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# Communication Parameters Summary

A summary of the GS2 Communications Parameters is listed below. For a complete listing of the GS2 Parameter, refer to Chapter 4.

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<th>Range</th>
<th>Default</th>
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<tr>
<td>P 9.00</td>
<td>Communication Address</td>
<td>01 to 254</td>
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<td>P 9.01</td>
<td>Transmission Speed</td>
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<td>01: 9600 baud</td>
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<td>02: 19200 baud</td>
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<td>03: 38400 baud</td>
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<td>Communication Protocol</td>
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<td>01: Modbus ASCII mode</td>
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<td>7 data bits, even parity, 1 stop bit</td>
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<td>02: Modbus ASCII mode</td>
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<td>7 data bits, odd parity, 1 stop bit</td>
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<td>03: Modbus RTU mode</td>
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<td>8 data bits, no parity, 2 stop bits</td>
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<td>Transmission Fault Treatment</td>
<td>00: Display fault and continue operating</td>
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<td>01: Display fault and RAMP to stop</td>
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<td>02: Display fault and COAST to stop</td>
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<td>03: No fault displayed and continue operating</td>
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<td>P 9.04</td>
<td>Time Out Detection</td>
<td>00: Disable</td>
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<td>01: Enable</td>
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<td>P 9.05</td>
<td>Time Out Duration</td>
<td>0.1 to 60.0 seconds</td>
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<td>P 9.07</td>
<td>Parameter Lock</td>
<td>00: All parameters can be set and read</td>
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<td>01: All parameters are read-only</td>
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<td>P 9.08</td>
<td>Restore to Default</td>
<td>99: Restores all parameters to factory defaults</td>
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<td>P 9.11</td>
<td>Block Transfer Parameter 1</td>
<td>P0.00 to P8.01, P9.99</td>
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<td>Block Transfer Parameter 2</td>
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<td>Block Transfer Parameter 3</td>
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<td>Block Transfer Parameter 5</td>
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<td>P 9.16</td>
<td>Block Transfer Parameter 6</td>
<td>P0.00 to P8.01, P9.99</td>
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<td>P 9.17</td>
<td>Block Transfer Parameter 7</td>
<td>P0.00 to P8.01, P9.99</td>
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◆ Parameter can be set during RUN Mode.
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<td>Block Transfer Parameter 12</td>
<td>P0.00 to P8.01, P9.99</td>
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<td>Block Transfer Parameter 13</td>
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<td>Block Transfer Parameter 14</td>
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<td>Block Transfer Parameter 15</td>
<td>P0.00 to P8.01, P9.99</td>
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<td><code>P 9.26</code></td>
<td>Serial Comm Speed Reference</td>
<td>0.0 to 400.0 Hz</td>
<td>60.0</td>
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<td><code>P 9.27</code></td>
<td>Serial Comm RUN Command</td>
<td>00: Stop</td>
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<td>01: Run</td>
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<td>Serial Comm Direction Command</td>
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<td>01: Reverse</td>
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<td><code>P 9.29</code></td>
<td>Serial Comm External Fault</td>
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<td>01: External fault</td>
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<td><code>P 9.30</code></td>
<td>Serial Comm Fault Reset</td>
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<td>Serial Comm JOG Command</td>
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<td>01: Jog</td>
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<td>Firmware Version</td>
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<td><code>P 9.41</code></td>
<td>GS Series Number</td>
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<td>02: GS2</td>
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<td>03: GS3</td>
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<td>01: GS2-21P0 (230V 1ph/3ph 1hp)</td>
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<td>02: GS2-22P0 (230V 1ph/3ph 2hp)</td>
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<td>03: GS2-23P0 (230V 1ph/3ph 3hp)</td>
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<td>04: GS2-25P0 (230V 3ph 5hp)</td>
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<td>05: GS2-27P5 (230V 3ph 7.5hp)</td>
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<td>07: GS2-41P0 (460V 3ph 1hp)</td>
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<td>08: GS2-42P0 (460V 3ph 2hp)</td>
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<td>09: GS2-43P0 (460V 3ph 3hp)</td>
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<td>10: GS2-45P0 (460V 3ph 5hp)</td>
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<td>11: GS2-47P5 (460V 3ph 7.5hp)</td>
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<td>12: GS2-4010 (460V 3ph 10hp)</td>
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<td>13: GS2-10P2 (115V 1ph 0.25hp)</td>
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<td>14: GS2-10P5 (115V 1ph 0.5hp)</td>
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<td>15: GS2-11P0 (115V 1ph 1hp)</td>
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<td>21: GS2-51P0 (575V 3ph 1hp)</td>
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<td>22: GS2-52P0 (575V 3ph 2hp)</td>
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<td>23: GS2-53P0 (575V 3ph 3hp)</td>
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<td>24: GS2-55P0 (575V 3ph 5hp)</td>
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<td>25: GS2-57P5 (575V 3ph 7.5hp)</td>
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<td>26: GS2-5010 (575V 3ph 10hp)</td>
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◆ Parameter can be set during RUN Mode.
## GS2 Parameter Memory Addresses

