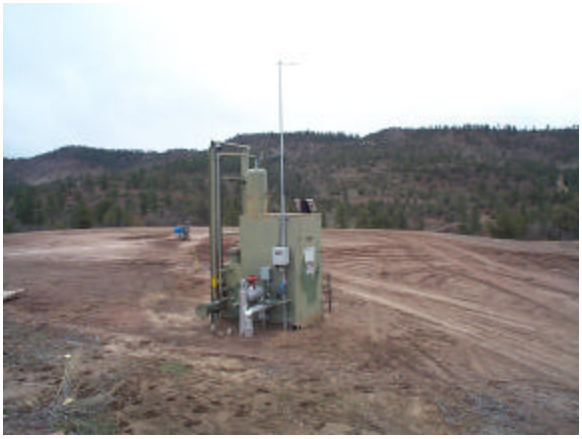
Control Design, Inc.

C46 Technical Manual

Firmware Revision v6.0x.xx
Firmware Revision v6.1x.xx

For Hardware Revision F (Model 6)

May 2005



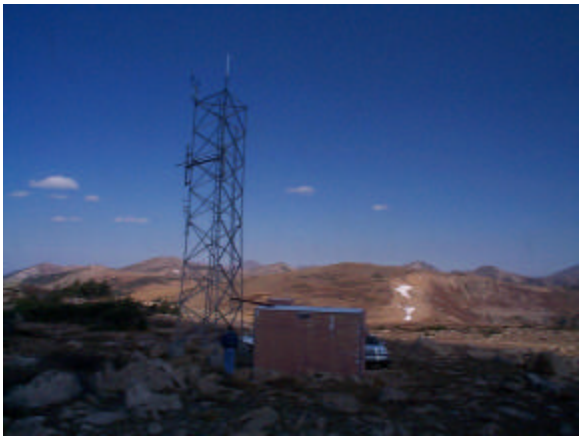


TABLE OF CONTENTS

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1.0 Specifications

1.1 General

Modem Version 6.1x.xx, 6.0x.xx Firmware revisions and Model 6 (F) hardware.

Protocol – Modem & I/O	Modbus RTU. Modem programmable using Modbus. I/O uses Modbus RTU for Input and Output control. RTU programs and responds over radio or serial port to all commands.
Communication Port(s)	COM 0, RS232 Only, D9 Male, C4x Basic52 Console and Programming Port. COM 1, RS232 or RS485, Terminal Block connection, C4x Modbus Port. COM 2 RS232 or RS485, D9 Female, C4x Radio Modem port supports most protocols or data formats for use with Radio Modem and allows access to Basic52 and Modbus I/O Registers.
Modbus Functions Supported by Modem and I/O	03 -- (4x) Read Holding Registers 05 -- (0x) Force Single Coil 06 -- (4x) Preset Single Register 16 -- (4x) Preset Multiple Registers 17 -- Report Slave ID (also reports serial #, Firmware Rev, configuration registers)

1.2 RF Data

Data Encoding/Recovery	Modified Manchester encoding technique with proprietary receive clock fast/continuous sync algorithm combined with encryption encoding/recovery.
Encryption	64 to 128 bit scheme over radio channel
RF Data Speed	4800/5800/6400/7200 bps user selectable, 25Khz radio 4800/5800/6400 bps user selectable, 12.5Khz radio
Data Buffer	152/136 bytes w/Firmware v6.0x.xx 288 to 1776 bytes w/Firmware v6.1x.xx
Store and Forward	Up to 4. Target Slave will program return path automatically or user can set fixed path. Modbus RTU protocol is supported for intelligent routing in Standard Firmware v6.1x.xx.
Error Checking	CRC-16 on RF packet, CRC-16 on Modbus packet, LRC-8 on RF packet, Frame Error check (Start/Stop Bits) on each byte.
Packet Accuracy	Greater than 99.999%.
Packet Success Rate	Greater than 95% without retries on any average radio channel (12 to 15db Sinad) at 4800 bps RF rate.
BER (Bit Error Rate) (Worst case using CDI digital radio)	1 x 10-5 @ -113dbm, 1 x 10-8 @ -110dbm, 1 x 10-8 @ -107dbm

1.3 Programmable Features

Control Design Basic Extensions v1.08 and later, Intel Basic 52 v1.1

Programming Language	Basic 52 based on the original Intel Basic Interpreter v1.1 Specification for the 8052 Microcontroller. CDI Extensions to the Basic 52 Interpreter include: • 2x5 Keypad support • LC Display support • Real Time Clock with Interrupts • Modbus for 16 and 32bit FP Registers
Memory Specifications	Basic 52 Operating SRam > 64K w/Battery Backup Total External Data SRam > 128K w/Battery Backup Internal Program Memory > 64K Flash Internal Data Memory > 32K of 64K Program Flash
Modbus RTU Holding Registers Support	General Purpose 16 Bit Integer Registers @ 4x4001 thru 4x4500. General Purpose 32 Bit Floating Point Registers @ 4x7001 thru 4x7500 and 4x10,001 thru 4x26,384
Input/Output Specifications	Basic 52 supports all Analog, Digital and Specialized I/O ports through Modbus Register access using Basic 52 (Com0) or direct Modbus (Com1) addressing. Registers @ 4x0001 thru 4x0013 support I/O functions.
Radio Modem Interface	Direct access to the Modbus operating system is provided internally through the Radio Modem connection via RS485 bus.
Setup Features	Programmable Features for I/O control and General operation are accessible as Setup Registers @ 4x4807 thru 4x4827

1.3.0 C46A I/O Ports

Analog Input Ports	8 each, 12 bit, 0-5vdc, 0-20ma dc or 4-20ma dc. 1 each, 12 bit, Power Supply Input voltage monitor. Range= 0 to 30VDC. Multiplier= .007326 1 each, 12 bit, Battery Supply Input voltage monitor. Range= 0 to 30VDC. Multiplier= .007326 Inputs 1 thru 8 are user accessible on the terminal blocks. Inputs 9 and 10 are internally dedicated to Power & Battery.
Digital/Pulse Counter Inputs	8 each, Optically isolated to 4000 volts, +10 to 24vdc input or Ground (active state = +voltage or ground applied) . Digital Inputs 5 thru 8 are jumper and software selectable as Pulse Counter Inputs.
Digital/Analog Outputs	4 each, Form C, Non-Latching, 1 amp @24VDC or 125VAC Relays. Digital Outputs 3 and 4 are jumper and software selectable for Analog Output operation with 0-5 Volt or 4-20 Milliamp Analog outputs.
RS485 Interface	RS485 Communication Port, COM 1, is accessible on the upper terminal block for communication to Smart Sensors or other RS485 devices.
SDI-12 Interface	Serial Digital Interface @1200 Baud is accessible by jumper selection on Analog Input 8 for communication to SDI Compatible Sensors.
Sensor Power Switched Voltage Output 1 (SWV+1)	Supplied to lower terminal block from Battery input voltage. 750 Milliamp output current with PTC (Thermal automatic reset) protection. A Built-In, Software selectable, Power saver feature allows switched power to sensors to be automatically applied from SWV+1 or this SWV+ can be controlled from software.
Sensor Power Switched Voltage Output 2 (SWV+2)	Supplied to upper terminal block from a switched step-up voltage converter. 24VDC is supplied to this V+ output. This SWV+ can be switched via software with SWV+1.

