



BERGES

Operating Instructions **Crane Control Application UD 7000** **(Software Version as of A19.06)**



UD UNIVERSAL Drive
7000

1 Crane Control Application UD 7000 (Software Version as of A19.06)

1.1 Different Crane Applications

The BERGES crane control option has been developed specially for crane or trolley travelling applications.

Besides the work limit settings for the maximum and minimum speed, the extensive crane control function also has switching inputs for speed limitation in the area of the limit switch or safety limit switch.

To achieve complete two axle control (crane and trolley travelling), two inverters are required, one for each axle.

With the aid of the parameter **2C-Application**, it is possible to switch the control terminals of the UD 7000 to the crane control option. Depending on the connected drive profile, a value from the following table must be entered to do this:

2C-Application	Description
200	Crane control with inverter (SL drive)
220	Crane control with field-oriented drive (FO)
250	Crane control with non-generator speed regulation (NFO)
252	Crane control with NFO II

Table 1.1

ATTENTION!

Actual parameter **DF-Crane via PS-Inp** = 0, signifies the "crane control" = standard inverter operation (or standard FO, NFO, ...) with the option of driving "load-dependent maximum frequencies". When the parameter reset (see Chapter 1.3, „Commissioning“) is used, the parameter is set to the value 1.

The following types of contact are used for controlling the individual control inputs:

Control input	Type of contact	Control voltage
FWD	NO contact	+24V
REV	NO contact	+24V
R/J	NO contact	+24V
PS1	NC contact	+24V
PS2	NC contact	+24V
PS3	NC contact	+24V
LIM	NC contact	COM

Table 1.2

1.2 Safety measures

ATTENTION!

- 1) The frequency converter-operated lifting motor is monitored as far as possible by the frequency converter. To prevent damage in the event of a fault occurring, an additional safety switch is required for the brake control.

EXAMPLE:

The maximum frequency (parameter 23) has been programmed from 50 Hz to 100 Hz or higher and the motor loses the torque in the weakening of the field; due to this, the load can pass through. The damage occurring as a result can be prevented by additional monitoring.

HINT!

- 2) The network downtime of the frequency converter must be maintained until the terminal “+24V” has attained 0 volt or the display of the converter has turned dark. Frequent switching on/off of the converter can lead to damage at the charging connection.

1.3 Commissioning

HINT!

The parameter **EA-Reset Parameter** can be used for fast and safe commissioning of a drive with crane control. Enter the same value here which is listed for the parameter **2C-Application** in Table 1.1. Disconnect the device from the network until the display is deactivated and reconnect the network. This results in the most important parameters for the crane control being set in parameter set 1 (see Table 1.4). It is essential that the motor data is subsequently entered and that a test operation (parameter **2A-Test mode**) is carried out according to the drive profile. Please note that the data for the crane control is only located in parameter set 1 after the reset. This data can easily be copied into other parameter sets (parameter **E9-Custom para.set**).

1.4 Functional Description of the “Motorpoti Function (Cylinder Control)”

FWD = Selection of rotation direction, right (forwards).
Save speed.

Parameter selection: 45-Preset speed #5

On initial selection of this input, the drive accelerates to the target frequency under the parameter **45-Preset speed #5** in a forwards direction of rotation. During the acceleration or deceleration, travel is continued with the rotation frequency just attained due to control of this input.

If the drive is operating in a reverse rotation direction when the input is actuated, direction of rotation is reversed and the drive subsequently operates forwards with the **45-Preset speed #5**.

If necessary, these speeds are limited during driving by the limit switch speeds which are entered into the parameters **44-Preset speed #4** (inputs PS1 and PS2) and **43-Preset speed #3** (input PS3).

Simultaneous actuation of the control inputs FWD and REV means Stop.

REV = Selection of rotation direction, left (reverse).
Save speed.

Parameter selection: 45-Preset speed #5

On initial selection of this input, the drive accelerates to the target frequency under the parameter **45-Preset speed #5** in a reverse direction of rotation. During the acceleration or deceleration, travel is continued with the rotation frequency just attained due to the control of this input.

