USER MANUAL

Teleterm
M3 Series RTU's
Models C2362A and C2363A
User Manual

REMOTE MONITORING SPECIALISTS

SCOPE

Products Covered by this Manual

This User Manual provides information on how to install, configure and use the C2362A and C2363A Series of Teleterm M3 RTU's.

This manual covers the following product Models:

Model	Description
Models without Ethernet Port	
C2362A-0-0	Teleterm M3 Series RTU's
C2362A-0-1	Teleterm M3 Series RTU's with ISaGRAF
C2362A-11-0	Teleterm M3 Series RTU's with GSM port
C2362A-11-1	Teleterm M3 Series RTU's with GSM port and ISaGRAF
C2362A-12-0	Teleterm M3 Series RTU's with GSM port
C2362A-12-1	Teleterm M3 Series RTU's with GSM port and ISaGRAF
C2362A-21-0	Teleterm M3 Series RTU's with Conet/c port
C2362A-21-1	Teleterm M3 Series RTU's with Conet/c port and ISaGRAF
C2362A-31-0	Teleterm M3 Series RTU's with 2.4GHz Radio port
C2362A-31-1	Teleterm M3 Series RTU's with 2.4GHz Radio port and ISaGRAF
C2362A-33-0	Teleterm M3 Series RTU's with 868MHz Radio port
C2362A-33-1	Teleterm M3 Series RTU's with 868MHz Radio port and ISaGRAF
C2362A-34-0	Teleterm M3 Series RTU's with 900M 1W Radio port
C2362A-34-1	Teleterm M3 Series RTU's with 900M 1W Radio port and ISaGRAF
C2362A-41-0	Teleterm M3 Series RTU's with RS232 Serial port
C2362A-41-1	Teleterm M3 Series RTU's with RS232 Serial port and ISaGRAF
Models with Ethernet Port	
C2363A-0-0	Teleterm M3 Series RTU's
C2363A-0-1	Teleterm M3 Series RTU's with ISaGRAF
C2363A-11-0	Teleterm M3 Series RTU's with GSM port
C2363A-11-1	Teleterm M3 Series RTU's with GSM port and ISaGRAF
C2363A-12-0	Teleterm M3 Series RTU's with GSM port
C2363A-12-1	Teleterm M3 Series RTU's with GSM port and ISaGRAF
C2363A-21-0	Teleterm M3 Series RTU's with Conet/c port
C2363A-21-1	Teleterm M3 Series RTU's with Conet/c port and ISaGRAF
C2363A-31-0	Teleterm M3 Series RTU's with 2.4GHz Radio port
C2363A-31-1	Teleterm M3 Series RTU's with 2.4GHz Radio port and ISaGRAF
C2363A-33-0	Teleterm M3 Series RTU's with 868MHz Radio port
C2363A-33-1	Teleterm M3 Series RTU's with 868MHz Radio port and ISaGRAF
C2363A-34-0	Teleterm M3 Series RTU's with 900M 1W Radio port
C2363A-34-1	Teleterm M3 Series RTU's with 900M 1W Radio port and ISaGRAF
C2363A-41-0	Teleterm M3 Series RTU's with RS232 Serial port
C2363A-41-1	Teleterm M3 Series RTU's with RS232 Serial port and ISaGRAF

Manual Revision History

Date	Revision	Comments
March 2014	1	Initial Issue
March 2014	2	Included C2362A-12, C2363A-12 and C2362A-41, C2363A-41 and adjustments for conformity across user manuals and various corrections and naming fixes.
February 2018	3	Corrected the title

Software Copy Available

This manual is available in Adobe Acrobat pdf format from the Omniflex website (www.omniflex.com).

The pdf file is named UMC236xAR03.pdf

Table of Contents

Table of Figures

Table of Tables

1. GENERAL DESCRIPTION

1.1 Overview

The C2362A and C2363A range of TELETERM M3 RTU's is designed specifically for industrial telemetry and remote I/O applications, combining powerful industrial network communications features with ease of use.

1.1.1 Communications

The TELETERM M3 Series RTU is available with a wide range of communications network options to enable communication with a broad selection of devices and machines.

All I/O and configuration data variables are automatically accessible through Data Interchange Registers in a single "Data Interchange Table", allowing the implementation of Remote I/O systems "out of the box".

1.1.2 Programmable

Conventional remote I/O systems can be implemented without the need for any software programming, but the inclusion of separate programming facilities within the M3 provides a powerful customisation capability.

The M3 Series can be supplied with the powerful and versatile ISaGRAF IEC61131 standard graphical programming environment. This allows PLC functionality to be easily added to the RTU by the user.

1.1.3 Memory Card

The SD Card Slot provides the ability to store readings on a removable SD Card for remote logging applications. The data written to the SD Card is under control of the User Program, allowing flexibility of file structure and contents.

1.1.4 Versatile Configurable Inputs and Outputs

A Teleterm M3 Series RTU provides the ideal low cost remote interface to your assets or processes to provide the control and information that you need to optimise your operations.

The M3 RTU's are all equipped with 12 direct Binary and Analogue Inputs and Outputs. Each I/O can be uniquely configured as an input or output; analogue or digital.

1.1.5 Built-in Serial Ports

An RS232/485 serial port and an RS232 port on an RJ11 socket support a number of protocols including Modbus and Conet/s allowing signals from a variety of sources to be monitored and controlled via the M3 RTU communications network of choice.

As a basic I/O outstation, the M3 RTU's are easily configurable using the free Omniset configuration software. Using Omniset PRO, the M3 Series can also be configured remotely over the installed network.

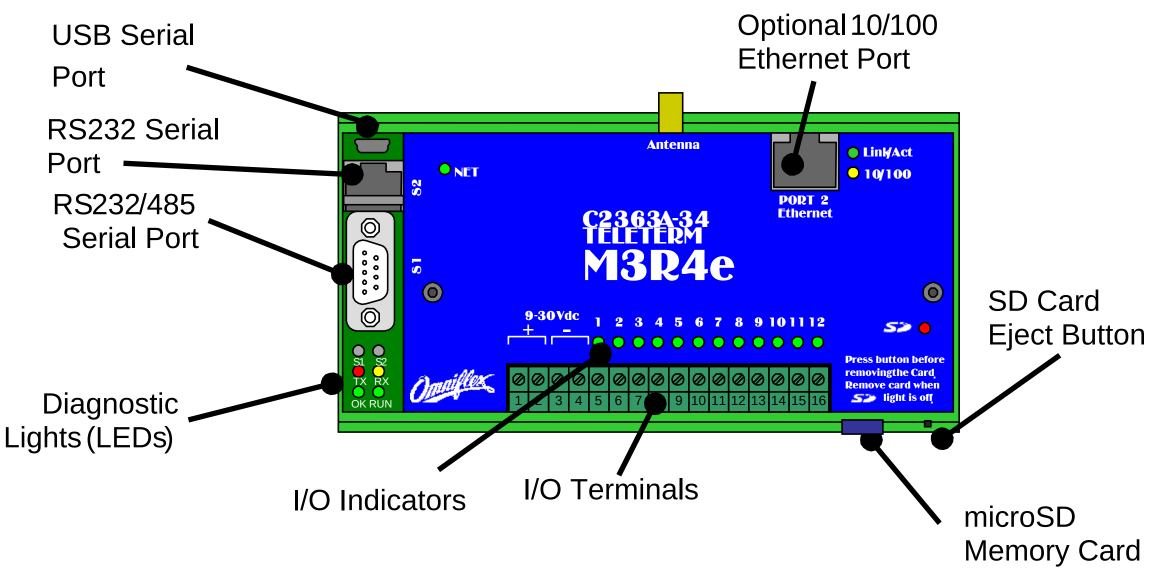


Figure 1.1: Front View of the Teleterm C2363A-34 M3Re with internal Radio modem – one of the products in the Teleterm M3 Range.

1.2 Product Feature Matrix

The following table identifies the features available on each of the products in the range:

Table 1-1: Product Feature Matrix.

Product Name	Order Code	Notes	12 I/O	USB Mini-B Port	RS232 Port	RS232/ RS485 Port	10/100 Ether-net	EGSM/ GPRS Port	3G UMTS Port	ISa-GRAF	Conet Port	2.4GHz FSHH Radio Port	868MHz FSHH Radio Port	900/ 920MHz FSHH Radio Port	+1 RS232/ 485 Port
M3	C2362A-0-0		✓	✓	✓	✓									
M3	C2362A-0-1		✓	✓	✓	✓				✓					
M3e	C2363A-0-0		✓	✓	✓	✓	✓								
M3e	C2363A-0-1		✓	✓	✓	✓	✓			✓					
M3G	C2362A-11-0	1, 2	✓	✓	✓	✓		✓							
M3G	C2362A-11-1	1, 2	✓	✓	✓	✓		✓		✓					
M3Ge	C2363A-11-0	1, 2	✓	✓	✓	✓	✓	✓							
M3Ge	C2363A-11-1	1, 2	✓	✓	✓	✓	✓	✓		✓					
M3G	C2362A-12-0	1, 2, 3	✓	✓	✓	✓		✓	✓						
M3G	C2362A-12-1	1, 2, 3	✓	✓	✓	✓		✓	✓	✓					
M3Ge	C2363A-12-0	1, 2, 3	✓	✓	✓	✓	✓	✓	✓						
M3Ge	C2363A-12-1	1, 2, 3	✓	✓	✓	✓	✓	✓	✓	✓					
M3C	C2362A-21-0		✓	✓	✓	✓					✓				
M3C	C2362A-21-1		✓	✓	✓	✓				✓	✓				
M3Ce	C2363A-21-0		✓	✓	✓	✓	✓				✓				
M3Ce	C2363A-21-1		✓	✓	✓	✓	✓			✓	✓				
M3R1	C2362A-31-0	4, 5	✓	✓	✓	✓						✓			
M3R1	C2362A-31-1	4, 5	✓	✓	✓	✓				✓		✓			
M3R1e	C2363A-31-0	4, 5	✓	✓	✓	✓	✓					✓			
M3R1e	C2363A-31-1	4, 5	✓	✓	✓	✓	✓			✓		✓			
M3R3	C2362A-33-0	4	✓	✓	✓	✓							✓		
M3R3	C2362A-33-1	4	✓	✓	✓	✓				✓			✓		
M3R3e	C2363A-33-0	4	✓	✓	✓	✓	✓						✓		
M3R3e	C2363A-33-1	4	✓	✓	✓	✓	✓			✓			✓		
M3R4	C2362A-34-0	4, 6, 7	✓	✓	✓	✓								✓	
M3R4	C2362A-34-1	4, 6, 7	✓	✓	✓	✓				✓				✓	
M3R4e	C2363A-34-0	4, 6, 7	✓	✓	✓	✓	✓							✓	
M3R4e	C2363A-34-1	4, 6, 7	✓	✓	✓	✓	✓			✓				✓	
M3S	C2362A-41-0		✓	✓	✓	✓									✓

Product Name	Order Code	Notes	12 I/O	USB Mini-B Port	RS232 Port	RS232/ RS485 Port	10/100 Ether-net	EGSM/ GPRS Port	3G UMTS Port	ISa-GRAF	Conet Port	2.4GHz FSHH Radio Port	868MHz FSHH Radio Port	900/ 920MHz FSHH Radio Port	+1 RS232/ 485 Port
M3S	C2362A-41-1		✓	✓	✓	✓				✓					✓
M3Se	C2363A-41		✓	✓	✓	✓	✓								✓
M3Se	C2363A-41-1		✓	✓	✓	✓	✓			✓					✓

NOTES:

1. *The M3G version is available in a number of options to conform to different GSM based networks. Please ensure that the correct unit is specified for your application.*
2. *The EGSM/GPRS port is a quad band device operating on 900/1800/850/1900MHz. This is suitable for use on most countries' GSM networks. Consult the factory for specific compatibility with your network.*
3. *The 3G UMTS port is a tri band device operating on 850/1900/2100MHz. This interface is specifically approved for use on the Australian Telstra NextG network.*
4. *The M3R version is available in a number radio band options to comply with different country regulations. Please ensure that the correct unit is specified for your application.*
5. *2.4GHz Band is suitable for use in all countries.*
6. *920MHz Band is suitable for use in Australia and New Zealand only.*
7. *900MHz Band is suitable for use in USA, Canada and other related FCC regulated areas.*

1.3 Feature Descriptions

1.3.1 I/O Terminals

The Teleterm M3 is equipped with 12 software configurable input/output points (IO points). Each IO point can be individually configured as digital or analogue, input or output selected from the options given in the following table:

Table 1-2: I/O Configuration Options.

I/O Point	Terminal No.	Digital Input	Analogue Input	Digital Output	Analogue Output
1	5	Yes	0-30Vdc	Yes	-
2	6	Yes	0-30Vdc	Yes	-
3	7	Yes	0-5Vdc	Yes	-
4	8	Yes	0-5Vdc	Yes	-
5	9	Yes	0-5Vdc	Yes	-
6	10	Yes	0-5Vdc	Yes	-
7	11	Yes	0-5Vdc	Yes	-
8	12	Yes	0-5Vdc	Yes	-
9	13	Yes	0-5Vdc	Yes	-
10	14	Yes	0-5Vdc	Yes	-
11	15	Yes	0-30Vdc	-	0/4-20mA
12	16	Yes	0-30Vdc	-	0/4-20mA

(See the specifications section for electrical specifications of each IO point option)

1.3.2 USB Port

The USB port is used for programming the M3.

1.3.3 RS232/RS485 Serial Port – S1

The Teleterm M3 RTU is equipped with a user serial port, labelled S1, on the front of the unit. This serial port can be used as a communications port to third party equipment.

This serial port can be wired for RS232 or RS485 communications.

In normal mode, the serial port can be configured for a number of protocol sets:

a) Modbus protocol (Master or Slave device, ASCII or RTU protocol) is available on this port allowing easy connection to other third party products such as Alarm Annunciators, PLC's DCS or SCADA systems.

b) Conet/s protocol is available for integration into Conet networks.

1.3.4 RS232 Serial Port (RJ11 socket) – S2

This port is a secondary serial port allowing increased network capacity and connectivity. It is typically reserved for connections to human machine interface devices. Note that this is not a complete 9-wire RS232 port. The serial port settings can be changed to suit the application.

1.3.5 Ethernet Port

A 10/100 Ethernet port is available on all C2363A models of the Teleterm M3. This port supports the following protocols:

a) Modbus/TCP protocol (Master or Slave) is available on this port allowing easy connection to other third party products such as Alarm Annunciators, PLC's DCS or SCADA systems.

b) Conet/e protocol is available for integration into Conet networks and for remote programming the Teleterm M3.

1.3.6 Network Port

Each M3 RTU in the series can be equipped with additional networking ports. The type of network port is dependent upon the Model of M3 RTU. The following table gives an overview of the available network port options and their applications:

Table 1-3: Network Selection and Applications.

Product	Order Code	Network Port	Description
M3	C2362A-0 C2363A-0	None	The standard Teleterm M3 is equipped with the USB programming port, an RJ11 socket serial port and an RS232/485 serial port
M3G	C2362A-11 C2363A-11 C2362A-12 C2363A-12	GSM	The M3G is equipped with an internal GSM modem capable of communicating over standard GSM mobile phone networks using dial-up, SMS or GPRS data services. The M3G is ideally suited for communicating with remote assets over very large distances (even different countries). The -11 option unit is compatible with all GSM networks worldwide. The -12 option unit is compatible with the Telstra NextG network in Australia.
M3C	C2362A-21 C2363A-21	Conet	The M3C is equipped with a Conet network port. Conet is the world's most rugged Industrial LAN, capable of running over existing plant cabling up to 10 kilometres. Up to 126 nodes may be connected to a Conet network in a token passing peer-to-peer architecture. The M3C is ideally suited for local in-plant communications where the cost of laying special networking cable is considered uneconomical for the application, but where existing cabling (of any sort) is already in place.
M3R	C2362A-31 C2363A-31 C2362A-33 C2363A-33 C2362A-34 C2363A-34	Radio	The M3R is equipped with an internal digital radio transceiver operating in the licence free radio bands. The C2362A-33, C2363A-33 and C2362A-34, C2363A-34 models are capable of Frequency Hopping Spread Spectrum (FHSS), an advanced technique for implementing secure error-free radio communications in the presence of high interference. The M3R is ideally suited for communications in areas where cable connections are impossible, and distances are relatively short (between 0.5km and 10km dependent upon the model and antenna selected) (See the selection guide for choosing the model appropriate for your country of use.) The all M3R models have legacy support to allow compatibility with older M2R models. This option may be found in the port setup.

M3S	C2362A-41 C2363A-41	RS232 + RS232 /485	The M3S is equipped with an additional serial port. Port S3 is an RS232 port with full hand-shaking capabilities suitable for interfacing to external modems, or to any other equipment capable of supporting a RS232 connection. The M3S is ideally suited for interfacing to external modems or to other third party equipment using the RS232/RS485 standard.

2. Installing the Teleterm M3 RTU

2.1 Mounting the Teleterm M3

The Teleterm M3 is designed to be clipped to one of the following mounting rails:

Top Hat Section (DIN) Rail 35/7.5mm in accordance with EN 60715: 1981
Top Hat Section (DIN) Rail 35/15mm in accordance with EN 60715: 1981
G Section Rail 32mm in accordance with EN 60715: 1981

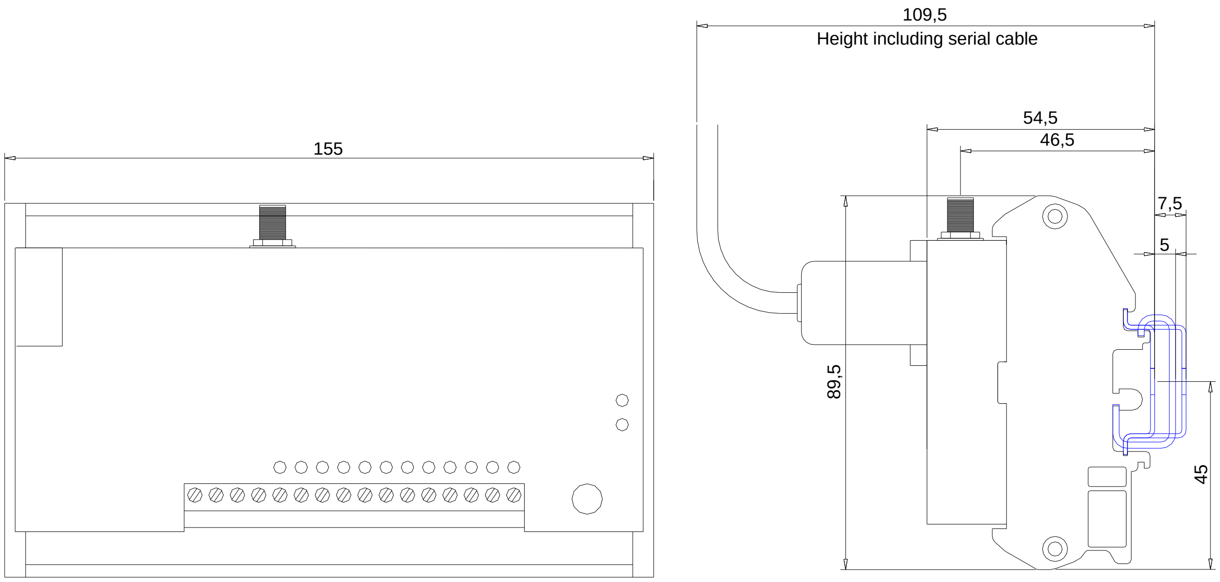


Figure 2.1: Mechanical Mounting Dimensions for the Teleterm M3.

2.2 Connecting direct Inputs and Outputs

The Teleterm M3 has a unique feature of allowing each I/O point to be software configured as analogue or digital, input or output, for the best possible utilisation of I/O in any application.

Review your I/O requirements, and then make the optimum allocation of the I/O, taking into account the variations in specification of each I/O Point.

See **Error! Reference source not found.**.

2.2.1 Connecting Digital Inputs

Digital Inputs must be connected in accordance with the following schematic:

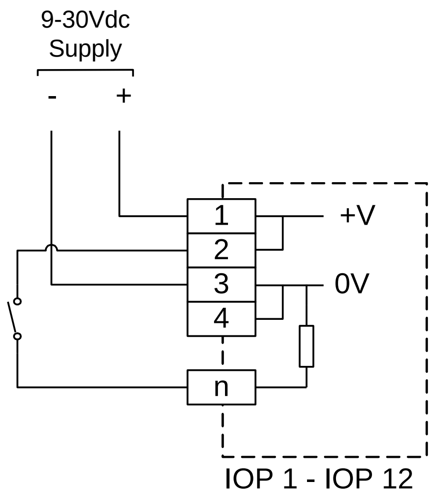


Figure 2.2: Digital Input Connections.

Table 2-1: Digital Input Specifications.

Parameter	Condition	Value
LED Indication	Input On	Green LED On
Absolute Maximum Input Voltage		30Vdc
Minimum High Level Input Voltage		3Vdc
Maximum Low Level Input Voltage		2Vdc
Input Current	Vin = 5V	0.7mA
Input Current	Vin = 10V	1.7mA
Input Current	Vin = 12V	2.2mA
Input Current	Vin = 24V	4.7mA
Input Current	Vin = 30V	6.0mA

2.2.2 Connecting Digital Outputs

Digital Outputs must be connected in accordance with the following schematic:

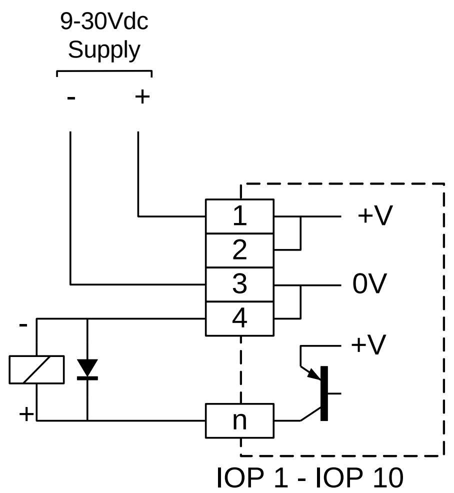


Figure 2.3: Digital Output Connections.

Table 2-2: Digital Output Specifications.

Parameter	Condition	Value
LED Indication	Output On	Green LED On
Maximum Continuous Output Current	Output On	50mA
Maximum Peak Output Current	10ms max	200mA
Maximum current for ALL Digital Outputs	Outputs ON	500mA
Minimum High Level Output Voltage		$+V_{PSU}$ – 2.5V

2.2.3 Connecting Analogue Inputs

Analogue Inputs must be connected in accordance with the following schematic:

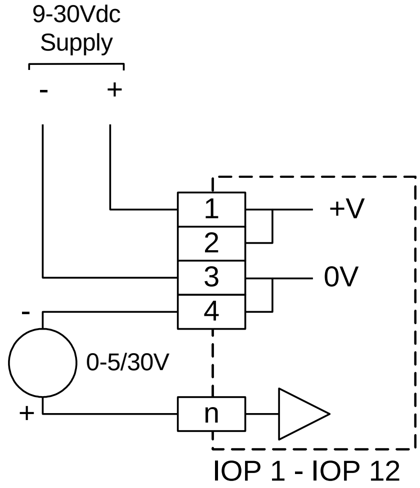


Figure 2.4: Analogue Input Connections.

Table 2-3: Analogue Input Specifications - I/O Points 1-2, 11 and 12.

Parameter	Value
LED Indication	None
Absolute Maximum Input Voltage	30Vdc
Input Impedance Minimum	>500kΩ
Minimum Measurable Input Voltage	0V
Maximum measurable Input Voltage	30V
Resolution over 0-5.5V	6mV
Resolution over 5.5-30V	30mV
Accuracy over 0-5.5V	0.15% of reading + 6mV
Accuracy over 5.5-30V	0.15% of reading + 30mV

Table 2-4: Analogue Input Specifications - I/O Points 3 to 10.

Parameter	**Value**
LED Indication	None
Absolute Maximum Input Voltage	30Vdc
Input Impedance Minimum	>1MΩ
Minimum Measurable Input Voltage	0V
Maximum measurable Input Voltage	5.5V
Resolution	6mV (10 bits)
Accuracy	0.15% of reading + 6mV

2.2.4 Connecting Analogue Outputs

Analogue Outputs must be connected in accordance with the following schematic:

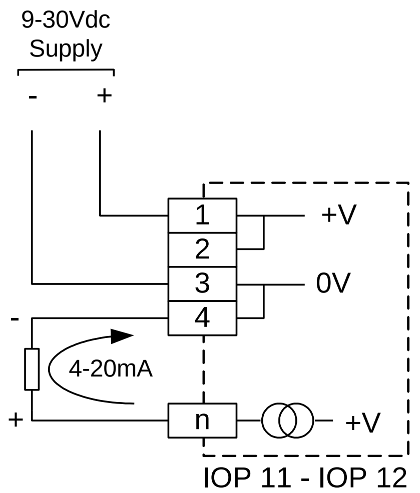


Figure 2.5: Analogue Output Connections.

