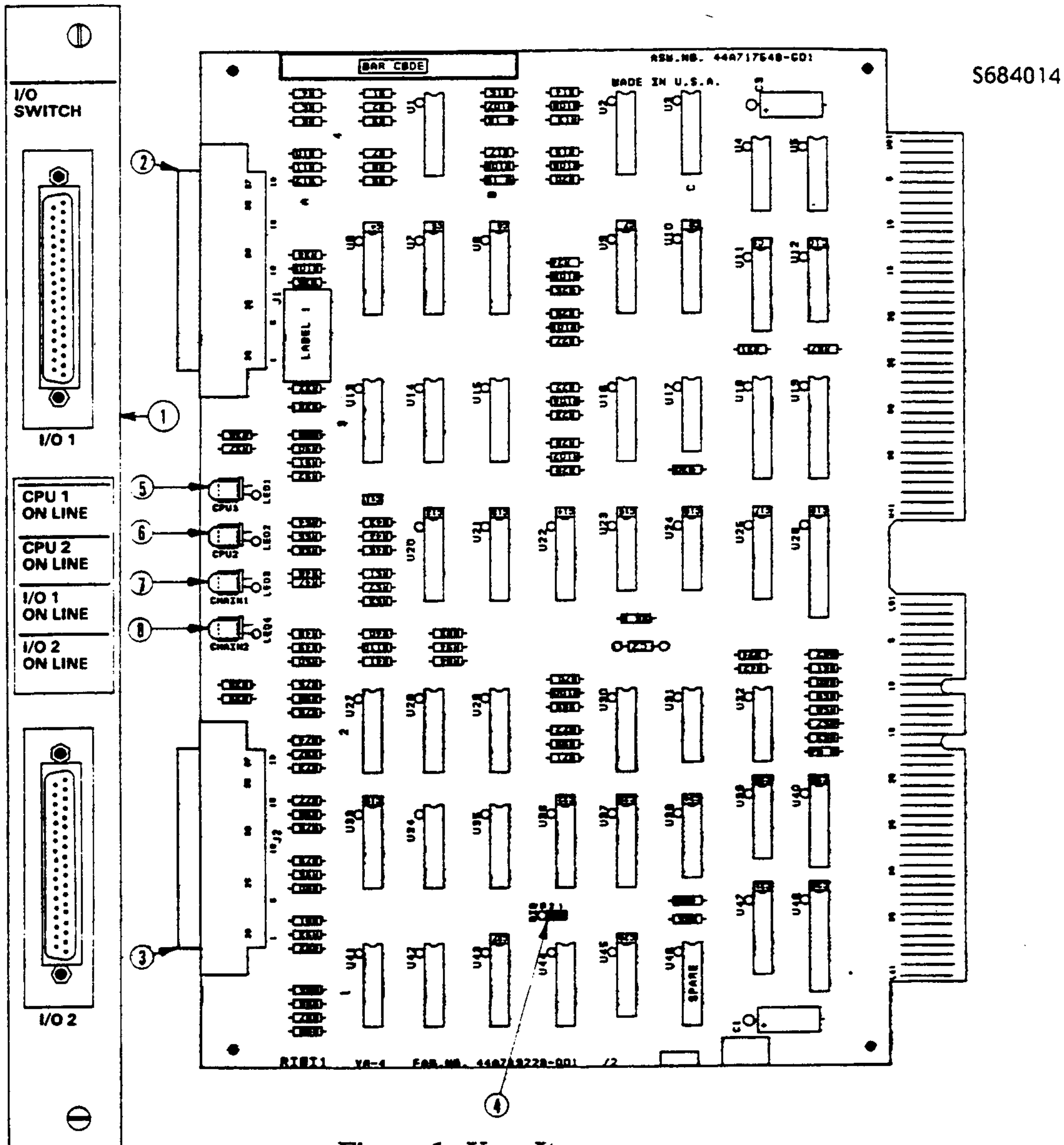


Figure 1. User Items

1. Faceplate.
2. I/O Chain No. 1 Connector.
3. I/O Chain No. 2 Connector.
4. Jumper (labeled DIO)

   Single I/O chain 3 2 1

   Dual I/O chains 3 2 1
5. CPU1 On-Line

   When on, indicates that CPU1 is available as the Master CPU.
6. CPU2 On-Line

   When on, indicates that CPU2 is available as the Master CPU.
7. I/O 1 On-Line

   When on, indicates that I/O chain No. 1 is available.
8. I/O 2 On-Line

   When on, indicates that I/O chain No. 2 is available.

Installation

Set the DIO jumper to the required position (See Figure 1). The I/O Switch Module must be installed in either the second or seventh slots (from the left) of the RPU, depending on whether it is to be used in the Auxiliary or Main I/O chain, respectively. Use the insertion/extraction tool provided with the RPU to ensure proper module seating. Guide the faceplate over the connectors; then secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

Connect a multi-pair cable from the I/O chain 1 port (37-pin D connector) on the RPU to the I/O Receiver card top 37-pin D connector which begins I/O chain No. 1.

If a second I/O chain is used, connect a multi-pair cable from the I/O chain No. 2 port (37-pin D connector) on the RPU to the I/O Receiver card top 37-pin D connector which begins I/O chain No. 2.

Repeat the previous two operations if the optional Auxiliary I/O chain(s) is used.

All connectors should be secured using the furnished screws.

CAUTION

While removing or installing the I/O Switch Module, power should be removed from the RPU. Removing either RIOI board from the RPU will cause an I/O Chain reset. The process controlled by the CPU will stop.

For best results, cables from the I/O Switch Module to either I/O chain should be routed separately from power, contactor or motor circuits containing high current or high frequency noise components. These cables should not exceed fifty feet in length, including cable when connecting to other I/O Receiver cards in the daisy chain.

Table 3. Ordering Information

Equipment	Catalog Number
Circuit Board and Faceplate	IC600RB750
Faceplate only	IC600FP750
I/O Chain Cable 2 feet (0.6m)	IC600WD002
I/O Chain Cable 5 feet (1.5m)	IC600WD005
I/O Chain Cable 10 feet (7.5m)	IC600WD010
I/O Chain Cable 25 feet (18.75m)	IC600WD025
I/O Chain Cable 50 feet (37.5m)	IC600WD050

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc.
(UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

GEK-84865B

Redundant Processor Unit
CPU Switch Module

March 1989

General Description

The CPU Switch Module is used in the Redundant Processor Unit (RPU) to monitor and select one of two external Series Six CPUs as the Master CPU, as well as to provide a communications link to either CPU from the RPU Data Control Module.

The I/O chains from both CPUs interface to the CPU Switch Module through two 37-pin connectors located at the top and middle positions of the Module.

