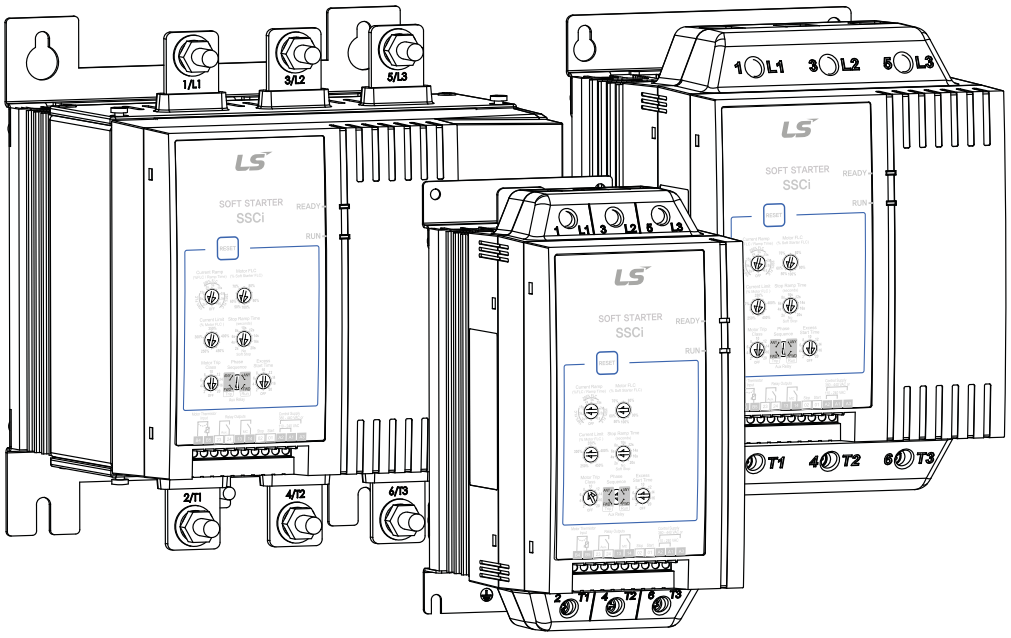
The right choice for the ultimate yield!

LS ELECTRIC strives to maximize your profits in gratitude for choosing us as your partner.

Soft Starter

LSLV-SSC series

Service Manual



Safety Instructions

- Read this manual carefully before installing, wiring, operating, servicing or inspecting this equipment.
- Keep this manual within easy reach for quick reference.

LS ELECTRIC

Contents

1 Caution Statements

WARNING - ELECTRICAL SHOCK HAZARD
The compact soft starter contains dangerous voltages when connected to mains voltage. Only a qualified electrician should carry out the electrical installation. Improper installation of the motor or the soft starter may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes.

1.1 Safety Regulations

Disconnect the soft starter from mains voltage before carrying out repair work.

Stopping the soft starter does not disconnect the equipment from mains voltage and leaves one phase connected to the motor. The soft starter should **not** be used as a safety switch.

NOTE
It is the responsibility of the user or person installing the soft starter to provide proper grounding and branch circuit protection according to local electrical safety codes.

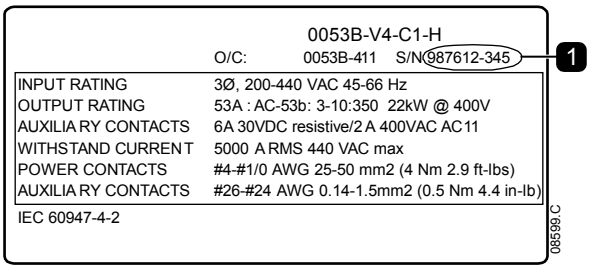
CAUTION
Many electronic components are sensitive to static electricity. Voltages so low that they cannot be felt, seen or heard, can reduce the life, affect performance, or completely destroy sensitive electronic components. When performing service, proper ESD equipment should be used to prevent possible damage from occurring.

NOTE
The compact soft starter is not user serviceable. The unit should only be serviced by authorised service personnel. Unauthorised tampering with the unit will void the product warranty.

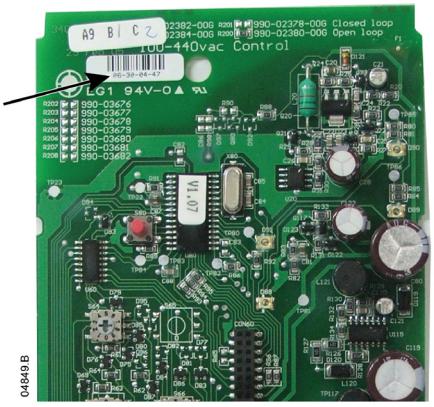
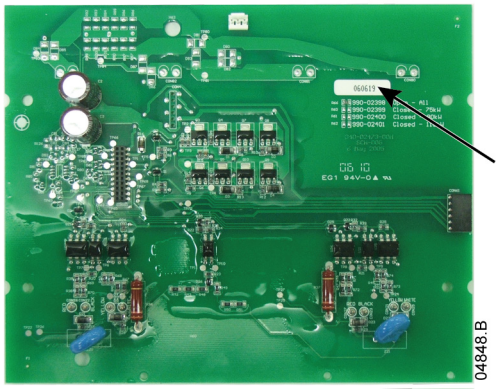
2 Identifying the serial number and version number

The soft starter's serial number can be identified from the silver label on the side of the starter.

The soft starter version number is the last two digits of the first part of the serial number (xxxx**VV**-xxx).



Each PCB is labelled with an individual serial number.

	
For boards with a barcode, the serial number is written below the barcode.	For boards with no barcode, the serial number is a six digit number on a white label.

3 Troubleshooting

3.1 Functional Tests

Use the tests in this section to identify the cause of problems with the soft starter.

Basic Functionality Test

This procedure tests that the soft starter is receiving control voltage.

1. Remove all external wiring from the soft starter control inputs (01, 02).
2. Connect the soft starter to control voltage (A1-A2 or A2-A3).
   - The Ready LED should come on. If it does not, the Main Control PCB is damaged.

Power Circuit Test

This procedure tests the soft starter's power circuit, including the SCR, Interface PCB and Main Control PCB.

Use a 500 VDC insulation tester on the 200 ohm scale or a standard multimeter (voltmeter).

1. Isolate the soft starter from the incoming mains supply and remove the control voltage.
2. Disconnect the motor cables and any external bypass contactor cables from the soft starter.
3. Allow the soft starter to cool to room ambient temperature.
4. Using a meter, check the resistance across each phase of the soft starter in both directions.
   - L1 to T1 and T1 to L1, L3 to T3 and T3 to L3.
5. If any reading is less than 200 ohms, the SCR or internal bypass relay has failed short circuit and must be replaced.

Open Loop Soft Starter Start Performance Test

This procedure tests that the soft starter soft starts correctly.

1. Connect the soft starter to mains voltage and to a motor.
2. Measure the voltage across L1-T1 and L3-T3. This should be close to the nominal mains voltage.
   - If the voltage is zero, the SCR or bypass relay on that phase may have failed.
3. Command the soft starter to start. While the soft starter is starting, measure the voltage across L1-T1 and L3-T3. The voltage should fall to less than 2 VAC just before the soft starter reaches Run mode.
   - If the voltage remains near nominal mains voltage, the SCR is not firing correctly. This can be caused by a faulty Main Control PCB, a faulty Interface PCB, or a poor connection between these two PCBs. To isolate the fault, perform the PCB integrity test.

Closed Loop Soft Starter Start Performance Test

This procedure tests that the soft starter soft starts correctly.

1. Calculate the expected motor start current by multiplying the soft starter *Motor FLC* setting and the *Current Limit* setting.
2. Connect the soft starter to mains voltage and to a motor.
3. Command the soft starter to start. While the soft starter is starting, measure the current on L1 and L3.
4. If the measured start current is equal to the calculated current, the soft starter is performing correctly.

NOTE
If the current is not at expected level, the SCR is not firing correctly. This can be caused by a faulty Main Control PCB, a faulty Interface PCB, or a poor connection between these two PCBs. To isolate the fault, perform the PCB integrity test.

Bypass Relay Test

Compact soft starters incorporate internal bypass relays. This procedure tests the operation of the internal bypass relays.

