JTL SYSTEMS LIMITED

EVAPORATOR CONTROLLER MANUAL

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INTRODUCTION

JTL Systems manufacture a comprehensive range of controllers and monitors for refrigeration evaporators. This manual covers the principles of operation of all these units. The different products incorporate some or all of these functions. For details of the individual products, see the user guides and item number sheets for the product.

The JTL electronic alarm, monitoring and control units can all be interrogated by a plug-in maintenance unit which displays data selected by the operator.

The maintenance unit is essential for commissioning the controllers and subsequently making adjustments to the operating data within the controllers.

The data that can be displayed and adjusted varies with the type of controller and in some cases with the firmware version of the controller. Each item of data is referred to by an item number which is in the range 0 to 999.

Throughout this manual where detailed reference is made to various data item numbers, they are shown thus: (item n). In each case "n" refers to the item number on the maintenance unit which will display the particular data.

The JTL controllers and monitors are compatible and connect to a central JTL network controller.

When a modem is used to connect the network controller to the public telephone network, the current and historic working status of the controllers, monitors and other associated equipment can be accessed from remote locations using a personal computer and JTL Systems software.

Note:
Where the item numbers are referred to, they are for the commonly used products. Some specialised products may use other item numbers for the function specified. Always refer to the item number or user guides for the product.

1. CONTROLLER FUNCTION

1.1 CONTROL

The evaporator controllers can control some or all the functions associated with the refrigeration evaporators. These include control of

a) Liquid Solenoid valves
b) Pulsed expansion valves
c) Suction valves
d) Defrost heaters
e) Defrost termination valves
f) Fans
g) Trim heater
h) Lights

1.2 MONITORING

The controllers can monitor the following:

a) Air Temperatures
b) Evaporator temperatures
c) Refrigerant pressure
d) Door switches
e) Defrost signals

2. CONTROLLER DESCRIPTION

2.1 CONTROLLER FEATURES

Each evaporator is generally fitted with its own controller. This controller has its own microprocessor and is capable of operating either totally independently or as part of an integrated system. The controllers have some or all of the following features:

a) Temperature conversion circuits
b) Pressure conversion circuits
c) Display driving circuits
d) Relay outputs
e) Contact inputs
f) Default data set-up switches
g) Battery backed real time clock
h) Rechargeable battery and charging circuit

All controllers contain:

a) Microprocessor, program and working memory
b) maintenance unit interface
c) Remote communications interface
d) Data logging memory
e) Non-volatile set-up data memory
f) Watchdog to ensure reliable operation

2.2 DIGITAL DISPLAY

All controllers and some monitors support a digital display as an optional accessory. The display will normally display the operating temperature and operating status, such as defrost, and is used in an alphanumeric mode to display limited text messages and graphics which indicate the alarm or operating status if necessary.

The temperature on the display can be set to display Celsius or Fahrenheit (item 122).

3. TEMPERATURE & PRESSURE MONITORING

3.1 Temperature Sensors

Temperature measurement is undertaken using temperature sensors mounted in the air on and off the evaporator and on the evaporator itself. Typically there are up to 4 sensors. These are assigned as follows:

1)	Air temperature on the evaporator	(item 21)
2)	Air temperature off evaporator	(item 22)
3)	Evaporating temperature	(item 23)
4)	Suction line temperature	(item 24)

In addition there may be additional sensors for the purposes such as:

5)	Termination temperature	(item 141)
6)	Energy saving temperature	(item 131)

3.2 Temperature Sensor Selection

The sensors used can be selected using the maintenance unit (items 36-39, 147 and 130). Any of the sensors may be selected or deselected as required.

If a sensor is deselected, then control is transferred, where possible, to other sensors, and any fault alarm for that sensor is cancelled.

If all sensors are deselected then an "all temperature sensors faulty" alarm is given.

3.3 Estimated Cabinet Temperature (Display Cabinets Only)

The air temperature in a refrigerated display cabinet, where the refrigerated product is located, cannot be directly measured, so it is estimated by taking a combination of the air on and air off temperatures.

