

STELLAR[™] SR44 SOFT STARTER USER MANUAL

SR44-M-WO
1st Edition, Revision A



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⚡ WARNING ⚡



The owner, installer, and user are responsible for the correct installation and use of the Stellar™ SR44, for ensuring that only qualified personnel install the SR44, and for ensuring that the operation and maintenance of the unit complies with the relevant Codes of Practice, Regulations, and Statutory Requirements. The manufacturer or his agent do not assume any expressed or implied liability for any consequences resulting from inappropriate, negligent, or incorrect installation, application, use, or adjustment of the product or circuit design, or from the mismatch of the unit to a motor. To prevent an electrical shock hazard, the SR44 must be properly grounded. The SR44 is not designed for use in hazardous areas. Use in such an area may invalidate the hazardous area certification.



WARNING: Read this manual thoroughly before using Stellar™ SR44 Series Soft Starters.



WARNING: The SR44 uses semiconductor devices in the main (power) circuit, and is not designed to provide isolation. For this reason, isolation device(s) must be installed in the power supply circuit in accordance with the applicable wiring and safety regulations.



WARNING: AC input power must be disconnected before performing any maintenance. Do not connect or disconnect wires or connectors while power is applied to the circuit. Maintenance must be performed only by a qualified technician.



WARNING: There are highly sensitive electronic components on the printed circuit boards, and these components are especially sensitive to static electricity. To avoid damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.



WARNING: Always replace the cover panel on the unit after gaining access to the electrical connections.



WARNING: The SR44 may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the SR44 output terminals T1, T2, and T3 directly to the AC main circuit power supply.



WARNING: Ground the SR44 soft starter using the ground terminal. The grounding method must comply with the laws of the country where the SR44 is to be installed. Refer to Chapter 2, "Electrical Installation".

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STELLAR™ SR44 SOFT STARTER USER MANUAL



Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

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Issue	Date	Description of Changes
First Edition	01/2011	Original Issue
1st Ed, Rev A	09/2011	Ch2: Bypass Control & external CT (2.4.1 & 2.5.2); Fuse and Current Ratings (2.10.1 & 2.10.2) Ch5: Modified parameter explanations, especially with regard to Auto Jog, Optimise +, bypass operation, and current-related features

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MECHANICAL INSTALLATION



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Manual Overview

Overview of this Publication

The SR44 Soft Starter User Manual describes the installation, configuration, and methods of operation of the SR44 Soft Starter.

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the SR44 Soft Starters.

Supplemental Publications

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

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Special Symbols



When you see the “notepad” icon in the left-hand margin, the paragraph to its immediate right will be a special note.



When you see the “exclamation mark” icon in the left-hand margin, the paragraph to its immediate right will be a WARNING. This information could prevent injury, loss of property, or even death (in extreme cases).

1 – Mechanical Installation

1.1 – Mounting

Mount the unit to a flat, vertical surface using the mounting holes (or slots) on its base-plate. The mechanical outline diagrams, shown in the “Mechanical Outline” section (1.9), give the dimensions and mounting hole positions for each model. Ensure that:

- The orientation of the unit has the “TOP” uppermost .
- The location allows adequate front access.
- You can view the alphanumeric display.

1.2 – Requirements for an Enclosure

For a typical industrial environment, an enclosure should provide the following:

- A single location for the unit and its protection/isolation switch-gear.
- The safe termination of cabling and/or bus-bars.
- Means to effect proper air flow through the enclosure.

1.3 – Ventilation

The installer must ensure that the enclosure can maintain the operating temperature below 40 °C (104 °F), or with derating 60 °C (140 °F). To ensure that the unit operates within a suitable temperature range, periodically measure the internal temperature of the enclosure. If you situate the unit above equipment that generates a significant amount of heat, reduce the unit full load rating.

1.4 – Storage and Derating

Above 40 °C (104°F), derate linearly by 2% of unit FLC / °C to maximum of 40% at 60 °C (140°F).

Temperature	Minimum	Maximum
Storage, continuous	-25 °C [-13 °F]	+60 °C [140 °F]
Storage, not exceeding 24 hours	-25 °C [-13 °F]	+75 °C [167 °F]
Operating (without derating) *	0 °C [32 °F]	+40 °C [104 °F]
Operating (with maximum derating) *	0 °C [32 °F]	+60 °C [140 °F]
* Above 40 °C (104°F), derate linearly by 2% of unit FLC / °C to maximum of 40% at 60 °C (140°F). [Unit FLC = Soft Starter rated Full Load Current; NOT motor Full Load Current.]		

Humidity
Max. 85% non-condensing, not exceeding 50% at 40 °C [104 °F]

1.5 – Altitude

Condition	Maximum Height Above Sea Level
Operating (without derating)	1000m [3281 ft]
Operating (with maximum derating)	2000m [6562 ft]
<i>Derating: Above 1000m (3281 ft), derate linearly by 1% Unit FLC per 100m to a maximum of 2000m (6562 ft).</i>	

1.6 – Assisted Flow

An enclosure may need additional fans to maintain the required air temperature immediately surrounding the unit. This temperature is referred to as the Ambient Temperature. Use the following formula to determine whether or not fan(s) are required. An allowance has been incorporated into the formula so that the figure for “Q” should be the air delivery quoted in the fan supplier’s data.

$$Q = (4 \times Wt) / (t_{max} - t_{amb})$$

- Q = required volume of air in cubic meters per hour (m³/h)
- Wt = heat produced by the unit and all other heat sources within the enclosure in Watts (W)
- t_{max} = maximum permissible temperature within the enclosure (°C)
- t_{amb} = temperature of the air entering the enclosure (°C)

(If you prefer to work in CFM, substitute °F for °C.)

Refer to the table in section 1.7 for the heat produced by the SR44, and note that the heat figure (Wt) is the total heat produced by everything within the enclosure.

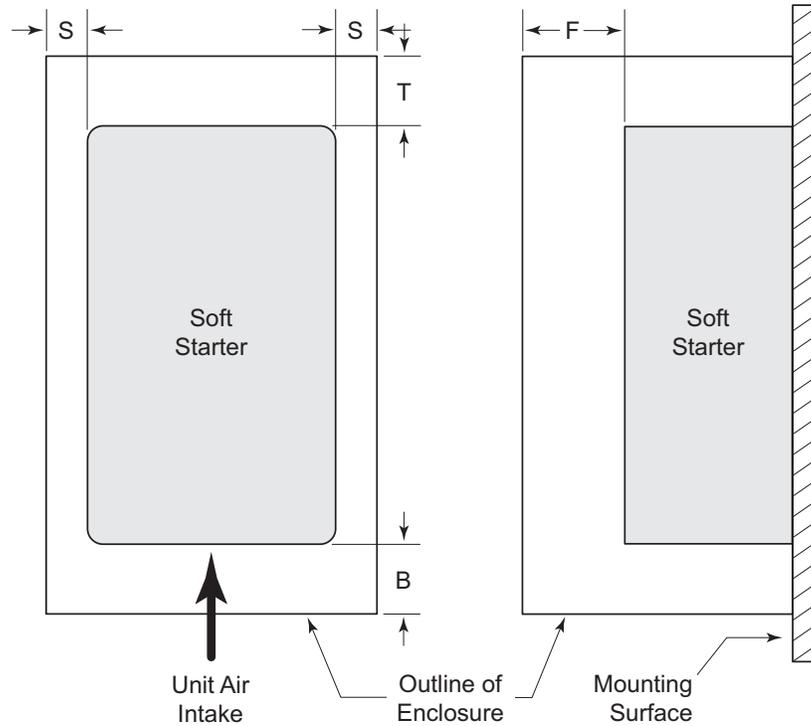
1.7 – Heat Output of Units

[At rated operational current, I_e, unit Full Load Current (FLC).]

SR44 Approximate Heat Output (non-bypass)			
Chassis Size 1		Chassis Size 2	
Model #	Heat Output (W)	Model #	Heat Output (W)
SR44-9	30	SR44-174	520
SR44-16	45	SR44-202	610
SR44-23	60	SR44-242	650
SR44-30	90	SR44-300	850
SR44-44	120	SR44-370	970
SR44-59	155		
SR44-72	210		
SR44-85	220		
SR44-105	275		
SR44-146	440		

1.8 – Clearance

To maintain adequate ventilation, each model of SR44 Soft Starter requires a minimum clearance to adjacent equipment and partitions. These clearances are specified in the following diagram and table.

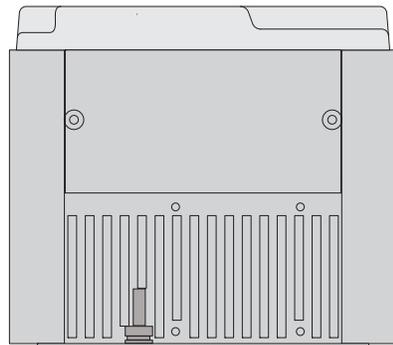
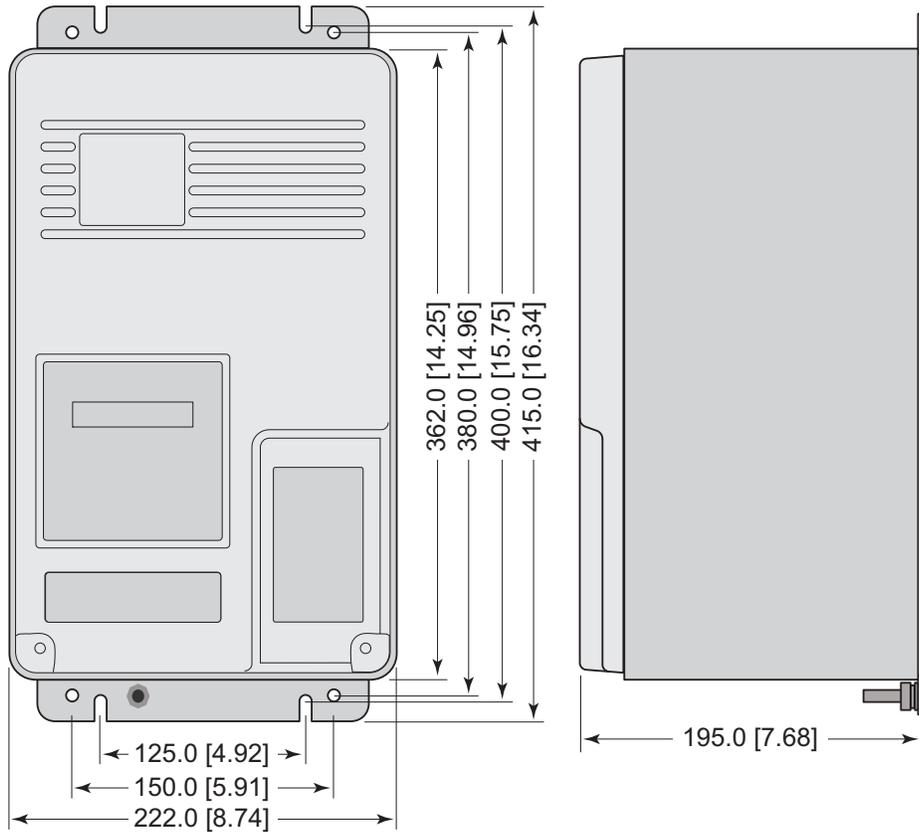


Minimum Clearance for Heat Dissipation

SR44 Mounting Clearances					
Model Number	Unit Cooling Method	Minimum Clearance (mm [in])			
		Top (T)	Bottom (B)	Side (S)	Front (F)
SR44-9 to SR44-23	Natural Convection	75 [2.95]	75 [2.95]	15 [0.59]	25 [0.98]
SR44-30 to SR44-370	Forced Air with internal cooling fan inside each starter				

1.9 – Mechanical Outline – Chassis Size 1

SR44-9 to SR44-146



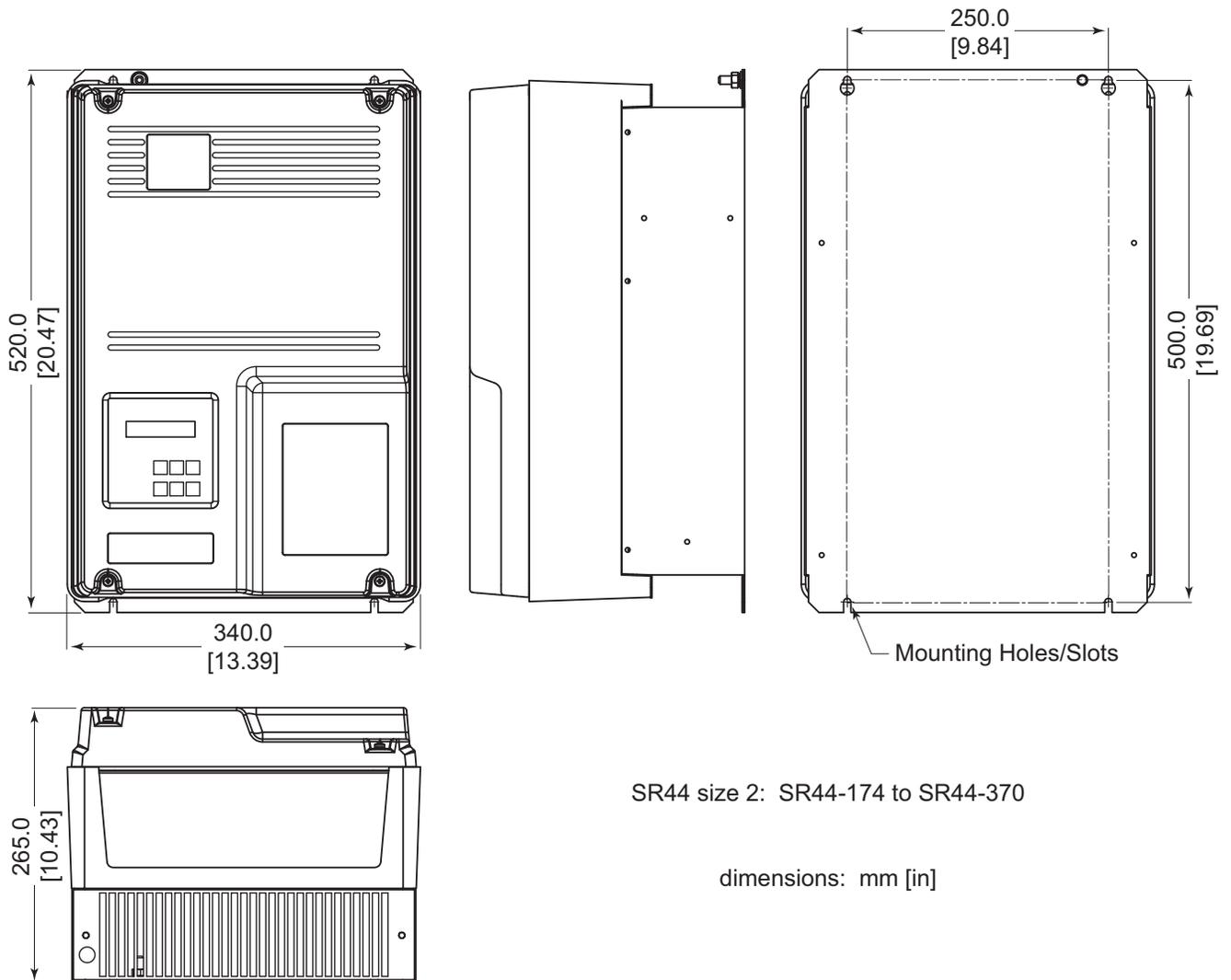
SR44 size 1: SR44-9 to SR44-146

dimensions: mm [in]

SR44 Chassis Size 1 Mounting Specifications			
Model Number	Mass/Weight (kg [lb])	Unit Mounting Holes	
		Top	Bottom
SR44-9 to SR44-44	7.3 [16]	(2) holes & (2) slots suitable for M6 or 1/4" fittings	(2) holes & (2) slots suitable for M6 or 1/4" fittings
SR44-59 to SR44-146	8.3 [18]	(2) holes & (2) slots suitable for M6 or 1/4" fittings	(2) holes & (2) slots suitable for M6 or 1/4" fittings

1.10 – Mechanical Outline – Chassis Size 2

SR44-174 to SR44-370



SR44 Chassis Size 2 Mounting Specifications			
Model Number	Mass/Weight (kg [lb])	Unit Mounting Holes	
		Top	Bottom
SR44-174 to SR44-202	16 [35]	(2) keyholes suitable for M6 or 1/4" fittings	(2) open slots suitable for M6 or 1/4" fittings
SR44-242 to SR44-370	22 [49]		

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**ELECTRICAL
INSTALLATION**



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2.1 – Warnings & Agency Approvals

2.1.1 – Isolation



Caution: The SR44 uses semiconductor devices in the main circuit, and is not designed to provide isolation. For this reason isolation means must be installed in the power supply circuit in accordance with the appropriate wiring and safety regulations.

2.1.2 – Electrical Power and Control Supply Requirements



All electrical connections are made to power input and output terminals, control terminals, and a ground stud. Before you apply control voltage to the control supply terminals, ensure that the control voltage selector switch is set to the correct voltage being used. (The diagrams in section 2.5 show the location of this selector switch.) Make electrical connections only to those terminals specified. If you connect to other terminals, then you may cause damage to the SR44 internal control circuitry.



Do NOT install power factor correction capacitors on the output side of the SR44.

2.1.3 – Access



Caution: Always replace the cover on the Soft Starter after gaining access to the electrical connections.

2.1.4 – Fuse Protection



The Main Supply and the Control Supply each require protection. Although all units have electronic overload protection for the Soft Starter, the installer should always install fuses for motor protection between the Soft Starter and the Main Supply; NOT between the Soft Starter and the motor.



Semiconductor fuses can be supplied as an option for short-circuit protection of the semiconductors. These fuses must be installed externally to the SR44 chassis to comply with UL standards. Chassis size 2 has the capability of installing fuses internally by replacing the fuse links in the power circuit. It is the responsibility of the installer and system designer/specifier to ensure that the required standards or regulations are not affected by so doing.

2.1.5 – Agency Approvals

- CE
- RoHS
- UL – E333109

2.2 – Electrical Connections - Specifications

2.2.1 – Electrical Supplies

The SR44 requires two AC electrical power sources:

- 1) A balanced 3-phase main source to provide the power for the controlled motor.
- 2) A single-phase supply: 115V or 230V, 50Hz/60Hz, for the internal control circuitry.



The unit will not operate unless the control supply voltage is within the specified limits. We recommend that the control supply be maintained between starts to ensure overload integrity, since the overload will reset on control supply removal.

2.2.2 – Control, Power, and Ground Terminations

Control Terminal Specifications

SR44 Control Terminal Specifications							
Terminals	Terminal Type	Wire Type	Cable Cross Section				Tightening Torque
			AWG		mm ²		
			Min	Max	Min	Max	
X1, X2 S0, S1 11, 12, 14 21, 22, 24	screw clamp terminals with captive screws	solid or stranded	22	14	0.3	2.5	4.4 lb·in [0.5 N·m]

Power and Ground Terminal Specifications

SR44 Power and Ground Terminal Specifications								
Soft Starter Model	Terminals		Terminal Type	Conductor Type	Cable Cross Section *		Bus-bar *	Tightening Torque
					AWG	mm ²		
Size 1: SR44-9 to SR44-146	Power	L1, L2, L3 T1, T2, T3	M8 metric threaded studs	Use 75 °C copper (CU) conductor only, and the wire shall be installed with eyelet lug	1/0	50	n/a	106 lb·in [12 N·m]
	Ground	PE						
Size 2: SR44-174 to SR44-370	Power	L1, L2, L3 T1, T2, T3	M8 metric threaded studs	Use 75 °C copper (CU) conductor only, and the wire shall be installed with eyelet lug, or use busbar	2 x 250 MCM	2 x 120	20 x 6	106 lb·in [12 N·m]
	Ground	PE						

** The indicated conductor sizes are the maximum allowed by UL for each chassis size. The actual conductors used must comply with local wiring regulations*

2.3 – Standard Wiring Configurations

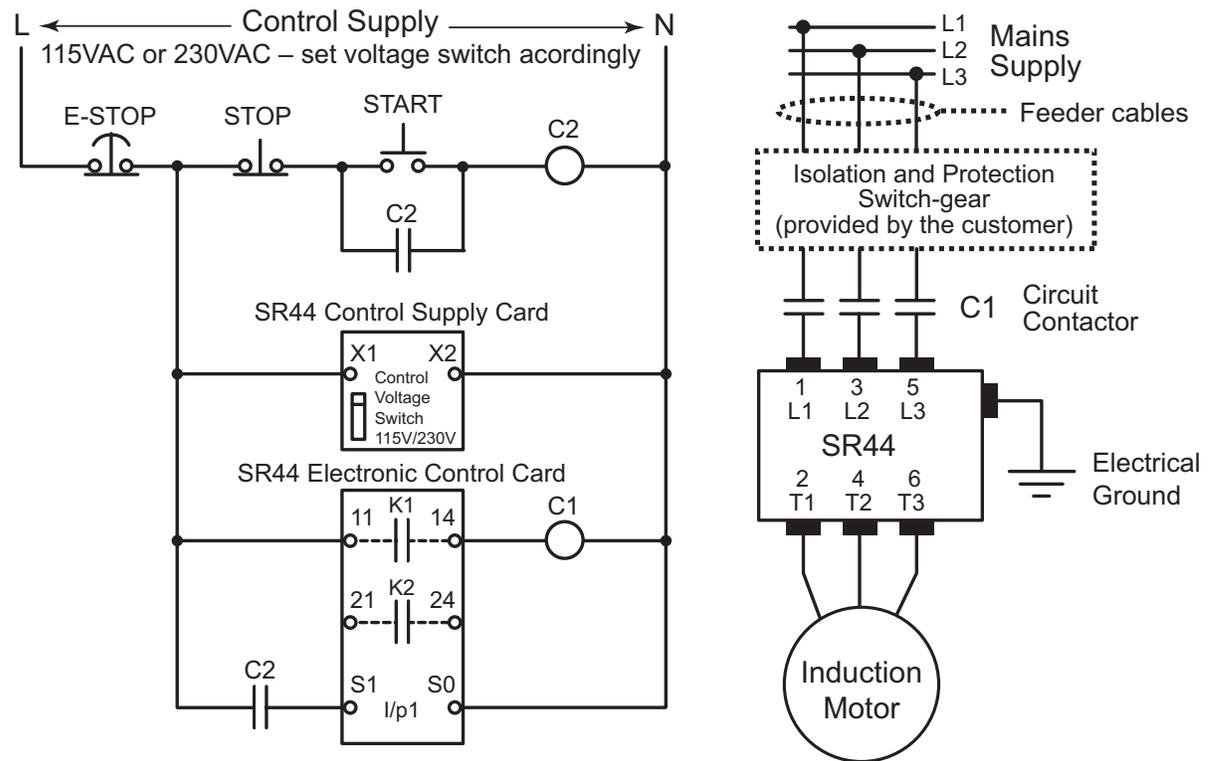
There are two standard wiring configurations for the connection of a motor, a motor controller (Soft Starter), and the main power supply:

- In-line connection for Delta and Star (Wye) connected motors.
This is the recommended connection that is suitable for most motors.
- In-delta connection for Delta connected motors.
If required, the SR44 can be electrically installed within the delta windings.

2.3.1 – Wiring Diagram for In-Line Connection of Motors

Figure 2.3.1: Wiring Diagram for In-Line Connection of Motors

(Two legs of a 230V 3-phase power source can be used to provide 230V 1-phase control power.)



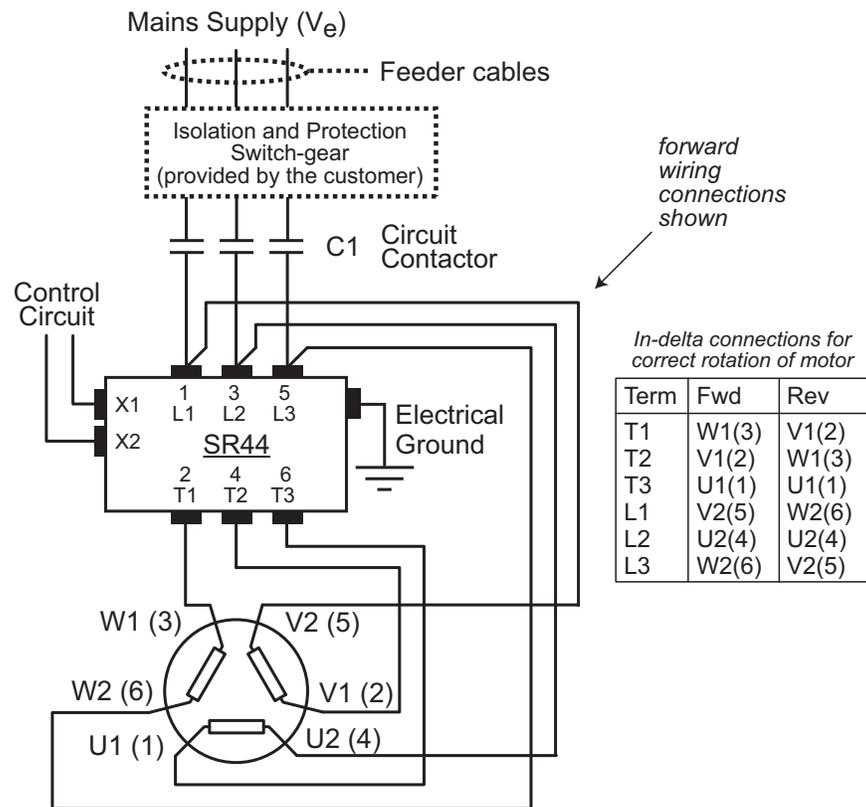
Important:

Be sure to set the Control Voltage Switch to the proper control voltage setting before applying voltage to the control circuit.

2.3.2 – Wiring Diagram for In-Delta Connection of Motors

For “In-Delta” connections, set the SR44 Parameter #6 (“Firing Mode”) to “1” (“Delta”).

Figure 2.3.2: Wiring Diagram for In-Delta Connection of 6-Lead Motors



An in-line isolation contactor controlled by the soft starter **MUST** be used with the In-Delta Firing Mode and motor connections. (C1 as shown in Figure 2.3.2)

2.4 – Motor Control Circuits

2.4.1 – Bypass Control

A separate bypass contactor may be connected in parallel with an SR44 Soft Starter. The bypass contactor allows a solid connection of the motor to the Main Supply, which will eliminate the heating effect associated with Soft Starter thyristor losses. Soft-Starting and Soft-Stopping remain active as normal when the wiring is configured as in Figure 2.4.1.

At the completion of the starting ramp a bypass contactor is closed around the main power supply connections of the Soft Starter to remove the thyristors from the circuit. The contactor is controlled by a programmable relay set as 'Bypass Relay', which is the default for relay K2. This configuration ensures that bypassing only occurs after the Soft Starter has completed the start (P8/B3=1), and the motor terminal voltage is at supply voltage.

The default configuration will detect the use of a bypass contactor when using this circuit arrangement, since "Auto bypass" is set as standard. You can also pre-set the protection mode to either "START+BYPASS" or "PHASE LOSS ONLY" for motor bypassing configurations.

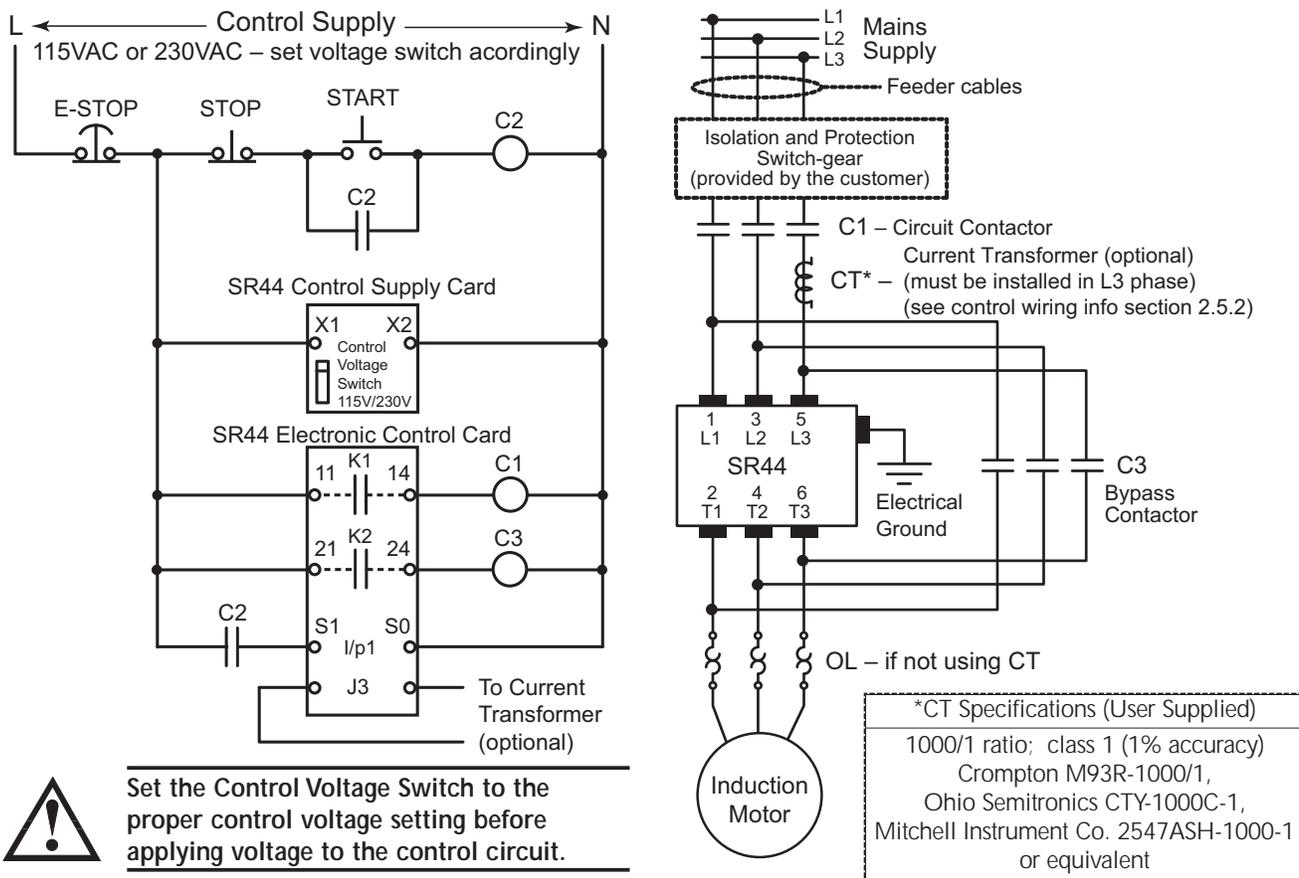


When using a bypass contactor, the "Auto Bypass" Auto Feature should be ON (P18/B2; P86/B2). Using a bypass contactor with Auto Bypass in the OFF state can cause thyristor faults.



An external user-supplied current transformer is required if any of the current or power related trip or monitoring features are needed in bypass mode. (Parameters: 8/B2, 9/B1/B2, 20, 21, 22, 23, 26, 28, 30, 32, 33, 34, 36, 39, 51/B1/B2/B3/B4, 87, 89, 91, 93, 112/B0/B1/B2/B3/B6, 121/B4) CT must be installed in the L3-T3 power phase OUTSIDE of the bypass circuit. See control section 2.5.2.

Figure 2.4.1: Power and Contactor Control Circuits for Motor Bypassing



Set the Control Voltage Switch to the proper control voltage setting before applying voltage to the control circuit.

2.4.2 – Multiple Motor Starting & Stopping

The SR44 is capable of starting parallel-connected motors simultaneously, provided each motor has similar characteristics and load. For such configurations the unit rating should be at least the sum of the current ratings of all the motors.

Alternatively, the SR44 can start and stop motors sequentially using bypass contactors under the control of the programmable relay set as a 'Top of Ramp' relay. The dual setting feature allows for the control of motors with different start-up requirements.

2.4.3 – External Motor Protection Relay

The rating for a motor protection relay should be for Direct-on-Line (DOL) starting, and if it is an electronic relay, then the user should confirm its suitability for use with a soft-starter. If the motor load is high-inertia (extended start time), then a longer trip time may be required.

2.4.4 – Motor Reversing

The diagram in figure 2.4.6 shows a typical motor reversing circuit using two contactors, C1 and C2, to interchange two phases of the 3-phase power supply connections.

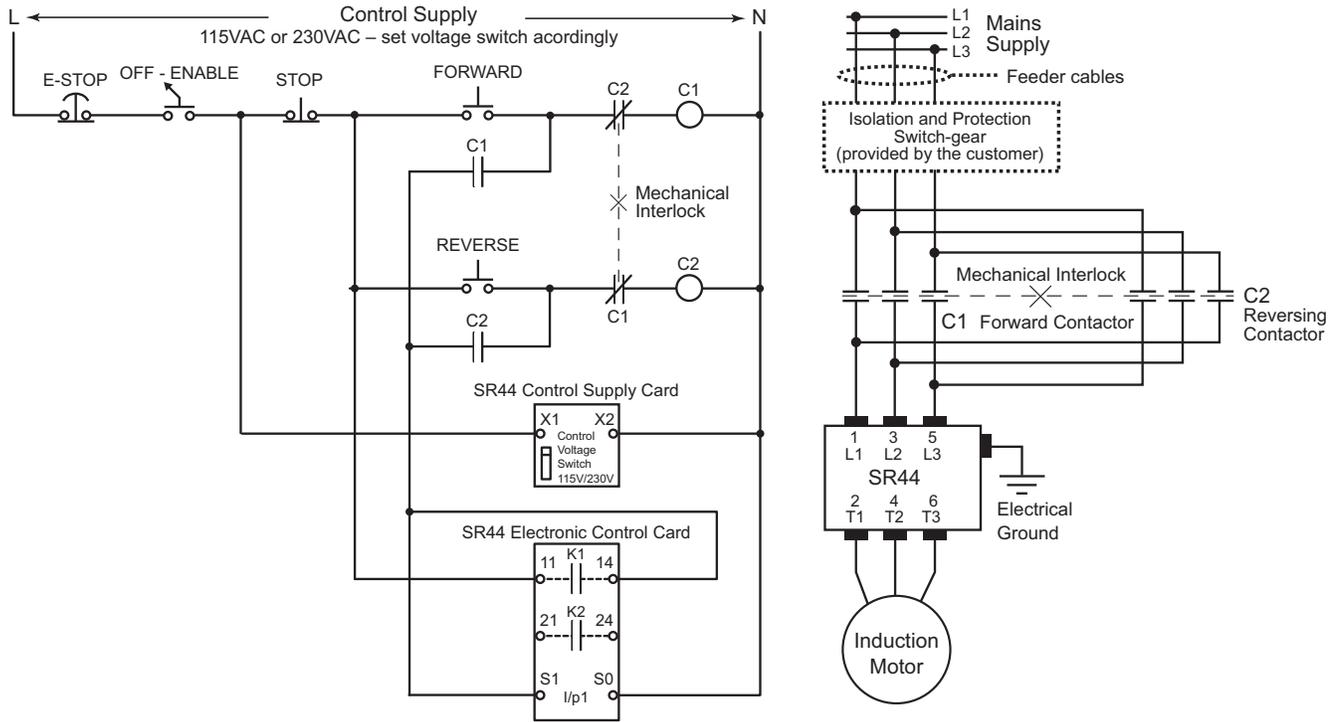
For this application the soft stop must be set to zero.

We also recommend the following:

- A period of 150 - 350 ms elapses between the FORWARD and REVERSE commands.
- If the reversing rate is high, the SR44 current rating may need to be increased compared to the operational current of the motor. Refer to sections 2.10.3 & 2.10.4, and also the Overcurrent trip curves shown in section 2.10.5.
- The current limit and the overload must be set with more consideration to the "reverse" function rather than the "start", as the motor will initially be "plug braked" then be stationary for a moment and finally undergo a normal soft start.

2.4.6 – Wiring Diagram for Motor Reversing

Figure 2.4.6: Typical Power and Contactor Control Circuits for Motor Reversing

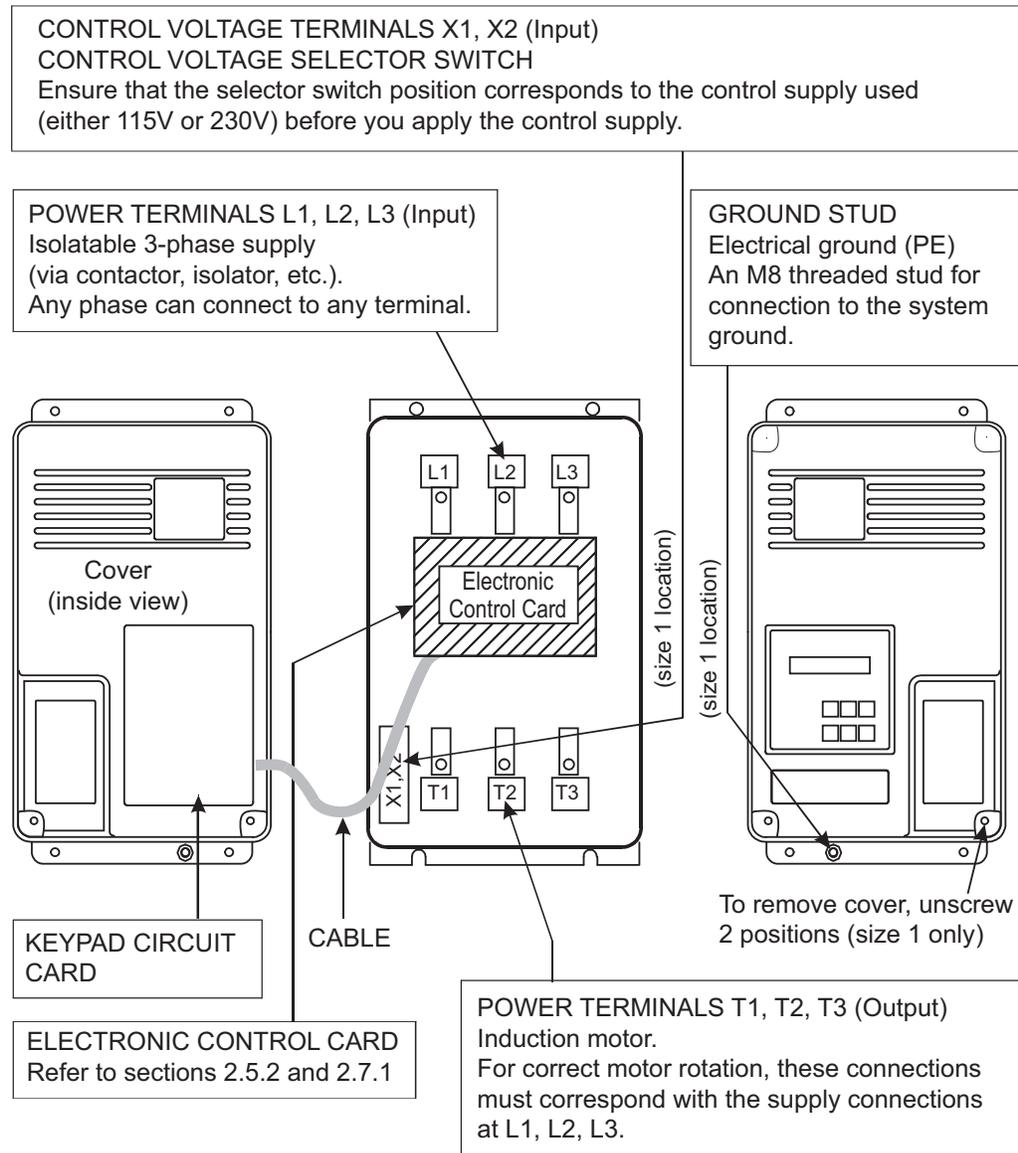


Important:
Be sure to set the Control Voltage Switch to the proper control voltage setting before applying voltage to the control circuit.

2.5 – Electrical Connections - Terminal Locations

2.5.1 – General Electrical Connections

Figure 2.5.1a: SR44 Chassis Size 1 Electrical Connections



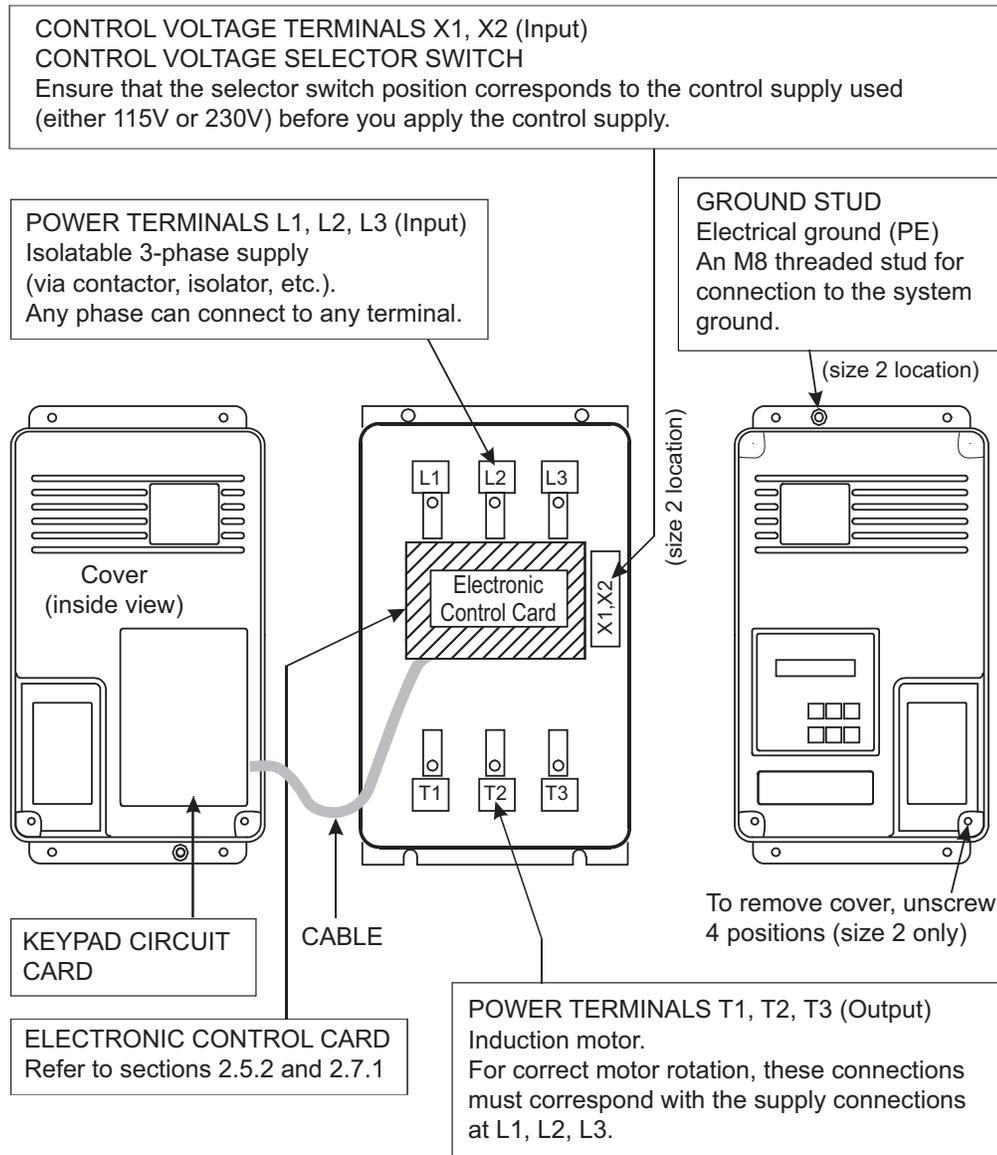
When removing and replacing the front cover, take care not to damage the cable that connects the Keypad and the Electronic Control Card.



The cable from the Keypad to the Electronic Control Card must be connected or disconnected ONLY when the control power is turned OFF to the unit. Otherwise the circuitry may be damaged.

2.5.1 – General Electrical Connections (continued)

Figure 2.5.1b: SR44 Chassis Size 2 Electrical Connections



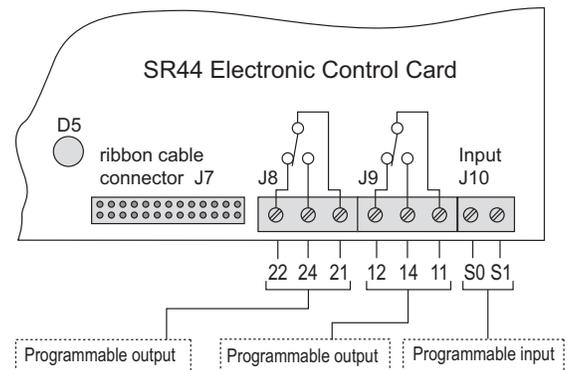
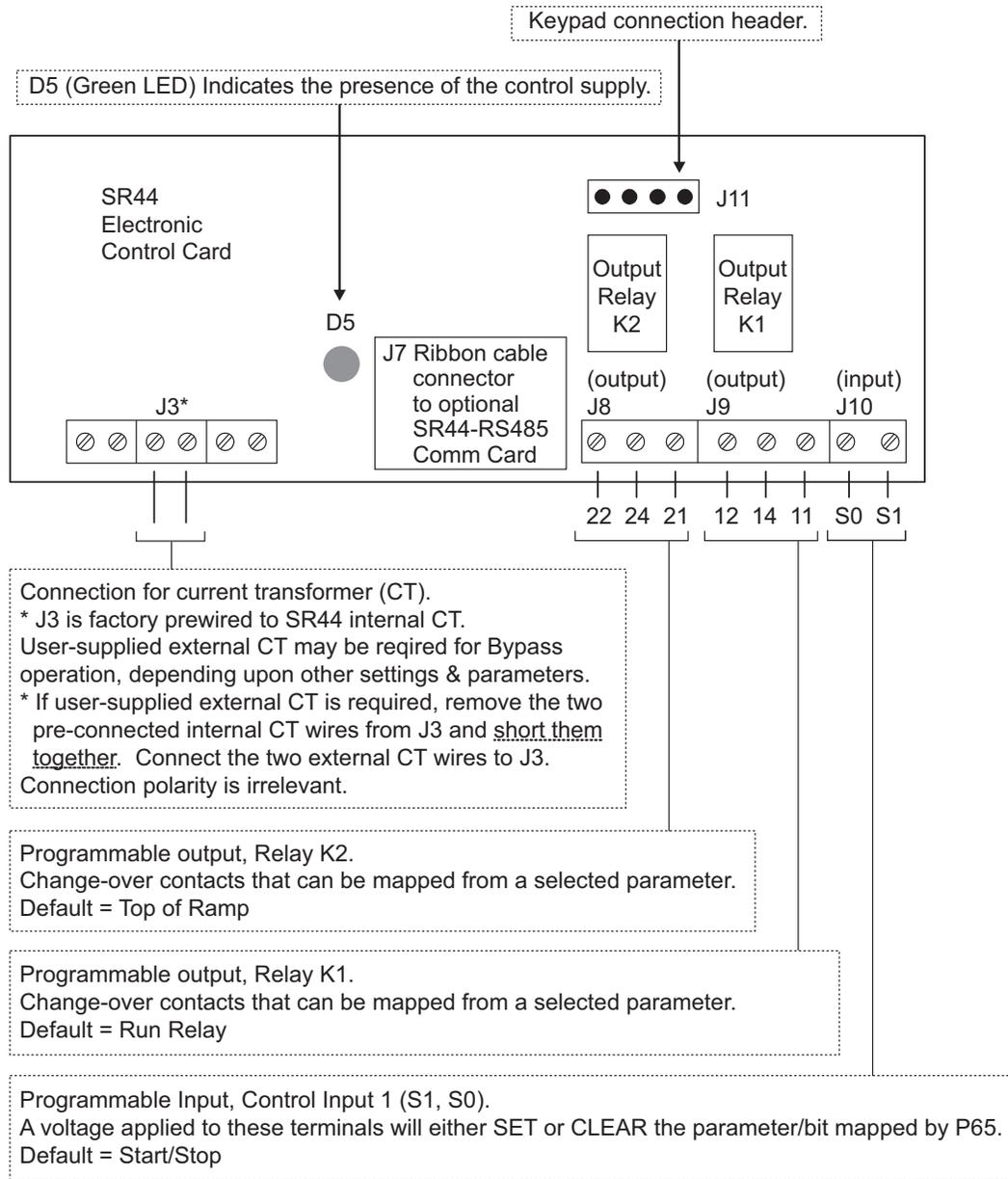
When removing and replacing the front cover, take care not to damage the cable that connects the Keypad and the Electronic Control Card.



The cable from the Keypad to the Electronic Control Card must be connected or disconnected **ONLY** when the control power is turned OFF to the unit. Otherwise the circuitry may be damaged.

2.5.2 – Electronic Control Card

Figure 2.5.2: Electronic Control Card Electrical Connections



2.6 – Power Supply Connections

2.6.1 – Power Circuit Electrical Supply

Power terminals 1 (L1), 3 (L2), 5 (L3) on all units must be connected to a balanced 3-phase, 3-wire AC power supply that is within the limits specified below.

SR44 Power Electrical Tolerances	
	Nominal Supply Voltage Range
Rated Operational Voltage (V_e) 230V/460V	230V -15% to 460V +10% (usable on 208V systems down to 196V)
Rated Frequency (Hz)	50/60 +/- 2Hz

Phase sequence:

The SR44 will operate with any 3-phase rotation sequence. It is important however, to ensure that the correct connections are made when used with a rotation sensitive load.

2.6.2 – Motor Connections

The motor connects to terminals 2 (T1), 4 (T2), 6 (T3). All SR44 units will control any standard 3-phase squirrel-cage induction motor capable of operating satisfactorily when connected to the main supply with its normal load coupled.

2.6.3 – Control Circuit Electrical Supply

All units require a separate 2-wire, single-phase supply connected to terminals X1 and X2. At the Control Voltage Selector Switch, the user can select either 115V or 230V. The diagrams in section 2.5 show the location of the terminals X1 and X2 for each model of SR44.

Supply voltage must be in the range 115V (-15%, +10%) or 230V (-15%, +10%).



1. The control supply requires external fuse protection.
2. Ensure that the control Voltage selector switch is set correctly before applying power.

SR44 Control Power Consumption						
Chassis Size	Soft Starter Model	Current Rating	Nominal Power Consumption	115V Fuse	230V Fuse	Fuse Type
Size 1	SR44-9 to SR44-23	up to 23A	8VA	200 mA	100 mA	CC
	SR44-30 to SR44-44	30A & 44A	10 VA			
	SR44-59 to SR44-146	59A to 146A	12 VA			
Size 2	SR44-174 to SR44-370	174A to 370A	18 VA			

2.7 – Control Card Connections

All the control inputs and outputs are on the Electronic Control Card (ELC), which is mounted within the unit. Diagrams in section 2.5 show the location of the electronic control card.

2.7.1 – Control Inputs

Control Card Inputs	
Identification	Description
Start/Stop 12/24 VDC or 115/230 VAC	<p>Programmable Input, Control Input 1. (S1, S0)</p> <p>Application of a voltage between S1 and S0 will either SET (normal logic sense) or CLEAR (inverted logic sense) the parameter mapped to by parameter P65.</p> <p>Removal of this voltage will either CLEAR (normal logic sense) or SET (inverted logic sense) the parameter mapped to by parameter P65.</p> <p>Default setting is P52, Bit 4: Start/Stop, which is active only when the operator selects and enters REMOTE STARTING at the keypad.</p> <p>The application of a voltage, as specified, between these terminals, will initiate a START. The removal of this voltage will initiate a STOP.</p>

2.7.2 – Control Outputs

Control Card Outputs	
Identification	Description
12, 14, 11	<p>Programmable Output, Relay K1.</p> <p>A bit = 1 on the parameter/bit selected by P57 makes Relay K1 ACTIVE (normal logic sense) or INACTIVE (inverted logic sense).</p> <p>Default setting is P52, Bit 5: Main Contactor</p> <p>Relay change-over contacts: Contact rating: 230VAC, 3A, AC1 ; 24VDC, 3A 11 – Common; 12 – Normally-closed; 14 – Normally-open</p>
22, 24, 21	<p>Programmable Output, Relay K2.</p> <p>A bit = 1 on the parameter/bit selected by P59 makes Relay K2 ACTIVE (normal logic sense) or INACTIVE (inverted logic sense).</p> <p>Default setting is P8, Bit 3: Top of Ramp or Full Volts</p> <p>Relay change-over contacts: Contact rating: 230VAC, 3A, AC1 ; 24VDC, 3A 21 – Common; 22 – Normally-closed; 24 – Normally-open</p>

2.8 – (Reserved for Future Use)

2.9 – Typical Motor Power at Rated Voltage

The amperage values for the Soft Starter are the maximum continuous current for the model.

The motor ratings are the nearest values for the output powers of standard squirrel-cage motors below the unit current rating of the SR44.

The currents (amps) quoted are for 3-phase, 4-pole motors operating on 50/60Hz power supplies. Actual currents of motors may vary by $\pm 10\%$ depending on size and manufacturer. Motors of lower speeds generally draw higher currents for the same rated output. Typically +10% for 6-pole or +20% for 8-pole as compared to 4 pole motors.

Motor ratings are in kiloWatts (kW) as defined by the IEC or Horsepower (HP) as defined by the American "National Electrical Code" and are, where possible, normal motor sizes.

2.9.1 – Chassis Size 1 Motor Power Ratings

SR44 Chassis Size 1 Motor Power Ratings									
Model	Current (Amps)	208 Volts *		230 Volts		400 Volts		460 Volts	
		kW	HP	kW	HP	kW	HP	kW	HP
SR44-9	9	1.5	2	2.2	3	4	5	4	5
SR44-16	16	2.2	3	3.7	5	7.5	10	7.5	10
SR44-23	23	3.75	5	6.3	7.5	11	15	11	15
SR44-30	30	5.5	7.5	7.5	10	15	20	15	20
SR44-44	44	7.5	10	11	15	22	30	22	30
SR44-59	59	11	15	16	20	30	40	32	40
SR44-72	72	15	20	20	25	37	50	40	50
SR44-85	85	18.5	25	22	30	45	60	45	60
SR44-105	105	22	30	30	40	55	75	55	75
SR44-146	146	37	50	45	60	75	100	80	100

** 208V applications are UL listed only as low as 196V.*

2.9.2 – Chassis Size 2 Motor Power Ratings

SR44 Chassis Size 2 Motor Power Ratings									
Model	Amps	208 Volts *		230 Volts		400 Volts		460 Volts	
		kW	HP	kW	HP	kW	HP	kW	HP
SR44-174	174	45	60	55	75	90	100	110	150
SR44-202	202	45	60	63	75	110	150	132	175
SR44-242	242	55	75	75	100	132	175	150	200
SR44-300	300	75	100	90	100	160	200	185	250
SR44-370	370	90	125	110	150	200	250	220	300

** 208V applications are UL listed only as low as 196V.*

2.10 – Fuse and Current Ratings

2.10.1 – Full-Load Current Limit and Short-Circuit Protection

SR44 Fuse and Current Ratings for UL Applications (Table 2.10.1)					
Model	I _e (A _{rms})	Short Circuit Current (RMS)	UL Recognized JFHR2 Fuse		
			Bussman Model #	Ferraz Model #	Amps
SR44-9	9	5kA	170M3110	6.9 URD 30 D08A 0063	63
SR44-16	16				
SR44-23	23				
SR44-30	30				
SR44-44	44				
SR44-59	59				
SR44-72	72	10 kA	170M3116	6.9 URD 30 D08A 0250	250
SR44-85	85				
SR44-105	105				
SR44-146	146				
SR44-174	174				
SR44-202	202				
SR44-242	242	18 kA	170M4114	6.9 URD 31 D08A 0500	500
SR44-300	300				
SR44-370	370				

These fuses are for short circuit protection of the semiconductors, and must be mounted externally by the user between the unit and the main power supply.

UL requires Recognized special purpose fuses (JFHR2) for the protection of semi-conductor devices, rated 700 VAC, as indicated in Table 2.10.1, be used to obtain the short circuit ratings required by UL.

Suitable for use on a circuit capable of delivering not more than the RMS Symmetrical Amperes indicated in Table 2.10.1 at maximum rated operational voltage when protected by Semiconductor Fuse type, Manufactured by Company and Model Number indicated in Table 2.10.1

Fuse rated 700 VAC, Amps as indicated in Table 2.10.1.

It is the responsibility of the installer and system designer/specifier to ensure that the required standards or regulations are not affected by so doing.

2.10.1 – Full-Load Current Limit and Short-Circuit Protection (continued)

SR44 Fuse and Current Ratings for Non-UL Applications*					
Model	I _e (A _{RMS})	Short Circuit Current (RMS)	Fuse		
			Bussman FWP 700V Model #	Edison E70S Model #	Amps
SR44-9	9	5kA	FWP-50B	E70S50	50
SR44-16	16				
SR44-23	23				
SR44-30	30		FWP-80B	E70S80	80
SR44-44	44				
SR44-59	59				
SR44-72	72	10 kA	FWP-125A	E70S125	125
SR44-85	85				
SR44-105	105				
SR44-146	146		FWP-200A	E70S200	200
SR44-174	174				
SR44-202	202				
SR44-242	242	FWP-300A	E70S300	300	
SR44-300	300				
SR44-370	370				
		18 kA	FWP-400A	E70S400	400
			FWP-500A	E70S500	500
			FWP-700A	E70S700	700

Use these fuses with SR44 soft starters only in NON-UL applications.

2.10.2 – External Fuse Requirements

The rating of HRC (High Rupturing Capacity) fuses for motor protection needs to be carefully analyzed when using a Soft Starter due to the longer start times which are involved. When high inertia loads (e.g. fans) are being started, special consideration should be given to fuse ratings due to the extended ramping times. Most fuse manufacturers have an “extended start” or “dual element” range of fuses intended for this type of application.

The advantage of an HRC fuse becomes evident during a fault current condition. As a result of the high current, large amounts of heat are created within the fuse, melting the filling of the fuse into glass. Being an insulator, glass suppresses arc-over and breaks the circuit instantly. This behavior minimizes the possibility of a continuing, dangerous high arc current.

For semiconductor protection fusing, refer to the table in section 2.10.1.

2.10.3 – Overload Current Profile and Duty Cycle AC-53a

IEC 60947-4-2 Motor Utilization Category: AC-53a (not operating in bypass mode)

SR44 Index Ratings (for AC-53a) *				
Soft Starter Model Number	I _e (A)	Standard Operation		
		UC	X-T _x	F-S
SR44-9 to SR44-105	9 to 105	AC-53a AC-53a	5-4 3-35	99-10 99-10
SR44-146 to SR44-202	146 to 202	AC-53a AC-53a	4-6 3-35	99-10 99-10
SR44-242 to SR44-370	242 to 370	AC-53a AC-53a	4-6 3-35	60-3 60-3

* Index ratings AC-53a and AC-53b are specified by IEC standard # 60947-4-2

IEC Index Ratings for standard operation are comprised of Rated Operational Current (I_e), Utilization Category AC-53a, Overload Current Profile (X-T_x), and Duty Cycle (F-S).