1. Connect the soft starter to mains voltage and to a motor.
2. Measure the voltage across L1-T1 and L3-T3. This should be close to the nominal mains voltage.
   - If the voltage is zero, the SCR or bypass relay on that phase may have failed (either short circuit or closed circuit).
3. Command the soft starter to start. When the Run LED stops flashing you should hear the bypass relay close.
   - If the bypass relay does not close, the bypass relay, Main Control PCB or Interface PCB may be faulty, or there may be a faulty connection between these components. To isolate the fault, perform the bypass relay integrity test.
4. When the soft starter is running, measure the voltage across L1-T1 and L3-T3. This should be approximately 0.5 VAC.
   - If the voltage is approximately 2 VAC the bypass relay did not close and the SCR is conducting the motor full load current. This can be caused by a faulty relay, a faulty Main Control PCB, a faulty Interface PCB, or a poor connection between these two PCBs. To isolate the fault, perform the bypass relay integrity test.
5. Command the soft starter to stop. You should hear the bypass relay open.
6. If the bypass relay does not open, perform the bypass relay integrity test.

3.2 Fault Diagnosis

PCB Integrity Test

This procedure further isolates a fault with the soft starter's control circuitry.

1. Verify that the connection between the Main Control PCB and the Interface PCB is sound.
   - remove and refit the Main Control PCB
   - check whether the soft starter now operates correctly
2. Verify that the Main Control PCB is sound
   - remove and replace the Main Control PCB
   - check whether the soft starter now operates correctly
3. Verify that the Interface PCB is sound
   - refit the original Main Control PCB
   - remove and replace the Interface PCB
   - check whether the soft starter now operates correctly

If the fault cannot be traced to either the Main Control PCB or the Interface PCB, replace both PCBs.

Bypass Relay Integrity Test

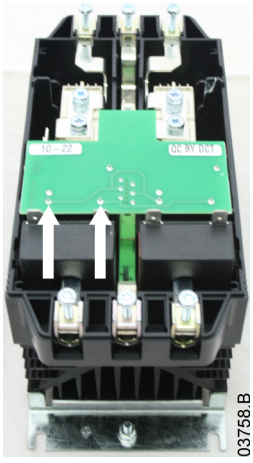
This procedure further isolates a fault with the soft starter's bypass circuitry.

1. Verify that the connections between the Main Control PCB and the Interface PCB, and between the Interface PCB and the bypass relay are sound.
   - remove the Main Control PCB
   - remove the Interface PCB
   - refit the Interface PCB to the bypass relays
   - refit the Main Control PCB
   - check whether the soft starter now operates correctly
2. Verify that the bypass relay is sound
   - remove the Main Control PCB and Interface PCB
   - momentarily apply 24 VDC to the bypass relay control pins. The bypass relay should change state. The bypass relays are latching, so behaviour must be checked by applying voltage in both directions.

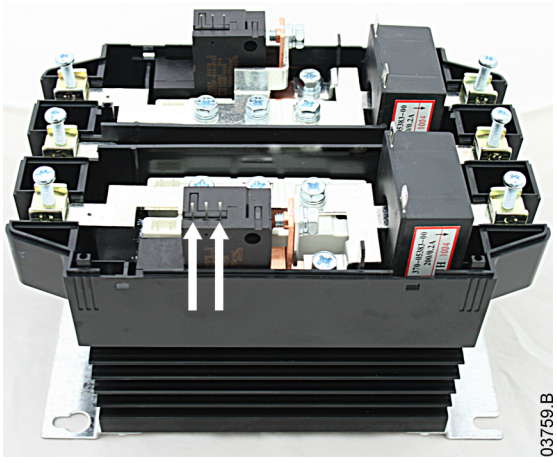
If the bypass relay does not change state correctly, it must be replaced.

Bypass relay control pins:

018 ~ 060

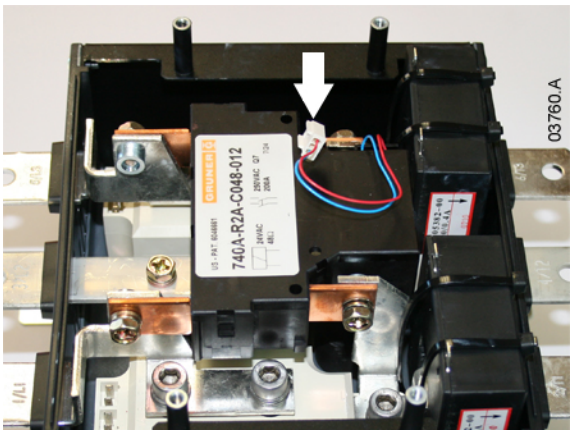


075 ~ 100



Bypass relay control wires

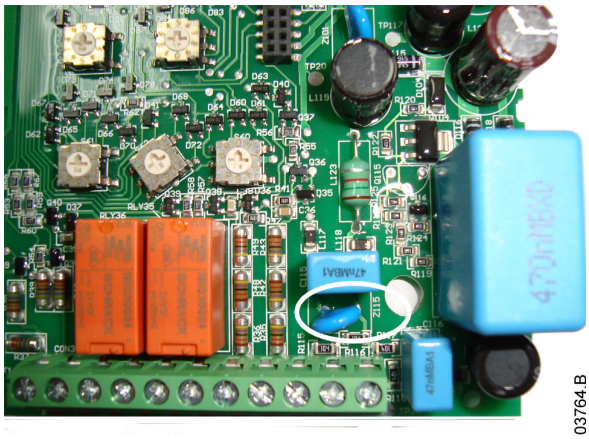
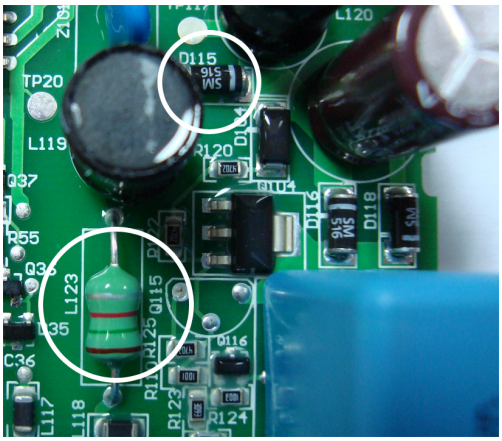
140 ~ 200



PCB Visual Inspection

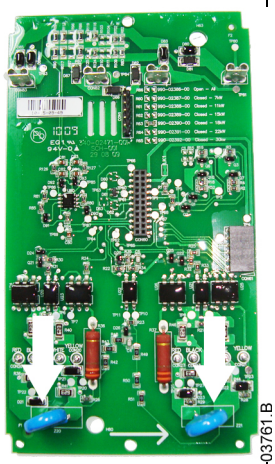
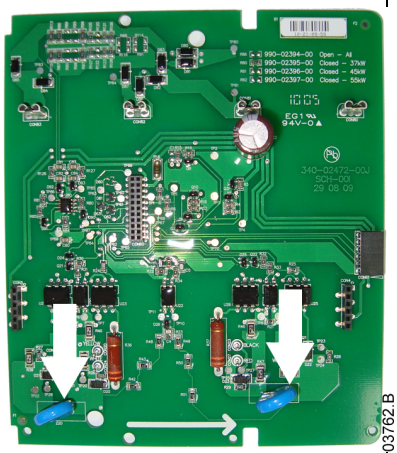
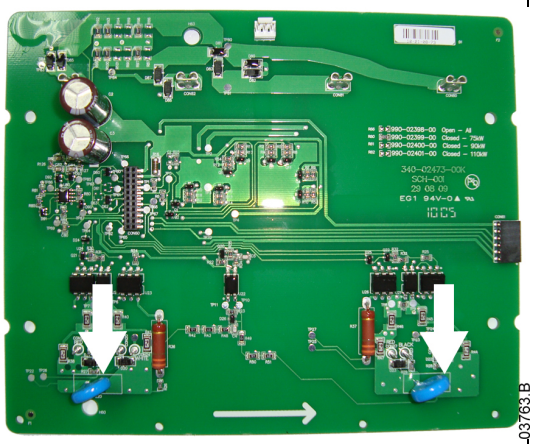
Damage will occur due to the following external control voltage conditions:

- Continuous overvoltage exceeding 275 VAC. This is typically indicated by MOV Z115 failure.
- Transient overvoltage between 700-800 VAC for 10 ms (half a cycle at 50 Hz). This is typically indicated by Inductor LI23 and/or Diode DI15 failure.