The CPU Switch Module transfers the selected CPU I/O chain bus to the RPU backplane bus for use by the I/O Switch Module.

Two CPU Switch Modules may be utilized in an RPU; one for the Main I/O chain and an optional module for the Auxiliary I/O chain. The features and benefits of the CPU Switch module are summarized in Table 1, while Table 2 provides module specifications.

Table 1. Features and Benefits

FEATURES	BENEFITS
Three parallel bus connectors	Provides RPU link to two CPUs
Solid state bus switch	Provides bumpless transfer of I/O chain control between CPUs

Table 2. AC Specifications

Dimensions:	Circuit Board: 8.15 x 11.0 x 1.1 (inches) 208 x 280 x 28 (mm) Faceplate: 12.46 x 1.175 (inches) 317 x 30 (mm)
Power Requirements:	5 V dc, 2.0 A (Supplied by RPU power supply)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 60° C (Outside of rack)
Humidity:	5% - 95% (non-condensing)

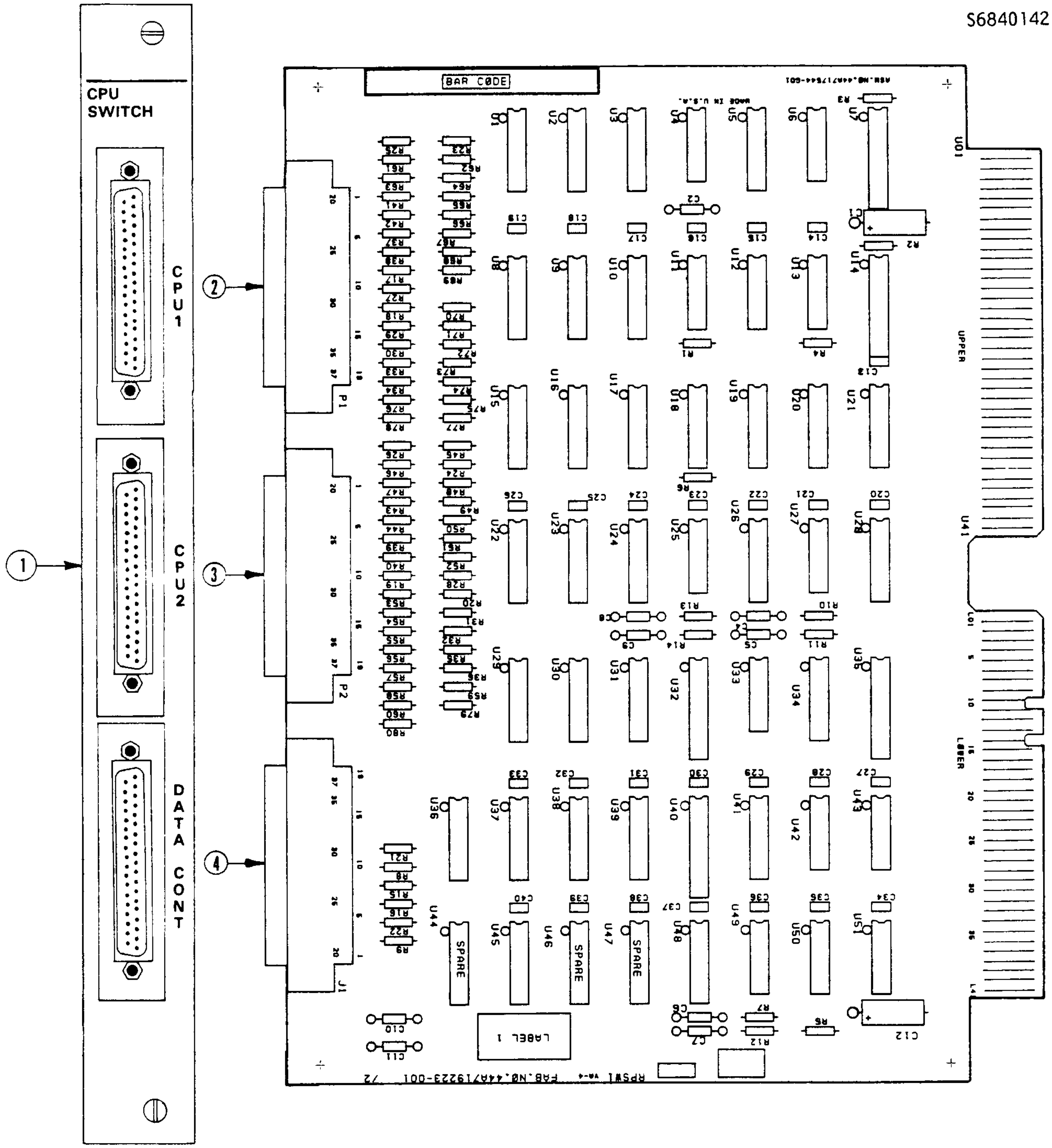


Figure 1. User Items

1. Faceplate.
2. CPU No. 1 Connector.
3. CPU No. 2 Connector.
4. Data Control Connector (Cable supplied with RPU)

Installation

The CPU Switch Module must be installed in either the first or sixth slot (from the left) of the RPU, depending on whether it is to be used in the Auxiliary or Main I/O chain, respectively. Use the insertion/extraction tool supplied with the RPU to ensure proper module seating. Guide the faceplate over the connectors; then secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

Connect a multi-pair cable from the CPU1 port (37-pin D connector) on the RPU to the I/O port (37-pin D connector) on the first CPU I/O Control Module or Auxiliary I/O Module for the Main or Auxiliary I/O chain, respectively.

Connect a multi-pair cable from the CPU2 port (37-pin D connector) on the RPU to the I/O port (37-pin D connector) on the second CPU I/O Control Module or Auxiliary I/O Module for the Main or Auxiliary I/O chain.

The other 37-pin connector on the CPU Switch module (Main I/O chain only) should be connected to the Data Control module bottom 37-pin connector using the short cable supplied with the RPU. All connectors should be secured using the furnished screws.

CAUTION

While removing or installing the CPU Switch Module, power should be removed from the RPU. Removing either RPSW board from the RPU will cause an I/O Chain reset. The process controlled by the CPU will stop.

For best results, cables from the CPU Switch Module to either CPU should be routed separately from power, contactor or motor circuits containing high current or high frequency noise components. These cables should not exceed 10 feet in length.