If the drive is running in a forwards rotation direction when the input is actuated, direction of rotation is reversed and the drive subsequently runs backwards with the **45-Preset speed #5**.

If necessary, these speeds are limited during driving by the limit switch speeds which are entered into the parameters **44-Preset speed #4** (inputs PS1 and PS2) and **43-Preset speed #3** (input PS3).

Simultaneous actuation of the control inputs FWD and REV means Stop.

R/J = Acceleration.

Parameter selection: 23-Max. frequency

When selecting the input together with a FWD or REV input, the drive is accelerated by the frequency just attained. The value defined under the parameter **23-Max. frequency** can be started at a steady state as a maximum frequency.

HINT!

This maximum frequency is overwritten in non-activated inputs PS1 (parameter **44-Preset speed #4**) or PS2 (parameter **44-Preset speed #4**) or PS3 (parameter **43-Preset speed #3**) or LIM (parameter **46-Preset speed #6**).

If the maximum frequency is greater than parameter **21-V/Hz knee**, please see the section 1.5, „Operation in the Field-Weak Area and Load-Dependent Maximum Frequency“.

PS1 = Limit switch S1 (back).

Parameter selection: 44-Preset speed #4

If the crane travels in reverse direction of rotation via the limit switch, input PS1 will become idle. If the current frequency of the drive is greater than that in the parameter **44-Preset speed #4**, the drive is braked to the frequency entered here via the down ramp.

If the current frequency is lower than that in parameter **44-Preset speed #4**, the limit switch does not cause a frequency or functional change. If the crane is located in the area between the limit switch S1 and S3/S4 and the direction of rotation selected is forwards, the frequency limitation for this direction of rotation is disabled.

PS2 = Limit switch S2 (forwards).

Parameter selection: 44-Preset speed #4

If the crane travels in forwards direction of rotation via the limit switch, input PS2 will become idle. If the current frequency of the drive is greater than that in the parameter **44-Preset speed #4**, the drive is braked to the frequency entered here via the down ramp.

If the current frequency is lower than that in parameter **44-Preset speed #4**, the limit switch does not cause a frequency or functional change. If the crane is located in the area between the limit switch S1 and S3/S4 and the direction of rotation selected is reverse, the frequency limitation for this direction of rotation is disabled.

PS3 = Limit switch S3 and S4 (safety area).

Parameter selection: 43-Preset speed #3

If the crane travels independently from the direction of rotation via one of these limit switches, the input PS3 will become idle. If the current frequency is greater than the frequency defined in the parameter **43-Preset speed #3**, the drive is braked to the frequency entered here via the down ramp. If the current frequency is lower than that in parameter **44-Preset speed #4**, the limit switch does not cause a frequency change or functional change. This frequency limit is effective for both directions of rotation. In practice, the limit switches at the craneway ends are jointly connected to the input PS3 by a Wired-And wiring.

LIM = Switching cabin (radio) floor control (switch S5).

Parameter selection: 46-Preset speed #6

If this input is defined on COM, the frequency defined under parameter **23-Max. frequency** is reduced to the frequency defined under parameter **46-Preset speed #6**. If the current frequency is greater than the frequency defined under the parameter **46-Preset speed #6**, the drive is braked to this frequency via the down ramp.

MOL = Motor protective relay input (terminals +MOL, –MOL).

- Connection of an NC contact or PTC thermistor for the thermal motor protection.
- A wire jumper between +MOL und –MOL is inserted ex works.
- See also: Operating Instructions, Part 1, Section “Typical Control Terminal Assignments”.

REL = Activation of holding brake.

