ALLEN–BRADLEY DF1 INTEGRATION KIT FOR OPTOCONTROL USER'S GUIDE

Form 0912–070817 — August, 2007

OPTO 22

Allen-Bradley DF1 Integration Kit for OptoControl User's Guide
Form 0912-070817 — August, 2007

Table of Contents

Allen–Bradley DF1 Integration Kit For OptoControl

Overview

Introduction

The ALLEN-BRADLEY DF1 INTEGRATION KIT (Part # OPTOINTAB) allows users of Opto 22's OptoControl software (version 3.0 and above) an easy method of communicating with Allen-Bradley drivers or PLCs using the DF1 protocol. Opto 22 controllers can act as either a "master" or a "slave" device. They can be connected directly to the serial port on an Allen-Bradley PLC or to Data Highway networks using standard Data Highway interface devices.

The integration kit's command set includes menu-driven OptoControl commands that can be used anywhere within an OptoControl strategy. These commands provide OptoControl applications the ability to exchange floating point, integer, I/O, ASCII, or string data with Allen-Bradley devices that support the DF1 protocol.

The command set is made up of OptoControl subroutines that transmit and receive serial messages according to the DF1 protocol specifications in the ALLEN-BRADLEY DATA HIGHWAY/DATA HIGHWAY PLUS/DH-485 COMMUNICATION PROTOCOL AND COMMAND SET, publication number 1770-6.5.16.

Requirements

To implement an interface between an Opto 22 controller and an Allen-Bradley device, you will need:

- **The Allen-Bradley DF1 Integration Kit.**

- **An Opto 22 controller with a firmware revision of OptoKernel 3.0 or later.**

- **A PC running OptoControl software.**

- **A user-fabricated serial cable connecting the Opto 22 controller to either the Data Highway interface device or the serial port of an Allen-Bradley PLC.**

- **A PLC capable of supporting DF1 commands Typed Read/Typed Write or Protected Type Logical Read/Protected Type Logical Write, such as the SLC 500 and PLC5 Allen-Bradley PLCs.**

OptoControl Architecture

OptoControl Implementation

The ALLEN-BRADLEY DF1 INTEGRATION KIT consists of a set of OptoControl subroutines supported by an extended command set. The extended command set uses an OptoControl library file (AB.LIB) that is downloaded to a controller prior to your OptoControl strategy and makes the extended command set available to the controller. In addition, there is an OptoControl definition file (AB.XID) that makes the extended command set available to the OptoControl configurator.

The "Master" subroutines for the PLC5 family support the TYPED READ (READ BLOCK) and TYPED WRITE (WRITE BLOCK) commands. In addition, the PLC5 "Slave" subroutine implements the WORD RANGE READ (READ BLOCK) and the WORD RANGE WRITE (WRITE BLOCK) commands. For the SLC family of PLCs, the commands PROTECTED TYPED LOGICAL READ and PROTECTED TYPED LOGICAL WRITE have been implemented in both the 'Master" and "Slave" subroutines. All these commands have been implemented to the element (word) level of addressing.

Addressing Limitations

The integration kit's PLC addressing limitations are as follows:

- The integration kit does not support reads or writes of individual bits.

- The integration kit does not allow reading and writing to PLC file numbers 2, 4, 5, or 6.

- The integration kit will not read or write to any PLC data files that have a file-type other than integer, float, I/O, ASCII, string, or binary.

Installation

Setup

Install Files

1. Insert the OptoIntegration CD to run the SETUP.EXE program.

2. The setup wizard will create the folder Opto22\OptoCtrl\AB DF1 Integration Kit. This folder will contain all the subroutine and support files for the integration kit, as well as example OptoControl strategies.

NOTE: Documentation for the integration kit is in a PDF format. If you don't already have it installed you will need it to view and print the supporting document. After installation is complete, you will have the option of installing Acrobat Reader.

