10.0 AutoMax PROCESSOR OVERVIEW

NOTE: *This chapter describes the AutoMax Processor module only. For information about the PC3000 Processor module, refer to instruction manual D2-3099.*

The AutoMax Processor module plugs into the backplane of an AutoMax rack and executes application programs which, in turn, control other AutoMax or DCS modules in the system. The Processor modules have the following memory/speed configurations:

Model	CPU Speed	Memory
M/N 57C431 AutoMax 6011 Processor module	8 mHz	512K Parity RAM
M/N 57C435 AutoMax 7010 Processor module	25 mHz	512K Parity RAM

Each Processor contains 32K of EPROM for board-level diagnostics and boot software. The operating system, which oversees the operation of the CPU and the execution of application tasks, is provided in two versions: the 6011 OS, which is used with M/N 57C431 Processors, and the 7010 OS, which is used with M/N 57C435 Processors. The M/N 57C431 and M/N 57C435 Processors both have 290K available for application tasks. Both versions of the operating system are included with the AutoMax Executive software (see section 5.4.3 for loading the operating system).

Processor modules come equipped with on-board battery back-up to protect against power failures. External battery back-up is therefore not required for racks containing a single Processor module. For racks containing multiple Processor modules, however, external battery back-up may be required to protect the Common Memory module against power failures. If you are using Common Memory module M/N 57C413 or earlier, external battery back-up is required. M/N 57C413B and later have on-board battery back-up. Although this section describes the Processor module in some detail, for more specific information, refer to instruction manual J-3650.

10.1 Single Processor Module in a Rack

A Processor can occupy any slot in the rack from 0-4 (refer to figure 10.1). A single M/N 57C431 or 57C435 Processor module makes 290K available for application tasks.

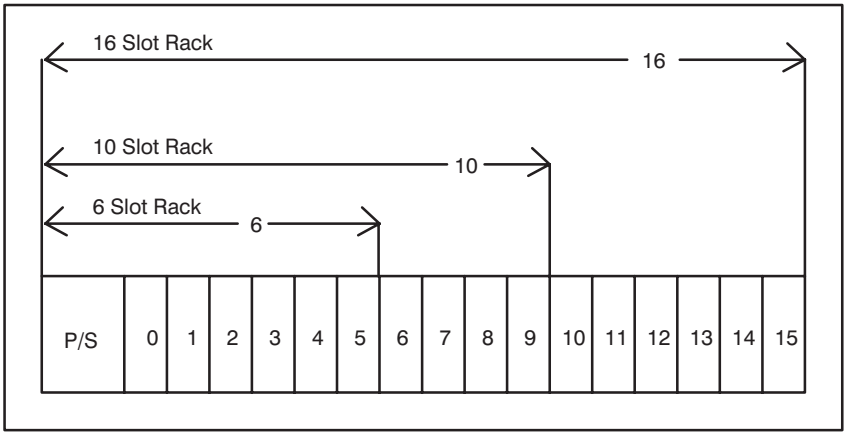

Figure 10.1 - Rack Slot Numbers

10.2 Additional Data Storage in a Rack Containing a Single Processor Module

A Common Memory module M/N 57C413A or 57C423 can be used to extend the amount of data storage available in a rack containing a single Processor module. In this configuration, the M/N 57C413 or 57C423 Common Memory module makes available an additional 128K of memory to use for storing common variables. You cannot use the Common Memory module to store application tasks or local variables. See instruction manual J-3675 for more information on common and local variables.

10.3 Multiple Processor Modules in a Rack

Additional Processor modules increase the processing capability and the total memory available in any one rack for application tasks. **Multiple Processor modules in a rack require the use of a Common Memory module in slot 0,** where it serves as a bus arbiter and stores data common to all the Processor modules. The Common Memory module can be used to oversee communications for up to four Processor modules, the maximum per rack. The Processor modules can occupy slots 1-4 only. In a rack containing multiple Processors, slot 1 must either contain a Processor module or be empty.

In this configuration, the Common Memory module, rather than a Processor module, also stores the configuration data. See J-3636 for more information about the Common Memory module.

If you are using M/N 57C431 and M/N 57C435 Processors in the same rack, make sure the left-most Processor is a M/N 57C435 Processor. This will allow all communication between the AutoMax rack and the personal computer to occur at 19200 baud.

10.4 Battery Back-Up

The contents of AutoMax Processor RAM (read/write memory) are preserved through power failures by the on-board battery back-up. As long as the LED labeled “BAT. OK” on the front of the Processor module is on, the battery is functional and 115 VAC is available to the power supply in the rack. Should the system lose power, the on-board battery can supply power to the Processor module for a minimum of 42 days. Note that the battery backup is designed to maintain the contents of RAM only. It is not a source of un-interruptible power.

