ALLEN-BRADLEY

TO

CATERPILLAR CCM PROTOCOL CONVERTER

CONFIGURATION AND OPERATION MANUAL

MARC™

PRODUCTS

PROTOCOL CONVERTER
ALLEN-BRADLEY TO CATERPILLAR

CONFIGURATION AND OPERATION

EQUIPMENT DESCRIPTION

The MARC Allen-Bradley to Caterpillar interface module provides a convenient, easy to use method for monitoring Caterpillar 3600 gas engine status with standard Allen-Bradley PLCs. The MARC 166-500 Omnii-Comm for the PLC 5 is used to implement the Caterpillar interface. The 166-500 mounts in a single slot of a standard Allen-Bradley 1771 I/O chassis and connects to the PLC backplane for +5 volt DC power only. The module has four (4) 9-pin D connectors that are used for serial communication. This application will use one port for connection to the Allen-Bradley PLC (can be either Channel 0 or a 1785-KE) and three ports for connection to standard Caterpillar CCM engine monitoring systems. A configuration file is loaded into the Omnii-Comm to provide setup and operation details. The user can easily define the engine parameters to read and the locations in the PLC that will be used to store the data using configuration software provided with the module. Some simple ladder programming may be required to initialize the Caterpillar interface as described in the paragraphs below. Once the interfaces have been initialized no further ladder logic programming is required. The data collected will be automatically sent to the PLC locations defined. This document provides additional comments and clarifications regarding the configuration file for the Caterpillar interface.

CONFIGURATION

The Omnii-Comm™ is configured by sending configuration data from a standard PC serial port to connector P1 (top connector) of the Omnii-Comm. A set of configuration utility programs along with several example configuration files are provided on a diskette shipped with each unit. The following paragraphs outline the steps for loading and changing a configuration.

CONFIGURATION PROCEDURE

Make a backup copy of the configuration files just in case you need to revert to a working version. Then look at each of the example configuration files provided on the diskette and identify those that are provide functions that are similar to what is required in your system. The CATTBL.ASM file is a specific example for the Caterpillar interface. You can print the configuration files or use a text editor to view them. The ASM files are flat ASCII text files. Subsequent sections of this document explain each section of the configuration file as used for the Caterpillar interface

Edit the tables as necessary using the editor provided or any other ASCII text editor that you feel comfortable using. Do not use a word processor program to edit the files.

Assemble the edited tables using AS11. There is a batch file on the disk named ASM.BAT. Type ASM <filename>. Do not type the filename extension (.ASM). The configuration file will be read by the assembler which will then generate two output files, one with an extension of .LST and the other a .S19. The ASM file will be unchanged. The .S19 file is the one that will be sent to the Omnii-Comm.

Download the new configuration information to the Omnii-Comm using FT or any other terminal emulation program. Download as follows:

> Connect a standard serial port of the PC to Port 1 of the Omnii-Comm. Set up for 9600 baud, 8 data bits, no parity and one stop bit. Use a standard null modem cable. Run the FT program. When you hit the ENTER key you should see a prompt message from the Omnii-Comm.

Press the black configuration button to force the unit into the configuration mode. The button is located just to the left and slightly below connector P2 on the Omnii-Comm for the SLC 500 and just above connector P1 on the Omnii-Comm for the PLC 5.

Type L to start the loading process. (must be uppercase)

Send the .S19 file built by the assembler. Press F6 if running FT and enter the name of the file to send. Don't forget to include the .S19 extension.

As the file is downloaded a series of dashes will appear on the screen. The configuration data file will be downloaded to RAM memory on the Omnii-Comm. You may view it if you wish by typing V 7000. Entering a space character will display the next 16 locations. A carriage return will terminate the view function. The Omnii-Comm can use a configuration file from either RAM or EEPROM memory. The location of the configuration file is determined by a "pointer" address located in EEPROM memory at locations FFD0 and FFD1. You can examine and change the pointer by typing: E FFD0. The Omnii-Comm will echo the address followed by the data contained at the address. Change the pointer as required to point to the configuration table. It will either be 70 for RAM or F8 for EEPROM. Location FFD1 is always 00. Test the configuration from RAM memory (set location FFD0/1 to 70/00).