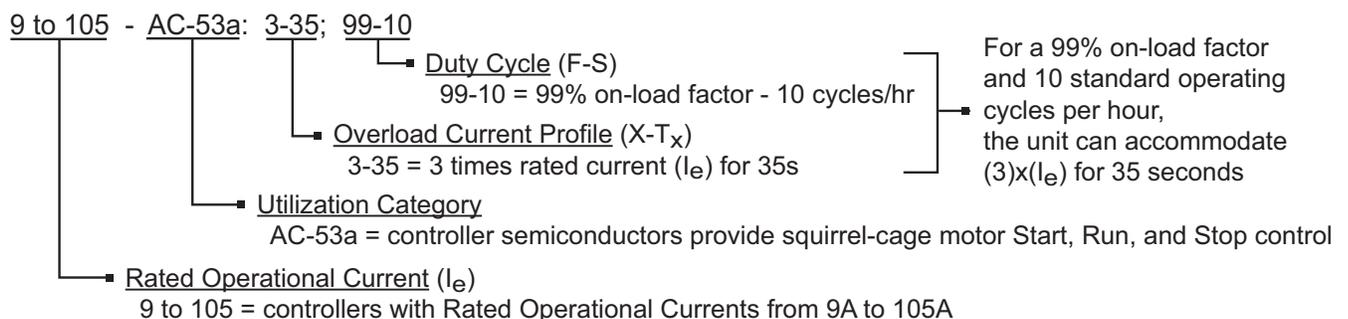
AC-53a Overload Current Profiles (applicable to specified Soft Starter models)				
Soft Starter Model	X Overload Current (multiple of I _e)	T _x Duration of Overload (seconds)	F Ratio of On-load Period to Total Load (%)	S Number of Operating Cycles per Hour
SR44-9 to SR44-105	3	35	99	10
	5	4	99	10
SR44-146 to SR44-202	3	35	99	10
	4	6	99	10
SR44-242 to SR44-370	3	35	60	3
	4	6	60	3

To calculate times for a lower value of current, divide the square of the next highest given current multiplied by its given time by the square of the required current.

For example:

- To find the time T_x for X = 2.5 x I_e, then T_x = (3² x 35) / (2.5)² = 50 seconds.

Index Rating Example – Standard Operation (AC-53a Utilization Category per IEC 60947-4-2)



2.10.4 – Overload Current Profile AC-53b

IEC 60947-4-2 Motor Utilization Category: AC-53b (operating in bypass mode)

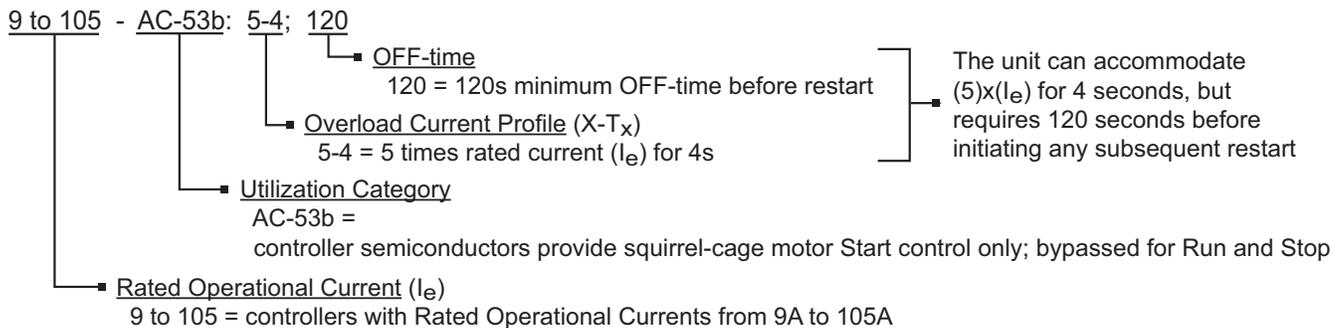
SR44 Index Ratings (for AC-53b) *				
Soft Starter Model Number	I _e (A)	Bypassed Operation		
		UC	X-T _x	OFF-time
SR44-9 to SR44-105	9 to 105	AC-53b AC-53b	5-4 3-35	120 120
SR44-146 to SR44-202	146 to 202	AC-53b AC-53b	4-6 3-35	120 120
SR44-242 to SR44-370	242 to 370	AC-53b AC-53b	4-6 3-35	420 420

* Index ratings AC-53a and AC-53b are specified by IEC standard # 60947-4-2

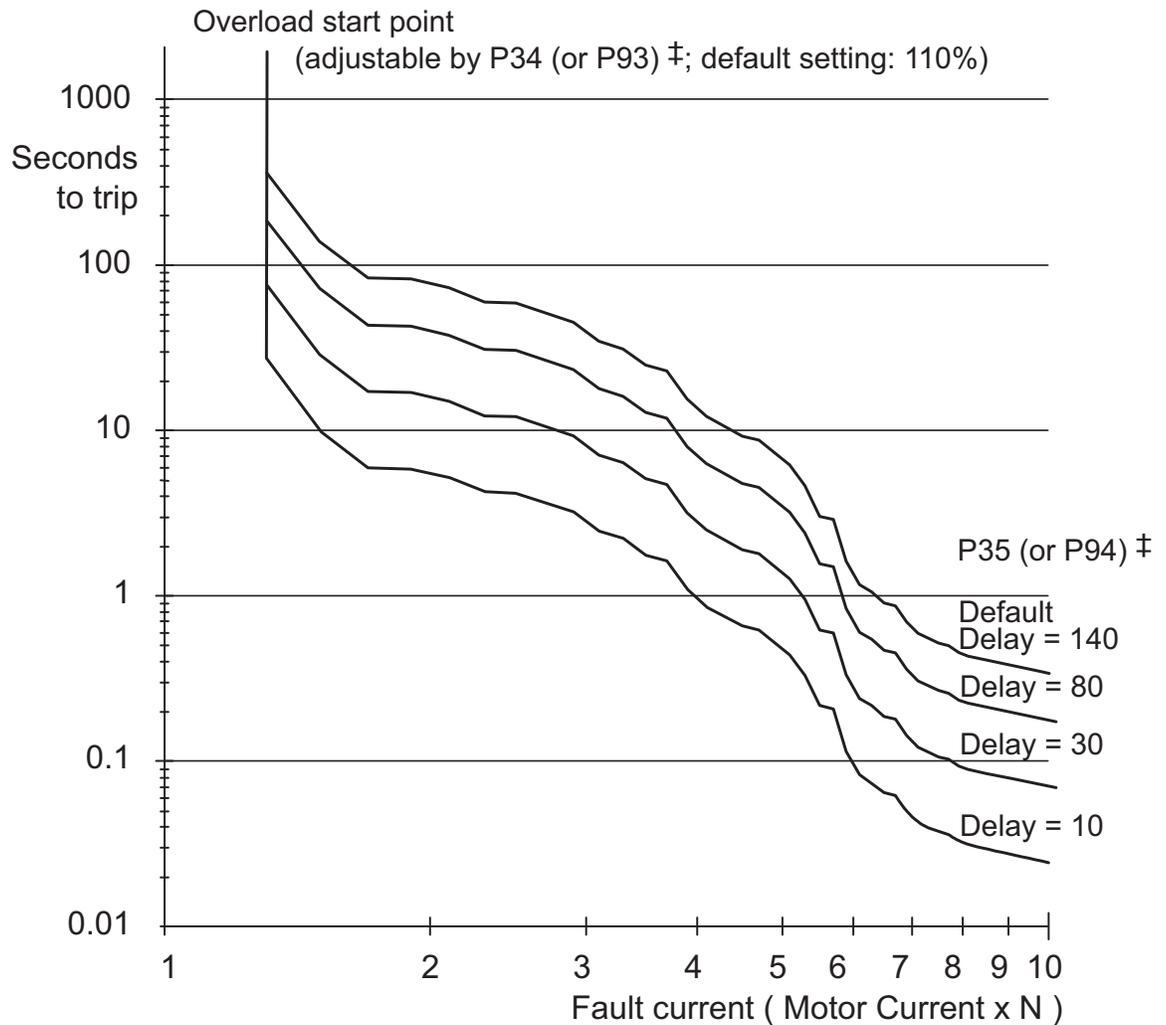
IEC Index Ratings for bypassed operation are comprised of Rated Operational Current (I_e), Utilization Category AC-53b, Overload Current Profile (X-T_x), and OFF-time.

AC-53b Overload Current Profiles (applicable to specified Soft Starter models)			
Soft Starter Model	X Overload Current (multiple of I _e)	T _x Duration of Overload (seconds)	OFF-Time (seconds)
SR44-9 to SR44-105	3	35	120
	5	4	120
SR44-146 to SR44-202	3	35	120
	4	6	120
SR44-242 to SR44-370	3	35	420
	4	6	420

Index Rating Example – Bypassed Operation (AC-53b Utilization Category per IEC 60947-4-2)



2.10.5 – Overcurrent Trip Graph



‡ Parameter selected through either the primary or secondary group of value parameters

'Current Limit', 'Overload Level' and 'Overload Delay' settings may be adjusted to limit overload currents in accordance with the trip curves shown in the Overload Trip Graph.

For motors with Full Load Currents lower than the rated current of the SR44, the Overload Level can be adjusted using the following formula:

$$\text{Overload Level} = \text{Motor FLC} \times 1.1 \text{ (A)}$$



The Overload monitors only one of the phases, and the 'Current Limit' level is only active during motor starting.



We recommend that the control power supply be maintained between starts to ensure the integrity of the Overload, which will reset on removal of control power.

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3.1 – Motor Suitability and Associated Considerations

The SR44 Soft Starter is based on a series of microprocessor-based optimizing soft starters which have been used world-wide in more than 100,000 critical and non-critical systems. Since 1983, these soft starters have successfully operated with almost every type of load and environment from the Antarctic to the Jungle. The design has proven to be both reliable and adaptable, and provides a powerful mechanism with which to control fixed-speed induction motors.

However, due to the intrinsic differences between electronic and electro-mechanical starting systems, there are a number of simple rules and observations to follow when using the SR44 Soft Starter. This section introduces guidelines for the user and those incorporating the unit as part of their system design.

3.1.1 – Suitability

In principle, any three-phase induction motor can be started by a soft starter. Normally, the breakaway torque of the load should be less than the full-load torque of the motor, unless a motor with a high locked-rotor torque characteristic is employed. As a quick assessment, any load which has a low or no-load start with a moderate starting time, or which can be started with a star-delta (wye-delta) starter, auto transformer or other forms of reduced-voltage starting, can be considered a potential application for a soft starter.

3.1.2 – Induction Motor Characteristics

Three-phase induction motors are required to provide sufficient torque to accelerate the motor and its load from standstill to full speed, and to maintain full speed efficiently at all torque levels up to the design full-load torque. Most modern three-phase induction motors have characteristics that are wholly suitable for use with soft starters. However, the characteristics vary considerably between different manufacturers and design types.

It is important that the motor is capable of providing sufficient torque to drive the load at all speeds from standstill to rated speed, to enable the SR44 to function properly. It is particularly important that the motor to be soft started does not have a low pull-up or saddle torque, or the load may not be accelerated correctly.

The primary function of the soft starter is to act as a torque-regulating device. It cannot apply a torque greater than that which the motor generates. For this reason, problematic applications for which many different starting methods have been tried but failed may need analysis of the motor or load performance before a soft starter can be successfully applied.

3.1.3 – Rating

For most applications, except high inertia loads, the starting demands and the inertia of the rotating masses are small enough to be insignificant. This means that no special consideration needs to be given to the rating of the soft starter, other than to ensure that it is equal or marginally greater than the rated voltage and current of the controlled motor.

Alternatively, if the number of poles of the motor and the moments of inertia of the load (J_{load}) and motor rotor (J_{motor}) are known, a soft starter will be suitable if the figures comply with the criteria given in the bottom row of Table 3.1.3.

Number of Poles	2	4	6	8
Synchronous Speed (rpm @ 60 Hz)	3600	1800	1200	900
$(J_{load})/(J_{motor})$ less than	5	15	20	25

Section 3.2.13 contains a table showing the more common applications.

3.1.4 – Maximum Motor Cable Length

The length of the cable between the output terminals of the starter and the motor should not normally be greater than 100 meters [328 ft].

3.1.5 – Power Factor Correction Capacitors

Power factor correction capacitors applied to a single motor must ALWAYS be connected by a separate contactor placed on the SUPPLY side of the SR44 Soft Starter. Capacitors should be switched into the circuit after top-of-ramp (full line voltage) is reached, and switched out of the circuit before a stop is initiated.

It is important that any total system PFC scheme that automatically corrects for a range of inductive loads is not operated in such a way as to leave it heavily over compensated since this might introduce oscillations leading to damaging over-voltages.

3.1.6 – Lightly Loaded Small Motors

Lightly loaded small-sized (less than 2kW [2.7 hp]), star connected motors can produce high voltages at the motor terminals when shut down by simply opening the line contactor. As these voltages can damage the soft starter, it is safer to control the opening of the line contactor with the soft starter run relay contacts.

3.1.7 – Motors Installed with Integral Brakes

Motors that include an integral, electrically operated brake internally connected to the motor input terminals can only be soft started when the brake is re-connected to the supply through its own contactor. (Do NOT soft start the brake.)

3.1.8 – Older Motors

The action of the fully-controlled soft starter introduces harmonic currents and voltages to the motor. Therefore, it is important to ensure that the motor employs techniques such as rotor skewing in its construction to suppress the effects of harmonic fluxes and avoid rough starting. This is rarely a problem with modern motors, because nearly all motors designed in the last 20 years employ these techniques.

3.1.9 – Wound-rotor or Slip-ring Motors

Slip-ring induction motors ALWAYS need some resistance in the rotor circuit to ensure that sufficient rotational torque is generated to overcome any alignment torque, which is present at start-up. The resistance can be safely shorted out in the normal fashion with a contactor controlled by the programmable relay set as '*top-of-ramp*' contacts.

3.1.10 – Enclosures

Thyristors are not perfect conductors, and the passage of current through them causes heat dissipation in the body of the soft starter, which in turn causes the heatsink temperature to increase. As a guide, the heat generated is 1 watt/amp/phase, which equates to a dissipation of 30 watts from the heatsink for a line current of 10 amps. Therefore, all cabinets or enclosures that house soft starters should have adequate ventilation. (Refer to the Mechanical Installation procedures, sections 1.6 to 1.8 for more detailed information.)

3.1.11 – Efficiency

Although the use of the soft starter introduces a power loss, the system still retains an overall efficiency of approximately 99.5%. If the optimizing function is selected, then the gain in motor efficiency at partial loads is far greater than the loss of efficiency arising from thyristor heat losses. If prolonged operation at full load is expected, the thyristor loss can be eliminated (as in some matched motor/pump drives) by closing a bypass contactor around the soft starter. (This contactor is readily controlled by the programmable relay set as '*top-of-ramp*' contacts as the circuit in section 2.4.1 shows.)

3.1.12 – High-Efficiency Motors

Due to an inherently steep front to the speed/torque curve, high-efficiency motors can exhibit instability when lightly loaded, and the optimizing rate parameter P19 may need to be adjusted to compensate.

3.1.13 – EU Compliance with the EMC Directive

When considering the use or fitting of any Soft Starter, users and installers in European countries must comply with the EMC Directive 89/336/EEC. The manufacturer of the soft starter has a statutory obligation to provide a guide for compliance with this directive.

For the SR44, this guidance is given in the EMC guide which is chapter 4 of this manual. It is essential that users and installers understand and comply with the requirements described in these sections.

3.1.14 – Fuses

Circuit protection fuses should be rated to allow for the extended start times associated with the use of a Soft Starter. Traditional HRC motor fuses may need to be rated higher than the motor rated current for normal low-inertia applications, but modern "extended start" fuses will generally give full motor protection. (See also section 3.2.2 relating to high inertia loads.)

Semiconductor fuses are available for the short-circuit protection of the thyristors in the SR44. See the "Fuse and Current Ratings" section in chapter 2 ("Electrical Installation") of this manual for semiconductor fuse recommendations and details of the Overload incorporated into the SR44.

3.2 – Rules for Specific Applications

3.2.1 – In-Delta Operation

The SR44 control system allows the soft starter to be installed “in the delta” connections of the motor, which can permit the use of a lower current rated unit. However, in this mode of operation it is important that the soft starter is connected in accordance with the relevant wiring diagram. The connection diagram in Figure 2.3.2 of the Electrical Installation chapter gives detailed instructions for this configuration. If motor rotation is incorrect, the connections should be changed as detailed in Figure 2.3.2. It should be noted that six connections are required between the motor and soft starter. Parameter P6 must be set to 1 for delta mode, which also disables optimizing. *An in-line isolation contactor controlled by the soft starter MUST be used with the In-Delta Firing Mode and motor connections.*

3.2.2 – High-Inertia Loads

High-inertia loads, such as centrifugal and axial fans, grinders, flywheel presses, etc., may require a larger size soft starter than the motor. For example, a 75kW [100 hp] starter may be needed for a 55kW [75 hp] motor. This is necessary to allow for the extra heating effects of the prolonged over-current on the soft starter thyristors during the extended starting time. If very high-inertia loads are involved, then an analysis of the starting characteristics should be made. This requires accurate data about the motor and the load:

- Complete motor data: Current, Voltage, Power, Speed, Rotor Inertia, Speed/Torque/Current curves
- Complete load data: Type of load, Speed, Inertia, Speed/Torque curve, Power absorbed or Full-load Torque

Consideration must also be given to thermal overload and fuse protection systems when extended start times are involved. This is the case for heavy duty starting, as a standard thermal overload will trip under these conditions. A heavy-duty start thermal overload or an electronic overload with dual settings for start and run is recommended. Modern HRC motor fuses will allow for some overload during the start, but the fuse curve, giving time/current data, will give an indication of suitability for the particular application.

3.2.3 – Reserved

3.2.4 – Resistive Loads

AutomationDirect does not support the control of resistive loads with the SR44 Soft Starter.

3.2.5 – Frequent Starting

High starting frequencies require careful consideration of the soft starter thermal capabilities. In many cases a standard sized SR44 may be suitable, as start times are generally shorter for this type of application. If this is not the case, then a larger soft starter may be required.

3.2.6 – Optimizing

Drives which operate for long periods of time at less than their rated capacity can benefit from the energy saving function (optimizing) of the SR44, which adjusts the thyristor triggering to reduce the excitation losses of the motor. This feature will lower the running temperature of the machine and help to extend its life. See Section 3.4, Principles of the Optimizing Mode.

3.2.7 – Soft Stopping

Soft stopping can reduce positive surge pressures in pipelines on shutdown. It is necessary to make sure that the ramp-down time is long enough to remove the energy from the fluid before the firing of the thyristors is stopped. Otherwise the surge pressure may still be present. Soft stopping can also be successfully applied to loads such as conveyer belt systems where sensitive items such as bottles are being transported.

3.2.8 – Reversing Drives and Plug-braking

SR44 Soft Starters used in conjunction with contactor controlled reversing and plug-braked motors show considerable benefits to the user by reducing mechanical and electrical stresses, particularly when utilizing the current limited start feature. This type of application requires inserting a 150–350 ms delay between the opening of one contactor and the closing of the other, to allow any residual flux in the rotor to die away. When plug-braking, there should be some form of zero-speed detection to stop the drive after braking has been completed, otherwise the drive may either accelerate the motor in the reverse direction, or switch off before zero speed has been reached. The SR44 has a dual parameter setting feature which is particularly useful in plug-braking, where the braking settings need to be different from the normal starting ramp time and current limit level. See section 2.4.4 and Figure 2.4.6 of the Electrical Installation chapter for details.

3.2.9 – Replacement of Fluid Couplings

Soft-starters can replace fluid couplings yielding benefits of higher efficiency running and lower costs to the user. If the coupling is used to magnify the available breakaway torque, it may be necessary to replace the installed motor with another of a larger size, or one with a high starting torque characteristic before a soft starter can be employed.

3.2.10 – Two-speed Motor Applications

Two-speed motors, whether Dahlander-connected or with dual windings, can be soft-started at each speed, provided that the start is initiated when the actual motor speed is less than the synchronous speed for the winding selected. This is particularly important when changing from high to low speeds. The SR44 has a dual setting feature, which allows different operating settings for the high and low speeds, and the ability to switch rapidly between them.

3.2.11 – Multiple Motor Starting

See section 2.4.2 of the Electrical Installation chapter for details.

3.2.12 – Overhauling Loads

Certain applications can overspeed the motor as part of normal operation. Power then flows from the motor to the power supply. It is important to disable Optimizing Mode during over-speed conditions, and reinstate Optimizing during normal conditions. (External control is required to disable and reinstate Optimizing Mode.)

3.2.13 – Application Table

The table on the following page shows many common motor applications that suit the SR44 Soft Starter. It lists typical breakaway torque requirements as a percentage of motor full-load torque (FLT). For the most satisfactory soft starter in a given application, the motor should have a full-voltage locked-rotor-torque (LRT) that is at least twice the breakaway torque (e.g. for a reciprocating compressor the FLT is normally in the region of 50% motor LRT.) As a general rule, the higher the motor LRT is above the load breakaway torque, the greater the control over the starting process.

Table 3.2.13 – Applications		
Application	Breakaway Torque (%FLT)	Remarks
Agitator	35	
Air compressor- rotary, unloaded start	25–35	
Air compressor- reciprocating, unloaded start	50–100	
Air compressor- screw type, unloaded start	30	Usually two-pole motor
Ball mill	30–50	Eccentric load, needs high starting torque motor
Carding machine	100	Often high inertia
Centrifuge	50–90	Usually high inertia
Centrifugal fan- dampers closed	10–25	Usually high inertia
Centrifugal fan- dampers open	10–25	Usually high inertia, very long ramp times
Centrifugal blower- valve closed	25–35	
Centrifugal blower- valve open	30–40	Can have long ramp time
Chillers	10–25	Usually started unloaded, two-pole motor
Conveyor- horizontal, unloaded	10–50	
Conveyor- horizontal, loaded	100–150	
Conveyor- vertical lifting, unloaded	50–85	
Conveyor- vertical lifting, loaded	100–175	
Conveyor- vertical lowering, unloaded	10–40	
Conveyor- vertical lowering, loaded	10–25	
Crusher (not rock)- unloaded	25–75	Can be high inertia
Drilling machine- unloaded	10	
Escalator- unloaded	25–50	Optimizing feature can be effective
Fan, axial-flow propeller	20–40	
Feeder- screw	100–175	Needs high starting torque motor
Feeder- vibrating, motor driven	100–150	Needs high starting torque motor
Grinder- unloaded	10–25	Usually high inertia
Hammer mill	20–125	Eccentric load, needs high starting torque motor
Mills- flour etc.	30–50	
Mixer- dry contents	35–75	
Mixer- fluid contents	10–40	
Mixer- plastic contents	75–125	High torque motor offers advantage
Mixer- powder contents	75–125	High torque motor offers advantage
Pelletizers	50–100	
Press, flywheel	50–150	Needs high starting torque motor
Pump- centrifugal	10–25	Soft stopping useful
Pump- positive displacement, piston type	100–175	Needs high starting torque motor
Pump- vane type, positive displacement	100–150	Needs high starting torque motor
Rolling mill	30–50	
Saw, band	10–35	
Saw, circular	25–50	May be high inertia; Plug brake may be useful
Screen, vibrating	30–60	
Travelators, walkways	25	Unloaded starting
Transformers, voltage regulators	Nil	Change firing mode
Tumblers	30–100	Can be eccentric load, may need high torque motor

3.3 – Concepts and Principles of Fixed-Speed Induction Motor Starting and Control

Since its invention one hundred years ago, the standard three-phase induction motor has become one of the most familiar items of industrial equipment ever known. Due to its simplicity of construction, low cost, reliability, and relatively high efficiency, it is likely to remain the prime source of mechanical energy for the foreseeable future.

3.3.1 – Introduction

Energy conversion, from the electrical supply to rotating mechanical energy, is a characteristic of all motors. To regulate energy flow, most motor circuits require a mechanism to connect and disconnect them from their electrical power source. Electro-mechanical switches, known as “contactors”, are the standard means of achieving this control. Even today, more than one hundred years after their introduction, contactor-based systems remain the most widely used method of motor control.

Nevertheless, there is a definite trend towards more sophisticated electronic systems of control being applied to fixed-speed motor drives. This section will discuss these forms of control; namely electronic microprocessor-controlled optimizing soft starters such as the SR44.

3.3.2 – The Induction Motor

In order to appreciate the benefits of using an electronic controller, it is important to have some understanding of the characteristics and limitations of the induction motor and the electro-mechanical systems currently used to control them.

The standard, fixed-speed induction motor fulfils two basic requirements:

- To accelerate itself and its load to full speed (or speeds with multi-speed motors).
- To maintain the load at full speed efficiently and effectively over the full range of loadings.

Due to the constraints of materials and design, it can be difficult to achieve both objectives effectively and economically in one machine.

So, how does a motor start in the first place? As mentioned previously, motors convert electrical energy drawn from the power supply into a mechanical form, usually as a shaft rotating at a speed fixed by the frequency of the supply. The power available from the shaft is equal to the torque (moment) multiplied by the shaft speed (rpm). From an initial value at standstill, the torque varies, up or down, as the machine accelerates until reaching a peak at about two thirds of full speed, and then dropping to zero at synchronous speed. This characteristic means that induction motors always run at slightly less than synchronous speed in order to develop power (the ‘slip speed’), and hence the term asynchronous. Figure 3.3.2.1 shows a graph of an induction motor torque/speed curve, and illustrates this important characteristic of asynchronous three-phase induction motors.

Figure 3.3.2.1: Torque/Speed Curve – Induction Motor

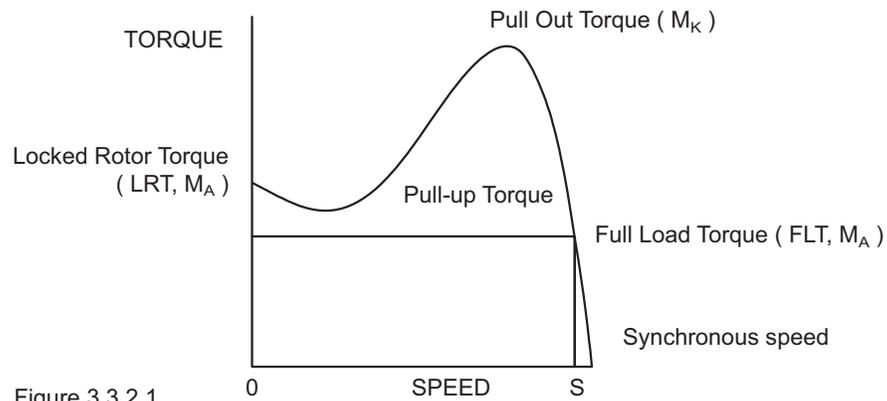


Figure 3.3.2.1
Torque/Speed Curve – Induction Motor

Figure 3.3.2.2: Torque/Speed Curve – Coupled Load

Each load coupled to an induction motor has its own speed/torque curve:

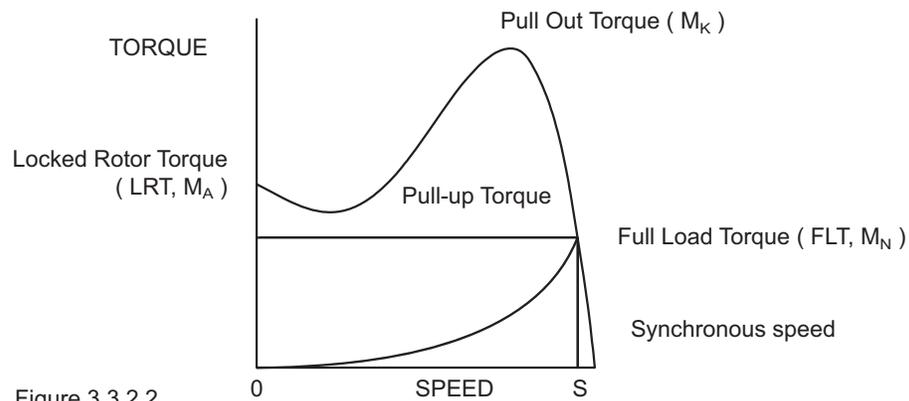


Figure 3.3.2.2
Torque/Speed Curve – Coupled Load

Figure 3.3.2.3: Torque/Speed Curve – Accelerating Torque

The acceleration of a motor-load system is caused by the difference between the developed torque (motor) and the absorbed torque (load), and is shown by the shaded area in the next figure:

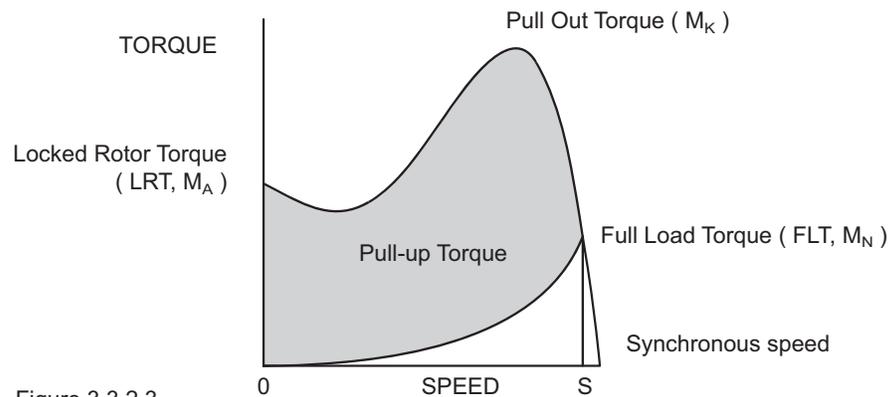


Figure 3.3.2.3
Torque/Speed Curve – Accelerating Torque

3.3.2 – The Induction Motor (continued)

Obviously, the larger the difference between the developed torque and the absorbed torque, the faster the acceleration and the quicker full speed is reached, and the greater the stresses experienced by the supply and drive systems during the acceleration process. An “ideal” start would accelerate the load with just sufficient force to reach full speed smoothly in a reasonable time, and with minimum stress to the supply and drive mechanisms.

Generally speaking, the motor speed/torque characteristic is controlled by the rotor resistance. A motor with high rotor resistance can generate its peak torque (pull-out torque) at standstill, giving the high break-away torque characteristic which reduces steadily as the speed increases, and becomes zero at synchronous speed. At the other end of the scale, a motor with a very low rotor resistance will produce a low starting torque, but will generate its peak torque closer to the synchronous speed. Consequently, this type of motor runs at full power with higher operating efficiency and low slip speed. It is possible to combine the twin requirements of high starting torque and efficient full-speed operation within a single motor by techniques such as double-cage or deep bar design, and this usually is the motor characteristic chosen for lifting and hoisting applications:

Figure 3.3.2.4: Torque/Speed Curve – High Starting Torque

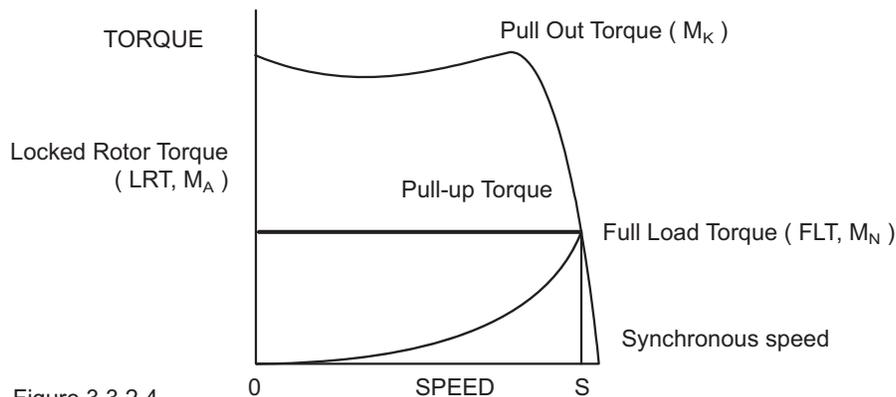


Figure 3.3.2.4
Torque/Speed Curve – High Starting Torque

However, most induction motors are designed to have a “standard” characteristic that provides a compromise between starting torque and operating efficiency. To summarize, **an induction motor will only start and accelerate when it produces more torque than the connected load absorbs.** This is true for all speeds, including standstill and full speed.

3.3.3 – Starting Induction Motors

Starting a de-magnetized induction motor from standstill is a demanding and complex process. At the instant of switching, all the energy must be present that is necessary to magnetize the motor, to provide the acceleration force, to supply the kinetic energy of the rotor and load, and to overcome the mechanical and electrical losses. To do so at full supply voltage places considerable stresses on the supply, the motor windings, and the iron cores of the stator and rotor. Excessive acceleration of a rotor when the mechanical load is small can produce torque oscillations in the shaft, causing severe wear to transmissions, gears and drives. Excessive acceleration when the load inertia is high, such as in centrifugal fans, causes belts to slip on the pulleys, producing rapid wear and early failure.

3.3.4 – Electro-Mechanical Methods Of Starting

Method A: Direct-on-Line

The most simple means of controlling energy flow to an induction motor is to interrupt the power supply by a single contactor. Very widely applied, the method is known variously as “direct-on-line”, “across-the-line”, “direct”, etc., and is the usual form of control where low cost is the first and most important consideration. As a result, it is most often used on small motor sizes (up to approx. 22 kW [30 hp]), or where the supply is strong enough to withstand the inrush and starting current surges without causing unacceptable voltage drops.

The harsh, damaging effects described earlier are all imposed by direct-on-line starting and, as a control method, it is the most destructive of equipment. Its simplicity and apparent low cost, although attractive at first sight, hide large cost penalties in the shape of increased maintenance, reduced transmission equipment life, and higher risk of motor failure, particularly when frequent starting and stopping is needed. In larger sized motors, special strengthening is necessary, at higher cost, before they can be safely used with direct-on-line starting.

However, the shortcomings of the direct-on-line starter have been recognized ever since motors have been used, and alternative systems have been developed over the years to reduce the damaging effects of this form of control.

Method B: Wye-Delta and other Reduced Voltage Starting Systems

Reduced voltage starting makes use of the fact that motor torque is proportional to the square of the terminal voltage. The most familiar type of reduced-voltage starter is the wye-delta, or star-delta starter.

Consisting of three contactors and a time switch (which can be mechanical, pneumatic, electrical, or electronic), the wye-delta starter changes the motor winding configuration from an initial wye connection to a delta connection as the motor accelerates. The change-over or transition point is controlled by the time switch and is usually arranged to be approximately at 80% of full speed. The effect of starting in the wye connection is to alter the voltage across each stator winding to 58% of normal. This reduces the starting torque to a third of locked rotor torque (LRT) with a consequent reduction in starting currents and acceleration forces.

Although an apparent improvement over the direct system, significant disadvantages still remain. The transfer from wye to delta momentarily removes the motor from the supply. During this time the motor is under the mechanical influence of the rotating load and, at the instant of disconnection, current will still flow in the rotor bars due to the time delay necessary for the magnetic flux to die away. Therefore, there is a residual flux “frozen” on the surface of the rotating rotor, which cuts the stator windings, generating a voltage whose frequency depends on the rotor speed. If the load inertia is small, such as in a pump, or if the friction is high, there could be a significant loss of speed during the time the supply is disconnected. In this case, when the reconnection to delta is made, a large phase differential can exist between the supply and the rotor fluxes. This can give rise to very large current surges (as much or more than full-voltage locked rotor current), together with massive transient torque oscillations, which can peak at levels in the region of fifteen times full-load torque. Although the effects described are only present for a very short period of time (about one fifth of a second), they are sources of great stress and damage to the whole drive system, and where frequent starting is necessary, invoke high maintenance costs. The current surges, in the form of very high-level short-duration “spikes”, are an increasing problem for computer control systems and other sensitive electronic equipment. The voltage disturbance on the supply is very difficult to filter out and can cause severe problems, especially when larger motors are involved.

There are methods of control, for example, the Wauchope starter, which eliminate or reduce the reconnection transients. However, such starters are expensive and have reliability implications, and they are not widely applied for these reasons.

The wye-delta starter also has disadvantages due to the restricted starting torque available (if you need 40% LRT to break-away, you can only increase the motor size, or revert to direct-on-line). Combined with the severe effects of the re-switching surges, and the additional costs of bringing six conductors from the motor to the starter instead of only three; wye-delta only offers an imperfect solution to the problem of starting the induction motor.

Method C: Primary Resistance Starter

It has long been recognized that the transition step in the wye-delta system was a source of problems such as welded contactors, sheared drive shafts etc. For many years a method of stepless control has been available in the form of the primary resistance starter.

This type of controller inserts a resistance in one, or more often in each, of the phase connections to the stator at start-up, after which it is progressively reduced and shorted out at the end of the acceleration process. Frequently, the resistances are movable blades that are gradually inserted into an electrolyte liquid. The mechanism is usually large and expensive, both to purchase and to maintain, and considerable heat is created by the passage of current through the electrolyte resistor. This limits the starting frequency (because the electrolyte has to condense back to liquid before a new start can proceed), and these restrictions prevent this starter from being a popular option when selecting a control system. However, it has the distinction of being the smoothest and least stressful method of accelerating an induction motor and its load.

Method D: Other Electro-Mechanical Systems

Other control methods such as auto-transformer starting (popular in North America), primary reactance starting etc., are employed to a greater or lesser extent, to compensate for some of the disadvantages of each type of starter discussed. Nevertheless, the fundamental problems of electro-mechanical starters remain, and it is only in the last decade or two that their dominance has been challenged by the introduction of power semiconductors controlled by electronics.

3.3.5 – The Semiconductor Motor Controller

During the 1950s, much effort was put into the development of a four-layer transistor device which had the power to switch large currents at high voltages when triggered by a very small pulse of current. This device became known as the silicon controlled rectifier (SCR), or in Europe, the “Thyristor”, and it is the basis on which all soft starting systems are built. The characteristic of most interest is the ability of the thyristor to switch rapidly (in about 5 millionths of a second) from “OFF” to “ON” when pulsed, and to remain “ON” until the current through the device falls to zero (which conveniently happens at the end of each half-cycle in alternating current supplies).

By controlling the switch-on point of a thyristor relative to the voltage zero crossing in each half wave of an alternating current, it is possible to regulate the energy passing through the device. The closer the turn-on point is to the voltage zero crossing point, the longer the energy is allowed to flow during the half-cycle. Conversely, delaying the turn-on point reduces the time for the energy to flow. Putting two thyristors back-to-back (or anti-parallel) in each of the phase connections to a motor, and by precisely controlling their turn-on points, an electronic soft starter continuously adjusts the passage of energy from the supply so that it is just sufficient for the motor to perform satisfactorily.

So, for instance, by starting with a large delay to the turn on point in each half cycle, and progressively reducing it over a selected time period, the voltage applied to the motor starts from a relatively low value and increases to full voltage. Due to the motor torque being proportional to the square of the applied voltage, the starting torque follows the same pattern giving the characteristic smooth, stepless start of the soft starter.

3.3.6 – Running Induction Motors

Once a start has been completed, the motor operating efficiency becomes of interest. When working at or near full load, the typical three-phase induction motor is relatively efficient, and readily achieves efficiencies of 85% to 95%. However, as shown below, motor efficiency falls dramatically when the load falls to less than 50% of rated output.

Figure 3.3.6.1: Motor Efficiency/Load Characteristic

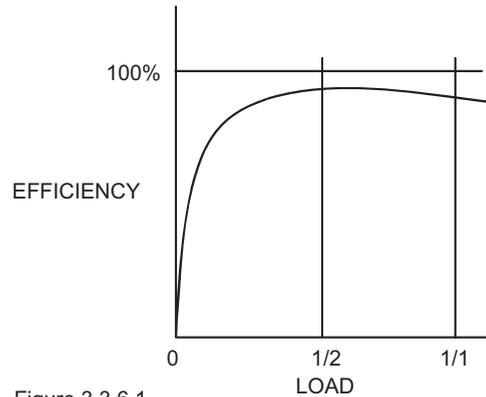


Figure 3.3.6.1
Motor Efficiency/Load Characteristic

In fact, very few motors actually experience consistent fully rated operation, and the vast majority operate at much lower loads due to either over-sizing (a very frequent situation), or natural load variations. For Fan and Pumping applications, the affinity laws will allow the inverter drive to show very considerable energy savings over virtually all other methods of control through varying the speed of the motor in response to changes in load. Where motor speeds cannot be varied, an optimizing version of semiconductor motor controller, such as the SR44, will also produce energy savings in lightly loaded motors. Less sophisticated systems of soft starters remain at full conduction, and the motor then behaves as if it were connected directly to the main supply. However, at light loads and mains voltages, induction motors always have excess magnetic flux, and efficiency loss and power factor degradation result. By detecting the load at any instant and adjusting the motor terminal voltage accordingly, it is possible to save some of the excitation energy and load loss, and therefore improve motor power factor when the motor is running inefficiently at light loads.

Figure 3.3.6.2: Motor Efficiency/Loss Characteristic

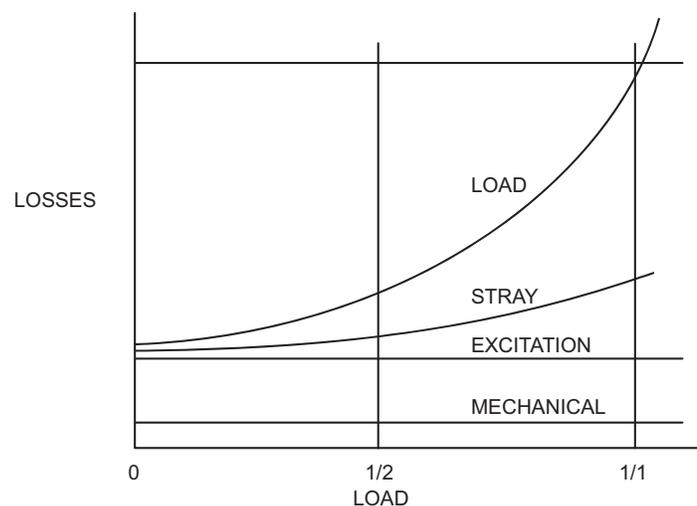


Figure 3.3.6.2
Motor Efficiency/Loss Characteristic

All SR44 Soft Starters are microprocessor controlled, and this gives them a number of advantages. Firstly, there are no adjustments to be made for the energy saving function; all calculations necessary to find the best degree of phase-back of the thyristors for any load condition is made by the microprocessor. Secondly, the start always synchronizes with the supply voltage, and a special structure of turn-on pulses virtually eliminates the inrush currents normally associated with motor start-up. This happens every time. Lastly, there is the absolutely stepless starting process, otherwise found only with primary resistance or reactance electromechanical starters – but without the wasted energy, and with the opportunity to control the maximum current allowed to flow during the starting process. Other features such as soft stopping are included to give considerable control over all modes of induction motor operation.

3.3.7 – Reliability Considerations

Reliability is an aspect which is of increasing concern regarding electronic controllers for induction motors. There is little point in installing an expensive item of electronic equipment to save potentially considerable amounts of money if the device is unreliable to the point that vital processes are constantly interrupted.

There are electronic products in the market place which appear to offer soft starting more cheaply. However, they almost always rely on less advantageous technologies such as analog control, or half-control, where one of the two thyristors in each phase is replaced with a diode. There are systems which only control the energy flow in one phase while the other two are directly connected. Owing to the variable quality and performance of many so-called inverters and soft starters available to the unsuspecting purchaser, international standards for these products have been developed.

So far, IEC 60947-4-2 – “AC Semiconductor Motor Controllers and Starters” defines the soft starter in every important respect, including thermal and overload performance as well as electromagnetic compatibility. By ensuring that any motor controller equipment purchased conforms to IEC 60947-4-2, a user should be reasonably safeguarded from shoddy or inadequate products when specifying equipment for future installations.

A particular advantage of the use of the optimizing soft starter is its impact on the maintenance requirements of associated electro-mechanical equipment. Optimizing lowers the surface temperature of the motor by reducing the losses within the motor. This prolongs the motor life, and reduces heating of the surrounding atmosphere in the process. If the atmosphere is subject to air conditioning, reducing the heat input will reduce the air conditioning costs. Reduced starting and running currents reduces cable losses, and contactor switching operations are carried out under the most advantageous conditions. No current flows on switch-on since all switching is carried out by the thyristors, which virtually eliminates the need for contact replacement.

Indeed, there are a growing number of installations where contactors are no longer employed, being replaced by controllable circuit breakers or isolators instead.

In summary, electronic controllers for most fixed-speed applications are opening new ways of increasing the efficient operation of induction motors, as well as offering significant benefits in control. Prospective users should ensure themselves of the quality and performance of any products they expect to fit, and this can be reasonably expected if compliance with the appropriate IEC standards is demanded.

3.4 – Principles of the Optimizing Mode

3.4.1 – Principles

Every wound-field electric motor must consume some minimum amount of energy to provide a magnetic field which enables it to work at all. With DC motors the field is under separate control, so that the amount of magnetizing energy can be adjusted to be sufficient to overcome losses and provide an armature reaction appropriate to the load. The squirrel cage AC induction motor has no such provision, with the result that energy is wasted at any load less than its rated full load (at full speed). When a squirrel-cage motor is supplied at a constant terminal voltage, as when it is connected directly to the supply without a controller of any kind, the strength of the field flux is fixed by the supply voltage. At normal running speed the field will take a fixed quantity of energy regardless of the torque demanded by the mechanical load. The energy required to support the load torque is determined by the torque demand. As load torque increases, the rotor slows down a little (ie 'slip' increases), causing induced rotor currents to also increase in order to increase the torque. These additional currents in the rotor are balanced by additional current in the stator coils. Conversely, if load torque demand falls, the slip decreases, the rotor currents decrease, and the current in the stator decreases accordingly. But at constant terminal voltage, the current providing the stator field flux remains unchanged at any level of load torque demand. As a consequence, the efficiency of an induction motor decreases as the load decreases.

Figure 3.4.1.1: Typical duty cycle for a machine load where the Torque Demand varies.

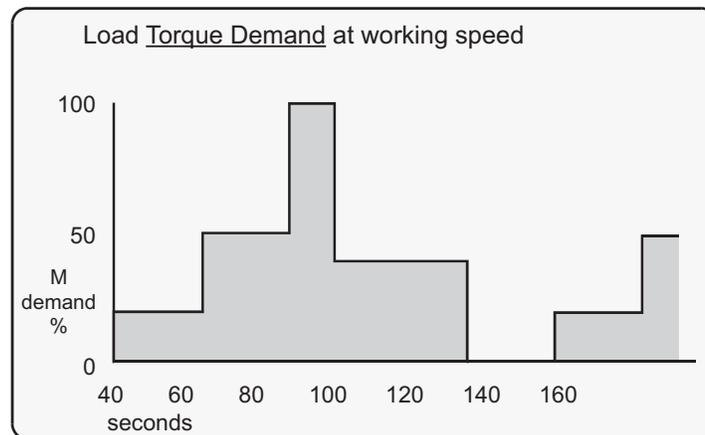
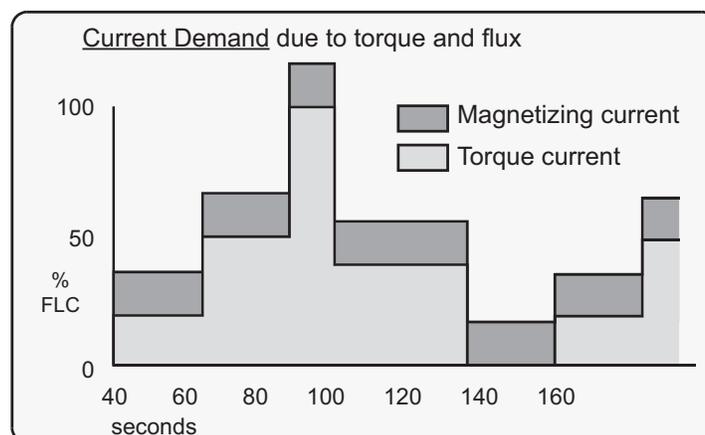


Figure 3.4.1.2: Torque Demand converted to an equivalent current with the motor magnetizing current added



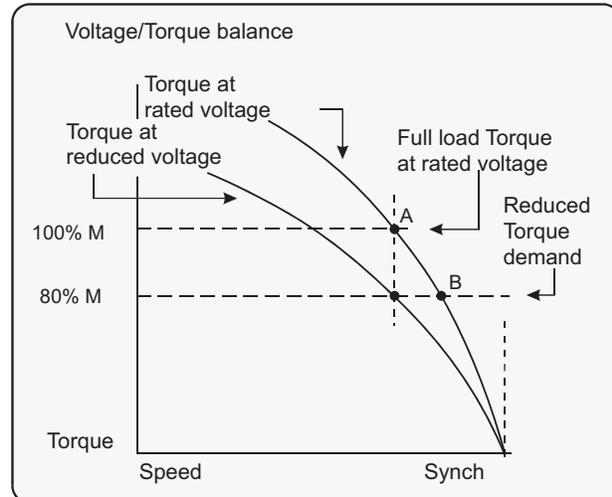
3.4.2 – Advantages of Energy Optimizing

A soft starter with an energy-optimizing feature alters the motor operation. The energy-optimizing function reduces the terminal voltage applied to the motor so that the energy needed to supply the field is more closely proportioned to the torque demand. The effect is shown in the Figure below.

Figure 3.4.2.1: 'Full Speed' end of the conventional Torque/Current curves.

The present considerations do not affect soft-starting options or strategies.

Point A on the current curve is the operating point of the motor when the motor terminal voltage is at its 'nominal', or rated value, and when the load is the maximum for which the motor is rated.



If the load decreases, a motor supplied at a fixed voltage will speed up slightly, the current demand will reduce, and the operating point moves along the curve to point "B". Because the torque developed by a motor is proportional to the square of the applied voltage, lowering the terminal voltage reduces the torque. If the reduced voltage is correctly chosen, the working point at the reduced torque demand becomes the point "A". By reducing the terminal voltage, the motor has in effect been 'exchanged' for one which has a lower rated power output. A reduced terminal voltage also means a reduced field energy requirement, and this simple relationship enables the optimizing function to maintain the efficiency of the motor over nearly the entire load range from 'no load' upwards. In practical terms, 'no load' means no external load. There are still internal mechanical and electrical losses to overcome – friction and windage of the rotor at speed, and the electrical heating and hysteresis losses. The ideal response to the 'no load' condition would be to supply precisely the amount of magnetizing current needed to provide the armature reaction to balance the losses. This is what the energy-optimizing feature of a soft starter seeks to do automatically and continuously.

3.4.3 – Additional Benefits in Practice

It is normal to select a standard motor with a rating somewhat higher than the maximum demand of the driven load. The motor selected for any given application will almost certainly be over-rated for this reason alone, and therefore energy could be saved even at full load when supplied at rated voltage. Furthermore, there are those applications where the size of motor has to be chosen to provide for high loadings which occur only intermittently, or for an arduous start, even though the load demand at most times is much lower.

3.4.4 – Optimizing with the SR44 System

During start-up, the SR44 software uses a patented method to compute and store a reference value for the power factor. When the motor has reached full speed and is driving the load at the demanded torque, the SR44 enters the 'motor running' stage. At this stage, if required, the motor may also operate in 'Optimizing Mode'. Entering this mode can be pre-set from the SR44 keypad and stored for automatic operation, which will suit the majority of applications where it is required. This is the default operating mode for the SR44. It can also be toggled on and off while running by using either the OPTIMIZE button on the keypad, or through external circuitry connected to one of the programmable inputs and controlled by the driven process.

In this mode the reference power factor is continuously compared with the running power factor. The software continuously uses this comparison to compute and adjust the firing point of the thyristors in order to maintain the best power factor. This method of continuous control minimizes wasted energy caused by overfluxing the motor. It also maintains the power factor at the most appropriate value for every condition of load demand. This can produce a significant reduction in the kVA demand.

This is an operating condition that may, at light or partial load conditions, provide the benefit of energy saving and if selected, is continuous from the dwell period until a STOP command is initiated or the mode is disabled. It should be noted that this function is inhibited by the software if the current being drawn by the motor exceeds 80% of the set current of the SR44 (at full voltage when the motor enters its running stage with the optimizing mode selected).

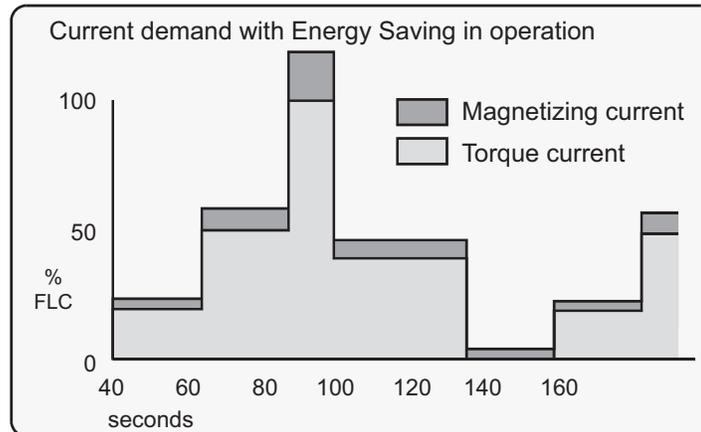
The method of power factor management described does not affect motor performance, nor does it detract from the motor's capability to respond to changes in load demand. This feature of the SR44 Soft Starter is a purely electrical function which has the effect of ensuring that the motor delivers the torque demanded at all times, but allows it to draw only the precise amount of magnetizing current required to support that torque output. Without this feature, the motor would draw the maximum magnetizing current regardless of load. The optimizing function cannot improve the power factor beyond what it would ordinarily be at full load, but it does make the optimum improvement possible at any partial load.

3.4.5 – How Much Energy?

The amount of energy used by a squirrel-cage induction motor operating with a soft starter in energy-optimizing mode is shown in the following figure (Figure 3.4.5.1), for the same duty cycle as Figure 3.4.1.2. By reducing the voltage when torque demand is below maximum, the magnetizing current is proportioned to the torque current.

Compare Figure 3.4.5.1 (energy-optimizing) with Figure 3.4.1.2 (non-optimizing). (These graphical representations are illustrative only and not to scale.) Arriving at any exact figure for the energy cost saved requires each individual case to be examined in detail, taking into account the motor rating, type, and any special characteristics such as load, load characteristics, duty cycle, supply voltage, and the cost of electricity.

Figure 3.4.5.1: Energy Savings



The calculations to cover all the likely or possible conditions would be laborious. An empirical method for arriving at a usefully realistic estimate has been devised. Used with a proper sense of engineering circumspection, the tables in Section 3.4.6 allow a user to gain a reasonably close estimate of the savings to be achieved within the motor by using the SR44 optimizing Soft Starter. The method does not include any additional savings and benefits conferred by other sources, such as:

- reduction of *heating losses* in cabling because of the lower voltages;
- potential reduction of *maximum demand* charges;
- further energy savings and other benefits deriving from the soft-starting process itself;
- reduced *total energy demand*;
- reduced *wear and tear*;
- reduced *maintenance and replacement* costs.

3.4.6 – Estimating Energy Savings

Basis for estimations:

- 3-phase squirrel cage induction motor, standard type.
- Supply: 380 to 440V, 50Hz.
- Supply voltage > minimum working voltage on motor rating plate.
- Operation 30% rated nameplate full load.

Table 3.4.6.1: Estimations

Energy Savings Estimations – Table 3.4.6.1			
Motor Size	kW	HP	Estimated Savings (% rated kW)
Less than	5	7.5	10
	22.5	30	6.5
	55	75	3.5
	110	150	2.5
More than	110	150	1.5

Table 3.4.6.2: Modifying Factors

Energy Savings Modifying Factors – Table 3.4.6.2			
Motor Poles		Motor Slip	
Number of Poles	Add (% kW)	% Slip	Add (% kW)
2	-0.5	0.5	-0.5
4	0	2	0
6	0.5	3.3	0.5
8	1	5	1

Examples of estimated savings:

- 1) 37.5 kW 4-pole motor
From Table 1, use the estimated savings figure for the next higher rating, ie 55 kW.
The savings would be approximately 3.5% x 37.5 kW = 1.3125 kW.
- 2) 37.5 kW 2-pole motor
From Table 1, use the estimated savings figure for the next higher rating, ie 55 kW.
From Table 2, apply the pole-number factor of -0.5 %.
The savings would be approximately (3.5 % - 0.5 %) x 37.5 kW = 1.125 kW
- 3) 37.5 kW 2-pole 'low slip' motor
From Table 1, use the estimated savings figure for the next higher rating, ie 55 kW.
From Table 2, apply the pole-number factor of -0.5 % and the %-slip factor of -0.5%.
The savings would be approximately (3.5 % - 0.5 % - 0.5 %) x 37.5 kW = 0.938 kW.

3.5 – Chapter 3 Glossary of Terms

Breakaway Torque	The minimum torque required to achieve rotor movement for the motor with its load.
Current Limit	The current at which the ramp is held. For the SR44, current limit is only active during start-up where it contributes to the motor control function. This feature is particularly useful when starting high-inertia loads that require an extended start-up period. (See also Overload Level.)
Direct-On-Line (DOL)	The direct connection and disconnection of a motor from the AC main supply by means of a contactor or switch. Acceleration and operation is at full mains voltage only.
Inrush Current or Locked Rotor Current	The current that flows at the instant of connection of a motor to the power source. It is limited by the impedance presented by a de-energized motor and the applied voltage. Usually expressed as a multiple of motor full-load current.
Kick-start Voltage	The percentage of supply voltage applied before commencing ramp-up when a load has a high breakaway torque and the standard settings of pedestal voltage may not allow sufficient torque to be developed by the motor to cause acceleration.
Overload Level	The level of current at which the controller overload begins to integrate. For the SR44, the overload detector is always active and provides protection against prolonged over-current operation.
Pedestal Voltage	The voltage that the unit applies to the motor at start-up. It is expressed as a percentage of the rated supply voltage.
Power Factor	The ratio, expressed as a trigonometric cosine, of the real power consumption to the apparent power consumption.
Top of Ramp (TOR)	The unit achieves Top of Ramp (TOR) when it completes the start-up stage of motor control. (This occurs when the voltage applied to the motor first equals the main supply voltage.)
Soft-start	The regulation by electronic means, of the supply voltage from an initial low value to full voltage during the starting process. This over-comes the inherent drawbacks of a switched supply. The motor torque is modified in proportion to the square of the voltage applied.
Trip	A trip occurs when the unit removes power to the motor because its operation equals the limit imposed by one of its self-protection features.

3.6 – Power Factor Conversion Chart

Parameter 20 is the reference power factor that the SR44 computes during the start. Parameter 21 is the present power factor of the load. The keypad display shows each of these parameters in angular degrees.

The table below can be used to convert this value (θ , in degrees) to the power factor ($\cos \theta$).

Power Factor Conversion Chart							
Degrees	Power Factor		Degrees	Power Factor		Degrees	Power Factor
0	1.00		30	0.87		60	0.50
1	1.00		31	0.86		61	0.48
2	1.00		32	0.85		62	0.47
3	1.00		33	0.84		63	0.45
4	1.00		34	0.83		64	0.44
5	1.00		35	0.82		65	0.42
6	0.99		36	0.81		66	0.41
7	0.99		37	0.80		67	0.39
8	0.99		38	0.79		68	0.37
9	0.99		39	0.78		69	0.36
10	0.98		40	0.77		70	0.34
11	0.98		41	0.75		71	0.33
12	0.98		42	0.74		72	0.31
13	0.97		43	0.73		73	0.29
14	0.97		44	0.72		74	0.28
15	0.97		45	0.71		75	0.26
16	0.96		46	0.69		76	0.24
17	0.96		47	0.68		77	0.22
18	0.95		48	0.67		78	0.21
19	0.95		49	0.66		79	0.19
20	0.94		50	0.64		80	0.17
21	0.93		51	0.63		81	0.16
22	0.93		52	0.62		82	0.14
23	0.92		53	0.60		83	0.12
24	0.91		54	0.59		84	0.10
25	0.91		55	0.57		85	0.09
26	0.90		56	0.56		86	0.07
27	0.89		57	0.54		87	0.05
28	0.88		58	0.53		88	0.03
29	0.87		59	0.52		89	0.02

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ELECTROMAGNETIC COMPATIBILITY



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4.0 – Electromagnetic Compatibility (EMC)

As supplied, all SR44 Soft Starters meet the standards of emission and immunity levels defined in the IEC 60947-4-2 and EN 60947-4-2 product standards for AC Semiconductor Motor Controllers and Starters. However, the EMC performance of the controller can be significantly affected by the manner in which it is incorporated into the system in which it is intended to operate. To prevent inadvertent degradation of EMC performance, attention must be given to motor cable lengths, wiring configurations, the nature of the power supply, etc., at the design, construction and implementation stages of a project.