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<thead>
<tr>
<th>GS2 Parameter</th>
<th>Description</th>
<th>Hexadecimal</th>
<th>Modbus Decimal</th>
<th>Octal</th>
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<td><strong>Motor Parameter Addresses</strong></td>
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<td>Accel 1 to Accel 2 frequency transition</td>
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<td>Decel 2 to Decel 1 frequency transition</td>
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<td>DC Injection during Start-up</td>
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<td>DC Injection during Stopping</td>
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<td>Start-point for DC Injection</td>
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<td>Mid-point Frequency</td>
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<td>PWM Carrier Frequency</td>
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◆ Parameter can be set during RUN Mode.
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<th>Octal</th>
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<td>Multi-Function Output Terminal 1</td>
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◆ Parameter can be set during RUN Mode.
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◆ Parameter can be set during RUN Mode.
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◆ Parameter can be set during RUN Mode.
GS2 Status Addresses

The GS2 Series 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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Status Monitor 1 \( h2100 \)

Error Codes:

- 00: No fault occurred
- 01: Over-current(oc)
- 02: Over-voltage(oV)
- 03: Overheat (oH)
- 04: Overload (oL)
- 05: Overload 1 (oL1)
- 06: Overload 2 (oL2)
- 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)
Chapter 5: GS2 Modbus Communications

**Status Monitor 2**

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<td>01 (1)</td>
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<td>10 (2)</td>
<td>Standby</td>
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<td>11 (3)</td>
<td>Drive operation running (RUN)</td>
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<td>2</td>
<td>1 (4)</td>
<td>JOG active</td>
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<td>3 and 4</td>
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<td>01 (8)</td>
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<td>FWD to REV transition</td>
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<td>Source of frequency determined by AI terminal (P4.00 = 2, 3, or 4)</td>
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</tr>
<tr>
<td>9 to 15</td>
<td>N/A</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

**GS2 Memory Data (binary)**

<table>
<thead>
<tr>
<th>Address</th>
<th>Bit(s) Value Binary (Decimal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2101</td>
<td>0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0</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.
Output Voltage U (XXX.X)  h2106
Status location for the output voltage present at the T1, T2, and T3 terminals.

Motor RPM  h2107
Status location for the present estimated speed of the motor.

Scale Frequency (Low word)  h2108
Status location for result of output frequency x P 8.01 (low word).

Scale Frequency (High word)  h2109
Status location for result of output frequency x P 8.01 (high word).

Power Factor Angle  h210A
Status location for the power factor angle.

% Load  h210B
Status location for the amount of load on the AC drive. (Output Current ÷ Drive Rated Current) x 100.

Firmware Version  h2110
Status location for the firmware version of the AC drive.
Chapter 5: GS2 Modbus Communications

Communicating with DirectLOGIC PLCs

The following steps explain how to connect to and communicate with the GS2 Series AC drives using DirectLOGIC PLCs.