OptoControl Configuration

To use the integration kit with an OptoControl strategy:

1. Start the OptoControl Configure Mode and open the strategy that you intend to use with the integration kit.

2. Use the Configure tool on the menu to select the controller. Then select Download Options, and click the Add button on the Before Run File list. Use the browser to select the AB.LIB file.

3. **For each subroutine you intend to use with your OptoControl strategy,** use the Configure tool on the menu to select Subroutine Includes. Click the Add button and use the browser to select the subroutine file (.CSB extension). When finished, the subroutine should appear in the Strategy Tree under the Subroutines Included folder.

If any of the subroutine or XID files have been moved from the folder they were installed into, you will need to follow step 4.

4. **For each subroutine you intend to use with your OptoControl strategy**, after the subroutine is included in the OptoControl Strategy Tree, click on the "+" sign next to the submarine icon and double-click the folder titled "Ext. Instruction Files Included" (see note below). Click the Add button and use the browser to add AB.XID to the list.

NOTE: When opening a subroutine for the first time, if the XID file is not found in the directory shown by the Ext. Instruction Files Included list, an error will occur indicating that OptoControl cannot find the external instruction file for the subroutine. Once the .XID file is added to the Ext. Instruction Files Included list (step 4), subsequent openings of the subroutine should be error-free.

5. The subroutines are now ready to be utilized in your strategy.

Data Highway Communication Wiring

The cables used for connecting an Opto 22 controller to a Data Highway interface device are specified in the drawings below. The cables require a DB25 female connector on the Data Highway interface end. Current Opto 22 controllers use screw-type terminal connectors, however, some older controllers use DB9 female connectors.

Opto 22 RS-232 serial connection to DH interface device

```
OPTO 22 RS232 PORT                                    DH INTERFACE
                                                    ASYNCHRONOUS PORT

       Tx  2  ─────────────────────────────────────  3
       Rx  3  ─────────────────────────────────────  2
      GND  7  ─────────────────────────────────────  7

                                                      4  ┐
                                                         │◄─
                                                      5  ┘
                                                              JUMPERS
                                                      6  ┐
                                                         │◄─
                                                      8  │
                                                     20  ┘
```
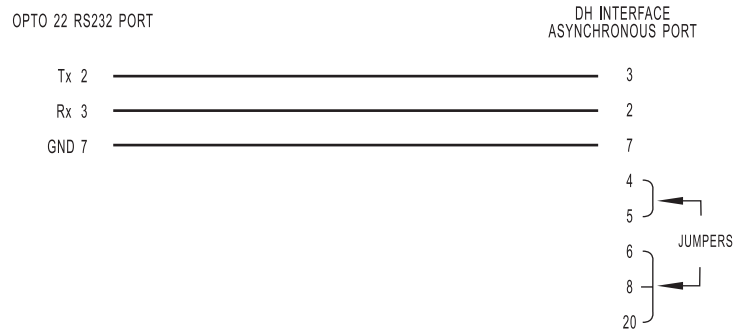
Opto 22 RS-422 serial connection to DH interface device

```
OPTO 22 RS422 PORT                                    DH INTERFACE
                                                    ASYNCHRONOUS PORT

      GND  3  ─────┐                              ┌──────  1

      Rx+  1  ───┐ │                              │ ┌────  14
                 │ │  ╲   ╱                        │ │
      Rx-  2  ───┘ │   ╳                          │ └────  25
                   │  ╱   ╲                        │
      Tx+  4  ───┐ │   ╲   ╱                      │ ┌────  16
                 │ │    ╳                          │ │
      Tx-  5  ───┘ │   ╱   ╲                      │ └────  18

                                                      4  ┐
                                                         │◄─
                                                      5  ┘
                                                              JUMPERS
                                                      6  ┐
                                                         │◄─
                                                      8  │
                                                     20  ┘
```
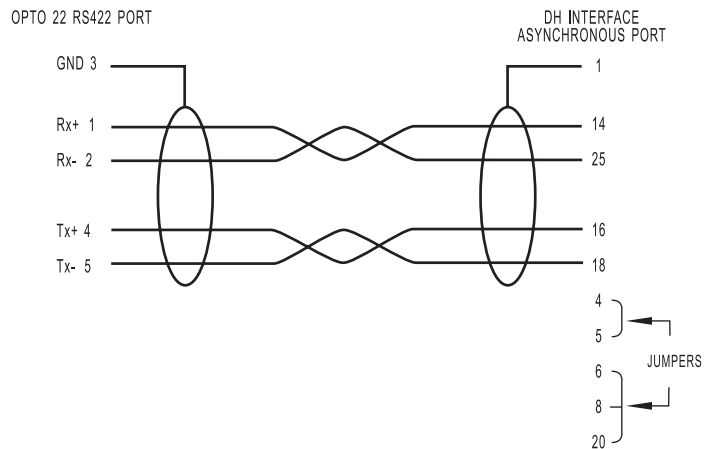
Data Highway Communication

