Installation and Maintenance Manual

Directional Control Equipment for Electric Cylinder

Series LC3F2

1. Safety Instruction

These instructions indicate the level of potential hazard by labels of "Warning" and "Caution". To ensure safety, be sure to observe ISO 10218-1992 / JIS B 8433-1993 and other safety practices.

Warning :
Operator error could result in serious injury or loss of life.

Caution :
Operator error could result in injury or equipment damage.

1.1 Symbols

Symbol	Explanation
Warning	Symbol meaning warning and caution. Contents are instructed by figure or phrase in the symbol.
Do not	Symbol meaning do not operate are instructed by figure or phrase in the symbol.
Do	Symbol meaning operate are instructed by figure or phrase in the symbol.

1.2 Operator

- This manual is for the person in charge of assembly, operation, and maintaining of machinery and device with electric control equipment who has enough knowledge and experience.
- The manual must be read through before assembly, operation and maintenance.

1.3 Application limitation

* This product aims at application for common factory automation equipment. Do not use LC3F2 for machinery and device (*1) that directly concerns human life or those which malfunction or failure could cause serious damage.

*1: Machinery and device that directly concerns human life are;
- Life support system or medical equipment.
- Device obligated by laws and regulation such as fire protection law and the building code.
- Equipment and devices which comply with above.

* Contact SMC Sales office before use on any of the following relating to human safety and have an impact on the public utility(*2). Special consideration(*3) is necessary for the management, maintenance and control of the system.

*2: Systems relating to human safety that has impact on the public utilities are;
- Main machine control and of nuclear plant control systems, safety protection system, nuclear installation, and other systems important for safety.
- Drive control and flight control system of public transport system.
- Equipment and device contact with food and beverage.

*3: Special consideration means to discuss with SMC engineers, and to construct a safe system (The foolproof design, the fail safe design, and design using redundancy circuits).

* **Special consideration for safety and security to prevent the risk of damage by failure and malfunction caused by the occurrence of environmental stress (change over time)**.

Warning	
Do not	■Do not overhaul or modify parts(incl. circuit board). It might cause injury or failure.
Do not	■Do not operate or set with wet hand. It might cause electric shock.
Do not	■Do not exceed specified operating range. It might cause fire accident, malfunction and cylinder breakage. Keep operating range.
Do not	■Do not use in areas containing flammable gas, explosive gas, corrosive gas. They might cause fire, explosion and corrosion. This electric cylinder is not an explosion proof structure.
Do not	■Do not connect or operate with non applicable motor, cylinder. It might cause fire or explosion.
Do not	■Do not short-circuit the line between motor output terminals to prevent fire or explosion.
Do	■Ground FG terminal and protection ground terminal to prevent electric shock and fire. It is recommended to keep the ground wiring distance as short as possible. And prepare separate ground.
Warning	■Do not touch the work while the cylinder operating. It might cause injury.
Do not	■To prevent fire or explosion, do not allow electroconductive foreign material and combustible foreign material to enter the product.
Do not	■To prevent electric shock or injury, do not touch internal part of the product.
Do	■To prevent electric shock, fire, or injury, do not start mounting, wiring, checking within 5 min. of turning off the power. Check the voltage with the tester before starting checking etc.
Do	■To avoid the risk and the damage due to failure and malfunction occurring. Establish back-up system to provide a fail-safe system in advance.
Do not	■To prevent electric shock, fire and injury, do not use product if it is not installed correctly or damaged.
Do not	■To prevent electric shock or fire, do not damage the cable, apply excessive stress, or place heavy material onto it.