Step 1: Choose the Appropriate CPU.
The GS2 Series AC drives will communicate with the following DirectLOGIC CPUs using Modbus communications:

- DL05
- DL06
- DL250(-1)
- DL260
- DL350
- DL450

Step 2: Make the Connections
First you must decide what type of interface will work best for your application. The GS2 Comm Port can accommodate an RS-232C or an RS-485 connection.

RS-232C
An RS-232C connection is somewhat limited. The maximum RS-232C network cable length is 15 meters (50 feet). In addition, using the RS-232C interface will allow you to connect an AC drive to only one PLC. For an RS-232C connection, set the GS2 DIP switches SW2 and SW3 to RS232.

RJ-12 (6P4C) Serial Comm Port

Use the following wiring diagrams to connect your DirectLOGIC PLC to a GS2 Series AC drive with an RS-232C interface:

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

**DL06/DL250/DL260: RS-232C Connection Wiring**

**DL350/DL450: RS-232C Connection Wiring**

Switches SW2 and SW3 must be set to RS232 for an RS-232C connection.
RS-232C to RS-485 Conversion

An RS-485 network cable can span up to 1000 meters (4000 feet). However, most DirectLOGIC PLCs require an FA-ISOCON (RS-232C to RS-422/485 network adapter) in order to make this type of connection. For an RS-485 connection, set the GS2 DIP switches SW2 and SW3 to RS485.

RS485

Switches SW2 and SW3 must be set to RS485 for an RS-485 connection.

Use the following wiring diagrams to connect your DirectLOGIC PLC to a GS2 Series AC drive with an RS-485 interface:

**Note:** If an FA-ISOCON module is used in your connection, set the module dipswitches S21 = ON; S22 - S27 = OFF; TERMINATE, BIAS, and DPX = ON. Refer to FA-ISOCON manual for more detailed information.

---

**DL05: RS-485 Connection Wiring**

**DL250: RS-485 Connection Wiring**

**DL350/DL450: RS-485 Connection Wiring**
Chapter 5: GS2 Modbus Communications

RS-485

**DL06/DL260: RS-485 Connection Wiring**

Note: The Termination Resistor is necessary only on large runs.

---

**Step 3: Set AC Drive Parameters**

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

- **P 3.00**: 03 or 04 – Operation Determined by RS-232C/RS-485 interface. Keypad STOP is enabled (03) or disabled (04).
- **P 4.00**: 05 – Frequency determined by RS-232/RS-485 communication interface
- **P 9.00**: xx – Communication address 1-254 (unique for each device, see P 9.00)
- **P 9.01**: 01 – 9600 baud data transmission speed
- **P 9.02**: 05 – Modbus RTU mode <8 data bits, odd parity, 1 stop bit>

Note: The previous 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 application.

---

**Step 4: Configure the DirectLOGIC CPUs**

The DirectLOGIC CPUs must be configured to communicate with the GS2 Series AC drives. This setup includes setting up the communication port and adding instructions to your logic program.

The setup 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.

Note: For instructions on Modbus Configuration for your specific CPU, refer to the appropriate CPU User Manual.
DirectLOGIC Modbus Port Configuration

The following configuration example is specific to the DL250(-1) CPU. 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 “0 ms”.
- The Station Number should be set to “1” to make the DL250(-1) CPU a Modbus master.

Note: The DL250(-1) network instructions used in Master mode will access only slaves 1 to 90. Each slave must have a unique number.

- The Baud Rate should be set at “9600”.
- In the Stop Bits list box, choose “1”.
- In the Parity list box, choose “Odd”.

![Setup Communication Ports](image)
**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 GS2 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.

**Note:** This program is for illustration purposes only, and is not intended for a true application.

In many drive applications, electromagnetic interference can sometimes cause frequent, short duration communication errors. Unless the application environment is perfect, an occasional communication error will occur. In order to distinguish between these non-fatal transients and a genuine communication failure, you may want to use the instructions as shown in Rungs 1 through 4.

