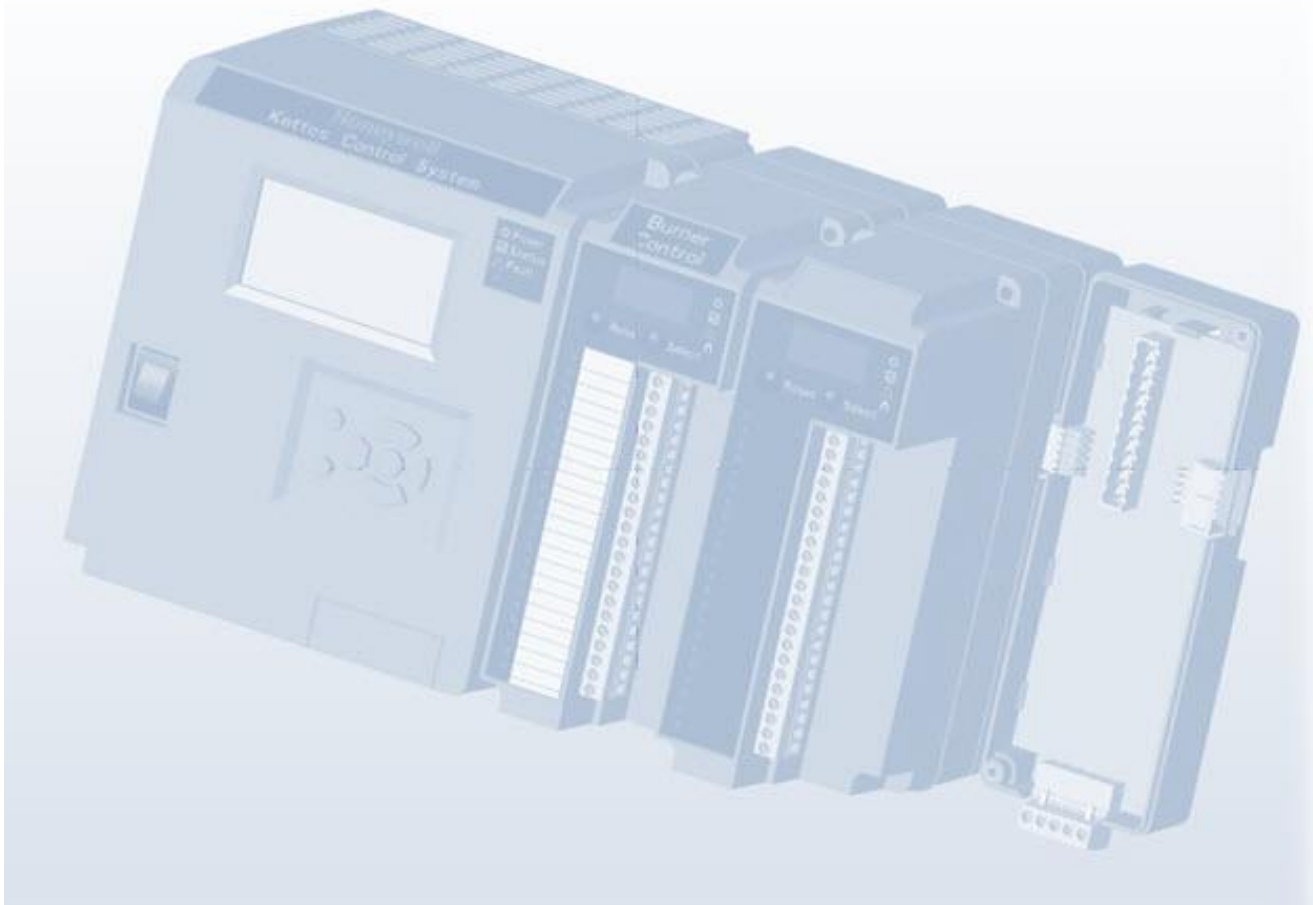


SLATE[®] Application Note



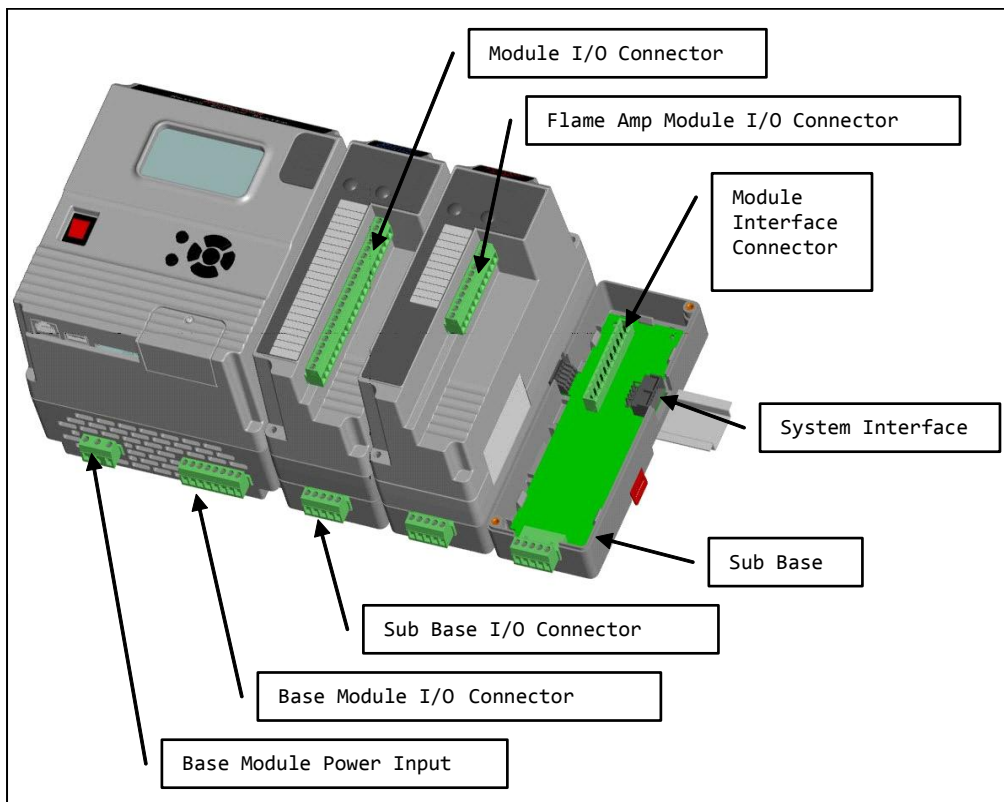
Power and Grounding Considerations for the SLATE System

1. Overview

1.1. This overview is intended to aid the SLATE system integrator in choosing the best method for ground and power connections. Every installation is different, but following these recommendations will greatly reduce potential for damaged equipment and incorrect I/O readings.

1.2. The figure below shows the different connections possible on the assembled SLATE system.

Base Module Power Input	Provides the main power interface for the Base module and modules on the DIN rail.
Base Module I/O	Supplies the auxiliary power output, and the BACnet interface and alarm relay contacts.
Sub Base	The sub base provides I/O module mounting.
Sub Base I/O	The I/O on this connector provides access to the system power supply (18VDC) and the flame safety bus if a flame amp is mounted.
Module Interface Connector	Connects the I/O module signal to the main system interface.
System Interface	Contains the module power ¹ (18VDC) and the inter module communication lines.
Module I/O	The standard 22 terminal connector for most I/O modules.
Flame Amplifier Module I/O	The 11 terminal connector for the flame amplifier modules.



SLATE Connector Definitions

Power and Grounding Considerations for the SLATE System

1. General Terminology

- SLATE System Ground* The ground for the 18V system power supply.
- Single Point Ground (SPG)* This term refers to a wiring point which provides little or no voltage differential between connections. A metal bar or a barrier terminal block with shorting bars between terminals is the most common type of implementation. Wiring which uses “daisy chain” connections is not considered to be a SPG and should be avoided.
- Digital Reference* Terminals labeled “Vref+” and “Vref-” used on the Limit, Burner, Digital, and Annunciator modules. The “Vref-” term should not be confused with the V+ or V- on the flame amplifiers. These references are electrically isolated from each other and have different purposes.

