CHAPTER 5

GS3 MODBUS COMMUNICATIONS

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Communications Parameters Summary

A summary of the DURApulse GS3 Communications Parameters is listed below. For a complete listing of the DURA GS3 Parameters, refer to Chapter 4.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
</table>
| ♦ P9.02   | Communication Protocol | 00: MODBUS ASCII mode  
7 data bits, no parity, 2 stop bits  
01: MODBUS ASCII mode  
7 data bits, even parity, 1 stop bit  
02: MODBUS ASCII mode  
7 data bits, odd parity, 1 stop bit  
03: MODBUS RTU mode  
8 data bits, no parity, 2 stop bits  
04: MODBUS RTU mode  
8 data bits, even parity, 1 stop bit  
05: MODBUS RTU mode  
8 data bits, odd parity, 1 stop bit | 00 |
| ♦ P9.03   | Transmission Fault Treatment | 00: Display fault and continue operating  
01: Display fault and RAMP to stop  
02: Display fault and COAST to stop  
03: No fault displayed and continue operating | 00 |
| ♦ P9.04   | Time Out Detection | 00: Disable  
01: Enable | 00 |
| ♦ P9.05   | Time Out Duration | 0.1 to 60.0 seconds | 0.5 |
| ♦ P9.07   | Parameter Lock | 00: All parameters can be read and set  
01: All parameters are read-only | 00 |
| ♦ P9.08   | Restore to Default | 09: Restores all parameters to factory defaults | 00 |
| ♦ P9.11   | Block Transfer Parameter 1 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.12   | Block Transfer Parameter 2 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.13   | Block Transfer Parameter 3 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.14   | Block Transfer Parameter 4 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.15   | Block Transfer Parameter 5 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.16   | Block Transfer Parameter 6 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.17   | Block Transfer Parameter 7 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.18   | Block Transfer Parameter 8 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.19   | Block Transfer Parameter 9 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.20   | Block Transfer Parameter 10 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.21   | Block Transfer Parameter 11 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.22   | Block Transfer Parameter 12 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.23   | Block Transfer Parameter 13 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.24   | Block Transfer Parameter 14 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.25   | Block Transfer Parameter 15 | P0.00 to P8.02, P9.99 | P9.99 |
| ♦ P9.26   | Serial Comm (RS485) Speed Reference | 0.0 to 400.0 Hz | 60.0 |
| ♦ P9.27   | Serial Comm RUN Command | 00: Stop  
01: Run | 00 |
| ♦ P9.28   | Serial Comm Direction Command | 00: Forward  
01: Reverse | 00 |
| ♦ P9.29   | Serial Comm External Fault | 00: No fault  
01: External fault | 00 |
| ♦ P9.30   | Serial Comm Fault Reset | 00: No action  
01: Fault Reset | 00 |

Unless otherwise stated, numeric data is in the unsigned decimal data format.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
</table>
| ♦ P9.31  | Serial Comm JOG Command | 00: Stop  
01: Jog | 00 |
| ♦ P9.40  | Parameter Copy | 00: Disable Copy Keypad Function  
01: Enable Copy Keypad Function | 00 |
| ♦ P9.41  | GS Series Number | 01: GS1  
02: GS2  
03: GS3  
04: GS4 | # |
| ♦ P9.42  | Manufacturer Model Information | 00: GS3-21P0 (230V 3ph 1.0hp)  
01: GS3-22P0 (230V 3ph 2.0hp)  
02: GS3-23P0 (230V 3ph 3.0hp)  
03: GS3-25P0 (230V 3ph 5.0hp)  
04: GS3-27P5 (230V 3ph 7.5hp)  
05: GS3-2010 (230V 3ph 10hp)  
06: GS3-2015 (230V 3ph 15hp)  
07: GS3-2020 (230V 3ph 20hp)  
08: GS3-2025 (230V 3ph 25hp)  
09: GS3-2030 (230V 3ph 30hp)  
10: GS3-2040 (230V 3ph 40hp)  
11: GS3-2050 (230V 3ph 50hp)  
12: GS3-41P0 (460V 3ph 1.0hp)  
13: GS3-42P0 (460V 3ph 2.0hp)  
14: GS3-43P0 (460V 3ph 3.0hp)  
15: GS3-45P0 (460V 3ph 5.0hp)  
16: GS3-47P5 (460V 3ph 7.5hp)  
17: GS3-4010 (460V 3ph 10hp)  
18: GS3-4015 (460V 3ph 15hp)  
19: GS3-4020 (460V 3ph 20hp)  
20: GS3-4025 (460V 3ph 25hp)  
21: GS3-4030 (460V 3ph 30hp)  
22: GS3-4040 (460V 3ph 40hp)  
23: GS3-4050 (460V 3ph 50hp)  
24: GS3-4060 (460V 3ph 60hp)  
25: GS3-4075 (460V 3ph 75hp)  
26: GS3-4100 (460V 3ph 100hp) | # |
## DURApulse GS3 Parameter Memory Addresses

The octal address also can be used in the WX/RX instructions of the DL-250-1, DL-450, and DL05.

<table>
<thead>
<tr>
<th>Parameter Memory Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>♦ Parameter can be set during RUN Mode.</td>
</tr>
<tr>
<td>* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.</td>
</tr>
<tr>
<td>** Some parameters are available only in later firmware versions of DURApulse GS3 drives. Refer to “GS3 Parameter Summary” in Chapter 4 (AC Drive Parameters) for more information.</td>
</tr>
</tbody>
</table>

### Motor Parameters

| P0.00 | Motor Nameplate Voltage | 0000 | 40001 | 0 |
| P0.01 | Motor Nameplate Amps | 0001 | 40002 | 1 |
| P0.02 | Motor Base Frequency | 0002 | 40003 | 2 |
| P0.03 | Motor Base RPM | 0003 | 40004 | 3 |
| P0.04 | Motor Maximum RPM | 0004 | 40005 | 4 |
| P0.05 | Motor Auto Tune | 0005 | 40006 | 5 |
| P0.06 | Motor Line to Line Resistance R1 | 0006 | 40007 | 6 |
| P0.07 | Motor No-Load Current | 0007 | 40008 | 7 |

### Ramp Parameters

| P1.00 | Stop Methods | 0100 | 40257 | 400 |
| ♦ P1.01 | Acceleration Time 1 | 0101 | 40258 | 401 |
| ♦ P1.02 | Deceleration Time 1 | 0102 | 40259 | 402 |
| P1.03 | Accel S-curve | 0103 | 40260 | 403 |
| P1.04 | Decel S-curve | 0104 | 40261 | 404 |
| ♦ P1.05 | Acceleration Time 2 | 0105 | 40262 | 405 |
| ♦ P1.06 | Deceleration Time 2 | 0106 | 40263 | 406 |
| P1.07 | Select method to use - 2nd Accel/Decel | 0107 | 40264 | 407 |
| P1.08 | Accel 1 to Accel 2 frequency transition | 0108 | 40265 | 410 |
| P1.09 | Decel 2 to Decel 1 frequency transition | 0109 | 40266 | 411 |
| P1.10 | Skip Frequency 1 | 010A | 40267 | 412 |
| P1.11 | Skip Frequency 2 | 010B | 40268 | 413 |
| P1.12 | Skip Frequency 3 | 010C | 40269 | 414 |
| P1.13 | Skip Frequency 4 | 010D | 40270 | 415 |
| P1.14 | Skip Frequency 5 | 010E | 40271 | 416 |
| P1.17 | Skip Frequency Band | 0111 | 40274 | 421 |
| P1.18 | DC Injection Current Level | 0112 | 40275 | 422 |
| P1.20 | DC Injection during Start-up | 0114 | 40277 | 424 |
| P1.21 | DC Injection during Stopping | 0115 | 40278 | 425 |
| P1.22 | Start-point for DC Injection | 0116 | 40279 | 426 |

### Volts/Hertz Parameters

| P2.00 | Volts/Hertz Settings | 0200 | 40513 | 1000 |
| ♦ P2.01 | Slip Compensation | 0201 | 40514 | 1001 |
| ♦ P2.02 | Auto-torque Boost | 0202 | 40515 | 1002 |
| ♦ P2.03 | Torque Compensation Time Constant | 0203 | 40516 | 1003 |
| P2.04 | Mid-point Frequency | 0204 | 40517 | 1004 |
| P2.05 | Mid-point Voltage | 0205 | 40518 | 1005 |
| P2.06 | Min. Output Frequency | 0206 | 40519 | 1006 |
| P2.07 | Min. Output Voltage | 0207 | 40520 | 1007 |
| P2.08 | PWM Carrier Frequency | 0208 | 40521 | 1010 |
| ♦ P2.09** | Slip Compensation Time Constant | 0209 | 40522 | 1011 |
| P2.10 | Control Mode | 020A | 40523 | 1012 |

* table continued next page
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Digital Parameters

Analog Parameters
### Parameter Memory Addresses (continued from previous page)

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<th>Modbus Decimal *</th>
<th>Octal</th>
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<tr>
<td>♦ P5.00</td>
<td>Jog</td>
<td>0500</td>
<td>41281</td>
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<td>♦ P5.01</td>
<td>Multi-Speed 1</td>
<td>0501</td>
<td>41282</td>
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<td>♦ P5.02</td>
<td>Multi-Speed 2</td>
<td>0502</td>
<td>41283</td>
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<td>♦ P5.03</td>
<td>Multi-Speed 3</td>
<td>0503</td>
<td>41284</td>
<td>2403</td>
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<td>♦ P5.04</td>
<td>Multi-Speed 4</td>
<td>0504</td>
<td>41285</td>
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<td>Multi-Speed 5</td>
<td>0505</td>
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<td>♦ P5.06</td>
<td>Multi-Speed 6</td>
<td>0506</td>
<td>41287</td>
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<td>♦ P5.07</td>
<td>Multi-Speed 7</td>
<td>0507</td>
<td>41288</td>
<td>2407</td>
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<td>♦ P5.08</td>
<td>Multi-Speed 8</td>
<td>0508</td>
<td>41289</td>
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<td>♦ P5.09</td>
<td>Multi-Speed 9</td>
<td>0509</td>
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<td>♦ P5.10</td>
<td>Multi-Speed 10</td>
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<td>Multi-Speed 11</td>
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<td>Multi-Speed 12</td>
<td>050C</td>
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<td>Multi-Speed 13</td>
<td>050D</td>
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<td>Multi-Speed 14</td>
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<td>♦ P5.15</td>
<td>Multi-Speed 15</td>
<td>050F</td>
<td>41296</td>
<td>2417</td>
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</tbody>
</table>

**Preset Parameters**

- ♦ P5.00: Jog
- ♦ P5.01: Multi-Speed 1
- ♦ P5.02: Multi-Speed 2
- ♦ P5.03: Multi-Speed 3
- ♦ P5.04: Multi-Speed 4
- ♦ P5.05: Multi-Speed 5
- ♦ P5.06: Multi-Speed 6
- ♦ P5.07: Multi-Speed 7
- ♦ P5.08: Multi-Speed 8
- ♦ P5.09: Multi-Speed 9
- ♦ P5.10: Multi-Speed 10
- ♦ P5.11: Multi-Speed 11
- ♦ P5.12: Multi-Speed 12
- ♦ P5.13: Multi-Speed 13
- ♦ P5.14: Multi-Speed 14
- ♦ P5.15: Multi-Speed 15