4.1 – Introduction

It is widely accepted that electromagnetic compatibility between electronic and electrical products is a desirable objective. Technical standards are increasingly stipulating levels of EMC performance which compliant products are required to meet. The decision by the European Union (EU) to implement a community-wide directive covering EMC caused considerable activity among electrical and electronic equipment manufacturers and suppliers to identify, understand, and mitigate the sources of electromagnetic interference within their products and systems.

4.2 – Applicable Standard Within the EU

The product standard which defines EMC performance for soft starters is IEC 60947-4-2 'AC Semiconductor Motor Controllers and Starters'. (The Official Journal of the EC will list this standard as EN 60947-4-2.) The SR44 has been type tested in accordance with the test procedures and levels laid down in the product standard.

4.3 – Mandatory Requirements Within the EU

(Applicable to any person involved in the installation and operation of the equipment.)

The EU Directive 89/336/EEC, describes the required EMC performance of all electrical equipment which is to be connected to a low voltage supply network. It imposes an obligation on the manufacturer of the soft starter to provide sufficient information for installers, system integrators, users, and anyone else connected with the installation and operation of the equipment. This section provides the technical information to support the obligation of the manufacturer.

The provision and maintenance of compatibility extends from the manufacturer to the panel builder, assembler, systems integrator, and ultimately to the installer and user. Anyone involved in the installation and operation of the equipment, through a lack of knowledge, misdirection, or for other reasons, can completely negate the initial EMC performance of the equipment.

4.4 – Guidance for Installation Personnel and System Designers

For safety reasons, all SR44 products are intended to be installed and set to work by skilled personnel who are capable of interpreting and following EMC guidelines correctly. Any person not fully trained in the appropriate technology should not attempt the installation.

If you do not understand, or if you are unclear about any part of these guidelines, then please consult your supplier. Often, consultation with the supplier can avoid unnecessary problems in specifying and installing the correct combination of equipment.

4.5 – EMC Basic Criteria

The electromagnetic compatibility of a product is defined by two criteria:

- 1) Immunity to electromagnetic disturbances generated externally to the product.
- 2) The type and amount of conducted and radiated electromagnetic emissions emanating from the product.

Ascertaining the nature of the power supply is of primary consideration when deciding on appropriate EMC requirements. The requirements for equipment installed in heavy industrial environments (fed from their own isolated low voltage power supply) differ from those installed in residential, commercial, light industrial, and health-care applications (directly connected to a public low-voltage network).

Generally, industrial installations require higher immunity levels and permit higher levels of conducted and radiated emissions than those for non-industrial installations. On the other hand, lower levels of emissions output, and lower immunity levels, are specified for installations connected directly to the public low-voltage network.

4.6 – Purchasing Implications of Meeting an EMC Standard

Before purchasing components for the installation, the specifier must evaluate the expected source of power for the Soft Starter and understand exactly the implications for meeting EMC requirements. It is likely that failure to do so will result in the purchase and installation of inappropriate equipment. Close consultation with your supplier will avoid these unnecessary problems, particularly when you do not understand, or are unclear about any part of the guidelines given later in this section. If you have any doubt, please ask.



IMPORTANT: The information and guidance given in section 4.7 forms part of the statutory requirements of the European Union Directive 89/336/EEC on EMC.

4.7 – Basic EMC Considerations

4.7.1 – Immunity

The product standard for immunity requirements is EN 60947-4-2:1996. All SR44 Soft Starter products meet, or exceed the industrial level immunity requirements laid down in this standard.

4.7.2 – Emissions

Emissions are classified as low frequency (below 9kHz), known as harmonics, and high or radio frequency (above 9kHz). Both radio-frequency emissions and low-frequency harmonics are generated by the action of the SR44 Soft-Starter.

4.7.3 – Emissions - Harmonics

During normal operation, soft starters turn their semiconductor switches on and off in order to vary the voltage at the motor terminals, and this introduces supply discontinuities and generates harmonics. However, the mode of pulsing used by SR44 Soft Starters minimizes these harmonic effects, since SR44 power circuits are configured as a fully-controlled regulators (W3C).

Only non-triplen (integer multiples of the third harmonic), odd harmonic frequencies are created, starting with and diminishing rapidly from the fifth harmonic, and virtually disappearing by the nineteenth harmonic.



The generic limits for harmonics for soft starters which operate with a power level > 1kW are under consideration.

*Until these limits have been defined, **harmonic filters are not required for any SR44 Soft Starter.***

4.7.4 – Emissions - Radio Frequency (RF)

Radio frequency emissions are propagated in two ways:

- 1) Conduction along the leads supplying the soft starter.
- 2) Radiation from the operating equipment.

They also have two sources:

- 1) The high-frequency currents associated with the control electronics (this includes the microprocessor)
- 2) The action of the semiconductor devices forming the power switching elements located in the controller main circuits.

The radiation measurements made from operating versions of SR44 Soft Starters show levels lower than the allowed limits. Further, enclosures (or cubicles) of metallic construction provide additional shielding for SR44 Soft Starters mounted within them. The only radiated interference effect that might arise from a soft starter would be if mobile telephones, walkie-talkies, etc. were to be used in very close proximity to a unit which was operating with the enclosure door open. For this reason, any enclosure must display a label that brings the possibility of electromagnetic interference to the attention of the operator under these circumstances.

4.7.5 – Emissions - Conducted

Conducted emissions are able to travel great distances and may cause interference to any neighboring consumers connected to the common low-voltage supply network.

Allowable levels for conducted emissions generated by semiconductor motor controllers and starters are influenced by the nature of the low-voltage power distribution network. The determining factor is whether the source of power is, either:

- (a) a private supply with a single consumer whose Point of Common Coupling (PCC) is at a high or medium voltage transformer, or
- (b) a public low-voltage network with more than one consumer, where the individual PCC is made directly to the network itself.

The first type of supply (a) is identified as "Industrial", and requires the use of soft starters compliant with EN 60947-4-2 Table 14: 'Equipment Class A Emission Levels'.

The second type of supply (b) is identified as "Residential" and requires the use of Equipment Class B Apparatus.

SR44 Soft Starters are able to comply with either classification provided the appropriate action is taken. (Section 4.7.7 describes the strategies for attaining and maintaining compliance.)

4.7.6 – Important Systems Information:

The specification limits for both equipment classes assume systems are grounded at the star (wye) point of the supply transformer through low impedance connections.

Certain industries, particularly continuous process industries, employ distribution systems that operate either with a ground connection through a high impedance or without a ground at all. These systems may cause severe problems of operator safety when installed with capacitive high frequency filters. Such systems are not considered in this document.

In the case of an isolated or high impedance grounded system, seek advice from your supplier before fitting a capacitive high frequency filter to an SR44 Soft Starter. It is essential that the specifying authority, user, or installer has a clear knowledge of the type of network to which the product is to be installed before making decisions as to which EMC strategy to adopt.

As supplied, all SR44 products comply with the conducted emissions requirements for Equipment class A soft starters as defined by EN 60947-4-2:1996 Table 14. However, the length and type of cable connecting the motor to the starter module materially affects the level of emissions generated, and can amplify them greatly. The standard also allows different levels of emissions depending on motor rated current, which also affects the need to fit filters. The EN 60947-4-2:1996 standard only requires consideration of steady-state conditions for EMC purposes, and expressly excludes varying conditions such as those during ramp-up and ramp-down. Therefore, closing a bypass contactor around the module during the run condition will remove the need for any high frequency filters. However, some of the features (protection, optimizing etc.), which are active during the run state, are disabled when the bypass contactor is closed. Users need to assess the cost and merit of fitting a bypass contactor compared with the cost of a filter when it is required.

Finally, statistics show that the number of disturbances arising from soft starters, operating in a very wide variety of applications and networks throughout the world, is insignificant. Where EMC disturbances occur, it is very unlikely that they can be genuinely attributed to a soft starter.

4.7.7 – Strategies for Attaining and Maintaining EMC Compliance

Where possible, minimize the effect of electrical interference by using the strategies listed below.

- Locate the SR44 Soft Starter unit as close as reasonably possible to the motor terminal box in order to minimize cable length.
- Ensure that, within any enclosure, the control wiring does not run parallel to the power wiring. Where this is unavoidable, maintain a 100 mm [3.9 in] separation between control cables and power cables.
- Where possible, ensure that the control wiring crosses at right angles to the power wiring. This practice reduces the cross-coupling between cables.
- Shield any cables carrying sensitive signals. The digital control inputs to a SR44 are opto-isolated, and do not normally require buffering (e.g. through a small relay) or shielding.

Compliance in residential environments (Equipment class B) can be achieved by one of the following two methods:

- a) Bypassing the soft starter with an AC1 rated contactor controlled by the programmable relay set to the 'top-of-ramp'. (The ramp-up and ramp-down features remain effective in this configuration)
- b) By running the soft starter in phase loss only mode.

Where a special purpose system filter has been applied at the point of common coupling, additional filtering of individual drives is not necessary and may introduce undesirable effects due to resonance.

For the purposes of EMC, the connections between the SR44 controller and motor are considered to be an extension of the enclosure, and preferably should be contained within grounded metallic trucking or conduit. Armored cable may be used providing it is correctly terminated, although the EMC performance will be slightly inferior. Shielded cable is not necessary.

An alternative method of achieving the residential environment EMC requirements is to insert a special purpose filter designed for use with variable-frequency drives. Care must be taken to ensure that the short-term current rating of the filter will allow for the starting currents experienced. If this method is adopted, it is essential that the motor/controller connections are kept within 10 meters.

All associated electrical and electronic equipment near to the controller complies with the emission and immunity requirements of the EMC Directive.

KEYPAD MENU ITEMS AND PARAMETERS



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**KEYPAD MENU ITEMS
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5.0 – How to Use This Chapter

SR44 Soft Starters have two basic types of settings that can be changed and/or viewed by users.

- Keypad Menu Items:
These settings have no numerical address, and can be accessed only through a keypad.
- Parameters:
These settings have numerical parameter numbers and numerical addresses, and they can be accessed through a keypad or by serial communications.
(Optional accessories are required for serial communications; refer to the “Accessories” chapter.)

5.0.1 – How Keypad Menu Items and Parameters are Arranged in this Chapter

1) Keypad Menu Structure – Abbreviated Map of Keypad Structure

This section contains a one-page flow chart that shows an abbreviated ‘map’ of the keypad layout, and how to scroll through the keypad to access the Keypad Menu Items and Parameters.

2) Keypad Menu Structure – Complete Keypad Menu Structure

This section contains tables that list all of the Keypad Menu Items and Parameters arranged in the same groups and sequential order as they can be accessed through a keypad menu.

3) Parameter Basic Information

This section contains tables that list and briefly describe all of the Parameters. They are listed in their numerical sequence, which is the same sequence as they can be accessed through the ‘Parameters’ menu of the keypad. (Some of the parameters may be accessed alternately through some of the other menu groups of the keypad.)

4) Menu Settings and Parameter Descriptions

This section contains detailed descriptions of all of the available Menu Items and Parameters. These items are presented in the same groups and sequential order as they can be accessed through a keypad menu.

Some of the Parameters can be accessed through non-parameter menu groups, and they are listed in the same sequence as they can be accessed through those groups, regardless of their numerical order.

All of the Parameters can be accessed through the ‘Parameters’ menu group in numerical sequence. Therefore, they are listed in the ‘Parameters’ menu group in numerical order.

5.1 – Configuring the SR44 Soft Starter

5.1.1 – General Configuration Information



WARNING: The owner, installer, and user are responsible for the correct installation and use of the SR44, and must ensure that only qualified personnel install the SR44. The owner, installer, and user must ensure that the installation, operation and maintenance of the SR44 complies with the relevant Codes of Practice, Regulations, and Statutory Requirements. The Manufacturer or his agent do not assume any liability, expressed or implied, for any consequence resulting from inappropriate, negligent, or incorrect installation, application, use or adjustment of the product or circuit design, or from the mismatch of the SR44 to a motor. To prevent an electrical shock hazard, the SR44 must be properly connected to a safety ground. The SR44 is not designed for use in hazardous areas. Use in such an area may invalidate the hazardous area certification.

Firmware Versions

This manual applies to all versions of SR44 firmware.

Useful Information

Additional useful quick-start information can be found in the following document which is available on our website, www.automationdirect.com:

- Stellar SR44 Soft Starter Basic Quick-start Guide.

Conventions

The following typographical conventions are used in this programming chapter of this user manual:

1. Characters that are quoted directly from the SR44 display are quoted within single quote marks. This includes:
Menu names: 'Basic';
Parameter names: 'Start Time';
Parameter values: '5 Seconds';
Status information: 'Stopped and ready'.
2. Buttons on the keypad to be pressed by the user will be indicated by their name, ENTER, in all capital letters, or by the appropriate symbol. Thus, ▼ indicates the decrement, or move down button.

Quick Start

Once the unit is mounted and wired per the instructions in the "Stellar SR44 Soft Starter Basic Quick-start Guide", or in the "Mechanical Installation" and "Electrical Installation" chapters of this User Manual, then select a suitable application from the "Applications Menu" described later in this chapter (5.2.2 & 5.4.2). The unit can then be started with the keypad. This will give a good basic setup, but fine tuning will be required in some instances.



We highly recommend that you configure the SR44 by first selecting and setting an application from the "Applications" menu that is similar to your application. If necessary, you can then 'fine-tune' your configuration by changing the settings of other parameters and menu items.

5.1.2 – User Interface

The Keypads

There are three types of user interface for use with the SR44 (Only one interface may be used at any one time.):

- The unit's built-in keypad (Figure 5.1.2a),
- An optional remote keypad (Figure 5.1.2b and "Optional Hardware" chapter),
- Optional Modbus communications ("Modbus Protocol" & "Optional Hardware" chapters).

All parameters that control the operation of the SR44 Soft Starter can be accessed via the interfaces. Parameters and their values are shown on the interface display, and any changes to parameter values are affected by using the buttons on the interface. The interface has three basic modes of operation:

- System Status Mode
- Menu Navigation Mode
- Data Entry Mode

Explanation of the modes mentioned above can be found in sections 5.2.3, 5.2.4, and 5.2.5.

Figure 5.1.2a: Keypad

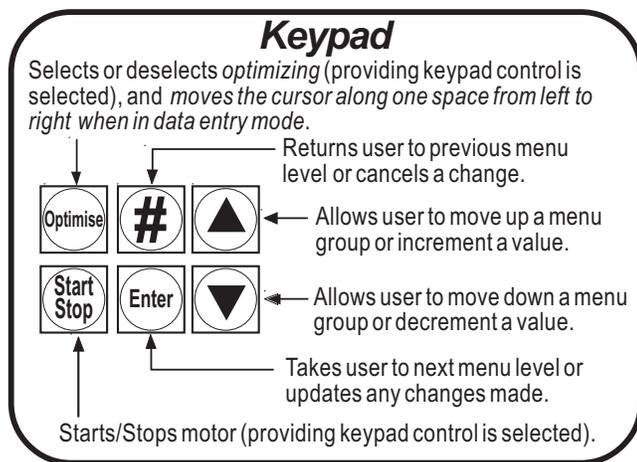
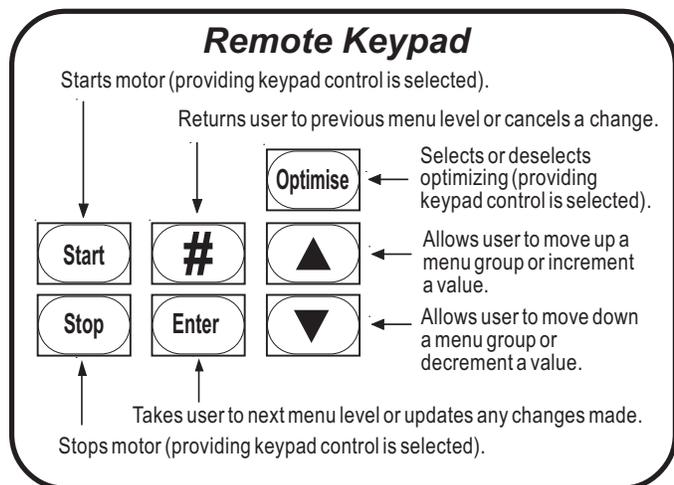


Figure 5.1.2b: Remote Keypad



Menu Structure

The menu structure of the user interface gives the operators two main routes by which they can change the operation of the SR44; the text based menus or the number based parameter list. The Menu Items and Parameters which are most commonly used by operators are shown and described in section 5.2 "Keypad Menu Structure". Section 5.3 "Parameter Basic Information" shows basic information for the Parameters, and section 5.4 "Menu Settings and Parameter Descriptions" provides more detailed information on both Menu Items and Parameters.

5.1.3 – System Status Mode

Following the initial boot-up report (see section 5.1.9), the unit enters the Status Mode. In this mode the operating status of the unit is constantly displayed, resulting in a number of status messages:

Non-Running Status

Two messages indicate that the unit is not running the load at present. 'Stopped and Ready' indicates the unit is enabled, and 'Starter Disabled' indicates that the unit is disabled. (See Appendix A.1.2).

Fault number Fault description

This message indicates that a fault has occurred, giving the fault number and a short fault description such as '#1 Phase Loss'. The second line of the message tells the user to reset the unit with the # key.

Temporary Comms Status Errors

These messages, ('CRC Error', 'Slave Busy', 'Illegal Address', and 'Illegal Function') tell the user when there has been a Modbus Comms Error. (See the Modbus chapter for more details.)

Running Status

This message indicates which running mode the unit is in either, 'Starting', 'Full Volts', or 'Optimizing'. The second line of the message gives a current indication in Amps. If an overload condition exists, then a bar graph indicating the state of overload integration will be shown across both lines on the right hand side of the display.

5.1.4 – Menu Navigation Mode

The Menu Navigation Mode is entered as soon as the ENTER button is pressed in the System Status Mode. In this mode, the user can navigate through all levels of the menu structure using the relevant buttons on the keypad. (See Figures 5.1.2a & 5.1.2b).

5.1.5 – Data Entry Mode

The Data Entry Mode is entered as soon as the bottom level of the menu structure for that particular menu branch is reached, i.e., a menu item or parameter name is displayed in the top line of the keypad display, and the associated value is displayed in the bottom line of the display. Not all parameter values can be changed by the user, as some are read-only.

A user can tell whether the menu item or parameter is writeable, as there will be a flashing cursor present on the bottom line of the display if writing is permitted. Writeable values may be changed by using the Up and Down keys (for a numerical value), or by pressing ENTER (for a change in a logic value). In the first case (a numerical value), the ENTER key must be pressed to confirm the changed value. The user interface display will flash once to confirm the change.



To keep Menu Item and Parameter setting changes, they must be permanently saved using the 'Permanent Store' menu. (See section A.1.5 for more information.)

5.1.6 – Changing Parameter Values

All parameters can be read by the user, and some parameters can also be written to by the user. The full list of parameters and their values can be found in the Parameter Menu and subsequent sub-menus. The most commonly read and written to parameters can also be found under the other Level 1 (see Figure 5.2.1) menus such as 'Basic' and 'Applications'. A simple example of how to view and change a parameter value is given in Appendix A.1.3.



To keep Menu Item and Parameter setting changes, they must be permanently saved using the 'Permanent Store' menu. (See section A.1.5 for more information.)

5.1.7 – Soft Starter Data Types

There are basically four types of data held in parameters: Analog, Multiple, Percentile, and Bit data. Their definitions are given below:

Analog Data

One of a range of values between two extremes (usually 0–255, 0–50 or 0–10) that represent units such as Volts, Amps, seconds, etc. For example: 'Start Time' ('Stopped & ready' --> 'Basic' --> 'Start Time') would be set at 5 seconds by default, but can be set to a maximum of 255 seconds.

Multiple Data

A multiple of an absolute quantity. For example: the running current displayed by the unit is a multiple of the value of the unit's 'Rated Current' (e.g. 1.0 x 'Rated Current' to 8.0 x 'Rated Current'). Note that the unit's 'Rated Current' normally approximates the motor or load Full Load Current.

Percentile Data

Percentage value of an absolute quantity, ranging from 0–100%. For example: the 'Kick Pedestal' ('Stopped & ready' --> 'Advanced' --> 'Kick Pedestal') is the percentage of supply voltage applied to the unit during an optional start-up kick.

Bit Data

This represents the selection or non-selection, turning 'On' or turning 'Off' of whichever bit parameter is in question.

5.1.8 – Bit Masks

Some parameters can also be addressed via the appropriate Bit Parameter, instead of or as well as being accessed via the more commonly used menus. These Bit Parameters can only be accessed by the 'Parameters' menu, i.e., the menu path for the Auto Config Bit Parameter would be: 'Stopped & ready' --> 'Parameters' --> 'P1 to P20' --> 'P18 Auto Config'. The user would then see a display similar to the one below:

Parameter Name:	P18 Auto Config
Bit Data:	0000011<u>0</u> Flags
Bit Number:	7_ _ _ _ _ 0



Note: Only the text shown in the shaded box would actually be displayed by the user interface.

A cursor would be flashing at the character on the display which represents the Least Significant Bit (LSB, also known as bit 0, i.e., the 0 or 1 on the right hand side of the eight 0's and/or 1's). This character is actually underlined for clarity in the example above.

The cursor represents the user's current input point, and the value of the bit highlighted by the cursor can now be changed. To move the cursor one place to the left, the user needs to press the OPTIMISE key, and the user will then be able to edit bit 1. Pressing the OPTIMISE key repeatedly will continue to move the cursor one place to the left until bit 7, or the Most Significant Bit (MSB; the 0 or 1 on the left of the eight 0's and/or 1's) is reached, after which pressing the OPTIMISE button again will wrap the cursor around to bit 0.

To continue with the example, let us suppose that the user wishes to enable the 'Auto Pedestal' (bit 7) and disable the 'Auto Bypass' (bit 2). The user should first press the OPTIMISE button twice to move the cursor two places to the left to bit 2. Then to change the value of bit 2 from "1" to "0", the user would simply press the ▼ key once. To move the cursor to the 'Auto Pedestal' bit (bit 7), the user would now press the OPTIMISE button five times. Then to turn on the 'Auto Pedestal' bit, just pressing the ▲ key once will change the bit to the required value. To confirm the changes made, the user would then press the ENTER button. Not pressing ENTER would effectively cancel the changes made by the user.

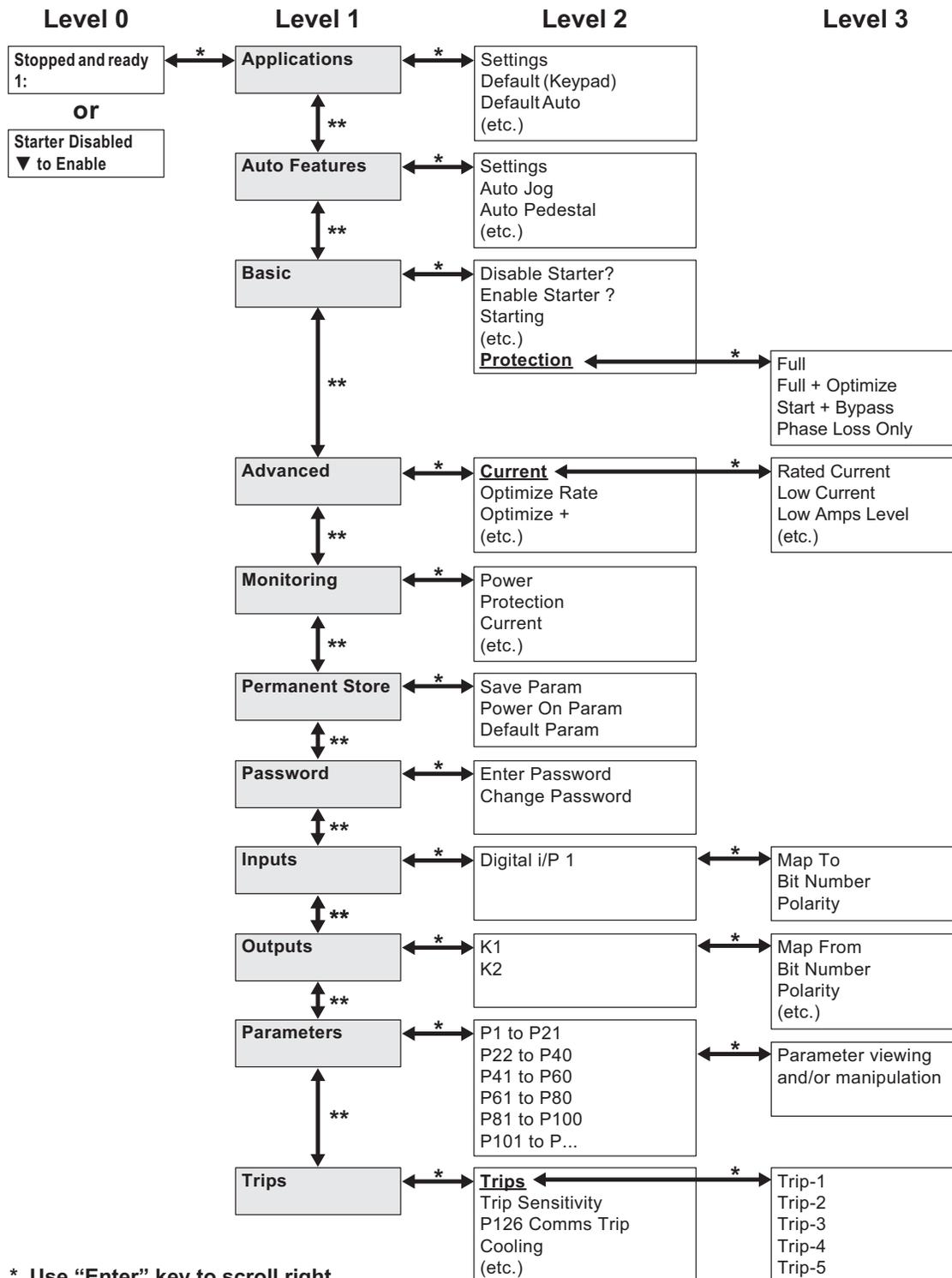
5.1.9 – Keypad Boot-up Messages

When the control supply to the SR44 is switched on, the user interface will go through a boot-up procedure during which it will display some information relevant to the SR44's current state. The messages are displayed during the boot-up procedure in the order that they are listed below. (A brief explanation of each message is included.)

'V1.069LM 10/12/16'	This message shows the keypad firmware version number and release date (date displayed in European format; YY/MM/DD).
'1 Find Starter'	This message indicates that the keypad is looking for a Soft Starter, starting with a station number of "1". If it is unable to find a starter with that station number, it will move on to station number 2, etc., until 32, (the highest valid station number) is reached. See section 5.3.4 for further details.
'Password is Set'	This message appears if the password has been set.
'Stopped & ready 1:'	'Stopped and ready' is displayed after the end of a successful boot-up procedure. The number on the second line is the station number of the unit that the keypad is currently talking to.

5.2 – Keypad Menu Structure

5.2.1 – Abbreviated Map of Keypad Structure



* Use "Enter" key to scroll right
Use "#" key to scroll left

** Use "▲" & "▼" keys to scroll up & down

5.2.2 – Complete Keypad Menu Structure



We highly recommend that you configure the SR44 by first selecting and setting an application from the “Applications” menu that is similar to your application. If necessary, you can then ‘fine-tune’ your configuration by changing the settings of other parameters and menu items.



To keep Menu Item and Parameter setting changes, they must be permanently saved using the ‘Permanent Store’ menu. (See section A.1.5 for more information.)

Keypad Menu Structure								
Horizontal Keypad Scrolling: Enter key = right (forward); # key = left (back)								
	Level 0	Level 1	Level 2	Parameter / Bit #	Level 3	Parameter / Bit #		
Vertical Keypad Scrolling: Down Arrow key = down; Up Arrow key = up	Stopped and Ready 1: –or– Starter Disabled 1: ▼ to Enable	Applications	Settings		n/a			
			Default (Keypad)					
			Default Auto					
			Small Pump					
			Large Pump					
			Conveyor					
			Low Inertia Fan					
			Hi Inertia Fan					
			Recip Compressor					
			Screw Compressor					
			Rotry Compressor					
			Crusher					
			Grinder					
			Hi Torque Start					
			Motor Gen Set					
		aerator						
		Flywheel / Press						
		Moulder						
				Auto Features	Settings	P18	n/a	
					Auto Jog (On/Off)	P18 / B3		
					Auto Pedestal (On/Off)	P18 / B7		
					Auto End Start (On/Off)	P18 / B6		
					Auto Stop (On/Off)	P18 / B5		
		Auto End Stop (On/Off)	P18 / B4					
		Auto Bypass (On/Off)	P18 / B2					
		Auto 3MC (On/Off)	P18 / B1					
		Auto Ramp (On/Off)	P18 / B0					
		Auto All (On/Off)						
		P122 Stop Smoothing (On/Off)	P121 / B2					

Table continued next page.

5.2.2 – Complete Keypad Menu Structure (continued)

Keypad Menu Structure (continued)								
Horizontal Keypad Scrolling: Enter key = right (forward); # key = left (back)								
Vertical Keypad Scrolling: Down Arrow key = down; Up Arrow key = up	Level 0	Level 1	Level 2	Parameter / Bit #	Level 3	Parameter / Bit #		
	Stopped and Ready 1: -of- Starter Disabled 1: ▼ to Enable	Basic	Disable Starter?	P52 / B1&B2		n/a		
			Enable Starter?					
			Starting (Keypad/Remote)	P51 / B7				
			Start Pedestal (20%)	P11				
			Start Time (5s)	P12				
			Stop Pedestal (10%)	P16				
			Stop Time (0s)	P17				
			Current Limit (3.5I _e)	P30				
			Protection	P7			Full	P7 / B6
							Full + Optimise	P7 / B6 & B7
	Start + Bypass	P7 / B7						
Phase Loss Only	P7 / B0							

Table continued next page.

5.2.2 – Complete Keypad Menu Structure (continued)

Keypad Menu Structure (continued)					
Horizontal Keypad Scrolling: Enter key = right (forward); # key = left (back)					
Level 0	Level 1	Level 2	Parameter / Bit #	Level 3	Parameter / Bit #
Vertical Keypad Scrolling: Down Arrow key = down; Up Arrow key = up	Stopped and Ready 1: -or- Starter Disabled 1: ▼ to Enable	Current		Rated Current (I_e)	P24 & P25
				Low Current (On/Off)	P51 / B4
				Low Amps Level (0.1xFLC)	P28
				Low Amps Time (50 cycles)	P29
				C/L Time Out (On/Off)	P51 / B1
				Current Limit ($3.5xI_e$)	P30
				Limit Time Out (30s)	P31
				Shearpin (On/Off)	P51 / B3
				Shearpin Level ($3.125xI_e$)	P32
				Shearpin Time (100 cycles)	P33
				Overload Level ($1.1xI_e$)	P34
				Overload Delay (140)	P35
			Optimise Rate (5)	P19	n/a
			Optimise + (On/Off)	P121 / B4	
			Kickstart (On/Off)	P51 / B0	
			Kick Pedestal (75%)	P13	
			Kick Time (25 cycles)	P14	
			Dwell Time (5s)	P15	
			Low Volts Stop (On/Off)	P52 / B0	
			Contactors Delay (160ms)	P71	
			Trip Sensitivity (1)	P72	
			Station Number (1)	P1	
			Firing Mode (0)	P6	
			P122 Stop Smoothing (5)	P122	
			Cooling (On/Off)	P53 / B5	
			Cooling Time (-)	P116	
			Temp/Alt Derate (0%)	P123	
			Line Contactor (On/Off)	P121 / B3	
			Thermistor Trip [not available]	P51 / B5	
			P126 Comms Trip (On/Off)	P126	
			P109 Upper Limit (12)	P109	
			P110 Lower Limit (10)	P110	

Table continued next page.

5.2.2 – Complete Keypad Menu Structure (continued)

Keypad Menu Structure (continued)							
Horizontal Keypad Scrolling: Enter key = right (forward); # key = left (back)							
	Level 0	Level 1	Level 2	Parameter / Bit #	Level 3	Parameter / Bit #	
	Vertical Keypad Scrolling: Down Arrow key = down; Up Arrow key = up Stopped and Ready 1: --or-- Starter Disabled 1: ▼ to Enable	Monitoring	Power			n/a	
Protection (full + optimise)			P7				
Current			P26				
P27 Peak Start			P27				
P40 Supply Volts			P40				
Real PF			P39				
P22 Delay Angle			P22				
P23 Max Angle			P23				
P20 Reference PF			P20				
P21 Internal PF			P21				
Permanent Store		Save Param			n/a		
		Power On Param					
		Default Param					
Pass-word		Enter Password	P5		n/a		
		Change Password					
Inputs		Digital I/p 1	Map to	P65	52 Parameter		
			Bit Number	P66	0001 0000 Mask		
			Polarity	P54 / B4	Positive Logic	Inverse Logic	

Table continued next page.

5.2.2 – Complete Keypad Menu Structure (continued)

Keypad Menu Structure (continued)						
Horizontal Keypad Scrolling: Enter key = right (forward); # key = left (back)						
Level 0	Level 1	Level 2	Parameter / Bit #	Level 3	Parameter / Bit #	
Vertical Keypad Scrolling: Down Arrow key = down; Up Arrow key = up	Stopped and Ready 1: –or– Starter Disabled 1: ▼ to Enable	K1		Map From	P57	52 Parameter
				Bit Number	P58	0010 0000 Mask
				Polarity	P54 / B0	Positive Logic Inverse Logic
				K = Run Relay	Note: The “K” selection in Level 3 loads P57 & P58 with the appropriate values to configure the K1 output relay to perform the described function. A simpler way to configure the relay. (Choose only one function.)	
				K = Bypass Relay		
				K = Alarm		
				K = Current Limiting		
				K = Ovld Integrating		
				K = Stall		
				K = Cooling		
				K = Enable Status		
				K = I/P1		
				K = 60Hz		
				K = Shearpin		
				K = Undercurrent		
				K = C/L Timeout		
			K = Thermistor [not available]			
			K = Overload			
			K = Thermal Switch			
			K = RYB (phase sequence ABC)			
		K2		Map From	P59	8 Parameter
				Bit Number	P60	0000 1000 Mask
				Polarity	P54 / B1	Positive Logic Inverse Logic
				K = Run Relay	Note: The “K” selection in Level 3 loads P59 & P60 with the appropriate values to configure the K2 output relay to perform the described function. A simpler way to configure the relay. (Choose only one function.)	
				K = Bypass Relay		
				K = Alarm		
				K = Current Limiting		
				K = Ovld Integrating		
	K = Stall					
	K = Cooling					
	K = Enable Status					
	K = I/P1					
	K = 60Hz					
	K = RYB (phase sequence ABC)					
	K = Shearpin					
	K = Undercurrent					
	K = C/L Timeout					
	K = Thermistor [not available]					
	K = Overload					
	K = Thermal Switch					

Table continued next page.

5.2.2 – Complete Keypad Menu Structure (continued)

Keypad Menu Structure (continued)					
Horizontal Keypad Scrolling: Enter key = right (forward); # key = left (back)					
Level 0	Level 1	Level 2	Parameter / Bit #	Level 3 Parameter / Bit #	
Vertical Keypad Scrolling: Down Arrow key = down; Up Arrow key = up Stopped and Ready 1: -or- Starter Disabled 1: ▼ to Enable	Parameters	P1 to P21		See the "Parameter Descriptions" section and table for parameter descriptions as they appear on the keypad.	
		P22 to P40			
		P41 to P60			
		P61 to P80			
		P81 to P100			
		P101 to P...			
	Trips	Trips			Trip-1 P73 (Last Trip)
					Trip-2 P74 (2nd Last Trip)
					Trip-3 P75 (3rd Last Trip)
					Trip-4 P76 (4th Last Trip)
					Trip-5 P77 (5th Last Trip)
			Trip Sensitivity (1)	P72	n/a
			P126 Comms Trip (On/Off)	P126	
			Cooling (On/Off)	P53 / B5	
			Thermistor Trip [not available]	P51 / B5	
			C/L Time Out (On/Off)	P51 / B1	
			Low Current (On/Off)	P51 / B4	
			Shearpin (On/Off)	P51 / B3	
			Overload (On/Off)	P51 / B2	
	Sensing Signal (On/Off)	P127 / B7			
	User - OK	P53 / B3			

5.3 – Parameter Basic Information

- The parameters are accessed through the “Parameters” menu in Level 1 of the Keypad Menu Structure.
- For SR44s with optional communications accessories, the parameters can also be accessed through Modbus addressing, as described in the “Serial Communications” chapter.
- Scaling applies **ONLY** when using serial communication, as described in the “Serial Communications” chapter.

Parameter Basic Information									
Parameter Number	Parameter Bit #s	Default	Maximum	Minimum	Units	Type *	Scaling **	Name / Function	User Setting
0	-	0	255	0	none	R	1	dummy parameter	
1	-	1	32	1	none	R/W	1	Station No	
2	-	44	255	1	none	R/W	1	Language	
3	-	5	56	5	none	R	1	Program Type	
4	-	11	255	0	none	R	1	Software Ver	
5	-	0	255	0	none	R/W	1	Password	
6	-	0	1	0	none	R/W	1	Firing Mode	
7	-	192	192	0	none	R/W	1	Protection	
8	-	0	255	0	flags	R	1	Status 1	
	0 (1)	0	1	0		-		Stopped	
	1 (2)	0						Starting	
	2 (4)	0						Current Limit	
	3 (8)	0						Top of Ramp	
	4 (16)	0						Dwell	
	5 (32)	0						Full Conduction	
	6 (64)	0						Energy Saving	
7 (128)	0	Stopping							
9	-	0	99	0	flags	R	1	Status 2	
	0 (1)	0	1	0		-		Alarm	
	1 (2)	0						Overload Integrating	
	2 (4)	0						Stall	
	3 (8)	0						Forced Override	
	4 (16)	0						Noise	
	5 (32)	0						Inhibit Start	
	6 (64)	0						DC I/p Level Reached	
7 (128)	0	Reserved							

* Type: R = Read Only; R/W = Read/Write

** Scaling applies **ONLY** when using serial communication; details in “Serial Communications” chapter.

Table continued next page.

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Parameter Number	Parameter Bit #s	Default	Max Value	Min Value	Units	Type *	Scaling **	Name / Function	User Setting
10	-	0	255	0	flags	R	1	Status 3	
	0 (1)	0	1	0		-		Relay K1 Status	
	1 (2)	0						Relay K2 Status	
	2 (4)	0						(unused)	
	3 (8)	0						(unused)	
	4 (16)	0						Input 1 Status	
	5 (32)	0						(unused)	
	6 (64)	0						(unused)	
7 (128)	0	(unused)							
11	-	20	60	10	%	R/W	1	Start Ped	
12	-	5	255	1	seconds	R/W	1	Start Time	
13	-	75	90	60	%	R/W	1	Kick Ped	
14	-	25	40	10	cycles	R/W	1	Kick Time	
15	-	5	255	1	seconds	R/W	1	Dwell Time	
16	-	10	60	10	%	R/W	1	Stop Ped	
17	-	0	255	0	seconds	R/W	1	Stop Time	
18	-	6	255	0	flags	R/W	1	Auto Config	
	0 (1)	0	1	0		-		Auto Ramp	
	1 (2)	1						Auto 3MC	
	2 (4)	1						Auto Bypass	
	3 (8)	0						Auto Jog	
	4 (16)	0						Auto end stop	
	5 (32)	0						Auto stop	
	6 (64)	0						Auto end start	
7 (128)	0	Auto Pedestal							
19	-	5	30	4	none	R/W	1	Opt Rate	
20	-	146.76	146.76	0	degrees	R	0.57554	Reference PF	
21	-	146.76	146.76	0	degrees	R	0.57554	Internal PF	
22	-	146.76	146.76	0	degrees	R	0.57554	Delay Angle	
23	-	57.554	146.76	17.27	degrees	R	0.57554	Max Angle	

* Type: R = Read Only; R/W = Read/Write

** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.

Table continued next page.

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Parameter Number	Parameter Bit #s	Default	Max Value	Min Value	Units	Type *	Scaling **	Name / Function	User Setting
24	-	0	3000	0	amps	R/W	100	Reserved – Rated Amps (100s)	
25	-	5	99	1	amps	R/W	1	Reserved – Rated Amps	
26	-	0	7.9688	0	amps	R	0.03125	Current	
27	-	0	255	0	amps	R	1	Peak Start I	
28	-	0.0938	0.7813	0.031	$\times I_e$	R/W	0.03125	Low I Level	
29	-	50	255	5	cycles	R/W	1	Low I Time	
30	-	3.5	7.9688	0.375	$\times I_e$	R/W	0.03125	C/L Level	
31	-	30	255	5	seconds	R/W	1	C/L Time	
32	-	3.125	5	0.5	$\times I_e$	R/W	0.03125	Shear Level	
33	-	100	255	5	cycles	R/W	1	Shear Time	
34	-	1.0938	1.25	0.5	$\times I_e$	R/W	0.03125	Ovld Level	
35	-	140	140	10	none	R/W	1	Ovld Delay	
36	-	0	100	0	%	R	0.39216	% Overload	
37	-	-	-	-	-	-	-	Reserved	
38	-	0	255	0	flags	R/W	1	UserFlags 5 – Reserved	
	0 (1)	0	1	0				(Unused)	
	1 (2)	0						Reserved	
	2 (4)	0						Reserved	
	3 (8)	0						(Unused)	
	4 (16)	0						(Unused)	
	5 (32)	0						(Unused)	
	6 (64)	0						(Unused)	
7 (128)	0	(Unused)							
39	-	0	127.5	0	degrees	R	0.5	PF Angle	
40	-	416	1000	108	volts	R	4	Supply Volts	
41	-	-	-	-	-	-	-	Reserved	
42	-	-	-	-	-	-	-	Reserved	
43	-	-	-	-	-	-	-	Reserved	
44	-	-	-	-	-	-	-	Reserved	
45	-	-	-	-	-	-	-	Reserved	
46	-	-	-	-	-	-	-	Reserved	
47	-	-	-	-	-	-	-	Reserved	
48	-	-	-	-	-	-	-	Reserved	
49	-	-	-	-	-	-	-	Reserved	
50	-	-	-	-	-	-	-	Reserved	

* Type: R = Read Only; R/W = Read/Write

** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.

Table continued next page.

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Parameter Number	Parameter Bit #s	Default	Max Value	Min Value	Units	Type *	Scaling **	Name / Function	User Setting
51	-	142	255	0	flags	R/W	1	User Flags 1	
	0 (1)	0	1	0				Kickstart	
	1 (2)	1						Current Limit Timeout Sel'd	
	2 (4)	1						Overload Selected	
	3 (8)	1						Shearpin Selected	
	4 (16)	0						Under Current Selected	
	5 (32)	0						Thermistor Selected [not available]	
	6 (64)	0						(Unused)	
	7 (128)	1						Terminal Starting	
52	-	0						255	0
	0 (1)	0	1	0				Low Voltage Soft-Stop	
	1 (2)	0						Not Global Enable 1	
	2 (4)	0						Not Global Enable 2	
	3 (8)	0						Pod Start/Stop	
	4 (16)	0						Board Start/Stop	
	5 (32)	0						Main Contactor	
	6 (64)	0						Second Parm Set	
	7 (128)	0						Zero Start Time	
53	-	51						255	0
	0 (1)	1	1	0				pf1 pol	
	1 (2)	1						pf2 pol	
	2 (4)	0						User Current Limit	
	3 (8)	0						User Trip	
	4 (16)	1						Invert Controller Input	
	5 (32)	1						Cooling (Inhibit Restart)	
	6 (64)	0						(Unused)	
	7 (128)	0						(Unused)	

* Type: R = Read Only; R/W = Read/Write

** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.

Table continued next page.

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Parameter Number	Parameter Bit #s	Default	Max Value	Min Value	Units	Type *	Scaling **	Name / Function	User Setting
54	-	255	255	0	flags	R/W	1	I/O Polarity	
	0 (1)	1	1	0		-		K1 Polarity	
	1 (2)	1						K2 Polarity	
	2 (4)	1						(Unused)	
	3 (8)	1						(Unused)	
	4 (16)	1						I/p 1 Polarity	
	5 (32)	1						(Unused)	
	6 (64)	1						(Unused)	
7 (128)	1	(Unused)							
55	-	-	-	-	-	-	-	Reserved	
56	-	-	-	-	-	-	-	Reserved	
57	-	52	123	0	prmtr	R/W	1	K1 Map	
58	-	32	255	0	mask	R/W	1	K1 Bit Mask	
59	-	8	123	0	prmtr	R/W	1	K2 Map	
60	-	8	128	0	mask	R/W	1	K2 Bit Mask	
61	-	-	-	-	-	-	-	Reserved	
62	-	-	-	-	-	-	-	Reserved	
63	-	-	-	-	-	-	-	Reserved	
64	-	-	-	-	-	-	-	Reserved	
65	-	52	123	0	prmtr	R/W	1	i/p1 Map	
66	-	16	128	0	mask	R/W	1	i/p1 bit Msk	
67	-	-	-	-	-	-	-	Reserved	
68	-	-	-	-	-	-	-	Reserved	
69	-	-	-	-	-	-	-	Reserved	
70	-	-	-	-	-	-	-	Reserved	
71	-	160	800	100	ms	R/W	4	Cntactor Dly	
72	-	1	15	1	none	R/W	1	Trip Snstvtly	
73	-	0	17	0	trips	R	1	Last Trip	
74	-	0	17	0	trips	R	1	2nd Last Trp	
75	-	0	17	0	trips	R	1	3rd Last Trp	
76	-	0	17	0	trips	R	1	4thLast Trp	
77	-	0	17	0	trips	R	1	5th Last Trp	
* Type: R = Read Only; R/W = Read/Write									
** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.									
Table continued next page.									

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Parameter Number	Parameter Bit #s	Default	Max Value	Min Value	Units	Type *	Scaling **	Name / Function	User Setting
78	-	192	192	0	none	R/W	1	Protection 2	
79	-	50	60	10	%	R/W	1	Start Ped 2	
80	-	5	255	1	seconds	R/W	1	Start Time 2	
81	-	75	90	60	%	R/W	1	Kick Ped 2	
82	-	25	40	10	cycles	R/W	1	Kick Time 2	
83	-	5	255	1	seconds	R/W	1	Dwell Time 2	
84	-	10	60	10	%	R/W	1	Stop ped 2	
85	-	0	255	0	seconds	R/W	1	Stop Time 2	
86	-	6	255	0	flags	R/W	1	AutoConfig 2	
	0 (1)	0						Auto Ramp	
	1 (2)	1						Auto 3MC	
	2 (4)	1						Auto Bypass	
	3 (8)	0						Auto Jog	
	4 (16)	0						Auto Endstop	
	5 (32)	0						Auto Stop	
	6 (64)	0						Auto Endstart	
7 (128)	0	Auto Pedestal							
87	-	0.125	0.7813	0	x I _e	R/W	0.03125	Low I 2	
88	-	50	255	5	cycles	R/W	1	Low I time 2	
89	-	4	7.9688	0.375	x I _e	R/W	0.03125	C/L 2	
90	-	15	255	5	seconds	R/W	1	C/L Time 2	
91	-	3	5	1.063	x I _e	R/W	0.03125	Shearpin 2	
92	-	50	255	5	cycles	R/W	1	Shear time 2	
93	-	1.0938	1.25	0.5	x I _e	R/W	0.03125	Ovld Level 2	
94	-	140	140	10	none	R/W	1	Ovld Delay 2	
95	-	134	255	0	flags	R/W	1	User Flags12	
	0 (1)	0						Kickstart 2	
	1 (2)	1						Current Limit Timeout Sel'd 2	
	2 (4)	1						Overload Selected 2	
	3 (8)	0						Shearpin Selected 2	
	4 (16)	0						Under Current Selected 2	
	5 (32)	0						Thermistor Selected 2 [not available]	
	6 (64)	0						(Unused)	
7 (128)	1	Terminal Starting 2							

* Type: R = Read Only; R/W = Read/Write

** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.

Table continued next page.

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Parameter Number	Parameter Bit #s	Default	Max Value	Min Value	Units	Type *	Scaling **	Name / Function	User Setting
96	-	64	255	0	flags	R/W	1	User Flags22	
	0 (1)	0	1	0		-		Low Voltage Soft-Stop (2)	
	1 (2)	0						Not Global Enable 1 (2)	
	2 (4)	0						Not Global Enable 2 (2)	
	3 (8)	0						Pod Start/Stop (2)	
	4 (16)	0						Board Start/Stop (2)	
	5 (32)	0						Main Contactor (2)	
	6 (64)	1						Second Parm Set (2)	
7 (128)	0	Zero Start Time (2)							
97	-	0	125	0	prmtr	R/W	1	U1 I/P srce	
98	-	0	128	0	mask	R/W	1	U1 I/P Mask	
99	-	0	125	0	prmtr	R/W	1	U1 O/P Dest	
100	-	0	255	0	mask	R/W	1	U1 O/P Mask	
101	-	0	125	0	prmtr	R/W	1	U2 I/P srce	
102	-	0	20	0	mask	R/W	1	U2 I/P Mask	
103	-	0	125	0	prmtr	R/W	1	U2 O/P Dest	
104	-	0	11	0	mask	R/W	1	U2 O/P Mask	
105	-	-	-	-	-	-	-	Reserved	
106	-	-	-	-	-	-	-	Reserved	
107	-	-	-	-	-	-	-	Reserved	
108	-	-	-	-	-	-	-	Reserved	
109	-	12	50	1	none	R/W	1	Bypass Upper Limit	
110	-	10	150	0	none	R/W	1	Bypass Lower Limit	
111	-	-	-	-	-	-	-	Reserved	
112	-	0	255	0	flags	R	1	Status 4	
	0 (1)	0	1	0		-		60 Hz	
	1 (2)	0						Phase Rotation Sequence	
	2 (4)	0						Shearpin	
	3 (8)	0						Under Current	
	4 (16)	0						Thermistor [not available]	
	5 (32)	0						Timeout	
	6 (64)	0						Overload	
7 (128)	0	Thermal Switch							
113	-	-	-	-	-	-	-	Reserved	

* Type: R = Read Only; R/W = Read/Write

** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.

Table continued next page.

5.3 – Parameter Basic Information (continued)

Parameter Basic Information (continued)									
Param. Number	Param. Bit #s	Default	Max Value	Min Value	Units	Type*	Scaling**	Name / Function	User Setting
114	-	0	100	0	none	R/W	1	StopProfile	
115	-	0	255	0	none	R/W	1	Last App	
116	-	0***	63.75	0	minutes	R/W	0.25	CoolingTime	
117	-	-	-	-	-	-	-	Reserved	
118	-	-	-	-	-	-	-	Reserved	
119	-	-	-	-	-	-	-	Reserved	
120	-	0	255	0	flags	R	1	Status 5	
	0 (1)	0	1	0		-		Over Temperature	
	1 (2)	0						Offline Command Fail	
	2 (4)	0						(unused)	
	3 (8)	0						Fan Status	
	4 (16)	0						(unused)	
	5 (32)	0						(unused)	
	6 (64)	0						(unused)	
7 (128)	0	(unused)							
121	-	0	255	0	flags	R/W	1	UserFlags 4	
	0 (1)	0	1	0		-		Impact Load	
	1 (2)	0						(unused)	
	2 (4)	0						Auto Soft Stop Smoothing	
	3 (8)	0						Breaker Present (0 = Contactor; 1 = Breaker)	
	4 (16)	0						Optimise +	
	5 (32)	0						Quick Ramp Times	
	6 (64)	0						Two Stop Bits	
7 (128)	0	Auto Stop (2)							
122	-	5	25	1	none	R/W	1	Stop Smooth	
123	-	0	50	0	%	R/W	1	Temp/Alt Derate	
124	-	0	255	0	none	R/W	1	Off-Line Command	
125	-	-	-	-	-	-	-	Reserved	
126	-	0	255	0	none	R/W	1	Comms Trip	
127	-	0	255	0	flags	R/W	1	Trip Flags	
	0 (1)	0	1	0		-		Trip 1 Enabled (Phase Loss)	
	1 (2)	0						Trip 8 Enabled (Motor Side Thyristor Loss)	
	2 (4)	0						Trip 9 Enabled (Thyristor Sensing Trip Type A)	
	3 (8)	0						Trip 10 Enabled (Thyristor Sensing Trip Type B)	
	4 (16)	0						Trip 4 Enabled (Thyristor Sensing Trip Type C)	
	5 (32)	0						Trip 5 Enabled (Edge Sensing Trip)	
	6 (64)	0						Trip 6 Enabled (Sensing Trip Type A)	
7 (128)	0	Trip 7 Enabled (Sensing Trip Type B)							

* Type: R = Read Only; R/W = Read/Write

** Scaling applies ONLY when using serial communication; details in "Serial Communications" chapter.

*** P116 default value varies depending upon soft starter model size.

5.4 – Menu Settings and Parameter Descriptions

This section gives a description of the individual menus and the functions that their parameters perform.

- **Menu Settings and Parameters are presented in the same groups and sequence as they appear in the Keypad Menu Structure.**



We highly recommend that you configure the SR44 by first selecting and setting an application from the “Applications” menu that is similar to your application. If necessary, you can then ‘fine-tune’ your configuration by changing the settings of other parameters and menu items.



To keep Menu Item and Parameter setting changes, they must be permanently saved using the ‘Permanent Store’ menu. (See section A.1.5 for more information.)

5.4.0 – Restoring Defaults

There are two methods of restoring the SR44 parameters and settings to their default values:

- 1) Through the ‘Applications’ menu; choose ‘Default (keypad)’ or ‘Default Auto’.
- 2) Through the ‘Permanent Store’ menu; choose ‘Default Param’.

Refer to the applicable menu descriptions for further details.

5.4.1 – Example of Menu Settings and Parameters Descriptions

Parameter Number (if applicable)	Parameter / Setting Name	Default Setting	Scaling* (if applicable)	Type: R/W
P-12	Start Time	Default: 5s	Scaling: 1	Type: R/W
	Range: 1 to 255 seconds			
	‘Soft Start Time’ sets the soft-start time period over which the unit ramps voltage to the motor.			
	<ul style="list-style-type: none"> • Start times are normally in the 5–30s range. • Long ramp times over 1minute are for special applications only. • The start (without current limit) is purely a voltage ramp. • Lightly loaded motors will normally reach full speed before the end of a long ramp. 			

Setting Range
Description
Type: R = Read Only; R/W = Read/Write

*** Scaling:**

- Scaling applies ONLY when using SERIAL COMMUNICATION to read and write parameters.
- When READING from parameters, MULTIPLY the serial comm value by the scaling factor.
- When WRITING to parameters, DIVIDE your desired value by the scaling factor (multiply by the inverse of the scaling factor).
- Refer to “Chapter 6: Serial Communications” for scaling example.

5.4.2 – ‘Applications’ Menu

This menu contains a list of typical applications for which a set of parameters have been predefined by the manufacturer. This feature provides a quick and easy way of setting up the unit. There are three exceptions to this list:

- 1) The first menu item, ‘Settings’, provides a brief report on the basic settings of the unit (see below and Appendix A.1.6).
- 2) The second menu item, ‘Default (keypad)’, provides a way of loading the default parameter values with ‘Keypad Starting’ as the choice for the starting option (see Appendix A.1.4).
- 3) The third menu item, ‘Default Auto’, loads default parameter values and additionally turns on a number of features from the Auto Features menu. Further details can be found in the “SR44 Applications Data” and “SR44 Bit Parameters” sections of the “Electromagnetic Compatibility” chapter (4).

‘Applications’ Menu Read Only Settings

-	Settings
---	-----------------

Range: n/a

Default: n/a

Displays information relevant to the SR44’s current state:

- ‘V1.069LM 10/12/16’
This message shows the keypad firmware version number and release date (date displayed in European format; YY/MM/DD).
- ‘5MC V56.11’
This message gives the version number of the firmware in the SR44 control board.
- ‘Menu V1.023’
This message gives the version number of the navigating menu.
- ‘Remote/Keypad Starting’
This message indicates whether the Starting Parameter has been set to keypad or remote starting.
- ‘Full/Full&Opt/Start&Bypass/Phase Loss Only’
This message shows what protection mode has been set in the Protection Parameter.
- ‘Small Pump’
This next message will show what (if any) application has been set from the Application menu (Small Pump is shown as an example). If no application has been set, then the display will appear blank for a couple of seconds.
- ‘Temp/Alt Derated’
This message will be displayed if the unit has been derated for temperature or altitude. If no derating has been set, then the display will appear blank for a couple of seconds.

5.4.2 – ‘Applications’ Menu (continued)

‘Applications’ Menu User configurable settings:

(These ‘Applications’ auto-features preset the SR44 for the selected application.)

* * *

Default (keypad)

Range: n/a

Default: n/a

The ‘Default (keypad)’ setting provides a way to RESTORE all **DEFAULT VALUES** to the starter. It also sets the starter for starting and stopping from the local or remote KEYPAD.

Provides a way of loading the default parameter values with ‘Keypad Starting’ as the choice for the starting option (see Appendix A.1.4).

* * *

Default Auto

Range: n/a

Default: n/a

The ‘Default Auto’ setting provides a way to RESTORE all **DEFAULT VALUES** to the starter. It also sets the starter for starting and stopping from the Auto Features menu

Loads default parameter values and additionally turns on a number of features from the Auto Features menu. Further details can be found in section 5.4.7 and Appendix B “Applications Data”.

-

Small Pump

Setting for Small Pump (≤ 60 hp) application. (See “Appendix B: Applications Data” for details.)

-

Large Pump

Setting for Large Pump (≥ 75 hp) application. (See “Appendix B: Applications Data” for details.)

-

Conveyor

Setting for Conveyor application. (See “Appendix B: Applications Data” for details.)

-

Low Inertia Fan

Setting for Low Inertia Fan application. (See “Appendix B: Applications Data” for details.)

-

Hi Inertia Fan

Setting for High Inertia Fan application. (See “Appendix B: Applications Data” for details.)

-

Recip Compressor

Setting for Reciprocal Compressor application. (See “Appendix B: Applications Data” for details.)

-

Screw Compressor

Setting for Screw Compressor application. (See “Appendix B: Applications Data” for details.)

-

Rotry Compressor

Setting for Rotary Compressor application. (See “Appendix B: Applications Data” for details.)

