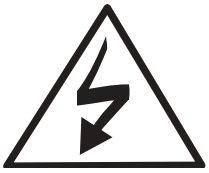
GE Industrial Systems

SOLID-STATE SOFT STARTER

ASTAT®-CD Plus
USER MANUAL

REMARKS:

1. Read this manual thoroughly before using the ASTAT-CD Plus and store in a safe place for reference.
2. Make sure that this manual is delivered to the end user.
3. CE Marking
   When using ASTAT-CD Plus in the EU, compliance with EMC is required.
   All ASTAT-CD Plus sizes comply with the generic EN 50081-2 and EN 50082-2
4. The policy of GE Industrial Systems is one of continuous improvement.
   The right is reserved to alter the design on any structural details of the products at any time without giving notice.



WARNINGS

1. Disconnect power before installing or servicing.

2. Hazardous voltages are present in the motor circuit even when the starter is OFF. An isolation contactor configured to provide automatic isolation when the motor is turned OFF is recommended.

3. Unit may contain more than one live circuit. Disconnect both control and main circuits before installing or servicing.

4. Soft stop should not be used as an Emergency stop.

5. Stopping mode must be set to meet applicable standards for operator safety.

6. Separate motor overcurrent protection is required to be provided in accordance with the Canadian Electrical Code, Part 1. ASTAT-CD Plus provides separate motor protection.

CAUTIONS

1. Semi-conductor fuses specified may not provide branch circuit protection. Refer to local applicable electrical codes.

2. Overload relay setting should be properly coordinated with motor.

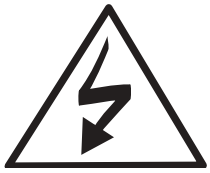
3. Slow speed running will affect the motor thermal characteristic due to reduced cooling. Care must be taken when operating motor under these conditions.

4 DC braking - braking current may cause motor overheating. Select the lowest braking current and time.

5. DC braking must use additional (DC3) in the motor circuit. See wiring diagram page 6-1.

6. Abnormal starting times in excess of 30 seconds, or closely repeated operations of acceleration ramp/deceleration ramp, slow speed, or DC injection braking may cause motor damage. Contact motor manufacturer to ensure proper motor selection has been made for these conditions.

7. If control power is lost between starts, the overload relay protection is reset to cold start conditions.



PRECAUTIONS

1. Debranchez l'alimentation en courant électrique avant de raccorder ou d'intervenir.

2. Des tensions dangereuses sort présente dans le circuit moteur même si le soft starter indique la position "arrêt". Un contacteur d'isolement assurant un isolement automatique quand le moteur est arrête, est recommendé.

3. L'appareil peut renfermer plus d'un circuit sous tension de'brancher les circuits principaux et les circuits de controle avant de raccorder ou d'intervenir.

4. Délestage "soft stop" ne devrait jamais être utilisé en lieu de délestage d'urgence.

5. Procédés de délestage doivent être conforme aux normes de sécurité des utilisateurs.

AVERTISSEMENTS

1. Les fusibles semi-conducteurs specifies ne protégent pas obligatoirement les circuits se conformer aux codes locaux d'installations électriques.

2. Le relais de courant de surcharge doit être proprement coordonné avec la marche du moteur.

3. La marche en sous-régime agira sur les caracteristiques thermiques à cause de la réduction de refroidessement. Opérez le moteur avec précaution dans en ce cas.

4. Ralentissement courant continu peut provoquer la surchauffe de moteur. Choisissez le plus foible courant de décéleration et la durée de ralentissement la plus courte.

5. Pour freinage courant continu, un contacteur (DC3) additional est nécessaire dans le circuit moteur, voir le schéma de raccordement page 6-1.

6. Les délais anormaux de mise en service d'une durée supérieure à 30 secondes, ainsi que les montées/descentes en regime, les exploitations régime lent ou les freinages par injection de courant continu répétés et rapportes sont suseptibles d'edommager le moteur. Mettez-vous en rapport avec votre fabricant en ce qui concerne le choix du moteur adéquat.

7. En cas d'interruption de l'alimentation entre deux dèmarrages, la protection assurée par démarrage à froid.

8. Le moteur doit être muni d'une protection distincte contre les surintensites, et la surchauffe conformement au code de l'electricite, premiere partie. ASTAT-CD Plus le relais de courant de surcharge doit être proprement coordonne avec la marche du moteur.

INDEX

1-1. Applications

There are numerous applications where soft starting and limited current peaks are needed for the starting of squirrel cage induction motors. Traditionally reduced voltage starting was accomplished using electromechanical starters such as star delta starters, autotransformer starters, stator resistance starters or by using part winding motors. These methods would provide a two, three or four step torque change by switching the motor voltage from reduced value to full voltage (in steps) after a preset time interval.

ASTAT-CD Plus Solid State Reduced-Voltage Starters (also known as soft starters) use solid state devices to gradually increase the voltage from an initial preset level (initial torque) to full voltage over a selected time period. The same solid state devices may also be used to reduce the voltage for the deceleration of the motor should this be required in the application. This starting and stopping method provides smooth, stepless acceleration and deceleration of AC squirrel-cage induction motors. The ASTAT-CD Plus control circuitry allows many additional functions to be accomplished, such as the monitoring, protection and secondary functions listed.

Versatile Use

ASTAT-CD Plus Solid State Reduced-Voltage Starters offer customer-configurable functions, including pedestal voltage, kick start (selectable), acceleration ramp, current limit, and soft stop (selectable). Typical applications include the following:

- Belted equipment
- Centrifugal fans
- Centrifuges
- Compressors
- Conveyors
- Crushers
- Extruders
- Fans and blowers
- Mixers
- Packaging equipment
- Pumps
- Textile machinery

Advanced Features

The ASTAT-CD Plus incorporates many additional advanced features to insure suitability for most applications.

Monitoring

- Motor Current
- Line Voltage (1)
- Line Power Factor
- Elapsed Time
- Fault History

Protection

- Password
- Lockout
- Undervoltage (1)
- Overvoltage (1)
- Undercurrent
- Overcurrent
- Long Start Time
- Stalled Rotor

Secondary Functions

- Secondary Ramp Up
- Secondary Ramp Down
- Tachometer Feedback
- Dual Motor Switch
- Slow Speed (7&14%)
- Reverse Slow Speed (20%)
- Retry
- DC Injection Braking
- Energy Saving

The ASTAT-CD Plus also features two programmable inputs, three programmable output relays and serial communications control.

Note: **(1)** Monitors L1

1-2. Features and benefits

An increase in productivity and reliability with the use of static soft starters.

The ability to start and stop the motor without steps or transitions lengthens the life of power-driven machines' mechanical parts, and it reduces stress on transmission belts and coupling parts. Consequently, maintenance time is reduced and machine/facility lifespans are lengthened.

Improvement in acceleration / deceleration characteristics

By starting with the voltage ramp or, alternatively, by starting current limitation, the acceleration and deceleration ramp more closely fits the load characteristics. A kick start also may be selected in instances of high static friction load.

Protected motor

The ASTAT-CD Plus protects the motor from overloads and from incorrect operating conditions such as loss of an input or output phase, stalled rotor, thyristor short circuit, etc.

Digital technology

The control system is based upon the use of a highly specialized microcontroller that treats the signals digitally, thereby avoiding deratings and adjustments common to analog circuits. This type of control ensures excellent precision and speed of execution. The control board uses surface-mounted devices (SMD) to increase equipment reliability.

High level of immunity

The control signals are optoelectronically isolated. Various levels of protection have been set up in the circuits to immunize the equipment against external disturbances and their harmful effects.

Easy to run and adjust

The ASTAT-CD Plus can be used for a wide range of applications. A keypad and digital display make it easy to select options that allow the equipment capabilities to be customized to application needs.

Easy maintenance due to full monitoring

Advanced microprocessor technology allows starters to identify 21 different types of fault conditions. The last four errors are retained in memory to facilitate troubleshooting and minimize downtime.

Pump control

The ASTAT-CD Plus includes a pump control function that is more effective in fluid systems than standard soft starting and stopping. The control reduces fluid surges and hammering in a pipeline system. This method controls the motor speed by monitoring the motor parameters with voltage control in a closed-loop system.

Advanced functions

The ASTAT-CD Plus includes advanced functions, such as, linear acceleration ramp, programmable I/O, and connection to a computer by serial communication (RS 232).

2-1. IEC Ratings (1)

HEAVY DUTY (2) Current rating	220V / 240V	380V / 415V	440V	480V / 500V	**LIGHT DUTY** Current rating (3)	220V / 240V	380V / 415V	440V	480V / 500V	Degree of protection	Cat. No.	Weight		Cooled
A	kW(4)	kW(4)	kW(4)	kW(4)	A	kW(5)	kW(5)	kW(5)	kW(5)			Kg.	Lbs.	
14	3	5.5	7.5	-	17	4	7.5	7.5	-	IP-00	**QC1FDP**	4.3	9.48	Natural
	3	5.5	7.5	7.5		4	7.5	7.5	11	IP-00	**QC2FDP**	4.3	9.48	Natural
17	4	7.5	7.5	-	21	5.5	11	11	-	IP-00	**QC1GDP**	4.3	9.48	Natural
	4	7.5	7.5	11		5.5	11	11	13	IP-00	**QC2GDP**	4.3	9.48	Natural
22	5.5	11	11	-	27	7.5	13	15	-	IP-00	**QC1HDP**	4.6	10.14	Natural
	5.5	11	11	15		7.5	13	15	15	IP-00	**QC2HDP**	4.6	10.14	Natural
32	7.5	15	18.5	-	38	10	18.5	22	-	IP-00	**QC1IDP**	4.6	10.14	Natural
	7.5	15	18.5	22		10	18.5	22	25	IP-00	**QC2IDP**	4.6	10.14	Natural
48	13	22	22	-	58	15	25	30	-	IP-00	**QC1JDP**	12.5	27.56	By fan
	13	22	22	30		15	25	30	37	IP-00	**QC2JDP**	12.5	27.56	By fan
63	15	30	37	-	75	22	37	45	-	IP-00	**QC1KDP**	12.5	27.56	By fan
	15	30	37	37		22	37	45	45	IP-00	**QC2KDP**	12.5	27.56	By fan
72	20	37	37	-	86	25	45	50	-	IP-00	**QC1LDP**	17.0	37.48	By fan
	20	37	37	45		25	45	50	50	IP-00	**QC2LDP**	17.0	37.48	By fan
105	30	55	55	-	126	37	63	75	-	IP-00	**QC1MDP**	17.0	37.48	By fan
	30	55	55	75		37	63	75	80	IP-00	**QC2MDP**	17.0	37.48	By fan
156	40	75	90	-	187	55	90	110	-	IP-00	**QC1NDP**	45.0	99.20	By fan
	40	75	90	110		55	90	110	132	IP-00	**QC2NDP**	45.0	99.20	By fan
240	63	110	132	-	288	80	150	165	-	IP-00	**QC1QDP**	45.0	99.20	By fan
	63	110	132	160		80	150	165	200	IP-00	**QC2QDP**	45.0	99.20	By fan
315	90	160	200	-	378	110	200	220	-	IP-00	**QC1RDP**	55.0	121.3	By fan
	90	160	200	220		110	200	220	250	IP-00	**QC2RDP**	55.0	121.3	By fan
370	110	200	220	-	444	132	220	250	-	IP-00	**QC1SDP**	55.0	121.3	By fan
	110	200	220	250		132	220	250	315	IP-00	**QC2SDP**	55.0	121.3	By fan
475	150	250	250	-	570	160	300	355	-	IP-00	**QC1TDP**	80.0	176.4	By fan
	150	250	250	335		160	300	355	400	IP-00	**QC2TDP**	80.0	176.4	By fan
610	200	315	400	-	732	220	400	450	-	IP-00	**QC1UDP**	105.0	231.5	By fan
	200	315	400	400		220	400	450	500	IP-00	**QC2UDP**	105.0	231.5	By fan
850	250	450	530	-	1020	300	560	600	-	IP-00	**QC1VDP**	120.0	264.5	By fan
	250	450	530	600		300	560	600	750	IP-00	**QC2VDP**	120.0	264.5	By fan
1075	355	600	670	-	1290	395	715	750	-	IP-00	**QC1XDP**	150.0	330.7	By fan
	355	600	670	750		395	715	750	850	IP-00	**QC2XDP**	150.0	330.7	By fan

Notes: **(1)** = Ratings in Amps. given for ambient temperature up to 40°C and 1000m altitude.
Derate output current by 1.5% / °C above 40°C.
Derate output current by 1% / 100m above 1000m.

(2) = Heavy duty ratings, IEC Class 10 and 20 protections allowed.

(3) = Light duty ratings, only IEC Class 10 protection allowed.

(4) = Maximum recommended Motor Power for IEC Class 20 protection. Set ASTAT-CD Plus's parameters "N" and "o" accordingly.

(5) = Maximum recommended Motor Power for IEC Class 10 protection. Set ASTAT-CD Plus's parameters "N" and "o" accordingly.

2-2. UL Ratings (1)

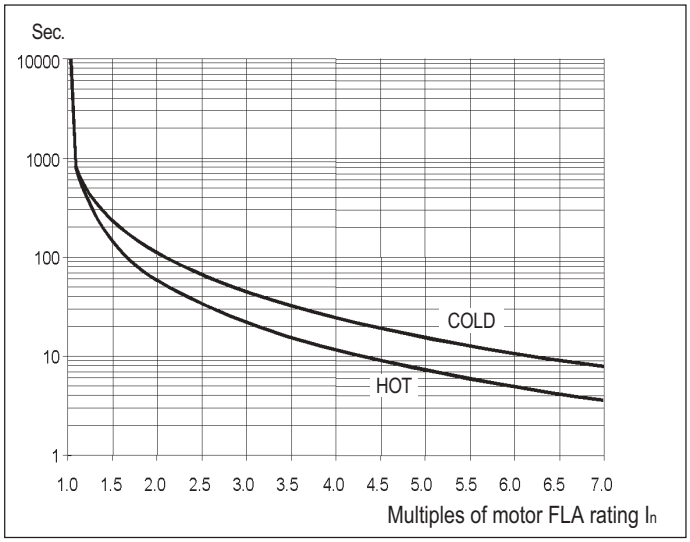
Current rating	Max. starting current	HEAVY DUTY 200V	HEAVY DUTY 230V	HEAVY DUTY 460V	STANDARD DUTY 200V	STANDARD DUTY 230V	STANDARD DUTY 460V	Degree of protection	Cat. No.	Weight		Cooled
A	A	HP	HP	HP	HP	HP	HP			Kg.	Lbs.	
14	63	3	3	7.5	3	3	7.5	IP-00	**QC2FDP**	4.3	9.48	Natural
17	77	3	3	10	3	3	10	IP-00	**QC2GDP**	4.3	9.48	Natural
22	99	5	7.5	15	5	7.5	15	IP-00	**QC2HDP**	4.6	10.14	Natural
34	153	7.5	7.5	20	10	10	25	IP-00	**QC2IDP**	4.6	10.14	Natural
48	216	10	15	30	15	15	30	IP-00	**QC2JDP**	12.5	27.56	By fan
63	284	15	20	40	20	20	40	IP-00	**QC2KDP**	12.5	27.56	By fan
72	324	20	20	40	20	25	50	IP-00	**QC2LDP**	17.0	37.48	By fan
105	473	30	30	60	30	30	75	IP-00	**QC2MDP**	17.0	37.48	By fan
156	702	40	50	100	50	60	125	IP-00	**QC2NDP**	45.0	99.20	By fan
240	1080	60	75	150	75	75	200	IP-00	**QC2QDP**	45.0	99.20	By fan
315	1418	75	100	200	100	125	250	IP-00	**QC2RDP**	55.0	121.25	By fan
370	1665	100	125	250	125	150	300	IP-00	**QC2SDP**	55.0	121.25	By fan
500	2250	150	150	350	150	200	400	IP-00	**QC2TDP**	80.0	176.36	By fan
630	2835	200	200	400	200	250	500	IP-00	**QC2UDP**	105.0	231.47	By fan
850	3825	250	300	600	300	350	700	IP-00	**QC2VDP**	120.0	264.54	By fan

Notes: **(1)** = Ratings in Amps. given for ambient temperature up to 40°C and 1000m altitude.
Derate output current by 1.5% / °C above 40°C.
Derate output current by 1% / 100m above 1000m.