**Protection Parameters**

- P6.00: Electronic Thermal Overload Relay
- P6.01: Auto Restart after Fault
- P6.02: Momentary Power Loss
- P6.03: Reverse Operation Inhibit
- P6.04: Auto Voltage Regulation
- P6.05: Over-Voltage Stall Protection
- P6.06: Auto Adjustable Accel/Decel
- P6.07: Over-Torque Detection Mode
- P6.08: Over-Torque Detection Level
- P6.09: Over-Torque Detection Time
- P6.10: Over-Current Stall Prevention during Acceleration
- P6.11: Over-Current Stall Prevention during Operation
- P6.12: Maximum Allowable Power Loss Time
- P6.13: Base-Block Time for Speed Search
- P6.14: Maximum Speed Search Current Level
- P6.15: Upper Bound of Output Frequency
- P6.16: Lower Bound of Output Frequency
- P6.17: Over-Voltage Stall Prevention Level
- P6.18: Braking Voltage Level
- P6.30**: Line Start Lockout
- P6.31: Present Fault Record
- P6.32: Second Most Recent Fault Record
- P6.33: Third Most Recent Fault Record
- P6.34: Fourth Most Recent Fault Record
- P6.35: Fifth Most Recent Fault Record
- P6.36: Sixth Most Recent Fault Record
- ♦ P6.37**: Hunting Gain

* Parameter can be set during RUN Mode.
* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.
** Some parameters are available only in later firmware versions of DURApulse GS3 drives. Refer to “GS3 Parameter Summary” in Chapter 4 (AC Drive Parameters) for more information.
### Parameter Memory Addresses (continued from previous page)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Hexadecimal</th>
<th>Modbus Decimal *</th>
<th>Octal</th>
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</thead>
<tbody>
<tr>
<td>P7.00</td>
<td>Input Terminal for PID Feedback</td>
<td>0700</td>
<td>41793</td>
<td>3400</td>
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<td>P7.01</td>
<td>PV 100% Value</td>
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<td>3401</td>
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<td>P7.02</td>
<td>PID Setpoint Source</td>
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<td>PID Feedback Gain</td>
<td>0703</td>
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<td>♦ P7.04</td>
<td>PID Setpoint Offset Polarity</td>
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<td>♦ P7.05</td>
<td>PID Setpoint Offset</td>
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<td>♦ P7.06</td>
<td>PID Setpoint Gain</td>
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<td>♦ P7.10</td>
<td>Keypad &amp; Serial PID Setpoint</td>
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<td>♦ P7.12</td>
<td>PID Multi-setpoint 2</td>
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<td>PID Multi-setpoint 3</td>
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<td>PID Multi-setpoint 6</td>
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<td>PID Multi-setpoint 7</td>
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<td>Proportional Control</td>
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<td>Integral Control</td>
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<td>Upper Bound for Integral Control</td>
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<td>Derivative Filter Time Constant</td>
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<td>Feedback Signal Detection Time</td>
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<td>PID Feedback Loss</td>
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<td>PID Feedback Loss Preset Speed</td>
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#### PID Parameters

- Parameter can be set during RUN Mode.
- For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.
- Some parameters are available only in later firmware versions of DURApulse GS3 drives. Refer to “GS3 Parameter Summary” in Chapter 4 (AC Drive Parameters) for more information.

#### Display Parameters

- ♦ P8.00 User Defined Display Function
- ♦ P8.01 Frequency Scale Factor
- ♦ P8.02 Backlight Timer

*Parameter Memory Addresses (continued from previous page)*

---

* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.

**Some parameters are available only in later firmware versions of DURApulse GS3 drives. Refer to “GS3 Parameter Summary” in Chapter 4 (AC Drive Parameters) for more information.*
### Parameter Memory Addresses (continued from previous page)

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Octal</th>
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#### Communications Parameters

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#### Encoder Feedback Parameters

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<th>Octal</th>
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<td>Encoder Pulse per Revolution</td>
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<td>5000</td>
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<td>Proportional Control</td>
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DURApulse GS3 Status Addresses

The DURApulse GS3 AC drive has status memory addresses that are used to monitor the AC drive. The status addresses and value definitions are listed below.

**Status Addresses (Read Only)**

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<tr>
<th>Description</th>
<th>Hexadecimal</th>
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<td>Status Monitor 2</td>
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<td>Frequency Command F</td>
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<td>Output Current A</td>
<td>h2104</td>
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<td>DC Bus Voltage d</td>
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<td>48454</td>
<td>20405</td>
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<tr>
<td>Output Voltage U</td>
<td>h2106</td>
<td>48455</td>
<td>20406</td>
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<tr>
<td>Motor RPM</td>
<td>h2107</td>
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<td>Scale Frequency (Low Word)</td>
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<td>48457</td>
<td>20408</td>
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<tr>
<td>Scale Frequency (High Word)</td>
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<td>48458</td>
<td>20409</td>
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<tr>
<td>Power Factor Angle</td>
<td>h210A</td>
<td>48459</td>
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<tr>
<td>% Load</td>
<td>h210B</td>
<td>48460</td>
<td>20411</td>
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<tr>
<td>PID Setpoint</td>
<td>h210C</td>
<td>48461</td>
<td>20412</td>
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<td>PID Feedback Signal (PV)</td>
<td>h210D</td>
<td>48462</td>
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<tr>
<td>Firmware Version</td>
<td>h2110</td>
<td>48465</td>
<td>20414</td>
</tr>
</tbody>
</table>

**Status Monitor 1**

*Error Codes:*

00: No fault occurred  
01: Over-current (oc)  
02: Over-voltage (ov)  
03: Overheat (oH)  
04: Overload (oL)  
05: Over-torque (oL2)  
06: Over-torque (oL1)  
07: External Fault (EF)  
08: CPU Failure 1 (cF1)  
09: CPU Failure 2 (cF2)  
10: CPU Failure 3 (cF3)  
11: Hardware Protection Failure (HPF)  
12: Over-current during accel (ocA)  
13: Over-current during decel (ocd)  
14: Over-current during steady state (ocn)  
15: Ground Fault or Fuse Failure (GFF)  
16: Low Voltage (Lv)  
17: Input Power 3-phase Loss (PHL)  
18: External Base-Block (bb)  
19: Auto Adjust accel/decel Failure (cFA)  
20: Software Protection Code (codE)  
21: PID Feedback Loss (FbE)  
22: Encoder Feedback Loss (ENCODER LOSS)  
23: Output Shorted (occ)  
24: Momentary Power Loss (MOM POWER LOSS)

Some error codes will not display under status address if only a warning message. The drive must have a hard trip. To manually check this, set “External Fault” to Terminal Control, and trip. This will simulate the result of a hard trip.
## Status Monitor 2 - Memory Address h2101

<table>
<thead>
<tr>
<th>Address Bit(s)</th>
<th>Bit(s) Value Binary (Decimal)</th>
<th>AC Drive Status</th>
</tr>
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<tbody>
<tr>
<td>0 and 1</td>
<td>00 (0)</td>
<td><em>(Stop state): driver Stop command state; drive has no output.</em></td>
</tr>
<tr>
<td></td>
<td>01 (1)</td>
<td><em>(Stopping): driver Stop command state and frequency deceleration (by Stop methods set Ramp stop mode); drive has an output.</em></td>
</tr>
<tr>
<td></td>
<td>10 (2)</td>
<td><em>(Standby state): driver Run command state and frequency command is 0 Hz; drive has no output.</em></td>
</tr>
<tr>
<td></td>
<td>11 (3)</td>
<td><em>(Running): driver Run command state and the frequency command is not zero; drive has an output.</em></td>
</tr>
<tr>
<td>2</td>
<td>1 (4)</td>
<td>JOG active</td>
</tr>
<tr>
<td>3 and 4</td>
<td>00 (0)</td>
<td>Rotational direction forward (FWD)</td>
</tr>
<tr>
<td></td>
<td>01 (8)</td>
<td>REV to FWD transition</td>
</tr>
<tr>
<td></td>
<td>10 (16)</td>
<td>FWD to REV transition</td>
</tr>
<tr>
<td></td>
<td>11 (24)</td>
<td>Rotational direction reverse (REV)</td>
</tr>
<tr>
<td>5 ~ 7</td>
<td>N/A</td>
<td>Reserved</td>
</tr>
<tr>
<td>8</td>
<td>1 (256)</td>
<td>Source of frequency determined by serial comm interface (P4.00 = 5)</td>
</tr>
<tr>
<td>9</td>
<td>1 (512)</td>
<td>Source of frequency determined by Al terminal (P4.00 = 2, 3, 4 or 6)</td>
</tr>
<tr>
<td>10</td>
<td>1 (1024)</td>
<td>Source of operation determined by serial comm interface (P3.00 = 3 or 4)</td>
</tr>
<tr>
<td>11</td>
<td>1 (2048)</td>
<td>Parameters have been locked (P9.07 = 1)</td>
</tr>
<tr>
<td>12</td>
<td>N/A</td>
<td>Copy command eable</td>
</tr>
</tbody>
</table>

### Frequency Command F (XXX.X)
Status location for the frequency setting of the AC drive.

### Output Frequency H (XXX.X)
Status location for the actual operating frequency present at the T1, T2, and T3 terminal.

### Output Current A
Status location for the output current present at the T1, T2, and T3 terminals.

### DC-BUS Voltage d (XXX.X)
Status location for the DC Bus Voltage.
<table>
<thead>
<tr>
<th>Status Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>h2106</td>
<td>Output Voltage U (XXX.X) Status location for the output voltage present at the T1, T2, and T3 terminals.</td>
</tr>
<tr>
<td>h2107</td>
<td>Motor RPM Status location for the present estimated speed of the motor.</td>
</tr>
<tr>
<td>h2108</td>
<td>Scale Frequency (Low Word) Status location for result of output frequency x P 8.01 (low word).</td>
</tr>
<tr>
<td>h2109</td>
<td>Scale Frequency (High Word) Status location for result of output frequency x P 8.01 (high word).</td>
</tr>
<tr>
<td>h210A</td>
<td>Power Factor Angle Status location for the power factor angle.</td>
</tr>
<tr>
<td>h210B</td>
<td>% Load Status location for the amount of load on the AC drive. (Output Current ÷ Drive Rated Current) x 100.</td>
</tr>
<tr>
<td>h210C</td>
<td>PID Setpoint Status location for the PID setpoint.</td>
</tr>
<tr>
<td>h210D</td>
<td>PID Feedback Signal (Process Variable) Status location for PID process variable feedback signal.</td>
</tr>
<tr>
<td>h2110</td>
<td>Firmware Version Status location for the firmware version of the AC drive.</td>
</tr>
</tbody>
</table>
Chapter 5: GS3 Modbus Communications

Communicating with AutomationDirect PLCs

The following steps explain how to connect and communicate with the DURA GS3 AC drives using AutomationDirect PLCs.

