GE Consumer & Industrial

ASTAT XT

User Manual

GE imagination at work

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 IS RECOMMENDED, CONFIGURED TO PROVIDE AUTOMATIC ISOLATION WHEN THE MOTOR IS TURNED OFF.

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-XT 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. ABNORMAL STARTING TIMES IN EXCESS OF 30 SECONDS, OR CLOSELY REPEATED OPERATIONS OF ACCELERATION RAMP/DECELERATION RAMP, SLOW SPEED, MAY CAUSE MOTOR DAMAGE. CONTACT MOTOR MANUFACTURER FOR PROPER MOTOR SELECTION.

5. IF CONTROL POWER IS LOST BETWEEN STARTS, THE OVERLOAD RELAY PROTECTION IS RESET TO COLD START CONDITIONS.

REMARKS:

1. Read this manual thoroughly before using the ASTAT-XT and store in a safe place for reference.

2. Make sure that this manual is delivered to the end user.

3. 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.

ASTAT-XT User Manual

1. GENERALITIES

1.1 Squirrel-Cage Motor Starting

There are numerous applications where soft starting and limited current peak are needed, thereby making direct starting of squirrel-cage motors impossible. Traditionally in such cases other types of starting with reduced stator voltage have been resorted to. The best-known are star-delta starters, autotransformer starters, stator resistance starters or using part winding motors.
Any reduced starting voltage imposes a current limitation, thus reducing the starting torque, but there will always be peaks during the change from one point or state to another which can damage the machine being driven.
Note that in general, all reduced voltage starts reduce torque in squared proportion to the current in the phases of the motor (not on the line) and the latter in turn is reduced in linear proportion to the voltage. From this it can be deduced that any start with reduced voltage reduces the torque in squared proportion to the voltage per motor phase. From this point of view soft starting produces just like any other reduced voltage start, a reduction in starting torque, according to the adjusted parameters. The advantage is the ease with which this ramp can be controlled to produce a soft start in accordance with the actual requirement of the machine.

1.2 Advantages of the ASTAT-XT Solid State Soft Starters

Increase in productivity and reliability with the use of static soft starters

Starting and stopping the motor without steps or transitions lengthens the life of power-driven machine mechanical elements, greatly reducing stress on transmission and coupling parts.
Consequently, overhauling times are reduced and machine and facility lifespans are lengthened.

Improvement in acceleration / deceleration characteristics

Being able to start by using the voltage ramp or alternatively by limiting current lets acceleration fit the load characteristics. Application of a pulse start may also be selected in cases of high static friction load.
Stopping may be made by cutting-off power or by soft stop ramp.

Protected motor

The soft starter protects the motor from overloads as well as from incorrect operating conditions such as loss of an input or output phase, blocked rotor, thyristor short circuit, etc.

Digital technology

The control system is based on the use of a highly specialized microcontroller by which signals are treated digitally, thereby avoiding deratings and adjustments common to analogue circuits and obtaining excellent precision and speed of execution.
The control board is made with the technology of surface mounting devices (SMD), which increases equipment reliability.

High level of immunity

Design of the unit was closely tied to the conditions of supply lines, which handle more disturbances every day. The control signals are opto-electronically isolated and various levels of protection have been set up in the circuits to immunize the equipment against external disturbance and its effects.

Easy to run and adjust

This unit can be used for a wide range of applications.
Adjustments are very easy to make and diverse options maybe selected for have equipment capabilities suited to application needs every time.

Easy maintenance due to full monitoring

The alphanumeric display and the LEDs on its front overlay makes the equipment working conditions known at any time.

Pump control

The ASTAT-XT includes several soft stop curves which is more effective than the standard soft stop, reducing fluid surges or hammering in a pipe line system. This method reduces the motor speed, by controlling internal parameters in the motor as well as the output voltage in a close-loop system.

Advanced functions

The ASTAT-XT includes advanced functions, like linear acceleration ramp, forward and reverse jog, programmable I/O or connection to a control system via Modbus protocol included as standard and other optional protocols. These functions allow the incorporation of the soft starter to a distributed control net, in automated plant processes, together with other soft starters, programmable controllers, variable speed drives, etc.

2. TYPES AND RATINGS

2.1 IEC Ratings[1]. Recommended Motor and Type Unit Ratings.

Light Duty	Normal Duty (IEC Class 10) Recommended Motor Ratings						Heavy Duty (IEC Class 20) Recommended Motor Ratings						Type Unit
Max Current Rating	Current rating[2]	230V	400V 415V	480V 500V	575V	690V	Current rating[3]	230V	400V 415V	480V 500V	575V	690V	
A	A	kW	kW	kW	HP	kW	A	kW	kW	kW	HP	kW	
8	8	2	3.0	4	5	5.5	8	1.5	3.0	4	5	5.5	QTx0008Uxxxx
17	17	4	7.5	7.5	15	15	12	3	5.5	5.5	10	8	QTx0017Uxxxx
34	31	8	15	18.5	15	22	31	8	15	18.5	25	22	QTx0031Uxxxx
54	44	11	22	30	40	37	44	11	22	30	40	37	QTx0044Uxxxx
65	58	15	30	37	50	55	55	15	30	37	50	45	QTx0058Uxxxx
72	72	22	37	45	60	55	66	18.5	37	45	60	55	QTx0072Uxxxx
104	85	22	45	55	75	75	80	22	45	55	75	75	QTx0085Uxxxx
130	105	30	55	55	100	90	99	30	55	55	100	90	QTx0105Uxxxx
156	145	45	75	90	150	132	130	37	55	90	125	90	QTx0145Uxxxx
170	170	55	90	110	150	160	134	37	75	90	125	132	QTx0170Uxxxx
248	210	55	110	132	200	200	203	55	110	132	200	200	QTx0210Nxxxx
361	310	90	160	200	300	250	310	75	160	200	300	250	QTx0310Nxxxx
390	390	110	200	250	300	355	344	110	160	250	350	315	QTx0390Nxxxx
480	460	132	250	315	450	400	432	132	250	315	450	400	QTx0460Nxxxx
480	460	132	250	315	450	400	432	132	250	315	450	400	QTx0460Uxxxx
610	580	160	315	400	500	560	488	160	250	355	500	400	QTx0580Nxxxx
610	580	160	315	400	500	560	552	160	315	400		560	QTx0580Uxxxx
820	650	200	355	400		630	552	160	315	400		560	QTx0650Nxxxx
820	820	250	400	560		800	690	200	400	500		710	QTx0820Uxxxx
1180	950	315	560	630		900	950	315	560	630		900	QTx0950Nxxxx
1375	1100	355	630	800		1000	1076	355	630	800		1000	QTx1100Nxxxx
1750	1400	400	800	1000			1400	400	800	1000			QTx1400Nxxxx

Note:
Select the appropriate ASTAT-XT, according to the main power supply and motor voltage rating.
Use QT1xxxx units for power supply and motors rated at 230V-500V
Use QT2xxxx units for power supply and motors rated at 460V-600V
Use QT3xxxx units for power supply and motors rated at 690V

[1] Ratings in Amps. given for ambient temperature up to 40°C and 1000m altitude.
For higher ambient temperature between 40°C and 50°C, derate the current by 2.5% for each °C that is above 40°C.
[2] Normal duty ratings, only IEC Class 10 protection is allowed.
[3] Heavy duty ratings, IEC Class 10 and 20 protections are allowed.

2.2 NEMA Ratings[4] . Recommended Motor and Type Unit Ratings.

Light Duty Nema 10				Normal Duty Nema 20				Heavy Duty Nema 30				Type Unit
Current rating[5]	230V	460V	575V	Current rating[6]	230V	460V	575V	Current rating[7]	230V	460V	575V	
A	HP	HP	HP	A	HP	HP	HP	A	HP	HP	HP	
8	2	5	5	8	2	5	5	8	2	5	5	QTx0008Uxxxx
17	5	10	15	17	5	10	15	12	3	7.5	10	QTx0017Uxxxx
34	10	25	30	31	10	20	25	31	10	20	25	QTx0031Uxxxx
54	20	40	50	44	15	30	40	44	15	30	40	QTx0044Uxxxx
65	20	50	60	58	20	40	50	55	20	40	50	QTx0058Uxxxx
72	25	50	60	72	25	50	60	66	20	50	60	QTx0072Uxxxx
104	40	75	100	85	30	60	75	80	30	60	75	QTx0085Uxxxx
130	50	100	125	105	40	75	100	99	40	75	100	QTx0105Uxxxx
156	60	125	150	145	50	100	150	130	50	100	125	QTx0145Uxxxx
170	60	125	150	170	60	125	150	134	50	100	125	QTx0170Uxxxx
262	100	200	250	210	75	150	200	203	75	150	200	QTx0210Uxxxx
387	150	300	400	310	100	250	300	310	100	250	300	QTx0310Uxxxx
414	150	350	400	390	150	300	400	361	150	300	300	QTx0390Uxxxx
480	200	400	500	460	150	350	400	432	150	350	400	QTx0460Uxxxx
610	250	500		580	200	400	400	552	200	400	500	QTx0580Uxxxx
820				820	250	500	500	690	250	500		QTx0820Uxxxx

Note:
Select the appropriate ASTAT-XT, according to the main power supply and motor voltage rating.
Use QT1xxxxUxxxx units for power supply and motors rated at 230V-500V
Use QT2xxxxUxxxx units for power supply and motors rated at 460V-600V

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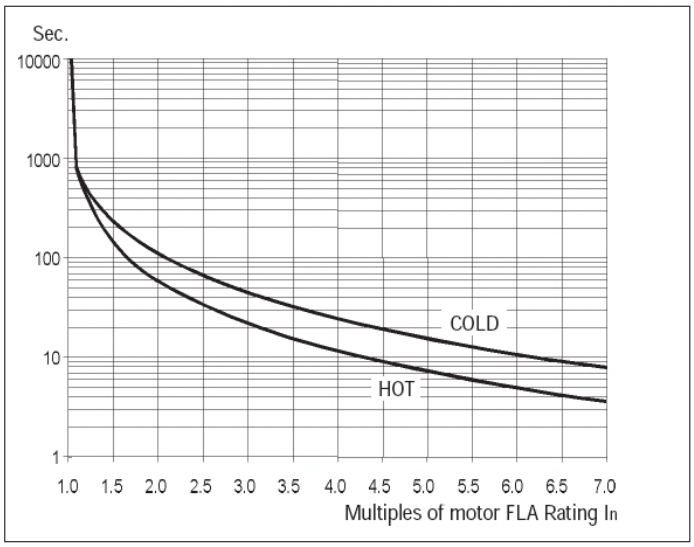
[4] Ratings in Amps. given for ambient temperature up to 40°C and 1000m altitude.
For higher ambient temperature between 40°C and 50°C, derate the current by 2.5% for each °C that is above 40°C.
[5] Light duty ratings, only NEMA Class 10 protection is allowed.
[6] Normal duty ratings, NEMA Class 10 and 20 protections are allowed.
[7] Heavy duty ratings, NEMA Class 10, 20 and 30 protections are allowed

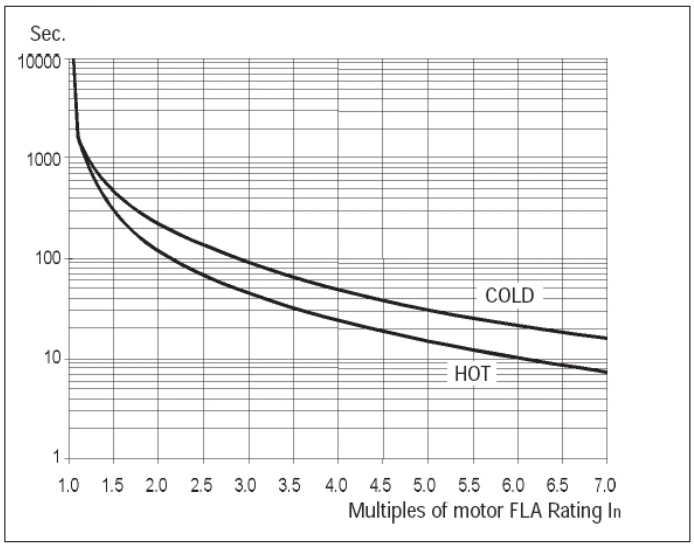
2.3 Thermal Characteristics

The ASTAT-XT allows the user to select motor protection according IEC Class 10, 20 and NEMA 10, 20 or 30, selectable by `Overload Class` parameter (refer to section 4.7.2 page 27)

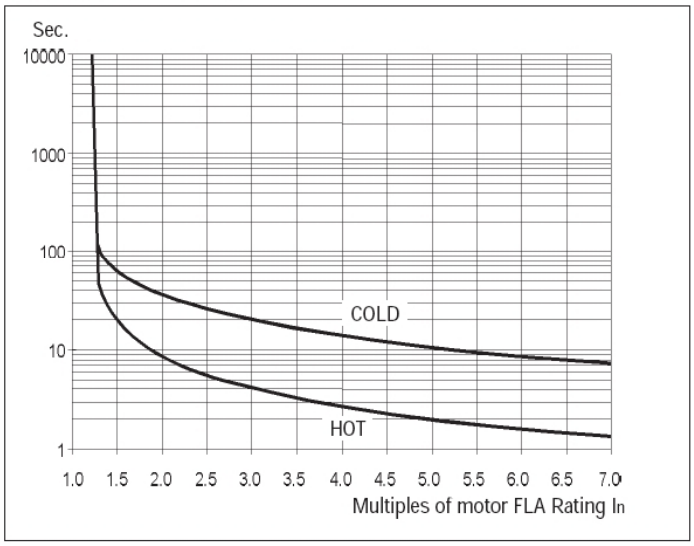
IEC Class 10



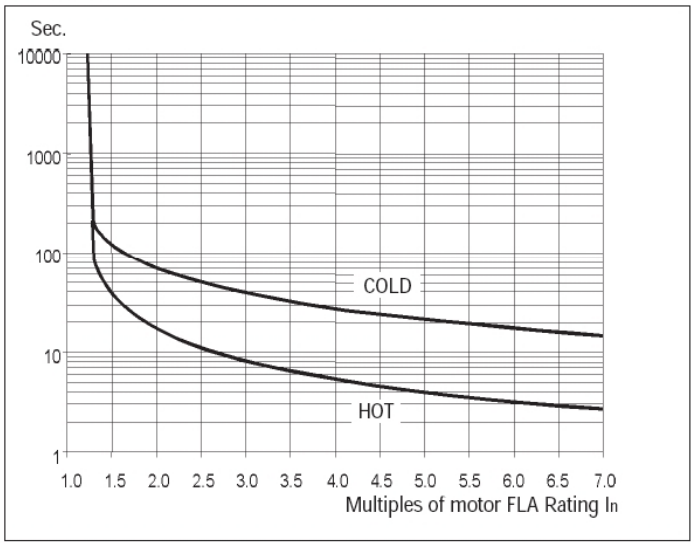
IEC Class 20



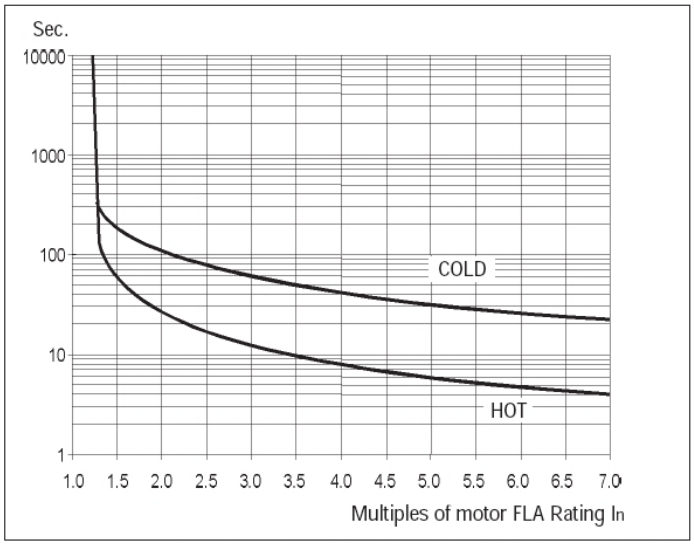
NEMA 10/Light Duty



NEMA 20



NEMA 30



3. TECHNICAL SPECIFICATIONS

3.1 General Specifications

General Information:	
Supply Voltage:	Line to line 230-690V (to be specified) + 10%-15%
Frequency:	45 – 65 Hz (fixed or variable frequency source)
Control Supply:	Either 110VAC or 230VAC (to be specified) +10% - 15%
Control Inputs:	Either 90-230VAC or 24VDC (to be specified)
Load:	Three phases, three/six wires, squirrel cage induction motor
Connection type:	Standard 3 wire U, V, W connection, or 6 wire Inside Delta (programmable)
Rated Insulation Voltage:	1,000V
Rated Impulse Voltage:	4kV
Form designation:	Form 1
This product was tested for compliance with IEC 60947-4-2 for class A equipment.	
Start-Stop Parameters:	
Starter Current:	ASTAT-XT's rated current according to its nameplate.
Motor Current:	Motor Full Load Ampere (Im) 50-125%[8] of Starter Current.
Start/Stop Curve 0 (Standard)	2 standard starting and stopping curves
Pump Control Curves (1!, 2!, 3!)	6 field selectable curves preventing over-pressure during start and water hammer during stop
Torque Control Curve (4)	2 selectable curves preventing over-pressure during start and water hammer during stop. In addition, these curves may be used for torque control starting of constant torque applications.
Kick Start Duration:	A pulse of 80% Un, for an adj. time 0.1-1 Sec, for starting high friction loads
Starting Voltage:	10-50% Un (5-80%[9])
Initial Current:	100-400% In. A single current control starting curve. It appears when `Starting Voltage` is displayed, the up arrow is pressed and `Starting Voltage` has reached its max.
Current Limit:	100-700% of Motor Current
Ramp UP Time:	1-30 Sec (1-90 sec[9])
Ramp DOWN Time:	1-30 Sec (1-90 sec[9])
DUAL Settings Parameters:	Secondary start stop characteristic for: Starting Voltage, Starting Current, Current Limit, Ramp UP, Ramp DOWN and Motor Current.
Energy Saving:	Energy save for lightly loaded motors
Slow Speed Torque:	Torque while motor is at 1/6 nominal speed
Motor Protection:	
Too Many Starts:	Maximum number of starts, range: Off or 1-10, during a time period 1-60 min.
Starts Inhibit:	Time period 1-60 min, when starting is prevented, after too many starts fault
Long Start Time (stall protection):	Maximum allowable starting time 1-30 sec. (1-250 Sec[9])
Over Current (JAM Fault):	Three trip functions: **At all time** - If I > 850% of Starter Current it trips the ASTAT-XT within 1 cycle (overrides the value of the `O/C – JAM Delay` setting). **At starting process** - If I > 850% of Motor Current it trips the ASTAT-XT after O/C JAM Delay (see here after) **At run time** - If I > `O/C – JAM Fault` setting of Im it trips the ASTAT-XT after O/C JAM Delay
Electronic Overload:	Can be set as IEC Class 10, 20 or NEMA Class 10, 20 or 30. Can be set to operate at all times, disabled or operate during Run only.
Under Current:	Trips when current drops below 20-90% of Motor Current, time delay 1-40 sec. Optional auto reset after time delay.
Under Voltage:	Trips when main voltage drops below 120-600V, time delay 1-10 Sec. Optional Auto Reset.
Over Voltage:	Trips when main voltage increase above 250-750V, time delay 1-10 sec.

[8] Refer to sections 2.1 page 8 and 2.2 page 9 for detailed information.
[9] Refer to section 5.5.5 page 50 for expanded setting.

Phase Loss, Under/over Frequency:	Trips when one or two phases are missing, or frequency is < 40Hz or > 65Hz. Optional auto reset.
Phase Sequence:	Trips when phase sequence is wrong
Long Slow Speed Time:	Trips if operating at slow speed TRQ for more than 1-30 sec (1-250 sec[9])
Wrong Connection:	Prevents starting, trips if motor is not connected / incorrectly connected to the ASTAT-XT (not active in `D.Set: Generator Parameters`)
Shorted SCR:	Trips if one or more SCRs have been shorted (not active in `D.Set: Generator Parameters`)
Heat Sink Over Temperature:	Trips when heat-sink temperature rises above 85°C
External Fault:	Trips when an external contact closes for 2 sec.
Motor Thermistor:	Trip level setting 1-10KΩ, trips when resistance decreases below the level set
Control:	
Displays:	LCD in 4 – Field selectable languages and 8 LEDs
Keypad:	6 keys for easy setting
Aux Contact – Immediate:	1 C/O, 8A, 250VAC, 2000VA
Aux Contact – End Of Ramp:	1 C/O, 8A, 250VAC, 2000VA
Fault Contact:	1 C/O, 8A, 250VAC, 2000VA
Communication:	RS 485 with Modbus protocol for full control and supervision
Communication (optional):	Profibus DPV1 for full control and supervision
Communication (optional):	DeviceNet™ for full control and supervision
Temperatures Operating:	-10° to 50°C
Storage:	-20° to 70°C
Standards:	
Dielectric Test:	2500VAC
Degree of Protection:	IP 20 for QTx0008 - QTx0072 ; IP 00 for QTx0085 – QTx1400
Pollution Degree:	3
EMC Emissions:	EN 61000-6-4 CISPR 11 Class A
Immunity:	EN 61000-6-2 ESD 8KV air, IEC 801-2; Electric RF field 10 V/m, 20-1000Mhz, IEC 801-3 Fast transients 2KV, IEC 801-4
Safety:	EN IEC 600947-4-2 and EN IEC 60947-1 Related to safety requirements. UL508C
Rated Operational Current	AC:53a:4-30: 50-4
Normal Service Conditions:	
Altitude:	Up to 1000m.
Humidity:	95% at 50°C or 98% at 45˚C

Fan and Control Consumption Ratings:		
QTx0008 to QTx0031:No fan	Total approximate consumption:	150VA
QTx0044 to QTx0072:Fan 35 VA	Total approximate consumption	185VA
QTx0085 to QTx0170 :Fan 60 VA	Total approximate consumption	210VA
QTx0210 to QTx0390 : Fans 105 VA (35VA x 3)	Total approximate consumption	255VA
QTx0460 to QTx1400A : Fans 150 VA (50VA x 3)	Total approximate consumption	300VA

3.2 Weight

Model	Weight	
	Kg	Lbs
QTx0008Uxxxx	4.2	9.3
QTx0017Uxxxx	4.2	9.3
QTx0031Uxxxx	5.3	11.7
QTx0044Uxxxx	6.7	14.8
QTx0058Uxxxx	6.7	14.8
QTx0072Uxxxx	6.7	14.8
QTx0085Uxxxx	15.2	33.5
QTx0105Uxxxx	15.2	33.5
QTx0145Uxxxx	15.2	33.5
QTx0170Uxxxx	15.2	33.5
QTx0210Nxxxx	32.7	72.1
QTx0210Uxxxx	46.5	102.5
QTx0310Nxxxx	32.7	72.1
QTx0310Uxxxx	46.5	102.5
QTx0390Nxxxx	32.7	72.1
QTx0390Uxxxx	46.5	102.5
QTx0460Nxxxx	58.4	128.7
QTx0460Uxxxx	61.8	136.2
QTx0580Nxxxx	63.2	139.3
QTx0580Uxxxx	69.5	153.2
QTx0650Nxxxx	64.8	142.9
QTx0820Uxxxx	69.5	153.2
QTx0950Nxxxx	86.7	191.1
QTx1100Nxxxx	169.8	374.3
QTx1400Nxxxx	175.5	386.9

3.3 I/O Terminal Board Specifications

Refer to drawing on page 17.

Terminal	Function	Description
1L1, 3L2, 5L3	Connection to mains voltage up to 690V	Thyristor's PIV rating, internal circuitry and insulation defines three voltage levels: **QT 1 x :** for 230-500V +10%/ -15% 50/60Hz **QT 2 x:** for 460-600V +10% /-15% 50/60Hz **QT 3 x:** for 690V +10% /-15% 50/60Hz Each ASTAT-XT is suitable for one of the above levels & for 50/60 Hz.
A, B, C	Preparation for bypass connection	Bypass preparation is standard in all models. All models from ASTAT-XT 950A and up **must** be operated with a bypass contactor. Refer to section 5.3 page 47 for more details.
2T1, 4T2, 6T3	Connection to motor	Connect motor's terminals to these terminals/busbars.
G	Connection to ground	For proper operation and for safety reasons soft ASTAT-XT must be properly grounded.
Terminal L	Control phase	The control voltage operates the electronic circuitry and the fans (when they exist). Two control voltages are available: **QT x xxxx x 1 x x S** for 110V +10%/-15% 50/60Hz **QT x xxxx x 2 x x S** for 230V +10%/-15% 50/60Hz
Terminal N	Control neutral (return)	

Terminal	Function	Description
Terminal F	Fan control	An internal jumper, connected between the fan and terminal 2 enables three modes of operation (refer to section 5.6 page 51). For fan power consumption, see technical specification in section 3 page 11.
Terminal 4	Input – STOP command. • Input from a N.C. contact • To stop the motor, disconnect Control Input voltage from terminal 4 for at least 250mSec. (no SOFT STOP)	• Control Input voltage (STOP, SOFT STOP, START, terminal inputs 7 and 8) can be the same as Control Supply (terminals 1, 3) or voltage from a different source. • The Control Inputs are opto-coupled and isolated from the microprocessor circuitry.
Terminal 5	Input – SOFT STOP command[10]. • Input from a N.C. contact • To SOFT STOP the motor disconnect Control Input voltage from terminal 5 for at least 250mS	Control Input voltages available: **QT x xxxx x x 1 x S** for 90-230V +10%/-15% 50/60Hz. **QT x xxxx x x 2 x S** for 24VDC +10%/-15%.
Terminal 6	Input – START command[11]. • Input from a N.O. contact. • To SOFT START the motor, connect Control Input voltage to terminal 4 for at least 250mSec.	
Terminal 7	Programmable input – Energy Save / Slow Speed / Reset	Refer to section 4.7.8.1 page 41.
Terminal 8	Programmable input – Dual Set / Reverse / Reset	
Terminal 9 [12]	Common to terminals 4-8.	This terminal is a reference for terminals 4, 5, 6, 7 & 8.
Terminal 10	Immediate Relay (N.O.)	Immediate Relay (RUN relay) is the immediate output relay. • Voltage free 8A, 250VAC, 2000VA max. • The relay is energized upon the START signal. • The relay is de-energized when one of the following occurs: Fault, Control Supply outage or STOP signal. • When SOFT STOP is operated - the relay is de-energized at the end of the SOFT STOP process. • The Immediate Relay (RUN relay) can be used for the following purposes: Release a brake of a motor, Interlock with other systems, Signalling, Delay the opening of a line contactor at the end of SOFT STOP, thus allowing current to decrease to zero before opening the contactor or to switch to / from DUAL settings with a time delay from the START signal (see Special Starting section 6.2.3.1 page 57). • The relay incorporates ON and OFF delays of 0-3600 sec. each. Refer to section 4.7.8 page 40 for `Relay ON Delay` programming.
Terminal 11	Immediate Relay (N.C.)	
Terminal 12	Immediate Relay (Common)	
Terminal 13	Programmable Fault Output relay (N.O.)	Voltage free 8A, 250VAC, 2000VA max. changes its position upon fault. The contact is programmable to function as `At Fault Close` or `At Fault Open`.
Terminal 14	Programmable Fault Output relay (N.C.)	

[10] If SOFT STOP is not required, connect a jumper between terminals 4 and 5.

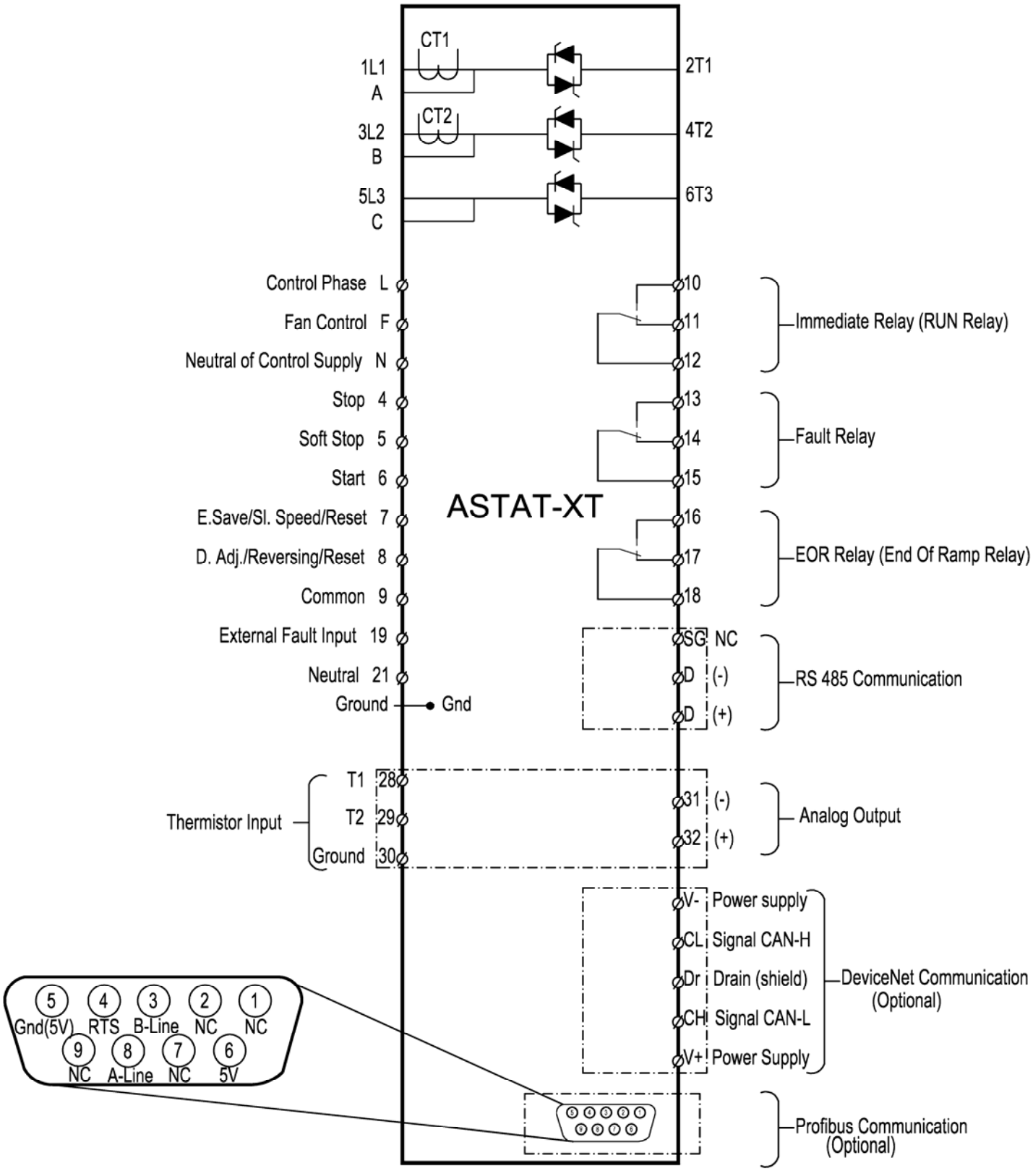
[11] Motor will start only if STOP (terminal 4) and SOFT STOP (terminal 5) terminals are connected to Control Input voltage. To reset a fault the START command must be removed.

[12] When Control Supply and Control Input voltage are from the same source, connect a jumper between terminals 3 and 9.

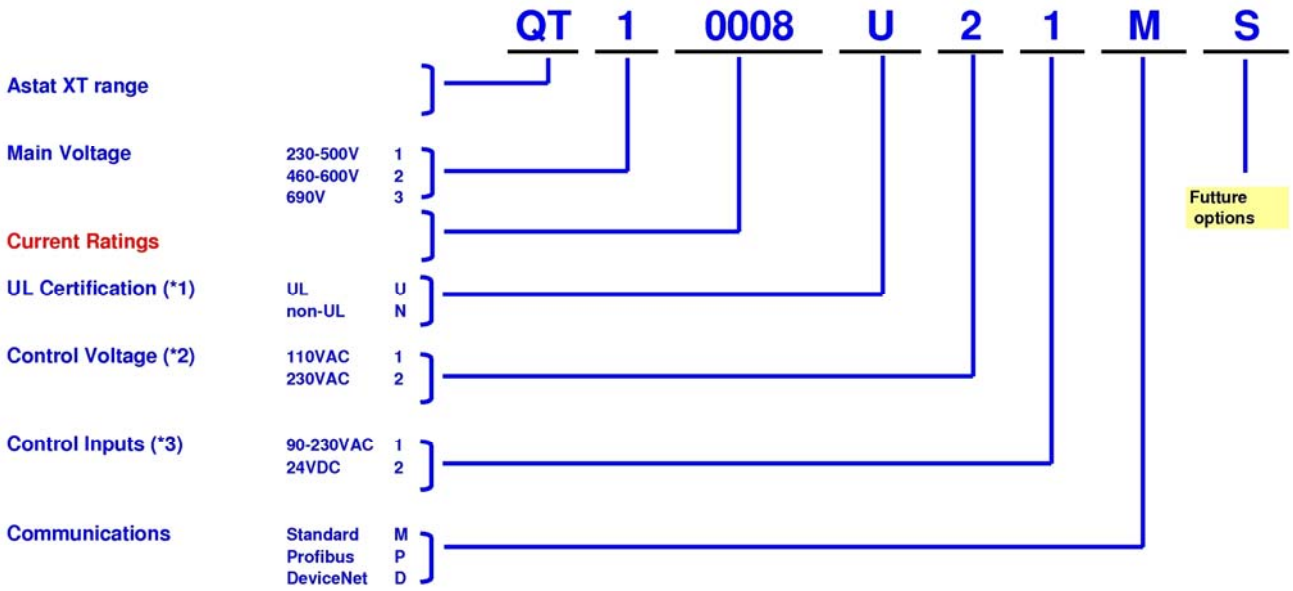
Terminal	Function	Description
Terminal 15	Programmable Fault Output relay (Common)	When the `At Fault Close` function is selected, the relay is energized upon fault. The contact returns to its original position when one of the following occurs: • The fault has been removed and ASTAT-XT was reset. • Disconnection of Control Supply When the `At Fault Open` function is selected, the relay is energized immediately when the Control Supply is connected and de-energizes when one of the following occurs: • Fault • Control Supply disconnection Refer to section 4.7.8 page 40 for `PROG. Fault Relay` programming.
Terminal 16	Programmable EOR (End Of Ramp) Output relay (N.O.)	Voltage free 8A, 250VAC, 2000VA max. changes its position at the end of ramp, after an adjustable time delay (Contact Delay), 0 – 120 sec. The contact returns to its original position when `Energy Save` is operated, on Soft Stop or Stop signals, on Fault condition, or upon voltage outage. The EOR (End Of Ramp) contact can be used for: • Closing a bypass contactor • Activating a valve after compressor has reached full speed • Loading a conveyor after motor reached full speed. Refer to section 4.7.3 page 29 for `EOR Relay Delay` programming
Terminal 17	Programmable EOR (End Of Ramp) Output relay (N.C.)	
Terminal 18	Programmable EOR (End Of Ramp) Output relay (Common)	
Terminal 19	External Fault input	Input from a N.O. contact that is connected between terminals 19 and 21. The ASTAT-XT will trip 2 seconds after the contact closes. **Notes:** • Wires connecting the External Fault contact to terminal 19 should not exceed 1 meter in length. • External Fault can be used only when terminal 21 is connected to neutral or ground. • Only potential free contacts may be connected to terminal 19. • Do not connect any voltage to terminal 19. • Any connection of voltage to this terminal may disrupt ASTAT-XT operation, and cause ASTAT-XT or motor damage. • Refer to section 8.12 page 67 for the External Fault wiring diagram.
Terminal 21	Neutral connection	When a **mains** neutral wire is available, connect terminal 21 to neutral. Terminal 21 serves only as a voltage reference to the control circuitry. **Caution:** • ASTAT-XT circuitry incorporates an internal artificial neutral, which should only be used, when the **mains** system is not grounded and **mains** neutral connection is not available. • Only potential free contacts may be connected to terminal 21. • Do not connect any voltage to terminal 21. Any connection of voltage to this terminal may disrupt ASTAT-XT operation, and cause ASTAT-XT or motor damage. • Refer to section 8.1 on page 62 for terminal 21 connection.

