VIGILANT

IO-NET PROGRAMMABLE CONTROLLER

USER'S MANUAL

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The VIGILANT IO-NET User's Manual is a product of

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The Vigilant IO-NET Programmable Controller is able to be programmed by the User, making use of a programming facility and the functions therein.

The Company, therefore cannot accept any responsibility as to the suitability of the functions generated by the user using the programming facility.

TABLE OF CONTENTS

Continued ...

TABLE OF CONTENTS (CONTINUED)

Continued ...

TABLE OF CONTENTS (CONTINUED)

7. POWERING UP AN IO-NET CONTROLLER OR NETWORK

8. DESIGNING AN IO-NET NETWORK

AMENDMENT LOG

3 FEBRUARY 1993	Issue 1	Original
4 MARCH 1994	Issue 1.1	Addition of Section 1.7 Amendment of Section 2.4 Amendment of Sections: 3.1 3.3.3.6 3.4 Change Section 3.4.3 to 3.4.4 New Section 3.4.3 Amendment of Section 4.6.2 Amendment of Section 5.4 Amendment to Fig 5.2 Amendment to Section 8.2
5 JULY 1995	Issue 2.0	Numerous modifications to the manual. Updated for V2.00 Compiler software and V2.00 software in the IO-NET Controller. Major additions include : - additions to section 3.3.3.6 - new section 3.3.3.9 - additions to section 3.4
5 FEB 1996	Issue 2.01	New software versions for controller & compiler released (V2.01). Pages 1-2,1-3,1-9,1-10,3-11,3-18,4-5,5-6,5-7,5-8 and 7-2 amended.

Chapter 1
SYSTEM DESCRIPTION

1.1 GENERAL

The IO-NET Programmable Controller may operate as a stand-alone unit or may be linked in a network to other IO-NET Controllers to provide similar functions to a traditional programmable logic controller.

It can also receive zone data from multiple F4000/F3200 Fire Panels and provide versatile AS1668 air-handling control functions or remote zone mimic indicators.

Multiple IO-NET units may be connected together (multidrop 2 or 3 wire) to provide low cost point-to-point telemetry between multiple locations. Up to 128 Controllers may be connected to the same network although physical constraints may limit a system to less than this.

Each IO-NET Controller comprises an IO-NET control card with up to 32 discrete inputs and 32 outputs. Available plug-on I/O termination boards are as follows:

32 input card
16 input card
32 digital output (transistor switch)
16 digital output (transistor switch)
16 relay output (single pole c/o)

A controller may operate in either programmed or non-programmed mode according to the setting of a dipswitch on the controller.

In both programmed and non-programmed mode the controller transmits the states of its 32 inputs on the network (if connected) for use by other controllers and receives the states of all the inputs on all other controllers on the network. The zone data received from an F4000/F3200 RZDU data connection may be transmitted onto the network by an IO-NET controller for other controllers to use without the need to wire the RZDU data line to all controllers.

NOTE :- there are several versions of IO-NET controller software in current use and these may be freely mixed on the same network, although the later versions of software have extra features that earlier versions do not have. Refer to section 1.7 for software version information.

1.1.1 NON-PROGRAMMED MODE

In non-programmed mode each of the 32 outputs on the controller will mimic the state of 32 inputs on a different controller - its "pair". The controller does not have to be programmed with a specific control program. Non-programmed mode is described in more detail in Chapter 6. The controller cannot transmit or receive zone data in non programmed mode.

1.1.2 PROGRAMMED MODE

In programmed mode a specific control program is field programmed into the controller and the state of the outputs on the controller is determined by logic expressions defined in the control program. The control program also includes the definition of network parameters which allow setting of values such as RTS (Request to Send) delays, etc. The control program also specifies whether the controller has an RZDU data input connected and whether it is to transmit that data onto the IO-NET network or not.

In programmed mode the state of each output is set according to a logic expression which may include the state of:

1. one of its own inputs
2. an input on any other controller on the network
3. one of its own outputs
4. any zone on one or more F4000/F3200 fire panels connected to the network.
5. one of its own logic variables
6. some system conditions such as network fault.
7. the state of a timer
8. the "scan status" of any IO-NET controller or F4000/F3200 fire panel.

In programmed mode a control program is generated from a user source file and is programmed into the controller EPROM. A controller EPROM can be re-programmed a limited number of times, typically 8 to 12, depending on the size of the control program.

Examples of possible applications are described in the following sections.

1.2 F3200/F4000 REMOTE MIMIC PANELS

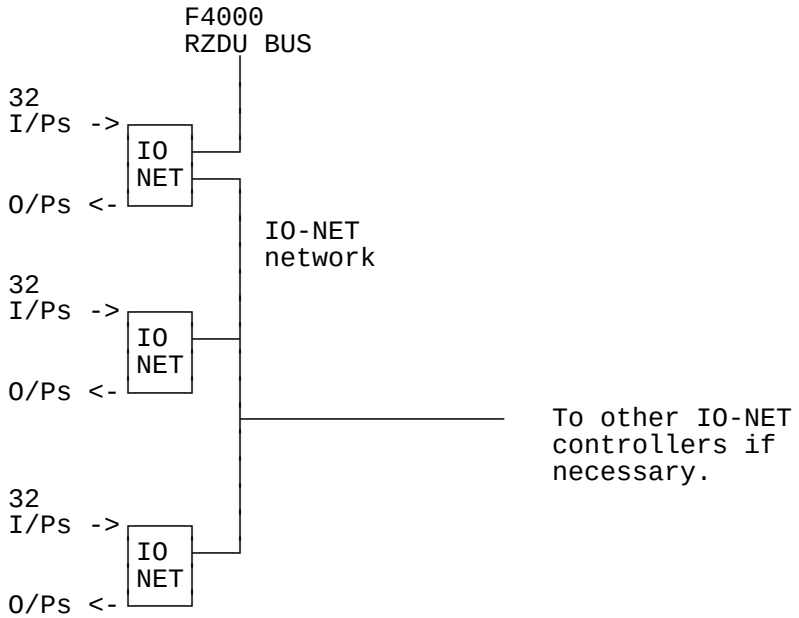
An IO-NET controller may receive F4000 or F3200 zone data from one RZDU data input wired directly into the controller. The controller may be programmed to transmit this zone data onto the network so that other controllers may also receive the zone data without being directly connected to an RZDU data line, although the same RZDU data line may be wired into multiple IO-NET controllers if desired. A controller may receive and access zone data received from both an RZDU data input and from zone data received on the network.

The controller can be programmed to display the state of one or more zones which may be from one or more F4000 or F3200 panels.

A local buzzer output can be turned on when a new alarm occurs and reset with a local pushbutton.

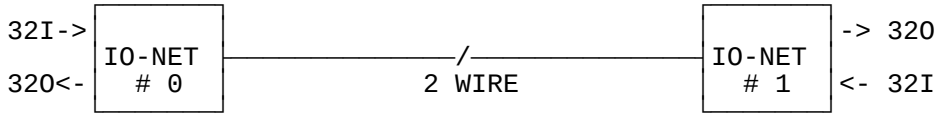
An IO-NET Controller can be connected to both the F4000 RZDU bus and the IO-NET network, ie. it can simultaneously receive data from an F4000 system as well as send and receive data on the IO-NET network.

The limit on the number of IO-NET controllers which can be connected to the same F4000/F3200 RZDU data line is hardware dependent.
Further details on using zone data are given in section 3.4 and 8.



1.3 POINT-TO-POINT TELEMETRY NON-PROGRAMMED MODE

An IO-NET Controller may operate in non-programmed mode where the outputs on one controller mimic the inputs of another controller.



Further details on non-programmed mode are given in Section 6.

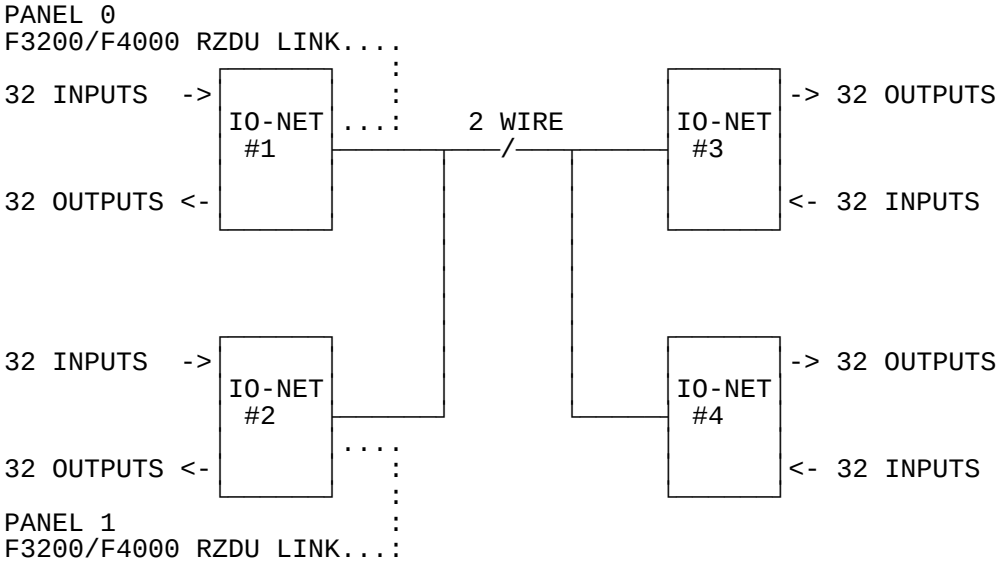
1.4 STAND-ALONE PROGRAMMABLE CONTROLLER

An IO-NET Controller may operate as a stand-alone unit without connection to a network.

The outputs can be programmed to operate based on a logic function involving the inputs and other output states.

1.5 AS1668 AIR HANDLING CONTROL FUNCTIONS

An IO-NET network can be used to do AS1668 type air handling control where remote controllers scattered round a building or site are used to turn electric fans on and off and to monitor whether the fan is running or not. Other controllers grouped together at a common site in the building have inputs (eg. pushbutton switches) which allow manual control of the remote electric fans (ie. start and stop). The inputs on the grouped controllers are monitored by the remote controllers. Grouped controllers monitor the state of inputs on remote controllers which indicate whether a fan is running or not (ie. a checkback) and these are used by the grouped controllers to turn LED's on or off to give an indication of the state of the remote electric fans.



1.6 INSTALLATION OF COMPILER UTILITY

The IO-NET programming facility consists of a number of files on an MS_DOS floppy disk and a programming module. The module is connected to the PC serial port and a PSU for operation. The files on the floppy disk should be installed on the PC as follows.

The files required to run the compiler/programmer on a PC are:

```
IONETCPL.EXE (for use with V2.00 or later controllers)
COMPIOR.EXE  (for use with V1.00,1.01,1.02 controllers)
DUMPMEM.BIN
PROGSBC8.BIN
PROGSBC9.BIN
```

and these should all reside in the same directory and for convenience the directory should be included in the PATH search setting.

These files do not have to reside in the user work directory. "User work directory" refers to the directory containing the source control programs written by the user.

There are also some text files supplied which contain the assignment of default parameter values which need to be included in every user source file.

These files are:

```
NETPRMV3.120
NETPRMV3.240
NETPRMV3.480
NETPRMV3.960
NETPRMV3.12M
           (for version 2.00 or later controllers /
                 version 2.00 compiler            )

NETPRMV2.240
NETPRMV2.480
NETPRMV2.960
NETPRMV2.12M
NETPRMV2.120
           (for version 1.02,1.01,1.00 controllers /
                 version 1.02 compiler           )
```

and should be copied to the user work directory.

1.7 SOFTWARE VERSION RELEASES

IO-NET Controller V1.00
First release of controller software February 1993.

IO-NET Controller V1.01
Second release of controller software March 1994.

This version includes the capability of operating with either "Non-LCD RZDU protocol" or "LCD RZDU protocol". Refer to Sections 3.4.3 and 8.2.

For a controller which does not access any zone data (ie. does not receive RZDU data from an F4000/F3200 Fire Panel) or is operating in non-programmed mode, there is no difference between Controller V1.00 software and Controller V1.01 software.

IO-NET Controller V1.02
Third release of controller software November 1994.
This version is operationally identical to V1.01 controller and was created to match a small change in a new release of the MOTOROLA MC68HC705C8 processor.

IO-NET Controller V2.00
Fourth release of controller software July 1995.
This version includes some new features including
- use of timers in the control program
- transmission of zone data over the network to reduce the amount of wiring required
- accessing zone data from multiple F4000/F3200 fire panels
- detection of scan fail on individual IO-NET controllers and F4000/F3200 panel links in addition to the INF/ZNF facility.

IO-NET Controller V2.01

Fifth release of controller software FEB 1996. Corrects problem with transient invalid input states in low current mode.

IO-NET Compiler V1.00 (COMPIOR.EXE program)
First release February 1993.

This version may be used with either V1.00 Controller software or V1.01/1.02 Controller software but does not provide the RZDP parameter which may be needed by V1.01 Controller software. Ie. it cannot be used to compile programs for Controllers requiring the LCD RZDU protocol.

1.7 SOFTWARE VERSION RELEASES (CONTINUED)

IO-NET Compiler V1.01 (COMPIOR.EXE)
Second release March 1994.
This version allows the programming of the RZDU protocol type with the RZDP parameter. Refer to Sections 3.4.3 and 8.2.

This version may be used with either V1.00 Controller software or V1.01/1.02 Controller software. A V1.00 Controller will ignore the RZDP parameter if it is included and can operate only with "Non-LCD RZDU protocol".

IO-NET Compiler V1.02 (COMPIOR.EXE)
Third release JULY 1995.

This version corrects a software bug in V1.01,V1.00 COMPIOR.EXE compiler software.
This version is for use with V1.00,1.01,1.02 controllers and cannot be used with V2.00 or later controllers.
If an attempt is made to use it to program V2.00 or later controller then an error message will be given.

IO-NET Compiler V2.00 (IONETCPL.EXE)
NOTE NEW FILE NAME IONETCPL.EXE

Third release JULY 1995.

This version includes some new features, including
- use of timers in the control program
- transmission of zone data over the network to reduce the amount of wiring required
- accessing zone data from multiple F4000/F3200 fire panels
- detection of scan fail on individual IO-NET controllers and F4000/F3200 panel links in addition to the INF/ZNF facility.

This version can be used with version 2.00 or later controllers only. If an attempt is made to use it to program V1.02 or earlier controller then an error message will be given.

IO-NET Compiler V2.01 (IONETCPL.EXE)

Fourth release FEB 1996.
Allow both [] and () in timer equation T[5,10]=... .

IO-NET network monitoring diagnostic program V2.00.

First release JULY 1995. IONETM1.EXE (COM1). IONETM2.EXE (COM2).
This program runs on a PC and can receive (but not transmit) messages from the network and display them, to allow the operation of the network to be observed.

Chapter 2

SPECIFICATIONS

2.1 GENERAL

Dimensions:	Main PCB 165mmW x 270mmH 16 I/O PCBs 93mmW x 135mmH 32 I/O & 16 Relay PCBs 93mmW x 270mmH
Format:	Supplied as circuit boards for incorporation in other equipment enclosures.
Power Supply:	24Vdc (17.5-28V)
Inputs:	Common ground. Clean contacts or end-of-line monitored. Limited analog values available for special applications software.
Outputs:	Open collector closure to 0V. Maximum 30V, 200mA.
Relay Outputs:	Single pole changeover. Contacts rated 30V, 2 Amps (resistive), 1A (inductive DC); 1A (AC inductive and resistive).
Network Length:	At a baud rate of 2400 and with 1mm diameter wire the total length should not exceed 3 kilometres. At 9600 baud the maximum length is 1 kilometre with 1mm diameter wire.
Network Address:	31 (32 IO-NET Controllers) in non-programmed mode. 127 (128 IO-NET Controllers) in programmed mode.
Network Baud Rates:	1200, 2400, 4800 or 9600
RZDU Data Line Length:	With 1mm wire the maximum length is 1km.
System Response Time:	Section 8.4 gives same information on the response times and delays that occur in an IO-NET system.

2.2 INPUT SPECIFICATIONS

IO-NET Controller inputs operate with either low current pullup or high current pullup according to the setting of dipswitch I0 on the IO-NET Controller board. With I0 off all inputs are high current pullup and with I0 on all inputs are low current pullup.

End of Line (normalising) Resistor
3K3 300mW for high current pullup
27K 300mW for low current pullup

On an input termination board each input has a 10V zener diode and 100N capacitor for transient suppression.

The following table shows the voltage and resistance thresholds and ranges for the four input conditions - open circuit, normal, alarm and short circuit.

Thresholds & Ranges for High Current/Low Current Pullup

	Voltage (Nominal)		Resistance (Ohms)			
State	Thres.	Mid	High Current Pullup		Low Current Pullup	
			Nom.	Range	Nom.	Range
Open Circuit	5V		O/C	>13K	O/C	>180K
Normal	4.16V	3.33V	3K3	2K1-5K5	27K	17K-48K
Alarm	2.50V	1.66V	830E	475E-1K25 (1)	6K8	3K85-11K (2)
Short Circuit	0.83V			<200E		<1K75
	0V		S/C		S/C	

Line Capacitance:
Hi Current Pull Up - 500nF maximum
Lo Current Pull Up - 300nF maximum

Notes
1. Nominal 830E achieved by 820E or 3K3 parallel with 1K1 (or 1K2).

2. Nominal 6K8 achieved by 6K8 or 27K parallel with 9K1 (or 10K).

3. The resistance ranges show the values of resistance for which the appropriate state is guaranteed.

2.3 OUTPUT SPECIFICATIONS

24V OUTPUT

VOLTAGE	-	Greater than Supply Voltage (at IO-NET) minus 2.5V.
CURRENT	-	Limited to 650mA typical (500mA min, 800mA max)
ACCESS	-	3 Way terminal block on Termination or Relay Bd.
	-	Common terminals on Output Termination Bd.

OPEN COLLECTOR OUTPUTS

NUMBER	-	32 max
"OFF" VOLTAGE	-	28.5V max
"ON" VOLTAGE	-	1V max at 30mA, 1.1V max at 100mA.
"ON" CURRENT	-	100mA max per output.
TERMINATION OPTIONS	-	16 way Output Termination Board. Screw terminals, 1.5sq mm max cable size.
	-	32 way Output Termination Board. Screw terminals, 1.5sq mm max cable size.
	-	16 Way Relay Board. Screw terminals, 1.5sq mm max cable size.

RELAY OUTPUTS

16 WAY RELAY BD

TYPE	-	Single Pole Changeover.
RATING	-	2A @ 30Vdc Resistive, 1A @ 30Vdc Inductive. 1A @ 30Vac Resistive, 1A @ 30Vac Inductive.
QUIESCENT CURRENT	-	Nil (ie. for relays all off).
OPERATED CURRENT	-	11.5mA @ 24Vdc per operated relay.