Table 3. Ordering Information

Equipment	Catalog Number
Circuit Board and Faceplate	IC600RB751
Faceplate only	IC600FP751
CPU No. 1 Cable 2 feet (0.6m)	IC600WD002
CPU No. 1 Cable 5 feet (1.5m)	IC600WD010
CPU No. 2 Cable 2 feet (0.6m)	IC600WH002
CPU No. 2 Cable 5 feet (1.5m)	IC600WH005
CPU No. 2 Cable 10 feet (7.5m)	IC600WH010
Data Control Cable	IC600WJ001

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc. (UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

GEK-84871B

March 1989

Redundant Processor Unit
Data Prom Module

General Description

The Data PROM Module contains the executive program for the Redundant Processor Unit (RPU). The module includes Programmable Read-Only Memory (PROM) devices which provide non-volatile storage of software required for RPU operations. The Data PROM Module features and benefits are summarized in Table 1, while module specifications are shown in Table 2.

Table 1. Featutes and Benefits

FEATURES	BENEFITS
Contains RPU executive firmware	Provides intelligent capabilities in the RPU
Programmable Read-Only Memory (PROM)	Provides reliable, non-volatile, storage

Table 2. Specifications

Dimensions:	Circuit Board: 8.15 x 11.0 x 1.1 (inches) 208 x 280 x 28 (mm) Faceplate: 12.46 x 1.175 (inches) 317 x 30 (mm)
Power Requirements:	5 V dc, 2.0 A (Supplied by RPU power supply)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 60° C (Outside of rack)
Humidity:	5% - 95% (non-condensing)

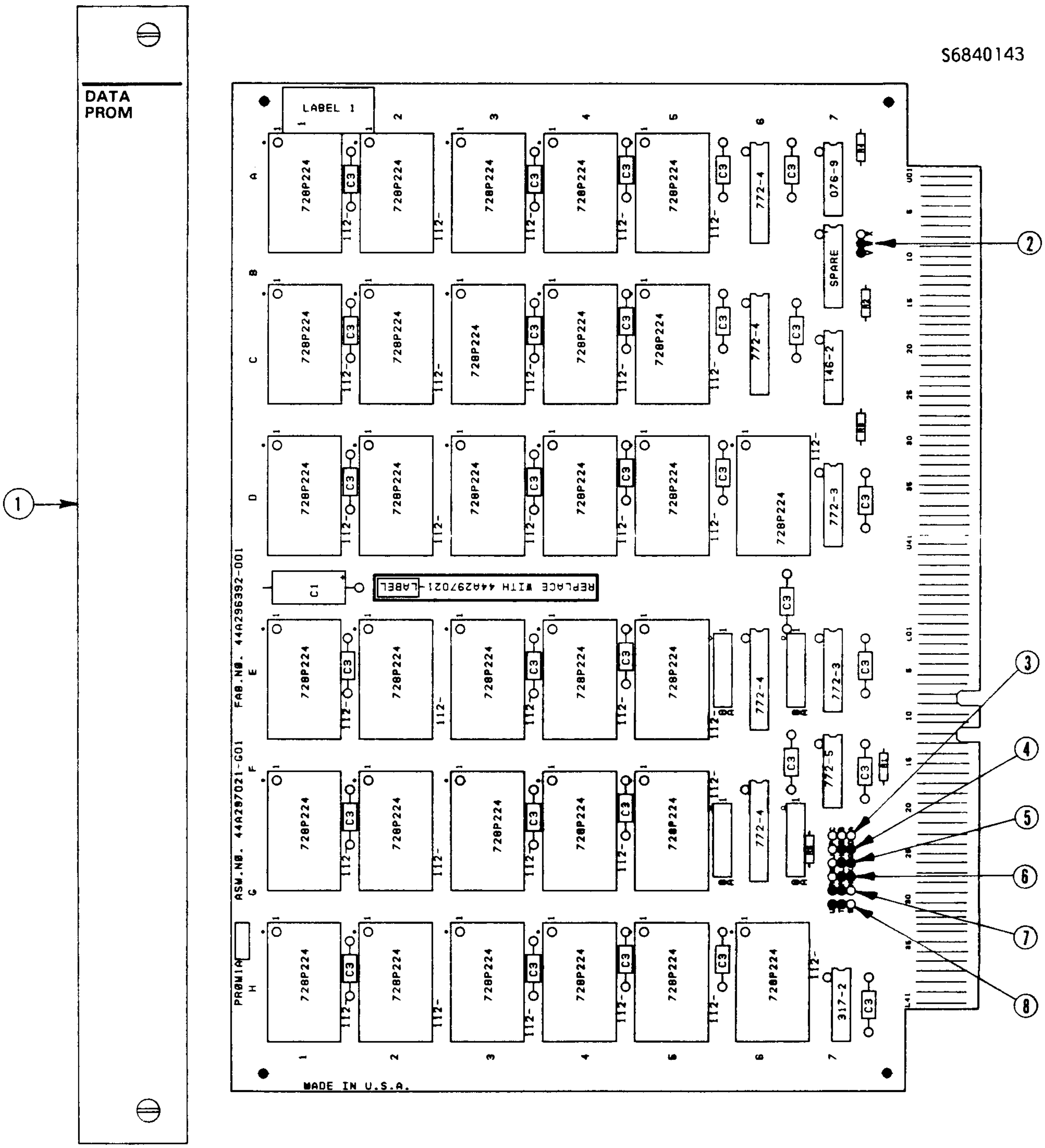


Figure 1. User Items

1. Faceplate.
2. Jumper VW Jumper position set at factory.
3. Jumper ABC No jumper
4. Jumper DE Jumper position set at factory.
5. Jumper GH Jumper position set at factory.
6. Jumper KL Jumper position set at factory.
7. Jumper PR Jumper position set at factory.
8. Jumper TU Jumper position set at factory.

Installation

Before installing the Data PROM module, verify the positions of the factory-installed jumpers as indicated in Figure 1.

The module must be inserted in the fifth slot from the left in the RPU. To ensure proper installation, use the extraction/insertion tool supplied with the RPU. Secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

This module may be inserted or removed under power provided that the RUN/HOLD switch on the Main Power Supply is set to the HOLD position.

EPROM upgrade kits are provided from time to time. These typically replace only the operational firmware contained in the EPROMS at locations H5, D5, H3, and D3.

Table 3. Ordering Information

Equipment	Catalog Number
Circuit Board and Faceplate	IC600RM716
Faceplate	IC600FP701

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc. (UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

FANUC

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GEK-84872C

Redundant Processor Unit
Data Control Module

June 1990

General Description

The Data Control Module contains a 16-bit microprocessor (Intel 8086) that controls Redundant Processor Unit (RPU) parallel communications to both the master and backup CPUs while also monitoring and displaying RPU hardware status. The module maintains CPU synchronization and transfer of I/O and register data between master and standby CPUs.

Table 1 summarizes features and benefits of the Data Control module, while Table 2 lists module specifications.

The module provides two 37-pin, D-type connectors; the top connector is not used, but the bottom connector is connected to the CPU Switch Module, also within the RPU, via a multi-pair cable.