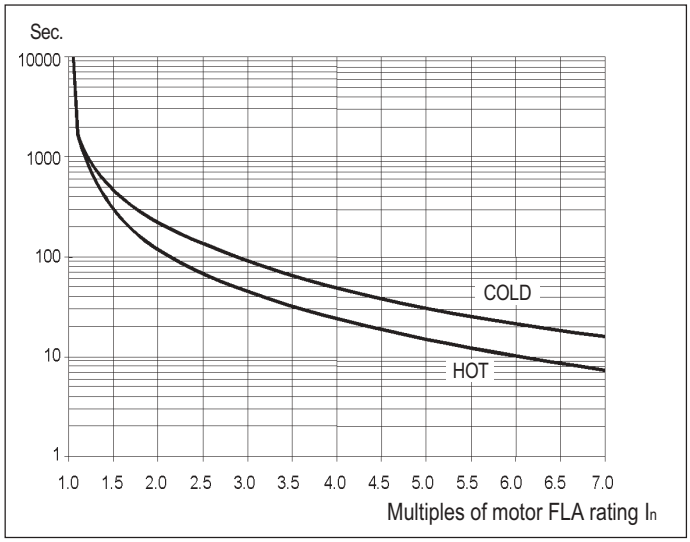
2-3. ASTAT®-CD Plus, Thermal characteristics

The ASTAT-CD Plus allows the user to select motor protection according to IEC Class 10, 20 and NEMA 10, 20 or 30, selectable by "o" -overload- parameter

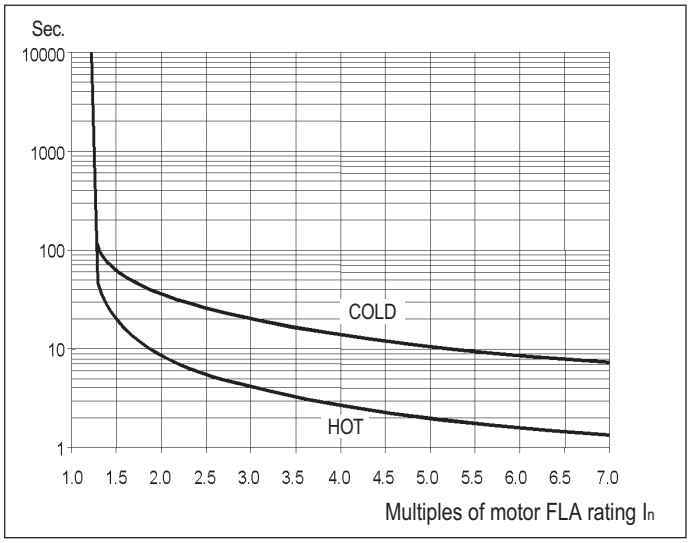
IEC Class 10



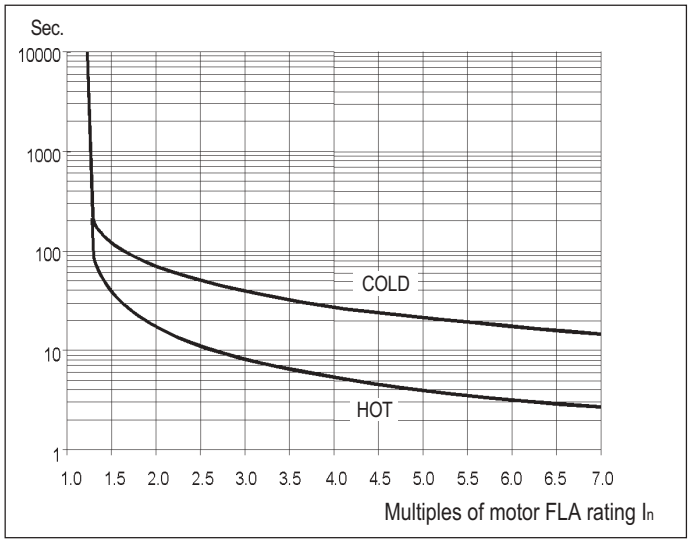
IEC Class 20



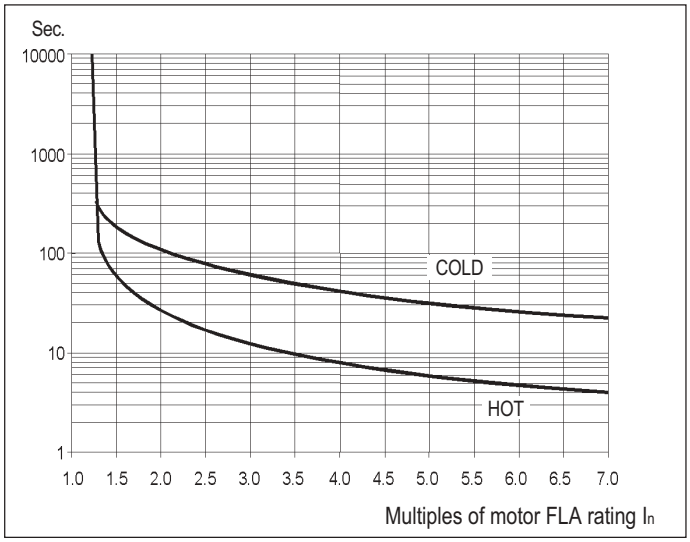
NEMA 10



NEMA 20



NEMA 30



Thermal memory:
If the control voltage is not removed, the unit has a cool down characteristic. The time for cool down is 300 sec. after the overload trip. If the control voltage is removed after tripping, you must wait at least 2 minutes before the unit can be restarted.

Operations per hour:
Using a cycle T, with starting time of t1, running time of T-2t1 at rated current and OFF time of t1 sec. (minimum), the ASTAT-CD Plus allows the following operations per hour.

Starting Current	Operations / Hour. Starting time t1= 10sec.	Operations / Hour Starting time t1=20 sec.
2 Ir	180	90
3 Ir	160	60
4 Ir	30	10

3. Technical Specifications

3-1. ASTAT®-CD Plus, General specifications

Voltage Ratings	3ph AC Systems		Up to 500V, +10%, -15% for QC2xDP ASTAT-CD Plus series
Freq. Range	50/60	Hz	Control range of 45-65 Hz
Control Specifications	Control system		Digital system with microcontroller
			Starting ramp with progressive increase in voltage and current limitation
	Initial voltage (pedestal)	%	30 - 95 U_n
	Starting torque	%	10 - 90 $M_{direct\ start}$
	Kick start	%	95 U_n (90% $M_{direct\ start}$), adjustable 0 to 999 ms
	Motor unit ratio (N)		0.4 - 1.2
	Current limit (starting)		1 to 4.5 (I_r/I_n) Max 7.0 I_n
	Acceleration ramp time	s	1 to 99 (types: standard or linear ramp up)
	Energy savings		Output voltage reduction according to power factor
	Override		Fixed output voltage permanently equal to supply voltage
	Bypass		Direct control of a bypass contactor
	Brake time by ramp	s	1 to 120 (1 to 99 in secondary ramp) adjustable independently of starting ramp time (types: standard, pump control or linear ramp down)
	DC braking		0 to 99 s.; 0.0 to 2.5xI_n
	Slow speed		Direct torque: 7% or 14% of nominal speed; reverse torque: 20% of nominal speed
	Retry		0 to 4 attemps, and 1 to 99 sec. retry time
	Monitoring		Motor current, line voltage (1), power, power factor and elapsed time
Running	External control		Start - Stop
	Acceleration phase		Adjustable time
	Permanent phase		Energy savings / Override choice
	Stop phase		Power cut-off / Ramp / DC braking/Pump control
Inputs / Outputs	Inputs		4 digital optocoupled. Two fixed (Start , Stop), and 2 programmable (I3, I4) 1 Analog 0-5VDC for Tachogenerator input feedback
	Outputs		3 programmable relays (1r, 2r, 3r) 1 Analog 0-10VDC output for current metering
Protections	Current limit		Adjustable from 1 to 4.5 (I_r/I_n) Max 7.0 I_n
	Overload		IEC class 10 and 20 ; NEMA class 10, 20 and 30 all selectable
	Cool-down time after overload trip	s	300 for reset
	Loss on input phase	s	Trip at 3
	Thyristor short circuit	ms	Trip at 200
	Heatsink overheating	ms	Trip at 200
	Motor thermistor	ms	Trip at 200 if thermistor impedance > response value
	Loss on output phase	s	Trip at 3
	Stalled rotor	ms	Trip at 200
	Supply frequency error	Hz	If f < 45 or f > 65, will not start
	Overcurrent		100 to 150% I_n; trip time adjustable from 0 to 99 sec.
	Undercurrent		0 to 99% I_n; trip time adjustable from 0 to 99 sec.
	Overvoltage (1)		100 to 130% U_n; trip time adjustable from 0 to 99 sec.
	Undervoltage (1)		0 to 50% U_n; trip time adjustable from 0 to 99 sec.
	Error (CPU)	ms	60
	Memory		4 former errors
	Long start time	s	2 x ta (ta = acceleration ramp time)
	Long slow speed time	s	120
Environmental conditions	Temperature	°C	0 to +55 (derate output current by 1.5% / °C above 40°C)
	Relative humidity	%	95% without condensation
	Maximum altitude	m	3000 (derate output current by 1% / 100m above 1000m)
	Mounting position		Vertical
	Protection Degree		IP00, UL Open
Standards	CE, cUL, UL		CE Conforming IEC 947-4-2; UL, cUL conforming to UL508
	Conducted & radiated emissions		Conforming IEC 947 -4-2, Class A
	Electrostatic discharges		Conforming to IEC 1000-4-2, level 3
	Radioelectric interference		Conforming to IEC 1000-4-6, level 3 and to IEC 1000-4-3, level 3
	Immunity to fast trasients		Conforming to IEC 1000-4-4, level 3
	Immunity to Surge Voltage		Conforming to IEC 1000-4-5, level 3

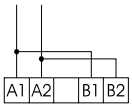
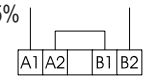
Abbreviations

I	Actual measured motor current
I_m	Maximum starting current desired
I_n	Nominal motor nameplate FLA
I_r	ASTAT rated nameplate FLA
L	Current limit for starting I_m/I_r
L_{max}	450/N
$M_{direct\ start}$	Full voltage starting torque
N	I_n/I_r
SF	Service factor
U_n	Full line voltage

Note: (1) Monitors L1

3-2. I/O Terminal board specifications

Power I/O terminals

Terminal	Function	Description
1L1, 3L2, 5L3	Mains Input	3ph input voltage 200-480 volts QC2xxx type
2T1, 4T2, 6T3	Motor output	Output terminals to 3ph AC motor
A1, A2, B1, B2	Input Control Voltage	110/120V AC, +10%, -15%  220/240V AC, +10%, -15% 

Digital Inputs

Terminal	Function	Description
57	Common for digital inputs	This is a common terminal for the digital input terminals specified below.
1	Run	Run order. Command signal may be provided by one NO **dry** momentary contact to terminals 1 and 57.
2	Stop	Stop order. Command signal may be provided by one NC **dry** momentary contact to terminals 2 and 57.
		NOTE: Run/Stop permanent command allows linking 1-57 and using one **dry** NO contact to 2-57 terminals.
3	Programmable input I3	These two inputs are programmable. They can be assigned to the following internal functions:
4	Programmable input I4	-soft stop, -pump control, -kick start, -override, -DC brake, -slow speed control, -reverse slow speed, -local / remote control, -Linear ramp, -dual ramp selection, -bypass function
		Command signal should be provided by one NC **dry** contact to terminals 57-3 or terminals 57-4. By switching this contact ON / OFF it is possible to enable or disable the assigned function.

Digital Outputs

Terminal	Function	Description
11, 12, 14	Programmable relay 1r	11-12 = NC, 11-14 = N.O. dry contacts. This relay can be assigned to several internal output functions (p. 3.6). As default assigned to function RUN
23, 24	Programmable relay 2r	23-24 = N.O. dry contact. This relay can be assigned to several internal output functions (page 3-6). As default assigned to function EOR
33, 34	Programmable relay 3r	33-34 = N.O. dry contact. This relay can be assigned to several internal output functions (page 3-6). As default assigned to function DC BRAKE
		Common for all relay output contacts: Maximum usage voltage: 380VAC (B300-UL); Thermal current: 8A; AC-15 use: 220V / 3A, 380V / 1A; DC-15 use: 30V max/ 3.5A

Analog I/O

Terminal	Function	Description
8	Analog input common (-)	This is a common terminal for the analog input terminal number 7 and analog output terminal number 9.
7	TG feedback input (+)	0-5V analog input for speed feedback. It should be provided by a DC tacho-generator coupled to the motor. This speed feedback signal is required when the "linear ramp" function is used.
9	Current output (+)	0-10V DC analog Output for current measurement purpose. (1 x I_F = 2V DC output) Load Impedance 10KΩ or higher.

Motor thermistor terminals

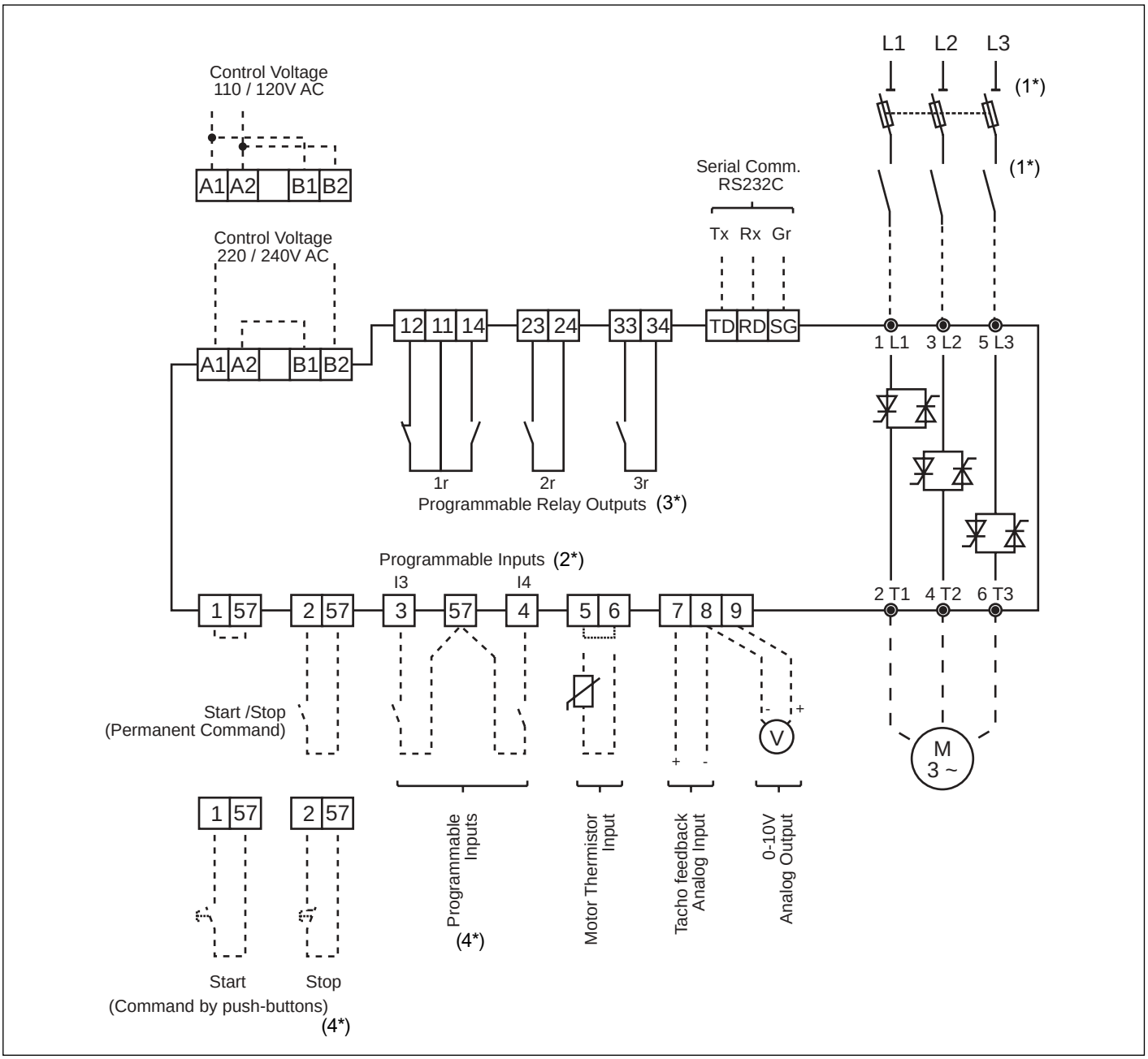
Terminal	Function	Description
5 , 6	Motor thermistor input	This input allows a motor thermistor with a response value from 2.8 to 3.2KΩ , and a reset value from 0.75 to 1KΩ to control motor temperature. When the motor thermistor is not used, a link must be used between terminals 5-6.

