Valid for the following inverter models

- VFB40-004 to VFB40-046
- VFX40-018 to VFX40-750
- VFX50-018 to VFX50-750
- Software VFB/VFX V2.xx
- Software CRIO RN022100.1xx

CRANE OPTION for VFB/VFX (CRIO and Crane Interface)

INSTRUCTION MANUAL

English

Document number: 800840 02
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Instruction manual
Read this instruction manual first!
Read also the VFB/VFX instruction manual first.

Software version
Check always that the software version number on the title page of this instruction manual is the same as used on the CRIO Card.

Safety instructions
Read the safety instructions in the VFB/VFX manual!

Technically qualified personnel
Installation, commissioning, demounting, making measurements, etc. of or on the frequency inverter may only be carried out by personnel who are technically qualified for the task.

Installation
Installation must be made by authorised personnel only and according to the local standards. Ensure that all necessary safety measures are taken.

DANGER! Take all necessary safety precautions during installation and commissioning to prevent personal injuries, e.g. by an uncontrolled load.

Opening the frequency inverter

DANGER! Always switch off the mains supply before opening the inverter and wait at least 5 minutes to allow the buffer capacitors to discharge.

Always take adequate precautions before opening the frequency inverter, although the connections for the control signals and jumpers are isolated from the mains voltage.

Motor ID-run
For optimum performance of the VFB/VFX inverter it is recommended to perform a Motor ID-run (window 228). For cranes only a Short ID-run without rotating the motor should be performed.

DANGER! PERFORM A SHORT ID-RUN ONLY WITHOUT ROTATING THE MOTOR TO PREVENT UNCONTROLLED BEHAVIOUR BY THE LOAD, E.G. DROPPING.

Disconnecting the CRIO card:

WARNING! ALWAYS DEACTIVATE THE CRIO CARD IN WINDOW 281 BEFORE DISCONNECTING IT.

Hoisting drives:

WARNING! Make sure the encoder function (window 251) and the deviation function (jumper j 101) are activated. The function „motor lost“ (window 353) must be set to „trip“. Check these functions carefully. They are safety related and prevent the load from falling down.

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LIST OF FIGURES

1. GENERAL INFORMATION

1.1 Option package contents

1.1.1 CRIO Card

For internal mounting the CRIO Card option contains:

- CRIO Card
- Flat cable CB (X5) – CRIO (X3)
- Mounting material
- This manual

For external mounting the CRIO Card option contains extra:

- Housing (Phoenix) for DIN-rail mounting:
  - 1x Profile housing UM108-profile 21.1cm
  - 1x Side element UM108-SEFE/R
  - 1x Side element UM108-SEFE/L
  - 1x Base element UM108-FE
  - 1x Perspex cover
- Cable from CB (X5) – CRIO (X3) through gland.
- Mounting material

1.1.2 Crane Interface

The Crane Interface extension contains:

- Crane Interface (suitable for DIN-rail mounting).
- Cable 20p header – 2x Sub-d

When the CRIO card is mounted inside the inverter, the Crane Interface extension contains:

- Crane Interface (suitable for DIN-rail mounting).
- Cable 20p header – 2x Sub-d (bottom of inverter).
- 2x Cable Sub-d – Sub-d

1.2 Introduction

The CRIO Card is an option for the VFB/VFX frequency inverters, which offers the inputs and outputs necessary for operating cranes. It can be extended with a Crane Interface option that provides mains isolated I/O when long control leads are used or to solve EMC problems.

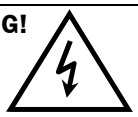
Read this instruction manual carefully before commencing installation, connecting or working with the frequency inverter with CRIO Card (and Crane Interface).

1.3 Notes, cautions, warnings and danger signs

The following indications have the meanings given and are printed in bold typeface:

NOTE! Additional information as an aid to avoid problems.

CAUTION!  **Failure to follow these instructions can result in malfunction or damage to the frequency inverter.**

WARNING!  **Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the frequency inverter.**

DANGER!  **The life of the user is in danger.**

1.4 Description

This instruction manual describes the installation and use of the option CRIO Card and Crane Interface in combination with the frequency inverters of the following type:

- VFB40-004 to VFB40-046
- VFX40-018 to VFX40-750
- VFX50-018 to VFX50-750

1.4.1 For whom is this instruction manual intended?

This instruction manual is intended for:

- Installation engineers
- Maintenance personnel
- Operators
- Designers
- Service engineers

1.5 Standards

See the VFB/VFX Instruction manual.

2. CRIO HARDWARE

2.1 CRIO Printed Circuit Board layout and dimensions

Fig. 1 shows the CRIO PCB layout and dimensions.

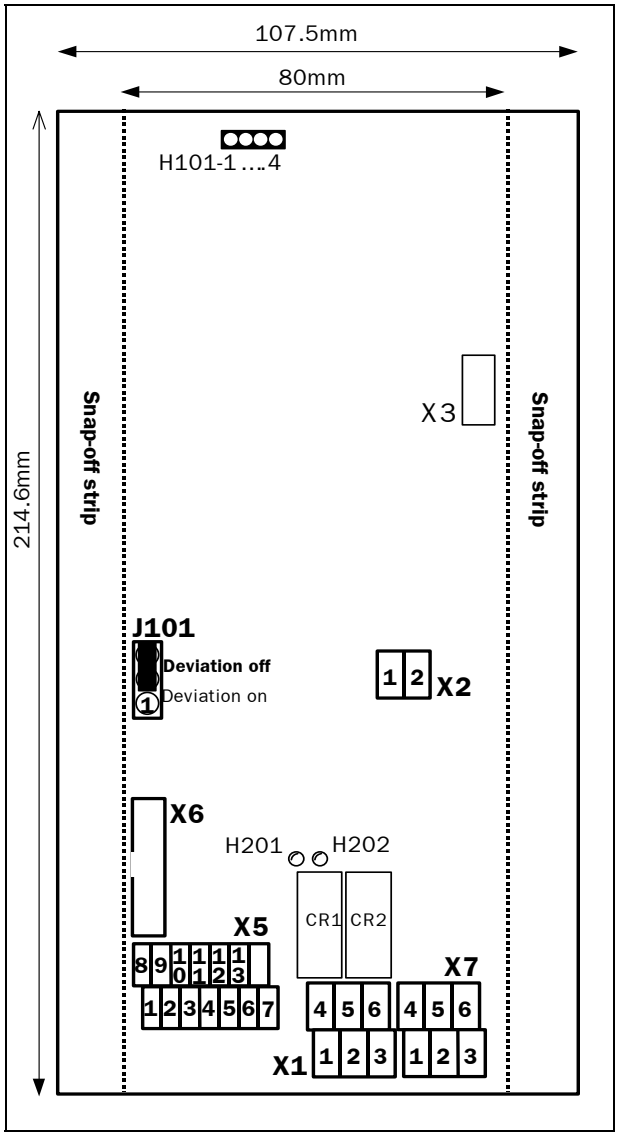


Fig. 1: CRIO PCB layout and dimensions.

The LED's on the CRIO PCB have the following indication function:

LED	Indication
H101-1	Blinking = Communication with Control Board Steady On or Off = Communication Error
H101-2	On = Encoder rotation LEFT Off = Encoder rotation RIGHT
H101-3	On = Encoder signal slightly unstable
H101-4	On = Encoder signal error
H201	On = CR1 on
H202	On = CR2 on

2.1.1 Jumper

Jumper J101 activates the deviation function; see also § 5.2.2, page 15.

2.2 Mounting of the CRIO Card

2.2.1 In the VFX

The CRIO Card with detached snap-off strips is mounted inside the inverter, see Fig. 2, page 6.

Connect the supplied flat cable between CRIO connector X3 and Control Board connector X5. See also Fig. 4, page 9.

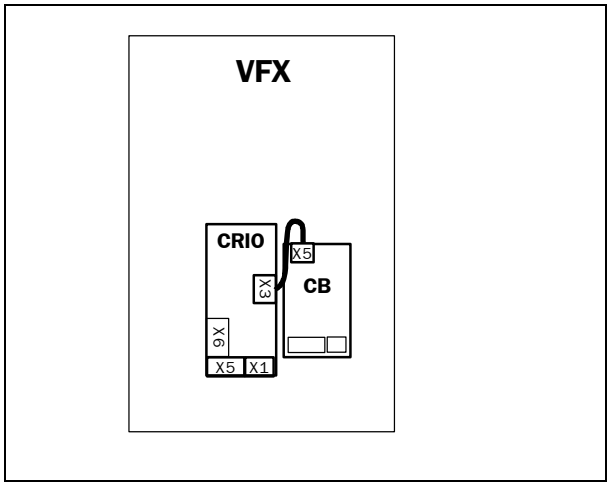


Fig. 2: Mounting the CRIO inside the inverter (possible for VFX).

