

data

SHEET



AI-FR Series — Redundant Fibre Ring Hubs

ARCNET should be cabled as a star or bus network; never as a ring — but a ring is possible if special conditions are implemented. A ring provides redundant cabling and continuity in case of cable failure. If one cable within the ring becomes disabled for any reason, another path remains available to pass messages. The AI-FR Series is designed and manufactured to achieve fibre optic redundancy in an otherwise non-redundant networking technology.

A fibre optic ring consists of two or more three-port hubs, each with a local drop through which standard ARCNET devices access the backbone and benefit from the redundant cabling. If the fault relay contacts open, a fault is noted but communication maintained.

The AI-FR operates from 8–24 VAC or 10–36 VDC. Redundant power is supported for critical applications.

LEDs aid troubleshooting. Port activity LEDs report ARCNET traffic received. The status LED will flash at a periodic rate when the AI-FR is correctly powered but in idle condition. When lit continuously, this LED indicates that ARCNET traffic is being received and faithfully regenerated to the other hub ports. The RECON LED will flash to show a routine network reconfiguration as an ARCNET node enters or exists the network.

Two models exist. The AI-FR/CXB provides a coaxial cable local drop while the AI-FR/TB5 supports twisted-pair. Either can be panel or DIN-rail mounted.

Signal delay imposes a 2-km limit on the ring when up to five AI-FR hubs are used. By reducing the circumference, more hubs can be employed — so additional devices can share the redundant ring.

Compatible with the baseband 2.5 Mbps ARCNET® network

- Provides redundant connection in case of cable failure
- Two ports for ring connection and one port for drop connection
- Allows fibre backbone fault monitoring via relay contact
- Panel-mount or DIN-rail mount
- Minimizes bit jitter with precision delay line timing
- Watch-dog timer stops hub lockup
- Hub unlatch delay digitally controlled
- Supports coaxial or twisted-pair drops
- LED indicators report network reconfigurations and valid port activity
- Wide-range, low-voltage AC-or DC-powered
- Provision for redundant power sources
- CE Mark
- RoHS compliant



Redundant Ring Topology — How It Works

With no ARCNET signal present, the three-port AI-FR hub has all its receivers enabled and all its transmitters disabled. When a drop port senses a signal, it becomes the sole receiving port and its transmitter is disabled — while the other two backbone ports become transmitters with their receivers disabled. With a fibre ring properly configured, activity from the two backbone ports will travel along the ring clockwise and counterclockwise. A receiving AI-FR located on the ring will latch onto activity sensed by one of its backbone ports and ignore the redundant transmission seen on the other port. In case both ports receive

simultaneous data, priority is given to port 2. If the ring is broken at any one point, the network will function in a traditional star topology.

The unlatch delay that squelches any recirculating message has been increased from 5.9 μ s to 11.9 μ s for greater distance. This must exceed total delay due to fibre propagation (5 ns/m) and the number of AI-FR hubs (330 ns/hub). If no data is received after 11.9 μ s, the hub assumes that transmission is complete and reverts to its quiescent state with all receivers enabled and all transmitters disabled.