Rung 1 monitors the number of times that the PLC attempts to communicate with the AC drive. When the PLC’s communication attempts are successful, SP116 will count up, and SP117 will not count. Once the count reaches 9999, the counter will reset and resume counting.

**Note:** SP116 and SP117 are special relays in the DirectLOGIC CPUs that monitor the PLC’s communications. SP116 is on when Port 2 is communicating with another device. SP117 is on when Port 2 has encountered a communication error.

This rung counts every time Port 2 is busy communicating.

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

Rungs 2 through 4 monitor the number of times the PLC fails in communicating with the AC drive. These instructions set the C0 control relay bit (to be used for alarm or shut-down) based on the number of times the SP117 bit is active in one minute. In this example, C0 will be set if the number of errors exceed 20 in one minute.

This rung counts every time Port 2 has an error communicating with the slave.

```
2
Comm Error Port 2
SP117
Comm Transaction Count
CT0
_1Minute
SP3
```

This rung sets a control relay to indicate a communication error.

```
3
Comm Error Count
CT1
Comm Error Occurred
C0
(SET)
External Comm Reset
X0
```

```
4
Comm Error Count
CT1
Comm Error Occurred
C0
(RST)
```

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

Rung 5 reads 12 of the status addresses of the GS2 AC drive. These instructions read the values from the GS2 status addresses, 2100 to 210B, and places the values into the PLC memory addresses, V2000 to V2013.

Notice the number in the RX box; V20400. 20400 is an octal number, as are all address references in the DirectLOGIC PLCs. 20400 octal converted to hex is 2100, which is the first status address for the GS2 AC drive.

Note: Refer to your PLC User Manual for more specifics on Modbus addressing and address conversions.

If not writing to the drive, this rung reads the first 12 status addresses of the drive.

(Continued following “Alternate Modbus Read Instruction”)

5

DL250-1/260 Comm SP116
Speed Reference Write Enable C10
Direction, Fault, Reset Write Enable C11

Run CMD Write Enable C12

LD Kf201
LD K24
LDA O2000
RX V20400
Alternate Modbus Read Instruction for DL06 and DL260 CPUs

The DL06 and DL260 CPUs offer “Modbus Read from Network” and “Modbus Write to Network” instructions that are easier to use than are the “Read from Network” and “Write to Network” instructions of the other DirectLOGIC CPUs.

Rung 5, as shown below, reads the first 12 of the status addresses of the GS2 AC drive. This instruction reads the values from the GS2 status addresses, 2100 to 210B, and place the values into the PLC memory addresses V2000 to V2013.

The Start Slave Memory Address in the MRX box is 48449, which is a Modbus decimal number (584/984 type). To convert 48449 decimal to hex, you first subtract 40001, and then convert the remainder to (hex) 2100. H2100 is the address for the GS2 Status Monitor.

Note: Refer to your PLC User Manual for more specifics on Modbus addressing and address conversions.
DirectLOGIC Modbus Ladder Programming (cont.)

Rungs 6 through 9 show examples of how data read from the drive Status Addresses to set Control Relay bits that can be used for alarm or shut-down.

6

This rung monitors the drive Status Monitor 1 for any drive fault, and sets a control relay if a fault occurs.

Drive Status Monitor 1
V2000

Drive Fault Occurred
C1

≥

K1

(SET)

Drive Fault Indication Reset
X1

RST

7

This rung monitors the drive Status Monitor 1 for an overload fault, and sets a control relay if an overload fault occurs.

Drive Status Monitor 1
V2000

Overload
K4

Overload Occurred
C2

=  

(SET)

Overload Indication Reset
X2

RST

8

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

Rung 10 monitors the Speed Reference, Direction, External Fault, and Fault Reset Commands for changes. If there are any changes, then a control relay is set to allow the Speed Reference to be written to the drive in the next rung. (This control relay is also used in later rungs to enable writes for the other three listed commands.)

The program monitors the commands for changes, and then writes to the drive only when there is a change. This procedure promotes safe machine operation by isolating the Run Command from the write block.

