# System 9000
# Alarm Annunciator

## Ultimate flexibility and reliability in a rack-mounted format

**Exclusive ASIC/micro-controller technology**

**Multi-redundant design (no single point of failure) including PSU and communications**

**Modular, rack-mounted design expandable to thousands of alarm points**

**Fully field programmable using the integral Setup Card or RTK configuration software**

**Alarm sequences to ISA-S18.1-1979 (R 1984)**

**Wide range of displays including mimic panels, LED light boxes**

The System 9000 Alarm Annunciator offers the latest in combined ASIC/micro-controller technology to provide an annunciator of unparalleled reliability and programmability. The system gives flexibility and security at a cost-effective price.

A unique “multi-redundant” design is used in the System 9000 which avoids the need for a central controller and also provides “multi-redundant” PSU and communications.

The programming flexibility means that users can easily configure hundreds of options including alarm sequence, time delays, relay operation, first-up grouping, functionality, communications etc. The range of displays to complement the System 9000 is also extensive, from the ultra-bright LED illuminated P725LO, hazardous area displays and alarm management software screens.

# Features & Benefits

- Provides independent annunciation of critical plant alarms while communicating back to the host DCS, PLC, ESD, SCADA or computer system
- Fully field programmable, from integral Setup Card or your configuration software
- Suitable for systems from a basic eight-point annunciator to a plant-wide alarm management system
- Total flexibility in choice of system size, display style, operation and options
- Field proven technology, with hundreds of thousands of alarm points already in operation worldwide
- Options available for multiplexing, sequence of events recording, etc.

**With the continued improvements in the complexity of process plants combined with the pressures to strive for greater operating efficiency, it is even more important that alarm annunciators offer the clearest means of showing alarms combined with the best reliability and highest integrity.**

**RTK has designed the System 9000 rack mounted alarm system with this in mind. Based on the field proven and highly acclaimed range of panel mounted Annunciators, the system employs exclusive ASIC and micro-controller technology with additional safety, communications and configuration facilities.**

### Total Configurability

All the facilities are field programmable using the in-built keypad or downloaded from a pc using RTK's Setup Software.

All features are configurable for each individual alarm way and can easily be set up in minutes without the need to learn a special programming language.

All the alarm sequences specified in the ISA publication "Annunciator Sequences and Specifications" are available in addition to a wide range of additional features.

### Displays

The System 9000 is suitable to drive almost any display, such as complex mimic panels, simple LEDs, or backlit lamp displays of a vast range of shapes and sizes. RTK Instruments can offer a whole range of display options for the System 9000, which are fully detailed in a separate datasheet.

### Total Flexibility

The modular construction and the advanced programming facilities mean that the System 9000 Alarm Annunciator can be supplied to match any process alarm application. The 19in racking system allows almost unlimited system expansion, and the Setup Card allows configuration down to each individual alarm way for both sequence and operation.

### High Density Packaging

A standard rear mounting 19in 3U Eurorack forms the basis of the System 9000. Each rack can contain up to 14 eight channel active input cards giving a total of 109 alarm ways and three pushbuttons per rack. Racks can easily be linked together to produce alarm systems of almost unlimited size.

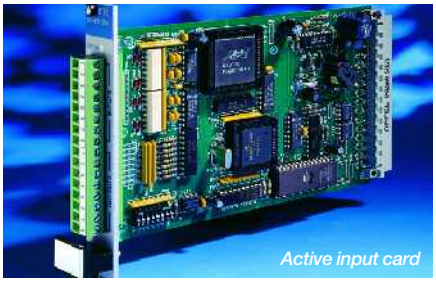
### First Up

In alarm annunciation applications, it is often essential to know which alarm occurred first. For this reason, the System 9000 has a flexible high resolution first-up facility as standard. Four different first-up sequences are provided to match the ISA standard S18-1 1979 (R 1984). Up to four separate first-up groups can be defined within the one system; each alarm way can be configured as being in one of these four groups.

### Relay Outputs

The standard system has relay outputs for all the commonly used functions, such as a horn relay, watchdog relay and total group relay (with optional reflash). If additional relays are required, then the optional Group Relay Card may be needed. This card will expand the relay outputs from the system by an additional eight.

Each alarm point can also be supplied with individual user configurable repeat relay outputs.



