HRVS-DN

Medium Voltage Digital Soft Starter
60-1,200A, 2,300-15,000V

SOLCON POWERED

Instruction and Commissioning Manual

Ver.27/12/2010

HRVS-DN Instruction and Commissioning Manual

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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 (IP00) of the HRVS-DN.

2.2 Attention

	1	This product was designed for compliance with IEC 60947-4-2 for class A equipment and EN 50178.
	2	For further information, see the Technical Specifications.

2.3 Warnings

	**1**	Internal components and PCBs are at mains potential when the HRVS-DN is connected to mains. This voltage is extremely dangerous and contact with it will cause death or severe injury.
	2	When the HRVS-DN is connected to mains full voltage may appear on the HRVS-DN's output terminals and motor's terminals, **even if control voltage is disconnected and motor is stopped**.
	3	The HRVS-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 HRVS-DN (U, V, W). Also make sure that power factor capacitors are not connected to the bypass preparation bus bars (L1B, L2B, L3B when exist)

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

3. INTRODUCTION

3.1 Why Solcon? Why Soft Starters?

Three-phase AC induction motors are commonly used in a wide variety of drive applications. Due to their starting characteristics, in many cases these motors cannot be connected directly to the power supply system. When starting Direct On Line (DOL) the motor can see a very high surge current reaching up to 6 times (and more…) the rated motor current. This excessive current puts stress on the supply system and the switchgear. Also, when starting DOL, a very high peak torque can occur, stressing the driven motor and the mechanical system including auxiliary power transmission parts (V-belt, gears, etc.).

There are several methods for reducing the damaging effects of this excessive starting current. Conventional methods include reactors and autotransformers. But these methods only allow the voltage to be reduced in steps whereas a soft starter provides step-free acceleration of the drive system by continuously increasing the voltage over a selected period of time. This approach to starting minimizes the effect of high inrush current on the supply system, the motor and the driven load.

Soft starters provide the following benefits:

- Reduced starting current, eliminates voltage drops and dips of the supply network
- Smoother acceleration of loads, eliminates process or product damage
- Extended lifetime of all mechanical components, e.g. eliminates gearbox damage and results in less maintenance & downtime
- Extended motor life
- Reduced maintenance and operating costs

The HRVS-DN soft starter represents a logical extension of the Solcon soft starter product range into medium voltage applications.

With HRVS-DN, Solcon presents an innovative standard product that provides a flexible, low cost alternative to fixed speed (DOL) starting.

Designed for use with standard medium voltage three-phase squirrel cage induction motors as well as synchronous motors, this high-performance digital soft starter ensures smooth acceleration and deceleration.

HRVS-DN is available in all standard internationally recognized medium voltage ratings: 2.3kV, 3.3kV, 4.16kV, 6kV and 6.6kV, 10kV, 11kV, 13.2kV, 13.8kV and 15kV.

The standard current output range capability is from 200kW to 27MW.

HRVS-DN is designed and built to meet international standards including:

• IEC • EN • DIN VDE • NEMA • UL/CUL • IEEE

The HRVS-DN soft starters are manufactured at the highest quality level. The entire design, production and delivery process, (i.e. construction, manufacturing, order processing and logistics delivery center) have been certified DIN ISO 9001.2000.

The enclosed versions of the HRVS-DN are provided as ready-to-connect cabinet enclosed type units (example shown in *Figure 1*) or - for OEM only - chassis type OEM kits (example shown in *Figure 2*) are available for building into custom enclosures or other relevant equipment (**note**: the complete interface engineering is the responsibility of the user).

Figure 1- HRVS-DN Cabinet Type IP31 (NEMA1)

Figure 2- HRVS-DN Chassis Type (IP00)

3.2 How Soft Starters Work?

By using thyristors (SCRs) in a phase angle control mode, reduced voltage control can be achieved. Phase control makes it possible to gradually increase the motor terminal voltage from an initial set point up to the system supply voltage level. The related starting current and the starting torque can be optimally adjusted to the motor/load conditions.

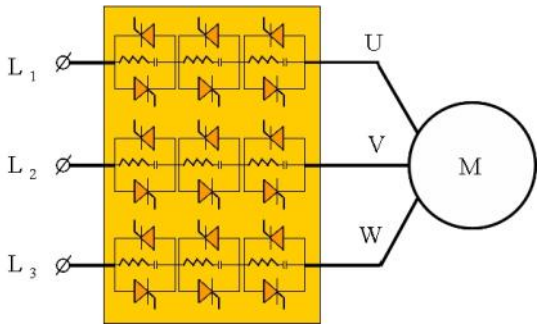


Figure 3 - Principle Diagram of Digital Medium Voltage Soft Starter (Bypass Preparations not Shown)

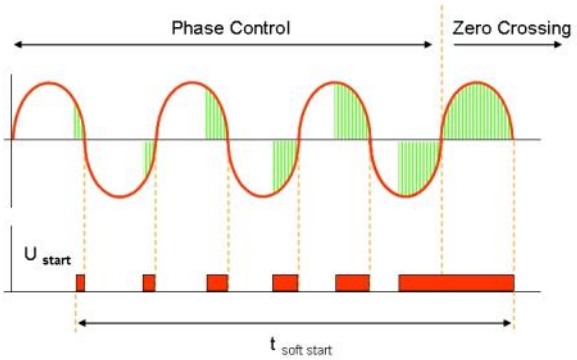


Figure 4 - Phase Control of the Line Voltage Using Semiconductor (SCR) Elements

Figure 5 shows a principal voltage increase curve.
Figure 6 demonstrates the torque reduction compared to the DOL torque. *Figure 7* demonstrates typical behavior of motor current.

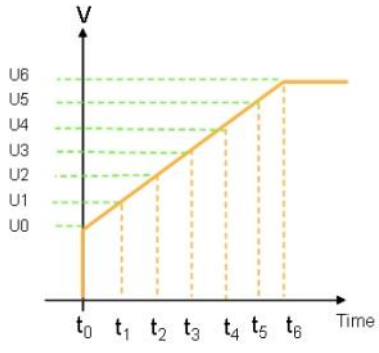


Figure 5 – Voltage Increase

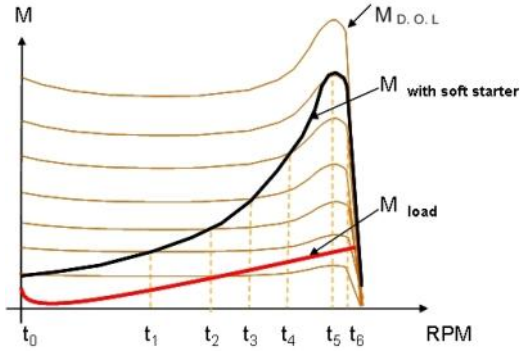


Figure 6 – Torque Reduction

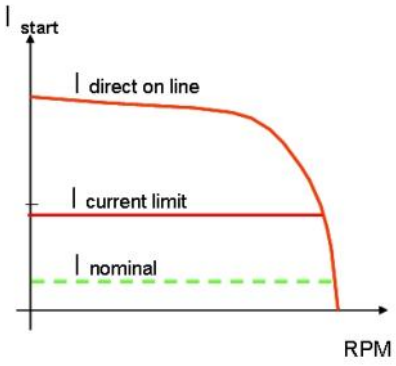


Figure 7 – Current Limit

In addition, the Solcon HRVS-DN soft starters provide the "soft stopping" function as a standard feature. Similar to the reduced voltage start, a stop command gradually reduces the motor voltage over time until the motor stops. Abrupt stopping is avoided, a specific advantage in pumping applications to prevent the damaging effects of water hammer and on conveyor belts where the load may be damaged by an abrupt stop.

Main Features, Options and Advantages

Advantages at a Glance

- Complete line of 60-1,200A, 2,300-15,000V as standard products
- Customized soft starters (consult the factory for details)
- Heavy duty, fully rated design
- Starting capacity of 400% of FLC for 30 seconds at a rated ambient temperature of 50°C
- Preparation for bypass - to maintain protection when bypass is closed
- Robust construction
- Superior starting & stopping characteristics
- Comprehensive motor protection package
- User friendly
- Unique protection for corrosive environments
- Generator ready - auto frequency tracking
- Sustains variations of 45-65Hz while starting
- Unique built in optional features including:
  - Motor insulation tester
  - Modbus / Profibus /DeviceNet comm.
  - Analog output
  - Relay PCB for comm. control
  - Tacho feedback
  - Multi-start (standard)and Multi-soft stop (optional) capability
  - Synchronous motor excitation system control
  - Remote display

Standard Ratings

- 2.3kV, 4.16kV, 6kV, 6.6kV, 10kV,11kV, 13.2kV, 13.8kV, 15kV

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
- Advanced pulse start
- Linear acceleration

Motor & Starter Protection

- Too many starts
- Coast Down Time
- Long start time (stall)
- Shear-pin
- Electronic overload with selectable curves according to IEC classes or NEMA classes
- Under current with adjustable delay
- Unbalance current with adjustable delay
- Ground fault with adjustable delay
- 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, Spanish and Turkish (Chinese and 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 10 trips with time stamp
  - Current at trip

Unique Built-in Options

❍ Analog output, related to the motor's current or related to the motor's rated power. Programmable as 0-10VDC, 4-20mA, 0-20mA

❍ Motor insulation test - 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 0.2-5Mohm, preventing starting when insulation is below acceptable levels

❍ Special tacho feedback circuitry

❍ Modbus RTU - enables setting, control & supervision

❍ Profibus DP – enables setting, control & supervision

❍ DeviceNet - enables setting, control & supervision

❍ Relay PCB – enables starting the application when the soft starter is installed in a cabinet via communication, and to control the excitation system of a synchronous motor

❍ Remote display allows the panel builder to mount the keypad of the HRVS-DN in a remote location of the Control Module. A standard length of 1.5m cable length is supplied

❍ Multi-soft stop special software allows to soft stop motors when a multi-start application is applied.

Unique External Options

❍ Customized tailor-made design of a cabinet

❍ Advanced motor protection MPS-3000

❍ Digital multi-meter for advanced measurement capabilities - DPM-10

❍ Motor Insulation Protection – MIP-6 for advanced tracking of motor insulation level over more than 20 years

❍ Line and Bypass Contactors/VCBs

❍ Fuses and disconnectors

❍ Capacitors for power factor correction

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 too many starts pre-alarm relay)

❍ **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

4. TECHNICAL DATA

4.1 HRVS-DN IP00 Unit (OEM Kit)

Power Section and Connection Harness | Control Module | Firing Transformer | EPT-Tx and EPT-Rx

Figure 8 – HRVS-DN IP00 Unit (OEM Kit)

The IP00 unit (OEM kit) is available for building into custom enclosures or other relevant equipment.

It consists of the following (refer to *Figure 8* above):

- **Power Section** consists of the 3 identical phase stacks, firing PCBs, power supplies to the firing PCBs (in HRVS-DN from 10kV and up power supplies to the firing PCBs are separated from the Power Section), 3 CTs and the connection harness to the low voltage compartment (including copper wires and fiber optic wires). The Power Section is installed in the medium voltage compartment of the cabinet.

- **Control Module** is the “brain” of the soft starter. It consists of the main CPU PCB, fireboard PCB, power supply, optional PCBs (when ordered) and input/output interface terminals.
  The Control Module for HRVS-DN is identical for all ratings and suitable for mounting in the L.V. compartment of the cabinet which should be fully segregated from the M.V. compartment.
  Interposing relays should be connected to all HRVS-DN auxiliary contacts, three relays must be incorporated: **Immediate**, **End of Acceleration** and **Fault**.

- **Firing Transformer**. This transformer is applicable for 115VAC or 230VAC control voltages.
  For HRVS-DN controlled by DC control voltages - DC power supply is supplied – for details consult the factory.
  The Firing transformer is installed in the low voltage compartment of the cabinet and supplies control power to the firing PCBs located in the Power Section of the HRVS-DN in the medium voltage compartment of the cabinet.

- **EPT-Tx** (transmitter) and **EPT-Rx** (receiver) are used instead of the traditional voltage transformer to measure the input voltage.
  The EPT-Tx is installed in the medium voltage compartment and is connected to the mains bus bars downstream from the Line Contactor.
  The EPT-Rx is installed in the low voltage compartment of the cabinet.
  The EPT-Tx and EPT-Rx are connected by 2 fiber optic wires which are part of the connection harness.

4.2 Typical Connection of the HRVS-DN IP00 Unit (OEM Kit)

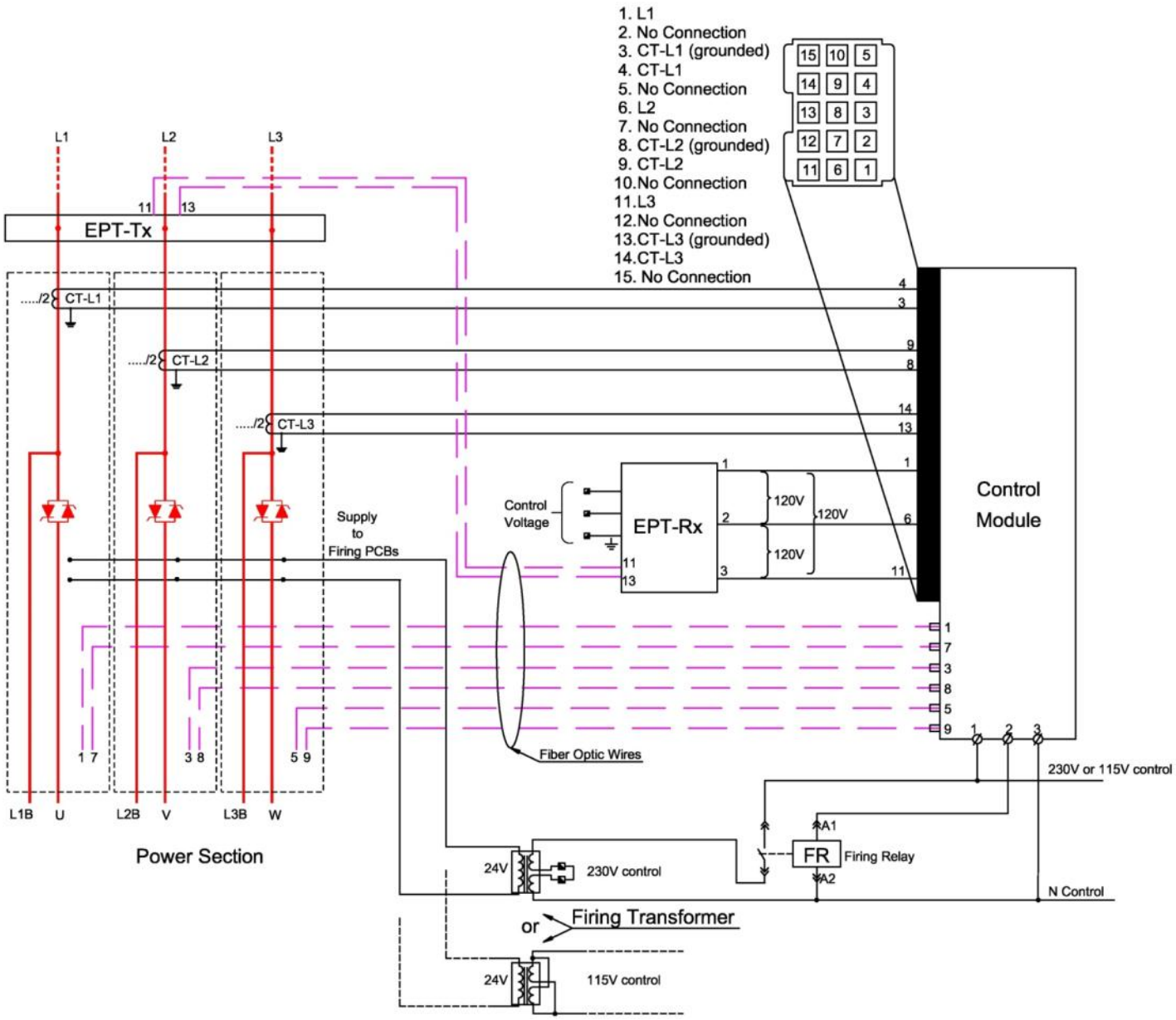


Figure 9 – Typical Connection of HRVS-DN IP00 Unit (OEM Kit)

Notes:

- *Figure 9* shows a typical connection of an HRVS-DN IP00 unit (OEM kit) of up to 6.6kV with a control voltage of 115/230VAC. For connection diagrams for other models consult the factory.
- L1B, L2B, L3B bus bars are only available in HRVS-DN up to 6.6kV.

4.3 Typical Connection of the HRVS-DN in a Cabinet

4.3.1 Typical Connection of HRVS-DN up to 6.6kV

The HRVS-DN must be connected with a Line Contactor and a Bypass Contactor as demonstrated in *Figure 10*.

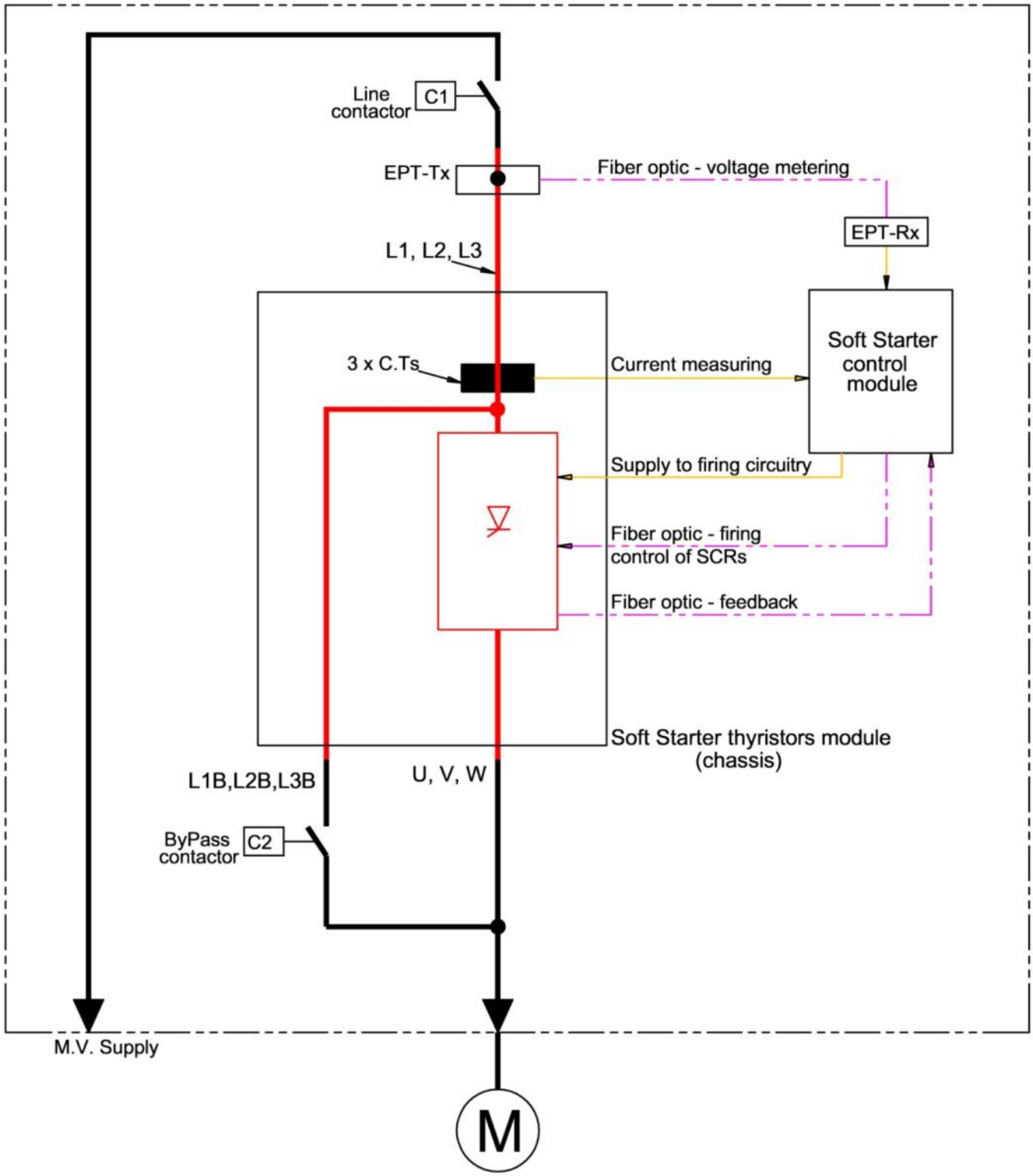


Figure 10 – Typical Connection of HRVS-DN up to 6.6kV with Line Contactor and Bypass Contactor

4.3.2 *Typical Connection of HRVS-DN from 10kV and up.*

The HRVS-DN must be connected with a Line Contactor and a Bypass Contactor as demonstrated in *Figure 11*.

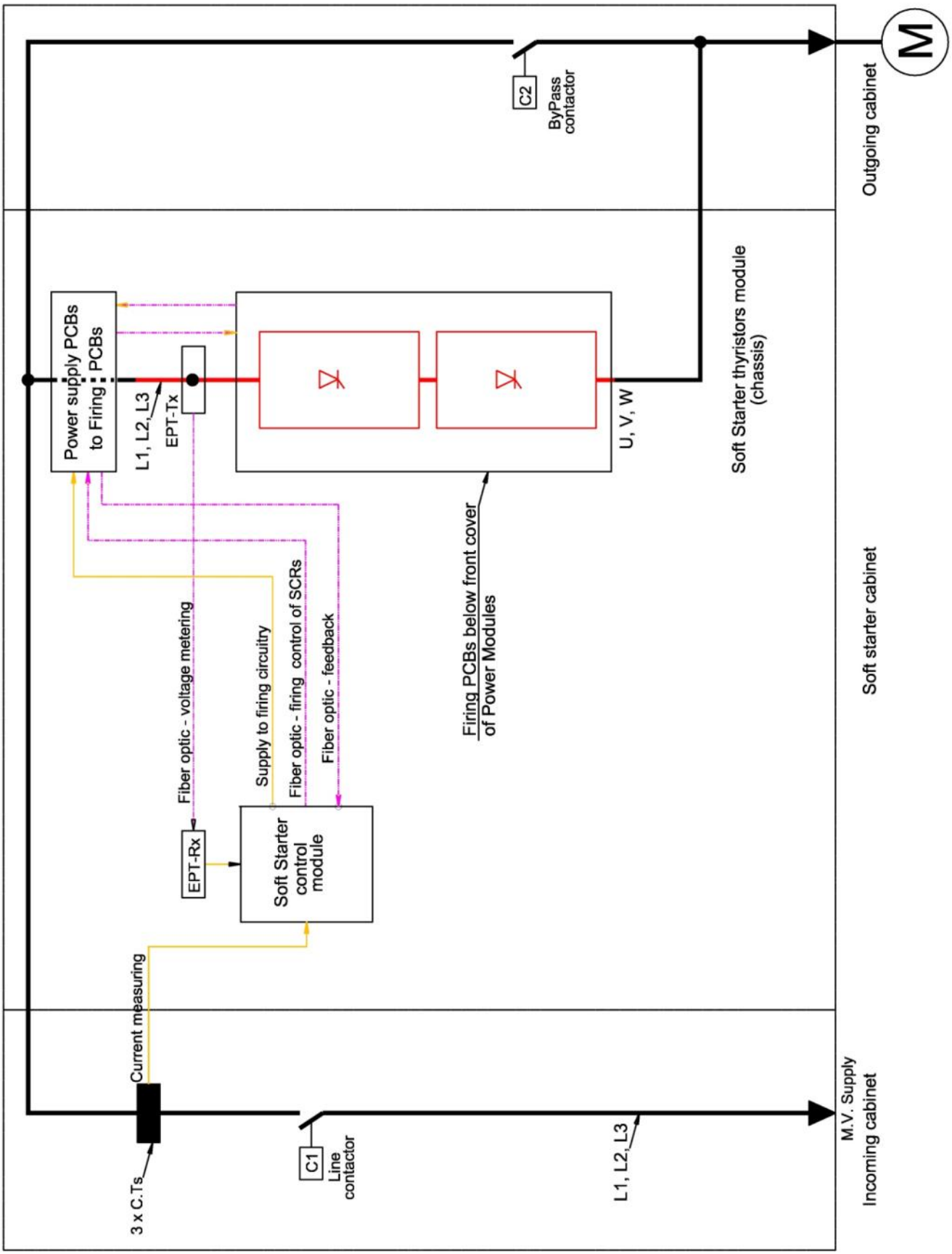


Figure 11 – Typical Connection of HRVS-DN from 10kV and up With Line Contactor and Bypass Contactor

4.4 HRVS-DN Selection

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

4.4.1 Motor Current and Starting Conditions

Select the HRVS-DN according to the motor's Full Load Ampere (FLA) - as indicated on its nameplate (even if the motor will not be fully loaded).

Soft Starter Full Load Current (FLC) must be ≥Motor's Full Load Ampere (FLA).

The HRVS-DN is designed to operate under the following maximum conditions:

Ambient Temperature [°C]	Max. Starting Current [A]	Max. Starting Time at 400% FLC [sec]
50	400%xFLC	30

Max. starts per hour: 2 starts per hour at maximum ratings.

4.4.2 PIV (Peak Inverse Voltage)

Thyristors PIV rating, internal circuitry and insulation define the following voltage levels:
2,300V, 3,300V, 4,160V, 6,600V, 10,000V, 11,000V, 13,800V and 15,000V.
Each soft starter is suitable for 50/60Hz.
PIV level is rated at 3 times the rated voltage or higher.

4.4.3 ***Rated Currents Frame Sizes***

System Voltage	Starter Current	Motor KW	Motor HP	IP 00 (Chassis Version) Dimensions (mm) & Weight				IP 31 - 67 (NEMA 1- 3R,4X) Dimensions (mm) & Weight			IP 31 With L+BP contactors
				W	H	D	(Kg)	W	H	D	(Kg)
2300	60	200	260	660	550	470	90	900	2300	1000	500
	110	360	480	660	550	470	90	900	2300	1000	500
	200	660	880	660	550	470	90	900	2300	1000	500
	320	1,060	1,420	660	550	470	130	900	2300	1000	530
	400	1,330	1,770	660	800	490	160	900	2300	1000	570
	600	2,000	2,700	660	800	490	200	900	2300	1000	650
	800	2,660	3,600	900	1120	620	350	1100	2300	1100	1050
	1000	3,330	4,500	900	1120	620	450	1100	2300	1100	1100
3300	60	280	380	660	900	470	140	900	2300	1000	550
	110	520	700	660	900	470	140	900	2300	1000	550
	200	950	1,300	660	900	470	140	900	2300	1000	550
	320	1,530	2,050	660	900	470	140	900	2300	1000	550
	400	1,910	2,600	660	1000	470	200	900	2300	1000	650
	600	2,850	3,900	660	1000	470	250	900	2300	1000	650
	800	3,820	5,200	900	1120	620	400	1100	2300	1100	900
	1000	4,780	6,500	900	1120	620	400	1100	2300	1100	1100
4160	60	360	490	660	900	470	140	900	2300	1000	550
	110	660	880	660	900	470	140	900	2300	1000	550
	200	1,200	1,600	660	900	470	140	900	2300	1000	550
	320	1,930	2,570	660	900	470	150	900	2300	1000	560
	400	2,410	3,210	660	1000	470	180	900	2300	1000	620
	600	3,610	4,900	660	1000	470	195	900	2300	1000	650
	800	4,820	6,500	900	1120	620	450	1100	2300	1100	1050
	1000	6,030	8,200	900	1120	620	500	1100	2300	1100	1100
6600	70	670	900	900	1030	570	250	1100	2300	1100	850
	140	1,340	1,800	900	1030	570	250	1100	2300	1100	850
	250	2,390	3,200	900	1030	570	250	1100	2300	1100	850
	300	2,870	3,900	900	1120	580	300	1100	2300	1100	900
	400	3,820	5,200	900	1120	580	300	1100	2300	1100	900
	500	4,780	6,500	900	1120	620	300	1100	2300	1100	900
	700	6,740	9,100	1200	1200	713	450	1400	2300	1200	1150
	800	7,650	10,400	1200	1200	713	550	1400	2300	1200	1250
	1000	9,570	13,000	1200	1200	713	650	1400	2300	1200	1350
	1200	11,500	15,600	1200	1200	713	650	1400	2300	1400	1350
10,000	70	1,020	1,360	1136	1370	640	785	2600	2300	1200	2100
	140	2,040	2,720	1136	1370	640	785	2600	2300	1200	2100
	250	3,650	4,900	1136	1370	640	785	2600	2300	1200	2100
	300	4,300	5,900	1136	1370	640	810	2600	2300	1200	2100
	400	5,800	7,900	1136	1370	640	850	2600	2300	1200	2100
	700	10,150	13,800	1500	1700	750	1200	3500	2400	1400	2500
	800	11,600	15,800	1500	1700	750	1200	3500	2400	1400	2500
	1000	14,500	19,700	1500	1700	750	1500	3500	2400	1400	2800
	1200	17,400	23,700	1500	1700	750	1500	3500	2400	1400	2800
11,000	70	1,100	1,500	1136	1370	640	800	2600	2300	1200	2100
	140	2,200	3,000	1136	1370	640	800	2600	2300	1200	2100
	250	4,000	5,400	1136	1370	640	800	2600	2300	1200	2100
	300	4,800	6,500	1136	1370	640	830	2600	2300	1200	2100
	400	6,400	8,650	1136	1700	640	870	2600	2300	1200	2100
	700	11,200	15,200	1500	1700	750	900	3500	2400	1400	2700
	800	12,800	17,300	1500	1700	750	950	3500	2400	1400	2700
	1000	16,000	21,700	1500	1700	750	1000	3500	2400	1400	2800
	1200	19,200	26,000	1500	1700	750	1000	3500	2400	1400	2800
13,800	70	1,400	1,900	1136	1700	640	900	3000	2400	1200	2800
	140	2,800	3,800	1136	1700	640	900	3000	2400	1200	2800
	250	5,000	6,800	1136	1700	640	900	3000	2400	1200	2800
	300	6,000	8,150	1136	1700	640	950	3000	2400	1200	2800
	400	8,000	10,900	1136	1700	640	1000	3000	2400	1200	2800
	700	14,000	19,000	3000	1400	750	1150	4200	2400	1400	2900
	800	16,000	21,800	3000	1400	750	1150	4200	2400	1400	2900
	1000	20,000	27,200	3000	1400	750	1400	4200	2400	1400	3100
	1200	24,000	32,700	3000	1400	750	1500	4200	2400	1400	3100
15,000	70	1,500	2,000	1136	1900	640	950	3000	2500	1200	3150
	140	3,000	4,100	1136	1900	640	950	3000	2500	1200	3150
	250	5,400	7,400	1136	1900	640	950	3000	2500	1200	3150
	300	6,500	8,800	1136	1900	640	1000	3000	2500	1200	3200
	400	8,700	11,800	1136	1900	640	1050	3000	2500	1200	3250
	700	15,200	20,700	3000	1500	750	1300	4200	2500	1400	4100
	800	17,400	23,700	3000	1500	750	1300	4200	2500	1400	4100
	1000	21,800	29,600	3000	1500	750	1700	4200	2500	1400	4200
	1200	26,150	35,500	3000	1500	750	1700	4200	2500	1400	4200

* HP and KW ratiings are for reference purpose only
* For values below 60A and above 1200A please consult factory
* For soft starters above 5000KW please consult factory
* At IP00 (chassis version) above 10KV, power supply dimension and weight are not included
* Please consult factory as dimensions may change pending certain options

4.5 Ordering Information

4.5.1 Ordering IP00 Unit (OEM kit)

HRVS-DN (IP00)	Internal Order No:	Rev.:
	Solcon cat. No.:	
Customer Name:		

Project Name:		**Motor Name Plate:**	
Contact Person:		**Application:**	
Tel:		**Qty:**	
Fax:		**Delivery:**	
E-mail:		**Order number**	

HRVS-DN	Rated current	Voltage	Control voltage supply	Control Input supply	Options	Lexan
	See below	See below	115VAC 230VAC 110VDC 125VDC 220VDC 24VDC	115VAC 230VAC 110VDC 125VDC 220VDC	**3M-**Modbus **3P**-Profibus **3D**-DeviceNet **5**-analog Card **D**-remote display **RU**-Russian characters. **ROC**-Chinese characters **Relay**-Relay PCB **NLR**-Special software for Multi soft stop applications	S RU N

No.	Main Components Model - P/N	QTY.
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		

MV Soft Starter Specification			
No.	**ITEM**	**Options**	**Specify**
1.	Mains Voltage	2300, 3300, 4160, 6000, 6600, 10000,11000 , 13200, 13800,15000	
2.	Starter FLC (Amp.)	At 2300-4160V: 60,110, 200, 320, 400, 700, 800,1000, 1200	
		At 6000-15000V: 70,140,250,300,400,500,700,800,1000, 1200	
3.	Control Supply Voltage	115VAC, 230VAC, 110VDC, 125VDC, 220VDC, 24VDC	
4.	Control Input Voltage	115VAC, 230VAC, 110VDC, 125VDC, 220VDC, 24VDC/AC	
5.	Test Voltage	230, 400, 500, 600, 690	
6.	Control wires type		
7.	Harness Side	Left/Right	
8.	Relay Card	NO / YES	
9.	Analogue Output	NO / YES	
10.	MODBUS Communication	NO / YES	
11.	PROFIBUS Communication	NO / YES	

MV Soft Starter Specification				
No.	**ITEM**	**Options**		**Specify**
12.	DeviceNet Communication	NO / YES		
13.	Insulation Test Module	NO / YES		
14.	**Optional loose Components**	YES/NO		
14.1	Extended Split Phase			
14.2	Motor Protection Relay (Refer to Relay Ordering Information Data)	MPS-6 , MPS 3000-P/C		
14.3	Digital Panel Meter DPM	NO / YES		
14.4	Line Contactor 2300-6600V J.C. model MVC/SVC/Toshiba model CV-6HA	NO / YES (Voltage & Current per selected starter rating)		
14.5	Bypass Contactor 2300-6600V J.C. model MVC/SVC/Toshiba model CV-6HA	NO / YES (Voltage & Current per selected starter rating)		
14.6	Auxiliary Contacts			
14.7	Coil Control Voltage	ACV:120,240 DCV:125,250		
14.8	Line Contactor 7200-12000V Toshiba model CV-10HA	NO / YES (Voltage & Current per selected starter rating)		
14.9	Bypass Contactor 7200-12000V Toshiba model CV-10HA	NO / YES (Voltage & Current per selected starter rating)		
14.1	Auxiliary Contacts	4NO+3NC , 6NO+5NC		
14.1	Coil Control Voltage	ACV:110,115,120,125,220,230,240,380,400,415,440,500 DCV:24,60,110,124.220		
14.1	MIP – Motor Insulation Protection	NO / YES		
15.	Packing	Sea fright, Air fright, No		
16.	Labeling			
17.	Instruction Manuals			
18.	Ex-Factory Delivery			
19.	Ship to Box Marking			
20.	Special Notes			
21.	Spare Parts	1.	7.	
		2.	8.	
		3.	9.	
		4.	10.	
		5.	11.	
		6.	12.	
	Issued by:		Date :	
	Approved by (Sales Manager) :		Date :	

4.5.2 ***Ordering a Cabinet Installed Soft Starter***

HRVS-DN (Cabinet enclosed)	Internal Order No:	Rev.:
Cabinet Manufacturer: **Solcon**	Solcon cat. No.:	
Customer Name:		

Project Name:		**Motor Name Plate:**	
Initiator (to be indicated on drawings)			
Contact Person:		**Application:**	
Tel:		**Qty:**	
Fax:		**Delivery:**	
E-mail:		**Order number**	

HRVS-DN	Rated current	Voltage	Control voltage supply	Control Input supply	Options	Lexan
	See below	See below	115VAC 230VAC 110VDC 125VDC 220VDC 24VDC	115VAC 230VAC 110VDC 125VDC 220VDC	**3M**-Modbus **3P**-Profibus **3D**-DeviceNet **5**-analog Card **D**-remote display **RU**-Russian characters. **ROC**-Chinese characters **Relay**-Relay PCB **NLR**-Special software for Multi **soft** stop applications	S RU N

No.	Main Components Model - P/N	QTY.
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		

MV Soft Starter Specification			
No.	**ITEM**	**Options**	**Specify**
1.	Mains Voltage	2300, 3300, 4160, 6000, 6600, 10000,11000 , 13200, 13800,15000	
2.	Starter FLC (Amp.)	At 2300-4160V: 60,110, 200, 320, 400, 700, 800,1000, 1200	
		At 6000-15000V: 70,140,250,300,400,500,700,800,1000, 1200	
3.	Control Supply Voltage	115VAC, 230VAC, 110VDC, 125VDC, 220VDC, 24VDC	
4.	Control Input Voltage	115VAC, 230VAC, 110VDC, 125VDC, 220VDC, 24VDC/AC	
5.	Test Voltage	230, 400, 500, 600, 690	
6.	Control Wiring	Standard - Fig. 1 (see manual) / Other-drawings attached	
7.	Control wires type		
8.	Relay Card	NO / YES	
9.	Analogue Output	NO / YES	
10.	MODBUS Communication	NO / YES	

MV Soft Starter Specification				
No.	**ITEM**	**Options**		**Specify**
11.	PROFIBUS Communication	NO / YES		
12.	DeviceNet Communication	NO / YES		
13.	Insulation Test Module	NO / YES		
14.	Enclosure Class	IP31,IP32,IP54,IP65	Keypad - Behind glass Window	
15.	Motor Insulation Protection (MIP)	YES/NO		
16.	Short Circuit Capacity			
17.	Paint 80µM	RAL 7032	Other	
18.	Incoming Cabinet	NO / YES		
19.	Input Cables	Top / Bottom		
20.	Output Cables	Top / Bottom		
21.	Door Opening	Open to the Left / Right		
22.	Door Locks & Stoppers	YES/NO		
23.	Mains On Load Switch			
24.	Main Fuse + Fuse Holder			
25.	Blown fuse indicator (striker-pin)			
26.	Line Contactor	NO / YES		
27.	Bypass Contactor	NO / YES		
28.	Capacitor Bank Contactor	NO / YES		
29.	Provision for Bank Connections	NO / YES		
30.	Motor Protection Relay	MPS-6, MPS 3000-P/C		
31.	Lamp Test System	NO / YES		
32.	Digital Panel Meter	NO / DPM-10		
33.	Space heater	NO / YES		
34.	Cooling Fan	NO / YES		
35.	Special Thick Painting	NO / YES		
36.	Packing	Sea fright, Air fright, No		
37.	Labeling			
37.1.	Solcon cabinet logo	NO / YES		
38.	Instruction Manuals	Standard – 2 sets at door pocket		
39.	Approvals			
39.1.	Marine Design Review	NO / YES		
39.2.	Requested Date			
40.	Drawings for Approval			
41.	Delivery - Chassis			
42.	Delivery – Final			
43.	Special Notes			
44.	Spare Parts	1.	7.	
		2.	8.	
		3.	9.	
		4.	10.	
		5.	11.	
		6.	12.	
45.	Packing Instructions			
46.	Marking			
	Issued by:		Date :	
	Approved by (Sales Manager) :		Date :	

4.6 Power Connections Description

Refer to Figure 12 below

Indication	Description	Remarks
L1, L2, L3	Connection to mains voltage up to 15,000V	Thyristor's PIV rating, internal circuitry and insulation defines the following voltage levels: **2,300V** +10%/ -15% 50/60Hz **4,160V** +10% /-15% 50/60Hz **6,000V** +10% /-15% 50/60Hz **6,600V** +10% /-15% 50/60Hz **10,000V** +10% / -15% 50/60Hz **11,000V** +10% / -15% 50/60Hz **13,200V** +10% / -15% 50/60Hz **13,800V** +10% / -15% 50/60Hz **15,000V** +10% / -15% 50/60Hz Each HRVS-DN is suitable for one of the above levels & for 50/60 Hz.
L1b, L2b, L3b (models up to 6.6kV only)	Preparation for bypass connection	Bypass preparation is standard in all HRVS-DN models up to 6.6kV. All HRVS-DN models must be operated with a Bypass Contactor. Bus bars and Bypass Contactor must be arranged to maintain current flow through the internal CTs after end of the acceleration process. Otherwise, current protection of the soft starter will not function.
U, V, W	Connection to motor	**Note:** Never connect power factor capacitors to soft starter output. Power Factor capacitors, if required should be connected to the HRVS-DN line side (mains).
G	Connection to ground	For proper operation and for safety reasons the HRVS-DN Power Section must be properly grounded.

Figure 12 illustrates the Power Section of HRVS-DN models up to 6.6kV.
HRVS-DN models from 10kV and up have no preparation for bypass (bypass must be performed in the cabinet), CTs are mounted externally to the Power Section and power supplies to the firing PCBs are mounted externally to the Power Section.

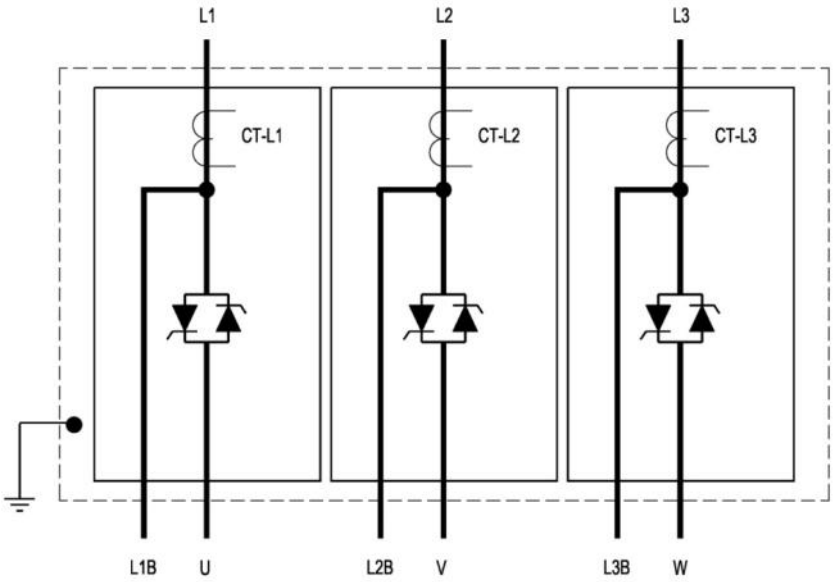


Figure 12 – HRVS-DN up to 6.6kV Power Section

4.7 Control Connections Description

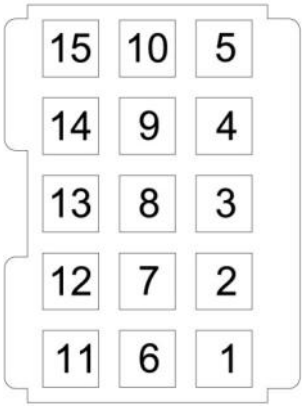
Refer to *Figure 13* page 29

Indication	Description	Remarks
Terminal 1	Control voltage - phase (positive – for DC control)	The control voltage operates the electronic circuitry and the auxiliary relay that controls the firing relay
Terminal 3	Control voltage - neutral (return – for DC control)	The available control voltages are: **115V** for 115V +10%/ -15% 50/60Hz **230V** for 230V +10%/ -15% 50/60Hz **24VDC** for 24VDC +10%/ -15% DC **110VDC** for 110V +10%/ -15% DC **125VDC** for 125V +10%/ -15% DC **220VDC** for 220V +10%/ -15% DC **Note:** It is recommended that terminals 1-3 be continuously connected to the control voltage.
Terminal 2	Firing control	An internal relay connects the control voltage from terminal 1 to terminal 2 when firing is required during Soft Start and Soft Stop. Typically external relay controlled by this terminal connect the firing transformer which feed the firing system.
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: **115V** for 115V +10%/ -15% 50/60Hz **230V** for 230V +10%/ -15% 50/60Hz **110VDC** for 110V +10%/ -15% DC **125VDC** for 110V +10%/ -15% DC **220VDC** for 220V +10%/ -15% DC
Terminal 6	Input – START command. • Input from a N.O. contact. • To SOFT START the motor, connect Control Input voltage to terminal 6 for at least 500mSec. **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. (except for UNDERCURRENT protection) • The soft starter ignores start within 3 seconds after stop. Wait at least 3 seconds before restarting.	

Indication	Description	Remarks
Terminal 7	Programmable input – TEST / RESET/MULTI SOFT STOP* (MULTI SOFT STOP applicable when special software for multi soft stop is ordered)	Refer to section 4.7.1 page 30.
Terminal 8	Programmable input – DUAL ADJUSTMENT / RESET	Refer to section 4.7.2 page 30.
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/ # STRT PREAL (N.O.)	IMM/# STRT PREAL is the immediate/# of starts pre-alarm output relay. • Voltage free 8A, 250VAC, 2000VA max. • Selection between functions is made from the keypad or through the communication. • Refer to section 7.8.7 page 73 for IMM/ # STRT PREAL programming. • Refer to section 4.7.3 page 30 for more details.
Terminal 11	Programmable IMM/ # STRT PREAL (N.C.)	
Terminal 12	Programmable IMM/ # STRT PREAL (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 HRVS-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 • Disconnection of Control Supply Refer to section 7.8.7 page 73 for FAULT RELAY TYPE programming.
Terminal 14	Programmable Fault Output relay (N.C.)	
Terminal 15	Programmable Fault Output relay (Common)	
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 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. Use an interposing relay. • Activating a valve after compressor has reached full speed • Loading a conveyor after motor reached full speed. Refer to section 7.8.3 page 60 for RUN CONTACT DLY programming
Terminal 17	Programmable End of Acceleration (Run) Output relay (N.C.)	
Terminal 18	Programmable End of Acceleration (Run) Output relay (Common)	

Indication	Description	Remarks
Terminal 19	External Fault #1 input	Input from a N.O. contact that is connected between terminal 19 and a control input voltage that is referred to terminal 21. The HRVS-DN will trip 2 seconds after the contact closes.
Terminal 20	External Fault #2 input	Same as terminal 19.
Terminal 21	Common to terminals 19 and 20.	This terminal is a reference for terminals 19 and 20. **Note:** When Control Supply and Control Input voltage to the external faults input are from the same source, connect a jumper between terminals 3 and 21.
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 5.11 page 36 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 7.8.8 page 75 for programming. • Refer to the Modbus communication manual section 16 page 131.
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 one of the following occurs: • The insulation level returns to normal for more than 60 seconds • HRVS-DN resets • Control Supply disconnection Refer to section 7.8.6 on page 71 for more details and programming. **Notes:** • Insulation test can be performed only when main voltage is not connected to the HRVS-DN, (upstream isolation device must be opened.) • For correct operation of Insulation test, it is important that the HRVS-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.
Terminal 26	Programmable Insulation Alarm Output relay (N.O.) (optional)	
Terminal 27	Programmable Insulation Alarm Output relay (N.C.) (optional)	
Terminal	Ground (optional)	Leave this terminal not connected. Ground the shield of the analog output signal at the recipient side. 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. Or reflects motor power and is related to Pn i.e., Full scale (10VDC or 20mA) is related to motor rated power. Motor rated power is set in the MAIN & PROTECT parameter. Refer to section 7.8.2 page 55.
Terminal out(-)	Analog output (-) (optional)	

Indication	Description	Remarks
Terminal out(+)	Analog output (+) (optional)	• Refer to section 6.5 page 43 for analog output dip switch setting. • Refer to section 7.8.7 page 73 for analog output programming.
Terminal 31	Start command output relay (N.O.) (optional)	Voltage free 8A, 250VAC, 2000VA max. closes upon start command via communication. (Modbus, Profibus or DeviceNet)
Terminal 32	Start command output relay (N.O.) (optional)	The contact opens on SOFT STOP or STOP commands via communication (Modbus, Profibus or DeviceNet). This contact is used to control the cabinet via the communication (i.e. closing the Line Contactor).
Terminal 33	Up to Speed Output relay (N.O.) (optional)	Voltage free 8A, 250VAC, 2000VA max. changes its position at the end of acceleration, after current is reduced below a programmable current and a time delay. The Up to Speed relay remains latched until the motor stops.
Terminal 34	Up to Speed Output relay (N.C.) (optional)	The Up to Speed relay is used to control the excitation system of a synchronous motor. Refer to section 7.8.3.2 page 66 for more details.
Terminal 35	Up to Speed Output relay (Common) (optional)	
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 7.8.9 page 75 for programming. • Refer to the Profibus communication manual section 17 page 149.
Terminal V-	0 Volt external power supply DeviceNet comm. (optional)	• Control, monitoring and setting parameters can be achieved via the DeviceNet connection. • Refer to section 7.8.9 page 7675 for programming. Refer to the DeviceNet communication manual section 17 page 164.
Terminal CL	Negative data line DeviceNet comm. (optional)	
Terminal Dr	Cable shield DeviceNet comm. (optional)	
Terminal CH	Positive data line DeviceNet comm.(optional)	
Fiber optic output #1	Phase L1 firing control via fiber optic wire.	
Fiber optic output #3	Phase L2 firing control via fiber optic wire.	
Fiber optic output #5	Phase L3 firing control via fiber optic wire.	
Fiber optic Input #7	Feedback signal from phase L1.	
Fiber optic Input #8	Feedback signal from phase L2.	
Fiber optic Input #9	Feedback signal from phase L3.	

Indication	Description	Remarks
15 pins connector		Pin 1 – L1 Voltage Pin 2 – No Connection Pin 3 – CT – L1(grounded) Pin 4 – CT – L1 Pin 5 – No Connection Pin 6 – L2 Voltage Pin 7 – No Connection Pin 8 – CT – L2 (grounded) Pin 9 – CT – L2 Pin 10 – No Connection Pin 11 – L3 Voltage Pin 12 – No Connection Pin 13 – CT – L3 (grounded) Pin 14 – CT – L3 Pin 15 – No Connection
G	Connection to ground	For proper operation and for safety reasons the Control Module must be properly grounded.

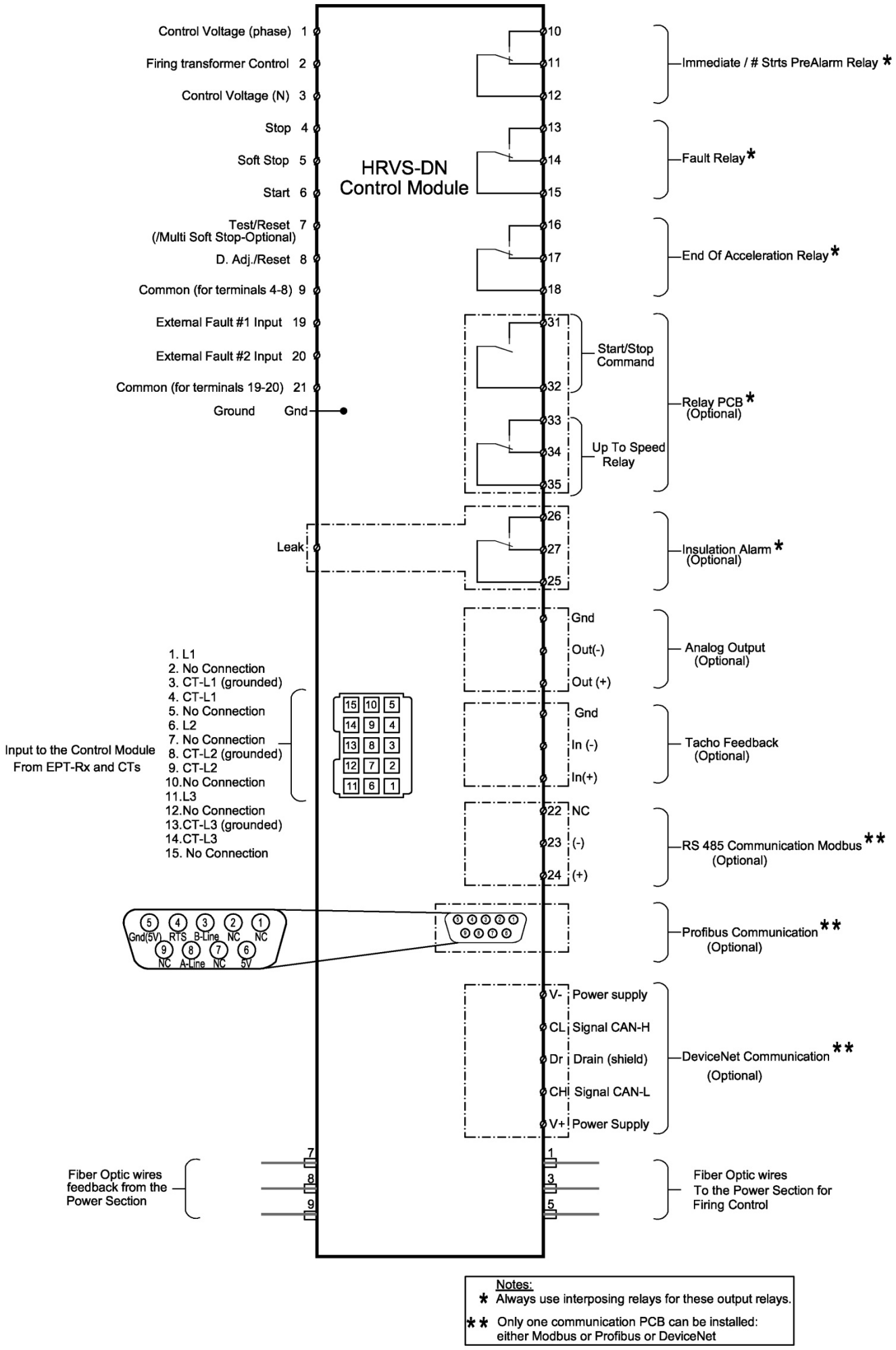


Figure 13 – Control Module Input/Output

4.7.1 Input Terminal 7 - Test/Reset/MULTI SOFT STOP

Input from a N.O. contact – the functions described above are selected from the keypad (refer to section 7.8.7 page 73) or software commands sent via the communication protocol (Modbus, Profibus or DeviceNet).

When RESET function is selected - connect terminal 7 using a N.O. momentary contact, to control input voltage to reset the HRVS-DN.

When TEST function is selected - connect terminal 7 to control input voltage (use a N.O. contact) to conduct a firing test to the HRVS-DN. For more details on the firing test refer to section 14.3 page 121.

When MULTI SOFT STOP optional function is selected - connect terminal 7 to control input voltage (use a N.O. contact) to operate the soft starter in a Multi Soft Stop procedure.

For wiring diagram refer to section 5.12 page 37.
For programming refer to section 7.8.7 page 73.

4.7.2 Input Terminal 8 - Dual Adjust/Reset

Input from a N.O. contact - selection between above functions is made from the keypad (refer to section 7.8.7 page 73) or through the communication (Modbus, Profibus or DeviceNet).

When DUAL ADJUSTMENT function is selected - connect terminal 8 to Control Input voltage to operate the HRVS-DN with the DUAL ADJUSTMENT characteristic. DUAL ADJUSTMENT characteristic is programmed as explained in section 7.8.5 page 70. You can switch between the primary and DUAL ADJUSTMENT settings before and/or during starting.

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

For wiring diagram refer to section 5.9 page 34.
For programming refer to section 7.8.7 page 73.

4.7.3 Output Terminals 10, 11 & 12 – Immediate/# Strts PreAlarm

Programmable functions (refer to section 7.8.7 page 73):
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:

- 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 13.5.3.1 page 117).

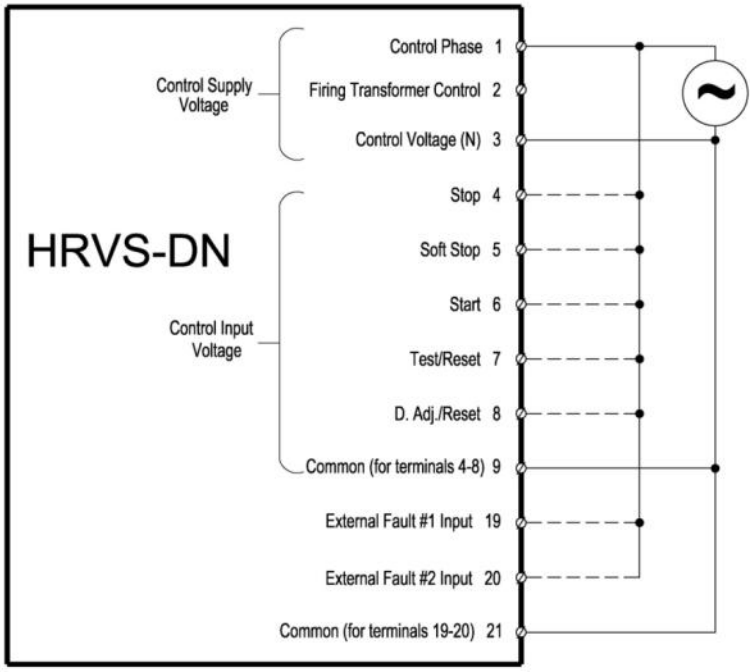
- **# Strts PreAlarm detection** - When configured to # STRTS PREALARM the relay is energized if a start command will cause the soft starter to trip on TOO MANY STARTS.

