# SERIAL COMMUNICATIONS

## COMMUNICATIONS PARAMETERS SUMMARY

A summary of the GS10 AC drives Communications Parameters is listed below.  Refer to "Parameters" Chapter 4 for a complete listing of all GS10 AC drives parameters, including details and Modbus addresses.

### SUMMARY – SERIAL COMMUNICATION PARAMETERS

| GS10 Parameters Summary – Communication Parameters (P09.xx) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | **Range** | **Run[1] Read/ Write** | **Modbus Address** | | **Settings** | | |
| | | | **Hex** | **Dec** | **Default[2]** | **User** | |
| 1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/write."  Read indicates "Read-only." | | | | | | | |
| 2) Parameters can be restored to their <u>default values</u> using P00.02. | | | | | | | |
| **P09.00** | Communication address | 1–254 | ♦R/W | 0900 | 42305 | 1 | |
| **P09.01** | COM1 transmission speed | 4.8–38.4 Kbps | ♦R/W | 0901 | 42306 | 38.4 | |
| **P09.02** | COM1 transmission fault treatment | 0: Warn and continue operation<br>1: Fault and ramp to stop<br>2: Fault and coast to stop<br>3: No warning, no fault, and continue operation | ♦R/W | 0902 | 42307 | 3 | |
| **P09.03** | COM1 time-out detection | 0.0–100.0 sec. | ♦R/W | 0903 | 42308 | 0.0 | |
| **P09.04** | COM1 communication protocol | 1: 7, N, 2 (ASCII)<br>2: 7, E, 1 (ASCII)<br>3: 7, O, 1 (ASCII)<br>4: 7, E, 2 (ASCII)<br>5: 7, O, 2 (ASCII)<br>6: 8, N, 1 (ASCII)<br>7: 8, N, 2 (ASCII)<br>8: 8, E, 1 (ASCII)<br>9: 8, O, 1 (ASCII)<br>10: 8, E, 2 (ASCII)<br>11: 8, O, 2 (ASCII)<br>12: 8, N, 1 (RTU)<br>13: 8, N, 2 (RTU)<br>14: 8, E, 1 (RTU)<br>15: 8, O, 1 (RTU)<br>16: 8, E, 2 (RTU)<br>17: 8, O, 2 (RTU) | ♦R/W | 0904 | 42309 | 13 | |
| **P09.09** | Communication response delay time | 0.0–200.0 ms | ♦R/W | 0909 | 42314 | 2.0 | |
| **P09.10** | Communication main frequency | 0.00–599.00 Hz | R/W | 090A | 42315 | 60.00 | |
| **P09.11** | Block transfer 1 | 0–65535 | ♦R/W | 090B | 42316 | 0 | |
| **P09.12** | Block transfer 2 | 0–65535 | ♦R/W | 090C | 42317 | 0 | |
| **P09.13** | Block transfer 3 | 0–65535 | ♦R/W | 090D | 42318 | 0 | |
| **P09.14** | Block transfer 4 | 0–65535 | ♦R/W | 090E | 42319 | 0 | |
| **P09.15** | Block transfer 5 | 0–65535 | ♦R/W | 090F | 42320 | 0 | |
| **P09.16** | Block transfer 6 | 0–65535 | ♦R/W | 0910 | 42321 | 0 | |
| **P09.17** | Block transfer 7 | 0–65535 | ♦R/W | 0911 | 42322 | 0 | |
| **P09.18** | Block transfer 8 | 0–65535 | ♦R/W | 0912 | 42323 | 0 | |
| **P09.19** | Block transfer 9 | 0–65535 | ♦R/W | 0913 | 42324 | 0 | |
| **P09.20** | Block transfer 10 | 0–65535 | ♦R/W | 0914 | 42325 | 0 | |
| **P09.21** | Block transfer 11 | 0–65535 | ♦R/W | 0915 | 42326 | 0 | |
| **P09.22** | Block transfer 12 | 0–65535 | ♦R/W | 0916 | 42327 | 0 | |
| **P09.23** | Block transfer 13 | 0–65535 | ♦R/W | 0917 | 42328 | 0 | |
| **P09.24** | Block transfer 14 | 0–65535 | ♦R/W | 0918 | 42329 | 0 | |

| GS10 Parameters Summary - Serial Communication Parameters (P09.xx) - (continued) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | | **Range** | **Run[1]** **Read/** **Write** | **Modbus Address** | | **Settings** | |
| | | | | **Hex** | **Dec** | **Default[2]** | **User** |
| **P09.25** | Block transfer 15 | 0–65535 | ♦R/W | 0919 | 42330 | 0 | |
| **P09.26** | Block transfer 16 | 0–65535 | ♦R/W | 091A | 42331 | 0 | |
| **P09.30** | Communication decoding method | 0: Decoding method 1 1: Decoding method 2 | R/W | 091E | 42335 | 1 | |

### BLOCK TRANSFER EXPLANATION

Block Transfer allows Parameters from many different Parameter Groups to be consolidated into one (or fewer) Modbus communication messages. This can greatly simplify PLC programming and reduce network traffic.