GS3 drives have a provision for shutting down control or power to the inverter in the event of a communications time out. This feature can be set up through parameters P9.03, P9.04, and P9.05.

Step 1: Choose the Appropriate CPU

The GS3 AC drives will communicate with the following AutomationDirect PLCs using Modbus communications.

- Modbus control is easier to accomplish from a DirectLOGIC PLC with an RS-485 port and MRX/MWX, or from a CLICK PLC using Send/Receive instructions.

<table>
<thead>
<tr>
<th>Choose Your CPU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Choices</strong></td>
</tr>
<tr>
<td>CLICK Analog CPU with Send/Receive instructions &amp; RS-485 comm port</td>
</tr>
<tr>
<td>D2-260 or DL06 with MRX / MWX instructions &amp; RS-485 comm port</td>
</tr>
<tr>
<td><strong>Secondary Choices</strong></td>
</tr>
<tr>
<td>CLICK Basic CPU with Send/Receive instructions &amp; RS-232 comm port</td>
</tr>
<tr>
<td>DL05, D2-250(-1), or D4-450 with RX / WX instructions &amp; RS-232 comm port</td>
</tr>
</tbody>
</table>

Step 2: Make the Connections

**GS3 RS-485 Serial Comm Port**

The GS3 Comm Port requires an RS-485 input. RS-232 signals can be converted to RS-485 by using a separate converter.

<p>| PLC Connections for RS-485 Modbus RTU Control of DURAPULSE GS3 AC Drive |
|-----------------------------|-----------------------------|-----------------------------|----------------------------|-----------------------------|</p>
<table>
<thead>
<tr>
<th>Drive</th>
<th>PLC *</th>
<th>PLC Port *</th>
<th>Communication</th>
<th>Direct Cable</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLICK</td>
<td>3</td>
<td>RS-485</td>
<td>ZL-RJ12-CBL-2P</td>
<td><strong>2m [6.6 ft]</strong>*</td>
<td>***</td>
</tr>
<tr>
<td>DL05</td>
<td>2 **</td>
<td>RS-232 – RS-485 **</td>
<td>N/A **</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>DL06</td>
<td>D0-DCM</td>
<td>2</td>
<td>RS-485</td>
<td>GS-485HD15-CBL-2 ***</td>
<td><strong>2m [6.6 ft]</strong>*</td>
</tr>
<tr>
<td>D2-DCM</td>
<td>D2-250(-1)</td>
<td>2 **</td>
<td>RS-232 – RS-485 **</td>
<td>N/A **</td>
<td>**</td>
</tr>
<tr>
<td>D2-260</td>
<td>2 **</td>
<td>RS-485</td>
<td>GS-485HD15-CBL-2 ***</td>
<td><strong>2m [6.6 ft]</strong>*</td>
<td>***</td>
</tr>
<tr>
<td>D4-450</td>
<td>3 **</td>
<td>RS-232 – RS-485 **</td>
<td>N/A **</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

* If a PLC type or port is not listed in this chart, it cannot function as a Modbus RTU master.
** Requires RS-232–RS-485 converter & generic cabling options described later in this chapter.
*** Termination resistors not required due to short cable length.
RS-485 Connections For Multiple Drives

ZIPLink™ RS-485 communication boards (ZL-CDM-RJ12X4 or ZL-CDM-RJ12X10) provide an easy means to break out the RS-485 signal to several drives at one location, which creates a star configuration. However, the transmission errors are negligible, so this configuration is acceptable for proper operation of the VFDs.

RS-485 Direct Connections

- Termination Resistors are required on both ends of RS-485 networks; especially on long runs. Select resistors that match the impedance rating of the cable (between 100 and 500Ω).

- Recommended RS-485 cable: Belden 9842 or equivalent.

**NOTE:**

(2) ZL-RJ12-CBL-2P cables can be used for distances of 2m (6.6ft) or less.
Chapter 5: GS3 Modbus Communications

**RS-232C to RS-485 Conversion**

An RS-485 network cable can span up to 1000 meters (4000 feet). However, many AutomationDirect PLCs have only RS-232C communication ports, and require an FA-ISOCON (RS-232C to RS-422/485 network adapter) in order to make an RS-485 connection.

If an FA-ISOCON module is used, set the module dipswitches as required. Refer to the FA-ISOCON manual for more detailed information.

- **S21~S23** OFF, ON, ON (19200 baud)
- **S24~S27** OFF (Automatic Network Transmit Enable)
- **Terminate** ON (End of Run Termination Resistors)
- **Bias** ON (End of Run Bias Resistors)
- **1/2 DPX (2)** ON (RS-485 TXD/RXD Jumpers)

**FA-ISOCON RJ-12 Serial Comm Port A RS-232 Input Port**

1: Signal Ground
2: CTS (input)
3: RXD (input)
4: TXD (output)
5: +5VDC in
6: Signal Ground

Recommended cable for RS-232: Belden 8102 or equivalent.
Recommended cable for RS-485: Belden 9842 or equivalent.
Various pre-terminated cables for specific wiring connections are available from AutomationDirect, as listed in applicable individual wiring sections of this chapter.
RS-232C to RS-485 Conversion (continued)

Use the following wiring diagrams to connect DirectLOGIC RS-232C PLCs to a DURA GS3 AC drive with an FA-ISOCON network adapter module:

**DL05: RS-232C to RS-485 Connection Wiring**

![Wiring Diagram](image)

**Cable D0-DSCBL (12ft; 3.7m) is available for connecting the DL05 to the FA-ISOCON. For a single run to only one AC Drive, cable GS-ISOCON-CBL-2 (2m; 6.6ft) is available for directly connecting the FA-ISOCON to the GS3 Com Port.**

**A cable that will connect the D0-DCM or DL250(-1) to the FA-ISOCON can be constructed using the FA-15HD adapter and the D0-CBL cable. A cable can also be constructed using the FA-15HD adapter and RJ12-6P6C cable from the FA-CABKIT.**
**Chapter 5: GS3 Modbus Communications**

---

**Ethernet Connection using GS-EDRV(100)**

The GS-EDRV(100) provides a high-performance Ethernet link between a control system and a GS3 AC drive. It mounts on DIN rail and connects a drive to an Ethernet hub/switch or PC. The GS-EDRV(100) processes signals to and from the drive. It formats the signals to conform with the Ethernet standard to the H2-ERM(100) or H4-ERM(100), KEPdirect EBC I/O server, or independent controller with a MODBUS TCP/IP driver. This Ethernet interface allows for great connectivity to many control system architectures. An additional feature is the built-in web browser which allows users to configure and control the drive from any web browser via the IP address of the GS-EDRV(100) card.

**Step 3: Set AC Drive Parameters**

The following parameters need to be set as shown in order to communicate properly.

- **P3.00**: 03 or 04  
  Operation Determined by RS-485 interface.  
  Keypad STOP is enabled (03) or disabled (04).

- **P4.00**: 05  
  Frequency determined by RS-485 communication interface.

- **P9.00**: xx  
  Communication address 1-254  
  (unique for each device, see P9.00).

- **P9.01**: 01  
  9600 baud data transmission speed  
  (higher baud rate setting may be required with  
  FA-ISOCON network adapter; set adapter DIP switches accordingly).

- **P9.02**: 05  
  MODBUS RTU mode  
  <8 data bits, odd parity, 1 stop bit>.

This list of parameter settings is the minimum required to communicate with a DirectLOGIC PLC. There may be other parameters that need to be set to meet the needs of your particular application.

**Step 4: Configure the PLC CPU**

The PLC CPUs must be configured to communicate with the DURApulse AC drives. This configuration includes setting up the communication port and adding instructions to your logic program.  

The set up for all of the AutomationDirect PLC CPUs is very similar, although there are some subtle differences between CPUs. Refer to the appropriate CPU User Manual for the specifics on your specific PLC CPU if more details are needed.

For instructions on Modbus Configuration for your specific PLC CPU, refer to the appropriate PLC User Manual.
Configure the CLICK PLC

Configure the CLICK CPU communication port before writing communication instructions into your logic program.

For more detailed instructions on Modbus Configuration for your CLICK, refer to the CLICK PLC Hardware User Manual, C0-USER-M, or to the CLICK software help file.

CLICK Port 3 MODBUS Configuration for RS-485

The following configuration example is specific for CLICK PLC CPUs.

• Configure the communication port before writing communication instructions into the logic program.
• In CLICK programming software, open the “Comm Port Setup Details” dialog box by choosing the Setup menu, then Comm Port Setup, then Port 2 Setup.
• From the “Port” list box, choose “Port 3.”
• For the “Protocol” list box, select “Modbus.”
• Set the “Node Address” to “1” to make the CLICK PLC a MODBUS master.
• Set the “Baud Rate” to “19200.”
• Set the “Parity” to “Odd.”
• Set the “Stop Bit” to “1.”
• Set the “Time-out Setting” to “500ms.”
• Set the “Response Delay Time” to “0ms.”

The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.
Chapter 5: GS3 Modbus Communications

**Configure the DirectLOGIC CPUs**

DirectLOGIC MODBUS Port Configuration for D2-260 and DL06

The following configuration example is specific to the D2-260 and DL06. Refer to the appropriate CPU User Manual for the specifics on your DirectLOGIC CPU.

- In DirectSOFT, choose the PLC menu, then Setup, then “Secondary Comm Port.”
- From the Port number list box at the top, choose “Port 2.”
- For the Protocol, select “MODBUS.”
- Response Delay Time should be “0ms.” Both RTS on and off delay times must be set to 0ms.
- The Station Number should be set to “1” to make the D2-260 or DL06 CPU a MODBUS master.
- The Baud Rate should be set at “9600” (or higher, if using an FA-ISOCON network adapter module).
- In the Stop Bits list box, Choose “1.”
- In the Parity list box, choose “Odd.”
Configure the DirectLOGIC CPUs (continued)

DirectLOGIC MODBUS Port Configuration for DL05, D2-250(-1), or D4-450

The following configuration example is specific to the D2-250(-1) and DL05. Refer to the appropriate CPU User Manual for the specifics on your DirectLogic CPU.

- In DirectSOFT, choose the PLC menu, then Setup, then "Secondary Comm Port."
- From the Port list box, choose "Port 2."
- For the Protocol, select "MODBUS."
- In the Timeout list box, select "800 ms."
- Response Delay Time should be "0ms."
- The Station Number should be set to "1" to make the D2-250(-1) or DL05 CPU a MODBUS Master.
- The Baud Rate should be set at "9600" (or higher, if using an FA-ISOCON network adapter module).
- In the Stop Bits list box, choose "1."
- In the Parity list box, choose "Odd."

The DL250 network instructions used in Master mode will access only slaves 1 to 90. Each slave must have a unique number.
CLICK Modbus Ladder Programming

The setup for all of the CLICK CPUs is very similar. However, there may be some subtle differences between CPUs, or for the requirements of your particular program. Refer to the CLICK programming software internal help file for more information regarding CLICK programming.

The following ladder program shows some examples of how to control the GS3 AC drive through Modbus RTU. The drive should be set up and tested for communications before it is connected to a load.

