

High System Availability for Foundation Fieldbus

Introduction

High system availability is critical in many Process Industry applications. As these industries are adopting the improved control and monitoring strategies offered by Foundation Fieldbus, high availability has become a requirement for Foundation Fieldbus (FF) installations as well. For the entire system to be highly available, each component must either be very reliable or redundant. Relcom's expertise is in physical layer components such as Fieldbus Power Supplies, Connection Devices, Terminators, and Short Circuit Protection devices. This application note will focus on these aspects. Consult the Host and Device manufacturers for their High Availability solutions.

The last page in this document illustrates a typical FF segment using components that we manufacture to achieve a system (from the physical layer standpoint) that is highly available. The components illustrated are the FPS-I Redundant Power System, the FCS-MB8-SG Eight port Megablock with SpurGuards™, and the Megablock Terminator. For detailed information on each of these products, see their individual data sheets.

Topology

The Host, 24 VDC Power Supplies, and the Fieldbus Power Supply (with integrated Terminator) are generally located in the Control Room while the Devices, field Terminator, and Connection Devices are located in the Field. The Trunk cable is both the power and the communications highway between the Control Room and the Field. To make the Trunk Cable highly available is achieved by careful installation - the Trunk cable cannot be made redundant. Proper terminations (which is always important), careful routing, and protection for the cable are all things to consider to maximize Trunk availability. The device connection method shown in the diagram is called the "chicken-foot" topology. This means that all of the devices on the segment are at the end of the Trunk cable. The "chicken-foot" topology has not only proved to be very popular, but also results in a more reliable system (compared to several spur drops along the Trunk) as it minimizes the number of wire terminations.

The FPS-I

Reliably delivering power to a FF segment has proved to be quite a challenge. The FPS-I is the result of two years of work and consultation with industry experts and Host manufacturers. 24VDC power cannot be directly connected to the Fieldbus segment. It must go through a power conditioner circuit that conforms to the FF Standard. For electronic components, the most reliable design would use Passive components (resistors, capacitors, inductors, etc.). These Passive components are more reliable than the newer, but more capable Active devices (transistors, integrated circuits, etc.). Power conditioning circuit designs with both Active and Passive components were carefully evaluated. Active components were chosen for the FPS-I to deliver the required power to the FF segment while maintaining the integrity of the data communications across many different devices and host systems. Note that although we specifically reference the FPS-I, there are several products that are based on the FPS-I design which this application note applies to. The thing they have in common is that they all use the FPS-IPM plug-in module and for the purpose of this application note are equivalent.

The FPS-I is a Redundant Fieldbus Power Supply that provides High Availability Fieldbus Power to your Foundation Fieldbus segments. The FPS-I provides redundant isolated power with redundant conditioning circuits along with monitoring (alarming) capability. The FPS-I provides for these important benefits:

Redundant 24 VDC input connection

24VDC Power Supplies are complex devices with many active components. For this reason, two supplies should be provided to provide redundancy in the event that one of them fails. The FPS-I provides connection points for the wires from these redundant supplies, as well as diodes to isolate the supplies from each other.

Redundant Hot Pluggable Galvanically Isolated Power Modules with Fieldbus conditioning circuitry

Each FPS-I provides 1500V of isolation from the 24VDC power supplies. This increases System Availability by allowing continued segment operation even if a segment that is powered from a FPS-I from a common 24VDC power supplies experiences a ground fault on either Fieldbus wire. (Note: galvanic isolation of a FF segment is a requirement of the FF Standard. It is also a requirement for the Short Circuit Protection that our Megablocks offer).

Input 24 VDC Power Monitoring and Output Fieldbus Power Monitoring with a relay contact for fault notification

It is very important to realize that redundancy alone is not enough. If the system has no way of monitoring for failures, how would service personnel know that something needs to be serviced to restore redundancy? Alarming is critical to high availability systems and the FPS-I provides alarming to indicate important fault conditions. To propagate the information to the system operator, a digital input connection must be made to the host.