Fault Monitoring — Vital Safeguards for Preserving Network Integrity

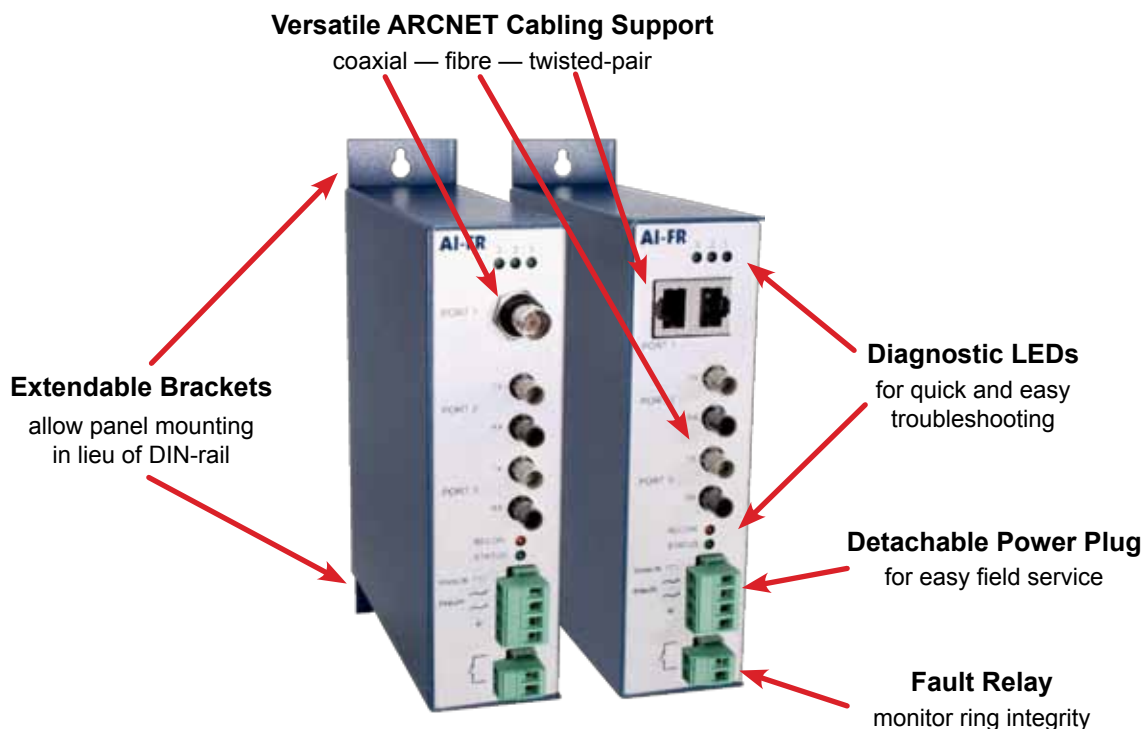
The AI-FR hub's most important requirement is to provide reliable data transfer. Cable failure is challenging if the cabling is in underground or hard-to-service locations. If a fibre fails the AI-FR fibre ring maintains uninterrupted communication by virtue of its redundant data path.

The AI-FR includes a fault relay by which fibre ring continuity can be