When you have a working configuration save it to EEPROM memory by typing S 7000 F800 0200 where 0200 is the number of bytes of data to move from RAM to EEPROM. The size may need to be changed if the table size changes significantly.

Type R to restart the Omnii-Comm with the new configuration.

CONFIGURATION FILE

PORT NAMES

The Caterpillar configuration file uses the following names to refer to internal microprocessor ports for convenience:

```
AB_PORT      EQU   DUSCC1_A
CAT1_PORT    EQU   DUSCC1_B
CAT2_PORT    EQU   DUSCC2_A
CAT3_PORT    EQU   DUSCC2_B
ERROR_PORT   EQU   AB_PORT
```

The names on the left can be changed as required. Do not change the names on the right.

APPLICATION NAMES

The example file has the following names defined for this application:

```
WRITEBACK    EQU   75           # registers for writeback data
CMDDAT       EQU   16           # registers for command data
NOFLAG       EQU   %00000001    protocol OPTION do not update flags
PLC          EQU   12Q          data highway address of PLC
```

The first three are specific for this application and should not be changed. The PLC data highway address must be changed to match the highway address of the PLC that will be used to receive data from the Caterpillar engines. If the number has a Q suffix, as in the example, it will be interpreted as an OCTAL number.

CONFIGURATION HEADER

The configuration header section contains information specific for this application and should not be changed. Leave the configuration header information as shown below:

```
FDB     $55AA                   OCINIT
FCB     01,0                    CM mode, OPTION
FCB     0,9                     RTU address (not used here), Omnii-Comm address
FCB     05,05                   #ports, #ports to init
FCB     6,6                     #polls, #CTDB PLC polls
FDB     1                       poll timer multiplier
```

GLOBAL ERROR LOCATION

A global error location should be defined. This section of the table is used to define a PLC address that will be used to store an error code if an error occurs and there is not an active poll table.

```
FCB     ERROR_PORT,ALLENBRADLEY     error port, protocol
FCB     PLC5,PLC                    spare, PLC address
FDB     PLC5_WRITE                  CMD, spare
FCB     0,0                         spare, station (HDX only)
FCB     00,'N'                      LP; File Type
FDB     10                          File number
FDB     60                          Global error address
FDB     2                           2 byte error message
FCB     0,0,0,0                     spares
```

The example defines a global error address in a PLC 5 at address “PLC” at location N10:60

