

Intrinsically-safe fieldbus installations can often be confusing and daunting for first time designers.

When plant designers determine they want to use intrinsically-safe fieldbus, there are some basic design criteria that need reviewing. One of the most common issues is how much power will I be afforded in today's design and how much power will I have for tomorrow's needs. All fieldbus devices need power and all of these devices need to coexist on the same twisted pair, thus available bus power is of utmost importance.

When it has been determined by the plant designer that the entire fieldbus segment shall be intrinsically-safe—from the control room to the last device in the field—FISCO designs are often considered. Why? Because FISCO has been promoted as the easiest way to implement intrinsically-safe fieldbus segments. However, what is not discussed about FISCO are its limited power capabilities, expensive power supplies and low MTBF (Mean Time Between Failure) data due to the inherent complicated circuit designs.

An intrinsically-safe option that provides more power to the fieldbus segment, redundancy, high MTBF and lower cost of implementation is the ROUTE-MASTER™ Fieldbus System from MooreHawke.

What is FISCO?

FISCO stands for **F**ieldbus **I**ntrinsically **S**afe **C**oncept. It was developed in Europe because there are problems making fieldbus intrinsically-safe (I.S.) using standard techniques. I.S. wants to limit the current and power in a circuit whereas fieldbus needs lots of current to drive lots of devices on the same wire pair. A FISCO power supply is electronically controlled to allow more current through into the field than a standard I.S. power supply, and FISCO devices are tested to make sure that they are still intrinsically-safe even if they were to receive that higher current. Typically, FISCO power supplies are rated at 110mA (Group A B, IIC) and around 250mA (Group C D, IIB).

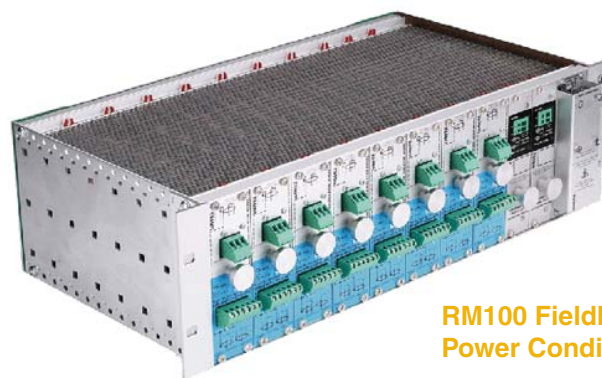
Why is Redundancy Required?

People commit many devices onto a fieldbus segment; typically 8 or 10, and sometimes as many as 16. Having that many devices on one wire pair with one power supply and one DCS interface card tends to heighten the concerns that revolve around single points of failure. Redundancy is used to minimize the potential loss of control or information.

Overall segment availability (or uptime percentage) depends on the reliability of the power supply/conditioner, the H1 interface, the trunk cable, the device coupler, the spur wire and the fieldbus device. Making redundant pairs of any or all of these component parts will increase the overall performance of the segment. Standard field-



**RMA100 Fieldbus
Device Coupler**



**RM100 Fieldbus
Power Conditioner**

bus segments used for control generally have redundant H1 cards and redundant power conditioners.

Why is Redundant FISCO Still Not a Good Solution?

Intrinsically-safe power supplies are designed to carefully control the power available in the field, even under fault conditions. It is not possible to take a FISCO power supply and simply connect two of them in parallel since that would allow twice the approved level of current. Also, if the FISCO power supply were simply re-designed with an output limited to 50% of the safe limit (so that if they were connected as a pair, they would be still safe), the segment designer would have to accept a severe restriction on the segment layout if that segment was to continue operations in the event of one half failing.

One possible solution is to make pairs of standard rated FISCO power supplies and connect them together via some sort of switch which will only allow one power supply to be connected to the segment at one time. The switch would also need to be duplicated and interlocked to make sure that no internal failure allows both power supplies on line at once. Clearly, this leaves the entire FISCO segment power supply dependent on the single “watchdog” module to ensure proper operation.

What Does ROUTE-MASTER Offer?

ROUTE-MASTER takes a pair of conventional DC power supplies and makes them load-sharing and hot-swappable. Then it feeds that power through a big coil (fieldbus conditioning) and a set of current-limiting resistors, with voltage controlled by some large Zener diodes (in other words, redundant fieldbus power through an I.S. barrier).

Intrinsically-Safe Fieldbus FISCO Facts

The really clever part is the way in which ROUTE-MASTER avoids large voltage drop in the trunk while still delivering lots of power to the segment. The ROUTE-MASTER splits the required current-limiting resistors into 2 parts; there is enough resistance in the control room module (RM102B Fieldbus Power Supply/Conditioner Rack) to make the trunk intrinsically-safe for Groups C & D (IIB), while the field device coupler (RMA100 Fieldbus Device Coupler) has more resistance per spur so that each spur is intrinsically-safe for Groups A & B (IIC).

In fieldbus applications, the spur carries only the current required for one device, whereas the trunk carries all the current for all the devices. Splitting the current-limiting resistors in this way allows ROUTE-MASTER to deliver 350mA per segment and still be capable of connecting to field devices in Groups A & B (IIC).