Communications

Terminal	Function	Description
TD, RD, SG	Tx, Rx, Gr data	RS232C, 3 wires, half duplex. Maximum cable length 3meters (10 feet). Asynchronous data transmission, 9600 Bauds, 1 bit start, 8 bits data, 2 bits stop, no parity.

3-3. I/O wiring

ASTAT-CD Plus terminal layout and wiring configuration is shown in the diagram below



Notes: (1) Control and Mains wiring recommendations are given in chapter 5.

(2) The programmable inputs I3, I4 are not assigned to any function as default. Check pages 3-6 prior to using these inputs.

(3) The programmable relay outputs are assigned to the following functions as default:
Relay (1r): RUN, (RUN status)
Relay (2r): EOR, (End of Ramp)
Relay (3r): DCBR, (DC Braking control)

(4) **Important:** Use dry contacts only

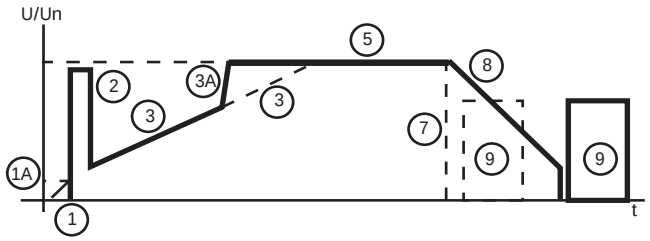
3-4. Operating modes

Starting and Stopping

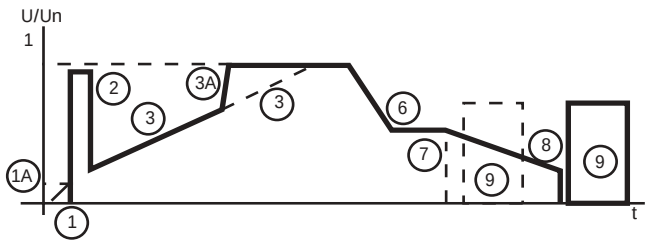
Initial ramp	(1)	5 main frequency cycles
Initial voltage (pedestal)	(1a)	30 to 95% U_n (adjustable via initial torque setting T)
Kick start	(2)	95% U_n. Enabled by parameter "Pxxx" to ON, 0-999 ms (adjustable)
Acceleration ramp	(3)	1-99 sec (adjustable). Dual ramp option.
		Linear speed ramp by tacho feedback also possible
	(3a)	Fast ramp (if motor is up to speed before end of normal ramp time)
Current limit	(4)	100% to 450% x I_r/I_n Max 700% I_n
Permanent state	(5)	Rated voltage (override)
	(5a)	Rated current
	(6)	Energy savings. Enabled by "Fxxx" to OFF
Stopping modes (All selectable)	(7)	Motor power cut-off. "Sxxx" to OFF, "Cxxx" to OFF
	(8)	Deceleration ramp 1-120 sec (adjustable). Secondary ramp 1-99 sec
		Ramp down modes available are:
		- Soft Stop -Voltage ramp down-. Enabled by "Sxxx" to ON
		- Pump control. Selectable by "Sxxx" to ON and "Cxxx" to ON
		- Linear ramp down (Tacho feedback needed)
	(8a)	Evolution of current in deceleration ramp mode
	(9)	DC brake (0-99 sec adjustable). Enabled by "Bxxx" to ON

Starting by voltage ramp

Override

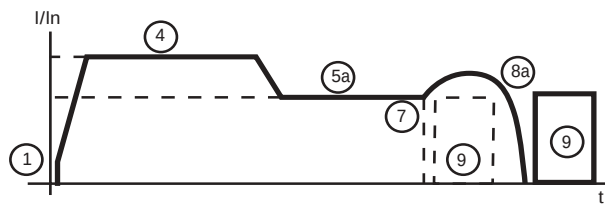


Energy savings

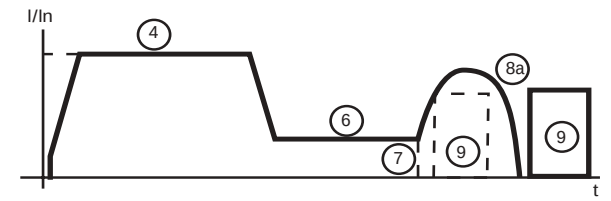


Starting by current limitation

Override



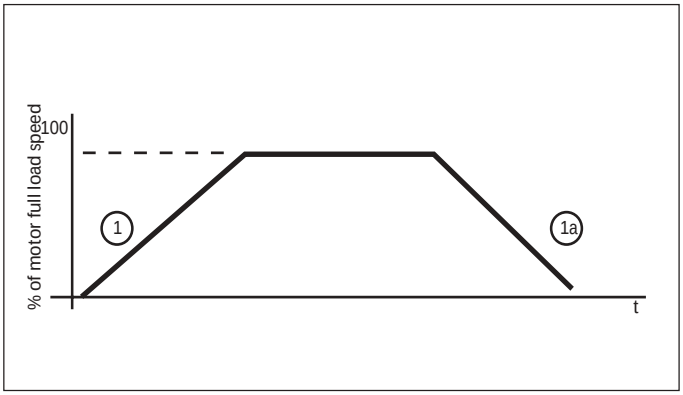
Energy savings



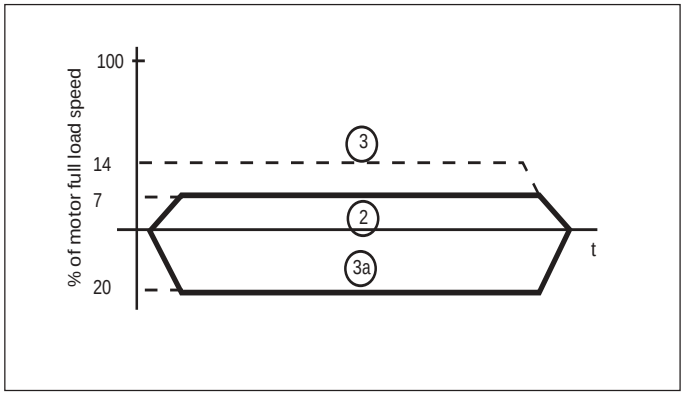
Jog and linear ramp

Linear acceleration and deceleration ramp	(1) (1a)	Ramp time adjustable (Selectable by parameter "Dxxx" to ON
Low slow (7%) and High slow (14%) speeds	(2) (3)	Enabled by parameter "Jxxx" to ON and "jxxx" to LO or HI
Reverse slow speed (20%)	(3a)	Enabled by parameter "Jxxx" to ON and "rxxx" to ON
Slow speed (7% or 14%)	(4)	Enabled by parameter "Jxxx" to ON
Acceleration ramp	(5)	Ramp time adjustable
Soft stop (deceleration ramp)	(6)	Ramp time adjustable
Slow speed (7% or 14%)	(7)	Enabled by parameter "Jxxx" to ON
DC Brake	(8)	Current and time adjustables, Enabled by parameter **B**xxx to ON, and **b**xx, **I**xxx adjustments

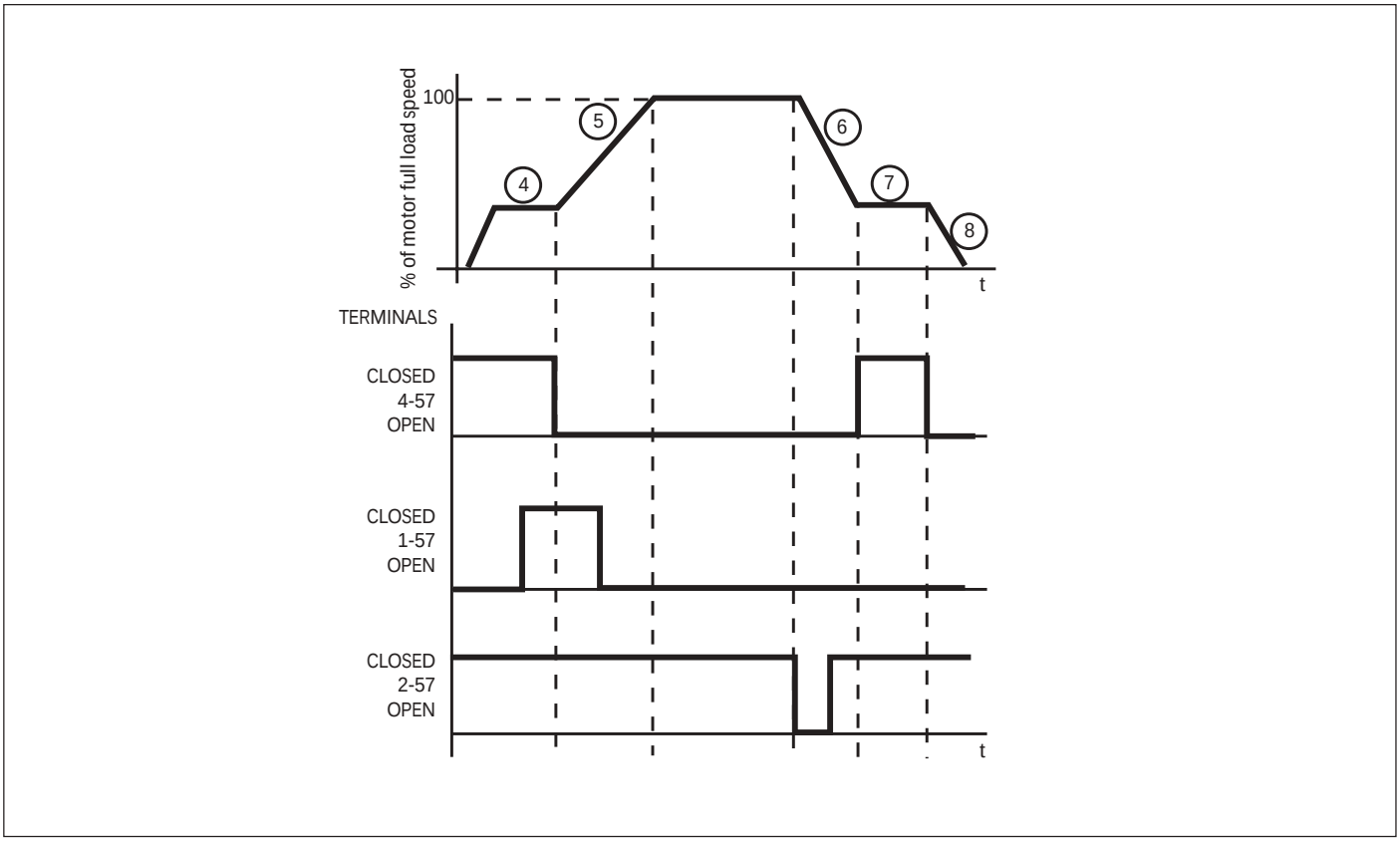
Linear ramp with T.G. feedback



Slow speed. Basic diagram



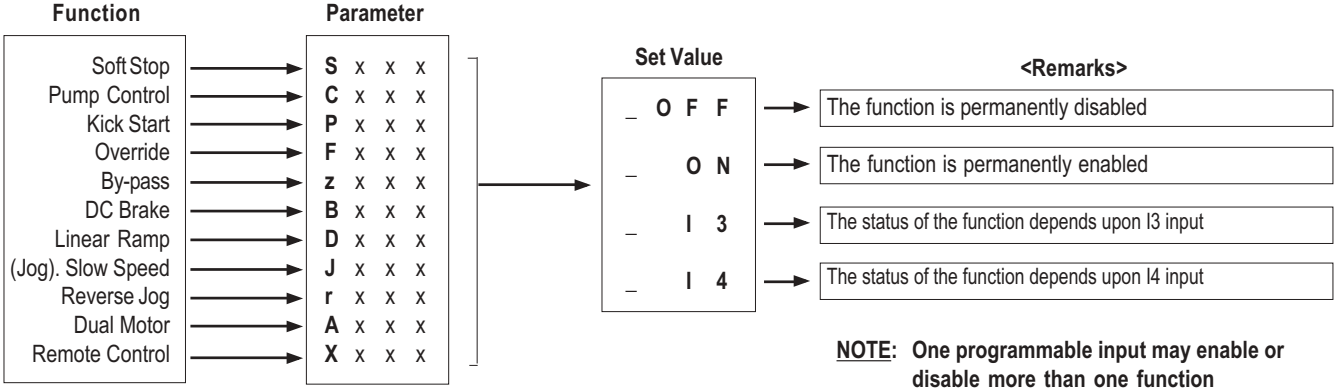
Slow speed. Full diagram



3-5. Programmable Inputs and Outputs

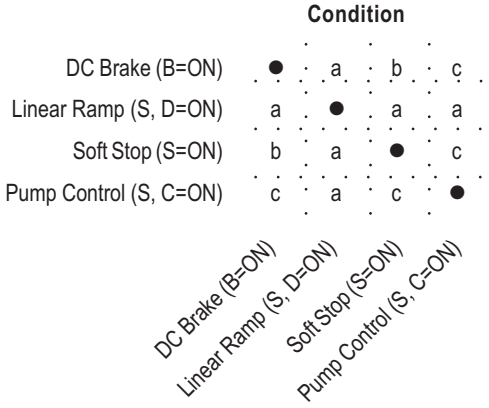
Programmable inputs and functions

The ASTAT-CD Plus functions such as soft stop, kick start, etc., can be enabled (ON) or disabled (OFF) in their dedicated parameters by using the keypad. Most of these functions can be enabled or disabled remotely as well, through the programmable inputs I3 or I4 (terminals 3-57 and 4-57).



NOTE: One programmable input may enable or disable more than one function

More than one function can be enabled in the ASTAT-CD Plus, either by the keypad or through the programmable inputs I3 and I4, but there are some functions which may not work as expected during stopping, such as when they are simultaneously enabled. When two or more of the below functions are simultaneously enabled, the priority is defined in the following table:



Action

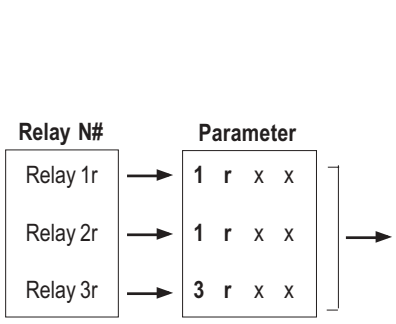
a The unit stops by Linear Ramp

b The unit stops by DC brake after the Soft Stop is completed.

c The unit stops by Pump Control

Programmable Relay Outputs

The ASTAT-CD Plus includes three programmable relays 1r, 2r and 3r (dry contacts). ASTAT-CD Plus terminals are 11-12-14, 23-24 and 33-34
These relays can be assigned to several functions, as shown below.

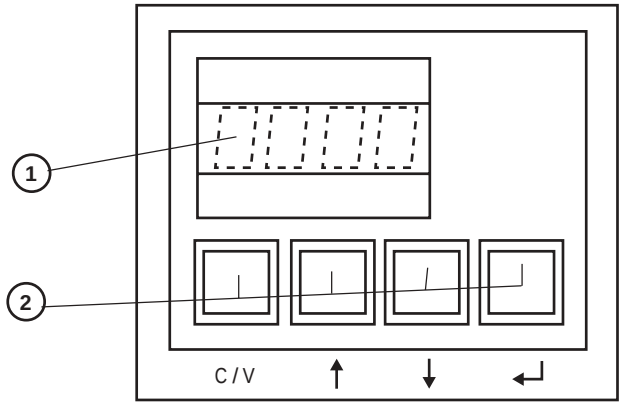


Set Value	<Remarks>	
20	EOR	Detects end of voltage ramp. -This function can only be assigned to relay 2r-
21	DC Brake	DC Brake command -This function can only be assigned to relay 3r-
22	Fault	Detects ASTAT-CD Plus fault status
23	Undervoltage	Detects limit set in parameter UVxx (1)
24	Overvoltage	Detects limit set in parameter OVxx (1)
25	RUN	Detects ASTAT-CD Plus run status
26	JOG	Detects Jog (slow speed) status
27	Undercurrent	Detects limit set in parameter UCxx
28	Overcurrent	Detects limit set in parameter OCxx
29	Disabled	Disables the relay function
30	Future use	

Note: (1) Monitors L1

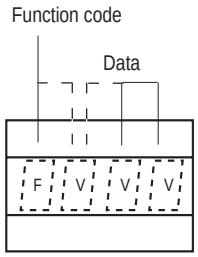
4. Programming

4-1. Keypad and display description



Display (1) Displays monitoring, status indications, error messages and function set values

Display Structure



F V V V	Status code
O N	Equipment is connected to main supply (equipment is ON)
S T O P	Stop
L O C K	Remote stop
P U L S	Kick start
R A M P	Acceleration ramp
F U L L	Full conduction or Override
S A V E	Energy saving
S O F T	Soft stop
P U M P	Pump control
D C B K	DC braking
I N C H	Inching / slow speed
T A C H	Linear ramp (tacho)

F V V V	Error code
E 0 1 0	Frequency out of range
E 0 1 1	Overload trip
E 0 1 3	Loss of synchronism
E 0 1 4	Phase U scr
E 0 1 5	Phase V scr
E 0 1 6	Phase W scr
E 0 1 7	Heatsink overtemperature
E 0 1 8	Motor thermistor
E 0 1 9	Phase U lost
E 0 2 0	Phase V lost
E 0 2 1	Phase W lost
E 0 2 2	Stalled rotor
E 0 2 3	Internal error
E 0 2 5	Long start time
E 0 2 6	Long slow speed time
E 0 2 7	Lock-out
E 0 2 8	Undervoltage
E 0 2 9	Overvoltage
E 0 3 0	Undercurrent
E 0 3 1	Overcurrent
E 0 3 2	Retry, attempts exceeded

F F/V V V	Function code (*)
M x x x	Motor current
v x x x	Software version
.	.
.	.
P F x x	Power factor
.	.
.	.
L x x x	Current limit
T x x x	Starting torque
a x x x	Ramp up time
d x x x	Ramp down time
S x x x	Soft stop selection
.	.
.	.
L K x x	Lock out
.	.
.	.