Table 2-5: Analogue Output Specifications.

Parameter	**Value**
LED Indication	None
Maximum Output Voltage Drive	$+V_{PSU}$ – 5.0V
Minimum Controllable Output Current	0mA maximum
Maximum Controllable Output Current	23mA minimum
Output Resolution	25µA
Output Accuracy	0.1% of reading + 25µA

2.3 Connecting the USB Port

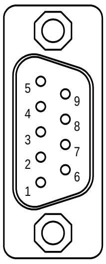
The USB port can is used for programming the M3. Please check out the knowledge base on our website, www.omniflex.com, for trouble shooting tips for USB programming.

When connecting the USB port to a standard PC compatible USB port, the Omniflex USB-A to USB Mini-B cable, Part Number M1838A can be used. Alternatively, a standard USB-A to USB Mini-B cable may be used.

2.4 Connecting Serial Port S1

This serial port is capable of RS232, RS422 or RS485 communications (two-wire or four-wire). The selection of either RS232 or RS422/RS485 is achieved by specific wiring of the serial port connector. No other settings need be changed to select between RS232 and RS422/485.

Table 2-6: Pin allocation of Port 1 serial port connector on Teleterm M3.

	Pin number	Communication Standard	
		RS232	**RS485**
	1	Do not connect	Rx Data + (In)
	2	Rx Data (In)	Rx Data – (In)
	3	Tx Data (Out)	Do not connect
	4	Do not connect	Tx Data+ (Out)
	5	Ground	Ground
	6	Do not connect	Vcc
	7	RTS (Out)	Do not connect
	8	CTS (In)	Do not connect
	9	Do not connect	Tx Data – (Out)

NOTE: The RTS and CTS handshaking lines are available for applications that require them. It is not a requirement of the CPU to use handshaking. In most applications connecting the RTS and CTS handshaking lines is not necessary.

2.5 Connecting Serial Port S2

The RJ11 socket serial port is normally reserved for HMI's, but can be used as an additional RS232 serial port if desired.

When connecting the port S2 to a standard PC compatible serial port (DB9), the Omniflex programming cable Part Number M1831A (supplied separately) can be used.

If another cable is to be used, the following connections will apply:

Table 2-7: Pin allocation of connectors on M1831A programming cable.

Signal Name	DB9F Pin No.	FCC-68 Pin No.
Rx Data from M3	2	4
Tx Data to M3	3	1
Ground Reference	5	2
All other pins are reserved and must not be connected.		

2.6 Connecting the optional Ethernet Port (Models C2363A-xx-x only)

The C2363A models provide a standard Untwisted Pair Ethernet interface utilising a RJ45 connector suitable for direct connection to a 10/100 Ethernet system.

This port must be configured with a fixed IP address suitable for use on your Ethernet network.

Consult your network administrator/consultant for further details of the Ethernet connectivity and setup before powering up the Teleterm M3 on to your Ethernet network.

2.7 Connecting Network Ports

2.7.1 Teleterm M3G (Models C2362A-11, C2363A-11, C2362A-12, C2363A-12) with internal GSM/3G modem

2.7.1.1. Inserting the Network SIM Card

The Teleterm M3G requires a SIM card (not supplied) to enable the unit to operate on the selected GSM mobile phone network.

To insert the SIM card:

1. Remove the top cover of the Teleterm M3 by undoing the two hex screws holding the top cover of the unit, using a 2.5mm hex key (supplied). The cover is connected to the unit by the internal antenna cable, so be careful not to place any strain on this cable while removing the cover or inserting the SIM card.

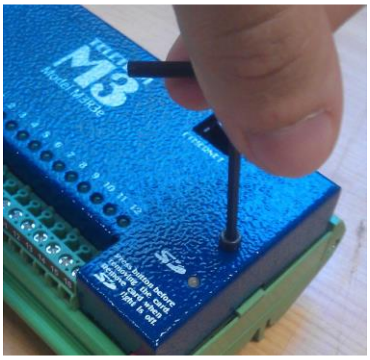


Figure 2.6: Removal of the top cover of the M3.

2. Insert the SIM card into the SIM card holder you will see in the centre of the unit. Take special care that the SIM card is correctly seated in the connector, and that the SIM card holder is properly closed. Press firmly down and slide forward to close securely.

Figure 2.7: SIM card placement in an M3G.

3. Replace the top cover.

2.7.1.2. Connecting the Antenna

The supplied Antenna's cable should be screwed into the Antenna socket. Do not over tighten. This connector should be only finger tight to avoid damage.

2.7.1.3. Positioning the Antenna

The antenna should be placed away from the Teleterm M3G in a position that gives the best possibility of a good signal on the mobile phone network. Avoid proximity of the antenna to shielding materials such as metal enclosures.

The signal strength of the chosen location can be easily checked by holding a mobile phone (connected to the same network) in the intended position of the antenna, and checking that the signal strength on the phone is good.

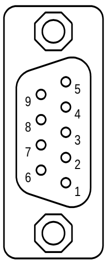
CAUTION: The antenna emits RF energy on a continuous basis, and should be positioned away from sensitive instrumentation, and away from areas where close proximity to personnel on a regular basis would occur. A separation distance in excess of 30cm is recommended.

2.7.2 Teleterm M3C (Models C2362A-21, C2363A-21) with Conet network port

It is recommended that the Teleterm M3C be connected to the Conet network using the C6169 Conet Termination Board and interconnecting cable. This ensures the integrity of the Conet network during maintenance of the RTU, and provides additional surge suppression and protection to the Teleterm M3C.

See the C6169 Datasheet with application notes for full Conet installation details.

Table 2-8: Pin allocation of Conet port connector on the Teleterm M3C.

	Pin number	Description
	2	Signal +
	5	Cable screen (S)
	8	Signal -
	1, 3, 4, 6, 7 and 9	No connection

2.7.3 Teleterm M3R (Models C2362A-31, C2363A-31, C2362A-32, C2363A-33, C2362A-34, C2363A-34) with Radio Network Port

2.7.3.1. Connecting the Antenna

The M3R RTU is equipped with an RPSMA antenna connector found on the top edge of Teleterm M3R RTU.

The appropriate antenna suitable for the application must be selected and purchased separately.

Screw the antenna's cable into the Antenna socket. Do not over tighten. This connector should be only finger tight to avoid damage.

2.7.3.2. Positioning the Antenna

The antenna should be placed away from the Teleterm M3R in a position that gives the best possibility of good reception. Avoid proximity of the antenna to shielding materials such as metal enclosures.

The signal strength of the chosen location can be easily checked by using the Omniset configuration software.

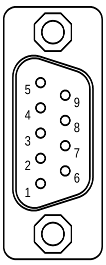
CAUTION: The antenna emits RF energy on a continuous basis, and should be positioned away from sensitive instrumentation, and away from areas where close proximity to personnel on a regular basis would occur.

2.7.4 Teleterm M3S (Models C2362A-41, C2363A-41) with an additional Serial Port

The M3S is equipped with an additional serial port called port S3.

Port 3 is RS232 only with full handshaking suitable for driving a modem or other external serial device.

Table 2-9: Pin allocation of Port 3 serial port connector on Teleterm M3S.

	Pin number	In/Out	Name	Description
	1	I	CD	Carrier Detect
	2	I	RD	Received Data
	3	O	TD	Transmitted Data
	4	O	DTR	Data Terminal Ready
	5	-	SG	Signal Ground
	6	I	DSR	Data Set Ready
	7	O	RTS	Request To Send
	8	I	CTS	Clear To Send
	9	I	RI	Ring Indicator

NOTE: This port is not isolated, and the Signal Ground is connected internally to the M3S Power Supply 0 Volt connection.

2.8 Powering up the Teleterm M3

Upon power up, the Teleterm M3 will take approximately a few seconds to initialise the system and connect to the network. The front panel LED’s will all light for a short period before switching to their operational state at which point the green OK LED will stay steady on. In the case where a User Program is loaded and running on the unit, then the green RUN LED will also turn on steady.

3. Configuring the Teleterm M3

3.1 Overview

The Teleterm M3 Series is configured using the ‘Omniset’ software utility version 7.3 or above.

Omniset is a Windows98/NT/2000/XP/7 compatible software package designed to configure a wide range of Omniflex products, including the Teleterm M3.

Omniset is available in two versions, standard and professional.

The standard Omniset software is on the CD supplied with the Teleterm M3 RTU. Omniset may also be downloaded for free in the Downloads section of the Omniflex web site www.omniflex.com .

The ISaGRAF Workbench software is used for more advanced programming of the Teleterm M3.

3.2 Incompatibility with Previous Versions of Omniset

It is recommended that you upgrade to the latest version of Omniset.

3.2.1 Versions of Omniset prior to 7.3

The Teleterm M3 is only compatible with Omniset or Omniset PRO Version 7.3 onwards. If you have a previous version of Omniset installed on your computer, then you need to upgrade to the latest version. It is recommended that you upgrade from version 7.3 anyway.

You can check which version of Omniset you have installed by opening Omniset and then selecting the “Help>About…” menu item.

3.3 Installing Omniset from the CD supplied

Omniset is Windows98/NT/2000/XP/7 compatible, and requires access to an RS232 port on your Windows computer.

If your computer does not have a serial port available for use with Omniset, then inexpensive USB-to-Serial Converter modules are readily available that can be used with Omniset, or the USB port may be used with a USB cable.

To install Omniset from the CD supplied, follow these steps:

1. Insert the CD into the CD drive of your computer. The Omniset installation should start automatically. If it does not, then, using Windows Explorer, navigate on the CD drive to the ‘Omniset’ directory and double click the file ‘setup.exe’.
2. Follow the prompts on the screen to complete the installation.
3. Select the COM port that you wish to use with Omniset by selecting ‘COM Port’ on the Data menu.
4. Omniset uses “templates” to customise its appearance to suit the product being configured. Omniset is supplied with a complete library of templates for all Omniflex products, including the Teleterm M3. This library is frequently being updated with new products and enhancements. If your computer is connected to the Internet, you can easily check for and download the latest template library by selecting “Update

Template Library from Web…" on the Omniset File menu. Follow the prompts to update your template library to the latest version. If you installed Omniset from the CD supplied with your Teleterm M3, and you do not have access to the Internet then do not worry. You will already have the template necessary to configure the Teleterm M3 (although it may not be the latest version available).

3.4 Connecting Omniset to the Teleterm M3 for first time

The first time you use an Omniflex USB-enabled device you will have to setup your computer to use USB. This is a once off procedure. Follow the steps corresponding to the version of Windows your computer is running. For further information, please access the knowledge base on our website (www.omniflex.com) and read the articles on connecting with USB.

3.4.1 Setting up Windows XP

If you are a Microsoft Windows XP user, follow these steps. Start with your computer on and your Teleterm M3 off.

1. With the USB disconnected, apply power to the Teleterm M3. Insert the CD you received with your Omniflex product into the computer.
2. Open Windows Explorer and navigate to the CD drive.
3. Open the USB driver directory.
4. If you are using Windows XP 32-bit, run the file ending in Setup.exe.
5. If you are using Windows XP 64-bit, run the file ending in Setup_x64.exe.
6. If you are unsure which one you are using, click the start menu, right-click My Computer and select Properties. This window will show you what version your computer is using.
7. Follow the installer instructions.
8. Once the installation is complete, connect the USB cable to the Teleterm M3 and to your computer.
9. Open the Device Manager:
    - Open the Start menu.
    - Under Settings, select the Control Panel.
    - Click on Performance and Maintenance. (If you do not see this option, skip to the next step.)
    - Select the System icon.
    - In the Systems Properties window, click on the Hardware tab.
    - Click the Device Manager button.
10. In the Device Manager under "Ports (COM & LPT)", there will be a COM port called "STMicroelectronics Virtual COM Port". Make note of the number of the COM port.
11. If the virtual COM port number value is above 9 or the same as another COM port device, you will have to change the port number. If this is the case:
    - Double-click on the virtual COM port. This will open the properties window.
    - Go to the tab Port Settings.
    - Click Advanced.

- In the Advanced settings window, there is a drop down box in the bottom left displaying the COM port number. Change this to a COM port number below 10.

12. Make a note of the number of the virtual COM port. You will need to know this number when setting up Omniset to use the virtual COM port.
13. Power down the Teleterm M3.

You have successfully installed the USB driver. Reboot your computer to ensure the setting changes have taken effect.

3.4.2 Setting up Windows 7

If you are a Microsoft Windows 7 user, follow these steps. Start with your computer on and your Teleterm M3 off.

1. With the USB disconnected, apply power to the Teleterm M3. Insert the CD you received with your Omniflex product into the computer.
2. Connect the USB cable to the Omniflex product and to your computer.
3. In Windows 7 you will see a message above your system tray indicating that Windows is installing the device driver.
4. Wait a few minutes for the device to install. Once Windows indicates the driver was successfully installed continue to step 5. (If Windows indicates there was problem, see the section below, 3.4.3 Installing the Driver Manually, and then return to step 5.)
5. Open the Device Manager:
    - Open the Start menu.
    - Right-click Computer and select Properties.
    - In the left-hand window pane, click Device Manager.
6. In the Device Manager under "Ports (COM & LPT)", there will be a COM port called "STMicroelectronics Virtual COM Port". Make a note of the number of the COM port.
7. If the virtual COM port number value is above 9 or the same as another COM port device, you will have to change the port number:
    - If this is the case, double-click on the virtual COM port. This will open the properties window.
    - Go to the tab Port Settings.
    - Click Advanced.
    - In the Advanced settings window, there is a drop down box in the bottom left displaying the COM port number. Change this to a COM port number below 10.
8. Make a note of the number of the virtual COM port.
9. Power down the unit.

You have successfully installed the USB driver. Reboot your computer to ensure the setting changes have taken effect.

3.4.3 Installing the Driver Manually

If you experienced trouble with step 4 in Setting up Windows 7:

1. Disconnect the USB cable.

2. Open Windows explorer and navigate to the CD drive. (If you do not have this CD, please refer to the articles on connecting via USB in the knowledge base on our website (www.omniflex.com) and see the Downloading the Driver section.
3. Open the USB driver directory.
4. If you are using Windows 32-bit, run the file ending in Setup.exe.
5. If you are using Windows 64-bit, run the file ending in Setup_x64.exe.
6. If you are unsure which one you are using, click the start menu and right-click My Computer. This window will show you what version your computer is running.
7. Follow the installer instructions.
8. Once the installation is complete, connect the USB cable to the Omniflex product and to your computer.

Continue with step 4 in Setting up Windows 7.

3.4.4 Connecting in Omniset via USB

To connect to your USB enabled device using Omniset, start with Omniset closed. Prepare the hardware by doing the following:

1. With the USB cable disconnected, turn on the Omniflex unit.
2. Once the unit is on, connect the USB cable between the PC and the unit.
3. Wait a few seconds to ensure the unit has been detected.
4. Open Omniset.
5. Under the Options menu, select Port Settings…
6. Under Port Settings, change the number to the number of your virtual COM port.
7. Click OK.

Omniset has now been successfully set up to use the USB port. If you select Connect... under the File menu, Omniset will search for Omniflex devices connected via USB.

3.4.5 Connecting in Omniset Pro via USB

To connect to your USB enabled device using Omniset, start with Omniset closed. Prepare the hardware by doing the following:

1. With the USB cable disconnected, turn on the Omniflex unit.
2. Once the unit is on, connect the USB cable between the PC and the unit.
3. Wait a few seconds to ensure the unit has been detected.

Configuring Omniset

To add the virtual COM port to the Conet Server:

1. Open Omniset.
2. In the system tray, double-click the Conet Server (7.3) icon.
3. Under the Edit menu select "Change Hardware Settings".
4. Conet Server will ask you to confirm that you are logged in as administrator.
5. Click Yes to proceed.
6. In the Hardware Port Setup window, select the first drop down box that says None.
7. Select the COM port number of your virtual COM port.
8. Click OK.

To setup the port protocol in Conet Server, while the Conet server window is still open, do the following:

1. Under the Edit menu, select Add Port.
2. Enter the text "Conet/s on COM X" in the New Port Name box, where X is the number of your virtual COM Port.
3. From the drop down menu next to Hardware Port, select the COM port of your virtual COM port. Select OK.
4. Under Selected Port Settings, chose the following values:
    - **Protocol:** Conet/s
    - **Hardware Port:** COM X (Where X is the number of your Virtual COM port.)
    - **BaudRate:** 19200
    - **No Reply Time-Out (ms):** 2000
    - **Own ID:** 1
    - **Handshake Timeout:** 2000
5. Click OK.

Connecting with Omniset Pro

In Omniset, if you select Connect... under the File menu:

- Select the ‘Teleterm’ Product Group if prompted, and press OK:

- If the target is not found, select "Change Link" in the pop-up window:

- Under Port in the next window, choose Conet/s on COM X where X is the number of your virtual COM port and click OK.

If you have already opened an existing template, do the following to switch to the USB port:

- Under the Remote menu, select File Target Address...
- Select Conet/s on COM X where X is the number of your virtual COM port.
- Click OK.

If successfully connected, you should see the following screen in Omniset:

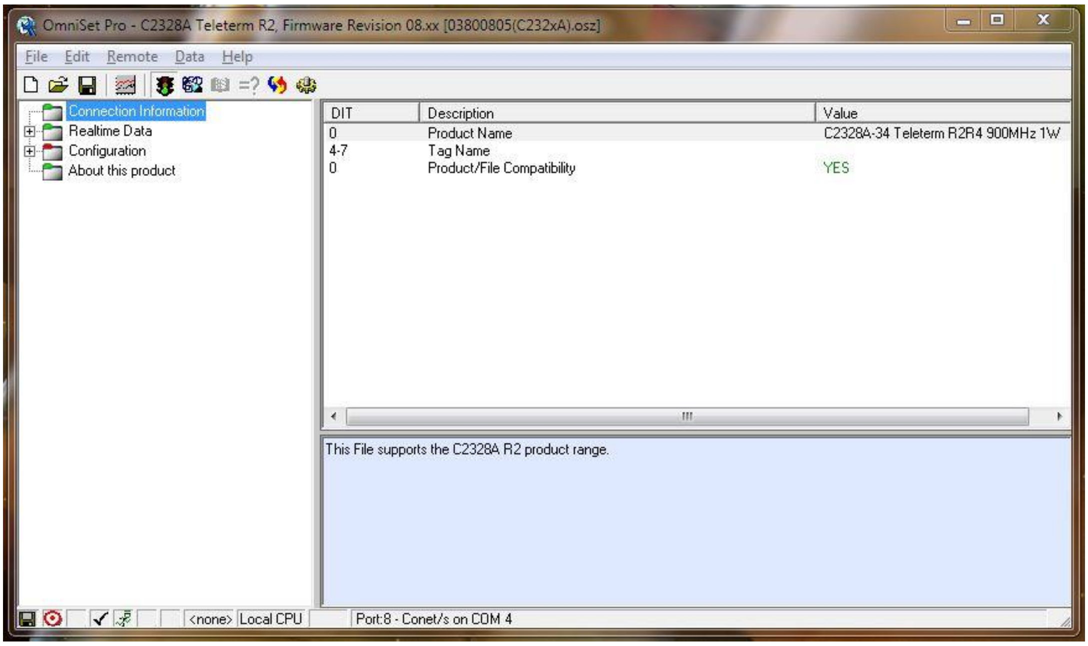


Figure 3.1: Omniset after successful connection.

Check that the Product Name is correct for the version of Teleterm M3 connected and that the Product/File Compatibility is 'Yes'. Note that the Product Name must match the product you are connected to and may be different to what is indicated above.

The simulate button must not be depressed. Make sure that the Sync button is depressed, and that the Sync mode icon is present in the Status bar at the bottom of the Omniset window. This indicates that Omniset is in Sync mode, and that the data visible in Omniset is synchronised with the Teleterm M3 connected. In this Sync mode, any changes that you make in Omniset will automatically be written to the Teleterm M3. If Sync mode is NOT enabled, then changes you make to the configuration will NOT be written automatically to the Teleterm M3. You can write these values manually to the Teleterm M3 by selecting "Write Current Group" or "Write All Groups" from the "Data" menu.

You are now ready to view or change any of the parameters in the Teleterm M3.

3.5 Overview of the Teleterm M3 Configuration Template

The pane on the left of the Omniset window shows a list of Groups of Items to be viewed or changed, arranged in Folders. Select a Group in the group pane on the left, to see the contents of the individual Items for that Group in the item pane on the right.

By selecting either a Group, or an Item, Help information will be displayed for that Group or Item in the Help pane below the Item pane at the bottom of the Omniset window.

See the Omniset Help for a more detailed description of the operation of Omniset.

There are two important Groups in the left group pane:

The Real-Time Data Group (green items) contains the current status of all data items in the Teleterm M3. Select one of the Real-Time Data Groups to see the current data in the Teleterm M3.

The Configuration Group (red items) contains all the Items that can be configured in a Teleterm M3.

The value of an Item in the right hand pane can be changed in a number of ways:

1. Double-click the Item or
2. Right Click the Item and select "New Value…" from the options provided.

Enter the new value in the dialogue box and then press Enter or the 'OK' button.

Once you have completed the configuration of your Teleterm M3, you should save your configuration to your hard drive, so you have a backup of the configuration.

Remember that if your Omniset is not synchronised to your target Teleterm M3 when you make any changes in Omniset, these changes will not be written to the Teleterm M3 until you press the "Write" or "Write All" button.

3.6 Quick Configuration

This procedure is recommended to check the Teleterm M3 operation for the first time. This provides the minimum amount of configuration necessary to achieve a simple functional test. This will give you a good starting point for further customisation to suit your specific application.

3.6.1 Set the Real-time Clock

The Real Time Clock Data Group shows the current date and time in the Teleterm M3, the time and date of the last power down, and the time and date of the last power up.

To set the real-time clock, write the current time and date to the relevant Data Items in this Data Group. The clock will run immediately from this new time when it is written to the Teleterm M3. To change a data item, double the Item, or right click and select "**New Value…**".

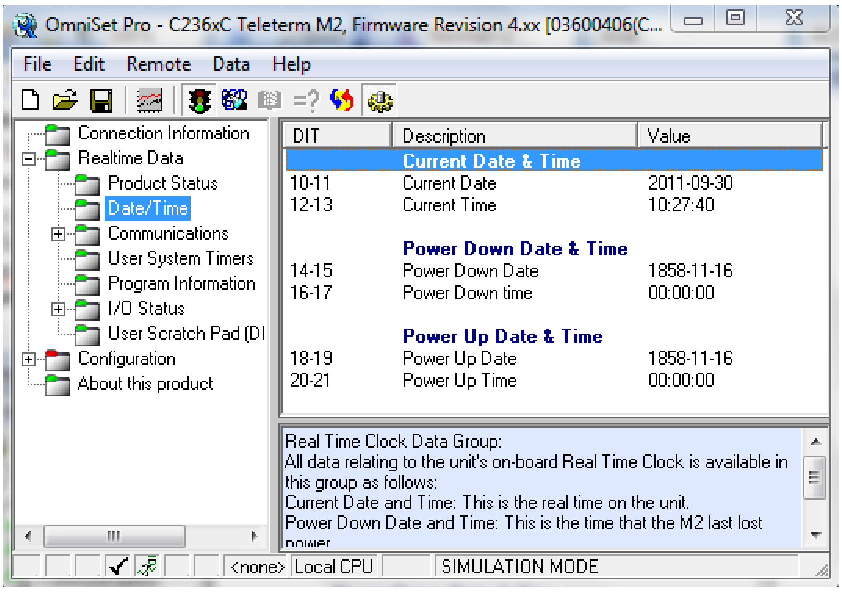


Figure 3.2: Changing the Date/Time settings in Omniset.

Note that it is not necessary to set the Power Down and Power Up times, these will be set automatically by the unit once the time has been set and power cycled to the unit.

3.6.2 Set the I/O Points to the type required

The default setting as shipped from the factory is with all I/O points set as disabled.

Each I/O Point can be set according to your requirements by selecting the I/O Points Group and then double-clicking each I/O Point in turn.

