8903/RS
RS485
Communications Option

Technical Manual

HA469261U001 Issue 1

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Safety Information

Requirements

IMPORTANT: Please read this information BEFORE installing the equipment.

Intended Users

This manual is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, EMC considerations, and to enable the user to obtain maximum benefit from the equipment.

Complete the following table for future reference detailing how the unit is to be installed and used.

INSTALLATION DETAILS	
Model Number *(see product label)*	
Where installed *(for your own information)*	
Unit used as a: *(refer to Certification for the Inverter)*	O Component O Relevant Apparatus
Unit fitted:	O Wall-mounted O Enclosure

Application Area

The equipment described is intended for industrial motor speed control utilising DC motors, AC induction or AC synchronous machines

Personnel

Installation, operation and maintenance of the equipment should be carried out by qualified personnel. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

Product Warnings

 **Caution** Risk of electric shock	 **Caution** Refer to documentation	 **Earth/Ground** Protective Conductor Terminal

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Safety Information

Hazards

DANGER! - Ignoring the following may result in injury

1. This equipment can endanger life by exposure to rotating machinery and high voltages.
2. The equipment must be permanently earthed due to the high earth leakage current, and the drive motor must be connected to an appropriate safety earth.
3. Ensure all incoming supplies are isolated before working on the equipment. Be aware that there may be more than one supply connection to the drive.
4. There may still be dangerous voltages present at power terminals (motor output, supply input phases, DC bus and the brake, where fitted) when the motor is at standstill or is stopped.
5. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range.
   CAT I and CAT II meters must not be used on this product.
6. Allow at least 5 minutes for the drive's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and earth.
7. Unless otherwise stated, this product must NOT be dismantled. In the event of a fault the drive must be returned. Refer to "Routine Maintenance and Repair".

WARNING! - Ignoring the following may result in injury or damage to equipment

SAFETY

Where there is conflict between EMC and Safety requirements, personnel safety shall always take precedence.

- Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.
- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.
- When replacing a drive in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all external wiring is rated for the highest system voltage.
- Thermal sensors contained within the motor must have at least basic insulation.
- All exposed metalwork in the Inverter is protected by basic insulation and bonded to a safety earth.
- RCDs are not recommended for use with this product but, where their use is mandatory, only Type B RCDs should be used.

EMC

- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.
- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
- This is a product of the restricted sales distribution class according to IEC 61800-3. It is designated as "professional equipment" as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

CAUTION!

APPLICATION RISK

- The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to the user's specific application. We can not guarantee the suitability of the equipment described in this Manual for individual applications.

RISK ASSESSMENT

Under fault conditions, power loss or unintended operating conditions, the drive may not operate as intended.
In particular:

- Stored energy might not discharge to safe levels as quickly as suggested, and can still be present even though the drive appears to be switched off
- The motor's direction of rotation might not be controlled
- The motor speed might not be controlled
- The motor might be energised

A drive is a component within a drive system that may influence its operation or effects under a fault condition.
Consideration must be given to:

- Stored energy
- Supply disconnects
- Sequencing logic
- Unintended operation

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8903/RS RS485 OPTION

Introduction

This manual describes the Parker SSD Drives' RS485 Option.

Product Features

- Suitable for use with 890CD Common Bus Drive, 890SD Standalone Drive and 890PX Drive
- 2-Wire RS485 Port
- Slave Modbus RTU Protocol
- LEDs to indicate status and bus activity status
- Software selectable Slave Address and Baudrate
- Up to 256 DSE input / output registers

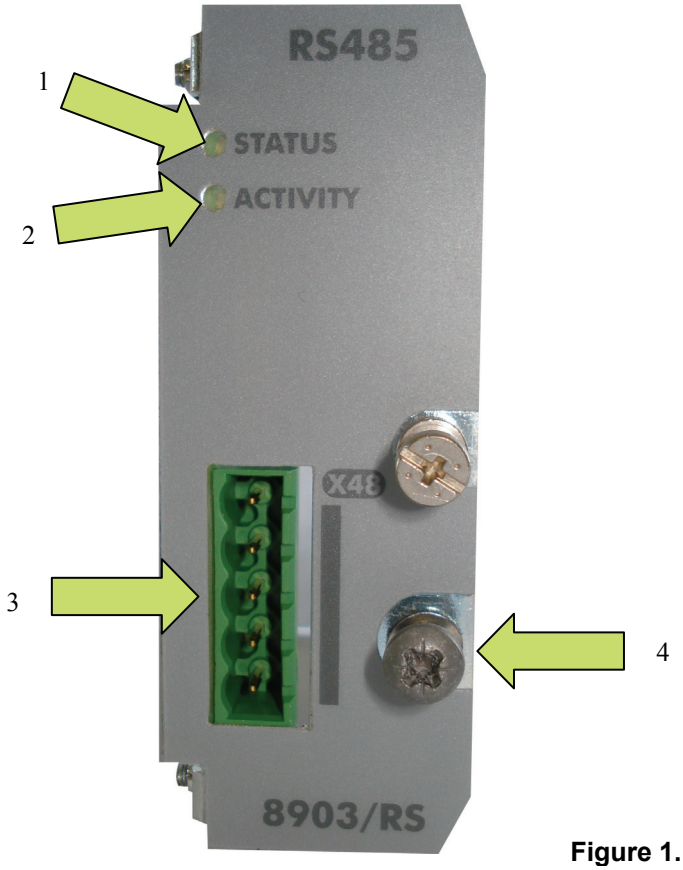


Figure 1. RS485 Option

1	Status LED	3	X48 RS485 port
2	Activity LED	4	Earthing screw

Product Order Code

Not fitted order code: 8903-RS-00
Factory fitted order code: 890xx-xxxxxxxx-xxx-xxxSx

Compatible Firmware

This option will work with the following version of 890 firmware:

Version 3.7 onwards Version 4.2 onwards

Restrictions

Option must be fitted in Slot A (top).

Installation

WARNING!

Before installing, ensure that the drive wiring is electrically isolated and cannot be made "live" unintentionally by other personnel. Wait 5 minutes after disconnecting power before working on any part of the system or removing the covers from the drives.

To Remove the Control Board

1. Remove the blanking plates, each secured by a single screw, that fits over the option slots(1).
2. Loosen the top and bottom screws from the handles on the Control Board (2).
3. Pull gently on the handles and slide the Control Board (2) out of the drive.

Note: Save the blanking plate and screw for future use. The drive should not be operated without either an option or a blanking plate fitted. When fitted, these maintain the drive's IP20 rating.

Caution

This Option contains ESD (Electrostatic Discharge) sensitive parts. Observe static control precautions when handling, installing and servicing this Option.

Figure 2. 890 showing Control Board withdrawn with Options fitted

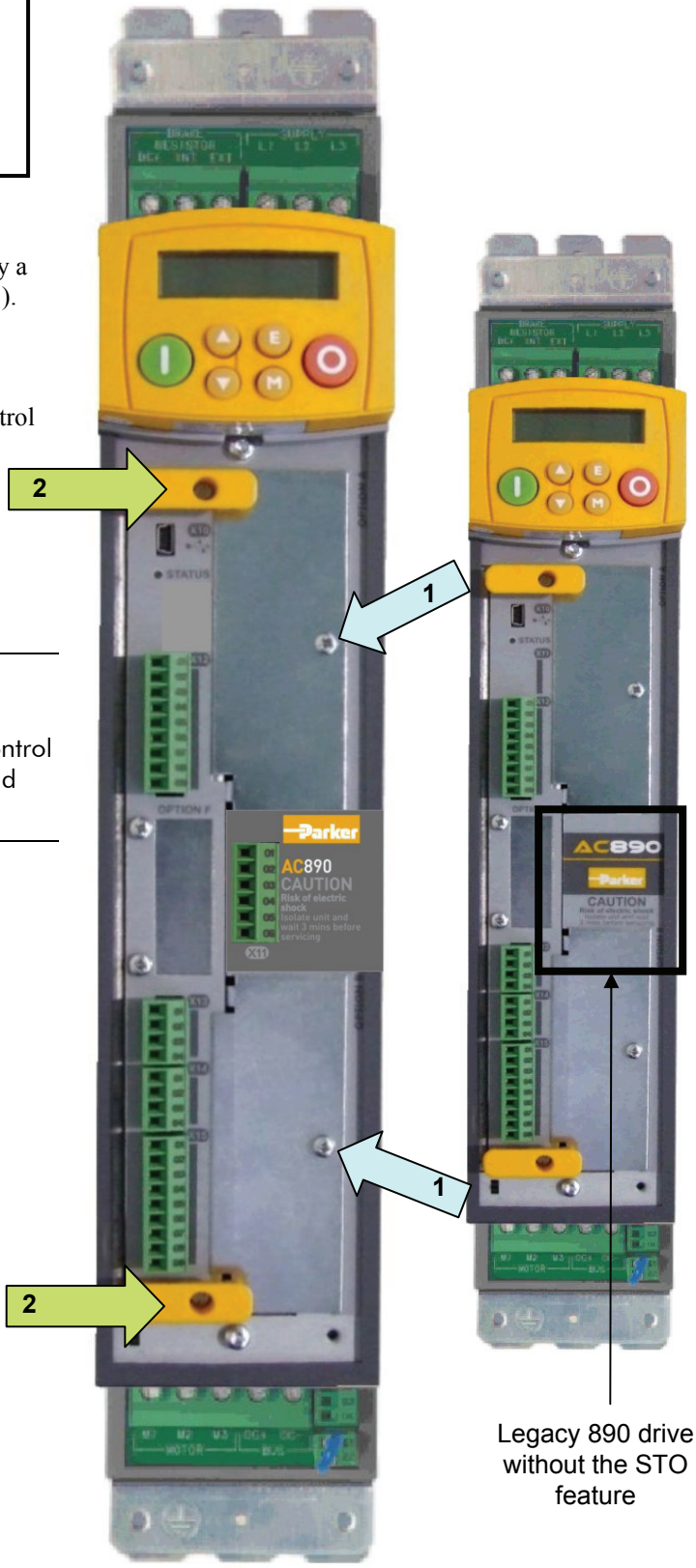


Figure 3. Front of 890 drive showing Control Board fitted

Fitting the Option

The Option fits onto the Control Board.