monitored. Using this relay a fibre failure can be quickly detected, the problem located and identified and the repair scheduled — all while data traffic is maintained. Connect the relay contact terminals on the AI-FR's front panel to a workstation (or other user-provided equipment) to monitor data path integrity.

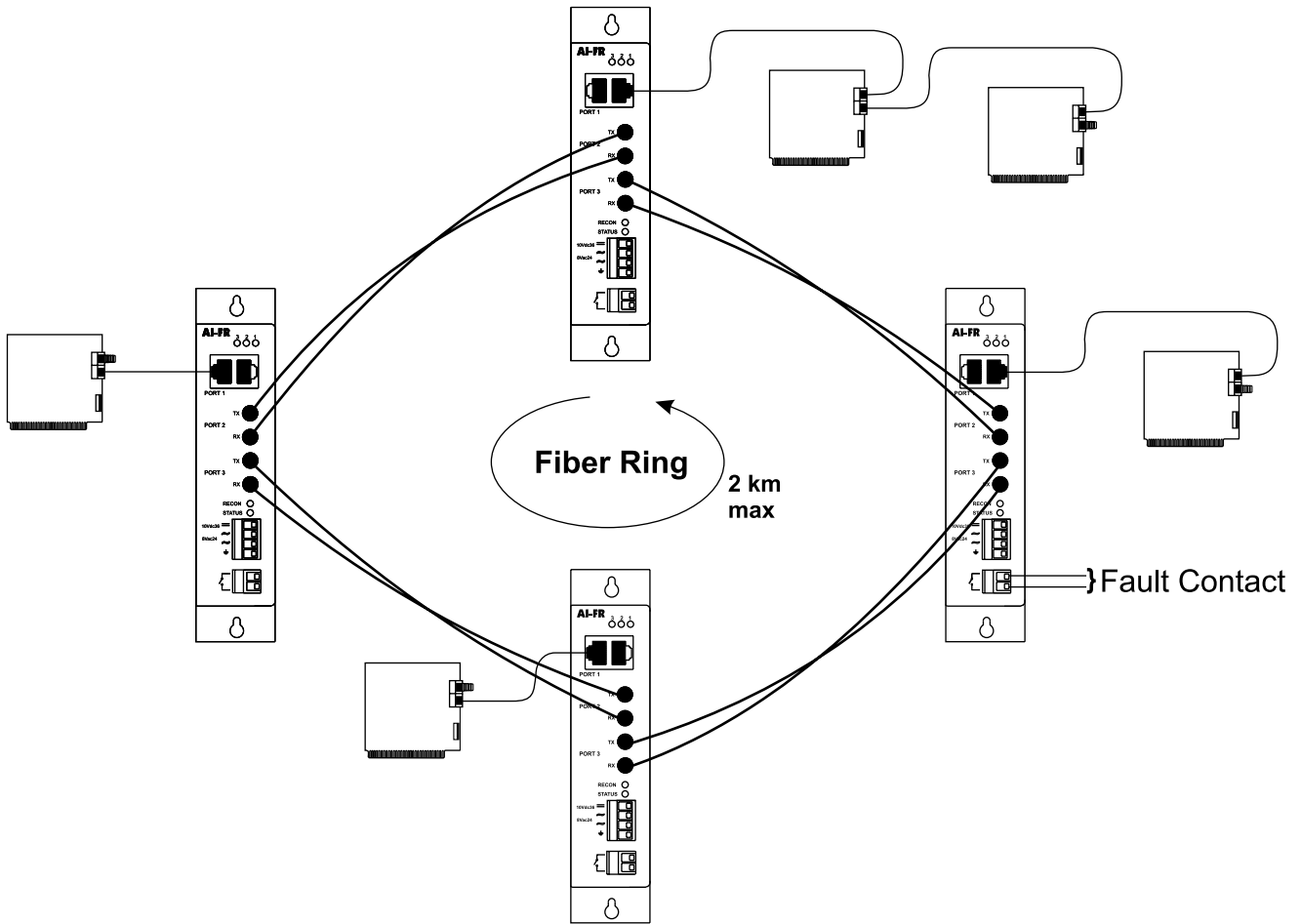
An AI-FR hub should sense data on both of its fibre ports, but if the signal is constantly absent on one its receiving