2.4 ORDERING CODES

The following gives the part number of PCBs associated with the IO-NET system, together with a brief description of their use.

PA0498 PCB ASSEMBLY,1901-117,IO-NET CONTROLLER

This is the IO-NET Controller PCB.

Field connection of inputs\output is provided by screw terminals on separate termination boards. These connect to the IO-NET Controller by 26 way FRCs (Flat Ribbon Cables) which have to be ordered separately.

PA0474 PCB ASSEMBLY,1901-73-1,F4000 IOR 32 WAY INPUT TERM BD
PA0479 PCB ASSEMBLY,1901-73-1,F4000 IOR 16 WAY INPUT TERM BD

These allow termination of up to 1.5mm² field wiring and carry the transient voltage protection components. One FRC is required for each 16 inputs. A PA0479 is half of a PA0474.

PA0475 PCB ASSEMBLY,1901-73-2,F4000 IOR 32 WAY O/P TERM BD
PA0480 PCB ASSEMBLY,1901-73-2,F4000 IOR 16 WAY O/P TERM BD

These allow termination of up to 1.5mm² field wiring to the open collector outputs. Each output has a protection diode to the positive supply.

There are single +V, 0V and Earth terminals for each 16 outputs. One 16 way FRC is required for each 16 outputs. A PA0480 is half of a PA0475.

PA0470 PCB ASSEMBLY,1901-64,F4000 16 WAY RELAY BOARD

Provides 16 sets of changeover clean contacts and includes voltage transient protection and suppression components on the coil. There are single +V, 0V and Earth terminals for each relay board. One 1.4m 26 way FRC is supplied with each relay board.

LM0044 LOOM,1901-81-1,26 WAY FRC,2M
LM0045 LOOM,1901-81-2,26 WAY FRC,5M
LM0046 LOOM,1901-81-3,26 WAY FRC,0.5M
LM0049 LOOM,1901-81-4,26 WAY FRC,250MM
LM0056 LOOM,1901-81-5,26 WAY FRC,1.2M

These 26 way FRCs provide the inter-connection between the IO-NET Controller and the input/output termination and relay boards.

PA0481 PCB ASSEMBLY,1901-100,F4000 RZDU/RS232 I/F BOARD

This converts the F4000 RZDU Comms line into a voltage compatible with the IO-NET Controller. Issue A can drive up to 5 IO-NET Controllers on up to 200m of cable. Issue B versions can drive up to 32 Controllers on up to 2km of cable.

ORDERING CODES (CONTINUED)

PA0483 PCB ASSEMBLY,1901-103,F4000 IOR UNPROTECTED TERM BOARD

This provides screw terminals for the 16 inputs or outputs on 1 26 way FRC from the IO-NET Controller. It should only be used for protected wiring inside a cabinet as it provides no transient protection for the inputs or outputs. Screw terminals for +V and 0V are also provided.

PA0700 PCB ASSEMBLY,1901-120,IO-NET PROGRAMMING MODULE

Programming module for "burning" of programmed mode EPROMs. Includes cable to connect to PC and programming software (SF0088). Requires 24V (19.2-28.3V) DC power supply for operation.

PA0464 PCB ASSEMBLY,1830-40-1,1200 BAUD MODEM CMOS/4 WIRE

This modem is suitable for use with IO-NET Controller. Refer to the Technical Manual for this product for full details. Special wiring of the modem to the IO-NET Controller is required.

SF0087 SOFTWARE,IO-NET CONTROLLER,V2.00,OTP

"Blank" OTP microprocessor for IO-NET Controller. Already programmed for non-programmed mode operation and for programmed mode the user program space is all blank.

SF0088 SOFTWARE,IO-NET COMPILER,V2.00,DISK C/W MANUAL

PC Compiler software and user manual. The disk includes two versions of software. Version 2.00 is for use with V2.00 or later Controller. Version 1.02 compiler is also supplied and is for use with Version 1.02, 1.01 or 1.00 Controllers.

LT0115 LITERATURE,1901-121,IO-NET USER MANUAL

This document. Supplied with SF0088 and PA0700.

Chapter 3

GENERATING A SOURCE FILE

3.1 INTRODUCTION

A source file consists of a text file containing logic expressions to control the state of the outputs on the controller.

It also includes the setting of some "network parameters" such as RTS delay, etc, and configuration parameters such as RZDU, RZDP, TXZD. Every source file must include the assignment of values to all of the network parameters. Assignment of parameters RZDU, RZDP and TXZD is optional. Parameters RZDU,RZDP,TXZD are optional. An error will occur if any of the network parameter assignments are missing.All network and configuration parameters must appear before any logic expression statements.

Any valid file name may be used for the name of the source file but it is recommended that some consistent naming of files be used.

For example, PROJNAME.S0 where PROJNAME is the name of the project or building etc, and the extension is the IO-NET controller number.

Also keep a record of the physical location of the IO-NET Controller associated with each source file. This could be included as a comment in the source file.

After making any changes to a user source file the file should be backed up to floppy disk.

A base file is supplied called NETPRMV3.240 which supplies default assignments for all of the required network parameters for a network operating at 2400 baud.

Alternative files are supplied for 9600, 4800 and 1200 modem baud rate systems.

File NETPRMV3.960 is for 9600 baud
File NETPRMV3.480 is for 4800 baud
File NETPRMV3.120 is for 1200 baud (without modems)
File NETPRMV3.12M is for 1200 baud with modems

Version 1.01/1.02 of the programmer software COMPIOR.EXE file uses an earlier set of parameter files which are NETPRMV2.240, NETPRMV2.480, NETPRMV2.960 and NETPRMV2.12M.

If accessing zone information from an RZDU link the parameter RZDP should always be included to specify the RZDU protocol type. The RZDU parameter is used to specify the panel number associated with the zone data received from the RZDU data connection.

3.2 ADDING NETWORK PARAMETERS TO THE USER SOURCE FILE

The first step in creating a source file is to copy the appropriate network parameter file to a new source file.

eg. COPY NETPRMV3.240 USERFIL1.TXT

will create the text file USERFIL1.TXT.

DO NOT do this copy command if USERFIL1.TXT already exists as it will destroy the existing contents of USERFIL1.TXT. (In this case use an editor (eg. EDIT) to edit the existing file USERFIL1.TXT and insert the contents of the NETPRMV3 file).

Alternatively, use the DOS COPY command to append the NETPRMV3 file to the end of USERFIL1.TXT with the command:

```
COPY USERFIL1.TXT + NETPRMV3.240
```

You will then need to use an editor to move the parameters from the end of the file to the start, since all parameters MUST appear before any logic expressions.

WARNING Be careful when using the copy command to append two files together. The example given of COPY USERFIL1.TXT + NETPRMV3.240 will work correctly and append the file NETPRMV3.240 to USERFIL1.TXT. However, if the command is entered incorrectly it could result in one of the files being destroyed.

If unsure, make backup copies of the files involved first.

Every source file must include the assignment of network parameters, even if the target controller is not going to be connected to an IO-NET network.

The values of network parameters may be modified if desired. The usage of network parameters is described in Section 3.4.

A source file may consist of network parameters only - it does not have to include any output logic expressions. If there are no output logic expressions then the controller will never control any outputs but will still transmit the state of its inputs onto the network and also transmit zone data onto the network if programmed to (with TXZD).

3.3 OUTPUT LOGIC EXPRESSIONS

3.3.1 GENERAL FORMAT

A source file may contain any number of output logic expressions (limited only by the available space in the target EPROM) which assign the value of an expression to a local output or internal variable or timer.

```
eg.         O4 = I7/9O OR I15/1A AND V3        ; to control output 4
```

and may also assign values to logic variables

```
eg.         V5 = V4 + I3/26A
```

and to timers

```
eg.         T1[15,25] = I1/4S
```

At run time the target controller will evaluate all of the logic expressions sequentially in exactly the order they appear in the source file.

When the controller gets to the end of the logic expressions it returns to the start and cycles through forever.

Expressions which assign values to outputs do NOT have to appear in numerical order of the output number. They may be in any order - however, the order that the expressions appear in the source file does NOT determine the order in which the PHYSICAL output changes. The physical state of the outputs is only updated at the completion of each pass through the entire list of logic expressions (and also at intervals of 100 milliseconds) so that the actual state of the physical output may not necessarily follow the logical state of the output generated by the logic expressions if the logical state changes quickly.

There does not have to be a logic expression for every output.

The same output should be controlled by ONLY ONE EXPRESSION and the compiler will display a warning message if more than one expression is given for the same output.

```
eg.  O5 = V1 OR V2
     O6 = I1/1A
     O5 = O6 OR I29/3S
```

is controlling output 5 with two different expressions and the actual state which appears at the physical output will be intermittent.

GENERAL FORMAT (CONTINUED)

Similarly, the program should not contain more than one expression defining the input condition and start/stretch delays of the same timer. The compiler will display a warning if this is done. The state of a timer may be accessed as many times as desired in multiple equations on the "right hand side" of a logic expression.

Expressions which assign values to variables may be in any order with more than one expression for the same variable being allowed if desired. The variable will then keep that value until the next occurrence of an expression which assigns a value to that variable. It is recommended that the same variable is not used for two different purposes except perhaps by an experienced user or if the compiler produces a "RAM limit exceeded" error.

Comments may be included anywhere in the source file. Any text on the same line following a semicolon ; is treated as a comment with the exception of the semicolon used in the NA function.

Be careful not to unintentionally convert a real logic expression into a comment by accidentally placing a semicolon at the start of or part way through, a logic expression.

Blank lines may appear anywhere in the source file.

Each logic expression must fit entirely on a single line but long lines are allowed- up to 299 characters (if your editor allows this many). Variables can be used to simplify complex or long expressions. Following the last logic expression in the file, the keyword END must appear on a new line to terminate the list of expressions. Any lines following the END statement may contain comments only.

Upper or lower case characters are allowed everywhere and are treated identically.

A logic expression does not have to start in column one, it may start in any column ie. a logic expression may be preceded by any number of blanks on that line.

In general, individual operands such as I15/3A should not contain any embedded blank characters (in some cases this is not strictly enforced and embedded blanks are allowed) but spaces may be used freely between operands and operators.

It is not essential to have any spaces between operands and operators but they should be included for clarity.

GENERAL FORMAT (CONTINUED)

Each logic expression is of the form :

Ox = Operand {Binary operator Operand} ...

to assign the state of output x (x = 1 to 32)

or

Vx = Operand {Binary operator Operand} ...

to assign a value to logic variable x (x = 1 to 256).

or

Tx[mmm,nnn] = Operand {Binary operator Operand} ...

to define the input condition and timer delays (start, stretch) for timer x (x = 1 to 128). The start delay (mmm) and stretch delay (nnn) are required and may be any value from 0 to 255 seconds.

The curly brackets {} which are not part of the expression indicate that their contents are optional and may be repeated any number of times. The right hand side of each expression consists of one or more operands with each pair of operands separated by a binary operator.

All operands return a logical value of TRUE or FALSE. If the right hand side of an expression evaluates to TRUE then the specified output on the left hand side will be turned ON (and FALSE = OFF) or if the left hand side is a variable, then the variable will be assigned a value of TRUE or FALSE. The operation of timers is described in section 3.3.3.8.

If the output or variable which appears on the left hand side of the = also appears as an operand on the right hand side then the value used on the right hand side is the value of the operand before the new assignment.

Any operand may be preceded by the unary operator NOT (the symbol ^ may also be used) which complements the value of the operand.

Each operand may itself consist of an expression enclosed in parentheses () with a maximum nesting level limited by the amount of stack space required for evaluation at run time. The nesting level limit is 16 which is more than enough for any foreseeable requirement.

GENERAL FORMAT (CONTINUED)

The binary operators which may be used are:

AND - logical AND (alternatively use .)
OR - logical OR (alternatively use +)
XOR - exclusive OR

The one unary operator which may be used is:

NOT - logical complement (alternatively use ^)

The single character "+" (plus) may be used instead of OR, the character "." (fullstop) may be used instead of AND, and the character "^" may be used instead of NOT.

The truth tables for AND,OR,XOR and NOT are (F = FALSE, T = TRUE)

A AND B

A	B	RESULT
F	F	F
F	T	F
T	F	F
T	T	T

A OR B

A	B	RESULT
F	F	F
F	T	T
T	F	T
T	T	T

A XOR B

A	B	RESULT
F	F	F
F	T	T
T	F	T
T	T	F

NOT A

A	RESULT
F	T
T	F

Example NOT A OR NOT B

A	B	RESULT
F	F	T
F	T	T
T	F	T
T	T	F

3.3.2 ORDER OF EVALUATION OF OPERANDS

The order of evaluation of operands is important and can affect the result of the expression.

When more than one operand appears in an expression, the order of evaluation of the operands is not necessarily left to right but depends on some rules as follows:

A. The contents of parentheses are evaluated first.

eg. O3 = V1 AND (V2 OR V3)

will cause "V2 OR V3" to be evaluated first with the result being "ANDed" with V1 resulting in the following truth table.

V1	V2	V3	O3
F	F	F	F
F	F	T	F
F	T	F	F
F	T	T	F
T	F	F	F
T	F	T	T
T	T	F	T
T	T	T	T

B. Each of the operators AND, OR, XOR and NOT have a priority which determines the order of evaluation when not overridden with parentheses as follows:

The NOT operator has highest priority, AND has the next highest priority, and OR and XOR have equal and lowest priority. Where operators have equal priority the order of evaluation is left to right.

Eg. NOT V1 AND V2 has a truth table of:

V1	V2	RESULT
F	F	F
F	T	T
T	F	F
T	T	F

with the "NOT V1" being done first

but NOT (V1 AND V2) has a truth table of:

V1	V2	RESULT
F	F	T
F	T	T
T	F	T
T	T	F

ORDER OF EVALUATION OF OPERANDS (CONTINUED)

Eg. V1 OR V2 AND V3 results in the "V2 AND V3" being evaluated first because the AND operator has a higher priority than OR.

Operators of equal priority result in evaluation of operands from left to right. Eg. V1 OR V2 XOR V3 OR V4 XOR V5 will result in the operands being evaluated in the order they appear with V1 first and V5 last.

If unsure, use parentheses. The use of parentheses does not affect the size of object code generated.

3.3.3 OPERAND TYPES

There are several different types of operands which may be used in a logic expression as follows:

1. The condition of one of the 32 inputs on the local controller or inputs on a remote IO-NET Controller received via the network.

2. The state of a local output on the controller.

3. The condition of any zone on an F4000/F3200 system received via either an RZDU connection directly wired into the controller or from zone data received on the IO-NET network.

4. The state of a local variable V1 to V256.

5. The "State" of an NA function.

6. System conditions and constants including the "scan status" of any IO-NET controller or F4000/F3200 fire panel RZDU data link.

7. The state of a timer.

Each operand returns a value of TRUE or FALSE as described in sections 3.3.3.1 to 3.3.3.8 below.

3.3.3.1 IO-NET CONTROLLER CIRCUIT INPUTS

The four conditions of a circuit input may be accessed as follows:

Ix/yO (open circuit)
Ix/yN (normal)
Ix/yA (alarm)
Ix/yS (short circuit)

Where x is the address of an IO-NET Controller 0 to 255, y is the number of a circuit input 1 to 32 and O, N, A, S refer to the four voltage bands where S is the lowest band (short circuit) and O is the highest (open circuit). The operand returns true if the circuit input x/y is in the specified condition O, N, A or S at the time the logic expression is evaluated.

NOTE - currently the maximum address which can be physically set (with dipswitches) an a controller is 127 but the compiler allows a controller number of 0-255 to be used in expressions.

The circuit input x/y can be any input on any IO-NET controller including the inputs of the controller running this program.

Eg. O1 = I3/15A OR I0/32S results in output 1 being on if either input 15 on controller 3 is in Alarm or if input 32 on controller 0 is in short circuit.

When the controller is first powered up the initial state of all inputs will be normal until their true state is received either from the network for remote controller inputs or from input boards for local controller inputs. If a local input termination board is not connected the associated inputs will all be in an open circuit condition.

3.3.3.2 CONTROLLER OUTPUTS

The local outputs can appear as an operand on the right hand side of an expression as:

OxF or OxN where x is the number of an output 1-32

NOTE It is not possible to use output states of other controllers.

OxF returns TRUE if the output is OFF, otherwise FALSE.
OxN returns TRUE if the output is ON, otherwise FALSE.

Eg. O2 = O1F OR 032N; will result in output 2 being ON if output 1 is off or output 32 is on.

After power-up or re-start of the controller all outputs will initially be off.

3.3.3.3 F4000/F3200 ZONE DATA

The condition of a zone on an F4000/F3200 fire panel may be accessed as follows:

Zpp:nnnA	returns TRUE if zone in alarm and NOT isolated
Zpp:nnnF	returns TRUE if zone in fault and NOT isolated
Zpp:nnnI	returns TRUE if the zone is isolated
Zpp:nnnN	returns TRUE if the zone is not isolated and not in fault or alarm.

where pp is a panel number, 0-63, nnn is a zone number 1-528. Zone data from multiple fire panels may be accessed but the total number of panels accessed should be 8 or less.

Each IO-NET controller which has an RZDU data link directly connected is programmed with a panel number and whether the zone data should be transmitted over IO-NET or not (TXZD). The zone data which it transmits onto the IO-NET network will include the panel number for identification by other controllers. Any controller may access zone data from both its own directly connected RZDU data link and from zone data which it receives via the IO-NET network.

eg. O32 = Z3:1A AND Z4:528N
results in output 32 being on if zone 1 on panel 3 is in alarm (and not isolated) and zone 528 on panel 4 is normal.

When the zone corresponds to an Ancillary Control Zone on F4000 or a relay on an F3200 FIP then the conditions A,I,F,N are

Zpp:nnnA	returns TRUE if zone activated and NOT isolated
Zpp:nnnF	returns TRUE if zone in fault and NOT isolated
Zpp:nnnI	returns TRUE if the zone is isolated
Zpp:nnnN	returns TRUE if the zone is not isolated and not in fault or activated.

After power-up or restart of the controller the state of all zones will initially be normal until the current actual state is received. This could take up to 7 or 8 minutes for a system with 528 zones depending on which version of software is being used in the F4000 panel. In the latest version of F4000 panel software the time to refresh the state of all 528 zones is approximately 70 seconds.

3.3.3.4 VARIABLES

Variables may be used for storage of logical values.

A variable is accessed with Vnnn where nnn is a value 1-256.

There are up to 256 variables available, the actual number limited by available RAM storage in the controller. A variable has a logical value of either TRUE or FALSE.

```
eg.         V1 = Z1A OR Z2F
            V2 = I0/1A OR I0/2S
            V3 = V1 OR V2
            V4 = V1 AND V2
```

Variables should be used "contiguously" starting with V1, then V2, V3 .... etc, to minimise RAM usage in the IO-NET Controller.