This group gives a summary of each Input setting.

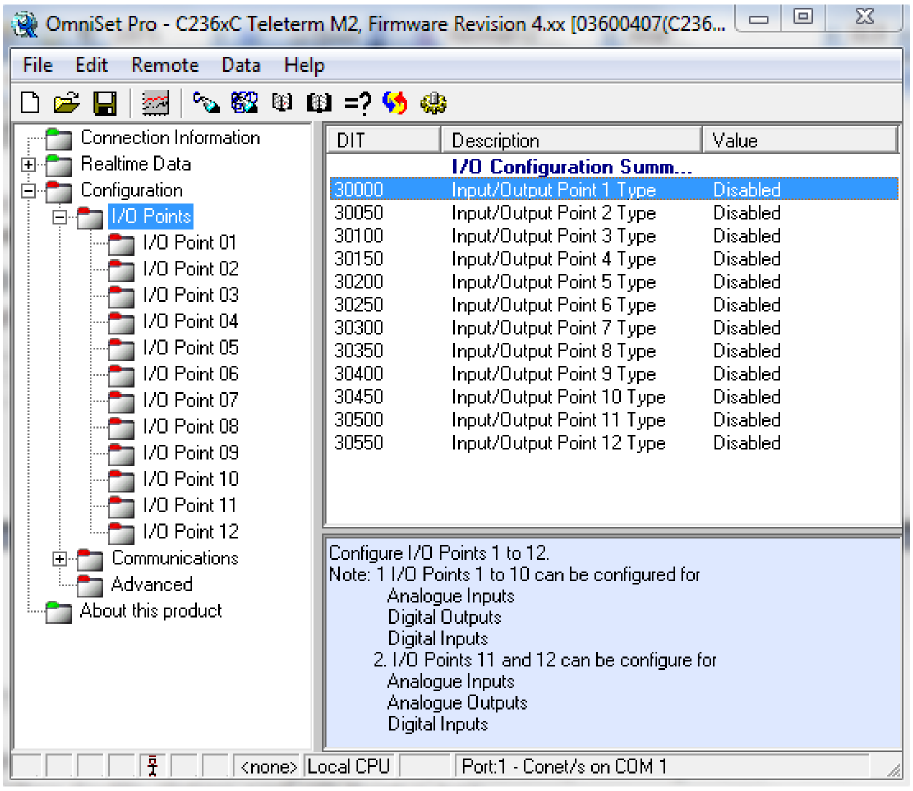


Figure 3.3: I/O Port settings on a template in Omniset.

For detailed configuration of each Input to suite your application, select the actual I/O Point in the left Group pane.

3.7 Configuring the Serial Port S1

The serial port (S1) on the Teleterm M3 comes equipped with four protocol options:

1. Modbus Master (ASCII and RTU)
2. Modbus Slave (ASCII and RTU)
3. Conet/s protocol.
4. User Protocol (Requires an installed user program to access the serial port)

The required protocol including any address selection is made in the Configuration>Communications>Port Setup" Group.

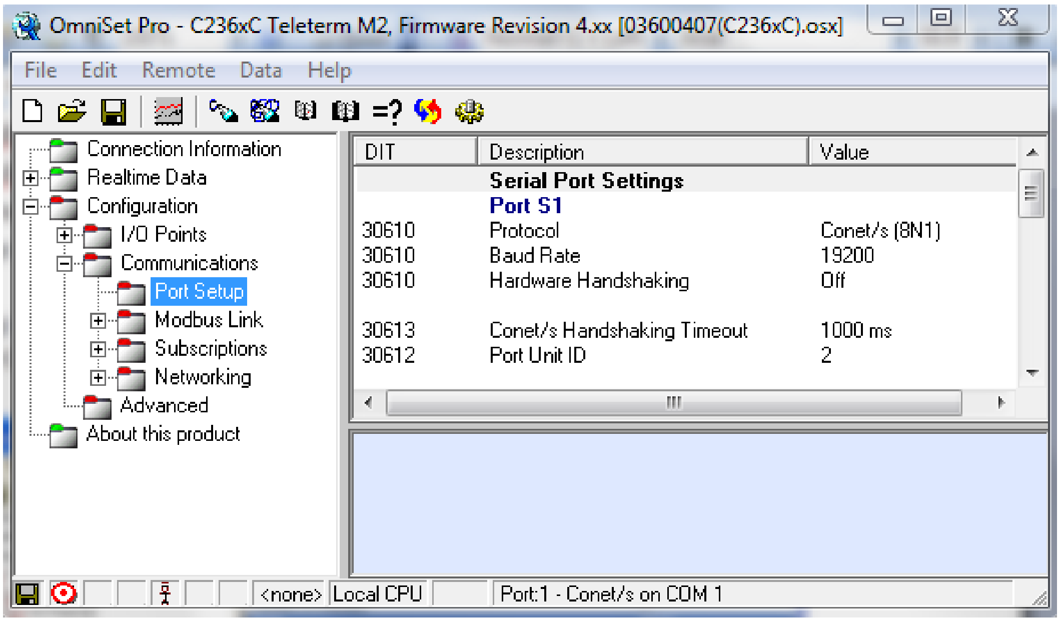


Figure 3.4: Serial Port Settings in Omniset.

3.8 Configuring the Conet/c Network Port (available on the Teleterm M3C C2362A-21 and C2363A-21 only.)

The Conet/c Port selection switch is located on the top edge of the M3 RTU along side the Port 2 Conet Network connector. Use this switch to configure the Node address of the RTU on the Conet network and the desired CONET baud-rate (Normal or Slow).

Table 3-1: Conet Port Address switch settings on the M3C RTU.

Communications Protocol	Conet Address switch setting
Conet (Normal mode): Baud rate: 62,500 baud	 **Switches 1-7: Conet ID** (Set in binary Switch 1 = LSB Switch 7 = MSB) **Switch 8: Baud Rate** Switch 8 OFF = 62.5 kBaud [Switch shown set to Address 2, Normal baud rate]
Conet (Slow mode): Baud rate: 7,800 baud	 Switches 1-7: Conet ID Switch 8: Baud Switch 8 ON = 7.8 kBaud [Switch shown set to Address 2, Slow baud rate]

Each node on the Conet/c network should be allocated a unique address in sequence, starting at 1. While a Conet/c network will operate reliably with missing node addresses, best performance of the network will be achieved with all operating nodes having consecutive addresses.

Note: All Conet nodes in a network must be set to the same baud rate.

Please refer to the Conet Installation Guide and Conet Protocol Datasheet for more information on the CONET network.

3.9 Configuring the Ethernet Port (Teleterm M3e C2363A range only)

The Ethernet port of the C2363A M3e Teleterm range supports both Modbus/TCP (Master and Slave) as well as Conet/e (for both TCP and UDP). Conet/e is a proprietary protocol from Omniflex.

Modbus/TCP, being an open standard protocol, allows M3e units to be easily connected to third party devices or SCADA systems easily.

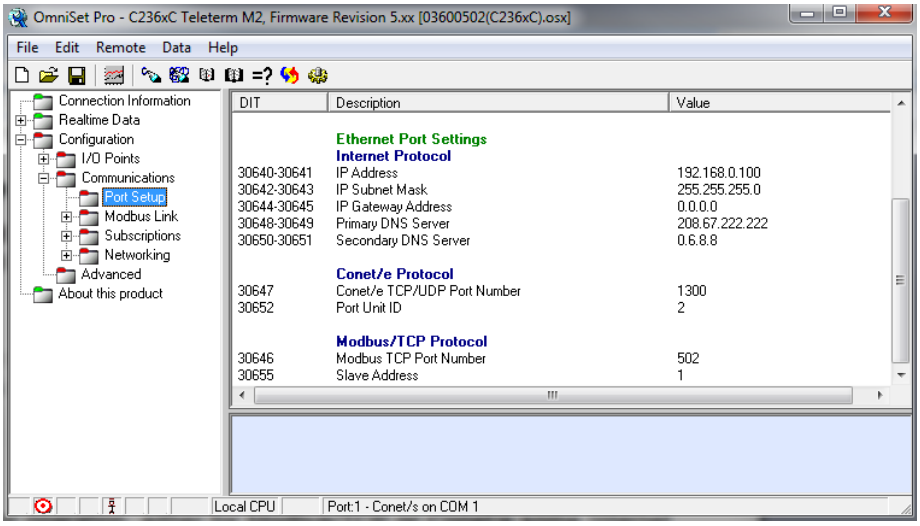


Figure 3.5: Ethernet Port Settings in Omniset.

To setup the Ethernet port for operation, either for Modbus/TCP or Conet/e some Internet Protocol settings are required. These settings need to be supplied by your network administrator if you are unfamiliar with what these settings should be:

3.9.1 Internet Protocol Settings:

IP Address: - This is the general Internet Protocol address given to the unit. It must be a unique address on the Local Area Network (LAN) that the M3e is part of. The default setting is 192.168.0.100.

IP Subnet Mask: The subnet mask for the (LAN) is configured here. This is the same for all network devices on the LAN.

IP Gateway Address: In the event the M3e is part of a Wide Area Network (WAN) and is to be accessed from a device on a different LAN, then the IP address of the IP Gateway, that connects to the WAN must be configured here.

Primary and Secondary DNS Servers: The M3e supports DNS lookup in certain applications where the M3e is deployed for access over the Internet. In this case the DNS server addresses must be configured to allow the use of Domain Names. The default settings of “208.67.222.222” and “8.8.8.8” are usually adequate and should not require to be changed.

3.9.2 Conet/e Protocol Settings:

Conet/e TCP/UDP Port Number: This is the IP port number used by Conet/e as a default (i.e. 1300). This does not normally require to be changed. In the event that this IP Port is being used by other devices on the network, then it can be changed to another number in the unused block of IP Port Numbers i.e. 49152-65535. Note that all communicating units must use the same IP Port number.

Port Unit ID: Each node on the Conet/e network also has a Unit ID over and above the IP address. This is necessary to support Conet Subnet Routing and must be set even if Conet Subnet Routing is not to be used.

Modbus/TCP Protocol Settings:

Modbus TCP Port Number: This is the IP port number used by Modbus TCP as per the Modbus TCP standard (i.e. 502). This does not normally require to be changed. In the event that this IP Port is being used by other devices on the network, then it can be changed to another number in the unused block of IP Port Numbers i.e. 49152-65535. Note that all communicating units must use the same IP Port number.

Slave Address: Each node acting as a Modbus/TCP Slave on the network must be configured with a Slave Address over and above the IP address. This is necessary to support Conet Subnet Routing and must be set even if Conet Subnet Routing is not to be used.

3.10 Configuring the Radio Network Port (Teleterm M3R models C2362A-31, C2363A-31, C2362A-32, C2363A-33, C2362A-34, C2363A-34)

M3R units use the Conet/r Protocol which is a full peer-to-peer radio network that allows the system designer to take advantage of flexible network topologies. The following parameters need to be configured in every node in the Conet/r network. These parameters can be found in the Omniset “Configuration>Communications>Port Setup” group. Look for the “Radio Network Port Settings” title to locate the specific Radio port settings.

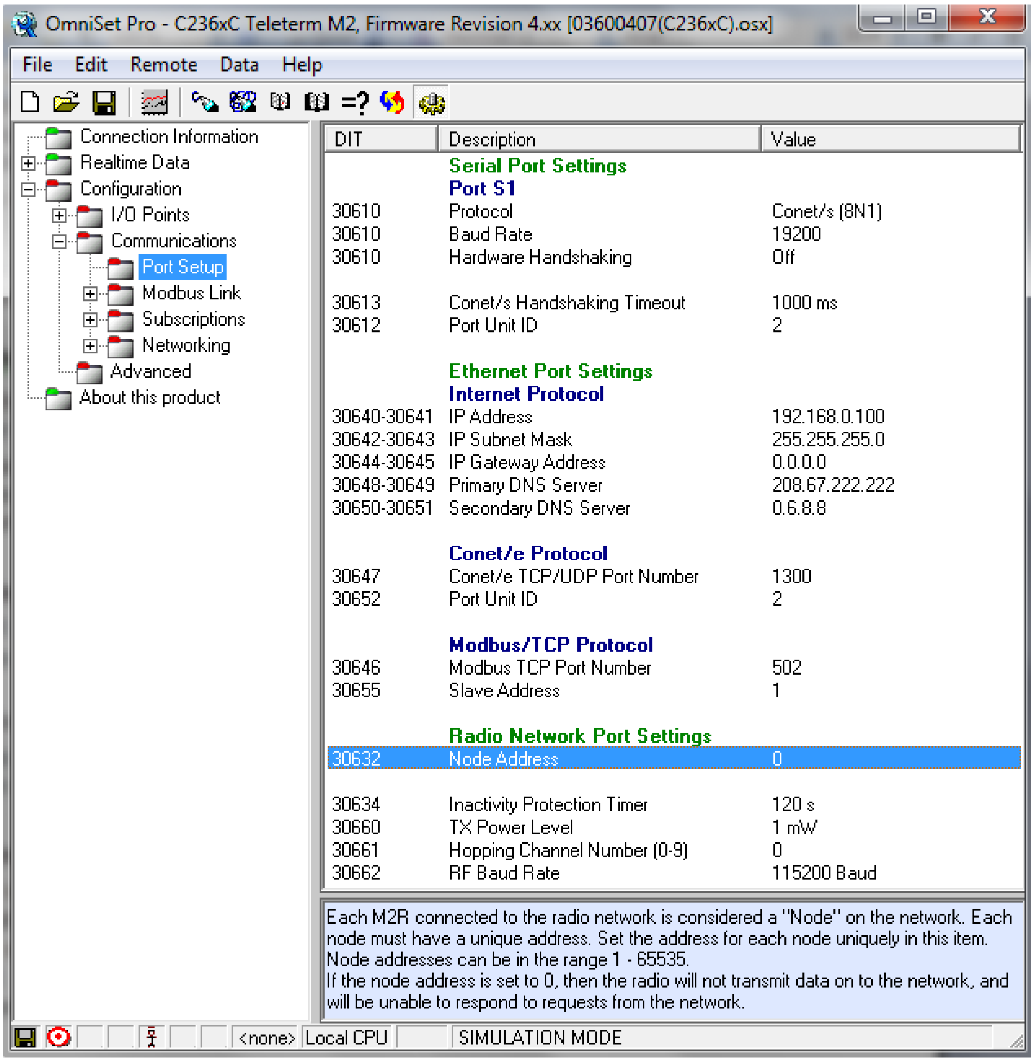


Figure 3.6: Radio Network Port Settings in Omniset.

3.10.1 Configuring the Radio Network Node Address

Each M3R connected to the radio network is considered a "Node" on the network. Each node must have a unique address. Set the address for each node uniquely in this item.

Conet/r Protocol makes use of a powerful networking feature known as “Conet Subnet Routing” which is a networking architecture that allows an entire intranet of networks to interconnect and communicate. It also integrates radio repeating requirements.

The network is therefore segmented into smaller localised networks called subnets.

Up to 30 Subnets can be supported with up to 999 nodes per subnet.

The subnet in which a node exists is implied in the Node address of the unit by multiplying the subnet by 1000 and adding it to the Node number. Thus a node identified as Node 1 in subnet 1 will have a Node address of 1001.

It is recommended practice that, for simple networks of a single subnet, a subnet of 1 be used so radio nodes can be addressed as Node 1001, 1002, 1003 etc…

Should additional subnets be required for repeating purposes or perhaps access from a SCADA system, then the application note: "Conet Subnet Routing" must be referred to for more details on how to implement such a system.

If the node address is set to 0, then the radio will not transmit data on to the network, and will be unable to respond to requests from the network.

3.10.2 Configuring the Inactivity Protection Timer

This timer is used to reset the radio channel when an unacceptable length of time has elapsed without radio communications. In unusual network conditions it is possible for the radio network to enter a "deadlock" condition, where radio communications is prevented. This protection timer is used to prevent this extreme condition from causing permanent loss of communications.

Set this timer to longer than you expect the network to ever be quiet. If this timer times out without network activity, then the M3 will assume that a deadlock condition has occurred, and will reset the radio channel to allow communications to resume.

3.10.3 Configuring the Hopping Sequence Number

Note: this applies to the C2362A-31, C2363A-31 and C2362A-34, C2363A-34 Models only. The C2362A-33 and C2363A-33 models (for 868MHz systems) do not support multi-channel hopping sequences.

The Conet/r network uses a Frequency Hopping Spread Spectrum (FHSS) to improve noise immunity and to allow multiple networks to exist within range of each other.

FHSS is a technique where the transmitting node transmits for short time on one frequency and then hops to another frequency to continue transmission, and so on through a range of frequencies in a particular order. The frequencies are used in a predefined pseudo-random sequence that both the transmitter and receiver know. Receiving nodes listen in order on each of these frequencies to receive the entire message.

Because the system transmits on a number of frequencies, the communication is more reliable and resistant to interference than a system operating on a single frequency.

By varying the hopping sequence, different radio networks can coexist within the same geographic area.

The M3R can be set with one of 7 Hopping Sequences (0-6). All nodes on a single network must have the same Hopping Sequence Number.

3.11 Other Configuration Settings

There are a number of other settings that can be made in Omniset to fully configure your Teleterm M3. The settings for your particular M3 RTU will vary dependent upon the model. There is an Omniset Template customised for each version of M3 RTU.

Browse through all of the Configuration Groups in Omniset. The Help pane in Omniset will explain each of these additional settings.

4. The Data Interchange Table explained

4.1 DIT Table Layout

All data exchange with the M3 RTU is done via the “Data Interchange Table” (DIT). Any exchange of data between functions in the M3 RTU and/or with the outside world takes place through this DIT. The Data Interchange Table (DIT) in the M3 RTU is used for reading and writing all configuration and dynamic data in the M3.

The DIT is an array of 16 bit registers accessible from any function or communications port in the M3 RTU – including Modbus. Even the Omniset configuration template interfaces to the M3 RTU through the DIT.

Each data register in the DIT has a data address on the range 0 to 65535. Not all addresses are accessible.

Any of these registers may be accessed through any of the network ports, allowing remote I/O systems to be implemented “out-of-the-box” without any programming required.

I/O status is also accessed through this interface and the unit automatically updates I/O status as it is read and written to and from the DIT.

In addition to I/O status and configuration requirements, the DIT is also the place where User will place user specific data such as Modbus Query status data or User Program data.

The DIT has two main sections, namely a Dynamic Data area and a Static Data area.

The Dynamic Data area is dedicated to status indication that is refreshed on an ongoing basis while the unit is powered. No values are retained during power fail.

The Static Data area is a non-volatile section of the DIT that retains settings during power fail. This area is where the M3 RTU configuration is stored.

The DIT has a predefined layout that includes these user areas that is summarised as follows:

Table 4-1: Data Interchange Table (DIT) Layout for the Teleterm M3 Series.

Dynamic DIT: from 0 to 29999 – Volatile memory area		
DIT Register	Range	Description
0 – 499	500	Status registers reserved for use by the M3 firmware. This area includes status indicators such as Program status, network status, I/O etc…
500 -19999	19500	Volatile User Scratch pad. This is an open area of registers available for application requirements whether by ISaGRAF program, Modbus query data or Subscription information. Values are reset to zero on power cycle.
20000 – 29999	10000	Not available
Static DIT: from 0 to 59999 – Non-Volatile memory area		
DIT Register	Range	Description

30000 - 39999	10000	Configuration registers reserved for the M3 firmware. Configuration of all the built-in functions of the unit is stored here.
40000 – 46999	7000	Non-volatile User Scratch pad. Available to the user for non-volatile storage of user specific data. Note that frequently changing values should not be stored here as this may result in non-volatile memory failure.
47000 – 59999	13000	Not available

For specific details, please refer to the Omniset template pertaining to the specific model being used.

4.2 DIT I/O Map

All inputs and outputs are read/written through registers in the DIT. The following table gives a summary of the more popularly used registers for I/O access. The current template file for your version of firmware should be used as a reference for any other register locations required.

Table 4-2: DIT I/O Map.

DIT Register	Range	Description
250	1	Digital Inputs Packed as 1 bit per input – Bits 0-11 for Inputs 1 – 12. Bits 12 -15 will always be 0.
260	1	Digital Outputs Packed as 1 bit per output – Bits 0-9 for outputs 1 – 10. Bits 12 -15 will be ignored
270	1	Analogue Input 1 voltage (in millivolts)
271	1	Analogue Input 2 voltage (in millivolts)
272	1	Analogue Input 3 voltage (in millivolts)
273	1	Analogue Input 4 voltage (in millivolts)
274	1	Analogue Input 5 voltage (in millivolts)
275	1	Analogue Input 6 voltage (in millivolts)
276	1	Analogue Input 7 voltage (in millivolts)
277	1	Analogue Input 8 voltage (in millivolts)
278	1	Analogue Input 9 voltage (in millivolts)
279	1	Analogue Input 10 voltage (in millivolts)
280	1	Analogue Input 11 voltage (in millivolts)
281	1	Analogue Input 12 voltage (in millivolts)
340-1	2	Analogue Output 11 Current (depends on user scaling)
342-3	2	Analogue Output 12 Current (depends on use scaling)

5. Modbus and the Teleterm M3

5.1 Overview

A unique and powerful feature of the Teleterm M3 is its ability to read data from any device equipped with a Modbus port.

Examples of equipment that can be interrogated for data are instruments such as PLC's, SCADA packages, on-line analysers, flow meters etc.

Modbus is the most popular standard for the exchange of data between industrial instrumentation today. Modbus is a well established reliable standard that is easy to use.

Modbus is a serial multi-drop Master/Slave protocol. This means that you can connect one or more Slave devices to a Master device over a serial communication link. If only one Slave device is being used, and the distance between the Master and Slave devices is less than 15m, then the simpler more popular RS232 electrical standard can be used. If two or more Slaves are to be connected to the Master Device, or the distance between the devices is greater than 15m, then the RS485 electrical standard must be used.

There are no internal settings in the Teleterm M3 for selecting RS232 or RS485. All that is required is to wire the appropriate pins of the serial connector for the chosen standard.

5.2 Modbus Slave

5.2.1 Selecting the Slave Protocol Details

Setting up Modbus Slave protocol requires configuration of the serial port in the "Configuration>Communications>Port Setup" group, including ASCII and RTU mode, Baud Rate, Parity, number of Data bits and Stop bits etc.

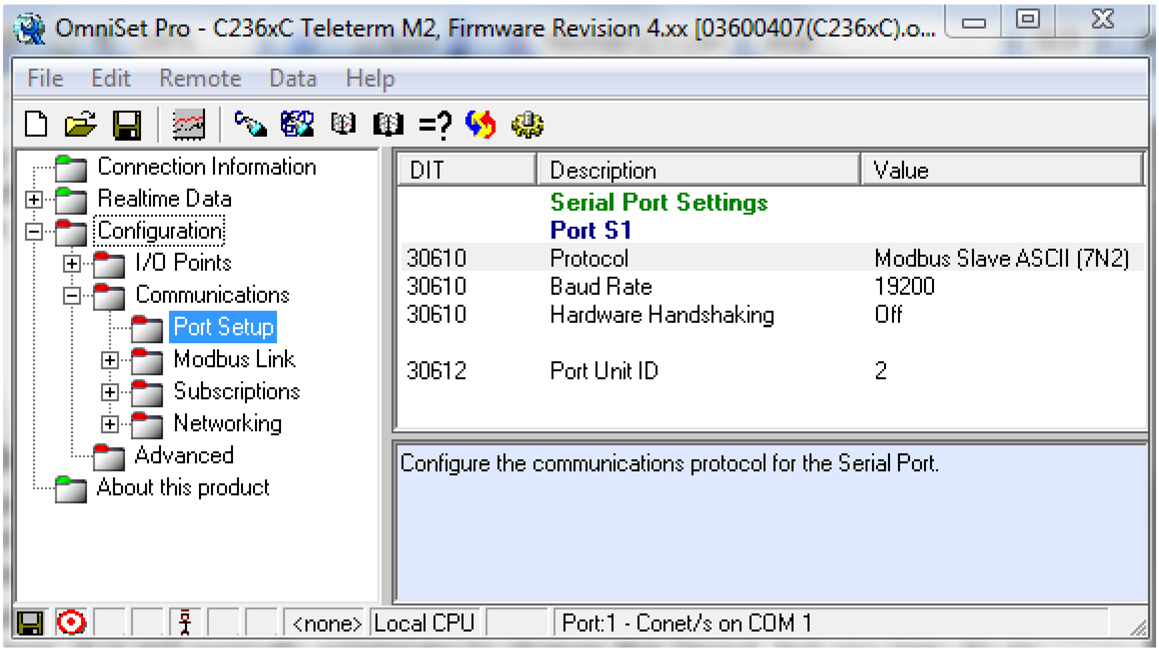


Figure 5.1: Serial port setup for Modbus slave.