Table 1. Features and Benefits

FEATURES	BENEFITS
Powerful 16-bit microprocessor	Centralized control of all RPU Operations
On-board Direct Memory Access capability	Provides an efficient parallel link to the master or backup CPUs

Table 2. Specifications

Dimensions:	Circuit Board: 8.15 x 11.0 x 1.1 (inches) 208 x 280 x 28 (mm) Faceplate: 12.46 x 1.175 (inches) 317 x 30 (mm)
Power Requirements:	5 V dc, 2.0 A (Supplied by RPU power supply)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 55° C (Outside of rack)
Humidity:	5% - 95% (non-condensing)

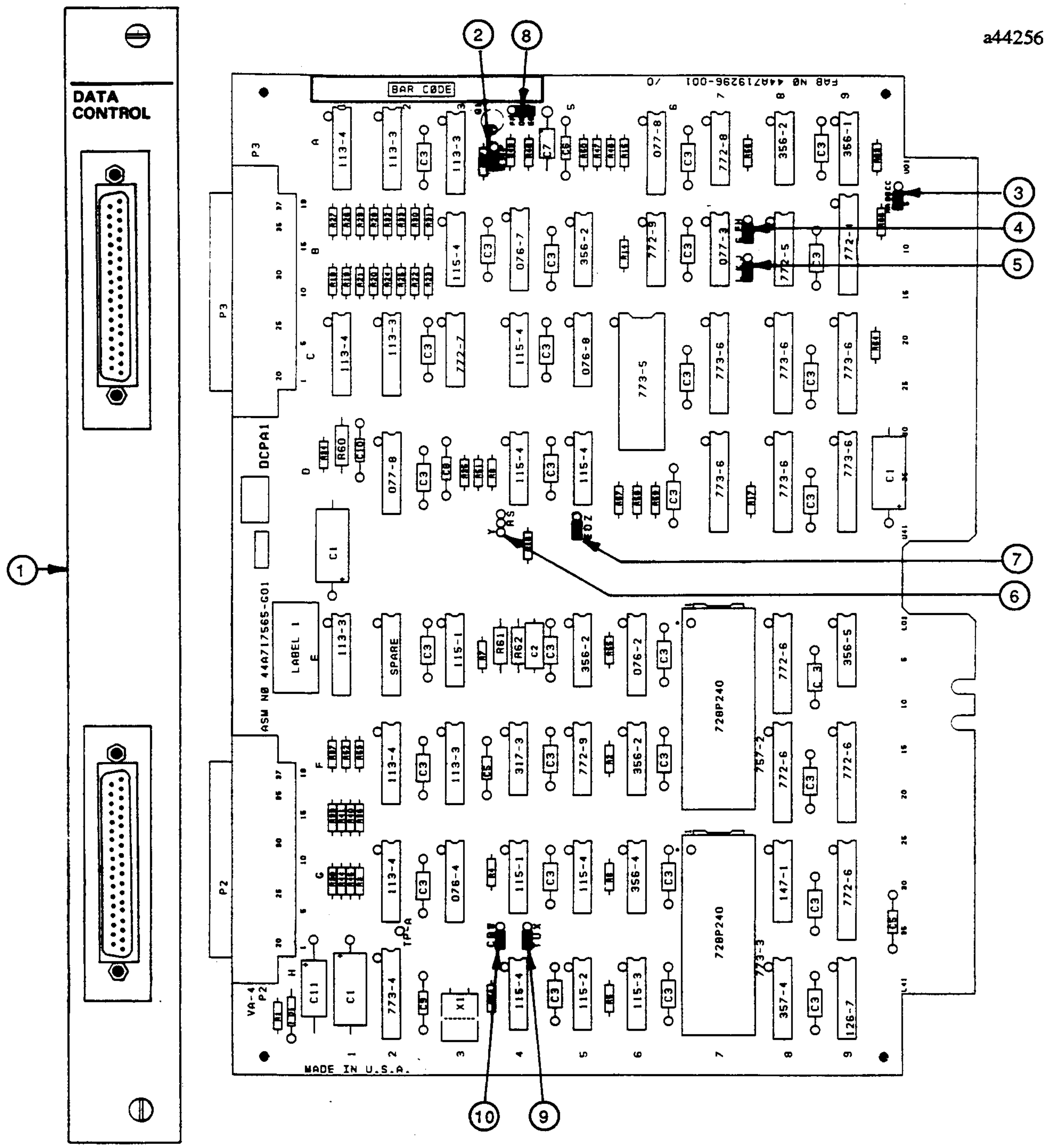

Figure 1. User Items

1. Faceplate.
2. Jumper MN Jumper position set at factory.
3. Jumper AA-BB Jumper position set at factory.
4. Jumper FG Jumper position set at factory.
5. Jumper LK Jumper position set at factory.
6. Jumper YRS No jumper
7. Jumper ED Jumper position set at factory.
8. Jumper DD-EE Jumper position set at factory.
9. Jumper TU Jumper position set at factory.
10. Jumper CB Jumper position set at factory.

Installation

Before installing the Data Control module, verify the positions of the factory-installed jumpers as indicated in Figure 1.

The Data Control module must be installed in the fourth slot from the left in the RPU. Use the insertion/extraction tool supplied with the RPU to firmly seat the module. Guide the faceplate over the connectors; then secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

Connect the short multi-pair Data Control cable supplied with the RPU between the bottom port (37-pin D connector) on the Data Control module and the bottom port of the CPU Switch module. The connector should be secured using the furnished screws. The top connector on the module is unused.

CAUTION

The Data Control module may be removed or inserted under power as long as the RUN/HOLD switch is set to the HOLD position.

Table 3. Ordering Information

Equipment	Catalog Number
Circuit Board and Faceplate	IC600RB753
Data Control Cable (supplied with RPU)	IC600WJ001
Faceplate	IC600FP700

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc.
(UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

GEK-84873C

Redundant Processor Unit
Data Storage CMOS Memory Module

March 1989

General Description

The CMOS Data Storage Memory Module (8K version) used in the Redundant Processor Unit (RPU) provides 8,192 words of random access memory. This module is supplied with a battery; however, since battery backup is not required for RPU functions, the battery and its associated status LED are not used in the RPU. The features and benefits of the Data Storage Memory module are summarized in Table 1, while Table 2 provides module specifications.