PORT CONFIGURATION

Each hardware port of the Protocol Converter is set up based on information read from “Port Configuration Tables” in the configuration file. This example sets up Allen-Bradley communication on the top port (P1) and Caterpillar communication on each of the other ports (P2, P3 and P4). If the application does not require three Caterpillar communications ports then you can use another protocol on the port simply by changing the protocol name. The NOFLAG protocol option name is included for each of the Caterpillar ports to disable setting of the NEW DATA AVAILABLE FLAG BITS when data is received from the engine interface. This will reduce the number of messages sent to the Allen-Bradley.

```
        FCB     SCI,DBG             SCI port, DBG protocol
        FCB     BAUD1200,EIGHT      1200 baud, 8 bits
        FCB     NONE,ONE                    no parity, 1 stop
        FCB     MODEM,00                    connector, spare
        FCB     00,00
        FCB     00,00
        FDB     00
        FDB     02                          ON delay
        FDB     02                          OFF delay
        FDB     00                          extension address
;---------------------------------- ALLENBRADLEY master port
        FCB     AB_PORT,ALLENBRADLEY    port, protocol=ALLENBRADLEY
        FCB     BAUD9600,EIGHT          9600 baud, 8 bits
        FCB     NONE,ONE                no parity, 1 stop
        FCB     P1, 00                  connector, spare
        FDB     00                      reserved
        FDB     00                      reserved
        FDB     00                      spare
        FDB     00                      ON delay
        FDB     00                      OFF delay
        FDB     00                      extension address (not used)
;---------------------------------- Caterpillar port
        FCB     CAT1_PORT,CAT           port, protocol=Caterpillar
        FCB     BAUD9600,EIGHT          9600 baud, 8 bits
        FCB     NONE,ONE                no parity, 1 stop
        FCB     P2,NOFLAG               connector, protocol options
        FDB     00                      OPTION1
        FDB     00                      OPTION2
        FDB     00                      spare
        FDB     00                      ON delay
        FDB     00                      OFF delay
        FDB     CAT1TABLE-$7000             extension address
;---------------------------------- Caterpillar port
        FCB     CAT2_PORT,CAT           port, protocol=Caterpillar
        FCB     BAUD9600,EIGHT          9600 baud, 8 bits
        FCB     NONE,ONE                no parity, 1 stop
        FCB     P3,NOFLAG               connector, protocol options
        FDB     00                      OPTION1
        FDB     00                      OPTION2
        FDB     00                      spare
        FDB     00                      ON delay
        FDB     00                      OFF delay
        FDB     CAT2TABLE-$7000             extension address
;---------------------------------- Caterpillar port
        FCB     CAT3_PORT,CAT           port, protocol=Caterpillar
        FCB     BAUD9600,EIGHT          9600 baud, 8 bits
        FCB     NONE,ONE                no parity, 1 stop
        FCB     P4,NOFLAG               connector, protocol options
        FDB     00                      OPTION1
        FDB     00                      OPTION2
        FDB     00                      spare
        FDB     00                      ON delay
        FDB     00                      OFF delay
        FDB     CAT3TABLE-$7000             extension address
```

POLL TABLE #1 DEFINE NEW DATA AVAILABLE FLAGS

This example defines three words in the Allen-Bradley that can be used to notify the ladder programs of the arrival of new data from an engine. The setting of the New Data Available Bits is disabled by including the NOFLAG protocol option in the port definition table for the port. This example uses N10:0 through N10:2 for the New Data Available Flags.

```
;---------------------------------------- POLLING TABLES:  table 1
;       Define the new data available flag words (one word per Caterpillar interface)
;       Bits 0-7 indicate new data available from lists 1-8, bit set means new data available
;       Bit 8 indicates new data available from a single read
;       Bit 9 indicates new status available
;       Bit 10 indicates new fault codes are available
        FDB     0                               timer (read once only)
        FDB     200                             time-out
        FDB     0                               spare
        FDB     0                               spare

        FCB     AB_PORT,ALLENBRADLEY            RWE=read port, protocol
        FCB     PLC5,PLC                        PLC type, PLC address
        FDB     PLC5_READ                       CMD,FNC= register read
        FCB     00,00                           reserved
        FCB     00,'N'                          LP; File Type
        FDB     10                              File Number
        FDB     00                              Element
        FDB     6                               read count (bytes)

        FCB     CTDB,ALLENBRADLEY               RWE=write port (CommTroller databa  se "port")
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FDB     POLL1DATA-$7000                         data offset
        FDB     6                               byte count

        FCB     ERROR_PORT,ALLENBRADLEY         error port, protocol
        FCB     PLC5,PLC                        spare, PLC address
        FDB     PLC5_WRITE                      CMD, spare
        FCB     0,0                             spare, station (HDX only)
        FCB     00,'N'                          LP; File Type
        FDB     10                              File number
        FDB     61                              error address
        FDB     2                               2 byte error message
```

