User Manual

105U-G Wireless Gateway

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Thank you for your selection of the 105G module. We trust it will give you many years of valuable service.

ATTENTION!

Incorrect termination of supply wires may

cause internal damage and will void warranty.

To ensure your 105G enjoys a long life,

double check ALL your connections with

the user's manual

before turning the power on.

Important Notice

ELPRO products are designed to be used in industrial environments, by experienced industrial engineering personnel with adequate knowledge of safety design considerations.

ELPRO radio products are used on unprotected licence-free radio bands with radio noise and interference. The products are designed to operate in the presence of noise and interference, however in an extreme case, radio noise and interference could cause product operation delays or operation failure. Like all industrial electronic products, ELPRO products can fail in a variety of modes due to misuse, age, or malfunction. We recommend that users and designers design systems using design techniques intended to prevent personal injury or damage during product operation, and provide failure tolerant systems to prevent personal injury or damage in the event of product failure. Designers must warn users of the equipment or systems if adequate protection against failure has not been included in the system design. Designers must include this Important Notice in operating procedures and system manuals.

These products should not be used in non-industrial applications, or life-support systems, without consulting ELPRO Technologies first.

1. For 105G modules, a radio licence is not required in most countries, provided the module is installed using the aerial and equipment configuration described in the 105U *Installation Guide.* Check with your local 105G distributor for further information on regulations.
2. For 105G modules, operation is authorised by the radio frequency regulatory authority in your country on a non-protection basis. Although all care is taken in the design of these units, there is no responsibility taken for sources of external interference. The 105U intelligent communications protocol aims to correct communication errors due to interference and to retransmit the required output conditions regularly. However some delay in the operation of outputs may occur during periods of interference. Systems should be designed to be tolerant of these delays.
3. To avoid the risk of electrocution, the aerial, aerial cable, serial cables and all terminals of the 105G module should be electrically protected. To provide maximum surge and lightning protection, the module should be connected to a suitable earth and the aerial, aerial cable, serial cables and the module should be installed as recommended in the Installation Guide.
4. To avoid accidents during maintenance or adjustment of remotely controlled equipment, all equipment should be first disconnected from the 105U module during these adjustments. Equipment should carry clear markings to indicate remote or automatic operation. E.g. "This equipment is remotely controlled and may start without warning. Isolate at the switchboard before attempting adjustments."
5. The 105G module is not suitable for use in explosive environments without additional protection.

Limited Warranty, Disclaimer and Limitation of Remedies

ELPRO products are warranted to be free from manufacturing defects for a period of 2 years from the effective date of purchase. The effective date of purchase is decided solely by ELPRO Technologies.

This warranty does not extend to:

- failures caused by the operation of the equipment outside the particular product's specification, or
- use of the module not in accordance with this User Manual, or
- abuse, misuse, neglect or damage by external causes, or
- repairs, alterations, or modifications undertaken other than by an authorised Service Agent.

ELPRO's liability under this warranty is limited to the replacement or repair of the product. This warranty is in lieu of and exclusive of all other warranties. This warranty does not indemnify the purchaser of products for any consequential claim for damages or loss of operations or profits and ELPRO is not liable for any consequential damages or loss of operations or profits resulting from the use of these products. ELPRO is not liable for damages, losses, costs, injury or harm incurred as a consequence of any representations, warranties or conditions made by ELPRO or its representatives or by any other party, except as expressed solely in this document.

How to Use This Manual

To receive the maximum benefit from your 105U-G product, please read the **Introduction**, **Installation** and **Operation** chapters of this manual thoroughly before using the 105U-G.

Chapter Four **Configuration** explains how to configure the modules using the Configuration Software available.

Chapter Six **Troubleshooting** will help if your system has problems.

The foldout sheet *105U-G Installation Guide* is an installation drawing appropriate for most applications.

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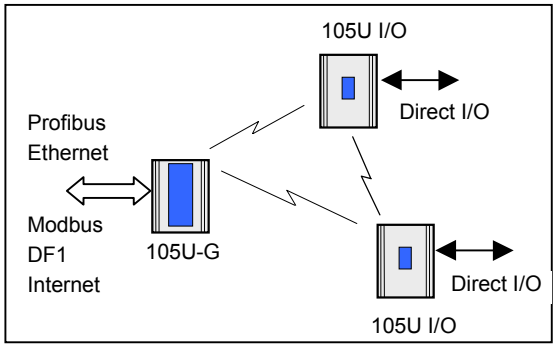
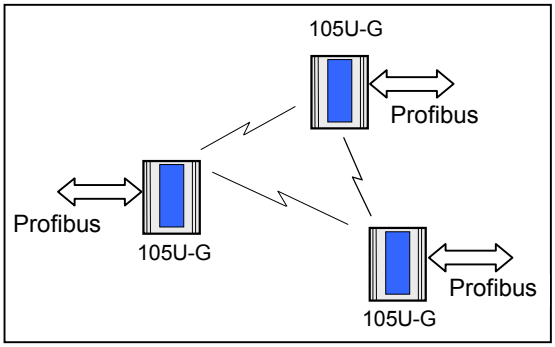
Chapter 1 INTRODUCTION

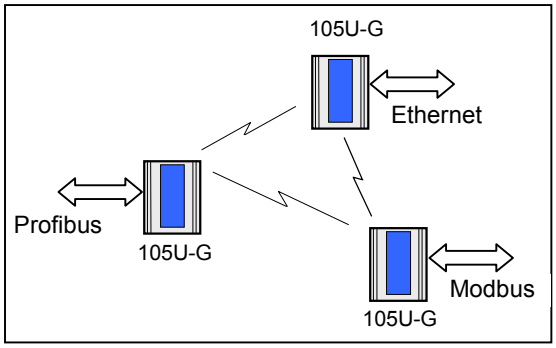
1.1 105G Overview

The 105U-G Wireless Gateway products provide a wireless interface between various data buses used in process and automation applications. The 105U-G includes an integral radio transceiver suitable for licence-free operation in many countries. The 105U-G transfers transducer and control signals (I/O) by radio using a highly secure and highly reliable radio protocol.



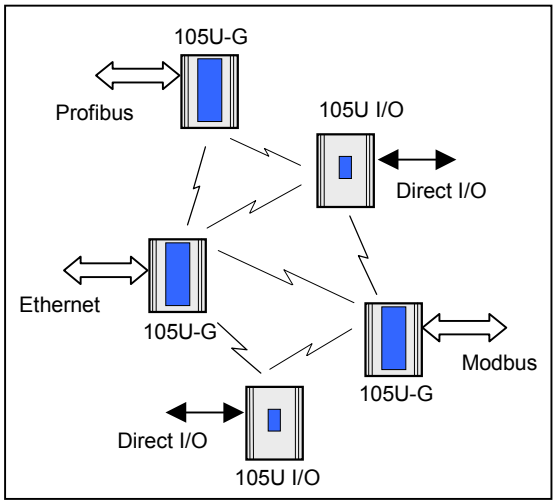
The 105U radio protocol is designed for very efficient radio band usage, with event reporting communications, automatic acknowledgement and error-correction, peer to peer addressing, multiple path routing, and frequency encoding and data encryption for system security.





Application types include:

- The 105U-G interfaces between 105U wireless I/O and various data buses. Connect wireless I/O to PLC's, DCS, SCADA or Internet.
- Wireless extension of factory automation buses such as Profibus.
- Wireless interconnectivity between different data buses - Ethernet to Profibus to Modbus to DF1.
- Combined networks of the above.



The 105U-G has eight on-board discrete I/O. Each I/O point can be configured individually as a contact input signal, or a discrete output signal. Input signals can sent via its data-bus connection to a host device (PLC, DCS etc) or be transmitted by radio to other 105U units. The output signals can be driven by a host device, or linked to inputs on remote 105U units.

This document assumes the reader is familiar with the operation of the 105U I/O modules - for further information, please refer to the User Manuals for these products.

The 105U-G is referred to as the 105G for the rest of this document, to clearly differentiate from normal 105U I/O modules.

Ordering information:

105U-G-MD1	Modbus Master & Slave / DF1 interface
105U-G-PR1	Profibus-DP Slave interface
105U-G-ET1	Ethernet interface - Modbus TCP, Ethernet IP, FTP, HTML, Email

1.1.1 Modbus / DF1 105G

The 105U-G-MD1 can be configured for Modbus master interface, Modbus slave, or DF1.

Modbus is a PLC protocol originally developed by Modicon (now part of the Schneider group). It became a popular interconnect protocol with many equipment manufacturers. Modbus is a "master-slave" protocol. One Modbus master controls the Modbus network communications, which can comprise up to 250 Modbus slave devices. The Modbus master can read or write I/O values to/from Modbus slaves. The 105G can be configured as either Modbus Master or Modbus Slave. The variation of Modbus supported by the 105G is "Modbus RTU" (also known as "Modbus binary").

DF1 is an Allen-Bradley protocol (Allen-Bradley is now part of the Rockwell Automation group). DF1 offers both full-duplex (point to point) and half-duplex (multidrop) operation. The 105G only supports the full-duplex operation - this is the default DF1 mode on most equipment. DF1 full-duplex is a "peer-to-peer" protocol. Either DF1 device can initiate commands to the other device, and both devices will respond to commands from the other device.

The 105U-G-MD1 has two serial connections - RS232 and RS485, on the bottom end plate of the module. The serial port provides both RS232 and RS485 hardware connections, however both connections are paralleled internally - both connections cannot be used at the same time. Either RS232 or RS485 can be used for Modbus communications, **however only the RS232 port can be used for DF1**. The serial port must be configured to suit the host device. Serial data rates between 1200 and 19200 baud may be selected, and character types with 7 or 8 data bits, even/odd/none parity, and 1 or 2 stop bits may be selected.

The Modbus/DF1 105G has 4300 I/O registers. Each discrete, analogue and pulse I/O point takes up one register.

1.1.2 Profibus 105G

The Profibus 105G provides Profibus-DP Slave functionality according to EN 50170. Profibus is a popular automation data bus that originated in Germany and used extensively by Siemens and other automation suppliers.

The Profibus connection on the 105G is optically isolated RS485 using an on-board DC/DC converter. The Profibus port has automatic baudrate detection (9600 bit/s - 12 Mbit/s).

The Profibus 105G I/O database has 4300 registers (each of 16 bit value), however the Profibus interface only supports 416 x 8 bit bytes of I/O, and this limits the amount of I/O that can be transferred via the Profibus port. Of the 416 bytes of I/O, there is a maximum 244 input bytes and maximum 244 output bytes - that is, if 244 input bytes are used then only 172 output bytes can be used (416 – 244). Each byte can represent 8 discrete inputs or outputs, or an 8-bit value, or two bytes can represent a 16-bit value. That is, analogue or pulse I/O can be transferred as 8-bit registers (1 byte) or 16-bit registers (2 consecutive bytes).

An “input” is a value coming into the 105G via the data bus (that is, a value written to the 105G from the Profibus master). An output is a value going out from the 105G via the data bus (a value read by the Profibus master).

So a Profibus 105G could handle up to 1952 (244 x 8) discrete inputs or 244 low resolution analogue inputs or 122 (244 x ½) high resolution analogue inputs, or some combination in between.

For example, a Profibus 105G can handle 400 discrete inputs, 240 discrete outputs, 90 analogue inputs and 60 analogue outputs (assume analogues are 16-bit). The number of input bytes is 230 (400/8 + 90*2). The number of output bytes is 150 (240/8 + 60*2). The total number of I/O bytes is 380. If the number of analogue outputs was increased to 90, then the total output bytes would be 210 (240/8 + 90*2), and the total number of I/O bytes is 440 - this exceeds the capacity of the Profibus interface.

1.1.3 Ethernet 105G

The Ethernet 105G provides several different types of Ethernet functionality:

- Modbus TCP. Modbus TCP uses Modbus as a base protocol within an Ethernet communications structure. The 105G provides class 0, 1 and partially class 2 slave functionality.
- EtherNet IP. EtherNet IP is the version of Ethernet used by Allen-Bradley devices. The 105G provides level 2 I/O server CIP (ControlNet and DeviceNet).
- Internet functionality. The 105G has 1.4Mbyte of non-volatile “flash” memory for embedded web “pages” (dynamic HTTP), on-board file system, user downloadable web pages thru FTP server, and email functionality (SMTP).

The Ethernet connection is a transformer isolated RJ45 connector, 10/100 Mbit/sec.

The Ethernet 105G I/O database has 4300 registers (each of 16 bit value), however the Ethernet interface only supports 2048 input bytes and maximum 2048 output bytes. Each byte can be 8 discrete inputs or outputs, but analogue or pulse I/O take up 1 byte for low resolution values (8-bit) or 2 bytes for high resolution values (16-bit).

An “input” is a value coming into the 105G via the data bus. An output is a value going out from the 105G via the data bus.

So an Ethernet 105G can handle up to 4300 I/O total, but analogue or pulse inputs are limited to 2048 x 8-bit values or 1024 x 16-bit values. The same limit applies to outputs.

For example, an Ethernet 105G can handle 2000 discrete inputs and 500 analogue inputs (assume analogues are 16-bit). The number of input bytes is 1250 (2000/8 + 500*2). The same unit could handle 4000 discrete outputs and 750 analogue outputs. The number of output bytes is 2000 (4000/8 + 750*2). The total number of I/O is 3250 which is less than the total limit of 4300.

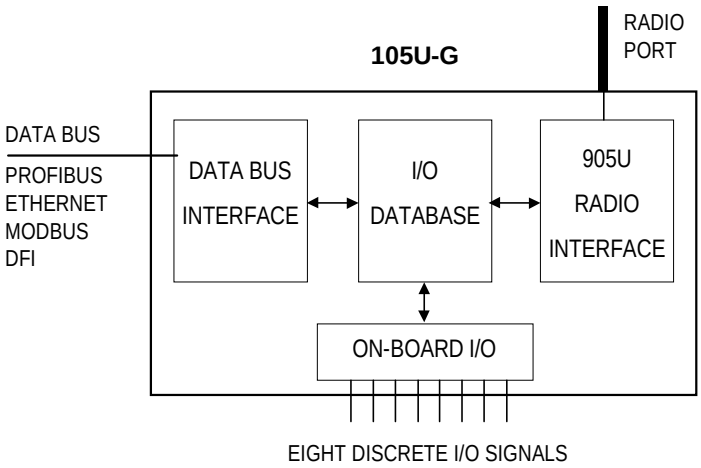
1.2 The 105G Structure

The 105G has three functional sections:

- An I/O database (or "Process Image") maintains the latest values of all I/O in the wireless I/O system. The I/O database comprises 4300 x 16 bit I/O registers and 4300 x 16 bit

status registers. There are also other registers in the database that can be used for system management - they are discussed later in this manual.

- The radio port allows the 105G to communicate with other 105G and/or 105U modules using the 105U protocol (called "ELPRO 105U"). Messages from the 105U modules are received by the radio port and used to update the input values in the 105G database. The radio port also creates the correct radio message to set outputs on the remote 105U modules.



  The ELPRO 105U protocol is an extremely efficient protocol for radio communications. Radio messages can be sent using exception reporting - that is, when there is a change of an input signal - or by read/write messages. Each message can comprise a single I/O value, or multiple I/O values (termed a "block" of I/O). There are also update messages, which are sent for integrity purposes. Messages include error checking, with the destination address sending a return acknowledgement. Up to five attempts are made to transmit the message if an acknowledgement is not received. The ELPRO 105U protocol is designed to provide reliable radio communications on an open licence-free radio channel.

- The Data-Bus port enables communications between a host device, which could be a PLC, DCS, HMI, intelligent transducer, or an actual data-bus), and the 105G database. A "host device" may be several devices connected to a data-bus (for example, an Ethernet LAN) - in this manual, the LAN is considered as a "host device".

The data-bus port decodes messages from the host device and reads or writes I/O values to the database. The data-bus port can also generate messages to the host device.

The 105G database effectively isolates the data-bus and the radio network. This provides a high level of system performance. The 105U radio protocol is very efficient and reliable for radio communications. It minimises radio channel usage by "change-of-state" reporting, and allows the use of intermediate repeater addresses. It also allows peer-to-peer (105U to 105U, 105G to 105G) and peer-to-master (105U to 105G) communications. PLC protocols, by comparison, are designed to provide transfer of large I/O files by "wire" link. The 105G retains the advantage of both protocols in their respective communications media.

1.2.1 On-board I/O

The 105G has eight on-board discrete I/O. Each I/O point can be used as either a discrete input (voltage free contact input) or discrete output (transistor output) - an I/O point cannot be used as both input and output. Each I/O point is linked to two separate registers I/O registers in the database - one for the "input" function and one for the "output" function.. If the output register is set "on" by the data bus or by a radio message from a remote module, then the 105G will automatically set the input register for the same I/O point to "off".

The 105G also has three internal inputs linked to I/O registers:

- Supply voltage status - if the normal supply fails, this status is set on.

- Low battery voltage. The 105G has an internal battery charger to trickle charge a back-up battery. If the battery voltage is low, this status is set.
- Battery voltage - the actual value of the connected battery voltage.

1.3 The Wireless Network

The 105G can communicate with up to 490 other addresses - this could be 490 other 105U modules, or in the case of 105K modules, it could be many thousands of modules (as many 105K modules can share the same address). 105G modules may take up more than one address under some circumstances.

Any 105G or 105U module can act as a radio repeater for other modules - that is, radio messages can be passed onto other modules. Up to five repeater addresses can be configured for messages transmitted to a 105G module.

Each module can have a unit address between 1 – 95, but the 105G also recognises repeater addresses in conjunction with the unit address as the module "identifier". Hence module #2 is recognised as different to #2 via #57 - #57 being a repeater.

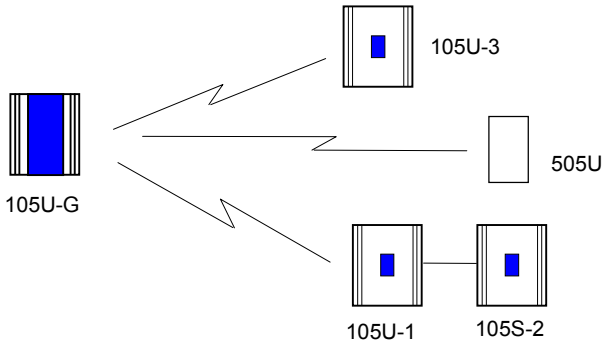
1.3.1 105U to 105G Network

In the wireless I/O system, the 105G acts as a normal 105U module (this covers 105U I/O, 105S I/O, 505U and 105U-C modules).

105U modules transmit messages to the 105G address and the 105G acknowledges these messages like a normal 105U module. When a 105G transmits messages to change remote outputs, it will "re-try" if it does not receive an acknowledgement, like a normal 105U module.

Remote 105U modules can connect to 105S modules in the normal way. The 105G host can access I/O on 105S modules by using the intermediate 105U as a repeater. 105S modules cannot connect directly to a 105G module.

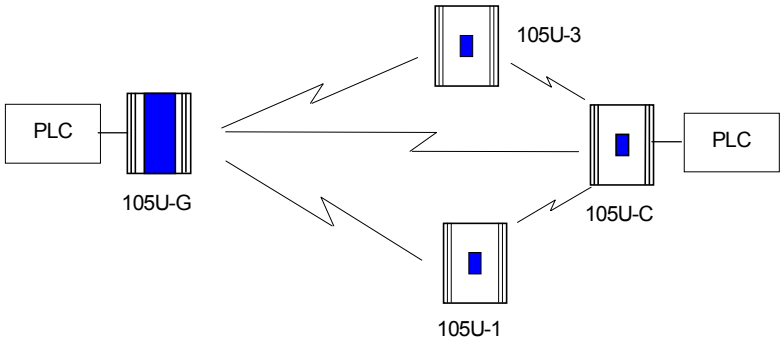
105U modules can transmit input messages directly to outputs on other 105U module, as well as the 105G. The same input can be transmitted to different addresses by entering two "mapping" configurations at the remote module.



Normal 105U Messages

I/O registers in a 105G can be configured (mapped) to outputs at remote 105U modules, or I/O registers in 105G modules. The 105G will transmit an I/O message when a "change-of-state" occurs for that I/O register . Registers have a configurable "sensitivity" value - this determines how much the register value has to change to trigger a change message. A change-of-state occurs when the register value has changed by more than the sensitivity value since the last transmission.

The 105G also transmits periodic update messages if there has been no change - if an I/O register is mapped to a remote output or another 105G, then that register can be configured with an update time.



105G modules can transmit to 105G modules as well as other 105G modules. There can be multiple 105G and 105C modules in a network - as well as 105U I/O. Because the 105U protocol is peer-to-peer, there are few constraints on communications between multiple 105U modules.

Poll Messages

A 105G can also generate poll messages to remote 105U modules. These poll messages act in the same way as a start-up poll - the remote module immediately responds with update messages for any I/O mappings configured to the 105G.

Poll messages can be triggered by:

- time period, configurable 1 – 4096 sec (1.1 hour), or
- real time clock, or
- on demand by the host device, by writing to a "trigger register" in the 105G

1.3.2 105G to 105G Network

Different types of 105G modules can communicate - for example, a Modbus 105G can communicate with an Ethernet 105G. I/O registers in one 105G can be transmitted to I/O registers in another 105G. When the 105G is configured, "mappings" can be entered linking I/O registers to registers in another 105G.

As well as the normal "I/O change" messages and update messages, the 105G has "block read" and "block write" messages for use with other 105G modules. These messages will transmit multiple register values instead of only one as in the normal 105U message. The block read/write messages increase the efficiency of radio communications where a 105G "sees" a large number of changes in its database at the one time. For example, if a host writes a block of 100 signal values to a 105G, and 20 of these values have changed since the last write-operation. If the block is mapped to another 105G, then the 105G can transmit all 20 values in one radio message, instead of 20 messages.

Normal I/O messages can be repeated by any type of 105U I/O module, however block read/write messages can only be repeated by other 105G modules.

Block Read Message

A block read message is a request to another 105G to transmit the values of a consecutive block of registers. The destination 105G will respond with the values, which will be stored in a corresponding block of registers in the originating 105G. A block read message can be triggered by:

- time period, configurable 1 – 4096 sec (1.1 hour), or

- real time clock, or
- on demand by the host device, by writing to a "trigger register" in the 105G.

Block Write Message

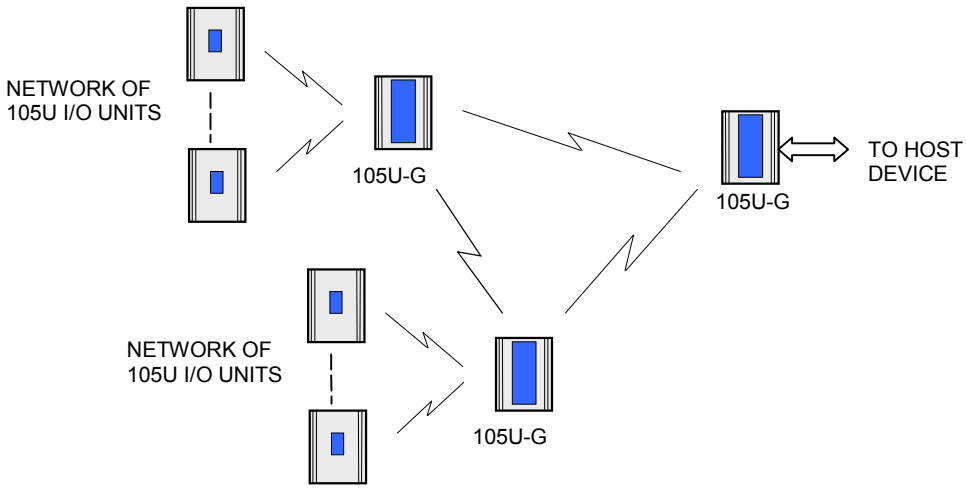
A block write message transmits a consecutive block of register values from one 105G to a destination 105G. It can be triggered by:

- time period, configurable 1 – 4096 sec (1.1 hour), or
- real time clock, or
- on demand by the host device, by writing to a "trigger register" in the 105G, or
- a change-of-state event occurring within the block of I/O registers.

If a block write message has been configured to be transmitted on change-of-state, a "time window" is configured. When a change-of-state occurs in one of the registers in the block, the time window will be activated. All changes during the time window will be grouped together and transmitted as one block write message. That is, the block write message will not be sent immediately the first change-of-state occurs (unless the time window is configured to zero), but will be sent at the end of the time window - any other registers in the block that change during the time window will be sent as part of the same message. The time window can be configured from 0 – 255 seconds.

1.3.3 "Data Concentrator" Networks

105G units can act as "data concentrator" units to collect I/O from a local network of 105U wireless I/O modules and pass the I/O on to another 105G as a block.



This type of network reduces the amount of radio traffic and is suitable for systems with a large number of I/O modules. The system is divided into local sub-networks, each with a 105G unit. The 105U modules transmit their I/O vlaues to the 105G. The 105G then transfers these values to the "central" 105G using a block transfer which is very efficient compared to a lot of individual I/O transmissions.

The data concentrator network is different than using the 105G as a repeater. A repeater re-transmits each message in the same format. A data concentrator collects the I/O values as a block, and transmits the complete block in one transmission.

Chapter 2 OPERATION

2.1 Start-up

The 105G operating software and the database configuration are stored in non-volatile memory, however the database I/O register values are lost on power failure (in the same way as a PLC).

On start-up, the 105G sends "start-up poll" messages to remote modules based on the source address of inputs configured in the database (the start-up messages can be disabled by configuration). The remote modules respond with update messages for their inputs, which sets initial values in the 105G I/O database registers. The 105G provides a delay of 5 seconds between each start-up poll, to allow the remote module to respond and to avoid overloading the radio channel.

If there are a lot of remote modules, then this start-up stage may take a significant time, and this should be allowed for in the system design. The 105G has an internal battery charger feature and the use of a back-up battery should be considered if this start-up delay presents a constraint to system reliability. Start-up polls may be disabled for individual remote modules in the database configuration.

For the host device, the 105G provides an "Active" signal on the RS232 port (DCD pin 1). Its purpose is to indicate to the host that the 105G is now processing output messages for the remote modules. When the 105G powers down (or should an internal fault occur), the "Active" signal resets (turn “off” or “0”). When the 105G starts-up, it holds the "Active" signal in a reset condition (“off” or “0”) for a time equal to the number of remote addresses (or modules) configured times 5 seconds plus any delay if remote addresses are offline. For example, if there are 20 remote addresses configured in the 105G database, then the “active” signal will be held in the reset state for 100 seconds (20 x 5). During this period, the 105G will not change any output values in its database. After this time, the 105G will set the "Active" signal (to “on” or “1”) - the host can then send messages to the 105G to update the output values in the database.

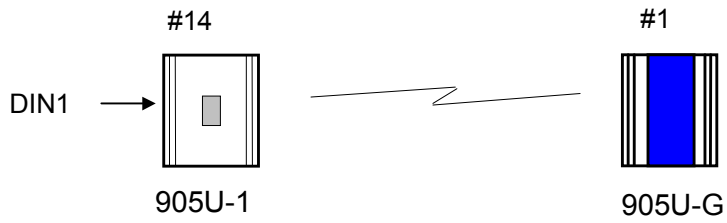
2.2 Operation

The 105G database can hold values for 4300 I/O signals plus the 8 on-board I/O. The database registers (also called I/O registers) can be accessed by both the radio port and the data bus port. The host device can change values in the database via the data bus, and the 105G can transmit radio messages out with the new values. Radio messages can be received with new values for database registers, and these new values can be written to the host device or read by the host device, via the data bus.

The 105G operation must be configured before the 105G will function. Configuration is achieved by creating a configuration file on a PC and downloading this file to the 105G. The 105G configuration may also be "uploaded" to a PC for viewing and modification. For more information, refer to the **Configuration** section of this document.

Each I/O register in the 105G database has a 16-bit value. It doesn’t matter if the remote I/O is digital (discrete), analogue or pulse. The host protocol driver in the 105G will convert the 16 bit value into a value that the host will understand. For example, if the host device

requests a binary/digital read command, the 105G will convert the 16 bit value into a binary (1 bit) value before it responds.



An example of normal operation - assume that a remote module has address 14 and the 105G is address 1. Module #14 is configured with a mapping DI1 → I/O Reg 76 at #1. When DI1 turns "on", module #14 transmits a message. If the 105G can hear this message, it will transmit an acknowledgement back to module #14, and updates the value of I/O register 76 in the 105G database. The host device can read I/O register 76 via the data-bus, or the 105G may write the value of I/O register 76 to the host device.

I/O registers that receive values from other 105U or G modules via radio are configured with a “Communications fail time”. If the 105G does not receive a message for this I/O register within the comms-fail time, then the I/O register is given a “comms fail” status which the host device can read.

I/O registers that transmit out to other 105U or G modules are configured with an “update time” and a “sensitivity”. The 105G will transmit a message to the configured remote output whenever the I/O register value changes by the sensitivity amount – if it has not changed within the update time, the 105G will send a message anyway. The 105G will make five attempts to send a message - if it does not receive an acknowledgement from the remote module, then the I/O register is given a “comms fail” status which the host device can read.

Each I/O register has an associated “status” register, which includes information such as comms-fail status. As well as each I/O register having an individual comms-fail status, each remote module has an overall comms fail status. This status is “set” (on) whenever a comms-fail occurs for an individual I/O register, and is “reset” (off) whenever a message is received from the remote module. The 105G can be configured to not send any update messages to a remote module if it senses that the remote module is in “comms fail” - that is, if any I/O register associated with the remote module is in “comms fail”. It will start sending update messages again when the 105G receives a message from the remote module. The default configuration is that output updates ARE sent during comms fail conditions.

2.3 Database

The 105G database has 10 000 registers, each of 16 bit size. The structure of the database is:

Registers	Purpose
0 - 4299	I/O registers
4300 - 4399	On-board I/O
4401 - 4495	Comms-fail status and radio strengths for remote modules
4496 – 4999	Spare - General use
5000 - 9399	Status registers - 16 bit status for each I/O signal
9400 – 9500	Spare – General use
9500 - 9999	Status registers for block read/write messages

The register numbers may be used by the Host Protocol Driver to access I/O values and I/O status information. Each configured I/O point has a 16 bit value (in registers 0000 - 4299), and a 16 bit status value. The status register is located at 5000 plus the I/O value register. For example, an I/O point in register number 2560 has a status value in register number 7560 (5000 + 2560).

Details of the status register are provided in Appendix A. The most important part of the status register is the 15th or most significant bit - this indicates comm-fail status for the I/O register. If the most significant bit is set, then the I/O register is in comms-fail.

The host device can read the status registers. For example, the communications status of an output configured at register number 3001 can be examined by reading register number 8001 (5000 + 3001). If the register value is greater than 32767, then the 15th bit is set, indicating that the output has a communications failure.

2.3.1 On-board I/O and Internal I/O

The 105G has eight discrete I/O points. These may be used as inputs or as outputs. Inputs are linked to registers 4300-4307. That is, if a contact connected to DIO1 is “on”, then register 4300 is given an “on” value. Outputs are controlled from registers 4320-4327; that is, if register 4327 is set to an “on” value, then output DIO8 is activated.

Whenever an output register is set “on”, the corresponding input register is automatically set “off”. For example, if register 4321 is set to “1”, the 105G will also set 4301 to “0”. This means that if both the input and output registers corresponding to the same I/O point are used in the configuration, then the output register has priority.

Outputs may be written to by either the host device or by a remote 105U via the radio port. Input values can be sent to the host device or to a remote module via the radio port.

The 105G also monitors its battery voltage and supply voltage. These are stored in registers 4310 and 4311 respectively, as 16 bit values, scaled so that a value of 16384 decimal (hex 4000) corresponds to 8 V, and a value of 49152 (hex C000) corresponds to 40V.