*Active input card*

### Communications

The communications facility allows the System 9000 to act as a data acquisition system and transmit alarm information serially to SCADA systems, computers, plcs, DCS systems etc. With the unique 'multi-redundant' design, all cards can communicate directly to the host system so there is no risk of card failure causing the communications to halt. This method of data transmission will operate over 4,000ft (1.2km) and uses standard MODBUS protocol.

### Isolated Inputs

Inputs are generally normally open or normally closed volt-free contacts. All inputs are opto-isolated as standard and can accept 24VDC signals without alterations. There are options for the higher field contact voltages of 48, 110 and 250VDC.

### Bulb Fault Indication

If any alarm point is unable to light its window, because either both lamps are open circuit or missing, or one of the lamps has failed short circuit, then a green 'status' LED on the input card flashes to indicate this problem. The lamp test pushbutton can then be pressed to find the faulty window. None of the above malfunctions will prevent the alarm annunciator from detecting and sounding alarms.

### Servicing

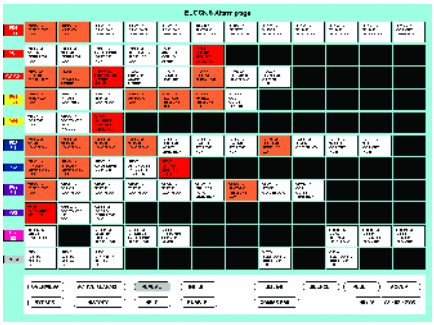
All alarm ways are configured from the keypad on the Setup Card mounted on the left hand side of the rack, or on systems with communications, this can be downloaded from the Setup Software. In the unlikely event of a card failure, the cable connections can be unplugged from the card and the card itself unplugged from the rack. This allows very fast card replacement without the need for any rewiring.

# Features & Benefits

**Setup Card**
Each system is supplied with a Setup Card. This card is not a master module; it is not required for the system to run correctly. The function of the Setup Card is to allow users to configure the input cards to their required operation. Once configured, all settings are stored on the EEPROM on the Active Input Cards. The Setup Card also filters and protects the incoming power supply and provides the common relay outputs.

**Alarm Management Software**

With its multi-redundant architecture and communications facility the System 9000 is an ideal front-end to a screen based alarm management system. RTK can provide alarm management software and complete systems using industrialized computers and screens. These are developed in conjunction with the users



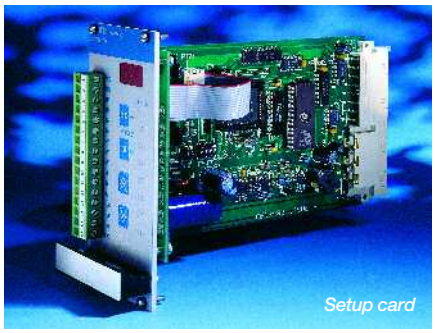
to provide the clearest possible means of showing alarms, the priority of these alarms and exactly what to do in each alarm situation. These systems can also provide a means of logging all alarm and event history for analysis at a later date.

**Mounting**
The standard method of mounting is directly onto the backplate of a control panel. The rack can easily be supplied as a normal front mounting 19in subrack suitable for direct mounting into 19in racking systems.

**Power Supply**
The supply voltage range for the system is wide enough for unregulated and battery backed supplies. The nominal 24VDC supply can be anywhere within the range 19-36VDC without affecting system performance. Alternative supply systems such as 48VDC can also be provided.

**Interfacing**
The System 9000 is ideally suited to interface to other plant equipment. Even basic systems come complete with output relays to link to external indicating devices and displays. The relays can be expanded to cover multiple group relays and individual repeat relays for all alarm ways.

Using the powerful communications features it is possible to interface to


Setup card

existing PLCs, SCADA systems, Emergency Shutdown Systems and plant-wide distributed control systems. The Annunciator can monitor and display critical alarms and communicate the results into the normal monitoring systems, giving another level of safety and independence from the general monitoring or control system.

**Pushbutton Inputs**
The standard requirement for the majority of alarm annunciators is three pushbuttons for Lamp Test, Accept and Reset. The System 9000 not only allows these standard functions, but can also allocate a further five inputs to operate additional more advanced control features. If these are not required, they are simply not used. The additional functions are Silence, System Test, First-up Reset, Sleep and Horn Inhibit.