This rung monitors Speed Ref, Direction, External Fault, and Fault Reset for changes. If any of them has changed, a write sequence is enabled to write the new values to the drive.

<table>
<thead>
<tr>
<th>Rung 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed Ref New V3000</td>
</tr>
<tr>
<td>Direction New V3002</td>
</tr>
<tr>
<td>Ext Fault New V3003</td>
</tr>
<tr>
<td>Fault Reset New V3004</td>
</tr>
<tr>
<td>Run CMD Write Enable C10</td>
</tr>
<tr>
<td>Speed Ref Write Enable C10 (SET)</td>
</tr>
</tbody>
</table>

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

Rungs 11 and 12 write the new Speed Reference, Direction, External Fault, and Fault Reset commands to the drive. We use two separate write commands in two separate rungs because the drive’s Speed Reference command address (O4432) is not sequential with the Direction, External Fault, and Fault Reset command addresses (O4434 – O4436).

This rung writes the Speed Reference to the drive when the Enable is on, and the comm port is not busy. To be able to write all four registers, we have to write them in two write cycles because the Speed Reference register is not consecutive with the Direction, External Fault, and Fault Reset registers.

This rung writes values to the Direction, External Fault, and Fault Reset registers. This write occurs after rung 5 has completed the first write cycle.

(Continued following “Alternate Modbus Write Instruction”)
Alternate Modbus Write Instruction for DL06 and DL260 CPUs

The DL06 and DL260 CPUs offer “Modbus Read from Network” and “Modbus Write to Network” instructions that are easier to use than are the “Read from Network” and “Write to Network” instructions of the other DirectLOGIC CPUs. Rungs 11, 12, and 15 write the V3000 Speed Reference, V3002 Direction, V3003 External Fault, V3004 Fault Reset, and V3001 Run values to the corresponding drive Modbus decimal addresses 42331, 42333, 42334, 42335, and 42332. In the first MWX box, the slave start memory address is 42331, which is a Modbus decimal number (584/984 type). To convert 42311 decimal to hex, you first subtract 40001, and then convert the remainder to hex (91A). 91A is the address for the Serial Comm Speed Reference.

Note: Refer to your PLC User Manual for more specifics on Modbus addressing and address conversions.

(Continued next page)
Alternate Modbus Write Instruction for DL06 and DL260 CPUs (cont.)

This rung writes values to the Direction, External Fault, and Fault Reset registers. This write occurs after rung 5 has completed the first write cycle.

DL250-1/260 Comm SP116

Speed Reference Write Enable C10
Direction, Fault, Reset Write Enable C11

MWX
Port Number: K2
Slave Address: K1
Function Code: 06 - Preset Single Register
Start Slave Memory Address: 42332
Start Master Memory Address: V2000
Number of Elements: K3
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5000

Speed, Direction, Fault, Reset Writes Finished C13

This rung writes the new Run Command to the drive

DL250-1/260 Comm SP116

Run Command Write Enable C12

MWX
Port Number: K2
Slave Address: K1
Function Code: 16 - Preset Multiple Registers
Start Slave Memory Address: 42333
Start Master Memory Address: V3002
Number of Elements: K3
Modbus Data type: 584/984 Mode
Exception Response Buffer: V5002

Run Command Write Finished C14

The Run Command has its own separate write instruction in order to prevent a new Speed Reference, Direction, External Fault, or Fault Reset Command from causing a previous Run Command to be rewritten to the drive and overwriting a keypad Stop Command. (For P3.00 = 03; serial comm with keypad STOP enabled.)
DirectLOGIC Modbus Ladder Programming (cont.)

Rung 13 loads the new Speed Reference, Direction, External Fault, and Fault Reset Command values into the retained value registers, and resets the applicable Write Enable control relays. Now the program is ready for the next command change detection and write to the drive.

When both write cycles are completed, the retained values will be updated with new values, and the write enable is reset.