5. RECOMMENDED WIRING DIAGRAMS

5.1 Control Supply and Control Inputs From a Single Source

Notes:

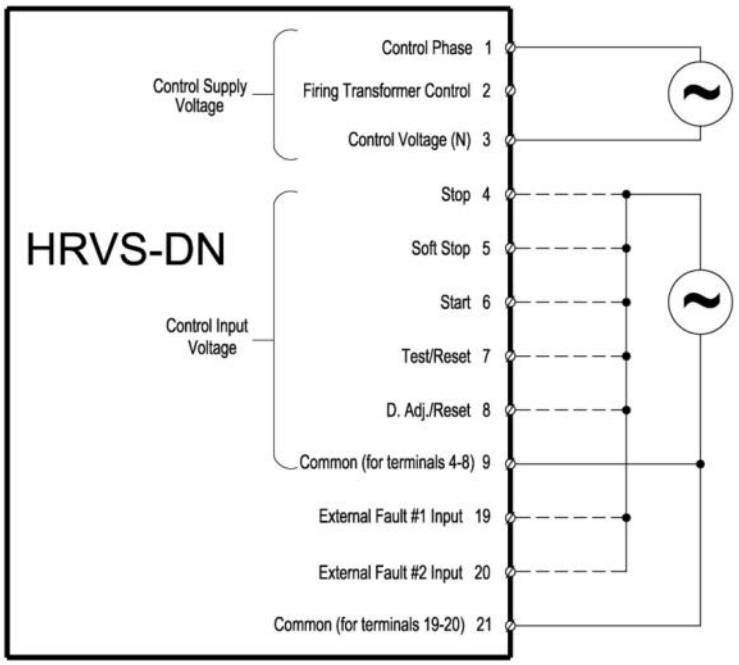
- Use this diagram when Control Supply, Control Input and Control Inputs for the External Faults are all from the same source.
- If External Faults are not used leave terminals 19, 20 and 21 not connected.
- Supply must be protected from short circuit and over load. 10A fuse must be used.
- It is recommended to use a separate fuse for the auxiliary circuits.



5.2 Separate Sources for Control Supply and Control Inputs

Notes:

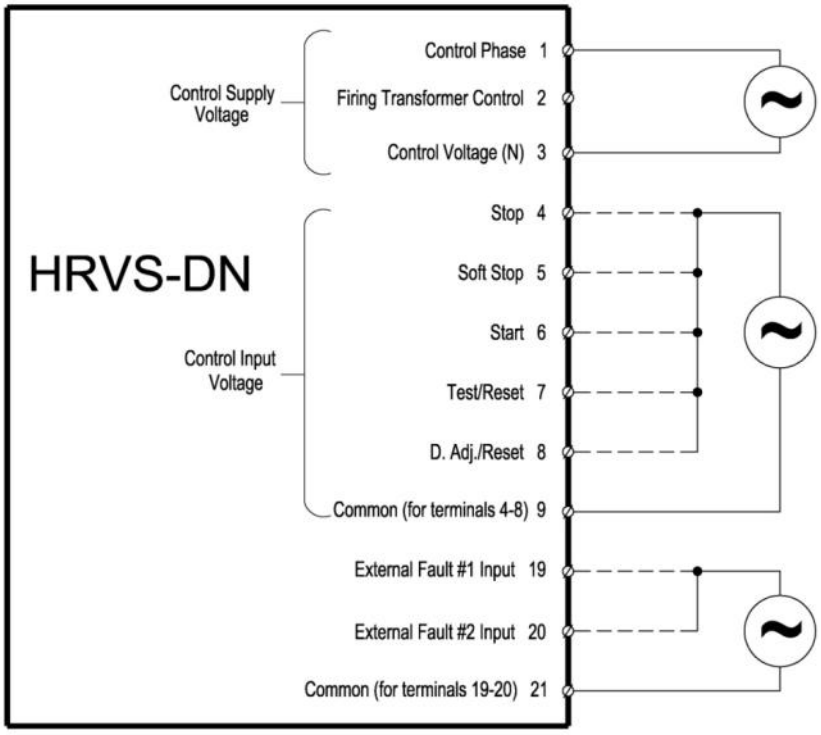
- Use this diagram when Control Supply and Control Input are from separate sources.
- If External Faults are not used leave terminals 19, 20 and 21 not connected.
- Supply must be protected for short circuit and over load. 10A fuse must be used.
- It is recommended to use a separate fuse for the auxiliary circuits.



5.3 Three Separate Sources for Control Supply and Control Inputs

Notes:

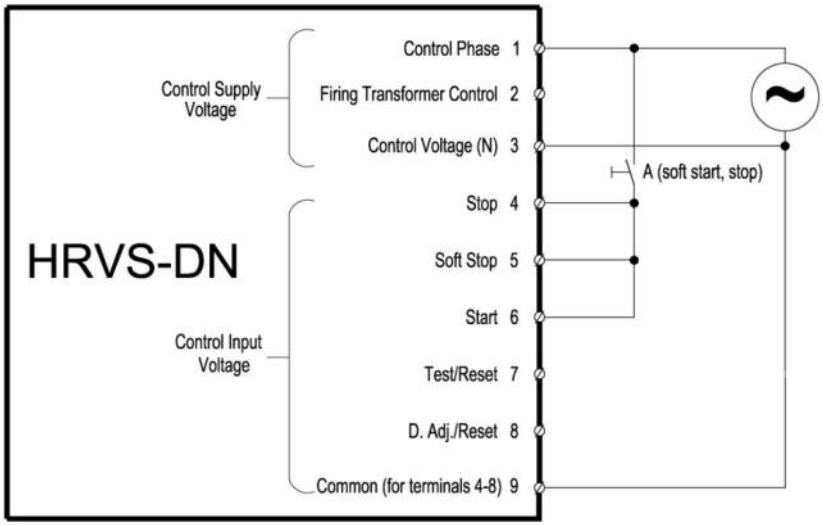
- Use this diagram when three separate sources for:
  - o Control Supply
  - o Control Input
  - o Control Input for the External Faults
- Supply must be protected for short circuit and over load. 10A fuse must be used.
- It is recommended to use a separate fuse for the auxiliary circuits.



5.4 Soft Start and Immediate Stop (No Soft Stop)

Notes:

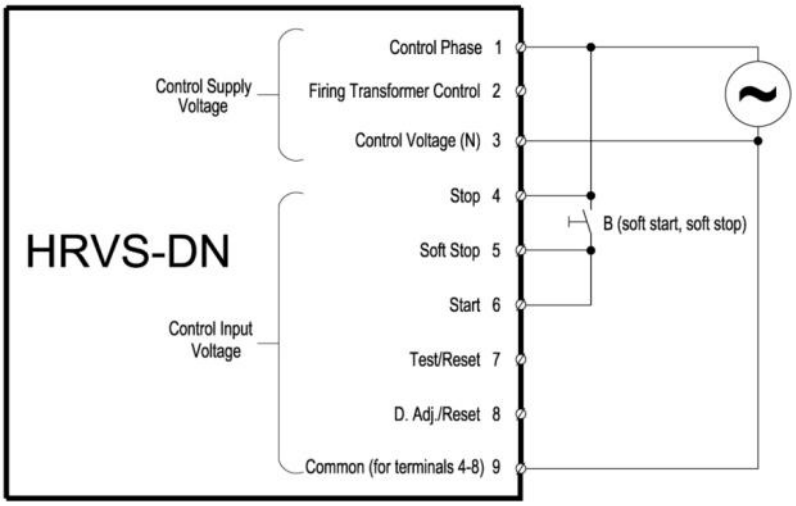
- When switch A closes the motor will soft start.
- When switch A opens the motor will stop immediately (no soft stop).
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



5.5 Soft Start and Soft Stop wiring

Notes:

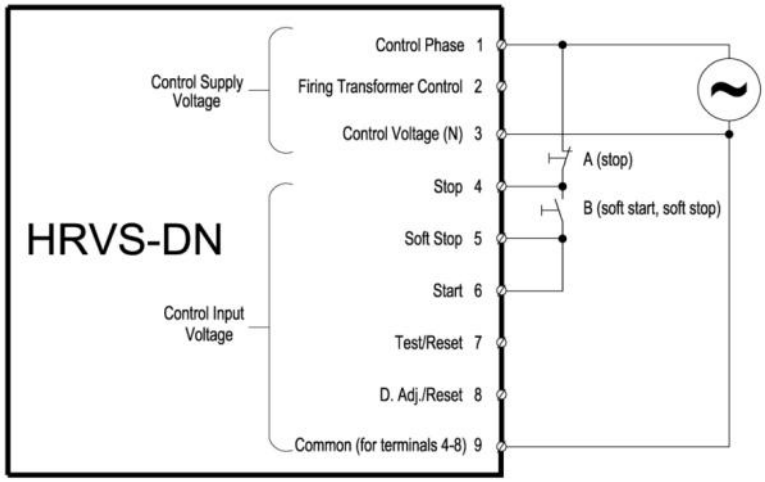
- When switch B closes the motor will soft start.
- When switch B opens the motor will soft stop.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



5.6 Soft Start, Soft Stop and Immediate Stop Wiring

Notes:

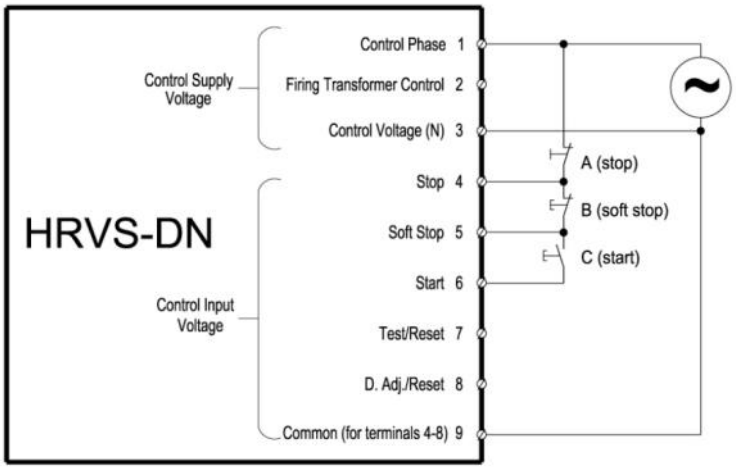
- When switch B closes the motor will soft start.
- When switch B opens the motor will soft stop.
- Switch A opens the motor will stop immediately.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



5.7 Soft Start, Soft Stop and Stop

Notes:

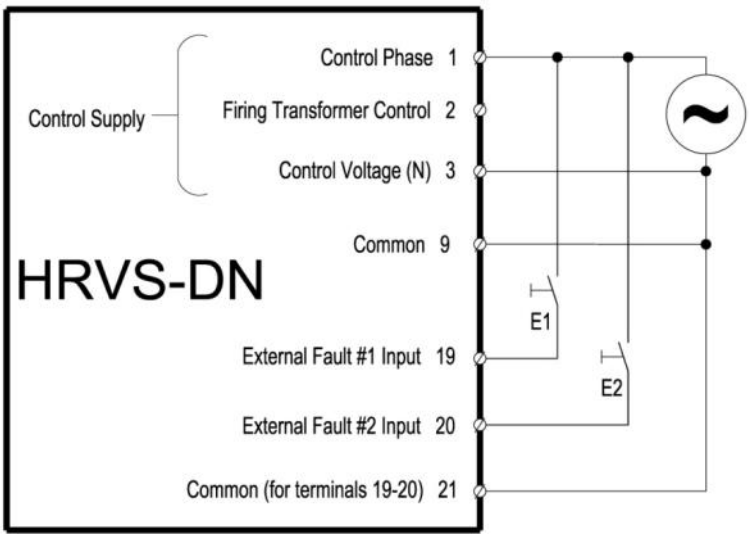
- Switch A can be used as an immediate stop.
- Switch B is used as a soft stop command to the HRVS-DN.
- Switch C is used as a momentary or maintained start command to the HRVS-DN.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



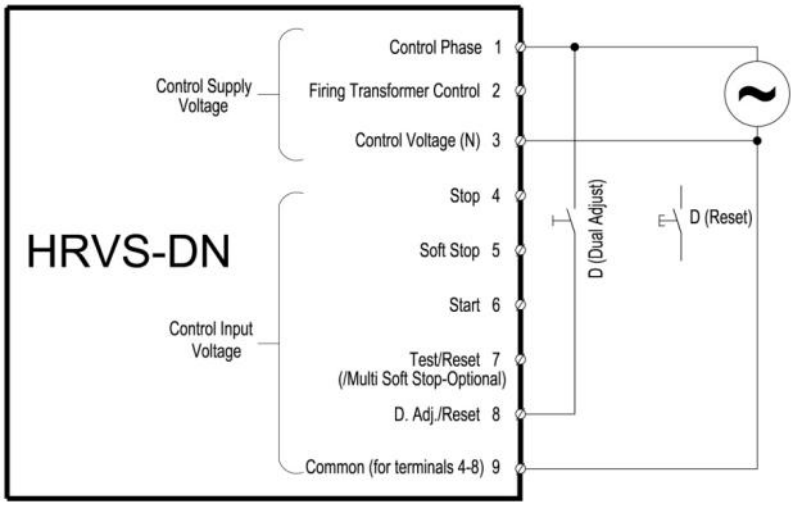
5.8 External Fault

Notes:

- Switches E1 and E2 can be used as EXTERNAL FAULT input.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



5.9 Dual Adjustment (Control Input #8)



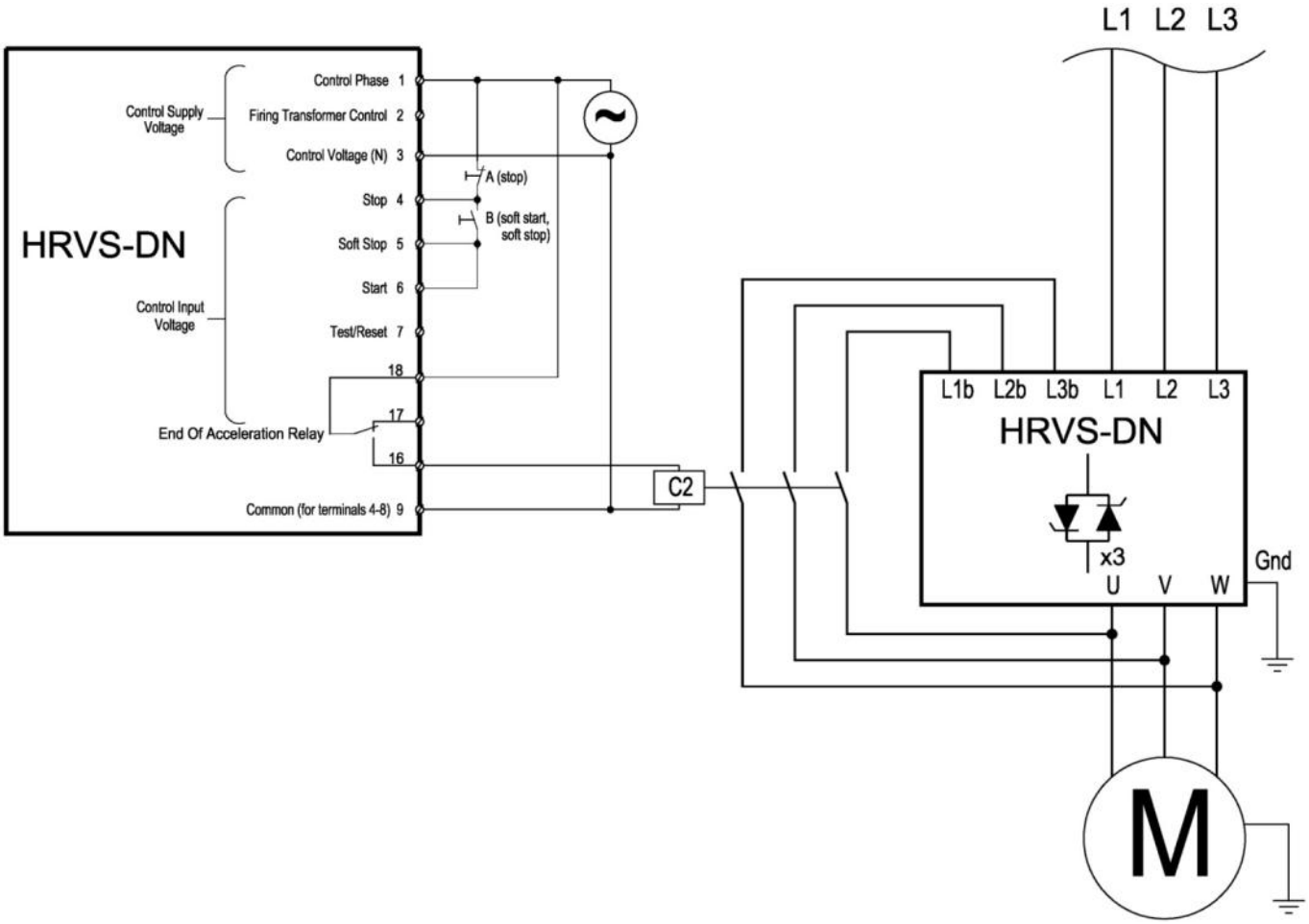
Notes:

When two set of starting/stopping parameters are required (for example for loaded/unloaded motor or for multistart applications) do the following:

- In I/O PROGRAMMING PARAMETERS mode page set PROG. INPUT #8 to DUAL ADJUSTMENT(default setting).
- Set first set of parameters in the MAIN & PROTECT, START PARAMETERS and STOP PARAMETERS mode pages:
  MOTOR FLA, INITIAL VOLTAGE, CURRENT LIMIT, ACC. TIME and DEC. TIME.

- Set second set of parameters in the DUAL ADJUSTMENT PARAMETERS mode page: DA: MOTOR FLA, DA: INIT. VOLT., DA: CUR. LIMIT, DA: ACC. TIME and DA: DEC. TIME.
- Start the motor with the primary set of parameters when switch D is open. Start the motor with the DA set of parameters when switch D is closed.
- Note that it is possible to change the starting parameters also during soft start or soft stop. (refer to section 13.5.3 page 116.)
- Note that if PROG. INPUT #8 is set to RESET than a momentary switch should be used for reset input to the soft starter.

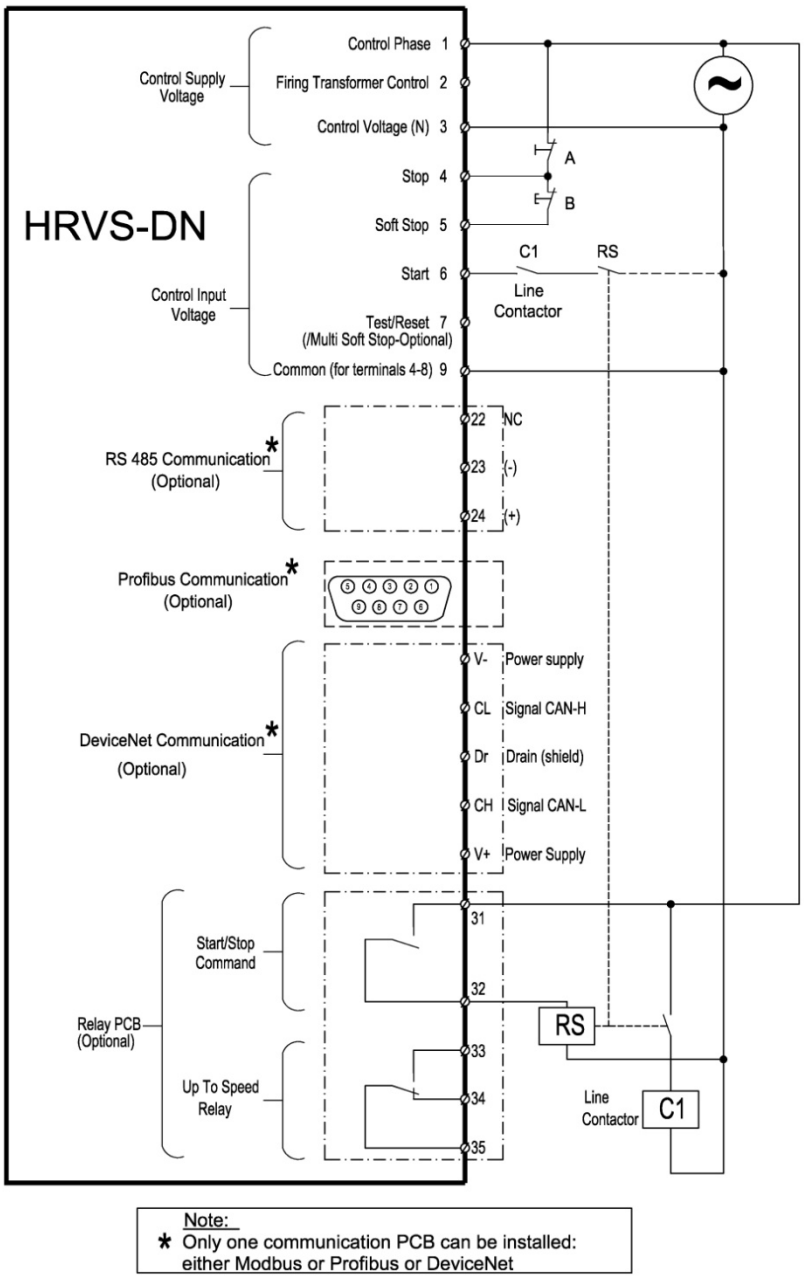
5.10 **Bypass Contactor**



Notes:

- End of Acceleration relay is energized after a programmed time delay RUN CONTACT DLY. Refer to section 7.8.3 page 60 for programming.
- The End of Acceleration relay is de-energized when:
  - SOFT STOP or STOP signals are initiated
  - Fault condition occurs.
- When a SOFT STOP signal is provided, the End of Acceleration relay returns to its original position thus opening the Bypass Contactor. Thereafter, the voltage will gradually ramp down to zero, soft stopping the motor.
- Use an interposing relay (not shown) to control the Bypass Contactor.

5.11 Operating via Communication Links



Notes:

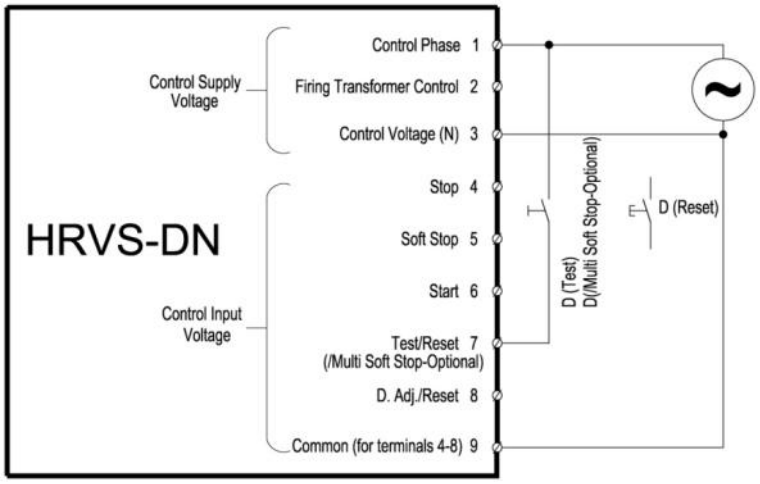
- In order to operate via communication, either Modbus, Profibus or DeviceNet optional PCBs must be installed and wired properly.
- In addition, optional Relay PCB must be installed in the control nodule. The optional Relay PCB will close a contact (terminals 31 & 32) when start signal is initiated via communication. This contact typically controls the Line Contactor via RS relay. When Line Contactor is closed mains power I connected to L1, L2 and L3.
- Start command to the soft starter (terminal 6) is initiated by an auxiliary contact from the Line Contactor in series to an auxiliary start relay (RS) thus ensuring that the Line Contactor is closed.
- HRVS-DN must be programmed to enable control (not only monitoring). Refer to section 7.8.8 and 7.8.9 page 75 for programming.
- Make sure that after programming, Control Supply voltage is disconnected and reconnected so that the communication settings will take affect.
- HRVS-DN will close the start/stop relay via communication commands **UNLESS** switches A or B are opened.

WARNING!	**Beware!** HRVS-DN Control Module and Power Section must be grounded at all times. When testing the HRVS-DN control/communication it is possible to use the Control Module only without the Power Section. **The Control Module MUST be properly grounded to avoid danger of electrical shock!!**

5.12 **Control Input #7**

Notes:

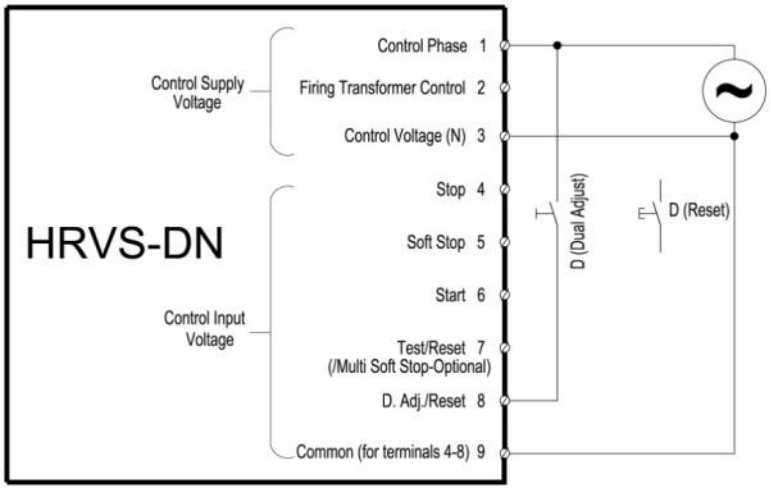
- Switch D can be used as a Test input/RESET/MULTI SOFT STOP (optional) as programmed in I/O PROGRAMMING PARAMETERS. Refer to section 7.8.7 page 73.
- MULTI SOFT STOP is applicable only when an optional software for MULTI SOFT STOP is installed.
- RESET function requires a momentary contact to operate.
- Test function is a unique feature of the HRVS-DN to test the operation of the firing system of the HRVS-DN. Refer to section 14.3 page 121.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



5.13 **Control Input #8**

Notes:

- Switch D can be used as a DUAL ADJUST/RESET as programmed in I/O PROGRAMMING PARAMETERS. Refer to section 7.8.7 page 73. Refer also to section 5.9 page 34.
- RESET function requires a momentary contact to operate.
- Drawing shows Control Supply and Control Input from the same source. Refer to section 5.2 and 5.3 for Control Supply and Control Input from separate sources.



6. INSTALLATION OF IP00 (OEM KIT) IN A CABINET

6.1 Mounting

The HRVS-DN must be mounted vertically. Allow sufficient space for suitable airflow above and below the HRVS-DN.
Verify that minimum clearances specified in the applicable codes/standards are applied.
In addition, when glass epoxy of any-type or thickness is utilized within the cabinet assembly, minimum clearances specified in the applicable codes/standards are not lowered.

Notes:
(1) Do not mount the HRVS-DN near heat sources.
(2) Cabinet internal temperature should not exceed 50°C. Refer to section 6.2 page 40 for heat dissipation of the soft starter during operation.
(3) Protect the HRVS-DN from dust and corrosive atmospheres.
(4) In order to perform low voltage test, certain provisions should be applied:
   a. When a step-down transformer provides the Control Voltage, allow for supply of Control Voltage from external source
   b. In HRVS-DN up to 6.6kV, allow sufficient access to the rear side of the EPT-Tx (to allow low voltage Test Harness connection).
   c. To allow phase disassembly, provide for the following assembly precautions (Refer to *Figure 14*) for:
      i. Horizontal support bar (this bar is mounted on the inner side of the M.V. door).
      ii. Two support rods 850mm length with M12 thread.

   For phase disassembly, the horizontal support bar is mounted at the front of the cabinet, bracing the support rods.

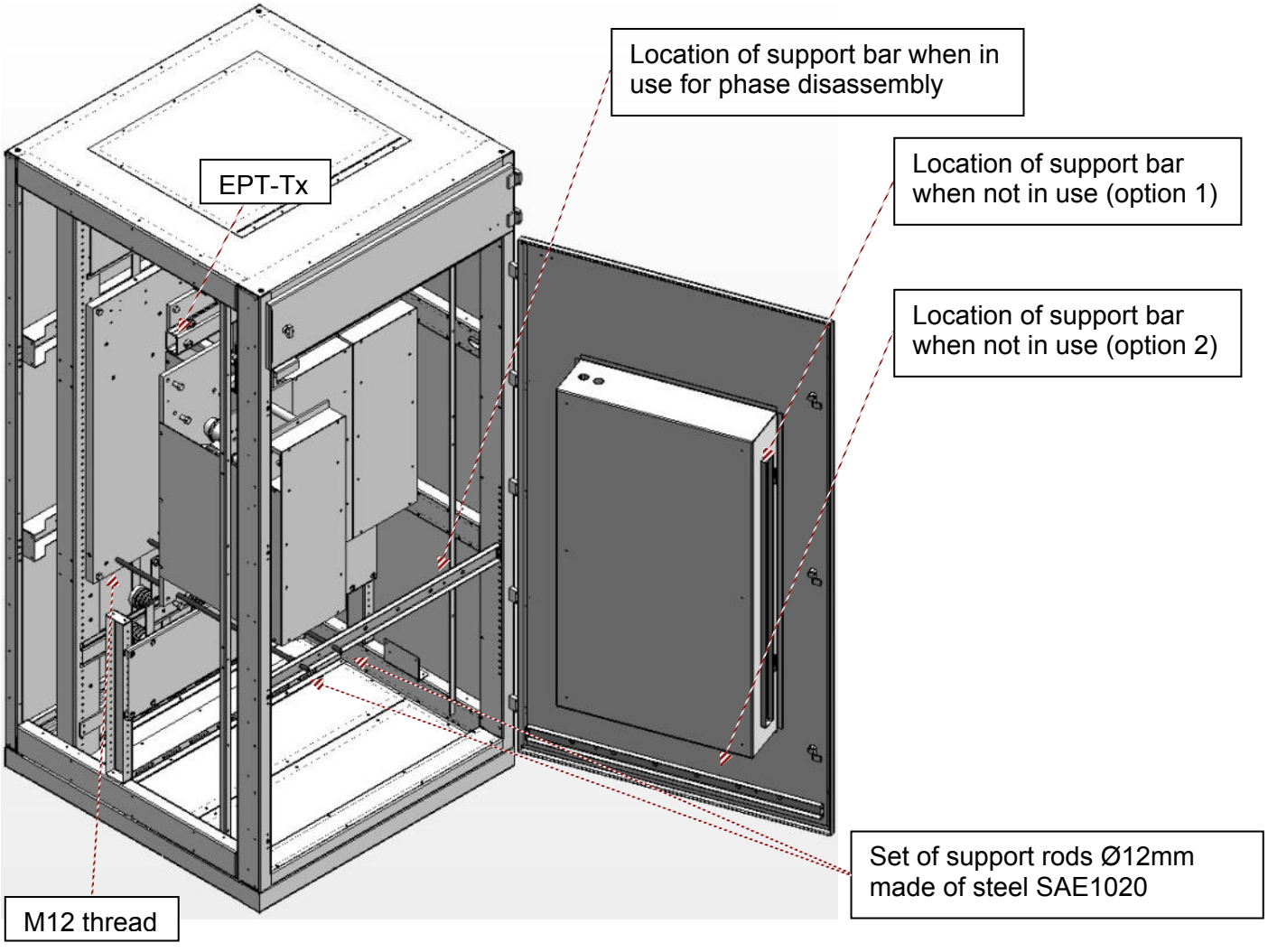


Figure 14 – HRVS-DN up to 6.6kV - Phase Disassembly Accessories

6.1.1 ***Low Voltage Section***

(1) Control Module should be installed in a convenient place allowing access from every direction (this is achieved by mounting it on a hinged plate).
(2) Due to fiber optic being a frail conductor, insert the fiber optic wires only at assembly completion.
(3) Avoid fiber optic wires bending or stretching (minimal bending radius of 4 cm).
(4) Avoid fiber optic wires installation near heat source.
(5) Control Module and EPT-Rx cases are well grounded.
Refer to standard cabinet wiring as detailed in section 10 page 87.

6.2 Temperature Range & Heat Dissipation

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

During soft start the maximum heat dissipation in Watts is as follows:
2,300V – 24xFLC [W]
3,300V – 72xFLC [W]
4,160V – 72xFLC [W]
6,600V – 72xFLC [W]
10,000V – 120xFLC [W]
11,000V – 120xFLC [W] – for marine applications: 144xFLC [W]
13,800V – 144xFLC [W] – for marine applications: 168xFLC [W]
15,000V – 192xFLC [W]

6.3 Control Module Main PCB and Optional PCBs

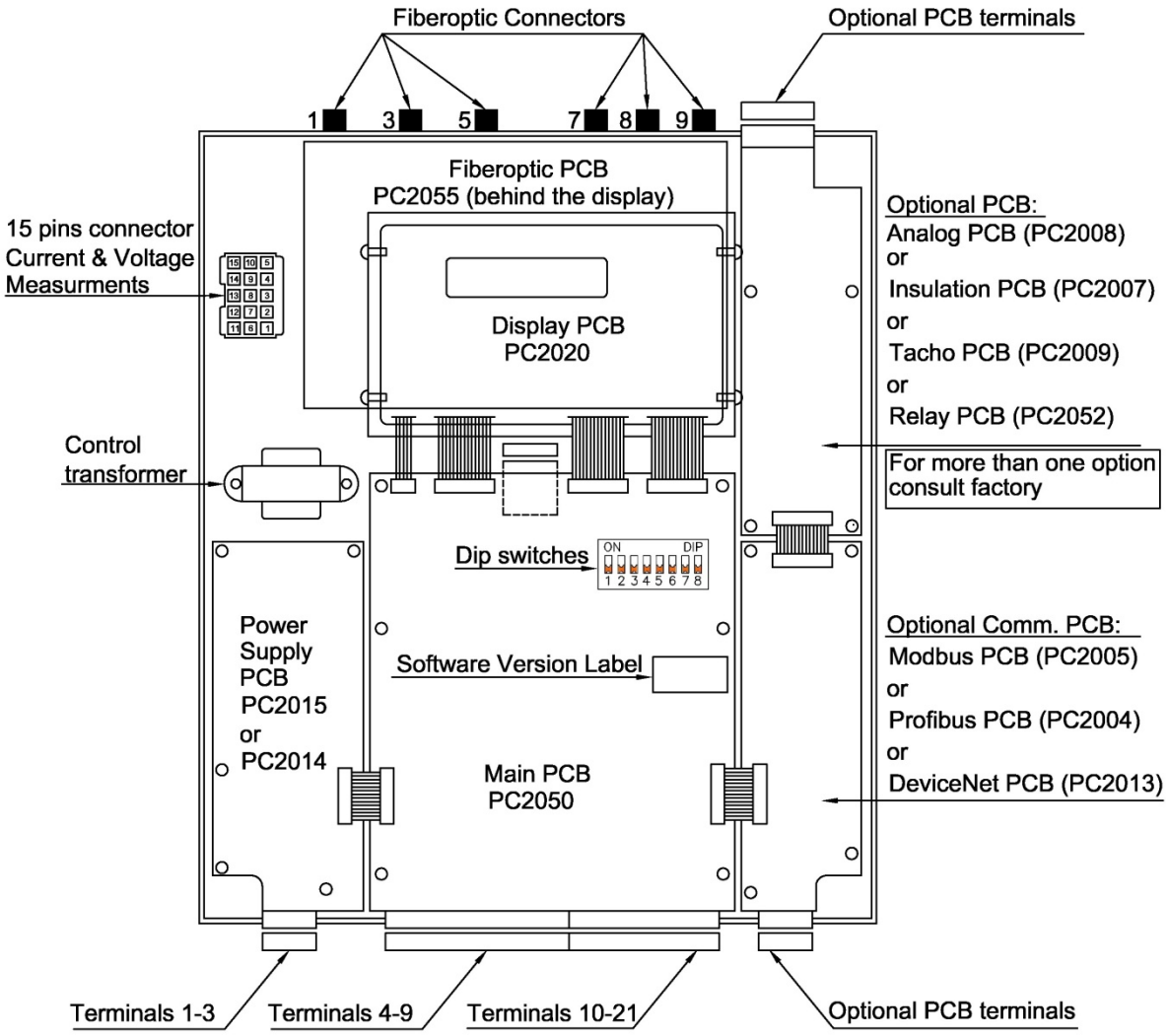


Figure 15 - HRVS-DN Control Module

Remove top cover of the Control Module to access the main PCB, optional PCBs and dip switches.

6.4 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.

No.	Switch Function	Switch Off	Switch On
1	Display format	Minimized	Maximized
2	Tacho feedback	Disabled	Enabled
3	Must be off	-	-
4	LCD language selection	See tables below section 6.4.3 page 41.	
5			
6			
7	Extended settings	Disabled	Enabled
8	Software lock	Open	Locked

6.4.1 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 7.7 page 51.

Maximized Mode - Switch #1 – On	Minimized Mode Switch #1 – Off
Display only	Display only
Main & Protect.	Main parameters
Start parameters	Start parameters
Stop parameters	Stop parameters
Dual adjustment	Statistical data
Fault parameters	
I/O programming	
Communication parameters	
Statistical data	

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

Set switch #2 to on when using tacho feedback.

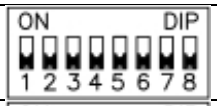
Note:

To operate tacho feedback consult with the factory for specific settings for each application.

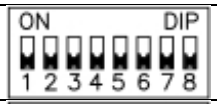
6.4.3 Switches # 4, 5 & 6 – Language Selection

Language selection defined by the switch settings and software version shown on the internal label (shown on section 6.3 page 40**).**

For software version: **MVSTMB.GN-ddmmyy** (where “ddmmyy” represents software version date in 6 digit format. i.e., 120809 refers to August 12th, 2009)

Language	Switch #4	Switch #5	Switch #6	Position of Switches
English	Off	Off	Off	
French	Off	Off	On	
German	Off	On	Off	
Spanish	Off	On	On	
Turkish	On	Off	Off	

For software version: **MVSTMB.HB-ddmmyy**

Language	Switch #4	Switch #5	Switch #6	Position of Switches
English	Off	Off	Off	
Russian	Off	Off	On	
Special Set	Off	On	Off	
Chinese	Off	On	On	

6.4.4 *Switch # 7 – Extended Settings*

EXTENDED SETTINGS corresponds to:

Parameter	Range Switch #7 - Off	Range switch #7 - On
INITIAL VOLTAGE	10-50%	5(1)-80%
CURRENT LIMIT	100-400%	700% with the maximum limitation of: 440x(FLC/FLA)
PULSE LEVEL	100-400%	700% If PULSE TIME>1sec, with the maximum limitation of: 440x(FLC/FLA)
ACCELERATION TIME	1-30 seconds	1-90 seconds
DECLERATION TIME	0-30 seconds	0-90 seconds
MAX. START TIME	1-30 seconds	1-250 seconds

Note:

(1) Setting the INITIAL VOLTAGE to lower than 10% is not practical for loaded motors.

WARNING! Operator's responsibility!	EXTENDED SETTINGS are for use in very special applications only! **Do not** set to switch #7 to **on** unless HRVS-DN is significantly larger than the motor! When using extended settings for the HRVS-DN **you must** be extremely careful to avoid damaging the motor or HRVS-DN.

6.4.5 *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.

6.5 Analog I/O (Option 5) (Terminals Gnd, Out (-), Out (+))

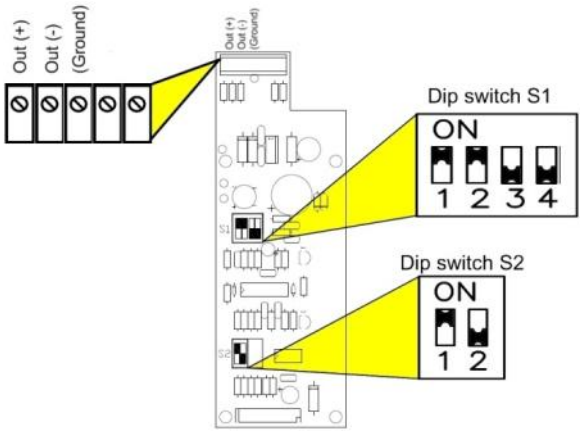


Figure 16 – Optional Analog PCB

Analog PCB is located on the upper right side of the control nodule.
(Refer to *Figure 15* page 10)

Ground Terminal (terminal Gnd)

Leave this terminal not connected. Ground the shield of the analog output signal at the recipient side**.**

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 or 0….200% of RATED MOTOR PWR .
Refer to section 7.8.7 on page 73 for ANALOG OUTPUT programming.

Switch No.	**4-20 mA***	**0-20 mA**	**0-10VDC**
S1- Switch # 1	On	On	Off
S1 - Switch # 2	On	On	Off
S1 - Switch # 3	Off	Off	On
S1 - Switch # 4	Off	Off	On
S2 - Switch # 1	On	Off	Off
S2 - Switch # 2	Not used	Not used	Not used

***** Factory default setting

6.6 Insulation test (Option 4) (Terminals 25, 26, 27 and Leak)

When this option is installed, resistor units RU-7 (Un≤7,200V) or RU13 (7,200>Un≤13,800V) must be installed as shown:

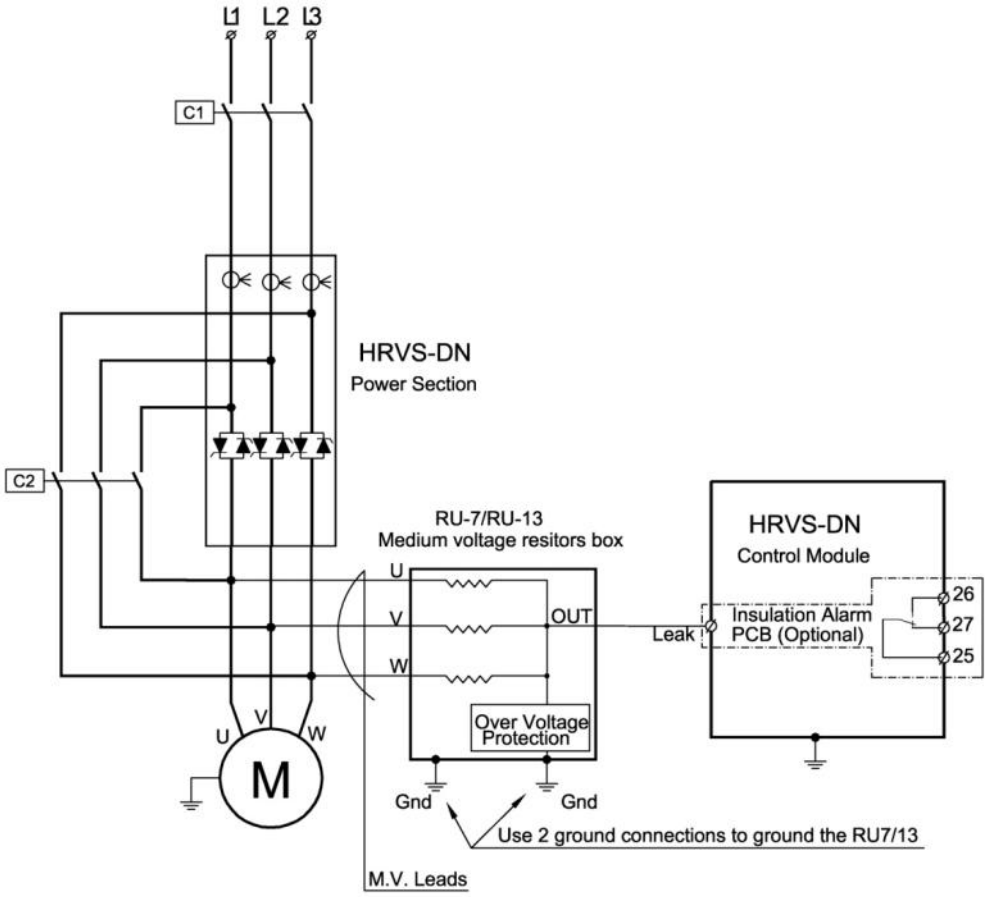


Figure 17 – Optional Insulation PCB Wiring

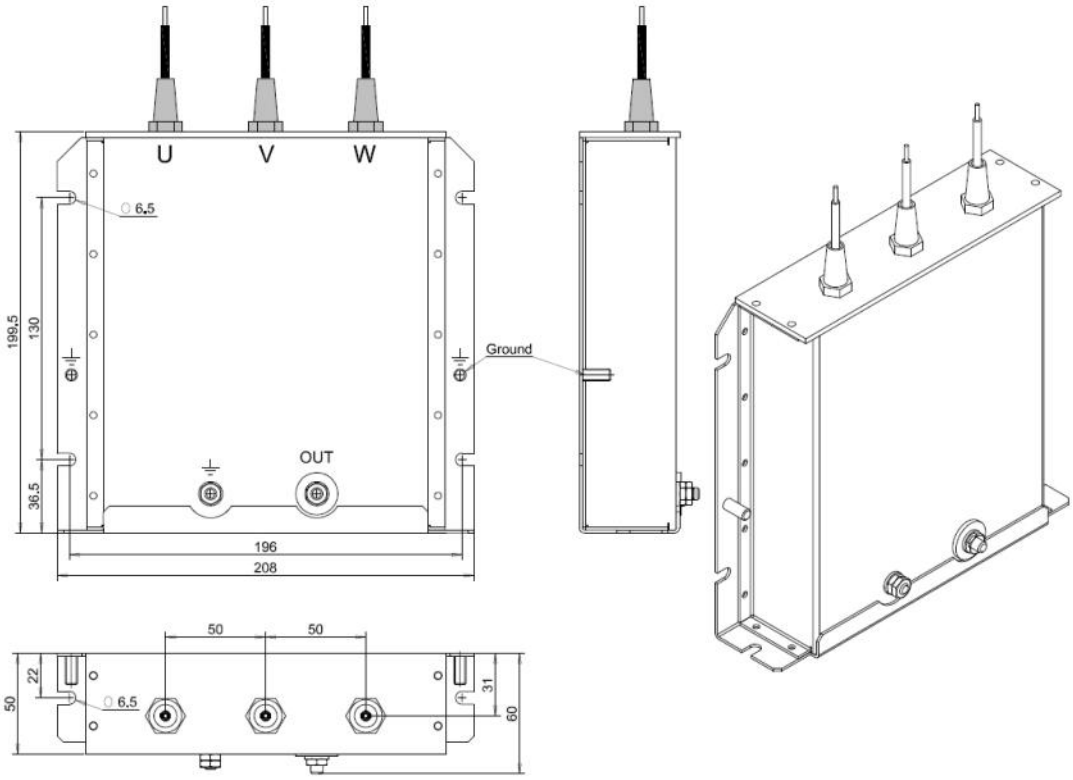


Figure 18 – RU-7, Resistor Unit – Dimensional Drawing

6.7 Remote Key-Pad Installation

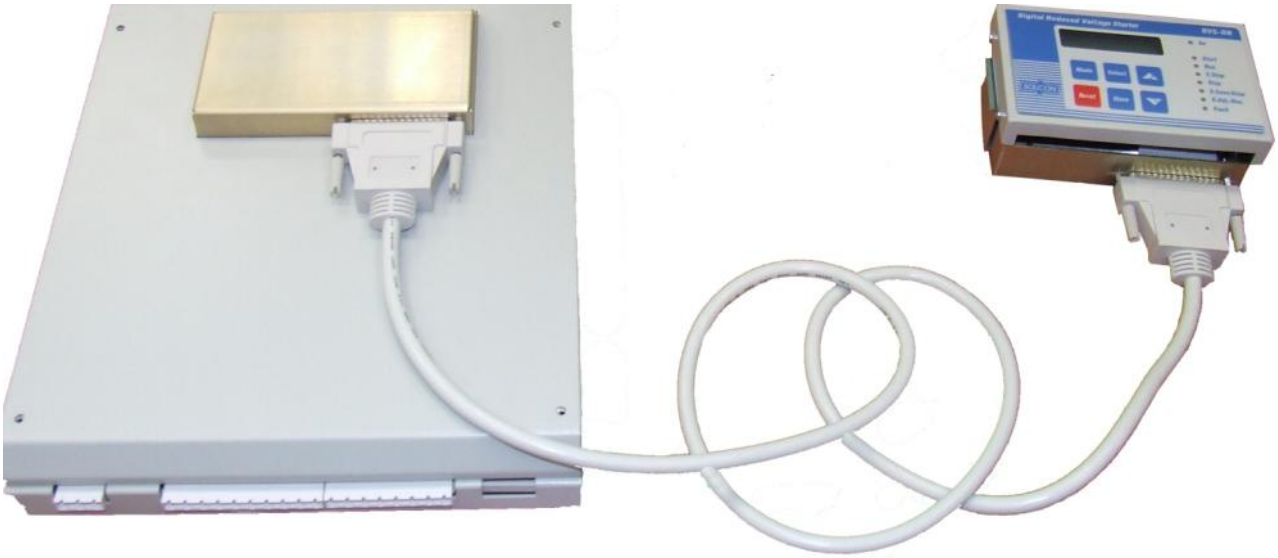


Figure 19 - Remote Key Pad, Connection Cable and Control Module.

Note: Cable length is 1.5 meters (consult with the factory if a longer cable is required).

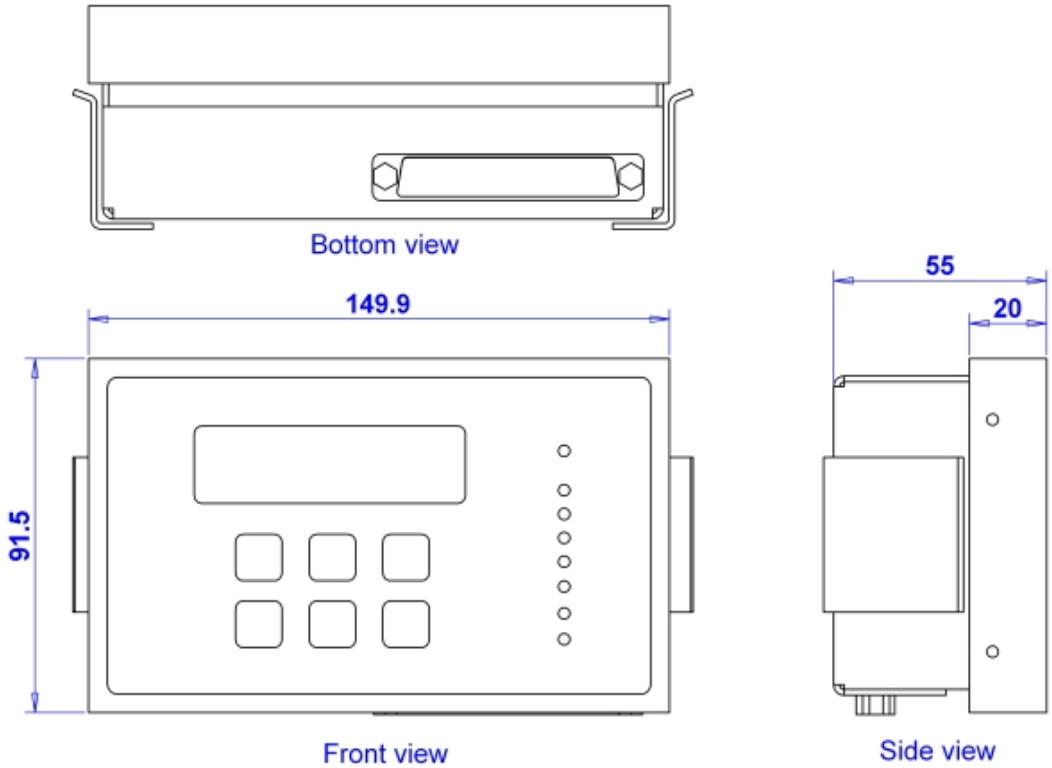


Figure 20 - Remote Key Pad - Dimensions

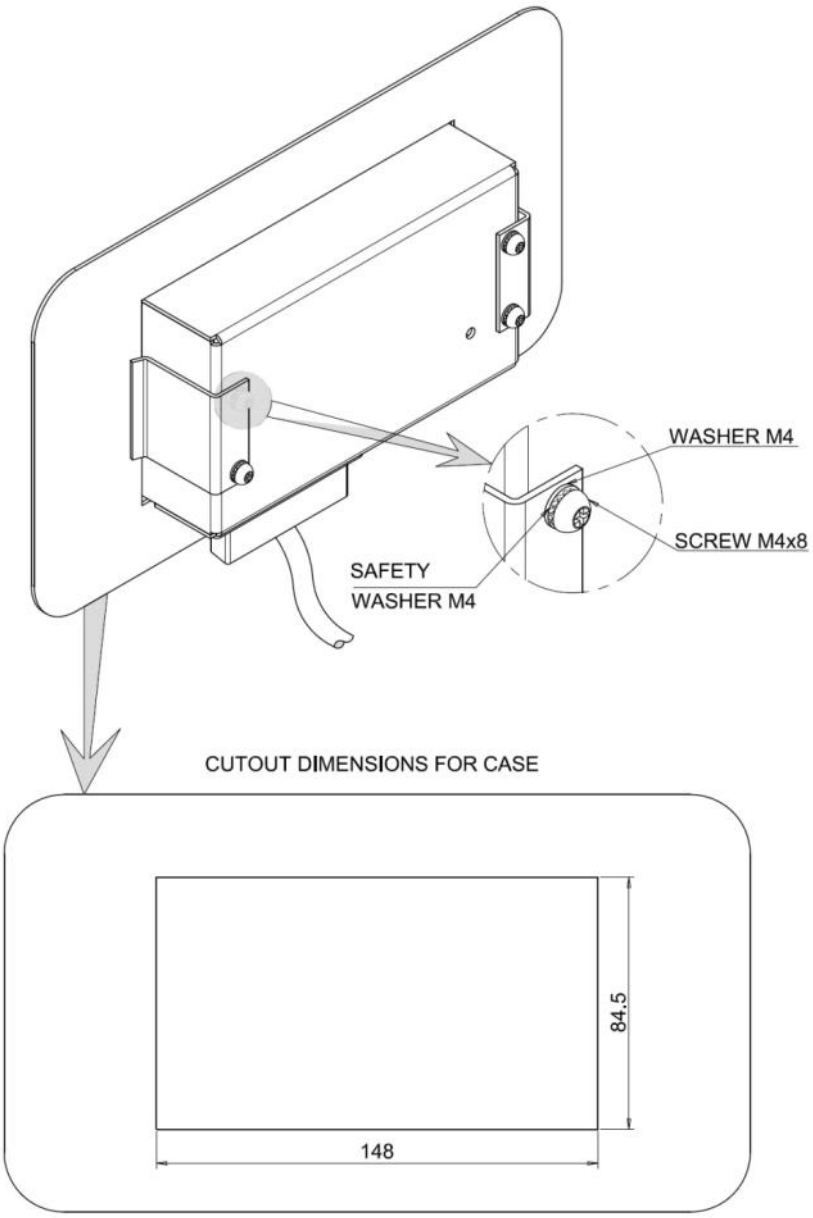


Figure 21 - Remote Key Pad - Mechanical Installation and Cut-out Dimensions

7. CONTROL KEYPAD

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

(1) Two lines of 16 alphanumeric characters each with selectable languages – English, French, German, Spanish and Turkish. Russian and Chinese 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, Test,, D.Adj., Fault*)

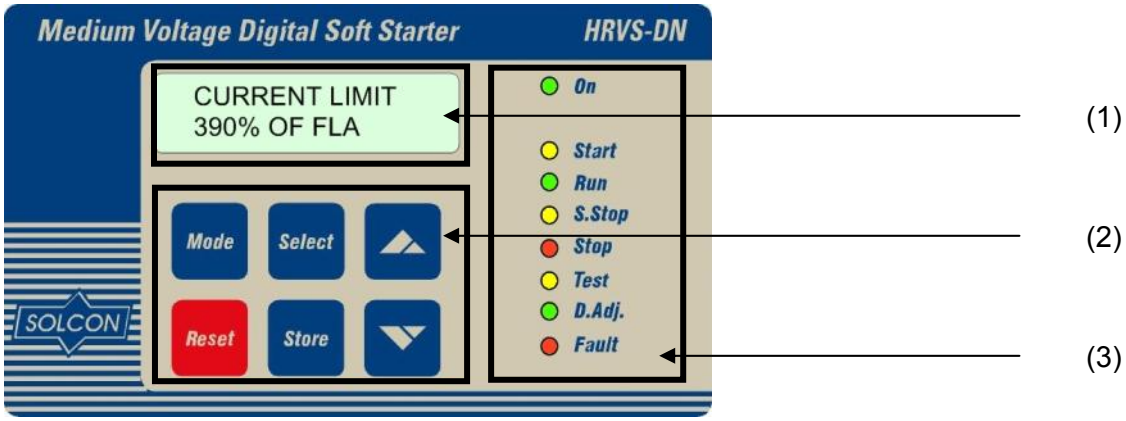


Figure 22 - HRVS-DN Control Keypad

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 HRVS-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 message will display. **Note**: Pressing this button at any other time has no effect.
Reset	Resets the HRVS-DN after a fault has been dealt with **and** the start command has been removed (except for UNDERCURR. TRIP – Refer to section 7.8.6 page 71 parameter UNDER CUR. RESET). 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 HRVS-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 receiving full voltage.
●	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	*Test*	Lights when the HRVS-DN is in TEST mode.
●	Green	*D.Adj.*	Lights when DUAL ADJUSTMENT is in operation.
●	Red	*Fault*	Lights upon operation of any of the built-in protections. Flashes when: • Date and time are not set • INSULATION ALARM optional relay is activated. Refer to section 7.8.6 page 71. • Fault was detected but TRIP AFTER BYPASS is set to DISABLE. Refer to section 7.8.6 page 71.

