SOLCON

RVS-DN

Digital Soft Starter
8-3000A, 220-1000V

Instruction Manual

Ver. 27/02/2009

RVS-DN Instruction Manual

1. TABLE OF CONTENT

2. SAFETY & WARNINGS

2.1 Safety

	**1**	Read this manual carefully before operating the equipment and follow its instructions.
	2	Installation, operation and maintenance should be in strict accordance with this manual, national codes and good practice.
	3	Installation or operation not performed in strict accordance with these instructions will void manufacturer's warranty.
	4	Disconnect all power inputs before servicing the soft starter and/or the motor.
	5	After installation, check and verify that no parts (bolts, washers, etc.) have fallen into the power section of the RVS-DN.
	6	During shipping, the RVS-DN might have been roughly handled, therefore, it is recommended to initialize the RVS-DN by connecting supply voltage prior to operating the RVS-DN with a motor.

2.2 Attention

	1	This product was designed for compliance with IEC 60947-4-2 for class A equipment.
	2	RVS-DN 8 - 820 are UL approved (when this option is specified). RVS-DN 950 - 3000 are designed to meet UL requirements.
	3	RVS-DN 8 - 1400 are LR approved (when this option is specified). RVS-DN 1800 - 3000 are designed to meet LR requirements (when this option is specified).
	4	Use of the product in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.
	5	Utilization category is AC-53a or AC53b, Form 1. For further information, see Technical Specification.

2.3 Warnings

	**1**	Internal components and PCBs are at mains potential when the RVS-DN is connected to mains. This voltage is extremely dangerous and contact with it will cause death or severe injury.
	2	When the RVS-DN is connected to mains full voltage may appear on the RVS-DN's output terminals and motor's terminals, **even if control voltage is disconnected and motor is stopped**.
	3	The RVS-DN must be grounded to ensure correct operation, safety and to prevent damage.
	4	Check that Power Factor capacitors are **not** connected to the output side of the RVS-DN.
	5	Do not interchange line and load connections.

The company reserves the right to make any improvements or modifications to its products without prior notice.

3. TECHNICAL DATA

3.1 Introduction

The RVS-DN is a highly sophisticated and reliable soft starter designed for use with standard three-phase, three-wire and six-wire, squirrel cage induction motors. It provides the best method of reducing current and torque during motor starting.

The RVS-DN starts the motor by supplying a slowly increasing voltage to the motor. This provides soft start and smooth, stepless acceleration while drawing the minimum current necessary to start the motor.

The third generation, microprocessor based digital control provides unique features like pump control, slow speed, electronic reversing and accurate motor protection. RVS-DN models can be supplied with options for insulation protection, thermistor input & analog output, etc.

The optional RS 485 Communication with Modbus protocol or the optional Profibus protocol enables full control (START, STOP, DUAL ADJUST, Command, etc.) and supervision.

Advantages at a Glance

- ☐ Complete line 8-3000A, 220-1000V
- ☐ Heavy duty, fully rated design
- ☐ Robust construction
- ☐ Superior starting & stopping characteristics
- ☐ Comprehensive motor protection package
- ☐ User friendly
- ☐ Line or Inside Delta connection
- ☐ Rated ambient temperature: 50°C
- ☐ Unique optional features including:
  - ☐ Motor insulation tester
  - ☐ RS 485 comm. Modbus / Profibus
  - ☐ Thermistor input / analog output

Starting & Stopping

- ☐ Soft start & soft stop
- ☐ Current limit
- ☐ Pump control program
- ☐ Torque and current control for optimized starting & stopping process
- ☐ Dual adjustments - two starting & stopping characteristics
- ☐ Slow speed with electronic reversing
- ☐ Pulse start
- ☐ Linear acceleration (tacho feedback)
- ☐ Energy Save for improved power factor

Standard Ratings

- ☐ 230V, 400V, 480V, 600V, 690V, 1000V

Motor & Starter Protection

- ☐ Too many starts
- ☐ Long start time (stall)
- ☐ Shear-pin
- ☐ Electronic overload with selectable curves
- ☐ Under current with adjustable delays
- ☐ Phase loss & phase sequence
- ☐ Under, over & no voltage
- ☐ Load loss (motor not connected)
- ☐ Shorted SCR
- ☐ Starter over-temperature

Displays LCD & LEDs

- ☐ Illuminated LCD - 2 lines x 16 characters
- ☐ Selectable languages: English, German, French and Spanish (Russian - optional)
- ☐ Two display modes for basic and advanced applications
- ☐ Friendly operation with default parameters
- ☐ Eight LEDs for quick operational status
- ☐ Statistical data including:
  - ☐ Total run time
  - ☐ Total number of starts
  - ☐ Total number of trips
  - ☐ Last start current
  - ☐ Last start time
  - ☐ Last trip
  - ☐ Current at trip

Options

☐ Analog output (see details below)

☐ Thermistor input (see details below)

☐ Motor insulation test (see details below)

☐ Preparation for bypass - to maintain protection when bypass is closed

☐ Special anti-corrosive treatment - special coating for harsh environments

☐ Special tacho feedback circuitry

☐ Modbus RTU - enables setting, control & supervision

☐ Profibus DP – enables setting, control & supervision

Analog Card (Optional)

Incorporates two functions:

☐ Thermistor input, PTC or NTC

☐ Analog output, related to motor's current, programmable as 0-10VDC, 4-20mA, 0-20mA or inverse (inverse available in RVS-DN 1000V models)

Motor Insulation Tester (Optional)

A unique feature for submersible pumps, motors installed in harsh environments, etc.
The system measures motor insulation when motor is not running.

Two programmable levels are available:

☐ Alarm level, adjustable 0.2-5 Mohm

☐ Start disable level, adjustable 0.2-5 Mohm, preventing starting when insulation is below acceptable levels

Auxiliary Relays

Three standard programmable relays (each relay with one C.O. 8A, 220VAC contacts)

☐ Immediate with adjustable on and off delays. Can be dedicated for shear-pin (jam) protection

☐ End of acceleration, with adjustable on delay

☐ Fault, programmable as fault or fault-fail safe operation.

☐ Low motor insulation alarm (optional relay)

Applications - Industrial

☐ Pumps

☐ Hydraulic systems

☐ Fans and blowers

☐ Compressors

☐ Conveyors

Applications - Marine & Offshore

☐ Water, ballast and fire-fighting pumps

☐ Refrigeration chillers and compressors

☐ Hydraulic pumps and power packs

☐ Thrusters

☐ Main propulsion motors

☐ Unique protection for corrosive environments

☐ Generator ready - auto frequency tracking

☐ Sustains variations of 45-65Hz while starting

☐ Heavy duty, fully rated design

Applications - 1000V for Mining, Quarries & Mixers

Digital Soft Starter for 105-460A, robust, heavy duty, fully featured, fiber-optically controlled (210-460A)

Stainless steel with copper heatsink is available below 100A – consult factory for details

The RVS-DN has Lloyds Type Approval for ENV1, ENV2. As well as, Germaniche Lloyds, Rina and DNV - consult factory for details

3.2 Rated Currents and Frame Sizes

RVS-DN Model	RVS-DN FLC [A]	Frame Size	Dimensions WxHxD [mm]	Weight [Kg]
RVS-DN 8	8	A	153x310x170	4.5
RVS-DN 17	17	A	153x310x170	4.5
RVS-DN 31	31	A	153x310x170	6.0
RVS-DN 44	44	A	153x310x217	7.5
RVS-DN 58	58	A	153x310x217	7.5
RVS-DN 72	72	A	153x310x217	7.5
RVS-DN 85	85	B	274x385x238	14.5
RVS-DN 105	105	B	274x385x238	14.5
RVS-DN 145	145	B	274x385x238	14.5
RVS-DN 170	170	B	274x385x238	14.5
RVS-DN 210	210	C	380x455x292 **(1)**	32
RVS-DN 310	310	C	380x455x292 **(1)**	32
RVS-DN 390	390	C	380x455x292 **(1)**	32
RVS-DN 460	460	D	380x555x292 **(1)**	39
RVS-DN 580	580	D	470x640x302 **(1)** 470x655x302 **(2)**	48
RVS-DN 820	820	D	470x710x302 **(1)** 470x715x302 **(2)**	65
RVS-DN 950	950	D	623x660x290 **(3)**	83.5
RVS-DN 1100	1100	E	723x1100x370 **(3)**	170
RVS-DN 1400	1400	E	723x1100x370 **(3)**	170
RVS-DN 1800	1800	E	723x1100x370 **(3)**	170
RVS-DN 2150	2150	F	750x1300x392 **(3)**	240
RVS-DN 2400	2400	G	900x1300x410 **(3) (4)**	350
RVS-DN 2700	2700	G	900x1300x410 **(3) (4)**	350
RVS-DN 3000	3000	G	900x1300x410 **(3) (4)**	350
RVS-DN 105 **1000V**	105		325x400x300	**(5)**
RVS-DN 170 **1000V**	170		592x500x345	**(5)**
RVS-DN 210 **1000V**	210		592x500x345	**(5)**
RVS-DN 310 **1000V**	310		592x500x345	**(5)**
RVS-DN 390 **1000V**	390		592x500x345	**(5)**
RVS-DN 460 **1000V**	460		592x500x345	**(5)**

Notes:

(1) – Different dimensions when ordered with UL/cUL/marine approvals.
Refer to section 5.3 page 47 for dimensions when ordered with these approvals.
(2) – Dimensions with preparation for bypass.
(3) – Must be operated with bypass contactor. Add space for current transformers and bus bars for preparation for bypass.
(4) – Control module is installed separately. Refer to section 5.1.1 page 45 for dimensions.
(5) – Consult factory.

Refer to section 5 on page 34 for detailed dimensions.

3.3 RVS-DN Selection

The RVS-DN should be selected in accordance with the criteria of motor current and starting conditions.

3.3.1 Motor Current and Starting Conditions

Select the RVS-DN according to motor's Full Load Ampere (FLA) - as indicated on its nameplate (even if the motor will not be fully loaded).
The RVS-DN is designed to operate under the following maximum conditions:

Ambient Temperature [°C]	Starting Current [A]	Acceleration Time [sec]
50	400%xIn	30

Max. starts per hour: 4 starts per hour at maximum ratings and up to 60 starts per hour at light load applications (consult factory).

Note:
For very frequent starts (inching applications) the inching current should be considered as the Full Load Current (FLC) (consult factory).

3.4 **Mains and Control Description**

Refer to drawing on page 13

Indication	Description	Remarks
L1, L2, L3	Connection to mains voltage up to 1000V	Thyristor's PIV rating, internal circuitry and insulation defines five voltage levels: **400V** for 230-400V +10%/ -15% 50/60Hz **480V** for 480V +10% /-15% 50/60Hz **600V** for 600V +10% /-15% 50/60Hz **690V** for 690V +10% /-15% 50/60Hz **1000V** for 1000V +10% / -15% 50/60Hz Each RVS-DN is suitable for one of the above levels & for 50/60 Hz.
L1b, L2b, L3b	Preparation for bypass connection (optional)	All models from RVS-DN 950A and up, and RVS-DN 1000V models must be operated with a bypass contactor. Bypass preparation is standard in models RVS-DN85-170A. Refer to section 3.5.1 page 14 for more details.
U, V, W	Connection to motor	
G	Connection to ground	For proper operation and for safety reasons soft RVS-DN must be properly grounded.
Terminal 1	Control phase (positive – for DC control)	The control voltage operates the electronic circuitry and the fans (when they exist). Three control voltages are available: **115** for 115V +10%/ -15% 50/60Hz **230** for 230V +10%/ -15% 50/60Hz **110VDC** for 110V +10%/ -15% DC
Terminal 3	Control neutral (return)	
Terminal 2	Fan control	An internal jumper, connected between the fan and terminal 2 enables three modes of operation (refer to section 6.6 page 58). For fan power consumption, see technical specification in section 10 page 99.
Terminal 4	Input – STOP command. • Input from a N.C. contact • To stop the motor, disconnect Control Input voltage from terminal 4 for at least 250mSec. (no SOFT STOP)	• Control Input voltage (STOP, SOFT STOP, START, terminal inputs 7 and 8) can be the same as Control Supply (terminals 1, 3) or voltage from a different source. • The Control Inputs are opto-coupled and isolated from the microprocessor circuitry.
Terminal 5	Input – SOFT STOP command. • Input from a N.C. contact • To SOFT STOP the motor disconnect Control Input voltage from terminal 5 for at least 250mS **Note:** If SOFT STOP is not required, connect a jumper between terminals 4 and 5.	Control Input voltages available: **230** for 90-230V +10%/ 50/60Hz or DC. **24** for 24V +10%/ -15% 50/60Hz or DC. **48** for 48V +10%/ -15% 50/60Hz or DC.

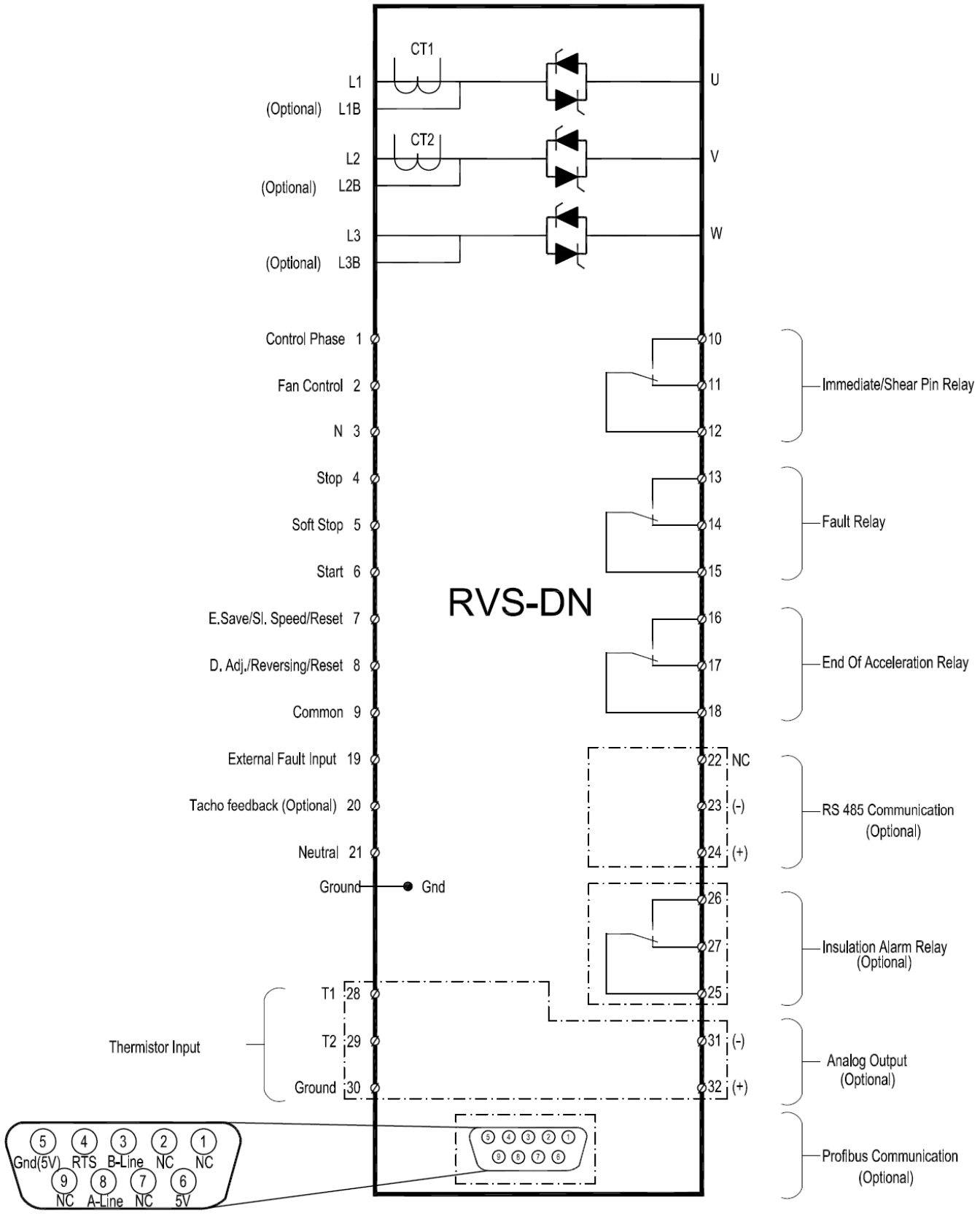
Indication	Description	Remarks
Terminal 6	Input – START command. • Input from a N.O. contact. • To SOFT START the motor, connect Control Input voltage to terminal 4 for at least 250mSec. **Notes:** • Motor will start only if STOP (terminal 4) and SOFT STOP (terminal 5) terminals are connected to Control Input voltage. • To reset a fault the START command must be removed.	
Terminal 7	Programmable input – ENERGY SAVE / SLOW SPEED / RESET	Refer to section 3.5.2 page 16.
Terminal 8	Programmable input – DUAL ADJUSTMENT / REVERSING / RESET	Refer to section 3.5.3 page 16.
Terminal 9	Common to terminals 4-8.	This terminal is a reference for terminals 4, 5, 6, 7 & 8. **Note:** When Control Supply and Control Input voltage are from the same source, connect a jumper between terminals 3 and 9.
Terminal 10	Programmable IMM/S.PIN RELAY (N.O.)	IMM/S.PIN RELAY is the immediate/shear pin output relay. • • Voltage free 8A, 250VAC, 2000VA max. • Selection between functions is made from the keypad or through the communication. • Refer to section 7.7.8 page 83 for IMM/ S.PIN RELAY programming. • Refer to section 3.5.4 page 16 for more details.
Terminal 11	Programmable IMM/S.PIN RELAY (N.C.)	
Terminal 12	Programmable IMM/S.PIN RELAY (Common)	
Terminal 13	Programmable Fault Output relay (N.O.)	Voltage free 8A, 250VAC, 2000VA max. changes its position upon fault. The contact is programmable to function as FAULT or FAULT-FAIL SAFE. When the FAULT function is selected, the relay is energized upon fault. The contact returns to its original position when one of the following occurs: • The fault has been removed and RVS-DN was reset • Disconnection of Control Supply When the FAULT-FAIL SAFE function is selected, the relay is energized immediately when the Control Supply is connected and de-energizes when one of the following occurs: • Fault • Control Supply disconnection Refer to section 7.7.8 page 83 for FAULT RELAY TYPE programming.
Terminal 14	Programmable Fault Output relay (N.C.)	
Terminal 15	Programmable Fault Output relay (Common)	

Indication	Description	Remarks
Terminal 16	Programmable End of Acceleration (Run) Output relay (N.O.)	Voltage free 8A, 250VAC, 2000VA max. changes its position at the end of acceleration, after an adjustable time delay (Contact Delay), 0 – 120 sec. The contact returns to its original position when ENERGY SAVE is operated, on SOFT STOP or STOP signals, on FAULT condition, or upon voltage outage. The End of Acceleration contact (Run) can be used for: •Closing a bypass contactor •Activating a valve after compressor has reached full speed •Loading a conveyor after motor reached full speed. Refer to section 7.7.3 page 72 for RUN CONTACT DELAY programming
Terminal 17	Programmable End of Acceleration (Run) Output relay (N.C.)	
Terminal 18	Programmable End of Acceleration (Run) Output relay (Common)	
Terminal 19	External Fault input	Input from a N.O. contact that is connected between terminals 19 and 21. The RVS-DN will trip 2 seconds after the contact closes. **Notes:** •Wires connecting the External Fault contact to terminal 19 should not exceed 1 meter in length. •External Fault can be used only when terminal 21 is connected to neutral or ground. •Do not use External Fault while using the Insulation Alarm option. •Only potential free contacts may be connected to terminal 19. •Do not connect any voltage to terminal 19. •Any connection of voltage to this terminal may disrupt RVS-DN operation, and cause RVS-DN or motor damage. •Refer to section 4.12 page 24 for the External Fault wiring diagram.
Terminal 20	Tacho Feedback input (optional)	•Provides linear acceleration and deceleration. •Requires high quality tacho generator on motor shaft, output voltage 0-10VDC, linear speed/voltage ratio. •Consult factory for further information before using the tacho feedback feature.
Terminal 21	Neutral connection	When a **mains** neutral wire is available, connect terminal 21 to neutral. Terminal 21 serves only as a voltage reference to the control circuitry. **Notes:** •RVS-DN circuitry incorporates an internal artificial neutral, which should only be used, when the system is not grounded and **mains** neutral connection is not available. •Only potential free contacts may be connected to terminal 21. •Do not connect any voltage to terminal 21. Any connection of voltage to this terminal may disrupt RVS-DN operation, and cause RVS-DN or motor damage. •Refer to section 14.1 on page 19 for terminal 21 connection.

Indication	Description	Remarks
Terminal 22	No connection (optional)	• Standard RS485, half duplex with Modbus protocol, baud rate 1200, 2400, 4800, 9600 BPS. • Twisted shielded pair should be used. Connect shield to ground on the PLC/Computer side. • Terminals 4 & 5 must be wired to Control Supply for operation in communication mode (refer to section 4.16 page 27 for wiring diagram). • Up 32 units can be connected for Modbus RS485 communication. For reliable communication, units should be installed in the vicinity of 200m maximum, from the first to the last unit. • Refer to section 7.7.9 page 85 for programming. • Consult the communication manual (ask factory).
Terminal 23	RS-485 communication (-) (optional)	
Terminal 24	RS-485 communication (+) (optional)	
Terminal 25	Programmable Insulation Alarm Output relay (Common) (optional)	Voltage free 8A, 250VAC, 2000VA max. is energized when the motor insulation level decreases below the Insulation Alarm level. The relay is de-energized and the alarm will disappear if on of the following occurs: • The insulation level returns to normal for more than 60 seconds • RVS-DN resets • Control Supply disconnection Refer to section 7.7.7 on page 81 for more details. **Notes:** • Do not use External Fault while using Insulation test option. • Insulation test can be performed only when main voltage is not connected to the RVS-DN, (upstream isolation device must be opened.) • For correct operation of Insulation test, it is important that the RVS-DN is properly grounded and that the control module is properly fastened to the power section. • Insulation test option and analog output option can not be applied together. • Refer to section 7.7.7 page 81 for insulation test programming.
Terminal 26	Programmable Insulation Alarm Output relay (N.O.) (optional)	
Terminal 27	Programmable Insulation Alarm Output relay (N.C.) (optional)	
Terminal 28	Thermistor input (T1) (optional)	Thermistor input is programmable as a PTC or NTC type thermistor. The trip value is adjustable between 1-10Kohm, preset delay of 2 Sec. Connect thermistor and/or Analog output shield to ground terminal. Analog output (0-10VDC or 0-20mA or 4-20mA) reflects motor current and is related to 2xFLA. i.e., Full scale (10VDC or 20mA) is related to 2xFLA. **Note**: In the RVS-DN 1000V models the analog output reflects motor current and is related to 2x**FLC**.Dip switches allow selection between: 0-10VDC, 0-20mA or 4-20mA. • Refer to section 6.7 page 59 for analog output dip switch setting. • Refer to section 7.7.8 page 83 for analog output programming. • Refer to section 7.7.7 page 81 for thermistor input programming.
Terminal 29	Thermistor input (T2) (optional)	
Terminal 30	Ground (optional)	
Terminal 31	Analog output (-) (optional)	
Terminal 32	Analog output (+) (optional)	

Indication	Description	Remarks
D-9 connector	Profibus communication (optional)	•Profibus DPV0 and DPV1, up to 12 MBPS. •D type 9 pin connector is applied. •Control, monitoring and setting parameters can be achieved via the Profibus connection. •Setting is possible only when DPV1 is implemented. •Refer to section 7.7.10 page 85 for programming. •Consult the Profibus manual (request from the factory).

3.5 Input/Output Indication



3.5.1 Preparation for Bypass Contactor

Under normal operating conditions the heat dissipated by an RVS-DN causes heating of the enclosure and energy losses. The heating and losses can be eliminated by the use of a bypass contactor, which bypasses the RVS-DN after completion of start-up so that motor current will flow through the bypass contactor.
In models RVS-DN 950A and up, current transformers CT1 and CT2 are mounted outside the RVS-DN and need to be connected to the RVS-DN by the customer. In this case the customer **MUST NOT ground the secondaries of current transformers!**

Heat dissipation from the RVS-DN is calculated as:

Ploss=3x1.3xI+FAN loss

where:
I represents motor current. Note that the motor current during the start process is higher than the motor rated current.
FAN loss represents power loss caused by all internal fans (refer to section 10 page 99 for fan loss per model).

For example, during start of a 820A motor when CURRENT LIMIT is set to 400%, heat dissipation can be calculated as:

Ploss=3x1.3x4x820+150=12,792Watt≈12.8kW

While a 820A motor is running and the motor current is 820A, heat dissipation can be calculated as:

Ploss=3x1.3x820+150=3,198Watt≈3.2kW

When a bypass contactor is used this changes the previous calculation to:

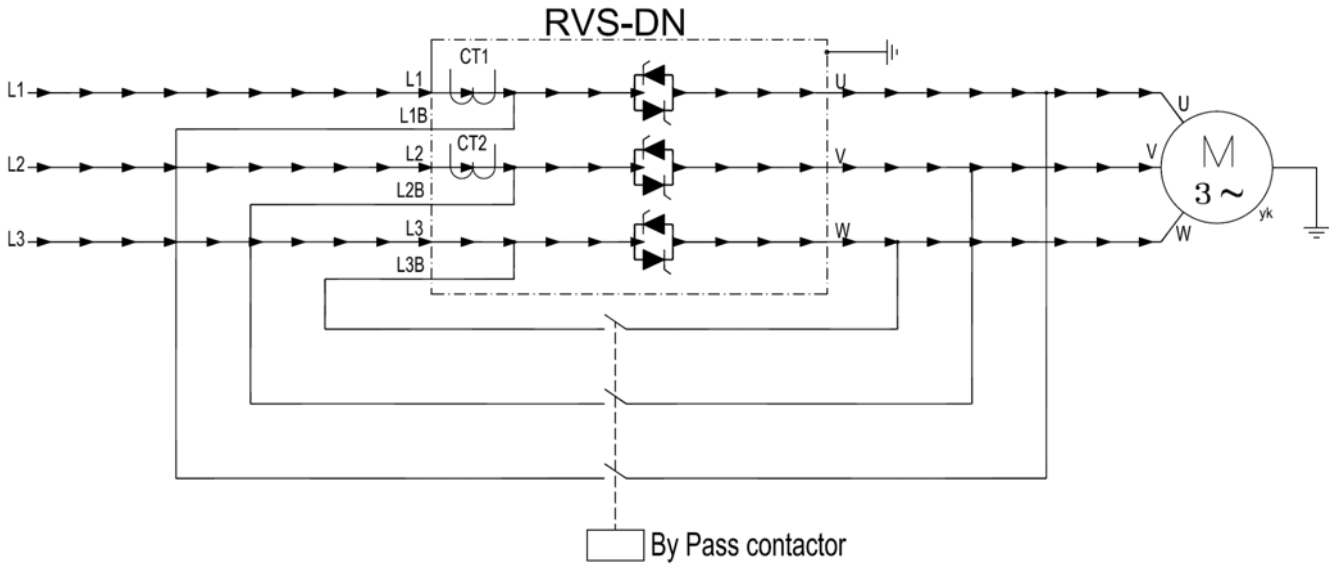
Ploss=3x1.3x0+150=150Watt≈0.15kW

It is obvious that using a bypass contactor can significantly reduce energy consumption.

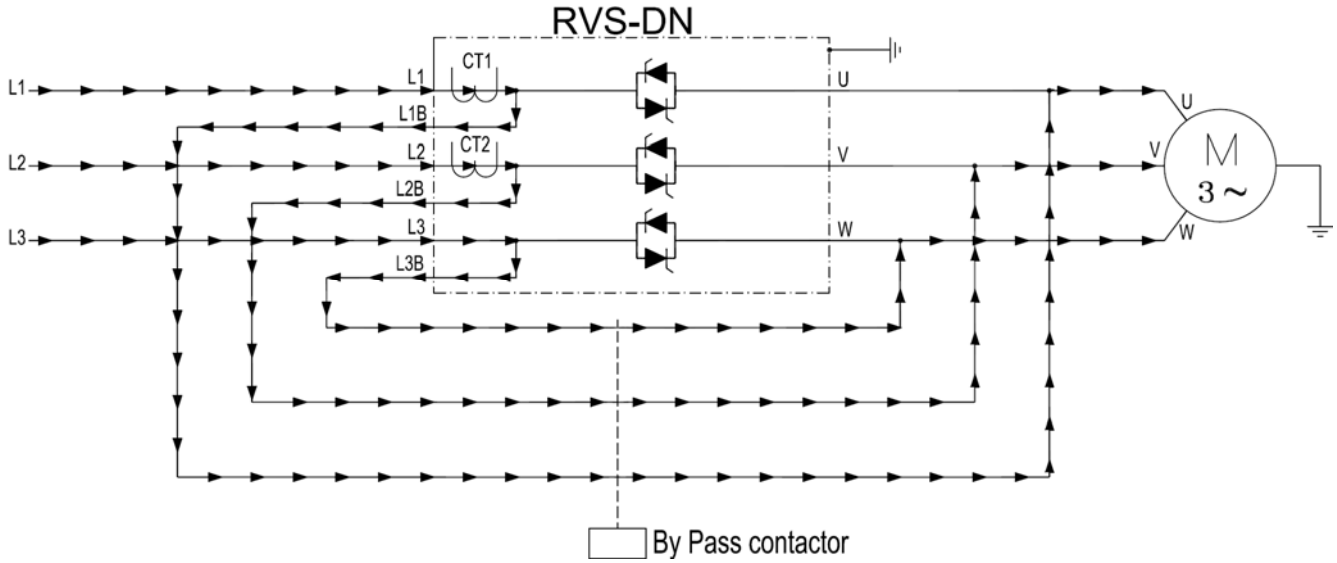
Notes:

- All models from RVS-DN 950A and up and RVS-DN 1000V must be implemented with a bypass contactor (see section 3.5.1.2 page 15).
- Bypass preparation is standard in models RVS-DN 85-170A.

3.5.1.1 Maintaining Current Protection after Bypass Closes



Current flow during soft start and soft stop.
Bypass contactor is open.



Current flow during RUN when the bypass contactor bypasses the RSV-DN. Current transformers CT1 and CT2 are able to measure motor current, thus the motor current protections of the RVS-DN are operable.

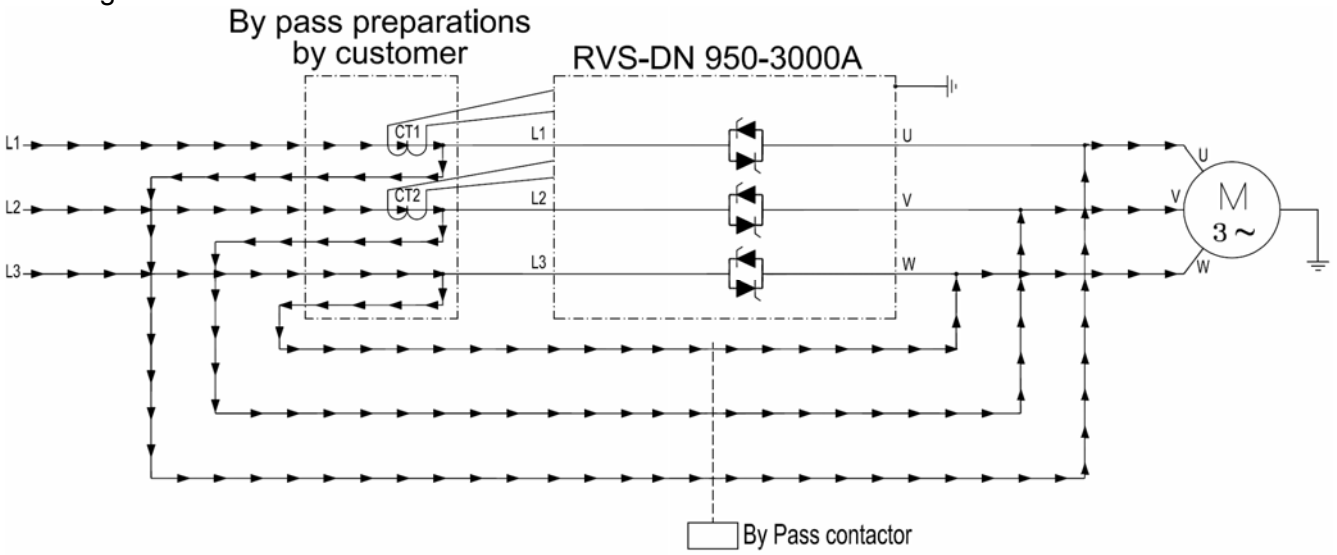
Note:
If the RVS-DN is bypassed without using the preparation for bypass the following protections are **not** operable during RUN:

- UNDER CURRENT
- O/C SHEAR PIN
- OVERLOAD TRIP

3.5.1.2 Maintaining Current Protection after Bypass Closes - RVS-DN 950-3000a

RVS-DN 950-3000A models are supplied without preparation for bypass. **However bypass must be applied for these models.**
Current transformers CT1 and CT2 are supplied separately and must be connected to the RVS-DN as shown below.

Note:
Do not ground current transformers secondaries!



Current flow during RUN when the bypass contactor bypasses the RVS-DN. The customer must perform the bypass connections shown. Current transformers CT1 and CT2 are supplied with the RVS-DN. Do NOT ground the CTs!

3.5.2 Input Terminal 7 - Energy Save/Slow Speed/Reset

Input from a N.O. contact - selection between above functions is made from the keypad (refer to section 7.7.8 page 83) or through the communication (Modbus or Profibus).

When ENERGY SAVE function is selected - connect terminal 7 to control input voltage by a jumper for automatic operation, upon load decrease.
When connected through a N.O. contact, closing the contact operates Energy Save.

When SLOW SPEED function is selected - connect control input voltage to terminal 7 before starting. When start command is initiated motor will run at 1/6 nominal speed for 30 seconds maximum. Closing terminal 7 while motor is running will not have any effect.

When RESET function is selected - connect terminal 7 to control input voltage (use a N.O. momentary contact) to reset the RVS-DN.

Refer to section 4.10 page 23 for the wiring diagram.

3.5.3 Input Terminal 8 - Dual Adjust/Reverse/Reset

Input from a N.O. contact - selection between above functions is made from the keypad (refer to section 7.7.8 page 83) or through the communication (Modbus or Profibus).

When DUAL ADJUSTMENT function is selected - connect terminal 8 to Control Input voltage to operate the RVS-DN with the DUAL ADJUSTMENT characteristic. DUAL ADJUSTMENT characteristic is programmed as explained in section 7.7.5 page 79. You can switch between the primary and DUAL ADJUSTMENT settings before and/or during starting.
When dip switch #3 is set to on, DUAL ADJUSTMENT operates as D.ADJ.:GENERATOR PARAMETERS. Use this mode if the normal starting process fails, i.e., SHORTED SCR or WRONG CONNECTION faults occur and, after testing, operator is sure that SCRs, motor and motor connections are not faulty.
Refer to section 4.17 page 29 for D.ADJ.:GENERATOR PARAMETERS wiring.
Refer to section 9 page 95 for trouble shooting.

When SLOW SPEED REVERSE function is selected - connect Control Input voltage to terminal 8 to reverse direction. In order to operate in SLOW SPEED REVERSE, terminal 7 must be programmed as SLOW SPEED and Control Input voltage must be connected to terminal 7 as well.
You can give the reverse command before the motor is started or during operation at SLOW SPEED.
Connecting Control Input voltage to terminal 8 before motor is started, starts the motor in reverse direction.
Connecting Control Input voltage while motor is running at SLOW SPEED stops the motor for 0.6 – 2 sec (according to motor size) before reversing its direction.
Refer to section 4.10 page 23 for wiring diagram.

When RESET function is selected - connect terminal 8 to Control Input voltage (use a N.O. momentary contact) to reset the RVS-DN.

Refer to section 4.10 page 23 for the wiring diagram.

3.5.4 Output Terminals 10, 11 & 12 – Immediate/Shear Pin Relay

Programmable functions (refer to section 7.7.8 page 83):
IMMEDIATE (after start signal) - when immediate is selected, the relay is energized upon the START signal. The relay is de-energized when one of the following occurs:
- Fault
- Control Supply outage
- STOP signal

When SOFT STOP is operated - the relay is de-energized at the end of the SOFT STOP process.

The relay incorporates on and off delays of 0-3600 sec. each.
The immediate relay can be used for the following purposes:
- Release a brake of a motor
- Interlock with other systems

- Signalling
- Delay the opening of a line contactor at the end of SOFT STOP, thus allowing current to decrease to zero before opening the contactor
- Switch to / from Dual Adjustment settings with a time delay from the START signal (see Special Starting section 8.2.3.1 page 92).

O/C SHEAR PIN detection - when O/C Shear-pin is selected, the relay is energized upon SHEAR-PIN detection (RVS-DN's trip can be delayed 0-5 sec).

In this case, the relay incorporates on and off delays of 0-5 sec. each.
The O/C SHEAR PIN relay can be used for the following purposes:

- Interlock with other systems
- Signalling
- Delay for operating a reversing combination of upstream contactors when SHEAR PIN is detected, thus allowing clearing of a jam condition.

3.6 Ordering Information

RVS-DN	31-	400-	230	230-	0-	S
	Full load Current	Mains Voltage	Control Supply Voltage	Control Input Voltage	Options	Front Panel

Full load Current	
Specify	**Description**
RVS-DN's FLC [A]	8, 17, 31, 44, 58, 72, 85[2], 105[2], 145[2], 170[2], 210, 310, 390, 460, 580, 820, 950[1], 1100[1], 1400[1], 1800[1], 2150[1], 2400[1], 2700[1], 3000[1].
Mains Voltage	
Specify	**Description**
400	230 – 400 VAC, +10% -15%, 50/60Hz
480	480 VAC, +10% -15%, 50/60Hz
600	600 VAC, +10% -15%, 50/60Hz
690	690 VAC, +10% -15%, 50/60Hz
1000[1]	1000 VAC +10% -15%, 50/60Hz; Models: 105A, 170A, 210A, 310A, 390A, 460A.
Control Supply Voltage (Terminals 1 and 3)	
Specify	**Description**
115	115 VAC, 50/60Hz, +10% -15%
230	230 VAC, 50/60Hz, +10% -15%
110VDC	110 VDC, +10% -15%
Control Input Voltage (Terminals 4 to 9)	
Specify	**Description**
115 or 230	90-230 VAC, 50/60Hz, +10%
24	24V AC/DC, +10% -15%
48	48V AC/DC, +10% -15%
Options	
Specify	**Description**
0	No options
3M	Communication - RS-485 (Modbus) [3] [5]
3P	Communication - Profibus[3] (Must be factory supplied).
4	Insulation tester [4] [5]
5	Analog card – Thermistor in and Analog out [4] [5]
8	Harsh environment treatment. (Must be factory supplied).
9	Preparation for Bypass contactor [1] [2]
B	Line and load bus bars at bottom (Applicable in Marine/UL models 210-820A)
D	Remote panel mounting replacing the original panel.(supplied with 1.5 m cable)
H	Special character set LCD display
M	Marine approval (consult factory)
U	UL & cUL approval (8-820A models only)
T	Tachometer card for special drive systems (consult factory) [4] [5]
ROC	Chinese display
Front Panel	
Specify	**Description**
S	Standard
RU	Russian front panel and Russian characters LCD display.

Notes:

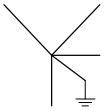
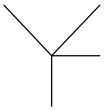
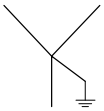
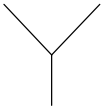
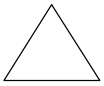
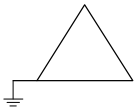
(1) RVS-DN 950-3000A and RVS-DN for 1000V must be operated with a bypass contactor. For usage without bypass contactor consult the factory.
(2) Preparation for bypass contactor is standard in RVS-DN 85-170A.
(3) Only one option, either 3M or 3P may be installed in one RVS-DN.
(4) Only one option, either 4 or 5 or T may be installed in one RVS-DN.
(5) All options must be factory installed in RVS-DN 8-72A.
(6) Current transformers (CTs) for RVS-DN950A and up are designed to allow installation within 1.5m from the RVS-DN (use the CTs for the RVS-DN only!)
(7) If you need more than one option, make sure to indicate it with a plus sign (+), for example **8+9** for Harsh environment and preparation for bypass contactor.

Ordering Example: RVS-DN rated 820A, mains voltage - 230V, Control Supply voltage - 115V, Control Input - 115V Modbus communication card, Analog card, Harsh environment treatment, preparation for bypass and standard front panel:

RVS-DN 820 - 400 - 115 – 115 - 3M + 5+ 8 + 9 – S

4. RECOMMENDED WIRING DIAGRAMS

4.1 Terminal 21 Connections With Various Mains

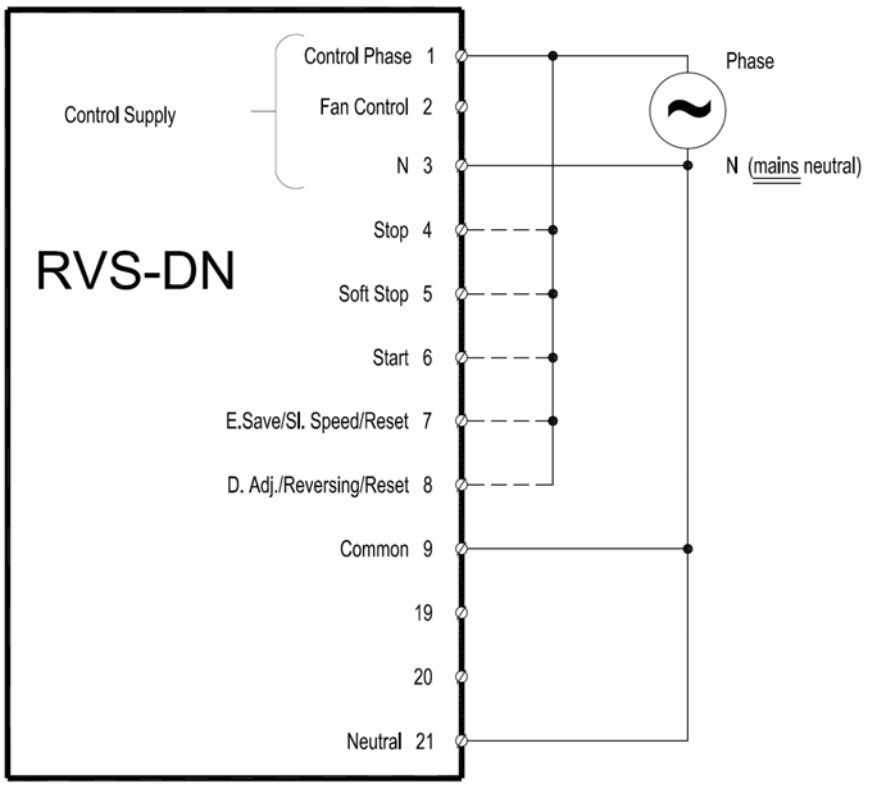
Mains Diagram	***Terminal 21 Connection***
	3P+N+GR - Connect terminal 21 to neutral
	3P+N - Connect terminal 21 to neutral
	3P+GR - Connect terminal 21 to ground
	3P - Leave terminal 21 unconnected
	3P - Leave terminal 21 unconnected
	3P+GR - Leave terminal 21 unconnected

WARNINGS!	Only potential free contacts may be connected to terminal 21! Do not connect any voltage to terminal 21! Any connection of voltage to terminal 21 may disrupt RVS-DN operation, and cause damage to the RVS-DN or the motor!