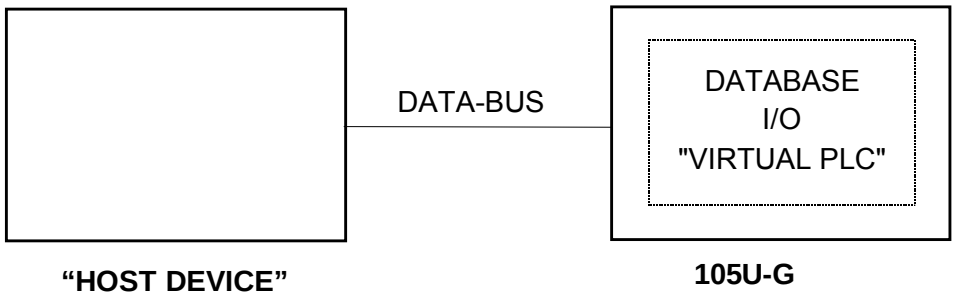
A low battery alarm is available at register 4308. This becomes active when the battery voltage falls below 11.3V, and clears when the battery voltage rises above 11.8V. Supply voltage is also monitored, and an alarm is available at register 4309. This becomes active if the supply voltage falls below 8.0V, and clears when the supply voltage rises above 9.0V.

I/O Register	Description
4300	Input value DIO 1
4301	Input value DIO 2
4302	Input value DIO 3
4303	Input value DIO 4
4304	Input value DIO 5
4305	Input value DIO 6
4306	Input value DIO 7
4307	Input value DIO 8
4308	Low battery voltage status
4309	Supply voltage fail status
4310	Battery voltage value
4311	Supply voltage value

I/O Register	Description
4320	Output value DIO 1
4321	Output value DIO 2
4322	Output value DIO 3
4323	Output value DIO 4
4324	Output value DIO 5
4325	Output value DIO 6
4326	Output value DIO 7
4327	Output value DIO 8

2.4 The Host - 105G Link

For the host device, the 105G "looks" like a PLC (or a "virtual PLC"), containing the I/O for the complete wireless I/O system.



2.4.1 Modbus / DF1

The user selects whether the 105U-G-MD1 should act as a Modbus Master or Modbus Slave or DF1 device.

The data type and baud rate of the serial communications must be configured at the 105G to match the host. Data types can be 7 or 8 bit, even/odd/no parity, with 1 or 2 stop bits. Data rates can be 300 - 19200 baud.

The full 105G database (4300 registers) can be accessed by the Host Device.

2.4.2 Profibus

The Profibus port has auto-detect of baud rate from 9600 bits/sec to 12Mbit/sec - no configuration is required. A Profibus slave address must be entered (1 – 126).

The Profibus port cannot access the full 105G database. The 105U-G-PF1 Profibus unit has an internal HMS Anybus board to provide the Profibus interface. The Profibus port (that is, the "host device") communicates with the HMS board which communicates with the 105G database. Links are configured linking the database I/O registers and the HMS Profibus I/O bytes.

The HMS module provides a total of 416 I/O bytes, with a maximum 244 input bytes and maximum 244 output bytes. A Profibus byte can contain 8 discrete (binary) values, or two bytes can be used for a 16-bit analogue or pulse register. So the HMS Profibus interface is limited to 1952 discrete inputs or 122 analogue inputs or a combination. The same applies for outputs.

For example, a Profibus host wants to read 800 discrete inputs (100 bytes) and write 400 discrete outputs (50 bytes). This will take up 150 bytes of the HMS interface, leaving 266 left. The remaining bytes could be used for 133 analogue I/O - up to 72 analogue inputs (244 – 100 discrete input bytes) plus 61 analogue outputs - or vice-versa.

2.4.3 Ethernet

The Ethernet port automatically handles Ethernet communications at 10 or 100 Mbit/sec. A device IP address is entered so that other Ethernet devices can recognise the 105G.

The Ethernet port cannot access the full 105G database. The 105U-G-ET1 Ethernet unit has an internal HMS Anybus board to provide the Ethernet interface. The Ethernet port (that is, the "host device") communicates with the HMS board which communicates with the 105G database. "Data bus links" are configured between the database I/O registers and the HMS Ethernet I/O bytes.

The HMS module provides a total of 2048 input bytes and 2048 output bytes. A Ethernet byte can contain 8 discrete (binary) values, or two bytes can be used for a 16-bit analogue or pulse register. So the HMS Ethernet interface is limited to 4300 discrete inputs (the limit of the 105G database) or 1024 analogue inputs (the limit of the HMS interface) or a combination. The same applies for outputs.

For example, an Ethernet host wants to read 500 analogue inputs (1000 bytes). The remaining input bytes (1548) could be used for 12,384 discrete inputs - but the 105G database is not this big. Provided there are no outputs required, there could be 3800 discrete inputs (4300 – 500 analogues). If there are outputs required, then the number of discrete inputs available will be further limited.

2.5 Radio System Design

Each wireless I/O system can have up to 95 unit addresses, although up to 255 505U module can share the same unit address (refer to 505U User Manual).

Each 105U module can have up to 31 x 105S modules connected to it. These modules are addressed 96 - 127. More than one 105S module can have the same address, provided they are not connected to the same 105U module - that is, #100 via #16 is identified as a different module to #100 via #65.

A constraint that needs to be considered is the capacity of the radio channel. If there is too much traffic on the radio channel, then the system quickly becomes unreliable. The recommended maximum average traffic density is 40 messages per minute provided all radio paths are reliable. If there are marginal radio paths, resulting in re-tries of transmitted messages, then the maximum traffic density is reduced considerably. Each block read/write messages should be counted as two messages because of the length of these messages.

A 105G can be used as a repeater module for messages between other modules.

2.5.1 Radio Signal Strength

The 105G records the radio signal strength of remote modules that communicate directly (that is, not via repeaters). There are 95 database registers (4401 – 4495) which store the radio strengths – corresponding to remote addresses #1 - #95. The radio strength (RSSI) is measured in dBm (relative to 1mW of RF power). The RSSI value is stored in the 8 least significant bits of each register - a value of –84 dBm would be stored as decimal 84.

These database registers will hold the strength of the last message received from the address. If a message is received from a remote module via a repeater, then the measurement is recorded in the address of the last repeater. For example, if a message is received from #24 directly, then the RSSI will be recorded in register 4424. If a message is received from #24 via #25, then the RSSI is recorded in register 4425. The 105G will not know what the radio strength of the message from #24 to #25 is. If #25 is another 105G, then it can record this RSSI and this register could be mapped to an I/O register in the first 105G.

These RSSI registers can be read by the host device as well as being mapped to I/O registers in other 105G modules.

The first half of the register (8 most significant bits) will be decimal 0 (hex 00) if the remote module has active communications. If a comms fail status to this address occurs, the most significant bit will be set. For example, if the last message received from #38 is –99dBm, then the 16 bit value of register 4438 will be decimal 99 or hex 0063. If the “comms fail” status for #38 is set, the 16 bit value of register 4438 will become decimal 32,867 (32768 + 99) or hex 8063.

2.5.2 Repeaters

Radio paths may be extended by using intermediate modules as repeaters. A repeater will receive and re-transmit the radio message. Up to five repeater addresses can be configured - that is, a radio message can pass through five intermediate modules. For normal I/O messages, any 105U module (except 505U modules) can be used as a repeater, however for block read/write messages, only 105G modules can act as repeaters.

2.6 Radio Comms Failure

The 105G has an internal "communications failure" (comms fail) status for each I/O point in its database. There is also a comms fail status for each module with direct communications - see 2.5.1 above.

For I/O registers which are mapped to a remote output or another 105G, the comms fail status is set if the 105G does not receive an acknowledgement for a message being sent to that remote output. The comms fail status resets when a successful transmission occurs.

For I/O registers which have been mapped , from a remote input or another 105G, a comms fail time period may be configured. If a radio message for this I/O register has not been received within this time, then this registers comms fail status is set. The comms fail status will reset when a message is received for this register. If the comms fail time is configured as zero, then the comms fail status will never be activated.

The communications failure status is bit 15 of the status register for each I/O point. If the host device reads a register as a digital or binary value, then the 105G returns bit 15 of the register (0 or 1) - this is the comms fail bit of a status register.

It is important to use the comms fail status in the overall system design, as any system can fail.

The 105G also provides an additional comms failure feature to stop the 105G transmitting output messages to an individual remote address if the 105G already knows that this remote address is in communication failure. This prevents the 105G from congesting the radio channel with a lot of unnecessary transmissions (and re-transmissions). This function is called "Don’t Send if In Comm Fail" and is configurable by the user for each individual remote address. The 105G retains a "remote address comms fail" status for the remote addresses configured for this function. If any output with this remote address goes into communications failure, then the remote address comms fail status is set ("on" or 1) - every time an input with this remote address receives a radio message, then the remote address comms fail status is reset ("off" or 0). While the remote address comms fail status is set, the 105G disables any output messages being sent to this remote address.

When this feature is configured, all output transmissions are stopped if communications with a remote module fails for a short period. They will start again when an input message from this module is received. If the 105G determines that a output message should be sent to an output which is disabled because of this feature, then the output message will not be sent and the comms fail status of that output is set ("on" or 1).

If it is desired to use this function with a remote 105U module, but there are no inputs from this module being used, then it is easy to configure an unused input or an internal input (mains fail or low battery voltage etc). It is the comms fail status for the input, which is used, not the input itself.

2.6.1 Monitoring Communications Failure

The host device can monitor the communications status of an I/O point by reading the status register for this point as a binary/discrete register. Modbus, and many other protocols, will convert a 16 bit register value to a binary/discrete value by returning the most significant bit - for the status register, this corresponds to the comms status bit.

For example, to monitor the comms status of I/O register 1045, perform a binary/discrete read on register 6045 (the status register for 1045). A value of "1" will be returned if this I/O point is in comms fail, and a "0" returned if the status is normal.

If it is desired to monitor the comms status of all I/O points, it is more efficient to only monitor the comms status of one I/O point at each remote module (if this point is in comms fail, then all points at the remote module will be in comms fail). If this point is an input, then the comms fail time for this input can be made short, to give an early warning of a comms problem (this means that the corresponding update time for the input at the 105U will need to be short). If the point is an output, then the update time for the output should be made short.

2.7 Security Considerations

There are three dimensions of security considerations:

1. Failure to operate when required - or "operational reliability".

   The features discussed above optimise operating reliability. Using an acknowledgement and re-try protocol ensures that the transmitting module is aware whether the transmitted message has been transmitted reliably. The "comms fail" alarms provide indication if the radio link has failed to operate.

2. Mal-operation, or operating when not requested.

   This problem occurs when an output is "triggered" by the wrong radio device. The 105G modules use frequency encoding and a very secure addressing system to ensure this does not occur. An additional security level using data encryption can also be selected.

3. Malicious operation, or "hacking"

   This is the problem most associated with security concerns - the ability for someone to access information from a radio system by "listening-in", or to cause damage by transmitting radio messages to force outputs.

   A security option can be selected during the module configuration to protect against this. The security option (if selected) adds data encryption to radio messages. Modules in the same system are automatically configured with the encryption key, such that only these modules can understand each other. "Foreign" modules will hear the messages, but cannot decrypt the messages. For more information, refer to section 4.2.2.

Chapter 3 INSTALLATION

3.1 General

The 105G module is housed in a rugged aluminium case, suitable for DIN-rail mounting. Terminals will accept wires up to 2.5 sqmm in size.

All connections to the module must be low voltage (SELV). Normal 110-240V mains supply should not be connected to any terminal of the 105G module. Refer to Section 3.3 **Power Supply**.

Before installing a new system, it is preferable to bench test the complete system. Configuration problems are easier to recognise when the system units are adjacent. Following installation, the most common problem is poor communications caused by incorrectly installed aerials, or radio interference on the same channel, or the radio path being inadequate. If the radio path is a problem (i.e. path too long, or obstructions in the way), then higher performance aerials or a higher mounting point for the aerial may rectify the problem. Alternately, use an intermediate 105U Module as a repeater.

The foldout sheet 105U-G ***Installation Guide*** provides an installation drawing appropriate to most applications. Further information is detailed below.

Each 105G module should be effectively earthed/grounded via the "GND" terminal on the 105U module - this is to ensure that the surge protection circuits inside the module are effective.

3.2 Antenna Installation

The 105 module will operate reliably over large distances. The distance which may be reliably achieved will vary with each application - depending on the type and location of antennas, the degree of radio interference, and obstructions (such as hills or trees) to the radio path. Please refer to your distributor for the expected maximum distance to comply with local radio regulations. Where it is not possible to achieve reliable communications between two 105 modules, then a third 105 module may be used to receive the message and re-transmit it. This module is referred to as a repeater. This module may also have input/output (I/O) signals connected to it and form part of the I/O network - refer to Chapter 4 **Configuration** of this manual.

An antenna must be connected to each 105 module using the coaxial female connector which protrudes though one of the end plates.

To achieve the maximum transmission distance, the antennas should be raised above intermediate obstructions so the radio path is true “line of sight”. Because of the curvature of the earth, the antennas will need to be elevated at least 5 metres above ground for paths greater than 5 km (3 miles). For short distances, the modules will operate reliably with some obstruction of the radio path. Obstructions which are close to either antenna will have more of a blocking affect than obstructions in the middle of the radio path. For example, a group of trees around the antenna is a larger obstruction than a group of trees 100 metres from the antenna.

An antenna should be connected to the module via 50 ohm coaxial cable (eg RG58 or RG213) terminated with a male coaxial connector. The higher the antenna is mounted, the greater the transmission range will be, however as the length of coaxial cable increases so do cable losses. For use on unlicensed frequency channels, there are several types of antennas suitable for use. It is important antenna are chosen carefully to avoid contravening the maximum power limit on the unlicensed channel - normally the net gain of the antenna/cable configuration should be no more than 2dB.

The net gain of an antenna/cable configuration is the gain of the antenna (in dBi) less the loss in the coaxial cable (in dB).

The gains and losses of typical antennas are

Antenna	**Gain (dB)**
Dipole with integral 3m cable	0
Dipole without cable	2
5dBi Collinear (3dBd)	5
8dBi Collinear (6dBd)	8
3 element Yagi	5
6 element Yagi	10

Cable type	**Loss (dB per 10 m)**	
	400-500MHz	**869MHz**
RG58	-3	-5
RG213	-1.5	-2.5
Cellfoil	-1.5	-3

The net gain of the antenna/cable configuration is determined by adding the antenna gain and the cable loss. For example, a 3 element Yagi with 15 metres of RG58 has a net gain of 0.5dB (5dB – 4.5dB) at 450MHz.

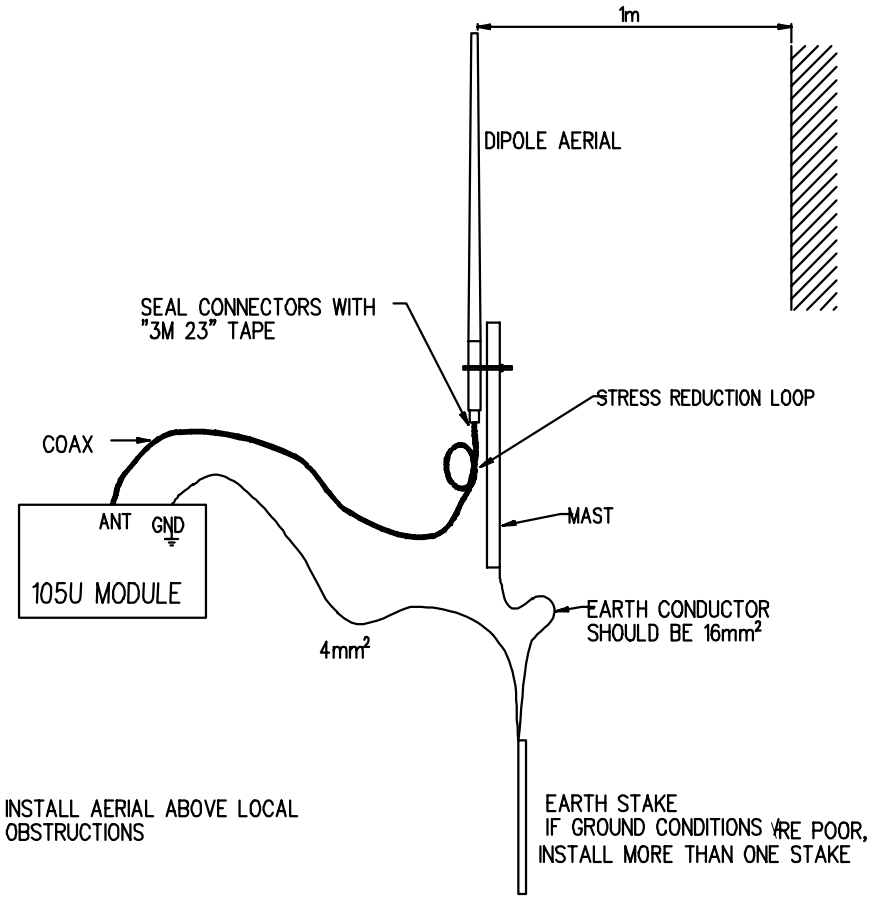
Connections between the antenna and coaxial cable should be carefully taped to prevent ingress of moisture. Moisture ingress in the coaxial cable is a common cause for problems with radio systems, as it greatly increases the radio losses. We recommend that the connection be taped, firstly with a layer of PVC Tape, then with a vulcanising tape such as "3M 23 tape", and finally with another layer of PVC UV Stabilised insulating tape. The first layer of tape allows the joint to be easily inspected when trouble shooting as the vulcanising seal can be easily removed.

Where antennas are mounted on elevated masts, the masts should be effectively earthed to avoid lightning surges. The 220MHz and 400 – 500MHz radios are fitted with surge protection, however the 868MHz radio does not. For high lightning risk areas, additional surge suppression devices are recommended. If the antenna is not already shielded from lightning strike by an adjacent earthed structure, a lightning rod may be installed above the antenna to provide shielding.

3.2.1 Dipole antenna.

A unity gain dipole is the normal antenna for use on unlicensed channels. As it does not provide any gain, then the power transmitted from the antenna will be the same as the power out of the module, and hence will not exceed the permitted power of the unlicensed channel.

Dipole antennas should be mounted vertically, at least 1 metre away from a wall or mast for maximum performance.

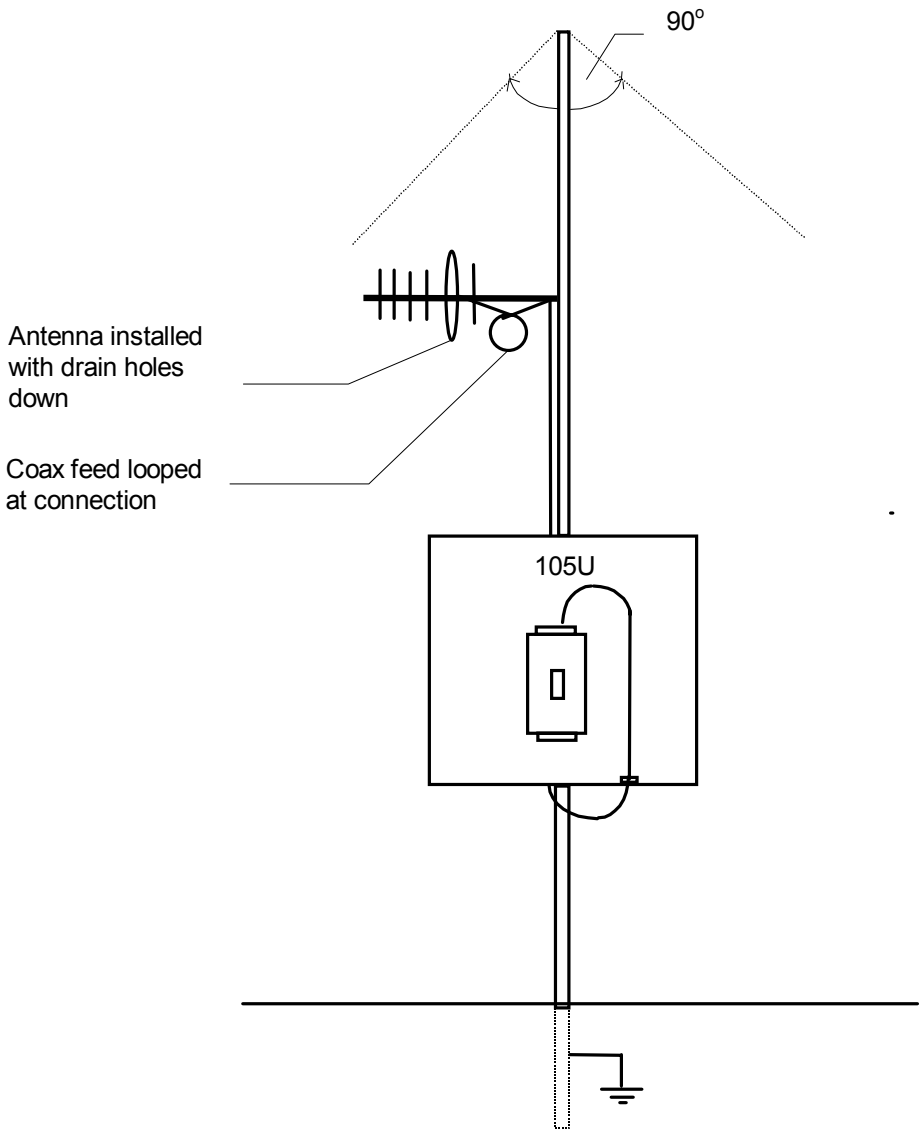


3.2.2 Yagi antenna.

Yagi antennas are directional. That is, they have positive gain to the front of the antenna, but negative gain in other directions. This may be used to compensate for coaxial cable loss for installations with marginal radio path.

Yagi antennas should be installed with the central beam horizontal and must be pointed exactly in the direction of transmission to benefit from the gain of the antenna. Also note that Yagi antennas normally have a drain hole on the folded element - the drain hole should be located on the bottom of the installed antenna.

The Yagi antennas may be installed with the elements in a vertical plane (vertically polarised) or in a horizontal plane (horizontally polarised). For a two station installation, with both modules using Yagi antennas, horizontal polarisation is recommended. If there are more than two stations transmitting to a common station, then the Yagi antennas should have vertical polarisation, and the common (or "central" station should have a dipole or collinear (non-directional) antenna.



3.2.3 Collinear antenna.

A collinear antenna may be used in the same way as a 3 element Yagi to compensate for the losses in long lengths of coaxial cable. This type of antenna is generally used at a central site with more than one remote site or at a repeater site. The collinear antenna looks similar to the dipole, except that it is longer.

3.3 Power Supply

The 105G power supply is a switch-mode design which will accept either AC or DC supply. The module includes an integral battery charger for a backup battery.

The module accepts supply voltages in the following ranges :

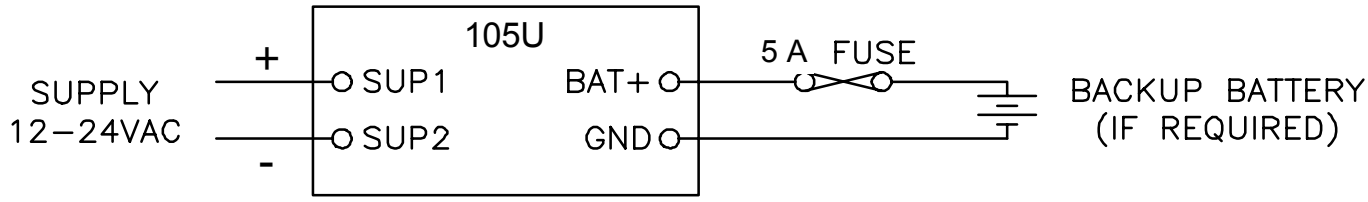
12 - 24 volts AC RMS or 9 - 30 volts DC at the “supply” terminals, or

10.8 -15 volts DC at the “battery” terminals.

The power supply should be rated at 1.5 Amps.

3.3.1 AC Supply

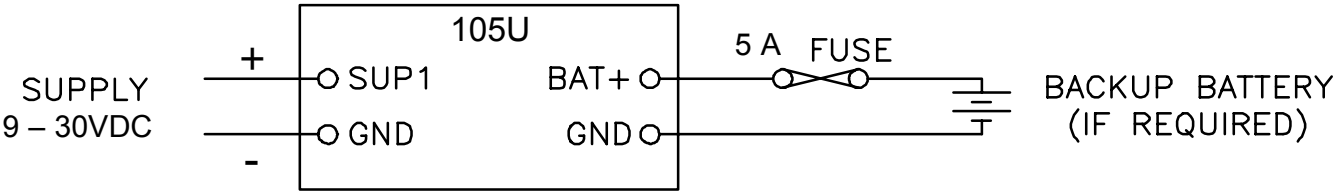
The AC supply is connected to the "SUP1" and "SUP2" terminals as shown below.



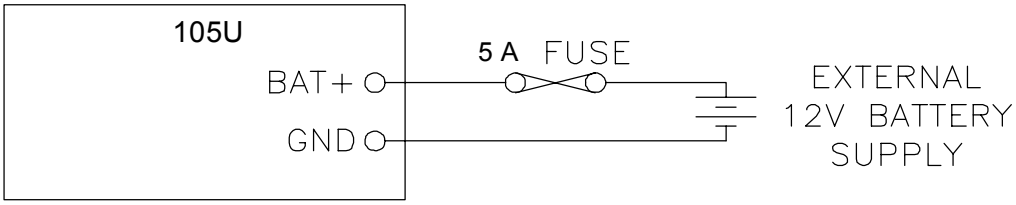
The AC supply should be "floating" relative to earth.

3.3.2 DC Supply

For DC supplies, the positive lead is connected to "SUP1" and the negative to "GND". The positive side of the supply **must not be connected to earth.** The DC supply may be a floating supply or negatively grounded.



The module may also be powered from an external 11 - 15 VDC battery supply without the need for a "normal" supply connected to "SUP1". This external battery supply is connected to "BAT+" and "GND" terminals. The positive lead of the external supply should be protected by a 5A fuse.



Upon failure of the normal supply, the module may continue to operate for several hours from a backup battery. The battery charger is rated at 1.5A and is designed for sealed or vented lead acid batteries between 5 and 24 amphours - **other types of batteries should not be used**.

On return of normal supply, the unit will recharge the battery. Typically, a 5 AHr battery will supply the 105G for 1 - 2 days, depending on the type of 105G.

The 105G monitors the power supply and provides the following internal values, which can be mapped as I/O values:

- Power failure (I/O Reg 4309) - if the supply voltage drops below 8V, this status value is set on, and set off again when the voltage is more than 9V. For AC Supplies, this indicates low voltage at approximately 10 VAC, and the status is cleared when the supply voltage rises above approximately 12VAC
- Low battery voltage (I/O Reg 4308) - this status value is set on if the battery voltage drops to 11.3, and resets off when the battery voltage is more than 11.8V.
- Battery voltage value (I/O Reg 4310) - 8 – 40VDC corresponds to hex 4000 – hex C000.
- Supply voltage (I/O Reg 4311) - 8 – 40VDC corresponds to hex 4000 – hex C000.

3.3.3 Solar Supply

A 12V solar panel (up to 30W) can be connected directly to the 105G as a DC power supply and the 105G will charge a battery. The 105G will charge the battery at 1.5A maximum.

A 105G can be powered from a solar supply using an external regulator. If a 12V solar supply is used, the 12V battery can be connected to the battery supply connections of the 105G and the 105G will monitor for low battery status and also battery voltage. If a 24V solar supply is used, the 24V battery should be connected as a DC supply (SUP1 and GND) - the supply voltage can be monitored however the "supply fail" voltage will activate too low to be used as a battery fail status.

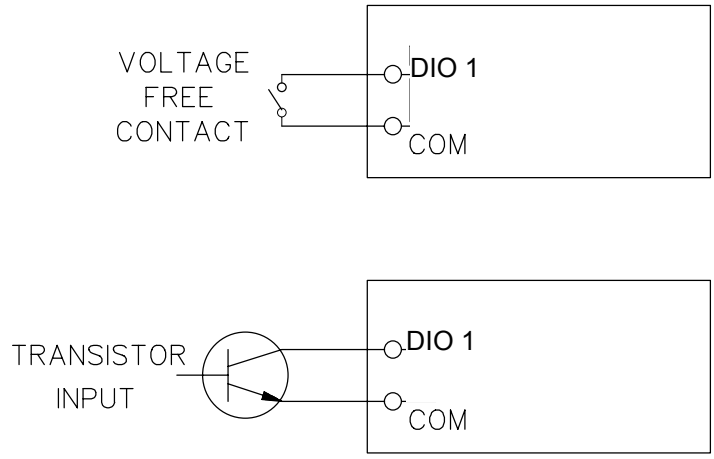
3.4 Input / Output

The 105G has eight on-board discrete/digital I/O. These act as both discrete inputs and discrete outputs.

3.4.1 Digital Inputs / Outputs

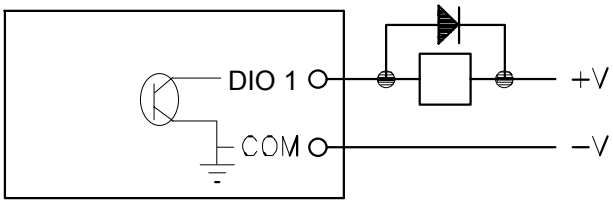
All eight of the 105G DIO terminals may be used as discrete inputs. These inputs are suitable for voltage free contacts (such as mechanical switches) or NPN transistor devices (such as electronic proximity switches). PNP transistor devices are not suitable. Contact wetting current of approximately 5mA is provided to maintain reliable operation of driving relays.

Each digital input is connected between the appropriate "DIO" terminal and common "COM". Each digital input circuit includes a LED indicator which is lit when the digital input is active, that is, when the input circuit is closed. Provided the resistance of the switching device is less than 200 ohms, the device will be able to activate the digital input.



All eight of the 105G DIO terminals may also be used as discrete outputs. The digital outputs are transistor switched DC signals, FET output to common rated at 30VDC 500 mA.

Digital outputs may be configured to individually turn off if no command message is received to that output for a certain period. This feature provides an intelligent watch dog for each output, so that a communications failure at a transmitting site causes the output to revert to a known state. See Chapter 4 **Configuration** for further details.



The output circuit is connected to the appropriate "DIO" terminal. Each digital output circuit includes a LED indicator which is lit when the digital output is active.

3.5 Serial Port

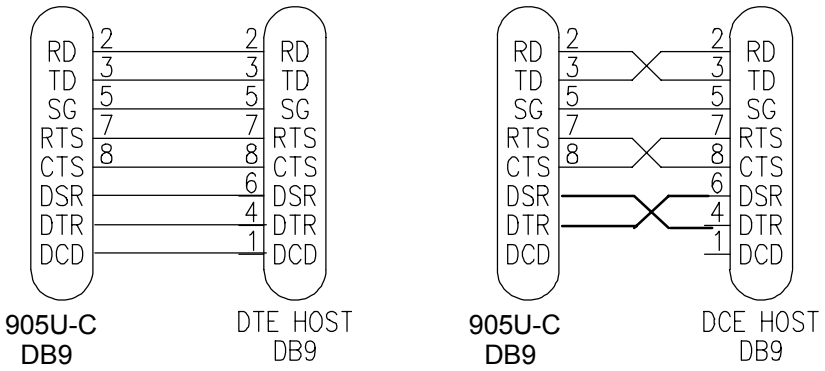
3.5.1 RS232 Serial Port

The serial port is a 9 pin DB9 female and provides for connection to a terminal or to a PC for configuration, field testing and for factory testing. It is also used by the Modbus/DF1 version for data-bus connection.

This port is internally shared with the RS485 - ensure that the RS485 is disconnected before attempting to use the RS232 port. Communication is via standard RS232 signals. The 105G is configured as DCE equipment with the pinout detailed below.