Caution	
Do not	■The heat sink of the directional control equipment and the drive motor becomes hot during operation. Do not touch until they are cooled down.
Do not	■Do not carry by the cables during transport. It might cause injury or failure.
Do not	■Do not use in locations with a lot of debris, dust, water, chemicals, or oil. It might cause fire, injury, failure or electric shock.
Do not	■Do not use in locations where magnetic field is generated. It might cause malfunction and failure.
Do not	■Do not use in locations where temperature cycles are applied. It might cause malfunction and failure.
Do not	■Do not use in locations where surge is generated. It might cause malfunction and failure.
Do not	■Prepare lightning surge protection on the device. It might cause malfunction and failure.
Do not	■Mount the unit where no vibration or impact occurs. It might cause malfunction and failure.
Do	■Inspect correct function after maintenance. Stop operation when device and equipment doe not work correctly. Unexpected malfunction might risk safe operation. Perform emergency stop and ensure safety.
Do not	■Do not apply rotating torque more than 68.6mN•m to the adjuster of the thrust adjustment trimmer. It might cause malfunction and failure.
Do	■Do not press the thrust adjustment trimmer at 4.9N or more. It might cause malfunction and failure.
Do	■Install the emergency stop circuit. External emergency stop circuit shall be prepared so that the operation of the electric cylinder is stopped and the power source is cut instantly.
Do	■Connect the power and turn on the switch after ensuring the safety of the slider's moving range. Moving slider might cause an accident.
Do not	■Do not apply a force that exceeds the specification of the actuator. Do not move the rod by applying an external force. Do not reverse direction of operation until the cylinder rod has stopped moving. It might cause malfunction and failure.

1.4 Caution on operation

Precautions below shall be kept for handling of this product, wiring, adjustment, usage, maintenance and the disposal.

* Mounting
- Do not drop or bump or apply excessive impact.
- Keep directional control equipment 50mm or more away from inner surface of control cabinet or other equipment.
- Keep maintenance space.

* Wiring
- Avoid repeatedly bending or stretching the cable.
- Use specified tools when crimping the contact and power lines.
- Do not wire adjacent to power lines or high voltage lines to avoid noise interference.
- Ensure proper insulation of wiring.
- Recommend to use shielded cables and ground them.

* Adjustment / Operation
- Do not press the manual switch with a sharply pointed tool.
- Use a screw driver which is suitable for the thrust adjustment trimmer. The screwdriver below available on the market is recommended.
  Vessel Co. : NO.9000+0×30
- Do not apply paint to lock the trimmer after adjustment.
- Adjustment of the thrust adjusting shall be within 100 cycles.
- Do not start operation by turning on/off of the main power. Start operation by the control terminal of CN2.

* Maintenance
- Periodic maintenance is required.
- Do not perform insulation resistance test or insulation withstand voltage test.
- For reference only the product life is up to 6 years providing the equipment is operated within the conditions stated below
  Operating ambient temp. : 25℃
  Operation rate : 16 hours or less/day

Life could be shorter due to surrounding environment or operating conditions. Replace parts when abnormality is found.

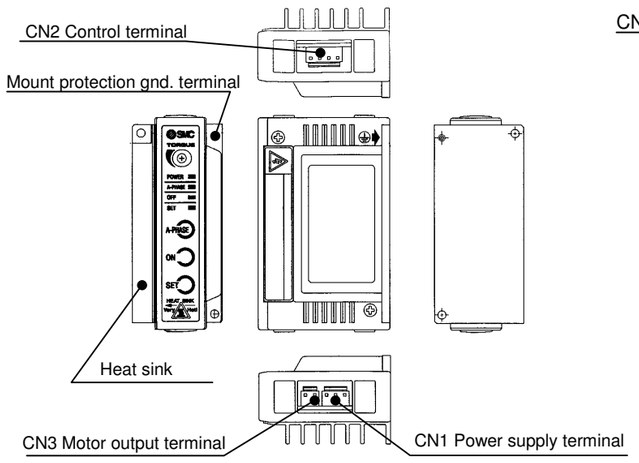
* Disposal
- Dispose as general industrial waste.

2. Parts check

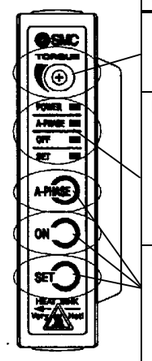
Ensure parts below are included in the package.

