XM Power Supply Solutions

Patrick Carle

The power requirements for an XM® system can vary significantly based on application. In addition to power (amps), other issues such as temperature range, hold-up time, and over-current protection, as well as system considerations such as redundant power, API-670 compliance, or use in hazardous areas, must be considered. It is therefore critical that when planning a system that an appropriate power solution be defined. This document is intended to aid in the proper design a selection of power solutions for XM systems that satisfy these requirements.

Regarding power, an overriding rule must be followed:

All connections to an XM System must be powered from a source compliant with the following:

> A Listed Class 2 power supply, or a Listed ITE Safety Extra Low Voltage (SELV) power supply with fuse kit 1440-5AFUSEKIT (specified later in this document), or a Protected Extra Low Voltage (PELV) power supply certified to 60950 with fuse kit 1440-5AFUSEKIT.

This means that the same power source must power any device(s) to which the module is connected via its side connector(1) or any of its non-isolated circuits which include: Power, DeviceNet(2), 4-20mA Outputs and the Set Point Multiplier circuit**(3)**.

This requirement is necessary to ensure that the XM system satisfies the conditions of its CSA approval, and that it meets the requirements of the Low Voltage Directive. Satisfying CSA and the LVD requirements are also a prerequisite to the UL/CSA and ATEX hazardous area certifications.

1 Power transmission across the XM module side connector is limited to 3A.

2 The DeviceNet circuit of the XM-124 Standard Dynamic Measurement module (1440-SDM02-01RA) is fully isolated. This means that for systems that include ONLY XM-124s, that an independent DeviceNet power supply may be used, and that other independently powered DeviceNet devices may be connected to the XM-124.

3 These circuits are all functionally isolated, but do not have adequate insulation to satisfy the isolation requirements of some electrical safety standards. Therefore the ground requirements for the circuits, specified in the individual user's manuals, must still be applied.

Module Applicability

This Application Technique applies to the following products**(**4**)**:

Table 1: Applicable Products

Catalog Number	**Model**	**Module Description**
1440-SDM02-01RA	XM-124	Standard Dynamic Measurement
1440-VST02-01RA	XM-120	Standard Dynamic Measurement
1440-VST02-01RA	XM-120E	Eccentricity Measurement (F/W update only)
1440-VLF02-01RA	XM-121	LF Vibration
1440-VSE02-01RA	XM-122	gSE Vibration
1440-VAD02-01RA	XM-123	Aeroderivative
1440-VLF02-01RA	XM-121A	Absolute Vibration (F/W update only)
1440-VDRS06-00RH	XM-160	Direct (OA) Vibration
1440-VDRS06-06RH	XM-161	Direct Vib w/4-20mA out
1440-VDRP06-00RH	XM-162	Direct Vib w/Prox Probe Pwr
1440-SPD02-01RB	XM-220	Dual Speed
1440-TPR02-01RB	XM-320	Position
1440-PRC06-00RE	XM-360	Process
1440-TUN06-00RE	XM-361	Temperature
1440-TTC06-00RE	XM-362	Isolated Temperature
1440-RMA00-04RC	XM-440	Master Relay
1440-REX00-04RD	XM-441	Expansion Relay
1440-REX03-04RG	XM-442	Expansion Voted Relay
Catalog Number	**Model**	**Terminal Base Description**
1440-TB-A	XM-940	Terminal Base for XM-120/121/122/123/124
1440-TB-B	XM-941	Terminal Base for XM-320

Catalog Number	Model	Module Description
1440-TB-C	XM-942	Terminal Base for XM-440
1440-TB-D	XM-943	Terminal Base for XM-441
1440-TB-E	XM-944	Terminal Base for XM-360/361/362
1440-TB-G	XM-946	Terminal Base for XM-442
1440-TB-H	XM-947	Terminal Base for XM-160/161/162

4 This Application Technique supplements the installation requirements and instructions provided in the Installation Guide and User Manuals for the products listed in table 1.

Power Supply Requirement

The XM Series of Machine Condition Monitoring modules require a 24Vdc (±10%) power source. The source must be one of:

- A Listed Class 2 rated device, or
- A Listed ITE Safety Extra Low Voltage (SELV) supply with fuse kit 1440-5AFUSEKIT (specified later in this document), or
- A Listed IE Protected Extra Low Voltage (PELV) supply with fuse kit 1440-5AFUSEKIT (specified later in this document).

The following table provides requirements for power supplied to XM systems.

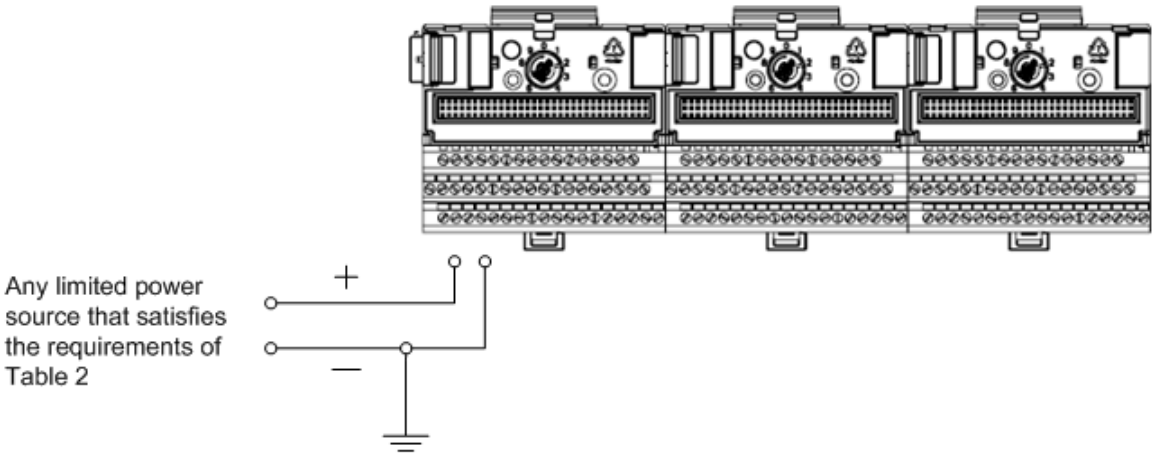
Table 2: Power Supply Requirements

XM Power Supply Requirements	
Protection	Listed Class 2 rated supply, or
	Fused ITE Listed SELV supply, or
	Fused ITE Listed PELV supply
Output Voltage	24Vdc ± 10%
Output Power	100 Watts Maximum (~4A @ 24Vdc)
Static Regulation	± 2%
Dynamic Regulation	± 3%
Ripple	< 100mVpp
Output Noise	Per EN50081-1
Overshoot	< 3% at turn-on, < 2% at turn-off
Hold-up Time	As required (typically 50mS at full rated load)

Powering XM

The XM system must be powered by a single limited power source.

Figure 1: XM System Power Source

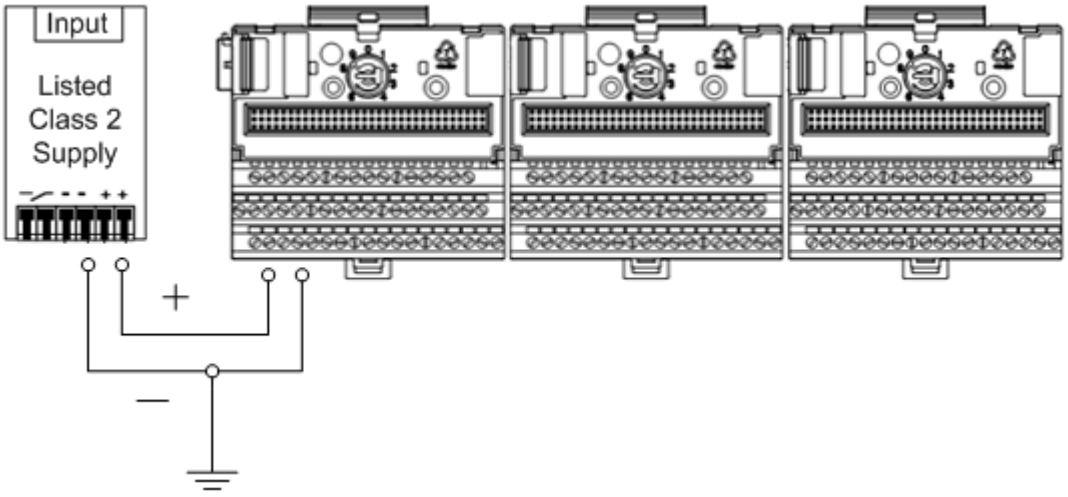


While it is possible for this source to be supplied by a customer's instrument power or other source, in most cases it will be provided by specific AC/DC Power Supplies or DC/DC Converters as described in the following.