The compiler will display an error message if the RAM storage limits of the controller are exceeded.

When the controller is first powered up or restarted, the initial value of all variables is FALSE.

A variable may be useful for holding the result of an expression which is common to several different logic expressions. This can result in a saving of EPROM space.

Variables are also useful in NA functions because an NA function is not allowed to use an expression in its operand list. This can be overcome by assigning the expression to a variable first and accessing the variable in the NA function.

Variables are also useful for other things. For example, the expression V1 = NOT V1 will toggle the value of V1 each time it is executed and produce an oscillating value.

The expression

```
   V1 = V1 OR ZNF
```

will latch the occurrence of a zone network fault.

3.3.3.5 THE NEW ALARM (NA) FUNCTION

The NA function may be used as an operand in any logic expression and has the form:

NA (reset input; operand list)

where operand list consists of a list of fundamental operands separated by commas and includes:

OnnF	-	local output nn (1-32) off
OnnN	-	local output nn (1-32) on
Ix/yO	-	input y (1-32) on controller x (0-127) open circuit
Ix/yN	-	input y on controller x normal
Ix/yA	-	input y on controller x alarm
Ix/yS	-	input y on controller x short circuit
Vnnn	-	variable nnn (1-256)
Zpp:nnnA	-	zone pp:nnn (1-528) alarm (and not isolated)
Zpp:nnnF	-	zone pp:nnn fault (and not isolated)
Zpp:nnnI	-	zone pp:nnn isolated
Zpp:nnnN	-	zone pp:nnn normal (not A,I or F)
Tnnn	-	timer nnn (1-128) state
IRnnn	-	IO-NET controller responding status
PRnn	-	Fire Panel responding status

and "reset input" may be any one of the above fundamental operands ie. it is a single operand such as I5/I2S or V15 or Z1:42A, etc.

The operand list may not include expressions ie. operators NOT, AND, OR, XOR may not be used in an NA function. If it is desired to use an expression in an NA function then the expression should first be assigned to a variable and the variable included in the operand list.

The NA function returns a value of TRUE or FALSE as follows. Whenever any operand in the list has a change of state from FALSE to TRUE then the function returns a value TRUE and continues to return a value TRUE (forever regardless of any further changes of state in the operand list) until the specified reset input has a change of state from FALSE to TRUE. At this point NA returns FALSE and continues to return FALSE until the next change of state from FALSE to TRUE of any operand in the list.

3.3.3.5 THE NEW ALARM (NA) FUNCTION (CONTINUED)

The same operand may appear any number of times in the list.

eg. NA(I5/12S; 03N, I7/25A, Z0:124A, V15)

This function is set to TRUE whenever one of the operands in the list becomes TRUE. Eg. if local output 3 changes state from off to on or if input 25 on controller 7 changes state into alarm, etc, and is set to FALSE when input 12 on controller 5 has a change of state into a short circuit condition.

After power up or restart of the controller the initial state (value returned) by all NA functions is FALSE.

The NA function may be used as often as desired (within the limits of RAM storage) in any logic expression.

eg. O5 = NA(Z12:42F; I2/1A, I2/2A) OR NA(I1/2S; Z1:52A) OR I3/7A

Each NA function uses some RAM storage in the controller which sets a limit on the number of new alarm functions which can be used. (A function with 6 or less operands in the operand list uses one byte of RAM storage, 7-14 operands uses 2 bytes of RAM).

If there is a large number of operands in the set list then multiple NA functions can be used to achieve the same thing.

eg.
```
V1 = NA(I1/1S ; Z1:1A, Z1:2A)
O32 = NA(I1/1S ; V1, Z1:3A, Z1:4A)

is the equivalent of
O32 = NA(I1/1S ; Z1:1A, Z1:2A, Z1:3A, Z1:4A)
```

Multiple reset operands can be achieved by using two NA functions as shown in the following example.

```
V1 = NOT V1
V2 = NA(V1; I1/1S, I1/2S, I1/3S)
O32 = NA(V2; I2/1S, I2/2S, I2/3S)
```

When any of I1/1S, I1/2S, I1/3S have a transition from FALSE to TRUE, the first NA function becomes TRUE so V2 goes from FALSE to TRUE which will provide a reset to the second NA function. The first NA function is being continually reset on every second pass of the equation (since the value of V1 is continually alternating), however, if any of the operands I1/1S, I1/2S, I1/3S become TRUE the NA function will always become TRUE because the operands in the "set list" override the reset operand.

3.3.3.6 SYSTEM CONDITIONS

INF IO-NET network fault
This returns TRUE if this controller is not regularly receiving input status information from any controller that is required by the output equations or from any controller accessed with the IR operand. If no input status information is required from any other controller and no IR operands are used, then INF will be TRUE if no valid messages of any kind are being received from the network, otherwise INF will be FALSE. INF is prevented from returning TRUE during the first 60 seconds after power-up.

Each controller transmits its input status information on to the network at regular intervals, but will not necessarily include the information in every message it transmits. The rate at which it transmits input information is set by a network parameter and must be often enough to prevent an INF fault occurring at other controllers requiring that data. The rate at which a controller requires to receive input information is also set by a network parameter (DRQT).

ZNF F4000/F3200 zone data receive fault.
This returns TRUE if the controller is not receiving valid data from the all of the F4000/F3200 fire panels that it requires. Valid data must be received from all of the panels being accessed with zone operands Zpp:nnnC (where C is A,I,F or N) or being accessed with PRpp (panel responding) regularly - at least every 32 seconds - or ZNF will be set TRUE. After being set true the value of ZNF will be updated every 32 seconds and will be set FALSE if it is found that valid data has been received from all required panels. This includes panels for which zone data is received via the IO-NET network and also any direct connection RZDU data link.

ZNF is prevented from returning TRUE during the first 60 seconds after power-up.

ZNF will also be set TRUE if a message is received from the IO-NET network which contains zone data and has a panel number the same as the panel number that has been assigned to the Controller's own RZDU data connection. ZNF will be cleared to FALSE at the next 32 second update time.

ZNF is always FALSE (except for the situation of duplicated panel numbers just mentioned) if the logic expressions do not access any zone status and no PRpp operands are used - even if the local RZDU data link is enabled (by including the RZDU parameter). Ie. if the local RZDU data link is enabled but no zone status or PR operands are used then ZNF will still always return FALSE even if the local RZDU data link fails.

3.3.3.6 SYSTEM CONDITIONS (CONTINUED)

If it is necessary to detect this fault then include a PRpp operand (see below) in the program. ZNF is a non-latching value, however, the occurrence of a fault can be latched with an expression V1 = V1 OR ZNF, for example, or by an NA function.

IB1 Input termination board 1 status. This returns TRUE if the board is present.

IB2 Input termination board 2 status. This returns TRUE if the board is present.

OB1 Output termination board 1 status. This returns TRUE if the board is present.

OB2 Output termination board 2 status. This returns TRUE if the board is present.

IRnnn IO-NET controller responding status. This may be used to detect a loss of communications with controller nnn. It is necessary to use a timer in conjunction with the IRnnn operand since IRnnn actually returns a value which OSCILLATES between TRUE and FALSE when controller nnn is responding normally. The value of IRnnn operand is set TRUE whenever a message containing input status data (ie. the status of the 32 input points on controller nnn) is received from controller nnn, but at periodic intervals of several seconds IRnnn is set FALSE and remains FALSE until the next point status data is received from controller nnn.

IRnnn is forced to return TRUE for the first 60 seconds after the controller powers up to allow time for communication with the network to be established.

The rate at which controller nnn transmits its point status data is set by a programmable parameter (DRFT) in the control program running in controller nnn when it is in programmed mode and for a controller running in slave mode the rate is one of 2 fixed values (6 seconds for non modem mode and 12 seconds for modem mode - refer section 6.1). Also, whenever a change of state on an input point occurs then that controller will immediately transmit its point status data. The IRnnn operand is set FALSE at periodic intervals according to the value of the programmed parameter DRQT and remains FALSE until the next point status data is received from controller nnn. Hence it is necessary to use a timer to detect the condition of IRnnn returning FALSE continuously for longer than a certain length of time - a time of 30 seconds or more is recommended.

3.3.3.6 SYSTEM CONDITIONS (CONTINUED)

IRnnn (continued)

As an example, the following logic will result in output 32 turning on if a period of 30 seconds occurred during which no point status data was received from Controller 16. Output 32 will turn off immediately any point status data is received from Controller 16.

```
T1[30,0] = NOT IR16
032 = T1
```

As a further example, the following logic results in output 32 turning on if, for 30 seconds, no status data is received from Controller 16. The output will stay on, even if point status data is subsequently received, until reset by input I1/1S.

```
T1[30,0] = ^IR16
032 = T1 + (032N. ^I1/1S)
```

When input I1/1 is put into short circuit, output 32 will turn off if the fault has cleared, i.e. if T1 is false. Output 32 will always be on if the fault is still present (T1 TRUE).

The value of DRQT also determines how often the value of the INF operand is updated and is normally set to about twice as long as the value of DRFT. It is not recommended to reduce the value of DRQT to anything less than the default value supplied in the parameter files NETPRMV3.*

PRnnn

Fire panel responding status. This is similar to the IRnnn operand described above and may be used to detect a loss of communications with panel nnn. It is necessary to use a timer in conjunction with the PRnnn operand since PRnnn returns a value which OSCILLATES between TRUE and FALSE when panel nnn is responding normally. The value of PRnnn is set TRUE whenever a valid communication is received from panel nnn (either from the local RZDU input or from zone data received on the network) but at periodic intervals (fixed at 32 seconds) the value of PRnnn is set FALSE and remains FALSE until the next valid communication is received from panel nnn. Normally one communication (a message) is received from each fire panel every 2 seconds, either from the local RZDU input or from zone data received on the network.

PRnnn is forced to return TRUE for the first 60 seconds after power up of the controller to allow time for communication with the network to be established.

3.3.3.6 SYSTEM CONDITIONS (CONTINUED)

As an example, the following logic will result in Output 32 turning on if no message is received from Panel 5 for approximately 60 seconds. The output will turn off as soon as a message is received.

```
T1[60,0] = NOT PR5
O32 = T1
```

The following modification shows how the output can be latched on until reset by input I1/1S.

```
T1[60,0] = ^PR5
O32 = T1 + (032N.^I1/1S)
```

3.3.3.7 CONSTANTS

TRUE may be used to return the value TRUE.
FALSE may be used to return the value FALSE.

```
eg.         V1 = FALSE  sets variable V1 to FALSE
            O3 = TRUE   turns output 3 on.
```

3.3.3.8 TIMERS

A timer can be used to detect a particular condition being continuously TRUE or FALSE for a set length of time. Up to 128 timers may be used but may be limited to less than this depending on the RAM storage limits in the controller. An input condition, start delay and stretch delay must be specified for a timer with a statement as follows.

```
            Tnnn[xxx,yyy] = input condition
    OR      Tnnn(xxx,yyy) = input condition

            where nnn is the timer number 1 to 128,
                  xxx is the start delay, 0-255  (seconds)
                  yyy is the stretch delay, 0-255  (seconds)
                  and input condition is any valid expression and may
                  include any number of operands, NA functions etc.
                  Either [] or () may be used.
```

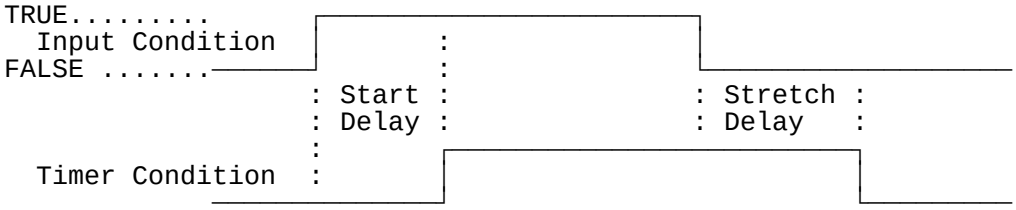
The current "state" of a timer is either TRUE or FALSE and may be accessed in an expression with the operand Tnnn, where nnn is the timer number 1-128.

Timer numbers used in a control program should be used "contiguously", starting with 1, to minimise the usage of RAM in the controller. Eg. if a program needs two timers, then use timers 1 and 2 - don't use timers 5 and 25 as this will waste RAM memory.

3.3.3.8 TIMERS (CONTINUED)

The state of a timer is set to TRUE or FALSE as follows.
If the current state of timer nnn is FALSE, then when the input condition has a transition from FALSE to TRUE, the start delay (xxx) starts. If the input condition remains continuously TRUE for the entire length of time specified by the start delay, then the current state of the timer will be set to TRUE - ie. Tnnn will return a value of TRUE. The current state of the timer will then remain TRUE until the input condition becomes FALSE (and remains FALSE) for the length of time specified by the stretch delay. Ie. if the current state of timer is TRUE, then when the input condition has a transition from TRUE to FALSE, the stretch delay (yyy) starts and if the input condition remains continuously FALSE for the length of time specified by the stretch delay then the current state of the timer will be set to FALSE - ie. Tnnn will return a value of FALSE.

When the timer is false, if the input condition does not remain continuously true for the full length of the start delay, then the timer will not become true. Similarly when the timer is true, if the input condition does not remain continuously false for the full length of the stretch delay then the timer will not become false.



Timer Operation

As the input condition is evaluated only once every pass through the entire control program, short lived changes in the input condition may not cause a timer to start or reset. The time to execute one pass of the control program is dependent on the size of the program ie. the number and size of the expressions it contains. Typically this could be 100 to 300 milliseconds, but could be as long as 500 to 600 milliseconds for large programs.

If the start delay is zero, then when the input condition becomes TRUE the state of the timer will immediately be set TRUE. Note that the state of the timer only changes when the input condition is evaluated, which is once on each pass through the entire control program. Ie. even with a start delay of zero, short lived changes of the input condition may not cause the timer state to become TRUE. The timer state will become TRUE only if the input condition is TRUE at the time the input condition is evaluated.

3.3.3.8 TIMERS (CONTINUED)

Similarly, if the stretch delay is zero, then when the input condition becomes FALSE, the state of the timer will immediately be set FALSE, but note again that short lived changes of the input condition may not cause the timer to change state.

At power up, the state of all timers is FALSE.

The state of a timer, Tnnn, may be used anywhere in an expression and the same timer or any number of timers may be accessed any number of times in the same expression. A timer Tnnn, may also be used in the set list of an NA function and may also be used as the reset operand in an NA function.

Timer example 1

The following example shows how a timer can be used to give a pulsed output with fixed pulse widths of 30 seconds on and 20 seconds off. Output 32 will be on for 30 seconds and off for 20 seconds.

```
T4[20,30] = NOT T4
O32 = T4
```

The input condition to timer 4 is NOT T4, hence if T4 is initially FALSE then the input condition will be TRUE, so after 20 seconds the state of the timer will then be set TRUE. This causes the input condition to become FALSE, so the stretch delay (30) starts and after 30 seconds the state of the timer will be set FALSE. The cycle then repeats.

Timer Example 2

This example shows the logic required to achieve the equivalent of the "pulse" timer provided on an F3200 fire panel.

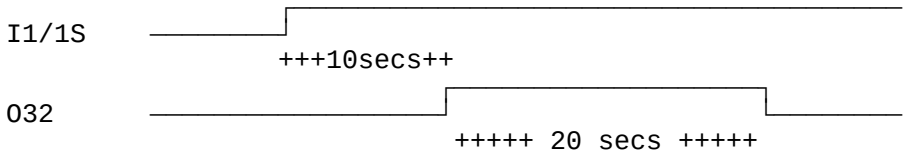
A timer can be used to give a single pulse and then turn off even if the "input condition" remains TRUE. Any input condition can be used - the example uses I1/1S but it may be any expression. When I1/1S has been TRUE continuously for 10 seconds, output 32 will turn on and stay on for exactly 20 seconds, after which it will turn off and stay off even if I1/1S is still TRUE. A transition of I1/1S from FALSE to TRUE is then required to start the process off again. Transitions of I1/1S while the timer is TRUE and output 32 is on are ignored.

```
V1 = I1/1S
V2 = NOT T1
T1[10,20] = NA(V2;V1) AND NOT T1 AND V1
O32 = T1
```

3.3.3.8 TIMERS (CONTINUED)

This is a fairly complex example. Suppose the state of the timer is initially FALSE and I1/1S is also FALSE. When I1/1S goes TRUE the NA function will be set TRUE and will remain TRUE until V2 has a transition from FALSE to TRUE (which will occur when timer T1 has a transition from TRUE to FALSE). When the NA function goes TRUE the start delay of the timer will start because the entire input condition is TRUE (V1 is TRUE and "NOT T1" is also TRUE).

After V1 has been TRUE for 10 seconds the state of the timer will become TRUE and output 32 will turn on. Now the input condition to the timer has become FALSE (because "NOT T1" is now FALSE) so the stretch delay starts and after 20 seconds the state of the timer will become FALSE and output 32 will turn off. The transition of the timer from TRUE to FALSE will reset the NA function so that a new transition of V1 from FALSE to TRUE is then required to start the whole process off again.



The delay before output 32 turns on is set by the start delay and the length of time that output 32 stays on for is set by the stretch delay.

Timer Example 3 - a Pulse Counter

"Pulse counter logic" may be used to create even longer time delays than the maximum of 255 seconds. The following example uses T5 (Timer 5) as the input condition to count pulses from, but the equation V131=T5 may specify any input condition for which pulses are to be counted, eg. a circuit input. (If pulses from a circuit input are being counted, short duration pulses may be missed.)

The following pulse counter logic relies on the fact that the equations are executed EXACTLY in the order shown - which is what an IO-NET controller does.

Note also that ideally a program should allocate variable numbers starting from 1 up contiguously. However, using variable numbers as shown makes the logic easier to understand.

3.3.3.8 TIMERS (CONTINUED)

```
T5[13,2] = NOT T5
V131 = T5
V132 = (V132 XOR (^V131.V151))
V151 = V131
V133 = (V133 XOR (^V132.V152))
V152 = V132
V134 = (V134 XOR (^V133.V153))
V153 = V133
V135 = (V135 XOR (^V134.V154))
V154 = V134
V136 = (V136 XOR (^V135.V155))
V155 = V135
```

The state of variable V132 will change every 15 seconds (13+2) at the time that timer 5 has a transition from TRUE to FALSE. Ie. V132 oscillates and is TRUE for 15 seconds and FALSE for 15 seconds.

Variable V133 will change every 30 seconds at the time that variable V132 has a transition from TRUE to FALSE.

Similarly, V134 will change state every 60 seconds, V135 every 2 minutes, and so on, with each successive timer doubling the time period.