Part description		Qty.
Directional control equipment		1
Operation manual		1
Parts relating to protection ground terminal	Cross recessed bind screw M3 X 4	1
	Spring seat Nominal 3	1
	Tooth lock washer (A) Nominal 3	1
Housings (equipped only for LC3F212-5[][]A)	Housing VHR-2N	1
	Housing VHR-3N	1
	Housing VHR-4N	1
	Contact BVH-21T-P1.1	12

3. Parts description and function



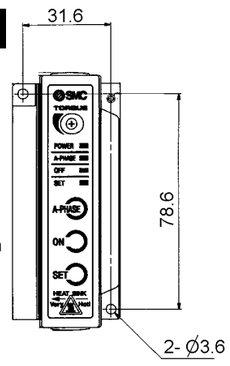
Description of display



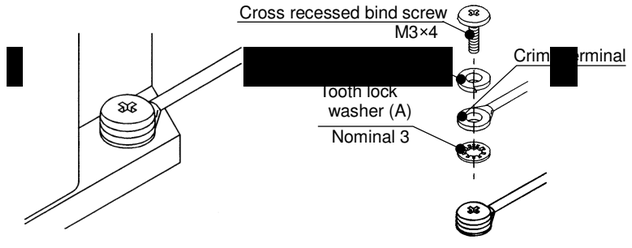
Class	Description	Explanation
Trimmer	Thrust adjustment trimmer	Thrust depends on adjustment (Adjustment turn 1 turn / Effective angle 240°)
Indicator lamp	POWER	Lights when powered
	A-PHASE	Lights when A-PHASE commanded
	OFF	Lights when ON isn't commanded
	SET	Lights when SET is commanded
Manual switch	A-PHASE	Press and A-PHASE is commanded
	ON	Press and motor output ON is commanded
	SET	Press and SET is commanded

4. Mounting

Mount the directional control equipment vertically on the wall using the two mounting holes on the drawing to the right so that the front faces the operator. (Surface with adjustment trimmer and manual switch are on.)
Keep directional control equipment 50 mm or more away from the control cabinet inner surface or other equipment so that the equipment is cooled down with natural convection.

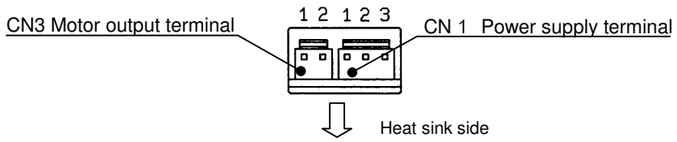


Applicable set screw : M3 (2 pcs.)
[Customer prepare screws]
∗Mounting protection gnd. terminal



Customer prepares crimp terminals and ground cable.

5. Wiring



CN1 Power supply terminal

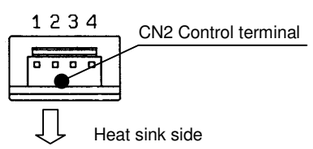
Pin No.	Terminal	Function
1	FG	Frame ground
2	DC(+)	Power input (+24V)
3	DC(-)	Power ground (0V)

Housing : VHR-3N (JST Mfg. Co. Ltd.,)
Contact : BVH-21T-P1.1 (JST Mfg. Co. Ltd.,)

CN3 Motor output terminal

Pin No.	Terminal	Function
1	OUTA	Motor output A (blue line)
2	OUTB	Motor output B (red line)

Housing : VHR-2N (JST Mfg. Co. Ltd.,)
Contact : BVH-21T-P1.1 (JST Mfg. Co. Ltd.,)