The power supply can be connected to the XM system using one of the following methods:

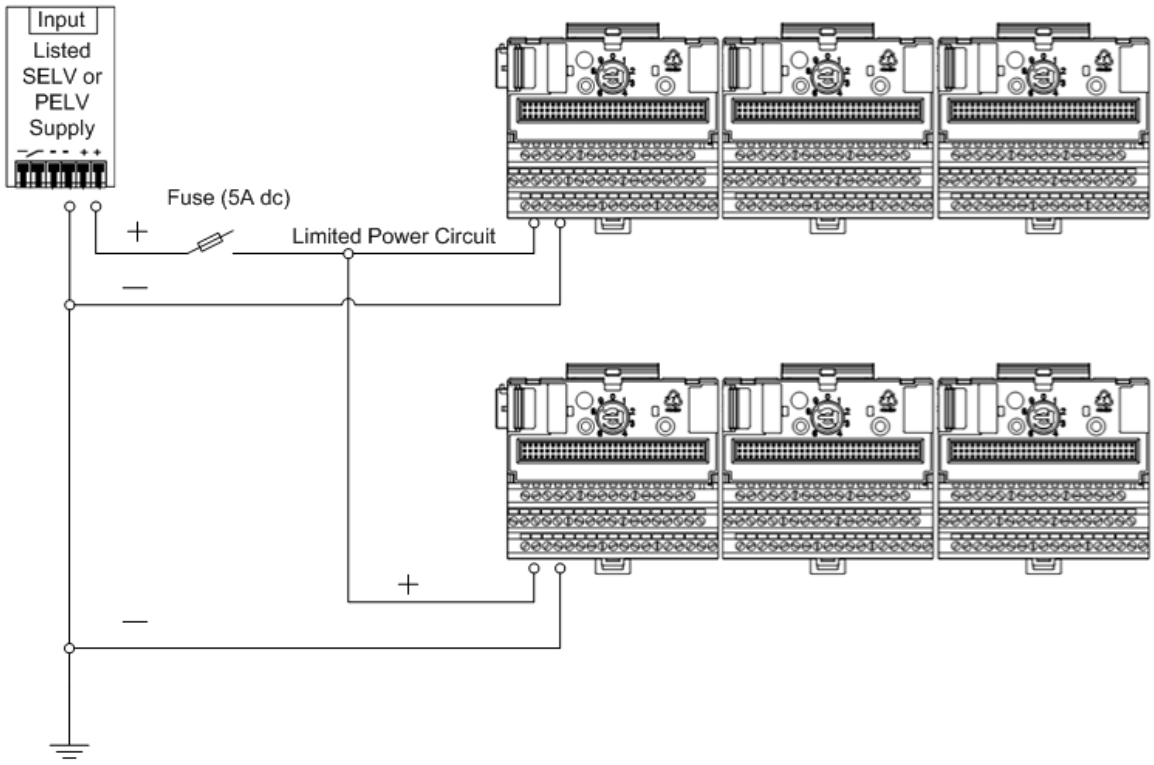
- Using a single listed Class 2 power supply.

Figure 2: XM System Powered from a Single Class 2 Supply



- Using a listed SELV or PELV with the 5A current limiting fuse specified later in this document.

Figure 3: XM System Powered from a Fused SELV Supply

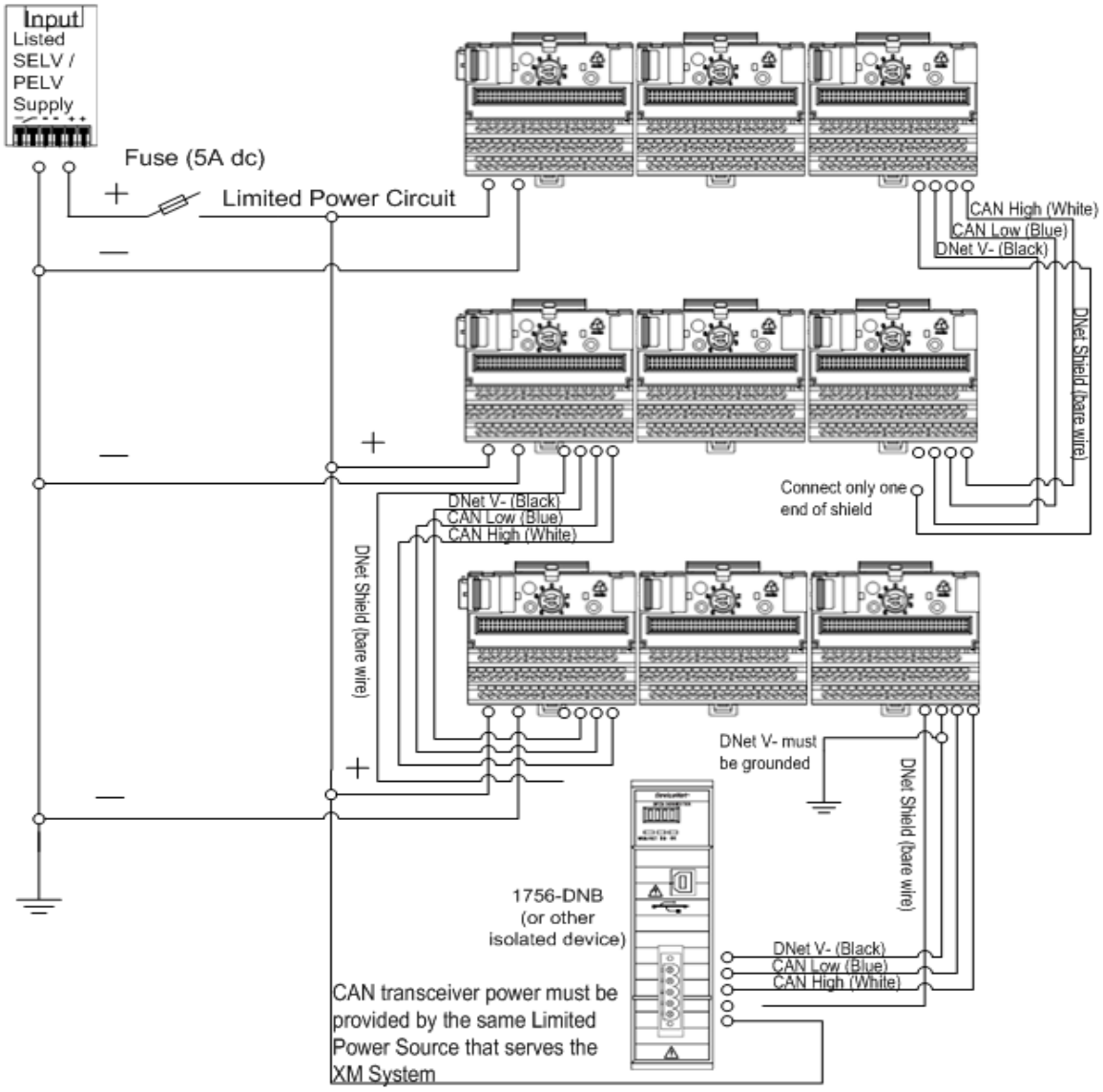


Powering an XM System

Regardless of how power is provided, the “system” must be inclusive of all non-isolated devices, such that only this single power source is used (Figure 4). This means that all non-isolated devices connected to the system’s DeviceNet(5), 4-20mA, SPM, or power circuits must be powered by this same source.

5 The DeviceNet connection of the XM-124 module is fully isolated. Therefore, when connected to an XM-124, an independently powered DeviceNet network is allowed (Figure 6).

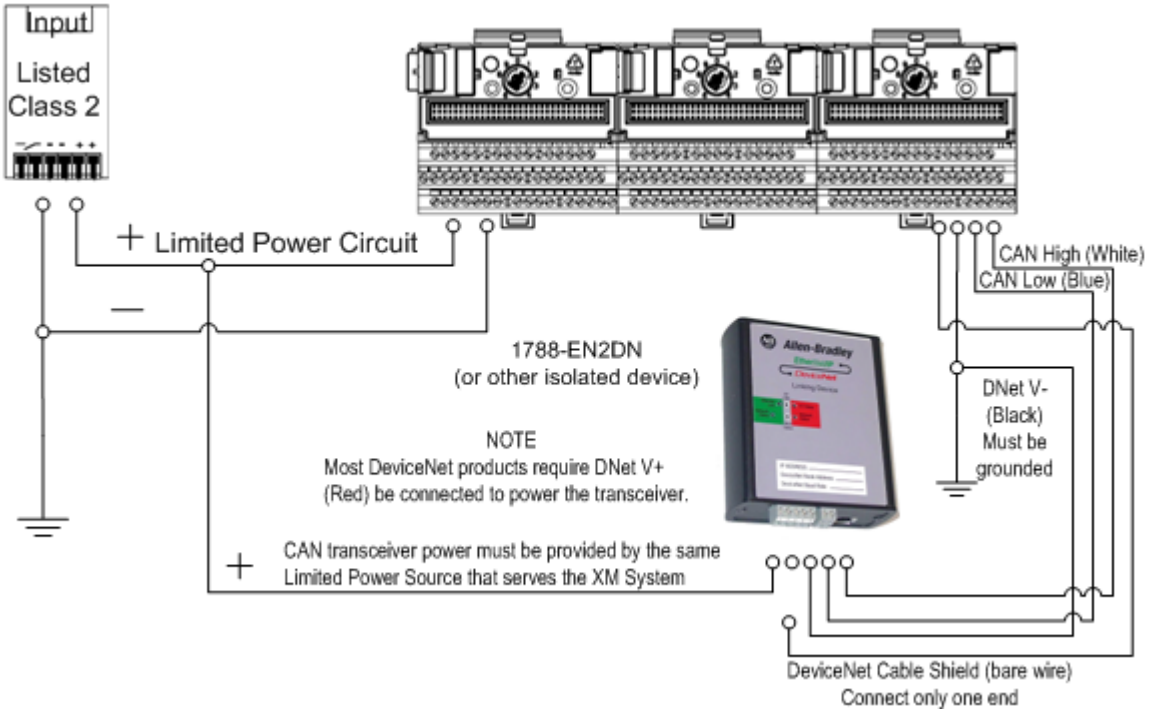
Figure 4: Powering DeviceNet in a Legacy XM System (1)



Allen-Bradley products such as the 1788-EN2DN, 1756-DNB, and PanelView products include isolated DeviceNet circuits and therefore can be used with an XM system, even if the device is powered by another source.