Table 1. Features and Benefits

Features	Benefits
CMOS RAM	Enhanced reliability through less power consumption and heat dissipation

Table 2. Specifications

Dimensions:	Circuit Board: 8.15 x 11.0 x 1.1 (inches) 208 x 280 x 28 (mm) Faceplate: 12.46 x 1.175 (inches) 317 x 30 (mm)
Power Requirements:	+5 V dc, 350 mA +12 V dc, 10 mA (Supplied by RPU power supply)
Storage Temperature:	-40° to +70° C
Operating Temperature:	0° to 60° C (Outside of rack)
Humidity:	5% - 95% (non-condensing)

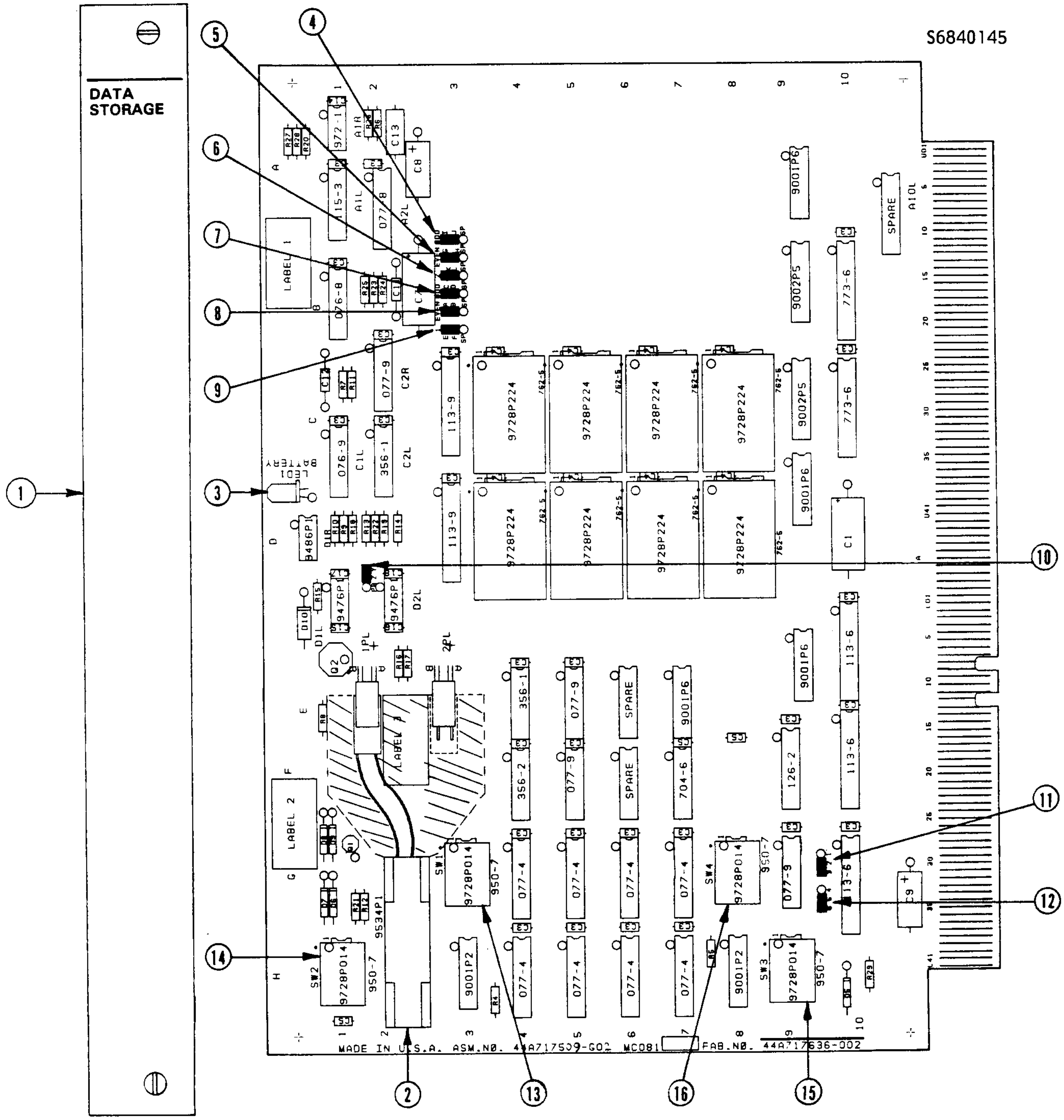

Figure 1. User Items

1. Faceplate.
2. Battery (not used in RPU)
3. Battery Status LED (not used in RPU)
4. Jumper IJ
5. Jumper GH
6. Jumper KL
7. Jumper CD
8. Jumper AB
9. Jumper EF
10. Jumper YZ
11. Jumper 3 2 1
12. Jumper 6 5 4
13. See below.

DIP SWITCHES	1	2	3	4	5	6	7
13 SW1	C	C	C	C	C	C	C
14 SW2	C	C	C	C	C	C	O
15 SW3	C	C	C	C	C	O	O
16 SW4	C	C	C	C	C	O	C

O = Open, C = Closed

Figure 1. User Items (Cont'd)

Installation

Before installing the CMOS module in the RPU rack, verify the positions of the factory-set jumpers as shown in Figure 1.

Set the Dual-In-Line-Package (DIP) switches to the correct configuration (Refer to Figure 1, User Items 13-16).

The CMOS Data Storage module must be inserted in the third slot from the left in the RPU. Use the extraction/insertion tool supplied with the RPU to firmly seat the module. Secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

CAUTION

This module may be removed or inserted under power, provided that the RUN/HOLD switch on the Main Power module is set to the HOLD position.

Table 3. Ordering Information

Equipment	Catalog Number
Circuit Board and Faceplate Faceplate	IC600RM715 IC600FP756

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc. (UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

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GEK-84874B

Redundant Processor Unit
To Central Processor Unit Cable

March 1989

General Description

This cable is used to interconnect the middle connector of the CPU switch module in either slot 6 or slot 11 of the Redundant Processor Unit (RPU) to the bottom connector of the I/O Control module in the CPU rack.

The cable has a male 37-pin D-type connector on one end and a female 37-pin D type connector on the other. The cable is made of 16 twisted pair (22 AWG) with an overall shield and a PVC jacket for a total of 32 wires plus shield. The features and benefits of this cable are summarized in Table 1, while Table 2 provides cable specifications.

