

AMOCAMS PROTOCOL EMULATION

1.1 GENERAL DESCRIPTION

This section generally describes the AMOCAMS communication protocol for reference purposes only. The AMOCAMS protocol is a proprietary protocol. This review contains only general information in order to describe the operation using the Comm-Troller. The user does not need to know the details of the protocol in order to use the MARC Comm-Troller.

The AMOCAMS protocol is an asynchronous protocol. The Comm-Troller emulation supports both the Audio (FSK) and RS232 communication modes. The protocol may be used in either a point-to-point or in a multidrop configuration. The protocol may be used in either a full or half-duplex operation. Communications security is provided by a 16-bit CRC, an 8 bit check word (CW) and the use of special control bytes (flags) and in the case of audio communication, message parity alteration.

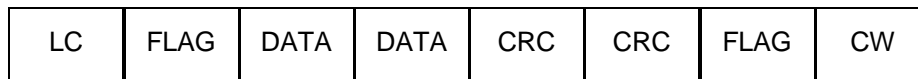
All communication exchanges in the AMOCAMS protocol are initiated by the host. The remote cannot initiate any exchange with the host nor can the remote directly address or communicate with another remote. The remote transmits a response to the host for all valid messages sent by the host and addressed to the remote. The remote will not respond to any messages which do not pass all the message security tests.

All message blocks from the host to the remote are of varying length depending on the specific type of message. Responses from the remote are a single block of variable length.

A typical AMOCAMS message exchange between a host computer and the Comm-Troller is shown below.



HOST TO COMM-TROLLER



COMM-TROLLER TO HOST

Figure F-1 General AMOCAMS Message Format

An AMOCAMS message from the host to the remote always contains a location code (LC), command code (CC) and error check (CRC) fields. There may be additional fields included in the host to remote message which can be interpreted as byte count (BC), index and data fields. The LC field is a 8-bit Unit Address which specifies one of up to 255 possible RTUs on a line. The command codes and their meanings are described in Section 1.2 below. The last 16 bits of any message are always the CRC code.

1.2 MESSAGE TYPES

The AMOCAMS protocol as implemented on the Comm-Troller provides for 5 message exchange types using up to 16 user defined command codes. These types are Data Acquisition Scans, Control Requests, Download Requests, Upload Requests and Special Function Requests. The message types are segregated by their assigned command code. Figure F-2 illustrates the basic message types and the command code range associated with each.

CC 21 - 40	Data Acquisition Scans
CC 41 - 50	Control Requests
CC 51 - 60	Download Requests
CC 61 - 70	Upload Requests
CC 71 - FF	Special Function Scans

Figure F-2 AMOCAMS Message Types

1.2.1 Data Acquisition Scan

The Data Acquisition Scan is used to gather (read) information from the PLC. Data from the PLC is categorized into 14 different areas called Contiguous Data Areas or CDAs. A Data Acquisition Scan can read data from one or more CDAs. If a CDA is referenced for a particular Data Acquisition Scan then **ALL** the data from the referenced data area is returned. The concept of Contiguous Data Areas, and their assignment to a particular scan is treated more fully in Section 1.3.

1.2.2 Control Requests

A Control Request is used to change the state of a **SINGLE BIT** in the PLC memory to the "on" state. Typically these bits are interpreted by the PLC ladder logic program as control points and the setting of a bit causes some type of control action to be performed. The PLC ladder logic program must clear the control bit after the control action has been performed.

1.2.3 Download Requests

A Download Request is used to change the value of one or more **WORDS** in PLC memory. Typically these words are interpreted by the PLC ladder logic program as analog outputs, timer values or other similar values. A Download Request is used to change the value of a single element within a specified CDA. The size of the element in bytes, is user defined when setting up the configuration table.

1.2.4 Upload Requests

An Upload Request is used to read the value of one or more **WORDS** in PLC memory. This command differs from the Data Acquisition Scan in that an Upload Request can only reference one element in one CDA. The size of the element is defined by the user when setting up the configuration table.