Current Limiting

Each FPS-I will deliver a limited amount of current to the Fieldbus segment. In the event of a short circuit (or overload) on the Trunk, a limited amount of current will flow from the 24VDC supplies - preventing the disturbance from propagating to the 24VDC power supplies and consequently to any other segments or equipment being serviced by these supplies. Current limiting is something that could not be effectively achieved without active components.

The FPS-I consists of three main components - the base, and two Isolated Power Modules (FPS-IPM). The base mounts to a DIN rail and provides terminations for the necessary connections. It includes the steering diodes necessary to allow connection of more than one 24VDC power source, and circuitry to control a dry contact used for fault notification (alarming). A fault condition from either input power supply, or either IPM results in the alarm contact opening. This alarm contact should be wired to a digital input on the Host that will notify the system operator in the event of a failure. Green LEDs indicate the availability of incoming power from each supply and that there is power flowing to the FF segment. A second six-position connector is provided on the base to allow for connection to another base. Each FPS-I is provided with a six-position jumper to allow this connection. A Fieldbus Terminator is included in the base unit for the FPS-I as indicated by the large "T" on the label. The IPMs are hot pluggable modules that provide the galvanic isolation and power conditioning for the FF segment. During normal operation, the two modules share the load and operate at about 50% of their rating. If a unit fails, the other unit takes over with no interruption to the FF data communication. A Green LED indicates proper output voltage on the IPM.

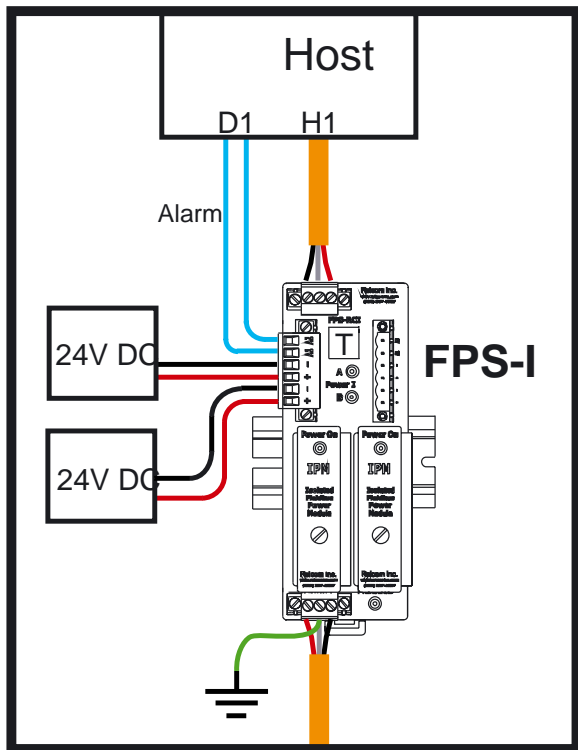
The Megablock

A Megablock with SpurGuards™ is shown in the Field Junction Box in the diagram on the following page. The Megablock is a wiring connection block that allows termination of two Trunk cables and a number of Spurs to devices (Eight in the case of this illustration - other sizes available). Each three-wire cable connection is made to a pluggable connector. After the cable is terminated to the connector, the connection may be removed for commissioning and maintenance. To prevent accidental plug disconnection, retaining screws are provided to secure the connector to the Megablock. All necessary interconnections are made within the Megablock. The user only needs to land the proper cables on the proper connectors. A Green power indicating LED is provided to confirm that sufficient bus voltage is available at the Trunk connector. The SpurGuarded Megablocks provide Short Circuit Protection on each gray Spur connector by limiting the maximum return current flow into the Spur connector to 59mA. A Red LED next to each connector illuminates when the Spur is in current limit. The spur automatically recovers when the short-circuit condition is cleared. For larger numbers of devices, multiple Megablocks may be cascaded by connecting the Trunk of one Megablock to the Trunk of the other.