1.3.1 C46B I/O Ports

Analog Input Ports	4 each, 12 bit, 0-5vdc, 0-20ma dc or 4-20ma dc. 1 each, 12 bit, Power Supply Input voltage monitor. Range= 0 to 30VDC. Multiplier= .007326 1 each, 12 bit, Battery Supply Input voltage monitor. Range= 0 to 30VDC. Multiplier= .007326 Inputs 1 thru 4 are user accessible on the terminal blocks. Inputs 9 and 10 are internally dedicated to Power & Battery.	
Digital Inputs	4 each, Optically isolated to 4000 volts, +10 to 24vdc input or Ground (active state = +voltage or ground applied) .	
Digital Outputs	2 each, Form C, Non-Latching, 1 amp @24VDC or 125VAC Relays.	
RS485 Interface	RS485 Communication Port, COM 1, is accessible on the upper terminal block for communication to Smart Sensors or other RS485 devices.	
Sensor Power Switched Voltage Output 1 (SWV+1)	Supplied to lower terminal block from Battery input voltage. 750 Milliamp output current with PTC (Thermal automatic reset) protection. A Built-In, Software selectable, Power saver feature allows switched power to sensors to be automatically applied from SWV+1 or SWV+1 can be controlled from software.	

1.4 Modem RF Interface

JP12 IDC 10 Pin: Pin 1= RFT Tx Data output to radio Pin 2= CD Active low input from radio carrier detect Pin 3= RFR Rx Data input from radio Pin 4= Frequency select F1/F2 Pin 5= PTT Active low output to radio transmit PTT Pin 6= RSSI input from Ritron Pin 7= GND Ground Pin 8= SPK Input from radio speaker audio output Pin 9= PWR +12v to radio (1.5 amp max) Pin 10= Programming line to Com2 Pin 4 (Ritron)	
Data Input	500mv to 1vrms
Data Output	250mvrms
Frequency response	0 to 2500 Hz, Flat

1.4 Serial Interfaces

Serial Ports	COM 0, RS232 Only, D9 Male, Basic52 Console and Programming Port. COM 1, RS232 or RS485, Terminal Block connection, Modbus Port. COM 2 RS232 or RS485, D9 Female, Radio Modem port supports most protocols or data formats for use with Radio Modem and allows access to Basic52 and Modbus I/O Registers.
Serial Data Speed	COM 0 > 1200 thru 115,200bps, Default = 19,200bps. COM 1 > 1200 thru 115,200bps, Default = COM 2 > 1200 thru 19,200bps, Default = 9600bps.
Serial Parity	COM 0 > Fixed at None and 8 Data Bits COM 1 > Fixed at None and 8 Data Bits COM 2 > None, Even, or Odd, 7 or 8 Data Bits. Default = None and 8 Data Bits.
Serial Connections: (COM 0 wired as DTE) (COM 1 wired to terminals) (COM 2 wired as DCE)	COM 0 > D9 Male connector: 2=Serial TX, 3=Serial RX, 5=Ground COM 1 > TB3-4=232 RX/485 +, TB3-5=232 TX/485 -, TB3-7=Ground. COM 2 > D9 Female connector: 1=CD (+5v) , 2=Serial TX, 3=Serial RX, 5=Ground, 6=RS485+, 7=Unused, 8=Unused, 9=RS485-
	Modem and I/O can be operated locally through serial port. Transparent data throughput for use with other serial devices also.
	Auto time-out for data send at end of data input to modem. Xon/Xoff flow control supported.
Serial Port Uses	Local control of I/O, Local programming of Modem & I/O, Local attachment of serial devices such as PLC's, ASCII devices, Etc. for transparent data throughput or storage.

1.5 Electrical

C46 Current Draw	Modem and I/O board w/Standard Radio: C46A C46B Leds On >>>> ?? ma ?? ma Leds Off >>>> ? ma ?? ma Each active DI add >> ? ma Each active DO add > ? ma Com Port in use add > ? ma Radio off delete >>>> ? ma
C46 Input Voltage	BATTERY INPUT : Unit with Standard Radio =10 VDC min to 15 VDC max Unit without Radio =6 VDC min to 24 VDC max POWER SOURCE INPUT: All units = 15 VDC to 24 VDC. 15 VDC minimum required to charge battery.

1.6 Physical

Temperature Range C46A and C46B: Industrial Temperature Range Radio: Commercial (Standard)	-40 to 185 Deg F (-40 to +85 Deg C) -22 to 140 Deg F (-30 to +60 Deg C)
C18A Unit Size C18B Unit Size	8.0” Wide x 10.0” High x 6.5” Deep 6.0” Wide x 8.0” Tall x 4.5” Deep
C46A and C46B PCB Sizes	0.00" Wide x 0.00" Long x 0.00” Tall
C46A Aluminum Bracket Unit Size C46B Aluminum Bracket Unit Size	Bracket A = 7.0” Wide x 5.50” High x 2.75” Tall

2.0 C46 MODEM-> MODBUS COMPATIBLE REGISTER INFORMATION

This information is for Modem Code Revisions v6.1x.xx and v6.00.xx

All Modem registers are organized as 16 bit Modbus compatible Integer registers.

2.1 Modem Registers 0x0001 thru 0x0004 and 0x9900 thru 0x9916

Registers 0x0001 thru 0x0004 are the 4 Digital Outputs (Coils).
Registers 0x9900 thru 0x9916 are special purpose bits.

Functions used to support Registers 1 thru 4 and 9900 thru 9916: 05

Register #:	**Use:**	**Description:**
0x0001	Digital Output 1	Relay 1 on C46A/B
0x0002	Digital Output 2	Relay 2 on C46A/B
0x0003	Digital Output 3	Relay 3 on C46A
0x0004	Digital Output 4	Relay 4 on C46A
0x9900	Set/Clear silent in ram NOTE: No response is returned in Silent mode.	Force data= 0 to set Silent mode, >0 to set Active mode NOTE: Functions in Silent or Active mode.
0x9901	Set/Clear silent in EEProm NOTE: No response is returned in Silent mode.	Force data= 0 to set Silent mode, >0 to set Active mode NOTE: Functions in Silent or Active mode.
0x9902	Frequency Select F1/F2 NOTE: No response is returned to this command. (v6.1x.08 & up only)	Force data= 0 to select F1, >0 to select F2 NOTE: Functions in Silent mode only.
0x9903	Not Used	
0x9904	Not Used	
0x9905	Not Used	
0x9906	Not Used	
0x9907	Not Used	
0x9908	Not Used	
0x9909	Not Used	
0x9910	Not Used	
0x9911	Not Used	
0x9912	Not Used	
0x9913	Not Used	
0x9914	Not Used	
0x9915	RF Test Mode B	Force Data 0=Return error, >0=Activate Test 2 Transmits 100 data packets in ~20 seconds or less to test RF Link.
0x9916	RF Test mode A Also initiated by pressing Switch 1 on CPU45 PCB.	Force Data 0=Return error, >0=Activate Test 1 Transmits Sine Wave for ~10 seconds then 101010 pattern for ~10 seconds.