1.2.5 Special Function Scans

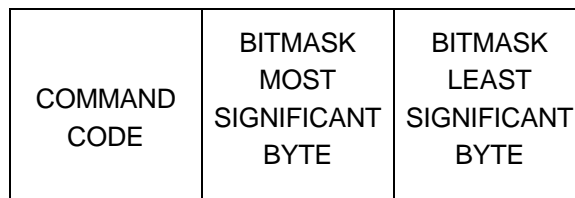
A Special Function Scan is used to perform diagnostic functions or to do other special functions in the Comm-Troller. The Comm-Troller supports three Special Function Scans. They are: CC=71 Reset Powerfail Bit, CC=72 Communications Loopback Test and CC=73 Special Control Function without a byte count field. Command Code 71 is used to reset the Comm-Troller Powerfail Bit. The Comm-Troller will set this bit whenever it executes its initialization code. This occurs when power is first applied to the Comm-troller. The Powerfail bit is reset only when a Command Code 71 is received. The Communications Loopback Test (CC=72) message is used to verify or test the communications channel. The test message is merely echoed back to the host as received. The Special Control Function (CC=73) is used to perform a control command except that a byte count field is not used. The special control command sets a **SINGLE BIT** in PLC memory.

1.3 CONTIGUOUS DATA AREAS (CDAs)

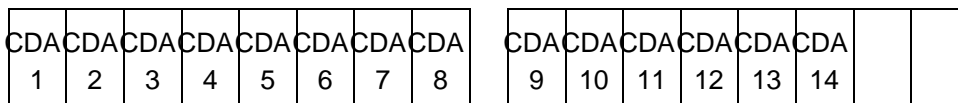
The AMOCAMS protocol as implemented in the Comm-Troller employs the concept of Contiguous Data Areas to organize the information which it processes. The interpretation of the data within a CDA and the assignment of CDAs to a particular command code is completely user definable. The relationship between command codes and CDAs is defined by filling in an area of the Comm-Troller configuration table. The configuration table is read by the Comm-Troller when it first powers up from PLC memory. This area contains room to define up to 16 unique command codes and the CDAs to be associated with it. Each 3-byte entry

contains the command code itself and a 2-byte bitmask which identifies the CDAs which are to be accessed by the command code. If a bit is set in the bitmask then the CDA is included, if the bit is not set then the CDA is not included. Figure F3 defines the relationship between each bit and the CDA number. The content of a CDA is not important to the Comm-Troller. It merely passes the data as received from the PLC on to the host or writes the data as received from the host into PLC memory. Obviously the PLC ladder logic program and the host computer must agree as to the interpretation of the data within a CDA.

CDA 1 is reserved for control output data. For this reason the Comm-Troller will only perform bit writes to CDA 1. The Comm-Troller will access all other CDAs using word reads and writes.



CDA DEFINITION FIELD



BYTE 0

BYTE

CDA BITMASK

Figure F-3 Contiguous Data Area Definition

1.4 CDA SIZES

The Comm-Troller can connect to up to 8 PLCs. Each PLC has a unique location code and can have one or more CDAs defined. The Comm-Troller combines the data for each CDA into a single larger table. The host computer effectively "sees" several RTUs each containing data that is physically located in a different PLC. There is a maximum size for each CDA data type. This size is the **COMBINED TOTAL** of each CDA area from all PLCs. Figure F-4 defines the maximum total size for each CDA.

CDA 1	128 Bytes (controls)
CDA 2	256 Bytes
CDA 3	256 Bytes
CDA 4	256 Bytes
CDA 5	256 Bytes
CDA 6	256 Bytes
CDA 7	64 Bytes
CDA 8	64 Bytes
CDA 9	64 Bytes
CDA 10	64 Bytes
CDA 11	256 Bytes
CDA 12	256 Bytes
CDA 13	256 Bytes
CDA 14	32 Bytes

Figure F-4 CDA Maximum Sizes

1.5 STATUS FLAG DEFINITION

The first two bytes of data returned for all Data Acquisition Scans (CC 21 - 40) will be two bytes of status flags indicating the current operating status of the Comm-Troller and the PLCs connected to it. The first byte consists of the logical 'OR' of the first byte of data returned in CDA 14 from all PLC's. The second byte contains information concerning internal Comm-Troller operation. Figure F-5 defines each of the bits of the error status word.