## RTK Engineering's Total Security Concept

**'Multi-redundant' design**
The System 9000 maintains the unique 'multi-redundant' design. Each alarm board contains an ASIC (Application Specific Integrated Circuit) which is capable of complete system control – if one board fails, or is removed, then another ASIC on another board will takeover system control, avoiding a single source of system failure and vastly increasing the system MTBF. An in-built watchdog relay will give an alarm if any Active Input Cards fail or are removed.

**'Multi-redundant' Communications**
This principle is now extended to the communications. All active alarm boards have full communications facilities – if a single board fails, an alarm is sounded but normal communications will continue with all the remaining boards. Again, this removes the single source of communication failure and goes far beyond a dual redundancy system.

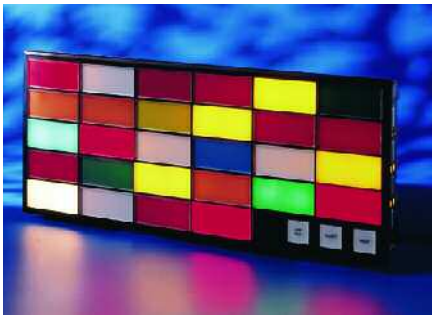
**'Multi-redundant' Power Supply**
Each alarm card has its own in-built fully isolated dc/dc converter, again providing distributed power supplies across the whole alarm system, so the system does not rely on a single power supply card.

**Line Monitoring**
The integrity of the rack itself is without question, but what of the connections to the outside world?
**Alarm contacts:** The System 9000 can be supplied complete with an extensive line monitoring facility. If the connections to the alarm contact go either short circuit, open circuit or high resistance then an alarm is sounded to identify the problem.
**Lamp Failure:** The connection to the lamp display module can also be fully monitored, so that if any alarm point is unable to light its lamps the system will also sound an alarm. Both features can have volt-free relay contact outputs.

# Displays

To complement the System 9000 Alarm Annunciator, RTK Instruments offers a wide range of displays from simple lamp arrays to full mosaic mimic panels. Most of the displays are modular in design to enable RTK to match your exact needs, rather than compromising on the nearest available shape and size. The main display types are illustrated and described here; for more detailed information, refer to the separate display datasheet.

**P725LO**
**Lamp-Only Modules**
This display has been designed to match the Series 725 Alarm Annunciator – it will look identical when viewed from the front. It is available in exactly the same format as the annunciator with three window sizes, six colors and a choice of lamp or LED illumination. This display is the best choice when LED illumination is required, offering the most competitive ultra-bright illumination. It is fitted with a 'Lamp Test' facility as standard.

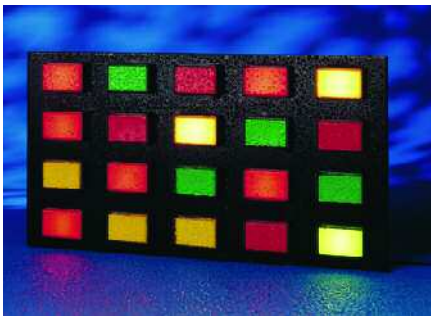


**DF30 Display Facia**

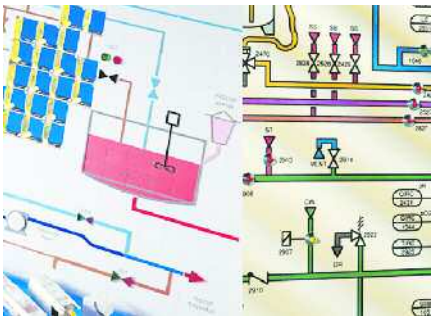
The DF30 display facia provides a flexible display panel for both LED or incandescent lamps. This display facia is totally modular allowing systems of almost any shape and size to be constructed. The basic lamp module is 30 x 30mm but these can be configured to give a range of window shapes and sizes by interconnecting multiple windows. This display can also have integral pushbuttons, keyswitches and audible devices. There is no limit to the number or position of these devices. All connections are by rear mounted screw terminals.

**Hazardous Area Displays**
When supplied through suitable certified interface devices, the System 9000 can be used to drive a display facia in the hazardous area. The DF30IS is a backlit display certified as Ex II 1G, EEx ia IIC T4. The display gives a bright LED illuminated backlit display that matches the safe area versions.

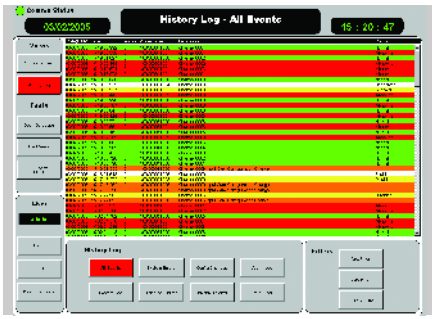
The L20 Intrinsically Safe Multiplexer can also be used to drive a hazardous area display using only two cables into the hazardous area.