Timer Example 4, Long Output Pulses

The pulse counters of Example 3 can be used to generate long time delays. Suppose it is necessary to turn output 32 on for 15 minutes and off for 30 minutes continually. This can be done using the pulse counter equations above but with start and stretch delays in the base timer of 178 and 2. Ie. T5[178,2] = NOT T5.

This means that variable 132 changes state every 3 minutes, V133 changes every 6 minutes, etc.

The following table shows the state of the 4 variables V132-V135 after 3,6,9,12,15..... minutes.

3.3.3.8 TIMERS (CONTINUED)

Time (Minutes)	V132	V133	V134	V135	Binary Value of Counter
0	F	F	F	F	0
3	T	F	F	F	1
6	F	T	F	F	2
9	T	T	F	F	3
12	F	F	T	F	4
15	T	F	T	F	5
18	F	T	T	F	6
21	T	T	T	F	7
24	F	F	F	T	8
27	T	F	F	T	9
30	F	T	F	T	10

With the addition of a reset variable (V130) the pulse counter logic can be used to make Output 32 oscillate on for 15 minutes and off for 30 minutes.

```
T5[178,2] = NOT T5.V130
V131 = T5
V132 = (V132 XOR (^V131.V151)).V130
V151 = V131
V133 = (V133 XOR (^V132.V152)).V130
V152 = V132
V134 = (V134 XOR (^V133.V153)).V130
V153 = V133
V135 = (V135 XOR (^V134.V154)).V130
V154 = V134
V160 = ((^V132.V133.^V134.V135).^V160) + (V160.^(V132.^V133.V134))
V130 = ^(V160 XOR V161)
V161 = V160
O32 = V160
```

At startup of the controller, V160 and V161 will both be false so V130 will be set TRUE after the first pass and the pulse counter will start counting. When the state of variables V132-V135 reaches FTFT respectively, (10 counts of 3 minutes = 30 minutes), V160 will become TRUE.

3.3.3.8 TIMERS (CONTINUED)

V130 will then immediately be set FALSE for exactly one pass of all equations which will reset the pulse counter. V160 then remains TRUE until the state of variables V132-V134 reaches TFT respectively (15 minutes) at which point V160 will become FALSE and once again V130 will immediately become TRUE for exactly one pass of all equations and reset the counter.

Note that the logic works for all cases of the on and off times being less, equal or greater than each other.

Timer Example 5 - Long Time Delay Input Monitoring

Suppose it is necessary to detect an input condition being continually true for 15 minutes at which point an output is to turn on and remain on until the input condition has been continually false for 6 minutes.

The following equations do this with the desired input condition being I1/1S. (The input condition could actually be any expression.)

```
T5[178,2] = NOT T5.V130
V131 = T5
V132 = (V132 XOR (^V131.V151)).V130
V151 = V131
V133 = (V133 XOR (^V132.V152)).V130
V152 = V132
V134 = (V134 XOR (^V133.V153)).V130
V153 = V133
V135 = (V135 XOR (^V134.V154)).V130
V154 = V134
V136 = (V136 XOR (^V135.V155)).V130
V155 = V135
V162 = I1/1S
V160 = ((V132.^V133.V134).^V160) + (V160.^(^V132.V133))
V130 = ^((^V162.^V160) + (V162.V160) + (V160 XOR V161))
V161 = V160
O32 = V160
```

The equation for V130 specifies the conditions which reset the counter. It is important that the length of the stretch timer is a small, non-zero value, otherwise the base timer will not get reset properly when the pulse counter is reset (V130 set false). A value of 2 should always be used for the stretch delay.

3.3.3.8 TIMERS (CONTINUED)

The counter is continuously reset while
"V160 is false and the input condition is false"
OR while
"V160 is TRUE and the input condition is also TRUE"

and the the counter is reset for exactly one pass following any transition of V160.
An alternative equation for V160 which produces the same result is
V160 = ((V132.V134).^V160) + (V160.^(V133)).
i.e. it is possible to leave out some of the "least significant" variables which for which the "match condition" is FALSE.

Timer Example 6 - Long Time Delay Input Monitoring

The following example of pulse counter timing is a variation of the preceding example. Suppose an output is to turn on after an input condition has been TRUE continually for 15 minutes and stay on for exactly 6 minutes and then turn off and stay off until the input condition has a transition from FALSE to TRUE and the cycle starts again.

```
T5[178,2] = NOT T5.V130
V131 = T5
V132 = (V132 XOR (^V131.V151)).V130
V151 = V131
V133 = (V133 XOR (^V132.V152)).V130
V152 = V132
V134 = (V134 XOR (^V133.V153)).V130
V153 = V133
V135 = (V135 XOR (^V134.V154)).V130
V154 = V134
V136 = (V136 XOR (^V135.V155)).V130
V155 = V135

V162 = I1/1S
V160 = ((V132.^V133.V134).^V160) + (V160.^(^V132.V133))
V163 = ((^V160.V161) + V163).V162
V130 = ^((^V162.^V160) + (V160 XOR V161) + V163)
V161 = V160
O32 = V160
```

V163 is set true when V160 has a transition from TRUE to FALSE (ie. the point at which the output turns off), and latches TRUE until V162 (the input condition) becomes FALSE.

The equation for V130 specifies the conditions which reset the counter, ie. the counter is reset when:
"the input condition is FALSE and V160 is FALSE"
OR while
"V163 is true"
and the counter is reset for exactly one pass following any transition of V160.

3.3.3.8 TIMERS (CONTINUED)

Timing Accuracy

For time delays requiring greater accuracy/resolution, smaller values of the start and stretch delays in the base timer of the pulse counter can be used but more equations and variables will be needed to achieve longer times. For accuracy, it is important that the stretch delay value in the base timer is a small non zero value - the value 2 is recommended. Also, the start delay should always be a non zero value - i.e. do not have a value of zero for the start delay.

There is an inaccuracy in the base rate of a timer. Due to the way the time is measured, the controller decrements every timer at a nominal rate of once every 1.008 seconds (1108 milliseconds) and this is also subject to a variation in the base crystal oscillator which is approximately 0.5% (half a percent).

Hence, with increasing a time delay, a variation of +1.3 percent to +.3 percent can occur. In a 24 hour period this can amount to 15 to 20 minutes.

Even with start and stretch delays both non-zero, there is potential for variation in the repeat rate of a time, eg. T5[1,1] = NOT T5, will repeat exactly every 2 seconds in most cases except for programs where the time to execute one pass of the output logic is approaching 1 second or more.

For all but extremely large programs, the execution time of one pass of the output logic is normally less than 500 milliseconds.

If a timer is used to drive a pulse counter, any inaccuracy in the base timer has a multiplying effect through the pulse counter.

3.4 ASSIGNING VALUES TO NETWORK PARAMETERS

The file NETPRMV3.240 contains the complete list of the network parameters which need to be assigned for a 2400 baud network. The following table shows which file to use for a particular baud rate.

```
NETPRMV3.960      - 9600 baud
NETPRMV3.480      - 4800 baud
NETPRMV3.240      - 2400 baud
NETPRMV3.120      - 1200 baud (without modems)
NETPRMV3.12M      - 1200 baud (with modems)
```

There are five network parameters in particular which may need to be set by the user. These are

- ADDR : target station address
- MXST : max station number
- RZDU : local RZDU data connection enable and panel number, if any.
- RZDP : assign local RZDU data input protocol type
- TXZD : enable transmission of zone data onto the IO-NET network.

If the compiler produces a "ram storage limit exceeded error" it may also be necessary to include the MRAM parameter to allow the compiler to reduce the amount of RAM it allocates to the RZDU receive buffer (if any) in the controller.

3.4.1 ASSIGNING TARGET STATION ADDRESS

The address of the target controller into which the source file is to be programmed can be specified with the parameter assignment

```
ADDR = nnn
```

where nnn is the controller number 0 to 127. This must be the same number as assigned to the address dipswitch on the IO-NET Controller.

The parameter to assign the address should be included only if a "Ram limit exceeded" error is produced by the compiler (see Section 4.6).

Normally it is not necessary to specify the address of the target station in the user source file. If the parameter for the target station address is specified in the source file then it is important that the EPROM be installed in a target controller with the specified address. If not, the controller may display an error cadence on its status LED after power up and not run (see Section 7).

3.4.2 ASSIGNING MAXIMUM STATION NUMBER

The value for max station number is assigned with the statement

```
MXST = nnn
```

where nnn = 0 to 255. The value for MXST should be set to the number of the highest controller address you are ever likely to connect to the network. Any controller connected to the network with an address higher than this will not be given access to the network. A reasonable upper limit value should be used for max station number. Too large a value can reduce the efficiency of the network and increase the start-up time of the network or increase the access time when adding a new station to the network.

The information in the following paragraph may be useful if adding new stations to an existing network and the new stations have addresses greater than the value of the max station parameter on the existing controllers.

It is not essential for all stations to have the same value for max station number, but is probably desirable. For a given station N, station N gets access to the network only if the next lowest numbered controller present on the network has a max station number greater than or equal to the value N. For example, if controllers 5,7 and 12 are the only controllers physically present on the network then the max station value of controller 7 determines whether controller 12 gets access to the network - BUT, note that if controller 7 disconnected from the network for a while it would then be the max station value of controller 5 which determined controller 12 access.

Note that in non programmed mode a default value of 31 is assigned for max station.

3.4.3 ENABLING LOCAL RZDU DATA INPUT

Zone status used in the control program may come from either a local RZDU data connection or from zone data received on the IO-NET network from other controllers which have their own RZDU data connection. Each controller which has a local RZDU data connection must include the parameter

RZDU = nn

where nn is the panel number (0-63) associated with that particular fire panel. Each controller with a local RZDU connection should be given a unique panel number and these should be carefully recorded in the documentation of the system.

When zone status is accessed in the control program, each zone operand must include the panel number - Zpp:nnnC, where pp is the panel number 0-63, nnn is the zone number 1-528, and C is A,I,F,N.
The panel number may specify any fire panel connected to a controller on the network provided that that controller has been programmed to transmit the zone data from its RZDU data connection onto the network (by including TXZD parameter).

The compiler (IONETCPL) is not able to detect duplication of panel numbers but a network controller is able to detect it and will set the ZNF operand to TRUE if it receives a message of zone data from the network where the panel number is the same as its own RZDU connection panel number.

The local RZDU data connection may be enabled even if none of the zone data from it is accessed in the control program - this could happen if it was desired for the controller to transmit the zone data onto the network. A controller may access zone data from either or both its own RZDU data connection (if any) or zone data received from the network.

Refer to Section 3.4.6 and 8 for information on RZDU zone data refresh rates and the delay from a zone change of state occurring to the new state being received by an IO-NET controller.

3.4.4 ENABLING TRANSMISSION OF ZONE DATA ONTO THE NETWORK

A controller may be programmed to transmit all of the zone data it receives on its local RZDU data connection onto the IO-NET network for use by other controllers. To enable the transmission of zone data onto the network, the parameter TXZD = 1 must be included in the control program. The parameter, RZDU, described above, must also be included and so must the RZDP parameter. The panel number specified by the RZDU parameter will be included in every message of zone data transmitted onto the IO-NET network so that other controllers can identify the zone data.

NOTE - for a network using 1200 baud modems the transmission of zone data takes up a significant amount of time on the network and if a controller does not get an opportunity to transmit often enough, it may have to continually discard some of the zone status data that it receives from its RZDU input - which could result in the status of some zones NEVER being transmitted on the network. Refer to section 8.3 for further information.

3.4.5 ASSIGNING RZDU PROTOCOL TYPE

The data received on the local RZDU data connection from an F4000/F3200 fire panel can be in one of two different formats or "protocol types". Older versions of F4000 panels transmit data in a format referred to as "non-LCD RZDU protocol" and newer versions of F4000/F3200 panels can be programmed to transmit using this or the newer "LCD RZDU protocol". The older non-lcd protocol transmits only led/zone status and the newer lcd protocol also sends event text and information for display on a remote lcd and allows more functions for isolating/ resetting zones from remote RZDUs/RDUs. Refer to Section 8.2 for information on how to configure an F4000 fire panel.

Version 1.00 of the IO-NET controller software can operate only with "non-LCD RZDU protocol".

For V1.01 and higher versions of the IO-NET controller software, the control program programmed into the controller must specify which type of RZDU protocol is to be used.

The parameter RZDP is used to specify which type of RZDU protocol is being used.

```
Including RZDP = 0    will select non-LCD/standard protocol
Including RZDP = 1    will select LCD RZDU protocol
```

If an IO-NET controller is connected to an F4000/F3200 fire panel which is transmitting the wrong version of the RZDU protocol, then the IO-NET controller will not operate correctly.

3.4.6 USING THE MRAM PARAMETER

If the compiler produces a "RAM storage limit exceeded" error the MRAM parameter (Minimise RAM) may be needed to reduce the size of the RZDU buffer (if any) allocated in the controller. The size of the buffer is set by the compiler and affects the capability of the controller to transmit zone data onto the IO-NET network. The MRAM parameter has no effect if the controller is not programmed to transmit zone data onto the network.

If the controller is programmed to transmit zone data onto the IO-NET network then the compiler will attempt to allocate an RZDU receive buffer size of at least 60 bytes - this is twice the size of the maximum sized message which can be received on its local RZDU data connection. The controller receives a message of zone data on its RZDU data connection once every 2 seconds, but is not able to transmit this data onto the network immediately - it must store it briefly until it gets an opportunity to transmit it onto the network.

The average and maximum lengths of time the controller must wait before it can transmit this zone data onto the network is dependent on the baud rate of the network, the number of controllers connected to the network, also the "activity level" of the network. Some approximate figures are given in Section 8.4 for the length of time a controller may have to wait before it is able to transmit on the network.

When the controller gets an opportunity to transmit on the network it will immediately transmit all of the zone data that it currently has stored in its buffer (which could require multiple messages being transmitted - and it may also transmit the status of its own input points) before relinquishing transmission right to the next controller.

The controller must therefore have a large enough RZDU receive buffer to be able to store a reasonable amount of zone data while it is waiting for the opportunity to transmit it. On a typical system a controller would get an opportunity to transmit more often than once every 2 seconds so that the message of zone data which it receives from the RZDU data connection every 2 seconds has probably been completely transmitted by the time the next RZDU message is received.

However, there may be times when the controller has not transmitted the last data received from the RZDU input. The size of the buffer set by the compiler determines how much zone data the controller can store while it is waiting to transmit it.

Since the controller has only a relatively small amount of total RAM storage space (approximately 130 bytes available to the user for a standard HC705C8 eprom type) some flexibility has been provided by the compiler to allow some control of the size of the RZDU buffer allocated.

3.4.6 USING THE MRAM PARAMETER (CONTINUED)

If the controller has its local RZDU data connection enabled but is not programmed to transmit zone data onto the IO-NET network then the compiler will allocate an RZDU receive buffer size of minimum 30 bytes - this is all that is needed to store the maximum size message that can be received from the RZDU input and the controller never needs to store more than one message at a time. (In actual fact the compiler will allocate all of the free RAM it has available to the RZDU buffer which may result in a buffer size of more than 30 bytes).

If the controller is programmed to transmit zone data onto the network then the compiler will initially attempt to allocate a minimum of 60 bytes to the buffer - which it will probably be able to do for a lot of control programs, however some larger programs may not have enough free RAM for a 60 byte buffer. By including the MRAM parameter the controller will allow the buffer size to be reduced to a minimum of 30 bytes. To enable this feature, the statement

```
MRAM = 1
```

should be included in the control program.

The compiler will ALWAYS allocate all of the free ram it can to the RZDU receive buffer so that the buffer size could be set at any value from 30 to 60 bytes when the MRAM parameter is enabled.

3.4.7 OTHER NETWORK PARAMETERS

It should not be necessary to change any other network parameters but further information can be found in the VIGILANT IO-NET PROTOCOL MANUAL and obtained on request if necessary.

3.5 EXAMPLE PROGRAMS

3.5.1 DUPLICATING NON-PROGRAMMED MODE

The following program duplicates the operation of non-programmed mode if it was running in a controller with address zero.

```
O1  = I1/1A OR I1/1S
O2  = I1/2A OR I1/2S
:       :       :
O32 = I1/32A OR I1/32S
```

3.5.2 PASSING DATA ON TO THE IO-NET NETWORK

Each controller transmits the state of all its inputs onto the IO-NET network. By wiring a local output to one of its own inputs it is possible for a controller to effectively pass output information onto the network for use by other controllers. This could include error conditions eg. INF or ZNF, or perhaps even the state of one of its own outputs.

With an output wired directly to an input, when the output is on, the state of the input will be EITHER alarm or short circuit (with low current pull-up it will definitely be short circuit but with high current pull-up it may be either alarm or short circuit) and when the output is off, the state of the input will be either normal or open circuit depending on whether an EOL resistor is connected or not.

Eg. if the controller at address 8 has output 32 wired directly to input 32 and included the statement O32 = INF OR ZNF, then if some other controller (say 5) included the statement

```
O1 = I8/32A OR I8/32S
```

then output 1 (on controller 5) would be on when controller 8 had a zone network fault (ZNF) or an IO-NET network fault (INF).

3.5.3 ACCESSING ZONES

The following are simple examples of output logic using F4000/F3200 fire panel zone data.

```
O1 = Z3:1A          ; output 1 on if zone 3:1 is in alarm

V1 = Z0:2A OR Z0:3A OR Z0:4A
O2 = V1             ; output 2 on if alarm on zones 2, 3 or 4 of panel 0.

O3 = NA (I1/1S; Z1:2A, Z1:3A, Z1:4A)
;    output 3 on if any new alarm on zones 2, 3 or 4 of panel 1, latched
;    until reset by short circuit on input 1 on controller 1.


O4 = Z2:156F OR Z3:157F OR V1
;    output 4 on if fault on zone 2:156 or zone 3:157 or if
;    alarm on zones 2, 3 or 4 of panel 0 (from expression for V1 above)
```

Chapter 4

PROGRAMMING A SOURCE FILE

4.1 RUNNING THE COMPILER/PROGRAMMER

A utility program is provided which runs under MSDOS on a PC and allows the programming of a user source control program into an IO-NET Controller EPROM. The name of the utility program is IONETCPL.EXE and may be run by typing IONETCPL. To program an IO-NET Controller EPROM the PC must be connected to the programming module via a serial port.

A controller EPROM may be re-programmed a limited number of times (approx 8 to 12 times).

The IONETCPL program allows the user to select which serial port to use (via menu option "Setup") and also the baud rate, etc. The programmer module requires 4800 baud, no parity, 8 data bits, 1 stop bit and no flow control. The parameters selected for the Port and baud rate, etc, are saved automatically into a file called IORSETUP.PRM.