15	
14	
13	
12	
11	
10	
9	
8	
7	
6	
5	Invalid control index received
4	Jump Table error - either all 0's in the mask or illegal data type referenced for the command code
3	Invalid data. When the Comm-Troller is unable to communicate with the PLC designated by the LC in the message it zeros the data and sets the invalid bit
2	Communications error (parity, framing) on the host to Comm-Troller link
1	Comm-Troller Transmit Buffer Overrun
0	Error in transmit/receive handlers (Comm-Troller software error)

Figure F-5 AMOCAMS Error Status Word

1.6 AMOCAMS CONFIGURATION TABLE

The AMOCAMS configuration table layout is shown in the following tables.

BYTE	DESCRIPTION
0	RTU Number
1	Number of PLC's
2,3	RTS OFF delay (10 ms/count)
4	Baud Rate
5	Not Used
6	Not Used
7	Must be 01 _{Hex}
9	Communication Mode (1=FSK, 0=232)
10-14	Not Used (Set to 00 _{Hex})
15	Swap Enable Flag (1=enable)
16,17	RTS ON Delay Time (10 ms/count)
18,19	Not Used
20,21	Momentary Contact Dwell Time
22	Location Code for PLC #1
23	Location Code for PLC #2
24	Location Code for PLC #3
25	Location Code for PLC #4
26	Location Code for PLC #5
27	Location Code for PLC #6
28	Location Code for PLC #7
29	Location Code for PLC #8
30-77	AMOCAMS Command Code/CDA Def.
78,79	End of Message Timer (10ms/count)

Figure F-6 Configuration Header

BYTE	DESCRIPTION
0	PLC Address
1-4	Definition for CDA 2
	# Bytes per CDA 2 Element
	# of CDA 2 Elements
	PLC Address for CDA 2 Elements
5-8	Definition for CDA 3
9-12	Definition for CDA 4
13-16	Definition for CDA 1
17-20	Definition for CDA 5
21-24	Definition for CDA 6
25-28	Definition for CDA 7
29-32	Definition for CDA 8
33-36	Definition for CDA 9
37-40	Definition for CDA 10
41-44	Definition for CDA 11
45-48	Definition for CDA 12
49-52	Definition for CDA 13
53-56	Definition for CDA 14

Figure F-7 PLC Data Configuration

1.6.1 AMOCAMS Configuration Header

The Configuration Table Header is of extended length for the AMOCAMS protocol. The header is 80 bytes long instead of the more standard 50 bytes. The extra length is used for storage of the Command Code/CDA definition table (16 3-byte entries).

The Location Code (LC) to which the Comm-Troller will respond when communicating with the host is defined by the first byte (byte #0) in the configuration header section. This entry is an 8-bit binary number. If the Comm-Troller is to be used to connect to several PLCs and each PLC is to be addressed with a unique Location Code then byte 0 should be set to zero. The location Code will then be obtained from a table located in the configuration header at byte offset 22.

The number of PLCs in the system is defined by byte #1. This entry is a 4 bit binary number which is right justified in the byte. The valid range for this number is from 1 to 8 (00000001 to 00001000). This number is used to determine the number of Data Configuration Blocks to read.

Bytes #2 and 3 are used as the RTS OFF delay timer. The RTS OFF delay timer is used to provide a quiet time at the end of a transmission which may be required when using radios for communication.