In order to communicate on the Data Highway network with an Opto 22 controller and a Data Highway interface device (i.e., KF module or DL2000), the settings on the Data Highway interface device for baud rate, parity, and number of stop bits must match the configuration for the serial port used in the AB Configure Port subroutine. In addition, the following parameters should be set for the Data Highway interface device's asynchronous port.

• Use BCC error check mode.

• Do not use imbedded response mode.

• Hand-shaking should be disabled.

• Full duplex.

Direct Serial Communication Wiring

The cables used for connecting an Opto 22 controller to an Allen-Bradley PLC serial port are specified in the drawings below. The cable for a PLC5 requires a DB25 male connector on the PLC5 end. The cable for a SLC requires a DB9 female connector on the SLC end. Current Opto 22 controllers use screw-type terminal connectors, however, some older controllers use DB9 female connectors.

Opto 22 RS-232 serial connection to PLC5/11 channel 0

OPTO 22 RS232 PORT   PLC5 SERIAL PORT

Tx 2 ———————————————————————— 3
Rx 3 ———————————————————————— 2
GND 7 ———————————————————————— 7

                                                           4
                                                           5
                                                              JUMPERS
                                                           6
                                                           8
                                                          20
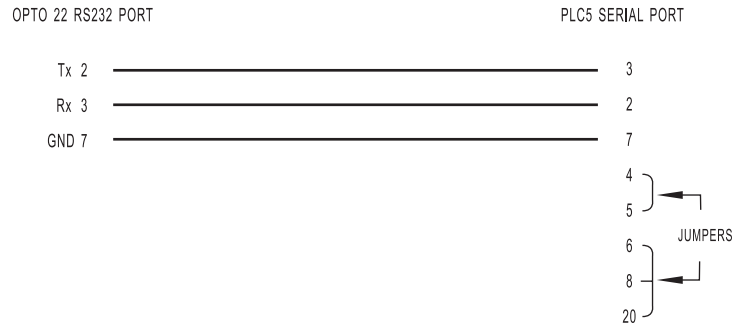
Opto 22 RS-232 serial connection to SLC5/04 RS232 port

OPTO 22 RS232 PORT   SLC SERIAL PORT

Tx 2 ———————————————————————— 2
Rx 3 ———————————————————————— 3
GND 7 ———————————————————————— 5

                                                           7
                                                           8
                                                              JUMPERS
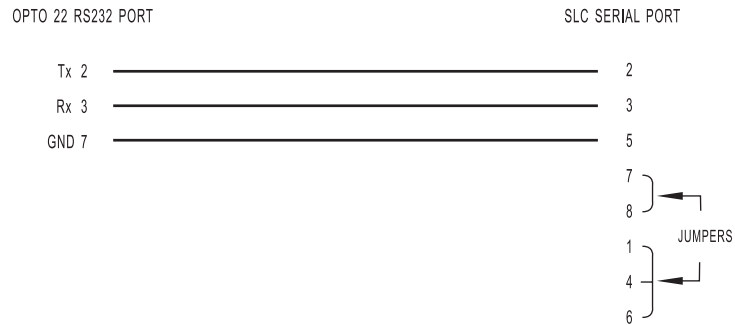   1
                                                           4
                                                           6

Direct Serial Communication

In order to communicate directly between an Opto 22 controller and an Allen-Bradley slave device, either full-duplex or half duplex mode can be used.