The estimated cabinet temperature is computed by the formula:

Cabinet = Air off + (Ratio x (air on - air off))/100

Ratio is a factor which can vary. For example, if the ratio is 66, the air on temperature is -20 C and the air off is -30 C. The cabinet temperature is calculated thus:

Cabinet temp = -30 + (66 x (10))/100
= -30 + 6.6
= -23.4 C

The ratio (item 33) is a factor which can be set by the Engineer using the maintenance unit.

3.4 Coldstore Temperature

This is always taken as the air on (or return) temperature.

3.5 Suction Pressure Transducer

On controllers that are suitable for pulsed expansion valve control there is a facility to measure the evaporator suction pressure (item 155). This can be used with the suction line temperature (item 24) to calculate the superheat (item 156).

3.6 Suction Pressure Transducer Selection

The pressure transducer can be selected using the maintenance unit (item 161).

4. TEMPERATURE CONTROL

4.1 Temperature Control

The evaporating temperature is controlled to achieve the desired air temperature in the display cabinet or coldroom. The temperature at which the evaporator is controlled varies according to the conditions at the time.

To achieve the desired cabinet or coldstore air temperature, it is the temperature of the air off the evaporator that is controlled. This is done in the following manner:

There are two air temperature setpoints. These are the cabinet or coldstore air temperature (item 30), which is set up the refrigeration engineer, and the air off setpoint (item 28). On display cabinets the initial value of this setpoint is set by the refrigeration engineer (item 31). On coldstores the initial value is related to the coldstore air temperature setpoint. The air off setpoint is then automatically calculated by the controller.

4.2 Liquid Solenoid Valve Control

The evaporator temperature is adjusted by energising or de-energising the liquid supply solenoid valve as required. The liquid solenoid valve is opened when the air off temperature is 0.2 Celsius above the air off setpoint, and closed when the temperature is 0.2 Celsius below the setpoint. Between these 2 levels the valve is left in whatever state it was in previously. This deadband is adjustable on some JTL controllers (item 140).

When the evaporator controller is first switched on, the computed air off setpoint (item 28) is set to the initial value. It will remain at this value until the cabinet or coldstore air temperature goes below the setpoint (item 30). When this occurs, the computed air off setpoint is automatically raised to prevent the air temperature going too low.

To prevent the air temperature becoming unstable, the calculated air off setpoint is raised slowly. If the cabinet or coldstore air temperature goes above its setpoint, the air off temperature setpoint is lowered. The rate at which the air off setpoint is raised and lowered varies according to the temperature. For larger errors the setpoint is changed faster.

The air off setpoint can only vary between its initial set value (item 31) and 4 Celsius higher than the cabinet air temperature setpoint (item 30).

4.3 Pulsed Expansion Valve Control

The evaporator temperature is adjusted by increasing or decreasing the amount of time that the expansion valve is open.

4.3.1 Normal Control

Under normal conditions as the air off temperature rises, the valve is opened a little and as the air off temperature falls the valve is closed a little. The opening of the valve (item 168) is controlled by a 2 term "PI" method relating the air off temperature to its setpoint. There is a proportional gain adjustment (item 170) and integral time constant (item 171). The gain and time constant can be adjusted to change the reaction to the air temperature changes.

4.3.2 Override Control

It is not always possible to maintain the operation of the expansion valve using the PI controller. This is because the evaporator performance is affected by external influences. It is possible to "overdrive" the PEV and flood the evaporator. When this occurs a low superheat is observed on the exit of the evaporator. When this low superheat is detected by the controller a different control strategy is implemented. This is called "OVERRIDE". Override is entered when the measured superheat (item 156) falls below the minimum superheat level (item 162). During override the drive to the PEV is reduced progressively until the minimum opening (item 164) occurs.