DB9 Connector Pinout

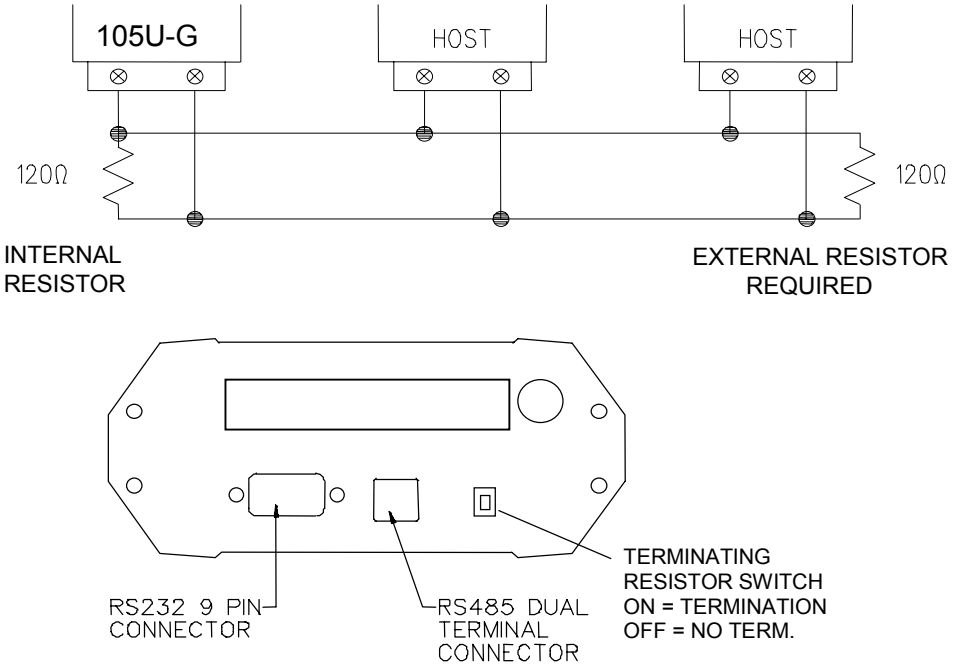
Pin	Name	Direction	Function
1	DCD	Out	Used for "active" signal.
2	RD	Out	Serial Data Output
3	TD	In	Serial Data Input
4	DTR	In	Data Terminal Ready - may be used by Host Protocol Driver
5	SG		Signal Ground
6	DSR	Out	Data Set Ready - always high when unit is powered on.
7	RTS	In	Request to Send - may be used by Host Protocol Driver
8	CTS	Out	Clear to send - may be used by Host Protocol Driver
9	RI		Ring indicator - not connected



Hardware handshaking using the CTS/RTS lines is provided, and are under the control of the Host Comms Driver. Example cable drawings for connection to a DTE host (a PC) or another DCE host are detailed above.

3.5.2 RS485 Serial Port

RS485 should not be used with the DF1 unit. The RS485 port provides for communication between the 105G unit and its host device using a multi-drop cable. Up to 32 devices may be connected in each multi-drop network. Note that the RS485 port is shared internally with the RS232 port - make sure that the RS232 port is disconnected before using the RS485 port.



RS485 is a balanced, differential standard but it is recommended that shielded, twisted pair cable be used to interconnect modules to reduce potential RFI. An RS485 network should be wired as indicated in the diagram below and terminated at each end of the network with a 120-ohm resistor. On-board 120 ohm resistors are provided and may be engaged by operating the single DIP switch in the end plate next to the RS485 terminals. The DIP switch should be in the "1" or "on" position to connect the resistor. If the module is not at one end of the RS485 cable, the switch should be off.

It is important to maintain the polarity of the two RS485 wires. On the 105G, terminal A (the terminal on the right) is positive and terminal B is negative.

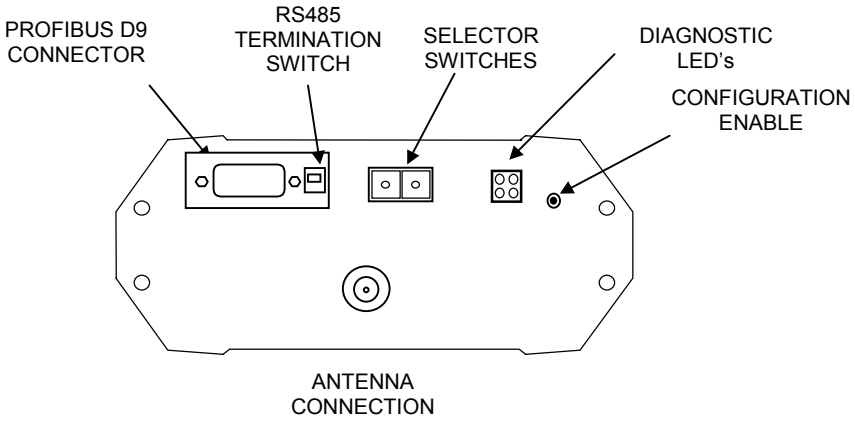
3.6 Profibus Port

For 105U-G-PR1 modules only.

The Profibus RS485 connector is a D9 connector in the top end-plate of the module. The Profibus RS485 connection should be made to pins 3 and 8 of the D9 connector. The connector pins are:

PIN	FUNCTION
1	Not connected
2	Not connected
3	+ve RS485 (Positive)
4	RTS (request to send)
5	GND - Isolated GND from RS485 side
6	+5V - Isolated 5V from RS485 side
7	Not connected
8	-ve RS485 (Negative)
9	Not connected

Where the 105G module is mounted at the end of the RS485 link, then the RS485 link should be terminated by switching the termination switch “on” (down in the above diagram).

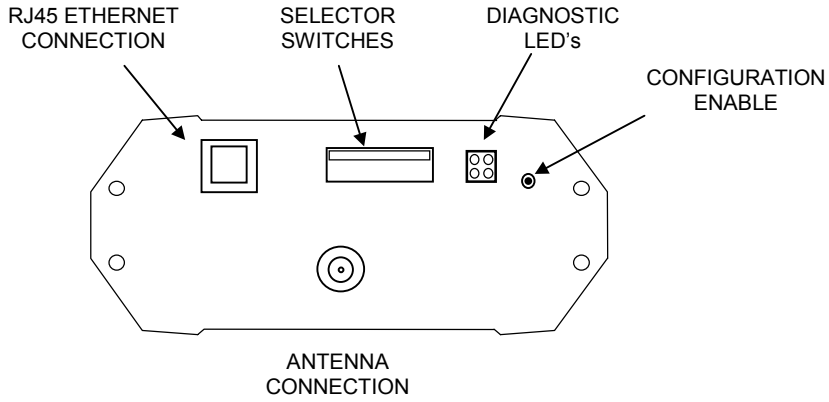


Note: The rotary selector dial on the end plate should be set to zero. If it is set to a non-zero position, the user-configured Profibus Slave address will be over-written by the selection.

3.7 Ethernet Port

For 105U-G-ET1 modules only.

The Ethernet connection uses a standard RJ45 connector on the top end-plate of the module. The selector switches should all be “off” (in the diagram below, “off” is up).



Chapter 4 CONFIGURATION

4.1 Introduction

A Windows program is provided to configure the 105U system. The configuration is done on a system basis - referred to as a "project" in the program. After the system configuration is entered, the configuration file can be loaded into each module via the RS232 port.

Each Project is configured with:

- a system address, which is common to every module in the same system, and is used to prevent "cross-talk" between modules in different systems. Separate networks with different system addresses may operate independently in the same area without affecting each other. The system address may be any number between 1 and 32 767. The actual value of the system address is not important, provided all modules in the same system have the same system address value. **A system address of zero should not be used.** The configuration program automatically offers a random number for the system address - you can change this to any number in the valid range but we recommend that you use the random number.
- a password for access protection. This is an optional feature. If selected, the project file can only be opened by entering the correct password.
- a security encryption key, used to encrypt and decrypt radio messages. This is an optional feature. If selected, the configuration program will offer a random security key, or this can be over-written with your own key. A key is a string of any 8 ASCII characters.

Each module in the project is configured with a unit address. Each module must have a unique unit address within the one system. A valid unit address for a 105G is 1 to 95. A network may have up to 95 addresses communicating directly via radio (unit addresses 1 to 95). 105U I/O modules can have up to 31 modules communicating via RS485 (unit addresses 96 to 127).

The configuration program may allocate more than one unit address to a 105G if it is required because of the size of the system. If this is necessary, it will be done automatically by the configuration software.

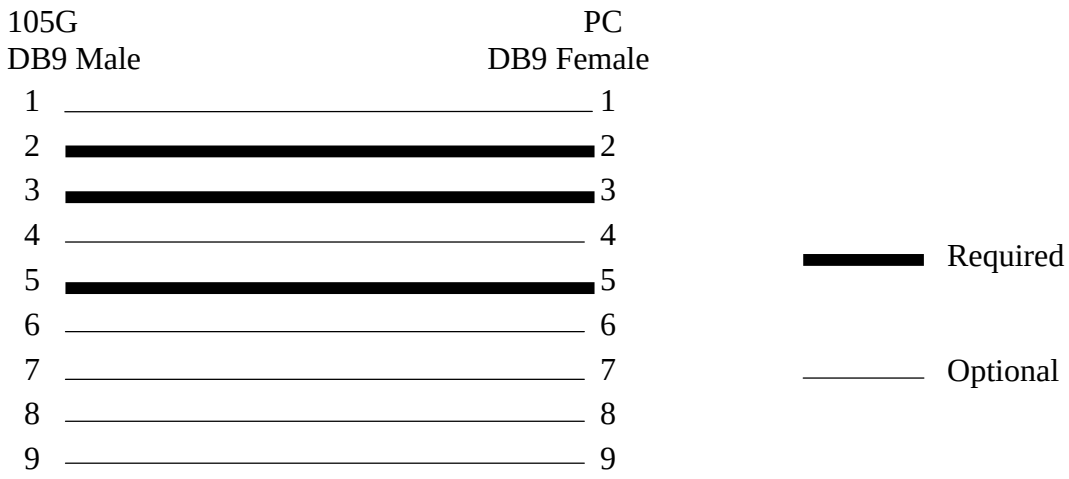
Configuration consists of:

1. selecting the types of modules in the system and selecting address values
2. linking (called "mapping") I/O registers to remote I/O
3. setting operating parameters such as change sensitivities and update times
4. selecting "block mappings" - only for block transfer of I/O registers between multiple 105G modules
5. selecting data bus addressing (all versions), and serial port configuration (Modbus and DF1 only)
6. linking I/O registers to data bus I/O bytes (Profibus and Ethernet only)

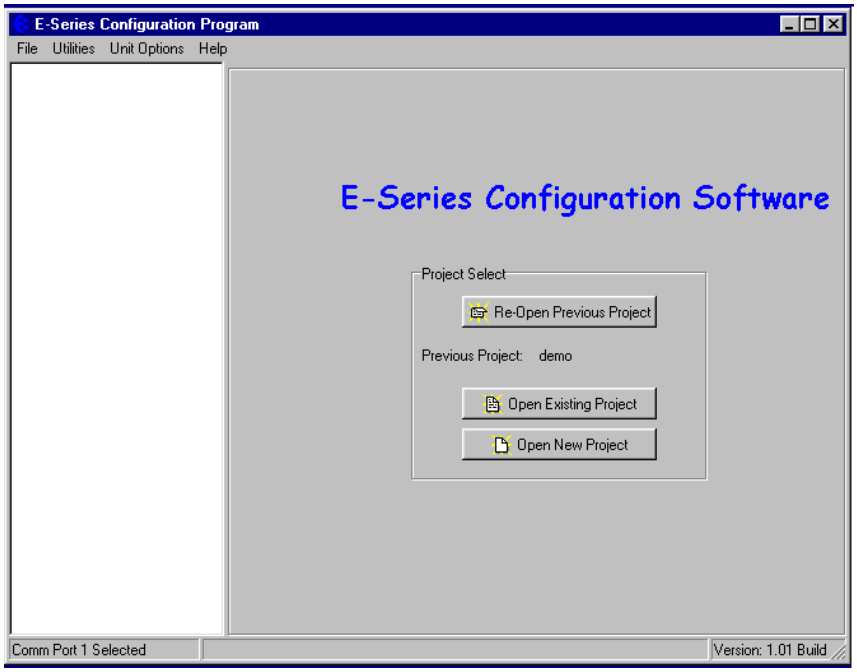
All of these steps must be performed to configure the 105G module.

4.2 Configuration Program

The configuration software is available on a CD, and needs to be installed on your PC before you can use it. The CD contains a setup file called *setup.exe*. Select the configuration software window on the Product CD and an installation Wizard will guide you through the installation procedure. To upload and download configuration files to a module, you will need a RS-232 serial cable as shown below.



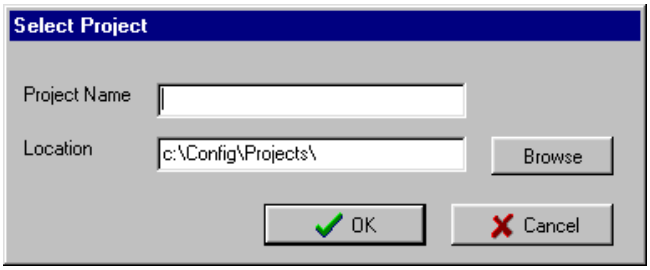
4.2.1 Program Operation



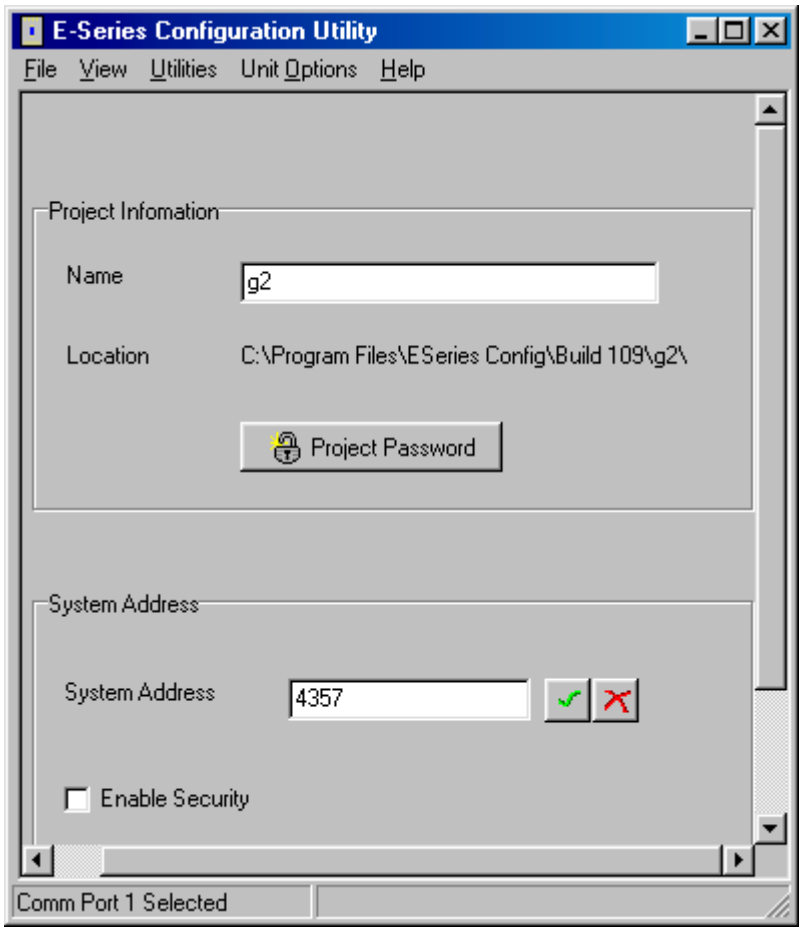
Start the software by either clicking on the start bar and navigating to the Configuration menu or by running ESERIES.EXE in the directory selected in the setup stage.

The Initial screen will appear.

From the initial screen, , you can select an existing project, or start a new project. The name of the project will create a new folder which will eventually contain the configuration files for the modules in this system. Project folders are located under the folder \Projects\ - for example, if you create a project called "Fire Pumps", then the files for this project will be found in the folder c:\……\Projects\Fire Pumps\.



When you have selected the project, a screen will appear where you may enter the system address.

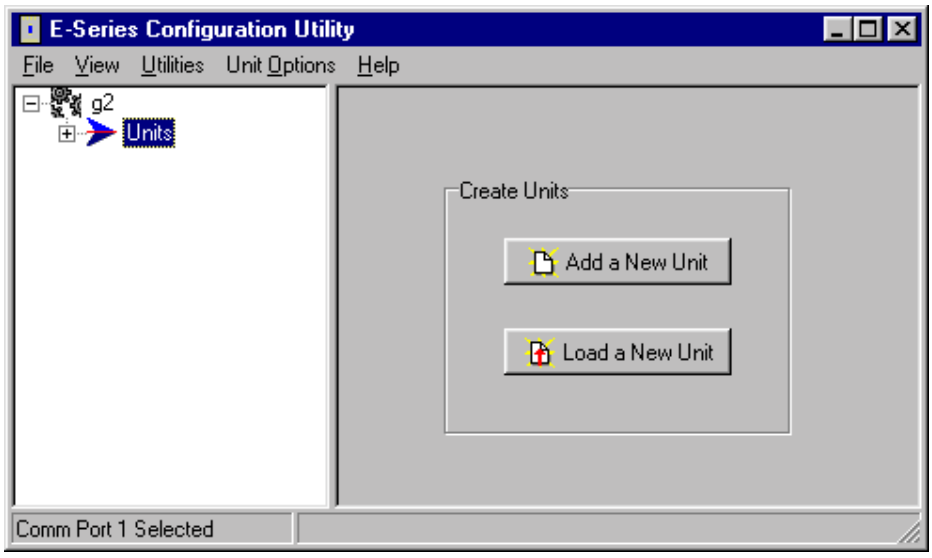


If you are editing an existing project, the system address will already have been entered. Do not change the system address unless you are going to re-program all of the modules in the system.

Password. You have the option of entering a password to protect the configuration files against unauthorized changes. When you open a new project, you will be asked to enter a password - if you do not enter any text - that is, press "ESC" or "Enter", then password protection is disabled. If you do enter a password, then you will need to enter this password to access the project. Without the password, you are unable access the project

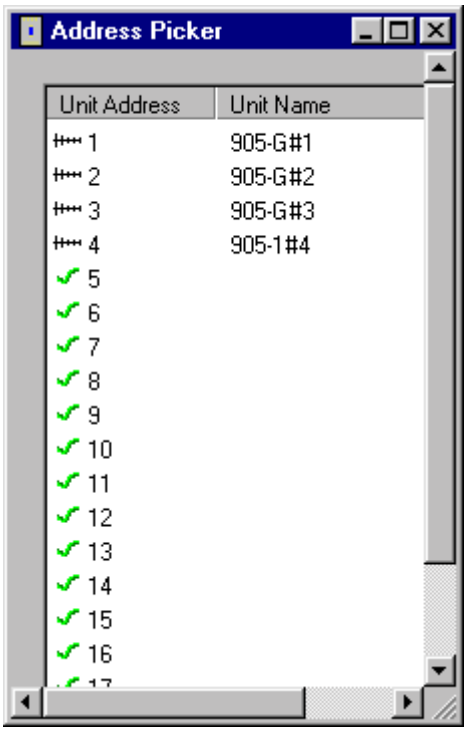
The password can be between 6 and 256 characters. You can also change password at any time by over-typing the passowrd.

If you are starting a new project, you have the option of "Enabling Security". This option enables encryption of the data sent over the radio. - please read Section 4.2.2 and the associated warnings before using this option.



To proceed with the configuration, double-click on the project name on the menu on the left side of the screen. "Units" will appear. You can now enter the types of units which will be used in the system. If you double-click on "Units"or select the "+" sign beside "Units", then the modules that have already been created will be displayed.

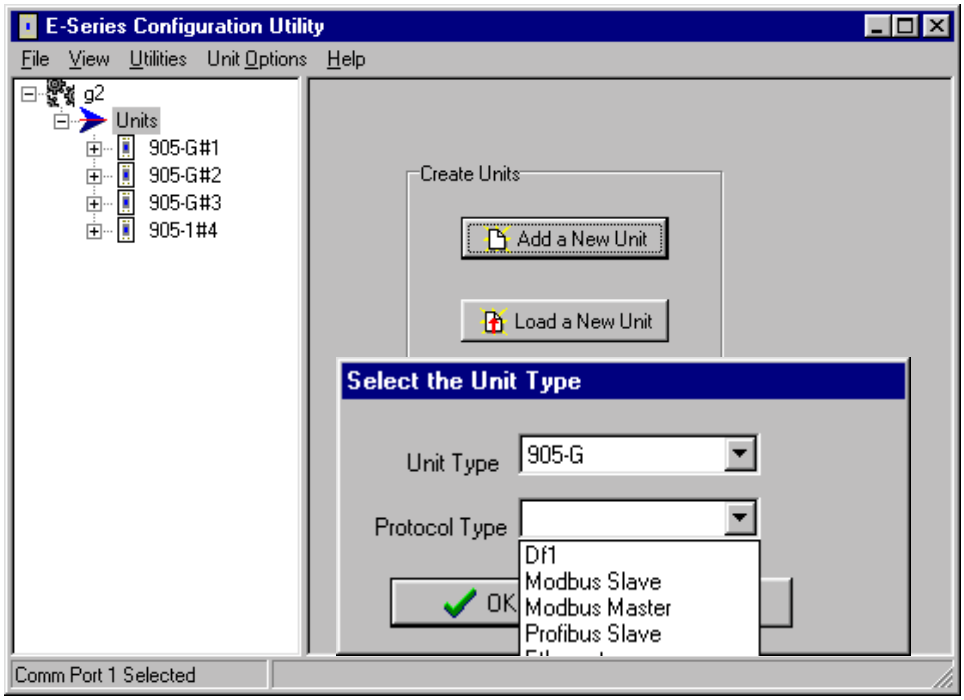
Loading configuration from an existing module
To load the configuration from a module, connect the module to the PC via the RS232 cable, put the module into "Configuration Mode" by pressing the configuration button on the top end-plate, and click on "Load Unit". This will allow you to view the module configuration, change it, or copy it for another module - refer to section 4.10 for full details.



Adding a new module to the system configuration
To add a new module to the system configuration, click on "Units" on the left-hand menu and then "Add Unit". Select the type of module from the list. For 105G modules, you will be asked to select the bus protocol. This must match the 105U-G module type you have installed.

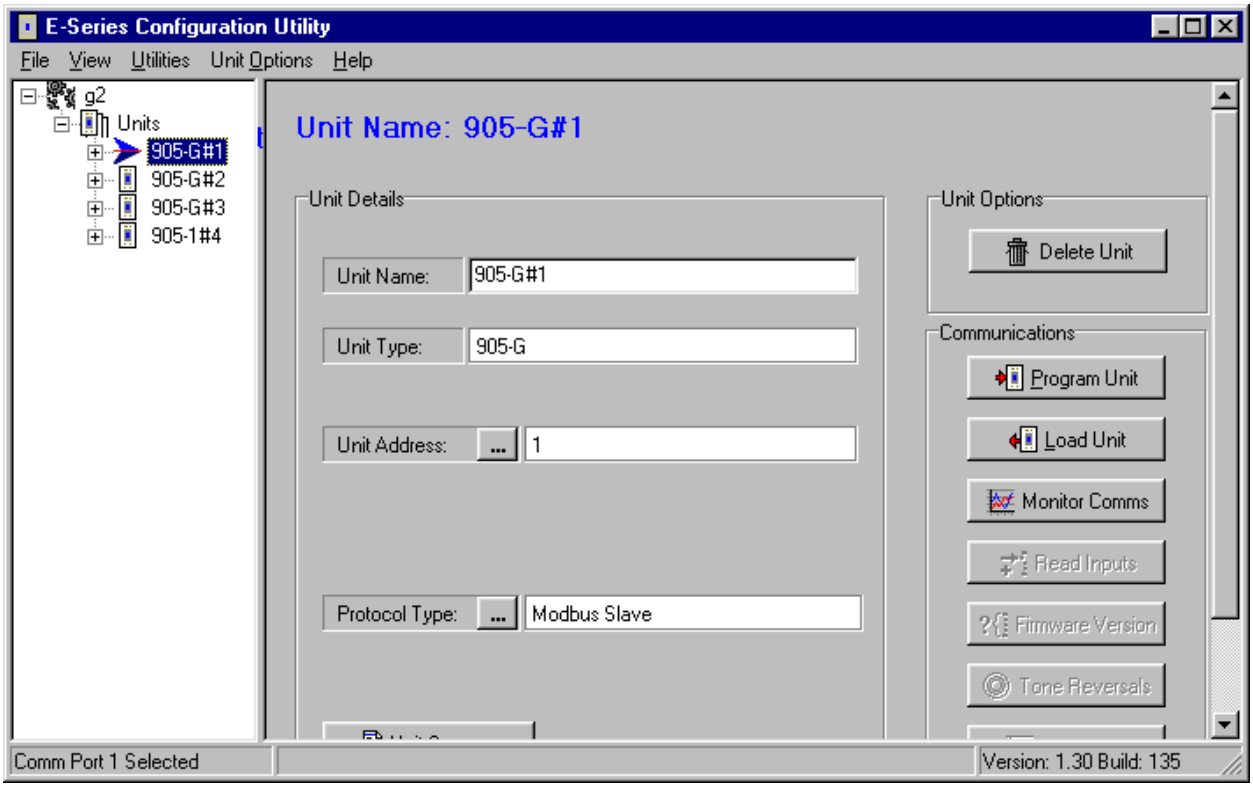
You have the option of selecting a unit address for the module, or allowing the program to select one automatically. If you choose to select the unit address the program will display the list of available addresses for you to select - valid addresses are 1 – 95.

The default name for a unit will include the unit address. For example, "105-G#10" is a 105U-G module with unit address 10. You can change the name of a unit - for example, you could replace the default name with "Pump Station 14".



Deleting a Unit

A module can be deleted from the configuration by highlighting the unit and selecting "Delete Unit".



4.2.2 Security

There are two security features available. You can enter a password to protect the configuration files, and you can enable security encryption of the radio transmissions.

The password can be between 6 and 256 characters. The password is case sensitive and any ASCII characters can be used. If you have entered a password, then this password will need to be entered whenever the configuration is changed. You are able to change the password from the "Utilities" menu. If unauthorised access to the files is a concern, we recommend that you change the password regularly or whenever there is a change of staff.

Data Encryption is an additional level of security. The security option uses a 64 bit security key to provide data encryption of the radio messages. All modules in the same system will be configured with the same security key used to encrypt and decrypt the messages. This feature is available for modules with firmware version 2.1 and higher. If you are adding modules to an old system which does not have the security encryption feature, then you cannot use security encryption on the new modules.

Note that the security key is different than the password.

- To enable the security encryption, select the "Enable Security" box on the project display. An 8-character random security key is automatically generated. If desired, a different security key may be entered and you will be prompted to enter the security code a second time to confirm. The security key can be any characters or numbers. Characters are case sensitive. The security key will never be displayed.
- If you do not enable security, there will be no data encryption of the radio messages. This is the default setting.
- If a security key has been entered, this key is downloaded into each module as part of the configuration download process. You can download another configuration at any time - if the security key is different, or if there is no security key in the new configuration, the old key will be over-written.
- You can change the security key in the configuration files simply by entering a new security key in the security key window. You will be prompted to confirm the new security key. Note that if you change the security key, it will not match the security key previously loaded into existing modules.
- If you want to change a configuration, we recommend that you change the archived configuration, and then download the configuration onto the module. The archived configuration already has the valid security key.
- If you lose the archived configuration, you can upload the configuration from a module, but you cannot upload a security key. That is, you can upload the module configuration, view it, change it - but if you don't know the original security key, the old key will be over-written when you download the new configuration. This module will no longer communicate with other modules in the system as the security key is different.

The security options provide security against a "hacker" in the following way:

- A hacker cannot listen-in to radio messages without the security key to decrypt the radio messages. Similarly, a hacker cannot force outputs by transmitting a radio message to a module without the security key.
- A hacker cannot access the security key from an installed module or from the configuration files.

- The archived configuration files cannot be changed, downloaded or uploaded without the password.

Warning!!

These security options provide a high level of security, but no data-security system can provide "100% protection". But it does make it very difficult for someone to interfere with the 105U system - difficult to the point where there would be many easier alternate ways to cause malicious damage.

The password must be kept in a secure place. Security procedures need to be adopted. If staff with access to the password leave your organisation, we recommend that the password be changed.

We recommend that you use a random 8-character string for the security key and that you do not record the key. It is not necessary to know what the security key is. The key will be recorded in the archived configuration files, and therefore the configuration files should be held in a secure place and backed up.

The security key does not prevent a hacker uploading a configuration from a module and downloading with a new security key. This module will no longer operate with other modules in the system. To prevent this, unauthorised access to modules must be prevented.

If you lose the configuration files, you can regenerate these by uploading the configuration from every module in the system into a new project with a new security key. After uploading each module, download the configuration with the new security key.

If you wish to change the security key, simply enter a new key in the configuration program, and download the new configuration to all modules in the system.

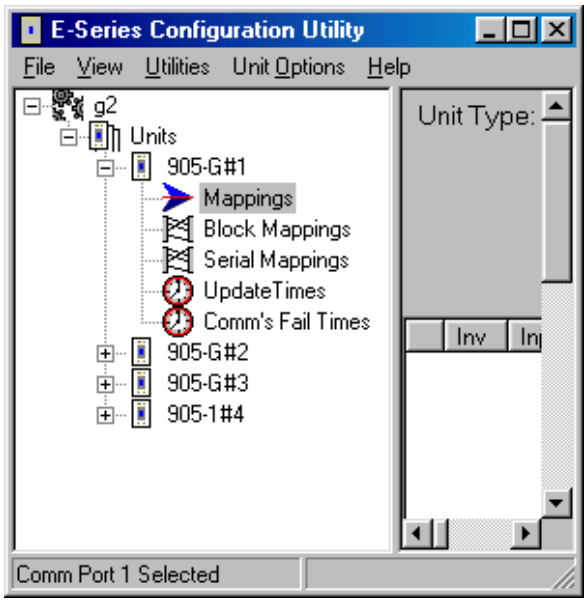
Note on Ethernet 105U-G. You are able to access the module configuration of an Ethernet 105G via the Ethernet port. To prevent this access, do not select "Enable Ethernet Debug" on the Ethernet configuration display - see section 4.8.

4.3 Mappings 105G to 105U I/O Modules

To transfer remote input signals to a 105G, or transfer a value to a remote output from a 105G, you set up “I/O mappings”. You enter mappings into the source unit, not the destination unit. That is, you configure a mapping at the “input” module. If you want to transfer an input signal at a 105U module to a 105G register, you enter a mapping at the 105U I/O module. If you want to transfer a 105G register to an output signal at a 105U module, you enter a mapping at the 105G module.

To configure mappings, double-click on the module in the left-hand menu - the menu will expand with selections for that module. Select “Mappings”.

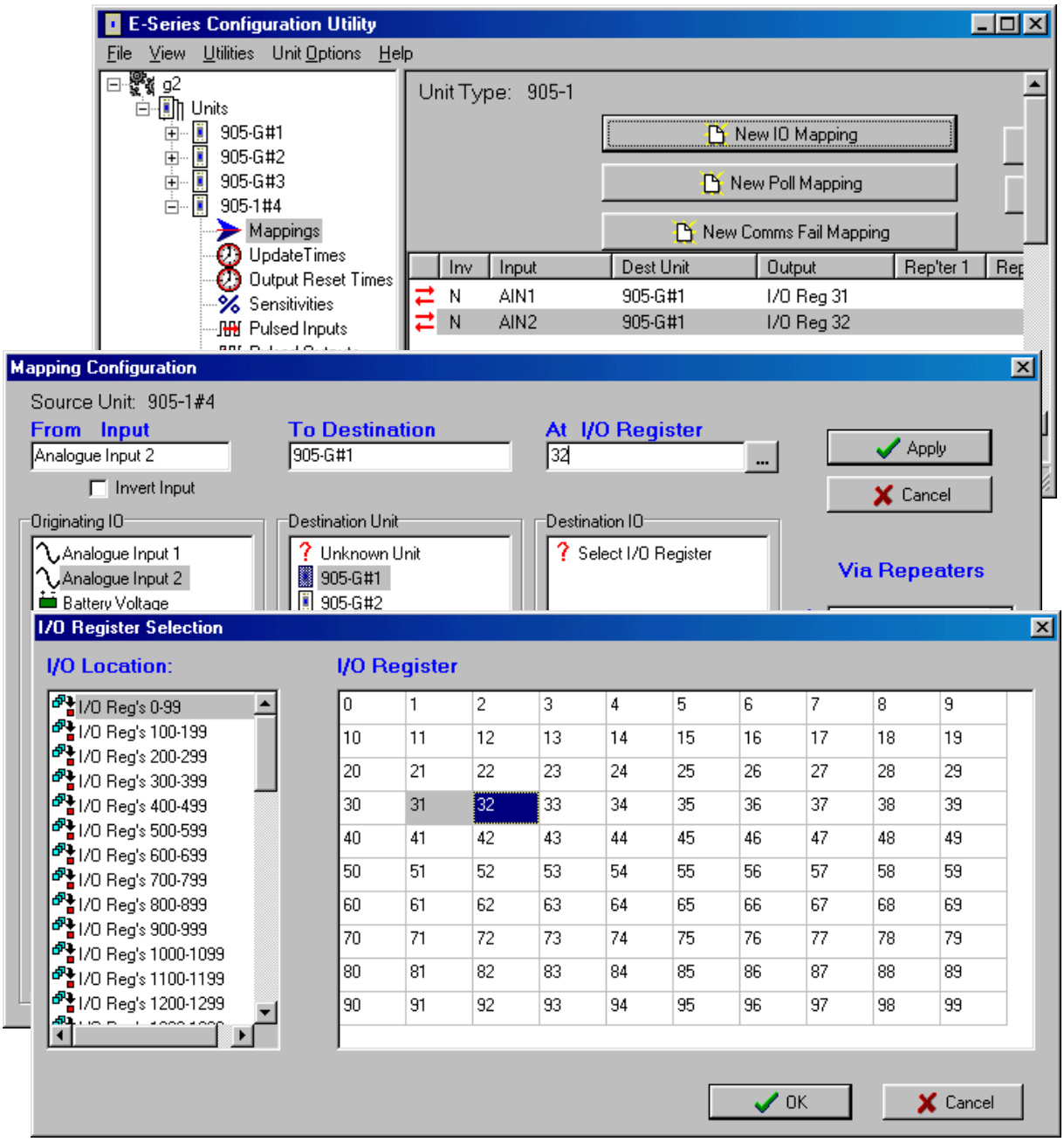
Each mapping comprises only one I/O point. “Block Mappings” provide more advanced communications between 105G modules.