**Warning:** A drive should never be connected to a load until any applicable communication programs have been proven.

**Warning:** Write programs in such a way that the program does not erroneously overwrite a remote Stop command with a Run command, such as when P3.00 is set to 03. This example program prevents such an accidental overwrite.

These programs are for illustrational purposes only, and are not intended for a true application.

Separate Run Command Write Instruction

Why do we write the Run Command with a separate write instruction? If we write the Run Command to the drive along with the Speed Reference, Direction, External Fault, and Fault Reset Commands, we can keep the parameter addresses in sequence, and we can update all five of the commands with one write instruction. This method is valid only if we disable the drive’s keypad STOP button (P3.00 = 04). Typically, the keypad STOP button will be enabled (P3.00 = 03), and we need to prevent a change in one of the other commands from overriding a keypad Stop Command by causing a previous Run Command to be rewritten to the drive. By using a separate Run Command write instruction, only a deliberate Run Command change by the program will run the drive again after a stop.

Block Transfer Parameters for Modbus Programs

For writing to any of the parameters from P0.00 to P8.02, a group of 15 block transfer parameters (P9.11 to P9.25) is available in the GS3 AC drive. This sequential block of parameters can be used to “group” various miscellaneous non-sequential parameters, so that you can update the parameters in one programming write block instead of having to use multiple write commands.

For example, it would typically take three different write commands to change the three non-sequential parameters Accel Time 1 (P1.01), Accel S-curve (P1.03), and Multi-speed 1 (P5.01). However, you could make the same three changes using one write command by setting P9.11 to P1.01, P9.12 to P1.03, and P9.13 to P5.01, so that the parameters become sequential.
CLICK Communication Program — (for CLICK PLCs)

This program is for illustrational purposes only, and is not intended for a true application.

CLICK PLC Program Example

This rung counts the number of times the PLC attempts to communicate with the drives.

1. _Port_3_Ready_Flag
   - SC102
   - _Port_3_Ready_Flag
   - SC102
   - Up
   - CT1
   - SetPoint
   - CT1
   - Complete
   - Current
   - CTD1
   - Current
   - CTD1
   - Reset

This rung counts the number of comm attempts that failed.

2. _Port_3_Error_Flag
   - SC103
   - _Port_3_Error_Flag
   - SC103
   - Up
   - CT2
   - SetPoint
   - CT2
   - Complete
   - Current
   - CTD2
   - Current
   - CTD2
   - Reset
   - Read Drive #1 Error
   - C202
   - Read Drive #2 Error
   - C205

This rung acts as an alternator, allowing the following logic to alternate between Drive #1 and Drive #2. If there were additional drives, the Setpoint for the counter would simply be increased to match the number of drives.

3. _Port_3_Ready_Flag
   - SC102
   - _Port_3_Ready_Flag
   - SC102
   - Up
   - CT3
   - SetPoint
   - CT3
   - Complete
   - Current
   - CTD3
   - Current
   - CTD3
   - Reset
   - (Coordinates the Receive boxes, so they toggle back and forth.)

Comm Interlock Counter
- CT3

(PLC program continued on next page)
This rung checks to see if it is time to communicate to Drive #1, and also if there are no current Write requests to that drive. If not, it reads data from Drive #1.

Port 3 Ready Flag

Drive #1 Direction, Fault, Reset, Write-Enable

Drive #1 Speed Ref Write-Enable

Receive (Port 3)

MODBUS
Slave ID 1
Modbus Function Code 03
Slave Addr 408449
NO. of Master Addresses 12
Word Swap OFF

Status from Drive #1

Master

DS1

Read Drive #1

Success

Error

ErrC...

This rung checks to see if it is time to communicate to Drive #2, and also if there are no current Write requests to that drive. If not, it reads data from Drive #2.

Port 3 Ready Flag

Drive #2 Speed Ref Write Enable

Receive (Port 3)

MODBUS
Slave ID 2
Modbus Function Code 03
Slave Addr 408449
NO. of Master Addresses 12
Word Swap OFF

Status from Drive #2

Master

DS20

Read Drive #2

Success

Error

ErrC...

(PLC program continued on next page)
This rung resets all the Receive status coils if either comm event is successful.

Read Drive #1 Success

Read Drive #2 Success

** The following rungs are used for Drive #1 communications, through rung #27 **

Status from Drive #1

Drive #1 Fault

Drive #1 Fault Indication

Drive #1 Overload

Drive #1 Overload Indicator

This rung determines if the Speed, Direction, Ext Fault, or Fault Reset words have changed and need to be written.

Drive #1 Speed Ref New

Drive #1 Speed Ref Retain

Drive #1 Speed Ref Write Enable

Drive #1 Direction New

Drive #1 Direction Retain

Drive #1 Run CMD Write Enable

Drive #1 Ext Fault New

Drive #1 Ext Fault Retain

Drive #1 Fault Reset New

Drive #1 Fault Reset Retain

( PLC program continued on next page )
This rung writes the new Speed Reference if it changes.

Port_3_Ready_Flag       Drive #1 Speed Ref Write Enable

Drive #1 Direction, Fault, Reset Write-Enable

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed Ref New

Master

Sending Error
Success

Error
ErrC.

Send(Port3)
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed Ref New

Master

Sending Error
Success

Error
ErrC.

Send(Port3)
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction, Fault, Reset writes finished

( PLC program continued on next page )

This rung writes the Direction, Ext Fault, and Fault Reset words if any of them changes.

Port_3_Ready_Flag       Drive #1 Speed Ref Write Enable

Drive #1 Direction, Fault, Reset Write-Enable

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.

Send(Port3) MODBUS
Slave ID 1
Modbus Function Code 06
Slave Addr 40231

Drive #1 Speed, Direction New

Master

Sending Error
Success

Error
ErrC.
This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.

Drive #1 Speed Ref Write Enable  
\[ \text{C10} \]

Drive #1 Direction, Fault, Reset Write-Enable  
\[ \text{C11} \]

Copy  
Single

Src  
Drive #1 Speed Ref New  
\[ \text{DS300} \]

Des  
Drive #1 Speed Ref Retain  
\[ \text{DS310} \]

Copy  
Single

Src  
Drive #1 Direction New  
\[ \text{DS302} \]

Des  
Drive #1 Direction Retain  
\[ \text{DS312} \]

Copy  
Single

Src  
Drive #1 Ext Fault New  
\[ \text{DS303} \]

Des  
Drive #1 Ext Fault Retain  
\[ \text{DS313} \]

Copy  
Single

Src  
Drive #1 Fault Reset New  
\[ \text{DS304} \]

Des  
Drive #1 Fault Reset Retain  
\[ \text{DS314} \]

Drive #1 Speed Ref Write Enable  
\[ \text{C10} \]

Drive #1 Direction, Fault, Reset Write Enable  
\[ \text{C11} \]

Drive #1 Speed Direction, Fault, Reset writes finished  
\[ \text{C13} \]
Rungs 15 & 16 write to the Run Command word if it changes.

Drive #1 Run CMD New \( \downarrow \) DS301

Drive #1 Run CMD Retain \( \uparrow \) DS311

Drive #1 Speed Ref Write Enable \( \square \) C10

Drive #1 Run CMD Write-Enable \( \checkmark \) C12

Drive #1 Speed Ref Write-Enable \( \checkmark \) C12

\_Port_3\_Ready\_Flag \( \downarrow \) SC102

Drive #1 Run CMD Write-Enable \( \checkmark \) C12

( PLC program continued on next page )
Chapter 5: GS3 Modbus Communications

This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.

Drive #1 Run CMD Write-Enable  Drive #1 Run CMD Write finished

Rungs 18 & 19 select either 30Hz or 60Hz based on C102.

Drive #1 Speed Control 60/30 Hz

Rungs 20 & 21 select Run or Stop based on C103.

Drive #1 Run Stop

(PLC program continued on next page)
Rungs 22 & 23 select Direction based on C104.

Drive #1 Fwd Rev

- Rung 22:
  - Copy: Single
  - Src: 1
  - Des: Drive #1 Direction New
  - DS302

- Rung 23:
  - Copy: Single
  - Src: 0
  - Des: Drive #1 Direction New
  - DS302

Rungs 24 & 25 select Ext Fault or no fault based on C105.

Drive #1 Fault

- Rung 24:
  - Copy: Single
  - Src: 1
  - Des: Drive #1 Ext Fault New
  - DS303

- Rung 25:
  - Copy: Single
  - Src: 0
  - Des: Drive #1 Ext Fault New
  - DS303

Rungs 26 & 27 select Fault Reset or no reset based on C106.

Drive #1 Ext Fault Reset

- Rung 26:
  - Copy: Single
  - Src: 1
  - Des: Drive #1 Fault Reset New
  - DS304

- Rung 27:
  - Copy: Single
  - Src: 0
  - Des: Drive #1 Fault Reset New
  - DS304

(PLC program continued on next page)
** The remaining rungs are for Drive #2 communications. **

Status from Drive #2

Drive #2 Fault Indication

Status from Drive #2

Drive #2 Overload Indicator

This rung determines if the Speed, Direction, Ext Fault, or Fault Reset words have changed and need to be written.

Drive #2 Speed Ref New

Drive #2 Speed Ref Retain

Drive #2 Speed Ref Write Enable

Drive #2 Run CMD Write Enable

Drive #2 Speed Ref Write Enable

(PLC program continued on next page)
This rung writes the new Speed Reference if it changes.

Drive #2 Speed Ref Write Enable

Drive #2 Direction, Fault, Reset, Write Enable

Send(Port3) MODBUS
Slave ID 2
Modbus Function Code 06
Slave Addr 402331

Sending Success Error ErrC...

Drive #2 Speed Ref New

Master

This rung writes the Direction, Ext Fault, and Fault Reset words if any of them changes.

Drive #2 Direction, Fault, Reset, Write Enable

Send(Port3) MODBUS
Slave ID 2
Modbus Function Code 16
Slave Addr 402333
NO. of Master Addresses 3
Word Swap OFF

Sending Success Error ErrC...

Drive #2 Direction New

Master

Drive #2 Speed, Direction, Fault, Reset, writes finished

(PLC program continued on next page)
This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.

Drive #2 Speed Ref Write Enable

Drive #2 Direction, Fault, Reset, Write-Enable

Drive #2 Speed, Direction, Fault, Reset, writes finished

This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.
Rungs 36 & 37 write to the Run Command word if it changes.

This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.
(CLICK PLC program continued from previous page)

Rungs 39 & 40 select either 30Hz or 60Hz based on C109.

<table>
<thead>
<tr>
<th>39</th>
<th>Drive #2 Speed Control 60/30 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B C109</td>
</tr>
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<table>
<thead>
<tr>
<th>40</th>
<th>Drive #2 Speed Control 60/30 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B C109</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>41</th>
<th>Drive #2 Run Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B C110</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>42</th>
<th>Drive #2 Run Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B C110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>43</th>
<th>Drive #2 Fwd Rev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B C111</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>44</th>
<th>Drive #2 Fwd Rev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B C111</td>
</tr>
</tbody>
</table>

(PLC program continued on next page)
(CLICK PLC program continued from previous page)

Rungs 45 & 46 select Ext Fault or no fault based on C112.

