XS SERIES
Traverse Inverter

Service Manual

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Read the instructions supplied with the product before installation and commissioning.

Keep the instructions in a safe place for future reference.

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1 CAUTION

-This manual rev6.0 is for XS rev 1.0 with software D2S2V051.

-Before starting, read the instructions carefully.

-Verify all of the connections are in accordance to the drawings.

-Verify the motor supply is connected correctly, faulty connection will destroy the inverter.

-Check the device cover is properly installed.

-High voltages are present in this device. Switch the power off and after the display turns off, wait 5 minutes before opening the cover.

-Insulation resistance test with a megger multimeter requires special precautions.

-Do not make any measurements inside the device when it is connected to the main supply.

-Do not touch the components on the circuit boards. Electrostatic discharge may cause damage or destroy the IC-circuits.

-Check all ventilation holes are clear and unobstructed.

-Check that hot air coming from the brake resistors does not cause any danger.

-Do not make any inspections unless the supply has been disconnected by the main switch.
It is forbidden to use radiophones or portable phones near this device with the doors open.

-All the doors and covers must be closed during crane operation.

-Drive is not intended to be used in a low-voltage public network, which supplies domestic premises. Radio frequency interference is expected if used in such a network.

2 GENERAL

2.1 Technical data

Power class	4005	4010	4013	4018	4024	4032	4042	4048
Horsepower (Hp) at 460V	3	5	7.5	10	15	20	25	30
Output current In (A)	5.0	10	13	18	24	32	42	48
Max. current 1min (A)	7.6	15	20	27	36	48	63	72

Overloadability	1.5 x In, 1min/10min							
Max. output voltage	Equals to supply voltage							
Supply								
Supply voltage	380-500VAC							
Allowable voltage fluctuation	+/- 10%							
Nominal supply frequency	50/60Hz +/- 5%							
Signal input levels								
Digital controls	S1, S2, DID3, DID4, DID5: 42 … 240Vac; 15mA							
Control features								
Control method	Open loop vector control							
Frequency control range	0 ... 250Hz							
Frequency command	Electronic potentiometer, 2-5-step controller or 0 … 10V analog signal							
Limit switch functions	Slowdown and stop limit inputs for both directions							
Speed control range	s_N ... 100% (s_N= motor nominal slip)							
Speed accuracy	1% of nominal speed at speed range 10 ... 100%							
	1/3 of motor nominal slip at speed below 10%							
Braking torque	150%							
Protections								
Motor overload protection	Thermistor or Klixon thermostat based temperature measurement							
Overload protection	Fault is detected if the current momentarily exceeds 280% of RMS rated current							
Undervoltage / blown fuse	Fault is detected if DC voltage drops below 333V							
Overvoltage protection	Fault is detected if DC voltage exceeds 911V							
Momentary power loss	Immediate fault stop							
Inverter overtemperature	Temperature sensor on the heat sink							
Mechanical brake	Circuit breaker (from 4018 upward)							
Ground fault	Provided by electronic circuitry							
Ambient conditions								
Ambient temperature	-10C ... +50C (14F ... 122F) for 40% Duty Cycle							
Storage temperature	-40C ... +70C (-31F ... 158F) dry							
Humidity	<95%RH (no condensation)							
Altitude	Maximum 1000m at In. Above 1000m: In reduces 1% per each 100m.							
	Above 3000m: consult factory.							
Vibration	Operation: maximum displacement amplitude 3mm at 2-9Hz.							
	Maximum acceleration amplitude 0.5g (5m/s²) at 9-200Hz							
	Conforms to LV and EMC directives.							
Power class dimensions	**4005**	**4010**	**4013**	**4018**	**4024**	**4032**	**4042**	**4048**
H x W x D (Inches)	7.2x3.3x6.8	11.5x5x7.48	15.4x5.6x8.4			20.4x7.6x9.3		

2.2 Type mark coding

Type marking is shown below.

000 XSx **Device name**
000- Base Drive (430) or Pre-engineered Panel (490,491,492,493)
XS Series
x- d (Base drive vector), s (open loop vector panel)

4 **Supply voltage**
4 380 - 500VAC, 50/60Hz

010 **Rated Amps**
005=5A, 010=10A, 013=13A, 018=18A, 024=24A,
032=32A, 042=42A, 048=48A

TC
Panel Motion and Duty Class
00=Base Drive only
TC=Traverse class C
TD=Traverse class D

0 **Option Control PCB's**
0 Standard

000 XSx	4	010	TC	0	55	0

Software Revision code
The latest revision may differ **55**

Special
0 None
L Varnished boards **0**

2.3 Main components

The main components are:

A1	Inverter
F7	Brake supply circuit breaker
K7	Brake contactor
R1	Braking resistor unit
Z1,Z2, Z3	Ferrite rings (Depending on EMC level,options
CM1	Filtering capacitors (Depending on EMC level,options
X1	Terminals

2.4 Functional description

Operation when power is switched on

- Stop limit switches S12 & S22 and slow down limit switches S11 & S21 are assumed to be normally closed, as well as the emergency stop button.
- The control voltage is supplied to OL10 and ON. The main voltage is connected to inverter power supply and then inverter powers up.
- If either of the direction signals S1 or S2 is on and the display shows F6 (see Chapter "Inverter fault codes"), driving can begin only after the fault has been reset and the direction signals have been off more than 0.3s.

Normal operation

- For the description of the speed reference setting see Chapter “Control methods”. Travelling starts when switch S1 or S2 closes. Closing the contact ROD1 on A1 energizes K7, which opens the brake. Motor accelerates according to the acceleration ramp settings to the selected speed.
- When the switch S1 or S2 opens motor stops according to the deceleration ramp settings and the brake closes.
- R1 dissipates the regenerated energy during deceleration periods. The regenerated power from the motor is disapated by the resistor and controlled by the inverter.

Other features
- Thermistor relay function, which can be supplied as needed.
- When the stop limit switch S12 or S22 opens, K7 de-energizes and the mechanical brake stops the motion

2.5 Control methods

There are three different control methods (8 control modes) available:

1	EP	Electronic potentiometer function. - Stepless control using a 2-step controller. - EP3 stepless control using a 3-step controller.
2	MS	Multistep control (up to 5 steps) - Requires programmable digital inputs for speed reference steps
3	AU	Automation control for any control device with an output in the range of 0 – 10V - E.g. radio controls, process computers.

All control methods are available without any changes in the hardware or software.The control mode of XS is selected by parameter P1.1.11 Input set, which has eight alternative settings: MS2 (stop-limit), MS2/MS3 (slow-limit), EP2 (stop-limit), EP2 (slow-limit), EP3, MS4, MS5 and AU (automation control). (See Chapter 5: parameter descriptions.) The parameter assigns digital inputs S1, S2 and DID3-DID5. It is not possible to change the functions of the inputs separately. Digital inputs DID1 and DID2 are for direction commands, so DID1 = S1, DID2 = S2 in every case. Digital inputs (DID3-DID5) are automatically assigned according to the selected mode. The state of inputs can be checked from parameter V2.3.

Control Mode	MS2 (stop-lim)	MS2 (slow-lim)	EP2 (stop-lim)	EP2 (slow-lim)	EP3	MS4	MS5	AU (Ain1)
Parameter P1.1.11	0	1	2	3	4	5	6	7
Signal								
S1	S1	S1	S1	S1	S1	S1	S1	S1
S2	S2	S2	S2	S2	S2	S2	S2	S2
DID3	MAX	MAX	AP	AP	AP	MS2	MS2	S11/S21
DID4	S12	S11/S21	S12	S11/S21	HOLD	MS3	MS3/MAX	S12
DID5	S22	ES	S22	ES	S11/S21	MAX	MS4	S22

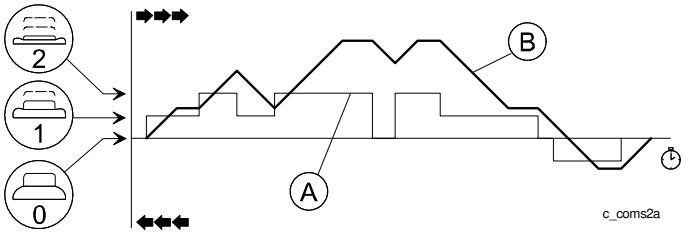
S1	Drive command forward	**S2**	Drive command reverse
AP	Acceleration command	**HOLD**	Hold speed command
S11	Slowdown limit forward	**S21**	Slowdown limit reverse
S12	Stop-limit forward	**S22**	Stop-limit reverse
S11/S21	Common slowdown limit	**MS2**	Multistep Frequency2
MS3	Multistep Frequency3	**MS4**	Multistep Frequency4
MAX	Maximum frequency	**ES**	External stop

Desired speed levels for multi-step control mode are selected with following parameters

Speed	**Parameter**	**Input**
Speed 1	P1.1.4	S1/S2
Speed 2	P1.1.8	MS 2
Speed 3 (only available in MS4)	P1.1.9	MS 3
Speed 4 (only available in MS5)	P1.1.10	MS 4
Speed 5	P1.1.5	MAX

2.6 Description of the control modes

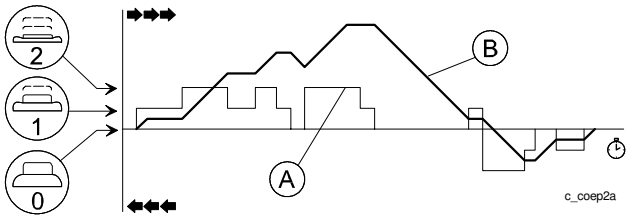
2.6.1 MS2-control



A. Pushbutton / controller position
B. Speed

0) "decelerate to zero"
1) step 1 "drive minimum speed"
2) step 2 "drive maximum speed"

