SCADAPack E Target 5 DF1
PLC Interface

Documentation

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I SCADAPack E Target 5 DF1 PLC Interface

Schneider Electric

Documentation

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

1 Technical Support

Support related to any part of this documentation can be directed to one of the following support centers.

Technical Support: The Americas

Available Monday to Friday 8:00am – 6:30pm Eastern Time

Toll free within North America	1-888-226-6876
Direct Worldwide	+1-613-591-1943
Email	TechnicalSupport@controlmicrosystems.com

Technical Support: Europe

Available Monday to Friday 8:30am – 5:30pm Central European Time

Direct Worldwide	+31 (71) 597-1655
Email	euro-support@controlmicrosystems.com

Technical Support: Asia

Available Monday to Friday 8:00am – 6:30pm Eastern Time (North America)

Direct Worldwide	+1-613-591-1943
Email	TechnicalSupport@controlmicrosystems.com

Technical Support: Australia

Inside Australia	1300 369 233
Email	au.help@schneider-electric.com

2 Safety Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

	The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result** in death or serious injury.

⚠CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result** in minor or moderate.

CAUTION

CAUTION used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage..

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

SCADAPack Workbench and SCADAPack E Smart RTU are not suitable for controlling safety-critical systems. SCADAPack Workbench and SCADAPack E Smart RTU are not tested for, nor have approval for use in, the control of safety-critical systems. Safety-critical systems should be controlled by an approved safety-critical platform that is independent of SCADAPack Workbench and SCADAPack E Smart RTU.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not control safety-critical systems with SCADAPack Workbench and SCADAPack E Smart RTU.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠CAUTION
EQUIPMENT OPERATION HAZARD
• Verify that all installation and set up procedures have been completed. • Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices. • Remove tools, meters, and debris from equipment.
Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.

- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

3 Overview

This document describes communication with Allen-Bradley PLCs using DF1 protocol.

The SCADAPack E Smart RTU communicates with an Allen-Bradley PLC DF1 I/O devices. PLC registers are read and the return values are cached and assigned to IEC 61131-3 variables. Outputs are written from the SCADAPack E Smart RTU output cache to the PLC. Communication is handled the same as other PLC driver communications. The age and status of the data read from the PLC is stored in system points that can be accessed from IEC 61131-3 logic.

Assumed Knowledge

Familiarity with Allen-Bradley DF1 protocol.

Target Audience

- Systems Engineers
- Commissioning Engineers
- Maintenance Technicians

References

- SCADAPack E Target 5 I/O Device Reference Manual
- SCADAPack E Configurator User Manual
- SCADAPack E Technical Reference Manuals.
- Workbench Help
- Allen-Bradley DF1 Protocol documentation

4 I/O Device Interface

I/O Devices beginning with DF1... communicate using the DF1 protocol using serial ports configured as *PLC Device*.

Each I/O device can access different PLC register data within the same PLC device, or in different PLCs. For example, multi-drop RS485 permits many uniquely addressed PLCs to be connected to a serial port. In addition, multiple I/O Devices may be configured to use

different RTU serial ports configured as a *PLC Device*.

Each I/O device uses a separate DF1 request to read or write its data. Improved communication efficiency can be achieved by grouping DF1 registers together and using fewer I/O Devices with a larger number of channels, rather than more I/O Devices with a smaller number of channels.

A maximum of 200 PLC Device I/O Devices (total of every PLC type) may be configured in total per IEC 61131-3 Resource.

Communication status is available on the first 60 I/O Devices for IEC 61131-3 Resource 1, and 14 I/O Devices for IEC 61131-3 Resource 2. See Section System Points for more information.

- Input Devices
- Output Devices

Data Communication Protocol

The DF1 Driver supports communications to the following Allen-Bradley PLC's:

- SLC 500 Series
- PLC 5 Series
- DF1 Generic PLC's

Each of the different DF1 PLC types result in different DF1 commands being issued. The table below outlines the types of commands issued.

PLC TYPE	DF1 COMMANDS
SLC 500	Protected typed logical Read Protected typed logical Write
PLC5	Typed Read Typed Write Read-Modify-Write (bit)
Generic	Unprotected Read Unprotected Write Unprotected bit Write

Refer to the Allen-Bradley DF1 Protocol and Command Set for a complete description of the DF1 protocol.