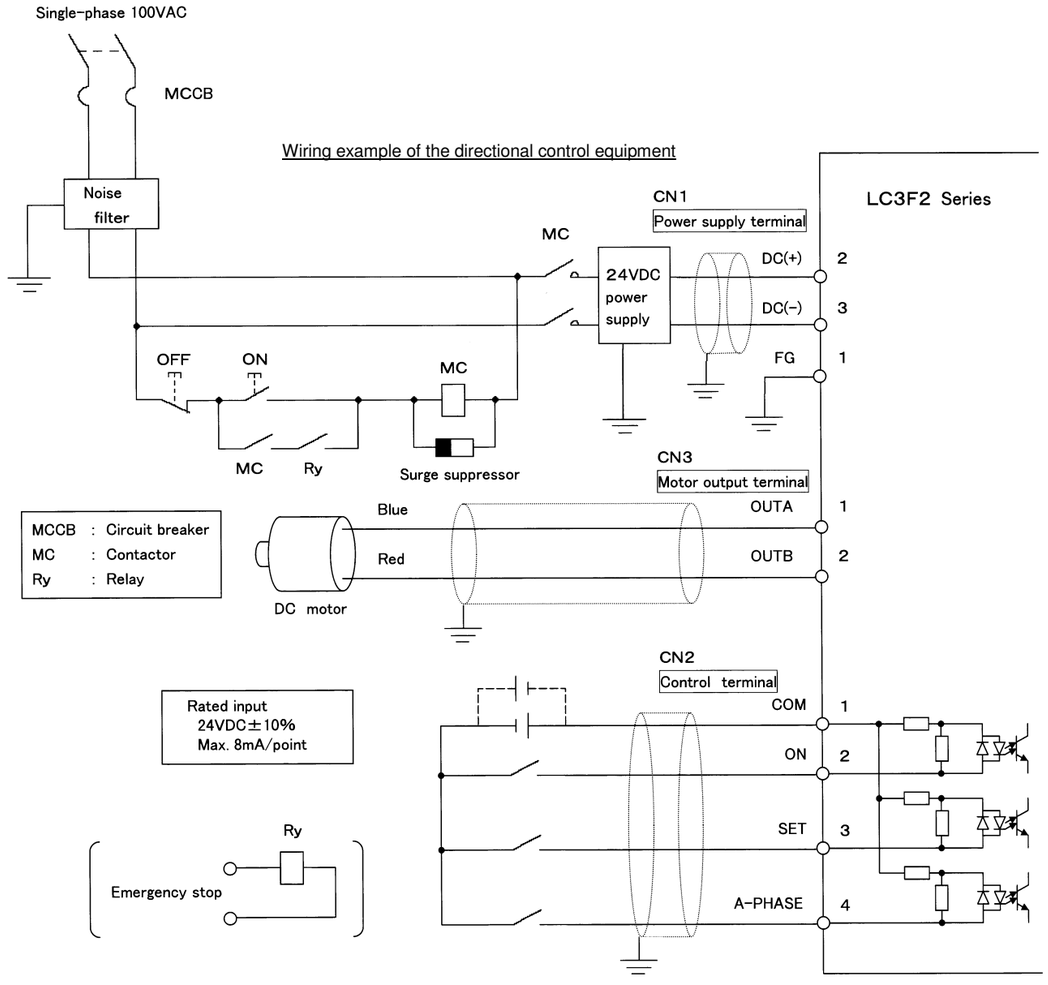


CN2 Control terminal

Pin No.	Terminal	Function	
1	COM	Common terminal	
2	ON	Output ON Comm. input	ON: Motor output
			OFF: No motor output
3	SET	Input adjusted thrust	ON :Adjusted thrust (Set range 10 to 70%)
			OFF:100% thrust(Max.)
4	A-PHASE	Input moving direction	ON: A-PHASE direction
			Off: B-PHASE direction

Housing : VHR-4N (JST Mfg. Co. Ltd.,)
Contact : BVH-21T-P1.1 (JST Mfg. Co. Ltd.,)

Wiring example of the directional control equipment



Caution

Do	Directional control equipment does not have an emergency stop or power on/off switch. Provide an emergency stop, circuit breaker (protection) for the total system, referring to the wiring example above. Disconnect the power supply before wiring the directional control equipment.