4.3.3 Override Modification

The override sequence ends when the superheat rises above the minimum setpoint. At this time, the time since the previous override and other previous overrides are taken into account. If there have been a number of recent overrides the output to the expansion valve is "modified" by a percentage value (item 190). After a succession of frequent "overrides" the drive to the valve will be reduced to a low level. The effect of this should be to stop overdriving the valve and prevent further overrides.

Subsequently if the set temperature is not achieved, the modifier output is allowed to increase at a controllable rate.

4.4 Coldroom Door Functions

On coldstore evaporator controllers the coldroom door can be monitored using a door switch. When the door is opened refrigeration is turned off by closing the liquid solenoid and Pulsed Expansion Valves. The fans are also turned off. Refrigeration is reinstated either when the door is closed or after an adjustable time delay (item 64). The input signal from the door switch is delayed to prevent manual operation of the switch by the coldstore operating personnel.

The door functions can be disabled using item 128.

5. DEFROST CONTROL

5.1 Defrost Initiation

There are six methods of defrost initiation which are supported by JTL evaporator controllers and monitors. The controllers support some or all of these methods:

a) Sensed defrost
b) Externally initiated defrost
c) Self timed defrost
d) Network initiated defrost
e) Co-ordinated defrost
f) JTL PREDICT defrost

The choice of defrost method is selected by the maintenance unit (items 45 or 107).

5.1.1 Sensed Defrost

Defrost is by hot or cool gas. The time sequence is controlled remotely at the compressor pack on a system basis.

The evaporator controller detects when the evaporator is on defrost by measuring the suction line temperature. When defrost gas is passed down the suction line in the opposite direction to the normal refrigerant flow, the temperature of the suction line rises. The suction line temperature is constantly compared with a setpoint in the controller (item 58). When the temperature goes above this value continuously for more than 30 seconds, the controller enters its defrost mode.

If the suction line temperature sensor is faulty or deselected, the controller will use the evaporator temperature sensor for defrost initiation, provided it is not faulty or deselected. If neither sensor is in operation, the controller will not enter the defrost cycle.

5.1.2 Externally Initiated Defrost

In this method the start of the defrost is signalled to the controller by a volt free contact or an optically isolated voltage input depending on the product type.

5.1.3 Self Timed Defrost

In this method the controller uses a built in battery supported real time clock and programmable schedule of up to 6 individual defrost times. The schedule (items 51-56) and the Clock (item 2) can be programmed by the maintenance unit. The schedule can be set for 12 or 24 hour operation (item 60). If set for 12 hours this effectively allows 12 defrosts a day to be programmed.

5.1.4 Network Initiated Defrost

In this method the defrost in initiated by a command in the JTL network. This command originates at the defrost scheduler, which may be a JTL compressor pack controller or a separate scheduler, and is passed to the evaporator via the JTL network controller. The network controller command status is visible on the JTL maintenance unit (item 46).

The controller is continually "learning" the defrost sequence for the previous 24 hours. If the network communicator fails the controller will revert to the learned defrost schedule. If the communications to the defrost scheduler fail then the evaporator will revert to the learned schedule.

For further details of the complete operation of the network initiation Scheme see Appendices 1 - 2.

For network initiated defrost to work the unit numbers must be set correctly (see Appendix - JTL Unit Numbering).

5.1.5 Co-ordinated Defrost

Co-ordinated defrost requires a JTL defrost coordinator to be present on the network. Each evaporator is programmed with a number of defrosts a day required (item 69). Once the time between defrosts has expired the evaporator controller sends a signal via the JTL network that a defrost is required together with priority information (item 223).

The coordinator schedules the defrost taking into account other factors such as other evaporators that are on defrost.

The initiation action is sent via the network as the standard network initiated sequence in 5.1.4 above.

5.1.6 JTL PREDICT Defrost

JTL PREDICT defrost requires a JTL PREDICT defrost co-ordinator to be present on the network. The patented PREDICT strategy on the evaporator controller works out from the refrigeration liquid flow, that a defrost is required in the near future. This requirement is sent via the JTL network to the PREDICT defrost coordinator together with priority information (item 223).