Table 1. Features and Benefits

FEATURES	BENEFITS
Available in several lengths	Provides flexibility for Series Six hookup
Color-coded twisted pairs	Simplifies troubleshooting

Table 2. Specifications

Cable Outside Diameter:	0.465 ± 0.020 inches 11.81 ± 0.5 mm
Cable Length:	2, 5, and 10 feet (0.61, 1.52, and 3.05 meters)
Conductor Size:	No. 22 AWG (each wire)
Jacket:	PVC material 300 V insulation Temperature: -20° C to +80° C
Internal Arrangement:	16 twisted pair (32 wires) with overall shield and jacket
Connectors:	37-pin D-type male 37-pin D-type female

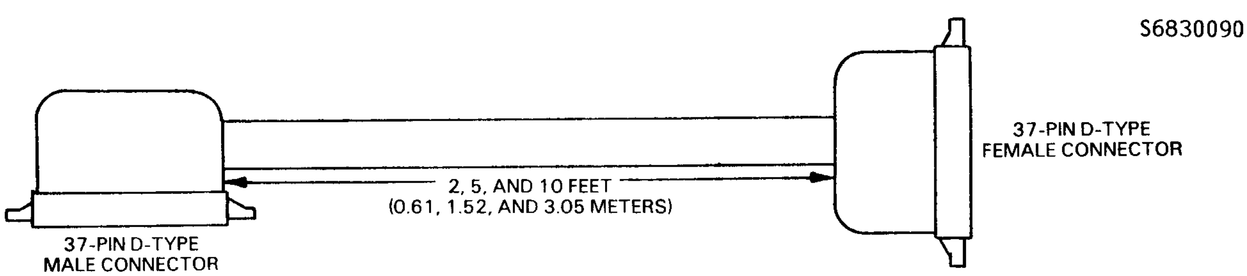

Figure 1. Mechanical Assembly

Installation

The male end of this cable is made to connect to the bottom connector of the I/O Control module in the CPU rack.

The female end of this cable is made to connect with the middle connector of the CPU Switch module in the RPU rack.

All cables should be firmly secured at both ends by using the captive screws supplied with the connectors.

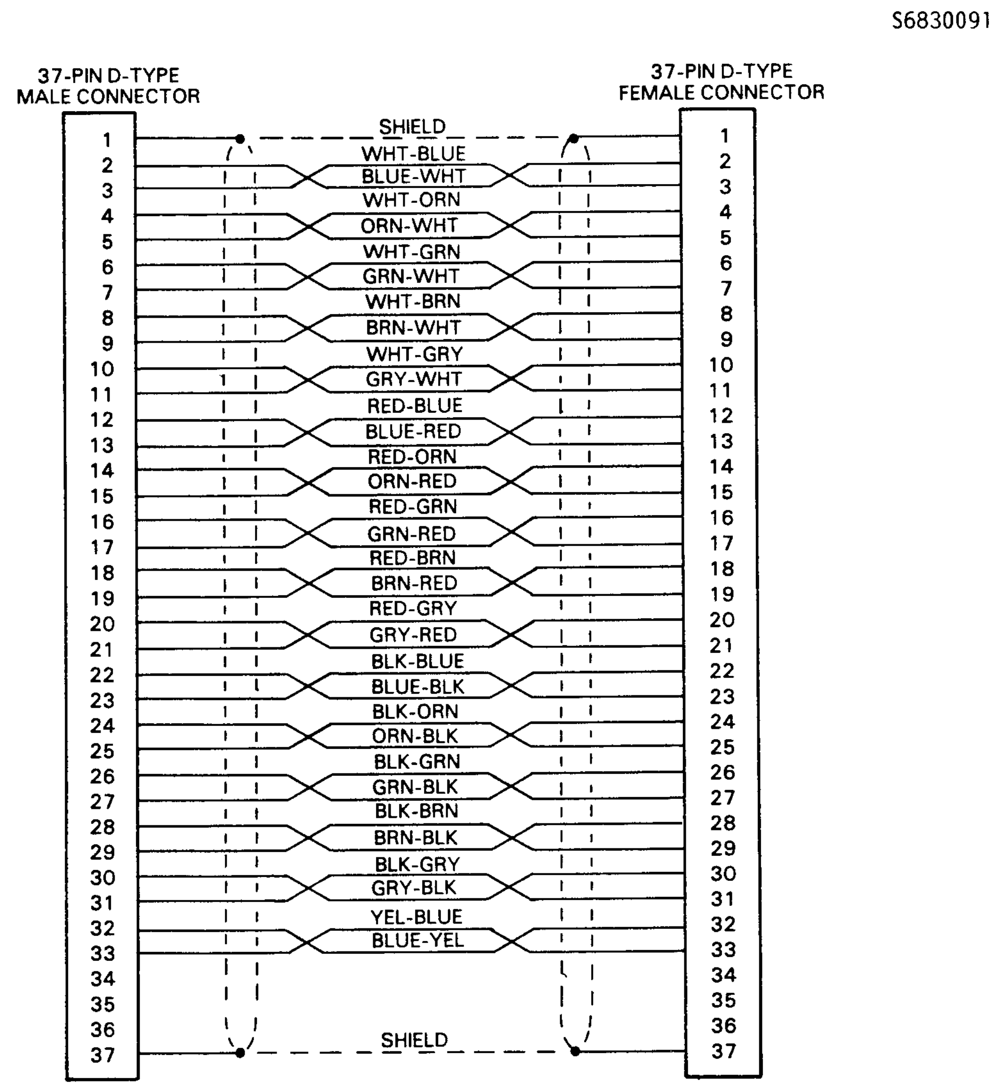

Figure 2. Wiring Diagram of Cable

Table 3. Ordering Information

Part Number	Description
IC600WH002	2 foot (.61 meters) cable with connectors each end
IC600WH005	5 foot (1.52 meters) cable with connectors each end
IC600WH010	10 foot (3.05 meters) cable with connectors each end

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc. (UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

Series Six™
Programmable Controllers

GEK-90754B

Redundant Processor Unit
To Central Processor Unit Cable
(Non-Industrial or Commercial Use)

March 1989

General Description

This cable is used to interconnect the middle connector of the CPU switch module in either slot 6 or slot 11 of the Redundant Processor Unit (RPU) to the bottom connector of the I/O Control module in the CPU rack. This cable provides radiated energy shielding.

The cable has a male 37-pin D-type connector on one end and a female 37-pin D type connector on the other. The cable is made up of 19 twisted pair (22 AWG) with an overall shield and a PVC jacket for a total of 38 wires plus shield. The features and benefits of this cable are summarized in Table 1, while Table 2 provides cable specifications.

Table 1. Features and Benefits

FEATURES	BENEFITS
Available in several lengths.	Provides flexibility for Series Six hookup.
Color-coded twisted pairs.	Simplifies troubleshooting.
Radiated energy shielding.	Meets FCC Part 15 Subpart J requirements.

