2500 Series™ Processor Scan

Discrete Scan

Analog Scan

Normal I/O
Write outputs, read inputs on local, remote, and Profibus I/O.

Main RLL
Run RLL Task 1 to completion.

Special Function I/O
Service all local and remote SF modules to max task codes / scan. Service RBC serial ports.

NOTE: all discrete scan tasks run to completion, even if it causes a scan overrun. You cannot set time slices for these tasks.
Local I/O Operation

- Read/write all I/O modules in the local base
- Very fast backplane access
- Typical scan time 1ms
Remote I/O Operation

- 1Mbit communications, up to 15 bases
- Overhead:
  - First remote base adds ~5ms per scan
  - Each additional remote base adds 1ms per scan
  - Note: each “enabled” add 1ms per scan even if unused
- Actual scan time for the base depends on I/O installed
- Each RBC Communication Port transaction adds ~2 ms
Remote I/O Optimization

- Use the minimum number of remote bases required for the application
- Disable all unused bases
- Minimize or eliminate the use of RBC serial ports
Profibus I/O Operation

- Operates through a dual port RAM interface to a separate Profibus microprocessor
• Important effects of separate Profibus scan
  – At the end of each Profibus cycle, the CPU receives an interrupt to get Profibus data
  – Transferring data from Dual-Port RAM to CPU memory requires 0.25-0.5 ms
  – Therefore, running a very fast Profibus cycle can degrade CPU performance.
  – For optimum performance, we recommend Profibus network operation at slowest baud rate that will achieve 2-3 cycles per PLC scan.
  – Profibus cycle speed is set in ComProfibus
Profibus I/O Optimization

- **Asynchronous Mode**
  - PLC and Profibus scans run independently and fast as possible

- **Synchronous Mode**
  - Profibus is required to complete 2 scans during the normal I/O cycle
  - CPU will wait on Profibus scan before starting new RLL scan

- For best performance we recommend operation in asynchronous mode
Main RLL

Operation

• Runs once each scan from start until it encounters an END instruction.
• Most instructions execute $< 20\mu s$
• Some exceptions
  – TSET, DSET, and RSD
  – MOVE (can copy 32767 elements / scan)
  – Immediate I/O: Contacts, Coils, IORW
  – RLL PID (Fast Loop)
  – In-Line SF Programs and SF Subroutines
Main RLL

Optimization

- SKP (Skip) and LBL (Label)
  - Can be used to bypass sections of logic and improve scan time
  - Take care because Outputs are not updated and Timers do not run if “skipped”
- Use X, Y or C contacts and coils when possible. Avoid using “bit of word” contacts.
- Monitor Main RLL (Task 1) Peak Execution Time using TPET1 variable to see effects of optimizations
• SF I/O transactions can be large (up to hundreds of bytes)
• Each SF module in the system can do up to 8 transactions per scan
• A high activity SF module (NIM or Ethernet) adds up to 40 ms per scan
• Moderate activity: ~15-20 ms per scan
Optimization

- Move SF modules to Local Base when possible, especially communications modules with high activity.
- If it is not possible to put all SF modules in the Local Base, distribute SF modules evenly among Remote Bases.
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Analog Scan

PID Loops
Analog Alarms
Cyclic SF
Priority SF Programs
Normal SF Programs
RLL SFSUB
RLL SFSUB0
Normal Comm
Priority Comm
Network Comm
Diagnostics
Analog Tasks
Operation

- Each task is guaranteed execution once per scan
- Each task has a user-defined time slice which sets the maximum execution time for that task
- The task runs until all work is completed, or until the time slice expires
- Analog tasks are also executed during “wait time” that occurs in Normal I/O and SF I/O
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Analog Tasks

- PID loops set for cyclic operation, executed in order of priority. SF programs called by loops are also executed here.

- Alarms set for cyclic operation, executed in order of priority. SF Programs called by alarms are also executed here.
2500 Series™ Processor Scan Analog Tasks

- SF Programs set for cyclic operation, executed in order of priority
- Priority SF Programs queued from RLL SFPGM box
- Normal SF programs queued from RLL SFPGM box
2500 Series™ Processor Scan Analog Tasks

- SFSUBs queued from RLL SFSUB box
- SFSUBs queued from RLL SFSUB0 box
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Analog Tasks

- Commands from serial and USB ports which execute over several scans (ie SEARCH commands)
- Commands from serial and USB ports which READ or WRITE data (0.5ms per command)
- Commands from CPU ethernet port (1-2ms per command)
- Memory test, program checksum, front panel, other hardware checks
Analog Tasks
Setting Time Slice

PLC Scan Time

Scan Time
Scan Time Mode: Variable
Scan Time (ms):

Time Slice (ms)
Loop: 34
Analog Alarm: 6
Cyclic SF Program: 4
Priority SF Program: 4
Normal SF Program: 2
Ladder SF Sub: 2
Normal Communication: 2
Priority Communication: 3
Ladder SF Sub Zero (0): 2
Network Communication: 5
Report By Exception:

Accept  Cancel  Close

Reset Peaks
Analog Tasks

Time Slice Optimization

• Programming Reference Guide Ch7

• Basic strategy
  – Reduce analog time slices as much as possible
    • Be sure loops and alarms don’t overrun
    • Be sure SF program execution is satisfactory

• Use STW162 to detect overrunning loops, alarms, SF programs
Analog Tasks

Time Slice Optimization

- Use “PET” variables to view individual peak execution times
  - TPET1, TPET2: RLL execution times
  - APETn, LPETn: Loop / Alarm time from scheduling until execution completes
  - PPETn: SF Programs (queued from RLL) from scheduling until execution completes
  - SPETn: SF Subroutine (queued from RLL) from scheduling until execution completes
PLC Scan Mode Selection

• Variable
  – Fastest PLC Scan
  – Executes each Analog Task once / scan

• Variable with Limit
  – Repeats Analog Task processing (if needed) until Scan Time Limit is reached

• Fixed
  – Use only if fixed I/O update required
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High Priority Interrupts
2500 Series™ Processor
High Priority Interrupts

• Cyclic RLL
  – Separate RLL program (TASK2) that runs periodically based on specified cycle time
  – Extends PLC Scan by the total time used to execute TASK2 logic during each scan.
  – Ideal for performing fixed time updates to critical I/O using Immediate I/O instructions.
  – It is also possible to “starve” processing time for other tasks if run too frequently.
Cyclic RLL

Effect on PLC Scan:
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High Priority Interrupts

• Communications Interrupts
  – Serial port (RS-232/USB) interrupts use minimal processing time (10-20μs)
  – TCP/IP message processing takes ~ 500μs to “run the stack” (validate and extract data).
  – Extends scan time if it occurs during Discrete Scan
  – Reduces time available for Analog Tasks if it occurs during Analog Scan
Communication Interrupts

Effect on Analog Tasks:

2 ms
Other Optimization Guidelines

• Use “Variable” or “Variable with Limit” scan type.

• When fixed-interval I/O update is required, use Immediate I/O instructions in Cyclic RLL task.

• Avoid running Cyclic RLL task more frequently than required. Check execution time (TPET2).

• If using Ethernet connection:
  – Set ‘Network Comm’ time slice at 5ms minimum