ROUTE-MASTER has the highest current output of any intrinsically-safe fieldbus system.

Is ROUTE-MASTER Compatible with FISCO?

Yes, the output per spur from the RMA100 device coupler is rated at FISCO levels, and any FISCO device can be connected to that spur. The spur cable has to be either marked FISCO or be of a type suitable for FISCO (there are quite wide limits on capacitance, inductance and resistance, so that isn't a problem) and that spur cable can be up to 120m long.

What About Entity Devices?

Yes, ROUTE-MASTER is also perfectly compatible with Entity devices. FOUNDATION fieldbus standard FF-816 required that device manufacturers ensure their devices were certified/approved as capable of receiving voltage

Simplex Intrinsically-Safe Segment Solutions

	ENTITY	FISCO	FISCO (ROUTE-MASTER)
Device Location	IIC	IIC	IIC
Control Drawing	Required	Required (But List of Devices Suffices)	Required
ENTITY Calculations	Required	Not Required (Assuming All Devices, Power Supplies, Cable and Screwdrivers Meet FISCO Specification)	Required on Trunk, Not Required for FISCO Spurs
Segment Capacity Calculations	Required	Required	Required
Max. Spur Length	120 Meters	60 Meters	120 Meters
Max. Segment Length IIC (A/B)	1900 Meters	1000 Meters	1900 Meters
Max. Current	80mA	120mA (IIC A/B) 265mA (IIB C/D)	350mA
Typical Power Voltage	18.4V	14V	18.5V
Typical Source Impedance	105 Ohms	100 Ohms	22 Ohms
Max. No. of Devices, 500m (Assuming 20mA/Device)	3	4 (IIC or Group A/B) 8 (IIB or Group C/D)	16 (IIC or Group A/B)
MTBF Per Segment		65 Years*	68 Years
Back-of-Panel Requirements for 128 Devices (IIB)	0.07m ² (43x 16x104mm)	0.16m ² (4x 160x255mm)	0.058m ² (1x 19" Rack x 3U High)
Max. Power Required for 128 Devices	74W (2.3W/unit)	78W (6W/Unit)	35W
Surge Protection	Extra	Extra	Inherent
Approvals	Approved	Approved	Approved
Additions to Segment	Awkward	Easy	Easy
FISCO Devices	No	Yes	Yes
ENTITY Devices	Yes	Additional Module Per Spur	Yes

* MTBF doesn't include AC/DC power pack

up to 24V, current up to 250mA and power up to 1.2W. RMA100 spurs have output ratings of 17.5V, 249.9mA and 1.18W, all below the input limits of Entity approved fieldbus devices. The main difference is that Entity parameters have to be calculated for spurs but this is also very simple; each spur is identical as far as entity parameters are concerned, and only one example of the worst case (120m) needs to be considered.

There Must Be a Catch?

Well yes, nobody gets something for nothing in the real world. The ROUTE-MASTER 'catch' is that the RMA100 Device Coupler cannot be installed in areas exposed to Groups A & B (IIC). This isn't generally too much of a

problem. Hydrogen-risk areas are typically few and quite compact; the extremely low density gas disperses rapidly and because of its ability to leak from conventional fittings, a hydrogen-related plant is usually built with welded joints and fittings. The only time large hydrogen areas are found is as a result of improper or accidental area classification by plant designers.

Does ROUTE-MASTER Need an I.S. Ground?

No. While the I.S. card (RM102B) is basically a Zener barrier, the design of the RM100 Rack incorporates fully-isolated power supplies and the DCS input is also isolated. The overall segment is galvanically-isolated to I.S. standards so there is no requirement for an I.S. ground.

Duplex Intrinsically-Safe Segment Solutions

	ENTITY	FISCO	FISCO (ROUTE-MASTER)
Device Location	N/A	IIB Only	IIC
Control Drawing	N/A	Required (But List of Devices Suffices)	Required
ENTITY Calculations	N/A	Not Required (Assuming All Devices, Power Supplies, Cable and Screwdrivers Meet FISCO Specification)	Required on Trunk, Not Required for FISCO Spurs
Segment Capacity Calculations	N/A	Required	Required
Max. Spur Length	N/A	60 Meters	120 Meters
Max. Segment Length	N/A	1000 Meters	1900 Meters
Max. Current	N/A	245mA (IIB or Group C/D)	350mA
Typical Power Voltage	N/A	14V	18.5V
Typical Source Impedance	N/A	100 Ohms	22 Ohms
Max. No. of Devices, 500m (Assuming 20mA/Device)	N/A	8 (IIB or Group C/D)	16 (IIC or Group A/B)
MTBF Per Segment	N/A	121 Years	468 Years
Back-of-Panel Requirements for 128 Devices (IIB)	N/A	0.3m ² (4x 320x255mm)	0.058m ² (1x 19" Rack x 3U High)
Max. Power Required for 128 Devices	N/A	78W (6W/Unit)	35W
Surge Protection	N/A	Extra	Inherent
Approvals	N/A	Pending	Approved
Additions to Segment	N/A	Easy	Easy
FISCO Devices	N/A	Yes	Yes
ENTITY Devices	N/A	Additional Module Per Spur	Yes



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