4.3.1 Mappings from Inputs at Remote 105U I/O Modules

Refer to the 105U I/O User Manual.

When mapping inputs to a 105G, you will be asked to select an I/O Register. Select the “…” box beside the “At I/O Register” heading - this will allow you to select the I/O register between 0 and 4299.



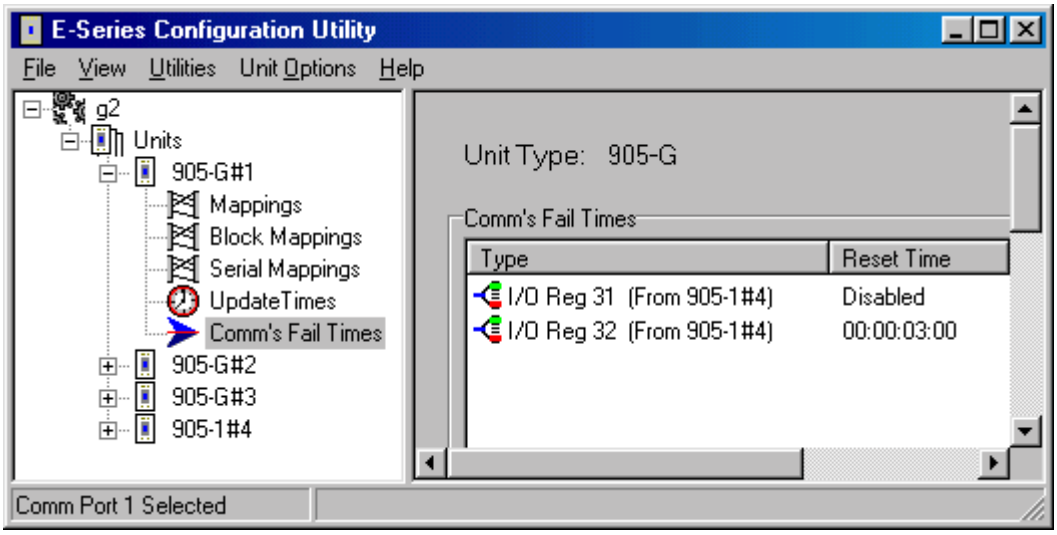
Any I/O registers that have already been selected will have a colour shading.

The update times, analogue sensitivities for these mappings can be set as per normal I/O mappings.

To map several inputs to consecutive I/O registers, use “Shift”-select or “Ctrl” - select to highlight the inputs, and select the first I/O register in the range. The selected mappings will be entered with consecutive I/O registers.

For each “remote input” configured to a 105G, there is a comms-fail time parameter in the 105G. If the 105G does not receive a message destined to that I/O register within the “comms fail” time, then the “comms fail” status for that I/O register will be set - the most significant bit of the status register will be set to 1. The comms fail time should be more than the corresponding update time at the remote input.

To set the comms fail times, select the 105G, and select the "Comms Fail Time" option. Each remote input already mapped to the 105G will automatically be listed, including the remote module containing the mapping.

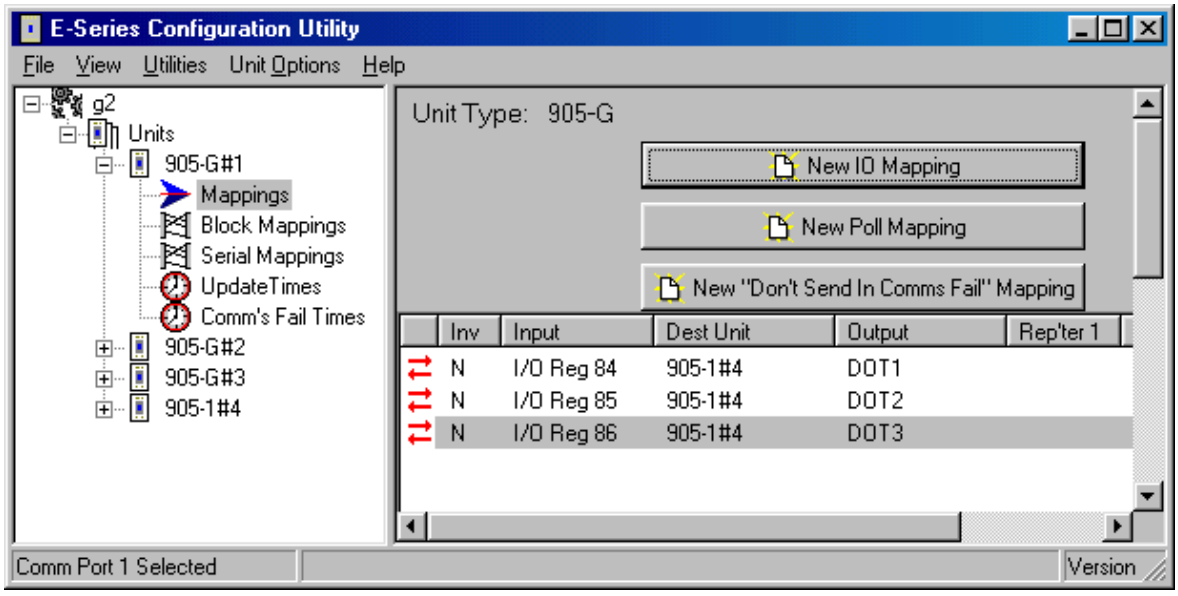


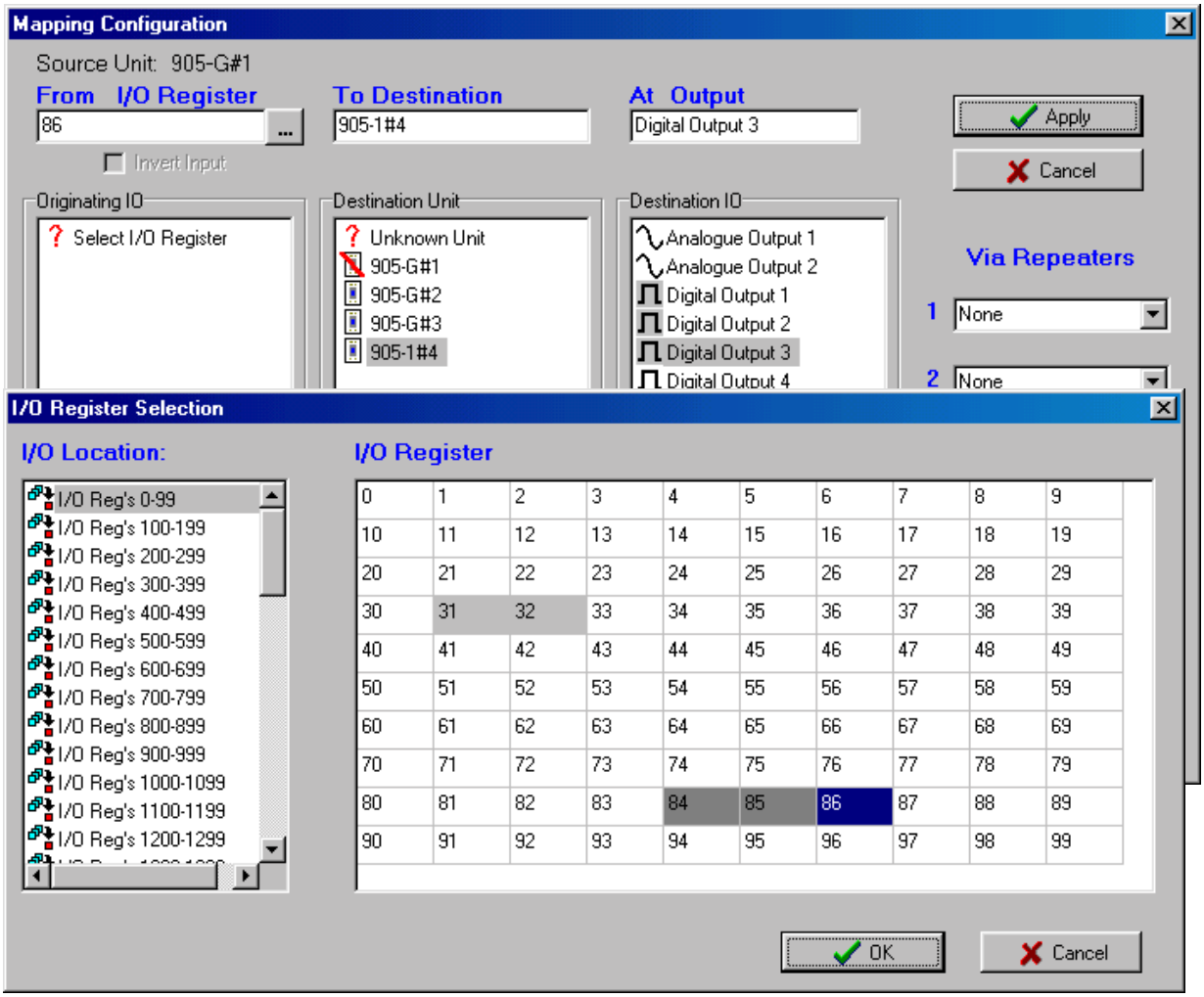
The default value for the comms-fail time is "disabled" or zero. To enter a time, select the I/O register from the list. The comms-fail time should be greater than the update time of the remote input.

4.3.2 Mappings from 105G to Outputs at Remote 105U I/O Modules

Mappings can be entered in the 105G to remote outputs. Select the "Mappings" option under the 105G. Select an I/O register and select the remote module and the output channel.

To map several consecutive I/O registers to several outputs, select the first I/O register in the range and use "Shift"-select or "Ctrl" - select to highlight the multiple outputs. The selected mappings will be entered with consecutive I/O registers.





Change Sensitivities

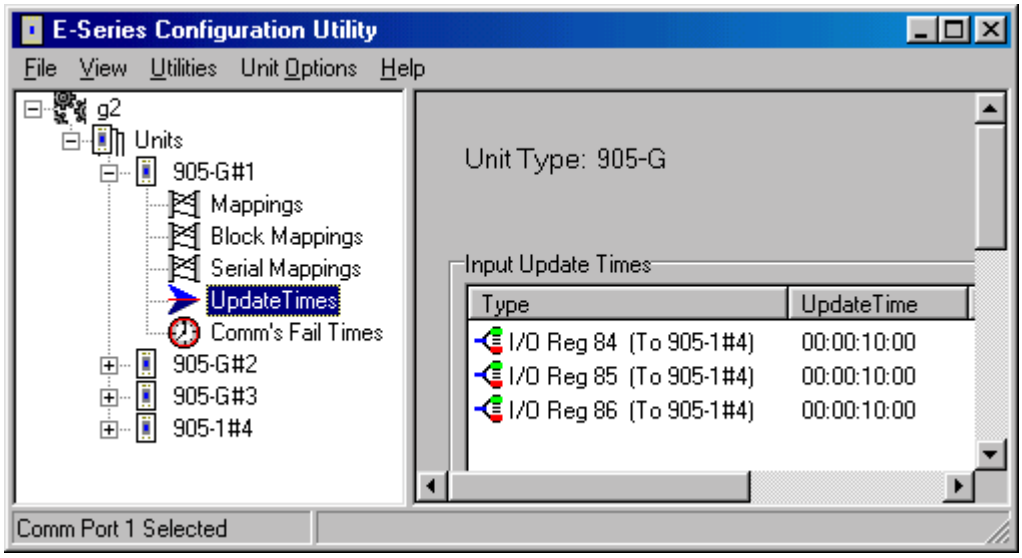
Radio messages to remote modules can be change messages (when the value of the I/O register changes) or update messages (when the update time has elapsed). If a change message is sent, the update period restarts.

You can configure the amount of change required to trigger a change message - this is called the change sensitivity. Sensitivities are configured for blocks of I/O registers - that is, each I/O register does not have a unique sensitivity. You can configure up to 50 sensitivity values - that is, there can be 50 blocks of registers with different sensitivities.

For more information on this, refer to section 4.5.

Update Times

To change the update times of output mappings, select the Update Times option. Any I/O registers that have already been mapped to remote outputs will automatically be listed. The default update time is 10 minutes.

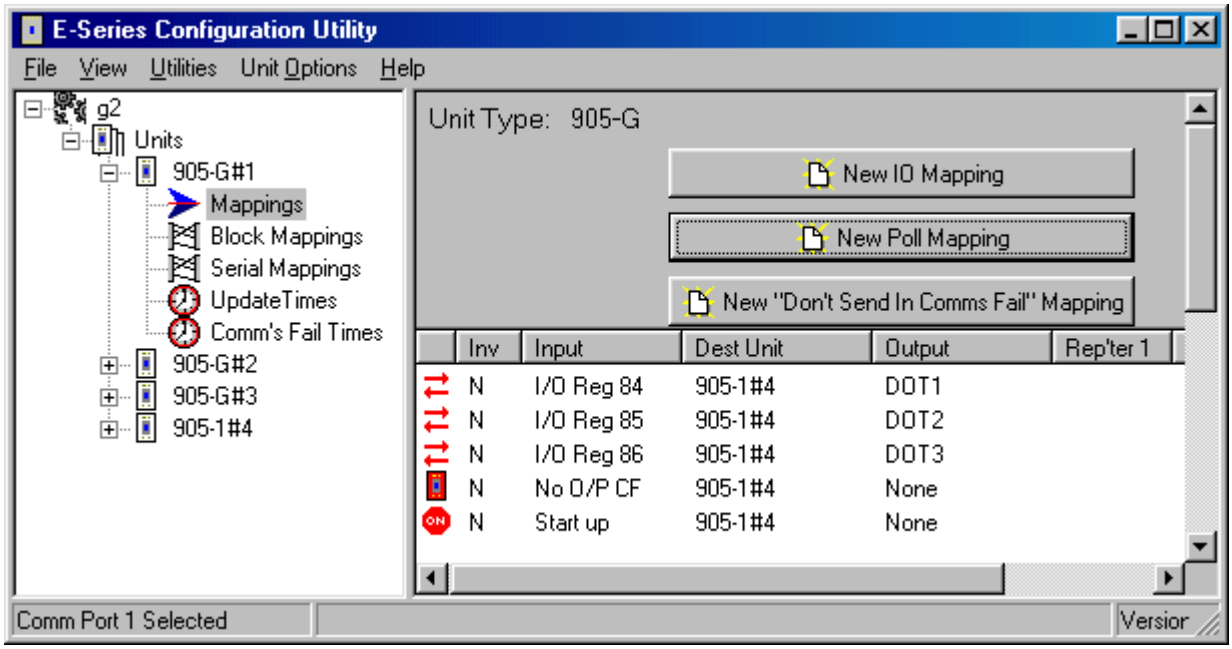


Changing Multiple Settings

You can change the Comms Fail Times or Update Times of several I/O points simultaneously by using the <Shift> Select feature. For example, if you want to change all times to 1 minute, you could change each individually, or you could "block" all entries using the "Shift" Select feature and select "Edit". You only need to enter the change once to change all of the inputs selected. This feature is also available with the other configurable parameters.

4.3.3 Don't Send if in Comm Fail

You can configure a special "Don't Send if in Comms Fail" mapping. If this is configured for a particular remote module, the 105G will not transmit output messages to this remote address, if there is a communications failure status on any input or output configured for the same remote address. Output messages will re-start when a message is received from the remote module. The use of this option can prevent the radio channel becoming congested if there are many outputs at that module.



To configure this special mapping, select the "New Don't Send in Comms Fail Mapping" box. You will be asked to select which remote module this function applies to. You can enter more than one of these mappings if there are more than one modules.

4.3.4 Startup Polls

You can enter start up polls for remote modules by using the "New Poll Mapping" box. This function is the same as for the 105U I/O modules. A start-up poll is a special message sent when the 105G starts up. When the remote module receives a start-up poll, it will immediately respond with update messages for all its inputs that are mapped to the 105G. This allows the 105G to have correct values on start-up.

4.3.5 Polls to Remote Modules

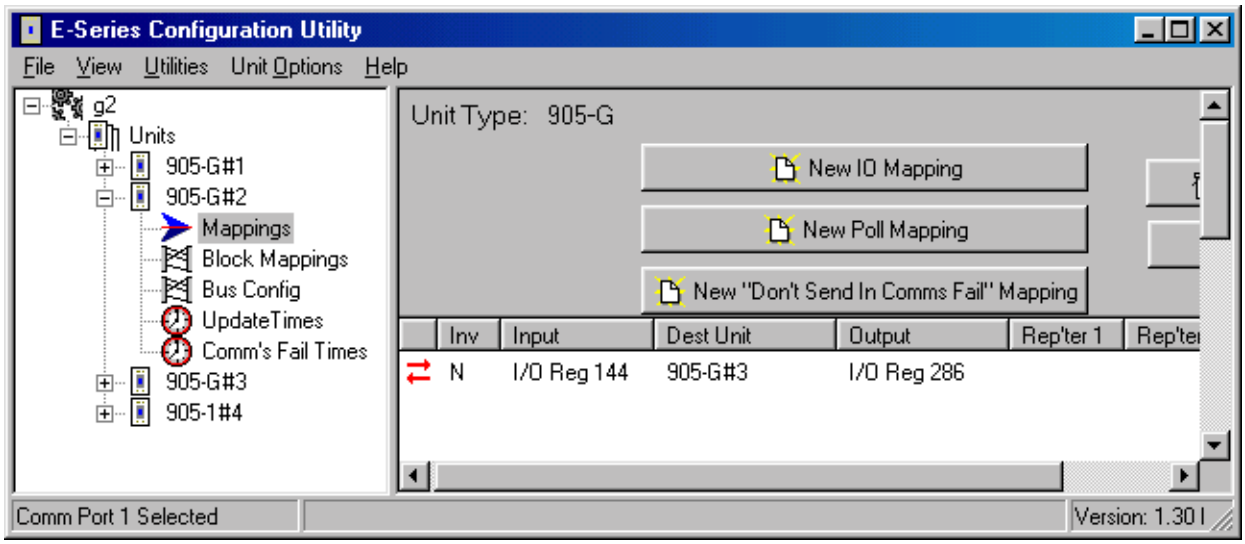
It is possible for a 105G to send a poll to a remote module at other times apart from start-up. A poll can be sent under the following events:

- based on a configurable time period
- based on real time clock
- on-demand by the host device.

For information on this configuration, refer to the next section on "Block Mappings".

4.4 Mappings from 105G to other 105G Modules

Individual links between 105G modules can be configured under the "Mappings" selection as described in the previous section. For example, if you want to transfer I/O Reg 144 in 105G#2 to I/O Reg 286 in 105G#3, you can enter the following mapping:

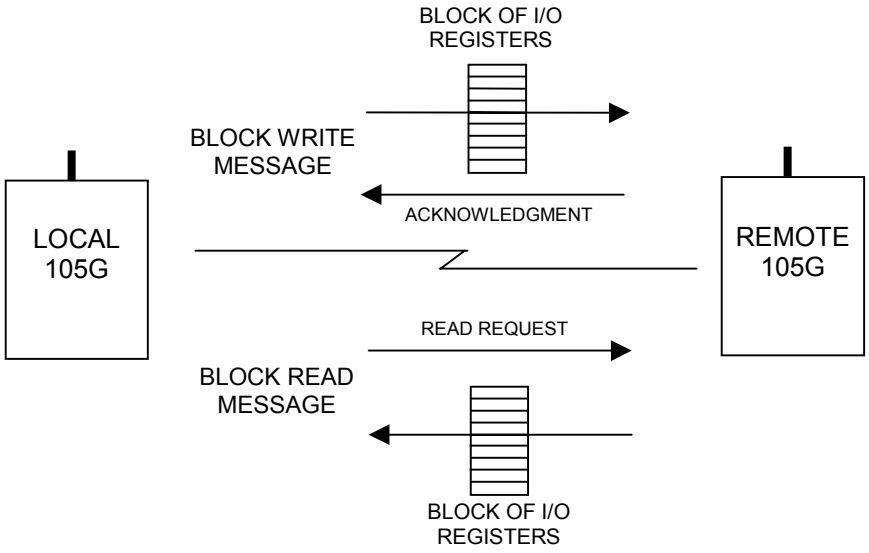


Whenever I/O Reg 144 changed by the sensitivity amount, 105G#2 would send a message to 105G#3 to write the value in I/O Reg 286. The problem arises if there are a lot of these mappings. Each radio message only relates to one register-register link. If you want to map 1000 registers from one 105G to another, then this could generate a lot of radio messages.

To get around this problem, it is possible to configure "block mappings". With a block mapping, multiple registers (a "block of registers") can be transferred together in the one radio message. This improves the efficiency of the radio communications.

Read/Write Mappings

The mappings can be “read” or “write” mappings. A Read mapping is a request sent to another 105G to return a block of values. A Write mapping is a message sending a block of values to another 105G. A Read mapping from 105G#2 to 105G#3 could be the same as a Write mapping from 105G#3 to 105G#2 (that is, in the reverse direction) - except the Read mapping is initiated from #2 and the Write mapping is initiated from #3.



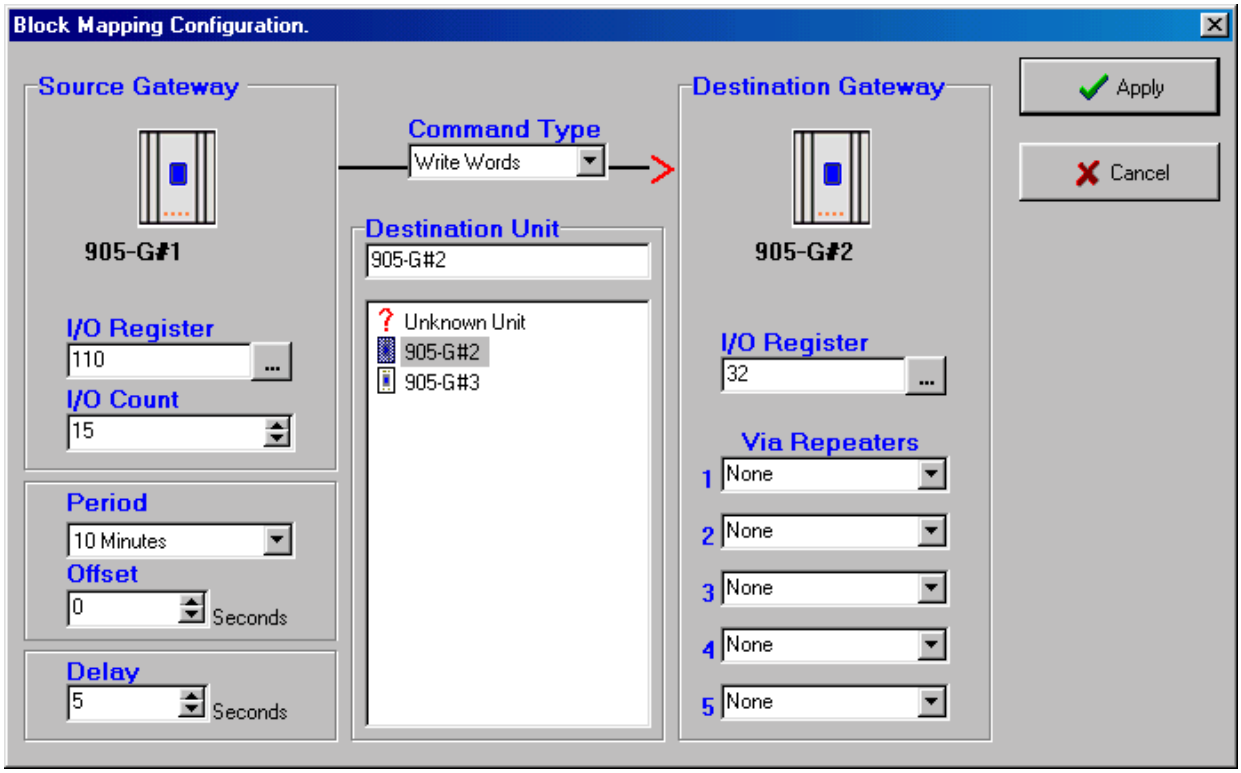
Word/Bit Mappings

Read and Write mappings are also selected as Word or Bit mappings - that is, you can select a Read Word mapping or a Read Bit mapping and you can select a Write Word mapping or a Write Bit mapping. “Word” refers to a complete 16-bit register value; “Bit” refers to the value of the most significant bit of a register - this bit is the “binary value” or “digital value” of the register.

If you use a Word block mapping of 100 registers, you are transferring a block of 100 x 16-bit values. If you use a Bit block mapping of 100 registers, you are only transferring the digital value of each register - that is 100 x 1 bit values. This is a lot more efficient for a radio message, but Bit mappings are only suitable for discrete or digital I/O. A Bit mapping will convert the 16-bit register to a single bit, transfer it and store the bit value in the most significant bit of the destination register.

4.4.1 Entering a Block Mapping

Select the "source" 105G on the left hand menu - select "Block Mappings" and then "New Block Mapping" from the right-hand display. The Block Mapping Configuration display will appear.



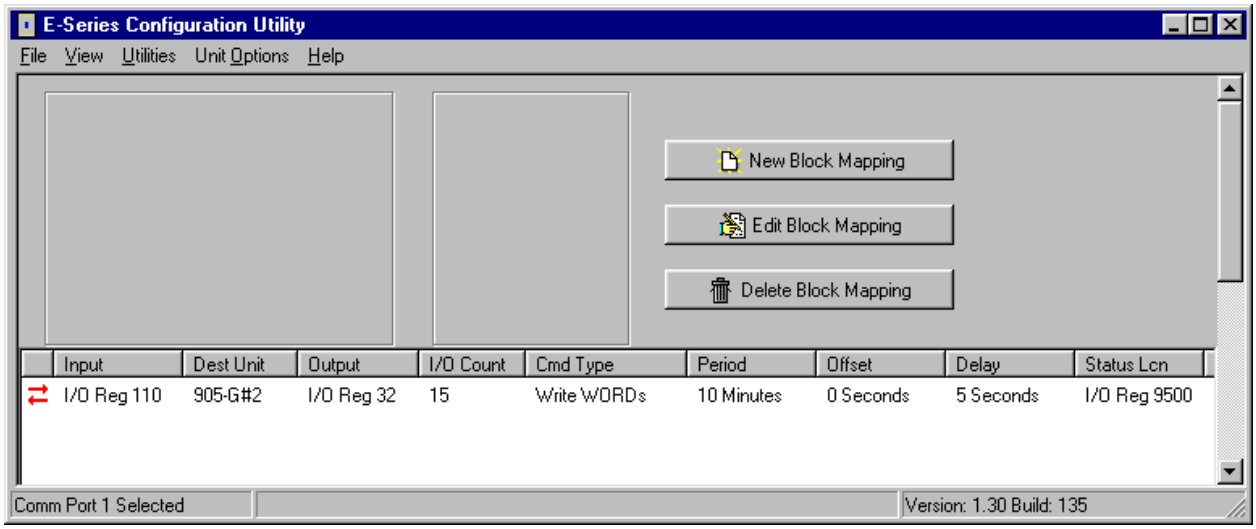
Select the "Command Type" from the pop-down window in the centre of the display. The red arrow will confirm the direction of the block transfer. Now select the destination module - only the 105G modules already configured will be shown. If you need to use repeaters in the radio link, enter the repeater addresses, starting with the repeater closest to the source module.

Under "Source Gateway", enter the I/O Register and I/O Count. The I/O Register is the first register in the block and the I/O Count is the number of registers - in the above example, the block of registers will be 110 – 124 (15 registers starting at I/O Reg 110).

If you are entering a Write mapping, then the values in this block will be sent to another 105G. If it is a Read mapping, then values from another 105G will be sent to this block.

Under "Destination Gateway", enter the I/O Register - this is the first register in the block. You do not need to enter the block size as this will always be the same as the block size in the source 105G. In the above example, the destination block will be I/O registers 32 – 46 (15 registers starting at register 32). So, in the above example, a block of 15 x 16-bit values will be written from I/O Reg 110 – 124 in 105G#1 to I/O Reg 32 – 46 in 105G#2.

Each mapping entered is allocated a status register - the register number appears on the right hand of the Block Mapping display. These registers store relevant status information about the block mapping - the structure of these Block Mapping status registers is shown in Appendix A.



In the above example, the status register for the block mapping has been automatically assigned to register 9500.

The rest of the mapping configuration involves the mapping trigger - or what initiates the mapping message.

Mapping "Triggers"

A block mapping can be "triggered" or initiated by several different methods.

- By the host device writing to a "trigger register" in the source 105G - the block mapping message is sent each time the host device writes to the trigger register.
- By configuring a time period - the 105G will send the block mapping message if this time period has elapsed since the last message has been sent.
- By configuring a real-time clock - the 105G will send the block mapping message at the configured times.
- By a change-of-state within the I/O block. This can only occur for Write mappings. If a value in the block changes by more than the sensitivity amount, then the block message will be sent. You can enter a delay period such that the message is sent after the delay period.

Combinations of the above triggers can occur - for example, the block mapping message will be sent if a change-of-state occurs, AND at the configured real-time, AND when the host device writes to the trigger register.

4.4.2 Host Device Trigger

Each mapping entered is allocated a status register - the register number appears on the right hand of the Block Mapping display. The structure of these Block Mapping status registers is shown in Appendix A.

Bit 13 of the status register is the "trigger bit" - if Bit 13 is turned "on", then the associated mapping is triggered. When the radio message is sent, the 105G automatically turns Bit 13 "off" again - ready for the host device to trigger the mapping again.