If you expect power to be off for long intervals during initial start-up and debugging, you should disconnect the battery backup on the Processor module and make use of the super-capacitor also on board each Processor module. Typically, the super-capacitor is capable of retaining memory for 10 hours at a time with no battery present. This procedure will avoid draining the Processor’s battery back-up.

Reserved Battery Status Variables

Five pre-assigned variables are available for use in all application tasks to test the status of the on-board battery of AutoMax Processor and Common Memory modules. These common boolean variables will have the value 1 if the battery is functional and 0 if the battery is not functional. The variables are named according to the Processor whose battery is being tested. BATTERYSTATUS0@ is used for the Processor or Common Memory module in slot 0. BATTERYSTATUS1@ is used for the Processor in slot 1, etc. up to slot 4.

10.5 Module Watchdog Circuity

Each Processor module has a local watchdog timer which must be reset by the operating system within a specified interval or the Processor will execute a STOP ALL and all I/O modules in the local rack will be reset (initialized to 0, FALSE, or OFF). The I/O modules in the rack will also be reset if you remove a Processor module from a single-Processor configuration. All UDC tasks in the rack will also be stopped, and most UDC registers will be reset. See 10.12 for more information.

In a multi-Processor configuration, there is a system watchdog timer located on the Common Memory module in slot 0 in addition to the watchdog on each individual Processor module. If the system watchdog is allowed to expire, the Common Memory module will generate an interrupt, and one of the Processors in the rack will issue a STOP ALL and reset the I/O modules in the rack. All Processor modules in the rack will then shut down.

Each UDC module also has a local watchdog timer. If the watchdog timer on a UDC module expires, the UDC module will generate an interrupt, and one of the Processors in the rack will issue a STOP ALL.

10.6 Processor Module Serial Ports

There are two RS-232 serial ports on the front of each Processor module. They are accessed through DB-25 connectors on the faceplate. The upper port, labeled “PROGRAMMER/PORT B”, is reserved for connection to the personal computer only. When there are multiple Processor modules in a rack, only the leftmost “PROGRAMMER/PORT B” slot is reserved. All remaining ports on all Processor modules in the rack can be used by application tasks running on the respective Processor modules.

The user ports are accessed using the OPEN statement (OPEN “PORTA” or OPEN “PORTB”) in BASIC tasks. Refer to J-3675 for more information on the OPEN statement. Refer to Appendix A for a description of the pins on user ports. Unless otherwise programmed by an application task, the default characteristics of the user ports are:

9600 baud
8 bit characters
1 stop bit
no parity
echo on
Xon/Xoff handshake enabled
ignore modem control
not hardcopy device

10.7 Status Indicators

The Processor module has four status indicators on the faceplate: a green LED labeled “OK”, an indicator light labeled “BAT. OK” for the on-board battery back-up and presence of 115 VAC power, and two seven-segment LEDs used to display status and error codes. See 10.4 for more information on the on-board battery back-up.

The “OK” indicator is controlled by the local hardware watchdog timer on the Processor. It is on when the timer has been reset within the timer interval and the Processor module is operating normally. See 10.5 for more information about the watchdog timer.

See 10.10-10.12 for more information on status and error codes that may be displayed on the seven-segment LEDs.

10.8 Power-Up Initialization

Whenever power is cycled, each Processor and UDC module performs diagnostics to detect any malfunctions on the module. In a rack with multiple Processors, the leftmost Processor will perform diagnostics on the Common Memory module.

While the diagnostics are being performed, various status codes are displayed on the Processor, indicating the particular diagnostic in progress. Most of these codes are displayed so briefly that they are not actually visible. Should a failure be detected on a Processor or Common Memory module, the Processor will be shut down and the “OK” indicator turned off. The status code indicating which diagnostic failed will remain on the Processor’s display. See Appendix B for a list of status and error codes. A failure on a UDC module will cause the “OK” indicator to be turned off.

After the diagnostics are complete, a checksum of a portion of the contents of memory is verified against a checksum which was stored in memory when a loss of AC power was detected. This determines whether the system performs a re-start or a cold-start when power is turned on. See 10.13 and 10.14 for more information on cold starts and system re-starts.

10.9 Run-Time Diagnostics

The Processor module performs real-time checking of all data paths on the module by means of a parity test. The Processor contains a memory management unit (MMU) that prevents errors such as writing to locations that are read-only.