2.2.2 Outside the VFB

The CRIO Card with attached snap-off strips is mounted outside the inverter with the supplied Phoenix Contact elements, suitable for DIN-rail mounting:

- 1x Profile housing UM108-profile 21.1cm
- 1x Side element UM108-SEFE/R
- 1x Side element UM108-SEFE/L
- 1x Base element UM108-FE
- Perspex cover

Connect the supplied cables between Control Board connector X5 and bottom of inverter and from there to CRIO connector X3. See also Fig. 3, page 7.

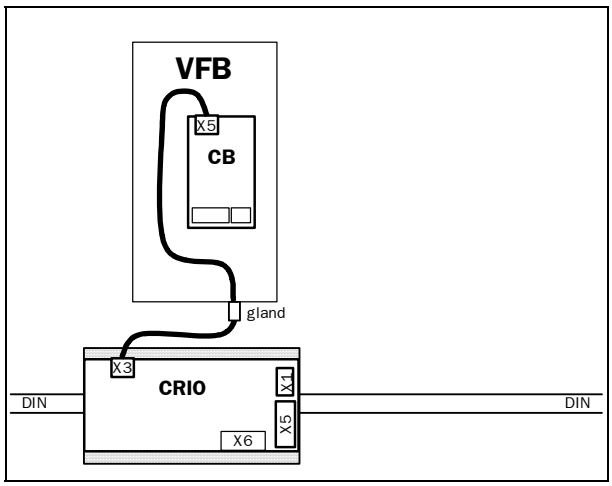


Fig. 3: Mounting the CRIO outside the inverter (necessary for VFB).

2.3 CRIO connections

2.3.1 X1: CRIO Relay CR1 & 2

Specification: 1A/250VAC/AC1

Pin	Name	Function
1	CR1 P	CRIO Relay CR1: Central contact
2	CR1 NC	CRIO Relay CR1: Normally closed contact; opens when CR1 is activated.
3	CR1 NO	CRIO Relay CR1: Normally open contact; closes when CR1 is activated.
4	CR2 P	CRIO Relay CR2: Central contact
5	CR2 NC	CRIO Relay CR2: Normally closed contact; opens when CR2 is activated.
6	CR2 NO	CRIO Relay CR2: Normally open contact; closes when CR2 is activated.

2.3.2 X2: PTC

Specification: See §5.11, page 19.

Pin	Name	Function
1	PTC Pos	Motor thermistor pos connection
2	PTC Neg	Motor thermistor neg connection

2.3.3 X5: CRIO User Interface

Specification:
All inputs are active high up to 24V. Switching voltages at TTL level.

Voltage range: 5 – 24VDC typ
Max. inp. voltage: 30VDC
Switching levels: HIGH >2.1V min
LOW <0.5V max
Input current: 1mA typ @5VDC
2.5mA typ @10VDC
7mA typ @24VDC

Pin	Name	Function
1	A1	Crawl Right/Hoist
2	B1	Preset Speed 2
3	E1	Limit Switch Right/Hoist
4	V2	Pre-limit Switch Left/Lower
5	E2	Limit switch Left/Lower
6	V1	Pre-limit Switch Right/Hoist
7	A2	Crawl Left/Lower
8	N	Null position
9	B2	Preset Speed 3
10	B3	Preset Speed 4
11	R1	2nd Acc/Dec Time via Parameter Set B
12	R2	Inverter activated (Low=Inverter deactivated)
13	Gnd	Signal ground

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must be connected to +24VDC (or 230V for Crane Interface) when not used.

2.3.4 X6: For Sub-d connectors to Crane Interface

All X5 inputs are doubled, marked ▭, into X6 and some I/O is added.

NOTE! Only used to connect the Crane Interface.

Pin	Name	Function
9	A1	Crawl Right/Hoist
8	B1	Preset Speed 2
7	E1	Limit Switch Right/Hoist
6	V2	Pre-limit Switch Left/Lower
4	E2	Limit switch Left/Lower
3	V1	Pre-limit Switch Right/Hoist
2	A2	Crawl Left/Lower
1	N	Null position
12	B2	Preset Speed 3
14	B3	Preset Speed 4
16	R1	2nd Ramp via Parameter Set B
18	R2	Inverter activated (Low=Inverter deactivated)
13	Gnd	Signal ground
15	Gnd	Signal ground
5	Gnd	Signal ground
10		Unused
11		Unused
17		Unused
19	CR2'	High (24V/8k2 open) when CRIO Relay CR2 activated
20	CR1'	High (24V/8k2 open) when CRIO Relay CR1 activated

2.3.5 X7: Encoder

The encoder signal inputs accept HTL (8 – 30VDC) or TTL (5VDC) level signals.

Specification: See § 5.10, page 19.

Pin	Name	Function
1	Gnd	Signal ground
2	A	Sensor A
3	A'	Sensor A'
4	22V	Supply voltage to sensor. Open voltage 22V, serial impedance 41.4Ω. 200mA max
5	B	Sensor B
6	B'	Sensor B'

3. CRANE INTERFACE

3.1 Crane Interface

The Crane Interface is a separate option and is connected to the CRIO Card.
Advantages:

- Mains isolation, better EMC
- Easy commissioning
- Easy faultfinding for service

There are two versions:

- 24VDC input signals
- 230VAC input signals.

For other voltages contact your supplier.

NOTE! When the Crane Interface is used, the CRIO Connectors X1 and X5 are not used.

3.2 Mounting the Crane Interface

The Crane Interface is supplied in a bracket for mounting on a DIN-rail outside the inverter. When the CRIO Card is mounted in the inverter (possible for VFX) the Sub-d connectors are at the bottom of the inverter, see Fig. 4, page 9. When the CRIO Card is also mounted outside the inverter (necessary for VFB) the Crane Interface is connected directly to the CRIO Card, see Fig. 5, page 9.

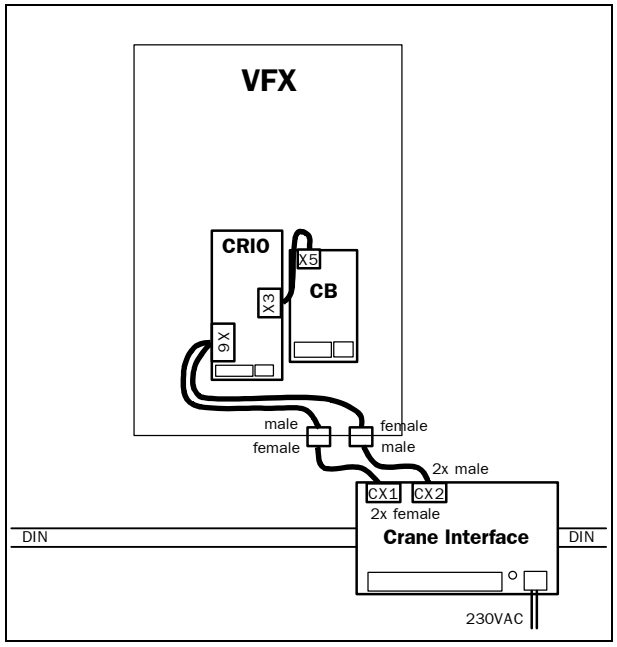


Fig. 4: Mounting the Crane Interface when the CRIO is mounted inside the inverter (possible for VFX).

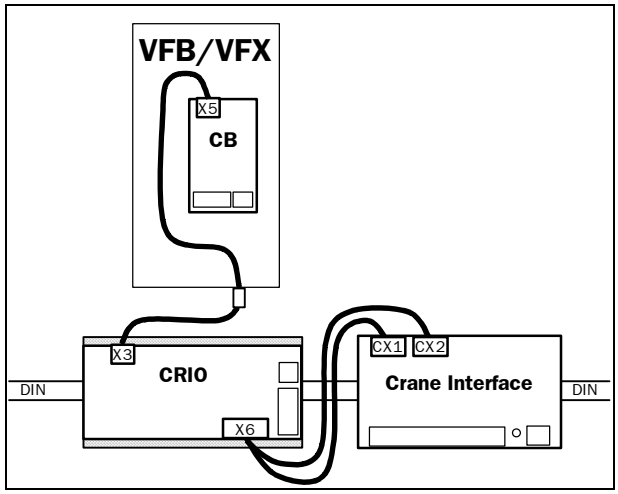


Fig. 5: Mounting the Crane Interface when the CRIO is mounted outside the inverter (necessary for VFB).

3.3 Crane Interface layout

The layout is shown in Fig. 6, page 10. The LED's indicate the status of the inputs and relays. F1 is the mains supply fuse and F2 the transformer secondary fuse.