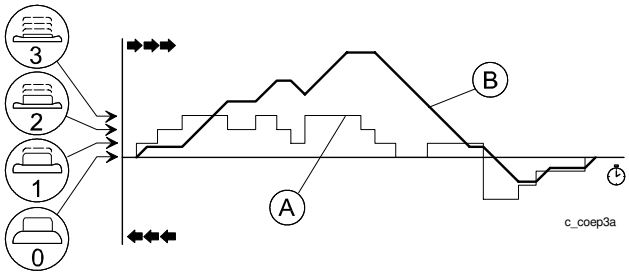
2.6.2 EP2-control



A. Pushbutton / controller position
B. Speed

0) "decelerate to zero"
1) while starting "drive minimum speed"
while running "hold speed"
2) while running "accelerate"
while running at maximum speed "hold speed"

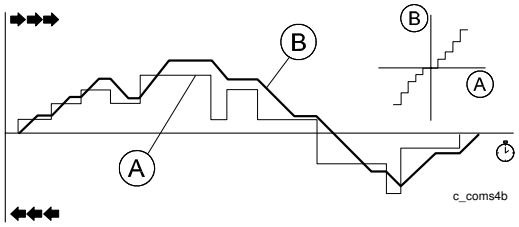
2.6.3 EP3-control



A. Pushbutton / controller position
B. Speed

0) "decelerate to zero"
1) step 1 "drive minimum speed"
2) step 2 "hold speed"
3) step 3 while running "accelerate"
while running at maximum speed "hold speed"

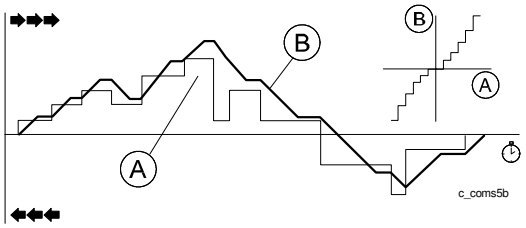
2.6.4 MS4-control



A. Controller position
B. Speed

0) "decelerate to zero"
1) step 1 "drive minimum speed"
2) step 2 "drive speed2"
3) step 3 "drive speed3"
4) step 4 "drive maximum speed"

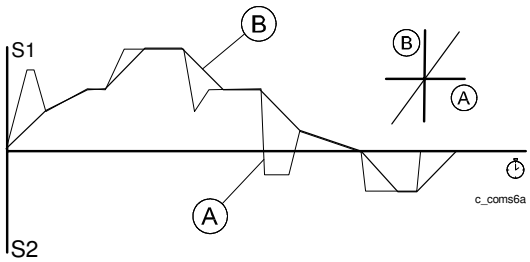
2.6.5 MS5-control



A. Controller position
B. Speed

0) "decelerate to zero"
1) step 1 "drive minimum speed"
2) step 2 "drive speed2"
3) step 3 "drive speed3"
4) step 4 "drive speed4"
5) step 5 "drive maximum speed"

2.6.6 AU/PO-control



A. Reference
B. Speed

AU control may be used with control device with an output in the range of 0 V – 10 V (for example radio or PLC).
PO control may be used with a controller with potentiometer.
The operation is as follows:

-Driving command S1 or S2 is given separately and means "drive minimum speed"
-The speed linearly follows the analog input signal.

2.7 Slowdown-limit Operation

The slowdown function is available in MS2- (slow-lim), EP2- (slow-lim), EP3- and AU-control modes. It can reduce maximum frequency at the both ends of the crane runway. When the function is active, the reference slowdown frequency is set automatically by parameter P1.1.8 “Multistep freq2/Slowdown”.

The action in slowdown-limit area depends on parameter P1.5.1 “Slowdown Mode” settings. The description on “Slowdown Mode” selections is shown as follows:

Parameter value	Action
0 = Slow	When the limit switch circuit is opened, the maximum speed is limited in both directions until the limit switch circuit is closed.
1 = Fast	When the limit switch circuit is opened during running the slowdown function is activated and the maximum speed is limited in the present running direction. If the limit switch circuit is open when power is turned on, the maximum speed is limited in both directions until the limit switch circuit is closed.
2 = Fast power up	When the limit switch circuit is opened during running the slowdown function is activated and the maximum speed is limited in the present running direction. When power is turned off, the limit switch status is saved in EEPROM. When power is turned back on and limit switch circuit is open, driving is allowed the maximum speed in opposite direction.

2.8 Stop-limit operation

Stop-limit function is available in MS2- (stop-lim), EP2- (stop-lim), and AU-control modes. Normally these inputs (S12 and S22) are "high" (limit switch closed, voltage present in the input). When either of these signals goes “down” (no voltage in the input), the motion is stopped by switching the motor current off immediately and by opening the relay contact ROD1 (mechanical brake closes).

Restart may occur only after one second. Restart is only allowed to the direction opposite to the stop-limit switch circuit being off. If both of these inputs are off restart is not permitted. Restart may be initiated only by a run command changing from off to on (= before restart both run commands must be off after the one-second time has passed).

2.9 Mechanical brake control

XS panels have a brake contactor to control electromechanical disk brake of the traveling motor. When there is no voltage present, the brake is closed and is kept closed by spring force.

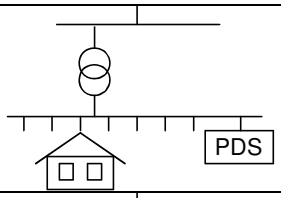
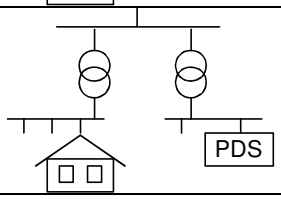
The brake is controlled so that during starting the motor generates torque first and after that the brake is opened. The same applies for stopping; while the brake is being closed, the motor still generates torque. During a direction change, the brake is kept held open. The inverter decelerates the motor to a stop according to the set deceleration time when the run command is switched off; so the brake is used only as a holding brake. This way brake wear is minimized. Only if a failure occurs, the emergency stop button is pushed, or a stop limit is triped will cause the brake to close immeadiately which stops the motor.

2.10 EMC

The abbreviated "EMC" stands for the Electromagnetic Compatibility. According to the European EMC directive "the apparatus shall be so constructed that:

The electromagnetic disturbance it generates does not exceed a level allowing other apparatus to operate as intended

The apparatus has an adequate level of intrinsic immunity of electromagnetic disturbance to enable it to operate as intended.

Declaration of conformity	With the declaration of conformity the manufacturer informs that device is manufactured to fulfill required EMC standards.	
CE-mark	The CE marking is a declaration by a manufacturer or importer located in the European Economic Area that a product complies with the safety and health requirements of the directive in question. The manufacturer demonstrates for the authorities that the product complies with the safety requirements within the EU.	
Environments	**Immunity and emission requirements are divided in two levels in the product standard according to the environments.**	
	First environment means environment that includes domestic premises and also establishments directly connected to a low-voltage power supply network.	
	Second environment means environment that includes all establishments other than those directly connected a low-voltage power supply network	

2.10.1 EMC levels

Three kinds of EMC levels are available in XS product family, they are S, N and 0 level.

-S-level: No Drivecon EMC solution is adopted and products will be used in other market areas than European Union (EU) when local power supply system is the grounded network.
-N-level: Drivecon EMC solution is adopted to fit for Second Environment and products will be used in EU when local power supply system is the grounded network.
-0-level: No Drivecon EMC solution is adopted, products can be used in either EU or other market areas when local power supply system is the non-grounded network.

2.10.2 Fulfilled EMC-standards

Immunity All XS products fulfil the immunity requirements defined in the EN 61800-3 Amendment 11 (2000) for the second environment.

Emissions XS N level products fulfil the emission requirements (lower than specification) of the EN 61800-3 A11 2000 for the second environment.

3 INSTALLATION

3.1 Power cabling

3.1.1 Shielded motor cable

In a crane application XS fulfills EN61800-3/A11 - second environment radiated emission requirements without shielded motor cable. In the second environment, shielded motor cable is recommended to be used in fixed installations, especially in buildings. However motor cables in crane and festoon power supplies are typically not shielded due to the practical reasons.

3.1.2 Double collectors

If the power is supplied to the crane via conductor rails, double collectors are necessary. This ensures a reliable contact with the rail in all circumstances. Short interruptions and sparks between the conductor rail and the collector may cause nuisance tripping or other undesired operations and even cause permanent damage to components.

3.1.3 4th Ground conductor

The power supply to the crane should contain a ground conductor. This ground conductor ensures that there is a reliable connection between the crane ground and earth ground. Without this ground conductor, the crane must rely on the ability of the bridge wheels to conduct ground currents through the bearings. This situation can cause instability in the crane's power supply and premature stress to the inverter components. NEC regulations require the use of a 4th ground conductor for all new installations beginning January 2005.

3.1.4 Cable selection

Cabling for XS can be done using normal crane cables. All the cables must be dimensioned according to local regulations. Ambient temperature, cabling method (size of bunches etc.) and allowable current for the cable in use must be taken into consideration. If there are no other regulations, following values can be used (three phase 480V supply).

The table below is based on ED ≤ 60% (60% duty cycle) and an ambient temperature of +40°C (104°F). A higher ambient temperature may require increased cable sizes. Also, cable lengths greater than 160ft. may require increased cable sizing. The input current does not exceed the continuous current (Icont) of XS, so it is selected to be the dimensioning current. If the actual load current is below the inverter's rated current, then the fuses and the motor cables may be dimensioned according to the load current. Otherwise the inverter rated current is used as the dimensioning current.

Power class			**4005**	**4010**	**4013**	**4018**	**4024**	**4032**	**4042**	**4048**
Continuous current	**I_{CONT}**	**A**	5.0	10	13	18	24	32	42	48
Max motor cable length		**m**	50	50	50	50	50	50	50	50
		Ft	160	160	160	160	160	160	160	160
Motor cable	**104°F**	**AWG**	14	14	14	14	12	10	8	6
Braking resistor cable	**104°F**	**AWG**	14	14	14	14	14	14	10	6

3.1.5 Cable length

The maximum motor cable lengths in the preceding table are based on 150% of inverter rated current (=current during acceleration) and a 2.5 % voltage drop in the cable. For longer cables, the required conductor cross sectional area A (mm2) is given by the formula below.

