



PowerTools Pro Application Note
PTAN #1, rev. 1, 3/31/2009
Applicable Products: Epsilon EP-P, FM4E,
SM EZMotion, Digitax ST-Z

**Real Time Program
&
Cyclical Programs**

Introduction

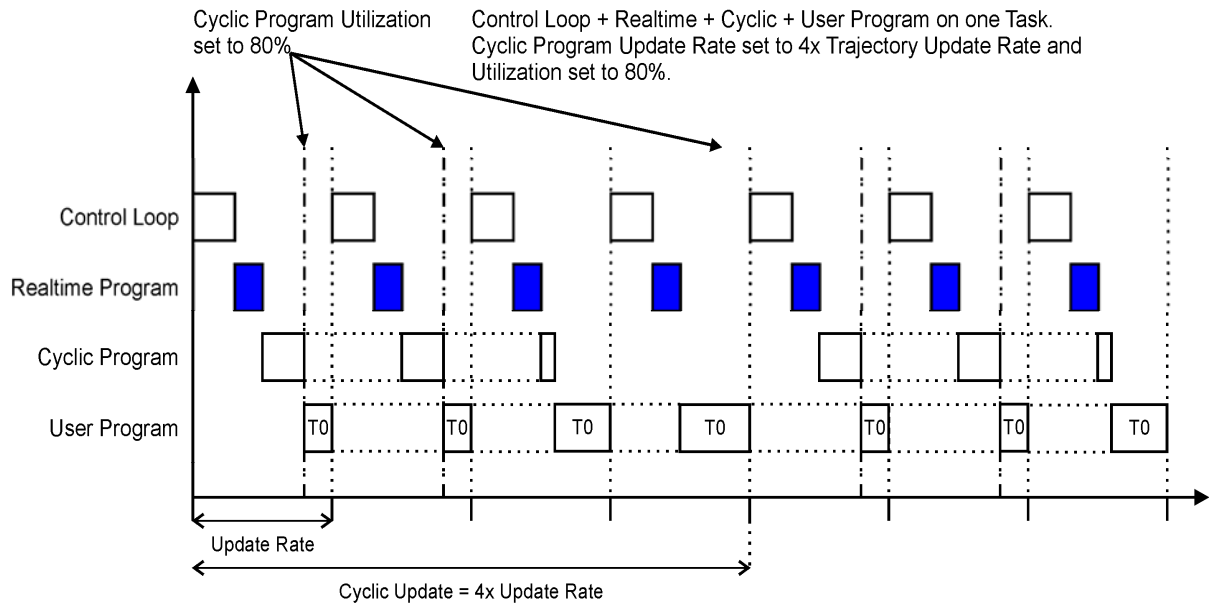
The Epsilon EP and SM EZMotion motion processors update their servo control loops every 1-2 milliseconds, depending upon the product and setup within the product.

User Programs are also serviced at this same rate; however user programs may take many servo update periods to process the entire program. This total time period is not deterministic and can cause some systems to perform poorly due to the time variations.

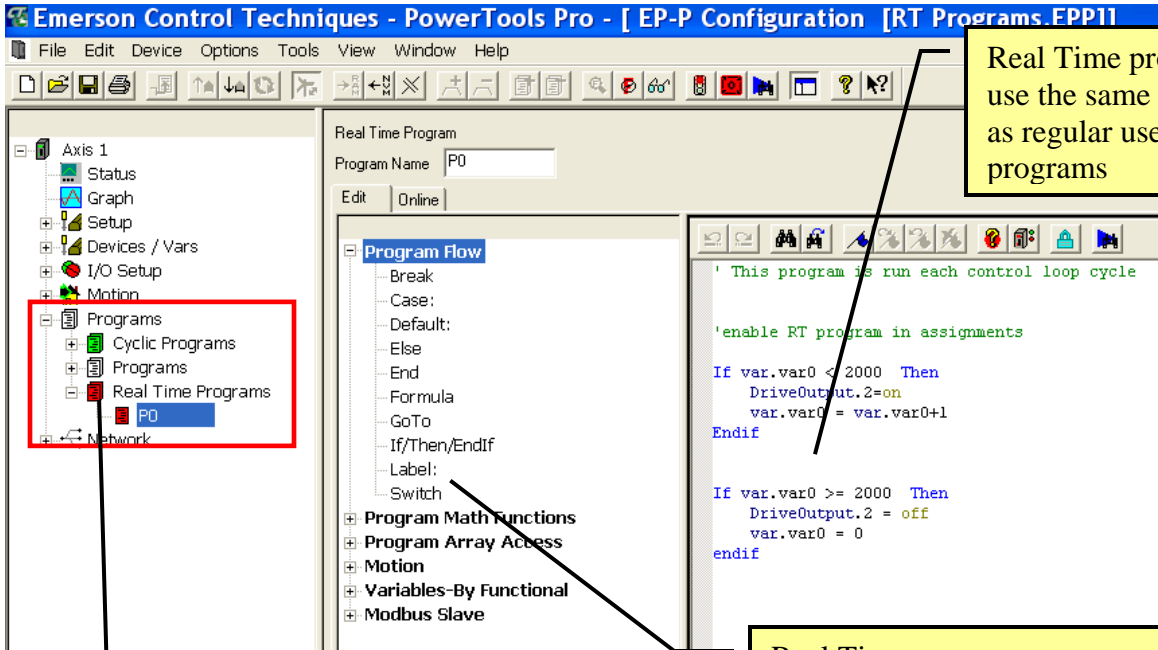
Real Time programs address this concern by servicing these special user programs every servo scan and guaranteeing that the program is complete by the end of the servo scan. This does require that the programs are short enough to be completed in the servo scan time frame.