Drive #2 Fault

<table>
<thead>
<tr>
<th>Copy</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Src</td>
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</table>

Drive #2 Ext Fault New

<table>
<thead>
<tr>
<th>Des</th>
<th>DS323</th>
</tr>
</thead>
</table>

Rungs 47 & 48 select Fault Reset or no reset based on C113.

Drive #2 Ext Fault Reset

<table>
<thead>
<tr>
<th>Copy</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Src</td>
<td>1</td>
</tr>
</tbody>
</table>

Drive #2 Fault Reset New

<table>
<thead>
<tr>
<th>Des</th>
<th>DS324</th>
</tr>
</thead>
</table>

Drive #2 Ext Fault Reset

<table>
<thead>
<tr>
<th>Copy</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Src</td>
<td>0</td>
</tr>
</tbody>
</table>

Drive #2 Fault Reset New

<table>
<thead>
<tr>
<th>Des</th>
<th>DS324</th>
</tr>
</thead>
</table>

END

46

47

48

49
DirectLOGIC Modbus Ladder Programming

The set up for all of the DirectLogic CPUs is very similar. However, there may be some subtle differences between CPUs. Refer to the appropriate CPU User Manual for the specifics on your DirectLogic CPU.

The following ladder program shows some examples of how to control the DURApulse GS3 AC drive through Modbus RTU. The drive should be setup and tested for communications before it is connected to a load.

**WARNING:** A drive should never be connected to a load until any applicable communication programs have been proven.

**WARNING:** Write programs in such a way that the program does not erroneously overwrite a remote STOP command with a Run command, such as when P3.00 is set to 03. This example program prevents such an accidental overwrite.

These programs are for illustrational purposes only, and are not intended for a true application.

Separate Run Command Write Instruction

Why do we write the Run Command with a separate write instruction? If we write the Run Command to the drive along with the Speed Reference, Direction, External Fault, and Fault Reset Commands, we can keep the parameter addresses in sequence, and we can update all five of the commands with one write instruction. This method is valid only if we disable the drive’s keypad STOP button (P3.00 = 04).

Typically, the keypad STOP button will be enabled (P3.00 = 03), and we need to prevent a change in one of the other commands from overriding a keypad Stop Command by causing a previous Run Command to be rewritten to the drive. By using a separate Run Command write instruction, only a deliberate Run Command change by the program will run the drive again after a stop.

Block Transfer Parameters for Modbus Programs

For writing to any of the parameters from P0.00 to P8.02, a group of 15 block transfer parameters (P9.11 to P9.25) is available in the GS3 AC drive. This sequential block of parameters can be used to “group” various miscellaneous non-sequential parameters, so that you can update the parameters in one programming write block instead of having to use multiple write commands.

For example, it would typically take three different write commands to change the three non-sequential parameters Accel Time 1 (P1.01), Accel S-curve (P1.03), and Multi-speed 1 (P5.01). However, you could make the same three changes using one write command by setting P9.11 to P1.01, P9.12 to P1.03, and P9.13 to P5.01, so that the parameters become sequential.
**DirectLOGIC Basic Communication Program – start with this code**

We recommend starting with the following program code, and using it to test communication to each of your drives before adding more advanced code for your application.

To target different drives, change the value Kf201 to Kf202 for slave 2, Kf203 for slave 3, etc.

*This program is for illustrational purposes only, and is not intended for a true application.*

---

**DirectLOGIC Basic Communication Program Example – start with this code**

1. This rung counts the number of times the PLC attempts to communicate to the drive.
   - SP116
   - CT0
   - K9999

2. This rung counts the number of times an attempted communication to the drive fails.
   - SP117
   - CT1
   - K9999

3. This rung reads the ‘Status Addresses’ information from the drive.
   - Use this code to test communication to each of your drives before writing more advanced code that polls multiple drives. To target different drives, change the value ‘Kf201’ to ‘Kf202’ for slave 2, ‘Kf203’ for slave 3, etc.
   - SP116
   - LD
   - Kf201
   - LD
   - K30
   - LDA
   - O2000
   - RX
   - V20400

4. (END)

---

**SP116 is a special relay in the DirectLOGIC CPUs that monitors the PLC’s communications. SP116 is on when Port 2 is communicating with another device.**

**SP117 is a special relay in the DirectLOGIC CPUs that monitors the PLC’s communications. SP117 is on when Port 2 has encountered a communication error.**
Programming Differences for DirectLOGIC PLCs

Different types of DirectLOGIC PLCs can be programmed differently, depending upon the types of network read and write instructions they can perform. There are two different types of these instructions, and this User Manual shows programming examples of both types.

RX/WX Instructions for DL05, D2-250(-1), D4-450

PLCs with DL05, D2-250, D2-250-1, and D4-450 CPUs can read from and write to networks using RX (Read from Network) and WX (Write to Network) programming instructions.

MRX/MWX Instructions for DL06, D2-260

In addition to the RX and WX instructions listed above, PLCs with DL06 and D2-260 CPUs can also read from and write to networks using MRX (Modbus Read from Network) and MWX (Modbus Write to Network) programming instructions.

The MRX and MWX instructions are simpler and easier to use than are the RX and WX instructions. Therefore, we recommend that you use DL06 or D2-260 with MRX and MWX instructions if you have a choice.
DL MRX/MWX Communication Program – for DL06 & D2-260 PLCs

This program is for illustrational purposes only, and is not intended for a true application.

DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs

This rung counts the number of times the PLC attempts to communicate to the drive.

Port Busy
SP116

CT0

K9999

This rung counts the number of times an attempted communication to the drive fails.

Port Comm Fail
SP117

CT1

K9999

This rung acts as an alternator, allowing the following logic to alternate between communicating to slave 1 or slave 2. If there were additional slaves, the “K” number for the counter would simply be increased to match the number of slaves in the system.

Port Busy
SP116

CT2

K2

This rung checks to see if it is time to communicate to slave 1, and also if there are no current write requests to that drive. If not, it reads data from slave 1.

Port Busy
SP116

CTA2

K0

C10

Drive #1
Speed Ref
Write Enable

C11

C12

Drive #1
Direction, Fault, Reset
Write Enable

Drive #1
Run CMD
Write Enable

MRX

CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K1
Function Code: 03 - Read Holding Registers
Start Slave Memory Address: K48449
Start Master Memory Address: V2000
Number of Elements: K15
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5000

This rung checks to see if it is time to communicate to slave 2, and also if there are no current write requests to that drive. If not, it reads data from slave 2.

Port Busy
SP116

CTA2

K1

C40

Drive #2
Speed Ref
Write Enable

C41

C42

Drive #2
Direction, Fault, Reset
Write Enable

Drive #2
Run CMD
Write Enable

MRX

CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K2
Function Code: 03 - Read Holding Registers
Start Slave Memory Address: K48449
Start Master Memory Address: V2020
Number of Elements: K15
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5000

(PLC program continued on next page)
Chapter 5: GS3 Modbus Communications

*** The following 21 rungs (6–26) are for slave 1 communications control. ***

This rung turns on C1 if there is a fault in drive #1.

\[ V2000 \geq K1 \]

\[ \text{Drive #1 Fault} \]

\[ C1 \]

\[ \text{SET} \]

This rung a switch on input X1 to reset the C bit used to indicate a drive #1 fault.

\[ \text{Drive #1 Fault Indication} \]

\[ \text{Reset} \]

\[ X1 \]

\[ \text{Drive #1 Fault} \]

\[ C1 \]

\[ \text{RST} \]

This rung turns on C2 if drive #1 has an overload fault.

\[ V2000 = K4 \]

\[ \text{Drive #1 OL} \]

\[ C2 \]

\[ \text{SET} \]

This rung allows a switch on input X2 to reset the overload fault bit C2.

\[ \text{Drive #1 Overload Indication} \]

\[ \text{Reset} \]

\[ X2 \]

\[ \text{Drive #1 OL} \]

\[ C2 \]

\[ \text{RST} \]

This rung checks to see if the drive Speed, Direction, External Fault, or Fault Reset conditions have been changed in the local program, and need to be written to drive #1.

\[ \text{Drive #1 Speed Ref New} \]

\[ V3000 \]

\[ \text{Drive #1 Speed Ref Retain} \]

\[ V3010 \]

\[ \text{Drive #1 Speed Ref Write Enable} \]

\[ C10 \]

\[ \text{PLC program continued on next page} \]
Chapter 5: GS3 Modbus Communications

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)

This rung writes the new Speed Reference if it changes.

Port Busy SP116

Drive #1 Speed Ref Write Enable C10

Drive #1 Direction, Fault, Reset Write Enable C11

MWX

CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K1
Function Code: 06 - Preset Single Register
Start Slave Memory Address: K42331
Start Master Memory Address: V3000
Number of Elements: n/a
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5006

Drive #1 Direction, Fault, Reset
Write Enabled
C11 ( )SET

This rung writes the Direction, Ext Fault, and Fault Reset words if any of them changes.

Port Busy SP116

Drive #1 Speed Ref Write Enable C10

Drive #1 Direction, Fault, Reset Write Enable C11

MWX

CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K1
Function Code: 16 - Preset Multiple Registers
Start Slave Memory Address: K42333
Start Master Memory Address: V3002
Number of Elements: K3
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5011

Drive #1, Speed,
Direction, Fault, Reset
Writes Finished
C13 ( )SET

(PLC program continued on next page)
This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.
Rungs 14 & 15 write to the Run Command word if it changes.

This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.

( PLC program continued on next page )
Rungs 17 & 18 select either 30Hz or 60Hz based on X3.

Rungs 19 & 20 select Run or Stop based on X5.

(PLC program continued on next page)
Rungs 21 & 22 select Direction based on X6.
Drive #1 Forward/Reverse

Rungs 23 & 24 select Ext Fault or no fault based on X7.
Drive #1 Ext Fault

Rungs 25 & 26 select Fault Reset or no reset based on X10.
Drive #1 Ext Fault Reset

( PLC program continued on next page )
*** The following 21 rungs (27–47) are for slave 2 communications control. ***

This rung turns on C31 if there is a fault in drive #2.

\[
\text{Drive #2 Fault Indication} \\
V2020 \geq K1 \quad (\text{SET}) \\
\]

This rung allows a switch on input X21 to reset the C bit used to indicate drive #2 fault.

\[
\text{Drive #2 Fault Reset} \\
X21 \quad (\text{RST}) \\
\]

This rung turns on C32 if drive #2 has an overload fault.

\[
\text{Drive #2 Overload Indication} \\
V2020 = K4 \quad (\text{SET}) \\
\]

This rung allows a switch on input X22 to reset the overload fault bit C32.

\[
\text{Drive #2 Overload Reset} \\
X22 \quad (\text{RST}) \\
\]

This rung checks to see if the drive Speed, Direction, External Fault, or Fault Reset conditions have been changed in the local program, and need to be written to drive #2.

\[
\text{Drive #2 Speed Ref New} \\
V3020 = \text{Drive #2 Speed Ref Retain} \quad V3030 \\
\text{Drive #2 Speed Ref Write Enable} \quad V3020 = \text{Drive #2 Speed Ref Retain} \quad V3030 \\
\]

\[
\text{Drive #2 Direction New} \\
V3022 = \text{Drive #2 Direction Retain} \quad V3032 \\
\text{Drive #2 Direction Write Enable} \quad V3022 = \text{Drive #2 Direction Retain} \quad V3032 \\
\]

\[
\text{Drive #2 External Fault New} \\
V3023 = \text{Drive #2 External Fault Retain} \quad V3033 \\
\text{Drive #2 External Fault Write Enable} \quad V3023 = \text{Drive #2 External Fault Retain} \quad V3033 \\
\]

\[
\text{Drive #2 Fault Reset New} \\
V3024 = \text{Drive #2 Fault Reset Retain} \quad V3034 \\
\text{Drive #2 Fault Reset Write Enable} \quad V3024 = \text{Drive #2 Fault Reset Retain} \quad V3034 \\
\]

( PLC program continued on next page )
This rung writes the new Speed Reference if it changes.