The IONETCPL program may be run even if the PC is not connected to the programming module so that a user may compile a source file to check for syntax errors without doing any programming. Before using the Program, Verify or Retrieve commands, the programming module must be connected to the PC as follows:

1. Power down the programming module if not already.
2. Install the desired EPROM in the programming module.
3. Connect the programming module to the PC with an RS232 cable into the appropriate serial port. Refer to Section 5.7 for wiring details of the programming module.
4. Switch the Run/Reset switch to RESET.
5. Power up the programming module.
6. Switch the Run/Reset switch to RUN.

Once an EPROM is installed and the programming module powered up the Program, Verify or Retrieve commands may normally be used any number of times (unless an error occurs) without having to reset or powerdown the programming module (except for when changing the EPROM).

ALWAYS ENSURE THAT WHENEVER INSTALLING OR REMOVING AN EPROM FROM THE PROGRAMMING MODULE THAT THE MODULE IS POWERED DOWN.

To run the programming utility, type IONETCPL.
A menu of options will be displayed.

At the bottom of the screen will appear a brief description of what each option does.

To select an option either use the up arrow and down arrow keys to move the "cursor" to the desired option and then press RETURN; or, press the leading character of each option (C for Compile, P for Program, etc).

RUNNING THE COMPILER/PROGRAMMER (CONTINUED)

Before a source file can be programmed into an EPROM it must first be compiled using the "Compile Source" option from the menu. Intermediate object data is created (hidden from the user) when a source file is compiled.

After a source file has been compiled with no errors it may then be programmed into an EPROM using the Program option. When programming is completed an automatic verify operation will be done, whereby data is read back from the EPROM and compared against the intermediate object data.

An IO-NET Controller EPROM may be re-programmed with a user control program a limited number of times (approximately 8 to 12 times depending on size), until all of the available user program space has been used up. The user will be informed if all of the user program space has been used up. The Program, Verify and Retrieve options all inform the user how much unused space is remaining in an EPROM. When a source file is compiled with no errors the size of the object data created is displayed, and this can be used to work out how many times a particular source file can be re-programmed into an EPROM.

After an EPROM has been programmed it may be verified at any time using the Verify option which compares the latest user control program in the EPROM against a user source file. The user source file must have already been compiled with the Compile option before the Verify command can be used.

4.2 COMPILING A USER SOURCE FILE

A user source file may be compiled with or without the target controller EPROM and programming device connected (on line) to the PC.

The user will be prompted to indicate whether the target EPROM is on line or not with:

Is target EPROM on line? [Y/N]

Press "Y" RETURN if the target EPROM is on line.

If the target EPROM is on line some information will be read from it which gives the amount of RAM storage space available for storing zone data and controller point data, etc, at run-time in the controller.

If the user control program requires more RAM storage space than there is available in the controller EPROM, then the compiler will indicate an error.

If the target EPROM is not on line, then default values will be used for the amount of RAM storage space available. These can be set in the user source file with the RAMT and RAMB parameters, if desired.

NOTE Before a control program can be programmed into a target EPROM the source file must be compiled with the target EPROM on line. Similarly with the VERIFY command the source file must be compiled with the target EPROM on line before the verify command can be used. The user will be prompted to recompile the source file with the target EPROM on line if this has not been done.

Having indicated whether the target EPROM is on line or not, the user will then be prompted for the name of the source file to be compiled.

A drive letter and directory may be included in the source file name if necessary. If the source file resides in the current directory then no directory name is needed.

The source file name may be edited if desired (eg. to correct a mistake when typing the name) with the editing keys as follows:

Right Arrow - move cursor right
Left Arrow - move cursor left
End - move cursor to end
Home - move cursor to start
Del - delete character under cursor
Backspace - delete character to left of cursor
Escape - abort the Compile operation

After the source file name has been entered and the file has been found, it will be compiled.

COMPILING A USER SOURCE FILE (CONTINUED)

After the completion of a successful compilation, some information is displayed about the RAM and EPROM usage of the program compiled as follows:

Program object code size
- this value is the number of bytes of EPROM the program uses.

Total non buffer RAM used
- this is the number of bytes of RAM used by the control program to hold point data, zone data, variables, timers etc. and does not include the number of bytes of RAM allocated to the RZDU receive buffer.

RZDU receive buffer size
- this is the size in bytes of the receive buffer. Refer to section 3.4.6 MRAM parameter.

Total physical user RAM
- this is the total amount of user RAM available in the controller (in bytes). It is the total amount of RAM available for storing point data, zone data, variables and RZDU receive buffer etc for any control program. The amount of free RAM remaining unused by this control program can be calculated by

Free RAM left = (Total physical user RAM)
minus
(Total non buffer RAM used plus RZDU receive buffer size)

Physical base page user ram
- this is the total amount of user base page RAM in the controller (bytes). Base page RAM is needed by variables, NA functions and timer state flags. Controller point data, zone data and timer counters can use either base page or non base page RAM.

If any errors are found in the source file then the line number in which the first error occurred will be indicated, and the contents of the line will be displayed along with a small up arrow character indicating the approximate position in the line that the error occurred.

Only the first error will be displayed. If no errors occur, the object size of the program, in bytes, will be displayed. Having been compiled the control program may then be programmed into a controller EPROM with the program command or verified against an existing programmed controller EPROM with the verify command.

After a successful compilation one of the following messages
"Transmitting of zone data onto the network is ENABLED"
or "Transmitting of zone data onto the network is DISABLED"
will appear as a reminder of whether the program included the TXZD=1 parameter setting or not.

4.3 PROGRAMMING A USER SOURCE FILE

To program a source file into a controller EPROM the source file must first be compiled with no errors and the target EPROM must be on line when the compile operation is done.

Before initiating the Program command, the EPROM should be installed in the programmer (with power off) and then the programmer device powered ON.

To initiate the Program operation select the Program option from the menu.

If no valid source compilation has been done an error message will be displayed, otherwise, the name of the source file that was compiled will be displayed and the operator will be prompted to proceed with the Program operation.

Press "Y" RETURN to proceed with programming.

If proceeding with programming the PC will attempt to read data from the EPROM. Section 4.6 describes the error messages which can occur when accessing the target EPROM in the programmer device.

If valid data is read from the EPROM then the source file will be programmed into the EPROM and then a verify operation will be performed to read the data back from the EPROM and check that it has been programmed correctly. While programming of data is being done, the red LED will be ON and the green LED will be OFF.

While the verify operation is in progress, both the red and green LEDs will be ON.

If the verify operation is successful, the following will be displayed:

```
EPROM verifies correctly
Chip is 8K C8 EPROM type
Space remaining = nnnn bytes
Size of last control program programmed = nnnn bytes
```

If the message:

"Failure During Programming"

appears, then a problem occurred during the actual programming of new data into the EPROM. It may be possible to recover by repeating the Program operation.

After a new control program has been programmed into a controller EPROM, the EPROM should be installed in the target IO-NET Controller and the operation of the new control program checked.

4.4 VERIFYING A SOURCE FILE

The Verify command can be used to check the control program contained in an EPROM against a source file. The source file must have been previously compiled with the target EPROM on line.

While the verify operation is reading data from the EPROM both the red and green LEDs will be ON.

Associated with the control program in an EPROM is a checksum (CRC) which is programmed along with the control program.

The verify command calculates the CRC of the control program in the EPROM and checks it against the value stored in the EPROM. If the CRC is incorrect the message:

```
EPROM control program CRC incorrect
```

will appear.

If a CRC error does occur, power the programmer device off and on and repeat the verify command. If a CRC error still occurs then either re-program the control program into the EPROM or throw the EPROM away. If the EPROM subsequently passes a verify operation the verify command should be repeated several times.

If a CRC error does occur, the number of bytes which do not match the source file will be displayed.

If the control program in the EPROM does verify correctly and exactly matches the source file then the following will be displayed:

```
EPROM verifies correctly.
Chip is 8KC8 EPROM type.
Space remaining = nnnn bytes.
Size of last control program programmed = nnnn bytes.
```

4.5 THE RETRIEVE COMMAND

The Retrieve command checks the CRC of the control program in an EPROM and if the CRC is correct, it displays the size of the control program, etc, as follows:

```
EPROM contains valid data with correct CRC.
Chip is 8KC8 EPROM type.
Space remaining = nnnn bytes
Size of last control program programmed = nnnn bytes.
```

While the Retrieve operation is reading data from the EPROM both the red and green LEDs will be ON.

4.6 ERROR MESSAGES

4.6.1 PROGRAMMING MODULE ERRORS

Error messages which can occur with the Compile, Program, Verify and Retrieve commands when accessing an EPROM in the programming module are as follows:

Chip Not Responding
The PC cannot communicate with the controller EPROM in the Programming Module. Check that the correct serial port on the PC is used and the correct baud rate etc has been set with the Setup command (4800 baud, no parity, 8 data bits, 1 stop bit is required).

Power the programmer module OFF and then ON and try the command again.

Chip Checksum Read Error
This indicates that a response of some sort was received from the programmer module but there was an error in the data received (perhaps due to noise on the serial line). Power the programmer module OFF and then ON and try again.

Invalid Data Read From Chip
This error indicates that the EPROM module is not valid or of the wrong type or software version. A valid controller EPROM contains some coded values stored in some fixed locations in the EPROM which allows the PC to check that the EPROM is the correct type and version. Version 1.02 and earlier controller eproms can be programmed only with version 1.02 or earlier compiler. Version 1.10 compiler can program only controller V2.00 version or later.

Unable to Program - EPROM is Full
This indicates that there is not enough space left in the EPROM to program the source file. The Retrieve command can be used to show how much free space is remaining in an EPROM (in bytes).

The Compile command also indicates the size (in bytes) of the object data produced when the source file is compiled.

The EPROM should either be thrown out or could be used in non-programmed mode. Also it is possible that the EPROM could be used with a smaller source file.

Error Reading File DUMPMEM.BIN
The file DUMPMEM.BIN must reside in the same directory as the IONETCPL.EXE file. If the file is present but the error still occurs try re-copying the file from the floppy disk it was originally supplied on.

PROGRAMMING MODULE ERRORS (CONTINUED)

Error Reading File PROGSBC8.BIN

Error Reading File PROGSBC9.BIN
Both of these files must be present in the same directory as the IONETCPL.EXE program. Try re-copying them from floppy disk.

Failure During Programming
This error occurs if something goes wrong during the programming of a source file into EPROM. Use the Verify and Retrieve command to check if the EPROM has been programmed correctly. If the Verify fails then it may be possible to try the programming operation again or it may be necessary to throw the EPROM away.

RAM Size Mismatch Error
This error can occur during programming an EPROM if the source file was compiled with a different target EPROM on line than the EPROM currently being programmed. The source file should be re-compiled with the target EPROM on line.

4.6.2 COMPILER ERROR MESSAGES

Range Error
This occurs when an out of range numerical value is used. Examples are use of a controller circuit input number of 33 when the allowed range is 1 to 32 or a variable number of 0 when the range is 1 to 256.

Syntax Error
This covers many different types of error such as illegal characters or unknown words or brackets or operators missing in an expression.

Line Too Long
The maximum length of a line is 299 characters.

Target Stack Error
This error is unlikely to occur but will if more than 16 levels of stack space are required at run-time in the IO-NET Controller to evaluate an expression. The compiler detects this and indicates an error.

Eg. O1 = V1 OR (V3 OR (V4 ... with 17 levels of nested brackets would exceed this limit.

To overcome the error, reduce the number of brackets or separate the expression into two parts using a variable.

Missing Network Parameters
Every source file must contain an assignment for every network parameter. The full list of network parameters is supplied in the file NETPRMV3.240 (or 480, etc) according to the baud rate of the network being used. All network and configuration parameters must appear before any output logic expressions.

COMPILER ERROR MESSAGES (CONTINUED)

Missing RZDP Parameter for Protocol Type
If a local RZDU data connection is enabled with the RZDU parameter then the RZDP parameter must also be included. Refer to Section 3.4.5.

No END Statement in Source File
An END statement must be included at the end of every source file.

Parameters must precede expressions
All network and configuration parameters (including RZDU,RZDP,TXZD if used) must appear in the source file before any output logic expressions ie. before statements such as V1 = Z1:2A, O32 = Z1:13F etc.

Cant access own address with IR
The IR operand (refer section 3.3.3.6) is not allowed to specify a controller number which is the same as the controller address assigned with the ADDR parameter.

Missing RZDU parameter
If the TXZD parameter is included to enable transmission of zone data onto the IO-NET network then the RZDU parameter must also be included.

WARNING multiple expressions for the same output
If the same output is controlled by more than one expression then a warning message is displayed.

```
eg.   O12 = Z1A
      O12 = Z1F
```

is an example where output 12 is controlled by more than one equation and will result in a potentially intermittent and indeterminant output state. This warning will not prevent programming of an eprom but, for normal operation, it should not be done.

WARNING multiple expressions for the same timer
If the same timer is controlled by more than one equation then a warning message is displayed.

```
eg.  T1[15,30] = I1/1S
     T1[15,30] = I2/1S
```

Control of a timer by more than one equation will give indeterminant operation and should not be done. Variables can be used if the input condition for a timer is long and complex.

COMPILER ERROR MESSAGES (CONTINUED)

Base Page RAM Limit Exceeded
If this error occurs it means that the source file compiled with no syntax errors but that the total number of variables, NA functions, timers and remote IO-NET controllers accessed exceeded available base page RAM space in the IO-NET controller.

If the target EPROM was not on line when the source file was compiled, then the source file should be re-compiled with the target EPROM on line.

If this error still occurs when the source file is compiled with the target EPROM on line, then it is necessary to reduce the usage of:

1. The range of variables used.
   ALWAYS start with variable V1 and use variables contiguously (without any "gaps"). Eg. if you require 3 variables, use V1, V2, V3 - do not use V1, V100, V256.

2. The number of NA functions used or the number of operands in an NA function.

3. The range of IO-NET Controller numbers accessed in the control program. The difference between the highest and lowest controller number accessed determines the amount of base page RAM required, so, if possible, station numbers should be accessed contiguously but the lowest station number accessed does not have to be station 0.

4. The range of timers used. Always start with timer T1 and use timers contiguously.

5. The RANGE of fire panels accessed in zone operands - the difference between the highest and lowest fire panel number determines the amount of base page RAM required. Use consecutive panel numbers if possible.

It requires fairly heavy use of variables, NA functions etc to exceed the base page RAM limit.

Eg. if the highest and lowest IO-NET Controller number accessed were 31 and 0, and all 256 variables (V1 to V256) were used, then approximately 144 NA function operands can be used (eg. 24 NA functions with 6 operands each or 12 NA functions with 14 operands each). An NA function with 7 to 14 operands uses 2 bytes of RAM.

Total RAM Limit Exceeded
If this error occurs it means that the source file compiled with no syntax errors but the total amount of RAM required in the IO-NET Controller for storing zone data, IO-NET Controller point status, variables, NA functions, timers and RZDU receive buffer, if any, exceeded the available RAM.

COMPILER ERROR MESSAGES (CONTINUED)

If the target EPROM was not on line when the source file was compiled then the source file should be re-compiled with the target EPROM on line.

If this error still occurs when the source file is compiled with the target EPROM on line then it is necessary to reduce the usage of:

1. The range of variables used, the number of NA functions and NA function operands, the range or number of timers used, and the range of IO-NET Controller numbers accessed as discussed under the "Base Page RAM Limit" error above. Use of the MRAM parameter may allow the size of the RZDU receive buffer to be reduced, if any - refer to section 3.4.6.

2. If any controller circuit inputs are accessed on the "local" station containing the controller EPROM then specify the address of the target station that the EPROM is to be installed in by including the parameter ADDR = nnn in the source file.

   If the parameter ADDR = nnn is included then the number of circuit inputs on the local station which are accessed makes no difference to the amount of RAM required.

3. Reduce or re-arrange the number of controller circuit inputs accessed on remote IO-NET controllers.

   IO-NET controller circuit inputs are stored in groups of four. Eg. 1, 2, 3, 4 are stored as one group, 5, 6, 7, 8 are next, etc, and it is possible that reducing the number of "groups" which are accessed can reduce the required RAM storage. Eg. if 3 circuits are accessed on controller 15 try to make them all from the same group such as circuits 1, 2, 3, rather than circuits from three different groups.

4. Reduce or rearrange the number of zones accessed. Less RAM is required if zones are contiguous rather than scattered through a wide range.

   Eg. Accessing zones 1, 2, 3, 4, 5, 6, 7, 8 requires less RAM than accessing zones 10, 20, 30, 40, 50, 60, 70 and 80.

5. Include the statement

   ```
   MRAM = 1
   ```

   in the source file. This may allow a reduced RZDU receive buffer size - refer Section 3.4.6.

   As a final resort, there is a version of the IO-NET Controller EPROM available that has more RAM data storage but it has limited availability.

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Chapter 5

HARDWARE CONFIGURATION

5.1 PHYSICAL WIRING OF THE CONTROLLER BOARD

Reference can be made to the F4000 Technical Manual, Chapter 14, (IOR) for technical information on the IO-NET Controller.

5.1.1 NETWORK WIRING

An IO-NET Controller has 8 screw terminals located at the top of the PCB and labelled from right to left as.

1. 24V OUT
2. 24V IN
3. 0V OUT
4. 0V IN
5. CHNL1 OUT
6. CHNL1 IN
7. CHNL2 OUT
8. CHNL2 IN

These should be connected as follows:

Pin 1 24V OUT - connect to 24 volt power source

Pin 2 24V IN - no connection.

Pin 3 0V OUT - connect to 0 volt wire of the power source.

Pin 4 0V IN - connect to 0V wire of the IO-NET network.

Pin 5 CHNL1 OUT - connect to "data" wire of the network and also to Pin 7 CHNL 2 OUT.

Pin 7 CHNL2 OUT - connect to "data" wire of the network and also to Pin 5 CHNL 1 OUT.

Ie. Pins 5 and 7 are joined together and also to the network data line.

Pin 6 CHNL1 IN - connect to RZDU protocol data line if required (refer Section 5.4).

Pin 8 CHNL2 IN - this is an output which is high when the controller is transmitting and low otherwise. It can be used as a "transmit" indication.

If the controller is not connected to the network, then it does not require any connections to pins 5 and 7. A wiring diagram is shown in Fig 5.1.

At the left hand side of the controller PCB there are two jumper links LK1, LK2 which should be set to the 0V position.