2.20 Modem Registers 4x0001 to 4x0032 Summary

Registers 4x0001 thru 4x0010 are unused registers in the Modem.
Registers 4x0011 thru 4x0032 are used for various functions as described in the following pages.
Modem must be in ACTIVE mode to access (read/write) these registers.
Functions used to support Registers: 03, 06, 16

Register #	Use:	Description:
4x0001 thru 4x0010	Unused	
4x0011	Optional Log Buffer	
4x0012	SDI-12 Port on "A" units only.	
4x0013	Unused	
4x0014	Unused	
4x0015	Setup features - Silent Mode, Com Port Disable, SnF, Com Parity, Etc.	See Page
4x0016	Setup features - Frequency select	See Page
4x0017	Setup features - LED control	See Page
4x0018	RF Port Rate and Com Port Rate	
4x0019	Modem ID	
4x0020	RF Port Keyup Delay	
4x0021	Timer 1 Rate	
4x0022	CTS Delay	
4x0023	Frame Sync and Start/Stop Bit Error Counts	
4x0024	LRC and CRC Error Counts	
4x0025	Data Packets Received Count	
4x0026	Total Buffer Memory in Modem	
4x0027	User Data Available Buffer Memory	
4x0028	Hi Byte=Internal Operating Flags Lo Byte=SnF # of SnFs in Route	
4x0029	Hi Byte=SnF Return Path 1 Lo Byte=SnF Return Path 2	
4x0030	Hi Byte=SnF Return Path 3 Lo Byte=SnF Return Path 4	
4x0031 and 4x0032	Unused	

2.21 Modem Registers 4x0033 to 4x4096 Summary

Registers 4x0033 thru 4x0544 are non-volatile memory registers in the Modem used for Store and Forward routing information.
Registers 4x0545 thru 4x4096 are used for Extended Store and Forward Routing Tables, the Optional Data Log Buffer or are Unused non-volatile memory registers in the Modem.
Modem must be in ACTIVE mode to access (read/write) these registers.
Functions used to support Registers: 03, 06, 16

Register #	Use:	Description:
4x0033	Upper Memory Reset Data Value= 32383 Decimal	Changing this value will cause Registers from 4x0025 up to be cleared on Reset.
4x0034	Lower Memory Reset Data Value= 32383 Decimal	Changing this value will cause Registers from 4x0024 down to be cleared on Reset.
4x0035 thru 4x0544	Store and Forward Routing Table Information for Standard Modbus	Applicable to all devices.
4x0545 thru 4x1024	Extended SnF Routing, Data Log Buffer or Unused Memory.	Applicable to all devices with the 2K EEPROM.
4x0545 thru 4x2048	Extended SnF Routing, Data Log Buffer or Unused Memory.	Applicable to all devices with the 4K EEPROM.
4x0545 thru 4x4096	Extended SnF Routing, Data Log Buffer or Unused Memory.	Applicable to all devices with the 8K EEPROM.

2.3 Modem Log Data Register 4x0011

This feature is NOT currently supported in any Modem Firmware Revision.
Registers 4x0011 is a specialized I/O port as described below.
Functions used to support this register vary and are given with this register.

4x0011 * Log Buffer Count Indicates number of bytes in Log Buffer

Non-volatile Log Buffer

Description
Version 6.x2.xx or higher firmware has a feature installed to allow data to be captured from an attached serial device to a non-volatile memory area (organized as Modbus Integer Registers) via the serial port connection (RS232 or RS485). This data can then be retrieved, using standard Modbus commands, later during routine polling.

The Modem must be in the Active Mode for this feature to be used.
Register 11 will indicate the number of bytes of data (NOT Registers) that has been stored in the buffer.

Register 4x0545 (see Section 2.xx for the log buffer registers information) is the actual memory area used to store the data.

Function 03 is used to read all Registers.
Function 16 writes allowed to Register:

Value:	Effect:
24929	Reset Log Buffer to beginning
24930	Unused
24931	Unused
24932	Reserved
24933	Reserved

* Log Buffer option is only available in specially equipped units.

2.4 Modem SDI-12 Register 4x0012

This information is for Code Revision v6.x1.xx or higher Modem Firmware.
Registers 4x0012 is a specialized I/O port as described below.
Functions used to support this register vary and are given with the register.

4x0012 ** SDI-12 Port

SDI-12 Support

Description
C4xA Modules can return data from an attached SDI device. The required SDI interface is built onto the Radio Modem section of the C4xA devices. The Modem must be in the Active Mode for this feature to be used.

Modbus Function 03 is used to read the SDI Register 12 as follows:

Slave ID = Modem ID
Start Register = 12
Number of Registers = SDI Device 0 thru 15
^ NOTE: The Modbus "Number of Registers" value, above, is used by the Modem to address the correct SDI sensor.

Also Note that NO other Functions or Registers are allowed with Register 12 ***- The SDI port must be the only register polled to return data! If any other registers are queried with register 12, an error response is returned.***

The C4xA Product supports only the "M" (command sensor to Measure) and "D" (retrieve Data) commands. The C4x will check for the sensor response to the "M" command and it will wait the sensor specified time before issuing the "D" command to get data. This is all handled internally by the C4x unit in response to the Modbus query to Register 12.

The SDI "D Command" Query is as follows:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Modbus ID	Modbus Function 03	Modbus Address Hi	Modbus Address Lo	Modbus #Regs Hi	Modbus #Regs Lo	Modbus CRC Hi	Modbus CRC Lo

The SDI "D Command" Response is as follows:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Modbus ID	Modbus Function 03	Modbus #Bytes	SDI ASCII ID (0-15)	SDI ASCII Command	SDI ASCII Command	SDI ASCII ! (End cmd)	SDI ASCII ID (0-15)
Byte 9	Byte 10	Byte 11	Byte 12 –17	Byte xx	Byte xx	Byte xx	Byte xx
SDI ASCII Data (+or -)	SDI ASCII Data 0-9 or Decimal	SDI ASCII Data 0-9 or Decimal	SDI ASCII Data varies to 9 chars	SDI ASCII Carriage Return (CR)	SDI ASCII Line Feed (LF)	Modbus CRC Hi	Modbus CRC Lo

2.5 Modem Unused Registers 4x0013 and 4x0014

Registers 4x0013 and 4x0014 are specialized I/O ports as described below.
Functions used to support these registers vary and are given with each register.