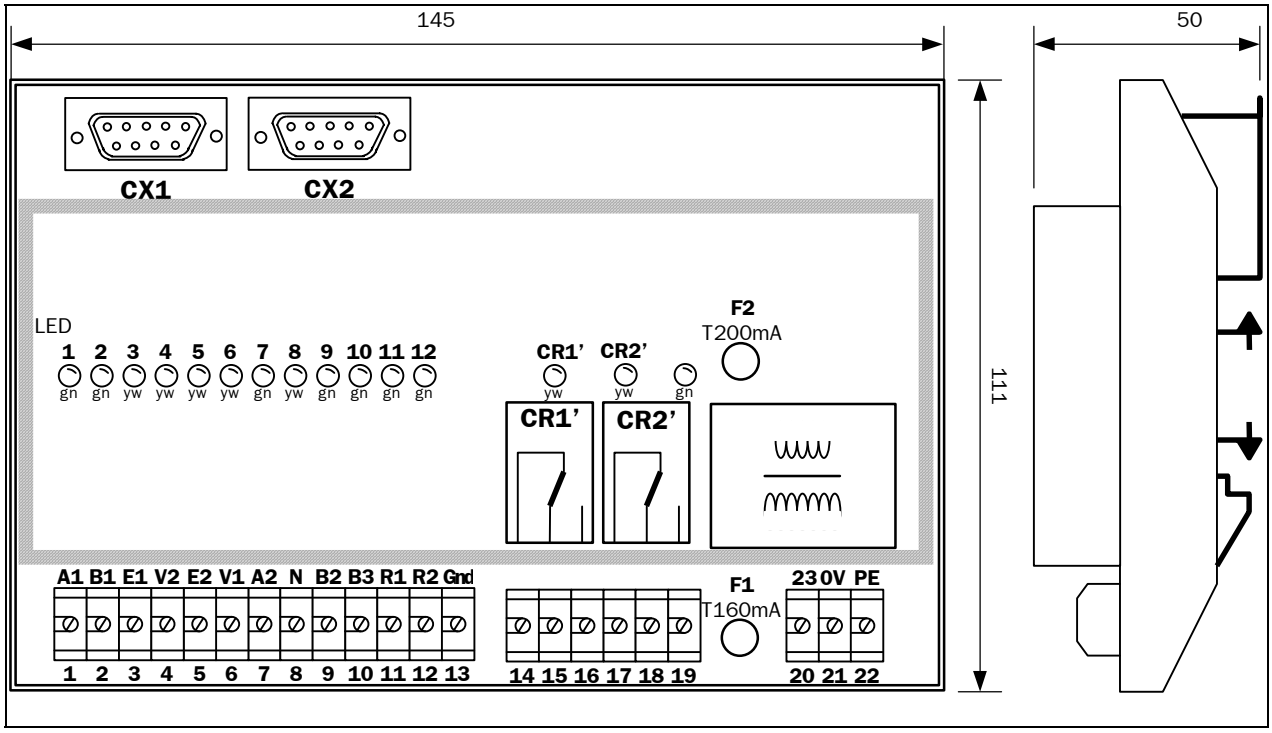


Fig. 6: Crane Interface layout.

3.4 Crane Interface connections

All control inputs 1-12 are active high.

24VDC version:

Input voltage	15-36V typ
Input resistance	2.7kΩ
Input current	7mA typ @ 24VDC

230VAC version:

Input voltage	120-250VAC typ
Input resistance	27kΩ
Input current	5mA typ @ 230VAC

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must connected to +24VDC (or 230V for Crane Interface) when not used.

Nr	Name	Function
1	A1	Crawl Speed H/R
2	B1	Preset Speed 2
3	E1	Limit Switch H/R
4	V2	Prelimit Switch L/L
5	E2	Limit Switch L/L
6	V1	Prelimit Switch H/R
7	A2	Crawl Speed L/L
8	Null	Null position
9	B2	Preset Speed 3
10	B3	Preset Speed 4
11	R1	2nd Acc/Dec Ramp
12	R2	Cut
13	Gnd	Ground connection for control signals
14	CR1 P	Identical function as CRIO Relay 1. 250VAC 1A max.
15	CR1 NC	
16	CR1 NO	
17	CR2 P	Identical function as CRIO Relay 2. 250VAC 1A max.
18	CR2 NC	
19	CR2 NO	
20	230V~	Mains supply for the Crane Interface. 30mA typ.
21		
22	PE	

4. SETUP CRIO AND VFB/VFX

NOTE! All window numbers refer to the set-up menu as described in the VFB/VFX manual.

4.1 Connecting CRIO and Crane Interface

4.1.1 CRIO inside VFX

See Fig. 1, page 6; Fig. 2, page 6 and § 2.2.1, page 6. Generally the manufacturer does this.

4.1.2 CRIO outside VFB

See Fig. 1, page 6; Fig. 3, page 7 and § 2.2.2, page 6. The CRIO is to be mounted on a DIN-rail. Connect the cable between Control Board X5 and CRIO X3 and tighten the gland.

4.1.3 Crane Interface (with CRIO inside VFX)

See Fig. 4, page 9 and Fig. 6, page 10. Connect the cables as indicated.

4.1.4 Crane Interface (with CRIO outside VFB)

See Fig. 5, page 9 and Fig. 6, page 10. The CRIO can be mounted on a DIN-rail. Connect the cable between Control Board X5 and CRIO X3 and tighten the gland. Connect the cable between CRIO X6 and Crane Interface CX1, CX2 as indicated.

4.2 External circuitry

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must connected to +24VDC (or 230V for Crane Interface) when not used.

4.2.1 With 4-Speed control

See wiring example in § 7, page 23. For control selection, see § 5.1, page 14 and § 6.1.2, page 20.

4.2.2 With 3-Position control

See wiring example in § 8, page 25. For control selection, see § 5.1, page 14 and § 6.1.2, page 20.

4.2.3 With analogue control

See wiring example in § 9, page 27. For control selection, see § 5.1, page 14 and § 6.1.2, page 20.

4.2.4 PTC and Encoder

Connect the PTC to CRIO X2, see § 2.3.2, page 7 or **leave the bridge wire if no PTC is used**.

Connect the Encoder to CRIO X7; see § 2.3.5, page 8.

4.2.5 Brake

Fig. 14, page 16 shows the recommended connection for Deviation (CRIO- Relay 1) and the brake relay. When the deviation function is activated, the brake is activated and the inverter stops. When the joystick is put in the null position within 3s, a restart can be made, otherwise the inverter trips with the trip message "Deviation".

4.2.6 Functionality of VFB/VFX User Interface when CRIO Card connected

When the CRIO Card is connected, some of the terminals of the VFB/VFX User Interface X1 have a different function, which are stated in the table below (Refer also to the VFB/VFX manual):

X1 Nr	Name	Function
1	+10VDC	
2	AnIn1+	4-Speed controller: Scaling. Analogue Control: Reference.
3	AnIn1–	
4	AnIn2+	
5	AnIn2–	
6	-10VDC	
7	Common	
8	RunL	Both HIGH: Motor kept magnetized in Stop Mode.
9	RunR	
10	Enable	Must be made HIGH.
11	+24VDC	
12	Common	
13	AnOut1	
14	AnOut2	
15	Common	
16	DigIn1	
17	DigIn2	
18	DigIn3	
19	DigIn4	
20	DigOut1	
21	DigOut2	
22	Reset	

4.3 Programming the VFB/VFX

The starting point is the default setting for all functions and parameters.

4.3.1 Unhidden windows when CRIO Card connected and their defaults

When the CRIO Card is connected, a number of windows will be unhidden in the menu upon detection of the CRIO Card by the VFB/VFX.

Program acc. to the required functionality for the application. Refer to § 6.1, page 20.

The unhidden windows are (See § 6, page 20 for the functional description of these windows):

Window	Function	Default
251	Encoder On/Off	**Off (set by user)**
252	Number of Encoder pulses	**1024**
271	PTC On/Off	**Off (set by user)**
281	CRIO On/Off	**Off (set by user)**
282	CRIO Control selection	**4-Speed**
283	CRIO Relay 2 function	**Brake**
284	Deviation Time	**100ms**
285	Set Load	**100%**

4.3.2 Changed defaults when CRIO Card activated

Activate the CRIO Card by setting window 281 CRIO On/Off = On.

After executing Load Defaults in window 235 a number of defaults will change, compared to the standard default settings.

The changed VFB/VFX defaults are:

Window	Function	Changed default
212	Reference Control	**Option**
213	Run/Stop Control	**Option**

See § 5.3, page 15.

317	tbh	**0.5s**
318	tbf	**0.5s**
319	tba	**0.5s**
32I	Start Speed	**10rpm**

See § 5.1, page 14 for the different speed settings, depending on the type of control.

326	Preset Speed 1: Prelimit switch speed	**150rpm**
327	Preset Speed 2	**600rpm**
328	Preset Speed 3	**1000rpm**
329	Preset Speed 4	**1500rpm**
32A	Preset Speed 5: Crawl speed H/R	**150rpm**
32B	Preset Speed 6: Crawl speed L/L	**150rpm**

See § 5.2, page 14.

32C	Preset Speed 7: Deviation bandwidth	**100rpm**

See § 5.9, page 18.