1. Insert the connector into the Option as shown. The legs of the connector will protrude through into the connector on the other side of the Option.
2. Press the assembly into the **TOP** connector (adjacent to terminals X10, X11 and X12) on the Control Board. Ensure that the front panel of the Option overlaps the front of the Control Board.

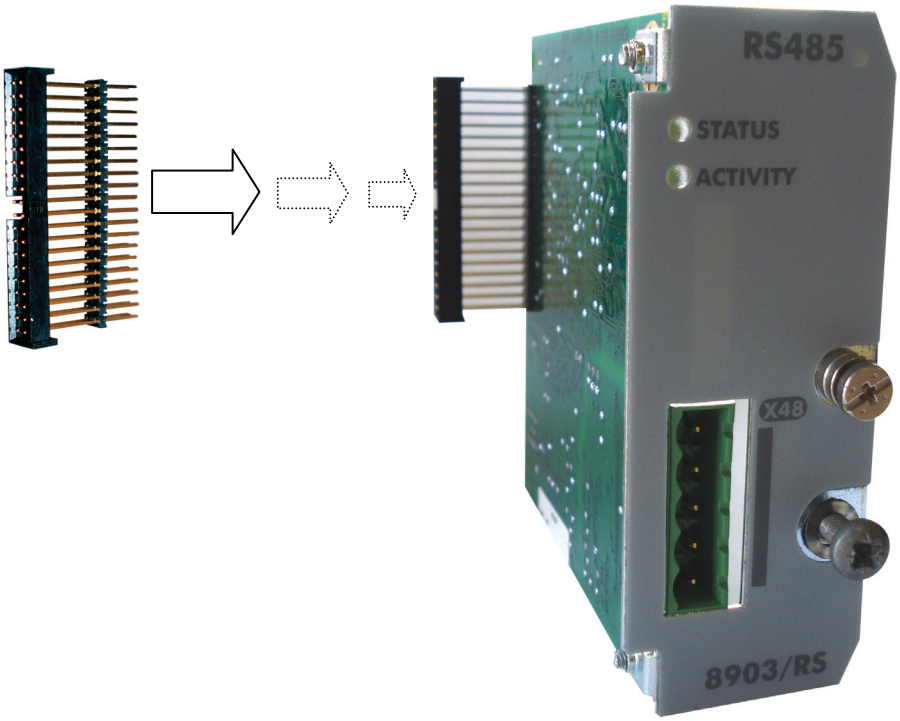


Figure 4. Fitting the connector to the Option

Re-fitting the Control Board

1. Slide the board into the drive, engaging the edges of the boards into the slots. Push until the back edge of the Control Board PCB locates with the connectors in the drive.
2. Tighten in position using the top and bottom screws in the handles of the Control Board.
3. Screw the Option in position using the captive screw on the front of the Option.
4. Replace lower blanking plate if no Slot B option is fitted.

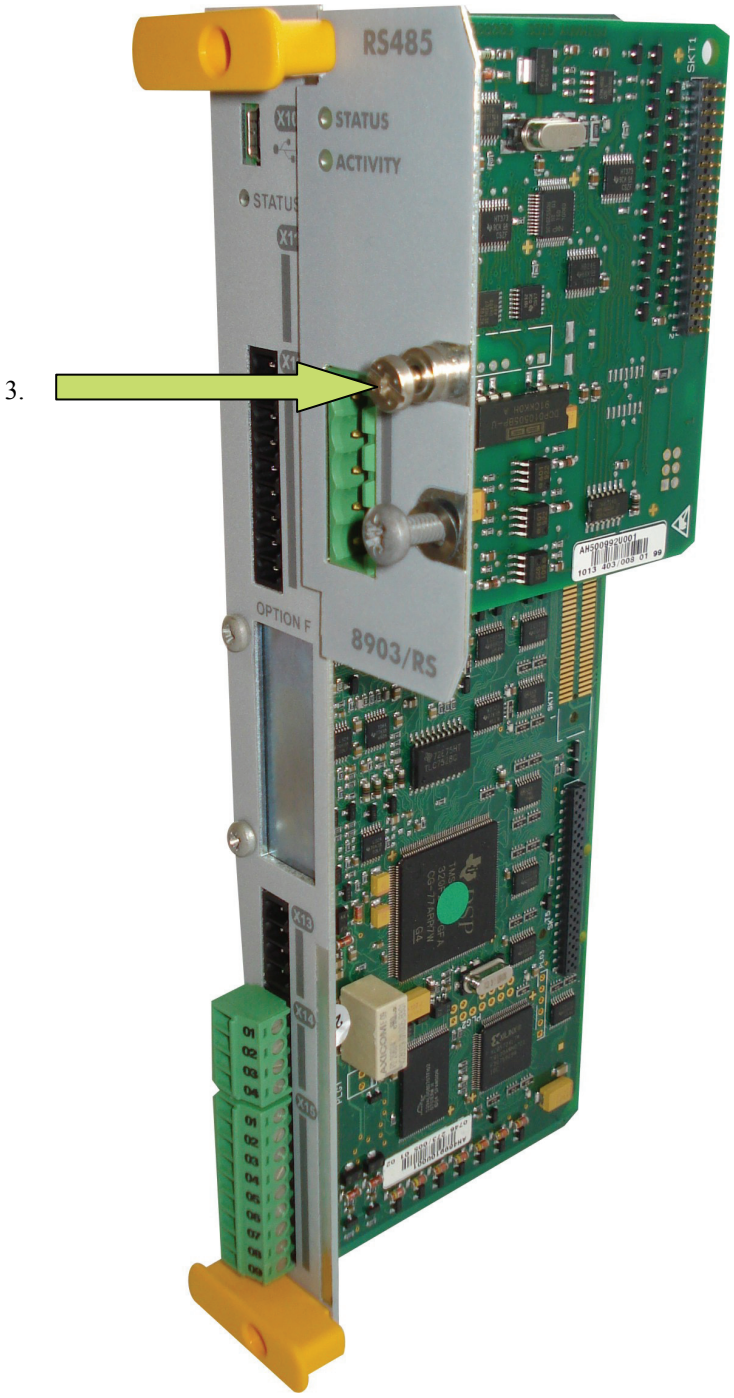


Figure 5. 890 Control Board with Option fitted

Wiring the RS485 System

Technical Specification of the 8903/RS Option

RS485 bus:	Isolated 2-wire + ground
Receiver input resistance:	12 kΩ (one Unit Load)
Differential input threshold:	±200 mV
Differential driver output voltage:	±5 V max.
Fixed biasing:	10 kΩ pull-down resistor to terminal A 10 kΩ pull-up resistor to terminal B
Optional selectable termination:	120 Ω in series with 10nF capacitor terminator
Number of nodes on one RS485 bus:	24 maximum including the master

Option Connector

Terminal X48

Pin	Connection
1	B
2	Ground
3	A
4	T (Terminator)
5	Screen

Figure 6. Terminal X48

Cable Specification

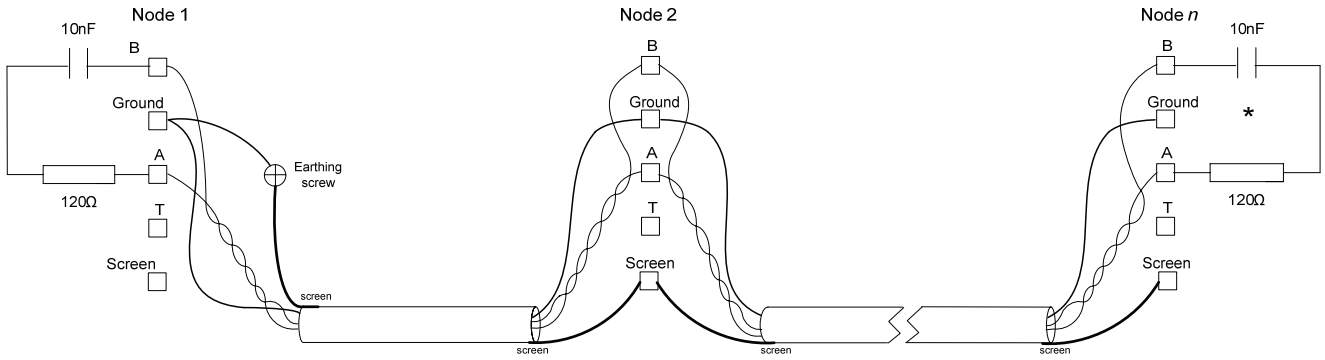
The **preferred cable** is a screened cable that has one twisted pair and a power core, or cable that has at least two twisted pairs. Cat 5e STP screened (braid or braid+foil) cable is recommended.