The PREDICT strategy requires the minimum and maximum time between defrosts to be specified (items 225 & 226). The PREDICT co-ordinator schedules the defrost as the co-ordinated defrost in 5.1.5 above.

5.2 Network Initiation Backup Strategies

There are two methods of backup for network initiated defrost. The choice is made when selecting the defrost initiation method (item 107). If network communication fails, the selected backup strategy is automatically used. The unit reverts to network control whenever the network communications is operational.

The backup strategy is also invoked if the network signals that communications has failed to the defrost scheduler or if there is a fault at the defrost scheduler.

5.2.1 Real Time Initiated Backup

This is applicable to all three network initiated defrost strategies. For real time backup the defrost schedule as set up for real time defrost on items 51-56 is used.

5.2.2 Learned Defrost Backup

This is applicable to standard network initiated and co-ordinated defrost strategies. For learned backup the last 24 hours defrost operation is continuously monitored and the defrost schedule is learned.

5.3 Pump Down Cycle

After defrost is initiated there may be a pump down cycle of fixed or adjustable duration (item 61) prior to the main defrost sequence. During this time refrigeration is terminated but the main defrost heating is not applied.

5.4 Defrost

There are 2 variations of the defrost cycle:

a) Control
b) Termination

This maintenance unit is used to select the appropriate method (item 75). When "control" is selected the main defrost output is energised during defrost. This can be used to drive a gas valve or electric heater contactor as required.

When "termination" is selected the output is not energised during the defrost phase, it energized on defrost termination i.e. after defrost. This is normally used with 2 pipe gas defrost arrangements to stop the reverse gas cycle.

5.5 Defrost Termination

Defrost can be terminated using the air off, evaporator or separate temperature sensor. It can also be terminated on time.

Generally on display cabinets the air off temperature is used and on coldstores the evaporator temperature is used. On some products the termination temperature is selectable (item 144).

During defrost, the termination temperature is constantly compared with the termination temperature setpoint (item 50). When the termination temperature goes above this value continuously for more than 30 seconds, the controller ends the defrost.

If the air off temperature sensor is selected for termination and is faulty or deselected, the controller may use the evaporator temperature sensor for defrost termination, provided it is not faulty or deselected and vice versa. If neither sensor is in operation, the controller will not end the defrost cycle on termination temperature.

If the duration of the defrost reaches the maximum defrost time (item 57), the defrost is terminated. On suction initiated defrost, the defrost mode is also terminated, if the suction line temperature falls continuously, for more than 30 seconds, to 5 Celsius below the defrost initiation temperature (item 58).

On network initiated defrost, the defrost is also terminated when the network command is removed.

A minimum defrost time can also be specified (item 145) if the termination temperature is reached before the minimum defrost duration has occurred then the defrost output is cycled off. There is a 5 degree Celsius deadband control on this output function.

5.6 Drain Down

The defrost period is followed by a "drain down" period prior to reapplication of refrigeration. The length of the drain down period is adjustable (item 59).

During drain down auxiliary heaters such as drain heaters are kept energised, but the main defrost heater is deenergised.

5.7 Liquid Hold Off

There can be a further period after the drain down period when the refrigeration is held off, but all heaters are also turned off. This liquid hold off time is adjustable (item 49). The liquid hold off time period does not start until all commands have been removed i.e. while the network or external defrost commands are present, even though the defrost and drain down periods have terminated the liquid hold off period timer remains preset. Only when these commands are removed does the liquid hold off time start.

At the end of liquid hold off refrigeration resumes.

5.8 Defrost Recovery

Liquid hold off is followed by the defrost recovery period. Defrost recovery lasts for a maximum of 20 minutes plus any surplus time left over due to the defrost terminating in less than the maximum defrost period(item 57).

The recovery period is terminated when the air temperature is back to normal. Normal temperature being when the air temperature error is less than half of the temperature error that would cause an air temperature alarm (see alarms).