Byte #4 is used to define the baud rate which will be used while communicating to the Host. This entry is a binary number which is right justified in the byte. Valid selections are: 300 baud (00000100), 600 baud (00000101), 1200 baud (00000110) and 2400 baud (00001000)

Byte #5 is used to set the parity on the serial communication line. Valid selections are 0 (no parity), 1 (odd parity) and 2 (even parity).

Byte 6 is used to set the number of stop bits. Valid selections are 1 (one stop bit) and 2 (two stop bits)

Bytes #7 and 8 are not used. They should be set to zero

Byte #9 is used to select the communications mode. If byte 9 is 0 then the RS232 mode of communication is selected. If byte 9 is non zero then the Audio Mode (FSK) is selected.

Bytes 10 thru 14 are not used. They should be set to zero.

Byte 15 is a "Swap Enable Flag". If this byte is non-zero any failure detected by the Comm-Troller while communicating with the PLC will result in an automatic switch-over to a backup PLC. The backup PLC address must be address 0B_{HEX}. If the backup PLC

subsequently fails the Comm-Troller will attempt to switch back to the primary unit. If this byte is a zero then a switch will not be attempted.

Bytes #16 and 17 are used to define the modem RTS/CTS delay time. The timer value is equal to the binary count stored in bytes 16 and 17 times 10 msec.

Bytes #18 and 19 are not used and should be set to zero

Bytes #20 and 21 are used to define the momentary contact dwell time. The dwell time is the amount of time that a PLC output will be turned on in response to a control operation from the host. The dwell time is equal to the binary count stored in bytes 20 (MSB) and 21 (LSB) times 10 msec.

Bytes #22 thru 29 are used to define the AMOCAMS Location Code (LC) which will be used to communicate with each PLC if byte 0 is equal to zero. There are 8 table entries. The first entry defines the LC for PLC #1, the second for PLC #2 and so on up to PLC #8.

Bytes 30 thru 77 are used to define the Contiguous Data Areas that are associated with each Command Code. Up to 16 Command Code/CDA definitions can be made. The first entry in each 3-byte entry is the Command Code in hex. The next 2 bytes define the CDA areas that are to be assigned to that Command Code. If a CDA is to be used then its associated bit (see table XXXXXXXX is set ON, if the CDA is not to be used then its bits is set OFF. Data Acquisition Scans can reference any combination of CDAs except CDA 1. Control requests can only reference CDA 1. Upload and Download Requests can only reference a single CDA and it cannot be CDA 1.

Bytes 78 and 79 are used to define an 'end of message time'. This timer is used to determine the end of an AMOCAMS message. The timer is restarted upon the reception of any character. If the timer times out then the message is declared complete. The end of message timer is equal to the binary count times 10 msec.

1.6.2 PLC Data Configuration for AMOCAMS Protocol

The PLC Data Configuration section(s) are each 57 bytes long. There is one table required for each PLC connected to the Comm-Troller. Up to 8 PLCs can be connected to each Comm-Troller. The number of sections to read is defined by byte #1 in the header section.

Byte #0 is used to define the address of the PLC on the data highway. This address will be used to read the data as defined by the remaining bytes in the Configuration table.

Byte #1 is used to define the number of bytes of data for each element of Contiguous Data Area (CDA) 2.

Byte #2 is used to define the number of CDA 2 elements assigned to this PLC.

Bytes #3 and 4 define the starting address in the PLC for CDA 2 data. The data contained in bytes 3 and 4 will be inserted exactly as read when the PLC is polled for data.

Bytes #5 thru 8 are used in the same fashion as bytes 1 thru 4 to define CDA #3. The starting address for CDA 3 must exactly follow the ending address of CDA 2. That is the data areas must be contiguous.

Bytes #9 thru 12 are used in the same fashion as bytes 1 thru 4 to define CDA #4.

Bytes #13 thru 16 are used in the same fashion as bytes 1 thru 4 to define CDA #1.

Bytes #17 thru 20 are used in the same fashion as bytes 1 thru 4 to define CDA #5.