2. General Description of the SLATE power and ground

The SLATE system power supply (18VDC output) is **isolated from the system power input** (i.e. not internally connected to Earth ground).

Unless application specifics preclude it, it is advisable to reference the SLATE system power supply to Earth ground by attaching a wire from terminal 2 on the sub-base I/O connector of any module to Earth ground (See Figure 1-A), or alternatively connecting terminal 6 on the Base Module I/O connector to earth ground (See Figure 1-B), or terminal 6 (G) on the Flame Amplifier module to earth ground (See Figure 1-C).

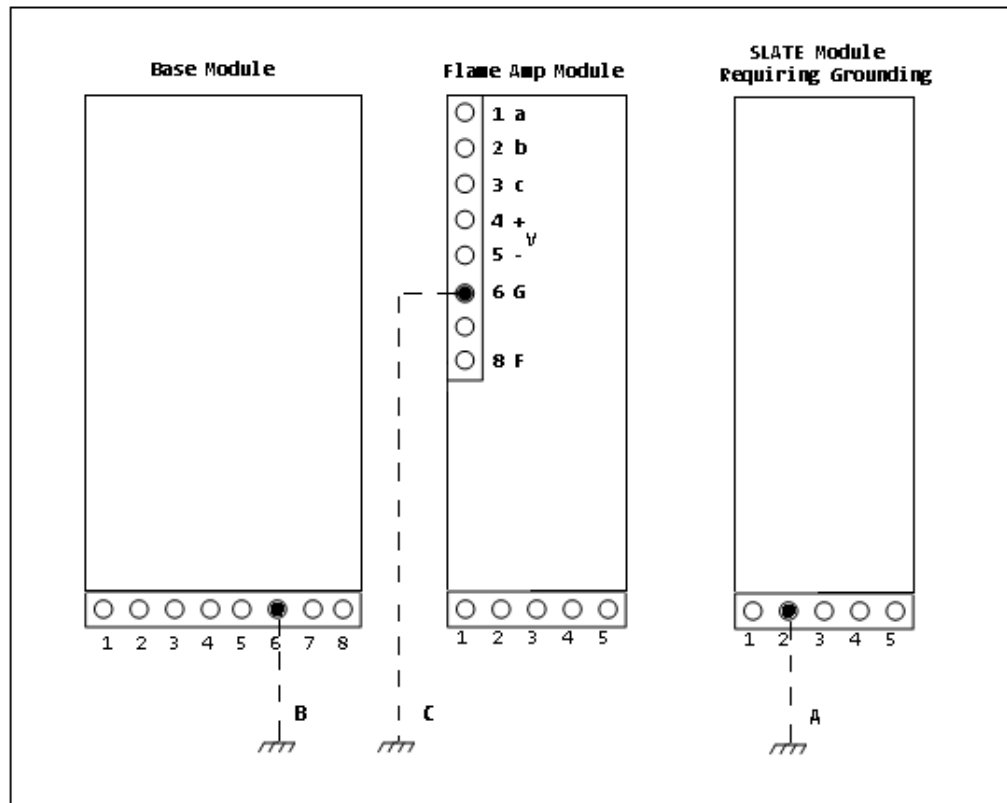


Figure 1: General Grounding Options

Power and Grounding Considerations for the SLATE System

Analog Modules (Analog I/O, Limit, Fuel/Air)

The analog cell terminals within these modules are not isolated; they are all referenced to the SLATE system ground.

An externally powered sensor (such as voltage, current or PWM input) to an analog cell must come from a power supply that is ground referenced to the SLATE system ground. Failure to do so may result in inaccurate sensor readings and possible damage to the analog cell or sensor. The power supply generating the voltage or current input should have its ground/common connected to terminal 2 of the sub-base I/O connector of the module utilizing the analog function. None of the four terminals of an analog cell are intended for grounding external equipment. Figure 2: Analog Module Grounding shows proper ground connections.