An **alternative cable** is a screened cable that has one twisted pair. This should only be used on short cable runs. See section **Maximum Cable Lengths** below.

Preferred Cable Connection

Connection using the preferred cable (see Figure 7):

- Connect one twisted pair to the signal terminals **A** and **B**.
- Connect the power core, or another twisted pair, to the **Ground** terminal. It is recommended to connect the Ground signal to earth *at one point only* on the RS485 bus.
- The screen should be connected to the **Screen** terminal, and earthed *at one end of the cable only* (the Earthing Screw may be used for this).



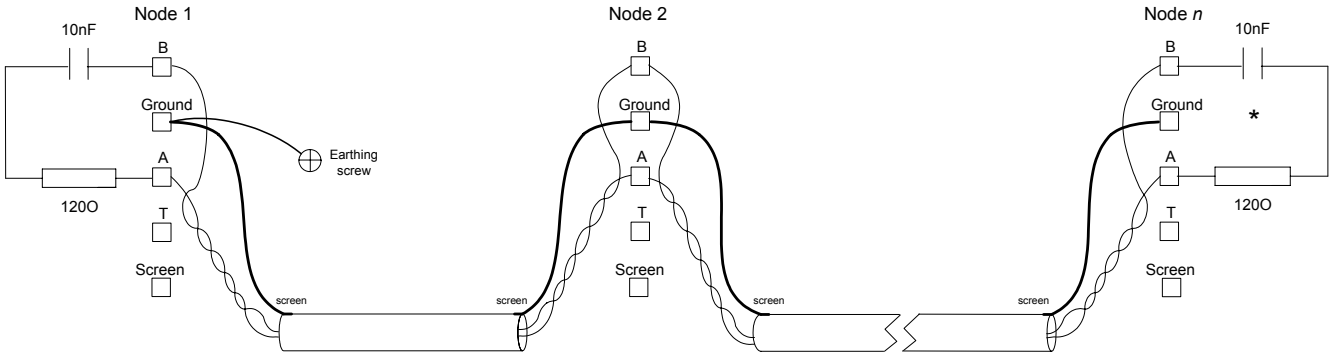
* If the 8903/RS is the last node then the on-board terminator (T) may be used instead

Figure 7. Preferred RS485 Wiring Configuration

Alternative Cable Connection

Connection using the alternative cable (see Figure 8):

- Connect one twisted pair to the signal terminals **A** and **B**.
- The screen should connected to the **Ground** terminal, and earthed *at one end of the cable only* (the Earthing Screw may be used for this).



* If the 8903/RS is the last node then the on-board terminator (T) may be used instead

Figure 8. Alternative RS485 Wiring Configuration

Maximum Cable Lengths

The RS485 options should be connected in a daisy chain configuration with cable stubs kept to a minimum distance.

Using the **preferred cable**, the total cable length should not exceed 1000 metres.

Using the **alternative cable**, the total cable length should not exceed 30 metres, the cable length between nodes should not exceed 3 metres, and the cable should not be grouped with power cables.

Biasing and Termination

Each end of the RS485 bus must be correctly terminated. Normally, the supervisor/master will be at one end and should provide suitable termination at that end.

If an 8903/RS option is at the *end* of the RS485 bus then this must be terminated. The on-board termination may be used by making the following connections on the X48 connector: bridge terminals **A** and **Terminator T**, as shown in Figure 9.

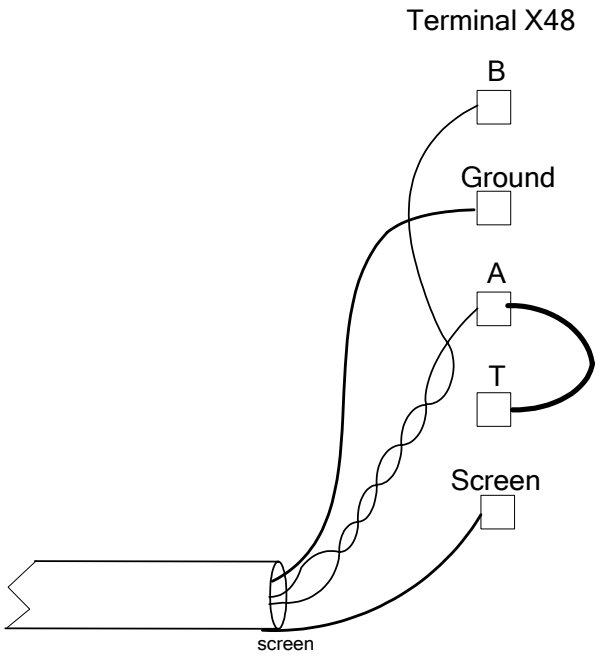


Figure 9. Using the 8903/RS On-Board Termination

Alternatively, an external termination may be connected across terminals A and B. The terminator should consist of a 120Ω resistor in series with a 10nF capacitor. A terminator consisting of a 120Ω resistor only should not be used as this places extra loading on the RS485 bus during the idle state.

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Status and Activity LED Indications

Table 1: RS485 Status LED

Status LED	State	Description
Off	-	- No power
Orange	Initialising	- RS485 initialising
Red / Green 50% flash	Configuring	- Configuring - Invalid DSE configuration
Green	Process Active	- A frame addressed to this node has been received within the timeout period - The process active timeout is disabled and the first frame addressed to this node has been received
Green 50% flash	Process Not Active	- Process not active

Table 2: RS485 Activity LED

ERROR LED	Description
Off	- No power - Not receiving frames addressed to this node - Not transmitting frames from this node
Orange	- RS485 initialising
Green Flickering	- Receiving frames addressed to this node - Transmitting frames from this node
Red Flickering	- Receiving frames addressed to this node with errors detected - Transmitting an exception code from the node

MMI Diagnostics

The RS485 Modbus RTU MMI View

Diagnostic information is available through the MMI under the menu MODBUS RTU.

MMI Menu Map

1 SETUP
2 COMMUNICATIONS
3 MODBUS RTU
- STATUS
- NODE ADDRESS
- BAUDRATE
- DATA BITS
- PARITY
- STOP BITS
- TIMEOUT
- WORD ORDER
- RX GOOD COUNT
- LAST TX STATUS
- LAST TX ERROR
- EXCEPTION COUNT
- CRC ERROR COUNT
- CHAR ERR COUNT
- DATA EXD COUNT
- RX ABORT COUNT
- RESET COUNTERS

Parameter Descriptions

STATUS *Read Only* *Range: Enumerated – see below*

Displays the status of Modbus RTU.

Emunerated Value : STATUS

0: UNKNOWN
1: CONFIGURING
2: NOT ACTIVE
3: ACTIVE

NODE ADDRESS *Read Only* *Range: 0 to 247*

Address identifier of the RS485 node.

BAUD RATE *Read Only* *Range: Enumerated - see below*

Baud rate of the network.

Enumerated Value : BAUD RATE

0 : UNKNOWN
1 : 1200
2 : 2400
3 : 4800
4 : 7200
5 : 9600
6 : 14400
7 : 19200
8 : 38400
9 : 57600
10: 115200

DATA BITS *Read Only* *Range: 8*

Number of data bits of a character.

PARITY *Read Only* *Range: Enumerated – see below*

Parity bit of a character.

Enumerated Value : PARITY

0: NONE
1: ODD
2: EVEN

STOP BITS *Read Only* *Range: Enumerated – see below*

Stop bits of a character.

Enumerated Value : STOP BITS

0: UNKNOWN
1: ONE
2: TWO

TIMEOUT *Read Only* *Range: 0 to 60,000 ms*

Process active timeout. If the node has not been addressed for the timeout period or longer then the STATUS parameter changes to the NOT ACTIVE state. Setting the timeout period to zero disables this feature.

WORD ORDER *Read Only* *Range: Enumerated – see below*

Word order of 32-bit registers.

Enumerated Value : WORD ORDER

0: LOW WORD FIRST
1: HIGH WORD FIRST

RX GOOD COUNT *Read Only* *Range: integer value*

Number of received Modbus frames addressed to this node without any errors.

LAST TX STATUS *Read Only* *Range: Enumerated – see below*

Exception code of last Modbus frame transmitted.

Enumerated Value : LAST TX STATUS

0: OK
1: ILLEGAL FUNCTION
2: ILLEGAL ADDRESS
3: ILLEGAL DATA VAL

LAST TX ERROR *Read Only* *Range: Enumerated – see below*

Exception code of last Modbus frame transmitted with an error.