322	Max Speed	**1500rpm**

See § 4.3.6, page 13.

353	Motor lost	**Trip**

4.3.3 Programming general

Since the VFB/VFX starts in Parameter Set B because of the 2nd Acc Time, it is best to program Parameter Set B first and then copy B into A (window 233). Subsequently the Acc Time and Dec Time in Parameter Set B can be set to their required values (window 311 and 313).

4.3.4 Disconnecting the CRIO Card

WARNING! Before disconnecting the CRIO Card, it must be deactivated in window 281 CRIO = Off.

4.3.5 Programming VFB/VFX for riding applications

NOTE! If more than one motor is connected to the VFB/VFX for riding applications, set 211 Drive Mode = V/Hz. Contact your supplier.

- For riding applications the deviation function is not necessary. Set Jumper J101 acc. to § 2.1.1, page 6 "Deviation off".
- Set in window 281 CRIO = On and execute Load Defaults in window 235.
- Enter the motor data acc. to menu 220 and execute a short ID-run without rotating the motor (window 228) for optimum performance.

WARNING! It is dangerous to perform an extended ID-run with the motor coupled to the cable drum, because then the motor will run at high speeds in both directions

- After initialising the inverter operates in Parameter Set B, because it always starts at 0rpm with the 2nd Acc/Dec Time.
- Set the control selection in window 282 acc. to the used controller, see § 5.1, page 14.
- Set all parameters in menu 300 and all I/O in menu 400 as required by the application.
- Set all the other parameters/functions to their required settings. The Set-up menu List in § 10, page 29 can be used as a guideline and filled in by the user for later reference.
- Copy in window 233 Parameter Set B to A (B>A).
- Change window 311 B:Acc Time and 313 B:Dec Time to the required values.

NOTE! When different maximum speeds are programmed, the largest one should be programmed in Parameter Set A. It is however recommended to keep all parameters in Parameter Set A and B equal and, if necessary, to only make the acceleration time [311] and deceleration time [313] different.

4.3.6 Programming VFB/VFX for hoisting applications

WARNING! Contact your supplier in case of multi-motor operation in hoisting applications.

- When for hoisting applications the deviation function is needed (strongly recommended), it is activated by setting Jumper J101 acc. to § 2.1.1, page 6 "Deviation on".
- Set in window 281 CRIO = On and execute Load Defaults in window 235.
- Enter the motor data acc. to menu 220 and execute a short ID-run without rotating the motor (window 228) for optimum performance.

WARNING! It is dangerous to perform an extended ID-run with the motor coupled to the cable drum, because then the motor will run at high speeds in both directions

- Set the control selection in window 282 acc. to the used controller, see § 5.1, page 14.
- Set all parameters in menu 300 and all I/O in menu 400 as required by the application.
- Set all the other parameters/functions to their required settings. The Set-up menu List in § 10, page 29 can be used as a guideline and filled in by the user for later reference.
- Copy in window 233 Parameter Set B to A (B>A).
- Change window 311 B:Acc Time and 313 B:Dec Time to the required values.

NOTE! When different maximum speeds are programmed, the largest one should be programmed in Parameter Set A. It is however recommended to keep all parameters in Parameter Set A and B equal and, if necessary, to only make the acceleration time [311] and deceleration time [313] different.

WARNING! Make sure the encoder function (window 251) and the deviation function (jumper j 101) are activated. The function „motor lost" (window 353) must be set to „trip". Check these functions carefully. They are safety related and prevent the load from falling down.

5. FUNCTIONS

5.1 Control

The crane is operated by a controller. There are three possible configurations, which are selected in window 282.

5.1.1 4-Speed controller

With the 4-Speed controller, as the name suggests, one of four speeds can be selected by moving the controller to the position, corresponding to the desired speed. There are four speeds in both directions, which can be adjusted in the menu.

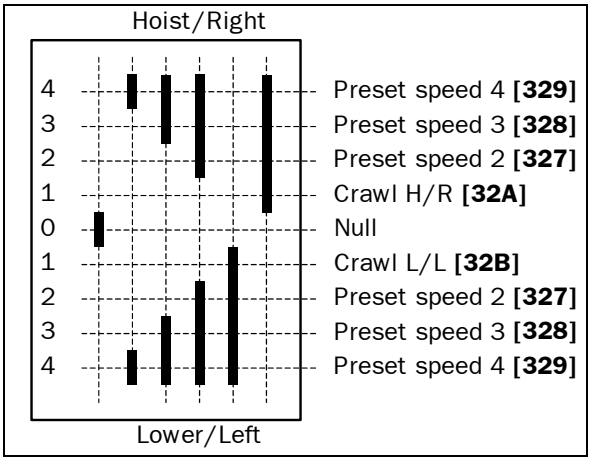


Fig. 7: 4-Speed controller.

5.1.2 3-Position switch

With the 3-Position switch the Crawl speed is selected in the first position and in the extreme position the speed is increased, depending on the direction, up to Preset Speed 4.

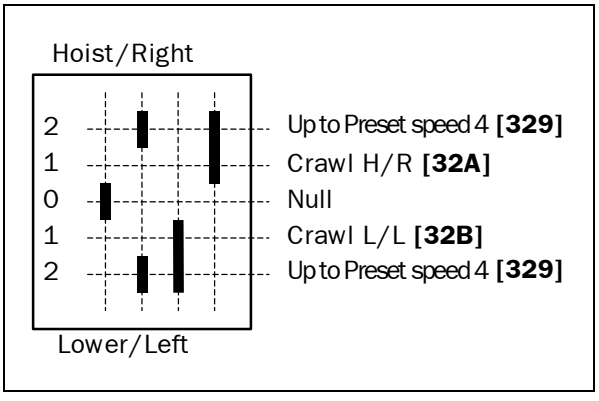


Fig. 8: 3-Position switch.

5.1.3 Analogue control

With an Analogue control the speed is determined by an analogue signal from the controller, which is similar to a potentiometer. Since the CRIO Card has no analogue input, these kinds of controllers must be connected to AnIn1 on the VFB/VFX User Interface. See the VFB/VFX Manual.

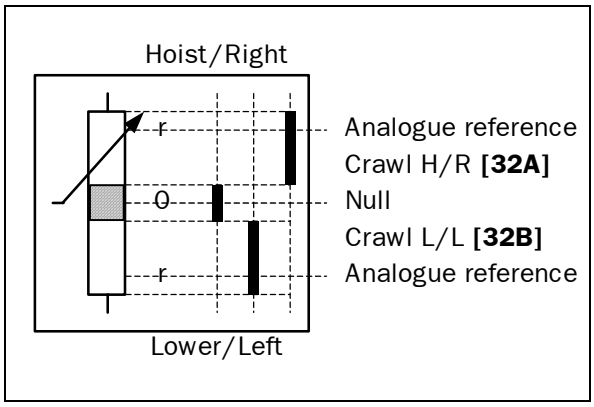


Fig. 9: Analogue control.

5.2 Deviation

Deviation is a special safeguard function for a crane's hoisting function. For safety reasons it cannot be performed by the inverter itself but must be performed by an independent unit, in this case the CRIO Card, because it functions independently after it has been initialised, although it uses info from the inverter.

WARNING! Depending on local regulations it may be necessary to install a fully independent safety system, including control of the mechanical brake.

5.2.1 Deviation function

The deviation function compares the actual reference speed on the inverter's internal ramp signal with the motor speed from the encoder and determines whether they match or not, whereby the direction is also taken into account. If they do not match, the load is assumed to be "lost", the CRIO switches Relay CR1 (Deviation) and the inverter activates the relay output for mechanical brake and trips. Also the communication between CRIO and inverter is monitored. After a communication time-out of ca. 600ms the CRIO relays activate accordingly. This condition is automatically ended when the communication is restored.

CAUTION! When 282 Control = Analogue the inverter reference speed does not come from the CRIO Card but from an analogue input AnIn1 or AnIn2.

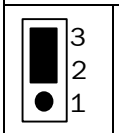
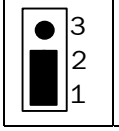
The bandwidth within which the difference between reference and encoder speed must lie, is set by Preset Speed 7 in window 32C. If it is exceeded, the deviation function becomes active.

The minimum duration for the difference to exceed the bandwidth before the deviation function is activated, is set in window 284 "Dev. Time".

NOTE! For the Deviation function an Encoder is mandatory.

5.2.2 (De)activating deviation function

For riding movements the deviation function is switched off by the jumper on the CRIO Card, see § 2.1.1, page 6 (PCB held in position as drawn in § 2.1, page 6)

Jumper J101 setting	
	Deviation function deactivated.
	Deviation function activated.

5.3 Mechanical brake

The mechanical brake can be controlled by selecting the function of one of the relays R1 and R2 on the Control Board or one of the relays CR1 and CR2 to "Brake". This is the default setting of relay CR2.