**IP65 Displays**
Where protection from the environment is essential a range of displays sealed to IP65 can be provided. These custom-built units have bright LED display modules wired to rear mounted terminals. The completed assembly is mounted with a gasket to the panel door to maintain the sealing.



**Mimic Displays**
Mosaic tiled mimic systems can be driven by the System 9000 to provide a flexible and informative overview display. The standard mosaic mimic uses a 24 or 25mm tile mounted on a strong aluminium honeycomb grid. Tiles are the molded type for process mimics or alternatively screen-printed or engraved to form the required display drawing. A wide range of suitable lamps, switches, pushbuttons and displays can also be integrated into the finished mimic. On smaller projects and simpler display requirements a hard wearing, single piece mimic can also be provided.




**Alarm Management Software**
With its multi-redundant architecture and communications facility the System 9000 is an ideal front-end to a screen based Alarm Management System. These can be set up in thousands of different ways to suit each individual alarm handling situation. Different display screens have already been developed and these building blocks would be used to provide a custom solution for each client. These systems could also incorporate touch screen displays, dual redundant servers and a range of industrial computers.

# Advanced Features

**The Best of Both Worlds**
Ideally, critical plant alarms should be hard wired to a dedicated alarm system like the System 9000 and data passed onto the DCS as a secondary function. This offers the best of both worlds in that the System 9000, which has been specially developed to offer high speed event capture and True First Out Discrimination, also provides the clearest possible indication of critical plant conditions. The System 9000 provides an independent, highly reliable, modular alarm system employing multiple redundant design features. It should be used to complement centralized DCS platforms that have been primarily developed for control and monitoring.

**Most of the features listed here are supplied as standard as part of the normal software; the system is simply configured exactly as required for each application. Further options exist from RTK to provide complete systems, undertake programming and commissioning, and provide alternative mounting arrangements. Please consult the Sales Office for further information on any of these options.**

**Timers**
Delay timers can be incorporated into the System 9000 on both the inputs and the outputs. This facility can avoid the possibility of nuisance alarms by setting an input time delay, so that the alarm contact must be in alarm for a certain time before triggering the input circuitry.

**Repeat Relays**
Each alarm point can have an individual repeat relay output in addition to any group relays configured. The relays can be set up as energised or de-energised on alarm and N/O or N/C contact. The relay functions are also user configurable to follow the alarm logic or follow the input.

**Group Relay Card**
An additional card is available for those systems requiring more than the standard 3 relay outputs. The card has 7 additional group relays and an further 3 horn relays, all of which are fully configurable. Any alarm way in a system can be configured into any of the 8 possible groups or 4 possible audible groups. Three of these group relays can alternatively be configured to give outputs for ‘line fault’, ‘communications fault’ and ‘bulb failure’.

**Output Relay Reflash**
Each of the group relays can have the reflash facility enabled. This is where the group relay will change state for approx 0.5s when another alarm in that group occurs. This allows a control room annunciator or monitoring system to indicate each occurence of a new alarm.

**Alarm Indication via PLCs**
The cost of digital output cards for PLCs to drive conventional backlit displays can be avoided by simply communicating all the alarm information serially to a System 9000 annunciator. The Annunciator will then convert the serial information and drive the lampbox display.

**Multiple Input Reflash**
It is often necessary to connect more than one alarm contact to a single alarm display window. This can be configured from the Setup Card so that up to 24 alarm contacts can all link to a single alarm window. After an alarm has occurred and been accepted then another alarm occurring in the same group will cause the display window to flash again (reflash) to indicate the occurrence of a new alarm.

**Discrepancy**
Rather than simply monitoring the state of a single alarm contact, it is possible to configure the Annunciator to monitor two or more contacts to ensure they correspond. If the two contacts go out of sync, a fault has occurred and the alarm will sound.

**Boolean Logic**
In a similar way to the discrepancy control, multiple inputs can be linked together by standard OR and AND functions. For example, the system can be programmed so that an alarm will only occur if four particular inputs are all on at the same time.