Enumerated Value : LAST TX ERROR

0: NONE
1: ILLEGAL FUNCTION
2: ILLEGAL ADDRESS
3: ILLEGAL DATA VAL

EXCEPTION COUNT *Read Only* *Range: integer value*

Number of Modbus error response frames transmitted.

CRC ERROR COUNT *Read Only* *Range: integer value*

Number of received Modbus frames addressed to this node with CRC errors.

CHAR ERR COUNT *Read Only* *Range: integer value*

Number of UART characters received with parity or framing errors.

DATA EXD COUNT *Read Only* *Range: integer value*

Number of received Modbus frames addressed to this node attempting to exceed the maximum number of data bytes allowed when reading or writing.

RX ABORT COUNT *Read Only* *Range: integer value*

Number of received Modbus frames addressed to this node aborted due to excessive inter-character delay.

RESET COUNTERS *Read/Write* *Range: False/True*

Set to True holds in reset all counters.

Modbus RTU

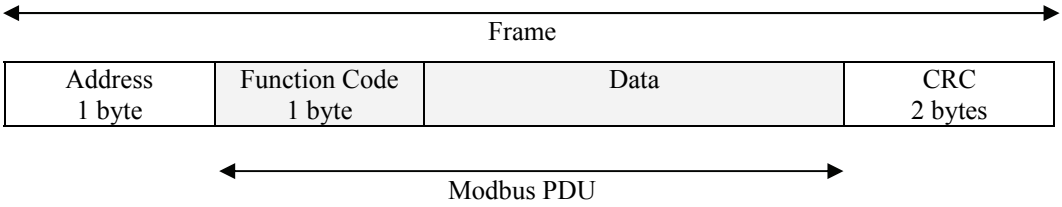
Modbus RTU Overview

Modbus is a request-reply protocol and offers services specified by function codes. Modbus function codes, as well as data, are elements of Modbus PDUs (Protocol Data Unit).

Modbus RTU is a serial line protocol with some additional fields to the PDU, namely, the node address identifier and the CRC error check. The address identifier range for individual slave addresses is 1 to 247. Address 0 is used for broadcast.

One master and one or several slave nodes are connected to the same serial bus. The master sends a request and one slave responds.

In RTU mode a Modbus message is placed by the transmitting device into a frame. The maximum size of a frame is 256 bytes. Each frame is separated by a silent interval of at least 3.5 character times.



The format of each character (11 bits) in RTU mode is:

- 1 start bit
- 8 binary data bits
- 1 bit parity and 1 stop bit, or no parity bit and 2 stop bits

Inter-Frame Delay and Inter-Character Delay

The silent interval or inter-frame delay between RTU frames is *at least* 3.5 character (38.5 bit) times. The maximum inter-character delay is 1.5 character (16.5 bit) times. Both delays are dependant on the baud rate. Above 19200 bit/s fixed values are used. This is summarised in the table below.

Baud Rate (bits/s)	Minimum Inter-Frame Delay (ms)	Maximum Inter-Character Delay (ms)
1200	32.08	13.75
2400	16.04	16.04
4800	8.02	3.44
7200	5.35	2.29
9600	4.01	1.72
14400	2.70	1.15
19200	2.00	0.86
38400	1.75*	0.75*
57600	1.75*	0.75*
115200	1.75*	0.75*

*Fixed value

Modbus Data Model

Modbus bases its data model on a series of tables. The four primary tables are: Discrete Input, Coils, Input Registers, and Holding Registers. The 8903/RS implementation maps the fixed parameters (PREFs) and user defined DSE field bus registers on to both the Input Registers and the Holding Registers. The Discrete Input and Coils tables are not used. This is summarised in the table below.

Mapping of the Holding Registers (4x) and Input Registers (3x)

Modbus Register	890 Data
00001 …. 00512	DSE field bus registers (1 or 2 Modbus registers per DSE register)
00513 …. 01000	Special registers
01001 …. 65536	PREF fixed parameters (2 Modbus registers per parameter)

Modbus registers have a data size of 16 bits. As some 890 data is 32-bit, this is split over two consecutive Modbus registers. The word-order of 32-bit data is selectable during setup to match the Modbus master's requirements.

DSE Register Mapping

DSE registers may be associated with fieldbus input connectors, output connectors or both. A DSE register is automatically mapped on to the Modbus register(s) starting from address **00001**, with no gaps. A DSE register may be mapped on to one or two Modbus registers depending on the data type:

No. of Modbus registers	Fieldbus data types
1	UINT16, INT16
2	UINT32, INT32, FLOAT (32-bit floating point [IEEE 754])

The conversions between DSE data types (VALUE, INTEGER, BOOLEAN) and the fieldbus data types (UINT16, INT16, UINT32, INT32, FLOAT) are described in **Appendix A: DSE/RS485 Conversion Rules**.

For 32-bit data parameter accesses the word order is determined by the **Word Order** setting in the RS485 DSE function block. A read/write of both data words *must* be done in a single Modbus request.

Example Configuration

Fieldbus Inputs: 2 Integer and 1 Value
Fieldbus Outputs: 1 Integer and 1 Value

These are configured as shown below:

These fieldbus registers could be arranged as follows:

Connector	DSE register	Data type	Modbus registers
FII.1	1 - input	UINT32	00001 / 00002
FII.2	2 - input	UINT16	00003
FIO.1	3 - output	INT32	00004 / 00005
FVI.1 / FVO.1	4 - input / output	FLOAT	00006 / 00007

Fixed Parameter (PREF) Mapping

All the fixed parameters (PREFs) are mapped to Modbus registers starting from address 01001. Each fixed parameter is mapped on to two Modbus registers regardless of the PREF data type. However for data types of 8-bit or 16-bit only the first Modbus register is used. This is summarised below.

No. of Modbus registers	PREF data types
1	BOOL, ENUM, WORD
2	INT, REAL
Not supported	Other data types, e.g. STRING

The PREF number consists of two parts: the **block number** and the **parameter number**. The Modbus register address is calculated from the PREF number:

*holding register address = (block number * 32 + parameter number) * 2 + 1001*

For 32-bit data parameter accesses the word order is determined by the Word Order setting in the RS485 DSE function block. A read/write of both data words *must* be done in a single Modbus request.

Note that parameters with a data type REAL are converted to/from 32-bit floating point [IEEE 754].

Example

The fixed parameter **ACCEL TIME** has a data type of REAL and a PREF number of **100.02**. This will map to a holding register of (**100***32 + **2**) * 2 +1001 = **7405**

As the data type is REAL this will be accessed over two holding registers (7405 and 7406) as a 32-bit floating point value. Both registers must be read or written to in one request.

Special Registers

The special registers occupy Modbus register range 00513 – 01000. Only registers 00513 – 00515 are currently defined and are **read-only** registers.

Modbus register	Response
00513	Device identity in hexadecimal format (0x0890)
00514	Firmware version number in hexadecimal format (eg. V3.7 is 0x0307)
00515	Last transmitted exception error code
00516 - 01000	Reserved

Modbus Functions

The 8903/RS option will recognise the Modbus functions given in **Appendix B.** The 8903/RS will reply with an error response for functions that are recognised but not supported.

Received frames with function codes not recognised will be ignored by the option, i.e. an error response will not be transmitted. However, the exception counter will be incremented and the status and error registers will hold the ILLEGAL FUNCTION exception code.

Exceptions

The following Modbus exception codes may be transmitted by the 8903/RS option during an error response:

Code	Name	Description
01	ILLEGAL FUNCTION	- The function code is recognised but the function is not supported.
02	ILLEGAL DATA ADDRESS	- Attempting to read or write to a fixed parameter (PREF) that does not exist or a DSE register that has not been allocated. - Attempting to write to a read-only register. - Attempting to read or write only half of a 32-bit value.
03	ILLEGAL DATA VALUE	- Attempting to write to a fixed parameter (PREF) with a value that is out of range.

Rules

The mapped data (DSE registers, fixed parameters and special registers) may be read or written to using the following functions:

Function	Description	32-bit data	broadcast	Max number of registers
03	Read Holding Registers	✓	×	125
04	Read Input Registers	✓	×	125
06	Write Single Register	×	✓	1
16	Write Multiple Registers	✓	✓	123

Reading or writing to a **block of registers** is permitted. However, the following rules apply:

- **Reading a block** of Modbus registers when some of the registers within the block are not allocated is permitted as long as the first register within the block is allocated. Registers that have not been allocated to a fixed parameter or a DSE register will return a value of 0.
- **Writing to a block** of Modbus registers when some of the registers within the block are not allocated or are read-only is permitted as long as the first register within the block is allocated and is not read-only. In this case read-only registers will not be affected.
- If a block of registers ends on a Modbus register that maps onto a **32-bit fixed parameter** (PREF) or a **32-bit DSE register,** then *both* Modbus registers that make up the 32-bit value must be read from or written to.

Configuring the RS485 System

To configure the RS485 system, complete the steps below.

Configuring the RS485 Option using DSE

You can configure your RS485 Option using DSE. Follow the instructions below.

Step 1: Inserting an RS485 Function Block

Display your configuration page. Click on the Block menu at the top of the screen.

1. Move the cursor down to select "890 Comms" and select "RS485".
2. Click to select the RS485 block. Move this to where you want on the screen then click again to place the block.