5.3.1 Mechanical brake function at start

See Fig. 10, page 15. After a start hoisting command the speed increases up to the Start Speed H/R. After **tbh** the speed is allowed to increase further, depending on the speed reference of course. The brake should be released within **tbh**, or **tbh** must be set to a value longer the brake release time. Only then it is ensured that the load will be held when the brake is released.

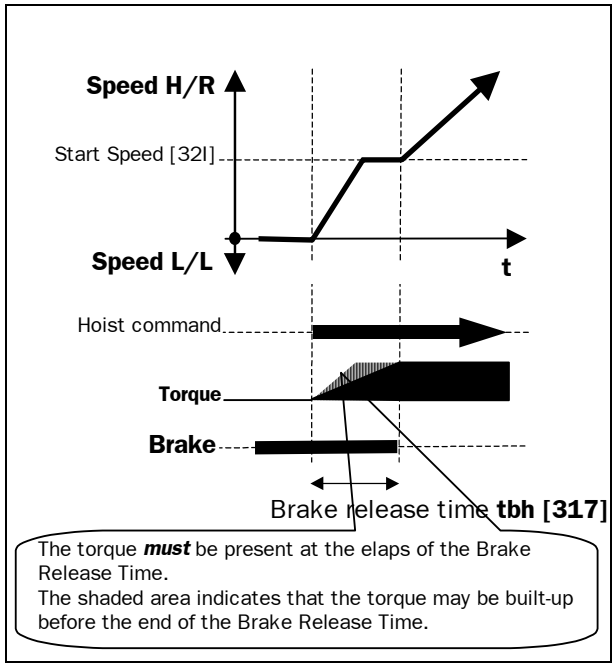


Fig. 10: Diagram for brake function at start of hoisting.

See Fig. 11, page 15. After a start lowering command the speed increases up to the Start Speed to build up torque to hold the load. After **tbh** the speed is allowed to decrease and increase in the opposite direction, depending on the speed reference of course. The brake should be released within **tbh**, or **tbh** must be set to a value longer the brake release time. Only then it is ensured that the load will be held when the brake is released.

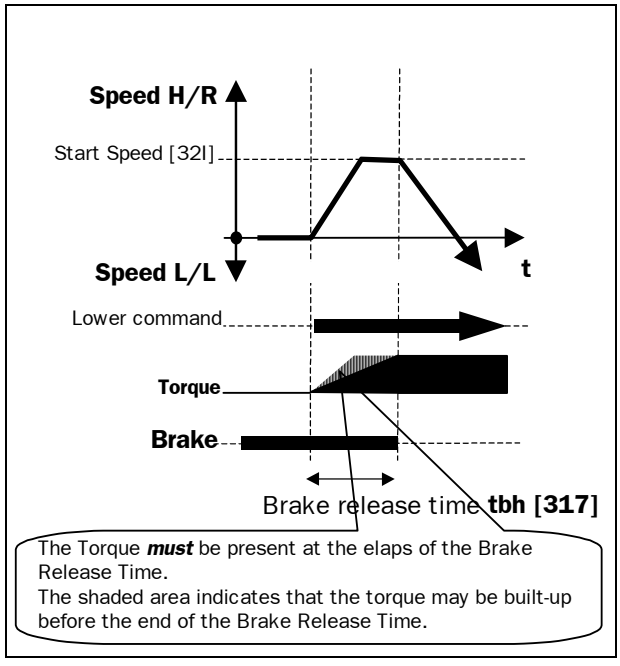


Fig. 11: Diagram for brake function at start of lowering.

5.3.2 Mechanical brake function at stop

See Fig. 12, page 16. When a stop command is issued during hoisting the hoisting speed is decreased down to 0rpm. During **tba** the load is held and it is possible to increase the hoisting speed again. During **tbf** the brake is engaged and **tbf** must be set longer than the brake engage time to ensure the brake is on when the torque is finally reduced to zero.

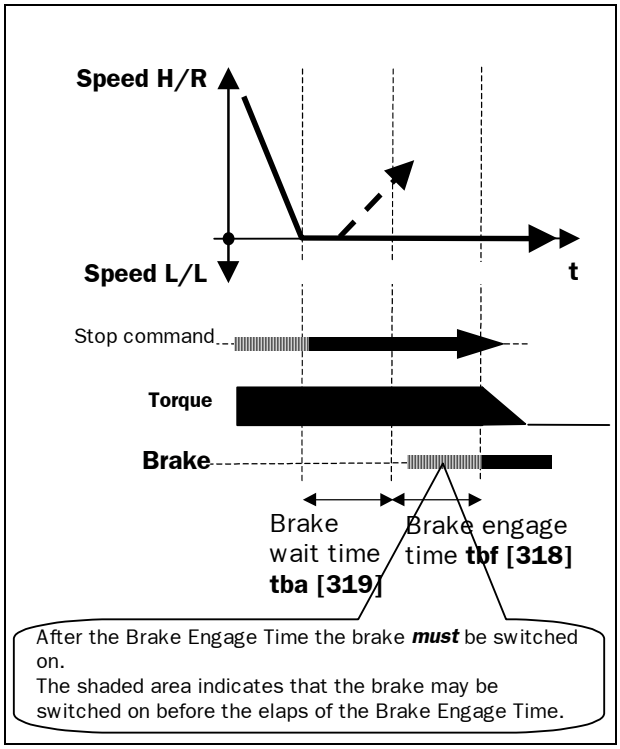


Fig. 12: Diagram for brake function at stop hoisting.

See Fig. 13, page 16. When a stop command is issued during lowering the speed is decreased to 0rpm. During **tba** the load is held and it is possible to lower or hoist again. During **tbf** the brake is engaged and **tbf** must be set longer than the brake engage time to ensure the brake is on when the torque is finally reduced to zero.

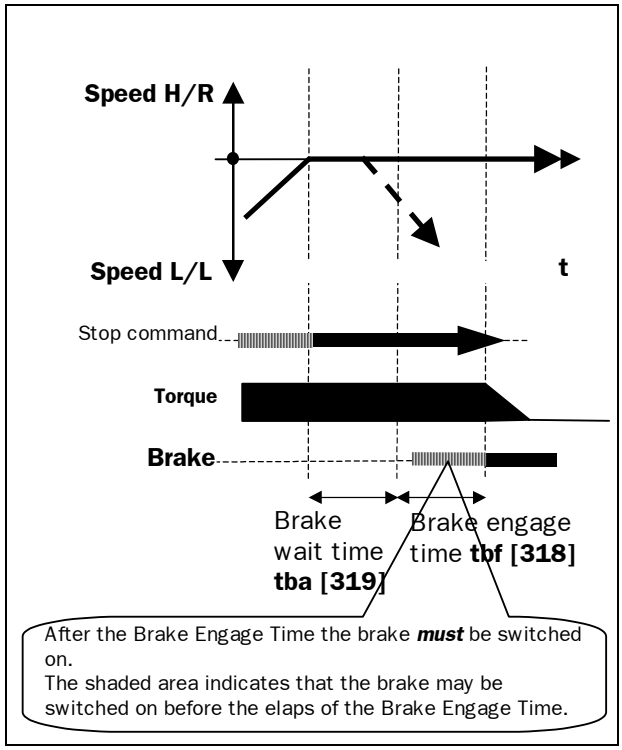


Fig. 13: Diagram for brake function at stop lowering.

5.3.3 Cooperation of brake and deviation function

To get the fastest response to a deviation condition, it is recommended to put the CRIO Relay 1 N/O contact (No Trip/Deviation) i**n series** with the N/O contacts of the brake relay (either CRIO Relay 2 or one of the relays on the control board, depending on programming). This series connection should be put in the brake circuit.

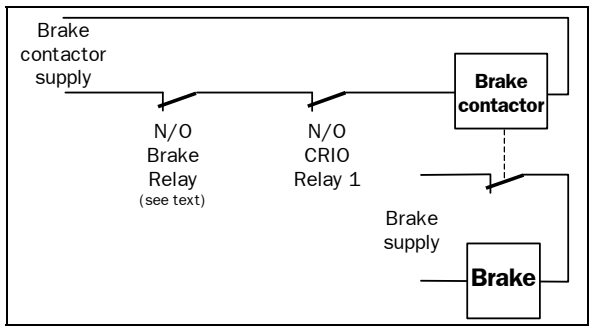


Fig. 14: Recommended brake circuitry.

Fig. 14, page 16 shows the recommended connection for Deviation (CRIO- Relay 1) and the brake relay. When the deviation function is activated, the brake is activated and the inverter stops. When the joystick is put in the null position within 3s, a restart can be made, otherwise the inverter trips with the trip message "Deviation".

When after activation of the deviation function a restart shall generally be prevented, CRIO Relay 1 shall operate the mains contactor.

5.3.4 Recommendation for tbh

It is recommended to set [317] Brake Release Time tbh to a value of 0.3s more than the actual used release time of the mechanical brake to compensate for the communication delay between CRIO and VFB/VFX.