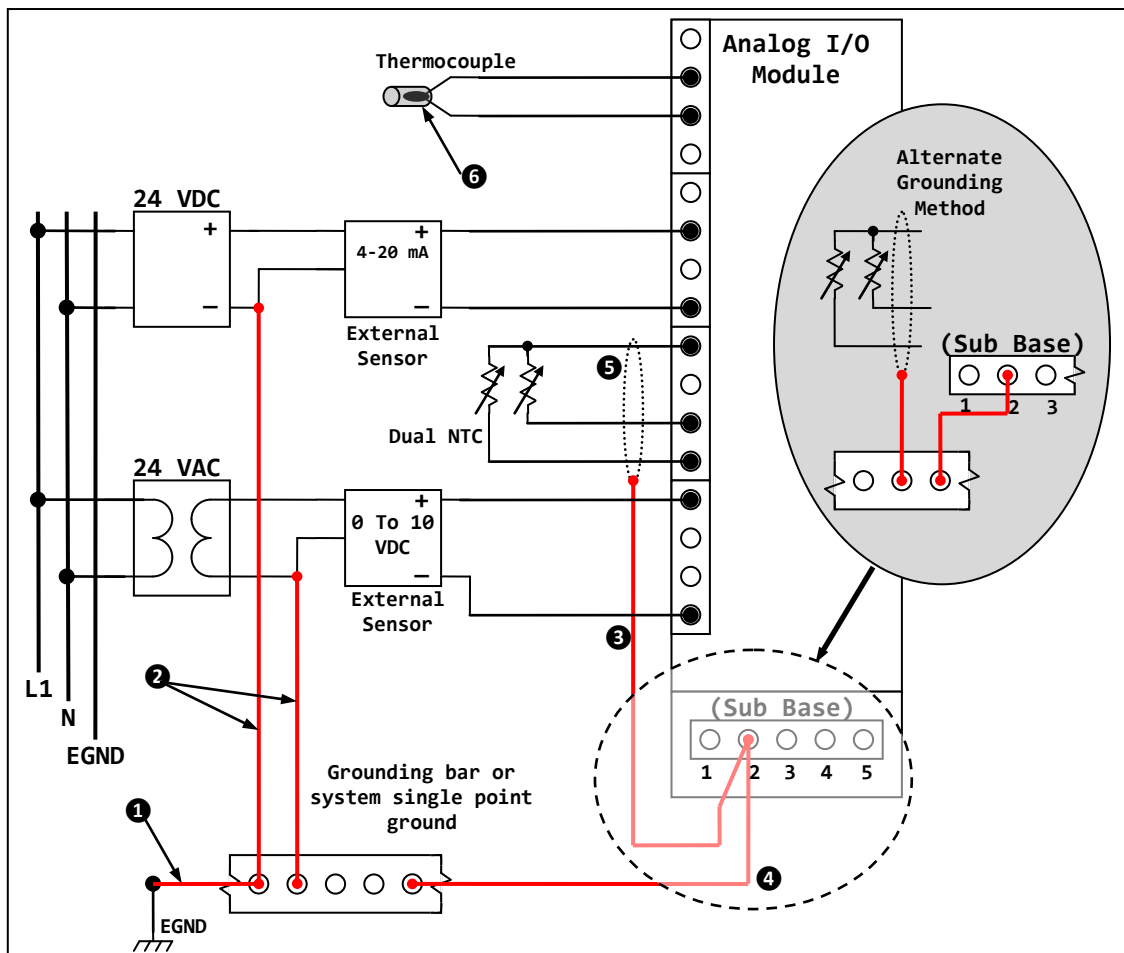


Figure 2: Analog Module Grounding

- 1 Recommended unless application specifics preclude this.
- 2 Applications using external power supplies to power external sensor(s) must have their ground reference terminal(s) in common with the SLATE system ground.
- 3 Shields for sensor cabling should be tied to SLATE system ground (terminal 2 of the sub base I/O connector) or the single point ground.
- 4 Add this connection when external supplies are present (2) or when tying shields directly to single point ground.
- 5 Shielded cable recommended for applications where electrical noise exists.

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- 6 Thermocouples must be isolated from SLATE system ground, Earth ground or any conductive path.

IMPORTANT: Do NOT use grounded node thermocouples. Use isolated node thermocouples only.

