Input Devices

Starting and Stopping the Motor

ATTENTION: The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove AC line power to the drive. When AC power is removed, there will be a loss of inherent regenerative braking effect & the motor will coast to a stop. An auxiliary braking method may be required.

Repeated Application/Removal of Input Power

ATTENTION: The drive is intended to be controlled by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies line power to the drive for the purpose of starting and stopping the motor is not recommended.

Bypass Contactors

ATTENTION: An incorrectly applied or installed bypass system can result in component damage or reduction in product life. The most common causes are:

- Wiring AC line to drive output or control terminals.
- Improper bypass or output circuits not approved by Allen-Bradley.
- Output circuits which do not connect directly to the motor.

Contact Allen-Bradley for assistance with application or wiring.

Electrical Interference - EMI/RFI

Immunity

The immunity of 1336 PLUS II drives to externally generated interference is good. Usually, no special precautions are required beyond the installation practices provided in this publication.

It is recommended that the coils of DC energized contactors associated with drives be suppressed with a diode or similar device, since they can generate severe electrical transients.

Emission

Careful attention must be given to the arrangement of power and ground connections to the drive to avoid interference with nearby sensitive equipment. The cable to the motor carries switched voltages and should be routed well away from sensitive equipment.

The ground conductor of the motor cable should be connected to the drive ground (PE) terminal directly. Connecting this ground conductor to a cabinet ground point or ground bus bar may cause high frequency current to circulate in the ground system of the enclosure. The motor end of this ground conductor must be solidly connected to the motor case ground.

Shielded or armored cable may be used to guard against radiated emissions from the motor cable. The shield or armor should be connected to the drive ground (PE) terminal and the motor ground as outlined above.

Common mode chokes at the drive output can help reduce common mode noise on installations that do not use shielded cable. Common mode chokes can also be used on analog or communication cables. Refer to page 2–37 for further information.

An RFI filter can be used and in most situations provides an effective reduction of RFI emissions that may be conducted into the main supply lines.

If the installation combines a drive with sensitive devices or circuits, it is recommended that the lowest possible drive PWM carrier frequency be programmed.

RFI Filtering

1336 PLUS II drives can be installed with an RFI filter, which controls radio-frequency conducted emissions into the main supply lines and ground wiring.

If the cabling and installation recommendation precautions described in this manual are adhered to, it is unlikely that interference problems will occur when the drive is used with conventional industrial electronic circuits and systems. However, a filter may be required if there is a likelihood of sensitive devices or circuits being installed on the same AC supply.

Where it is essential that very low emission levels must be achieved or if conformity with standards is required the optional RFI filter must be used. Refer to *Appendix C* and instructions included with the filter for installation and grounding information.

CE Conformity

Refer to *Appendix C.*

Grounding

Refer to the grounding diagram on page 2–13. The drive must be connected to system ground at the power ground (PE) terminal provided on the power terminal block (TB1). Ground impedance must conform to the requirements of national and local industrial safety regulations (NEC, VDE 0160, BSI, etc.) and should be inspected and tested at appropriate and regular intervals.

In any cabinet, a single, low-impedance ground point or ground bus bar should be used. All circuits should be grounded independently and directly. The AC supply ground conductor should also be connected directly to this ground point or bus bar.

Sensitive Circuits

It is essential to define the paths through which the high frequency ground currents flow. This will assure that sensitive circuits do not share a path with such current. Control and signal conductors should not be run near or parallel to power conductors.

Motor Cable

The ground conductor of the motor cable (drive end) must be connected directly to the drive ground (PE) terminal, not to the enclosure bus bar. Grounding directly to the drive (and filter, if installed) can provide a direct route for high frequency current returning from the motor frame and ground conductor. At the motor end, the ground conductor should also be connected to the motor case ground.

If shielded or armored cables are used, the shield/armor should also be grounded at both ends as described above.

Encoder & Communications Cabling

If encoder connections or communications cables are used, the wiring must be separated from power cabling. This can be accomplished with carefully routed, shielded cable (ground cable shield at the drive end only) or a separate steel conduit (grounded at both ends).

Discrete Control and Signal Wiring

The control and signal wiring must be grounded at a single point in the system, remote from the drive. This means the 0V or ground terminal should be grounded at the equipment end, not the drive end. If shielded control and signal wires are used, the shield must also be grounded at this point.

