MIDI-MAESTRO SERVO DRIVE
ELECTROMAGNETIC COMPATIBILITY DATA

PRODUCT DCD 140×8/16, DCD 140×14/28

IMMUNITY
The drive complies with the following international and European harmonized standards for immunity:

Standard	Type of immunity	Test specification	Application	Level
EN 61000-4-2*	Electrostatic discharge	6kV contact discharge 8kV air discharge	Module enclosure	Level 3 (industrial)
ENV 50140*	Radio frequency radiated field	10V/m prior to modulation 80 - 1000MHz 80% AM (1kHz) modulation	Module enclosure	Level 3 (industrial)
ENV 50141*	Conducted radio frequency	10V prior to modulation 0.15 - 80MHz 80% AM (1kHz) modulation	Control and power lines	Level 3 (industrial)
EN 61000-4-4*	Fast transient burst	5/50ns 2kV transient at 5kHz repetition frequency via coupling clamp	Control lines	Level 4 (industrial harsh)
		5/50ns 2kV transient at 5kHz repetition frequency by direct injection	Power lines	Level 3 (industrial)
IEC 1000-4-5	Surges	Common mode 4kV 1.2/50µs waveshape	AC supply lines: line to earth	Level 4
		Differential mode 2kV 1.2/50µs waveshape	AC supply lines: line to line	Level 3
EN50082-1	Generic immunity standard for the residential, commercial and light - industrial environment			Complies
EN50082-2	Generic immunity standard for the industrial environment Calls up basic standards marked *			Complies

The immunity is achieved without any additional measures such as filters or suppressors. To ensure correct operation the wiring guidelines specified in the User Guide must be carefully adhered to. All inductive components such as relays, contactors, electromagnetic brakes etc. associated with the drive must be fitted with appropriate suppression, otherwise the immunity of the drive may be exceeded.

CONDUCTED EMISSION

Radio frequency emission in the frequency range from 150kHz to 30MHz is mainly conducted out of the equipment through electrical wiring. It is essential for compliance with emission standards that the recommended filter and a shielded (screened) motor cable are used. Most types of cable can be used provided it has an overall screen, for example, the shield formed by the armouring of steel wired armoured cable is acceptable. The capacitance of the cable forms a load on the drive and should be kept to a minimum. Compliance tests were done with cable having a capacitance between the three power cores and the shield of 412pF per metre (measured at 1kHz), which is typical of steel wire armoured cable. Wiring guidelines are given in Figure1 which shows full precautions where minimum emissions are required.

When used with the recommended filters, the drive complies with the requirements for conducted emission in the following standard:

Motor cable length (m)	**Emission level**
1	I
10	I

Key to table	**Standard**	**Description**	**Frequency range**	**Limits**	**Application**
I	EN50081-2	Generic emission standard for the industrial environment	0.15 - 0.5MHz	79dBµV quasi peak 66dBµV average	AC supply lines
			0.5 - 5MHz	73dBµV quasi peak 60dBµV average	
			5 - 30MHz	73dBµV quasi peak 60dBµV average	

Conducted emission test data

The conducted emission from a DCD 140×8/16 operating with the recommended filter, is shown in the average measurement plot No. 4048, Figure4, and quasi peak measurement plot No. 4049, Figure5. These show compliance with the industrial standard using 10m of screened motor cable.

In the tests, a 380/105 VAC 2000VA isolating transformer (Soprel part number PN 4.91.449), was used to generate the three phase supply to the drive. The transformer was of standard construction and did not have a screen between primary and secondary. This component has the beneficial effect of reducing the lower frequency conducted emission from the drive, and must be used in conjunction with the input filter to achieve the stated emission levels.

Recommended filters

Drive	**Motor cable length (m)**	**Input filter (Roxbrugh Part Nos.)**
DCD 140×8/16	1 to 10	S-1213-10 *
DCD 140×14/28	1 to 10	S-1213-10 *

*available through Roxbrugh Electronics Ltd, UK. Tel +44 (0) 1724 281770.

Schaffner filter, part number FN355-10/05, may be used as an alternative to the one listed in the table but it will be necessary to fit the following additional components, close to the filter's terminals, to achieve comparable performance:

1) 10nF Y rated capacitor connected N to E on the load side.
2) 100nF X rated capacitor star network connected between power lines on the line side.