4.2 Control Supply, Control Input and Mains are From the Same Source, Neutral Connected to Terminal 21

Notes:

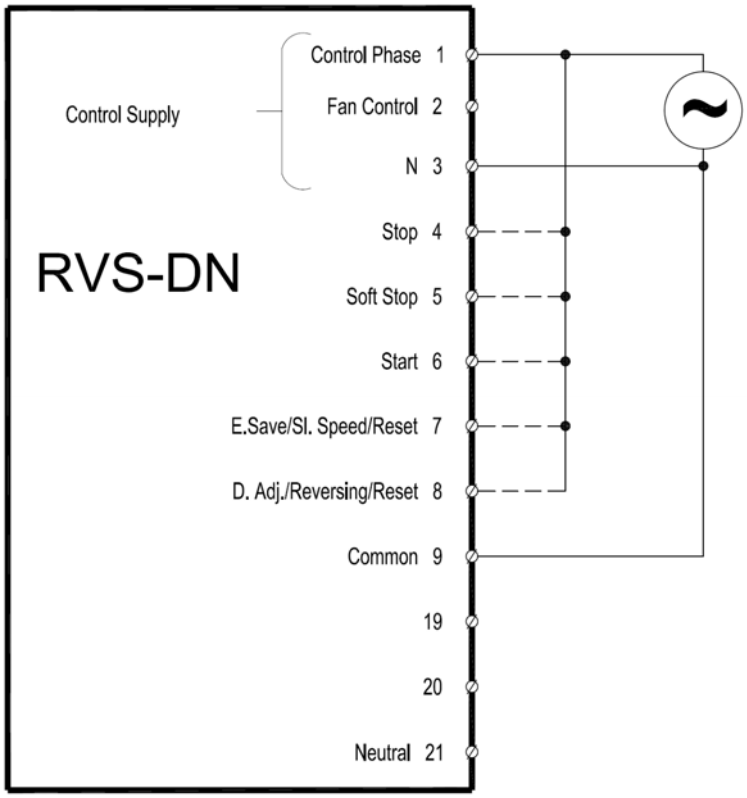
- Use this diagram when Control Supply, Control Input and mains are all from the same source, **and** terminal 21 is connected to neutral as per section 4.1 page 19.
- Supply must be protected for short circuit and over load. 6A fuse is recommended.
- It is recommended to use a separate fuse for the auxiliary circuits.



4.3 Control Supply and Control Input From the Same Source, Neutral not Connected to Terminal 21

Notes:

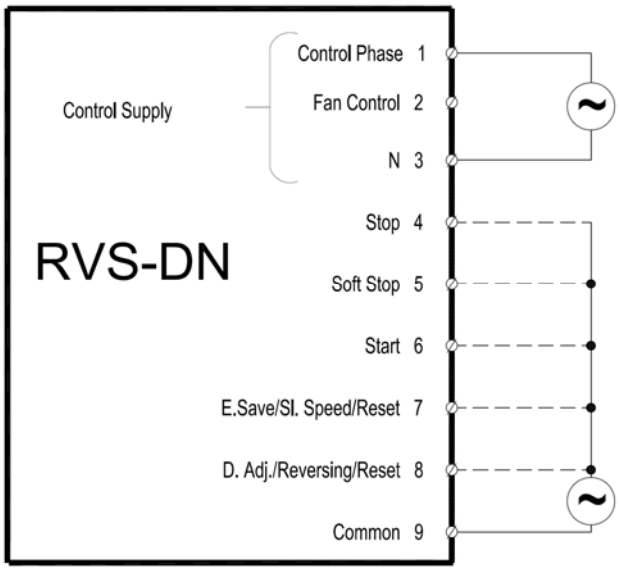
- Use this diagram when mains and control voltage are not from the same source
  or
  when mains and control voltage are from the same source, but terminal 21 is **not** connected to neutral as per section 4.1 page 19.
  In this case leave terminal 21 open.
- Supply must be protected for short circuit and over load. 6A fuse is recommended.
- It is recommended to use a separate fuse for the auxiliary circuits.



4.4 Control Supply and Control Input from Separate Sources

Notes:

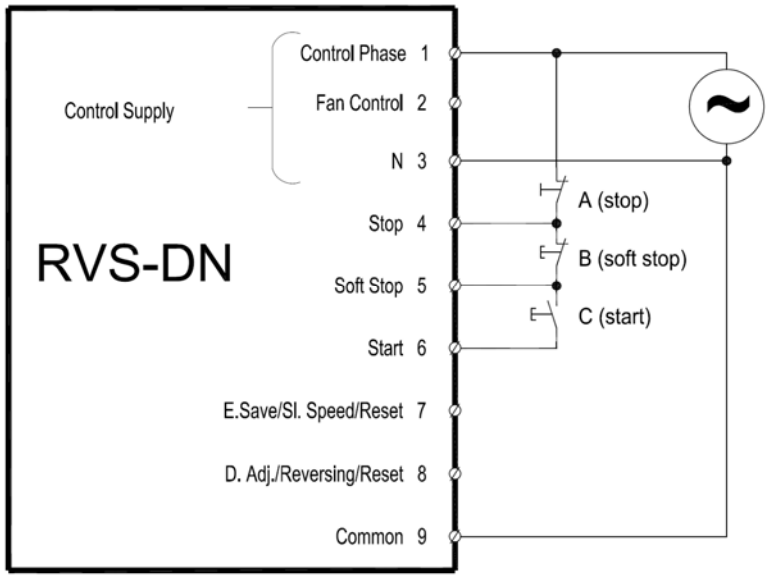
- Use this diagram when Control Supply and Control Input voltages are not from the same source.
- Connect terminal 21 as per section 4.1 page 19.
- Supply must be protected for short circuit and over load. 6A fuse is recommended.
- It is recommended to use a separate fuse for the auxiliary circuits.



4.5 Soft Start, Soft Stop and Stop, Control Supply and Control Input from the Same Source

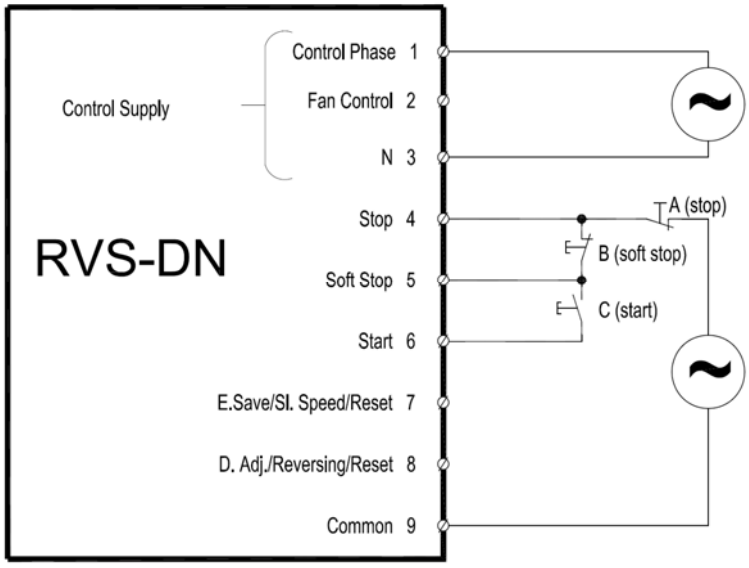
Notes:

- Switch A can be used as an immediate stop.
- Switch B is used as a soft stop command to the RVS-DN.
- Switch C is used as a momentary or maintained start command to the RVS-DN.



4.6 Soft Start, Soft Stop and Stop, Control Supply and Control Input from Separate Sources

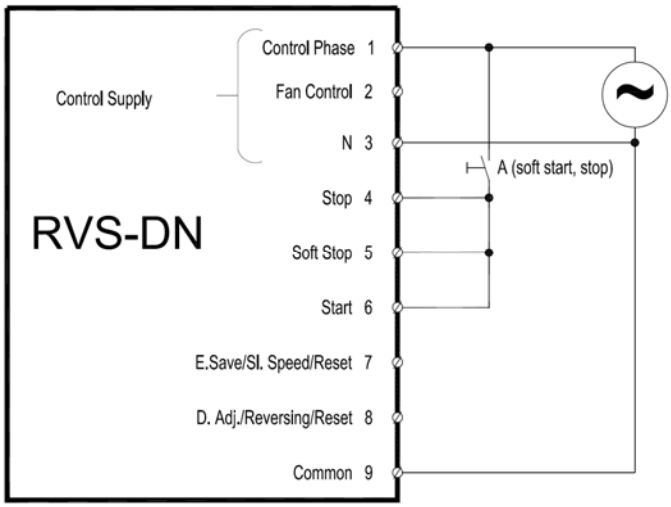
See notes to section 4.5.



4.7 Soft Start and Immediate Stop (no Soft Stop)

Notes:

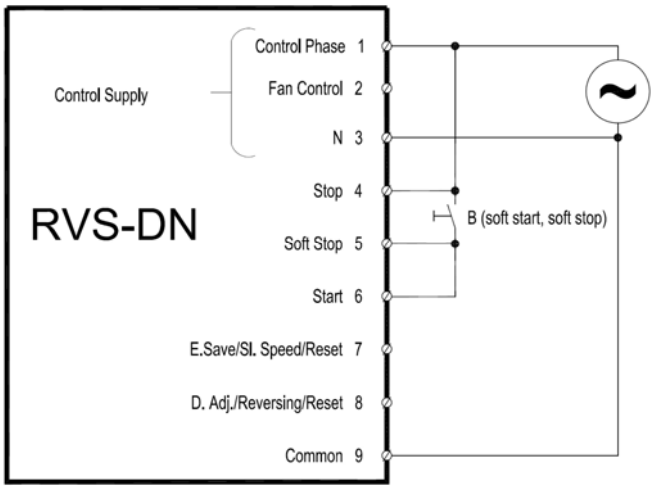
- When switch A closes the motor will soft start.
- When switch A opens the motor will stop immediately (no soft stop).
- Drawing shows Control Supply and Control Input from the same source. Refer to section 4.6 for Control Supply and Control Input from separate sources.



4.8 Soft Start and Soft Stop

Notes:

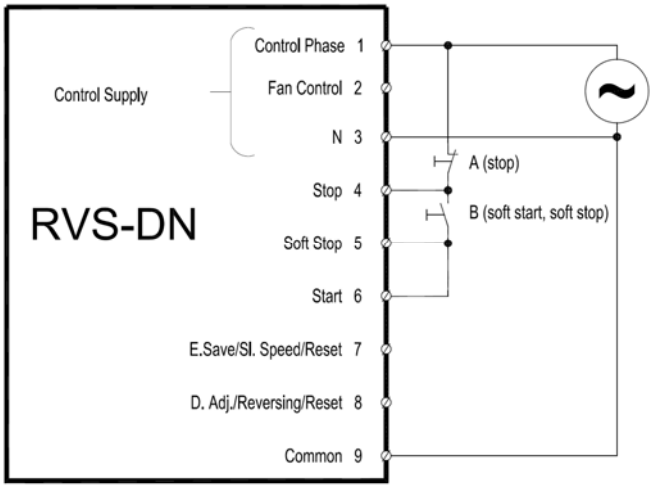
- When switch B closes motor will soft start.
- When switch B opens motor will soft stop.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 4.6 for Control Supply and Control Input from separate sources.



4.9 Soft Start, Soft Stop and Immediate Stop

Notes:

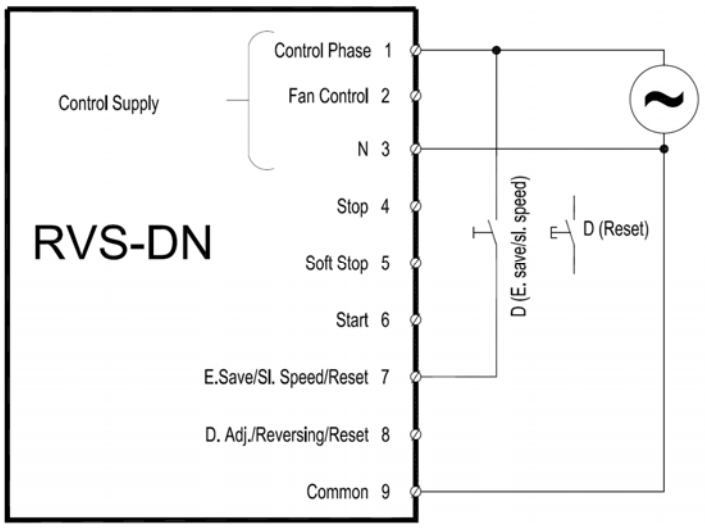
- When switch B closes motor will soft start.
- When switch B opens motor will soft stop.
- Switch A opens the motor will stop immediately.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 4.6 for Control Supply and Control Input from separate sources.



4.10 Energy Save, Slow speed or Reset

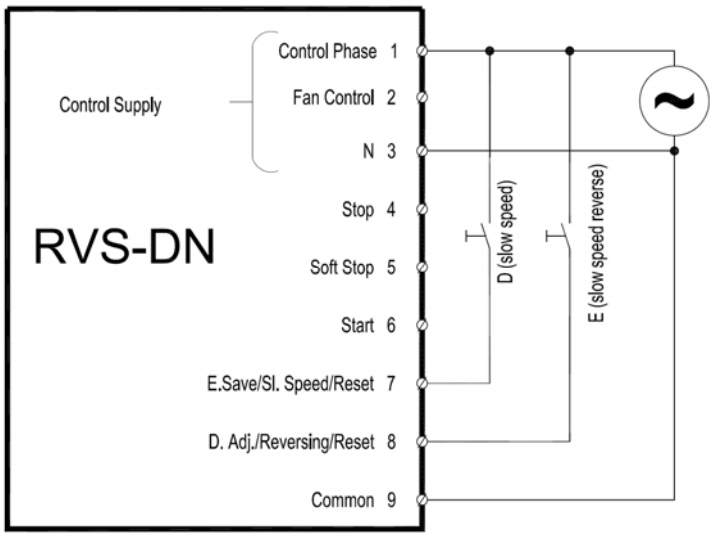
Notes:

- Switch D can be used as an ENERGY SAVE/SLOW SPEED/ RESET, as programmed in I/O PROGRAMMING PARAMETERS. Refer to section 7.7.8 page 83.
- ENERGY SAVE or SLOW SPEED functions require a maintained contact to operate.
- RESET function requires a momentary contact to operate
- Drawing shows Control Supply and Control Input from the same source. Refer to section 4.6 for Control Supply and Control Input from separate sources.



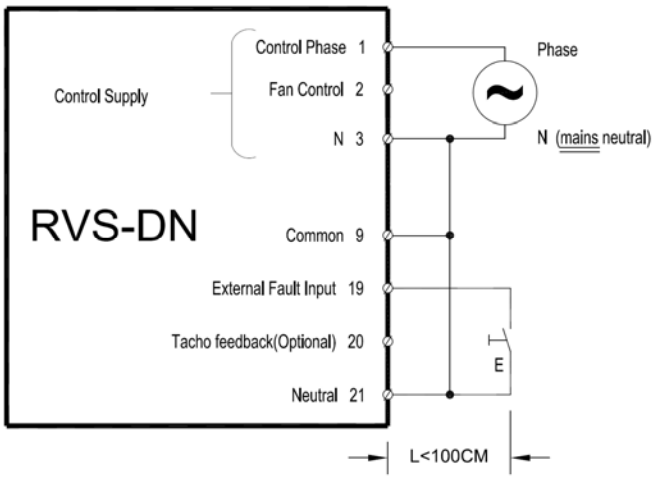
4.11 Slow Speed and Slow Speed Reverse

- For Slow speed operation:
  - Program Input terminal 7 as SLOW SPEED. Refer to section 7.7.8 page 83.
  - Connect Control Input voltage to terminal 7 and start the soft starter. Motor will run at SLOW SPEED.
- For Slow speed reverse operation:
  - Program Input terminal 7 as SLOW SPEED. Refer to section 7.7.8 page 83.
  - Program Input terminal 8 as SLOW SPEED REVERSE. Refer to section 7.7.8 page 83.
  - Connect Control Input voltage to terminal 7 and start the soft starter. Motor will run at SLOW SPEED. When Control Input voltage is connected to terminal 8 motor will stop and SLOW SPEED REVERSE.
  - If Control Input voltage is connected to terminal 8 before start command, motor will run at SLOW SPEED REVERSE when the start command is initiated.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 4.6 for Control Supply and Control Input from separate sources.

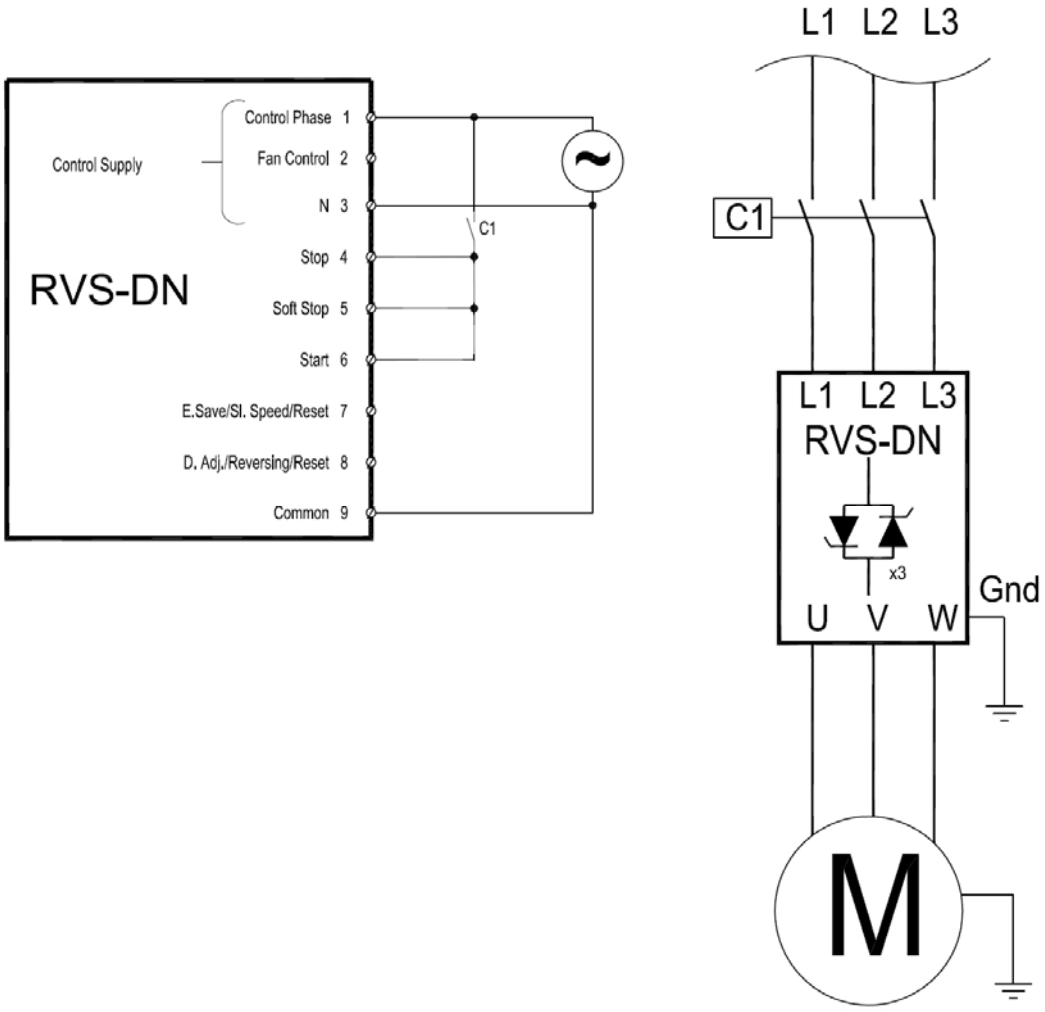


4.12 External Fault

Note:
Switch E can be used as an EXTERNAL FAULT input only when terminal 21 is connected to neutral or ground **and** INSULATION TEST option is **not** installed.



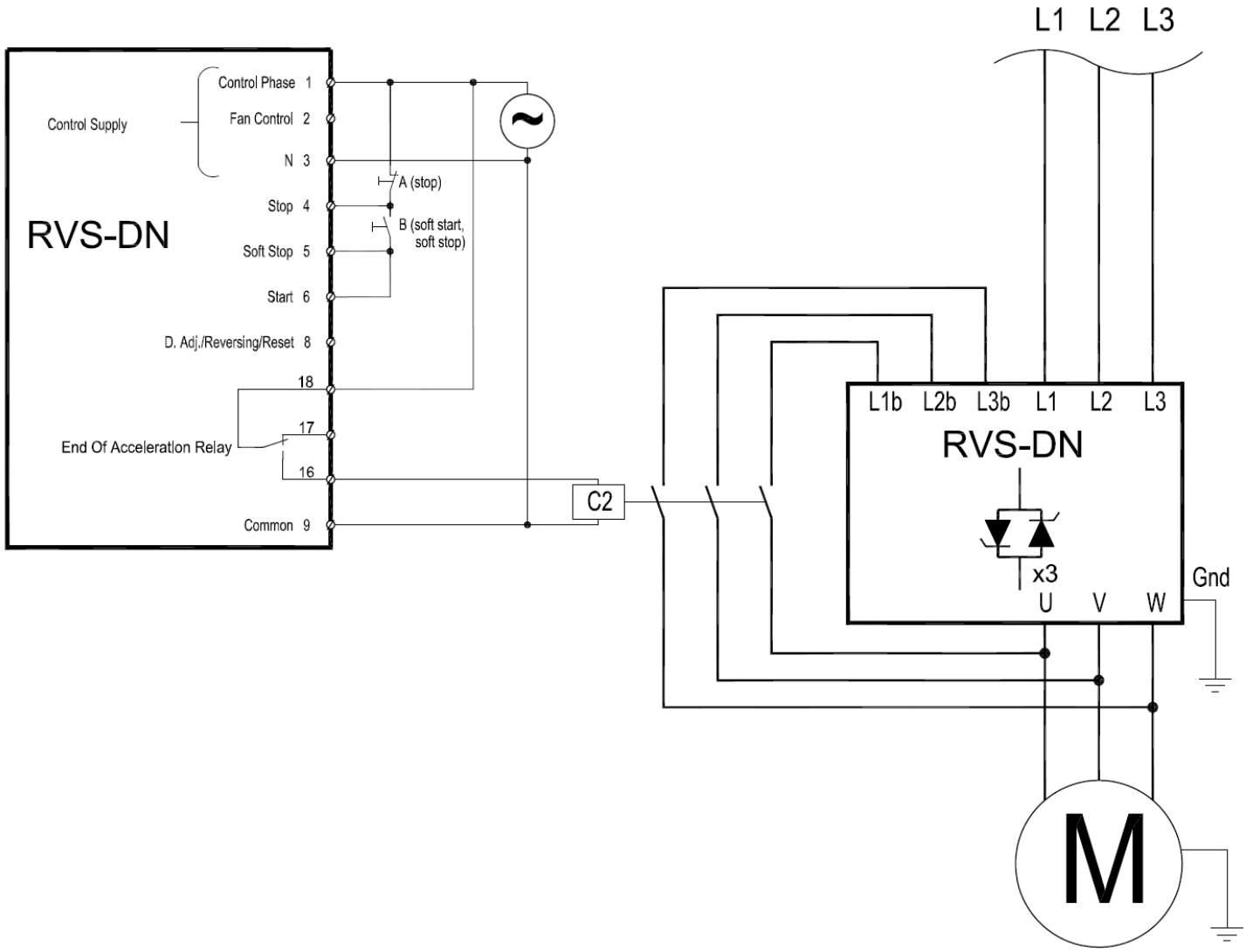
4.13 Line Contactor



Notes:

- Typical wiring when RVS-DN is retrofitted into an existing system to reduce modifications in existing installations.
- Start signal is switched on upon closure of the line contactor. The RVS-DN will operate as long as the line contactor is energized.
- Control Supply obtained from mains must match the RVS-DN Control Supply voltage.
- It is recommended that terminals 1-3 are always connected to Control Supply voltage.
- Soft stop can not be applied for this wiring diagram. If soft stop is required, the line contactor can be held by the immediate relay contacts because the relay is de-energized only at the end of the soft stop.
- Verify that N.O. contact C1 closes after the main contactor closes. RVS-DN requires 500 mSec. delay for the start signal after the line contactor is closed. If it closes prior to that, UNDER VOLTAGE fault will occur. It is recommended to use a time delay timer to prevent possible faults.

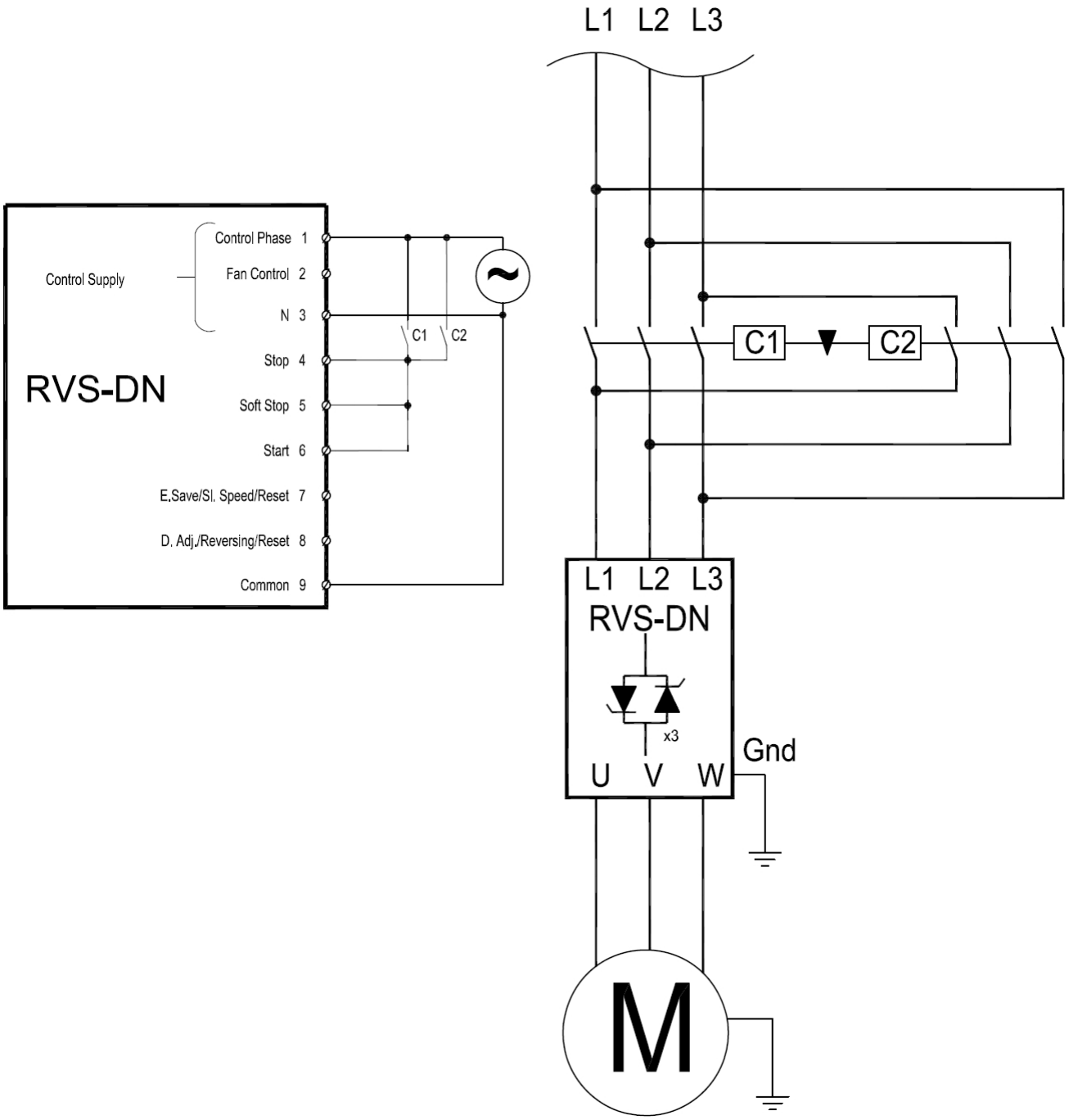
4.14 **Bypass Contactor**



Notes:

- End of Acceleration relay is energized after a programmed time delay RUN CONTACT DEL. Refer to section 7.7.3 page 72 for programming.
- The End of Acceleration relay is de-energized when:
  - SOFT STOP or STOP signals are initiated
  - ENERGY SAVER signal is initiated
  - SLOW SPEED/ SLOW SPEED REVERSE signal is initiated
  - Fault condition occurs
- When a bypass contactor is used, it is recommended to order the RVS-DN with preparation for bypass contactor, so that the RVS-DN current protection are operative after the bypass contactor closes.
- When a SOFT STOP signal is provided, the End of Acceleration relay returns to its original position opening the bypass contactor. Thereafter, the voltage will gradually ramp down to zero, soft stopping the motor.

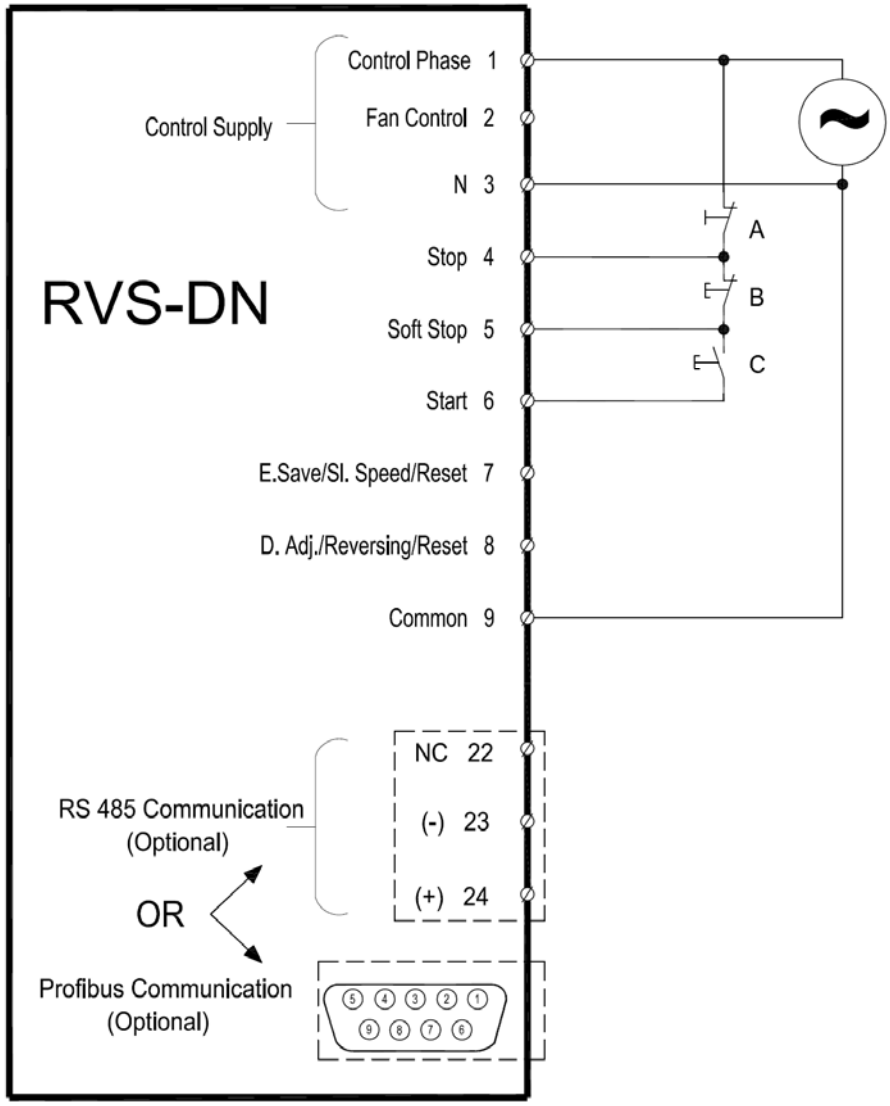
4.15 **Reversing with Two Line Contactors**



Notes:

- A N.O. auxiliary contact in each of the two line contactors C1 & C2 controls the START/STOP command. Closure of either contactor will supply main power and a start signal to the RVS-DN.
- It is recommended to employ a mechanical interlock between the forward and reverse contactors.
- It is required to delay the transfer between opening of one contactor and closing of second contactor.
- PHASE SEQUANCE fault must be disabled to operate reversing contactors at the line input of the RVS-DN. Refer section 7.7.7 page 81 for programming.

4.16 Operating via Communication Links

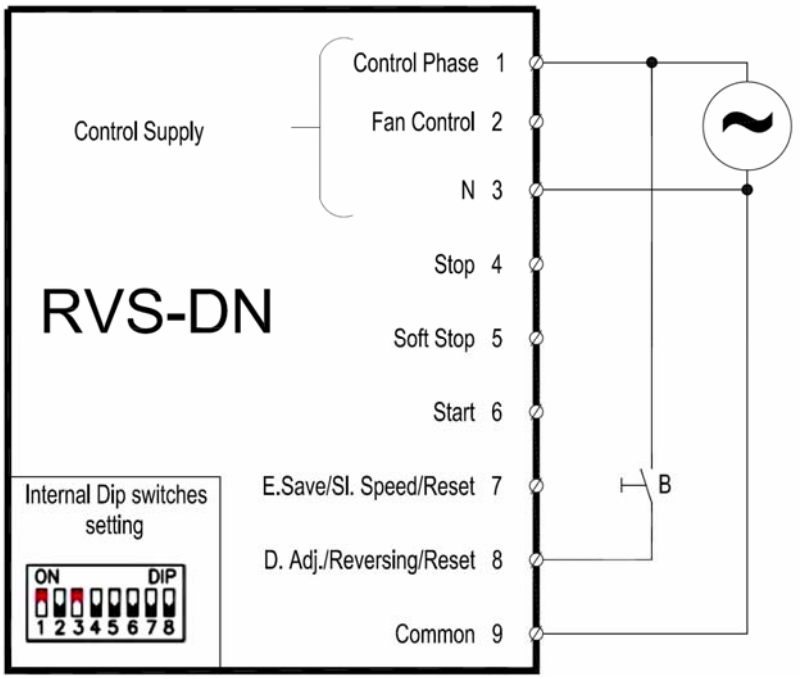


Notes:

- In order to operate via communication, either Modbus or Profibus optional PCBs must be installed and wired properly.
- RVS-DN must be properly grounded.
- RVS-DN must be programmed to enable control (not only monitoring). Refer to section 7.7.9 and 7.7.10 page 85 for programming.
- Make sure that after programming, Control Supply voltage is disconnected and reconnected so that the communication settings will take affect.
- RVS-DN will toggle between communication commands and local commands **UNLESS** switches A or B are opened.
  - Switch A and B each overrides a START command coming from the communication channel.
  - Switch A can be used as an immediate stop that prevents an unwanted remote start coming from communication.
  - Switch C can be used as a local SOFT START.
  - Switch B can be used as a local SOFT STOP.

WARNING!	**Beware!** RVS-DN must be grounded at all times. When testing the RVS-DN control/communication it is possible to use the control module only without the power section (RVS-DN 85A and up). **The control module MUST be properly grounded to avoid danger of electrical shock!!**

4.17 D.ADJ.:GENERATOR PARAMETERS Wiring



Notes:

- When starting from a diesel generator make sure that its size is suitable. Based on experience, the power (kW) of a diesel generator should usually exceed at least 1.8 times the power (kW) of the motor in order to enable consistent motor starts, consult the factory if necessary. However this should be checked on a case by case basis.
- When starting from a diesel generator, its voltage regulator (especially older type regulators) may be affected during the starting process, thus causing rapid voltage fluctuations (~350V to ~500V in 400V systems). In these rare cases, the voltage regulator must be upgraded – consult your diesel generator supplier.
- When operating from mains and alternatively from a diesel generator, set normal starting characteristics for mains and suitable parameters for the diesel generator in the DUAL ADJUSTMENT setting. When starting from mains, the primary settings (suitable for main starting) will be operative. Upon starting from a diesel generator, close the contact between the Control Supply and terminal 8 to operate in D.ADJ.:GENERATOR PARAMETERS mode.
- To operate D.ADJ.:GENERATOR PARAMETERS mode:
  - Set dip switch # 3 and dip switch #1 to on - refer to sections 6.5.1 page 56 & 6.5.3, page 57.
  - Insert a contact (or jumper) between Control Supply and input terminal 8 (DUAL ADJUST) and close contact to operate the D.ADJ.:GENERATOR PARAMETERS. Dual Adjust LED will light.
  - Set the DUAL ADJUST parameters to the values necessary for the application (e.g., shorter ACCELERATION TIME, lower CURRENT LIMIT, etc.). Refer to section 7.7.5 page 79 for parameters settings.

Note:

The D.ADJ.:GENERATOR PARAMETERS must not always be used when a diesel generator is supplying the RVS-DN. Only use D.ADJ.:GENERATOR PARAMETERS when the normal starting process fails, i.e. SHORTED SCR or WRONG CONNECTION faults occur, **and** only after you have tested and are sure that the SCRs, motor and motor connections are not faulty.

WARNINGS!	When operating in D.ADJ.:GENERATOR PARAMETERS, the motor must be loaded to avoid vibration during starting and stopping.
	It is recommended to disconnect the power factor capacitors when operating with a diesel generator.

4.18 Short Circuit Protection

For “type 2 coordination”, use fuses for semiconductor protection to protect the RVS-DN from a short circuit. Fuses for semiconductor protection give excellent results because they have low I²t values and high interruption ratings.

Recommended fuse selection procedure:

(1) **Fuse rated voltage**: Choose minimum fuse rated voltage which is above the rated voltage of the mains.
(2) **Fuse rated current:** Select a fuse which is able to carry 8 times the rated RVS-DN current for 30 seconds (this is double the maximum RVS-DN current for the maximum acceleration time).
(3) **Fuse I²t:** Verify that the I²t value of the fuse is less than or equal to the I²t value of the thyristor in the RVS-DN as shown in the table below.

RVS-DN Model	Max. Thyristor I^2t [A2Sec]	RVS-DN Model	Max. Thyristor I^2t [A2Sec]
8	400	390	700,000
17	5,000	460	800,000
31	10,000	580	1,200,000
44	12,000	820	2,000,000
58	15,000	950	4,500,000
72	18,000	1100	4,500,000
85	50,000	1400	6,500,000
105	60,000	1800	12,500,000
145	100,000	2150	16,500,000
170	140,000	2400	26,000,000
210	200,000	2700	26,000,000
310	600,000	3000	Consult factory

4.19 Transient Protection

Line transient voltages can cause a malfunction of the RVS-DN and damage to the thyristors. All RVS-DNs incorporate Metal Oxide Varistors (MOV) to protect from normal line voltage spikes.

When higher transients are expected, additional external protection should be used (consult factory).

4.20 UL, cUL Installation Instructions

1. Input power and output motor field wiring shall be copper conductors, rated 75°C.
2. Use UL listed closed-loop connectors sized for the selected wire gauge. Install connectors using the correct crimp tool recommended by the connector manufacturer. Applies only to units bus bars.
3. Table showing corresponding wire size, terminal screw, closed-loop connector size. Torque ratings for attachment of connector to bus bar (see table).
4. Branch circuit protection, shall be provided per the NEC.

For units with UL cUL, see ordering information.