POLL TABLE #2 DEFINE COMMAND CONTROL BITS

Poll table #2 is used to define the Command Control Bits. This example defines three words per engine for convenience. We only use the first five (5) bits of each word.

```
;---------------------------------------- POLLING TABLES:  table 2  (Coils)
;           Define the control bits to be used to send commands to the Caterpillar engine
;           One word per engine defined for convenience
;           Bit 0 = Send Activate List Command (List number is 2nd word of command data)
;           Bit 1 = Send Deactivate List Command (List number is 2nd word of command data)
;           Bit 2 = Program List (List number is 2nd word, IID parameters are words 5-12
;                       programming flags come from 4th word and list time from word number 3
;           Bit 3 = Request Single Read Command (Single Read IID is 13th data word and
;                       flags are 14th data word)
;           Bit 4 = Request Fault Codes (word 15 of data is update time and word 16 is flags)

            FDB     10                          timer
            FDB     200                         time-out
            FDB     0                           spare
            FDB     0                           spare

            FCB     AB_PORT,ALLENBRADLEY        RWE=read port, protocol
            FCB     PLC5,PLC                    PLC type, PLC address
            FDB     PLC5_READ                   CMD,FNC= register read
            FCB     00,00                       reserved
            FCB     00,'N'                      LP; File Type
            FDB     10                          File Number
            FDB     03                          Element
            FDB     6                           read count (bytes)

            FCB     CTDB,ALLENBRADLEY           RWE=write port (CommTroller database port")
            FCB     00,00
            FCB     00,00
            FCB     00,00
            FCB     00,00
            FCB     00,00
            FDB     POLL2DATA-$7000                     data offset
            FDB     6                           byte count

            FCB     ERROR_PORT,ALLENBRADLEY     error port, protocol
            FCB     PLC5,PLC                    spare, PLC address
            FDB     PLC5_WRITE                  CMD, spare
            FCB     0,0                         spare, station (HDX only)
            FCB     00,'N'                      LP; File Type
            FDB     10                          File number
            FDB     62                          error address
            FDB     2                           2 byte error message
```

POLL TABLE #3 DEFINE THE LOCATION FOR COMMAND DATA

Poll table #3 is used to define the location of the data that will be used for each of the commands that will be sent to the engines. The data contained in the command data words will be sent when the command enable bit is set.

```
;--------------------------------------- POLLING TABLES:  table 3  (COMMAND DATA)
;           Define the location for the data to be used in the commands
;           "CMDDAT" words per engine (CMDDAT=16)
            FDB     10                          timer
            FDB     200                         time-out
            FDB     0                           spare
            FDB     0                           spare

            FCB     AB_PORT,ALLENBRA DLEY       RWE=read port, protocol
            FCB     PLC5,PLC                    PLC type, PLC address
            FDB     PLC5_READ                   CMD,FNC= register read
            FCB     00,00                       reserved
            FCB     00,'N'                      LP; File Type
            FDB     10                          File Number
            FDB     10                          Element
            FDB     3*CMDDAT*2                  byte count (3 engines, CMDDAT words each)

            FCB     CTDB,ALLENBRADLEY           RWE=write port (CommTroller database "port")
            FCB     00,00
            FCB     00,00
            FCB     00,00
            FCB     00,00
            FCB     00,00
            FDB     POLL3DATA-$7000                     data offset
            FDB     3*CMDDAT*2                  byte count (N10:0 thru N10:47)

            FCB     ERROR_PORT,ALLENBRADLEY     error port, protocol
            FCB     PLC5,PLC                    spare, PLC address
            FDB     PLC5_WRITE                  CMD, spare
            FCB     0,0                         spare, station (HDX only)
            FCB     00,'N'                      LP; File Type
            FDB     10                          File number
            FDB     63                          error address
            FDB     2                           2 byte error message
```