Should a failure be detected, a fault code will be displayed and the Processor shut down. See instruction manual J-3650 for more information on run-time diagnostics.

10.10 Status Codes

Status Codes are those codes displayed on the seven-segment LEDs on the Processor module faceplate while the “OK” indicator is on.

Status codes simply indicate that a particular operation is occurring or that a particular condition exists. They do not cause the Processor to shut down. Status codes may or may not be cleared when the condition they indicated no longer exists. See Appendix B for a list of status codes.

10.11 Shut-Down Faults

Serious hardware malfunctions that cause the Processor to shut down and the “OK” indicator to be turned off are called shut-down faults. When possible, the cause of the shut-down is indicated by an error code on the seven segment LEDs. See Appendix B for a list of status and error codes.

Once a Processor module has shut down, it will not execute any instructions or respond to commands from the personal computer until it is reset by cycling power.

10.12 Stop-All Faults

In AutoMax systems, both a Stop-All command and a Stop-All fault have the same result. A Stop-All command can be issued from the online menu of the Programming Executive software. A Stop-All fault occurs when there is a serious error either in an application task in the rack (e.g., invalid BASIC language EVENT statement), or when there is a serious error in an AutoMax Processor or Universal Drive Controller module. See Appendix B for a list of status and error codes.

Both a Stop-All fault and a Stop-All command will result in all application tasks in the rack being stopped. The common clock signal on the rack backplane (CCLK) will also be disabled. A Stop-All fault will result in an error code display on the faceplate of the AutoMax Processor that was running the task that caused the Stop-All. Neither the operating systems or the application tasks on

AutoMax Processors and UDC modules will be deleted by Stop-All faults or commands.

The effect of a Stop-All on data in the rack depends on the data type. Local tunable data in both AutoMax and UDC application tasks is always retained. Local data is retained for AutoMax tasks, but not for UDC tasks. Common memory data, which can be defined in the Variable Configurator for AutoMax Processors only, is maintained when it is configured as non-volatile. Otherwise, it is reset to 0. For I/O data, inputs are retained and continue to be updated, while outputs are reset (set to 0 or off). Note that the UDC dual port memory is treated like I/O data in the system.

AutoMax Processors will retain the last values of all local variables and non-volatile common memory variables. All I/O input values are retained and continue to be updated. All I/O outputs in the rack and in any remote I/O racks will be reset.

UDC modules will retain their parameter configuration data, UDC test switch information, D/A setup configuration, local tunable variables, and the following input data: feedback registers and UDC task error log information.

UDC modules will NOT retain local variables and data found in the following registers, which are considered outputs: command registers, application registers, the ISCR (interrupt status and control register), scans per interrupt register, and scans per interrupt counter register. The UDC-PMI communication status registers will not be retained.

For Distributed Power Drive applications, the PMI Processor connected to UDC modules will react to a Stop-All as follows. All I/O in the PMI rack, including the rail I/O and I/O connected to the Resolver and Drive I/O module, is reset. Because a Stop-All causes the CCLK signal being used to synchronize UDC and PMI Processor communication to be turned off, the UDC and PMI will become unsynchronized. The PMI Processor reacts to all serious synchronization problems in the same way: armature and field current reference will be set to 0, and the PMI Processor will continue commanding 0 current until it senses discontinuous conduction. At this point, the PMI Processor will turn off the M- contactor output signal on the Resolver and Drive I/O module in the PMI rack.

10.13 Forcing a Cold Start/Deleting Operating Systems

At times it may be necessary to cold start the Processor(s) to erase the contents of RAM. Because of the on-board battery back-up, you cannot erase the contents of RAM simply by cycling power. To force a cold start, perform the steps below.

Before proceeding, note carefully that this operation will erase the contents of RAM for all Processors in the rack and that it will require re-loading the AutoMax OS, the rack configuration and all application tasks. Make certain that you have an accurate backup of all tasks in the rack, including utility tasks. See 14.3.1 for more information on utility tasks.

Read all directions carefully before starting the procedure.

1. Turn off power to the system. All power to the rack, as well as all power leading to modules in the rack, must be off.

2. Take any Processor module in the rack out of its current slot and insert it into slot 5, 6 or 7. If there are modules in these slots already, take one out and set aside for the moment. Then insert the Processor into the empty slot.
3. Turn on power to the rack.
4. Turn off power to the rack.
5. Move the Processor back to its original slot and re-insert any other module taken out in step 2 above.
6. Turn on power to the rack. The leftmost Processor will execute its power-up diagnostics and then display “L” “O” on its LEDs.
7. Re-load the AutoMax OS, rack configuration, and all application tasks.