Cables, Terminal Screws and Torque Recommendations

Max. Motor FLA [A]	Min. Dimensions for Copper Cables [mm^2]	Terminal Screw	Mechanical Torque [Nm]
8	4 x 1.5 N2XY	M5	3
17	4 x 2.5 N2XY	M5	3
31	4 x 4 N2XY	M5	3
44	4 x 10 N2XY	M6	4.5
58	4 x 16 N2XY	M6	4.5
72	4 x 16 N2XY	M6	4.5
85	4 x 25 N2XY	M8	15
105	4 x 35 N2XY	M8	15
145	3 x 50 + 25 N2XY	M8	15
170	3 x 70 + 35 N2XY	M10	30
210	3 x 95 + 50 N2XY	M10	30
310	3 x 150 + 70 N2XY	M12	60

Max. Motor FLA [A]	Min. Dimensions for Copper Cables [mm^2]	Terminal Screw	Mechanical Torque [Nm]
390	3 x 185 + 95 N2XY	M12	60
460	3 x 240 + 120 N2XY	M12	60
580	2 x (3x 150 + 70)N2XY	M12	60
820	3 x (3x 185+ 95) N2XY	M12	60
950	3 x (3x 240 + 120) N2XY	M12	60
1100	4 x (3x 240 + 120) N2XY	M12	60
1400	5 x (3x 240 + 120) N2XY	M12	60
1800	8 x (3x 240 + 120) N2XY	M12	60
2500	8 x (3x 300 + 150) N2XY	M16	120

4.21 LR Recommendations for Marine, Off-shore or Industrial Use

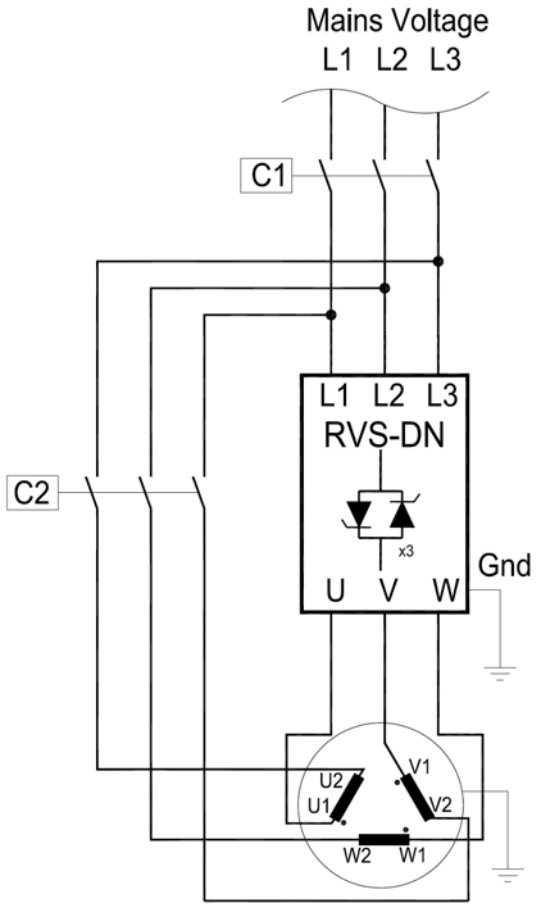
System design needs to take into account the power supply source and the motor drive together with the electronic soft starter.

Particular features to be considered are torque production, harmonic production and their consequential effects and EMC. These points are relevant for marine, off-shore or industrial use.

4.22 Inside Delta Mode

4.22.1 General Information

When the RVS-DN is installed Inside Delta, the individual phases of the RVS-DN are connected in series with the individual motor windings (6 conductor connections as with the star-delta starter). The RVS-DN must only conduct about 58 % (=1\√3) of the rated motor current. This allows the use of a significantly smaller RVS-DN. **Note that although when connected Inside Delta the current is reduced by 1.73 (√3), you should choose an RVS-DN as if current is reduced only by 1.5. (1/1.5=0.667=67%)**



For example:
For a motor with a rated current of 870A motor, a 950A starter will be selected to operate In-Line.
For Inside Delta RVS-DN, we calculate (870 x 67% = 580A) and select a 580A starter.

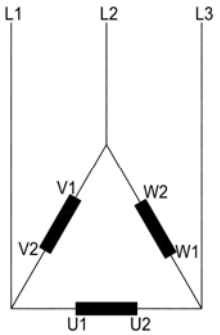
4.22.2 Notes on Inside Delta Connection

- Inside Delta requires 6-wires to the motor.
- **Wrong motor connection might cause serious damage to the motor windings**.
- When installing the RVS-DN Inside Delta it is highly recommended to use a contactor in series to the RVS-DN or upstream (after motor protection) in order to avoid a damage to the motor if the RVS-DN short circuits.
- The sinusoidal shape of the current might be imperfect. As a result, higher harmonic content is incurred (THD), which may be twice the THD value as in the standard In-Line connection.
- Motor heat may increase (due to the higher THD).
- Phase sequence to the input of the RVS-DN (L1, L2 & L3 terminals) must be correct. Otherwise, PHASE SEQUENCE fault will trip the RVS-DN immediately.
- Higher torque can not be obtained.
- The following factory preset features and functions are **not active** when Inside Delta mode is configured:
  - PULSE START
  - Curve selection (CURVE 0 !! only).
  - EN. SAVE and SL. SPD (energy save and slow speed)
  - PHASE SEQUENCE in off mode
- When using INSIDE DELTA configuration, current wave shape is different than that in LINE configuration. This difference casus the current RMS value of the INSIDE DELTA configuration to be lower than that of LINE configuration assuming both have the same amplitude.
  In order to best protect the SCRs in the INSIDE DELTA we do not allow the amplitude of the current to be higher than that in LINE connection. Therefore the current RMS value expected for the same setting of the CURRENT LIMIT is lower than that in LINE connection.

Note :
For a high starting torque process, it is recommended to use the RVS-DN in the In Line connection.

INSIDE DELTA WARNINGS!	**Beware!** Wrong connection of the RVS-DN or the motor may seriously damage the motor.
	When using Inside Delta connection: • It is highly recommended to use a line contactor in order to avoid possible damage of the motor if the SCR is short circuited in the RVS-DN. • If the RVS-DN is connected Inside the Delta, motor terminals are “live” (full voltage) even when the contactor is open.

4.22.3 Motor Connection and Terminals

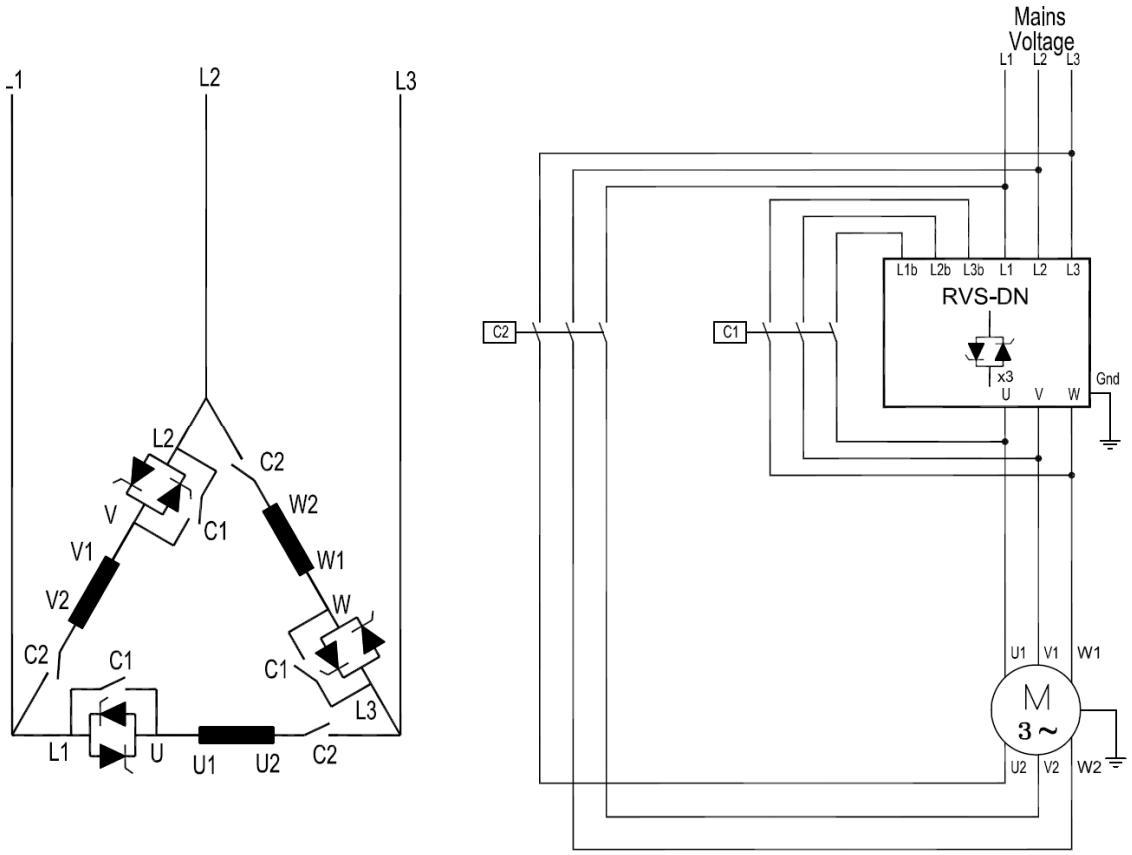


Motor connection in Delta with no RVS-DN.

Note:
Motor terminals are marked as follows:

ASA (USA)	BS	VDE	IEC
T1 - T4	A1-A2	U - X	U1 - U2
T2 - T5	B1-B2	V - Y	V1 - V2
T3 - T6	C1-C2	W - Z	W1 - W2

4.22.4 ***RVS-DN Connected Inside Delta w/Bypass Contactor and Inside Delta Contactor***

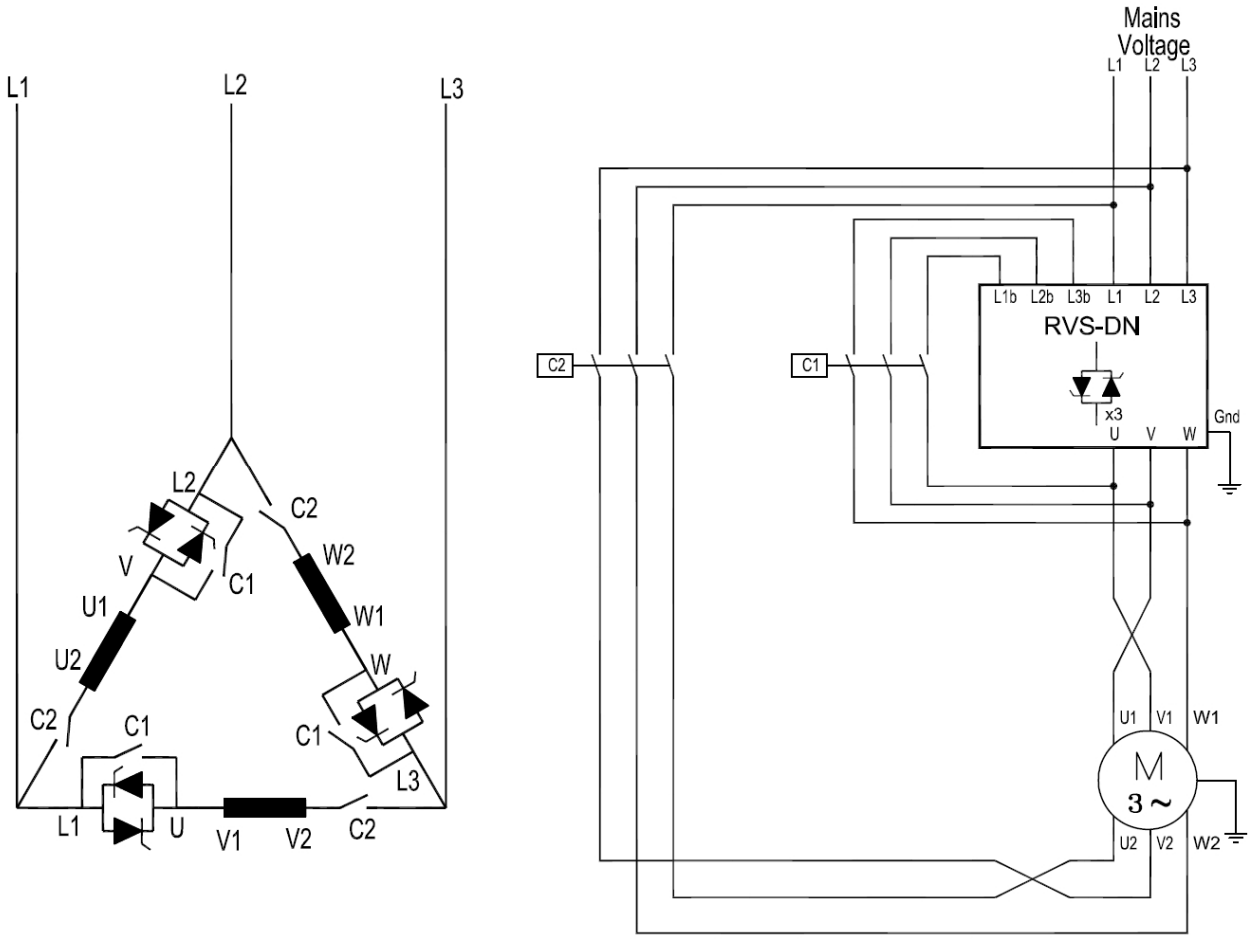


RVS-DN connection Inside Delta with bypass contactor to the RVS-DN and Inside Delta contactor.

C1 is a bypass contactor.
C2 is an Inside Delta contactor.
U1-U2, V1-V2, W1-W2 are motor windings.
L1-U, L2-V, L3-W are RVS-DN controlled phases.
L1b, L2b, L3b are preparation for bypass to maintain current protection when the RVS-DN is bypassed.

4.22.5 RVS-DN Connected Inside Delta - Reverse Speed

IMPORTANT! If speed reversing is required, L1, L2 and L3 on the input of the RVS-DN **can not** be switched!
This is because PHASE SEQUENCE OFF can not be implemented when RVS-DN is connected Inside Delta. Thus, in order to reverse motor rotation two motor windings need to be switched as shown in the following diagram:
(Winding V1-V2 is switched with winding U1-U2):

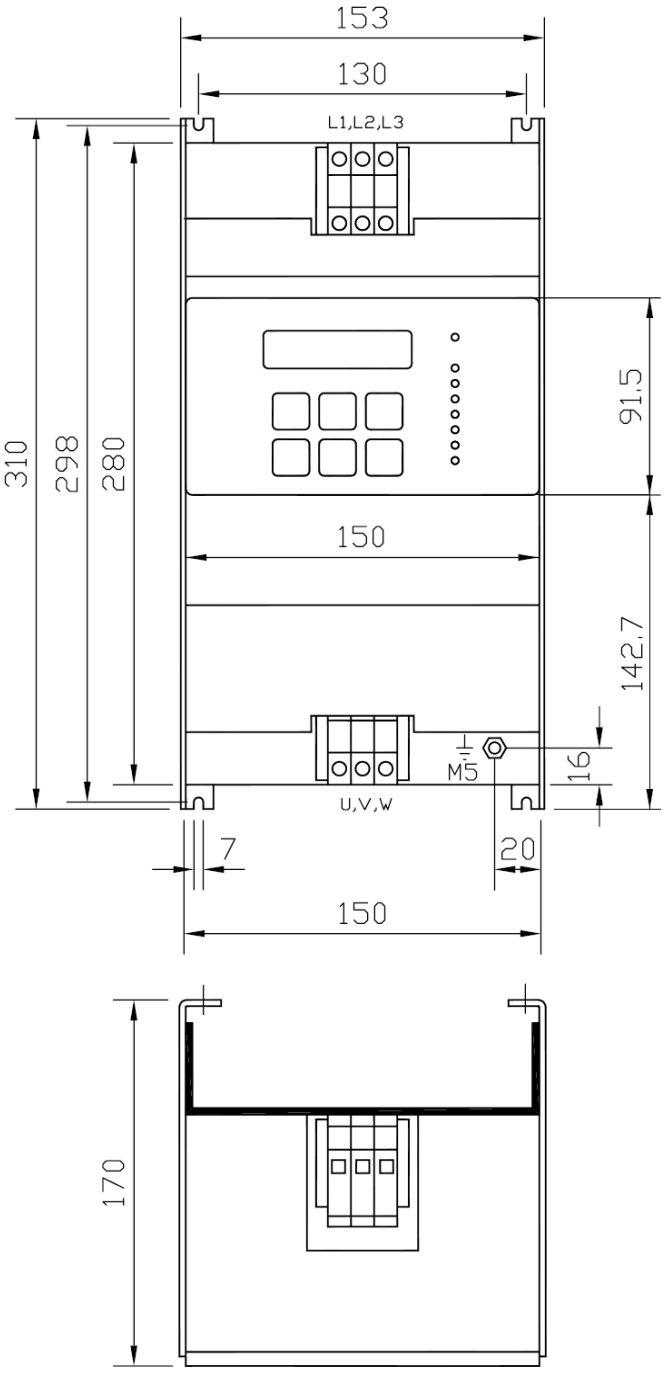


Reverse speed with RVS-DN connection Inside Delta with bypass contactor to the RVS-DN and Inside Delta contactor.

C1 is a bypass contactor.
C2 is an Inside Delta contactor.
U1-U2, V1-V2, W1-W2 are motor windings.
L1-U, L2-V, L3-W are RVS-DN controlled phases.
L1b, L2b, L3b are preparation for bypass to maintain current protection when the RVS-DN is bypassed.

5. DIMENSIONS

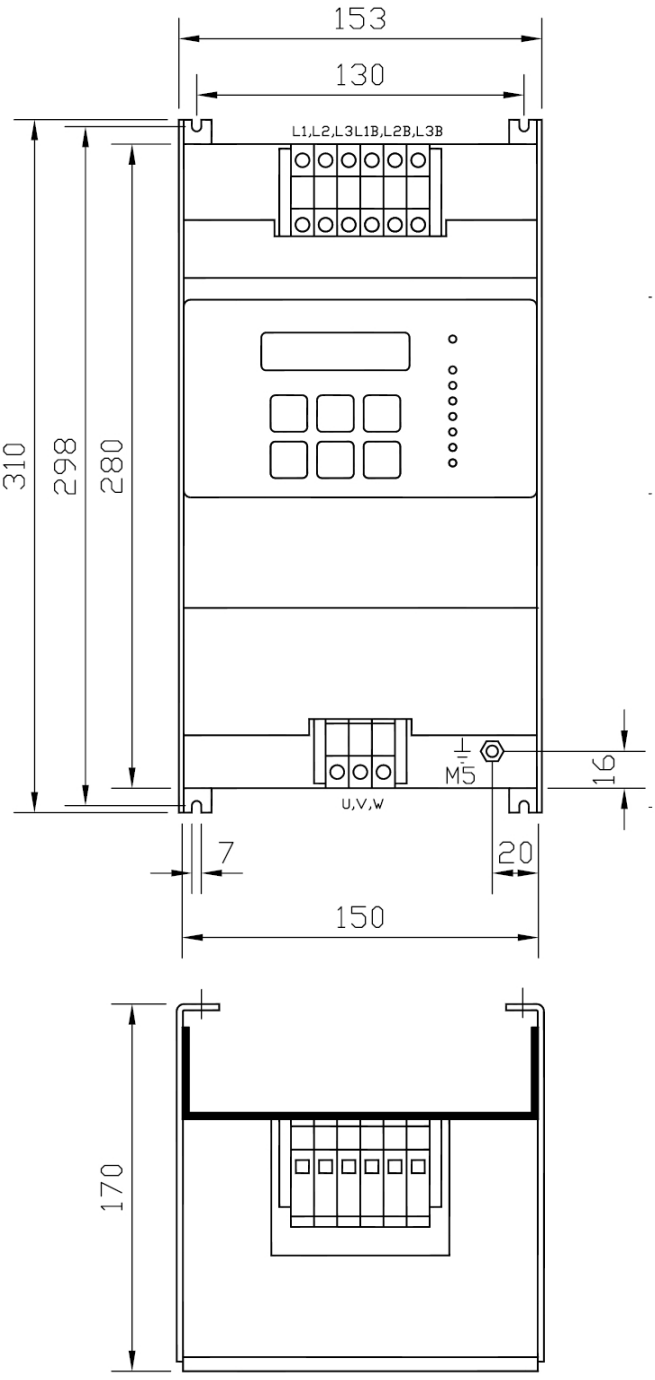
5.1 Standard Models



RVS-DN 8A 17A

Notes:

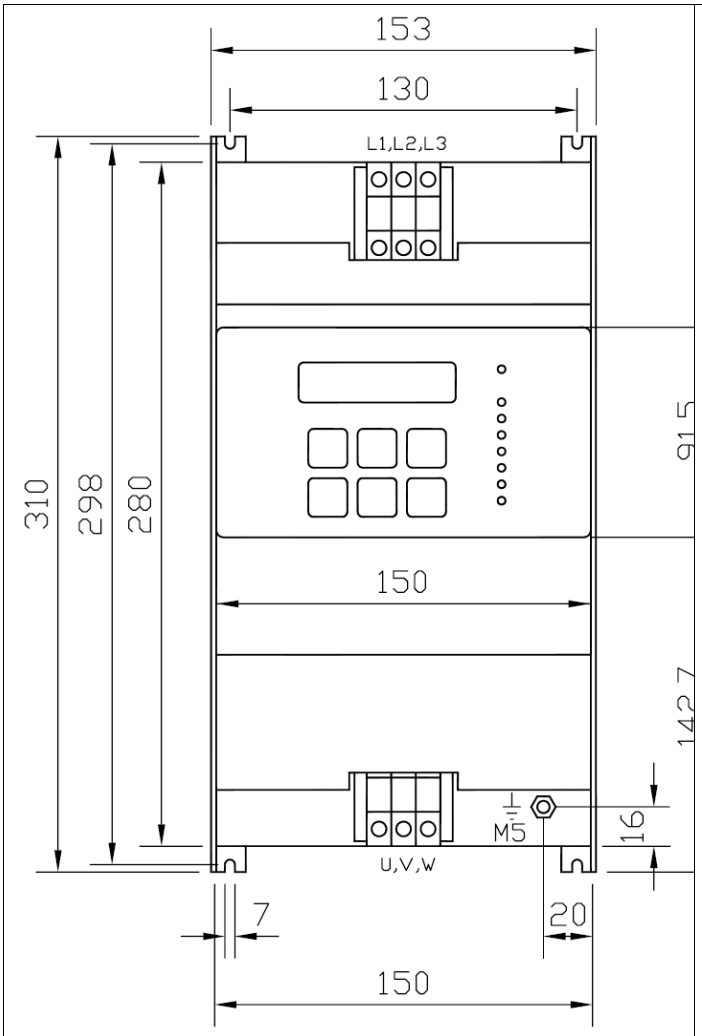
- Mains voltage terminals: 16mm^2.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

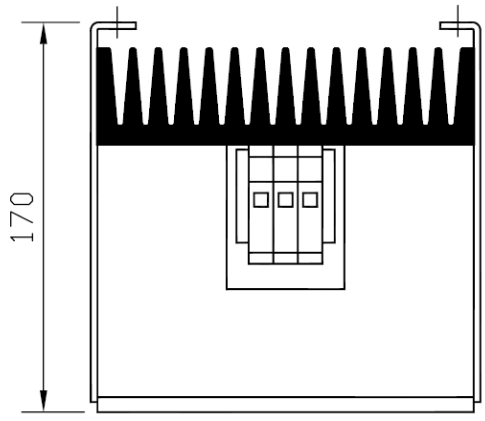


RVS-DN 8A 17A with preparation for bypass

Notes:

- Mains voltage terminals: 16mm^2.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

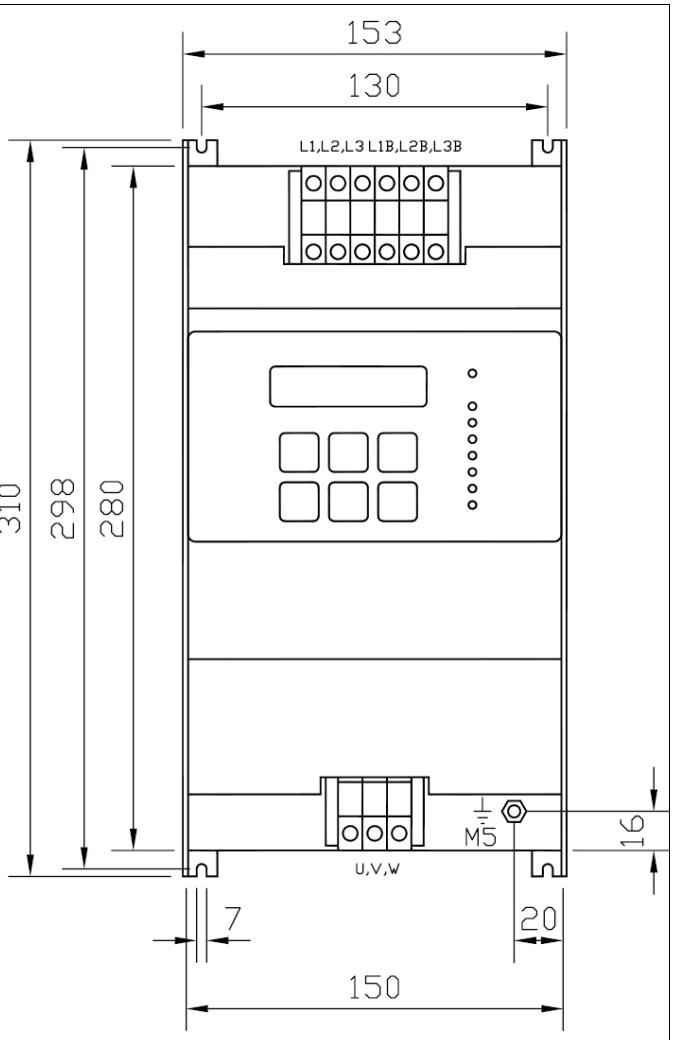


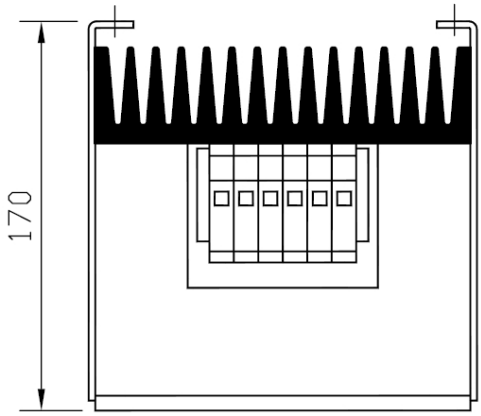


RVS-DN 31A

Notes:

- Mains voltage terminals: 16mm^2.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

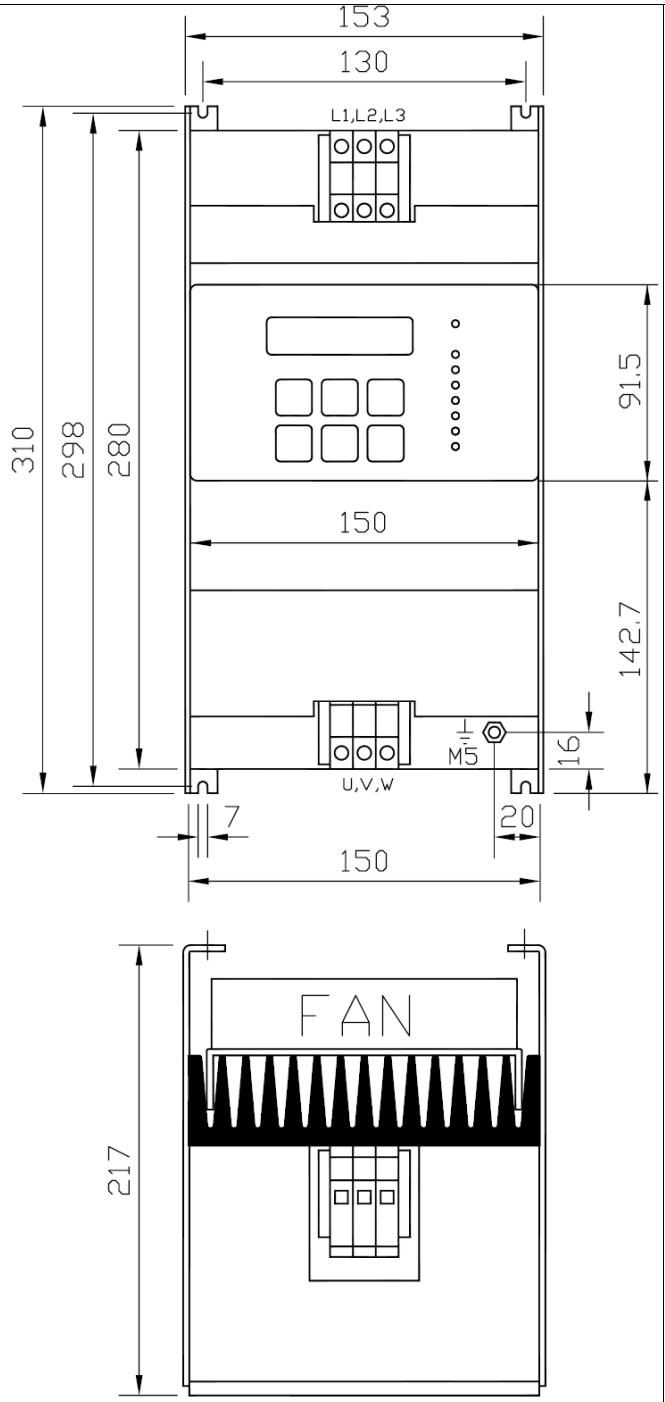




RVS-DN 31A with preparation for bypass

Notes:

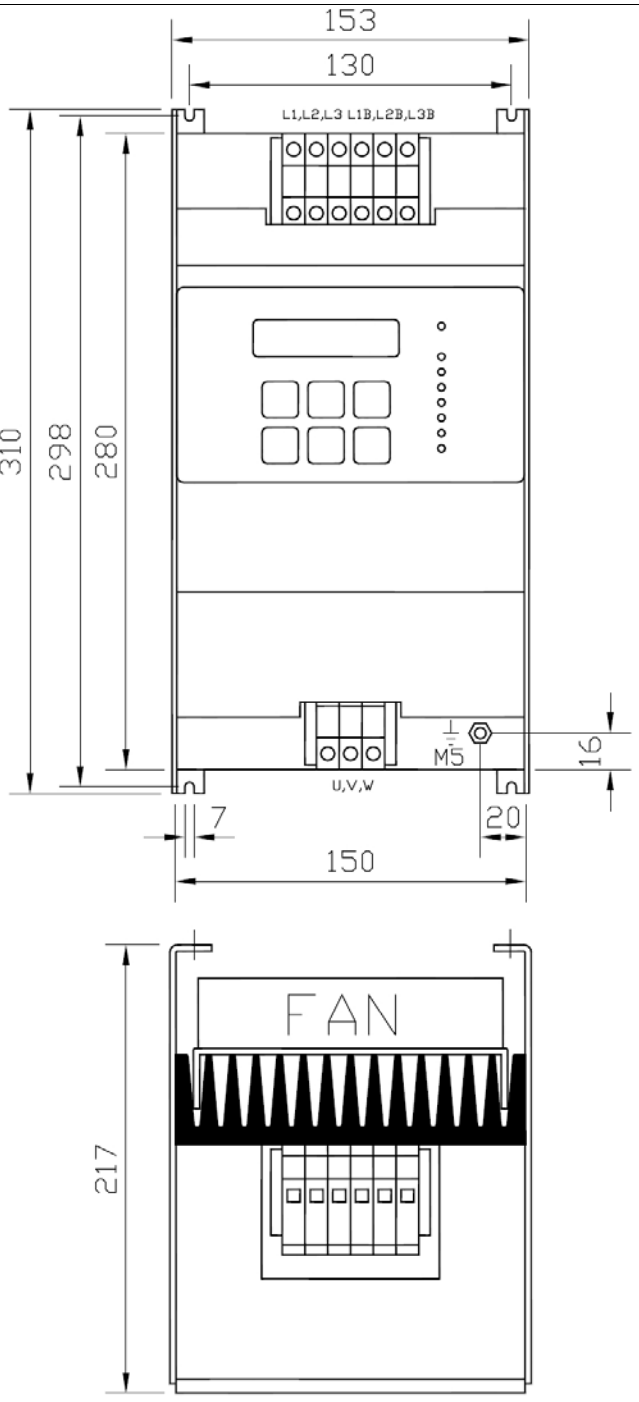
- Mains voltage terminals: 16mm^2.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 44A 58A 72A

Notes:

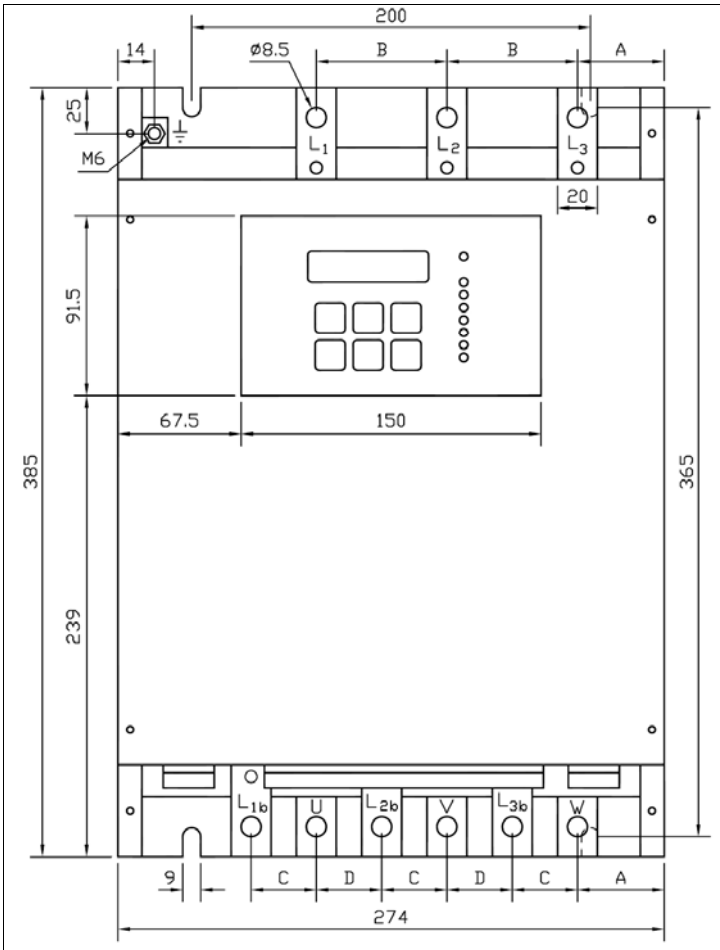
- Mains voltage terminals: RVS-DN 44A 58A - 16mm^2.
- Mains voltage terminals: RVS-DN 72A - 35mm^2
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

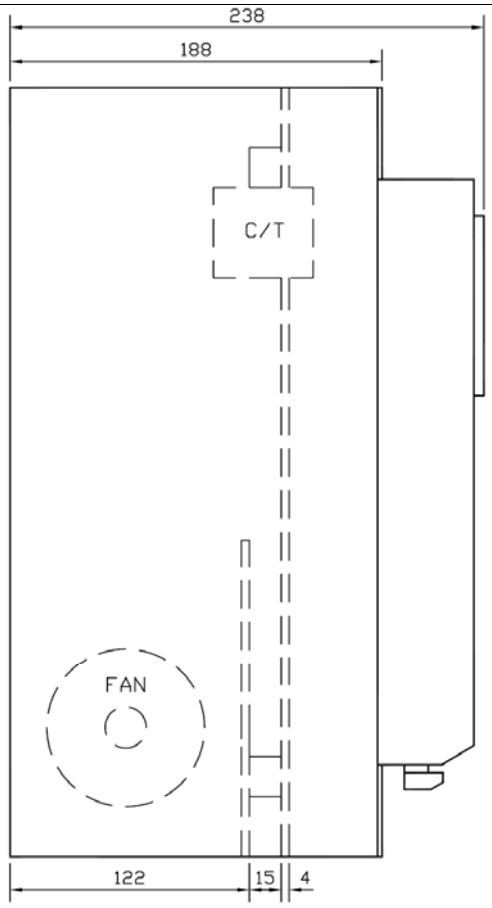


RVS-DN 44A 58A 72A with preparation for bypass

Notes:

- Mains voltage terminals: RVS-DN 44A 58A - 16mm^2.
- Mains voltage terminals: RVS-DN 72A - 35mm^2
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



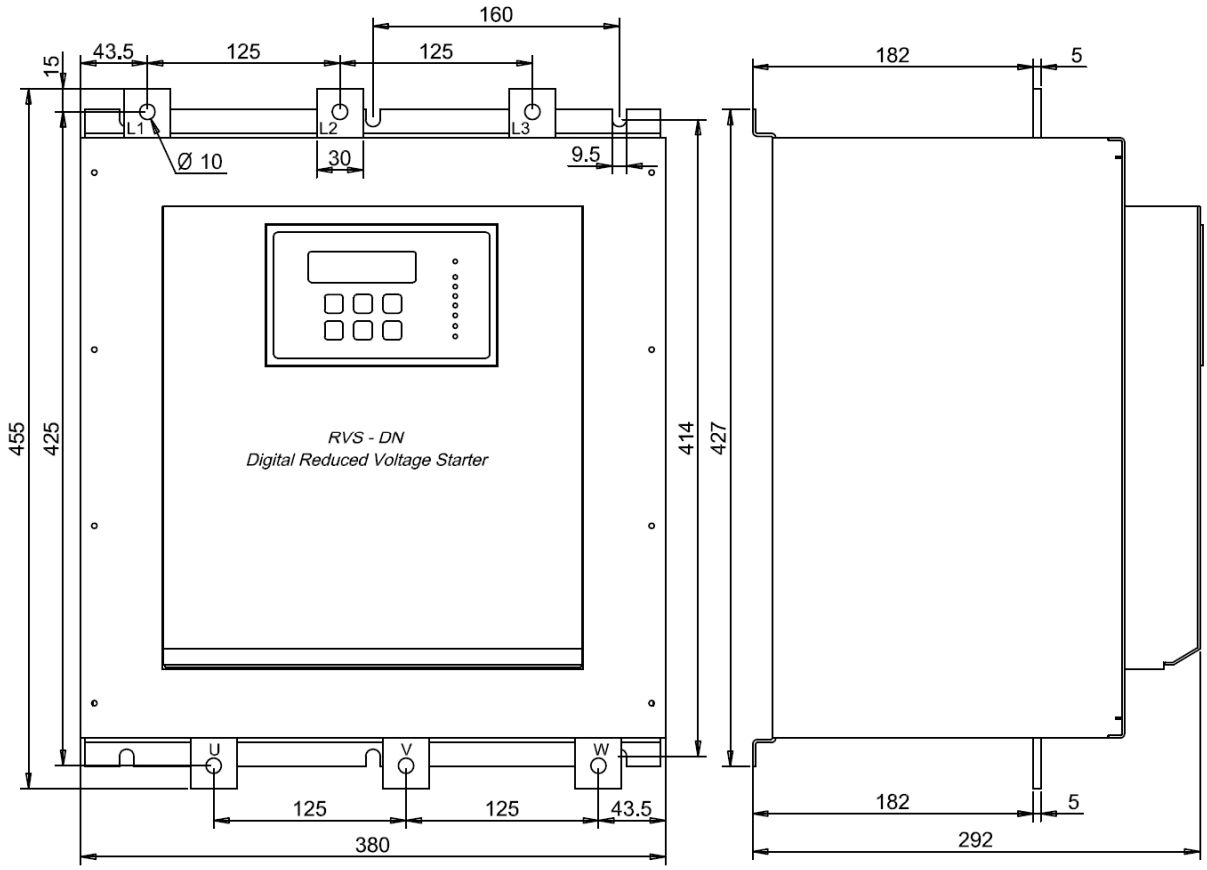


RVS	A	B	C	D
85,105	48.5	60	29	31
145,170	43.5	65.4	32.7	32.7

RVS-DN 85A 105A 145A 170A with preparation for bypass

Notes:

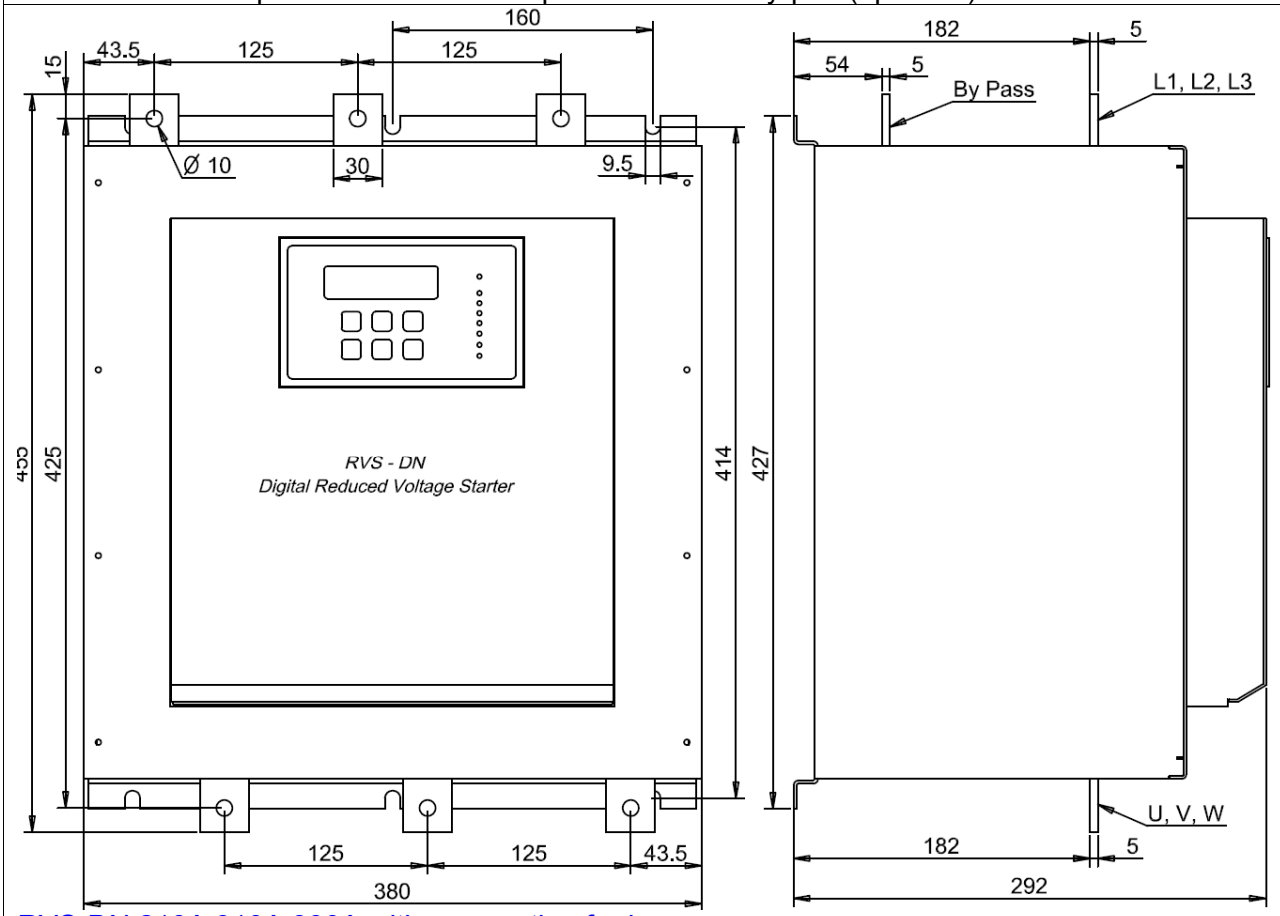
- In this model preparation for the bypass are standard
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 210A 310A 390A