Drive #2
Port Busy SP116
Speed Ref Write Enable C40
Drive #2 Direction, Fault, Reset Write Enable C41

MWX
CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K2
Function Code: 06 - Preset Single Register
Start Slave Memory Address: K42331
Start Master Memory Address: V3030
Number of Elements: n/a
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5017

Drive #2
Direction, Fault, Reset
Write Enabled
C41
\( \text{(SET)} \)

This rung writes the Direction, Ext Fault, and Fault Reset words if any of them changes.

Drive #2
Port Busy SP116
Speed Ref Write Enable C40
Drive #2 Direction, Fault, Reset Write Enable C41

MWX
CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K2
Function Code: 16 - Preset Multiple Registers
Start Slave Memory Address: K42333
Start Master Memory Address: V3032
Number of Elements: K3
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5022

Drive #2, Speed,
Direction, Fault, Reset
Writes Finished
C43
\( \text{(SET)} \)

( PLC program continued on next page )
This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.

( PLC program continued on next page )
Rungs 35 & 36 write to the Run Command word if it changes.

Rungs 35 & 36 write to the Run Command word if it changes.

35
Drive #2 Run CMD New V3021
Drive #2 Run CMD Retain V3031
Drive #2 Speed Ref Write Enable C40
Drive #2 Run CMD Write Enable C42
Drive #2 Run CMD Write Enable C42

36
Port Busy SP116 C42

MWX
CPU/DCM Slot: CPU
Port Number: K2
Slave Address: K2
Function Code: 06 - Preset Single Register
Start Slave Memory Address: K42332
Start Master Memory Address: V3031
Number of Elements: n/a
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5025

This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.

Rungs 35 & 36 write to the Run Command word if it changes.

Rungs 35 & 36 write to the Run Command word if it changes.

37
Drive #2 Run CMD Write Enable C42
Drive #2 Run CMD Write Finished C44

PLC program continued on next page
Rungs 38 & 39 select either 30Hz or 60Hz based on X23.

Rungs 40 & 41 select Run or Stop based on X25.
Rungs 42 & 43 select Direction based on X26.

- Drive #2 Forward/Reverse
  - Rung 42: LD K1
  - Rung 43: LD K0

- OUT Drive #2 Direction New V3022
  - Rung 42: OUT Drive #2 Direction New V3022
  - Rung 43: OUT Drive #2 Direction New V3002

Rungs 44 & 45 select Ext Fault or no fault based on X27.

- Drive #2 Ext Fault
  - Rung 44: LD K1
  - Rung 45: LD K0

- OUT Drive #2 Ext Fault New V3023
  - Rung 44: OUT Drive #2 Ext Fault New V3023
  - Rung 45: OUT Drive #2 Ext Fault New V3002

Rungs 46 & 47 select Fault Reset or no reset based on X30.

- Drive #2 Ext Fault Reset
  - Rung 46: LD K1
  - Rung 47: LD K0

- OUT Drive #2 Ext Fault Reset New V3024
  - Rung 46: OUT Drive #2 Ext Fault Reset New V3024
  - Rung 47: OUT Drive #2 Ext Fault Reset New V3002

END
This program is for illustrational purposes only, and is not intended for a true application.

This rung counts the number of times the PLC attempts to communicate to the drive.

Port Busy
SP116
CT0

This rung counts the number of times an attempted communication to the drive fails.

Port Comm Fail
SP117
CT1

This rung acts as an alternator, allowing the following logic to alternate between communicating to slave 1 or slave 2. If there were additional slaves, the ‘K’ number for the counter would simply be increased to match the number of slaves in the system.

Port Busy
SP116
CT2

This rung checks to see if it is time to communicate to slave 1, and also if there are no current write requests to that drive. If not, it reads data from slave 1.

Port Busy
SP116
CTA2 = K0

This rung checks to see if it is time to communicate to slave 2, and also if there are no current write requests to that drive. If not, it reads data from slave 2.

Port Busy
SP116
CTA2 = K1

(PLC program continued next page)
Chapter 5: GS3 Modbus Communications

( DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page )

*** The following 21 rungs (6–26) are for slave 1 communications control. ***

This rung turns on C1 if there is a fault in drive #1.

\[ V2000 \geq K1 \]

This rung allows a switch on input X1 to reset the C bit used to indicate a drive #1 fault.

- Drive #1 Fault Indication
  - Reset
  - Drive #1 Fault

\[ X1 \]

This rung turns on C2 if drive #1 has an overload fault.

\[ V2000 \leq K4 \]

This rung allows a switch on input X2 to reset the overload fault bit C2.

- Drive #1 Overload Indication
  - Reset
  - Drive #1 OL

\[ X2 \]

This rung checks to see if the drive Speed, Direction, External Fault, or Fault Reset conditions have been changed in the local program, and need to be written to drive #1.

\[ V3000 \geq V3010 \]

\[ V3002 \geq V3012 \]

\[ V3003 \geq V3013 \]

\[ V3004 \geq V3014 \]

( PLC program continued next page )
This rung writes the new Speed Reference if it changes.

Drive #1
Port Busy
Speed Ref
Write Enable
C10

Drive #1
Direction, Fault, Reset
Write Enable
C11

This rung writes the Direction, Ext Fault, and Fault Reset words if any of them changes.

Drive #1
Port Busy
Speed Ref
Write Enable
C10

Drive #1
Direction, Fault, Reset
Write Enable
C11

LD Kf201

LD K2

LDA O3000

WX V4432

Drive #1
Direction, Fault, Reset
Write Enabled
C11

( )SET

LD Kf201

LD K6

LDA O3002

WX V4434

Drive #1 Speed,
Direction, Fault, Reset
Writes Finished
C13

( )SET

( PLC program continued next page )
This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.

( PLC program continued next page )
Rungs 14 & 15 write to the Run Command word if it changes.

This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.

(PLC program continued next page)
Rungs 17 & 18 select either 30Hz or 60Hz based on X3.
Drive #1 Speed Control
bit 60/30Hz

Rungs 19 & 20 select Run or Stop based on X5.
Drive #1 Run/Stop

( PLC program continued next page )
Rungs 21 & 22 select Direction based on X6.
Drive #1 Forward/Reverse

21

LD
K1

OUT Drive #1 Direction New V3002

Drive #1 Forward/Reverse

22

LD
K0

OUT Drive #1 Direction New V3002

Rungs 23 & 24 select Ext Fault or no fault based on X7.
Drive #1 Ext Fault

23

LD
K1

OUT Drive #1 Ext Fault New V3003

Drive #1 Ext Fault

24

LD
K0

OUT Drive #1 Ext Fault New V3003

Rungs 25 & 26 select Fault Reset or no reset based on X10.
Drive #1 Ext Fault Reset

25

LD
K1

OUT Drive #1 Ext Fault Reset New V3004

Drive #1 Ext Fault Reset

26

LD
K0

OUT Drive #1 Ext Fault Reset New V3004

( PLC program continued next page )
*** The following 21 rungs (27–47) are for slave 2 communications control. ***

27  V2020 ≥ K1
                Drive #2 Fault
                C31 (SET)

28  This rung allows a switch on input X21 to reset the C bit used to indicate drive #2 fault.
                    Drive #2 Fault Indication
                    Reset
    X21
                Drive #2 Fault
                C31 (RST)

29  V2020 = K4
                Drive #2 Overload Indication
                Reset
    X22
                Drive #2 OL
                C32 (SET)

30  This rung checks to see if the drive Speed, Direction, External Fault, or Fault Reset conditions have been changed in the local program, and need to be written to drive #2.
                    Drive #2 Speed Ref
                    Speed Ref New
    V3020
                    Drive #2 Speed Ref Retain
                    V3030
                    Write Enable
                    C40

31  Drive #2
    V3022
        Drive #2 Direction New
        Direction Retain
        V3032

                      Drive #2
                      Run CMD
                      Write Enable
                      C42
                      C40
                      (SET)

                      Drive #2
                      Speed Ref
                      Write Enable
                      C40

                      Drive #2
                      Fault Reset New
                      Fault Reset Retain
                      V3034

( PLC program continued next page )
This rung writes the new Speed Reference if it changes.

Port Busy
SP116
Write Enable
C40
Write Enable
C41

LD Kf202
LD K2
LDA O3000
WX V4432

Drive #2
Direction, Fault, Reset
Write Enabled
C41

SET

This rung writes the Direction, Ext Fault, and Fault Reset words if any of them changes.

Port Busy
SP116
Write Enable
C40
Write Enable
C41

LD Kf202
LD K6
LDA O3002
WX V4434

Drive #2, Speed, Direction, Fault, Reset
Writes Finished
C43

SET

(PLC program continued next page)
This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.

Drive #2 Speed Ref Write Enable C40
Drive #2 Direction, Fault, Reset Write Enable C41
Drive #2, Speed, Direction, Fault, Reset Writes Finished C43

LD Drive #2 Speed Ref New V3020
OUT Drive #2 Speed Ref Retain V3030
LD Drive #2 Direction New V3022
OUT Drive #2 Direction Retain V3032
LD Drive #2 Ext Fault New V3023
OUT Drive #2 Ext Fault Retain V3033
LD Drive #2 Fault Reset New V3024
OUT Drive #2 Fault Reset Retain V3034

Drive #2 Speed Ref Write Enable C40
(RST)
Drive #2 Direction, Fault Reset Write Enable C41
(RST)
Drive #2 Speed, Direction, Fault Reset Writes Finished C43
(RST)

(PLC program continued next page)
Rungs 35 & 36 write to the Run Command word if it changes.

Drive #2  Drive #2  Drive #2  Drive #2  Drive #2
Run CMD  Run CMD  Speed Ref  Run CMD  Run CMD
New  Retain  Write Enable  Write Enable  Write Enable
V3021  V3031  C40  C42  C42

35

Drive #2
Run CMD
Write Enable
C42

Port Busy
Write Enable
SP116  C42

36

LD
K1202

LD
K2

LDA
O3001

WX
V4433

This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.