Terminal	Function	Description
Terminal SG	No connection	• Standard RS485, half duplex with Modbus protocol, baud rate 1200, 2400, 4800, 9600 BPS. • Twisted shielded pair should be used. Connect shield to ground on the PLC/Computer side. • Terminals 4 & 5 must be wired to Control Supply for operation in communication mode (refer to section 8.16 page 70 for wiring diagram). • Up 32 units can be connected for Modbus RS485 communication. For reliable communication, units should be installed in the vicinity of 200m maximum, from the first to the last unit. • Refer to section 4.7.9 page 42 for programming. • Refer to Appendix A of this manual for Modbus protocol manual.
Terminal D-	RS-485 communication (-)	
Terminal D+	RS-485 communication (+)	
Terminal 28	Thermistor input (T1)	Thermistor input is programmable as a PTC or NTC type thermistor. The trip value is adjustable between 1-10Kohm, preset delay of 2 Sec. Connect thermistor and/or Analog output shield to ground terminal. Analog output (0-10VDC or 0-20mA or 4-20mA) Reflects motor current and is related to 2xIm. i.e., Full scale (10VDC or 20mA) is related to 2xIm. **Note:** Refer to section 5.7 page 51 for analog output PCB dip switch setting. • Refer to section 4.7.8 page 40 for `Analog Output` programming. • Refer to section 4.7.7 page 38 for `Thermistor Type` and `Thermistor Trip` programming.
Terminal 29	Thermistor input (T2)	
Terminal 30	Ground	
Terminal 31	Analog output (-)	
Terminal 32	Analog output (+)	
D-9 connector	Profibus communication (optional)	• Profibus DPV0 and DPV1, up to 12 MBPS. • D type 9 pin connector is applied. • Control, monitoring and setting parameters can be achieved via the Profibus connection. • Setting is possible only when DPV1 is implemented. • Refer to section 4.7.10 page 42 for programming. • Refer to Appendix B of this manual for Profibus protocol manual.
Terminal V-	DeviceNet communication (optional)	0 Volt external power supply
Terminal CL		Negative data line
Terminal Dr		Cable shield
Terminal CH		Positive data line
Terminal V+		+24V external power supply

3.4 I/O Wiring


CT1
CT2
1L1
A
3L2
B
5L3
C
2T1
4T2
6T3
ASTAT-XT
Control Phase L
Fan Control F
Neutral of Control Supply N
Stop 4
Soft Stop 5
Start 6
E.Save/Sl. Speed/Reset 7
D. Adj./Reversing/Reset 8
Common 9
External Fault Input 19
Neutral 21
Ground
Gnd
10
11
12
13
14
15
16
17
18
Immediate Relay (RUN Relay)
Fault Relay
EOR Relay (End Of Ramp Relay)
SG NC
D (-)
D (+)
RS 485 Communication
Thermistor Input
T1 28
T2 29
Ground 30
31 (-)
32 (+)
Analog Output
V- Power supply
CL Signal CAN-H
Dr Drain (shield)
CH Signal CAN-L
V+ Power Supply
DeviceNet Communication
(Optional)
5 4 3 2 1
Gnd(5V) RTS B-Line NC NC
9 8 7 6
NC A-Line NC 5V
Profibus Communication
(Optional)

3.5 Ordering Information



Notes:

cUL Certification

(*1) – ASTAT-XT up to 600V, and up to 170A (Cat Numbers up to to QT10170_ or QT20170) are always cUL certified. Option "N" not available
- Units QT1 or QT2 from QTx0950_ up to QTxx1400 are not UL certified. Option "U" not available.
- Units QT3x, rated to 690V, are not UL certified. Option "U" not available

Control and Inputs Voltage

(*2) ASTAT XT standard Control Voltage configuration is option 2, Voltage 230VAC, +10%, -15%

(*3) ASTAT XT standard configuration for Inputs is option 1, Voltage 90-230VAC, +10%, -15%

3.5.1 Ordering Accessories

Catalog Number	Description
QTAKPADKIT1	Keypad mounting kit for ASTAT-XT up to 72A
QTAKPADKIT2	Keypad mounting kit for ASTAT-XT above 72A

3.6 Operating Modes

Operating Mode	Key	Description
Starting Voltage	1	5 to 80% Un. Adjustable via `Starting Voltage` parameter.
Kick Start	2	Fixed level of 80% Un with an adjustable time, 0-1 sec., via `Kickstart Time` parameter.

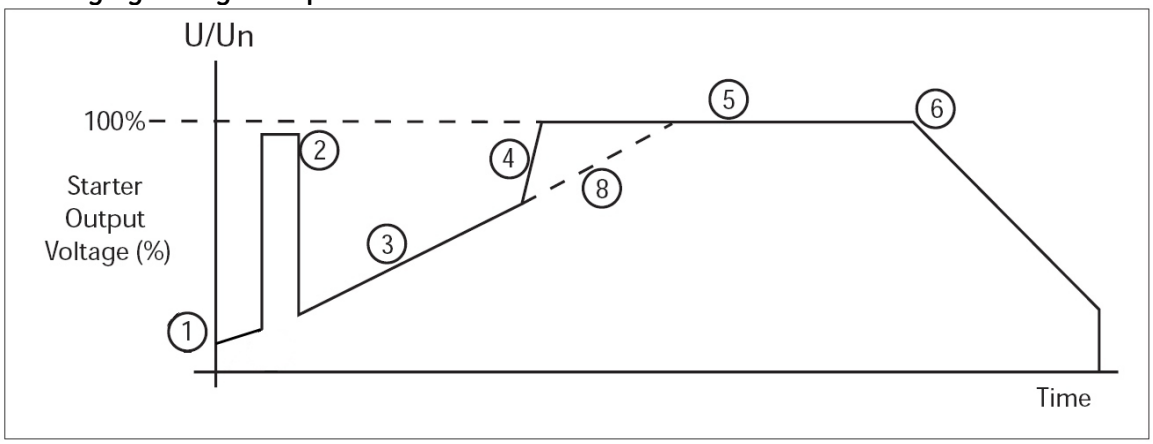
Acceleration Ramp	3	1-30 sec. (1-90[13] sec.). Adjustable via `Ramp UP Time`.
		Secondary ramp 1-30sec. (1-90[13] sec.). Adjustable via `Ramp UP-2` parameter.
		Ramp up modes available are:
		`Soft Start Curve 0 (Standard)`
		`Soft Start Curve 1!!-3!!`
		`Soft Start Curve 4(Torque)` for linear torque control

	4	Fast ramp (if the motor is up to speed before the end of normal ramp time)
Running mode	5	Nominal voltage

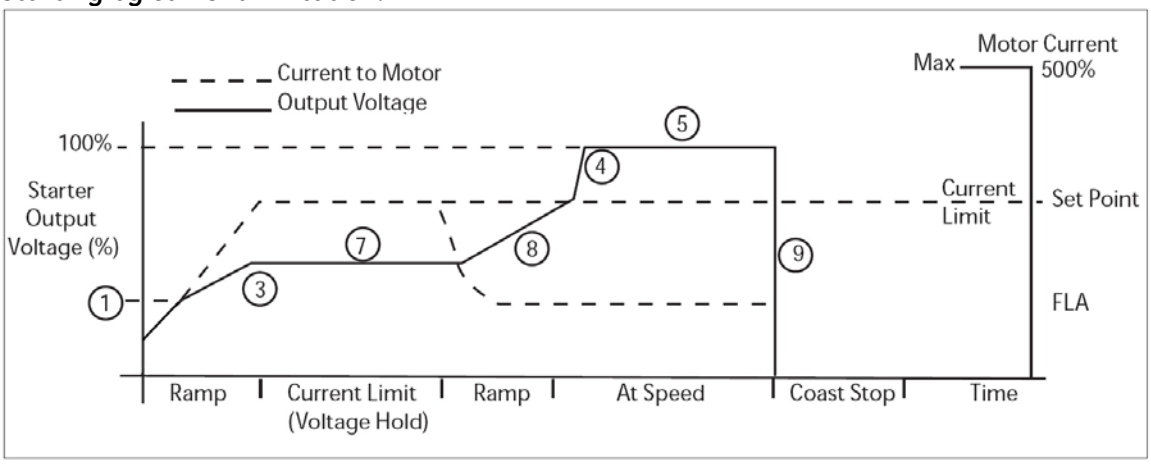
Soft stop mode	6	Deceleration ramp 1-30sec. (1-90[13] sec.). Adjustable via `Ramp DOWN Time`.
		Secondary ramp 1-30sec. (1-90[13] sec.). Adjustable via `Ramp DOWN-2` parameter .
		Ramp down modes available are:
		`Soft Stop Curve 0 (Standard)`
		`Soft Stop Curve 1!!-3!!`
		`Soft Stop Curve 4(Torque)` for linear torque control

	7	Current limiting set point (100-500%xMotor Current)
	8	Acceleration ramp (continuation after motor amps drop below the current limit).
	9	Standard stopping (coast to rest)

Starting by voltage ramp:



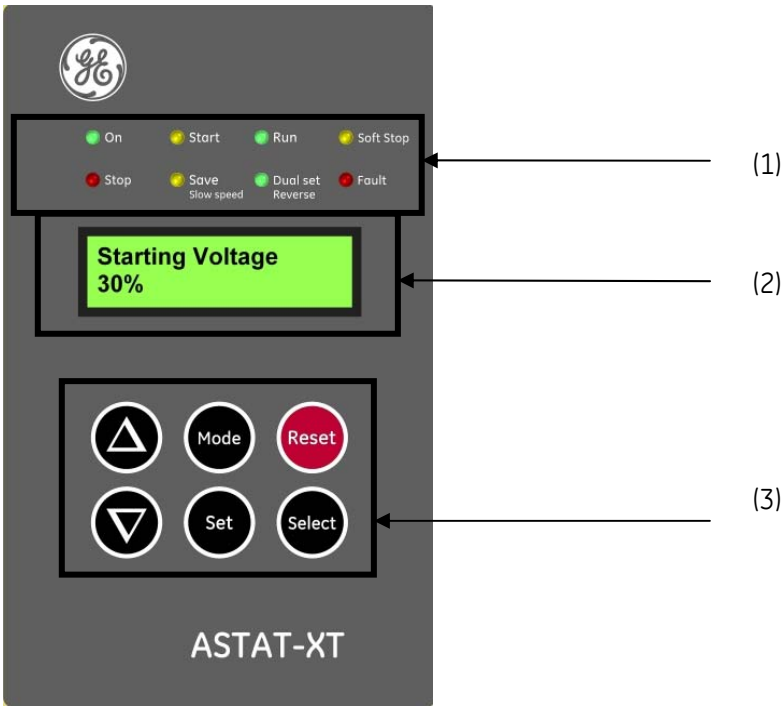
Starting by current limitation:



[13] Refer to section 5.5.5 page 50 for expanded setting.

4. CONTROL KEYPAD

The control keypad is the interface between the ASTAT-XT and the user.
The ASTAT-XT control keypad features:
Eight indication LEDs (On, Start, Run, Soft Stop, Stop, Save/Slow Speed, Dual Set/Reverse, Fault)
Two lines of 16 alphanumeric characters each with selectable languages – English, Italian, German, and Spanish.
Six push-buttons - Mode, Reset, Select, Set, Up (▲) and Down (▼) keys.



ASTAT-XT control keypad

4.1 LCD Arrangement

Starting Voltage 30%

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

4.2 Push-Buttons

Mode	Scrolls through the display and programming menus of the ASTAT-XT.[14]
Select	When a mode name is displayed, pressing this button drills down to the parameters for that mode. When a parameter is displayed, pressing this button scrolls to the next parameter.
▲	Allows the operator to increment adjusted values shown in the display. Operator should press this button once to increment one value, or continuously to rapidly increment values up to the maximum value.
▼	Allows the operator to decrement adjusted values shown in the display. Operator should press this button once to decrement one value, or continuously to rapidly decrement values up to the minimum value.
Set	Stores modified parameters only when you have scrolled through all parameters and `Store Settings Xxxxxx Parameters` is displayed. After you store a parameter successfully `Data Saved OK` will display.[15]
Reset	Resets the ASTAT-XT after a fault has been dealt with and the start command has been removed. This cancels the fault displayed and allows you to restart the motor.

4.3 Status LEDs

●	Green	On	Lights when the control supply voltage is connected to the ASTAT-XT.
●	Yellow	Start	Lights during soft start, indicating that motor supply voltage is ramping up.
●	Green	Run	Lights after completion of the starting process, indicating that motor is receiving full voltage. This LED flashes during slow speed operation.
●	Yellow	Soft Stop	Lights during soft stop, indicating that the motor supply voltage is ramping down.
●	Red	Stop	Lights when the motor is stopped.
●	Yellow	Save/Slow Speed	Lights when `Energy Saving` is in operation. Flashes when the motor is running in Slow Speed.
●	Green	Dual set/Reverse	Lights when `Dual Settings` is in operation. Flashes when the motor is running in `Slow SP Reverse`.
●	Red	Fault	Lights upon operation of any of the built-in protections.

4.4 Reviewing and Modifying Parameters

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

Once you reach the required parameter, use the ▼ or ▲ keys to modify its value.
To store the new parameters, press the Select key until the `Store Settings Xxxxxx Parameters` message displays and then press the Set key. The `Data Saved OK` message will display for 2 seconds.

Note:
After completing parameter settings:
- Turn control voltage OFF
- Wait 3 seconds
- Reconnect control voltage

[14] Pressing Mode continuously increases the speed at which the parameters change.
[15] Pressing the Set button at any other time has no effect.

• Verify that all parameters are set correctly.

4.5 Special Actions Performed in Test/Maintenance Mode

4.5.1 Run Self Test

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

```
Test/Maintenance
Statistics
```

Press the Select key. The LCD will display:

```
Auto Test.
Press UP Key
```

Press the ▲ key. The LCD will display:

```
Self Test Passed
```

And after a few seconds the LCD will display:

```
Motor Current
0
```

4.5.2 View Software Version

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

```
Test/Maintenance
Statistics
```

Press the Select key twice. The LCD will display:

```
Firmware Version
STRT.GE-031208
```

Press the Mode and ▼ keys simultaneously to exit the Test/Maintenance mode. The LCD will display:

```
Motor Current
0
```

4.5.3 Obtain Default Parameters

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

```
Test/Maintenance
Statistics
```

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

```
Store Settings
Default data
```

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

```
Data Saved OK
```

And after a few seconds the LCD will display:

```
Motor Current
0
```

CAUTION!	Obtaining Default Data erases all previously modified settings and requires the operator to reprogram all parameters that differ from the factory default. **Note:** It is especially important to reprogram the `Starter Current` (as shown on the name plate of the ASTAT-XT), `Motor Current` and voltage protection values again.

4.5.4 Reset Statistical Data

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

```
Test/Maintenance
Statistics
```

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

```
Reset Statistics
```

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

```
Data Saved OK
```

And after a few seconds the LCD will display:

```
Statistical  Data
- **** -
```

Press the Mode and go back to:

```
Motor Current
0
```

4.5.5 Calibrate Voltage and Current (Factory Use Only!)

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

```
Test/Maintenance
Statistics
```

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

```
Calibration VOLT
0 VOLT
```

Press the Select key. The LCD will display:

```
Calibration CURR
5% of Ir
```

Press the Mode and ▼ keys simultaneously to exit the Test/Maintenance mode.

4.6 Mode Pages

Upon initiation of the ASTAT-XT, the LCD displays motor's operating current:

```
Motor Current
0
```

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

```
Main Settings
- **** -
```

```
Start Settings
- **** -
```

```
Stop Settings
- ****  -
```

```
DUAL Settings
Parameters
```

```
Slow SP & Saving
Parameters
```

```
Fault Settings
- **** -
```

```
I/O Settings
Parameters
```

```
COMM. Parameters
- **** -
```

These pages are skipped if ASTAT-XT is programmed to Minimized Mode and are shown only in Maximized Mode. Refer to section 5.5.1 on page 49 for changing mode from Minimized Mode to Maximized Mode.

```
Statistical Data
- **** -
```

4.7 Overview of All Mode Pages and Factory Defaults

				Appears only in Maximized[16]
Display Page	**Main Settings - **** -**	**Start Settings - **** -**	**Stop Settings - **** -**	**DUAL Settings Parameters**
Function & Default	Function & Default	Function & Default	Function & Default	Function & Default
Motor Current 0	Starter Current 58 AMP.	Soft Start Curve 0(Standard)	Soft Stop Curve 0(Standard)	Starting VOLT-2 30%
Line Voltage 0 Volt	Motor Current 58 AMP.	Kickstart Time 0 SEC.	Ramp DOWN TIME 10 SEC.	Starting CURR-2 100%
Thermistor Input. 3.1 Kohm	LINE/DELTA Conf. Line	Starting Voltage 30 %	End Torque 0 (MIN.)	Current Limit-2 300% of Im
	Undercurrent FLT 0% of Im	Starting Current 100 %	Store Settings Stop Settings	Ramp UP-2 10 SEC.
	Undercurrent DLY 10 SEC.	Current Limit 400% OF Im		Ramp DOWN-2 10 SEC.
	O/C JAM Fault 850% OF Im	Ramp UP Time 10 SEC.		Motor Current-2 31 AMP.
	O/C JAM Delay 0.5 Sec.	Max. Start Time 30 SEC.		Store Settings Dual Settings
	Overload Class IEC CLASS 10	Number of Starts 10		
	Overload Protect Enabled	Duty Cycle Time 30 Min.		
	Undervoltage FLT 300 Volt	Start Lockout 15 Min.		
	Undervoltage DLY 5 SEC.	EOR Relay Delay. 5 Sec.		
	Overvoltage FLT 480 Volt	Store Settings Start Settings		
	Overvoltage DLY 2 SEC.			
	Store Settings Main Settings			

[16] Refer to section 5.5.1 on page 49 for changing mode from Minimized Mode to Maximized Mode.

Only in Max. Mode[16]	Only in Max. Mode[16]	Only in Max. Mode[16]	Only in Max. Mode[16]	
Slow SP & Saving Parameters	**Fault Settings - **** -**	**I/O Settings Parameters**	**COMM. Parameters - **** -**	**Statistical Data - **** -**
Function & Default	Function & Default	Function & Default	Function & Default	Function & Default
Energy Saving 0 (MIN)	Phase Loss Enabled	PROG. Input #7 Reset	COMM. Protocol Modbus	Last Start Time No Data
Slow Speed TRQ. 8	Phase Sequence Disabled	PROG. Input #8 Dual Settings	Baud Rate 9600 (MODBUS)	Last Start Curr. No Data
Max Slow SP Time 30 SEC.	Auto Reset Disabled	PROG. Fault Relay At Fault Close	Parity Check EVEN	Elapsed Run Time 0 Hours
Store Settings Slow SP & Saving	Thermistor Type PTC	Relay ON Delay 0 SEC.	Station Number. OFF	Number Of Starts 0
	Thermistor Trip Disabled	Relay OFF Delay 0 SEC.	S. Link Par. Set DISABLED	Last Fault No Data
	Undercurrent RST Disabled	Analog Output I, 0...200% OF Im	Ser. Link Control DISABLE	Motor FLT Current 0 % of Im
	Store Settings Fault Settings	Store Settings I/O Settings	Store Settings COMM. Parameters	Fault Counter 0
			COMM. Protocol Profibus	Previous Fault -1 No Data
			Baud Rate AUTO (Profibus)	PREVIOUS Fault -9 No Data
			Parity Check AUTO (Profibus)	
			PROFI. Network ID OFF	
			S. Link Par. Set Disabled	
			Ser. Link Control Disabled	
			Store Settings COMM. Parameters	

Appears when in Test/Maintenance
Test/Maintenance ***Statistics***
Display and default values
Auto Test Press UP Key
Firmware Version STRT-GE-270508
Store Settings Default Data
Reset Statistics
Calibration VOLT 0 VOLT
Calibration CURR 5% of Ir

COMM. Protocol DeviceNet
Baud Rate Set Manually
Parity Check AUTO (DeviceNet)
DeviceNet ID Set Manually
S. Link Par. Set Disabled
Ser. Link Control Disabled
Store Settings COMM. Parameters

Note: There are three different groups of COMM. Protocol parameters. Each group of COMM. Protocol parameters are only valid when its corresponding optional PCB is installed.

4.7.1 Display Mode[17] – Page 0[18]

Function & Default	Unit	Description
Motor Current 0	A	Displays operating current of the motor. ASTAT-XT's Default Display. After pressing the Mode or Select keys, a time delay is initiated. Following the delay the LCD returns to display Motor Current. If current is lower than 0.1 of the rated current of the ASTAT-XT, the display will show: I < 0.1 Ir
Line Voltage 0 Volt	V	Displays the mains voltage.
Thermistor Input 3.1 Kohm	Kohm	Displays the resistance level of the motor's thermistor.

[17] Displays in MINIMIZED MODE and MAXIMIZED MODE.
[18] Parameters cannot be programmed in page 0.

4.7.2 Main Settings[19] – Page 1

Function & Default	Range	Unit	Description
Starter Current 58 Amp.	8 – 1400	A	Sets ASTAT-XT's Rated Current (Type Unit) Check the name plate on the soft starter and make sure that digits 4 to 7 of the model name are the same as the Starter Current setting. For example the setting for model QTx**0008**Uxxx must be **8** Amp. Refer to section 5.1 on page 47.
Motor Current 58 Amp.	4-1750[20] Based on % of Starter Current	A	Sets the motor's Full load Ampere Should be programmed as shown on the motor's name plate.[21] **Note:** When setting Motor Current to a higher level than Starter Current, Overload Class parameter (see below) is automatically set to NEMA Class 10.
LINE/DELTA Conf. Line	Line, Inside Delta		Sets ASTAT-XT's connection type.[22] Factory preset - features and functions not active when DELTA Conf. is configured: Kickstart. Soft Start Curve selection (Curve 0!! only) Slow Speed Phase Sequence Disabled mode Refer to section 8.20 on page 74 for further information.
Undercurrent FLT 0% of Im	0%=OFF; 20-90	% of Motor Current	Sets Undercurrent protection. Trips the ASTAT-XT when the motor current drops below the level that was set for a time period longer than Undercurrent Dly.
Undercurrent DLY 10 SEC.	1-40	sec.	Sets the time delay for Undercurrent FLT protection. **Note:** Operational when the motor is running (the *RUN* LED is lit).
O/C JAM Fault 850% of Im	100-850	% of Motor Current	Sets O/C JAM Fault protection. Operational when ASTAT-XT is energized and has three trip functions: At all time - If I > 850% of Starter Current it trips the ASTAT-XT within 1 cycle (overrides the value of the O/C JAM Fault setting). At starting process - If I > 850% of Motor Current it trips the ASTAT-XT after O/C JAM Delay At run time - If I > O/C JAM Fault setting of Motor Current it trips the ASTAT-XT after O/C JAM Delay. **Caution:** The O/C JAM Fault is not intended to replace the fast acting fuses, required to protect the thyristors. Refer to section 8.18 on page 72.
O/C JAM Delay 0.5 Sec.	0.0 – 5	sec.	

[19] Displays in MINIMIZED MODE and MAXIMIZED MODE.

[20] The lower limit can be set as low as 50% of Starter Current. The upper limit is automatically set by the ASTAT-XT and is between 100 and 126% of Starter Current.
The Motor Current can be set as high as indicated in columns "Current Rating" for Light Duty applications in the tables in section 2.1 page 8 and in section 2.2 page 9.

[21] When the ASTAT-XT is installed in the Inside Delta configuration set:
Motor Current = <*rated motor current*>/1.73.

[22] When the ASTAT-XT is installed in DELTA Conf. set Motor Current = <*rated motor current*>/1.73.

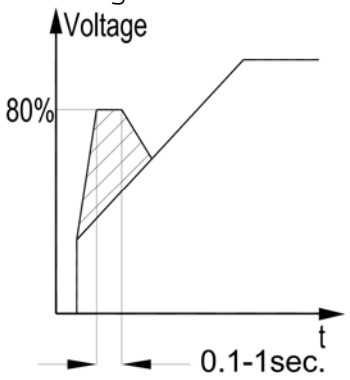
Function & Default	Range	Unit	Description
Overload Class IEC CLASS 10	IEC CLASS 10; IEC CLASS 20; NEMA CLASS 10; NEMA CLASS 20; NEMA CLASS 30;		Sets Overload CLASS. Overload Class is operational as programmed in the Overload Protect parameter. (see next parameter) The O/L circuitry incorporates a thermal memory register that calculates heating minus dissipation of the motor. The ASTAT-XT trips when the register fills up. The time constant for cool down after overload trip is: For IEC/NEMA Class 10 – 320seconds For IEC/NEMA Class 20 – 640seconds For NEMA Class 30 – 960seconds Refer to section 2.3 on page 10 for thermal characteristic. **Note:** When setting Motor Current to a higher level than Starter Current, Overload Class parameter is automatically set to NEMA Class 10.
Overload Protect Enabled	Enable after EOR; Enabled; Disabled;		Sets Overload Protection operation. Enable after (End Of Ramp) will set the overload protection to be operative after starting process is completed and (End Of Ramp) relay is energized. Enabled will set the overload protection to be operative at all time. Disabled will set the overload protection not to be operative at all time. **ATTENTION!** When Overload Protect is set to Disabled the motor is not protected for Overload!!
Undervoltage FLT 300 Volt	120-600	V	Sets Undervoltage Fault level. Trips the ASTAT-XT when mains voltage drops below the level that was set for a time longer than Undervoltage DLY.
Undervoltage DLY 5 SEC.	1 –10	sec.	Sets Undervoltage Fault delay[23]
Overvoltage FLT 480 Volt	250-750	V	Sets Overvoltage Fault level. Trips the ASTAT-XT when mains voltage increases above the level that was set for a time longer than Overvoltage DLY. Can not be set lower than the Undervoltage FLT setting.
Overvoltage DLY 2 SEC.	1 –10	sec.	Sets Overvoltage Fault delay.[24]
Store Settings Main Settings			Storing modified parameters[25] To store selected parameters scroll through all parameters until you reach Store Settings Main Settings, then press the Set key. After you store a parameter successfully the Data Saved OK message will display. If ASTAT-XT fails to store the parameter the LCD Will display the Storage Error message (refer to section 7 on page 59 for more details).

[23] Becomes operational only after the start signal.
When voltage drops to zero (voltage outage) the ASTAT-XT will trip immediately, thus overriding the delay.

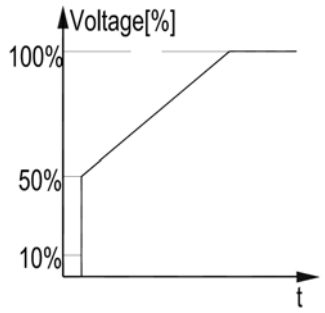
[24] Becomes operational only after the start signal.

[25] Pressing the Set key when the Store Settings Xxxxx Settings message does not appear on the display has no effect.

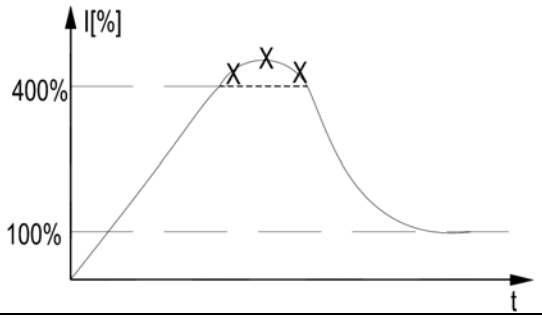
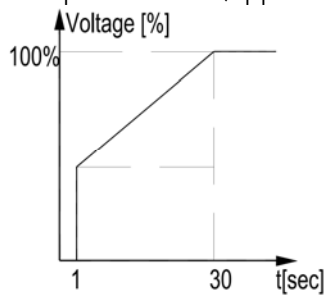
4.7.3 Start Settings[26] – Page 2

Function & Default	Range	Unit	Description
`Soft Start Curve 0(Standard)`	0 (Standard) 1 !! 2 !! 3 !! 4 (Torque)		Sets ASTAT-XT's Soft Start Curve.[27] Refer to section 4.7.3.1 on page 32.
`Kickstart Time 0 Sec.`	0 –1.0	sec.	Sets ASTAT-XT's Kickstart Time.[28] Kickstart level is 80% Un. Intended to start high friction loads that require high starting torque for a short time. A pulse of 80% Un without Current Limit is initiated to break the load free. `Kickstart Time` is adjustable, 0.1–1sec. After this pulse the voltage is ramped down to `Starting Voltage` setting before ramping up again to full voltage according to the `Start Settings`. 

[26] Displays in MINIMIZED MODE and MAXIMIZED MODE.
[27] When ASTAT-XT is connected in `DELTA Conf`. only `Soft Start Curve 0` (Standard) is applied.
[28] There is no `Kickstart` function when ASTAT-XT is connected in `DELTA Conf.`

Function & Default	Range	Unit	Description
`Starting Voltage 30 %`	10-50% After reaching 50% the display changes to: Starting Current 100-400% [29]	% of mains voltage	Sets the motor's Starting Voltage. The motor's torque is directly proportional to the square of the voltage. This adjustment also determines the inrush current and mechanical shock. A setting that is too high may cause high initial mechanical shock and high inrush current. This can occur even if `Current Limit` is set low because the `Starting Voltage` setting overrides the `Current Limit` setting. A setting that is too low may result in prolonged time until the motor starts to turn. In general, this setting should ensure that the motor starts turning immediately after start signal.  **Note:** When `Starting Voltage` is set its maximum value, this displays changes to `Starting Current`. When `Starting Current` is set the ASTAT-XT causes current ramp instead of voltage ramp.
`Starting Current 100 %`			

[29] The range of the Starting Voltage can be extended to 5-80% by using the EXPANDED SETTING as described in section 5.5.5 page 50.

Function & Default	Range	Unit	Description
Current Limit 400% of Im	100-700%	% of Motor Current	Sets the motor's highest current during starting. A setting that is too high will increase the current drawn from mains and speed up acceleration. A setting that is too low may prevent the motor from completing the acceleration process and reaching full speed. In general, this setting should be set to a value that is high enough to prevent stalling. Current Limit is limited to the value of: *<400x(Starter Current/Motor Current)>* with a minimum setting of 300% and a maximum setting of 700%. **Note:** Current Limit does not operate during *RUN* and *SOFT STOP*. 
Ramp UP Time 10 SEC.	1-30 [30]	sec.	Sets Ramp UP Time of the motor. Determines the motor's voltage Ramp UP Time, from initial to full voltage. It is recommended to set the Ramp UP Time to the minimum acceptable value (approx. 5 sec).  **Notes:** Since Current Limit overrides Ramp UP Time, when Current Limit is set low, the starting time will be longer than the Ramp UP Time setting. When the motor reaches full speed before voltage reaches nominal, Ramp UP Time setting is overridden, causing voltage to quickly ramp-up to nominal. Using Soft Start Curve 1, 2, 3 prevents quick ramp up.

[30] The range of the Ramp UP Time can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 5.5.5 page 50.

Function & Default	Range	Unit	Description
Max. Start Time 30 SEC.	1-60	sec.	Sets Maximum Start Time The maximum allowable start time, from the start signal to the end of the acceleration process. If voltage/speed does not reach nominal during Max. Start Time then ASTAT-XT will trip the motor and create a fault. The LCD will display the Long Start Time fault message. For example, this can occur when the Current Limit setting is too low. **Notes:** • When Overload Class is set to NEMA Class 10 Max. Start Time can be set to 15 seconds maximum. • When Overload Class is set to IEC Class 10 or NEMA Class 20 Max. Start Time can be set to 30 seconds maximum. • When Overload Class is set to IEC Class 20 or NEMA Class 30 Max. Start Time can be set to 60 seconds maximum with limitation automatically calculated by the soft starter.
Number of Starts 10	1-10, OFF		Sets Number of Starts permitted during Duty Cycle Time (see below). Limits the Number of Starts during the period of time defined by Duty Cycle Time. If you try to start even one more time within that period the START Lockout period will take effect.
Duty Cycle Time 30 Min.	1–60	min.	Sets Duty Cycle Time during which Number of Starts is counted. During the START Lockout period the Wait before RST XX Min message will be displayed.
Start Lockout 15 Min.	1–60	min.	Sets START Lockout time during which starting is disabled after Too Many Starts trip.
EOR Relay Delay 5 Sec.	0-120	sec.	Sets the time delay for the End of Ramp relay to close. End of Ramp relay can signal that the motor is at its full speed which can be used for closing the bypass contactor and for loading the motor.
Store Settings Start Settings			Same as Store Settings Main Settings on page 28.

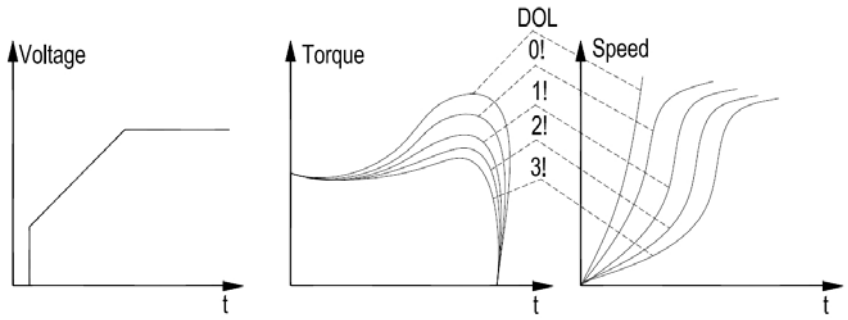
4.7.3.1 Soft Start Parameters

The ASTAT-XT incorporates five starting curves to enable you to select a suitable torque curve.

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

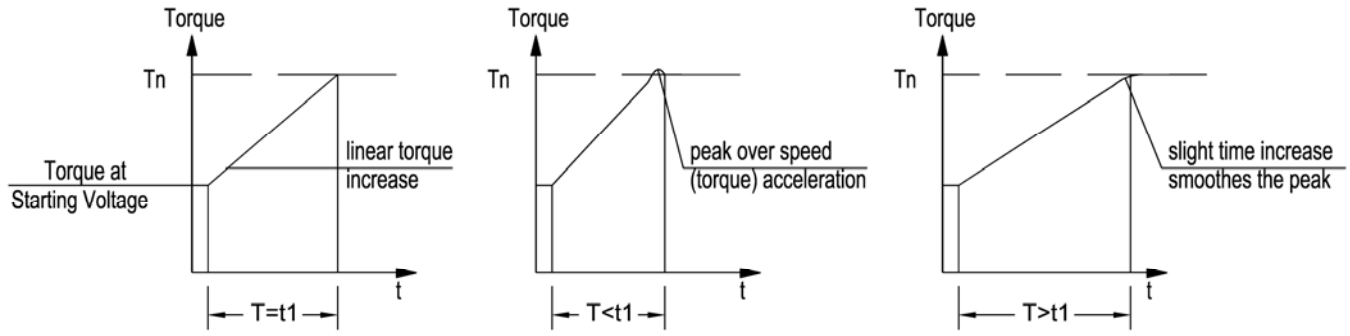
Note:
When ASTAT-XT is connected in DELTA Conf., the ASTAT-XT will always use Curve 0 regardless of the curve defined.

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



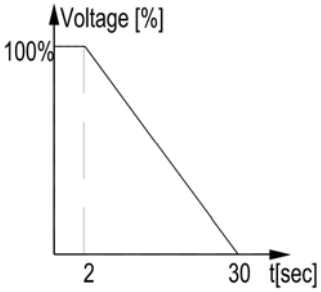
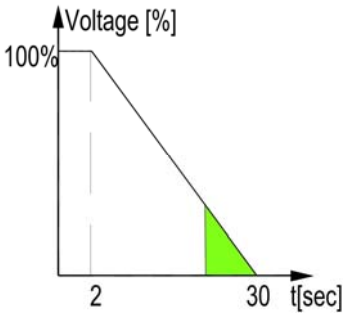
Choice of four pump control acceleration curves: 0!, 1!, 2!, 3!

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



Note:
Always start with Soft Start Curve 0. If towards the end of ramp, peak torque is too high (pressure is too high) proceed to Soft Start Curve 1, 2, 3 or 4 in that order.