fibres for a period of 1.6 seconds, the fault relay contacts open. Thus, an open relay at only one hub will indicate a fault in one fibre attached to that hub. If a complete duplex pair fails, neither hub connected by the pair will receive data along that path — and each relay in each hub will open to indicate a complete failure of the cable between them.

When the AI-FR is powered, the relay contacts close as normal operation is assumed. If power is interrupted, the contacts open and report a problem. If the hub malfunctions and fails to keep the contacts closed, the open contacts will indicate the need for service. If a hub fails, for any reason, the two hubs which normally communicate with it will not receive data from the downed hub. They each will indicate a fault and its source.

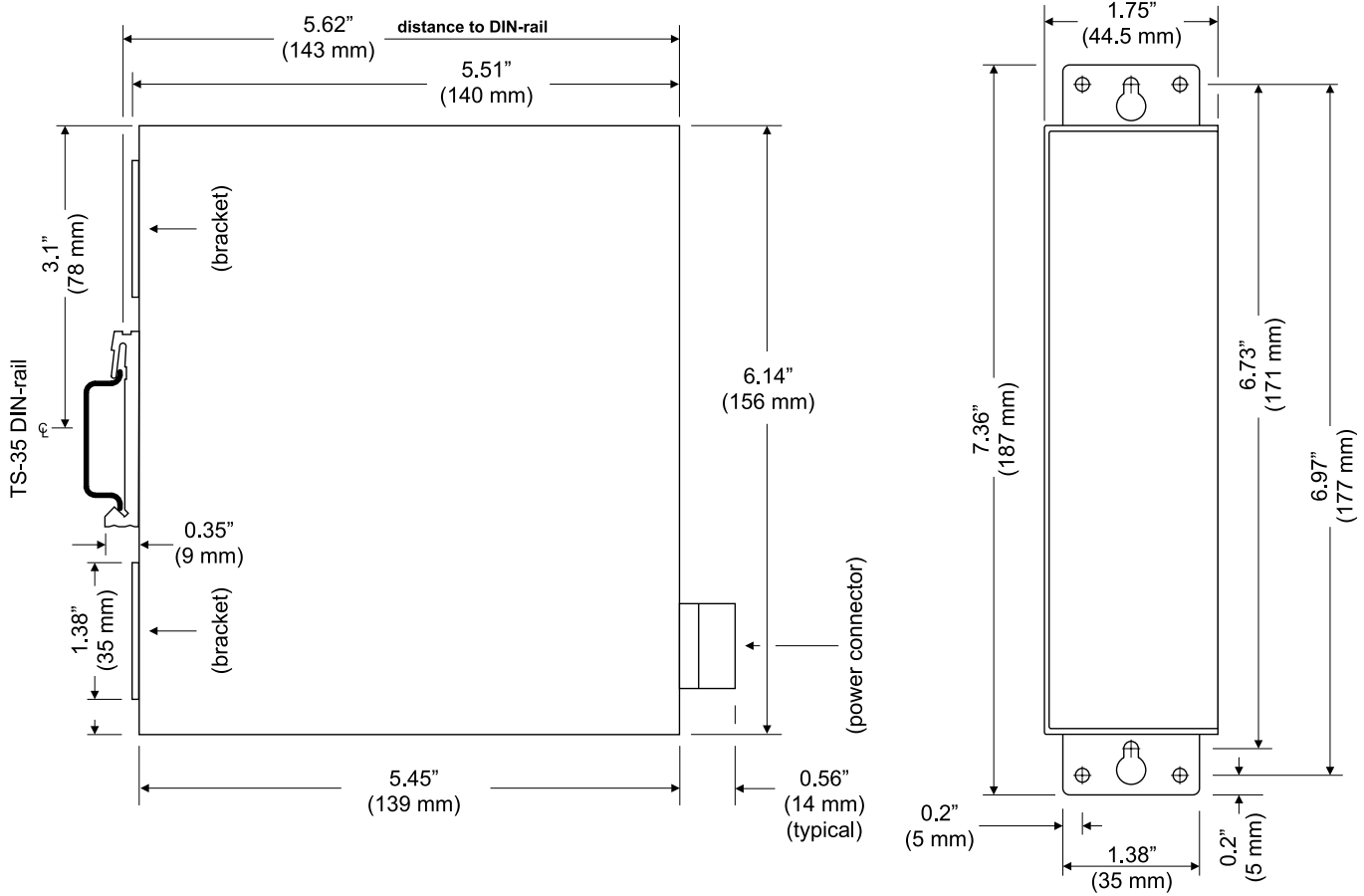


Topology



Each AI-FR is a three-port hub with a single twisted-pair or coaxial bus connection serving as a local drop. Terminators must be applied to each end of the bus connection.

Mechanical Diagram



**Side View showing DIN-rail Clip
(Mounting Brackets Retracted)**

**Front View with
Mounting Brackets Extended**

Permissible Cable Lengths and Nodes Per Segment (2.5 Mbps)

Port Type	Description	Cable	Connectors	Cable Length		Max Nodes Bus Segment	Notes
				Min	Max		
-CXB	Coaxial bus	RG-62/u	BNC	6ft/2m ¹	1000ft/305m	8	5.5 dB/1000ft max
-TB5	Twisted-pair bus	IBM type 3	RJ-45	6ft/2m ¹	400ft/122m	8	
Fibre	Duplex fibre optic	50/125	ST	0	3000ft/915m ²	N/A	4.3 dB/km max
Fibre	Duplex fibre optic	62.5/125	ST	0	6000ft/1825m ²	N/A	4.3 dB/km max

¹ This represents the minimum distance between any two nodes or between a node and a hub.

² The circumference of the fibre ring cannot exceed 2 km.

Specifications

Electrical Input	DC	AC
Voltage	10–36 VDC	8–24 VAC
Power	4 W	4 VA
Frequency	N/A	47–63 Hz
Fault relay	200 Volts, 500 mA, resistive	

Environmental/Mechanical	
Operating temperature	0°C to 60°C
Storage temperature	–40°C to +85°C
Relative humidity	10–95%, non-condensing
Protection	IP30

Optical Power Budget <i>(850 nm at 25°C)</i>	Fibre Size (microns)	dB
	50/125	6.6
	62.5/125	10.4

Functionality	
Data rate	2.5 Mbps
AI-FR delay time	330 ns typical
Unlatch delay time	11.9 µs
Compliance	ATA 878.1-1999