2.1. Flame Rectification Amplifier Modules

The Rectification Flame Amplifier module requires the SLATE system ground be connected to the burner ground (typically Earth ground). Drawing A in Figure 3: Rectification Flame Amplifier Connections shows best practice for a SLATE system that does not have any other points tied to earth ground. If the SLATE system ground is already connected to burner (Earth) ground, the wire from terminal G to earth ground is not required (see drawing B).

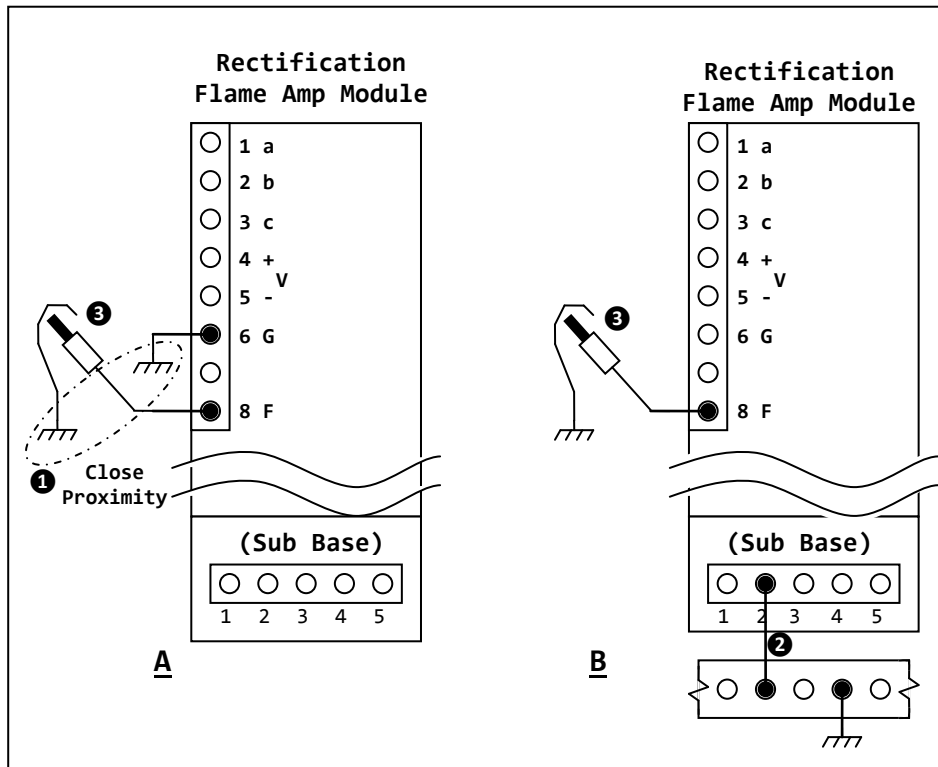


Figure 3: Rectification Flame Amplifier Connections

- 1 The connection from the flame rod return (G lead wire) should use the shortest direct path back to the Flame Amplifier Module. For best practice, the flame rod return (G lead wire) should be in close proximity with the F lead wire.
- 2 Grounding bar or system single point ground.
- 3 The Rectification Flame Rod.

Power and Grounding Considerations for the SLATE System

2.2. Digital Reference Terminals

The terminals labeled “Vref+” and “Vref-” (found on the Limit, Burner, Digital, and Annunciator modules) are electrically isolated from the SLATE system power supply and the SLATE system ground. These terminals are used only to configure the digital inputs and relay outputs of a module for operation at various voltage levels (24VDC, 24 VAC or line voltages).

The digital reference terminals have no impact on analog cell functionality.

Any device providing voltage to the digital inputs or receiving voltage from the relay outputs of these modules must be referenced to the Vref- terminal. The voltage must be the same phase and magnitude of the Vref+ reference voltage. Failure to comply may result in erroneous terminal readings or possible damage to the SLATE module or connected device.

The Vref terminals on a module are unique to that specific module. Different modules may use different Vref voltages.

Proper connections are shown in Figure 4: Digital I/O Reference. It is not permissible to make any connections to terminal 21.

