DF1 Driver Plug-in Usage Notes:

The DF1 driver plug-in allows the robot to communicate with an Allen Bradley™ PLC using a point to point protocol (DF1) on an RS-232 serial port. An initialization database allows selection of serial port and associated parameters. The settings for the robot must match the settings for the PLC channel 0 (channel 0 must also be set up to use the system driver DF1 full duplex mode). DF1 is an Allen Bradley™ protocol that can be used to directly access PLC data files. These data files may be written as well as read. While the DF1 protocol specifies many types of commands, only a few (read and write data) are actually implemented by this plug-in. There are two basic parts of the plug-in that each run in separate tasks. The DF1 driver (kag.df1.driver) provides the "link layer" of the protocol and handles communication between the robot serial port and the PLC serial port. This program strictly handles the communication but is oblivious to the actual information that is communicated. Another program (kag.df1.poll) provides the "application layer" of the protocol and actually creates messages to be sent out and interprets the responses that are received. A group of queues are implemented that allow the two programs to share information. Both tasks must be running properly for the DF1 plug-in to operate. The polling task continuously alternates between reading a block of addresses from the PLC and writing a block of addresses to the PLC. The data is read and written approximately 2 to 4 times per second depending on how busy the robot CPU is performing other tasks. There are global V+ variable arrays in the robot memory that have counterparts in the PLC memory. V+ real variables DF1.READ[x] are read from PLC integer files. V+ real variables DF1.WRITE[x] are written to PLC integer files. Any program in the robot controller may read the DF1.READ[x] variables at any time. However, it is recommended that you use the program KAG.SET.PLC.DAT() to write to the DF1.WRITE[x] variables. This program writes the appropriate variable and then waits until it reads the same value back from the PLC. This provides a method of handshaking to be sure the value has been written to the PLC before moving on. Standard AIM variables may be used for reading values. Simply set the AIM variable type to be V+ Variable and enter DF1.READ[x] as the variable name (with the element number replacing the x). The DF1.WRITE[x] can also be made an AIM variable and set using the SET statement if it is not critical that the value actually be written to the PLC before the statement exits. If it is critical that the value be written before the statement exits, use the custom statement (SET_PLC_DATA) to write to the PLC from within a sequence. This statement will not exit until it is confirmed that the value has been written to the PLC. The PLC integer files that are read from and written to are specified in the initialization database provided with the plug-in. They can be the same file number (as long as the read and write elements don't overlap) or they can be different file numbers. Up to 50 elements each can be read or written and element numbers can range from 0 to 255 but must be consecutive. Using only the number of elements required for your application will increase the polling update speed.

The examples below assume that PLC integer file N9 is used for read operations and N10 is used for write operations.