5.4 Magnetizing the motor

In order to get the fastest motor response to a Run command (derived from the controller action), the motor maybe kept magnetized during stop. When in Window 315 Start Mode=Normal DC is selected, the motor is first magnetized every time before a run command is executed. In many crane applications this takes too long. It is therefore possible to keep the motor magnetized by making the Run R and Run L inputs on the VFB/VFX User Interface (X1 #8 and #9) High. When the motor is stopped, it will be kept magnetized. The current level is ca. 0.4 I_{NOM}. In that case heat is dissipated in the rotor and the motor must be dimensioned for this use. Forced external cooling is recommended.

WARNING! When the motor is permanently magnetized, it shall be dimensioned correspondingly. Forced external cooling is recommended.

5.5 (Pre)limit switches

The (pre)limit switches are connected to the inputs E1, E2, V1, V2, see Fig. 22, page 23, Fig. 24, page 25 and Fig. 26, page 27, and should open when active. The following diagram illustrates their effect:

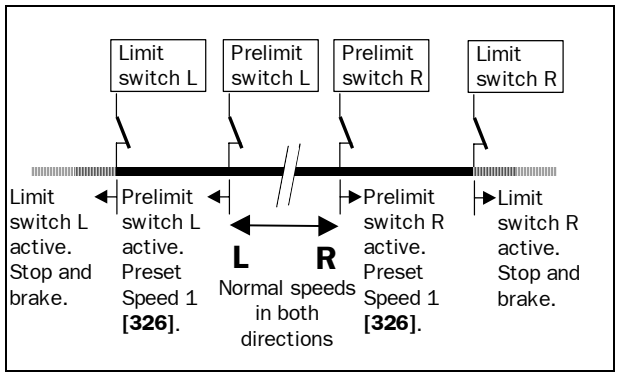


Fig. 15: Effect of (pre)limit switches.

In between the two Prelimit switches the inverter operates normally.

When only a Prelimit switch is active the inverter is allowed to move with the prevailing Crawl Speed or Preset Speed 1 (or a speed in between these values in case of 3-Position switch or Analogue control) in the direction of the Limit switch or is allowed to move in the opposite direction at any speed.

When a Limit switch is active the inverter stops (and the brake is activated) and is only allowed to move in the opposite direction at any speed.

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must connected to +24VDC (or 230V for Crane Interface) when not used.

5.5.1 Operation of limit switch without activated prelimit switch

Sometimes the limit switch can be activated without an activated prelimit switch, e.g. when two traverses ride over the same rail with a limit switch on each cable reel or as an anti-collision mechanism.

Upon activation the traverse is stopped. Contrary to normal limit switch operation, the traverse can be moved again in both directions after the controller has been in the null-position, provided the limit switch concerned is deactivated.

5.6 Fast reverse

When during hoisting the controller is moved in the opposite speed direction, the inverter reverses fast and decelerates with the 2nd Dec Time.

It keeps decelerating with the 2nd Dec Time until 0rpm, after which it accelerates in the opposite speed direction with the 2nd Acc Time to Crawl Speed. Then, depending on the controller position, it accelerates further to the desired speed. See diagrams in § 7, page 23, § 8, page 25 and § 9, page 27.

NOTE! The 2nd Dec Time and 2nd Acc Time are set in Parameter Set B.

5.7 Scaling

NOTE! Only applicable when controlled by a 4-Speed controller.

When window 282 Control = 4-Speed, the inverter speed is scaled by AnIn1. If scaling is not required, AnIn1 must be connected to +10V (or +20mA).

The scaling works acc. to the diagram in Fig. 16, page 18:

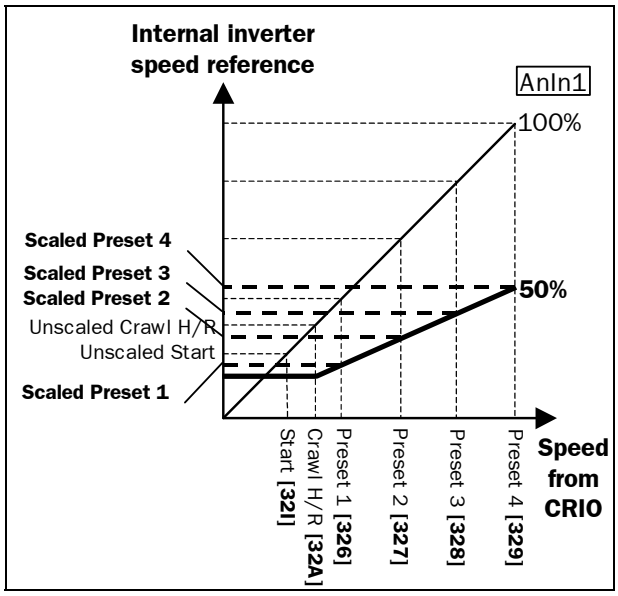


Fig. 16: Effect of scaling the speed reference from the CRIO Card.

NOTE! If no scaling is used when 4-Speed control is selected, AnIn 1 has to be connected to +10V by a jumper, see Fig. 22.

5.8 CRIO Relay CR1

This relay has a fixed function "No Trip".

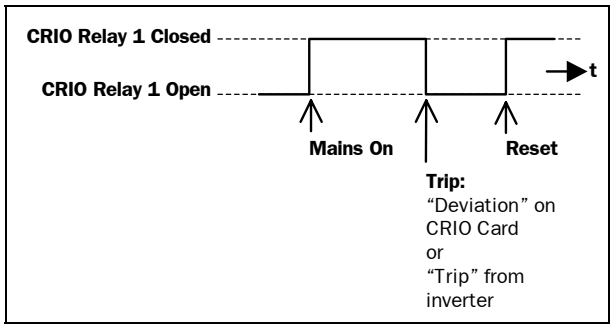


Fig. 17: CRIO Relay CR1 function.

NOTE! When the inverter is switched off, CRIO Relay CR1 is open and indicates a "Trip" condition where there is none. This must be dealt with by the user to prevent a false trip warning.

5.9 Load dependent field weakening operation

Load dependent field weakening operation allows hoisting/lowering at speeds above sync speed when the load is low or zero (empty hook).

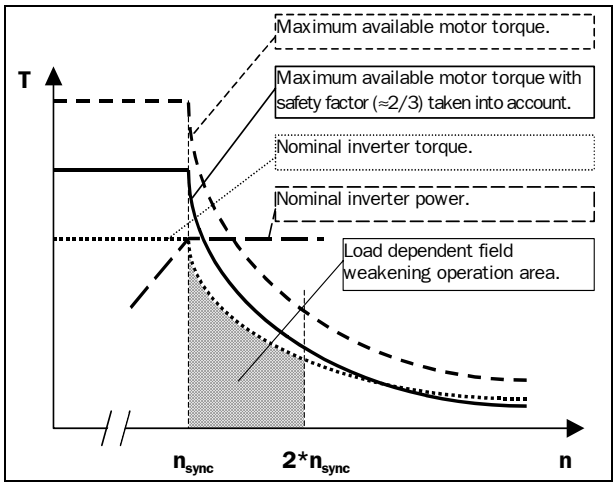


Fig. 18: Theoretical load dependent field weakening operation.

The maximum over synchronous speed can be set between Sync. Speed and 2*Sync. Speed via Preset Speed 4 in window 329. If Preset Speed 4 is set to a value <Sync Speed, load dependent field weakening operation is not active.

Set [322] Max Speed at least 200rpm higher than Preset Speed 4, to give the internal speed PI controller room for regulation. The load above which the load dependent field weakening operation is active can be set in window 285, see § 6.1.5, page 20. Read in window 100 or 620 the torque indication in % with the max. load used in practice at sync speed and set this value in window 285 accordingly. For more information about field weakening operation, contact your sales representative.

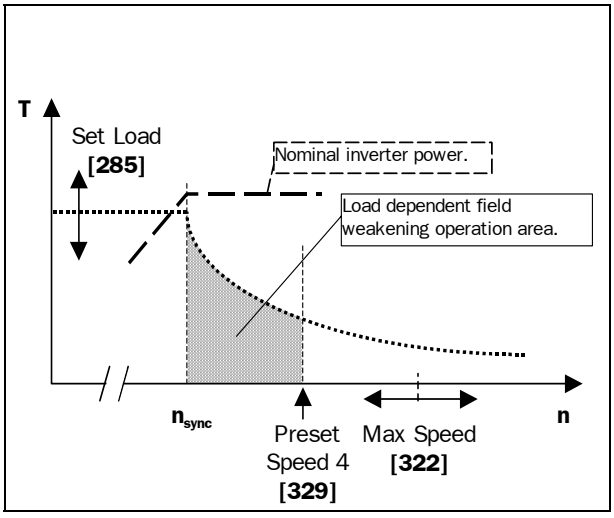


Fig. 19: Settings for load dependent field weakening operation.