4.1 Input Devices

The Input I/O Devices supported by the DF1 Driver are:

- DF1_INT_READ - 16 INT analog input
- DF1_REAL_READ - 16 REAL analog input
- DF1_BOOL_READ - 16 BOOL input

Parameters

DF1 input and output devices have these parameters.

The ***file_number*** field of the DF1 device (default 1) is the configurable file address of the required registers in the DF1 PLC.

The ***register_format*** field of the DF1 device (default SLC UINT for the AI devices, and SLC DISCRETE for the DI device) configures the device to communicate with the specified type of register in the specified PLC. Allowable values are outlined below:

Value	Description
SLC500 DISCRETE	Use on a digital device to communicate to a SLC500 PLC.
SLC500 INT	Use on an analog device to communicate to a SLC500 PLC. 16-bit signed value.
SLC500 REAL	Use on an analog device to communicate to a SLC500 PLC. 32-bit floating point value.
PLC5 DISCRETE	Use on a digital device to communicate to a PLC5 PLC.
PLC5 INT	Use on an analog device to communicate to a PLC5 PLC. 16-bit signed value.
PLC5 REAL	Use on an analog device to communicate to a PLC5 PLC. 32-bit floating point value.
GEN DISCRETE	Use on a digital device to communicate to a DF1 Generic PLC.
GEN INT	Use on an analog device to communicate to a DF1 Generic PLC. 16-bit signed value.

The ***data_update_rate*** of the DF1 device (default 1000) is the number of seconds after which the SCADAPack E Smart RTU will request element array values from the DF1 PLC. The SCADAPack E Smart RTU will also request data from the Allen-Bradley PLC constantly if the cache data age is greater than the *data_update_rate*. I.e. if communications are lost with the PLC, they are retried until the communications are restored.

The ***plc_device_addr*** of the device is the address of the Allen-Bradley PLC. The default value is 1.

The ***timeout*** specifies the communications timeout on an individual I/O device (i.e. the timeout applies to communications associated with that device). Where this value is “0”, the device driver will use the default timeout (1200 milliseconds). Units for this field are in milliseconds.

The ***port*** field of the device provides a parameter which defines which of multiple *PLC Device* ports will be used to communicate with the PLC or peripheral device. If only one *PLC Device* port is configured, this field is ignored. I/O devices not including this parameter can only be used when a single *PLC Device* port is configured.

The ***comms_options*** field is a string field that specifies the local DF1 address, whether it’s half or full duplex, and whether it uses a CRC or BCC. The format for this string is as follows:

XXX YYYY ZZZ , where:

- XXX is the DF1 Address that the RTU will appear as (default is 0).
- YYYY is HALF or FULL for the duplex setting (default is FULL).
- ZZZ is CRC or BCC (default is CRC).

If any of the communication options fields are missing, then the default will be used for that parameter.

For Full Duplex operation set the DF1 address to the address the SCADAPack E Smart RTU should appear as. For Half-Duplex operation set the DF1 address to be the 'Node Address' specified in the channel configuration of the PLC.

The ***first_address*** specifies the offset address of the device into the specified file.

Controlling PLC Device Communications

Communication using these I/O Devices can be controlled by the function block df1ctrl using the En_RD parameter. See *SCADAPack E Target 5 Function Block Reference* for details.

4.2 Output Devices

The output devices supported by the DF1 Driver are:

- DF1_BOOL_WRITE - 16 BOOL output

- DF1_INT_WRITE - 16 INT analog output
- DF1_REAL_WRITE - 16 REAL digital output

Parameters

DF1 input and output devices have these parameters.

The ***file_number*** field of the DF1 device (default 1) is the configurable file address of the required registers in the DF1 PLC.