Subroutines

AB_Configure_Port

Description

This subroutine sets the communication port that will be used with the "AB Master" subroutines. It also configures the serial port operating parameters and sets the communication protocol to be used. **The port configuration command must be executed prior to using any "AB Master" subroutines.**

Parameters

PORT CFG STR

This string variable is used to select and configure the port number, baud rate, parity, data bits, and stop bits for use with any "AB Master" subroutine. See OptoControl command "Configure Port" for string syntax.

TA DELAY (SEC)

This float variable is used to set the amount of time in seconds that the "Master" subroutines will wait for a reply from a slave device.

COMM MODE

This integer variable is used to indicate which communication mode the "Master" subroutines will use. The values to use are zero for "Full-Duplex" or "Point-To-Point" mode of communication, or -1 for "Half_Duplex" or "Multidrop" mode of communication.

ERROR CODE

This integer variable is used to return the result of the port configuration portion of the command.

AB Typed Read / AB Protected Typed Logical Read

Description

These subroutines read a block of data from a PLC data file.

Parameters

PARAMETER TABLE

Enter the parameter table name in the field next to the prompt PARAMETER TABLE when calling the subroutine.

ELEMENT 0	Holds the address of the **slave device**.
ELEMENT 1	Holds the number to indicate the **type of file**. See "File Types" on page 15.)
ELEMENT 2	Holds the **file number** within the slave device. If reading from SLC I/O files (file type = 6 or 7), this element holds the **starting slot number.**
ELEMENT 3	Holds the value used to indicate the **starting element number** within the file. If reading from SLC I/O files (file type = 6 or 7), this element holds the **starting word number** within the slot.
ELEMENT 4	Holds the **starting table element number** where data read from the slave device should be stored in the associated OptoControl table. If reading from ASCII or string files (file type = 4 or 5), this element is unused.
ELEMENT 5	Holds the **number of elements.**
	For file types 1 or 3, the maximum number of integer or word values to be read with a single command is 120.
	For file type 2, the maximum number of float values to be read with a single command is 59.
	For file type 4, the maximum number of ASCII word values to be read with a single command is 63 or 126 characters.
	For file type 5, this value defaults to 1. String file elements are up to 80 characters long.

POINTER TABLE

Enter the pointer table name in the field next to the prompt POINTER TABLE when calling the subroutine.

ELEMENT 0	Holds a pointer to the object that will be used to store information read from the slave device. For file types 4 and 5, the object will be a string. For other file types, the object will be a table of float or integer type.
ELEMENT 1	Holds a pointer to the string table which will hold the transmit and receive strings (for diagnostic purposes).

ERROR CODE

The prompt "ERROR CODE" requires an integer variable. Upon completion of the command, this integer variable will contain the status/error code. (See "Errors Reported by OptoControl 'Master' Subroutines" on page 18.)

AB Typed Write / AB Protected Typed Logical Write

These subroutines write a block of data to a PLC data file.

Parameters

PARAMETER TABLE

Enter the parameter table name in the field next to the prompt PARAMETER TABLE when calling the subroutine.