The Block Transfer parameters are P09.11 through P09.26. To use these parameters, enter the value of another parameter you wish to read or write through the keypad or GSoft2 configuration software. The parameter values must be converted by adding the upper byte value to the lower byte value, convert the sum to hex, then convert the hex to decimal.

*Example:*

Parameter P02.22. 0200 + 16 (hex of 22) = 0x0216 = result is 534. 534 is what would be entered in the Block Transfer parameter to read or write parameter P02.22.

*Examples of Block Transfer are below:*

1) Block transfer 1 (P09.11) = 0000 (AC Motor drive identity code). A Modbus read of P09.11 results in a value of 104. In this case, the drive is model # GS11-11P0 and corresponds to the value 104 in Parameter P00.00.

2) Block transfer 2 (P09.12) = 0006 (Firmware version). A Modbus read of P09.12 results in a value of 100. This is the firmware version of the GS10 drive.

3) Block transfer 3 (P09.13) = 8448 (decimal value of 0x2100 Status Monitor 1). A Modbus read of P09.13 returns the current status of Status Monitor 1.

4) Block transfer 4 (P09.14) = 8449 (decimal value of 0x2101 Status Monitor 2). A Modbus read of P09.14 returns the current status of Status Monitor 2.

5) Block transfer 5 (P09.15) = 8451 (decimal value of 0x2103 Output Frequency). A Modbus read of P09.15 returns the current running frequency of the GS10.

6) Block transfer 6 (P09.16) = 0268 (Acceleration time 1 is parameter P01.12. 12 = 0x0c. 0100 + 0c = 0x010C = 0268 decimal). A Modbus write to P09.16 will set the Acceleration time 1 value.

7) Block transfer 7 (P09.17) = 0269 (Deceleration time 1 is parameter P01.13. 13 = 0x0d. 0100 + 0d = 0x010d = 0269 decimal). A Modbus write to P09.17 will set the Deceleration time 1 value.

8) Block transfer 8 (P09.18) = 8192 (Control Word 1 (Run, Stop, etc…) is 0x2000 = 8192). A Modbus write to P09.18 will control the Run/Stop of the drive along with other items.

9) Block transfer 9 (P09.19) = 8193 (Control Word 2 (Frequency Command) is 0x2001 = 8193). A Modbus write to P09.19 will control the commanded Frequency of the drive.

Accessing all of the registers above would typically take about 6 Modbus messages but by blocking them together in the Block Transfer parameters, we can access everything with 1 read and 1 write.

## SERIAL MODBUS STATUS ADDRESSES

The *DURAPULSE* GS10 AC drive has status memory addresses that are used to monitor the AC drive. For complete listing, see page 4–195.

### STATUS ADDRESSES (READ ONLY)

| GS10 Addresses | | | | | |
|---|---|---|---|---|---|
| **Description** | | **Range** | | **Modbus Address** | |
| | | | | Hex | Dec | Octal |