Notes:

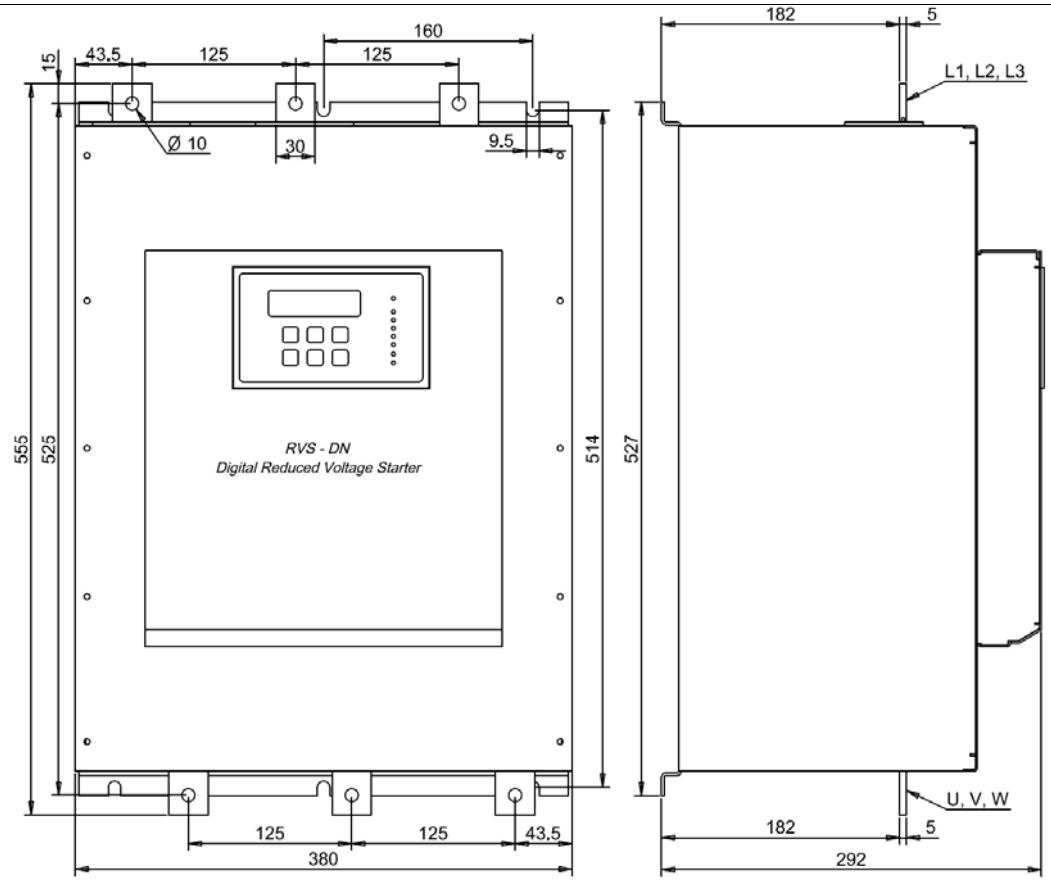
- For marine/UL cUL approved model dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 210A 310A 390A with preparation for bypass

Notes:

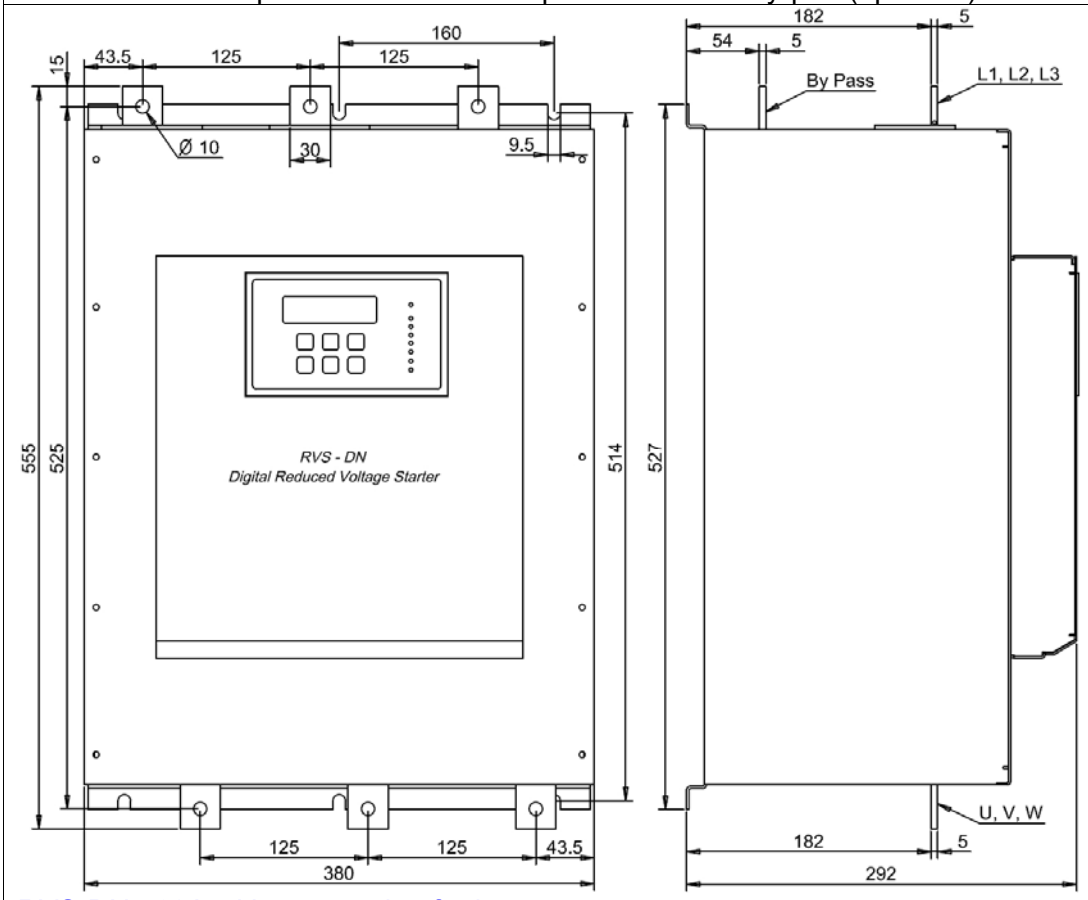
- For marine/UL cUL approved model dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 460A

Notes:

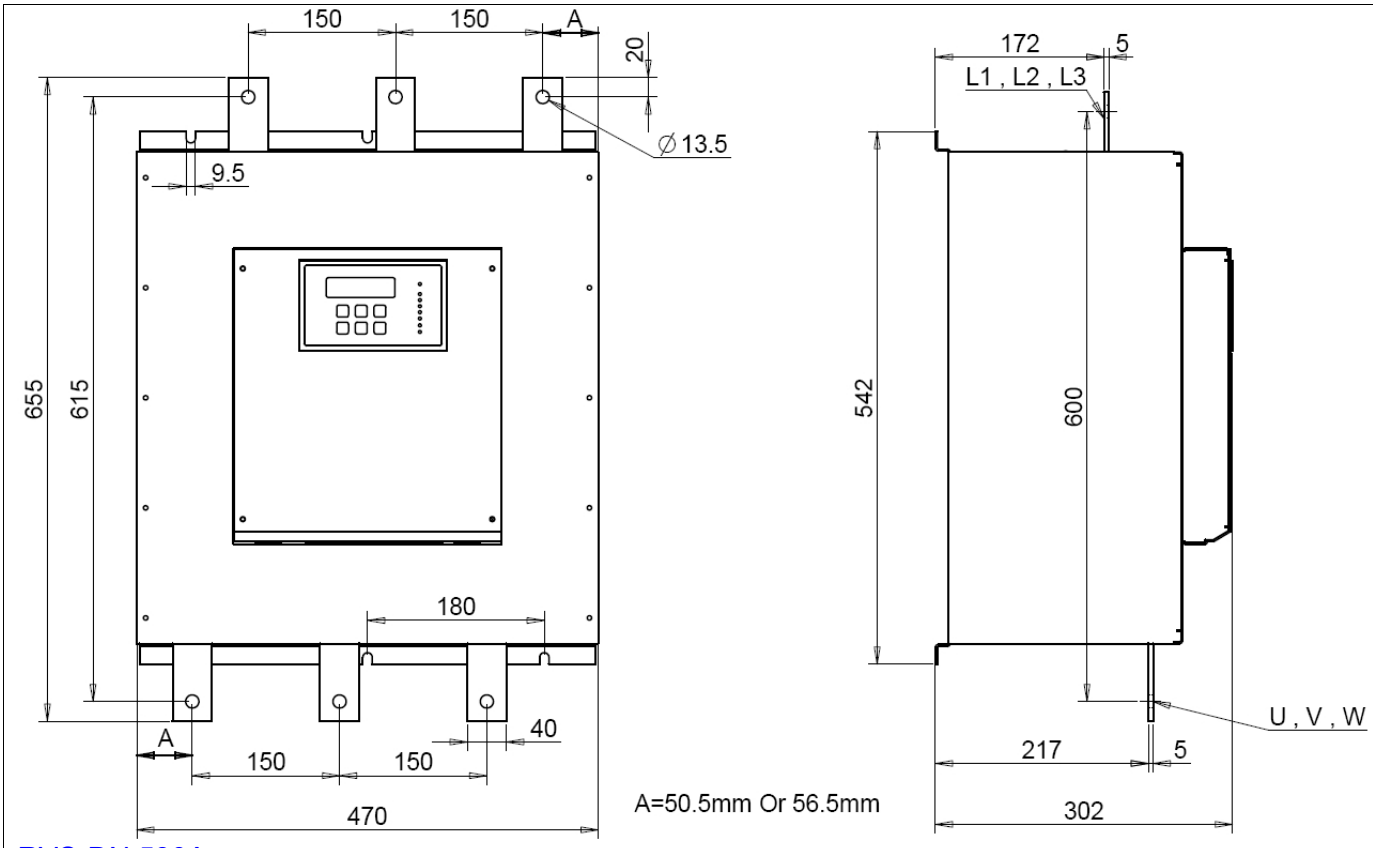
- For marine/UL cUL approved model dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 460A with preparation for bypass

Notes:

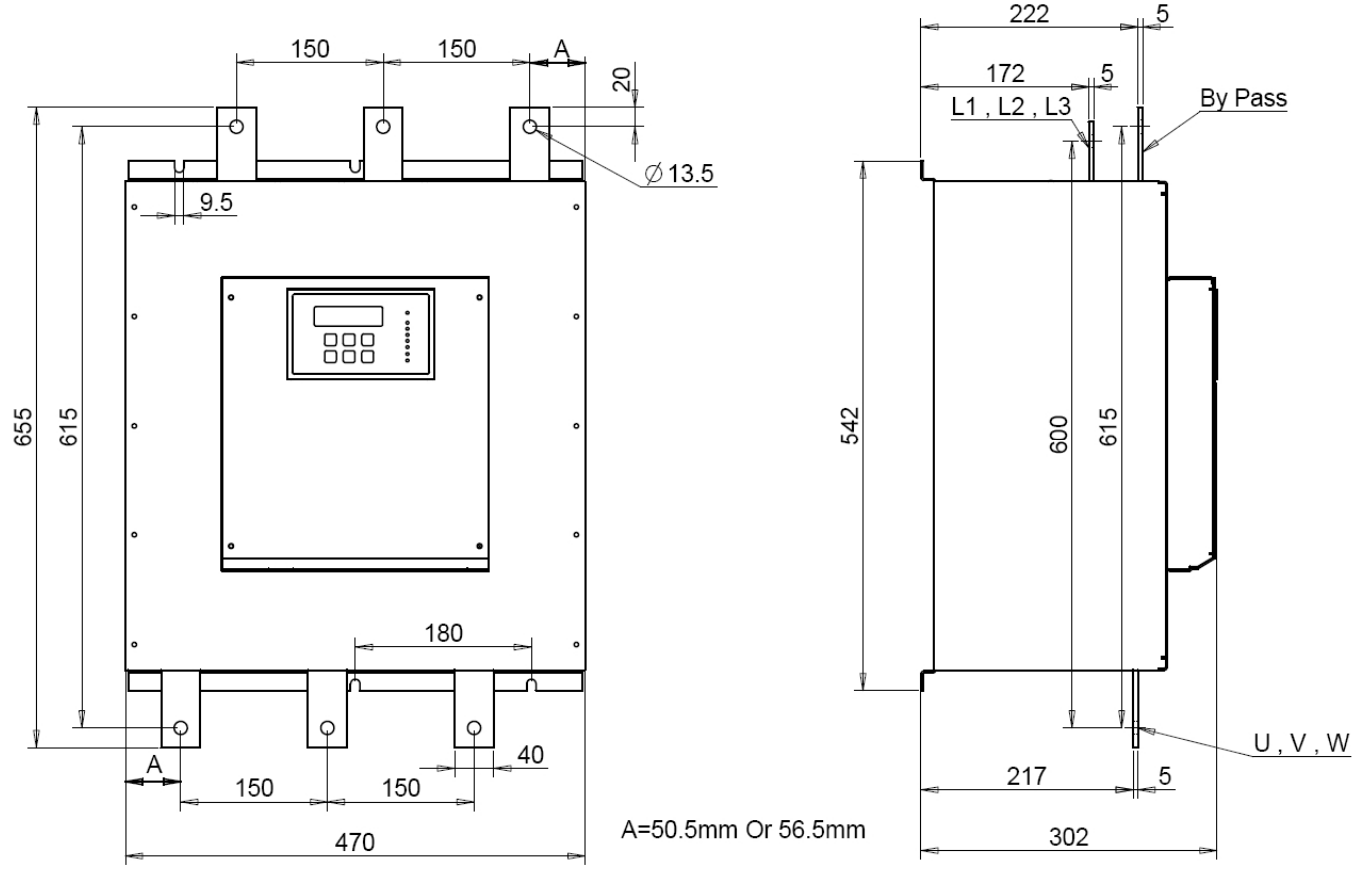
- For marine/UL cUL approved model dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 580A

Notes:

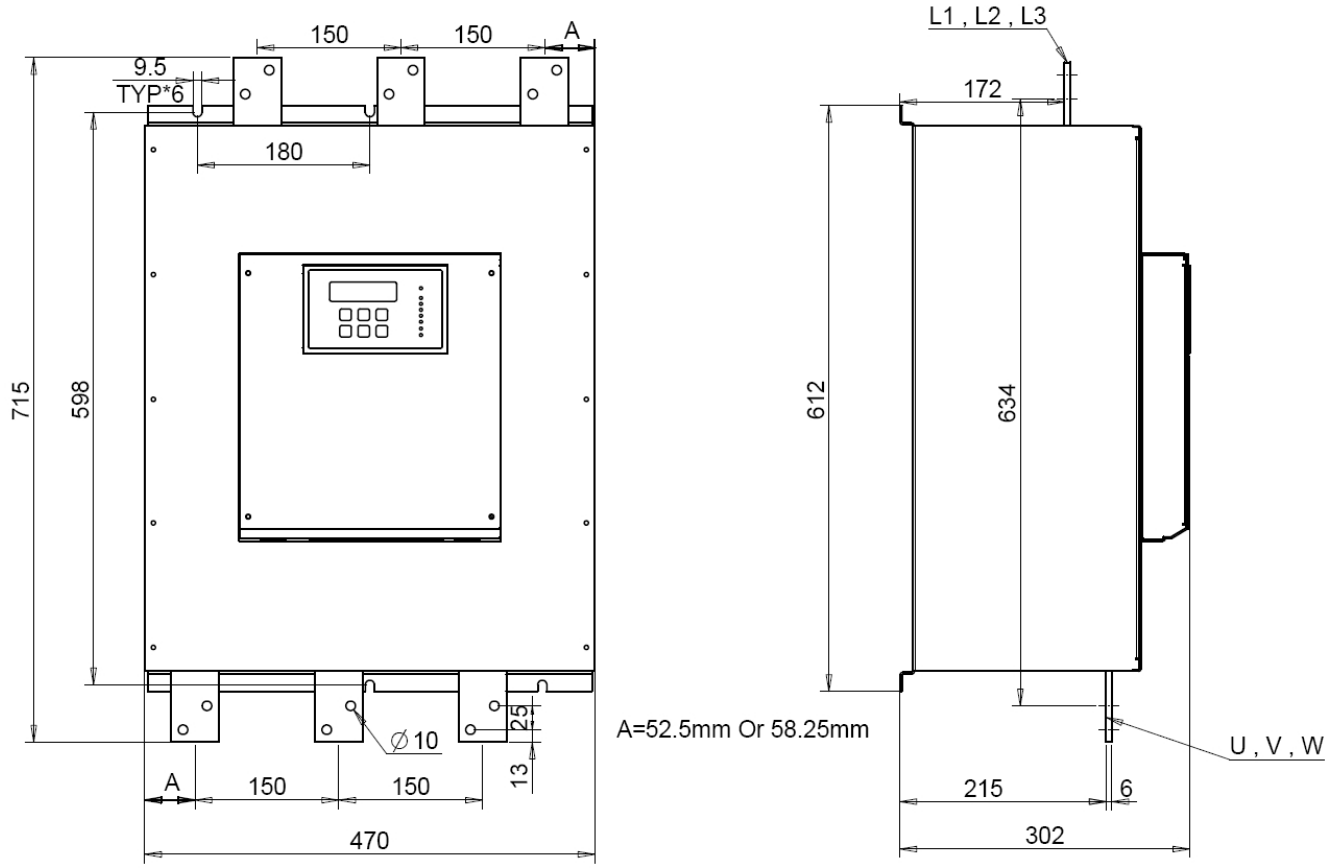
- For marine/UL cUL approved model dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 580A with preparation for bypass

Notes:

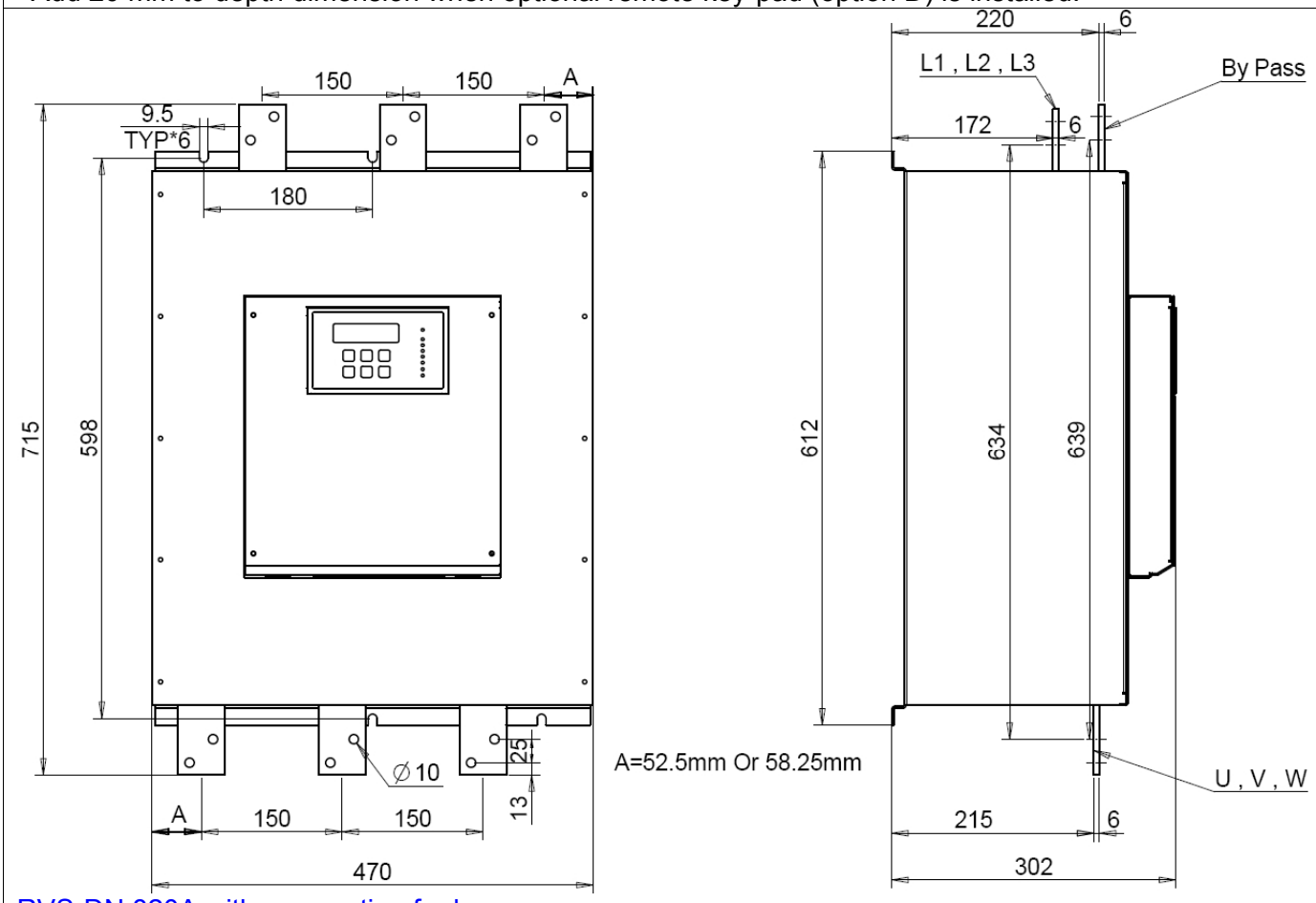
- For marine/UL cUL approved model dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 820A

Notes:

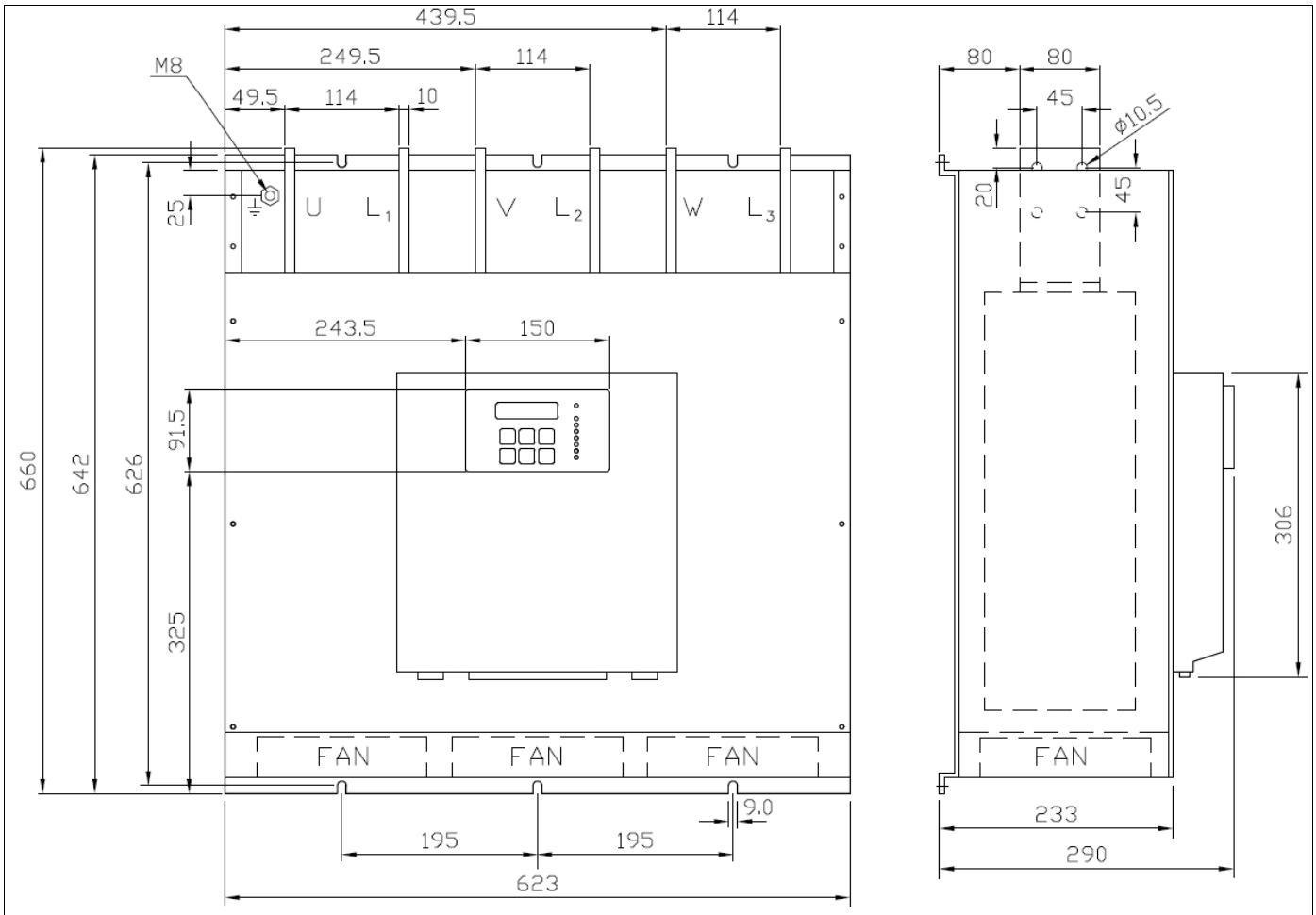
- For marine/UL cUL approved model (RVS-DN 820A only) dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 820A with preparation for bypass

Notes:

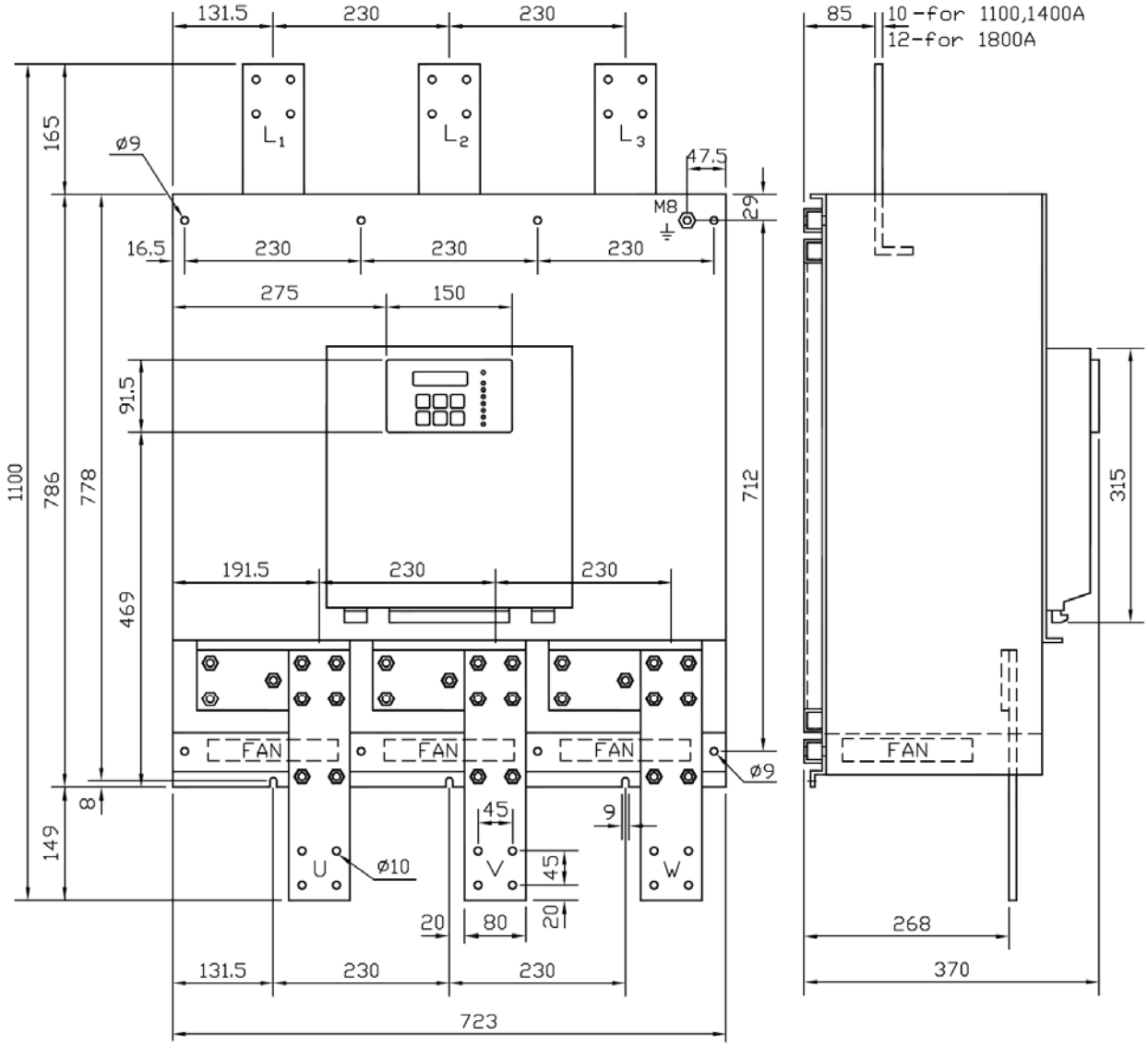
- For marine/UL cUL approved model (RVS-DN 820A only) dimensions refer to section 5.3 page 47.
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 950A

Notes:

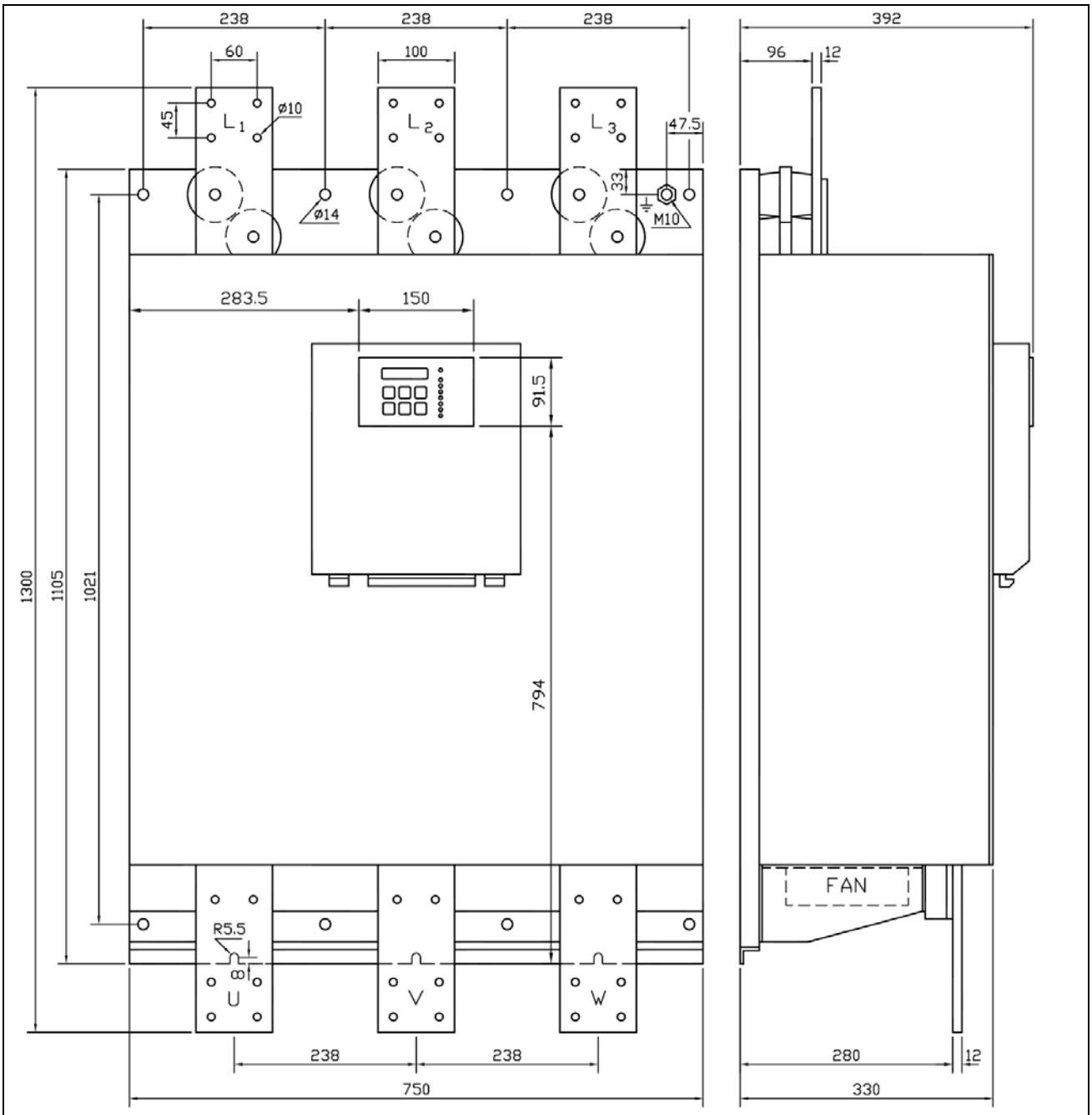
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.
- Must be operated with a bypass contactor
- Add space for current transformers (supplied separately from the main unit) and bus bars for preparation for bypass
- Approximate current transformers dimensions: W=240mm, H=130mm, D=90mm



RVS-DN 1100A 1400A 1800A

Notes:

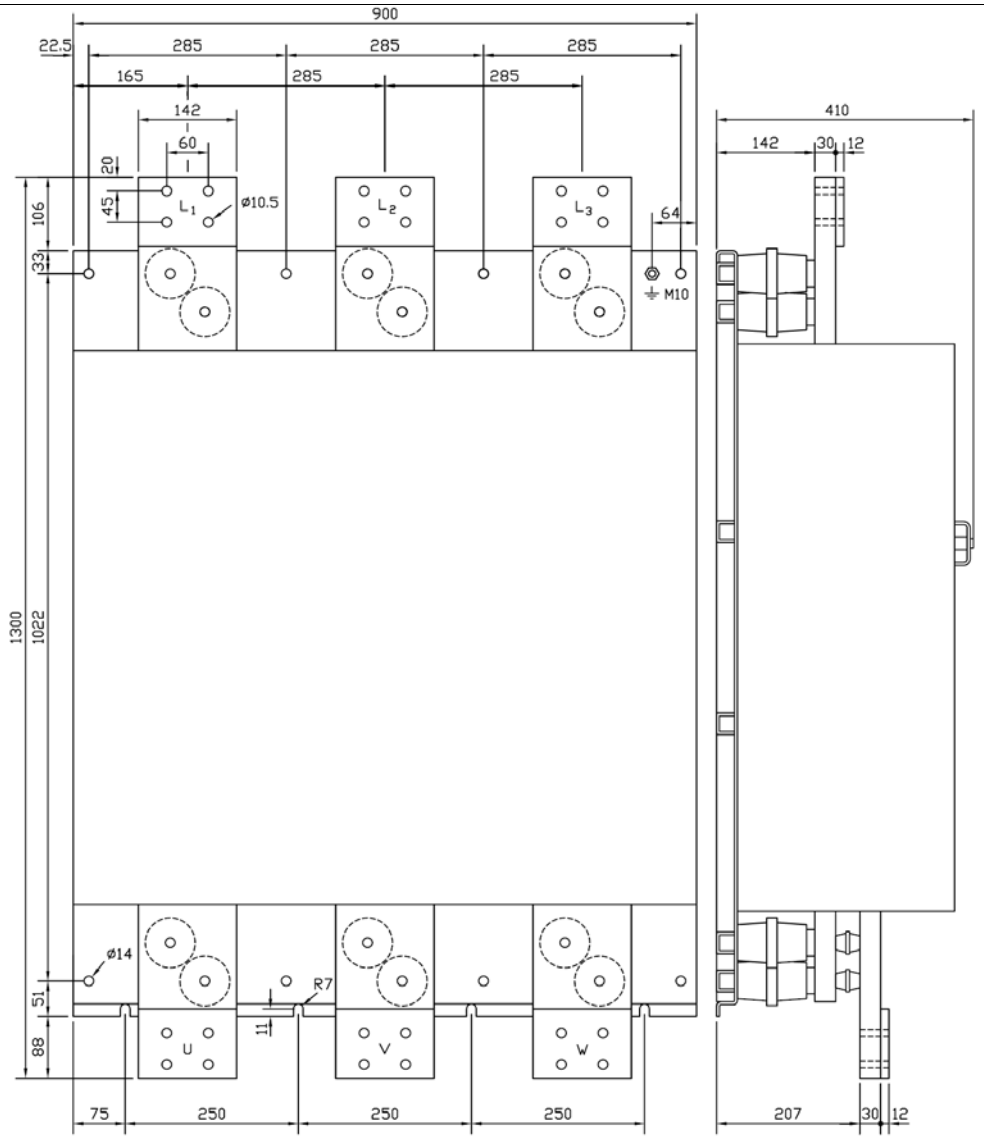
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.
- Must be operated with a bypass contactor
- Add space for current transformers (Supplied separately from main unit) and bus bars for preparation for bypass
- Approximate current transformers dimensions:
  W=240mm, H=130mm, D=90mm. (1100A)
  W=270mm, H=155mm, D=90mm. (1400A)
  W=270mm, H=155mm, D=100mm. (1800A)



RVS-DN 2150A

Notes:

- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.
- Must be operated with a bypass contactor
- Add space for current transformers (Supplied separately from main unit) and bus bars for preparation for bypass
- Approximate current transformers dimensions: W=270mm, H=155mm, D=100mm



RVS-DN 2400A 2700A 3000A

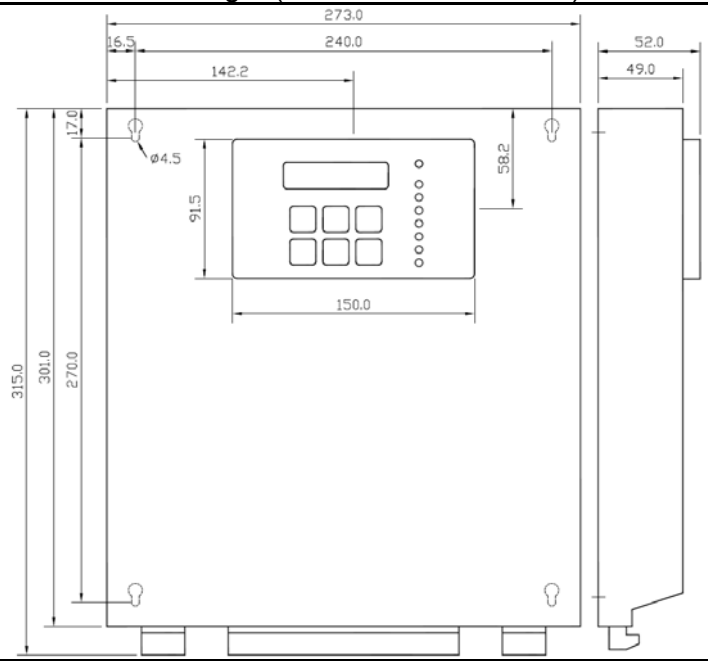
Notes:

- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.
- Must be operated with a bypass contactor.
- Add space for current transformers (Supplied separately from main unit) and bus bars for preparation for bypass
- Approximate current transformers dimensions: W=330mm, H=190mm, D=110mm
- Control module is supplied separately with a 1.5 m cable length (see dimensions below)

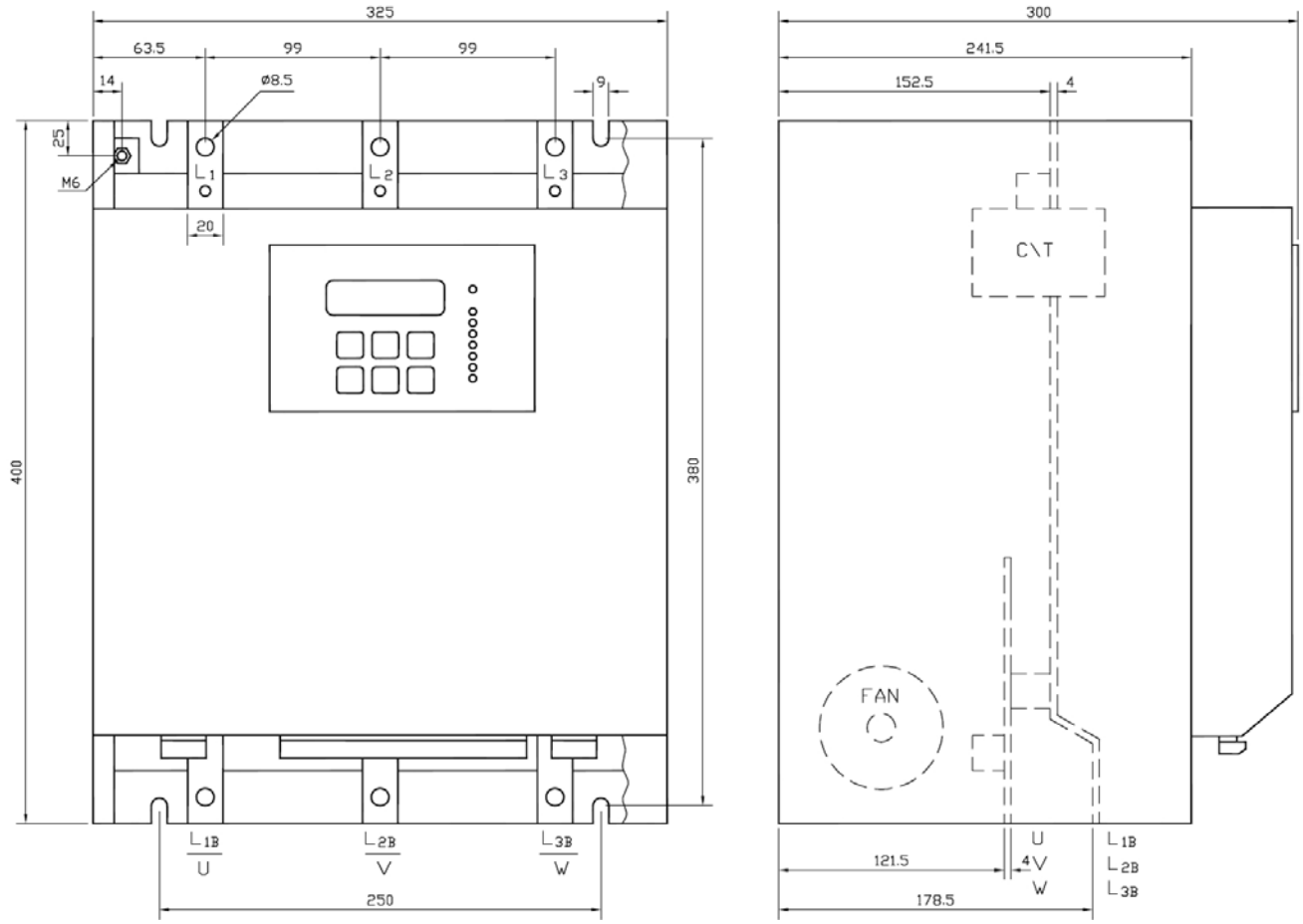
5.1.1 Control Module Dimensions

Notes:

- RVS-DN control module is supplied separately in RVS-DN 2400A, 2700A 3000A
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



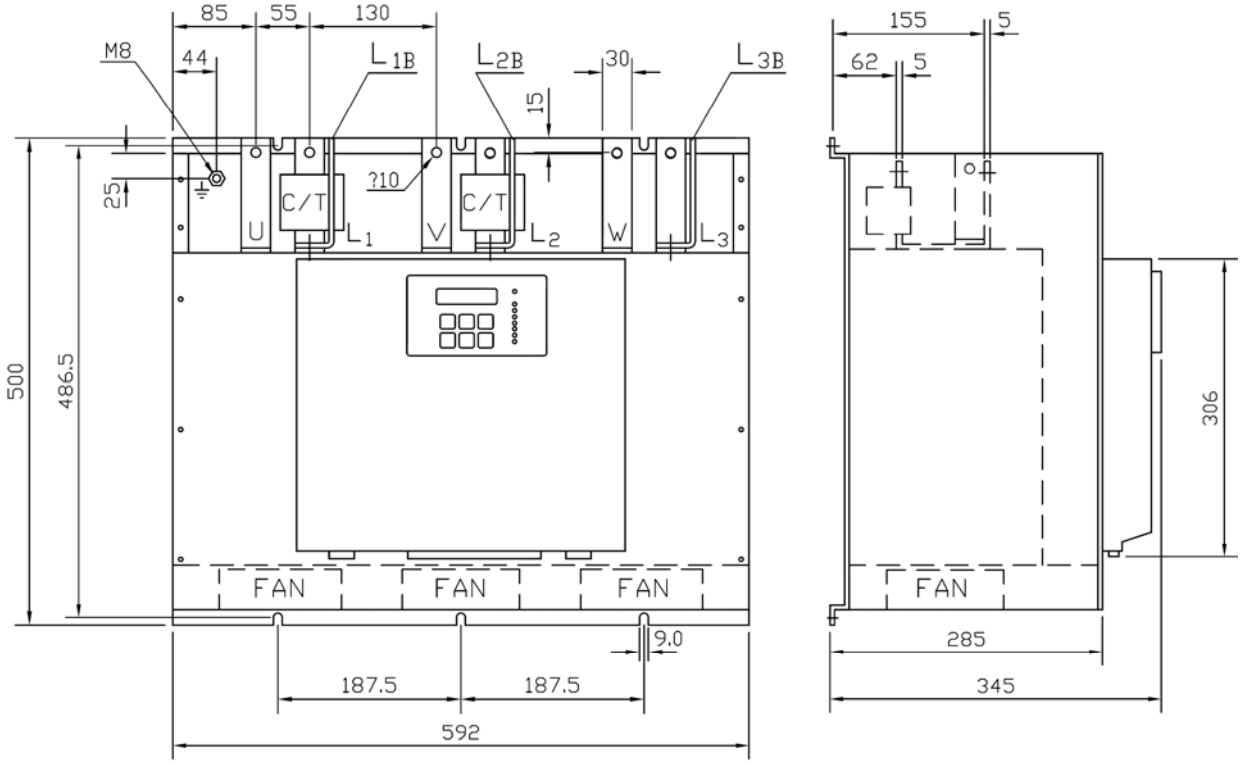
5.2 RVS-DN 1000V Models



RVS-DN 105A **1000V**

Notes:

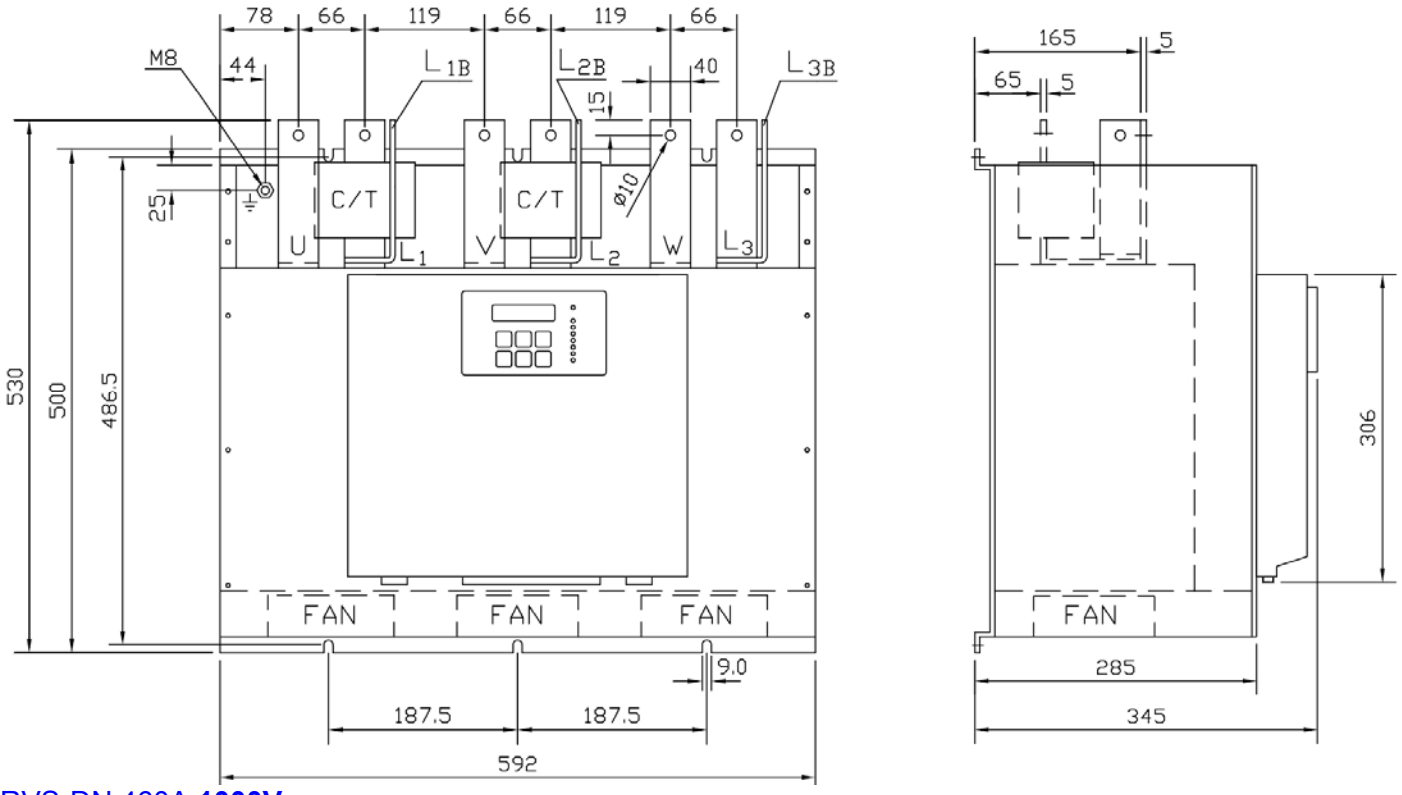
- Must be operated with a bypass contactor
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 170A 210A 310A 390A **1000V**

Notes:

- Must be operated with a bypass contactor
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



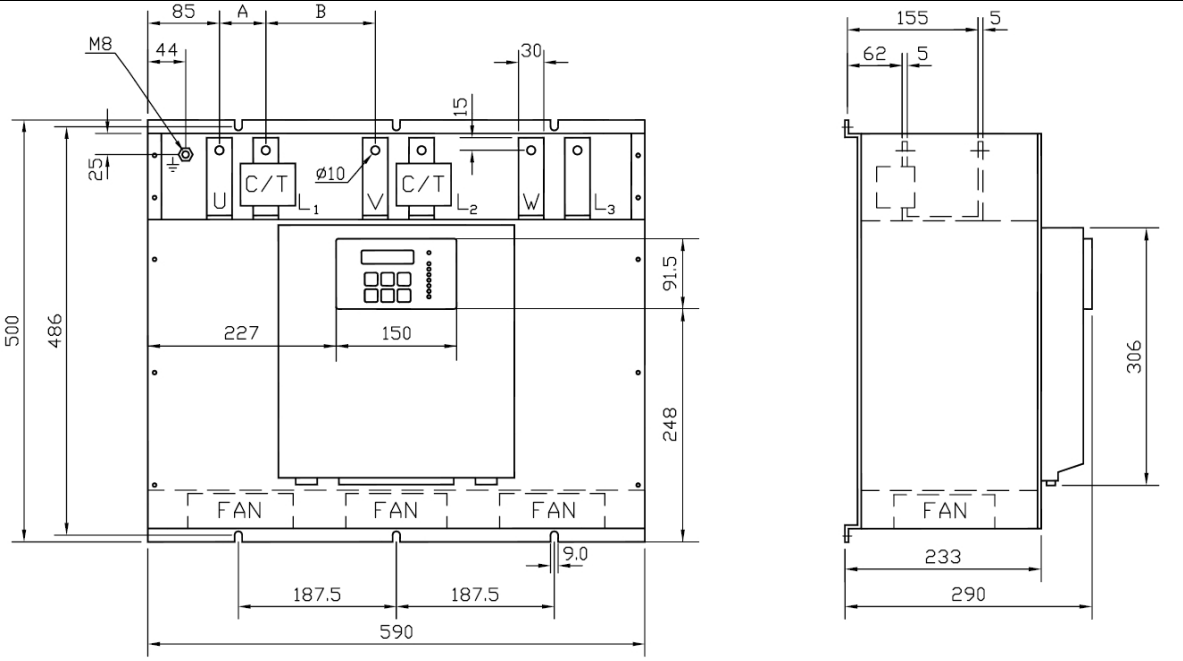
RVS-DN 460A **1000V**

Notes:

- Must be operated with a bypass contactor
- Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

5.3 UL/cUL/Marine Models

The following models have different dimensions when ordered with UL/cUL/marine approvals.
Other models have the same dimensions as standard models listed in section 5.1 page 34.

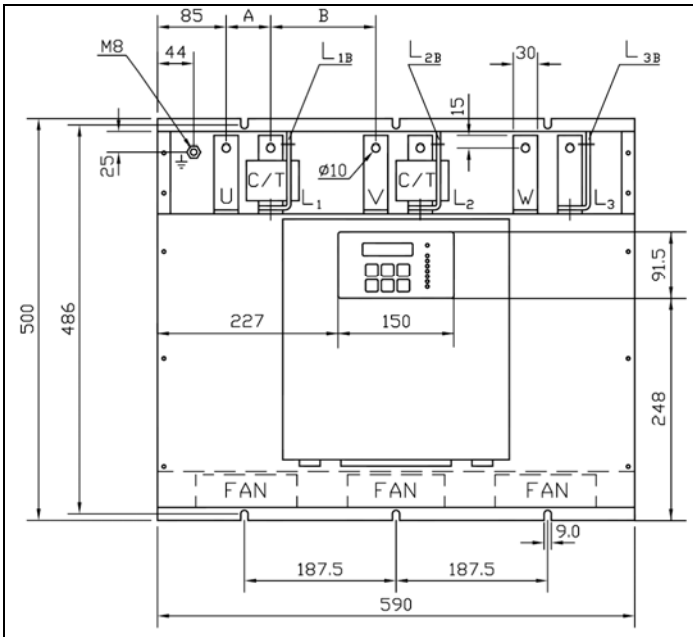


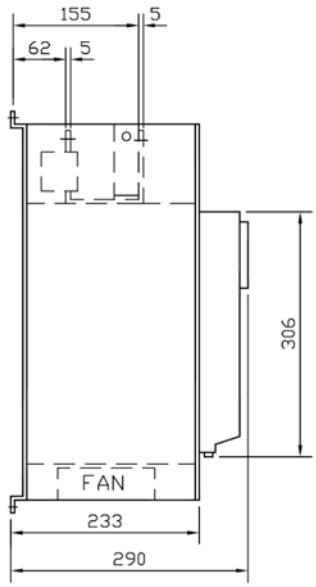
RVS	210	310	390
A	45	45	55
B	140	135	130

RVS-DN 210A 310A 390A **UL/cUL/Marine approved**

Note:

Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



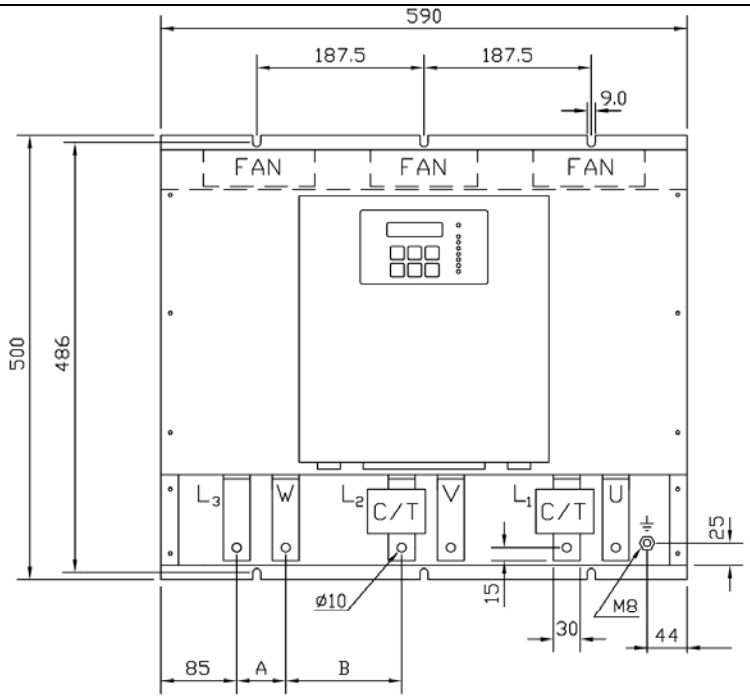


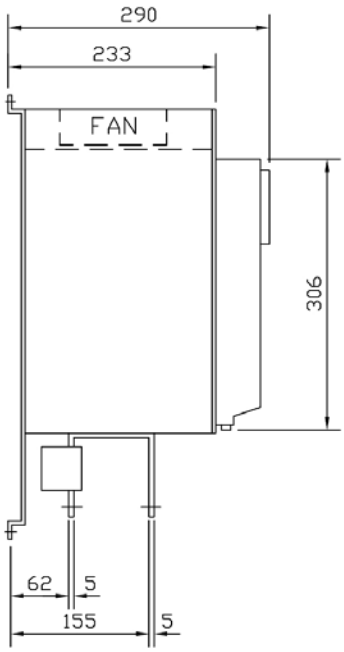
RVS	210	310	390
A	45	45	55
B	140	135	130

RVS-DN 210A 310A 390A with preparation for bypass **UL/cUL/Marine approved**

Note:

Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



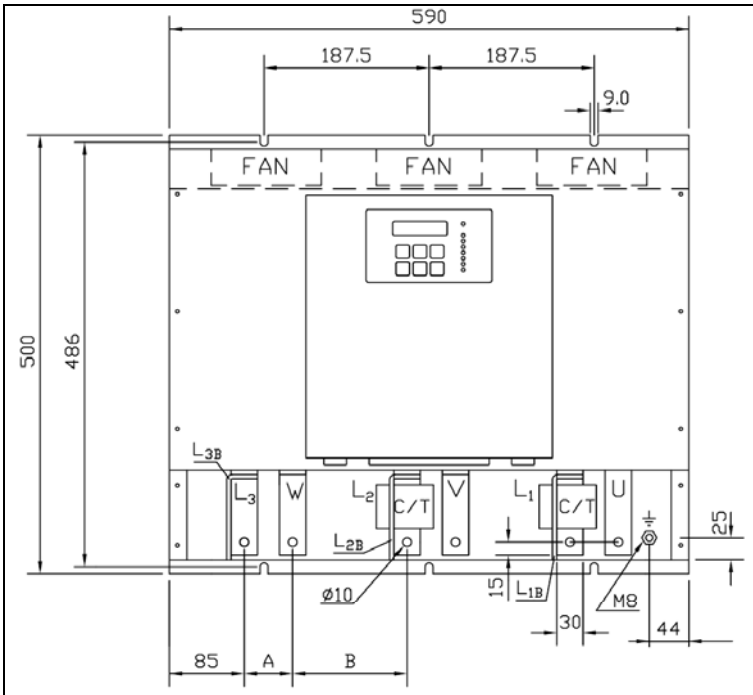


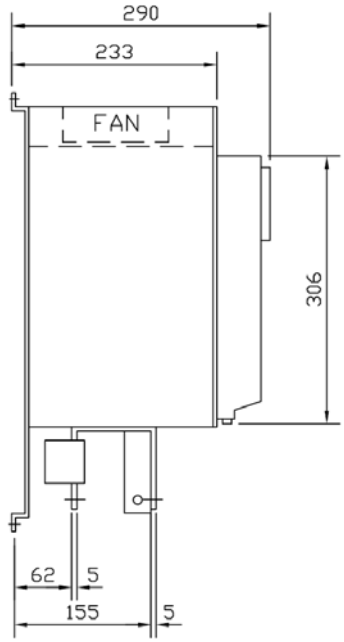
RVS	210	310	390
A	45	45	55
B	140	135	130

RVS-DN 210A 310A 390A line and load bus bars at the bottom **UL/cUL/Marine approved**

Note:

Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



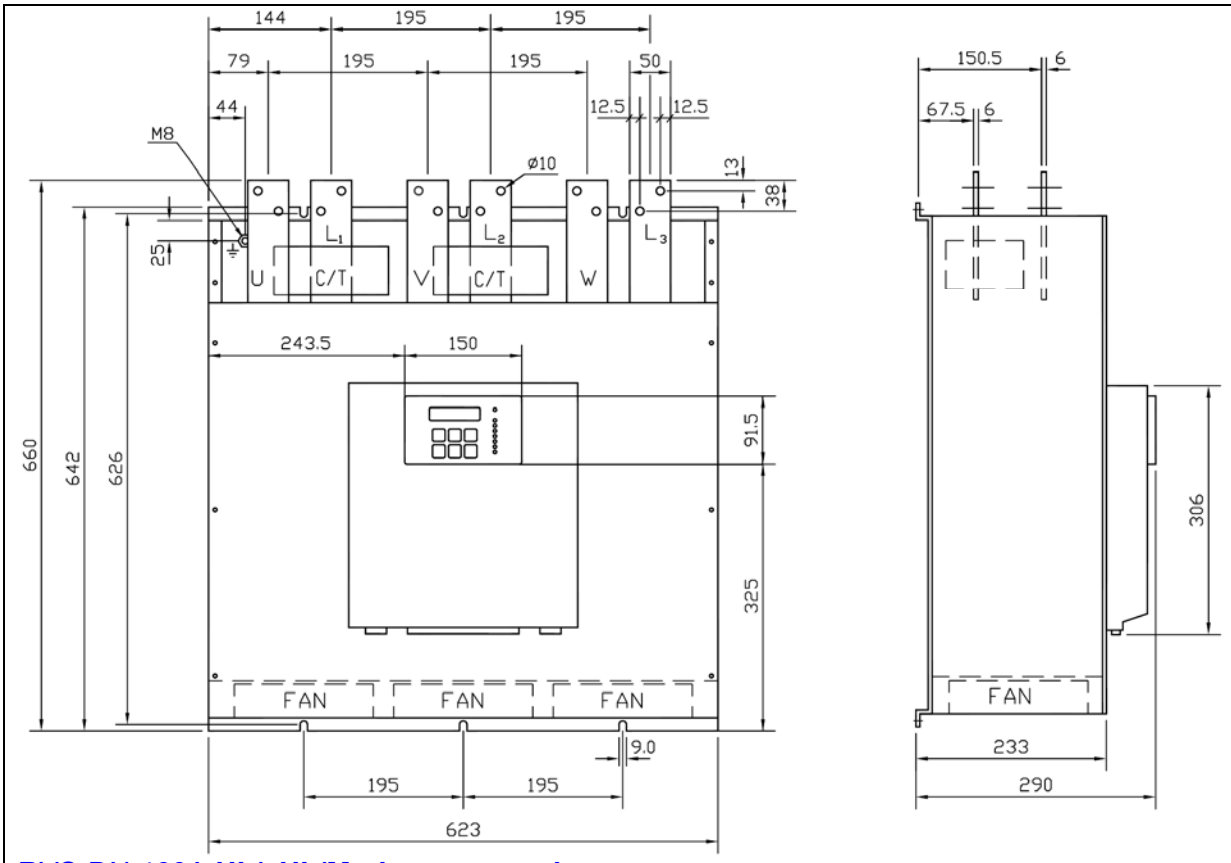


RVS	210	310	390
A	45	45	55
B	140	135	130

RVS-DN 210A 310A 390A line and load bus bars at the bottom with preparation for bypass **UL/cUL/Marine approved**

Note:

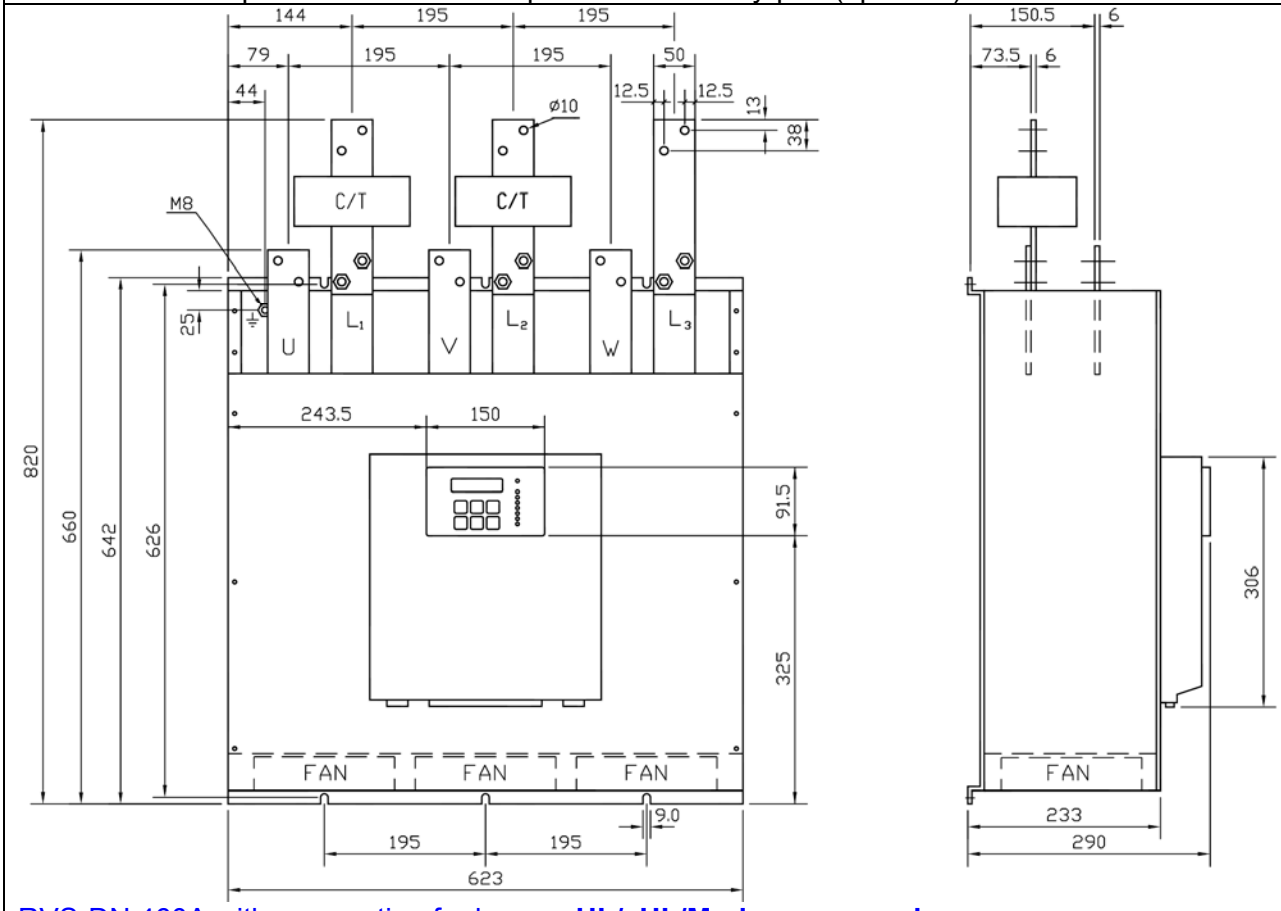
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 460A **UL/cUL/Marine approved**

Note:

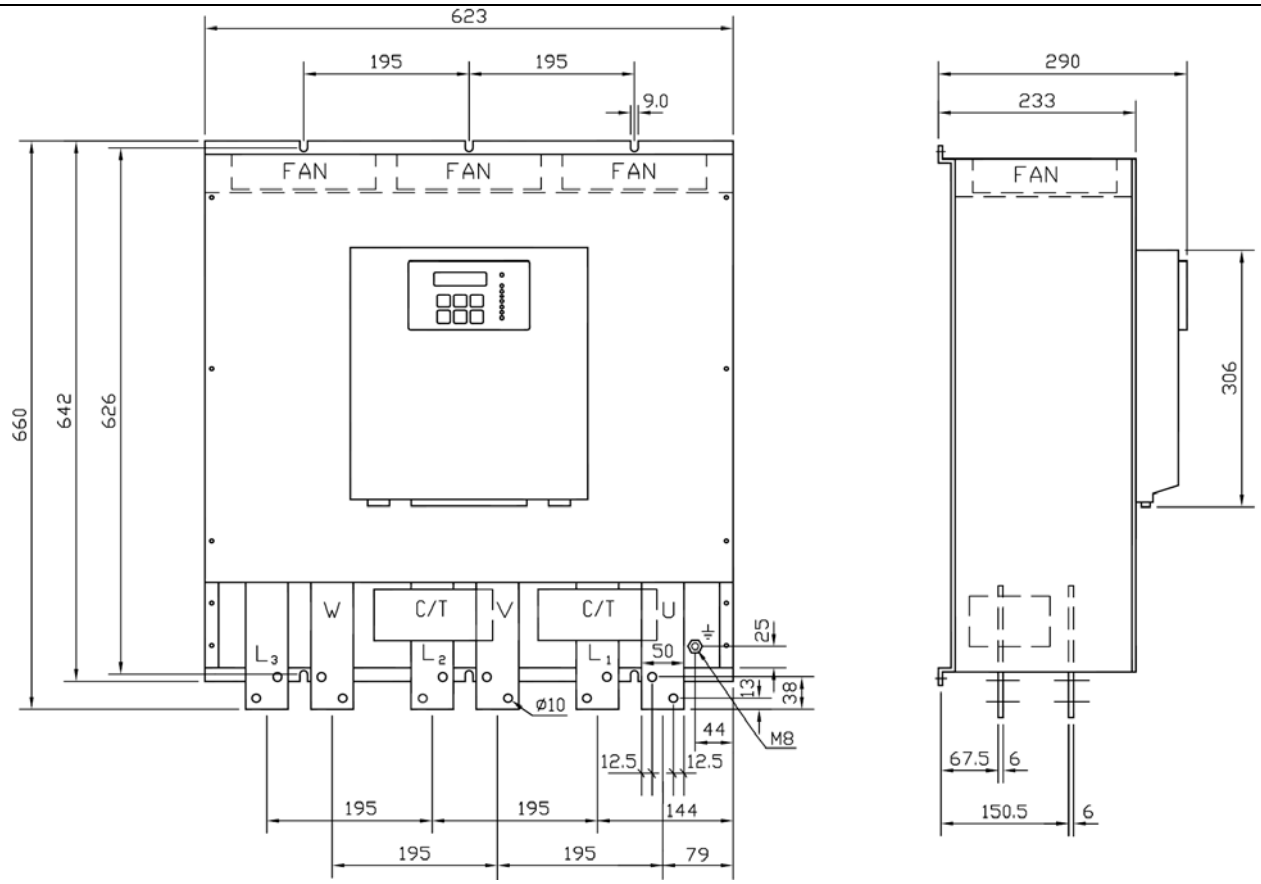
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 460A with preparation for bypass **UL/cUL/Marine approved**

Note:

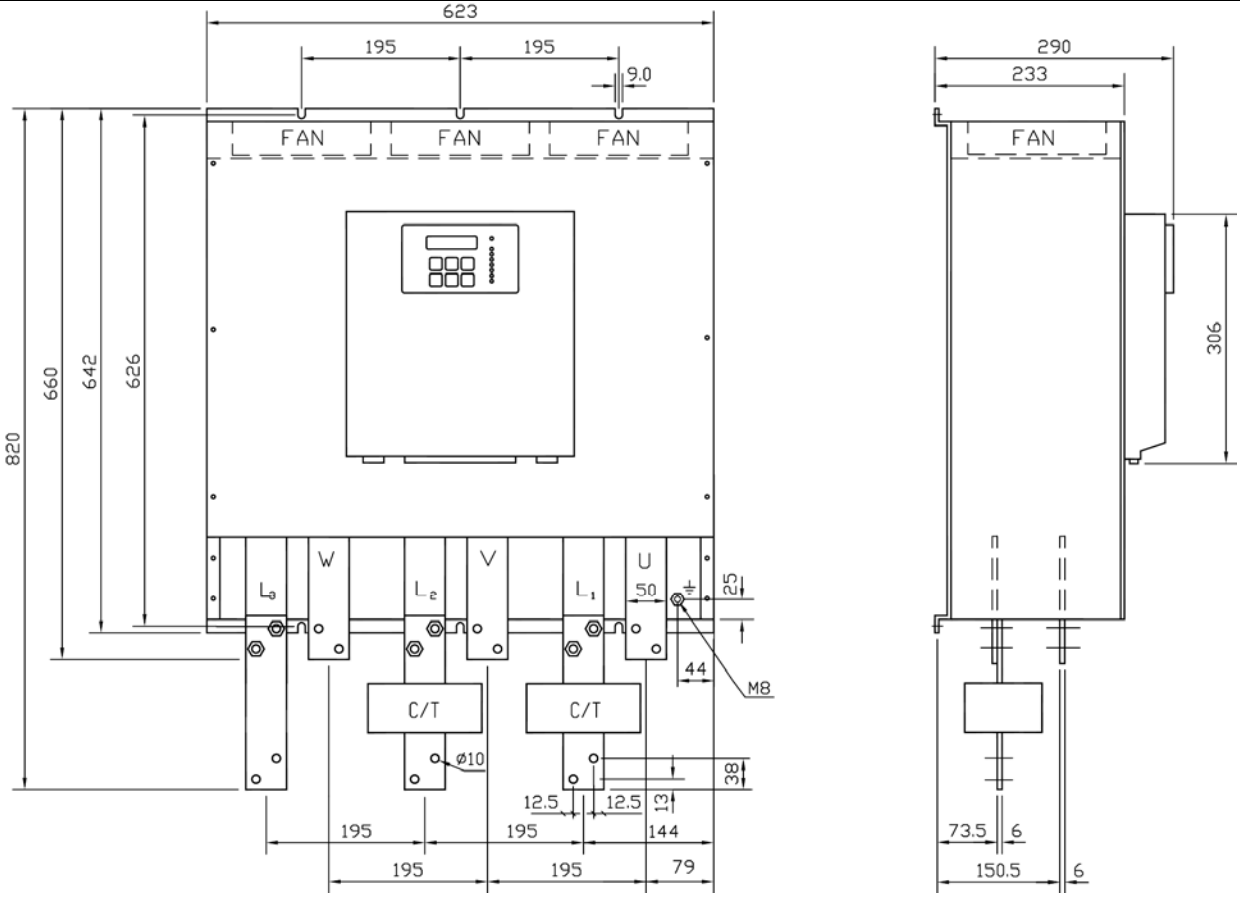
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 460A line and load bus bars at the bottom **UL/cUL/Marine approved**

Note:

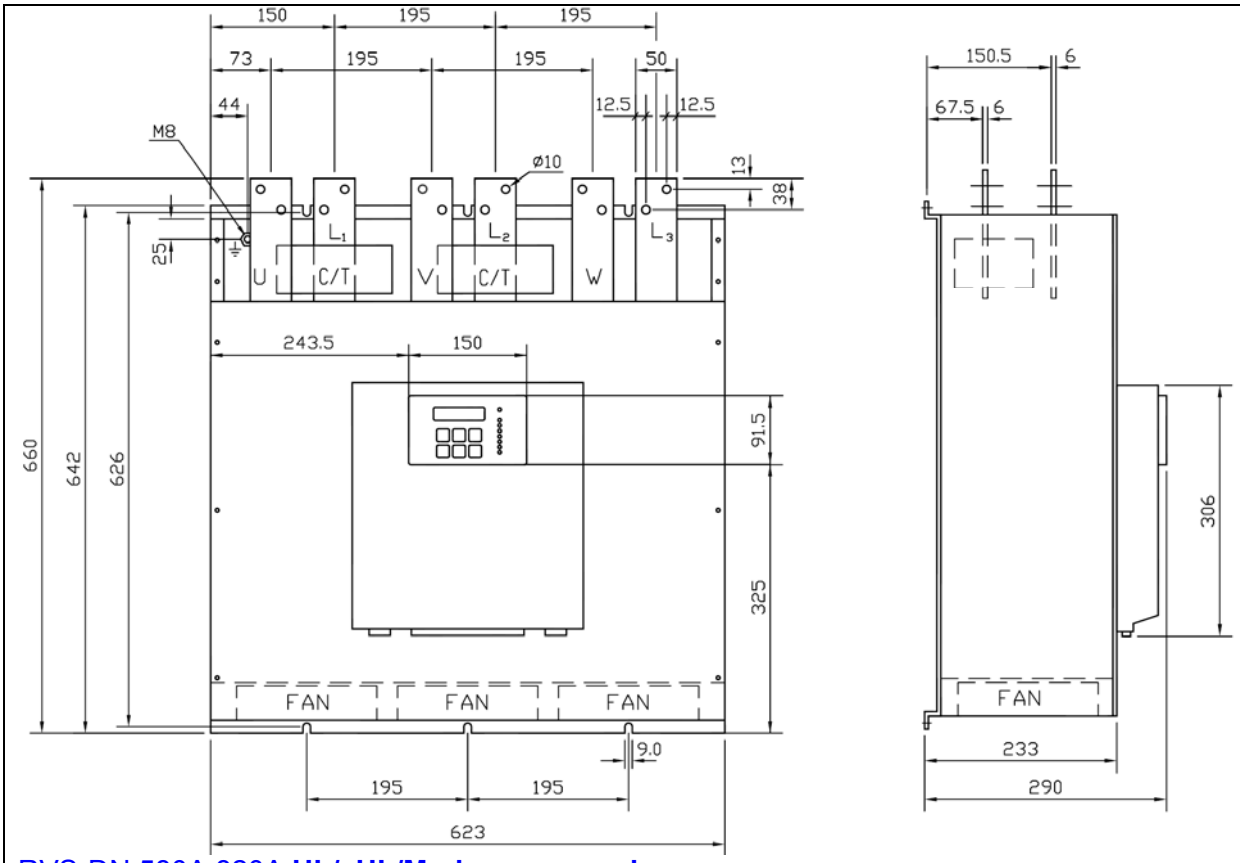
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 460A line and load bus bars at the bottom with preparation for bypass **UL/cUL/Marine approved**

Note:

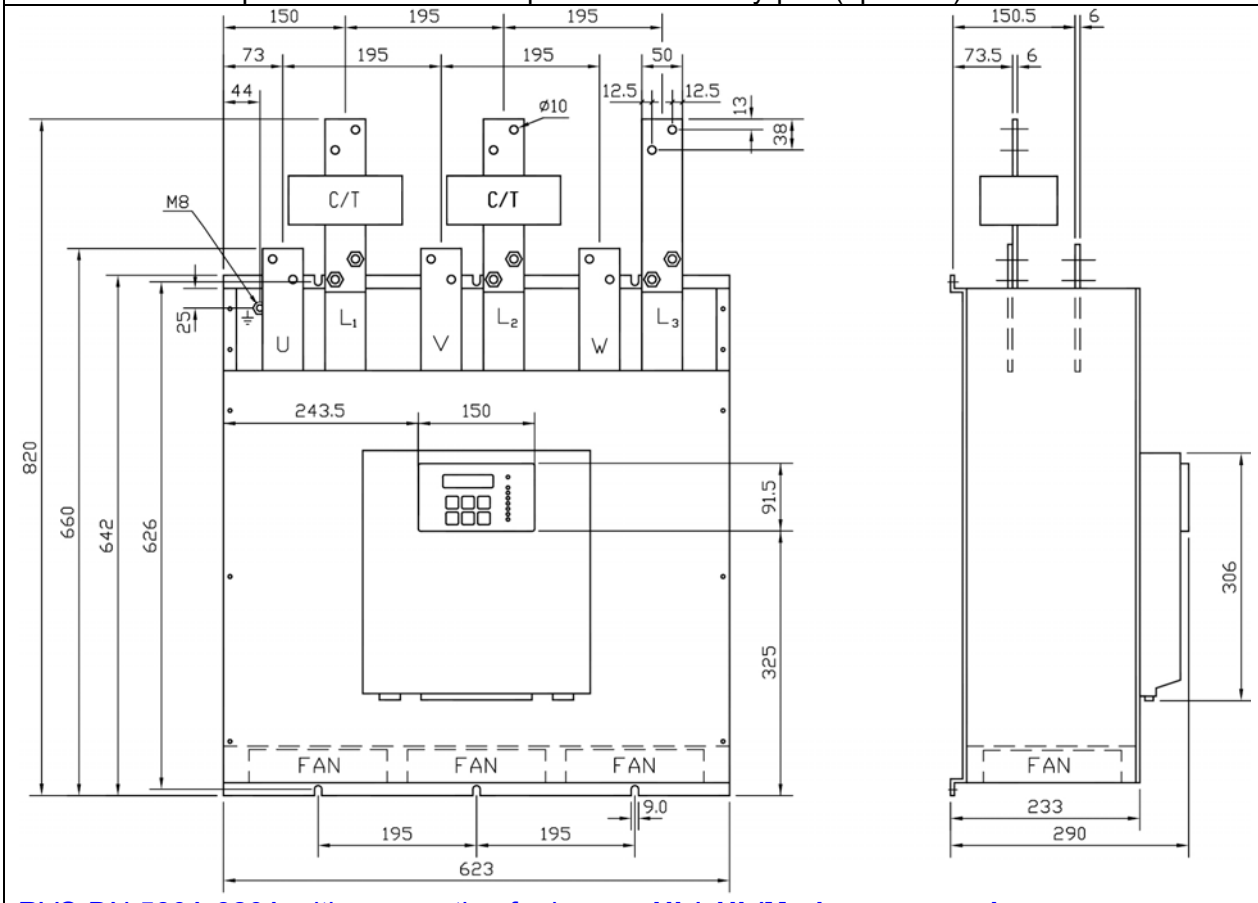
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 580A 820A **UL/cUL/Marine approved**

Note:

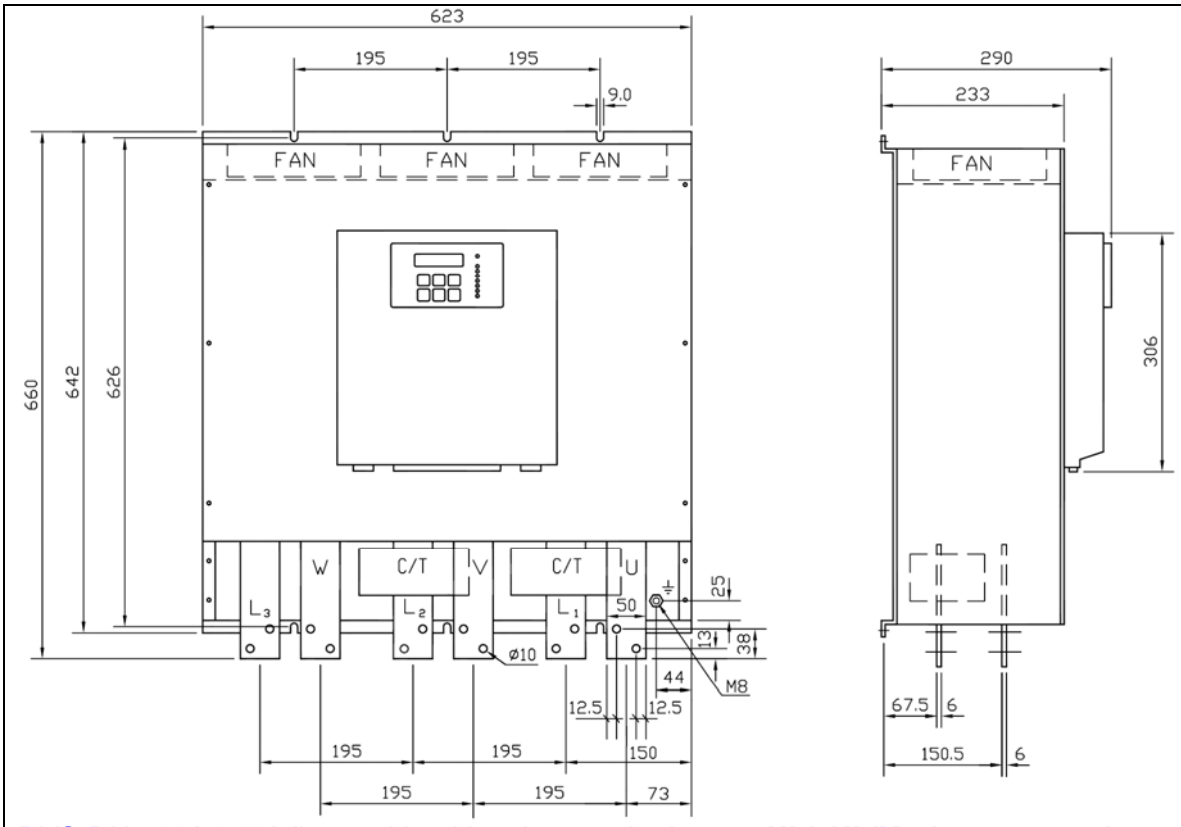
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 580A 820A with preparation for bypass **UL/cUL/Marine approved**

Note:

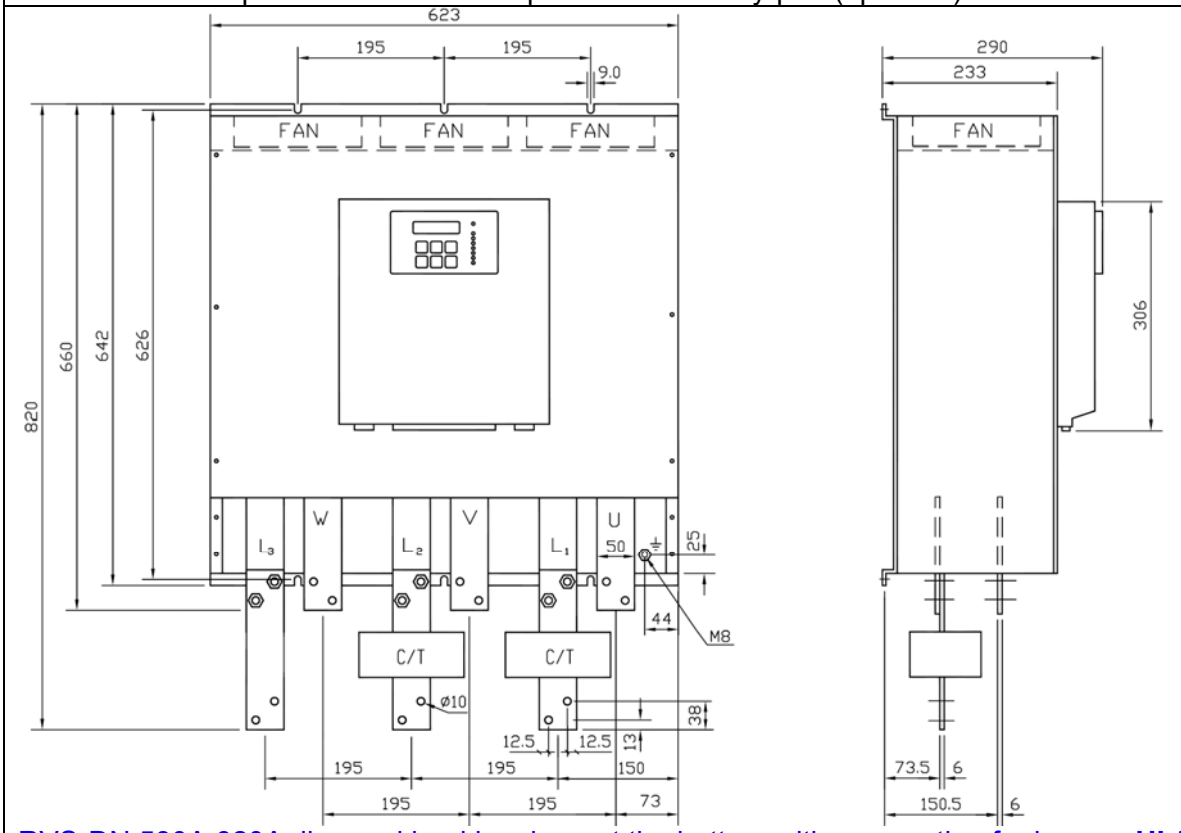
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 580A 820A line and load bus bars at the bottom **UL/cUL/Marine approved**

Note:

Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.