4x0013 Unused/Reserved

4x0014 Unused/Reserved

2.6 Modem Setup Register 4x0015 High Byte

Register 4x0015 is a bit programmable register for specific Modem setup as described below.
Functions used to support Register 15: 03, 06, 16

Bit #:	Description:	Binary Value:	Function: (* = Default Setting)
8	Selects whether I/O ports will be active along with modem functions. (Silent)	256	0=Modem Silent mode (Modem functions only) *1=Modem Active mode (Modem registers read/write)
9	Serial Port Disable (NoTxDa)	512	0=Serial port data will be transmitted to RF 1=Serial port data will NOT be sent to RF
10	Skip Carrier Detect routine. (SkipCd) *** NOTE:** this bit is for test purposes only!! Do NOT leave this bit set in normal operation.	1024	0=Check for RF busy at CD 1=Skip RF busy check at CD
11	Sniffer Bit (Snif0)	2048	0=Normal data sent to serial port 1=1st SnF response data only to serial port
12	CTS Enable (v6.1x.xx) (CTS) NOTE: There is no hardware to support the CTS output on the C46 PCB. The CTS Delay in Reg 22 will function.	4096	0=No CTS delay added to serial port output 1=CTS delay added to serial port output plus CTS pin on serial port becomes active during delay. See Register 22 low for delay time.
13	Unused	8192	0= 1=
14	Unused	16384	0= 1=
15	Skip CRC16 check on Modbus data. (SkipCrc) NOTE: This works in the Modem ONLY.	32768	0=Test Modbus CRC value. 1=Do NOT test Modbus CRC value.

2.7 Modem Setup Register 4x0015 Low Byte

Bit #:	Description:	Binary Value:	Function: (* =Default setting)
0	Store and Forward feature. Prevents forwarded packet form appearing at serial port until final response. (PktDmp)	1	* 0= All data to serial port. 1= SnF Response data only to serial port.
1	Store and Forward method 1: Automatic or Lookup using Modbus address. (SnF01)	2	* 0=SnF return path = automatic (Slave Only) 1= SnF uses lookup w/Modbus slave ID (Master/Slave)
2	Store and Forward method 2: (SnF02)	4	* 0= Use SnF method 1 (Bit 1) 1= Use path in Reg 35, 36 for all data.
3 4	These 2 bits determine parity, data and stop bits of serial port. (Parity0) (Parity1)	8 16	0 0 1 1 0 1 0 1 -Odd, 8 data, 1 stop -Even, 9 data, 1 stop -None, 8 data, 2 stop -None, 8 data, 1 stop
5	Unused	32	0= 1=
6	Unused	64	0= 1=
7	Unused	128	0= 1=

2.8 Modem Setup Register 4x0016 High Byte

Register 4x0016 is a bit programmable register for specific setup items as described below.
Functions used to support Register 16: 03 06, 16

Bit #:	Description:	Binary Value:	Function: (* =Default setting)
8	Unused	256	0= 1=
9	Unused	512	0= 1=
10	Unused	1024	0= 1=
11	Unused	2048	0= 1=
12	Unused	4096	0= 1=
13	Unused	8192	0= 1=
14	Unused	16384	0= 1=
15	Unused	32768	0= 1=

2.9 Modem Setup Register 4x0016 Low Byte

Bit #:	Description:	Binary Value:	Function: (* =Default setting)
0	Frequency Select (v6.1x.08 & up)	1	0= Select F1 1= Select F2
1	Unused	2	0= 1=
2	Unused	4	0= 1=
3	Unused	8	0= 1=
4	Unused	16	0= 1=
5	Unused	32	0= 1=
6	Unused	64	0= 1=
7	Unused	128	0= 1=

2.10 Modem Setup Register 4x0017 High Byte

Register 4x0017 is a bit programmable register for specific I/O setup as described below.
Functions used to support Register 17: 03, 06, 16

Bit #:	Description:	Binary Value:	Function: (* =Default setting)
8	Modem LED Control (LedCon)	256	0=LEDs ON 1=LEDs OFF
9	Unused	512	0= 1=
10	Unused	1024	0= 1=
11	Unused	2048	0= 1=
12	Unused	4096	0= 1=
13	Unused	8192	0= 1=
14	Unused	16384	0= 1=
15	Unused	32768	0= 1=

2.11 Modem Setup Register 4x0017 Low Byte

Bit #:	Description:	Binary Value:	Function: (* =Default setting)
0	Unused	1	O= 1=
1	Unused	2	0= 1=
2	Unused	4	0= 1=
3	Unused	8	0= 1=
4	Unused	16	0= 1=
5	Unused	32	0= 1=
6	Unused	64	0= 1=
7	Unused	128	0= 1=

2.12 Modem Setup Registers 4x0018 thru 4x0022

Registers 4x0018 thru 4x0022 are configuration registers for the Modem.
Functions used to support Registers 18 thru 22: 03, 06, 16

Register #:	Use:	Description:
4x0018 High Byte (T0Rate)	RF (Radio Data) Rate	255=9600bps, 253=7200bps, 252=6400bps, 250=5800bps, 244=4800bps * Default value =0 in e2, 244 in ram
4x0018 Low Byte (T2Rate)	Uart (Serial Port) Rate	220=115.2Kbps, 224=57.6Kbps, 228=38.4Kbps, 255=19.2Kbps, 253=9600bps, 250=4800bps, 244=2400bps, 240=1200bps * Default value =0 in e2, 253 in ram

NOTE: A 0 value in the EEPROM (e2) will set the default ram value.

4x0019 High Byte (IDH)	Group ID (NOT used in standard firmware).	User programmable from 0 to 255 * Default value = 0
4x0019 Low Byte (IDL)	Slave ID (Address)	User programmable from 0 to 255 * Default value = 1
4x0020 High Byte (RfDly1)	RF Delay 1	RF Key up delay multiplier 1 to 32 * Default value = 1 (x byte 0 =total)
4x0020 Low Byte (RfDly0)	RF Delay 0	RF Key up delay value 1 to 255 n* Default value =144 (@4800bps n=.208), (@5800bps n=.172, @7200bps n=.138

The number in Reg 20 Low times n equals the delay in milliseconds. Multiply the delay in ms times the number in Reg 20 High to get total delay time.
Example: If Reg 20 Low =144 Decimal, Reg 20 High =2 and the RF Rate in Reg 18 High =4800bps then n=.208 144 x .208 =29.95. 29.95 x 2 =59.90 milliseconds.

4x0021 High Byte (T1Rate)	Timer 1 rate (Unused)	
4x0021 Low Byte (VarDly)	User Set Variable Delay Time (Power Save Delay in early firmware versions) (Not used in current revisions)	A value (1 to 255) here will set a delay time =100msec x value in 21L. Ex.- If Reg 21L=10 then the delay would be = 10 x 100ms = 1000ms.
4x0022 High Byte (SnfOfs)	Store and Forward offset value for extended group SnF routing. (Not used in current revisions)	A value here will automatically offset the data lookup table to allow multiple group routing tables to be stored in the SnF data base area of the eeprom.
4x0022 Low Byte (CtsDly)	CTS Delay Time	A value (1 to 255) here will set a delay time =5.5 msec x value in 22L. Ex.- If Reg 22L=10 then the delay would be = 10 x 5.5ms = 55ms

2.13 Modem Error Count Registers 4x0023 thru 4x0025

Registers 4x0023 thru 4x0025 are used to count data transactions in the modem for troubleshooting and problem diagnosis.