| Description | | Range | | Modbus Address | | |
|---|---|---|---|---|---|---|
| | | | | Hex | Dec | Octal |
| Status Monitor 1 Read Only | Error Codes | 0: No Error<br>1: Overcurrent during Accel (ocA)<br>2: Overcurrent during Decel (ocd)<br>3: Overcurrent during normal speed (ocn)<br>4: Ground Fault (GFF)<br>6: Overcurrent during Stop (ocS)<br>7: Overvoltage during Accel (ovA)<br>8: Overvoltage during Decel (ovd)<br>9: Overvoltage during normal speed (ovn)<br>10: Overvoltage during Stop (ovS)<br>11: Low voltage during Accel (LvA)<br>12: Low voltage during Decel (Lvd)<br>13: Low voltage during normal speed (Lvn)<br>14: Low voltage during Stop (LvS)<br>15: Input phase loss (OrP)<br>16: IGBT Overheat (oH1)<br>18: IGBT temperature detection failure (tH1o)<br>21: Overload (oL) (150% 1Min, Inverter)<br>22: Motor1 Thermal Overload (EoL1)<br>23: Motor2 Thermal Overload (EoL2)<br>24: Motor Overheat-PTC (oH3)<br>26: Over Torque 1 (ot1)<br>27: Over Torque 2 (ot2)<br>28: Under current (uc)<br>31: EEPROM read error (cF2)<br>33: U phase current sensor detection error (cd1)<br>34: V phase current sensor detection error (cd2) | 35: W phase current sensor detection error (cd3)<br>36: CC Hardware Logic error 0 (Hd0)<br>37: OC Hardware Logic error 1 (Hd1)<br>40: Motor auto tune error (AuE)<br>41: PID Feedback loss (AFE)<br>48: Analog input signal loss (ACE)<br>49: External Fault (EF)<br>50: Emergency Stop (EF1)<br>51: Base Block (bb)<br>52: Password Error (Pcod)<br>54: PC Command error (CE1)<br>55: PC Address error (CE2)<br>56: PC Data error (CE3)<br>57: PC Slave error (CE4)<br>58: PC Communication Time Out (CE10)<br>63: Over Slip Error (oSL)<br>82: U Phase Loss (UPHL)<br>83: V Phase Loss (VPHL)<br>84: W Phase Loss (WPHL)<br>87: Overload protection at low frequency (oL3)<br>142: Auto-tune error 1 (AUE1)<br>143:  Auto-tune error 2 (AUE2)<br>149: Total resistance measurement fault (AUE5)<br>150:  No-load current IO measurement fault (AUE6)<br>151:  dq axis inductance measurement fault (AUE7)<br>152:  High frequency injection measurement fault (AUE8)<br>157:  Pump PID feedback error (dEv)<br>159: Gate driver error (Hd7) | 0611 | 41554 | 3021 |

**Note:** *Status Monitor 1 corresponds to P06.17 Fault Record 1.*

| Description | Range | | Modbus Address | | |
|---|---|---|---|---|---|
| | | | **Hex** | **Dec** | **Octal** |
| Status monitor read only | High byte: Warning code / Low Byte: Error code | | 2100 | 48449 | 20400 |
| | bit 1–0 | AC motor drive operation status<br>00B: The drive stops<br>01B: The drive is decelerating<br>10B: The drive is in standby status<br>11B: The drive is operating | 2101 | 48450 | 20401 |
| | bit 2 | 1: JOG command | | | |
| | bit 4–3 | Operation direction<br>00B: FWD running<br>01B: From REV running to FWD running<br>10B: From FWD running to REV running<br>11B: REV running | | | |
| | bit 8 | 1: Master frequency controlled by the communication interface | | | |
| | bit 9 | 1: Master frequency controlled by the analog / external terminal signal | | | |
| | bit 10 | 1: Operation command controlled by the communication interface | | | |
| | bit 11 | 1: Parameter locked | | | |
| | bit 12 | 1: Enable to copy parameters from keypad | | | |
| | bit 15–13 | Reserved | | | |
| | Frequency command (XXX.XX Hz) | | 2102 | 48451 | 20402 |
| | Output frequency (XXX.XX Hz) | | 2103 | 48452 | 20403 |
| | Display the drive's output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places. | | 2104 | 48453 | 20404 |
| | DC bus voltage (XXX.X V) | | 2105 | 48454 | 20405 |
| | Output voltage (XXX.X V) | | 2106 | 48455 | 20406 |
| | Current step for the multi-step speed operation | | 2107 | 48456 | 20407 |
| | Reserved | | 2108 | 48457 | 20410 |
| | Counter value | | 2109 | 48458 | 20411 |
| | Output power factor angle (XXX.X) | | 210A | 48459 | 20412 |
| | Output torque (XXX.X %) | | 210B | 48460 | 20413 |
| | Actual motor speed (XXXXX rpm) | | 210C | 48461 | 20414 |