POLL TABLE #4 DEFINE THE PLC ADDRESS LOCATIONS FOR ENGINE DATA

Poll tables #4, 5 and 6 define the PLC registers to use for storing data from the three engines. This example defines a total of 75 registers for each engine. Engine #1 data is stored in N11, engine #2 in N12 and engine #3 in N13.

```
;---------------------------------------- POLLING TABLES:  table 4 (WRITEBACK)
;       Define register locations to use to store data from engine #1. Register offsets
;       are defined in extension data tables (located at the end of this file).
;       Set up as one table per engine
        FDB     0                       timer (READ ONCE ONLY!)
        FDB     200                     time-out
        FDB     0                       spare
        FDB     0                       spare

        FCB     AB_PORT,ALLENBRADLEY    RWE=read port, protocol
        FCB     PLC5,PLC                PLC type, PLC address
        FDB     PLC5_READ               CMD,FNC= register read
        FCB     00,00                   reserved
        FCB     00,'N'                  LP; File Type
        FDB     11                      File Numbe r
        FDB     00                      Element
        FDB     WRITEBACK*2             byte count

        FCB     CTDB,ALLENBRADLEY       RWE=write port (CommTroller database "port")
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FDB     POLL4DATA-$7000                 data offset
        FDB     WRITEBACK*2             byte count

        FCB     ERROR_PORT,ALLENBRADLEY         error port, protocol
        FCB     PLC5,PLC                spare, PLC address
        FDB     PLC5_WRITE              CMD, spare
        FCB     0,0                     spare, station (HDX only)
        FCB     00,'N'                  LP; File Type
        FDB     10                      File number
        FDB     64                      error address
        FDB     2                       2 byte error message
;---------------------------------------- POLLING TABLES:  table 5 (WRITEBACK)
;       Define register locations to use to store data from engine #2. Register offsets
;       are defined in extension data tables (located at the end of this file).
;       Set up as one table per engine
        FDB     0                       timer (READ ONCE ONLY!)
        FDB     200                     time-out
        FDB     0                       spare
        FDB     0                       spare

        FCB     AB_PORT,ALLENBRADLEY    RWE=read port, protocol
        FCB     PLC5,PLC                PLC type, PLC address
        FDB     PLC5_READ               CMD,FNC= register read
        FCB     00,00                   reserved
        FCB     00,'N'                  LP; File Type
        FDB     12                      File Number
        FDB     00                      Element
        FDB     WRITEBACK*2             byte count

        FCB     CTDB,ALLENBRADLEY       RWE=write port (CommTroller database "port")
        FCB     00,00
        FCB     00,00
```

```
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FDB     POLL5DATA-$7000                 data offset
        FDB     WRITEBACK*2             byte count

        FCB     ERROR_PORT,ALLENBRADLEY         error port, protocol
        FCB     PLC5,PLC                spare, PLC address
        FDB     PLC5_WRITE              CMD, spare
        FCB     0,0                     spare, station (HDX only)
        FCB     00,'N'                  LP; File Type
        FDB     10                      File number
        FDB     65                      error address
        FDB     2                       2 byte error message
;---------------------------------- POLLING TABLES:  table 6 (WRITEBACK)
;       Define register locations to use to store data from engine #3. Register offsets
;       are defined in extension data tables (located at the end of this file).
;       Set up as one table per engine
        FDB     0                       timer (READ ONCE ONLY!)
        FDB     200                     time-out
        FDB     0                       spare
        FDB     0                       spare

        FCB     AB_PORT,ALLENBRADLEY    RWE=read port, protocol
        FCB     PLC5,PLC                PLC type, PLC address
        FDB     PLC5_READ               CMD,FNC= register read
        FCB     00,00                   reserved
        FCB     00,'N'                  LP; File Type
        FDB     13                      File Number
        FDB     00                      Element
        FDB     WRITEBACK*2             byte count

        FCB     CTDB,ALLENBRADLEY       RWE=write port (CommTroller database "port")
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FCB     00,00
        FDB     POLL6DATA-$7000                 data offset
        FDB     WRITEBACK*2             byte count

        FCB     ERROR_PORT,ALLENBRADLEY         error port, protocol
        FCB     PLC5,PLC                spare, PLC address
        FDB     PLC5_WRITE              CMD, spare
        FCB     0,0                     spare, station (HDX only)
        FCB     00,'N'                  LP; File Type
        FDB     10                      File number
        FDB     66                      error address
        FDB     2                       2 byte error message
```