Function 03 is used with Registers 23 thru 25 to read them.
Function 16, any data value, to Reg 23 thru 25 will clear the register (s).

Register #:	Use:	Description:
4x0023 High Byte (FSErro)	Frame sync error count (0-255)	Errors here indicate a likely radio path problem, weak signal, etc. The modem cannot sync up to the incoming preamble and sync data. These errors occur before user data reception.
4x0023 Low Byte (SSErro)	Start/Stop bit error count (0-255)	Errors here also relate to weak signals, interference or distortion to the radio signal. Missing start/stop bits indicate sync problems during data receive. These errors occur during user data reception.
4x0024 High Byte (LRErro)	LRC error count (0-255)	This error occurs due to corrupted bits in the data stream. It usually indicates a disturbance to the data stream during transmission or reception. Interference or noise, but not usually weak signals. This error check is calculated as the bytes of data are received.
4x0024 Low Byte (CRErro) NOTE: Any one of the above errors will cause the modem to discard the data packet and wait for another to be sent by the user system. The modem will NOT allow a data packet to go to the serial port with any errors.	CRC error count (0-255)	This error is the least likely to occur and usually indicates one or more bit errors are present in the received data due to corruption from interference, signal fades, etc. This error check is calculated after all data has been received into the modem buffer.
4x0025 High Byte (RxdMe)	Number of good data packets received for this unit ID only. (RESERVED- Not used currently)	This count is for good data packets for the unit when ID matches only. Other data packets in system will NOT be counted.
4x0025 Low Byte (RxdOK)	Number of good data packets received by this unit.	This count is typically used in conjunction with Test Mode B (See Register 0x9915) to count the number of good data packets received. Also can be used to count normal data packet transfers in system.

2.14 Modem E2 Registers 4x0026 thru 4x1024 (2K EE), -4x2048 (4K EE), -4x4096 (8K EEPROM)

Registers 4x0026 thru 4x4096 are EEPROM memory locations.
Functions used to support Registers 34 thru 4096: 03, 06, 16

Register #:	Description:
4x0026	Displays total amount of extended memory in the modem.
4x0027	Displays amount of extended memory available for the data buffer.
4x0028	28Hi=Internal operating flags (stored to EEPROM). Do NOT Change!! 28Hi Bit 0=unused, Bit 1=Repeat flag, Bit 2=User set Silent flag, Bit 3=User set ID flag 28Hi Bit 4=unused, Bit 5=unused, Bit 6=unused, Bit 7=unused 28Lo=Number of SnFs in the return path.
4x0029	Store and Forward return path data (High byte=Path 1, Low byte=Path 2)
4x0030	Store and Forward return path data (High byte=Path 3, Low byte=Path 4)
4x0031	Unused
4x0032	Unused
4x0033	* Upper memory reset data. Default = 32383D (7E7FH) Clears Registers 4x0025 Up.
4x0034	* Lower memory reset data. Default = 32383D (7E7FH) Clears Registers 4x0024 Down.

* Writing any value other than 32383D (7E7FH) to Register 4x0033 and Register 4x0034 will cause a complete memory erase to be performed on the EEPROM upper and lower memory areas when the unit is reset.

The Upper Memory area holds Store and Forward data for up to 255 slave ID's.
The Lower Memory area holds Configuration information for the Modem setup and operation.

To reset the unit: A) Remove and restore power or
B) Write a value to any register 4x0015 thru 4x0022.

4x0035 thru 4x0544 are used to hold Store and Forward Unit ID's 1 thru 255 in the EEPROM.

4x0545 thru 4x1024 are 480 unused* data registers in the 2K EEPROM.
4x0545 thru 4x2048 are 1,504 unused* data registers in the 4K EEPROM.
4x0545 thru 4x4096*** are 3,552 unused* data registers in the 8K EEPROM.

***NOTE: The above "unused" registers in the eeprom assume the user is NOT setting up an extended address SnF routing table. If extended address routing tables are used, the eeprom is automatically read/written in the above mentioned "unused" areas.

All standard Store and Forward data table locations are defined in the Store and Forward Data Table in this manual. Extended Store and Forward tables are not defined in this manual.

The standard EEPROM is a 4096 byte device. To calculate the amount of memory needed for a SnF table: 4 bytes are needed per SnF unit ID. 255 x 4 = 1020 bytes are needed for a Store and Forward database of 255 units.)

2.15 Modem Log Buffer Registers 4x3329 thru 4x4353

***Note overlap of these registers with EEPROM registers in 8K Eeprom on previous page.

Registers 4x3329 thru 4x4353 are non-volatile data storage locations used for the * Log Buffer feature.

Register #:	Description:
4x3329	16 bit pointer for the next location to store data in the log buffer
4x3330	16 bit number of bytes counter for data in the log buffer
4x3331	Unused
4x3332	Unused
4x3333 thru 4x4353	Log buffer data registers. 1020 registers or 2040 bytes of data stored in these locations.

* Log Buffer option is only available in specially equipped units and may vary in length depending on available memory in unit as ordered.

NOTE: The Log Buffer option is NOT currently supported in the C46 v6.xx Modem firmware. It might be added later and the above register definitions will likely change to reflect memory locations in the new product.

3.0 C46 I/O-> MODBUS COMPATIBLE REGISTER INFORMATION

This information is for Operating System v1.08 and up

All registers are organized as 16 bit Modbus compatible Integer and 32 bit, IEEE754 Modbus Floating Point registers.

3.1 I/O Registers 4x0001 to 4x26,384 Summary

Registers 4x0001 thru 4x26,384 are registers in the I/O Processor.