Drive #2  Drive #2
Run CMD  Run CMD
Write Enable  Write Finished
C42  C44

37

LD
Drive #2
Run CMD New
V3021

OUT
Drive #2
Run CMD Retain
V3031

Drive #2
Run CMD
Write Enable
C42

(RST )

Drive #2
Run CMD
Write Finished
C44

(RST )

( PLC program continued next page )
Rungs 38 & 39 select either 30Hz or 60Hz based on X23.
Drive #2 Speed Control
bit 60/30Hz
X23

Rungs 40 & 41 select Run or Stop based on X25.
Drive #2 Run/Stop
X25

---

38
LD K300
BIN
OUT Drive #2 Speed Ref New V3020

39
LD K600
BIN
OUT Drive #2 Speed Ref New V3020

40
LD K1
OUT Drive #2 Run CMD New V3021

41
LD K0
OUT Drive #2 Run CMD New V3021

---

( PLC program continued next page )
Rungs 42 & 43 select Direction based on X26.
  Drive #2 Forward/Reverse
  X26
  
  Drive #2 Forward/Reverse
  X26
  
  Drive #2 Ext Fault
  X27
  
  Drive #2 Ext Fault
  X27
  
  Drive #2 Ext Fault Reset
  X30
  
  Drive #2 Ext Fault Reset
  X30
  
  Rungs 44 & 45 select Ext Fault or no fault based on X27.
  Drive #2 Ext Fault
  X27
  
  Rungs 46 & 47 select Fault Reset or no reset based on X30.
  Drive #2 Ext Fault Reset
  X30

K1
 LD
 OUT Drive #2 Direction New V3022

K0
 LD
 OUT Drive #2 Direction New V3022

K1
 LD
 OUT Drive #2 Ext Fault New V3023

K0
 LD
 OUT Drive #2 Ext Fault New V3023

K1
 LD
 OUT Drive #2 Ext Fault Reset New V3024

K0
 LD
 OUT Drive #2 Ext Fault Reset New V3024

( END )
**Communicating with Third-party Devices**

The DURApulse GS3 RJ-12 Serial Comm Port will accommodate an RS-485 connection. An RS-485 network cable can span up to 1000 meters (4000 feet). The DURApulse GS3 AC drive communication address is specified by P9.00. The third party device then controls each AC drive according to its communication address.

The DURApulse GS3 AC drive can be set up to communicate on standard MODBUS networks using the following transmission modes: ASCII or RTU. Using the Communication Protocol parameter (P9.02), you can select the desired mode, data bits, parity, and stop bits. The mode and serial parameters must be the same for all devices on a MODBUS network.

**DURApulse GS3 RS-485 Serial Comm Port**

<table>
<thead>
<tr>
<th>Number</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+15V</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>SG-</td>
</tr>
<tr>
<td>4</td>
<td>SG+</td>
</tr>
<tr>
<td>5</td>
<td>nc</td>
</tr>
<tr>
<td>6</td>
<td>reserved</td>
</tr>
</tbody>
</table>

DURApulse GS3 drives have a provision for shutting down control or power to the inverter in the event of a communications time out. This feature can be set up through parameters P9.03, P9.04, and P9.05.

**Common Third-party MODBUS RTU Masters**

- MODSCAN from www.wintech.com
- KEPSERVER EX 4.0 from www.kepware.com
- Entivity Studio 7.2
- Think & Do Live 5.5.1

For additional technical assistance, go to our Technical support home page at:
http://support.automationdirect.com/technotes.html
### Data Format

**ASCII Mode: 10-bit character frame (For 7-bit character):**

P9.02 = 00 (7 data bits, no parity, 2 stop bits)

<table>
<thead>
<tr>
<th>Start bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Stop bit</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10-bit character</td>
<td>10-bit character</td>
</tr>
</tbody>
</table>

P9.02 = 01 (7 data bits, even parity, 1 stop bit)

<table>
<thead>
<tr>
<th>Start bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Even parity</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7-bit character</td>
<td>10-bit character</td>
</tr>
</tbody>
</table>

P9.02 = 02 (7 data bits, odd parity, 1 stop bit)

<table>
<thead>
<tr>
<th>Start bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Odd parity</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7-bit character</td>
<td>10-bit character</td>
</tr>
</tbody>
</table>

**RTU Mode: 11-bit character frame (For 8-bit character):**

P9.02 = 03 (8 data bits, no parity, 2 stop bits)

<table>
<thead>
<tr>
<th>Start bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Stop bit</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8-bit character</td>
<td>11-bit character</td>
</tr>
</tbody>
</table>

P9.02 = 04 (8 data bits, even parity, 1 stop bit)

<table>
<thead>
<tr>
<th>Start bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Even parity</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8-bit character</td>
<td>11-bit character</td>
</tr>
</tbody>
</table>

P9.02 = 05 (8 data bits, odd parity, 1 stop bit)

<table>
<thead>
<tr>
<th>Start bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Odd parity</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8-bit character</td>
<td>11-bit character</td>
</tr>
</tbody>
</table>
Chapter 5: GS3 Modbus Communications

COMMUNICATION PROTOCOL

**ASCII Mode:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td>Start Character: (3AH)</td>
</tr>
<tr>
<td>ADR 1</td>
<td>Communication Address: 8-bit address consists of 2 ASCII codes</td>
</tr>
<tr>
<td>ADR 0</td>
<td>CONTENTS OF DATA:</td>
</tr>
<tr>
<td>CMD 1</td>
<td>n x 8-bit data consists of 2n ASCII codes, n ≤ 25 maximum of 50 ASCII codes</td>
</tr>
<tr>
<td>CMD 0</td>
<td>DATA (n-1)</td>
</tr>
<tr>
<td>DATA 0</td>
<td>DATA 0</td>
</tr>
<tr>
<td>LRC CHK 1</td>
<td>LRC check sum: 8-bit check sum consists of 2 ASCII codes</td>
</tr>
<tr>
<td>LRC CHK 0</td>
<td>END 1</td>
</tr>
<tr>
<td>END 1</td>
<td>END characters: END 1 = CR (0DH); END 0 = LF (0AH)</td>
</tr>
<tr>
<td>END 0</td>
<td></td>
</tr>
</tbody>
</table>

**RTU Mode:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td>A silent interval of more than 10 ms</td>
</tr>
<tr>
<td>ADR</td>
<td>Communication Address: 8-bit address</td>
</tr>
<tr>
<td>CMD</td>
<td>Command Code: 8-bit command</td>
</tr>
<tr>
<td>DATA (n-1)</td>
<td>CONTENTS OF DATA: n x 8-bit data, n ≤ 25</td>
</tr>
<tr>
<td>......</td>
<td>DATA 0</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>CRC check sum: 16-bit check sum consists of 2 8-bit characters</td>
</tr>
<tr>
<td>CRC CHK High</td>
<td>END</td>
</tr>
<tr>
<td>END</td>
<td>A silent interval of more than 10 ms</td>
</tr>
</tbody>
</table>

**ADR (Communication Address)**

Valid communication addresses are in the range of 0 to 254. A communication address equal to 0 means broadcast to all AC drives, in which case the drives will not reply any message to the master device.

For example, communication to AC drive with address 16 decimal:
- **ASCII mode:** (ADR 1, ADR 0)='1','0' => '1'=31H, '0'=30H
- **RTU mode:** (ADR)=10H
**CMD (command code) and DATA (data characters)**

The format of data characters depends on the command code. The available command codes are described as follows: Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of the AC drive with address 01H.

**ASCII mode:**

<table>
<thead>
<tr>
<th>Command Message</th>
<th>Response Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td>STX ':'</td>
</tr>
<tr>
<td>ADR</td>
<td>': '</td>
</tr>
<tr>
<td>ADR 0</td>
<td>':'</td>
</tr>
<tr>
<td>CMD</td>
<td>'0'</td>
</tr>
<tr>
<td>CMD 0</td>
<td>'0'</td>
</tr>
<tr>
<td>Starting data address</td>
<td>'2'</td>
</tr>
<tr>
<td>Number of data (Count by byte)</td>
<td>'2'</td>
</tr>
<tr>
<td>LRC CHK</td>
<td>'0'</td>
</tr>
<tr>
<td>LRC CHK 0</td>
<td>'0'</td>
</tr>
<tr>
<td>END</td>
<td>CR</td>
</tr>
<tr>
<td>END 0</td>
<td>LF</td>
</tr>
</tbody>
</table>

**RTU mode:**

<table>
<thead>
<tr>
<th>Command Message</th>
<th>Response Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR</td>
<td>ADR</td>
</tr>
<tr>
<td>CMD</td>
<td>CMD</td>
</tr>
<tr>
<td>Starting data address</td>
<td>'21H '</td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
<td>'00H '</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>CRC CHK Low</td>
</tr>
<tr>
<td>CRC CHK High</td>
<td>CRC CHK High</td>
</tr>
<tr>
<td>Number of data (Count by byte)</td>
<td>'04H '</td>
</tr>
<tr>
<td>Content of data address 2102H</td>
<td>'00H '</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>CRC CHK Low</td>
</tr>
<tr>
<td>CRC CHK High</td>
<td>CRC CHK High</td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
<td>'17H '</td>
</tr>
<tr>
<td>Content of data address 2103H</td>
<td>'00H '</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>CRC CHK Low</td>
</tr>
<tr>
<td>CRC CHK High</td>
<td>CRC CHK High</td>
</tr>
<tr>
<td>Number of data (Count by byte)</td>
<td>'70H '</td>
</tr>
<tr>
<td>Content of data address 2102H</td>
<td>'02H '</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>CRC CHK Low</td>
</tr>
<tr>
<td>CRC CHK High</td>
<td>CRC CHK High</td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
<td>'FEH '</td>
</tr>
<tr>
<td>Content of data address 2103H</td>
<td>'5CH '</td>
</tr>
</tbody>
</table>
Command code: 06H, write 1 word
For example, writing 6000(1770H) to address 0100H of the AC drive with address 01H.

**ASCII mode:**

<table>
<thead>
<tr>
<th>Command Message</th>
<th>Response Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX ' '</td>
<td>STX ' '</td>
</tr>
<tr>
<td>ADR 1 '0'</td>
<td>ADR 1 '0'</td>
</tr>
<tr>
<td>ADR 0 '1'</td>
<td>ADR 0 '1'</td>
</tr>
<tr>
<td>CMD 1 '0'</td>
<td>CMD 1 '0'</td>
</tr>
<tr>
<td>CMD 0 '6'</td>
<td>CMD 0 '6'</td>
</tr>
<tr>
<td>Data Address</td>
<td>Data Address</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'1'</td>
<td>'1'</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'1'</td>
<td>'1'</td>
</tr>
<tr>
<td>'7'</td>
<td>'7'</td>
</tr>
<tr>
<td>'7'</td>
<td>'7'</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>LRC CHK 1 '7'</td>
<td>LRC CHK 1 '7'</td>
</tr>
<tr>
<td>LRC CHK 0 '1'</td>
<td>LRC CHK 0 '1'</td>
</tr>
<tr>
<td>END 1 CR</td>
<td>END 1 CR</td>
</tr>
<tr>
<td>END 0 LF</td>
<td>END 0 LF</td>
</tr>
</tbody>
</table>

**RTU mode:**

This is an example of using function code 16 for writing to multiple registers.