MOV Z115 (indicated below)	Inductor LI23 and Diode DI15 (indicated below)
	

Damage to the MOVs and/or surrounding circuitry on the Interface PCB may indicate that the soft starter has suffered overvoltage. This usually also damages the SCRs.

MOV locations on Interface PCB:

018 ~ 060	075 ~ 100	140 ~ 200
		

3.3 Avoiding Damage

SCRs

SCR damage is generally caused by overcurrent, overvoltage or overtemperature. To prevent future damage, check that the soft starter has been installed properly. Common causes of SCR problems include:

Overcurrent:

- cable fault on soft starter output
- motor fault
- start current and/or start time exceeds the soft starter's rating
- starts per hour exceed the soft starter rating

Overvoltage:

- power supply transient or surge
- lightning strike (direct or indirect) on power supply
- motor fault
- loose connection in power circuit, before or after the starter
- power factor correction connected to the output of the soft starter
- over-corrected bulk power factor correction on a lightly loaded system causing severe ringing voltages

Overtemperature:

- blocked heatsinks or restricted ventilation
- inadequate ventilation
- excessive ambient temperatures
- bypass relay fails to close during running

- **Protecting SCRs**

Modern SCRs are generally rugged and reliable. However, the risk of SCR damage can be reduced by using semiconductor fuses and/or a main contactor.

Semiconductor Fuses

Semiconductor fuses reduce the potential for SCR damage caused by short circuits on the output of the starter.

Protection systems such as circuit breakers or HRC fuses do not operate quickly enough to protect SCRs from short circuits.

Main Contactors

SCRs are most vulnerable to overvoltage damage when voltage is applied to their input terminal while they are off. In this condition the SCR is blocking the full line voltage. Using a main contactor to remove voltage from the SCR input when the starter is off eliminates the risk of SCR damage due to overvoltage.

Output Relays

All compact soft starters have two output relays (terminals 13, 14 and 23, 24).

- On open loop soft starters, the functionality of both relays is fixed (main contactor and run).
- Closed loop soft starters have one fixed output relay (terminals 13, 14: main contactor) and one programmable output relay (terminals 23, 24: trip/run).

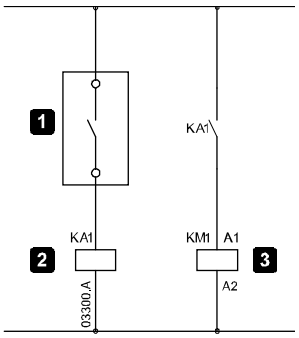
These relays are often used to control external contactors. The electronic contactor coils used in many contactors have a high initial inrush current, which can damage the soft starter's internal relays if the contactor coil is switched directly.

- **Using the Soft Starter to Switch a Contactor**

Before using the soft starter's output relay to switch an electronic contactor coil, consult the contactor manufacturer. Some contactor manufacturers (eg Klockner-Moeller) state that you cannot use PCB mount relays for direct switching of their electronic contactor coils.

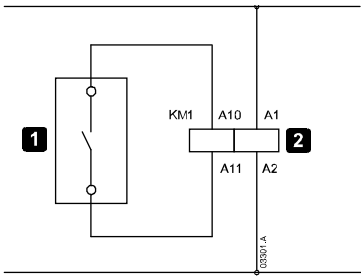
If this is the case, there are two solutions:

1. Use the soft starter's output relay to control a slave relay. This slave relay can then be used to directly switch the electronic contactor coil circuit.



1	Soft starter output relay
2	Slave relay coil
3	Contactor coil

2. If the contactor has a volt free electronic input (low voltage/low current), the soft starter's output relay can be wired directly into this input for contactor control.



1	Soft starter output relay
2	Contactor coil

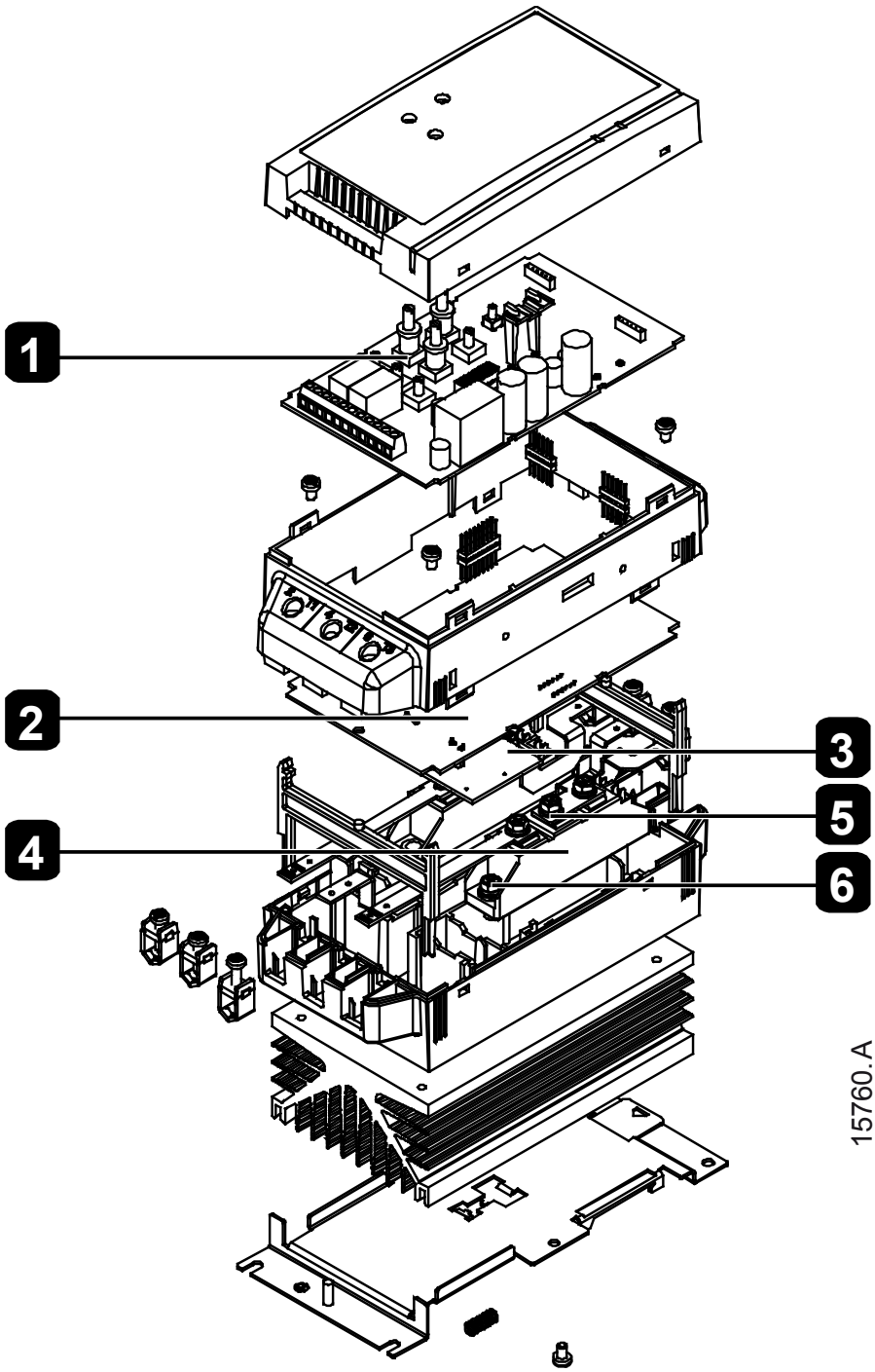
Control Inputs

Compact soft starters can be operated by external two wire or three wire control signals. External switches are configured and wired into control input terminals 01, 02.

- External switches operating the control inputs must be rated for the control voltage being used and a continuous current of 100 mA.
- Incorrect configuration and wiring of the external contacts/switches to the control input terminals may cause damage.
- If long cable runs are used, wiring must be twisted pair or shielded cable and must be separated from AC power cables by at least 300 mm.