Cyclical programs are similar to Real Time programs, except the user specifies how many servo scans for the program operate in. If the value is set to 10, the program will finish within 10 servo scans (possibly sooner) and then wait for the 11th servo scan before it starts again. This is very useful for slower, yet deterministic program requirements.

Below is a timing diagram of how the processor slices it's tasks every servo loop:



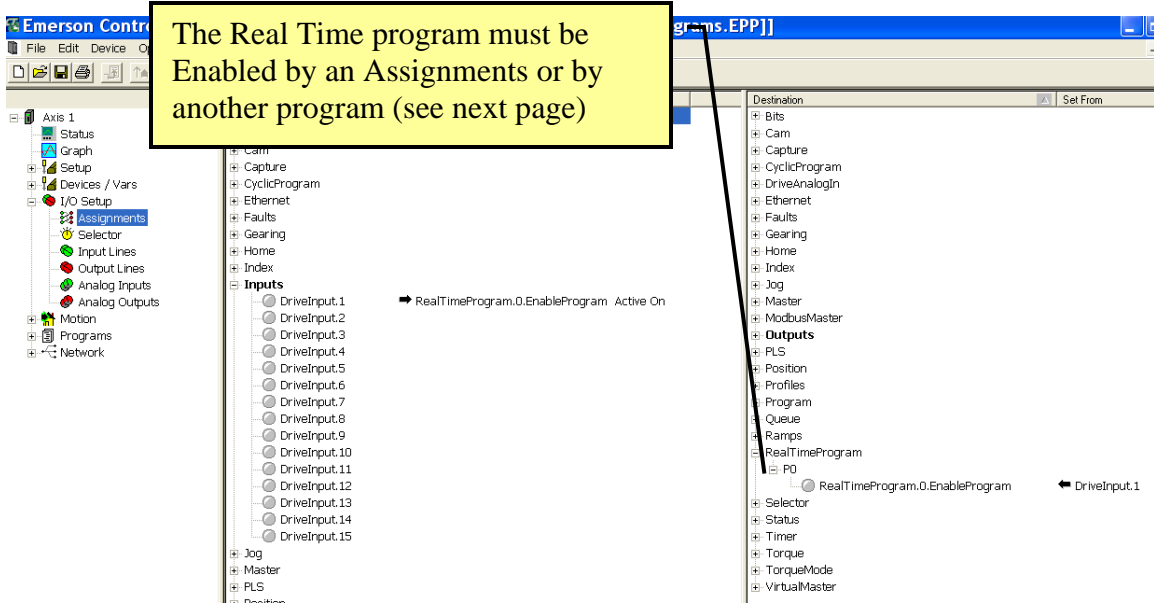