4.7.4 Stop Settings[31] – Page 3

Function & Default	Range	Unit	Description
`Soft Stop Curve` `0(Standard)`	0 (Standard) 1 !! 2 !! 3 !! 4 (Torque)		Sets ASTAT-XT's Soft Stop Curve. Refer to section 4.7.4.1 on page 34.
`Ramp DOWN Time` `10 SEC.`	1–30 [32]	Sec.	Sets Ramp DOWN Time of the motor. Used for controlled deceleration of high friction loads. Determines the motor's voltage ramp down time.  **Note:** When the ASTAT-XT operates with a bypass contactor, the bypass contactor can be controlled by the ASTAT-XT's End of Ramp relay. Upon soft stop initiation the End of Ramp relay is de-energized, the load is transferred to the ASTAT-XT, and voltage begins ramping down.
`End Torque` `0 (MIN.)`	0 (MIN.) – 10 (MAX.)		Sets End Torque during soft stop. Determines torque towards the end of a soft stop. If the current still flows after speed is softly reduced to zero, you should increase the `End Torque` setting. 
`Store Settings` `Stop Settings`			Same as `Store Settings Main Settings` on page 28.

[31] Displays in MINIMIZED MODE and MAXIMIZED MODE.

[32] The range of the Ramp DOWN Time can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 5.5.5 page 50.

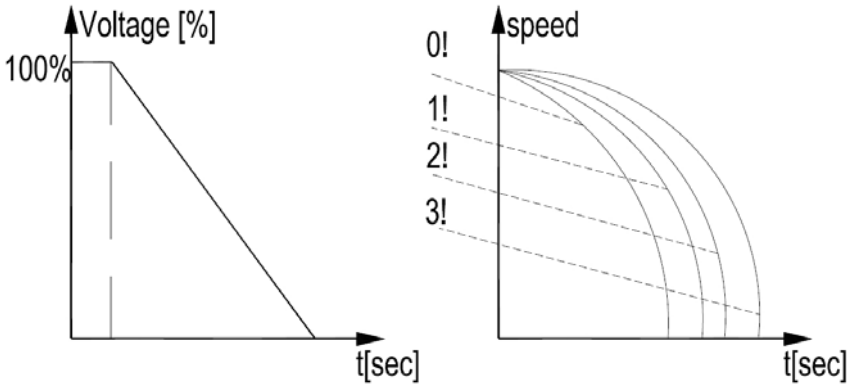
4.7.4.1 Soft Stop Parameters

The ASTAT-XT incorporates 5 stopping curves that enable you to select the suitable torque curve

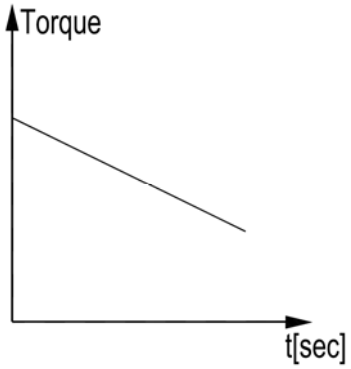
Soft Stop Curve 0 – Standard Curve (Default) – voltage is linearly reduced from nominal to zero.
The most stable and suitable curve for preventing prolonged stopping and motor overheating.

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

Note:
It is recommended that Soft Stop Curve 0 be used for all standard applications (not pumps).
To reduce water hammer, select Soft Stop Curve 1, then 2, then 3 in that order.



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



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

4.7.5 DUAL Settings Parameters[33] – Page 4

When `D.Set: Generator Parameters` is required, do the following:
Program PROG. Input #8 to `DUAL Settings` (this is its default setting). Refer to section 4.7.8 on page 40.
Set dip switch #3 to ON (refer to section 5.5.3 on page 50).
Connect control inputs voltage to input terminal 8.
The following display appears:

D.Set: Generator Parameters

Function & Default	Range	Unit	Description
`Starting VOLT-2 30%`	10-50% After reaching 50% the display changes to: Starting CURR-2 100-400%.[34]	% of mains voltage	Sets the motor's Starting Voltage in DUAL Setting mode. (Motor's torque is directly proportional to the square of the voltage) Refer to section 4.7.3 on page 29 parameter: `Starting Voltage`
`Starting CURR-2 100%`			
`Current Limit-2 300% of Im`	100-700%.	% of Motor Current	Sets the motor's highest current during starting in DUAL Setting mode. Refer to section 4.7.3 on page 29 parameter: `Current Limit`.
`Ramp UP-2 10 SEC.`	1-30 [35]	sec.	Sets Ramp UP-2 time of the motor in DUAL Setting mode. Refer to section 4.7.3 on page 29 parameter: `Ramp UP Time`.
`Ramp DOWN-2 10 SEC.`	1–30 [36]	sec.	Sets Ramp DOWN-2 time of the motor in DUAL Setting mode. Refer to section 4.7.4 on page 34 parameter: `Ramp DOWN time`.
`Motor Current-2 31 Amp.`	50-100% of STARTER Current.	A.	Sets the motor's Full load Ampere, Im, in DUAL Setting mode. Refer to section 4.7.2 on page 25 parameter: `Motor Current`. **Note:** `Motor Current-2` can be set to an equal or lower value than `Motor Current` set in `Main Settings` page.
`Store Settings DUAL Settings`			Same as `Store Settings Main Settings` on page 28.

[33] Displays in MINIMIZED MODE and MAXIMIZED MODE.
[34] The range of the Starting Voltage can be extended to 10-80% by using the EXPANDED SETTING as described in section 5.5.5 page 50.
[35] The range of the Ramp UP-2 time can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 5.5.5 page 50.
[36] The range of the Ramp DOWN-2 time can be extended to 1-90 sec. by using the EXPANDED SETTING as described in section 5.5.5 page 50.

4.7.6 *Slow Speed & Energy Save Parameters[37] – page 5*

Function & Default	Range	Unit	Description
`Energy Saving 0 (MIN)`	0(MIN.) – 10(MAX.)		Sets the required energy saving level. Activated when the motor has a light load for extended periods of time. Supply voltage to the motor decreases (lowering the rotating magnetic field intensity), thus reducing the reactive current and copper/iron losses. In order to activate this function: Program `PROG. Input #7` to `Energy Saving` (refer to section 4.7.8 on page 40) Connect control inputs voltage to input terminal 7 **Note:** When using `Energy Saving` function, harmonics should be taken into consideration. At maximum energy save settings, the 5th harmonic may exceed 30% of the RMS current value. **ATTENTION!** When using ASTAT-XT in the EU, compliance with EMC is required. ASTAT-XT range comply with the generic EN 50081-2 and EN 50082-2 only when not using the `Energy Saving` function.
`Slow Speed TRQ. 8`	1(MIN.) – 10(MAX.)		Sets Slow Speed Torque. Determines the torque while motor is operating at 1/6 of nominal speed. Refer to section 4.7.8.1 on page 41.
`Max Slow SP Time 30 SEC.`	1-30sec. [38]		Sets the maximum time for Slow Speed Torque operation. Determines the maximum allowable operation time at slow speed. ASTAT-XT will trip when this time is exceeded and a `Slow Speed Time` message will display. **WARNING** Operating current while motor is running at 1/6 speed is much higher than nominal current and motor ventilation is much weaker. Special caution must be taken to prevent overheating when running the motor at slow speed for long periods of time.
`Store Settings Slow SP & Saving`			Same as `Store Settings Main Settings` on page 28.

[37] Displays in MINIMIZED MODE and MAXIMIZED MODE.

[38] The range of the Max Slow SP Time can be extended to 1-60 by using the EXPANDED SETTING as described in section 5.5.5 page 50.

4.7.7 Fault Settings[39] – Page 6

Function & Default	Range	Unit	Description
`Phase Loss Enabled`	Enabled[40]		Sets Phase Loss trip Phase Loss protection trips the ASTAT-XT when 1 or 2 phases are missing. **Notes:** If ASTAT-XT trips on `Phase Loss` do the following: (1) In cases where the current transformers are connected externally (ASTAT-XT 950-1400A models), verify that that the current transformers are not grounded. Each current transformer is connected with its 2 wires only and these wires are not grounded externally. (2) Check phase voltages related to terminal 21 even if terminal 21 is not connected. Verify that phase voltages are within the required range of line to neutral voltages. (3) Verify that terminal 21 is connected correctly. For terminal 21 connection refer to section 8.1 on page 62. (4) If terminal 21 is connected correctly, disconnect terminal 21 and try to start when terminal 21 is disconnected. (5) If all previous actions are do not solve the problem and the you are sure that no real phase loss exists, you can set Phase Loss protection to `Disable`. This situation can occur in rare cases when there is no real fault but the ASTAT-XT recognizes unusual behaviour like when Total Harmonic Distortion in Voltage (THDV) in the network is high. (6) If this is a true case of `Phase Loss` then after setting `Phase Loss` protection to `Disable` the motor will single phase and most likely be tripped by the over load protection mechanism. (7) `Phase loss` might not be detected in motor operating under a light load. **WARNING** Do not set `Phase Loss` to `Disable` unless it is found to be necessary in the field!
Phase Sequence Disabled	Enabled/ Disabled		Sets Phase Sequence trip When ASTAT-XT is connected in `DELTA Conf.` you can not set `Phase Sequence` protection to `Disabled`.
`Auto Reset Disabled`	Enabled/ Disabled		Sets ASTAT-XT's Auto Reset mode of operation. The ASTAT-XT can be automatically reset for `Undervoltage` and `Phase Loss` faults. Refer to section 4.7.2 on page 27 for details on setting `Undervoltage` protection. To start the motor after `Undervoltage` and `Phase Loss` faults have been cleared, remove the START signal and recommence the signal. Auto Reset function has a non-programmable time delay of 60 seconds. **Note:** The `Auto Reset` operation is limited to 10 operations.

[39] Displays in MINIMIZED MODE and MAXIMIZED MODE.

[40] The range of the PHASE LOSS can be extended to Enabled or Disabled by using the EXPANDED SETTING as described in section 5.5.5 page 50.

Function & Default	Range	Unit	Description
`Thermistor Type PTC`	PTC/NTC		Sets input Thermistor Type Measures the motor's thermistor resistance and trips the ASTAT-XT when the level decreases below set level.
`Thermistor Trip Disabled`	Disabled, 0.1–10Kohm		Sets ASTAT-XT's Thermistor Trip mode of operation. **Note:** Thermistor Trip has a factory preset time delay of 2 sec.
`Undercurrent RST Disabled`	10–120min., Disabled.		Sets ASTAT-XT's Undercurrent Reset time delay. If the `Undercurrent RST` setting is `OFF` then ASTAT-XT will not automatically reset after an `Undercurrent Trip` fault occurs. If you set the `Undercurrent RST` setting to a time value then ASTAT-XT will automatically reset with a delay (the time defined for `Undercurrent RST`). If the start command is not removed, the motor will restart automatically after the delay time. During the delay time a message `U/C Fault Retry In: XX Min.` is displayed. Refer to section 4.7.2 on page 27 for details on setting of `Undercurrent Trip`.
`Store Settings Fault Settings`			Same as `Store Settings Main Settings` on page 28.

4.7.8 I/O Settings Parameters[41] – Page 7

Function & Default	Range	Unit	Description
PROG. Input # 7 Reset	Reset; Slow Speed; Energy Saving		Sets the terminal 7 function Refer to section 4.7.8.1 on page 41.
PROG. Input # 8 Dual Settings	Dual Settings; Slow SPD Reverse; Reset;		Sets the terminal 8 function Refer to section 4.7.8.1 on page 41.
PROG. Fault Relay At Fault Close	At Fault Close, At Fault Open		Sets the Fault Relay mode of operation. When configured to `At Fault Close` the internal relay is energized upon fault. When configured to `At Fault Open` the relay is de-energized upon fault. In this mode, while normal operation, the fault relay is energized. Relay will also de-energize upon control power outage.
Relay ON Delay 0 SEC.	0 – 3600	sec.	Sets ASTAT-XT's Immediate Relay (RUN relay) ON delay time.
Relay OFF Delay 0 SEC.	0 – 3600	sec.	Sets ASTAT-XT's Immediate Relay (RUN relay) OFF delay time.
Analog Output I, 0...200% OF Im	I, 0…200% OF Im		Sets Analog Output mode of operation. The dip switch settings on the analog card define full scale as either 20mA or 10V. Refer to section 5.7 on page 51 for more details. The full scale of the analog card is related to 200% of `Motor Current` (2x <*rated motor current*>).
Store Settings I/O Settings			Same as `Store Settings Main Settings` on page 28.

[41] Displays in MINIMIZED MODE and MAXIMIZED MODE.

4.7.8.1 Terminal 7 and 8 Programming

Input Terminal 7 Programmed Function	Description
`Reset` (default setting)	Input terminal 7 is used as Reset to reset all ASTAT-XT faults. The `Reset` command will take effect only if the start command is removed. (Except for `Undercurrent RST` when enabled. Refer to page 39.)
Slow Speed	While input terminal 7 is ON, the motor will start `slow speed` forward. Refer to section 4.7.6 on page 37 and section 8.11 page 66.
Energy Saving	While input terminal 7 is ON, the motor will operate in the `Energy Saving` mode. Refer to section 4.7.6 on page 37.

Input Terminal 8 Programmed Function	Description
`DUAL Setting` (default setting)	Input terminal 8 is used to start and stop from the `DUAL Setting Parameters` page. Refer to section 4.7.5 on page 36. **Note:** When dip switch #3 is ON, `DUAL Settings Parameters` will operate the ASTAT-XT with `D.Set: Generator Parameters`. Refer to section 8.17 on page 71.
Reset	Input terminal 8 is used as `Reset` all ASTAT-XT faults. The `Reset` command will take affect only if the start command is removed. (Except for `Undercurrent RST` when enabled. Refer to page 39.)
Slow SPD Reverse	In order to operate in `Slow SPD Reverse` terminal 7 must be programmed as `Slow Speed` and the control input voltage must be connected to terminal 7 as well. You can give the reverse command before the motor is started or during operation at `Slow Speed`. Connecting control voltage to terminal 8 before the motor is started, starts the motor in reverse direction. Connecting the control voltage while the motor is running at `Slow Speed` stops the motor for 0.6 – 2 sec (according to motor size) before it reverses its direction. Refer to section 4.7.6 on page 37 and section 8.11 page 66.

4.7.9 COMM. Parameters[42] – Page 8 – With the Modbus standard PCB

Function & Default	Range	Unit	Description
COMM.Protocol Modbus	Profibus/ Modbus/ DeviceNet		Sets ASTAT-XT's communication PROTOCOL. Operational when the Modbus communication PCB is installed.
Baud Rate 9600 (MODBUS)	1200, 2400, 4800, 9600		Sets ASTAT-XT's Baud Rate.
Parity Check EVEN	EVEN, ODD, NO		Sets ASTAT-XT's communication Parity Check.
Station Number OFF	OFF,1 – 247		Sets ASTAT-XT's communication Station Number.
S. Link Par. Set Disabled	Enabled/ Disabled		Enables parameter modification via serial communication
Ser. Link Control Disabled	Enabled/ Disabled		Enables start, stop, reset, etc. via serial communication
Store Settings COMM. Parameters			Same as Store Settings Main Settings on page 28. **Note:** After changing communication parameters and storing them, control power must be switched OFF and ON to load the new communication parameters.

4.7.10 Comm. Parameters[42] – Page 8 – With the Profibus optional PCB

Function & Default	Range	Unit	Description
COMM. PROTOCOL Profibus	Profibus/ Modbus/ DeviceNet		Sets ASTAT-XT's communication protocol. Operational when the optional communication PCB is installed.
Baud Rate AUTO (Profibus)			User can not change the Baud Rate value. Max. rate is 12 mega bit per second (MBPS).
Parity Check AUTO (Profibus)			User can not change the Parity Check value.
PROFI.Network ID OFF	OFF, 1-126		Sets the Profibus network ID. When set to OFF the Profibus card will not function.
S. Link Par. Set Disabled	Enabled/ Disabled		Enables parameter modification via serial communication
Ser. Link Control Disabled	Enabled/ Disabled		Enables start, stop, reset, etc. via serial communication
Store Settings COMM. Parameters	Enabled/ Disabled		Same as Store Settings Main Settings on page 28. **Note:** After changing communication parameters and storing them, control power must be switched OFF and ON to load new communication parameters.

[42] Displays in MINIMIZED MODE and MAXIMIZED MODE.

4.7.11 Comm. Parameters[42] – Page 8 – With the DeviceNet Optional PCB

Function & Default	Range	Unit	Description
COMM. PROTOCOL DeviceNet	Profibus/ Modbus/ DeviceNet		Sets ASTAT-XT's communication protocol. Operational when the optional communication PCB is installed.
Baud Rate Set Manually			Set the `Baud Rate` by changing the position of the rotary switches on the optional PCB as shown on section C.1.5 page 109.
Parity Check AUTO (DeviceNet)			User can not change `Parity Check` value.
DeviceNet ID Set Manually			Set the unit ID by changing the position of the rotary switches on the optional PCB as shown on section C.1.5 page 109.
S. Link Par. Set Disabled	Enabled/ Disabled		Enables parameter modification via serial communication
Ser. Link Control Disabled	Enabled/ Disabled		Enables start, stop, reset etc. via serial communication
Store Settings COMM. Parameters	Enabled/ Disabled		Same as `Store Settings Main Settings` on page 28. **Note:** After changing communication parameters and storing them, control power must be switched OFF and ON to load new communication parameters.

4.7.12 Statistical Data [43]– page 9

Function & Default	Range	Unit	Description
Last Start Time No Data		Sec.	Displays the last starting time in seconds. Starting time is the duration until motor current drops to nominal.
Last Start Curr. No Data		A	Displays the last starting current.
Elapsed Run Time 0 Hours		Hour	Displays the motor's total run time.
Number Of Starts 0			Displays the total number of starts.
Last Fault No Data			Displays the cause of the motor's last trip.
Motor FLT Curren 0 % Of Im		% of Motor Current	Displays motor current when the motor was tripped by the ASTAT-XT.
Fault Counter 0			Displays the total number of trips.
Previous Fault -1 No Data			Displays motor trip history.
Previous Fault -2 No Data			
Previous Fault -3 No Data			
Previous Fault -4 No Data			
Previous Fault -5 No Data			
Previous Fault -6 No Data			
Previous Fault -7 No Data			
Previous Fault -8 No Data			
Previous Fault -9 No Data			

[43] Displays in MINIMIZED MODE and MAXIMIZED MODE

4.8 Non Adjustable Protection and Fault Reset

4.8.1 Under/Over Frequency

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

4.8.2 Phase Loss

Operational when the ASTAT-XT is energized, provided this protection has not been de-activated. Phase loss protection trips the ASTAT-XT when 1 or 2 phases are missing.
Refer to section 4.7.7 on page 38 parameter `Phase Loss`.

4.8.3 Phase Sequence

Operational when the ASTAT-XT is energized, provided this protection has not been de-activated. Phase sequence protection trips the ASTAT-XT when phase sequence is wrong.
Refer to section 4.7.7 on page 38 parameter `Phase Sequence`.

4.8.4 Wrong Connection

Operational after start signal. Trips if motor is not properly connected to the ASTAT-XT's load terminals, when internal disconnection is detected in the motor winding.
This protection is not active when `D. Set.:Generator Parameters` is selected.

4.8.5 Shorted SCR

Trips the ASTAT-XT if one or more of the SCRs have been shorted.
This protection is not active when `D. Set.:Generator Parameters` is selected.

4.8.6 Heat-Sink Over Temperature

Thermal sensors are mounted on the heat-sink and trip the ASTAT-XT when the temperature rises above 85°C.

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

4.8.7 External Fault

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

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

4.8.8 Fault and Reset

When any of the above protection trips, the ASTAT-XT locks in a fault condition, disabling firing of the thyristors. The *Fault* LED lights, the fault description is displayed on the LCD and the fault relay operates.

- For local reset after fault has been removed, press the *Reset* key.
- Remote reset can be performed through terminals 7 or 8 (see `I/O Settings Parameters` section 4.7.8 page 40).

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

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

4.8.9 Auto Reset

`Undervoltage` and `Phase Loss` faults can auto-reset (refer to section 4.7.7 on page 38). The ASTAT-XT will reset itself 60 seconds after voltage was fully restored, provided that the START signal is removed.

`Undercurrent` fault can be set to auto-reset (refer to section 4.7.7 on page 38).
The ASTAT-XT will reset itself when a programmed time delay has elapsed, even if the START signal is not removed.

4.9 Timing Occurrence Table

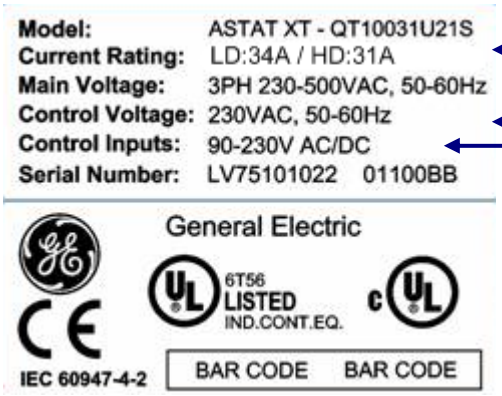
Timing And Occurrence	Active During			
	Start	Run	Stop	Soft Stop
Too many starts with Start Lockout period	√			
Electronic overload with curve selection		√		
O/C JAM Fault				
ASTAT-XT protection – trip immediately at I≥850% Starter Current	√	√		√
Motor protection – trip function				
During start – factory set at 850% Motor Current after O/C JAM Delay.	√			√
During run – adjustable 200 – 850% Motor Current after O/C JAM Delay.		√		
Undercurrent adjustable time delay		√		
Phase Loss	√	√		√
Phase Sequence	√			
Undervoltage with adjustable time delay. Time delay is override in case of Phase Loss.	√	√		√
Overvoltage with adjustable time delay	√	√		√
Long start time (stall protection)	√			
Shorted SCR	√			√
Wrong Connection (load loss)	√			
External fault – input from a N.O. contact	√	√	√	√
SCR protection by Metal Oxide Varistors (MOV)	√	√	√	√
ASTAT-XT over-temperature	√	√	√	√
ASTAT-XT internal test, when the *On* LED is lit.	√	√	√	√
Motor thermistor – programmable PTC/NTC, with adjustable trip level.	√	√	√	√

5. INSTALLATION

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

5.1 Prior to Installation

Check that the Full Load Ampere (Im) of the motor is lower than or equal to the Current Rating in the expected load duty (LD or HD) indicated on the side and/or front name plate of the ASTAT-XT.
Note that Current Rating indicated as LD corresponds to load duty NEMA Class 10; Current Rating indicated as HD corresponds to load duty IEC Class 20 or NEMA Class 30.
Also verify that the mains voltage, Control Voltage and Control Input voltage are as indicated on the name plate of the ASTAT-XT.



Verify that motor current and load duty (LD or HD) matches the Current Rating indication.
Verify mains voltage is correct!
Verify that Control Voltage (terminals L, N) is correct!
Verify that Control Input voltage (terminals 4-9) is correct!

ASTAT-XT name plate - example

5.2 Mounting

The ASTAT-XT must be mounted vertically. Allow sufficient space for suitable airflow above and below the ASTAT-XT. To improve heat dissipation, it is recommended that you mount the ASTAT-XT directly on the rear metal plate.
Notes:
(8) Do not mount the ASTAT-XT near heat sources.
(9) Surrounding air temperature in the cabinet should not exceed 50°C
(10) Protect the ASTAT-XT from dust and corrosive atmospheres.

5.3 Temperature Range & Heat Dissipation

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

ATTENTION	Operating the ASTAT-XT with a surrounding air temperature that is higher than 40°C and up to 50°C, derate the current by 2.5% for each °C that is above 40°C.
CAUTION	Operating the ASTAT-XT with a surrounding air temperature that is higher than 60°C may cause damage to the ASTAT-XT.

Heat dissipation from the ASTAT-XT is calculated as:

$$Ploss=3x1.3xI+FAN\ loss$$

where:
I represents motor current. Note that the motor current during the start process is higher than the motor rated current.
FAN loss represents power loss caused by all internal fans (refer to section 3 page 11 for fan loss per model).
For example, during start of a 820A motor when `Current Limit` is set to 400%, heat dissipation can be calculated as:

$$Ploss=3x1.3x4x820+150=12,792Watt\approx12.8kW$$

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

Ploss=3x1.3x820+150=3,198Watt≈3.2kW

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

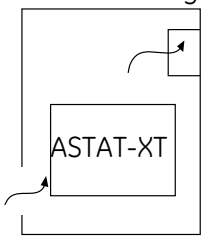
Ploss=3x1.3x0+150=150Watt≈0.15kW

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

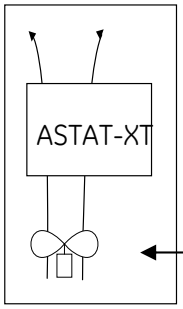
Important Note: If the motor is started frequently, the cabinet should be designed for greater heat dissipation. You can reduce the enclosure heating by adding ventilation.

5.3.1 Forced Ventilation

Use the following arrangement for forced ventilation of the ASTAT-XT's enclosure:



General purpose enclosure
Fan at air outlet ventilates



Non-ventilated enclosure
Fan circulates existing air.

Fan

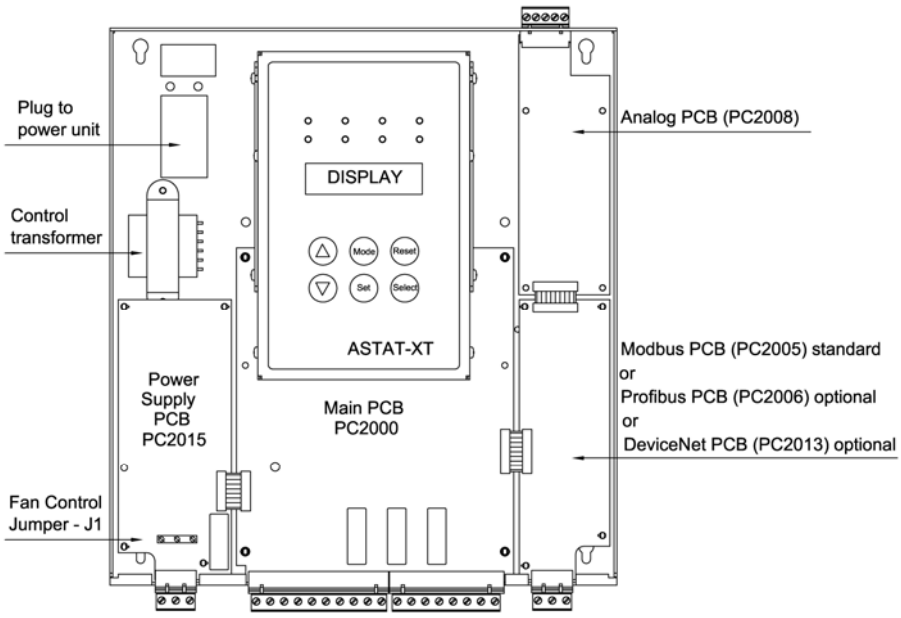
Calculating the Enclosure Size, for Non-Ventilated Metal Enclosure

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

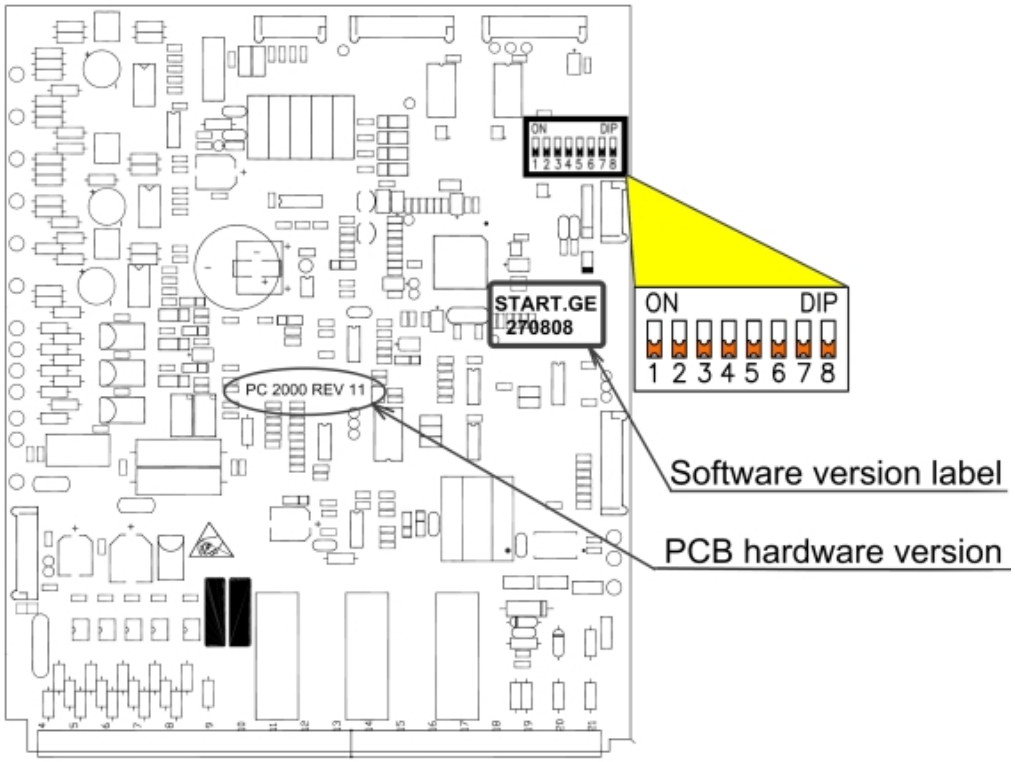
where:
Area [m²] represents the surface area that can dissipate heat (front, sides, top).
Total heat dissipation [Watt] represents the total heat dissipation of the ASTAT-XT and other control devices in the enclosure. If the ASTAT-XT is started frequently you should use average power.

5.4 Main PCB and Optional PCBs

QTx0008-QTx0072
Remove top cover and display to access the main PCB.



QTx0085-QTx1400
Remove top cover of the control module to access the main PCB, optional PCBs and fan control jumpers.



ASTAT-XT main PCB.
Dip switches location, software version label location and PCB hardware version identification.

5.5 Dip Switch Settings on the Main PCB

The dip switch has eight separate switches. It is located under the front cover of the control module (models QTx0085x-QTx1400) or under the display unit (models QTx0008x-QTx0072).

No.	Switch Function	Switch Off	Switch On
1	Display format	Minimized	Maximized
2	Not Used	-	-
3	Mains/generator	Mains	Generator
4	Must be OFF	-	-
5	LCD language selection	See tables below section 5.5.4 page 50.	
6			
7	Expanded settings	Disabled	Enabled
8	Software lock	Open	Locked

5.5.1 Switch # 1 – Display Modes

Two display modes are available:
Maximized – display of all possible parameters.
Minimized – display of pre-selected parameters.
Setting switch # 1 to OFF will minimize the LCD displays.
Refer also to section 4.6 page 23.

Maximized Mode - Switch #1 – On
Display Only
Main Settings
Start Settings
Stop Settings
Dual Settings
Slow SP & Saving Parameters
Fault Settings
I/O Settings Parameters
COMM. Parameters
Statistical Data

Minimized Mode Switch #1 – Off
Display Only
Main Settings
Start Settings
Stop Settings
Statistical Data

5.5.2 *Switch # 2 – Not used*

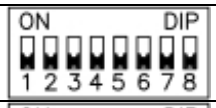
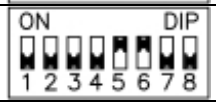
5.5.3 *Switch # 3 – Main/ D.Set: Generator Parameters*

Refer to section 8.17 page 71 for information regarding the operation of this switch.

WARNING	When operating in `D.Set: Generator Parameters`, the motor must be loaded to avoid vibration during starting and stopping.

5.5.4 *Switches # 5, 6 – Language Selection*

Language selection defined by the switch settings.

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

5.5.5 *Switch # 7 – Expanded Settings*

EXPANDED SETTINGS corresponds to:

Parameter	Range Switch #7 - Off	Range switch #7 - On
Starting Voltage	10-50%	5[1]-80%
Ramp UP Time	1-30 seconds	1-90 seconds
Ramp DOWN Time	1-30 seconds	1-90 seconds
Phase Loss	Enabled[2]	Enabled/Disabled [2]
Max Slow SP Time	1-30 seconds	1-60 seconds
`OC or Wrong CON.` protection in Inside Delta configuration.	Protection active in normal set[3]	Protection active in high set[3]

Notes:

(1) Setting the `Starting Voltage` to lower than 10% is not practical for loaded motors.
(2) Refer to section 7 page 59. See `Phase Loss` protection and refer to the warning below.
(3) Refer to section 7 page 59. See `OC or Wrong CON.` protection.

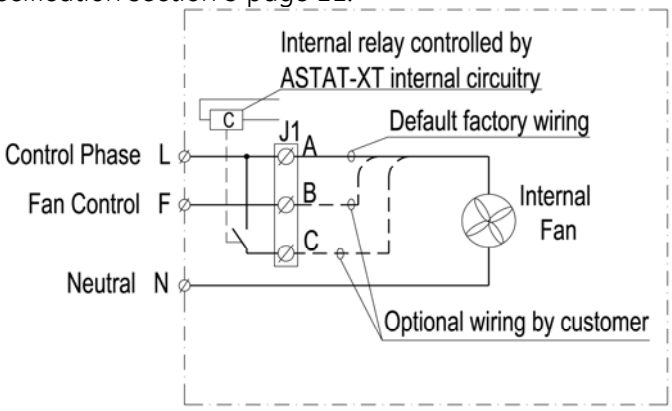
WARNING Operator's responsibility!	• EXPANDED SETTINGS are for use in very special applications only! Do not set to switch #7 to ON unless ASTAT-XT is significantly larger than the motor! When using expanded settings for the ASTAT-XT you must be extremely careful to avoid damaging the motor or ASTAT-XT.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

5.5.6 *Switch # 8 – Software Lock*

The software lock prevents undesired parameter modifications.
When locked, pressing the *Set*, ▼or ▲ keys causes the LCD to display `Access Locked`.

5.6 Internal Fan Control

An internal jumper connected between the fan and terminal 2, enables three modes of operation. For fan power consumption, see technical specification section 3 page 11.



Fan control jumper J1. Refer to section 5.4 page 48 for J1 location.

Continuous mode (factory default) – Fan operates as long as the control supply is connected to terminals L-N. Leave the internal jumper connected to the left terminal of JI (marked A in the drawing).

External control mode – Fan operates when the control supply is connected to terminal 2. Connect the internal jumper to the centre terminal of JI terminal (marked B in the drawing). For use without bypass, connect the fans before giving the start command and disconnect at least 5 minutes after giving the stop or soft stop command.

Automatic mode – Whenever the start or stop signals is given the fan operates for approximately 5 minutes. Connect the internal jumper to the right terminal of JI (marked C in the drawing).

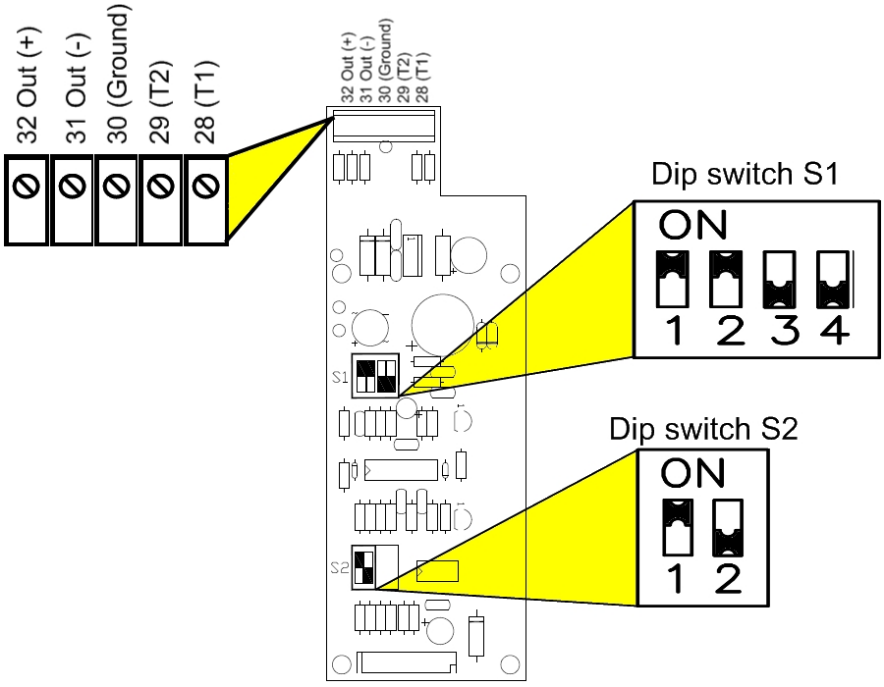
CAUTION	Automatic mode may be used only if bypass contactor is directly controlled by the ASTAT-XT's EOR (End Of Ramp) relay contact.