RVS-DN 580A 820A line and load bus bars at the bottom with preparation for bypass **UL/cUL/Marine approved**

Note:

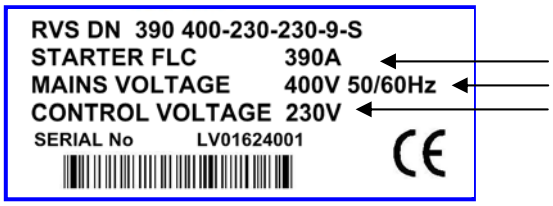
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

6. INSTALLATION

WARNINGS!	Do not interchange line and load connections
	When mains voltage is connected to the RVS-DN, **even if control voltage is disconnected**, full voltage may appear on the RVS-DN's load terminals. Therefore if isolation is required you must connect an isolation device between the mains and the RVS-DN.
	Power factor correction capacitors must not be installed on the load side of the RVS-DN. When required, install capacitors on the line side of the RVS-DN.

6.1 Prior to Installation

Check that the Full Load Ampere (FLA) of the motor is lower than or equal to the Full Load Current (FLC) the RVS-DN, and that the mains and control voltages are as indicated on the side and/or front label of the RVS-DN.



Make sure RVS-DN FLC ≥ motor FLA!
Make sure mains voltage is correct!
Make sure control voltage is correct!

RVS-DN label - example

6.2 Mounting

The RVS-DN must be mounted vertically. Allow sufficient space for suitable airflow above and below the RVS-DN. To improve heat dissipation, it is recommended that you mount the RVS-DN directly on the rear metal plate.

Notes:

(1) Do not mount the RVS-DN near heat sources.
(2) Surrounding air temperature in the cabinet should not exceed 50°C
(3) Protect the RVS-DN from dust and corrosive atmospheres.
(4) For harsh environments (sewage treatment plants, etc.) you should order the RVS-DN with the optional harsh environment treatment (refer to ordering information page 18).

6.3 Temperature Range & Heat Dissipation

The RVS-DN is rated to operate within a temperature range of -10°C (14°F) to + 50°C (122°F).
Relative non-condensed humidity inside the enclosure must not exceed 95%.

ATTENTION!	Operating the RVS-DN with a surrounding air temperature that is higher than 50ºC will cause derating. Operating the RVS-DN with a surrounding air temperature that is higher than 60ºC may cause damage to the RVS-DN.

Heat dissipation from the RVS-DN is calculated as:

Ploss=3x1.3xI+FAN loss

where:
I represents motor current. Note that the motor current during the start process is higher than the motor rated current.
FAN loss represents power loss caused by all internal fans (refer to section 10 page 99 for fan loss per model).

For example, during start of a 820A motor when CURRENT LIMIT is set to 400%, heat dissipation can be calculated as:

Ploss=3x1.3x4x820+150=12,792Watt≈12.8kW

While a 820A motor is running and the motor current is 820A, heat dissipation can be calculated as:

Ploss=3x1.3x820+150=3,198Watt≈3.2kW

When a bypass contactor is used this changes the previous calculation to:

Ploss=3x1.3x0+150=150Watt≈0.15kW

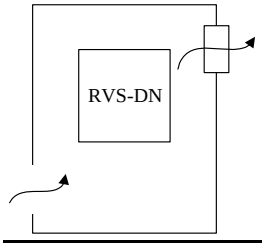
It is obvious that using a bypass contactor can significantly reduce energy consumption.
You can reduce the amount of heat in an internal enclosure by:

a. Using additional ventilation
b. Using a bypass contactor

Important Note: If the motor is started frequently, the cabinet should be designed for greater heat dissipation. You can reduce the enclosure heating by adding ventilation.

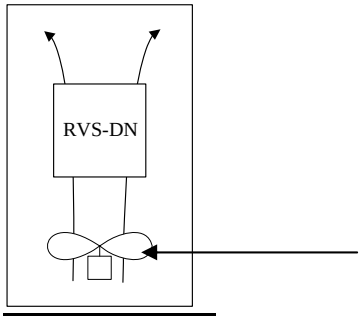
6.3.1 Forced Ventilation

Use the following arrangement for forced ventilation of the RVS-DN's enclosure:



General purpose enclosure

Fan at air outlet ventilates



Non-ventilated enclosure

Fan circulates existing air.

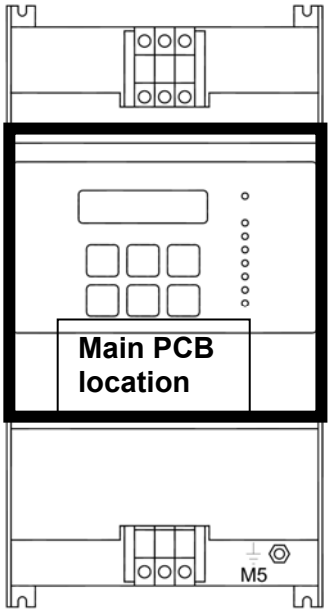
Fan

6.3.2 Calculating the Enclosure Size, for Non-Ventilated Metal Enclosure

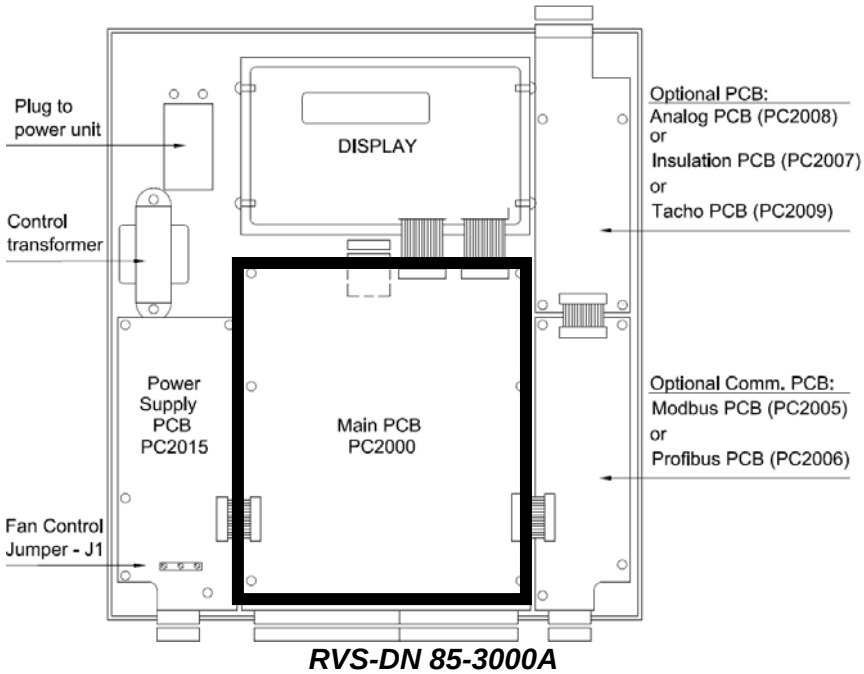
$$\text{Area } [m^2] = \frac{0.12 \times \text{Total heat dissipation [Watts]}}{60 - \text{External ambient temperature [ºC]}}$$

where:
Area [m^2] represents the surface area that can dissipate heat (front, sides, top).
Total heat dissipation [Watt] represents the total heat dissipation of the RVS-DN and other control devices in the enclosure. If the RVS-DN is started frequently you should use average power.

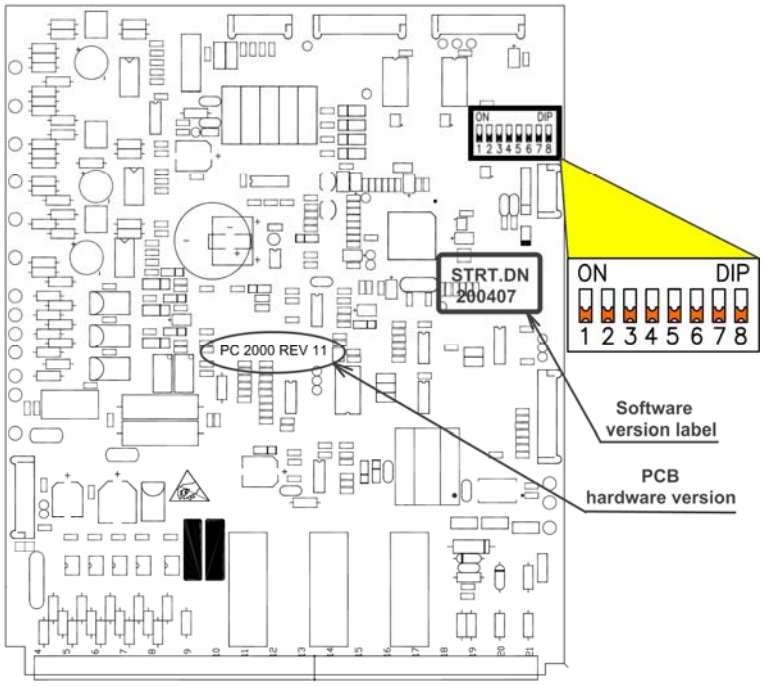
6.4 Main PCB and Optional PCBs



RVS-DN 8-72A
Remove top cover and display to access the main PCB.



RVS-DN 85-3000A
Remove top cover of the control module to access the main PCB, optional PCBs and fan control jumpers.



RVS-DN main PCB.
Dip switch location, software version label location and PCB hardware version identification.

6.5 Dip Switch Settings on the Main PCB

The dip switch has eight separate switches. It is located under the front cover of the control module (in sizes B-F) or under the display unit (in size A).

No.	Switch Function	Switch Off	Switch On
1	Display format	Minimized	Maximized
2	Tacho feedback	Disabled	Enabled
3	Mains/generator	Mains	Generator
4	Must be off	-	-
5	LCD language selection	See tables below section 6.5.4 page 57.	
6			
7	Expanded settings	Disabled	Enabled
8	Software lock	Open	Locked

6.5.1 Switch # 1 – Display Modes

Two display modes are available:
Maximized – display of all possible parameters.
Minimized – display of pre-selected parameters.
Setting switch # 1 to off will minimize the LCD displays.
Refer also to section 7.6 page 65.

Maximized Mode - Switch #1 – On
Display only
Main parameters
Start parameters
Stop parameters
Dual adjustment
Energy save & slow speed parameters
Fault parameters
I/O programming
Communication parameters
Statistical data

Minimized Mode Switch #1 – Off
Display only
Main parameters
Start parameters
Stop parameters
Statistical data

6.5.2 *Switch # 2 – Tacho Feedback (0-10VDC)*

Set switch #2 to on when using tacho feedback.
Note:
To operate tacho feedback consult with the factory for specific settings for each application.

6.5.3 *Switch # 3 – Main/D.ADJ.:GENERATOR PARAMETERS*

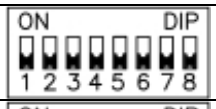
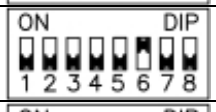
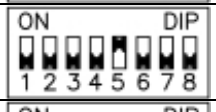
Refer to section 4.17 page 28 for information regarding the operation of this switch.

WARNING!	When operating in D.ADJ.:GENERATOR PARAMETERS, the motor must be loaded to avoid vibration during starting and stopping.

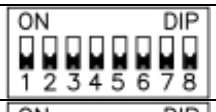
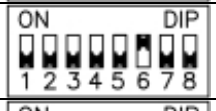
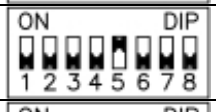
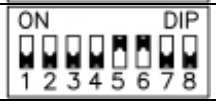
6.5.4 *Switches # 5, 6 – Language Selection*

Language selection defined by the switch settings and software version.
To identify your software version refer to section 7.5.2 on page 63.
The software version is also shown on the internal label as shown on section 6.4 page 55**.**

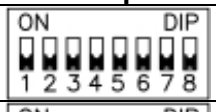
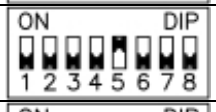
For software version: **STRT.DN MMDDYY & STRT.DN 1k MMDDYY** (where "MMDDYY" represents software version date in 6 digit format. i.e., 020407 refers to April 2nd, 2007)

Language	Switch #5	Switch #6	Position of Switches
English	Off	Off	
French	Off	On	
German	On	Off	
Spanish	On	On	

For software version: **STRT.DN MMDDYY –H**

Language	Switch #5	Switch #6	Position of Switches
English	Off	Off	
NA	Off	On	
Special Set	On	Off	
Spanish	On	On	

For software version: **STRT.DN MMDDYY –R**

Language	Switch #5	Switch #6	Position of Dip switches
English	Off	Off	
Russian	Off	On	
NA	On	Off	
Spanish	On	On	

6.5.5 *Switch # 7 – Expanded Settings*

EXPANDED SETTINGS corresponds to:

Parameter	Dip switch #7 - Off	Dip switch #7 - On
INITIAL VOLTAGE	10-50%	5(1)-80%
CURRENT LIMIT	100-400%	100-500%
ACCELERATION TIME	1-30 seconds	1-90 seconds
DECELERATION TIME	1-30 seconds	1-90 seconds
MAX. START TIME	1-30 seconds	1-250 seconds
PHASE LOSS Y/N	Yes(2)	Yes/No(2)
MAX SLOW SP TIME	1-30 seconds	1-250 seconds
O/C or WRONG CON protection in Inside Delta mode.	Protection active in normal set(3)	Protection active in high set(3)
OVERLOAD TRIP protection.	OVERLOAD TRIP will be active after *Run* LED is Lit. (Motor is at full voltage) (4)	OVERLOAD TRIP will be active after MAX. START TIME has elapsed. (4)

Notes:

(1) Setting the INITIAL VOLTAGE to lower than 10% is not practical for loaded motors.
(2) Refer to section 9 page 95. See PHASE LOSS protection and refer to the warning below.
(3) Refer to section 9 page 95. See O/C or WRONG CON protection.
(4) In order to avoid OVERLOAD TRIP in special cases (very high inertia loads), where at the end of the acceleration process, although motor is at full voltage (*Run* LED is Lit) and the current does not reduce to nominal, set Dip switch #7 to On causing the OVERLOAD TRIP to be active only after MAX. START TIME has elapsed.

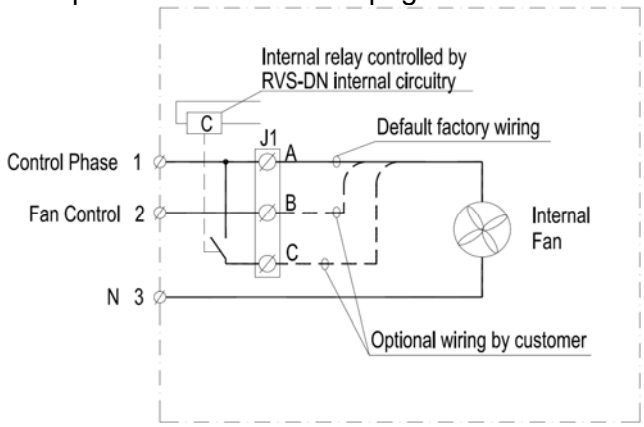
WARNING! Operator's responsibility!	(1) EXPANDED SETTINGS are for use in very special applications only! **Do not** set to switch #7 to **on** unless RVS-DN is significantly larger than the motor! When using expanded settings for the RVS-DN **you must** be extremely careful to avoid damaging the motor or RVS-DN. (2) Only cancel PHASE LOSS protection when the operator is sure that no real phase loss exists and PHASE LOSS protection is activated. This situation can occur in rare cases when there is no real fault but the RVS-DN recognizes unusual behaviour like when THDV (Total Harmonic Distortion in Voltage) in the network is high. If this is a true case of PHASE LOSS then after cancelling PHASE LOSS protection the motor will single phase and most likely be tripped by the over load protection mechanism.

6.5.6 *Switch # 8 – Software Lock*

The software lock prevents undesired parameter modifications.
When locked, pressing the *Store*, ▼or ▲ keys causes the LCD to display UNAUTHORIZED ACCESS.

6.6 Internal Fan Control

An internal jumper connected between the fan and terminal 2, enables three modes of operation. For fan power consumption, see technical specification section 10 page 99.



Fan control jumper J1. Refer to section 6.4 page 55 for J1 location.

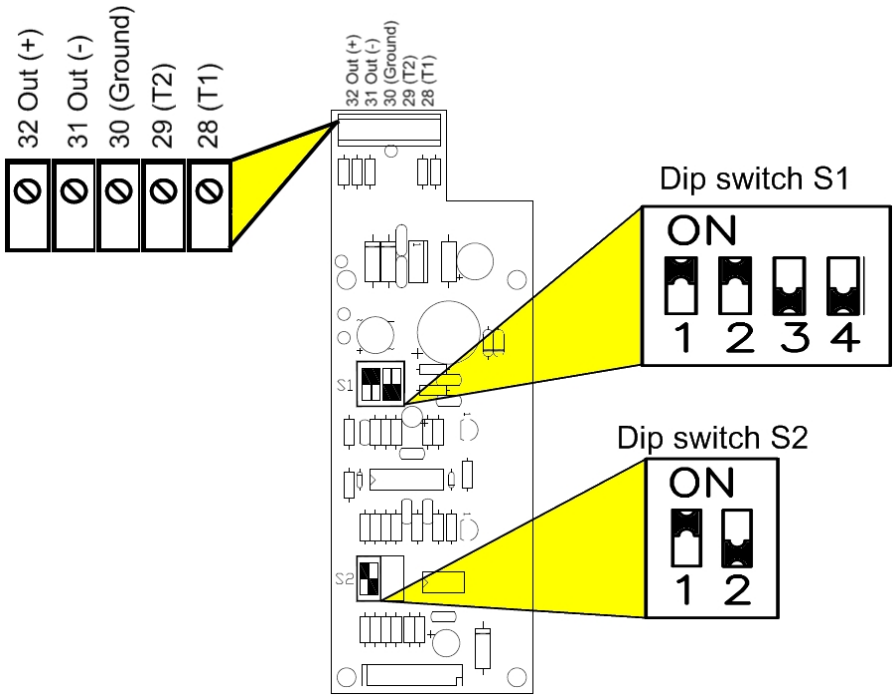
Continuous mode (factory default) – Fan operates as long as the control supply is connected to terminals 1-3. Leave the internal jumper connected to the left terminal of JI (marked A in the drawing).
External control mode – Fan operates when the control supply is connected to terminal 2. Connect the internal jumper to the middle terminal of JI terminal (marked B in the drawing). For use without bypass, connect the fans before giving the start command and disconnect at least 5 minutes after giving the stop or soft stop command.
Automatic mode – Whenever the start or stop signals is given the fan operates for approximately 5 minutes. Connect the internal jumper to the right terminal of JI (marked C in the drawing).

WARNING!	Automatic mode may be used only if bypass contactor is directly controlled by the RVS-DN's END OF ACCELERATION contact.

6.7 Analog I/O (Option 5) (Terminals T1, T2, Gnd, Out (-), Out (+))

The analog option incorporates two functions:

- Thermistor input
- Analog output



Analog P.C.B. layout

Thermistor Input (Terminals T1, T2)

Programmable as PTC or NTC type thermistor. Trip value is adjustable between 1-10K, preset delay of 2 sec. For thermistor input programming refer to section 7.7.7 on page 81.

Ground Terminal (terminal Gnd)

Connect the thermistor and/or the analog output shield to this ground terminal.

Analog Output (Terminals Out (+), Out (-))

Dip switches allow selection between: 0-10VDC, 0-20mA, 4-20mA
The analog value is related to I, 0….200% of **FLA** (not programmable).
In RVS-DN 1000V models the analog value is related to I, 0….200% of **FLC**. In RVS-DN 1000V models inverse programming is optional as well (refer to section 7.7.8 on page 83).

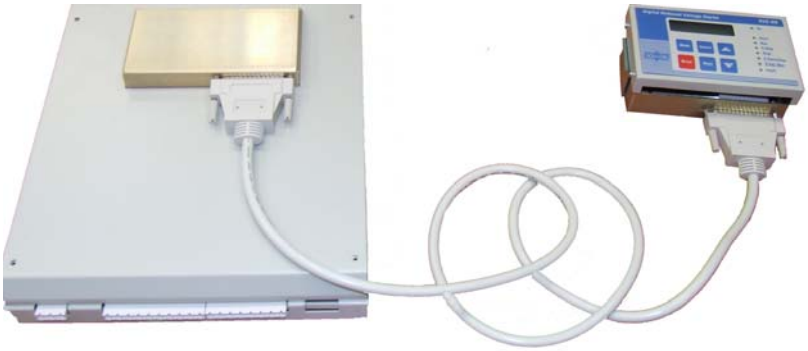
Switch No.	4-20 mA*	0-20 mA	0-10VDC
Switch # 1	On	On	Off
Switch # 2	On	On	Off
Switch # 3	Off	Off	On
Switch # 4	Off	Off	On
Switch # 1	On	Off	Off
Switch # 1	Not used	Not used	Not used

* Factory default setting

Notes:

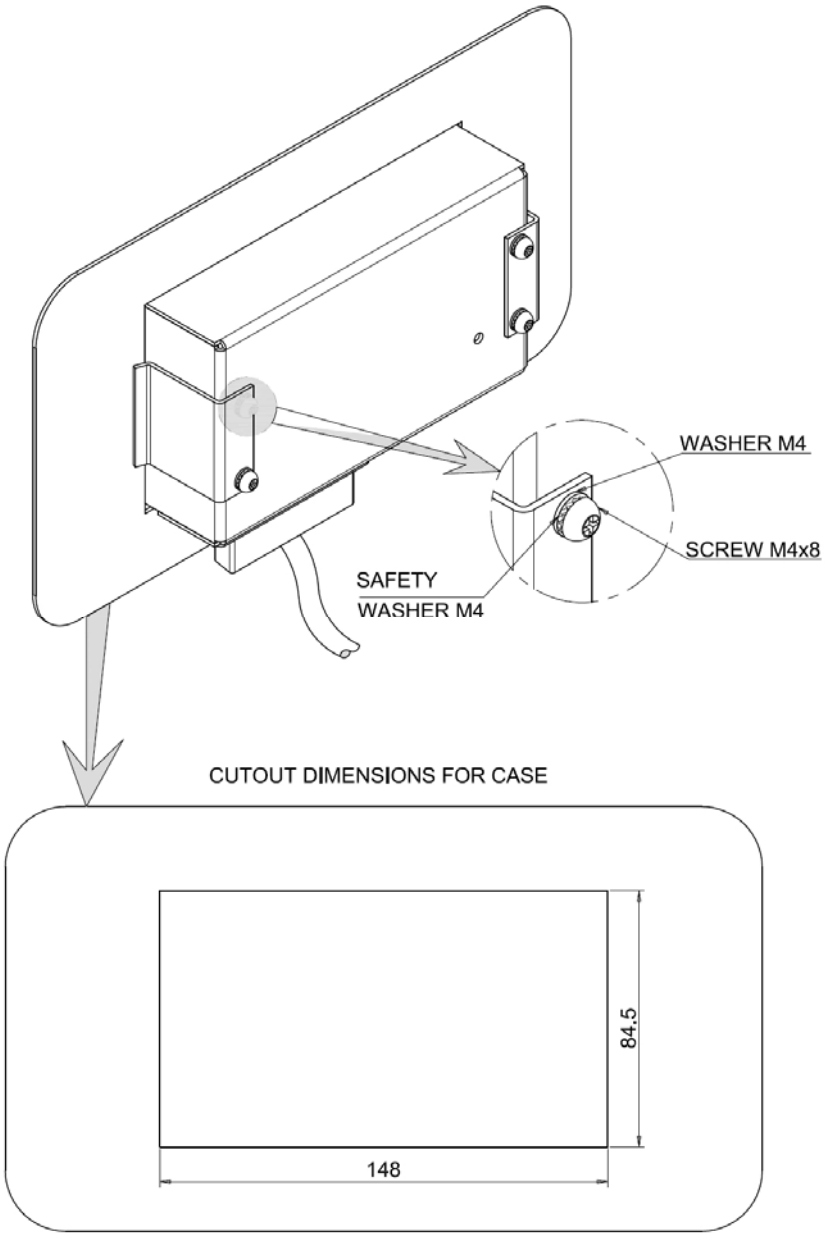
(1) It is important that the RVS-DN is properly grounded and that the control module is tightly fastened to the power module.
(2) Use twisted shielded cable for the thermistor connection.

6.8 Remote Key-Pad Installation



Remote key pad, connection cable and control module.

Cable length is 1.5 meters (consult with the factory if a longer cable is required).
Add 20 mm to depth dimension when optional remote key-pad (option D) is installed.

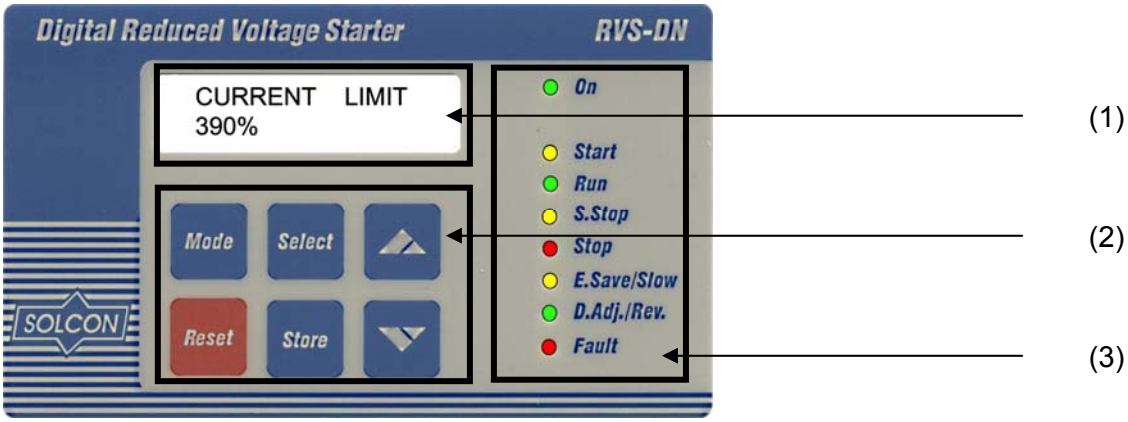


Remote key pad, mechanical installation and cut-out dimensions.

7. CONTROL KEYPAD

The control keypad is the link between the RVS-DN and the user.
The RVS-DN control keypad features:

(1) Two lines of 16 alphanumeric characters each with selectable languages – English, French, German, and Spanish. Russian characters are optional and must be pre-ordered.
(2) Six push-buttons (**Mode**, **Reset**, **Select**, **Store**, Up (▲) and down (▼) keys).
(3) Eight indication LEDs (*On, Start, Run, S.Stop, Stop, E.Save/Slow, D.Adj./Rev., Fault*)



RVS-DN control keypad

7.1 LCD Arrangement

CURRENT LIMIT 390%

Upper line displays function.
Lower line displays setting and\or measured values.

7.2 Push-Buttons

Mode	Scrolls through the display and programming menus of the RVS-DN. **Note**: Pressing **Mode** continuously increases the speed at which the parameters change.
Select	When a mode name is displayed, pressing this button drills down to the parameters for that mode. When a parameter is displayed, pressing this button scrolls to the next parameter.
▲	Allows the operator to increment adjusted values shown in the display. Operator should press this button once to increment one value, or continuously to rapidly increment values up to the maximum value.
▼	Allows the operator to decrement adjusted values shown in the display. Operator should press this button once to decrement one value, or continuously to rapidly decrement values up to the minimum value.
Store	Stores modified parameters **only** when you have scrolled through all parameters and STORE ENABLE XXXXXX PARAMETERS is displayed. After you store a parameter successfully DATA SAVED OK will display. **Note**: Pressing this button at any other time has no effect.
Reset	Resets the RVS-DN after a fault has been dealt with **and** the start command has been removed. This cancels the fault displayed and allows you to restart the motor.

7.3 Status LEDs

●	Green	*On*	Lights when the control supply voltage is connected to the RVS-DN.
●	Yellow	*Start*	Lights during soft start, indicating that motor supply voltage is ramping up.
●	Green	*Run*	Lights after completion of the starting process, indicating that motor is at full voltage. This LED flashes during slow speed operation.
●	Yellow	*S.Stop*	Lights during soft stop, indicating that the motor supply voltage is ramping down.
●	Red	*Stop*	Lights when the motor is stopped.
●	Yellow	*E.Save/Slow*	Lights when ENERGY SAVE is in operation. Flashes when the motor is running in SLOW SPEED.
●	Green	*D.Adj./Rev*	Lights when DUAL ADJUSTMENT is in operation. Flashes when motor is running in SLOW SPEED REVERSE.
●	Red	*Fault*	Lights upon operation of any of the built-in protections. Flashes when the INSULATION ALARM optional relay is activated.

7.4 Reviewing and Modifying Parameters

Press the **Mode** key several times until you reach the required mode page.
Press the **Select** key to review parameters for this mode.

Once you reach the required parameter, use the ▼ or ▲ keys to modify its value.
To store the new parameters, press the **Select** key until the STORE ENABLE message displays and then press the **Store** key. The DATA SAVED OK message will display for 2 seconds.

7.5 Special Actions Performed in TEST/MAINTENANCE Mode

Note:
For RVS-DN 1000V refer to section 7.5.6 page 64.

7.5.1 Run Self Test

Press the **Mode** and ▼ keys simultaneously.
The LCD will display:

```
TEST/MAINTENANCE
***OPTIONS***
```

Press the **Select** key.
The LCD will display:

```
RUN SELF TEST?
PUSH UP ARROW
```

Press the ▲ key.
The LCD will display:

```
SELF TEST PASSED
```

And after a few seconds the LCD will display:

```
% OF MOTOR FLA
```

7.5.2 View Software Version

Press the **Mode** and ▼ keys simultaneously.
The LCD will display:

TEST/MAINTENANCE ***OPTIONS***

Press the **Select** key **twice**.
The LCD will display:

BTL-19/03/2006 STRT.DN-020407

Press the **Mode** and ▼ keys simultaneously to exit the TEST/MAINTENANCE mode.
The LCD will display:

% OF MOTOR FLA

7.5.3 Obtain Default Parameters

Press the **Mode** and ▼ keys simultaneously.
The LCD will display:

TEST/MAINTENANCE ***OPTIONS***

Press the **Select** key **three times**.
The LCD will display:

STORE ENABLE DEFAULT PARAMET.

Press the **Store** + **Mode** keys simultaneously.
The LCD will display:

DATA SAVED OK

And after a few seconds the LCD will display:

% OF MOTOR FLA

CAUTION!	Obtaining DEFAULT PARAMETERS erases all previously modified settings and requires the operator to **reprogram** all parameters that differ from the factory default. **Note**: It is especially important to reprogram the **FLC** (as shown on the label of the RVS-DN), **FLA** and **voltage protection** values again.

7.5.4 Reset Statistical Data

Press the **Mode** and ▼ keys simultaneously.
The LCD will display:

TEST/MAINTENANCE ***OPTIONS***

Press the **Select** key **four times**.
The LCD will display:

RESET STATISTICS

Press the **Reset** + **Store** keys simultaneously.
The LCD will display:

DATA SAVED OK

And after a few seconds the LCD will display:

STATISTICAL DATA - **** -

Press the **Mode** and go back to:

% OF MOTOR FLA

7.5.5 Calibrate Voltage and Current (Factory Use Only!)

Press the **Mode** and ▼ keys simultaneously.
the LCD will display:

TEST/MAINTENANCE ***OPTIONS***.

Press the **Select** key **five times**.
The LCD will display:

VOLTAGE ADJUST. X VOLT

Press the **Select** key.
The LCD will display:

CURRENT ADJUST. X% OF FLC

Press the **Mode** and ▼ keys simultaneously to exit the TEST/MAINTENANCE mode.

7.5.6 TEST/MAINTENANCE in RVS-DN 1000V

Press the **Mode** and ▼ keys simultaneously.
The LCD will display:

STORE ENABLE DEFAULT PARAMET.

At this point press the **Store** + **Mode** keys simultaneously to obtain the default parameters.

CAUTION!	Obtaining DEFAULT PARAMETERS erases all previously modified settings and requires the operator to **reprogram** all parameters that differ from the factory default. **Note**: It is especially important to reprogram the **FLC** (as shown on the label of the RVS-DN), **FLA** and **voltage protection** values again.

OR
Press the **Select** key again
The LCD will display:

RESET STATISTICS

Press **Reset** + **Store** keys simultaneously to reset statistics.
The LCD will display:

DATA SAVED OK

And after few seconds the LCD will display automatically:

STATISTICAL DATA - **** -

OR
Press the **Select** key again
The LCD will display:

PROGRAM VERSION STRT.DN 1K-270105

Press the **Select** key again
The LCD will display:

VOLTAGE ADJUST. X VOLT

(This page is for factory use only)
Press the **Select** key.
The LCD will display:

CURRENT ADJUST. X% OF FLC

(This page is for factory use only)
Press the **Mode** and ▼ keys simultaneously at each point to exit the TEST/MAINTENANCE mode.

7.6 **Mode Pages**

Upon initiation of the RVS-DN, the LCD displays motor's operating current:

% OF MOTOR FLA 0%

You can review all mode pages by pressing the **Mode** key:

MAIN PATAMETERS - **** -
START PARAMETERS - **** -
STOP PARAMETERS - **** -
DUAL ADJUSTMENT PARAMETERS
EN. SAVE & SL SPD PARAMETERS
FAULT PARAMETERS - **** -
I/O PROGRAMMING PARAMETERS
COMM. PARAMETERS - **** -
STATISTICAL DATA - **** -

These pages are skipped if RVS-DN is programmed to MINIMIZED MODE and are shown only in MAXIMIZED MODE. Refer to section 6.5.1 on page 56 for changing mode from MINIMIZED MODE to MAXIMIZED MODE.

7.7 Overview of All Mode Pages and Factory Defaults

				Appears only in MAXIMIZED MODE[1]
% OF MOTOR FLA XX%	**MAIN PARAMETERS** - **** -	**START PARAMETERS** - **** -	**STOP PARAMETERS** - **** -	**DUAL ADJUSTMENT PARAMETERS**
Display and default values	**Display and default values**	**Display and default values**	**Display and default values**	**Display and default values**
% OF MOTOR FLA	STARTER FLC 58 AMP.	SOFT START CURVE 0(STANDARD)	SOFT STOP CURVE 0(STANDARD)	DA: INIT. VOLT. 30%
AMP. VOLT 0 0	MOTOR FLA 58 AMP.	START TACHO. GAIN 0(MIN. GAIN)	STOP TACHO. GAIN 0(MIN. GAIN)	DA: INIT. CURRENT 100%
MOTOR INSULATION 52.8Mohm	CONNECTION TYPE LINE	PULSE TIME 0 SEC.	DEC. TIME 10 SEC.	DA: CUR. LIMIT 400% OF FLA
THERMISTOR RES. 3.1 Kohm	UNDERCURR. TRIP 0% OF FLA	INITIAL VOLTAGE 30 %	FINAL TORQUE 0 (MIN.)	DA: ACC. TIME 10 SEC.
OPTION CARD NOT INSTALLED	UNDERCURR. DELAY 10 SEC.	INITIAL CURRENT 100 %	STORE ENABLE STOP PARAMETERS	DA: DEC. TIME 10 SEC.
	O/C – SHEAR PIN 850% OF FLA	CURRENT LIMIT 400% OF FLA		DA: MOTOR FLA 31 AMP.
	O/C DELAY 0.5 SEC.	ACC. TIME 10 SEC.		STORE ENABLE D. ADJ. PARAMETERS
	OVERLOAD TRIP 115% OF FLA	MAX. START TIME 30 SEC.		
	OVERLOAD DELAY 4 SEC – AT 5 FLA	NUMBER OF STARTS 10		
	UNDERVOLT. TRIP 300 VOLT[2]	STARTS PERIOD 30 MIN.		
	UNDERVOLT. DELAY 5 SEC.	START INHIBIT 15 MIN.		
	OVERVOLT. TRIP 480 VOLT[2]	RUN CONTACT DEL. 5 sec.		
	OVEERVOLT. DELAY 2 SEC.	STORE ENABLE START PARAMETERS		
	STORE ENABLE MAIN PARAMETERS			

[1] - Refer to section 6.5.1 on page 56 for changing mode from MINIMIZED MODE to MAXIMIZED MODE.