User Data Words:

V3000: Load P9.26 Speed Ref Command (with implied decimal place) here
Example: K150 for 15.0Hz
V3002: Load P9.28 Direction Command here
0 = Forward
1 = Reverse
V3003: Load P9.29 Ext Fault Command here
0 = No Action
1 = External Fault
V3004: Load P9.30 Fault Reset Command here
0 = No Action
1 = Fault Reset

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

Rungs 14 through 16 check for a Run Command change, write it to the drive, store the new value in the program register, and reset the enable control relays.

Rung 14

This rung monitors the Run Command for changes. If a change is detected, a write sequence is enabled to write the new value to the drive.

14

```
Kf201
LD
V4433
WX
O3001
LDA
K2
LD
```

15

```
DL250-1/260
Comm
SP116
Run Command
Write Enable
C12
```

The Run Command has its own separate write instruction in order to prevent a new Speed Reference, Direction, External Fault, or Fault Reset Command from causing a previous Run Command to be rewritten to the drive and overwriting a keypad Stop Command. (For P3.00 = 03; serial comm with keypad STOP enabled.)

16

```
Run Command
Write Enable
C12
Run Command
Write Finished
C14
```

When the Run Command write is complete, this rung updates the Run Command retained value with the new value, and resets the Write Enable.

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

Rungs 17 through 26 show an example of a method of inputting command values into the PLC.

17

This rung loads speed 1 into V3000.
LD: loads the constant value of 300 in BCD format;
BIN: converts from BCD to binary (HEX) format;
OUT: stores value in V3000 to instruct the drive to run at 30.0 Hz.

<table>
<thead>
<tr>
<th>X3</th>
<th>K300</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>BIN</td>
</tr>
<tr>
<td>OUT V3000</td>
<td></td>
</tr>
</tbody>
</table>

18

This rung loads speed 2 into V3000.
LD: loads the constant value of 600 in BCD format;
BIN: converts from BCD to binary (HEX) format;
OUT: stores value in V3000 to instruct the drive to run at 60.0 Hz.

<table>
<thead>
<tr>
<th>X3</th>
<th>K600</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>BIN</td>
</tr>
<tr>
<td>OUT V3000</td>
<td></td>
</tr>
</tbody>
</table>

19

This rung loads a value of 1 into V3001 for the drive Run Command

<table>
<thead>
<tr>
<th>X5</th>
<th>K1</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>OUT V3001</td>
</tr>
</tbody>
</table>

20

This rung loads a value of 0 into V3001 for the drive Stop Command

<table>
<thead>
<tr>
<th>X5</th>
<th>K0</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>OUT V3001</td>
</tr>
</tbody>
</table>

(Continued next page)
DirectLOGIC Modbus Ladder Programming (cont.)

This rung loads a value of 1 into V3002 for the drive Reverse Command
Reverse / Forward
X6

21
LD K1
OUT V3002

This rung loads a value of 0 into V3002 for the drive Forward Command
Reverse / Forward
X6

22
LD K0
OUT V3002

This rung loads a value of 1 into V3003 for the drive External Fault Command.
External Fault
X7

23
LD K1
OUT V3003

This rung loads a value of 0 into V3003 to remove the External Fault Command.
External Fault
X7

24
LD K0
OUT V3003

This rung loads a value of 1 into V3004 for the drive External Fault Reset Command
External Fault Reset
X8

25
LD K1
OUT V3004

This rung loads a value of 0 into V3004 to remove the External Fault Reset Command
External Fault Reset
X8

26
LD K0
OUT V3004

27
(END)
DirectLOGIC Modbus Ladder Programming (cont.)

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 writing to any of the parameters from P0.00 to P8.01, a group of 15 block transfer parameters (P9.11 to P9.25) is available in the GS2 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 WX commands.

For example: If you need to change the PID setpoint (P7.11), accel time (P1.01), and multi-speed 1 (P5.01), this would typically take three different WX commands because the parameters are non-sequential. However, by setting P9.11 to P7.11, P9.12 to P1.01, and P9.13 to P5.01, the parameters become sequential, and can be controlled using one WX command (LD Kf201, LD K6, LDA Oxxxx, WX V4413).
Communicating with Third-party Devices

First you must decide what type of interface will work best for your application. The GS2 RJ-12 Serial Comm Port can accommodate an RS232C or an RS-485 connection.