$A = (2.43 \times l \times 1.5 \times I_F) / (p \times U)$

where l is the cable length (m)
I_F is the motor current (A) at shaft power P_F
p is the allowed voltage drop in %
U is the nominal motor voltage

3.1.6 Cable Protection

To protect the supply cables against short circuit there must be fuses or motor circuit breakers (MCCBs) installed at the supply end of the cable. Dimensioning of the fuses or MCCBs depends on the cable used and on the type of primary fuses or MCCBs. If there are no other regulations, the values given in this section can be used to dimension fuses (three phase 480V power supply).

The overload protection of XS protects both the supply and the motor cables. The supply fuses provide the short circuit protection.

3.1.7 Du/dt filters

Du/dt filters should be used also in IT-network.

3.1.7.1 XS 4005 – 4010

- Motors are not made for inverter use
- XS inverter is not mounted on the crane
- Number of motors is greater than 2
- Total motor cable length is over 100m (330ft)

3.1.7.2 XS 4013 – 4048

Du/dt filter at motor supply is needed if

- Motors are not made for inverter use
- XS inverter is not mounted on the crane
- Number of motors is greater than 4
- Total motor cable length is over 200m (660ft)

3.2 EMC compatible grounding

3.2.1 Construction connections

All metal construction parts of the enclosure must be electrically connected to each other using largest possible surface area to ensure proper grounding. Paint to paint connection must not be used.

3.2.2 Cable connections

Control cables and power cables should be separated and routed separately for eliminating noise coupling. The distance between braking resistor cables and the other cables should be kept as large as possible. The distance between the resistor cables should be kept as short as possible to prevent antenna behavior. Cable lengths should be kept as short as possible to minimize coupling capacitances and inductances.

-Du/dt filter should be installed as close as possible to XS.
-All control cables must be placed as far as possible from the motor and braking resistor cables.
-Take care of the necessary cooling/heating to ensure that the ambient temperature of XS is within –10C to +50C if it is installed in a harsh environment.

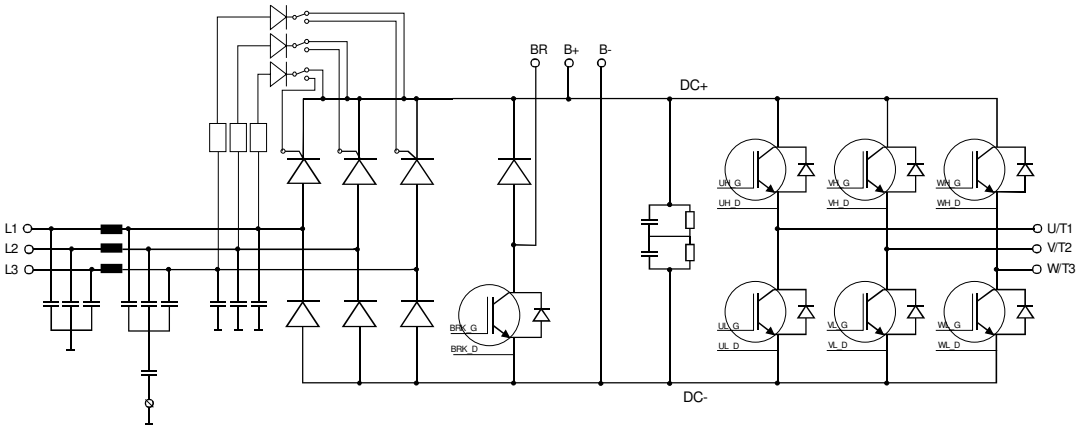
4 COMPONENTS

4.1 Inverter

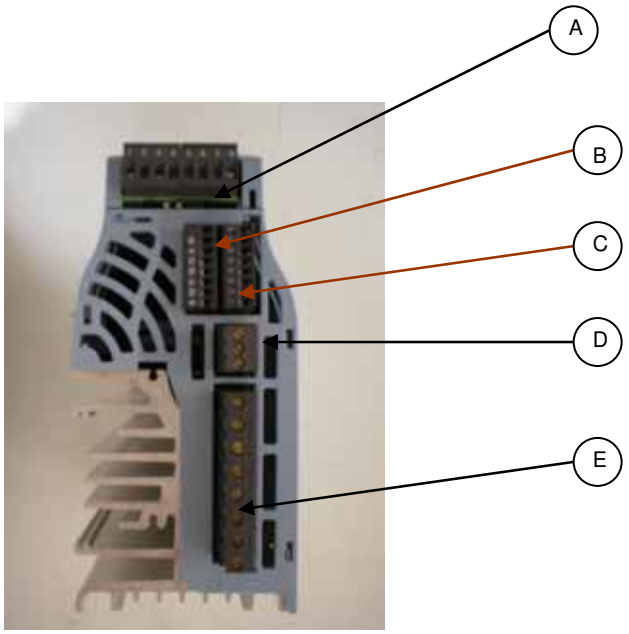
Inverter (XS) includes a Power supply unit (PSS) and a Control unit (CSS), which are connected through a pin connector. PSS includes supply, brake resistor and motor connections. IGBTs are located within the PSS. Microprocessors and Application Special Integral Circuit (ASIC) Chip are located within the CSS.

XS Series	I_{in} (A)	I_{max} at 1min IA)	Weight kg	Weight lbs
XSd4005	5.0	7.6	1.9	4
XSd4010	10	15	5	11
XSd4013	13	20	8.1	18
XSd4018	18	27	8.1	18
XSd4024	24	36	8.1	18
XSd4032	32	48	18.5	41
XSd4042	42	63	18.5	41
XSd4048	48	72	18.5	41

Example main circuit diagram of the XS



In the XSd4005 the PSS and CSS are integrated into the same unit, in all of the other drive sizes the PSS and CSS are separate units. This is illustrated in the pictures shown below.



XSd4005 terminal location and connections

	Terminal description
A	Digital input terminal, Pins E1 through E8
B	Analog Output terminals
C	Analog Input terminals, pins 1 through 8
D	ROA1 Programmable Relay Pins 21,22, and 23.
E	Power terminals

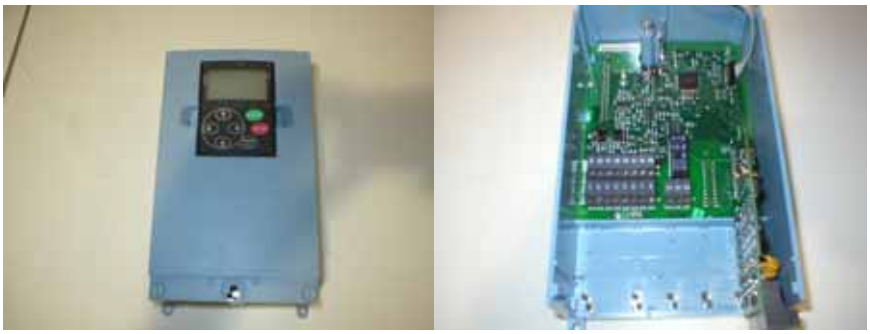
4.1.1 Power supply unit (PSS)

Power supply unit (PSS) includes the main circuit components. PSS has connectors for supply cables, motor cables and braking resistor cables. PSS also includes a connector for CSS-connection. The picture shown below illustrates the power I/O terminals grouped together and the pin connector for communication with the CSS on the other end of the drive.

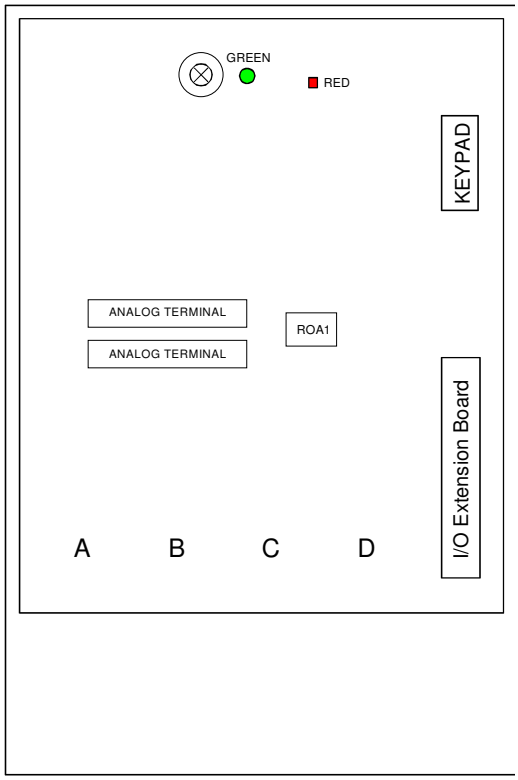
Main supply voltage terminals	
L1	Mains L1
00	Mains L2
L3	Mains L3
PE	Protective earth (Ground)
DC-bus terminals	
B-	DC-bus negative (XSd4010-XSd4048)
B+	DC-bus positive (XSd4010-XSd4048)
R-	Brake resistor negative (XSd4010-XSd4048)
BR+	DC-bus positive / Brake resistor positive (XSd4005)
BR-	Brake resistor negative (XSd4005)
Motor output voltage terminals	
U/T1	Motor U/T1
V/T2	Motor V/T2
W/T3	Motor W/T3

4.1.2 Control unit (CSS)

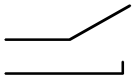
Control unit (CSS) includes a control board with one board slot for an option boards and a control keypad for parameter adjustments. The XS uses only the E slot and is used to connect to an I/O extension board. The CSS is connected to PSS through a connector. The pictures shown below illustrate the layout of a CSS. The pin connector for communication with the PSS is on the bottom of the unit.