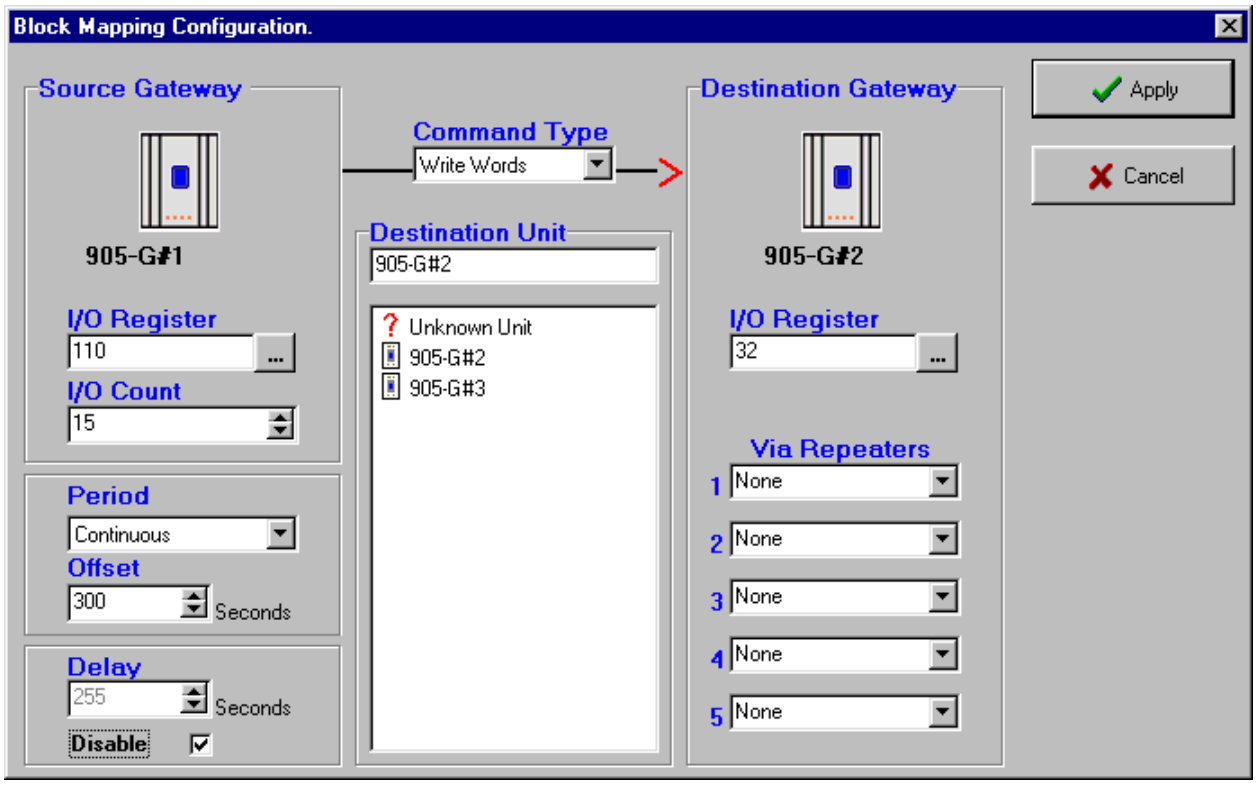
The easiest way for the host device to write to Bit 13 is to write a value of hex 2000 (decimal 8192) to the status register. This value writes "1" into Bit 13 and zeros into the other bits of

the register. In the above example, if a value of hex 2000 is written to register 9500, the block mapping would be triggered.

4.4.3 Time Period

On the Block Mapping display, there are two configuration windows - "Period" and "Offset" - these determine the time period trigger and real-time trigger.

For a time-period trigger, select "Continuous" in the "Period" pop-down window. Under "Offset" enter the time-period in seconds. In the above example, the mapping will be sent



every 300 seconds or 5 minutes.

Note that the time period is after the last transmission - if the block mapping message is triggered by the host device, or by a change-of-state, then the timer is reset and the time period starts again.

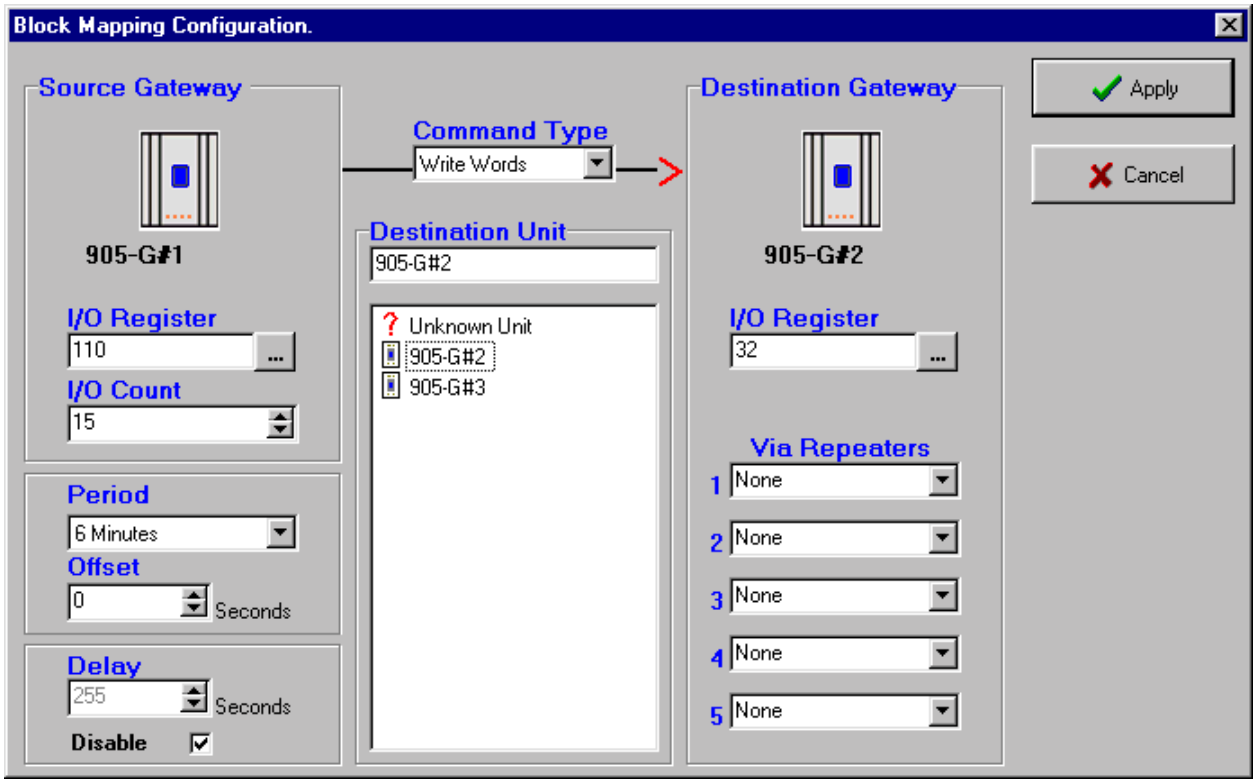
The "Offset" value can be set from 0 – 4095 seconds (68 minutes). If you do not want the message to be sent on a time period, set the "Offset" value to zero.

If you want the block mapping to be sent only on time period (and not on change as well), select the "Disable" box in the bottom left hand corner - this disables change messages for this block mapping.

4.4.4 Real-Time

The block mapping message can be sent at a real-time by setting the "Period" value. In this example, "period" is set to 6 minutes - the message will be sent every 6 minutes starting at the beginning of each hour. That is, the message will be sent at XX:00, XX:06, XX:12, XX:18, XX:24 …. XX:54 - where XX represents any hour of the day.

If "Period" was set to 1 minute, then the message would be sent every minute, on the minute.



The "Offset" value provides an offset to the specified time. In this example, if the "Offset" was set to 10 seconds, then the messages will be sent 10 seconds later - at XX:00:10, XX:06:10, XX:12:10 etc.

The reason for the offset is to stagger messages with the same time setting. For example, if you configure 5 block mappings all to be sent at 10 minutes, then the 105G will try to send these messages at the same time - some of the messages will have to wait until the earlier messages have been sent. If you are sending Read messages as well as Write messages, then the return messages could clash with outgoing messages.

To avoid this, you can delay some messages using the Offset feature. For example, if you have 5 mappings to be sent at 10 minutes, then the first could have zero offset, the second 3 sec offset, the third 6 sec offset etc.

If you do not wish to have a real-time trigger, set "Period" to continuous.

If you want the block mapping to be sent only on real-time (and not on change as well), select the "Disable" box in the bottom left hand corner - this disables change messages for this block mapping.

Setting the Clock

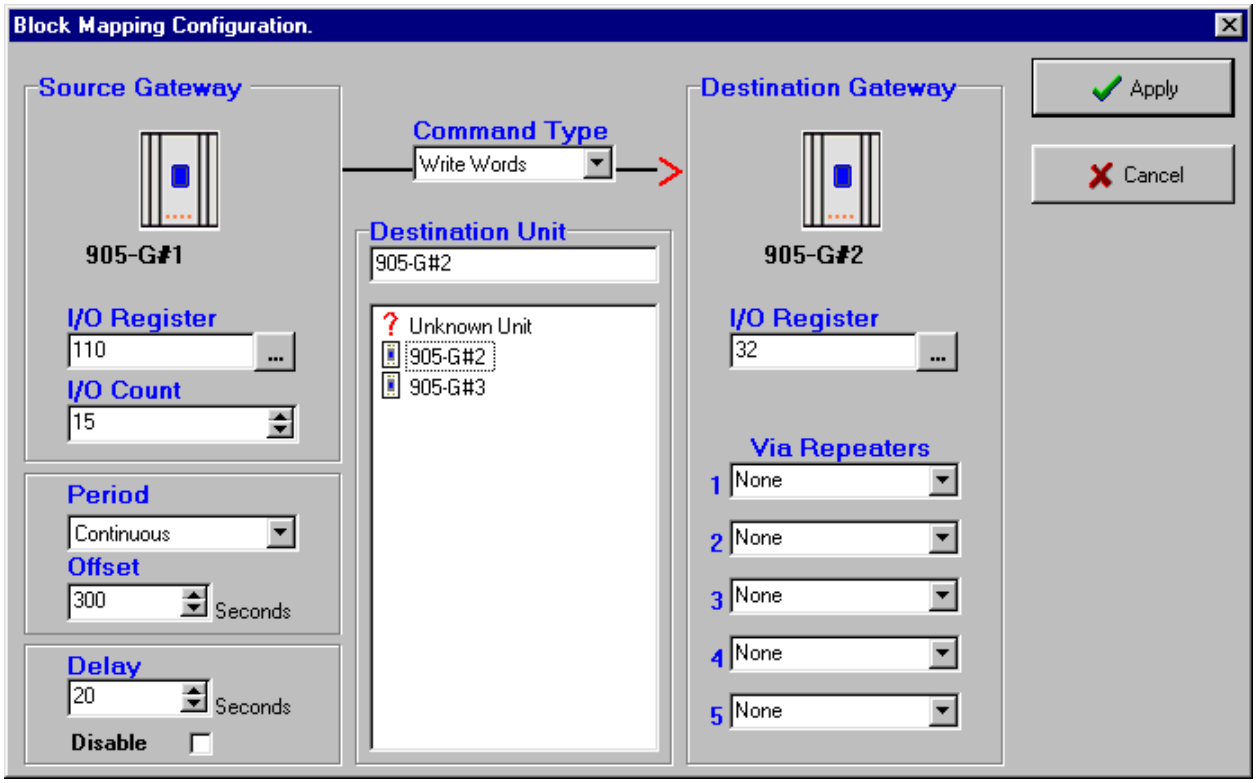
The clock within the 105G can be set by the host device, and read by the host device. The 105G provides four clock registers for days/hours/minutes/seconds - these are registers 4330 – 4333. On start-up, these registers are set to zero. Reg 4333 increments each second, Reg 4332 increments each minute, Reg 4331 each hour and Reg 4330 each day.

These clock registers are used by the 105G for the real-time clock trigger. The host device can read these registers.

Item	Read Location	Set Location
Days	4330	4340
Hours	4331	4341
Minutes	4332	4342
Seconds	4333	4343

The host device can also set the 105G clock at any time by writing to another set of registers 4340 – 4343. These registers are normally zero. When a value is written into one of these registers, the 105G copies the value into the corresponding clock register, and then sets the "Set" register back to zero. For example, if the host device writes a value of 7 into Reg 4341, the 105G will write 7 into 4331 and set 4341 back to zero.

4.4.5 Change-of-State



If a value in the block changes by more than the sensitivity amount, then the block message will be sent. The sensitivity values are set under the "Sensitivity" option as per section 4.5.

This can only occur for Write mappings.

A delay time can be entered to reduce the number of change triggers in active systems. For example, if 20 seconds is selected in the "Delay" window, then the change message will be sent 20 seconds after the change-of-state occurs - if other changes occur during the 20 second period, all of these changes are sent in the one message.

The delay time can be set from 0 – 254 seconds.

If you do not wish change messages to occur, select the “Disable” box.

4.4.6 Mixing Normal Mappings and Block Mappings

Block mappings can include I/O Registers already used with normal I/O mappings.

For example, a remote 105U I/O module could map a remote input to I/O Reg 743. At the 105G, the host device could read I/O Reg 743, and you could also configure a block mapping including this register to another 105G. You could write a block I/O Reg 700 – 800 to another 105G.

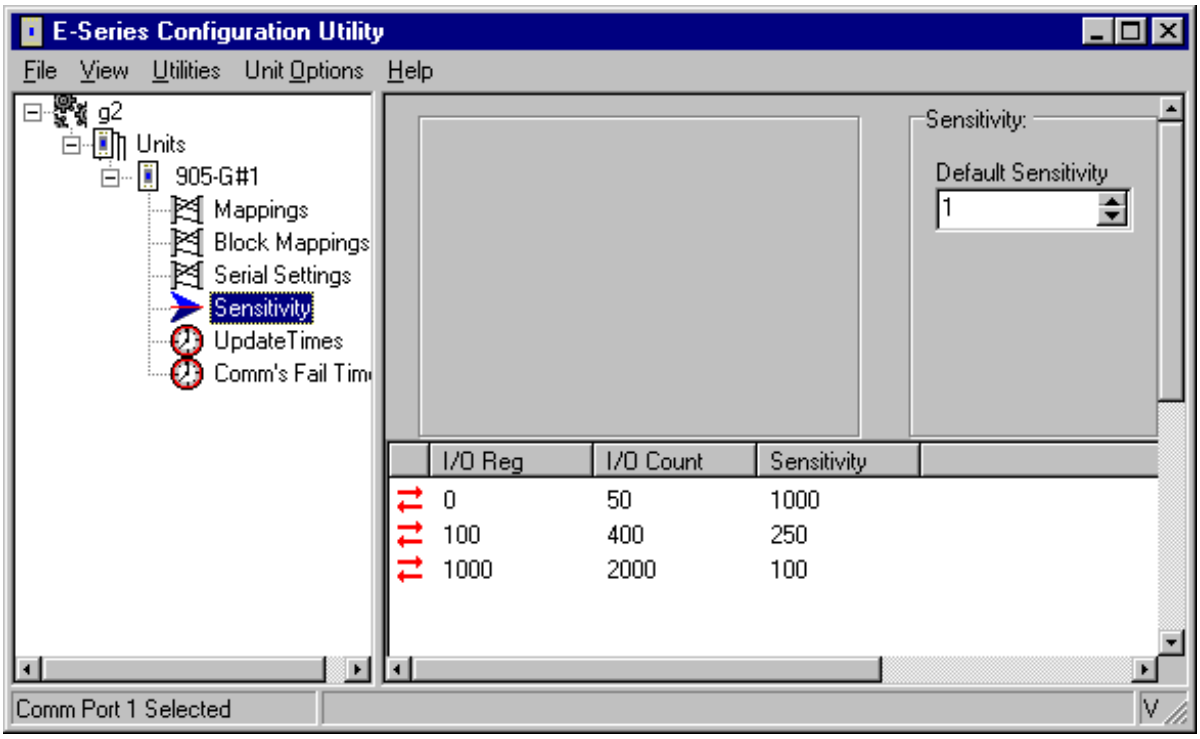
4.4.7 Comms Fail for Block Mappings

Each block mapping has an associated mapping number. Up to 500 block mappings may be entered. A status register is maintained for each block mapping. The most significant bit of this register contains the comm fail status.

If a block mapping does not receive an acknowledgement from the remote module, then the comms fail status is set - this can be monitored by the host device.

4.5 Change Sensitivity

“Change” messages for both individual I/O mappings and block mappings use a sensitivity



value to trigger the message. Sensitivities are configured for blocks of I/O registers - that is, each I/O register does not have a unique sensitivity. You can configure up to 50 sensitivity values - that is, there can be 50 blocks of registers with different sensitivities.

In the above example, three sensitivity blocks have been configured:

1. I/O registers 0 – 49 have a sensitivity of 1000 (or 1.5% of the 16 bit range)
2. I/O registers 100 – 499 have a sensitivity of 250 (or 0.4% of the 16 bit range)
3. I/O registers 1000 – 2999 have a sensitivity of 100 (or 0.15% of the 16 bit range)

All of the registers between 0 and 49 have a sensitivity value of 1000. If register 34 has changed value by more than 1000 since the last transmission for that register, then a change trigger will occur for register 34. Sensitivity values are in decimal and can vary between 1 and 65535 (16-bit).

Up to 50 blocks of sensitivities can be configured. If a register is included in more than one block, then the first sensitivity value configured will be accepted and later values ignored.

Registers which are not included in any block use the "default" sensitivity which is also user-configurable. In the above example, the default sensitivity is 1 and is the sensitivity for all I/O registers not included in the three blocks.

Important Note. Sensitivity values need to be selected carefully for analogue or counting registers as small values can result in a large number of change messages which can overload the radio channel. A sensitivity value of 1 in 65535 is a change of 0.0015%. If the host device writes an analogue value to a 105G every 100msec, it will change by at least 1 bit each time. A small sensitivity value will cause a change message to be sent every 100msec. If there are many analogue values in the same situation, then there would be many change messages every 100msec. Sensitivity values for analogue I/O should be set to be greater than the normal process noise of the signal. For example, if a flow signal has a normal process oscillation of 2.5%, then the sensitivity should be set to 3% (or a value of 2000) to avoid change transmissions from the process oscillations.

4.6 Data Bus Configuration - MODBUS

The 105U-G-MD1 module provides interface for Modbus Slave, Modbus Master and Allen-Bradley DF1. This Modbus interface uses the Modbus RTU protocol - also known as the Modbus Binary protocol. This manual assumes that the reader has a good understanding of the Modbus or DF1 protocol.

4.5.2 MODBUS Slave

If you use the 105G Modbus Slave interface, then the host device will be a Modbus Master device.

The only configuration required for the Modbus slave interface is selecting the Modbus address and serial port parameters. This is done in the "Serial Settings" screen. A valid Modbus slave address is 1 to 255.

Each I/O register (and status register) in the 105G can act as one of the following types of Modbus registers

00001-09999 = Output Coils (digital/binary)

10001-19999 = Input Bits (digital/binary)

30001-39999 = Input Registers (16 bit)

40001-49999 = Output Registers (16 bit)

For example:

- If the Modbus Master sends the 105G a "read" command for Modbus input 10457, then the 105G will respond with the value in I/O register 457.

- If the Modbus Master sends the 105G a “write” command for Modbus output 02650, then the 105G will write the value to I/O register 2650.
- If the Modbus Master sends the 105G a “read” command for Modbus input 30142, then the 105G will respond with the value in I/O register 142.
- If the Modbus Master sends the 105G a “write” command for Modbus output 40105, then the 105G will write the value to I/O register 105.

The 105G will respond to the following Modbus commands from a Modbus master:

CODE	ACTION
01	Read the state of multiple digital output points
02	Read the state of multiple digital input points
03	Read the value of multiple output registers
04	Read the value of multiple input registers
05	Set a single digital output ON or OFF
06	Set the value of a single output register
07	Read Exception Status - compatibility - returns zero
08	Loopback test Supported codes 0 return query data 10 clear diagnostic counters 11 bus message count 12 CRC error count 14 slave message count
15	Set multiple digital output points ON or OFF
16	Set multiple output registers

The 105G I/O register values are 16 bit (hexadecimal values ‘0000’ to ‘FFFF’, or decimal 0 to 65535), regardless of whether the register represents a discrete, analogue or count point.

The value of a discrete (digital) I/O point is stored in the 105G database as a hexadecimal '0000' (“off”) or hex 'FFFF' (“on”). However the 105G will respond with either a ‘0’ (“off”) or ‘1’ (“on”) to a digital read command from the Modbus master - these are commands 01 and 02. Similarly, the 105G will accept ‘0’ or ‘1’ from the Modbus master in a digital write command and store ‘0000’ or ‘FFFF’ in the database location - these commands are 05 and 15.

Analogue I/O are 16 bit register values. A value of decimal 8192 (hex 2000) represents 0mA. A value of 49152 (hex C000) represents 20mA. Each 1 mA has a value of 2048 (hex 0800) - a change of 4096 (hex 1000) is equivalent to a change of 2mA. A 4-20mA signal will vary between 16384 (hex 4000) and 49152 (hex C000). A 0-20mA signal will vary between 8192 (hex 2000) and 49152 (hex C000).

Pulse counts are stored as a 16-bit register. When the register rolls over, from ‘FFFF’ (hex), the next value will be ‘0001’. The register will only have a value of ‘0000’ when the remote module starts up, and the previous count is lost. This value will indicate that the counter has reset.

Modbus Errors

Four Modbus error messages are reported to the Modbus Master. An error response is indicated by the address of the return message being 128 plus the original slave address.

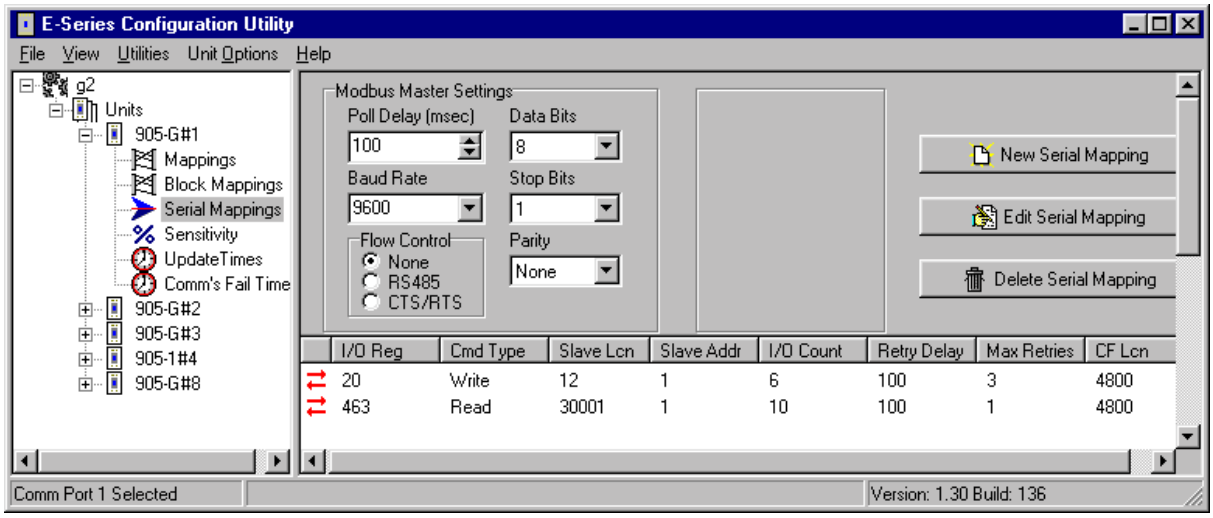
CODE	MEANING
01	Illegal Function. The message received was not an allowable function for the slave.
02	Illegal Data Address. The data address in the received frame refers to an I/O location with no attached hardware.
03	Illegal data value
06	Busy - unable to process message

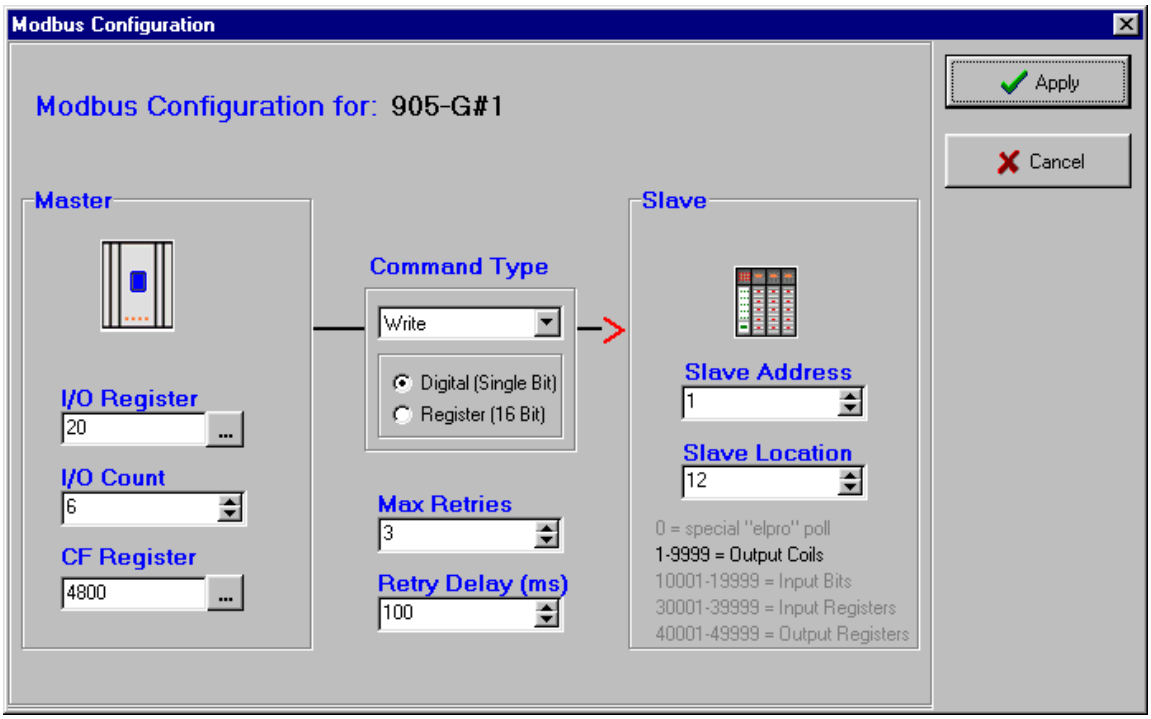
4.5.2 MODBUS Master

If you use the 105G as a Modbus Master, then the host device/s will be Modbus Slave device/s. If the RS485 port is used, then multiple Modbus Slave devices can be connected to the 105G. The 105G Modbus Master will generate Modbus read and write commands to the Modbus Slave devices.

First read the above section on Modbus Slave operation, for an understanding of how the 105G handles Modbus registers, and the types of Modbus commands the 105G Master can generate.

The Modbus Master commands are configured in the "Serial Mapping" screen. The serial port is configured in the same way as described in the above section on Modbus Slave.





To enter a Modbus command, select “New Serial Mapping”. The following example is a digital write command which writes 105G I/O registers 20 – 25 (6 registers) to Modbus outputs 00012 – 00017, at Modbus Slave address 1.

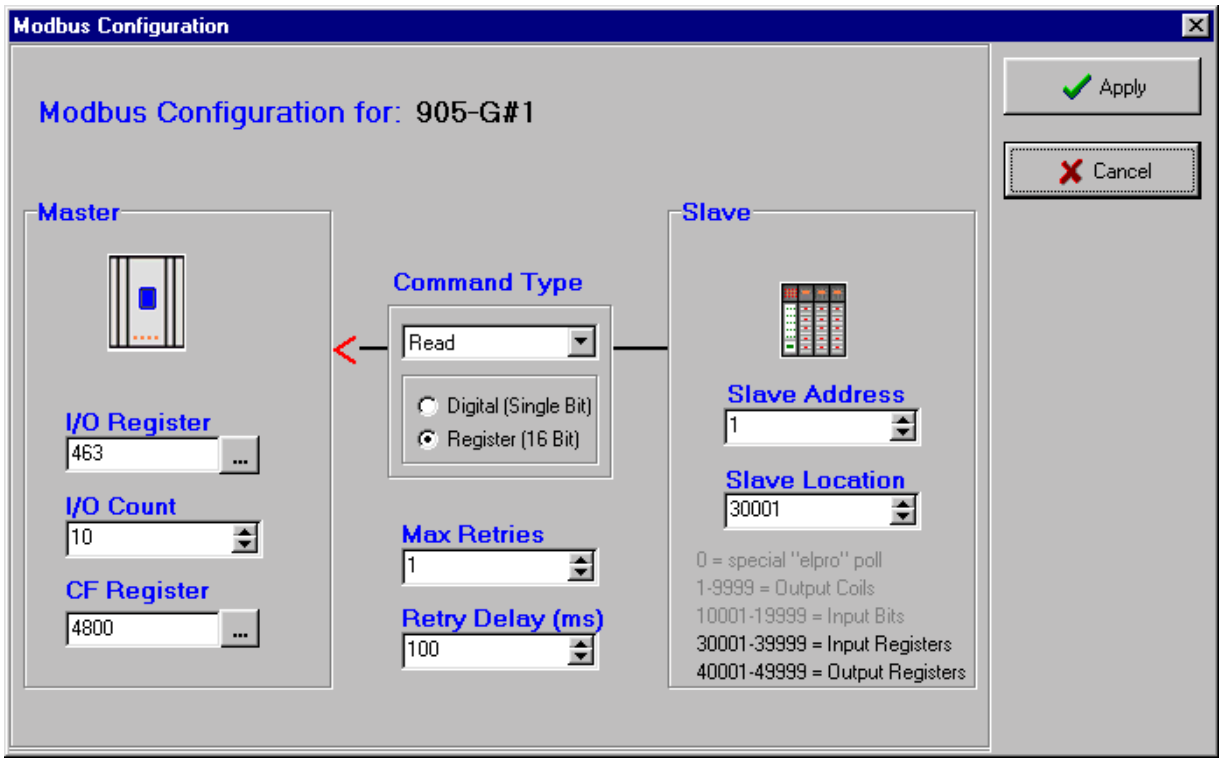
The entry under “I/O Register” is the first I/O register in the 105G to be transferred - the “I/O count” is the number of registers to be transferred. If the selected Modbus slave does not respond to the command, then the 105G will write a ‘FFFF’ value to one of its own registers, configured under “CF Register” - in this case it is register 4800.

The “Command Type” selected is a write command (you can select read or write) - which means that the values are sent from the 105G to the Modbus Slave. The type of write command is a “Digital” write, meaning that the register values will be written as digital/binary values”.

If the Modbus Slave device does not respond to the Modbus command, the 105G will try another 3 times (“Max Retries” = 3). The Modbus command will be sent to the Modbus Slave every 100msec.

The address of the Modbus Slave is 1 (permissible addresses are 1 – 255). Because a digital write command has been selected, the destination register type will be digital outputs, with Modbus tag “0xxxxx”. The first destination Modbus location is 12 (or 00012) - as there are 6 registers transferred, the destination locations will be 00012 – 00017.

The second example is a register read command to the same Modbus Slave (address 1). The command requests the Modbus Slave to return the values of 10 registers which will be stored in I/O registers 463 - 473 in the 105G. As the command is a “register read” command, the target Modbus locations will be of the type 3xxxx. The starting location is 30001. So the values of locations 30001 – 30010 in Modbus Slave 1 will be transferred to I/O registers 463 – 473 in the 105G.



Note that the same CF Register ("comms fail" register) has been used in the 105G. You can use the same register or a different register in the range 4800 – 4999.

To complete the Data Bus Configuration, enter all of the Modbus commands required to transfer I/O points between the 105G and the Modbus Slave devices.

Digital I/O

The value of a digital I/O point is stored in the 105G database as a hexadecimal '0000' ("off") or hex 'FFFF' ("on"). However the 105G will generate either a '0' ("off") or '1' ("on") to a digital output point (Coil) when sending commands to a Modbus slave - these are commands 05 and 15. Similarly, the 105G will accept '0' or '1' from the Modbus slave in response to a digital read command and store '0000' or 'FFFF' in the database location - these commands are 01 and 02.

Analogue I/O

Analogue I/O from the remote 105U modules are 16 bit register value. A value of 8192 (hex 2000) represents 0mA. A value of 49152 (hex C000) represents 20mA. Each mA has value of 2048 (hex 0800) - a change of 4096 (hex 1000) is equivalent to a change of 2mA. A 4-20mA signal will vary between 16384 (hex 4000) and 49152 (hex C000). A 0-20mA signal will vary between 8192 (hex 2000) and 49152 (hex C000).

Pulse I/O

Pulse counts from the remote 105U modules are shown as a 16-bit register. When the register rolls over, from 'FFFF' (hex), the next value will be '0001'. The register will only have a value of '0000' when the remote module starts up, and the previous count is lost. This value will indicate that the counter has reset.

Modbus Retry Delay

The 105G Modbus Master configuration includes a feature to limit the frequency at which slave devices are polled for data. The 105G will poll each Modbus slave in order. If there is no delay time entered, the 105G will poll as quickly as it is able to. If there is a delay time entered, then this delay time will occur between each poll message.