[2] – Under/Over voltage protection default settings are as follows:

Rated Voltage [V]	Default Setting	
	UNDER VOLT. TRIP [V]	OVER VOLT. TRIP [V]
400	300	480
480	360	576
600	450	720
690	516	750
1000	750	1,200

Appears only in MAXIMIZED MODE[1]	Appears only in MAXIMIZED MODE[1]	Appears only in MAXIMIZED MODE[1]	Appears only in MAXIMIZED MODE[1]	
EN. SAVE & SL. SPD PARAMETERS	**FAULT PARAMETERS** - **** -	**I/O PROGRAMMING PARAMETERS**	**COMM.PARAMETERS** - **** -	**STATISTICAL DATA** - **** -
Display and default values	**Display and default values**	**Display and default values**	**Display and default values**	**Display and default values**
SAVING ADJUST. 0 (MIN)	PHASE LOSS Y/N YES	PROG. INPUT #7 RESET	PROTOCOL MODBUS	LAST STRT PERIOD NO DATA
SLOW SPEED TORQ. 8	PHASE SEQ. Y/N NO	PROG. INPUT #8 DUAL ADJUSTMENT	BAUD RATE 9600 (MODBUS)	LAST STRT MAX I NO DATA
MAX SLOW SP TIME 30 SEC.	INSULATION ALARM OFF	FAULT RELAY TYPE FAULT	PARITY CHECK EVEN	TOTAL RUN TIME 0 HOURS
STORE ENABLE SPECIAL FEATURES	INSULATION TRIP OFF	IMM/ S.PIN RELAY IMMEDIATE	SERIAL LINK NO. OFF	TOTAL # OF START 0
	AUTO RESET NO	RELAY ON DELAY 0 SEC.	S. LINK PAR. SAVE DISABLE	LAST TRIP NO DATA
	THERMISTOR TYPE PTC	RELAY OFF DELAY 0 SEC.	SER. LINK CONTROL DISABLE	TRIP CURRENT 0 % OF FLA
	THERMISTOR TRIP OFF	AN. OUT PARAMETER I, 0...200% OF FLA	MODBUS TIME OUT OFF	TOTAL # OF TRIPS 0
	UNDER CUR. RESET OFF	STORE ENABLE I/O PROG.PARAMETERS	FRONT COM ADDRES OFF	PREVIOUS TRIP -2 NO DATA
				.
	STORE ENABLE FAULT PARAMETERS		STORE ENABLE COMM. PARAMETERS	.
			Applicable when Optional Modbus PCB installed ↑	.
			Applicable when Optional Profibus PCB installed ↓	PREVIOUS TRIP -9 NO DATA
			COMM. PROTOCOL PROFIBUS	
				Appears when in TEST/MAINTENANCE[2]
			BAUD RATE AUTO (PROFIBUS)	**TEST/MAINTENANCE ***OPTIONS*****
				Display and default values
			PROFI.NETWORK ID 126	RUN SELF TEST? PUSH UP ARROW
			S. LINK PAR. SAVE DISABLE	BTL-19/03/2006 STRT.DN-020407
			SER. LINK CONTROL DISABLE	STORE ENABLE DEFAULT PARAMETERS
			MODBUS TIME OUT OFF	RESET STATISTICS
			FRONT COM ADDRES OFF	VOLTAGE ADJUST X VOLT
			STORE ENABLE COMM. PARAMETERS	CURRENT ADJUST X% OF FLC

[1] - Refer to section 6.5.1 on page 56 for changing mode from MINIMIZED MODE to MAXIMIZED MODE.
[2] - Refer to section 7.5 on page 62 for entering TEST/MAINTENANCE.

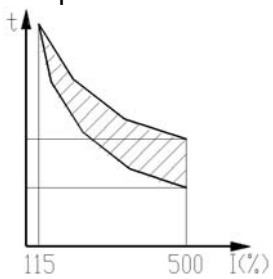
7.7.1 ***Display Mode – Page 0***

% OF MOTOR FLA XX%	Displays in MINIMIZED MODE and MAXIMIZED MODE
Display and default values	**Description**
% OF MOTOR FLA	Displays operating current as a percentage of motor FLA (Full Load Ampere). RVS-DN's Default Display. After pressing the **Mode** or **Select** keys, a time delay is initiated. Following the delay the LCD returns to display % OF MOTOR FLA.
AMP. VOLT 0 0	Displays the current of the motor and mains voltage. **Note:** These measurements are not shown in RVS-DN 1000V models.
MOTOR INSULATION 52.8Mohm	Displays the motor winding insulation level (displays only if the optional motor insulation card is installed).
THERMISTOR RES. 3.1 Kohm	Displays the resistance level of the motor's thermistor (displays only if the optional analog card is installed).
OPTION CARD NOT INSTALLED	Displays only if there is no motor insulation or analog option card installed in the RVS-DN. **Note:** This ignores the communication cards. Even if a communication card is installed this message can display.

Note:
In this page parameters cannot be programmed.

7.7.2 *Main Parameters – Page 1*

MAIN PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
STARTER FLC 58 AMP.	8 – 3000A	Sets RVS-DN's FLC (Full Load Current)	RVS-DN's FLC should be as shown on its name plate. Refer to section 6.1 on page 54.
MOTOR FLA 58 AMP.	50-100% of STARTER FLC	Sets motor's FLA (Full load Ampere)	Should be programmed as shown on the motor's name plate. **Note**: When the RVS-DN is installed Inside Delta set MOTOR FLA = <*rated motor current*>/1.73.
CONNECTION TYPE LINE	LINE, INSIDE DELTA	Sets RVS-DN's connection type.	Factory preset - features and functions **not** active when Inside Delta mode is configured: • Pulse Start. • Curve selection (CURVE 0!! only) • Slow speed • PHASE SEQUENCE "Off" mode Refer to section 4.22 on page 30 for further information. **Note**: When the RVS-DN is installed INSIDE DELTA set MOTOR FLA = <*rated motor current*>/1.73.
UNDERCURR. TRIP 0% OF FLA	0%=off; 20-90% of FLA	Sets UNDER CURRENT TRIP protection.	Trips the RVS-DN when the motor current drops below the level that was set for a time period longer than UNDER CURRENT DELAY. **Note**: Operational when the motor is running (the *RUN* LED is lit).
UNDERCURR. DELAY 10 SEC.	1-40sec.	Sets the time delay for UNDER CURRENT TRIP protection.	
O/C – SHEAR PIN 850% OF FLA	100-850% of motor's FLA setting	Sets OVER CURRENT SHEAR PIN protection.	Operational when RVS-DN is energized and has three trip functions: **At all time** - If I > 850% of FLC it trips the RVS-DN within 1 cycle (overrides the value of the O/C – SHEAR PIN setting). **At starting process** - If I > 850% of FLA it trips the RVS-DN after O/C DELAY (see here after) **At run time** - If I > O/C – SHEAR PIN setting of FLA it trips the RVS-DN after O/C DELAY ***Important Note***: The O/C SHEAR PIN is not intended to replace the fast acting fuses, required to protect the thyristors. Refer to section 4.18 on page 29.
O/C DELAY 0.5 SEC.	0.0 – 5sec.	Sets O/C – SHEAR PIN delay time.	

MAIN PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
OVERLOAD TRIP 115% OF FLA	75-150% of FLA	Sets OVERLOAD TRIP current.	OVERLOAD TRIP is operational when running (the *RUN* LED is lit), except if using the EXPANDED SETTING as described in section 6.5.5 page 58. The O/L circuitry incorporates a thermal memory register that calculates heating minus dissipation of the motor. The RVS-DN trips when the register fills up. The thermal register resets itself 15 minutes after the motor stops. 
OVERLOAD DELAY 4 SEC – AT 5 FLA	1–10sec.	Sets OVERLOAD DELAY at 500% of the motor's FLA.	**ATTENTION!** Overload protection is not operative during soft-start or soft stop. Refer to section 7.7.2.1 on page 71.
UNDERVOLT. TRIP 300 VOLT	120-600V <u>For RVS-DN 1000V</u> 600-900V	Sets UNDER VOLTAGE TRIP.	Trips the RVS-DN when mains voltage drops below the level that was set for a time longer than UNDERVOLT DELAY. Refer to section 7.7 page 66 for different factory settings depends on the rated voltage of the RVS-DN.
UNDERVOLT. DELAY 5 SEC.	1 –10sec.	Sets UNDERVOLT TRIP DELAY.	**<u>Notes</u>**: Becomes operational only after the start signal. When voltage drops to zero (voltage outage) the RVS-DN will trip immediately, thus overriding the delay.
OVERVOLT. TRIP 480 VOLT	150-750V <u>For RVS-DN 1000V</u> 1100-1300V	Sets OVER VOLTAGE TRIP.	Trips the RVS-DN when mains voltage increases above the level that was set for a time longer than OVERVOLT DELAY. Refer to section 7.7 page 66 for different factory settings depends on the rated voltage of the RVS-DN.
OVERVOLT. DELAY 2 SEC.	1 –10sec.	Sets OVERVOLT TRIP DELAY.	Can not be set lower than the UNDER VOLTAGE setting. **<u>Notes</u>**: Becomes operational only after the start signal.

MAIN PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
STORE ENABLE MAIN PARAMETERS		Storing modified parameters	To store selected parameters scroll through all parameters until you reach STORE ENABLE MAIN PARAMETERS, then press the **Store** key. After you store a parameter successfully the DATA SAVED OK message will display. If RVS-DN fails to store the parameter the LCD Will display the STORAGE ERROR message (refer to section 9 on page 95 for more details). **Note**: Pressing the **Store** key when the STORE ENABLE XXXXX PARAMETERS message does not appear on the display has no effect.

7.7.2.1 *Overload Calculation*

Note:
In the overload procedure measurement of the current is limited to 5 x motor FLA to prevent saturation from affecting the calculation. Therefore the trip time at 5 x motor FLA will be identical to the trip time at 8 x motor FLA.
The **approximate** trip time is calculated as follows:

$$\text{O/L Trip Time} = \frac{1{,}375{,}000}{I_{\%}^{\,2} - \text{OLT}^2} \times \frac{\text{OLD}}{6} \text{ [seconds]}$$

where:

$$I_{\%} = \text{Actual Current} \times \frac{100}{\text{motor FLA}}$$

OLT represents **O**ver**L**oad **T**rip setting – (default = 115%).

OLD represents **O**ver**L**oad Trip **D**elay – trip delay at 5 x Motor FLA, (default = 4 sec).

Example 1: Motor FLA = 80A, actual current = 120A.

$I_{\%}$ = 120 x 100 / 80 = 150%
If settings are as in the default then:

$$\text{O/L Trip Time} = \frac{1{,}375{,}000}{150^2 - 115^2} \times \frac{4}{6} = 99 \text{ sec.}$$

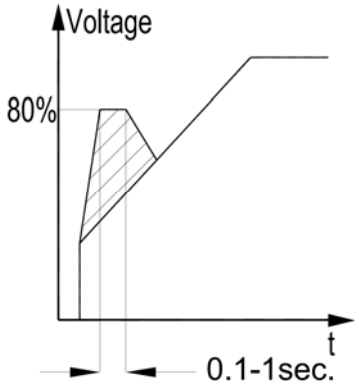
Example 2: The same motor and setting, but the current is 400A.
$I_{\%}$ = 400 x 100 / 80 = 500%
If settings are as in the default then

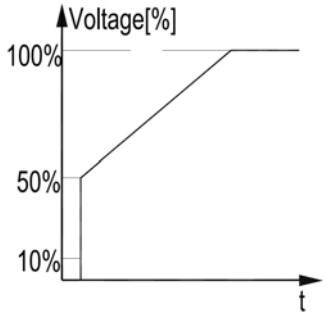
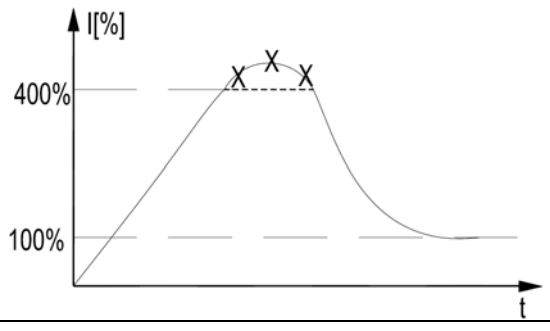
$$\text{O/L Trip Time} = \frac{1{,}375{,}000}{500^2 - 115^2} \times \frac{4}{6} = 4 \text{ sec.}$$

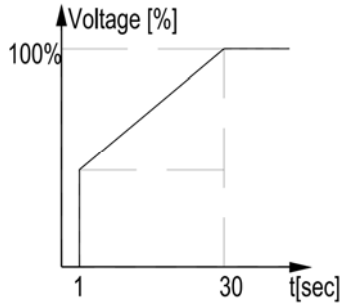
Example 3: Motor FLA = 80A, actual current = 200A, Overload Delay (OLD) = 10
$I_{\%}$ = 200 x 100 / 80 = 250%

$$\text{O/L Trip Time} = \frac{1{,}375{,}000}{250^2 - 115^2} \times \frac{10}{6} = 47 \text{ sec.}$$

*7.7.3 **Start Parameters – Page 2***

START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
SOFT START CURVE 0(STANDARD)	0 (STANDARD) 1 !! 2 !! 3 !! 4 (TORQUE)	Sets RVS-DN's SOFT START CURVE.	Refer to section 7.7.3.1 on page 75. **Note:** When RVS-DN is connected Inside Delta, only CURVE 0 is applied.
START TACHO. GAIN 0(MIN. GAIN)	0 (MIN. GAIN) 1 !! 2 !! 3 !! 4 !! 5 !!	**1!!** represents the 2nd level tacho gain **2!!** represents the 3rd level tacho gain ……. **5!!** represents the 6th level tacho gain.	**Notes:** (1) This parameter will appear only if the optional PCB is installed and dip switch # 2 is set to on. Refer to section 6.5.2 on page 57 for dip switch setting details. (2) Tacho Feedback is operational in its basic form. Additional curves except for the basic linear curve are optional. (3) Consult the factory for the correct tacho selection and mechanical installation.
PULSE TIME 0 SEC.	0 –1.0 SEC.	Sets RVS-DN's PULSE START TIME. PULSE START level is 80% Un.	Intended to start high friction loads that require high starting torque for a short time. A pulse of 80% Un **without** CURRENT LIMIT is initiated to break the load free. Pulse duration is adjustable, 0.1–1sec. After this pulse the voltage is ramped down to INITIAL VOLTAGE setting before ramping up again to full voltage according to the START PARAMETERS settings.  **Note:** There is no PULSE START function when RVS-DN is connected Inside Delta.

START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
INITIAL VOLTAGE 30 % INITIAL CURRENT 100 %	10-50% After reaching 50% the display changes to: INITIAL CURRENT 100-400%. **Note:** The range of the INITIAL VOLTAGE can be extended to 5-80% by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets motor's INITIAL STARTING VOLTAGE. The motor's **torque** is directly proportional to the square of the voltage.	This adjustment also determines the inrush current and mechanical shock. A setting that is too high may cause high initial mechanical shock and high inrush current. This can occur even if CURRENT LIMIT is set low because the INITIAL VOLTAGE setting overrides the CURRENT LIMIT setting. A setting that is too low may result in prolonged time until the motor starts to turn. In general, this setting should ensure that the motor starts turning **immediately** after start signal.  **Note:** When INITIAL VOLTAGE is set its maximum value, this displays changes to INITIAL CURRENT. When INITIAL CURRENT is set the RVS-DN causes current ramp instead of voltage ramp.
CURRENT LIMIT 400% OF FLA	100-400%. **Note:** The range of the CURRENT LIMIT can be extended to 100-500% by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets motor's highest current during starting.	A setting that is too high will increase the current drawn from mains and faster acceleration. A setting that is too low may prevent the motor from completing acceleration process and reaching full speed. In general, this setting should be set to a value that is high enough to prevent stalling. **Note:** CURRENT LIMIT does not operate during *RUN* and *SOFT STOP*. 

START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
ACC. TIME 10 SEC.	1-30sec. **Note:** The range of the ACC. TIME can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets ACCELERATION TIME of the motor.	Determines the motor's voltage ramp-up time, from initial to full voltage. It is recommended to set ACCELERATION TIME to the minimum acceptable value (approx. 5 sec).  **Notes:** (1) Since CURRENT LIMIT overrides ACC. TIME, when CURRENT LIMIT is set low, the starting time will be longer than the ACC. TIME setting. (2) When the motor reaches full speed before voltage reaches nominal, ACC. TIME setting is overridden, causing voltage to quickly ramp-up to nominal. (3) Using starting curves 1, 2, 3 prevents quick ramp up.
MAX. START TIME 30 SEC.	1-30sec. **Note:** The range of the MAX. START TIME can be extended to 1-250 sec. by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets MAXIMUM START TIME	The maximum allowable start time, from the start signal to the end of the acceleration process. If voltage/speed does not reach nominal during MAX. START TIME then RVS-DN will trip the motor and create a fault. The LCD will display the LONG START TIME fault message. For example, this can occur when the CURRENT LIMIT setting is too low. .

START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE		
Display and Default Values	**Range**	**Description**	**Remarks**
NUMBER OF STARTS 10	1-10, OFF	Sets NUMBER OF STARTS permitted during STARTS PERIOD (see below).	Limits the NUMBER OF STARTS during the period of time defined by STARTS PERIOD. If you try to start even one more time within that period the START INHIBIT period will take effect. During the START INHIBIT period the WAIT BEFORE RST XX MIN message will be displayed.
STARTS PERIOD 30 MIN.	1–60min.	Sets STARTS PERIOD during which NUMBER OF STARTS is being counted.	
START INHIBIT 15 MIN.	1–60min.	Sets START INHIBIT time which starting is disabled after TOO MANY STARTS trip.	
RUN CONTACT DEL. 5 sec.	0-120sec.	Sets time delay for End of Acceleration relay to close.	End of Acceleration relay can signal that motor is at its RUN position which can be used for motor loading.
STORE ENABLE START PARAMETERS			Same as STORE ENABLE MAIN PARAMETERS on page 71.

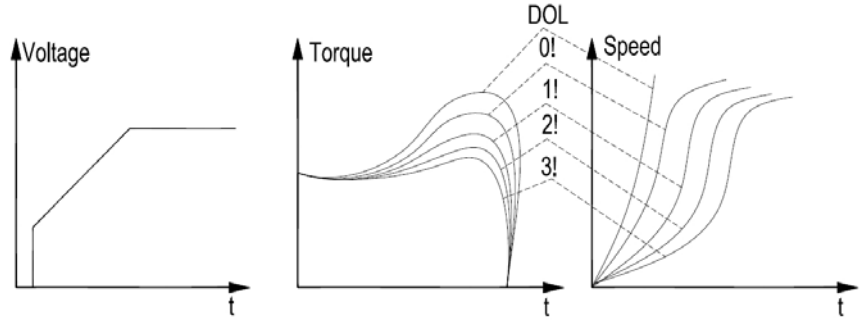
7.7.3.1 Soft Start Parameters

The RVS-DN incorporates five starting curves to enable you to select a suitable torque curve.

Start Curve 0 – Standard curve (Default). This curve is the most suitable curve for preventing prolonged starting and motor overheating.

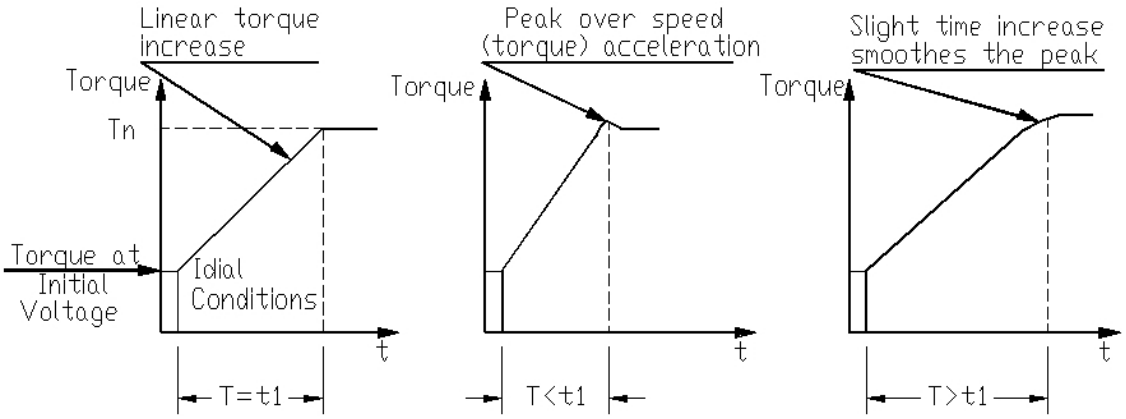
Note:
When RVS-DN is connected Inside Delta, the RVS-DN will always use CURVE 0 regardless of the curve defined.

Start Curves 1-3 - Pump Control - Induction motors produce peak torque of up to 3 times the rated torque towards the end of starting process. In some pump applications, this peak may cause pressure surge in the pipes.
Start Curves 1, 2, 3 – During acceleration, before reaching peak torque, the Pump Control Program automatically controls the voltage ramp-up, thus, reducing peak torque.



Choice of four pump control acceleration curves: 0!, 1!, 2!, 3!

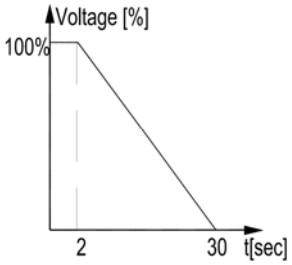
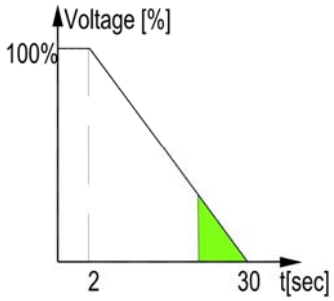
Start Curve 4 (Torque) – Torque Controlled acceleration - This provides a smooth time-controlled torque ramp for the motor and the pump.



Note:

Always start with START CURVE 0. If towards the end of acceleration peak torque is too high (pressure is too high) proceed to Curve 1, 2, 3 or 4 in that order.

*7.7.4 **Stop Parameters – Page 3***

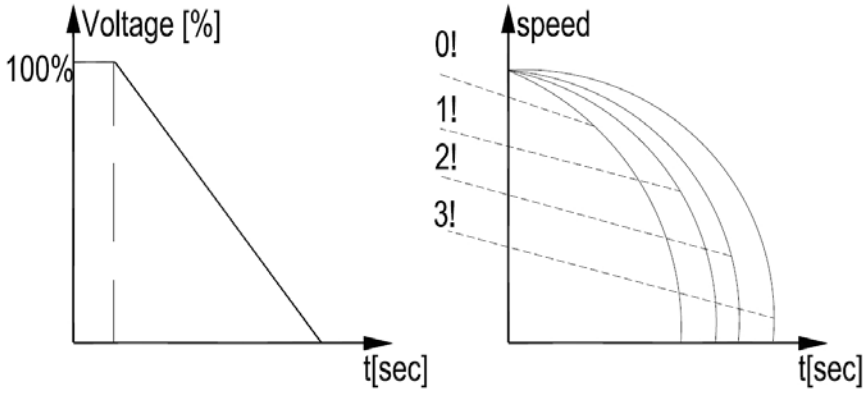
STOP PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
SOFT STOP CURVE 0(STANDARD)	0 (STANDARD) 1 !! 2 !! 3 !! 4 (TORQUE)	Sets RVS-DN's SOFT STOP CURVE.	Refer to section 7.7.4.1 on page 78.
STOP TACHO. GAIN 0(MIN. GAIN)	0 (MIN. GAIN) 1 !! 2 !! 3 !! 4 !! 5 !!	**1!!** represents the 2nd level tacho gain **2!!** represents the 3rd level tacho gain ……. **5!!** represents the 6th level tacho gain.	**Notes:** (1) This parameter will appear only if the optional PCB is installed and dip switch # 2 is set to on. Refer to section 6.5.2 on page 57 for dip switch setting details. (2) Tacho Feedback is operational in its basic form. Additional curves except for the basic linear curve are optional. (3) Consult the factory for the correct tacho selection and mechanical installation.
DEC. TIME 10 SEC.	1–30sec. **Note:** The range of the DEC. TIME can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets DECELERATION TIME of the motor.	Used for controlled deceleration of high friction loads. Determines the motor's voltage ramp down time.  **Note:** When the RVS-DN operates with a bypass contactor, the bypass contactor can be controlled by the RVS-DN's End of Acceleration relay. Upon soft stop initiation the End of Acceleration relay is degenergized, the load is transferred to the RVS-DN, and voltage begins ramping down.
FINAL TORQUE 0 (MIN.)	0 (min.) – 10 (max.)	Sets FINAL TORQUE during soft stop.	Determines torque towards the end of a soft stop. If the current still flows after speed is softly reduced to zero, you should increase the FINAL TORQUE setting. 
STORE ENABLE STOP PARAMETERS			Same as STORE ENABLE MAIN PARAMETERS on page 71.

7.7.4.1 Soft Stop Parameters

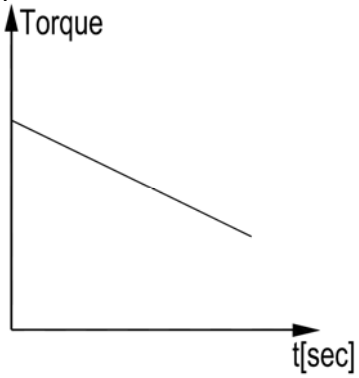
The RVS-DN incorporates 5 stopping curves that enable you to select the suitable torque curve

Stop Curve 0 – Standard Curve (Default) – voltage is linearly reduced from nominal to zero.
The most stable and suitable curve for preventing prolonged stopping and motor overheating.

Stop Curves 1, 2, 3 Pump Control – In some pump applications, when pumping to higher elevation a considerable part of the torque is constant and does not decrease with speed.
It may happen that during the deceleration process when voltage decreases the motor torque abruptly falls below load torque (instead of smoothly decreasing speed to zero), thus closing the valve and causing water hammer.
Curves 1, 2 and 3 eliminate the water hammer phenomenon. In pump applications the load torque decreases in square relation to the speed, thus correcting control of voltage to reduce torque adequately and to smooth deceleration to a stop.
Note:
It is recommended that STOP CURVE 0 be used for all standard applications (not pumps).
To reduce water hammer, select STOP CURVE 1, then 2, then 3 in that order.



Curve 4 - Torque Curve - Provides linear deceleration of the torque. In certain loads, linear torque deceleration can result in close to linear speed deceleration, thus eliminating stall conditions.



Note:
Always use STOP CURVE 0. If the motor stalls quickly instead of slowly decreasing its speed, select STOP CURVE 1, 2, 3 or 4 in that order until the problem is solved.

7.7.5 Dual Adjustment Parameters – Page 4

DUAL ADJUSTMENT PARAMETERS	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
When D.ADJ: GENERATOR PARAMETERS is required, do the following: • Program PROG. INPUT #8 to DUAL ADJUSTMENT (default setting). Refer to section 7.7.8 on page 83. • Set dip switch #3 to on (refer to section 6.5.3 on page 57). • Connect control inputs voltage to input terminal 8. The following display appears: D. ADJ: GENERATOR PARAMETERS			
DA: INIT. VOLT. 30% DA: INIT. CURRENT 100%	10-50% After reaching 50% the display changes to: DA: INITIAL CURRENT 100-400%. **Note:** The range of the DA: INITIAL VOLTAGE can be extended to 10-80% by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets motor's INITIAL STARTING VOLTAGE **in DA mode.** (Motor's **torque** is directly proportional to the square of the voltage)	Refer to section 7.7.3 on page 72 parameter: INITIAL VOLTAGE
DA: CUR. LIMIT 400% OF FLA	100-400%. **Note:** The range of the DA: CURRENT LIMIT can be extended to 100-500% by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets motor's highest current during starting **in DA mode.**	Refer to section 7.7.3 on page 72 parameter: CURRENT LIMIT.
DA: ACC. TIME 10 SEC.	1-30sec. **Note:** The range of the DA: ACC. TIME can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets ACCELERATION TIME of the motor **in DA mode.**	Refer to section 7.7.3 on page 72 parameter: ACC. TIME.
DA: DEC. TIME 10 SEC.	1–30sec. **Note:** The range of the DA: DEC. TIME can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets DECELERATION TIME of the motor **in DA mode.**	Refer to section 7.7.4 on page 77 parameter: DEC. TIME.
DA: MOTOR FLA 31 AMP.	50-100% of STARTER FLC	Sets motor's FLA (Full load Ampere) **in DA mode.**	Refer to section 7.7.2 on page 67 parameter: MOTOR FLA.
STORE ENABLE D. ADJ. PARAMETERS			Same as STORE ENABLE MAIN PARAMETERS on page 71.

7.7.6 Energy Save & Slow Speed Parameters – page 5

EN. SAVE & SL. SPD PARAMETERS	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
SAVING ADJUST. 0 (MIN)	0(MIN.) – 10(MAX.)	Sets required energy saving level.	Activated when the motor has a light load for extended periods of time. Supply voltage to the motor decreases (lowering the rotating magnetic field intensity), thus reducing the reactive current and copper/iron losses. In order to activate this function: • Program PROG. INPUT #7 to ENERGY SAVER (refer to section 7.7.8 on page 83) • Connect control inputs voltage to input terminal 7 **Note**: When using Energy Save function, harmonics should be taken into consideration. At maximum energy save settings, the 5th harmonic may exceed 30% of the RMS current value. **ATTENTION!** To meet CE standards while in energy save mode, the user may be required to employ additional mitigation methods.
SLOW SPEED TORQ. 8	1(MIN.) – 10(MAX.)	Sets SLOW SPEED TORQUE.	Determines the torque while motor is operating at 1/6 of nominal speed. Refer to section 7.7.8.1 on page 84.
MAX SLOW SP TIME 30 SEC.	1-30sec. **Note:** The range of the MAX SLOW SP TIME can be extended to 1-250 by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets maximum time for SLOW SPEED TORQUE operation.	Determines the maximum allowable operation time at slow speed. RVS-DN will trip when this time is exceeded and a LONG SLOW-SPEED TIME message will display. **WARNING!** Operating current while motor is running at 1/6 speed is much higher than nominal current and motor ventilation is much weaker. Special caution must be taken to prevent overheating when running the motor at slow speed for long periods of time.
STORE ENABLE EN.SAVE & SL.SPD			Same as STORE ENABLE MAIN PARAMETERS on page 71.

7.7.7 *Fault Parameters – Page 6*

FAULT PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
PHASE LOSS Y/N YES	YES **Note:** The range of the PHASE LOSS can be extended to YES or NO by using the EXPANDED SETTING as described in section 6.5.5 page 58.	Sets PHASE LOSS trip	PHASE LOSS protection trips the RVS-DN when 1 or 2 phases are missing for more than 1 sec. **Notes:** If RVS-DN trips on PHASE LOSS do the following: (1) In cases where the current transformers are connected externally (RVS-DN 950-3000A models), verify that that the current transformers are not grounded. Each current transformer is connected with its 2 wires only and these wires are not grounded externally. (2) Check phase voltages related to terminal 21 even if terminal 21 is not connected. Verify that phase voltages are within the required range of line to neutral voltages. (3) Verify that terminal 21 is connected correctly. For terminal 21 connection refer to section 4.1 page 19. (4) If terminal 21 is connected correctly, disconnect terminal 21 and try to start when terminal 21 is disconnected. (5) If all previous actions are do not solve the problem **and** the you are sure that no real phase loss exists, you can set PHASE LOSS Y/N protection to NO. This situation can occur in rare cases when there is no real fault but the RVS-DN recognizes unusual behaviour like when Total Harmonic Distortion in Voltage (THDV) in the network is high. (6) If this is a true case of PHASE LOSS then after setting PHASE LOSS Y/N protection to NO the motor will single phase and most likely be tripped by the over load protection mechanism. (7) PHASE LOSS setting is not valid in RVS-DN 1000V. (8) Phase loss might not be detected in motor operating under a light load.
			WARNING! Do not set PHASE LOSS to NO unless it is found to be necessary in the field!
PHASE SEQ. Y/N NO	NO/YES	Sets PHASE SEQUANCE trip	When RVS-DN is connected Inside Delta, you can not set PHASE SEQUENCE protection to NO.

FAULT PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
INSULATION ALARM OFF	OFF, 0.2–5Mohm	Sets INSULATION ALARM level.	Insulation testing is enabled only when motor is not running and after 60 seconds in the *Stop* state. While motor is running the value of the insulation resistance shown in the display is the last measured value prior to starting of the motor. While testing, if the insulation level drops below Alarm level - a message: MOTOR INSULATION ALARM will display and the insulation alarm relay will be energized. The *Fault* LED on the control keypad of the RVS-DN will blink. The alarm will disappear if insulation level will return to normal for more than 60 seconds. While testing, if the insulation level drops below Fault level - a message: INSULATION TRIP will display and the fault relay of the RVS-DN will go to the fault position (as programmed in the I/O PROGRAMMING PARAMETERS). The *Fault* LED on the front of the RVS-DN will light. In this status motor can not be started. **Note**: In order for the INSULATION ALARM or TRIP option to operate properly an isolating device, such as a line contactor must exist between the mains and the RVS-DN **and** it must be open.
INSULATION TRIP OFF	OFF, 0.2–5Mohm	Activates INSULATION ALARM trip.	
AUTO RESET NO	NO/YES	Sets RVS-DN's AUTO RESET mode of operation.	The RVS-DN can be automatically reset for UNDER VOLTAGE and PHASE LOSS faults. Refer to section 7.7.2 on page 69 for details on setting UNDER VOLTAGE protection. To start the motor after UNDER VOLTAGE and PHASE LOSS faults have been cleared, remove the START signal and recommence the signal. AUTO RESET function has a non-programmable time delay of 60 seconds.
THERMISTOR TYPE PTC	PTC/NTC	Sets input THERMISTOR TYPE	Available only when analog card is installed. Measures the motor's thermistor resistance and trips the RVS-DN when the level decreases below set level. **Note:** THERMISTOR TRIP has a factory preset time delay of 2 sec.
THERMISTOR TRIP OFF	OFF, 0.1–10Kohm	Sets RVS-DN's THERMISTOR TRIP mode of operation.	
UNDER CUR. RESET OFF	10–120min., OFF.	Sets RVS-DN's UNDER CURRENT RESET time delay.	If the UNDER CUR. RESET setting is OFF then RVS-DN will not automatically reset after an UNDER CURRENT TRIP fault occurs. If you set the UNDER CUR. RESET setting to a time value then RVS-DN will automatically reset with a delay (the time defined for UNDER CUR. RESET). If the start command is not removed, motor will restart automatically after the delay time. During the delay time a message U/C TRIP.RST IN: XX MIN. is displayed. Refer to section 7.7.2 on page 69 for details on setting of UNDER CURRENT TRIP.

FAULT PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
STORE ENABLE FAULT PARAMETERS			Same as STORE ENABLE MAIN PARAMETERS on page 71.

7.7.8 I/O Programming Parameters – Page 7

I/O PROGRAMMING PARAMETERS	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
PROG. INPUT # 7 RESET	RESET; SLOW SPEED; ENERGY SAVER;	Sets terminal 7 function	Refer to section 7.7.8.1 on page 84.
PROG. INPUT # 8 DUAL ADJUSTMENT	DUAL ADJUSTMENT; SLOW SPD REVERSE; RESET;	Sets terminal 8 function	Refer to section 7.7.8.1 on page 84.
FAULT RELAY TYPE FAULT	FAULT, FAULT – FAIL SAFE	Sets FAULT RELAY mode of operation.	When configured to FAULT the internal relay is energized upon fault. When configured to FAULT-FAIL SAFE the relay is **de**-energized upon fault. In this mode, while normal operation, the fault relay is energized. Relay will also **de**-energize upon control power outage.
IMM/ S.PIN RELAY IMMEDIATE	IMMEDIATE/ SHEAR-PIN.	Sets RVS-DN's IMM/ S.PIN RELAY mode of operation.	When configured to IMMEDIATE the IMM/ S.PIN RELAY energizes at the start signal after the programmed RELAY ON DELAY time has elapsed. It de-energizes at the end of the deceleration time (if any) after the programmed RELAY OFF DELAY time has elapsed. When configured to SHEAR PIN the IMM/ S.PIN RELAY energizes when a O/C-SHEAR PIN fault occurs after the programmed RELAY ON DELAY time has elapsed. It de-energizes after the O/C-SHEAR PIN fault is cleared and after the programmed RELAY OFF DELAY time has elapsed. For more information regarding the O/C-SHEAR PIN parameter refer to section 7.7.2 setting on page 69.
RELAY ON DELAY 0 SEC.	0 – 3600SEC. (when IMM/ S.PIN RELAY Is programmed as IMMEDIATE); 0.0 – 5.0SEC. (when IMM/ S.PIN RELAY Is programmed as SHEAR PIN)	Sets RVS-DN's IMM/ S.PIN RELAY on delay time.	
RELAY OFF DELAY 0 SEC.	0 – 3600SEC. (when IMM/ S.PIN RELAY Is programmed as IMMEDIATE); 0.0 – 5.0SEC. (when IMM/ S.PIN RELAY Is programmed as SHEAR PIN)	Sets RVS-DN's IMM/ S.PIN RELAY off delay time	

I/O PROGRAMMING PARAMETERS	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)		
Display and Default Values	**Range**	**Description**	**Remarks**
All RVS-DN except 1000V AN. OUT PARAMETER I, 0...200% OF FLA	All RVS-DN except 1000V I, 0...200% OF FLA	Sets ANALOG OUTPUT mode of operation.	Available when the analog card is installed. The dip switch settings on the analog card define full scale as either 20mA or 10V. Refer to section 6.7 on page 59 for more details. All RVS-DN except 1000V The full scale of the analog card is related to 200% of **FLA** (2x <*rated motor current*>).
For RVS-DN 1000V ANALOG OUTPUT NORMAL	For RVS-DN 1000V NORMAL/INVERTED		For RVS-DN 1000V The full scale of the analog card is related to 200% of **FLC** (2x <*rated RVS-DN current*>). When INVERTED is set the full scale relates to 0 current and 0mA, 0V or 4mA relates to 200% FLC.
STORE ENABLE I/O PROG.PARAMETERS			Same as STORE ENABLE MAIN PARAMETERS on page 71

7.7.8.1 Terminal 7 and 8 Programming

Input Terminal 7 Programmed Function	**Description**
RESET (default setting)	Input terminal 7 is used as RESET to reset all RVS-DN faults. The RESET command will take effect only if the start command is removed.
SLOW SPEED	While input terminal 7 is on, the motor will start slow speed forward. Refer to section 7.7.6 on page 80 and section 4.11 page 23.
ENERGY SAVER	While input terminal 7 is on, the motor will operate in the ENERGY SAVER mode. Refer to section 7.7.6 on page 80.

Input Terminal 8 Programmed Function	**Description**
DUAL ADJUSTMENT (default setting)	Input terminal 8 is used to start and stop from the DUAL ADJUSTMENT PARAMETERS page. Refer to section 7.7.5 on page 79. **Note:** When dip switch #3 is on, DUAL ADJUSTMENT parameters will operate the RVS-DN with D.ADJ.:GENERATOR PARAMETERS. Refer to section 4.17 on page 28.
RESET	Input terminal 8 is used as RESET to reset all RVS-DN faults. The RESET command will take affect only if the start command is removed.
SLOW SPD REVERSE	In order to operate in SLOW SPEED REVERSE terminal 7 must be programmed as SLOW SPEED and the control input voltage must be connected to terminal 7 as well. You can give the reverse command before the motor is started or during operation at SLOW SPEED. Connecting control voltage to terminal 8 before the motor is started, starts the motor in reverse direction. Connecting the control voltage while the motor is running at SLOW SPEED stops the motor for 0.6 – 2 sec (according to motor size) before it reverses its direction. Refer to section 7.7.6 on page 80 and section 4.11 page 23.

7.7.9 ***Comm. Parameters – Page 8 – With the Modbus Card***

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)	
Display and Default Values	**Range**	**Description**
PROTOCOL MODBUS	MODBUS	Sets RVS-DN's communication PROTOCOL. Operational when the optional communication card is installed.
BAUD RATE 9600 (MODBUS)	1200, 2400, 4800, 9600	Sets RVS-DN's BAUD RATE.
PARITY CHECK EVEN	EVEN, ODD, NO	Sets RVS-DN's communication PARITY CHECK.
SERIAL LINK NO. OFF	OFF,1 – 247	Sets RVS-DN's communication SERIAL LINK NO.
S. LINK PAR. SAVE DISABLE	ENABLE/ DISABLE	Enables parameters modification via serial communication
SER. LINK CONTROL DISABLE	ENABLE/ DISABLE	Enables start, stop, reset etc… via serial communication
MODBUS TIME OUT OFF	0.1-60 SEC., OFF	Sets MODBUS TIME OUT. If no valid Modbus communication during MODBUS TIME OUT the HRVS-DN will trip. If set to OFF protection is disabled.
FRONT COM ADDRES OFF	OFF,1 – 247	Future enhancement
STORE ENABLE COMM. PARAMETERS	**Notes:** (1) Same as STORE ENABLE MAIN PARAMETERS on page 71. (2) After changing communication parameters and storing them, control power must be switched off and on to load new communication parameters.	

7.7.10 ***Comm. Parameters – Page 8 – With the Profibus Card***

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)	
Display and Default Values	**Range**	**Description**
COMM. PROTOCOL PROFIBUS	PROFIBUS/ MODBUS	Sets RVS-DN's communication protocol. Operational when the optional communication card is installed.
BAUD RATE AUTO (PROFIBUS)		User can not change BAUD RATE value. Max. rate is 12 mega bit per second (MBPS).
PROFI.NETWORK ID 126	OFF, 1-126	Sets the Profibus network ID. When set to OFF the Profibus card will not function.
S. LINK PAR. SAVE DISABLE	ENABLE/ DISABLE	Enables parameter modification via serial communication
SER. LINK CONTROL DISABLE	ENABLE/ DISABLE	Enables start, stop, reset etc… via serial communication
MODBUS TIME OUT OFF		Do not change this parameter! Must be set to OFF.

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.5.1 page 56 for changing mode)	
Display and Default Values	**Range**	**Description**
FRONT COM ADDRES OFF	OFF,1 – 247	Future enhancement
STORE ENABLE COMM. PARAMETERS	**Notes:** (1) Same as STORE ENABLE MAIN PARAMETERS on page 71. (2) After changing communication parameters and storing them, control power must be switched off and on to load new communication parameters.	

*7.7.11 **Statistical Data – page 9***

STATISTICAL DATA - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
LAST STRT PERIOD NO DATA		Displays last starting time in seconds. Starting time is the duration until motor current drops to nominal.
LAST STRT MAX I NO DATA		Displays last starting maximum starting current.
TOTAL RUN TIME 0 HOURS		Displays the motor's total run time.
TOTAL # OF START 0		Displays the total number of starts.
LAST TRIP NO DATA		Displays the cause of the motor's last trip.
TRIP CURRENT 0 % OF FLA		Displays motor current when the motor was tripped by the RVS-DN.
TOTAL # OF TRIPS 0		Displays the total number of trips.
PREVIOUS TRIP -2 NO DATA . . . . PREVIOUS TRIP -9 NO DATA		Displays motor trip history.

7.8 Non Adjustable Protection and Fault Reset

7.8.1 Under/Over Frequency

Operational when the RVS-DN is energized and protects the motor when the frequency is less than 45 or greater than 65Hz.