Functions used to support Registers: 03, 06, 16

Register #	Use:	Description:
0x0001 thru 0x0004	Write Single Coil	Digital Outputs (Relays or Coils)
4x0001 thru 4x0013	Hardware I/O Ports	Digital Inputs, Analog Inputs, Digital Outputs
4x0014 thru 4x4000	Except Reg 4x0030 and 4x0031, Unused in I/O section	Registers 4x0030 and 4x0031 are the Watch Dog Timer setup registers.
4x4001 thru 4x4500	Integer Holding Registers	500 Read/Write Integer Registers in Battery Backed SRAM
4x4501 thru 4x4781	? Unused	General Purpose Integer Registers
4x4782 thru 4x4871	Operational and Setup Features	Buffers, GP Memeory, Real Time Clock, Setup Registers
4x4872 thru 4x4999	Flash Based Holding Registers	128 GP Non-Volatile Integer Registers
4x5000 thru 4x5001	Parameter Save and Reset Registers	
4x5002 thru 4x7000	Unused	
4x7001 thru 4x7500	Floating Point Holding Registers	500 Read/Write Floating Point Registers in Battery Backed SRAM
4x7501 thru 4x7890	Reserved/Unused	
4x4x7891 thru 4x7898	Pulse and Runtime Counters	4x7891 thru 4x7894 are Pulse Counters on DI5 thru DI8. 4x7895 thru 4x7898 are Runtime Counters on DI5 thru DI8.
4x7899 thru 4x7968	Reserved/Unused	
4x7969 thru 4x8000	Flash Based Holding Registers	32 GP Non-Volatile Floating Point Registers
4x8001 thru 4x10000	Unused	NOTE: Modem utilizes Registers 9900 thru 9916
4x10001 thru 4x26384 (OS v1.13 EB)	Floating Point Holding Registers	16,384 Read/Write Floating Point Registers in Battery Backed SRAM

3.2 I/O Port Registers Detail

0x0001	Digital Output 1
0x0002	Digital Output 2
0x0003	Digital Output 3
0x0004	Digital Output 4
4x0001	Digital Inputs: Bits 0-7 = Inputs 1-8 Bits 8-15 = Reserved, Return 0
4x0002	Analog Input 1 (Analog Inputs=12 Bit Resolution)
4x0003	Analog Input 2
4x0004	Analog Input 3
4x0005	Analog Input 4
4x0006	Analog Input 5
4x0007	Analog Input 6
4x0008	Analog Input 7
4x0009	Analog Input 8
4x0010	Power Monitor x.007326 = VDC (0 to 30v Scale)
4x0011	Battery Monitor x.007326 = VDC (0 to 30v Scale)
4x0012	Temperature (x.21346)-271.33 = Deg C
4x0013	Digital Outputs: Bits 0-3 = Relay Outputs 1-4 Bits 4-15 Reserved, Return 0
4x0014 thru 4x0029	Reserved, Unused Register space

3.3 I/O Watch Dog Timer Registers

4x0030	Watch Dog Timer Enable and Timeout Value 0 = Disable WDT 1-255 = Number of Seconds to Timeout and Reset
4x0031	Watch Dog Timer Counter and Match for Reset This register counts seconds to Timeout and Reset. If the value in Register 4x0030 is greater than 0 (WDT Enabled) and the value in this register increments to match the value in 4x0030, Reset will occur. To prevent Reset, this register must be written to 0 (or a value that does not allow a match with register 4x0030) before a match occurs.
4x0032 thru 4x4000	Reserved, Unused Registers

3.4 I/O Integer Holding and Operating Registers

4x4001 thru 4x4500 (Max #Regs=?)	500 General Purpose, Battery Backed SRAM based Integer Registers
4x4501 thru 4x4781	281 General Purpose, Battery Backed SRAM based Integer Registers from 4x4501 up and Reserved Operating Registers from 4x4781 Down.
4x4782	Modbus Buffer Address (Com 1) Default = 28935 (v1.12<) 30983 (v1.13)
4x4783	Modbus Buffer Size (Com 1) Default = 256 Bytes
4x4784	I/O Microprocessor Speed 1 = Full Speed (22Mhz) 2 = Low Speed (4Mhz) NOTE: This parameter should only be set within a Basic program. Setting this parameter to Slow will cause loss of communication via Com0 & Com1.
4x4785	Reserved
4x4786	Modbus (Com1) Master State Read Only Value: 0 = Idle Write Only Value: 1 = Master Send Packet Read Only Values: 2 = Master Sending 3 = Master Send Complete 4 = Master Receiving 5 = Master Receive Complete 6 = Transaction Completed Successfully Master Transaction Error Codes: 255 = Not in Master Mode 254 = Timeout- No Response 253 = Incorrect or Bad CRC
4x4787	Reserved
4x4788	Scratchpad Memory Start Address
4x4789	Scratchpad Memory Length

3.5 I/O Real Time Clock (RTC) Registers

4x4790 thru 4x4806 Time Keeping Registers:	Real Time Clock Registers
4x4790	Seconds (0 – 59)
4x4791	Minutes (0 – 59)
4x4792	Hours (0 – 23)
4x4793	Day of Week (1 – 7)
4x4794	Day of Month (1 – 31)
4x4795	Month (1 – 12)
4x4796	Year (0 – 99)
Alarm Registers:	
4x4797	Alarm 1 Seconds (0 – 59)
4x4798	Alarm 1 Minutes (0 – 59)
4x4799	Alarm 1 Hours (0 – 23)
4x4800	Alarm 1 Day of Month or Day of Week as follows: Bit 6 = 0 Selects Day of Month: Bits 0 – 3 hold ones place of Day (1 – 9) Bits 4 – 5 hold tens place of Day (1 – 3) Bit 6 = 1 Selects Day of Week: Bits 0 – 3 hold the Day of Week value (1 – 7)
4x4801	Alarm 2 Minutes (0 – 59)
4x4802	Alarm 2 Hours (0 – 23)
4x4803	Alarm 2 Day of Month or Day of Week (See 4x4800 above)
4x4804	Clock Control Register
4x4805	Clock Status Register
4x4806	RTC Action Register as follows: 0 = Read all 16 RTC Registers 1 = Write all 16 RTC Registers 2 = Write Time & Date Registers Only 3 = Write Alarm 1 Registers Only 4 = Write Alarm 2 Registers Only 5 = Clear Alarms

3.6.0 I/O Setup Registers 4807 thru 4812

The following registers must be saved to Flash memory for permanent use by writing to Register 4x5000, 12345 when finished with I/O Setup.	Otherwise, if Register 4x5000 is not written, the changes made to these registers will reset when the unit is powered off or Reset by WDT or manually.
4x4807	Basic Program Auto-Run Mode 13312D (3400H) = Do NOT run Program stored in Slot 1 on Reset or Power On. 13313D (3401H) = Run Program stored in Slot 1 on Reset or Power On.
4x4808	Basic52 Console Baud Rate (Com 0) 600 bps = 64384D (0FB80H) 1200 bps = 64960D (0FDC0H) 2400 bps = 65248D (0FEE0H) 4800 bps = 65932D (0FFB8H) 9600 bps = 65464D (0FFB8H) 19200 bps = 65500D (0FFDCH) Default 38400 bps = 65518D (0FFEEH) 57600 bps = 65524D (0FFF4H) 115200 bps = 65530D (0FFFAH)
4x4809	Basic Workspace Top of Memory (MTOP) Default = 18432 (v1.12<), 26431 (v1.13>)
4x4810	Basic Programs Storage Slot Size Default = 2056D (88H) Hi Byte determines # of 512 byte sectors used Lo Byte determines # of slots to setup Example: to set 4 each 8K slots- Hi Byte = 16 (16 x 512 = 8192 bytes), Lo Byte = 4 (4 x 8192 =32768).
4x4811	Modbus Slave ID (Com 1) Default = 11 Valid settings = 1 – 255
4x4812	Modbus Baud Rate (Com 1) 600 bps = 0 1200 bps = 1 2400 bps = 2 4800 bps = 3 9600 bps = 4 Default 19200 bps = 5 38400 bps = 6 57600 bps = 7 115200 bps = 8 NOTE: Requires reset to take effect.