However, the CAN transceiver for these devices, which is powered from the devices’ DeviceNet V+ connection, must be powered from the same limited power source as the XM system, except when the XM System is comprised of XM-124 modules only (Page 10).

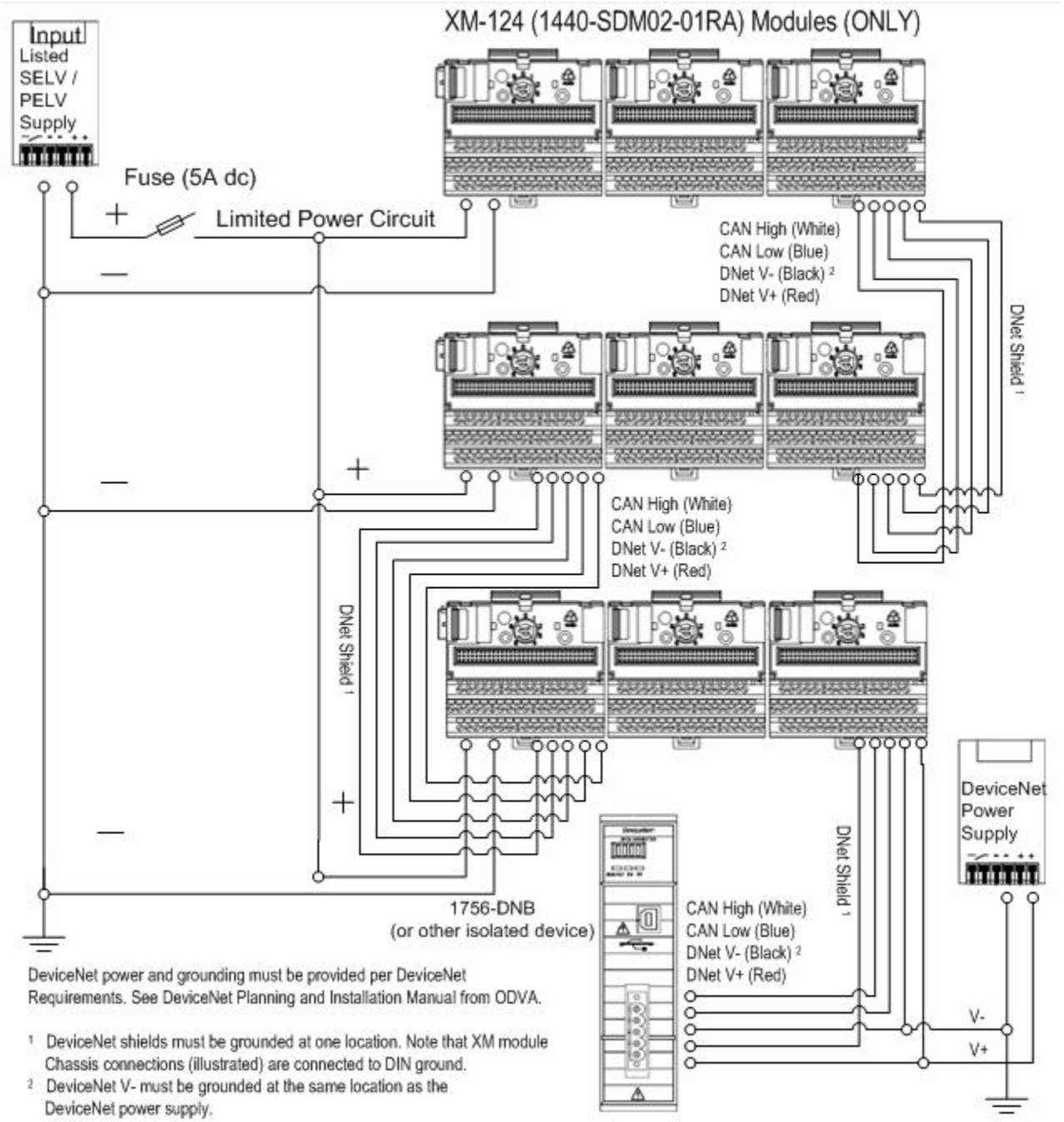
Figure 5: Powering DeviceNet in a Legacy XM System (2)



Powering an XM-124 (only) System

Where applications consist of one or more XM-124 modules (only) the DeviceNet network can be powered independently, per applicable DeviceNet installation requirements. In these cases all DeviceNet connections should be made, as illustrated in Figure 6.

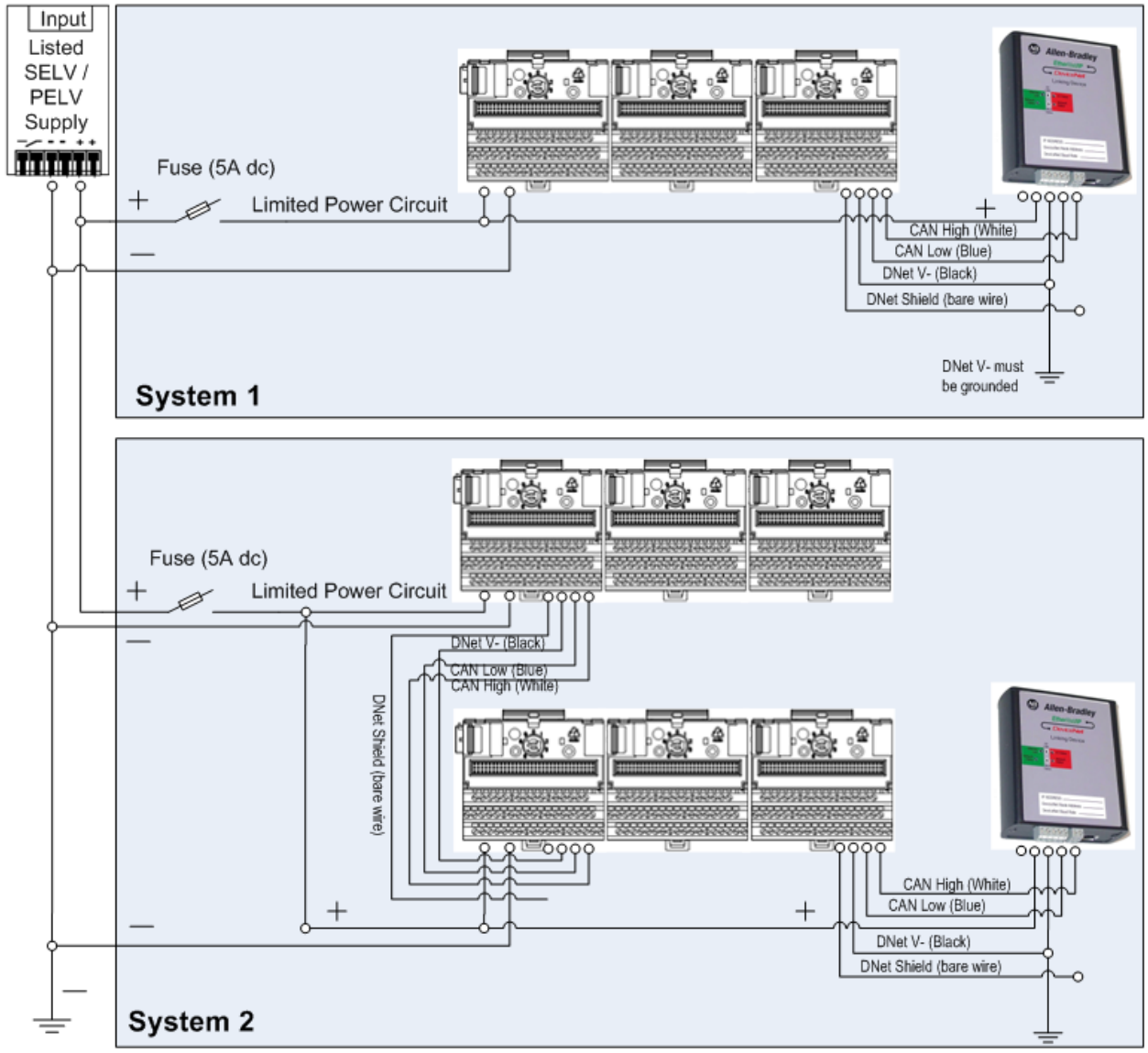
Figure 6: Wiring DeviceNet in an XM-124 (only) Installation



Powering Multiple XM Systems

Where applications require multiple XM systems that include legacy XM modules (if XM-124s only, see Figure 8) a single high-capacity power source can be used (Figure 7). However, the power supply must still satisfy the requirements stated above; each system must be independently protected by its own fuse. The systems cannot be connected in any way.