5.2.2 Modbus Data Register Mapping

The Modus protocol in the Teleterm M3 supports the reading and writing of a number of different types of data: Digital Status Inputs, Coil Outputs, Input Registers and Holding Registers.

These Modbus Data types are mapped to specific areas of the Teleterm M3's Scratch Pad Registers. It is not normally necessary to change this layout, but you may do so for specific applications. The default settings are as follows:

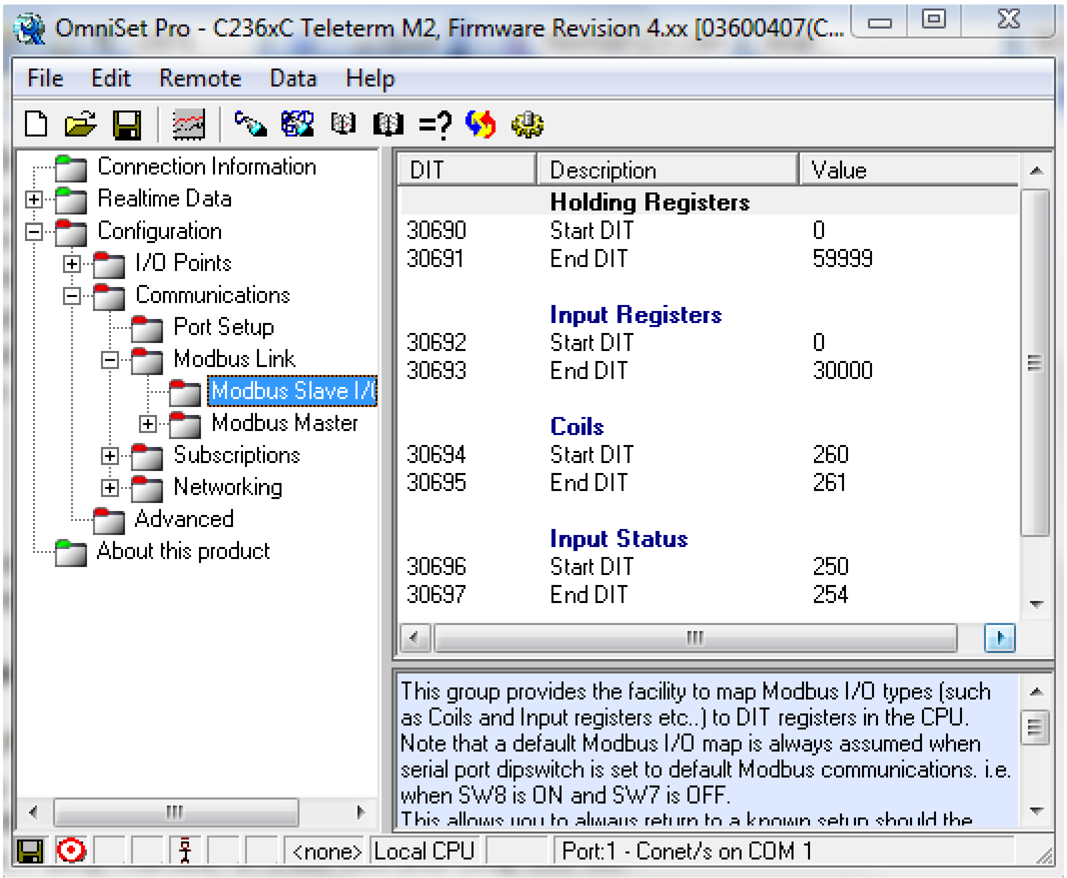


Figure 5.2: Modbus slave default settings.

The most efficient data type to use is Holding Register Read (Modbus Function 3) and Holding Register Write (Modbus Function 16).

5.3 Modbus Master

5.3.1 Selecting the Master Protocol Details

Setting up Modbus Master protocol requires configuration of the serial port in the "Configuration/Communications/Serial Port" group, including ASCII and RTU mode, Baud Rate, Parity, number of Data bits and Stop bits etc.

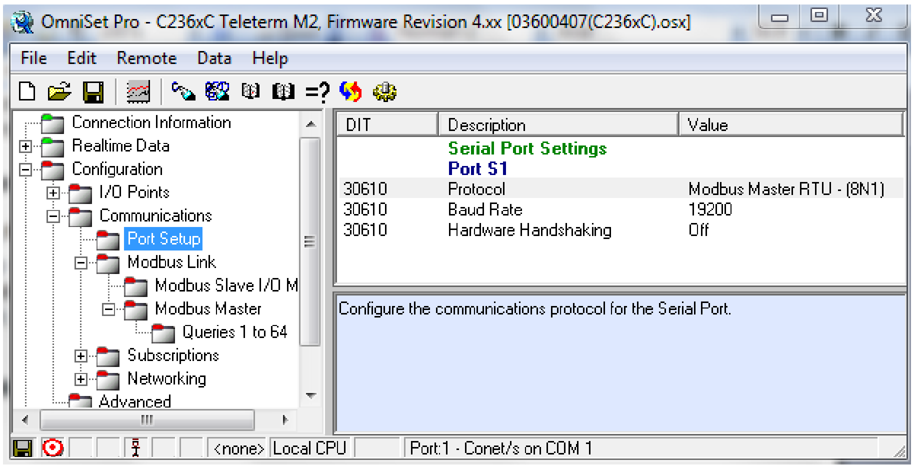


Figure 5.3: Serial port setup for Modbus master.

5.3.2 Modbus Master General Settings

In order to control the manner in which Modbus queries are executed, it is necessary to configure some general settings.

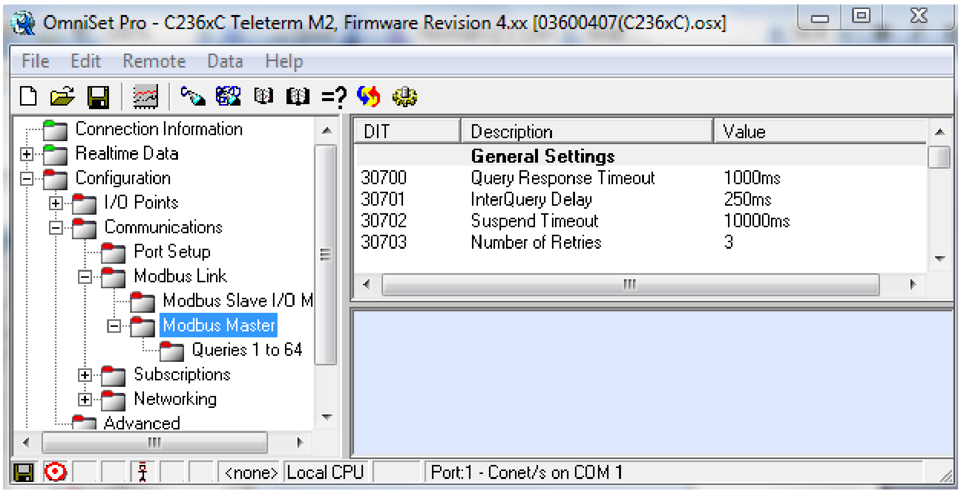


Figure 5.4: Modbus master settings.

Query Response Timeout: This is the time period the Modbus Master will wait to receive a response to a Modbus Query just sent. If the reply is not received within the timeout period then the query is considered failed and the query will be sent again for as many retries are configured or until a reply is received.

Interquery Delay: This delay is inserted in between each query from the Modbus Master regardless of whether a query is due to run or not. Its purpose is to regulate the flow of packets to multiple devices on the multidropped network. This Delay overrides the cyclic timer settings of a query such that if a query is configured for 1 second poll rate (i.e. Cyclic timer is set to 1 second) but the interquery delay is set to 3 seconds, then the fastest that query will poll the slave unit is one poll every 3 seconds.

Suspend Timeout: In the event that a query to a Modbus Slave unit fails (i.e. no reply after the retries have been exhausted) the Modbus Master will suspend that query and all other queries configured for that Modbus Slave for the duration of the suspend timeout. This allows all other queries to other operational units to resume without interruption while a unit is offline. The suspension is lifted after the timeout to see if that unit has come back online.

Number of Retries: This configures how many times the Modbus Master will retry the transmission of a Modbus query if the first attempts are unsuccessful. Once all the retries have been exhausted, with no successful reply, the query is suspended from the polling sequence for the duration of the suspend timeout.

5.3.3 Query Blocks

In order to use the Modbus Master facility in the Teleterm M3 to get data from another Modbus Slave, “Query Blocks” have to be configured that tell the Teleterm M3 where to get the data from which Slave, where in the Teleterm M3 to place the data, and which Modbus Function to use to acquire the data.

M3s support up to 128 Query Blocks.

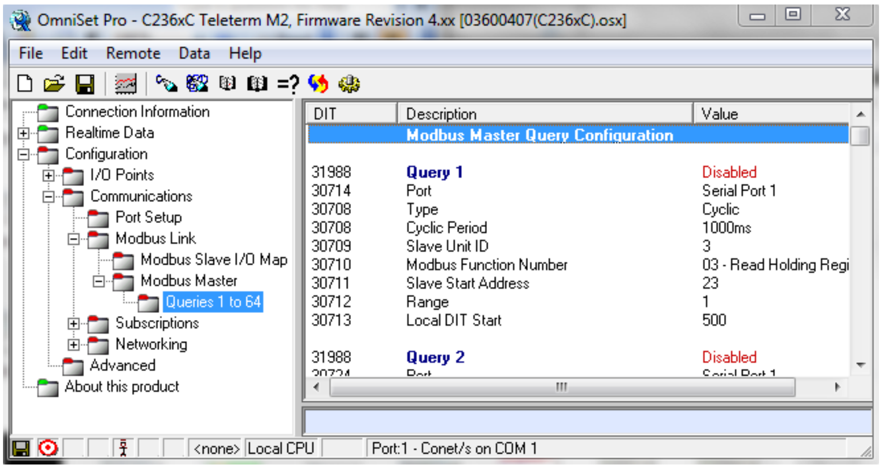


Figure 5.5: Setup of Modbus queries.

In the example shown above for Query 1, each data item has the following meaning:

Port: Select the communications port that Modbus Master will communicate with.

Type: Queries can be configured to run in either Cyclic or One-shot mode.

Cyclic means that the query will repeat on a timed cycle as set by the **Cyclic Period**.

One-shot queries are queries that are run on manually trigger, single or “one-shot” basis. One-shot queries are triggered using the Modbus Master Query Trigger group as shown below.

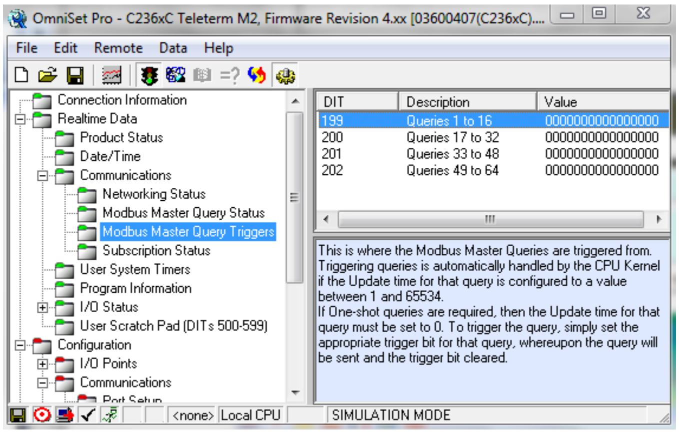


Figure 5.6: Modbus Master Query Triggers.

Slave Unit ID: This is the Modbus Address of the Slave device to be polled.

Modbus Function Number: There are number of types of messages called “functions” that the Modbus protocol supports. Function 3 for reading general purpose Holding Registers is the most commonly used for this purpose because it is the most efficient for reading larger amounts of data.

Table 5-1: Modbus query functions.

Function	Description
1	Read Coil Status
2	Read Input Status
3	Read Multiple Holding Registers
4	Read Multiple Input Registers
5	Write Single Coil
6	Write Single Holding Register
15	Write Multiple Coils
16	Write Multiple Holding Registers

Slave Start Address: This is the address of the first Holding Register to be read from the Slave device,

Range: This is the number of Holding registers to be read from the Slave device.

Local DIT Start: This is the starting address of the local Register in the Teleterm M3 where the data will be written. The registers in the range 350 to 399 are reserved for this purpose in the Teleterm M3.

Once Queries are configured, they must then be enabled. This applies to both cyclic and one-shot queries. The Query Summany group is a convenient group to enable and disable queries:

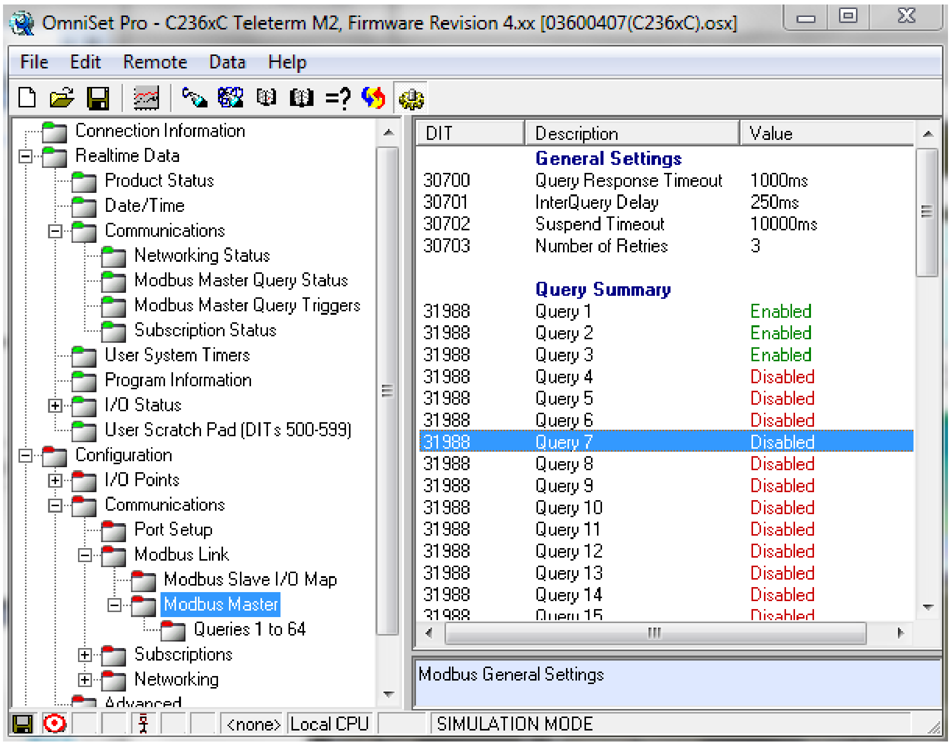


Figure 5.7: Enabling and disabling of Modbus queries.

6. The Subscription Service Explained

6.1 Introduction to Subscriptions

Central to many applications involving communications across networks is the need to replicate data between nodes on the network.

Examples include a SCADA system acquiring data from remote telemetry units in the field; or a point-to-point telemetry application, where inputs are transmitted from one location to outputs at another location.

In all these cases, the traditional method is for a controlling master node to poll the slave nodes regularly for data in case something has changed. This crude method is an inefficient use of the limited network bandwidth, and is inherently slow in typical and worst case update times. It also limits the number of master nodes in the system to one, and makes the system update times very slow where many outstations are involved.

The Teleterm M3 provides a far superior mechanism to accomplish this commonly used function through its Subscription Service. The subscription Service runs on all Conet/c (industrial LAN), Conet/r (FHSS radio) and Conet/e (Ethernet) networks, and is supported on all Omniflex products supporting these network types. This allows the M3 RTU to be used as remote I/O for other Omniflex equipment such as the Maxiflex Process Automation Controller Suite of products, or to be interconnected in a unified data environment.

6.2 How Subscriptions Work

The Subscription Service operates as follows:

The node requiring the data (the receiver) sets up a subscription with the node that has the data (the sender), very much like you would subscribe to a magazine through your newsagent. You establish a magazine subscription by telling the newsagent which magazine you want, your home address, and how often you want it, and then the newsagent takes the responsibility to send you the magazine whenever a new issue becomes available.

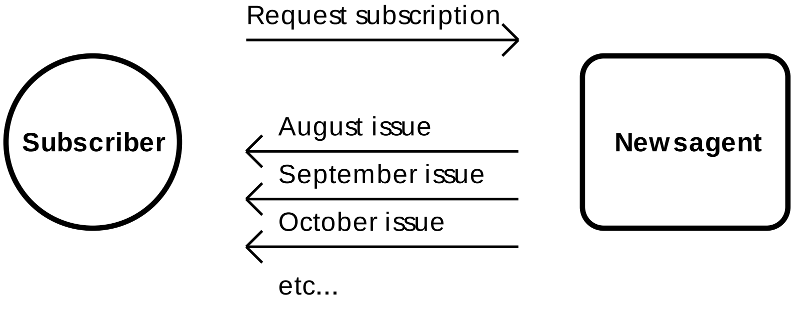


Figure 6.1: The Magazine Subscription Analogy.

In the same way, the M3's Subscription Service allows the M3 (acting as a node on the network) to subscribe to a range of DIT registers on a remote node.

The remote node will then send the data at an agreed time interval, plus, if required, when the data changes state. The receiving node expects these regular updates, and will flag an error if the subscribed data is interrupted for any reason.

6.3 Setting up subscriptions

Just like the magazine subscription, the receiving M3 is responsible for setting up and maintaining subscriptions with other nodes to replicate data across the network. The advantages of using subscriptions over regular polling mechanisms are as follows:

1. Only one message is required on the network for a data update as opposed to two in a Request/Reply polling method. This reduces network overhead allowing more data throughput on the network.
2. The regular data updates can be much slower than the response time required for the system. By using change-of-state detection, the source node will send data immediately when there is a change of state, providing the optimum system response, without the need to have a fast regular update time. This reduces network overhead allowing more/faster data throughput on the network when something does change.
3. On peer-to-peer networks multiple subscriptions can be configured between nodes in different directions, each of which would operate independently of any other. This provides far more flexibility than typical Poll/Response Master/Slave methods.

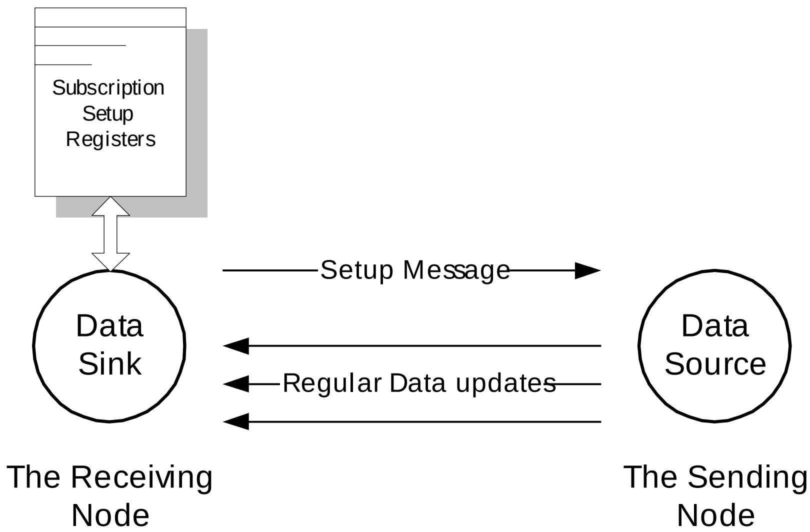


Figure 6.2: Subscription service process.

The node acting as a data “producer” (the sending node) requires no user configuration to participate in a subscription contract with another node. The node acting as data “consumer” (the receiving node) is configured by the user for the required data. The “consumer” node then automatically manages the subscription including sending the requests to the data source, and managing errors in the process.

The following table shows the information required to configure a subscription:

Table 6-1: Subscription Configuration Information.

ITEM	DESCRIPTION	VALID RANGE
Change-of-State Required	This sets whether the subscription data block will be sent when any data in the block changes.	Yes/No
Update time	This is the time between regular updates of data that will be sent whether the data has changed or not.	1 – 63 seconds, 1-63 minutes
Communications Port	This is the Network Port in this, the receiving node, to which the network containing the remote (source) node is connected.	Refer to the relevant product template file for network ports available on specific product suitable for subscriptions.
Destination DIT Start Address	This is the first DIT register address where the data will be written in this receiving node.	0 – 65535
Source Node Address	This is the node address of the sending or source node from where the required data originates. This can be expressed as a local network address plus the local slot and port to which the network is connected, or it can be expressed as a global network address if network routing is configured in the CPU.	0-65535 on Conet/r 0-126 on Conet/c (local) 128-254 on Conet/c (global)
Source DIT Start Address	This is the first DIT register address of the block of registers to be sent from the source node.	0 – 65535
Data Range	This is the number of 16 bit DIT registers that will be transferred in the subscription.	1 – 120

Subscriptions are configured in Omniset as follows:

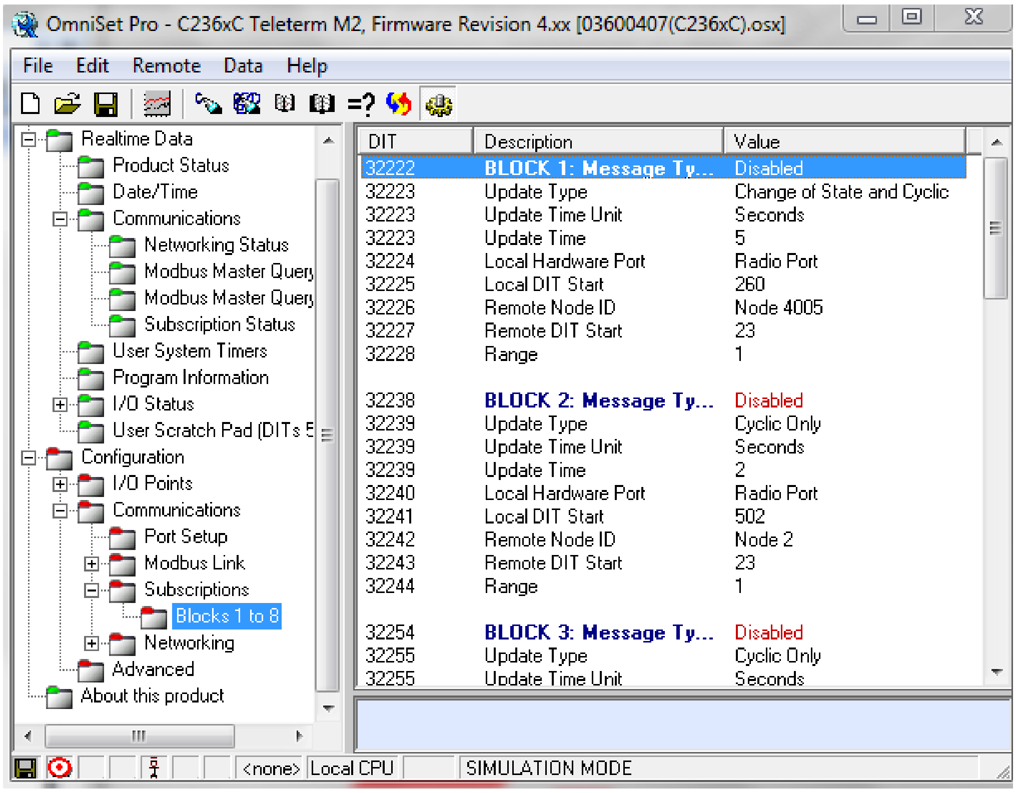


Figure 6.3: Subscription setup in Omniset.

When subscription configuration is changed, messages are sent to the sender of the data to cancel the subscription to ensure superfluous data is not transmitted on the network. These are referred to as cancellation messages. In most cases these parameters are not required to be altered, but depending on atypical network considerations, it may be necessary to alter these settings as follows:

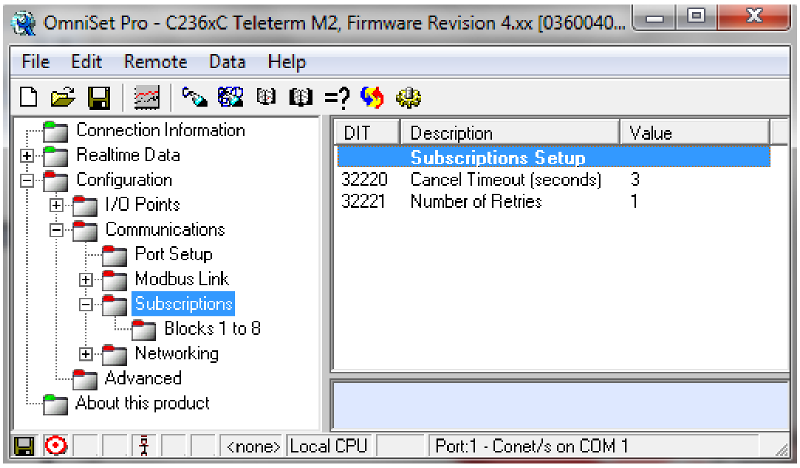


Figure 6.4: Subscription cancellation settings.