Parameter selection: 96-Auxiliary relay

This parameter controls the relay output. One of the following functions should be entered here:

x02	Inverter output frequency greater than 0 Hz in relation to the entered slip frequency calculated from the nominal rpm specified under parameter 14
x03	Inverter output frequency greater than 0.5 Hz in right or left direction of rotation. Operation with feedback: Actual frequency of motor >0.5 Hz
x25	Inverter setpoint frequency behind ramp-up/ramp down generator greater than “Preset speed #2” (parameter 42) in right or left direction of rotation
x30	Function for controlling a holding brake in field-oriented lifting gear drives (application 220) or in travelling gears in all applications. The output is active when 75% of the field build-up time (parameter 66) has expired and inactive when 50% of the “DC-brake time” has expired after a STOP command (parameter 64).
0xx	Active level Low
1xx	Active level High
2xx	Output indicates that the selected condition is fulfilled and the inverter is OK, Active level Low. Possible for all functions which are marked with ■ in the table.
3xx	Output indicates that the selected condition is fulfilled and the inverter is OK, Active level High. Possible for all functions which are marked with ■ in the table.
Table 1.3	

EXAMPLE:

96-Auxiliary relay = 225. The relay output is switched if the inverter functions correctly and the inverter output frequency behind the ramp-up integrator is greater than the “Preset speed #2” specified in parameter 42. The output does not open during the measurements in test operation. A contactor connected here can control a mechanical holding brake. The connected contactor should drop and activate the holding brake in the case of a malfunction or if the selected output frequency is exceeded.

HINT!

Of course, every other binary output can be used instead of the relay output to control the holding brake.

1.5 Operation in the Field-Weak Area and Load-Dependent Maximum Frequency

Using the crane control in the UD 7000, it is also possible to operate crane drives with asynchronous motors in the frequency area above the nominal frequency of the motor (in the field-weak area).

For safety reasons, it is necessary to carry out a “load test” before entry into the field-weak area, particularly with lifting gears. To do this, the **21-V/Hz knee** is started first and the load presently hanging on the hook is tested during the time specified by the parameter **DA-Time LoadTest ms**. The program automatically determines which new maximum frequency is permitted.

As faults could occur when determining the load conditions (oscillating load, insufficient test times, high losses and thereby higher torques required at greater speeds), a load reserve (parameter **DB-Reserv.Load 0.1%**) can be entered to increase the safety. The dynamic operating case is particularly critical (lower load). Therefore, there is an additional load reserve for the dynamic operating case (parameter **DC-Reserv.Gen.Load**). The load reserves are entered by the nominal load in percent.

As a dynamic operating case does not occur in trolley travelling applications, the function can be switched off via the parameter **DD-Test Load On/Off**.

The acceleration or braking times are entered into the parameters **25-Acceleration #1** and **26-Deceleration #1**. Under circumstances, it is useful to switch on the function “S-shaped ramps” via the parameter **72-Ramp function selection**. If value 14 is entered here, ramp set 2 is used in addition to the S-shaped ramp in the field-weak area. By entering longer times in the parameters **27-Acceleration #2** and **28-Deceleration #2**, the acceleration torque can be reduced, thereby taking into account the fact that lower torques are available in the field-weak area.

1.6 Special Parameters for Crane Applications

Parameters	Description	Default	Crane application
Group 1 Parameter 11–16	Motor data. Before the initial switch-on: Please enter completely and carry out test operation.	(1)	(1)
21-V/Hz knee	The motor is operated with rated-load excitation up to this frequency if parameter 62-V-Hz selector is set at value 3 or 4.	50 Hz	43 Hz ^{(3) (5)}
23-Max. frequency	Determines the maximum speed.	50 Hz	50 Hz
29-Control mode	Different combinations of the active control source can be selected with this parameter.	13	14
2A-Test mode	Measurements for determining motor-specific data, the test operation is to be performed at least once.	1	4 ^{(3) (4)} 9 ⁽⁵⁾
2C-Application	Application Crane control with standard inverter. Crane control with field-oriented drive (FO). Crane control with NFO.	0	200 220 250
32-Selection LIM	Functions of the LIM input. Value 5 cannot be entered manually, but is set automatically if a parameter reset on the crane application (parameter EA to value 2xx) is carried out or the motorpoti function (parameter DF to value 1, then the LIM input is used to switch between radio and floor control (see 46-Preset speed #6).	1	5
42-Preset speed #2	This parameter determines at which frequency a holding brake (connected to the control outputs or the relay output) is activated if one of the parameters 92–96 is programmed on the function x06 or x25.	20 Hz	2 Hz
43-Preset speed #3	Determines the travel speed in the safety area.	40 Hz	3 Hz
44-Preset speed #4	Determines the travel speed in the limit switch area.	60 Hz	5 Hz
45-Preset speed #5	Determines the minimum speed.	0 Hz	10 Hz
46-Preset speed #6	With the aid of this parameter it is possible to programme a second maximum speed which can be activated via the control terminal LIM.	0 Hz	40 Hz
72-Ramp selector	Selection of ramp functions. The use of S-shaped ramps is recommended for trolley travelling applications.	0	0
76-Slip compensat.	Slip compensation.	0 (Off)	0 (Off) 1 (On) ^{(3) (4)}