5.4.2 – ‘Applications’ Menu (continued)

- | | |
|---|----------------|
| - | Crusher |
|---|----------------|

Setting for Crusher application. (See “Appendix B: Applications Data” for details.)
- | | |
|---|----------------|
| - | Grinder |
|---|----------------|

Setting for Grinder application. (See “Appendix B: Applications Data” for details.)
- | | |
|---|------------------------|
| - | Hi Start Torque |
|---|------------------------|

Setting for application requiring High Starting Torque. (See “Appendix B: Applications Data” for details.)
- | | |
|---|----------------------|
| - | Motor Gen set |
|---|----------------------|

Setting for Motor Generator Set application.
(See “Appendix B: Applications Data” for details.)
- | | |
|---|----------------|
| - | aerator |
|---|----------------|

Setting for Aerator application. (See “Appendix B: Applications Data” for details.)
- | | |
|---|-------------------------|
| - | Flywheel / Press |
|---|-------------------------|

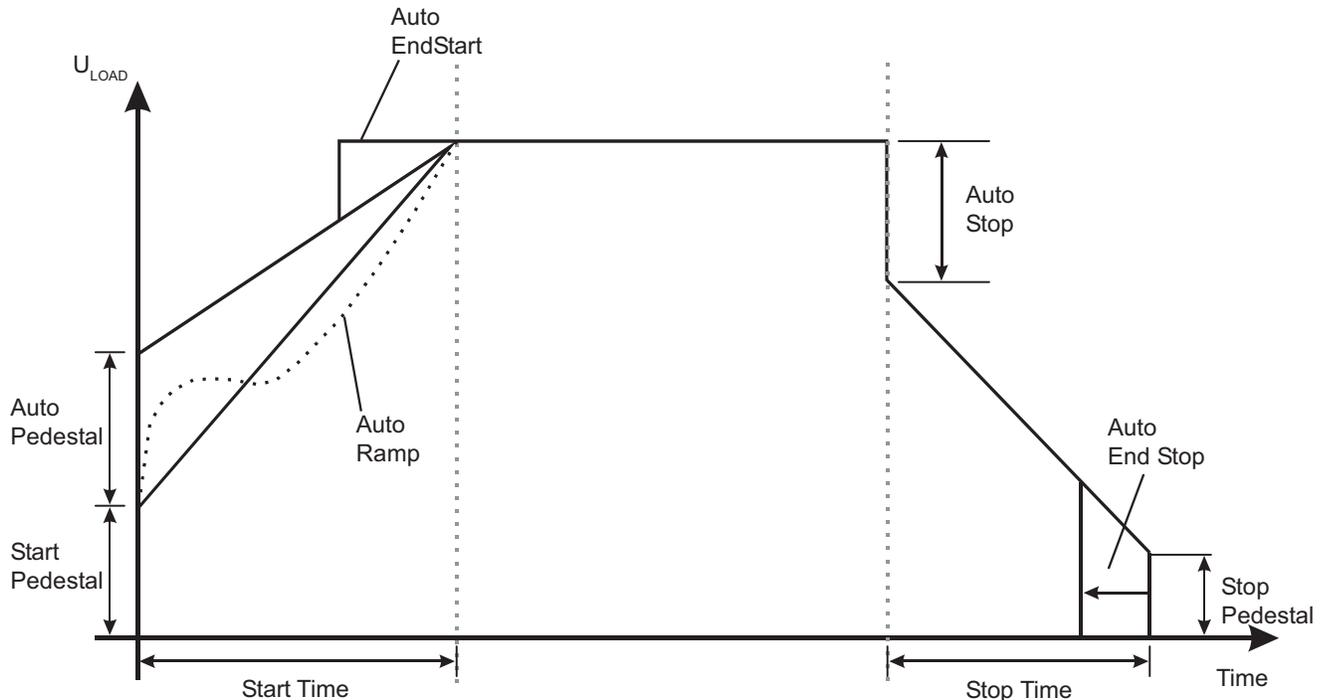
Setting for Flywheel or Press application. (See “Appendix B: Applications Data” for details.)
- | | |
|---|----------------|
| - | Moulder |
|---|----------------|

Setting for Moulder application (injection molding). (See “Appendix B: Applications Data” for details.)

5.4.3 – ‘Auto Features’ Menu

The Auto Features Menu contains commonly used parameters that may be automatically adjusted by the unit.

‘Auto Features’ Menu Explanation Diagram



‘Auto Features’ Menu Settings

(P-18)

Settings

Range: P18 ‘Auto’ settings listed by name

Default: Auto 3MC, Auto Bypass

When active, the ‘Settings’ menu item will provide a brief report on which, if any, ‘Auto’ options have been switched ‘On’. A downwards facing arrow will appear on the right hand side of the top line of the user interface display. While this icon is present, all of the ‘Auto’ options that appear on the bottom line of the display have been switched ‘On’.

- Auto Jog (P18 / B3)
- Auto Pedestal (P18 / B7)
- Auto End Start (P18 / B6)
- Auto Stop (P18 / B5)
- Auto End Stop (P18 / B4)
- Auto Bypass (P18 / B2)



Auto Bypass detects the presence of a bypass contactor, and should be ON when using one. Using a bypass contactor with Auto Bypass in the OFF state can cause thyristor faults.

- Auto 3MC (P18 / B1)
- Auto Ramp (P18 / B0)

5.4.3 – ‘Auto Features’ Menu (continued)

(P18.B2)

Auto Bypass

Range: P18 / B2

Default: On

Scaling: n/a

Type: R/W

‘Auto Bypass’ turns ‘On’ and ‘Off’ the automatic detection of a bypass contactor. When ‘On’, a bypass contactor will be automatically detected. Soft-starter thyristor trips and thyristor short-circuit trips will be disabled during Run (after full voltage is reached). Thyristor protection and thyristor short-circuit protection are still available during the start ramp, and phase-loss protection is available during both Start and Run.



An external user-supplied current transformer is required if any of the current or power related trip or monitoring features are needed in bypass mode.

(Parameters: 8/B2, 9/B1/B2, 20, 21, 22, 23, 26, 28, 30, 32, 33, 34, 36, 39, 51/B1/B2/B3/B4, 87, 89, 91, 93, 112/B0/B1/B2/B3/B6, 121/B4)

Refer to Electrical Installation Chapter 2, subsections 2.4.1 & 2.5.2 for wiring information.



Auto Bypass detects the presence of a bypass contactor, and should be ON when using one. Using a bypass contactor with Auto Bypass in the OFF state can cause thyristor faults.

(P18.B1)

Auto 3MC

Range: P18 / B1

Default: On

Scaling: n/a

Type: R/W

‘Auto 3MC’ turns ‘On’ and ‘Off’ the automatic removal of the low voltage ramp for high pedestal starts.

‘Auto 3MC’ applies only to ‘Start Pedestal’ voltages set above 50% (P-11 or P-79). The SR44 normally does a very brief low-voltage ramp up to the pedestal voltage level before the start ramp begins, but ‘Auto 3MC’ applies a higher starting torque and eliminates this initial pedestal ramp for pedestal voltages above 50%.

(P18.B0)

Auto Ramp

Range: P18 / B0

Default: Off

Scaling: n/a

Type: R/W

‘Auto Ramp’ automatically detects motor acceleration and dynamically adjusts the ramp to give smoother acceleration. This menu item works in conjunction with the Start Time parameter (P12), which should be set to the estimated start time of the load. This would be suitable for starts with varying loads.

-

Auto All -> OFF

Range: n/a

Default: n/a

‘Auto All -> OFF’ turns ‘Off’ all the ‘Auto’ options (all options contained in this submenu except ‘Stop Smoothing’). The only action of this menu item is to turn ‘Off’ these ‘Auto’ options when the menu item is activated.

(P122.B1)

P122 Stop Smooth

Range: P121 / B1

Default: Off

Scaling: n/a

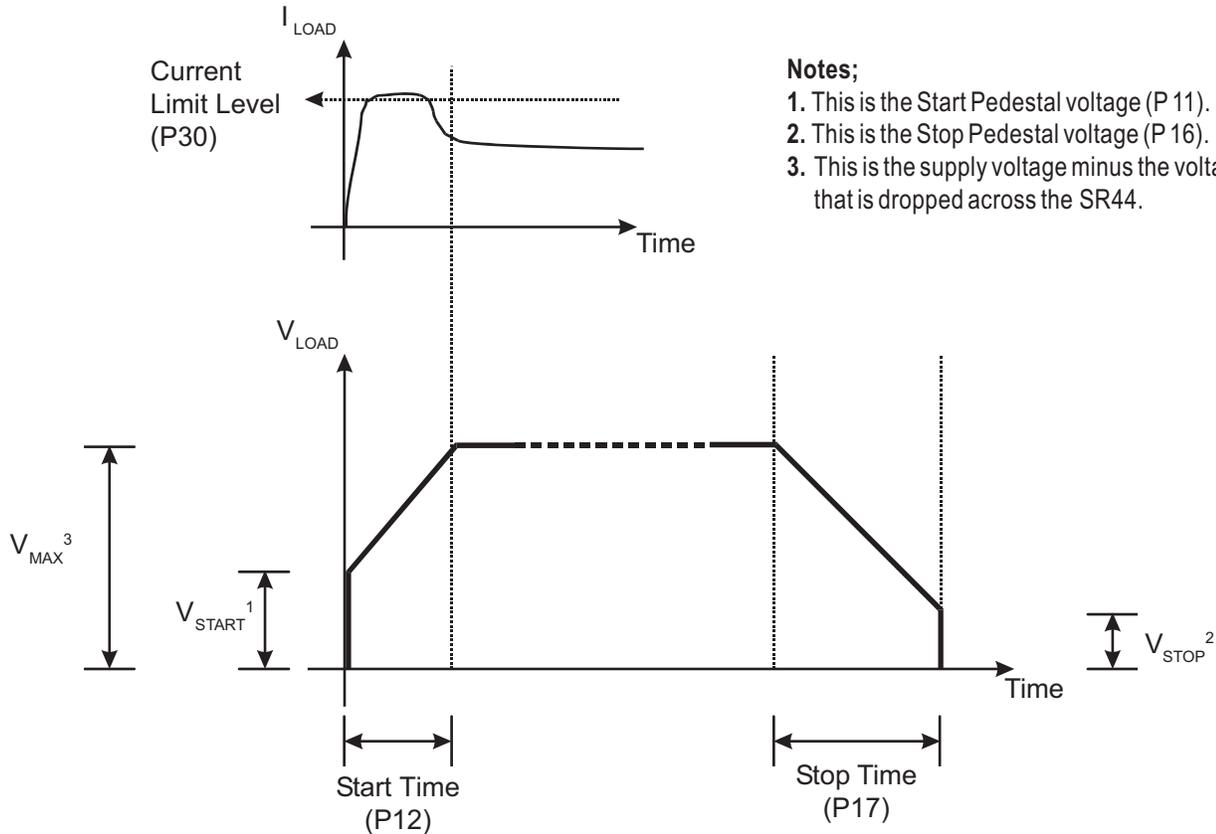
Type: R/W

‘Auto Soft Stop Smoothing’ (P121 / B1) turns ‘On’ and ‘Off’ the ‘Stop Smoothing’ function (P122). When turned ‘On’, this menu item attempts to eliminate any oscillations that may occur when the unit Soft Stops with an unstable load.

5.4.4 – ‘Basic’ Menu

The Basic menu holds the parameters which control the primary functions of the unit. Changing the values of these parameters will vary the starting and stopping duties, the trip protection set for the unit, and the source of the start signal (Keypad or Remote).

‘Basic’ Menu Explanation Diagram



Notes;

1. This is the Start Pedestal voltage (P 11).
2. This is the Stop Pedestal voltage (P 16).
3. This is the supply voltage minus the voltage that is dropped across the SR44.

‘Basic’ Menu Settings

(P52.B1&2) Disable Starter?

Range: P52 / B1&B2 Default: Off Scaling: n/a Type: R/W

‘Disable Starter?’ disables the starter by setting P52/B1&B2 = 1. While the unit is disabled it will not comply with a start signal. Disabling the starter also allows the user to change certain parameters which cannot be changed while the unit is enabled (such as Password and Station #).

(P52.B1&2) Enable Starter?

Range: P52 / B1&B2 Default: On Scaling: n/a Type: R/W

‘Enable Starter?’ enables the starter by setting P52/B1&B2 = 0. While the unit is enabled it will comply with a start signal. Some parameters cannot be changed while the unit is enabled.

5.4.4 – ‘Basic’ Menu (continued)

(P-7)

Protection

Range: 0 to 192

Default: 192

Scaling: n/a

Type: R/W

‘Protection Mode’ controls which trips are available:

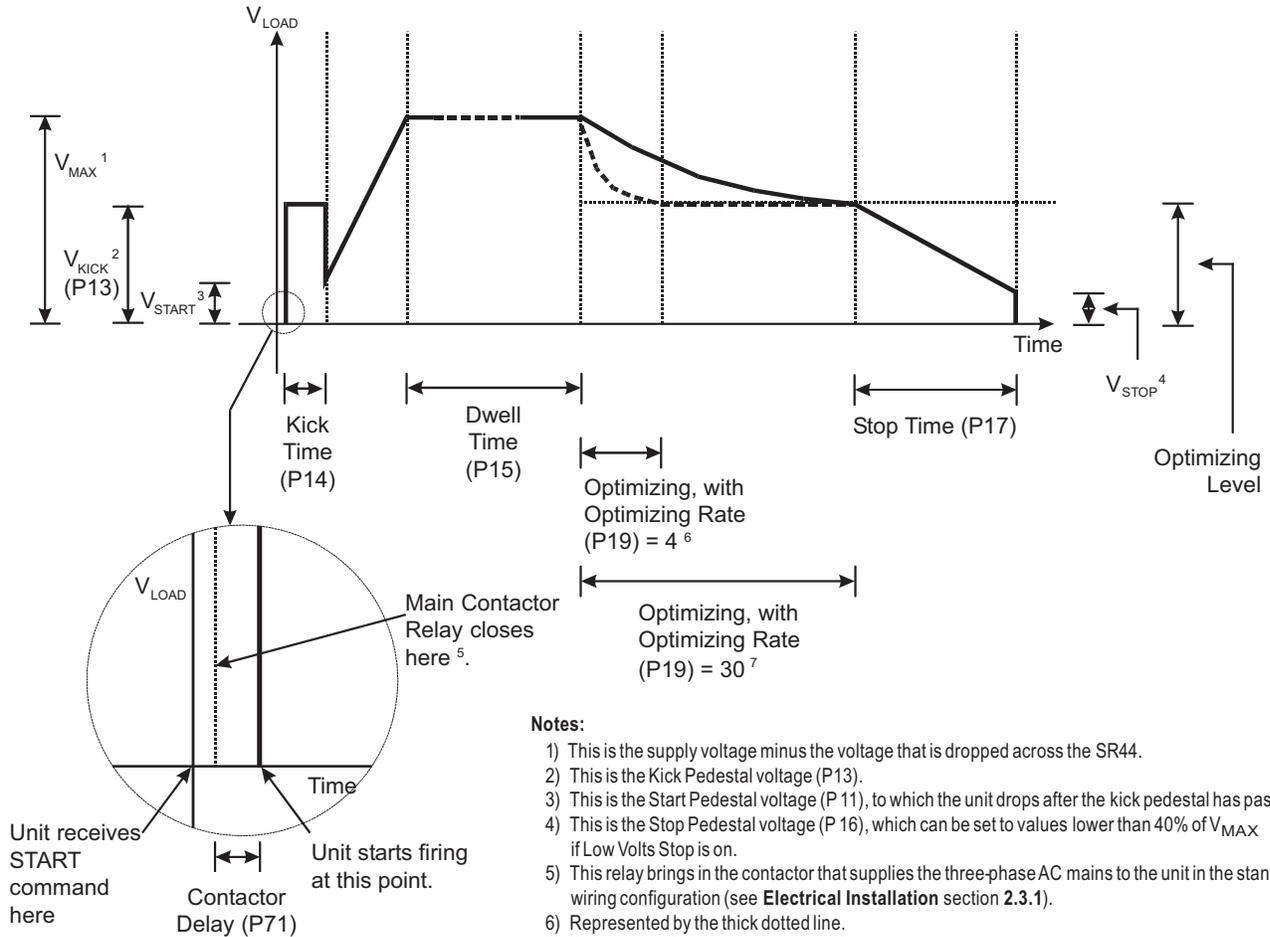
- 64 = FULL = full protection with full volts after top of ramp; optimizing function turned off
- 192 = FULL+OPTIMIZE = full protection + optimize
- 128 = START+BYPASS = protection during start; then bypass
- 0 = PHASE LOSS ONLY = I/p phase loss detection only

Start and Optimize mode is forced to ‘FULL’ Protection Mode when ‘Delta’ Firing Mode is selected (P-6 = 1). In ‘PHASE LOSS ONLY’ Protection Mode (P-7 = 0), the bottom 12.5% of starter current is ignored after TOR (Top Of Ramp).

5.4.5 – ‘Advanced’ Menu

The Advanced Menu holds parameters that need to be changed only to solve specific sets of circumstances.

‘Advanced’ Menu Explanation Diagram



‘Advanced’ Menu (continued)

- Current

‘Current’ provides access to the ‘Current’ submenu, which contains all the parameters associated with the Unit Full Load Current and its associated trip levels.

(P24&25) Rated Current (‘Current’ sub-menu of ‘Advanced’ menu)

Range: P24 & P25 Default: n/a Scaling: n/a Type: R

The ‘Rated Current’ (I_{θ}) menu item holds the value of the Soft Starter’s rated current. It cannot be altered by the user.

'Current' Sub-menu of 'Advanced' Menu (continued)

(P51.B4) Low Current ('Current' sub-menu of 'Advanced' menu)

Range: P51/B4 Default: Off Scaling: n/a Type: R/W

The 'Low Current' menu item turns 'On' and 'Off' the 'Low Current' trip. A 'Low Current' trip occurs when the current output measured by the unit falls below the level specified by the 'Low Amps Level' parameter (P28) for a length of time specified by the 'Low Amps Time' parameter (P29).

- Refer to "Low Current Protection Explanation Diagram".

«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, 'Auto Bypass'.)

(P-28) Low Amps Level ('Current' sub-menu of 'Advanced' menu)

Range: 0.031 to 0.7813 x I_e Default: 0.0938 x I_e Scaling: n/a Type: R/W

The 'Low Amps Level' menu item specifies the current level below which a 'Low Current' trip can occur.

- Refer to "Low Current Protection Explanation Diagram".

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, 'Auto Bypass'.)

(P-29) Low Amps Time ('Current' sub-menu of 'Advanced' menu)

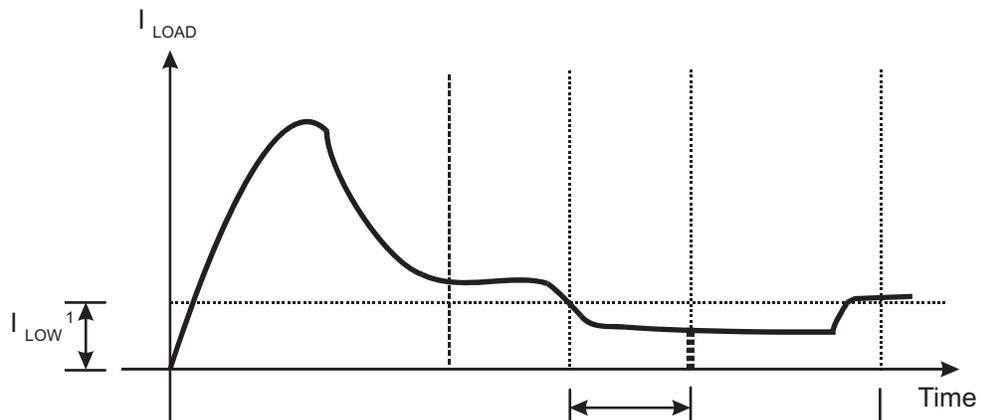
Range: 5 to 255 cycles Default: 50 cycles Scaling: n/a Type: R/W

The 'Low Amps Time' menu item specifies the time that the current must remain below the level specified by the 'Low Amps Level' (P28) before a 'Low Current' (P51/B4) trip occurs. The time is specified in supply frequency cycles. The default value is 50 cycles (at the supply frequency).

[For 60 Hz: (50 cycles) ÷ (60 cycles/s) = 0.833s]

- Refer to "Low Current Protection Explanation Diagram".

Low Current Protection Explanation Diagram



Notes

1. I_{LOW} = Low Amps Level.
2. If I_{LOAD} drops below 'Low Amps Level', 'Low Current' is set to 'on', and 'Low Amps Time' is set to minimum, then the unit will trip as indicated by the short thick dotted line.
3. If 'Low Amps Time' is set to maximum and I_{LOAD} rises above 'Low Amps Level' before 'Low Amps Time' has elapsed, then the unit will not trip.

'Current' Sub-menu of 'Advanced' Menu (continued)

(P-34) Overload Level ('Current' sub-menu of 'Advanced' menu)

Range: 0.5 to 1.25 x I_e Default: 1.0938 x I_e Scaling: n/a Type: R/W

The 'Start of Overload Level' parameter holds the level in Amps at which an 'Overload' trip will start integrating.

- Refer to "Overload Explanation Diagram".

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, 'Auto Bypass'.)



Special case: If a load current exceeding 7.2 x FLC occurs for longer than 60 ms, a 'Shearpin Trip' is forced whenever the 'Overload' is 'On' (see section 5.4.12).

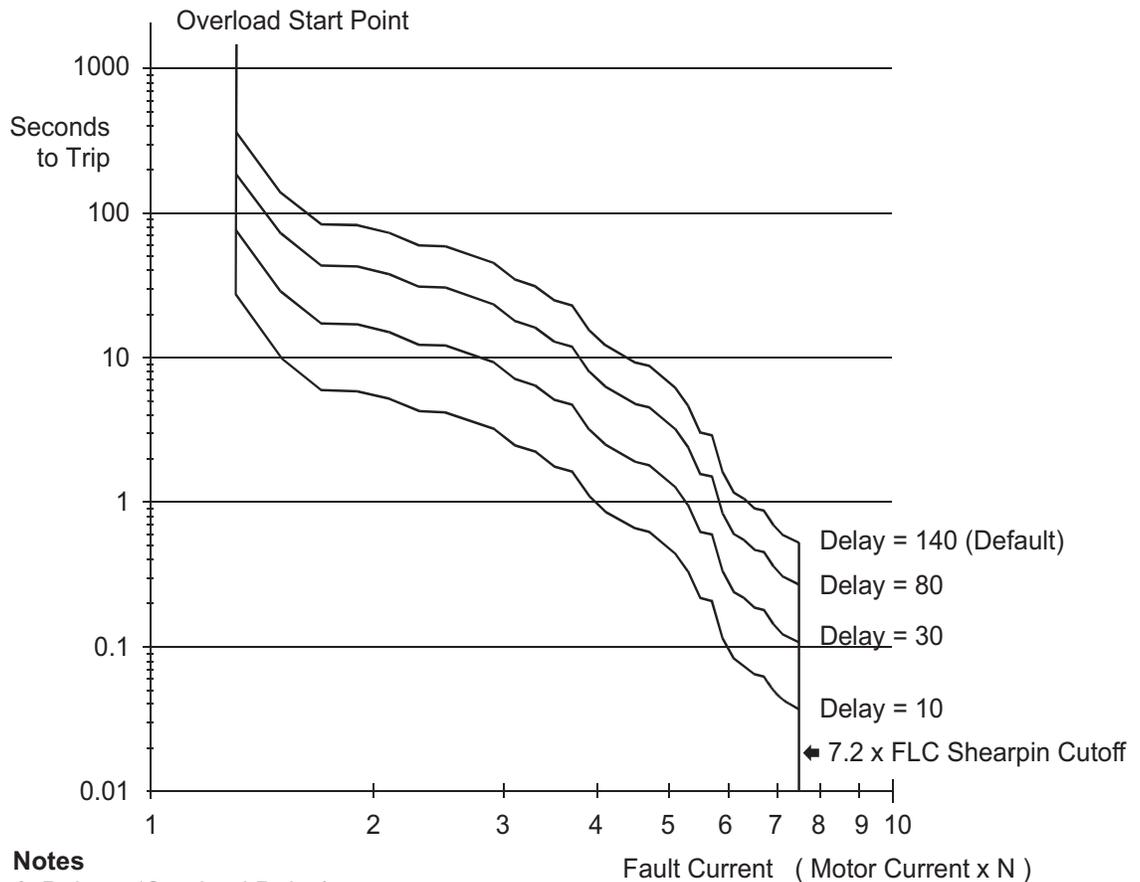
(P-35) Overload Delay ('Current' sub-menu of 'Advanced' menu)

Range: 10 to 140 Default: 140 Scaling: n/a Type: R/W

The 'Overload Delay' parameter holds an arbitrary dimensionless number which slows down the integration of an 'Overload' trip. The larger the value of the number stored here, the longer a given 'Overload' will take to result in a trip.

- Refer to "Overload Explanation Diagram".

Overload Explanation Diagram



5.4.5 – ‘Advanced’ Menu (continued)

(P-19) Opt Rate

Range: 4 to 30 Default: 5 Scaling: n/a Type: R/W

‘Optimize Rate’ sets the speed at which the SR44 will reduce the voltage during optimizing. Some unstable loads benefit from a slower optimizing rate

(P121.B4) Optimise +

Range: P121 / B4 Default: Off Scaling: n/a Type: R/W

‘Optimize +’ gains the maximum amount of energy savings on variable loads. For lightly loaded motors, the soft starter provides energy savings in Energy Optimizing mode. For fully loaded motors, a bypass contactor provides better energy savings.

- Requires an external user-supplied bypass contactor and current transformer
- Associated with P109 Upper Limit and P110 Lower Limit

When motor is lightly loaded as set in P110, the bypass contactor is de-energized to run the motor from the soft starter in Energy Optimizing mode. When motor is heavily loaded as set in P109, the bypass contactor is energized to eliminate the soft starter thyristor losses.



‘Optimise +’ requires an external user-supplied bypass contactor and current transformer. Refer to Electrical Installation Chapter 2, subsections 2.4.1 & 2.5.2 for details.

(P51.B0) Kick Start

Range: P51 / B0 Default: Off Scaling: n/a Type: R/W

This menu item turns the Kick Start function ‘On’ or ‘Off’. The Kick Start applies a short-lived voltage kick at the beginning of the start ramp to dislodge sticky loads.

(P-13) Kick Pedestal

Range: 60 to 90 percent Default: 75% Scaling: n/a Type: R/W

‘Kick Pedestal’ provides a short kick of voltage at start of ramp to dislodge sticky load.

(P-14) Kick Time

Range: 10 to 40 cycles Default: 25 cycles Scaling: n/a Type: R/W

‘Kick Time’ sets the number of cycles for which Kick Ped (P13) is applied, if selected (P51/B0).

(P-15) Dwell Time

Range: 1 to 255 seconds Default: 5s Scaling: n/a Type: R/W

‘Dwell Time’ provides a period of time following soft-start allowing the load to settle, and to ensure that it is up to speed, before optimizing commences (if selected).

5.4.5 – ‘Advanced’ Menu (continued)

(P53.B5) Cooling

Range: P53 / B5 Default: On Scaling: n/a Type: R/W

This menu item turns ‘On’ and ‘Off’ the ‘Cooling’ (Inhibit Restart) function. Once this menu item has been turned ‘On’, and the unit has been started and subsequently stopped, the ‘Cooling’ function inhibits the start command (not allowing the unit to start), until the time held in ‘Cooling Time’ has elapsed (measured from the last stop signal). During this period the unit displays ‘Stopped. Cooling’. This menu item is mainly for use in commissioning soft-start units that have large thyristor stacks, and its purpose is to avoid damage to the thyristors during the commissioning process.

(P-116) Cooling Time

Range: 0 to 63.75 minutes Default: varies by unit model Scaling: n/a Type: R/W

This parameter holds the time in seconds that the soft-start unit will ignore a start signal if ‘Cooling’ is turned on (see above). By default, this is set to zero (0) for units of less than 242A. For units of 242A and above, the default value is 420 seconds (7 mins). (Changes should be entered in seconds.) The default value can be extended, but it should NOT be reduced as it will invalidate the manufacturer’s warranty.

(P-123) Temp/Alt Derate

Range: 0 to 50% Default: 0 Scaling: n/a Type: R/W

This parameter enables the user to derate by percentage of Unit Full Load current, where local temperature or altitude is outside of the normal operating range. (Refer to the Mechanical Installation chapter for temperature and altitude specs.)

(P121.B3) Line Contactor (Breaker Present)

Range: P121 / B3 Default: On (0) Scaling: n/a Type: R/W

This menu item turns ‘On’ and ‘Off’ the ‘Line Contactor’ function, which selects the use by the customer of an in-line contactor in his wiring configuration.

However, if the decision is made to use a breaker instead, a new mode has been introduced so that the Soft Start can trip the breaker via the alarm relay when it is in the ‘Stopped and ready’ state (see section 5.1.3). This helps to eliminate the problems that arise when the breaker is closed and a faulty Soft Start has short circuit devices. The breaker option is selected by turning this menu item, ‘Line Contactor’, ‘Off’, or by enabling bit 3 of ‘User Flags 4’ (P121).

- P121/B3 = 0 = ‘Line Contactor’
- P121/B3 = 1 = ‘Breaker Present’



*An in-line contactor **MUST** be used with ‘In Delta’ mode, and the use of an in-line contactor is always recommended.*

5.4.6 – ‘Monitoring’ Menu



User-supplied current transformer is required if any of the current- and power-related monitoring features are needed in bypass mode. Refer to Electrical Installation Chapter 2, sections 2.4.1 & 2.5.2 for details.

- Power

Range: 0 to 20,000,000W Default: 0W
 Three phase power as calculated by the Soft Starter keypad.

(P-7) Protection

Range: 0 to 192 Default: 192 Scaling: n/a Type: R/W

‘Protection Mode’ controls which trips are available:

- 64 = FULL = full protection with full volts after top of ramp; optimizing function turned off
- 192 = FULL+OPTIMIZE = full protection + optimize
- 128 = START+BYPASS = protection during start; then bypass
- 0 = PHASE LOSS ONLY = l/p phase loss detection only

Start and Optimize mode is forced to ‘FULL’ Protection Mode when ‘Delta’ Firing Mode is selected (P-6 = 1). In ‘PHASE LOSS ONLY’ Protection Mode (P-7 = 0), the bottom 12.5% of starter current is ignored after TOR (Top Of Ramp).

(P-78 ‘Protection Mode 2’ is the second parameter set counterpart of P-7 ‘Protection Mode’.)

(P-26) Current

Range: 0 to 3000 Amps Default: 0A Scaling: n/a Type: R

‘Running Current’ displays the current that the motor is taking, as monitored in one phase. This is the source parameter for the Overload, Current Limit, Shearpin, Under Current Trip, etc. The divisor is 32, and the multiplier is the rated current of the unit.

(P-27) P27 Peak Start I

Range: 0 to 255 Amps Default: 0 Scaling: n/a Type: R

‘Peak Start Current’ displays the peak current seen by the unit during the last start. Scaling is per the running current.

(P-40) P40 Supply Volts

Range: 108 to 1000 Volts Default: 416V Scaling: n/a Type: R

‘Supply Volts’ is the manually entered main supply voltage. (It also works in conjunction with Bit 1 of User Flags 5 for voltages above 500V.)

(P-39) Real PF

Range: 0 to 127.5 degrees Default: 0° Scaling: n/a Type: R

‘Real Power Factor Angle’ displays the angle by which the sine curve of the voltage in a circuit leads the sine curve on the current in that circuit; calculated by the Soft Starter keypad.

5.4.6 – ‘Monitoring’ Menu (continued)



User-supplied current transformer is required if any of the current- and power-related monitoring features are needed in bypass mode. Refer to Electrical Installation Chapter 2, sections 2.4.1 & 2.5.2 for details.

(P-22)

P22 Delay Angle

Range: 0 to 146.76 degrees Default: 146.76° Scaling: n/a Type: R
 ‘Firing Delay Angle’ shows the firing delay angle (thyristor off time).

(P-23)

P23 Max Angle

Range: 17.27 to 146.76 degrees Default: 57.554° Scaling: n/a Type: R
 ‘Maximum Optimizing Delay Angle’ shows the maximum allowed Firing Delay Angle during optimizing. (The Optimize function reduces energy consumption by reducing voltage, but the system also senses motor conditions and automatically adjusts the maximum delay angle by which the voltage can be reduced without allowing the motor to stall.)

(P-20)

P20 Reference PF

Range: 0 to 146.76 degrees Default: 146.76° Scaling: n/a Type: R
 ‘Reference PF’ shows the Power Factor Angle that the SR44 has calculated as the target for the optimizing control loop. (Refer to Ch 3.6 for PF degrees-to-ratio conversion.)

(P-21)

P21 Internal PF

Range: 0 to 146.76 degrees Default: 146.76° Scaling: n/a Type: R
 ‘Internal PF’ shows the Power Factor Angle of the load.
 (Refer to Ch 3.6 for PF degrees-to-ratio conversion.)

5.4.7 – ‘Permanent Store’ Menu

- Save Param

Range: n/a

Default: n/a

‘Save Parameters’ saves all the parameter settings to a permanent store. This means that if the control supply is removed from the main control board, the parameters will still remain stored and will be recalled the next time the unit boots up.

- Power on Param

Range: n/a

Default: n/a

‘Power on Parameters’ recalls all the parameter settings from the last ‘Save Param’, and loads the current parameters with these recalled values.

* * * Default Param

Range: n/a

Default: n/a

‘Default Parameters’ loads all the parameters with their factory default values.

The ‘Starting’ parameter is set to ‘Remote’ by this menu item (P51, bit 7).

5.4.8 – ‘Password’ Menu

(P-5)

Enter Password

Range: 0 to 255

Default: 0

Scaling: n/a

Type: R/W

‘Password’ is used by the keypad; Keypad sees 0s as no password set.

This option enables the user to temporarily unlock a unit by entering a previously set password. When the unit is ‘locked’, the user can read all parameters as usual, but the user cannot write to any parameters. The unit can be started and stopped while it is locked. (See Appendix A.1.10a).

-

Change Password

Range:

Default: 0

‘Change Password’ enables the user to change a previously set password, to enter a password for the first time, or to clear the password. If the password is non-zero, then you must unlock the password using ‘Enter Password’ previous to using ‘Change Password.’ This last action (clear password) is performed by changing the password to zero (0) and pressing Enter. This action clears any set password, but the control supply must be cycled or the unit reset by pressing the ▲ and ▼ buttons at the same time after the password has been cleared. (See Appendix A.1.9).

5.4.9 – 'Inputs' Menu

-

Digital i/p 1

Range: n/a

Default: n/a

'Digital Input 1' gives access to the setup parameters for the first programmable input (see section 2.7.2 of Electrical Installation). An example showing how to set up a digital input is given in Appendix A.2.4.

I/p1 Map To – P-65

I/p1 Bit Mask – P-66

I/p1 Polarity – P-54 / B-4

5.4.10 – ‘Outputs’ Menu

-

K1

Range: n/a

Default: Run Relay

The ‘K1’ menu item allows the customer to program the K1 relay (section 2.7.2 of Electrical Installation). At the bottom of the sub-menu is a list of programming shortcuts which will set up the relay for the user. Below is a list of the shortcuts with a description of when they energize the relay:

Map From – P-57

Bit Mask – P-58

Polarity – P-54 / B-0

K = ‘Run Relay’ – Usually for controlling the main contactor; energizes while the unit is running.

K = ‘Bypass Relay’ – Usually for controlling the bypass contactor; energizes when the unit reaches ‘Top of Ramp’ (P8/B3=1).

K = ‘Alarm’ – Energizes when an Alarm condition is present.

K = ‘Current Limiting’ – Energizes when the unit is current limiting.

K = ‘Ovld Integrating’ – Energizes when the SR44’s overload is integrating.

K = ‘Stall’ – Energizes when the motor is stalling.

K = ‘Cooling’ – Energizes when the SR44 is cooling (start inhibited).

K = ‘Enable Status’ – Energizes when the SR44 is enabled.

K = ‘I/P1’

K = ‘60Hz’

K = ‘Shearpin’

K = ‘Undercurrent’

K = ‘C/L Timeout’

K = ‘Thermistor’ – not available

K = ‘Overload’

K = ‘Thermal Switch’

K = ‘RYB’ – Phase sequence ABC, or L1, L2, L3

A worked example showing how to program a relay is given in Appendix A.1.11.

5.4.10 – ‘Outputs’ Menu (continued)

-

K2

Range: n/a

Default: Bypass Relay

The ‘K2’ menu item allows the customer to program the K2 relay (section 2.7.2 of Electrical Installation). At the bottom of the sub-menu is a list of programming shortcuts which will set up the relay for the user. Below is a list of the shortcuts with a description of when they energize the relay:

K2 Map From – P-59

K2 Bit Mask – P-60

K2 Polarity – P-54 / B-1

K = ‘Run Relay’ – Usually for controlling the main contactor; energizes while the unit is running.

K = ‘Bypass Relay’ – Usually for controlling the bypass contactor; energizes when the unit reaches ‘Top of Ramp’ (P8/B3=1).

K = ‘Alarm’ – Energizes when an Alarm condition is present.

K = ‘Current Limiting’ – Energizes when the unit is current limiting.

K = ‘Ovld Integrating’ – Energizes when the SR44’s overload is integrating.

K = ‘Stall’ – Energizes when the motor is stalling.

K = ‘Cooling’ – Energizes when the SR44 is cooling (start inhibited).

K = ‘Enable Status’ – Energizes when the SR44 is enabled.

K = ‘I/P1’

K = ‘60Hz’

K = ‘RYB’ – Phase sequence ABC, or L1, L2, L3

K = ‘Shearpin’

K = ‘Undercurrent’

K = ‘C/L Timeout’

K = ‘Thermistor’ – not available

K = ‘Overload’

K = ‘Thermal Switch’

A worked example showing how to program a relay is given in Appendix A.1.11.

5.4.11 – ‘Parameters’ Menu

P-0	dummy parameter
Range: 0 to 255	Default: 0
Scaling: 1	Type: R
Dummy used for mapping unused bit parameters, etc. No keypad access.	
P-1	Station No
Range: 1 – 32	Default: 1
Scaling: 1	Type: R/W
‘Station Number’ assigns the Local Network ID of this card.	
P-2	Language
Range: 1 to 255	Default: 44
Scaling: 1	Type: R/W
‘Language’ sets the international language code for country, e.g. English = 44; Used by keypads to determine which language to use. (English is the only language available.)	
P-3	Program Type
Range: 5 to 56	Default: 5
Scaling: 1	Type: R
‘Program Type’ shows the generic firmware type; always 5-something.	
P-4	Software Ver
Range: 0 to 255	Default: 11
Scaling: 1	Type: R
‘Software Version’ shows the issue number for particular firmware type.	
P-5	Password
Range: 0 to 255	Default: 0
Scaling: 1	Type: R/W
‘Password’ is used by the keypad; Has no effect on the firmware; Keypad sees 0s as no password set.	
This option enables the user to unlock a unit by entering a previously set password. When the unit is ‘locked’, the user can read all parameters as usual, but the user cannot write to any parameters. The unit can be started and stopped while it is locked.	

5.4.11 – ‘Parameters’ Menu (continued)

P-9

Status 2

Range: 0 to 99 (flags) Default: 0 Scaling: 1 Type: R

‘Status 2’ flags – Read this parameter by individual bits.

• Bit #:

- 0: Alarm – starter has detected a Fault and has tripped.
- 1: Overload Integrating – onboard overload has detected Overcurrent and is integrating.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 2: Stall – starter has detected that motor speed is slipping.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 3: Forced Override – starter has turned off optimizing since the current has risen above 80% FLC.
- 4: Noise – starter is experiencing poor mains reference signals.
- 5: Inhibit Start – Start is Inhibited for a period to keep the unit within its allowable start duty.
- 6: DC I/p Level Reached – DC I/p has risen above the level specified in parameter 48.
- 7: Reserved

P-10

Status 3

Range: 0 to 255 (flags) Default: 0 Scaling: 1 Type: R

‘Status 3’ flags – Read this parameter by individual bits.

• Bit #:

- 0: K1 – Relay K1 Status
- 1: K2 – Relay K2 Status
- 2: (unused)
- 3: (unused)
- 4: I/p 1 – Input 1 Status
- 5: (unused)
- 6: (unused)
- 7: (unused)

5.4.11 – ‘Parameters’ Menu (continued)

P-11

Start Ped

Range: 10 to 60 percent Default: 20% Scaling: 1 Type: R/W

‘Start Pedestal’ sets the percentage of the unit’s rated supply voltage that is applied to the load before the ramp starts.

(P-79 ‘Start Ped 2’ is the 2nd parameter set counterpart of P-11 ‘Start Ped’.)

P-12

Start Time

Range: 1 to 255 seconds Default: 5s Scaling: 1 Type: R/W

‘Soft Start Time’ sets the soft-start time period over which the unit ramps voltage to the motor.

- Start times are normally in the 5–30s range.
- Long ramp times over 1minute are for special applications only.
- The start (without current limit) is purely a voltage ramp.
- Lightly loaded motors will normally reach full speed before the end of a long ramp.

(P-80 ‘Soft Start Time 2’ is the 2nd parameter set counterpart of P-12 ‘Soft Start Time’.)

P-13

Kick Ped

Range: 60 to 90 percent Default: 75% Scaling: 1 Type: R/W

‘Kick Pedestal’ provides a short kick of voltage at start of ramp to dislodge sticky load.

(P-81 ‘Kick Pedestal 2’ is the 2nd parameter set counterpart of P-13 ‘Kick Pedestal’.)

P-14

Kick Time

Range: 10 to 40 cycles Default: 25 cycles Scaling: 1 Type: R/W

‘Kick Time’ sets the number of cycles for which Kick Ped (P13) is applied, if selected (P51/B0).

P-15

Dwell Time

Range: 1 to 255 seconds Default: 5s Scaling: 1 Type: R/W

‘Dwell Time’ provides a period of time following soft-start allowing the load to settle, and to ensure that it is up to speed, before optimizing commences (if selected).

P-16

Stop Ped

Range: 10 to 60 percent Default: 10% Scaling: 1 Type: R/W

‘Soft Stop Pedestal’ sets the percentage of supply voltage at which the Soft Stop will cease. The actual value is affected by certain load variations.

P-17

Stop Time

Range: 0 to 255 seconds Default: 0s Scaling: 1 Type: R/W

‘Soft Stop Time’ sets the time period over which the Soft Stop Ramp is performed.

5.4.11 – ‘Parameters’ Menu (continued)

P-18

Auto Config

Range: 0 to 255 (flags) Default: 6 Scaling: 1 Type: R/W

‘Auto Configuration’ – Set this parameter by individual bits.

• Bit #:

- 0: Auto Ramp – gently ramps voltage to starter; acts somewhat like an automatic current limit.
- 1: Auto 3MC – enable automatic removal of low voltage ramp for high start pedestals. ‘Auto 3MC’ applies only to ‘Start Pedestal’ voltages set above 50% (P-11 or P-79). The SR44 normally does a very brief low-voltage ramp up to the pedestal voltage level before the start ramp begins, but ‘Auto 3MC’ applies a higher starting torque and eliminates this initial pedestal ramp for pedestal voltages above 50%.
- 2: Auto Bypass – enable automatic bypass contactor detection. ‘Auto Bypass’ turns ‘On’ and ‘Off’ the automatic detection of a bypass contactor. When ‘On’, a bypass contactor will be automatically detected. Soft-starter thyristor trips and thyristor short-circuit trips will be disabled during Run (after full voltage is reached). Thyristor protection and thyristor short-circuit protection are still available during the start ramp, and phase-loss protection is available during both Start and Run.



An external user-supplied current transformer is required if any of the current or power related trip or monitoring features are needed in bypass mode.

(Parameters: 8/B2, 9/B1/B2, 20, 21, 22, 23, 26, 28, 30, 32, 33, 34, 36, 39, 51/B1/B2/B3/B4, 87, 89, 91, 93, 112/B0/B1/B2/B3/B6, 121/B4)

Refer to Electrical Installation Chapter 2, subsections 2.4.1 & 2.5.2 for wiring information.



Auto Bypass detects the presence of a bypass contactor, and should be ON when using one. Using a bypass contactor with Auto Bypass in the OFF state can cause thyristor faults.

- 3: Auto Jog – enable automatic Jog detection; Stop requests within about 0.5 seconds of a Start request are forced to 0 stop time. Use this feature for short jogging of light loads (For details & timing chart, refer to subsection “5.4.3 – ‘Auto Features’ Menu.”)
- 4: Auto Endstop – enable Detect Stalled Motor during soft-stop, and turn off thyristors.
- 5: Auto Stop – detect variations in PF during stop smooth stall.
- 6: Auto Endstart – enable detection of full speed during Start, and complete Start ramp.
- 7: Auto Pedestal – enable approximate detection of motor rotation at Start, and adjust pedestal to suit.

(P-86 ‘Auto Configuration 2’ is the 2nd parameter set counterpart of P-18 ‘Auto Configuration’.)

P-19

Opt Rate

Range: 4 to 30 Default: 5 Scaling: 1 Type: R/W

‘Optimize Rate’ sets the speed at which the SR44 will reduce the voltage during optimizing. Some unstable loads benefit from a slower optimizing rate

5.4.11 – ‘Parameters’ Menu (continued)

P-20

Reference PF

Range: 0 to 146.76 degrees Default: 146.76° Scaling: 0.57554 Type: R

‘Reference PF’ shows the Power Factor Angle that the SR44 has calculated as the target for the optimizing control loop. (Refer to Ch 3.6 for PF degrees-to-ratio conversion.)

«•» This parameter is not fully functional in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

P-21

Internal PF

Range: 0 to 146.76 degrees Default: 146.76° Scaling: 0.57554 Type: R

‘Internal PF’ shows the Power Factor Angle of the load. (Refer to Ch 3.6 for PF degrees-to-ratio conversion.)

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

P-22

Delay Angle

Range: 0 to 146.76 degrees Default: 146.76° Scaling: 0.57554 Type: R

‘Firing Delay Angle’ shows the firing delay angle (thyristor off time).

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

P-23

Max Angle

Range: 17.27 to 146.76 deg Default: 57.554° Scaling: 0.57554 Type: R

‘Maximum Optimizing Delay Angle’ shows the maximum allowed Firing Delay Angle during optimizing. (The Optimize function reduces energy consumption by reducing voltage, but the system also senses motor conditions and automatically adjusts the maximum delay angle by which the voltage can be reduced without allowing the motor to stall.)

«•» This parameter is not fully functional in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

P-24

Rated Amps (hundreds)

Range: 0 to 3000 amps Default: 0A Scaling: 100 Type: R/W

Unit’s Rated Current is stored in two bytes; parameters 24 & 25. Parameter 24 holds the number of hundreds. Parameter 25 holds the number of units. These parameters should not be changed, since they go hand-in-hand with the burden resistors installed to the board.

P-25

Rated Amps

Range: 1 to 99 amps Default: 5A Scaling: 1 Type: R/W

(Refer to P-24 for explanation.)

P-26

Current

Range: 0 to 7.9688 Amps Default: 0A Scaling: 0.03125 Type: R

‘Running Current’ displays the current that the motor is taking, as monitored in one phase. This is the source parameter for the Overload, Current Limit, Shearpin, Under Current Trip, etc. The divisor is 32, and the multiplier is the rated current of the unit.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-27

Peak Start I

Range: 0 to 255 Amps Default: 0A Scaling: 1 Type: R

‘Peak Start Current’ displays the peak current seen by the unit during the last start. Scaling is per the running current.

P-28

Low I LevelRange: 0.031 to $0.7813 \times I_e$ Default: $0.0938 \times I_e$ Scaling: 0.03125 Type: R/W

The ‘Low Current Level’ parameter, if enabled, sets a level of current under which the unit will trip. This low current trip level is not active during the starting or stopping phases. The Low Current Level flag (P-112 / B3) is continually updated even if tripping is disabled.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-87 ‘Low Current Level 2’ is the 2nd parameter set counterpart of P-28 ‘Low Current Level’.)

P-29

Low I Time

Range: 5 to 255 cycles Default: 50 cycles Scaling: 1 Type: R/W

‘Low Current Time’ sets the number of cycles for which an Under Current situation must exist before tripping.

(P-88 ‘Low Current Time 2’ is the 2nd parameter set counterpart of P-29 ‘Low Current Time’.)

P-30

C/L LevelRange: 0.375 to $7.9688 \times I_e$ Default: $3.5 \times I_e$ Scaling: 0.03125 Type: R/W

‘Current Limit Level’ sets the current level at which the the Soft Start ramp will be held.

The Current Limit only holds the ramp if its level is reached.

The current naturally falls as motor speed increases, allowing the ramp to continue.

«•» This parameter is not fully functional in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-89 ‘Current Limit Level 2’ is the 2nd parameter set counterpart of P-30 ‘Current Limit Level’.)

P-31

C/L Time

Range: 5 to 255 seconds Default: 30s Scaling: 1 Type: R/W

‘Current Limit Time’ sets the maximum time allowed for the current limit before it trips or continues the ramp regardless of motor current level.

(P-90 ‘Current Limit Time 2’ is the 2nd parameter set counterpart of P-31 ‘Current Limit Time’.)

P-32

Shear LevelRange: 0.5 to $5 \times I_e$ Default: $3.125 \times I_e$ Scaling: 0.03125 Type: R/W

‘Shearpin Level’ sets the level of current which will cause a quick trip. Not active during Start or Stop.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-91 ‘Shearpin Level 2’ is the 2nd parameter set counterpart of P-32 ‘Shearpin Level’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-33

Shear Time

Range: 5 to 255 cycles Default: 100 cycles Scaling: 1 Type: R/W

‘Shearpin Time’ sets the number of cycles a Shearpin Current must be present before tripping. The shearpin is active only during the running phase; not Start or Stop. The shearpin flag (P-112 / B2) is updated even if tripping is not enabled.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-92 ‘Shearpin Time 2 ’ is the 2nd parameter set counterpart of P-33 ‘Shearpin Time’.)

P-34

Ovld Level

Range: 0.5 to 1.25 x I_e Default: 1.0938 x I_e Scaling: 0.03125 Type: R/W

‘Start of Overload Level’ sets the level at which the on-board single phase Overload starts to integrate. This Overload does NOT replace an overload for the motor. The overload is designed to detect Soft Start overloads.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-93 ‘Start of Overload Level 2 ’ is the 2nd parameter set counterpart of P-34 ‘Start of Overload Level’.)

P-35

Ovld Delay

Range: 10 to 140 Default: 140 Scaling: 1 Type: R/W

‘Overload Delay’ sets an arbitrary delay to slow Overload integration down. The overload delay mapping is designed primarily for protection of the thyrisors.

(P-94 ‘Overload Delay 2 ’ is the 2nd parameter set counterpart of P-35 ‘Overload Delay’.)

P-36

% Overload

Range: 0 to 100 percent Default: 0% Scaling: 0.39216 Type: R

‘% Overload’ is a status value showing how close the Overload is to tripping. (100 = tripped)

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

P-37

(reserved)

P-38

UserFlags 5 (reserved)

Range: 0 to 255 (flags) Default: 0 Scaling: 1 Type: R/W

‘User Flags 5’ – (reserved)

• Bit #:

- 0: (unused)
- 1: Reserved
- 2: Reserved
- 3: (unused)
- 4: (unused)
- 5: (unused)
- 6: (unused)
- 7: (unused)

5.4.11 – ‘Parameters’ Menu (continued)

P-39

PF Angle

Range: 0 to 127.5 degrees Default: 0° Scaling: 0.5 Type: R

‘Real Power Factor Angle’ displays the angle by which the sine curve of the voltage in a circuit leads the sine curve on the current in that circuit.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

P-40

Supply Volts

Range: 108 to 1000 Volts Default: 416V Scaling: 4 Type: R

‘Supply Volts’ is the manually entered main supply voltage.

(It also works in conjunction with Bit 1 of P-38, User Flags 5, for voltages above 500V.)

P-41

(reserved)

P-42

(reserved)

P-43

(reserved)

P-44

(reserved)

P-45

(reserved)

P-46

(reserved)

P-47

(reserved)

P-48

(reserved)

P-49

(reserved)

P-50

(reserved)

5.4.11 – ‘Parameters’ Menu (continued)

P-51

User Flags 1

Range: 0 to 255 (flags) Default: 142 Scaling: 1 Type: R/W

‘User Flags 1’ is a set of individual bits for user control or system status.

(Other ‘User Flags’ are parameters 52, 53, 95, 96, & 121. P95 is a direct 2nd set for P51.)

• Bit #:

- 0: Kickstart – selects Kickstart (except in 3MC mode).
- 1: Current Limit Timeout Selected – selects Trip or Continue on Current Limit Timeout.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 2: Overload Selected – selects Overload operation
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 3: Shearpin Selected – selects Shearpin operation.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 4: Under Current Selected – selects Under Current operation.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 5: Thermistor Selected – not available.
- 6: (unused)
- 7: Terminal Starting – Start/Stop through onboard terminals

P-52

User Flags 2

Range: 0 to 255 (flags) Default: 0 Scaling: 1 Type: R/W

‘User Flags 2’ is a second set of individual bits for user control or system status.

(Other ‘User Flags’ are parameters 51, 53, 95, 96, & 121. P96 is a direct 2nd set for P52.)

• Bit #:

- 0: Low Voltage Soft-Stop –
- 1: Not Global Enable 1 – bits 1 & 2 must both be Off (0) to enable the starter
- 2: Not Global Enable 2 – bits 1 & 2 must both be Off (0) to enable the starter
- 3: Pod Start/Stop
- 4: Board Start/Stop
- 5: Main Contactor
- 6: Second Parameter Set
- 7: Zero Start Time

5.4.11 – ‘Parameters’ Menu (continued)

P-53

User Flags 3

Range: 0 to 255 (flags) Default: 51 Scaling: 1 Type: R/W

‘User Flags 3’ is a second set of individual bits for user control or system status.
(Other ‘User Flags’ are parameters 51, 52, 95, 96, & 121.)

- Bit #:
 - 0: pf1 polarity
 - 1: pf2 polarity
 - 2: User Current Limit
 - 3: User Trip
 - 4: Invert Controller Input
 - 5: Cooling (Inhibit Restart)
 - 6: (Unused)
 - 7: (Unused)

P-54

I/O Polarity

Range: 0 to 255 (flags) Default: 255 Scaling: 1 Type: R/W

‘I/O Polarity’ sets the I/O polarity for output relays K1 & K2, and input I/p1; i.e. 1-to-1 or 1-to-0.

- Bit #:
 - 0: K1 Polarity
 - 1: K2 Polarity
 - 2: (Unused)
 - 3: (Unused)
 - 4: I/p 1 Polarity
 - 5: (Unused)
 - 6: (Unused)
 - 7: (Unused)

P-55

(reserved)

P-56

(reserved)

5.4.11 – ‘Parameters’ Menu (continued)

P-57

K1 Map

Range: 0 to 123 parameter # Default: 52 parameter Scaling: 1 Type: R/W
‘Map K1 To’ holds the parameter # for the internal starter function assigned to drive the K1 relay output. (Works in conjunction with P58.)

- Refer to Appendix A.1.12 or A.1.13 in the “Programming” chapter.

P-58

K1 Bit Mask

Range: 0 to 255 bit mask Default: 32 Scaling: 1 Type: R/W
‘K1 Bit Mask’ holds the parameter bit # for the internal starter function assigned to drive the K1 relay output. (Works in conjunction with P57.)

P-59

K2 Map

Range: 0 to 123 parameter # Default: 8 parameter Scaling: 1 Type: R/W
‘Map K2 To’ holds the parameter # for the internal starter function assigned to drive the K2 relay output. (Works in conjunction with P60.)

- Refer to Appendix A.1.12 or A.1.13 in the “Programming” chapter.

P-60

K2 Bit Mask

Range: 0 to 128 bit mask Default: 8 Scaling: 1 Type: R/W
‘K2 Bit Mask’ holds the parameter bit # for the internal starter function assigned to drive the K2 relay output. (Works in conjunction with P59.)

P-61

(reserved)

P-62

(reserved)

P-63

(reserved)

P-64

(reserved)

P-65

i/p1 Map

Range: 0 to 123 parameter # Default: 52 parameter Scaling: 1 Type: R/W
‘I/p1 Map To’ holds the Parameter # of the User Flag that contains the internal starter function assigned to be driven by the I/p1 input (S1, S0). (Works in conjunction with P66.)

User Flag mapping through parameters 65, 66.

65, 66 = the source User Flag address; 65 = parameter; 66 = bit mask.

P-66

i/p1 bit Msk

Range: 0 to 128 bit mask Default: 16 Scaling: 1 Type: R/W
‘I/p1 Bit Mask’ holds the parameter bit # of the User Flag that contains the internal starter function assigned to be driven by the I/p1 input (S1, S0). (Works in conjunction with P65.)

User Flag mapping through parameters 65, 66.

65, 66 = the source User Flag address; 65 = parameter; 66 = bit mask.

5.4.11 – ‘Parameters’ Menu (continued)

P-67	(reserved)
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P-68	(reserved)
------	------------

P-69	(reserved)
------	------------

P-70	(reserved)
------	------------

P-71	Cntactor Dly
------	---------------------

Range: 100 to 800 milli-seconds Default: 160 ms Scaling: 4 Type: R/W

‘Contactor Delay’. Following a start command, this is the delay allowed for the main incoming contactor to close. After this time, a phase loss detection routine checks the incoming supply.

P-72	Trip Snstvtv
------	---------------------

Range: 1 to 15 Default: 1 Scaling: 1 Type: R/W

‘Trip Sensitivity’ holds an arbitrary number to adjust the sensitivity of some of the fault trips. The larger the number, the slower the trip.

P-73	Last Trip
------	------------------

Range: 0 to 17 trip number Default: 0 Scaling: 1 Type: R

‘Last Trip’ holds the number of the last trip.

- Trip #:

- E0 – no trip
- E1 – Phase Loss
- E2 – Too Hot
- E3,5,6 – SCR Signal
- E4 – SCR Firing
- E7,8,9 – Sensing Signal
- E10 – SCR Shorted
- E11 – Low Current
- E12 – C/L Time Out
- E13 – Overload
- E14 – Shearpin
- E15 – Thermistor – not available
- E16 – External trip
- E17 – Comms Timeout

5.4.11 – ‘Parameters’ Menu (continued)

P-74

2nd Last Trp

Range: 0 to 17 trip number Default: 0 Scaling: 1 Type: R

‘2nd Last Trip’ holds the number of the second to last trip.

• Trip #:

- E0 – no trip
- E1 – Phase Loss
- E2 – Too Hot
- E3,5,6 – SCR Signal
- E4 – SCR Firing
- E7,8,9 – Sensing Signal
- E10 – SCR Shorted
- E11 – Low Current
- E12 – C/L Time Out
- E13 – Overload
- E14 – Shearpin
- E15 – Thermistor – not available
- E16 – External trip
- E17 – Comms Timeout

P-75

3rd Last Trp

Range: 0 to 17 trip number Default: 0 Scaling: 1 Type: R

‘3rd Last Trip’ holds the number of the third to last trip.

• Trip #:

- E0 – no trip
- E1 – Phase Loss
- E2 – Too Hot
- E3,5,6 – SCR Signal
- E4 – SCR Firing
- E7,8,9 – Sensing Signal
- E10 – SCR Shorted
- E11 – Low Current
- E12 – C/L Time Out
- E13 – Overload
- E14 – Shearpin
- E15 – Thermistor – not available
- E16 – External trip
- E17 – Comms Timeout

5.4.11 – ‘Parameters’ Menu (continued)

P-76**4th Last Trp**

Range: 0 to 17 trip number Default: 0 Scaling: 1 Type: R

‘4th Last Trip’ holds the number of the fourth to last trip.

• Trip #:

- E0 – no trip
- E1 – Phase Loss
- E2 – Too Hot
- E3,5,6 – SCR Signal
- E4 – SCR Firing
- E7,8,9 – Sensing Signal
- E10 – SCR Shorted
- E11 – Low Current
- E12 – C/L Time Out
- E13 – Overload
- E14 – Shearpin
- E15 – Thermistor – not available
- E16 – External trip
- E17 – Comms Timeout

P-77**5th Last Trp**

Range: 0 to 17 trip number Default: 0 Scaling: 1 Type: R

‘5th Last Trip’ holds the number of the fifth to last trip.

• Trip #:

- E0 – no trip
- E1 – Phase Loss
- E2 – Too Hot
- E3,5,6 – SCR Signal
- E4 – SCR Firing
- E7,8,9 – Sensing Signal
- E10 – SCR Shorted
- E11 – Low Current
- E12 – C/L Time Out
- E13 – Overload
- E14 – Shearpin
- E15 – Thermistor – not available
- E16 – External trip
- E17 – Comms Timeout

5.4.11 – ‘Parameters’ Menu (continued)



P-78 through P-96 define the 2nd parameter set, which can be used to define a different Start/Stop profile. See appendix A.2.1 (Using An Alternative Parameter Group) for more information.

P-78

Protection 2

Range: 0 to 192 Default: 192 Scaling: 1 Type: R/W

‘Protection Mode 2’ – Use with 2nd parameter set.

‘Protection Mode 2’ controls which trips are available; for use with second parameter set:

- 64 = FULL = full protection with full volts after top of ramp; optimizing function turned off
- 192 = FULL+OPTIMIZE = full protection + optimize
- 128 = START+BYPASS = protection during start; then bypass
- 0 = PHASE LOSS ONLY = I/p phase loss detection only

Start and Optimize mode is forced to ‘FULL’ Protection Mode when ‘Delta’ Firing Mode is selected (P-6 = 1). In ‘PHASE LOSS ONLY’ Protection Mode (P-78 = 0), the bottom 12.5% of starter current is ignored after TOR (Top Of Ramp).