5.10 Encoder

The encoder is to be connected to connector X7 and is used to measure the real motor shaft speed. When the deviation function, see § 5.2, page 14, is used, an encoder is mandatory.

The encoder function can be (de)activated, see § 6.3.1, page 21.

The number of impulses per encoder revolution can be adjusted acc. to 6.3.2 between 5 and 5500 with a default of 1024. Select the encoder number of impulses acc. to the max. encoder input frequency at max. speed.

The encoder signal inputs accept HTL (8-30VDC) or TTL (5VDC) level signals.

Sw. Level A-A'/B-B' (differential)	±0.5V to ±1V max (see Fig. 20, page 19).
Input current A, B	±9.8mA max
Input current A', B'	±4.2mA max
Supply to encoder	22VDC open, 200mA max Serial impedance 41.4Ω
Max input frequency	50kHz
Pulse range (adjustable in inverter)	5 – 5500 pulse/rev

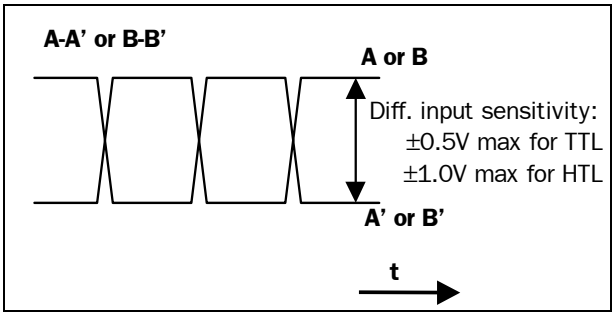


Fig. 20: Encoder inputs A-A'/B-B' switching level

WARNING! Make sure the encoder frequency does not exceed the max. input frequency at max. speed.

5.11 PTC

The PTC function consists of a galvanically isolated PTC circuit for connecting motor thermistors acc. to DIN44081/44082 with the following spec:

Number of PTC's	1, 3 or 6 acc. to DIN44081/44082
Switching point	2V ±10% (Pin 1 "+", pin 2 "–")
Switch-off (trip) at	2825Ω ±10%
Switch-on at	1500Ω ±10%

The PTC function can be (de)activated, see § 6.2.1, page 21.

6. VFB/VFX MENU

In the VFB/VFX a number of windows appear in the menu when the CRIO Card is connected and automatically recognised.

In certain windows a different selection, compared with the standard settings, has to be made.

6.1 Additional functions for CRIO in Window 280

6.1.1 281 CRIO Card

When the CRIO Card is connected, it is possible to (de)activate the CRIO Card.

281 CRIO Card Stp On	
Default:	Off
Selection:	Off, On
Off	CRIO Card deactivated
On	CRIO Card activated

6.1.2 282 Control

To select the type of control . See § 5.1, page 14.

282 Control Stp 4-Speed	
Default:	4-Speed
Selection:	3-Pos, 4-Speed, Analogue
3-Pos	3-Position switch
4-Speed	4-Speed controller
Analogue	Analogue control

6.1.3 283 CRIO Relay CR2

To select the function of CRIO Relay CR2 on the CRIO Card. See § 2.3.1, page 7.

283 CRIO Relay 2 Stp Brake	
Default:	Brake
Selection:	Run, Stop, Acc/Dec, At speed, At max speed, No trip, Trip, Autoreset Trip, Limit, Warning, Ready, $T=T_{LIM}$, $I>I_{NOM}$, Brake, Sgnl<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Pre-alarm, Deviation
Run	The inverter output is active.
Stop	The inverter output is not active.
Acc/Dec	The speed is increasing or decreasing.
At speed	The Output Speed =Reference Speed.
At max speed	The speed is limited by the Maximum Speed.
No trip	No trip condition active.
Trip	A Trip condition is active.
Limit	A Limit condition is active.
Warning	A warning condition is active.
Ready	The inverter is ready for operation. This means that the inverter is powered up and healthy and ready to take a command.
$T=T_{LIM}$	The Torque is limited by the Torque Limit function.
$I>I_{NOM}$	The output current is higher than the inverter rated current.
Brake	The output is used to control a mechanical brake.
Sgnl<Offset	One of the AnIn input signals is lower than 75% of the offset level.
Alarm	Max or Min Alarm level reached.
Pre-alarm	Max or Min Pre-alarm level reached.
Max Alarm	Max Alarm level reached.
Max Pre-alarm	Max Pre-alarm level reached.
Min Alarm	Min Alarm level reached.
Min Pre-Alarm	Min Pre-alarm level reached.
Deviation	Tripped on deviation.

6.1.4 284 Deviation Time

To set the time during which the deviation condition must be active, before the inverter trips. See also § 5.2, page 14.

284 Dev. Time Stp A: ms	
Default:	100ms
Range:	50 – 1000ms

6.1.5 285 Set Load

To set the load above which the VFB/VFX goes into load dependent field weakening operation. See also § 5.9, page 18.

285 Set Load Stp A: %	
Default:	100%
Range:	25 – 100%, OFF

When set to OFF, the load dependent field weakening function is switched off.

6.2 Added PTC function for CRIO in Window 270

6.2.1 271 PTC (Card)

When the CRIO Card is connected, it is possible to (de)activate the PTC function.

	271 PTC Card Stp On
Default:	Off
Selection:	Off, On
Off	PTC function on CRIO Card deactivated
On	PTC function on CRIO Card activated

6.3 Added Encoder functions for CRIO in Window 250

6.3.1 251 Encoder (Card)

When the CRIO Card is connected, it is possible to (de)activate the encoder function.

	251 Encoder Card Stp On
Default:	Off
Selection:	Off, On
Off	Encoder function on CRIO Card deactivated
On	Encoder function on CRIO Card activated

6.3.2 252 Encoder pulses

To adjust the number of pulses per revolution for the connected encoder, see § 5.9, page 18.

	252 Encoder Puls Stp 1024
Default:	1024
Range:	5 - 5500

7. 4-SPEED CONTROLLER OPERATION

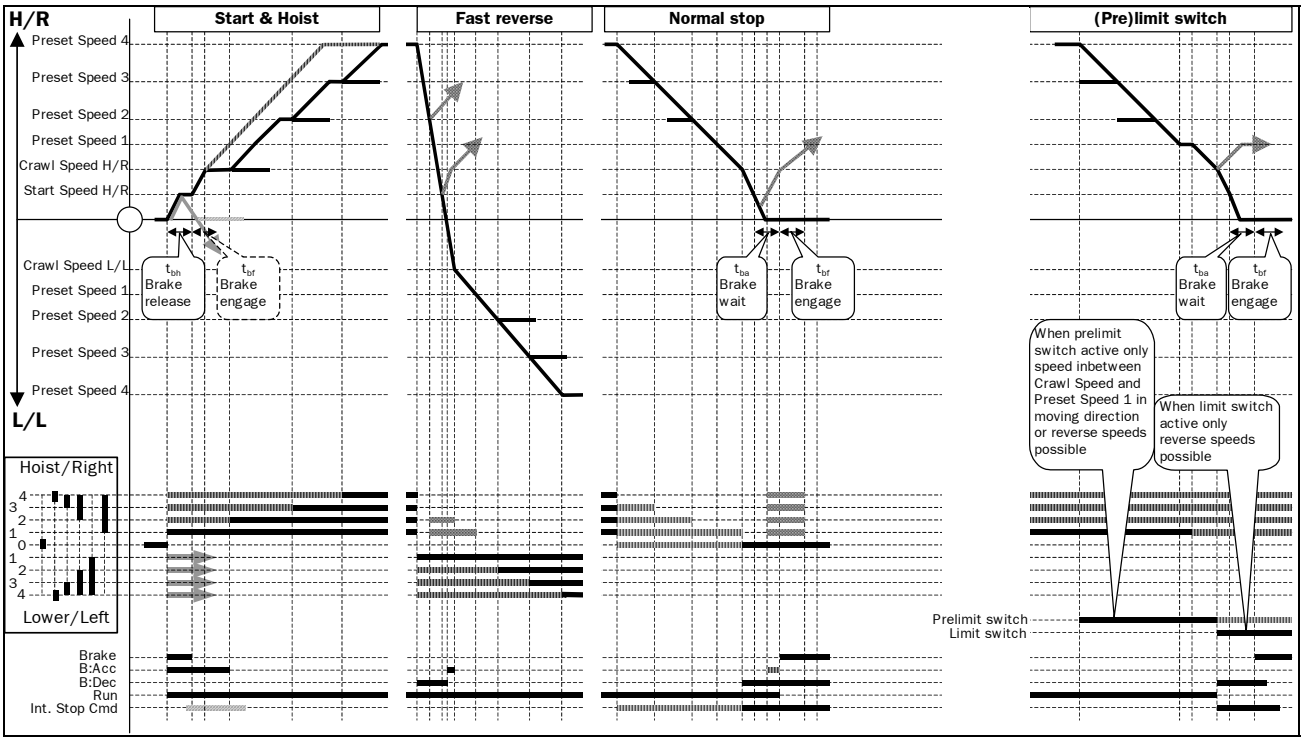


Fig. 21: General diagram for 4-Speed controller operation.