ELEMENT 0	Holds the address of the **slave device**.
ELEMENT 1	Holds the number to indicate the **type of file**. (See "File Types" on page 15.)
ELEMENT 2	Holds the **file number** within the slave device. If writing to SLC I/O files (file type = 6 or 7), this element holds the **starting slot number.**
ELEMENT 3	Holds the value used to indicate the **starting element number** within the file. If writing to SLC I/O files (file type = 6 or 7), this element holds the **starting word number** within the slot.
ELEMENT 4	Holds the **starting table element number** in the associated OptoControl table where source data to be written to the slave device is stored. If writing to ASCII or string files (file type = 4 or 5), this element is unused.
ELEMENT 5	Holds the **number of elements.**
	For file types 1 or 3, the maximum number of integer or word values to be written with a single command is 120.
	For file type 2, the maximum number of float values to be written with a single command is 59.
	For file type 4, the maximum number of ASCII word values to be written with a single command is 63 or 126 characters.
	For file type 5, this value defaults to 1. String file elements are up to 80 characters long.

POINTER TABLE

Enter the pointer table name in the field next to the prompt POINTER TABLE when calling the subroutine.

ELEMENT 0	Holds a pointer to the object that holds information to be written to the slave device. For file types 4 and 5, the object will be a string. For other file types, the object will be a table of float or integer type.
ELEMENT 1	Holds a pointer to the string table which will hold the transmit and receive strings (for diagnostic purposes).
ELEMENT 3	Holds a pointer to the string table which will hold ASCII data when file type 4 is used.

ERROR CODE

The prompt "ERROR CODE" requires an integer variable. Upon completion of the command, this integer variable will contain the status/error code. (See "Errors Reported by OptoControl 'Master' Subroutines" on page 18.)

AB_PLC5 Slave / AB SLC Slave

Description

The AB_PLC5_Slave subroutine is used to make an Opto 22 controller communicate like a PLC5 slave. The AB_SLC_Slave subroutine is used to make an Opto 22 controller communicate like an SLC slave.

Operation

Create a new chart and ensure the appropriate slave subroutine call is the last command in the chart. Start and stop the subroutine by starting or stopping the associated chart. Each subroutine monitors a serial port for AB message traffic and supports PLC files 0, 1, 3, 7, and 8 by using five OptoControl numeric tables to hold the data. These five tables are referenced in the subroutine using an OptoControl "pointer table," which is passed by parameter to the subroutine. Both subroutines run continuously and require a dedicated chart in OptoControl.

Parameters

PORT CFG STR

The prompt "PORT CFG STR" requires a string-type variable that is used to select and configure the port number, baud rate, parity, data bits, and stop bits for use with the subroutine. See OptoControl command "Configure Port" for string format.

POINTER_TABLE

The prompt "POINTER TABLE" requires a pointer table type variable that holds the addresses for each of the five numeric data tables. The index number within the pointer table associates the OptoControl table with the corresponding PLC file number.

Using the OptoControl configurator:

> Create an integer type numeric table to support each file number you want to use from the PLC file numbers 0, 1, 3, and 7. These tables should be configured with a length parameter large enough to hold all the required data.

> Create a float type numeric table if you plan to use PLC file number 8. This table should be configured with a length parameter large enough to hold all the required data.

> Create a pointer type table with nine elements.

During runtime:

> Before the slave subroutine is started, use the OptoControl command "Move to Pointer Table" to modify each element in the pointer table according to the "POINTER_TABLE specification." If any of the five supported PLC file types are not being used, ensure the associated element/pointer in the pointer table is set to "null."

POINTER_TABLE specifications

PLC File Type	PLC File #	OptoControl Table Type	FILE_TABLE_POINTER Index
Outputs	0	Integer	0
Inputs	1	Integer	1
Binary	3	Integer	3
Integer	7	Integer	7
Float	8	Float	8

NOTE: Pointer table elements 2, 4, 5, and 6 are unused.

SLAVE ADDRESS

The prompt "SLAVE ADDRESS" requires an integer variable. It is used to indicate the device address that the slave subroutine should respond to. **If using a Data Highway Plus interface device, this address must match the node ID number of the interface device.**

ERROR CODE

This integer variable is used to return the result of the port configuration portion of the command.