5.7 Analog I/O (Terminals T1, T2, Gnd, Out (-), Out (+))

The analog option incorporates two functions:

Thermistor input

Analog output



Analog PCB layout

Thermistor Input (Terminals T1, T2)

Programmable as PTC or NTC type thermistor. Trip value is adjustable between 1-10K, preset delay of 2 sec. For thermistor input programming refer to section 4.7.7 on page 38.

Ground Terminal (terminal Gnd)

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

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

Dip switches allow selection between: 0-10VDC, 0-20mA, 4-20mA
The analog value is related to I, 0....200% of `Motor Current` (not programmable).

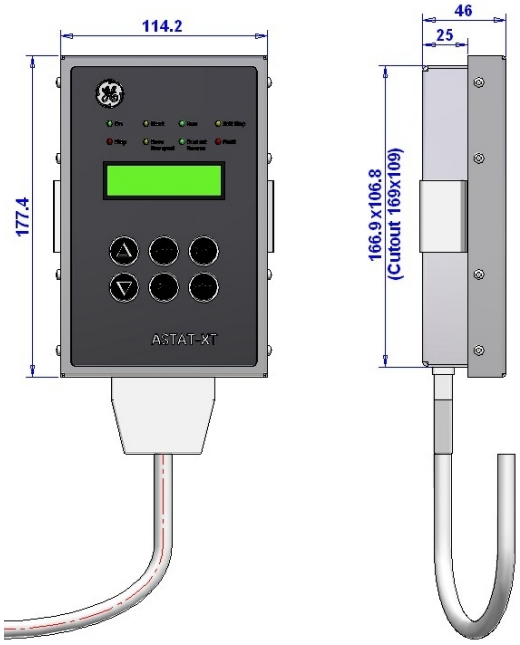
Switch No.	4-20 mA*	0-20 mA	0-10VDC
S1 - Switch # 1	On	On	Off
S1 - Switch # 2	On	On	Off
S1 - Switch # 3	Off	Off	On
S1 - Switch # 4	Off	Off	On
S2 - Switch # 1	On	Off	Off
S2 - Switch #2	Not used	Not used	Not used

* Factory default setting

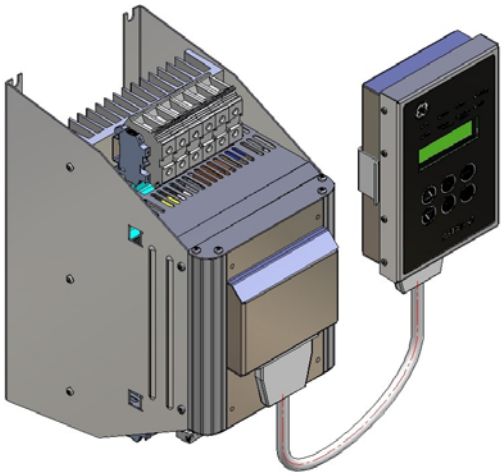
Notes:

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

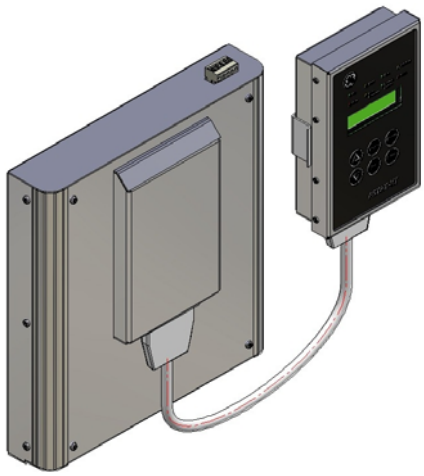
5.8 Remote Key-Pad Installation



Remote key pad dimensions and cut out; Cable length is 1.5 meters



QTx0008-QTx0072



QTx0085-QTx1400

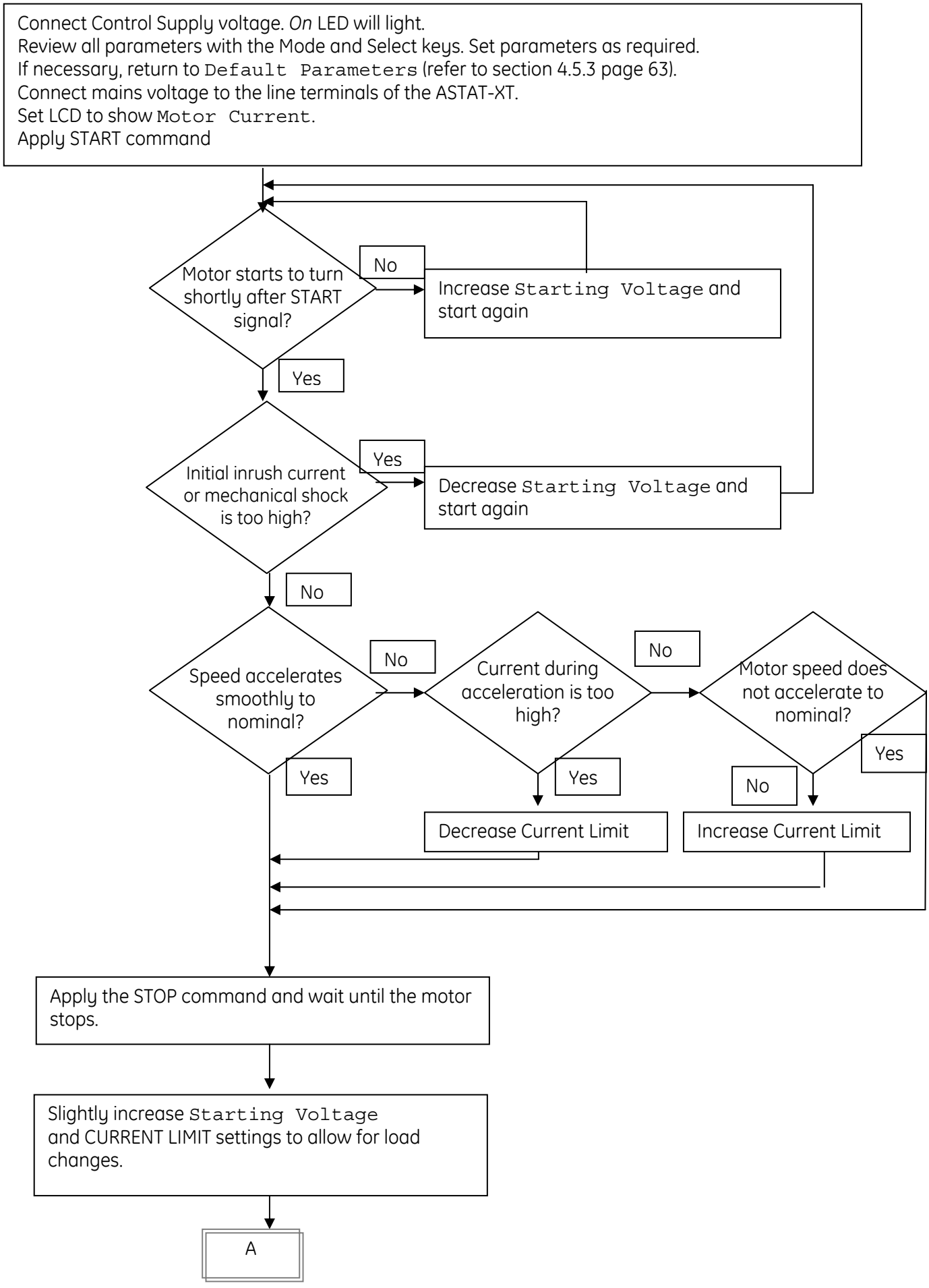
Remote key pad connection to various models of soft starters
Note: Add 20 mm to the depth dimension of the ASTAT-XT when optional remote key-pad is installed.

6. STARTING PROCEDURE

Note:
It is necessary to connect a motor to load terminals; otherwise `Shorted SCR` or `WRONG CONNECTION` faults are activated (`OC or Wrong CON.`). Other loads such as incandescent light bulbs, resistors, etc. may also cause an `OC or Wrong CON.` fault.

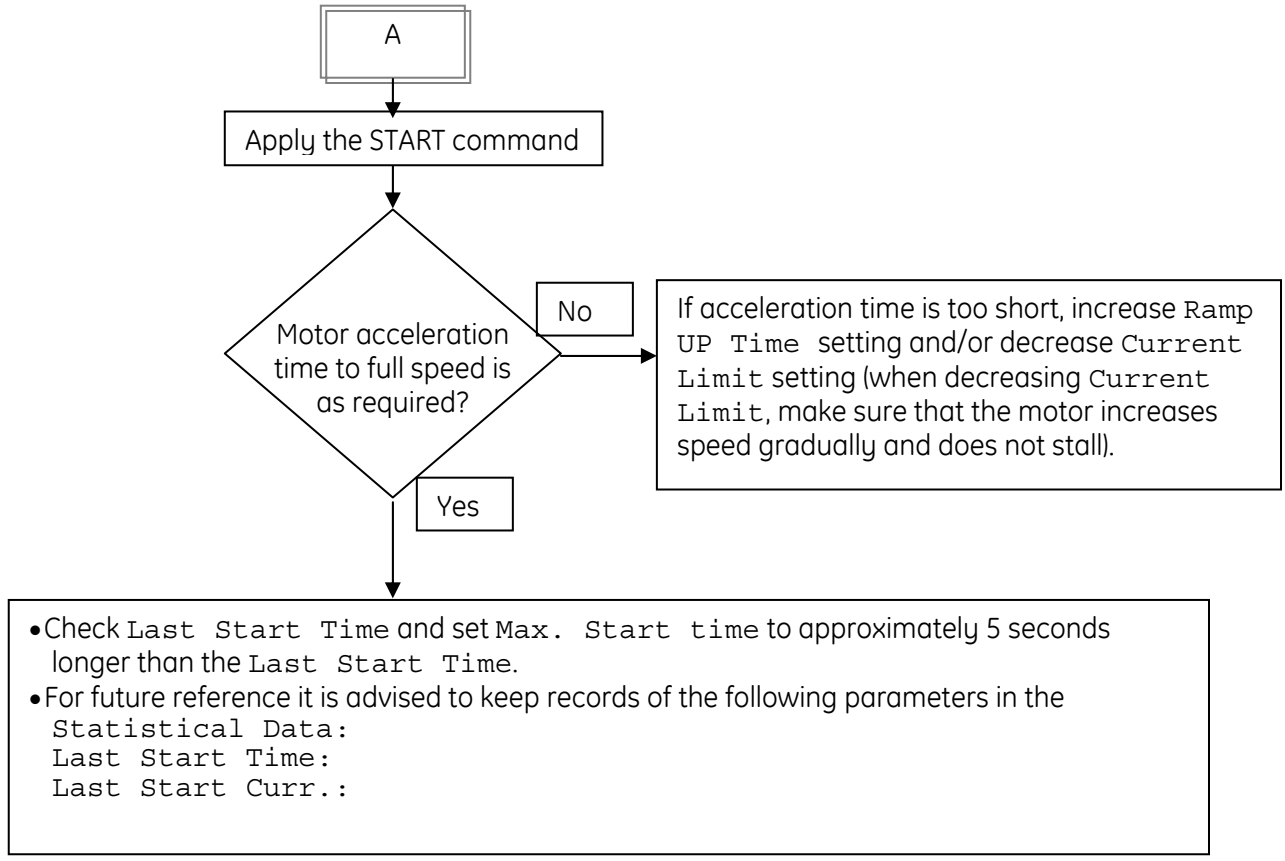
WARNING	1	When mains voltage is connected to the ASTAT-XT, even if control voltage is disconnected, full voltage may appear on the ASTAT-XT load terminals. Therefore, for isolation purposes, it is necessary to connect an isolating device upstream to the ASTAT-XT.
	2	Power factor correction capacitors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

6.1 Standard Starting Procedure



See next page

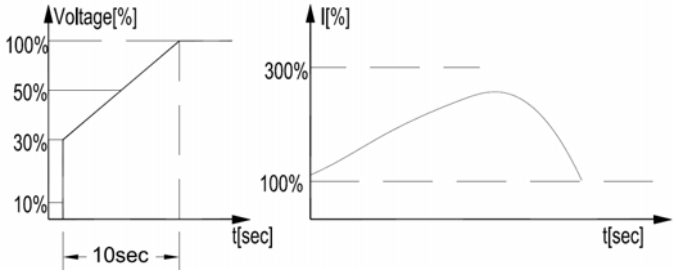
Continued from previous page



6.2 Examples of Starting Curves

6.2.1 Light Loads - Pumps, Etc.

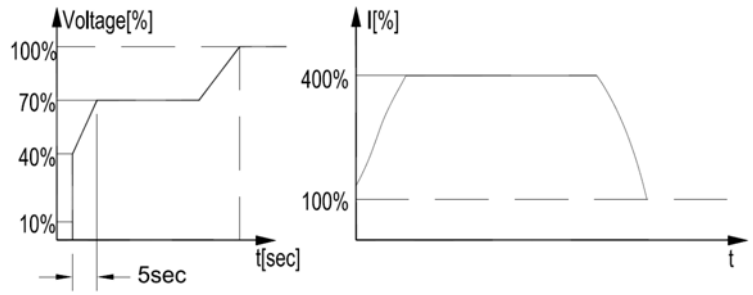
(In these cases the actual current is always lower than the Current Limit setting)
Starting Voltage- set to 30%
Current Limit - set to 300-350%
Ramp UP Time- set to 10 sec.



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

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

(In these cases the actual current is at the CURRENT LIMIT setting during part of the starting time)
Starting Voltage– set 40%
Current Limit– set 400%
Ramp UP Time– set 3 sec

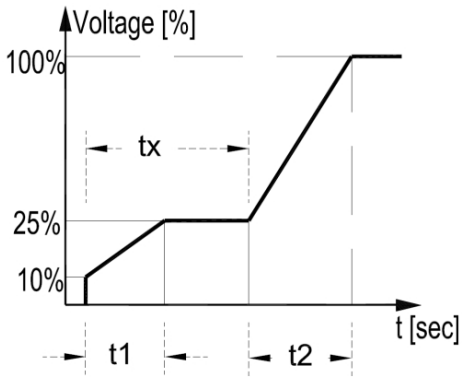


Upon START the voltage and current increase until the current reaches the `Current Limit` value. The voltage remains at this value until the motor reaches close to nominal speed, where current starts to decrease and voltage continues to ramp-up to nominal.

6.2.3 Special Starting Using DUAL Settings

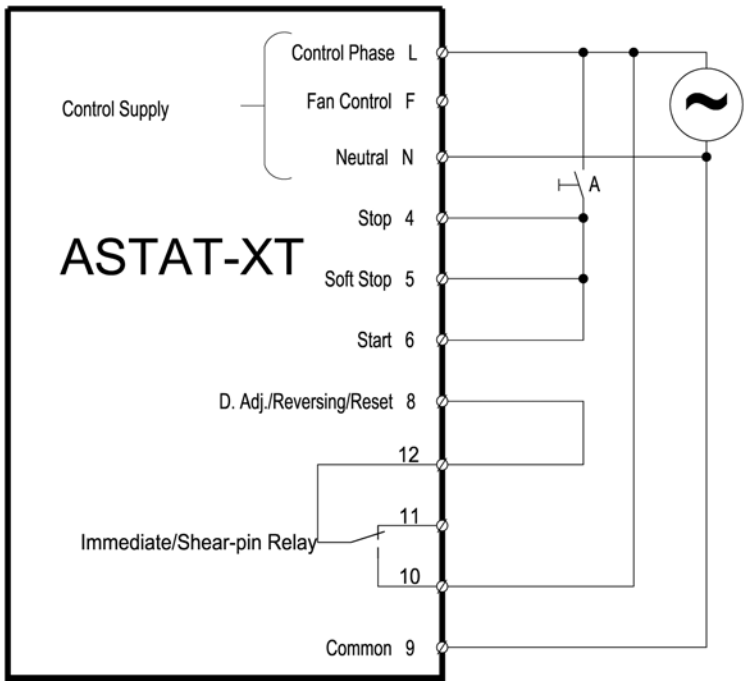
Using two starting characteristics, the ASTAT-XT will accelerate using standard characteristics (`Starting Voltage`, `Ramp UP Time` and `Current Limit`). After transition (tx), Immediate Relay (RUN relay) `ON Delay`, voltage to input terminal 8 is switched ON using the `DUAL Settings` characteristic to complete acceleration. Perform the following steps:

- To use `DUAL Settings` automatically, connect immediate relay in series to input terminal 8 as shown in section 6.2.3.1 below.
- Program Immediate Relay (RUN relay) `ON Delay` to tx.
- Program `PROG. Input #8` to `DUAL Settings` (default setting).
- Program standard parameters and `DUAL Settings parameters` as shown in the table below.
- Using two starting characteristics, the ASTAT-XT will accelerate to reach the 200% current limit. After tx voltage to `PROG. Input #8` is switched ON, using the `DUAL Settings` characteristic to complete acceleration.



Parameter	Standard Parameter	DUAL Settings Parameter
Starting Voltage	10%	25%
Ramp UP Time	t1 = 2-30 sec	t2 = 2-30 sec
Current Limit	200%	300-400%
Relay ON Delay	tx = 1-60 sec.	-----

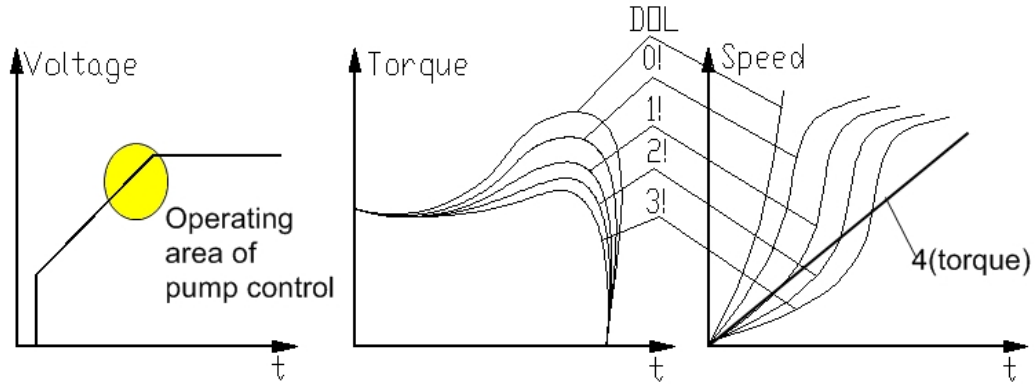
6.2.3.1 Special Starting – Using DUAL Settings – Wiring Diagram



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

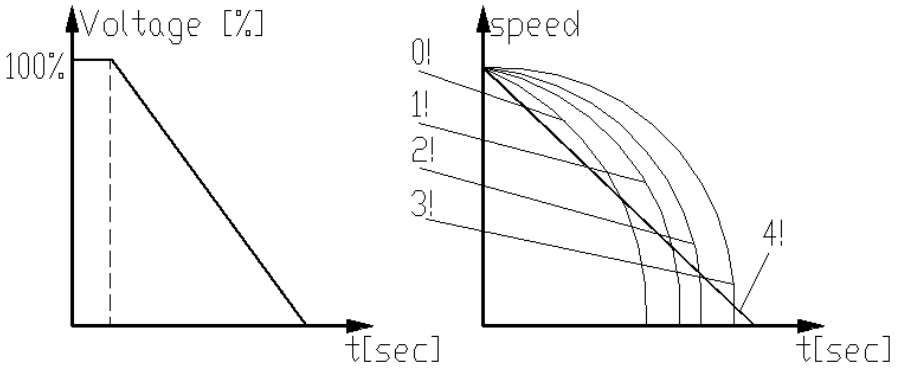
6.2.4.1 Starting Curve

- Adjust Main Settings as necessary (Starter Current, Motor Current, etc.).
- Set `Soft Starting Curve`, `Ramp UP Time`, `Current Limit`, and `Starting Voltage` to their default values (curve 0, 10 sec., 400% and 30% respectively).
- Start the pump while watching the pressure gauge as the pump starts and look for overshooting ("pressure surge") of the gauge needle above the target pressure. In case of over pressure, choose a peak torque reduction curve (Soft Start Curve 1!!).
- Set `Soft Start Curve 1!!`, increase `Ramp UP Time` to 15 seconds and reduce `Current Limit` to 350%. Start the pump and watch the pressure gauge while the pump starts.
- In most cases overshooting is reduced. If the overshoot persists, increase `Ramp UP Time` to 25 seconds (confirm with the motor manufacturer) and try again.
- If overpressure persists, increase the `Soft Start Curve` setting to `2!!` or `3!!` if necessary. Each increase in the `Soft Start Curve` setting will reduce the peak torque, thus reducing the overpressure and preventing "pressure surge" during start.



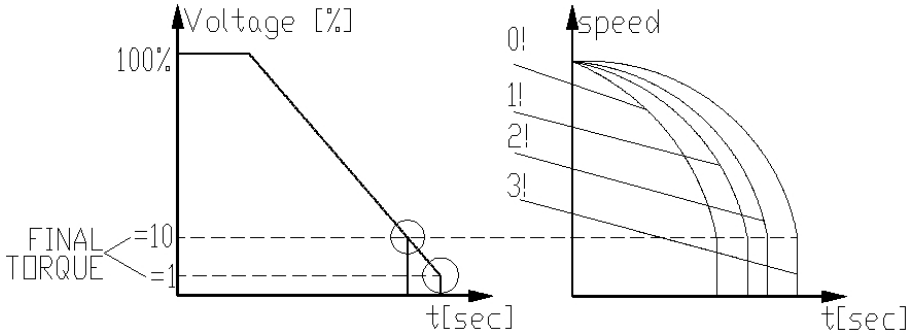
6.2.4.2 Stopping Curve

- Adjust Main Parameters as necessary (Starter Current, Motor Current, etc.)
- Set `Soft Stop Curve` and `Ramp DOWN Time` to their default values (Curve 0 and 10 sec. respectively).
- Stop the pump, watching the pressure gauge and check valve as the pump stops. Look for overshooting ("water hammer") of the gauge (abruptly stops the pump and the motor).
- Select `Soft Stop Curve 1!!` and increase `Ramp DOWN Time` to 15 seconds. Stop the pump and watch the pressure gauge and the rate of closing of the check valve as the pump stops. Abrupt stopping of the pump and motor will cause a loud audible noise emitted from the check valve.
- In most cases, "water hammer" is reduced. If "water hammer" persists, increase the time to 25 seconds (confirm with motor manufacturer) and try again.
- If "water hammer" persists, increase the `Soft Stop Curve` setting to `2!!` or `3!!`. Each increase in the `Soft Stop Curve` will reduce the abrupt stop of the pump, thus preventing the "water hammer" phenomenon.



6.2.4.3 End Torque During Soft-Stopping a Pump Motor

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



7. TROUBLE SHOOTING

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

`Storage Error`	Storage Error displays in case of a failure in parameter storing. Wait 3 seconds and try to store again. If does not help, load the default parameters of the ASTAT-XT and re-program all parameters. To obtain default parameters refer to section 4.5.3 page 22.
`Access Locked`	Avoids parameter changing when dip switch # 8 –Software Lock is set to ON. If parameter changing is required verify that dip switch #8 is set to OFF. For Dip switch #8 setting refer to section 5.5.6 page 50.
`Thermistor Trip`	Trips the ASTAT-XT when the motor thermistor resistance decreases below trip level set. Check resistance of the thermistor and cables; Check motor temperature near thermistor location. For `Thermistor Trip` protection setting refer to section 4.7.7 page 38.
`Too Many Starts`	Trips the ASTAT-XT if the `number of starts`, during `Duty Cycle Time` exceeds the preset number. Wait until motor and ASTAT-XT cool down – according to `Number Of Starts`, `Duty Cycle Time` and `Start Lockout settings`. Refer to section 4.7.3 page 32.
`Long Start Time`	Trips the ASTAT-XT if output voltage does not reach nominal at the preset `Max. Start time.` Check `Starter Current` and `Max. Start Time` settings. Increase `Starting Voltage, Current Limit` & `Max. Start Time` or decrease `Ramp UP Time` as necessary. For `start Settings Parameters` refer to section 4.7.3 page 32.
`O/C JAM Fault`	Trips the ASTAT-XT when: • Instantaneously when current exceeds 8.5 x ASTAT-XT Current • During starting when current exceeds 8.5 x Motor Current • During running when current exceeds 200-850% of Motor Current. `O/C JAM Fault` has a programmable delay of 0-5 seconds where the ASTAT-XT detects the fault and does not trip before time delay has elapsed (delay is overriden when current reaches 8.5 x ASTAT-XT Current). Check that motor is not stalled or jammed. Check `Motor Current and Starter Current` settings. Check motor and cable connections. Perform a "Megger" test to verify motor and cable's condition. For protection parameters settings refer to section 4.7.2 page 27.
CAUTION	Check that "Megger" maximum voltage is no more than 500V! Disconnect terminal 21 before performing a "Megger" test.
`Overload`	Trips the ASTAT-XT when current exceeds the Overload Trip level and the thermal register has filled up. Check `Motor Current`, `Starter Current` settings and overload settings and check motor current, then wait at least 15 minutes to let the motor and ASTAT-XT cool down before restarting. For protection parameters settings refer to section 4.7.2 page 27.

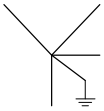
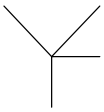
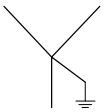
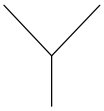
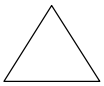
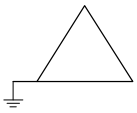
`Undercurrent FLT`	Trips the ASTAT-XT when line current drops below the preset level for the preset time. Check `Undercurrent FLT` and `Undercurrent DLY` settings; check line currents of L1, L2, L3. For protection parameters settings refer to section 4.7.2 page 27.
`Undervoltage`	Trips the ASTAT-XT when line voltage drops below the preset level for the preset time. Check `Undervoltage FLT` and `Undervoltage DLY` settings, check line voltages on L1, L2, L3. When voltage drops to zero, the ASTAT-XT trips immediately with no delay. For protection parameters settings refer to section 4.7.2 page 27.
`Overvoltage`	Trips the ASTAT-XT when line voltage increases above a preset level for a preset time. Check `Overvoltage FLT` and `Overvoltage DLY` settings, check line voltage on L1, L2, L3. For protection parameters settings refer to section 4.7.2 page 27.
`Phase Loss`	Trips the ASTAT-XT if 1 or 2 phases are missing. In cases where the current transformers are connected externally (ASTAT-XT 950-1400A models), verify that that the current transformers are not grounded. Each current transformer is connected with its 2 wires only and these wires are not grounded externally. Check phase voltages related to terminal 21 even if terminal 21 is not connected. Verify that phase voltages are within the required range of line to neutral voltages. Verify that terminal 21 is connected correctly. For terminal 21 connection refer to section 8.1 page 62. If terminal 21 is connected correctly, disconnect terminal 21 and try to start when terminal 21 is disconnected. If all previous actions are do not solve the problem and you are sure that no real phase loss exists, you can set Phase Loss protection to Disable. This situation can occur in rare cases when there is no real fault but the ASTAT-XT recognizes unusual behaviour like when Total Harmonic Distortion in Voltage (THDV) in the network is high. If this is a true case of Phase Loss then after setting Phase Loss protection to Disable the motor will single phase and most likely be tripped by the over load protection mechanism. Phase loss might not be detected in motor operating under a light load. For Phase Loss protection setting refer to section 4.7.7 page 38.
`Freq. or ph loss`	Trips the ASTAT-XT if frequency is not in the range of 40-66.6Hz Check that frequency variations are between 40-66.6Hz.
`Phase Sequence`	Trips the ASTAT-XT if line phase sequence is wrong. Check line phase sequence and if wrong, swap two wires on line side. If motor now rotates in the wrong direction, swap two wires on load side of the ASTAT-XT. For `Phase Sequence` protection setting refer to section 4.7.7 page 38.
`Slow Speed Time`	Trips the ASTAT-XT when operating at slow speed for extended periods. Check that operation time at Slow Speed is shorter than `Max Slow Sp Time`. **Note:** Motor and ASTAT-XT may be overheated when operating at slow speed for an extended period. For `Max Slow SP Time` protection setting refer to section 4.7.6 page 37.

`Wrong Connection`	Trips the ASTAT-XT when one or more motor phases is not properly connected to ASTAT-XT's load terminals or if there is an internal disconnection in the motor winding. Verify that the motor is connected properly. See note 1 at the end of this section.
`Shorted SCR`	Trips the ASTAT-XT and prevents starting if any SCR is short-circuited or when motor windings are shorted. Check with an ohmmeter between L1-U, L2-V, L3-W; resistance > 20 KΩ. Check for no voltage on terminals U, V, W (from parallel system or an independent bypass). SCRs may fail due to: * High short current not protected by proper fuses * High voltage spikes not protected by proper external varistors. * Frequent starting at maximum conditions or fault conditions. See note 1 at the end of this section.
`Over Temperature`	Heat-sink over-temperature. Trips the ASTAT-XT when the heat-sink temperature rises above 85°C. Improve cooling or use a bypass contactor. Check that motor starting is not too frequent.
`External Fault`	Trips the ASTAT-XT when a N.O. contact between terminals 19-21 closes for over two seconds. Check contact position and cause of closure.
`Wrong Parameters`	Parameters not transferred from RAM to EEPROM or vice versa. After loading new software version or after power up, press Reset, then Mode and ▼ simultaneously and save the default parameters by pressing Set and Mode simultaneously. (If the Fault LED is ON, press Reset after `Wrong Parameters`). Refer to section 4.4 page 21 for reviewing and modifying parameters.
`OC or wrong CON.`	Trips the soft ASTAT-XT when connected Inside Delta and Wrong connection or if over current is detected by the ASTAT-XT. Verify that the motor is not stalled or shorted and check cables and wiring. Verify that motor and ASTAT-XT are connected exactly as shown in section 8.20 page 74. If the circuitry is 100% confirmed it is possible to start when dip switch #7 (expanded settings) is ON (refer to section 5.5.5 page 50). If a fault occurs again consult the factory. The operator is advised to try operating one time only. Note that it is useless to try starting in this mode more than once.

Note 1: When operating in `D.Set: Generator Parameters`, `Shorted Scr` and `Wrong Connection` faults are not active.
If required, these faults may be eliminated by implementing D.Set: Generator Parameters.
Refer to section 8.17 page 71 for setting the ASTAT-XT in `D.Set: Generator Parameters` wiring.

8. APPLICATION DIAGRAMS

8.1 Terminal 21 Connections With Various Mains

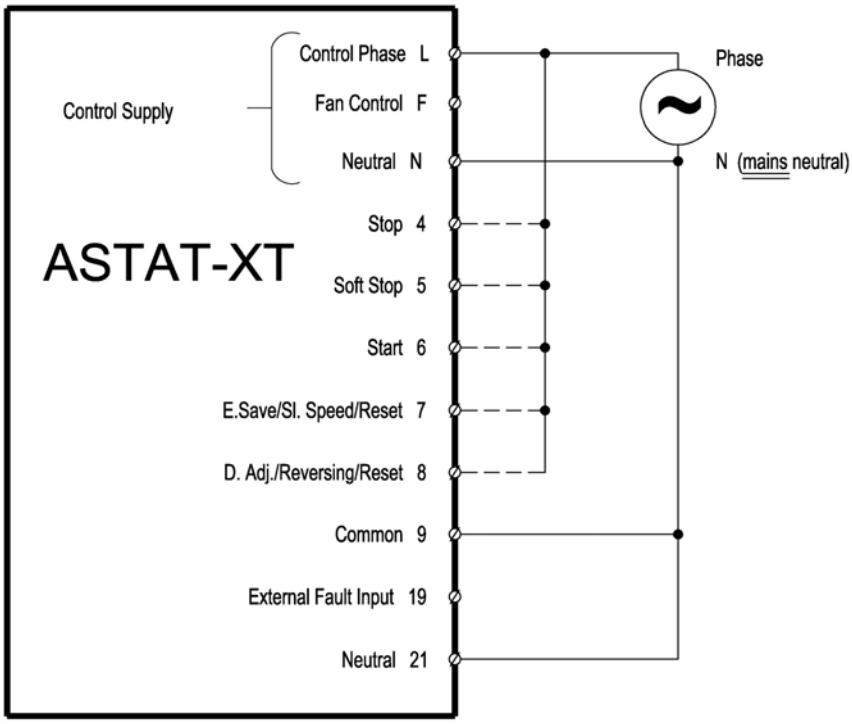
Mains Diagram	Terminal 21 Connection
	3P+N+GR - Connect terminal 21 to neutral
	3P+N - Connect terminal 21 to neutral
	3P+GR - Connect terminal 21 to ground
	3P - Leave terminal 21 unconnected
	3P - Leave terminal 21 unconnected
	3P+GR - Leave terminal 21 unconnected

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

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

Notes:

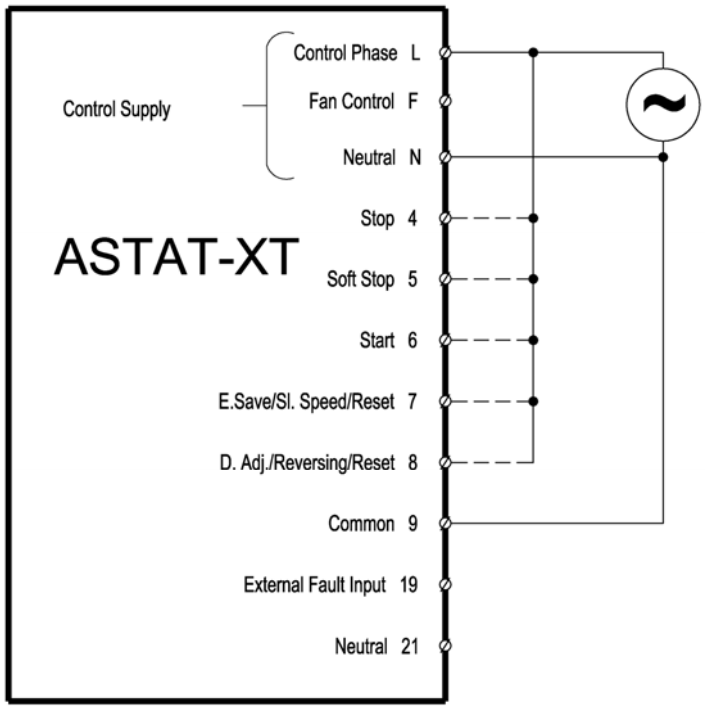
- Use this diagram when Control Supply, Control Input and mains are all from the same source, **and** terminal 21 is connected to neutral as per section 8.1 page 62.
- Supply must be protected for short circuit and over load. 6A fuse is recommended.
- It is recommended to use a separate fuse for the auxiliary circuits.



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

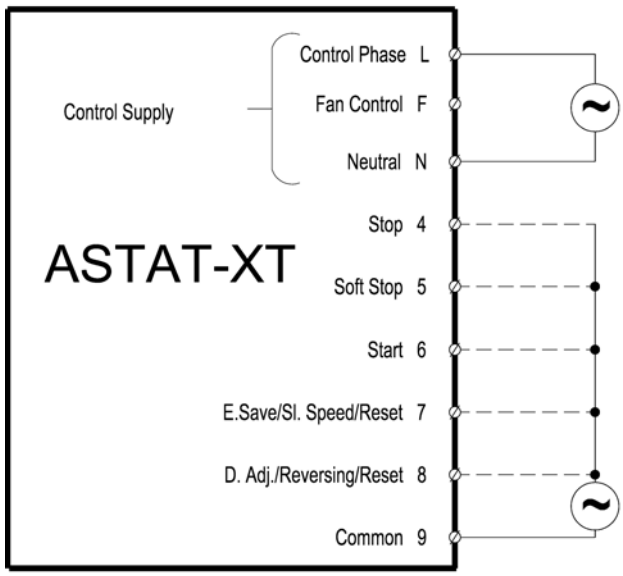
Notes:

- Use this diagram when mains and control voltage are not from the same source
  or
  when mains and control voltage are from the same source, but terminal 21 is **not** connected to neutral as per section 8.1 page 62.
  In this case leave terminal 21 open.
- Supply must be protected for short circuit and over load. 6A fuse is recommended.
- It is recommended to use a separate fuse for the auxiliary circuits.