<table>
<thead>
<tr>
<th>Command Message</th>
<th>Response Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR 01H</td>
<td>ADR 01H</td>
</tr>
<tr>
<td>CMD 10H</td>
<td>CMD 10H</td>
</tr>
<tr>
<td>Starting data address 20H 00H</td>
<td>Starting data address 20H 00H</td>
</tr>
<tr>
<td>Number of registers 00H 02H</td>
<td>Number of data (Count by word) 00H 02H</td>
</tr>
<tr>
<td>Byte count 04H</td>
<td>CRC CHK Low 04AH</td>
</tr>
<tr>
<td>Content of data address 2000H 02H</td>
<td>CRC CHK High 08H</td>
</tr>
<tr>
<td>Content of data address 2001H 58H</td>
<td></td>
</tr>
<tr>
<td>CRC CHK Low 34H</td>
<td>CRC CHK High 34H</td>
</tr>
</tbody>
</table>
CHK (check sum)

**ASCII Mode:**
LRC (Longitudinal Redundancy Check) is calculated by summing up module 256, the values of the bytes from ADR1 to last data character, then calculating the hexadecimal representation of the 2’s-complement negation of the sum.

For example, reading 1 word from address 0401H of the AC drive with address 01H.

| Command Message |
|-----------------|----------------|
| STX             | ‘:\’          |
| ADR 1           | ‘0’           |
| ADR 0           | ‘1’           |
| CMD 1           | ‘0’           |
| CMD 0           | ‘3’           |
| Starting data address | ‘0’  |
|                  | ‘4’           |
|                  | ‘0’           |
|                  | ‘1’           |
| Number of data (Count by word) | ‘0’  |
|                  | ‘0’           |
|                  | ‘0’           |
|                  | ‘1’           |
| LRC CHK 1       | ‘F’           |
| LRC CHK 0       | ‘6’           |
| END 1           | CR            |
| END 0           | LF            |

**RTU Mode:**

| Response Message |
|------------------|----------------|
| ADR              | 01H            |
| CMD              | 03H            |
| Starting data address | 21H  |
|                  | 02H            |
| Number of data (Count by word) | 00H  |
|                  | 02H            |
| CRC CHK Low      | 6FH            |
| CRC CHK High     | F7H            |
CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1: Load a 16-bit register (called CRC register) with FFFFH.
Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.
Step 3: Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.
Step 4: If the LSB of CRC register is 0, repeat step 3; else Exclusive or the CRC register with the polynomial value A001H.
Step 5: Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
Step 6: Repeat steps 2 to 5 for the next 8-bit byte of the command message.
Continue doing this until all bytes have been processed. The final contents of the CRC register are the CRC value.

When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer
Unsigned char length ← the quantity of bytes in the message buffer
The function returns the CRC value as a type of unsigned integer.

Unsigned int crc_chk(unsigned char* data, unsigned char length){
    int j;
    unsigned int reg_crc=0xFFFF;
    while(length--){
        reg_crc ^= *data++;
        for(j=0;j<8;j++){
            if(reg_crc & 0x01){  /* LSB(b0)=1 */
                reg_crc=(reg_crc>>1) ^ 0xA001;
            }else{
                reg_crc=reg_crc >>1;
            }
        }
    }
    return reg_crc;
}

RTU mode is preferred. Limited support is available to ASCII users.
COMM DELAY – OPTIMIZING COMMUNICATIONS

OPTIMIZING COMMUNICATIONS TO GS DRIVES

In most cases, optimizing communications to GS Drives MAY NOT BE NECESSARY.

If you are only communicating to one or two drives and reading or writing only a few parameters, the communication speed will most likely be sufficient for your application.

However, in the case that the communication speed (reaction time from reading or writing an event to a given drive) is too slow, you may need to take a more detailed look at how your code is designed to communicate to the GS Drives in your application.

To properly design the system, it is necessary to understand all of the propagation delays that are incurred when triggering the event to send a Modbus message to the point of receiving the data or status of the reply into the PLC or Modbus master.

To determine the time necessary to transmit a message from the Master to the Slave and vice versa, we must first determine the “Bit Time” and the “Character Time”. This is calculated by using the following formulas:

• **Bit Time:**
  The value one divided by the baud rate. A baud rate of 19,200 equals a bit rate of 0.0000528 \((1/19200)\) or 52 µs (microseconds).

• **Character Time:**
  Bit Time multiplied by the number of bits. With Modbus this is typically 10–12 bits per character [1 start bit (fixed), 1 or 2 stop bits (usually configurable), 0 or 1 parity bit (Odd & Even = 1 bit; None = 0), & 8 data bits]. For a setting of Odd parity and 1 Stop bit, this would be 11 bits. So at 19200, Odd parity and 1 stop bit, a character time would be 0.000573 or 573 µs \((0.0000528 \cdot 11)\).

Now that we know the byte time, we can multiply that time by the number of characters in each message.
Types of Messages Sent to GS Drives

There are three different types of messages typically be sent to GS Drives:

1) Read Registers (Function Code 3).
2) Write Multiple Registers (Function Code 16).
3) Write Single Register (Function Code 6).

Format of “Read Registers” Messages:

Request:
XX = Node Address (1 Char)
03 = Function Code (1 Char)
XXXX = Starting Address to read (2 Chars)
XXXX = Number of Registers to read (2 Chars)
XXXX = 16 Bit CRC (2 Chars)

Reply:
XX = Node Address (1 Char)
03 = Function Code (1 Char)
XX = Byte count of data being sent from Slave (1 Char)
XXXX... = Depends upon Request (2 Chars per Register requested)
XXXX = 16 Bit CRC (2 Chars)

Format of “Write Multiple Registers” Messages:

Request:
XX = Node Address (1 Char)
10 = Function Code (Hex format) (1 Char)
XXXX = Starting Address to write to (2 Chars)
XXXX = Number of Registers to write to (2 Chars)
XX = Number of bytes of data to write (1 Char)
XXXX... = Depends upon Request (2 Chars per Register requested)
XXXX = 16 Bit CRC (2 Chars)

Reply:
XX = Node Address (1 Char)
10 = Function Code (Hex format) (1 Char)
XXXX = Starting Address to write to (2 Chars)
XXXX = Number of Registers to write to (2 Chars)
XXXX = 16 Bit CRC (2 Chars)

Format of “Write Single Register” Messages:

Request:
XX = Node Address (1 Char)
06 = Function Code (1 Char)
XXXX = Register to Write to (2 Chars)
XXXX = Data to Write (2 Chars)
XXXX = 16 Bit CRC (2 Chars)

Reply:
XX = Node Address (1 Char)
06 = Function Code (1 Char)
XXXX = Register to Write to (2 Chars)
XXXX = Data to Write (2 Chars)
XXXX = 16 Bit CRC (2 Chars)

Example Message:

Write a value of 60Hz to P9.26 and a value of 1 to P9.27 = 01 10 09 1b 00 02 04 02 58 00 01 5a 66

We receive a good reply = 01 10 09 1b 00 02 a3 9f

Sending message (13 characters from above) = 7.4 ms (0.00744796)

Reply message (8 characters from above) = 4.6 ms (0.004583)

For more specific information on how Modbus messages are formed, refer to the Modbus specifications found at www.modbus.org.
**Additional Message Delay Times**

So we have the total transmission time for sending a message and receiving a reply but this does not include all of the delays for a given message. The receiving device must have time to process the receipt of a message and formulate a reply. The amount of time that the receiving device needs will vary greatly depending upon the hardware platform and other processes that the device is running. For the previous example message, the GS Drive responds in 4ms when the drive is stopped and will respond in 5ms when the drive is running. This may vary somewhat depending upon the specific parameter values and the size of the request.

**Modbus-specified Delays Between Messages**

There is one additional time delay required in the Modbus protocol. The protocol specifies at least a 3.5 character delay between messages. For the settings above, a 3.5 character time in our example would be about 2ms.

So the total time required for the message sent above would be:

- 7.4 ms (Transmission time for sending message)
- 5.0 ms (response delay from GS Drive when drive running)
- 4.6 ms (Transmission time for reply message)
- +2.0 ms (Modbus message wait delay)
- 19.0 ms (approximately)

Remember from our description, this is purely the time from when the message leaves the serial port to when the reply is received back in to the serial port.
**Other Delays**

Depending upon the master device, there may be additional delays. For example:

In the DirectLogic PLC, the serial communications are serviced in the housekeeping portion of the PLC scan. So if the communications instruction is in rung #1 of a ladder program, the serial communications message does not get sent until the end of the total PLC scan. Likewise, if the reply message was received into the serial port at the beginning of the PLC scan, it would not be serviced until the end of the PLC scan.

So you would need to add an additional possible two PLC scan times to the number above to truly calculate the time necessary to read or write an event to the GS drive.

These delays are shown in the following Communication Delay Timing Diagram.

**Communication Delay Timing Diagram**

- $t_1 =$ Scan delay from the point of turning on a communications instruction to when it actually goes out of the serial port.
- $t_2 =$ Transmission time to send Message request (read or write).
- $t_3 =$ Response delay from GS drive to receive the reply and formulate the response.
- $t_4 =$ Transmission time to send Reply message.
- $t_5 =$ Scan delay from the point of receiving reply, processing it and placing in PLC memory for Logic usage.
- $t_6 =$ Wait time required by Modbus spec (3.5 byte times). This may or may not be present depending upon the Scan delay, but safer to factor in.
Communication Delay Summary

Now that you know how to calculate the time required for one message to one GS drive, you would simply multiply this value per message to each GS drive on the network, since only one message can be sent at a time.

As you can deduce from the statement above, the more messages being sent to GS drives, the longer it takes to communicate to an individual drive as each message has to take its turn.

So how do you optimize your communications to get messages faster to your GS drives?

There is no way to make a message go faster than what is specified above, but what you can affect is the amount of messages being sent to any given GS drive in two ways.

1) Group together messages into Block requests whenever possible. For example, if you wanted to read Status Monitor 1 and the Output Frequency status register from the drive, read the two together as a block (Status Monitor 1, Status Monitor 2, Frequency Command and Output Frequency), and ignore the other two status registers that you don't need instead of sending two separate read commands. If you do the calculations above, you will see that is much faster to take the additional hit from four extra bytes in the reply message than it would be to send a separate message. NOTE that you cannot read across non-contiguous Modbus addresses, so this typically only works when reading within the Status registers or in a Parameter category (P9.xx, P1.xx, etc…).

2) Only send a write message when the value changes in the Master device. It is simpler to setup your communications instructions to read and write all the time, but it wastes precious network time to write the same value to the GS drive over and over if that value is not changing. Write some simple logic that only triggers a write command when the value to be sent has changed.

For more specific instructions on how to configure and/or interlock, in detail, the individual communications instructions, consult your PLC or Modbus Master Device user manual. If using DirectLogic PLCs as the Modbus Master, consult the Dx-USER-M manuals for specifics on configuring the individual communications instructions and look at the Hx-ECOM-M manual for information on interlocking communications instructions.