DF-1 PROTOCOL EMULATION

1.1 GENERAL DESCRIPTION

This section briefly describes the Allen-Bradley DF-1 half-duplex communication protocol for reference purposes only. The appropriate Allen-Bradley documentation should be consulted for complete details of the protocol.

The DF-1 protocol is an asynchronous byte oriented protocol that is used to communicate with most Allen-Bradley RS232 interface modules. The protocol may be used to provide either peer-to-peer communication through a full-duplex (unpolled) protocol or in a multi-dropped configuration using the half-duplex (polled) protocol. The Comm-Master uses DF-1 half-duplex protocol to communicate with equipment connected to its "RTU" port and full-duplex protocol to communicate with PLC equipment connected to its "HOST" port. Communication between the Comm-Master and the local PLC equipment operates at 9600 baud using 8 data bits, 1 stop bit and no parity. Communication security is provided by a 16-bit calculated cyclic redundancy check (CRC).

The communication parameters used for transferring information between the Comm-Master and the RTU equipment can set by the user as required. The Comm-Master can be operated at any baud rate from 300 to 9600 baud with any combination of data, parity and stop bits. The message security field can be selected as either BCC or CRC. Section 1.4.1 provides the detailed information for setting the RTU communication parameters.

All communications exchanges in DF-1 half-duplex protocol are initiated by the host, in this case the Comm-Master. The remote cannot initiate any exchange with the host nor can the remote directly address or communicate with another remote.

1.2 MESSAGE STRUCTURE

1.2.1 DF-1 Half-Duplex Protocol

Half-duplex protocol is a multi-drop protocol used for communication between one master and one or more slave devices. The Comm-Master is the master device and the slave devices are Allen-Bradley (or compatible) modules that have DF-1 slave mode capability. The Comm-Master can communicate with from 1 to 254 stations on a single communication link.

1.2.2 Transmission Symbols

Comm-Master™ DF-1 Protocol Emulation

Half-duplex protocol is character oriented. It uses the ASCII control characters shown in Figure B-1. The control characters are combined to make control and data symbols. A symbol is a sequence of one or more bytes having a specific meaning to the protocol. The characters of a symbol must be sent one after another with no other characters inserted between them. Figure B-2 defines the symbols used in DF-1 half-duplex protocol.

Code	Abbreviation	Hexadecimal
SOH	01	
STX	02	
ETX	03	

Figure B-1 DF-1 Control Characters

pical Message Transaction

The following diagram details the

Symbol	Type	Description
DLE SOH	Control	Master Symbol That Indicates The Start Of A Message
DLE STX	Control	Indicates The Start Of The Data Field
DLE ETX BCC	Control	Message Termination With BCC Error Check
DLE ETX CRC	Control	Message Termination With CRC Error Check
DLE ACK	Control	Acknowledge Good Receipt Of A Message
DLE NAK	Control	Negative Acknowledge Signifying An Error In A Received Message
DLE ENQ	Control	Issued By Master To Request (poll) Data From A Remote
DLE EOT	Control	Issued By Remote When It Has No More Data To Send
Data	Data	Single Characters Having Values From 00 To FF (hex) Except 10 (hex)
Dle Dle	Data	Represents The Data Value 10 (hex)

Figure B-2 Half-Duplex Protocol Symbols

messages sent between the Comm-Master and a remote to read a block of data in the remote. This typical "poll" message starts with the Comm-Master issuing a "Master Message Link Packet" which contains the address of the remote device which is to receive the message, the message itself and the BCC/CRC check field at the end of the message. The addressed slave device receives the message, checks it for errors and returns an acknowledge packet. The Comm-Master then issues an Enquiry command. The addressed slave then sends the data requested by the Comm-Master. The Comm-Master will check the received data and return an acknowledge to the slave. The master will then send another enquiry message. The slave will respond with either more data if available or an end of transmission message. The Comm-Master will transfer the data received into the local PLC's memory and proceed with the next poll message.