Table 2. Specifications

Cable Outside Diameter:	0.465 ± 0.020 inches 11.81 ± 0.5 mm
Cable Length:	2, 5, and 10 feet (0.61, 1.52, and 3.05 meters)
Conductor Size:	No. 22 AWG (each wire)
Jacket:	PVC material 300 V insulation Temperature: -20°C to +80°C
Internal Arrangement:	19 twisted pair (38 wires) with overall shield and jacket
Connectors:	37-pin D-type male 37-pin D-type female

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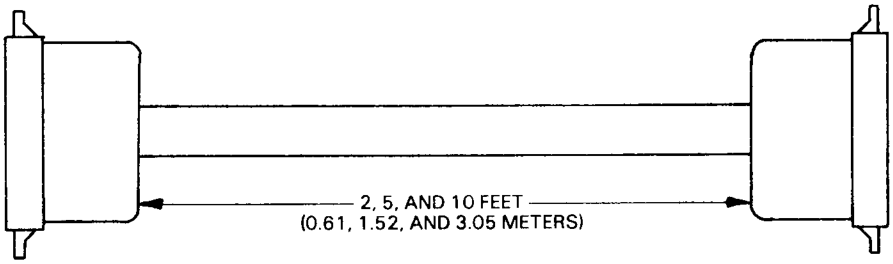

Figure 1. Mechanical Assembly

Installation

The male end of this cable is made to connect to the bottom connector of the I/O Control module in the CPU rack.

The female end of this cable is made to connect with the middle connector of the CPU Switch module in the RPU rack.

All cables should be firmly secured at both ends by using the captive screws supplied with the connectors.

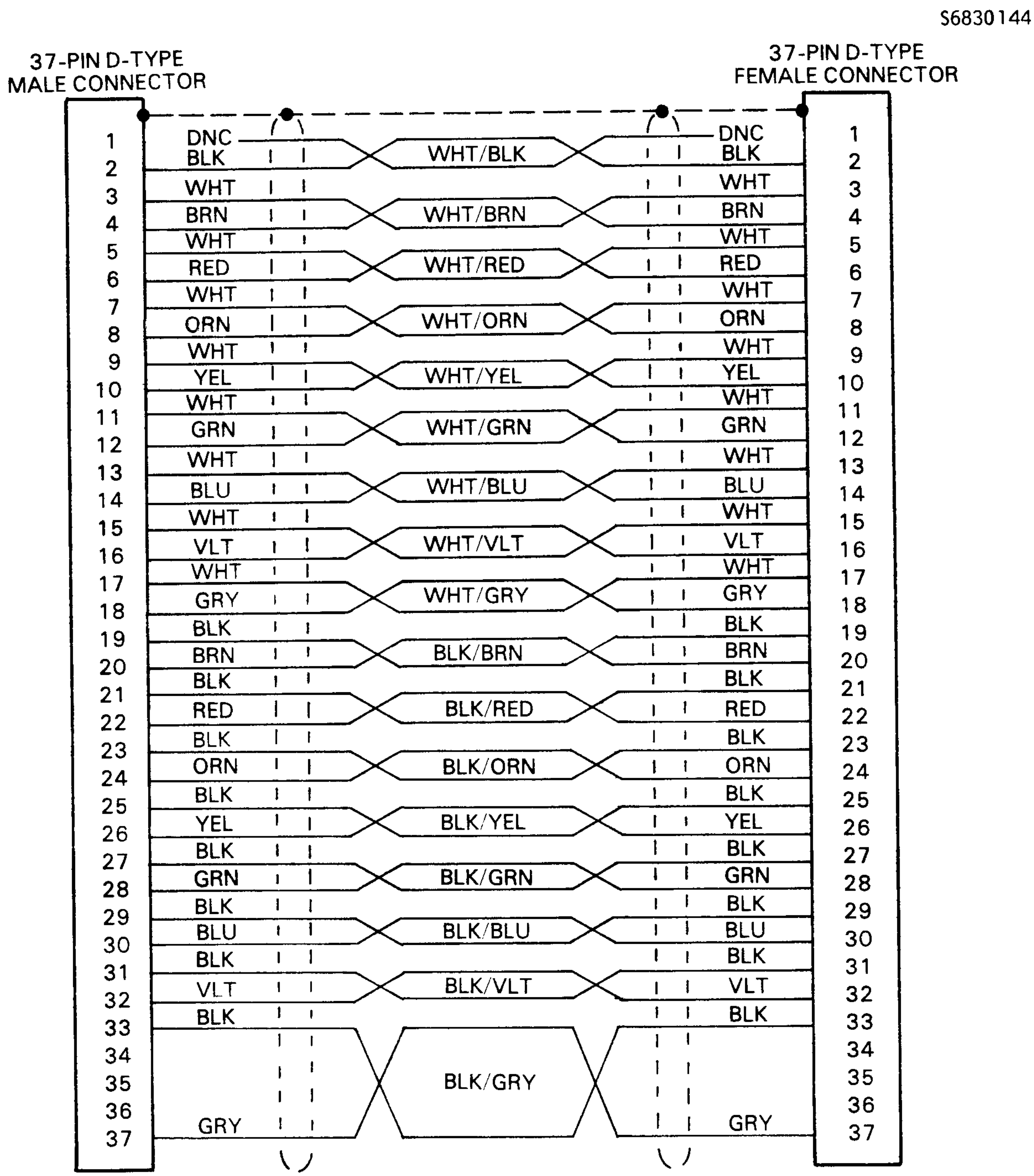

Figure 2. Wiring Diagram of Cable

Table 3. Ordering Information

Part Number	Description
IC600WHF002	2 foot (.61 meters) cable with connectors each end
IC600WHF005	5 foot (1.52 meters) cable with connectors each end
IC600WHF010	10 foot (3.05 meters) cable with connectors each end

For further information, contact your Local GE Fanuc sales representative.

Series Six™
Programmable Controllers

GEK-90755C

Redundant Processor Unit
DMA Cable
(Non-Industrial or Commercial Use)

June 1990

General Description

The Redundant Processor Unit (RPU) DMA cable is used internal to the RPU to interconnect the Data Control module bottom connector in slot 8 to the bottom connector in slot 6. This cable provides radiated energy shielding.

The cable consists of a male 37-pin D-type connector on each end. The cable is made up of 19 twisted pair (22 AWG) with an overall shield and a PVC jacket for a total of 38 wires plus shield. The features and benefits of this cable are summarized in Table 1, while Table 2 provides module specifications.

Table 1. Features and Benefits

FEATURES	BENEFITS
Available in several lengths.	Provides flexibility for Series Six hookup.
Color coded twisted pairs.	Simplifies troubleshooting.
Radiated energy shielding.	Meets FCC Part 15 Subpart J requirements.