(*) These are examples. Full details in sections 4-2, 4-3, 4-4, 4-5 and 4-6

Keypad (2) Allows setting of parameters and functions

C / V

SELECTION

Use with ↑ or ↓ to select the parameter or function code to be displayed and/or modified

SEARCH / ADJUSTMENT

Decreases the value of the selected parameter

SEARCH / ADJUSTMENT

Increases the value of the selected parameter

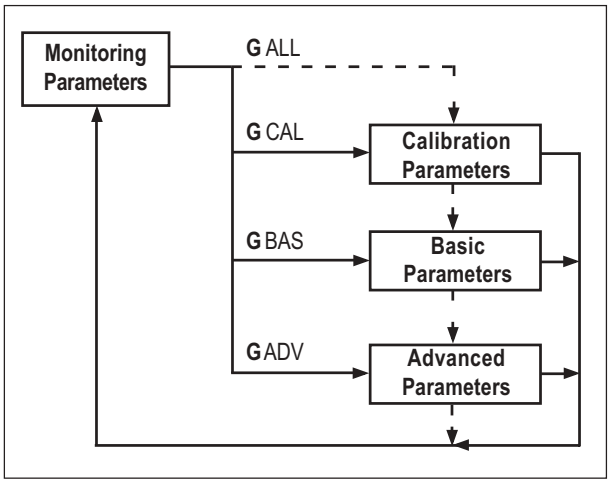
ENTER / SAVE

- Introduces the new parameter value into memory
- Updates the selected parameter value with the displayed value

4-2. Parameter block configuration

Mode Selection

The ASTAT-CD Plus includes a large number of parameters which are divided in four blocks: Monitor, Calibration, Basic and Advanced. The parameters of each group can be displayed or skipped according the selection done in parameter "G".
The monitor parameters are always displayed regardless of the mode selected



Settings in parameter "G"

GCAL	The Calibration parameters are displayed
GBAS	The Basic parameters are displayed
GADV	The Advanced parameters are displayed
GALL	All parameters are displayed

Searching and Setting Parameters

The ASTAT-CD Plus displays the parameters sequentially while depressing the C / V key and pushing repeteadly ↓ or ↑ keys. Proceed in this way untill the parameter "G" is displayed.

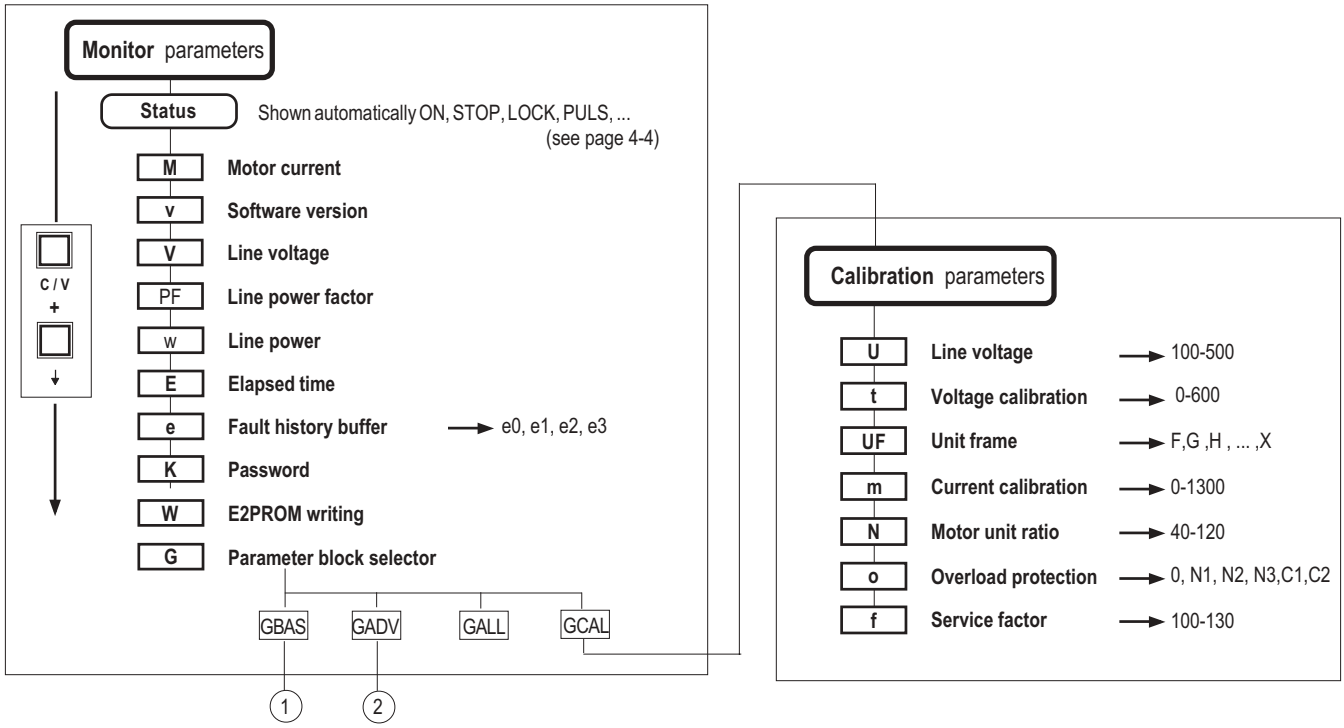
There is a quick way to search automatically the parameter "G" by pressing C / V and ↵ Keys. "Gxxx" will be shown on the display.

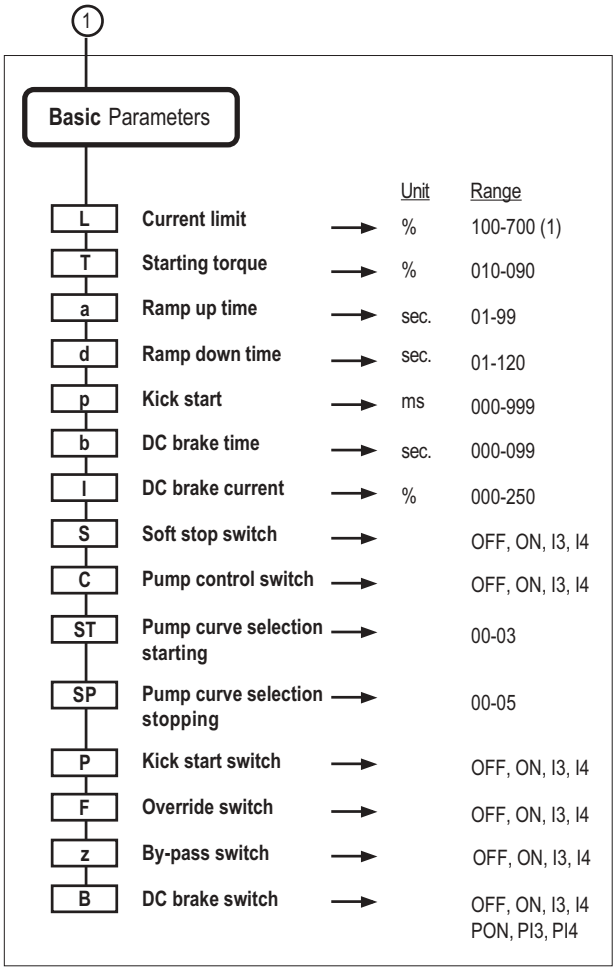
Once the parameter "G" is displayed, choose the value desired by pressing ↓ or ↑ Keys. The display will sequence "GBAS", "GCAL", "GADV" and "GALL" values repeatedly. The actual value displayed can be stored in a temporal memory buffer by pressing ↵ key.

Values stored in the temporal memory are lost upon control power loss, unless saved in the permanent E2PROM memory through parameter "W". Additional instructions are given on page 4-9.

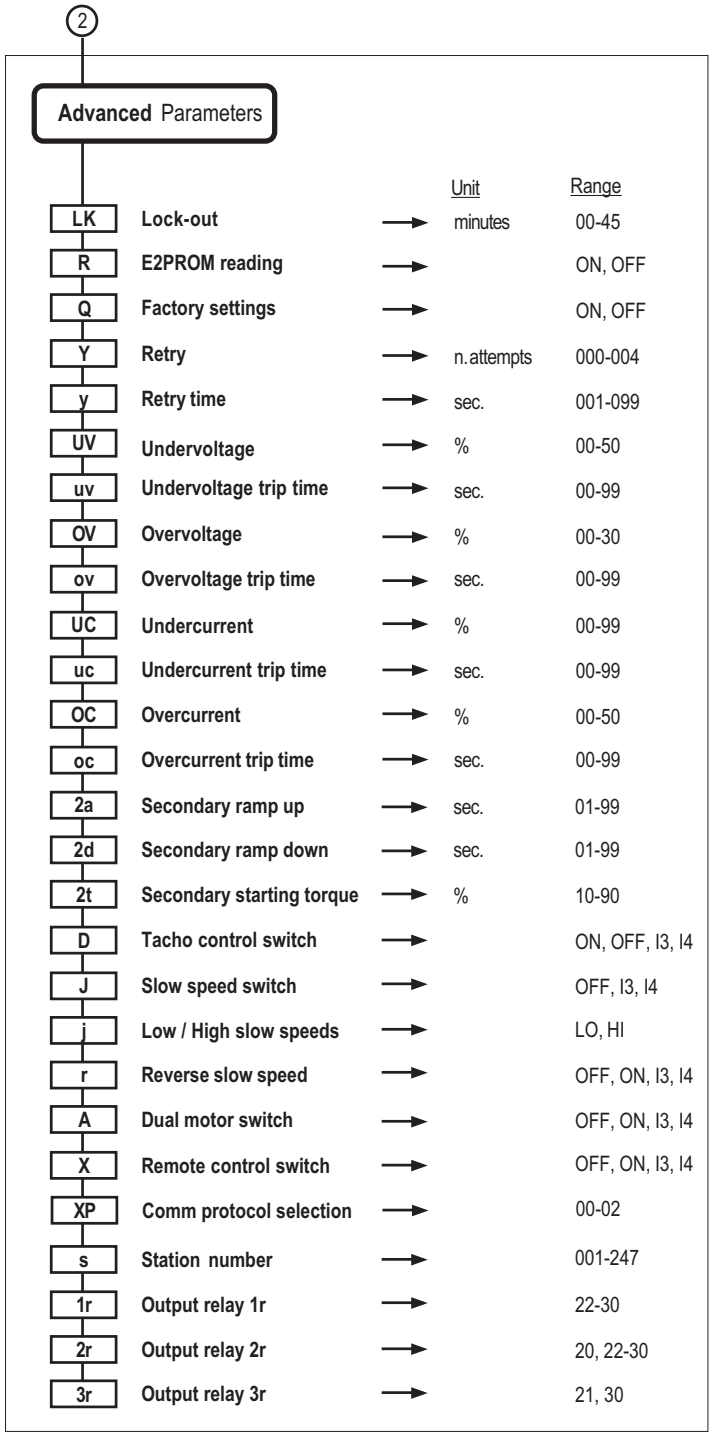
The above is an example given for parameter "G", but all ASTAT-CD Plus parameters can be modified from its default factory value in a similar way.

Parameter layout





(1) 100-450 (I_r/I_n) ; 700 max.



4-3. Monitor block parameters

Display	Function	Default	Range	Unit	Description
O N	**Status**	**O N**	ON STOP LOCK PULS RAMP FULL SAVE SOFT PUMP DCBK INCH TACH	- - - - - - - - - - - -	Switch on time. Equipment is connected to main supply Stop Remote control through serial port Kick start Acceleration ramp Full conduction / Override (full voltage) Energy saving Soft stop Pump control DC braking Inching / slow speed Linear ramp (tacho feedback needed)
M x x x	**Motor current**		000-999 1.0-9.9	A kA %	Displays motor current in Amps. Current higher than 999A is displayed in kA. If parameter UFxx is not calibrated, the motor current is displayed in % I_n
v x x x	**Software version**		-	-	xxx = Version number.
V x x x	**Main source voltage** (1)		-	V	Displays line voltage in Volts.
P F x x	**Power factor**		00-99	%	Displays line Power Factor.
w x x x	**Line power**		-	kW	Displays Line Power.
E x x x	**Elapsed time**		-	Hrs	Displays RUN time in Hours (x 1000)
e x x x	**Error trace buffer**		e0xx-e3xx	-	Saves the last four errors: e0xx: Fault 1 -Latest fault- xx: Fault code error e1xx: Fault 2 e2xx: Fault 3 e3xx: Fault 4
K x x x	**Password**	**K** 0 0 0	000-999	-	= 69 allows E2PROM writing operation = 10 Key lock enabled = 20 Key lock disabled
W x x x	**E2PROM writing**	**W** O F F	ON, OFF	-	Saves the unit current parameters to the E2PROM. This rewrites the last values saved. (Password 69 required)
G x x x	**Parameter display selection**	**G** B A S	CAL, BAS, ADV, ALL	-	CAL: Displays Calibration Parameters BAS: Displays Basic Parameters ADV: Displays Advanced Parameters ALL: Displays All parameters

Note: (1) Monitors L1

4-4. Calibration block parameters *-CAL-*

Display	Function	Default	Range	Unit	Description
U x x x	**Line voltage setting**	**U** 4 8 0	100-500	V	Line Voltage from 200 to 500V. Set rated value.
t x x x	**Voltage calibration**	**t** 4 8 0	000-600	V	Setting of this parameter allows better accuracy in monitoring and voltage protections (see the voltage calibration procedure).
U F x	**Unit frame**	**U F** 0	F, G, H, I, J, K, L, M, N, Q, R, ...X	-	Unit frame rating (F,G,H,...X). Setting "0" disables current calibration.
m x x x	**Current calibration**	**m** 0 0 0	000-1300	A	Setting of this parameter allows better accuracy in monitoring and current protections (see the current calibration procedure).
N x x x	**Motor rated current**	**N** 1 0 0	040-120	%	100 x (I_n/I_r) When this parameter is adjusted at a value higher than 105% the overload protection curve is automatically adjusted to Class 10. "C1" if Cx was selected, or to NEMA 20 "N2" if Nx was selected.
o x x x	**Overload protection**	**o** N 2	OFF N1, N2, N3, C1, C2	-	Selects either the following overload curves: OFF: Overload protection disabled (external overload relay must be used) N1: NEMA 10 N2: NEMA 20 N3: NEMA 30 - (not available if N ≥ 105) C1: Class 10 C2: Class 20 - (not available if N ≥ 105)
f x x x	**Service factor**	**f** 1 0 0	100-130	%	Motor service factor.

Voltage calibration procedure

When the ASTAT-CD Plus is installed on site for the first time or after the logic printed circuit board is replaced, the voltage measurements will have an accuracy of ±10%. To improve the voltage measurement accuracy up to ±3%, proceed as follows:

1. Turn the ASTAT-CD Plus ON and measure the RMS voltage on phases 1L1-3L2 using a calibrated voltmeter.
2. Search for the parameter "txxx", set the measured voltage, and save this value by depressing the enter key. It is not necessary to save this to the E2PROM, as the ASTAT-CD Plus does this automatically. NOTE: Set the actual, measured voltage while the ASTAT-CD Plus is ON. DO NOT enter the motor nameplate voltage rating.
3. Once the ASTAT-CD Plus has been calibrated, this operation does not need to be repeated unless the logic printed circuit board has been replaced or the ASTAT-CD Plus has been installed into a new application. NOTE: The parameter "txxx" will show the latest calibration entry, which may differ from the actual voltage value.