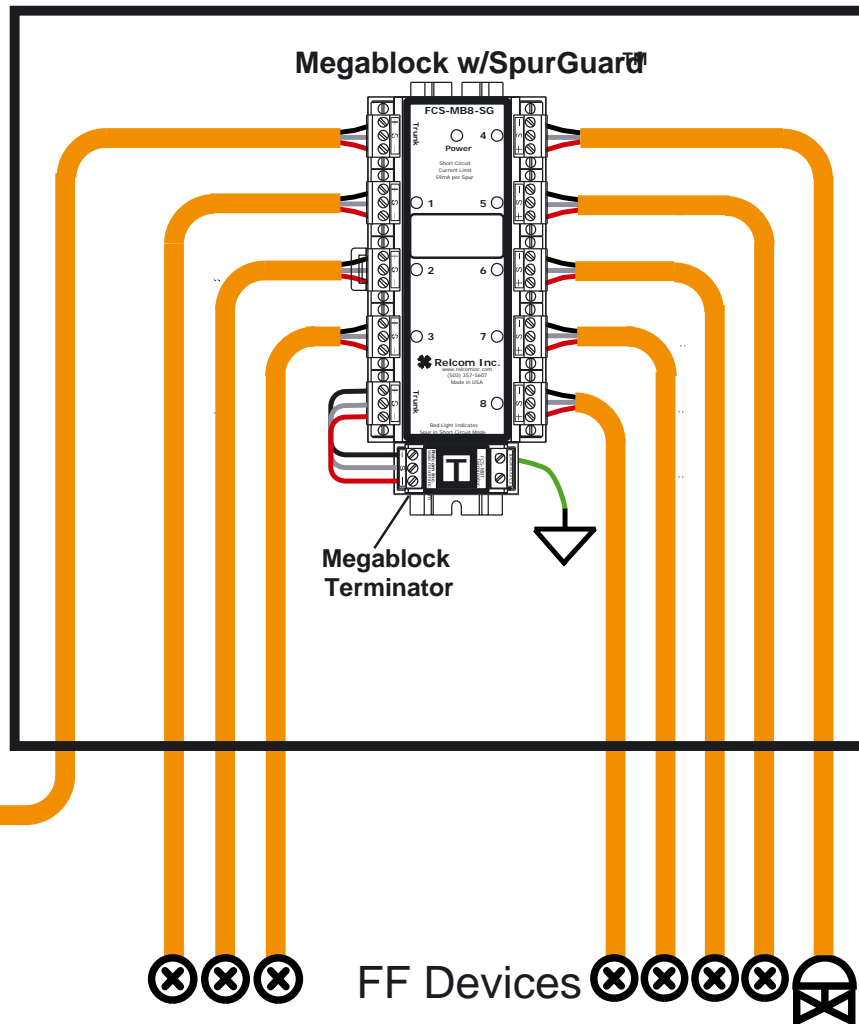
The Megablock Terminator

The FF Standard requires that two Terminators be placed on each FF segment - generally one located on each end of the segment. As mentioned earlier, we have integrated a Terminator into the FPS-I Redundant Power System. The other Terminator is usually located in the Field after some distance of cable. This is the purpose of the Megablock Terminator (FCS-MBT). A single three-terminal black connector is connected from the MBT to a Trunk connector on a Megablock as shown in the diagram. The DIN rail mounted MBT also contains some surge protection components. The local ground connection shown on the drawing is terminated to one of the two positions on the Green connector. During a surge event, the voltage on the cable shield may rise to a dangerous level. An internal component (spark gap) conducts when this happens and shunts the surge current to the local ground connection. Note that this only occurs during a surge event and will not cause ground loop currents under normal operating conditions. The local ground connection that is shown in the Control Room is the permanent ground for the cable shield. The Megablock Terminator is very reliable because it is constructed of entirely passive components. For non-IS installations, the F100 is functionally equivalent to the FCS-MBT at a lower cost.

Control Room



Field Junction Box



Trunk Cable

FF Devices