If the control and signal wires are short, and contained within a cabinet which has no sensitive circuits, the use of shielded control and signal wiring may not be necessary, but is always recommended.

Shield Termination - TE (True Earth)

The TE terminal block (not available on A Frame drives) is used for all cable shields at the drive. It must be connected to an earth ground by a separate continuous lead. TE connections may exist on power and/or control terminal blocks to terminate shield cables for both power and control. Refer to Figure 2.1 for locations.

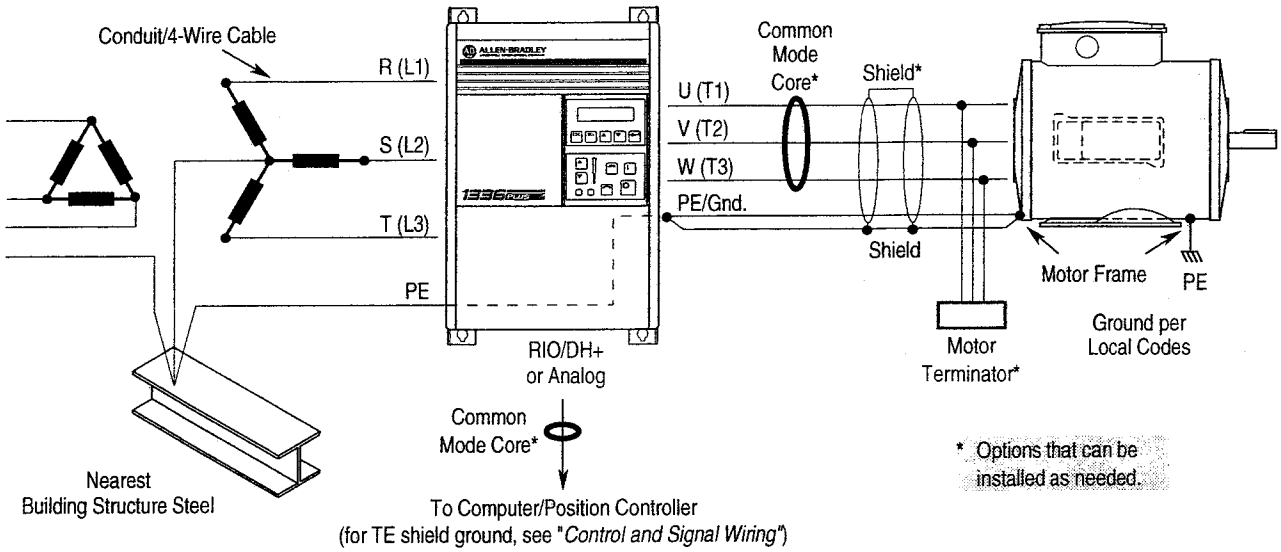
Safety Ground - PE (Potential Earth)

This is the safety ground required by code. This point must be connected to adjacent building steel (girder, joist) or a floor ground rod, provided grounding points comply with national or local electric code regulations. If a cabinet ground bus is used, refer to *Grounding* on page 2–11.