Current calibration procedure

When the ASTAT-CD Plus is installed on site for the first time or after the logic printed circuit board is replaced, the current measurements will have an accuracy of ±10%. The internal electronic overload protection is also affected by this procedure. To improve the current measurement accuracy up to ±3% and to improve the accuracy of the motor overload protection, proceed as follows:

1. Search for the parameter "UF_ x" and enter the correct ASTAT-CD Plus frame type letter ("F","G","H",..etc.).
2. Start the motor and measure the rms motor current using a calibrated ammeter. This measurement should be done at full load and full speed and after the motor current has stabilized.
3. Search for the parameter "mxxx", set the measured current and save this value by depressing the enter key. It is not necessary to save this to the E2PROM, as the ASTAT-CD Plus does this automatically. NOTE: Set the actual rms measured current while motor is running at full speed and under full load. DO NOT enter the motor nameplate current rating.

Once the ASTAT-CD Plus has been calibrated, this operation does not need to be repeated unless the logic printed circuit board has been replaced or the ASTAT-CD Plus has been installed into a new application. NOTE: The parameter "mxxx" will show the latest entry, which may differ from the actual current value.

4-5. Basic block parameters. *-BAS-*

4-5-1. Basic Functions

Display	Function	Default	Range	Unit	Description
L x x x	**Current limit**	**L** 4 0 0	100-L_{max}	%	Sets Device current limit. Sets motor starting current limit if parameter "N" is properly adjusted. The maximum range setting is automatically calculated by the unit according the following expression: L_{max}=450 (I_r/I_n); Max. 700
T x x	**Starting torque**	**t** 2 5	10-90	%	Sets the initial voltage applied to the motor.
a x x	**Ramp up time**	**a** 1 5	01-99	sec.	Sets Voltage ramp up time. Motor acceleration time will depend of load conditions.
d x x x	**Ramp down time**	**d** 0 2 0	001-120	sec.	Sets Voltage ramp down time. Motor deceleration time will depend of load conditions. Enabled only if the parameter "Sxxx" is ON.
p x x x	**Kick start (1)**	**p** 0 0 0	000-999	ms.	During the time adjusted, provides 95% of full voltage to motor at starting time. Useful for high static-friction loads Enabled only if the parameter "Pxxx" is ON.
b x x	**DC Brake time (1)**	**b** 0 0	00-99	sec.	Provides DC braking at stopping time. Enabled only if the parameter "Bxxx" is ON.
I x x x	**DC Brake Current (1)**	**I** 0 5 0	000-250	%	% I_n

Note: (1) Parameters "p ", "b " and "I " are disabled while "C" is ON.

4-5-2. Programmable basic functions

Display	Function	Default	Range	Description
S x x x	**Soft stop selector**	**S** O F F	OFF, ON, I3, I4	Enables or disables all modes of Soft stop.
C x x x	**Pump control selector**	**C** O F F	OFF, ON, I3, I4	Enables the Pump control function. Usefull to limit fluid hammering. The parameter "Sxxx" must also be enabled. NOTE: Parameters "p ", "b " and "I " are disabled while "C" is ON
S T X X	**Pump curve selection at starting phase**	**S T** 0 2	00-03	Choice of various pump control algorithms for starting: **0**: Voltage ramp up **01-03**: Various pump algorithms
S P X X	**Pump curve selection at stopping phase**	**S P** 0 2	00-05	Choice of various pump control algorithms for stopping phase: **0**: Voltage ramp down **01-05**: Various pump algorithms

Notes:

- Curve 0 (both ST00, SP00): Standard voltage ramp up -starting- and ramp down -soft stop-
- Curve 1 (both ST01, SP01): Pump Algorithm based on estimated average PF -power factor- , with large sampling period.
- Curve 2 (both ST02, SP02): Pump Algorithm based on instantaneous PF with short sampling period.
- Curve 3 (both ST03, SP03): Pump Algorithm based on estimated average PF with short sampling period. Application: low pressure system/low flow rate change.
- Curve 4 (SP04): Same as Curve 3, but with higher accuracy on PF average estimation. Application: high head pressure/low flow rate change.
- Curve 5 (SP05): Pump Algorithm based on former ASTAT-CD.

P x x x	**Kick start selector**	**P** O F F	OFF, ON, I3, I4	Enables or disables the Kick start function. If Pump control function “C” is enabled, both Kick start and DC Brake functions are internally disabled.
F x x x	**Override selector**	**F** O F F	OFF, ON, I3, I4	When this function is enabled, the unit provides constant full voltage after starting, producing the lowest harmonic distortion. Note that the energy saving function is disabled when Override is enabled.

Programmable Basic Functions (follow from previous page)

z x x x	**By-pass selector**	**z** O F F	OFF, ON, I3, I4	This function provides control of an external by-pass contactor, significantly lowering heating losses and eliminating harmonics. When the By-Pass function “z” is enabled, the programmable relay output 2r is automatically assigned to this function, and must be used to control the external by-pass contactor.
B x x x	**DC Brake selector**	**B** O F F	OFF, ON, I3, I4, PON, PI3, PI4	Enables or disables the DC brake function. When the DC Brake function “B” is enabled, the programmable relay output 3r is automatically assigned to this function. PON, PI3 or PI4 settings enable the DC Brake function just before starting the motor. This is usefull to stop a fan which is rotating in reverse at the starting time.

4-6. Advanced block parameters *-ADV-*

4-6-1. Advanced functions

Display	Function	Default	Range	Unit	Description
L K x x	**Lock-out**	**L K** 0 2	00-45	min.	Sets time between consecutive starts. Setting "0" disables this function.
R x x x	**E2PROM reading**	**R** O F F	ON, OFF	-	Loads the parameters from the E2PROM to the temporal buffer.
Q x x x	**Factory settings**	**Q** O F F	ON, OFF	-	Loads default factory settings to the temporal buffer. Resave to E2PROM if default settings are desired.
Y x	**Retry**	**Y** 0	0-4	-	Allows up to four tries of automatic restart after a fault. Setting “0” disables this function.
y x x	**Retry time**	**y** 1 0	01-99	sec.	Time between retries.
U V x x	**Undervoltage (1)**	**U V** 0 0	00-50	%	The unit trips if the line voltage decreases below the percentage set. Setting “0” disables this protection. **NOTE:** Perform voltage calibration procedure on page 4-5 before enabling this protection.
u v x x	**Undervoltage trip time**	**u v** 2 0	00-99	sec.	Delay trip time.
O V x x	**Overvoltage (1)**	**O V** 0 0	00-30	%	The unit trips if the line voltage increases above the percentage set. Setting “0” disables this protection. **NOTE:** Perform voltage calibration procedure on page 4-5 before enabling this protection.
o v x x	**Overvoltage trip time**	**o v** 2 0	00-99	sec.	Delay trip time.
U C x x	**Undercurrent**	**U C** 0 0	00-99	%	The unit trips if the current decreases below the percentage set. Setting “0” disables this protection. **NOTE:** Perform current calibration procedure on page 4-5 before enabling this protection.
u c x x	**Undercurrent trip time**	**u c** 2 0	00-99	sec.	Delay trip time.
O C x x	**Overcurrent**	**O C** 0 0	00-50	%	The unit trips if the current increases above the percentage set. Setting “0” disables this protection. **NOTE:** Perform current calibration procedure on page 4-5 before enabling this protection.
o c x x	**Overcurrent trip time**	**o c** 2 0	00-99	sec.	Delay trip time.
2 a x x	**Dual ramp up**	**2 a** 1 5	01-99	%	These are a secondary set of ramp up, ramp down and starting torque parameters, which take over the primary "a", "d" and "T" when the programmable function “A” is enabled.
2 d x x	**Dual ramp down**	**2 d** 2 0	01-99	%	
2 T x x	**Dual starting torque**	**2 T** 2 0	10-90	%	

Note: (1) Monitors L1

4-6-2. Programmable advanced functions

Display	Function	Default	Range	Description
D x x x	**Linear ramp**	**D** O F F	OFF, ON, I3, I4	This function provides linear acceleration and deceleration ramps in a wider range of load conditions using tachogenerator feedback. A DC Tacho-Generator coupled to motor must be used to provide an analog signal feedback of 0-5VDC to terminals 7 and 8.
J x x x	**Slow speed**	**J** O F F	OFF, I3, I4	This function enables slow speed operation Maximum operation time 120sec.
j x x	**Speed changeover**	**j** L O	LO, HI	LO: Low Speed, 7% of rated speed. HI: High Speed, 14% of rated speed.
r x x x	**Reverse**	**r** O F F	OFF, ON, I3, I4	Reverse direction is allowed in "High slow speed" mode only. It provides 20% of rated speed.
A x x x	**Dual motor selector**	**A** O F F	OFF, ON, I3, I4	This function allows dual motor control settings of acceleration, deceleration and starting torque, and is useful to start or stop a motor in diferent load conditions. When this function is enabled, the parameters 2a, 2d and 2T take over the parameters a, d and T. It allows dual motor control settings.
X x x x	**Remote control selector**	**X** O F F	OFF, ON, I3, I4	Allows serial communication control by SG, TD and RD terminals. Check Appendix section for more details
X P x x	**Comunication protocol**	**X P** 0 0	00-02	Sets serial communications protocol **0**: ASCII **1**: Future use **2**: Future use
s x x x	**Station number**	**s** 0 0 1	001-247	ASCII protocol allows a maximum of 90 stations only.

4-6-3. Programmable relay output functions

Display	Function	Default	Range	Description
1 r x x	**Output relay 1r**	**1 r** 2 5 (RUN)	22-30	This is a programmable relay with one NO / NC dry contact to ASTAT-CD Plus terminals 11-12-14.
2 r x x	**Output relay 2r**	**2 r** 2 0 (EOR)	20, 22-30	This is a programmable relay with one NO dry contact to ASTAT-CD Plus terminals 23-24. This relay is automatically assigned to BY-Pass control if the function “z” is ON. Any other assignment by the user is overwritten in this case.
3 r x x	**Output relay 3r**	**3 r** 2 1 (DC Brake)	21-30	This is a programmable relay with one NO dry contact to ASTAT-CD Plus terminals 33-34. This relay is automatically assigned to DC-Brake control if the function “B” is ON. Any other assignment by the user is overwritten in this case.

The programmable relays can be set to the functions shown in the following table:

Range	Function	Remarks
20	EOR	Detects end of voltage ramp. **-This function may only be assigned to relay 2r-**
21	DC Brake	DC Brake control command **-This function may only be assigned to relay 3r-**
22	FAULT	Detects unit Fault status. ON is normal status and switches OFF if a fault occurs
23	Undervoltage	Detects Undervoltage according limit adjusted in function “UV”
24	Overvoltage	Detects Overvoltage according limit adjusted in function “OV”
25	RUN	Detects unit RUN status
26	Slow Speed	Detects slow speed status
27	Undercurrent	Detects Undercurrent according limit adjusted in function “UC”
28	Overcurrent	Detects Overcurrent limits as adjusted in function “OC”
29	Disabled	Disables the relay function
30	Future use	

4-7. Application and basic settings

Different applications will require different characteristics and settings for the ASTAT-CD Plus. The table below lists typical settings for various applications.

Parameters (1)	Display Parameter	Settings (X X X)					
		Factory Default	Compressor	Mill	Fan	Machine Tool	Pump Control
Nominal motor current	N x x x	100					
Current limit	L x x x	400	375	400			
Initial torque	T x x x	025	030	035		020	020
Acceleration ramp time	a x x x	015	015	030	030	015	
Deceleration ramp time	d x x x	020					040
Kick start time (2)	p x x x	000		100			
Soft stop	S x x x	OFF					ON
Pump control	C x x x	OFF					ON
Pump curve starting	S T x x	02					02
Pump curve stopping	S P x x	02					02
Kick start	P x x x	OFF		ON			
Overload trip curve(3)	o x x x	ooN2	ooN2	ooN2	ooC2	ooC1	ooC1
Service Factor(3)	f x x x	100					

Notes: **(1)** = GBAS Block Parameters unless noted(2)(3)
(2) = Parameter "p" is disabled while "C" is ON.
(3) = GCAL Block Parameters

4-8. Saving parameters to E2PROM

Advance the display to **K000** with the **C/V** and up arrow button.

Change the parameter to **K069** with the up arrow button.

With **K069** displayed, press the enter button.

Display will show **SET** momentarily and then display **K ON.**

Advance the display to **WOFF** with the **C/V** and up arrow button.

Change parameter to **W ON** by using the up arrow button.

With **W ON** displayed, press the enter button.

Display the show **SET** momentarily and then display **WOFF.**

5-1. Equipment installation

CAUTION! DISCONNECT POWER BEFORE INSTALLING OR SERVICING

ONLY SPECIALIZED PERSONNEL SHOULD INSTALL THE EQUIPMENT AND ONLY AFTER HAVING READ THIS USER'S GUIDE.

THE USER IS RESPONSIBLE FOR ANY PHYSICAL INJURY OR MATERIAL DAMAGE RESULTING FROM MISHANDLING THE EQUIPMENT.

5-2. General

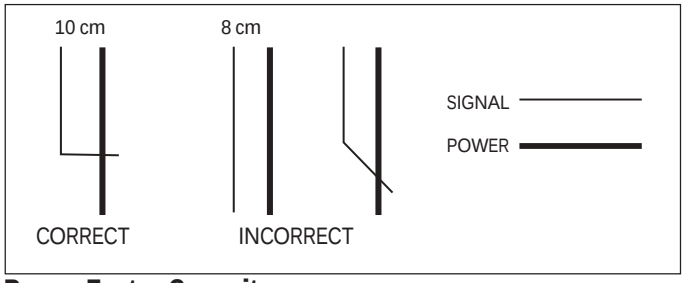
Terminal Connections

Use minimum of 75°C copper wire only for connections to ASTAT-CD Plus terminals. The minimum wire size must conform to the 75°C table according to applicable electrical codes. Tighten connections to the torque values given below. Supply conductors should have, as a minimum, the same cross section as a full voltage starter.

Catalog Numbers	Wire Range	Torque, in-lb
QC*FDP - QC*KDP	#14 - #3 AWG	40
QC*LDP - QC*MDP	#14 - #2 AWG	125
QC*NDP - QC*QDP	#6 AWG - 350kcmil	275
QC*RDP - QC*SDP	#2 AWG - 2x250 or 1x600kcmil	550
QC*TDP	#4 AWG - 6 x350kcmil	275
QC*UDP	#4 AWG - 4x250 or 2x600kcmil	550
QC*VDP	#4 AWG - 3x600kcmil	500

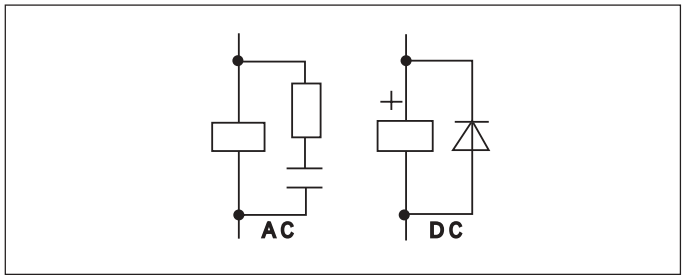
Signal Wiring

Signal wiring should be no longer than 18 feet (up to 80 feet when using shield cable). It must be separated from power wires (line, motor, commands relays, etc.) by at least four inches and, if they cross, they should do so at a 90° angle.



Coil Surge Suppression

Relays and contactors located in the same housing as the equipment should have an RC suppressor parallel to the coil (or a reverse diode, if controlled by DC).



Power Factor Capacitors

Do not install capacitors to correct the power factor between equipment output and motor.

Transformers

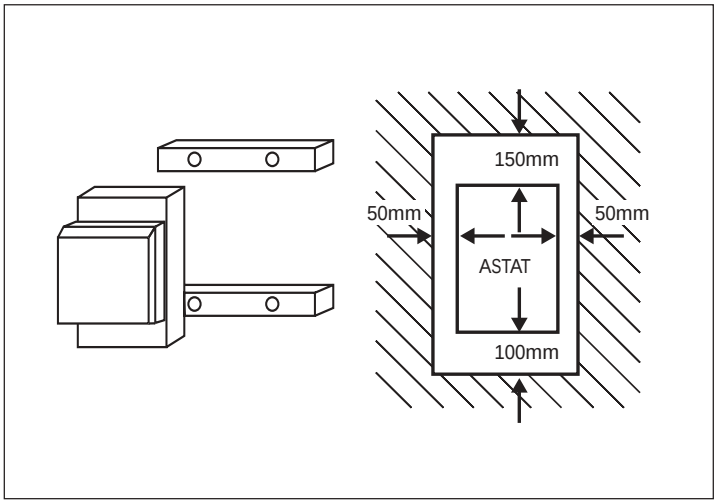
If the equipment is fed by a line transformer, its rated power should be at least 1.5 times, but less than 10 times, higher than equipment supply.