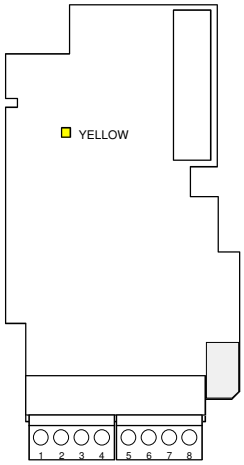


Red	Status
OFF	Everything is OK.
ON	Fault
blinking	In process of downloading software.



4.1.3 I/O Extension board

NXOPTB9 / I/O Extension board		ID: 52305691	
Terminal	**Signal name**		**Description**
1	DID1		42-240VAC 50/60Hz
2	DID2		42-240VAC 50/60Hz
3	DID3		42-240VAC 50/60Hz
4	DID4		42-240VAC 50/60Hz
5	DID5		42-240VAC 50/60Hz
6	COM		Common for DID1-DID5
7	ROD1		Relay output, 250V 8A, normal open For brake contactor control
8	ROD1		



LED	Blinking	Status
Yellow	0.25Hz	OK
Yellow	4Hz	Board internal fault or communication fault with control unit

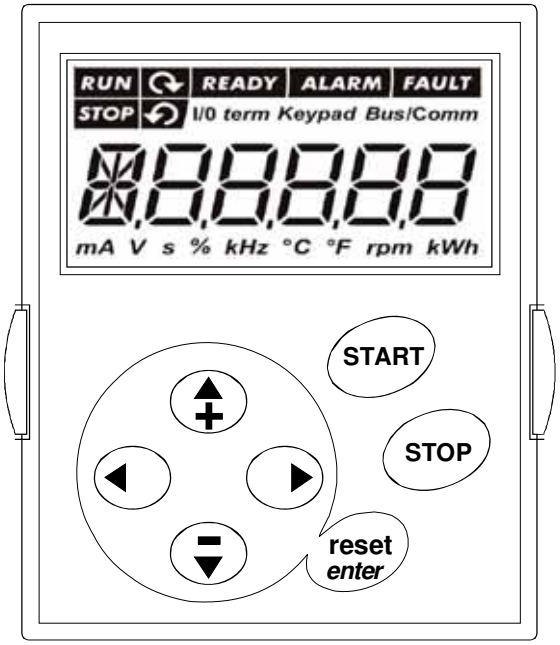
4.2 Control voltage transformer

Power of control voltage transformer has to be n x 50VA + 50VA (min. 250VA), n = number of inverters. This power does not have to be added to other additional transformer requirements.

5 PARAMETER ADJUSTMENTS

5.1 The display panel

The display panel is used for:
- *Displaying the drive identification, electrical values, operating or fault parameters*
- *Altering the parameter settings*



Meaning of the displays:

Drive status indications:

RUN	Motor is running, blinks when ramping down.
	Direction of motor rotation.
STOP	Motor is not running.
READY	Power is on. In case of a fault, the symbol will not light up.
ALARM	Drive is running outside of certain limit.
FAULT	Fault is active

Control place indications:

I/O term	I/O-terminals are the selected control place
Keypad	Keypad is the selected control place (not used)
Bus/Comm	Control through Profibus is selected (not used)

Button description

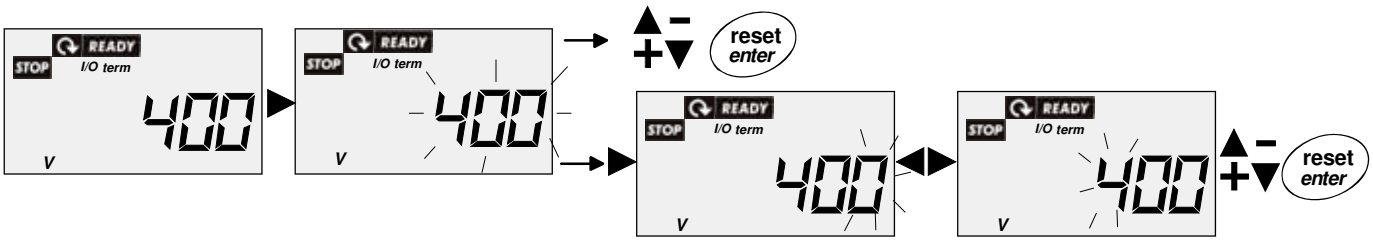
	Browse the main menu and the pages of submenus Edit values
	Move in menu Move cursor Enter and exit edit mode
START	Start button
STOP	Stop button
reset *enter*	Active faults reset / Fault history reset /Confirmation of selections

5.2 Navigation on the control keypad

5.2.1 Editing numerical settings

WARNING! Changing parameter settings during running may cause a hazardous situation. Parameter settings must not be changed during running.

a. Pushing ▶ button takes you into the edit mode. As an indication, the parameter value starts to blink.
b. Two different methods are available to change values.
One is to set with ▼▲ buttons till your desired value,
Another is to select desired digit and edit it. First push ▶ button, the digit before decimal point will blink, then use ▶◀ buttons to select desired digit, set value with ▼▲ buttons.
c Accept and exit with the "reset/enter" button.



5.3 Monitor Parameter

In the monitor parameter parameter V2.3. there is one digit for each input. 1 = There is voltage in input = input is active, 0 = There is no voltage in input = input is not active

5.4 Storing and restoring parameters

5.4.1 User parameters

- File "User parameters" is stored in the inverter's control unit.
- User parameters should be saved after *final set up.*
- The entire customized parameter set can be stored with parameter P3.3.1 by selecting option 1(=Store user parameters)
  - Select Option number 1, then press "Enter"
- User parameters can be reloaded with parameter P3.3.1 by selecting option 2 (=Load user parameters).
  - Select Option number 2, then press "Enter"
- *After reloading a parameter set, always check the motor parameters.*

5.4.2 Factory parameters

- File "Factory parameters" is stored in the inverter's control unit.
- Factory parameters are saved at the factory according to the order and they should not be changed, the values are the same as those in parameter list delivered with inverter.
- Factory parameters can be reloaded with parameter P3.3.1 by selecting option 4 (=Load factory parameters).
  - Select Option number 4, then press "Enter"
- After reloading a parameter set, always check the motor parameters.

5.5 Motor parameterization

There are two different ways to set up motor parameters.

- The motor can be selected from the motor list at parameter P1.2.2. (default values can be checked from Chapter "Factory parameters"). All motor parameters of these motors are stored in the inverter memory. If motor selection parameter is changed to the value 1 “Free Travel”, these parameters can be changed
- Parameters may be set up manually or by Autotuning. Autotuning sets U/f curve, torque boost and current limit.

5.5.1 Voltage at low frequencies (U/f- curve)

Following parameters need to be set for U/f setting. For listed motors, values of these parameters are stored into the inverter memory, but they can also be set manually or by Autotuning. The manual setting procedure is as follows:

Starting values

				Value
U_N	P1.2.1	Motor nominal voltage	From motor nameplate	V
f_N	P1.2.4.1	Motor nominal frequency	From motor nameplate	Hz
I_N	P1.2.4.2	Motor nominal current	From motor nameplate	A
R_S	Not a parameter	Stator resistance of motors + cable resistance	Resistance between phases. Measured on disconnected motor cable ends at terminal X1.	Ohm
I_0	P1.2.4.3	Flux current	From motor nameplate (if not available, set to value 0,5*I_N)	A
U_{f0}	P1.2.5.1	Zero frequency voltage % of nominal voltage (voltage at 0Hz)	$\frac{100 * R_S * I_0}{U_N}$	%
U_{mid}	P1.2.5.2	Midpoint voltage % of nominal voltage (voltage at f_{mid})	$1{,}41 * U_{f0}$	%
f_{mid}	P1.2.5.3	Midpoint frequency	$\frac{U_{f0} * f_N}{100}$	Hz

If several motors are connected in parallel, the correct value of R_S is the resistance of one motor divided by the number of motors. The correct value of I_N and I_0 are the value of one motor multiplied by the number of motors.

5.5.2 Midpoint voltage adjustment

- Check that there is no load on the crane.
- Set minimum speed for both directions (P1.1.4) to value f_{mid}.
- Drive at maximum speed and check the motor current from parameter V2.5.
- Drive at minimum speed. Motor current should be approximately average of measured maximum speed current and the I_N.
- Adjust value of parameter U_{mid} (P1.2.5.2) until current at minimum speed (= f_{mid}) is within desired range.

5.5.3 Zero frequency voltage adjustment

- Set minimum speed for both directions (P1.1.4) to value 0.5 * f_{mid}.
- Drive at minimum speed. Motor current should be approximately average of measured maximum speed current and the I_N.
- Adjust value of parameter U_{f0} (P1.2.5.1) till current at minimum speed (=0.5 * f_{mid}) is within desired range

5.5.4 Test run

- Set minimum speed for both directions (P1.1.4) to desired minimum speed.
- Drive at minimum speed with nominal load to both directions.
- If motor is not driving at minimum speed, increase values of parameters U_{f0} and U_{mid}, then continue from Midpoint voltage adjustment.

If the main girder is new, it might be necessary to drive trolley several times with no load from end to end, before beginning of u/f-curve tuning.