**Sleep Mode**
Useful in unmanned/not normally manned situations. Any single input can be configured as a “sleep” input. When this input is switched on the drive outputs to the lamps and audibles are disabled. The annunciator will work exactly the same in all other respects; all alarms are monitored as standard and all repeat relays and communications function as normal. As soon as the system is switched out of the ‘sleep’ mode, the display facias will display all alarm information, complete with all first-up details.

**Multiplexer**
To cut down on the costs of installing vast numbers of cables across large sites, the System 9000 can be used as an economical multiplexer system, where all the alarm contacts are gathered by a single System 9000TX Module and transmitted serially on 4 wires up to 4,000ft (1.2 km) away to the receiving module, the System 9000RX Module. The alarms can then be displayed on a display facia or via VDU screens.

**Complete Systems**
RTK can provide the System 9000 mounted in a wall mounted or floor standing cabinet and provide all the necessary wiring to the displays, PSUs and terminals ready for final installation on site. These panels are quoted against each specific customer requirement; please contact the Sales Office for further details.

**Card Types**

**Active Input Card (P925A)**
Connects to the alarm and pushbutton inputs and drives the lamp facia display.

**Setup Card (P925S)**
Allows configuration of Active Input Cards, filters the incoming supply voltage and provides 3 relay outputs.

**Relay Card (P925R)**
This card is connected directly to the Active Input Card and gives an individual repeat relay per alarm input.

**Group Relay Card (P925G)**
Has 8 relays fitted, 7 additional group relays and 3 additional horn relays.

**Interface Card (P925X)**
Provides a link to the systems communications facilities via RS485.

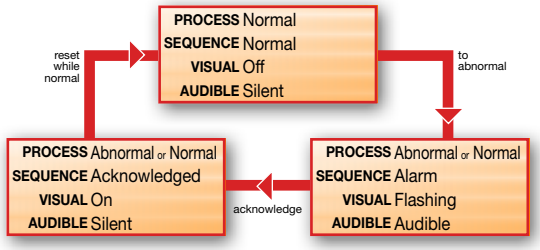
**Power Input Card (P925P)**
Used on extension racks in place of the setup card. This simply filters the incoming power and provides a connection to the rear backplane.

**Interconnect Card (P925I)**
Use on larger systems to buffer the signals between racks and link the common lines. Supplied with an interconnect cable.

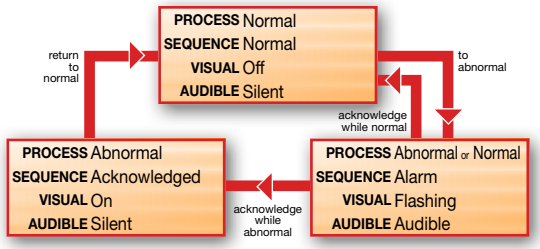
# Sequence tables

Each alarm channel can be configured to suit the operating sequence required as listed in the ISA publication *Annunciator Sequences and Specifications S18.1 1979 (R1985)*. Systems can be configured with different features on different alarm points and there is no need to switch the power off. The diagram below shows the most commonly used sequences.