Bytes #21 thru 24 are used in the same fashion as bytes 1 thru 4 to define CDA #6.

Bytes #25 thru 28 are used in the same fashion as bytes 1 thru 4 to define CDA #7.

Bytes #29 thru 32 are used in the same fashion as bytes 1 thru 4 to define CDA #8.

Bytes #33 thru 36 are used in the same fashion as bytes 1 thru 4 to define CDA #9.

Bytes #37 thru 40 are used in the same fashion as bytes 1 thru 4 to define CDA #10.

Bytes #41 thru 44 are used in the same fashion as bytes 1 thru 4 to define CDA #11.

Bytes #45 thru 48 are used in the same fashion as bytes 1 thru 4 to define CDA #12.

Bytes #49 thru 52 are used in the same fashion as bytes 1 thru 4 to define CDA #13.

Bytes #53 thru 56 are used in the same fashion as bytes 1 thru 4 to define CDA #14.

1.7 JUMPER SELECTIONS FOR AMOCAMS PROTOCOL

The Comm-Troller jumper selections and EPROM selections for AMOCAMS operation is detailed in the following figures.

JUMPER	POSITION	JUMPER	POSITION	AMOCAMS Protocol Communication is
J2	1-2	J10	1-3, 11,13	on Port P1 (top port), PLC
J3	1-2	J11	1-2	Communication is on Port P2 (center
J4	NOT USED	J12	1-2	port).
J5	NOT USED	J13	1-2	U13 = #160-002-0 Dated 9/13/90
J6	1-2	J14	1-2	U23 = #160-001-0 Dated 9/13/90
J7	1-2	J15	1-2	U16 = #PCMAID5.0 Dated 2/19/90
J8	1-2	J16	1-2	
J9	1-2	J17	1-2	

Figure F-8 Jumper Selections for AMOCAMS

Figure F-9 AMOCAMS EPROM Part Numbers

1.8 EXAMPLE CONFIGURATION FILE

The following figures detail a sample configuration file for a typical AMOCAMS protocol application. The configuration information is based on the following information:

Protocol	AMOCAMS
PLC Type	PLC-5/15
Comm. Data	Leased Line, 600 baud, FSK
Num. of PLCs	Two PLC #1 is LC 33H and PLC #2 is LC 27H)
Status Inputs Assigned to CDA #2	PLC #1 = 32, PLC #2 = 0
Analog Inputs Assigned to CDA #3	PLC #1=8, PLC #2 = 8
Accums. Assigned to CDA #4	PLC #1 = 0, PLC #2=4
Controls Assigned to CDA #1	PLC #1 = 16, PLC #2=16
Setpoints Assigned to CDA #5	PLC #1 = 12, PLC #2=0
Timer Values Assigned to CDA #6, 5 tables, 6 bytes each	PLC #1=3, PLC #2 = 1
Desired location of configuration table at word 0 ₁₀	
Desired starting location of data at word 200 ₁₀	
Desired location for Config. Table address Pointer 128 ₁₀	
Allen-Bradley RS232 Interface module address is 11 ₈	

Figure F-10 Example System Info.

1.8.1 Comm-Troller Switch Settings

The location of the word which points to the start of the configuration table must be specified by setting the three (3) address selection switches on the Comm-Troller. For this example the switch selections are:

Pointer Address = 128₁₀ (decimal word address)

= 256₁₀ (decimal byte address)

= 100_H (hex byte address)

Set Comm-Troller switches to 010 (least significant 0 is implied)

1.8.2 Example Table Entries

PLC WORD	
128	0000
000	0C01
001	0000
002	0500
003	0001
004-014	
015	5010
016	3040
017	2000
018-024	

Figure F-11 Example
AMOCAMS Header

PLC WORD	
025	0A02
026	0200
027	7602
028	0800
029	7A02
030	0200
031	8A02
032	0100
033	8E02
034	0400
035	9000
036-052	
053	00XX

Figure F-12
Example
AMOCAMS Data
Table