Related product standards
The conducted emission levels specified in EN50081-2 are equivalent to the levels required by the following product specific standards:

Conducted emissions from 150kHz to 30MHz		
Generic standard	**Product standard**	
EN50081-2	EN55011 Class A Group 1 CISPR 11 Class A Group 1	Industrial, scientific and medical equipment
	EN55022 Class A CISPR 22 Class A	Information technology equipment

RADIATED EMISSIONS
When installed in a standard metal enclosure according to the wiring guidelines in Figure 1, the drive will meet the radiated emission limits required by the generic industrial emission standard EN50081-2.

Important note
Compliance was achieved in tests using representative enclosures and following the guidelines given. Every effort was made to ensure that the arrangements were robust enough to be effective despite the normal variations which will occur in practical installations. However no warranty is given that installations built according to these guidelines will necessarily meet the same emission limits.

The limits for emission required by the generic industrial emission standard are summarized in the following table:

Radiated emission from 30 to 1000MHz				
Standard	**Application**	**Frequency range**	**Limits**	**Comments**
EN50081-2	Enclosure	30 - 230MHz	40dBµV/m quasi peak at 10m	Standard specifies limits of 30 and 37dBµV/m respectively at a measuring distance of 30m; emissions may be measured at 10m if limits are increased by 10dB
		230 - 1000MHz	47dBµV/m quasi peak at 10m	

Test Data
The test data is based on radiated emission measurements made on a standard steel enclosure containing a single DCD 140×8/16 140drive, in a calibrated open area test site. Details of the test arrangement are described:

A standard Rittall enclosure was used having dimensions 1900mm (high) × 600mm (wide) × 500mm (deep). Two ventilation grilles, both 200mm square, were provided on the upper and lower faces of the door.

The Drive was fitted to the internal back-plate of the enclosure, the drive heatsink directly grounded to the back-plate using the metal mounting brackets. In the tests, no RFI filter was connected to the drive. Standard unscreened power cable was used to connect the enclosure to the supply.

A standard 0.37kW DC servo motor, with tacho feedback, was connected by 4m of shielded cable (steel braided - type SY) and mounted externally. The shield of the motor cable was bonded to the back-plate using a metal clamp, it was not bonded to the enclosure wall at the point of entry.

A 2m screened control cable was connected to the drive control terminals, but the screen was isolated from the cubicle wall.

Emission measurements were made on the enclosure with the drive operating at 150rpm.

No additional EMC preventative measures were taken, e.g. RFI gaskets around the cubicle doors.

The following table summarizes the results for radiated emissions, showing the six highest measurements over the frequency range 30 to 1000 MHz:

Frequency MHz	Emission dBµV/m	Level required by industrial standard EN50081-2 at 10m
30	34	40
32	36	40
33	36	40
34	35	40
50	33	40
52	33	40

The results show that the limit for the industrial emission standard is met with a margin of at least 4dB.

Enclosure construction

For many installations, an enclosure will have a back-plate which will be used to mount variable speed drive modules, RFI filters and ancillary equipment. The motor cable should be bonded to the back-plate close to the drive before it leaves the enclosure wall (Refer to *Wiring guidelines* in Figure1). However there is no disadvantage if the motor cable is bonded at the point of exit as well, through the normal gland fixings.

Depending on construction, the enclosure wall used for cable entry may have separate panels and could make poor electrical contact at high frequencies with the remaining structure. If the motor cable is only bonded to these surfaces and not to a back-plate, then the enclosure may provide insufficient attenuation of RF emissions.

It is the bonding to a common metal plate which minimizes radiated emission. In the tests described, opening the cubicle door had little effect on the emission level, showing that the enclosure design is not critical.

Related product standards

The radiated emission levels specified in EN50081-2 are equivalent to the levels required by the following product standards:

Radiated emissions from 30 to 1000MHz		
Generic standard	**Product standard**	
EN50081-2	EN55011 Class A Group 1 CISPR 11 Class A Group 1	Industrial, scientific and medical equipment
	EN55022 Class A CISPR 22 Class A	Information technology equipment

WIRING GUIDELINES

The wiring guidelines on the following pages should be observed to achieve minimum emissions. The details of individual installations may vary, but details which are indicated in the guidelines to be important for EMC must be adhered to closely. The guidelines do not preclude the application of more extensive measures which may be preferred by some installers. For example, the use of full 360° ground terminations on shielded cables in the place of 'pig-tail' ground connections are beneficial, but not necessary unless specifically stated in the instructions.