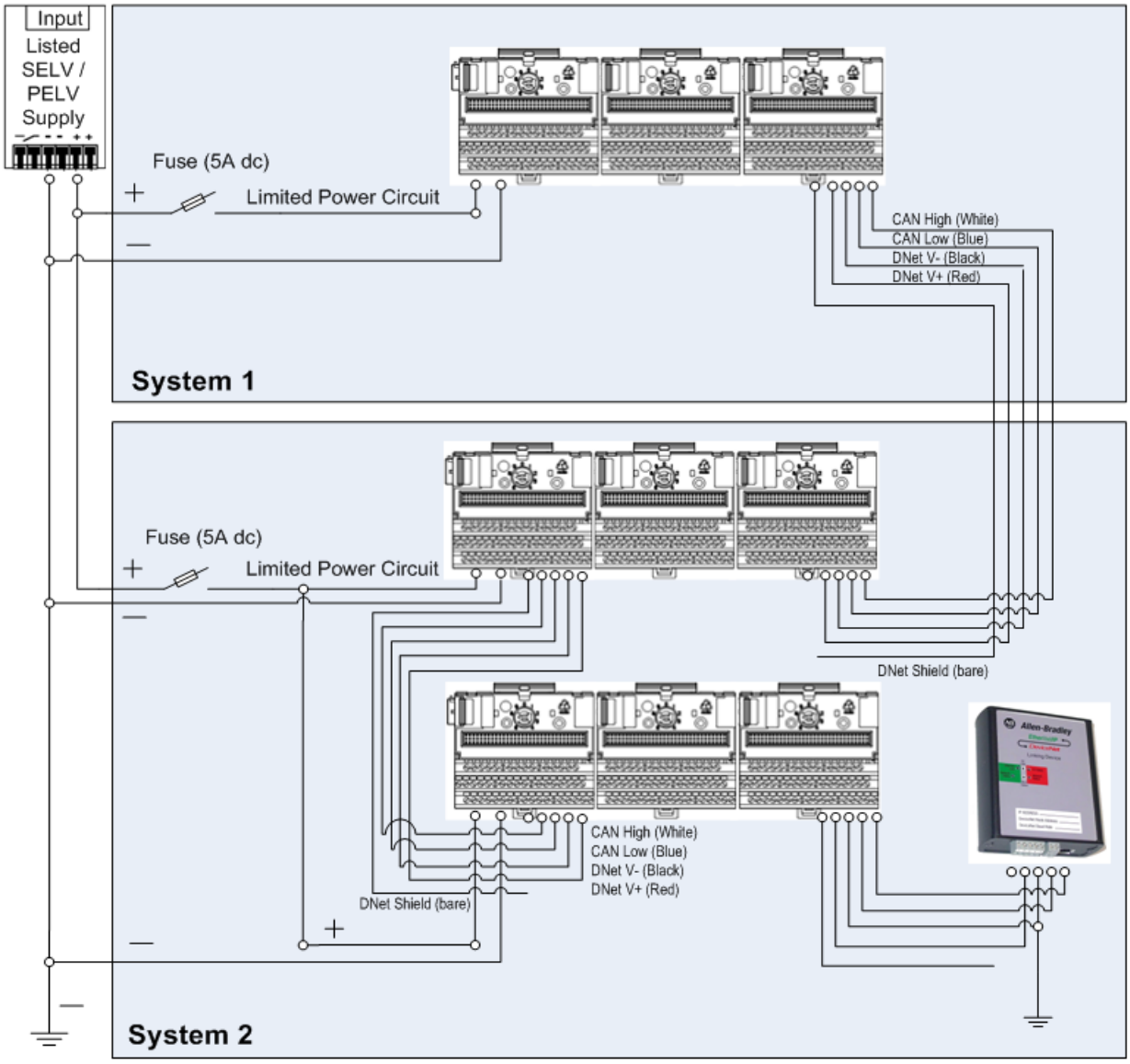
Figure 7: Powering Multiple Legacy XM Systems



Powering Multiple XM-124 (only) Systems

Where applications require multiple XM systems a single high capacity power source can be used (Figure 7). However, the power supply must still satisfy the requirements stated above. Note though that if the systems are comprised exclusively of XM-124 modules, then the DeviceNet network can be powered independently, and can connect to both systems (Figure 8).

Figure 8: Powering Multiple XM-124 (only) Systems



Grounding Requirement

Although the above illustrations indicate multiple different ground connections, all grounds in the system must be tied to the same point of the same grounding electrode system(6).

The key requirement is that in no case should the grounds be at different potentials relative to the power source.

The grounding electrode system is a method by which the neutral and grounding conductors are connected to the common "earth" reference. Requirements of these are specified by NEC and other standards organizations.

6 If the system is comprised of XM-124 modules (only) then DeviceNet power may be provided independently, in which case DeviceNet V- will be tied to ground at the same location as DeviceNet power.

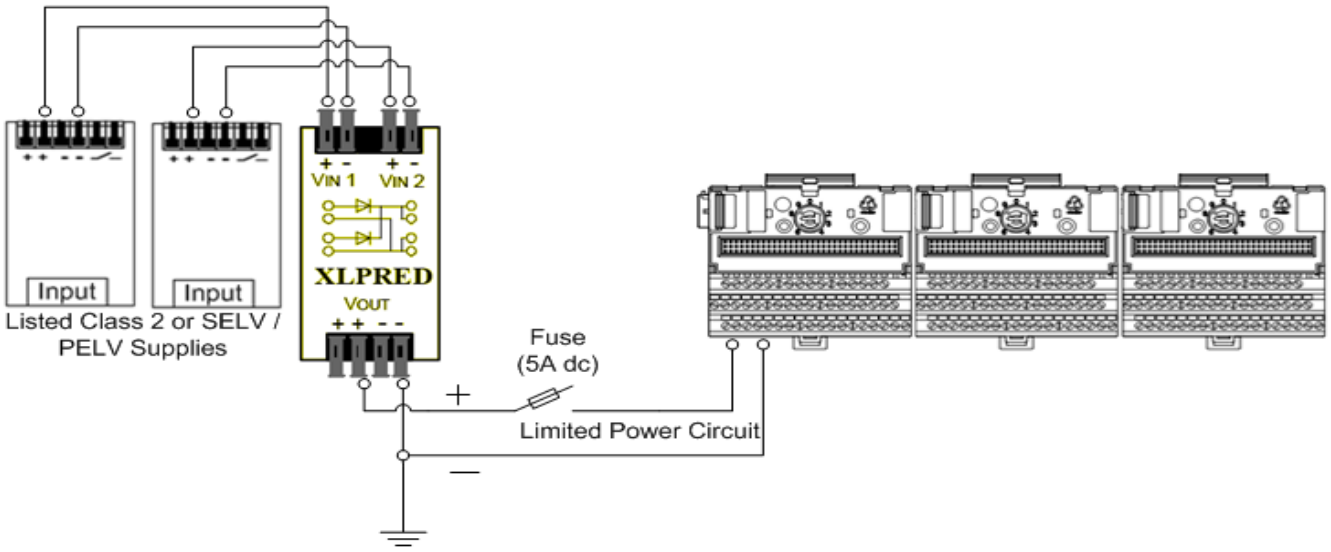
Solutions for Redundant Power

Many applications require redundant power be provided to assure higher system availability. There are two methods available for implementing a redundant power solution.

Redundant / Decoupler Module

The preferred method of providing redundancy is to install a Redundant/Decoupler module after the power supplies (Figure 9). Rockwell Automation offers several redundancy modules including the 1606-XLRED20-30, 1606-XLRED40, 1606-XLSRED, 1606-XLPRED and 1606-XLERED. These decoupling and redundancy modules can be used to configure highly reliable and true redundant power supply systems.

Figure 9: Redundant Power using a Redundancy Module



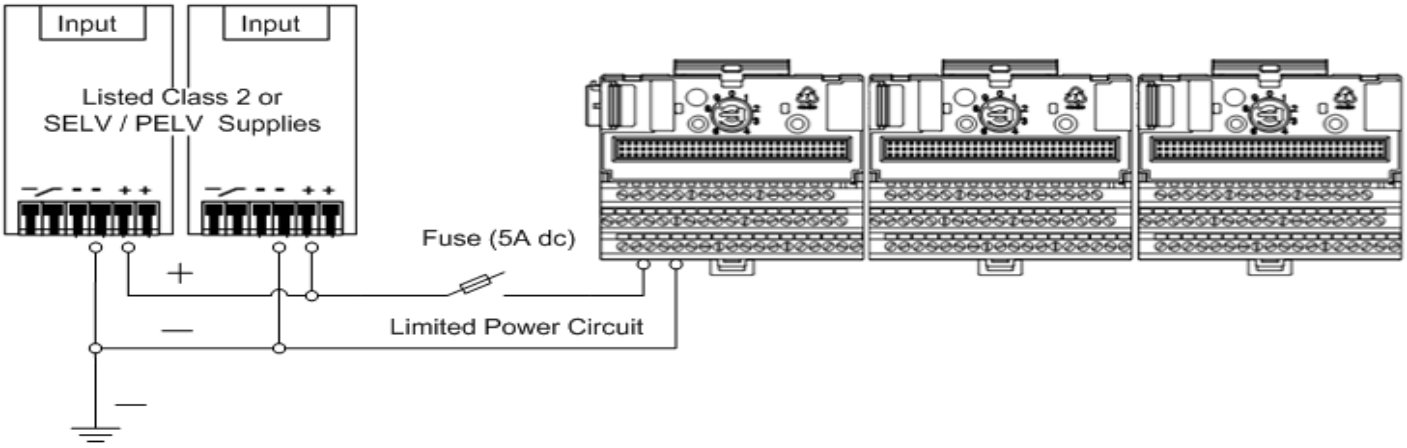
Recommendations for building redundant power systems:

- Use separate input fuses for each power supply.
- Monitor the individual power supply units to report a faulty unit. Depending on the specific power supplies and redundancy modules used, DC-ok lamps and DC-ok contacts will be included in either the power supplies or the redundancy module.
- When possible, connect each power supply to different phases or circuits.