6.4 Number of subscriptions allowed

There is a limit to the number of subscriptions that a Teleterm M3 RTU can receive, and a limit to the number of subscriptions that it can send. The M3 RTU can be configured to receive subscriptions from a maximum of 16 other nodes and can send subscriptions to a maximum of 8 other receiving nodes.

In other words each M3 RTU can act as data receiver for up to 16 subscriptions and data sender for up to 8 subscriptions simultaneously.

6.5 Subscription Application Example

Refer to the diagram of a simple network below:

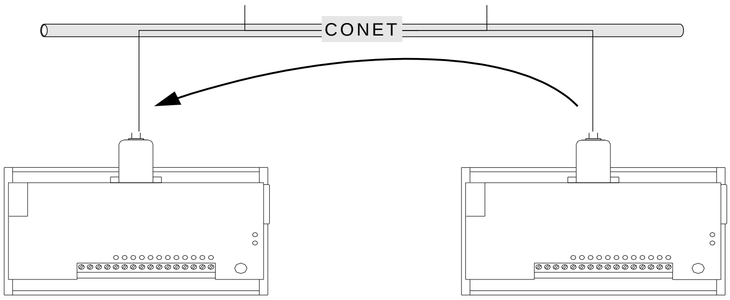


Figure 6.5: A simple subscription network.

Remote node 5 on the CONET network has digital input information in DIT register 250. Node 2 needs to monitor these digital inputs and copy the status to its digital outputs. A regular update time of every 10s is quite satisfactory to determine that the remote system is still connected and functioning if nothing changes, but the data should be sent immediately if any of the digital inputs changes state.

Node 2 is the Destination node (it sets up the subscription and receives the data). Node 5 is the sending node, and requires no user configuration to participate in the subscription process.

Fill in the following data into one of the eight subscription blocks in the Subscription Table in the M3 of Node 2 to configure this function:

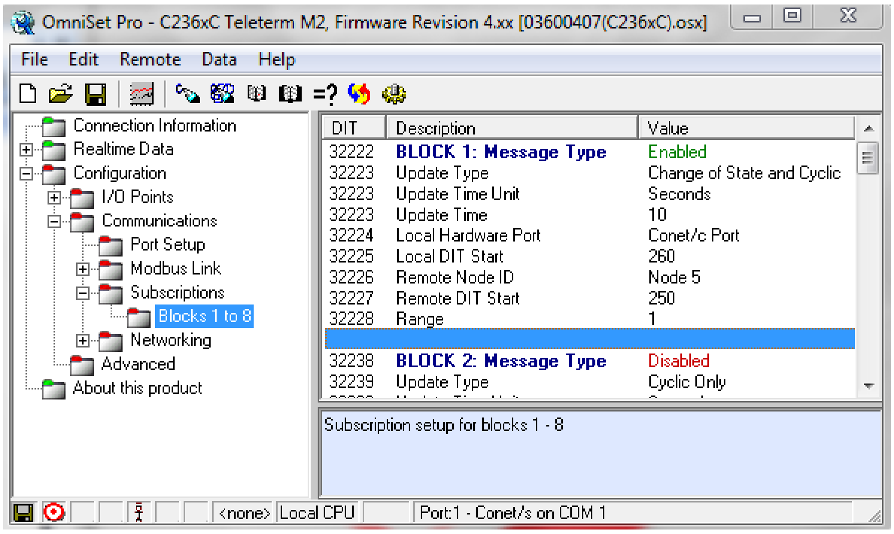


Figure 6.6: Subscription Block Data Example.

When configured, Node 2 automatically requests a subscription with the data from Node 5 on the Conet network.

Node 5 undertakes to send the contents of its own DIT register 250 over the network to node 2 whenever any of the bits change, or every 10s if no change occurs in that time. The information will be placed in node 2's DIT register 260 – the digital output status register.

Node 2 can monitor the status of the subscription by monitoring the relevant bit in the Subscription Status DIT register. If this bit is clear then the subscription is operating successfully. If this bit is set, then the subscription has failed and received data is not valid, or the subscription has not been correctly set.

Be sure to configure the I/O Points for Node 5 as digital inputs and the I/O Points for Node 2 as digital outputs.

A few seconds after the subscription has been configured, communications will commence between the nodes as evident from the Tx and Rx LEDs for the Conet/c port flashing. Energising inputs on Node 5 will result in the corresponding output on Node 2 being energised.

7. Conet Subnet Routing

7.1 Introduction

The Teleterm range of RTU's is equipped with **Conet** networking capability. **Conet** is the peer-to-peer networking technology used in many Omniflex products to implement powerful features such as remote programming and data subscriptions.

Conet networks can operate over various physical media such as existing plant cabling, Ethernet, and various radio carrier networks. The following table lists the available Conet physical media supported:

Table 7-1: Conet networks supported on the M3.

Conet Network	Physical Medium	Comment
Conet/c	Twisted pair cables	This is the original rugged Conet cable network that operates over just about any grade twisted pair cable up to 10km in some cases.
Conet/s	RS232E	This is a point-to-point network used commonly for programming Omniflex products.
Conet/e	Ethernet	Allows peer-to-peer communication over conventional Ethernet networks.
Conet/r	Short range wireless	This is actually a suite of radio networks depending upon the radio frequency of operation. Different versions of Conet/r are available in different countries depending upon the frequency bands allowed: Conet/r1 – 2.4GHz (suitable for most countries) Conet/r3 – 868MHz FSK (suitable for most European countries) Conet/r4 – 920MHz FHSS (suitable for USA, Australia and New Zealand)

Many of the Teleterm M3 products also have the capability to communicate across different Conet networks – for example the ability to communicate through the serial or Ethernet port of an M3R RTU directly over the radio network with remote M3R RTU's on the network.

For the Teleterm M3R radio RTU's this also includes the ability to act as a repeater to extend the range of radio networks when line of sight is impossible to achieve.

The capability also exists in the Teleterm M3 RTU's to convert between the supported Open protocols and the Conet networks, allowing you to communicate for example with remote RTU's over the radio network using the Modbus/TCP protocol, as if those remote RTU's are on the Modbus network.

These capabilities are collectively called "**Conet Subnet Routing**".

7.2 Conet Subnet Routing Concepts

7.2.1 Nodes

A “node” is the term used to describe the device connected to a Conet network. If there are five devices connected to a network, then that network is said to have 5 nodes.

7.2.2 Node Addressing

Each node on a Conet network is given a unique address called an “ID”. These addresses are up to 16 bits in size, giving a theoretical address range of 0 to 65535.

If a device has got more than one communication port, then each port can be a node on a different network, and will have its own “node address” or “node ID”.

7.2.3 Subnets

The 16 bit address range in Conet networking is segmented into smaller networks called subnets. The subnet is automatically implied from the Conet address.

Up to 30 subnets are supported. There can up to 999 nodes (addresses) per subnet as follows:

Table 7-2: Conet address range for subnetting.

Address Range	Subnet	Comment
1-999	0	Reserved for Conet/c as a subnet
1001-1999	1	All subnet addresses should start at 1001
2001-2999	2	Subnet 2 addresses
3001-3999	3	Subnet 3 addresses
etc.		
30001-30999	30	Subnet 30 adresses

The ‘thousands’ in the Conet address implies the subnet number for that address. A node that is part of a Conet intranet is addressed by combining the Subnet number of the subnet the node finds itself in, with the node number of the node in the subnet.

e.g. Node number 3 in subnet 5 is addressed as 5003. This forms the identity of a node in a Conet network.

Subnet 0 is reserved for legacy products that don’t implement Conet Subnet Routing. Therefore we typically start numbering subnets from 1, and therefore Conet subnet addresses from 1001.

7.2.4 A Conet Intranet

A collection of Conet subnets that are configured to operate together using Conet Subnet Routing is called a **Conet Intranet**.

Any node on a Conet intranet is able to communicate with any other node anywhere else on the Conet intranet using “subnet routing”. This includes radio repeating when the radio nodes are on different Conet subnets.

7.3 Conet Subnet Routing Examples

The best way to explain Conet Subnet Routing is by way of example. The following examples progressively introduce the different concepts of Conet Subnet Routing.

These examples assume that you are familiar with the Omniset Configuration Software and how to configure Teleterm M3's using this software tool. For further information see Section 3 of this Manual.

7.3.1 Example 1 – Simple point-to-point radio network using subscriptions

This example describes a simple point to point radio system where one radio copies data from the other radio using subscriptions. In this example we will be reading the alive counter of one M3R radio node periodically into another M3R radio node.

7.3.1.1. STEP 1 – Sketch Your Network

The best way of designing your system is by starting with a simple sketch of the system and allocating the subnets and node addresses on your sketch. This assists in visualising your network, and you will find this invaluable in later troubleshooting on site.

This system consists of two Teleterm M3R's on the same radio Subnet. We allocate the first available Subnet number (1). This gives allowable addresses in this subnet in the range 1001 to 1999.

Allocate Conet ID's for each node in the subnet. In this case we allocated Conet ID's 1001 and 1002.

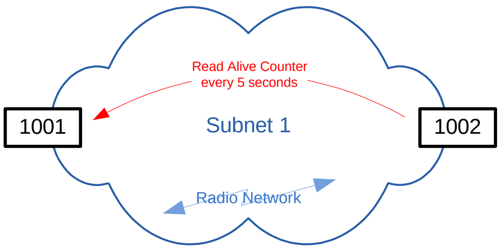


Figure 7.1: Sketch of simple point-to-point radio network for Conet Example 1.

7.3.1.2. STEP 2 - Program the Radio Node Address 1002 on the second M3R

Under "Communications>Port Setup" in Omniset:

	Radio Network Port Settings	
30632	Node Address	1002
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.2: Radio Network Port Settings for Node 2 of Conet Example 1.

"Conet Subnet Routing Start" and "Conet Subnet Routing Stop" values can be left at 0 in this case because we are not doing subnet routing on the radio port.

7.3.1.3. STEP 3 – Program the Radio Node Address 1001 on the first M3R

Under "Communications >Port Setup" in Omniset:

	Radio Network Port Settings	
30632	Node Address	1001
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.3: Radio Network Port Settings for Node 1 of Conet Example 1.

"Conet Subnet Routing Start" and "Conet Subnet Routing Stop" values can be left at 0 in this case because we are not doing subnet routing on the radio port.

7.3.1.4. STEP 4 - Configure a subscription on the first M3R [1001] to retrieve the alive counter from the second M3R [1002]:

Under "Communications>Subscriptions>Blocks 1-8" in Omniset:

	Subscription Block 1 (Enabled)	
32222	Message Type	Normal
32223	Update Type	Cyclic Only
32223	Update Time Unit	Seconds
32223	Update Time	5
32224	Local Hardware Port	Radio Port
32225	Local DIT Start	1000
32226	Remote Node ID	Node 1002
32227	Remote DIT Start	23
32228	Range	1

Figure 7.4: Subscription settings for Conet Example 1.

7.3.1.5. Observe the Working Example

- Every 5 seconds Node1002's alive counter (DIT 23) will be copied to Node 1001 (DIT 1000).
- Observe the TX LED flash on Node 1002 and the RX LED flash on Node 1001 every 5 seconds.
- Check the Alive Counter value being written every 5 seconds to DIT register 1000, visible in the User Scratch Pad in the Dynamic DIT Group.

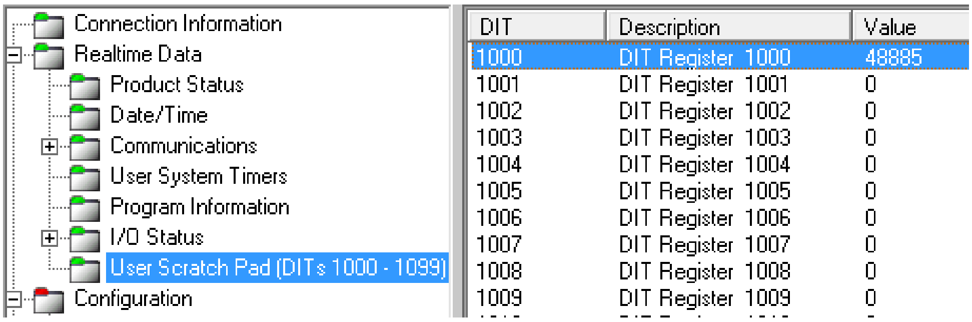


Figure 7.5: DIT 1000 showing the Alive Counter of the second M3 as a result of our subscription.

Check the subscription is enabled:

180	Subscription Blocks 1 to 8	0000000000000000
181	Subscription Blocks 17 to 32	0000000000000000
180	Subscription Block 1 Status	Active
180	Subscription Block 2 Status	Disabled
180	Subscription Block 3 Status	Disabled
180	Subscription Block 4 Status	Disabled
180	Subscription Block 5 Status	Disabled
180	Subscription Block 6 Status	Disabled
180	Subscription Block 7 Status	Disabled
180	Subscription Block 8 Status	Disabled

Figure 7.6: Subscription status for Conet Example 1.

7.3.2 Example 2 – Simple point-to-point radio network using subscriptions with COS

This example is similar to Example 1, but this time we are going to read the digital Inputs from Node 1002 and write them to the outputs of Node 1001, using Change-Of-State subscriptions to improve system response time while reducing communications traffic.

7.3.2.1. STEP 1 – Sketch Your Network

This system consists of two Teleterm M3R's on the same radio Subnet. We allocate the first available Subnet number (1). This gives allowable addresses in this subnet in the range 1001 to 1999.

Allocate Conet ID's for each node in the subnet. In this case we allocated Conet ID's 1001 and 1002.

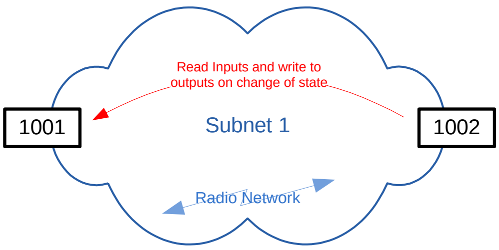


Figure 7.7: Sketch of simple point-to-point radio network for Conet Example 2.

7.3.2.2. STEP 2 - Program the Radio Node Address 1002 on the second M3R Under "Communications >Port Setup" in Omniset:

	Radio Network Port Settings	
30632	Node Address	1002
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.8: Radio Network Port Settings for Node 2 of Conet Example 2.

"Conet Subnet Routing Start" and "Conet Subnet Routing Stop" values can be left at 0 in this case because we are not doing subnet routing on the radio port.

7.3.2.3. STEP 3 - Program the IO on the second M3R to be 12 Digital Inputs Under "Configuration>I/O Points" in Omniset:

DIT	Description	Value
	I/O Configuration Summary	
30000	Input/Output Point 1 Type	Digital Input
30050	Input/Output Point 2 Type	Digital Input
30100	Input/Output Point 3 Type	Digital Input
30150	Input/Output Point 4 Type	Digital Input
30200	Input/Output Point 5 Type	Digital Input
30250	Input/Output Point 6 Type	Digital Input
30300	Input/Output Point 7 Type	Digital Input
30350	Input/Output Point 8 Type	Digital Input
30400	Input/Output Point 9 Type	Digital Input
30450	Input/Output Point 10 Type	Digital Input
30500	Input/Output Point 11 Type	Digital Input
30550	Input/Output Point 12 Type	Digital Input

Figure 7.9: I/O Port Settings for Node 2 of Conet Example 2.

7.3.2.4. STEP 4 – Program the Radio Node Address 1001 on the first M3R Under "Communications >Port Setup" in Omniset:

	Radio Network Port Settings	
30632	Node Address	1001
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.10: Radio Network Port Settings for Node 1 of Conet Example 2.

"Conet Subnet Routing Start" and "Conet Subnet Routing Stop" values can be left at 0 in this case because we are not doing subnet routing on the radio port.

7.3.2.5. STEP 5 - Program the IO on the first M3R to be 10 Digital Outputs. (Note IO points 11 and 12 cannot be set to digital outputs)

Under "Configuration>I/O Points" in Omniset:

DIT	Description	Value
	I/O Configuration Summary	
30000	Input/Output Point 1 Type	Digital Output
30050	Input/Output Point 2 Type	Digital Output
30100	Input/Output Point 3 Type	Digital Output
30150	Input/Output Point 4 Type	Digital Output
30200	Input/Output Point 5 Type	Digital Output
30250	Input/Output Point 6 Type	Digital Output
30300	Input/Output Point 7 Type	Digital Output
30350	Input/Output Point 8 Type	Digital Output
30400	Input/Output Point 9 Type	Digital Output
30450	Input/Output Point 10 Type	Digital Output
30500	Input/Output Point 11 Type	Digital Input
30550	Input/Output Point 12 Type	Digital Input

Figure 7.11: I/O Port Settings for Node 1 of Conet Example 2.

7.3.2.6. STEP 6 - Configure a subscription on M3R [1001] to read the digital input register from M3R [1002] and write it to the outputs of M3R [1001].

Under "Communications>Subscriptions>Blocks 1-8" in Omniset:

DIT	Description	Value
32222	BLOCK 1: Message Type	Enabled
32223	Update Type	Change of State and Cyclic
32223	Update Time Unit	Seconds
32223	Update Time	5
32224	Local Hardware Port	Radio Port
32225	Local DIT Start	260
32226	Remote Node ID	Node 1002
32227	Remote DIT Start	250
32228	Range	1

Figure 7.12: Subscription settings for Conet Example 2.

In this example we are using Change of State Subscriptions, so that the change of any input is transmitted immediately to Node 1001, avoiding the up to 5 second delay if a cyclic only query were used.

7.3.2.7. Observe the working Example

- Energise Input 1 on the second M3R. The input LED will light, and the transmit light will flash immediately.
- Note the Receive light on the first M3R flash, and Output 1 LED will light and the output will energise.
- Every 5 seconds Node1002 will send an update of the digital input status to Node 1001 to ensure that the IO stays in sync even when no changes are occurring.

Check the Subscription Status:

(under Realtime Data>Communications>Subscription Status)

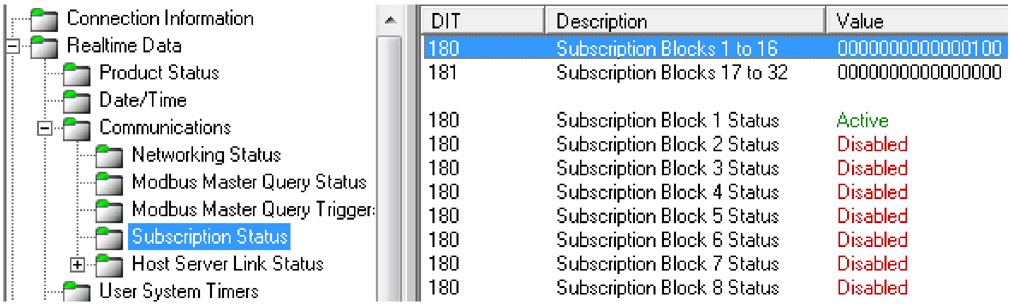


Figure 7.13: Subscription status for Conet Example 2.

7.3.3 Example 3: Modbus/TCP Polling

In this example, we are going to poll both M3Rs using Modbus/TCP from a Windows PC running Omniset. For this example, the first M3R must support a built in Ethernet port (i.e. Model C2363A-3x-x.). (This example only needs slight modification to use Modbus through the serial port S2 or USB port of the first M3R instead).

For convenience we are going to use the same PC for both configuration and Modbus/TCP polling but of course in real life these are likely to be different.

Conet Subnet Routing provides an additional feature that allows the 8-bit address limit of the Modbus protocol to be mapped to up to 254 Nodes on a Conet Subnet network. This allows the Modbus Master to “see” these nodes as Modbus slave devices connected directly to it when in fact they are distributed over the Conet intranet.

To accomplish this we have to allocate a subnet for the Modbus network as well as provide an address map of Modbus Slave address to Conet Subnet IDs as per the procedure outlined below:

7.3.3.1. STEP1 - Draw the system picture and allocate subnets.

In this example the Modbus/TCP network must also be assigned as a subnet in the Conet Intranet.

The subnet for the Ethernet port is typically allocated as subnet 30 to allow room for expansion when allocating other radio subnets for the future.

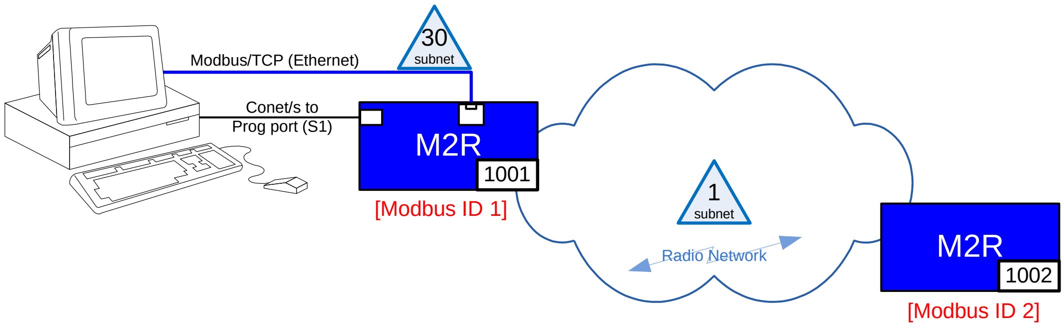


Figure 7.14: Sketch the system for Conet Example 3.

7.3.3.2. STEP 2 - Allocate Radio Subnet ID's for the radio network (1001, 1002)

Allocate these numbers as required to the sketch, as was done in examples 1 and 2 above.

7.3.3.3. STEP 3 - Allocate Equivalent Modbus addresses

We wish to read the two M3R's using Modbus, and so they each have to be allocated a Modbus Address. Modbus addresses are in the range from 1 to 254. In this case we allocate 1 for the directly connected M3R and 2 for the other M3R node on the network.

Allocate these numbers as required to the sketch

7.3.3.4. STEP 4 - From the sketch configure the Radio Port settings as follows:

For Radio Node 1001 (under "Communications">"Port Setup"):

	Radio Network Port Settings	
30632	Node Address	1001
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.15: Radio Network Port Settings for Node 1 of Conet Example 3.

"Conet Subnet Routing Start" and "Conet Subnet Routing Stop" values can be left at 0 in this case because we are not doing subnet routing on the radio port.

For Radio Node 1002:

	Radio Network Port Settings	
30632	Node Address	1002
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.16: Radio Network Port Settings for Node 2 of Conet Example 3.

7.3.3.5. STEP 5 - Configure the Ethernet Port Settings.

Set the Modbus/TCP Slave Address to 1. Set the Ethernet IP Address compatible with your Ethernet network. (The selection of IP address is outside the scope of this example). (configure under "Communications">"Port Setup")

	Ethernet Port Settings	
	Internet Protocol	
3064...	IP Address	192.168.0.199
3064...	IP Subnet Mask	255.255.255.0
3064...	IP Gateway Address	0.0.0.0
3064...	Primary DNS Server	208.67.222.222
3065...	Secondary DNS Server	0.6.8.8
	Conet/e Protocol	
30647	Conet/e TCP/UDP Port Number	1300
30652	Port Unit ID	2
	Modbus/TCP Protocol	
30646	Modbus TCP Port Number	502
30655	Slave Address	1

Figure 7.17: Ethernet Port Settings for Node 1 of Conet Example 3.

7.3.3.6. STEP 6 – Configure the Conet Subnet Settings for the Ethernet Port

In "Conet Subnet Routing>Modbus/TCP Ethernet Port":

Set the Conet Subnet of Ethernet Port to 30.

Set the mapping of Modbus Slave ID to Conet Address.

Note: We do not need to enter the Conet subnet ID for slave 1 as slave 1 is this node, and will be addressed directly.