POLLXDATA and CATXTABLE

There is a POLLDATA definition file for each poll table. These files define how the data referenced in the poll tables will be used. DO NOT CHANGE THE POLL DATA DEFINITION FILES unless you thoroughly understand the operation of the Omnii-Comm.

Likewise, there is a CATTABLE defined for each engine. You should not change the CATTABLEs unless you thoroughly understand the operation of the Omnii-Comm.

PLC MEMORY SUMMARY

This example uses PLC files N10, N11, N12 and N13 for interfacing to up to three Caterpillar engines. The following summarizes the address locations used.

N10:00 - N10:02	new data available flags, engine 1,2 and 3
N10:03 - N10:05	command control bits, engine 1,2 and 3
N10:10 - N10:25	command data for engine #1
N10:26 - N10:41	command data for engine #2
N10:42 - N10:57	command data for engine #3
N10:60 - N10:66	error locations
N11:00 - N11:74	data from engine #1
N12:00 - N12:74	data from engine #2
N13:00 - N13:74	data from engine #3

NEW DATA AVAILABLE FLAG BIT DEFINITIONS (one word per engine)

BIT #	
00	new data available from list 1
01	new data available from list 2
02	new data available from list 3
03	new data available from list 4
04	new data available from list 5
05	new data available from list 6
06	new data available from list 7
07	new data available from list 8
08	new data available from single read
09	new status available
10	new fault codes are available

CONTROL BIT DEFINITIONS (set bit to issue control)

BIT #	
00	send Activate List Command (list number is 2nd word of command d ata)
01	send Deactivate List Command (list number is 2nd word of command data)
02	send Program List Command (list number is 2nd word, IID parameters are words 5-12, programming flags come from 4th word and list time from 3ed word)
03	request Single Read Command (single read IID is 13 data word and flags are 14th data word)
04	request fault codes (word 15 is update time and 16 is flags)

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COMMAND DATA WORD DEFINITIONS (16 words per engine)

WORD #	
00	used when receiving list messages from the CAT engines to enable or disable the use of delimiters. 1 bit per list. Bit 00 is for list 1, bit 01 is for list 2 etc. Set to bit to expect delimiters.
01	list number (1-8)
02	list time (1 bit for each .5 second--range 1-250)
03	list flags
	bit 00 0=ASCII, 1=Binary
	bit 02,01 00=Message terminator is CR
	01=Message terminator is CR+LF
	10=not defined
	11=not defined
	bit 03 not implemented
	bit 05,04 00=comma separator
	01=space separator
	10=no separator
	11=not defined
04-11	IIDs for list (up to 8, set unused parameters to 0000)
12	single read IID
13	single read flag
	bit 00 0=ASCII, 1=Binary
14	fault time 1 bit for each 5 seconds
15	fault flags
	bit 00 0=ASCII, 1=Binary
	bit 01-06 not used
	bit 07 0=active, 1=inactive
	bit 08-15 not used

ENGINE DATA (N11, N12 & N13) 75 WORDS PER ENGINE

WORD #	
00 - 07	data from list 1
08 - 15	data from list 2
16 - 23	data from list 3
24 - 31	data from list 4
32 - 39	data from list 5
40 - 47	data from list 6
48 - 55	data from list 7
56 - 63	data from list 8
64	data from single read command
65 - 73	fault codes (from 1 to 9)
74	status from last command
	00=OK
	10=IID data not defined
	20=bad checksum or bad command format