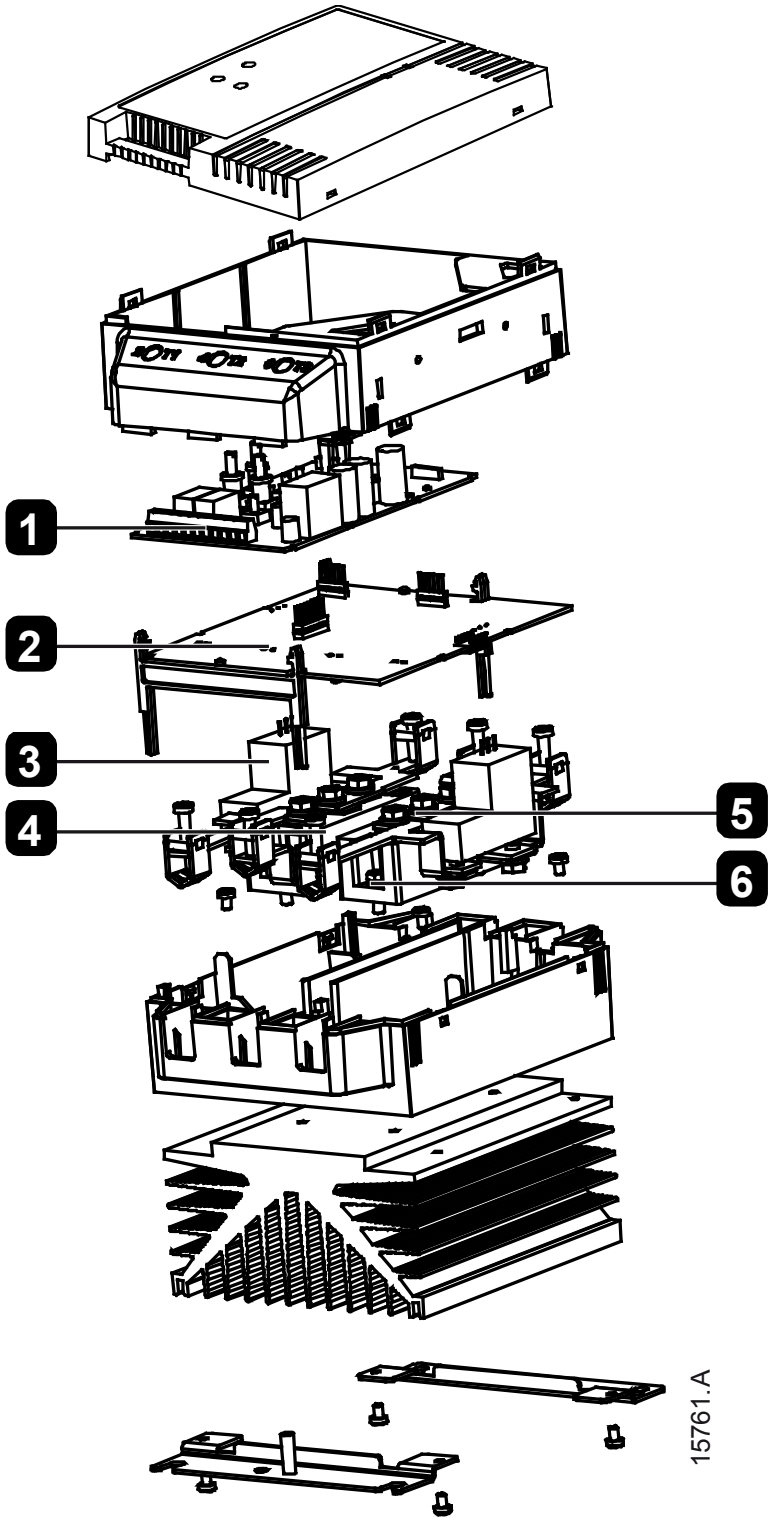
4 Service Instructions

4.1 Exploded View: Open Loop 018~-060



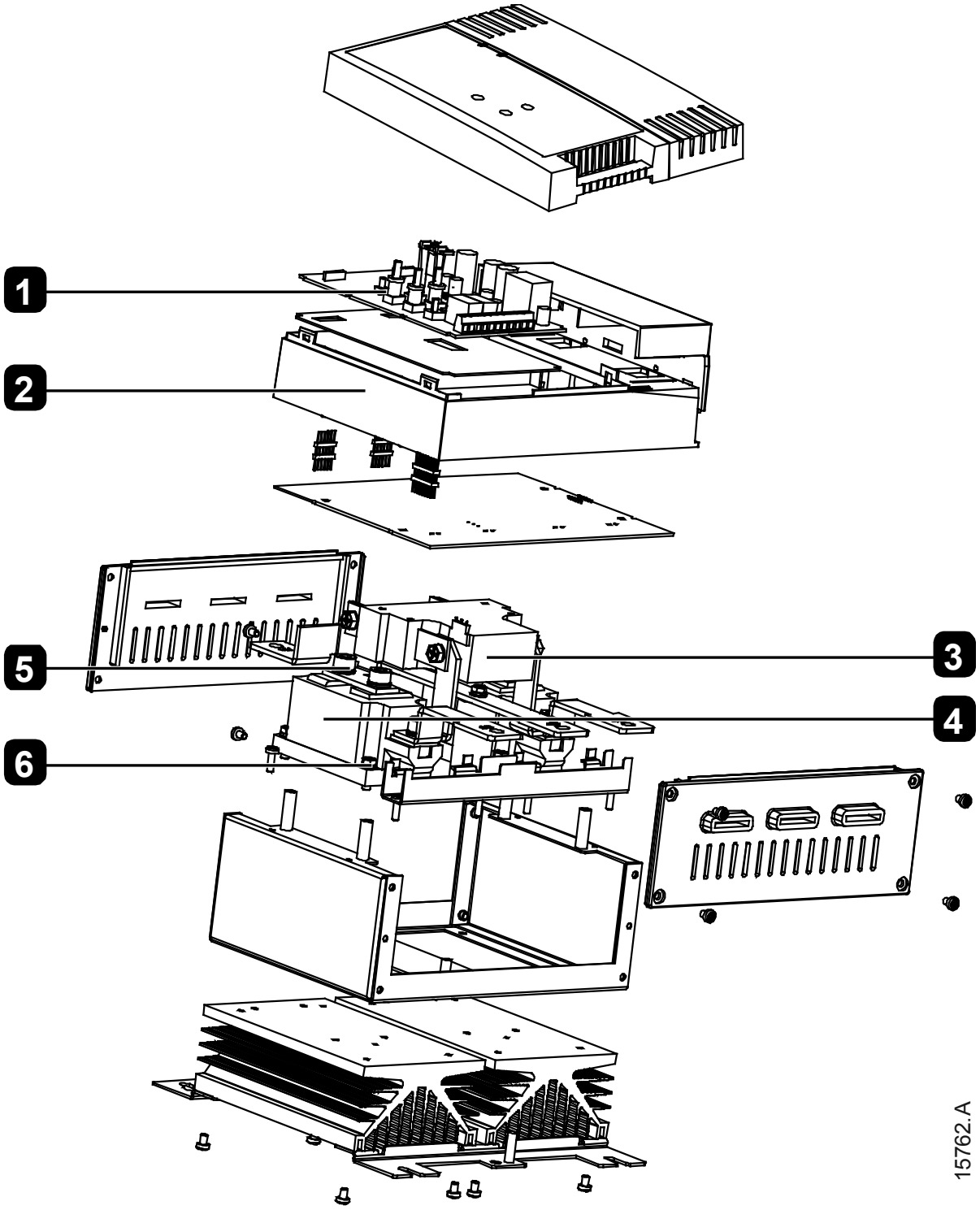
1	Main Control PCB
2	Interface PCB
3	Bypass relays
4	SCRs
5	SCR-bus bar connection (tighten to 4 Nm)
6	SCR-heatsink connection (tighten to 4 Nm)