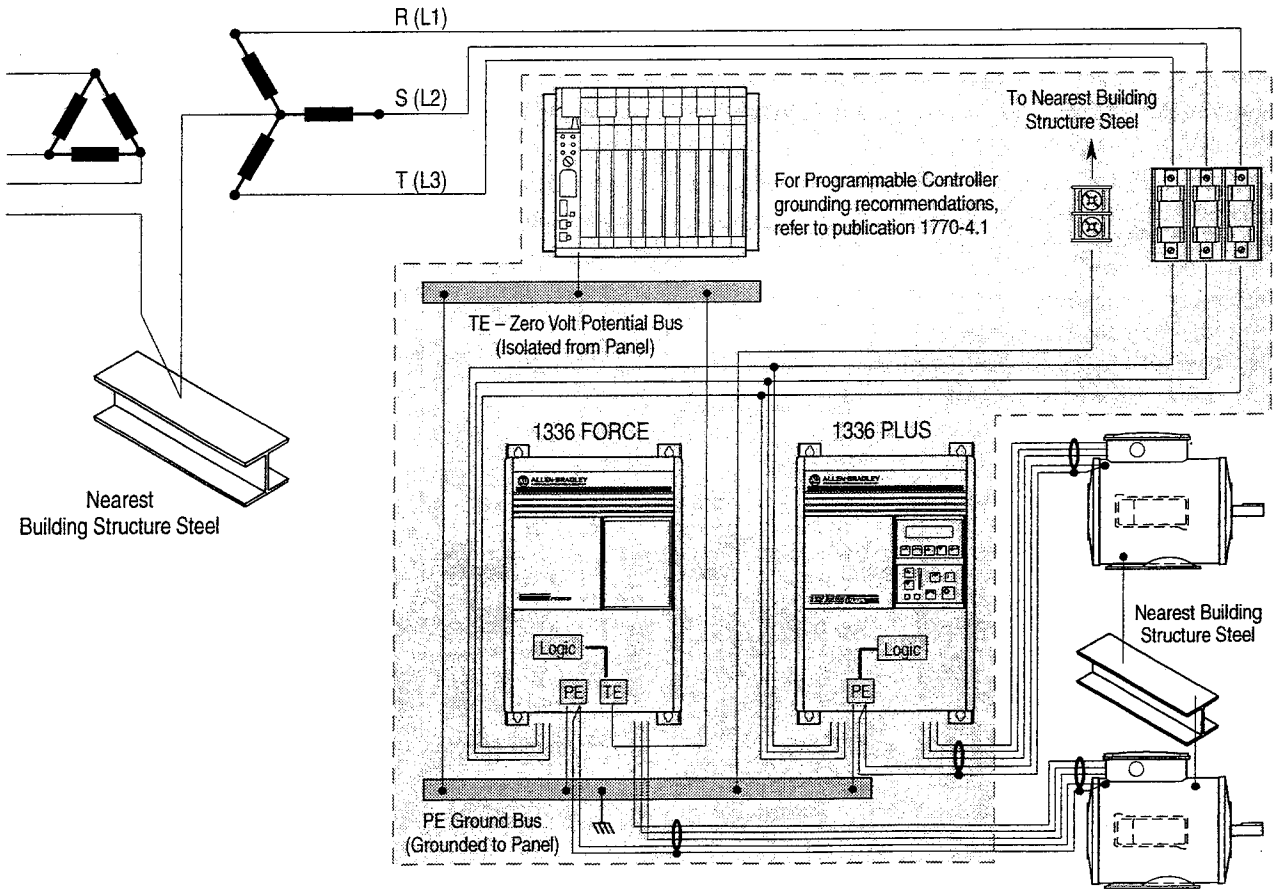
RFI Filter

Important: Using an optional RFI filter may result in relatively high ground leakage currents. Surge suppression devices are also incorporated in the filter. Therefore, the filter must be permanently installed and solidly grounded to the supply neutral. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. The integrity of this connection should be periodically checked.

General Grounding



Single-Point Grounding/Panel Layout



Important: Grounding requirements will vary with the drives being used. Drives with True Earth (TE) terminals must have a zero potential bus, separate from potential earth (PE) ground bus. Note that buses can be tied together at one point in the control cabinet or brought back separately to the building ground grid (tied within 3 meters (10 feet)).

Motor Cables

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than or equal to 15 mils (0.4 mm/0.015 in.).

The cable should be 4-conductor with the ground lead being connected directly to the drive ground terminal (PE) and the motor frame ground terminal.

Shielded Cable

Shielded cable is recommended if sensitive circuits or devices are connected or mounted to the machinery driven by the motor. The shield must be connected to both the drive ground (drive end) and motor frame ground (motor end). The connection must be made at both ends to minimize interference.

If cable trays or large conduits are to be used to distribute the motor leads for multiple drives, shielded cable is recommended to reduce or capture the noise from the motor leads and minimize "cross coupling" of noise between the leads of different drives. The shield should be connected to the ground connections at both the motor and drive end.

Armored cable also provides effective shielding. Ideally it should be grounded only at the drive (PE) and motor frame. Some armored cable has a PVC coating over the armor to prevent incidental contact with grounded structure. If, due to the type of connector, the armor is grounded at the cabinet entrance, shielded cable should be used within the cabinet if power leads will be run close to control signals.

In some hazardous environments it is not permissible to ground both ends of the cable armor because of the possibility of high current circulating at the input frequency if the ground loop is cut by a strong magnetic field. This only applies in the proximity of powerful electrical machines. In such cases, consult factory for specific guidelines.