	Conet Subnet Settings for Ethernet Port as...	
	Modbus/TCP Subnet: Ethernet Port	
33942	Conet Subnet of Ethernet Port	30
	Modbus/TCP Slave Address Map: Ethernet...	
33943	Conet Subnet ID for Modbus/TCP Slave 1	0
33944	Conet Subnet ID for Modbus/TCP Slave 2	1002
33945	Conet Subnet ID for Modbus/TCP Slave 3	0
33946	Conet Subnet ID for Modbus/TCP Slave 4	0
33947	Conet Subnet ID for Modbus/TCP Slave 5	0

Figure 7.18: Conet Subnet Settings for the Ethernet Port for Node 1 for Conet Example 3.

7.3.3.7. STEP 7 – Configure the Subnet Routing Table in each node

The Routing Table tells the node where to send messages destined for another subnet. Apply the following procedure to configuring the Subnet routing table.

Node 1001:

Identify the subnets connected to this node and on which port:

Subnet 1 is connected on radio port.

Subnet 30 is connected on the Ethernet (Modbus TCP) port.

Always enter node's own ID as the Router ID for the node's own subnet. So in this case the Router ID for Subnet 1 will be the node's own address [1001].

Messages from this node intended for nodes on subnet 30, must be sent via Node Address 30001 on this node.

Therefore we configure 30001 as the router Id for subnet 30.

Note: the ID of 30001 is a derived Conet subnet ID taken from the Modbus Slave address of 1 and the configured Conet subnet of 30.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1001
33302	Router ID for Subnet 2	0
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	0
33330	Router ID for Subnet 30	30001

Figure 7.19: Conet Subnet Routing Table for Node 1 for Conet Example 3.

Node 1002:

Identify the subnets connected to this node and on which port:

Subnet 1 is connected on radio port.

Subnet 30 is also connected on the radio port via node 1001.

Again, enter own ID [1002] as the router ID for own Subnet.

In this example, messages intended for nodes on subnet 30, must be sent via Node 1001. Therefore we configure 1001 as the router ID for subnet 30 in this node.

Conet Subnet Routing Table		
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1002
33302	Router ID for Subnet 2	0
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	0
33330	Router ID for Subnet 30	1001

Figure 7.20: Conet Subnet Routing Table for Node 2 for Conet Example 3.

7.3.3.8. Observe the Working Example

At this stage all the configuration is complete.

Note that in a Conet Subnet Routing system it is possible to connect the Programming cable into a serial port on any node in the system and be able to communicate to any other node.

Plug the programming cable into Node 1001's Prog port.

In Omniset set target node address to 1001 as shown and observe communication with the connected node.

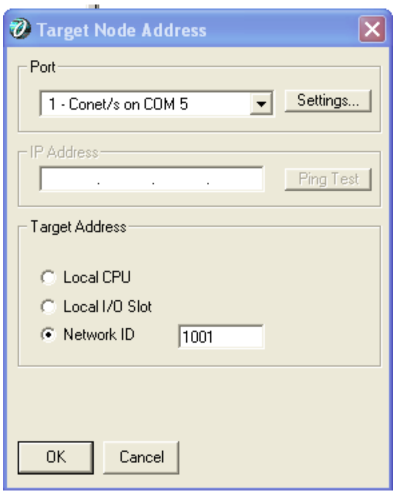


Figure 7.21: Serial connection to Node 1 using Conet network ID for Conet Example 3.

Now set the target node address to communicate to node 1002 by setting the Network ID to 1002 as shown and observe communication to node 1002.

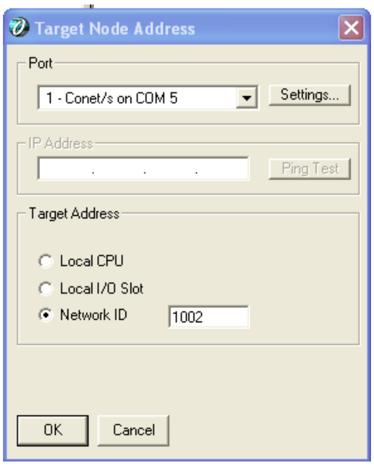


Figure 7.22: Conet radio connection to Node 2 through Serial connection to Node1 for Conet Example 3.

Now set Omniset to Modbus/TCP, and enter the IP address of unit 1001.

Ping the unit. If the ping is successful, set the network ID to 1 and observe communication to node 1001.

Now set the network ID to 2 and observe communication to node 1002.

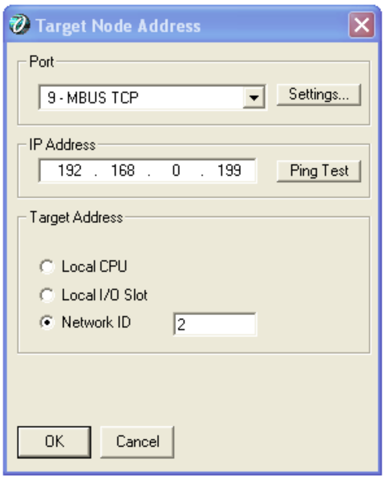


Figure 7.23: Conet radio connection to Node 2 through Modbus/TCP connection to Node 1 for Conet Example 3.

Now an OPC server (or any Modbus/TCP master) can be connected via the Ethernet port and all the nodes can be polled.

7.3.4 Example 4 – Radio Repeating using Conet Subnet Routing

In this example, another Radio Subnet will be added to our Example 3 and it will link with the current system via an additional Radio Node acting as a Radio Repeater.

7.3.4.1. STEP 1 - Sketch the new network configuration and allocate the addresses.

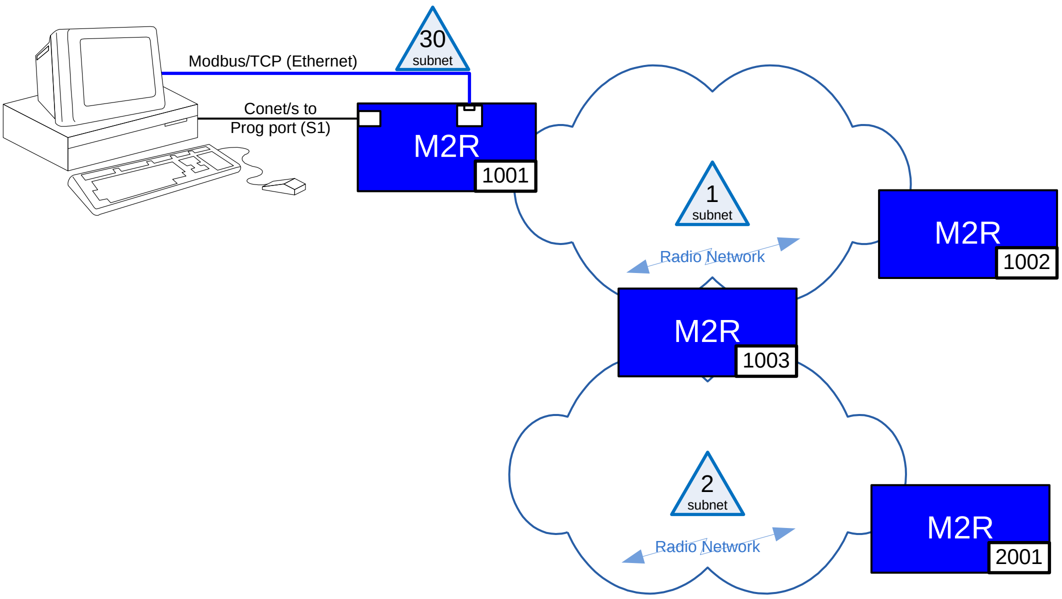


Figure 7.24: Sketch the system for Conet Example 4.

Subnet 1 and Subnet 2 are two radio networks that are not in contact except for one node that is in range of both subnets. This Node could be part of either subnet. In this case it is part of subnet 1 and we give it a Radio Subnet ID = 1003.

We identify the second subnet as Subnet 2 and we allocate Radio Subnet ID's for the nodes in this subnet. The example node in Subnet 2 is given a Subnet ID of 2001.

We also need to allocate Modbus Addresses if we wish to talk to these additional nodes using Modbus/TCP.

In this case we allocate Modbus Address 3 for Node 1003 and 4 for Node 2001.

7.3.4.2. STEP 2 – Configure the new Radio Node Addresses

Configure the node addresses for new nodes 1003 and 2001 in "Communications > Port Setup"

	Radio Network Port Settings	
30632	Node Address	1003
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.25: Radio Network Port Settings for Node 1003 of Conet Example 4.

	Radio Network Port Settings	
30632	Node Address	2001
30635	Conet Routing Subnet Start	0
30636	Conet Routing Subnet End	0
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.26: Radio Network Port Settings for Node 2001 of Conet Example 4.

In this example we are using Conet Subnet Routing on the radio network and so we need to configure "Conet Routing Subnet Start" and "Conet Routing Subnet Stop" values. See the next step.

7.3.4.3. STEP 3 - Set Subnet Ranges for Nodes 1003 and 2001.

Because we are using multiple radio subnets with an M3R as a radio repeater, we need to configure in each node which subnets are accessed through the radio port.

In this example our radio system operates on subnets 1 and 2. Configure

Configure "Conet Routing Subnet Start" = 1 and

"Conet Routing Subnet End" = 2 in each M3R in the system.

For Node 1003 (and any other nodes on Subnet 1) we configure Conet Routing Subnet Start of 1 and End of 2 as shown below.

	Radio Network Port Settings	
30632	Node Address	1003
30635	Conet Routing Subnet Start	1
30636	Conet Routing Subnet End	2
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.27: Conet Routing Subnet Settings for Subnet 1 of Conet Example 4.

For Node 2001 (and any other nodes on Subnet 2) configure a Routing Subnet Start of 1 and End of 2 and shown.

	Radio Network Port Settings	
30632	Node Address	2001
30635	Conet Routing Subnet Start	1
30636	Conet Routing Subnet End	2
30634	Inactivity Protection Timer	120 s
30660	TX Power Level	1 mW
30661	Hopping Channel Number (0-9)	0
30662	RF Baud Rate	115200 Baud

Figure 7.28: Conet Routing Subnet Settings for Subnet 2 of Conet Example 4.

7.3.4.4. STEP 4 - Complete the Modbus Address Mapping

Now we need to go back and add the new Modbus Slave Addresses to the Modbus address map in Node 1001.

Connect to Node 1001 and under “Conet Subnet Routing” -> “Modbus/TCP Ethernet Port” enter the subnet ID’s for Modbus Slaves 3 and 4.

	Conet Subnet Settings for Ethernet Port as Modbus TCP...	
	Modbus/TCP Subnet: Ethernet Port	
33942	Conet Subnet of Ethernet Port	30
	Modbus/TCP Slave Address Map: Ethernet Port	
33943	Conet Subnet ID for Modbus/TCP Slave 1	0
33944	Conet Subnet ID for Modbus/TCP Slave 2	1002
33945	Conet Subnet ID for Modbus/TCP Slave 3	1003
33946	Conet Subnet ID for Modbus/TCP Slave 4	2001
33947	Conet Subnet ID for Modbus/TCP Slave 5	0
33948	Conet Subnet ID for Modbus/TCP Slave 6	0
33949	Conet Subnet ID for Modbus/TCP Slave 7	0
33950	Conet Subnet ID for Modbus/TCP Slave 8	0

Figure 7.29: Modbus/TCP Slave Address Map for Node 1001 of Conet Example 4.

7.3.4.5. STEP 5 - Configure the Subnet Routing Tables:

Node 1001:

Node 1001 has to route through node 1003 to reach Subnet 2.
So enter 1003 as the router ID for Subnet 2.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1001
33302	Router ID for Subnet 2	1003
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	0
33330	Router ID for Subnet 30	30001

Figure 7.30: Conet Subnet Routing Table for Node 1001 for Conet Example 4.

Node1002:

Node 1002 has to route through node 1003 to reach Subnet 2.
So enter 1003 as the router ID for Subnet 2.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1002
33302	Router ID for Subnet 2	1003
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	0
33330	Router ID for Subnet 30	1001

Figure 7.31: Conet Subnet Routing Table for Node 1002 for Conet Example 4.

<u>Node1003</u>

Node 1003 can send directly to Subnet 2. It is in effect using itself as a Router because it is addressed as a member of Subnet 1.

So enter 1003 as the router ID for Subnet 2.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1003
33302	Router ID for Subnet 2	1003
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	0
33330	Router ID for Subnet 30	1001

Figure 7.32: Conet Subnet Routing Table for Node 1003 for Conet Example 4.

<u>Node 2001:</u>

Node 2001 needs to route through Node 1003 to communicate with Nodes on Subnet 1 and 30. So enter 1003 for these subnets.

Enter Own ID for Own Subnet.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1003
33302	Router ID for Subnet 2	2001
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	0
33330	Router ID for Subnet 30	1003

Figure 7.33: Conet Subnet Routing Table for Node 2001 for Conet Example 4.

7.3.4.6. Observe the working example

Plug the programming cable into Node 1001's prog port.

In Omniset set target node address to 1001 as shown and observe communication with the connected node.

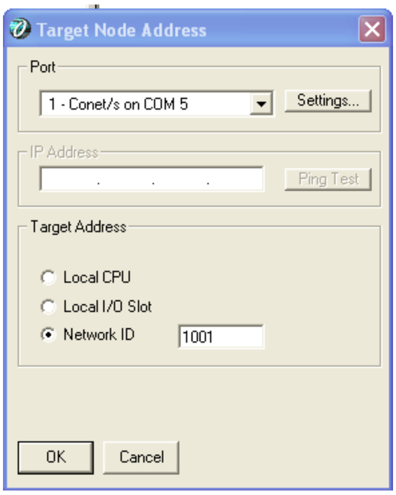


Figure 7.34: Serial connection to Node 1001 using Conet network ID for Conet Example 4.

Now set the target node address to communicate to node 1002, 1003 and 2001 by changing the Network ID In Omniset as shown below and observe communication to all the nodes is possible.

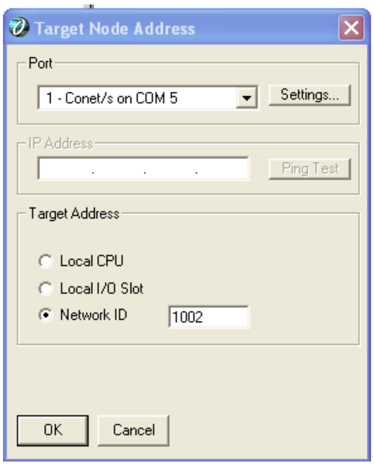


Figure 7.35: Serial connection to Node 1002 using Conet network ID for Conet Example 4.

Now set Omniset to Modbus/TCP, and enter the IP address of unit 1001.

Ping the unit. If the ping is successful, set the network ID to 1, 2, 3, 4 and observe communication to all the nodes.

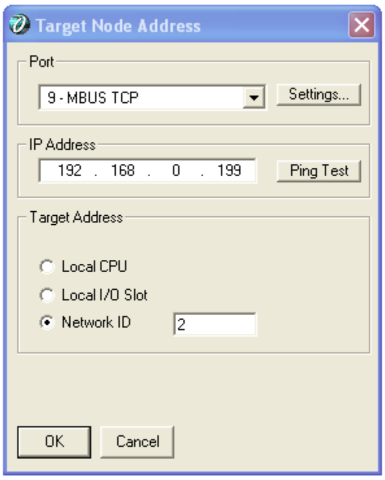


Figure 7.36: Conet radio connection to Node 2 through Modbus/TCP connection to Node 1 for Conet Example 4.

Now an OPC server (or any Modbus/TCP master) can be connected via the Ethernet port and all the nodes can be polled.

7.3.5 Example 5: Adding a conet/e Subnet

In this example we will add a Conet/e network to the system. This example assumes that you have the network in example 4 already operational.

Conet/e is part of the Conet protocol which works on the Ethernet physical layer. In this example, we going to use Conet/e to communicate with Node 1001 and hence all the nodes in the network. This will allow us to use IsaGRAF to program all the nodes in the network via an Ethernet connection to Node 1001.

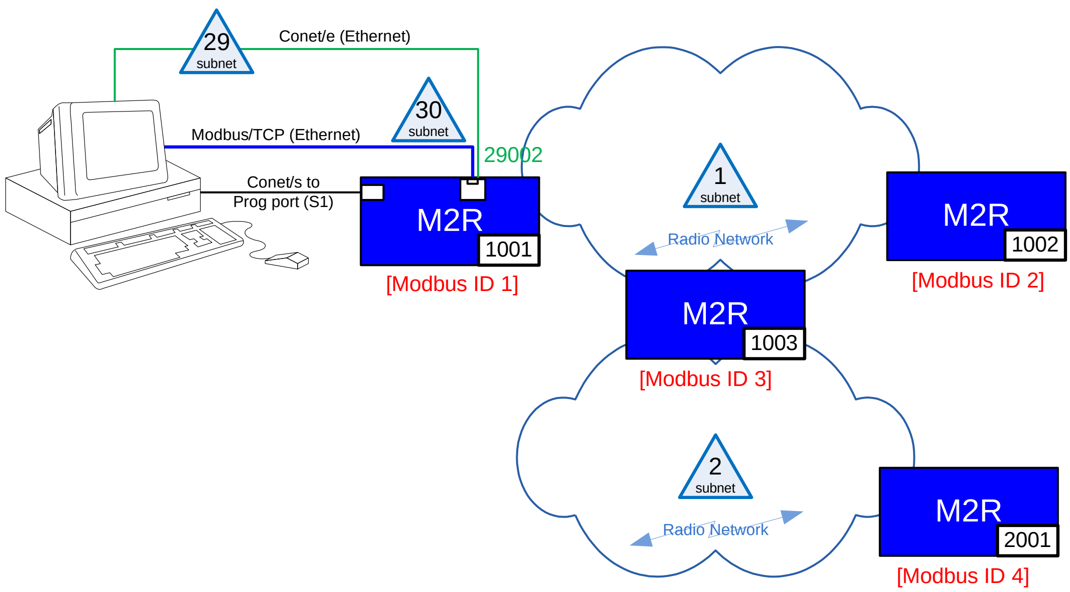


Figure 7.37: Sketch the system for Conet Example 5.

7.3.5.1. STEP 1 – Add this network to our sketch

In this case we assign the subnet ID 29 to the Conet/e subnet, and consequently an ID of 29002 to the Conet/e port on the M3Re in the system. (The computer is ID 1)

7.3.5.2. STEP 2 - Program the Conet/e port unit ID on unit 1001

	Conet/e Protocol	
30647	Conet/e TCP/UDP Port Number	1300
30652	Port Unit ID	29002
30653	Conet Routing Subnet Start	0
30654	Conet Routing Subnet End	0

Figure 7.38: Conet/e Protocol Settings for Node 1003 of Conet Example 5.

7.3.5.3. STEP 3 - Program the Conet Subnet Routing tables:

Node 1001:

Add the Router ID for Subnet 29 (**29002**). This means that any messages reaching this node destined for Subnet 29 get routed to Subnet ID 29002.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1001
33302	Router ID for Subnet 2	1003
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	29002
33330	Router ID for Subnet 30	30001

Figure 7.39: Conet Subnet Routing Table for Node 1001 for Conet Example 5.

Node 1002:

Add the router ID for subnet 29. In this case node 1002 has to route through node **1001** to reach node 29. So the Router ID for Subnet 29 is 1001. (This applies to all radio nodes in subnet 1.)

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1002
33302	Router ID for Subnet 2	1003
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	1001
33330	Router ID for Subnet 30	1001

Figure 7.40: Conet Subnet Routing Table for Node 1002 for Conet Example 5.

Node 1003:

Add the router ID for subnet 29 as in Node 1002 above.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1003
33302	Router ID for Subnet 2	1003
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	1001
33330	Router ID for Subnet 30	1001

Figure 7.41: Conet Subnet Routing Table for Node 1003 for Conet Example 5.

Node 2001:

This node is in subnet 2 and hence has to route through node **1003** (the router node into Subnet 1) to reach subnet 1 and therefore subnet 29. So the router ID for Subnet 29 in this case is 1003.

	Conet Subnet Routing Table	
33300	Router ID for Subnet 0	0
33301	Router ID for Subnet 1	1003
33302	Router ID for Subnet 2	2001
33303	Router ID for Subnet 3	0
33304	Router ID for Subnet 4	0
33305	Router ID for Subnet 5	0
33306	Router ID for Subnet 6	0
33307	Router ID for Subnet 7	0
33308	Router ID for Subnet 8	0
33309	Router ID for Subnet 9	0
33310	Router ID for Subnet 10	0
33311	Router ID for Subnet 11	0
33312	Router ID for Subnet 12	0
33313	Router ID for Subnet 13	0
33314	Router ID for Subnet 14	0
33315	Router ID for Subnet 15	0
33316	Router ID for Subnet 16	0
33317	Router ID for Subnet 17	0
33318	Router ID for Subnet 18	0
33319	Router ID for Subnet 19	0
33320	Router ID for Subnet 20	0
33321	Router ID for Subnet 21	0
33322	Router ID for Subnet 22	0
33323	Router ID for Subnet 23	0
33324	Router ID for Subnet 24	0
33325	Router ID for Subnet 25	0
33326	Router ID for Subnet 26	0
33327	Router ID for Subnet 27	0
33328	Router ID for Subnet 28	0
33329	Router ID for Subnet 29	1003
33330	Router ID for Subnet 30	1003

Figure 7.42: Conet Subnet Routing Table for Node 2001 for Conet Example 5.

7.3.5.4. Configuration is now complete. In Omniset, change the port to Conet/e.

Enter the IP address, and select any network ID (1001, 1002, 1003 or 2001) to communicate with. Verify that communication to all the nodes is possible.

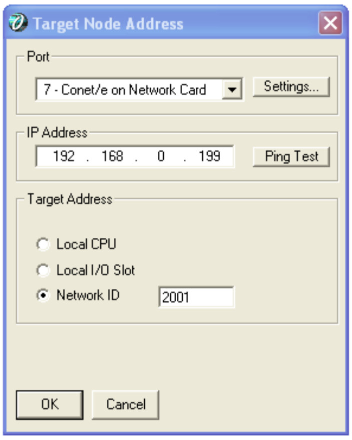


Figure 7.43: Conet radio connection to Node 2001 through Conet/e connection to Node 1001 for Conet Example 5.

8. Programming the M3 with ISaGRAF

8.1 Optional ISaGRAF programming

Each of the Teleterm M3 series RTU's can be shipped with ISaGRAF programming capability. Products with ISaGRAF installed are identified from the Order Code on the label on the rear of the unit (e.g. C2362A-33-**1**) as well as a label on the top cover "ISaGRAF enabled".

8.2 Introduction to IEC61131-3 Programming

8.2.1 The IEC61131 Standard

The IEC61131 standard was created to fulfil the need for standardisation in PLC programming languages.

The IEC61131 standard is divided into a number of parts:

Part 1 – General information Definition of basic terminology and concepts.

Part 2 – Equipment requirements and tests, electronic and mechanical construction and verification tests. - published 1992

Part 3 – Programmable languages PLC software structure, languages and program execution.

Part 4 – User guidelines Guidance on selection, installation, maintenance of PLC's.

Part 5 – Messaging service specification Software facilities to communicate with other devices using communications based on MAP Manufacturing Messaging Services.

Part 6 – Communications via fieldbus Software facilities of PLC communications using IEC fieldbus

Part 7 – Fuzzy control programming Software facilities, including standard function blocks for handling fuzzy logic within PLC's - published 1997

Part 8 – Guidelines for the implementation of languages for programmable controllers Application and implementation guidelines for the IEC61131-3 languages.

The part applicable to PLC programming is IEC61131-3. The Teleterm M3 series together with the Application Workbench conforms to this IEC standard for programming languages.

8.2.2 The IEC61131-3 Programming Languages

The IEC61131-3 standard defines 5 programming languages:

- Sequential Flow Chart (SFC)
  A graphical language for depicting sequential behaviour of a control system. It is used for defining control sequences that are time and event driven.
  Sequential Function Chart (SFC), the core language of the IEC 61131-3 standard, divides the process cycle into a number of well-defined steps, separated by transitions. The other languages are used to describe the actions performed within the steps and the logical conditions for the transitions. Parallel processes can easily be described using SFC.
- Function Block Diagram (FBD)
  A graphical language for depicting signal and data flows through function blocks -

re-usable software elements. FBD is very useful for expressing the interconnection of control system algorithms and logic.