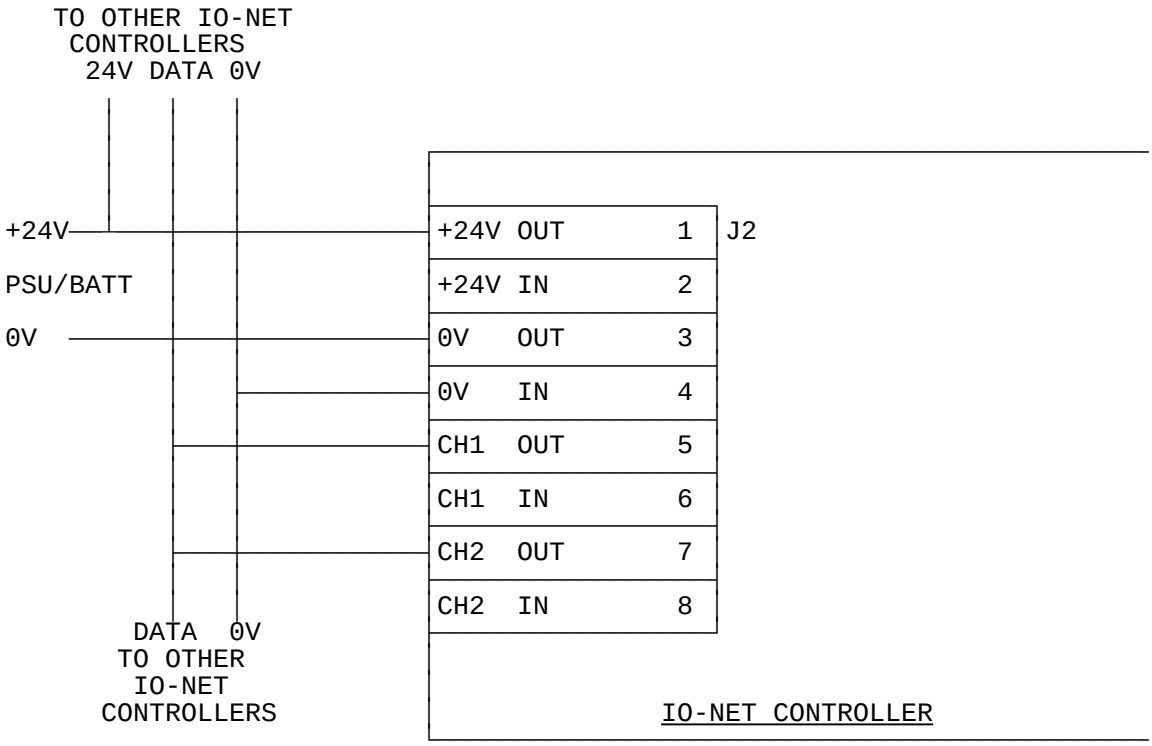


FIG 5.1
IO-NET CONTROLLER PSU & NETWORK WIRING

5.1.2 INPUT/OUTPUT TERMINATION BDS

The IO-NET Controller provides inputs and outputs in 16 way blocks ie. a choice of any combination of 0, 16 or 32 inputs or outputs. An Output Termination Board (1901-73-2) provides open collector outputs and a Relay Board (1901-64) provides clean contact outputs. Both types are approved for field cabling eg. an open collector output can be used to drive a remote LED.

Inputs 1 to 16 connect via socket J3, inputs 17-32 via socket J4, outputs 1 to 16 via socket J5 and outputs 17-32 via socket J6.

The following gives the part number of PCBs associated with the IO-NET controller, together with a brief description of its use.

PA0498 PCB ASSEMBLY,1901-117,IO-NET CONTROLLER

This is the IO-NET Controller PCB.

Field connection of inputs/outputs is provided by screw terminals on separate termination boards. These connect to the IO-NET Controller by 26 way FRCs (Flat Ribbon Cables) which have to be ordered separately.

The controller has a nominal 650mA current limited 24V output to power LEDs, relay coils, etc.

PA0474 PCB ASSEMBLY,1901-73-1,F4000 IOR 32 WAY INPUT TERM BD
PA0479 PCB ASSEMBLY,1901-73-1,F4000 IOR 16 WAY INPUT TERM BD

Allows termination of up to 1.5sq mm field wiring.
Also carries the transient voltage protection components.
Requires one FRC per each 16 inputs.
A PA0479 is half of a PA0474.

PA0475 PCB ASSEMBLY,1901-73-2,F4000 IOR 32 WAY O/P TERM BD
PA0480 PCB ASSEMBLY,1901-73-2,F4000 IOR 16 WAY O/P TERM BD

Allows termination of up to 1.5sq mm field wiring to the open collector outputs.
Has a protection diode per circuit up to the positive supply.
Has one common +V, 0V and Earth terminal per each 16 circuits.
Requires one 16 Way FRC per each 16 circuits.
A PA0480 is half of a PA0475.

PA0470 PCB ASSEMBLY,1901-64,F4000 16 WAY RELAY BOARD

Provides 16 sets of changeover clean contacts.
Has voltage transient protection and suppression components on the coil side and one common +V, 0V and Earth connector.
An IO-NET controller may be connected to 0,1 or 2 relay boards.
One 1.4m 26 Way FRC is supplied with each relay board.

5.2 INPUT WIRING

Inputs to the IO-NET Controller are normally terminated with an End-of-Line (or normalising) resistor - 3k3 for high current mode and 27k for low current mode.

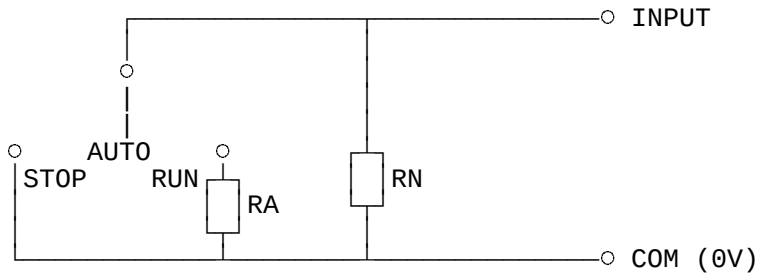
The controller can determine 4 states from the resistance presented to the input terminals - Open Circuit, Normal, Alarm and Short Circuit. The normal state is with the EOL resistor present.

These states are then transmitted over the network for other IO-NET Controllers to use.

How the inputs are wired up to field devices will depend on the field device and the functionality for each state.

For example the AS1668 Fire Fighters Air-Conditioning fan control requires Auto, Run and Stop conditions to control a remote fan.

These three states can be combined on a single input as follows:



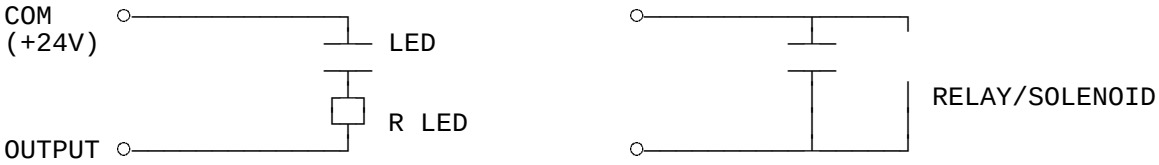
RA = Alarm Resistance RN = Normal Resistance

The input is Normal for the Auto position, Alarm for the Run position and Short Circuit for the Stop position. These states can be combined with other information - such as F4000 zone alarm states, to control the operation of an output at another IO-NET Controller.

5.3 OUTPUT WIRING

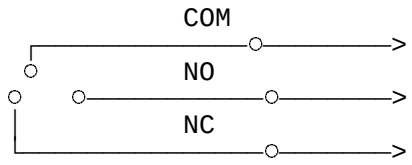
5.3.1 OPEN COLLECTOR OUTPUTS

The open collector outputs can be used to turn on LEDs, relays, solenoids and other control or indicating devices.



5.3.2 RELAY OUTPUTS

The relay contacts on the 16 Way Relay Module can be used to control external isolated equipment.



Relay Bd (Relay Shown Off)

5.4 F4000 RZDU DATA WIRING

The IO-NET Controller can be connected to the F4000 (or F3200) RZDU data bus with the use of the RZDU/RS232 1901-100 Interface Board. This board isolates and converts the F4000 RZDU data bus signals to a voltage compatible with the IO-NET Controller. It can be powered from the same +24V supply as the IO-NET Controller. Issue A Rev 1 and Rev 2 versions of the Interface Board require the use of a 1k5 resistor and a 15 volt zener diode as shown in Fig 5.2(A). Issue B versions can be connected to 24 volts directly.

The RXD output (J4 pin 3) or TXD output (J2 pin 3) of the RZDU/RS232 Interface Bd can drive a number of IO-NET Controllers over a maximum cable distance of 200 metres. Beyond this, the RZDU data cable should be extended and another RZDU/RS232 Interface Bd used for the remote IO-NET Controllers. J4 pin 3 and J2 pin 3 are in fact the same signal, just labelled differently on the two connectors.

An IO-NET controller with a local RZDU data connection can be programmed to transmit the zone data it receives from the RZDU input onto the IO-NET network for use by other controllers. This saves wiring the RZDU data line directly to all IO-NET controllers which need it. Multiple controllers, each connected to a different fire panel, may be programmed to transmit zone data onto the network. Each controller is programmed with a unique panel number for the zone data it receives on its RZDU input.

NOTE transmitting zone data on to the network can slow the network down and for 1200 baud networks it may be preferable to wire the RZDU data line directly to controllers which need zone data. Refer to Section 8.4 for more detail on network time delays.

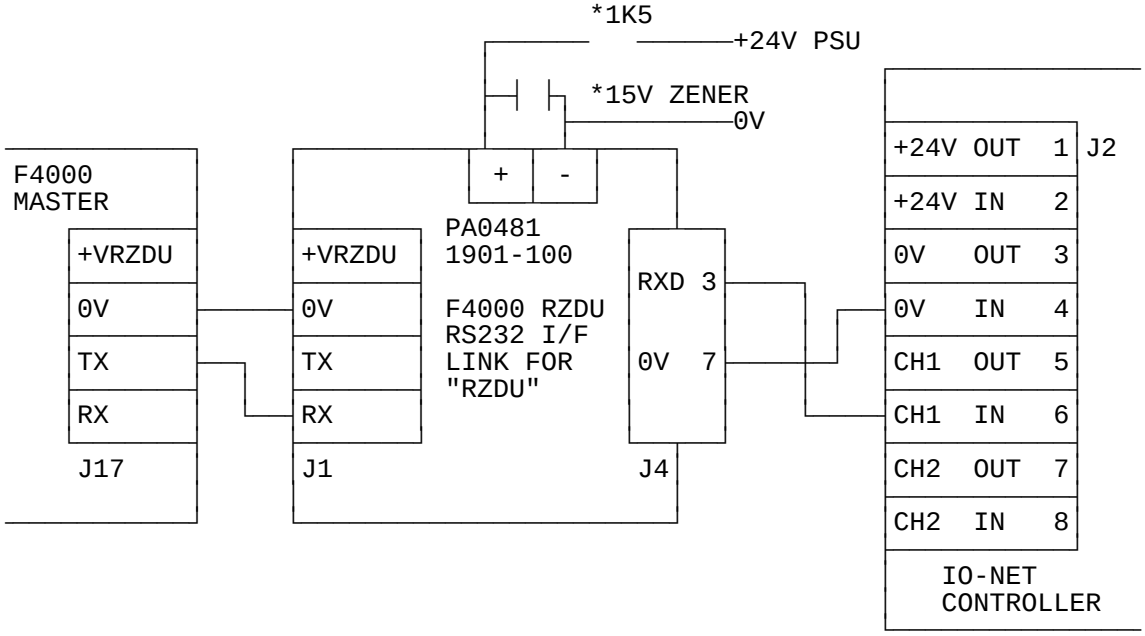


FIG 5.2(A) PA0481 ISSUE A

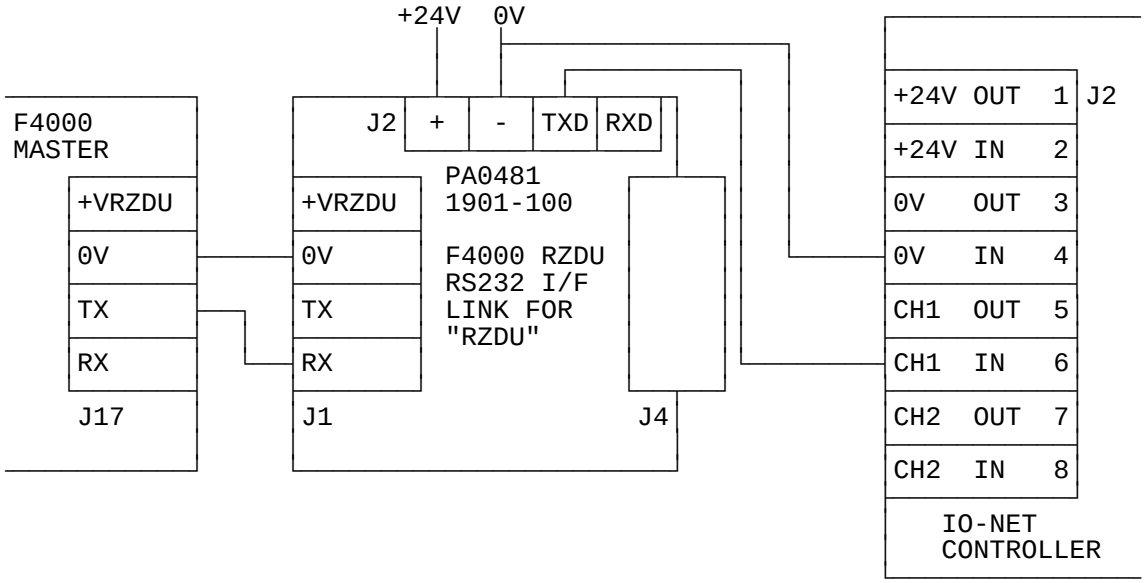


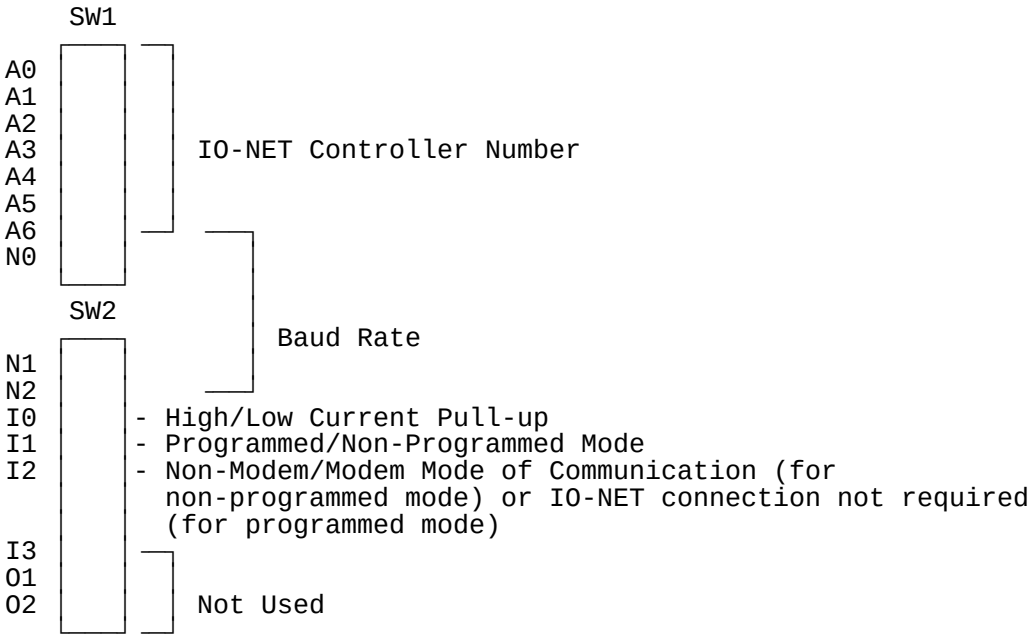
FIG 5.2 (B) PA0481 ISSUE B

IO-NET CONTROLLER TO F4000 RZDU WIRING

5.5 DIPSWITCH SETTINGS ON THE IO-NET CONTROLLER

There are two blocks of 8 dipswitches labelled SW1 and SW2 on the controller which are used as follows. (Block SW1/switch 1 is closest to the processor EPROM and connector for power supply and comms lines).

The dipswitches are read only on power-up of the IO-NET Controller and cannot be changed after the controller has powered up.



Switches 1 to 7 on SW1 (A0-A6) set the IO-NET Controller address (number) with switch 1 (A0) being the least significant bit of the address. An address of zero corresponds to all 7 switches being off. An address of 127 is all switches on.

Each address switch has the following weighting, with the address being equal to the sum of the weightings for those switches turned on.

Switch	Weighting
A0	1
A1	2
A2	4
A3	8
A4	16
A5	32
A6	64

DIPSWITCH SETTINGS ON THE IO-NET CONTROLLER (CONTINUED)

Switch 8 on SW1 (labelled N0) and switches 1 and 2 on SW2 (N1, N2) set the baud rate as follows:

N2	N1	N0	Baud Rate
off	off	off	9600
off	off	on	4800
off	on	off	2400
off	on	on	1200
on	off	off	600
on	off	on	300
on	on	off	150
on	on	on	75

Switch 3 on SW2 (labelled I0) selects either high current pullup or low current pullup.

I0 = OFF = high current pullup
I0 = ON = low current pullup

Switch 4 on SW2 (labelled I1) selects either programmed or non-programmed mode.

I1 OFF = programmed mode
I1 ON = non-programmed mode

Switch 5 on SW2 (labelled I2) is used for two different purposes according to whether programmed mode or non-programmed mode is selected.

When non-programmed mode is selected (switch I1 ON) switch I2 selects between modem operation and non-modem operation.

When non-modem operation is selected, a default set of network parameters corresponding to 2400 baud or higher is used. When modem operation is selected a default set of network parameters corresponding to 1200 baud with modems is used.

For non-programmed mode (I1 ON)

I2 OFF = non-modem mode
I2 ON = modem mode

For programmed mode (I1 OFF) switch I2 must be switched OFF if connection to the IO-NET network is required and switched ON if no connection is required. Refer to Section 7.2.1. The setting of this dipswitch affects only the Status led.

Switches 6, 7, 8 on SW2 are not used.

5.6 SELECTING THE BAUD RATE FOR THE NETWORK

The baud rate for the network is selectable on dipswitches but not all of the baud rates which are selectable are practical. With a DC network 2400,4800 or 9600 baud would normally be used.

At 2400 baud, with up to 24 stations on the network any (the first) change of state occurring on any controller input would be transmitted on the network and received by all other controllers within 1.2 seconds of the change of state occurring. Refer to Section 8.4 for more detail.

The lower the baud rate, the longer the maximum data line length of the total network.

A controller operating in non-programmed mode has a choice of 1200 baud with modems, or 2400, 4800, 9600 baud without modems.

If a mixture of controllers operating in both programmed and non-programmed mode are on the same network, then it is important that the controllers in programmed mode use network parameters which match the controllers operating in non-programmed mode. Chapter 6 lists the default network parameters used in non-programmed mode.