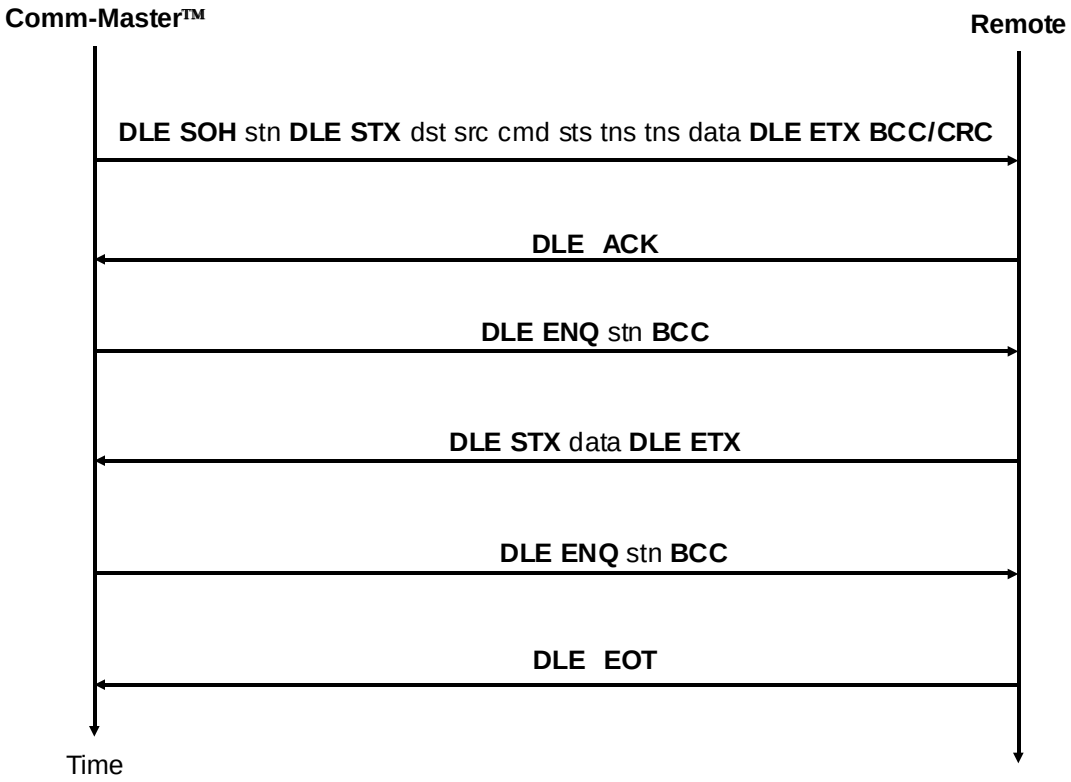

Figure B-3 Typical Message Exchange (no errors)

1.3 Message Types

DF-1 protocol communication exchanges can be divided into two types: data requests (polls) and control commands. In data requests (poll requests), the Comm-Master transmits a message requesting data values from the remote. The remote responds by transmitting the requested data values. These data values may be discrete (status), analog, accumulator, calculated variables, remote parameters, RTU status, analog outputs or discrete outputs. The format of the data must be as required by the master PLC. Note that the Comm-Master does not do any processing on the data collected from the remote. The PLC ladder logic must perform any data formatting that is required prior to using the data that is transferred by the Comm-Master.

Control requests are defined as any message from the master PLC requesting the remote to change the state of a field device or to change or modify an internal condition of the remote.

1.4 COMM-MASTER DF-1 CONFIGURATION TABLE

The following paragraphs detail the orginization of the configuration table for a Comm-Troller with DF-1 communication protocol installed on the RTU side.

Word	Byte Numbers	Function
0	00,01	Comm-Master Address; Number of Polling tables
1	02,03	Radio turn-on Delay (x 10 msec)
2	04,05	Radio turn-off Delay (x 10 msec)
3	06,07	Reserved
4	08,09	Remote Baud Rate; # Data Bits
5	10,11	Remote Parity; # Stop BIts
6	12,13	Reserved
7	14,15	Reserved
8	16,17	BCC Enable (BCC = 1, CRC = 0); Reserved
9	18,19	Reserved
10	20,21	Radio Key Address
11-19	22-39	Spare

Figure B-4 Comm-Master Configuration Header

1.4.1 Comm-Master DF-1 Configuration Header

Word offset 0 is used for 2 functions: Byte # 0 is used to define the Allen-Bradley Data Highway address of the interface module that is connected to the Comm-Master. This address is typically 11_8 but may be assigned to other values depending on the final system configuration. The address of the data highway interface module is used as the file address when reading or writing data to a PLC-5 system. The interface module can be assigned any address from 1 thru $77_{8.;}$ Byte # 1 is used to define the number of RTU Polling Tables that are defined in the system. The Comm-Master will use this number to determine the number of Polling Table Entries to read.

Word offset 1 is used for a Radio Turn-On Delay Timer. This is the time that the Comm-Master will delay (hold-off) sending data after raising the Request To Send line (RTS). The delay time will be 10ms times the number stored in word 1.

Word offset 2 is used for a Radio Turn-Off Delay Timer. This is the time that the Comm-Master will hold the line quiesent after transmitting the last byte of data. This delay is sometimes required when using the Comm-Master with some types of radio systems in order to insure the proper reception at the remote end. The delay time will be 10ms times the number stored in word 2.

Word offset 3 is reserved for future use. Set its value to 0000_H.

Word offset 4 is used for two functions. Byte # 0 is used to select the RTU port Baud Rate. Valid settings for this byte are: 04_H= 300, 05_H= 600, 06_H= 1200, 08_H= 2400, 09_H= 4800, $0A_H$= 7200 and $0B_H$= 9600 . Byte 1 is used to select the RTU Port Number of data Bits option. Valid selections are: 07_H and 08_H, corresponding to seven and eight data bits respectively.