Environment

When installing equipment, keep the following points in mind:

- The equipment should be installed vertically and hang over a platform or bars. The vertical position is essential for proper cool air circulation.
- Environmental conditions are in accordance with the following ranges and maximum values:
  - Operating temperature: 0°C to +55°C
  - Relative humidity (without condensation): 95%
  - Maximum altitude: 3000m

  Reduce rating by 1.5% / °C from 40°C and 1% / 100m from 1000m
- Do not install equipment in environments containing explosive or flammable gases, or near important heat sources.
- Equipment should be well ventilated, with minimum keeping clearances as indicated in the illustration.
- When equipment is to be mounted on a platform subject to strong vibrations, there should be an elastic base to protect the equipment.
- When mounted in an enclosure, the temperature inside the enclosure must be kept within the range of 0-45°C (32-113°F).



5-3. Fuses, contactors and supply wiring

IEC Class 10 Ratings Cat Number	In A	Total losses 100% In W	Fuses aM (F1) A	Fuses FERRAZ type (XX=according mech. design)	Fuses BUSSMANN type (Typower Sicu 660V~) Size	 In	Control voltage Fuse A	 Consumpt. VA	Contactor DC 1	Contactor DC 3 (2)	Conductor section mm^2
QC _ F DP	17	67	25	6,600 CP URC 14.51/40	00	40	1	18	CL02	CL02	4
QC _ G DP	21	78	32	6,6 URD 30 XX 0063	00	50	1	18	CL03	CL03	4
QC _ H DP	27	88	40	6,6 URD 30 XX 0080	00	80	1	18	CL04	CL03	6
QC _ I DP	38	116	63	6,6 URD 30 XX 0100	00	100	1	18	CL45	CL04	10
QC _ J DP	58	208	80	6,6 URD 30 XX 0125	00	125	2	55	CL07	CL45	16
QC _ K DP	75	277	100	6,6 URD 30 XX 0160	00	160	2	55	CL08	CL06	25
QC _ L DP	86	302	125	6,6 URD 30 XX 0160	00	200	2	55	CL09	CL06	35
QC _ M DP	126	389	200	6,6 URD 30 XX 0250	00	250	2	55	CK75	CL07	50
QC _ N DP	187	719	250	6,6 URD 30 XX 0315	00	315	2	78	CK08	CL10	95
QC _ Q DP	288	1097	400	6,6 URD 31 XX 0500	2	550	2	78	CK95	CK85	185
QC _ R DP	378	1286	500	6,6 URD 31 XX 0630	2	630	4	118	CK10	CK85	240
QC _ S DP	444	1374	630	6,6 URD 32 XX 0800	2	800	4	118	CK11	CK95	Bus bar (1)
QC _ T DP	570	2086	800	6,6 URD 33 XX 1000	3	1000	4	118	CK12	CK10	Bus bar (1)
QC _ U DP	732	2352	1000	6,6 URD 33 XX 1250	3	1250	4	248	CK12	CK10	Bus bar (1)
QC _ V DP	1020	3000	1250	6,6 URD 233 XX 2000	-	-	4	248	CK13	CK11	Bus bar (1)
QC _ X DP	1290	3839	2x800	6,6 URD 233 XX 2000	-	-	4	248	CK13	CK12	Bus bar (1)

IEC Class 20 Ratings Cat Number	In A	Total losses 100% In W	Fuses aM (F1) A	Fuses FERRAZ type (XX=according mech. design)	Fuses BUSSMANN type (Typower Sicu 660V~) Size	 In	Control voltage Fuse A	 Consumpt. VA	Contactor DC 1	Contactor DC 3 (2)	Conductor section mm^2
QC _ F DP	14	56	20	6,600 CP URC 14.51/40	00	40	1	18	CL01	CL01	4
QC _ G DP	17	65	25	6,6 URD 30 XX 0063	00	50	1	18	CL02	CL02	4
QC _ H DP	22	74	32	6,6 URD 30 XX 0080	00	80	1	18	CL03	CL03	4
QC _ I DP	32	99	63	6,6 URD 30 XX 0100	00	100	1	18	CL04	CL04	6
QC _ J DP	48	178	80	6,6 URD 30 XX 0125	00	125	2	55	CL06	CL04	10
QC _ K DP	63	236	80	6,6 URD 30 XX 0160	00	160	2	55	CL07	CL04	16
QC _ L DP	72	257	100	6,6 URD 30 XX 0160	00	200	2	55	CL08	CL06	25
QC _ M DP	105	325	160	6,6 URD 30 XX 0250	00	250	2	55	CL10	CL06	35
QC _ N DP	156	591	200	6,6 URD 30 XX 0315	00	315	2	78	CK75	CL07	70
QC _ Q DP	240	901	315	6,6 URD 31 XX 0500	2	550	2	78	CK85	CK75	120
QC _ R DP	315	1063	400	6,6 URD 31 XX 0630	2	630	4	118	CK95	CK85	185
QC _ S DP	370	1136	500	6,6 URD 32 XX 0800	2	800	4	118	CK10	CK85	240
QC _ T DP	475	1721	630	6,6 URD 33 XX 1000	3	1000	4	118	CK11	CK95	Bus bar (1)
QC _ U DP	610	1950	800	6,6 URD 33 XX 1250	3	1250	4	248	CK12	CK10	Bus bar (1)
QC _ V DP	850	2491	1000	6,6 URD 233 XX 2000	-	-	4	248	CK13	CK10	Bus bar (1)
QC _ X DP	1075	3168	1250	6,6 URD 233 XX 2000	-	-	4	248	CK13	CK12	Bus bar (1)

(1) As per IEC 947 (2) The 3 contacts of DC3 must be connected in parallel

Branch circuit protection, UL

	Gould-Shawmut, semi-conductor fuses				Short-Circuit Rating Max @480V		
Cat Number	Type A50QS [1]	Type A50P[2]	Max. Fuse Rating Class RK5 & J	Max. Circuit Breaker Size	Non-Combination	Combination	<Remarks>
QC _ F DP	50A	-	30A	35A	25KA	5KA	
QC _ G DP	60A	-	35A	40A	25KA	5KA	
QC _ H DP	80A	-	40A	50A	25KA	5KA	
QC _ I DP	100A	-	70A	80A	25KA	5KA	
QC _ J DP	150A	-	100A	125A	25KA	10KA	
QC _ K DP	200A	-	125A	150A	25KA	10KA	
QC _ L DP	225A	-	150A	150A	25KA	10KA	
QC _ M DP	350A	-	200A	250A	25KA	10KA	
QC _ N DP	450A	-	350A	350A	65KA	25KA	
QC _ Q DP	600A	-	500A	600A	65KA	25KA	
QC _ R DP	2X500A in parallel	-	600A	700A	65KA	25KA	
QC _ S DP	2x600A in parallel	-	600A	800A	65KA	25KA	
QC _ T DP	-	2x1000A in parallel	-	800A	65KA	30KA [*2]	
QC _ U DP	-	2x1200A in parallel	-	1000A	65KA	30KA [*2]	
QC _ V DP	-	2x1600A in parallel	-	1200A	65KA	65KA	

(1) Suitable for use on a circuit capable of delivering not more than 100KA RMS symetrical amperes, for 208V, 240V and up to 480V maximum, when used with the semi-conductor fuse for short-circuit protection. Listed with Gould Shawmut Form 101, Type A5QS or A50P.

(2) Suitable for use on a circuit capable of delivering not more than 65KA RMS symetrical amperes, for 208V, 240V and up to 480V maximum, when used with contactors (isolation or by-pass) that are also rated for 65KA withstand.

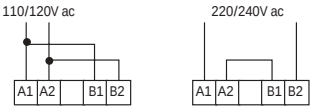
NOTE: When ASTAT-CD Plus reduced voltage starters are used in conjunction with semi-conductor fuses, Type 2 Coordination to IEC 947-4 is attained. These fuses are recommended for best overall short-circuit protection. The semiconductor fuse specified may provide branch circuit protection. Refer to local applicable electrical codes.

5-4. Start-up

- Make sure equipment wiring corresponds to one of the recommended routing diagrams or equivalent.

- If the motor has thermal protection sensor, remove the link between terminals 5 and 6 prior to wire the sensor

- Make sure the control wire harness corresponds to the control voltage used.



- Adapt equipment rated current to motor, setting the motor current In.

$$N\,x\,x\,x\,;\ x\,x\,x = \frac{I_n}{I_r} \times 100$$

1. Enter the motor nameplate full load amperes: (I_n) _____
2. Enter the ASTAT-CD Plus nameplate full load amperes: (I_r) _____
3. Divide Line 1 by Line 2 and multiply by 100. This is your N parameter value. _____
4. Enter the facility or installation maximum allowable amperes: _____
5. Divide Line 4 by Line 1 and multiply by 100. This is your maximum allowable L parameter value governed by facility limitations. _____
6. Divide 450 by Line 3 and multiply by 100. If the result is greater than 700, enter 700. This is you maximum allowable L parameter value governed by ASTAT-CD Plus limitations. _____
7. Enter the value of Line 5 or Line 6, whichever is lower. This is your maximum allowable L parameter value. _____

Factory setting

N 1 0 0

- Set starting parameters as needed:

L x x x = 450/N

$$L\,x\,x\,x = \frac{Im\ (start)}{In\ (motor)} \times 100$$

		Factory setting
Starting torque	T _ x x	T _ 2 5
Acceleration ramp time	a x x x	a _ 1 5
Kickstart	P ON/OFF/I3/I4	P OFF
Kickstart time	p x x x (if P enabled)	p 0 0 0
Current limit	L x x x	L 4 0 0

- Set overload trip curve as needed:

oxxx ; xx x OFF = disabled (extermal overload relay must be used
C1/C2 = IEC Class 10 or Class 20
N1/N2/N3= Nema 10, 20 or 30

Factory setting

o N2

- Set braking parameters as needed:

		Factory setting
Soft stop	S ON/OFF/I3/I4	S OFF
Decceleration ramp time	d x x x	d _ 2 0
DC injection brake	B ON/OFF/I3/I4	B OFF
DC braking time	b _ x x (if B enabled)	b 0 0 0
DC braking current	I x x x (if B enabled)	I 0 5 0

If you change the default configuration and wish to keep it, remember to rewrite the parameters in E2PROM as follows:
(See page 4-9 for details)

- Set parameter K to ON (ON = 69 + ↵)
- Set parameter W to ON
- Press ↵ (parameter W is set to OFF automatically)

- Send run command to equipment and make sure that operation is correct.

5-5. Troubleshooting

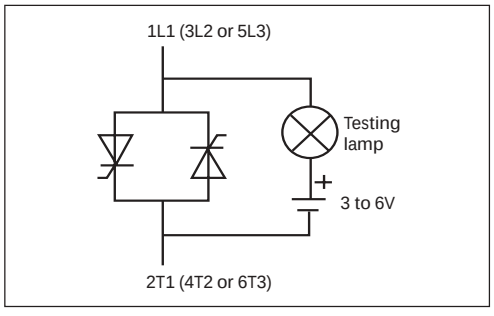
Symptom or Error & (Error Code)	Possible Cause	Measures to be taken
Display OFF	No control voltage Main breaker tripped or fuse blown	Check wire harness and control voltage
	F1 fuse blown on power supply PCB	Check and change, page 6-10
	Bad connection of flat ribbon wire joining power supply PCB to control PCB	Verify connectors Check Power Supply Board and Logic Board for 5VDC. Use a DC voltmeter on the Power Supply Board, (-) lead of voltmeter on the top lead of C6 (located next to the black heatsink on the right edge of the Power Supply Board) and the (+) lead of voltmeter on top lead of Diode AD21 or R25 (located on the upper right corner of the Power Supply Board).
Fans not running	No voltage to fans	Verify voltage and connections
Equipment does not respond to STOP / START controls	F2 fuse blown on power supply PCB	Check and change, page 6-10
Motor will not start but display shows – Ramp, Full, etc.	No power to gate circuits	Check 12VDC on Power Supply Board. Use a DC voltmeter on the Power Supply Board, (-) lead of voltmeter on the top lead of C6 (located next to the black heatsink on the right edge of the Power Supply Board) and the (+) lead of voltmeter on bottom lead of Diode AD20 (located near the lower left corner of the black heatsink on the Power Supply Board).

Symptom or Error & (Error Code)		Possible Cause	Measures to be taken
Frequency error (admits 45Hz ≤ f main ≤ 65Hz)	**(Ex10)**	No **1L1** phase or frequence is out of range	Check **1L1** phase and/or mains frequence
Overload trip	**(Ex11)**	Excessive load or excessive current during starting	Verify overload conditions during starting time and steady state. Check settings in parameters "Nxxx", "Lxxx", and "oxxx"
Synchronism loss	**(Ex13)**	Phase **1L1** lost	Check **1L1** phase
Phase A, B, C thyristor	**(Ex14)** **(Ex15)** **(Ex16)**	Short circuited thyristor	Check thyristor module Check ground connections and voltage to ground Poor ribbon cable connection
		No output phases	Check **2T1, 4T2** and **6T3** phases
Heatsink thermostat	**(Ex17)**	Heatsink thermostat tripped by overheating or defective	Check for adequate ventilation Check thermostat and wiring
Motor thermistor	**(Ex18)**	Motor thermistor tripped by overheating or defective	Check thermistor and wiring, if no thermistor terminal 5 and 6 must be jumpered
Phase A, B, C loss	**(Ex19)** **(Ex20)** **(Ex21)**	No input / output phases	Check power wire harness for **1L1, 3L2, 5L3, 2T1, 4T2** and **6T3**
		Defective thyristor or ribbon wire harness loose or defective	Verify gate and cathode wire harness. Verify thyristors
Stalled rotor	**(Ex22)**	Equipment detected stalled motor rotor	Restart equipment and check for an appreciable loss in motor speed at any time
Internal error	**(Ex23)**	Micro-controller malfunction	Check IC1 and IC8 are correctly inserted in their sockets. Check for noise on control voltage power or line
Long start time	**(Ex25)**	Current limit condition present more than 2 x ta sec. or 240 sec. (ta = acceleration ramp time)	Increase current limit and / or acceleration ramp time
Long slow speed time	**(Ex26)**	Equipment has been in slow speed mode more than 120 sec.	Reduce time slow speed is engaged
Lock-out	**(Ex27)**	The time between startings is less that the adjusted in parameter "LKxx"	Check if settings are correct This protection may be disabled
Undervoltage **Overvoltage**	**(Ex28)** **(Ex29)**	The line voltage exceeds of limit set in parameters "UVxx" or "OVxx"	Check if settings are correct. This protection may be disabled
Undercurrent **Overcurrent**	**(Ex30)** **(Ex31)**	The motor current exceeds of limit set in parameters "UCxx" or "OCxx"	Check if settings are correct. This protection may be disabled
Retry	**(Ex32)**	The retry feature could not re-start the motor after a fault	Check last message "e1xx" and correct. Be sure that retry settings are correct as well.

5-6. Thyristor check

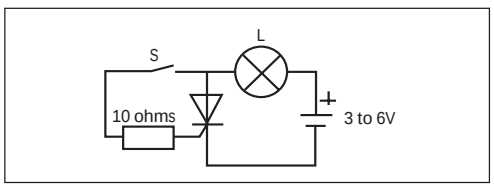
Shortcircuit

Use a testing lamp to check the defective power module between input and output phases.
If the lamp goes on, at least one of the thyristors has a short circuit.
With a tester, check the value or the R resistance between input and output of the same phase (connector B on main PCB must be previously removed).
If R < 50KΩ, at least one of the thyristors is defective.