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 Upon first Control Voltage Connection

Few seconds after first connection of control voltage the *Fault* LED will flash and the LCD will display:

```
ALARM:
SET TIME & DATE
```

It is advised to set the time and date as described on section 7.6.6 on page 50.
If time and date are not set properly no time stamp to the faults shown in the STATISTICAL DATA.
Note:
If the *Reset* button is pressed this message will not appear any more!!

7.6 Special Actions Performed in TEST/MAINTENANCE Mode

7.6.1 Run Self Test

Press the **Mode** and ▼ keys simultaneously.
The *Test* LED will light and 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 *Test* LED will turn off and the LCD will display:

SELF TEST PASSED

And after a few seconds the LCD will display:

I1	I2	I3	
0	0	0	%

7.6.2 ***View Software Version***

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

TEST/MAINTENANCE ***OPTIONS***

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

BTL-R-16/09/2008 MVSTMB.GN-121008

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

I1	I2	I3	
0	0	0	%

7.6.3 ***Obtain Default Parameters***

Press the **Mode** and ▼ keys simultaneously.
The *Test* LED will light and 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 *Test* LED will turn off and the LCD will display:

DATA SAVED OK

And after a few seconds the LCD will display:

I1	I2	I3	
0	0	0	%

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 **RATED LINE VOLTAGE** and **STARTER FLC** (as shown on the label of the HRVS-DN) and all other parameters in MAIN & PROTECT mod page. Refer to section 7.8.2 page 55.

7.6.4 ***Reset Statistical Data***

Press the **Mode** and ▼ keys simultaneously.
The *Test* LED will light and 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 *Test* LED will turn off and 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:

I1	I2	I3	
0	0	0	%

Note!	Resetting STATISTICAL DATA resets the thermal capacity register as well.

7.6.5 ***Calibrate Voltage and Current (Factory Use Only!)***

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

TEST/MAINTENANCE ***OPTIONS***.

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

VOLTAGE ADJUST. 98 % OF Vn

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

CURRENT ADJUST. 23 % OF FLC

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

I1	I2	I3	
0	0	0	%

7.6.6 ***Setting Time and Date***

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

TEST/MAINTENANCE ***OPTIONS***.

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

hh.mm	mm.dd.yy
01:10	01/19/08

The hour value blinks.
modify the hour value with ▼ or ▲ keys.
Press **Store** key.
The LCD will display (now the minutes value blinks):

hh.mm	mm.dd.yy
12:10	01/29/08

Repeat the same procedure as for the hour settings to the minutes, day, month and year settings.
After **Store** key is pressed last time the LCD will display:

TEST/MAINTENANCE ***OPTIONS***

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

I1	I2	I3	
0	0	0	%

7.7 **Mode Pages**

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

I1	I2	I3	
0	0	0	%

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

MAIN & PROTECT. - **** -	
START PARAMETERS - **** -	
STOP PARAMETERS - **** -	
DUAL ADJUSTMENT PARAMETERS	These pages are skipped if HRVS-DN is programmed to MINIMIZED MODE and are shown only in MAXIMIZED MODE. Refer to section 6.4.1 on page 40 for changing mode from MINIMIZED MODE to MAXIMIZED MODE.
FAULT PARAMETERS - **** -	
I/O PROGRAMMING PARAMETERS	
COMM. PARAMETERS - **** -	
STATISTICAL DATA - **** -	

7.8 Overview of All Mode Pages and Factory Defaults

				Appears only in MAXIMIZED MODE[1]
DISPLAY MODE PAGE	**MAIN & PROTECT** - **** -	**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**
I1 I2 I3 0 0 0 %	RATED LINE VOLT. 6600 VOLT	SOFT START CURVE 1 (STANDARD)	SOFT STOP CURVE 1(STANDARD)	DA: INIT. VOLT. 30%
I1 I2 I3 0 0 0 A	STARTER FLC 150 AMP.	START TACHO. GAIN[2] 0(MIN. GAIN)	STOP TACHO. GAIN 0(MIN. GAIN)	DA: INIT. CURRENT [2] 100%
VOLTAGE FREQ. 3,300V 49.9Hz	MOTOR FLA 150 AMP.	PULSE LEVEL 70% OF FLA	DEC. TIME 0 SEC.	DA: CUR. LIMIT 400% OF FLA
POWER 1,500 KW	RATED MOTOR PWR 1000 KW	PULSE TIME 0.0 SEC.	FINAL TORQUE 0 (MIN.)	DA: ACC. TIME 10 SEC.
REACTIVE POWER 500 KVAR	SERVICE FACTOR 100 %	INITIAL VOLTAGE 30 %	COAST DOWN DELAY OFF	DA: DEC. TIME 0 SEC.
POWER FACTOR 0.85	UNDERCURR. TRIP 0% OF FLA	INITIAL CURRENT [2] 100 %	STORE ENABLE STOP PARAMETERS	DA: MOTOR FLA 150 AMP.
THERMAL CAPACITY 0 %	UNDERCURR. DELAY 10 SEC.	CURRENT LIMIT 400% OF FLA		STORE ENABLE D. ADJ. PARAMETERS
MOTOR INSULATION [2] 52.8Mohm	O/C – SHEAR PIN 850% OF FLA	ACC. TIME 10 SEC.		
OPTION CARD NOT INSTALLED	O/C DELAY 0.5 SEC.	MAX. START TIME 30 SEC.		
	OVERLOAD CLASS IEC CLASS 10	NUMBER OF STARTS 1		
	OVERLOAD PROTECT ENABLE WHILE RUN	STARTS PERIOD 20 MIN.		
	UNBALANCE TRIP 20% OF FLA	START INHIBIT 15 MIN.		
	UNBALANCE DELAY 5 SEC.	RUN CONTACT DLY 5 sec.		
	GND FAULT TRIP 20% OF FLA	TURN BYPS ON AT [2] 120% OF FLA		
	GND FAULT DELAY 5 SEC.	MIN TIME TO BYPS [2] 3 SEC.		
	UNDERVOLT. TRIP 70% OF Vn	STORE ENABLE START PARAMETERS		
	UNDERVOLT. DELAY 5 SEC.			
	OVERVOLT. TRIP 120% OF Vn			
	OVEERVOLT. DELAY 2 SEC.			
	STORE ENABLE MAIN & PROTECT.			

[1] - Refer to section 6.4.1 on page 40 for changing mode from MINIMIZED MODE to MAXIMIZED MODE.
[2] - Parameter viewed only when used.

Appears only in MAXIMIZED MODE[1]	Appears only in MAXIMIZED MODE[1]	Appears only in MAXIMIZED MODE[1]		Appears when in TEST/MAINTENANCE[2]
FAULT PARAMETERS - **** -	**I/O PROGRAMMING PARAMETERS**	**COMM.PARAMETERS** - **** -	**STATISTICAL DATA** - **** -	**TEST/MAINTENANCE ***OPTIONS***
Display and default values	**Display and default values**	**Display and default values**	**Display and default values**	**Display and default values**
UV & PL AUTO RST NO	PROG. INPUT #7 RESET	COMM. PROTOCOL MODBUS	T SINCE LST STRT NO DATA	RUN SELF TEST? PUSH UP ARROW
UNDER CUR. RESET OFF	PROG. INPUT #8 DUAL ADJUSTMENT	BAUD RATE 19200 (MODBUS)	LAST STRT PERIOD NO DATA	PROGRAM VERSION MVSTMB.GN-110808
BYPASS OPEN TRIP ENABLE	FAULT RELAY TYPE FAULT	PARITY CHECK EVEN	LAST STRT MAX I NO DATA	STORE ENABLE DEFAULT PARAMET.
TRIP AFTER BYPASS ENABLE	IMM. RELAY TYPE IMMEDIATE	SERIAL LINK NO. OFF	TOTAL RUN TIME 0 HOURS	RESET STATISTICS
BY-PASS AUTO RST NO	RELAY ON DELAY 0 SEC.	S. LINK PAR. SAVE DISABLE	TOTAL # OF START 0	VOLTAGE ADJUST. 15 % OF Vn
SET CURVE 0 FLT ENABLE	RELAY OFF DELAY 0 SEC.	SER. LINK CONTROL DISABLE	TOTAL ENERGY 0 KWH	CURRENT ADJUST 99% OF FLC
PWR ON & NO STRT ENABLE	ANALOG OUTPUT RELATIVE CURRENT	MODBUS TIME OUT OFF	TOTAL R. ENERGY 0 KVARH	hh.mm mm.dd.yy 00:00 01/01/00
INSULATION ALARM OFF	STORE ENABLE I/O PROG.PARAM.	FRONT COM ADDRES OFF	LAST TRIP NO DATA	
INSULATION TRIP OFF		STORE ENABLE COMM. PARAMETERS	TRIP CURRENT 0 % OF FLA	
PHASE SEQUENCE POSITIVE		**Applicable when Modbus optional PCB installed**	TOTAL # OF TRIPS 0	
STORE ENABLE FAULT PARAMETERS	**Applicable when DeviceNet optional PCB installed**	**Applicable when profibus optional PCB installed**	LAST 10 TRIPS hh.mm mm.dd.yy	
	COMM. PROTOCOL DVICENET	COMM. PROTOCOL PROFIBUS	. . . . .	
	BAUD RATE AUTO	BAUD RATE AUTO		
	PARITY CHECK AUTO	PARITY CHECK AUTO	PREVIOUS TRIP -10 hh.mm mm.dd.yy	
	DEVICENET ID SET MANUALLY	PROFI.NETWORK ID 126		
	S. LINK PAR. SAVE DISABLE	S. LINK PAR. SAVE DISABLE		
	SER. LINK CONTROL DISABLE	SER. LINK CONTROL DISABLE		
	MODBUS TIME OUT OFF	MODBUS TIME OUT OFF		
	FRONT COM ADDRES OFF	FRONT COM ADDRES OFF		
	STORE ENABLE COMM. PARAMETERS	STORE ENABLE COMM. PARAMETERS		

[1] - Refer to section 6.4.1 on page 40 for changing mode from MINIMIZED MODE to MAXIMIZED MODE.
[2] - Refer to section 7.6 on page 48 for entering TEST/MAINTENANCE.

7.8.1 ***Display Mode – Page 0***

I1 I2 I3 0 0 0 %	Displays in MINIMIZED MODE and MAXIMIZED MODE
Display	**Description**
I1 I2 I3 0 0 0 %	Displays operating current in each of the three phases as a percentage of motor FLA (Full Load Ampere). HRVS-DN's Default Display. After pressing the **Mode** or **Select** keys, a time delay is initiated. Following the delay the LCD returns to this display.
I1 I2 I3 0 0 0 A	Displays the current of the motor in Ampere.
VOLTAGE FREQ. 3300V 49.9Hz	Displays line voltage and frequency. Frequency is displayed after start command only.
POWER 0 KW	Displays motor power in kW.
REACTIVE POWER 0 KVAR	Displays motor reactive power in kVAR.
POWER FACTOR 0.83	Displays motor power factor.
THERMAL CAPACITY 0 %	Displays motor's THERMAL CAPACITY in %. When THERMAL CAPACITY is 100% motor will trip on OVERLOAD. **Note:** Resetting the STATISTICAL DATA resets the THERMAL CAPACITY register.
MOTOR INSULATION 52.8Mohm	Displays the motor winding insulation level (displays only if the optional motor insulation PCB is installed).
OPTION CARD Not Installed	Displays only if there is no motor insulation or analog optional PCBs installed in the HRVS-DN. **Note:** This ignores the optional communication PCBs. Even if a communication PCB is installed this message can display.

Notes:
In this page parameters cannot be programmed.
Browsing the display in Display Mode is possible by pressing the Select key or the ▼ or ▲ keys.

7.8.2 *Main & Protect. – Page 1*

MAIN & PROTECT. - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
RATED LINE VOLT. 6600 VOLT	2300-15000	Sets HRVS-DN's rated voltage. HRVS-DN's rate voltage should be as shown on its label. Refer to section 13.2 on page 112. **Note**: Setting RATED LINE VOLTAGE to other than the value on the label will cause a wrong operation and wrong readings of the soft starter.
STARTER FLC 150 AMP.	20 – 1800A	Sets HRVS-DN's FLC (Full Load Current) HRVS-DN's FLC should be as shown on its label. Refer to section 13.2 on page 112. **Note**: Setting FLC to other than the value on the label will cause a wrong operation and wrong readings of the soft starter.
MOTOR FLA 150 AMP.	30-100% of STARTER FLC	Sets motor's FLA (Full load Ampere) Should be programmed as shown on the motor's name plate.
RATED MOTOR PWR 1000 KW	50-40000KW	Sets motor rated power as indicated on its name plate.
SERVICE FACTOR 100%	100-130%	Sets motor rated service factor as indicated on its name plate.
UNDERCURR. TRIP 0% OF FLA	0%(=OFF)/ 20-90% of FLA	Sets UNDER CURRENT TRIP protection. Sets the time delay for UNDER CURRENT TRIP protection. Trips the HRVS-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). • Can be set to AUTO RESET. Refer to section 7.8.6 page 71.
UNDERCURR. DELAY 10 SEC.	1-40SEC.	
O/C – SHEAR PIN 850% OF FLA	100-850% of motor's FLA setting	Sets OVER CURRENT SHEAR PIN protection. Sets O/C – SHEAR PIN DELAY time. Operational when HRVS-DN is energized and has three trip functions: **At all time** - If I > 850% of FLC it trips the HRVS-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 HRVS-DN after O/C DELAY (see here after) **At run time** - If I > O/C – SHEAR PIN setting of FLA it trips the HRVS-DN after O/C DELAY. **Note:** The OVER CURRENT SHEAR PIN protection is not intended to replace fast acting fuses to protect from short current!
O/C DELAY 0.5 SEC.	0.0 – 5sec. **Note:** When set to 0.0 it is practically up to 200msec.	

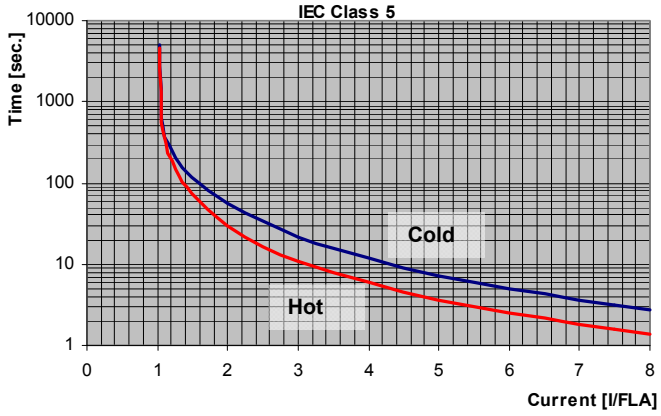
<table>
<tr><td>MAIN & PROTECT.
- **** -</td><td colspan="2">Displays in MINIMIZED MODE and MAXIMIZED MODE</td></tr>
<tr><td>Display and Default Values</td><td>Range</td><td>Description</td></tr>
<tr><td>OVERLOAD CLASS
IEC CLASS 10</td><td>IEC CLASS 5/
IEC CLASS 10/
IEC CLASS 15/
IEC CLASS 20/
IEC CLASS 25/
IEC CLASS 30/
NEMA CLASS 5/
NEMA CLASS 10/
NEMA CLASS 15/
NEMA CLASS 20/
NEMA CLASS 25/
NEMA CLASS 30/</td><td>Sets OVERLOAD CLASS characteristics
Sets OVERLOAD PROTECT functionality.
The HRVS-DN allows motor protection according to IEC class 5, 10, 15, 20, 25 or 30
or according to NEMA class 5, 10, 15, 20, 25 or 30.
Tripping curves are shown on section 7.8.2.1 page 58.
The OVERLOAD protection incorporates a THERMAL CAPACITY register that calculates heating minus dissipation of the motor.
The HRVS-DN trips when the register fills up. (THERMAL CAPACITY=100%)
The time constant, in seconds, for cool down after overload trip is:
<table><tr><th>Class</th><th>5</th><th>10</th><th>15</th><th>20</th><th>25</th><th>30</th></tr><tr><td>IEC</td><td>160</td><td>320</td><td>480</td><td>640</td><td>510</td><td>960</td></tr><tr><td>NEMA</td><td>140</td><td>280</td><td>420</td><td>560</td><td>700</td><td>840</td></tr></table></td></tr>
<tr><td>OVERLOAD PROTECT
ENABLE WHILE RUN</td><td>DISABLE/
ENABLE
WHILE RUN/
ENABLE</td><td>The overload protection can be set to protect the motor as set in the OVERLOAD PROTECT parameter:
ENABLE – motor is protected at all time.
ENABLE WHILE RUN – motor is protected only when in Run.
DISABLE – motor is not overload protected by the soft starter.
<u>Note:</u>
In order to restart after OVERLOAD trip, the thermal register should be 50% or less.</td></tr>
<tr><td>UNBALANCE TRIP
20% OF FLA</td><td>10-100%/ OFF</td><td rowspan="2">Sets UNBALANCE TRIP level.
Sets UNBALANCE TRIP DELAY.
Trips the HRVS-DN when current unbalance increases above level that was set for a time longer than UNBALANCE DELAY.
<u>Notes</u>:
Becomes operational after the start signal.</td></tr>
<tr><td>UNBALANCE DELAY
5 SEC.</td><td>1 –60sec.</td></tr>
<tr><td>GND FAULT TRIP
20% OF FLA</td><td>10-100%/OFF</td><td rowspan="2">Sets GND FAULT TRIP level.
Sets GND FAULT TRIP DELAY.
Trips the HRVS-DN when ground current increases above level that was set for a time longer than GND FAULT DLY.
<u>Note</u>:
Becomes operational after the start signal.</td></tr>
<tr><td>GND FAULT DELAY
5 SEC.</td><td>1 –60sec.</td></tr>
<tr><td>UNDERVOLT. TRIP
70% OF Vn</td><td>50-90%</td><td rowspan="2">Sets UNDER VOLTAGE TRIP level.
Sets UNDERVOLT TRIP DELAY.
Trips the HRVS-DN when mains voltage drops below the level that was set for a time longer than UNDERVOLT DELAY.
<u>Notes</u>:
• Becomes operational only after the start signal.
• When voltage drops to zero (voltage outage) the HRVS-DN will trip immediately, thus overriding the delay.
• Can be set to AUTO RESET. Refer to section 7.8.6 page 71.</td></tr>
<tr><td>UNDERVOLT. DELAY
5 SEC.</td><td>1 –10sec.</td></tr>
<tr><td>OVERVOLT. TRIP
120% OF Vn</td><td>110-125%</td><td rowspan="2">Sets OVER VOLTAGE TRIP.
Sets OVERVOLT TRIP DELAY.
Trips the HRVS-DN when mains voltage increases above the level that was set for a time longer than OVERVOLT DELAY.
Can not be set lower than the UNDER VOLTAGE setting.
<u>Note</u>:
Becomes operational only after the start signal.</td></tr>
<tr><td>OVERVOLT. DELAY
2 SEC.</td><td>1 –10sec.</td></tr>
</table>

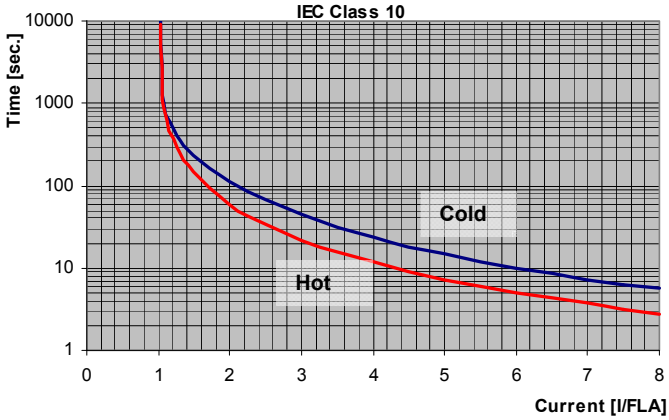
MAIN & PROTECT. - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
STORE ENABLE MAIN & PROTECT.		Storing modified parameters To store selected parameters scroll through all parameters until you reach STORE ENABLE MAIN & PROTECT, then press the **Store** key. After you store a parameter successfully the DATA SAVED OK message will display. If HRVS-DN fails to store the parameter the LCD Will display the STORAGE ERROR message (refer to section 8.2.4 on page 80 for more details). **Note**: Pressing the **Store** key when the STORE ENABLE XXXXX PARAMETERS message does not appear on the display has no effect.

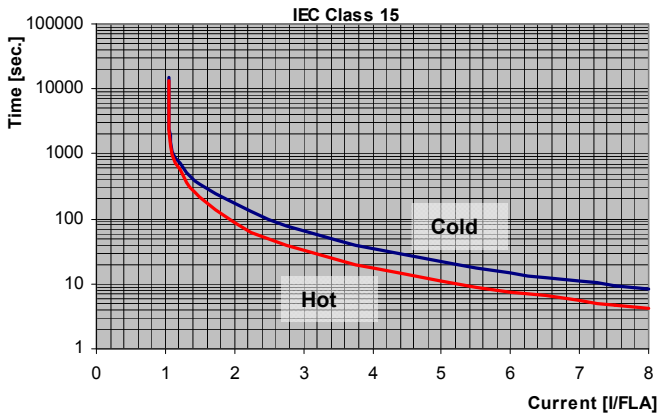
7.8.2.1 Tripping Curves of the Integrated Overload Protection

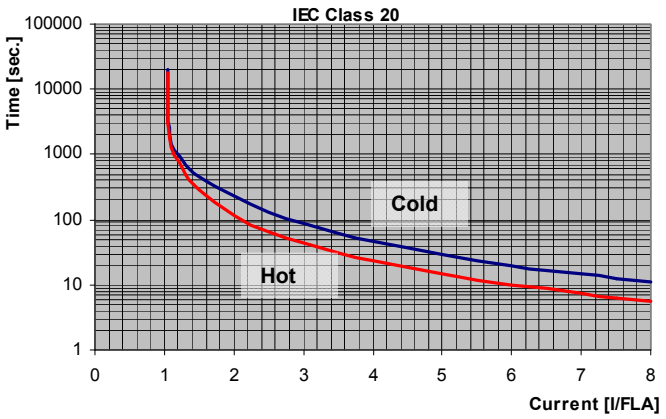
The HRVS-DN allows motor protection according to IEC class 5, 10, 15, 20, 25 or 30 OR according to NEMA class 5, 10, 15, 20, 25 or 30.

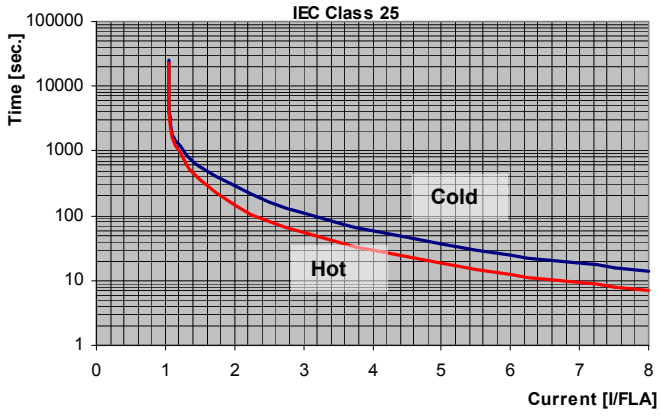
IEC Class OVERLOAD curves

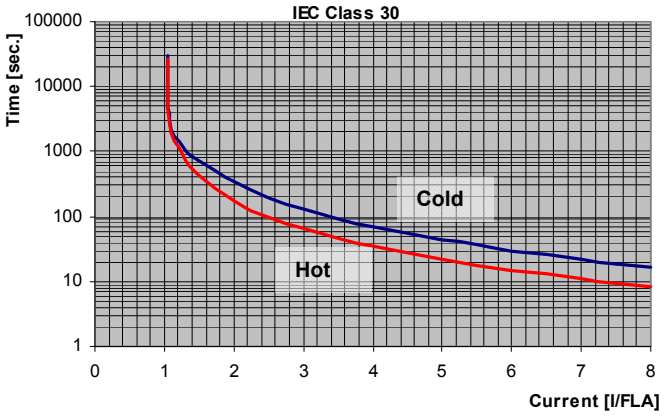




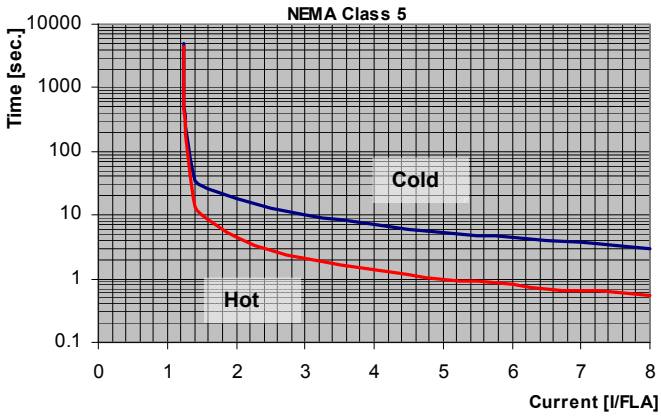


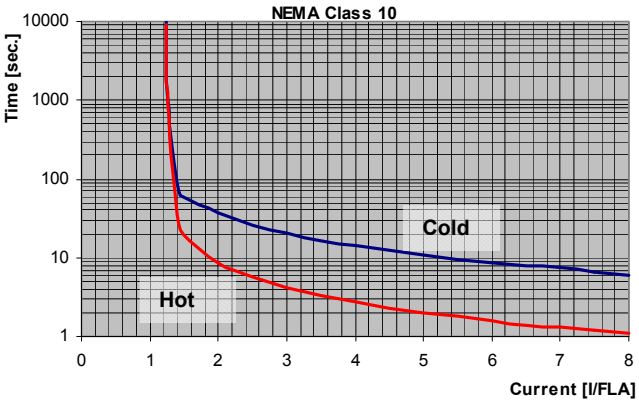


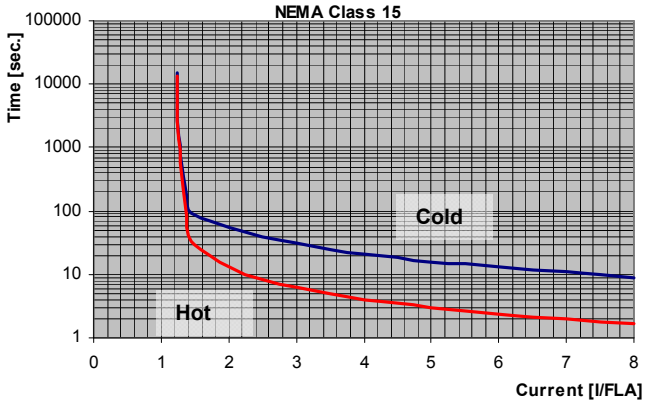


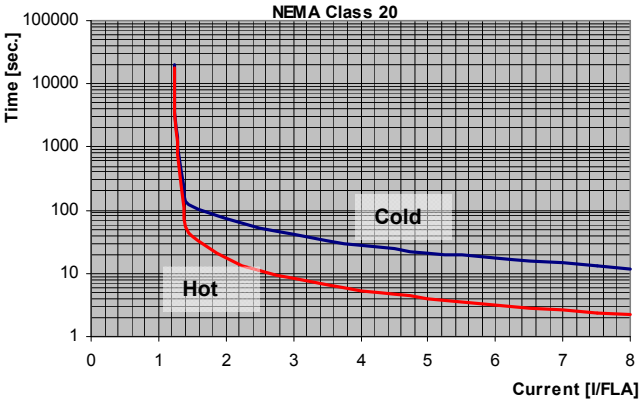


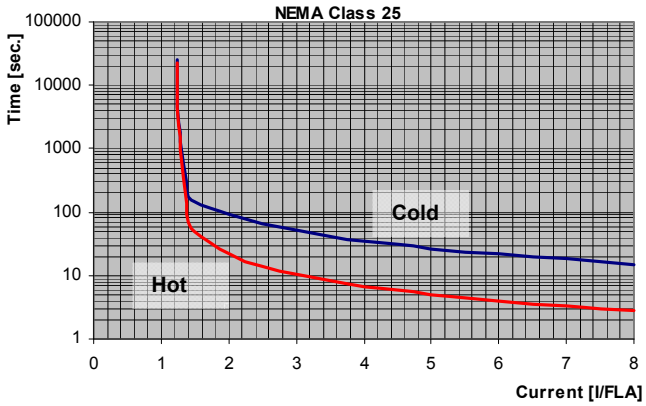
NEMA Class OVERLOAD curves

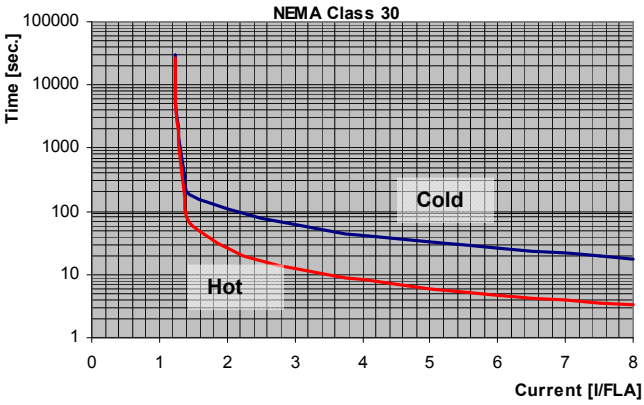












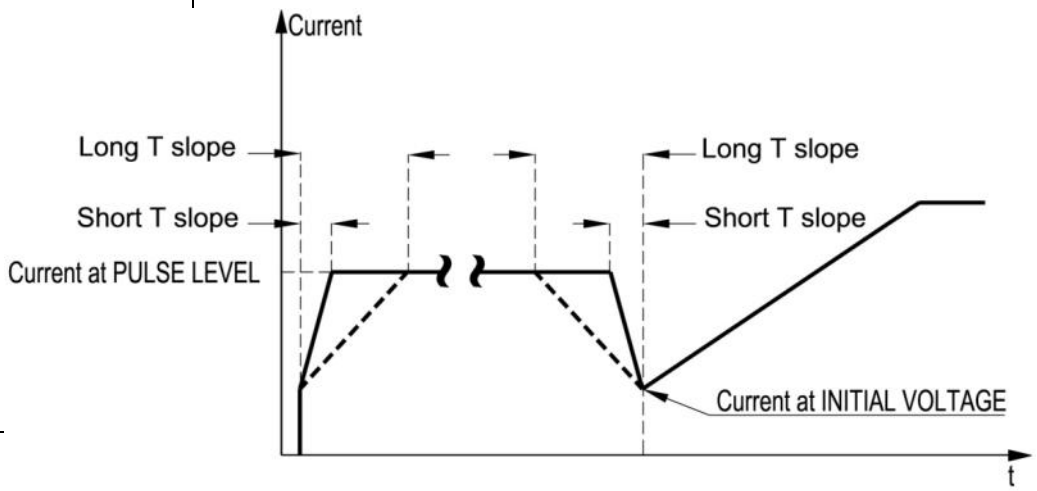
7.8.3 ***Start Parameters – Page 2***

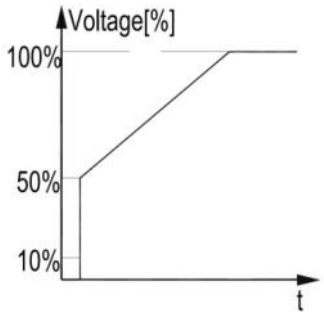
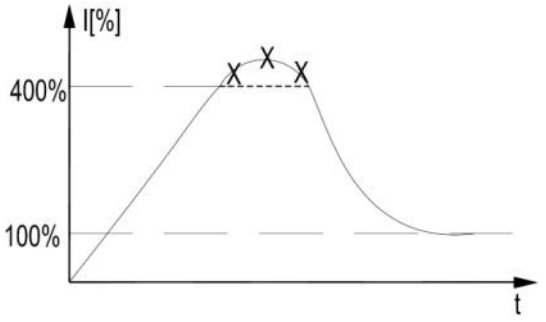
START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
SOFT START CURVE 1 (STANDARD)	0 (BASIC)/ 1 (STANDARD)/ 2 !!/ 3 !!/ 4 !!/ 5 (TORQUE)	Sets HRVS-DN's SOFT START CURVE. Refer to section 7.8.3.1 on page 65.
START TACHO. GAIN 0(MIN. 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 6.4.2 on page 41 for dip switch setting details. (2) Tacho Feedback is operational in its basic form. Additional curves except for the basic linear curve are optional. Consult the factory for the correct tacho selection and mechanical installation.

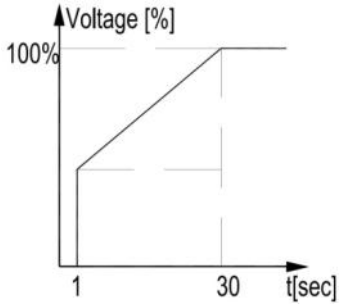
START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
PULSE LEVEL 70% OF FLA	For PULSE TIME<1SEC. 70-700% of FLA; For PULSE TIME≥1SEC. 70-400% of FLA; o **Note:** The range of the PULSE LEVEL can be extended to 70-700% even if PULSE TIME≥1SEC. by using the EXTENDED SETTING as described in section 6.4.4 page 42.	Sets PULSE LEVEL and PULSE START TIME. Intended to break free high friction loads requiring high starting torque for a short time or for pedestal start by holding the current at a predefined level for predefined time period. The pulse is defined by its current level and time length (width). 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. For PULSE TIME<1SEC. PULSE LEVEL can be set to 70-700% of FLA; For PULSE TIME≥1SEC. PULSE LEVEL can be set to 70-400% of FLA; In EXTENDED SETTING (refer to section 6.4.4 page 42) PULSE LEVEL can be set to 70-700% with the limitation of: 440x(FLC/FLA). **Notes:** • PULSE START is not effective in SOFT START CURVE 0. For better control of the current withdrawn from the network (mainly from generators), the following settings applies (applies from software versions newer than MVSTMB.GN-010509):
PULSE TIME 0.0 SEC.	0-10SEC	

PULSE TIME [seconds]		**T slope**
≤ 1		Approx. 0.1 second.
> 1	x.0, x.5 (1)	Very short
	x.1, x.6 (2)	short
	x.2, x.7 (3)	Medium length
	x.3, x.8 (4)	long
	x.4, x.9 (5)	Very long

(1) **x.0, x.5** applies to PULSE TIME: 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0 seconds
(2) **x.1, x.6** applies to PULSE TIME: 1.1, 1.6, 2.1, 2.6, 3.1, 3.6, 4.1, 4.6, 5.1, 5.6, 6.1, 6.6, 7.1, 7.6, 8.1, 8.6, 9.1, 9.6 seconds
(3) **x.2, x.7** applies to PULSE TIME: 1.2, 1.7, 2.2, 2.7, 3.2, 3.7, 4.2, 4.7, 5.2, 5.7, 6.2, 6.7, 7.2, 7.7, 8.2, 8.7, 9.2, 9.7 seconds
(4) **x.3, x.8** applies to PULSE TIME: 1.3, 1.8, 2.3, 2.8, 3.3, 3.8, 4.3, 4.8, 5.3, 5.8, 6.3, 6.8, 7.3, 7.8, 8.3, 8.8, 9.3, 9.8 seconds
(5) **x.4, x.9** applies to PULSE TIME: 1.4, 1.9, 2.4, 2.9, 3.4, 3.9, 4.4, 4.9, 5.4, 5.9, 6.4, 6.9, 7.4, 7.9, 8.4, 8.9, 9.4, 9.9 seconds



START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
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 EXTENDED SETTING as described in section 6.4.4 page 42.	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 HRVS-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 100-700% by using the EXTENDED SETTING as described in section 6.4.4 page 42.	Sets motor's CURRENT LIMIT 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**
ACC. TIME 10 SEC.	1-30sec. **Note:** The range of the ACC. TIME can be extended to 1-90 sec. by using the EXTENDED SETTING as described in section 6.4.4 page 42.	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:** • Since CURRENT LIMIT overrides ACC. TIME, when CURRENT LIMIT is set low, the starting time will be longer than the ACC. TIME setting. • When the motor reaches full speed before voltage reaches nominal, ACC. TIME setting is overridden, causing voltage to quickly ramp-up to nominal. • Using starting curves 2, 3, 4 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 EXTENDED SETTING as described in section 6.4.4 page 42.	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 HRVS-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.
NUMBER OF STARTS 1	1-10/ OFF	Sets NUMBER OF STARTS permitted during STARTS PERIOD. 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.
STARTS PERIOD 20 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. During the START INHIBIT period the WAIT BEFORE RST XX MIN message will be displayed.

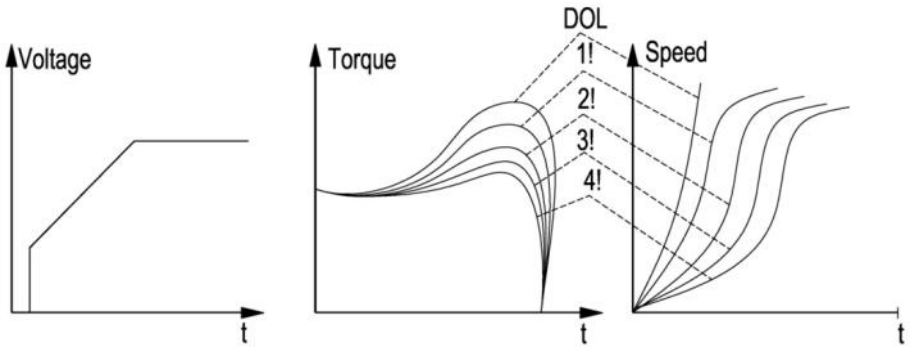
START PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
RUN CONTACT DLY 5 SEC.	0-120sec. After reaching 120 seconds, keep pressing for 10 seconds the ▲ key and **only** if optional Relay PCB is installed the display changes to: TURN BYPASS ON AT 120-300%.	Sets time delay for End of Acceleration relay to close after completion of starting process. End of Acceleration relay can signal that motor is at its RUN position which can be used for motor loading.
TURN BYPAS ON AT 120 % OF FLA		For information on TURN BYPAS ON AT and MIN TIME TO BYPS refer to section 7.8.3.2 on page 66.
MIN TIME TO BYPS 3 SEC.	3-60sec.	
STORE ENABLE START PARAMETERS		Same as STORE ENABLE MAIN & PROTECT page 57.

7.8.3.1 Soft Start Parameters

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

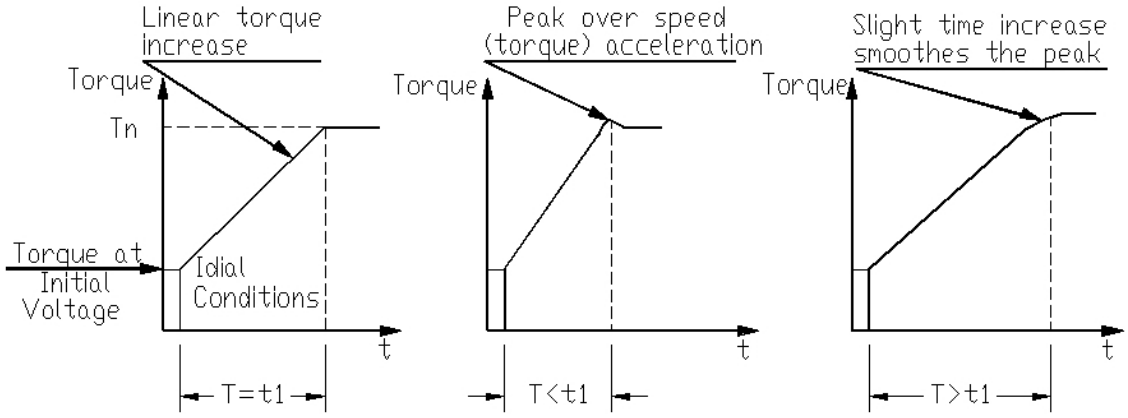
SOFT START CURVE 1 – Standard curve (Default). This curve is the most suitable curve for preventing prolonged starting and motor overheating.

SOFT START CURVE 2-4 - 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.
SOFT START CURVE 2, 3, 4 – 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: 1!, 2!, 3!, 4!

SOFT START CURVE 5 (TORQUE) – Torque Controlled acceleration - This provides a smooth time-controlled torque ramp for the motor and the pump.



Note:
Always start with SOFT START CURVE 1. If towards the end of acceleration peak torque is too high (pressure is too high) proceed to Curve 2, 3, 4 or 5 in that order.

SOFT START CURVE 0 – Basic curve. This curve uses less feedback signals. Use this curve if other curves do not give good results.

WARNING!	When operating in SOFT START CURVE 0 motor must be loaded, otherwise, vibration may occur towards the end of the soft start process.

7.8.3.2 Special Control for Synchronous Motors Excitation

In normal cases of synchronous motor starting, the HRVS-DN signals to motor's excitation system to start via the *Up to Speed relay* installed on the optional Relay PCB (via terminals 33, 34 & 35 I refer to *Figure 13 – Control Module Input/Output* page 29).
The signal is initiated when:

- The HRVS-DN is in Run
- The Bypass is closed (*End on Acceleration* contact is closed) and 1 second time delay was elapsed.
- Motor current is below 120% of FLA.

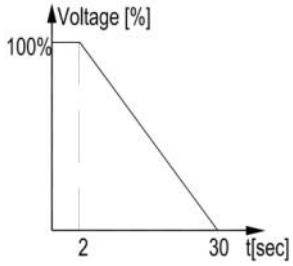
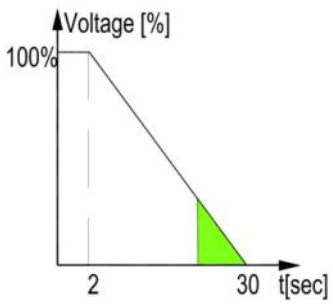
The parameters TURN BYPAS ON AT and MIN TIME TO BYPS are used for special cases where the sub-synchronous current (at sub-synchronous speed) exceeds 120% of FLA.
These parameters are active only under the following conditions:

- Optional Relay PCB is installed
- When setting the RUN CONTACT DLY parameter, after reaching 120 seconds (maximum value) and operator keeps pressing for additional 16 seconds the ▲ key.

The parameter TURN BYPAS ON AT determines motor current below which the soft starter goes into *Run* condition and closes the End Of Acceleration relay.
The parameter MIN TIME TO BYPS must be set above the total acceleration time to sub-synchronous speed assuring that *Run* condition can not be reached before the set time after the beginning of the starting process. (sub-synchronous current can be observed when current ceases to decrease at the end of the acceleration)

This special feature is for synchronous motor starting applications where the motor current at asynchronous speed may be at higher level than regular asynchronous motor starting conditions.
In this case the level of current at which the *Run* condition is being achieved can be programmed.

7.8.4 ***Stop Parameters – Page 3***

STOP PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
SOFT STOP CURVE 1 (STANDARD)	0 (BASIC)/ 1 (STANDARD)/ 2 !!/ 3 !!/ 4 !!/ 5 (TORQUE)/	Sets SOFT STOP CURVE. Refer to section 7.8.4.1 on page 68.
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 6.4.2 on page 41 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 0 SEC.	0–30sec. **Note:** The range of the DEC. TIME can be extended to 0-90 sec. by using the EXTENDED SETTING as described in section 6.4.4 page 42.	Sets DECELERATION TIME of the motor. Used for controlled deceleration of high friction loads. Determines the motor's voltage ramp down time.  **Note:** The HRVS-DN operates with a Bypass Contactor. The Bypass Contactor is controlled by the HRVS-DN's End of Acceleration relay. Upon soft stop initiation the End of Acceleration relay is de-energized, the load is transferred to the HRVS-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. 

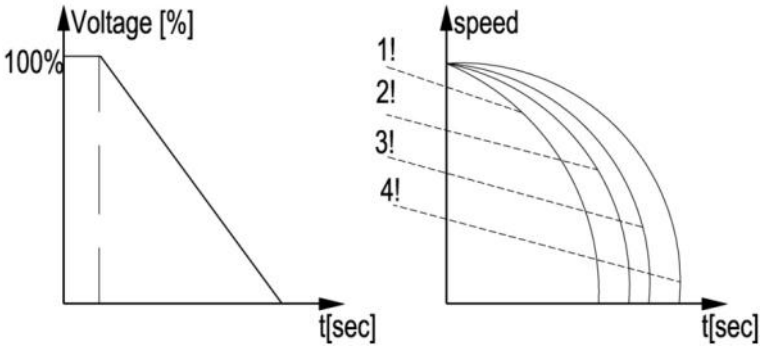
STOP PARAMETERS - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
COAST DOWN DELAY OFF	OFF, 10 – 3600 Sec.	Sets an Off delay timer that prevents the HRVS-DN to start before the COAST DOWN DELAY time has elapsed. When COAST DOWN DELAY is set to OFF: • If start command is initiated momentarily (via push button, for example, to terminal 6 of the control module) before 3 seconds after stop are elapsed, it is ignored. • If start command is initiated and maintained (via closing a switch, for example, to terminal 6 of the control module), start occurs after 3 seconds (from stop) are elapsed. When COAST DOWN DELAY is set to a value (10-3600 seconds): • If start command is initiated momentarily (via push button, for example, to terminal 6 of the control module) before 3 seconds after stop are elapsed, it is ignored (same as if COAST DOWN DELAY is set to OFF). • If start command is initiated and maintained or if pressed after 3 seconds and before the set time of COAST DOWN DELAY, the HRVSDN trips (same as for TOO MANY STARTS), displaying a fault message COAST DOWN TIME. Reset is possible immediately.
STORE ENABLE STOP PARAMETERS		Same as STORE ENABLE MAIN & PROTECT page 57.

7.8.4.1 Soft Stop Parameters

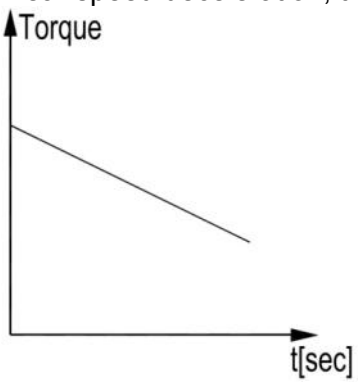
SOFT STOP initiation opens the End of Acceleration contact and opens the Bypass Contactor. Load will be transferred to the HRVS-DN thyristors and voltage begins to ramp down.
The HRVS-DN incorporates 5 stopping curves that enable you to select the suitable torque curve:

SOFT STOP CURVE 1 – Standard Curve (Default) – voltage is linearly reduced from nominal to zero.
The most stable and suitable curve for preventing prolonged stopping and motor overheating.

SOFT STOP CURVE 2, 3, 4 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 2, 3 and 4 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 SOFT STOP CURVE 1 be used for all standard applications (not pumps).
To reduce water hammer, select SOFT STOP CURVE 2, then 3, then 4 in that order.



SOST STOP CURVE 5 - 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 SOFT STOP CURVE 1. If the motor stalls quickly instead of slowly decreasing its speed, select SOFT STOP CURVE 2, 3, 4 or 5 in that order until the problem is solved.

SOFT STOP CURVE 0 – Basic curve. This curve uses less feedback signals. Use this curve if other curves do not give good results.

WARNING!	When operating in SOFT STOP CURVE 0 motor must be loaded, otherwise, vibration may occur during the beginning of the soft stop process.

7.8.5 ***Dual Adjustment Parameters – Page 4***

DUAL ADJUSTMENT PARAMETERS	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
DA: INIT. VOLT. 30%	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 EXTENDED SETTING as described in section 6.4.4 page 42.	Sets motor's INITIAL STARTING VOLTAGE **in DA mode.** (Motor's **torque** is directly proportional to the square of the voltage) Refer to section 7.8.3 on page 60 parameter: INITIAL VOLTAGE
DA: INIT. CURRENT 100%		
DA: CUR. LIMIT 400% OF FLA	100-400%. **Note:** The range of the DA: CURRENT LIMIT can be extended to 100-700% by using the EXTENDED SETTING as described in section 6.4.4 page 42.	Sets motor's highest current during starting **in DA mode.** Refer to section 7.8.3 on page 60 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 EXTENDED SETTING as described in section 6.4.4 page 42.	Sets ACCELERATION TIME of the motor **in DA mode.** Refer to section 7.8.3 on page 60 parameter: ACC. TIME.
DA: DEC. TIME 0 SEC.	0–30sec. **Note:** The range of the DA: DEC. TIME can be extended to 0-90 sec. by using the EXTENDED SETTING as described in section 6.4.4 page 42.	Sets DECELERATION TIME of the motor **in DA mode.** Refer to section 7.8.4 on page 67 parameter: DEC. TIME.
DA: MOTOR FLA 150 AMP.	33-100% of STARTER FLC	Sets motor's FLA (Full load Ampere) **in DA mode.** Refer to section 7.8.2 on page 53 parameter: MOTOR FLA.
STORE ENABLE D. ADJ PARAMETERS		Same as STORE ENABLE MAIN & PROTECT page 57.

7.8.6 ***Fault Parameters – Page 5***

FAULT PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
UV & PL AUTO RST NO	NO/YES	Sets UNDERVOLTAGE and PHASE LOSS AUTO RESET. If UV & PL AUTO RST is set to NO then HRVS-DN will not automatically reset after an UNDER VOLTAGE or PHASE LOSS faults occur. If you set the UV & PL AUTO RST setting to YES then HRVS-DN will automatically reset. **Notes**: • Reset is performed only after the start signal is removed. To restart the motor recommence the start command. • Refer to section 7.8.2 on page 55 for details on setting of UNDERVOLT. TRIP.
UNDER CUR. RESET OFF	10–120 MIN./ OFF.	Sets UNDER CURRENT RESET time delay. If the UNDER CUR. RESET setting is OFF then HRVS-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 HRVS-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. **Notes**: • **If the start command is not removed, motor will restart automatically after the delay time!!** • Refer to section 7.8.2 on page 55 for details on setting of UNDER CURRENT TRIP.
BYPASS OPEN TRIP ENABLE	ENABLE/ DISABLE	Sets BYPASS OPEN TRIP protection. Becomes operational when the Bypass Contactor does not close after EOA contact command the pilot (interposing) relay to close. Set to ENABLE when motor current is running through the internal CTs. Set to DISABLE when motor current is **not** running through the internal CTs.
TRIP AFTER BYPAS ENABLE	ENABLE/ DISABLE	Sets TRIP AFTER BYPASS trip. TRIP AFTER BYPASS can be set to DISABLE if motor is protected by an additional relay usually upstream to the soft starter. If during operation a fault occurs, *Fault* LED will flash and soft starter will display the fault but will not trip the motor until the soft starter is stopped.
BY-PASS AUTO RST NO	YES/ NO	Sets BY-PASS AUTO RST reset. When TRIP AFTER BYPASS is DISABLE and if during operation a fault occurs, *Fault* LED will flash and soft starter will display the fault but will not trip the motor until the soft starter is stopped. In this case the soft starter will go to Trip position. If BY-PASS AUTO RESET is set to YES, the soft starter will be automatically reset the fault. **Note**: Reset is performed only after the start signal is removed. To restart the motor recommence the start command.

FAULT PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
SET CURVE 0 FLT ENABLE	ENABLE/ DISABLE	SET CURVE TO 0 message may occur seldom during starting with special conditions of mains and load. Change start (and stop, if used) curve to SOFT START CURVE 0 and SOFT STOP CURVE 0. Set SET CURVE 0 FLT to DISABLE, only if SET CURVE TO 0 FLT fault occurs during starting and if SOFT START CURVE 0 is not good enough for the application. When set to DISABLE verify that motor starts normally in the selected curve.
PWR ON & NO STRT ENABLE	ENABLE/ DISABLE	Sets POWER ON & NO STRT trip POWER ON & NO START is operational upon mains voltage connection. It trips the HRVS-DN when mains voltage is connected to the HRVS-DN for more than 30 seconds without a start signal. **Set to DISABLE only in special occurrences. (Consult factory!)**
INSULATION ALARM OFF	OFF/ 0.2– 20Mohm	Sets INSULATION ALARM level. Activates INSULATION ALARM trip. Applicable only if optional insulation PCB and resistor unit are installed and connected. 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 HRVS-DN will blink. If insulation level will return to normal for more than 60 seconds the alarm will automatically reset. While testing, if the insulation level drops below Fault level - a message: INSULATION TRIP will display and the fault relay of the HRVS-DN will go to the fault position (as programmed in the I/O PROGRAMMING PARAMETERS). The *Fault* LED on the front of the HRVS-DN will light. In this status motor can not be started. If insulation level will return to normal the HRVS-DN will not automatically reset.
INSULATION TRIP OFF	OFF/ 0.2– 20Mohm	
PHASE SEQUENCE POSITIVE	POSITIVE/ NEGATIVE/ IGNORE	Sets PHASE SEQUENCE protection of the soft starter. Allows to start the motor in POSITIVE sequence of the mains OR in the NEGATIVE sequence of the mains or, when set to IGNORE, in both sequences. 
STORE ENABLE FAULT PARAMETERS		Same as STORE ENABLE MAIN & PROTECT page 57.

7.8.7 *I/O Programming Parameters – Page 6*

I/O PROGRAMMING PARAMETERS	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
PROG. INPUT # 7 RESET	RESET/ TEST/ MULTI SOFT STOP (optional)	Sets terminal 7 function Refer to section 7.8.7.1 on page 74.
PROG. INPUT # 8 DUAL ADJUSTMENT	DUAL ADJUSTMENT/ RESET	Sets terminal 8 function Refer to section 7.8.7.1 on page 74.
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 contacts are open. Relay will also **de**-energize upon control power outage.
IMM. RELAY TYPE IMMEDIATE	IMMEDIATE/ # STRTS PREALARM	Sets IMM/ # STRT PREAL mode of operation. When configured to IMMEDIATE the relay is 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 # STRTS PREALARM the relay is energized if a start command will cause the soft starter to trip on TOO MANY STARTS.
RELAY ON DELAY 0 SEC.	0 – 3600SEC.	Sets IMM/ # STRT PREAL on delay time. Sets IMM/ # STRT PREAL off delay time
RELAY OFF DELAY 0 SEC.	0 – 3600SEC.	
ANALOG OUTPUT RELATIVE CURRENT	RELATIVE CURRENT/ RELATIVE POWER	When set to RELATIVE CURRENT the full scale of the optional analog PCB output is related to 200% of **FLA** (2x< *Motor rated current*>). Or, when set to RELATIVE POWER the full scale of the analog PCB output is related to 200% of motor power (2x< *Motor rated power*>). Motor rated power is set in the MAIN & PROTECT parameter. Refer to section 7.8.2 page 55.
STORE ENABLE I/O PROG. PARAM.		Same as STORE ENABLE MAIN & PROTECT page 57.

7.8.7.1 *Terminal 7 and 8 Programming*

Input Terminal 7 Programmed Function	Description
RESET (default setting)	Input terminal 7 is used as RESET to reset all HRVS-DN faults. The RESET command will take effect only if the start command is removed (except for UNDER CURRENT fault)
TEST	While input terminal 7 is on firing test can be done. Refer to section 14.3 on page 121 for firing test procedure.
MULTI SOFT STOP (Optional – only if optional software is installed)	While input terminal 7 is on, the soft starter will go to Run even if current is not running through the soft starter. This will enable Multi Soft Stop operation with the HRVS-DN.