Real Time Programs



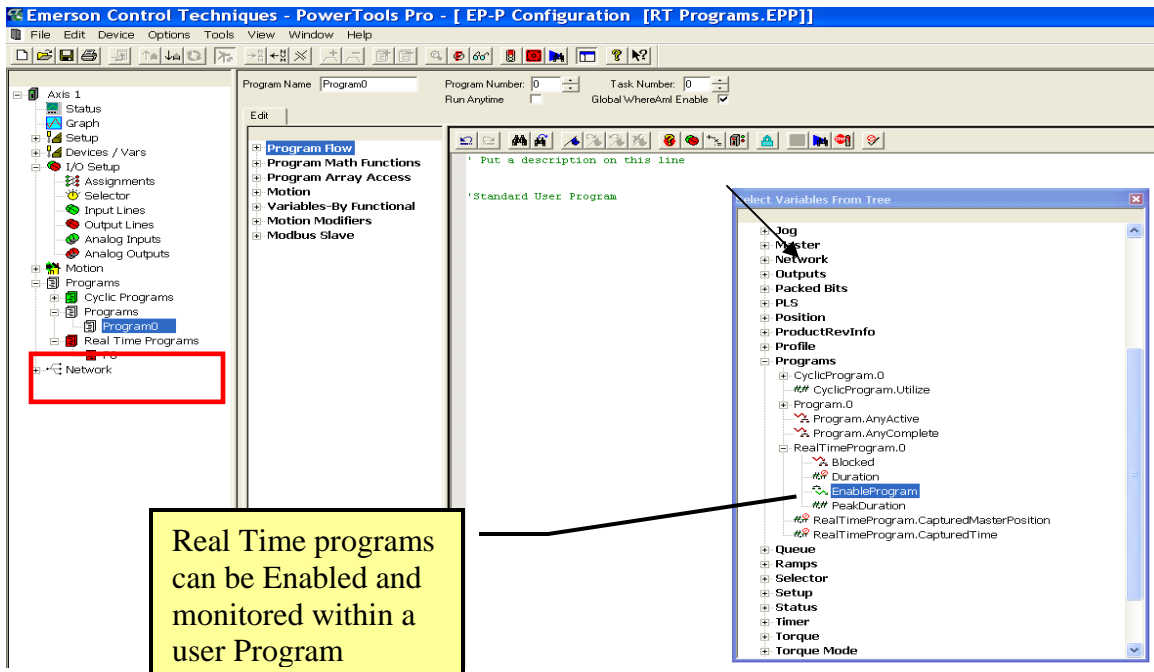
Real Time programs use the same syntax as regular user programs

Real Time program view is found in the Program tree just below the standard user Programs.
 Only 1 RT program is available

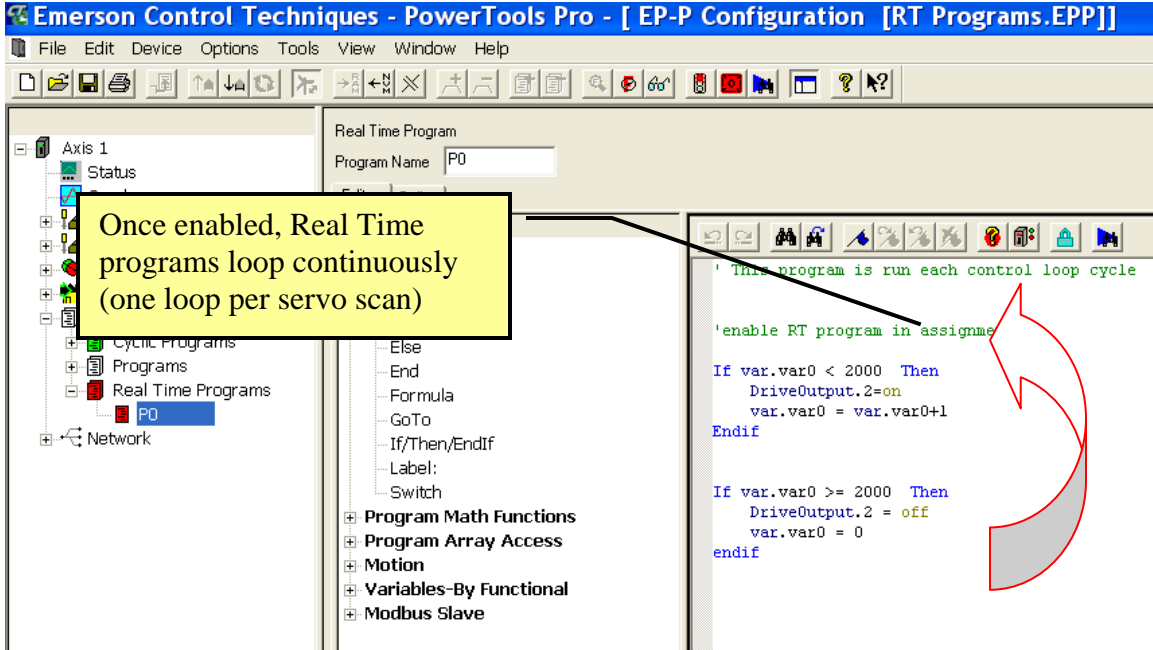
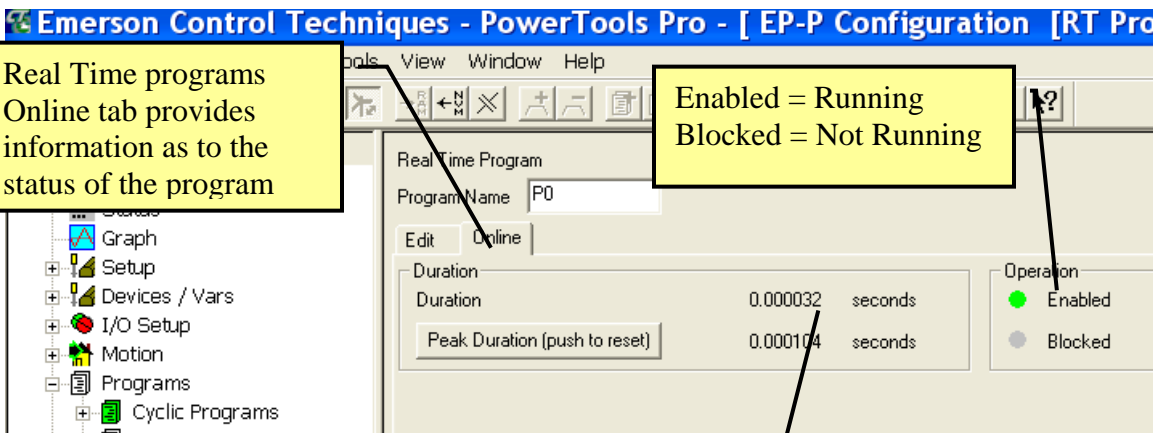
Real Time programs use a shortened set of program syntax. There are no 'Wait For' or calls to other programs.