5.7 WIRING THE IO-NET PROGRAMMING MODULE

Wiring of the IO-NET Programming Module to a 24V PSU and to a PC RS232 serial port is shown in Fig 5.3 below. For connection to the J1 connector standard cables are available from Vigilant Fire & Evacuation Systems. The part numbers for these are LM0042 (DB25) and LM0041 (DB9).

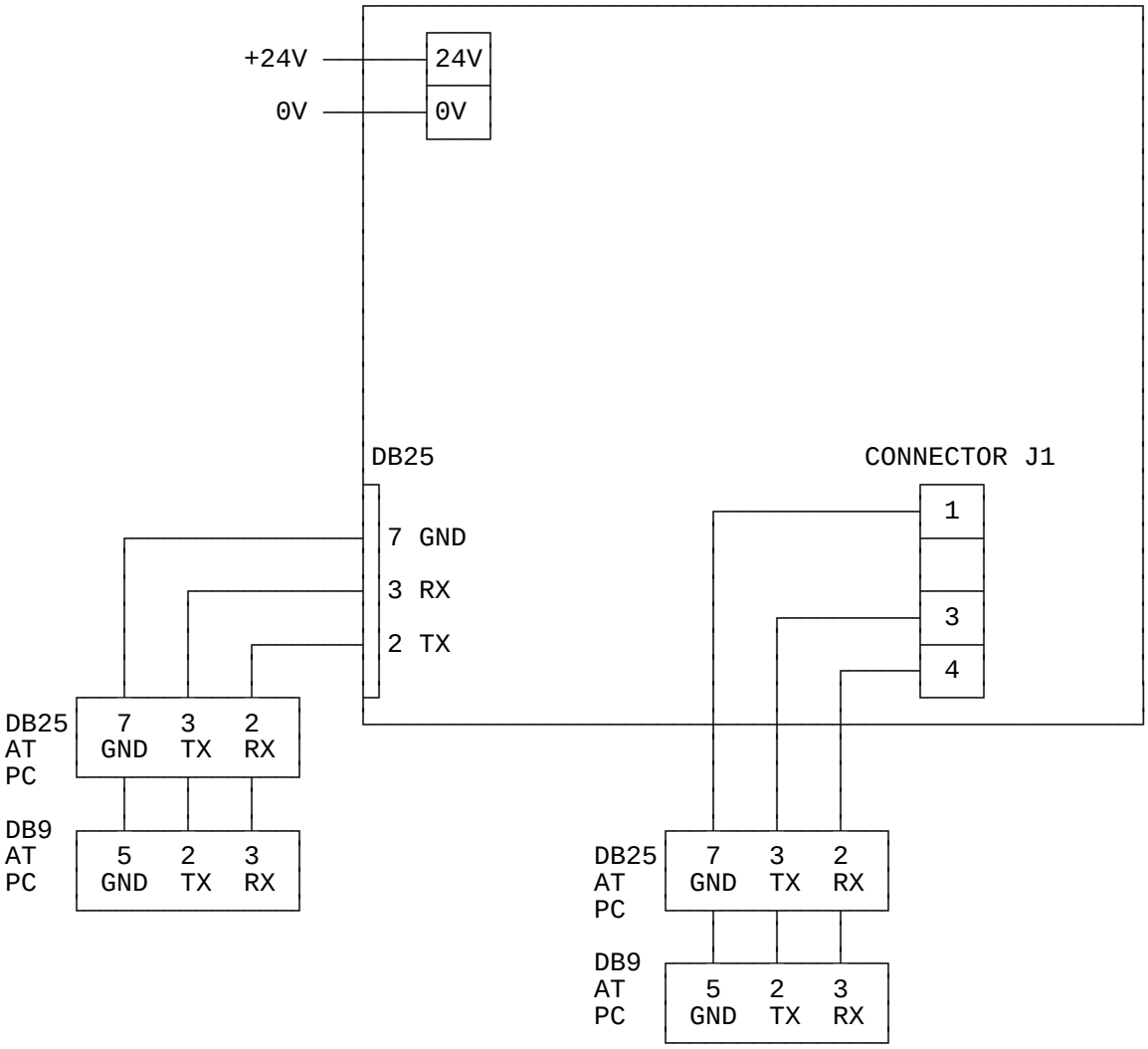


FIG 5.3
IO-NET PROGRAMMING MODULE TO PC WIRING

5.8 MODEM CONNECTION

Connection of the 1830-40-1 modem to the IO-NET Controller involves some special wiring between them. This is shown in Fig 5.4.

Refer to the 1830-40 Modem Technical Manual for setup and wiring of the 1830-40 Modem.

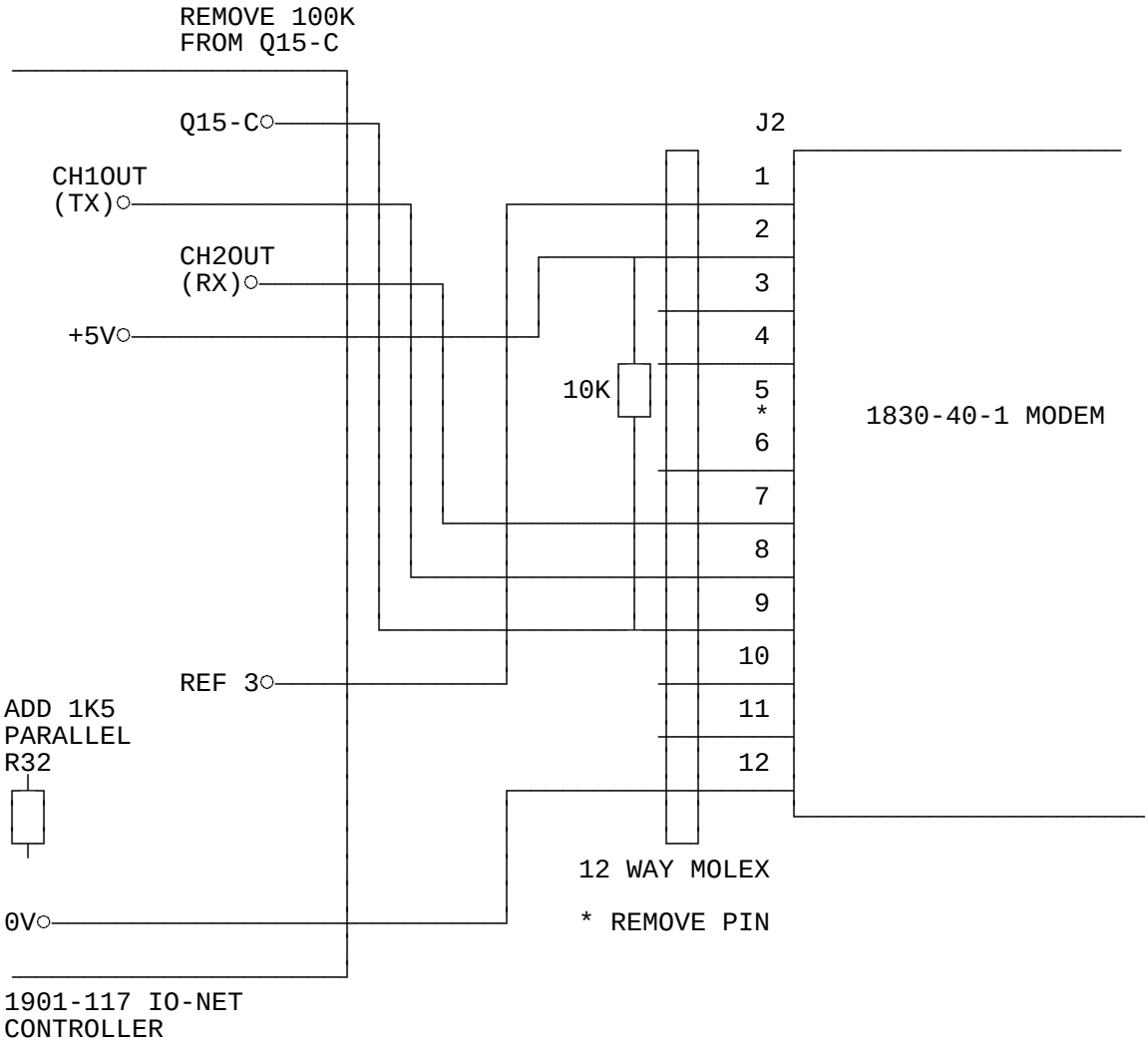


FIG 5.4
IO-NET CONTROLLER TO 1830-40-1 MODEM WIRING

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Chapter 6

NON-PROGRAMMED MODE OPERATION

6.1 OPERATION OF NON-PROGRAMMED MODE

An IO-NET Controller can operate either in programmed mode or non-programmed mode. Dipswitch I1 should be ON to select non-programmed mode. In programmed mode the outputs of the controller follow the logic equations of the user control program programmed into it.

In non-programmed mode the controller does not have a user control program programmed into it (or if it does it will ignore it).

In non-programmed mode the outputs of the controller (if any) are set according to the state of the inputs on its "Controller pair".

"Controller pair" is the controller with an adjacent address as follows. Addresses are arranged in pairs with 0, 1 being a pair, 2, 3 being a pair, etc, with the even address being the lower address.

If controller 0 is set to non-programmed mode then the outputs of controller 0 mimic the inputs of controller 1. Similarly if controller 1 is set to non-programmed mode, then the outputs of controller 1 mimic the inputs of controller 0.

It is not necessary to have both controllers in the pair set to non-programmed mode, ie. one of them could be set to programmed mode and one to non-programmed mode.

Also, it is not necessary to have both controllers in the pair present on the network. If a controller is set to non-programmed mode but does not have any output termination boards connected, then it is not necessary for its controller pair to be present in the system. Section 7.2.1 describes the operation of the status led in non-programmed mode. In non-programmed mode the controller is normally connected to the IO-NET network, but has no need to be connected to the F4000 RZDU network. If valid messages are not being received from the IO-NET network then the status led will give a single flash instead of a double flash.

A controller with no output termination boards would normally be set to non-programmed mode unless it is necessary to change some of the network parameters.

The outputs of a non-programmed mode controller follow the state of its pair's inputs as follows:

Input	Output
Open Circuit	off
Normal	off
Alarm	on
Short Circuit	on

OPERATION OF NON-PROGRAMMED MODE (CONTINUED)

A user control program can be written to duplicate the operation of non-programmed mode as follows (for a controller with address zero):

```
O1  = I1/1A   OR  I1/IS
O2  = I1/2A   OR  I1/2S
:       :           :
:       :           :
:       :           :
O32 = I1/32A  OR  I1/32S
```

In non-programmed mode (dipswitch I1 ON), dipswitch I2 selects one of two sets of default network parameters as follows:

Dipswitch I2 ON = modem mode (1200 baud)
Dipswitch I2 OFF = non-modem mode (2400 baud or higher)

In non-modem mode (I2 off), the default parameter settings are suitable of 2400 baud or higher.

The network parameters assigned for modem mode (I2 ON) are as follows:

```
LRTS = 24 ; LEADING RTS DELAY 25 MILLISECONDS
TURN = 0  ; TURN-AROUND DELAY 11 MILLISECONDS
LDFF = 1  ; ONE LEADING DUMMY FF CHARACTER
TRFF = 0  ; NO TRAILING FF
TRTS = 0  ; TRAILING RTS DELAY 0
TIGN = 37 ; END TX IGNORE PERIOD 40 MILLISECONDS
CTST = 30
CTCT = 30
IACT = 10
RTD1 = 12
RTD2 = 15
RTST = 11
NRRT = 3
TNRT = 6
SENR = 2
DRFT = 12
DRQT = 21
MXST = 31 ; MAX STATION = 31
```

Note that the maximum station is set to a value of 31.

OPERATION OF NON-PROGRAMMED MODE (CONTINUED)

The network parameters assigned for non-programmed mode, non-modem mode (I2 OFF) are:

```
LRTS = 0  ; LEADING RTS DELAY ZERO
TURN = 2  ; TURN-AROUND DELAY 2 MILLISECONDS
LDFF = 0
TRFF = 0
TRTS = 0  ; TRAILING RTS DELAY 0
TIGN = 2
CTST = 12
CTCT = 12
IACT = 4
RTD1 = 4
RTD2 = 5
RTST = 2
NRRT = 3
TNRT = 6
SENR = 2
DRFT = 6
DRQT = 12
MXST = 31 ; MAX STATION = 31
```

The above parameter settings are suitable for 2400, 4800 or 9600 baud.

If the default network parameters above are not suitable, then the controller should be run in programmed mode with the user control program specifying the desired network parameters and an appropriate control program to control the outputs.

Chapter 7

POWERING UP AN IO-NET CONTROLLER OR NETWORK

7.1 CONNECTING A NEW CONTROLLER

When a network of IO-NET Controllers is to be powered up the controllers may be powered up in any order as the network will automatically allow the addition of new controllers.

Similarly, the network will keep operating if an IO-NET Controller is powered down or disconnected from the network.

When a new controller is being added to a network the entire network does not have to be powered down. The network can be left running while the new controller is connected.

1. If connection to the network is required then connect the controller to the network data line via the screw terminal connections labelled CHNL1 OUT and CHNL2 OUT.

2. If the controller is to be connected to an F4000 system via the RZDU protocol data line then connect the pin labelled CH1 IN (Pin 6) to the RZDU data line using the RZDU F4000 RS232 interface board (refer Section 5.4).

3. Connect power via the screw terminals labelled 24V OUT and 0V OUT.

NOTE :- There are several versions of controller software in current use and these may be freely mixed on the same network. e.g. if some controllers are version 1.00 and some are version 2.01 the network will operate correctly without any compatibility problems. Of course, later versions of software have some additional features that earlier versions did not have. Refer to section 1.7 for software version information.

7.2 PROCEDURE AFTER POWER UP

7.2.1 STATUS LED

A red status led is located approximately in the centre of the IO-NET Controller PCB.

For both programmed and non-programmed modes during normal operation with no faults the status led will give a "double flash" every 2 seconds, ie. two blips, 100 milliseconds apart, every 2 seconds.

If either a "zone network fault" (RZDU protocol connection) or an IO-NET network fault is present the status led will give a single flash every 2 seconds.

A zone network fault can occur only in programmed mode and the possible causes are described in Section 3.3.3.6 with the ZNF operand.

An IO-NET network fault can occur as follows:

1. Non-programmed Mode.
   For non-programmed mode a network fault will occur if either the controller is not receiving valid messages from the network, or if it is receiving valid messages from the network but not input information from its controller pair at regular intervals AND it has at least one output board connected. If it has no output boards connected, then it does not require any input information from its controller pair, but it still requires to receive valid messages from the network.

2. Programmed Mode.
   In programmed mode the status led will give a single flash every 2 seconds if there is either an IO-NET network fault or a "zone network fault".

   A dipswitch is used (I2 - switch 5 on SW2) to select whether connection to the IO-NET network is required. If no connection to the IO-NET network is required then dipswitch I2 should be switched ON to prevent an IO-NET network fault from occurring. Dipswitch I2 should be switched OFF if connection to the IO-NET network is required.

   An IO-NET network fault will occur if connection to the network is required and either no valid messages are being received, or valid messages are being received, but input information is not being regularly received from all controllers whose inputs are included in the logic equations of this controller.

   The setting of dipswitch I2 affects only the status led. It does not affect the value returned by the INF parameter in a logic equation.

7.2.2 SELF TESTS ON START-UP

The controller performs some self tests on start-up and if any faults are found will indicate the fault by flashing the status led rapidly at a certain rate. The controller will then attempt to restart the program.

1. Internal EPROM/RAM CRC checksum fault.
   The status led flashes once per second for 8 seconds but the led is on for 800 milliseconds and off for 200 milliseconds each second ie. the on time is 4 times as long as the off time. If this fault occurs and does not clear itself the EPROM should be thrown away (but first check that the EPROM is installed correctly with no bent pins and no other problems such as a power supply fault).

2. Fault with shift register circuitry on controller PCB.
   At start-up a test is performed on the shift register circuitry. If a fault is found the status led will flash at a rate of 10 flashes per second, 10 milliseconds on, 90 milliseconds off, for a period of 5 seconds, before re-starting. If this fault occurs, check that the processor EPROM is installed correctly with no bent pins.

3. Fault with user control program.
   If the controller is operating in programmed mode, the EPROM contains a CRC checksum of the control program and this is checked on start-up. Also the controller checks for illegal instruction codes contained in the control program. Illegal instruction codes are not expected to occur and indicate a software bug either in the controller or in the PC compiler program.

   If either of these faults occur, then the status led will flash at a rate of five flashes every second for a period of ten seconds before restarting itself. The led will be on for 10 milliseconds and off for 190 milliseconds.

   If this fault occurs and does not clear itself, then check that the processor EPROM is installed correctly, etc. It may be possible to re-program the user control program into the EPROM and to try again or the EPROM may need to be thrown away and a new EPROM installed. If the problem still occurs with a new EPROM, then a copy of the user source file used and also the faulty EPROM should be returned to the manufacturer for evaluation.

7.2.3 VERIFICATION OF NETWORK OPERATION

If all controllers are connected and working correctly, they should all be giving a double flash on their status led every 2 seconds. A single flash every 2 seconds indicates a fault is present. It may be that the fault is not with the controller giving the single flash but with some other controller not transmitting data correctly.

Check that all controllers are set to the correct addresses and that no two controllers are at the same address.

After commissioning a new system or making any changes to a network, all controllers should be checked that they are giving a double flash on their status led.

Also, if possible, each controller should be checked that it operates its outputs correctly according to the logic of its control program.

7.3 NETWORK DIAGNOSTIC PROGRAM

A diagnostic program is available which can be run on a Personal Computer or Laptop to allow the monitoring of the messages being transmitted on an IO-NET network. There are two executable files supplied with the IO-NET compiler, IONETM1.EXE which uses serial port COM1, and IONETM2.EXE which uses serial port COM2.

The PC/laptop serial port can be connected to the IO-NET network as shown in Figure 7.3.1. Take care when connecting "earthed" computers or laptops as there could be an earth fault on the IO-NET cables.

Enter IONETM1 or IONETM2 to run the appropriate program.

When the program is first started the user is prompted to select the baud rate of the IO-NET Network to be monitored. Following this different commands may be selected with single keystrokes as follows:

M. Press M to display the menu of single keystroke commands.

Q. Press Q to exit and return to DOS.

Space Press SPACE to pause/resume the display of messages. While paused, any received messages are discarded.

H. Press H to hold display output - the display of messages will stop but, unlike the SPACE key, received messages are not discarded while the display is in hold mode. Press H to release from hold mode.

P. Press P to change the baud rate.

E. Press E to display and then clear a count of the number of messages that have been received with a crc error.

D. Press D at any time to stop or start the display of ALL messages received - when display of ALL messages is enabled, it overrides the selections for individual stations which are set with the S command. When display of ALL messages is turned off, messages will be displayed according to the S command.