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 7.8.5 on page 70 for programming. Refer to section 5.9 on page 34 for wiring.
RESET	Input terminal 8 is used as RESET to reset all HRVS-DN faults. The RESET command will take effect only if the start command is removed (except for UNDER CURRENT fault)

7.8.8 ***Comm. Parameters – Page 7 – With the Optional Modbus PCB***

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
COMM. PROTOCOL MODBUS	MODBUS/ POFIBUS/ DEVICENET	Sets HRVS-DN's communication PROTOCOL. Operational when the optional communication PCB is installed.
BAUD RATE 19200 (MODBUS)	1200, 2400, 4800, 9600, 19200	Sets HRVS-DN's BAUD RATE.
PARITY CHECK EVEN	EVEN, ODD, NO	Sets HRVS-DN's communication PARITY CHECK.
SERIAL LINK NO. OFF	OFF,1 – 247	Sets HRVS-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. Trip occurs only if the following conditions exist: • SER. LINK CONTROL is set to ENABLE • SERIAL LINK NO. is not set to OFF If MODBUS TIME OUT is 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 & PROTECT page 57. (2) After changing communication parameters and storing them, control power must be switched off and on to load new communication parameters.	

7.8.9 ***Comm. Parameters – Page 7 – With the Optional Profibus PCB***

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
COMM. PROTOCOL PROFIBUS	MODBUS/ POFIBUS/ DEVICENET	Sets HRVS-DN's communication protocol. Operational when the optional communication PCB is installed.
BAUD RATE AUTO		User can not change BAUD RATE value. Max. rate is 12 mega bit per second (MBPS).
PARITY CHAECK AUTO		Do not change this parameter! Must be set to AUTO.
PROFI.NETWORK ID 126	OFF, 1-126	Sets the Profibus network ID. When set to OFF the Profibus PCB will not function. **Note:** When ID=126 monitoring and parameter setting is enabled. Control is disabled when ID=126. In order to be able to control the HRVS-DN ID must be set to 1-125.

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
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. **Note:** When ID=126 control is disabled. In order to be able to control the HRVS-DN ID must be set to 1-125.
MODBUS TIME OUT OFF		Do not change this parameter! Must be set to OFF.
FRONT COM ADDRES OFF	OFF,1 – 247	Future enhancement
STORE ENABLE COMM. PARAMETERS	**Notes:** (1) Same as STORE ENABLE MAIN & PROTECT page 57. (2) After changing communication parameters and storing them, control power must be switched off and on to load new communication parameters.	

7.8.10 ***Comm. Parameters – Page 7 – With the Optional DeviceNet PCB***

COMM.PARAMETERS - **** -	Displays in MAXIMIZED MODE only (refer to section 6.4.1 page 40 for changing mode)	
Display and Default Values	**Range**	**Description**
COMM. PROTOCOL DEVICENET	MODBUS/ POFIBUS/ DEVICENET	Sets HRVS-DN's communication protocol. Operational when the optional communication PCB is installed.
BAUD RATE AUTO		User can not change BAUD RATE value.
PARITY CHAECK AUTO		Do not change this parameter! Must be set to AUTO.
DEVICENET ID SET MANUALLY	SET MANUALLY, 1-63	Sets the DeviceNet network ID. When set to SET MANUALLY the ID is determined by the encoders mounted on the DeviceNet optional PCB installed in the control module.
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.
FRONT COM ADDRES OFF	OFF,1 – 247	Future enhancement
STORE ENABLE COMM. PARAMETERS	**Notes:** (1) Same as STORE ENABLE MAIN & PROTECT page 57. (2) After changing communication parameters and storing them, control power must be switched off and on to load new communication parameters.	

7.8.11 ***Statistical Data – page 8***

STATISTICAL DATA - **** -	Displays in MINIMIZED MODE and MAXIMIZED MODE	
Display and Default Values	**Range**	**Description**
T SINCE LST STRT NO DATA		Displays time since last start in minutes.
LAST STRT PERIOD NO DATA		Displays last starting time in seconds. Starting time is the duration until motor current drops to nominal.
LAST START 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.
TOTAL ENERGY 0 KWH		Displays motor kWH consumption.
TOTAL R. ENERGY 0 KVARH		Displays motor kVARH consumption.
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 HRVS-DN.
TOTAL # OF TRIPS 0		Displays the total number of trips.
LAST 10 TRIPS: hh.mm mm.dd.yy PREVIOUS TRIP -1 hh.mm mm.dd.yy PREVIOUS TRIP -2 hh.mm mm.dd.yy . . . . NO DATA NO DATA		Displays motor trip history.

8. MOTOR AND SOFT STARTER PROTECTION

Protection functions are distinguished between adjustable protection functions and non-adjustable protection functions.
Upon fault – motor stops, *Fault* LED lights and Fault Relay chances position.
The LCD shows TRIP: < fault description>. (for example: TRIP: UNDER CURRENT).

WARNING!	Upon any fault read carefully the **COMMISSIONING AND OPERATION** chapters in this manual before you try to identify the cause.

8.1 Adjustable Protection Functions

8.1.1 ***UNDER CURRENT***

Trips the HRVS-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 parameter settings refer to section 7.8.2 page 55.

8.1.2 ***O/C –SHEAR PIN***

Trips the HRVS-DN when:
- Instantaneously when current exceeds 850% of HRVS-DN FLC
- While starting when current exceeds 850% of Motor FLA
- While running when current exceeds 100-850% of Motor FLA with a programmable delay of 0-5 seconds. Delay is overridden when current reaches 850% of HRVS-DN FLC.

Check that the motor is not stalled or jammed.
Check FLA, FLC settings.
Check motor and cable connections.
Perform a "Megger" test to check the condition of the motor and cables.
For protection parameter settings refer to section 7.8.2 page 55.

8.1.3 ***OVERLOAD***

Trips the HRVS-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 HRVS-DN cool down before restarting.
You may want to check motor THERMAL CAPACITY as displayed in the data page refer to section 7.8.1 page 54.
For protection parameter settings refer to section 7.8.2 page 55.

8.1.4 ***UNBALANCE CURRENT***

Current Unbalance is the difference between the maximum and minimum values of the motor's three line currents divided by the motor's maximum current or motor FLA, whichever is greater. A fault occurs when the actual Unbalance is greater than the setpoint for a delay that exceeds the UNBALANCE DELAY.

For protection parameter settings refer to section 7.8.2 page 55.

8.1.5 ***GROUND FAULT***

Trips the motor when Ground Current exceeds the preset GND FAULT TRIP for more than GND FAULT DLY.

Check motor and cable connections.
Perform a "Megger" test to verify motor and cables condition.
For protection parameter settings refer to section 7.8.2 page 55.

8.1.6 ***UNDER/NO VOLTAGE***

Trips the HRVS-DN when line voltage drops below the preset level for the preset time.
When voltage drops to zero, the HRVS-DN trips immediately with no delay.

Check UNDERVOLT. TRIP and UNDERVOLT. DELAY settings, check line voltages on L1, L2, L3.
For protection parameter settings refer to section 7.8.2 page 55.

8.1.7 ***OVER VOLTAGE***

Trips the HRVS-DN when line voltage increases above the preset level for the preset time.

Check OVERVOLT. TRIP and OVERVOLT. DELAY settings, check line voltages on L1, L2, L3.
For protection parameter settings refer to section 7.8.2 page 55.

8.1.8 ***LONG START TIME***

Trips the HRVS-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 parameter settings refer to section 7.8.3 page 60.

8.1.9 ***OPEN BYPASS***

Operates when the Bypass Contactor does not close after the EOA contact of the HRVS-DN closes.

Note: This protection can be disabled by setting BY PASS OPEN TRIP to DISABLE when the Bypass is connected in a separate cabinet, in a configuration where the starter CTs do not measure motor current while the Bypass Contactor is closed.

For parameter settings refer to section 7.8.6 page 71.

8.1.10 ***SET CURVE TO 0***

Trip occurs if the Soft Starter starts with a non-adequate starting curve to the network.

Change start and stop parameter to SOFT START CURVE 0 and try again.
For parameter settings refer to section 7.8.3 page 60.

8.1.11 ***PWR ON & NO STRT***

Operates upon main voltage connection and activated while mains voltage is connected to the HRVS-DN for more than 30 seconds without a start signal.

Note: This protection can be disabled by setting PWR ON & NO STRT to DISABLE. Do not set to DISABLE before you consult the factory!

Reset the fault, and initiate the start command within less than 30 seconds after mains voltage is applied to L1, L2 and L3.

8.1.12 ***MOTOR INSULATION***

(Optional) Trips the HRVS-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 7.8.6 page 71.

8.1.13 ***PHASE SEQUENCE***

Trips the HRVS-DN if line phase sequence is wrong.

The HRVS-DN can be operated in any phase sequence as set in the PHASE SEQUENCE protection of the soft starter.

It allows the motor to start in the POSITIVE sequence of the mains OR in the NEGATIVE sequence of the mains or, when set to IGNORE both sequences.

For PHASE SEQUANCE protection settings refer to section 7.8.6 page 71.

8.1.14 ***TOO MANY STARTS***

Trips the HRVS-DN if NUMBER OF STARTS during START PERIOD exceeds the preset number.

You must wait until the motor and the starter cool down according to the START INHIBIT setting.
For protection settings refer to section 7.8.3 page 60.

8.1.15 ***MODBUS TIME OUT***

If no valid Modbus communication during MODBUS TIME OUT, the HRVS-DN will trip.
Trip occurs only if the following conditions exist:
- SER. LINK CONTROL is set to ENABLE
- SERIAL LINK NO. is not set to OFF

For MODBUS TIMEOUT settings refer to section 7.8.8 page 75.

8.1.16 ***SET TIME & DATE***

Alarms if on initial start-up time and date are not set to the HRVS-DN.

Set time and date correctly.
For time and date settings refer to section 7.6.6 page 50.

8.1.17 ***COAST DOWN TIME***

Trips if start command is initiated before COAST TIME DELAY set time has elapsed.

Prevent initiating start command before COAST TIME DELAY set time has elapsed*.*
For COAST TIME DELAY settings refer to section 7.8.4 page 67.

8.2 **Non Adjustable Protection Functions**

8.2.1 ***UNDER/OVER FREQUENCY***

Trips the HRVS-DN if frequency is not in the range of 44-65Hz

Check that frequency variations are between 44-65Hz.

8.2.2 ***PHASE LOSS***

Trips the starter if 1 or 2 phases are missing.

Check lines voltages and correct connection.

8.2.3 ***WRONG PARAMETERS***

After power up parameters not transferred from RAM to EEPROM or vice versa.

Press Reset then load DEFAULT PARAMETERS. Refer to section 7.6.3 page 49 for more details on loading default parameters.Note that 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 RATED LINE VOLTAGE and STARTER FLC (as shown on the label of the HRVS-DN) and all other parameters in the MAIN & PROTECT mod page. Refer to section 7.8.2 page 55.

8.2.4 ***STORAGE ERROR***

When trying to store parameters at the end of a mode page or after lading DEFAULT PRAMETERS.

Press Reset and try again. If this does not succeed load DEFAULT PARAMETERS. Refer to section 7.6.3 page 49 for more details on loading default parameters.

Note that 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 RATED LINE VOLTAGE and STARTER FLC (as shown on the label of the HRVS-DN) and all other parameters in MAIN & PROTECT mod page. Refer to section 7.8.2 page 55.*

8.2.5 *S. SCR OR WR. CON*

Operational after start signal. Trips if the motor is not properly connected to HRVS-DN's load terminals, when:

- Internal disconnection is detected in the motor winding
- One or more of the SCRs have been shorted.
- Incorrect fiber optic leads connection

This protection is not active when SOFT START CURVE 0 is selected.

Check with an ohmmeter between L1-U, L2-V, L3-W; resistances are listed on section 14.1 page 120.
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.*

For SOFT START CURVE 0 setting refer to section 7.8.2 page 55.

8.2.6 *OVER TEMPERATURE*

Thermal sensors are mounted on the heat-sinks of the Power Section and trip the HRVS-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 HRVS-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 HRVS-DN.

8.2.7 *EXTERNAL FAULT 1 & EXTERNAL FAULT 2*

External Faults becomes operational when HRVS-DN is energized.
The HRVS-DN will trip if contact between terminals 19 and 21 closes for more than 2 sec.

8.2.8 *COMM. PORT FAILED*

Trips the HRVS-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.

8.3 Fault and Reset

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

- For local reset, after fault has been removed, press ***Reset*** key.
- Remote reset can be performed through terminals 7 or 8 (see I/O PROGRAMMING section 7.8.7 page 73).

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

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

8.4 Auto Reset

UNDER VOLTAGE and PHASE LOSS faults can auto-reset (refer to section 7.8.6 on page 71). The HRVS-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 7.8.6 on page 71).
The HRVS-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 7.8.6 on page 71).

WARNING!	Auto Reset explained here above corresponds to the HRVS-DN IP00 unit (OEM Kit). When the HRVS-DN is installed in a cabinet the behavior of the Auto Reset depends on the cabinet wiring as well. It is customer responsibility to avoid any dangerous conditions when the HRVS-DN IP00 is installed in a medium voltage cabinet.

8.5 Timing Occurrence Table

Timing And Occurrence	**Active During**			
	Start	**Run**	**Stop**	**Soft Stop**
Too many starts with START INHIBIT period	√			
Coast Down Time with start (after stop) inhibit time setting.	√			
Electronic overload with curve selection	√(1)	√(1)		
O/C shear pin (jam)				
HRVS-DN protection – trip immediately at I≥850% FLC in less than 1 cycle.	√	√		√
Motor protection – trip function				
During start – factory set at 850% FLA after O/C DELAY.	√			√
During run – adjustable 100 – 850% FLA after O/C DELAY.		√		
Under current adjustable time delay		√		
Unbalance current adjustable time delay	√	√		√
Ground fault 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 or Wrong Connection	√			√
External fault 1 & 2– input from a N.O. contact	√	√	√	√
SCR protection by Metal Oxide Varistors (MOV)	√	√	√	√
HRVS-DN Power Section over-temperature	√			√
HRVS-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.			√	

Power ON and no Start			√	
Bypass open trip		√		
Set curve to 0	√			

Notes:

(1) Electronic OVERLOAD can be set to operate at all times, during Run or it can be disabled.

9. PACKING, STORAGE, HANDLING AND ASSEMBLY

Note!	This section only refers to standard cabinet! For other than standard cabinet design refer to the supplied drawings and/or consult the factory.

9.1 Packing Specification

Equipment is packed and covered and placed on the case base of the crate.
Crate side walls 8mm thick playwood and 20x90mm beams
Crate is closed by pins and metal band
Crate is marked by international marks
Wood is marked in according to ISPM 15

9.2 Storage

The soft starter is designed for indoor use and must not be left outdoors.
Soft starter should be stored in a warm, dry room and protected against dust and debris.
If the soft starter is to be kept in store before use make sure that the ambient conditions are acceptable:
Storing temperature: -20…..+70°C
Relative humidity: <95%, no condensation.

9.3 Handling

The cabinet is delivered in its crate. See weights and dimensions below.
The crates can be off loaded by forklift truck.
Off load the soft starter using an overhead crane (see below scheme).

Approximate weights and dimensions

Unpacked				Packed			
Width [mm]	Height [mm]	Depth [mm]	Weight [kg]	Width [mm]	Height [mm]	Depth [mm]	Weight [kg]
1100	2300(1)	1100	600	1200	2500	1200	660

Notes:
(1) Add 65mm for eye bolt.
(2) Each eye bolt can carry 700kg max.

Each cabinet, after unpacked, must be lifted using 4 eye bolts as shown on the pictures below.
Use 1100mm cables for each eye bolt, make sure top angle ≤60°.

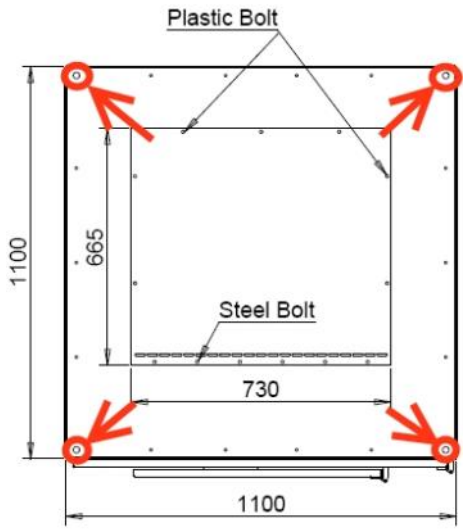


Figure 23 – Eye Bolts Location on Top of the Cabinet

Use the marked eye bolts for lifting the cabinet.
During lifting procedures it is mandatory to use ALL lifting eye bolts provided on each cabinet.

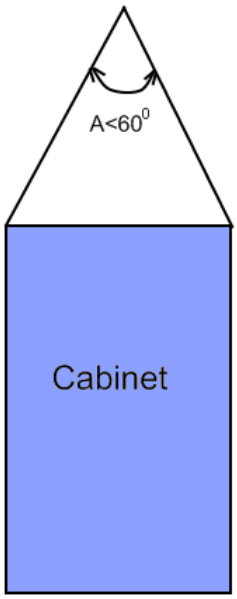


Figure 24 – Cabinet Lifting Using 4 Lifting Cables. Top angle, A, Should be ≤60°

9.4 Soft starter's Assembly Procedure:

Assembly procedure comprised of:
Mechanical assembly & Power and Control cables connection
When assembling the cabinet the following torque table should be applied for the mechanical and electrical bolts closing:

Bolt size	Torque
M4	1.5Nm
M5	2.5Nm
M6	4.5Nm
M8	10Nm
M10	20Nm
M12	40Nm
M16	80Nm

9.4.1 Mechanical Assembly

Four 22mm diameter holes located at the bottom frame of the cabinet as indicated in the *Figure 25*.
Mount the cabinet in place and anchor it with 4 bolts.

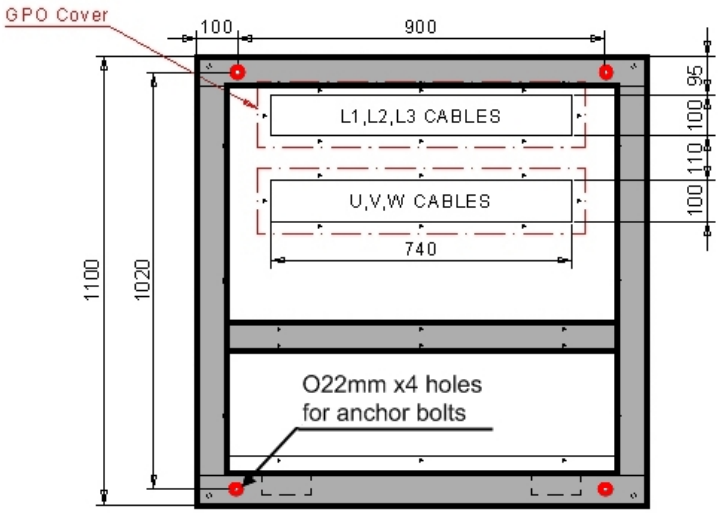


Figure 25 – Anchor Bolts Holes Location on the Base of the Cabinet at Level 0mm.

9.4.2 Power and Control Cable Connections

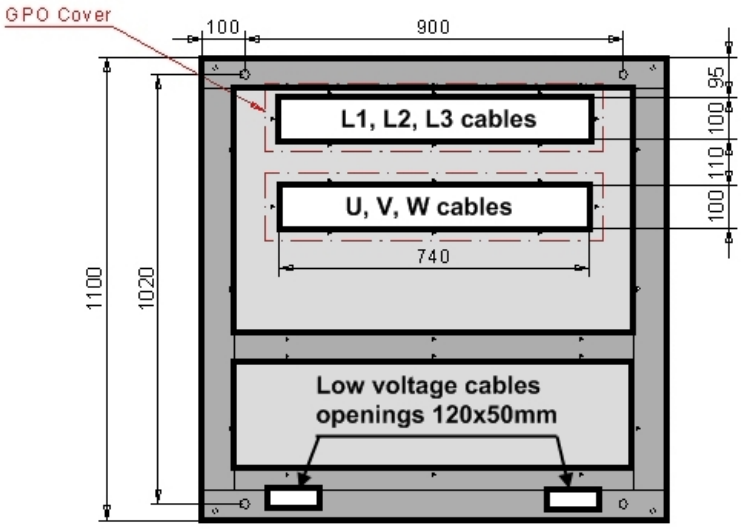


Figure 26 – Power and Control Cables Penetration to the Cabinet at Level 75mm

9.4.3 Power Cables Connection

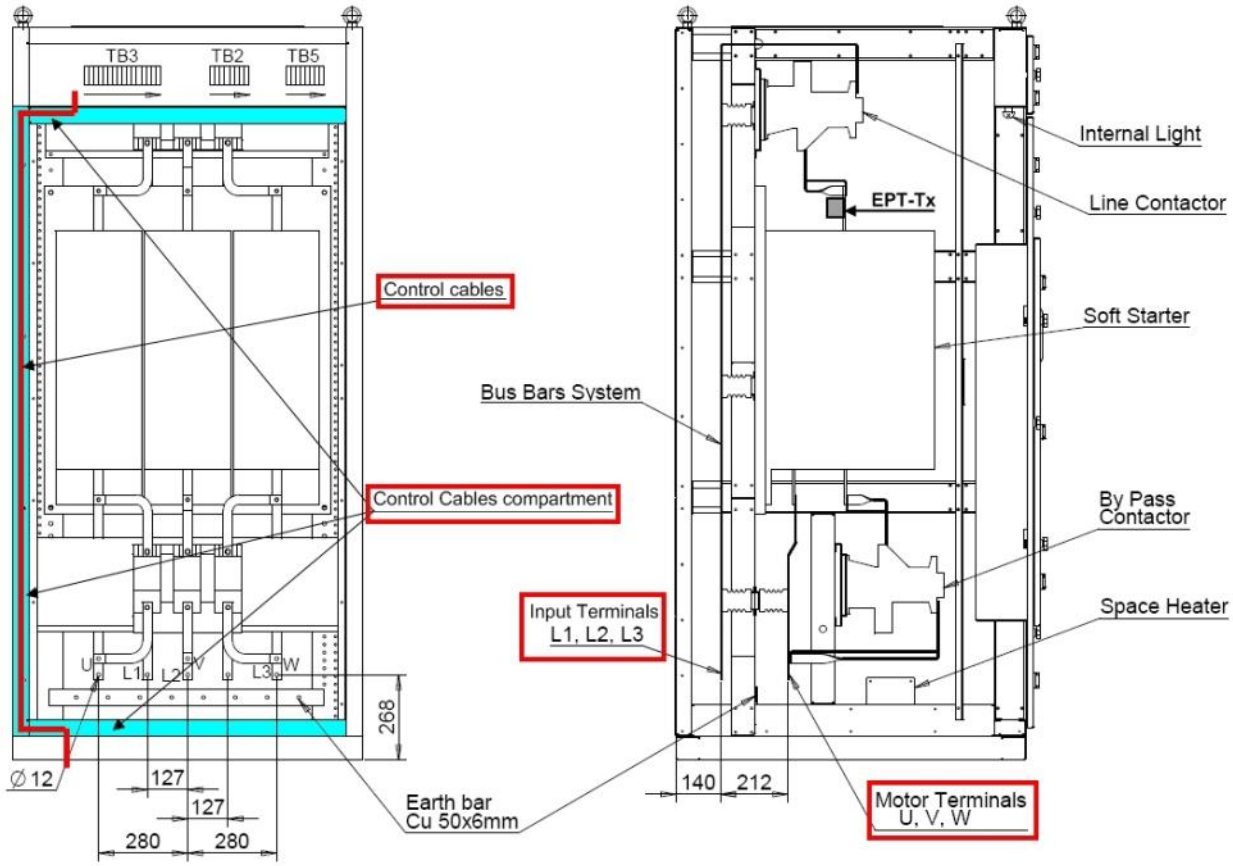


Figure 27 – Power Cables Connection and Control Cables Routing.

Note!	For low voltage test it is advised to leave motor terminals open to enable easy connection of the low voltage motor.

10. COMMISSIONING AND OPERATION MANUAL

WARNING!	The information in this manual does not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, please contact your local Solcon office. Further, the contents of this Manual shall neither become a part of nor modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Solcon. The warranty contained in the contract between the parties is the sole warranty of Solcon. Any statements contained herein do not create new warranties nor modify the existing warranty.

Safety Precautions!	• Read this manual carefully before operating the equipment and follow its instructions. • Installation, operation and maintenance should be in strict accordance with this manual, national codes and good practice. Installation or operation not performed in strict accordance with these instructions will avoid manufacturer's warranty. • Never open the medium voltage doors of the cabinet while medium voltage is connected to the cabinet. • Do not open the medium voltage doors, even if the motor is not running and the Line Contactor is open. Medium voltage may still be connected to the cabinet (upstream the contactor)! • Ensure, before opening the medium voltage doors, that the input medium voltage lines are disconnected from mains and grounded. • It is absolutely forbidden to change the position of the internal selector switches while Line Contactor is closed. • Before closing the doors for medium voltage operation, ensure that the low voltage Test Harness is not connected. The Test Harness is only used for the low voltage test. As a rule, always disconnect the harness immediately after ending the low voltage test. It should be mounted inside small plastic bag in the drawing pocket. This Test Harness is equipped with long tape, intended to prevent forgetting it connected. Never cut this warning tape. Leave open for its full length and laid in such a way that the harness will not be forgotten connected after the low voltage test. • The Line Contactor is not designed for disconnecting high short circuit currents. Therefore the trip relay terminals 39-40-41 must be used to open the upstream breaker. Alternatively, upstream fuses can be used. • The software of the external PLC (if used) controlling the starter must check the status of the trip relay in customer terminals 39-40-41. Upon detecting a trip signal, the PLC should open the Remote Start / Stop contact (connected to customer terminals 15-16) immediately.

10.1 Operational notes

- The seven Logic Inputs of the Control Module (terminals 4-5-6-7-8-9 & 19-20-21) are high impedance inputs. Add an auxiliary relay for each Logic Input connected through long wire to a remote location outside the HRVS-DN cabinet.
- Do not connect power factor correction capacitors in parallel with the motor at the output side of the soft starter. It may cause an immediate damage to the starter and/or capacitors and can be dangerous.
- Do not use power factor capacitors at all if the starter is powered from a generator. The capacitors may interfere with the voltage regulator of the generator. They may cause significant dangerous over voltages.
- If there are power factor capacitors connected upstream of the starter, and they are mounted close to the starter, it is recommended to disconnect the capacitors until the end of commissioning.
- Perform a Megger test to the motor and its cables while disconnected from the cabinet. After the end of test, leave the cable unconnected to enable the low voltage test.

Warning!

- Internal components and PCBs are connected to high potential when the starter's cabinet is connected to mains voltage.
- Never connect medium voltage to the cabinet, while any of the medium voltage doors is open.
- This high voltage is extremely dangerous and causes death or severe injury if contacted.
- Unit must be grounded to ensure correct operation, safety and to prevent damage.
- This medium voltage unit must be tested and operated only by authorized and licensed personnel.

10.2 Parts Identification in the HRVS-DN Cabinet

This section describe the standard cabinet comprising of: input bus bars, Line Contactor, Power Section, Bypass Contactor, low voltage compartment and output bus bars.

10.2.1 Parts Identification in the HRVS-DN Cabinet (HRVS-DN up to 6.6kV)

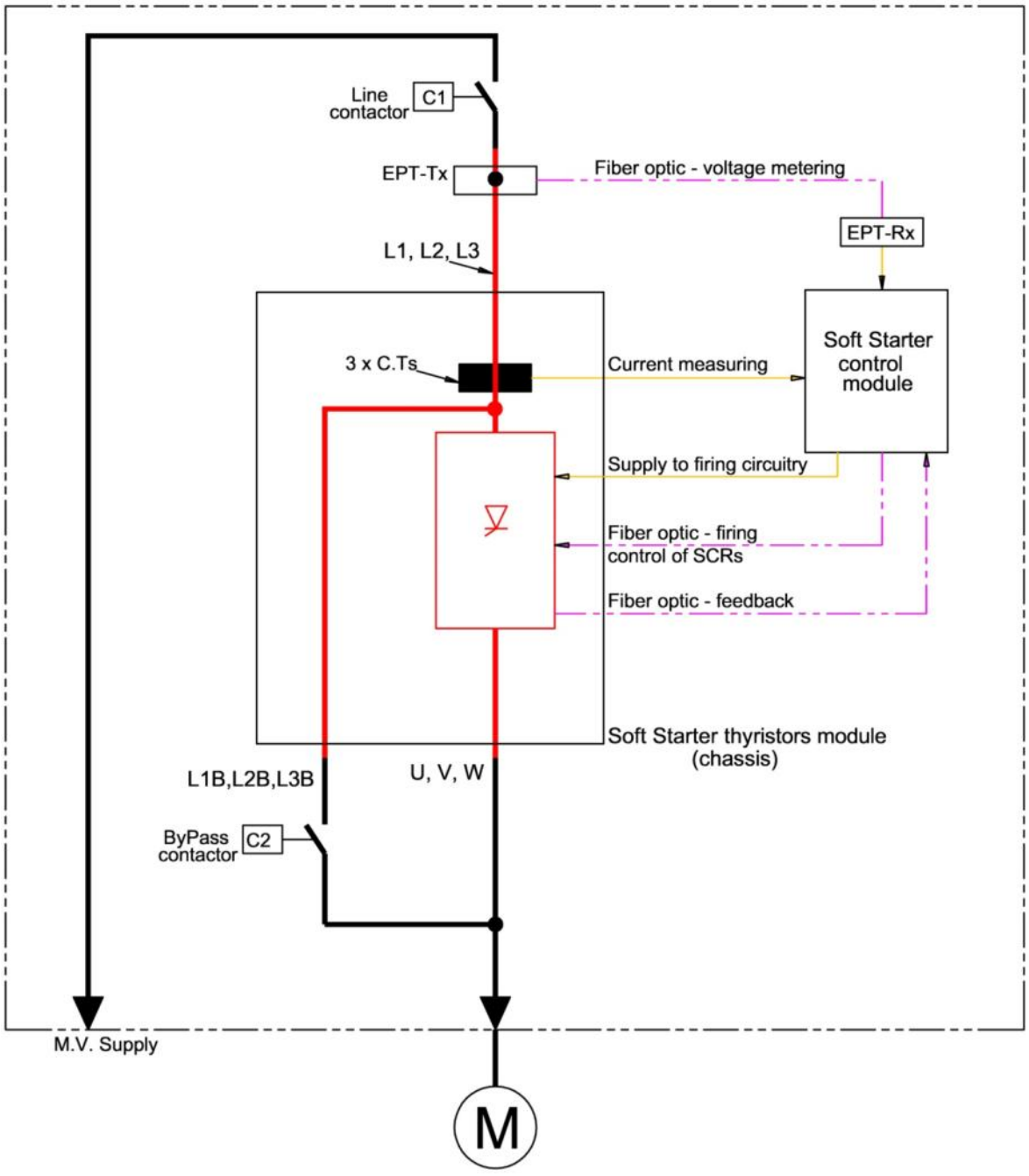


Figure 28 – HRVS-DN up to 6.6kV Standard Cabinet – One Line Diagram

The standard cabinet includes one frame with three doors. One of the doors is a medium voltage door and two doors are for low voltage: low voltage compartment door and the customer terminals compartment door.

Warning!

You are only allowed to open the low voltage compartment door and customer terminal compartment door when medium voltage is connected to the cabinet!
It is strictly forbidden to open the medium voltage compartment door at any time when medium voltage is connected to the cabinet!

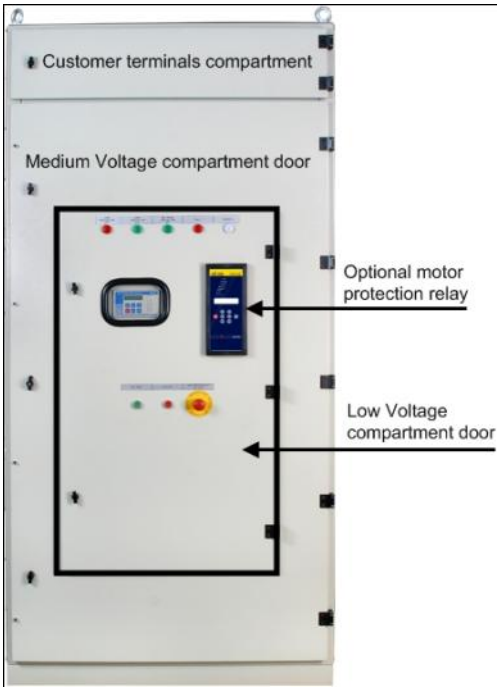


Figure 29 - HRVS-DN up to 6.6kV Standard Cabinet – Doors Closed

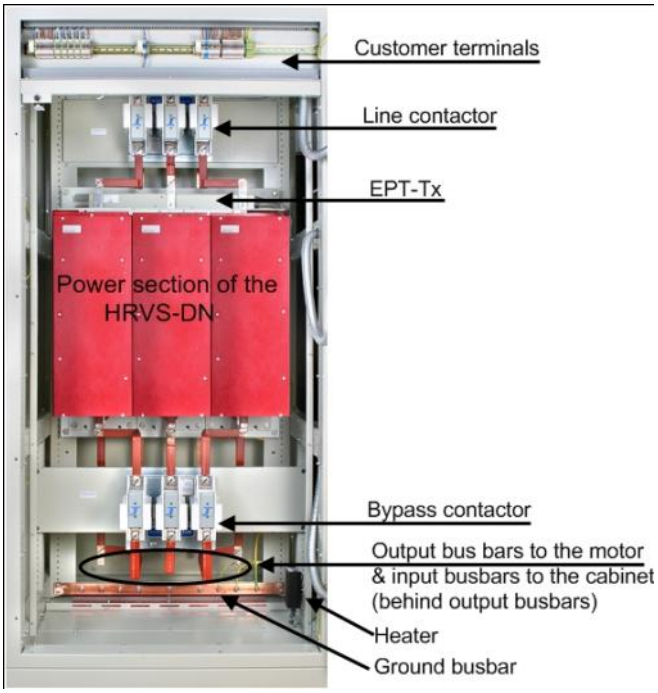


Figure 30 - HRVS-DN up to 6.6kV Standard Cabinet – Doors Open

View with medium voltage door open and customer terminals compartment door:

- Customer terminals are located in a dedicated compartment on the top of the cabinet.
- Line Contactor is mounted on the top of the medium voltage compartment.
- The EPT-Tx (Electronic Potential Transformer Transmitter) is mounted on the medium voltage bus bars downstream the Line Contactor on the input to the Power Section of the HRVS-DN thus measuring the input voltage to the Power Section.
  The output of the EPT-Tx are two fiber optic wires running to the EPT-Rx (Electronic Potential Transformer Receiver) which is located in the low voltage compartment.
  The harness runs out of the Power Section to the low voltage compartment. This harness includes both fiber optic wires and copper wires.
- The main unit is the Power Section of the soft starter.
  Note that this Power Section is actually composed of three identical modules, one per phase.
  The input bus bars to the Power Section are on top of it marked L1,L2, L3.
  Two sets of three bus bars each are mounted at the bottom of the Power Section:
  - One set, marked L1B,L2B,L3B, is connected to the input bus bars of the Power Section. These bus bars are brought to the bottom of the Power Section to enable convenient connection of the Bypass Contactor.
  - Second set, marked U,V,W, is the output bas bars.

- At the bottom of the cabinet the Bypass Contactor is located.
- Verify on cabinet label that both, medium voltage and control voltage, are according to the supplied mains voltage and control voltage.
- Input bus bars and output bus bars are located at the bottom of the cabinet.
  The input bus bars are at the back of the lower part of the cabinet.
  The output bus bars are at the front of the lower part of the cabinet.

10.2.2 ***Parts Identification in the HRVS-DN Cabinet (HRVS-DN from 10kV and up)***

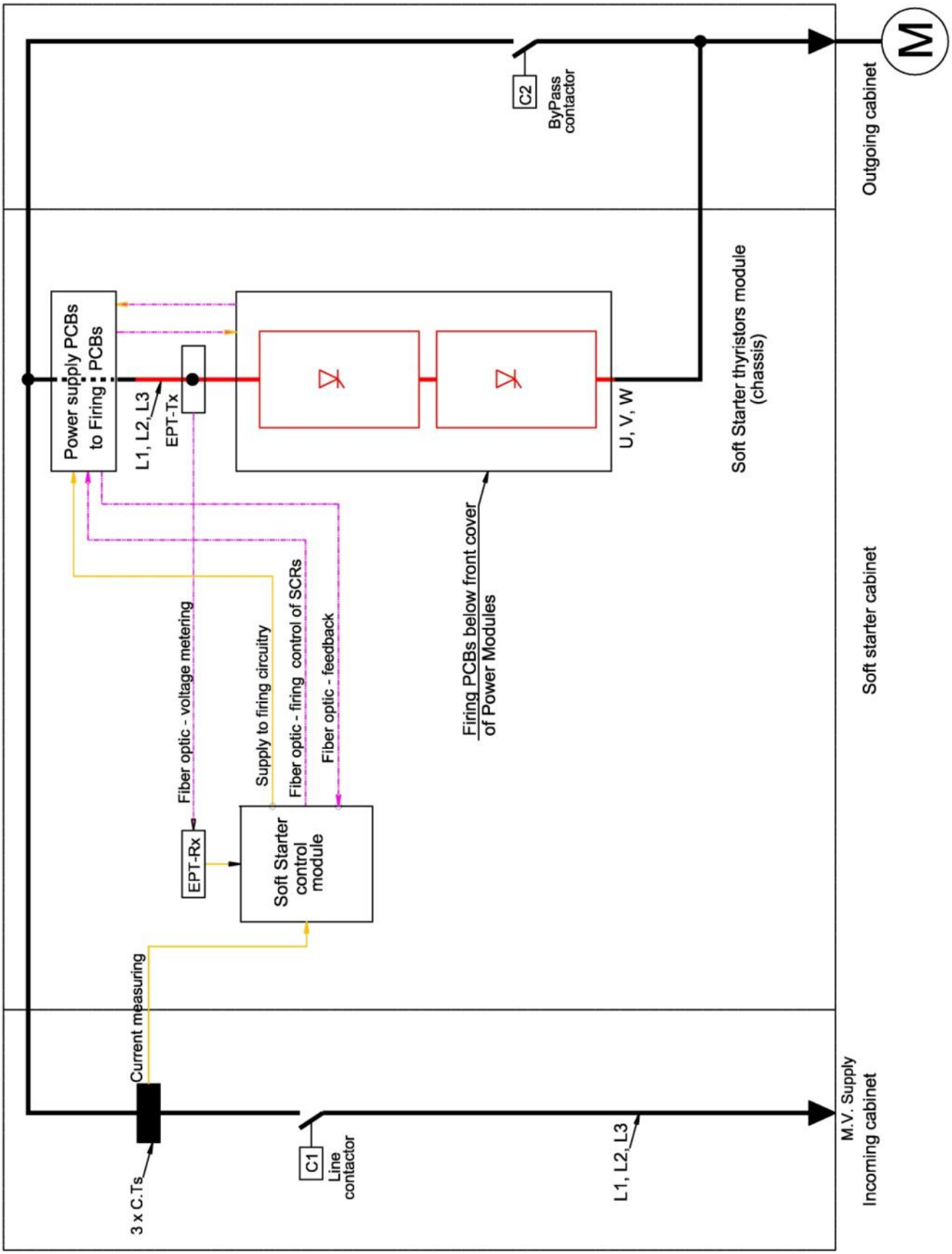


Figure 31 – HRVS-DN from 10kV and up, Standard Cabinet – One Line Diagram

The standard cabinet includes three frames with nine doors. Four of the doors are medium voltage doors and five doors are for low voltage: low voltage compartment door and customer terminals compartment doors.

Note:

You are only allowed to open the low voltage compartment door and customer terminal compartments doors when medium voltage is connected to the cabinet!

It is strictly forbidden to open the medium voltage compartment door at any time when medium voltage is connected to the cabinet!

Figure 32 - HRVS-DN from 10kV and up Standard Cabinet – Doors Closed

Figure 33 - HRVS-DN from 10kV and up Standard Cabinet – Doors Open

View with medium voltage doors open and customer terminals compartment doors open:

- Customer terminals are located in a dedicated compartments on the top of the cabinet.
- Line Contactor is mounted on the left medium voltage compartment.
- The EPT-Tx (Electronic Potential Transformer Transmitter) is mounted on the medium voltage bus bars downstream the Line Contactor on the input to the Power Section of the HRVS-DN thus measuring the input voltage to the Power Section.
  The output of the EPT-Tx are two fiber optic wires running to the EPT-Rx (Electronic Potential Transformer Receiver) which is located in the low voltage compartment.
  The harness runs out of the Power Section to the low voltage compartment. This harness includes both fiber optic wires and copper wires.
- The main unit is the Power Section of the soft starter.
  Note that this Power Section is actually composed of three identical modules, one per phase.
  The input bus bars to the Power Section are on top of it marked L1,L2, L3.
  The output bus bars from the Power Section are on its bottom and are marked U, V, W.
- Bypass Contactor is mounted on the right medium voltage compartment.
- Verify on cabinet label that both, medium voltage and control voltage, are according to the supplied mains voltage and control voltage.
- Input bus bars and output bus bars are located at the bottom of the cabinet.
  The input bus bars are at the input cabinet.
  The output bus bars are at the output cabinet.

10.2.3 ***Low Voltage Compartment***

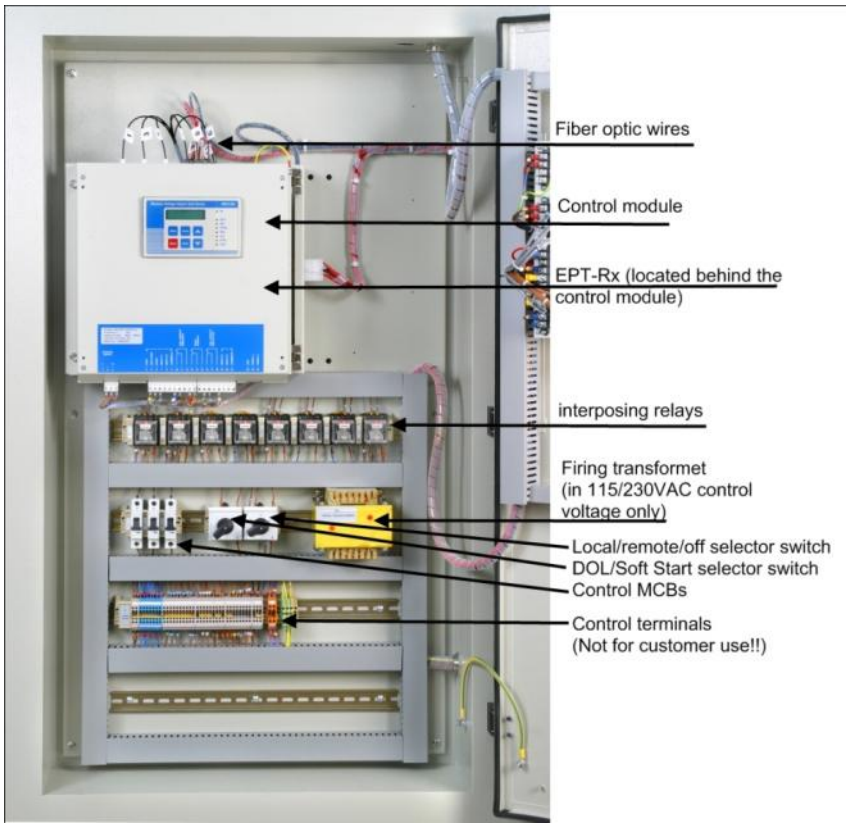


Figure 34 - HRVS-DN Low Voltage Compartment

- The Control Module is the heart of the soft starter which controls the firing angle of the thyristors (located in the Power Section).
  Warning: The six fiber optic wires on top of the control unit are sensitive to bending and heat.
- The EPT-Rx (Electronic Potential Transformer Receiver) is located behind the Control Module.
  Note the two fiber optic wires connecting the EPT-Rx to the EPT-Tx (Electronic Potential Transformer Transmitter) (located in the Power Section). The EPT-Rx is equipped with a fused supply voltage connector.
  The EPT-Rx provides three phase replica of the mains voltages in level of 120VAC (line to line). These voltages are connected to the Control Module, and also (optional) to the motor protection relay (MPR) located on the door of the low voltage compartment.

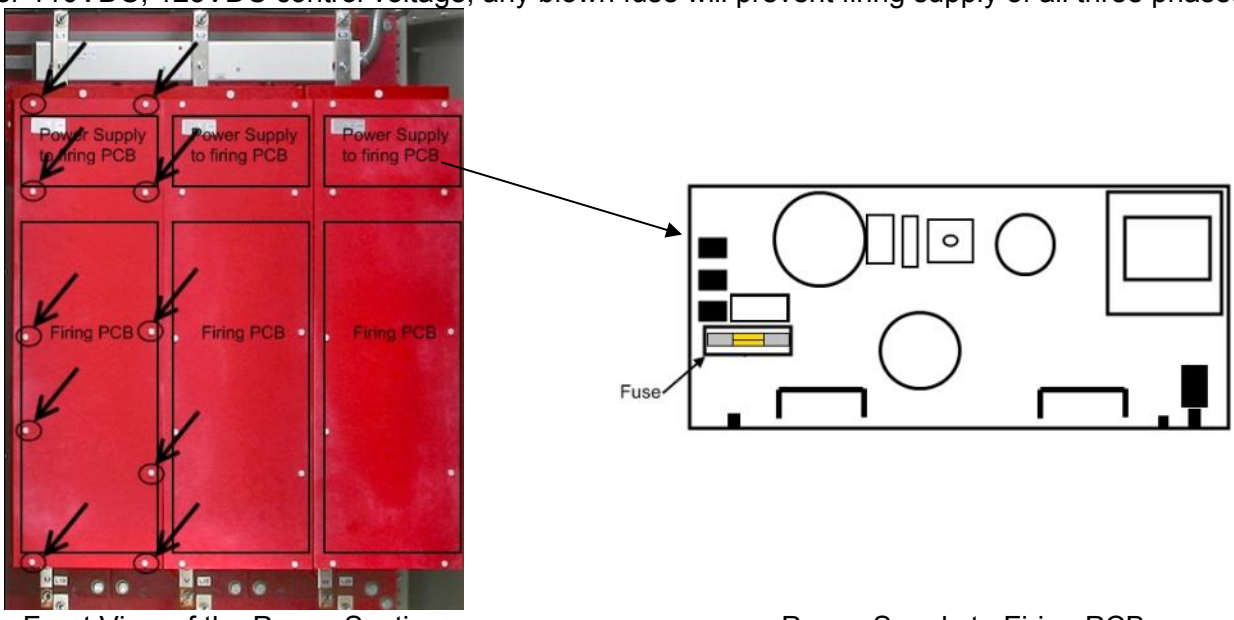
- Interposing relays connect the commands and indications to/from the Control Module.
- The selector switches (DOL/Soft start and Local/remote/Comm./Off) are mounted inside the low voltage compartment to prevent accidental change in their position while the Line Contactor is closed.
  Note: it is forbidden to change the position of these selector switches while Line Contactor is closed.
- The Firing Transformer located on the right side of the low voltage section.
- The control terminals in the low voltage compartment are NOT for customer use.

10.2.4 ***Fuses***

The soft starter includes four fuses:

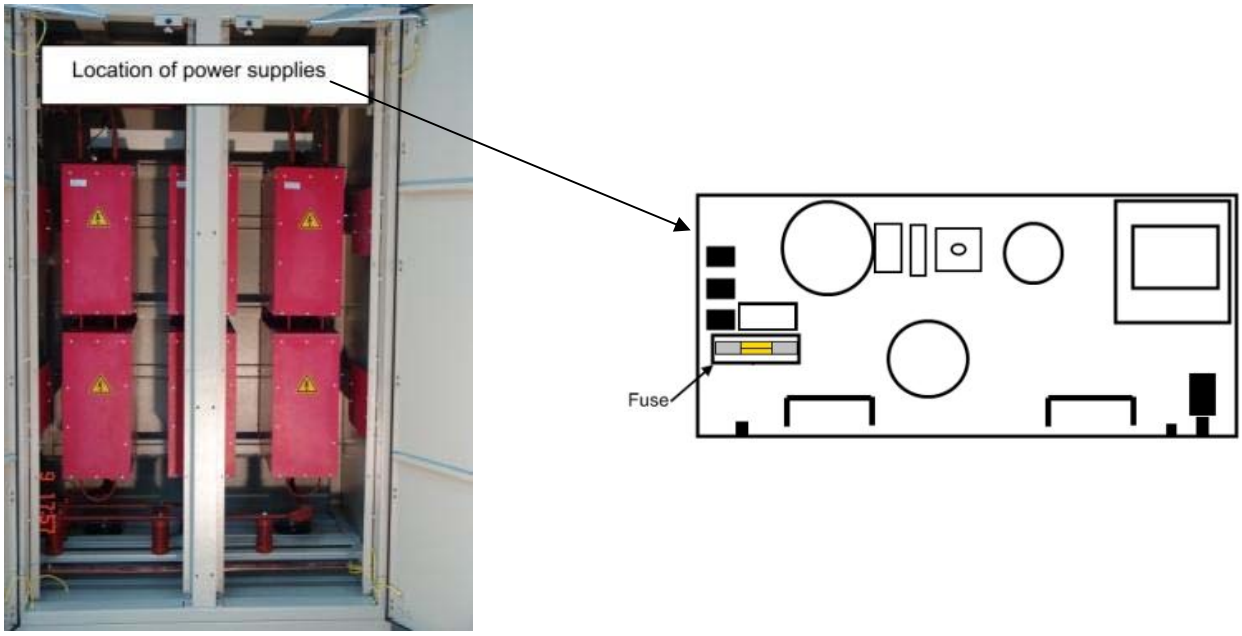
- Three fuses are located in the medium voltage Power Section, one per phase. They are located at the smaller PCBs PC2075 (for 110VAC, 230VAC, 220VDC control voltage) or PC2076 (for 110VDC, 125VDC control voltage). These fuses are connected at the input side of the firing switched mode power supplies and rated 10A.
  To check these fuses:
  - In HRVS-DN rated up to 6.6kV it is required to disassemble the phases cover (open the plastic screws as shown on *Figure 35*).
  - In HRVS-DN rated from 10kV and up the power supplies are located at the top compartment in the medium voltage compartment as shown on *Figure 36*).

  Note:
  For 110VAC, 230VAC, 220VDC control voltage a blown fuse will prevent firing supply for Its own phase only.
  For 110VDC, 125VDC control voltage, any blown fuse will prevent firing supply of all three phases.



Front View of the Power Section Power Supply to Firing PCB

Figure 35 – Power Supply to Firing PCB (HRVS-DN Models up to 6600V).

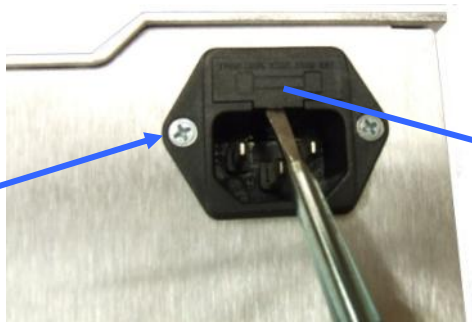


Front View of the Power Section Power Supply to Firing PCB

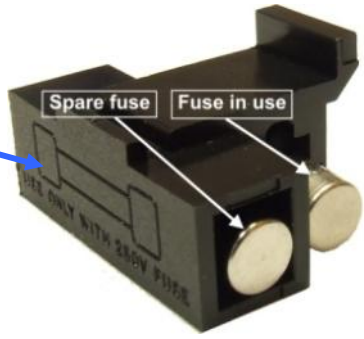
Figure 36 – Power Supply to Firing PCB (HRVS-DN Models From 10000V and up)

- <u>One fuse</u> is located in the Low voltage compartment, inside the input connector of the Electronic Potential Transformer Receiver (EPT-Rx). The EPT-Rx is located behind the Control Module.

Bottom view of the EPT-Rx



Use 5mm screw driver to remove the fuse holder from the socket



Fuse holder with fuse in use and a spare fuse

Figure 37 – EPT-Rx Fuse Replacement Procedure

10.3 **Standard Control Diagram**

Note!!	• The following diagram shows a standard wiring for a 115VAC and 230V control voltage. • This drawing is given for demonstrating purposes only. • **Note that the cabinet you have might be wired differently!!**

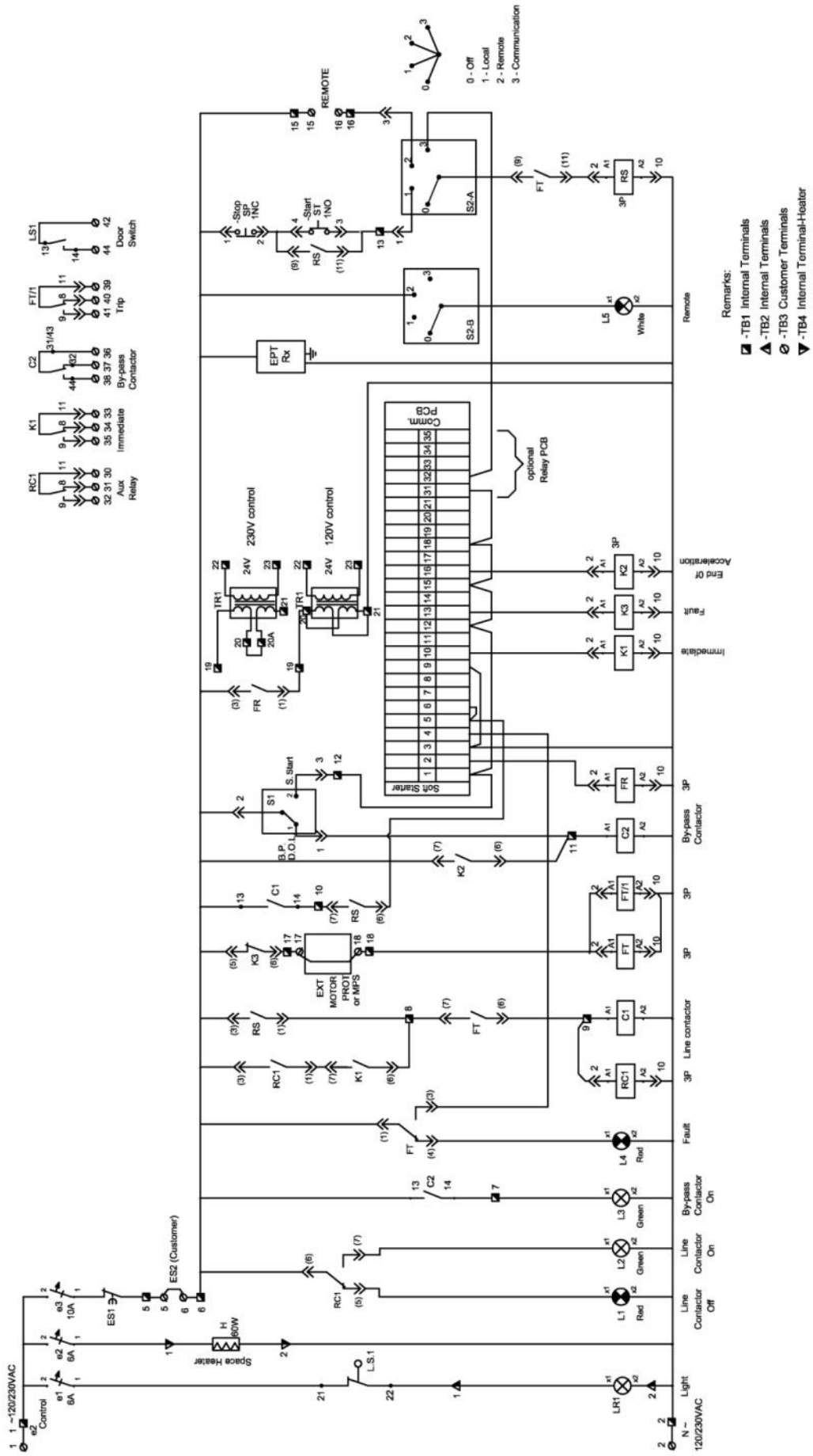


Figure 38 - HRVS-DN - Typical Control Wiring of Standard Cabinet

- **Control voltage** is supplied via customer terminals number 1 & 2.
- **L.S. 1** is a limit switch that control the internal lighting fixture and signal to external control system (via terminal 42 & 44) that medium voltage door is opened. Customer can trip the incoming circuit breaker to disconnect medium voltage from the input bus bars of the cabinet for safety.
- **H** is a heater to avoid humidity in the cabinet.
- **ES1** is a N.C. emergency stop push button mounted on the front of the low voltage compartment door.
- **Terminals 5 & 6** are for remote emergency stop N.C. push button. Customer can connect several N.C. push buttons located in several locations in the plant. For example: near the motor and at the control room.
- **L1-Line Contactor off (Red)** – indicates that Line Contactor is open. Mounted on the front of the low voltage compartment door.
- **L2-Line Contactor on (Green)** – indicates that Line Contactor is closed. Mounted on the front of the low voltage compartment door.
- **L3-Bypass Contactor on (Green)** – indicates that Bypass Contactor is closed. Mounted on the front of the low voltage compartment door.
- **L4-Fault (Red)** – indicates that the soft starter tripped either because of a fault indicated by the Control Module or from an internal motor protection or an external motor protection indication via customer terminals 17 & 18. Mounted on the front of the low voltage compartment door.
- **C1** is the Line Contactor. Mounted in the medium voltage compartment.
- **RC1** is an interposing relay to enable more contacts representing the position of the Line Contactor.
- **FT & FT/1** are the fault relays. The relays are energized in normal operation and de-energized upon fault indicated by the Control Module or from an external motor protection indication via customer terminals 17 & 18.
- **C2** is the Bypass Contactor. Mounted in the medium voltage compartment.
- **S1** is a selector switch for DOL/Soft Start by the user.
  When set to DOL:
  - Energizes the Bypass Contactor C2
  - Disconnects control voltage from the Control Module thus avoiding soft start and avoiding the Control Module to trip the motor in case of a fault.
    Note that external motor protection relays (if exist) will stay in operation and protect the motor.