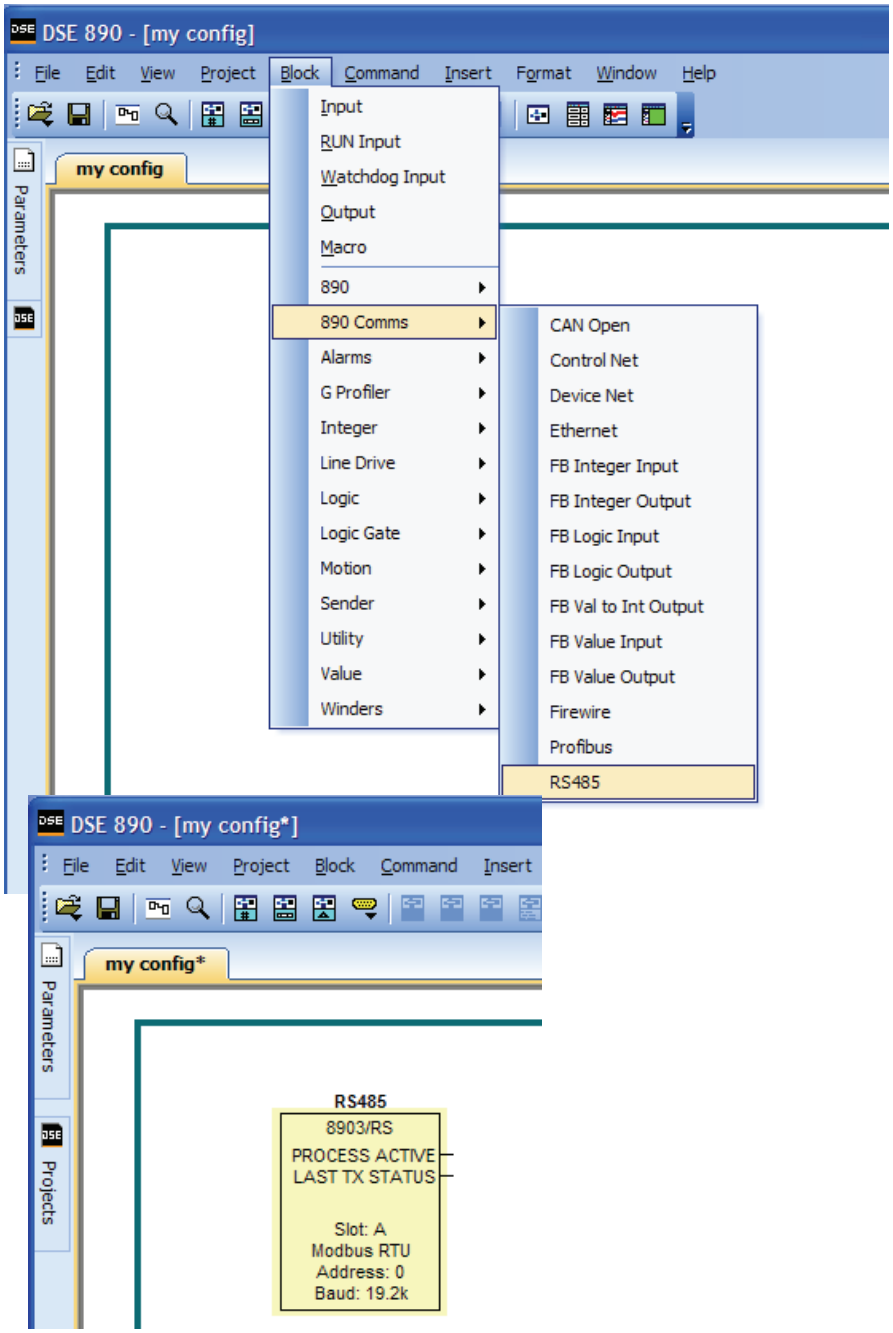


Figure 9. Configuration showing RS485 function block

Step 2: Attaching Fieldbus Connectors

Seven fieldbus connector types are available:

FB Logic Input	FB Integer Input	FB Value Input	
FB Logic Output	FB Integer Output	FB Value Output	FB Val to Int Output

Input connector: the data is sent from Master (PLC) → 890

Output connector: the data is sent from 890 → Master (PLC)

The fieldbus connectors must be added before they will appear in the RS485 function block.

Note: *The function block and connectors can be renamed by using the right mouse button and selecting* ***Rename Block****.*

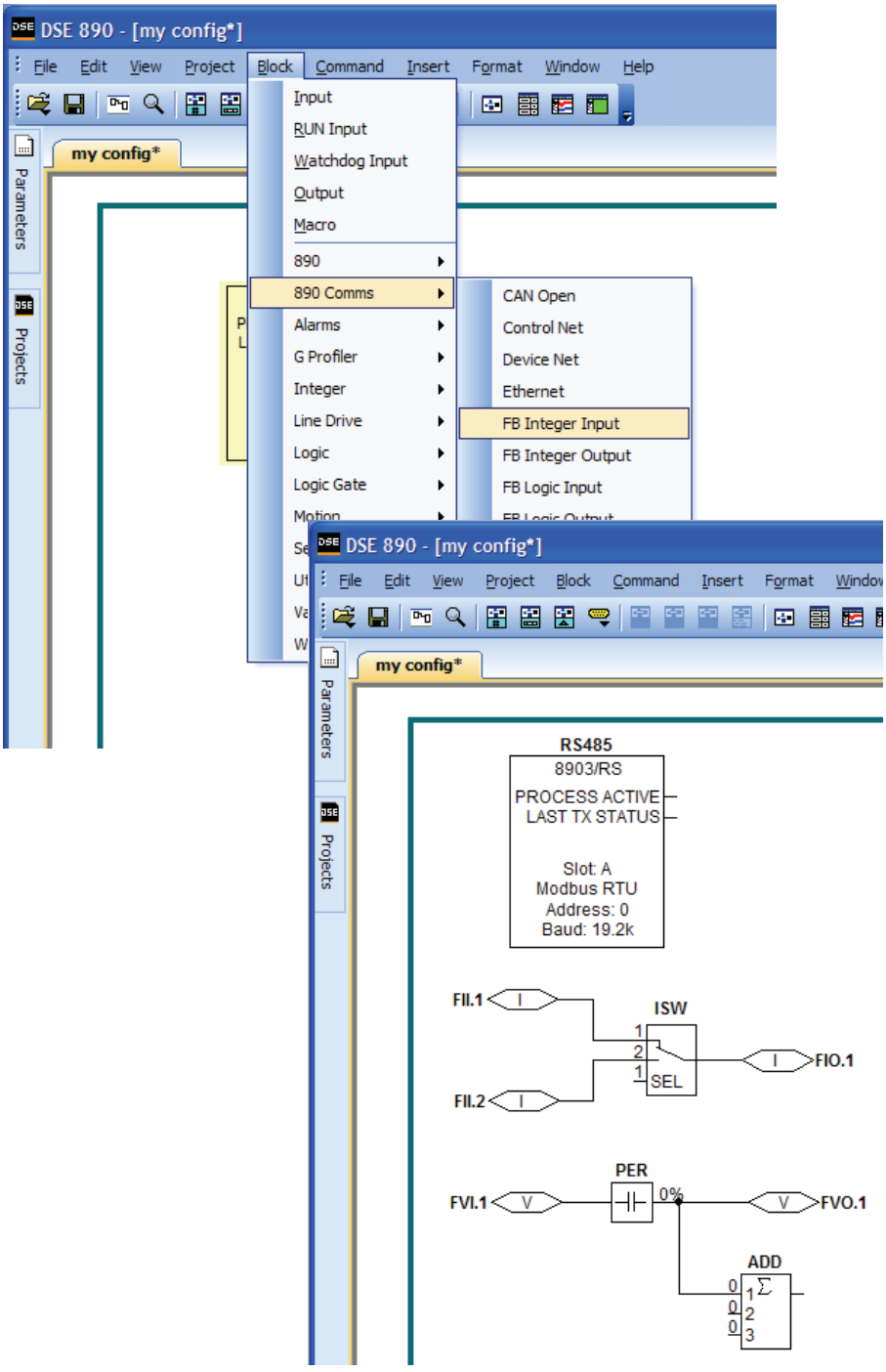
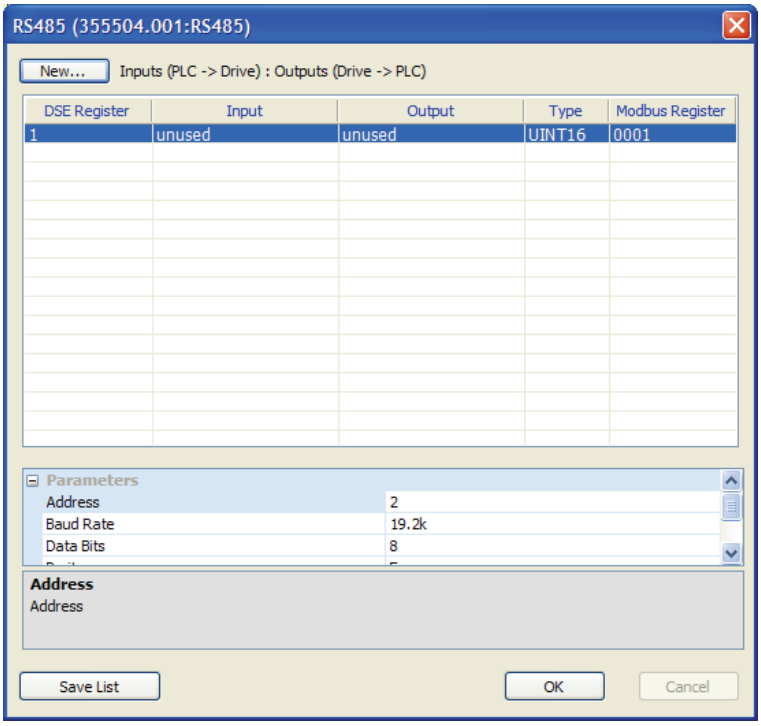