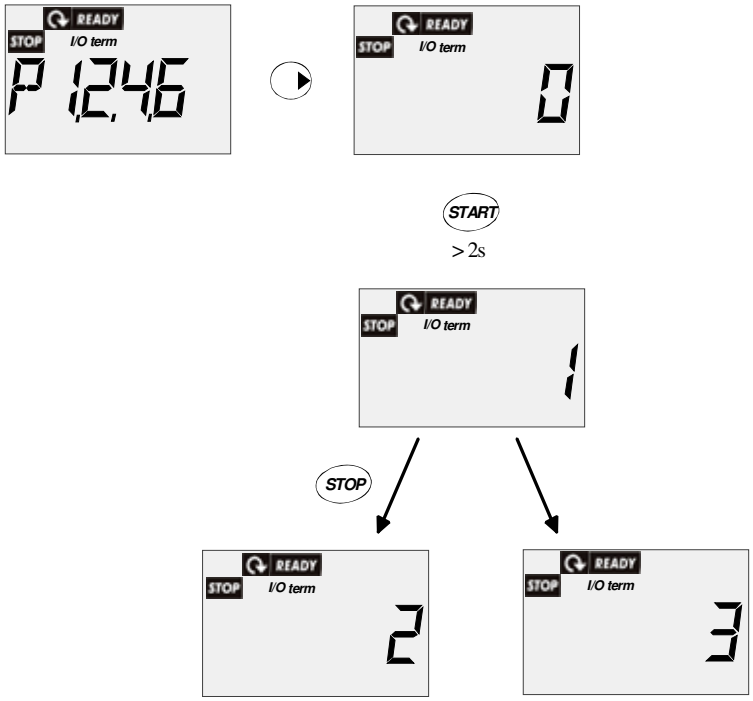
Check minimum speed from the crane calculations. Minimum speed is not allowed to be under nominal slip S_n

S_n = [(synchronous speed – nominal speed) x nominal frequency] / synchronous speed

5.5.5 Autotuning

Before Autotuning,

- *Check that there is no load on the crane.*
- *Set P1.1.1. "Password" = 2156*
- *Set P1.2.2 "Motor selection" = 1 "Free Travel"*
- *Set Motor nameplate values P1.2.1, P1.2.4.1- P1.2.4.3*
- *If value of P1.2.4.3 "Nom Flux Curr" is not available, set value to 50% of motor rated current*
- *If value of P1.2.4.5 "Motor Cos Phi" is not available, do not change it from its default setting.*
- *Check motor connections*



- *Go to parameter P1.2.4.6*
- *Push Start over 2 seconds to start Autotuning*
- *Autotuning can be terminated pushing Stop-button.*
- *Autotuning values will be accepted automatically if Autotuning did not fail or was not terminated.*

- *A- Check connections and Motor Set selection*
- *B- Do Autotuning?*
- *C- Autotuning succeed?*
- *0- No*
- *1- Yes*

- *When parameter P1.2.4.6 has value "3", Autotuning has completed successfully.*

Autotuning will set open loop U/f-curve, RsVoltageDrop, torque boost and current limit parameters automatically.

Parameter number	Parameter name
P1.2.5.1	Zero Freq Volt
P1.2.5.2	U/f Mid Volt
P1.2.5.3	U/f Mid Freq
P1.2.5.4	Torque boost => on
P1.2.5.7	Rs Voltage Drop
P1.2.4.4	Current Limit

The explanations on Autotuning parameter P1.2.4.6 is as follows:

Parameter number	Parameter name	Description	
P1.2.4.6	Autotuning	0	Autotuning has not been done
		1	Autotuning in progress
		2	Autotuning has been failed
		3	Autotuning values has been accepted
		4	Autotuning values has been modified

6 PARAMETER DESCRIPTIONS

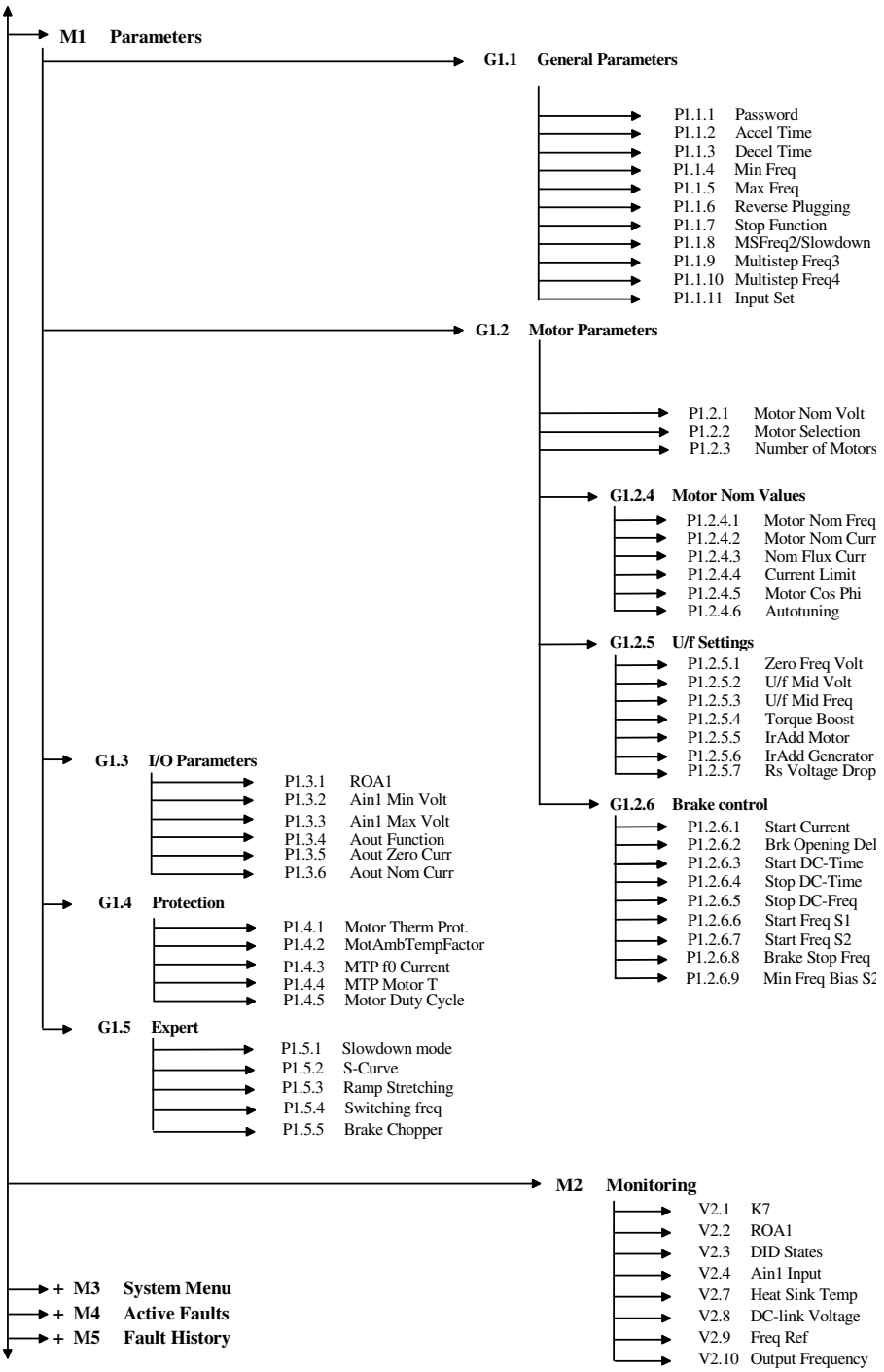
This manual describes the parameters for software version D2S2V050. Underneath the display, there is sticker for software version.

6.1 General Description

Parameters are assorted to Groups. All Groups are not always listed in control panel. Groups are shown in the control panel according to password level and selected functions. This feature makes the viewable parameter menu simple and only needed parameters are shown.

Letter front of the code number describes variable type

P	**=**	**Parameter**
G	**=**	**Group**
V	**=**	**Value**
M	**=**	**Menu**
S	**=**	**System**
F	**=**	**Active Fault**
H	**=**	**Fault History**



6.2 Parameter descriptions

P1 Parameters

G 1.1 General Parameters					
Code	Name	Min	Max	Unit	Description
P1.1.1	Password	0	9999		The password 2156 makes group G1.3 visible
P1.1.2	Acceleration Time	0.0	20.0	s	Time it will take to accelerate from zero to the set maximum frequency
P1.1.3	Deceleration Time	0.0	20.0	s	Time it will take to decelerate from max frequency to zero.
P1.1.4	Minimum Freq	0.00	Max freq	Hz	The set minimum operating frequency. Must be above motor slip frequency.
P1.1.5	Maximum Freq	Min freq	120.00	Hz	The maximum frequency may not be higher than the motor nominal frequency for listed motors.
P1.1.6	Reverse Plugging	50	100	%	See *Chapter "Reverse plugging"* Default value is 100%.
P1.1.7	Stop Function	0	1		Stopping mode selection 0 = Brake 1 = Ramping (default) Ramping: When the drive command is switched off the motion is stopped according to the set deceleration ramp. Brake: When the drive command is switched off the motor current is cut off, then the motion is stopped by the mechanical brake.
P1.1.8	MSFreq2/Slowdown	0	120	Hz	Slowdown frequency and Multistep frequency2, - Setting “120 Hz” equals maximum frequency, - if the setting is lower than minimum frequency then it equals the minimum frequency
P1.1.9	Multistep Freq 3	0	120	Hz	3rd preset speed. - Setting “120 Hz” equals maximum frequency, - if the setting is lower than minimum frequency then it equals the minimum frequency
P1.1.10	Multistep Freq 4	0	120	Hz	4th preset speed. - Setting “120 Hz” equals maximum frequency, - if the setting is lower than minimum frequency then it equals the minimum frequency
P1.1.11	Input set	0	7		Control mode selection, see *Chapter "control methods"* 0 = MS2 (stop-limit) 1 = MS2/MS3 (slow-limit) 2 = EP2 (stop-limit) 3 = EP2 (slow-limit) 4 = EP3 5 = MS4 6 = MS5 7 = AU (Ain)
G1.2 Motor Parameters					
Code	Name	Min	Max	Unit	Description
P1.2.1	Motor Nominal Voltage	200	500	V	Nominal motor voltage (Un) from motor nameplate.
P1.2.2	Motor Selection	0	13		0 = Not Used 1 = Free Travel (see Note 1) 2 = MF06MA100 3 = MF06MA200 4 = MF06LA100 5 = MF06LA200 6 = MF06LA20P 7 = Not Used 8 = Not Used 9 = Not Used 10 = Not Used 11 = Not Used 12 = Not Used 13 = Not Used (see Note 2) **Note 1:** when one of listed motors is selected, Parameters group G1.2.4, G1.2.5 and G1.2.6 are not viewable. Parameters group G1.2.4, G1.2.5 can be viewed after P1.2.2 is set back to 1 ‘‘free travel’’. **Note 2:** Parameters group G1.2.6 “Brake Control” can only be viewed when Parameter P1.2.2 is set to 13.
P1.2.3	Number of Motors	0	10	pcs	The parameter is not active if P1.2.2 is set to 0, 1