  When set to Soft Start:
  - Bypass Contactor C2 is energized via the control circuitry.
  - The Control Module is powered from the Control voltage and the Control module is controlling the starting process and protecting the motor.
- **FR –** is the firing relay controlled by the Control Module to energize the firing transformer (TR1 in the diagram).
  The firing transformer energizes the power supply PCBs which feed the firing PCBs in the Power Section. This is required only during soft start and soft stop periods
  - The firing transformer applicable in 115VAC, 230VAC control voltage. See different wiring of TR1 transformer for 115VAC and 230VAC
  - In 220VDC control voltage a power supply (not shown in the diagram) is controlled by the FR relay
  - In 110VDC and 125VDC the FR relay energize a power contactor that feeds the power supply PCBs (not shown in the diagram)
- **Soft Starter** – is the HRVS-DN Control Module.
- **K1** – Is an interposing relay controlled by the internal IMMEDIATE relay of the HRVS-DN. Controlled by terminal 10 of the Control Module. The relay Energized when starter is in any condition except for stop and de-energized at stop. Its Normally Open contact is used in series with RC1 contact to hold the Line Contactor C1 energized at the soft stop process.
- **K3** – Is an interposing relay controlled by the internal FAULT relay of the HRVS-DN. Controlled by terminal 13 of the Control Module. Energized only when starter trips for fault. The normally closed contact is connected in series with the N.C. trip contact of the optional motor protection relay (MPR).
- **K2** – Is an interposing relay controlled by the internal END OF ACCELERATION relay of the HRVS-DN. Controlled by terminal 16 of the Control Module. K2 is energized after the end of the starting process to close the Bypass Contactor C2. K2 is de-energized upon Stop or Soft Stop commands or upon Fault.
- **EPT-Rx** – Is the Electronic Potential Transformer – Receiver.
- **S2** - is a selector switch for Local/Remote/Comm./Off controlled by the user.

  - When set to Off disconnects control voltage to RS thus avoids the possibility to start the motor either locally or from remote
  - When set to Local enables control from ST & SP (start & stop) push buttons mounted on the front of the low voltage compartment door
  - When set to Remote enables control via terminals 15 & 16 by a maintained contact controlled by the customer
  - When set to Communication enables control via terminals 31 & 32 of the Control Module. These terminals are of the optional Relay PCB. The contacts are controlled by the communication link (either Modbus, Profibus or DeviceNet).
- **L5-Remote control (White)** – indicates that the cabinet is controlled remotely. Mounted on the front of the low voltage compartment door.
- **ST** – N.O. contact of a push button controls the Start command locally. Mounted on the front of the low voltage compartment door.
- **SP** – N.C. contact of a push button controls the Stop command locally. Mounted on the front of the low voltage compartment door.
- **RS** – start relay controlled locally or remotely and if no fault is indicated will start the motor via the soft starter or DOL (depends on the position of selector switch S1).

10.3.1 ***How Does it Operate?***

Selector switches position: Local/Remote/Comm./Off selector is in the Local position and DOL/Soft Start selector switch is in Soft Start position.

Soft start process is initiated when the Start pushbutton (**ST** terminals 4 & 3) is pressed.
RS relay is energized (**RS** terminals 2 & 10). **RS** N.O. contact (**RS** terminals 9 & 11), connected in parallel with the start pushbutton (**ST** terminals 4 & 3) and holds the relay energized.
Line Contactor C1 and interposing relay **RC1** are now energized via another N.O. contact of **RS** (**RS** terminals 1 & 3).
Start command to the soft starter is initiated after the Line Contactor is closed (**C1** terminals 13 & 14) and via another N.O. contact of **RS** (**RS** terminals 6 & 7) to the soft starter by connecting control voltage to terminals 5 & 6 of the Control Module.
FR relay is energized and energizes the firing transformer via its N.O. contact. (**FR** terminals 1 & 3)
Relay **K1** (IMMEDIATE) is energized immediately after start command is initiated to the soft starter.
The starter ramps up the mains voltage to the motor until it reaches full voltage.
Relay **K2** (END OF ACCELERATION) is energized after programmable time delay (default of 5 seconds). The Bypass Contactor **C2** is energized through the N.O. contact of **K2** (**K2** terminals 6 & 7).
FR relay de-energizes after 2 more seconds and disconnects the firing transformer from the control voltage.
Motor is now running with the Bypass Contactor (**C2**) closed and the soft starter Power Section is idle.

Soft stop process is initiated when the Stop pushbutton (**SP** terminals 1 & 2) is pressed.
RS relay is de-energized.
Soft Starter terminals 5 & 6 are disconnected (**RS** terminals 6 & 7) from the control voltage and cause the soft starter to enter into soft stop process.
FR relay is energized and energizes the firing transformer via its N.O. contact. (**FR** terminals 1 & 3)
K2 relay is de-energized.
Bypass Contactor **C2** de-energizes via the N.O. contacts of **K2** (**K2** terminals 6 & 7).
The soft starter ramps down the voltage to the motor.
At the end of the soft stop process the HRVS-DN de-energizes **K1** relay. N.O. contact of **K1** (**k1** terminals 6 & 7) relay in series with N.O. contact of **RC1** (**RC1** terminals 1 & 3) act as a holding system to the Line Contactor C1. This enables the Line Contactor to be energized until the soft stop process is concluded.
FR relay is de-energized and de-energizes the firing transformer via its N.O. contact. (**FR** terminals 1 & 3)

Upon Fault condition:
If trip condition, is detected by the HRVS-DN, **K3** is energized. FT and FT/1 are de-energized via N.C. contact of **K3** (**K3** terminals 5 & 6) causing **RS** to trip, **C1** to trip and **L4** (Fault indication lamp) to turn on.
If trip condition is detected by the external motor protection relay, customer terminals 17 & 18 are opened, causing **FT** and **FT/1** to be de-energized.

Selector switches position: Local/Remote/Comm./Off selector is in the Remote position and DOL/Soft Start selector switch is in Soft Start position.
The process is exactly the same as above but **RS** relay is directly controlled by the remote Start/Stop contacts (Customer terminals 15 & 16).

WARNING!	When operating the HRVS-DN cabinet from Remote or via the communication links it is extremely important, because of safety reasons, to monitor the Trip relay (FT/1 terminals 39-40-41)) indication (See *Figure 38* page 95). **When the trip relay signals for trip remove the start command!**

Selector switches position: Local/Remote/Comm./Off selector is in the Comm. position and DOL/Soft Start selector switch is in Soft Start position.
When it is required to control the cabinet via communication (not only to monitor and/or change the parameters) it is required to install, in additional to the communication PCB (either Modbus, Profibus or DeviceNet), an optional Relay PCB.
When the selector is set to communication control, the **RS** relay is controlled by a relay located in the optional Relay PCB mounted in the Control Module.
Output terminals from the optional Relay PCB are 31, 32. Refer also to *Figure 13* page 29.

Selector switches position: Local/Remote/Comm./Off selector is in the Local or Remote position and DOL/Soft Start selector switch is in DOL position.

Switch the selector Switch **S1** to Bypass position only for testing the cabinet or in rare cases when the HRVS-DN does not function properly.
When Selector switch **S1** is in DOL position, control voltage from terminal 1 of the soft starter is removed thus the soft starter is not in active. Bypass Contactor **C2** is energized.
Start/Stop commands are initiated in the same way as if selector switch **S1** is in Soft start.

Notes:

- When selector switch Local/Remote/Comm./Off is in Comm. position and DOL/Soft Start selector switch is in DOL position it is not possible to control the cabinet.
- When DOL/Soft Start selector switch is in DOL position motor is not protected unless external or internal protections are installed.

WARNING!	When operating the HRVS-DN cabinet from Remote or via the communication links it is extremely important, because of safety reasons, to monitor the Trip relay (FT/1 terminals 39-40-41)) indication (See *Figure 38* page 95). **When the trip relay signals for trip remove the start command!**

11. HIGH-POT TEST OF THE HRVS-DN CABINET

Note: The high-pot test is performed in the factory as part of the cabinet FAT. (Factory Acceptance Test). Thus it is not recommended to do the high-pot test at customer site.

High-pot test levels and duration are as follows:

- Up to 3.6kV: 10kVAC for 60 seconds
- Up to 7.2kV: 20kVAC for 60 seconds
- Up to 12kV: 28kVAC for 60 seconds
- Up to 15kV: 38kVAC for 60 seconds

Two options for high-pot test available:

- With the EPT-Tx connected. In this case only one test can be performed when the soft starter is short connected as one unit (L1 to U, L2 to V, L3 to W and L1 to L2 to L3)
- With EPT-Tx disconnected. In this case it is possible to perform the high-pot test between each of the phases while the other two phases are grounded.

11.1 High-Pot Test in HRVS-DN up to 6.6kV, EPT-Tx Connected

Preparations (refer to *Figure 39*):
Short circuit the L1B and U busbars of phase L1.
Short circuit the L2B and V busbars of phase L2.
Short circuit the L3B and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Short circuit U, V, W bus bars at the output of the soft starter.
High-pot test procedure:
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-pot tester to the soft starter basbars.
Set the tester for the correct testing voltage, as specified above.
Perform the test for 1 minute.

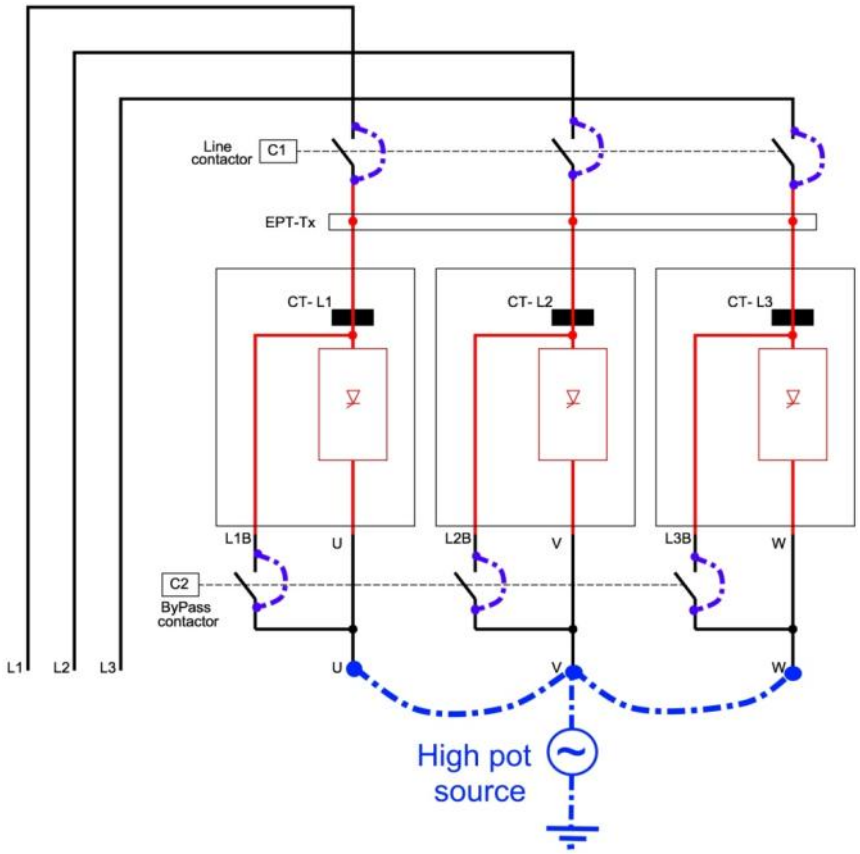


Figure 39 – HRVS-DN up to 6.6kV – Preparations for High-pot Test

Megger test:

You can perform a Megger test (5kVDC) between the three phases connected together as one group and ground. This Megger test should give a very high resistance result.
You can also perform a Megger test between the three phases. To do this you must connect L1B-U, L2B-V, L3B-W.
Since the EPT-Tx is connected between the phases, the following resistances are be expected (all values are ±5%):

HRVS-DN Rated Voltage	L1 – L2	L2 – L3	L1 – L3
2.3kV	670KΩ	4MΩ	4.67MΩ
3.3kV	1MΩ	6MΩ	7MΩ
4.16kV	1.33MΩ	8MΩ	9.13MΩ
6.6kV	2MΩ	12MΩ	14MΩ

11.2 High-Pot Test in HRVS-DN up to 6.6kV, EPT-Tx Not Connected

High-pot test procedure for L1 (refer to *Figure 40*):

Dismantle the EPT-Tx

Short circuit the L1B and U busbars of phase L1.
Short circuit the L2B and V busbars of phase L2.
Short circuit the L3B and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Connect to ground L2 and L3
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-Pot tester to the soft starter busbars of L1.
Set the tester to the correct testing voltage, as specified above. Perform the test for 1 minute.

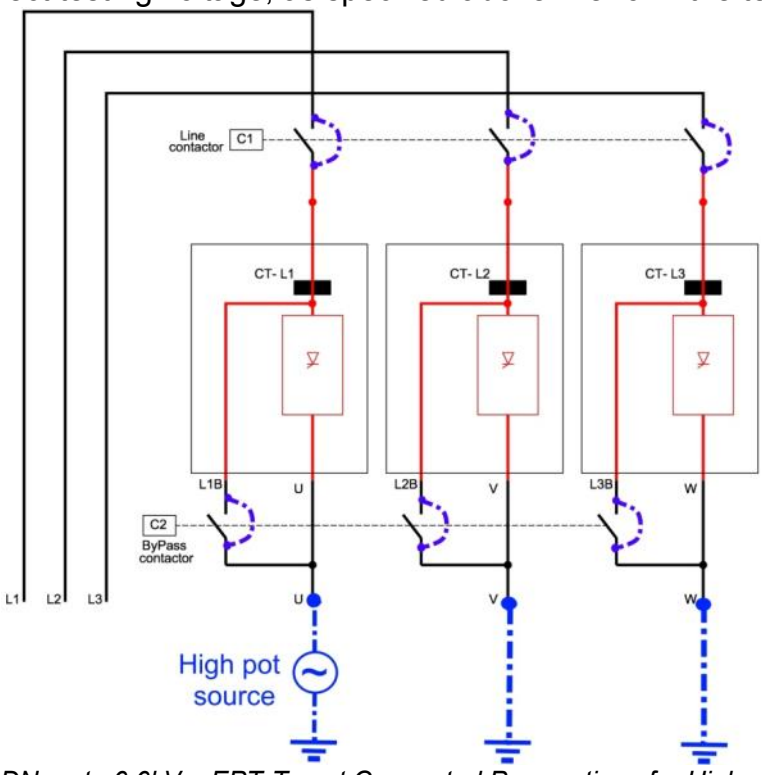


Figure 40 – HRVS-DN up to 6.6kV – EPT-Tx not Connected Preparations for High-pot Test, Testing L1

High-pot test procedure for L2 (refer to *Figure 41*):

Dismantle the EPT-Tx

Short circuit the L1B and U busbars of phase L1.
Short circuit the L2B and V busbars of phase L2.
Short circuit the L3B and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Connect to ground L1 and L3
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-Pot tester to the soft starter busbars of L2.

Set the tester to the correct test voltage, as specified above. Perform the test for 1 minute.

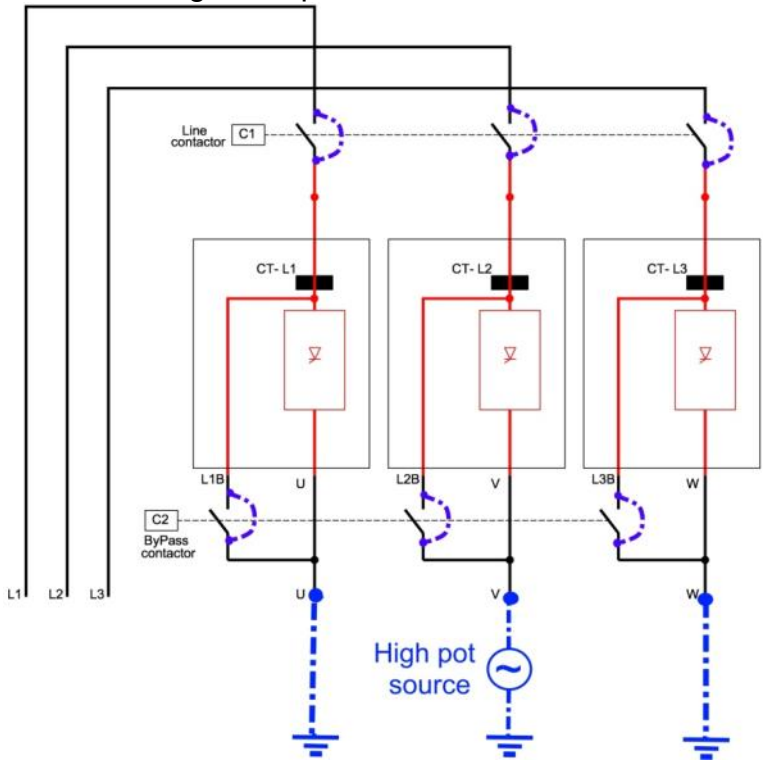
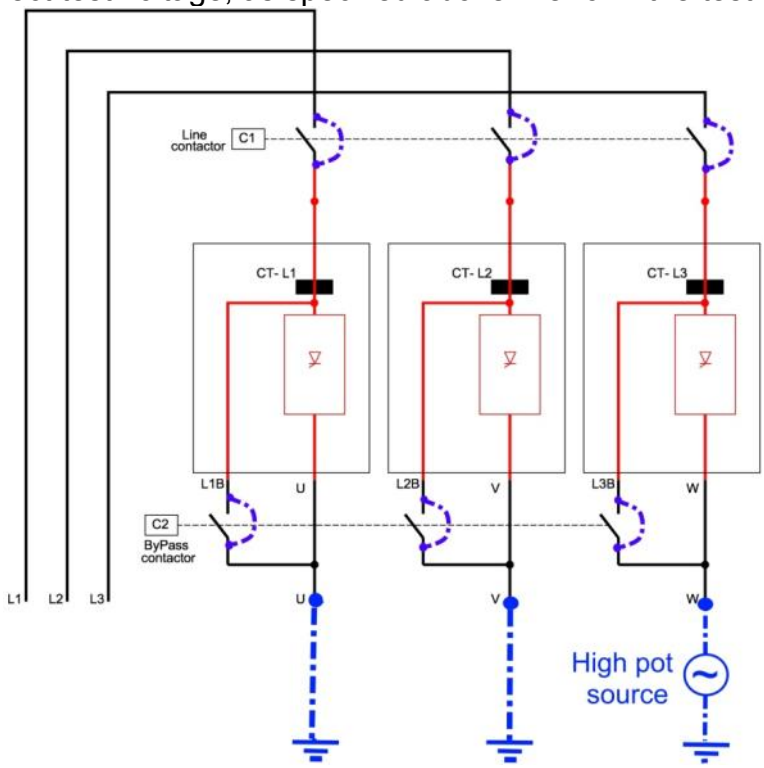


Figure 41 – HRVS-DN up to 6.6kV – EPT-Tx not Connected Preparations for High-pot Test, Testing L2

High-pot test procedure for L3 (refer to *+Figure 42*):

Dismantle the EPT-Tx

Short circuit the L1B and U busbars of phase L1.
Short circuit the L2B and V busbars of phase L2.
Short circuit the L3B and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Connect to ground L1 and L2
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-Pot tester to the soft starter busbars of L3.
Set the tester to the correct test voltage, as specified above. Perform the test for 1 minute.



+Figure 42 – HRVS-DN up to 6.6kV – EPT-Tx not Connected Preparations for High-pot Test, Testing L3

Megger test:

You can perform a Megger test (5kVDC) between each phase to ground.

11.3 High-Pot Test in HRVS-DN from 10kV and Up, EPT-Tx Connected

Preparations (refer to *Figure 43*):
Short circuit the L1 and U busbars of phase L1.
Short circuit the L2 and V busbars of phase L2.
Short circuit the L3 and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Short circuit input-output phases of the Bypass Contactor.
Short circuit U, V W bus bars at the output of the soft starter.

High-pot test procedure:
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-pot tester to the soft starter basbars.
Set the tester to the correct test voltage, as specified above.
Perform the test for 1 minute.

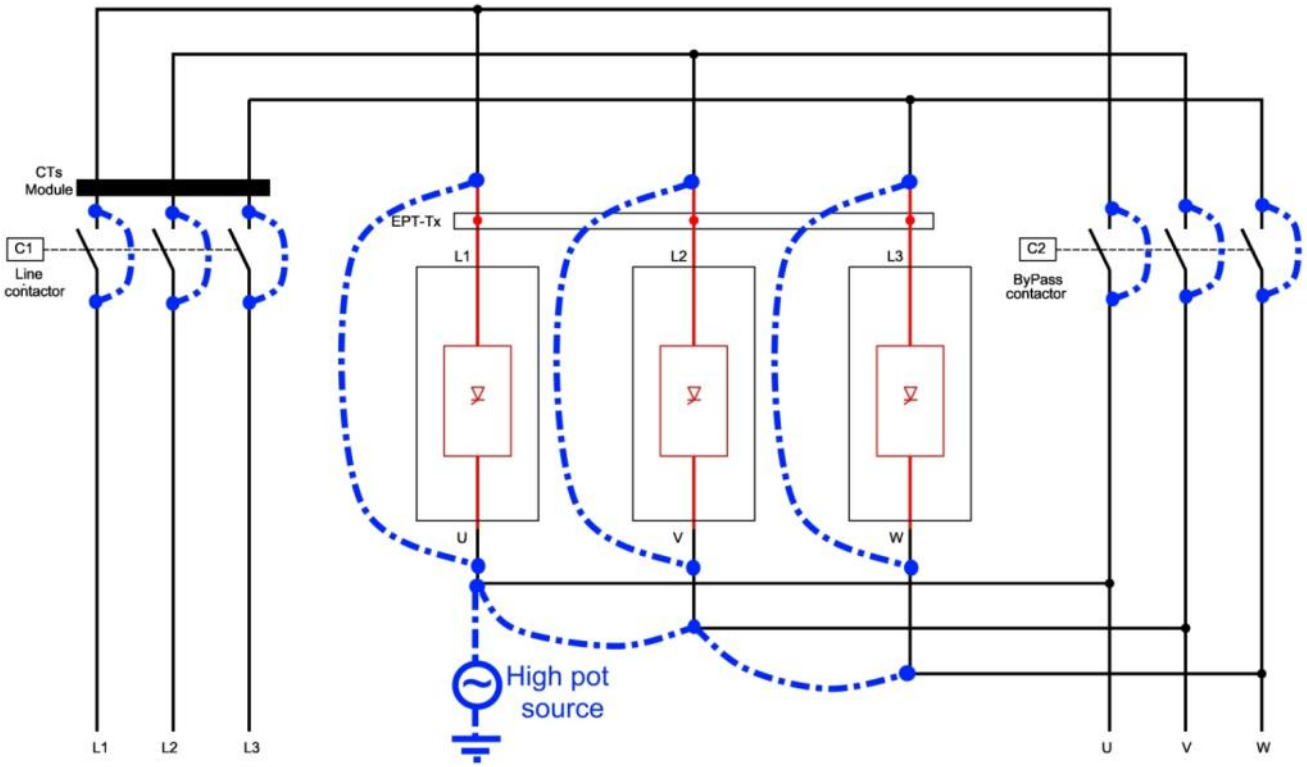


Figure 43 – HRVS-DN from 10kV and Up – Preparations for High-pot Test

Note: You are allowed to perform a Megger test (5kVDC) between the three phases connected together as one group and ground. This Megger test should give a very high resistance result.
You can also perform a Megger test between the three phases. To do so, make sure that the L1-U, L2-V, L3-W connections are performed.
Since the EPT-Tx is connected between the phases, the following resistances are expected (all values are ±5%):

HRVS-DN Rated Voltage	L1 – L2	L2 – L3	L1 – L3
10kV	18MΩ	3MΩ	21MΩ
11kV	20MΩ	3.3MΩ	23.3MΩ
13.2kV	24MΩ	4MΩ	28MΩ
13.8kV	24MΩ	4MΩ	28MΩ
15kV	26MΩ	4.3MΩ	30.3MΩ

11.4 High-Pot Test in HRVS-DN from 10kV and Up, EPT-Tx Not Connected

High-pot test procedure for L1 (refer to *Figure 44*):

Dismantle the EPT-Tx

Short circuit the L1 and U busbars of phase L1.
Short circuit the L2 and V busbars of phase L2.
Short circuit the L3 and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Short circuit input-output phases of the Bypass Contactor.
Connect to ground L2 and L3.
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-Pot tester to the soft starter busbars of L1.
Set the tester to the correct test voltage, as specified above. Perform the test for 1 minute.

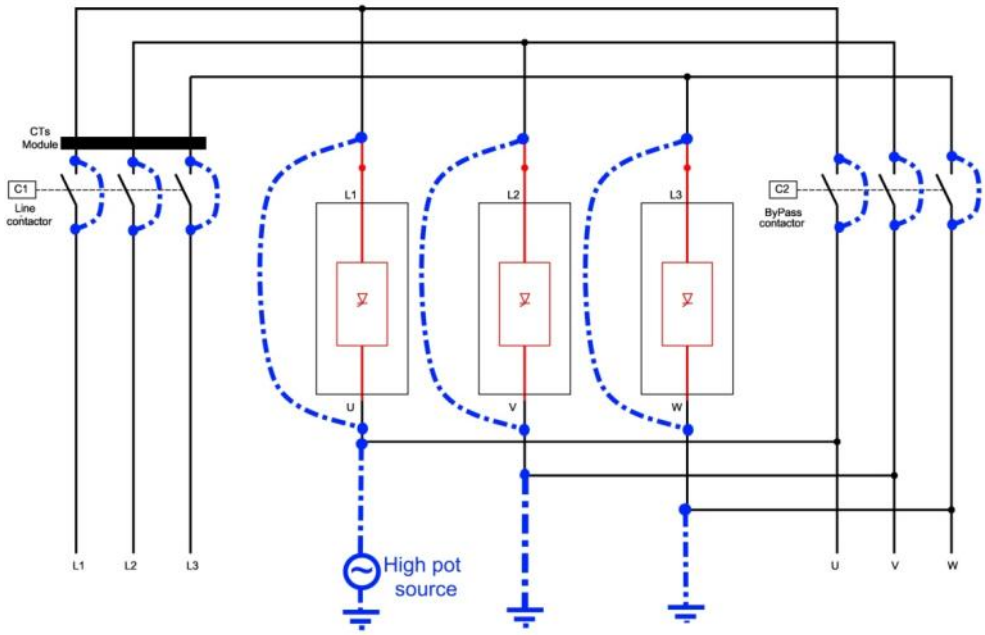


Figure 44 – HRVS-DN from 10kV and up, EPT-Tx not Connected, Preparations for High-pot Test, Testing L1

High-pot test procedure for L2 (refer to *Figure 45*):

Dismantle the EPT-Tx

Short circuit the L1 and U busbars of phase L1.
Short circuit the L2 and V busbars of phase L2.
Short circuit the L3 and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Short circuit input-output phases of the Bypass Contactor.
Connect to ground L1 and L3.
Connect the ground cable of the High-pot tester to cabinet ground (earth).
Connect the live cable of the High-Pot tester to the soft starter busbars of L2.
Set the tester to the correct test voltage, as specified above. Perform the test for 1 minute.

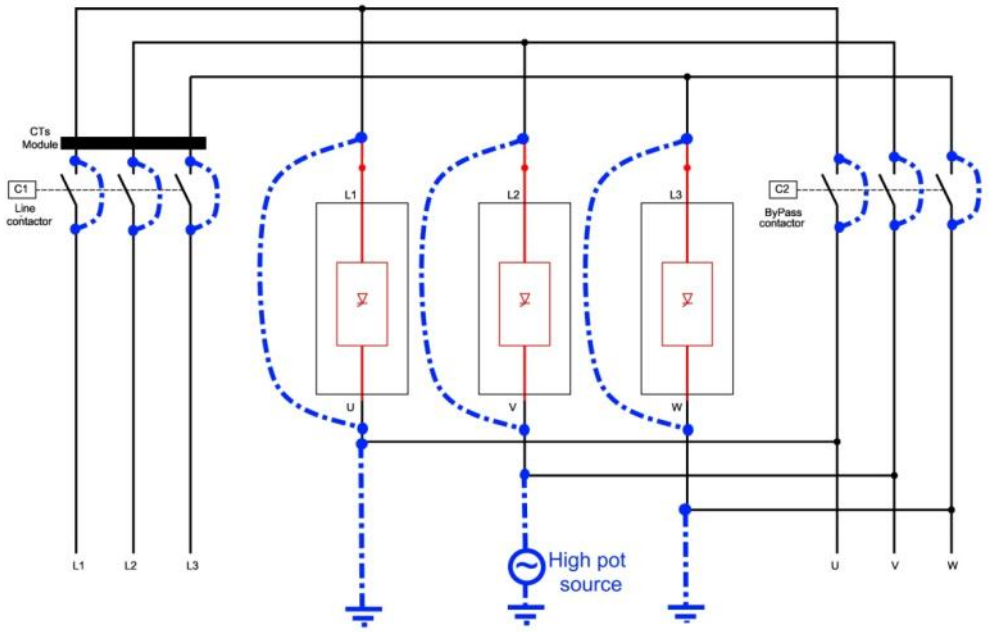


Figure 45 – HRVS-DN from 10kV and up, EPT-Tx not Connected, Preparations for High-pot Test, Testing L2

High-pot test procedure for L3 (refer to *Figure 46*):

Dismantle the EPT-Tx

Short circuit the L1 and U busbars of phase L1.
Short circuit the L2 and V busbars of phase L2.
Short circuit the L3 and W busbars of phase L3.
Short circuit input-output phases of the Line Contactor.
Short circuit input-output phases of the Bypass Contactor.
Connect to ground L1 and L2
Connect the ground cable of the High-pot tester to Cabinet ground (earth).
Connect the live cable of the High-Pot tester to the soft starter busbars of L3.
Set the tester to the correct test voltage, as specified above. Perform the test for 1 minute.

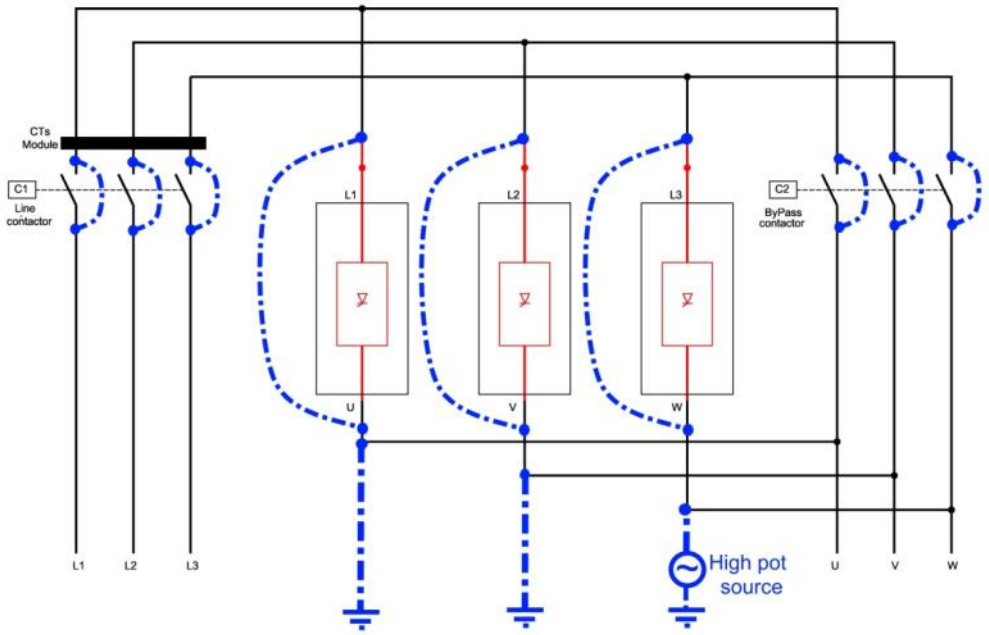


Figure 46 – HRVS-DN from 10kV and up, EPT-Tx not Connected, Preparations for High-pot Test, Testing L3

Megger Test:
You can perform a Megger test (5kVDC) between each phase to ground.

12. TEST PROCEDURE FOR LOW VOLTAGE TESTING

12.1 Accessories Required for LOW VOLTAGE Testing of the Starter and Cabinet.

☐ Control cable – three wires (two wires+ground) and a switch, to connect the control voltage (110VAC, 230VAC, 115VDC, 125VDC or 220VDC).
Note: Rated power of the control power source should be 2.5kW minimum. This will ensure all inrush current to the HRVS-DN will not cause voltage drop to the control circuitry.

☐ Power cable - four wires (3 phase + ground) cable + fused three phase switch, to connect the low voltage 400VAC three phase mains voltage to the cabinet. Prepare one side of the cable with a connector to the mains voltage according to the type of connectors used in the field. The other side with cable lugs or, more conveniently, with adequate alligator clips suit the bus bar size.
Note: If low voltage mains is generated by a step up or step down transformer, its kVA should be 10 times greater than the testing motor kVA. Otherwise, the mains (low) voltage may be heavily distorted and prevent proper operation of the soft starter.

☐ Start / Stop toggle switch with 2 wire cable, to simulate the remote Start / Stop contact.

☐ Three phase 400VAC induction motor 5 -10KW. The motor should be loaded by a fan or any other kind of inertia (fly wheel). Note that test motor rated current should follow the rule:
<test motor FLA X gain > 40% STARTER FLC>. (see here after information on gain settings)

☐ Digital multimeter.

☐ Test Harness with three colored wires (supplied with the cabinet, located in a small plastic bag in the drawings pocket).
Note: Test harnesses for other than 400VAC (in the range of 440VAC to 690VAC) can be ordered. The test voltage (if other than the standard 400V), is indicated on the tape of the test harness.

12.2 Notes and Warnings

Notes:
- The starter and the cabinet are designed to ensure a complete, convenient and safe test procedure for the starter and for the cabinet, using only the above accessories.
- The next procedure should be used for the following:
    - To ensure that the unit functions properly.
    - To learn the operational modes and options of the cabinet.
    - To test the cabinet together with the external control system (Factory Scada system, external PLC, etc.) It is strongly recommended to perform as many tests as possible in the low voltage mode to debug the external control system hardware and software in this low voltage mode until the entire system operates satisfactorily.
    - To debug the system in a rare event of a problem in the starter, cabinet or control system.

WARNING!	• Make sure that Medium voltage is disconnected and secured. • Check that the test control voltage is equal to the rated control voltage. • Immediate damage can be expected if the control voltage level is incorrect. • Check that the three phase mains testing voltage is equal to 400VAC, which is the standard testing voltage. An immediate damage can be expected if the mains voltage is not 400VAC±10%. • Read the soft starter instruction manual carefully as well as the optional Motor Protection Relay (MPR) instruction manual, If installed.

12.3 **Low Voltage Test Procedure**

1.	☐ Disconnect mains voltage from the soft HRVS-DN cabinet.
2.	☐ Ground the medium voltage lines.
3.	☐ Put warning signs that will prevent anyone from connecting the medium voltage lines to the HRVS-DN cabinet.
4.	☐ The HRVS-DN cabinet inputs bus bars (marked L1, L2, L3).should be free from any connection. Do not ground them, since low testing voltage should be connected to these input lines.
5.	☐ Disconnect the medium voltage Motor lines from the output bus bars of the cabinet (marked U, V, W).
6.	☐ Visual test. Make sure that there is:
7.	No meChoose an item.chanical damage
8.	No loose screws
9.	No excessive dust
10.	No loose parts.
11.	No cut wires
12.	No open fiber optic wires
13.	No broken insulators
14.	☐ Connect the safety ground to the cabinet.
15.	☐ Double check that the cabinet is free from any voltage connection and is disconnected also from the medium voltage motor.
16.	☐ Disassemble the clear plastic cover in the front of the starter Power Section.
17.	Connect the low voltage test harness:
18.	☐ **HRVS-DN up to 6.6kV**: Refer to section 12.3.2.1 page 110.
19.	☐ **HRVS-DN 10kV and up**: Refer to section 12.3.2.2 page 111.
20.	☐ Connect the motor cable to the output bus bars U, V, W.
21.	☐ Connect the control voltage cable (equipped with switch) to customer terminals 1 & 2 located in customer terminal compartment.
22.	☐ Connect three phase cable (equipped with switch) to the input bus bars (L1, L2, L3), upstream the Line Contactor (so that voltage is disconnected from starter, when the contactor is open).
23.	☐ Connect the remote control switch wires to customer terminals 15 & 16 located in customer terminal compartment.
24.	☐ Turn on the two MCBs located in the top-left side of the low voltage section (marked e1 and e2).
25.	☐ Verify that the Emergency push button is in the normal operating position.
26.	☐ Set DOL/Soft Start selector switch (S1) to Soft Starter position.
27.	☐ Set the Local/Remote/Comm./Off selector switch (S2) to Local.
28.	☐ Turn on the control voltage switch.
29.	☐ The Control Module should be powered now.
30.	☐ Verify that the remote control indication light (L5) on the external door is turned off.
31.	☐ Get familiar with the soft starter settings, using its instruction manual.
32.	☐ Press the Reset buttons on the soft starter Control Module panel and on the optional MPR panel.
33.	Enter MAIN & PROTECT. parameters. set: ☐ RATED LINE VOLT. – As indicated on the HRVS-DN label ☐ STARTER FLC – As indicated on the HRVS-DN label ☐ MOTOR FLA – Set to <test motor FLA X gain> (see here after information on gain settings) ☐ Browse all the way down until you see the message: STORE ENABLE MAIN & PROTECT. ☐ Press the Store button and wait for the message: DATA SAVED OK.
34.	Enter START parameters, set: ☐ SOFT START CURVE – set to 1 (standard) ☐ INITIAL VOLTGE – set to 10% ☐ NUMBER OF STARTS – set to OFF (to enable unlimited number of starts with the low voltage motor)

☐ Browse all the way down until you see the message: STORE ENABLE START PARAMETERS.
☐ Press the Store button and wait for the message: DATA SAVED OK.

35. Enter STOP parameters, set:
☐ SOFT STOP CURVE – set to 1 (standard)
☐ DEC. TIME – set to 10SEC.
☐ Browse all the way down until you see the message: STORE ENABLE STOP PARAMETERS.
☐ Press the Store button and wait for the message: DATA SAVED OK.

36. ☐ Turn off the control voltage.

37. ☐ Release the four screws at the corners of the front panel of the soft starter control unit. Remove the front panel. Refer to *Figure 15* page 40. Identify Main PCB - PC2050 and Fiberoptic PCB – PC2055.

38. ☐ On the Main PCB – PC2050 set the required interface language on the display, you need to change the position of dip switches 5 & 6. Refer to section 6.4.3 page 41.

39. ☐ On the Fiberoptic PCB – PC2055 set the Current gain dip switches for low voltage motor testing. Refer to section 12.3.1 page 110:

Dip Switch #1	Dip Switch #2	Gain
ON	ON	1
OFF	ON	5
ON	OFF	13.4
OFF	OFF	67

40. ☐ Re-check that the Gain dip switches of the three phases are set identically.

41. ☐ Tilt back the display and re-install the front panel.

42. ☐ While 400VAC mains voltage is still not connected to the cabinet, press the Start push button. The Line Contactor (C1) is energized for a short time and then trips. UNDER / NO VOLTAGE message is displayed on the screen of the soft starter's control unit. *Fault* lamp lights on the external door.

43. ☐ Press Reset on the Control Module. The fault indications are distinguished.

44. ☐ Turn on the (three phase) mains low voltage.

45. ☐ Verify that the Line Contactor is open and indication light on the external door is lit.

46. ☐ Press the Start push button. The Line Contactor is energized and after a short time the soft start process begin. the LINE CONTACTOR ON indication light will indicate that the contactor is now closed. Since the motor is not heavily loaded, the starter enters RUN conditions in few seconds. After few more seconds(adjustable), the Bypass Contactor closes and the BYPASS CONTACTOR ON indication light is on.

47. ☐ If the motor is not equipped with loading inertia and/or is not loaded, it may vibrate mechanically while reaching full speed. If this is the case, make sure that the motor is not too small, and that SOFT START CURVE 1!! is used. Also make sure that the Gain dip switches are in the correct position. If it does not help enough, try to replace motor with a loaded one (like a fan motor).

48. ☐ Press the Stop pushbutton.
The Bypass Contactor opens and the starter ramps down the voltage to the motor. At the end of the soft stop process, the Line Contactor opens and the motor slows down to a stop.
Note: Since the motor is not loaded it may be seen, in the soft stop process that the motor runs normally and then stops just at the end of the soft stop process. Using a low current clamp ammeter it can be seen that during the soft stop process, motor current is reduced to approximately one half of its value while running before the soft stop process.

49. Enter START parameters, set:
☐ ACC. TIME – set to 20sec.
☐ CURRENT LIMIT – set to 300%
☐ Browse all the way down until you see the message: STORE ENABLE START PARAMETERS.
☐ Press the Store button and wait for the message: DATA SAVED OK.
☐ Start the motor again and note that motor accelerates slower.

50. ☐ When the motor is stopped, change the Local/Remote/Comm./Off selector switch (S2) to Remote. Now, the external Start / Stop pushbuttons have no effect. Verify that REMOTE indication light on the external door is lit on.

51. ☐ Repeat the start / stop process using the external remote control switch.

52.	☐	When the motor is stopped, change the Local/Remote/Comm./Off selector switch (S2) to Comm. Now, the external Start / Stop pushbuttons have no effect. Verify that REMOTE indication light on the external door is off.
53.	☐	Repeat the start / stop process using the communication link.
54.	☐	While the motor is stopped, change the DOL/Soft Start selector switch (S1) to DOL. Bypass Contactor C2 closes immediately. The Control Module is not powered now. Start the motor and notice that motor speed rise to maximum “at once” since it gets full voltage immediately when mains contactor C1 is closed.
55.	☐	When the motor is stopped, set DOL/Soft Start selector switch (S1) to Soft Starter position and set the Local/Remote/Off selector switch (S2) to Local.
56.	☐	Set the optional Motor Protection Relay (MPR) according to customer’s preferences. Note that the MPR cannot sense the start and run process, since the testing low voltage motor current is very low if compared to the rated current of the medium voltage motor.
57.	☐	Clearing out of the low voltage test:
58.	☐	Verify that both mains and control voltages are turned off and their plugs are pulled out.
59.	☐	Disconnect the Test Harness from the EPT transmitter. Put it back in the small plastic bag and return to the drawing pocket.
60.	☐	Disconnect mains, motor and control external cables.
61.	☐	Reconnect power cables to the mains.
62.	☐	Connect motor cables to the output bus bars.
63.	☐	Re-assemble the clear plastic cover on top of the starter Power Section.
64.	☐	Close the medium voltage compartment doors and secure the screws.
65.	☐	Open the front panel of the Control Module of the soft starter. Loosen the 4 screws that hold the display in place then tilt it forward. this will give you access to the dip switches on the PC2055. Set the dip switches to ON. Tilt back the display and fasten its four screws. Reinstall the front panel of the Control Module.
66.	☐	Connect control voltage to the cabinet.
67.	☐	Enter TEST/MAINTENANCE OPTIONS (press Mode+▼) press Select 3 times until STORE NOW? DEFAULT SETTINGS shows. Press Mode+Store. Verify that DATA SAVED OK message appears.
68.	☐	Enter TEST/MAINTENANCE OPTIONS (press Mode+▼) press Select 4 times until CLEAR NOW? STATISTICAL DATA shows. Press Reset+Store. Verify that DATA SAVED OK message appears.
69.	☐	Enter TEST/MAINTENANCE OPTIONS (press Mode+▼) press Select 5 times until the clock adjustment display is shown. Set the time and date correctly.
70.	☐	Enter MAIN & PROTECT. parameters. set: ☐ RATED LINE VOLT. – As indicated on the HRVS-DN label ☐ STARTER FLC – As indicated on the HRVS-DN label ☐ MOTOR FLA – As indicated on the medium voltage motor label. ☐ RATED MOTOR PWR – As indicated on the medium voltage motor label. ☐ SERVICE FACTOR – As indicated on the medium voltage motor label. ☐ Browse all the way down until you see the message: STORE ENABLE MAIN & PROTECT. ☐ Press the Store button and wait for the message: DATA SAVED OK.
71.	☐	Enter START parameters, set the parameters as required for the medium voltage motor. If no other data is available, leave all parameters in their default values.
72.	☐	Enter STOP parameters, set the parameters as required for the medium voltage motor. If Soft Stop process is used it is recommended to use same curve as for Soft Start.
73.	☐	To ensure that there were no mistakes in storing the parameters, it is advised to turn off the control voltage and then turn it on, after 10 seconds. Verify that all above parameters are properly stored. Verify that statistical data is erased. (NO DATA message is displayed when browsing the STATISTICAL DATA)
74.	☐	Turn off Control voltage.

12.3.1 ***Current Gain Dip Switches Setting***

The unit is factory calibrated to the rated current of the starter. For example, if the STARTER FLC is 320A and the rated current of the low voltage motor used for testing is 15A. The ratio between these current values is 21.3. In order to enable testing with that low level of current, additional gain should be added to the current path. To do so, loosen the four screws holding the display case that covers the upper Printed Circuit Board (PCB). Slide out the top while the two bottom screws are used as a shaft. On the right side of the PCB, there are three couples of Gain dip switches. Each pair is for a single phase. Note that all Gain dip switches are set to ON. Gain dip switch # 1 when set to OFF (for testing) adds gain of 5. Gain dip switch # 2 when set to OFF, adds gain of 13.4. By setting both to OFF, a gain of 5x13.4=67 is added. Set the Gain dip switches according to the ratio between STARTER FLC and the motor rated current. In the above example of 320A versus 15A, set Gain dip switch # 1 to ON and Gain dip switch # 2 to OFF (total gain=13.4). Than, for the low voltage test ser MOTOR FLA=200A (15x13.4=201). Refer to *Figure 47* below.

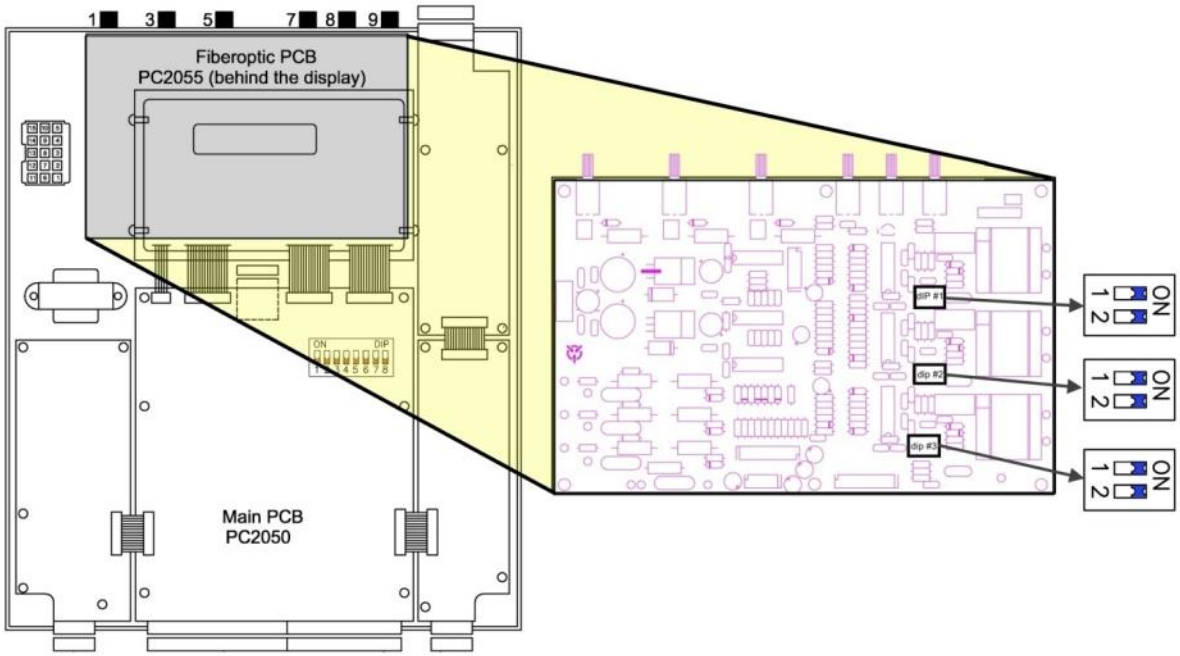


Figure 47 – Current Gain Dip Switches Location

12.3.2 ***Test Harness Installation***

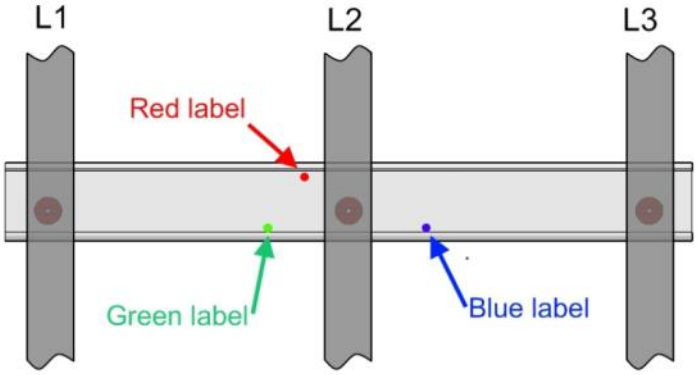
Warning: The Standard test harness is designed for testing with low voltage mains, rated 400V. When the test harness is ordered for higher than 400V, internal resistors are normally connected in the middle of the wires. Never use the standard 400V Test Harness to perform low voltage tests with test voltages that exceed 400V . Higher than the specified voltage may cause damage to the EPT transmitter.

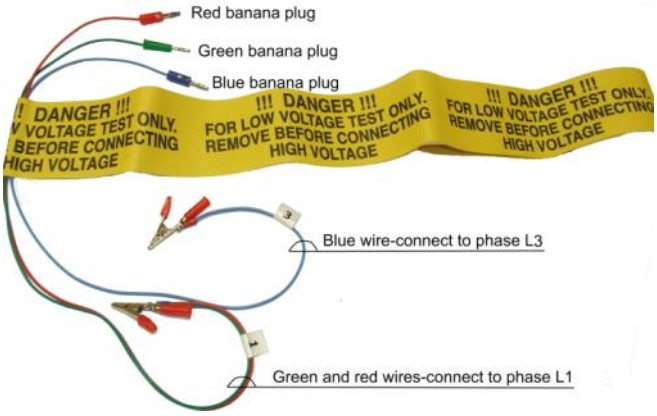
12.3.2.1 Test Harness Installation in HRVS-DN up to 6.6kV

The Test Harness includes three colored wires: blue, red and green wires.
These wires are used to change the resistors voltage dividing ratio in the EPT-Tx (Electronic Potential Transformer Transmitter).
At one end of each colored wire there is banana plug with the same color as of the wire.
At the second end of the blue wire there is an alligator clip.
The second end of the red and green wires are clamped together and connected to a second alligator clip.

On the front side of the EPT-Tx you will see three colored round stickers: blue, red and green stickers.
On the rear side of the EPT-Tx, exactly at same location as the stickers, there are three small holes. These holes have an internal banana jacks for the banana plugs.
Connect the three banana plugs the banana jacks at the rear side of the EPT-Tx. Ensure that the wire colors match the round sticker colors at the front of the EPT-Tx.
Connect the alligator clip marked “1”, with red and green wires to phase L1.
Connect the alligator clip marked “3”, with blue wire to phase L3.

The Test Harness is equipped with a long warning tape, intended to prevent forgetting it connected. Never cut this warning tape. Leave the warning tape open for its full length and laid in such a way that the harness will not be connected accidentally after the low voltage test.
As a rule, always disconnect the harness immediately after ending the low voltage test. It should be mounted inside a small plastic bag in the drawing pocket mounted on the front door.
Refer to *Figure 48* below.





EPT-Tx – bus bars in front of the EPT-Tx Test harness

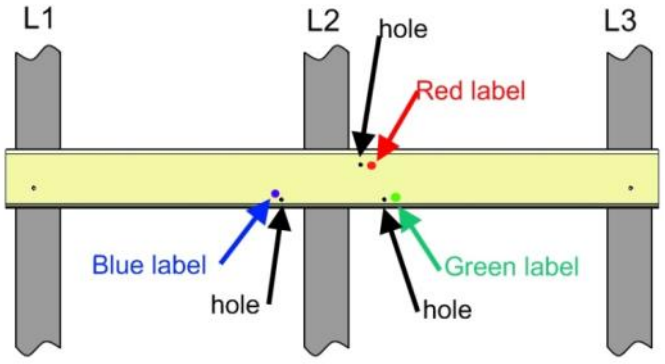
Figure 48 – HRVS-DN up to 6.6kV – EPT-Tx and Test Harness

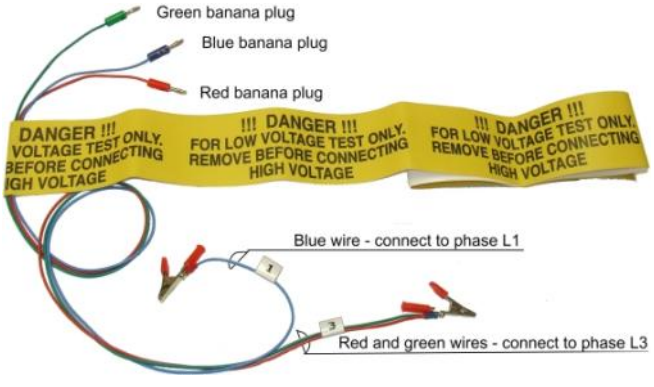
12.3.2.2 Test Harness Installation in HRVS-DN from 10kV and up

The Test Harness includes three colored wires: blue, red and green.
These wires are used to change the resistor voltages dividing ratio in the EPT-Tx (Electronic Potential Transformer Transmitter).
At one end of each colored wire there is banana plug with the same color as the wire.
At the other end of the blue wire there is an alligator clip.
The other end of the red and green wires are clamped together and connected to a second alligator clip.

On the front side of the EPT-Tx you will see three colored round stickers: blue, red and green.
These stickers are located near three small holes. These holes have internal banana jacks for the banana plugs.
Connect the three banana plugs to the banana jacks near the colored stickers at the front side of the EPT-Tx.
Ensure that the wire and banana plugs colors match the round sticker near the hole.
Connect the alligator clip marked “1”, with blue wire to phase L1.
Connect the alligator clip marked “3”, with red and green wires to phase L3.

The Test Harness is equipped with a long warning tape, intended to prevent forgetting it connected. Never cut this warning tape. Leave the warning tape open for its full length and laid in such a way that the harness will not be connected accidentally after the low voltage test.
As a rule, always disconnect the harness immediately after ending the low voltage test. It should be mounted inside a small plastic bag in the drawing pocket mounted on the front door.
Refer to *Figure 49* below.