Table title: **GS10 Addresses (continued)**

| Description | Range | | Modbus Address | | |
|---|---|---|---|---|---|
| | | | Hex | Dec | Octal |
| Command write only | bit 1–0 | 00B: No function | 2000 | 48193 | 20000 |
| | | 01B: Stop | | | |
| | | 10B: Run | | | |
| | | 11B: JOG + RUN | | | |
| | bit 3–2 | Reserved | | | |
| | bit 5–4 | 00B: No function | | | |
| | | 01B: FWD | | | |
| | | 10B: REV | | | |
| | | 11B: Change direction | | | |
| | bit 7–6 | 00B: 1st accel. / decel. | | | |
| | | 01B: 2nd accel. / decel. | | | |
| | | 10B: 3rd accel. / decel. | | | |
| | | 11B: 4th accel. / decel. | | | |
| | bit 11–8 | 000B: Master speed | | | |
| | | 0001B: 1st step speed frequency | | | |
| | | 0010B: 2nd step speed frequency | | | |
| | | 0011B: 3rd step speed frequency | | | |
| | | 0100B: 4th step speed frequency | | | |
| | | 0101B: 5th step speed frequency | | | |
| | | 0110B: 6th step speed frequency | | | |
| | | 0111B: 7th step speed frequency | | | |
| | | 1000B: 8th step speed frequency | | | |
| | | 1001B: 9th step speed frequency | | | |
| | | 1010B: 10th step speed frequency | | | |
| | | 1011B: 11th step speed frequency | | | |
| | | 1100B: 12th step speed frequency | | | |
| | | 1101B: 13th step speed frequency | | | |
| | | 1110B: 14th step speed frequency | | | |
| | | 1111B: 15th step speed frequency | | | |
| | bit 12 | 1: Enable bit 06–11 function | | | |
| | bit 14–13 | 00B: No function | | | |
| | | 01B: Operated by the digital keypad | | | |
| | | 10B: Operated by Pr.00-21 setting | | | |
| | | 11B: Change the operation source | | | |
| | bit 15 | Reserved | | | |
| Frequency command (XXX.XX Hz) | | | 2001 | 48194 | 20001 |
| | bit 0 | 1: E.F. (External Fault) ON | 2002 | 48195 | 20002 |
| | bit 1 | 1: Reset command | | | |
| | bit 2 | 1: B.B. ON | | | |
| | bit 4–3 | Reserved | | | |
| | bit 5 | 1: Enable fire mode | | | |
| | bit 15–6 | Reserved | | | |

## SERIAL COMMUNICATIONS OVERVIEW

The *DURAPULSE* GS10 RJ-45 Serial Comm Port will accommodate an RS-485 connection, through which the drive can be controlled by a remote master device on an RS-485 network spanning up to 1200 meters (4000 feet) of cable. RS-232 signals can be converted to RS-485 by using a separate converter.

The *DURAPULSE* GS10 AC drive communication address is specified in P9.00, and the remote master device can control each AC drive according to its individual communication address.

The *DURAPULSE* GS10 AC drive can be configured to communicate using either Modbus RTU or ASCII. The desired protocol is selected in parameter P09.04, COM1 Protocol. (The GS10 drive cannot use both protocols simultaneously.)

- *Standard Modbus protocol using ASCII or RTU transmission modes.*
  *Parameter P09.04, Communication Protocol, is used to select the desired mode, number of data bits, parity, and number of stop bits. The mode and serial parameters must be the same for all devices on a Modbus network.*

*DURApulse GS10 drives have a provision for shutting down control or power to the drive in the event of a communications time out. This feature can be set up through parameters P09.02 (COM1 transmission fault treatment) and P09.03 (COM1 time-out detection).*

## SERIAL COMMUNICATIONS CONNECTIVITY

*This section contains information regarding wiring connections to the GS10 RS-485 serial communication ports. For information regarding serial connections to AutomationDirect PLCs, please refer to Appendix D of this user manual, or to the applicable PLC user manual.*

### MINIMUM AC DRIVE PARAMETER SETTINGS FOR SERIAL COMMUNICATION

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

| Minimum Parameter Settings (for Communication to ADC PLC) | | |
|---|---|---|
| **Parameter Setting** | **Description** | **Setting Value Explanation** |
| **P00.21 = 02** | 1st Source of Operation Command [Remote] | 02: RS-485 communication input |
| **P00.31 = 02** | 2nd Source of Operation Command [Local] | 02: RS-485 communication input, Keypad STOP is Enabled (P00.32) |
| **P02.01~P02.05 = 56** | Multifunction Inputs (DI1-DI5) Definition | 56: Local/Remote selection |
| **P00.20 = 1** | 1st Source of Frequency Command [Remote] | 1: RS-485 communication input |
| **P00.30 = 1** | 2nd Source of Frequency Command [Local] | 1: RS-485 communication input |
| **P09.00 = 1~254** | Communication Address | 01~254 Drive Comm Address |
| **P09.01 = 4.8~38.4** | Transmission Speed | 4.8–38.4 Kbps |
| **P09.04 = 1 to 17** | COM1 Protocol | 1: 7, N, 2 (ASCII)<br>2: 7, E, 1 (ASCII)<br>3: 7, O, 1 (ASCII)<br>4: 7, E, 2 (ASCII)<br>5: 7, O, 2 (ASCII)<br>6: 8, N, 1 (ASCII)<br>7: 8, N, 2 (ASCII)<br>8: 8, E, 1 (ASCII)<br>9: 8, O, 1 (ASCII)<br>10: 8, E, 2 (ASCII)<br>11: 8, O, 2 (ASCII)<br>12: 8, N, 1 (RTU)<br>13: 8, N, 2 (RTU)<br>14: 8, E, 1 (RTU)<br>15: 8, O, 1 (RTU)<br>16: 8, E, 2 (RTU)<br>17: 8, O, 2 (RTU) |

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

## Common Third-Party Modbus RTU Masters
- *KEPSERVER EX 5.0 from www.kepware.com*
- *Modbus Poll from www.modbustools.com*

## AutomationDirect PLCs as Modbus Master

Serial Modbus-capable AutomationDirect PLCs can communicate with the GS10 drive.