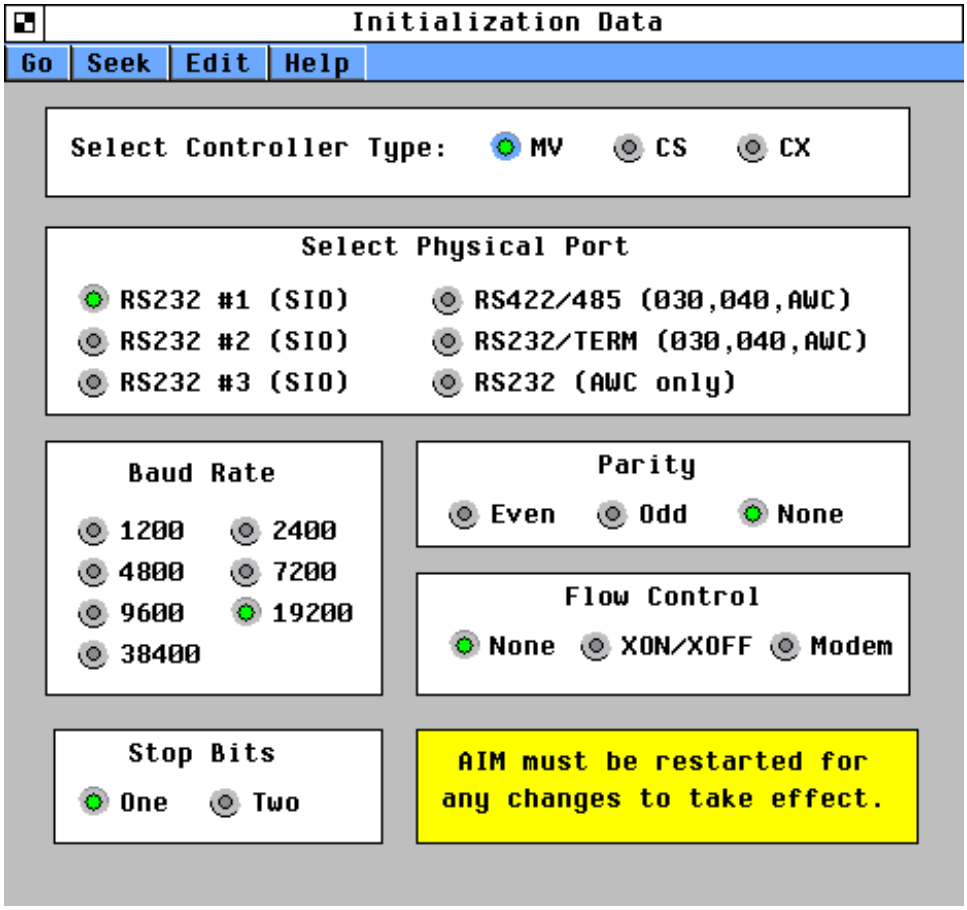
PLC Data File Address	Robot variable
N9:15	DF1.READ[15]
N9:2	DF1.READ[2]
N10:20	DF1.WRITE[20]
N10:6	DF1.WRITE[6]

Initialization Database (DF1INI.DB) Options

Disable Error pop-up	If this is true the error message pop-up will be disabled. However, errors will still be indicated on the DF1 status menu. If error message pop-ups are enabled, the driver or polling task will pause while the error pop-up is displayed.
Driver Task Number	This is the V+ task number in which the DF1 Driver will run. Default is 21.
Driver task Runsig	This is a digital signal that will be true whenever the DF1 Driver task is running (using V+ Runsig command) This can be a soft signal. Default is 2100
Enable DF1 Driver at startup	If this is true, the driver will be enabled at startup. If false, the driver will not be enabled but can be started manually on the DF1 driver status menu page. The driver is disabled when the plug-in is first installed to allow for set-up of the initialization database.
Enable verify of WRITE data	If this is ON, the polling task will read from the WRITE data table into a scratch variable array immediately after writing the WRITE data table to the PLC. This slows down the polling but provides a way to know when the new data has been written to the PLC. The custom statement SET_PLC_DATA (and V+ program kag.set.plc.dat) uses this scratch array to verify that the data was written to the PLC.
Error detection character(s)	Enter 0 to use BCC (block check character) or enter 1 to use CRC (cyclical redundancy check). This value must match the error detection used on the PLC. CRC is the better method of error detection.
First element for read	This is the number of the first element to be read from the PLC. ie. N9:20 (element = 20)
First element for write	This is the number of the first element to be written to the PLC. ie. N9:20 (element = 20)
Max ENQs	This is the maximum number of ENQs to send before reporting a timeout waiting for ACK. Default is 3
Max NAKs	This is the maximum number of NAKs received before a message is considered undeliverable. Default is 3
Number of elements to read	This is the number of elements to be read from the PLC. For SLC 5/01 and SLC 5/02 the maximum is 40. For SLC 5/03, SLC 5/04 and Micrologix the maximum is 50.
Number of elements to write	This is the number of elements to be written to the PLC. For SLC 5/01 and SLC 5/02 the maximum is 40. For SLC 5/03, SLC 5/04 and Micrologix the maximum is 50.
PLC File Number for READ	This integer specifies the PLC file number to be accessed during READ operations. The file number must be between 7 and 254. Default is 9. Read and write can be from the same file number as long as the elements do not overlap.