Table 1.4

Parameters	Description	Default	Crane application
92-Aux. output #1	Control output 1. This parameter determines the function of output ST1 (of course all other control outputs ST2 to ST4 can also be programmed in the same way).	3	203
96-Auxiliary relay	This parameter determines the function of the relay output for controlling the holding brake.	101	225
98-Input Run/Jog	Crane control: Acceleration.	0	18
99-Input PS1	Crane control: Limit switch S1.	4	18
9A-Input PS2	Crane control: Limit switch S2.	1	18
9B-Input PS3	Crane control: Limit switch for safety area S3/S4.	6	18
B1-P-gain	Proportional gain of speed regulator.	100 ms	20 ms ⁽³⁾
B2-I-gain	Specific reset time of speed regulator.	500	200 ⁽³⁾
DA-Time LoadTest ms	Duration for determining the load conditions. Value area: 0–10000 ms.	0 ⁽²⁾	1000 ms
DB-Reserv.Load 0.1%	General load reserve. Value area: 0–100%.	0 ⁽²⁾	10%
DC-Reserv.Gen.Load	Additional load reserve, dynamic operating case. Value area: 0–50%.	0 ⁽²⁾	10%
DD-Test Load On/Off	Switch on/off function “load-dependent maximum frequency”. Value area: 0–2 (Off/On/Extern). See Chapter 1.8, „Extension of the Function: External Load Test“.	0 ⁽²⁾	0 (Off) 1 (On) 2 (Extern)
DE-BrakeChanceDirec	Braking when reversing. Value area: 0–1 (Off/On/).	0 ⁽²⁾	0 (Off) 1 (On)
DF-Crane via PS-Inp	Control crane via PS terminals (e.g. with bottle) when using the function “hold frequency” (6).	0 ⁽²⁾	0 (Off) 1 (On)
EA-Reset Parameter	Parameter reset and application-dependent default settings of the client parameter set 1 (see section 1.3, „Commissioning“).	0	0

Table 1.4
NOTES:

- (1) Presettings dependent on the power of the UD 7000 used. Please refer to the values in the operating manual of the UD 7000.
- (2) Application-dependent parameters whose significance and presetting depend on the active **2C-Application**.
- (3) Values apply only for the application 250 (crane + NFO).
- (4) Values apply only for the application 200 (crane + inverter).
- (5) Values apply only for the application 220 (crane + field-oriented drive).
- (6) If the crane is to be controlled via a cylinder (i.e. via PS terminals) using the function “hold frequency”, the parameter **DF-Crane via PS-Inp** should be = set to 1 (on). The special parameter reset (parameter EA = 200) is recommended for the commissioning to ensure that all terminals are parametrised correctly. These functions are then described in detail in Chapter 1.1, „Different Crane Applications“ and 1.3, „Commissioning“.