Serial Modbus control is easier to accomplish from a PLC that has a built-in RS-485 port and supports dedicated Modbus messaging. [RS-232-only PLCs will require an RS-232–RS-485 converter (FA-ISOCON); and older PLCs may require programming to construct the Modbus strings.] We recommend PLCs with built-in RS-485 ports and dedicated Modbus serial commands: CLICK (with RS-485 ports), P1000, P2000, P3000, BRX/Do-more, DirectLogic (DL06, D2-260, or D2-262). Other PLC-Drive connectivity is possible: Please refer to the "Typical ADC PLC to GS10 Serial Connectivity Matrix" below.

*Typical ADC PLC to GS10 Serial Communications Connectivity*

| Typical ADC PLC to GS10 Serial Communications Connectivity Matrix | | | | | | |
|---|---|---|---|---|---|---|
| **Recommended PLC Connectivity** | | | | | **GS10** | |
| PLC | Port # | Port Type | **Communication** | **Direct Cable** | Port Type | Port # |
| CLICK | 3 | 3 screw terminals | RS-485 | Q8304-1 cable | RJ45 | n/a |
| D2-260 | 2 | HD15 | RS-485 | D2-DSCBL-2 | | |
| D2-262 | 2 | HD15 | RS-485 | D2-DSCBL-2 | | |
| DL06 | 2 | HD15 | RS-485 | D2-DSCBL-2 | | |
| BRX/Do-more | RS-485 | 3 screw terminals | RS-485 | Q8304-1 cable | | |
| Do-more H2-DM1 | RS-232 | RJ12 | RS-232 to RS-485 | FA-ISOCON with Q8304-1 cable | | |
| P1-550 | RS-485 | 4 screw terminals | RS-485 | Q8304-1 cable | | |
| P2-550 | RS-485 | 3 screw terminals | RS-485 | Q8304-1 cable | | |
| P3-530 | RS-485 | 3 screw terminals | RS-485 | Q8304-1 cable | | |
| P3-550 | RS-485 | 3 screw terminals | RS-485 | Q8304-1 cable | | |
| P3-550E | RS-485 | 3 screw terminals | RS-485 | Q8304-1 cable | | |
| **Other PLC Connectivity** | | | – | – | | |
| D2-250-1 | 2 | HD15 | RS-485 | D2-DSCBL-2 | | |
| D4-450/D4-454 | 1 | DB25 | RS-232 to RS-485 | FA-ISOCON with Q8304-1 cable | | |
| DL05 | 2 | RJ12 | RS-232 to RS-485 | FA-ISOCON with Q8304-1 cable | | |
| DL06 + DCM | 2 | HD15 | RS-485 | D2-DSCBL-2 | | |
| Do-more H2-DM1 + H2-SERIO-4 | 3 | 5 screw terminals | RS-485 | Q8304-1 cable | | |
| Do-more T1H-DM1 | RS-232 | RJ12 | RS-232 to RS-485 | FA-ISOCON with Q8304-1 cable | | |
| P2-SCM | 4 | 4 screw terminals | RS-485 | Q8304-1 cable | | |
| P3-SCM | 4 | 4 screw terminals | RS-485 | Q8304-1 cable | | |

## CONNECTING COMMUNICATION CABLES

*A 120 ohm external terminating resistor is required for the drive end.  An external termination resistor may be required on the other end of RS-485 network; especially on long runs.  Select resistors that match the impedance of the cable (between 100Ω and 500Ω).*

The *DURAPULSE* GS10 serial communication port is an RS-485 input.  That means the user can use standard RJ45 patch cables or industrial RS-485 cabling to access the comm port.  GS10 to GS10 serial connections can be accomplished with standard Ethernet patch cables (do not use cross-over cables).  RS-232 signals can be converted to RS-485 by using a separate converter (see the FA-ISOCON drawings on ).