After defrost recovery, the controller returns to normal refrigeration mode.

5.9 Forcing Defrost or Refrigeration

The maintenance unit can be used to force the controller into permanent defrost refrigeration mode, for test or servicing purposes.

Setting forced defrost (item 77) will switch off the liquid solenoid valve and keep the defrost valve open regardless of the air off termination temperature. This action is permanent while the maintenance unit is plugged in. When the controller is set for one of the network initiated strategies the forcing function is actioned by the defrost scheduler. There is therefore a delay before the defrost is actioned. All units on the same "system" will thus go on defrost together.

Setting inhibit defrost (item 78) will prevent a normal defrost while the forcing function remains set.

Setting forced refrigeration (item 79) will force the evaporator to refrigerate regardless of the temperature or defrost control.

For network defrost initiation the forced defrost function is different in that when item 77 is operated the controller will send the command to the network controller to put the system on defrost.

If communications to the network fail then item 77 will force the defrost directly at the evaporator in the same way as the other defrost strategies are selected.

5.10 Defrost Inhibit Period

After a suction initiated defrost, the controller is prevented from entering defrost mode for a further period, generally 3 hours.

5.11 Defrost Gas Valve Operation

In defrost termination mode the defrost output is deenergised during drain down, liquid hold off and defrost recovery.

In addition to the normal defrost sequence, the termination temperature is always compared with the termination temperature setpoint (item 57). If at any time the termination temperature goes above the termination temperature continuously for more than 30 seconds, the defrost output is energized, regardless of the defrost cycle status. In this mode the output will stay energized until the termination temperature falls to 5 Celsius below the termination temperature setpoint. This operation is to ensure that a 2 pipe gas defrost sequence will terminate when used in suction initiated mode even though the defrost is not detected.

5.12 Defrost Information

The duration of the last defrost (item 40) and the time since the end of the last defrost (item 41) is recorded for access by the refrigeration Engineer as required.

5.13 Power on Condition

On suction initiated defrost for 30 minutes after power up the controller cannot detect a defrost until the suction temperature falls below the defrost initiation temperature for at least 30 seconds.

5.14 Evaporator Fan Control

The fans can be controlled in various ways.

If item 108 is set to "fans off during defrost" then during defrost recovery the fans can be controlled depending on the evaporator temperature or time delay after defrost. If item 109 is set to 00:00 when the evaporator temperature is low enough, the fans start. There is a 5 degree deadband. If item 109 is set to a time then the fans are held off until the time delay has occurred.

If item 108 is set to "fan control during defrost"; the fans are turned off during defrost when the evaporating temperature goes above the setting on item 146. After defrost the fans are turned on when the evaporating temperature falls below the setting on item 150 or the time delay on item 109, if it is not set to 00:00.

If energy saving is selected using item 130, then the fans will be cycled during normal refrigeration. When the energy saving temperature, item 131, goes below the energy saving setpoint, item 132, the fans stop. There is a deadband of ±0.5°C.

6. LIGHTING CONTROL

6.1 Cabinet Lights

The display cabinet lights can be controlled by command from the JTL communications network. A JTL time scheduler connected to the network can initiate the "Lights off" command to the display cabinet.

The network command sent by the network controller is visible on the maintenance unit (item 111).

For further details of the operation of the lighting control see Appendix - JTL Unit Numbering).

6.2 Night Blinds

The lighting output can also be used to sequence the light blinds when fitted.

6.3 Lighting and Blind Override

When the controller is used in conjunction with the appropriate JTL display unit the lights off/blinds down operation can be manually overriden by operating the appropriate switch on the display. Alternatively a keyswitch can be fitted on the display cabinet to override the lights and blind control function.

The lights are switched off when the cabinet is shutdown electronically if item 119 is set on.