Parallel Supplies

The simplest way to achieve redundancy is to wire two power supplies(7) in parallel (Figure 10). In the event one power supply fails, the other one automatically assumes the load current without any interruption.

Figure 10: Redundant Power using Parallel Supplies



Only supplies designed and listed specifically for redundant operation are allowed for use in an XM system.

7 Not all power supplies can be operated in parallel. Consult the specific power supply technical data and installation guides before wiring any supplies in parallel.

Paralleling Redundant Power Supplies

Rockwell Automation offers three supplies that are *specifically* designed for parallel redundant application(8). Using these supplies avoids the disadvantages of simply paralleling common power supplies.

The 1606-XL60DR, XL120DR and XL240DR are enhanced versions of the standard power supplies designed specifically for parallel use. Each device has internal diodes which provide isolation against DC bus problems corrupting working supplies. These devices provide "DC OK" output relay to allow remote monitoring of DC power status. When redundancy is required, and the capabilities of the 1606-XL60/120/240DR supplies can serve the requirement, then these are recommended for use with XM.

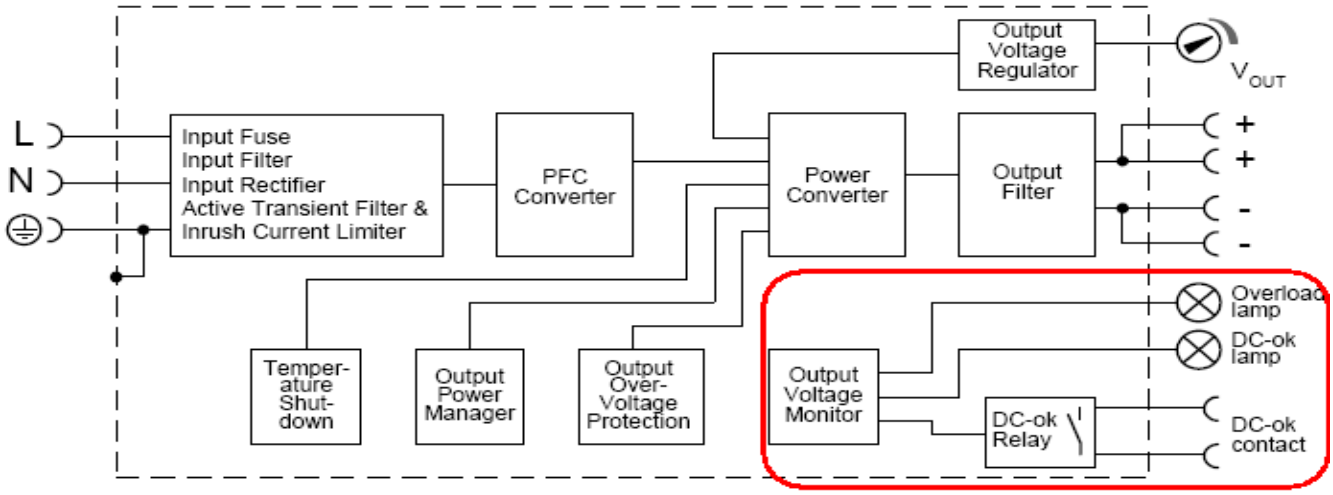
8 Rockwell Automation offers other supplies that are capable of redundant use but are not designed specifically for redundant applications (below).

Paralleling Redundant Capable Power Supplies

Besides the DR modules above, all 1606 **XLS** series supplies allow parallel operation while providing a *DC-ok Relay Contact and LED that are independent of a return voltage from a parallel supply.* Other supplies, such as the 1606-XLP100E, also protect the DC-ok LED and/or relay from being powered by a paralleled supply.

However, many supplies, such as the XLE series, do not support redundant operation and/or do not protect the supplies' DC-okay indication from reverse power. Only supplies that have an independent output voltage monitor, such as the 1606 XLS series, are recommended for use with an XM system.

Figure 11: Power Supply Independent Power Monitor Circuit



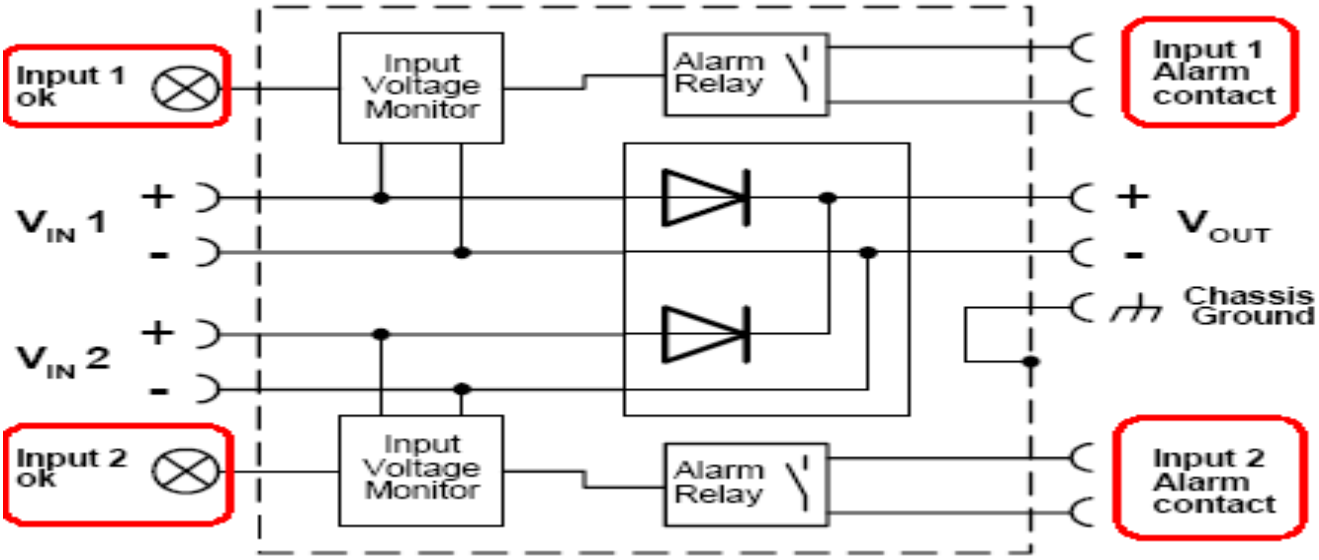
Faulted Redundant Supply Indication

In many (most) redundant power applications, an additional requirement exists which specifies that indication of a faulted supply be provided. In some cases “indication” can be served by a simple LED, while other cases require that a relay be provided. What is available depends on which series of power supply are used, and what redundancy solution is applied. Not all supplies in every series have identical capabilities. Users should always consult the power supply selection guide and power supply technical literature to insure that any specific supply includes the features required.

1606-XLERED Redundant/Decoupler Module

The redundancy module 1606-XLERED has monitoring circuitry included. Two LEDs and two relay contacts signal when one of the two DC-input voltages is not in range due to a non-functioning or disconnected power supply.

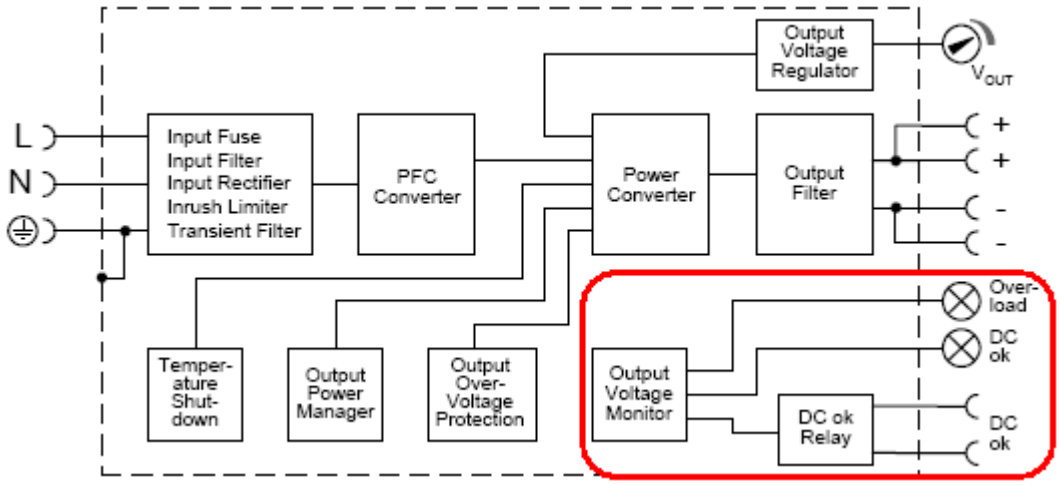
Figure 12: 1606-XLERED Functional Diagram



1606-XLS Series Supplies

Each supply in the XLS series is equipped with a DC-OK LED and relay.