1.7 Switching Matrix

Function of the Input Terminals

FWD	REV	R/J	LIM	PS1	PS2	PS3	Description
0	0	X					Stop.
1	1	X					Stop.
1	0	0					1. Start forwards with 45-Preset speed #5 . 2. Maintain speed.
1	0	1					Forwards acceleration.
0	1	0					1. Start backwards with 45-Preset speed #5 . 2. Maintain speed.
0	1	1					Reverse acceleration.
1	0	1	1	X	1	1	Forwards with 23-Max. frequency .
1	0	X	0	X	1	1	Forwards with 46-Preset speed #6 .
1	0	X	X	X	0	1	Forwards with limit switch speed 44-Preset speed #4 .
1	0	X	X	X	X	0	Forwards with safety speed S3 or S4 43-Preset speed #3 .
0	1	1	1	1	X	1	Backwards with 23-Max. frequency .
0	1	X	0	1	X	1	Backwards with 46-Preset speed #6 .
0	1	X	X	0	X	1	Backwards with limit switch speed 44-Preset speed #4 .
0	1	X	X	X	X	0	Backwards with safety speed S3 or S4 43-Preset speed #3 .

Table 1.5

NOTES:

- 0 = Inactive.
- 1 = Active.
- X = Insignificant.

Switches and Terminals

Switches	Terminal
Limit switch S1 (back) (REV/left rotation field)	PS1
Limit switch S2 (for) (FWD/right rotation field)	PS2
Safety area limit switch S3 and S4	PS3

Table 1.6

1.8 Extension of the Function: External Load Test

For higher-order controls, it is possible to start the load measurement via a signal to a binary input (subsequently: load test signal) and to collect the result at the analogue output.

To do so, the following parameters must be adapted:

- One of the two analog outputs must be set to the function “permissible maximum frequency” via the parameter A1 or A2. To do so enter the value 21.

- Value 20 is entered in the corresponding parameters (98–9B) for one of the binary inputs PS1–PS3 or Run/Jog and activates thereby the function “external load test”.

The load measurement is started with the aid of the load test signal on the binary input configured for it. The result appears at the analog output according to the time entered in the parameter **DA-Time LoadTest ms** plus a maximum 20 ms. The analog output is set for this function as follows:

- Unipolar 0–10 Volt.
- Scaling: $10 \text{ Volt} = F_{\text{max}}$ (parameter **23-Max. frequency**) [Hz].

Definitions

- If the load test signal is not present on the binary input configured for it, 0 voltage is output.
- The result of the calculation is only output at the analog output for as long as the signal is present at the binary input.
- If the load test signal is removed before a measurement result is available, only 0 volt will continue to be output.
- If the setpoint frequency is greater than the set “knee frequency” (parameter 21) at the time of the measurement, i.e. the motor is already running in the field-weak area, the value for the set knee frequency is immediately output at the analog output.

EXAMPLE:

Parameters	Designation/explanation	Value
21	Knee frequency f_{knee} .	43 Hz
23	Maximum frequency.	90 Hz
98, 99, 9A or 9B	Programming of a binary input to “starting a load test”.	20
A1 or A2	Analog output with function “permissible maximum frequency”.	21
DA	Duration for determining the load conditions.	200 ms
DD	A higher-order control starts the load test and evaluates the result output at the analog output.	2

1. Case:

The drive is accelerated to 55 Hz. The test requirement is specified. As the knee frequency is lower than the applied setpoint value, only the value for the knee frequency is output as the new permissible maximum frequency:

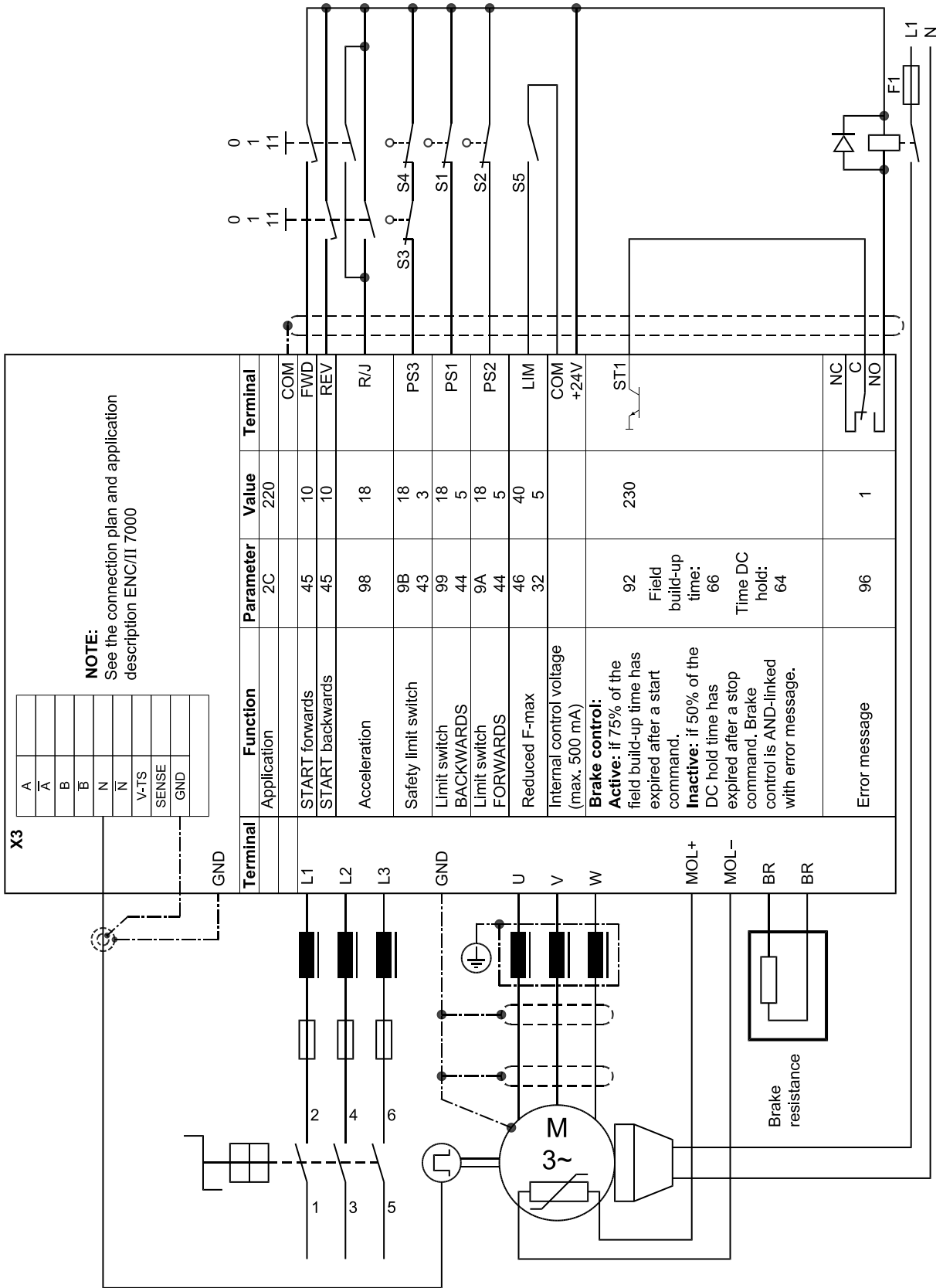
$$f_{\text{max,new}} = 43 \text{ Hz} \Rightarrow \text{Met1} = \frac{f_{\text{max,new}} \times 10 \text{ V}}{f_{\text{max}}} = \frac{43.0 \text{ Hz} \times 10.0 \text{ V}}{90.0 \text{ Hz}} = 4.77 \text{ V}$$