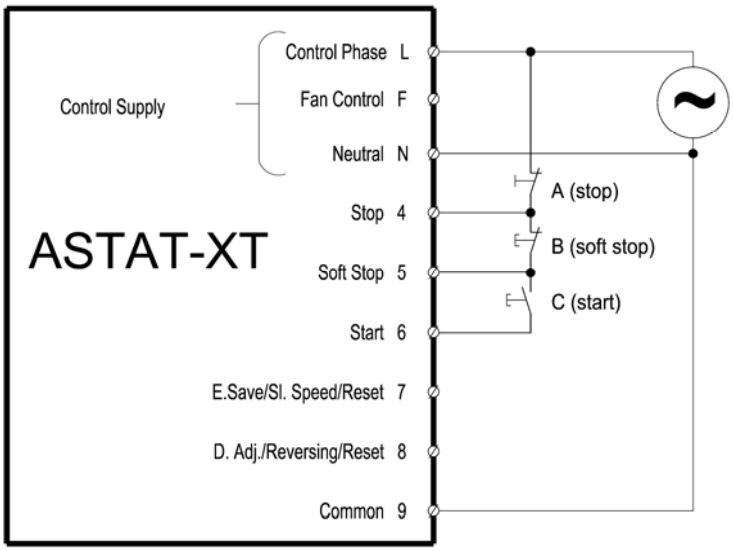
8.4 Control Supply and Control Input from Separate Sources

Notes:
- Use this diagram when Control Supply and Control Input voltages are not from the same source.
- Connect terminal 21 as per section 8.1 page 62.
- Supply must be protected for short circuit and over load. 6A fuse is recommended.
- It is recommended to use a separate fuse for the auxiliary circuits.



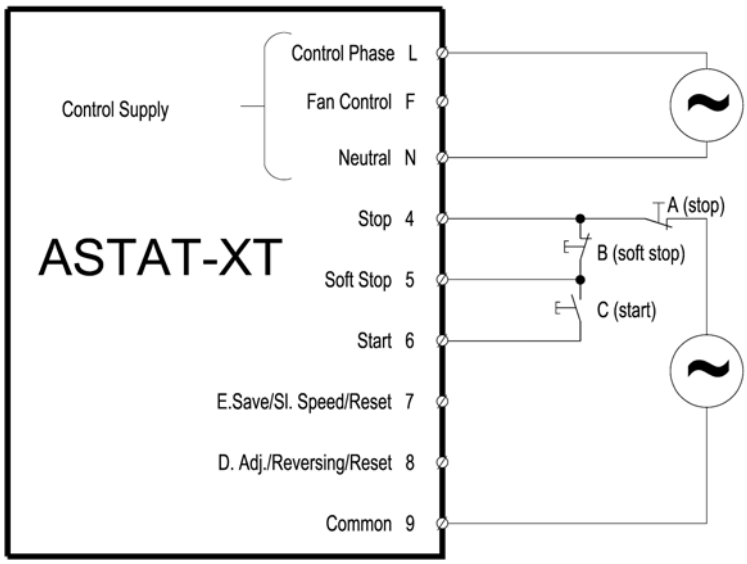
8.5 Soft Start, Soft Stop and Stop, Control Supply and Control Input from the Same Source

Notes:
- Switch A can be used as an immediate stop.
- Switch B is used as a soft stop command to the ASTAT-XT.
- Switch C is used as a momentary or maintained start command to the ASTAT-XT.



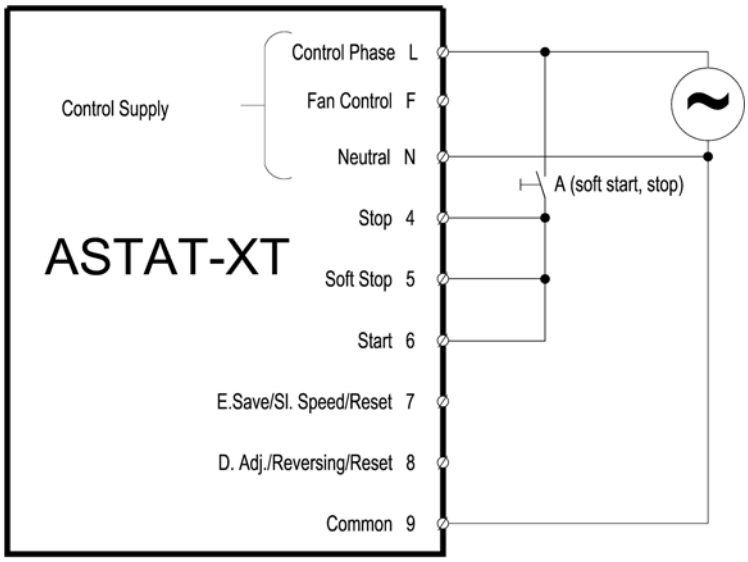
8.6 Soft Start, Soft Stop and Stop, Control Supply and Control Input from Separate Sources

See notes to section 8.5.



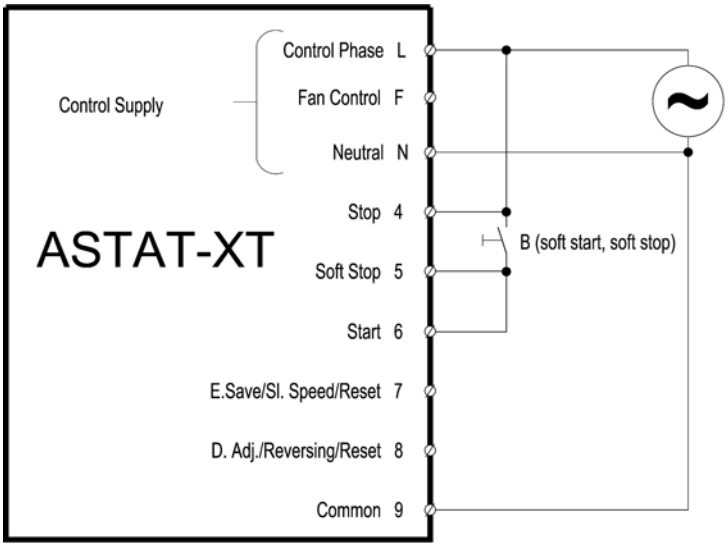
8.7 Soft Start and Immediate Stop (no Soft Stop)

Notes:
- When switch A closes the motor will soft start.
- When switch A opens the motor will stop immediately (no soft stop).
- The drawing shows Control Supply and Control Input from the same source. Refer to section 8.6 for Control Supply and Control Input from separate sources.



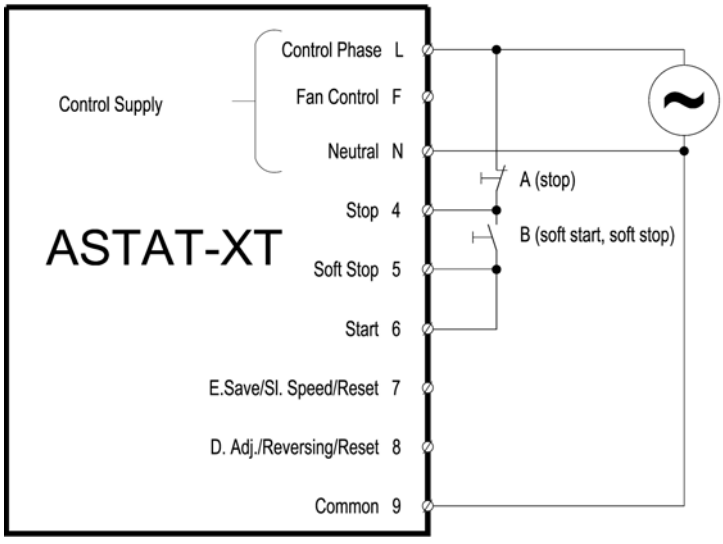
8.8 Soft Start and Soft Stop

Notes:
- When switch B closes motor will soft start.
- When switch B opens motor will soft stop.
- The drawing shows Control Supply and Control Input from the same source. Refer to section 8.6 for Control Supply and Control Input from separate sources.



8.9 Soft Start, Soft Stop and Immediate Stop

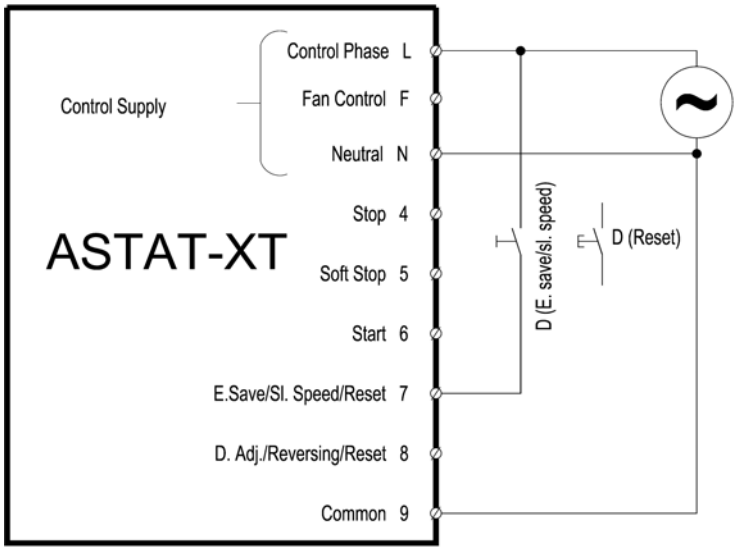
Notes:
- When switch B closes motor will soft start.
- When switch B opens motor will soft stop.
- Switch A opens the motor will stop immediately.
- The drawing shows Control Supply and Control Input from the same source. Refer to section 8.6 for Control Supply and Control Input from separate sources.



8.10 Energy Save, Slow Speed or Reset

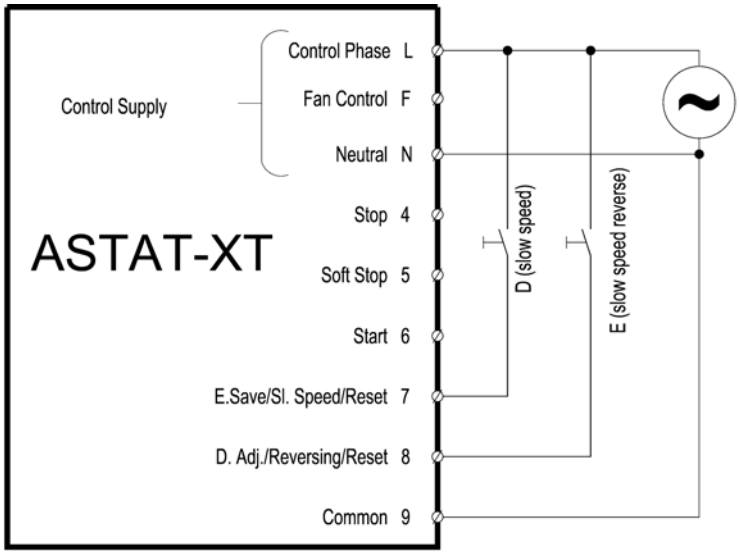
Notes:

- Switch D can be used as an `Energy Save/Slow Speed/ Reset`, as programmed in I/O `Programming Parameters`. Refer to section 4.7.8 page 40.
- `Energy Save` or `Slow Speed` functions require a maintained contact to operate.
- `Reset` function requires a momentary contact to operate
- The drawing shows Control Supply and Control Input from the same source. Refer to section 8.6 for Control Supply and Control Input from separate sources.



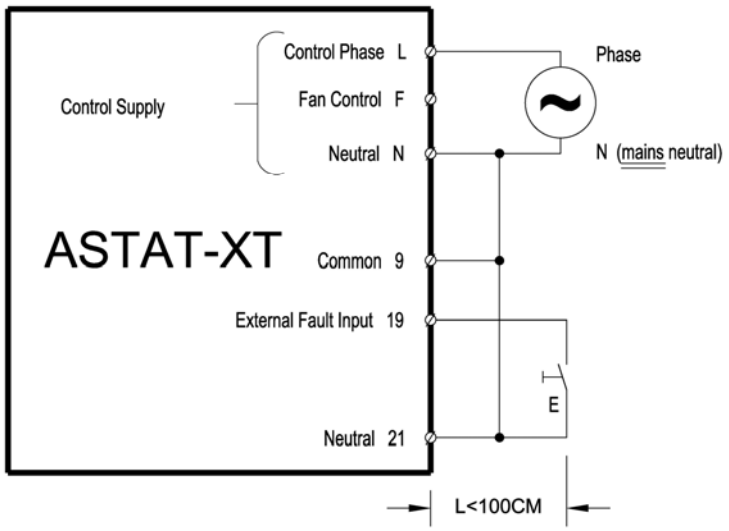
8.11 Slow Speed and Slow Speed Reverse

- For Slow speed operation:
  - Program Input terminal 7 as `Slow Speed`. Refer to section 4.7.8 page 40.
  - Connect Control Input voltage to terminal 7 and start the soft starter. Motor will run at `Slow Speed`.
- For Slow speed reverse operation:
  - Program Input terminal 7 as `Slow Speed`. Refer to section 4.7.8 page 40.
  - Program Input terminal 8 as `Slow Speed Reverse`. Refer to section 4.7.8 page 40.
  - Connect Control Input voltage to terminal 7 and start the soft starter. Motor will run at `Slow Speed`. When Control Input voltage is connected to terminal 8 motor will stop and `Slow Speed Reverse`.
  - If Control Input voltage is connected to terminal 8 before start command, motor will run at `Slow Speed Reverse` when the start command is initiated.
- The drawing shows Control Supply and Control Input from the same source. Refer to section 8.6 for Control Supply and Control Input from separate sources.

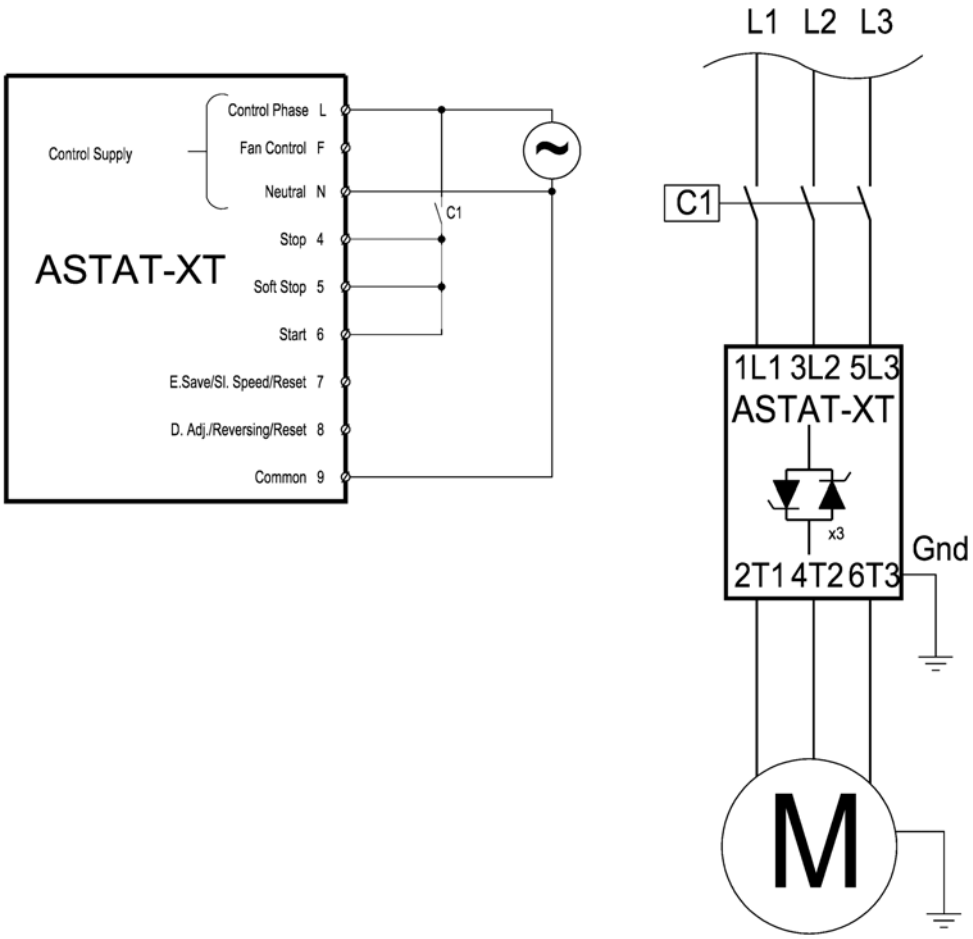


8.12 External Fault

Note:
Switch E can be used as an `External Fault` input only when terminal 21 is connected to neutral or ground.

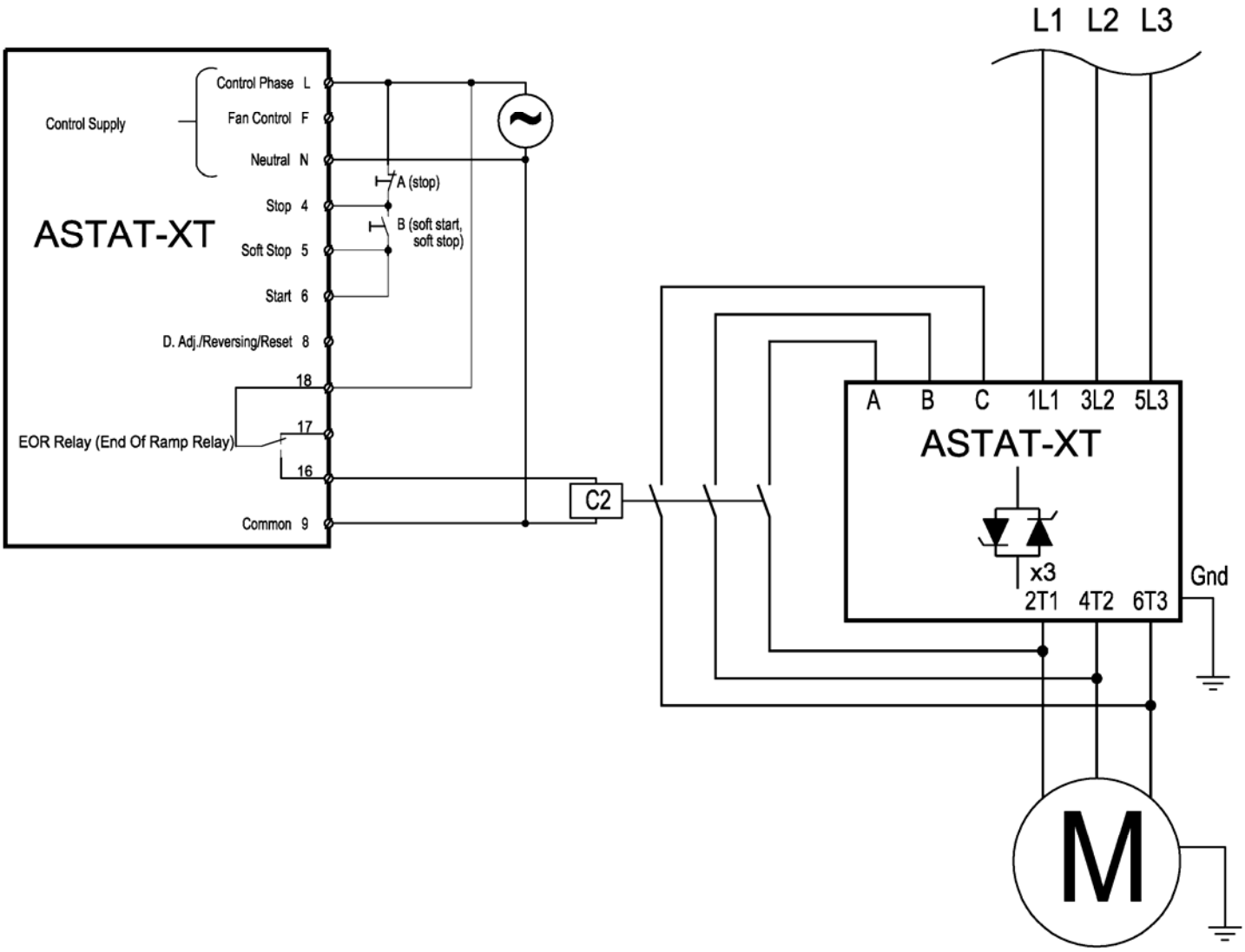


8.13 Line Contactor



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

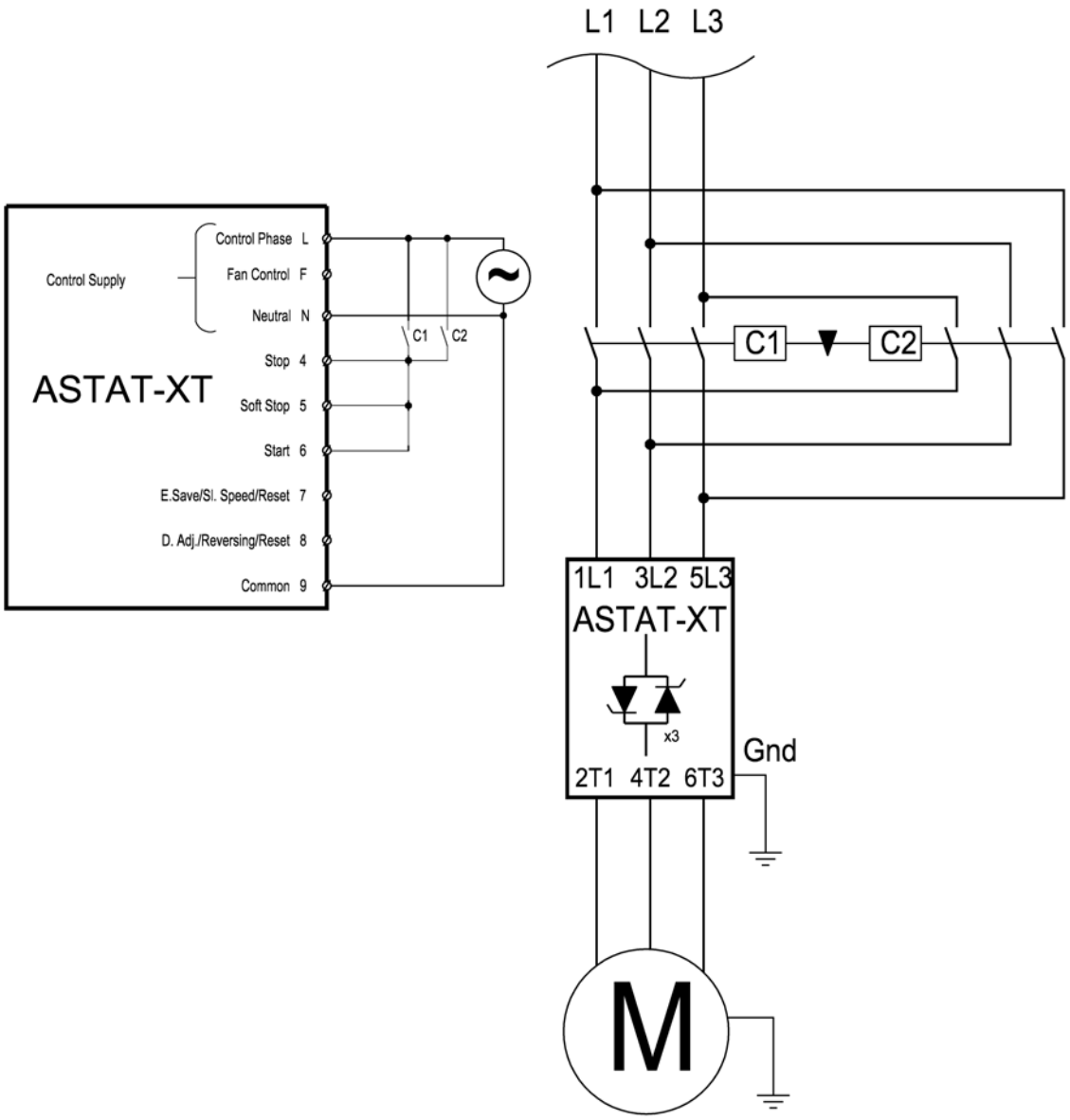
8.14 **Bypass Contactor**



Notes:

- End of Ramp relay is energized after a programmed time delay `EOR Relay Delay` Refer to section 4.7.3 page 29 for programming.
- The End of Ramp relay is de-energized when:
  - SOFT STOP or STOP signals are initiated
  - `Energy Save` signal is initiated
  - Slow Speed/ Slow Speed Reverse signal is initiated
  - Fault condition occurs
- ASTAT-XT current protection is operative after the bypass contactor closes only when the bypass contactor is wired to terminals A, B and C as shown in the drawing above.
- When a SOFT STOP signal is provided, the End of Ramp relay returns to its original position opening the bypass contactor. Thereafter, the voltage will gradually ramp down to zero, soft stopping the motor.

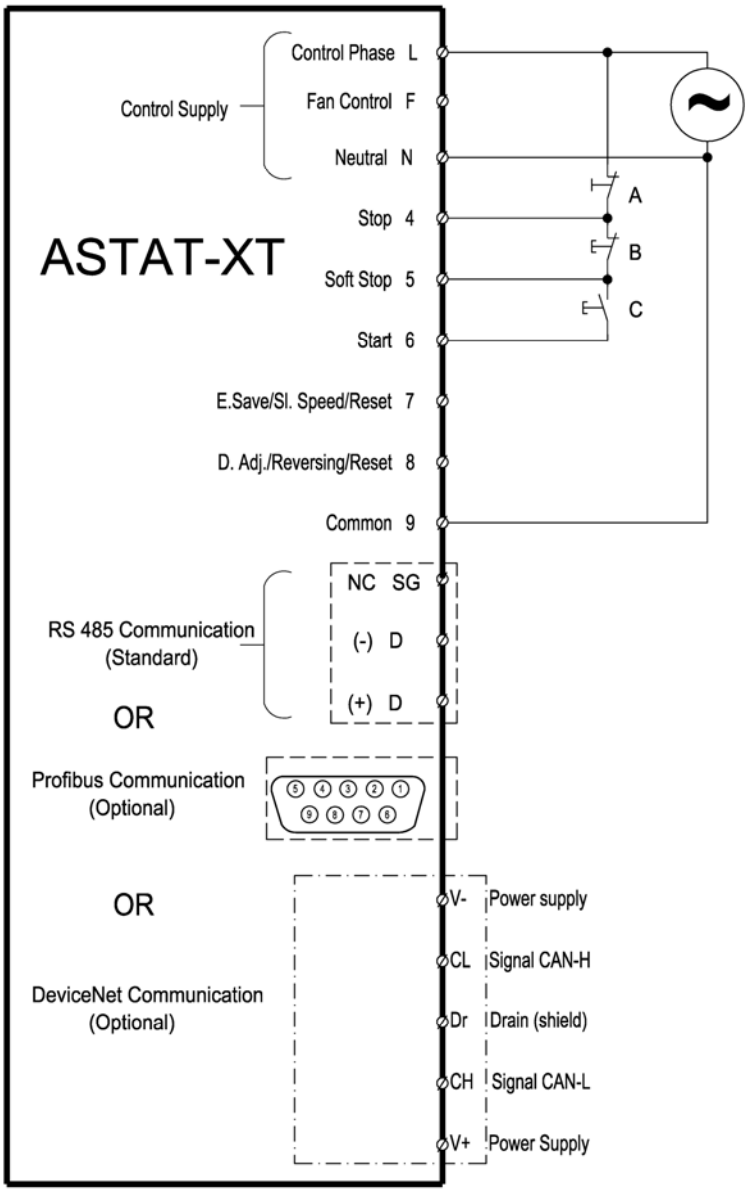
8.15 Reversing with Two Line Contactors



Notes:

- A N.O. auxiliary contact in each of the two line contactors C1 & C2 controls the START/STOP command. Closure of either contactor will supply main power and a start signal to the ASTAT-XT.
- It is recommended to employ a mechanical interlock between the forward and reverse contactors.
- It is required to delay the transfer between opening of one contactor and closing of second contactor.
- `Phase Sequence` fault must be disabled to operate reversing contactors at the line input of the ASTAT-XT. Refer section 4.7.7 page 38 for programming.

8.16 Operating via Communication Links

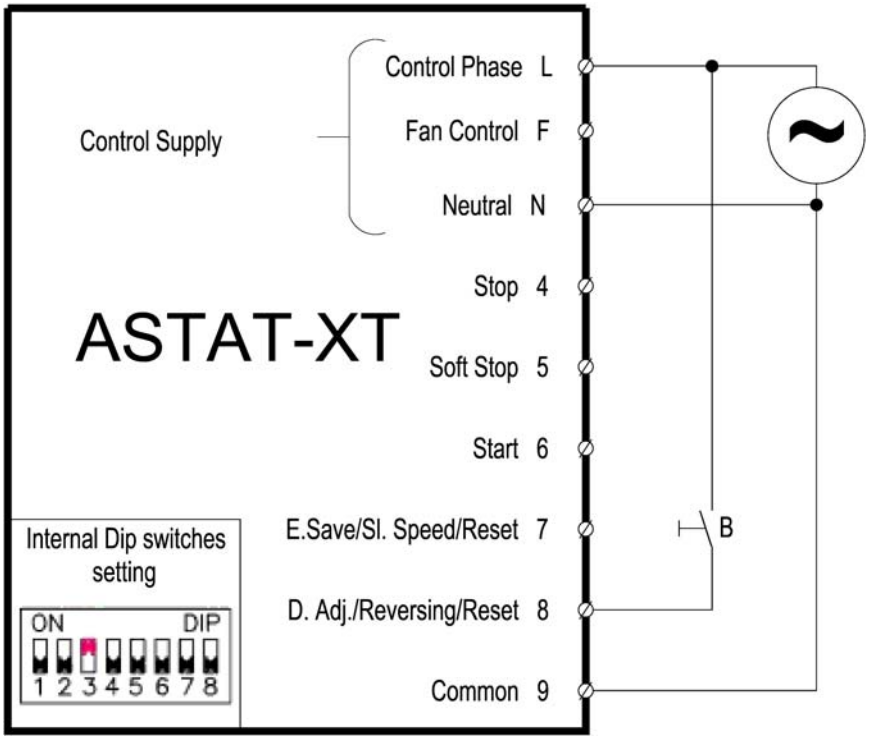


Notes:

- In order to operate via communication, either Modbus (standard) or Profibus (optional) or DeviceNet (optional) optional PCBs must be installed and wired properly.
- ASTAT-XT must be properly grounded.
- ASTAT-XT must be programmed to enable control (not only monitoring). Refer to section 4.7.9 and 4.7.10 page 42 for programming.
- Make sure that after programming, Control Supply voltage is disconnected and reconnected so that the communication settings will take affect.
- ASTAT-XT will toggle between communication commands and local commands **UNLESS** switches A or B are opened.
    - Switch A and B each overrides a START command coming from the communication channel.
    - Switch A can be used as an immediate stop that prevents an unwanted remote start coming from communication.
    - Switch C can be used as a local SOFT START.
    - Switch B can be used as a local SOFT STOP.

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

8.17 D.Set: Generator Parameters Wiring



Notes:

- When starting from a diesel generator make sure that its size is suitable.
  Based on experience, the power (kW) of a diesel generator should usually exceed at least 1.8 times the power (kW) of the motor in order to enable consistent motor starts, consult the factory if necessary. However this should be checked on a case by case basis.
- When starting from a diesel generator, its voltage regulator (especially older type regulators) may be affected during the starting process, thus causing rapid voltage fluctuations (~350V to ~500V in 400V systems). In these rare cases, the voltage regulator must be upgraded – consult your diesel generator supplier.
- When operating from mains and alternatively from a diesel generator, set normal starting characteristics for mains and suitable parameters for the diesel generator in the `DUAL Settings Parameters` settings. When starting from mains, the primary settings (suitable for main starting) will be operative. Upon starting from a diesel generator, close the contact between the Control Supply and terminal 8 to operate in `D.Set: Generator Parameters` mode.
- To operate D.Set: Generator Parameters mode:
  - Set dip switch # 3 and dip switch #1 to ON - refer to sections 5.5.1 page 49 & 5.5.3, page 50.
  - Insert a contact (or jumper) between Control Supply and input terminal 8 (DUAL ADJUST) and close contact to operate the `D.Set: Generator Parameters`. DUAL set LED will light.
  - Set the `D.Set: Generator Parameters` to the values necessary for the application (e.g., shorter `Ramp UP-2`, lower `Current Limit-2`, etc.). Refer to section 4.7.5 page 36 for parameters settings.

Note:

The `D.Set: Generator Parameters` must not always be used when a diesel generator is supplying the ASTAT-XT. Only use `D.Set: Generator Parameters` when the normal starting process fails, i.e. `Shorted Scr` or `Wrong Connection` faults occur, **and** only after you have tested and are sure that the SCRs, motor and motor connections are not faulty.

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

8.18 Short Circuit Protection

8.18.1 Type 1 Coordination

For Type 1 coordination either aM type fuses or Circuit breakers can be applied as shown in the tables below:

8.18.1.1 Type 1 Coordination with GE Circuit Breakers:

Soft Starter Rated Current	GE Circuit Breaker			
	O/L			Breaking Capacity
A	A	Frame Type	O/L Type	KA
8	16	FD63	LTMD 16	65
17	40	FD63	LTMD 40	65
31	50	FD63	LTMD 50	65
44	63	FD160	LTMD 63	65
58	80	FD160	LTMD 80	65
72	80	FE160	LTMD 80	65
85	125	FE160	SMR1-125	65
105	160	FE160	SMR1-160	65
145	160	FE160	LTMD 160	65
170	250	FE250	LTMD 250	65
210	250	FE250	LTMD 250	65
310	400	FG630	SMR1-400	65
390	400	FG400	SMR1-400	65
460	630	FG630	SMR1-630	65
580	630	FG630	SMR1-630	65
650	800	FK800	SMR1s-800	50
820	1250	FK1250	SMR1s-1250	50
950	1250	FK1250	SMR1s-1250	50
1100	1250	FK1250	SMR1s-1250	50
1400	1600	FK1600	SMR1s-1600	50

8.18.1.2 Type 1 Coordination with Type aM Siba Fuses:

Soft Starter Rated Current	SIBA aM Fuses					
	Rated Current					Breaking Capacity
A	A	P/No.	Size	Un	Type	KA
8	16	20 477 08.16	000	690	aM	120
17	20	20 477 08.20	000	690	aM	120
31	35	20 477 08.35	000	690	aM	120
44	50	20 477 08.50	00	690	aM	120
58	80	20 209 08.80	00	690	aM	120
72	100	20 209 08.100	00	690	aM	120
85	125	20 209 08.125	00	690	aM	120
105	160	20 210 08.160	0	690	aM	120
145	200	20 211 08.200	1	690	aM	120
170	200	20 211 08.200	1	690	aM	120
210	250	20 211 08.250	1	690	aM	120
310	400	20 212 08.400	2	690	aM	120
390	500	20 213 08.500	3	690	aM	120
460	630	20 213 08.630	3	690	aM	120
580	800	20 225 08.800	4	690	aM	120
650	800	20 225 08.800	4	690	aM	120
820	1000	20 225 08.1000	4	690	aM	120
950	2x630	2x20 213 08.630	2x3	690	aM	120
1100	2x800	2x20 225 08.800	2x4	690	aM	120
1400	2x800	2x20 225 08.800	2x4	690	aM	120

8.18.2 Type 2 Coordination

For Type 2 coordination, use fuses for semiconductor protection to protect the ASTAT-XT from a short circuit. Fuses for semiconductor protection give excellent results because they have low I^2t values and high interruption ratings.

Recommended fuse selection procedure:

Fuse rated voltage: Choose minimum fuse rated voltage which is above the rated voltage of the mains.

Fuse rated current: Select a fuse which is able to carry 8 times the rated ASTAT-XT current for 30 seconds (this is double the maximum ASTAT-XT current for the maximum acceleration time).

Fuse I^2t: Verify that the I^2t value of the fuse is less than or equal to the I^2t value of the thyristor in the ASTAT-XT as shown in the table below.