PLC File Number for WRITE	This integer specifies the PLC file number to be accessed during WRITE operations. The file number must be between 7 and 254. Default is 9. Read and write can be from the same file number as long as the elements do not overlap.
Polling Task Number	This is the V+ task number in which the DF1 Polling program will run. Default is 22
Polling Task Runsig	This is a digital signal that will be true whenever the DF1 Polling task is running (using V+ Runsig command) This can be a soft signal. Default is 2101
Read from PLC to initialize	If this is ON the values in DF1.WRITE[] will be read from PLC when initializing before polling begins. If this is OFF the values in DF1.WRITE[] will be zero after initialization.
Timeout waiting for ACK	This is the timeout value (in seconds) while waiting for acknowledge from PLC.

Serial Port Parameters



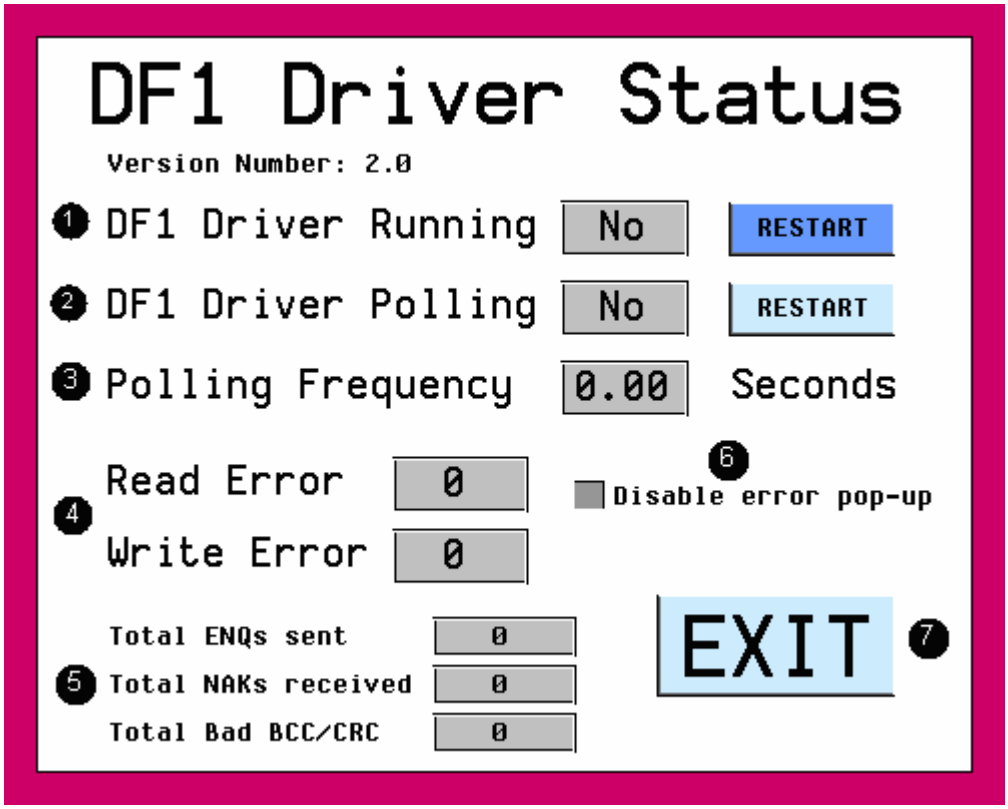
The values on this page (which is accessible through the initialization database) must match those in the PLC Channel 0 System settings. Channel 0 must be in system mode and must use the DF1 Full Duplex protocol.

DF1 Driver Status

The status of the DF1 driver programs can be verified by clicking:

SHOW => DF1 Driver Status

The following menu page will be displayed:



❶ This shows the status of the DF1 Driver that handles the "link layer" of the protocol. If **DF1 Driver Running** says **NO**, then the V+ task is not executing. Clicking the **RESTART** button will attempt to restart the program ***kag.df1.driver*** in the appropriate V+ task. *Note: if the **RESTART** button is clicked when the program is already running, it will be stopped then restarted.*

❷ This shows the status of the polling program that handles the "application layer" of the protocol. If the **DF1 Driver Polling** says **NO** then the V+ task is not executing. Clicking the **RESTART** button will attempt to restart the program ***kag.df1.poll*** in the appropriate V+ task. *Note: if the **RESTART** button is clicked when the program is already running, it will be stopped then restarted.*

❸ Polling Frequency displays the frequency of the "polling" or read / write cycle in seconds.