File Types

The file type argument used with the "Master" subroutines allows the read and write commands to handle each kind of data properly. It is set by storing the proper value in element 1 of the "PARAMETER TABLE" used with each call to a subroutine. The following table shows what file type value to use for each PLC file type.

File Types Used With AB Master Subroutines

OptoControl File Type	AB File Type
1	Integer
2	Floating point
3	Unsigned integer (supports file numbers 0, 1, and 3)
4	ASCII
5	String
6	Output logical by slot (SLC only)
7	Input logical by slot (SLC only)

Error Reporting for ABMaster Subroutines

Error Codes Reported by the 1770–KF2 Module

Code	Description
00	Success – no error.
02	Cannot guarantee delivery: link layer. The PLC may not be responding.
03	Duplicate token holder detected.
04	Local port disconnected.
05	Application layer timed out waiting for a response.
06	Duplicate node detected.
07	Station is offline.
08	Hardware fault.

Error Codes Reported by the PLC

Code	Description
16	Illegal command or format. SLC File Number vs. File Type mismatch.
32	Host has a problem and will not communicate.
48	Remote node host is missing.
64	Host could not complete function due to hardware fault.
80	Addressing problem or memory protect rungs.
96	Function disallowed due to command protection selection.
112	Processor is in program mode.
128	Compatibility mode file missing or communication zone problem.
144	Remote node cannot buffer command.
160	Not used.
176	Remote node problem due to download.
192	Cannot execute command due to active IPBs.
208	Not used.
224	Not used.
240	Indicates an "extended error code." See "PLC Extended Status Codes" on page 17.

PLC Extended Status Codes

Code	Description
61441	A field has an illegal value.
61442	Less levels specified in address than minimum for any address.
61443	More levels in address than system supports.
61444	Symbol not found.
61445	Symbol is of improper format.
61446	Address doesn't point to something usable.
61447	File is wrong size.
61448	Cannot complete request, situation has changed since the start of the command.
61449	Data or file is too large.
61450	Transaction size plus word address is too large.
61451	Access denied, improper privilege.
61452	Condition cannot be generated; resource is not available.
61453	Condition already exists; resource is already available.
61454	Command cannot be executed.
61455	Histogram overflow.
61456	No access.
61457	Illegal data type.
61458	Invalid parameter or invalid data.
61459	Address reference exists to deleted area.
61460	Command execution failure for unknown reason.
61461	Data conversion error.
61462	Scanner not able to communicate with 1771 rack adapter.
61463	Adapter cannot communicate with module.
61464	1771 module response was not valid.
61465	Duplicated label.
61466	File is open; another node owns it.
61467	Another node is the program owner.

Errors Reported by OptoControl "Master" Subroutines

Code	Description
-1	Received packet was too short.
-2	Received packet was too long.
-3	Unknown symbol received in packet.
-4	Reply timeout.
-5	BCC mismatch.
-6	Size error (data block won't fit into table or string).
-7	EOT limit exceeded (no response to half duplex poll).
-8	TNS mismatch (transmit and receive transaction numbers don't match.
-9	Too many NACK responses received. (Make sure the Allen-Bradley controller is in BCC mode.)
-10	Bad control symbol received (half duplex).
-11	Could not acquire port.
-12	Bad file type.

Port Configuration Errors Reported by OptoControl

These errors are returnrd in the ERROR_CODE parameter by the"AB Configure Port" subroutineor on startup of either "Slave" subroutine.

Code	Description
0	Configuration successful.
-40	Timeout – specified port in use.
-50	Improper configuration string syntax.

Errors Reported by OptoControl "Slave" Subroutine

These error codes will be returned by response string to the polling device as **Extended Status Codes.**

Code	Description
06h	Address doesn't point to something usable (bad address).
0Eh	Command cannot be executed (bad command or function code).
11h	Illegal data type (bad file number).