The ***register_format*** field of the DF1 device (default SLC UINT for the AI devices, and SLC DISCRETE for the DI device) configures the device to communicate with the specified type of register in the specified PLC. Allowable values are outlined below:

Value	Description
SLC500 DISCRETE	Use on a digital device to communicate to a SLC500 PLC.
SLC500 INT	Use on an analog device to communicate to a SLC500 PLC. 16-bit signed value.
SLC500 REAL	Use on an analog device to communicate to a SLC500 PLC. 32-bit floating point value.
PLC5 DISCRETE	Use on a digital device to communicate to a PLC5 PLC.
PLC5 INT	Use on an analog device to communicate to a PLC5 PLC. 16-bit signed value.
PLC5 REAL	Use on an analog device to communicate to a PLC5 PLC. 32-bit floating point value.
GEN DISCRETE	Use on a digital device to communicate to a DF1 Generic PLC.
GEN INT	Use on an analog device to communicate to a DF1 Generic PLC. 16-bit signed value.

These parameters are the same as described for the Input devices. The only difference is the data_update_rate. The unit for this parameter is in Milliseconds, and specifies the rate at which the data for the Output device is written to the PLC.

The ***data_update_rate*** specifies the time (in milliseconds) at which the output data is written to the PLC. Individual I/O Devices may have different data update rates allowing prioritization of data extracted from a PLC. The SCADAPack E Smart RTU may not be able to request PLC data within the time set by the data update rate depending on the quantity of data to be read, rate of write requests and PLC communication speed. In this case the update rates will be slower.

The ***plc_device_addr*** of the device is the address of the Allen-Bradley PLC. The default value is 1.

The ***timeout*** specifies the communications timeout on an individual I/O device (i.e. the timeout applies to communications associated with that device). Where this value is "0", the device driver will use the default timeout (1200 milliseconds). Units for this field are in milliseconds.

The ***port*** field of the device provides a parameter which defines which of multiple *PLC Device* ports will be used to communicate with the PLC or peripheral device. If only one *PLC Device* port is configured, this field is ignored. I/O devices not including this parameter can only be used when a single *PLC Device* port is configured.

The ***comms_options*** field is a string field that specifies the local DF1 address, whether it's half or full duplex, and whether it uses a CRC or BCC. The format for this string is as follows:

XXX YYYY ZZZ , where:

- XXX is the DF1 Address that the RTU will appear as (default is 0).
- YYYY is HALF or FULL for the duplex setting (default is FULL).
- ZZZ is CRC or BCC (default is CRC).

If any of the communication options fields are missing, then the default will be used for that parameter.

For Full Duplex operation set the DF1 address to the address the SCADAPack E Smart RTU should appear as. For Half-Duplex operation set the DF1 address to be the 'Node Address' specified in the channel configuration of the PLC.

The ***first_address*** specifies the offset address of the device into the specified file.

Controlling PLC Device Communications

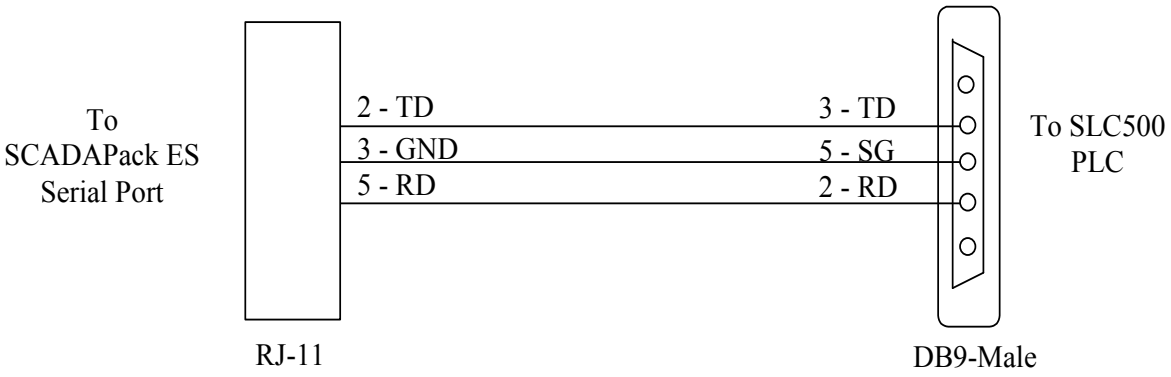
Communication using these I/O Devices can be controlled by the function block df1ctrl using the En_WR parameter. See *SCADAPack E Target 5 Function Block Reference* for details.