(P-7 ‘Protection Mode’ is the 1st parameter set counterpart of P-78 ‘Protection Mode 2’.)

P-79

Start Ped 2

Range: 10 to 60 percent Default: 50% Scaling: 1 Type: R/W

‘Start Pedestal 2’ – Use with 2nd parameter set.

‘Start Pedestal 2’ sets the percentage of the unit’s rated supply voltage that is applied to the load before the ramp starts.

(P-11 ‘Start Ped’ is the 1st parameter set counterpart of P-79 ‘Start Ped 2’.)

P-80

Start Time 2

Range: 1 to 255 seconds Default: 5s Scaling: 1 Type: R/W

‘Soft Start Time 2’ – Use with 2nd parameter set.

‘Soft Start Time 2’ sets the soft-start time period over which the unit ramps voltage to the motor.

- Start times are normally in the 5–30s range.
- Long ramp times over 1minute are for special applications only.
- The start (without current limit) is purely a voltage ramp.
- Lightly loaded motors will normally reach full speed before the end of a long ramp.

(P-12 ‘Start Time’ is the 1st parameter set counterpart of P-80 ‘Start Time 2’.)

P-81

Kick Ped 2

Range: 60 to 90 percent Default: 75% Scaling: 1 Type: R/W

‘Kick Pedestal 2’ – Use with 2nd parameter set.

‘Kick Pedestal 2’ provides a short kick of voltage at start of ramp to dislodge sticky load.

(P-13 ‘Kick Pedestal’ is the 1st parameter set counterpart of P-81 ‘Kick Pedestal 2’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-82**Kick Time 2**

Range: 10 to 40 cycles Default: 25 cycles Scaling: 1 Type: R/W

‘Kick Time 2’ – Use with 2nd parameter set.

‘Kick Time 2’ sets the number of cycles for which Kick Ped 2 (P81) is applied, if selected (P95/B0). (P-14 ‘Kick Time’ is the 1st parameter set counterpart of P-82 ‘Kick Time 2’.)

P-83**Dwell Time 2**

Range: 1 to 255 seconds Default: 5s Scaling: 1 Type: R/W

‘Dwell Time 2’ – Use with 2nd parameter set.

‘Dwell Time 2’ provides a period of time following soft-start allowing the load to settle, and to ensure that it is up to speed, before optimizing commences (if selected).

(P-15 ‘Dwell Time’ is the 1st parameter set counterpart of P-83 ‘Dwell Time 2’.)

P-84**Stop ped 2**

Range: 10 to 60 percent Default: 10% Scaling: 1 Type: R/W

‘Soft Stop Pedestal 2’ – Use with 2nd parameter set.

‘Soft Stop Pedestal 2’ sets the percentage of supply voltage at which the Soft Stop will cease. The actual value is affected by certain load variations.

(P-16 ‘Soft Stop Pedestal’ is the 1st parameter set counterpart of P-84 ‘Soft Stop Pedestal 2’.)

P-85**Stop Time 2**

Range: 0 to 255 seconds Default: 0s Scaling: 1 Type: R/W

‘Soft Stop Time 2’ – Use with 2nd parameter set.

‘Soft Stop Time 2’ sets the time period over which the Soft Stop Ramp is performed.

(P-17 ‘Soft Stop Time’ is the 1st parameter set counterpart of P-85 ‘Soft Stop Time 2’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-86

AutoConfig 2

Range: 0 to 255 (flags) Default: 6 Scaling: 1 Type: R/W

‘Auto Configuration 2’ – Use with 2nd parameter set.

– Set this parameter by individual bits.

• Bit #:

0: Auto Ramp – gently ramps voltage to starter; acts somewhat like an automatic current limit.

1: Auto 3MC – enable automatic removal of low voltage ramp for high start pedestals.

‘Auto 3MC’ applies only to ‘Start Pedestal’ voltages set above 50% (P-11 or P-79). The SR44 normally does a very brief low-voltage ramp up to the pedestal voltage level before the start ramp begins, but ‘Auto 3MC’ applies a higher starting torque and eliminates this initial pedestal ramp for pedestal voltages above 50%.

2: Auto Bypass – enable automatic bypass contactor detection.

‘Auto Bypass’ turns ‘On’ and ‘Off’ the automatic detection of a bypass contactor. When ‘On’, a bypass contactor will be automatically detected. Soft-starter thyristor trips and thyristor short-circuit trips will be disabled during Run (after full voltage is reached). Thyristor protection and thyristor short-circuit protection are still available during the start ramp, and phase-loss protection is available during both Start and Run.



An external user-supplied current transformer is required if any of the current or power related trip or monitoring features are needed in bypass mode.

(Parameters: 8/B2, 9/B1/B2, 20, 21, 22, 23, 26, 28, 30, 32, 33, 34, 36, 39, 51/B1/B2/B3/B4, 87, 89, 91, 93, 112/B0/B1/B2/B3/B6, 121/B4)

Refer to Electrical Installation Chapter 2, subsections 2.4.1 & 2.5.2 for wiring information.



Auto Bypass detects the presence of a bypass contactor, and should be ON when using one. Using a bypass contactor with Auto Bypass in the OFF state can cause thyristor faults.

3: Auto Jog – enable automatic Jog detection; Stop requests within about 0.5 seconds of a Start request are forced to 0 stop time. Use this feature for short jogging of light loads (For details & timing chart, refer to subsection “5.4.3 – ‘Auto Features’ Menu.”)

4: Auto Endstop – enable Detect Stalled Motor during soft-stop, and turn off thyristors.

5: Auto Stop – detect variations in PF during stop smooth stall.

6: Auto Endstart – enable detection of full speed during Start, and complete Start ramp.

7: Auto Pedestal – enable approximate detection of motor rotation at Start, and adjust pedestal to suit.

(P-18 ‘Auto Configuration’ is the 1st parameter set counterpart of P-86 ‘Auto Configuration 2’.)

P-87

Low I 2

Range: 0 to 0.7813 x I_e Default: 0.125 x I_e Scaling: 0.03125 Type: R/W

‘Low Current Level 2’ – Use with 2nd parameter set.

The ‘Low Current Level 2’ parameter, if enabled, sets a level of current under which the unit will trip. This low current trip level is not active during the starting or stopping phases. The Low Current Level flag is continually updated even if tripping is disabled.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-28 ‘Low Current Level’ is the 1st parameter set counterpart of P-87 ‘Low Current Level 2’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-88

Low I time 2

Range: 5 to 255 cycles Default: 50 cycles Scaling: 1 Type: R/W

‘Low Current Time 2’ – Use with 2nd parameter set.

‘Low Current Time 2’ sets the number of cycles for which an Under Current situation must exist before tripping.

(P-29 ‘Low Current Time’ is the 1st parameter set counterpart of P-88 ‘Low Current Time 2’.)

P-89

C/L 2Range: 0.375 to 7.9688 xI_e Default: 4 xI_e Scaling: 0.03125 Type: R/W

‘Current Limit Level 2’ – Use with 2nd parameter set.

‘Current Limit Level 2’ sets the current level at which the the Soft Start ramp will be held.

The Current Limit only holds the ramp if its level is reached.

The current naturally falls as motor speed increases, allowing the ramp to continue.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-30 ‘Current Limit Level’ is the 1st parameter set counterpart of P-89 ‘Current Limit Level 2’.)

P-90

C/L Time 2

Range: 5 to 255 seconds Default: 15s Scaling: 1 Type: R/W

‘Current Limit Time 2’ – Use with 2nd parameter set.

‘Current Limit Time’ sets the maximum time allowed for the current limit before it trips or continues the ramp regardless of motor current level.

(P-31 ‘Current Limit Time’ is the 1st parameter set counterpart of P-90 ‘Current Limit Time 2’.)

P-91

Shearpin 2

(external CT required for bypass mode; see P-86/Bit-2 for note)

Range: 1.063 to 5 xI_e Default: 3 xI_e Scaling: 0.03125 Type: R/W

‘Shearpin Level 2’ – Use with 2nd parameter set.

‘Shearpin Level 2’ sets the level of current which will cause a quick trip.

Not active during Start or Stop.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-32 ‘Shearpin Level’ is the 1st parameter set counterpart of P-91 ‘Shearpin Level 2’.)

P-92

Shear time 2

(external CT required for bypass mode; see P-86/Bit-2 for note)

Range: 5 to 255 cycles Default: 50 cycles Scaling: 1 Type: R/W

‘Shearpin Time 2’ – Use with 2nd parameter set.

‘Shearpin Time 2’ sets the number of cycles a Shearpin Current must be present before tripping. The shearpin is only active during the running phase; not Start or Stop. The shearpin flag (P-95 / Bit 3) is updated even if tripping is not enabled.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-33 ‘Shearpin Time’ is the 1st parameter set counterpart of P-92 ‘Shearpin Time 2’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-93

Ovld Level 2

Range: 0.5 to 1.25 x I_e Default: 1.0938 x I_e Scaling: 0.03125 Type: R/W

‘Start of Overload Level 2’ – Use with 2nd parameter set.

‘Start of Overload Level 2’ sets the level at which the on-board single phase Overload starts to integrate. This Overload does NOT replace an overload for the motor. The overload is designed to detect Soft Start overloads.

«•» This parameter is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)

(P-34 ‘Start of Overload Level’ is the 1st parameter set counterpart of P-93 ‘Start of Overload Level 2’.)

P-94

Ovld Delay 2

Range: 10 to 140 Default: 140 Scaling: 1 Type: R/W

‘Overload Delay 2’ – Use with 2nd parameter set.

‘Overload Delay’ sets an arbitrary delay to slow Overload integration down. The overload delay mapping is designed primarily for protection of the thyrisors.

(P-35 ‘Overload Delay’ is the 1st parameter set counterpart of P-94 ‘Overload Delay 2’.)

5.4.11 – ‘Parameters’ Menu (continued)

P-95

User Flags12

Range: 0 to 255 (flags) Default: 134 Scaling: 1 Type: R/W

‘User Flags 1, 2’ – Use with 2nd parameter set.

‘User Flags 1, 2’ is a set of individual bits for user control or system status.
(Other ‘User Flags’ are parameters 51, 52, 53, 96, & 121. P95 is a direct 2nd set for P51.)

• Bit #:

- 0: Kickstart – selects Kickstart (except in 3MC mode).
- 1: Current Limit Timeout Selected – selects Trip or Continue on Current Limit Timeout.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 2: Overload Selected – selects Overload operation
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 3: Shearpin Selected – selects Shearpin operation.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 4: Under Current Selected – selects Under Current operation.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 5: Thermistor Selected – not available.
- 6: (unused)
- 7: Terminal Starting – Start/Stop through onboard terminals.

P-96

User Flags22

Range: 0 to 255 (flags) Default: 64 Scaling: 1 Type: R/W

‘User Flags 2, 2’ – Use with 2nd parameter set.

‘User Flags 2, 2’ is a set of individual bits for user control or system status.
(Other ‘User Flags’ are parameters 51, 52, 53, 95, & 121. P96 is a direct 2nd set for P52.)

• Bit #:

- 0: Low Voltage Soft-Stop –
- 1: Not Global Enable 1 – bits 1 & 2 must both be Off (0) to enable the starter
- 2: Not Global Enable 2 – bits 1 & 2 must both be Off (0) to enable the starter
- 3: Pod Start/Stop
- 4: Board Start/Stop
- 5: Main Contactor
- 6: Second Parameter Set
- 7: Zero Start Time

5.4.11 – ‘Parameters’ Menu (continued)

P-97

U1 I/P srce

Range: 0 to 125 parameter # Default: 0 Scaling: 1 Type: R/W

The ‘ipf1_addr’ parameter holds the parameter # for the internal starter input function assigned to drive the P99 internal starter output function. (Works in conjunction with P98.)

User Flag mapping through parameters 97, 98, 99, 100.

97, 98 = the source flag address; 97 = parameter; 98 = bit mask.

99, 100 = the destination flag address; 99 = parameter; 100 = bit mask.

P-98

U1 I/P Mask

Range: 0 to 128 bit mask Default: 0 Scaling: 1 Type: R/W

The ‘ipf1_mask’ parameter holds the parameter bit # for the internal starter input function assigned to drive the P99 internal starter output function. (Works in conjunction with P97.)

User Flag mapping through parameters 97, 98, 99, 100.

97, 98 = the source flag address; 97 = parameter; 98 = bit mask.

99, 100 = the destination flag address; 99 = parameter; 100 = bit mask.

P-99

U1 O/P Dest

Range: 0 to 125 parameter # Default: 0 Scaling: 1 Type: R/W

The ‘opf1_addr’ parameter holds the parameter # for the internal starter output function assigned to be driven by the P97 internal starter input function. (Works in conjunction with P100.)

User Flag mapping through parameters 97, 98, 99, 100.

97, 98 = the source flag address; 97 = parameter; 98 = bit mask.

99, 100 = the destination flag address; 99 = parameter; 100 = bit mask.

P-100

U1 O/P Mask

Range: 0 to 255 bit mask Default: 0 Scaling: 1 Type: R/W

The ‘opf1_mask’ parameter holds the parameter bit # for the internal starter output function assigned to be driven by the P97 internal starter input function. (Works in conjunction with P99.)

User Flag mapping through parameters 97, 98, 99, 100.

97, 98 = the source flag address; 97 = parameter; 98 = bit mask.

99, 100 = the destination flag address; 99 = parameter; 100 = bit mask.

5.4.11 – ‘Parameters’ Menu (continued)

P-101**U2 I/P srce**

Range: 0 to 125 parameter # Default: 0 Scaling: 1 Type: R/W

The ‘ipf2_addr’ parameter holds the parameter # for the internal starter input function assigned to drive the P103 internal starter output function. (Works in conjunction with P102.)

User Flag mapping through parameters 101, 102, 103, 104.

101, 102 = the source flag address; 101 = parameter; 102 = bit mask.

103, 104 = the destination flag address; 103 = parameter; 104 = bit mask.

P-102**U2 I/P Mask**

Range: 0 to 20 bit mask Default: 0 Scaling: 1 Type: R/W

The ‘ipf2_mask’ parameter holds the parameter bit # for the internal starter input function assigned to drive the P103 internal starter output function. (Works in conjunction with P101.)

User Flag mapping through parameters 101, 102, 103, 104.

101, 102 = the source flag address; 101 = parameter; 102 = bit mask.

103, 104 = the destination flag address; 103 = parameter; 104 = bit mask.

P-103**U2 O/P Dest**

Range: 0 to 125 parameter # Default: 0 Scaling: 1 Type: R/W

The ‘opf2_addr’ parameter holds the parameter # for the internal starter output function assigned to be driven by the P101 internal starter input function. (Works in conjunction with P104.)

User Flag mapping through parameters 101, 102, 103, 104.

101, 102 = the source flag address; 101 = parameter; 102 = bit mask.

103, 104 = the destination flag address; 103 = parameter; 104 = bit mask.

P-104**U2 O/P Mask**

Range: 0 to 11 bit mask Default: 0 Scaling: 1 Type: R/W

The ‘opf2_mask’ parameter holds the parameter bit # for the internal starter output function assigned to be driven by the P101 internal starter input function. (Works in conjunction with P103.)

User Flag mapping through parameters 101, 102, 103, 104.

101, 102 = the source flag address; 101 = parameter; 102 = bit mask.

103, 104 = the destination flag address; 103 = parameter; 104 = bit mask.

5.4.11 – ‘Parameters’ Menu (continued)

P-112

Status 4

Range: 0 to 255 (flags) Default: 0 Scaling: 1 Type: R

‘Status 4’ flags – Read this parameter by individual bits.

• Bit #:

- 0: 60 Hz – the unit is using 60 Hz parameters.
«•» This parameter bit is not fully functional in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 1: Phase Rotation Sequence – the phase rotation detected at start was
«•» This parameter bit is not fully functional in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 2: Shearpin – current is above Shearpin level.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 3: Under Current – current is below Under Current level.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 4: Thermistor – not available.
- 5: Timeout – Current Limit has timed out.
- 6: Overload – overload has passed Trip Level.
«•» This parameter bit is not available in Bypass Operation unless a user-supplied external current transformer is installed. (Refer to P18/B2, ‘Auto Bypass’.)
- 7: Thermal Switch – heatsink is above max allowed temperature.

P-113

(reserved)

P-114

StopProfile

Range: 0 to 100 Default: 0 Scaling: 1 Type: R/W

‘Soft Switch Off’ – system variable

P-115

Last App

Range: 0 to 255 Default: 0 Scaling: 1 Type: R/W

‘Selected App’ – Value selected from application table.

P-116

CoolingTime

Range: 0 to 63.75 minutes Default: varies per model Scaling: 0.25 Type: R/W

‘Cooling Inhibit Time’

Time for which the unit is not allowed to restart; display shows “Stopped.Cooling”.

Mainly for larger stacks to avoid destroying thyristors during commissioning.

This parameter holds the time in seconds that the soft-start unit will ignore a start signal if ‘Cooling’ is turned on (P53/B5). By default, this is set to zero (0) for units of less than 242A. For units of 242A and above, the default value is 420 seconds (7 mins). (Changes should be entered in seconds.) The default value can be extended, but it should NOT be reduced as it will invalidate the manufacturer’s warranty.

5.4.11 – ‘Parameters’ Menu (continued)

P-117

(reserved)

P-118

(reserved)

P-119

(reserved)

P-120

Status 5

Range: 0 to 255 (flags) Default: 0 Scaling: 1 Type: R

‘Status 5’ flags – Read this parameter by individual bits.

• Bit #:

- 0: Over Temperature – inhibits re-start if set; effectively the heatsink is too hot to start, but is OK to run.
- 1: Offline Command Fail – the last offline command failed; automatically resets when the next command is attempted.
- 2: (unused)
- 3: Fan Status – used in conjunction with an output relay to control fans
- 4: (unused)
- 5: (unused)
- 6: (unused)
- 7: (unused)

P-121

UserFlags 4

Range: 0 to 255 (flags) Default: 0 Scaling: 1 Type: R/W

‘User Flags 4’ is a fourth set of individual bits for user control or system status.

(Other ‘User Flags’ are parameters 51, 52, 53, 95, & 96.)

• Bit #:

- 0: Impact Load – limit max delay adjustment in optimizing for highly volatile loads.
- 1: (unused)
- 2: Auto Soft Stop Smoothing – Enable P-122 Soft Stop Smoothing for pumps.
- 3: Breaker Present (Line Contactor)
If the starter is to be used with a circuit breaker, then set bit 3 to a one (1).
Read the description of the “Line Contactor” Menu Item in section 5.4.5 (“Advanced Menu”) for a more detailed explanation of this functionality.
 - 0 = ‘Line Contactor’
 - 1 = ‘Breaker Present’
- 4: Optimize + – gains the maximum amount of energy savings on variable loads.
 - Requires an external user-supplied bypass contactor and current transformer
 - Associated with P109 Upper Limit and P110 Lower LimitWhen motor is lightly loaded as set in P110, the bypass contactor is de-energized to run the motor from the soft starter in Energy Optimizing mode. When motor is heavily loaded as set in P109, the bypass contactor is energized to eliminate the soft starter thyristor losses.



‘Optimize +’ requires an external user-supplied bypass contactor and current transformer. See Electrical Installation Chapter 2, subsections 2.4.1 & 2.5.2 for details.

- 5: Quick Ramp Times – selects ramp times to be 10 times faster than the value entered, although min = 0.3 seconds.
- 6: Two Stop Bits – when set, the comms will have two stop bits.
- 7: Auto Stop (2) – alternative stopping method.

5.4.12 – ‘Trips’ Menu

This menu holds all the parameters that are associated with control of the various trips

-	Trips
---	--------------

Range: 0 to 17 trip number Default: 0

The ‘Trips’ sub-menu accesses a trip history of the unit’s last five trips. These trips are recorded automatically, and need no intervention from the user. They are useful in troubleshooting a unit.

Most trips can be turned off, either via this menu, or through the ‘Trip Byte’, P127, or via the ‘Current’ menu for the current related trips. Below is a list of each trip condition used by the SR44.

Trip Numbers and Explanations:

- 01 ‘Phase Loss’ – One or more input phases are missing at start, during the ramp, and after full voltage; even when running on bypass. (See section 5.4.5, Line Contactor.)
- 02 ‘Too Hot’ – Soft starter heat sink is too hot. (This trip applies only to units SR44-30 and larger.)
- 03 ‘Comms’ – Errors in serial communications while communications are still active between the user interface and the Soft Starter.
- 04 ‘SCR Firing’ (Thyristor Sensing Trip Type C) – Short-circuit thyristor after full voltage.
- 05 ‘SCR Signal’ (Edge Sensing Trip) – Short-circuit thyristor during the ramp and after full voltage. Motor-side phase loss during the ramp and after full voltage.
- 06 ‘SCR Signal’ (Sensing Trip Type A) – Short-circuit thyristor during the ramp and after full voltage. Motor-side phase loss during the ramp and after full voltage. Input-side phase loss during the ramp and after full voltage.
- 07 ‘Sensing Signal’ (Sensing Trip Type B) – Short-circuit thyristor or external noise during the ramp and after full voltage. Motor-side phase loss during the ramp and after full voltage.
- 08 ‘SCR Loss Motor’ (Motor-Side Thyristor Loss) – Short-circuit thyristor at the start. Motor-side phase loss at the start.
- 09 ‘Sensing Signal’ (Thyristor Sensing Trip Type A) – Short-circuit thyristor or external noise during the ramp and after full voltage.
- 10 ‘SCR Shorted’ (Thyristor Sensing Trip Type B) – Short-circuit thyristor during the ramp. Motor-side phase loss during the ramp.
- 11 ‘Low Current’ – Output current falls below a previously set level (P28 ‘Low Amps Level’) for a specified time (P29 ‘Low Amps Time’). Active only during the running stage.
- 12 ‘C/L Time Out’ – During start-up ramp, output current exceeds the ‘Current Limit’ level (P30) for the time specified in ‘Limit Time Out’ (P31).
- 13 ‘Overload’ – Output current exceeds the previously set ‘Overload Level’ (P34) and ‘Overload Delay’ time (P35). Active in all stages of operation. (See section 5.4.5, “Overload Explanation Diagram”.)
- 14 ‘Shearpin’ – Output current exceeds the previously set ‘Shearpin Level’ (P32) for a time set in ‘Shearpin Time’ (P33). Active only during the running stage. (See section 5.4.5, “Shearpin Explanation Diagram”.)
- 15 Unused
- 16 ‘User’ – A trip which can be triggered by the customer via a variety of means, e.g., through the serial comms or via a programmable input.
- 17 ‘Comms Timeout’ – No communication on the serial connection for more than five seconds.

5.4.12 – ‘Trips’ Menu (continued)

(P51.B1) C/L Time Out

Range: P51 / B1 Default: On Scaling: n/a Type: R/W

The ‘C/L Time Out’ menu item turns ‘On’ and ‘Off’ the ‘Current Limit Time Out’ trip. A ‘Current Limit Time Out’ trip will occur if this menu item is set to ‘On’, and the load is demanding more current than the level specified in the ‘Current Limit’ parameter for longer than the time specified in the ‘Limit Time Out’ parameter. If the ‘C/L Time Out’ menu item is set to ‘Off’, then no trip would occur in a similar situation.

(P51.B4) Low Current

Range: P51 / B4 Default: Off Scaling: n/a Type: R/W

Under Current Selected – selects Under Current operation.

(P51.B3) Shearpin

Range: P51 / B3 Default: On Scaling: n/a Type: R/W

Shearpin Selected – selects Shearpin operation.

(P51.B2) Overload

Range: P51 / B2 Default: On Scaling: n/a Type: R/W

Overload Selected – selects Overload operation

The ‘Overload’ menu item switches ‘On’ and ‘Off’ the ‘Overload Trip’.

Special case: If a load current exceeding $7.2 \times \text{FLC}$ occurs for longer than 60 ms, a ‘Shearpin Trip’ is forced whenever the ‘Overload’ is ‘On’.

(P127.B7) Sensing Signal

Range: P127 / B7 Default: On Scaling: n/a Type: R/W

Hidden Trip Flag 7 – enable or disable Trip 7 – Sensing Trip Type B

The ‘Sensing Signal’ menu item switches ‘On’ and ‘Off’ Trip 7. This may be useful if there is excessive noise on the supply causing spurious ‘Trip 7 Sensing Signal’ trips.

(P53.B3) User

Range: P53 / B3 Default: Off Scaling: na Type: R/W

The ‘User’ menu item is a trip which can be triggered by the customer via a variety of means, e.g., through the serial comms or via a programmable input.

5.5 – Definitions for Chapter 5

Dwell

This is the period between 'Top of Ramp' and 'Run', which is designed to give unstable loads a chance to settle down, and to ensure that they are up to speed.

Index Rating

The Index Rating defines the duty of the starter.

Jog

Small movements of a three-phase induction motor, usually used when commissioning the motor or load.

Keypad

The keypad is the internally mounted user interface. The user can start/stop, program, and query the unit's status through this interface. Fitting of the keypad precludes fitting of a remote keypad.

Keypad, Remote

The remote keypad is the externally mounted user interface. The user can start/stop, program, and query the unit's status through this interface. Fitting of the remote keypad precludes fitting of the internal keypad.

Kick Start

This is an optional extra 'kick' of voltage to start 'sticky' loads.

Load Current

The current drawn by the application or load.

Optimize

This is an optional energy saving feature. The SR44 will reduce voltage to a lightly loaded motor. (Refer to the "Applications" chapter of this user manual for a detailed explanation.)

Overload

An Overload is a sustained over-current, with a duration of seconds or minutes rather than cycles, that might or might not end in a trip. Changes in the load characteristics might cause an overload. (An Overload generally draws less current than a Shearpin.)

Parameter

A parameter is a menu item that directly relates to an internal parameter of the Soft Starter.

Rated Current

This is the nominal current (in Amps) at which the unit has been designed to run.

Shearpin

Shearpin is also an over-current, but of a much shorter duration (cycles rather than seconds), and is generally a higher current than an Overload.

Stall

The point at which the load placed on a motor threatens to stop a motor's rotational movement.

5.5 – Definitions for Chapter 5 (continued)

Static

Static, as in static loads. This term refers to loads with no moving parts, so induction motors, linear motors, etc., are non-static loads. An example of a static load would be a resistor bank.

Top of Ramp

This is the point at which the Soft Starter reaches maximum output voltage.

Unit Full Load Current

This is another name for the Rated Current of the unit.

Writeable Parameters

A parameter that can be written to by the user as well as being read by the user, as opposed to a read-only parameter which can only be read by the user.

SERIAL COMMUNICATIONS



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WARNING: The owner, installer, and user are responsible for the correct installation and use of the SR44, and must ensure that only qualified personnel install the SR44. The owner, installer, and user must ensure that the installation, operation and maintenance of the SR44 complies with the relevant Codes of Practice, Regulations, and Statutory Requirements. The Manufacturer or his agent do not assume any liability, expressed or implied, for any consequence resulting from inappropriate, negligent, or incorrect installation, application, use or adjustment of the product or circuit design, or from the mismatch of the SR44 to a motor. To prevent an electrical shock hazard, the SR44 must be properly connected to a safety ground. The SR44 is not designed for use in hazardous areas. Use in such an area may invalidate the hazardous area certification.

6.1 – Overview

The SR44 has built-in serial communication capability that is a compatible subset of the widely recognized Modbus RTU protocol (slave), and the SR44 may be connected to a PC or suitable PLC network via an optional SR44-RS485 interface card.



Serial communication requires an optional interface card (SR44-RS485), which includes a “Local/Remote” switch to easily switch starter control from communication to keypad. Serial communication is valid only in the “Remote” position, and the local keypad powers down. In the “Local” position, the local keypad powers up and controls the soft starter, and all serial communication is ignored.

6.2 – Quick Start

Work should only be carried out on the SR44 with all electrical power disconnected

- 1) Communication settings:
 - a) 9600 baud, 8 data bits, 1 stop bit, no parity.
 - b) network station number = 1.
- 2) Before Connecting a Comm interface, use the standard keypad to make any changes for your bus system:
 - a) Set Parameter 1 to the required network station number (slave address).
 - b) If not continuously polling the unit at least once every 5 seconds, set P-126 to 0, turning off comms timeout trip
 - c) Make any changes to Parameter 121, bit 6.
0 = 1 Stop bit.
1 = 2 Stop bits
 - d) Store changes to EEROM (save RAM).
- 3) The Local/Remote switch must be set to “Remote” to use the optional communication interface SR44-RS485. When this switch is set to “Local”, serial communication is ignored and the integrated local keypad controls the soft starter. (Refer to “Chapter 7: Optional Hardware” for information about installing and using the optional Local/Remote switch.)
- 4) Register and coil addresses start at zero.



SR44 has a Modbus offset of one address for registers and bits. PLC programs should target one address higher than desired, e.g., PLC targets SR44 address 40019 to read/write to/from address 40018 (P-18).

Allowed address ranges are Register numbers 0...127, EEPROM Registers 1000...1127, Coils (flags) 0...1024.

(Refer to the “Parameter Memory Addresses” section of this chapter for more information.)

6.2 – Quick Start (continued)

- 5) Function 06 (Write Single Register)
Parameters in the SR44 are 8-bit bytes which are written to by 16-bit Modbus words. Only the low byte of the Modbus word in the PLC gets sent to the SR44 parameter.
- 6) Function 05 (Write Single Coil)
This function is used to set or clear a single bit within the Read/Write parameters between 0 through 127. (Only the bits within parameters designated as Read/Write can be preset with this function; Parameters 18, 51, 52, 53, 54, 86, 95, 96, 121, & 127)
- 7) Function 03 (Read Holding Registers)
This function reads 8-bit bytes back to the PLC. If more than one byte is requested from the SR44, the PLC program will have to separate 16-bit Modbus words into the 8-bit SR44 bytes.
- 8) SR44 Status Bits (User Flags) are read as holding registers, i.e., read register 9 to read Status2 bits. For status bit writes, bits are mapped one-to-one, e.g., the Kickstart flag bit 0 of User Flags 1 (P51) is bit no $51 * 8 + 0 = \text{bit } 408$.
(Refer to the “Specifications” section of this chapter for supported Modbus function codes.)

6.3 – Specifications

1. Refer to Modicon Modbus Protocol Reference Guide PI-MBUS-300 at www.modbus.org for full protocol specification.
2. Baud rate is 9600.
3. 8 data bits, no parity, 1 stop (default) or 8 data bits, no parity, two stop bits.
4. Modbus timeout is 3.5 character times. The in message timeout is also 3.5 character times, unlike the standard which is 1.5 character times. Further, it is possible that the SR44 will be delayed in responding to a request if it is checking a fault condition.
5. Broadcast is not supported.
6. SR44 parameters retain their normal numbers (0-127).
7. Status bits (flags) are bit positions starting at parameter 0 bit 0.
8. Register numbers are 0...127.
9. Coils (flags) 0...1024.
10. Offline EEROM Registers are 1000...1127.
(Non-volatile registers where the “Permanent Store” parameters are saved.)
11. Supports the following Modbus functions:
 - Function 03 read holding registers up to 4 words (8 parameters) in number.
 - Function 05 write single coil.
 - Function 06 write single register (byte).
 - Function 07 exception status.
 - Error 01 illegal function (write to read-only parameter).
 - Error 02 illegal data address (bad parameter number).
 - Error 03 illegal data (trying to read or write too much data).
 - Error 06 slave busy.
 - Error 07 negative acknowledge.

6.4 – Parameter Memory Addresses

Parameter Memory Addresses										
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***			
	Address	Byte	Individual Bit	Decimal	Hex					
0	40000	High	n/a			dummy parameter	R			
1	40001					Station No	R/W			
2	40002					Language	R/W			
3	40003					Program Type	R			
4	40004					Software Ver	R			
5	40005					Password	R/W			
6	40006					Firing Mode	R/W			
7	40007					Protection	R/W			
8	40008	High	n/a			–	–	–	Status 1	R
						0 (1)	64	40	Stopped	
						1 (2)	65	41	Starting	
						2 (4)	66	42	Current Limit	
						3 (8)	67	43	Top of Ramp	
						4 (16)	68	44	Dwell	
						5 (32)	69	45	Full Conduction	
						6 (64)	70	46	Energy Saving	
7 (128)	71	47	Stopping							
9	40009	High	n/a			–	–	–	Status 2	R
						0 (1)	72	48	Alarm	
						1 (2)	73	49	Overload Integrating	
						2 (4)	74	4A	Stall	
						3 (8)	75	4B	Forced Override	
						4 (16)	76	4C	Noise	
						5 (32)	77	4D	Inhibit Start	
						6 (64)	78	4E	DC I/p Level Reached	
7 (128)	79	4F	Reserved							
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).										
** Parameter Bit #s apply only to Function 05 (Write Single Coil).										
*** Type: R = Read Only; R/W = Read/Write										
Table continued next page.										

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
10	40010		-	-	-	Status 3	R
			0 (1)	80	50	Relay K1 Status	
			1 (2)	81	51	Relay K2 Status	
			2 (4)	82	52	(unused)	
			3 (8)	83	53	(unused)	
			4 (16)	84	54	Input 1 Status	
			5 (32)	85	55	(unused)	
			6 (64)	86	56	(unused)	
7 (128)	87	57	(unused)				
11	40011	High	n/a			Start Ped	R/W
12	40012					Start Time	R/W
13	40013					Kick Ped	R/W
14	40014					Kick Time	R/W
15	40015					Dwell Time	R/W
16	40016					Stop Ped	R/W
17	40017					Stop Time	R/W
18	40018						-
		0 (1)	144	90	Auto Ramp		
		1 (2)	145	91	Auto 3MC		
		2 (4)	146	92	Auto Bypass		
		3 (8)	147	93	Auto Jog		
		4 (16)	148	94	Auto end stop		
		5 (32)	149	95	Auto stop		
		6 (64)	150	96	Auto end start		
7 (128)	151	97	Auto Pedestal				
19	40019	High	n/a			Opt Rate	R/W
20	40020					Reference PF	R
21	40021					Internal PF	R
22	40022					Delay Angle	R
23	40023					Max Angle	R
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).							
** Parameter Bit #s apply only to Function 05 (Write Single Coil).							
*** Type: R = Read Only; R/W = Read/Write							
Table continued next page.							

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
24	40024	High	n/a			Reserved – Rated Amps (100s)	R
25	40025					Reserved – Rated Amps	R
26	40026					Current	R
27	40027					Peak Start I	R
28	40028					Low I Level	R/W
29	40029					Low I Time	R/W
30	40030					C/L Level	R/W
31	40031					C/L Time	R/W
32	40032					Shear Level	R/W
33	40033					Shear Time	R/W
34	40034					Ovld Level	R/W
35	40035					Ovld Delay	R/W
36	40036					% Overload	R
37	40037					Reserved	–
38	40038					–	–
		0 (1)	304	130	(unused)		
		1 (2)	305	131	Reserved		
		2 (4)	306	132	Reserved		
		3 (8)	307	133	(unused)		
		4 (16)	308	134	(unused)		
		5 (32)	309	135	(unused)		
		6 (64)	310	136	(unused)		
7 (128)	311	137	(unused)				
39	40039	High	n/a		PF Angle	R	
40	40040				Supply Volts	R	
41	40041				Reserved	–	
42	40042				Reserved	–	
43	40043				Reserved	–	
44	40044				Reserved	–	
45	40045				Reserved	–	
46	40046				Reserved	–	
47	40047				Reserved	–	
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).							
** Parameter Bit #s apply only to Function 05 (Write Single Coil).							
*** Type: R = Read Only; R/W = Read/Write							
Table continued next page.							

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
48	40048	High	n/a			Reserved	-
49	40049					Reserved	-
50	40050					Reserved	-
51	40051		-	-	-	User Flags 1	R/W
			0 (1)	408	198	Kickstart	
			1 (2)	409	199	Current Limit Timeout Sel'd	
			2 (4)	410	19A	Overload Selected	
			3 (8)	411	19B	Shearpin Selected	
			4 (16)	412	19C	Under Current Selected	
			5 (32)	413	19D	Thermistor Selected	
		6 (64)	-	-	(Unused)		
52	40052	7 (128)	415	19F	Terminal Starting	R/W	
		-	-	-	User Flags 2		
		0 (1)	416	1A0	Low Voltage Soft-Stop		
		1 (2)	417	1A1	Not Global Enable 1		
		2 (4)	418	1A2	Not Global Enable 2		
		3 (8)	419	1A3	Pod Start/Stop		
		4 (16)	420	1A4	Board Start/Stop		
		5 (32)	421	1A5	Main Contactor		
53	40053	6 (64)	422	1A6	Second Parm Set	R/W	
		7 (128)	423	1A7	Zero Start Time		
		-	-	-	User Flags 3		
		0 (1)	424	1A8	pf1 pol		
		1 (2)	425	1A9	pf2 pol		
		2 (4)	426	1AA	User Current Limit		
		3 (8)	427	1AB	User Trip		
		4 (16)	428	1AC	Invert Controller Input		
5 (32)	429	1AD	Cooling (Inhibit Restart)				
6 (64)	-	-	(Unused)				
7 (128)	-	-	(Unused)				
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).							
** Parameter Bit #s apply only to Function 05 (Write Single Coil).							
*** Type: R = Read Only; R/W = Read/Write							
Table continued next page.							

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
54	40054		-	-	-	I/O Polarity	R/W
			0 (1)	432	1B0	K1 Polarity	
			1 (2)	433	1B1	K2 Polarity	
			2 (4)	-	-	(Unused)	
			3 (8)	-	-	(Unused)	
			4 (16)	436	1B4	I/p 1 Polarity	
			5 (32)	-	-	(Unused)	
			6 (64)	-	-	(Unused)	
7 (128)	-	-	(Unused)				
55	40055	High				Reserved	-
56	40056					Reserved	-
57	40057					K1 Map	R/W
58	40058					K1 Bit Mask	R/W
59	40059					K2 Map	R/W
60	40060					K2 Bit Mask	R/W
61	40061					Reserved	-
62	40062					Reserved	-
63	40063					Reserved	-
64	40064					Reserved	-
65	40065					i/p1 Map	R/W
66	40066		n/a			i/p1 bit Msk	R/W
67	40067					Reserved	-
68	40068					Reserved	-
69	40069					Reserved	-
70	40070					Reserved	-
71	40071					Cntactor Dly	R/W
72	40072					Trip Snstvtly	R/W
73	40073					Last Trip	R
74	40074					2nd Last Trp	R
75	40075					3rd Last Trp	R
76	40076					4thLast Trp	R
77	40077					5th Last Trp	R
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).							
** Parameter Bit #s apply only to Function 05 (Write Single Coil).							
*** Type: R = Read Only; R/W = Read/Write							
Table continued next page.							

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)											
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***				
	Address	Byte	Individual Bit	Decimal	Hex						
78	40078	High	n/a			Protection 2	R/W				
79	40079					Start Ped 2	R/W				
80	40080					Start Time 2	R/W				
81	40081					Kick Ped 2	R/W				
82	40082					Kick Time 2	R/W				
83	40083					Dwell Time 2	R/W				
84	40084					Stop ped 2	R/W				
85	40085					Stop Time 2	R/W				
86	40086					-	-	-	AutoConfig 2	R/W	
						0 (1)	688	2B0	Auto Ramp		
		1 (2)	689	2B1	Auto 3MC						
		2 (4)	690	2B2	Auto Bypass						
		3 (8)	691	2B3	Auto Jog						
		4 (16)	692	2B4	Auto Endstop						
		5 (32)	693	2B5	Auto Stop						
		6 (64)	694	2B6	Auto Endstart						
7 (128)	695	2B7	Auto Pedestal								
87	40087	High	n/a			Low I 2	R/W				
88	40088					Low I time 2	R/W				
89	40089					C/L 2	R/W				
90	40090					C/L Time 2	R/W				
91	40091					Shearpin 2	R/W				
92	40092					Shear time 2	R/W				
93	40093					Ovld Level 2	R/W				
94	40094					Ovld Delay 2	R/W				
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).											
** Parameter Bit #s apply only to Function 05 (Write Single Coil).											
*** Type: R = Read Only; R/W = Read/Write											
Table continued next page.											

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
95	40095		-	-	-	User Flags12	R/W
			0 (1)	760	2F8	Kickstart (2)	
			1 (2)	761	2F9	Current Limit Timeout Sel'd (2)	
			2 (4)	762	2FA	Overload Selected (2)	
			3 (8)	763	2FB	Shearpin Selected (2)	
			4 (16)	764	2FC	Under Current Selected (2)	
			5 (32)	765	2FD	Thermistor Selected (2)	
			6 (64)	-	-	(Unused)	
96	40096	High	7 (128)	767	2FF	Terminal Starting (2)	R/W
			-	-	-	User Flags22	
			0 (1)	768	300	Low Voltage Soft-Stop (2)	
			1 (2)	769	301	Not Global Enable 1 (2)	
			2 (4)	770	302	Not Global Enable 2 (2)	
			3 (8)	771	303	Pod Start/Stop (2)	
			4 (16)	772	304	Board Start/Stop (2)	
			5 (32)	773	305	Main Contactor (2)	
6 (64)	774	306	Second Parm Set (2)				
7 (128)	775	307	Zero Start Time (2)				
97	40097		n/a			U1 I/P srce	R/W
98	40098					U1 I/P Mask	R/W
99	40099					U1 O/P Dest	R/W
100	40100					U1 O/P Mask	R/W
101	40101					U2 I/P srce	R/W
102	40102					U2 I/P Mask	R/W
103	40103					U2 O/P Dest	R/W
104	40104					U2 O/P Mask	R/W
105	40105					Reserved	-
106	40106					Reserved	-
107	40107					Reserved	-
108	40108					Reserved	-
* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).							
** Parameter Bit #s apply only to Function 05 (Write Single Coil).							
*** Type: R = Read Only; R/W = Read/Write							
Table continued next page.							

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
109	40109	High	n/a			Bypass Upper Limit	R/W
110	40110					Bypass Lower Limit	R/W
111	40111					Reserved	-
112	40112		-	-	-	Status 4	R
			0 (1)	896	380	60 Hz	
			1 (2)	897	380	Phase Rotation Sequence	
			2 (4)	898	382	Shearpin	
			3 (8)	899	383	Under Current	
			4 (16)	900	384	Thermistor	
			5 (32)	901	385	Timeout	
		6 (64)	902	386	Overload		
7 (128)	903	387	Thermal Switch				
113	40113	High	n/a			Reserved	-
114	40114					StopProfile	R/W
115	40115					Last App	R/W
116	40116					CoolingTime	R/W
117	40117					Reserved	-
118	40118					System Use Only	-
119	40119					Reserved	-
120	40120	-	-	-	Status 5	R	
		0 (1)	960	420	Over Temperature		
		1 (2)	961	421	Offline Command Fail		
		2 (4)	962	422	(unused)		
		3 (8)	963	423	Fan Status		
		4 (16)	964	424	(unused)		
		5 (32)	965	425	(unused)		
		6 (64)	966	426	(unused)		
7 (128)	967	427	(unused)				

* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).

** Parameter Bit #s apply only to Function 05 (Write Single Coil).

*** Type: R = Read Only; R/W = Read/Write

Table continued next page.

6.4 – Parameter Memory Addresses (continued)

Parameter Memory Addresses (continued)							
Parameter Number	Modbus *		Parameter Bit #s **			Name / Function	Type ***
	Address	Byte	Individual Bit	Decimal	Hex		
121	40121	High	-	-	-	UserFlags 4	R/W
			0 (1)	-	-	Impact Load	
			1 (2)	969	429	(unused)	
			2 (4)	970	42A	Auto Soft Stop Smoothing	
			3 (8)	971	42B	Breaker Present	
			4 (16)	-	-	Optimise +	
			5 (32)	973	42D	Quick Ramp Times	
			6 (64)	974	42E	Two Stop Bits	
7 (128)	-	-	Auto Stop (2)				
122	40122	High	n/a			Stop Smooth	R/W
123	40123		Temp/Alt Derate	R/W			
124	40124		OffLine Command	R/W			
125	40125		Bus BaudRate	R/W			
126	40126		Comms Trip	R/W			
127	40127	High	-	-	-	Trip Flags	R/W
			0 (1)	1016	458	Trip 1 Enabled – Phase Loss	
			1 (2)	1017	459	Trip 8 Enabled – SCR Loss Motor (Motor-Side Thyristor Loss)	
			2 (4)	1018	45A	Trip 9 Enabled – Sensing Signal (Thyristor Sensing Trip Type A)	
			3 (8)	1019	45B	Trip 10 Enabled – SCR Shorted (Thyristor Sensing Trip Type B)	
			4 (16)	1020	45C	Trip 4 Enabled – SCR Firing (Thyristor Sensing Trip Type C)	
			5 (32)	1021	45D	Trip 5 Enabled – SCR Signal (Edge Sensing Trip)	
			6 (64)	1022	45E	Trip 6 Enabled – SCR Signal (Sensing Trip Type A)	
7 (128)	1023	45F	Trip 7 Enabled – Sensing Signal (Sensing Trip Type B)				

* Modbus addresses apply only to Function 06 (Write Single Register), or to only the first parameter of Function 03 (Read Holding Registers).

** Parameter Bit #s apply only to Function 05 (Write Single Coil).

*** Type: R = Read Only; R/W = Read/Write

6.5 – Serial Communication to SR44

SR44 parameters are stored in 8-bit bytes. Modbus reads the values from the slave as 16-bit words. Therefore two SR44 parameter bytes are packed into each Modbus word. The lowest parameter is in the data High of the word, and the next parameter is in the data Low. This also means that even when the read request is for one register, two SR44 parameters are read. Up to four contiguous words (8 parameters) may be read with one query.



SR44 has a Modbus offset of one address for registers and bits. PLC programs should target one address higher than desired, e.g., PLC targets SR44 address 40019 to read/write to/from address 40018 (P-18).

6.5.0 – Parameter Scaling

Certain parameters have non-unity scaling factors which must be applied when using serial communication to read and write the parameters. (Parameter scaling factors are shown in Chapter 5: Keypad Menu Items and Parameters.)

- Scaling applies only when using serial communication to read and write parameters.
- Scaling Factor = Maximum Parameter Value ÷ 255
- When READING from parameters, MULTIPLY the serial comm value by the scaling factor.
- When WRITING to parameters, DIVIDE your desired value by the scaling factor (multiply by the inverse of the scaling factor).

Parameter Scaling Example:

P-71 = Contactor Delay; Default value = 160 ms; Scaling Factor = 4

For default value = 160 ms:

Keypad shows "160 ms"; Comms data reads "40" [multiply by 4 to get actual value of 160]

To change value to 200 ms:

Enter "200" through keypad, or

Write "50" through serial comm [divide by 4 to determine value to write]

Keypad display will show "200 ms"; serial comm will read "50" [multiply by 4 to get actual value]

To change value to 240 ms:

Enter "240" through keypad, or

Write "60" through serial comm [divide by 4 to determine value to write]

Keypad display will show "240 ms"; serial comm will read "60" [multiply by 4 to get actual value]



The minimum value that a scaled parameter can be changed is equal to that parameter's scaling factor.

Parameters referenced in the following examples:

Modbus Function 03 example 6.5.1:

- P-73 = Last Trip
- P-74 = 2nd Last Trip
- P-75 = 3rd Last Trip
- P-76 = 4th Last Trip
- P-77 = 5th Last Trip
- P-78 = Protection 2

Modbus Function 05 example 6.5.2:

- P-52 / B-6 = User Flags 2 / 2nd parameter set

Modbus Function 06 example 6.5.3:

- P-124 = OffLine Command

6.5.1 – Reading Holding Registers (Modbus Function 03)

This function is used to read a group of up to eight parameters from the SR44. The allowable address range for this function is 0-127 for working parameters and 1000–1127 for offline EEROM parameters.

Example – Modbus Function 03:

Read the fault history (P-73 – P-77) from SR44 slave #1 into a PLC

- Start Slave Address (SR44): 40074 *
- Start Master Address (PLC): internal PLC register 1
- Number of Elements: 3

SR44				→	PLC	
Parameter	Address / Byte *	Data Value			Hex Data	Address ***
		Decimal	Hex			
P-73 (Last Trip)	40073 / high	0 (no trip)	00	→	00 02	internal PLC register #1
P-74 (2nd Last Trip)	40073 / low	2 (too hot)	02		0D 0E	internal PLC register #2
P-75 (3rd Last Trip)	40074 / high	13 (overload)	0D		10 C0	internal PLC register #3
P-76 (4th Last Trip)	40074 / low	14 (shearpin)	0E			
P-77 (5th Last Trip)	40075 / high	16 (external trip)	10			
P-78 (Protection2) **	40075 / low **	192 (full+optimize)	C0			

** SR44 Modbus addresses are variable. Only the 1st address of the Function 03 read instruction 'matches' the parameter number, but there is an offset of one address from the parameter#. If the PLC targets 40074, the PLC will return data starting with P-73. P-73 will be in the high byte, and P-74 will be in the low byte.*

*** The Function 03 multiple read instruction gets data from an even number of parameters. Unwanted data can be discarded by the PLC.*

**** PLC addresses are any valid user-assigned memory addresses.*

Query		Response	
Field	Hex Byte	Field	Hex Byte
Slave Address	01	Slave Address	01
Function	03	Function	03
Start Address High	00	Byte Count	04
Start Address Low *	4A (decimal = 74) *	Data High Byte	00 (P-73)
No. of Registers High	00	Data Low Byte	02 (P-74)
No. of Registers Low	02	Data High Byte	0D (P-75)
CRC Low	PLC & SR44 automatically calculate CRC checksum values	Data Low Byte	0E (P-76)
CRC High		Data High Byte	10 (P-77)
		Data Low Byte	C0 (P-78)
		CRC Low Byte	PLC & SR44 automatically calculate CRC checksum values
		CRC High Byte	

** The SR44 has a Modbus offset of one address for registers & bits; PLC targets one address higher.*

6.5.2 – Writing Single Coil (Modbus Function 05)

This function is used to set or clear a single bit within the Read/Write parameters between 0 through 127. (Only the bits within parameters designated as Read/Write can be preset with this function; Parameters 18, 51, 52, 53, 54, 86, 95, 96, 121, & 127)

Example – Modbus Function 05:

PLC writes “Select 2nd Parameter Group” to SR44 (send a value of 1 to Bit#6 of P-52):

- Start Slave Bit Number (SR44): 423*
- Start Master Address (PLC): internal PLC bit address #1 (value = 1)

SR44				←	PLC	
Parameter Bit	Address *	Data Value			Hex Data	Address **
		Decimal	Hex			
P-52 / Bit 06 Second Parm Set	423 *	1	1	1	internal PLC bit address #1	
<p>* SR44 bit addresses have an offset of one address from the parameter bit#. The PLC needs to target slave bit #423 in order to change bit #422.</p> <p>** PLC addresses are any valid user-assigned bit addresses.</p>						

Modbus Function 05 Transaction Table			
Query		Response	
Field	Hex Byte	Field	Hex Byte
Slave Address	01	Slave Address	01
Function	05	Function	05
Bit Address	1A7 (decimal = 423) *	Bit Address	1A7 (bit 422*) (bit 06 of P-52)
Force Data	01 (select 2nd parameter set)	Force Data	01 (select 2nd parameter set)
CRC Low	PLC & SR44 automatically calculate CRC checksum values	CRC Low Byte	PLC & SR44 automatically calculate CRC checksum values
CRC High		CRC High Byte	
<p>* SR44 has a Modbus offset of one address for registers & bits; PLC targets one address higher.</p>			

6.5.3 – Writing Single Register (Modbus Function 06)

This function is used to set the value of a single parameter. It differs from the Modbus protocol in that only the data low byte of the query is written to the parameter address. The data high byte is ignored. (The normal response for correct operation is an echo of the data.)

If the PLC uses Function 06 to write one word of data into the SR44, only the low byte of the PLC data is used. The PLC low byte is written into the SR44 parameter, and the PLC high byte is ignored.

Example – Modbus Function 06:

PLC writes “Enable” to SR44 (send a value of 2 to P-124):

- Start Slave Address (SR44): 40125 *
- Start Master Address (PLC): internal PLC register #1 (value = 2)

SR44				←	PLC	
Parameter	Address / Byte *	Data Value			Hex Data**	Address ***
		Decimal	Hex			
P-124 (OffLine Command)	40125* / high	02	02**	00 02**	internal PLC register #1	

* SR44 Modbus addresses have an offset of one address from the parameter #.
The PLC needs to target slave address 40125 in order to change P-124.

** For Function 06 single write instructions, the SR44 accepts only the low byte of the PLC word; the high byte is ignored. In this example, only P-124 is changed by the write instruction.

*** PLC addresses are any valid user-assigned memory addresses.

Modbus Function 06 Transaction Table					
Query			Response		
Field	Hex Byte		Field	Hex Byte	
Slave Address	01		Slave Address	01	
Function	06		Function	06	
Address High	00		Address High	00	
Address Low	7D (decimal = 125) *		Address Low	7D (P-124) *	
Force Data High	n/a (doesn't matter)		Force Data High	n/a (ignored)	
Force Data Low	02 (Enable Starter)		Force Data Low	02 (Enable Starter)	
CRC Low	PLC & SR44 automatically calculate CRC checksum values		CRC Low	PLC & SR44 automatically calculate CRC checksum values	
CRC High			CRC High		

* SR44 has a Modbus offset of one address for registers & bits; PLC targets one address higher.

6.5.4 – P-124 Offline Commands

The SR44 has a mechanism for carrying out common functions, or offline ones which take a long time and require the SR44 to be off and disabled. Commands are carried out by writing various values to a Command Register (parameter 124). For example, writing a 1 to P-124 using function 06 disables the starter.

Once a value has been written to this special register, further Modbus queries will receive a “slave busy” error until the command execution is completed. If an error occurred during the execution of the command (say the unit was not disabled before execution), then the Offline Command failed flag will be set. If function 7 has been used to poll the SR44, then once the busy period is over this flag is available in the returned status byte position 80h.

Parameter 124 Command Codes *			
Value	Command	Active	Meaning
1	Disable Starter	Always	Stop the SR44 responding to start commands, remote or local. If running the SR44 will stop immediately. The status of any start signal is not changed.
2	Enable Starter	Always	The SR44 will respond to new or existing start commands.
3	Bus Starting	Always	The SR44 responds to start requests from the keypad / bus port.
4	Remote Starting	Always	The SR44 responds to start requests from the hardware input.
5	Reset Starter	Always	The SR44 is forced to a cold start.
6	Reset Trip	Always	Resets the SR44 to stopped and ready state.
7	Bus Start	When Enabled	If Starting = bus & unit is enabled, SR44 will start.
8	Bus Stop	When Enabled	SR44 will always stop.
9	Factory Default	When Disabled	The working RAM is loaded with factory default values. This may take up to 5 seconds.
10	Power On Default	When Disabled	The working RAM is loaded with the permanent store values.
11	Save RAM	When Disabled	The working RAM is saved to the permanent store for future use. This may take up to 5 seconds.

* Use only Function Code 06 for P-124 Offline Commands.

6.5.5 – Read Exception Status (Modbus Function 07) – Starter 01

This function's format is per the Modbus standard, but the bits in the value returned have different meanings shown below. This is the quickest of the Modbus functions, and should be used in the context of the SR44 to check if a station is present or check if it is busy.

Modbus Function 07 Transaction Table			
Query		Response	
Field	Hex Byte	Field	Hex Byte
Slave Address	01	Slave Address	01
Function	07	Function	07
CRC Low	41	Exception Data	00
CRC High	E2	CRC Low	PLC & SR44 automatically calculate CRC checksum values
		CRC High	
Returned Exception Data			
Bit	Meaning		
0	Enabled		
1	Stopped		
2	Starting		
3	Current Limiting		
4	TOR (Start Complete)		
5	Cooling		
6	Alarm		
7	Offline Command Failed		

6.5.6 – Returned Errors

If there is a communication error in the query, the SR44 does not reply.

If the network communication is OK, but for some reason the SR44 cannot correctly execute the query, then it will return an error reply. In an error reply, the function byte is returned OR'ed with 80h, and the following byte contains the error number, e.g. if Function 07 cannot be executed, 87h will be returned.

Modbus Function 07 Transaction Table Showing Error Response			
Query		Response	
Field	Hex Byte	Field	Hex Byte
Slave Address	01	Slave Address	01
Function	07	Function	87
CRC Low	41	Exception Data	01
CRC High	E2	CRC Low	PLC & SR44 automatically calculate CRC checksum values
		CRC High	
Returned Error Response			
Number	Modbus	Meaning	
0	Illegal Function	Writing	
1	Illegal Data Address	Out of allowed parameter range	
2	Illegal Data	Too many data bytes in query	
3	Slave Busy	Slave is performing a long command	

6.7 – Example PLC Communications Programs

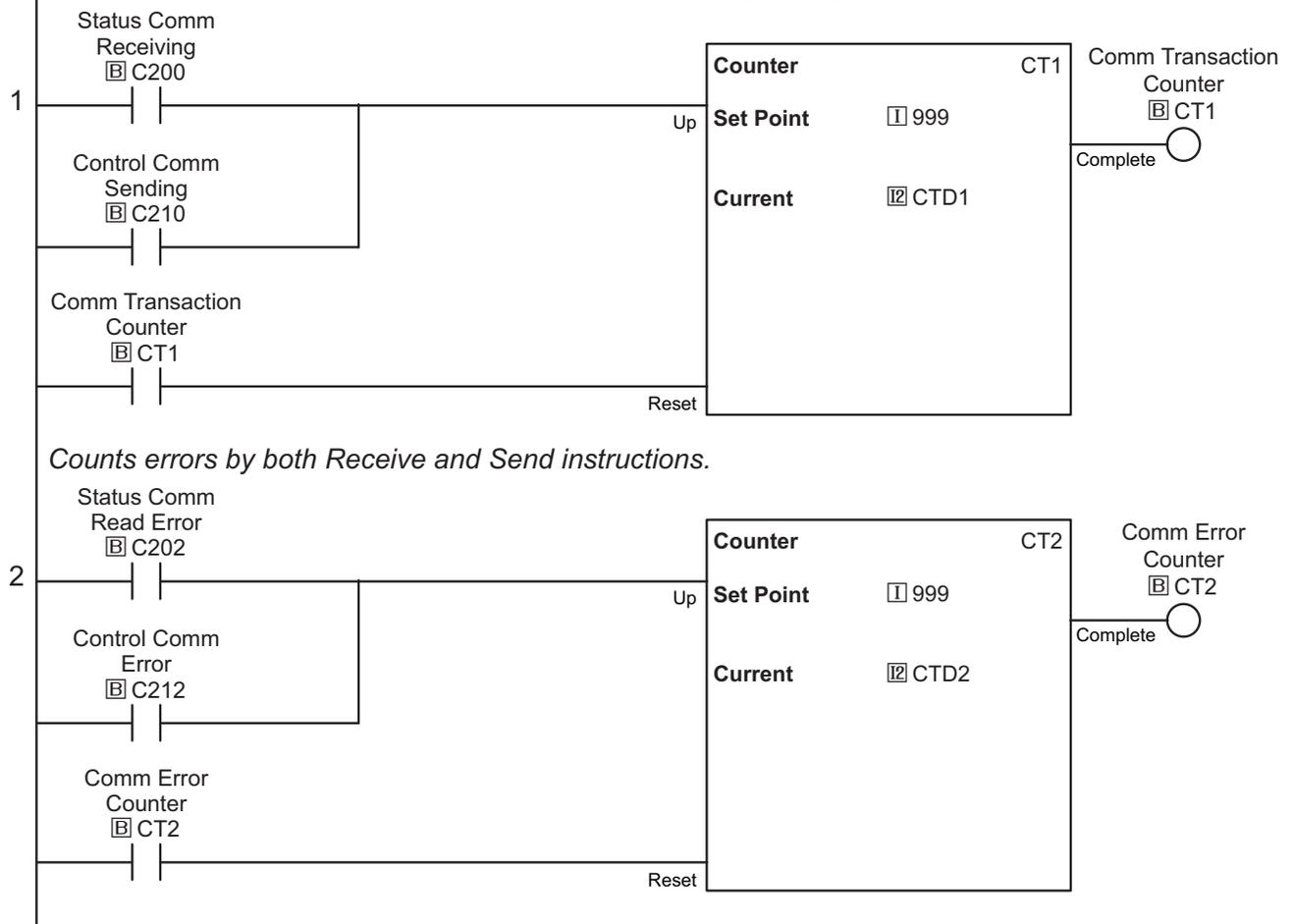
6.7.1 – CLICK PLC Example Program

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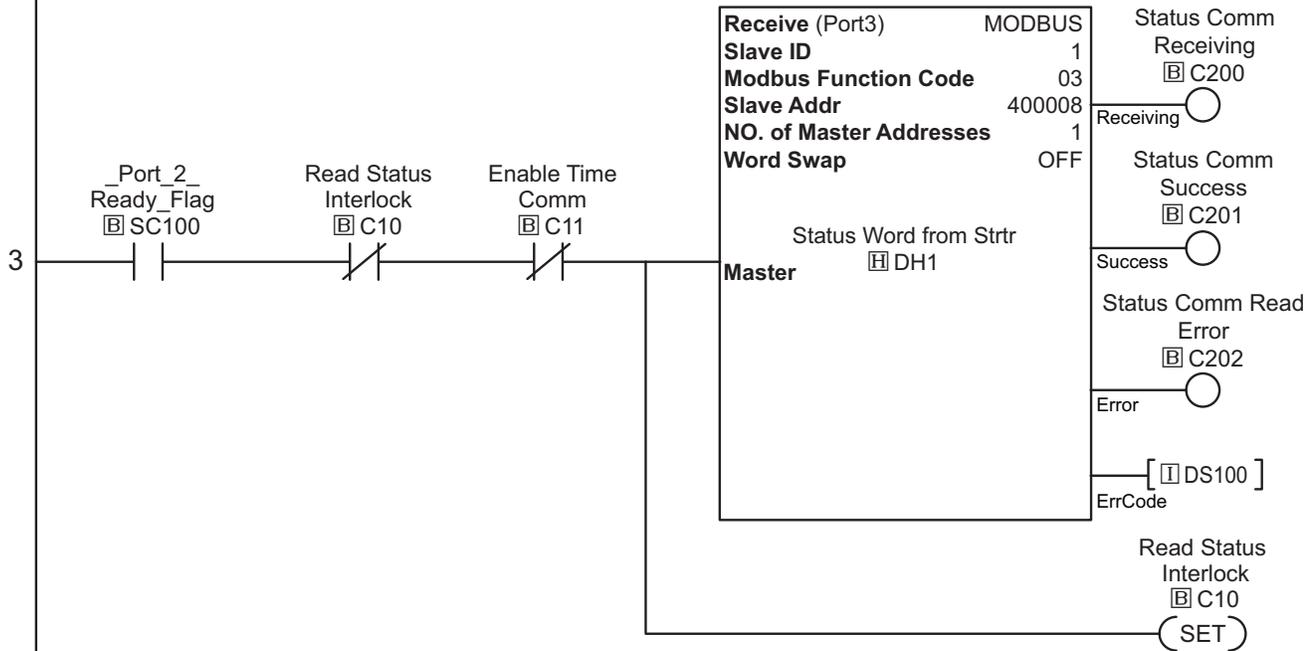
This program is for illustrational purposes only, and is not intended for a true application.