Figure 10. Configuration showing RS485 function block and Fieldbus Connectors

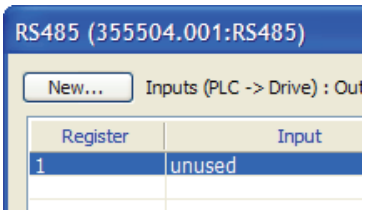
Step 3: Configuring the Fieldbus Connectors

Double-click on the function block to display the dialog below. The fieldbus connectors (inputs and outputs) are assignable in the function block along with their data type to/from the PLC. Other RS485 parameters are set here.

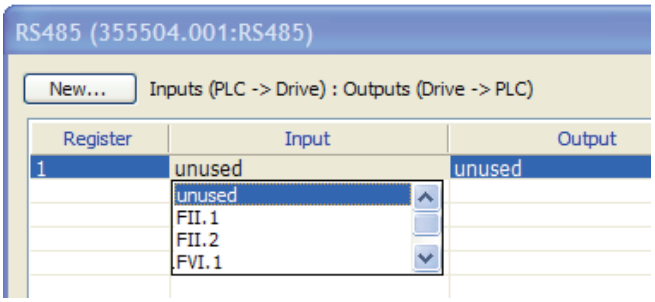


To configure the input and output connectors you have placed in the configuration:

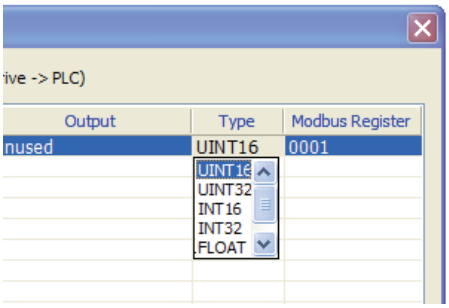
1. To add more registers click on **New…**



2. Click on **unused** in either the **Input** column or **Output** column. From the drop-down list select the required connector. A DSE register may be associated with an input connector, an output connector or both, in which case the input and output connector *must* have the same DSE type, i.e. VALUE, INTEGER or BOOLEAN.

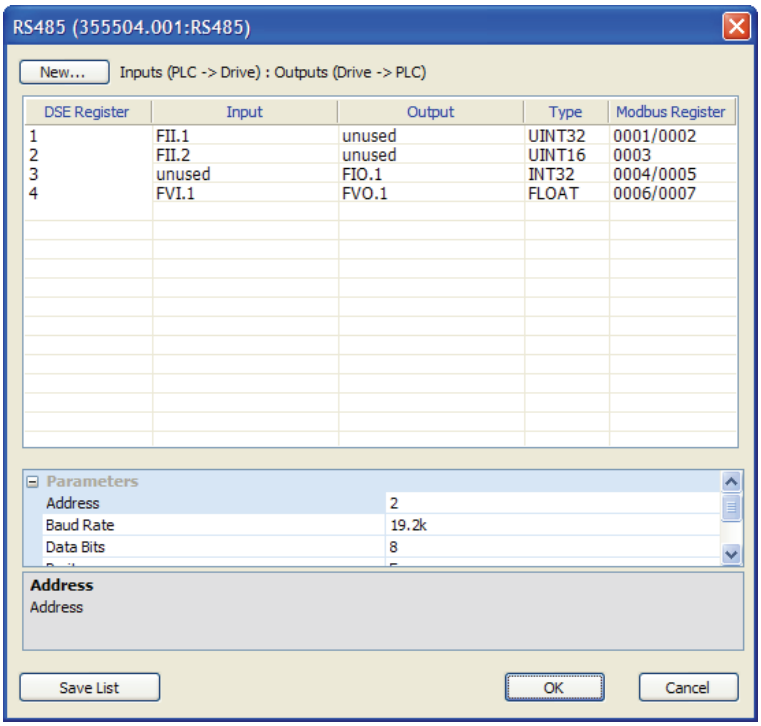


3. Click on **UINT16** in the **Type** column to change the type of the Modbus register(s) associated with the DSE register.

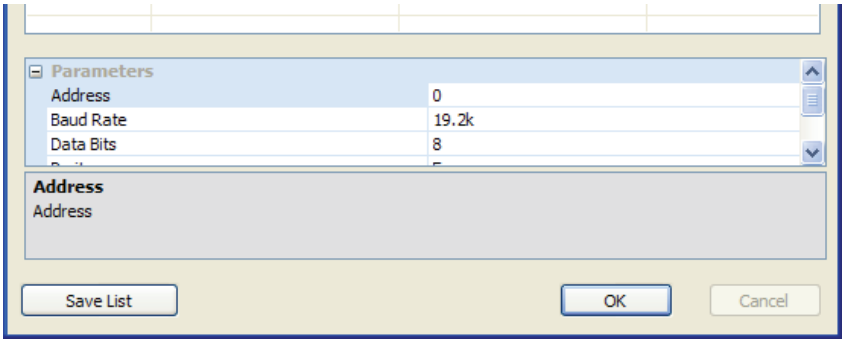


4. The Modbus Register column is automatically filled. This shows which Modbus register(s) are mapped to the DSE register.

5. Set up all the DSE registers in a similar way.
Right click on a register to reveal a menu that allows registers to be moved, inserted or deleted.



6. Other RS485 parameters may be set up, as shown below.



Address:	Address identifier: 1 - 247
Baud Rate:	Standard baud rates: 1.2k – 115.2k
Data Bits:	8 (fixed)
Parity:	Even, Odd, None
Word Order:	32-bit word (register) order: Low Word First, High Word First
Timeout ms:	Process active timeout in milliseconds: 0 – 60,000ms. Set to 0 to disable. If used, the timeout should be set to greater than the maximum period in which frames addressed to the node will be received. This depends on a number of factors including the baud rate, quantity of data, number of slaves, cycle time of the master, etc.

7. If required, click on **Save List** to generate a text file mapping DSE registers to Modbus registers.

Initial DSE Fieldbus Register Values

Modbus registers mapped to DSE registers will have initial values of zero. A DSE fieldbus input register will generate an event in DSE the first time data is written to the Modbus register mapped to it. Subsequent events will be generated when the data written to the register *changes*.

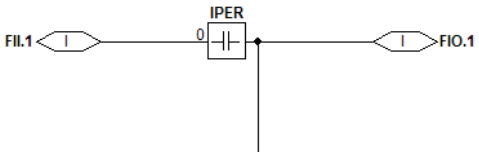
DSE Input/Output Registers and Persistent Data

It is possible to have a DSE input register and a DSE output register map to the same Modbus register(s). In this case both fieldbus connectors *must* be the same DSE type, i.e. VALUE, INTEGER or BOOLEAN.

A change of data on the DSE output connector will generate an event on the input connector. Any limiting of data that occurs due to conversions will not appear on the input connector.

For example, consider a DSE INTEGER input connector and a DSE INTEGER output connector mapped to the same modbus register with an RS485 data type of UINT16, as shown below. If a data value of say 100,000 is send to the output connector, 100,000 will appear at the input connector. However, the data on the RS485 bus will be limited to 65,536; the maximum limit of UINT16.

An input and output connector mapped to the same Modbus register(s) may be used with a persistent block as shown in the example below. This combination allows persistence of data when the power is removed from the 890 drive.