2. Case:

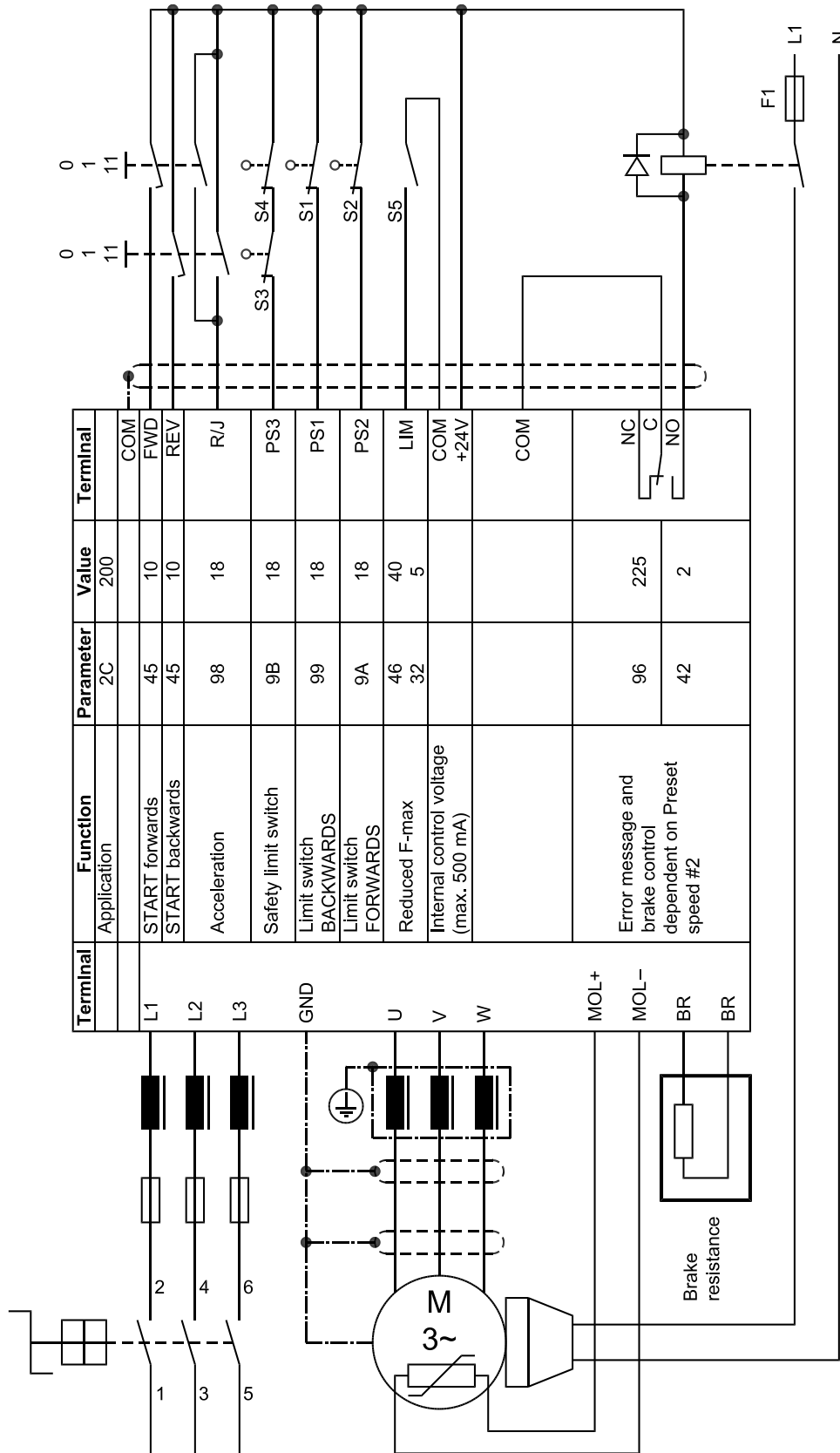
The drive is accelerated to 43 Hz and the test requirement is provided. The torque is determined after little more than 200 ms (the end of the transient specified and assumed in the parameter DA). Assumed the inverter determines that a maximum frequency of 69.3 Hz is permissible with the current load:

$$f_{\text{max,new}} = 69.3 \text{ Hz} \Rightarrow \text{Met1} = \frac{f_{\text{max,new}} \times 10 \text{ V}}{f_{\text{max}}} = \frac{69.3 \text{ Hz} \times 10.0 \text{ V}}{90.0 \text{ Hz}} = 7.7 \text{ V}$$

1.9 Connection



Switching suggestion of stroke drive with feedback



Switching suggestion for crane travelling gear



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