G1.2.4 Motor Nominal Values. These parameters can only be viewed if parameter P1.2.2 is set to 1 "free travel."					
Code	Name	Min	Max	Unit	Description
P1.2.4.1	Motor Nominal Frequency	0.00	120.00	Hz	Nominal motor frequency (fn) from motor nameplate
P1.2.4.2	Motor Nominal current	0.0		A	Disc brake motors: Number of motors * In (Motor nominal current) Compact brake motors: Number of motors * In or Number of motors * 2,3A, if In<2,3A DC-current during starting = Motor Nominal current P1.2.4.2. * Start DC factor P1.2.6.1 DC-current during stoping = Motor Nominal current P1.2.4.2.
P1.2.4.3	Motor Nominal Flux Current	0.0		A	Motor nominal flux current (Io), same as no-load current or magnetizing current from motor nameplate. In multimotor drives nominal flux currents must be summed up. If no information is available from the nameplate, set to 50% of the total motor nominal current.
P1.2.4.4	Current Limit	0.0		A	Defines the maximum motor current from the inverter. If the output current exceeds the value set in parameter P1.2.4.4 the output frequency is lowered until the current drops below the current limit. Typical value is 1.5 times motor(s) nominal ($1.5xI_n$). In multimotor drives nominal currents must be added together. **Must not be set over inverters max 1 min. current.**
P1.2.4.5	Motor Cos Phi	0.00	1.00		From motor nameplate (Power factor). Only used if Motor Nominal Flux Current P1.2.4.3 is set to 0.
P1.2.4.6	Autotuning	0	4		See *Chapter "Autotuning"* 0 = Not Done 1 = Tuning 2 = Failed 3 = Done 4 = Modified
G1.2.5 U/f Settings. These parameters can only be viewed if parameter P1.2.2 is set to 1 "free travel."					
Code	Name	Min	Max	Unit	Description
P1.2.5.1	Zero Frequency Voltage	0.00	40.00	%	Output voltage at zero frequency, % of motor nominal voltage.
P1.2.5.2	U/f Middle point Voltage	0.00	100.00	%	Voltage in the selected middle point frequency, % of motor nominal voltage.
P1.2.5.3	U/f Middle point Frequency	0.00	120.00	Hz	Middle point frequency.
P1.2.5.4	Torque Boost	0	1		Torque maximization 0 = Off 1 = On Torque boost is adjustable with parameters P1.2.5.5 "IrAdd Motor" and P1.2.5.6 "IrAdd Generator" when "Free Travel" is selected with parameter P1.2.2 "Motor Selection"
P1.2.5.5	IrAdd Motor	0	100	%	With small speeds and heavy load the drive may not have enough voltage to produce sufficient torque. Raising the value of parameter increases the voltage. Default value is 30% in travellling .
P1.2.5.6	IrAdd Generator	0	100	%	If motor voltage at generator area is too high, reducing value of parameter decreases the voltage. Default value is 50% in travelling.
P1.2.5.7	Rs Voltage Drop	0	512		Relative value of motor stator impedance voltage drop. Value of this parameter is calculated by formula given below. $\frac{\text{Motor Nom Flux current x Measured motor resistance (phase to phase) x 2217}}{\text{Motor nominal voltage}}$
G1.2.6 Brake Control. These parameters can only be viewed if parameter P1.2.2 is set to 13.					
Code	Name	Min	Max	Unit	Description
P1.2.6.1	Start DC-Factor	0	200	%	To adjust DC-current during starting. See P1.2.4.2 Travelling with disc brake motors 80%.
P1.2.6.2	Brake Opening Delay	0.00	10.00	s	Defines the opening delay of mechanical brake. "Start Freq S1" or "Start Freq S2" is commanded during "Brk Opening Del". After delay, output frequency increases according to the acceleration parameters. Default 0.05s
P1.2.6.3	Start DC-Time	0.00	5.00	s	Defines duration of the "Start Current"
P1.2.6.4	Stop DC-Time	0.00	5.00	s	Defines the function and the duration of the DC-braking time when stopping the motor. If "Stop DC-Time" = 0 the DC-braking is not used.
P1.2.6.5	Stop DC-Frequency	0.00	250.00	Hz	Defines the DC-braking starting frequency
P1.2.6.6	Start Frequency S1	0.0	100.0	%	Defines the output frequency during brake opening delay in the S1 direction.
P1.2.6.7	Start Frequency S2	0.0	100.0	%	Defines the output frequency during brake opening delay in the S2 direction.

P1.2.6.8	Brake Stop Frequency	0.00	Max Freq	Hz	Defines the output frequency when the relay output ROD1 for brake control opens during stopping
P1.2.6.9	Minimum Frequency Bias S2	0.00	Min Freq	Hz	Helps to define the Minimum frequency in reverse direction for hoisting. Minimum frequency in reverse direction is “Min Frequency” - “Minimum Frequency Bias S2”.

G1.3 I/O Parameters					
Code	Name	Min	Max	Unit	Description
P1.3.1	ROA1	0	12		Selection of relay output ROA1 function (See *Chapter "Relay output"*) 0 = Not Used 1 = Fault 2 = External Brake Control 3 = Run, current is fed to the motor (default) 4 = Drive is ready to operate 5 = Drive is NOT ready to operate 6 = Fan. DC-link voltage is above braking chopper operating value –70V. Relay is closed minimum 300s. 7 = Emergency Stop, relay is activated in case of faults F1 Overcurrent, F2 Overvoltage, F3 Earth Fault. Relay is deactivated when the power is switched off. 8 = Reverse Plugging. Direction request is different than direction of actual frequency. 9 = At Speed. The Drive has reached the speed reference request. 10 = S2 Active. Motor actual speed direction is S2. 11 = Temp1. Relay is activated when temperature is 20ºC (68F) or below. Relay is inactivated when temperature is 23ºC (73F) or above. 12 = Temp2. Relay is activated when temperature is 40ºC (104F) or above. Relay is inactivated when temperature is 37ºC (98F) or below.
P1.3.2	Ain1 Minimum Voltage	0.000	10.000	V	Minimum value of analog input Ain1 for AU-control
P1.3.3	Ain1 Maximum Voltage	0.000	10.000	V	Maximum value of analog input Ain1 for AU-control
P1.3.4	Aout Function	0	5		0 = Not Used 1 = Motor Freq (100%*Normal Motor Frequency) 2 = Motor Curr (100%*Normal Motor Current) 3 = Motor Volt (100%*Normal Motor Voltage) 4 = DC-link Volt (1000V) 5 = MotorFreqABS (Absolute value of Motor Frequency)
P1.3.5	Aout Zero Current	0.00	Aout Nom Curr	mA	
P1.3.6	Aout Nominal Current	Aout Zero Curr	100.00	mA	
G1.4 Protection					
Code	Name	Min	Max	Unit	Description
P1.4.1					0 = Default value 1 = must not be used 2 = must not be used
P1.4.2					Not used
P1.4.3					Not used
P1.4.4					Not used
P1.4.5					Not used
G1.5 Expert					
Code	Name	Min	Max	Unit	Description
P1.5.1	Slowdown Mode	0	2		0 = Slow 1 = Fast 2 = Fast Power Up (default) See *Chapter "Slowdown-limit operation.*"
P1.5.2	S-Curve	0.00	0.50	s	The start and end of the acceleration and end of deceleration ramp can be smoothed with this parameter. Setting value 0.00-0.50 seconds for this parameter produces an S-shaped acceleration/deceleration. Default value is .2s.
P1.5.3	Ramp Stretching	0.00	50.0	%	See Chapter "*Ramp Stretching.* Default value is 0%
P1.5.4	Switching Frequency				Must not be changed from factory setting
P1.5.5	Brake Chopper				1 (default) Must not be changed

M2 Monitoring					
Code	Name	Min	Max	Unit	Description
V2.1	K7	0	1		State of relay output ROD1, which controls brake contactor
V2.2	ROA1	0	1		State of relay output ROA1
V2.3	DID states	.00000	.11111		State of digital input DID1-DID5
V2.4	Ain1 Input	0.00	10.00	V	Value of analog input Ain1
V2.5	Motor Current			A	Measured motor current
V2.6	Motor Voltage			V	Calculated motor voltage
V2.7	Heat Sink Temperature			℃	Temperature of heat sink.
V2.8	DC-link Voltage			V	Actual value of measured DC bus voltage.
V2.9	Frequency Reference			Hz	Frequency that the drive is being commanded to run to or stay running at.
V2.10	Output Frequency			Hz	Output frequency to the motor
M3 System Menu					
Code	Name	Min	Max	Unit	Description
S3.3 Copy parameters					
P3.3.1	Parameter sets				0 = Select 1 = Store user parameters 2 = Load user parameters 3 = Store factory parameters (Factory use only) 4 = Load factory parameters 5 = Reset parameters (Do not use) 6 = Fault 7 = Wait 8 = OK
S3.5 Security					
P3.5.2	Parameter lock				0 = Change Enabled 1 = Change Disabled
S3.6 Keypad settings					
P3.6.1	Default page				Display goes to Default page after Timeout time. If value 0 is selected, this feature is not active. Default value 2.10. “Output Frequency”
P3.6.3	Timeout time	0	65535	s	Display goes to Default page after Timeout time.
S3.7 Hardware settings					
P3.7.2	Fan control				0 = Continuous, default 1 = Temperature
P3.7.3					Not used
P3.7.4					Not used
S3.8 System info					
S3.8.1 Counters menu					
C3.8.1.1	MWh counter		KWh		
C3.8.1.2	Operating days Counter		hh:mm:ss		
C3.8.1.3	Operating hours Counter		hh:mm:ss		
S3.8.2 Trip counters					
T3.8.2.1	MWh trip counter		KWh		
P3.8.2.2	Clear MWh trip counter				
T3.8.2. 3	Operating days trip counter				
T3.8.2.4	Operating hours trip Counter		hh:mm:ss		
P3.8.2.5	Clear operating time Counter				
S3.8.3 Software info					
I3.8.3.1	Software package				
I3.8.3.2	System SW version				
I3.8.3.3	Firmware interface				
I3.8.3.4	System load				