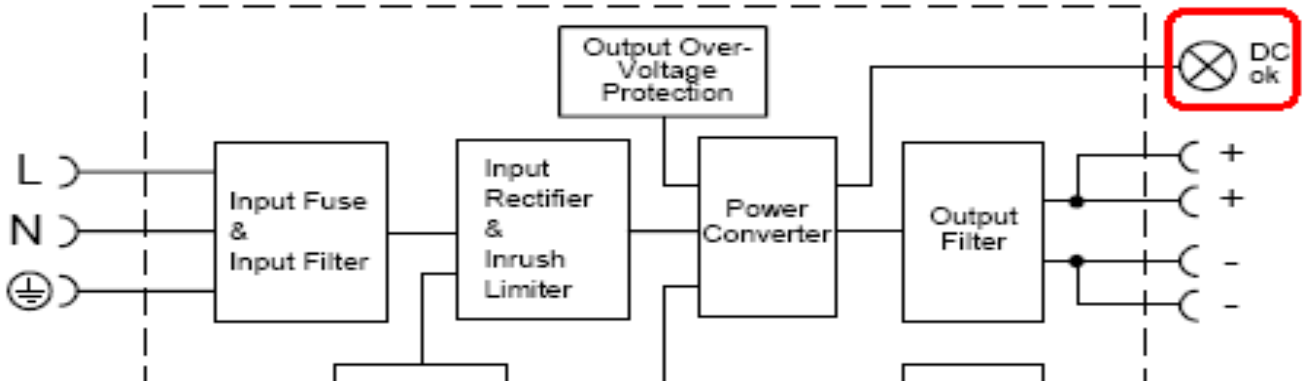
Figure 13: XLS Series Functional Diagram



1606-XLP Series Supplies

Each supply in the XLP series is equipped with a DC-OK LED indication (but no relay).

Figure 14: XLP Series Functional Diagram



1606-XL Series Redundant Supplies

The 1606-XL60DR, XL120DR, and XL240DR include a "DC OK" output relay to allow remote monitoring of DC power status.

Hazardous Area Solutions

When the XM system must be installed in a hazardous area any power supplies or converters used must be rated appropriately for the area. Additionally, the 1440-5AFUSEKIT fuse kit must be used with any supply other than a listed Class 2 supply.

Table 3 lists all 24Vdc output hazardous area certified(9) 1606 products.

Table 3: 1606 Series Hazardous Area Certified Products

Hazardous Location Rating **Class I Div 2**			
	Catalog Number	**Input Voltage**	**Output Amps**
XLS Series	1606-XLS80E	100…240 VAC, 110…300 VDC	3.3
	1606-XLS120E	100…240 VAC, 110…300 VDC	5.0
	1606-XLS240E	100…240 VAC, 110…300 VDC	10
	1606-XLS480E	100…240 VAC, 110…300 VDC	20
	1606-XLS240EC	100…240 VAC, 110…300 VDC	10
	1606-XL240E-3C	400…500 VAC, 450…820 VDC	10
	1606-XLS480E-3C	100…240 VAC, 110…300 VDC	20
	1606-XLSDNET4	100…240 VAC, 110…300 VDC	3.8
	1606-XLSDNET8	100…240 VAC, 110…300 VDC	8.0
	1606-XLSRED	10…60Vdc	20
XLP Series	1606-XLP15E	100…240 VAC, 85…375 VDC	0.6
	1606-XLP30E	100…240 VAC, 85…375 VDC	1.3
	1606-XLP50E	100…240 VAC, 85…375 VDC	2.1
	1606-XLP50EZ		2.1
	1606-XLP72E	100…120 / 220…240 VAC, 220…375 VDC	3.0

	Catalog Number	Input Voltage	Output Amps
	1606-XLP95E	100…120/ 220…240 VAC, 220…375 VDC	3.9
	1606-XLP100E		4.2
	1606-XLPRED	10…60Vdc	10
XL	1606-XLDC92D	14…32.4VDC	4.0
	1606-XL240E	100…240 VAC, 240…375 VDC	10
	1606-XL240EP		10

9 The only ATEX EX certified 1606 product is the 1606-XLDC92D DC/DC converter.

API-670 Solutions

Requirements

The American Petroleum Institutes Standard 670, Fourth Edition, December 2000, specifies power requirements in its section 5.4.1.7. Table 4 illustrates that section with comments as to how each paragraph may be addressed in an XM system.

Note that in the 1606 family of power supplies only a limited number of XLP and XLS series supplies fully satisfy the requirements of section 5.4.1.7.

Table 4: API-670 Power Requirements

Power Supplies	**Comments**
The monitor system components shall be capable of meeting the accuracy requirements specified in Table 1 with input voltage to the power supply of 90 to 132 volts AC rms or 180 to 264 volts AC rms, switch selectable, with a line frequency of 50-60 hertz. When specified, the following power supply options may be used: • 19 to 32 volts DC • 14 to 70 volts DC • 90 to 140 volts DC	In most cases the offered XM System will include AC/DC power supplies that will satisfy this requirement. In cases where the client requires the system be connected to DC sources, such as instrument power, DC to DC converters, such as the 1606-XLDC92DC are available.
The monitor system power supply(ies) shall be capable of supplying power to all components of the machinery protection system as defined in 3.38. Note: Non-integral displays are excepted from this requirement and may be powered by external supplies.	If the power required for the system exceeds 4 amps then the system must be split into multiple segments as necessary to satisfy the power requirements as stated in this document.
The output voltage to all oscillator-demodulators shall be –24 volts DC with sufficient regulation and ripple suppression to meet the accuracy requirements specified in Table 1.	XM modules are fully capable of satisfying this requirement.
All power supplies shall be capable of sustaining a short circuit of indefinite duration across their outputs without damage. Output voltages shall return to normal when an overload or short circuit is removed.	1606-XLP and 1606-XLS series supplies satisfy this requirement.
The transducer power source shall be designed to prevent a fault condition in one transducer circuit from affecting any other channel.	XM modules are fully capable of satisfying this requirement.

Power Supplies	Comments
All power supplies shall be immune to an instantaneous transient line input voltage equal to twice the normal rated peak input voltage for a period of 5 microseconds. Such a transient voltage shall not damage the power supplies or affect normal operation of the monitor system.	1606-XLP and 1606-XLS series supplies satisfy this requirement.
All power supplies shall continue to provide sufficient power to allow normal operation of the monitor system through the loss of AC power for a minimum duration of 50 milliseconds.	Some supplies hold-up time can satisfy this requirement only when power is limited to some reduced value or if powered from a 230VAC or greater source as indicated in the power supplies technical specifications.
As a minimum, the input power supply transformer for all instruments shall have separate windings with grounded laminations or shall be shielded to eliminate the possibility of coupling high voltage to the transformer secondary. In case of an insulation fault, the input voltage shall be shorted to ground.	1606-XLP and 1606-XLS series supplies satisfy this requirement.
When specified, the monitor system shall be fitted with a redundant power supply capable of meeting all the requirements of 5.4.1.7. This redundant supply shall be capable of accepting the same input voltages or different input voltages as the other power supply (for input voltage options, see 5.4.1.7.a). Each power supply shall be independently capable of supplying power for the entire monitor system, and a failure in one supply and its associated power distribution busses shall not affect the other.	Redundant solutions can be implemented as discussed in this document.

Conformal Coating Requirement

API-670 section 5.4.1.3 paragraph g states the following.

> Printed circuit boards shall have conformal coating to provide protection from moisture, fungus, and corrosion.

In applications where the system will be installed in a benign environment the customer may agree to an exception to this requirement. However, if no exception is allowed, then the following conformal coated power supplies(10) are available in the 1606 series.

Conformal Coating

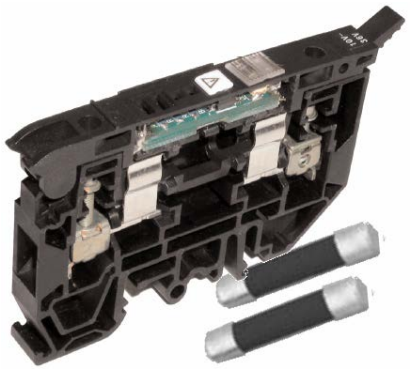
- 1606-XLE120EC
- 1606-XLS240EC
- 1606-XL240E-3C
- 1606-XLS480E-3C

See “Selecting a Power Supply Solution” later in this document.

10 While the above conformal coated power supplies are available, there are no conformal coated redundancy modules. As API-670 also requires redundant power, an exception to the conformal coating requirement will be required for both the power supplies and the redundancy module, or for just the redundancy module.

Fuse Kit

The optional fuse kit, part number 1440-5AFUSEKIT, may be used to provide an alternative to a listed Class 2 power source. The fuse kit can be used to limit the available current from a listed SELV/PELV source to the XM system.