7.8.2 Phase Loss

Operational when the RVS-DN is energized, provided this protection has not been de-activated. Phase loss protection trips the RVS-DN when 1 or 2 phases are missing for more than 1 sec.

Refer to section 7.7.7 on page 81 parameter PHASE LOSS. Y/N.

7.8.3 Phase Sequence

Operational when the RVS-DN is energized, provided this protection has not been de-activated. Phase sequence protection trips the RVS-DN when phase sequence is wrong.
Refer to section 7.7.7 on page 81 parameter PHASE SEQ. Y/N.

7.8.4 Wrong Connection

Operational after start signal. Trips if motor is not properly connected to the RVS-DN's load terminals, when internal disconnection is detected in the motor winding. This protection is not active when D. ADJ.: GENERATOR PARAMETERS is selected.

7.8.5 Shorted SCR

Trips the RVS-DN if one or more of the SCRs have been shorted. This protection is not active when D. ADJ.: GENERATOR PARAMETERS is selected.

7.8.6 Heat-Sink Over Temperature

Thermal sensors are mounted on the heat-sink and trip the RVS-DN when the temperature rises above 85ºC.

WARNING!	The over temperature protection is designed to operate under normal conditions, e.g., in the event of extended low overload, insufficient ventilation due to fan stoppage or air flow blockage. Incorrect RVS-DN selection, frequent starting at max. conditions, or repeated starting under fault conditions can cause the SCR to overheat and fail before the heat-sink reaches 85°C thereby causing the thermal sensors to trip the RVS-DN.

7.8.7 External Fault

External Fault becomes operational when RVS-DN is energized.
The RVS-DN will trip if contact closes for more than 2 sec.

WARNING!	Do not use External Fault when terminal 21 is not connected to ground.

7.8.8 Fault and Reset

When any of the above protections (except INSULATION ALARM) trip, the RVS-DN locks in a fault condition, disabling firing of the thyristors. ***Fault*** LED lights, fault description is displayed on the LCD and the fault relay operates.

- For local resetting, after fault has been removed, press ***Reset*** key.
- Remote resetting can be performed through terminals 7 or 8 (see I/O PROGRAMMING section 7.7.8 page 83).

When a fault occurs, followed by a voltage outage, the fault condition is latched and reappears upon voltage restoration.

Note:
Resetting of all faults, except for UNDER CURRENT protection, (Local, Remote, Serial Link or Auto Reset) is not possible as long as the **START** signal exists.

7.8.9 Auto Reset

UNDER VOLTAGE and PHASE LOSS faults can auto-reset (refer to section 7.7.7 on page 81). The RVS-DN will reset itself 60 seconds after voltage was fully restored, provided that the START signal is removed.
UNDER CURRENT fault can be set to auto-reset (refer to section 7.7.7 on page 81).
The RVS-DN will reset itself when a programmed time delay has elapsed, even if the START signal is not removed!
MOTOR INSULATION ALARM auto-resets if the resistance exceeds the INSULATION ALARM level (refer to section 7.7.7 on page 81).

7.9 Timing Occurrence Table

Timing And Occurrence	Active During			
	Start	Run	Stop	Soft Stop
Too many starts with START INHIBIT period	√			
Electronic overload with curve selection		√		
O/C shear pin (jam)				
RVS-DN protection – trip immediately at I≥850% FLC	√	√		√
Motor protection – trip function				
During start – factory set at 850% FLA after O/C DELAY.	√			√
During run – adjustable 200 – 850% FLA after O/C DELAY.		√		
Under current adjustable time delay		√		
Phase loss	√	√		√
Phase sequence	√			
Under voltage with adjustable time delay. Time delay is override in case of PHASE LOSS.	√	√		√
Over voltage with adjustable time delay	√	√		√
Long start time (stall protection)	√			
Shorted SCR	√			√
Wrong connection (load loss)	√			
External fault – input from a N.O. contact	√	√	√	√
SCR protection by Metal Oxide Varistors (MOV)	√	√	√	√
RVS-DN over-temperature	√	√	√	√
RVS-DN internal test, when the *On* LED is lit.	√	√	√	√
Motor insulation test (optional) – Two levels for alarm & trip. When installed, operates when mains voltage is removed.			√	
Motor thermistor (optional) – programmable PTC/NTC, with adjustable trip level.	√	√	√	√

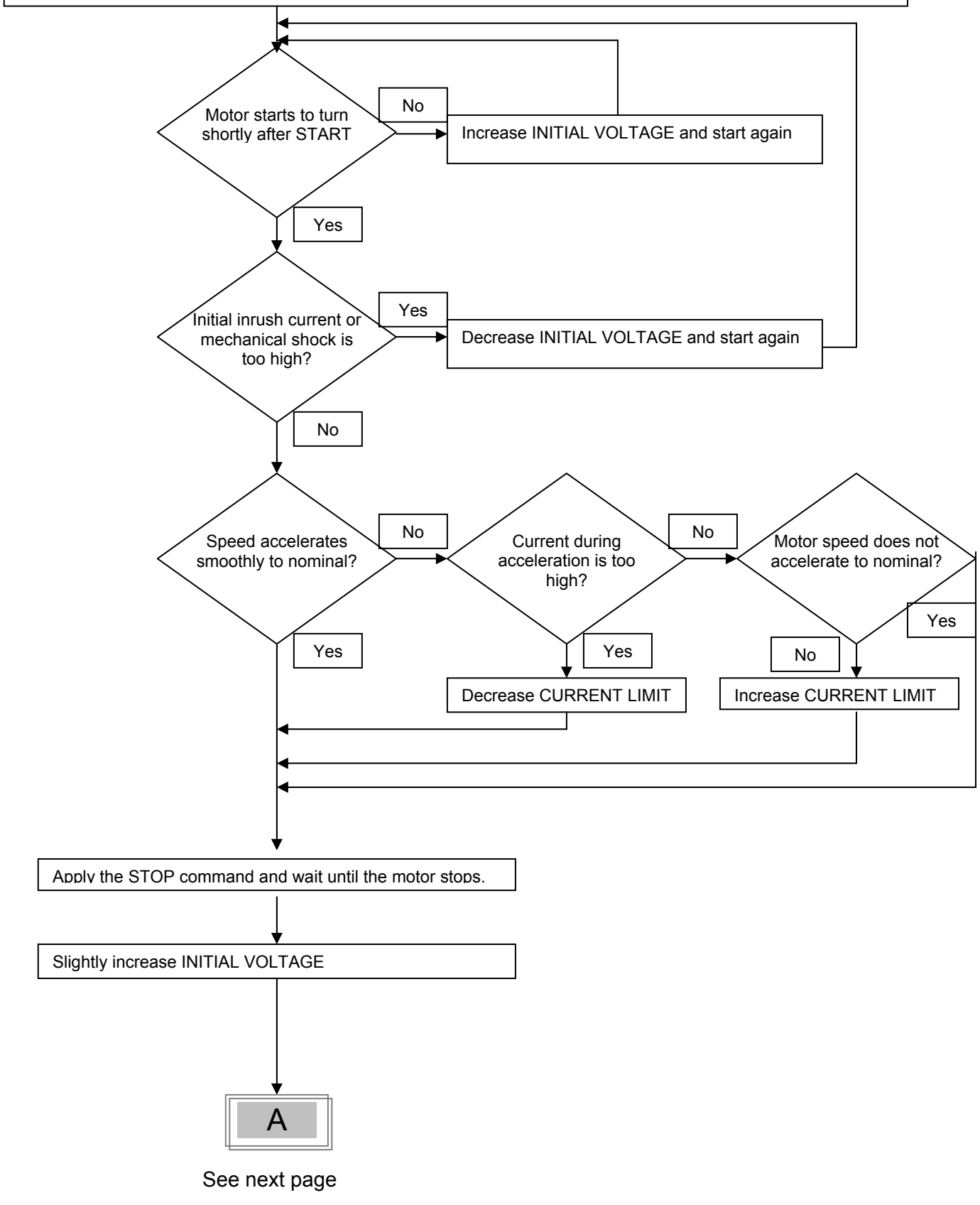
8. STARTING PROCEDURE

Note:
It is necessary to connect a motor to load terminals; otherwise S.SCR or WRONG CONNECTION faults are activated. Other loads such as incandescent light bulbs, resistors, etc. may also cause a WRONG CONNECTION fault.

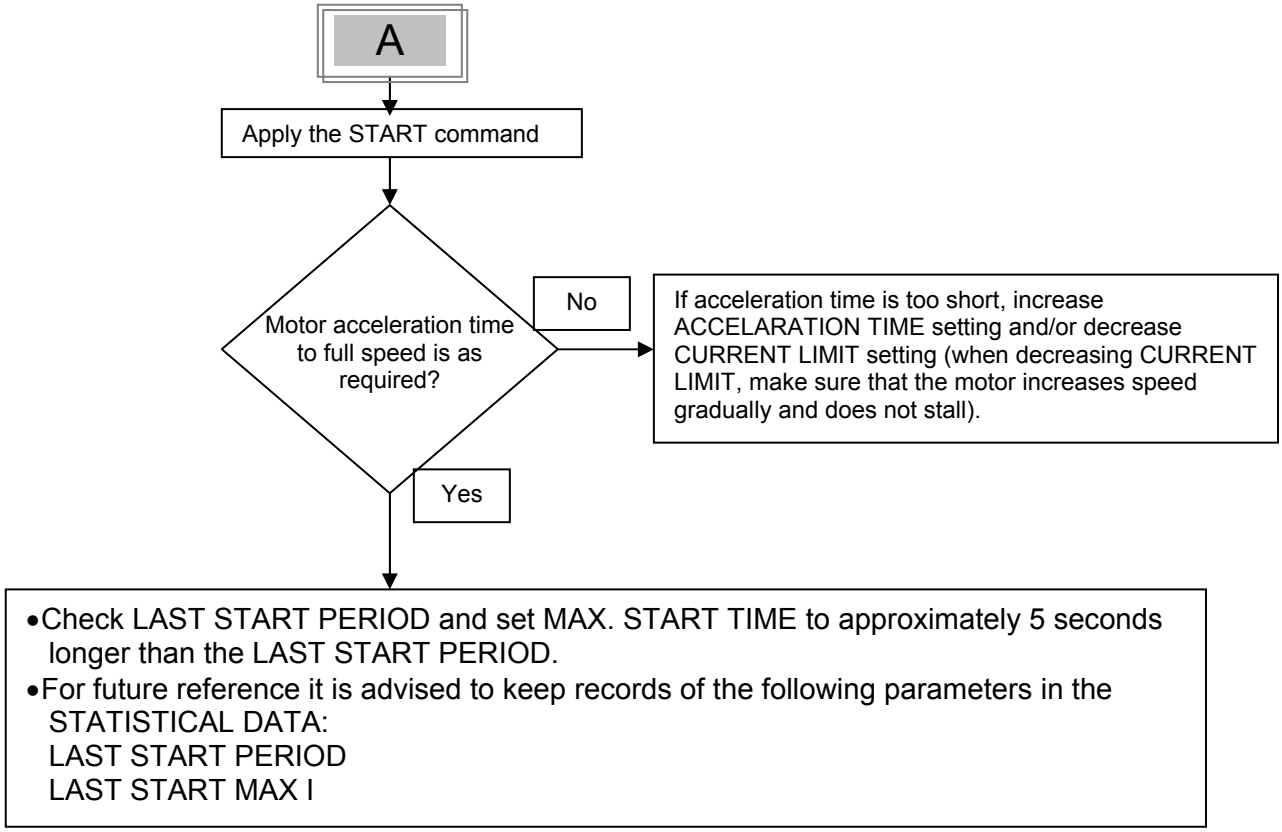
1	When mains voltage is connected to the RVS-DN, even if control voltage is disconnected, full voltage may appear on the RVS-DN load terminals. Therefore, for isolation purposes, it is necessary to connect an isolating device upstream to the RVS-DN.
2	Power factor correction capacitors must not be installed on the load side of the RVS-DN. When required, install capacitors on the line side of the RVS-DN.
3	When using Inside delta connection, wrong connection of the RVS-DN or the motor may damage the motor; therefore please confirm that the motor is connected properly!
4	Do not interchange line and load connections
5	Before starting the motor verify its rotation direction. If needed, disconnect the rotor from the mechanical load and verify the correct direction of rotation.
6	Prior to start up procedure, make sure that line voltage and control voltage match the ones shown on the name plate of the RVS-DN.
7	When the START signal is initiated and a motor is not connected to load terminals, the SHORT SCR or WRONG CONNECTION protection will be activated.

8.1 Standard Starting Procedure

- Connect Control Supply voltage. *On* LED will light.
- Review all parameters with the **Mode** and **Select** keys. Set parameters as required.
- If necessary, return to default parameters (refer to section 7.5.3 page 63).
- Connect mains voltage to the line terminals of the RVS-DN.
- Set LCD to show % OF MOTOR FLA.



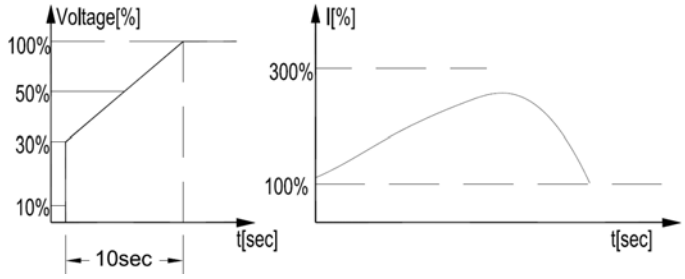
See next page



8.2 Examples of Starting Curves

8.2.1 Light Loads - Pumps, Etc.

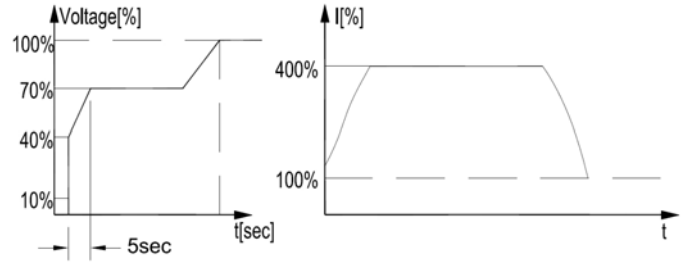
(In these cases the actual current is always lower than the CURRENT LIMIT setting)
INITIAL VOLTAGE- set to 30%
CURRENT LIMIT - set to 300-350%
ACCELERATION TIME- set to 10 sec.



Upon start, the voltage quickly increases to the INITIAL VOLTAGE value (30% of Un) and then gradually ramps-up to nominal.
The current will simultaneously increase to peak current value (lower than the CURRENT LIMIT setting), before smoothly decreasing to the operating current.

8.2.2 High Inertia Loads: Crushers, Centrifuges, Mixers, Etc.

(In these cases the actual current is at the CURRENT LIMIT setting during part of the starting time)
INITIAL VOLTAGE– set 40%
CURRENT LIMIT– set 400%
ACCELERATION TIME– set 3 sec



Upon START the voltage and current increase until the current reaches the CURRENT LIMIT value. The voltage remains at this value until the motor reaches close to nominal speed, where current starts to decrease and voltage continues to ramp-up to nominal.

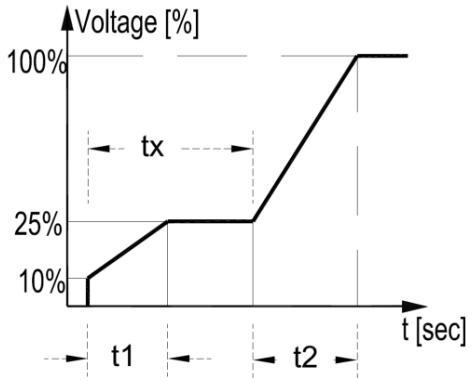
8.2.3 Special Starting Using DUAL ADJUSTMENT

Using two starting characteristics, the RVS-DN will accelerate using standard characteristics (INITIAL VOLTAGE, ACCELERATION TIME and CURRENT LIMIT). After transition (tx) (IMMEDIATE relay delay), voltage to input terminal 8 is switched on using the DUAL ADJUSTMENT characteristic to complete acceleration.

Perform the following steps:

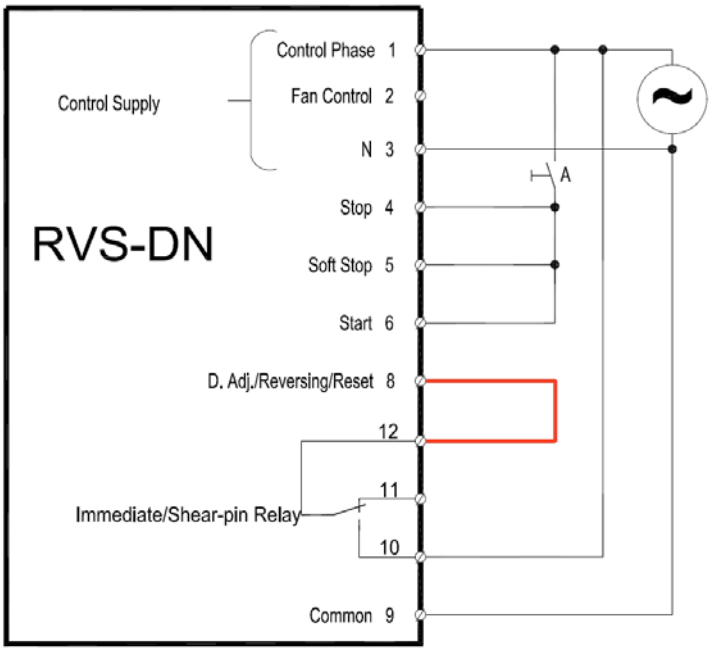
- To use DUAL ADJUSTMENT automatically, connect IMMEDIATE in series to input terminal 8 as shown in section 8.2.3.1 below.
- Program IMMEDIATE/SHEAR-PIN relay to IMMEDIATE (default setting) and program RELAY ON DELAY to tx.
- Program PROG. INPUT #8 to DUAL ADJUSTMENT (default setting).
- Program standard parameters and DUAL ADJUSTMENT parameters as shown in the table below.

Using two starting characteristics, the RVS-DN will accelerate to reach the 200% current limit. After tx voltage to PROG. INPUT #8 is switched on, using the DUAL ADJUSTMENT characteristic to complete acceleration.



	Standard Parameter	DUAL ADJUSTMENT Parameter
INITIAL VOLTAGE	10%	25%
ACCELERATION TIME	t1 = 2-30 sec	t2 = 2-30 sec
CURRENT LIMIT	200%	300-400%
RELAY ON DELAY	tx = 1-60 sec.	-----

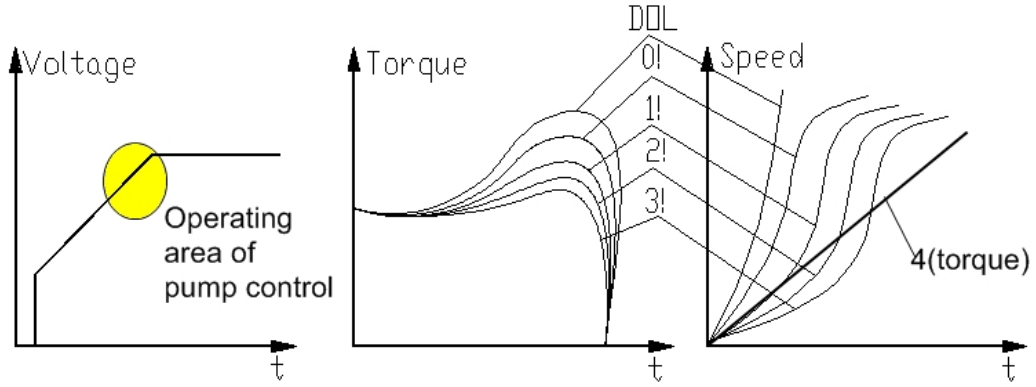
8.2.3.1 Special Starting – Using DUAL ADJUSTMENT – Wiring Diagram



8.2.4 Choosing a Suitable Pump Curve (Centrifugal Pumps)

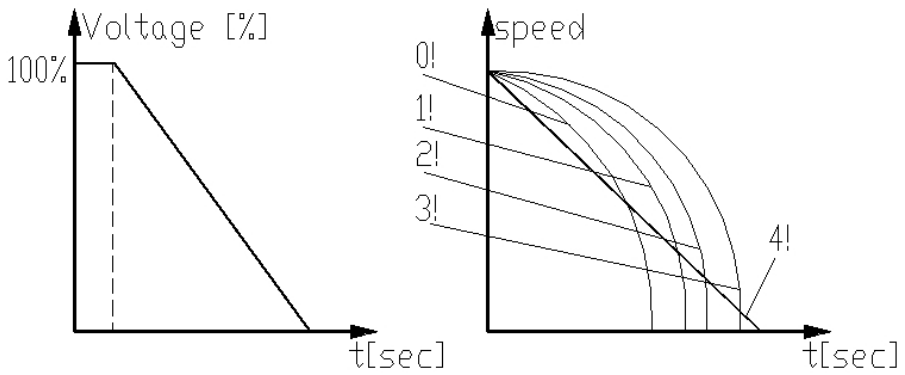
8.2.4.1 Starting Curve

- Adjust MAIN PARAMETERS as necessary (FLA, FLC, etc.).
- Set STARTING CURVE, ACCELERATION TIME, CURRENT LIMIT, and INITIAL VOLTAGE to their default values (curve 0, 10 sec., 400% and 30% respectively).
- Start the pump while watching the pressure gauge as the pump starts and look for overshooting (“pressure surge”) of the gauge needle above the target pressure. In case of over pressure, choose a peak torque reduction curve (SOFT START CURVE 1!!).
- Set SOFT START CURVE 1!!, increase ACCELERATION TIME to 15 seconds and reduce CURRENT LIMIT to 350%. Start the pump and watch the pressure gauge while the pump starts.
- In most cases, overshooting is reduced. If the overshoot persists, increase ACCELERATION TIME to 25 seconds (confirm with motor manufacturer) and try again.
- If the overpressure persists, increase the SOFT START CURVE setting to 2!!, or 3!!, if necessary. Each increase in the SOFT START CURVE setting will reduce the peak torque, thus reducing the overpressure and preventing “pressure surge” during start.



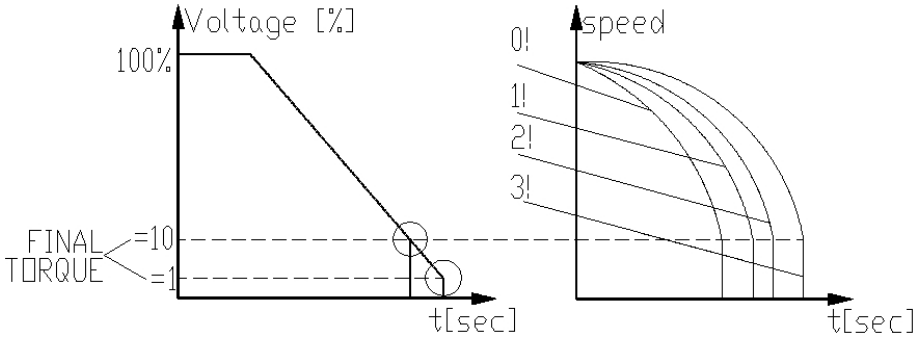
8.2.4.2 Stopping Curve

- Adjust MAIN PARAMETERS as necessary (FLA, FLC, etc.)
- Set SOFT STOP CURVE and DECELERATION TIME, to their default values (curve 0, 10 sec., respectively).
- Stop the pump, watching the pressure gauge and check valve as the pump stops. Look for overshooting (“water hammer”) of the gauge (abruptly stops the pump and the motor).
- Select SOFT STOP CURVE 1!! and increase DECELERATION TIME to 15 seconds. Stop the pump and watch the pressure gauge and the rate of closing of the check valve as the pump stops. Abrupt stopping of the pump and motor will cause a loud audible noise emitted from the check valve.
- In most cases, “water hammer” is reduced. If “water hammer” persists, increase the time to 25 seconds (confirm with motor manufacturer) and try again.
- If “water hammer” persists, increase the SOFT STOP CURVE setting to 2!!, or 3!!. Each increase in the SOFT STOP CURVE will reduce the abrupt stop of the pump, thus preventing the “water hammer” phenomenon.



8.2.4.3 FINAL TORQUE During Soft-Stopping a Pump Motor

While decelerating, the check valve may close before DECELERATION TIME has elapsed, thus allowing current to flow through stator winding causing unnecessary heat. Select FINAL TORQUE sensitivity to 1 and stop the pump, then confirm that the current stopped flowing through the motor shortly after the check valve closed.
If current still flows more than 3-5 seconds after check valve closure, increase FINAL TORQUE (up to a maximum value of 10) to stop current flow earlier.



9. TROUBLE SHOOTING

Upon fault – motor stops, *Fault* LED lights and Fault Relay chances position. The LCD shows TRIP: < fault description>. (for example: TRIP: UNDER CURRENT).

INSULATION ALARM

(Optional) Alarms when the motor insulation level decreases below the level set. Alarm ceases automatically 60 seconds after resistance exceeds the level set.

Check motor and cable insulation.
For INSULATION ALARM/TRIP protection settings refer to section 7.7.7 page 81.

INSULATION TRIP

(Optional) Trips the RVS-DN when the motor insulation level decreases below the trip level set.

Check motor and cable insulation level.
For INSULATION ALARM/TRIP protection settings refer to section 7.7.7 page 81.

THERMISTOR TRIP

(Optional) Trips the RVS-DN when the motor thermistor resistance decreases below trip level set.

Check resistance of the thermistor and cables; check motor temperature near thermistor location.
For THERMISTOR TRIP protection setting refer to section 7.7.7 page 81.

TOO MANY STARTS

Trips the RVS-DN if the number of starts, during STARTS PERIOD exceeds the preset number.

Wait until motor and RVS-DN cool down – according to NUMBER OF STARTS, STARTS PERIOD and START INHIBIT settings. Refer to section 7.7.3 page 75.

LONG START TIME

Trips the RVS-DN if output voltage does not reach nominal at the preset MAX. START time.

Check FLA, FLC, and MAX START TIME settings. Increase INITIAL VOLTAGE, CURRENT LIMIT & MAX. START TIME or decrease ACC. TIME as necessary.
For start parameters settings refer to section 7.7.3 page 75.

O/C – SHEAR PIN

Trips the RVS-DN when:

- Instantaneously when current exceeds 8.5 x RVS-DN FLC
- During starting when current exceeds 8.5 x Motor FLA
- During running when current exceeds 200-850%

O/C Shear-Pin has a programmable delay of 0-5 seconds where the RVS-DN detects the fault and does not trip before time delay has elapsed (delay is overriden when current reaches 8.5 x RVS-DN FLC).

Check that motor is not stalled or jammed.
Check FLA, FLC settings.
Check motor and cable connections.
Perform a "Megger" test to verify motor and cable's condition.
For protection parameters settings refer to section 7.7.2 page 69.

CAUTION	Check that "Megger" maximum voltage is no more than 500V! Disconnect terminal 21 before performing a "Megger" test.

OVERLOAD

Trips the RVS-DN when current exceeds the OVERLOAD TRIP level and the thermal register has filled up.

Check FLA, FLC and overload settings and check motor current, then wait at least 15 minutes to let the motor and RVS-DN cool down before restarting.
For protection parameters settings refer to section 7.7.2 page 69.

UNDER CURRENT

Trips the RVS-DN when line current drops below the preset level for the preset time.

Check UNDERCURR. TRIP and UNDERCURR. DELAY settings; check line currents through L1, L2, L3.
For protection parameters settings refer to section 7.7.2 page 69.

UNDER VOLTAGE Trips the RVS-DN when line voltage drops below the preset level for the preset time.

Check UNDERVOLT. TRIP and UNDERVOLT. DELAY settings, check line voltages on L1, L2, L3. When voltage drops to zero, the RVS-DN trips immediately with no delay.
For protection parameters settings refer to section 7.7.2 page 69.

OVER VOLTAGE Trips the RVS-DN when line voltage increases above a preset level for a preset time.

Check OVERVOLT. TRIP and OVERVOLT. DELAY settings, check line voltage on L1, L2, L3.
For protection parameters settings refer to section 7.7.2 page 69.

PHASE LOSS Trips the RVS-DN if 1 or 2 phases are missing.

(1) *In cases where the current transformers are connected externally (RVS-DN 950-3000A models), verify that that the current transformers are not grounded. Each current transformer is connected with its 2 wires only and these wires are not grounded externally.*
(2) *Check phase voltages related to terminal 21 even if terminal 21 is not connected. Verify that phase voltages are within the required range of line to neutral voltages.*
(3) *Verify that terminal 21 is connected correctly. For terminal 21 connection refer to section 4.1 page 19.*
(4) *If terminal 21 is connected correctly, disconnect terminal 21 and try to start when terminal 21 is disconnected.*
(5) *If all previous actions are do not solve the problem and the you are sure that no real phase loss exists, you can set PHASE LOSS Y/N protection to NO. This situation can occur in rare cases when there is no real fault but the RVS-DN recognizes unusual behaviour like when Total Harmonic Distortion in Voltage (THDV) in the network is high.*
(6) *If this is a true case of PHASE LOSS then after setting PHASE LOSS Y/N protection to NO the motor will single phase and most likely be tripped by the over load protection mechanism.*
(7) *Phase loss might not be detected in motor operating under a light load.*

For PHASE LOSS protection setting refer to section 7.7.7 page 81.
PHASE LOSS setting is not valid in RVS-DN 1000V.

FREQUENCY Trips the RVS-DN if frequency is not in the range of 40-66.6Hz

Check that frequency variations are between 40-66.6Hz.

PHASE SEQUENCE Trips the RVS-DN if line phase sequence is wrong.

Check line phase sequence and if wrong, swap two wires on line side. If motor now rotates in the wrong direction, swap two wires on load side of the RVS-DN.
For PHASE SEQUANCE protection setting refer to section 7.7.7 page 81.

MAX SLOW SP TIME Trips the RVS-DN when operating at slow speed for extended periods.

Check that operation time at Slow Speed is shorter than MAX SLOW SP TIME.

Note: Motor and RVS-DN may be overheated when operating at slow speed for an extended period.
For MAX SLOW SP TIME protection setting refer to section 7.7.6 page 80.

WRONG CONNECTION Trips the RVS-DN when one or more motor phases is not properly connected to RVS-DN's load terminals or if there is an internal disconnection in the motor winding.

Verify that the motor is connected properly.
See note 1 at the end of this section.

SHORTED SCR

Trips the RVS-DN and prevents starting if any SCR is short-circuited or when motor windings are shorted.

Check with an ohmmeter between L1-U, L2-V, L3-W; resistance > 20 KΩ.

Check for no voltage on terminals U, V, W (from parallel system or an independent bypass).

SCRs may fail due to:
** High short current not protected by proper fuses*

** High voltage spikes not protected by proper external varistors.*

** Frequent starting at maximum conditions or fault conditions.*
See note 1 at the end of this section.

OVER TEMPERATURE

Heat-sink over-temperature. Trips the RVS-DN when the heat-sink temperature rises above 85°C.

Improve cooling or use a bypass contactor. Check that motor starting is not too frequent.

EXTERNAL FAULT

Trips the RVS-DN when a N.O. contact between terminals 19-21 closes for over two seconds.

Check contact position and cause of closure.

WRONG PARAMETERS

Parameters not transferred from RAM to EEPROM or vice versa.

After loading new software version or after power up, press Reset, then Mode and ▼ simultaneously and save the default parameters by pressing Store and Mode simultaneously.
(If the Fault LED is on, press Reset after WRONG PARAMETERS).
Refer to section 7.4 page 62 for reviewing and modifying parameters.

O/C or WRONG CON.

Trips the soft RVS-DN when connected Inside Delta and Wrong connection or if over current is detected by the RVS-DN.

Verify that the motor is not stalled or shorted and check cables and wiring.

Verify that motor and RVS-DN are connected exactly as shown in section 4.22 page 30.

If circuitry is 100% confirmed it is possible to start when dip switch #7 (expanded settings) is on. Refer to section 6.5.5 page 58. If a fault occurs again consult the factory. The operator is advised to try operating one time only. Note that it is useless to try starting in this mode more than once.

COMM. PORT FAILED

Trips the RVS-DN if, when controlled via Profibus communication link, the communication cable is torn or the communication from the PLC is lost.
Note that the occurrence of this fault depends on then “Watch Dog” function of the Profibus controller.

You must reconnect the wiring and/or the communication with the PLC and wait for a start command initiated by the PLC.

MODBUS TIME OUT

Trips the RVS-DN if Modbus communication is lost for a longer time then the time defined in MODBUS TIME OUT parameter.

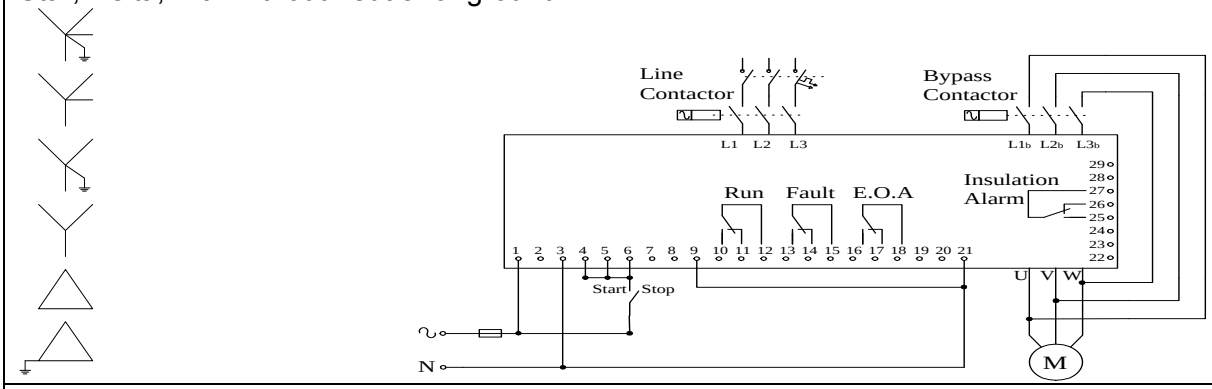
For MODBUS TIME OUT settings refer to section 7.7.9 page 85..

Note 1: When operating in DA:GENERATOR PARAMETERS, SHORTED SCR and WRONG CONNECTION faults are not active.
If required, these faults may be eliminated by IMPLEMENTING DA:GENERATOR PARAMETERS.
Refer to section 4.17 page 28 for setting the RVS-DN in DA:GENERATOR PARAMETERS wiring.

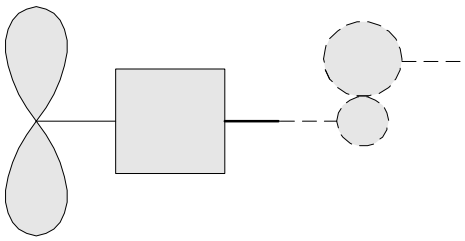
9.1 **Warranty Claim and Fault Inquiry**

Representative Name:	Country:	Fax Number:
Model Number And Built Options:	Example: 390 – 400 – 230 – 230 – 3 + 4 + 9 + B – S RVS-DN _ _ _ _ - _ _ _ - _ _ _ - _ _ _ - _ + _ + _ + _ - _	
Serial Number:		
Purchasing Date:		
Sale / Installation Date:		
Failure Date:		
Program Version: STRT.DN- _ _ _ _ _ _	Press MODE + ∇, press SELECT twice, the LCD displays the program version (e.g. STRT.DN-011197)	

Connection Diagram & Supply Network Type. Circle the correct main supply and add or erase parts in the drawing:
Star, Delta, with/without neutral or ground



Application Description:



Details of Fault / Fault Message:

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Define time of fault occurrence: (during start, after start, during soft stop, end of soft stop, when closing B.P. contactor, when performing…)	

Statistical Information		RVS-DN Operative Information	
Last Start Period:		RVS-DN FLC:	
Last Start Max. I		Motor FLC:	
Total Run Time:		Initial Voltage:	
Total Number Of Starts:		Acceleration Time:	
Last Trip:		Current Limit:	
Trip Current:			
Total Number Of Trips:			
Trip History :			

10. TECHNICAL SPECIFICATIONS

General Information:

Supply Voltage:	Line to line 220-1000V (to be specified) + 10%-15%
Frequency:	45 – 65 Hz (fixed or variable frequency source)
Control Supply:	110-230VAC or 110VDC (to be specified) +10% - 15%
Control Inputs:	Either same as Control Supply or by special order 24-230V AC/DC (to be specified)
Load:	Three phases, three/six wires, squirrel cage induction motor
Connection type:	Standard 3 wire U, V, W connection, or 6 wire Inside Delta (programmable)

Start-Stop Parameters:

RVS-DN FLC:	RVS-DN's Full Load Current (FLC), according to ordering information
Motor FLA:	Motor Full Load Ampere (FLA) 50-100% of RVS-DN FLC
Starting Curve 0 (Standard)	2 standard starting and stopping curves
Pump Control Curves (1!, 2!, 3!)	6 field selectable curves preventing over-pressure during start and water hammer during stop
Torque Control Curve (4)	2 selectable curves preventing over-pressure during start and water hammer during stop. In addition, these curves may be used for torque control starting of constant torque applications.
Pulse Start Duration:	A pulse of 80% Un, for an adj. time 0.1-1 Sec, for starting high friction loads
Initial Voltage:	10-50% Un (5-80% (1))
Initial Current:	100-400% In (1 current control starting curve, appears when INITIAL VOLTAGE is displayed, up arrow is pressed, and INITIAL VOLTAGE has reached its max.)
Current Limit:	100-400% of Motor FLA (100-500%(1))
Acceleration Time:	1-30 Sec (1-90 sec(1))
Deceleration Time:	1-30 Sec (1-90 sec(1))
Dual Adjustments:	Secondary start stop characteristic for: MOTOR FLA, INITIAL VOLTAGE, CURRENT LIMIT, ACC. TIME and DEC. TIME
Energy Saving:	Energy save for lightly loaded motors
Slow Speed Torque:	Torque while motor is at 1/6 nominal speed
Tacho and Linear Acceleration:	12 field selectable curves – defining gain control, improving tacho feedback
	Note: (1) Refer to section 6.5.5 page 58 for Expanded setting.

Motor Protection:

Too Many Starts:	Maximum number of starts, range: Off or 1-10, during a time period 1-60 min.
Starts Inhibit:	Time period 1-60 min, when starting is prevented, after too many starts fault
Long Start Time (stall protection):	Maximum allowable starting time 1-30 sec. (1-250 Sec(1))
Over Current (shear-pin):	Three trip functions: **At all time** - If I > 850% of FLC it trips the RVS-DN within 1 cycle (overrides the value of the O/C – SHEAR PIN setting). **At starting process** - If I > 850% of FLA it trips the RVS-DN after O/C DELAY (see here after) **At run time** - If I > O/C – SHEAR PIN setting of FLA it trips the RVS-DN after O/C DELAY
Electronic Overload (I^2t):	Adjustable 75-150% of motor FLA, adjustable trip time at 500% In of 1-10 sec.
Under Current:	Trips when current drops below 20-90% In, time delay 1-40 sec. Optional auto reset after time delay.
Under Voltage:	Trips when main voltage drops below 120-600V (600-900V in RVS-DN 1000V models), time delay 1-10 Sec. Optional Auto Reset.
Over Voltage:	Trips when main voltage increase above 150-750V (1100-1300V in RVS-DN 1000V models), time delay 1-10 sec.
Phase Loss, Under/over Frequency:	Trips when one or two phases are missing, or frequency is < 40Hz or > 65Hz. Optional auto reset.
Phase Sequence:	Trips when phase sequence is wrong
Long Slow Speed Time:	Trips if operating at slow speed for more than 1-30 sec (1-250 sec(1))
Wrong Connection:	Prevents starting, trips if motor is not connected / incorrectly connected to the RVS-DN (not active in DA:GENERATOR PARAMETERS)
Shorted SCR:	Trips if one or more SCRs have been shorted (not active in DA:GENERATOR

	PARAMETERS)
Heat Sink Over Temperature:	Trips when heat-sink temperature rises above 85°C
External Fault:	Trips when an external contact closes for 2 sec.
Motor Insulation (optional):	Alarm and trip level setting 0.2 – 5MΩ, trips and alarms when insulation decreases below levels set
Motor Thermistor (optional):	Trip level setting 1-10KΩ, trips when resistance decreases below the level set
	Note: (1) Refer to section 6.5.5 page 58 for expanded setting

Control:

Displays:	LCD in 4 – Field selectable languages and 8 LEDs
Keypad:	6 keys for easy setting
Aux Contact – Immediate:	1 C/O, 8A, 250VAC, 2000VA
Aux Contact – End Of Acceleration:	1 C/O, 8A, 250VAC, 2000VA
Fault Contact:	1 C/O, 8A, 250VAC, 2000VA
Insulation Alarm Contact (optional):	1 C/O, 8A, 250VAC, 2000VA
Communication (optional):	RS 485 with Modbus protocol for full control and supervision
Communication (optional):	Profibus DPV1 for full control and supervision
Temperatures Operating:	-10° to 50°C
Storage:	-20° to 70°C

Standards:

Dielectric Test:	2500VAC
Degree of Protection:	IP 20 for frame size A; IP 00 for frame sizes B, C, D, E, F, G
Pollution Degree:	3
EMC Emissions:	EN 55011 CISPR 11 Class A
Immunity:	EN 55082-2 ESD 8KV air, IEC 801-2; Electric RF field 10 V/m, 20-1000Mhz, IEC 801-3 Fast transients 2KV, IEC 801-4
Safety:	EN 600947-1 Related to safety requirements. UL508C

Normal Service Conditions:

Altitude:	Up to 1000m. For equipment to be used at higher altitudes consult the factory.
Humidity:	95% at 50°C or 98% at 45˚C

Fan and RVS-DN Consumption Ratings:

Size A (8-31A):	No fan	Total RVS-DN Consumption: 150VA
Size A (44-72A):	Fan 35 VA	Total RVS-DN Consumption 185VA
Size B:	Fan 60 VA	Total RVS-DN Consumption 210VA
Size C:	Fans 105 VA (35VA x 3)	Total RVS-DN Consumption 255VA
Size D, E, F, G	Fans 150 VA (50VA x 3)	Total RVS-DN Consumption 300VA