The first 2 rungs monitor comm attempts and errors for troubleshooting. Counter CT1 counts the attempts by both Receive and Send instructions, and CT2 counts errors. CT1 will normally be counting rapidly, while CT2 will be counting very infrequently, if at all. If both counters are counting up, then there are problems which could be in addressing, wiring, or PLC/SR44 setup.

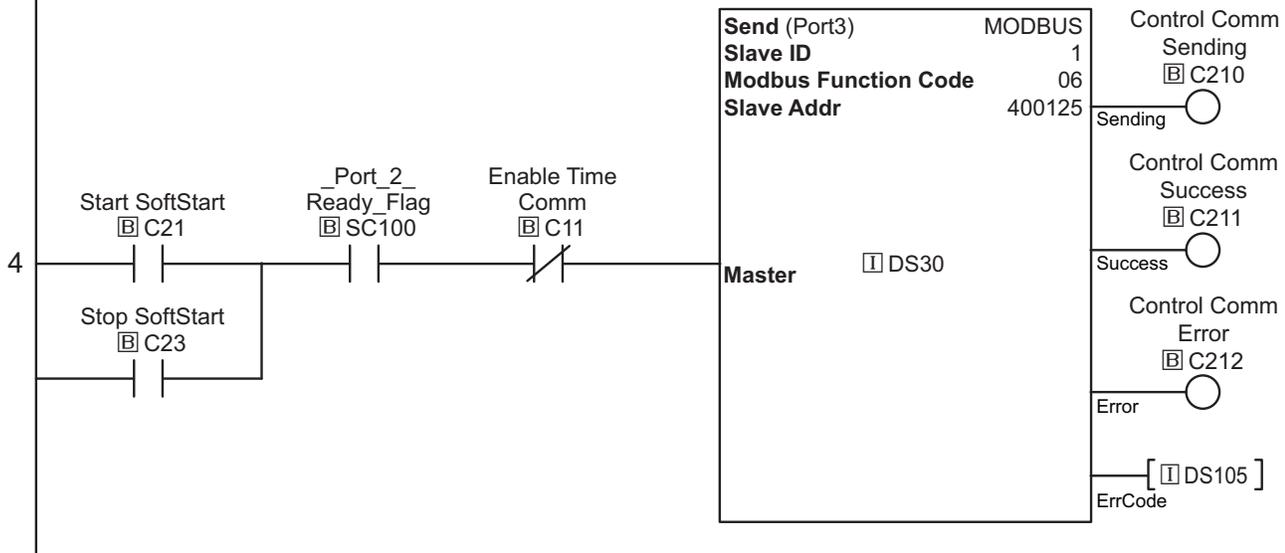


6.7.1 – CLICK PLC Example Program (continued)

This rung will be performing nearly all the comms with the starter. It will continuously read parameters P8 and P9 (the soft starter is 8-bit based) and the CLICK performs communications by 16-bit words. So the single value that is retrieved from the soft starter contains 2 values. Since both values are actually bit patterns, they are placed directly into a Hex data register DH1. This will be copied to C bits further in the program.



This rung will be used for Start/Stop control of the unit. It will only be activated when the user activates the Start and Stop inputs, which will send a value of "7" (Start) or "8" (Stop), contained in DS30, to the "Command Register" (P124) of the unit.



6.7.1 – CLICK PLC Example Program (continued)

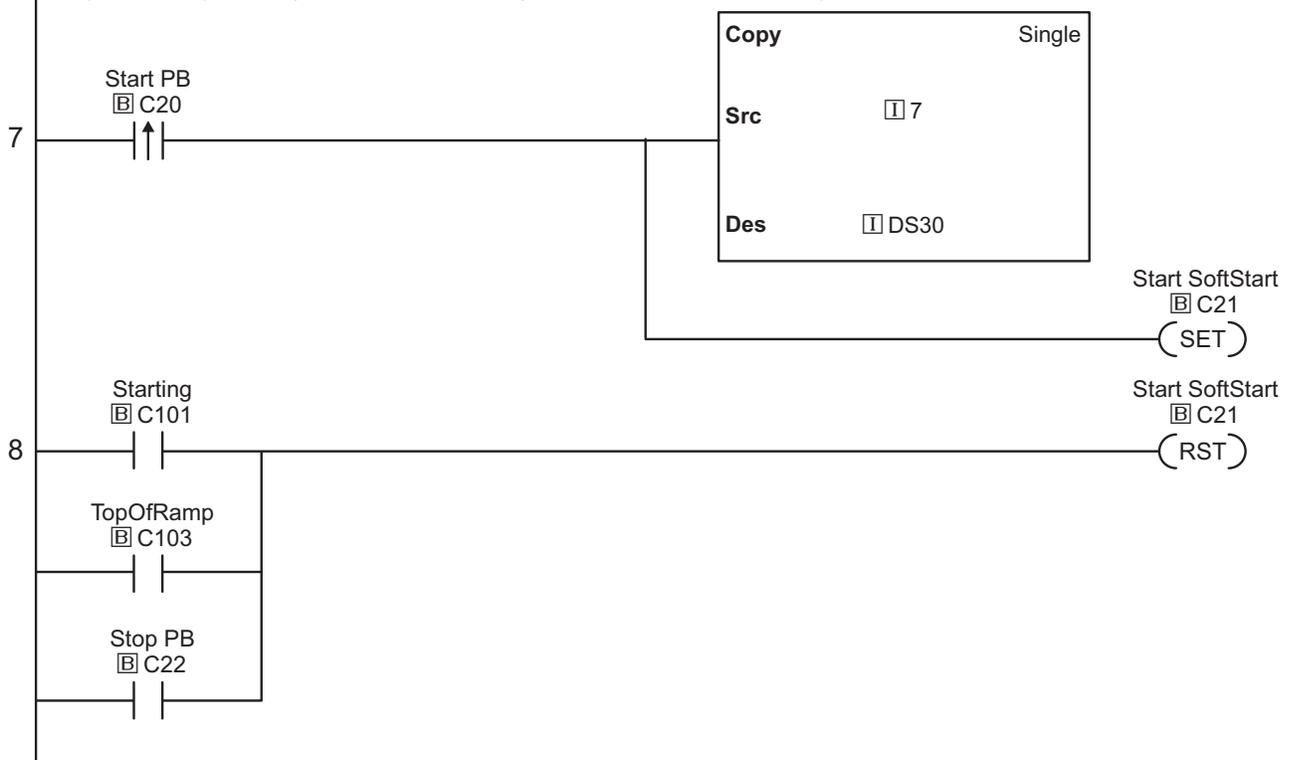
This rung controls the interlocking of the 2 previous comm instructions. Since the Receive instruction is programmed to read continuously, this logic resets the interlock, UNLESS, the CLICK program calls for the Start/Stop Send instruction to be activated.



This rung takes the Status Word that was read from the Soft Start, and converts the word to control bits. The bits, C100 thru C115, could be used in your program to turn on outputs, and/or they could just be monitored by an Operator Interface to generate messages.

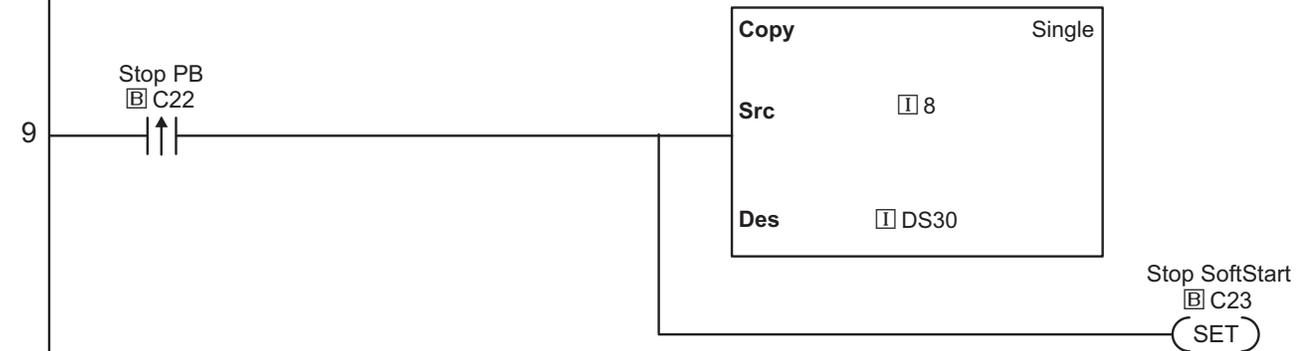


When "Start PB" is pressed (activated), a value of "7" is copied to DS30, and C21 is set. This will activate the Send instruction, which will write the contents of DS30 to P124. When the "Starting" or "Top of Ramp" bits (read from the unit) turn on, the "Start" sequence is reset.

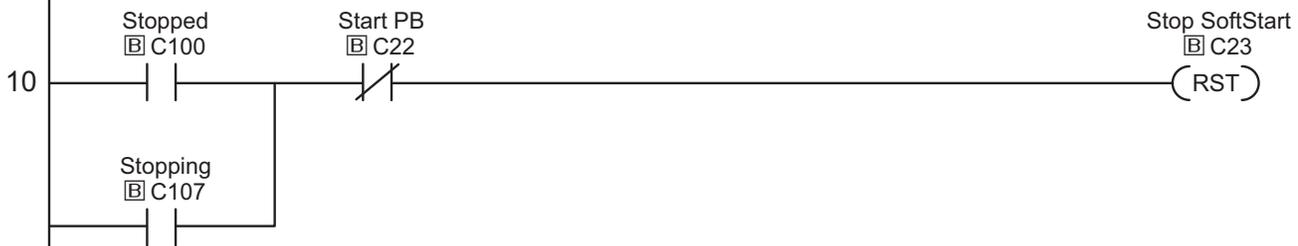


6.7.1 – CLICK PLC Example Program (continued)

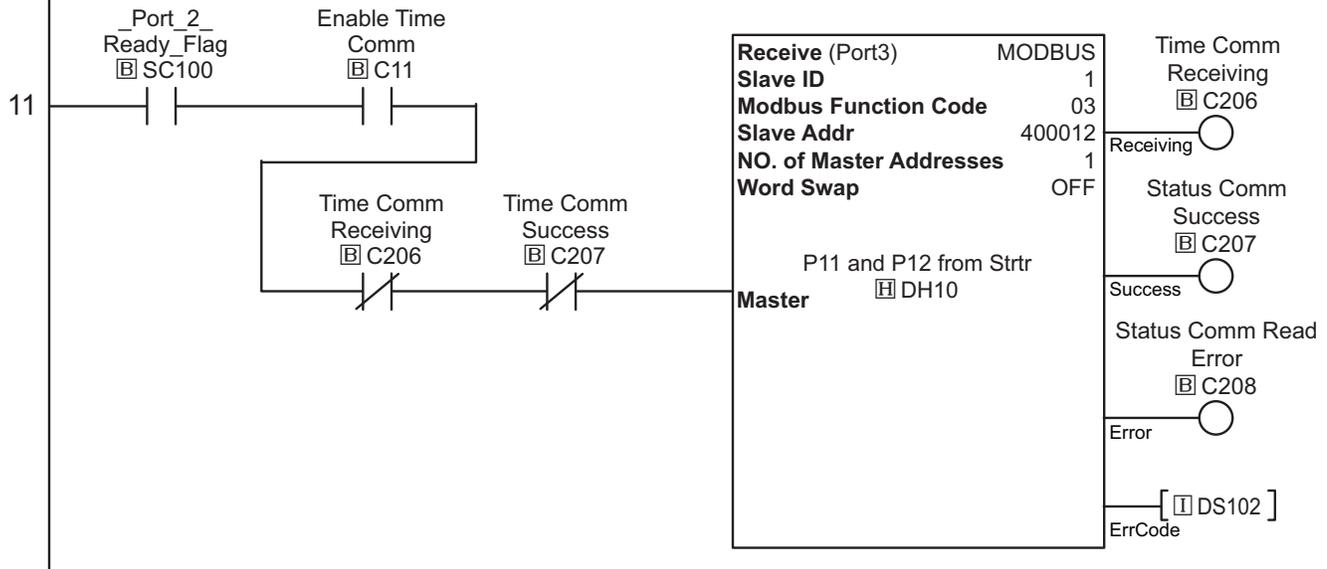
When "Stop PB" C22 is pressed (activated), a value of "8" (Stop) is copied to DS30, and C23 is set. This will activate the Send instruction, which will write the contents of DS30 to P124.



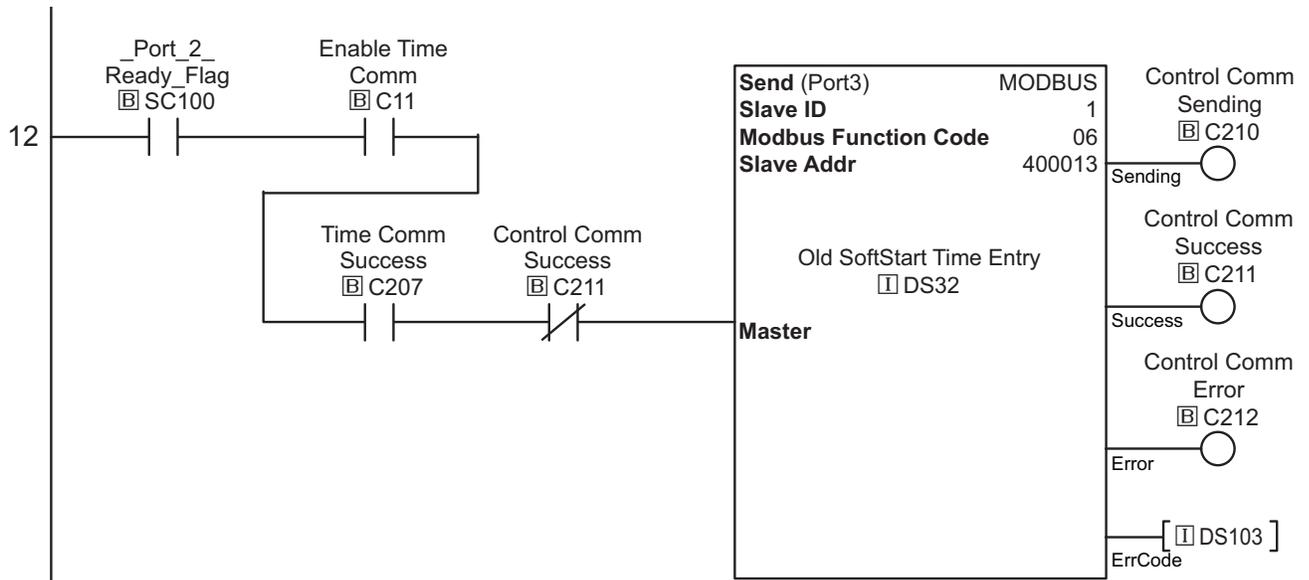
When the "Stopping" or "Stopped" bits (read from the unit) turn on, the "Stop" sequence is reset.



The next 2 rungs Receive and Send P12 (Soft Start Time) to the unit. This is complex because 2 hex values are actually retrieved (P11 and P12) by reading 1 Modbus address. The 2 rungs will synch themselves and communicate until the value that is sent to the unit is also confirmed by being read back from the unit. Once that occurs, the sequence resets.



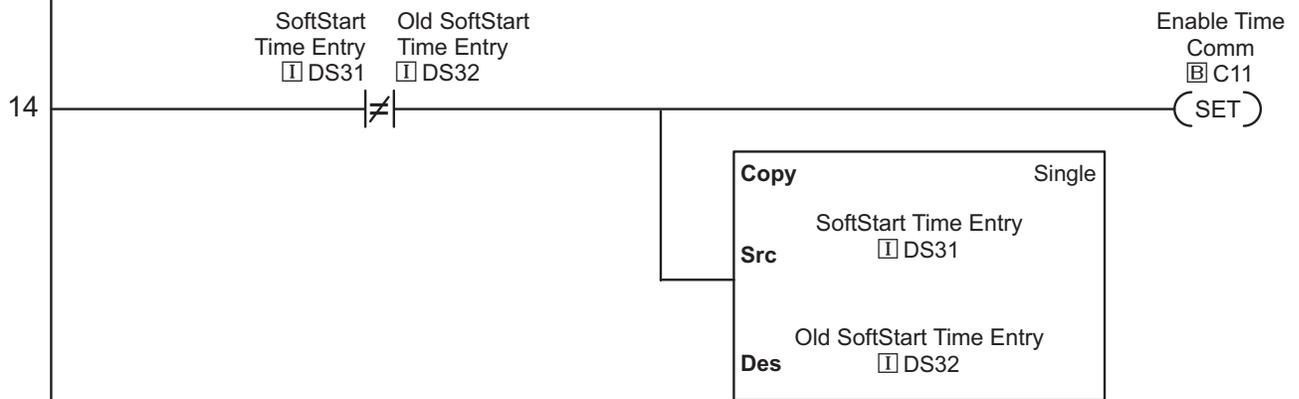
6.7.1 – CLICK PLC Example Program (continued)



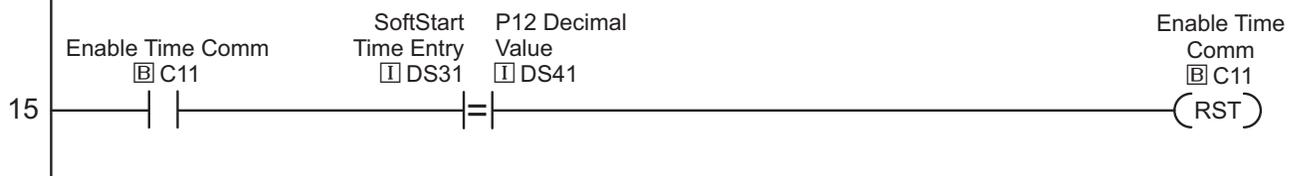
When both comm instructions have successfully operated, this rung will reset the communication bits and allow the comms to restart.



DS31 is assumed to come from an HMI (C-more for example), and when a new value is entered, it will not be equal to the old value, and this difference will set C11. That will start the Receive/Send sequence. Then, the new value is copied to DS32, which will turn off the rung.



This rung will be activated, until DS31 is equal to DS41, which is the Received value from the unit. When equal, the sequence is reset.



6.7.1 – CLICK PLC Example Program (continued)

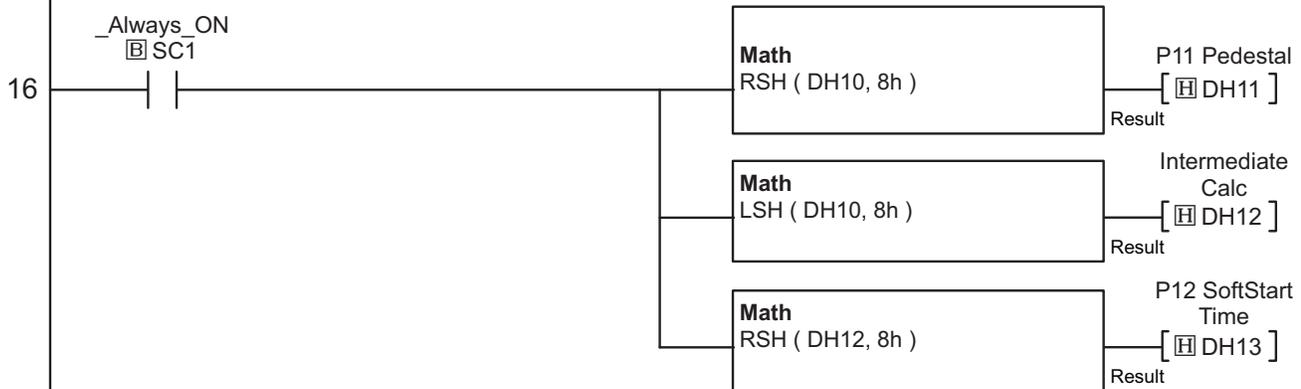
This rung manipulates the data retrieved (DH10) from the soft starter paramters P11 and P12. Since each Modbus word actually has 2 values (1 in each byte), the data has to be manipulated to put each relevant value in its' own register.

First, DH10 is loaded and the RSH instruction is performed to Shift the value to the right by 8 bits, which moves the upper byte to the lower byte, and this is output to DH11 (P11 Pedestal).

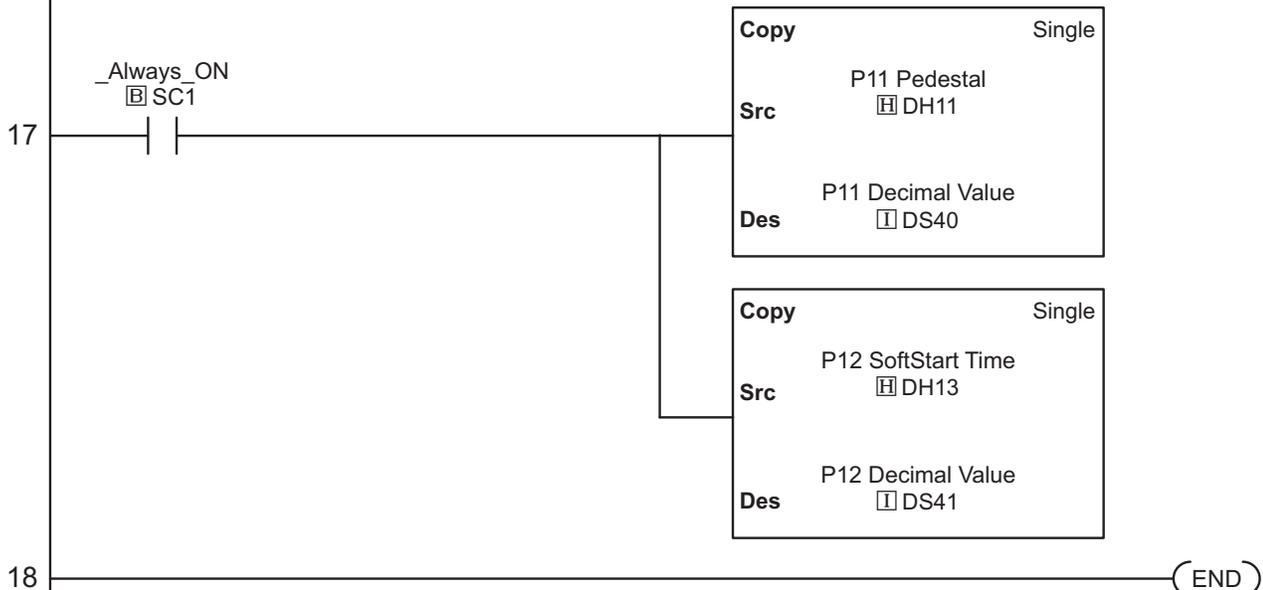
Next, the LSH (Left Shift Register) instruction is used in the 2nd MATH box to reload the original value in DH10, and move the lower byte to the upper byte (shifting left 8 bits), and we put the result in DH12 as an intermediate step.

Finally, we load DH12 in the 3rd MATH box, and perform a RSH (Right Shift Register) instruction to move the upper byte back to the lower byte, again, shifting 8 bits. Now the result is the bare lower byte value from the original word and this result is output to DH13 as our final value.

To summarize, the original data is shifted to the right 8 bits, which moved our original upper byte to the lower byte, and zeroed out the upper byte. This was the 1st MATH box. Then, the original value is reloaded, moved to the left 8 bits, then moved to the right 8 bits. This zeroed out the upper byte and resulted in the lower byte value. This took 2 MATH boxes. The values now reside in DH11 and DH13.



This rung copies the Hex values in DH11 and DH13 to DS40, and DS41, respectively.



6.7.2 – DirectLOGIC PLC Example Program

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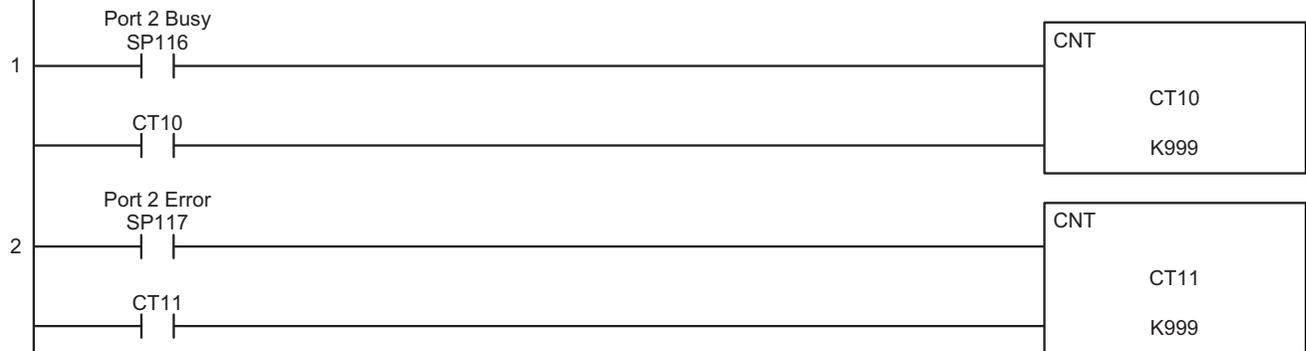
This *DirectLOGIC* ladder program example works with the MWX and MRX instructions found in the DL06 and DL260 PLC platforms.

(The DL06 and the DL260 can do RS-485 directly out of port 2.)



This program is for illustrational purposes only, and is not intended for a true application.

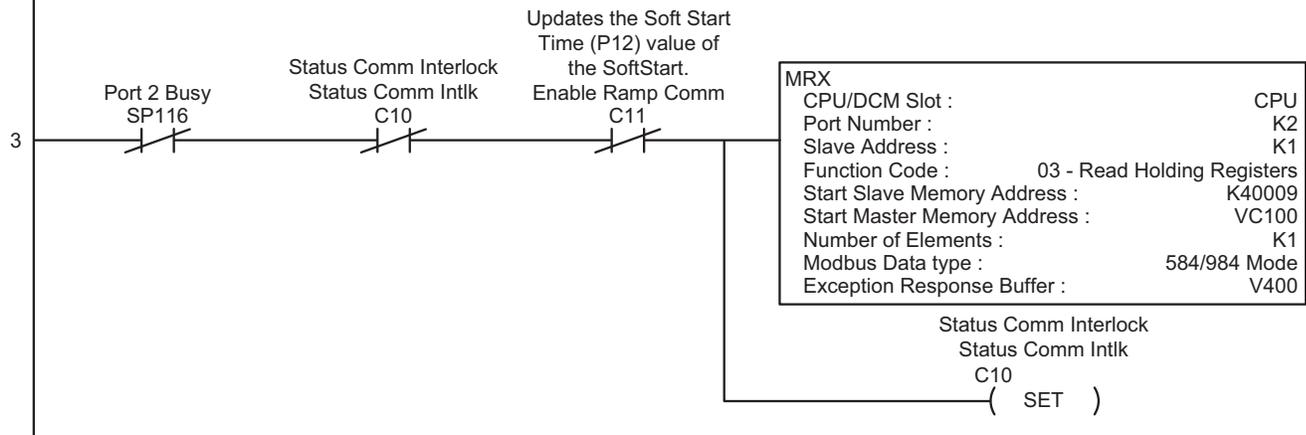
The first 2 rungs monitor comm attempts and errors for troubleshooting. Counter CT0 counts the attempts by both MRX and MWX instructions, and CT1 counts errors. CT0 will normally be counting rapidly, while CT1 will be counting very infrequently, if at all. If both counters are counting up, then there are problems which could be in addressing, wiring, or PLC/SR44 setup.



This rung will be doing nearly all the Comms with the soft starter.

It reads the Status Bits from the soft starter, from P8 and P9. Note that 8 is added for the starting address of 40001, 40001 + 8 (P8's address), and the result is 40009 for the "Start Slave Memory Address" field in the MRX.

P8 and P9 are read as one 16-bit word, and they are stored as a word starting at C100, so the bits C100-C117 will reflect the status of the starter, and those bits can be used in ladder as desired.

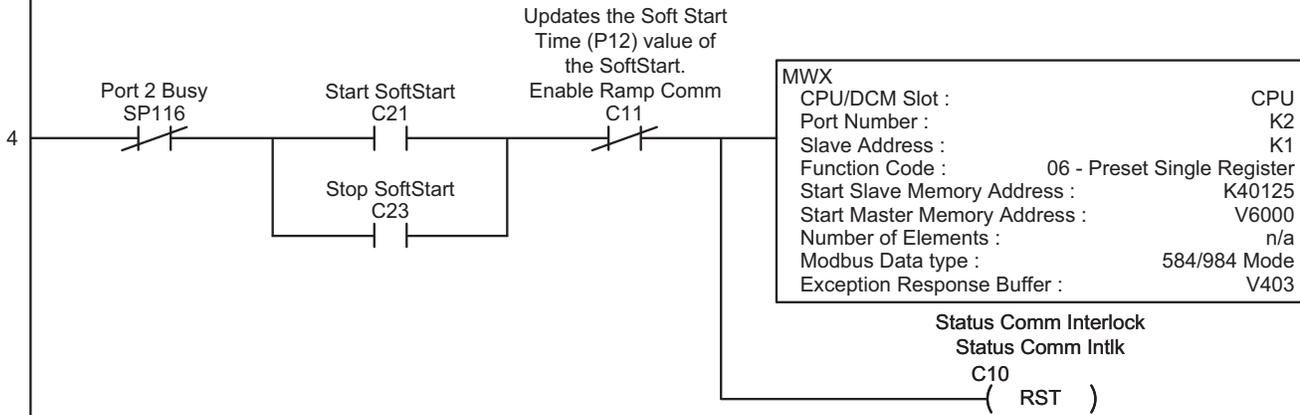


6.7.2 – DirectLOGIC PLC Example Program (continued)

This rung will be used when the user activates it. Ordinarily, it will only be active for a short period because the user is Starting or Stopping the soft starter.

This rung will write the value contained in V6000 to the Command Register (P124). The values of 7 and 8 will "Start" and "Stop" the soft starter, respectively. Note that 124 is added to the starting address of 40001, and we have 40125 for the "Start Slave Memory Address".

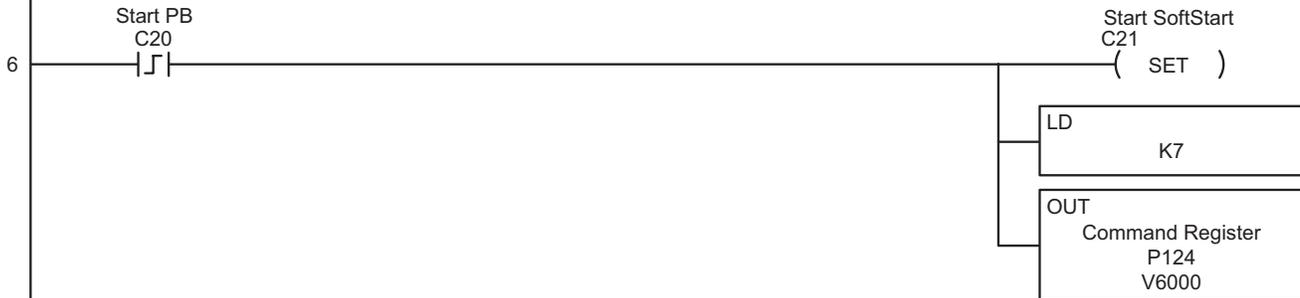
C21 (Starting) and C23 (Stopping) are located lower in the ladder, and they will enable Comms to the soft starter until the pertinent Status bits reflect the desired operation of the soft starter, then those Status bits will reset C21 and C23.



This rung will reset the Status Comm Interlock if no attempt is made to write to the soft starter. This will allow rung 3 to read the status again. Status will be read continuously from the starter, and writes will be done by exception, that is, when the user causes it.



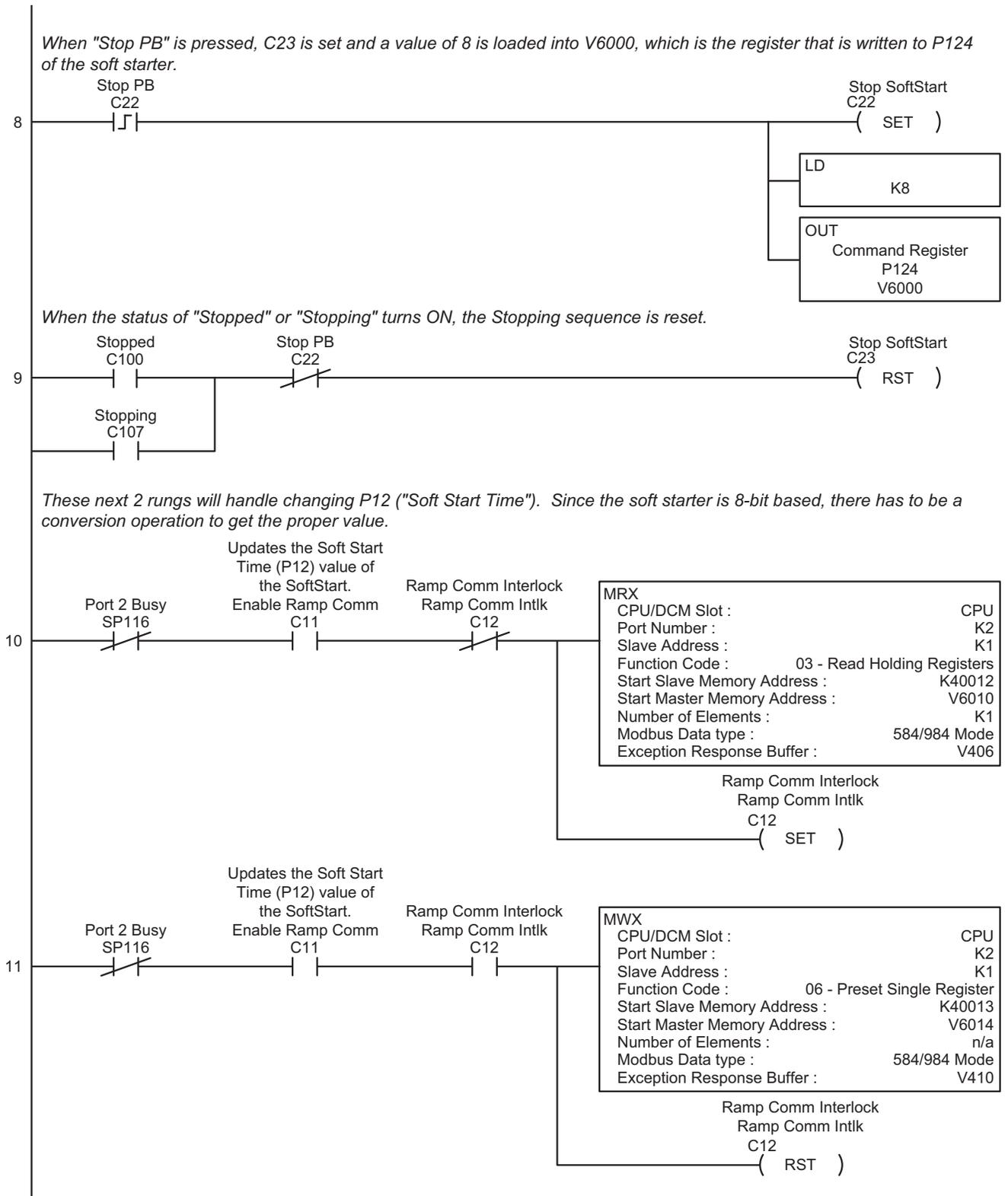
When "Start PB" is pressed, C21 is set, and a value of 7 is loaded into V6000, which is the register that is written to P124 of the soft starter.



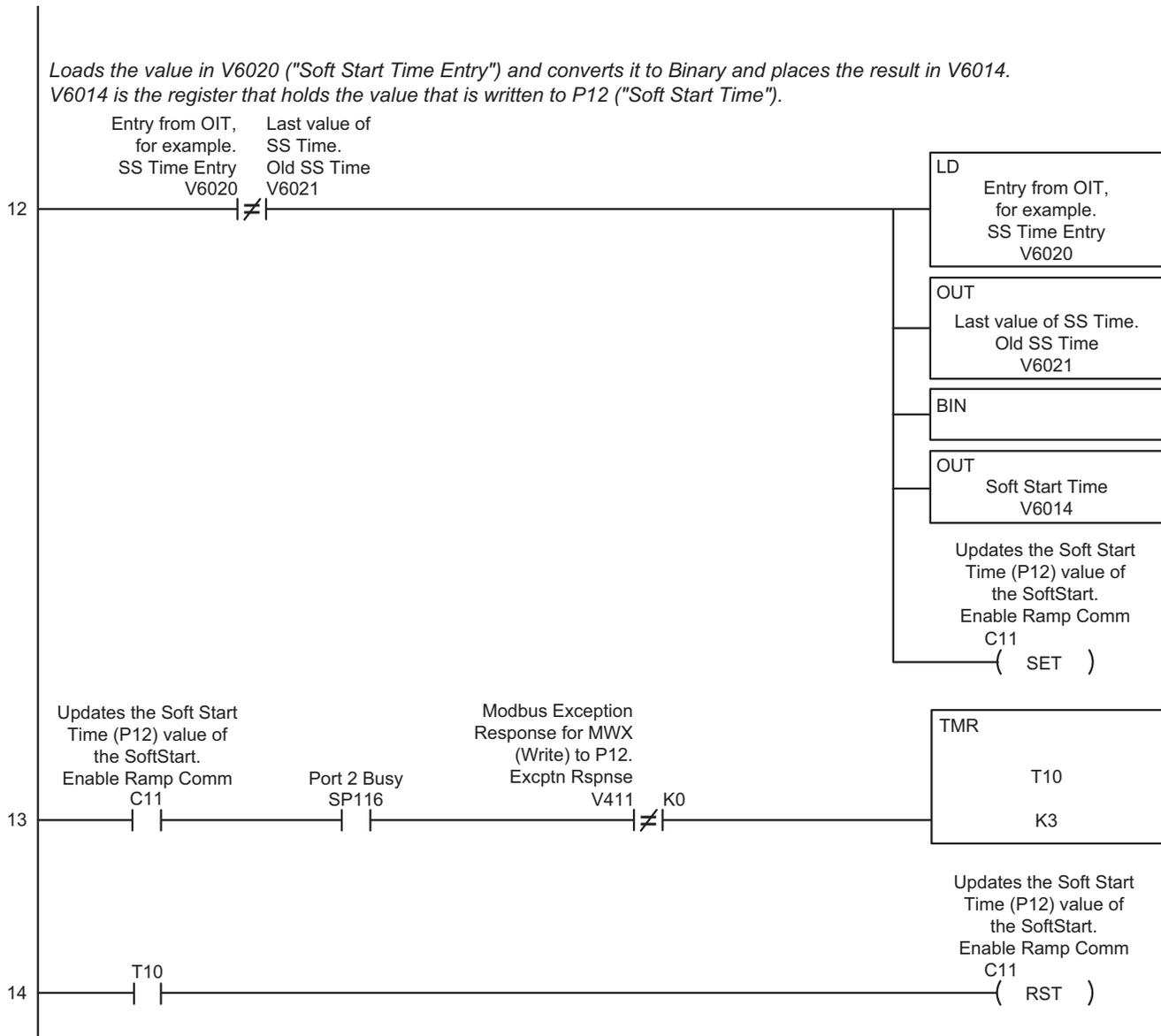
When the status of "Starting" or "Top of Ramp" turns ON, the Starting sequence is reset.



6.7.2 – DirectLOGIC PLC Example Program (continued)



6.7.2 – DirectLOGIC PLC Example Program (continued)



6.7.3 – Productivity3000 PLC Example Program

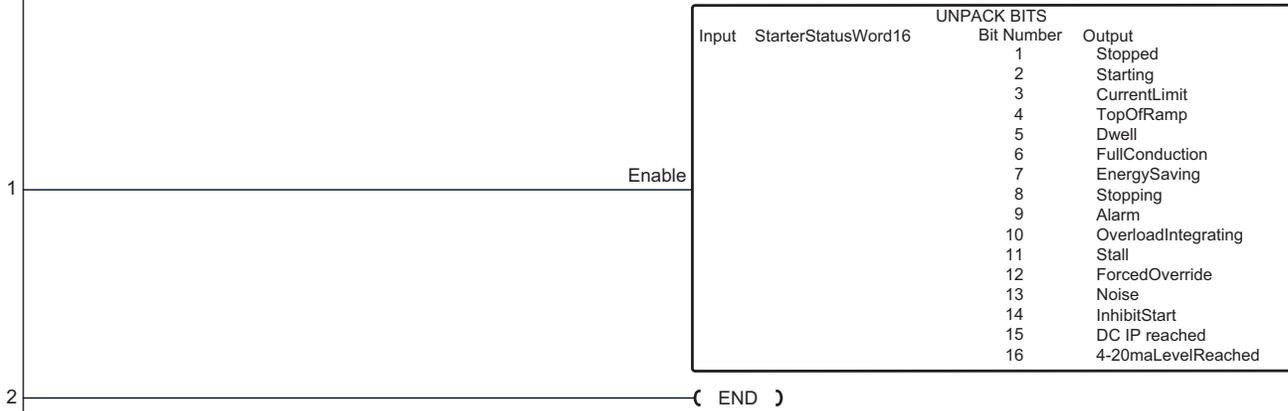
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This program is for illustrational purposes only, and is not intended for a true application.

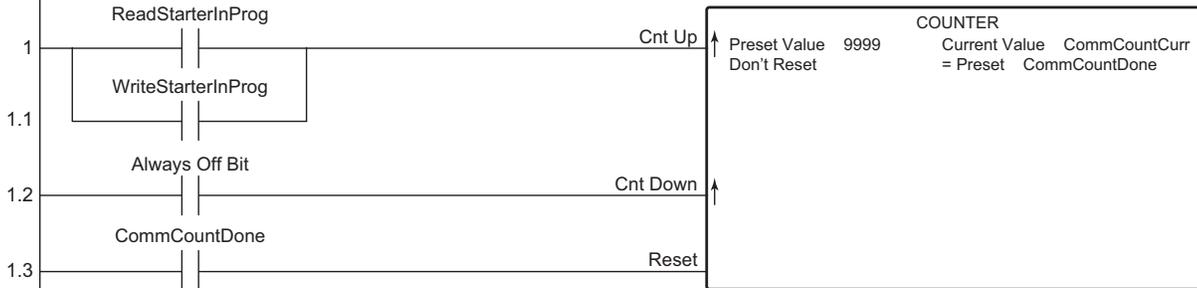
Task: StatusBits

This rung breaks down the tag “StarterStatusWord16” retrieved from the Soft Start (Parameters 8 & 9). We use the “Unpack Bits” instruction, which converts the 16-bit tag into 16 separate Boolean tags. These Bool tags can be monitored or used in the program for status, alerts, alarms, etc.

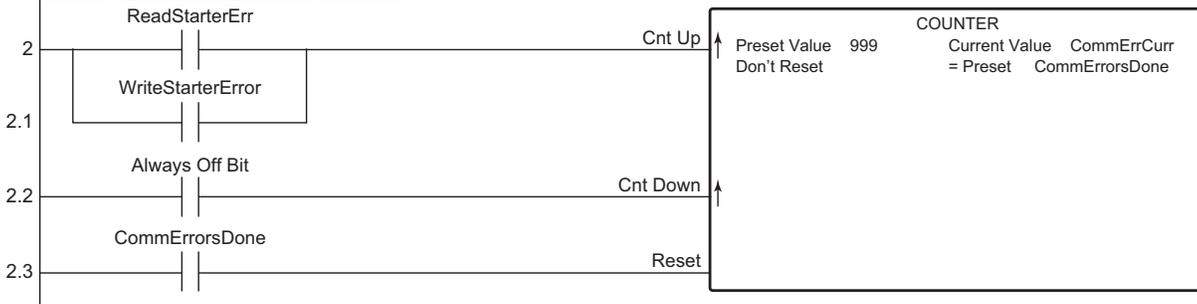


Task: Comms

This rung monitors our Comm “InProgress” attempts to the SoftStarter. The 2 inputs are the Bool tags that are assigned in the MRX and MWX instructions. It has a preset of 9999, and will reset itself. These 2 counters give us an easy way to monitor comms, to verify attempts and the occurrence of errors. If both counters are counting up in synch, then there are problems, which could be in addressing, wiring, or the slave itself.

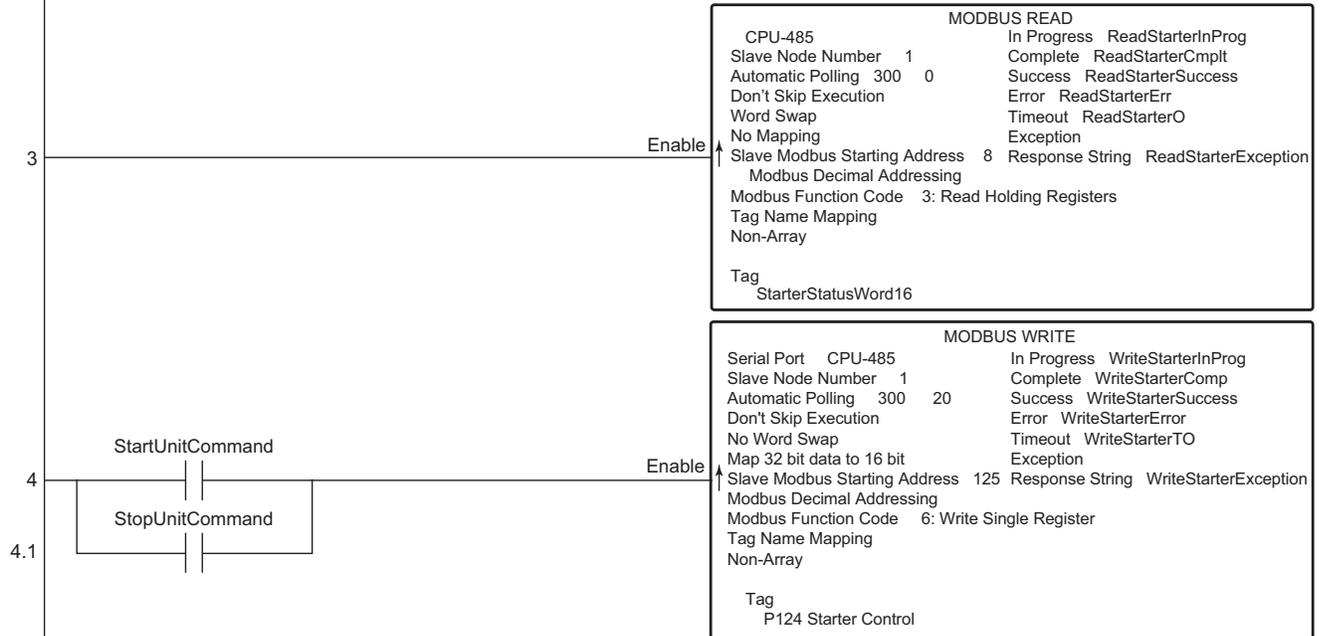


This rung monitors our Comm Errors. Ordinarily, this counter will only be activated very infrequently, unless a slave been lost. It has a preset of 999, and will repeat itself.

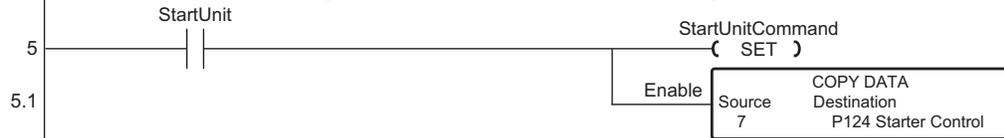


6.7.3 – Productivity3000 PLC Example Program (continued)

This rung is always active and Auto-Polls the SoftStarter for Status. The tag “StarterStatusWord16” is converted into Bool tags via the Unpack Bit instruction (located in task “StatusBits”), so we will have a tag dedicated to various status conditions (Stopped, Starting, Current Limit, Alarm, etc.). These Bool tags could be used in ladder to verify operation or to set indicator lights, for example.



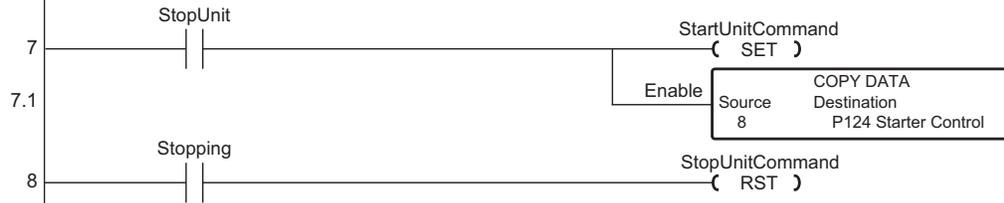
This rung, controlled by “StartUnit” input (usually a pushbutton input to the P3) activates the “Start Unit” sequence by setting the Bool “StartUnitCommand”. Then a value of 7 (“Bus Start”) is written to tag “P124 Starter Control”. This will begin writing the tag value to the SoftStart until the status bits being read from the SoftStart show the unit is acting on the command. Then the sequence resets.



“TopOfRamp” and “Starting” are Bool tags used to display the status of the unit. When either of these tags turns on, the sequence will reset.

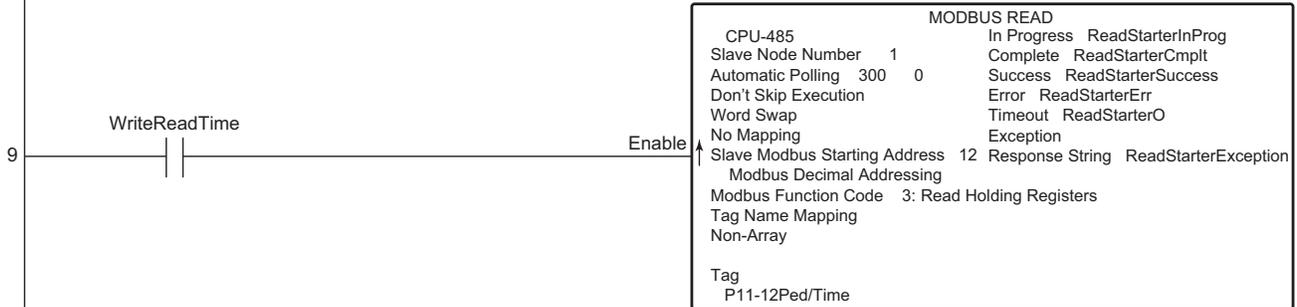


This rung, controlled by “StopUnit” input (usually a pushbutton input to the P3) activates the “Stop Unit” sequence by setting the Bool tag “StopUnitCommand”. Then a value of 8 (“Bus Stop”) is written to tag “P124 Starter Control”. Again, writing will begin until status bits reflect the desired response. Then the sequence resets.

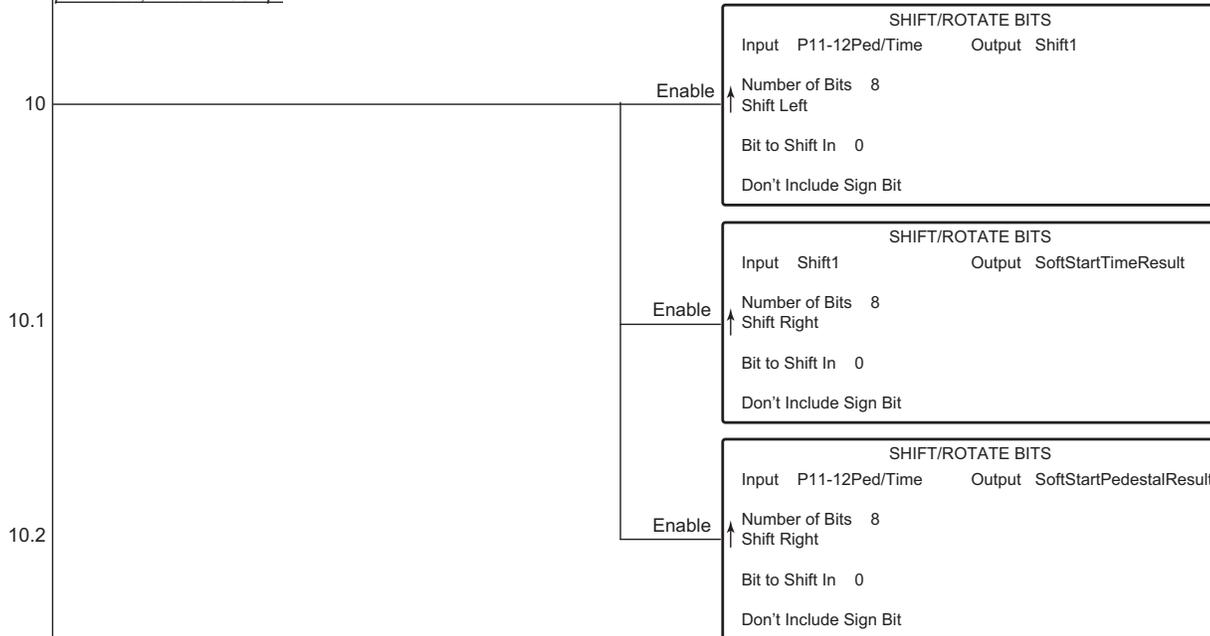


6.7.3 – Productivity3000 PLC Example Program (continued)

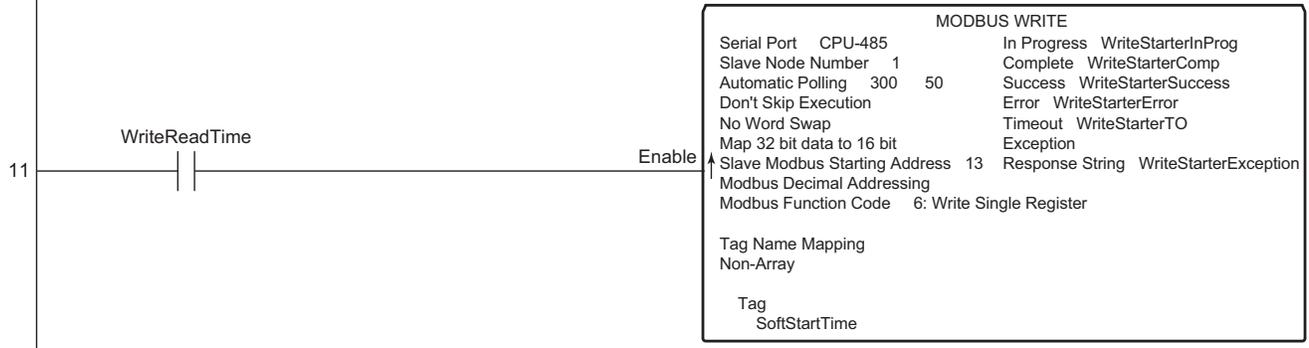
The following rungs are optional, and are included as an example of how to Read and Write to a parameter of the SoftStart. The SoftStart is 8-bit based, so Reads actually return 2 values which have to be separated (shown on the next rung with the Shift/Rotate instructions) so we can use them.



This rung takes the value in tag "P11-12", which was retrieved from the SoftStart, and performs some Shift operations on it to isolate the 2 values that actually are retrieved from the SoftStart due to its 8-bit architecture. First, the value is Shifted Left by 8 bits (to zero out the data), and the result is placed in tag "Shift1". Next, tag "Shift1" is Shifted Right by 8 bits to return the value to its original location. The resulting value is stored in tag "SoftStartTimeResult". Finally, "P11-12" is Shifted Right to move the upper byte to the lower byte and the value is stored in tag "SoftStartPedestalResult". This is the value that is used to demonstrate how to Write/Read with the unit, since the "Soft Start Time" would be the most commonly changed parameter, after Start/Stop.

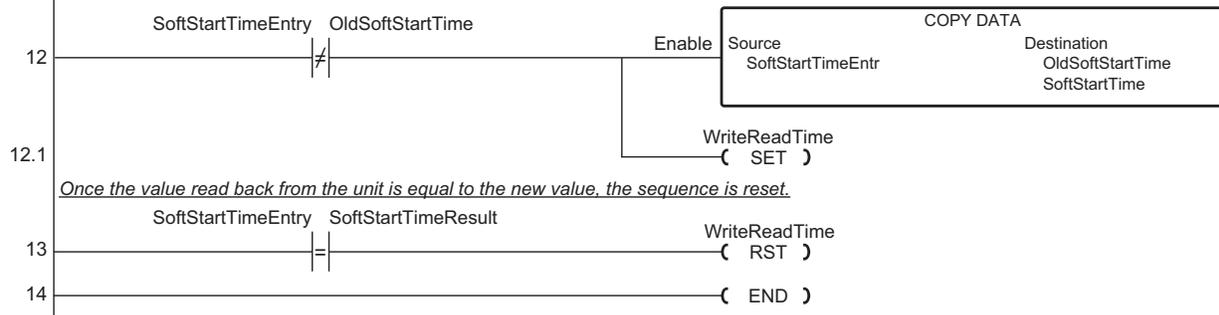


This rung will write to the unit, updating P12 ("SoftStartTime") with the latest entry (coming from an HMI, for example).