Soft Starter Rated Current		Bussman Fuses DIN 43620					
		Rated Current					Breaking Capacity
A	A^2Sec	A	P/No.	Size	Un	Type	KA
8	400	40	170M3808D	1	690	H.S.D.I.	200
17	5000	63	170M3810D	1	690	H.S.D.I.	200
31	10000	125	170M3813D	1	690	H.S.D.I.	200
44	12000	160	170M3814D	1	690	H.S.D.I.	200
58	15000	160	170M3814D	1	690	H.S.D.I.	200
72	18000	200	170M3815D	1	690	H.S.D.I.	200
85	50000	250	170M3816D	1	690	H.S.D.I.	200
105	60000	315	170M3817D	1	690	H.S.D.I.	200
145	10000	315	170M3817D	1	690	H.S.D.I.	200
170	140000	400	170M3819D	1	690	H.S.D.I.	200
210	200000	500	170M4864D	1	690	H.S.D.I.	200
310	600000	500	170M4864D	1	690	H.S.D.I.	200
390	700000	800	170M5814D	2	690	H.S.D.I.	200
460	800000	900	170M6813D	3	690	H.S.D.I.	200
580	1200000	1000	170M6814D	3	690	H.S.D.I.	200
650	2000000	2x800	2x170M5814D	2x2	690	H.S.D.I.	200
820	2000000	2x800	2x170M5814D	2x2	690	H.S.D.I.	200
950	4500000	2x1000	2x170M5816D	2x2	690	H.S.D.I.	200
1100	4500000	2x1100	2x170M6892D	2x2	690	H.S.D.I.	200
1400	6500000	2x1400	2x170M8555D	2x3	690	H.S.D.I.	200

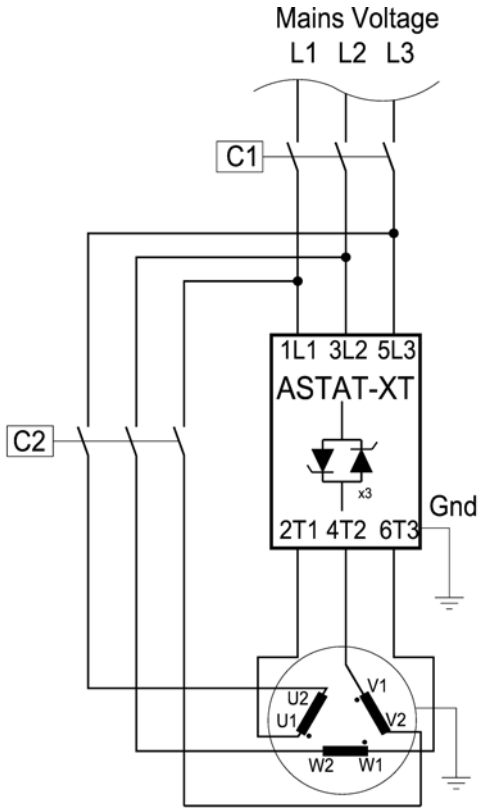
8.19 Transient Protection

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

8.20 Inside Delta Configuration

8.20.1 General Information

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



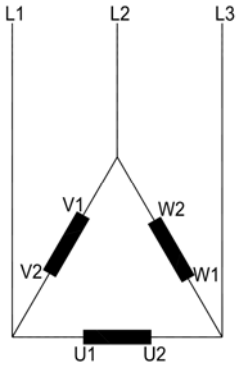
For example:
For a motor with a rated current of 870A motor, a 950A starter will be selected to operate In-Line.
For Inside Delta ASTAT-XT, we calculate (870 x 67% = 580A) and select a 580A starter.

8.20.2 Notes on Inside Delta Connection

Inside Delta requires 6-wires to the motor.
Wrong motor connection might cause serious damage to the motor windings.
When installing the ASTAT-XT Inside Delta it is highly recommended to use a contactor in series to the ASTAT-XT or upstream (after motor protection) in order to avoid a damage to the motor if the ASTAT-XT short circuits.
The sinusoidal shape of the current might be imperfect. As a result, higher harmonic content is incurred (THD), which may be twice the THD value as in the standard In-Line connection.
Motor heat may increase (due to the higher THD).
Phase sequence to the input of the ASTAT-XT (1L1, 3L2 & 5L3 terminals) must be correct. Otherwise, `Phase Sequence` fault will trip the ASTAT-XT immediately.
Higher torque can not be obtained.
The following factory preset features and functions are not active when Inside Delta mode is configured:
Kickstart
Soft Start Curve selection (Soft Start Curve 0 !! only).
`Energy Saving` and `Slow Speed TRQ`. (energy save and slow speed)
Phase Sequence in OFF mode
Note :
For a high starting torque process, it is recommended to use the ASTAT-XT in the In Line connection.

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

8.20.3 Motor Connection and Terminals

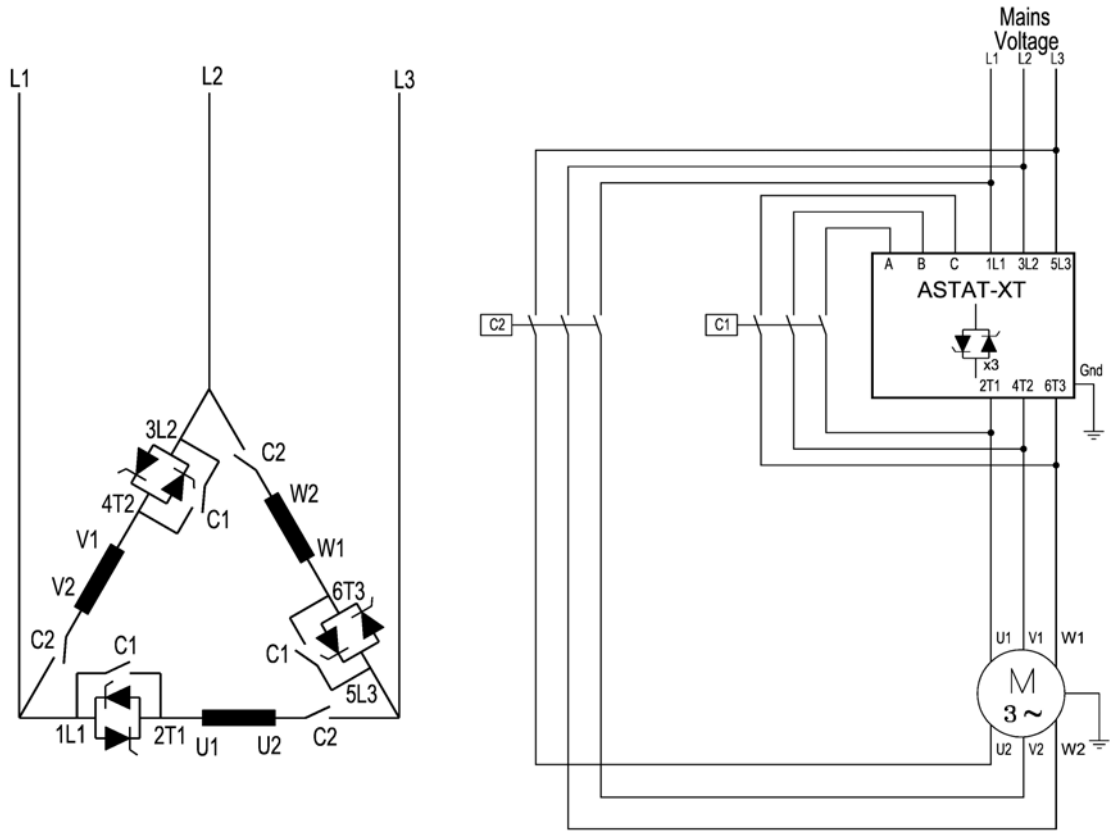


Motor connection in Delta with no ASTAT-XT.

Note:
Motor terminals are marked as follows:

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

8.20.4 ASTAT-XT Connected Inside Delta w/Bypass Contactor and Inside Delta Contactor

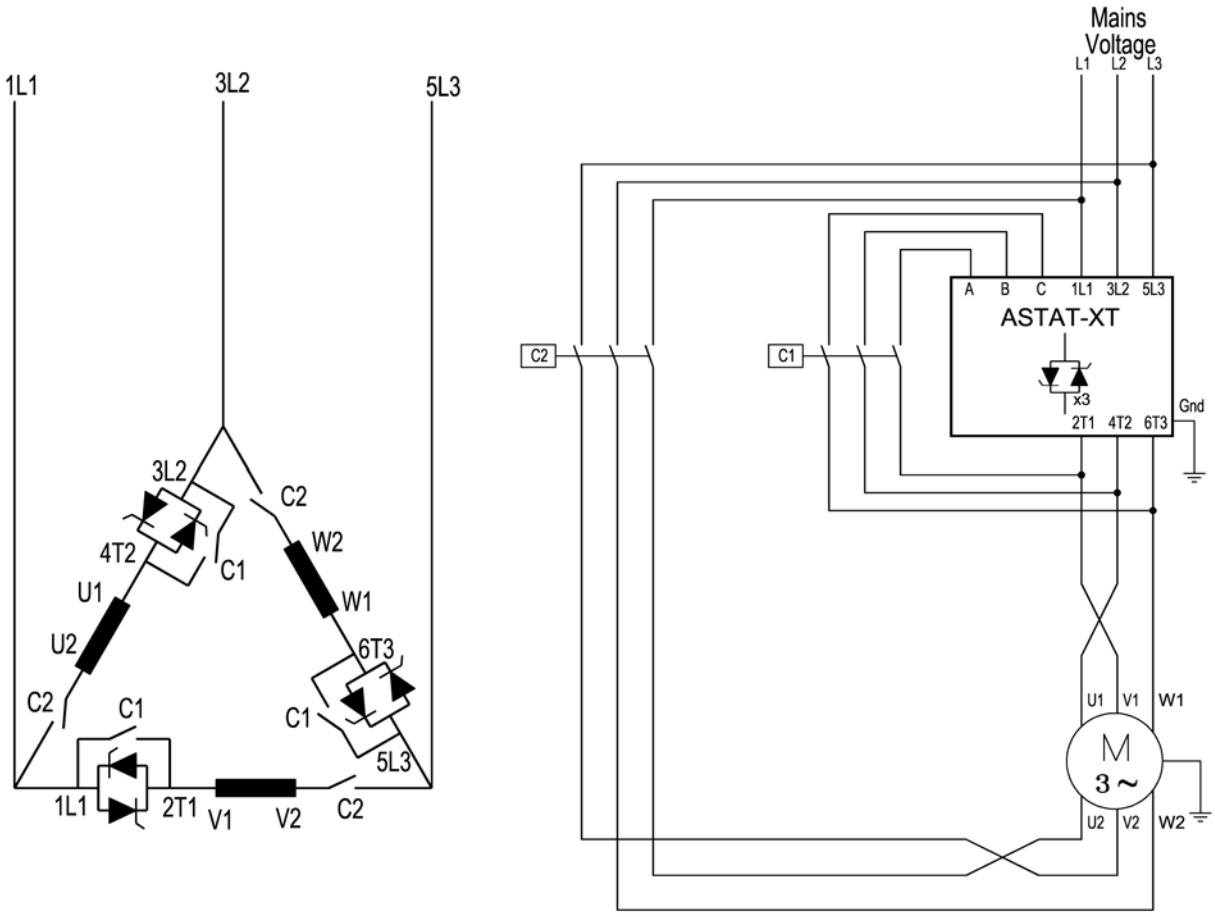


ASTAT-XT connection Inside Delta with bypass contactor to the ASTAT-XT and Inside Delta contactor.

C1 is a bypass contactor.
C2 is an Inside Delta contactor.
U1-U2, V1-V2, W1-W2 are motor windings.
1L1-2T1, 3L2-4T2, 5L3-6T3 are ASTAT-XT controlled phases.
A, B, C are preparation for bypass to maintain current protection when the ASTAT-XT is bypassed.

8.20.5 ASTAT-XT Connected Inside Delta - Reverse Speed

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

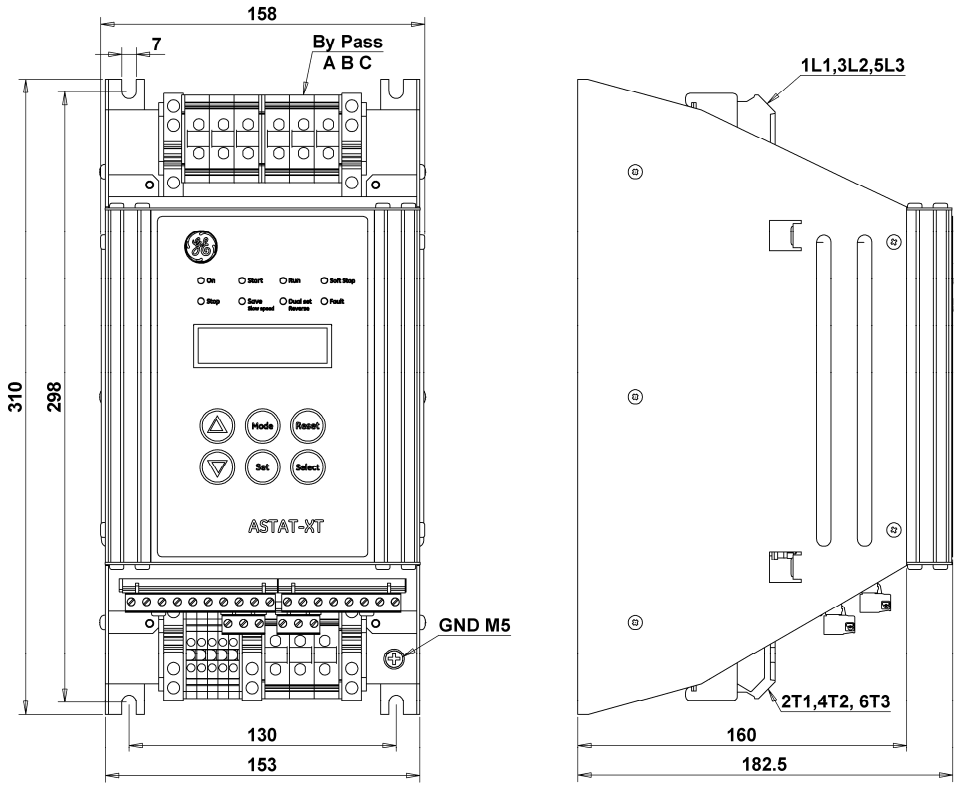


Reverse speed with ASTAT-XT connection Inside Delta with bypass contactor to the ASTAT-XT and Inside Delta contactor.

C1 is a bypass contactor.
C2 is an Inside Delta contactor.
U1-U2, V1-V2, W1-W2 are motor windings.
1L1-2T1, 3L2-4T2, 5L3-6T3 are ASTAT-XT controlled phases.
A, B, C are preparation for bypass to maintain current protection when the ASTAT-XT is bypassed.

9. DIMENSIONS

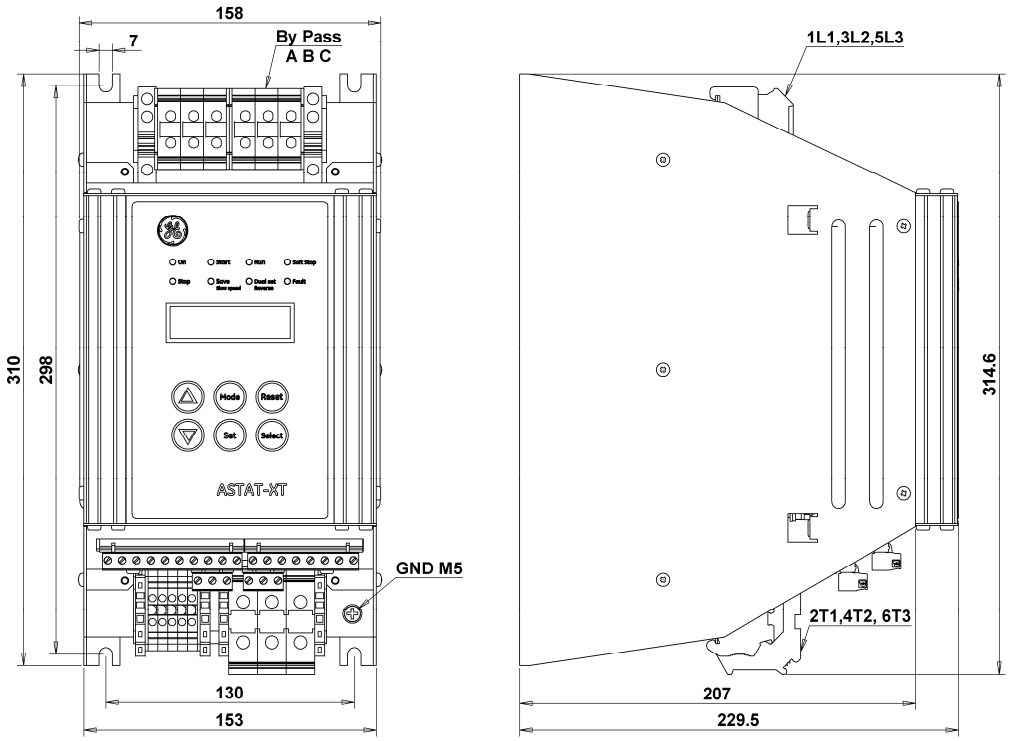
9.1 UL cUL Approved Models



ASTAT-XT 8A 17A 31A. Cat numbers QTx0008U_, QTx0017U_, QTx0031U_

Notes:

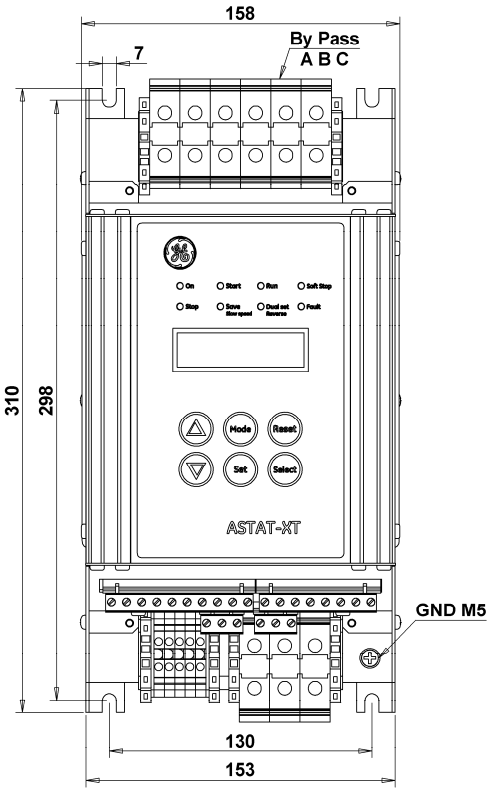
- Mains voltage terminals: 16mm²
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.

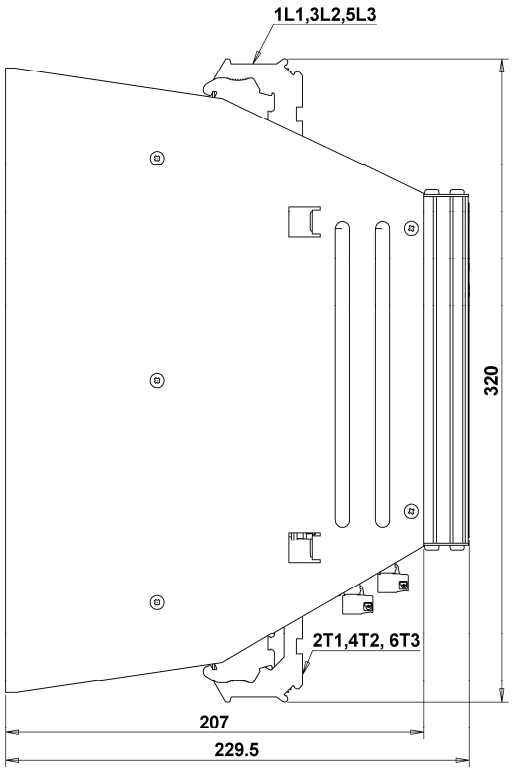


ASTAT-XT 44A 58A. Cat numbers QTx0044U_, QTx0058U_

Notes:

- Mains voltage terminals (1L1, 3L2, 5L3) and preparation for bypass terminals (A, B, C): 16mm²
- Connection to motor terminals (2T1, 4T2, 6T3): 35mm²
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.

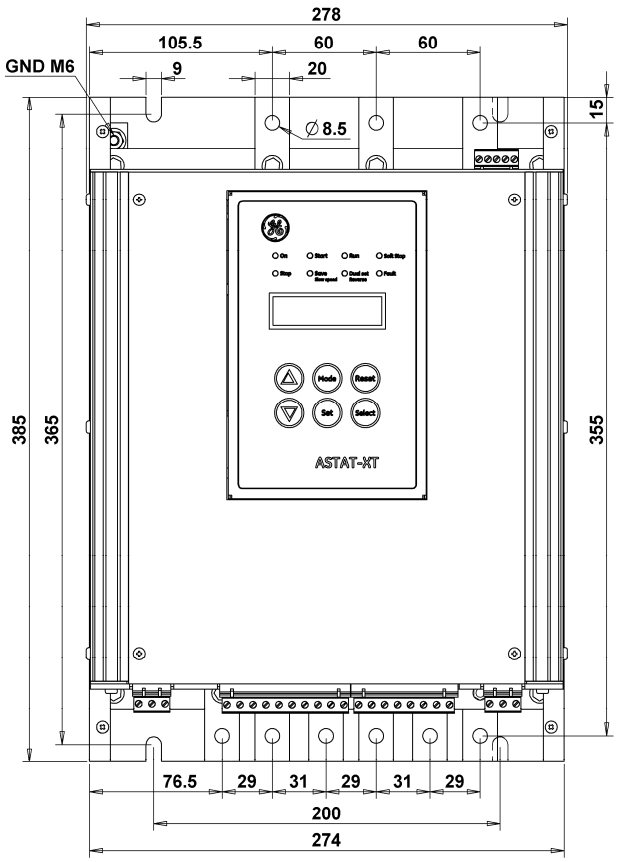


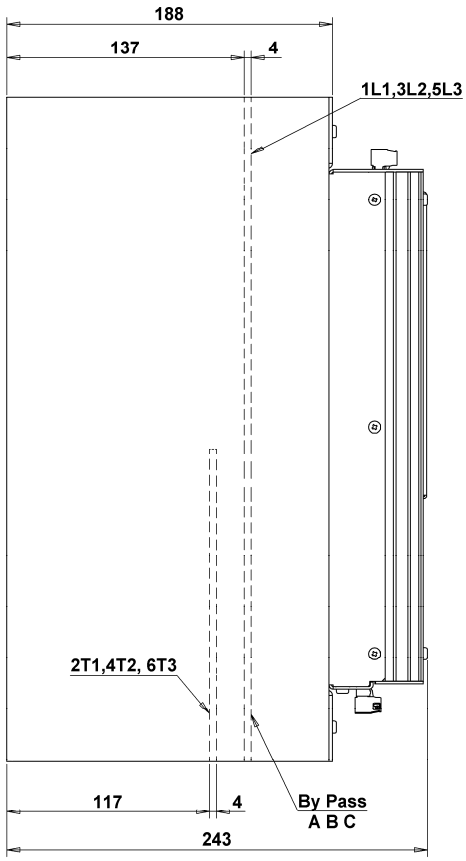


ASTAT-XT 72A. Cat number QTx0072U_

Notes:

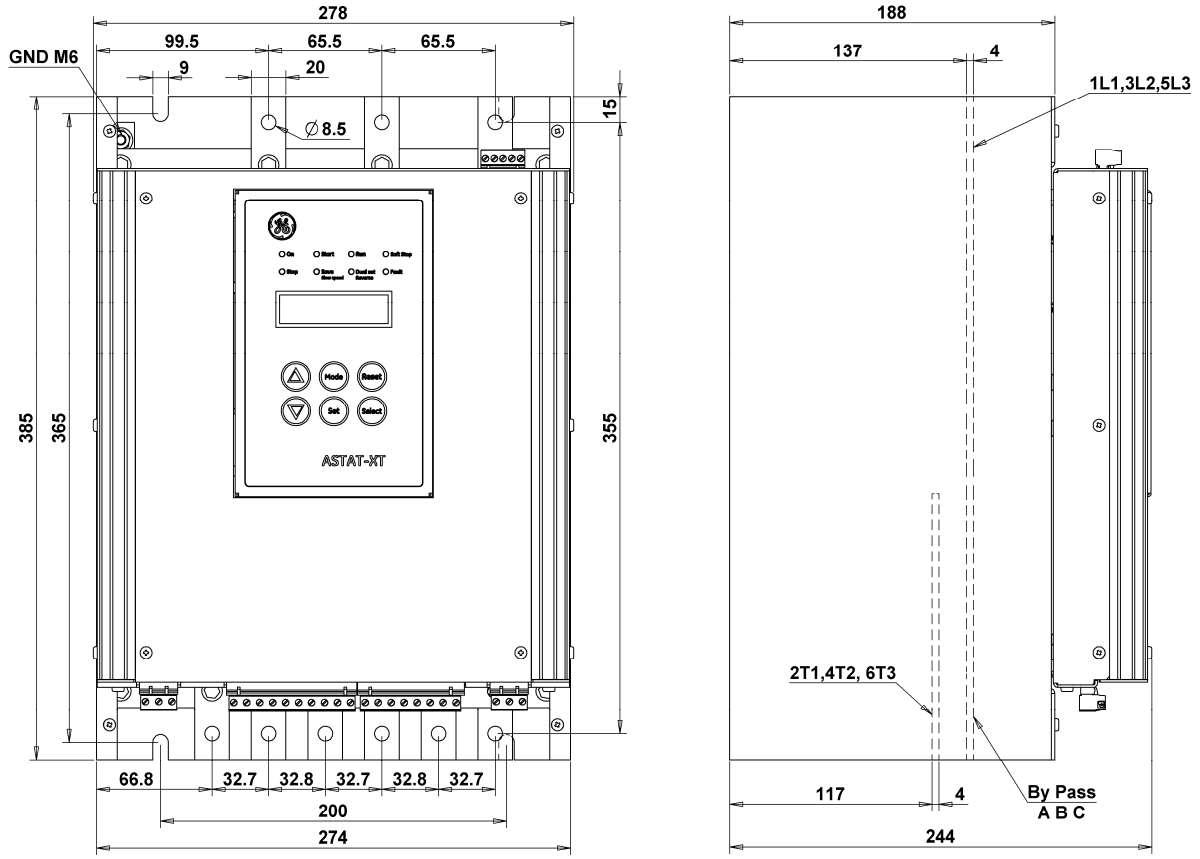
- Mains voltage terminals: 35mm^2
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.





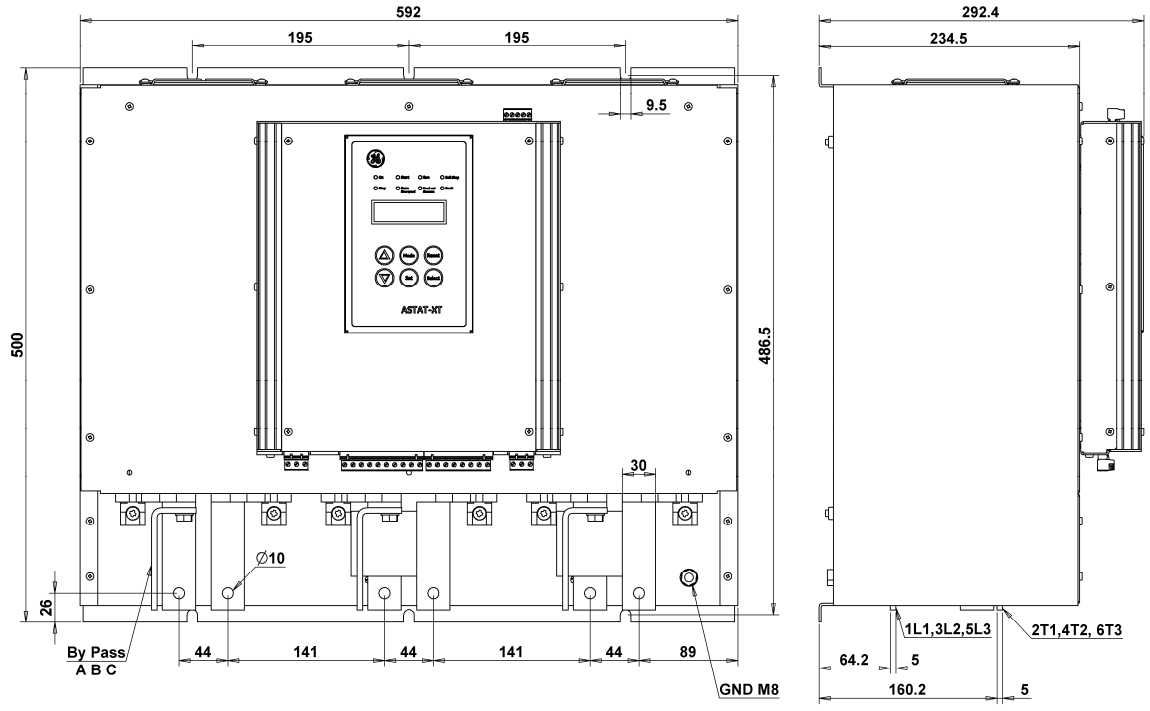
ASTAT-XT 85A 105A. Cat numbers QTx0085U_, QTx0105U_

Note: Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 145A 170A. Cat numbers QTx0145U_, QTx0170U_

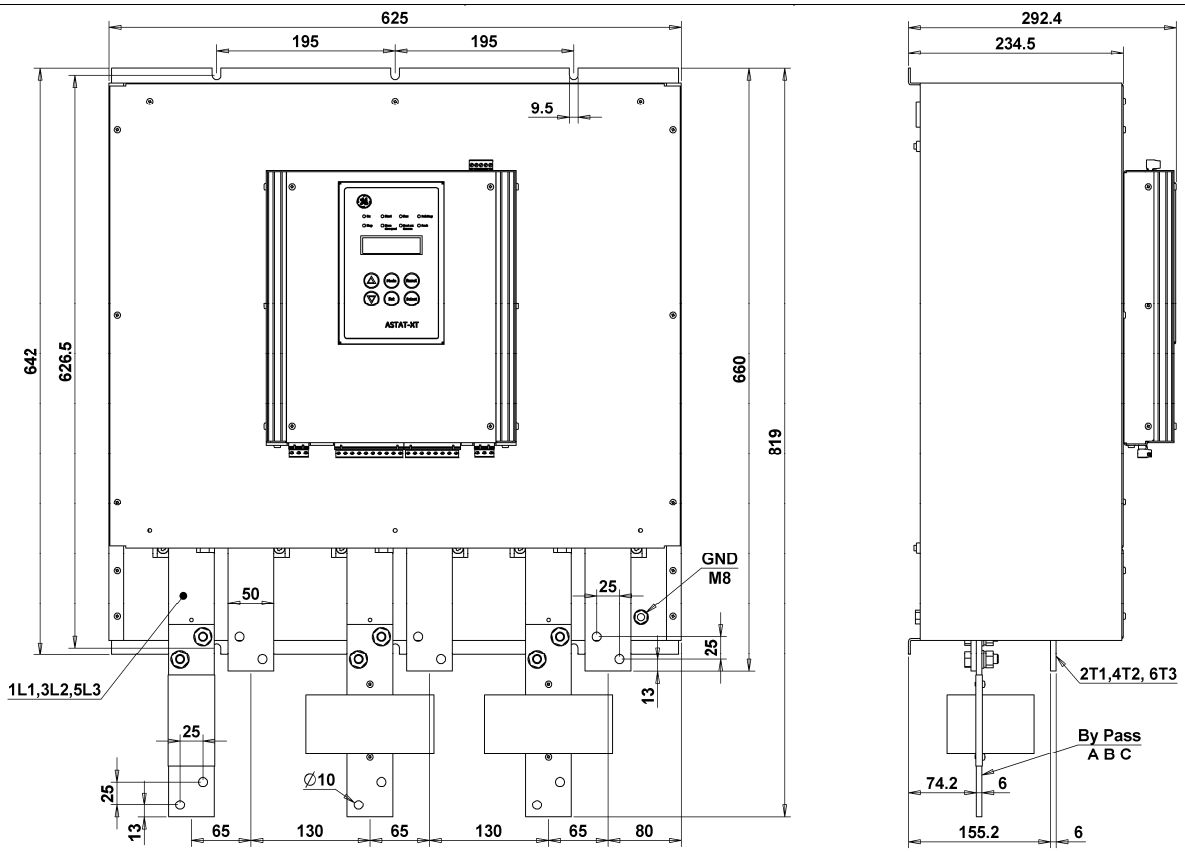
Note: Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 210A 310A 390A. Cat numbers QTx0210U_, QTx0310U_, QTx0390U_

Notes:

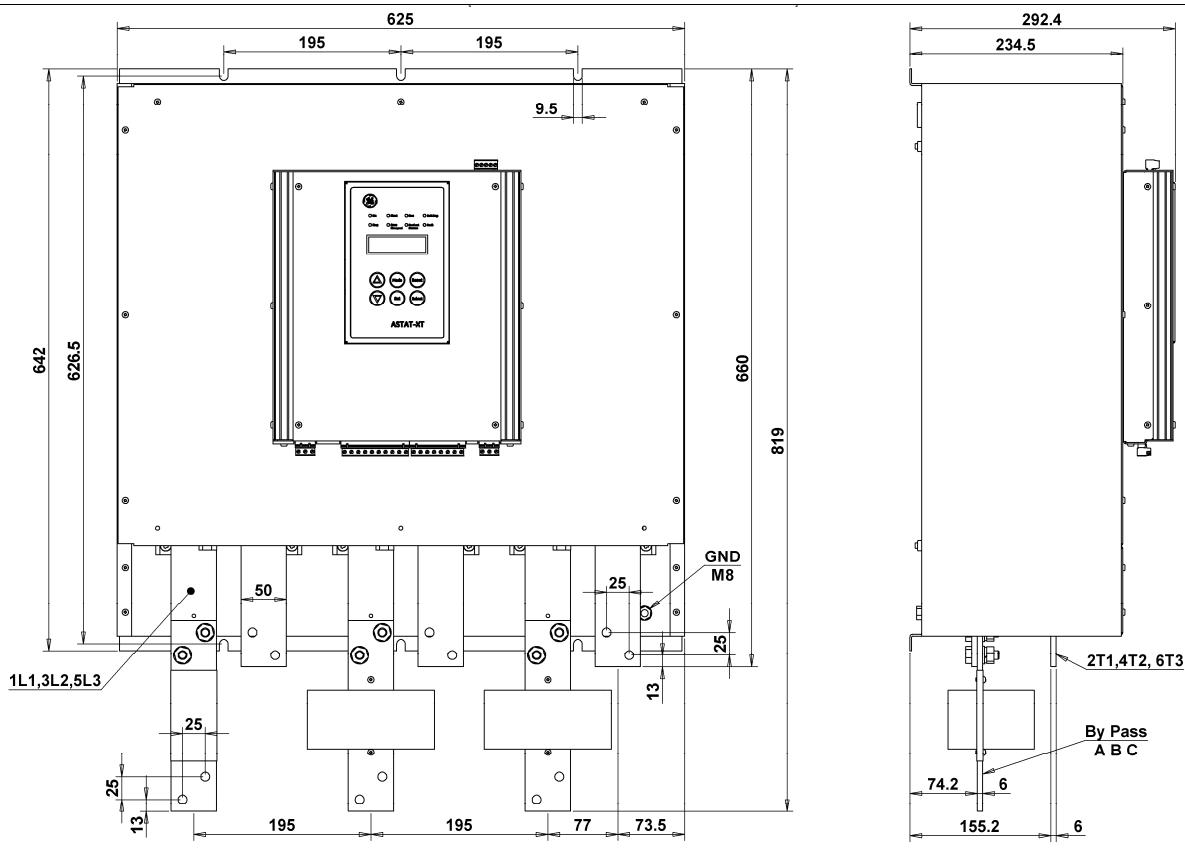
- For the dimensions of non UL cUL approved models QTx0210N_, QTx0310N_, QTx0390N_, refer to section 9.2 page 82.
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 460A. Cat number QTx0460U_

Notes:

- For the dimensions of non UL cUL approved model QTx0460N_ refer to section 9.2 page 82.
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.