When updated values are received from the 105U radio network, the current polling sequence is interrupted, and the new values are written immediately to the appropriate slaves.

Re-tries on the Serial Port

When communicating with Modbus slaves, the 105G may be configured to re-try (or re-send) a message zero or more times if no response is received from a slave. If all retries are used up, that slave is flagged as being in communication failure. Further attempts to communicate with the slave will have zero re-tries. When a successful response is received from the Modbus slave, the communication failure flag is reset and the configured number of re-tries will be used. This means that an off-line slave device will not unduly slow down the communications network.

Comms Fail

A "Comms Fail" image location in the 105G database. This image location should be in the range 4500 to 4999. If a response is not received from the Modbus slave after all re-tries have been sent, the 105G will set this Comms Fail image location to hex(FFFF). When the 105G sends the next poll for this I/O Command, it will not send any re-tries if a response is not received to the first message. When a response is eventually received, the 105G will reset the value in Comms Fail image location to 0, and the normal re-try sequence will operate.

Different I/O Commands can use different Comms Fail image locations, however we recommend that you use the same image location for all I/O Commands to the same Modbus slave address.

4.7 Data Bus Configuration - DF1

The 105G DF1 Driver allows the 105G to communicate with Allen-Bradley devices supporting the DF1 protocol. Supported commands allow communication with 500 CPU devices (SLC and Micrologix) and with PLC2 series devices. DF1 offers both full-duplex (point to point) and half-duplex (multidrop) operation. The 105G only supports the full-duplex operation - this is the default DF1 mode on most equipment. DF1 full-duplex is a "peer-to-peer" protocol. Either DF1 device can initiate commands to the other device, and both devices will respond to commands from the other device. The 105G can act as both a command initiator and a command responder.

The 105G will initiate the following command types to a command responder, according to the configuration. The 105G will automatically generate the correct command type depending on the configuration you enter. The 105G will also respond to these command types if they are sent from a command initiator.

Command Description	**Code**	**Function Code**	**Comment**	
Protected Write	0x00	NONE	PLC2 series and SLC / Micrologix	
Unprotected Read	0x01	NONE	PLC2 series and SLC / Micrologix	
Diagnostic Status	0x06	0x00	Diagnostic Commands	
Echo message	0x06	0x00		
Unprotected Write	0x08	NONE	PLC2 series and SLC500 / Micrologix	
Typed logical Read	0x0F	0xA2	Type	SLC500 and Micrologix
Read Bits	0x0F	0xA2	0x85	Return MSB of each register
Read Integers	0x0F	0xA2	0x89	Return signed 16 bit value
Read Long Ints	0x0F	0xA2	0x91	Unsigned 16 bit register per long-word
Typed logical Write	0x0F	0xAA	Type	SLC500 and Micrologix
Write Bits	0x0F	0xAA	0x85	Each Bit placed in MSB of register
Write Integers	0x0F	0xAA	0x89	Writes a signed 16 bit value
Write LongIntegers	0x0F	0xAA	0x91	Low 16 bits of long-word placed in register. Upper 16 bits ignored.

The SLC and Micrologic PLC's read/write two types of registers. An "Integer" has a signed 16 bit value (-32768 to 32767). A "Long Integer" has a 32 bit value. The 105G registers contain an unsigned 16 bit value (0 to 65535). We recommend that you use Long Integer read/write commands - the upper 16 bits of the 32 bit value will be ignored. Refer to more information in the Analogue I/O and Pulse I/O sections below. The PLC2 uses unsigned 16 bit registers in the same format as the 105G.

The 105G DF1 driver will update remote outputs whenever a data value changes by more than the I/O register sensitivity. If the response from a data request contains a changed data value, the new value will be transmitted to the remote 105U on the radio network. Similarly, if the 105G receives a command to change a data value, the new value will be transmitted to the remote 105U module.

The DF1 commands are configured in the "Serial Mapping" screen. The serial port should be configured in the same way as the host device. If the 105G acts only as a command responder, no further configuration is required.

If the 105G acts as a command initiator, you can enter a "Request Delay" between commands sent to the host. To enter a DF1 command, select "New Serial Mapping". The following example is a file write command which writes 105G I/O registers 20 – 104 (25 registers) to DF1 files l3.1 to l27.1 at DF1 address 2

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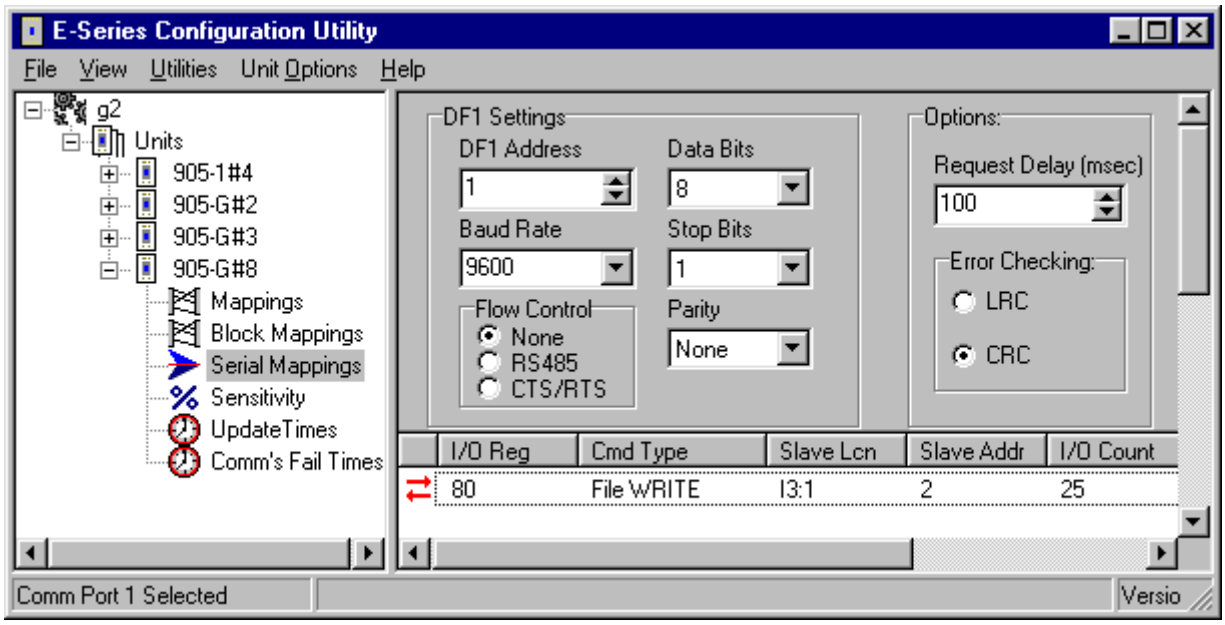
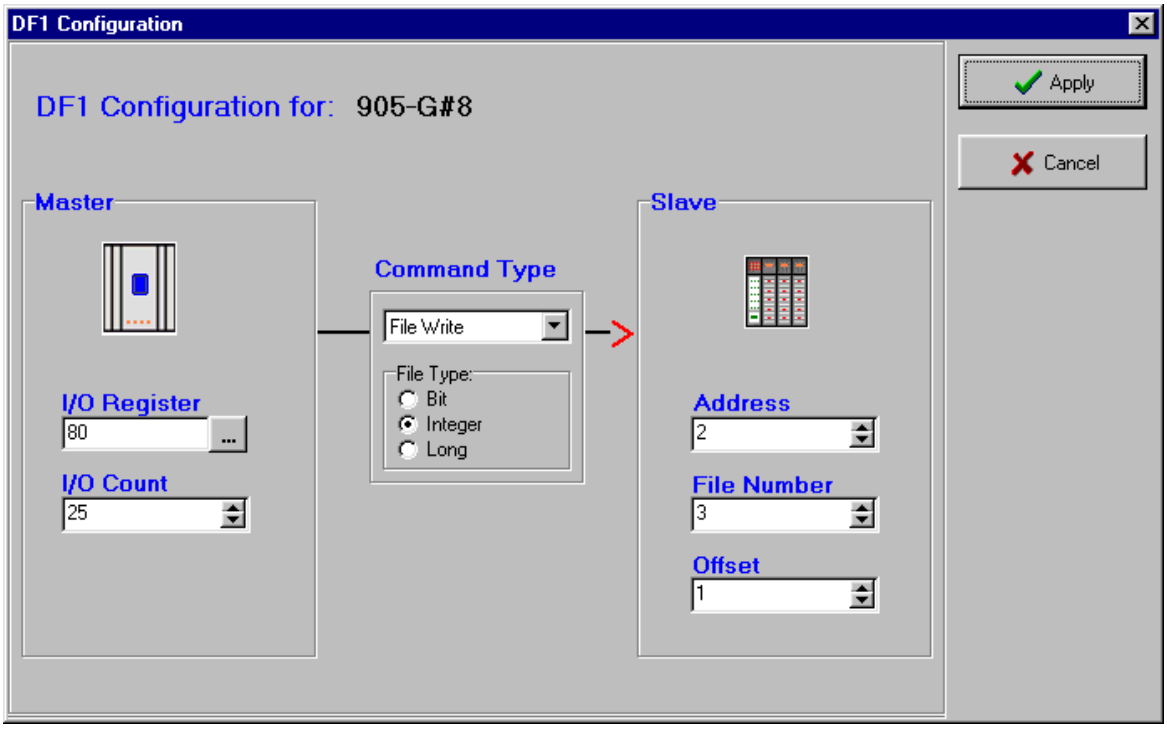




The entry under “I/O Register” is the first I/O register in the 105G to be transferred - the “I/O count” is the number of registers to be transferred.

The “Command Type” selected is a file write command (you can select read or write) - which means that the values are sent from the 105G to the host device. The type of write command is a “Integer” write, meaning that the register values will be written as register values.

The DF1 address of the host device (or “Slave”) is 2.

Discrete I/O

The value of a digital I/O point is stored in the 105G database as a hexadecimal '0000' (“off”) or hex 'FFFF' (“on”). However the 105G will generate either a ‘0’ (“off”) or ‘1’ (“on”) to a binary

file when initiating a "Typed Logical Write" command or responding to a "Typed Logical Read" command. Similarly, the 105G will accept '0' or '1' from responding device to a "Typed Logical Read" command or from an initiating device generating a "Typed Logical Write" command and store '0000' or 'FFFF' in the database location. The file type for a binary file (bit file) is 0x85.

In the PLC (that is, the DF1 host device), discrete values ("bits") are stored in 16 bit registers - each register stores 16 bit values (or 16 discrete values). You can only transfer these values in groups of 16. That is, a read or write command will transfer a minimum of 16 bits to/from the 105G. If more than 16 are transferred, then they will be transferred in multiples of 16. You cannot transfer an individual bit - you must transfer the 16 bits in that PLC register, which will be transferred to/from 16 consecutive I/O registers in the 105G.

Analogue I/O

Analogue I/O from the remote 105U modules are 16 bit register value. A value of 8192 (hex 2000) represents 0mA. A value of 49152 (hex C000) represents 20mA. Each mA has value of 2048 (hex 0800) - a change of 4096 (hex 1000) is equivalent to a change of 2mA. A 4-20mA signal will vary between 16384 (hex 4000) and 49152 (hex C000). A 0-20mA signal will vary between 8192 (hex 2000) and 49152 (hex C000).

Note: If analogue values are read to and written from an integer file in an SLC or Micrologix CPU, integer files contain 16 bit ***signed*** values. These represent values in the range -32768 to 32767. The data values from the 105U modules are treated as 16 bit ***unsigned*** values. To convert the data from an analogue input, move the data from the integer file to a long file (MOV command) then mask out the high 16 bits (MVM with mask value FFFF). This will result in a long integer value in the range 0 to 65535.

Alternatively, use a long integer file type to transfer the analogue value as a long integer in the range 0-65535.

Pulse I/O

Pulse counts from the remote 105U modules are shown as a 16-bit register. When the register rolls over, from 'FFFF' (hex), the next value will be '0001'. The register will only have a value of '0000' when the remote module starts up, and the previous count is lost. This value will indicate that the counter has reset.

Note: The values from the 105G module are 16 bit ***unsigned*** values. When they are copied to the Integer file in the PLC, they will be treated as 16 bit ***signed*** values. These values may be converted to the original (unsigned) values using the MOV and MVM instructions described in the previous section (Analogue I/O). Again, using a Long Integer type will avoid this problem.

500 CPU (SLC and MicroLogix) file types and addressing

The 105G provides a linear address space of 10,000 data words. This is compatible with PLC2 addresses, but does not match the addressing used by the 500CPU modules (SLC and Micrologic). These address data by file number and file offset. To address an image location, *L*, in the 105G, set the file number to *L* / 100 and set the file offset to L % 100. For example, to read image location 4623 in the 105G, read from file number 46, offset 23.

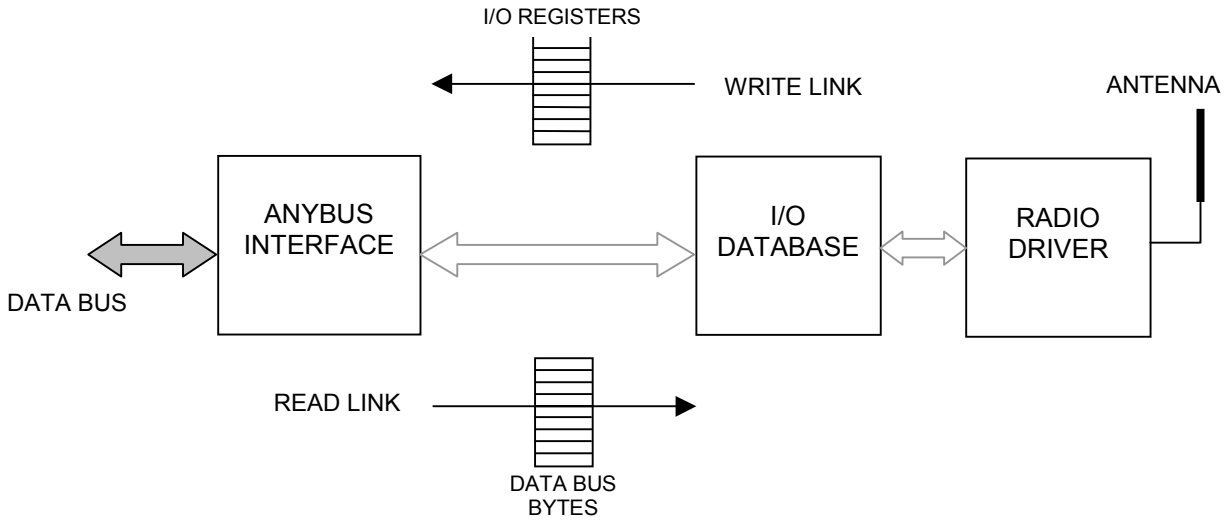
4.8 Data Bus Configuration - Profibus Slave

The Profibus 105U-G-PF1 acts as a Profibus DP Slave - the host device is a Profibus Master. If you use the 105U-G with a PLC, the PLC will require a GSD file so it can recognise the Profibus interface in the 105U-G. This file loads into the PLC. The file is available on the same CD as the configuration software.

Configuration of the Profibus data bus comprises allocating a Profibus Slave address to the 105G, and configuring links between the I/O registers and the Profibus bytes in the Anybus interface module.

The Profibus address can be set in the "Bus Config" screen or via the rotary switch on the end-plate of the module- valid slave addresses are 1 – 126. If the "Enable Rotary Switch" box is not selected, then the address entered in the program will be used and the rotary switch value ignored. If the "Enable Rotary Switch" box is selected, then the address entered in the configuration program will be ignored and the rotary switch read on start-up of the 105G.

The Anybus Profibus interface has 416 bytes, of which 244 can be used as input bytes, or 244 can be used as output bytes. These "Anybus bytes" are directly addressable by the data bus. Read or write links are configured between the Anybus interface bytes and the I/O registers.



A Read Link reads values from Anybus "output" bytes and stores the values in I/O registers. If the host device wants to send a value to the 105G, it will write to the Profibus output bytes - the 105G will then transfer these values to the I/O data base using a Read Link.

A Write Link writes I/O register values to Anybus "input" bytes. If you want to send a value from the 105G to the host device, the value is transferred from the I/O database to a Profibus input byte using a Write Link - the host device can then read this input byte.

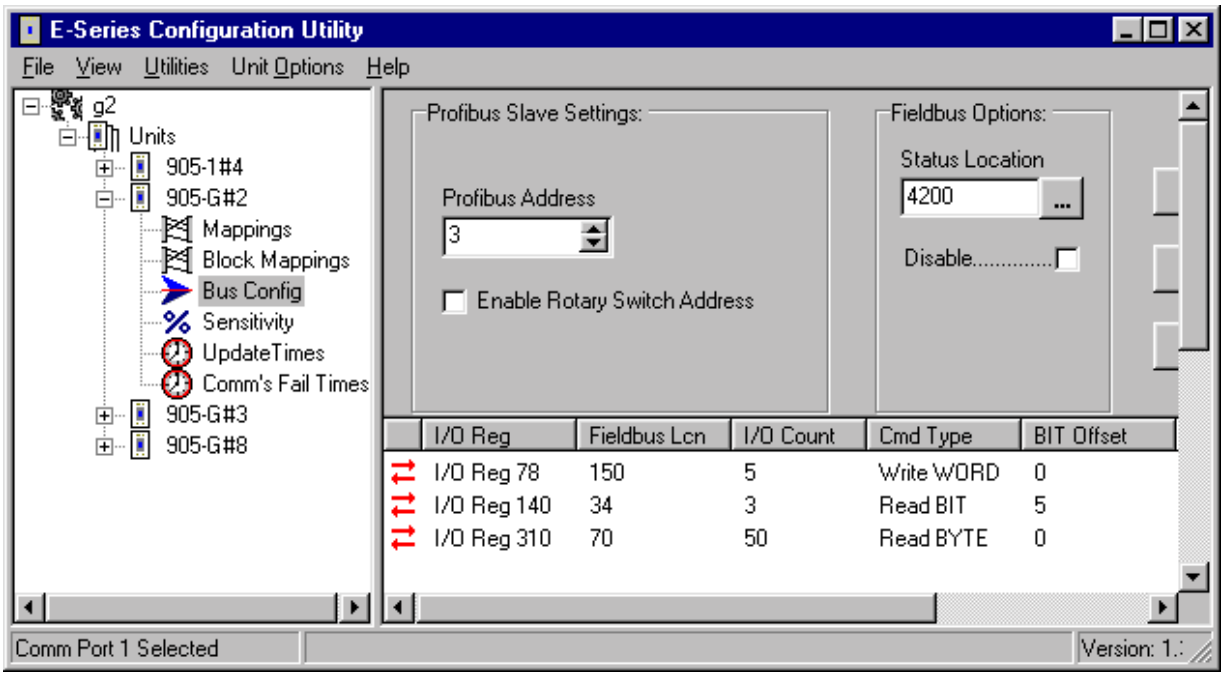
The Profibus bytes are 8-bit. Each byte can contain 8 digital values, or one 8-bit value, or two consecutive bytes can be converted to a 16-bit value.

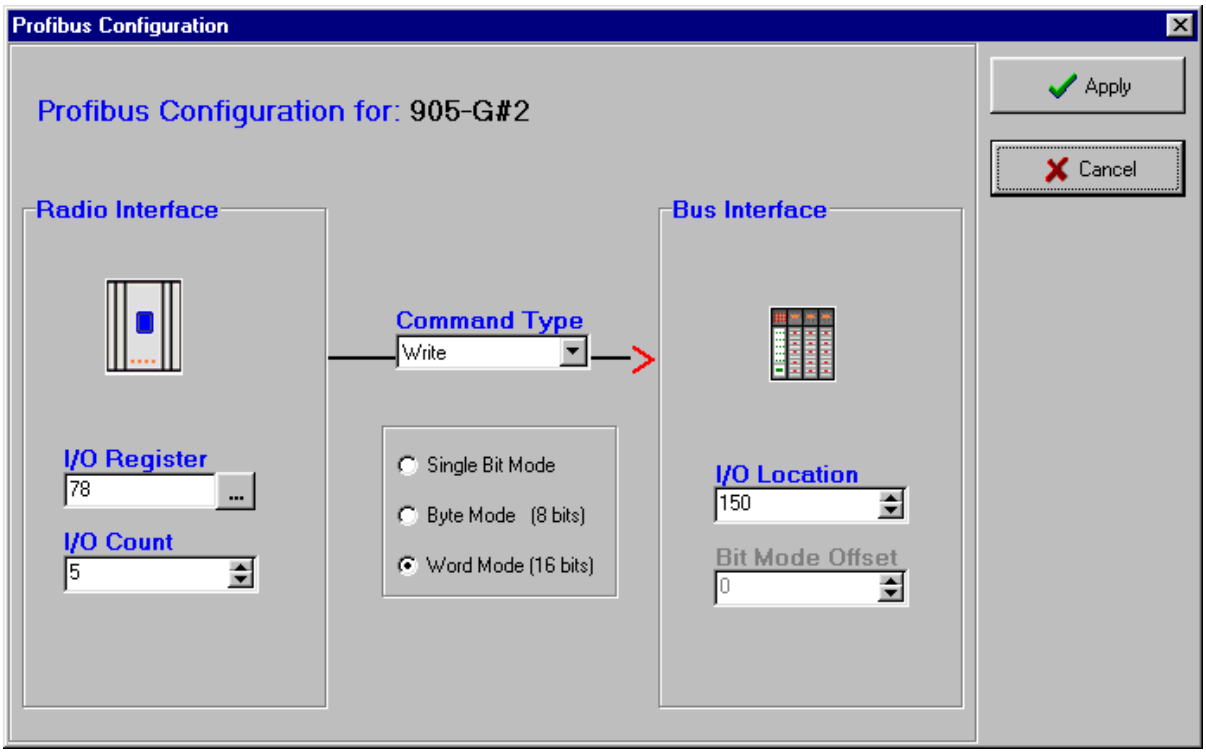
Note that the Profibus input bytes and output bytes both number from 0 - that is, there is an input byte 125 as well as an output byte 125.

There are six types of links that can be configured:

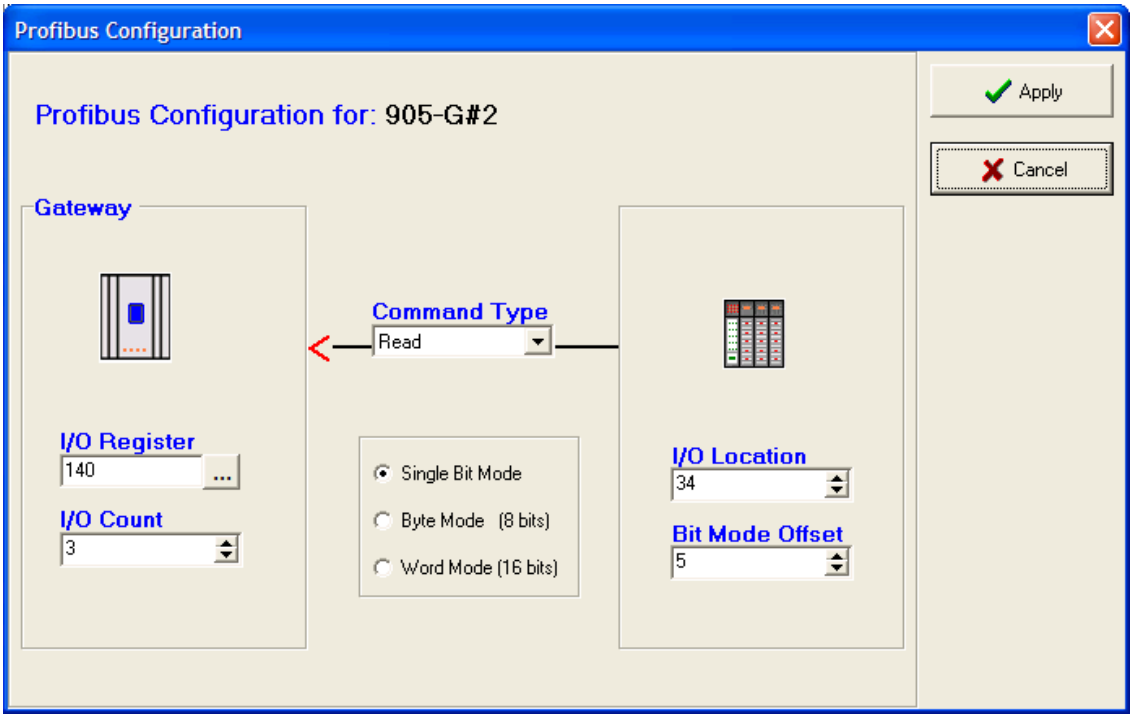
	Read Links	*Write Links*
Single Bit	The 105G reads single bits as digital values and stores in I/O registers as hex FFFF or 0000.	The 105G writes I/O registers to single bits of a Profibus byte, converting the 16 bit I/O register values into 0 or 1.
Byte (8-bit)	The 105G reads a block of bytes as 8-bit values and stores each 8-bit value in the most significant 8-bits of I/O registers.	The 105G writes the most significant 8-bits of I/O registers to a block of Profibus bytes.
Word (16-bit)	The 105G reads a block of bytes, converting consecutive bytes into 16-bit words, and stores each word value into a block of I/O registers.	The 105G writes a block of I/O registers to a block of Profibus bytes, converting the 16-bit register words into two consecutive bytes.

In the following example, the 105G is allocated a Profibus Slave address of 3. The first link is a "write word" link, writing 5 x 16-bit words from I/O registers 78 – 82 to Profibus bytes 150 – 160. Each 16-bit I/O register is converted into two consecutive 8-bit bytes. I/O register 78 will be written to Profibus bytes 150 and 151, with the most significant 8-bits into byte 150.





The second link is a "single bit read" link - bits 5 to 7 (3 bits) of Profibus byte 34 are read and stored in I/O registers 140 – 142. For single bit transfers, the offset is counted from the least significant bit (LSB) of the byte (with bit 0 being the LSB). This is different than the Ethernet unit which counts the offset from the most significant bit - refer next section.



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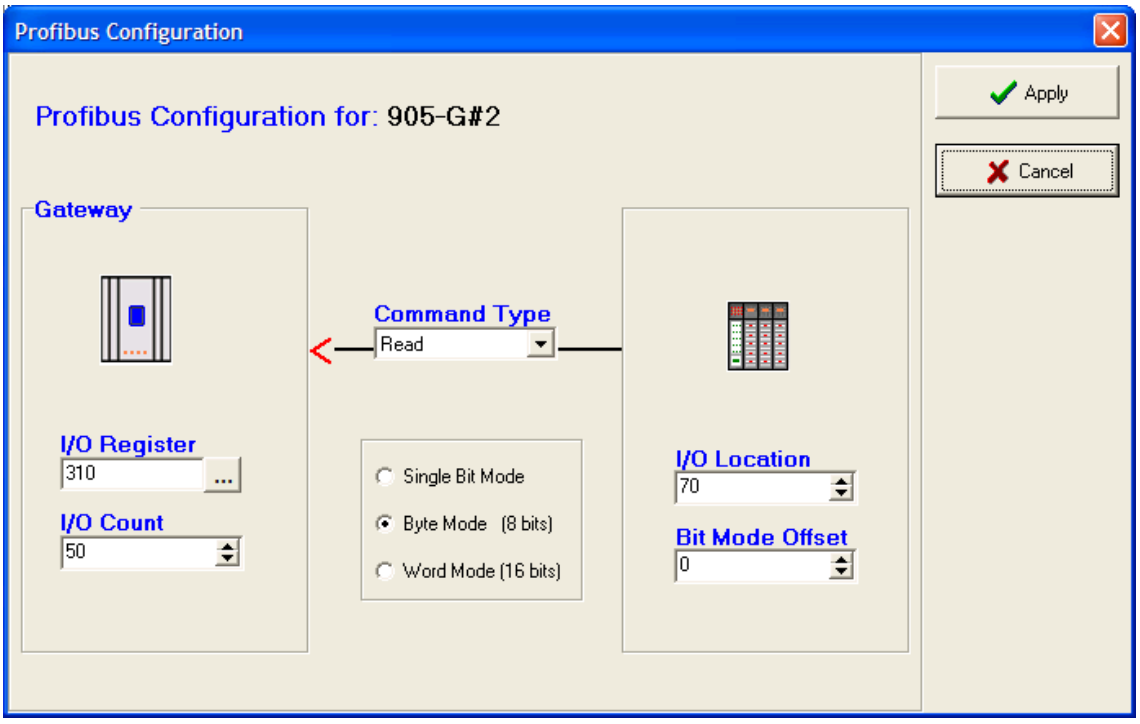


The third link is a "byte read" link - a block of 50 bytes are read from Profibus byte 70 – 119, and stored in I/O registers 310 – 359. The 8-bit values of each byte are stored in the most significant 8-bits of the I/O register.

Byte read and write links allow 8-bit registers to be transferred. Although the resolution of the register is decreased (0.4% instead of 0.00015%), twice as many analogue or count I/O values can be transferred thru the Profibus interface.

Note that the Profibus master cannot read or write a selective block of Profibus bytes in the 105G interface. That is, if you want the Profibus master to read or write to bytes 70 – 119, it will read or write to bytes 0 – 119 - each Profibus command starts at byte 0. You should allocate bytes from byte 0.

A status location for each data bus link may be entered. If you wish to use a status register, select the "Enable Status Location" box and enter an I/O register. The status register will give information regarding the Anybus module.

4.9 Data Bus Configuration - Ethernet

The Ethernet 105G uses an Anybus Ethernet interface board. This interface board has many sophisticated functions - this manual only provides basic instructions on how to use the Ethernet functions of the 105G. For full details, refer to the Anybus manual "ABS-EIP-2 - Modbus/TCP, EtherNet/IP & IT Functionality" - this manual is available from the Elpro Configuration CD and web-page.

The 105G provides the following Ethernet functionality:

1. Modbus/TCP. The module supports the Modbus/TCP protocol and conforms to the Modbus/TCP specification 1.0 (full information on this protocol can be obtained from http://www.modicon.com/openmbus/index.html). Refer to section 4.9.3 below for configuration details.

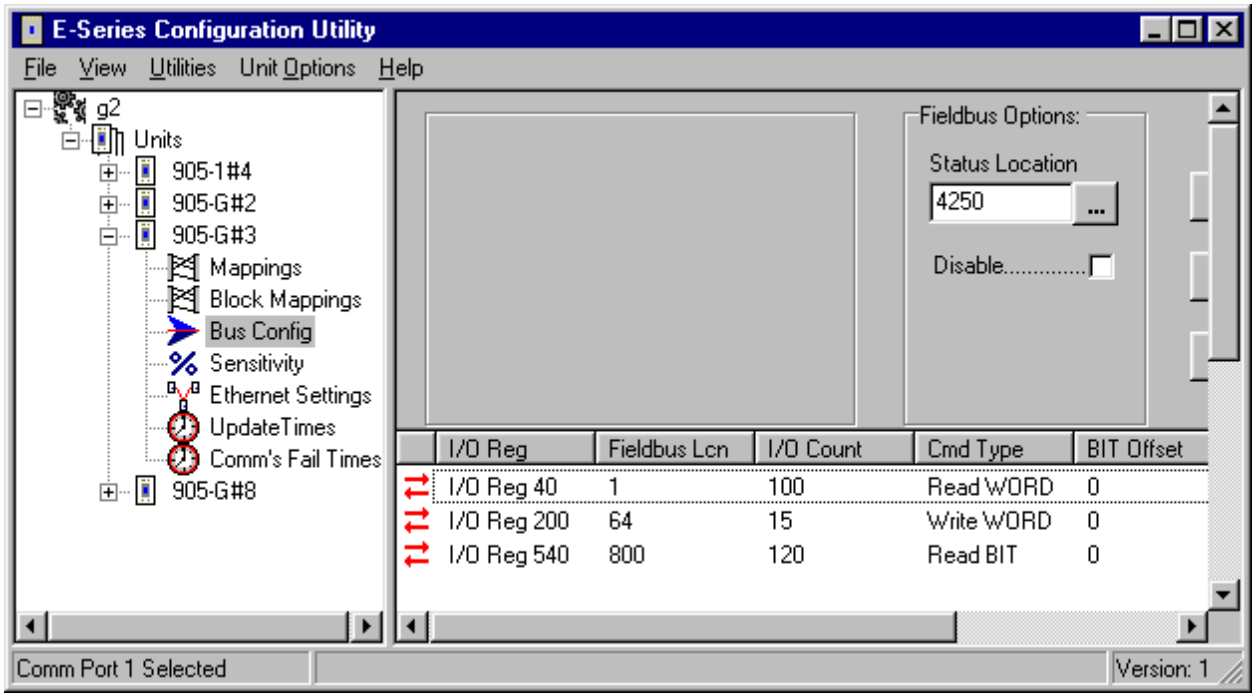
2. Ethernet/IP. EtherNet/IP is based on the Allen-Bradley Control and Information protocol, CIP, which is also the framework for both DeviceNet and ControlNet, to carry and exchange data between nodes. Refer to section 4.9.4 below for configuration details.
3. Mailbox Interface/Transparent Socket Interface. Other protocols can be implemented on top of TCP/IP or UDP using the transparent mailbox socket interface. For information on this feature, refer to the Anybus manual.
4. IT-Functionality. The Anybus board has several IT features, including Internet functionality - for information on how to implement these functions, refer to the Anybus manual.