- Ladder Diagram (LD)
  A graphical language that is based on relay ladder logic - a technique commonly used to program current generation PLC's. However, the IEC Ladder Diagram language also allows the connection of user defined function blocks and functions and so can be used in a hierarchical design.
- Structured Text (ST)
  A high level textual language that encourages structured programming. It has a language structure (syntax) that strongly resembles PASCAL and supports a wide range of standard functions and operators.
  This language is primarily used to implement complex procedures that cannot be easily expressed with graphical languages (e.g. IF / THEN / ELSE, FOR, WHILE...).
- Instruction List (IL)
  A low level 'assembler like' textual language that is based on similar instruction list languages found in a wide range of today's PLC's.

The Teleterm M3 RTU implements all 5 of these IEC61131-3 languages as well as a sixth language called "Flow Chart".

- Flow Chart (FC)
  Recognizing that virtually every engineer graduating from college today has programmed in Flow Chart, the Workbench fully supports graphical Flow Chart programming. The Flow Chart is an easy to read decision diagram where actions are organized in a graphic flow. Binary decisions are used to control the flow. The Flow Chart Editor has full support for connectors and sub-programs. Actions and tests can be programmed in LD, ST or IL.

8.3 Programming the Teleterm M3 RTU

The Teleterm M3 RTU can be programmed in any of the supported languages with the aid of the Omniflex ISaGRAF Programmer's Workbench.

For program development, the Application Workbench provides powerful and intuitive Windows based graphical and textual editors with drag-and-drop, and cut-and-paste to enhance ease of use.

The Application Workbench offers the following features:

- Project Management
- I/O Definition
- Modular Programming
- Simulation
- Real-time on-line debugging
- Document Generation

Full instructions on the use of the Application Workbench are available in a separate manual.

This manual is restricted to instructions specific to the Teleterm M3 RTU.

8.4 Installing the Omniflex ISaGRAF Application Workbench for the Teleterm M3 RTU.

The Omniflex ISaGRAF Application Workbench installs together with the Omniset Pro configuration utility. This software suite allows remote programming as well as providing simultaneous access to the CPU by Omniset for remote configuration.

See the Application Workbench installation instructions supplied with the software to install the Application Workbench with Omniset Pro.

8.5 Setting up the Application Workbench for the Teleterm M3 RTU.

The following settings in the workbench are applicable for the Teleterm M3 RTU's:

From the Start Menu, select "Omniflex>ISaGRAF>Projects".

Start a new Project or open an existing Project.

Then set the following parameters as directed below:

8.5.1 PC-PLC Link Parameters

1. On the "Debug" menu, select "Link Setup".
2. Select all parameters as shown below. For remote programming over slow links, the Time out value may need to be increased if timeouts occur:

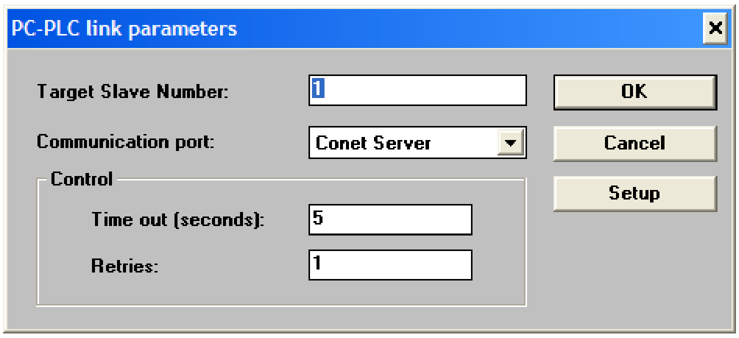


Figure 8.1: ISaGRAF Link setup.

3. Select "Setup" and then choose the desired Conet Port and Target Address for communicating with theTeleterm M3 RTU.

   Programming of the Teleterm M3 can be performed via any of the following links:

   - Via the USB port (using Conet/s through a USB port on your PC)
   - Via the optional Ethernet port (using Conet/e through an Ethernet port on your PC.
   - Via the Conet/c network port of the Teleterm M3C (requires a Conet PCI card installed in your computer, or an external Conet gateway.)
4. For communicating with the Teleterm M3 RTU through the programming port via a serial port on your computer, select the following settings (Note: The actual COM

port number may vary on your computer, depending upon which COM port you selected when installing the ISaGRAF Workbench:

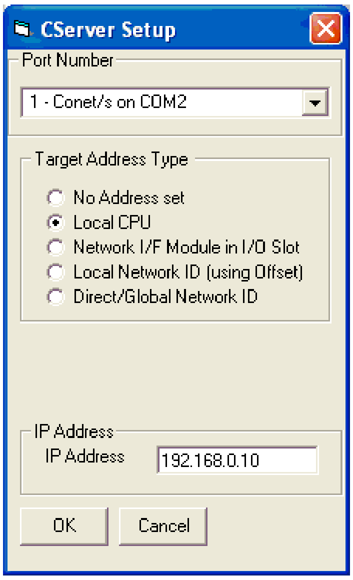


Figure 8.2: ISaGRAF CServer setup.

An IP Address is only required if communicating using Conet/e over Ethernet. Select “Local CPU” to connect with the RTU over any of the ports.

8.5.2 I/O Slot and Channel Numbering

You now need to ensure that the Slot Numbering starts from 0, and the Channel Numbering starts from 1 as follows:
In your open Project:

1. From the “Project” menu, open the “I/O Connection” Window.
2. From the “Options” menu in this window, select “Numbering”

Check that your settings match the following:

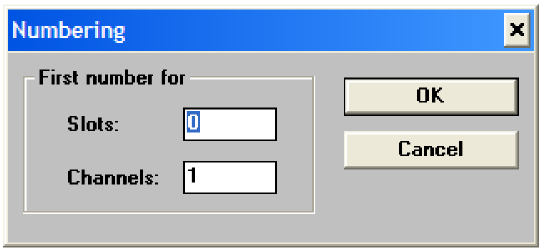


Figure 8.3: ISaGRAF I/O connections numbering settings.

8.5.3 Compiler Options

Ensure that the following compiler options are selected in your Application Workbench for use with your Teleterm M3 RTU:

From within your open project:

1. Start a new Program or open an existing program in the project (any language) as follows:
   To start a new program select File New. You will get the following dialogue box:

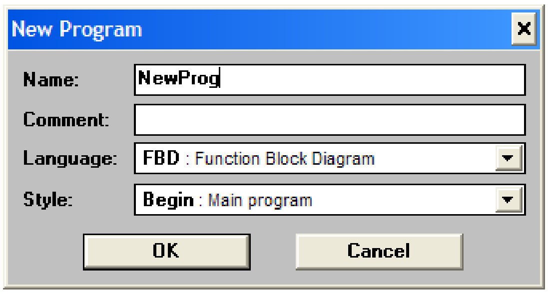


Figure 8.4: New program options.

Fill in a program name, select a language, and then press OK.
The program will appear in the project window

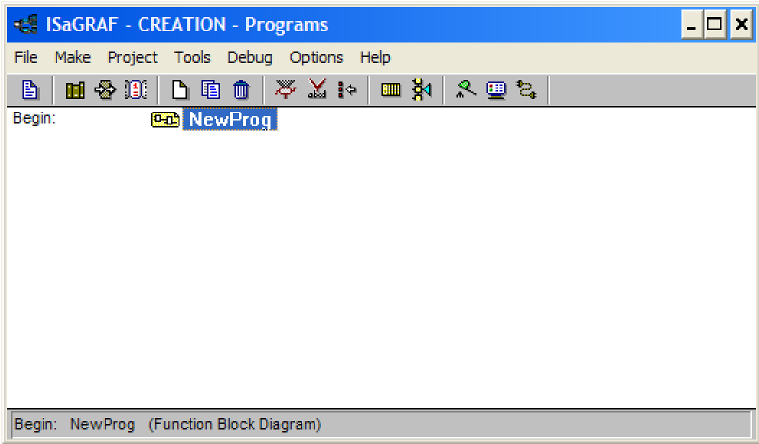


Figure 8.5: Project window showing the new program.

To open a program, select the program in the window and then select File Open, (or double click the program name in the window)

2. In the Program Window, select "Compiler options" from the "Options" Menu

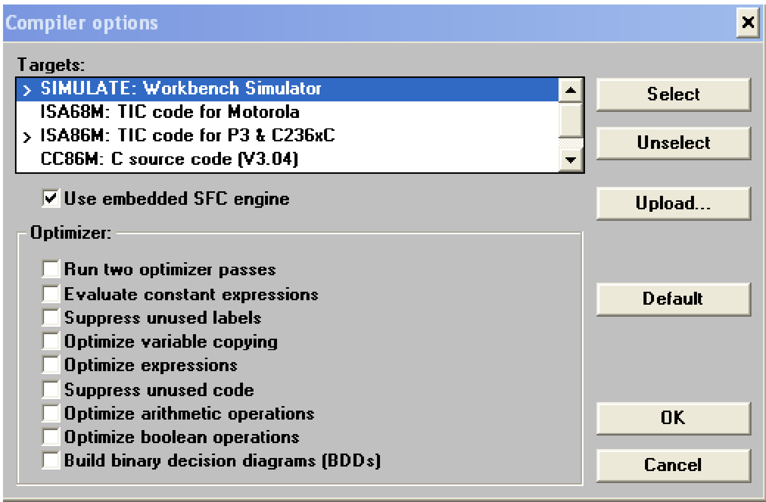


Figure 8.6: ISaGRAF I/O Connections Numbering settings.

Ensure that the **"SIMULATE"** and **"ISA68M" (TIC code for P3 & C2362A/C2363A)** options are both selected in the "Targets" list. To select an option in the list. Click on the item and press the "Select" button.

You can also select any compile optimisations that you require at this stage. (These can also be selected at any time in he future in the same way).

8.6 Creating I/O Connections

You must define the virtual I/O Modules in your project in accordance with the physical configuration of I/O Points in the Teleterm M3 RTU target.

If the virtual I/O modules in the project do not match the configuration of the Teleterm M3, then your program cannot be started.

To define the I/O Point modules in your project:

1. Start a new Project or open an existing Project.
2. From the "Project" menu, select "I/O Connection" (or use the "I/O Connection" button on the toolbar).
3. Select the I/O Module position to be defined.
   The following table gives the physical I/O Point module positions in the Teleterm M3 for the ISaGRAF Slot Numbers in this dialogue box:

Table 8-1: ISaGRAF slot numbers to M3 I/O mapping.

ISaGRAF Slot No.	I/O Point No.	Comments
0	0	Install the M3 Supervisor virtual module here
1	1	Install the relevant M3 I/O Point virtual module
2	2	Install the relevant M3 I/O Point virtual module
3	3	Install the relevant M3 I/O Point virtual module
4	4	Install the relevant M3 I/O Point virtual module
5	5	Install the relevant M3 I/O Point virtual module
6	6	Install the relevant M3 I/O Point virtual module
7	7	Install the relevant M3 I/O Point virtual module
8	8	Install the relevant M3 I/O Point virtual module
9	9	Install the relevant M3 I/O Point virtual module
10	10	Install the relevant M3 I/O Point virtual module
11	11	Install the relevant M3 I/O Point virtual module
12	12	Install the relevant M3 I/O Point virtual module
13 onwards		Other virtual Modules can be installed in any of the unused ISaGRAF slots.

4. Select "Set Board/Equipment" from the "Edit" menu. (This selection can also be made by double clicking the Slot Number).
5. The Application Workbench separates I/O modules that have a single type of Input/Output from those with multiple Input/Output Types.
   Select "Boards" in the Library box to display all virtual I/O Modules with a single Input/Output type, or "Equipments" to display all virtual I/O Modules with multiple Input/Output types.
   All Teleterm M3 specific virtual I/O Modules have names that begin M2xxx.
   You can view more information about each module using the "Note" button.

6. Select the desired virtual I/O module and press “Ok” to insert the module in the current slot.

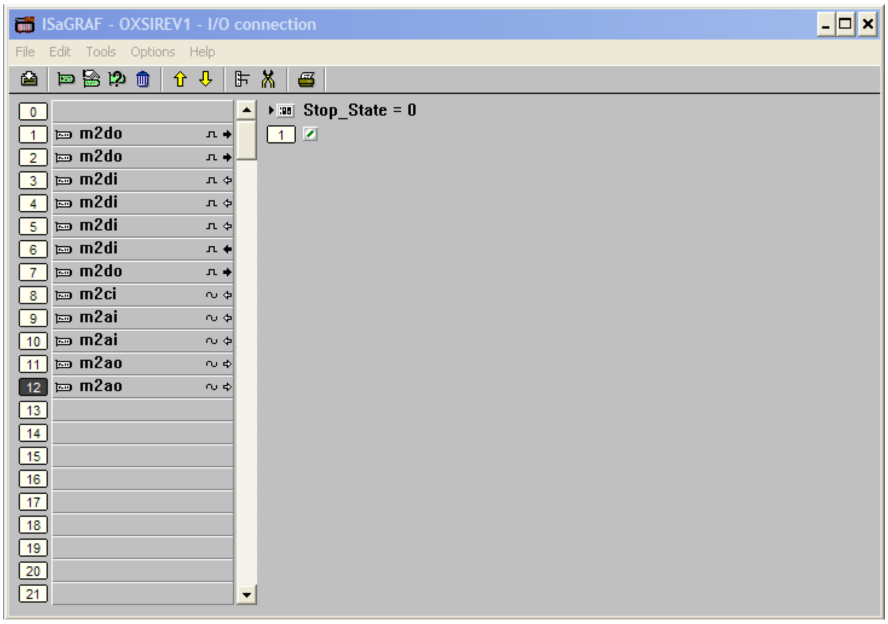


Figure 8.7: ISaGRAF I/O Connections.

7. Once Input and Output variables have been defined in your project dictionary, you can connect these variables to the appropriate virtual I/O Module in this window by selecting “Select Channel/Parameter” from the “Edit” menu or double clicking the desired Channel number on the selected Slot.
NOTE: Some virtual I/O modules have “parameters” which must be set for the correct operation of those modules. See a full explanation in the Note attached to the Maxiflex Module.

8.7 Programming with the DIT

The Data Interchange Table provides a versatile repository for all data used within the Teleterm M3 RTU. This data may be accessed in a User Program in a number of ways:

8.7.1 Using DIT Functions to access data in the DIT

A number of functions are available in the Application Workbench to access data in the DIT. These can be found in the pull-down list of functions available when editing a program in the FBD language, or by entering these functions as text in the ST or IL languages.

NOTE: These functions are implemented immediately, and are NOT synchronised to the program scan. This has the consequence that data is written to the DIT when the function is implemented, and this data is available immediately for use in the same program scan.

8.7.1.1. DITRD - Read a DIT register

Arguments:

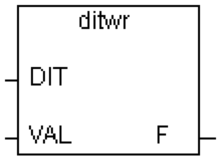
Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address to be read
VAL	OUT	Integer	The 16-bit value read from the DIT Register

Description:

Use this function to read an integer from a local DIT register.

This function cannot be used to access the extended DIT Range

8.7.1.2. DITWR - Write a value to a DIT register



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address to be written
VAL	IN	Integer	The 16-bit value to write to the DIT Register
F	OUT	Boolean	“True” if write is successful

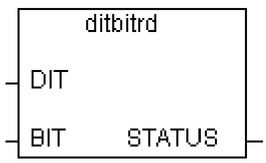
Description:

Use this function to write a 16 bit integer to a local DIT register.

The integer must be in the range –32768 to 32767

This function cannot be used to access the extended DIT Range. (Use the MxDIT_CPY function to copy extended DIT’s to/from an unused local DIT area).

8.7.1.3. DITBITRD - Read a bit from a DIT

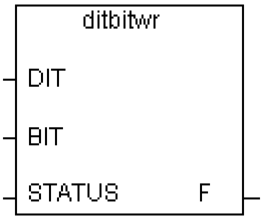


Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address to be read
BIT	IN	Integer	The BIT of the DIT register to be read. BIT must be in the range 0 to 15. BIT 0 is the least significant bit. BIT 15 is the most significant bit.
STATUS	OUT	Boolean	The Bit value read from the DIT Register

Description:
Use this function to read a BIT from a local DIT register as a Boolean.

8.7.1.4. DITBITWR - Write a bit in a DIT



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address to be written to
BIT	IN	Integer	The BIT of the DIT register to be written to. BIT must be in the range 0 to 15. BIT 0 is the least significant bit. BIT 15 is the most significant bit.
STATUS	IN	Boolean	The Bit value to be written
F	OUT	Boolean	“True” if write is successful

Description:
Use this function to write a Boolean value to a BIT in a local DIT register.

8.7.1.5. DITRDD - Read a double word from the DIT

Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address from which to read the double word.
DVAL	OUT	Integer	The 32-bit double word read from the register 'DIT' and 'DIT +1'

Description:

Use this function to read a double word from a local DIT register.

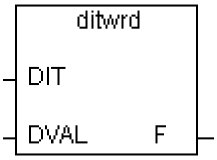
NOTE: the word order for a double word read from DIT register *n* is as follows:

DIT *n* = Most significant word

DIT *n* +1 = Least significant word

This function cannot be used to access the extended DIT Range.

8.7.1.6. DITWRD - Write a double word to the DIT



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address at which to write the double word.
DVAL	IN	Integer	The 32-bit double word to be written to register 'DIT' and 'DIT +1'
F	OUT	Boolean	“True” if write is successful

Description:

Use this function to write a double word to a local DIT register.

NOTE: the word order in the double word written to DIT register *n* is as follows:

DIT *n* = Most significant word

DIT *n* +1 = Least significant word

This function cannot be used to access the extended DIT Range.

8.7.1.7. DITRDDX - Read a double word from the DIT, swapped

Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address from which to read the double word.
DVAL	OUT	Integer	The 32-bit double word read, in reverse word order, from the register 'DIT' and 'DIT +1'

Description:

Use this function to read a double word from a local DIT register.

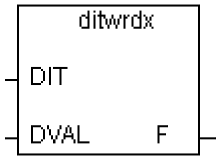
NOTE: the word order for a double word read from DIT register *n* is as follows:

DIT *n* = Least significant word

DIT *n* +1 = Most significant word

This function cannot be used to access the extended DIT Range.

8.7.1.8. DITWRDX - Write a double word to the DIT, swapped



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address at which to write the double word.
DVAL	IN	Integer	The 32-bit double word to be written, in reverse word order, to register 'DIT' and 'DIT +1'
F	OUT	Boolean	“True” if write is successful

Description:

Use this function to write a double word to a local DIT register.

NOTE: the word order in the double word written to DIT register *n* is as follows:

DIT *n* = Least significant word

DIT *n* +1 = Most significant word

This function cannot be used to access the extended DIT Range.

8.7.1.9. DITRDR - Read a real number from the DIT

Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address from which to read the real number.
RVAL	OUT	Real	The 32-bit IEEE floating point real number read from register 'DIT' and 'DIT +1'

Description:

Use this function to read a 32-bit IEEE floating point real number from a local DIT register.

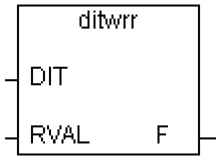
NOTE: the word order for a real number read from DIT register *n* is as follows:

DIT *n* = Most significant word

DIT *n* +1 = Least significant word

This function cannot be used to access the extended DIT Range.

8.7.1.10. DITWRR - Write a real number to the DIT



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address at which to write the real number.
RVAL	IN	Real	The 32-bit IEEE floating point real number to be written to register 'DIT' and 'DIT +1'
F	OUT	Boolean	“True” if write is successful

Description:

Use this function to write a 32-bit IEEE floating point real number to a local DIT register.

NOTE: the word order in the real number written to DIT register *n* is as follows:

DIT *n* = Most significant word

DIT *n* +1 = Least significant word

This function cannot be used to access the extended DIT Range.

8.7.1.11. DITRDRX - Read a real number from the DIT, swapped

Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address from which to read the real number.
RVAL	OUT	Real	The 32-bit IEEE floating point real number read, in reverse word order, from the register 'DIT' and 'DIT +1'

Description:

Use this function to read a 32-bit IEEE floating point real number from a local DIT register.

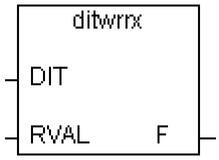
NOTE: the word order for a real number read from DIT register *n* is as follows:

DIT *n* = Least significant word

DIT *n* +1 = Most significant word

This function cannot be used to access the extended DIT Range.

8.7.1.12. DITWRRX - Write a real number to the DIT, swapped



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address at which to write the double word.
RVAL	IN	Real	The 32-bit IEEE floating point real number to be written, in reverse word order, to register 'DIT' and 'DIT +1'
F	OUT	Boolean	“True” if write is successful

Description:

Use this function to write a 32-bit IEEE floating point real number to a local DIT register.

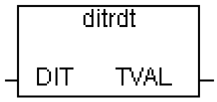
NOTE: the word order in the real number written to DIT register *n* is as follows:

DIT *n* = Least significant word

DIT *n* +1 = Most significant word

This function cannot be used to access the extended DIT Range.

8.7.1.13. DITRDT - Read a timer from the DIT



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address from which to read the timer.
TVAL	OUT	Timer	The timer value read from the register 'DIT' and 'DIT +1'

Description:

Use this function to read a timer from a local DIT register.

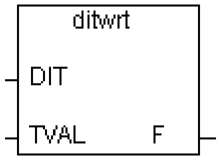
NOTE: the word order for a timer read from DIT register *n* is as follows:

DIT *n* = Most significant word

DIT *n* +1 = Least significant word

This function cannot be used to access the extended DIT Range.

8.7.1.14. DITWRT - Write a timer to the DIT



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address at which to write the timer.
TVAL	IN	Timer	The timer to be written to register 'DIT' and 'DIT +1'
F	OUT	Boolean	“True” if write is successful

Description:

Use this function to write a timer to a local DIT register.

NOTE: the word order in the timer written to DIT register *n* is as follows:

DIT *n* = Most significant word

DIT *n* +1 = Least significant word

This function cannot be used to access the extended DIT Range.

8.7.1.15. DITRDM - Read a message from the DIT

Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address from which the message will be read.
LEN	IN	Integer	The length of the message string or number of characters.
MESS	OUT	Message	Message read from the DIT table starting at 'DIT'.

Description:

Use this function to read a message from the local DIT registers. Each DIT contains two characters. Messages are read from the DIT in increasing DIT order. For example, the message 'user', stored at DIT *n* would be read from DIT *n* and DIT *n*+1 as follows:

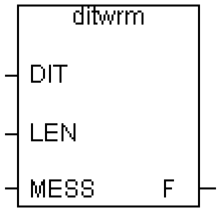
DIT *n* = 'u' (msb), 's' (lsb)

DIT *n*+1 = 'e' (msb), 'r' (lsb)

Always ensure that the variable connected to MESS is greater than or equal to LEN.

This function cannot be used to access the extended DIT Range.

8.7.1.16. DITWRM - Write a message to the DIT



Arguments:

Name	In/Out	Type	Description
DIT	IN	Integer	The DIT Register Address to which the message will be written.
LEN	IN	Integer	The length of the message string or number of characters.
MESS	IN	Message	Message written to the DIT table starting at 'DIT'.
F	OUT	Boolean	“True” if write is successful

Description:

Use this function to write a message to the local DIT registers. Each DIT contains two characters. Messages are to the DIT in increasing DIT order. For example, the message 'user', stored at DIT *n* would be written to DIT *n* and DIT *n*+1 as follows:

DIT *n* = 'u' (msb), 's' (lsb)

DIT *n*+1 = 'e' (msb), 'r' (lsb)

The number of DIT registers that will be written can be calculated as follows:

If LEN is an even number then the number of DIT’s written equals LEN/2

If LEN is an odd number then the number of DIT’s written equals LEN/2+1

This function cannot be used to access the extended DIT Range.

8.7.2 Using “DIT” Virtual I/O Modules to access data in the DIT

In the library of virtual I/O Modules are a number of “virtual” modules that represent data in the DIT as if it were an actual module.

These virtual Modules can be used to read/write data to/from the DIT just as if it was data from the outside world.

As I/O modules, these inputs and outputs can be tagged in the dictionary, and will be updated once per scan.

To use these modules, assign them to an I/O slot in the normal way. I/O slots 13 to 255 can be used for this purpose without encroaching on the real I/O Slots available in the system, although any I/O slot can be used for a virtual module.

Set the DIT parameter in the module to the DIT(s) to be addressed.

See the Descriptive Notes attached to these modules in the ISaGRAF Workbench for more detailed information.

The following table gives a list of these available “DIT” virtual I/O Modules:

Table 8-2: Dit Virtual I/O Modules.