5 Serial Communication Interface

The SCADAPack E Smart RTU communicates with the Allen-Bradley PLC using an serial port configured as a *PLC Device*. Each port must be configured to communicate at the same rate and in the same format as the peripheral devices. For example 9600 bps, 8 data bits, 1

stop bit, and no parity.

A cable configuration for connecting a SLC500 PLC to a SCADAPack ES or SCADAPack ER RTU port is shown below. See SCADAPack 300E Hardware manual for other cabling diagrams.



6 System Points

System points are provided to indicate the status of some I/O Devices that are used for Slave I/O communications with peripheral devices such as PLCs.

Where multiple Slave I/O Devices are present in an IEC 61131-3 Resource , consecutive, sequential system point pairs are used for the next Slave I/O device, regardless of what PLC port the devices are connected to. Each Resource is allocated a separate set of system points for Slave I/O Devices.

The status for the Slave I/O Devices reported (according to the above rules) has two system points associated with it. The communications status, and the data cache time.

The communication status indicates the status of the communication with the PLC for the data on the I/O device. For more information see Return Status Values & Data Cache Age (Return Status Values).

The age of the cached data for a slave Input devices is stored in the cache time system point for that device. For more information see Return Status Values & Data Cache Age (Return Status Values).

The RTU Slave I/O device status system points for a user application loaded for Resource 1 are as follows:

System Point Description	Point Number	Point Type
Resource 1 Slave I/O device 1 communication status	53300	16-bit unsigned integer (read-only)

Resource 1 Slave I/O device 1 data cache time	53301	16-bit unsigned integer (read-only)
Resource 1 Slave I/O device 2 communication status	53302	16-bit unsigned integer (read-only)
Resource 1 Slave I/O device 2 data cache time	53303	16-bit unsigned integer (read-only)
…		
Resource 1 Slave I/O device 60 communication status	53418	16-bit unsigned integer (read-only)
Resource 1 Slave I/O device 60 data cache time	53419	16-bit unsigned integer (read-only)

The RTU Slave I/O device status system points for a user application loaded for Resource 2 are as follows:

System Point Description	Point Number	Point Type
Resource 2 Slave I/O device 1 communication status	53422	16-bit unsigned integer (read-only)
Resource 2 Slave I/O device 1 data cache time	53423	16-bit unsigned integer (read-only)
Resource 2 Slave I/O device 2 communication status	53424	16-bit unsigned integer (read-only)
Resource 2 Slave I/O device 2 data cache time	53425	16-bit unsigned integer (read-only)
…		
Resource 2 Slave I/O device 14 communication status	53448	16-bit unsigned integer (read-only)
Resource 2 Slave I/O device 14 data cache time	53449	16-bit unsigned integer (read-only)

6.1 Return Status Values & Data Cache Age

Return Status Value

The communications status values for the I/O Device are as follows:

Status	Comment	Value
Success	Normal	0
Unknown Error	A generic result was returned	101
Illegal Address	The DF1 PLC did not give the correct response address in its return message	103
Timeout	The DF1 PLC did not respond	104
Corrupt Message	The message from the DF1 PLC was not understood by the RTU.	106
Busy	The DF1 PLC is busy.	107
Undefined address	The DF1 PLC does not have the requested address defined.	108

Data Cache Age

The age of the data in the RTU cache for the DF1 PLC array elements are presented by reading system point for the I/O Device (usually Slave I/O Device 1 system points). The cache age is initialized to zero when the IEC 61131-3 Resource starts and increases until a successful read occurs, after which time the value is reset to zero.

This system point may be used to determine the suitability of using the input data from the I/O Device.

7 Diagnostics

The SCADAPack E Smart RTU indicates configuration or communication diagnostics via Diagnostic Display mode from a Command line session. Configuration diagnostics are displayed when in Diagnostic Display mode (use DIAG command at command prompt).

Communication diagnostics for the DF1 PLC are enabled when the following commands are entered at the command prompt:

```
PLCDIAG ENABLE COMMS_ERROR
DIAG
```