### *DURApulse GS10 RS-485 Serial Comm Ports*
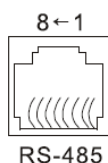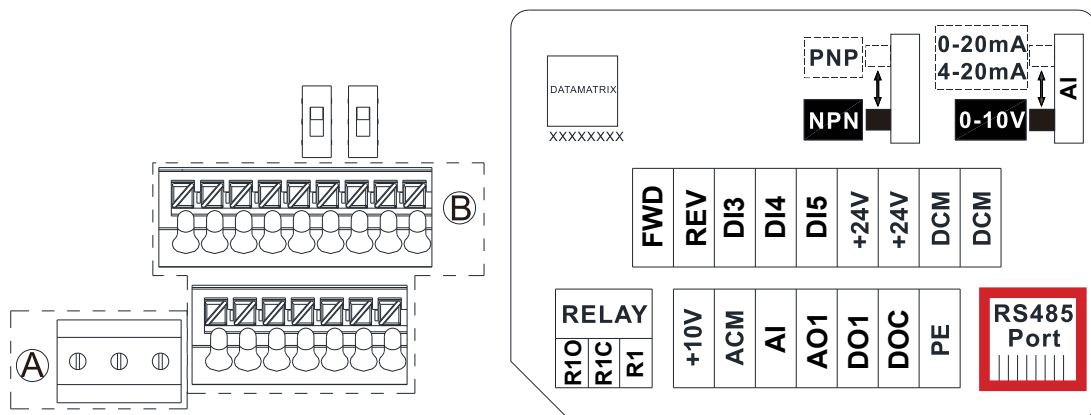
Modbus RS-485
8 ← 1
Pin 1, 2, 6: Reserved
Pin 3, 7: SGND
Pin 4: SG-
Pin 5: SG+
Pin 8: +10VS
RS-485

*Recommended RS-485 cable:  Belden 9842, AutomationDirect L19954 series, or equivalent.*

### RS-232C to RS-485 Conversion

An RS-485 network cable can span up to 1200 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.
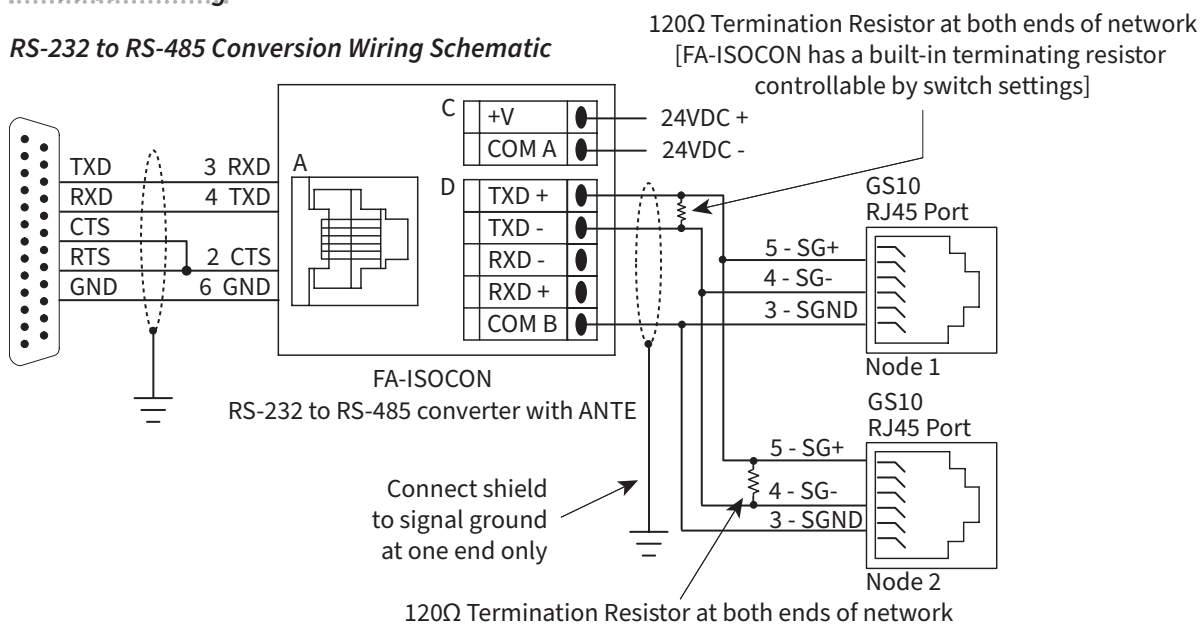
*If an FA-ISOCON module is used, set the module dipswitches as required.*
*Refer to the FA-ISOCON manual for more detailed information.*

### FA-ISOCON Switch Settings:

- • S21–S23:  OFF, ON, ON (19200 baud)
- • S24–S27:  OFF (Automatic Network Transmit Enable)
- • *Terminate:  ON (end of run term resistors)*
- • *Bias (2):  ON (end of run bias resistors)*
- • *1/2 DPX (2):  ON (RS-485 TXD/RXD jumpers)*

Helpful Hint:  Some applications require that the FA-ISOCON baud rate is set faster than the drive/network baud rate.