Conduit

If metal conduit is preferred for cable distribution, the following guidelines must be followed.

- Drives are normally mounted in cabinets and ground connections are made at a common ground point in the cabinet. Normal installation of conduit provides grounded connections to both the motor frame ground (junction box) and drive cabinet ground. These ground connections help minimize interference. This is a noise reduction recommendation only, and does not affect the requirements for safety grounding (refer to pages 2–11 and 2–12).

- No more than three sets of motor leads can be routed through a single conduit. This will minimize "cross talk" that could reduce the effectiveness of the noise reduction methods described. If more than three drive/motor connections per conduit are required, shielded cable as described above must be used. If practical, each conduit should contain only one set of motor leads.

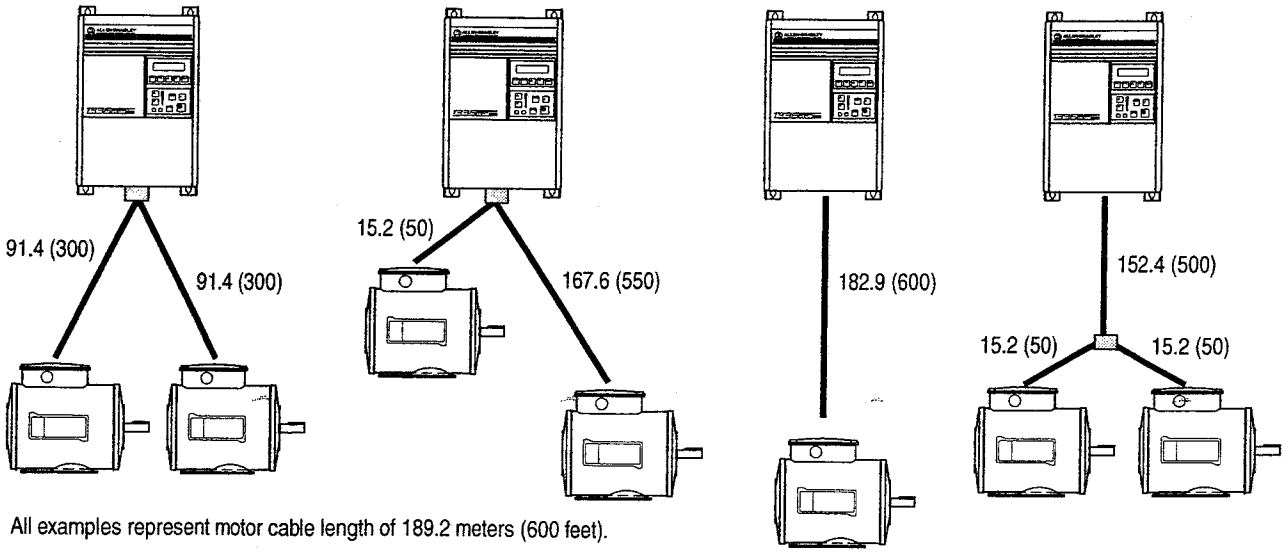
ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will eliminate the possible shock hazard from "cross coupled" drive motor leads.

Motor Lead Lengths

Installations with long cables to the motor may require the addition of output reactors or cable terminators to limit voltage reflections at the motor. Excessive cable charging current can also reduce the amount of current available to produce rated motor torque. Refer to Tables 2.F and 2.G for the maximum cable length allowed for various installation techniques. Shaded distances are restricted by cable capacitance charging current. The figure below demonstrates how total cable length is calculated. Failure to follow these guidelines can result in poor motor performance and nuisance drive overcurrent or overload tripping. For installations that exceed the recommended maximum lengths listed, contact the factory.

Please note that the cable lengths shown are guidelines. Your application may be restricted to a shorter cable length due to wire type, wire placement, line reactor and type of motor.

How to Measure Motor Cable Lengths Limited by Capacitance



All examples represent motor cable length of 189.2 meters (600 feet).

CE Conformity

Low Voltage Directive

The following low voltage directives apply:

- EN 60204-1
- PREN 50178

EMC Directive

This apparatus is tested to meet Council Directive 89/336 Electromagnetic Compatibility (EMC) using a technical construction file and the following standards:

- EN 50081-1, -2 - Generic Emission Standard
- EN 50082-1, -2 - Generic Immunity Standard

Declarations of Conformity to the European Union Directives are available. Please contact your Allen-Bradley Sales Representative.

