SCADAPack E ISaGRAF 3 DF1 PLC Interface

Schneider Electric

Documentation

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Version: 8.05.4

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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

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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

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 Preface

The purpose of this document is to describe the ISaGRAF 3 DF1 driver implementation for the SCADAPack E RTU.

Assumed Knowledge

Exposure to the ISaGRAF 3 Workbench is recommended.

Target Audience

- Systems Engineers
- Commissioning Engineers
- Maintenance Technicians

References

- SCADAPack E Configurator User Manual
- ICS Triplex ISaGRAF Manuals
- Allen-Bradley DF1 Protocol and Command Set

4 Overview

The Allen-Bradley PLC communicates with the SCADAPack E RTU using an ISaGRAF **df1_xxx** I/O board through an RTU '*PLC Device*' port.

The DF1 device's registers are read and the return values cached in the RTU for access through an ISaGRAF input board.

Outputs are written from the RTU's output cache to the DF1 PLC. The SCADAPack E RTU's handling of the communications is the same as other PLC driver communications. The age and status of the data read from the DF1 PLC is present in RTU system points that can be accessed from within ISaGRAF, or external to the RTU.

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

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

5 ISaGRAF I/O Board Interface

The **df1_xxx** ISaGRAF 3 I/O boards use an RTU port configured as a '*PLC Device*' to communicate with the Allen-Bradley RTU.

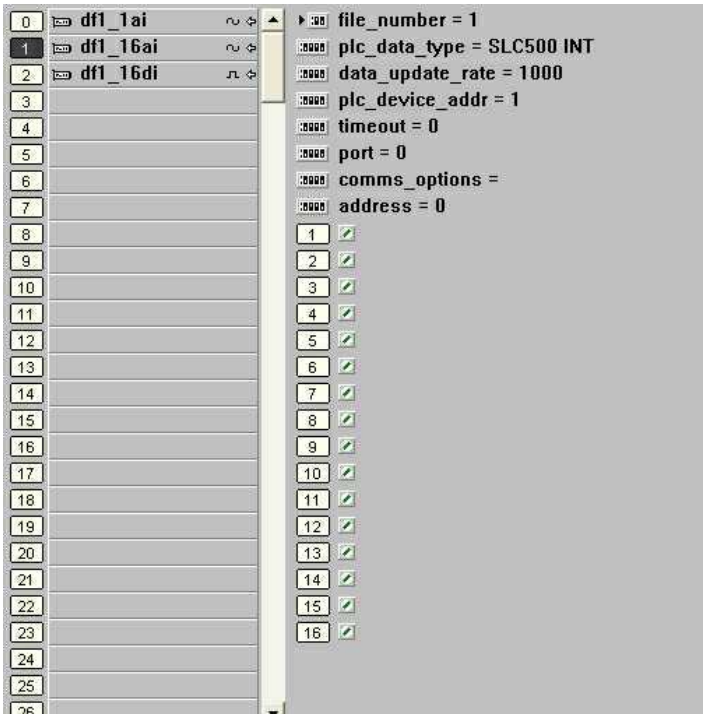
PLC device communications using these I/O boards can be controlled by an ISaGRAF function block: df1**ctrl**.

5.1 Input Boards

The Input boards supported by the DF1 Driver are:

- 1 analog input
- 16 analog input
- 16 digital input

These each have the same basic layout as shown below.



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

The **plc_data_type** field of the DF1 ISaGRAF board (default SLC UINT for the AI boards, and SLC DISCRETE for the DI board) configures the board 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 board to communicate to a SLC500 PLC.
SLC500 INT	Use on an analog board to communicate to a SLC500 PLC. 16-bit signed value.
SLC500 REAL	Use on an analog board to communicate to a SLC500 PLC. 32-bit floating point value.

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

The **data_update_rate** field of the **df1_xxx** ISaGRAF board (default 1000) is the configurable number of *seconds* after which the RTU will request element array values from the DF1 PLC. The 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** (default 1) field of the ISaGRAF board is the configurable address of the Allen-Bradley PLC.

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

The **port** field of the ISaGRAF board driver provides a parameter which defines which of multiple SCADAPack E RTU ports configured as a "PLC Device" will be used to communicate with the PLC or peripheral device. If only one port is configured as a "PLC Device" this field is ignored. ISaGRAF PLC Device I/O boards not including this parameter can only be used when a single SCADAPack E port is configured as a "PLC Device".

The **comms_options** field is a string field that allows the user to set 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 (with spaces in between the parameters) , where:

- XXX is the DF1 Address that the SCADAPack E 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 comms options fields are not populated, then the default will be used for that parameter.