4.2 Exploded View: Open Loop 075~-100



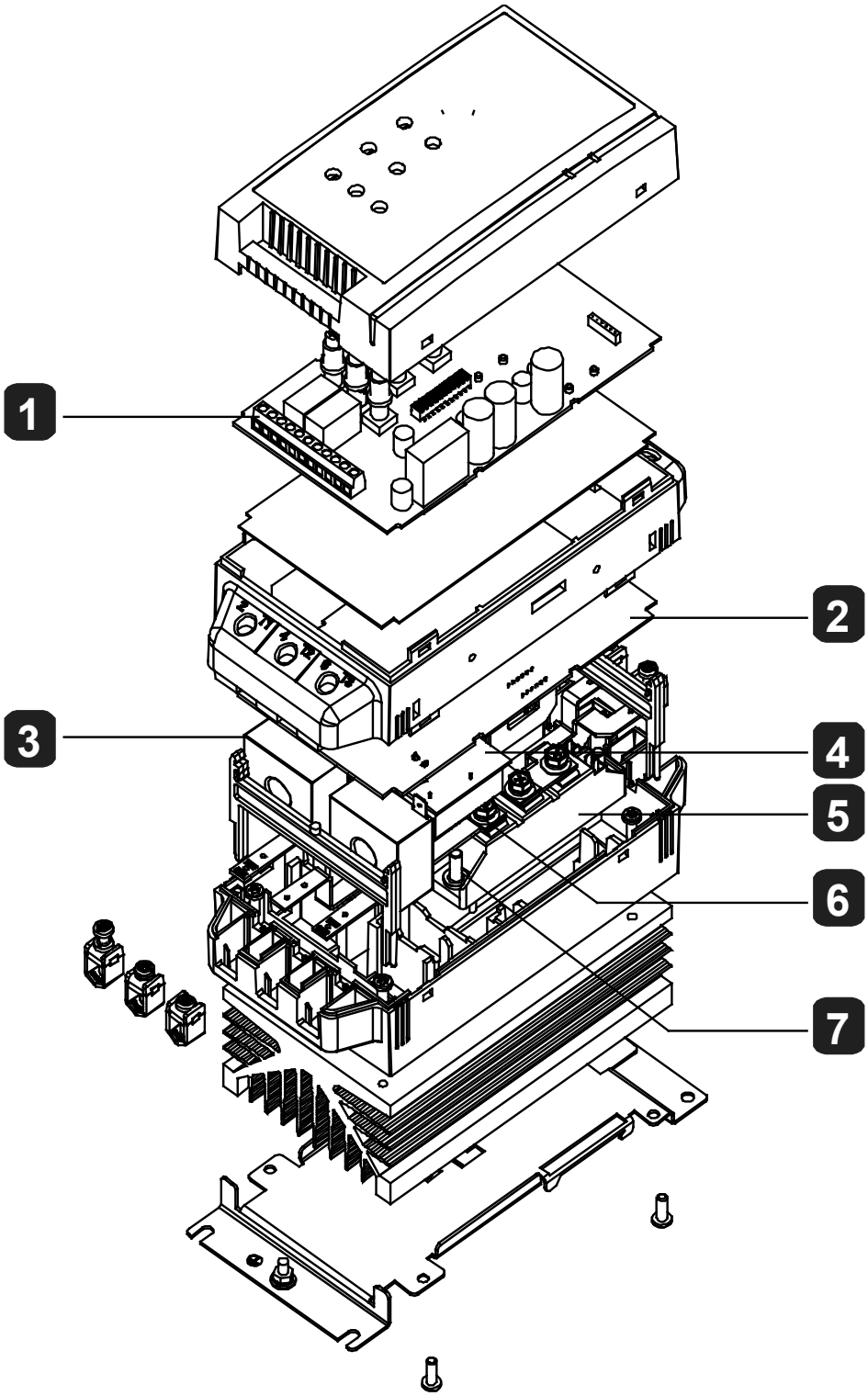
1	Main Control PCB
2	Interface PCB
3	Bypass relays
4	SCRs
5	SCR-bus bar connection (tighten to 5 Nm)
6	SCR-heatsink connection (tighten to 4 Nm)

4.3 Exploded View: Open Loop 140~-200



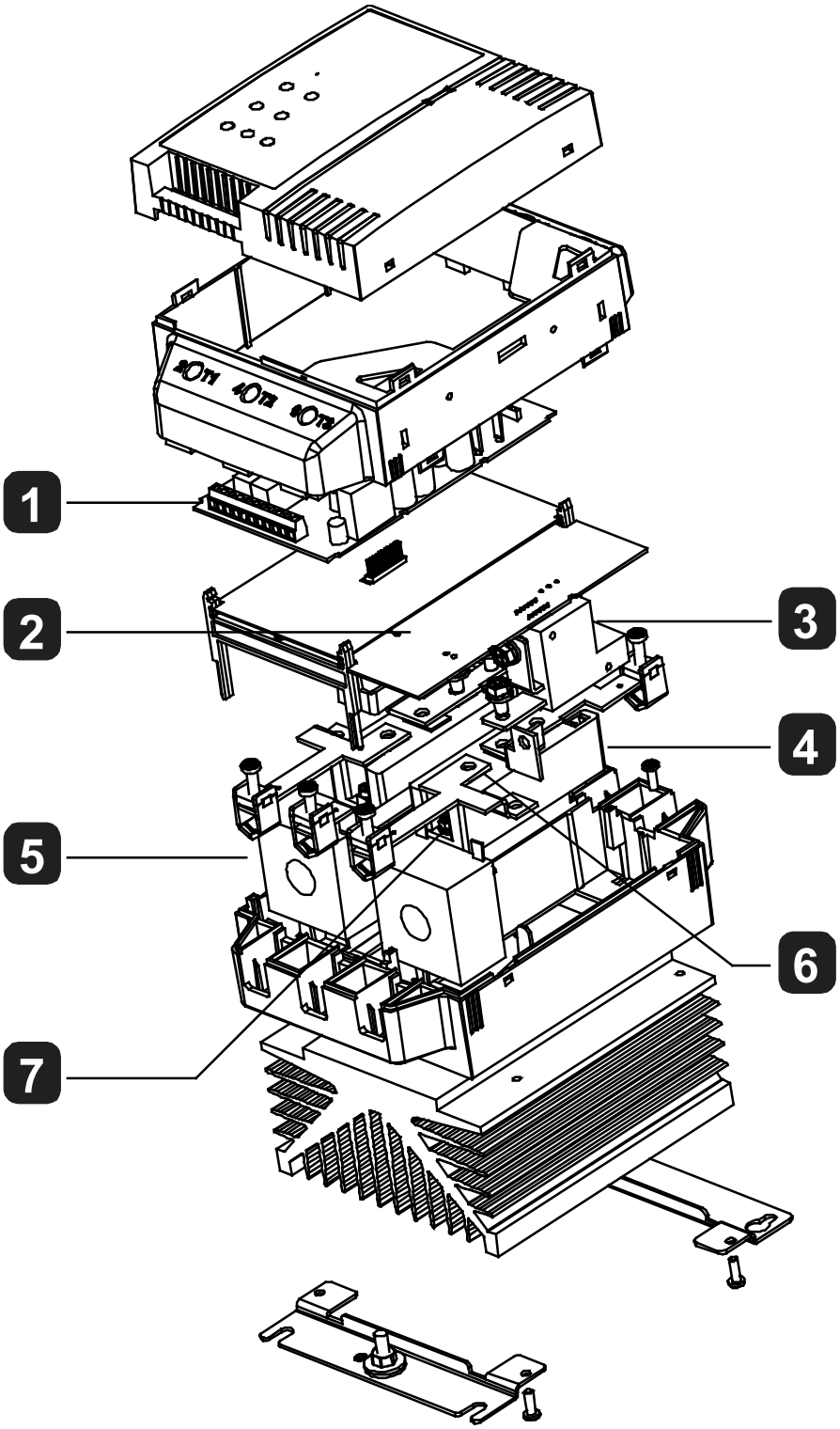
1	Main Control PCB
2	Interface PCB
3	Bypass relays
4	SCRs
5	SCR-bus bar connection (tighten to 9 Nm)
6	SCR-heatsink connection (tighten to 4 Nm)