S3.8.4 Application info				
A3.8.4.1	Application			
A3.8.4.1.1	Application id			
A3.8.4.1.2	Application version			
A3.8.4.1.3	Firmware interface			
S3.8.5 Hardware info				
I3.8.5.2	Unit voltage			
I3.8.5.3	Brake chopper			
I3.8.5.4	Brake resistor			
S3.8.6 Options				
S3.8.6.1	NXOPT			
E3.8.6.1.1	Status			
E3.8.6.1.2	Program version			
S3.9 (not used)				
S3.10 (not used)				
M4 Active faults				
The memory of active faults can store the maximum of 10 faults in the order of appearance. By pushing the ⊙ button you will enter the Fault history section.				
M5 Fault history				
The fault memory can store a maximum of 5 faults in the order of appearance. The number of faults currently in the fault history is shown on the value line of the main page. The latest fault carries the indication H5.1, the second latest H5.2 etc. If there are 5 uncleared faults in the memory, the next occurring fault will erase the oldest from the memory. Pressing the Enter button for about 2 to 3 seconds resets the whole history.				

6.2.1 Reverse Plugging

When opposite drive command is active while the inverter is operating, the deceleration/acceleration ramp can be shorter than the normal ramp. Reverse plugging function is “on” if the driving frequency > 30% of the “Max Freq.” (not the “Motor Nom Freq”).Reverse plugging function turns “off” in opposite direction to original direction when driving frequency > 95% of reference frequency.
The value can be set between 50 to 100%. 100% corresponds that the ramp is the same as the normal ramp. 50% corresponds that the ramp is a half of the normal ramp. The default value is 100%.

6.2.2 Relay output

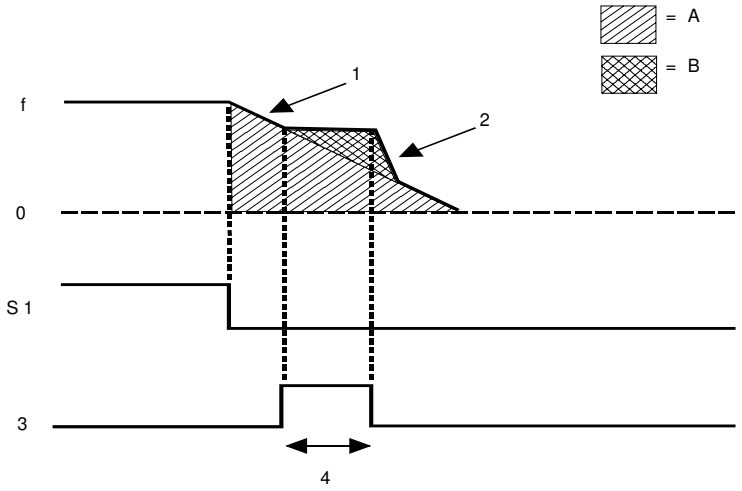
Inverter has one programmable relay output (ROA1) and one relay output for brake control (ROD1). Relay output functions for ROA1 are listed below.

Par value	Name	Description
0	Not Used	
1	Fault	Relay is activated when fault is on.
2	Brake Control	External brake ON/OFF-control. Default value in relay output ROD1 (K7 control).
3	Run	Relay is activated when current is fed to motor.
4	Ready	Relay is activated when Drive is ready to operate.
5	Ready Inverted	Relay is activated when Drive is not ready to operate.
6	Fan	Relay is activated when DC-link voltage is above braking chopper operating level - 70V. Relay is closed for a minimum of 300s.
7	Emergency Stop	Relay is activated in case of F1 Overcurrent, F2 Overvoltage or F3 Earth Fault. Relay is deactivated when the power is switched off.
8	Reverse Plugging	Relay is activated when direction requested is different than direction of actual frequency.
9	At Speed	Relay is activated when ramp generator output has reached speed reference request.
10	S2 Active	Relay is activated when motor actual speed direction is S2.
11	Temp 1	Relay contact is activated when temperature is 20°C (68F) or below. Relay is inactivate when temperature is 23°C (73F) or above.
12	Temp 2	Relay contact is activated when temperature is 40°C (104F) or above. Relay is inactivate when temperature is 37°C (98F) or below.

6.2.3 Ramp stretching

The inverter allows stretching the ramp on the generating side. The ramp stretching is adjustable as percentage of nominal deceleration time. The default stretch of the normal ramp is 0% of the nominal deceleration distance.

If the inverter cannot stop with the set ramp stretching, it will stop using the electromachanical brake and show fault code F56 Generator side current limit.



1. Normal ramp
2. 0.5s ramp
3. Current limit
4. Motor current at current limit level

7 START-UP PROCEDURE

If any problems or malfunctions occur during the start-up, refer to *Chapter "Troubleshooting"* for tips on determining the reason. All problems must be resolved before continuing.

Warning! High voltages inside device. Wait for at least five minutes after the supply voltage has been switched off before service actions. Display in operating condition (lights on) indicates a dangerous voltage on the DC-bus. When display turns off, the DC-bus voltage is about 100V. Note also that there is a dangerous voltage in the braking resistor always when the DC-bus is charged.

Do not connect any voltage to the output terminals (U, V, W). Doing so will cause the inverter to be damaged.

The overload protection protects both the supply and the motor cables. The supply fuses provide short circuit protection.

7.1 Visual checks

- *Check condition of cubicles.*
- *Check that serial number of the drive is the same as in delivery documents.*
- *Check the cabling to braking resistor.*
- *Check the cabling to motor, brake, thermistors (and speed sensor).*
- *Check motor type.*
- *Check the wire terminations in the motor connection box*
- *Check connections for motor thermistors/ thermostat and brake wear.*
- *Disconnect motor (U, V, W) and brake cables to prevent damage of inverter. Measure insulation resistance of brake coil and motor windings (each phase to ground).*
- *Re-connect motor and brake cables.*

7.2 Checks before the first test run

- *Check power supply voltage (nominal voltage +/- 10%).*
- *Check control voltage (nominal voltage +/- 10%).*
- *Make sure that run commands are off (pushbuttons / controller (master switch) at zero position).*
- *Turn on power from main switch and control voltage switch.*
- *Within about 1 second the control panel should have display.*
- *In a fault situation the red FAULT status indicator blinks and the display shows a fault code instead of frequency.*
- *Check that green RUN status indicator is off.*
- *Check that external connections and selected control parameters are according to application.*

7.3 Check motor parameters

In most cases parameters are properly set after factory tests and no adjustments are needed except for the parameters that depend on the application. In case the factory did not have information about the motors, motor related parameters need to be adjusted with the following steps. Write down on the parameter list all the values that have been changed and at the end save parameters to User parameters, see Chapter *"*User parameters*"*.

If correct motor type is selected at the factory (parameters P1.2.1. & P1.2.2. & P1.2.3.), calculated values for u/f-curve parameters are also stored as default. In some cases the factory set parameters do not give the best result, then u/f-curve tuning should be done. See *Chapter "Voltage at low frequencies (U/f curve)".*

If motor type is not marked on the parameter list, set motor nominal values to parameters P1.2.1, P1.2.4.1 – P1.2.4.3. according to the motor nameplate. After that, perform Autotuning. See *Chapter "Autotuning".*

7.4 Test run without load

- *Make sure that movement will not cause any danger to the environment or to the crane itself. Avoid driving close to the limit areas.*
- *Check limit switches manually if possible.*
- *Check the run commands on the display panel and correct the traveling direction. The arrow rotates clockwise if S1 is applied and counter-clockwise if S2 is applied.*
- *Drive direction S1 at minimum speed for 5 to 10 seconds. Accelerate to full speed. Run 5 to 10 seconds. Stop. Repeat the same in direction S2. Check the frequency display to make sure that the frequency changes through the whole operational frequency range from minimum to nominal speed.*
- *Check motor operation (acceleration, deceleration and braking): accelerate to full speed direction S1, change to full speed direction S2 and full speed direction S1 again and stop.*
- *Check limit switch functions: drive direction S1 slowly and check the limit switch operations. Re-check using full speed. Repeat the same check for direction S2.*

7.5 Test run with load

- *Make sure that movement will not cause any danger to the environment or to the crane itself.*
- *Drive in both directions at minimum and maximum speeds.*

7.6 Test run with overload

If an overload test has to be performed during crane commissioning, minimum frequency should be raised for duration of the commissioning to 20Hz. Minimum frequency can be changed with parameters P1.1.4. After testing, minimum frequency should be changed back to its original value.

7.7 After the test run

- *Record all parameter value changes in the parameter list.*
- *Make sure all remarks and setting values are recorded.*

It is recommended to store the parameter settings in file User parameters, see *Chapter "User parameters"*.

8 TROUBLESHOOTING

Warning! High voltages** inside Frequency converter. **Wait for at least five minutes after the supply voltage has been switched off before service actions. The display in the operating condition (lights on) indicates a dangerous voltage on the DC-bus. When display turns off, the DC-bus voltage is approximately 100V. Note also that there is always a dangerous voltage in the braking resistor when the DC-bus is charged.