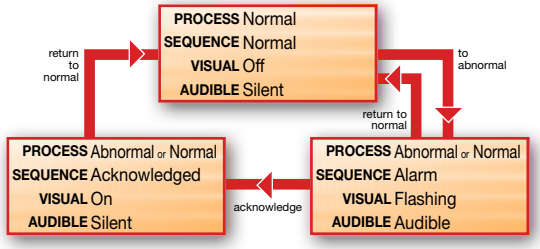
## MANUAL RESET — Sequence Code M



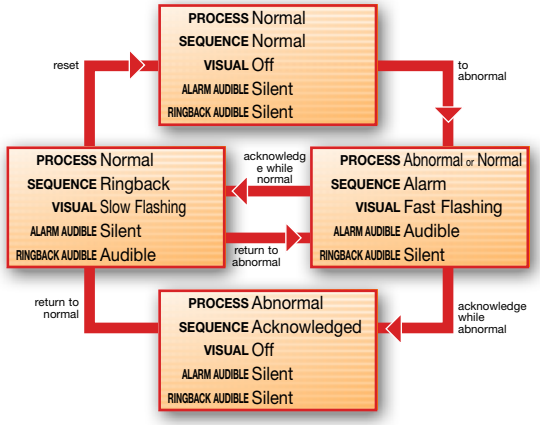

## AUTOMATIC RESET — Sequence Code A




## NO LOCK IN

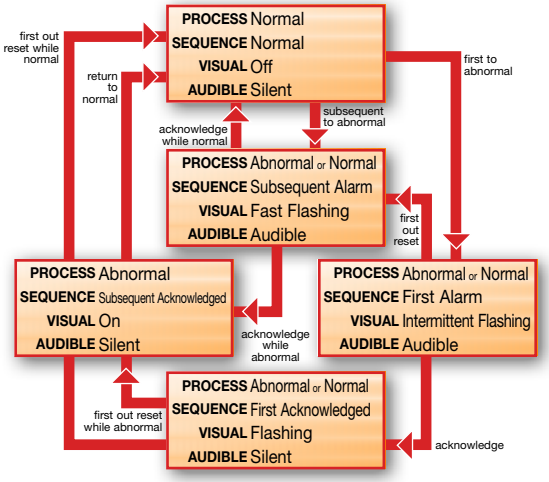



## RINGBACK — Sequence Code R



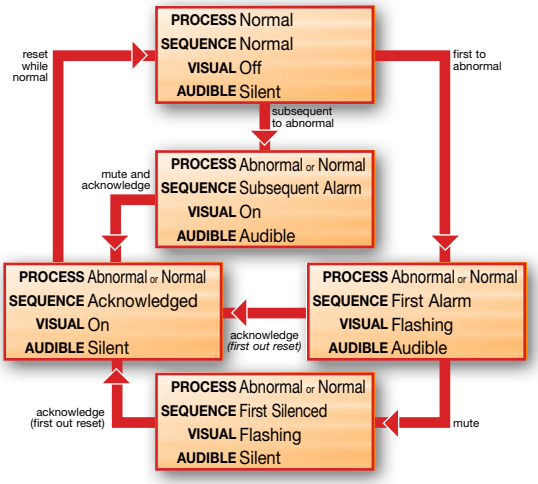

## AUTOMATIC RESET FIRST OUT — Sequence F3A

WITH FIRST OUT FLASHING AND RESET PUSHBUTTON



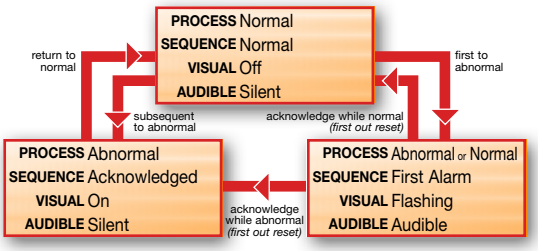

## MANUAL RESET FIRST OUT — Sequence F2M-1

WITH NO SUBSEQUENT ALARM FLASHING AND SILENCE PUSHBUTTON



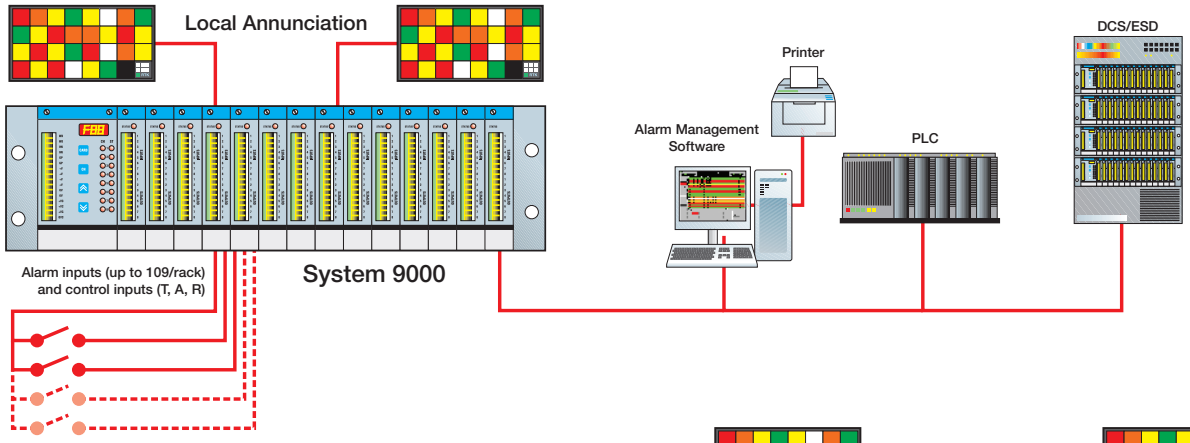

## AUTOMATIC RESET FIRST OUT — Sequence F1A

WITH NO SUBSEQUENT ALARM STATE

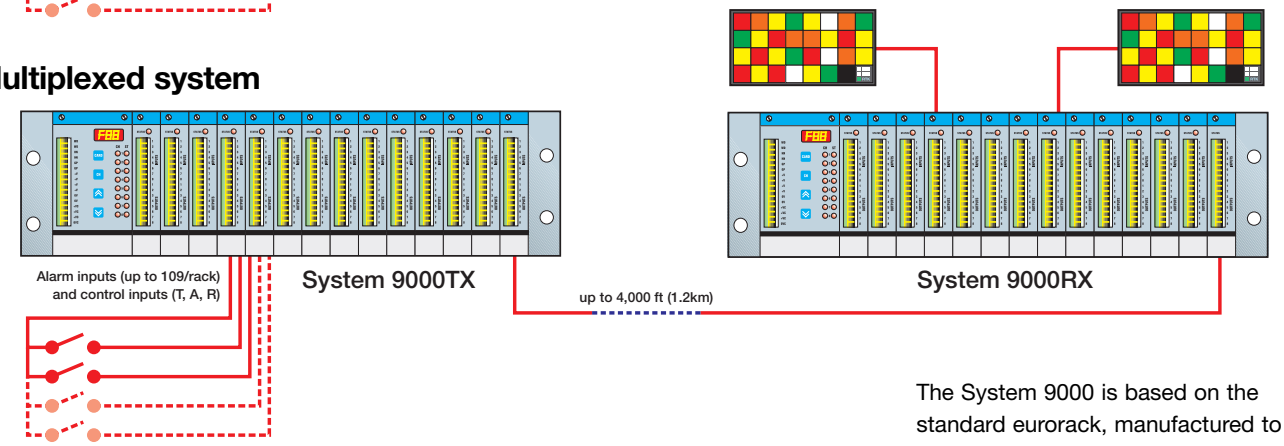


# Installation and Mechanical Details

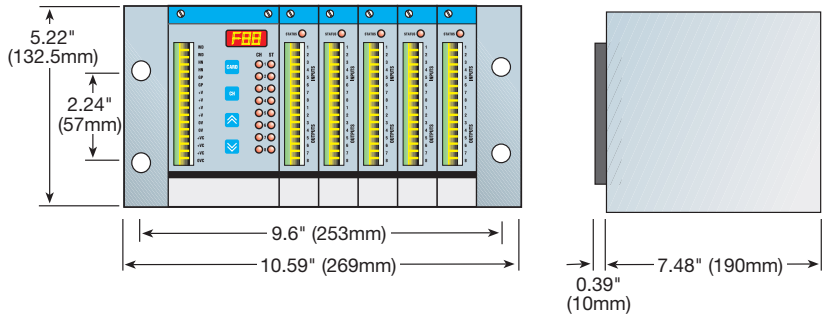