**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

### FA-ISOCON Wiring

**RS-232 to RS-485 Conversion Wiring Schematic**



For information regarding configuration of AutomationDirect PLCs or other PLCs, please refer to Appendix C of this user manual, or to the applicable PLC user manual for your application.

## Detailed Serial Modbus Communication Information

The GS10 drive follows the standard Modbus RTU and Modbus ASCII protocols. The following pages provide some brief information on this but if your device does not support these protocols natively and you are required to develop this framework on your own, consult the more detailed documentation at www.modbus.org.
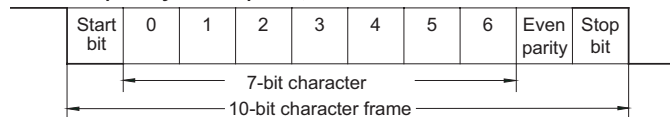
### Data Format

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

P09.04 = 01 (7 data bits, no parity, 2 stop bits)
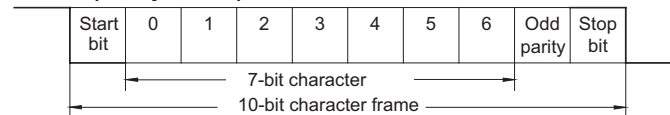
| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Stop bit | Stop bit |
|---|---|---|---|---|---|---|---|---|---|

7-bit character
10-bit character frame
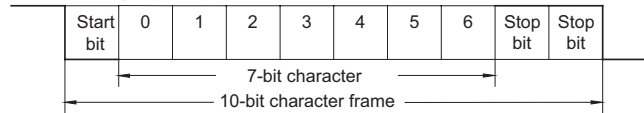
P09.04 = 02 (7 data bits, even parity, 1 stop bit)

| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Even parity | Stop bit |
|---|---|---|---|---|---|---|---|---|---|

7-bit character
10-bit character frame

P09.04 = 03 (7 data bits, odd parity, 1 stop bit)

| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Odd parity | Stop bit |
|---|---|---|---|---|---|---|---|---|---|

7-bit character
10-bit character frame

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

P09.04 = 13 (8 data bits, no parity, 2 stop bits)

| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Stop bit | Stop bit |
|---|---|---|---|---|---|---|---|---|---|---|

8-bit character
11-bit character frame
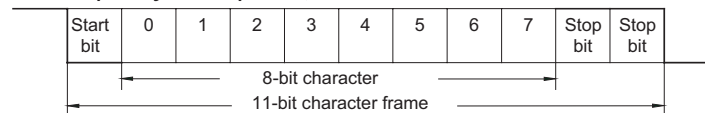
P09.04 = 14 (8 data bits, even parity, 1 stop bit)

| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Even parity | Stop bit |
|---|---|---|---|---|---|---|---|---|---|---|

8-bit character
11-bit character frame
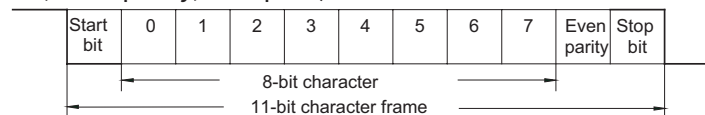
P09.04 = 15 (8 data bits, odd parity, 1 stop bit)

| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Odd parity | Stop bit |
|---|---|---|---|---|---|---|---|---|---|---|

8-bit character
11-bit character frame
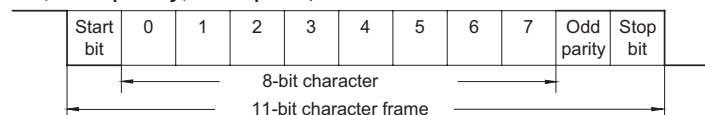
## COMMUNICATION PROTOCOL

### ASCII Mode:

| STX | Start Character: (3AH) |
|---|---|
| ADR 1 | Communication Address: 8-bit address consists of 2 ASCII codes |
| ADR 0 | |
| CMD 1 | |
| CMD 0 | |
| DATA (n-1) | Contents of data: n x 8-bit data consists of 2n ASCII codes.  n ≤ 25 maximum of 50 ASCII codes |
| ....... | |
| DATA 0 | |
| LRC CHK 1 | LRC check sum: 8-bit check sum consists of 2 ASCII codes |
| LRC CHK 0 | |
| END 1 | END characters: END 1 = CR (0DH); END 0 = LF (0AH) |
| END 0 | |