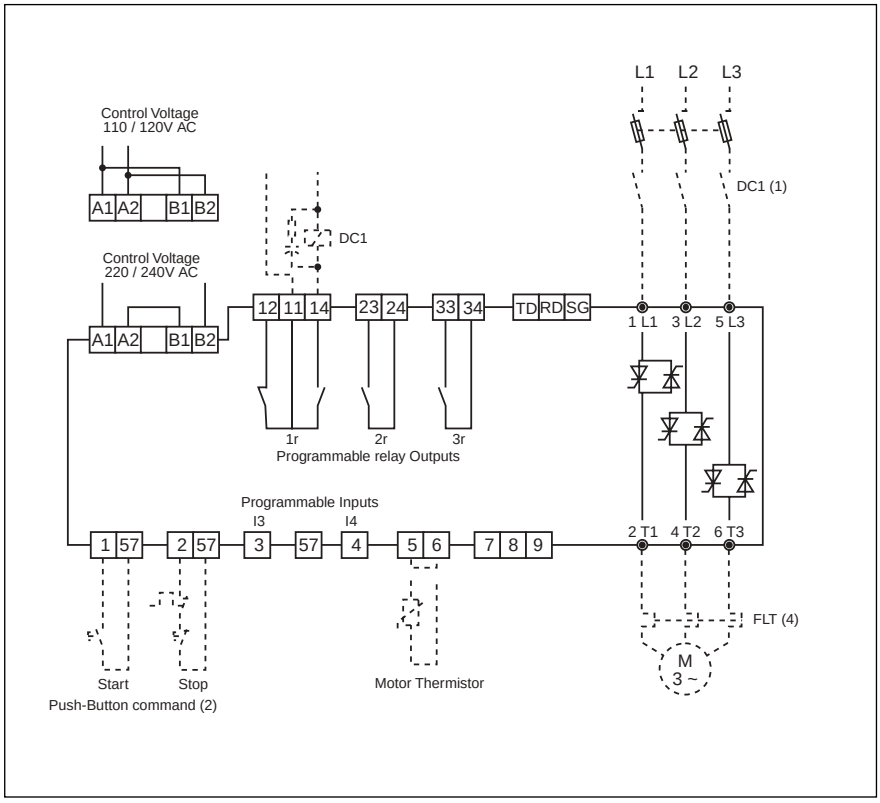
Open thyristor

With the simple assembly shown, the lamp should light when the S switch is closed and remain lit when open.
If not, the thyristor is defective.



6-1. Application diagrams

Basic diagram



REMARKS:

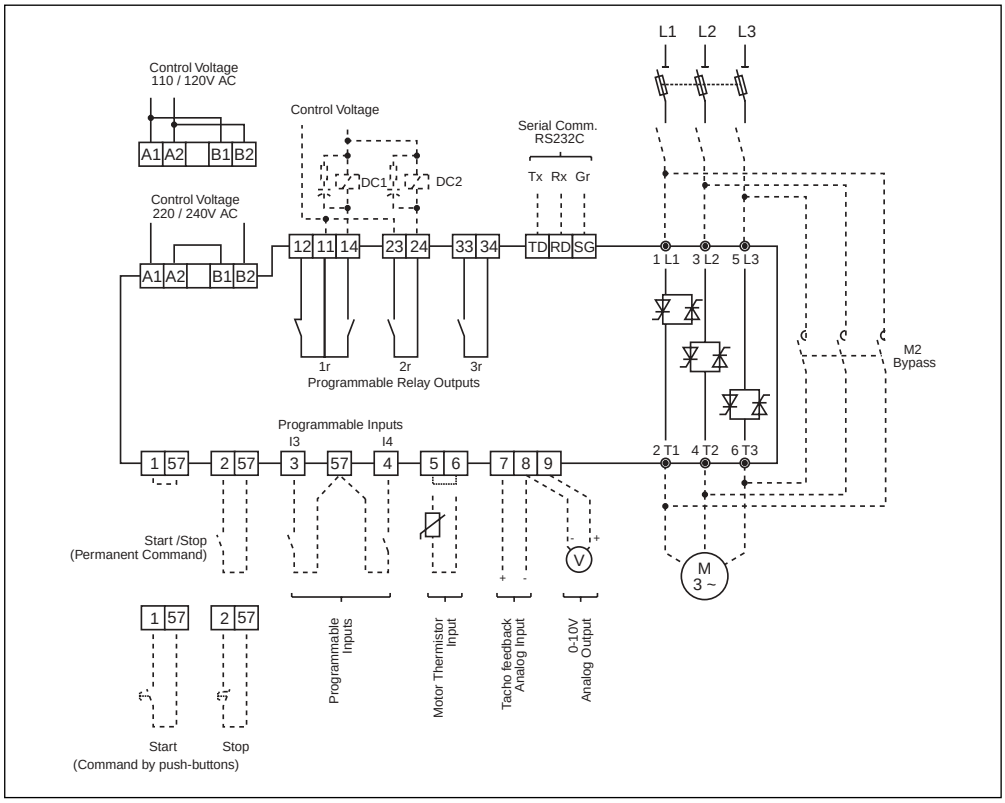
(1) The isolation contactor DC1, is not required to perform operation to the motor.
Be aware however that DC1 provides galvanic isolation from the incoming line increasing the safety.

(2) In this example, Start and Stop command is enabled by push-buttons. Permanent command is allowed as well, wiring 1, 2 and 57 terminals as shown on page 3-3.

(3) The output relays allow for direct action on contactors according to ratings specified on page 3-2 of this manual.

(4) The ASTAT-CD Plus is provided with an electronic motor overload protection, which should be adequate protection for most of the applications.
An external overload should be used if required by local codes or to protect the motor against current unbalance.

Basic diagram with by-pass control



REMARKS:

(1) The isolation contactor DC1, is not required to perform operation to the motor. Be aware however that DC1 provides galvanic isolation from the incoming line increasing the safety.

(2) In this example, Start and Stop command is enabled by permanent command. Push-button control is allowed as well, wiring 1, 2 and 57 terminals as shown on page 3-3.

(3) The output relays allow for direct action on contactors according to ratings specified in page 3-2 of this manual.

(4) CAUTION:
In by-pass mode an external overload relay must be used.

(5) By-pass control using function "zxxx" and external contactor DC2. Details given below.

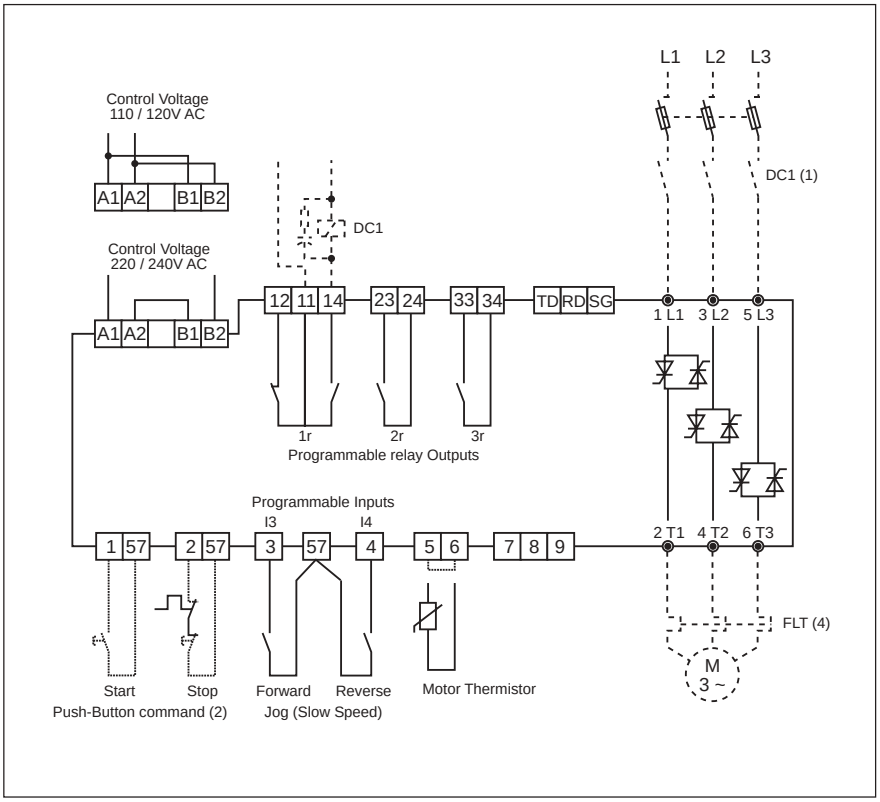
By-pass control. Programming steps

1. The by-pass function may be enabled by setting "zxxx" to ON. In this case the by-pass is automatically done after starting. An alternative, if "zxxx" is set to one of the programmable inputs "I3" or "I4", the by-pass may be controlled by one remote signal (5). Check section 4-5-2 for more details.

2. Once this function is enabled, the relay 2r is automatically assigned to this function (check section 4-6-3). This relay must be used to control the by-pass contactor.

6-1. Application diagrams

Basic diagram with jog (slow speed) function



REMARKS:

(1) The isolation contactor DC1, is not required to perform operation to the motor.
Be aware however that DC1 provides galvanic isolation from the incoming line increasing the safety.

(2) In this example, Start and Stop command is enabled by push-buttons. Permanent command is allowed as well, wiring 1, 2 and 57 terminals as shown on page 3-3.

(3) The output relays allow for direct action on contactors according to ratings specified on page 3-2 of this manual.

(4) The ASTAT-CD Plus is provided with an electronic motor overload protection, which should be adequate protection for most of the applications.
You should use an external overload protection if required by local codes or to protect the motor against current unbalance.

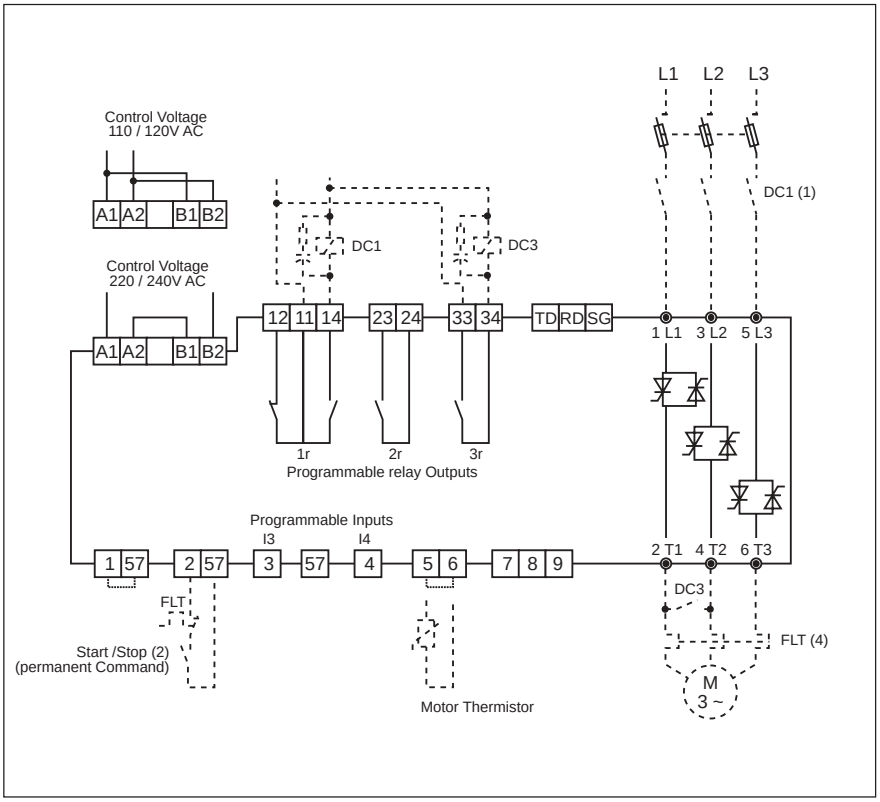
(5) Slow Speed for Jog forward or reverse using programmable inputs I3, I4. Details given bellow.

Jog (Slow Speed) function. Programming steps

1. The slow speed function may be enabled by setting "Jxxx" to I3. In this case Slow Speed is allowed by a push-button wired to ASTAT-CD Plus's terminals 3-57.
Reverse jog is also possible by setting "rxxx" to ON. As alternative, if "rxxx" is set to programmable input I4, forward or reverse may be controlled by remote push-button signal (5). Check section 4-6-3 for more details.

2. Slow Speed can be effected with ASTAT-CD Plus in stop status. Slow speed and normal run commands are internally interlocked.

Basic diagram with DC brake injection



REMARKS:

(1) The isolation contactor DC1, is not required to perform operation to the motor.
Be aware however that DC1 provides galvanic isolation from the incoming line increasing the safety.

(2) In this example, Start and Stop command is enabled by permanent command. Push-buttons control is allowed as well, wiring 1, 2 and 57 terminals as shown on page 3-3.

(3) The output relays allow for direct action on contactors according to ratings specified in page 3-2 of this manual.

(4) The ASTAT-CD Plus is provided with an electronic motor overload protection, which should be adequate protection for most of the applications.
An external overload relay should be used if required by local codes or to protect the motor against current unbalance.

(5) DC brake at stopping time is provided by the DC brake function and external contactor DC3.
CAUTION:
The 3 contacts of DC3 must be connected in parallel. Mandatory between 2T1 and 4T2 phases, otherwise a short-circuit can occur

DC brake function. Programming steps

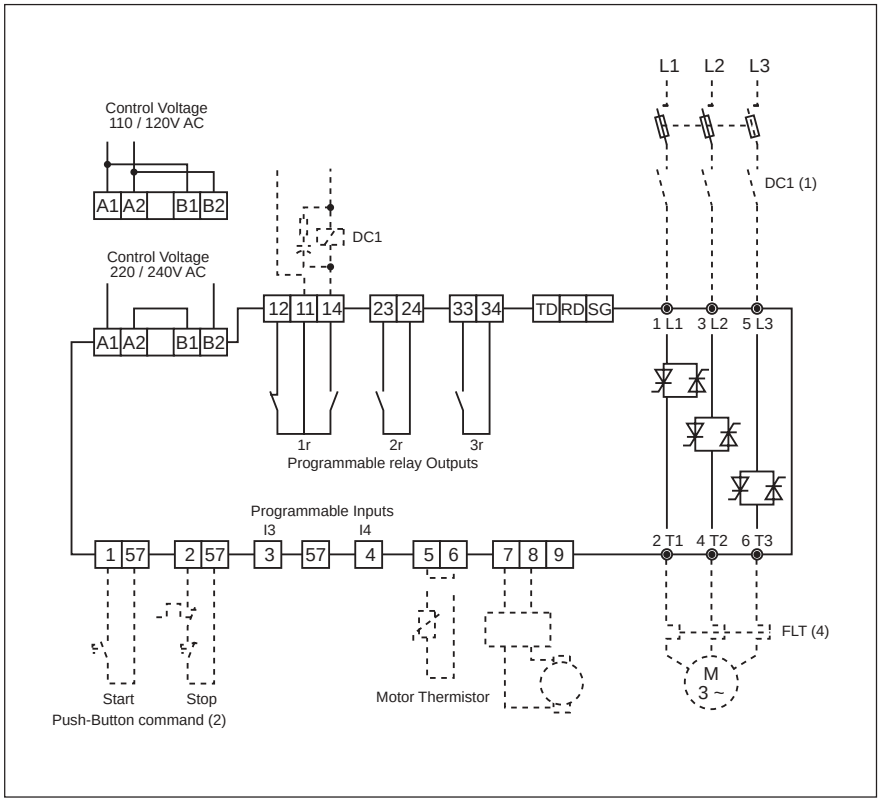
1. The DC function may be enabled by setting "Bxxx" to ON.

2. Once this function is enabled, the relay 3r is automatically assigned to this function. This relay must be used to control the DC brake contactor.

Check section 4-5-1 and 4-5-2 for more details

6-1. Application diagrams

Basic diagram with linear ramp



REMARKS:

(1) The isolation contactor DC1, is not required to perform operation to the motor.
Be aware however that DC1 provides galvanic isolation from the incoming line increasing the safety.

(2) In this example, Start and Stop command is provided by push-buttons. Permanent command is allowed as well, wiring 1, 2 and 57 terminals as shown on page 3-3.

(3) The output relays allow for direct action on contactors according to ratings specified in page 3-2 of this manual.

(4) The ASTAT-CD Plus is provided with an electronic motor overload protection, which should be adequate protection for most of the applications.
An external overload relay should be used if required by local codes or to protect the motor against current unbalance.

(5) Linear ramp provided by "Dxxx" function. A tacho generator must be used as feedback. Details given bellow.

Linear ramp function. Programming steps

1. The linear ramp function may be enabled by setting "Dxxx" to ON. In this case, linear ramp is independent of the load.
This function needs the speed feedback provided by an external tacho generator. Check section 4-6-2 for more details.

6-2. Serial communications

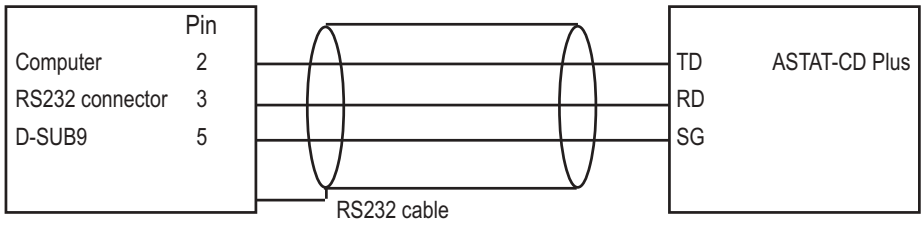
ASTAT-CD Plus is able to send and receive data through a serial RS232 port. Within this port ASTAT-CD Plus communicates with a host PC.