S. Press S to select a station (0-255) to which the following commands A,C and V will apply.

- press A to toggle (enable or disable) the display of all messages received for station S. Enabling display of all messages will override the C & V settings.

- press C to toggle (enable or disable) display of messages for station S ONLY when the message is DIFFERENT to the last message received for station S.

Running the Network Diagnostic Program (Continued)

- press V to toggle (enable or disable) the display of messages for station S ONLY when the message contains point or zone data which is DIFFERENT from the last status received for those points or zones.

  The S and A,C,V commands can be used to get different combinations of messages for multiple stations displayed.

X,Y,Z,U The keys X,Y,Z and U are global commands that are applied to all stations as if the user had entered the A (enable), A (disable), C or V commands respectively for all stations (0-255). I.e.

- X - Enable displaying of all messages for all stations (= A enable).
- Y - Disable displaying of all messages for all stations (= A disable).
- Z - Enable displaying of messages for all stations ONLY when the message received is different to the last message received for that station (= C enable).
- U - Enable displaying of messages for all stations which have CHANGING point or zone data (= V enable).

The Y command is used to undo the settings of A,C,V,X,Z, and U. ie. it turns everything off. By combining these commands and the A, C and V commands for various stations, it is possible to select the configuration of messages displayed.

B. The B key can be used to select "byte mode" which displays every character received and does not check for valid messages.

The format of IO-NET messages is fully described in the IO-NET protocol manual, however, sufficient information is given here to determine which controller has sent the message; what the next controller in the token passing scheme is; the message control type; and the user message type and data if any. Messages are displayed starting with the byte count of the message and ending with the 2 CRC bytes of the message.

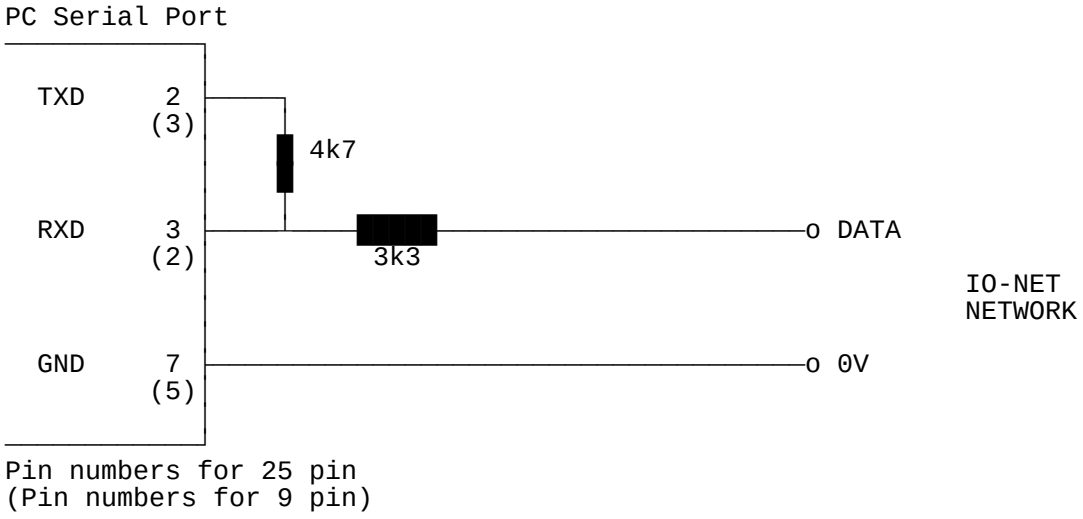
Byte 1 - count byte, number of bytes in the message, starting with the count byte but not including the 2 CRC bytes.

Byte 2 - Source Controller address

Byte 3 - Destination Controller address

Byte 4 - message control type
09 = token pass, 0A = broadcast, 05 = station entry are the most common messages received.

Byte 5 - user message type 01,02,03.
This byte and any following user data is optional.
Type 01,02 contain controller input status. The next 8 bytes contain the status of 32 inputs, with bit 0,1 of the first byte being point 0.
Type 03 = zone data, next byte is panel number.



PC TO IO-NET NETWORK CABLE
FIG 7.3.1

Chapter 8

DESIGNING AN IO-NET NETWORK

8.1 RECOMMENDATIONS FOR NETWORK DESIGN

When designing an IO-NET system, there are some simple rules which can be followed which help to make it more efficient.

It is not essential to follow these rules. A system will still work whatever the arrangement and assignment of station addresses, circuit inputs or zones. However, assigning controller addresses and circuit inputs sequentially can reduce the possibility of exceeding the RAM and EPROM storage space limitations in the controller (see Section 4.2 Compiling a User Source File) and make the network communication more efficient.

1. Assign the controller numbers (addresses) sequentially starting with 0 (zero) then 1, etc. This makes the network more efficient and can allow a faster data transfer rate between controllers on the network. It can also minimise the amount of RAM and EPROM storage space required in each controller by the user control program when operating in programmed mode (see Section 4.2 Compiling a User Source File).

2. Allocate inputs on each controller sequentially starting with input 1 then input 2, etc. This can help to minimise the amount of RAM and EPROM storage space required in each controller.

3. Set the value of the network parameter for maximum station number (MXST = nnn) in each source file control program to the number of the highest station address you are ever likely to connect to the network. Any station connected to the network with an address higher than this will not be given access to the network. Note that in non-programmed mode the default value for max station is 31.

   See Section 3.4 on network parameters.

4. An IO-NET Controller which does not have any outputs but has inputs only, and does not have an RZDU data connection, does not need to be run in programmed mode unless some of the network parameters require changing. The controller can be run in non-programmed mode (dipswitch I1 ON). (See Chapter 6 on Non-Programmed Mode).

5. If possible, allocate and access F4000 zones sequentially. Eg. using zones 1, 2, 3 say Z1:1N, Z1:2N, Z1:3N, is preferable to using zone 1, zone 100, zone 528, because accessing a wide range of zones can use up more space in the controller EPROM and RAM.

8.2 CONFIGURING THE F4000 FIP

An IO-NET Controller may be connected to Vigilant F3200 and F4000 Fire Indicator Panels (FIP) to access the state of zones - zone alarm, zone fault and zone isolate. The zone data is output from the FIP using the RZDU communications protocol which runs at 1200 baud. Some additional detail on the RZDU data connection is also given in section 3.4.3-3.4.6.

It is recommended that the version of F4000 FIP software be V1.36 or higher for NON-LCD fire panels, or be V2.06 or higher for LCD fire panels.

It is necessary to configure the F4000 FIP to ensure that it sends out all the necessary zone data on the RZDU port.

Some types of F4000 systems (those with a liquid crystal display) allow the programming of the RZDU protocol type. This is done with the RP command from the CS menu.

There are several different versions of F4000 systems in use, and the action required to configure the RZDU protocol link is not the same for all versions.

The following procedure, if followed step by step, will work for all versions.

Step 1 Use the ND (Number of Displays) command from the CS (Configure System) menu on the F4000 programmers terminal.

When prompted, enter the number of zone display boards which are in use on the F4000 system or just press RETURN to leave the value unchanged. The current setting of this value is probably already correct.

After entering a value for the Number of Display Boards, one of the following will occur:

A: You will be returned to the CS menu as there are no RZDUs programmed as connected.

Use the NR command in the CS menu to set the number of RZDUs to that which are actually connected, or if none are actually connected then set the value to 1 temporarily. Then return to the start of Step 1 and use the ND command again. This should now allow you to assign a value for the number of remote zone display boards (options B or C).

After completing Step 1, if there are no actual RZDUs connected, then use Step 2 to set the value back to zero.

CONFIGURING THE F4000 FIP (CONTINUED)

OR

B: You will be prompted to enter the "largest number of display boards at any RZDU".

The number of zones for which data is transmitted on the RZDU protocol link is dependent on this value. If there are any actual F4000 RZDU devices present, then the value entered here will need to be at least the "largest number of display boards at any RZDU" but may need to be higher depending on the highest numbered zone accessed in any IO-NET Controller.

The value entered should be the higher of the largest number of display boards at any RZDU or the highest zone number accessed by any IO-NET Controller, minus 1, divided by 16, plus 1. = $\frac{HZN-1}{16} + 1$

OR

C: You will be prompted to enter the number of the highest numbered zone displayable by any RZDU. You should enter the highest numbered zone accessed at any RZDU OR at any IO-NET Controller.

Step 2 If you set the number of RZDUs to 1 as part of Step 1 A then, use the NR command to set the number of RZDUs connected to zero if there are no actual RZDUs connected.

Step 3 If the RP command is available in the CS menu (type HE for help to check) then use it to select the type of RZDU protocol required.

IO-NET controllers with software version 1.01 or later may be programmed to operate with either version of the protocol.

If the CS menu does not have an RP command then the F4000 panel will always transmit old "non-LCD RZDU protocol". Refer to Section 3.4.3 for programming the RZDU protocol type into the IO-NET controller.

After configuring the F4000 system it is desirable, if possible, to check that the correct zone data is being sent to the IO-NET Controllers by creating a variety of conditions on the zones accessed by the controllers and testing the response of the controllers. The diagnostics facilities on an F4000 programmers terminal can be used to check what data is being sent on the RZDU data link.

CONFIGURING THE F4000 FIP (CONTINUED)

If the zone is an Ancillary Control Zone (which is used to control one or more relays) then

Zpp:nnnA	- TRUE if zone activated and not isolated
Zpp:nnnF	- TRUE if supervision fault on zone and not isolated
Zpp:nnnI	- TRUE if the zone is isolated.
Zpp:nnnN	- TRUE if none of the above.

8.3 CONFIGURING THE F3200 FIP

An IO-NET controller may alternatively be connected to an F3200 FIP which will transmit zone data in the same format as an F4000 FIP. The RZDU protocol type (LCD or NON-LCD) must be selected at the F3200 FIP using the keypad and program mode/system config/rzdu options in the menus - refer to the F3200 Installation & Programming Manual.

An F3200 panel will always transmit data for all of the zones and relays (total maximum of 64) that it has assigned. The first physical relay will be mapped to the first unused zone at the end of the alarm zones. For example, if there are three 8 zone and two 8 relay modules fitted then zones 1 to 24 correspond to the inputs and zones 25-40 correspond to the relay outputs.

The state of a relay can be accessed with

```
Zpp:nnnA    - TRUE if relay activated and not isolated
Zpp:nnnF    - TRUE if supervision fault on relay and not isolated
Zpp:nnnI    - TRUE if the relay is isolated.
Zpp:nnnN    - TRUE if none of the above.
```

8.4 SYSTEM RESPONSE AND TIMING

The information given here may be used to estimate the time delay that will occur from the time of an input changing state to the new state of that input being received and used at another controller. The delay is affected by

1. the baud rate of the network
2. the number of stations on the network
3. the number of fire panels for which data is being transmitted onto the network.
4. the activity level on the network
5. the error/retry rate of the network
6. the number of gaps between adjacent station addresses - the more gaps then the more time is taken up doing station entry messages. For example, a configuration with stations 0,1,2,3,4 is more efficient than 0,3,6,8,9.

8.4.1 Network Transmit Delay

The average and approximate maximum delay before a controller has an opportunity to transmit on the network can be estimated from the information here.
Under normal operation each controller in turn will transmit onto the network and the maximum time a station has to wait before being able to transmit is the sum of the maximum time each individual station takes.

When each controller transmits, it will transmit one of the following:

1. no status data - it just passes the "token" on - this is an 8 byte message - this includes the 2 byte header FF 02.

2. one or more messages of fire panel zone status data AND/OR a message containing the status of all of its 32 inputs.
   The message containing the status of its 32 inputs is a 17 byte message.
   Each message containing zone data is a maximum of 22 bytes and a controller may transmit more than one zone data message if it has more zone data to send then will fit into a single message. The transmission time to add on for zone status messages is given further below.

A controller does not normally transmit the status of its own inputs each time it transmits on the network. The network parameter DRFT has a default rate of every 6 seconds for this. A controller will transmit the status of its own inputs whenever it has a change of state to send, and also, if any one controller whose input status is needed by other controllers is actually "off the air" and not responding, then, every few seconds in one scan EVERY controller will transmit the status of its inputs (ie. this only happens in a fault condition).

Network Transmit Delay (Continued)

Hence each station may or may not transmit the status of its own inputs each time it transmits. For each baud rate, the data below gives a value at the end to add on if any zone data is being transmitted on the network. These figures assume mostly contiguous station addresses and little or no errors/retries - which is normal.

2400 baud rate.

Transmit time per station when no input status data sent = 40 millisecs

Transmit time per station when status data sent = 80 millisecs

For 25 stations, maximum delay before station transmits = 2 seconds (worst case 25 times 80 msecs) - this is the maximum "scan time" of the network (plus zone status transmit time to be added) and assumes all stations transmit input status data.

For 25 stations, typical delay before transmitting = 0 to 1.2 seconds ie. average of 0.6 seconds. This assumes that an average of 4 stations per scan transmit input status data.

If zone data is being transmitted on the network then, every 2 seconds, there is an additional amount of transmit time taken up on the network as follows.

1. For EACH F3200 panel for which zone data is being transmitted on the network - add 200 millisecs (2 messages containing the status of 32 zones every 2 seconds). This value is the same regardless of whether zone changes of state occur.

2. For EACH F4000 panel for which zone data is being transmitted on the network - add 100 millisecs (1 message containing the status of 16 zones every 2 seconds) - this is the rate for zone status refresh - OR, if multiple changes of state occur on zones, this value can be a maximum of 280 millisecs (requiring 3 messages of zone data sent on the network every 2 seconds).

4800 baud rate

For 4800 baud the data rate is twice as fast so the transmit times and delays are (approximately) half the figures given for 2400 baud above eg. for 25 stations, the maximum delay before transmitting is 1 second and the typical delay is 0.3 seconds. If zone status is being transmitted the time taken up every 2 seconds is 100 msecs for each F3200 panel and 50 millisecs for each F4000 panel.

Network Transmit Delay (Continued)

9600 baud rate

9600 baud is twice as fast as 4800 baud so the figures for this are half again eg. for 25 stations the maximum delay is 0.5 seconds and the typical delay is 150 millisecs.

1200 baud rate

The times for this are twice the 2400 baud rate figures.

1200 baud with modems

The figures given here assume that the default network parameters supplied in the file NETPRMV3.12M are being used.

Transmit time per station when no input status data sent = 120 millisecs

Transmit time per station when status data sent = 190 millisecs

For 25 stations, maximum delay before station transmits = 4.75 seconds (worst case 25 times 190 msecs) - this is the maximum "scan time" of the network (plus zone status transmit time to be added) and assumes all stations transmit input status data.

For 25 stations, typical delay before transmitting = 0 to 3.42 seconds ie. average of 1.7 seconds. This assumes that an average of 6 stations per scan transmit input status data.

If zone data is being transmitted on the network then, every 2 seconds, there is an additional amount of transmit time taken up on the network as follows.

1. For EACH F3200 panel for which zone data is being transmitted on the network - add 520 millisecs (2 messages containing the status of 32 zones every 2 seconds). This value is the same regardless of whether zone changes of state occur.

2. For EACH F4000 panel for which zone data is being transmitted on the network - add 260 millisecs (1 message containing the status of 16 zones every 2 seconds) - this is the rate for zone status refresh - OR, if multiple changes of state occur on zones, this value can be a maximum of 730 millisecs (requiring 3 messages of zone data sent on the network every 2 seconds).

NOTE - for a network using 1200 baud modems the transmission of zone data takes up a significant amount of time on the network and if a controller does not get an opportunity to transmit often enough, it may have to continually discard some of the zone status data that it receives from its RZDU input - which could result in the status of some zones NEVER being transmitted on the network. Refer to section 3.4.6 for further information.

8.4.2 Controller Status Input Scan Rate

The IO-NET controller reads the status of all 32 of its inputs every 300 milliseconds and any change of state which occurs must be present for two consecutive scans before being accepted as the new state of the input. Hence there is a maximum delay of 600 millisecs before the status of the input changes, and a minimum of 300 msecs. After the status changes there is a further delay before the new status is processed by the control program running in that controller (see section 8.4.3 below) and a delay before the new status is transmitted onto the network for other controllers to use as described in section 8.4.1 above.

8.4.3 Controller Output Logic Execution Time

In non-programmed mode there is no output logic execution delay and the status of an output is physically updated within 10 milliseconds of the required input status being received from the network.

In programmed mode, the IO-NET controller continually and repeatedly executes the output logic programmed into it. The time to execute one pass of all equations is dependent on the number and size of equations and also partly dependent on baud rate of the network and the rate of arrival of status data from other controllers - the faster the network baud rate, the slower the execution time of the output logic (because of higher interrupt and message processing overheads).

A VERY ROUGH estimate of 1 millisecond per "operand" accessed in the control program can be used. For example, a moderate to large program accessing 200 operands would take about 200 milliseconds to complete one pass of all equations. An operand consists of eg. Z1:5A or I1/32S or V12 etc. For example, the equation O32 = Z3:120A OR Z3:121A would be counted as accessing 2 operands.

The physical state of the 32 outputs is updated at the completion of every pass through the entire output logic and also exactly every 100 milliseconds so this can add to the delay that can occur.

8.4.4 Delay From Input Change Of State To Output COS

The network transmit delay, the input status scan rate and the output logic execution time all affect the delay which can occur from the time an input point physically changes to the time of a physical change on any output using that input status. For example, the maximum delay from an input changing state to an output on a different controller using that input state is the sum of

600 millisecs (input scan delay max)
plus network delay max 500 msecs (9600 baud, 25 stations)
plus 300 millisec output logic execution delay

giving a total max delay of 1.4 seconds to the physical output changing on another controller. The actual delay would range from about 0.5 seconds up to 1.4 seconds. For an output and input on the same controller don't include the network delay.

8.4.5 Delay From Zone Change Of State To Output COS

If the state of the zone is being received via the IO-NET network rather than directly from the local RZDU input then the network delay described in section 8.4.1 above must be added to the time given here.

An F4000 or F3200 fire panel transmits exactly one message of zone status exactly every 2 seconds, plus there is also a 500 msec (max) delay for the transmit time of the RZDU message. Also, for an "LCD" type protocol (refer section 3.4.5 RZDP parameter) FFCIF zone alarm events are transmitted ahead of zone status so there can be an additional delay of 2,4,6... seconds for 2,4,6 ... FFCIF zone alarm events. Assuming no FFCIF zone alarm event delay then the delay is 2.5 seconds (max) before the status is received in the controller via its RZDU connection, plus 300 millisec output logic execution delay before the physical output changes giving a total delay of 2.8 seconds.

If the state of the zone is being received via the IO-NET network rather than directly from the local RZDU input then the network delay described in section 8.4.1 above must be added to the time given here. Eg. add 0.5 seconds for a 9600 baud/25 station network.

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