Tools
Crimping tool: YC-160R (JST Mfg. Co. Ltd.,)
Pulling tool: EJ-NV (JST Mfg. Co. Ltd.,)

Recommended cables
(Common for cables) AWG21 (0.5 mm²)
Insulated wire O.D. 1.7 to 3.0 mm
Heatproof temp. 80°C or more

CN1 Power supply terminal cable
3 core shielded heavy-duty cable 2 m or less
CN2 Control terminal cable
4 core shielded heavy-duty cable 2 m or less
CN3 Motor output terminal cable
2 core shielded heavy-duty cable 5 m or less

6. Adjustment / Test run

Procedure of adjustment / test run

Perform adjustment and test run after checking installation and wiring.
(1) Apply power
Display lamp (POWER) turns on when applying power.
(2) Test run
Inputting signal to the control terminal causes the electric cylinder to start. Set the trimmer at minimum (counterclockwise), and raise the thrust slowly to adjust. Operation with the max. thrust may cause the electric cylinder rod to move suddenly.

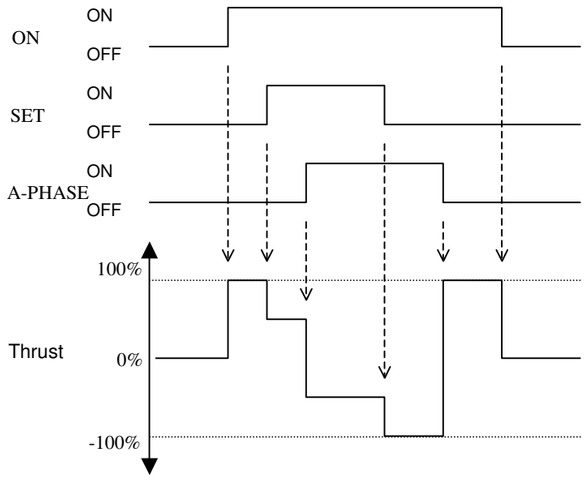
Signal input example for adjusting thrust

CN2 terminal	A-PHASE direction command	B-PHASE direction command	Stop command
ON	ON :	ON :	Off :
SET	ON :	ON :	-
A-PHASE	ON :	Off :	-

Warning

Warning	Do not touch the work during test run or thrust adjustment.

7. Timing chart



8. Trouble shooting

Inspect items below when (1)-(3) below occurs. If trouble shootings below do not work, consult with SMC.

(1) Electric cylinder (motor) does not start.
(2) Operation becomes unstable during operation.
(3) The electric cylinder (motor rotation) moves in reversed way to commanded direction.

Trouble	Inspection	Trouble shooting
(1)(2)	Check voltage between DC(+) and DC(-)	Supply 24VDC±10%.
(1)(2)	Check the capacity of power source	Source capacity may not be enough for supply power spec. of directional control equipment.
(1)(2)	Power display lamp not illuminated.	Possibly, fuse blown. Consult SMC.
(1)(2)(3)	Check Housing terminal	Possible housing connect failure or contact crimp failure.
(1)(2)	OFF display lamp illuminated.	Turn on ON input (CN2-2) .
(1)(2)(3)	Switch the input of A-PHASE (CN2-4)	Commanded logic for A-PHASE may possibly be reversed. Motor output terminal OUTA (CN3-1) and OUTB(CN3-2) are connected in reversed condition.
(1)(2)	Operate with no load	Excess load is possible cause. Check the transported load.
(1)(2)	Turn off SET (CN2-3)	Operate with max. thrust. Re-adjust the thrust adjusting trimmer for this operation.
(1)(2)	Check ambient temperature	Thermal overload protection (*) may have worked. Check if specified operating ambient temp. and recommended space are correct.