Table 2. Specifications

Cable Outside Diameter:	0.465 ± 0.020 inches 11.81 ± 0.5 mm
Cable Length:	One or two feet (30.5 or 61 cm)
Conductor Size:	No. 22 AWG (each wire)
Jacket:	PVC material 300 V insulation Temperature: -20°C to +80°C
Internal Arrangement:	19 twisted pair (38 wires) with overall shield and jacket
Connectors:	37-pin D-type male connectors each end

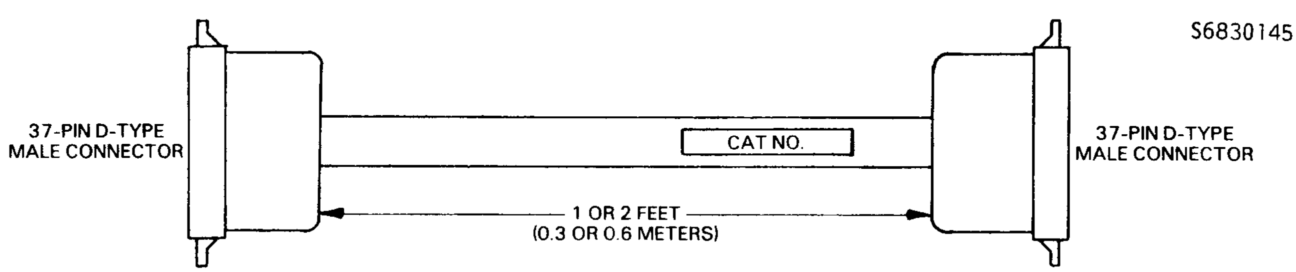

Figure 1. Mechanical Assembly

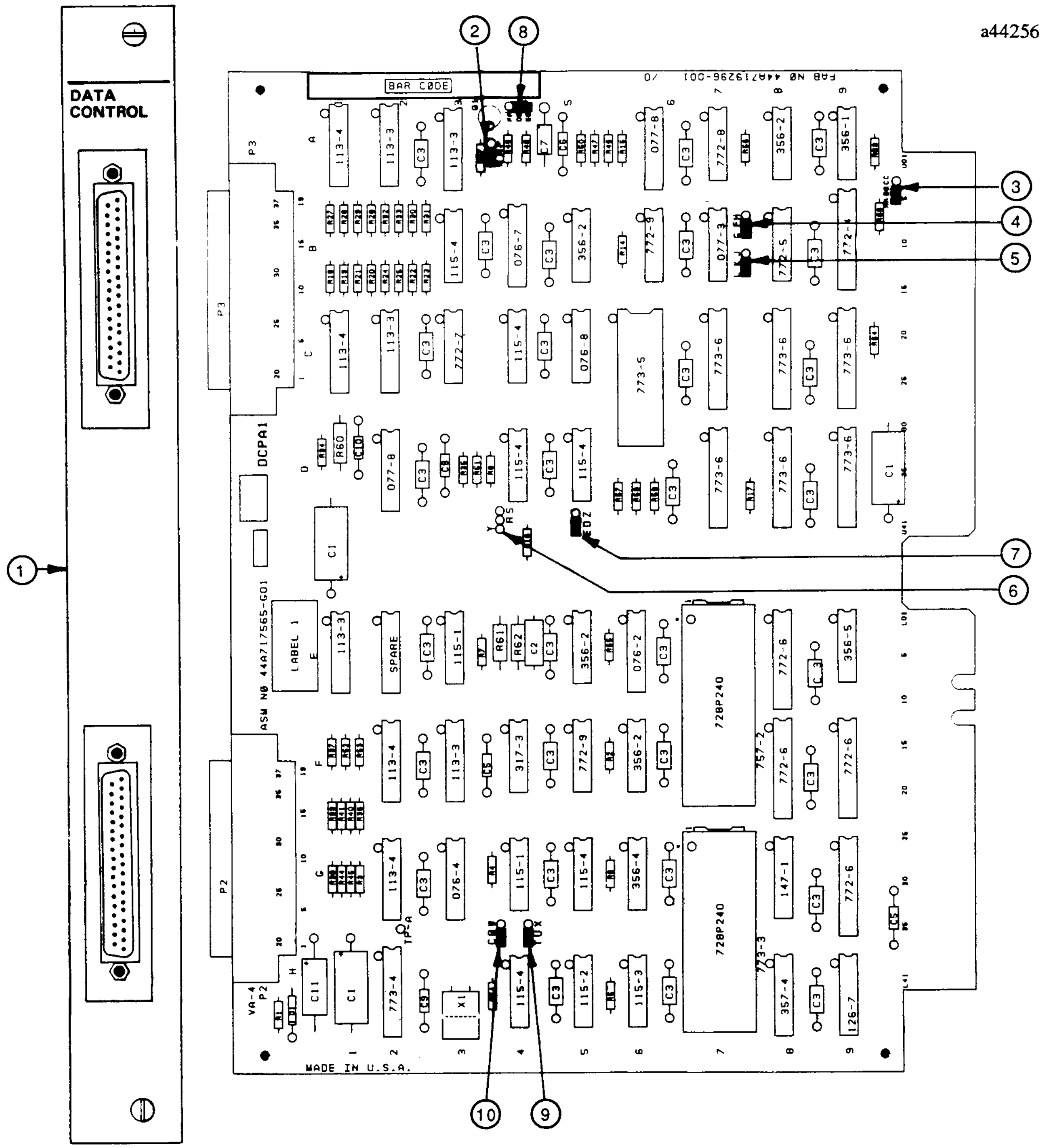

Figure 1. User Items

1. Faceplate.
2. Jumper MN Jumper position set at factory.
3. Jumper AA-BB Jumper position set at factory.
4. Jumper FG Jumper position set at factory.
5. Jumper LK Jumper position set at factory.
6. Jumper YRS No jumper
7. Jumper ED Jumper position set at factory.
8. Jumper DD-EE Jumper position set at factory.
9. Jumper TU Jumper position set at factory.
10. Jumper CB Jumper position set at factory.

Installation

Before installing the Data Control module, verify the positions of the factory-installed jumpers as indicated in Figure 1.

The Data Control module must be installed in the fourth slot from the left in the RPU. Use the insertion/extraction tool supplied with the RPU to firmly seat the module. Guide the faceplate over the connectors; then secure the faceplate to the rack by tightening the thumbscrews at the top and bottom.

Connect the short multi-pair Data Control cable supplied with the RPU between the bottom port (37-pin D connector) on the Data Control module and the bottom port of the CPU Switch module. The connector should be secured using the furnished screws. The top connector on the module is unused.

CAUTION

The Data Control module may be removed or inserted under power as long as the RUN/HOLD switch is set to the HOLD position.

Table 3. Ordering Information

Equipment	Catalog Number
Circuit Board and Faceplate	IC600RB753
Data Control Cable (supplied with RPU)	IC600WJ001
Faceplate	IC600FP700

This symbol on the nameplate means the product is listed by Underwriters Laboratories Inc.
(UL Standard No. 508, Industrial Control Equipment, subsection Electronic Power Conversion Equipment.)

For further information, contact your local GE Fanuc sales representative.

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GEK-25366C