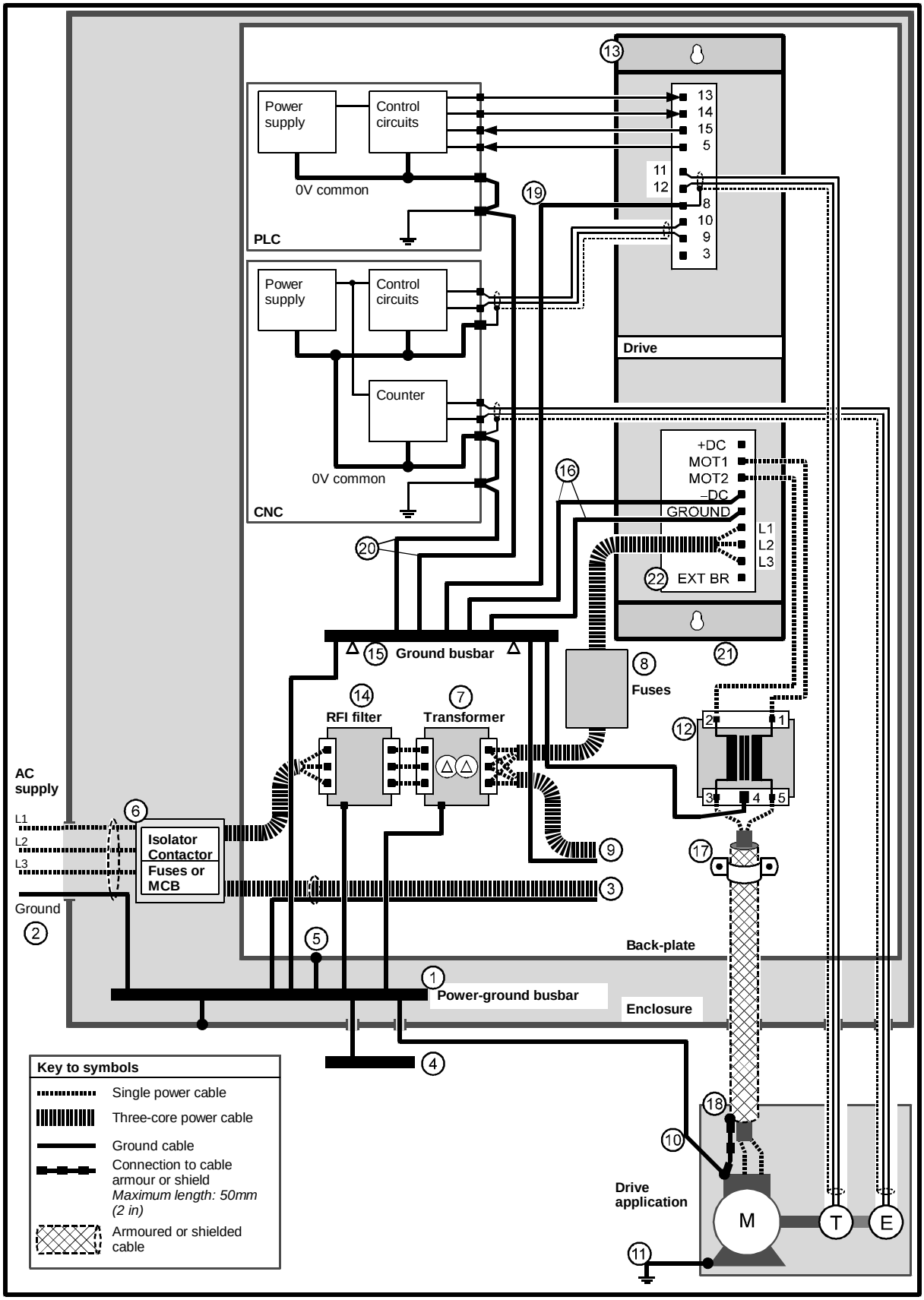


Figure1 Wiring guidelines for Midi-Maestro

Key to Figure1

General features

1. Single power ground busbar or low impedance ground terminal.

2. Incoming supply ground connected to power ground busbar.

3. Connect grounds of any other circuits to power ground busbar.

4. Site ground if required.

5. Metal back-plate, safety bonded to power ground busbar.

6. System isolator, circuit contactors and fuses/MCB.

7. Isolating transformer to provide 105VAC supply to Midi-Maestro drive(s).

8. Drive fuses.

9. AC supply/ground to other Midi-Maestro drive(s).

10. Safety ground for motor.

11. Motor frame ground connection, if required.

12. Optional motor line choke. Cables between drive and choke should not exceed 0.3m (12 in).

Special features for EMC

13. Drive heatsink directly grounded to the back-plate using the metal mounting brackets.

14. RFI filter mounted on the primary side of the transformer. The RFI filter casing is directly grounded to the back-plate by the fixing screws.