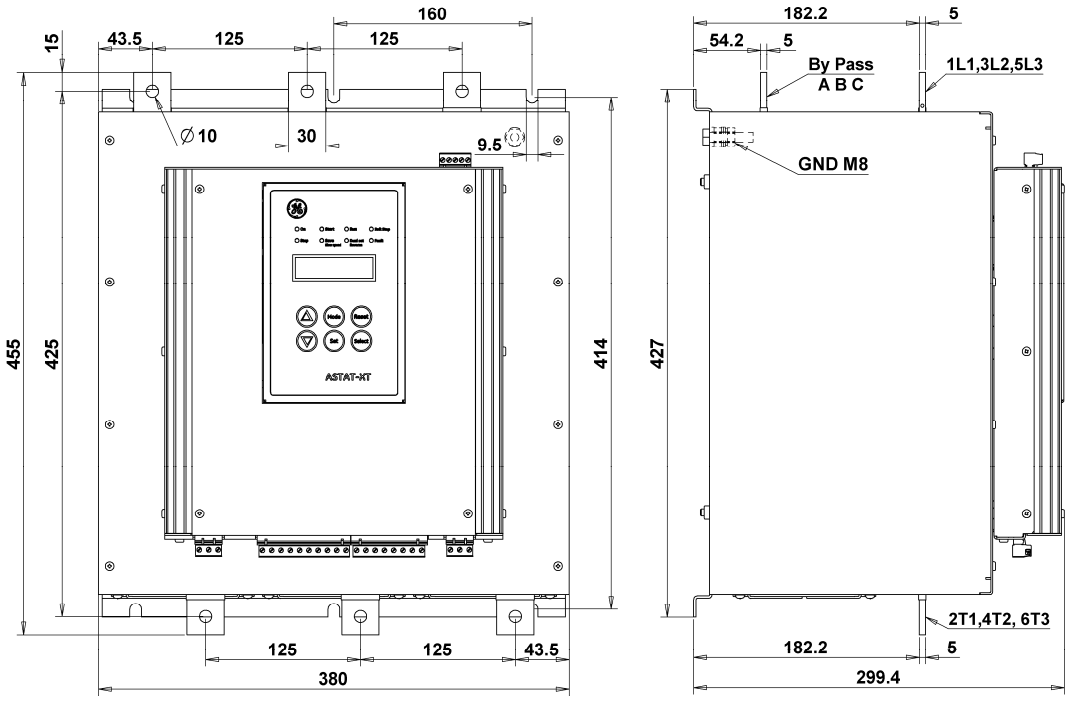


ASTAT-XT 580A 820A. Cat numbers QTx0580U_, QTx0820U_

Notes:

- For the dimensions of non UL cUL approved models QTx0580N_, QTx0820N_ refer to section 9.2 page 82.
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.

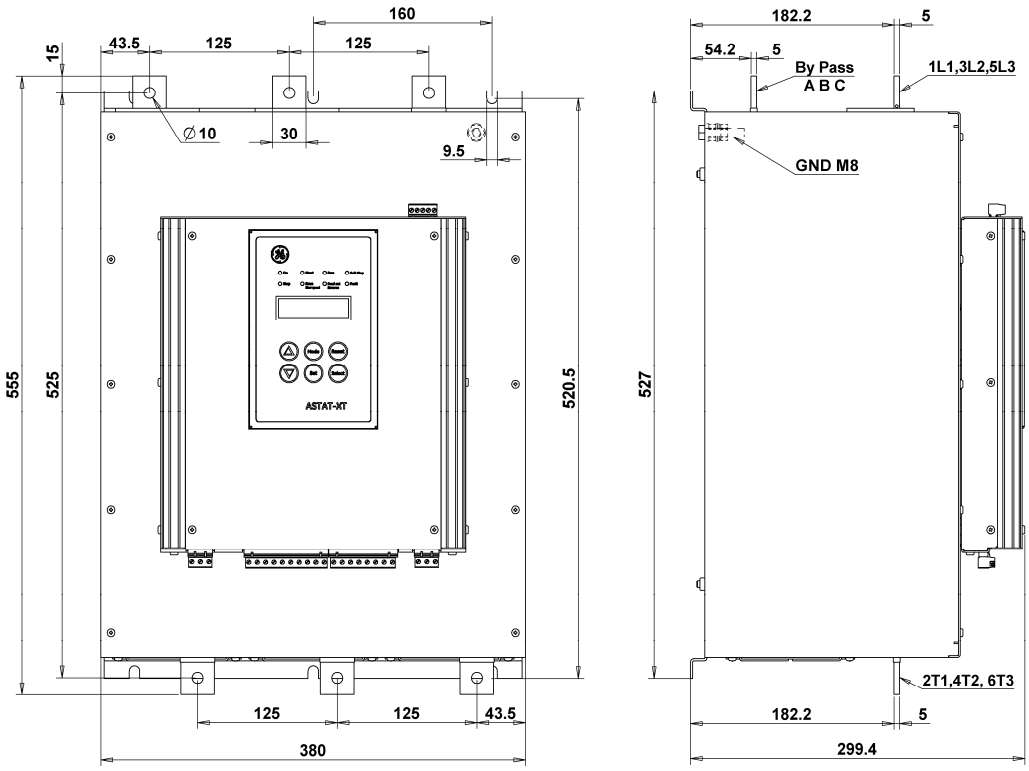
9.2 Non UL cUL Approved Models



ASTAT-XT 210A 310A 390A. Cat numbers QTx0210N_, QTx0310N_, QTx0390N_

Notes:

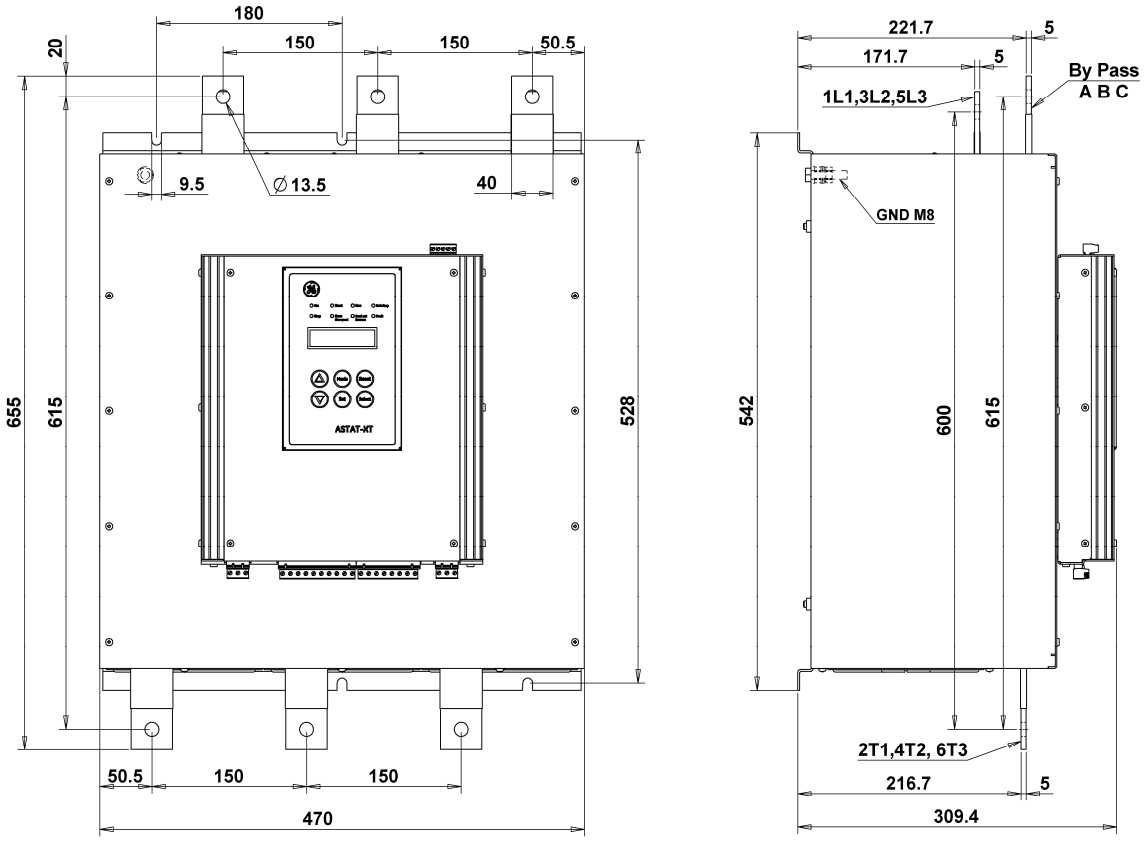
- For the dimensions of UL cUL approved models QTx0210U_, QTx0310U_, QTx0390U_ refer to section 9.1 page 78.
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 460A. Cat number QTx0460N_

Notes:

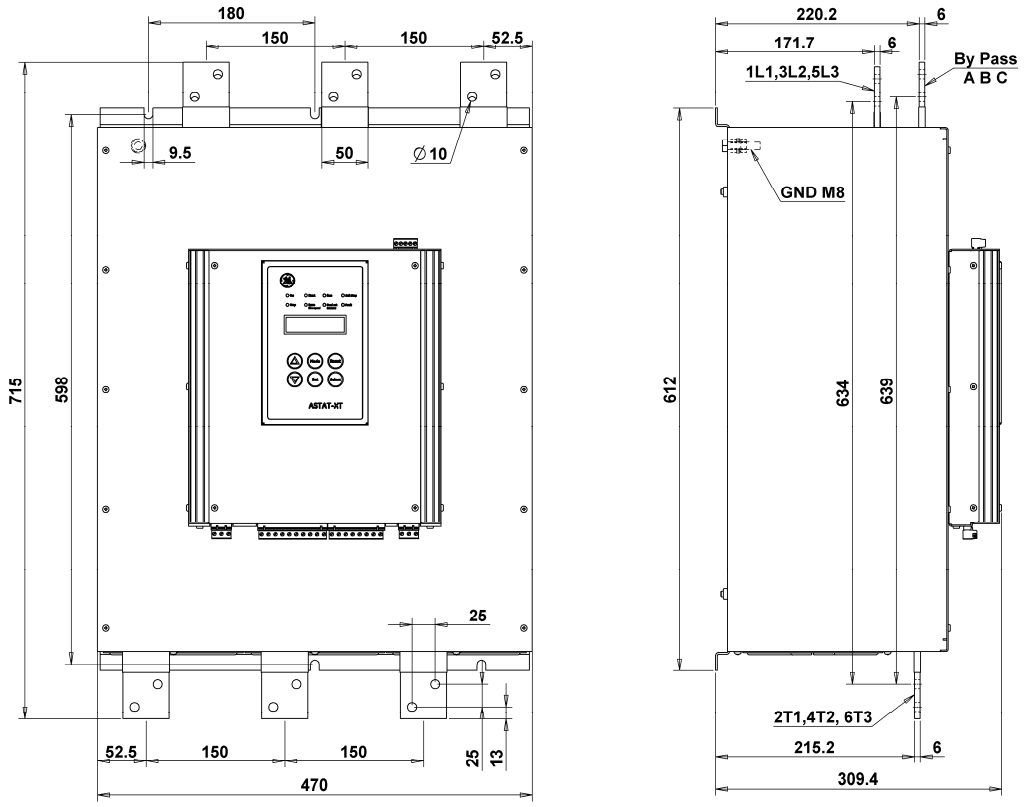
- For the dimensions of UL cUL approved model QTx0460U_ refer to section 9.1 page 78.
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 580A. Cat number QTx0580N_

Notes:

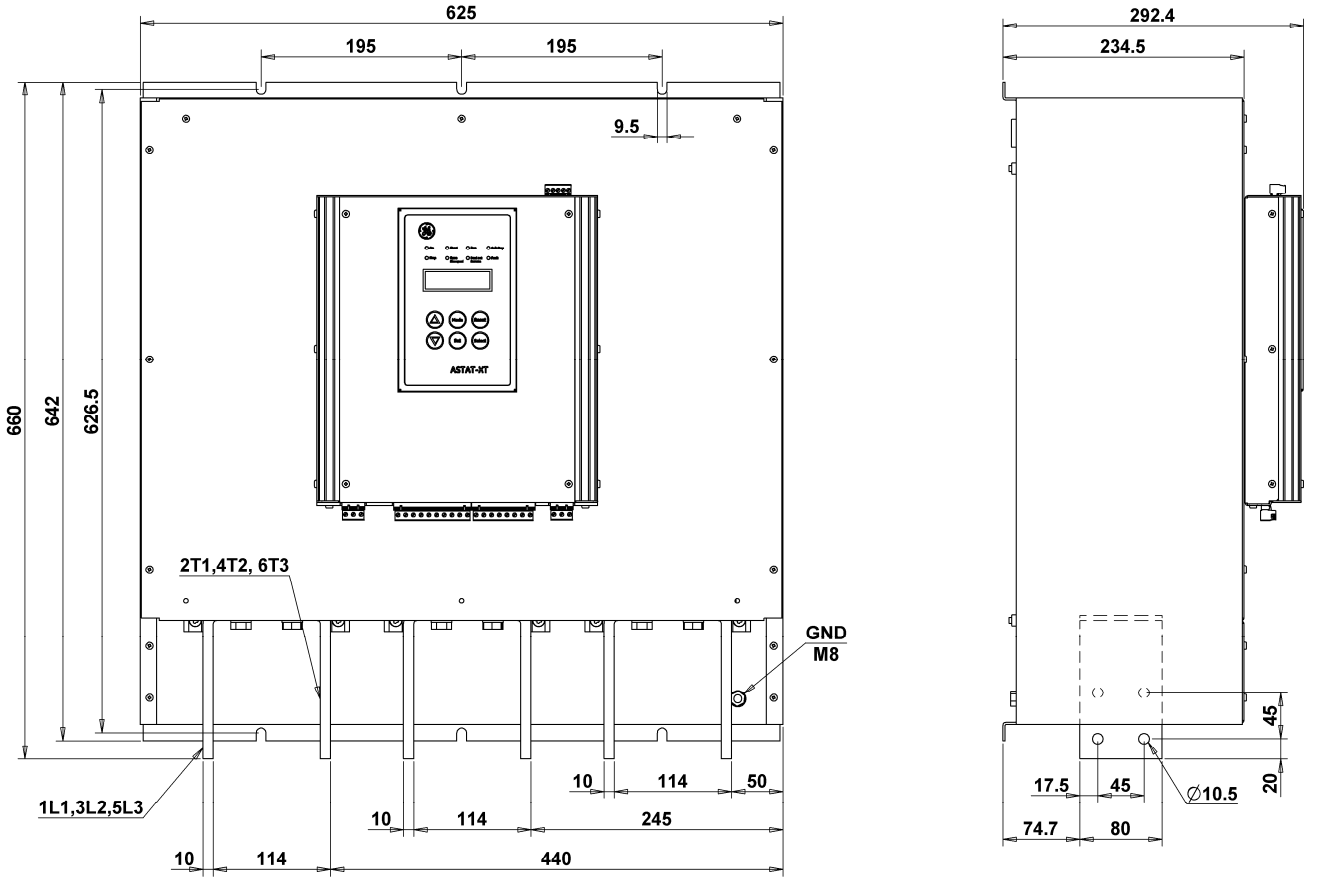
- For the dimensions of UL cUL approved model QTx0580U_ refer to section 9.1 page 78.
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 650A. Cat number QTx0650N_

Note:

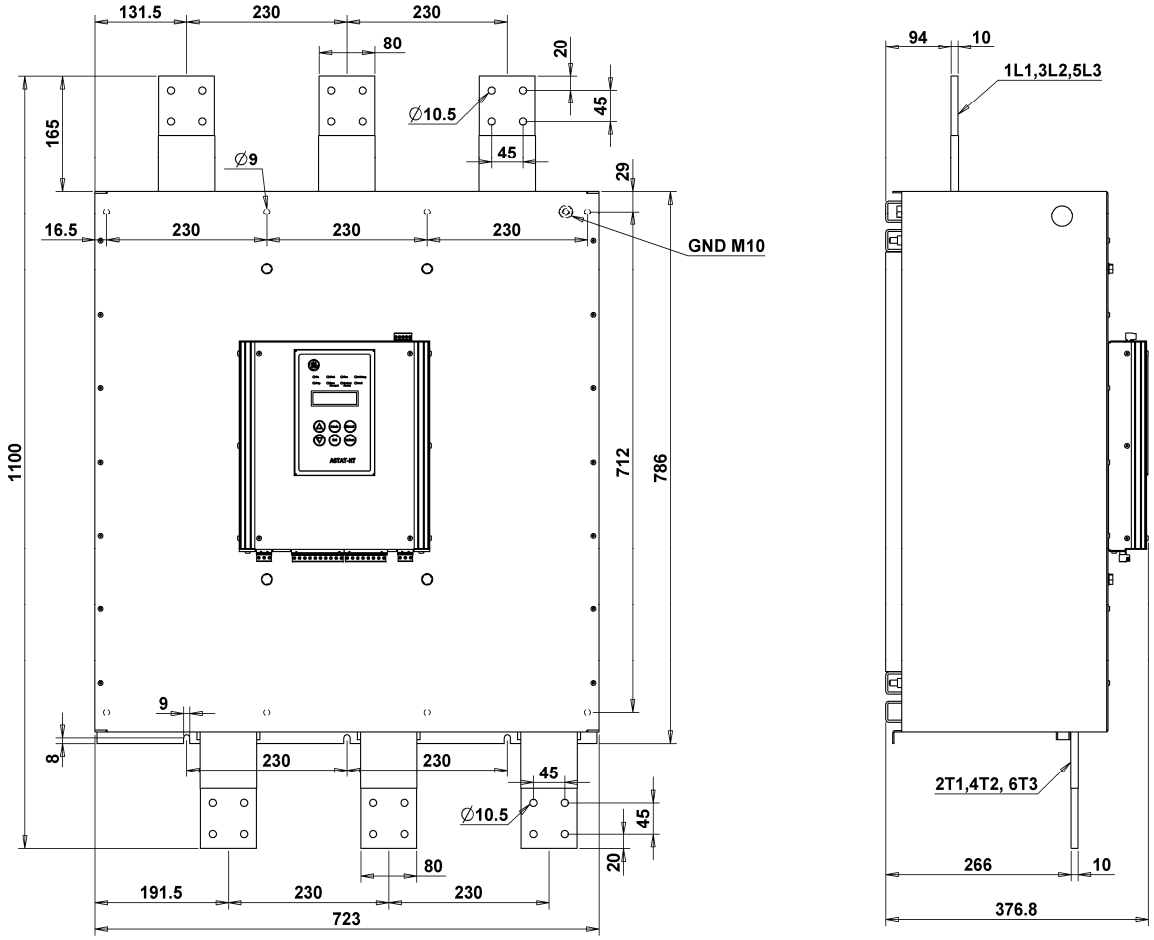
- Add 20 mm to the depth dimension when the optional remote key-pad is installed.



ASTAT-XT 950A. Cat number QTx0950N_

Notes:

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



ASTAT-XT 1100A 1400A. Cat numbers QTx1100N_, QTx1400N_

Notes:

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

APPENDIX A - MODBUS RTU PROTOCOL

A.1.Introduction

This document summarizes the serial link protocol to / from the DIGITAL SOFT STARTER(ASTAT-XT).

Features:

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

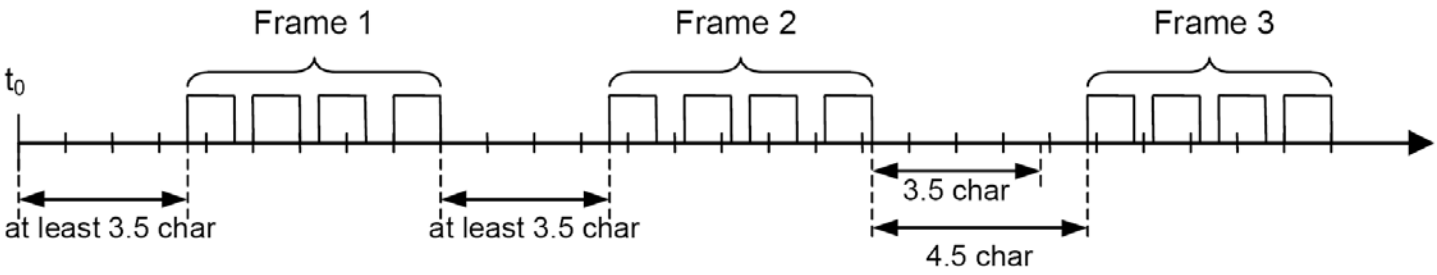
Notes:

* It is recommended that you connect 120 OHM resistors to both ends of the serial link.
* You must turn OFF (and ON again) power to the controller after changing Baud_Rate, Parity_Check or Serial_Link_No (Slave Address). These parameters can only be modified manually and not through the Serial Link.

WARNING	You must connect earth to the ASTAT-XT earth screw before connecting serial link wires. Ignoring this instruction may result in permanent damage to the Serial Link Hardware and might result in death or serious injury.

A.2.Basic Structure of the Serial Link Frame

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



"sync":	Silent Interval for at least 3.5 character times[44]	
byte 1:	Serial Link No. (= Slave Address)	(1..247)
byte 2:	Function	(1,2,3,4,5,6,8,15 &16 are supported)
byte 3:	Data Bytes	($XX)
. .		($XX)
. .		($XX)
byte n-1:	CRC_Low	($XX)
byte n:	CRC_High	($XX)

"sync": Silent Interval for at least 3.5 characters

A.3.SYNC (Silent Interval)

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

A.4.Serial Link No. (Slave Address)

This contains the ASTAT-XT Slave Number (1..247) on the serial link. The ASTAT-XT default value is 248, which is the communication OFF condition. Serial Link No. is used as the first byte in both the "Query" transmission from Master to Slave and in Response transmission from Slave to Master.
Note: Address 0, which is normally used for broadcast transmissions is not supported by the ASTAT-XT.

A.5.Function

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

A.6.List of Functions Supported By The ASTAT-XT

Function	Modbus Name	Use in ASTAT-XT
01	Read Coil Status	Read discrete commands status.
02	Read Input Status	Read discrete inputs status.

[44] When a parity bit is used each character is 11 bits. Therefore the silent interval is 3.5 * 11 / baud rate.

03	Read Holding Registers.	Read setting parameters. Read actual data (for Modbus Plus users).
04	Read Input Registers.	Read actual data.
05	Force Single Coil.	Force one discrete command.
06	Preset Single Register.	Write one parameter setting.
08	Diagnostics.	Loopback diagnostics.
15	Force Multiple Coils.	Force discrete commands.
16	Force Multiple Registers	Write parameter setting Control commands

DATA

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

CRC

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

ASTAT-XT MEMORY ORGANIZATION

The ASTAT-XT memory is organized according to the common Modbus addresses as follows:

ASTAT-XT Use	Memory Type	Max Query/Response Parameters
Actual Data	3X References Registers,	# 1...128, addressed 0..127.
	4X References Registers,	#257...384 addressed. 256...383
Setting Parameters	4X References Registers,	# 1...109, addressed 0...108
Hardwired Control Inputs	1X References 16 Inputs,	# 1..16, addressed 0..15.
Discrete Serial Commands	0X References 16 Coils,	# 1..16, addressed 0..15.
Control Commands	4X References 1 Register,	# 753, addressed 752.

Notes:

1. Actual Data parameters can be read both at 3X references starting at parameter #1, or (same parameters) at 4X references starting at parameter #257 (100 hex higher). The additional mapping in 4X references is designed for the convenience of Modbus Plus users.

2. ASTAT-XT can be controlled using the standard discrete commands (Coils, 0x references) or by writing to parameter setting #753 with function 16. The additional control option using 4X references is designed for the convenience of Modbus Plus users. To control, write to register #753 (address 752) only! (one register write, with function 16).
3. Function 3 should be used to read 4X references. Function 4, to read 3x references.

*A.7.*Actual Data (3X References & 4X References)

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

Parameter	# (3x)	# (4x)	Comment
Logic Status	1	257	Logic status of ASTAT-XT. 1 indicates: d15: ASTAT-XT Tripped. d14: Motor Stopped. d13: Motor in Soft Stop Process. d12: Motor in Start Process. d11: Motor is Running. d10: Dual_Adjust On. d9: Motor is running with Energy Save On. d8: Motor is running at Slow Speed forward. d7: Motor is running at Slow Speed reverse. d6: Reserved d5..d0: Reserved.
Motor Current	2	258	Current, % Im
Line Voltage	3	259	Line voltage, volts
Phase_Sequence	4	260	1: Correct Phase seq. 0 : Wrong Phase Seq.
Hardwired inputs	5	261	Discrete Hardwired control inputs: d15..d8: Reserved. d7: External fault. d6: Reserved. d5: Reserved. d4: D.Adj / S.Spd / Rst (Programmable) Input. d3: E.Save / Rvrs / Rst (Programmable) Input. d2: Start Input. d1: Soft Stop Input. d0: Stop Input.
Dip_Switch	6	262	d15..d8: Reserved. d7: Prevent Setting Lock - (right-most) d6: Expanded Setting Ranges d5: Language Selection. d4: Language Selection. d3: Reserved - Must be set to Off. d2: Generator Starting - Set to Off. d1: Reserved d0: Min (OFF) / Max display pages- (left most)
Reserved	7..9	264..265	
Frequency	10	266	Frequency [Hz]
Thermistor_Resistance	11	267	Thermistor resistance, tenth Kohm.
Reserved	12..16	268..272	
Logic Status at Power Fail	17	273	Logic Status at Control Pwr Supply turn OFF.
Elapsed Run Time	18	274	Total Hours of Running Motor.
Number of Starts	19	275	Total Number Of Starts
Last_Start_Period	20	276	Duration of Last Start, Seconds.
Last_Start_Peak_I	21	277	Peak Current During Last Starting process
Reserved	22	278	
Total_Trips	23	279	Total Number Of Trips

Parameter	**# (3x)**	**# (4x)**	**Comment**
Last Fault	24	280	# of the fault that caused trip. # Fault 01 Over Temperature 02 Short Cir. Curr. 03 Overload 04 Under Current 05 Under Voltage 06 Over Voltage 07 Phase Loss 08 Phase Sequence 09 Shorted Scr 10 Long Start Time 11 Slow Speed Time 12 Wrong Connection 13 External Fault 14 Wrong Parameters 15 EMI/RFI Fault 16 Too Many Starts 17 Reserved 18 Thermistor. 19 Frequency
Motor FLT Current	25	281	Current at trip time, % of Im.
Reserved	26..36	282..292	
Thermal Capacity	37	293	
Reserved	38..108	293..364	
Actual_Data_Group	109..128	365..384	Group of 20 actual parameters selected by parameter settings 90..109

Example 1:

To read actual parameters 2 and 3 (Motor Current and Mains Voltage Actual Parameters, Addressed as 1 and 2) of ASTAT-XT # 18 (its SERIAL LINK NO. = 18), the host computer should send following frame:

			Another Possibility (Modbus Plus users)
byte 1: Serial Link No.	($12)		($12)
byte 2: Function	($04)		($03)
byte 3: Starting Address High	($00)		($01)
byte 4: Starting Address Low	($01)		($01)
byte 5: No. of Points High	($00)		($00)
byte 6: No. of Points Low	($02)		($02)
byte 7: CRC_Low	($XX)		($XX)
byte 8: CRC_High	($XX)		($XX)

The ASTAT-XT response, when Current = 400 % of Im, and Voltage = 420V, is:

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

Note:
$XX indicates Hexadecimal byte.

A.8.Parameter Settings (4X References)

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

All of these parameters must be set with care. Inappropriate settings of some parameters can result in damage to both the motor and the ASTAT-XT.

The parameters have the following 4x references:
Note: Use function 3 to read the parameter settings.

Parameter	#	Range	Default
Main Settings			
Starter Current	1	8..1400	58 (Amp.)
Motor Current	2	4..4000	58 (Amp.)
Line/Delta Configuration	3	0 (Line), 1(Inside Delta)	0 (Line)
Undercurrent_FLT	4	0..90	0 (% of Im)
Undercurrent_DLY	5	1..40	10 (Seconds)
O/C JAM Fault	6	100..850	400 (% of Im)
O/C JAM Delay	7	0..50	5 (0.5 Sec.)
Overload_Class	8	0-iec 10, 1-iec 20, 2-nema 10, 3-nema 20, 4-nema 30	0-iec 10
Overload_Protect	9	0-Disable, 1-Enable after EOR 2-Enable	1-Enabled
Undervoltage_FLT	10	120..600	300 (Volt)
UnderVoltage_DLY	11	1..10	5 (Seconds)
Overvoltage_FLT	12	150..750	480 (Volt)
Overvoltage_DLY	13	1..10	2 (Seconds)
Reserved	14..24		
Start Settings			
Soft Start Curve	25	0..10 (5..9 are reserved)	0 (Standard).
Kickstart Time	26	0..10 (Tenth Seconds)	0 (No Pulse)
Starting Voltage/Current	27	10..80	30 (% of full voltage)
Current Limit	28	100..700	400 (% of Im)
Ramp UP Time	29	1..90	10 (Seconds)
Max. Start Time	30	1..60	30 (Seconds)
Number of Starts	31	1..10 & (11 = OFF)	10
Duty Cycle Time	32	1..60	30 (Minutes)
Start_Lockout	33	1..60	15 (Minutes)
EOR Relay Delay	34	0..40	5 (Seconds)
Reserved	35..40		
Stop Settings			
Soft Stop Curve	41	0..10 (5..9 are for reserved)	0 (Standard)
Ramp DOWN Time	42	1..30	10 (Seconds)
End Torque	43	0..10	0 (Minimum)
Reserved	44..48		
DUAL Settings			
Starting VOLT-2	49	10..80 %, 100-400	30
Current Limit-2	50	100..700	300 % of Im
Ramp UP-2	51	1..90	10 (Seconds)
Ramp DOWN-2	52	1..30	10 (Seconds)
Motor Current-2	53	5..1400	31 (Amp.)
Reserved	54..56		

Parameter	#	Range	Default
Slow SP & Saving Parameters			
Energy Saving	57	0..10	10 (Max Save)
Slow Speed_TRQ.	58	1..10	8
Max_Slow_SP_Time	59	1..60	30 (Seconds)
Reserved	60..63		
Fault Settings			
Phase Loss	64	0..1 (0-Disabled, 1-Enabled)	1 (Enabled)
Phase Sequence	65	0..1 (0-Disabled, 1-Enabled)	0 (Disabled)
Auto Reset	66	0 / 1 (0-Disabled, 1-Enabled)	0 (Disabled)
Thermistor Type	67	0 / 1 (0 - PTC, 1 - NTC)	0 (PTC)
Thermistor Trip	68	0..100 Tenth Kohm 0.1..10 K	0 (Disabled)
Undercurrent RST	69	10..120 (&121=Disabled)	121 (Disabled)
Reserved	70-72		
I/O Settings			
PROG. Input # 7	73	0..2 (0=En.Save,1=S.Spd,2=Rst)	0 (Reset)
PROG. Input # 8	74	0..2 (0=D.Set.,1=Rvrs,2=Rst)	0 (Dual Set)
PROG. Fault Relay	75	0..1 (0=Fault close, 1=Fault open)	0 (Fault close)
Relay ON Delay	76	0..3600	0 (Seconds)
Realy OFF Delay	77	0..3660	0 (Seconds)
Analog Output	78	0- Current, 0..200% of motor_fla	0- Current
Reserved	79..80		
COMM. Parameters			
COMM. Protocol	81	0-Modbus,1-Profibus, 2-DeviceNet	0-Modbus
Baud Rate	82	12..96 (*100) Auto for Profibus	96 (9600 bps)
Parity Check	83	0/1/2 (Even / Odd / No)	0 (Even)
Station Number	84	1..247 & (248= Off) 1..126 & (127= Off) for Profibus	248 (Off)
S. Link Par. Set	85	0 (Disable), 1 (Enable)	0 (Disable)
S. Link Control	86	0 (Disable), 1 (Enable)	0 (Disable)
Reserved	87...89		
Modbus_#_Array	90..109 (# of parameter)		

(defaults # are:
1 - Logic Status, 2 - I, 3 - V, 5 – Control In, 11 – Thermistor Resistance, 37 – Thermal Capacity, 10 – frequency, 4 - Phase Sequence, 6-Dip Switch, 18 – Total Run Time, 19 – Total Starts, 20-Last Start Period, 21-Last Start Peak I, 22-time to start, 23 – Total Trips, 24-last trip Number, 25 – Pre Trip I, 26 – Time to Reset U/C, 39-Spare, 40-Spare

Notes:

1. Parameter # is "1 based". The address is 1 lower than parameter #. For example address of parameter #1 is 0 (40000).
2. When the Preset Single Register Function (06) is used to adjust *one* parameter setting, the communication program checks that the parameter value is within the allowed limits. If not, an Exception Response (Exception code 03) is returned instead of Normal response. See Exception Responses later in this document.
3. If Preset Multiple Register Function (16) is used to adjust one or multiple parameter settings, then even if one or more parameter settings are out of range, Normal response will be returned.
   ASTAT-XT program will check later the value of each parameter. If it is beyond the allowed limit, the limit value will be stored instead of the transmitted parameter value.
4. *It is strongly recommended to preset parameter settings only when the motor is stopped.* The ASTAT-XT enables, however to preset *one* parameter (using function 06 only) when the motor is running at full voltage. When motor is Soft Started, Soft Stopped, runs with energy saving or at slow speed, the ASTAT-XT ignores "Preset Single Register" or "Force Multiple Register" instructions. A "busy" Exception response is returned by ASTAT-XT whenever its logic condition does not enable presetting.

5. Always wait more than 0.5 sec after using Functions 06 or 16 to preset parameter(s) before transmitting again to the same ASTAT-XT.
6. Communication parameters 81...87 can only be read through the serial link. They can only be set (written) manually.
7. It is the user's responsibility to read and check all changed parameter settings after presetting.

Example 2:
To Read Stop Parameter settings 41-43 addressed as 40-42 (Soft Stop Curve, Ramp Down Time and End Torque) of ASTAT-XT # 96. The host computer sends the following frame:

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

The ASTAT-XT Normal response:

byte 1: Serial Link No.	($60)	
byte 2: Function	($03)	
byte 3: Byte Count	($08)	
byte 4: Data High	($00)	(Soft Stop Curve = 0)
byte 5: Data Low	($00)	
byte 6: Data High	($00)	(Ramp Down Time = 10Sec)
byte 7: Data Low	($10)	
byte 8: Data High	($00)	(End Torque = 0)
byte 9: Data Low	($00)	
byte 10: CRC_Low	($XX)	
byte 11: CRC_High	($XX)	

Example 3:
To write one parameter setting (Undervoltage FLT = 300V) to Parameter Setting # 10 (Addressed as 9) of ASTAT-XT # 5, the host computer sends the following frame:

byte 1: Serial Link No.	($05)	
byte 2: Function	($06)	
byte 3: Starting Address High	($00)	
byte 4: Starting Address Low	($09)	(9)
byte 5: Preset Data High	($01)	(300)
byte 6: Preset Data Low	$2C)	
byte 7: CRC_Low	($XX)	
byte 8: CRC_High	($XX)	

The ASTAT-XT Normal response is an echo of the query:

byte 1: Serial Link No.	($05)
byte 2: Function	($06)
byte 3: Starting Address High	($00)
byte 4: Starting Address Low	($09)
byte 5: Preset Data High	($01)
byte 6: Preset Data Low	($2C)
byte 7: CRC_Low	($XX)
byte 8: CRC_High	($XX)

Example 4:

To write multiple parameter settings (Undervoltage_FLT = 300V, Undervoltage_DLY = 10Sec, Overvoltage_FLT = 480V, Overvoltage DLY = 2Sec) to Parameter settings # 10-13(Addressed as 9-12) of ASTAT-XT # 128, the host computer sends the following frame:

byte 1: Serial Link No.	($80)	
byte 2: Function	($10)	
byte 3: Starting Address High	($00)	
byte 4: Starting Address Low	($09)	
byte 5: No. of Registers High	($00)	
byte 6: No. of Registers Low	($04)	
byte 7: Byte Count	($08)	
byte 8: Data High	($01)	(300)
byte 9: Data Low	($2C)	
byte 10: Data High	($00)	(10)
byte 11: Data Low	($10)	
byte 12: Data High	($01)	(480)
byte 13: Data Low	($E0)	
byte 14: Data High	($00)	(2)
byte 15: Data Low	($02)	
byte 16: CRC_Low	($XX)	
byte 17: CRC_High	($XX)	

The ASTAT-XT Normal response:

byte 1: Serial Link No.	($80)
byte 2: Function	($10)
byte 3: Starting Address High	($00)
byte 4: Starting Address Low	($09)
byte 5: No. of Registers High	($00)
byte 6: No. of Registers Low	($04)
byte 7: CRC_Low	($XX)
byte 8: CRC_High	($XX)

Note:
A Normal response will be returned even if the preset data value is beyond the allowed range for one or more parameter settings. Later the ASTAT-XT program will check the value of each parameter. If it exceeds the allowed limit, the limit value will be stored instead the transmitted parameter value. It is the user's responsibility to read and check all parameter settings after presetting.