4.4 Exploded View: Closed Loop 018~-060



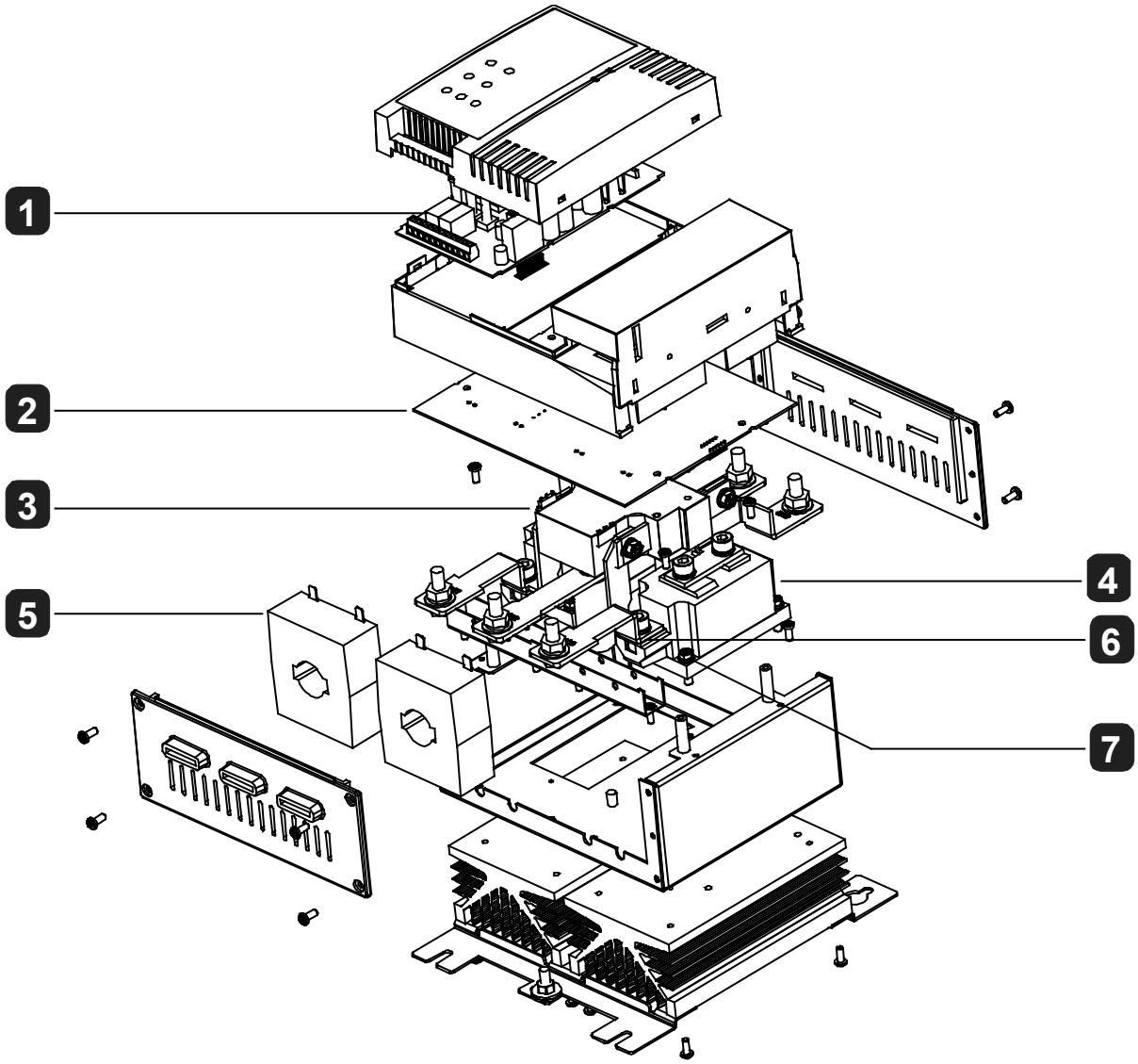
1	Main Control PCB
2	Interface PCB
3	Current transformers
4	Bypass relays
5	SCRs
6	SCR-busbar connection (tighten to 4 Nm)
7	SCR-heatsink connection (tighten to 5 Nm)

4.5 Exploded View: Closed Loop 075~-100



1	Main Control PCB
2	Interface PCB
3	Bypass relays
4	SCRs
5	Current transformers
6	SCR-busbar connection (tighten to 4 Nm)
7	SCR-heatsink connection (tighten to 5 Nm)

4.6 Exploded View: Closed Loop 140~-200



1	Main Control PCB
2	Interface PCB
3	Bypass relays
4	SCRs
5	Current transformers
6	SCR-busbar connection (tighten to 9 Nm)
7	SCR-heatsink connection (tighten to 5 Nm)

4.7 Bolt Tightening Torque - Busbars to SCRs

Open loop soft starter

Model	Bolt size	Torque (Nm)
018	M5	4
034		
042		
048		
060		
075	M6	4
085		
100		
140	M8	9
170		
200		

4.8 Bolt Tightening Torque - SCRs to Heatsink

Closed loop soft starter

Model	Bolt size	Torque (Nm)
018	M5	5
034		
042		
048		
060		
075	M5	5
085		
100		
140	M5	5
170		
200		

5 Spare Parts

NOTE
Unless otherwise indicated, spare part kits contain only one of each item.

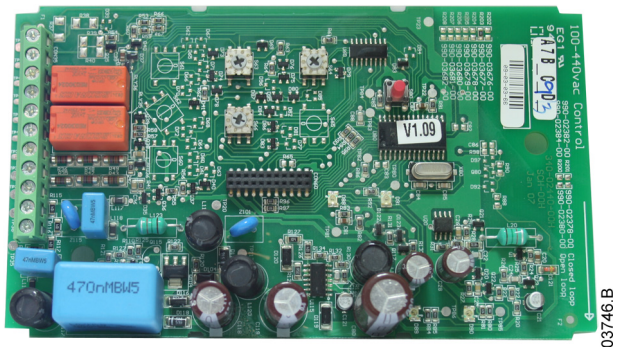
All images in this section are indicative.

5.1 Open loop soft starter

Main Control PCB

Each soft starter requires one Main Control PCB.

	C1 Models	C2 Models
xxxV4xx	995-02535-00	995-02536-00
xxxV6xx	995-02539-00	995-02540-00



995-02535-00 ~ 995-02540-00

Interface PCB

Each soft starter requires one Interface PCB.

018	995-02543-00
034	
042	
048	
060	
075	995-04516-00
085	
100	
140	995-03874-00
170	
200	

SCRs

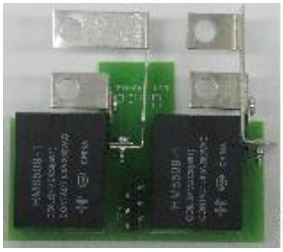
Each soft starter requires two SCRs.

018	995-02557-00
034	995-02558-00
042	995-02559-00
048	995-02560-00
060	995-02561-00
075	995-02562-00
085	995-02563-00
100	995-02564-00
140	995-02565-00
170	995-02566-00
200	995-02567-00

Bypass Relays

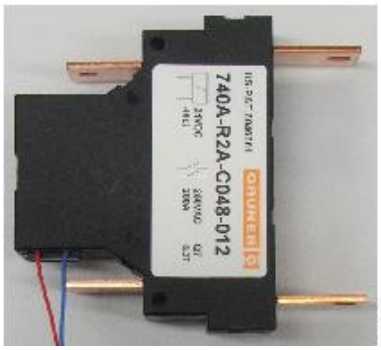
Soft starter models 018~060 and 140~200 require one bypass relay per starter. Models 075~100 require two relays per starter.

018	995-02568-00
034	
042	
048	
060	
075	995-04515-00
085	
100	
140	995-03873-00
170	
200	



995-02568-00

995-04515-00



995-03873-00

PCB List

The table below shows the spare part kit for each open loop soft starter PCB. If you require a new PCB, please order using the kit part number (995-xxxxx-00).

PCB Part Number	Description	Soft Starter Model(s)	Kit Part Number
990-02380-00	Main control PCB	xxx-V4-C1	995-02535-00
990-02381-00	Main control PCB	xxx-V4-C2	995-02536-00
990-02384-00	Main control PCB	xxx-V6-C1	995-02539-00
990-02385-00	Main control PCB	xxx-V6-C2	995-02540-00
990-02386-00	Interface PCB	007-xx-xx 015-xx-xx 018-xx-xx 022-xx-xx 030-xx-xx	995-02543-00
990-02394-00	Interface PCB	037-xx-xx 045-xx-xx 055-xx-xx	995-04516-00 [1]
990-02398-00	Interface PCB	075-xx-xx 090-xx-xx 110-xx-xx	995-03874-00 [2]

[1] This kit is suitable for use with compact soft starter units of version 10 or later (serial number xxxxx-10, batch number 060227). Please contact your local supplier for assistance with earlier versions.