FB Input and Output Data Types

Data Type	Description	Range
LOGIC	Logic	False (F) and True (T)
INTEGER	32-bit signed integer	-2,147,483,648 to 2,147,483,647
VALUE	32-bit fixed point value	-32768.0 to 32767.9999

RS485 Data Types

Data Type	Description	Range
INT16	16-bit signed integer	-32,768 to 32,767
INT32	32-bit signed integer	-2,147,438,648 to 2,147,483,647
UINT16	16-bit unsigned integer	0 to 65,535
UINT32	32-bit unsigned integer	0 to 4,294,967,295
FLOAT	32-bit IEEE-754 floating-point value	1.19209290e-38 to 3.4028235e+38

Conversion of DSE Type < > RS485 Type

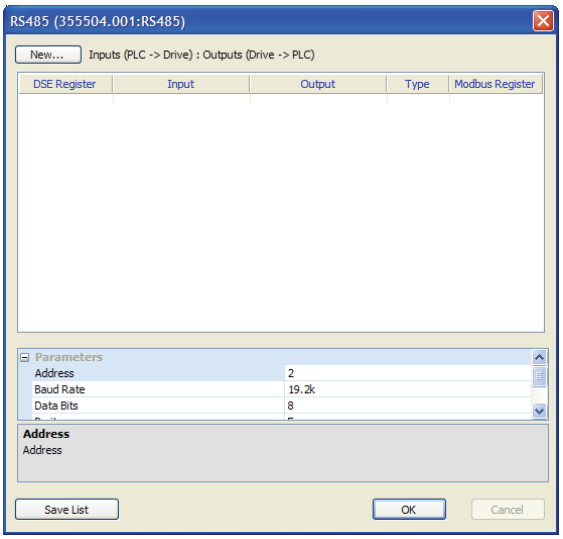
Each DSE register may have one of the RS485 data types described. This is the format that the Modbus master will 'see'. The fieldbus input and output connectors have one of three types: logic, integer or value. DSE will automatically convert between the fieldbus connector type and the register type (see **Appendix A: DSE/RS485 Conversion Rules**).

Some recommended RS485 type assignments to fieldbus connectors are given in the table below.

Fieldbus Connector	RS485 Type
LOGIC	UINT16
INTEGER	UINT16 UINT32 INT16 INT32
VALUE	FLOAT

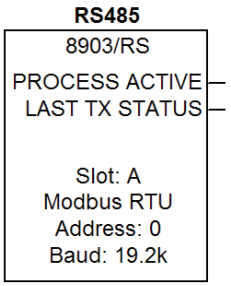
Accessing Fixed Parameters Only

If DSE registers are not required and only fixed parameters (PREFs) are to be accessed then follow the instructions above for configuring the RS485 option but make sure no unused registers are listed in the dialog box.



RS485 Status Information

The RS485 function block in DSE provides status information about the RS485 bus interface.



When online, the address and baud rate can be found by clicking the right mouse button over the "Address" or "Baud" text and selecting **Get** from the menu.

The function block also provides two status outputs that can be wired to: PROCESS ACTIVE and LAST TX STATUS.

PROCESS ACTIVE

Logic value: True (T) indicates that the Modbus interface has received a frame addressed to the node within the timeout period, or, if the timeout period is disabled, the first frame has been received.

The LAST TX STATUS output gives the exception error code of the last transmitted frame or 0 if there was no error. This output could be used with the LOGIC::LOOKUP function block to determine a particular state.

LAST TX STATUS

Enumerated value: Status Run
0: NONE
1: ILLEGAL FUNCTION
2: ILLEGAL ADDRESS
3: ILLEGAL DATA VALUE

Communications Command

When sequencing is in the Remote Comms mode, the sequencing of the Drive is controlled by writing to the COMMS COMMAND (PREF 95.05, Modbus Holding Register 7091).

The COMMS COMMAND parameter is a 16-bit word based on standard fieldbus drive profiles. Some bits are not implemented in this release (see "Supported" column of the table below).

Bit	Name	Description	Supported	Required Value
0	Switch On	OFF1 Operational	✓	
1	(Not) Disable Voltage	OFF2 Coast Stop	✓	
2	(Not) Quick Stop	OFF3 Fast Stop	✓	
3	Enable Operation		✓	
4	Enable Ramp Output	=0 to set ramp output to zero		1
5	Enable Ramp	=0 to hold ramp		1
6	Enable Ramp Input	=0 to set ramp input to zero		1
7	Reset Fault	Reset on 0 to 1 transition	✓	
8				0
9				0
10	Remote	=1 to control remotely		1
11				0
12				0
13				0
14				0
15				0

Switch On

Replaces the RUN FWD, RUN REV and NOT STOP parameters of the SEQUENCING LOGIC function block. When Set (=1) is the same as :

RUN FWD = TRUE
RUN REV = FALSE
NOT STOP = FALSE

When Cleared (= 0) is the same as :

RUN FWD = FALSE
RUN REV = FALSE
NOT STOP = FALSE

(Not) Disable Voltage

ANDed with the NOT COAST STOP parameter of the SEQUENCING LOGIC function block. When both Set (=1) is the same as:

NOT COAST STOP = TRUE

When either or both Cleared (= 0) is the same as :

NOT COAST STOP = FALSE

(Not) Quick Stop

ANDed with the NOT FAST STOP parameter on the SEQUENCING LOGIC function block. When both Set (=1) is the same as:

NOT FAST STOP = TRUE

When either or both Cleared (= 0) is the same as :

NOT FAST STOP = FALSE

Enable Operation

ANDed with the DRIVE ENABLE parameter on the SEQUENCING LOGIC function block. When both Set (=1) is the same as:

DRIVE ENABLE = TRUE

When either or both Cleared (= 0) is the same as :

DRIVE ENABLE = FALSE

Enable Ramp Output, Enable Ramp, Enable Ramp Input

Not implemented. The state of these bits must be set (=1) to allow this feature to be added in the future.

Reset Fault

Replaces the REM TRIP RESET parameter on the SEQUENCING LOCIC function block. When Set (=1) is the same as:

REM TRIP RESET = TRUE

When Cleared (= 0) is the same as :

REM TRIP RESET = FALSE

Remote

Not implemented. It is intended to allow the PLC to toggle between local and remote. The state of this must be set (=1) to allow this feature to be added in the future.

Example Commands

047F hexadecimal to RUN

047E hexadecimal to STOP

Communications Status

The COMMS STATUS parameter (PREF 95.08, Modbus Holding Register 7097) in the COMMS CONTROL function block monitors the sequencing of the Drive. It is a 16-bit word based on standard fieldbus drive profiles. Some bits are not implemented in the initial release and are set to 0 (see "Supported" column of the table below).

Bit	Name	Description	Supported
0	Ready To Switch On		✓
1	Switched On	Ready for operation (refer control bit 0)	✓
2	Operation Enabled	(refer control bit 3)	✓
3	Fault	Tripped	✓
4	(Not) Voltage Disabled	OFF 2 Command pending	✓
5	(Not) Quick Stop	OFF 3 Command pending	✓
6	Switch On Disable	Switch On Inhibited	✓
7	Warning		
8	SP / PV in Range		
9	Remote	= 1 if Drive will accept Command Word	✓
10	Setpoint Reached	= 1 if not ramping	✓
11	Internal Limit Active	= 1 if current limit active or speed loop is in torque limit	✓
12			
13			
14			
15			

Ready To Switch On

Same as the SWITCH ON ENABLE output parameter of the SEQUENCING LOGIC function block.

Switched On

Same as the SWITCHED ON output parameter of the SEQUENCING LOGIC function block.

Operation Enabled

Same as the RUNNING output parameter of the SEQUENCING LOGIC function block.

Fault

Same as the TRIPPED output parameter of the SEQUENCING LOGIC function block.

(Not) Voltage Disabled

If in Remote Comms mode, this is the same as Bit 1 of the COMMS COMMAND parameter. Otherwise it is the same as the NOT COAST STOP input parameter of the SEQUENCING LOGIC function block.

(Not) Quick Stop

If in Remote Comms mode, this is the same as Bit 2 of the COMMS COMMAND parameter. Otherwise it is the same as the NOT FAST STOP input parameter of the SEQUENCING LOGIC function block.

Switch On Disable

Set (=1) only when in START DISABLED state.

Remote

This bit is set (= 1) if the Drive is in Remote mode **AND** the parameter REMOTE COMMS SEL of the COMMS CONTROL function block is Set (= 1).

Setpoint Reached

This bit is set (=1) if the Reference Ramp is not ramping.

Internal Limit Active

This bit is set (=1) if, while in vector control mode, the speed limit has reached the torque limit; or, while in Volts/Hz mode, the open loop current limit is active.

Appendix A: DSE/RS485 Conversion Rules

The rules governing the conversion between 890 data types and RS485 data types are given below. Note carefully that some conversions will result in rounding, limiting and truncation of the original value.