6.7.3 – Productivity3000 PLC Example Program (continued)

This rung compares 1 tag, "SoftStartTimeEntry", to another tag, "OldSoftStartTime". This allows the ladder to perform a sequence if the first tag (assumed for example purposes to be coming from an HMI, but can also be changed from Data View). It will Copy the new value to the old value tag, and then start the Write/Read confirmation sequence. When the value read from the soft starter is equal to the new entry, the sequence resets.



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OPTIONAL HARDWARE



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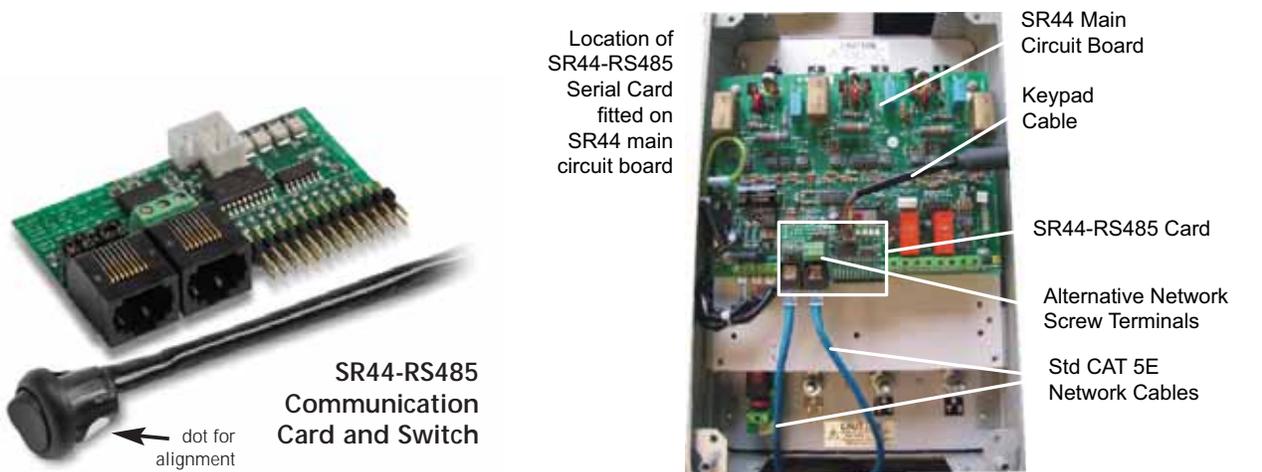
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7.1 – SR44-RS485 Communication Card

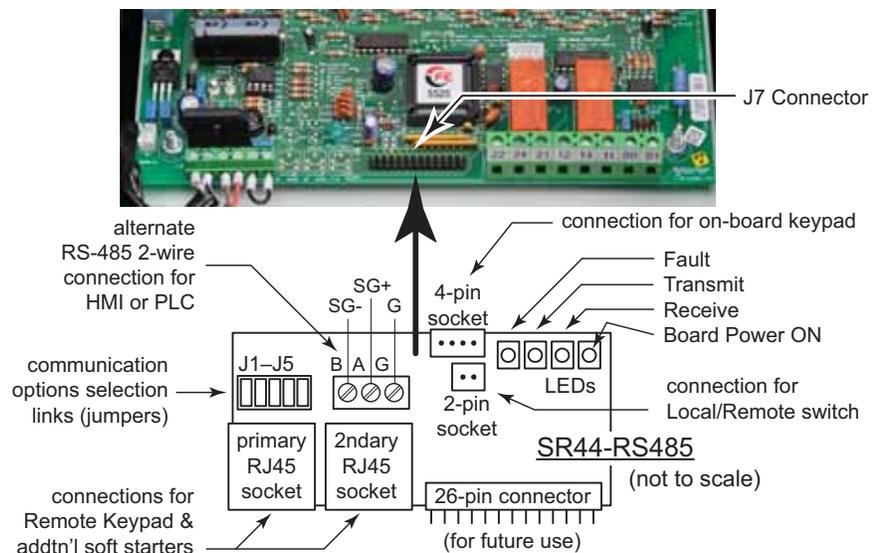
7.1.1 – Communication Card General Information

An optional RS-485 communication adapter card is available for use with SR44 Soft Starters.

- Communication Adapter Part Number: SR44-RS485
- Allows control to be switched between an integral Keypad or alternately through an external isolated network based on the Modbus standard
- Provides the ability to set up, control, and monitor single or multiple SR44 Soft Starters
- Provides an RS-485 interface with 50V isolation for demanding industrial applications
- Suitable for connection to a Remote Keypad or RS-485 serial network at 9600 baud 8, N, 1
- Allows maximum network lengths: 25 meters [82 ft] for RJ45 connections;
1200m [3937 ft] for RS-485 screw-terminal connections
- Allows connection via RJ45 connectors, or through screw terminals (2-wire)



SR44 Main PCB (not to scale)



Serial Communication and the soft starter's integral Local Keypad are mutually exclusive. Only one function can control the starter at a time. Switching to "Local" will always disable remote control of the starter.

7.1.2 – Connecting the Communication Card

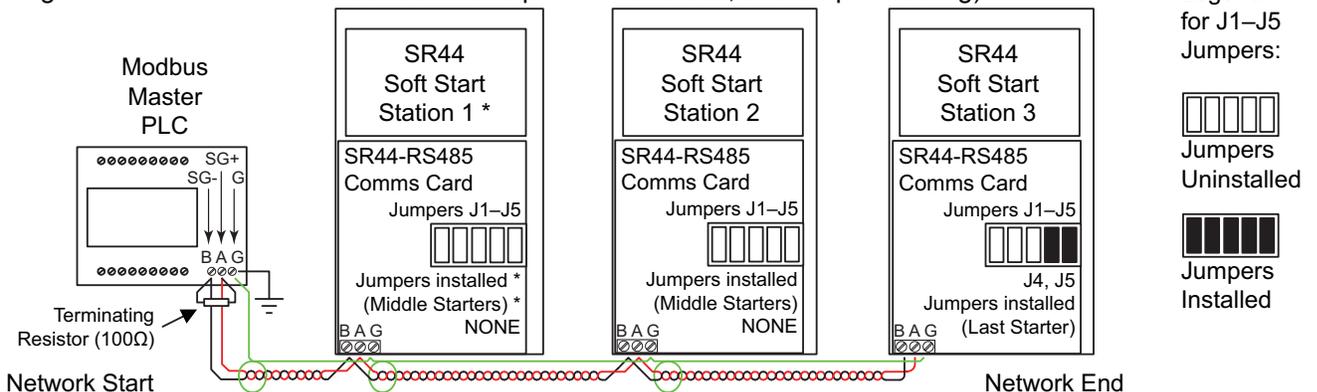
- 1) Isolate the SR44 from all electrical power sources.
- 2) Remove the front cover.
- 3) For size-2 soft starters (174A & higher), insert the Local/Remote extension cable through the starter and out the plugged hole in the bottom of the unit. Then connect the Local/Remote switch to the extension cable.
For size-1 soft starters (146A & below), discard the extension cable.
- 4) Install the “Local/Remote” label and switch/cable assembly (supplied with SR44-RS485) in the plugged hole in the bottom left corner of the starter. Orient the switch so that the white dot faces the “Remote” side of the label.
- 5) Install the SR44-RS485 communication card onto the J7 26-pin header (lower middle of main PCB), and then connect the cover keypad cable from the main PCB board to the 4-pin socket on the SR44-RS485 communication card.
- 6) Install the “Local/Remote” cable onto the SR44-RS485 board in the 2-pin socket.
- 7) Set Communication Card jumpers J1–J5 as shown in Network Connections drawing.

The starter can now communicate via serial communications when the “Local/Remote” switch is placed in “Remote”. This setting disables the integral keypad on the cover of the starter.

Switching to “Local” will disable serial communication, and enable the integral keypad.

One PLC Controlling Multiple SR44 Soft Starters via Serial Protocol

(using screw terminals and Belden 9841 or equivalent shielded, twisted-pair cabling)



* The ‘Network Start’ terminating resistor is installed at the PLC, and Station 1 is jumpered as a ‘Middle Starter’.

* For RS-485 connection to only one SR44, install jumpers 4, 5.

Functions of SR44-RS485 Jumpers J1–J5

- J1: This jumper is for use only with the SR44-KPD Remote Keypad, and only the starter closest to the keypad should have this jumper installed. It passes 12V through to the RJ45 connectors to supply power to the remote keypad.
- J2: This jumper is for use only with the SR44-KPD Remote Keypad, and only the starter closest to the keypad should have this jumper installed. It shorts out the 1k Ω grounding resistor.
- J3: This jumper connects the serial comms isolated ground to the local unit ground. If multiple SR44s (with SR44-RS485) are connected, one of them must have this jumper shorted.
- J4: This jumper is for use only with RS-485 networks. It connects a 100 Ω terminating resistor between the A and B RS485 lines on both the RJ45 and screw terminal connections. Only the nodes at each physical end of the RS-485 network should have terminating resistors.
- J5: This jumper connects a 1k Ω resistor between screw terminal G and local ground. Normally only the last starter in the network should have this jumper installed.

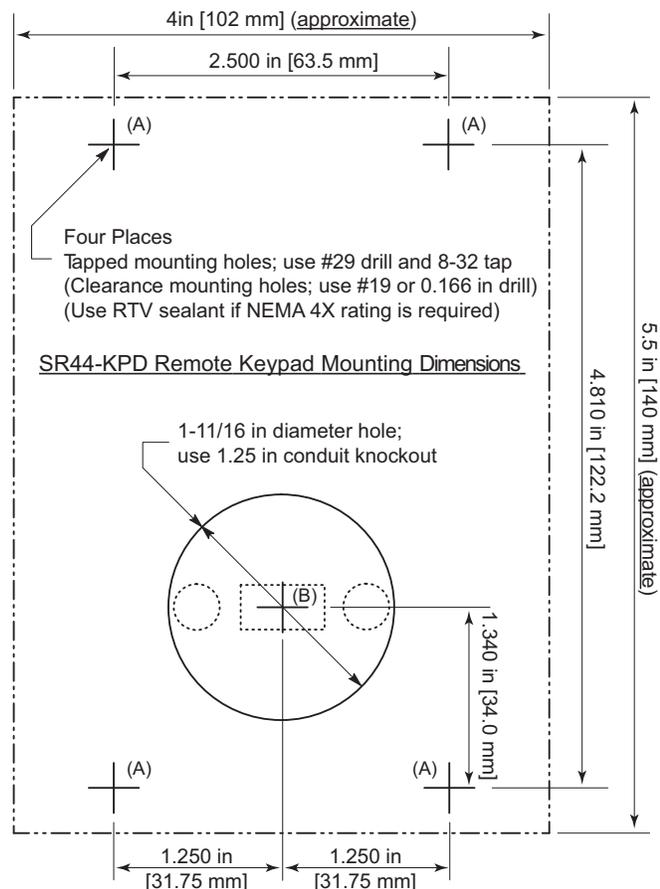
7.2 – SR44-KPD Remote Keypad

7.2.1 – Remote Keypad General Information

An optional Remote Keypad is available for use with SR44 Soft Starters.

- Remote Keypad Part Number: SR44-KPD
- Remote Keypad requires installation of an SR44-RS485 communication card
- Can be used with all SR44 series soft starters
- Connects with standard CAT5 RJ45 terminated Ethernet patch cable (use ferrites if EMC compliance is required)
- Includes 3-meter (10 ft) RJ45 twisted-pair CAT5 Ethernet patch cable with ferrites
- Can be mounted up to 10 meters (33 ft) from the SR44 Soft Starter.
- Can be used on a one to one basis, or one Remote Keypad can control several soft starters *one at a time* (multiple soft-starter control requires optional SR44-RS485 communication cards for each SR44 Soft Starter)
- Seven buttons with individual Start and Stop
- Display via a 2-line, 32-character LCD
- Eliminates panel mounted Start and Stop pushbuttons, ammeters, and pilot lights
- Gives continuous display of motor phase current and control status: Starting, Stopping, Full Volts, Optimizing, Current Limitation, Overload, and Fault Indication for one soft starter.
- “Local/Remote” switch (supplied with SR44-RS485) on the side of each SR44 Soft Starter can quickly swap starter control from remote keypad to integral keypad.

SR44-KPD Remote Keypad



7.2.2 – Connecting the Remote Keypad



Remote Keypad requires installation of an SR44-RS485 communication card.

- 1) The RJ45 cable that is supplied with the remote keypad has two ferrites installed on it to ensure EMC compliance. Plug the end with the thinner ferrite into the Communication Card primary RJ45 socket.
- 2) Secure the ferrite to the starter using a cable tie.
- 3) Set Communication Card jumpers J1–J5 as shown in Network Connections drawing below.
- 4) Mount the Keypad using the screws provided and plug the other end of the cable, with the larger ferrite, into the SR44-KPD Remote Keypad. (SR44-KPD mounting dimensions are shown on the reverse side of this page.) (Use RTV sealant at mounting holes “A” if NEMA 4X rating is required.) (Remote keypad is NEMA 4X; soft starter is not.)

The starter can now be controlled by the Remote Keypad when the “Local/Remote” switch is placed in “Remote”. This setting disables the integral keypad on the cover of the starter.

Switching to “Local” disables the Remote Keypad and enables the integral Local Keypad.



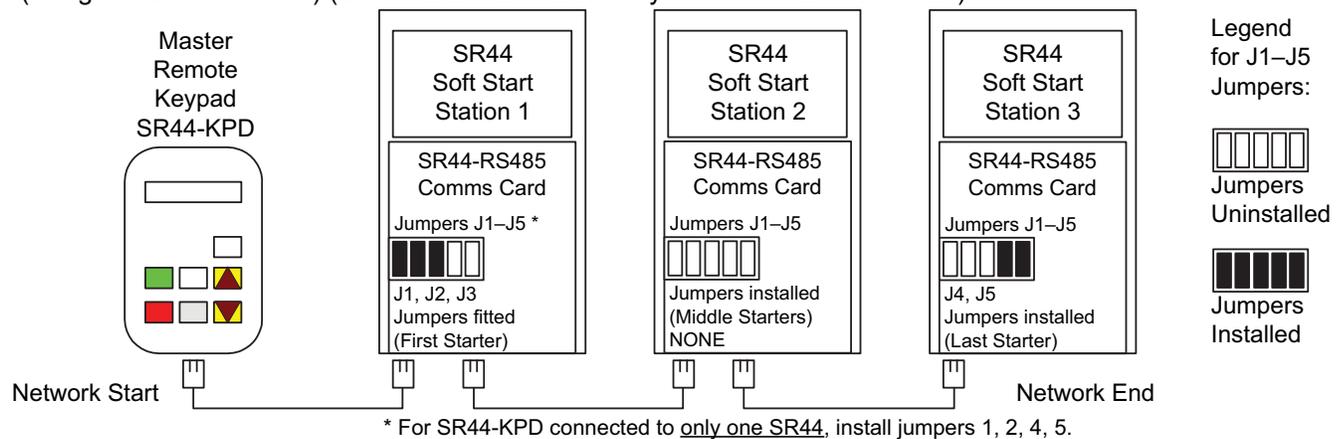
The Remote Keypad and the soft starter’s integral Local Keypad are mutually exclusive.

Only one function can control the starter at a time.

Switching to “Local” will always disable remote control of the starter.

One SR44-KPD Remote Keypad Controlling Multiple SR44 Soft Starters

(using RJ45 connections) (SR44-KPD can control only *one* soft starter at a time)



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SETUP EXAMPLES



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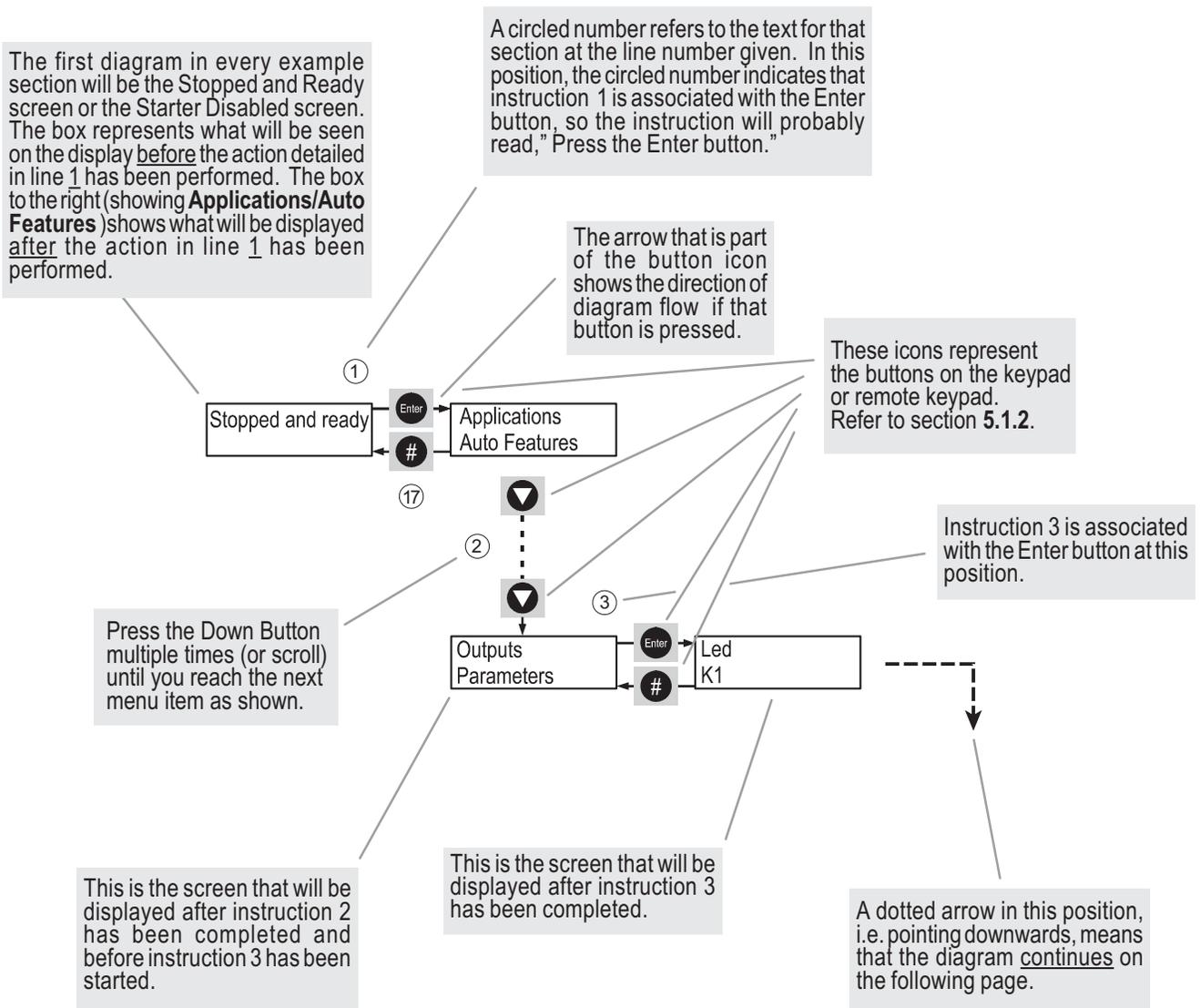
A.1 – Setup Examples

This section holds common programming examples that any customer might wish to use. They explain how to set up the SR44 for common tasks. More advanced examples are given in section A.2.

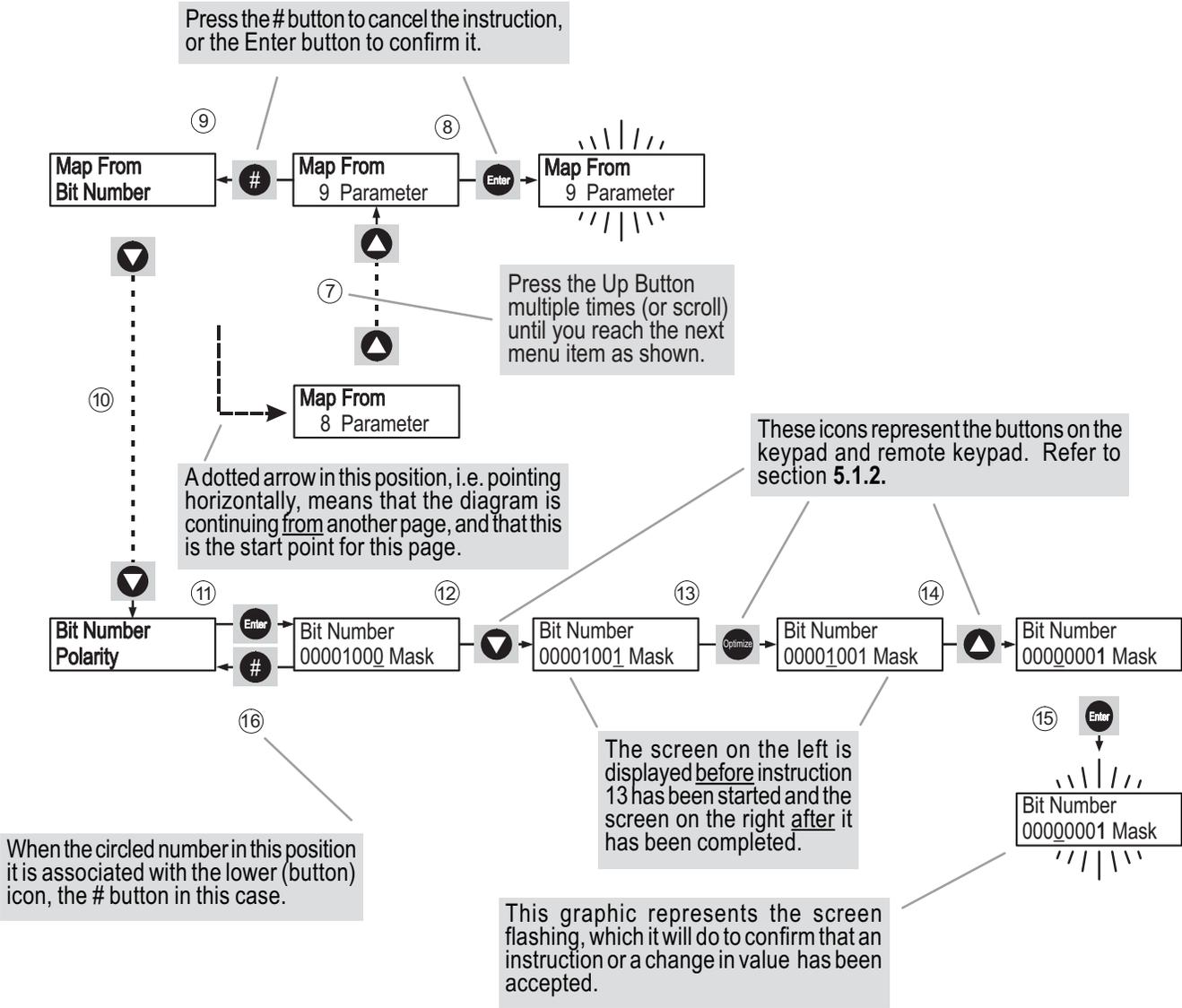
A.1.1 – How to Read the Setup Examples

Each example consists of numbered step-by-step instructions which take the user through every action needed to complete the particular programming example. In addition, there are diagrams which reference the text. The form these diagrams take are briefly explained below. (Note that the actual instructions in the diagrams in this section, A.1.1, are for display only and are not intended to make sense as instructions.)

If the unit needs to be 'Disabled' (see section A.1.2) before carrying out the instructions, the example will say so in its introduction.



A.1.1 – How to Read the Setup Examples (continued)



A.1.2 – Enabling and Disabling the SR44

The effect of this parameter is that the user cannot start the SR44 (running the motor) without enabling the unit first.

Whenever the control supply to the SR44 is turned on, the unit powers up in an enabled state, and the display will indicate whether or not the unit is enabled.

If the SR44 is enabled, the display will look like this:

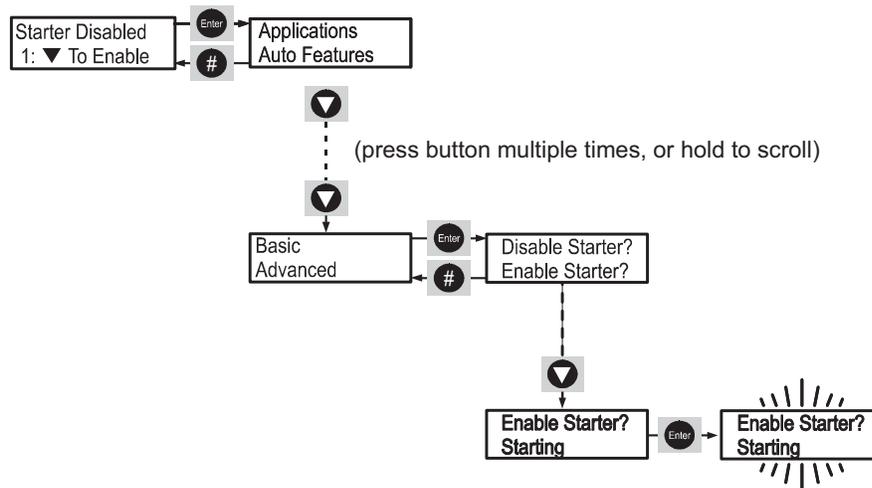
Stopped and Ready
1:

If the SR44 is disabled, the display will look like this:

Starter Disabled
1: ▼ To Enable

If the unit has been disabled, there are two ways to enable the unit:

- 1) By pressing the down button when presented with the 'Start Disabled' screen shown above.
- 2) By following the instructions below.



With 'Starter Disabled' on the screen, press the ENTER button once. Press the down button until 'Basic' appears on the top line of the display. Press the ENTER button once, and with 'Disable Starter?' showing press the down button once until 'Enable Starter?' is on the top line of the display. Press the ENTER button once and the display will flash once confirming the change.

There is only one menu-driven way to disable the unit, and that follows the same procedure as above, except choosing 'Disable Starter?' at the point where 'Enable Starter?' was previously chosen.

There is another situation in which the user may need to disable the starter. That is when trying to write to a parameter to which write access is denied when the unit is enabled. Given such a situation (for instance, trying to load default parameters), the unit will ask the user whether he/she wishes to disable the starter. The user must then press the pound (#) button to answer no, or the ENTER button to answer yes.



If the SR44 is disabled while running a load, it will stop running the load as soon as it is disabled.

To sum up, when the unit is disabled, all writable parameters can be written to. When the unit is enabled, most (but not all) writable parameters can be written to. Examples of parameters that cannot be written to while the unit is enabled are the Password and the currently loaded application. Also, default parameter values cannot be loaded while the unit is enabled.

Note for A.1 Setup Examples



In the following examples, the default parameters are assumed to have been loaded before the start of the example, unless otherwise stated. This is to provide a common reference point for the instructions.

A.1.3 – Loading the ‘Large Pump’ Application into Memory.

There are a number of pre-programmed applications included in the SR44 for speed and ease of setup. The parameters loaded by each selection characterize the standard setup of each particular application.

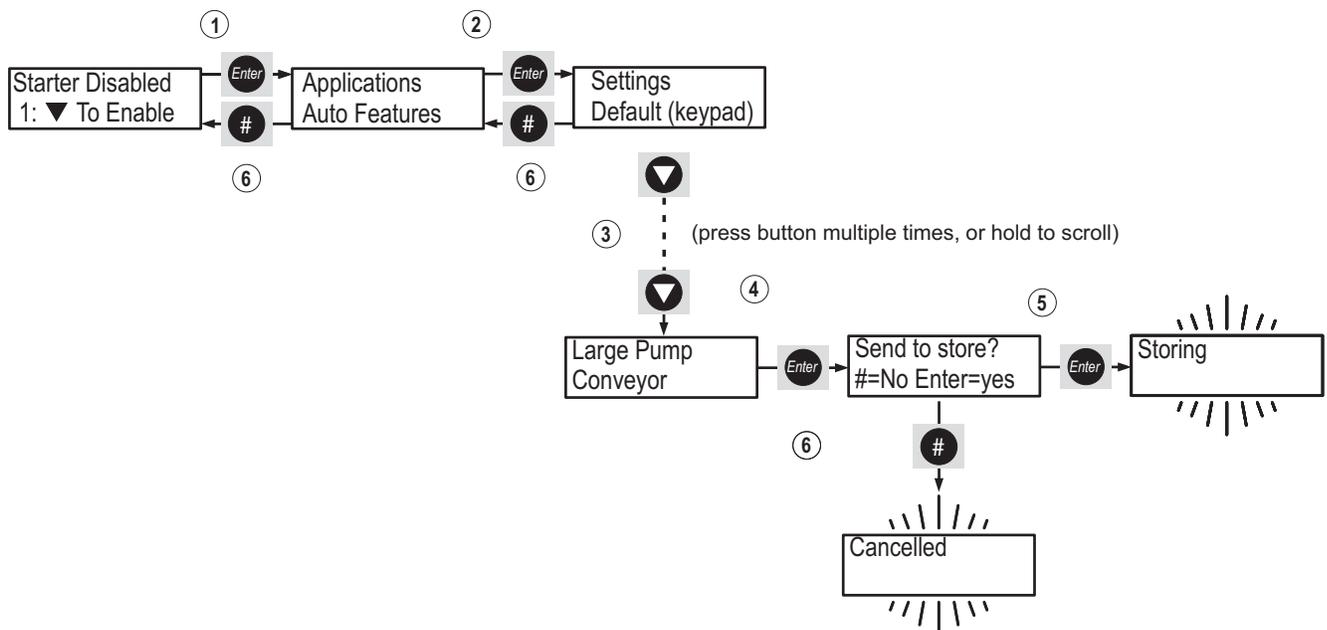


This example assumes that the unit has been disabled (see section A.1.2).

1. With ‘Starter Disabled’ shown on the display, press the ENTER button.
2. With ‘Applications’ shown on the top line of the display, press the ENTER button.
3. With ‘Settings’ shown at the top of the display press ▼ button until ‘large pump’ is shown at top of display.
4. Press ENTER to select ‘large pump’. The display will indicate which parameters are to be changed.
5. With the top line of the display showing ‘Send to store?’, press ENTER to save the settings for a ‘large pump’. (If the # button is pressed instead at this point the unit will flash the message ‘Cancelled’ three times). The display will flash the message ‘Storing’ twice to indicate this has been done.
6. At any of the above stages, pressing # will return the user to the previous menu. The unit will not start until the display indicates ‘Stopped and ready’.



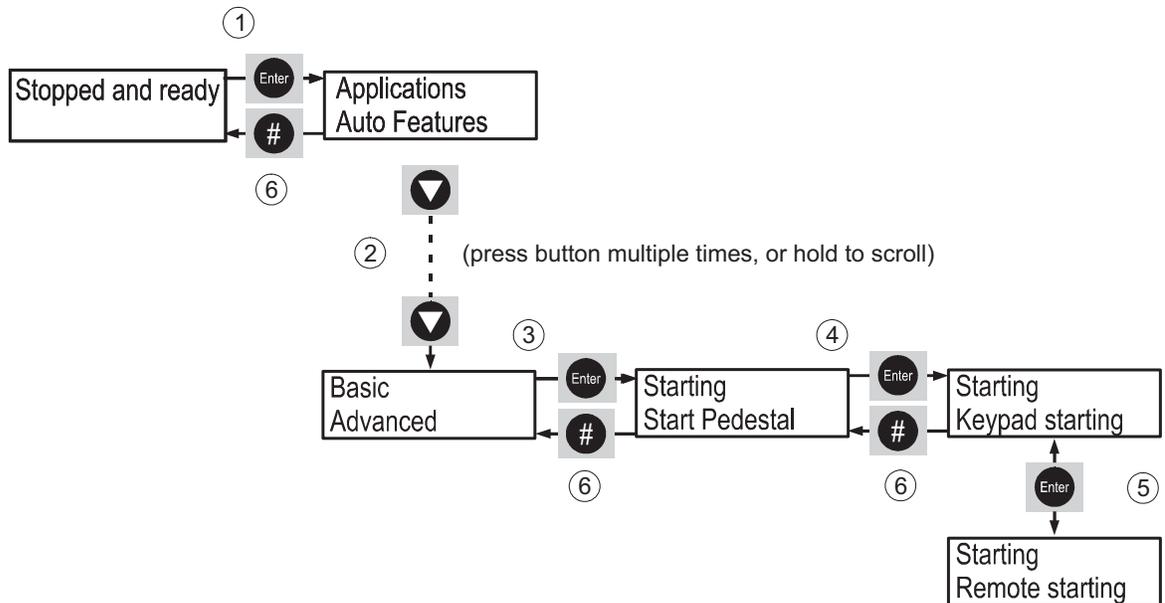
There is no need to save the changed parameter values, as they are automatically saved at instruction 5.



A.1.4 – Changing from ‘Keypad Starting’ to ‘Remote Starting’

With ‘Keypad Starting’ set, the unit is started from the keypad or remote keypad. While ‘Remote Starting’ is set, the unit is started with a start signal between S0 and S1. ‘Keypad Starting’ is the factory default value.

1. With ‘Stopped and ready’ shown on the display, press the ENTER.
2. With ‘Applications’ shown on the top line of the display, press ▼ button until ‘Basic’ is shown at top of display.
3. Press ENTER to select ‘Basic’ menu.
4. With ‘Starting’ shown at top of display, press ENTER to select the ‘Starting’ option.
5. With the display now showing ‘Starting’ on the top line, press ENTER to toggle the bottom line of display from ‘Keypad Starting’ to ‘Remote Starting’.
6. At any of the above stages, pressing # will return the user to the previous menu.
7. The SR44 will now start and stop remotely from the customer’s switches (see section 2.3.1 of Electrical Installation), but will return to ‘Keypad Starting’ if the control supply on terminals X1 and X2 is removed and a ‘Save Param’ has not been performed. Alternatively, to return to ‘Keypad Starting’, repeat the above procedure and select ‘Keypad Starting’ at step 5. To keep the ‘Remote starting’ setting after removal of the control supply, the settings must be permanently saved (See section A.1.5).



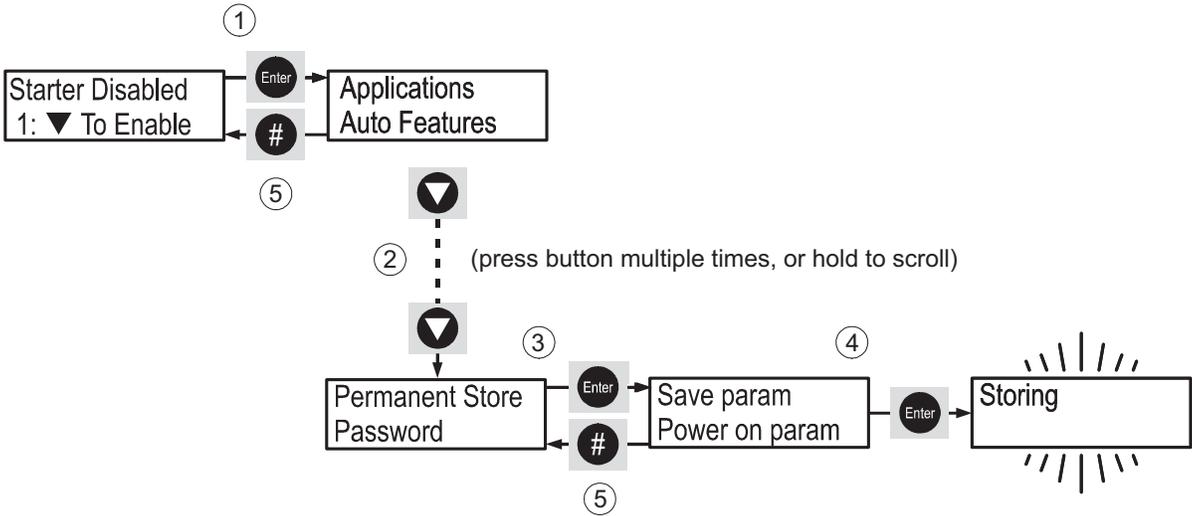
A.1.5 – Permanently Saving Parameters Set by the User



Follow this procedure to save parameters set by the customer.

This example assumes that the unit has been disabled (see section A.1.2).

1. With 'Starter Disabled' shown on the display, press ENTER button.
2. With 'Applications' shown on the top line of the display, press ▼ button until 'Permanent Store' is shown at top of display.
3. Press ENTER to select 'Permanent Store' menu.
4. With 'Save Param' shown at top of display, press ENTER to permanently save parameters. The display will flash twice to indicate this has been done.
5. At any of the above stages, pressing # will return the user to the previous menu.



A.1.6 – Loading the Default Parameter Values with 'Keypad Starting' Option

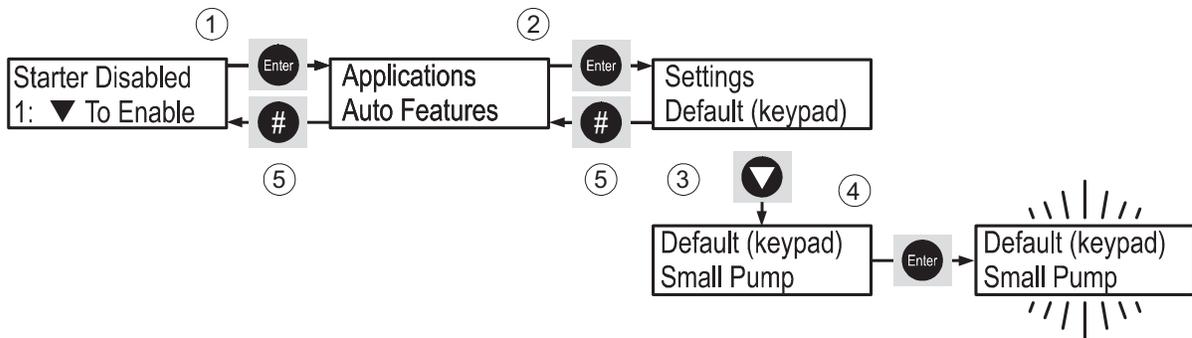


This example assumes that the unit has been disabled (see section A.1.2).

1. With 'Starter Disabled' shown on the display, press the ENTER button.
2. With 'Applications' shown on the top line of the display, press the ENTER button again.
3. With 'Settings' on the top line of the display, press the ▼ button until 'Default (keypad)' is shown on the top line of the display.
4. Press the ENTER button, and the display will flash three times to indicate that the default parameters (with keypad starting) have been loaded.
5. Press the # button twice to return to 'Stopped and ready'.



There is no need to save the parameters, as they have automatically been saved when the system was reset to default values.



A.1.7 – Loading the Default Parameter Values with ‘Remote Starting’ Option

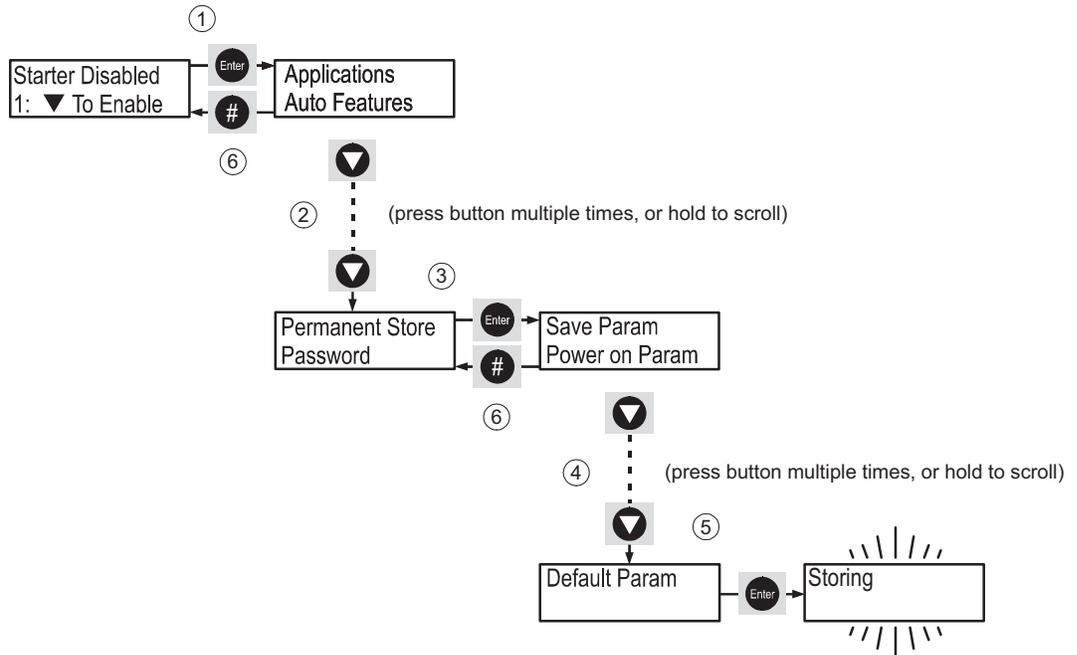


This example assumes that the unit has been disabled (see section A.1.2).

1. With ‘Starter Disabled’ shown on the display, press the ENTER button.
2. With ‘Applications’ shown on the top line of the display, press the ▼ button until ‘Permanent Store’ is on the top line of the display.
3. Press the ENTER button.
4. Press the ▼ button until ‘Default Param’ is shown on the top line of the display.
5. Press the ENTER button, and the display will flash indicating that default parameters have been loaded. The display will then show the selected starting option (‘Remote’), and the selected protection option (‘Full + Optimise’) before returning ‘Default Param’ to the top line of the display.
6. Press the # button twice to return to ‘Starter Disabled’.



There is no need to save the parameters, as they have automatically been saved when the system was reset to default values.

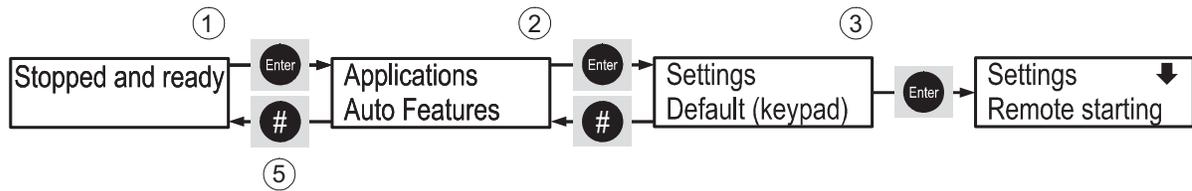


A.1.8 – Viewing Basic Operating Parameter Values via the Settings Menu Option

1. With 'Stopped and Ready' shown on the display, press the ENTER button.
2. With 'Applications' shown on the top line of the display, press the ENTER button again.
3. With 'Settings' on the top line of the display, press the ENTER button and a downwards pointing arrow will appear on the right hand-side of the top line. While this icon is displayed, the bottom line of the display will show a brief list of some of the basic parameters and their current values, including: the firmware version numbers; the starting option ('Remote' or 'Keypad'); the current protection mode; the selected application (if none, the lower line of the display will remain blank for a moment); and whether any derating has been applied to the unit (if none, the lower line of the display will remain blank for a moment). When the arrow icon has disappeared, the report showing the basic parameters has finished and the user is the back in Menu Navigation mode, (see section 5.4.2).
4. This menu item is read-only.
5. Press the # button twice to return to 'Stopped and ready'.



Since this menu item is read-only, it cannot be saved.



A.1.9 – Changing a Password



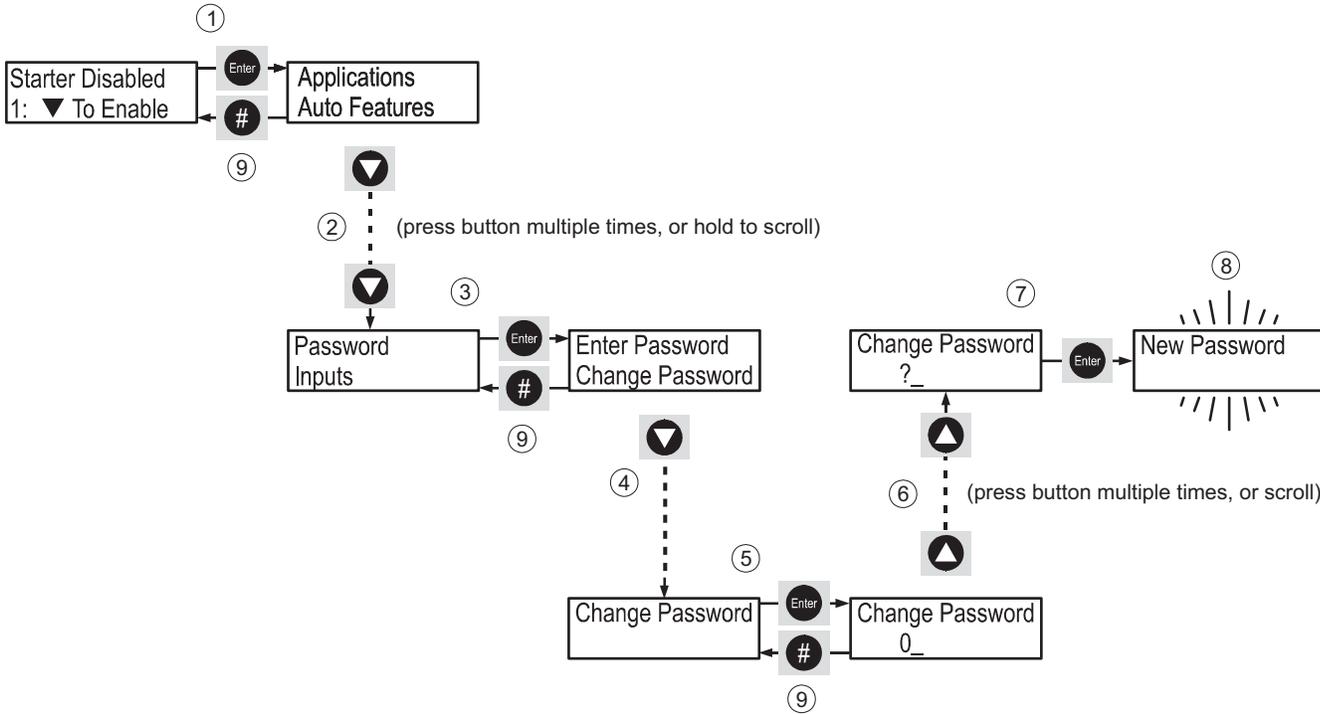
This example assumes that the unit has been disabled (see section A.1.2) and, if necessary, has already been unlocked (see section A.1.10).

1. With 'Starter Disabled' displayed, press the ENTER button.
2. With 'Applications' shown on the top line of the display, press the ▼ button until 'Password' takes its place on the top line.
3. Press the ENTER button to select the 'Password' menu.
4. Press the ▼ button, and 'Change Password' will be displayed on the top line.
5. Press ENTER to select 'Change Password'. A cursor will be visible on the bottom line of the display.
6. Use the ▲ or ▼ button to enter a new password number.
7. Press the ENTER button once.
8. The display will flash 'New Password!' twice to confirm that the change has been made.
9. Press the # button three times to return to 'Starter Disabled'.

Notes:



- 1) The unit must be unlocked (section A.1.10) in order to change the password.
- 2) Setting the password to zero (0) deletes any set password, and leaves the unit unlocked AFTER the control supply has been cycled or the keypad / remote keypad has been reset.
- 3) It is not necessary to save the password since it is stored automatically every time that its value is changed.

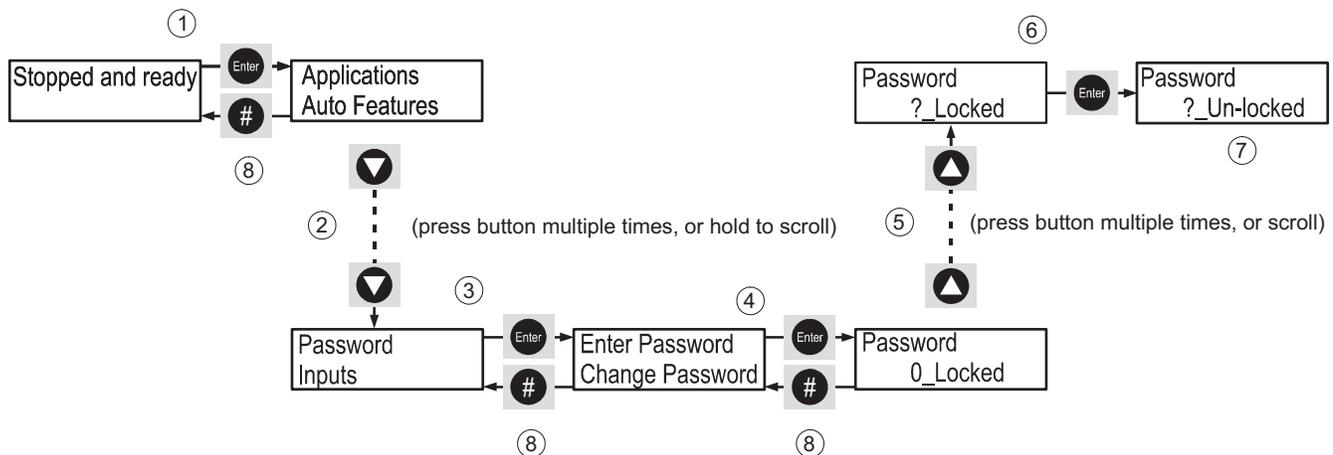


A.1.10a – Unlocking and Locking the Keypad

1. With 'Stopped and ready' displayed, press the ENTER button once.
2. With 'Applications' shown on the top line of the display, press the ▼ button until 'Password' takes its place on the top line.
3. Press ENTER once to select the 'Password' menu.
4. Press ENTER with 'Enter Password' shown on the top line of the display. The unit will display its security status, 'Locked' on the bottom line of the display. A cursor will also be visible on the bottom line of the display.
5. Use the ▲ or ▼ button to enter the password.
6. Press the ENTER button once.
7. If the correct password has been entered, the unit will display its security status, 'Unlocked' on the bottom line of the display. To lock the unit again, simply use the ▲ or ▼ buttons to enter any value, apart from zero (0), and the password. Press the ENTER button once and the display will now say that it is 'Locked'.
8. Press the # button three times to return to 'Stopped and ready'.



If the control supply on an un-locked unit (i.e., the password has been set previously and then entered to unlock the unit) is cycled, upon reboot the unit will be in a locked state. Conversely, if the password has never been "Changed" from zero, cycling power will unlock the SR44.



A.1.10b – Clearing the Password

1. Press the ▲ and ▼ buttons simultaneously to reset the password.
2. Once the display has flashed, press and hold the ▼ button until '# to reset' is displayed.
Do NOT press '# to reset'.
3. Press the ▲ button once.
4. Press the ▼ button once.
5. Press ENTER.
6. Display shows 'BingoØ?'.
7. Press ENTER.
8. Display will show 'Comms Failure'.
9. Cycle power to the SR44, and all parameters will be reset to factory defaults.

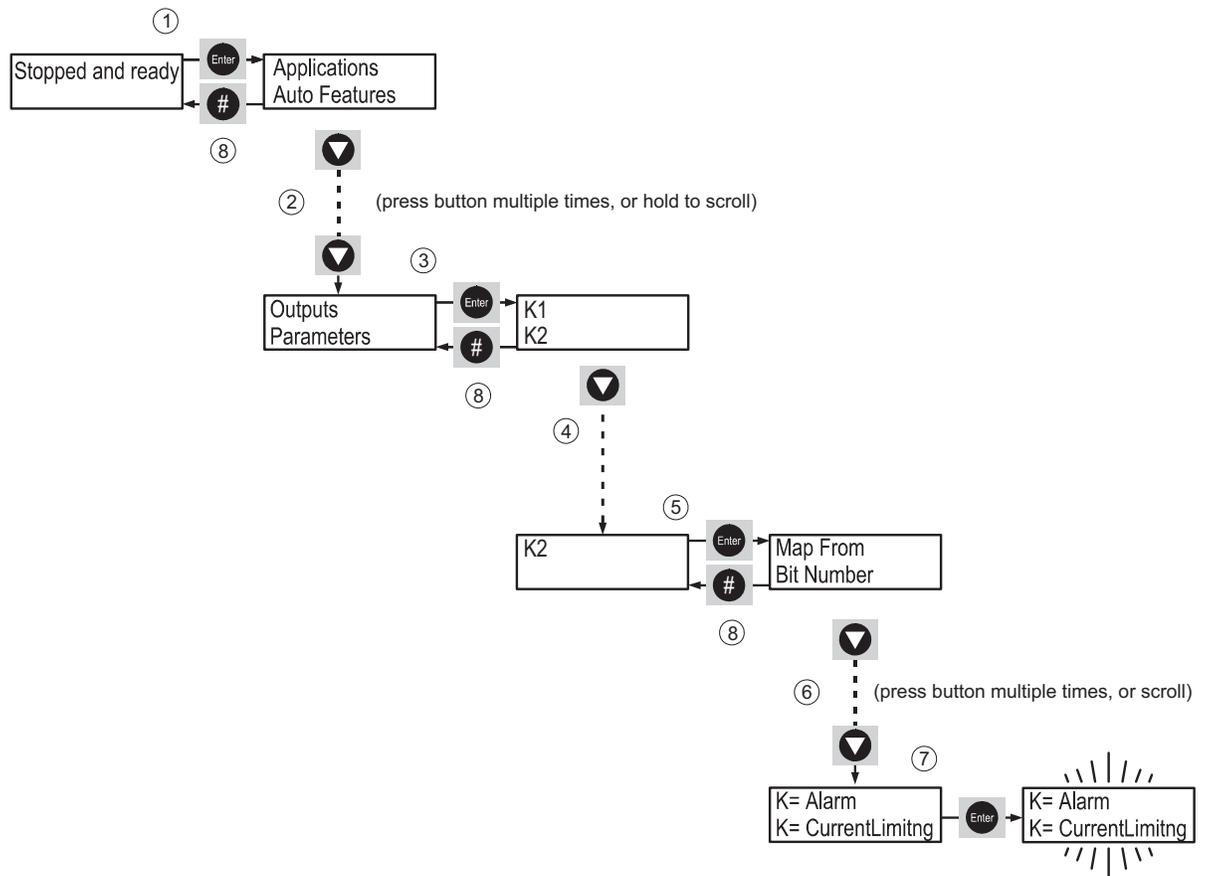
A.1.11 – Using the Pre-programmed Relay Options

This example shows the user how to program any relay on the unit via the pre-programmed options. The option shown in the example below is the 'Alarm', but the instructions apply to all of the pre-programmed relay options (see section 5.4.10), and for all of the relays since they are all programmable.

1. With 'Stopped and ready' shown on the display, press the ENTER button.
2. With 'Applications' shown on the top line of the display, press the ▼ button until 'Outputs' is shown at the top of the display.
3. Press ENTER to select the 'Outputs' menu.
4. With 'K1' on the top line of the display, press the ▼ button until 'K2' is shown at the top of the display.
5. Press ENTER to select 'K2'.
6. With 'Map From' on the top line of the display, press the ▼ button until 'K=Alarm' is shown on the top line of the display.
7. Press ENTER to select 'K=Alarm'. The display will flash twice to confirm the user's selection.
8. Press the # button three (3) times to return to 'Stopped and ready'.



To keep the above settings, they must be permanently saved. See section A.1.5

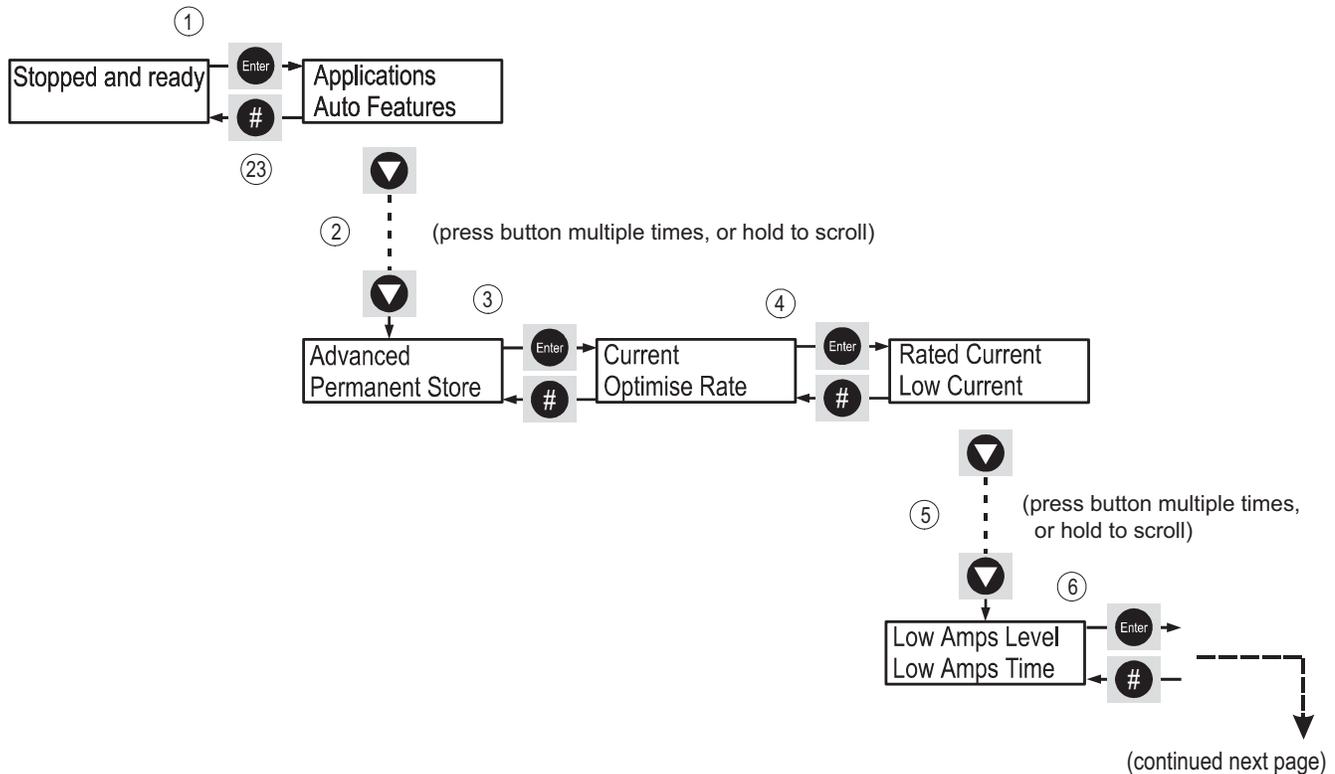


A.1.12 – Setting the Low Amps Level and Using the K2 Relay to Display the Status of Low Current Bit

This example shows the user how to set the Low Amps Level, and how to monitor the status of the Low Current bit via the K2 relay (see section 5.4.5).

1. With 'Stopped and ready' shown on the display, press the ENTER button.
2. With 'Applications' shown on the top line of the display, press the ▼ button until 'Advanced' is shown on the top line.
3. Press the ENTER button to select the 'Advanced' menu.
4. With 'Current' on the top line of the display, press ENTER to select the 'Current' menu.
5. With 'Rated Current' on the top line of the display, press the ▼ button until 'Low Amps Level' is shown on the top line.
6. With 'Low Amps Level' on the top line of the display, press ENTER.