❹ Read Error and Write Error will display a hexadecimal value that specifies an error encountered by the DF1 protocol. A value of zero means no error. See Allen Bradley™ DF1 documentation for more info on these error codes.

❺ **Total ENQs Sent** displays the total number of ENQs (enquiries) sent to the PLC. ENQs are sent if the robot does not receive an ACK after sending a command to the PLC. **Total NAKs Received** displays the total number of NAK (negative acknowledge) messages received. (A NAK is sent from the PLC if it does not understand the last message sent to it by the robot.) **Total Bad BCC/CRC** displays the total number of times the checksum character(s) did not match the message that was received. (A checksum is used to verify the integrity of the message received) All of these counter values should remain zero. Any non-zero values in the counters indicate a problem with communications and would likely be related to electrical 'noise' on the transmission lines. *Note: Restarting the DF1 Driver will reset these counters.*

❻ If a check mark is present the error pop-up windows will be disabled. Error pop-ups cause the driver or polling task to suspended until the error is acknowledged by the operator. Data tables will not be updated while the message is displayed.

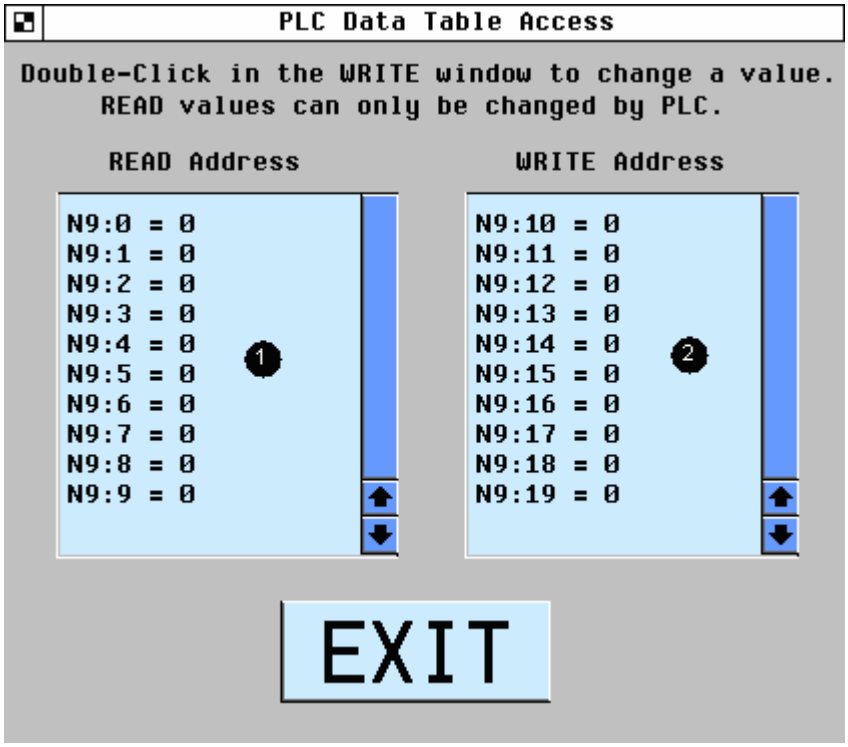
❼ This button exits the DF1 Driver status page.

PLC Data Table Access

The PLC data tables that are being read and written can be displayed by clicking:

SHOW > PLC Data Table

The following menu page will be displayed:



❶ This scrolling window displays the PLC addresses that are being read from the PLC and the associated values. These values can only be changed from the PLC.

❷ This scrolling window displays the PLC addresses that are being written to the PLC and the associated values. Double-clicking on an item in this list will cause a pop-up window to be displayed allowing a new value to be entered.

Note: The values displayed on this page come directly from the DF1.READ[] and DF1.WRITE[] V+ variable arrays. These arrays may not reflect the actual values in the PLC if the DF1 driver tasks are not functioning properly. Check the DF1 driver status window to verify DF1 driver operation.