**RS-232C**

An RS-232C connection is somewhat limited. The maximum network cable length for an RS-232C connection is 15 meters (50 feet). In addition, using the RS-232C interface will allow you to connect only one AC drive to one Modbus device. For an RS-232C connection, set the GS2 DIP switches SW2 and SW3 to RS232.

RS-485

An RS-485 network cable can span up to 1000 meters (4000 feet). For an RS-485 connection, set the GS2 DIP switches SW2 and SW3 to RS485.

The GS2 Series AC drive communication address is specified by P9.00. The third party device then controls each AC drive according to its communication address. The GS2 Series AC drive can be setup 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.
### Data Format

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

- **P9.02 = 00:** (7 data bits, no parity, 2 stop bits)
  - Start bit: 0 1 2 3 4 5 6
  - Stop bit: 8-bit character
    - 10-bit character frame

- **P9.02 = 01:** (7 data bits, even parity, 1 stop bit)
  - Start bit: 0 1 2 3 4 5 6
  - Even parity: 8-bit character
    - 10-bit character frame

- **P9.02 = 02:** (7 data bits, odd parity, 1 stop bit)
  - Start bit: 0 1 2 3 4 5 6
  - Odd parity: 8-bit character
    - 10-bit character frame

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

- **P9.02 = 03:** (8 data bits, no parity, 2 stop bit)
  - Start bit: 0 1 2 3 4 5 6 7
  - Stop bit: 8-bit character
    - 11-bit character frame

- **P9.02 = 04:** (8 data bits, even parity, 1 stop bit)
  - Start bit: 0 1 2 3 4 5 6 7
  - Even parity: 8-bit character
    - 11-bit character frame

- **P9.02 = 05:** (8 data bits, odd parity, 1 stop bit)
  - Start bit: 0 1 2 3 4 5 6 7
  - Odd parity: 8-bit character
    - 11-bit character frame
## Communication Protocol