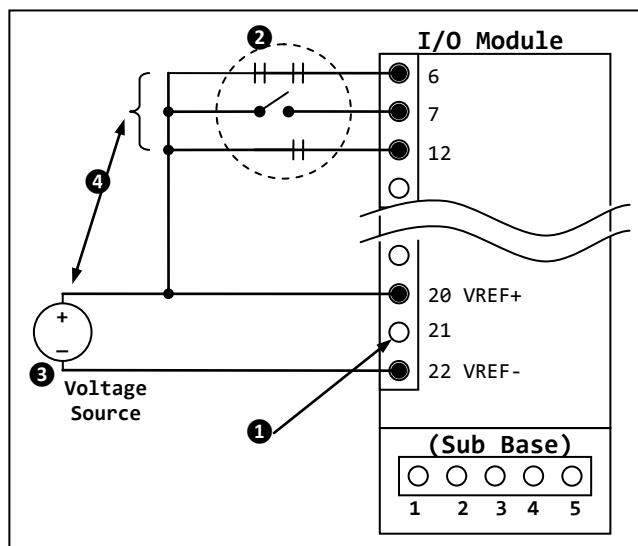


Figure 4: Digital I/O Reference

- ① Do not make any connections to this terminal.
- ② Typical application shown.
- ③ Voltage source may be 85 to 240 VAC, 24 VAC. or 24 VDC.
- ④ The voltage being sensed at the module I/O connector **must** originate from the same voltage source at the VREF terminals.

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2.3. Shielded cables

It is strongly advised that the shielded cable be used for analog signals that are sensitive to electrical noise and for digital or line voltage signals that can radiate electrical noise.

The RS-485 cables to the actuator can be an electrical noise radiator and should be grounded at one end of the cable. The actuator interface provides a terminal for grounding the shield(s). If this connection at the actuator is not made, or a different actuator used, then the cable shield should be tied to Earth ground at the module, using terminal 2 on the sub base I/O connector.

IMPORTANT: Do not ground both ends of the cable shield as a possible loop current may occur producing offsets in the analog signals.

Thermocouple and RTD signals are susceptible to electrical noise and it is recommended that shielded cabling be used with the shield tied to system or Earth ground (preferred). The connection point of the shield should be made at the SLATE end of the cable. Figure 2: Analog Module Grounding note 5 illustrates this concept.