7. ALARMS & DATALOGGING

7.1 Temperature Alarms

The estimated cabinet air temperature (item 20) or the coldstore air temperature (item 21) is constantly monitored and compared with the setpoint (item 30). The difference or error is then averaged over time. The average error (item 26) is compared with the temperature alarm tolerance item (32). If the average error is such that, over an adjustable period (item 47), the average error exceeds the set tolerance and the current temperature error exceeds the set tolerance, then an alarm is given.

The alarm is cancelled when either the temperature error or the average temperature error falls below three-quarters of the set tolerance.

This arrangement gives a rapid alarm if air is drastically over temperature. However, when it is not performing quite to specification, an alarm can also be given, but less rapidly. This minimises spurious and marginal alarms.

On display cabinets the air off temperature (item 22) is also monitored in the same way. The average air off temperature error (item 27) is compared with the air off alarm tolerance (item 34).

If the alarm tolerance is set to zero (0.0) then the alarm function is disabled.

On display cabinets during defrost and defrost recovery, the alarms are cancelled and the average temperature errors set to zero.

On coldstores, the temperature alarms can be enabled or disabled during defrost and recovery using item 127.

On coldstores during defrost and defrost recovery, the alarm can be cancelled and the average temperature errors set to zero by using item 127.

7.2 Temperature Sensor Faults

The temperature sensors are thermistors. The thermistors and the thermistor power supply are constantly monitored, and if a fault is detected in a selected sensor, an alarm is given.

In the event of a fault being detected in a sensor, or the sensor being deselected, the software transfers control to the remaining sensors as best it can. For example, if the air on temperature sensor fails, control is passed to the air off temperature sensor. If both air temperature sensors fail, control will be done using the evaporator temperature sensor and so on.

In the extreme case of all sensors being registered faulty, then the outputs are set to refrigeration.

If all sensors are faulty or deselected, then an "all temperature sensors faulty" alarm is given.

7.3 Coldstore Door Monitoring

Door monitoring on coldstores can be enabled or disabled (item 128). On coldstore controllers the door position is detected by a limit or proximity switch. If the door is open for more than a set time period (item 33) an alarm is given.

Information is also available on the door open times. Item 34 gives the time the door has currently been open and item 35 gives the total time the door has been open in the last 24 hours.

This alarm can be specified as critical or non-critical (item 126).

7.4 Alarm and Status Display

Alarms and Status are indicated on the temperature display. The messages that are displayed are:

i)	Ht	High temperature alarm (1st priority)
ii)	door	Door open alarm (2nd priority)
iii)	DEF	Defrost
iv)	DEFr	Defrost recovery
v)	t.SEn	All temperature sensors faulty

The high temperature and door open alarm messages are flashed alternately with the temperature or defrost indication. In the event of there being more than one alarm the highest priority alarm is displayed.

7.5 Data Logging

When JTL network communications are operational, data logging is provided as a standard feature. The choice and number of temperatures logged is preset in the software.

On coldstores the data logged are:

a) coldstore temperature (air on)
b) air off temperature
c) evaporator temperature
d) suction line temperature

On display cabinets the data logged:

a) cabinet temperature
b) evaporator temperature
c) superheat

The log capacity is up to 1000 temperatures for each logged value.

Data are logged continuously on the basis of 'first in first out', i.e. when the data buffer is full, each time a new set of data is logged, the oldest set is discarded. This means that at any time a full set of historic data is always available from the controller.

The logging interval is adjustable from 1 to 60 mins. (adjustment via network only).

When battery back up is fitted the logged data is maintained by the battery during power down. On power up the log is checked and adjusted to show the correct power down interval as no data can be collected during power down.

If on power up the log data are found to be corrupt, the log is erased.

8. SERVICE & COMMISSIONING

8.1 Maintenance Unit

Local interrogation and adjustment of controllers is made using a hand-held maintenance unit, which plugs into a socket on the controller.

The following sections require use of the maintenance unit. For full details on operation of the maintenance unit see the relevant chapter of the manual.

8.2 Forcing Functions

It is possible on most JTL controllers to force the controller into conditions that would not be the normal operating state. This is done using the maintenance unit.