    - Filesystem. The module features a flexible file system with two security levels. The size available for user files is approximately 1.4 Mbyte of non-volatile memory.
    - FTP Server. The FTP Server provides easy file management using standard FTP clients.
    - Telnet Server. The Telnet server features a command line interface similar to the MS-DOS™ environment.
    - HTTP Server. The module features a flexible HTTP server with SSI functionality. This enables the user to configure a web interface (or web page) accessing I/O values in the 105G.
    - Email Client (SMTP). The application can send email messages using the Mailbox interface. Predefined messages stored within the file system can be sent, triggered by a specified I/O value in the 105G. It is also possible to include I/O values in emails, using SSI functionality.
    - IP Access Control. It is possible to configure which IP addresses and what protocols that are allowed to connect to the module.

4.9.1 Linking I/O Registers with Ethernet Bytes

Select “Bus Config” from the left-hand menu. I/O registers need to be linked to Ethernet bytes in the same way as for the Profibus 105G - please read section 4.6 above. The difference between the Ethernet version and Profibus version is simply the number of bytes available in the Anybus interface. With the Ethernet version, there are 2048 input bytes and 2048 output bytes.

Note that “bit transfers” count from the most significant bit (MSB) with the Ethernet interface, instead of LSB with the Profibus interface. If you transfer 3 bits with an offset of 2, then you will be transferring bits 6, 5 and 4 of the byte (bit 7 being the MSB). Another example - if you transfer 10 bits, starting at byte 89, offset 3 - then bits 5, 4, 3, 2, 1 and 0 of byte 89, and bits 7, 6, 5 and 4 of byte 90 will be transferred.



4.9.2 Setting IP Address

The Ethernet IP address can be set from the configuration software or via the Ethernet port or via the selector switches in the top end-plate of the module. If the "Enable Switch Address" box is not selected, then the address entered in the program will be used and the switch value ignored. The IP address can be overwritten from the Ethernet port. If the "Enable Switch Address" box is selected, then the address entered in the configuration program will be ignored and the rotary switch read on start-up of the 105G.

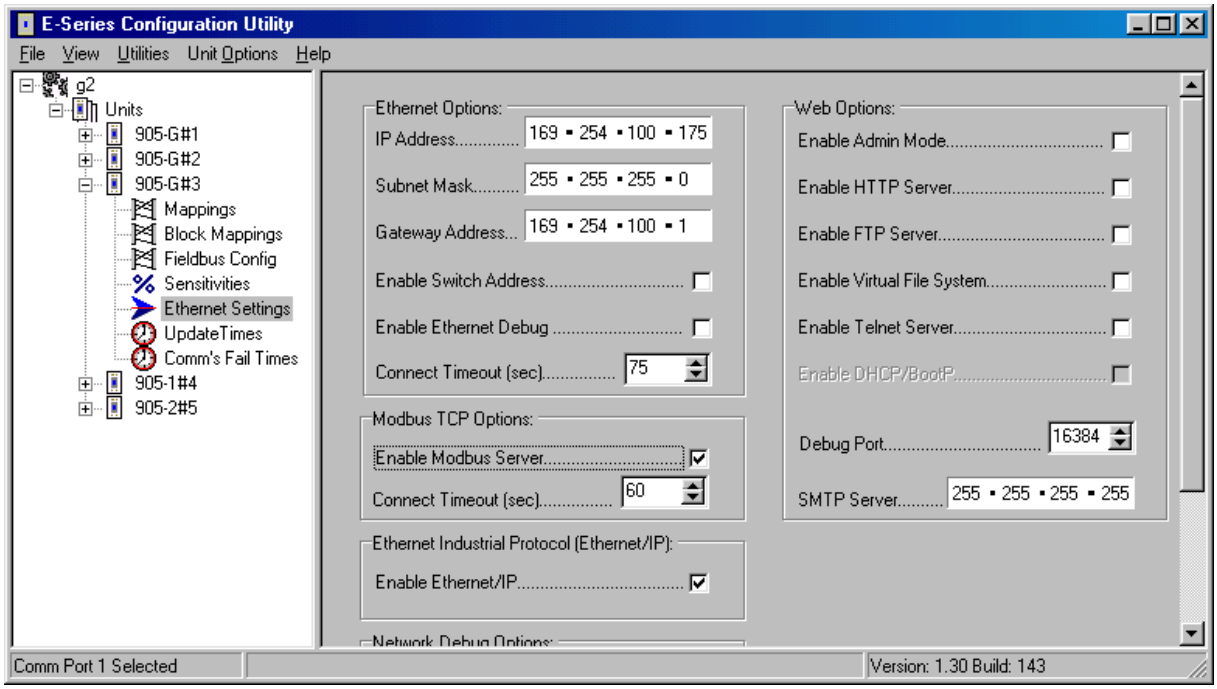
The IP address is used to identify each node on the Ethernet network. Therefore, each node on the network must have a unique IP address. IP addresses are written as four decimal integers (0-255) separated by periods, where each integer represents the binary value of one byte in the IP address. This is called dotted-decimal notation.

Example: 169.254.100.1

Normally the first three parts of the IP address represents the Ethernet LAN, and the last part is the Ethernet node address.

Subnet Mask

To be able to establish communication between two Ethernet devices, both devices must belong to the same subnet. If not, the communication must be done through a gateway. It is therefore recommended to configure the module to the same subnet as your host device.



Special case IP addresses

Devices on an Ethernet network are not allowed to be configured to the following IP addresses; therefore do not configure the module to use any of them.

0.x.x.x - IP address where the first byte is zero

127.x.x.x - IP address where the first byte is 127

x.x.x.0 - IP address where the last byte is zero

x.x.x.255 - IP address where the last byte is 255

Gateway

The Gateway IP is the IP address of the LAN server or the host device.

Connect Timeout

The Connect Timeout parameter in the IP addressing section of the display refers to the IP functionality of the module. If an IP connection to the module has not been active for this amount of time, the 105G will timeout and disconnect that connection. Note that there can be several active connections at the same time - only the inactive connection will be disconnected.

Enable Ethernet Debug

Select this box if you wish the Ethernet host device to be able to change the configuration of the 105G or use diagnostic features via the Ethernet port.

4.9.3 Modbus TCP

To use Modbus TCP, select the Enable Modbus Server box. The Modbus TCP Server will accept Modbus TCP connections on TCP/IP port 502.

Supported Commands

Function Code	Function Name	7 Class	Affects Area	Addressing method
1	Read coils	1	IN/OUT	Bit
2	Read Input discretes	1	IN/OUT	Bit
3	Read multiple registers	0	IN/OUT	Word
4	Read input registers	1	IN/OUT	Word
5	Write coil	1	OUT	Bit
6	Write single register	1	OUT	Word
7	Read exception status	1	-	-
15	Force multiple coils	2	OUT	Bit
16	Force multiple registers	0	OUT	Word
22	Mask write register	2	OUT	Word
23	Read/Write registers	2	IN/OUT	Word

Modbus/TCP Addressing

The AnyBus-S IN and OUT areas can be configured to a maximum size of 2048 bytes each. I/O Data is transferred from I/O registers to the IN area using fieldbus *write* mappings in the configuration software. Conversely, Data is transferred from the OUT area to I/O registers using fieldbus *read* mappings. When accessing these areas, with Modbus commands, the addressing is done according to the following tables.

IN area

Word addr.	Bit address															
000h	0000h	0001h	0002h	0003h	0004h	0005h	0006h	0007h	0008h	0009h	000Ah	000Bh	000Ch	000Dh	000Eh	000Fh
001h	0010h	0011h	0012h	0013h	0014h	0015h	0016h	0017h	0018h	0019h	001Ah	001Bh	001Ch	001Dh	001Eh	001Fh
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3FFh	3FF0h	3FF1h	3FF2h	3FF3h	3FF4h	3FF5h	3FF6h	3FF7h	3FF8h	3FF9h	3FFAh	3FFBh	3FFCh	3FFDh	3FFEh	3FFFh

OUT area

Word addr.	Bit address															
400h	4000h	4001h	4002h	4003h	4004h	4005h	4006h	4007h	4008h	4009h	400Ah	400Bh	400Ch	400Dh	400Eh	400Fh
401h	4010h	4011h	4012h	4013h	4014h	4015h	4016h	4017h	4018h	4019h	401Ah	401Bh	401Ch	401Dh	401Eh	401Fh
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7FFh	7FF0h	7FF1h	7FF2h	7FF3h	7FF4h	7FF5h	7FF6h	7FF7h	7FF8h	7FF9h	7FFAh	7FFBh	7FFCh	7FFDh	7FFEh	7FFFh

Supported Exception codes

Exception Code	Name	Description
01	Illegal function	The module does not support the function code in the query
02	Illegal data address	The data address received in the query is outside the initialised memory area
03	Illegal data value	The data in the request is illegal

Connect Timeout

The Connect Timeout parameter in the Modbus TCP section of the display refers to the Modbus TCP functionality of the module. If a TCP connection to the module has not been active for this amount of time, the 105G will timeout and disconnect that connection. Note that there can be several active connections at the same time - only the inactive connection will be disconnected.

4.9.4 Ethernet/IP

Ethernet/IP (Ethernet Industrial Protocol) is based on the Control and Information Protocol (CIP), which is also the framework for both DeviceNet and ControlNet, to carry and exchange data between nodes. The Ethernet/IP implementation is a Level 2 I/O Server, which means that the module will respond to both explicit and IO messages but requires that an Ethernet/IP client initiate IO connections. For additional information on the Ethernet/IP protocol see www.ethernet-ip.org and www.odva.org. The rest of this section assumes the reader is familiar with Ethernet/IP.

If you use the 105U-G with a PLC, the PLC will require an EDS file so it can recognise the Ethernet/IP interface in the 105U-G. This file loads into the PLC. The file is available on the same CD as the configuration software.

Implemented Objects:

EtherNet/IP requires some mandatory objects; these are implemented as well as some vendor specific objects. The mandatory objects are the ones in the specification from ODVA.

The following vendor specific objects are implemented:

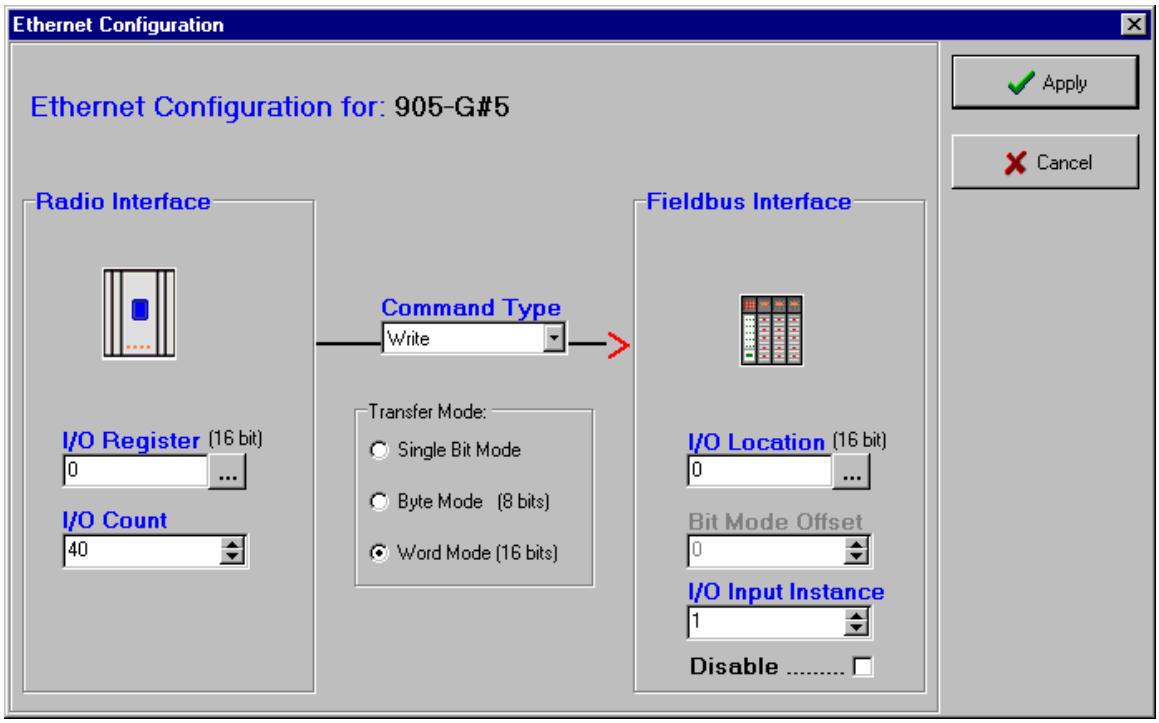
• I/O data input mapping object, Class A0h

• I/O data output mapping object, Class A1h

The 105G will support up to 6 produced IO connections and 6 consumed IO connections. The maximum individual connection size is 512 bytes. Ethernet/IP interface to these IO connections is made available in the mandatory Ethernet/IP 'Assembly Object' (class 04h) as vendor specific instance attributes 64h-69h for produced IO (i.e. IO data configured using fieldbus *write* commands) and 96-9Bh for consumed IO (i.e. IO data configured using fieldbus *read* commands). The same IO are also available in the vendor specific objects I/O data input mapping object (class A0h) and IO data output mapping object (class A1h) respectively as instance attributes 1 – 6. (See Object Specifications below)

To make I/O data available via Ethernet/IP, ensure that the Enable Ethernet/IP checkbox on the Ethernet Settings page is checked. Data bus links need to be configured to link the required I/O registers to the Ethernet bytes, as described above in the Profibus and

Modbus/TCP sections. An "*I/O Instance*" for each databus link must also be specified so that the configured I/O data is made available to one of the six possible Ethernet connections.



In this example, 40 I/O Registers (80 bytes) are transferred to I/O Input Instance 1 (i.e. Ethernet connection 1). As per the table below, this data would then be available via Ethernet/IP in class 04h, Instance Attribute 64h *or* in class A0h, Instance Attribute 1. If the *Disable* option is checked, the I/O transfer will not be made available to Ethernet/IP. The table below shows the possible IO Instances and their corresponding Ethernet/IP locations.

IO Instance	*Assembly Object*	*Vendor Specific Object*
IO Input Instance 1-6	Class 04h, Instance 64h-69h	Class A0h, Attribute 01h-06h
IO Output Instance 1-6	Class 04h, Instance 96h-9Bh	Class A1h, Attribute 01h-06h

Assembly Object, Class 04h

The Assembly Object binds all mapped I/O data. This data is used for I/O connections. This object is set-up dynamically via databus links through configuration software.

Class Attributes

ID#	Name	Service	Description	Semantics	Def, Min, Max	Type
01h	Revision	Get_attribute_all	Object Revision	The revision attribute containing the revision of the object	1, 1, 1	UINT

Input Area, Instance 64h

Note: This data is also available in the vendor specific object: I/O Data Input Mapping Object, Class A0h, Instance Attribute 01h, and Attribute ID 01h.

ID#	Name	Service	Description	Type
03h	Data	Get_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 1.	Array of USINT

Input Area, Instance 65h – 69h

Note: This data is also available in the vendor specific object: I/O Data Input Mapping Object, Class A0h, Instance Attribute 01h, and Attribute ID's 01h to 06h.

ID#	Name	Service	Description	Type
03h	Data	Get_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 2-6.	Array of USINT

Output Area, Instance 96h

Note: This data is also available in the vendor specific object: I/O Data Output Mapping Object, Class A1h, Instance Attribute 01h, and Attribute ID 01h.

ID#	Name	Service	Description	Type
03h	Data	Get_attribute_single Set_attribute_single	The data produced is configured from fieldbus read mappings from I/O Output Instance 1.	Array of USINT

Output Area, Instance 97h – 9Bh

Note: This data is also available in the vendor specific object: I/O Data Output Mapping Object, Class A1h, Instance Attribute 01h, and Attribute ID 01h.

ID#	Name	Service	Description	Type
03h	Data	Get_attribute_single Set_attribute_single	The data produced is configured from fieldbus read mappings from I/O Output Instance 2-6.	Array of USINT

I/O Data Input Mapping Object, Class A0h

This object is setup dynamically via fieldbus write mappings through configuration software. This data is also available as vendor specific Instance Attributes (64h to 69h) in the Assembly Object.

ID#	Name	Service	Description	Semantics	Def, Min, Max	Type
01h	Revision	Get_attribute_all	Object Revision	The revision attribute containing the revision of the object	1, 1, 1	UINT

Instance Attributes, Instance 01h

ID#	Name	Service	Description	Type
01h	Data	Get_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 1.	Array of USINT
02h	Data	Get_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 2.	Array of USINT
…	…	…	…	…
06h	Data	Get_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 6.	Array of USINT

I/O Data Output Mapping Object, Class A1h

This object is setup dynamically via fieldbus write mappings through configuration software. This data is also available as vendor specific Instance Attributes (96h to 9Bh) in the Assembly Object.

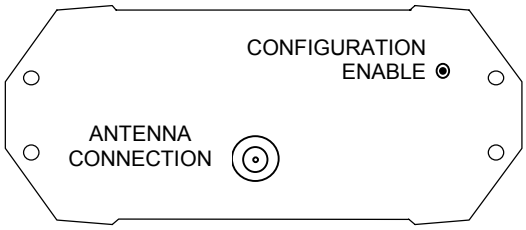
ID#	Name	Service	Description	Semantics	Def, Min, Max	Type
01h	Revision	Get_attribute_all	Object Revision	The revision attribute containing the revision of the object	1, 1, 1	UINT

Instance Attributes, Instance 01h

ID#	Name	Service	Description	Type
01h	Data	Get_attribute_single Set_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 1.	Array of USINT
02h	Data	Get_attribute_single Set_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 2.	Array of USINT
…	…	…	…	…
06h	Data	Get_attribute_single Set_attribute_single	The data produced is configured from fieldbus write mappings to I/O Input Instance 6.	Array of USINT

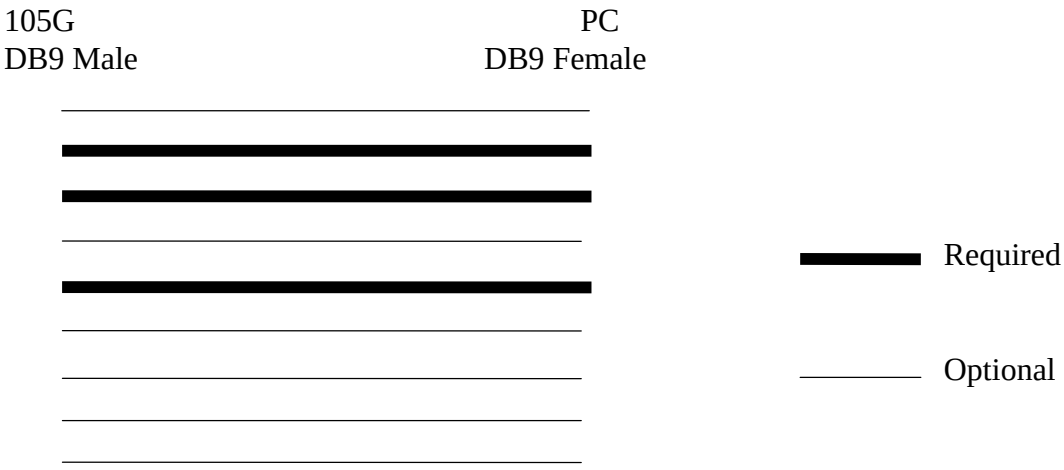
4.10 Uploading and Downloading

To upload or download a configuration file, the 105G must be connected to the PC via a RS232 cable. For Modbus/DF1 units, the host device must be disconnected, even if it is connected to the RS485 port. Other units do not need to disconnect the data bus. When the PC is connected, put the 105G into configuration mode by pressing the small pushbutton switch in the end plate of the module. Hold the pushbutton in for 5 seconds until the ACT LED starts flashing.



In configuration mode, the 105G will stop its normal functions.

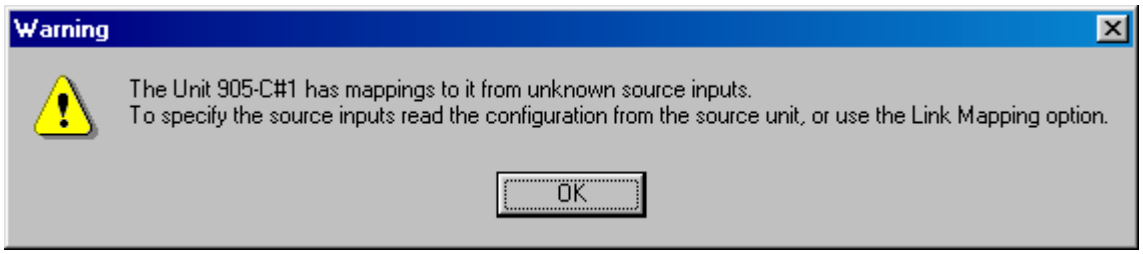
Make sure the correct communications port is selected on the PC - if necessary, change the selection from the Utilities menu. Connect the PC to the module using the configuration cable.



The configuration may be programmed into a 105G, or a configuration may be loaded from a 105G. After programming or loading is complete, disconnect the PC from the 105G. Reset the 105G by removing power and re-connecting power. The 105G will start up normally and the OK led will be on. The serial port will have its original set-up.

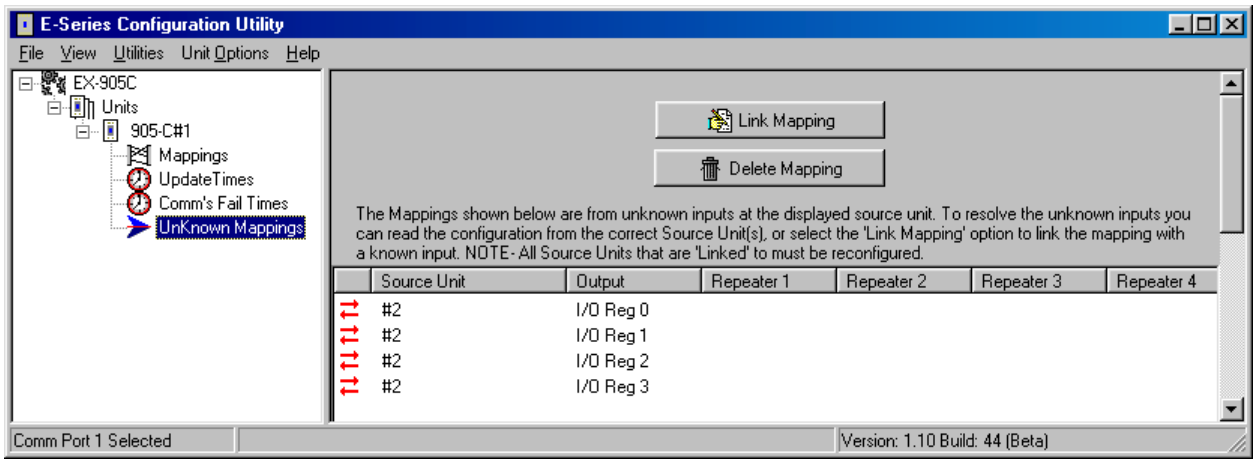
4.10.1 Loading from a 105G

If you load a configuration from a 105G into a "blank" or new project, then the program will not be able to display the mappings from remote modules (as the program does not know what the remote modules are). You will get a warning message like this:



If you open the archived project first, and load into the archived project, then all mappings will display as normal - any mappings to/from the 105C will be over-written on the PC display by the loading process.

If you are unable to load into the archived project, then mappings to remote modules will be displayed, but mappings from remote inputs will be shown as “Unknown Mappings”.



If you also load the configurations from the other remote modules in the system, then these unknown mappings will disappear as the program can determine where the remote inputs are. Alternately, you can select “Link Mapping” and manually enter the remote inputs.

Chapter 5 SPECIFICATIONS

General		
EMC approval	EN55022 (CISPR 22) EN 50082-1 AS 3548	89/336/EEC
Radio standards	EN-300-220 AS 4268.2 AUST RFS29 NZ	405 – 490 MHz, 10 - 500 mW 869 MHz, 500mW 220 – 235MHz, 5W
Housing	130 x 185 x 60mm DIN rail mount	Powder-coated, extruded aluminium
Terminal blocks	Removable	Suitable for 2.5 mm^2 conductors
LED indication	Power supply/OK, Active operation, digital I/O, Radio RX and TX, Serial RX and TX	
Operating Temperature	105U-G-MD1 105U-G-PR1 105U-G-ET1	-20 to 60 degC 0 to 60 degC 0 to 60 degC
Humidity	0 – 99% RH non-condensing	
Power Supply		
Battery supply	11.3 - 15.0 VDC	
AC supply	12 - 24 VAC, 50/60 Hz	
DC supply	9 - 30 VDC	
Battery Charging circuit	Included, suitable for 12Vsealed lead acid batteries	Regulated to max 1.5 amp charging current
Normal Current Drain at 12VDC	105U-G-MD1 105U-G-PR1 105U-G-ET1	150 mA 270 mA 270 mA add 5mA per active I/O
Normal Current Drain at 24VDC	105U-G-MD1 105U-G-PR1 105U-G-ET1	90 mA 170 mA 170 mA add 3mA per active I/O
Radio transmitter inrush, additional to above	350mA @ 12VDC 250mA @ 24VDC	
Power fail status	Monitored	Can be transmitted to remote modules
Battery voltage	Monitored	Analogue value can be transmitted Low voltage status can be transmitted

Radio Transceiver (105U)		
Single channel	synthesised	Direct frequency modulation
Frequency	405 - 490 Mhz 220 – 235MHz 869.4 – 869.65 MHz	12.5 kHz, 10 - 500 mW 25 kHz, 5W 250KHz, 500mW
Spurious emissions	RX - <-57 dBm TX - <-37 dBm	
Frequency Stability	+/- 1.0 kHz	
Receiver Sensitivity	0.4uV at 12dB SINAD	
Signal detect / RSSI	-120 to -80 dBm	
Expected line-of-sight range 400 – 500MHz	2 km @ 10mW EIRP 5 km @ 100mW EIRP 10 km @ 500 mW EIRP	RANGE MAY BE EXTENDED BY UP TO 5 INTERMEDIATE MODULES AS REPEATERS
Expected line-of-sight range 220 MHz	25 km @ 4W EIRP 40 km @ 10W EIRP	
Expected line-of-sight range 869 MHz	5 km @ 500mW EIRP	
Antenna Connector	Female coaxial	Protected by gas discharge surge arrester (but not the 869MHz model).
Serial Ports		
RS232 Port	DB9 male DCE	RTS/CTS hardware signals provided
RS485 Port	2 pin terminal block	Typical distance 1 - 2 km
Data rate (bit/sec) - configurable	50, 75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200	
Byte format	7 or 8 data bits	Stop/start/parity bits configurable
Profibus Port		
RS485 Port	Optically isolated	Autobaud detection 9.6 Kbit/sec – 12Mbit/sec
Ethernet Port		
RJ45	Transformer isolated	10/100 Mbit/sec
Digital I/O	Eight on-board I/O	3000V surge protection input, voltage free contact output, FET 30VDC 500mA

Chapter 6 DIAGNOSTICS

Before installing a new system, it is always best to set up the system on a bench to test the system configuration. It is always easier to detect problems when the modules are together.

After installation, test the radio paths, using the radio strength testing function described later in this section. Record the radio strength and background noise measurements for later reference (refer section 6.2.2 for this feature). If a later test shows that the radio path has changed, this may be the cause of a new problem.

6.1 Diagnostics Chart

The LED indicators on the 105G have the following meanings: -

INDICATOR	CONDITION	MEANING
OK	OFF continuously	Module power off, or module failure
	ON continuously	Normal Operation
RADIO TX	Flashes yellow	Radio transmitting
RADIO RX	Flashes green	Radio receiving good radio signal
	Flashes red	Radio receiving weak radio signal
SERIAL TX	Flashes yellow	Sending serial data
	Brief flash each second	Configuration Mode
SERIAL RX	Flashes green	Receiving serial data
	Flashes red	Serial RX buffer full
ACTIVE	OFF continuously	Start-up initialising sequence Diagnostic or configuration menu
	ON continuously	Module in active operation
	Flashes Yellow	Re-configuration required

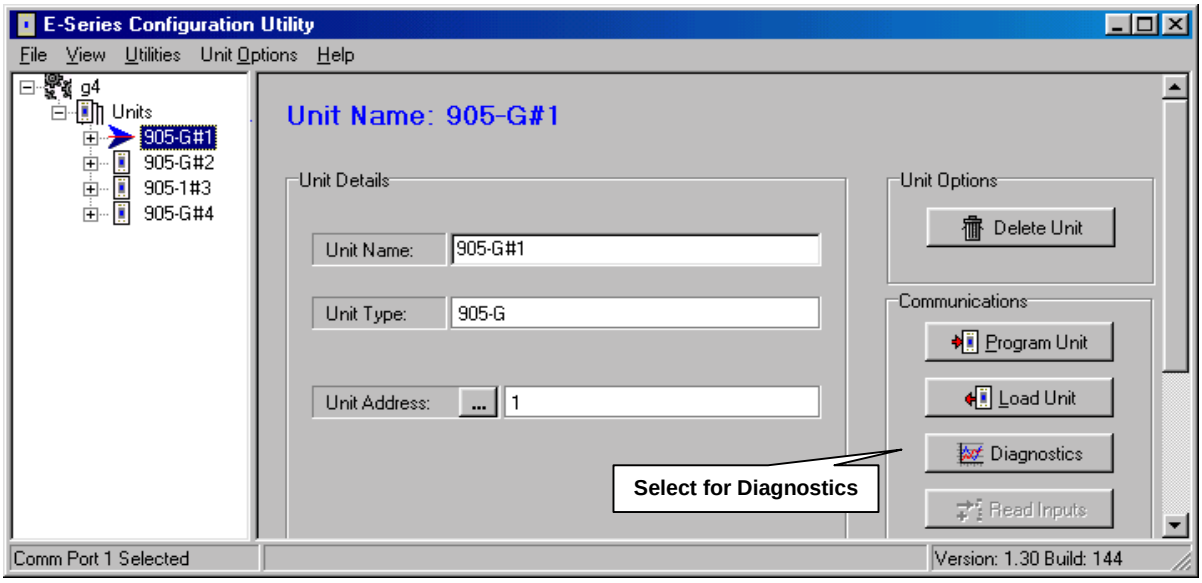
The Ethernet and Profibus modules also have four diagnostic LED's on the end-plate - refer section 6.4.

6.2 Diagnostics Menu

The 105G provides both offline and online diagnostic features to assist with troubleshooting. These features may be selected from the Configuration software using the “Diagnostics” feature.