LED indicators	
RECON	yellow
ACTIVITY	green
STATUS	green

Regulatory Compliance

CE Mark
RoHS
CFR 47, Part 15 Class A



Electromagnetic Compatibility

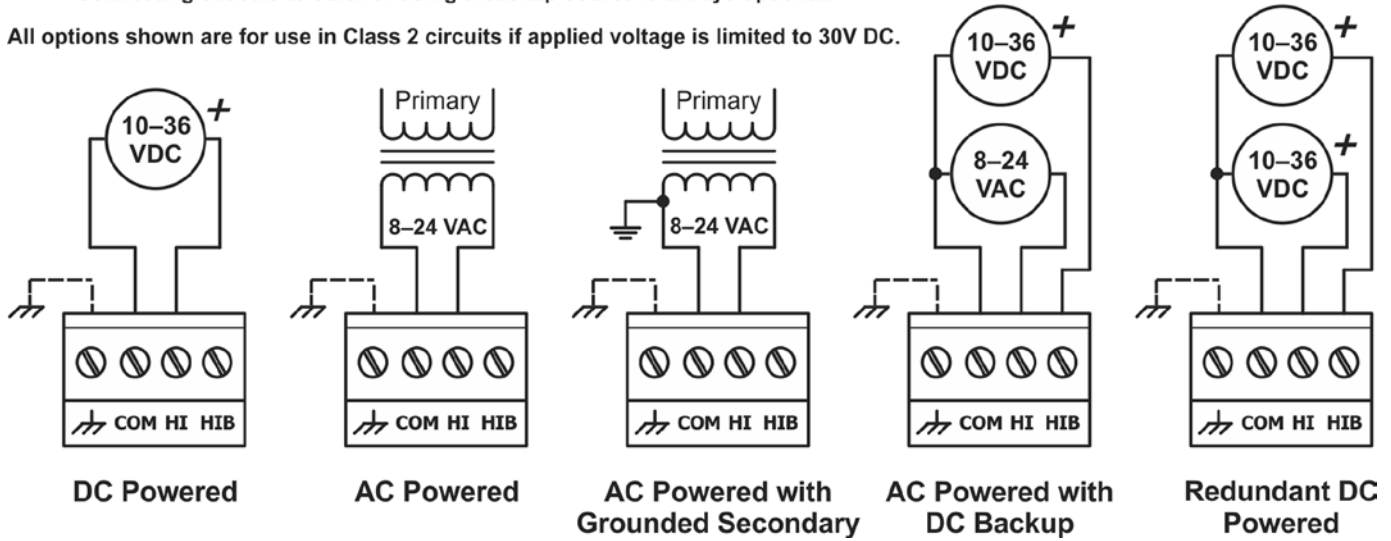
Standard	Test Method	Description	Test Levels
EN 55024	EN 61000-4-2	Electrostatic Discharge	4 kV contact, 8 kV air
EN 55024	EN 61000-4-3	Radiated Immunity	10 V/m, 80 MHz to 1 GHz
EN 55024	EN 61000-4-4	Fast Transient Burst	1 kV clamp, 2 kV direct
EN 55024	EN 61000-4-5	Voltage Surge	1 kV L-L, 2 kV L-Earth
EN 55024	EN 61000-4-6	Conducted Immunity	10 Volts (rms)
EN 55024	EN 61000-4-11	Voltage Dips & Interruptions	1 Line Cycle, 1 to 5 s @ 100% dip
EN 55022	CISPR 22	Radiated Emissions	Class A
EN 55022	CISPR 22	Conducted Emissions	Class A
CFR 47, Part 15	ANSI C63-4	Radiated Emissions	Class A

Power Diagrams

Input power: 10–36 VDC or 8–24 VAC, 47–60 Hz.

Connecting chassis to earth or using a backup source is always optional.

All options shown are for use in Class 2 circuits if applied voltage is limited to 30V DC.



Ordering Information

<i>Model</i>	<i>Description</i>
AI-FR/CXB	Fibre ring backbone with coaxial bus drop
AI-FR/TB5	Fibre ring backbone with twisted-pair bus drop

Accessories

<i>Model</i>	<i>Description</i>
AI-XFMR	Wall-mount plug-in transformer, 120 VAC input/24 VAC output (nominal values)
AI-XFMR-E	Wall-mount plug-in transformer, 230 VAC input/24 VAC output (nominal values)
BNC-T	BNC “T” connector
BNC-TER	93-ohm BNC terminator
TB5-TER	100-ohm RJ-45 terminator

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