## Standard system with Communications



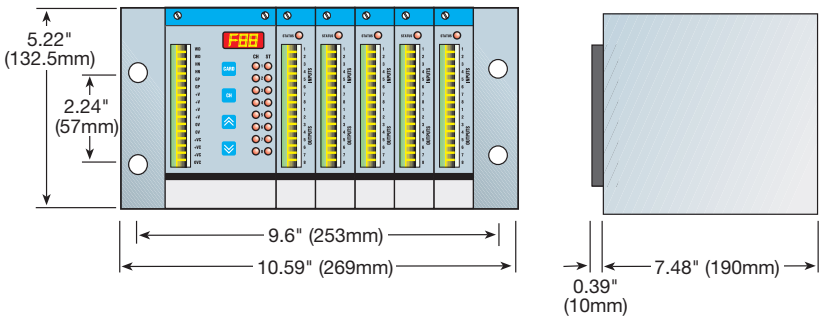

## Multiplexed system




## Five module, half 19in rack




## Fourteen module, full 19in rack




The System 9000 is based on the standard eurorack, manufactured to IEC 297-3 (DIN 1494 Pt.5). The standard subrack size is 3U and 84E wide (19in). This module will fit the Setup Card and up to 14 Active Input Cards. For smaller systems, a half rack version is available, this is 42E wide (10½in) and will fit the Setup Card and up to 5 Active Input Cards. The units can be supplied as rear mounting for direct fixing to backplanes or front mounting for use in 19in racks. Larger systems can be supplied by interconnecting multiple racks. All signals are fully buffered using the Interconnect Card, so no signal deterioration will occur even on extremely large systems.