Name	In/Out	Channels	Type	Description
RBI16	IN	16	Binary	Reads the 16 bits from a single DIT register as 16 Binary Inputs.
RBO16	OUT	16	Binary	Writes 16 Binary outputs to the bits of a single DIT register.
RIS1	IN	1	Integer	Inputs 1 single DIT register as a 16 integer
RID1	IN	1	Integer	Inputs 2 contiguous DIT registers as a double integer.
RID1x	IN	1	Integer	As per RID1 but the word order is swapped to calculate the double integer.
RIF1	IN	1	Float	Inputs 2 contiguous DIT registers as a 16 IEEE floating point number.
RIF1x	IN	1	Float	As per RIF1 but the word order is swapped to calculate the 32 bit floating point value.
ROS1	OUT	1	Integer	Outputs 16 integers to a contiguous block of 16 single DIT registers.
ROD1	OUT	1	Integer	Outputs 16 integers to a contiguous block of 32 DIT registers – each integer occupying two consecutive registers as a 32 bit value.
ROD1x	OUT	1	Integer	As per ROD16 but the word order is swapped when storing the double integer.
ROF1	OUT	1	Float	Outputs 16 IEEE floating point numbers to a contiguous block of 32 DIT registers – each number occupying two consecutive registers as a 32 bit number.
ROF1x	OUT	1	Float	As per ROF16 but the word order is swapped when storing the number to the two consecutive DIT registers.
RIS8	IN	8	Integer	Inputs 8 contiguous single DIT registers as 8 integers
RID8	IN	8	Integer	Inputs 16 contiguous DIT registers as 8 double integers. i.e. Each integer is derived from a contiguous pair of DIT's as a single 32 bit integer
RID8x	IN	8	Integer	As per RID8 but the word order is swapped to calculate the double integer.
RIF8	IN	8	Float	Inputs 16 contiguous DIT registers as 8 IEEE floating point numbers. i.e. Each floating point number is derived from a contiguous pair of DIT's as a single 32 bit floating point number.
RIF8x	IN	8	Float	As per RIF8 but the word order is swaped to calculate the 32 bt floating point value.
ROS8	OUT	8	Integer	Outputs 8 integers to a contiguous block of 8 single DIT registers.
ROD8	OUT	8	Integer	Outputs 8 integers to a contiguous block of 16 DIT registers – each integer occupying two consecutive registers as a 32 bit value.
ROD8x	OUT	8	Integer	As per ROD8 but the word order is swapped when storing the double integer.
ROF8	OUT	8	Float	Outputs 8 IEEE floating point numbers to a contiguous block of 16 DIT registers – each number occupying two consecutive registers as a 32 bit number.
ROF8x	OUT	8	Float	As per ROF8 but the word order is swapped when storing the number to the two consecutive DIT registers.
RIS16	IN	16	Integer	Inputs 16 contiguous single DIT registers as 16 integers

RID16	IN	16	Integer	Inputs 32 contiguous DIT registers as 16 double integers. i.e. Each integer is derived from a contiguous pair of DIT's as a single 32 bit integer
RID16x	IN	16	Integer	As per RID16 but the word order is swapped to calculate the double integer.
RIF16	IN	16	Float	Inputs 32 contiguous DIT registers as 16 IEEE floating point numbers. i.e. Each floating point number is derived from a contiguous pair of DIT's as a single 32 bit floating point number.
RIF16x	IN	16	Float	As per RIF16 but the word order is swapped to calculate the 32 bit floating point value.
ROS16	OUT	16	Integer	Outputs 16 integers to a contiguous block of 16 single DIT registers.
ROD16	OUT	16	Integer	Outputs 16 integers to a contiguous block of 32 DIT registers – each integer occupying two consecutive registers as a 32 bit value.
ROD16x	OUT	16	Integer	As per ROD16 but the word order is swapped when storing the double integer.
ROF16	OUT	16	Float	Outputs 16 IEEE floating point numbers to a contiguous block of 32 DIT registers – each number occupying two consecutive registers as a 32 bit number.
ROF16x	OUT	16	Float	As per ROF16 but the word order is swapped when storing the number to the two consecutive DIT registers.

Table 8-3 DIT based ISaGRAF Virtual I/O Module List

8.8 Teleterm M3 RTU Specific Function Blocks

In addition to the standard library of functions and function blocks available in the Application Workbench, some additional Function Blocks (such as Auto-tuning PID control blocks) are available for the Teleterm M3 RTU.

Details of these function blocks can be found in the separate Function Block Application Notes distributed with these function blocks. See your Omniflex distributor for availability.

8.9 Quick Start Example

This example is a quick step by step instruction from starting IsaGRAF for the first time to getting a simple program running on an M3.

1. Start IsaGRAF.
2. From the menu select *File -> New*

3. Give your project a name…

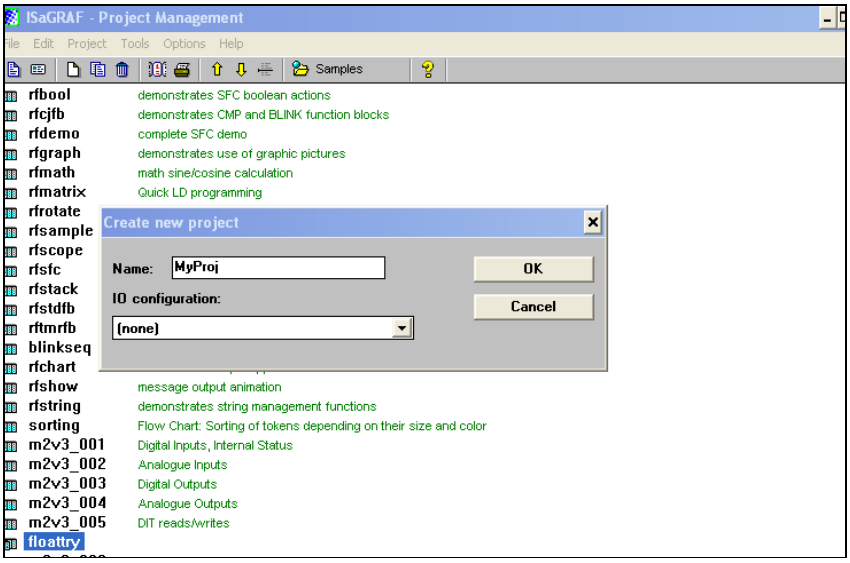


Figure 8.8: Creating a new ISaGRAF project.

4. In the Programs window, from the menu select *File -> New*.

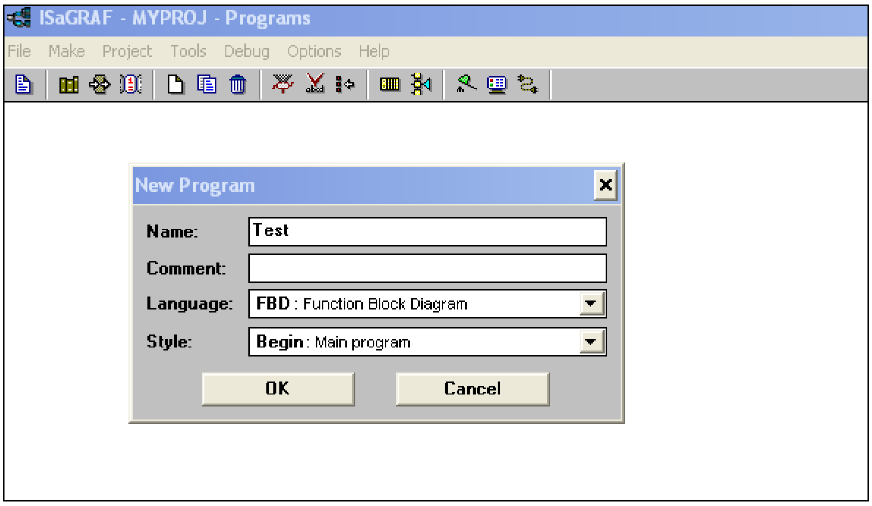


Figure 8.9: Creating a new program.

5. Give the program a name and select FBD for the language. Then Click OK.
6. Click Make -> Compiler Options.
7. Select ISA86M: TIC code for P3 & C236xD, then click OK.

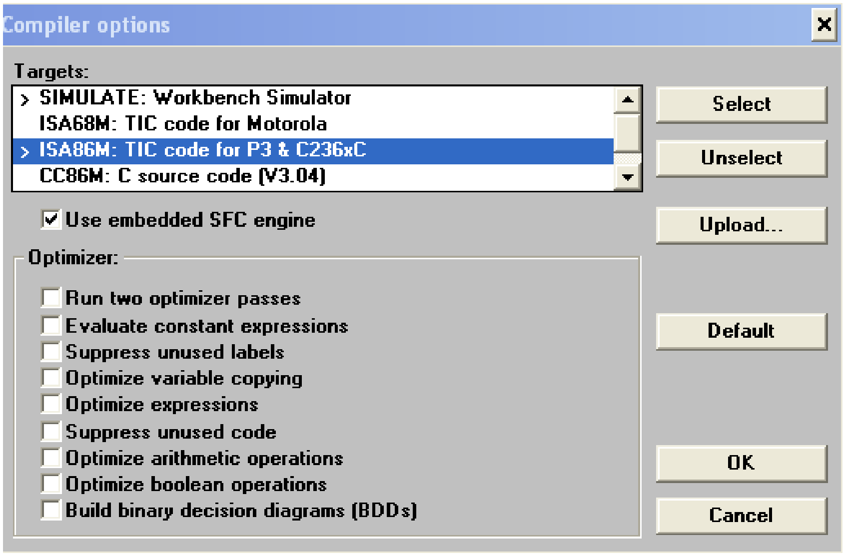


Figure 8.10: Compile options.

8. In the Programs window, double click on your program to open it. (test)
9. In the FBD/LD Program window, from the menu select *File -> Dictionary*.
10. Select the Booleans tab.

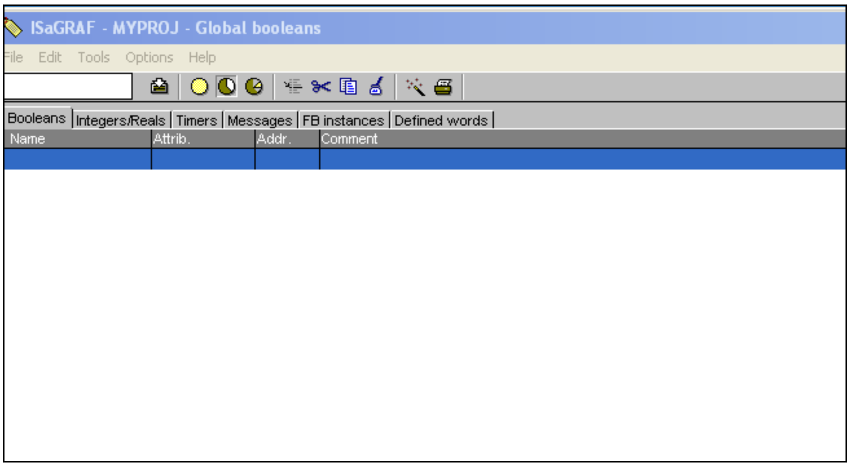


Figure 8.11: ISaGRAF dictionary.

11. Double click under the name space and add three Boolean variables as follows:

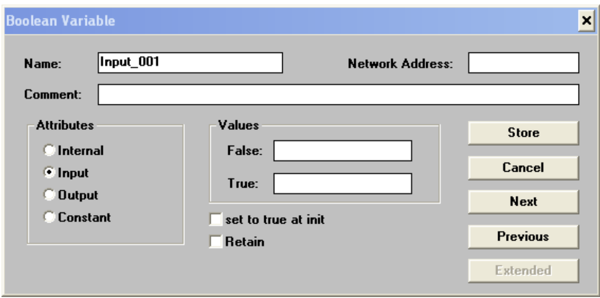


Figure 8.12: Quick start example variable 1.

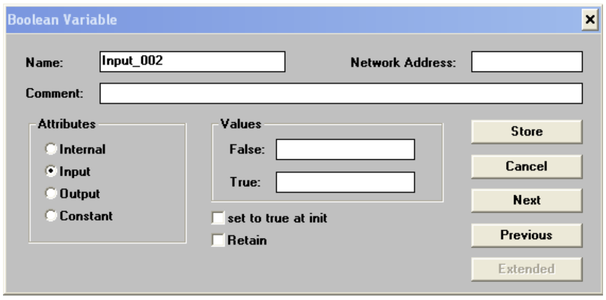


Figure 8.13: Quick start example variable 2.

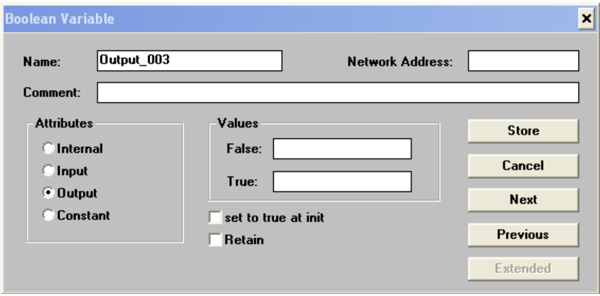


Figure 8.14: Quick start example variable 3.

Then you should have this:

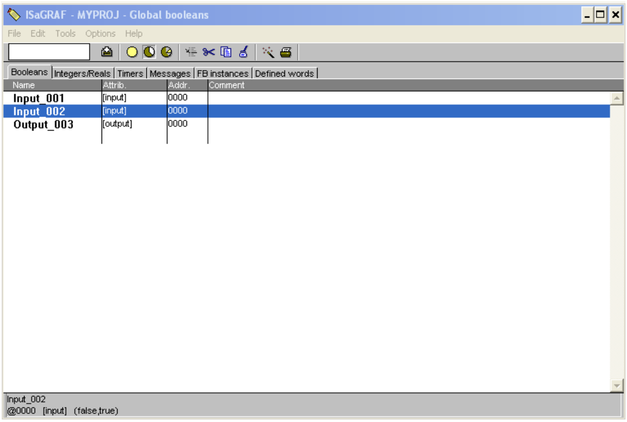


Figure 8.15: Quick start example variables.

12. Save and close this window.
13. Make a *Boolean AND* function.
    Add Input 1 and Input 2 to the inputs and Output3 to the output.
    To add the inputs, you have to click on the “Insert Variable” (4th icon from the left on the bottom row.) button and look for the variables that you created in step 11.

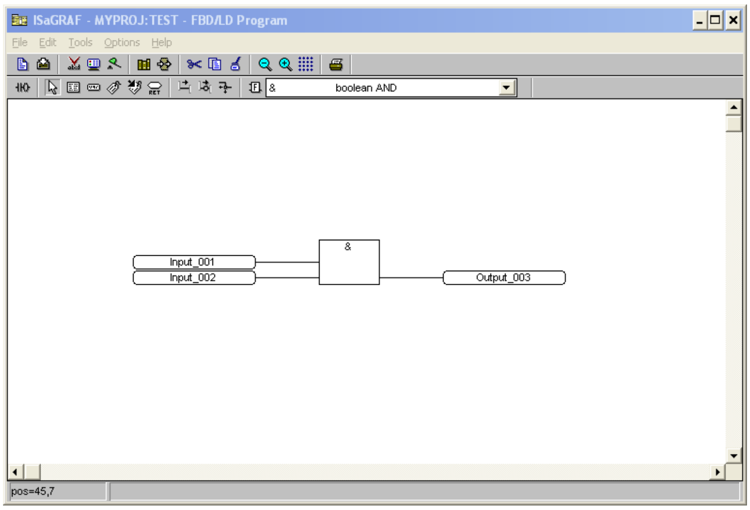


Figure 8.16: Boolean AND function using the variables created.

14. Save and Close the FBD/LD Program Window.
15. Back in the Programs window from the menu select *Project-> IO connection*.
16. Double click on slot 1 and choose M2di.
    Slot 2 – M2di.
    Slot 3 – M2do

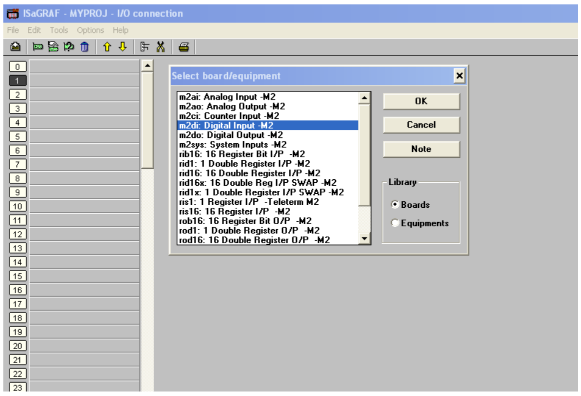


Figure 8.17: Selecting slots numbers.

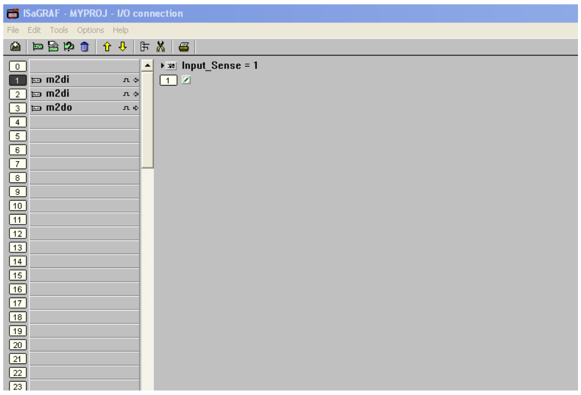


Figure 8.18: I/O connections.

17. Now Connect Slot 1 and Variable: Input_001
    Connect Slot2 and Variable: Input_002
    Connect Slot3 and Variable: Output_003

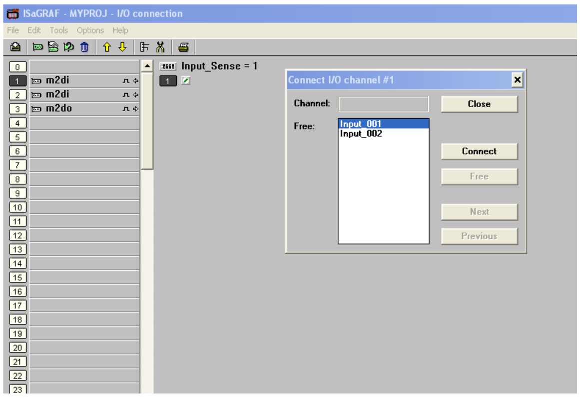


Figure 8.19: Connecting the slots to the variables.

18. Save and close this window.
19. In the Programs window, from the menu select *Make -> Make Application*.
20. Program will compile with no errors.

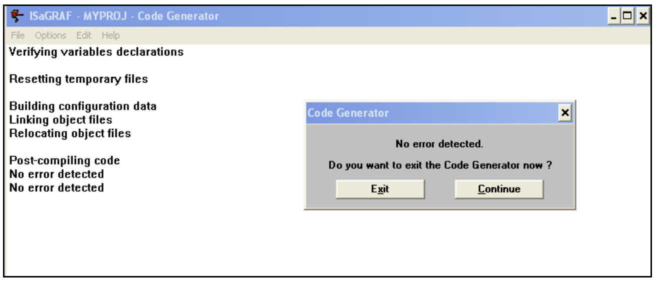


Figure 8.20: Program compiled with no errors.

21. Click EXIT.
22. Select *Debug->Link Setup*.
23. Select *Conet Server* for 'Communication Port'.

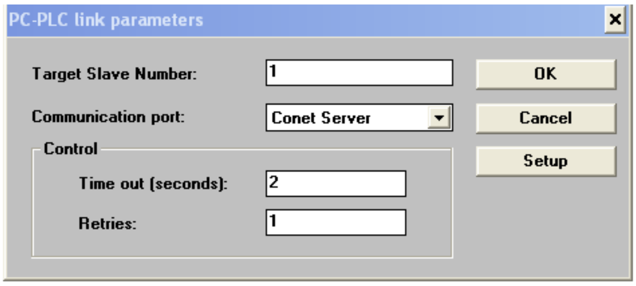


Figure 8.21: PC-PLC link parameters.

Click Setup…

24. Select Conet/s on the COM Port that you are using.

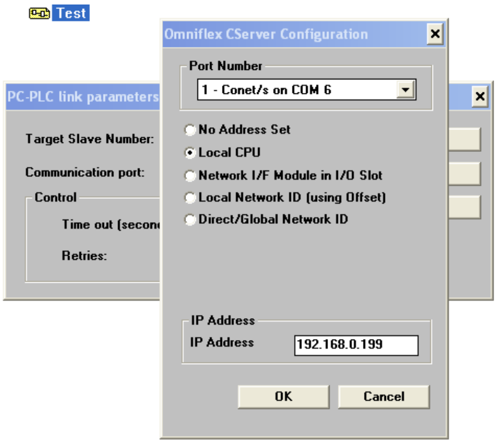


Figure 8.22: CServer configuration.

25. Click On OK, and OK.
26. Then click on Debug->Debug.

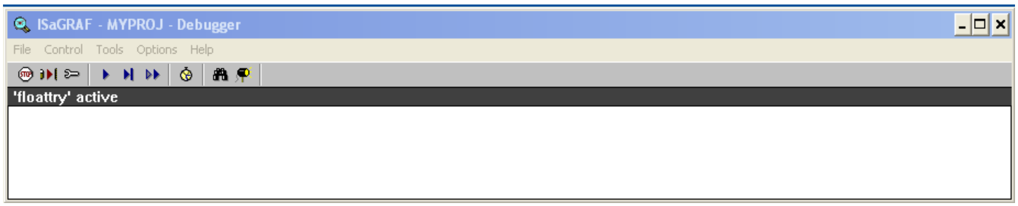


Figure 8.23: ISaGRAF debugger.

27. If there's any program running, then stop the program.
28. Download TIC Code, by selecting *File->Download* from the menu.
29. The program should start to run after download completes.
30. If Input 1 and Input 2 are ON then Output 3 will come ON.

9. Maintenance

9.1 Battery Type

The Teleterm M3 is equipped with an internal clip-in battery for retaining the real time clock during power failures.

This battery is a type CR1220 Lithium Battery. This battery is commonly available from electronic stores or can be obtained from Omniflex.

It is recommended that the battery be replaced at least every three years, or when the battery low indicator in the Teleterm M3 shows LOW. (See the Real Time/Product Status Group in Omniset.

9.2 Battery Replacement Procedure

To replace the internal battery proceed as follows:

1. Remove the top cover of the Teleterm M3 by undoing the two hex cover screws on the top of the unit. The cover is connected to the unit by the internal antenna cable, so be careful not to place any strain on this cable while removing the cover or inserting the SIM card.
2. You will see the battery toward the left lower side of the unit.
3. Unclip the old battery and replace with a new battery
4. Replace the top cover.
5. Restore power to the Teleterm M3.
6. Using Omniset, check that the Battery Indicator is showing “Healthy”.
7. Using Omniset, set the Current Date and Time of Real Time Clock:

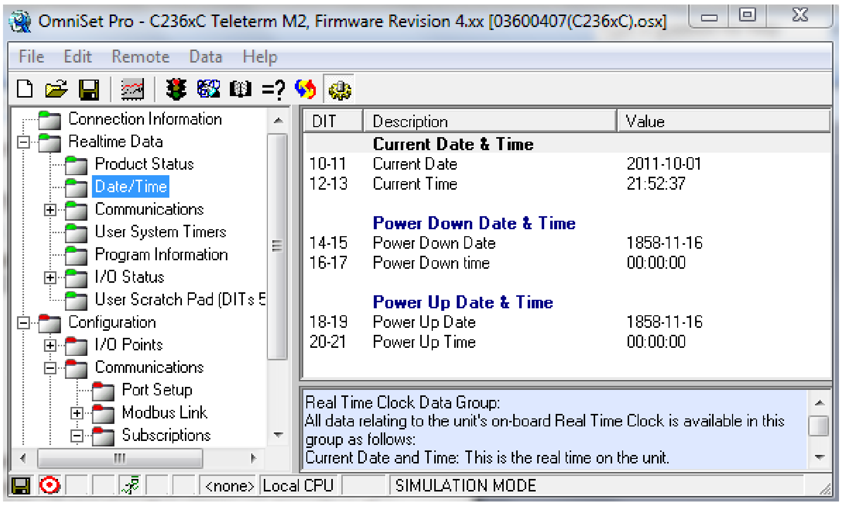


Figure 9.1: Date/Time settings in Omniset.

8. Take care in disposing of the old Lithium battery to preserve the environment, and to prevent accidents.

10. Technical Support

Lifetime technical support for all Omniflex products is available by email on techsupport@omniflex.com.

Alternatively, you can check the knowledgebase on the Omniflex web site at www.omniflex.com.