Fuse kit 1440-5AFUSEKIT includes the following parts:

Manufacturer	Part Number	Description	Qty
Weidmuller	WSI 4/2 C1D2	Fuse Terminal	1
Weidmuller	WAP WSI 4/2	End Plate, Fuse Terminal	1
Bussmann	MDA-5-R	Fuse, Ceraminc Tube, 1/4” x 1-1/4”	2

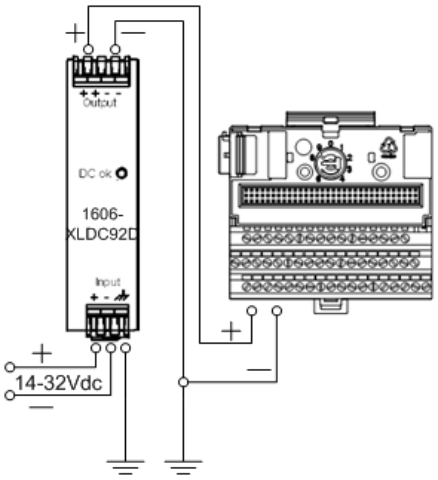
XM Module Power Requirements

The following table provides the maximum rated power requirement for each XM Series module. Use these values in calculating the total power requirement for an XM system. For the power requirements of non-XM devices such as a 1788-EN2DN, consult that product's technical data.

Table 5: XM Module Power Requirements

Catalog Number	Model	Description	Amps
Dynamic Measurement			
1440-SDM02-01RA	XM-124	Standard Dynamic	0.35
1440-VST02-01RA	XM-120	Standard Dynamic	0.30
1440-VLF02-01RA	XM-121	Low Frequency Dynamic	0.30
1440-VSE02-01RA	XM-122	gSE Vibration	0.30
1440-VAD02-01RA	XM-123	Aeroderivative	0.30
1440-VDRS06-00RH	XM-160	Direct (OA) Vibration	0.40
1440-VDRS06-06RH	XM-161	Direct (OA) Vibration w/4-20mA Outputs	0.40
1440-VDRP06-00RH	XM-162	Direct (OA) Vibration /w Prox-Probe Power	0.40
Speed Measurement			
1440-SPD02-01RB	XM-220	Dual Speed	0.30
Process Measurement			
1440-TPS02-01RB	XM-320	Position	0.20
1440-TPR06-00RE	XM-360	Process	0.25
1440-TUN06-00RE	XM-361	Universal Temperature	0.25
1440-TTC06-00RE	XM-362	Isolated TC Temperature	0.25
Relays			
1440-RMA00-04RC	XM-440	Master Relay	0.14
1440-REX00-04RD	XM-441	Expansion Relay	0.12
1440-REX03-04RG	XM-442	Voted EODS Relay	0.12

Selecting a Power Supply Solution



You can use the following logic to arrive at recommended power supply solutions for common XM applications.

Alternatively, Rockwell Automation offers a wide range of power supplies that can work with any standard AC or DC input voltage and that each offer its own advantages and disadvantages. Consult the Power Control catalog, publication number **A116-CA909** and the 1606 Power Supplies Brochure, publication **1606-BR001B**, as well as the specific power supply technical literature, for a complete list of and information on available power supply solutions.

The First Questions

Before researching power supplies, the following information must be gathered.

- What is the total power (load) requirement?

This can be arrived at by summing the maximum power consumption (in Amps) rating for each device in the system and then adding an appropriate amount of surplus(11**)**. For XM modules, these values are included in Table 5 of this document.

If the total is greater than 4A the system will have to be segmented into multiple smaller systems as illustrated earlier in this document.

Notes:

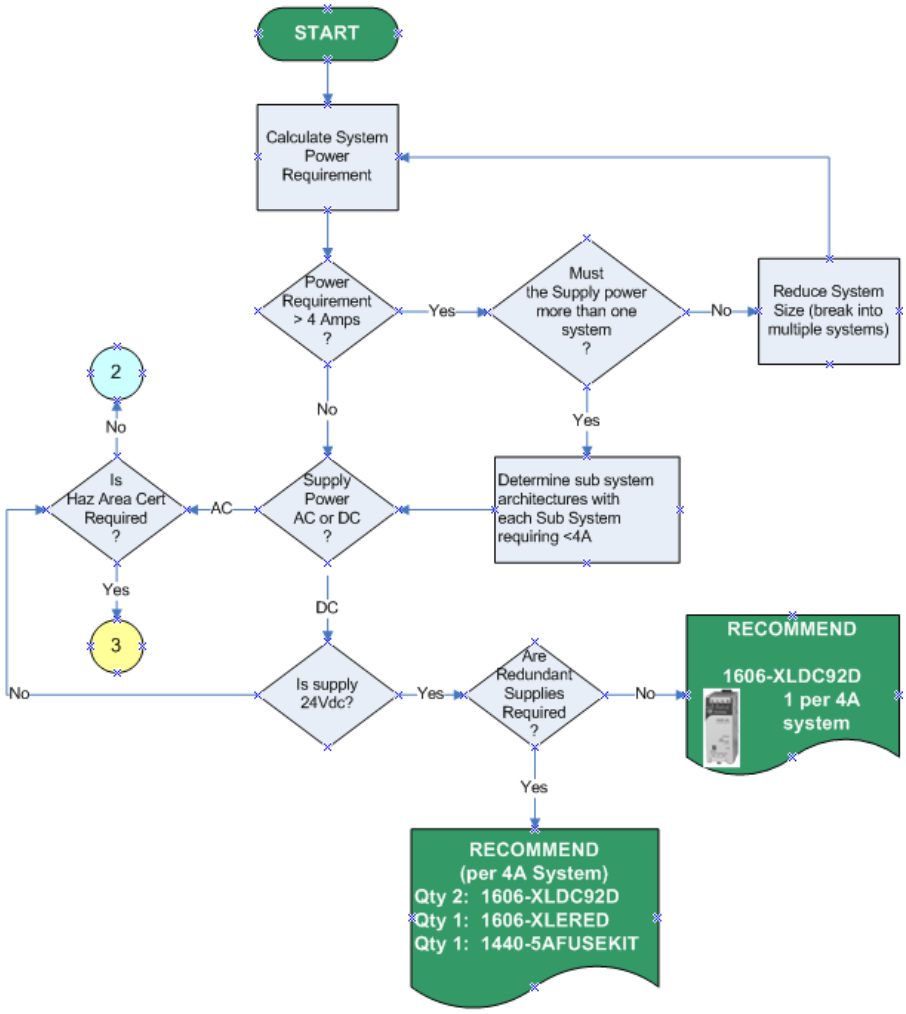
This may require that any communications or scanner devices be replicated for each system.

If the system consists of modules other than the XM-124, and includes devices with isolated DeviceNet connections, such as a PanelView, then consider powering the device from a different power supply or from the same supply but before the current limiting fuse.

- Is the customer's power supply AC or DC and what is the voltage?

If the customer's supply is 24Vdc, then the solution will be the 1606-XLDC92D(12).

Figure 15: Selecting a Power Solution (1)



11 Typical surplus power calculations use multipliers of 1.3 to 1.5 (30% to 50%) over the sum of the component loads. This is to allow for some future growth of the system, and to insure long life for the power supplies selected.

12 If the solution must satisfy API-670 then an exception may be required as the 1606-XLDC92D and 1606-XLERED are not conformal coated as required per paragraph 5.4.1.3 g.

Hazardous Area Certification Not Required

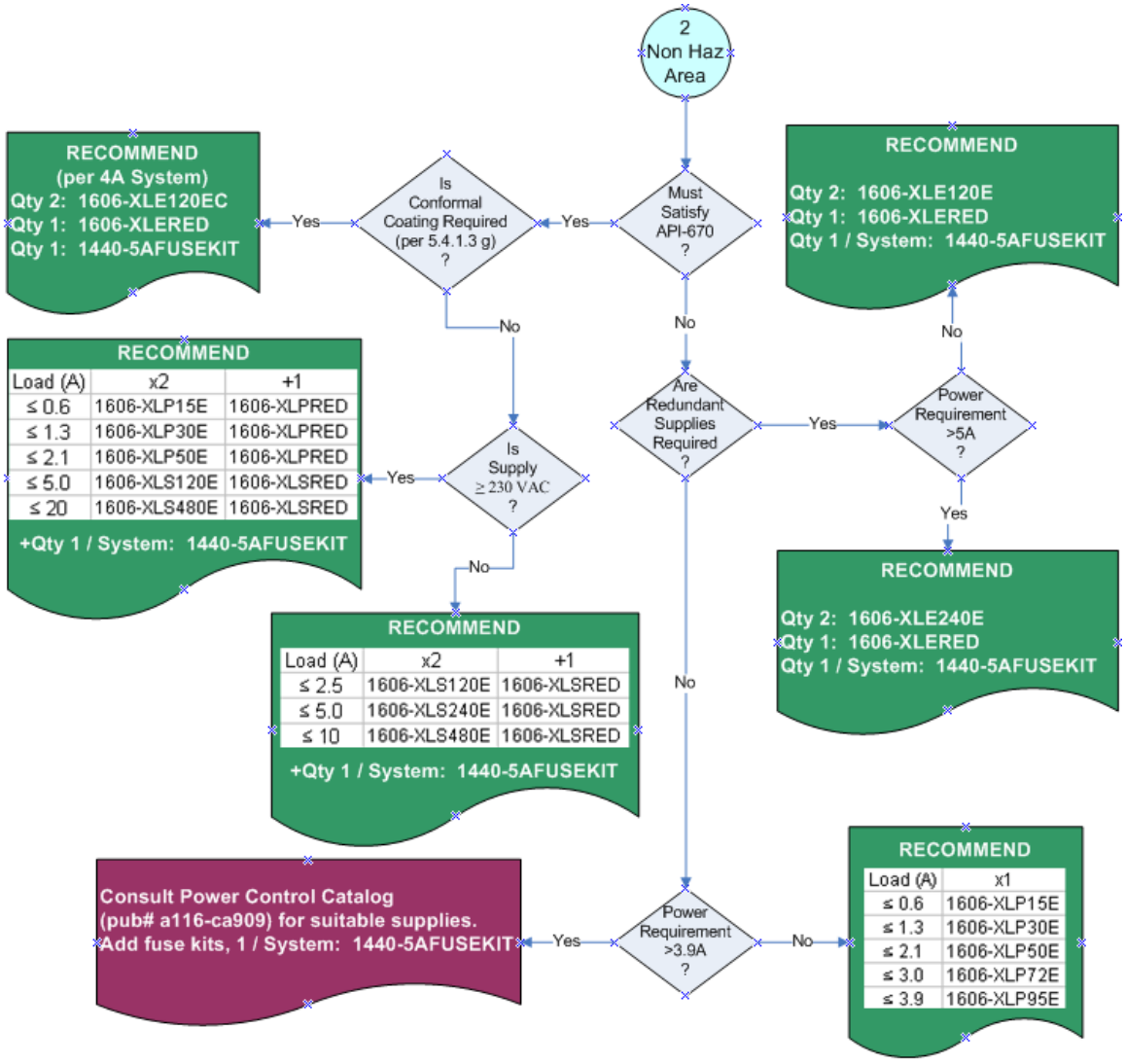
The supply does not require hazardous location rating.