For Full Duplex operation set the DF1 address to be the address that you want the SCADAPack E RTU to appear as. However, for Half-Duplex operation set the DF1 address to be the 'Node Address' specified in the channel configuration of the PLC.

The **address** field of the ISaGRAF board driver specifies the offset address of the board into the specified file (i.e. the file_number above). Range: 0 – 255.

If floating point values are to be read out of the Allen-Bradley PLC (i.e. PLC5 REAL or SLC500 REAL) then ISaGRAF Analog Input (Real) variables should be attached to the Input Board channels as required.

Controlling PLC Device Communications

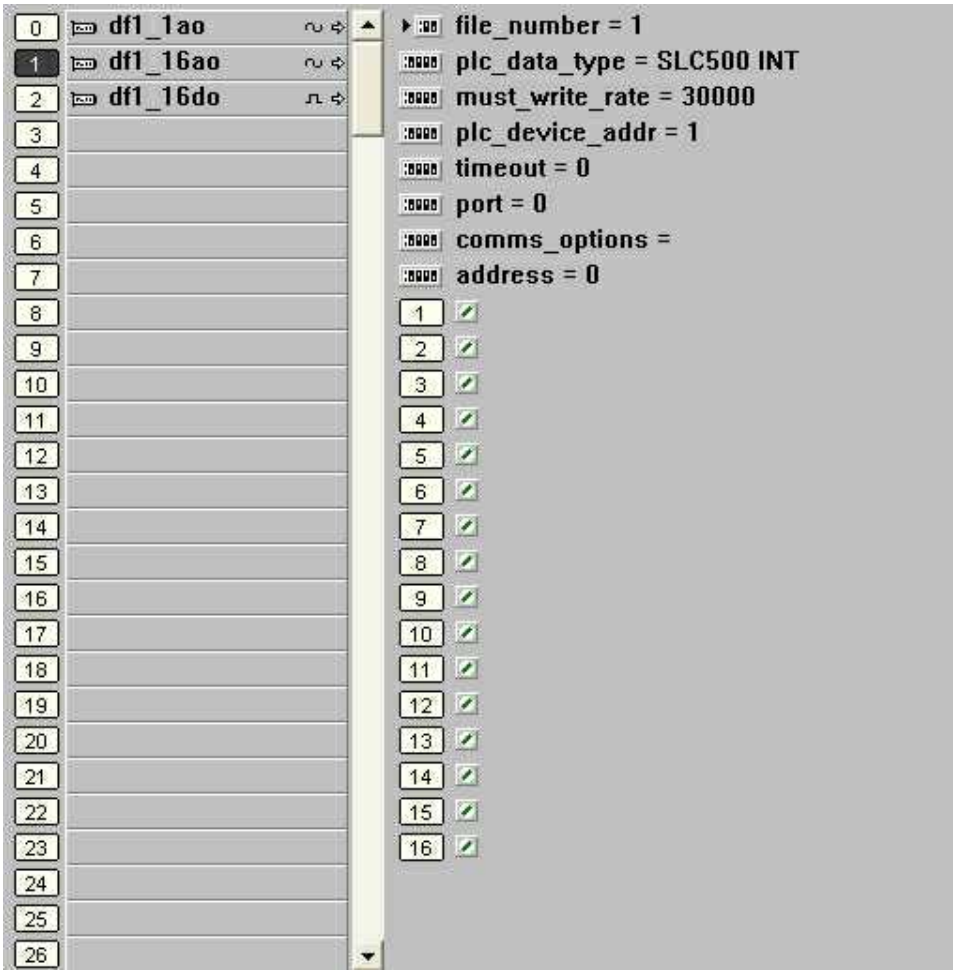
PLC device communications using these I/O boards can be controlled by an ISaGRAF function block: **df1ctrl**. The En_RD parameter on the block affects PLC device Input Boards. For more information see *SCADAPack E Function Block Reference* manual for more information.

5.2 Output Boards

The Input boards supported by the DF1 Driver are:

- 1 analog output
- 16 analog output
- 16 digital output

These each have the same basic layout as shown below.



Many of these parameters are the same as described for the Input Boards. The only difference is the **must_write_rate**. The unit for this parameter is the Milliseconds and specifies the rate at which the data for the output board is written to the PLC. Between "*must_write_rate*" periods, data is written to the PLC only when the ISaGRAF output variable values change. Individual I/O boards may have different must write rates allowing prioritization of data sent to a PLC Device.

PLC device communications using these I/O boards can be controlled by an ISaGRAF function block: **mbusctrl**. The En_WR parameter on the block affects PLC device Output Boards. For more information see *SCADAPack E Function Block Reference Manual* for more information.