3.6.1 I/O Setup Registers 4813 thru 4820

4x4813 NOTE: Do NOT set this Register via Radio. Communications will cease once set to 1.	Modbus Mode (Com 1) Slave = 0 Master = 1
4x4814	Modbus Master Relaod Timer Default = 50 (50 x 10ms = 500ms Total) Valid Settings = 1 – 254 Setting x 10ms increments = Timeout in Milliseconds. This Register determines the amount of time, in milliseconds, the Master will wait after sending a query before declaring a "No Response" condition (see Register 4x4786 for Timeout Error message).
4x4815	Modbus Inter-Packet Timeout Default = 5 (5 x 10ms = 50ms Total) Valid Settings = 1 – 254 Setting x 10ms increments = Timeout in Milliseconds. This Register determines the amount of time between data packets before a new packet is declared.
4x4816 thru 4x4818	Reserved, Unused
4x4819	Analog Inputs Voltage/Current Select Bit Value = 0 for Voltage, 1 for Current AI1 = Bit 0 (Binary 1) AI2 = Bit 1 (Binary 2) AI3 = Bit 2 (Binary 4) AI4 = Bit 3 (Binary 8) AI5 = Bit 4 (Binary 16) AI6 = Bit 5 (Binary 32) AI7 = Bit 6 (Binary 64) AI8 = Bit 7 (Binary 128) Example: To set Analog Inputs 1, 4 and 6 to Current mode, add the Binary values as follow: Analog Input 1 Binary = 1 Analog Input 4 Binary = 8 Analog Input 6 Binary = 32 Total of Binary values = 41 (write this to 4x4819)
4x4820	Analog Inputs Current Mode Select Bit Value = 0 for 0 to 20ma, 1 for 4 to 20ma AI1 thru AI8 Binary values and selection are the same as Register 4x4819 above.

3.6.2 I/O Setup Registers 4821 thru 4871, Flash Integer Registers, Flash Save & Reset Registers

4x4821	Switched V+ 1 & 2 (C46) Auto-On Mode 0 = Disabled, 1 = Enabled This feature allows turning the Switched V+ voltage out on automatically when a query to Modbus I/O Ports 1 thru 9 is made via Com 1.
4x4822	Switched V+ 1 & 2 (C46) Auto-On Time Default = 5 (5 x 100ms = 500ms Total) Valid Values = 0 – 65535 (0 = 100ms) This feature is used in conjunction with above Register 4821 to determine how long the switched V+ stays on before the I/O Port is read.
4x4823	Switched V+ 1 & 2 Power On/Off 0 = Off, 1 = On This register allows switching V+ Power on/off via Basic52 or Modbus commands for "manual" Switched power control.
4x4824	Reserved for Switched V+ 2 on C47
4x4825	Radio Power Control 0 = Radio Off, 1= Radio On Default = 1
4x4826	I/O LEDs Control (CHG & PWR LEDs) 0 = LEDs Off, 1 = LEDs On Default = 1
4x4827	Battery Charge Voltage Setting 0 = ~13.75 volts (for constant power source) 1 = ~14.85 volts (for intermittent (solar) power source)
4x4828 thru 4x4871	Reserved Setup Parameters
4x4872 thru 4x4999	128 General Purpose, Non-Volatile, Flash based Integer Registers
4x5000	Flash Save Parameters Control Write Value: 12345 to save Registers 4807 thru 4999 and 7969 thru 8000 to Flash memory. Read Value: 0 = No Parameters Changed 1 = Parameter Changed, Write to save
4x5001	Reset I/O Processor Write Value: 12345 to Warm Reboot Read Value: 0 for No Reset, 1 for Reset

3.6.3 I/O Floating Point Registers, Pulse & Runtime Counters

4x7001 thru 4x7500 Max #Regs per Query =	500 General Purpose, Non-Volatile, Battery Backed SRAM Based, Floating Point Registers
4x7501 thru 4x7890	Reserved Registers Space
4x7891 thru 4x7894	Pulse Counters for Digital Inputs 5 thru 6 (C46 A Only) Counts Frequency to 3Khz Holds Long Integer value up to Millions of counts
4x7895 thru 4x7898	Runtime Counters for DI 5 thru 6 (C46A Only) Counts Seconds Elapsed while Input is Active Holds Long Integer value up to Millions of Seconds
4x7899 thru 4x7968	Reserved Special Purpose Registers
4x7969 thru 4x8000	32 General Purpose, Non-Volatile, Flash Based, Floating Point Registers
4x10,001 thru 4x26,384 (OS = v1.13 EB or Later)	16,384 General Purpose, Non-Volatile, Battery Backed, SRAM Based, Floating Point Registers

3.7 I/O Operating System (OS), Function 17 Response, Date Codes

The Operating System utilized in the C4x device is a combination Modbus and Basic52 user interface. OS upgrades and fixes may be apparent in one or both interfaces (Modbus or Basic52).

Date Codes are used in the Serial Number of each Device as well as in the OS revisions.

Modbus Function Code 17 may be used to Query the I/O OS for the Hardware and Firmware versions. The following is the C46 I/O Response structure:

"Control Design C4X vHH.ZZ.YM",255

Where HH=Hardware Version, ZZ=Firmware Version, YM=Year and Month Serial (See below).

The following are the Date Code Year and Month characters:

YEAR:	A=2001	B=2002	C=2003	D=2004	E=2005	F=2006
	G=2007	H=2008	J=2009	K=2010	L=2011	M=2012
	N=2013	P=2014	R=2015	S=2016	T=2017	U=2018
	V=2019	W=2020				

MONTH:	A=January	B=February	C=March	D=April	E=May	F=June
	G=July	H=August	J=September	K=October	L=November	M=December

3.8 Operating System Revision History

V1.13 EB	Added RBANK Memory Bank select to Basic52 Added 16,384 Float Registers to Modbus
V1.12 DH	Fixed bug- Erase 0 would allow the user to erase OS space below Program Slot 1 in Flash.
V1.11 DH	Fixed bug- OS would lockup due to infinite loop at LCD initialization with some LCDs.
V1.10 DF	Deleted Watch Dog Timer for Modbus. Timer 3 Resets Modbus every 10ms. Modbus WDT caused Flash Write problems.
V1.09 DE	Added Watch Dog Timers to Modbus and Basic52 OS.
V1.08 DC	Added Pulse and Runtime Counters to DI5 thru DI8.
V1.07 DC	Added Power Down Mode using RTC. Changed Revision Code from 7 to 4 Digits.
V1.000.06 CH	Original Release.