A.9.Control Register Write (4X Reference)

The ASTAT-XT incorporates one Control register intended for controlling the ASTAT-XT.
Address: The Control register is register # 753 addressed as 752 (40752).
In order to control the ASTAT-XT uses the Control register:

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

bit	function	Comment
d0	Stop	Write "1" (ON) to stop.
d1	Soft Stop	Write "1" (ON) to Soft Stop
d2	Start	Write "1" (ON) to start
d3	Energy Save	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.
d4	Dual Adjust	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.
d5	Slow Speed	Write "1" for Slow Speed. Write "0" for Normal Start.
d6	Slow Spd Reverse	Write "1: for Reverse Direction. Write "0" for Forward Direction
d7	Reset	Write "1" (ON) to Reset.

Notes:
1. The Read function of the control register is not possible. To read the ASTAT-XT status, read the Logic_Status (Actual parameter # 1).
2. Bytes 2..8 of the control frame must be exactly as in the following example. Otherwise an error message is returned.
3. Hardwired Stop and Soft Stop inputs override the communication. To enable motor starting through communication, terminals 4 and 5 (Stop & Soft stop) must be connected to the control voltage.

Example 5 - Control Register Write:

To start ASTAT-XT # 11, the host computer sends the following Query frame:

byte 1: Serial Link No.	($0B)	
byte 2: Function	($10)	Bytes 2..8 must be as in this example!!!
byte 3: Starting Address High	($02)	
byte 4: Starting Address Low	($F0)	
byte 5: No. of Registers High	($00)	
byte 6: No. of Registers Low	($01)	
byte 7: Byte Count	($02)	
byte 8: Data High	($5A)	
byte 9: Data Low	($04)	Bit 2 is set, to start.
byte 10: CRC_Low	($XX)	
byte 11: CRC_High	($XX)	

The ASTAT-XT Normal response:

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

A.10. Discrete Commands (Coils, 0x References)

The ASTAT-XT incorporates 16 "Coils", (bit parameters), of which only 5 are operative. The other 10 are reserved and were incorporated to enable the user to use word (16 bits) type parameters. Coil # is 1"1 based". The actual address is 1 lower than coil #. For example coil #1 is addressed as 0 (00000). The coils have the following 0x references:

Coil #	Coil Address	Use in ASTAT-XT	Comment
1	0	Stop	Write "1" (ON) to stop.
2	1	Soft Stop	Write "1" (ON) to Soft Stop
3	2	Start	Write "1" (ON) to start
4	3	Energy Save	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.
5	4	Dual Adjust	Write "1" (ON) to turn On. Write "0" (OFF) to turn Off.
6	5	Slow Speed	Write "1" for Slow Speed. Write "0" for Normal Start.
7	6	Slow Spd Reverse	Write "1: for Reverse Direction. Write "0" for Forward Direction
8	7	Reset	Write "1" (ON) to Reset.
9..16	8..15	Reserved	

Example 6 - Read Coils:

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

byte 1: Serial Link No.	($0A)
byte 2: Function	($01)
byte 3: Starting Address High	($00)

byte 4: Starting Address Low ($00)
byte 5: No. of Coils High ($00)
byte 6: No. of Coils Low ($08)
byte 7: CRC_Low ($XX)
byte 8: CRC_High ($XX)

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

Example 7 - Force Single Coil:

To stop the motor controlled by ASTAT-XT # 1, the host computer writes "1" to the "STOP COIL" (coil 1 addressed as 0)
.
Note: For the Force Single Coil Function, Force Data of $0000 forces "0" = OFF. Force data of $FF00 forces "1" = ON.
The "Query" frame is sent by the host:

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

The Normal (if no exception) response:

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

Notes:
1. Format is identical for the 3 "discrete" commands: Stop, S.Stop, Start & Reset. For these commands, writing "OFF" to coil is meaningless. For example, when the ASTAT-XT is in the Stop condition, Coil #1 (Addressed as 0) = 1 (ON). Forcing the Stop Coil #1 to OFF does nothing. However, forcing the Start Coil (#3) to ON will turn ON the Start Coil, but will also turn Off the Stop Coil.
2. For Energy Save, Dual Adjust, Slow Speed & Slow Speed Reverse Coils, writing "ON" will turn the option ON, while writing "OFF" will turn it OFF .

Example 8 - Force Multiple coils:

The motor that is controlled by ASTAT-XT # 32 is stopped, Energy Save, Dual Adjust, Slow Speed and Reverse are set to OFF.
To start the motor using the Dual Adjust parameters and enable Energy Saving feature (after end of starting), the host computer should write "1" to the Start , Energy Save and Dual Adjust Coils no. 3-5, addressed as 2-4.

The "Query" frame sent by the host:

byte 1: Serial Link No. ($20)
byte 2: Function ($0F)

byte 3: Coil Address High ($00)
byte 4: Coils address Low ($02)
byte 5: No. of Coils High ($00)
byte 6: No. of coils Low ($03)
byte 7: Byte Count ($01)
byte 8: Force Data ($07)
byte 9: CRC_Low ($XX)
byte 10: CRC_High ($XX)

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

byte 1: Serial Link No. ($20)
byte 2: Function ($0F)
byte 3: Coil Address High ($00)
byte 4: Coils address Low ($02)
byte 5: No. of Coils High ($00)
byte 6: No. of coils Low ($03)
byte 7: CRC_Low ($XX)
byte 8: CRC_High ($XX)

A.11. Discrete Hardwired Inputs (1x References)

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

Input #	Address	ASTAT-XT use	Comment
1	0	Stop	Open Input (Input reads" 0") to Stop. (Terminal # 4) Close Input (Input reads "1") to enable Start / Run.
2	1	Soft Stop	Open Input (Input reads"0") to Soft Stop. (Terminal # 5) Close Input (Input reads"1") to enable Start / Run.
3	2	Start	Close Input (Input reads "1") to Start. (Terminal # 6)
4	3	Energy Save * Slow Speed * Reset *	(Terminal # 7) Close Input (Input reads "1") to turn On. Open Input (Input reads "0") to turn Off.
5	4	Dual Adjust * S. Spd Rvrs * Reset *	(Terminal # 8) Close Input (Input reads "1") to turn On. Open Input (Input reads "0") to turn Off.
6..7	5	Reserved	
8	7	External Fault	Open Input = no fault (Input reads" 0") (Terminal #19) indicates No Fault Condition.
9..16	8..15	Reserved	

* Programmable inputs.

Example 9:

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

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

The ASTAT-XT response when only Stop and Soft Stop terminals (Inputs 1&2) are connected:

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

A.12. Diagnostics

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

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

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

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

A.13. Exception Responses

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

1. When no communication error is detected in the query, and no mistake is found by the communication program module in the ASTAT-XT, a Normal response is returned.

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

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

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

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

Exception Codes supported by the ASTAT-XT:

Exception Code	Type	Comment
01	Illegal Function	Requested Function is not supported. Functions 1..6, 8, 15 or 16 are supported.
02	Illegal Data Address	Data address is not allowable.
03	Illegal Data Value	Data Value is not in allowable range.
06	ASTAT-XT Busy	ASTAT-XT is busy now. The master retransmits the message later.

Example 10:

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

Query:

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

Exception response:

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

byte 4: CRC_Low ($XX)
byte 5: CRC_High ($XX)

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

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

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

APPENDIX B - PROFIBUS

B.1.Operation Mode in PROFIBUS:

ASTAT-XT supports both DPV0 and DPV1.

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

B.1.1. Structure of the ASTAT-XT Receiving Frame

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

Bit number:	Function:	Note:
0	Stop	Write '1' for Stop
1	Soft Stop	Write '1' for Soft Stop
2	Start	Write '1' for Start
3	Energy Save	Write '1' (ON) to turn On. Write '0' (OFF) to turn Off.
4	Dual Adjust Write	Write '1' (ON) to turn On. Write '0' (OFF) to turn Off.
5	Slow Speed	Write '1' for Slow Speed Write '0' for normal Start
6	Slow Speed Reverse	Write '1' for Reverse Direction Write '0' for Forward Direction
7	Reset	Write '1' for reset

Note:
Bit number 0 is the LSB.

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

B.1.2. Structure of the ASTAT-XT Transmitting Frame

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

B.1.2.1. Selection of the DPV0 Registers through Data Request (DPV1)

By writing to Slot number 1 and Index 2, you can change the register that appears in DPV0.
Remember that for each register there are 16 bits (two bytes/one word). The first byte represents the high value of the register number.
To demonstrate this, let's say that we want to see the following registers in DPV0 (cyclic):

Logic Status
Motor Current
Line Voltage
Hardwired Inputs
Thermistor Resistance
Thermal Capacity
Frequency
Phase Sequence
DIP Switch
Elapsed Run Time

Step 1: Find the register numbers

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

Go to the table in section B.4 and find the register number for each register. The tool used in our example requires the hexadecimal value so we also need to convert the register number into its hex equivalent.
The following table shows the register numbers for the registers used in our example.

Register name	Decimal number	Hex number
Logic Status	1	00 01
Motor Current	2	00 02
Line Voltage	3	00 03
Hardwired inputs	5	00 05
Thermistor Resistance	11	00 0B
Thermal Capacity	37	00 25
Frequency	10	00 0A
Phase Sequence	4	00 04
DIP switch	9	00 09
Elapsed Run Time	18	00 12

Step 2: Update the register numbers
Write the following to slot number 1 and index number 2 using Data Request (DPV1).

B.1.3. Read and Write from Random Registers via Data Request

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

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

Configure the first register number by writing to slot number 2 and index number 2.
The length of the register number must always contain two bytes (word). If we want to read from register number 5 we need to read from register number 0x0005. The first byte is the high part of the number (the MSB).

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

B.2.Configure the PROFIBUS in the ASTAT-XT

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

Press the SET PAGE button until the following message appears:

COMM. PARAMETERS - **** -

Press SELECT FWD one time and the following message will appear:

COMM. PROTOCOL PROFIBUS

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

Press SELECT FWD again and the following message will appear:

BAUD RATE AUTO (PROFIBUS)

Press SELECT FWD again and the following message will appear:

PROFI.NETWORK ID 3

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

Press SELECT FWD again and the following message will appear:

S.LINK PAR. SAVE ENABLE

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

Press SELECT FWD again and the following message will appear:

SER.LINK CONTROL ENABLE

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

Press SELECT FWD again and the following message will appear:

Store Settings COMM. Parameters

Pressing the SET button stores the parameters in the ASTAT-XT memory.

B.3.Watch Dog Definition

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

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

B.4.Actual Data Register Numbers (decimal)

Number	Parameter Name	Description
1	Logic Status	Logic status of ASTAT-XT. 1 indicates: d15: ASTAT-XT Tripped. d14: Motor Stopped. d13: Motor in Soft Stop Process. d12: Motor in Start Process. d11: Motor is Running. d10: Dual_Adjust On. d9: Motor is running with Energy Save On. d8: Motor is running at Slow Speed forward. d7: Motor is running at Slow Speed reverse. d6: Reserved d5..d0: Reserved
2	Motor Current	Current, % FLA
3	Line Voltage	Line voltage, Volts
4	Phase Sequence	1: Correct phase seq. 0: Wrong phase seq.
5	Hardwired inputs	Discrete Hardwired control inputs: d15..d8: Reserved. d7: External fault. d6: Reserved. d5: Reserved. d4: D.Adj / S.Spd / Rst (Programmable) Input. d3: E.Save / Rvrs / Rst (Programmable) Input. d2: Start Input. d1: Soft Stop Input. d0: Stop Input.
6	DIP switch	d15..d8: Reserved. d7: Prevent Setting Lock - (right-most) d6: Enlarged Setting Ranges d5: Language Selection. d4: Language Selection. d3: Reserved - Must be set to Off. d2: Generator Starting - Set to Off. d1: Reserved. d0: Min (OFF) / Max display pages- (left most)
10	Frequency	Main frequency, Hz
11	Thermistor Resistance	Thermistor resistance, tenth Kohm.
17	Logic status at power fail	Logic status at control power supply turns OFF.
18	Elapsed Run Time	Total Hours of motor runs.
19	Number of Starts	Total number of starts
20	Last start period	Duration of last start, Seconds
21	Last start peak I	Peak current during last starting process
22	Time to start	After too many starts trip, Seconds
23	Total trips	Total number of trips
24	Last Fault number	# of the fault that caused trip. # Fault 01: Over Temperature 02: Short Circuit Current 03: Overload 04: Under Current 05: Under Voltage 06: Over Voltage 07: Phase Loss 08: Phase Sequence 09: Shorted SCR. 10: Long Start Time 11: Slow Speed Time

Number	Parameter Name	Description
		12: Reserved 13: External Fault 14: Wrong Parameters 15: EMI/RFI Fault 16: Reserved 17: Reserved 18: Thermistor. 19: Frequency.
25	Motor Fault Current	Current at trip time, Amp.
37	Thermal Capacity	Simulated winding temperature, %. 100% = trip
109	Actual_Data_Group_1	Group of 20 actual parameters selected by setting parameters 90..109.
110	Actual_Data_Group_2	Group of 20 actual parameters selected by setting parameters 90..109.
111	Actual_Data_Group_3	Group of 20 actual parameters selected by setting parameters 90..109.
112	Actual_Data_Group_4	Group of 20 actual parameters selected by setting parameters 90..109.
113	Actual_Data_Group_5	Group of 20 actual parameters selected by setting parameters 90..109.
114	Actual_Data_Group_6	Group of 20 actual parameters selected by setting parameters 90..109.
115	Actual_Data_Group_7	Group of 20 actual parameters selected by setting parameters 90..109.
116	Actual_Data_Group_8	Group of 20 actual parameters selected by setting parameters 90..109.
117	Actual_Data_Group_9	Group of 20 actual parameters selected by setting parameters 90..109.
118	Actual_Data_Group_10	Group of 20 actual parameters selected by setting parameters 90..109.
119	Actual_Data_Group_11	Group of 20 actual parameters selected by setting parameters 90..109.
120	Actual_Data_Group_12	Group of 20 actual parameters selected by setting parameters 90..109.
121	Actual_Data_Group_13	Group of 20 actual parameters selected by setting parameters 90..109.
122	Actual_Data_Group_14	Group of 20 actual parameters selected by setting parameters 90..109.
123	Actual_Data_Group_15	Group of 20 actual parameters selected by setting parameters 90..109.
124	Actual_Data_Group_16	Group of 20 actual parameters selected by setting parameters 90..109.
125	Actual_Data_Group_17	Group of 20 actual parameters selected by setting parameters 90..109.
126	Actual_Data_Group_18	Group of 20 actual parameters selected by setting parameters 90..109.
127	Actual_Data_Group_19	Group of 20 actual parameters selected by setting parameters 90..109.
128	Actual_Data_Group_20	Group of 20 actual parameters selected by setting parameters 90..109.

B.5.Setting Parameters Registers for Data Request

Parameter	#	Range	Default
Main Parameters			
Starter Current	0	8..1400	58 (Amp.)
Motor Current	1	4..1750	58 (Amp.)
Line/Delta Configuration	2	0 (Line), 1 (Inside Delta)	0 (Line)
Undercurrent_FLT	3	0..90 (% of FLA)	0 (% of FLA)
Undercurrent_DLY	4	1..40	10 (Seconds)
O/C JAM Fault	5	200..850 (% of FLA)	850 (% of FLA)
O/C JAM Delay	6	0..50	5 (0.5 Sec.)
Overload_Class	7	75..150	115 (% of FLA)
Overload_Protect	8	1..10	4 (Seconds)
Undervoltage_FLT	9	120..600	300 (Volt)
UnderVoltage_DLY	10	1..10	5 (Seconds)
Overvoltage_FLT	11	150..750	480 (Volt)
Overvoltage_DLY	12	1..10	2 (Seconds)
Reserved	14..23		
Start Settings			
Soft Start Curve	24	0..10 (5..9 are reserved)	0 (Standard).
Kickstart Time	25	0..10 (Tenth Seconds)	0 (No Pulse)
Starting Voltage/Current	26	10..80	30 (% of full voltage)
Current Limit	27	100..500	400 (% of FLA)
Ramp UP Time	28	1..90	10 (Seconds)
Max. Start Time	29	1..250	30 (Seconds)
Number of Starts	30	1..10 & (11 = OFF)	10
Duty Cycle Time	31	1..60	30 (Minutes)
Start_Lockout	32	1..60	15 (Minutes)
EOR Relay Delay	33	0..40	5 (Seconds)
Reserved	35..39		
Stop Settings			
Soft Stop Curve	40	0..10 (5..9 are reserved)	0 (Standard)
Ramp DOWN Time	41	1..30	10 (Seconds)
End Torque	42	0..10	0 (Minimum)
Reserved	43..47		
Dual Settings			
Starting VOLT-2	48	10..80 % of full voltage	30
Current Limit-2	49	100..500	400 % of FLA
Ramp UP-2	50	1..90	10 (Seconds)
Ramp DOWN-2	51	1..30	10 (Seconds)
Motor Current-2	52	5..1400	31 (Amp.)
Reserved	53..55		
Slow SP & Saving Parameters			
Energy Saving	56	1..10	0
Slow Sp eed TRQ.	57	1..10	8
Max_Slow_SP_Time	58	1..250	30 (Seconds)
Reserved	59..62		
Fault Settings			
Phase Loss	63	0..1	0 (No)
Phase Sequence	64	0..1	0 (No)
Auto Reset	65	0 / 1 (0 - No, 1 - Yes)	1 (No)

Parameter	#	Range	Default
Thermistor Type	66	0 / 1 (0 - PTC, 1 - NTC)	0 (PTC)
Thermistor Trip	67	0..100 Tenth Kohm 0.1..10 K	0 (Off)
Undercurrent RST	68	10..120 (&121=OFF)	121 (Off)
Reserved	69..71		
I/O Settings			
Prog. Input #7	72	0..2(0=En.Save,1=S.Spd,2=Rst)	0 (Energy Saver)
Prog. Input #8	73	0..2(0=D.Adj.,1=Rvrs,2=Rst)	0 (Dual Adjust)
Prog. Fault Relay	74	0..1 (0=Fault, 1=Fault-Fail Safe)	0 (Fault)
Relay ON Delay	75	0..3600	0 (Seconds)
Realy OFF Delay	76	0..3600	0 (Seconds)
Analog Output	77	0- Current, 0..200% of motor FLA	0 (Current)
Reserved	78		
Communication Parameters			
COMM. Protocol	80	0 – Modbus, 1-Profibus	1 - Profibus
Baud Rate	81	12..96 (*100)	96 (9600 bps)
Parity Check	82	0/1/2 (Even / Odd / No)	0 (Even)
Station Number	83	1..247 & (248= Off)	248 (Off)
		1..126 & (127= Off) for Profibus	
S. Link Par. Set	84	0 (Disable), 1 (Enable)	0 (Disable)
S. Link Control	85	0 (Disable), 1 (Enable)	0 (Disable)
Reserved	86..88		
Modbus_#_Array	89..108	(# of parameter)	
		Defaults # are: 1 - Logic Status, 2 - I, 3 - V, 5 - Control In, 11 – Thermistor Resistance, 37 - Thermal Capacity, 10 - frequency, 4 - Phase Sequence, 6 - Dip Switch, 18 - Total Run Time, 19 - Total Starts, 20 - Last Start Period, 21 - Last Start Peak I, 22 - time to start, 23 - Total Trips, 24 - last trip Number, 25 - Pre Trip I, 26 - Time to Reset U/C, 39 - Spare, 40 – Spare	

APPENDIX C - DEVICENET™ TO MODBUS™ GATEWAY

C.1.Introduction

C.1.1. Overview

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

C.1.2. Definitions

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

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

C.1.3. Reference Documents

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

C.1.4. Open DeviceNet Vendor Association, Inc. (ODVA)

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

C.1.5. Rotary Switch Configuration

Two rotary switches configure the DeviceNet MacID, and one rotary switch configures the baud rate. Use a small screwdriver to change the switch settings. The NODE ADDRESS (MAC ID) rotary switches are shown in Figure 1, and the DATA RATE rotary switch is shown Figure 2.

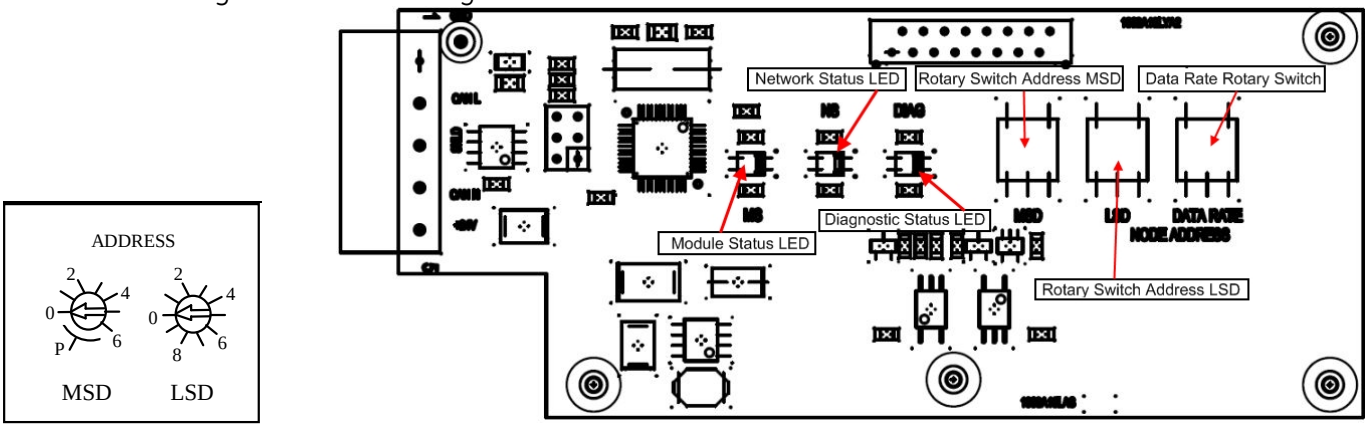


Figure 1 MAC ID rotary switch layout

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

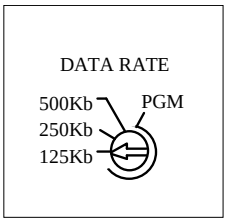


Figure 2 Baud rate rotary switch layout

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

C.1.6. LED Indicators

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

Table 1Modbus Diagnostic Status LED

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

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

Table 2DeviceNet Network Status LED

Color	State	Indication
None	Off	No Power

Color	State	Indication
Red	Solid	Unrecoverable Fault
	Flashing	Recoverable Fault I/O Connection Timed Out
Green	Solid	Normal runtime operation
	Flashing	Device is idle or not allocated to a master
Red / Green	Alternating	Identify (Offline Connection Set)

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

Table 3DeviceNet Module Status LED

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

C.2.Identity Object (01_{HEX} - 1 Instance)

C.2.1. Class Attributes (Instance 0)

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

C.2.2. Instance Attributes (Instance 1)

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

C.2.3. Common Services

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

C.3.Message Router Object (02_{HEX} - 1 Instance)

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

C.4.DeviceNet Object (03_{HEX} - 1 Instance)

C.4.1. Class Attributes (Instance 0)

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

C.4.2. Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Mac ID	USINT	63	Get / Set[45] [46]
2	Baud Rate	USINT	0	Get / Set[47] [46]
5	Structure of: Allocation Choice Byte Master's Mac ID	 BYTE USINT	 0xFF 0	 Get Get
6	MAC ID Switch Changed	BOOL	0	Get
7	Baud Rate Switch Changed	BOOL	0	Get
8	MAC ID Switch Value	USINT	63	Get
9	Baud Rate Switch Value	USINT	0	Get

C.4.3. Common Services

Service	Implemented for	Service Name

45 When switches are used to set the MacID, the attribute is not settable over the DeviceNet network
46 Stored to NVRAM
47 When switches are used to set the Baud Rate, the attribute is not settable over the DeviceNet network

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

C.5.Assembly Object (04_{HEX} – 4 Instances)

C.5.1. Class Attributes (Instance 0)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Revision	UINT	2	Get
2	Max Instance	UINT	112	Get
100	Input Index 60 = Instance 60 61 = Instance 61 100 = Instance 100	USINT	2	Get / Set[48]
101	Input Size (in bytes)	UINT	1	Get
102	Output Index 112 = Instance 112	USINT	0	Get / Set[49]
103	Output Size (in bytes)	UINT	1	Get

C.5.2. Output (O2T) Instance Attributes – Register 40752

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

C.5.2.1. Output Instance 112 (0x70) – Control Output

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reset	Slow Speed Reverse	Slow Speed	Dual Adjust	Energy Save	Start	Soft Stop	Stop

C.5.3. Input (T20) Instance Attributes – Register 40257

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

C.5.3.1. Input Instance 60 (0x3C) – Basic Softstart Input

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

C.5.3.2. Input Instance 61 (0x3D) – Extended Softstart Input

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

C.5.3.3. Input Instance 100 (0x64) – Status

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Slow Speed Reverse	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
1	ASTAT-XT Tripped	Stopped	Soft Stop Process	Start Process	Running	Dual_Adjust On	Energy Save On	Slow Speed

48 Stored to NVRAM
49 Stored to NVRAM

C.5.4. Common Services

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

C.6.Connection Object (05_{HEX} - 2 Instances)

C.6.1. Class Attributes (Instance 0)

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

C.6.2. Instance Attributes (Instances 1-2) Explicit, Polled I/O

Attribute ID	Name	DeviceNet Data Type	Data Value		Access Rule
			Instance 1[50]	Instance 2[51]	
1	State	USINT	0 = NonExistent 3 = Established 5 = Deferred Delete	0 = NonExistent 1 = Configuring 3 = Established 4 = Timed Out	Get
2	Instance Type	USINT	0	1	Get
3	Transport Trigger	usint	83_{HEX}	82_{HEX}	Get
4	Produced Connection ID	uint	$10xxxxxx011_{BIN}$ xxxxxx = Node Address	$01111xxxxxx_{BIN}$ xxxxxx = Node Address	Get
5	Consumed Connection ID	uint	$10xxxxxx100_{BIN}$ xxxxxx = Node Address	$10xxxxxx100_{BIN}$ xxxxxx = Node Address	Get
6	Initial Comm. Character	USINT	21_{HEX}	01_{HEX}	Get
7	Produced Connection Size	uint	40	4	Get
8	Consumed Connection Size	uint	40	4	Get
9	Expected Packet Rate	uint	2500 msec	0	Get / Set
12	Watchdog Timeout Action	USINT	4 = Deferred Delete	0 = Timeout	Get / Set
13	Produced Connection Path Length	UINT	0	3	Get
14	Produced Connection Path	USINT Array	NULL	0x62 0x36 0x34 (0x64 = 100)	Get / Set[52]
15	Consumed Connection Path Length	UINT	0	0	Get

[50] Instance 1 is an Explicit Message Connection.
[51] Instance 2 is a Polled I/O Message Connection.
[52] Must select Assembly via Connection Object per AC/DC Drive Profile (Symbolic Segment Type) – Stored in NVRAM

Attribute ID	Name	DeviceNet Data Type	Data	Value	Access Rule
16	Consumed Connection Path	USINT Array	NULL	0x62 0x37 0x30 (0x70 = 112)	Get / Set[52]

C.6.3. Common Services

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

C.7.Softstart Object ($2D_{HEX}$ - 1 Instance)

C.7.1. Class Attributes (Instance 0)

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

C.7.2. Instance Attributes (Instance 1)

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

C.7.2.1. Extended AtReference Values

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

C.7.2.2. Extended StartMode Values

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

C.7.3. Common Services

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

C.8.Control Supervisor Object (29_{HEX} - 1 Instances)

C.8.1. Class Attributes (Instance 0)

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

C.8.2. Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule	Modbus Register

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

C.8.3. Common Services

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

C.9.Modbus / Serial Object (65_{HEX} - 1 Instance)

C.9.1. Class Attributes (Instance 0)

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

C.9.2. Instance Attributes (Instance 1)

Attribute ID	Name	DeviceNet Data Type	Data Value	Access Rule
1	Modbus Slave ID (1-247)	USINT	1	Get / Set[53]
2	Baud Rate 0 = 4800 1 = 9600 2 = 19200	USINT	2	Get / Set[53]
3	Parity 0 = 8N 1 = 8E 2 = 8O	USINT	1	Get / Set[53]
10	Timeout (milliseconds) (10ms – 60000ms)	UINT	500	Get / Set[53]
100	Number of Valid Reads (since power up)	UDINT	0	Get
101	Number of Read Errors (since power up)	UDINT	0	Get
102	Number of Read Timeouts (since power up)	UDINT	0	Get
110	Number of Valid Write (since power up)	UDINT	0	Get
111	Number of Write Errors (since power up)	UDINT	0	Get
112	Number of Write Timeouts (since power up)	UDINT	0	Get

[53] Stored to NVRAM

C.9.3. Common Services

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

C.10. Input Object (70_{HEX} - 1 Instance)

C.10.1. Class Attributes (Instance 0)

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

C.10.2. Instance Attributes (Instance 1)

Attribute ID	Name	Description	Access Rule	Modbus Address
1	Logic Status	Logic Status of ASTAT-XT:	Get	40257
2	Motor Current	Current, % Im	Get	40258
3	Line Voltage	Line Voltage (Volts)	Get	40259
4	Phase Sequence	1 – Correct Phase Seq. 0 – Wrong Phase Seq.	Get	40260
5	Hardwired inputs		Get	40261
6	DIP switch		Get	40262
7	Thermal Capacity		Get	40293
8	Reserved		Get	40264
9	Reserved		Get	40265
10	Frequency	Main frequency, Hz	Get	40266
11	Thermistor_ Resistance	Thermistor resistance, tenth Kohm.	Get	40267
12	Reserved		Get	40268
13	Reserved		Get	40269
14	Reserved		Get	40270
15	Reserved		Get	40271
16	Reserved		Get	40272
17	Logic status at power fail	Logic status at control power supply turns OFF.	Get	40273
18	Elapsed Run Time	Total Hours of motor runs.	Get	40274
19	Number of Starts	Total number of starts	Get	40275
20	Last start period	Duration of last start, Seconds	Get	40276
21	Last start peak I	Peak current during last starting process	Get	40277
22	Time_to_Start	After too many starts trip, Seconds	Get	40278
23	Total trips	Total number of trips	Get	40279
24	Last Fault number	# of the fault that caused trip. # Fault 01: Over Temperature 02: Short Circuit Current 03: Overload 04: Under Current 05: Under Voltage 06: Over Voltage 07: Phase Loss 08: Phase Sequence	Get	40280

Attribute ID	Name	Description	Access Rule	Modbus Address
		09: Shorted SCR. 10: Long Start Time 11: Slow Speed Time 12: Reserved 13: External Fault 14: Wrong Parameters 15: EMI/RFI Fault 16: Too Many Starts 17: Reserved. 18: Thermistor. 19: Frequency.		
25	Motor Fault Current	Current at trip time (Amp)	Get	40281
26-45	Actual_Data_Group	20 actual parameters selected by Setting Parameters 90-109	Get	40365-40384

C.10.3. Common Services

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

C.11. Main Parameter Object (71_{HEX} - 1 Instance)

C.11.1. Class Attributes (Instance 0)

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

C.11.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Starter Current	8-1400 (Amps)	58	Get/Set	40001
2	Motor Current	4-1750 (Amps)	58	Get/Set	40002
3	Line/Delta Configuration	0 – Line 1 – Inside Delta	0	Get/Set	40003
4	Undercurrent FLT	0-90 (% of Im)	0	Get/Set	40004
5	Undercurrent DLY	1-40 (Sec)	10	Get/Set	40005
6	O/C JAM Fault	200-850 (% of Im)	400	Get/Set	40006
7	O/C JAM Delay	0-50 (0.5 Sec.)	5	Get/Set	40007
8	Overload Class	75-150 (% of Im)	115	Get/Set	40008
9	Overload Protect	1-10 (Sec.)	4	Get/Set	40009
10	Under voltage FLT	120-600 (Volt)	300	Get/Set	40010
11	Under voltage DLY	1-10 (Sec)	5	Get/Set	40011
12	Over voltage FLT	250-750 (Volt)	400	Get/Set	40012
13	Over voltage DLY	1-10 (Sec)	2	Get/Set	40013

C.11.3. Common Services

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

C.12. Start Settings Object (72_{HEX} - 1 Instance)

C.12.1. Class Attributes (Instance 0)

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

C.12.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Soft Start Curve	0-10	0	Get/Set	40025
2	Kickstart Time	0-10 (10^{th} Sec)	0	Get/Set	40026
3	Starting Voltage/Current	10-80	30	Get/Set	40027
4	Current Limit	100-500	400	Get/Set	40028
5	Ramp UP Time	1-90	10	Get/Set	40029
6	Max. Start Time	1-250	30	Get/Set	40030
7	Number of Starts	1-10 & 11 - OFF	10	Get/Set	40031
8	Duty Cycle Time	1-60	30	Get/Set	40032
9	Start_Lockout	1-60	15	Get/Set	40033
10	EOR Relay Delay	0-40	5	Get/Set	40034

C.12.3. Common Services

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

C.13. Stop Settings Object (73_{HEX} - 1 Instance)

C.13.1. Class Attributes (Instance 0)

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

C.13.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Soft Stop Curve	0-10	0	Get/Set	40041
2	Ramp DOWN Time	1-30	10	Get/Set	40042
3	End Torque	0-10	0	Get/Set	40043

C.13.3. Common Services

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

C.14. Dual Settings Object (74_{HEX} - 1 Instance)

C.14.1. Class Attributes (Instance 0)

Attribute	Name	DeviceNet	Data Value	Access

ID		Data Type		Rule
1	Revision	UINT	1	Get

C.14.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Starting VOLT-2	10-80	30	Get/Set	40049
2	Current Limit-2	100-500	400	Get/Set	40050
3	Ramp UP-2	1-90	10	Get/Set	40051
4	Ramp DOWN-2	1-30	10	Get/Set	40052
5	Motor Current-2	5-1400	105	Get/Set	40053

C.14.3. Common Services

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

C.15. Slow SP & Saving Parameters Object (75_{HEX} - 1 Instance)

C.15.1. Class Attributes (Instance 0)

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

C.15.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Energy Saving	0-10	10	Get/Set	40057
2	Slow Speed TRQ.	1-10	8	Get/Set	40058
3	Max_Slow_SP_Time	1-250	30	Get/Set	40059

C.15.3. Common Services

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

C.16. Fault Settings Object (76_{HEX} - 1 Instance)

C.16.1. Class Attributes (Instance 0)

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

C.16.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Phase Loss	0-1	0	Get/Set	40064
2	Phase Sequence	0-1	0	Get/Set	40065
5	Auto_Reset	0-1	1	Get/Set	40066
6	Thermistor_Type	0-1	0	Get/Set	40067
7	Thermistor_Trip	0-100 (Tenth Kohm)	0	Get/Set	40068
8	Undercurrent RST	10-120 & 121 - OFF	121	Get/Set	40069

C.16.3. Common Services

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

C.17. I/O Settings Object (77_{HEX} - 1 Instance)

C.17.1. Class Attributes (Instance 0)

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

C.17.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	Prog. Input #7	0-2	0	Get/Set	40073
2	Prog. Input #8	0-2	0	Get/Set	40074
3	Prog. Fault Relay	0-1	0	Get/Set	40075
4	Relay ON Delay	0-3600	0	Get/Set	40076
5	Realy OFF Delay	0-3600	0	Get/Set	40077
6	Analog Output	0-200% of Motor_Im	0	Get/Set	40078
7	Reserved			Get/Set	40079

C.17.3. Common Services

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

C.18. Communication Parameter Object (78_{HEX} - 1 Instance)

C.18.1. Class Attributes (Instance 0)

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

C.18.2. Instance Attributes (Instance 1)

Attribute ID	Name	Range	Default Value	Access Rule	Modbus Address
1	COMM. Protocol	0-2	2	Get	40081
2	Baud Rate	12-96 (*100)	9600	Get	40082
3	Parity Check	0-2	0	Get	40083
4	Station Number	1-247 & 248 1-126 &127 (Profibus)	248	Get	40084
5	S. Link Par. Set	0-1	0	Get/Set	40085
6	S. Link Control	0-1	0	Get/Set	40086
7-9	Reserved			Get/Set	40087-89
10-29	Modbus_#_Array			Get/Set	40090-40109

C.18.3. Common Services

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

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