6 Communications Interface & Data Communication Protocol

Communications Interface

The SCADAPack E RTU communicates with the Allen-Bradley PLC using an RTU serial port configured as a *'PLC Device*'. This port needs to be configured to with the same settings as the PLC port to which it will be communicating with.

A cable configuration for connecting a SLC500 PLC to a SCADAPack ES or SCADAPack ER RTU port is shown in ***Figure 6.1***.

See SCADAPack 300E Hardware manual for other cabling diagrams.

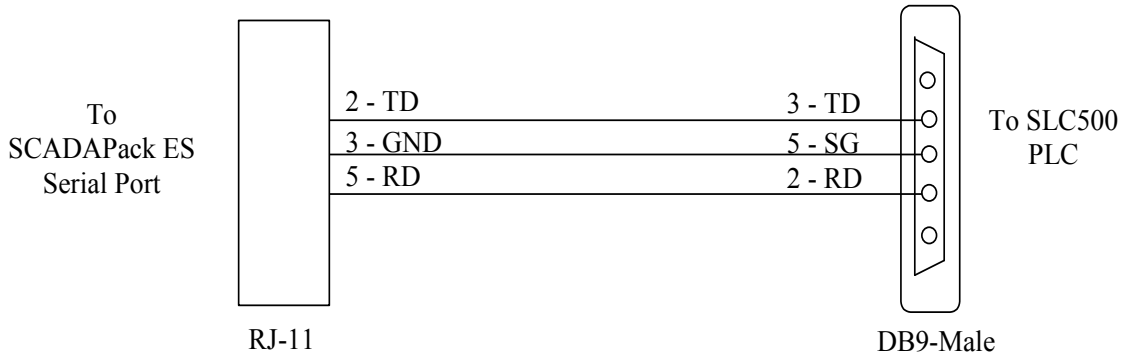


Figure 6.1: RJ-12 to DB9-M Converter Cable

Data Communication Protocol

Refer to *Allen-Bradley DF1 Protocol and Command Set* for a complete description of the DF1 protocol as implemented by the driver.

Each of the different DF1 PLC types as selected by the user (SLC500, PLC5, and Generic) 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

7 System Points

RTU system points are provided to indicate the status of the ISaGRAF 3 I/O boards that are used for Slave I/O communications with devices such as PLCs, and the DF1 PLC.

Where multiple ISaGRAF Slave I/O boards are present in an ISaGRAF application, consecutive, sequential system point pairs are used for the next Slave I/O board, regardless of what PLC port the boards are connected to. Each ISaGRAF kernel is allocated a separate set of system points for Slave I/O boards.

Each ISaGRAF Slave I/O board has two system points associated with it. The communications status, and the data cache age.

The communication status indicates the status of the communication with the DF1 PLC for data points on the I/O board. For more information see Section ***Return Status Values & Data Cache Age (Return Status Values)***.

The age of the cached data is stored in the Slave I/O Board Data Cache Age system point for that I/O board. For more information see Section ***Return Status Values & Data Cache Age (Data Cache Age)***.

The RTU Slave I/O board status system points for ISaGRAF Kernel 1 are as follows.

System Point Description	Point Number	Point Type
ISaGRAF Kernel 1 Slave I/O board 1 communication status	53300	16-bit unsigned integer (read-only)
ISaGRAF Kernel 1 Slave I/O board 1 data cache time	53301	16-bit unsigned integer (read-only)
ISaGRAF Kernel 1 Slave I/O board 2 communication status	53302	16-bit unsigned integer (read-only)
ISaGRAF Kernel 1 Slave I/O board 2 data cache time	53303	16-bit unsigned integer (read-only)
…		
ISaGRAF Kernel 1 Slave I/O board 60 communication status	53418	16-bit unsigned integer (read-only)
ISaGRAF Kernel 1 Slave I/O board 60 data cache time	53419	16-bit unsigned integer (read-only)

The RTU Slave I/O board status system points for ISaGRAF Kernel 2 are as follows.

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

7.1 Return Status Values & Data Cache Age

Return Status Value

The return status values for the **df1_xxx** board communications status are as follows:

Status	Comment	Value
Success	Normal Operation	0
Unknown Error	An unsuccessful operation has occurred.	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 board (usually Slave I/O board 1 system points). The cache age is initialized to zero when the ISaGRAF application starts and increases until a successful read occurs, after which time the value is reset to zero.

This system point may be used by the ISaGRAF application to determine the suitability of using the input data from the I/O board.

8 Diagnostics

The SCADAPack E RTU indicates configuration or communication diagnostics via Diagnostic Display mode from a Command line session.

Configuration diagnostics are indicated via ISaGRAF I/O board messages and 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 SCADAPack E RTU command prompt:

```
PLCDIAG ENABLE COMMS_ERROR
DIAG
```