# Technical Specification

## Inputs

**Alarm Contacts**
All inputs are opto-isolated (isolation voltage 500VDC). By using different wiring configurations, the same system can be used for both:

- Volt-free contacts which can have the operating mode configured using the Setup Card, to operate to alarm for contact open or to alarm for contact closed.
- Voltage input from 19VDC minimum to 36VDC maximum with a common 0V for the 24VDC system and 38 to 58VDC for the 48VDC system. 110V field contact voltage option

**Alarm Contact and Cable Resistance**
N/C contact – series resistance of contact cables 20kΩ maximum.

N/O contact – parallel resistance of contact cables 200kΩ minimum.

**Field Contact Voltage and Current**
The voltage for volt-free alarm contacts is fed from the unit at 24VDC at approximately 2mA.

To maintain complete isolation it is possible to use a separate PSU to feed all the alarm contacts.

**Input Transient Filter (24V input)**
Signals narrower than approx 40ms at 30V will not trigger the annunciator.

Tolerable transient at higher voltages:
100V for 2ms
200V for 1ms
1kV for 200µs

**First-up Discrimination**
Typical 10ms

**Control Inputs**
Any input can be configured to one of the following control inputs:

- Lamp test
- Acknowledge
- Reset
- System test
- Mute
- First-up reset
- Sleep
- Horn Inhibit

## Outputs

**Lamp Drive**
Each output can drive up to 160mA at 24VDC, making it suitable for multi bulb displays or multiple repeat displays.

**Standard Relays**
Standard relays fitted on the Setup Card: Horn, Group and Watchdog.

Contact rating 3A at 24VDC resistive or 2A at 240VAC resistive. Selection of N/O or N/C contact by jumper link.

**Repeat and Group Relays**
Group relay card and individual repeat relays for each alarm point. Contact rating 3A at 24VDC resistive or 2A at 240VAC resistive. Relay ouputs may be normally energised or normally de-energised and contacts can be N/O or N/C.

**Communications**
Alarm data can be transmitted using the serial communications port to other System 9000 units, DCS systems, PLCs or computers.

Transmission – RS485C. Full duplex, 1 start bit, 7 data bits, 1 parity, 1 stop bit.

Baud Rate – up to 9600

Protocol – ASCII MODBUS and RTU

## General

**Supply Voltage**
24VDC nominal (19–36VDC) Standard

48VDC nominal ( 38–58VDC)

A range of power supplies is available to convert from other ac or dc voltages.

| Supply current (mA) | 24V | 48V |
|---|---|---|
| Quiescent: Setup Card | 120 | 60 |
| Quiescent: Active Input Card | 40 | 30 |
| Relay current/per relay | 22 | 10 |

Add the current for the lamp drive to the totals of the above cards

**EMC Compliance**
Immunity to EN61000-6-2:2001
Emissions to EN61000-6-4:2001

**LVD Compliance**
The unit is designed and manufactured to safety specification BS EN61010-1:1993

**Environment**

| | |
|---|---|
| Operating temperature | -4 to 140°F (–20°C to +60°C) |
| Storage temperature | -4 to 176°F (–20°C to +80°C) |
| Humidity | 0–95% RH, non-condensing |
| Protection | IP41 |

## Mechanical Details

**19in Rack**
Standard 3U by 19in Eurorack to IEC 297-3 (DIN 1494 Pt.5) for up to 109 alarm inputs and 3 control inputs.

Standard 3U by 10½in Eurorack to IEC 297-3 (DIN 1494 Pt.5) for up to 37 alarm inputs and 3 control inputs.

Larger systems can be provided using multiple racks and interconnect cable.

**Mounting**
Either rear mounting direct to backplate or front mounting in a standard 19in racking system.

**Assembly**
All cards plug in to a standard pre-tested motherboard using DIN41612 connectors. This allows simple system expansion of system size at a later date.

**Connections**
Two part rising clamp terminals, maximum wire size 12 AWG (2.5mm²). Side mounted and front mounted screw terminals are available.

Due to our policy of continuous product development, we reserve the right to amend specifications without notice.

RTK Instruments
1531 Stuyvesant Avenue
Union
New Jersey 07083
USA

Telephone: 908 688 6709
Facsimile: 908 688 9040
Email: sales@rtkinstruments.com
Web: www.rtkinstruments.com