LOGIC Type Connector

	Data from RS485	Data to 890
From FLOAT to LOGIC	Zero Non-zero	False True
From INT16 to LOGIC	Zero Non-zero	False True
From INT32 to LOGIC	Zero Non-zero	False True
From UINT16 to LOGIC	Zero Non-zero	False True
From UINT32 to LOGIC	Zero Non-zero	False True

	Data from 890	Data to RS485
From LOGIC to FLOAT	False True	0.0 1.0
From LOGIC to INT16	False True	0 1
From LOGIC to INT32	False True	0 1
From LOGIC to UINT16	False True	0 1
From LOGIC to UINT32	False True	0 1

INTEGER Type Connector

	Data from RS485	Data to 890
From FLOAT to INTEGER	32-bit IEEE floating-point	-2,147,483,648 to 2,147,483,547 Fractional part rounded
From INT16 to INTEGER	-32,768 to 32,767	-32,768 to 32,767
From INT32 to INTEGER	-2,147,483,648 to 2,147,483,547	-2,147,483,648 to 2,147,483,547
From UINT16 to INTEGER	0 to 65,535	0 to 65,535
From UINT32 to INTEGER	0 to 4,294,967,295	0 to 2,147,483,647 limits apply

	Data from 890	Data to RS485
From INTEGER to FLOAT	-2,147,483,648 to 2,147,483,647	32-bit IEEE floating-point
From INTEGER to INT16	-2,147,483,648 to 2,147,483,647	-32768 to 32767 limits apply
From INTEGER to INT32	-2,147,483,648 to 2,147,483,647	-2,147,483,648 to 2,147,483,647
From INTEGER to UINT16	-2,147,483,648 to 2,147,483,647	0 to 65,535 limits apply
From INTEGER to UINT32	-2,147,483,648 to 2,147,483,647	0 to 2,147,483,647 limits apply

VALUE Type Connector

	Data from RS485	Data to 890
From FLOAT to VALUE	32-bit IEEE floating-point	-32,768.0 to 32,767.9999
From INT16 to VALUE	-32,768 to 32,767	-32,768.0 to 32,767.0
From INT32 to VALUE	-2,147,483,648 to 2,147,483,547	-32,768.0 to 32,767.0 limits apply
From UINT16 to VALUE	0 to 65,535	0.0 to 32,767.0 limits apply
From UINT32 to VALUE	0 to 4,294,967,295	0.0 to 32,767.0 limits apply

	Data from 890	Data to RS485
From VALUE to FLOAT	-32,768.0 to 32,767.9999	32-bit IEEE floating-point
From VALUE to INT16	-32,768.0 to 32,767.9999	-32,768 to 32,767 limits apply/ rounding applies
From VALUE to INT32	-32,768.0 to 32,767.9999	-32768 to 32,767 limits apply/ rounding applies
From VALUE to UINT16	-32,768.0 to 32,767.9999	0 to 32,767 limits apply/ rounding applies
From VALUE to UINT32	-32,768.0 to 32,767.9999	0 to 32767 limits apply/ rounding applies

Appendix B: Modbus Functions

01 Read Coils

Not supported.

Request PDU:

Function code	1 byte	0x01
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of coils	2 bytes	N

Error Response:

Function code	1 byte	0x81
Exception code	1 byte	01

02 Read Discrete Inputs

Not supported.

Request PDU:

Function code	1 byte	0x02
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of inputs	2 bytes	1 to 2000

Error Response:

Function code	1 byte	0x82
Exception code	1 byte	01

03 Read Holding Registers

This function reads the contents of a contiguous block of holding registers.

Request PDU:

Function code	1 byte	0x03
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of registers	2 bytes	1 to 125 (N)

Response:

Function code	1 byte	0x03
Byte count	1 byte	N*2
Register value	N*2 bytes	value

Error Response:

Function code	1 byte	0x83
Exception code	1 byte	02 or 03

04 Read Input Registers

This function reads the contents of a contiguous block of input registers.

Request PDU:

Function code	1 byte	0x04
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of registers	2 bytes	1 to 125 (N)

Response:

Function code	1 byte	0x04
Byte count	1 byte	N*2
Register value	N*2 bytes	value

Error Response:

Function code	1 byte	0x84
Exception code	1 byte	02 or 03

05 Write Single Coil

Not supported.

Request PDU:

Function code	1 byte	0x05
Starting address	2 bytes	0x0000 to 0xFFFF
Output value	2 bytes	value

Error Response:

Function code	1 byte	0x85
Exception code	1 byte	01

06 Write Single Registers

This function is used to write to a single holding register. The normal response is an echo of the request. The function allows a request from a broadcast, in which case there is no response.

Request PDU:

Function code	1 byte	0x06
Starting address	2 bytes	0x0000 to 0xFFFF
Register value	2 bytes	value

Response:

Function code	1 byte	0x06
Starting address	2 bytes	0x0000 to 0xFFFF
Register value	2 bytes	value

Error Response:

Function code	1 byte	0x86
Exception code	1 byte	02 or 03

07 Read Exception Status

This function reads the last exception code transmitted in an error response or 0 if a normal response was transmitted. This function does not modify the exception status itself.

Request:

Function code	1 byte	0x07

Response:

Function code	1 byte	0x07
Exception status	1 byte	00, 01, 02, 03

08 Diagnostics

This function provides a series of diagnostics for checking the communication status of the slave. It uses a two-byte sub-function code field in the request to define the diagnostic required.

Request PDU:

Function code	1 byte	0x08
Sub-function code	2 bytes	*See below*
Data	2 bytes	

Response:

Function code	1 byte	0x08
Sub-function code	2 bytes	*See below*
Data	2 bytes	

Error Response:

Function code	1 byte	0x88
Exception code	1 byte	01

Sub-functions:

Sub-function code	Function	Description
00 00	Query data (loopback)	Responds with the two data bytes
00 02	Return diagnostic register	Responds with the last error exception transmitted
00 10	Clear Counters and Diagnostic Register	Clears the status and error registers and resets all error counters
00 12	Return Bus Communications Error Count	Responds with the CRC error count
00 13	Return Bus Exception Count	Responds with the exception count
Other	Not supported	Responds with error response (Illegal Function)

15 Write Multiple Coils

Not supported.

Request PDU:

Function code	1 byte	0x0F
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of outputs	2 bytes	N
Byte count	1 byte	N/8
Output value	N/8 bytes	value

Error Response:

Function code	1 byte	0x8F
Exception code	1 byte	01

16 Write Multiple Registers

This function is used to write a block of contiguous registers. The function allows a request from a broadcast, in which case there is no response.

Request PDU:

Function code	1 byte	0x10
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of registers	2 bytes	1 to 123 (N)
Byte count	1 byte	2*N
Register value	N*2 bytes	value

Response:

Function code	1 byte	0x10
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of registers	2 bytes	1 to 123 (N)

Error Response:

Function code	1 byte	0x90
Exception code	1 byte	02 or 03

Appendix C: Troubleshooting

LEDs

The LEDs status indicating possible errors are given in the table below. For more details see section **Status and Activity LED Indications**.

Status LED	Activity LED	Description
Orange	Orange	- Initialising – will change after a few moments - Incorrect 890 drive firmware - if the LEDs remain in this state
Red / Green 50% flash	Off	- Configuring - Failure to configure - if the LEDs remain in this state (see below)

DSE Configuration Error

If the RS485 is not configured correctly then the module list in DSE, or the Scratch Pad in DSELite, will report a status of **LERROR**. The Status LED will flash 50% RED/GREEN (see above). Possible configuration problems are:

- An 8903/RS option is fitted without an RS485 fieldbus block in the DSE configuration. No LERROR will be reported, but the Status LED will flash 50% RED/GREEN.
- DSE configuration includes an RS485 fieldbus block without an 8903/RS option fitted to the drive.
- The RS485 fieldbus node address has not been configured (has a node address of 0).
- The RS485 fieldbus block has a DSE register allocated without an input or output connector associated with it. Unwanted DSE registers should be deleted.
- The RS485 fieldbus block has a DSE register allocated with an input and an output fieldbus connector of different DSE data types. If a DSE register is associated with both input and output connectors both must be of the same type, i.e. VALUE, INTEGER or BOOLEAN.

MMI Error Diagnostics

The MMI diagnostics for the Modbus RTU function block can be found under the menu SETUP::COMMUNICATIONS::MODBUS RTU. The diagnostics are described in the section **MMI Diagnostics**.

The possible reasons for error counters incrementing are given in the table below.

Error Counter	Reason
EXCEPTION COUNT	- An error response has been transmitted by the 8903/RS option (see section **Modbus RTU:Exceptions)**. - The 8903/RS has received a frame with an unrecognised Modbus function code.
CRC ERROR COUNT	- The 8903/RS has received a frame with an incorrect CRC checksum. This could be due to noise corrupting the data.
CHAR ERR COUNT	The 8903/RS has received a character with either a framing error or parity error. - Check all nodes have the same baud rate. - Check all nodes have the same parity. - Noise could be corrupting the data.
DATA EXD COUNT	The maximum data permitted in a Modbus request/response has been exceeded. - Maximum number of Modbus read registers is 125. - Maximum number of Modbus write registers is 123.
RX ABORT COUNT	Excessive delay between characters has been detected whilst the 8903/RS option was receiving a frame (see section **Modbus RTU: Inter-Frame Delay and Inter-Character Delay**). In this case the received frame is ignored.

32
Disposal

This product contains materials which are consignable waste under the Special Waste Regulations 1996 which complies with the EC Hazardous Waste Directive - Directive 91/689/EEC.

We recommend you dispose of the appropriate materials in accordance with the valid environmental control laws. The following table shows which materials can be recycled and which have to be disposed of in a special way.

Material	Recycle	Disposal
metal	yes	no
plastics material	yes	no
printed circuit board	no	yes

The printed circuit board should be disposed of in one of two ways:

1. High temperature incineration (minimum temperature 1200°C) by an incinerator authorised under parts A or B of the Environmental Protection Act
2. Disposal in an engineered land fill site that is licensed to take aluminium electrolytic capacitors. Do not dispose of in a land fill site set aside for domestic waste.

Packaging

During transport our products are protected by suitable packaging. This is entirely environmentally compatible and should be taken for central disposal as secondary raw material.