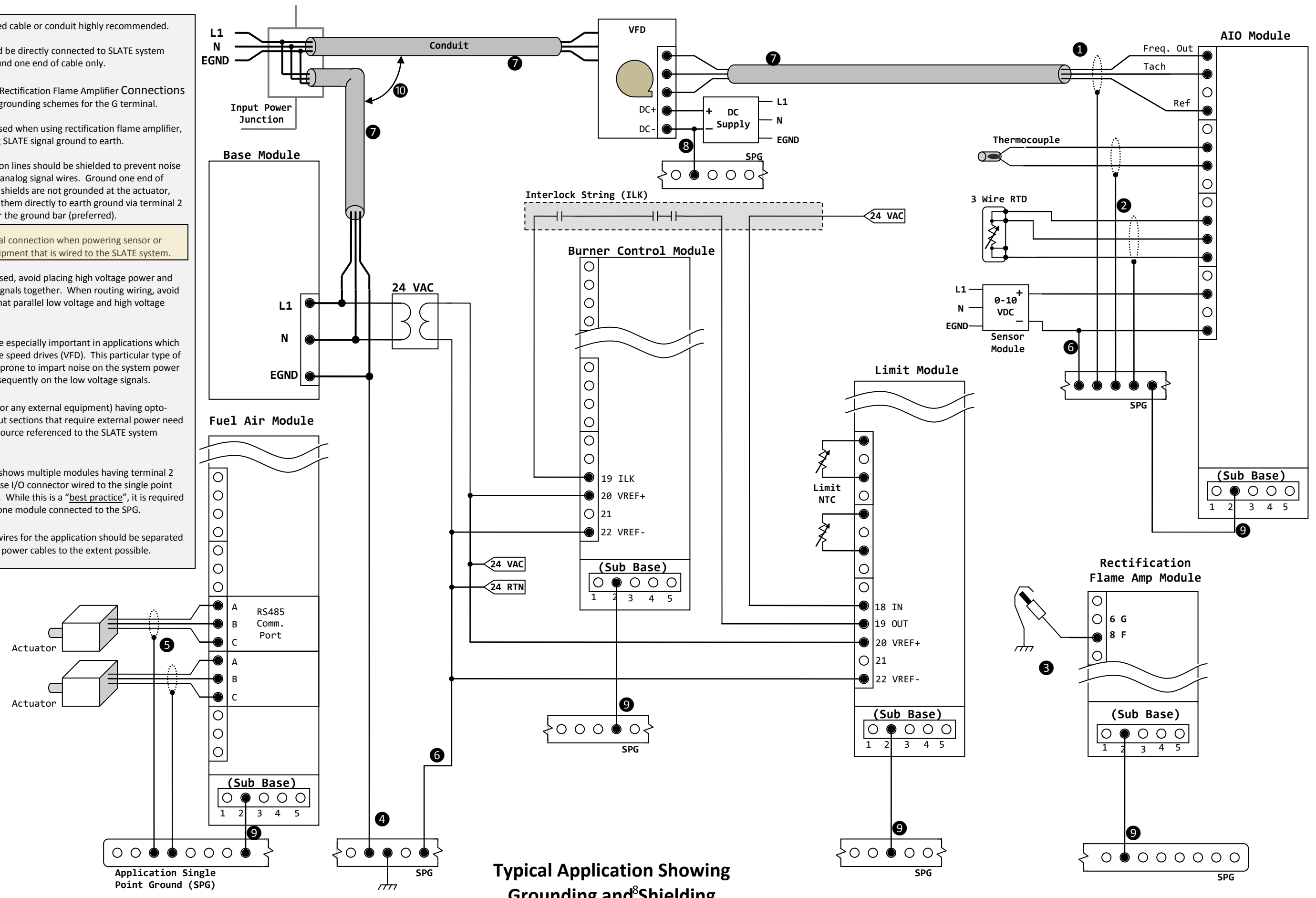
All analog signals should be separated from VFD (if present) cabling. Avoid running analog wires parallel to VFD wires (especially line voltage). The analog wires should never be placed in conduit with line voltage or VFD wires.

2.4. Thermocouples

The thermocouple circuit in the SLATE module uses a biasing voltage that is present on the wire sensing junction. Although the analog cell's input is heavily protected against static and short term over voltages, it is still possible to damage the input if care is not exercised in placement of the sense point (junction).

As shown in Figure 2: Analog Module Grounding, the thermocouple sense point (junction) is required to be isolated from ground and other conductive paths. Failure to isolate the sense point may also result in additional electrical noise pickup on the thermocouple signals or offset readings.

- 1 Use of shielded cable or conduit highly recommended.
 - 2 Shields should be directly connected to SLATE system ground. Ground one end of cable only.
 - 3 See Figure 3: Rectification Flame Amplifier Connections for alternate grounding schemes for the G terminal.
 - 4 Connection used when using rectification flame amplifier, or when tying SLATE signal ground to earth.
 - 5 Communication lines should be shielded to prevent noise coupling into analog signal wires. Ground one end of cable only. If shields are not grounded at the actuator, then connect them directly to earth ground via terminal 2 of sub base or the ground bar (preferred).
 - 6 This is a critical connection when powering sensor or interface equipment that is wired to the SLATE system.
 - 7 If conduit is used, avoid placing high voltage power and low voltage signals together. When routing wiring, avoid placements that parallel low voltage and high voltage signals.
- These become especially important in applications which utilize variable speed drives (VFD). This particular type of equipment is prone to impart noise on the system power lines and subsequently on the low voltage signals.
- 8 When VFD's (or any external equipment) having opto-isolated output sections that require external power need to have that source referenced to the SLATE system ground.
 - 9 This drawing shows multiple modules having terminal 2 on the sub base I/O connector wired to the single point ground (SPG). While this is a "best practice", it is required to have only one module connected to the SPG.
 - 10 Line voltage wires for the application should be separated from the VFD power cables to the extent possible.



Typical Application Showing Grounding and Shielding