### ASCII Mode:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</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></td>
</tr>
<tr>
<td>CMD 1</td>
<td>Communication Address: 8-bit address consists of 2 ASCII codes</td>
</tr>
<tr>
<td>CMD 0</td>
<td></td>
</tr>
<tr>
<td>DATA (n-1)</td>
<td>Contents of data: n x 8-bit data consists of 2n ASCII codes.  n ≤ 25</td>
</tr>
<tr>
<td>......</td>
<td></td>
</tr>
<tr>
<td>DATA 0</td>
<td></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></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:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</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></td>
</tr>
<tr>
<td>DATA 0</td>
<td></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></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. Communication address equals 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 1</td>
<td>ADR</td>
</tr>
<tr>
<td>ADR 0</td>
<td>ADR</td>
</tr>
<tr>
<td>CMD 1</td>
<td>CMD</td>
</tr>
<tr>
<td>CMD 0</td>
<td>CMD</td>
</tr>
<tr>
<td>Starting data address</td>
<td>Number of data (Count by byte)</td>
</tr>
<tr>
<td>'2'</td>
<td>'1'</td>
</tr>
<tr>
<td>'1'</td>
<td>'1'</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'2'</td>
<td>'1'</td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
<td>Content of starting data address 2102H</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'0'</td>
<td>'0'</td>
</tr>
<tr>
<td>'2'</td>
<td>'0'</td>
</tr>
<tr>
<td>LRC CHK 1</td>
<td>LRC CHK 1</td>
</tr>
<tr>
<td>LRC CHK 0</td>
<td>LRC CHK 0</td>
</tr>
<tr>
<td>END 1</td>
<td>CR</td>
</tr>
<tr>
<td>END 0</td>
<td>LF</td>
</tr>
<tr>
<td>CR</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>Number of data (Count by byte)</td>
</tr>
<tr>
<td>21H</td>
<td>00H</td>
</tr>
<tr>
<td>02H</td>
<td>00H</td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
<td>Content of data address 2102H</td>
</tr>
<tr>
<td>00H</td>
<td>17H</td>
</tr>
<tr>
<td>02H</td>
<td>70H</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>Content of data address 2103H</td>
</tr>
<tr>
<td>CRC CHK High</td>
<td>00H</td>
</tr>
<tr>
<td>F7H</td>
<td>02H</td>
</tr>
<tr>
<td>FEH</td>
<td>02H</td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td>CRC CHK High</td>
</tr>
<tr>
<td>CRC CHK High</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 1'1</td>
<td>STX 1'1</td>
</tr>
<tr>
<td>ADR 1 0'1</td>
<td>ADR 1 0'1</td>
</tr>
<tr>
<td>ADR 0 1'1</td>
<td>ADR 0 1'1</td>
</tr>
<tr>
<td>CMD 1 0'6</td>
<td>CMD 1 0'6</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>17'</td>
<td>17'</td>
</tr>
<tr>
<td>0'</td>
<td>0'</td>
</tr>
<tr>
<td>1'1</td>
<td>1'1</td>
</tr>
<tr>
<td>0'</td>
<td>0'</td>
</tr>
<tr>
<td>1'</td>
<td>1'</td>
</tr>
<tr>
<td>17'</td>
<td>17'</td>
</tr>
<tr>
<td>17'</td>
<td>17'</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</td>
<td>Starting data address</td>
</tr>
<tr>
<td>20H</td>
<td>20H</td>
</tr>
<tr>
<td>00H</td>
<td>00H</td>
</tr>
<tr>
<td>Number of registers</td>
<td>Number of data</td>
</tr>
<tr>
<td>00H</td>
<td>(Count by word)</td>
</tr>
<tr>
<td>02H</td>
<td>00H</td>
</tr>
<tr>
<td>02H</td>
<td>02H</td>
</tr>
<tr>
<td>Byte count</td>
<td>CRC CHK Low</td>
</tr>
<tr>
<td>04H</td>
<td>CRC CHK High</td>
</tr>
<tr>
<td>Content of data</td>
<td>4AH</td>
</tr>
<tr>
<td>address 2000H</td>
<td>08H</td>
</tr>
<tr>
<td>00H</td>
<td></td>
</tr>
<tr>
<td>02H</td>
<td></td>
</tr>
<tr>
<td>Content of data</td>
<td></td>
</tr>
<tr>
<td>address 2001H</td>
<td></td>
</tr>
<tr>
<td>02H</td>
<td></td>
</tr>
<tr>
<td>58H</td>
<td></td>
</tr>
<tr>
<td>CRC CHK Low</td>
<td></td>
</tr>
<tr>
<td>CBH</td>
<td></td>
</tr>
<tr>
<td>CRC CHK High</td>
<td></td>
</tr>
<tr>
<td>34H</td>
<td></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.

<table>
<thead>
<tr>
<th>Command Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
</tr>
<tr>
<td>ADR 1</td>
</tr>
<tr>
<td>ADR 0</td>
</tr>
<tr>
<td>CMD 1</td>
</tr>
<tr>
<td>CMD 0</td>
</tr>
<tr>
<td>Starting data address</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LRC CHK 1</td>
</tr>
<tr>
<td>LRC CHK 0</td>
</tr>
<tr>
<td>END 1</td>
</tr>
<tr>
<td>END 0</td>
</tr>
</tbody>
</table>

01H+03H+04H+01H+00H+01H=0AH; the 2's complement negation of 0AH is F6H.

**RTU Mode:**

<table>
<thead>
<tr>
<th>Response Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR</td>
</tr>
<tr>
<td>CMD</td>
</tr>
<tr>
<td>Starting data address</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Number of data (Count by word)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>CRC CHK Low</td>
</tr>
<tr>
<td>CRC CHK High</td>
</tr>
</tbody>
</table>
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.

Note: 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.

```c
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{  // LSB(b0)=0
                reg_crc=reg_crc >>1;
            }
        }
    }
    return reg_crc;
}
```