### RTU Mode:

| START | A silent interval of more than 10 ms |
|---|---|
| ADR | Communication Address: 8-bit address |
| CMD | Command Code: 8-bit command |
| DATA (n-1) | Contents of data: n x 8-bit data, n ≤ 25 |
| ....... | |
| DATA 0 | |
| CRC CHK Low | CRC check sum: 16-bit check sum consists of 2 8-bit characters |
| CRC CHK High | |
| END | A silent interval of more than 10 ms |

### 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 acknowledge any message from 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 followed: 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:_

| Command Message | | Response Message | |
|---|---|---|---|
| STX | ':' | STX ':' | ':' |
| ADR 1 | '0' | ADR 1 | '0' |
| ADR 0 | '1' | ADR 0 | '1' |
| CMD 1 | '0' | CMD 1 | '0' |
| CMD 0 | '3' | CMD 0 | '3' |
| Starting data address | '2' | Number of data (Count by byte) | '0' |
| | '1' | | '4' |
| | '0' | Content of starting data address 2102H | '1' |
| | '2' | | '7' |
| Number of data (Count by word) | '0' | | '7' |
| | '0' | | '0' |
| | '0' | | '0' |
| | '2' | Content data address 2103H | '0' |
| LRC CHK 1 | 'D' | | '0' |
| LRC CHK 0 | '7' | | '0' |
| END 1 | CR | LRC CHK 1 | '7' |
| END 0 | LF | LRC CHK 0 | '1' |
| | | END 1 | CR |
| | | END 0 | LF |

_RTU mode:_

| Command Message | | Response Message | |
|---|---|---|---|
| ADR | 01H | ADR | 01H |
| CMD | 03H | CMD | 03H |
| Starting data address | 21H | Number of data (Count by byte) | 04H |
| | 02H | | '0' |
| Number of data (Count by word) | 00H | Content of data address 2102H | 17H |
| | 02H | | 70H |
| CRC CHK Low | 6FH | Content of data address 2103H | 00H |
| CRC CHK High | F7H | | 02H |
| | | CRC CHK Low | FEH |
| | | CRC CHK High | 5CH |

### COMMAND CODE: 06H, WRITE 1 WORD

For example, writing 6000(1770H) to address 0100H of the AC drive with address 01H.

*ASCII mode:*

| Command Message | | Response Message | |
|---|---|---|---|
| STX | ':' | STX ':' | ':' |
| ADR 1 | '0' | ADR 1 | '0' |
| ADR 0 | '1' | ADR 0 | '1' |
| CMD 1 | '0' | CMD 1 | '0' |
| CMD 0 | '6' | CMD 0 | '6' |
| Data Address | '0' | Data Address | '0' |
| | '1' | | '1' |
| | '0' | | '0' |
| | '0' | | '0' |
| | '1' | Data Content | '1' |
| | '7' | | '7' |
| | '7' | | '7' |
| | '0' | | '0' |
| LRC CHK 1 | '7' | LRC CHK 1 | '7' |
| LRC CHK 0 | '1' | LRC CHK 0 | '1' |
| END 1 | CR | END 1 | CR |
| END 0 | LF | END 0 | LF |

*RTU mode:*

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

| Command Message | | Response Message | |
|---|---|---|---|
| ADR | 01H | ADR | 01H |
| CMD | 10H | CMD | 10H |
| Starting data address | 20H | Starting data address | 20H |
| | 00H | | 00H |
| Number of registers | 00H | Number of data (Count by word) | 00H |
| | 02H | | 02H |
| Byte count | 04H | CRC CHK Low | 4AH |
| Content of data address 2000H | 00H | CRC CHK High | 08H |
| | 02H | | |
| Content of data address 2001H | 02H | | |
| | 58H | | |
| CRC CHK Low | CBH | | |
| CRC CHK High | 34H | | |

> NOTE Concerning 2100h:  When GS10 drive is setup with reference RS-485 (P00.20 = 1 and drive in Remote/Auto) –OR– (P00.30 = 1 and drive in Local/Hand) –AND– Reference > P01.00 Drive Max Out Freq, the GS10 drive goes up to Max Out Freq and remains there until Max Out Freq is modified or a lower Freq Ref or a Stop Command is sent to the drive.

## 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' | 01h+03h+04h+01h+00h+01h=0Ah; the 2's complement negation of 0Ah is F6h. |
| | '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:_

10) Load a 16-bit register (called CRC register) with FFFFh.
11) 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.
12) Shift the CRC register one bit to the right with MSB zero filling.  Extract and examine the LSB.
13) If the LSB of CRC register is 0, repeat step 3; else Exclusive or the CRC register with the polynomial value A001h.
14) Repeat step 3 and 4 until eight shifts have been performed.  When this is done, a complete 8-bit byte will have been processed.
15) 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._