Marked for all applicable directives[1]		CE
Emissions	EN 50081-1 EN 50081-2 EN 55011 Class A EN 55011 Class B EN 61800-3	
Immunity	EN 50082-1 EN 50082-2 IEC 801-1, 2, 3, 4, 6, 8 per EN 50082-1, 2 EN 61800-3	
Low Voltage	EN 60204-1 PREN 50178	

[1] Note: Installation guidelines stated below must be adhered to.

Important: The conformity of the drive and filter to any standard does not guarantee that the entire installation will conform. Many other factors can influence the total installation and only direct measurements can verify total conformity.

Requirements for Conforming Installation

The following six items **are required** for CE conformance:

1. Standard 1336 PLUS II Drive 0.37-448kW (0.5-600HP) CE compatible (Series D or higher).
2. Factory installed EMC enclosure (-AE option) or field installed EMC Enclosure Kit (1336x-AEx - see page C–3).
3. Filter as called out below.
4. Grounding as shown on page C–4.
5. Input power (source to filter) and output power (filter to drive & drive to motor) wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or other with equivalent or better attenuation, mounted with appropriate connectors. For shielded cable it is recommended to use a compact strain relief connector with double saddle clamp for filter and drive input and compact strain relief connector with EMI protection for motor output.
6. Control (I/O) and signal wiring must be in conduit or have shielding with equivalent attenuation.

Filter

Filter Selection

Filter Catalog Number	Filter Series	Mounting *See...*	Power Dissipation	Three-Phase Volts	Used with...	Frame Reference
1336-RFB-7-AA	A	Figure C.1	4.5 Watts	200-240V	1336F-AQF05 - AQF10	A1
				380-480V	1336F-BRF05 - BRF20	A1-A2
1336-RFB-7-A	B	Figure C.1 or Figure C.2	2 Watts	200-240V	1336F-AQF05 - AQF10	A1
				380-480V	1336F-BRF05 - BRF20	A1-A2
1336-RFB-16-AA	A	Figure C.1	9 Watts	200-240V	1336F-AQF15 - AQF20	A2
				380-480V	1336F-BRF30 - BRF50	A2-A3
1336-RFB-16-A	B	Figure C.1 or Figure C.2	9.5 Watts	200-240V	1336F-AQF15 - AQF20	A2
				380-480V	1336F-BRF30 - BRF50	A2-A3
1336-RFB-30-A	A	Figure C.1	14 Watts	200-240V	1336F-AQF30 - AQF50	A3
1336-RFB-30-A4	A	Figure C.2	35 Watts	380-480V	1336F-BRF75 - BRF200	A4
1336-RFB-27-B	A	Figure C.2	30 Watts	200-240V	1336F-A007	B
				380-480V	1336F-B007 - B015	B
1336-RFB-48-B	A	Figure C.2	56 Watts	200-240V	1336F-A010 - A015	B
				380-480V	1336F-B020 - B030	B
1336-RFB-80-C	A	Figure C.2	71 Watts	200-240V	1336F-A020 - A030	C
				380-480V	1336F-BX040 - BX060	C
1336-RFB-150-D	A	Figure C.3 or Figure C.4	90 Watts	200-240V	1336F-A040 - A050	D
				380-480V	1336F-B060 - B100	D
1336-RFB-180-D	A	Figure C.3 or Figure C.4	125 Watts	200-240V	1336F-A060	D
				380-480V	1336F-B125 - BX150	D
1336-RFB-340-E	A	Figure C.3 or Figure C.4	60 Watts	200-240V	1336F-A075 - A125	E
				380-480V	1336F-B150 - B250	E
1336-RFB-475-G	A	Figure C.5	61 Watts	380-480V	1336F-BP/BPR250 - BP/BPR350	F
					1336F-BX250 - B350	G
1336-RFB-590-G	A	Figure C.5	94 Watts	380-480V	1336F-BP/BPR400 - BP/BPR450	F
					1336F-B400 - B450	G
1336-RFB-670-G	A	Figure C.5	121 Watts	380-480V	1336F-B500 - B600	G