(continued next page)



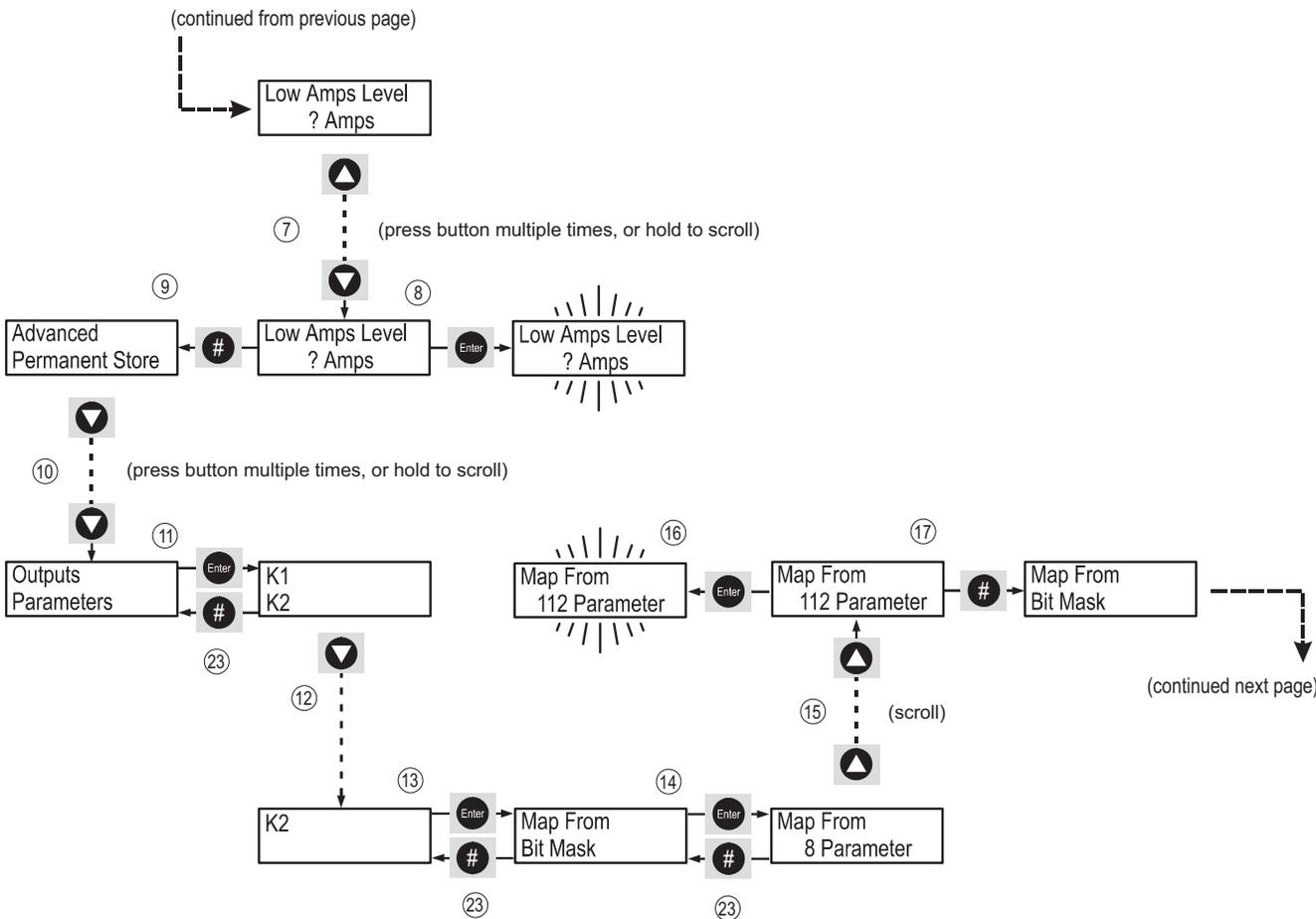
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A.1.12 – Setting the Low Amps Level and Using the K2 Relay to Display the Status of Low Current Bit (continued)

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7. With 'Low Amps Level' showing on the top line, press the ▲ or ▼ buttons until the required level is set.
8. Press ENTER to confirm the change. The display will flash to confirm that the change has been made.
9. Press the # button twice to return to the 'Advanced' menu.
10. With 'Advanced' on the top line of the display, press the ▼ button until 'Outputs' is displayed on the top line.
11. Press the ENTER button to select 'Outputs'.
12. Press the ▼ button until 'K2' is shown on the top line of the display.
13. Press the ENTER button to select 'K2'.
14. With 'Map From' on the top line of the display, press ENTER.
15. With '8 Parameter' showing, press the ▲ button until '112 Parameter' is displayed.
16. Press the ENTER button to confirm the change, and the display will flash once.
17. Press the # button once to return to 'Map From'.

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A.1.12 – Setting the Low Amps Level and Using the K2 Relay to Display the Status of Low Current Bit (continued)

(continued from previous page)

18. With 'Map From' on the top line of the display, press the ▼ button.
19. Press the ENTER button to select 'Bit Number'.
20. Press the 'Optimise' button to move the cursor to bit 3.
21. Press the ▲ button to change the bit state to one (1). (This may not be necessary; bit 3 may already be a one).



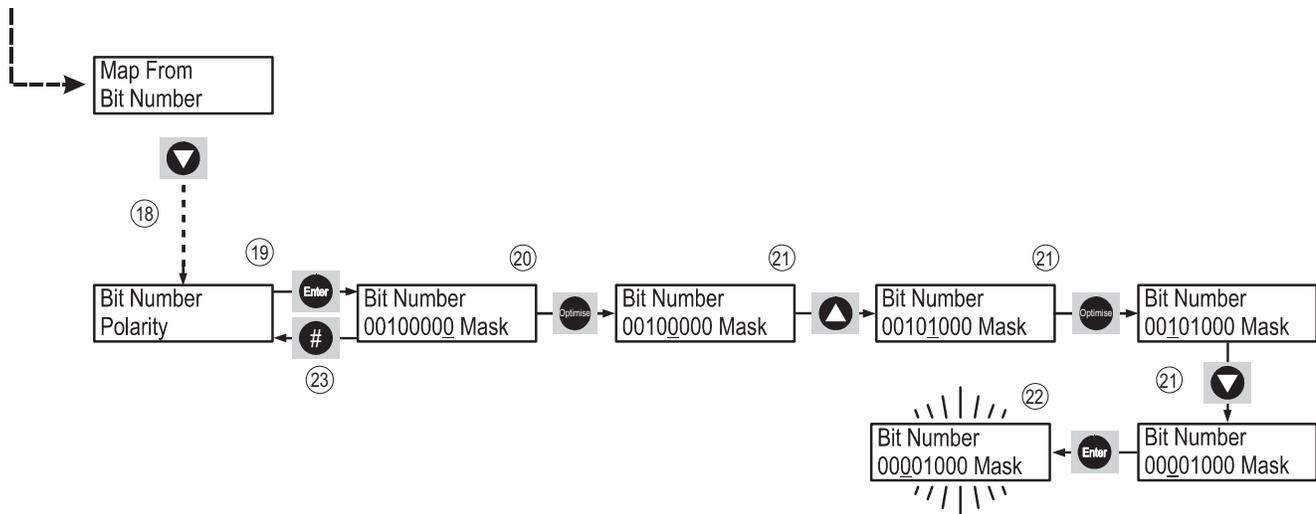
Only one bit in any relay bit mask may be set to a positive bit state (set to one (1)), at any one time. To turn off any other bits, simply use the 'Optimise' button to navigate to the required bit, and press the ▼ button to change its bit state to zero (0).

22. Press the Enter button to confirm any changes, the display will flash.
23. Press the # button four times to return to Stopped and ready.



To keep the above settings, they must be permanently saved. See section A.1.5

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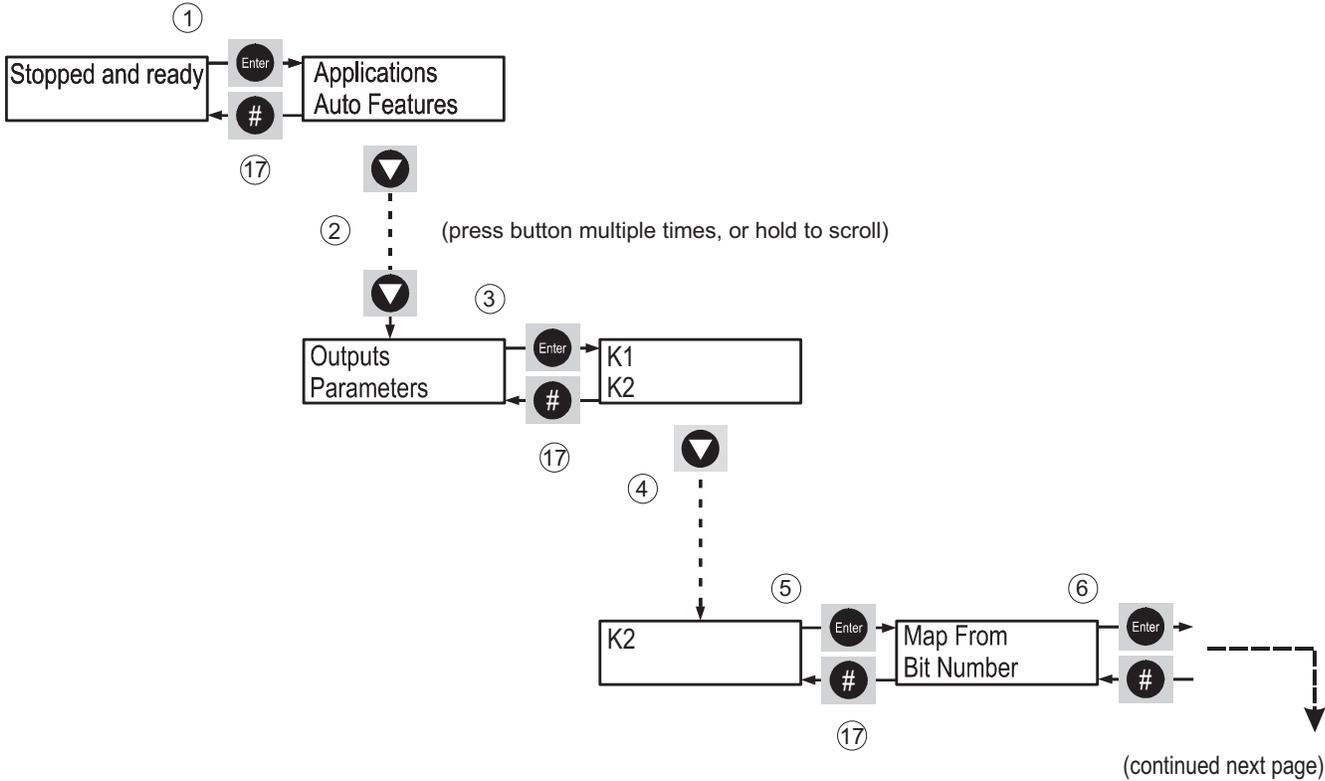


A.1.13 – Using the K2 Relay to Mimic Programmable Input 1

This example shows the user how to energize a relay via the start signal.

- 1. With 'Stopped and Ready' shown on the display, press the ENTER button.
- 2. With 'Applications' shown on the top line of the display, press the ▼ button until 'Outputs' is shown at the top of the display.
- 3. Press ENTER to select the 'Outputs' menu.
- 4. With 'K1' on the top line of the display, press the ▼ button until 'K2' is shown at the top of the display.
- 5. Press the ENTER button to select 'K2'.
- 6. With 'Map From' on the top line of the display, press ENTER.

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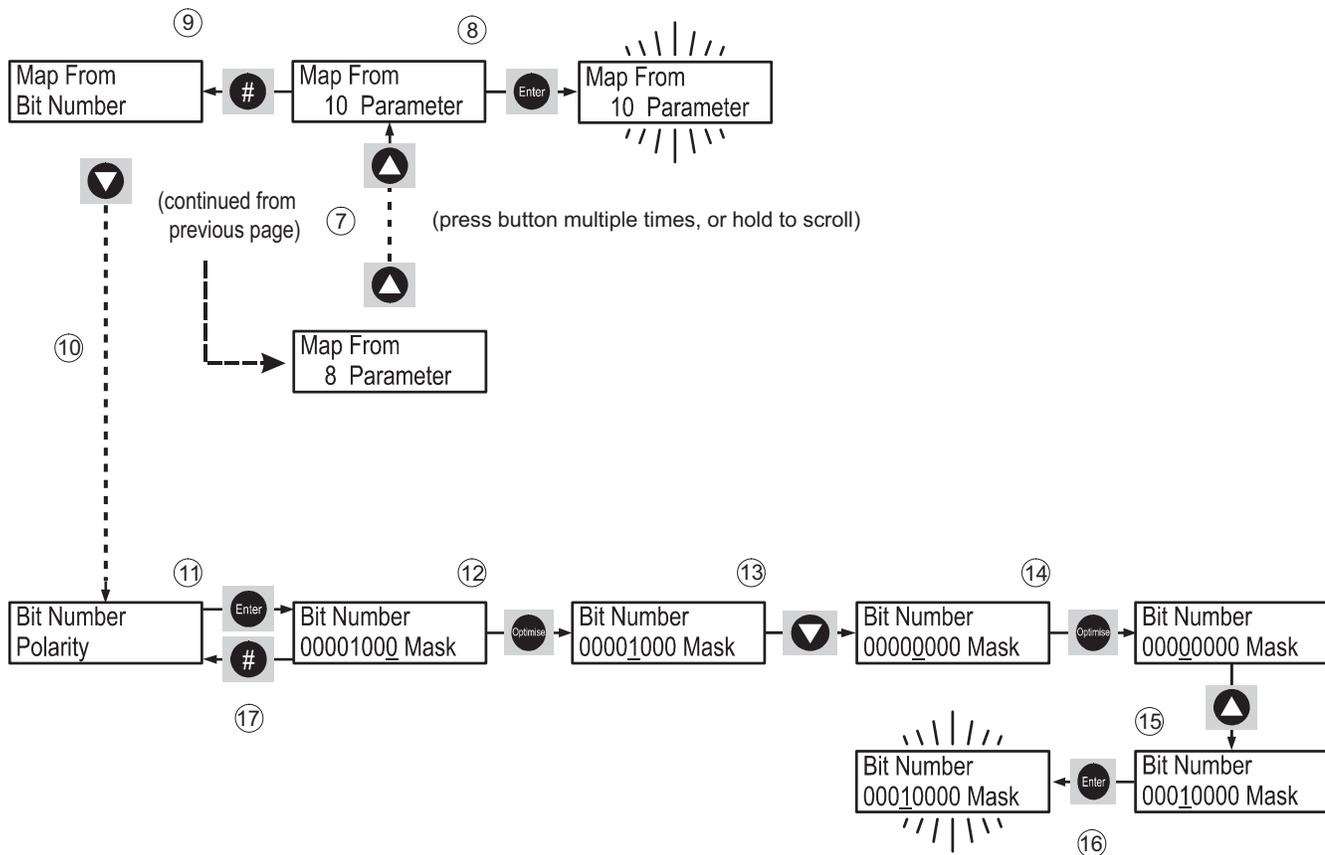
A.1.13 – Using the K2 Relay to Mimic Programmable Input 1 (continued)

(continued from previous page)

7. With '8 Parameter' showing, press the ▲ button until '10 Parameter' is displayed.
8. Press ENTER to apply the change.
9. Press # once to return to 'Map From'.
10. With 'Map From' on the top line of the display, press ▼ button until 'Bit Number' is displayed.
11. Press ENTER to select 'Bit Number'.
12. Press the 'Optimise' button three times so the cursor is displayed on bit 3.
13. Press the ▼ button to change the bit state to zero (0).
14. Press the 'Optimise' button once so the cursor is displayed on bit 4.
15. Press the ▲ button once to change the bit state to one (1).
16. Press ENTER once to accept the change.
17. Press # four times to return to 'Stopped and Ready'.



To keep the above settings, they must be permanently saved. See section A.1.5



A.2 – Advanced Setup Examples

A.2.1 – Using an Alternative Parameter Group

For applications that require the control of two motors, or where the user requires different control characteristics for a single motor at different stages of the duty cycle, the SR44 Soft Starter offers two parameter groups. The Primary parameter group holds the parameters considered necessary for motor starting and stopping, and it is this group to which the starter defaults. The Secondary parameter group is a mirror of the parameters in the first parameter group, but NOT necessarily a mirror of the values in the first parameter group. The parameters in each group are shown in Table A.2.1.

Parameter	Primary Group	Secondary Group
Protection Mode	P7	P78
Start Pedestal	P11	P79
Start Time	P12	P80
Kick Pedestal	P13	P81
Kick Time	P14	P82
Dwell Time	P15	P83
Stop Pedestal	P16	P84
Stop Time	P17	P85
Auto Config	P18	P86
Low Current Level	P28	P87
Low Current Time	P29	P88
Current Limit Level	P30	P89
Current Limit Time	P31	P90
Shearpin Level	P32	P91
Shearpin Time	P33	P92
Overload Level	P34	P93
Overload Delay	P35	P94
User Flags 1	P51	P95
User Flags 2	P52	P96

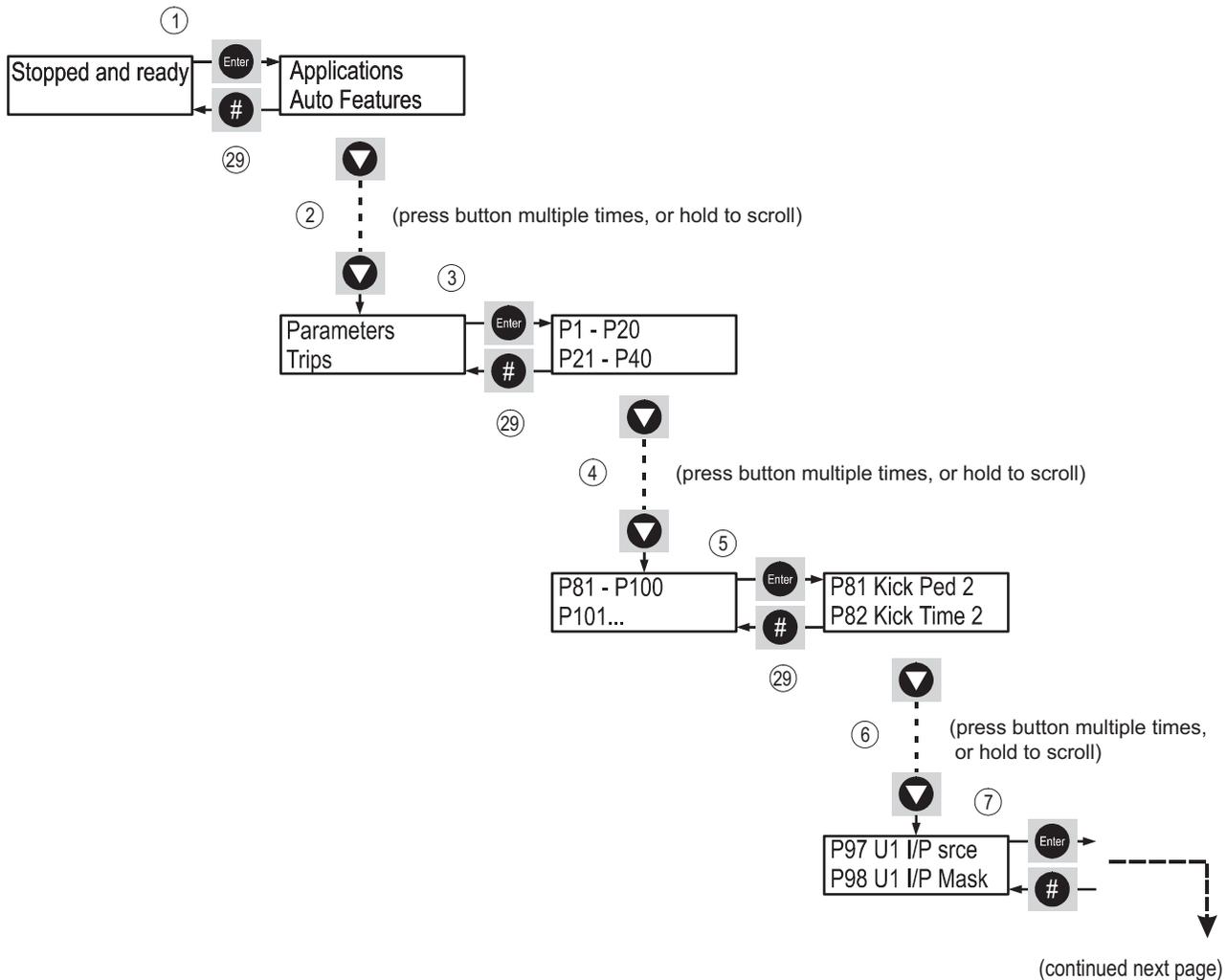
The Primary group parameters can also be changed via the menu structure. However, the Secondary group parameters can only be changed via the dedicated parameter numbers. As a default, the Soft Starter uses the Primary group of parameters. The user can select either group from the keypad or by using one of the programmable control inputs.

A.2.2 – Changing the Parameter Group After the Unit Has Passed Top of Ramp

In this example the user is shown how to change parameter groups while running. This could be useful, for example, if two overload values were required; one for starting and the other for running.

1. With 'Stopped and ready' shown on the display, press the ENTER button once.
2. With 'Applications' shown on the top line of the display, press the ▼ button until 'Parameters' is shown at the top of the display.
3. Press ENTER once to select the 'Parameters' menu.
4. With 'P1 - P20' shown on the display, press the ▼ button until 'P81 - P100' is shown at the top of the display.
5. Press ENTER to select 'P81 - P100'.
6. With 'P81 Kick Ped 2' at the top of the display, press the ▼ button until 'P97 U1 I/P srce' is shown on the top line of the display.
7. Press ENTER to select 'P97 U1 I/P srce'.

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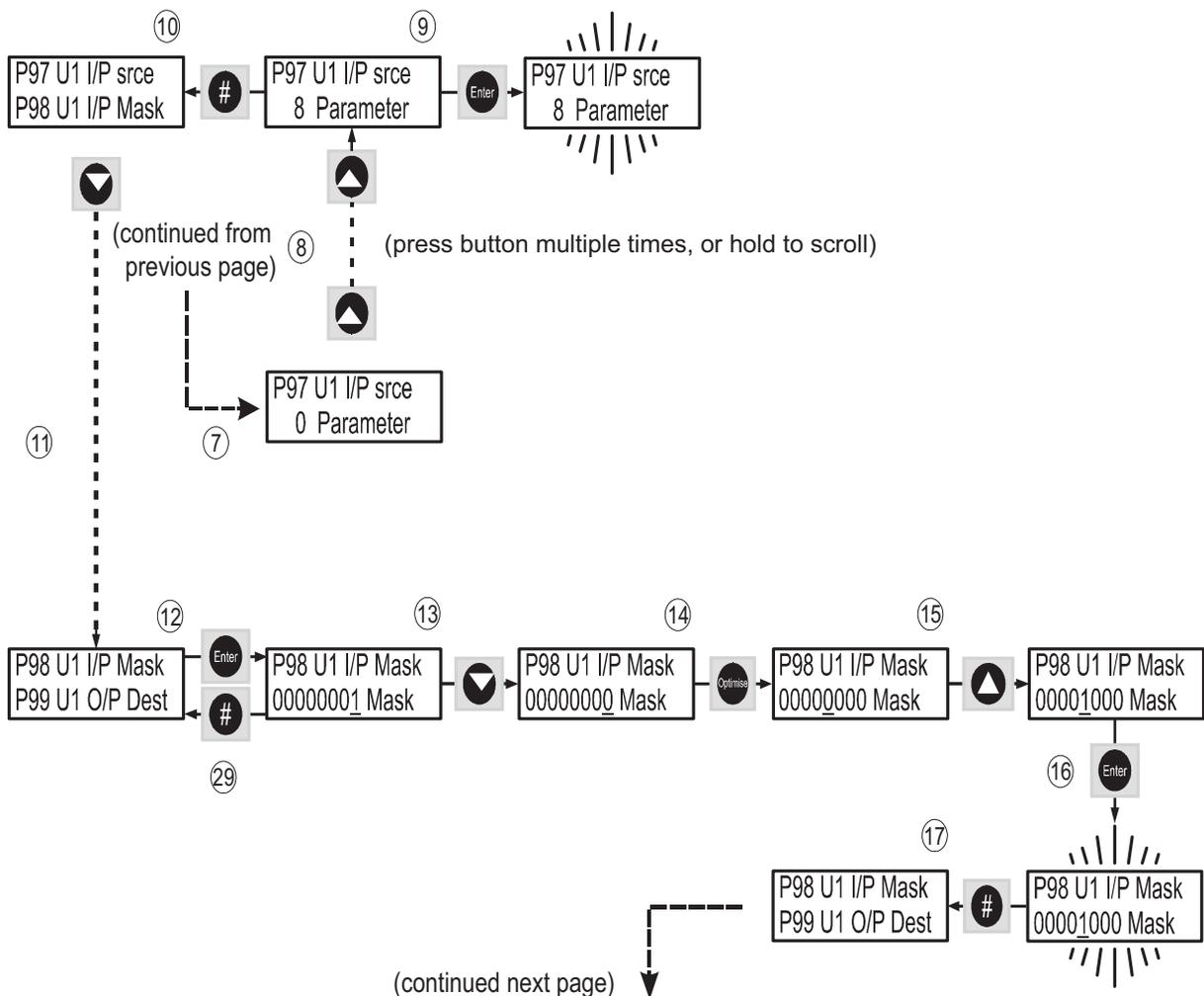


A.2.2 – Changing the Parameter Group After the Unit Has Passed Top of Ramp (continued)

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8. With '0 Parameter' shown on the display, press the ▲ button until '8 Parameter' is displayed.
9. Press ENTER once to accept the change.
10. Press # once to return to 'P97 U1 I/P srce'.
11. Press the ▼ button once until 'P98 U1 I/P Mask' is shown at the top of the display.
12. Press ENTER to select 'P98 U1 I/P Mask'.
13. Press the ▼ button once to change the bit state of bit 0 to zero (0).
14. Press the OPTIMISE button three times so that the cursor is displayed on bit 3.
15. Press the ▲ button once to change the bit state of bit 3 to one (1).
16. Press ENTER once to confirm the changes.
17. Press # once to return to 'P98 U1 I/P Mask'.

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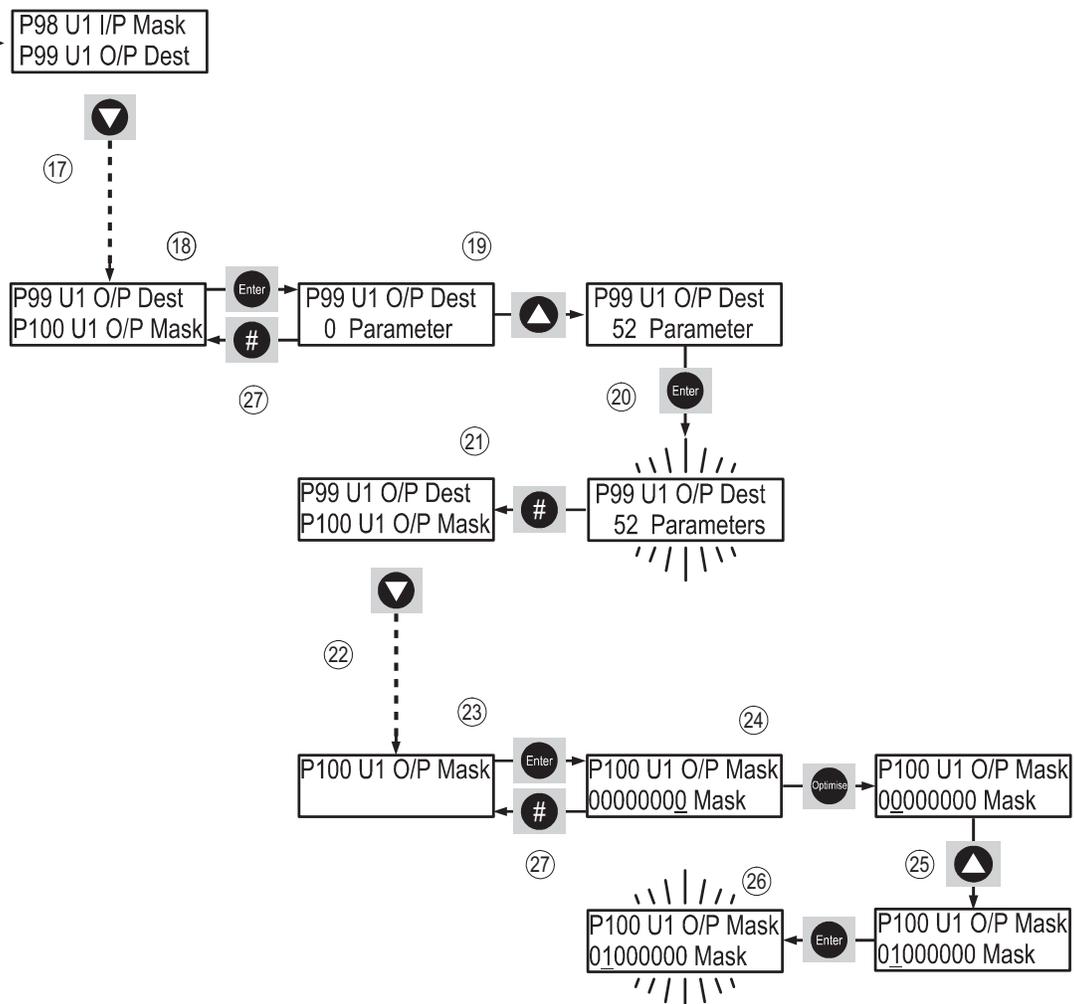
A.2.2 – Changing the Parameter Group After the Unit Has Passed Top of Ramp (continued)

17. Press the ▼ button once so that 'P99 U1 O/P Dest' is shown at the top of the display.
18. Press ENTER to select 'P99 U1 O/P Dest'.
19. With '0 Parameter' shown on the display, press the ▲ button until '52 Parameter is displayed'.
20. Press ENTER once to accept the change.
21. Press # once to return to 'P99 U1 O/P Dest'.
22. Press ▼ once until 'P100 U1 O/P Mask' is shown at the top of the display.
23. Press ENTER to select 'P100 U1 O/P Mask'.
24. Press the OPTIMISE button six times so that the cursor is displayed on bit 6.
25. Press the ▲ button once to change the bit state of bit 6 to one (1).
26. Press ENTER once to accept the change.
27. Press # four times to return to 'Stopped and Ready'.



To keep the above settings, they must be permanently saved. See section A.1.5

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A.2.3 – (Reserved for Future Use)

A.2.4 – Selecting Optimizing with Programmable Input 1

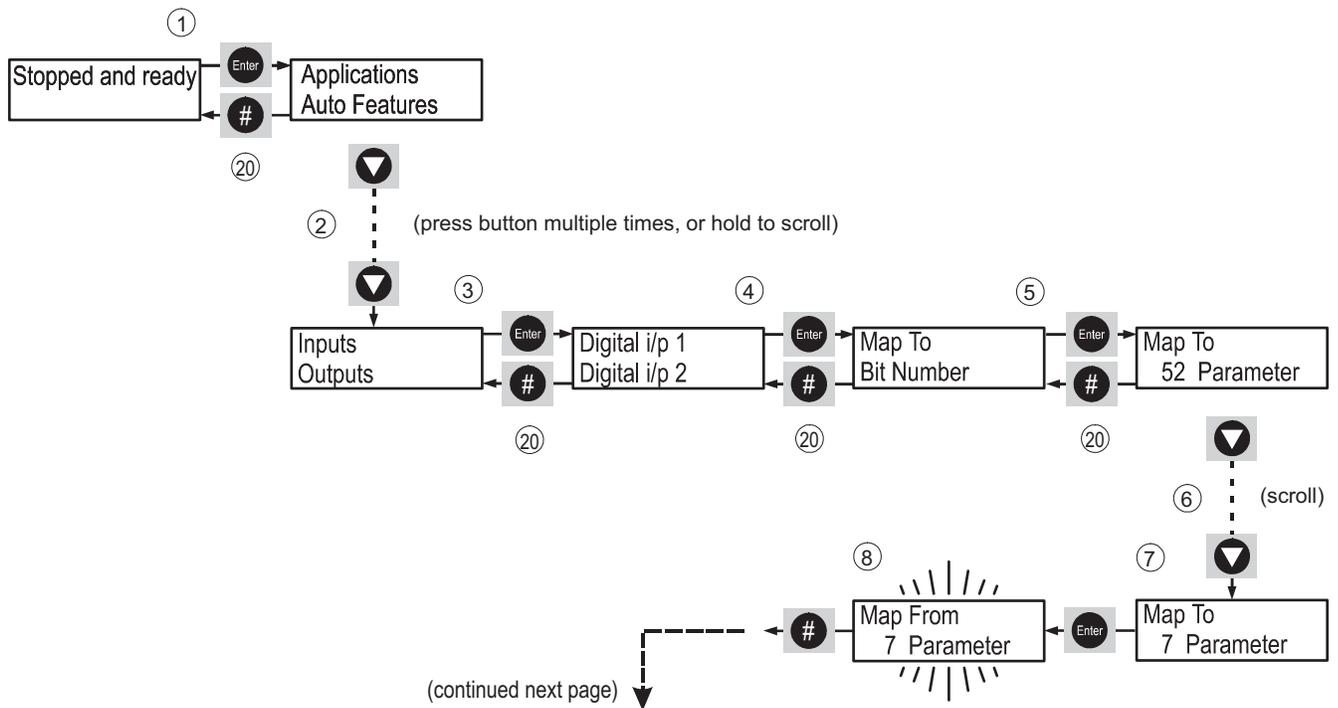
This example programs the S1 input to turn the Optimizing function Off and On. When the specified voltage is applied to and removed from the S1 input, the energy optimizing function is turned Off and On (note the inverse action).



*If input S1 is assigned to toggle the Optimizing function, it toggles with inverse action.
Voltage applied to S1 = Optimizing Off; No voltage at S1 = Optimizing On.*

1. With 'Stopped and Ready' shown on the display, press ENTER button once.
2. With 'Applications' shown on the top line of the display, press ▼ button until 'Inputs' is shown at the top of the display.
3. Press ENTER once to select the 'Inputs' menu.
4. With 'Digital i/p 1' on the top line of the display, press ENTER once.
5. With 'Map To' on the top line of the display, press ENTER once.
6. With '52 Parameter' showing, press the ▼ button until '7 Parameter' is displayed.
7. Press ENTER once to accept the change.
8. Press # once to return to 'Map To'.

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A.2.4 – Selecting Optimizing with Programmable Input 1 (continued)

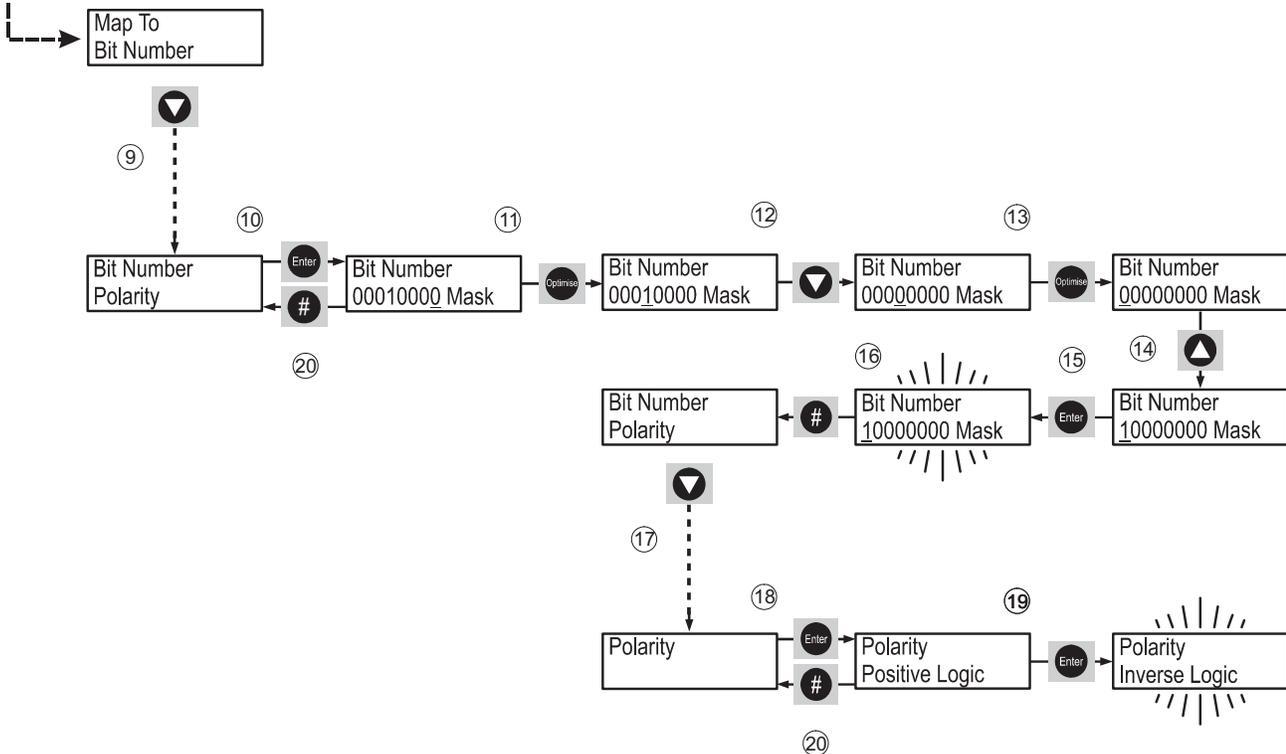
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9. With 'Map To' on the top line of the display, press the ▼ button once until 'Bit Number' is displayed.
10. Press ENTER once to select 'Bit Number'.
11. Press the OPTIMISE button four times so that the cursor moves to bit 4.
12. Press the ▼ button once to change the bit state of bit 4 to zero (0).
13. Press the OPTIMISE button three times so the cursor moves to bit 7.
14. Press the ▲ button once to change the bit state of bit 7 to one (1).
15. Press ENTER once to accept the change. The display will flash once to confirm that the change has been accepted.
16. Press # once to return to 'Bit Number'.
17. With 'Positive Logic' displayed, press the ▼ button until 'Polarity' is displayed on the top line.
18. Press ENTER once to select 'Polarity'.
19. With 'Positive Logic' displayed, press ENTER once to change to 'Inverse Logic'. The display will flash once to confirm that the change has been accepted.
20. Press # four times to return to 'Stopped and ready'.



To keep the above settings, they must be permanently saved. See section A.1.5

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APPLICATIONS DATA



Contents of this Appendix...

SR44 Applications DataB-2

SR44 Applications Data

The 'Application' tables show the specific individual settings that are configured by the SR44 'Applications' menu 'Level 2' settings.

Application Type	Default (Keypad)		
Start Pedestal (%)	20	Stop Pedestal (%)	10
Start Time (s)	5	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	30
Optimize Rate	5	Auto Pedestal	<input type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Default Auto		
Start Pedestal (%)	10	Stop Pedestal (%)	10
Start Time (s)	10	Soft-Stop Time (s)	10
Current Limit Level (x FLC)	5	Current Limit Time (s)	10
Optimize Rate	0	Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input type="checkbox"/>
Soft-Stop Smoothing	<input checked="" type="checkbox"/>	Low Voltage Soft-Stop	<input checked="" type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Stop	<input checked="" type="checkbox"/>
		Auto Ramp	<input checked="" type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Small Pump		
Start Pedestal (%)	10	Stop Pedestal (%)	10
Start Time (s)	5	Soft-Stop Time (s)	30
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	25
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input checked="" type="checkbox"/>	Low Voltage Soft-Stop	<input checked="" type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Stop	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto End Stop	<input checked="" type="checkbox"/>
Notes:			

Application Type	Large Pump		
Start Pedestal (%)	10	Stop Pedestal (%)	10
Start Time (s)	7	Soft-Stop Time (s)	45
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	25
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input checked="" type="checkbox"/>	Low Voltage Soft-Stop	<input checked="" type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Stop	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto End Stop	<input checked="" type="checkbox"/>
Notes:			

SR44 Applications Data (continued)

Application Type	Conveyor		
Start Pedestal (%)	10	Stop Pedestal (%)	0
Start Time (s)	10	Soft-Stop Time (s)	7
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	30
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input checked="" type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input checked="" type="checkbox"/>
		Auto End Stop	<input checked="" type="checkbox"/>
Notes:			

Application Type	Low Inertia Fan		
Start Pedestal (%)	30	Stop Pedestal (%)	0
Start Time (s)	15	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	30
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input checked="" type="checkbox"/>	Low Voltage Soft-Stop	<input checked="" type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	High Inertia Fan		
Start Pedestal (%)	40	Stop Pedestal (%)	0
Start Time (s)	3	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	2.8125	Current Limit Time (s)	60
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input checked="" type="checkbox"/>	Low Voltage Soft-Stop	<input checked="" type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Reciprocating Compressor		
Start Pedestal (%)	45	Stop Pedestal (%)	0
Start Time (s)	3	Soft-Stop Time (s)	-
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	25
Optimize Rate	15	Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

SR44 Applications Data (continued)

Application Type	Screw Compressor		
Start Pedestal (%)	40	Stop Pedestal (%)	0
Start Time (s)	7	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	7.185	Current Limit Time (s)	25
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Rotary Compressor		
Start Pedestal (%)	35	Stop Pedestal (%)	0
Start Time (s)	7	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	3.5	Current Limit Time (s)	25
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Crusher		
Start Pedestal (%)	40	Stop Pedestal (%)	0
Start Time (s)	3	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	2.8125	Current Limit Time (s)	60
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing		Low Voltage Soft-Stop	
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Grinder		
Start Pedestal (%)	40	Stop Pedestal (%)	0
Start Time (s)	3	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	2.8125	Current Limit Time (s)	60
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

SR44 Applications Data (continued)

Application Type	High Torque Start		
Start Pedestal (%)	60	Stop Pedestal (%)	0
Start Time (s)	3	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	4.375	Current Limit Time (s)	12
Optimize Rate		Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input checked="" type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Motor/Generator Set		
Start Pedestal (%)	40	Stop Pedestal (%)	0
Start Time (s)	5	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	2.8125	Current Limit Time (s)	25
Optimize Rate	0	Auto Pedestal	<input type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Aerator		
Start Pedestal (%)	10	Stop Pedestal (%)	10
Start Time (s)	60	Soft-Stop Time (s)	60
Current Limit Level (x FLC)	3	Current Limit Time (s)	60
Optimize Rate	5	Auto Pedestal	<input type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input checked="" type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input checked="" type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Flywheel / Press		
Start Pedestal (%)	40	Stop Pedestal (%)	10
Start Time (s)	3	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	3	Current Limit Time (s)	60
Optimize Rate	5	Auto Pedestal	<input checked="" type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
Notes:			

Application Type	Molder		
Start Pedestal (%)	10	Stop Pedestal (%)	10
Start Time (s)	10	Soft-Stop Time (s)	0
Current Limit Level (x FLC)	3	Current Limit Time (s)	30
Optimize Rate	5	Auto Pedestal	<input type="checkbox"/>
Auto End Start	<input type="checkbox"/>	Auto 3MC	<input checked="" type="checkbox"/>
Soft-Stop Smoothing	<input type="checkbox"/>	Low Voltage Soft-Stop	<input type="checkbox"/>
		Auto Bypass	<input checked="" type="checkbox"/>
		Auto Ramp	<input type="checkbox"/>
		Auto Jog	<input type="checkbox"/>
		Auto Stop	<input type="checkbox"/>
		Auto End Stop	<input type="checkbox"/>
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TECHNICAL HINTS



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Technical Hints

Category: General

No: 1	Subject: Motor Configuration
If the motor starts OK but stalls as soon as a load is applied, then check the configuration of the motor, i.e., it may be that the motor is meant to be connected in delta but is actually connected in star (wye).	
No: 2	Subject: Kick Start
Kick start is not always suitable for use with rolling starts or very light loads.	
No: 3	Subject: Slip-Ring Motors 1
When sizing a single stage of resistors for use with a Soft-Starter, care must be taken to balance the standstill torque requirements against large slips at full voltage.	
No: 4	Subject: Slip-Ring Motors 2
Slip rings may be shorted at partial voltage by forcing a user current limit at start, and then using the current limit timeout flag to control K2 and hence the shorting contactor.	
No: 5	Subject: Commissioning 1
It is a good idea to start by using one of the standard applications. (Refer to 'Applications' Menu Settings in Ch.5)	
No: 6	Subject: Sizing Starters
Starters may need to be de-rated for high start frequency, current, ambient temperature, altitude, or long starts.	
No: 7	Subject: Contactors
Contactors marked (for example K1) on wiring diagrams are not included within the Soft Starters.	
No: 8	Subject: Soft-Starts
Soft-Starters reduce motor starting current at the expense of reducing starting torque and increasing start time.	
No: 9	Subject: Start Time with "Auto Ramp"
When "Auto Ramp" is selected, the ramp time is an arbitrary number, with "1" being fastest up to "255" the slowest. The unit will be accelerated to full speed by the microprocessor with a varying ramp profile while trying to keep the start current to a minimum.	

Technical Hints (continued)

Category: Troubleshooting

No: 1	Subject: Reset Trip
Trips can be reset by pressing the '#' key on the keypad, or by changing the Start/Stop I/p to 'Start' if control is set to remote.	
No: 2	Subject: Load (1)
The Soft-Starter will trip (8) if a start is attempted with no motor connected on the output.	
No: 3	Subject: Intermittent "7 Sensing Signal" Trip
Normally caused by a noisy site. First try increasing the optimize rate; secondly increase trip sensitivity.	
No: 4	Subject: Stopped Cooling
This message is displayed during the cooling time (pnu116), and is the period allowed for the unit to cool before a restart.	
No: 5	Subject: Keypad Displays "2 Comms Failure"
Check that the unit has its original front cover and keypad.	
No: 6	Subject: No Current Display
If the motor current drops below 12.5% I_e while running in "Phase Loss only" or "Start & Bypass", then no value is displayed.	
No: 7	Subject: Cancelled 1
If trying to change from Keypad to Remote Starting with a start signal present, the display flashes "cancelled".	
No: 8	Subject: Commissioning 2
If the Soft-Start trips on overload during the start, check that the starter is large enough for the load.	
No: 9	Subject: "Too Hot"
Check ventilation into the cabinet. If the unit has worked for a long time, check fans and airflow through unit.	

Category: Wiring

No: 1	Subject: When Replacing Star-Delta (Wye-Delta) Starters
If you are planning to re-use the existing overload and contactor, ensure that they are sized for the full motor line current; not just for delta-phase current.	
No: 2	Subject: Running Inside the Delta 1
The unit must be set to Firing Mode 1. The current displayed is now the phase current (58% of the line current).	
No: 3	Subject: Running Inside the Delta 2
When running with Firing Mode 1, the maximum cable length between starter and motor is reduced to 50M.	
No: 4	Subject: Running Inside the Delta 3
An in-line contactor must be used when running in the Delta.	

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**USING
AUTOMATIONDIRECT
PLCs WITH
SR44 SOFT STARTERS**



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Compatibility Overview

- The SR44 control input accepts 12/24 VDC and 115/230 VAC.
- The SR44 relay outputs are rated for 230 VAC @ 3A, and 24 VDC @ 3A.

The inputs and outputs are compatible with PLC I/O as shown in the following tables.

CLICK PLC I/O Compatible with SR44 Soft Starters

CLICK PLCs Compatible with SR44 Soft Starters	
CLICK PLCs	
C0-00AR-D	PLC, 8 AC IN / 6 RELAY OUT MICRO PLC REQUIRES 24VDC POWER
C0-00DD1-D	PLC, 8 DC IN / 6 SINKING DC OUT MICRO PLC REQUIRES 24VDC POWER
C0-00DD2-D	PLC, 8 DC IN / 6 SOURCING DC OUT MICRO PLC REQUIRES 24VDC POWER
C0-00DR-D	PLC, 8 DC IN / 6 RELAY OUT MICRO PLC REQUIRES 24VDC POWER
C0-02DD1-D	MICRO ANLG PLC, 4 DC IN / 4 SINK OUT, 2-CH IN / 2-CH OUT, REQUIRES 24VDC PWR
C0-02DD2-D	MICRO ANLG PLC, 4 DC IN / 4 SOURCE OUT, 2-CH IN / 2-CH OUT, REQUIRES 24VDC PWR
C0-02DR-D	MICRO ANLG PLC, 4 DC IN / 4 RELAY OUT, 2-CH IN / 2-CH OUT, REQUIRES 24VDC PWR
CLICK AC I/O & Relay Outputs	
C0-04TRS	4PT 6-240VAC/6-27VDC ISOLATED RELAY OUTPUT SPDT 7A PER POINT
C0-08TA	8PT 17-240VAC OUTPUT MODULE 0.3AMPS PER POINT
C0-08TR	8PT 6-240VAC/6-27VDC RELAY OUTPUT 1A 2 ISOLATED COMMONS
CLICK DC I/O	
C0-08TD1	8PT 12-24VDC OUTPUT MODULE SINKING OUTPUTS
C0-08TD2	8PT 12-24VDC OUTPUT MODULE SOURCING OUTPUTS
C0-16TD1	16PT 12-24VDC OUTPUT MODULE SINKING OUTPUTS
C0-16TD2	16PT 12-24VDC OUTPUT MODULE SOURCING OUTPUTS

DL05/DL06 PLC I/O Compatible with SR44 Soft Starters

DL05/DL06 PLCs Compatible with SR44 Soft Starters	
DL05 PLCs	
D0-05AA	8 AC IN / 6 AC OUT MICRO PLC W/AC P/S
D0-05AD	8 AC IN / 6 DC OUT MICRO PLC W/AC P/S
D0-05AR	8 AC IN / 6 RELAY OUT MICRO PLC W/AC P/S
D0-05DD	8 DC IN / 6 DC OUT MICRO PLC W/AC P/S
D0-05DD-D	8 DC IN / 6 DC OUT MICRO PLC DC POWER SUPPLY
D0-05DR	8 DC IN / 6 RELAY OUT MICRO PLC W/AC P/S
D0-05DR-D	8 DC IN / 6 RELAY OUT MICRO PLC DC POWER SUPPLY
DL05/DL06 Discrete I/O	
D0-07CDR	COMBO 4 PT 12-24VDC INPUT 3 PT RELAY OUTPUT
D0-08CDD1	COMBO 4 PT 12-24VDC INPUT 4 PT 12-24VDC OUTPUT
D0-08TR	8PT RELAY OUTPUT 6-27VDC OR 6-240VAC
D0-10TD1	10PT 12-24VDC SINK OUTPUT
D0-10TD2	10PT 12-24VDC SOURCE OUTPUT
D0-16TD1	16PT 6-27 VDC SINK OUTPUT
D0-16TD2	10PT 12-24VDC SOURCE OUTPUT
F0-04TRS	4PT ISO RELAY OUTPUT 5-30VDC OR 5-125VAC
DL06 PLCs	
D0-06AA	DL06 20 AC IN / 16 AC OUT MICRO PLC W/AC P/S
D0-06AR	DL06 20 AC IN / 16 RELAY MICRO PLC W/AC P/S
D0-06DA	DL06 20 DC IN / 16 AC OUT MICRO PLC W/AC P/S
D0-06DD1	DL06 20 DC IN / 16 DC OUT MICRO PLC W/AC P/S
D0-06DD1-D	DL06 20 DC IN / 16 DC OUT MICRO PLC W/DC P/S
D0-06DD2	DL06 20 DC IN / 16 DC OUT MICRO PLC W/AC P/S
D0-06DD2-D	DL06 20 DC IN/16 DC OUT SRC MICRO PLC W/DC P/S
D0-06DR	DL06 20 DC IN / 16 RELAY MICRO PLC W/AC P/S
D0-06DR-D	DL06 20 DC IN / 16 RELAY MICRO PLC W/DC P/S

DL105 PLC I/O Compatible with SR44 Soft Starters

DL105 PLCs Compatible with SR44 Soft Starters	
DL105 PLCs	
F1-130AA	10 AC INPUT/8 AC OUTPUT 85-265VAC .5A 24VDC
F1-130AD	10 AC INPUT/8 DC OUTPUT 85-265VAC .5A 24VDC
F1-130AR	10 AC INPUT/8 RELAY OUTPUT
F1-130DA	10 DC INPUT/8 AC OUTPUT 85-265VAC .5A 24VDC
F1-130DD	10 DC INPUT/8 DC OUTPUT 85-265VAC .5A 24VDC
F1-130DD-D	10 DC INPUT/8 DC OUTPUT 10-30VDC P/S
F1-130DR	10 DC INPUT/8 RELAY OUTPUT 85-265VAC .5A 24VDC
F1-130DR-D	10 DC INPUT/8 RELAY OUTPUT 10-30VDC P/S

DL205 PLC I/O Compatible with SR44 Soft Starters

DL205 PLCs Compatible with SR44 Soft Starters	
DL205 AC I/O	
D2-08TA	8PT 18-220VAC OUTPUT
D2-12TA	12PT 18-110VAC OUTPUT
F2-08TA	8PT 24-140VAC OUTPUT HIGH CURRENT 1.5A/PT
DL205 DC I/O	
D2-04TD1	4PT 12-24VDC SINK OUTPUT
D2-08TD1	8PT 12-24VDC SINK OUTPUT
D2-08TD2	8PT 12-24VDC SOURCE OUTPUT
D2-16TD1-2	16PT 12-24VDC SINK (2TERM) 0.1A/PT 1.6A/MODULE
D2-16TD2-2	16PT 12-24VDC SOURCE(2TERM) 0.1A/PT 1.6A/MODULE
D2-32TD1	32PT 24V DC OUTPUT MODULE
D2-32TD2	32PT 24V DC SOURCING OUTPUT
F2-16TD1P	16 PT 12-24VDC SINKING OUTPUT ELECTRONIC SHORT CIRCUIT PROTECTED
F2-16TD2P	16 PT 12-24VDC SOURCING OUTPUT ELECTRONIC SHORT CIRCUIT PROTECTED
DL205 AC/DC I/O (Relay Outputs)	
D2-04TRS	4PT ISOLATED RELAY OUTPUT 5-30VDC OR 5-250VAC
D2-08CDR	COMBO 4 PT 24VDC INPUT AND 4 PT RELAY OUTPUT
D2-08TR	8PT RELAY OUTPUT 5-30VDC OR 5-240VAC
D2-12TR	12PT RELAY OUTPUT 5-30VDC OR 5-250VAC
F2-08TR	8PT RELAY OUT 10A/COMMON 12-28VDC / 12-250VAC
F2-08TRS	8PT RELAY OUTPUT 12-28VDC OR 12-250VAC

DL305 PLC I/O Compatible with SR44 Soft Starters

DL305 PLCs Compatible with SR44 Soft Starters	
DL305 AC I/O	
D3-04TAS	4PT 110/220VAC ISOLATED OUTPUT
D3-08TA-1	8PT 110/220VAC OUTPUT REMOVABLE TERM BLK
D3-08TA-2	8PT 110/220VAC OUTPUT NON-REMOVABLE BLOCK
D3-16TA-2	16PT 15-220VAC OUTPUT
F3-08TAS-1	8PT 20-125VAC ISOLATED OUTPUT 1.5A/POINT, 8 COMMONS (ISOLATED)
F3-16TA-2	16PT 20-125VAC OUTPUT MODULE 1.1A
DL305 DC I/O	
D3-04TD1	4PT 5-24VDC SINK OUTPUT
D3-08TD1	8PT 5-24VDC SINK OUTPUT
D3-08TD2	8PT 5-24VDC SOURCE OUTPUT
D3-16TD1-1	16PT 5-24VDC SINK OUTPUT
D3-16TD2	16PT 5-24VDC SOURCE OUTPUT
DL305 AC/DC I/O (Relay Outputs)	
D3-08NE3	8PT 24VAC/VDC SINK SOURCE INPUT
D3-08TR	8PT 5-30VDC OR 5-220VAC RELAY OUTPUT
D3-16NE3	16PT 24VAC/VDC SINK SOURCE INPUT
D3-16TR	16PT RELAY 5-30VDC OR 5-220VAC OUTPUT
F3-08TRS-1	8PT RELAY 12-30VDC OR 12-220VAC OUTPUT
F3-08TRS-2	8PT RELAY 12-30VDC OR 12-220VAC OUTPUT
F3-08TRS-5	8PT RELAY 12-30VDC OR 12-220VAC OUTPUT

DL405 PLC I/O Compatible with SR44 Soft Starters

DL405 PLCs Compatible with SR44 Soft Starters	
DL405 AC I/O	
D4-08TA	8PT 18-220VAC OUTPUT
D4-16TA	16PT 18-220VAC OUTPUT
DL405 DC I/O	
D4-08TD1	8PT 12-24VDC SINK OUTPUT
D4-16TD1	16PT 5-24VDC SINK OUTPUT
D4-16TD2	16PT 12-24VDC SOURCE OUTPUT
D4-32TD1	32PT 5-24VDC SINK OUTPUT
D4-32TD1-1	32PT 5-15VDC SINK OUTPUT
D4-32TD2	32PT 5-15VDC SINK OUTPUT
D4-64TD1	64PT 5-24VDC SINK OUTPUT
F4-08TD1S	8PT 24-150VDC SINK SOURCE ISOLATED OUTPUT
DL405 AC/DC I/O (Relay Outputs)	
D4-08TR	8PT RELAY 5-30VDC OR 5-250VAC OUTPUT
D4-16TR	16PT RELAY 5-30VDC OR 5-250VAC OUTPUT
F4-08TRS-1	8PT RELAY 12-30VDC OR 12-250VAC OUTPUT
F4-08TRS-2	8PT RELAY 12-30VDC OR 12-250VAC OUTPUT

P3000 PLC I/O Compatible with SR44 Soft Starters

P3000 PLCs Compatible with SR44 Soft Starters	
P3000 DC I/O	
P3-08TD1S	8PT ISOLATED SINKING OUTPUT, 6-27VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-08TD2S	8PT ISOLATED SOURCE OUTPUT, 6-27VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-16TD1	16PT SINKING OUTPUT, 6-27VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-16TD2	16PT SOURCING OUTPUT, 6-27VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-32TD1	32PT SINKING OUTPUT, 12-24VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-32TD2	32PT SOURCE OUTPUT, 20-30VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-64TD1	64PT SINKING OUTPUT, 6-27VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3-64TD2	64PT SOURCE OUTPUT, 20-30VDC, PRODUCTIVITY3000 DC OUTPUT MODULE
P3000 AC/DC I/O (Relay Outputs)	
P3-08TAS	8PT ISOLATED OUTPUT, 80-288VAC, PRODUCTIVITY3000 AC OUTPUT MODULE
P3-08TRS	8PT ISOLATED RELAY (8 FORM A), PRODUCTIVITY3000 RELAY OUTPUT MODULE
P3-08TRS-1	8CH, ISOLATED, 5A RELAY, OUTPUT MODULE PRODUCTIVITY 3000 RELAY OUTPUT MODULE
P3-16TA	16PT OUTPUT, 80-288VAC, PRODUCTIVITY3000 AC OUTPUT MODULE
P3-16TR	16PT OUTPUT RELAY (16 FORM A), PRODUCTIVITY3000 RELAY OUTPUT MODULE

Terminator I/O Compatible with SR44 Soft Starters

Terminator I/O Compatible with SR44 Soft Starters	
Terminator I/O Discrete Output Modules	
T1H-08TDS	8PT 12-24VDC ISOLATED OUTPUT SINK/SOURCE 8 CMNS
T1K-08TA	16PT 17-240VAC OUTPUT
T1K-08TAS	8PT 17-240VAC OUTPUT ISOLATED COMMONS
T1K-08TD1	8PT 12-24VDC SINK OUTPUT
T1K-08TD2-1	16PT-12-24VDC SOURCE OUTPUT
T1K-08TR	8PT RELAY OUTPUT 5-30VDC OR 5-240VAC
T1K-08TRS	8PT ISO RELAY OUTPUT 5-30VDC OR 5-240VAC
T1K-16TA	16PT 17-240VAC OUTPUT
T1K-16TD1	16PT 12-24VDC SINK OUTPUT
T1K-16TD2-1	16PT-12-24VDC SOURCE OUTPUT
T1K-16TR	16PT RELAY OUTPUT 5-30VDC OR 5-240VAC

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