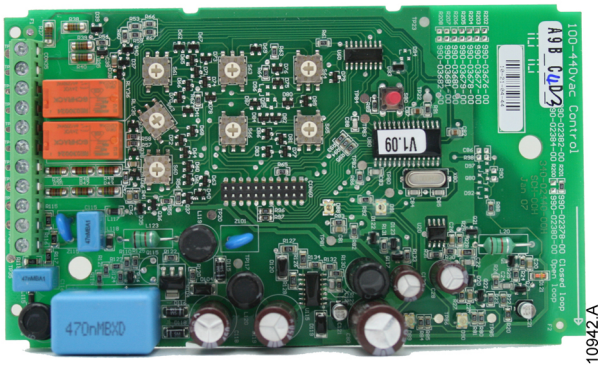
[2] This kit is suitable for use with compact soft starter units of version 7 or later (serial number xxxxx-07, batch number 050602). Please contact your local supplier for assistance with earlier versions.

5.2 Closed loop soft starter

Main Control PCB

Each soft starter requires one Main Control PCB.

	C1 Models	C2 Models
xxx-V4-xx	995-02537-00	995-02538-00
xxx-V6-xx	995-02541-00	995-02542-00

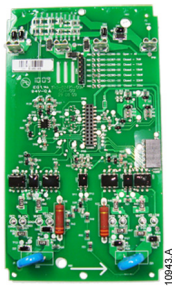


995-02537-00 ~ 995-02542-00

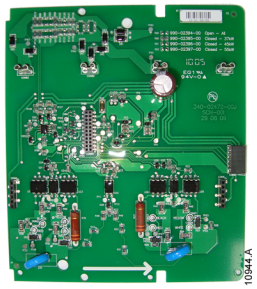
Interface PCB

Each soft starter requires one Interface PCB.

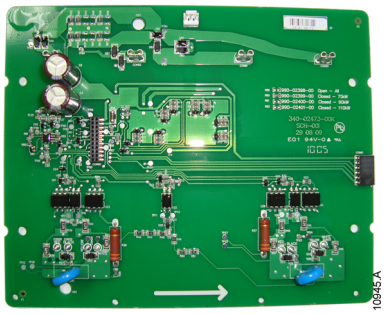
018	995-02546-00
034	995-02547-00
042	995-02548-00
048	995-02549-00
060	995-02550-00
075	995-04517-00
085	995-04518-00
100	995-04519-00
140	995-03875-00
170	995-03876-00
200	995-03877-00



995-02546-00~995-02550-00



995-04517-00~995-04519-00



995-03875-00~995-03877-00

SCRs

Each soft starter requires two SCRs.

018	995-02557-00
034	995-02558-00
042	995-02559-00
048	995-02560-00
060	995-02561-00
075	995-02562-00
085	995-02563-00
100	995-02564-00
140	995-02565-00
170	995-02566-00
200	995-02567-00

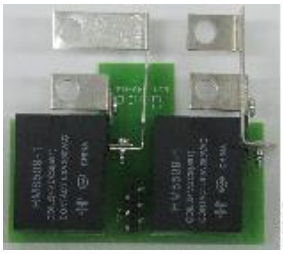
Bypass Relays

Soft starter models 018~060 and 140~200 require one bypass relay per starter. Models 075~100 require two relays per starter.

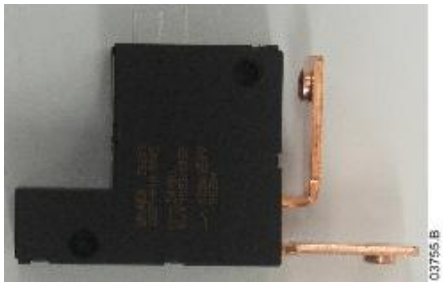
018	995-02568-00
034	
042	
048	
060	
075	995-04515-00
085	
100	
140	995-03873-00
170	
200	

[1] This kit is suitable for use with compact soft starter units of version 10 or later (serial number xxxxx-10, batch number 060227). Please contact your local supplier for assistance with earlier versions.

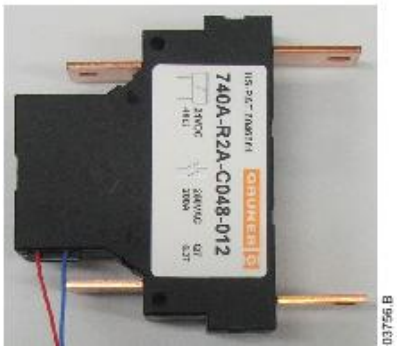
[2] This kit is suitable for use with compact soft starter units of version 7 or later (serial number xxxxx-07, batch number 050602). Please contact your local supplier for assistance with earlier versions.



995-02568-00



995-04515-00

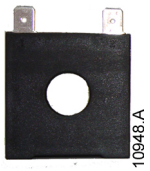


995-03873-00

Current Transformers

Each soft starter requires two current transformers.

018	995-02571-00
034	
042	
048	
060	
075	995-02572-00
085	
100	
140	995-02573-00
170	
200	



995-02571-00

995-02572-00

995-02573-00

PCB List

The table below shows the spare part kit for each closed loop soft starter PCB. If you require a new PCB, please order using the kit part number (995-xxxxx-00).

PCB Part Number	Description	Soft Starter Model(s)	Kit Part Number
990-02378-00	Main control PCB	xxx-V4-C1	995-02537-00
990-02379-00	Main control PCB	xxx-V4-C2	995-02538-00
990-02382-00	Main control PCB	xxx-V6-C1	995-02541-00
990-02383-00	Main control PCB	xxx-V6-C2	995-02542-00
990-02387-00	Interface PCB	007-xx-xx	995-02546-00
990-02389-00	Interface PCB	015-xx-xx	995-02547-00
990-02390-00	Interface PCB	018-xx-xx	995-02548-00
990-02391-00	Interface PCB	022-xx-xx	995-02549-00
990-02392-00	Interface PCB	030-xx-xx	995-02550-00
990-02395-00	Interface PCB	037-xx-xx	995-04517-00 [1]
990-02396-00	Interface PCB	045-xx-xx	995-04518-00 [1]
990-02397-00	Interface PCB	055-xx-xx	995-04519-00 [1]
990-02399-00	Interface PCB	075-xx-xx	995-03875-00 [2]
990-02400-00	Interface PCB	090-xx-xx	995-03876-00 [2]
990-02401-00	Interface PCB	110-xx-xx	995-03877-00 [2]

[1] This kit is suitable for use with compact soft starter units of version 10 or later (serial number xxxxx-10, batch number 060227). Please contact your local supplier for assistance with earlier versions.

[2] This kit is suitable for use with compact soft starter units of version 7 or later (serial number xxxxx-07, batch number 050602). Please contact your local supplier for assistance with earlier versions.

5.3 SCR Connectoins

NOTE
Spare part kits may include SCRs from different manufacturers. SCRs from different manufacturers are fully interchangeable and can be mixed within the same soft starter.

CAUTION
SCR firing loom connections may be different for different manufacturers. Ensure correct wiring of connections for type of SCR.

Connect the coloured firing looms to the numbered gates according to the diagrams below:

Models 018~060

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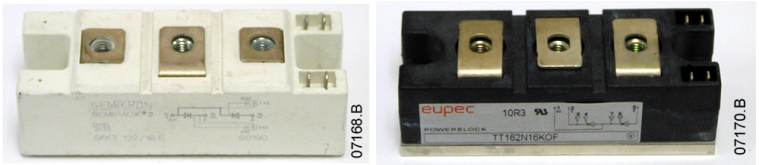
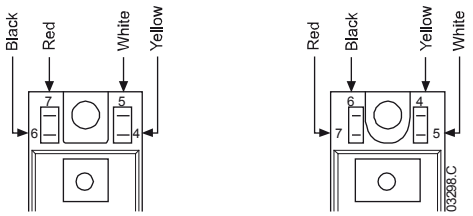
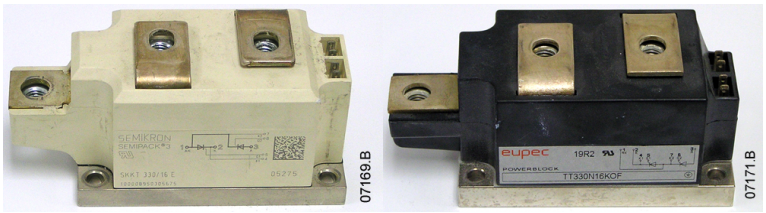
Model 075~100