EPT-Tx – EPT-Tx in front of the busbars Test harness

Figure 49 – HRVS-DN From 10kV and up – EPT-Tx and Test Harness

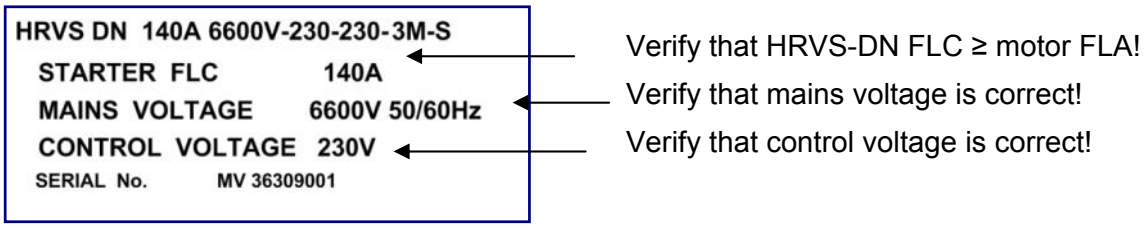
13. START PROCEDURE FOR MEDIUM VOLTAGE MOTOR

13.1 Special Attention Notes

Special Attention!	
	• Make sure that you know where the Emergency stop button is located, so you can stop immediately if needed. • Verify that the Emergency stop button is operative and pushing the Emergency stop button disconnecting the motor from the mains. • During the entire starting time you should continuously read the three currents as shown on the HRVS-DN LCD display. They should show, more or less same values. • If the currents are significantly different - STOP IMMEDIATELY. Do not wait the total start time until a trip occurs. • Verify that NUMBER OF STARTS parameter is set to 1 and STARTS PERIOD is set to 20. Remember ! Do not start too often, especially if the starting time is long. Prevent damage to both motor and starter ! • Carefully read the Soft Starter Instruction Manual as well as the optional Motor Protection Relay (MPR) Instruction Manual if installed. • When mains voltage is connected to the HRVS-DN, even if control voltage is disconnected, full voltage appear on the HRVS-DN load terminals. Therefore, for isolation purposes, it is necessary to connect an isolating device upstream to the HRVS-DN. • Power factor correction capacitors must **not** be installed on the load side of the HRVS-DN. When required, install capacitors on the line side of the HRVS-DN. • Do not interchange line and load connections. Verify correct connections to the HRVS-DN terminals: L1, L2, L3, L1b, L2b, L3b, U, V, W. • Before starting the motor verify its rotation direction. If needed, disconnect the rotor from the mechanical load and verify the correct direction of rotation. • Prior to start up procedure, make sure that line voltage and control voltage match the ones shown on the label of the HRVS-DN. • When the Start signal is initiated and a motor is not connected to load terminals, the S. SCR OR WR. CON protection will be activated. Other loads such as incandescent light bulbs, resistors, etc. may also cause a S. SCR OR WR. CON fault.

13.2 Prior to Commissioning in Medium Voltage

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

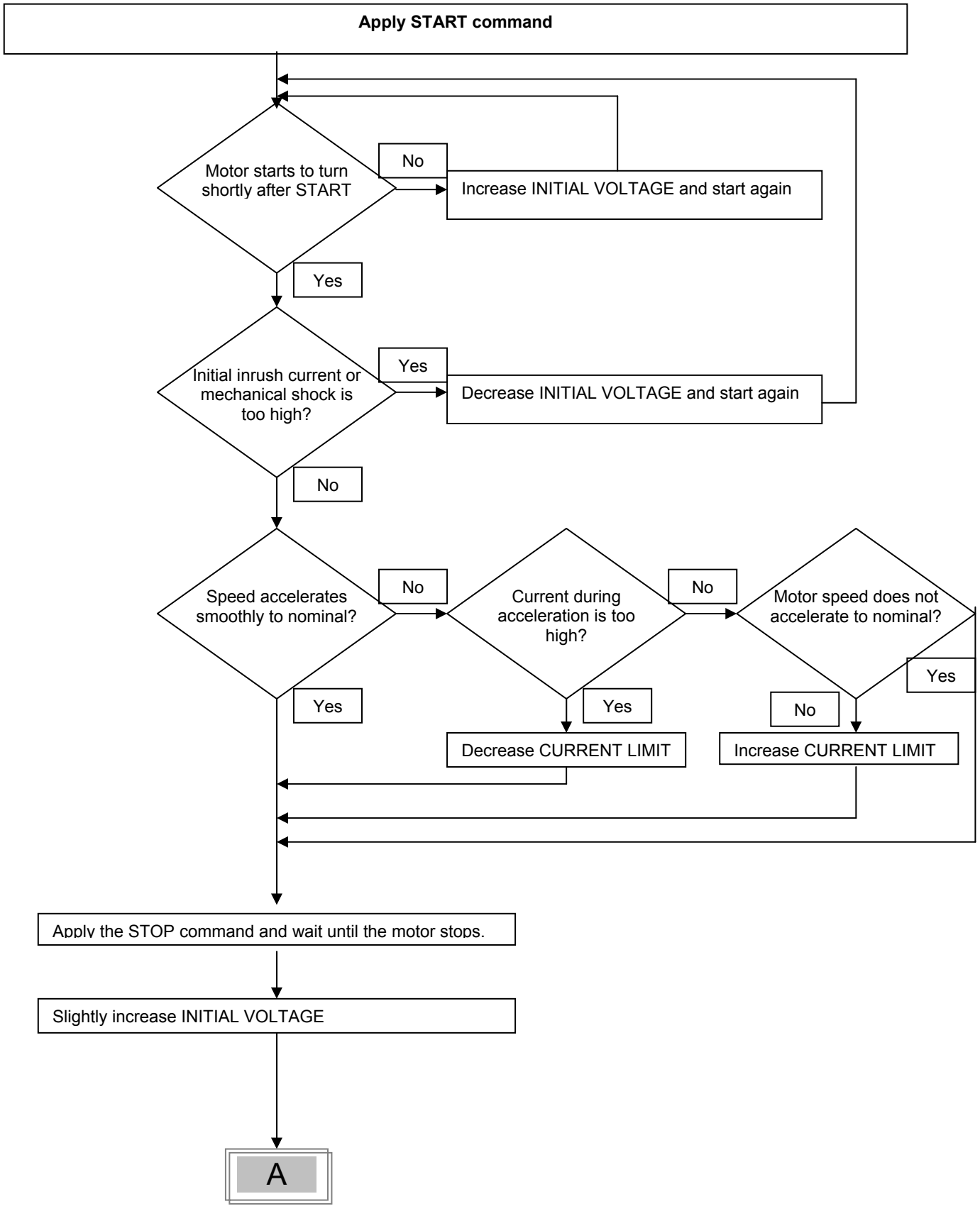


HRVS-DN label - example

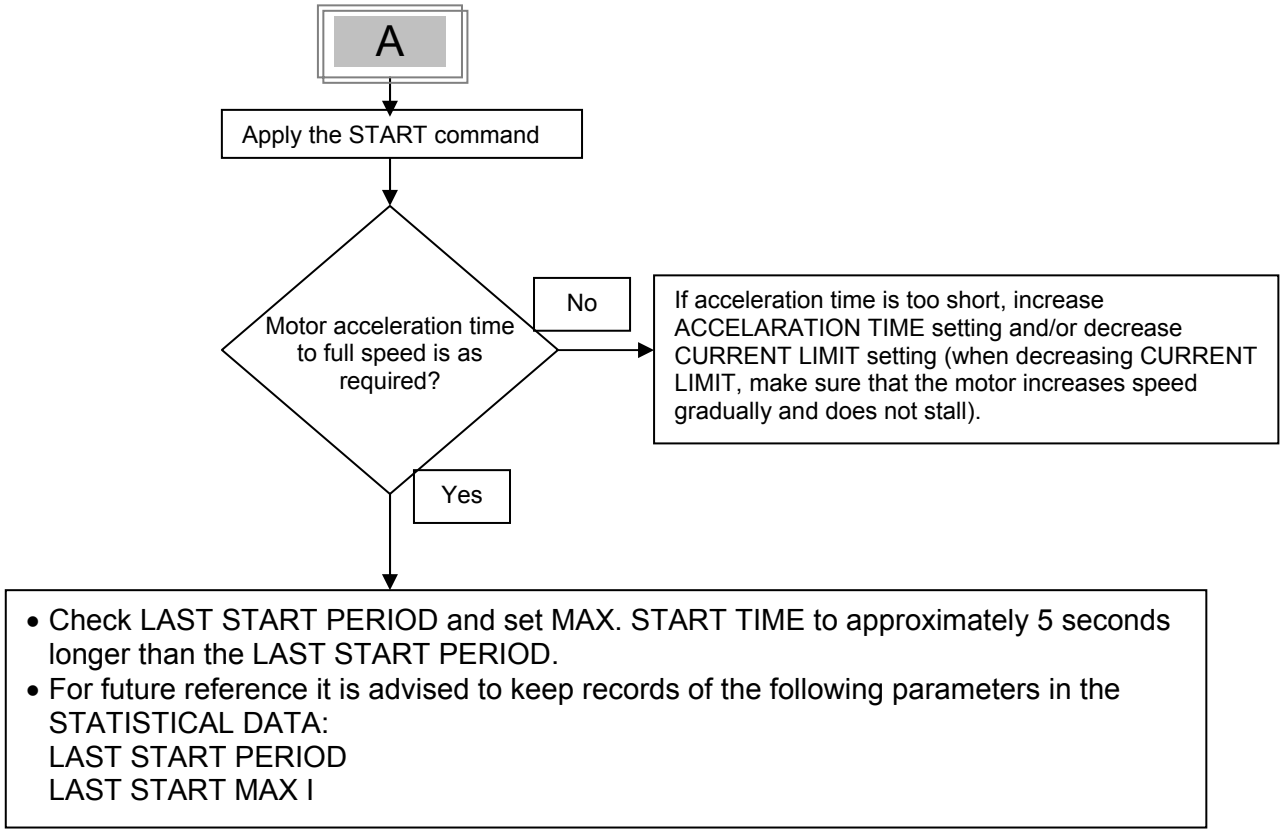
13.3 **Medium Voltage Test Procedure**

1.	☐ Verify that a Megger test was performed to the motor and its cables. This test should be carried when the HRVS-DN is not connected to the motor.
2.	☐ Verify that low voltage Test Harn`ess and cables are disconnected and removed.
3.	☐ Verify that all 6 Gain dip switches on the fiberoptic PCB (PC2055) are set to ON.
4.	Enter MAIN & PROTECT. parameters. set: ☐ RATED LINE VOLT. – As indicated on the HRVS-DN label ☐ STARTER FLC – As indicated on the HRVS-DN label ☐ MOTOR FLA – As indicated on the medium voltage motor label. ☐ RATED MOTOR PWR – As indicated on the medium voltage motor label. ☐ SERVICE FACTOR – As indicated on the medium voltage motor label. ☐ Browse all the way down until you see the message: STORE ENABLE MAIN & PROTECT. ☐ Press the Store button and wait for the message: DATA SAVED OK.
5.	☐ Enter START parameters, set the parameters as required for the medium voltage motor. If no other data is available, leave all parameters in their default values. ☐ Verify that NUMBER OF STARTS parameter is set to 1. Remember ! Do not start too often, especially if starting time is long. Prevent damage to both motor and starter ! ☐ Browse all the way down until you see the message: STORE ENABLE START PARAMETERS. ☐ Press the Store button and wait for the message: DATA SAVED OK.
6.	Enter STOP parameters. ☐ If Soft Stop process is required it is recommended to use same SOFT STOP CURVE as SOFT START CURVE. ☐ Set DEC. TIME ☐ If soft stop is not required, set Deceleration time (DEC. TIME) to minimum value (0 seconds). ☐ Browse all the way down until you see the message: STORE ENABLE STOP PARAMETERS. ☐ Press the Store button and wait for the message: DATA SAVED OK.
7.	☐ Verify that all other parameters are setting properly for the application.
8.	☐ Return the screen to the current display (first currents reading screen is in % OF MOTOR FLA).
9.	☐ Be sure to know where an Emergency stop button is located, so you can stop immediately if needed.
10.	☐ It is strongly recommended that another person stand near the motor and have cellular (or other) contact with you. He should be authorized to stop immediately (if a remote stop button is available) or to ask you to immediately stop in any case where an unusual mechanical noise is heard.
11.	☐ During the entire starting time you should continuously read the three currents as shown on the starter's display. They should show, more or less same values.
12.	☐ If the currents are significantly different - STOP IMMEDIATELY. Do not wait the total start time until a trip occurs.
13.	☐ In any problem occurs, look at the following troubleshooting instructions.
14.	☐ It is strongly recommended to go back to the low voltage test if in doubt.
15.	☐ After successful starting, with real load, set MAX START TIME (in START PARAMETERS page) to few seconds above the actual time seen in the STATISTICAL DATA page, to prevent starter and motor overheating if load is increased and motor cannot start.

13.4 Standard Starting Process



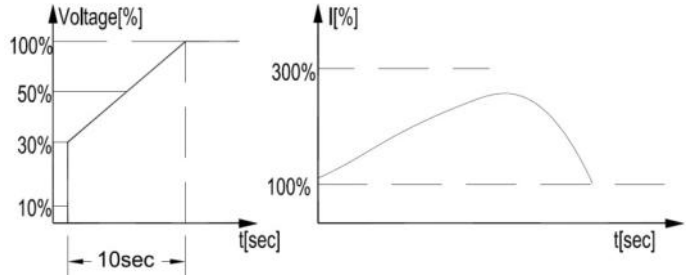
See next page



13.5 Examples of Starting Curves

13.5.1 ***Light Loads - Pumps, Etc.***

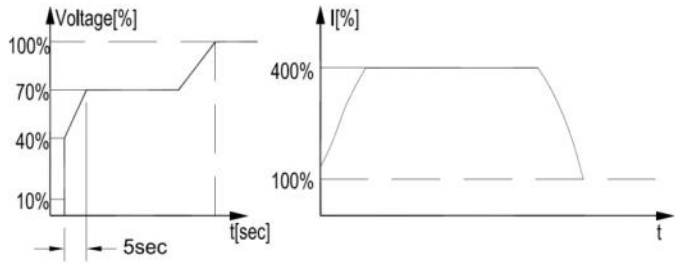
(In these cases the actual current is always lower than the CURRENT LIMIT setting)
INITIAL VOLTAGE- set to 30%
CURRENT LIMIT - set to 300-350%
ACCELERATION TIME- set to 10 sec.



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.

13.5.2 ***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.

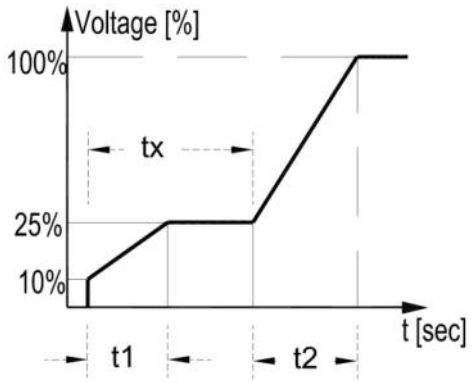
13.5.3 ***Special Starting Using DUAL ADJUSTMENT***

Using two starting characteristics, the HRVS-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:

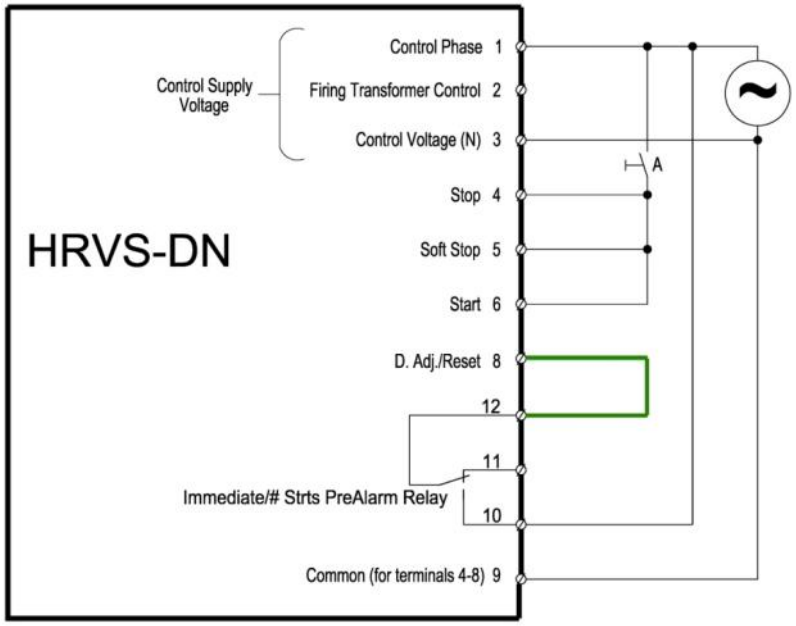
- To use DUAL ADJUSTMENT automatically, connect IMMEDIATE in series to input terminal 8 as shown in section 13.5.3.1 below.
- Program IMM./ RELAY TYPE to IMMEDIATE (default setting) and program RELAY ON DELAY to tx.
- Program PROG. INPUT #8 to DUAL ADJUSTMENT (default setting).
- Program standard parameters and DUAL ADJUSTMENT parameters as shown in the table below.

Using two starting characteristics, the HRVS-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.



Parameter	Main Setting	DUAL ADJUSTMENT Setting
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.	-----

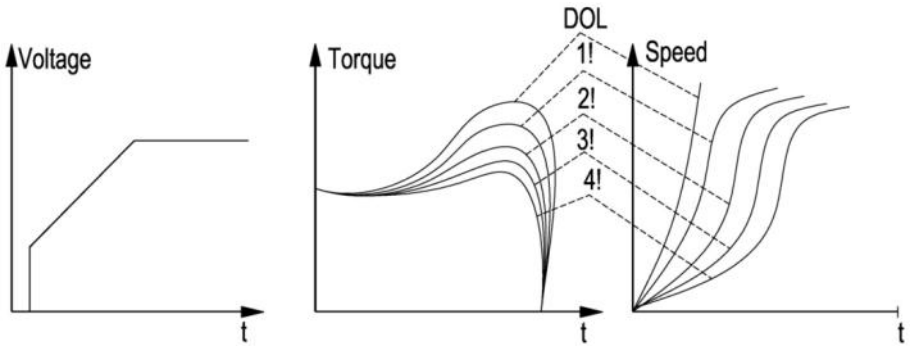
13.5.3.1 *Special Starting – Using DUAL ADJUSTMENT – Wiring Diagram*



13.5.4 ***Choosing a Suitable Pump Curve (Centrifugal Pumps)***

13.5.4.1 *Starting Curve*

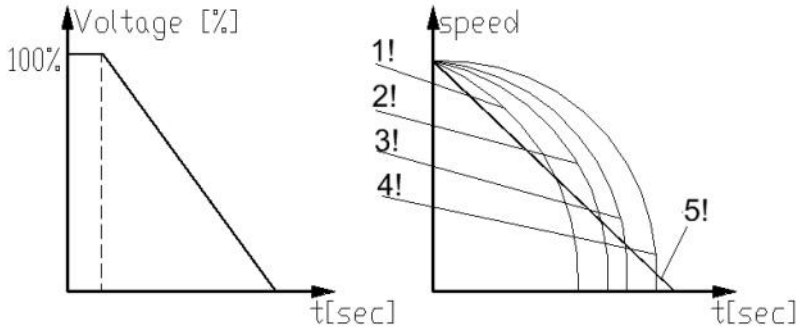
- Adjust MAIN PARAMETERS as necessary (FLA, FLC, etc.).
- Set STARTING CURVE, ACCELERATION TIME, CURRENT LIMIT, and INITIAL VOLTAGE to their default values (curve 1, 10 sec., 400% and 30% respectively).
- Start the pump while watching the pressure gauge as the pump starts and look for overshooting (“pressure surge”) of the gauge needle above the target pressure. In case of over pressure, choose a peak torque reduction curve (SOFT START CURVE 2!!).
- Set SOFT START CURVE 2!!, 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 3!!, or 4!!, 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.



13.5.4.2 *Stopping Curve*

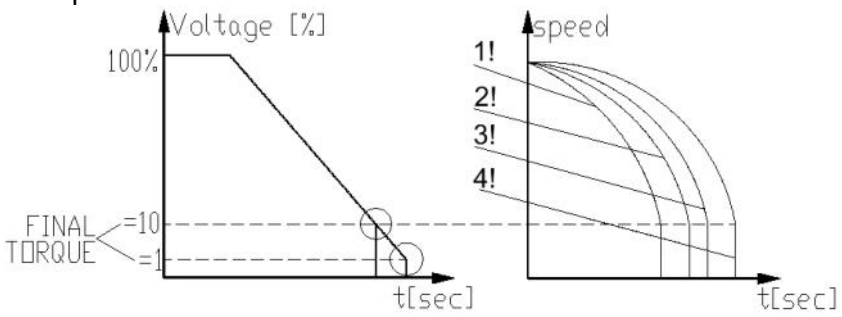
- Adjust MAIN PARAMETERS as necessary (FLA, FLC, etc.)
- Set SOFT STOP CURVE and DECELERATION TIME, to their default values (curve 1, 10 sec., respectively).
- Stop the pump, watching the pressure gauge and check valve as the pump stops. Look for overshooting (“water hammer”) of the gauge (abruptly stops the pump and the motor).

- Select SOFT STOP CURVE 2!! 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 3!!, or 4!!. Each increase in the SOFT STOP CURVE will reduce the abrupt stop of the pump, thus preventing the “water hammer” phenomenon.



13.5.4.3 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.



13.6 **How to set MPS-3000 and DPM-10 when installed with HRVS-DN**

If MPS-3000 (Solcon motor protection) and/or DPM-10 (Solcon digital power meter) are integrated in the HRVS-DN cabinet in a way that voltage readings are from the EPT and current measurements are from the HRVS-DN internal CTs special attention must be given to the setting of these units.
Before setting the MPS-3000, read the MPS-3000 instruction manual.
Before setting the DPM-10, read the DPM-10 instruction manual.

If the MPS and DPM-10 use separate (not the internal soft starter) CTs and PTs (current and voltage transformers), then set all MPS and DPM-10 parameters according to the instruction manual.

If, however the MPS and DPM-10 use the HRVS-DN Internal CTs and Electronic Potential Transformer (EPT), a number of parameter settings must be performed as explained below.
Inside the soft starter, there is an EPT. Its “primary” rated voltage is equal to the starter rated voltage. Its “secondary” rated voltage is 120VAC.

Inside the soft starter, special CTs are used. Their primary rated current equals to the starter rated current. Their secondary rated current is 2A. The secondary current is connected to the MPS-3000 5A input and to the DPM-10 5A input.

In the MPS-3000 SYSTEM PARAMETER setting page, please set:

LINE VOLTS = Actual rated line voltage (should be equal or lower than starter rated voltage).

VT PRIMARY = Starter rated voltage (the Electronic Potential Transformer is calibrated to the starter rated voltage).

VT SECONDARY = 120 (the EPT "secondary" rated voltage).

MOTOR FLC = Actual Motor Name Plate (Rated) current (should be equal or lower than starter rated current).

CT PRIMARY = 2.5 x Starter Rated Current. (See note 1 below)

GND CT PRIMARY = same as CT PRIMARY setting.

In the DPM-10 PARAMETER setting page, please set:

P+ (Potential Transformer ratio) = Ratio between Primary and secondary of the P/T. Set to: Vn/120.
If, for example Vn=3300V then set to: 3300/120=27.5.
C+ (C.Ts Primary) = 2.5 x Starter Rated Current.

Explanation of CT PRIMARY: If The rated starter current is - for example - 1000A, its CTs (that are used also for the MPS and DPM-10) are 1000 / 2A.
Please note that CTs secondary current is 2A, not 5A as of the DPM-10 and as of the MPS-3000 (See note 1 below).

When 1000A flows, the DPM-10 and MPS-3000 gets only 2A instead 5A and will calculate 2 / 5 x1000 = 400A. Therefore we have to set the CT Primary to 1000x(5/2)=2500, which with 2A will read exactly 1000A as required.

Notes:

1. In the MPS-3000 there is a second set of current transformers with a secondary of 1A. (Terminals 82, 85, 88 and 91).
   In this case, when 1000A flows, the MPS-3000 gets 2A instead 1A and will calculate 2 / 1 x1000 = 2000A.
   Therefore we have to set the CT Primary to 1000x(1/2)= 500, which with 2A will read exactly 1000A as required.

2. In the MPS-3000 and DPM-10, each parameter has to be stored separately (while in the soft starter you store all parameters of a page together).

14. TROUBLE SHOOTING

The following procedures should be done only upon fault and in case trouble shooting is required.

14.1 In-Out Resistance and Cathode-Cathode Resistance

Verify that the motor is disconnected.
Disconnect the cabinet mains isolator switch or fuses, if installed.
In-Out resistances should be the same for all three phases in each model. Cathode-Cathode resistances are indicated in the following table:

HRVS-DN Rated Voltage	L1 – U L2 - V L3 - W	Cathode-Cathode
2.3kV	1.2MΩ ±10%	1/2 of In-Out resistance
3.3kV	135kΩ ±10%	1/3 of In-Out resistance
4.16kV	135kΩ ±10%	
6.6kV	300kΩ ±10%	
10kV	420kΩ ±10%	1/5 or 1/6 of In-Out resistance. (depends on number of thyristors in the soft starter)
11kV	450kΩ ±10%	
13.2kV	500kΩ ±10%	
13.8kV	500kΩ ±10%	
15kV	550kΩ ±10%	

Refer to Figure 50 In order to identify the Cathode terminals of all 6 SCRs on the firing PCB.
A number is written on the firing PCB to identify the SCRs.
Measure Cathode-Cathode resistances as follows:
Cathode SCR#1 to Cathode SCR#2 (should be 1/3 of L1-U, L2-V, L3-W)
Cathode SCR#2 to Cathode SCR#3 (should be 1/3 of L1-U, L2-V, L3-W)
Cathode SCR#3 to Cathode SCR#4 (should be 1/3 of L1-U, L2-V, L3-W)
Cathode SCR#1 to Cathode SCR#4 (should be same as L1-U, L2-V, L3-W)
Verify that values correspond to the above table.

14.2 Rgk (thyristors Gate-Cathode) Resistances.

Thyristors Gate-Cathode resistances can easily be measured from the firing PCBs.
In order to access the testing points the front cover of the Power Section needs to be dismantled.
Gate-Cathode connection points of SCR#1 are illustrated in Figure 50. Measure all SCRs' Rgk resistances in each of the phases.
Rgk values should be about the same for all thyristors in the phase, and in the range of 7-20 Ω.

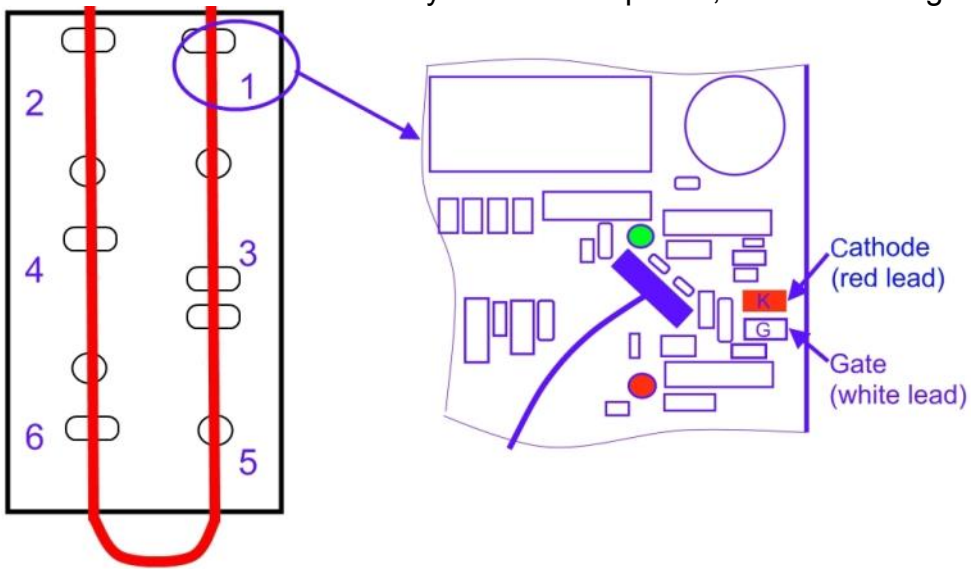


Figure 50 – Firing PCB – SCR#1 Gate-Cathode Testing

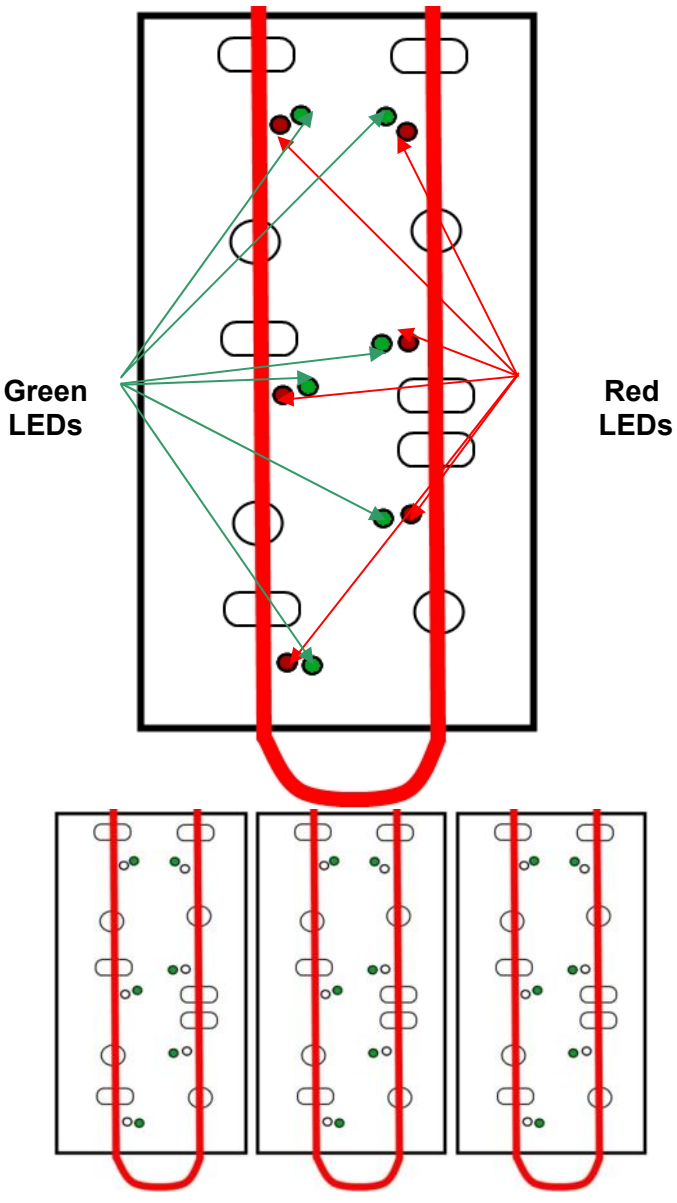
14.3 Firing Test

The purpose of this test is to check that the firing system of all thyristors functions properly.
This procedure requires control supply voltage only (No need for mains three phases).

- Disconnect mains. Verify all safety issues are resolved.
- Open 10 hexagon head white plastic screws holding the front cover of all 3 phases.
- Dismantle front cover of all three phases

- Identify 6 green LEDs and 6 red LEDs as shown in the picture.
  Number of LEDs varies for different voltages models.
- Program input #7 to TEST. (Remember to store the parameter!) Refer to section7.8.7 page 73.
- Connect control input voltage to terminal #7. The Test LED on the control keypad will lit. Refer to section 5.12 page 37.
- Press the Mode key until the following appears in the display :

FIRING TEST DISCONNECT MAINS

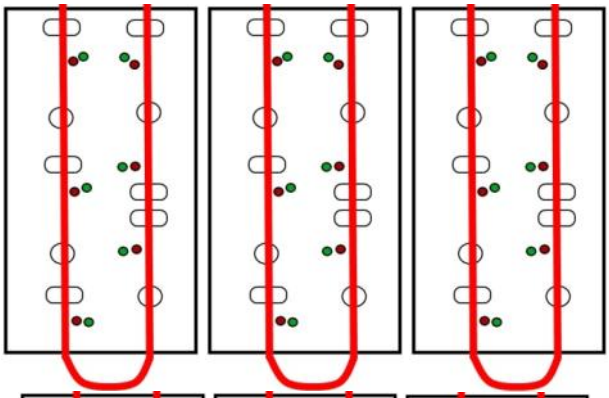


Press the Select button.
The display will show:

FIRING PWR SUPPLY CHECK GREEN LEDS

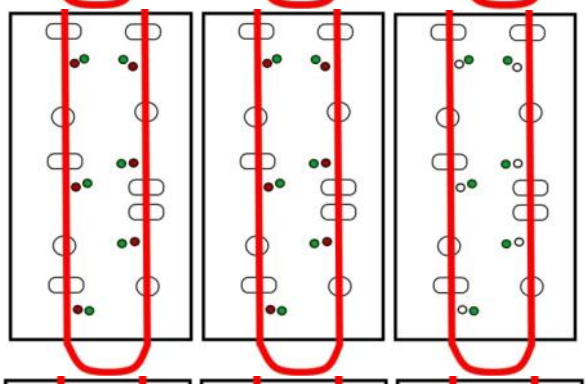
Press the Select button a second time.
The display will show:

FIRING NOW CHECK GREEN & RED LEDS



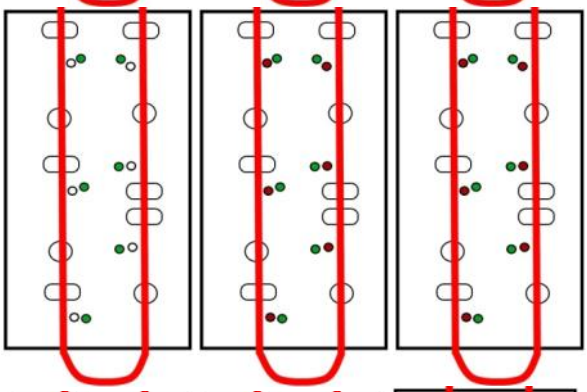
Press the Select button a third time.
The display will show:

FIRING NOW CHECK ALL LEDS OF R&S



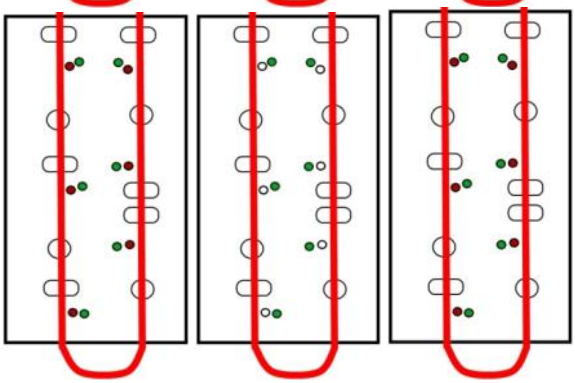
Press the Select button a fourth time.
The display will show:

FIRING NOW CHECK ALL LEDS OF S&T



Press the Select button a fifth time.
The display will show:

FIRING NOW CHECK ALL LEDS OF R&T



Note:

- The firing test is limited to 60 seconds (30 seconds in older than 27.12.2010 software versions). If you did not manage to conclude the test you can repeat until all 5 stages are done.

If the firing test fails:

- Check the fuses in the switch mode power supplies (PC2075 for AC control voltage, PC2076 for DC control voltage). Refer to section 10.2.4 page 93 for fuse locations.
  Note: DC control voltage uses all three fuses in a series, so if one fails to operate, all firing LEDs can't light.
- Check that fiber optic wires # 1, 3 and 5 (firing phases 1, 2 and 3) are properly connected according to the markings on the Control Module.
- Check that they are inserted into their connectors to the full depth and not damaged .
- Check that the fiber optic wires of the power modules that are connected between the individual power supplies (PC2075 or PC2076) and the firing PCBs are properly inserted.
- When Control Voltage is turned ON, the green LEDs in the power modules may blink shortly. This is normal.

14.4 **Low Voltage Test Trouble Shooting**

Problem	What To Do
HRVS-DN Control Module is not powered after external control voltage is connected.	• Verify that cabinet MCBs are set to ON position. • Verify that the Emergency Stop push button is released. • Verify that customer terminals 5 & 6 are jumpered. • Verify that the DOL/Soft Start selector switch is set to Soft Start. • Verify that rated control voltage is connected to customer terminals 1 & 2. • Verify correct polarity for DC control voltage.
Upon control voltage connection the HRVS-DN Control Module trips immediately	• Disconnecting control voltage from the Control Module and reconnecting the control voltage does not reset the soft starter if tripped. • Reset the HRVS-DN by pressing the Reset key.
PWR ON & NO STRT Trip occurs before starting.	• It occurs, when mains voltage is connected to the HRVS-DN more than 30 sec. without a start signal. • It may occur if mains voltage is connected downstream (“below”) from the Line Contactor instead of upstream (“above”) the Line Contactor. The starter protects itself from overheating. • Can be disabled for special applications.
Local start command does not cause any action.	• Verify that the Local/Remote/Off Selector switch is set to Local and remote light does not light. • Verify that the Fault light is not active on the front panel, or on the starter control panel or on the MPR panel. • If the Fault light is turned ON: o Verify that there are no fault messages on HRVS-DN & MPR displays. o Reset if necessary. o Check setting of the trip relay logic (FAULT/FAULT FAIL-SAFE) of the soft starter and MPR. Improper setting de-energizes fault relays FT & FT/1.
Remote start command does not cause any action.	• Verify that the Local/Remote/Off Selector switch is set to Remote and the Remote indication light is on. • Verify that the Fault indication light is not active on the door and starter & MPR panels. • If the trip indication light is turned ON: o Verify that there are no fault messages on the Starter & MPR displays. o Reset if necessary. o Check setting of the trip relay logic (FAULT/FAULT FAIL-SAFE) of the soft starter and MPR. Improper setting de-energizes fault relays FT & FT/1.

Problem	What To Do
UNDER/NO VOLTAGE trip occurs immediately after starting.	• Verify that all three mains phases are connected. • At low voltage, testing a missing phase can cause UNDER/NO VOLTAGE trip. • Verify that the test harness is connected to the EPT-Tx while testing at low voltage. • Verify that the Line Contactor is closed, at least for a short time, at the beginning of the start process. • If external line (mains) contactor is used, ensure that its auxiliary contact is wired back to the HRVS-DN cabinet and used (in series with RS relay contact) to initiate the start command (this contact should not be bridged in the customer terminals). • Check UNDERVOLT. TRIP setting level in MAIN & PROTECT page. • Verify that the Electronic Potential Transformer Receiver (EPT-Rx) fuse located in the Receiver auxiliary supply plug is OK. • Verify that the fiber optics wires connecting the EPT-Tx and EPT-Rx are properly connected. • Move the external mains connection from upstream of the Line Contactor to down stream the Line Contactor and turn on the mains voltage . Check 120VAC line to line between EPT-Rx output terminals. Try to start now. • Take out fibers 11 and 13 from the EPT-Rx, they should emit red light with the same intensity. • Check that the 15 pin white connector is properly connected, at the back of the Control Module.
OVER VOLTAGE trip occurs immediately after starting.	• Make sure that the mains testing voltage is 400V or as written as on the test harness. • If it is higher, disconnect the mains voltage immediately. • Check OVERVOLT. TRIP setting level in MAIN & PROTECT page.
PHASE SEQUENCE trip occurs immediately after starting.	• Phase sequence of the mains lines is wrong. • Two options are available: o Swap two input lines. o Set PHASE SEQUENCE setting in FAULT PARAMETERS as required.
TOO MANY STARTS trip occurs immediately after starting.	• The default setting allows for one start per 20 minutes. • To reset the fault find the NUMBER OF STARTS setting at the end of the START PARAMETERS page, increase setting to OFF, then reset. Store at the end of the page. • Be sure to set for medium voltage operation after end of testing.
S.SCR OR WR CON. Trip occurs after starting.	• Verify that the motor's rated current multiplied by the Gain (as set by the dip switches) is greater than or equal to 30% of FLC. • It may occur when the load is not a motor. • Verify that fiber optic wires 1,3 & 5 are properly connected. • Verify that Current Gain dip switches are set equally for the three phases and according to the ratio between starter rated current and testing motor rated current. • Try to start using SOFT START CURVE 0, the basic curve. If the motor is not loaded and has no inertia, the motor may vibrate after reaching full speed. This is normal and will not occur with the MV motor. o If the test motor starts properly then the current transformers and their wiring should be checked. o If the test motor does not start properly the measured current may be too low. • Perform a firing test as described on section 14.3 page 121. • Check fuses and fuses holders in phases firing power supplies. Refer to section 10.2.4 page 93. • Sometimes SOFT START CURVE 0 enables the soft start process, even if a CT or its wiring is problematic, if mains conditions are not ideal or with non-standard motor. Current in every phase must, however be above 5% of starter FLC, or the same trip might occur.

Problem	What To Do
SET CURVE TO 0 trip occurs after starting.	• Check that pairs of Gain dip switches are set identically for the three phases. • Try SOFT START CURVE 0.
Motor makes irregular noise while starting.	• Verify that the motor is not too small. Try to use a larger motor, with inertia or loaded, if possible. • If vibration occurs at the beginning of start process with SOFT START CURVE 1, 2, 3, 4 or 5 try SOFT START CURVE 0. • If vibrations occurs at the beginning of start process with SOFT START CURVE 0 check low voltage test harness installation, fiber optic 11 & 13 and EPT-Rx outputs. • Vibrations, when approaching full speed at the start of SOFT START CURVE 0 with motors that have no load are normal and do not indicate a problem. With other SOFT START CURVE it can occur with small / unloaded motor which accelerates too fast. Try to reduce INITIAL VOLTAGE to a minimum. • Verify that current Gain dip switches are set according to the ratio between the rated current of the HRVS-DN and the testing motor rated current . • If the test motor is loaded or has some inertia, try to start with SOFT START CURVE 0, the basic curve. If the problem is solved, then test the current transformers and their wiring. Sometimes the SOFT START CURVE 0 enables a loaded motor to start properly, even if a CT or its wiring are faulty or with a problematic mains (weak transformer for the low voltage test). • Check that all fibers are properly connected according to their numbers.
O/C-SHEAR PIN trip occurs immediately after starting.	• Verify that Current Gain dip switches are set according to the ratio between the rated current of the starter and the testing motor rated current. • The trip can occur if added (by setting of Gain dip switches) gain is too high. • Try to start with SOFT START CURVE 0 and stop with SOFT STOP CURVE 0. If problem us solved the current transformers and their wiring should be checked. • Check that all fiber optic wires are properly connected.
PHASE LOSS trip occurs after starting.	• Verify that all three phases are within range. • Verify that EPT-Tx and EPT-Rx fiber optic wires are properly connected. • If low voltage mains is powered from a generator, check that frequency is within the range of 46Hz < f <64Hz.
UNBALANCE CURRENT trip occurs after starting.	• Verify, by reading currents on the display, that the three current readings are identical (before the trip). • Check that fiber optic wires 1, 3 & 5 are properly connected to the Control Module. • Check that the current Gain dip switches are set identically in the three phases. • Verify that current flows in all three phases. • If there is no current display on one phase: o Change to SOFT START CURVE 0 (basic). o Try to start. • If problem still exist perform a firing test. Refer to section 14.3 page 121.
GROUND FAULT trip occurs after starting.	• View the three currents on starter's display. • Check that the current Gain dip switches are set identically in the three phases. • Verify that an output cable to the motor is not short circuited to the chassis ground. • Verify that two wires of a CT are not swapped (can occur only if user changed CTs wiring!) **Note: SUCH ACTION WILL VOID MANUFACTURER'S WARRANTY !** • Disconnect the low voltage motor. Check motor insulation with a Megger tester.

Problem	What To Do
Motor vibrates mechanically at the end of starting process or at the beginning of soft stop. current fluctuates.	• This phenomena may occur with unloaded or lightly loaded motor, if SOFT START CURVE 0 is used. • Use standard curve SOFT START CURVE 1 and SOFT STOP CURVE 1.
OPEN BYPASS trip occurs after end of start process.	• Verify that Current Gain dip switches are set according to the ratio between the rated current of the starter and the testing motor rated current. • Check Bypass Contactor wiring.
Current reading as displayed on starter's panel is not correct.	• Verify that HRVS-DN FLC setting parameter is set according to the rated current of the starter. • Current Gain dip switches gain current reading as follows: o Both Gain dip switches of phases set to on -> gain = 1 o Gain dip switches # 1 of phases set to off -> gain = 5 o Gain dip switches # 2 of phases set to off -> gain = 13.4 o Both Gain dip switches of phases set to off -> gain = 67 • Use a Clamp-on the Ammeter to measure test the motor current. • Starter's current reading should be approximately actual current multiplied by the gain ratio set by the Gain dip switches. • Set parameters to default parameters and re-program the HRVS-DN.
OVERLOAD trip occurs after Bypass is closed.	• Verify that current Gain dip switches are set according to the testing motor rated current versus rated current of the starter. Overload trip can occur if gain (set by Gain dip switches settings) is too high. • Verify that the HRVS-DN FLC setting parameter is set according to the rated current of the HRVS-DN. • Set Motor FLA identically to HRVS-DN FLC. • Reset, start again and read currents on screen. • Check if current readings after start are is more than starter's rated current.
UNDER CURRENT trip occurs after Bypass is closed.	• Reduce setting of Undercurrent setting in the MAIN & PROTECT Parameters settings.
MPR does not respond to current during low voltage motor starting.	• This is normal. The MPR (Motor Protection Relay) does not have extra gain for testing. Its current reading may be very low, below the minimum threshold.
Motor is started immediately after resetting a trip.	• Might occur when the Local / Remote switch is set to remote, and the remote contact is closed. **Note:** It is the responsibility of the remote controller to open the remote start/stop contact immediately upon trip.

14.5 Medium Voltage Trouble shooting

This troubleshooting table is intended for Medium voltage testing, while medium voltage and motor are connected to the cabinet .It is intended to be used only after low voltage tests are successfully performed.

WARNING!	It is absolutely forbidden to open one or more of the medium voltage doors, even if the motor is not running and Line Contactor is open. It is not advised to try troubleshooting the system while connected to the medium voltage mains. Should any other than operational or minor problem occur, it is recommended to go back to the low voltage test. Before starting, recheck rated mains voltage and current, and compare them to HRVS-DN rated values. **Note**: If the mains network is weak (long lines, small transformers, generator supply), it is recommended to set SOFT START CURVE 0 and SOFT STOP CURVE 0.

Problem	What To Do
HRVS-DN Control Module is not powered after external control voltage is connected.	• Verify that the cabinet MCBs are set to the ON position. • Verify that the Emergency Stop push button is released. • Verify that customer terminals 5 & 6 are jumpered. • Verify that the DOL/Soft Start selector switch is set to Soft Start. • Verify that rated control voltage is connected to customer terminals 1 & 2. • Verify correct polarity for DC control voltage.
Upon control voltage connection the HRVS-DN Control Module trips immediately	• Disconnecting control voltage from the Control Module and reconnecting the control voltage do not reset the soft starter if tripped. • Reset the HRVS-DN by pressing the Reset key.
PWR ON & NO STRT Trip occurs before starting.	• It occurs, when mains voltage is connected to the HRVS-DN more than 30 sec. without a start signal. • Normal control logic is such that the start command first closes the Line Contactor and apply medium voltage to the L1, L2, L3 bus bars of the HRVS-DN IP00 unit. • When the Line Contactor is located outside the cabinet, make sure that its auxiliary contact is wired to apply control input voltage to terminals 5 & 6 of the Control Module via the customer terminals. The auxiliary contact of the Line Contactor must be connected in a series to a contact of the RS relay.
Local start command does not cause any action.	• Verify that the Local/Remote/Off Selector switch is set to Local and remote light does not lit. • Verify that the Fault light is not active on the front panel, on the starter control panel or on the MPR panel. • If the Fault light is turned ON: o Verify that there are no fault messages on HRVS-DN & MPR displays. o Reset if necessary. o Check the settings of the trip relay logic (FAULT/FAULT FAIL-SAFE) of the soft starter and MPR. Improper settings de-energizes fault relays FT & FT/1.
Remote start command does not cause any action.	• Verify that the Local/Remote/Off Selector switch is set to Remote and the Remote indication light is on. • Verify that Fault indication light is not active on the door, starter and MPR panels. • If the trip indication light is turned ON: o Verify that there are no fault messages on Starter & MPR displays. o Reset if necessary. • Check setting of the trip relay logic (FAULT/FAULT FAIL-SAFE) of the soft starter and MPR. Improper setting de-energizes fault relays FT & FT/1.

Problem	What To Do
UNDER/NO VOLTAGE trip occurs immediately after starting.	• Verify that the Mains voltage is connected (no open Isolator, etc.). • Verify by listening, that the Line Contactor is closed at start, at least for a short period of time (until the Trip command opens it). • If an external Line Contactor is used, ensure that its auxiliary contact is wired back to the HRVS-DN cabinet and used (in series with RS relay) to apply the start command in terminals 5 & 6 in the Control Module (this contact should not be bridged in the customer terminals. • Check UNDERVOLT TRIP setting level in the MAIN & PROTECT setting page. • Verify that the fuse located in the EPT-Rx connector did not melt. Refer to section 10.2.4 page 93. • Check that the 15 pin white connector is properly connected, at the back of the HRVS-DN Control Module • Disconnect and secure the mains source. • Check EPT-Tx to EPT-Rx fiber optic connections. • If required perform a second low voltage test .
OVER VOLTAGE trip occurs immediately after starting.	• Verify that HRVS-DN rated voltage is identical to mains voltage. • Check OVERVOLT TRIP setting level in MAIN & PROTECT page. • If the unit is powered from the generator, check its output voltage.
PHASE SEQUENCE trip occurs immediately after starting.	• Phase sequence of the mains lines is wrong. • Two options are available: o Swap two input lines. o Set PHASE SEQUENCE setting in FAULT PARAMETERS as required.
TOO MANY STARTS trip occurs immediately after starting.	• Check and verify correct settings of the following parameters in the START PARAMETRS page: NUMBER OF STARTS, STARTS PERIOD and START INHIBIT. Refer to section 7.8.3 page 60. • **Warning**: Wait at least the required time between starts to prevent damage, both to the starter and motor !
S.SCR OR WR CON. Trip occurs after starting.	• Verify that the Current Gain dip switches are set to ON. • Disconnect medium voltage and verify that motor and mains input are properly connected. • Check that all fiber optic wires are properly connected. • Set SOFT START CURVE 0 and try to start. o If the problem is solved and the start process is OK, leave it on SOFT START CURVE 0. Set SOFT STOP CURVE 0 as well. o If the problem is not solved then the measured current in one or more phases may be too low. • Another reason can be nonstandard motor parameters. • SOFT STOP CURVE 0 may enable it to function properly, even if the mains conditions are not ideal or with non-standard motor. Current in every phase must however be above 10% of starter FLC, or the same trip may occur.
SET CURVE TO 0 trip occurs after starting.	• Mains and system conditions are not optimal for other than SOFT START 0 and SOFT STOP CURVE 0. Set both parameters in START PARAMETERS page and in STOP PARAMETERS page. • Try to start the motor again.
Motor makes irregular noise while starting.	• Check that all fiber optic wires are properly connected. • Try to start with SOFT START CURVE 0. • If the problem is resolved, check the current transformers and their wiring. • SOFT START CURVE 0 may enable it to function properly even if a CT or its wiring are faulty.
O/C-SHEAR PIN trip occurs immediately after starting.	• Verify that current Gain dip switches are set to on and not left in the high gain off position, used for the low voltage test. • Try to start and stop with SOFT START 0 and SOFT STOP CURVE 0. • If the problem is solved, check the current transformers and their wiring. • Check that all fiber optic wires are properly connected.

Problem	What To Do
PHASE LOSS trip occurs after starting.	• Verify that all three phases are within range. • Verify that EPT-Tx and EPT-Rx fiber optic wires are properly connected. • If low voltage mains is powered from a generator, check that the frequency is within the range of 46Hz < f <64Hz. Try to start and stop with SOFT START 0 and SOFT STOP CURVE 0.
UNBALANCE CURRENT trip occurs after starting.	• Verify, by reading currents on the display, that the three current readings are identical (before the trip). • Check that fiber optic wires 1, 3 & 5 are properly connected to the Control Module. • Check that the Current Gain dip switches are set identically in the three phases. • Verify that current flows in all three phases. • If there is no current display on one phase: o Change to SOFT START CURVE 0 (basic). o Try to start. • If the problem persists perform a firing test. Refer to section 14.3 page 121.
GROUND FAULT trip occurs after starting.	• View the three currents on starter's display. • Check that the current Gain dip switches are set identically to ON in the three phases. • Verify that output cables to the motor are not short circuited to the chassis ground. • Verify that two wires of a CT are not swapped (can occur only if user changed CTs wiring!) **Note: SUCH ACTION WILL VOID MANUFACTURER'S WARRANTY !** • Disconnect the motor. Check motor insulation with a Megger tester.
Motor vibrates mechanically at the end of starting process or at the beginning of soft stop. current fluctuates.	• This may occur if SOFT START CURVE 0 is used with a motor that has a light or non-existent load,. • Use standard curve SOFT START CURVE 1 and SOFT STOP CURVE 1.
OPEN BYPASS trip occurs after end of start process.	• Bypass Contactor cannot close. • If, when the Bypass is closed, currents do not flow through the starter CTs then it is possible to override this trip by setting BY PASS OPEN TRIP at the FAULT PARAMETERS page to DISABLE. This type of problem may occur if the Bypass Contactor is located in another cabinet.
Current reading as displayed on starter's panel is not correct.	• Verify that the HRVS-DN FLC setting parameter is set according to the rated current of the starter. • Verify that current Gain dip switches are set to on.
OVERLOAD trip occurs after Bypass is closed.	• Verify that the STARTER FLC setting parameter is set according to the rated current of the starter. • Verify that the MOTOR FLA is set according to motor nameplate current. • Reset, start again and read currents on screen. • Check if current readings are more than 100% of the motor's rated current. • Compare to current readings of another device (if available).
UNDER CURRENT trip occurs after Bypass is closed.	Reduce setting of UNDERCURR. TRIP setting in Starter's MAIN & PROTECT parameters page settings.
Motor is started immediately after resetting a trip.	• It may be possible when Local / Remote switch is set to remote, and remote contact is closed. • **Note**: It is the responsibility of the remote controller to open the remote start/stop contact immediately upon detecting a trip in the soft starter. Trip auxiliary contact exists in the customer terminals.

15. SPARE PARTS

When ordering spare parts for HRVS-DN specify the model and the serial number of the HRVS-DN as shown on its label and/or on its documentation.
Recommended spare parts list for a soft starter:

All spare parts are for:
Model: HRVS-DN____ _____ _____ _____ _____

Serial number:_____

Description	Cat. Number (to be filled by the factory)	Quantity in standard soft starter	Recommended quantity as spare parts
Complete stack (phase assembly)		3	1
Firing PCB		3	1
Power supply for firing PCB		3	1
EPT-Rx	TRAF540964 (identical for all models)	1	1
EPT-Tx		1	1
Current transformer …/2		3	3
Control module. Order with all options installed)		1	1
Firing transformer Or DC power supply		1	1
Fiber optic wires			10m
Set of support rods for disassembling phase module for HRVS-DN up to 6.6kV	TOOL00002	-	1
Low voltage components spare parts. (terminal blocks, indication lights, fuses, etc…)			1
Line and Bypass Contactors/VCBs		2	1

16. HRVS-DN COMMUNICATION (MODBUS PROTOCOL)

16.1 Introduction

This document summarizes the Modbus serial link protocol to / from the Digital Soft Starter (HRVS-DN). The HRVS-DN can be equipped with many other serial link protocols.

Features:

* RS485 Hardware.
* Asynchronous serial link.
* Half duplex.
* Format: **Modbus RTU Mode** (Remote Terminal Unit Mode).
  - Binary,
  - Each character contains 11 bits:
    - 1 start bit
    - 8 data bits, least significant bit sent first.
    - 1 Parity bit. Even / Odd / No can be selected.
    - 1 Stop bit if Parity is used, 2 stop bits if Parity is not used.
  - **C**yclical **R**edundancy **C**heck (CRC), 16 bits.
* Baud Rates: 1200 / 2400 / 4800 / 9600 bits per second.
* Response time of the HRVS-DN:
  - Normally, 4ms <= time response <= 40mS .
  - For a long response, time response <= 200mS.
* It is not recommended to transmit to the HRVS-DN, at a rate higher than once per second because this can slow down HRVS-DN response times.
* After storing parameter settings, there is a 1 sec. time period during which transmission to the same HRVS-DN is forbidden.
* Broadcast commands: not supported.