4.0 C46 Modem to Radio Connections and Keyup Delays

Standard Radio Interface	**IDC10 PIN # TO**	**Radio D9 Male PIN # and Description**
	1	1 RFT Transmit data to radio
	2	6 CD Carrier Detect output from radio
	3	2 RFR Receive data from radio
	4	7 Frequency select to Ritron radio
	5	3 PTT Active low push to talk (transmit) to radio
	6	8 RSSI input from Ritron radio
	7	4 GND Ground
	8	9 SPK Speaker audio from radio
	9	5 V+ +9 to 15 vdc to radio
	10	To Com2 Pin 4 for Ritron radio programming
Keyup Delay Info	**Midland/Maxon radio Keyup Delay**	50ms from 32 Deg F up 60ms from 32 Deg F down to –10 Deg F 80 to 100ms from -10 Deg F down
	Ritron DTX Ls radio Keyup Delay	15ms from 0 Deg F to +140 Deg F 20ms below 0 Deg F

5.0 Modem Device Setup Parameters

5.1 Modem Function 17 Read Setup from Device

The following is the Modem response given to a Modbus Function 17 Query:

Byte 1= ID sent in query
Byte 2= Function code returned
Byte 3= Number of bytes returned (37 bytes)
Byte 4= Actual ID assigned to unit responding
Byte 5= Eeprom type: 01=2K, 02=4K, 03=8K
Byte 6= Letter v indicating beginning of Firmware revision number
Byte 7= First number of firmware revision
Byte 8= Dot (separator)
Byte 9= Second number of firmware revision
Byte 10= Third number of firmware revision
Byte 11= Dot (separator)
Byte 12= Fourth number of firmware revision
Byte 13= Fifth number of firmware revision
Byte 14= Space
Byte 15= Space
Byte 16= First character of serial number
Byte 17= Second character of serial number
Byte 18= First digit of serial number
Byte 19= Second digit of serial number
Byte 20= Third digit of serial number
Byte 21= Fourth digit of serial number

Begin Register Setup Data:

Byte 22= Register 15 high data
Byte 23= Register 15 low data
Byte 24= Register 16 high data
Byte 25= Register 16 low data
Byte 26= Register 17 high data
Byte 27= Register 17 low data
Byte 28 = Register 18 high data
Byte 29= Register 18 low data
Byte 30= Register 19 high data
Byte 31= Register 19 low data
Byte 32= Register 20 high data
Byte 33= Register 20 low data
Byte 34= Register 21 high data
Byte 35= Register 21 low data
Byte 36= Register 22 high data
Byte 37= Register 22 low data

This is the last of data returned for use in reading the unit.
Two more bytes will be apparent:

Byte 38= CRC high calculated
Byte 39= CRC low calculated

5.2 Modem Function 16 Write Setup to Device

The following is the Function 16 write to setup the device:

Write data byte 1= Register 15 high	[Data Hi(1)]
Write data byte 2= Register 15 low	[Data Lo(1)]
Write data byte 3= Register 16 high	[Data Hi(2)]
Write data byte 4= Register 16 low	[Data Lo(2)]
Write data byte 5= Register 17 high	[Data Hi(3)]
Write data byte 6= Register 17 low	[Data Lo(3)]
Write data byte 7= Register 18 high	[Data Hi(4)]
Write data byte 8= Register 18 low	[Data Lo(4)]
Write data byte 9= Register 19 high	[Data Hi(5)]
Write data byte 10= Register 19 low	[Data Lo(5)]
Write data byte 11= Register 20 high	[Data Hi(6)]
Write data byte 12= Register 20 low	[Data Lo(6)]
Write data byte 13= Register 21 high	[Data Hi(7)]
Write data byte 14= Register 21 low	[Data Lo(7)]
Write data byte 15= Register 22 high	[Data Hi(8)]
Write data byte 16= Register 22 low	[Data Lo(8)]

6.0 Modem Header Information

All Control Design modems add information to the beginning of every data packet. On the front of each data packet, preceding the user data, are 16 bytes of information. This data is used by the modem to control system functions and features of the modem such as Store and Forward. After a data packet reaches its destination, this data is stripped, by the modem, before the user data is sent to the com (serial) port. The header information can be used to help diagnose some problems in the system.

To cause the modem to send its header info to the com port, tie a ground to Modem microcontroller Pin 28 on the C46 PCB. (This grounds Port pin 2.0 of the microcontroller.)

The following describes each byte of information that will be in the header for different firmware revisions.

6.1 Header for Modem Firmware Revision v6.00.xx

The following information will be apparent from the header:

Byte 1 = Number of bytes in entire data packet. This includes the 16 header bytes.
Byte 2 = Reserved.
Byte 3 = Encryption Encoding Scheme. 0 is the normal value.
Byte 4 = Store and Forward data byte 1, indicates the number of store and forwards in the route.
Byte 5 = Store and Forward data byte 2, the ID of the first SnF unit in the path.
Byte 6 = Store and Forward data byte 3, the ID of the second SnF unit in the path.
Byte 7 = Store and Forward data byte 4, the ID of the third SnF unit in the path.
Byte 8 = Store and Forward data byte 5, the ID of the fourth SnF unit in the path.
Byte 9 = Reserved.
Byte 10 = Reserved.
Byte 11 = Reserved.
Byte 12 = Reserved.
Byte 13 = Reserved.
Byte 14 = Reserved.
Byte 15 = Reserved.
Byte 16 = Slave ID of unit data is being sent from.

6.2 Header for Modem Firmware Revision v6.11.xx and v6.10.xx

The following information will be apparent from the header:

Byte 1 = Number of bytes low in entire data packet. This includes the 16 header bytes.
Byte 2 = Number of bytes high in entire data packet.
Byte 3 = Low nibble is the Store and Forward routing Select as follows:
0= Modbus 8 Bit address.
1= Reserved for Modbus 16 Bit address.
2= Flow Automation Protocol.
3= Reserved.
4= Bristol BSAP Group 0.
5= Bristol BSAP Groups 1-127.
6= Reserved.
7= Reserved.
8= Reserved.
9 thru 15 are Reserved.

Byte 3 = High nibble is Reserved for the Encryption Encoding Scheme.
0 thru 15 are reserved.

Byte 4 = Store and Forward data byte 1, indicates the number of store and forwards in the route.
Byte 5 = Store and Forward data byte 2, the ID of the first SnF unit in the path.
Byte 6 = Store and Forward data byte 3, the ID of the second SnF unit in the path.
Byte 7 = Store and Forward data byte 4, the ID of the third SnF unit in the path.
Byte 8 = Store and Forward data byte 5, the ID of the fourth SnF unit in the path.
Byte 9 = Reserved.
Byte 10 = Reserved.
Byte 11 = Reserved.
Byte 12 = Reserved.
Byte 13 = Reserved.
Byte 14 = Reserved.
Byte 15 = Slave ID of unit data is being sent from.
Byte 16 = Group ID of unit data is being sent from.