The Real Time program must be Enabled by an Assignments or by another program (see next page)



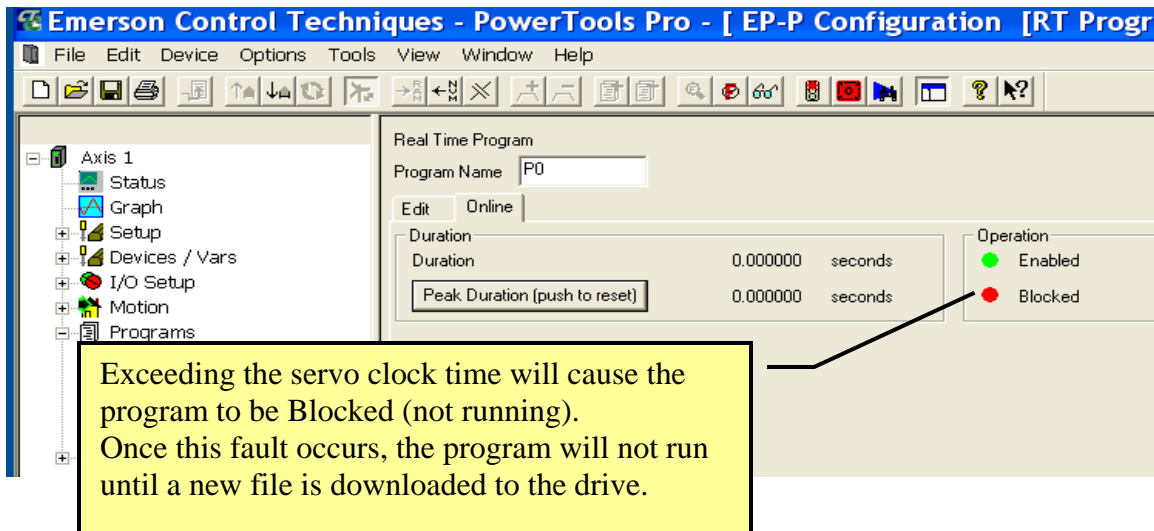
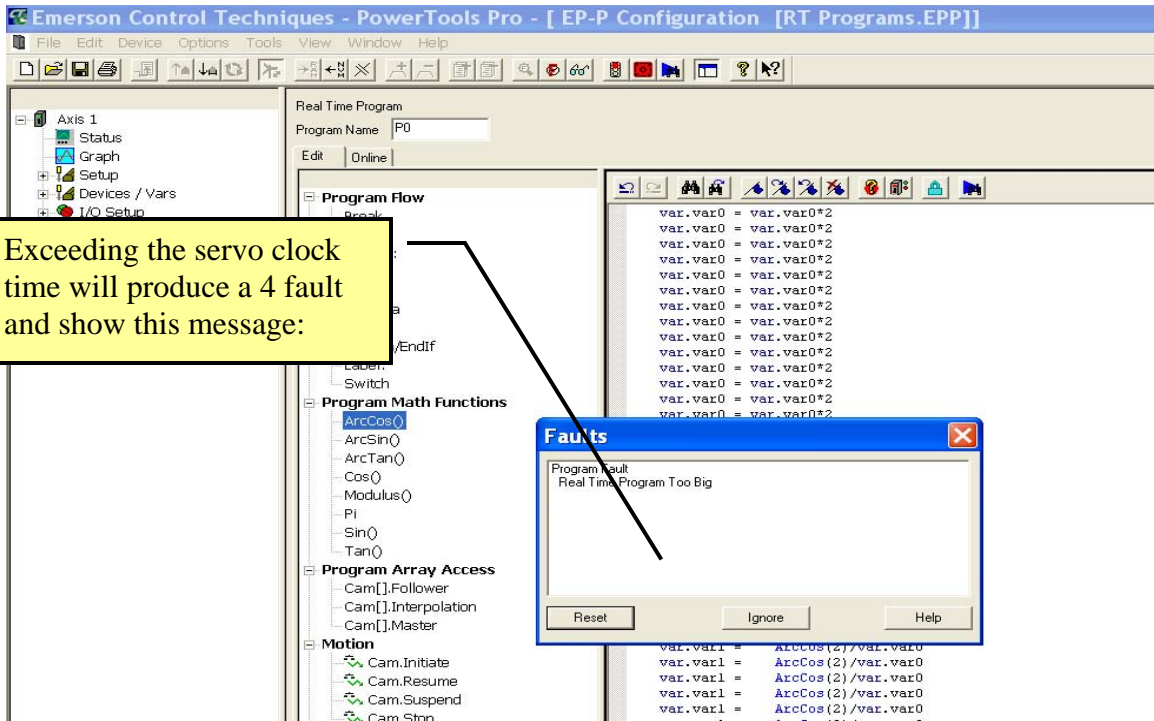
Real Time programs can be Enabled and monitored within a user Program