10.14 Stopping and Re-Starting AutoMax and UDC Tasks in the Rack

WARNING

DEPENDING ON THE APPLICATION, STOPPING AN INDIVIDUAL TASK MAY RESULT IN LOSS OF CONTROL OF THE APPLICATION PROCESS. IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE THE POTENTIAL HAZARDS INVOLVED. IT IS RECOMMENDED THAT STOP-ALL BE USED TO STOP TASKS NORMALLY. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

WARNING

THE STOP-ALL FUNCTION STOPS THE APPLICATION PROGRAMS IN A RACK. IT IS THE RESPONSIBILITY OF THE USER TO ENSURE THAT THE APPLICATION PROCESS STOPS IN A SAFE MANNER WHEN THE APPLICATION PROGRAMS STOP. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

WARNING

THE STOP-ALL FUNCTION MAY CAUSE THE OUTPUTS TO CHANGE STATE, RESULTING IN MACHINE MOVEMENT. IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE THE POTENTIAL HAZARDS INVOLVED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

The following is a description of what happens to a rack when tasks are stopped under different circumstances. It also describes how tasks can be re-started under those circumstances. Refer to section 10.15 and 12.4 for more information.

1. You stop a task from the personal computer using the STOP command described in 16.1. The outputs controlled by this task will remain at their last state.

The task is stopped and will not go into run again until you put it into run using the RUN command described in 15.1.

2. You stop all tasks in the rack to which you are connected, either directly or over a network, using the STOP-ALL command described in 16.2.

   All tasks in the rack are stopped and all I/O modules are cleared, i.e., set to 0, false, or off.

   Application tasks will not go into run again until you put them all into run using the RUN-ALL command described in 15.2. You can also put the tasks into run individually using the RUN command described in 15.1.

3. A Stop-All fault occurs.

   All tasks in the rack are stopped and all I/O modules are cleared. The Processor module detecting the fault will display an error code. See 10.12 for more information about stop-all faults.

   Before you run tasks again, you should first clear the error log described in 19.0. Application tasks will not go into run again until you use the RUN or RUN-ALL commands described in 15.1 and 15.2, respectively.

4. You cycle power or a power failure occurs.

   All tasks in the rack are stopped and all I/O modules are cleared. When power is returned to the system, a re-initialization occurs.

   Application tasks in the rack can be put into run in two ways after power comes back on: manually, using the RUN or RUN-ALL commands described in 15.1 and 15.2, respectively; or automatically by the system if AUTO-RUN was enabled at the time power went off.

   AUTO-RUN puts into run only those application tasks that were running when power went off. It will not put any tasks into run if any errors occurred prior to power going off, or if any errors occur during the system re-start.

10.15 System Re-Initialization

System re-initialization refers to a condition that occurs in a rack that contains at least one Processor module. It does not necessarily affect other racks on networks connected to the rack through 57C404, 57C404A, or 57C404B modules.

A system re-initialization will occur under the following conditions:

- when the system powers-up after power to the system is turned off either by cycling power or through a power failure,
- after the occurrence of a STOP-ALL fault,
- after you issue a STOP-ALL command

The following steps occur during a system re-initialization:

1. The following codes are cleared:

   drive fault codes “81” through “86”
   status codes “d0” through “dF”
   configuration task error codes “E0” through “EF”

   Any other fault codes are re-displayed.

2. An application configuration check is performed. If the application configuration check determines that an I/O module is missing or not functioning, an error code is displayed.
3. Forced outputs are set to their forced values.

WARNING

VARIABLES AND OUTPUTS WHICH ARE FORCED BEFORE A-C POWER IS LOST WILL REMAIN FORCED WHEN A-C POWER IS RESTORED. SHOULD A-C POWER BE LOST WHILE VARIABLES ARE FORCED, THE USER MUST ENSURE THAT UNEXPECTED MACHINE MOVEMENT DOES NOT OCCUR WHEN A-C POWER IS RESTORED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

4. Volatile common variables are cleared, i.e., initialized to 0, false, or off, if they are not forced. The values of local variables, non-volatile common variables, and forced volatile common variables are retained. All I/O points are cleared.
5. The application tasks are “built,” i.e., the system data structures are created.
6. The application tasks are installed. The status code “d0” is displayed during the installation because this may take a significant amount of time, depending on the size and number of tasks to be installed. The Processor attempts to read all I/O locations to verify that they are still there.
7. Application tasks may be re-started if the re-initialization was the result of power being turned off and AUTO-RUN is enabled. Otherwise, application tasks are not automatically re-started. See 12.4 for more information on AUTO-RUN.