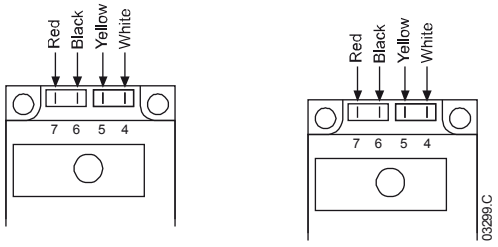




SEMIKRON INFINEON

Models 140~200





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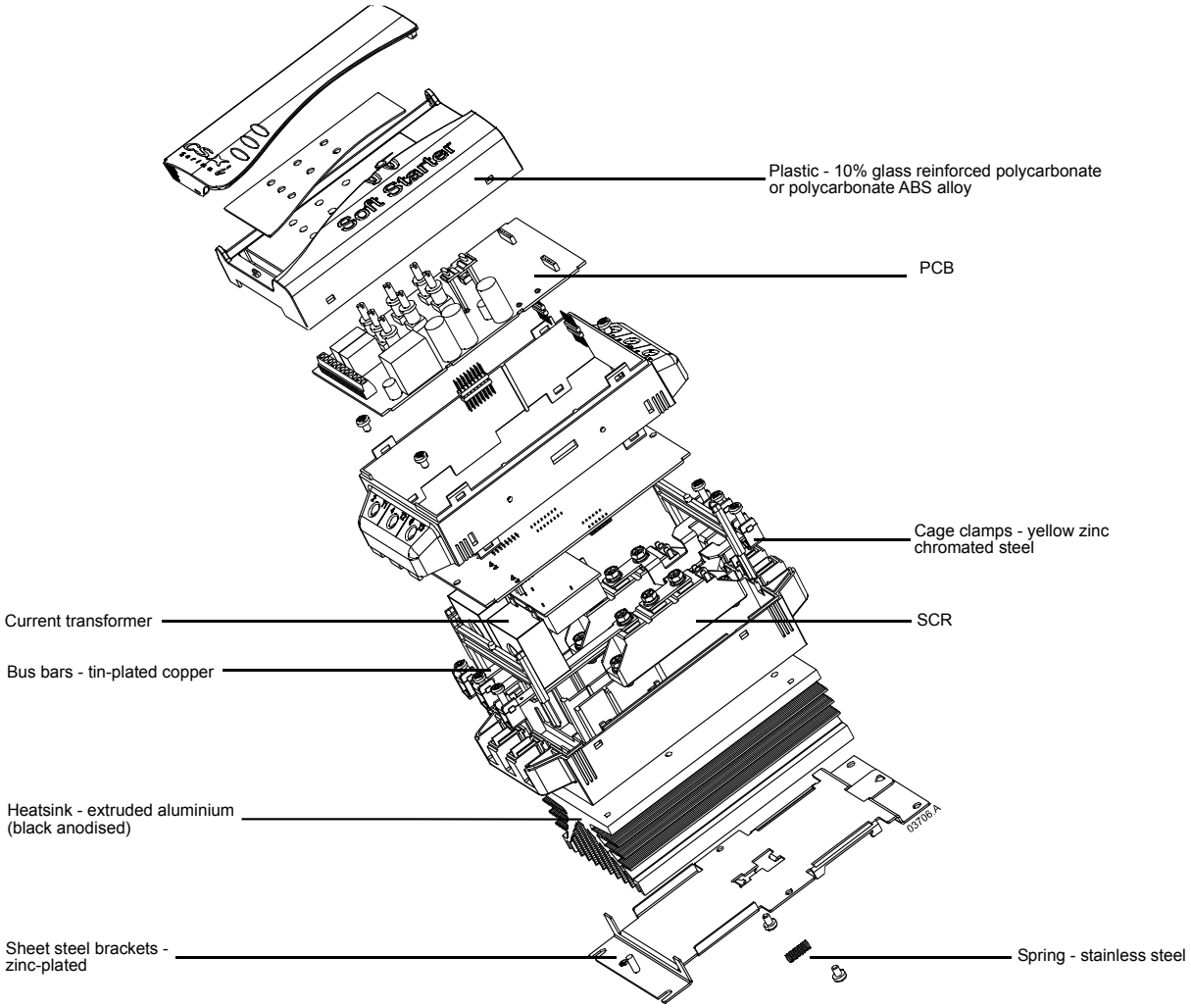
6 Disposal Instructions

Component/Fraction	Environmental conditions	Dismantling/Scrapping	Characteristics
Aluminium	No problems	Re-melt.	Separate from the rest to secure high grade of recovery.
Steel	No problems	Re-melt.	Separate from the rest to secure high grade of recovery.
Wires	No problems	Re-melt in copper works with previous shredding if necessary. PVC must be incinerated at high temperature followed by rapid cooling.	The isolation contains softeners, gloves are recommended. Some of the isolation is made of PVC.
Printed circuit boards Current transformers SCRs	Problems	Copper recycling facilities, where all precious metals are recovered and heavy metals and other hazardous substances are bounded in the remainder fraction.	All printed circuit boards and components with plastics contain flame retardant. The tin solder contains lead.
Plastics	Problems	Controlled incineration or recycling	Plastics are polycarbonate or polycarbonate/ABS alloy and contain glass and flame retardant.



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LS ELECTRIC Co., Ltd.

■ Headquarter
LS-ro 127(Hogye-dong) Dongan-gu, Anyang-si, Gyeonggi-Do, 14119, Korea
■ Seoul Office
LS Yongsan Tower, 92, Hangang-daero, Yongsan-gu, Seoul, 04386, Korea
Tel: 82-2-2034-4033, 4888, 4703 Fax: 82-2-2034-4588
E-mail: automation@ls-electric.com

■ Overseas Subsidiaries
• LS ELECTRIC Japan Co., Ltd. (Tokyo, Japan)
Tel: 81-3-6268-8241 E-Mail: jschuna@lselectric.biz
• LS ELECTRIC (Dalian) Co., Ltd. (Dalian, China)
Tel: 86-411-8730-6495 E-Mail: jiheo@lselectric.com.cn
• LS ELECTRIC (Wuxi) Co., Ltd. (Wuxi, China)
Tel: 86-510-6851-6666 E-Mail: sblee@lselectric.co.kr
• LS ELECTRIC Vietnam Co., Ltd.
Tel: 84-93-631-4099 E-Mail: jhchoi4@lselectric.biz (Hanoi)
Tel: 84-28-3823-7890 E-Mail: sjbaik@lselectric.biz (Hochiminh)
• LS ELECTRIC Middle East FZE (Dubai, U.A.E.)
Tel: 971-4-886-5360 E-Mail: salesme@lselectric.biz
• LS ELECTRIC Europe B.V. (Hoofddorp, Netherlands)
Tel: 31-20-654-1424 E-Mail: europartner@lselectric.biz
• LS ELECTRIC America Inc. (Chicago, USA)
Tel: 1-800-891-2941 E-Mail: sales.us@lselectricamerica.com

■ Overseas Branches
• LS ELECTRIC Tokyo Office (Japan)
Tel: 81-3-6268-8241 E-Mail: jschuna@lselectric.biz
• LS ELECTRIC Beijing Office (China)
Tel: 86-10-5095-1631 E-Mail: khpaek@lselectric.com.cn
• LS ELECTRIC Shanghai Office (China)
Tel: 86-21-5237-9977 E-Mail: tsjun@lselectric.com.cn
• LS ELECTRIC Guangzhou Office (China)
Tel: 86-20-3818-2883 E-Mail: chenxs@lselectric.com.cn
• LS ELECTRIC Chengdu Office (China)
Tel: 86-28-8670-3201 E-Mail: yangcf@lselectric.com.cn
• LS ELECTRIC Qingdao Office (China)
Tel: 86-532-8501-2065 E-Mail: wangzy@lselectric.com.cn
• LS ELECTRIC Nanjing Office (China)
Tel: 86-25-8467-0005 E-Mail: ylong@lselectric.com.cn
• LS ELECTRIC Bangkok Office (Thailand)
Tel: 66-90-950-9683 E-Mail: sjleet@lselectric.biz
• LS ELECTRIC Jakarta Office (Indonesia)
Tel: 62-21-2933-7614 E-Mail: dioh@lselectric.biz
• LS ELECTRIC Moscow Office (Russia)
Tel: 7-499-682-6130 E-Mail: jdpark1@lselectric.biz
• LS ELECTRIC America Western Office (Irvine, USA)
Tel: 1-949-333-3140 E-Mail: ywyun@lselectricamerica.com

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