(*) Thermal overload protection

Thermal overload protection works and cuts the power supply to the motor when the inner temperature of the motor is raised and the heat sink reaches 70°C. Recovers automatically when the inner temp. is lowered after Thermal overload protection has operated.

9. How to Order

L C 3 F 2 1 2 - 5 [] [] []

Applicable motor

A3	DC motor (Type3)
A5	DC motor (Type5)

Housing

A	Housing for CN1, 2, 3 and contact are included
B	Nothing included

10. Specifications

	LC3F212-5A3[]	LC3F212-5A5[]
Supply source	24VDC±10%	
	Max. 1.3A	Max. 2.3A
Input signal	Photo-coupler input 24VDC+/-10% Max. 8mA/point	
Select output current	100% or set value (Set range 10 to 70%)	
Operating ambient temp.	+5 to +40°C	
Operating ambient humidity	35 to 85%RH (No dew formed)	
Storage temp.	0 to +40°C (Non freezing)	
Storage humidity	35 to 85%RH (No dew formed)	
Display LED	POWER, A-PHASE, OFF, SET	
Weight	145g	

11. CE directive

Conforms to the CE directive (EMC 89/336/EEC) for electric cylinder LZ series / directional control equipment for electric cylinder LC3F2 series.

(1) EMC directive is applied to the DC motor LZC[][]-0401series which are used for the electric cylinder LZ series and the LC3F2 series as a combination. SMC have had the following set in the “Relating to EMC directive” section tested by a third party organization to ensure that they pass all relevant standards as set out in the EMC directive when installed in accordance with these instructions.

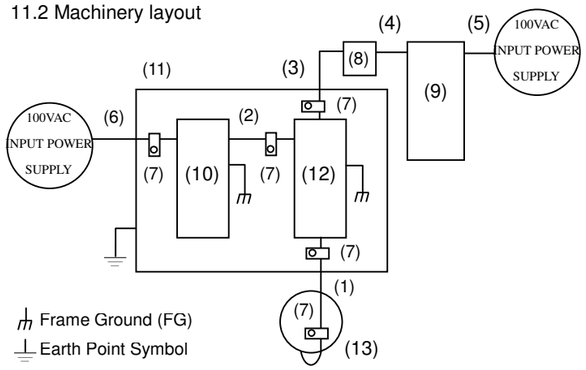
(2) The low voltage directive is not applicable for these products.

(3) These products are defined as components and thus are intended for incorporation into machinery and assemblies, which are covered by the Machinery Directive 98/37/EC. The machinery directive 98/37/EC therefore does not apply to this product.

11.1 Relating to EMC directive

EMC conformity of the customer's equipment containing the electric cylinder or directional control equipment for the electric cylinder cannot be confirmed by SMC. The customer must confirm EMC conformity of the customer's machinery or equipment as a whole.

11.2 Machinery layout



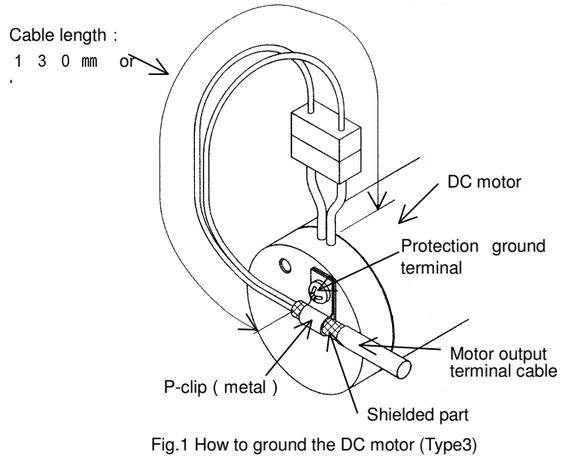


Fig.1 How to ground the DC motor (Type3)