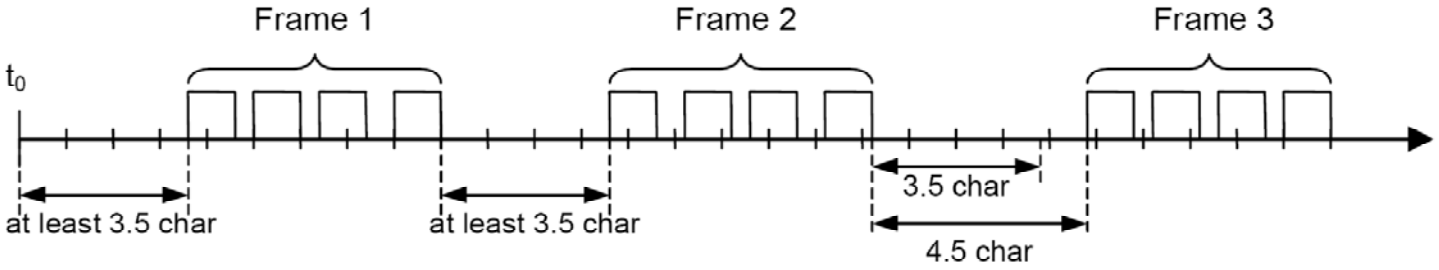
Notes:

* **You must connect earth to the earth screw before connecting serial link wires. Ignoring this instruction may result in permanent damage to the Serial Link Hardware, and can be dangerous.**

* It is recommended that you connect 120 OHM resistors to both ends of the serial link.
* When the serial link is connected to Solcon's Serial Link Adapter you are not allowed to connect the 120 OHM resistors.
* Turn off (and on again) power to the controller after changing Baud_Rate, Parity_Check or Serial_Link_No (Slave Address). These parameters can only be modified manually and not through the Serial Link.

16.2 Basic Structure of the Serial Link Frame

The Modbus RTU frame has the same principal structure for both the "Query" transmission from the Master to the Slave (HRVS-DN) and the Response transmission from the Slave to the Master:



"sync":	Silent Interval for at least 3.5 character times[1]	
byte 1:	Serial Link No. (= Slave Address)	(1..247)
byte 2:	Function	(1,2,3,4,5,6,8,15 &16 are supported)
byte 3:	Data Bytes	($XX)
.	.	($XX)
.	.	($XX)
byte n-1:	CRC_Low	($XX)
byte n :	CRC_High	($XX)
"sync":	Silent Interval for at least 3.5 characters	

16.3 SYNC (Silent Interval)

In RTU mode, messages use a "Silent Interval" more than 3.5 characters to "synchronize". This silent interval separates transmission frames.
The entire frame must be transmitted as a continuous stream. A silent interval of more than 3.5 characters during frame transmission will cause the receiving device to ignore the incomplete frame. The next byte is assumed to be the Serial Link No. of the next frame.
Ignoring the frame can also occur if a second message is transmitted less than 3.5 characters from the end of the previous frame. This causes the receiving device to consider that frame to be a continuation of the first frame, thus resulting in a CRC error.

16.4 Serial Link No. (Slave Address)

Contains HRVS-DN Slave Number (1..247) on the serial link. The HRVS-DN default value is 248, which is the communication OFF condition. Serial Link No. is used as the first byte in both the "Query" transmission from Master to Slave and in Response transmission from Slave to Master.

Note: Address 0, which is normally used for broadcast transmissions is not supported by the HRVS-DN.

16.5 Function

The Function code informs the HRVS-DN what action is requested. In most cases, Function is used as the second byte in both the "Query" transmission from Master to Slave and in Response transmission from Slave to Master.

16.6 List of Functions Supported By The HRVS-DN

Function	Modbus Name	Use in HRVS-DN
01	Read Coil Status	Read discrete commands status.
02	Read Input Status	Read discrete inputs status.
03	Read Holding Registers.	Read parameter settings. Read actual data (for Modbus Plus users).
04	Read Input Registers.	Read actual data.
05	Force Single Coil.	Force one discrete command.
06	Preset Single Register.	Write one parameter setting.
08	Diagnostics.	Loopback diagnostics.
15	Force Multiple Coils.	Force discrete commands.
16	Force Multiple Registers	Write parameter setting control commands

DATA
Data field includes information transferred to and from the HRVS-DN. The specific data format is changed with Function. When Word data parameters are transmitted, High Byte is transmitted first, followed by the Low Byte.

CRC
The CRC (Cyclic Redundancy Check) two bytes (16 bit) are used to check the bytes of the entire frame.
It is generated in the master device and transmitted as the last two bytes of the frame (Low byte is appended first, followed by the High byte). The slave device regenerates the CRC bytes and compares it to the CRC bytes received. If the CRC bytes are not identical, the frame is flushed and no response is transmitted to the master.

HRVS-DN MEMORY ORGANIZATION

The HRVS-DN memory is organized according to the common Modbus addresses as follows:

HRVS-DN Use	Memory Type	Max Query/Response Parameters	
Actual Data	3X References	Registers,	# 1..150, addressed 0.. 149.
	4X References	Registers,	#257...384 addr. 256..283
Parameter Settings	4X References	Registers,	# 1..110, addressed 0..109
Hardwired Control Inputs	1X References	Inputs,	# 1..16, addressed 0..15.
Discrete Serial Commands	0X References	Coils,	# 1..16, addressed 0..15.
Control Commands	4X References	Register,	# 753, addressed 752.

Notes:

1. Actual Data parameters can be read both at 3X references starting at parameter #1, or (same parameters) at 4X references starting at parameter #257 (100 hex higher). The additional mapping in 4X references is designed for the convenience of Modbus Plus users.
2. HRVS-DN can be controlled using the standard discrete commands (Coils, 0x references) or by writing to parameter setting #753 with function 16. The additional control option using 4X references is designed for the convenience of Modbus Plus users. To control, write to register #753 (address 752) only! (one register write, with function 16).
3. Function 3 should be used to read 4X references. Function 4, to read 3x references.

16.7 **Actual Data (3X References & 4X references)**

Actual data includes measured values such as voltage, current and insulation resistance. It includes both logic and statistical information. All parameters are **word** (two bytes) parameters. The protocol supports only reading of these parameters.
Parameter # is "1 based". The actual parameter address is 1 lower than parameter #. For example the address of parameter #1 is 0 (30000).
The parameters have double mapping, at the following **3x & 4x** references:

Note: Function 4 should be used to read 3x references and function 3 to read 4x references.

Parameter	**# (3x)**	**# (4x)**	**Comment**
Logic Status	1	257	Logic status of HRVS-DN. 1 indicates: d15: HRVS-DN Trip. d14: Motor Stopped. d13: Motor in Soft Stop Process. d12: Motor in Start Process. d11: Motor is Running. d10: Motor is running with Closed By_Pass. d9: Up_To_Speed. Like d10 and I reduced (once) below 115% of FLA. d8: Reserved. d7: Dual_Adjust On. d6..d0: Reserved. Note: After bypass is closed, trip (d15) and running (d11), can be ON together. See Trip_after_By-Pass setting parameter at fault parameters page.
Hardwired inputs	2	258	Discrete Hardwired control inputs: d15..d8: Reserved. d7: External fault 2, Terminal 20. d6: External Fault 1,Terminal 19. d5: Reserved. d4:Programmable Input , Terminal 8 Programming options: 0-D.Adj / 1- Slow.Speed / 2-Reset d3: Programmable Input, Terminal 7 Programming options: 0-Test1 / 1-Reverse / 2-Reset d2: Start Input. Terminal 6 d1: Soft Stop Input. Terminal 5 d0: Stop Input. Terminal 4
Relays	3	259	d0 - Immediate,d1- End Of Acc, d2 - Fault relay
Voltage	4	260	Line voltage, % of rated voltage.
I1_amp	5	261	Current of phase 1, Ampere.
I2_amp	6	262	Current of phase 2, Ampere.
I3_amp	7	263	Current of phase 3, Ampere.
Reserved	8	264	
Dip_Switch	9	265	d15..d8: Reserved. d7: Setting Lock - (right-most) d6: Enlarged Setting Ranges d5: Language Selection. d4: Language Selection. d3: Reserved - Must be set to Off. d2: Generator Starting - Set to Off. d1: Tacho feedback available (1). d0: Min (off) / Max display pages- (left most)
Phase_Sequence	10	266	1: Correct Phase seq. 0 : Wrong Phase Seq.
Motor Insulation R	11	267	Motor Insulation Resistance [KOhm]
Reserved	12..14	268..270	

Parameter	# (3x)	# (4x)	Comment
Power	15		Power consumption [KW]
Reactive Power	16		Reactive Power consumption [KVAR]
Power Factor	17		Power Factor * 100
Time Since Last Start	18		Elapsed minutes since last start
Frequency	19		Frequency [tenth Hz]
Reserved	20..24		
Logic_Status_at_Power_Fail	25	281	Logic Status at Control Pwr Supply turn off. (See parameter # 1 for detailed description)
Total_Run_Time	26	282	Total Hours of Running Motor.
Total_Starts	27	283	Total Number Of Starts
Last_Start_Period	28	284	Duration of Last Start, Seconds.
Last_Start_Peak_I	29	285	Peak Current During Last Starting process
Time_To_Start	30	286	After Too Many Starts Trip, Seconds.
Total_Trips	31	287	Total Number Of Trips
Last_Trip_Number	32	288	Number of the fault that caused trip.

No.	Fault
01	Over Temperature
02	Overcurrent / Shear pin
03	Overload
04	Under Current
05	Under / No Voltage
06	Over Voltage
07	Phase Loss
08	Phase Sequence
09	Wrong Connection or Shorted Scr
10	Long Start Time
11	Slow Speed Time (Future feature)
12	External Fault 1 (Input # 3)
13	External Fault 2 (Input # 4)
14	Wrong Parameters
15	Mains ON & No Start Signal
16	Too Many Starts
17	Currents Unbalance
18	Insulation
19	Ground Fault
20	Open By-Pass
21	Frequency out of range
22	Comm Port Failure
23	Set Clock
24	Coast Down Time

Pre_Trip_I	33	289	Current at trip time, % of FLA.
Reserved	34..38	290..294	
Thermal Capacity	39	295	Simulated winding temperature, %. 100% = trip
Reserved	40	296	
Clk_Hour	41	297	Setting can be done at # 131
Clk_Minute	42	298	Setting can be done at # 132
Clk_Month	43	299	Setting can be done at # 133
Clk_Day	44	300	Setting can be done at # 134
Clk_Year	45	301	Setting can be done at # 135
Reserved	46	302	
KWH	47,48	303,304	dword parameter (47=LSword,48=MSword)
KVARH	49,50	305,306	dword parameter (49=LSword,50=MSword)
Reserved	51..56	307..312	
Trip_Array(10)	57..66	313..322	List of last 10 Trip
(See fault list starting at parameter # 24)			
Trip_Hour_Array(10)	67..76	323..332	List of time (Hour) of the last 10 trips
Trip_Minute_Array(10)	77..86	333..342	List of time (Minute) of the last 10 trips
Trip_Day_Array(10)	87..96	343..352	List of date (Day) of the last 10 trips
Trip_Month_Array(10)	97..106	353..362	List of date (Month) of the last 10 trips
Trip_Year_Array(10)	107..116	363..372	List of date (Year) of the last 10 trips

Trip_Pointer	117 373	Pointer for the 10 cyclic above arrays
Actual_Data_Group	151..170 407..426	Group of 20 actual parameters selected by setting parameters #90..109

Example 1:

To read actual parameters 5,6,7 (I1,I2,I3 Actual Parameters, Addressed as 4.5 and 6) of HRVS-DN # 18 (its Serial Link No. = 18) , the host computer should send following frame:

				Another Possibility (Modbus Plus users)
byte 1:	Serial Link No.	($12)		($12)
byte 2:	Function	($04)		**($03)**
byte 3:	Starting Address High	($00)		**($01)**
byte 4:	Starting Address Low	($04)		($04)
byte 5:	No. of Points High	($00)		($00)
byte 6:	No. of Points Low	($03)		($03)
byte 7:	CRC_Low	($XX)		($XX)
byte 8:	CRC_High	($XX)		($XX)

The HRVS-DN response, when Current = 400 % of FLA, and Voltage = 420V, is:

byte 1:	Serial Link No.	($12)		($12)
byte 2:	Function	($04)		($03)
byte 3:	Byte Count	($06)		($06)
byte 4:	Data High, parameter 5	($01)	(400)	($01)
byte 5:	Data Low, parameter 5	($90)		($90)
byte 6:	Data High, parameter 6	($01)	(420)	($01)
byte 7:	Data Low, parameter 6	($A4)		($A4)
byte 8:	Data High, parameter 7	($01)	(410)	($01)
byte 9:	Data Low, parameter 7	($9A)		($9A)
byte 10:	CRC_Low	($XX)		($XX)
byte 11:	CRC_High	($XX)		($XX)

Note: $XX indicates Hexadecimal byte.

16.8 Parameter Settings (4X References)

Parameter settings include all parameters that can be set manually. These parameters determine the modes of operation of the HRVS-DN. They also set protections level. All parameters are word (two bytes) parameters**.** The protocol supports both reading and modifying of (most of) these parameters.

Note: Use function 3 to read the setting parameters.

Any one of these parameters must be set with care. Inappropriate settings of some parameters can result in damage to both the motor and the HRVS-DN.

The parameters have the following **4x** references:

Parameter	#	Range	Default
Main & protect. parameters			
Rated Line Voltage	1	2300..15000	6600 (Volt.)
Starter FLC	2	20..1800	150 (Amp.)
Motor FLA	3	20..1800	150 (Amp.)
Rated Motor Power	4	50..40000	1000 (KW)
Service Factor	5	100..130%	100 (%)
Undercurrent Trip	6	0..90	0 (% of FLA)
Undercurrent Delay	7	1..40	10 (Seconds)
Overcurrent Shear Pin	8	100..850	850 (% of FLA)
Overcurrent Delay	9	0..50	5 (0.5 Sec.)
Overload Class	10	IEC 5,10,15,20,25,30 NEMA 5,10,15,20,25,30 FLA)	IEC Class 10
Overload Protect	11	0=Disable 1=Enable While Run 2=Enable	1=Enable While Run
Unbalance Trip	12	10..100, 101 = Off.	20 (%)
Unbalance Delay	13	1..60	5 (Seconds)
Ground Fault Trip	14	10..100, 101 = Off.	20 (% of FLA)
Ground Fault Delay	15	1..60	5 (Seconds)
Undervoltage Trip	16	50..90	70 (%)
Undervoltage Delay	17	1..100	5 (Seconds)
Overvoltage Trip	18	110..125	120 (%)
Overvoltage Delay	19	1..10	2 (Seconds)
Reserved	20..24		
Start Parameters			
Soft Start Curve	25	0..11 (6..11 are for Tacho only)	1 (Standard).
Pulse Level	26	70 (%of FLA) – 700 (%of FLA)	70% of FLA
Pulse Time	27	0..10 (Tenth Seconds)	0 (No Pulse)
Initial Voltage	28	10..80	30 (% of full voltage)
Initial Current	28 !	100..400 % of FLA	100 % of FLA
Current Limit	29	100..700	400 (% of FLA)
Acceleration Time	30	1..90	10 (Seconds)
Max. Start Time	31	1..250	30 (Seconds)
Number Of Starts	32	1..10 & (11 = off)	1
Starts Period	33	1..60	20 (Minutes)

Parameter	#	Range	Default
Start Inhibit	34	1..60 minutes	15 (Minutes)
Run Contact Delay	35	0..120 seconds	5 (Seconds)
Turn Bypass On at	35	121..250 % of Motor FLA	Only with relay PCB for optional sync motor start
Min Time To Bypass	36	3..60	3sec. Only with relay PCB for optional sync motor start
Reserved	37..40		
Stop Parameters			
Soft Stop Curve	41	0..11 (6..11 are for Tacho only)	1 (Standard)
Deceleration Time	42	0..90	0 (Seconds)
Final Torque	43	0..10	0 (Minimum)
Coast Down Delay	44	Off (9) 10-3600	9 (Off)
Reserved	45..48		
Dual Adjustment Parameters			
DA: Initial Voltage	49	10..80 % of full voltage	30
DA: Initial Current	49 !	100..400 % of FLA	100 % of FLA
DA: Current Limit	50	100..700	400 % of FLA
DA: Acceleration Time	51	1..90	10 (Seconds)
DA: Deceleration Time	52	0..90	0 (Seconds)
DA: Motor_FLA	53	20..1800	150 (Amp.)
Reserved	54..56		
Fault Parameters			
UV & PL Auto Reset	57	0 / 1 (0 - No, 1 - Yes)	0 (No)
Under Current Reset	58	10..120 (&121-off)	121 (Off)
ByPass Open Trip	59	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
Trip after Bypass	60	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
By-Pass Auto Reset	61	0 – No, 1 – Yes	0 - No
Set Curve 0 Flt	62	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
Power On & No Start	63	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
Insulation Alarm	64	1(Off) – 100 (10Mohm)	1 (Off)
Insulation Trip	65	1(Off) – 100 (10Mohm)	1 (Off)
Phase Sequence	66	0 – Pos., 1 – Neg., 2 – Ignore	0 (Positive)
Reserved	67..72		
I/O Programming			
Prog. Input # 7 (terminal 7)	73	0 ..3 (0-Test,1-Resst) 0 - Test 1 - Reset 2 - Multi Soft Stop– consult the factory. 3 - Current Control– consult the factory.	1 (Reset)
Prog. Input # 8 (terminal 8)	74	0 / 1 (0-D.Adj.,1-Rseet)	0 (Dual Adjust)
Fault Relay Type	75	0..1 (0-Fault, 1-Fault Fail Safe)	0 (Fault)
Immediate Relay Type	76	0..1 (0-Immediate, 1-shear pin)	0 (Immediate)
Realy On Delay	77	0..3600	0 (Seconds)
Realy Off Delay	78	0..3600	0 (Seconds)
Analog output	79	0..1 (0 - Normal, 1 - Inverted)	0 (Normal)
Reserved	80		
Communication Parameters			
Comm. Protocol	81	0 – Modbus, 1 – Profibus	0 – Modbus
Modbus Baud Rate	82	12..192 (*100)	192 (19200 bps)
Parity Check	83	0/1/2 (Even / Odd / No)	0 (Even)
Serial Link Number	84	1..247 & (248= Off)	248 (Off)
S. Link Parameters Save	85	0 – Disable, 1 – Enable	0 (Disable saving)
Serial Link Control	86	0 – Disable, 1 – Enable	0 (Disable Control)

Modbus Time Out	87	1..600 & (601= Off)	601 (Off) (Tenth Sec)
Front Comm. Address	88	1..247 & (248= Off)	248 (Off)
Reserved	89		
Parameter	**#**	**Range**	**Default**
Modbus_#_Array	90..109	1..60 (# of parameter)	(default # are: 1-Logic_Status, 5 - I1, 6-I2, 7 - I3, 4 - V, 2 - Ctrl-In, 3- Ctrl_Out (relays), 15-Power,17-Power Factor, 8 - frequency, 10 - Phase Sequence, 26-Total Run Time, 27 - Total Starts, 31 - Total Trips, 28 - Last Start Period, 29 - Last Start Peak I, 32-Last Trip Number, 33-Pre Trip I, 39-Thermal Capacity, 11 – Insulation Resistance

Notes:

1. Parameter # is "1 based". The address is 1 lower than parameter #. For example address of parameter #1 is 0 (40000).

2. When the Preset Single Register Function (06) is used to adjust ***one*** parameter setting, the communication program checks that the parameter value is within the allowed limits. If not, an Exception Response (Exception code 03) is returned instead of Normal response. See Exception Responses later in this document.

3. If Preset Multiple Register Function (16) is used to adjust one or multiple parameter settings, then even if one or more parameter settings are out of range, Normal response will be returned.
   HRVS-DN program will check later the value of each parameter. If it is beyond the allowed limit, the limit value will be stored instead of the transmitted parameter value.

4. *It is strongly recommended to preset parameter settings only when the motor is stopped.* The HRVS-DN enables, however to preset *one* parameter (using function 06 only) when the motor is running with closed Bypass Contactor. When motor is Soft Started, Soft Stopped, runs with open bypass or at slow speed, the HRVS-DN ignores "Preset Single Register" or "Force Multiple Register" instructions. A "busy" Exception response is returned by the HRVS-DN whenever its logic condition does not enable presetting.

5. Always wait more than 0.5Sec after using Functions 06 or 16 to preset parameter(s) before transmitting again to the same HRVS-DN.

6. Communication parameters 81, 82, 83 can only be read through the serial link. They can only be set (written) manually.

7. It is the user's responsibility to read and check all changed parameter settings after presetting.

8. It is not possible to write data to the setting parameters when dip switch 8 (pc2000) is set.

Example 2:
To Read Stop Parameter settings 41-43 addressed as 40-42 (Soft Stop Curve, Deceleration Time and Final Torque) of HRVS-DN # 96. The host computer sends the following frame:

byte 1:	Serial Link No.	($60)	
byte 2:	Function	($03)	
byte 3:	Starting Address High	($00)	(40)
byte 4:	Starting Address Low	($28)	
byte 5:	No. of Registers High	($00)	
byte 6:	No. of Registers Low	($03)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The HRVS-DN normal response:

byte 1:	Serial Link No.	($60)	
byte 2:	Function	($03)	
byte 3:	Byte Count	($06)	
byte 4:	Data High	($00)	(Soft Stop Curve = 0)
byte 5:	Data Low	($00)	

byte 6:	Data High	($00)	(Deceleration Time = 10Sec)
byte 7:	Data Low	($10)	
byte 8:	Data High	($00)	(Final Torque = 0)
byte 9:	Data Low	($00)	
byte 10:	CRC_Low	($XX)	
byte 11:	CRC_High	($XX)	

Example 3 :
To write one setting parameter (Under_Voltage_Trip = 300V) to Parameter Setting # 16 (Addressed as 15) of HRVS-DN # 5, the host computer should send following frame:

byte 1:	Serial Link No.	($05)	
byte 2:	Function	($06)	
byte 3:	Starting Address High	($00)	
byte 4:	Starting Address Low	($0F)	(15)
byte 5:	Preset Data High	($01)	(300)
byte 6:	Preset Data Low	($2C)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The HRVS-DN normal response, is an echo of the query (Identical frame).

Example 4 :

To write multiple parameter settings (Undervoltage__Trip = 300V, Under_Voltage_delay = 10Sec, Over_Voltage_Trip = 480V, Over_Voltage_delay = 2Sec) to Parameter settings # 16-19 (Addressed as 15-18) of HRVS-DN # 128, the host computer sends the following frame:

byte 1:	Serial Link No.	($80)	
byte 2:	Function	($10)	
byte 3:	Starting Address High	($00)	
byte 4:	Starting Address Low	($0F)	
byte 5:	No. of Registers High	($00)	
byte 6:	No. of Registers Low	($04)	
byte 7:	Byte Count	($08)	
byte 8:	Data High	($01)	(300)
byte 9:	Data Low	($2C)	
byte 10:	Data High	($00)	(10)
byte 11:	Data Low	($10)	
byte 12:	Data High	($01)	(480)
byte 13:	Data Low	($E0)	
byte 14:	Data High	($00)	(2)
byte 15:	Data Low	($02)	
byte 16:	CRC_Low	($XX)	
byte 17:	CRC_High	($XX)	

The HRVS-DN normal response:

byte 1:	Serial Link No.	($80)
byte 2:	Function	($10)
byte 3:	Starting Address High	($00)
byte 4:	Starting Address Low	($0F)
byte 5:	No. of Registers High	($00)
byte 6:	No. of Registers Low	($04)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

Note:
A Normal response will be returned even if the preset data value is beyond the allowed range for one or more parameter settings. Later the HRVS-DN program will check the value of each parameter. If it exceeds the

allowed limit, the limit value will be stored instead the transmitted parameter value. It is the user's responsibility to read and check all parameter settings after presetting.

16.9 **Control Register Write (4X Reference)**

The HRVS-DN incorporates **one** Control register intended for controlling the HRVS-DN.
Address: The Control register is register # 753 addressed as 752 (40752).

In order to control the HRVS-DN using the Control register:

* Use Function 16 only.
* Use Address_High (page) = 2
* Use Address_Low = 240 (0F0H).
* Write to one register only.
* Use data_high (ms-byte of data) = 5AH.
* Data_low Bits resolution of the control register (ls-byte of data):

bit	function	Comment	Note
d0	Reserved.		
d1	Reserved.		
d2	Reserved.		
d3	Start/Stop Relay	Write "1" (ON) to Start / Run.	Operates relay (terminals 31-32)
		Write "0" (OFF) to Stop.	Located in the Control Module optional Relay Card.
d4	Dual Adjust	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.	
d5	Reserved.		
d6	Reserved.		
d7	Reset	Write "1" (ON) to Reset.	

Notes:

1. Read function of the control register is not available. To read the HRVS-DN status, read Logic Status (Actual parameter # 1).
2. Bytes 2..8 of the control frame must be exactly as in the following example. Otherwise, an error message is returned.
3. Hardwired Stop and Soft Stop inputs, overrides the communication. To enable motor starting through communication, terminal 4 (Stop) must be connected to the control voltage. Connect terminals 5 & 6 to control voltage through the HRVS-DN Start/Stop optional relay output contact.
4. Start/Stop and Dual Adj bits, should be of maintained type, like a toggle switch.
5. Reset bit should be of momentary type, like a momentary reset pushbutton. It is rejected, if given together with Start command.
6. Before (or simultaneously with) resetting, be sure to turn off start/stop relay bit first.
7. It is the host responsibility, to immediately write a Stop command (writing 5A00 Hex) when detecting that the Trip bit is set in the Logic Status parameter (parameter # 1 on the In data). This is to prevent unwanted start command upon resetting the fault.

Example 5 - Control Register Write:

To start HRVS-DN # 11, the host computer sends the following Query frame:

byte 1:	Serial Link No.	($0B)	
byte 2:	Function	($10)	Bytes 2..8 must be as in this example!!!
byte 3:	Starting Address High	($02)	
byte 4:	Starting Address Low	($F0)	
byte 5:	No. of Registers High	($00)	
byte 6:	No. of Registers Low	($01)	
byte 7:	Byte Count	($02)	
byte 8:	Data High	($5A)	
byte 9:	Data Low	($08)	Bit 3 is set, to start.

byte 10: CRC_Low ($XX)
byte 11: CRC_High ($XX)

The HRVS-DN normal response:

byte 1: Serial Link No. ($0B)
byte 2: Function ($10)
byte 3: Starting Address High ($02)
byte 4: Starting Address Low ($F0)
byte 5: No. of Registers High ($00)
byte 6: No. of Registers Low ($01)
byte 7: CRC_Low ($XX)
byte 8: CRC_High ($XX)

16.10 **Discrete Commands (Coils, 0x References)**

The HRVS-DN incorporates 16 "Coils", (bit parameters), from which only 3 are operative. The other 13 are reserved and were incorporated to enable the user to use word (16 bits) type parameters. Coil # is 1"1 based". The actual address is 1 lower than coil #. For example coil #1 is addressed as 0 (00000). Use functions 5 or 15 to send control commands to the starter.
The coils have the following **0x** references:

Coil #	Coil Address	Use in HRVS-DN	Comment
1	0	Reserved.	
2	1	Reserved.	
3	2	Reserved.	
4	3	Start/Stop Relay	Write "1" (ON) to Start / Run. Write "0" (OFF) to Stop.
5	4	Dual Adjust	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.
6	5	Reserved.	
7	6	Reserved.	
8	7	Reset	Write "1" (ON) momentarily to Reset. Rejected, if given together with Start command.
9..16	8..15	Reserved	

Example 6 - Read Coils:

To read coils 1..8 status of HRVS-DN # 10, the host computer sends the following Query frame:

byte 1: Serial Link No. ($0A)
byte 2: Function ($01)
byte 3: Starting Address High ($00)
byte 4: Starting Address Low ($00)
byte 5: No. of Coils High ($00)
byte 6: No. of Coils Low ($08)
byte 7: CRC_Low ($XX)
byte 8: CRC_High ($XX)

The HRVS-DN response, when coils 7..0 are OFF OFF OFF ON OFF ON OFF OFF:
byte 1: Serial Link No. ($0A)
byte 2: Function ($01)
byte 3: Byte Count ($01)
byte 4: Data (coils 7..0) ($14)
byte 5: CRC_Low ($XX)
byte 6: CRC_High ($XX)

Example 7 - Force Single Coil:

To start the motor controlled by HRVS-DN # 1, the host computer writes "1" to the "START/STOP COIL" (coil 4 addressed as 3) .

Note: For Force Single Coil Function, Force Data of $0000 forces "0" = OFF. Force data of $FF00 forces "1" = ON. The "Query" frame is sent by the host:

byte 1:	Serial Link No.	($01)	
byte 2:	Function	($05)	
byte 3:	Coil Address High	($00)	
byte 4:	Coils address Low	($03)	Start/Stop relay
byte 5:	Force Data High	($FF)	(force ON)
byte 6:	Force Data Low	($00)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The normal (if no exception) response:

byte 1:	Serial Link No.	($01)
byte 2:	Function	($05)
byte 3:	Coil Address High	($00)
byte 4:	Coils address Low	($03)
byte 5:	Force Data High	($FF)
byte 6:	Force Data Low	($00)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

Notes:

1. Hardwired Stop and Soft Stop inputs, overrides the communication. To enable motor starting through communication, terminal 4 (Stop) must be connected to the control voltage. Connect Terminals 5 & 6 to control voltage through the HRVS-DN Start/Stop optional relay output contact.
2. Start/Stop coil and Dual Adj coil should be of maintained type, like a toggle switch.
3. Reset coil should be of momentary type, like a momentary reset pushbutton. It is Rejected, if given together with Start command.
4. Before reseting, be sure to turn off start/stop relay coil first.
5. It is the host responsibility, to immediately write a Stop command when detecting that the Trip bit is set in the Logic_Status parameter (parameter # 1 in the Actual data). This is to prevent unwanted start command upon resetting the fault.

Example 8 - Force Multiple coils:

Motor that is controlled by HRVS-DN # 32 is stopped. Dual Adjust is set to off.
To start the motor using the Dual Adjust parameters , the host computer writes "1" to the Start and Dual Adjust Coils no. 4 &5, addressed as 3 & 4. One of the many possible ways:

The "Query" frame sent by the host:

byte 1:	Serial Link No.	($20)	
byte 2:	Function	($0F)	
byte 3:	Coil Address High	($00)	
byte 4:	Coils address Low	($00)	
byte 5:	No. of Coils High	($00)	
byte 6:	No. of coils Low	($08)	
byte 7:	Byte Count	($01)	
byte 8:	Force Data	($18)	(coil # 4 & coil # 5)
byte 9:	CRC_Low	($XX)	
byte 10:	CRC_High	($XX)	

The normal (if no exception) response:

byte 1:	Serial Link No.	($20)
byte 2:	Function	($0F)
byte 3:	Coil Address High	($00)
byte 4:	Coils address Low	($00)
byte 5:	No. of Coils High	($00)
byte 6:	No. of coils Low	($08)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

16.11 **Discrete Hardwired Inputs (1x References)**

The HRVS-DN incorporates 16 Discrete Inputs, (bit parameters), from which only 6 are operative. The other 10 are reserved and were incorporated to enable use of word (16 bits) type parameters. Input # is "1 based". The actual address is 1 lower than input #. For example input #1 is addressed as 0 (10000). The inputs have the following **1x** references:

Input #	Address	HRVS-DN use	Comment	
1	0	Stop	Open Input (Input reads" 0") to Stop. Close Input (Input reads "1") to enable Start / Run.	(Terminal # 4)
2	1	Soft Stop	Open Input (Input reads"0") to Soft Stop. Close Input (Input reads"1") to enable Start / Run.	(Terminal # 5)
3	2	Start	Close Input (Input reads "1") to Start.	(Terminal # 6)
4	3	Input # 1	Close Input (Input reads "1") to turn On. Open Input (Input reads "0") to turn Off. Programmable to: 0- Test1 1- Slow Speed 2- Reset	(Terminal # 7)
5	4	Input # 2	Close Input (Input reads "1") to turn On. Open Input (Input reads "0") to turn Off. Programmable to: 0- Dual Adjust 1- S. Spd Rvrs 2- Reset	(Terminal # 8)
6	5	Reserved		
7	6	Ext. Fault 1	Close to Trip (Input reads" 1")	(Terminal # 19)
8	7	Ext. Fault 2	Close to Trip (Input reads" 1")	(Terminal # 20)
9..16	8..15	Reserved		

Example 9:

To read all discrete inputs of HRVS-DN # 12, the host computer sends the following Query frame:

byte 1:	Serial Link No.	($0C)	(12)
byte 2:	Function	($02)	
byte 3:	Starting Address High	($00)	
byte 4:	Starting Address Low	($00)	
byte 5:	No. of Points High	($00)	
byte 6:	No. of points Low	($08)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The HRVS-DN response, when only Stop and Soft Stop terminals (Inputs 1&2) are connected:

byte 1:	Serial Link No.	($0C)	(12)
byte 2:	Function	($02)	
byte 3:	Byte Count	($01)	
byte 4:	Data (Inputs 7..0)	($03)	
byte 5:	CRC_Low	($XX)	
byte 6:	CRC_High	($XX)	

16.12 **Diagnostics**

Modbus Function 08 , as implemented in the HRVS-DN supports only Subfunction $0000. It provides for "loopback" (Return Query Data) feature, for checking the Communication Serial Link between the master and the HRVS-DN.
To request HRVS-DN # 1 to return Query data, the master should send following Query frame:

byte 1:	Serial Link No.	($01)
byte 2:	Function	($08)

byte 3:	Subfunction High	($00)
byte 4:	Subfunction Low	($00)
byte 5:	Data High	($37)
byte 6:	Data Low	($A5)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

The normal (if no exception) response is the echo of the Query:

byte 1:	Serial Link No.	($01)
byte 2:	Function	($08)
byte 3:	Subfunction High	($00)
byte 4:	Subfunction Low	($00)
byte 5:	Force Data High	($37)
byte 6:	Force Data Low	($A5)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

16.13 **Exception Responses**

When the master sends a query frame to an HRVS-DN, one of the following four responses from the HRVS-DN is possible:

1. When no communication error is detected in the query, and no mistake is found by the communication program module in the HRVS-DN, a normal response is returned.

2. If the HRVS-DN does not receive the query frame (for example because of disconnected serial link cable) then no response is returned by the HRVS-DN. After proper time the master will cause a timeout condition.

3. If the HRVS-DN receives the query, but faulty CRC bytes and / or Parity bits are detected, no response is returned by the HRVS-DN. After the proper time the master will cause a timeout condition.

4. If no communication error is detected in the query, but the HRVS-DN communication program module finds an error such as illegal Function, data address or data value, or if the HRVS-DN is busy, then an Exception response is returned. The Exception response includes Exception Code to inform the master about the type of the error.

Exception Code Response Frame:
The Exception response frame holds fix number of 5 bytes. The first one, the Slave Address field is the Serial link number (transmitted in query and identical to HRVS-DN Serial Link No.). The second byte, the Function field returns the echo of the transmitted query function, but with the Most Significant Bit set to 1 (adding $80 to the transmitted function code). The third byte is the Exception Code informing about the type of error. The last two bytes are the CRC bytes.

Exception Codes supported by the HRVS-DN:

Exception Code	Type	Comment
01	Illegal Function	Requested Function is not supported. Functions 1..6, 8, 15 or 16 are supported.
02	Illegal Data Address	Data address is not allowable.
03	Illegal Data Value	Data Value is not in allowable range.
06	HRVS-DN Busy	HRVS-DN is busy now. The master retransmits the message later. Note: After using function 16 to store setting parameters, it is forbidden to transmit again to the same MPR after less than 1Sec.

Example 10:

The master is trying to force coil # 17 of the HRVS-DN 32. The HRVS-DN incorporates only 16 coils. The Illegal Data Address Exception code will be returned:

Query:

byte 1:	Serial Link No.	($20)	(32)
byte 2:	Function	($05)	
byte 3:	Coil Address High	($00)	
byte 4:	Coils address Low	($11)	(17, Non existent Coil)
byte 5:	Force Data High	($00)	($0000 = "0" = Low)
byte 6:	Force Data Low	($00)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

Exception response:

byte 1:	Serial Link No.	($20)	
byte 2:	Function	($85)	(Original + $80)
byte 3:	Exception Code	($02)	(Illegal Data Address)
byte 4:	CRC_Low	($XX)	
byte 5:	CRC_High	($XX)	

Note:
There are cases where the HRVS-DN returns Normal response, but the requested action cannot be performed, or is modified by the HRVS-DN. Few examples are:

Requested Action	**Performed Action**
Write Parameter settings during start process	Ignored.
Write multiple parameters (Function 16), some are out of range	Limit to allowed range.
Start command (Function 05) while Stop Hardwired Input is open	Command ignored

It is the user responsibility to verify that the requested action was performed, by reading the value of the modified parameters or the status of the command Coils.

17. HRVS-DN COMMUNICATION (PROFIBUS PROTOCOL)

17.1 Global Parameters:

```
33:  ;=========================================
34:  ;==== General DP Keywords ==================
35:  ;=========================================
36:
37:  GSD_Revision      = 5
38:  Vendor_Name       = "Solcon Ltd"
39:  Model_Name        = "HRVS-DN"
40:  Revision          = "1.00"
41:  Ident_Number      = 0x0BAB
42:  Protocol_Ident    = 0
43:  Station_Type      = 0
44:  FMS_supp          = 0
45:  Hardware_Release  = "V1.00"
46:  Software_Release  = "V1.00"
47:  Redundancy        = 0
48:  Repeater_Ctrl_Sig = 2
49:  24V_Pins          = 0
```

Code 1 – Global Parameters in the GSD file

17.2 Operation Mode in PROFIBUS:

HRVS-DN supports both DPV0 and DPV1.

- DPV0 (Cyclic) allows:
  - Start and shutdown.
  - Read parameters (write parameters are not allowed via DPV0).
- DPV1 allows:
  - Everything that DPV0 allows
  - Change the cyclic parameters that display via DPV0.
  - Write to registers.

17.3 Description of the DPV0 (Cyclic) Frame:

From the Profibus controller to the HRVS-DN two bytes (16 bits) are transferred.
From the HRVS-DN to the controller 40 bytes are transferred.

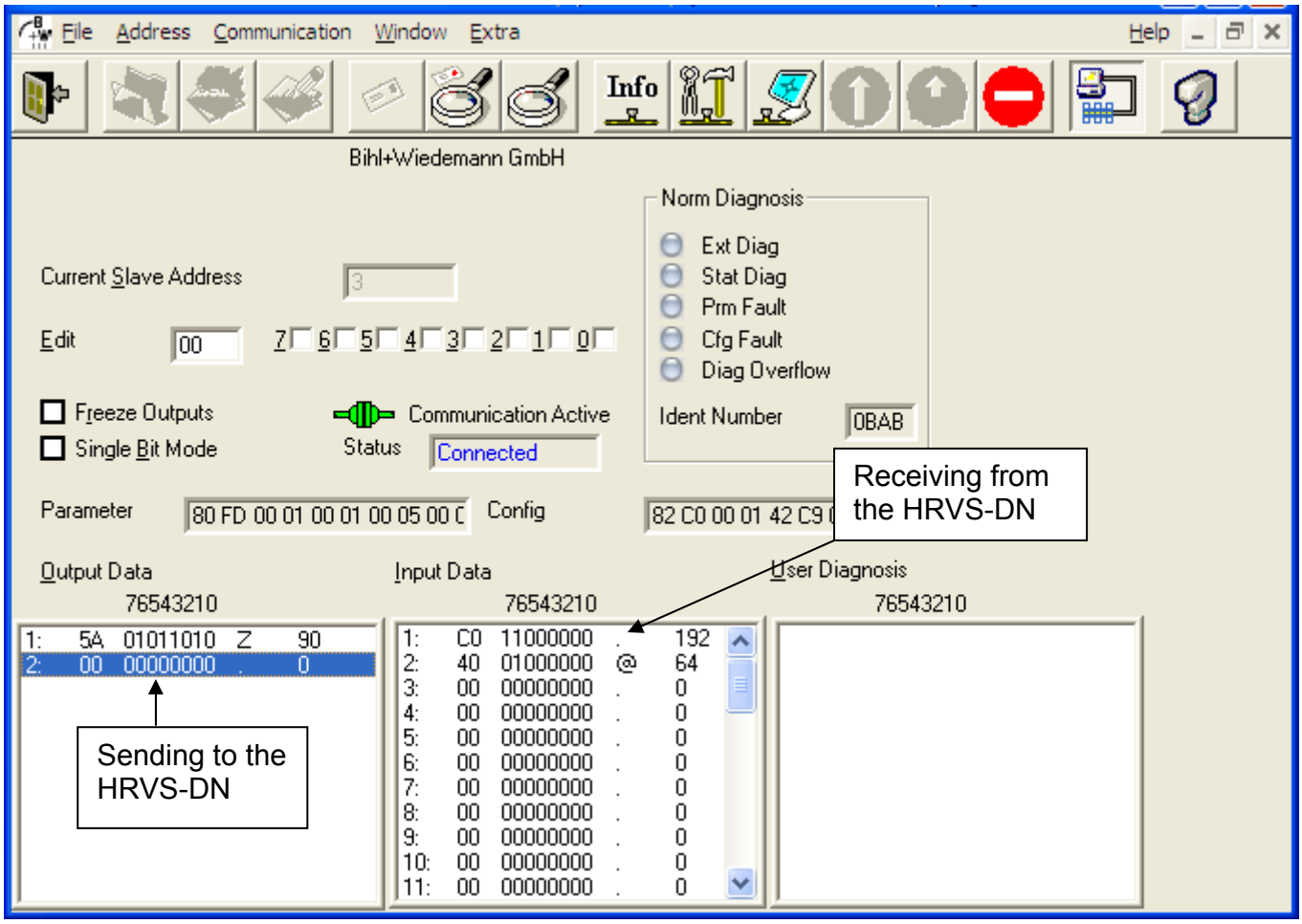


Figure 51 – DPV0 parameters (Cyclic parameters)

17.3.1 ***Structure of the HRVS-DN Receiving Frame***

The first byte must to be 0x5A (90 decimal)
The second byte is as follows:

Bit number:	Function:	Note:
0	Reserved	
1	Reserved	
2	Reserved	
3	Start/Stop Relay	Write "1" (ON) to Start / Run. Write "0" (OFF) to Stop.
4	Dual Adjust	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.
5	Reserved	
6	Reserved	
7	Reset	Write '1' for reset

Note:
Bit number 0 is the LSB.

Example:
To send Reset, you first need to send 0x5A followed by 0x80.

17.3.2 ***Structure of the HRVS-DN Transmitting Frame***

The return frame contains 20 pairs of bytes (40 bytes total), representing the contents of 20 registers.
Each pair of bytes represents one register; all of the registers are 16 bit numbers.
The first byte represents the high value of the number (the MSB).

17.3.3 ***Choosing the Receiving DPV0 Registers***

There are two methods to change which registers will be displayed in DPV0 (cyclic).

- Change the parameters in the GSD file. This method can be used with both DPV0 and DPV1. The change can only take place when communication is first established.

- Write a data request. This method can only be used with DPV1. The change can be made after communication has already been established.

17.3.3.1 Selection of the DPV0 Registers by the GSD

The GSD file contains a list of parameters at lines 190 to 288.
The parameters appear in blocks, each block contains 4 lines, and each block refers to one register (there are 20 blocks representing 20 registers).

```
190:  ExtUserPrmData = 1001 "INDIREC PAR 1"
191:  Unsigned16 1 1-1000
192:  Prm_text_Ref   = 100
193:  EndExtUserPrmData
194:
196:  ExtUserPrmData = 1002 "INDIREC PAR 2"
197:  Unsigned16 2 1-1000
198:  Prm_text_Ref = 100
199:  EndExtUserPrmData
200:
201:  ExtUserPrmData = 1003 "INDIREC PAR 3"
202:  Unsigned16 3 1-1000
203:  Prm_text_Ref = 100
204:  EndExtUserPrmData
205:
   .....
   .....
284:
285:  ExtUserPrmData = 1020 "INDIREC PAR 20"
286:  Unsigned16 40 1-1000
287:  Prm_text_Ref   = 100
288:  EndExtUserPrmdata
```

Code 2 – GSD file, the part that is responsible for displaying the registers in DPV0 (cyclic)

The second line of each block begins with "`Unsigned16`", followed by the register number (shown above in green).
The list of register numbers appears in section 17.8 on page 161.

17.3.3.2 Selection of the DPV0 Registers through Data Request (DPV1)

By writing to Slot number 1 and Index 2, you can change the register that appears in DPV0.
Remember that for each register there are 16 bits (two bytes/one word). The first byte represents the high value of the register number.

To demonstrate this, let's say that we want to see the following registers in DPV0 (cyclic):

1. Logic Status.
2. I1.
3. I2.
4. I3.
5. Voltage.
6. Ctrl-In.
7. Ctrl_Out (relays).
8. Power.
9. Power Factor.
10. Frequency.

Step 1: Find the register numbers

In this document, we will use a simple PROFIBUS master tool to demonstrate how to change parameters. This tool is very simple and it allows you to modify the parameters only by writing the hex numbers.

Go to the table in section 17.7 page 157 and find the register number for each register. The tool used in our example requires the hexadecimal value so we also need to convert the register number into its hex equivalent.
The following table shows the register numbers for the registers used in our example.

Register name	Decimal number	Hex number
Logic Status	1	00 01
I1	5	00 02
I2	6	00 05
I3	7	00 07
Voltage	4	00 04
Ctrl-In	2	00 02
Ctrl_Out (relays)	3	00 03
Power	15	00 0F
Power Factor	17	00 11
Frequency	8	00 08

Step 2: Update the register numbers
In the Data Request area defines the following:
- Slot Number = 1
- Index = 2
- Operation = Write
- Write Data (hex) = the hex numbers in the table above

This updates the registers that are shown in DPV0.

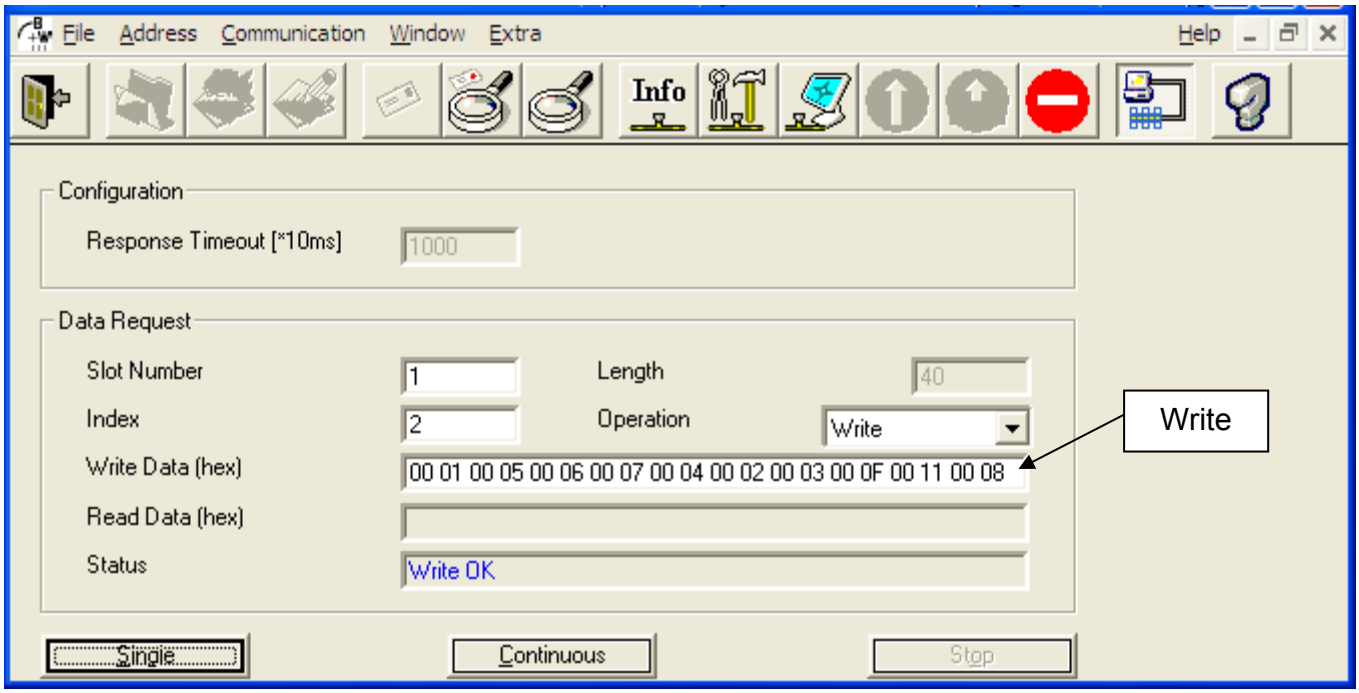


Figure 52 – Updating the register number that will show at DPV0 (by Data Request)

17.3.3.3 Reading of the DPV0 (Cyclic) Registers via Data Request (DPV1)

In the Data Request areas define the following:

- Slot Number = 1
- Index = 2
- Operation = Read

The registers in DPV0 will display in the Read Data (hex) field.

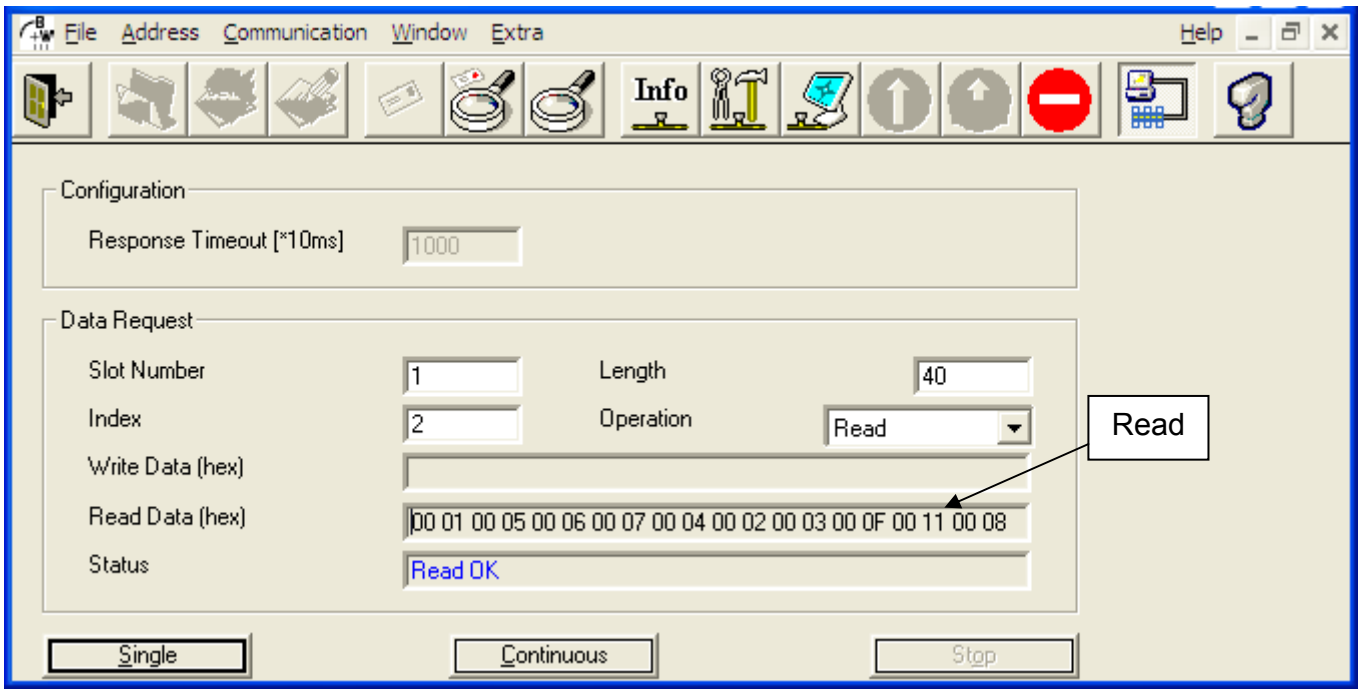


Figure 53 – Reading the register number that is shown in the DPV0 (cyclic) list

17.4 Operations that are Available in DPV1

- Choose the registers that will display in DPV0 (cyclic). This was described in the previous section.
- Read and write from random registers.

17.4.1 ***Read and Write from Random Registers via Data Request***

Reading or writing by Data Request (DPV1) allows you to read or write up to 20 registers in a single request.

In order to read or write via Data Request (DPV1) you need to perform 2 operations:
- First update the first register number that we want to read or write.
- Second read or write the register.

To configure the first register number, define the following:
- Slot Number = 1
- Index = 2
- Operation = Write
- Write Data (hex) = the first register number

The length of the register number must always contain two bytes (word). If we want to read from register number 5 we need to read from register number 0x0005. The first byte is the high part of the number (the MSB).

To read or write multiple registers, we need to define the number of the words that we want to read or write.

The following example shows how to read from register number 0x80 to register number 0x83.
Step 1: Write the number 80 hex to Slot number 2 and Index number 2.

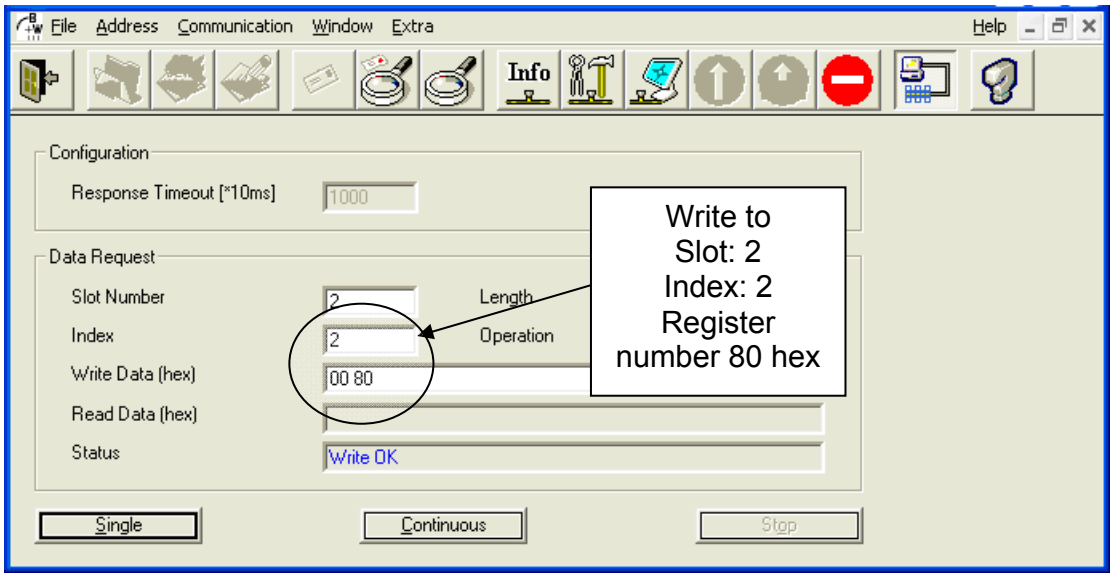


Figure 54 – Choosing register number 80 hex

Step 2: Read from Slot number 3 and Index number 2

The following eight bytes are displayed: Register number 0x80 , Register number 0x81, Register number 0x82 and Register number 0x83 (4 words = 8 bytes total)

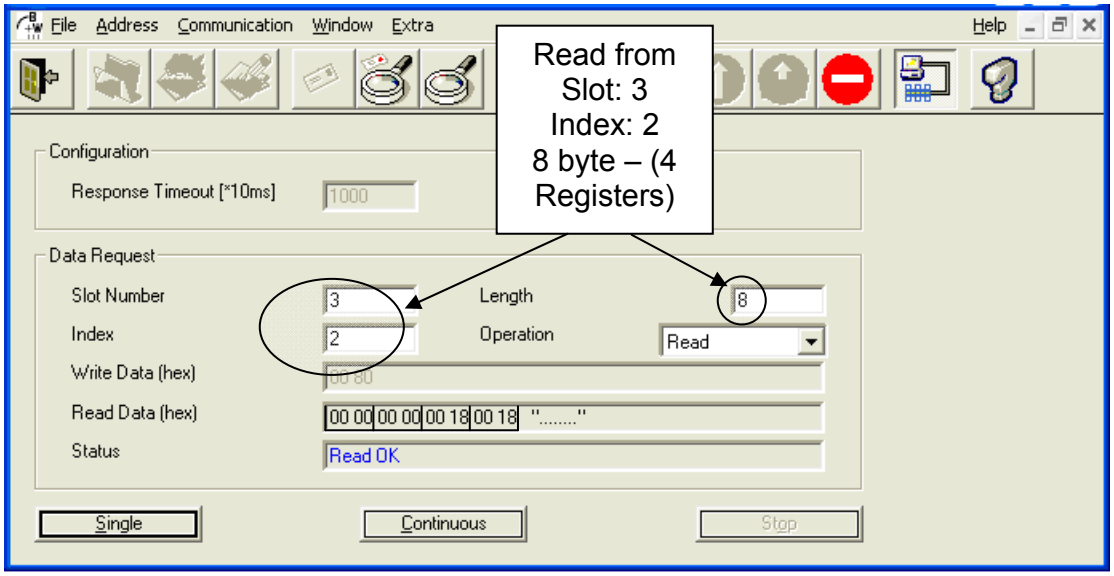


Figure 55 – Reading 4 following register by Data Request (DPV1)

17.5 Configure the PROFIBUS in the HRVS-DN

All the settings to establish PROFIBUS communication are located under the Communication menu. Follow the steps below to define the PROFIBUS in the HRVS-DN .