For example, on a display cabinet controller type EC, setting item 77 to '1' will give a forced defrost. This function shuts the liquid solenoid valve and leaves the gas defrost open, regardless of temperature.

Forced functions are maintained for 30 minutes after the maintenance unit is unplugged, but after that time the forced functions are automatically cancelled. If at any time during the 30 minutes the maintenance unit is plugged back into the controller, the time delay is reset to 30 minutes until it is again plugged.

For full details of the forcing functions see the appropriate sections of the manual.

8.3 Initial Commissioning or Default Data

Each controller generally has one or more sets of default operating data stored in its program memory. All controllers are supplied with the working memory set to one of these default sets of data.

During commissioning, the Installation Engineer should check if the data are suitable for the required application and, if not, load an appropriate set of data into the controller's parameter memory. This is done by setting the bitswitches on the controller to the pattern for the required type of unit and then setting item 9 to "1,2,3,4", using the plug-in maintenance tool.

This means that to complete the commissioning, only certain items of data may need to be adjusted or trimmed.

The parameter memory is non-volatile, which means that the data are not lost when the power supply is removed. No batteries are involved, so the power can be off indefinitely without loss of data.

To ensure that data is fully saved in the unit's non-volatile memory, do not switch it off for 2 minutes after making adjustments to the data. If it is necessary to switch the unit off immediately after setting data, set item 9 to "1, 0, 6, 6" and wait until the maintenance unit display reverts to "0".

8.4 Parameter Data Loss

In the event of a loss of operating data due to failure of the non-volatile parameter memory of the controller, the appropriate default data are automatically loaded into the working memory, depending on the controller bitswitch setting.

This allows the unit to operate in a sensible manner until the correct operating data are reinstated manually.

8.5 Replacing an Existing Controller

The bitswitches on the replacement controller must be set in the same way as on the controller being replaced. If the bitswitches have to be adjusted, then the replacement controller should be recommissioned by setting the default values (item 9) on the maintenance unit. The operating data should be checked against the original commissioning data and changed if necessary.

Finally, the maintenance unit is used to set the controller unit number (item 1) to the correct number.

8.6 Electronic Fault Alarms

The microprocessor is continuously monitoring its own program and memory operation. In the event of a fault, an alarm is logged.

The faults are divided into two groups: catastrophic and advisory. If the fault is regarded as catastrophic, the controller is restarted as if it had just been powered up. If the fault is regarded as advisory, no action is taken.

The alarms logged are as follows:

Catastrophic

a) Program counter outside range (item 12)
b) Stack memory pointer outside range (item 13)
c) Background loop counter fault (item 14)
d) Invalid instruction code (item 16)

Advisory

a) Working memory [RAM] check fault (item 11)
b) Program memory [PROM] checksum fault [item 15]
c) Non-volatile setpoint memory fault (item 17)

All these processor faults are alarms are retained in memory for 15 minutes to allow the communications controller to access the alarm.

8.7 Display Test

The displays can normally be tested by setting maintenance unit item 99 to 1. For full details refer to the item number data for the controller.

8.8 Firmware Version

The firmware version number is available on item 19 of the maintenance unit.

9. COMMUNICATIONS

9.1 Zone Communications

Communication to remote locations is achieved using the JTL network controller. Up to 31 display cabinets or other units can be connected to the communications controller using a single pair of wires.

One JTL network controller can be connected to up to 5 such groups (zones) of units giving a total capacity of 155.

Communications between the controllers and the JTL network controller is in serial format either at 600 Baud (bits/second) or 4800 Baud. Network products despatched from JTL Systems on or after the 1st October 1989 can run at 4800 Baud. Many of these products run at both 600 and 4800 Baud. Prior to this date only 600 Baud is available.

All controllers on one zone must run at the same speed.

The communications speed for each zone is selected by a setting in the JTL network controller. The speed selection at the controllers is automatic.

On dual speed controllers the active communications speed is shown on the maintenance unit on item 6.