11.3 Machinery, parts

No.	Part name	Part no./Material	Manufacturer
(1)	Motor output terminal cable	2 wire with shield Heavy-duty cable	-
(2)	Power supply terminal cable	3 wire with shield Heavy-duty cable	-
(3)	Control terminal cable	4 wire with shield Heavy-duty cable	-
(4)	DC power supply cable	-	-
(5)	AC power supply cable	-	-
(6)	AC power supply cable(with shield)	-	-
(7)	P-clip (for shield ground)	metal	-
(8)	Programmable controller	FP0-C16T	Panasonic
(9)	Switching power supply	S82K-10024	OMRON
(10)	Switching power supply	S82K-10024	OMRON
(11)	Control box	Aluminum case	-
(12)	Directional control equipment for electric cylinder	LC3F2 series	SMC
(13)	DC motor for the electric cylinder	L1ZC[][]-0401 series	SMC

Above parts/equipment supplied by customer except items (12), (13).

Caution for designing considering conformity to EMC directive

See cautions below for the conformity to EMC directive when designing equipment containing this product.

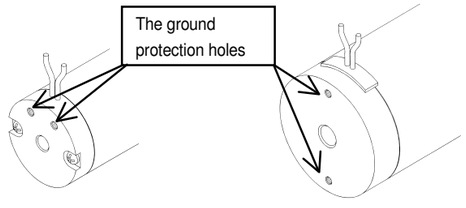
11.4 Installation

This product is required to be put in the control cabinet.
- The switchboard shall be IP54 (or higher).
- Use metal (ferrous, aluminium) for the switchboard material.
- Switchboard shall be properly grounded with a cable as short as possible.

11.5 Ground

Resistance of contacted parts and contact resistance of contacted area shall be minimized.
- Keep ground cable short and thick as mush as possible to keep impedance low.
- Remove the paint of contact surface and the insulation cover to keep the contact resistance of the contact surface low.

To reduce radiation noise, ground the motor output terminal cable shield to the protection ground terminal with metal P-clip.
The ground protection holes are different for the type3 and type5.



DC motor (Type3)
L1ZC30-0401series
M3×0.5×3 deep

DC motor (Type5)
L1ZC45-0401 series
M4×0.7×3 deep

*** Regarding the motor output terminal cable, the power supply terminal cable and the control terminal cable.**

Use the cable with shield. Connector sheath and the part with shield removed shall be short as possible.
Cable shield shall be grounded at just before the connected component (LC3F2 series, switching power supply etc.). Use a metal P-clip (Fig.2-1), metal U-clip (Fig.2-2) when grounding. Ground effect is not adequate by soldering the shield wire with wire rod to install the cable (Fig.2-3).

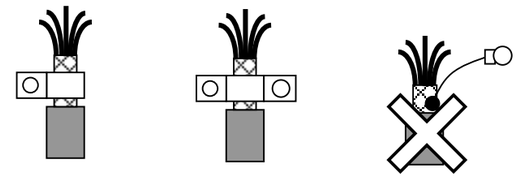


Fig.2-1 P-clip Fig.2-2 U-clip Fig.2-3 Soldering

12.European Contact List

SMC Corporation

Country	Telephone	Country	Telephone
Austria	(43) 2262 62 280	Italy	(39) 02 92711
Belgium	(32) 3 355 1464	Netherlands	(31) 20 531 8888
Czech Republic	(420) 5 414 24611	Norway	(47) 67 12 90 20
Denmark	(45) 70 25 29 00	Poland	(48) 22 548 50 85
Finland	(358) 207 513 513	Portugal	(351) 2 610 89 22
France	(33) 1 64 76 1000	Spain	(34) 945 18 4100
Germany	(49) 6103 4020	Sweden	(46) 8 603 0700
Greece	(30) 1 342 6076	Switzerland	(41) 52 396 3131
Hungary	(36) 1 371 1343	Turkey	(90) 212 221 1512
Ireland	(353) 1 403 9000	United Kingdom	(44) 800 138 2930

*Websites

SMC Corporation	www.smcworld.com
SMC Europe	www.smceu.com