8.1 Field repair actions

The purpose of troubleshooting and field repair actions is primarily to determine whether the drive or external devices in fact cause the problems. After that, the next step is to detect the possibly damaged components inside the drive. If any damage inside the drive is caused by the environment (motor failure, brake failure, power supply problems etc.) it is very important to repair/change faulty items to prevent reoccurring problems.

The best way to repair a faulty inverter is to replace it with a new one. If the fault can be located, it is also possible to replace some of the components. When replacing an inverter or a Control unit with a new one, the parameter list of the existing drive is needed so that the parameter settings can be copied to new the one.

8.2 Typical functional problems

- *Inverter does not start when mains are connected.*
  - Check main supply voltage between terminal L1, L2 and L3

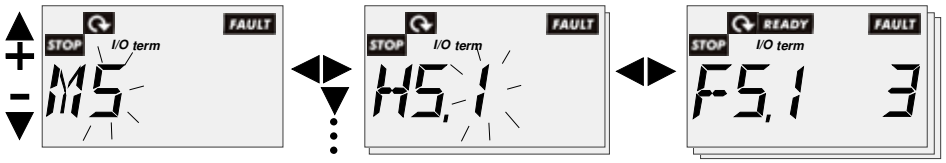
- *Indicator "Ready" is on and indicator "Fault" is off, but motor does not run.*
  - Check control mode selection
  - Check voltage at run command terminals
  - Check state of digital inputs from parameter V2.3
- *Indicator "Ready" is on and indicator "Run" is on, but motor does not run.*
  - Check motor cable connection
- *Motor runs poorly*
  - Check that load is not over nominal
  - Check that all cables are connected correctly and the junctions are reliable
  - Check that all motor dependant parameters are correct
  - Check the voltage of the slowdown limit switch input
  - Check state of digital inputs from parameter V2.3
  - Check that motor's brake opens completely
  - Check that minimum speed parameters do not have too small values
  - For travelling application: check u/f-curve tuning and/or Autotuning. If the main girder is new, it might be necessary to drive trolley several times with no load from end to end, before beginning of u/f-curve tuning and/or Autotuning.
- *Some parameters are not accessible or changing is not possible*
  - Check that password has value 2156
  - Check that parameter value is inside the limits
  - Parameter value can not be changed in RUN state
  - Parameter value change must be confirmed with "Enter" button

8.3 Inverter fault codes

If any of the following failures is found, the inverter displays the fault code and closes the mechanical brake causing the movement to stop. If several faults occur one after another, the latest one is displayed, the others are stored to fault history page.

When inverter fault supervision trips, the FAULT indicator turns on and the blinking fault code "F1 xx" (F1= fault number, xx = actual fault code number) appears on the display.
The drive includes an automatic fault reset operation; the fault code stays on the display until the fault is removed and the controller released back to 0-position. Some of the fault codes require to switch the power off before run is possible, for example F1 (overcurrent).

All faults are stored in the Fault History menu except F51 Stop-Limit, from there they can be seen if necessary. The fault history stores the last 5 fault codes.



Fault code	Fault	Possible cause	Checking
F 1	**Overcurrent**	Inverter has measured too high current (over 4*I_N peak or over 2.8* I_N rms) in the motor output: sudden heavy load increase short circuit in the motor or cable not suitable motor wrong motor parameters	Reset: switch power off and restart after the lamps of display are off. Check: brake operation motor type and power rating parameters motor cable connection motor insulation motor loading
F 2	**Overvoltage**	DC-bus voltage has exceeded 135% maximum level, 911Vdc deceleration time is too short supply voltage raised >1.35 x Un (high overvoltage spikes at mains or not sinusoidal wave form)	Reset has an additional 5s time delay. Check: adjust the deceleration time P1.1.3 longer measure main supply voltage level and wave form while not driving braking resistor cable braking resistor type and resistance braking chopper operation
F 3	**Earth fault**	Current measurement has sensed unbalance in motor phase currents. Supervision level is 5% of inverter nominal current not symmetric load insulation failure in the motor or the cable	Reset has an additional 5s time delay. Check: motor insulation motor cable insulation (phase-ground, phase-phase)
F 6	**External Stop**	ES signal inactive	Check: ES external connections Control mode selection P1.1.11 State of input DID5, V2.3. Thermal protection of motor is normally connected to ES signal, check motor temperature.
F 8	**System fault**	Component failure Faulty operation	Reset: switch power off and restart after the lamps of display are off. If the fault comes again, contact authorized service center.
F 9	**Undervoltage**	DC-bus voltage has dropped below 333Vdc mains supply voltage interrupted inverter fault can also cause an undervoltage trip external fault during run may cause an undervoltage trip	In case of temporary supply voltage break, reset the fault and start again. Check mains input. If mains supply is correct, an internal failure has occurred. Contact Drivecon.

F 11	**Output phase supervision**	Current supervision has sensed that at least one of the motor phases has no current	Check: motor cable connections measure motor phase currents and compare to display value
F13	**Inverter undertemperature**	Temperature of heat sink is below acceptable operating level -10°C (14°F)	Check ambient temperature cubicle heating
F 14	**Inverter overtemperature**	Temperature of heat sink is over acceptable operating level +90°C (194°F). Overtemperature warning is issued when the heat sink temperature exceeds +85°C (185°F)	Check: ambient temperature inverter cooling fan operation cooling air flow through heat sink heat sink is not dirty
F 16	**Motor Overtemperature**	Motor is calculated to be too hot for operation	Check: Brake operation Ambient temperature Motor temperature If motor temperature is not hot, contact Drivecon.
F 22 **F 23**	**EEPROM checksum fault**	Parameter save error interference fault component failure (control unit)	After power off the inverter will automatically reset parameter settings. The drive does not work properly nor enable driving after this fault. Check: all parameter settings. +24V voltage output loading If the fault comes again, contact Drivecon.
F 25	**Microprocessor watchdog-fault**	interference fault component failure (control unit)	Reset: switch power off and restart after the lamps of display are off. If the fault comes again, contact service center.
F 39	**Device removed**	Option board removed.	Reset the fault Check option board connection
F 40	**Device unknown**	Unknown option board or drive.	Check board and drive type.
F 41	**IGBT temperature**	IGBT transistors is calculated to be over heated long duration overload lowered cooling high environment temperature	Reset: switch power off and restart after the lamps of keypad are off. Check: motor loading brake operation inverter heatsink inverter cooling fan operation environment temperature
F 44	**Device changed**	Option board changed.	Reset the fault
F 45	**Device added**	Option board added.	Reset the fault
F 51	**Stop limit**	S12 or S22 signal is inactive	Reset: keep controller at zero >300ms. Check control mode selection P1.1.11 Check the state of inputs DID4 and DID5, V2.3
F 55	**Board fault**	Option board is missing or not working	Reset: switch power off and restart after the lamps of display are off. Check: Option board
F 56	**Generator side current limit**	The inverter cannot stop with the set ramp stretching, it will stop by brake and show F56 Too short deceleration time	Reset has an additional 5 s time delay. Check: deceleration time
F 60	**Parameter fault**	“Motor selection” parameter P1.2.2 has value = “Not Used”	Download parameters again
F 73	**Both drive commands active**	S1 and S2 signals were active at the same time for more than 500ms The inverter stops according “Stop Function” parameter Short circuit in pendent cable	Check: Control wiring

9 TROUBLESHOOTING TABLE

If the drive doesn't work, and the cause of the problem can't be found, write down the following information before contacting Drivecon.

GENERAL INFORMATION	
WORK NUMBER	
CUSTOMER REFERENCE	
DATE PUT IN OPERATION	
DATE OF FAILURE	
SHORT DESCRIPTION OF FAILURE, ERROR CODE	

INVERTER INFORMATION			
TYPE CODE		ACCELERATION TIME, P1.1.2	S
SERIALNUMBER		DECELERATION TIME, P1.1.3	S
CONTROL METHOD, P1.1.11		MIN FREQ, P1.1.4	Hz
EP2		MAX FREQ, P1.1.5	Hz
EP3			
MS			

MOTOR INFORMATION			
TYPE CODE		NOMINAL VOLTAGE	S
SERIALNUMBER		NOMINAL CURRENT	S
		NOMINAL FREQUENCY	
		NOMINAL SPEED	
		POWER FACTOR	

MEASURED VALUES							
INVERTER				MOTOR			
VOLTAGE PHASE-TO-PHASE	L1-L2 Vac	L1-L3 Vac	L2-L3 Vac	NOMINAL CURRENT	U-V Ω	V-W Ω	W-U Ω
VOLTAGE PHASE-TO-GROUND	L1 Vac	L2 Vac	L3 Vac				
MEASURED CONTROL VOLTAGE	V						

10 SERVICE

The drive does not require regular maintenance. However the following actions are recommended:

- *Check fault history*
  - Find out reasons of possible faults
  - Clear the fault history
- *Clean the heat sink*
  - Prevent the dust to spread inside cubicles
  - Lock the fans before blowing compressed air
- *Check that there are no abnormal noises coming from the cooling fan*
- *Tighten all screws and connectors*
- *Clean dust from PC-boards*
- ***Reform DC bus capacitors annually. See description below:***

Drivecon's XS series frequency inverter have large aluminium electrolytic capacitors in their DC bus as do all PWM style inverters. The aluminium electryolitic capacitors are commonly used due to the fact that they have very good capacitance and a very high ripple current capacity. In normal operation, the leakage current of the capacitor is low and is due to a homogeneous dielectric aluminium oxide layer forming on the foil. **If an XS inverter is stored for a long period without an applied voltage, a non-homogeneous layer forms and when the nominal voltage is connected, a high leakage current can exist and cause damage.** This is a typical feature of all aluminium oxide capacitors and is not dependent upon the manufacturer. This means that after a long storage period, the inverter can be damaged if they are put back into service without reforming them. Contact Drivecon technical support for information on the correct reforming procedure.