- Does the customer require that the system satisfy the requirements of API-670?

If so, then must the power supply be conformal coated per section 5.4.1.3 paragraph g?

- Must the power supply solution be redundant?

Figure 16: Selecting a Power Solution (2)

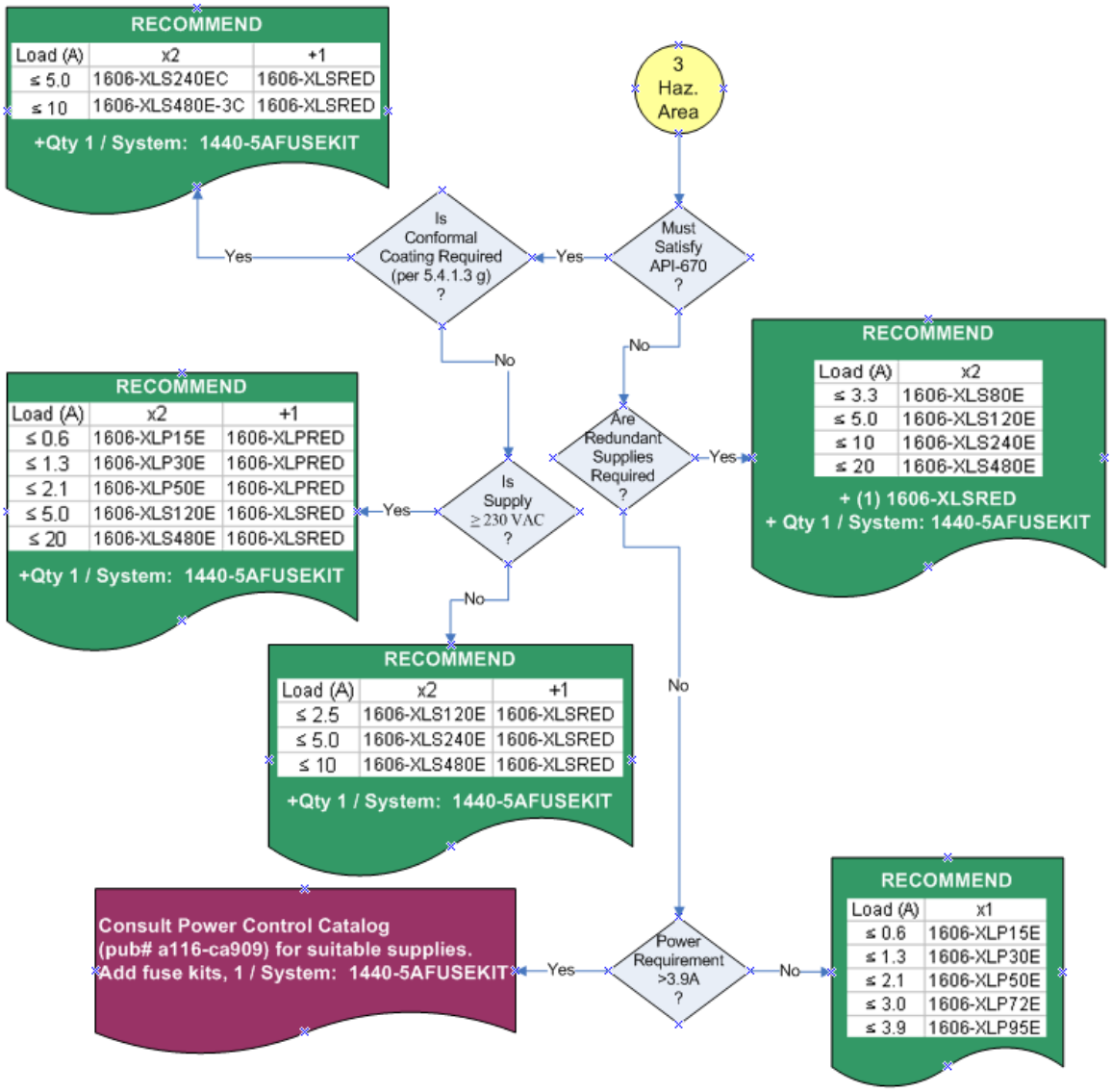


Hazardous Area Certification Required

The supply must be rated for use in a hazardous area (Class 1 Div 2).

- Does the customer require that the system satisfy the requirements of API-670?
- If so, then must the power supply be conformal coated per section 5.4.1.3 paragraph g?
- Must the power supply solution be redundant?

Figure 17: Selecting a Power Solution (3)



Best Practices

Once an appropriate power supply solution is defined, consideration should be given to the wiring solution. For a “Best Practices” installation the following recommendations should be considered:

- Breaker per Power Supply

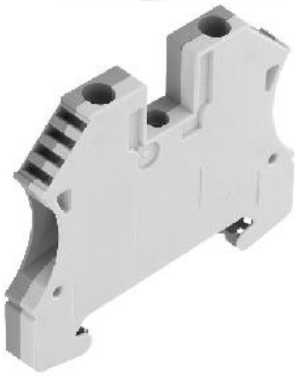
Always place a DIN mounted breaker, such as the 1492-SP1D050 (5 Amp) breaker, in front of each power supply. Typically a single pole breaker that isolates only the hot side of the supply is adequate.

- System Breaker

If redundant power supplies are included, or if power is routed to other components in the cabinet before the 24Vdc power supply (and its breaker), then add a breaker that isolates the entire system. Typically an adequate solution can be provided by a single pole breaker such as the 1492-SP1D100 (10 Amp).

- Terminal Blocks

In almost any system terminal blocks such as the 1492-J4 should be used to simplify the wiring solution.



- Ground Blocks

XM modules make a chassis ground connection through the DIN rail. Therefore every DIN rail must be connected to ground using either a DIN grounding block, such as the 1492-JG4, or by connecting the ground wire directly to the DIN rail (Figure 18).

Figure 18: XM System DIN Rail Grounding

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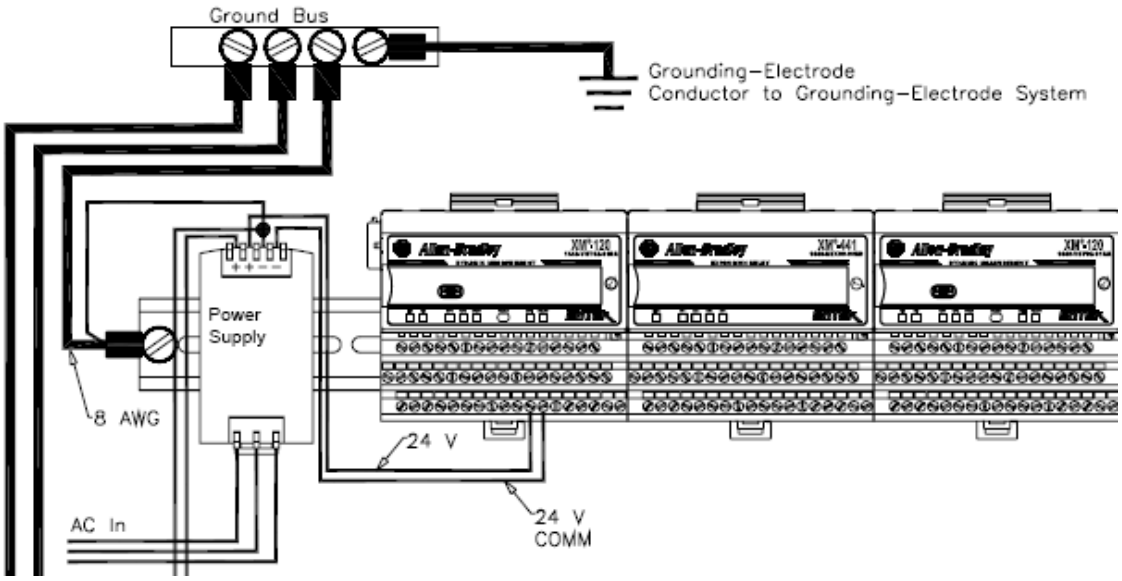

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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