Actual program time and peak time performance

Exceeding 800 microseconds (0.000800) peak time is not recommended.

Exceeding the servo clock time (1600 – 2000 microseconds) will cause the drive to fault with a global program fault value of 4 for EP-P, FM4 and a slot fault for SM EZMotion





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If unable to recover from RT program exceeding the servo clock fault, or unable to communicate to the drive when it's running a Real Time program, follow this procedure to reset the processor:

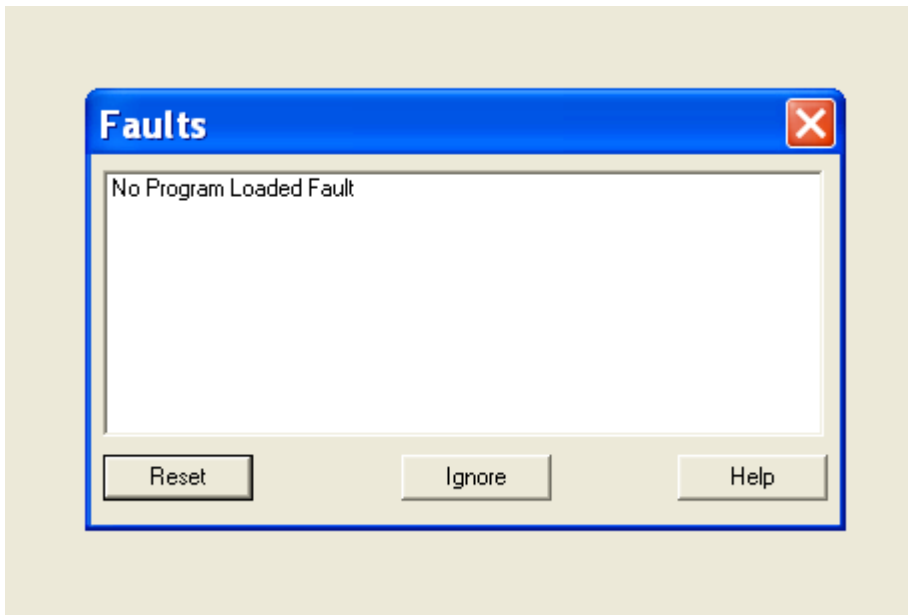
For EP-P or FM4E

Hold the Reset button while the drive is powering up. The PowerTools application file in the drive will be reset to factory defaults and another 4 fault will show in the display. In this case the 4 fault is the 'No Program Loaded fault'.