1. Press the MODE button until the following message appears:

   ```
   COMM. PARAMETERS
       - **** -
   ```

2. Press SELECT one time and the following message will appear:

   ```
   COMM. PROTOCOL
   PROFIBUS
   ```

   In this menu, use the up/down arrows to define that the communication will be PROFIBUS.

3. Press SELECT again and the following message will appear:

   ```
   BAUD RATE
   AUTO (PROFIBUS)
   ```

4. Press SELECT again and the following message will appear:

   ```
   PARITY CHECK
   AUTO (PROFIBUS)
   ```

5. Press SELECT again and the following message will appear:

   ```
   PROFI.NETWORK ID
   3
   ```

   In this menu, use the up/down arrows to define the PROFIBUS Address of the HRVS-DN.

6. Press SELECT again and the following message will appear:

   ```
   S.LINK PAR. SAVE
   ENABLE
   ```

   In this menu, use the up/down arrows to define whether to enable/disable writing of parameters via the PROFIBUS.

7. Press SELECT again and the following message will appear:

   ```
   SER.LINK CONTROL
   ENABLE
   ```

   In this menu, use the up/down arrows to define whether to enable/disable control via the PROFIBUS.

8. Press SELECT again a number of times until the following message appears:

   ```
   Store  Settings
   COMM. Parameters
   ```

   Pressing the STORE button stores the parameters in the HRVS-DN memory.

17.6 Watch Dog Definition

The Watch-Dog mechanism can be enabled or disabled only via the PROFIBUS controller.

When the Watch-Dog is enabled, the HRVS-DN will stop the motor when there is a break in communication between the controller and the device.

17.7 **Numbers of actual data Register for (decimal)**

Number	Parameter Name	Description
1	Logic Status	Logic status of HRVS-DN. 1 indicates: d15: HRVS-DN Tripped. d14: Motor Stopped. d13: Motor in Soft Stop Process. d12: Motor in Start Process. d11: Motor is Running. d10: Motor is running with Closed By_Pass. d9: Up_To_Speed. Like d10 and I reduced (once) below 115% of FLA. d8: Reserved. d7: Dual_Adjust On. d6..d0: Reserved. Note: After by-pass is closed, trip (d15) and running (d11), can be ON together. See Trip_after_By-Pass setting parameter at fault parameters page.
2	Hardwired inputs	Discrete Hardwired control inputs: d15..d8: Reserved. d7: External fault 2, Terminal 20. d6: External Fault 1,Terminal 19. d5: Reserved. d4: Programmable Input , Terminal 8 d3: Programmable Input, Terminal 7 d2: Start Input. Terminal 6 d1: Soft Stop Input. Terminal 5 d0: Stop Input. Terminal 4
3	Relays	d0 - Immediate, d1- End Of Acc, d2 - Fault relay
4	Voltage	Line voltage, % of rated voltage.
5	I1_amp	Current of phase 1, Ampere.
6	I2_amp	Current of phase 2, Ampere.
7	I3_amp	Current of phase 3, Ampere.
8	Reserved	
9	Dip_Switch	d15..d8: Reserved. d7: Setting Lock - (right-most) d6: Enlarged Setting Ranges d5: Language Selection. d4: Language Selection. d3: Reserved - Must be set to Off. d2: Generator Starting - Set to Off. d1: Tacho feedback available (1). d0: Min (off) / Max display pages- (left most)
10	Phase_Sequence	1: Correct Phase seq. 0 : Wrong Phase Seq.
11	Motor Insulation R	Motor Insulation Resistance [KOhm]
12	Reserved	
13	Reserved	
14	Reserved	
15	Power	Power consumption [KW]
16	Reactive Power	Reactive Power consumption [KVAR]
17	Power Factor	Power Factor * 100
18	Time Since Last Start	Elapsed minutes since last start
19	Frequency	Frequency [tenth Hz]
20	Reserved	
21	Reserved	
22	Reserved	
23	Reserved	
24	Reserved	
25	Logic Status at Power Fail	Logic Status at Control Pwr Supply turn off.
26	Total Run Time	Total Hours of Running Motor.
27	Total Starts	Total Number Of Start
28	Last start period	Duration of last start, Seconds
29	Last start peak I	Peak current during last starting process

Number	Parameter Name	Description
30	Time to start	After too many starts trip, Seconds
31	Total trips	Total number of trips
32	Last trip number	# of the fault that caused trip. # Fault 01: Over Temperature 02: Over current / Shear pin 03: Overload 04: Under Current 05: Under / No Voltage 06: Over Voltage 07: Phase Loss 08: Phase Sequence 09: Wrong Connection or Shorted SCR. 10: Long Start Time 11: Set Curve to 0 12: External Fault 1 (Input # 3) 13: External Fault 2 (Input # 4) 14: Wrong Parameters 15: Mains ON & No Start Signal 16: Too Many Starts 17: Currents Unbalance 18: Insulation 19: Ground Fault 20: Open By-Pass 21: Frequency out of range 22: Comm Port Failure 23: Set Clock 24: Coast Down Time
33	Pre Trip	Current at trip time, % of FLA
34	Reserved	
35	Reserved	
36	Reserved	
37	Reserved	
38	Reserved	
39	Thermal Capacity	Simulated winding temperature, %. 100% = trip
40	Reserved	
41	Clk Hour	Setting can be done at setting # 130
42	Clk Minute	Setting can be done at setting # 131
43	Clk Month	Setting can be done at setting # 132
44	Clk Date	Setting can be done at setting # 133
45	Clk Year	Setting can be done at setting # 134
46	Reserved	
47	KWH_LS	KWH dword parameter: LS word
48	KWH_MS	KWH dword parameter: MS word
49	KVARH_ LS	KVARH dword parameter: LS word
50	KVARH_MS	KVARH dword parameter: MS word
51	Reserved	
52	Reserved	
53	Reserved	
54	Reserved	
55	Reserved	
56	Reserved	
57	Trip Array 1	List of last 10 Trip
58	Trip Array 2	List of last 10 Trip
59	Trip Array 3	List of last 10 Trip
60	Trip Array 4	List of last 10 Trip
61	Trip Array 5	List of last 10 Trip
62	Trip Array 6	List of last 10 Trip
63	Trip Array 7	List of last 10 Trip
64	Trip Array 8	List of last 10 Trip
65	Trip Array 9	List of last 10 Trip
66	Trip Array 10	List of last 10 Trip

Number	Parameter Name	Description
67	Trip Hour Array 1	List of time (Hour) of last 10 trips
68	Trip Hour Array 2	List of time (Hour) of last 10 trips
69	Trip Hour Array 3	List of time (Hour) of last 10 trips
70	Trip Hour Array 4	List of time (Hour) of last 10 trips
71	Trip Hour Array 5	List of time (Hour) of last 10 trips
72	Trip Hour Array 6	List of time (Hour) of last 10 trips
73	Trip Hour Array 7	List of time (Hour) of last 10 trips
74	Trip Hour Array 8	List of time (Hour) of last 10 trips
75	Trip Hour Array 9	List of time (Hour) of last 10 trips
76	Trip Hour Array 10	List of time (Hour) of last 10 trips
77	Trip Minute Array 1	List of time (Hour) of last 10 trips
78	Trip Minute Array 2	List of time (Hour) of last 10 trips
79	Trip Minute Array 3	List of time (Hour) of last 10 trips
80	Trip Minute Array 4	List of time (Hour) of last 10 trips
81	Trip Minute Array 5	List of time (Hour) of last 10 trips
82	Trip Minute Array 6	List of time (Hour) of last 10 trips
83	Trip Minute Array 7	List of time (Hour) of last 10 trips
84	Trip Minute Array 8	List of time (Hour) of last 10 trips
85	Trip Minute Array 9	List of time (Hour) of last 10 trips
86	Trip Minute Array 10	List of time (Hour) of last 10 trips
87	Trip Date Array 1	List of date (day) of the last 10 trips
88	Trip Date Array 2	List of date (day) of the last 10 trips
89	Trip Date Array 3	List of date (day) of the last 10 trips
90	Trip Date Array 4	List of date (day) of the last 10 trips
91	Trip Date Array 5	List of date (day) of the last 10 trips
92	Trip Date Array 6	List of date (day) of the last 10 trips
93	Trip Date Array 7	List of date (day) of the last 10 trips
94	Trip Date Array 8	List of date (day) of the last 10 trips
95	Trip Date Array 9	List of date (day) of the last 10 trips
96	Trip Date Array 10	List of date (day) of the last 10 trips
97	Trip Month Array 1	List of date (Month) of the last 10 trips
98	Trip Month Array 2	List of date (Month) of the last 10 trips
99	Trip Month Array 3	List of date (Month) of the last 10 trips
100	Trip Month Array 4	List of date (Month) of the last 10 trips
101	Trip Month Array 5	List of date (Month) of the last 10 trips
102	Trip Month Array 6	List of date (Month) of the last 10 trips
103	Trip Month Array 7	List of date (Month) of the last 10 trips
104	Trip Month Array 8	List of date (Month) of the last 10 trips
105	Trip Month Array 9	List of date (Month) of the last 10 trips
106	Trip Month Array 10	List of date (Month) of the last 10 trips
107	Trip Year Array 1	List of date (Year) of the last 10 trips
108	Trip Year Array 2	List of date (Year) of the last 10 trips
109	Trip Year Array 3	List of date (Year) of the last 10 trips
110	Trip Year Array 4	List of date (Year) of the last 10 trips
111	Trip Year Array 5	List of date (Year) of the last 10 trips
112	Trip Year Array 6	List of date (Year) of the last 10 trips
113	Trip Year Array 7	List of date (Year) of the last 10 trips
114	Trip Year Array 8	List of date (Year) of the last 10 trips
115	Trip Year Array 9	List of date (Year) of the last 10 trips
116	Trip Year Array 10	List of date (Year) of the last 10 trips
117	Trip Pointer	Pointer of the 10 cyclic above arrays

Number	Parameter Name	Description
118-150	Reserved	
151	Actual_Data_Group_1	Group of 20 actual parameters selected by setting parameters 90..109.
152	Actual_Data_Group_2	Group of 20 actual parameters selected by setting parameters 90..109.
153	Actual_Data_Group_3	Group of 20 actual parameters selected by setting parameters 90..109.
154	Actual_Data_Group_4	Group of 20 actual parameters selected by setting parameters 90..109.
155	Actual_Data_Group_5	Group of 20 actual parameters selected by setting parameters 90..109.
156	Actual_Data_Group_6	Group of 20 actual parameters selected by setting parameters 90..109.
157	Actual_Data_Group_7	Group of 20 actual parameters selected by setting parameters 90..109.
158	Actual_Data_Group_8	Group of 20 actual parameters selected by setting parameters 90..109.
159	Actual_Data_Group_9	Group of 20 actual parameters selected by setting parameters 90..109.
160	Actual_Data_Group_10	Group of 20 actual parameters selected by setting parameters 90..109.
161	Actual_Data_Group_11	Group of 20 actual parameters selected by setting parameters 90..109.
162	Actual_Data_Group_12	Group of 20 actual parameters selected by setting parameters 90..109.
163	Actual_Data_Group_13	Group of 20 actual parameters selected by setting parameters 90..109.
164	Actual_Data_Group_14	Group of 20 actual parameters selected by setting parameters 90..109.
165	Actual_Data_Group_15	Group of 20 actual parameters selected by setting parameters 90..109.
166	Actual_Data_Group_16	Group of 20 actual parameters selected by setting parameters 90..109.
167	Actual_Data_Group_17	Group of 20 actual parameters selected by setting parameters 90..109.
168	Actual_Data_Group_18	Group of 20 actual parameters selected by setting parameters 90..109.
169	Actual_Data_Group_19	Group of 20 actual parameters selected by setting parameters 90..109.
170	Actual_Data_Group_20	Group of 20 actual parameters selected by setting parameters 90..109.

17.8 Number of Setting Registers for Data Request

17.8.1 Main & protect. parameters

Parameter	#	Range	Default
Rated Line Voltage	0	2300..15000	6600 (Volt.)
Starter FLC	1	20..1800	150 (Amp.)
Motor FLA	2	20..1800	150 (Amp.)
Rated Motor Power	3	50..40000	1000 (KW)
Service Factor	4	100..130 (% of FLA)	100 (%)
Undercurrent Trip	5	0..90	0 (% of FLA)
Undercurrent Delay	6	1..40	10 (Seconds)
Overcurrent Shear Pin	7	100..850	850 (% of FLA)
Overcurrent Delay	8	0..50	5 (0.5 Sec.)
Overload Class	9	IEC 5,10,15,20,25,30 NEMA 5,10,15,20,25,30 FLA)	IEC Class 10
Overload Protect	10	0=Disable 1=Enable While Run 2=Enable	1=Enable While Run
Unbalance Trip	11	10..100, 101 = Off	20 (%)
Unbalance Delay	12	1..60	5 (Seconds)
Ground Fault Trip	13	10..100, 101 = Off	20 (% of FLA)
Ground Fault Delay	14	1..60	5 (Seconds)
Undervoltage Trip	15	50..90	70 (%)
Undervoltage Delay	16	1..100	5 (Seconds)
Overvoltage Trip	17	110..125	120 (%)
Overvoltage Delay	18	1..10	2 (Seconds)
Reserved	20..24		

17.9 Start Parameters

Parameter	#	Range	Default
Soft_Start_Curve	24	0..11 (6..11 are for Tacho only)	1 (Standard).
Pulse Level	25	70 (%of FLA) – 700 (%of FLA)	70% of FLA
Pulse Time	26	0..10 (Tenth Seconds)	0 (No Pulse)
Initial Voltage / Initial Current	27	10..80 / 100..400 % (of FLA)	30 (% of full voltage) / 100 (% of FLA)
Current Limit	28	100..700	400 (% of FLA)
Acceleration Time	29	1..90	10 (Seconds)
Max. Start Time	30	1..250	30 (Seconds)
Number Of Starts	31	1..10 & (11 = off)	1
Starts_Period	32	1..60	20 (Minutes)
Start Inhibit	33	1..60 minutes	15 (Minutes)
Run Contact Delay / Turn Bypass On at	34	0..120 seconds / 121..250 % of Motor FLA	5 (Seconds) / Only with relay card for optional sync motor start
Min Time To Bypass	35	3..60	3 Sec Only with relay card for optional sync motor start
Reserved	36..39		

17.10 **Stop Parameters**

Parameter	#	Range	Default
Soft_Stop_Curve	40	0..11 (6..11 are for Tacho only)	1 (Standard)
Deceleration_Time	41	0..90	0 (Seconds)
Final_Torque	42	0..10	0 (Minimum)
Coast Down Delay	43	Off (9) 10..3600	9 (Off)
Reserved	43..47		

17.11 **Dual Adjust Parameters**

Parameter	#	Range	Default
DA Initial Voltage / DA Initial Current	48	10..80 % of full voltage / 100..400 % of FLA	30 / 100 % of FLA
DA Current Limit	49	100..700	400 % of FLA
DA Acceleration Time	50	1..90	10 (Seconds)
DA Deceleration Time	51	0..90	0 (Seconds)
DA Motor FLA	52	20..1800	150 (Amp.)
Reserved	53..55		

17.12 **Fault Parameters**

Parameter	#	Range	Default
UV & PL Auto_Reset	56	0..1 (0 - No, 1 - Yes)	0 (No)
Under_Current_Reset	57	10..120 (&121=off)	121 (Off)
By-Pass_Open_Trip	58	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
Trip_after_By-Pass	59	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
By-Pass_Auto_Reset	60	0 – No, 1 – Yes	0 (No)
Set_Curve_To_0	61	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
Power On & No Start	62	0 / 1 (0 – Disable,1 - Enable)	1 (Enable)
Insulation_Alarm	63	1(Off) – 100 (10 Mohm)	1 (Off)
Insulation_Trip	64	1(Off) – 100 (10 Mohm)	1 (Off)
Phase Sequence	65	0 – Pos., 1 – Neg., 2 – Ignore	0 (Positive)
Reserved	66..71		

17.13 **I/O Programming**

Parameter	#	Range	Default
Prog. Input #7 (thermal 7)	72	0..3 0 – Test 1 – Reset 2 – Multi Soft Stop - consult the factory 3 – Current Control - consult the factory	1 (Reset)
Prog. Input #8 (thermal 8)	73	0..1 (0=D.Adj.,1=Reset)	0 (Dual Adjust)
Fault Relay Type	74	0..1 (0=Fault, 1=Fault-Fail Safe)	0 (Fault)
Immediate Realy Type	75	0..1 (0=Immediate, 1=shear pin)	0 (Immediate)
Realy On Delay	76	0..3600	0 (Seconds)
Realy Off Delay	77	0..3600	0 (Seconds)
Analog output	78	0..1 (0 - Normal, 1 - Inverted)	0 (Normal)
Reserved	79		

17.14 **Communication Parameters**

Parameter	#	Range	Default
Comm. Protocol	80	0 – Modbus, 1-Profibus	1 – Profibus
Modbus Baud Rate	81	12..96 (*100)	192 (19200 bps)
Parity Check	82	0/1/2 (Even / Odd / No)	0 (Even)
Profibus_Network	83	0..126 (0-Off)	0 (Off)
S. Link Parameters Save	84	0 (Disable), 1 (Enable)	0 (Disable saving)

Parameter	#	Range	Default
Ser. Link Control	85	0 (Disable), 1 (Enable)	0 (Disable control)
Modbus Time Out	86	1..247 & (248= Off)	248 (Off)
Front Com Address	87	1..600 & (601= Off)	601 (Off) (Off) (Tenth Sec)
Reserved	88		
Modbus_#_Array	89..108	# of parameter	Defaults # are: 1 - Logic Status 5 – I1 6 – I2 7 – I3 4 – Voltage 2 – Ctrl-In 3 – Ctrl_Out (relays) 15 – Power 17 – Power Factor 19 – Frequency 10 – Phase Sequence 26 – Total Run Time 27 – Total Starts 31 – Total Trips 28 – Last Start Period 29 – Last Start Peak I 32 – Last Trip Number 33 – Pre Trip I 39 – Thermal Capacity 11 – Insulation Resistance

17.15 **Time Parameters**

Parameter	#	Range	Default
Clk Hour	130	0 – 23	Set here, Read at actual # 41
Clk Minute	131	0 – 59	Set here, Read at actual # 42
Clk Month	132	1 – 12	Set here, Read at actual # 43
Clk Day	133	1 – 31	Set here, Read at actual # 44
Clk Year	134	0 – 99	Set here, Read at actual # 45

18. HRVS-DN COMMUNICATION (DEVICENET™)

18.1 Introduction

18.1.1 ***Overview***

This is a description of the different data types that are used in the documentation of the object model. These are standard definitions of the Open DeviceNet Vendor Association (ODVA).

18.1.2 ***Definitions***

The following table has a description of all of the data types used.

USINT	Unsigned Short Integer (8-bit)
UINT	Unsigned Integer (16-bit)
UDINT	Unsigned Double Integer (32-bit)
INT	Signed Integer (16-bit)
STRING	Character String (1 byte per character)
SHORT STRING*NN*	Character String (1st byte is length; up to *NN* characters)
BYTE	Bit String (8-bits)
WORD	Bit String (16-bits)
DWORD	Bit String (32-bits)
REAL	IEEE 32-bit Single Precision Floating Point

18.1.3 ***Reference Documents***

- ODVA Volume 1: CIP Common Specification, Edition 3.2 ©2007 ODVA
- ODVA Volume 3: DeviceNet Adaptation of CIP, Edition 1.4 ©2007 ODVA

18.1.4 ***Open DeviceNet Vendor Association, Inc. (ODVA)***

ODVA is an independent supplier organization that manages the DeviceNet and EtherNet/IP specification and supports the worldwide growth of the Common Industrial Protocol (CIP).

18.1.5 ***Rotary Switch Configuration***

Two rotary switches configure the DeviceNet MacID, and one rotary switch configures the baud rate. Use a small screwdriver to change the switch settings. The NODE ADDRESS (MAC ID) rotary switches are shown in Figure 56, and the DATA RATE rotary switch is shown Figure 57.

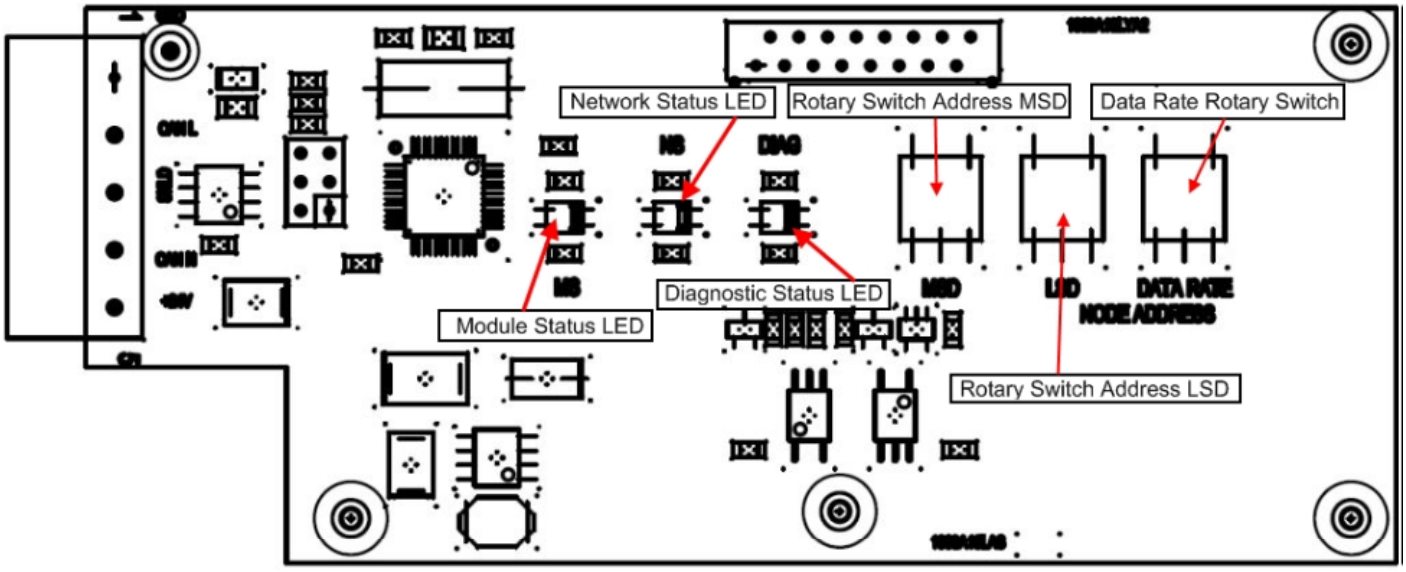


Figure 56 - MAC ID rotary switch layout

Use the NODE ADDRESS switches to select the DeviceNet MAC ID address. The valid range of addresses is 0 – 63. All combinations above 63 set the device address to the last address the device was powered up at and allow software configuration tools to modify the MAC ID address.

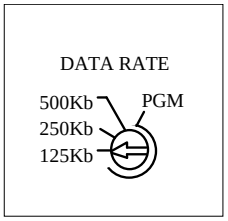


Figure 57 - Data rate (Baud rate) rotary switch layout

Rotary switch S1 (BAUD) is used to select the DeviceNet Baud Rate. The valid range of baud rates is 1 (125K), 2 (250K), 5 (500K), and P (programmable). All values P and above set the baud rate to the last baud rate the device was powered up at and allow software configuration tools to modify the baud rate.
Factory default settings for the rotary switches are typically Address 63, 125K.

18.1.6 ***LED Indicators***

The DeviceNet Gateway provides support for three LEDs: Serial Status (Modbus Diagnostic), Network Status, and Module Status. The LED on the right indicates the current Serial or Modbus Diagnostic status. The operation of the Modbus LED is described in Table 1.

Table 1 Modbus Diagnostic Status LED

Color	State	Indication
None	Off	No power
Red	Flashing	Modbus Timeout
Orange	Flashing	Modbus Error
Green	Flashing	Normal operation

The LED in the middle indicates the Network Status. The operation of the Network Status LED is described in Table 2.

Table 2 DeviceNet Network Status LED

Color	State	Indication
None	Off	No Power
Red	Solid	Unrecoverable Fault
	Flashing	Recoverable Fault I/O Connection Timed Out
Green	Solid	Normal runtime operation
	Flashing	Device is idle or not allocated to a master
Red / Green	Alternating	Identify (Offline Connection Set)

The LED on the left indicates the Module Status. The operation of the Module Status LED is described in Table 3.

Table 3 DeviceNet Module Status LED

Color	State	Indication
None	Off	No Power
Red	Solid	Unrecoverable Fault
	Flashing	Recoverable Fault
Green	Solid	Normal operation
	Flashing	Not Used
Red / Green	Alternating	Not used

18.2 Identity Object (01HEX - 1 Instance)

18.2.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.2.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Vendor Number	UINT	143DEC	Get
2	Device Type	UINT	17HEX	Get
3	Product Code Number	UINT	10840	Get
4	Product Major Revision Product Minor Revision	USINT USINT	01 01	Get
5	Status	WORD	See Below	Get
6	Serial Number	UDINT	Unique 32 Bit Value	Get
7	Product Name	SHORT STRING32	“ASTAT XT”	Get

18.2.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
05_{HEX}	No	Yes	Reset
$0E_{HEX}$	No	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single

18.3 Message Router Object (02HEX - 1 Instance)

There are no required attributes or services for the Message Router.

18.4 DeviceNet Object (03HEX - 1 Instance)

18.4.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	2	Get

18.4.2 Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Mac ID	USINT	63	Get / Set[2] [3]
2	Baud Rate	USINT	0	Get / Set[4] [3]
5	Structure of: Allocation Choice Byte Master’s Mac ID	 BYTE USINT	 0xFF 0	 Get Get
6	MAC ID Switch Changed	BOOL	0	Get
7	Baud Rate Switch Changed	BOOL	0	Get
8	MAC ID Switch Value	USINT	63	Get
9	Baud Rate Switch Value	USINT	0	Get

18.4.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single

2 When switches are used to set the MacID, the attribute is not settable over the DeviceNet network
3 Stored to NVRAM
4 When switches are used to set the Baud Rate, the attribute is not settable over the DeviceNet network

18.5 Assembly Object (04HEX – 4 Instances)

18.5.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	2	Get
2	Max Instance	UINT	112	Get
100	Input Index 60 = Instance 60 61 = Instance 61 100 = Instance 100	USINT	2	Get / Set[5]
101	Input Size (in bytes)	UINT	1	Get
102	Output Index 112 = Instance 112	USINT	0	Get / Set[6]
103	Output Size (in bytes)	UINT	1	Get

18.5.2 Output (O2T) Instance Attributes – Register 40752

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
3	Output Data	USINT[]	0	Get/Set

18.5.2.1 Output Instance 112 (0x70 – Attribute 3) – Control Output

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	1	1	0	1	0
1	Reset	Reserved	Reserved	Dual Adjust	Start/Stop Relay	Reserved	Reserved	Reserved

18.5.3 Input (T20) Instance Attributes – Register 40257

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
3	Input Data	USINT[]	0	Get

18.5.3.1 Input Instance 60 (0x3C) – Basic Softstart Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Reserved	Reserved	Reserved	Reserved	Running 1	Reserved	Faulted / Trip

18.5.3.2 Input Instance 61 (0x3D) – Extended Softstart Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Reserved	Control From Net	Ready	Running2	Running1	Warning	Faulted / Trip

5 Stored to NVRAM
6 Stored to NVRAM

18.5.3.3 Input Instance 100 (0x64) – Status

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Dual_Adjust On	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
1	HRVS-DN Tripped	Stopped	Soft Stop Process	Start Process	Running	Motor is running with Closed By_Pass	Up_To_Speed. Like d10 and I reduced (once) below 115% of FLA	Reserved

18.5.4 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	Yes	Yes	Set_Attribute_Single

18.6 Connection Object (05HEX – 2 Instances)

18.6.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.6.2 Instance Attributes (Instances 1-2) Explicit, Polled I/O

Attribute ID	Name	DeviceNet Data Type	Data	Value	Access Rule
			Instance 1[7]	Instance 2[8]	
1	State	USINT	0 = NonExistent 3 = Established 5 = Deferred Delete	0 = NonExistent 1 = Configuring 3 = Established 4 = Timed Out	Get
2	Instance Type	USINT	0	1	Get
3	Transport Trigger	usint	83_{HEX}	82_{HEX}	Get
4	Produced Connection ID	uint	$10xxxxxx011_{BIN}$ xxxxxx = Node Address	$01111xxxxxx_{BIN}$ xxxxxx = Node Address	Get
5	Consumed Connection ID	uint	$10xxxxxx100_{BIN}$ xxxxxx = Node Address	$10xxxxxx100_{BIN}$ xxxxxx = Node Address	Get
6	Initial Comm. Character	USINT	21_{HEX}	01_{HEX}	Get
7	Produced Connection Size	uint	40	4	Get
8	Consumed Connection Size	uint	40	4	Get
9	Expected Packet Rate	uint	2500 msec	0	Get / Set
12	Watchdog Timeout Action	USINT	4 = Deferred Delete	0 = Timeout	Get / Set

[7] Instance 1 is an Explicit Message Connection.
[8] Instance 2 is a Polled I/O Message Connection.

Attribute ID	Name	DeviceNet Data Type	Data	Value	Access Rule
13	Produced Connection Path Length	UINT	0	3	Get
14	Produced Connection Path	USINT Array	NULL	0x62 0x36 0x34 (0x64 = 100)	Get / Set[9]
15	Consumed Connection Path Length	UINT	0	0	Get
16	Consumed Connection Path	USINT Array	NULL	0x62 0x37 0x30 (0x70 = 112)	Get / Set[9]

18.6.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single

18.7 Softstart Object (2DHEX - 1 Instance)

18.7.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.7.2 Instance Attributes (Instance 1)

Attribute ID	Name	Data Type	Data Value	Access Rule	Modbus Register
3	AtReference	BOOL	See Below	Get	Bit 11: 40257
4	StartMode	USINT	See Below	Get / Set	Will Always be 0

18.7.2.1 Extended AtReference Values

Value	Extended AtReference Description
0	Not At Reference
1	Output At Voltage Reference

18.7.2.2 Extended StartMode Values

Value	Extended StartMode Description
0	No Voltage Ramp No Current Limit
1	Voltage Ramp No Current Limit
2	No Voltage Ramp Current Limit
3	Voltage Ramp Current Limit
4 – 9	Reserved
10 - 255	Vendor Specific

[9] Must select Assembly via Connection Object per AC/DC Drive Profile (Symbolic Segment Type) – Stored in NVRAM

18.7.3 ***Common Services***

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single

18.8 Control Supervisor Object (29HEX - 1 Instances)

18.8.1 ***Class Attributes (Instance 0)***

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.8.2 ***Instance Attributes (Instance 1)***

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule	Modbus Register
3	Run1 (Forward)	BOOL	0	Get / Set	Bit 2: 40752 Bit 8-15: 0x5A
4	Run2 (Reverse)	BOOL	0	Get / Set	Always 0
7	Running1 (Forward)	BOOL	0	Get	Bit 11: 40257
9	Ready	BOOL	0	Get	Bit 5: 40257
10	Faulted	BOOL	0	Get	Bit 15: 40257
11	Warning	BOOL	0	Get	Bit 6: 40257
15	Ctrl From Net	BOOL	1	Get	Always 1
100	Control Word	UINT	0	Get / Set	40752 (Read always 0- since register is not readable)

18.8.3 ***Common Services***

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
05_{HEX}	No	Yes	Reset
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single

18.9 Modbus / Serial Object (65HEX – 1 Instance)

18.9.1 ***Class Attributes (Instance 0)***

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.9.2 ***Instance Attributes (Instance 1)***

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Modbus Slave ID (1-247)	USINT	1	Get / Set[10]
2	Baud Rate 0 = 4800 1 = 9600 2 = 19200	USINT	2	Get / Set[10]
3	Parity 0 = 8N 1 = 8E 2 = 8O	USINT	1	Get / Set[10]
10	Timeout (milliseconds) (10ms – 60000ms)	UINT	500	Get / Set[10]

[10] Stored to NVRAM

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
100	Number of Valid Reads (since power up)	UDINT	0	Get
101	Number of Read Errors (since power up)	UDINT	0	Get
102	Number of Read Timeouts (since power up)	UDINT	0	Get
110	Number of Valid Write (since power up)	UDINT	0	Get
111	Number of Write Errors (since power up)	UDINT	0	Get
112	Number of Write Timeouts (since power up)	UDINT	0	Get

18.9.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single
32_{HEX}	No	Yes	Clear Counters

18.10 Solcon Input Object (70HEX – 1 Instance)

18.10.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.10.2 Instance Attributes (Instance 1)

Attribute ID	Name	Description	Access Rule	Modbus Address
1	Logic Status	Logic Status of HRVS-DN:	Get	40257
2	Hardwired inputs	Discrete Hardwired control inputs	Get	40258
3	Relays	d0 - Immediate,d1- End Of Acc, d2 - Fault relay	Get	40259
4	Voltage	Line voltage, % of rated voltage	Get	40260
5	I1_amp	Current of phase 1, Ampere	Get	40261
6	I2_amp	Current of phase 2, Ampere	Get	40262
7	I3_amp	Current of phase 3, Ampere	Get	40293
8	Reserved		Get	40264
9	Dip_Switch	d15..d8: Reserved. d7: Setting Lock - (right-most) d6: Enlarged Setting Ranges d5: Language Selection. d4: Language Selection. d3: Reserved - Must be set to Off. d2: Generator Starting - Set to Off. d1: Tacho feedback available (1). d0: Min (off) / Max display pages- (left most)	Get	40265
10	Phase_Sequence	1: Correct Phase seq. 0 : Wrong Phase Seq	Get	40266

Attribute ID	Name	Description	Access Rule	Modbus Address
11	Reserved		Get	40267
12	Reserved		Get	40268
13	Reserved		Get	40269
14	Reserved		Get	40270
15	Power	Power consumption [KW]	Get	40271
16	Reactive Power	Reactive Power consumption [KVAR]	Get	40272
17	Power Factor	Power Factor * 100	Get	40273
18	Time Since Last Start	Elapsed minutes since last start	Get	40274
19	Frequency	Frequency [tenth Hz]	Get	40275
20	Reserved		Get	40276
21	Reserved		Get	40277
22	Reserved		Get	40278
23	Reserved		Get	40279
24	Reserved		Get	40280
25	Logic Status at Power Fail	Logic Status at Control Pwr Supply turn off	Get	40281
26	Total Run Time	Total Hours of Running Motor	Get	40282
27	Total Starts	Total Number Of Starts	Get	40283
28	Last Start Period	Duration of Last Start, Seconds	Get	40284
29	Last Start Peak I	Current During Last Starting process	Get	40285
30	Time To Start	After Too Many Starts Trip, Seconds	Get	40286
31	Total Trips	Total Number Of Trips	Get	40287
32	Last Trip Number	Number of the fault that caused trip	Get	40288
33	Pre Trip I	Current at trip time, % of FLA.	Get	40289
34	Reserved		Get	40290
35	Reserved		Get	40291
36	Reserved		Get	40292
37	Reserved		Get	40293
38	Reserved		Get	40294
39	Thermal Capacity	Simulated winding temperature, %. 100% = trip	Get	40295
40	Reserved		Get	40296
41	Clock Hour	Real Time Hour	Get	40297
42	Clock Minute	Real Time Minute	Get	40298
43	Clock Month	Real Time Month	Get	40299
44	Clock Day	Real Time Day	Get	40300
45	Clock Year	Real Time Year	Get	40301
46	Reserved		Get	40302
47	KWH_L	KWH Low word	Get	40303
48	KWH_H	KWH High word	Get	40304
49	KVARH_L	KVARH Low word	Get	40305
50	KVARH_H	KVARH High word	Get	40306
51	Reserved		Get	40307
52	Reserved		Get	40308
53	Reserved		Get	40309
54	Reserved		Get	40310
55	Reserved		Get	40311
56	Reserved		Get	40312
57-66	Trip Array [10]	List of last 10 Trip	Get	40313-

Attribute ID	Name	Description	Access Rule	Modbus Address
				40322
67-76	Trip Hour Array [10]	List of time (Hour) of the last 10 trips	Get	40323-40332
77-86	Trip Minute Array [10]	List of time (Minute) of the last 10 trips	Get	40333-40342
87-96	Trip Day Array [10]	List of time (Day) of the last 10 trips	Get	40343-40352
97-106	Trip Month Array [10]	List of time (Month) of the last 10 trips	Get	40353-40362
107-116	Trip Year Array [10]	List of time (Year) of the last 10 trips	Get	40363-40372
117	Trip Pointer	Pointer for the 10 cyclic above arrays	Get	40373

*18.10.3 **Common Services***

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single

18.11 Main Parameter Object (71HEX – 1 Instance)

*18.11.1 **Class Attributes (Instance 0)***

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

*18.11.2 **Instance Attributes (Instance 1)***

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Rated Line Voltage	2300-15000	6600 (Volt)	Get/Set	40001
2	Starter FLC	20-1800	150 (Amp)	Get/Set	40002
3	Motor FLA	20-1800	150 (Amp)	Get/Set	40003
4	Rated Motor Power	50-40000	1000 (KW)	Get/Set	40004
5	Service Factor	100-130%	100 (%)	Get/Set	40005
6	Undercurrent Trip	0-90	0 (% of FLA)	Get/Set	40006
7	Undercurrent Delay	1-40	10 (Second)	Get/Set	40007
8	Over current Shear Pin	100-850	850 (% of FLA)	Get/Set	40008
9	Over current Delay	0-50	5 (0.5 Sec)	Get/Set	40009
10	Overload Class	IEC: 5,10,15,20,25,30 NEMA: 5,10,15,20,25,30 FLA	IEC Class 10	Get/Set	40010
11	Overload Protect	0=Disable 1=Enable While Run 2=Enable	1=Enable While Run	Get/Set	40011

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
12	Unbalance Trip	10-100, 101 = Off	20 (%)	Get/Set	40012
13	Unbalance Delay	1-60	5 (Second)	Get/Set	40013
14	Ground Fault Trip	10-100, 101 = Off	20 (% of FLA)	Get/Set	40014
15	Ground Fault Delay	1-60	5 (Second)	Get/Set	40015
16	Under voltage Trip	50-90	70 (%)	Get/Set	40016
17	Under voltage Delay	1-100	5 (Second)	Get/Set	40017
18	Overvoltage Trip	110-125	120 (%)	Get/Set	40018
19	Overvoltage Delay	1-10	2 (Second)	Get/Set	40019

18.11.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single

18.12 Start Settings Object (72HEX – 1 Instance)

18.12.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.12.2 Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Soft Start Curve	0-11 (6-11 are for Tacho only)	1 (Standard)	Get/Set	40025
2	Pulse Level	70 (%of FLA) – 700 (%of FLA)	70% of FLA	Get/Set	40026
3	Pulse Time	0-10 (Tenth Seconds)	0 (No Pulse)	Get/Set	40027
4	Initial Voltage/ Initial Current	10-80 / 100-400 % of FLA	100 % of FLA	Get/Set	40028
5	Current Limit	100-700	400 (% of FLA)	Get/Set	40029
6	Acceleration Time	1-90	10 (Seconds)	Get/Set	40030
7	Max. Start Time	1-250	30 (Seconds)	Get/Set	40031
8	Number Of Starts	1-10 & (11 = off)	1	Get/Set	40032
9	Starts Period	1-60	20 (Minutes)	Get/Set	40033
10	Start Inhibit	1-60 minutes	15 (Minutes)	Get/Set	40034
11	Run Contact Delay	0-120 seconds	5 (Seconds)	Get/Set	40035

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
12	Turn Bypass On at	121-250 % of Motor FLA	Only with relay PCB for optional sync motor start	Get/Set	40036
13	Min Time To Bypass	3-60	3 Sec	Get/Set	40037

18.12.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single

18.13 Stop Settings Object (73HEX – 1 Instance)

18.13.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.13.2 Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Soft Stop Curve	0-11 (6-11 are for Tacho only)	1 (Standard)	Get/Set	40041
2	Deceleration Time	0-90	0 (Seconds)	Get/Set	40042
3	Final Torque	0-10	0 (Minimum)	Get/Set	40043
4	Coast Down Delay	Off (9) 10-3600	9-(Off)	Get/Set	40044

18.13.3 Common Services

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single

18.14 Dual Settings Object (74HEX – 1 Instance)

18.14.1 Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.14.2 Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	DA: Initial Voltage / DA: Initial Current	10-80 % of full voltage / 100-400 % of FLA	30 / 100 % of FLA	Get/Set	40049
2	DA: Current Limit	100-700	400 % of FLA	Get/Set	40050
3	DA: Acceleration Time	1-90	10 (Seconds)	Get/Set	40051

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
4	DA: Deceleration Time	0-90	0 (Seconds)	Get/Set	40052
5	DA: Motor FLA	20-1800	150 (Amp.)	Get/Set	40053

18.14.3 ***Common Services***

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single

18.15 Fault Settings Object (76HEX – 1 Instance)

18.15.1 ***Class Attributes (Instance 0)***

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	1	Get

18.15.2 ***Instance Attributes (Instance 1)***

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	UV & PL Auto Reset	0/1 (0 - No, 1 - Yes)	0 (No)	Get/Set	40057
2	Under Current Reset	10-120 (&121-off)	121 (Off)	Get/Set	40058
5	ByPass Open Trip	0/1 (0-Disable, 1-Enable)	1 (Enable)	Get/Set	40059
6	Trip after Bypass	0/1 (0-Disable, 1-Enable)	1 (Enable)	Get/Set	40060
7	By-Pass Auto Reset	0/1 (0 - No, 1 - Yes)	0 - No	Get/Set	40061
8	Set Curve 0 Flt	0/1 (0-Disable, 1-Enable)	1 (Enable)	Get/Set	40062
9	Power On & No Start	0/1 (0-Disable, 1-Enable)	1 (Enable)	Get/Set	40063
10	Insulation Alarm	1(Off) – 100 (10Mohm)	1 (Off)	Get/Set	40064
11	Insulation Trip	1(Off) – 100 (10Mohm)	1 (Off)	Get/Set	40065
12	Phase Sequence	0–Pos, 1–Neg, 2–Ignore	0 (Positive)	Get/Set	40066

18.15.3 ***Common Services***

Service Code	Implemented for		Service Name
	Class Level	Instance Level	
$0E_{HEX}$	Yes	Yes	Get Attribute Single
10_{HEX}	No	Yes	Set Attribute Single

19. PARAMETERS LIST

Parameter	Default setting	Range Range w/dip switch #7=ON	Set 1	Set 2	Set 3	Set 4
MAIN & PROTECT	**Refer to section 7.8.2 page 55**					
RATED LINE VOLT.	6600 VOLT.	2300-15000 VOLT.				
STARTER FLC	150 AMP.	20 – 1800 AMP.				
MOTOR FLA	150 AMP.	33-100% of STARTER FLC				
RATED MOTOR PWR	1000KW	50-40000KW				
SERVICE FACTOR	100%	100-130%				
UNDERCURR. TRIP	0% OF FLA	0 = OFF, 20-90% of FLA				
UNDERCURR. DELAY	10 SEC.	1-40 SEC.				
O/C – SHEAR PIN	850% OF FLA	100 – 850% OF FLA				
O/C DELAY	0.5 SEC.	0.0 - 5 SEC.				
OVERLOAD CLASS	IEC CLASS 10	IEC CLASS 5, 10, 15, 20, 25, 30 NEMA CLASS 5, 10, 15, 20, 25, 30				
OVERLOAD PROTECT	ENABLE WHILE RUN	DISABLE, ENABLE WHILE RUN, ENABLE				
UNBALANCE TRIP	20% OF FLA	OFF/10-100% OF FLA				
UNBALANCE DELAY	5 SEC.	1-60 SEC.				
GND FAULT TRIP	20% OF FLA	OFF/ 10-100%				
GND FAULT DELAY	5 SEC.	1-60 SEC.				
UNDERVOLT. TRIP	70% OF Vn	50-90% OF Vn.				
UNDERVOLT. DELAY	5 SEC.	1-10 SEC.				
OVERVOLT TRIP	120% OF Vn.	110-125% OF Vn				
OVERVOLT DELAY	2 SEC.	1-10 SEC.				
START PARAMETERS	**Refer to section 7.8.3 page 60**					
SOFT START CURVE	1 (STANDARD)	0 (BASIC)= Basic 1 (STANDARD)= Standard Curve 2!! = Pump Control Curve # 1 3!! = Pump Control Curve # 2 4!! = Pump Control Curve # 3 5 (RORQUE) = Torque Control				
START TACHO. GAIN When setting Dip sw. # 2 On for Tacho Mode Note: Tacho Feedback functions in its basic form. Additional curves except for the basic Linear curve are optional. Consult the factory for correct tacho selection and mechanical installation.	0 (MIN. GAIN)	0 (MIN. GAIN)= Minimum gain tacho control 1!! = Second level Tacho gain 2!! = Third level Tacho gain 3!! = Fourth level Tacho gain 4!! = Fifth level Tacho gain 5!! = Sixth level Tacho gain				
PULSE LEVEL	70% OF FLA	70-700% OF FLA. If PULSE TIME>1sec 400% 70-700% OF FLA. If PULSE TIME>1sec, with the maximum limitation of: 440x(FLC/FLA)				
PULSE TIME	0.0 SEC.	0-10 SEC.				
INITIAL VOLTAGE or INITIAL CURRENT	30% or 100%	10-50% of Vn or 100-400% of motor FLA 5-80% of Vn or 100-400% of motor FLA				
CURRENT LIMIT	400% OF FLA	100-400% of motor FLA. 100-700% of motor FLA. With the maximum limitation of: 440x(FLC/FLA)				
ACC. TIME	10 SEC.	1-30 SEC. 1-90 SEC.				
MAX. START TIME	30 SEC.	1-30 SEC. 1-250 SEC.				
NUMBER OF STARTS	1	1-10, OFF.				
STARTS PERIOD	20 MIN.	1-60 MIN.				
START INHIBIT	15 MIN.	1-60 MIN.				
RUN CONTACT DLY	5 SEC.	0-120 SEC.				
TURN BYPASS ON AT *	120% OF FLA	120-300% OF FLA				
MIN TIME TO BYPS *	3 SEC.	3-60 SEC.				
* Only displays if optional relay PCB is installed and pressing ▲ key for 10 seconds when RUN CONTACT DLY parameters reaches maximum.						

Parameter	Default setting	Range Range w/dip switch #7=ON	Set 1	Set 2	Set 3	Set 4
STOP PARAMETERS	**Refer to section 7.8.4 page 67**					
SOFT STOP CURVE	1 (STANDARD)	0 (BASIC) = Basic 1 (STANDARD)= Standard Curve 2!! = Pump Control Curve # 1 3!! = Pump Control Curve # 2 4!! = Pump Control Curve # 3 5 (TORQUE) = Torque Control				
STOP TACHO. GAIN When setting Dip sw # 2 On for Tacho Mode, Note: Tacho Feedback functions in its basic form. Additional curves except for the basic Linear curve are optional. Consult the factory for correct tacho selection and mechanical installation.	0 (MIN. GAIN)	0 (MIN. GAIN)= Minimum gain tacho control 1!! = Second level tacho gain 2!! = Third level tacho gain 3!! = Fourth level tacho gain 4!! = Fifth level tacho gain 5!! = Sixth level tacho gain				
DEC. TIME	0 SEC.	0-30 SEC. 0-90 SEC.				
FINAL TORQUE	0 (MIN)	0 (MIN.)– 10 (MAX.)				
COAST DOWN DELAY	OFF	OFF, 10-3600 SEC.				
DUAL ADJUSTMENT PARAMETERS	**Refer to section 7.8.5 page 70**					
DA: INIT. VOLT or DA: INIT. CURRENT	30% or 100%	10-50% of Vn or 100-400% of motor FLA 5-80% of Vn or 100-400% of motor FLA				
DA: CUR. LIMIT	400% OF FLA	100-400% of motor FLA. 100-700% of motor FLA. With the maximum limitation of: 440x(FLC/FLA)				
DA: ACC. TIME	10 SEC.	1-30 SEC. 1-90 SEC.				
DA: DEC. TIME	0 SEC.	0-30 SEC. 0-90 SEC.				
DA: MOTOR FLA	150 AMP	33-100% of STARTER FLC				
FAULT PARAMETERS	**Refer to section 7.8.6 page 71**					
UV & PL AUTO RST	NO	YES/NO				
UNDER CUR. RESET	OFF	10-120 MIN. / OFF				
BYPASS OPEN TRIP	ENABLE	ENABLE / DISABLE				
TRIP AFTER BYPAS	ENABLE	ENABLE / DISABLE				
BY-PASS AUTO RST	NO	YES/NO				
SET CURVE 0 FLT	ENABLE	ENABLE / DISABLE				
PWR ON & NO STRT	ENABLE	ENABLE / DISABLE				
INSULATION ALARM	OFF	OFF/ 0.2-20Mohm				
INSULATION TRIP	OFF	OFF/ 0.2-20Mohm				
PHASE SEQUENCE	POSITIVE	POSITIVE/NEGATIVE/IGNORE				
I/O PROGRAMMING PARAMETERS	**Refer to section 7.8.7 page 73**					
PROG. INPUT #7	RESET	TEST/ RESET/MULTI SOFT STOP (MULTI SOFT STOP with optional software only)				
PROG. INPUT #8	DUAL ADJUSTMENT	DUAL ADJUSTMENT/RESET				
FAULT RELAY TYPE	FAULT	FAULT/FAULT – FAIL SAFE				
IMM. RELAY TYPE	IMMEDIATE	IMMEDIATE/# STRTS PREALRM				
RELAY ON DELAY	0 SEC.	0.0-3600 SEC.				
RELAY OFF DELAY	0 SEC.	0.0-3600 SEC.				
ANALOG OUTPUT	RELATIVE CURRENT	RELATIVE CURRENT/RELATIVE POWER				
COMM. PARAMETERS MODBUS	**Refer to section 7.8.8 page 75**					
COMM. PROTOCOL	MODBUS	MODBUS/PROFIBUS/DEVICENET				
BAUD RATE	19200(MODBUS)	1200/2400/4800/9600/19200				
PARITY CHECK	EVEN	EVEN/ODD/NO				
SERIAL LINK NO.	OFF	OFF/1-247				

Parameter	Default setting	Range Range w/dip switch #7=ON	Set 1	Set 2	Set 3	Set 4
S.LINK PAR. SAVE	DISABLE	ENABLE/DISABLE				
SER. LINK CONTROL	DISABLE	ENABLE/DISABLE				
MODBUS TIME OUT	OFF	0.1-60/OFF				
FRONT COM ADDRES	OFF	OFF/1-247				
COMM. PARAMETERS PROFIBUS	**Refer to section 7.8.9 page 75**					
COMM. PROTOCOL	PROFIBUS	MODBUS/PROFIBUS/DEVICENET				
BAUD RATE	AUTO(PROFIBUS)					
PROFI.NETWORK ID	126	OFF/1-126				
S.LINK PAR. SAVE	DISABLE	ENABLE/DISABLE				
SER. LINK CONTROL	DISABLE	ENABLE/DISABLE				
MODBUS TIME OUT	OFF					
FRONT COM ADDRES	OFF	OFF/1-247				
COMM. PARAMETERS DEVICENET	**Refer to section 7.8.9 page 76**					
COMM. PROTOCOL	DEVICENET	MODBUS/PROFIBUS/DEVICENET				
BAUD RATE	AUTO					
PARITY CHECK	AUTO	OFF/1-126				
DEVICENET ID	SET MANUALLY	1-63/ SET MANUALLY				
S.LINK PAR. SAVE	DISABLE	ENABLE/DISABLE				
SER. LINK CONTROL	DISABLE	ENABLE/DISABLE				
MODBUS TIME OUT	OFF					
FRONT COM ADDRES	OFF	OFF/1-247				
STATISTICAL DATA	**Refer to section 7.8.11 page 77**					
T SINCE LST STRT						
LAST STRT PERIOD						
LAST START MAX I.						
TOTAL RUN TIME						
TOTAL # OF START						
TOTAL ENERGY						
TOTAL R. ENERGY						
LAST TRIP						
TRIP CURRENT						
TOTAL # OF TRIPS						
PREVIOUS TRIP -1						
PREVIOUS TRIP -2						
PREVIOUS TRIP -3						
PREVIOUS TRIP -4						
PREVIOUS TRIP -5						
PREVIOUS TRIP -6						
PREVIOUS TRIP -7						
PREVIOUS TRIP -8						
PREVIOUS TRIP -9						

20. GENERAL INFORMATION:

Supply Voltage .....Line to Line 2,300V, 3,300V, 4,160V, 6,000V, 6,600V, 6,900V, 11,000V, 13,800V, 15,000V (consult the factory for other voltages) + 10%-15%

P.I.V ratings.....Not less than 3 times rated voltage

Frequency .....45 – 65 Hz (with frequency automatically change)

Control Supply.....110-230V 50/60Hz(to be specified) +10% - 15%
110VDC, 125VDC, 220VDC (to be specified) +10% - 15%

Control inputs & Outputs .....Either same as Control Supply or by special order 24-230V AC/DC (to be specified)

Load .....Three phases, three wire, squirrel cage induction motor.
Synchronous motor with asynchronous starting characteristics.

Start-Stop Parameters:

Starter FLC.....Starter Full Load Current according to Selector Guide

Motor FLA.....Motor Full Load Ampere 33-100% of starter FLC

Pump Control Curves .....6 field selectable curves including torque control curve preventing over-pressure during start and water hammer during stop.

Pulse Start Level and Duration..Adjustable level of pulse, for an adjustable time 0-10 Sec, for starting high friction loads or holding constant current level.

Initial Voltage.....10-50% Un (*5-85%)

Initial Current .....for current ramp

Current Limit.....100-400% of Motor FLA (*100-700%)

Acceleration Time.....1-30 Sec (*1-90 sec)

Deceleration Time .....0-30 Sec (*0-90 sec)

Dual Adjustments .....Secondary start stop characteristic for: Motor FLA, Initial Voltage, Current Limit, Acceleration Time and Deceleration Time.

Tacho and Linear Acceleration..12 field selectable curves – defining Tacho Feedback gain improving linearity.

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, where starting is prevented, after too many starts fault.

Long start time (Stall protection)Maximum allowable starting time 1-30 sec. (*1-250 Sec).

Over current (Shear-pin).....Two operation functions: during starting trips the starter at 850% and during running at 100-850% In, both within 1 Cycle.

Electronic overload……..According to IEC class 5, 10, 15, 20, 25 or 30 OR according to NEMA class 5, 10, 15, 20, 25 or 30.

Under current .....Trips when current drops below 20-90% In with time delay of 1-40 sec.

Under voltage** .....Trips when main voltage drops below 50-90% of Un. Time delay 1-10 Sec

Over voltage .....Trips when main voltage increases above 110-125% of Un.
Time delay of 1-10 sec.

Phase loss.....Trips when one or two phases are missing.

Phase sequence****. .....Trips when phase sequence is wrong.

Wrong connection & Shorted SCR…

Prevents starting, trips if motor is not connected / incorrectly connected to the starter or in case one or more SCRs have been shorted.

Heat-sink over temp. .....Trips when heat-sink temperature rises above 85˚C.

External fault 1 .....Trips when an external contact closes for 2 sec.

External fault 2 .....Trips when an external contact closes for 2 sec.

Unbalance Current. .....Trips when Current Unbalance exceeds preset value for more than "Unbalance delay"

Ground Fault Current.....Trips when Ground Fault Current exceeds preset level for more than "Gnd Fault Delay"

Power ON & No Start****.....Trips when three phases voltage is connected to the soft-starter input and start signal was not issued for more than 30 seconds.

By-Pass Open ****.....Trips if the Bypass Contactor and one or two if its phases did not close.

* Special settings, extended range

** With optional Auto Reset

*** Future enhancement

**** Can be disable

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

Communication .....RS 485 with MODBUS or PROFIBUS or DeviceNet protocols

Temperatures.....Operating -10˚ to 50˚C

Storage -20˚ to 70˚C

Enclosure:

Degree of Protection.....IP 00 - Chassis type
IP 32 - Standard
IP 54 – Optional

Paint .....RAL 7032 – standard
Other colors - optional

Normal Service Conditions:

Altitude .....Should not exceed 1000m.
Consult the factory for equipment to be used at higher altitudes.

Humidity .....95% Non condensed

Starter Consumption Ratings (for IP00 OEM Kit)

Peak consumption.....350VA during start process and less than 20 VA otherwise