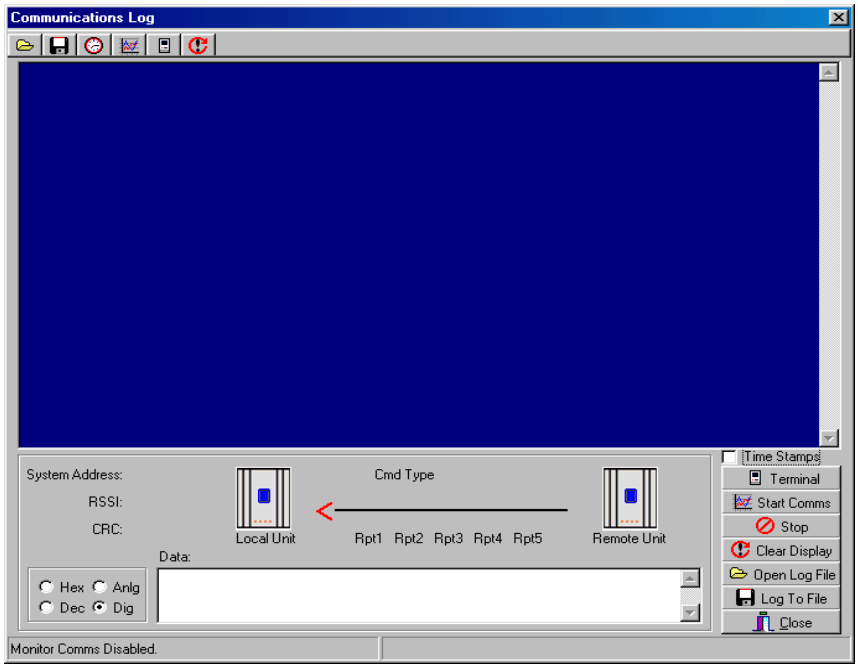
For the Modbus/DF1 module, all diagnostics features are effectively off-line as the data bus needs to be disconnected from the data bus to view the diagnostics. For the Ethernet and Profibus units, some diagnostic features can be viewed via the RS232 port while the data bus is connected and the 105G module is operational.

To view diagnostics, first open the project configuration using the Configuration software:



A “Terminal” screen will appear. With this screen, you can enter “off-line” or “on-line” diagnostics. You will need to connect the PC to the 105G using the RS232 configuration cable.

Select the “Terminal” box.



6.2.1 Radio signal strength measurements

There are two ways of displaying radio signal strength:

- Using the off-line diagnostics menu, or
- Using the on-line "debug" features (still off-line for Modbus/DF1 version) - for more information on this feature, refer to the next section, 6.2.2

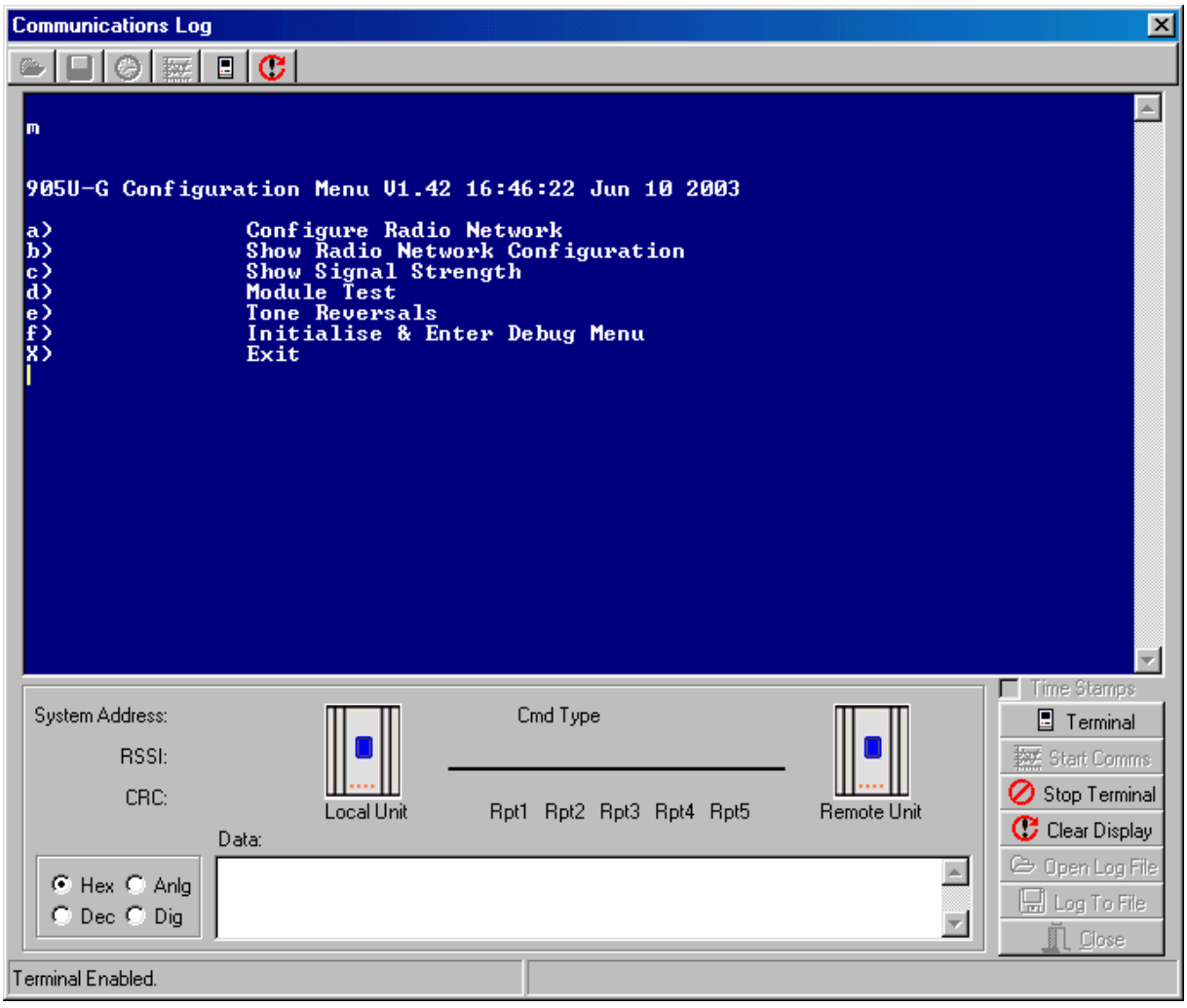
To access the offline diagnostics menu:

First select "Diagnostics" to get the Terminal screen as per the previous section, and select "Terminal";

Then put the 105G into configuration mode by pressing the small pushbutton switch in the end plate of the module for 5 seconds (as per section 4.9) until the ACT led flashes - then release (then the ACT is off and the RX LED flashes);

Enter m to get the off-line diagnostics menu.

The module will stop normal operations and a menu like the following will appear on the PC screen for all 105G versions.



Note: Options a), b), d) and f) are used in factory test and should not be selected.

The diagnostic functions available for field diagnostics are options "c) - Show Signal Strength", "e) - Tone Reversals".

c) - Show Signal Strength

These options allow measurement of radio path between two locations. This is done by the display of the received radio signal strength at one location (select "c"). With no transmitted signal from the other site, the display will show the strength of the radio noise - normally this is in the range between -100 and -130 dBm. At the other site, the transmitter may be turned on (select "e" at the other 105G, or "Tone Reversals" if the other module is a 105U). The display will now show the received radio signal from the other transmitter. For reliable operation, the average signal strength should be better than –95dBm (that is, -90dBm, not –100dBm) provided the average background noise is less than –105dBm (between –105 and –130 dBm). If the average noise is greater than –105, the difference between the noise level and the transmitter signal should be at least 10dB for reliable operation. For example, if the average noise level is -101dBm, then a transmitter signal of better than -91dBm is required for reliable operation.

Note the RSSI (received signal strength) of a received message is also stored in the database registers - refer to section 2.5.1

e) Tone Reversals

If you select this option, the module will continuously transmit - you can use this feature for radio tests. Note that if you are powering the module from a battery only, the battery will be discharged quickly.

x) Exit

After you have finished doing the radio measurements, restart the module by selecting x). The module will restart via its normal power-up and initialisation sequence. Select "Stop Terminal" to shut down the terminal screen.

6.2.2 Online Diagnostics

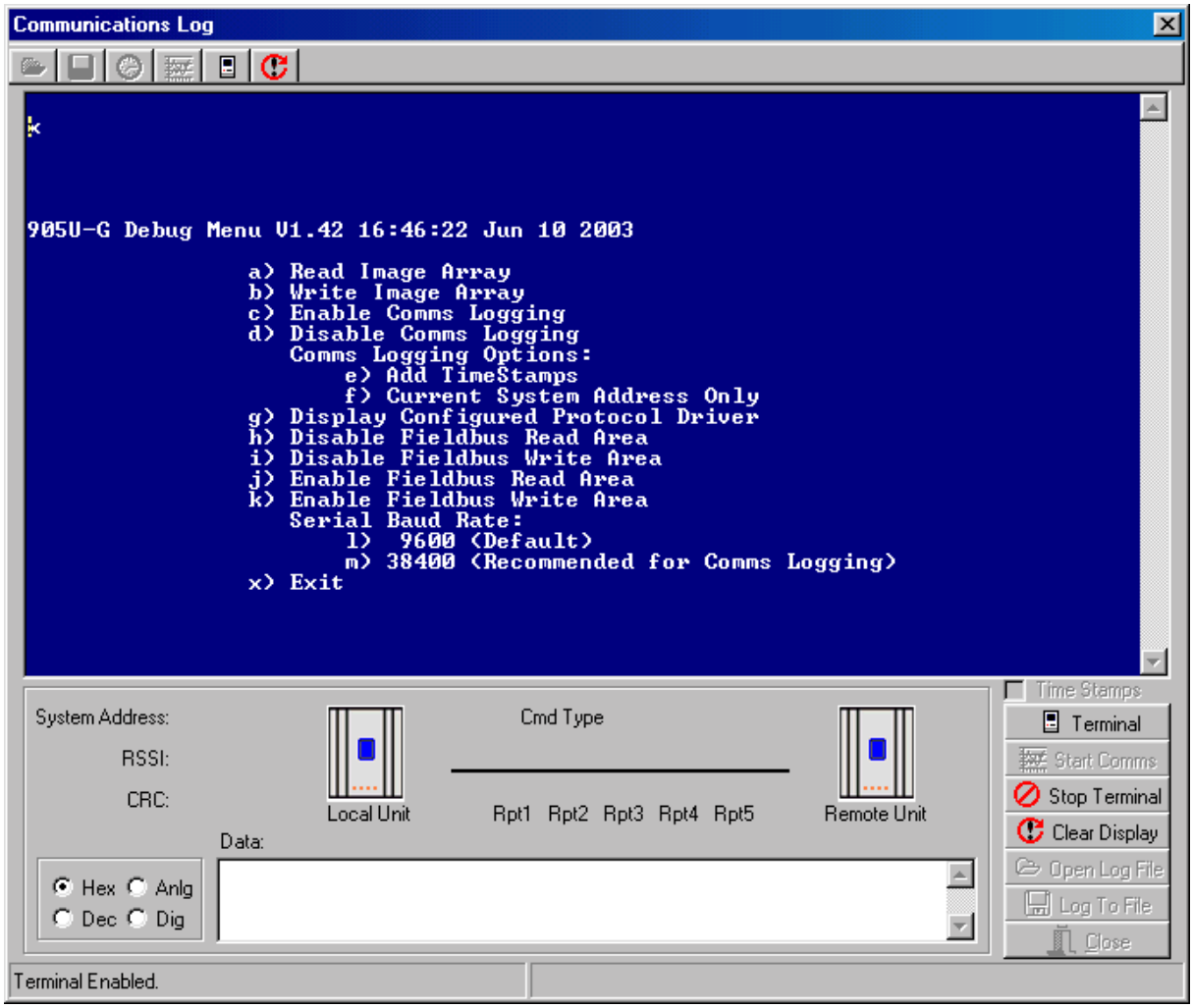
To access the online diagnostics when connected to Terminal diagnostics display

> First select "Diagnostics" to get the Terminal screen as per the previous section, and select "Terminal";
>
> Then press "Enter" on your keyboard to access the menu.

A menu like the following will appear on the PC screen for the all models, however Modbus/DF1 model will not have options h) through k).

If the module is in the Offline Diagnostics State then you may need to exit this menu by pressing (x), wait for it to finish Initialising. then Press 'Enter'

The on-line diagnostics menu is called the "Debug" menu.



The Debug Menu allows the I/O Database to be viewed and modified to confirm the operation of the radio network. These options may be used to check operation of outputs at remote sites, and to check the values of inputs reported from remote sites.

Option a) Read Image Array

Displays the I/O registers of the database - the register values for a block of 50 registers are updated every 1.5 seconds. For example, to display the I/O Database value at locations 0 to 49.

Select a), then enter Location: 0

0 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000
10 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000
20 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000
30 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000
40 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000

Note that I/O Image locations are specified in decimal, whereas register values are displayed and specified in hexadecimal. If you want the 105G to stop the host device writing values to the I/O database at the same time, then select option i) Disable Fieldbus Write Area.

Press “Enter” to go back to the menu.

Option b) Write Image Array

This option allows you to write a value to a I/O register.

To change the value of a register, select option b) write image array.

Enter location, then the value to be written to the register – for example

b

`Location: 12`

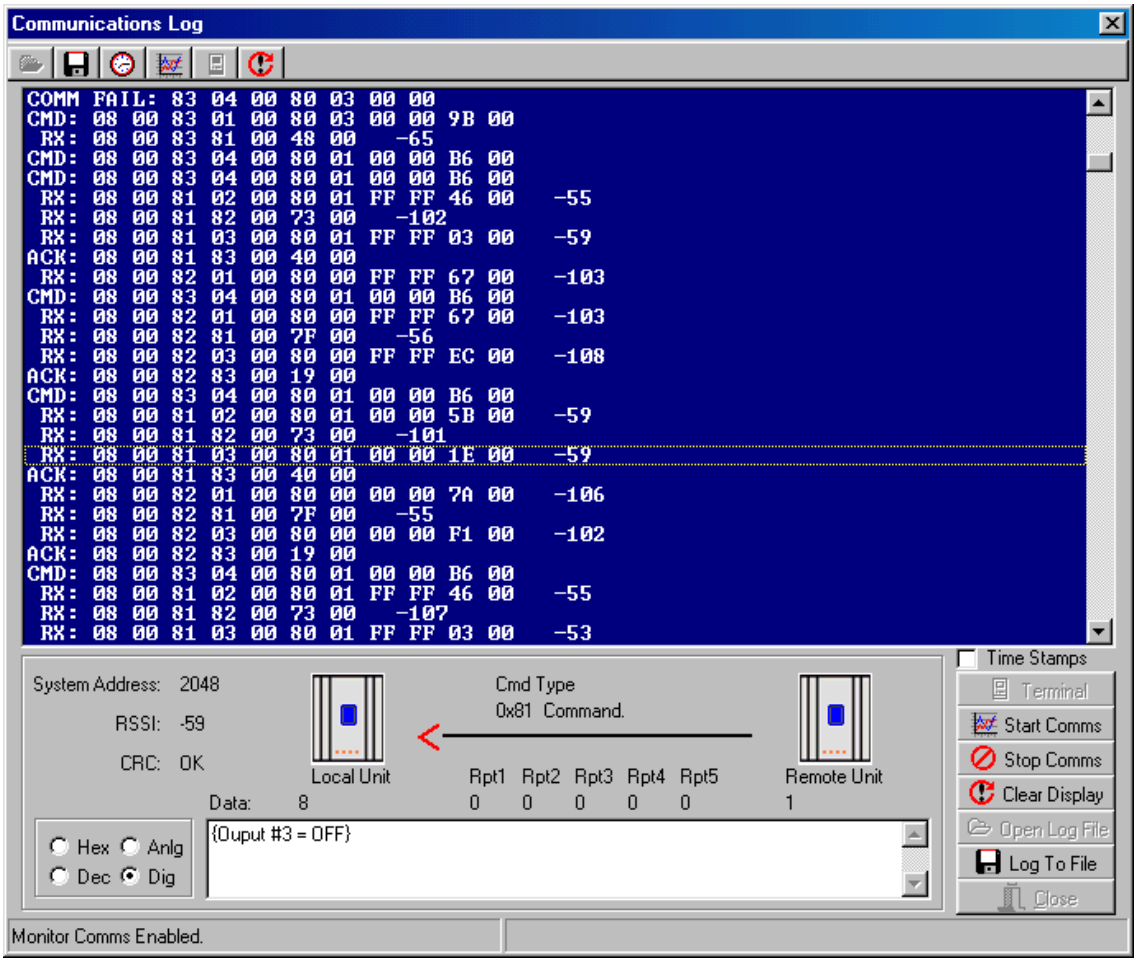
`New Value: 0x`**`FFFF`**

Register values should always be written in hexidecimal format. If you want the 105G to stop the host device reading or writing values to the I/O database at the same time, then select option h) or i).

Options c), d) Enable/Disable Comms logging

These options allow logging and display of radio communications. To start "Comms logging":

- selecting c) Enable Comms Logging
- in the Terminal window, select 'Stop Terminal' and then 'Start Comms'.



The display will show radio messages transmitted and received. Messages starting with RX are received messages, CMD are transmitted messages and ACK are acknowledgement messages. At the end of each message is the RSSI (radio signal strength) in dBm.

If you select any message line with the mouse, information about the message will be displayed at the bottom of the screen - the system address, RSSI and CRC (error-check) status. The "text box" at the bottom middle of the screen decodes the message - that is, it decodes the message to display I/O channel and value.

You can display the register values in Decimal by selecting "Dec" at the bottom of the screen. If you select "Dig", the values will be displayed as a 0 or 1 digital value (1 if the 16-bit value is greater than 50% - that is, the most significant bit is 1). If you select "Anlg", the value will be displayed as a 4-20mA range.

To stop "comms logging", select the "Stop Comms" box. You can then shut down the diagnostics screen, or select "Terminal" to go back to the diagnostics menu.

Option e) Add Time Stamps

Time stamps can be added by selecting the "Time Stamps" box. This will allow the current time and date to be displayed with each message.

The "Comms log" can be saved to a file for future reference by selecting "Log to File".

Option f) Current System Address only

This option will only display messages that have the same system address as the module you are monitoring. If you have another system with a different system address these messages will not be displayed on the screen. This option is useful where there are a lot of systems in the same area and the comms log is very active with messages from other systems.

Option g) Display Configured Protocol Driver

This option displays the configured Protocol Driver for this unit e.g.

Configured Protocol is: Ethernet TCP-IT

Option h, i, j, k) Enable/Disable Fieldbus Read/Write Area (These options not available on the Modbus/DF1 version)

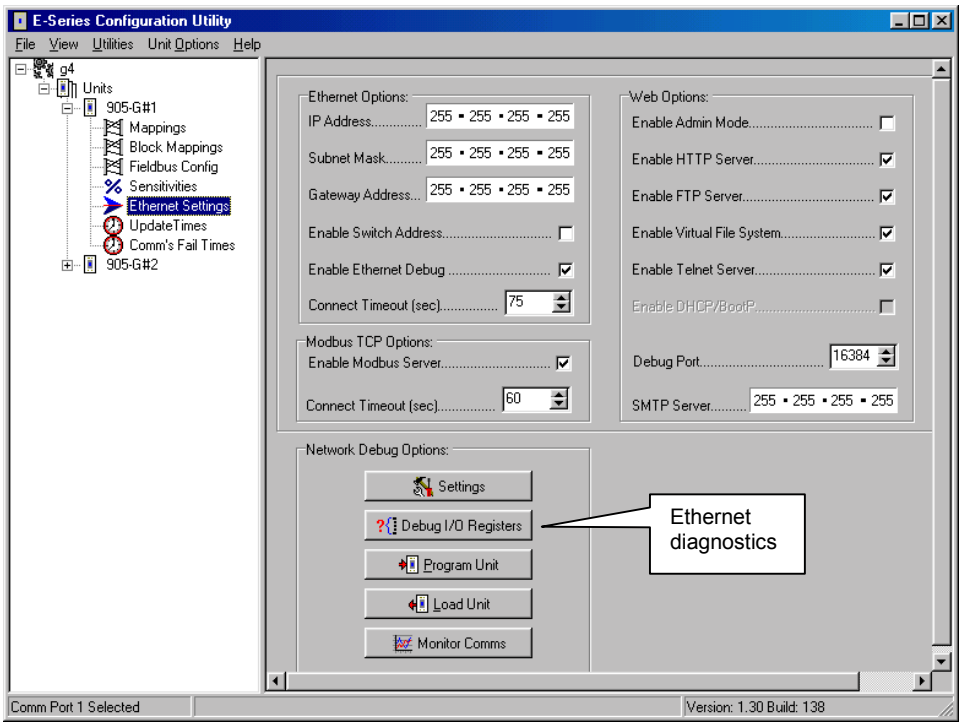
This option is used to stop the Fieldbus database from accessing the I/O database. This is mainly used when trying to read or write image arrays. If the Fieldbus read area "h" is not disabled when trying to read or write to the I/O registers then the value in the Fieldbus database will overwrite the I/O register and you may get an incorrect value.

When doing read/write image array and the module has been configured with Fieldbus mappings, you may need to disable the Fieldbus read area option h. This stops the Fieldbus database overwriting the radio database.

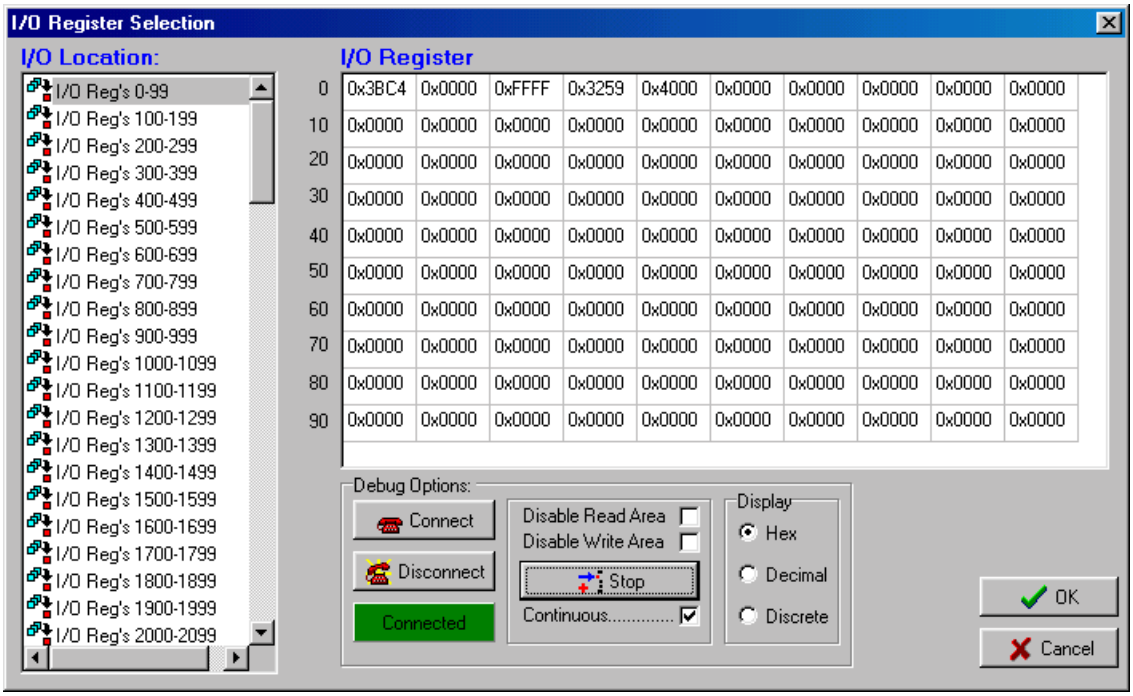
To stop the Comms logging press the 'Stop Comms' and 'Terminal' buttons then press 'enter' on keyboard to get Main Menu back up on screen. You may also need to press d) to stop Comms logging.

6.3 Ethernet Diagnostics

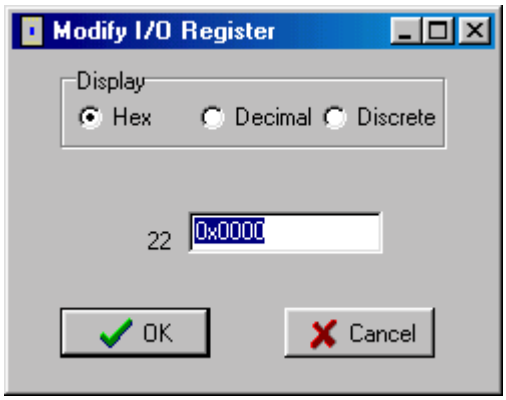
Read and Write image array can also be done via the Ethernet port by selecting 'Debug I/O Registers' from within the Ethernet Settings window in the configuration software. The IP address of the module must have previously been configured in the module - refer to section 4.8.2 for setting IP address.



To debug the registers you will need to select 'Connect' under Debug Options. The Green / Red box will indicate the Connected / Disconnected State. Once connected select "Read" and check "Continuous". The display option allows you to view the registers in different formats, and you can select which I/O register you want to view from the left-hand side of the screen.



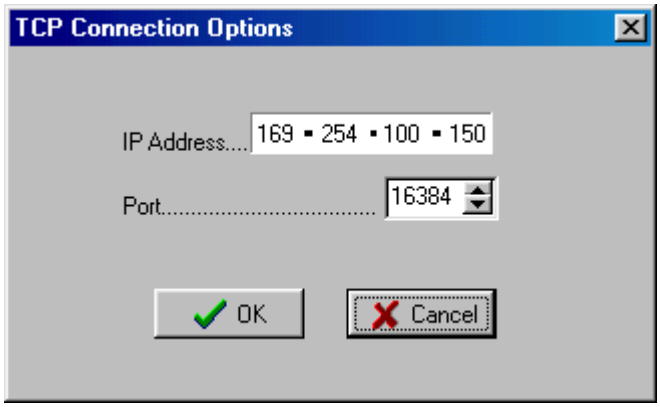
To write to a register double click with mouse on the register and a pop up box will appear as shown below. Enter value and press 'OK'.



You can disable the links between the I/O registers and the Ethernet interface by selecting "Disable Read Area" and "Disable Write Area" - if you do this, remember to re-enable before you leave the diagnostics screen.

Settings

You can change your TCP Connection setting i.e. IP address and port.



Program / Load Unit

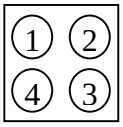
These options allow you to program and upload the configuration from the module via the Ethernet port. Must ensure the IP address has been set on the module before uploading the Configuration

6.4 Ethernet / Profibus Indicating LEDs

6.4.1 Ethernet Indicating LED's

The module is equipped with four LED's mounted at the front and one LED on the board, used for diagnostics purposes.

Led Positions are shown below.

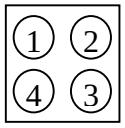


The function of the LED's is described in the table below.

1	**Green**	**-**	The Link led indicates that the module is connected to an Ethernet network.
2	**Green**	**Off**	No power applied to module.
2	**Green**	**Steady**	Device operating correctly.
2	**Green**	**Flashing**	Module has not been configured.
2	**Red**	**Flashing**	Minor recoverable fault has been detected.
2	**Red**	**Steady**	Major internal error has been detected.
2	**Green/Red**	**Flashing**	Power on self-test.
3	**Green**	**Off**	No power applied or no IP address has been assigned.
3	**Green**	**Steady**	Module has at least one Ethernet/IP connection established.
3	**Green**	**Flashing**	No Ethernet/IP connections to the module.
3	**Red**	**Flashing**	Connection timeout
3	**Red**	**Steady**	Duplicate IP address
3	**Green/Red**	**Flashing**	Power on self-test.
4	**Green**	**Flashing**	Flashes each time a packet is received or transmitted.

6.4.2 Profibus Indicating LED's

The module is equipped with four LED's mounted at the front and one LED on the board, used for debugging purposes.



Led Positions are shown below.

The function of the LED's is described in the table below.

1	-	Not Used
2	**Green**	Module is On-Line and data exchange is possible.
2	**Off**	Module is not On-Line
3	**Red**	Module is Off-Line and no data exchange is possible.
3	**Off**	Module is not Off-Line
4	**Flashing Red 1 Hz**	Error in configuration: IN and/or OUT length set during initialization of the module is not equal to the length set during configuration of the network.
4	**Flashing Red 2 Hz**	Error in User Parameter data: The length/contents of the User Parameter data set during initialization of the module is not equal to the length/contents set during configuration of the network.
4	**Flashing Red 4 Hz**	Error in initialization of the Profibus communication ASIC.
4	**Off**	No diagnostics present

Chapter 7 WARRANTY

We are pleased that you have purchased this product.

ELPRO products are warranted to be free from manufacturing defects for a period of 2 years from the effective date of purchase. The effective date of purchase is decided solely by ELPRO Technologies.

This warranty does not extend to:

- failures caused by the operation of the equipment outside the particular product's specification, or
- use of the module not in accordance with this User Manual, or
- abuse, misuse, neglect or damage by external causes, or
- repairs, alterations, or modifications undertaken other than by an authorised Service Agent.

ELPRO's liability under this warranty is limited to the replacement or repair of the product. This warranty is in lieu of and exclusive of all other warranties. This warranty does not indemnify the purchaser of products for any consequential claim for damages or loss of operations or profits and ELPRO is not liable for any consequential damages or loss of operations or profits resulting from the use of these products. ELPRO is not liable for damages, losses, costs, injury or harm incurred as a consequence of any representations, warranties or conditions made by ELPRO or its representatives or by any other party, except as expressed solely in this document.

Full product specifications and maintenance instructions are available from your Service Agent, your source of purchase, or from the master distributor in your country upon request and should be noted if you are in any doubt about the operating environment for your equipment purchase

In the unlikely event of your purchase being faulty, your warranty extends to free repair or replacement of the faulty unit, after its receipt at the master distributor in your country. Our warranty does not include transport or insurance charges relating to a warranty claim.

Should you wish to make a warranty claim, or obtain service, please forward the module to the nearest authorised Service Agent along with proof of purchase. For details of authorised Service Agents, contact your sales distributor.

Appendix 1

I/O Status Registers 5000 - 9399

Bit	Information	Meaning
15	Communications failure	For inputs, this bit is set (“on”) if no message has been received from the remote address within the timeout period configured for this input. The bit is reset ("off") when a message is received. For outputs, this bit is set (“on”) if transmission to the remote was unsuccessful after five attempts. The bit is reset ("off") when a message is transmitted successfully. This bit may also be set if the Disable Output Transmissions on Comms Fail option is selected - see the Radio Comms Failure section.
14	Start-up status	For inputs, this bit remains set ("on") following start-up until a message has been received for this input to give an initial input value. For outputs, this bit remains set ("on") following start-up until the 105C sends the first radio message for this output to the remote address.
13	Input / Output status	This bit is set ("on") if this I/O point has been configured as an input.
12	Active status	This bit is set ("on") if the register has been configured as an I/O point.
11-10	Timer Units	This field determines whether the timer counts down every 10 seconds, every minute, or every hour. Timer Units — Timer timebase 00 — Every 10 seconds 01 — Every minute 10 — Every Hour 11 — Every Hour
9 - 0	Timer	For inputs, the timer value is set to the configured comms fail time for the input whenever a message has been received for this input. The timer value will decrease until another message is received. When the timer value reaches zero, the comms fail status is set. If the configured comms fail time is zero, then the comms fail status for this input is never set. For outputs, the timer value is set to the configured update time for the output whenever a message is transmitted by the 105C to the remote address. The timer value decreases. When the timer value reaches zero, another update message is transmitted to the remote address. If the configured update time is zero, no update messages are transmitted for this output.

Block Message Status Registers 9500 - 9999

Bit	Information	Meaning
15	Communications failure	For read commands – Read Bits and Read Words – This bit is set if no response is received to the read command after a timeout, or if a communication fail response is received to a read. For Write Commands this bit is set if a communication failure response is received to the write command. For a Poll command, this bit should not be set.
14	Startup	This bit is set initially, and remains set until the first time the command executes.
13	Force	To force the command to happen immediately regardless of the current timer value, write a '1' to this bit.
12	Waiting	This bit is set when the command is active. For Write commands, the command delays before sending to see if any more changes occur. For Read commands, the command delays while waiting for a response from the remote device.
11-0	Timer	When the Waiting bit is clear, this field is either zero, or contains the time (in seconds) until the command next becomes active. If this field is zero, the field will be loaded with the configured delay value at the next update time. When the Waiting bit is set, and the command is a read command, this field contains the time in seconds, within which a reply is expected. If no reply is received within this time, the Communications failure bit is set. When the Waiting bit is set, and the command is a write command, the field contains the time, in seconds before the write command is transmitted.