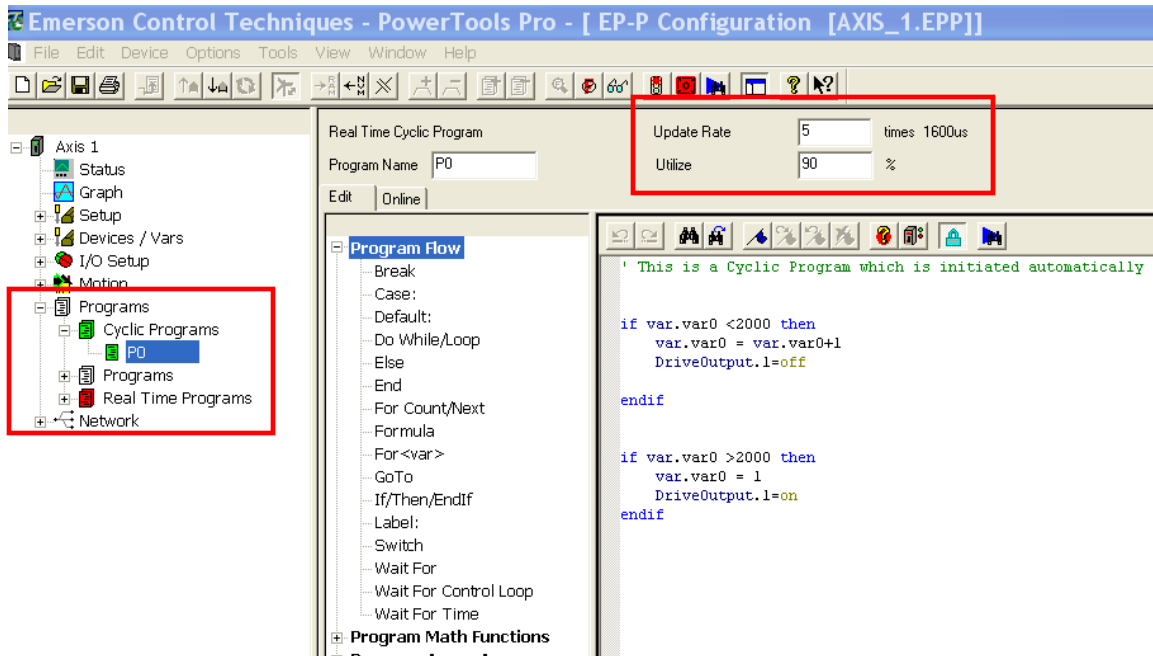
This procedure will not change the drive's Ethernet or Modbus address

For SM EZMotion

Enter 19237 in menu 18.01 and reset power



Cyclical Program



Cyclical programs have two parameters to enter:

Update Rate

The user specifies the number of servo cycles for the Cyclical Program to repeat in.

Utilize

Utilize is the percent of the Control Loop time utilized for control loop, Real Time Program and a portion of the Cyclical Program. When this limit is hit, the cyclic program is suspended until the next control loop. The percentage left over will processes user programs, communications and other processes. To prevent complete starvation of user programs and communications, the execution of the Cyclical Program is spread out over several control loops based on the Utilize percentage.

The drive's CPU time is allocated between the background processes and the foreground control loop interrupt. The control loop interrupt executes event updates, motion calculations, the complete real time program and a portion of the cyclic program up to the

Utilize percentage of the trajectory rate. Then the control loop interrupt is exited and the background processes continue to run.

No matter how low the Utilize percentage is set, the required control loop motion calculations will be completed, the Real Time Program will run to completion, and at least one cyclic instruction will be executed. If these do not complete, a real time program timeout fault is generated. A Cyclic Program Timeout Fault occurs if the cyclic program has not completed at the next Cyclic Program Initiate.

In actuality the Cyclic Programs are initiated from the control loop but are run outside the control loop interrupt. They run as processes along with user programs, but at a higher priority so cyclic programs are run before any user program. Other processes may run at lower or higher priorities. These include processing the communications. The cyclic programs are suspended and resumed based the utilize percentage and trajectory rate.