For RS232 ASCII communications, parameter "XP" must be set to 0.

6-2-1. RS232 port, wiring and communications settings

RS232 is an operating standard of communication only in terms of electrical characteristics (voltage, timing, etc.) while the communication procedures are defined by ASCII.
The maximum allowed RS232 cable length is 3 meters. ASTAT-CD Plus uses a connector with only 3 pins: TD, RD, SG.

Astat Terminal	Name
TD	Transmit Data
RD	Receive Data
SG	Signal Common



The following table indicates the communications setting used by ASTAT-CD Plus to perform data communication via its serial port.

Name	Setting	Description
Baud Rate	9600 bps	Bits per second transmission rate
Parity	None	Data error checking method
Data Bits	8	Number of data bits in each transmission
Start Bits	1	Number of bits to indicate beginning of transmission
Stop Bits	2	Number of bits to indicate ending of transmission
Data	ASCII	Communications protocol used
Handshaking	None	No need to request to send or clear to send

6-2-2. ASCII protocol

To select this communications protocol, XP must be set to 0.
It is possible to operate the ASTAT-CD Plus from a host using standard ASCII characters. Two functions are available to be able to READ and WRITE parameters.

Write Parameters to ASTAT-CD Plus:
To write data into a parameter, the command format is the following:

Request from host : **:ssWxxxyyy↵**

Response from the ASTAT : **:ssWxxxyyy↵**

where '**:**' is a char to indicate the command start, '**ss**' is the station address, '**xxx**' (3 bytes needed) is the parameter number, and '**yyy**' (3 bytes needed) is the value to write into the parameter. The '↵' is the return key to indicate the command stop.

Note: the parameters modification is not allowed while the motor is operating.

Read Parameters from ASTAT-CD Plus:
To read a parameter, the command format is the following:

Request from host : **:ssRxxx↵**
Response from the ASTAT : **:ssRxxxyyyyy↵**

where '**:**' is a char to indicate the command start, '**ss**' is the station address, '**xxx**' (3 bytes needed) is the parameter number, and '**yyyyy**' (5 chars response) is the value of the parameter. The '↵' is the return key to indicate the command stop.

Examples:
If we are trying to communicate with station 2:

- to start the unit, the command will be: **:02W060000↵**
- to stop the unit, the command will be: **:02W060001↵**
- to set the acceleration ramp time to 35 sec., the command will be: **:02W005035↵**
- to know which overload curve is selected, the command will be: **:02R016↵** ; (if, for instance the response is **:02R01600004↵**, this means that the overload curve selected is IEC class 10).

The Table shown in 6-2-3 provides a complete reference for the parameters that can be controlled by the serial interface.

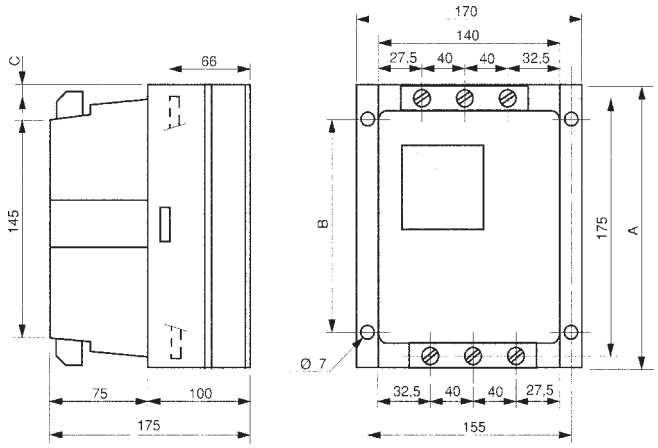
6-2-3. List of parameters that can be controlled by the serial interface

Parameter number	Parameter name	Function	Read/Write (R/W)	Range	Comments
0	Status	Soft starter status	R/-	0 - 14	0: ON 1: STOP 2: LOCK 3: Alarm (errors) 4: PULS 5: RAMP 6: FULL 7: SAVE 8: SOFT 9: DCBK 10: FULL (override) 11: Not used 12: INCH 13: TACH 14: PUMP
1	M	Motor current % I_n or Amps depending on UF parameter	R/-		
2	N	Nominal motor current (% I_n/I_r)	R/W	40-120	
3	L	Current limit (% I_m/I_n)	R/W	100-700	
4	T	Starting torque (% DOL torque)	R/W	10-90	
5	a	Acceleration ramp time (sec)	R/W	1-99	
6	d	Deceleration ramp time (sec)	R/W	1-120	
7	p	Kick start time (msec)	R/W	0-999	
8	b	DC brake time (sec)	R/W	0-99	
9	I	DC brake current (% I_n)	R/W	000-250	
10	S	Soft stop control	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
11	C	Pump control	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
12	P	Kick start control	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
13	F	Override	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
14	B	DC brake control	R/W	0-6	0: OFF 1: ON 2: I3 3: I4 4: PON 5: PI3 6:PI4
15	LK	Lockout (min.)	R/W	0-45	
16	o	Overload trip curve	R/W	0-5	0: OFF 1: N1 2: N2 3: N3 4: C1 5: C2
17		internal use			
18	W	Write EEPROM	-/W	1	
19	R	Read EEPROM	-/W	1	
20	—-	internal use			
21	v	Software version	R/-	xxx	vxxx
22	—-	internal use			
23	—-	internal use			

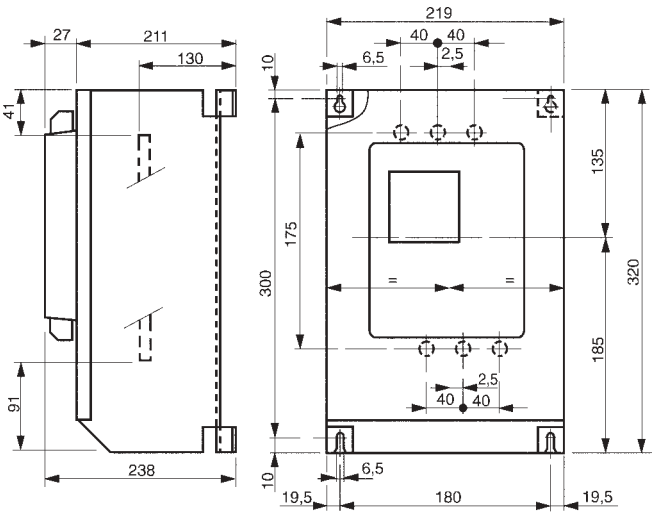
Parameter number	Parameter name	Function	Read/Write (R/W)	Range	Comments
24	1r	Programmable relay 11-12-14	R/W	22-30	See programmable relays functions in page 3-6
25	2r	Programmable relay 23-24	R/W	20,22-30	
26	3r	Programmable relay 33-34	R/W	21-30	
27	OC	Overcurrent ($\%I_n$)	R/W	0-50	0: OFF
28	oc	Overcurrent time (sec)	R/W	0-99	
29	r	Reverse slow speed	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
30	Y	Retry attempts	R/W	0-4	
31	y	Retry time (sec)	R/W	1-99	
32	UV	Undervoltage (%U)	R/W	0-50	0: OFF
33	uv	Undervoltage time (sec)	R/W	0-99	
34	OV	Overvoltage (%U)	R/W	0-30	0: OFF
35	ov	Overvoltage time (sec)	R/W	0-99	
36	UC	Undercurrent ($\%I_n$)	R/W	0-99	0: OFF
37	uc	Undercurrent time (sec)	R/W	0-99	
38	PF	Power factor (%)	R/-	00-99	
39	U	Nominal voltage (volt)	R/W	100-500	
40	V	Line voltage (volt)	R/-		
41	w	Power (KW*10)	R/-		
42	X	Local/remote control		0-3	0: OFF 1: ON 2: I3 3: I4
43	D	Linear ramp control	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
44	J	Slow speed control	R/W	0-2	0: OFF 1: I3 2: I4
45	j	Slow speed type	R/W	0-1	0: HI 1: LO
46	2a	Secondary acceleration ramp time (sec)	R/W	1-99	
47	2d	Secondary deceleration ramp time (sec)	R/W	1-99	
48	A	Dual ramp selection	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
49	UF	Unit frame	R/W	0-16	0: not defined 1 to 16: F to X frames
50	E	Elapsed time (hours)	R/-		
51	—-	internal use			
52	Q	Recall factory settings	-/W	1	
53	2T	Secondary starting torque (%DOL torque)	R/W	10-90	
54	m	Current calibration	R/-		
55	—-	internal use			
56	z	Bypass function	R/W	0-3	0: OFF 1: ON 2: I3 3: I4
57	—-	internal use			
58	f	Service factor ($\%I_n$)	R/W	100-130	
59	t	Voltage calibration	R/-	000-600	
60	RUN/STOP	RUN/STOP order	-/W		0: RUN 1: STOP
61	—-	internal use			
62	—-	internal use			
63	—-	internal use			
64	—-	internal use			

Parameter number	Parameter name	Function	Read/Write (R/W)	Range	Comments
65	—-	internal use			
66	—-	internal use			
67	—-	internal use			
68	—-	internal use			
69	—-	internal use			
70	ST	Pump Control selection curve	R/W	0-3	0 : standard voltage ramp 1-3 : Pump algorithms
71	—-	internal use			
72	—-	internal use			
73	SP	Pump Control selection curve	R/W	0-5	0 : standard voltage ramp 1-5 : Pump algorithms
74	—-	internal use			
75	—-	internal use			
76	—-	internal use			
77	—-	internal use			
78	—-	internal use			
79	—-	internal use			
80	—-	internal use			
81	—-	internal use			
82	—-	internal use			
83	XP	Communication protocol	R/W	0-2	0 : ASCII 1 : Future use 2 : Future use
84	s	Station number for communication	R/W	1-247	
85	e0xx	error e0	R/-		xx: error code
86	e1xx	error e1	R/-		xx: error code
87	e2xx	error e2	R/-		xx: error code
88	e3xx	error e3	R/-		xx: error code

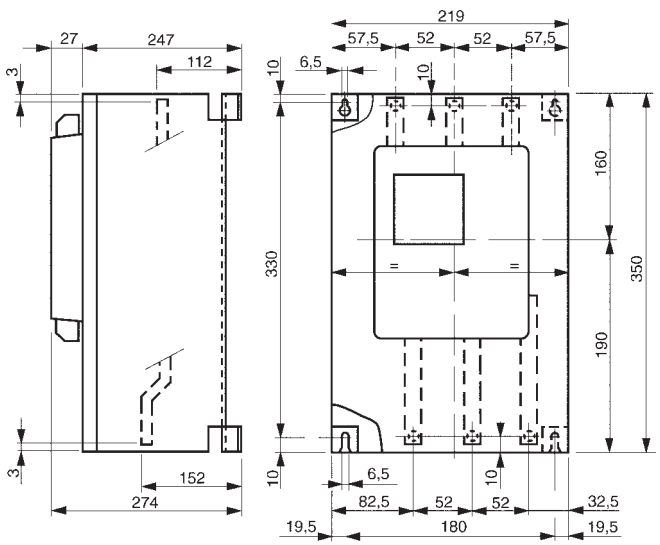
6-3. Dimensions



	A	B	C
QC_FDP	200	160	6
QC_GDP	200	160	6
QC_HDP	200	160	6
QC_IDP	250	200	31

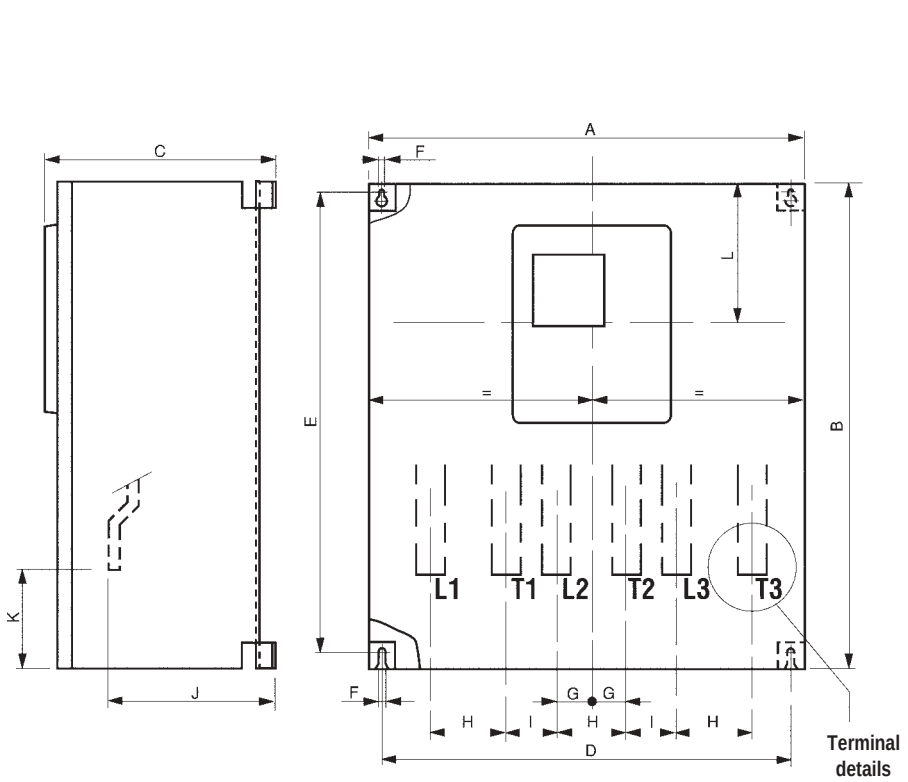


QC _ JDP , QC _ KDP

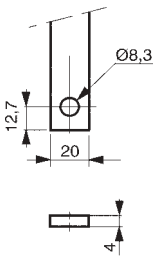


QC _ LDP , QC _ MDP

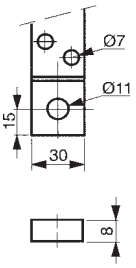
6-3. Dimensions



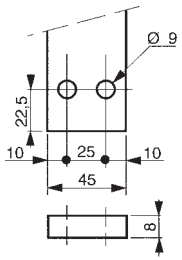
Terminal detail



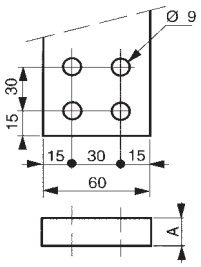
QC _ NDP
QC _ QDP



QC _ RDP
QC _ SDP

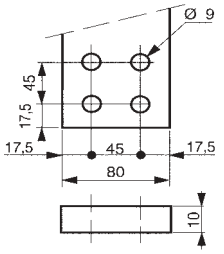


QC _ TDP



	A
QC _ UDP	6
QC _ VDP	10

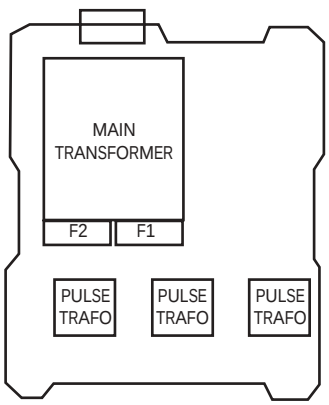
	A	B	C	D	E	F	G	H	I	J	K	L
QC_NDP	510	490	305	460	465	9	53	106	54	259	70	168
QC_QDP	510	490	305	460	465	9	53	106	54	259	70	168
QC_RDP	550	540	317	480	495	9	59	118	54	275	78	168
QC_SDP	550	540	317	480	495	9	59	118	54	275	78	168
QC_TDP	590	685	317	520	640	9	59	118	64,5	270	100	168
QC_UDP	790	850	402	700	805	11	60	120	120	352	120	175
QC_VDP	790	850	402	700	805	11	60	120	120	352	120	175
QC_XDP	810	1000	407	720	955	11	70	140	110	357	120	175



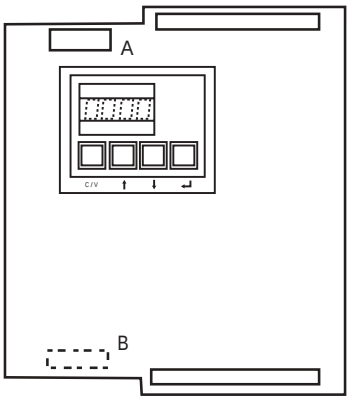
QC _ XDP
QC _ XDP

6-4. P.C.B.s layout

Supply



Control



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