Word offset 5 is used for two options. Byte 0 is used to select the RTU Port Parity option and byte 1 is used to select the number of stop bits to use. Valid selections for byte 0 are 00_H= no parity, 01_H= odd parity and 02_H= even pariry. Valid selections for byte 1 are 01_H and 02_H, corresponding to one or 2 stop bits.

Word offsets 6 and 7 are reseerved for future use. Set to 0000_H.

Word offset 8 is used for two functions. Byte 0 is used to select either BCC or CRC error checking. Set byte 0 to 0 for CRC and to 1 for BCC. Byte 1 is reserved for future use, set it to 0.

Word offset 9 is reserved for future use. Set word 9 to 0.

Word offset 10 is used to define a "radio key address". The radio key address is an address in the master PLC which will be written to when the Comm-Master has data to send on its RTU communications port. The address is entered in decimal notation. In some applications it may be necessary to switch on or "key" a radio transmitter for subsequent transmission of data. A PLC relay output module could be used for this function. If a radio key address is defined (word is non zero) then the contents of this word are intrepreted as a radio key address. The Comm-Master will set bit 0 ON whenever it wishes to transmit data. The Comm-Master will clear this bit when it has no more data to send.

Word offset 11 thru 19 are reserved for future use. Set to zero.

1.4.2 Polling Table Entry for DF-1 Protocol

The Polling tables start immediately following the end of the configuration table header section. The polling tables are contiguous, one immediately following the other. Each Polling table is 20 words long. There is a polling table for each poll message that the Comm-Master is required to send. The number of polling tables to read is specified in the Configuration header word 0 byte 1 entry as described above.

Word	Byte Numbers	Function
0	00,01	Remote Address; PLC Type
1	02,03	Data Point Count (words)
2-5	04-11	Data Address in RTU
6	12,13	Destination PLC Address; PLC Type
7-10	14-21	Data Address in PLC
11	22,23	Scan Update Frequency (x 10 msec)
12	24,25	Scan Error Timeout (x 10 msec)
13	26,27	Reserved
14-17	28-35	Poll Error Address in local PLC
18-19	36-39	Spare

Figure B-5 Comm-Master Polling Table Entry

Word offset 0 is used for two functions. Byte 0 (high byte) is used to define the address of the RTU that is to be accessed with the poll command. It can be any number from 0 to 255 (0 to FF_H). Byte 1 is used to select the type of addressing to use when communicating with the remote device. Current versions of the Comm-Master only support PLC2 type addressing modes. Set byte 1 to 2.

Word offset 1 is used to store the data point count (amount of data to be returned). All 16 bits can be used to specify the data point count. Byte 0 is the high order byte; byte 1 is the low order byte.

Word offset 2 thru 5 are used to store the data source address (starting point). Curreent versions of the Comm-Master use the PLC-2 mode of addressing. Therefore only the first word of address information is all that is used. Set the remaining words to 0.

Word offset 6 is used to specify the destination PLC Data Highway Address and the Type of PLC. Set the high order byte (byte 0) to the destination PLC data Highway address. Set the Low order byte to 02_H since only PLC-2 addressing modes are supported.

Word offset 7 thru 10 are used to specify a destination PLC address. The contents of word 7 are used as the decimal word address within the current file that the Comm-Master will use when writing data returned from an RTU.

Word offset 11 is used to specify the interval between polls. Polls will be issued by the Comm-Master at the rate specified by the contents of this word. The polling interval can be specified in 10 ms increments. That is an entry of 200 (decimal) would result in the Comm-Master polling for the data specified in this table entry once every 2 seconds (200 X 10ms per count = 2000 ms = 2 sec)

Word offset 12 is used to specify the message time-out time. The message time out will be set to the number stored in this word times 10ms.

Word offset 13 is reserved for future use. Set to 0000H.

Word offsets 14 thru 17 are used to specify a Poll Message Error Address. This address will be updated by the Comm-Master at the conclusion of the poll request. The poll request is ended whenever either the RTU responds with the requested data or an error occurs. Word 14 will be updated with the latest status available to the Comm-Master.

Words 18 and 19 are reserved. Set to 0000_H.

1.5 JUMPER SELECTIONS FOR DF-1 PROTOCOL

The Comm-Master jumper settings and EPROM part numbers for Comm-Master DF-1 protocol operation is detailed in the following figure.

JUMPER	POSITION
J2	1-2
J3	NOT USED
J4	NOT USED
J5	NOT USED
J6	1-2
J7	1-2
J8	NOT USED

JUMPER	POSITION
J10	NOT USED
J11	1-2
J12	1-2
J13	NOT USED
J14	NOT USED
J15	1-2
J16	NOT USED

DF-1 Half Duplex Protocol Communication is on Port P1 (top port), Allen-Bradley Communication is on Port P2 (center port)

U13 = # 166-004-0 2/5/91

U23 = # 166-003-0 2/5/91

U16 = PCMAID50 2/19/90

Figure B-6 Jumper Settings