15. Ground busbar (copper) mounted on insulated pillars, recommended bar size: 5×20×100/200mm. Connect to the power ground busbar using 10 to 20mm^2 cable, maximum length: 0.5m (20 in).

16. Connect drive –DC and ground terminals to ground busbar using 2.5mm^2 cable. Maximum length: 0.5m (20 in).

17. A shielded (screened) or steel wire armoured cable must be used to connect the Drive to motor. The shield must be bonded to the back-plate using an uninsulated metal cable-clamp. The clamp must be positioned no further than 100mm (4 in) from the drive when a motor line choke is not used.

18. Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50mm (2 in) in length. A full 360° termination of the shield to the motor terminal housing (usually metal) is beneficial.

19. Connect drive 0V to the ground busbar using a short connection.

20. Connect the 0V commons of the CNC and PLC to the ground busbar.

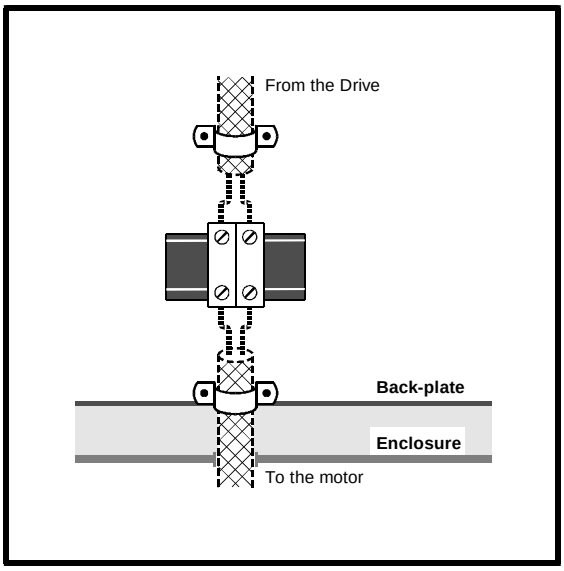
21. Avoid sensitive signal circuits in a zone extending 0.3m (12 in) all around drive.

22. Unshielded wiring to optional braking resistor(s) may be used, provided the resistor is either in the same enclosure as the drive or the wiring does not run external to the enclosure. Ensure a minimum spacing of 0.3m (12 in) from signal wiring and the supply side wiring of the RFI filters.

VARIATIONS

Interruptions to the motor cable
The motor cable should ideally be a single run of shielded cable having no interruptions. In some situations it may be necessary to interrupt the cable, for example to connect the motor cable to a terminal block within the Drive enclosure, or to fit an isolator switch to allow safe working on the motor. In these cases the following guidelines should be observed.

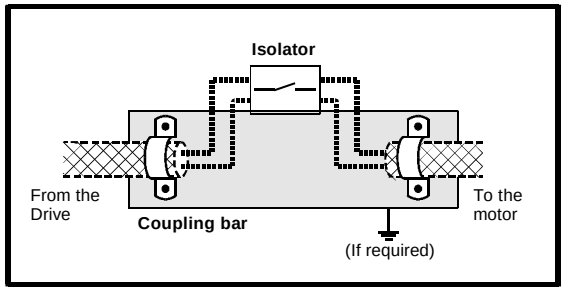
Terminal block within enclosure
The motor cable shields should be bonded to the back-plate using uninsulated cable-clamps which should be positioned as close as possible to the terminal block. Keep the length of power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away form the terminal block.



(Refer to *Key to symbols* in Figure1)

Figure2 Connecting the motor cable to a terminal block in the enclosure

Using a motor isolator switch
The motor cable shields should be connected by a very short conductor having a low inductance. The use of a flat metal bar is recommended; conventional wire is not suitable. The shields should be bonded directly to the coupling bar using uninsulated metal cable-clamps. Keep the length of power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away. The coupling bar may be grounded to a known low impedance ground nearby, for example a large metallic structure which is connected closely to the Drive ground.



(Refer to *Key to symbols* in Figure1)

Figure3 Connecting the motor cable to an isolating switch