7.1 Windows for setting the speeds for 4-Speed controller operation

Window	Function
282	**4-Speed**

326	Prelimit switch speed
327	Preset Speed 2
328	Preset Speed 3
329	Preset Speed 4
32A	Crawl Speed H/R
32B	Crawl Speed L/L
32I	Start Speed

7.2 Windows for setting the brake functions

Window	Function/Selection
317	tbh Brake Release time
318	tbf Brake Engage time
319	tba Brake Wait time

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must connected to +24VDC (or 230V for Crane Interface) when not used.

7.3 Connection example for 4-Speed controller operation

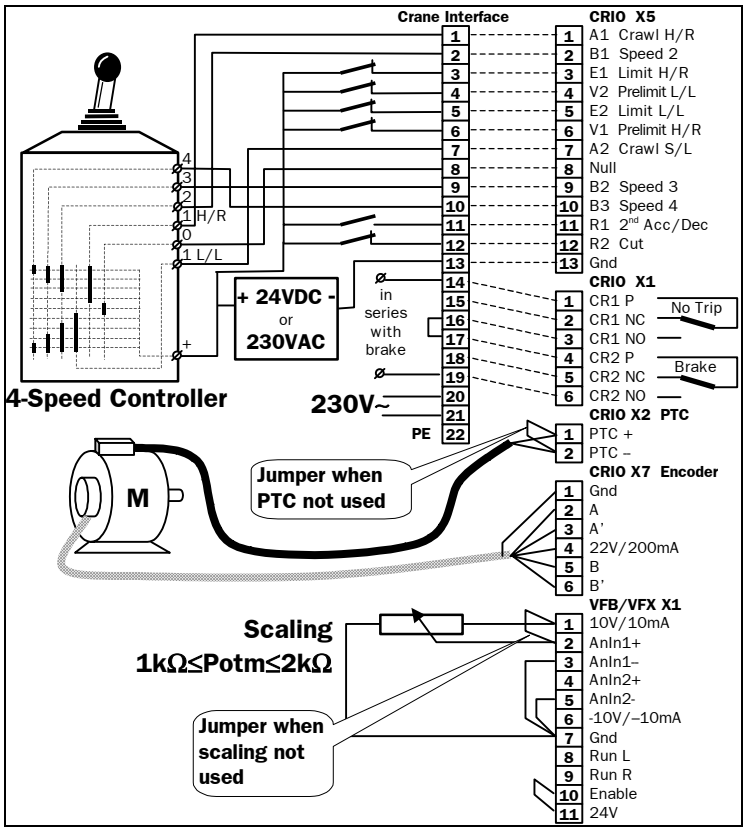


Fig. 22: Connection diagram for 4-Speed controller operation

8. 3-POS SWITCH OPERATION

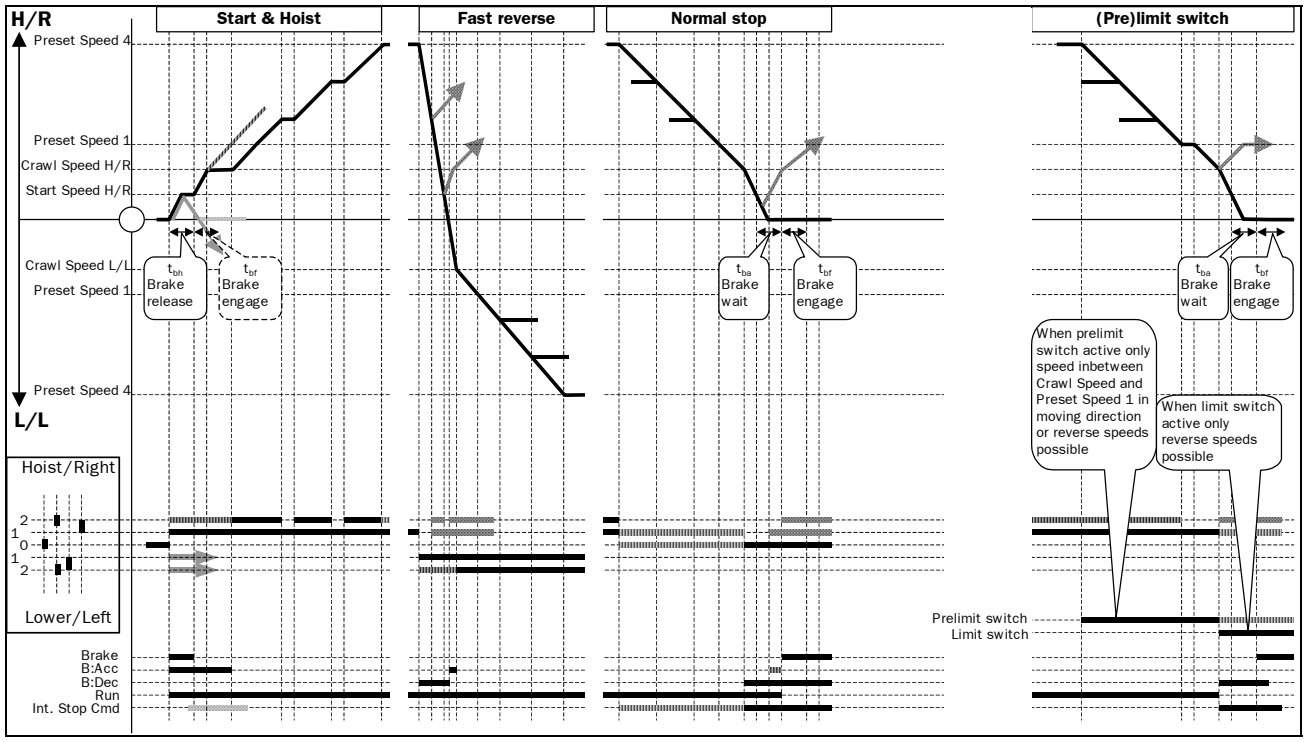


Fig. 23: General diagram for 3-position switch operation.

8.1 Windows for setting the speeds for 3-Position switch operation

Window	Function/Selection
282	3-Position

326	Prelimit switch speed
329	Preset Speed 4
32A	Crawl Speed H/R
32B	Crawl Speed L/L
32I	Start Speed

8.2 Windows for setting the brake functions

Window	Function/Selection
317	tbh Brake Release time
318	tbf Brake Engage time
319	tba Brake Wait time

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must connected to +24VDC (or 230V for Crane Interface) when not used.

8.3 Connection example for 3-Position switch operation

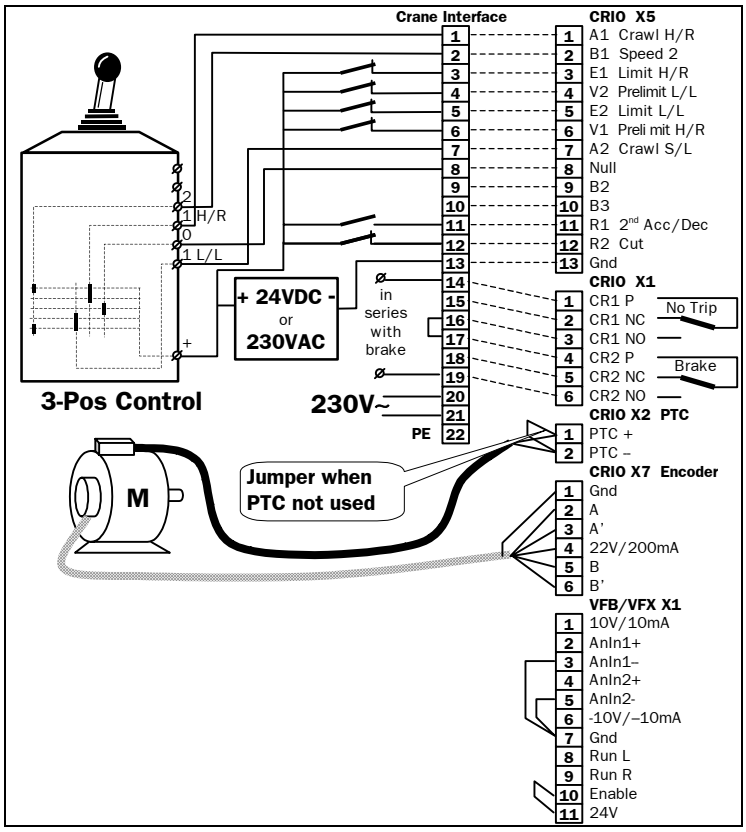


Fig. 24: Connection diagram for 3-Position switch operation

9. ANALOGUE CONTROL

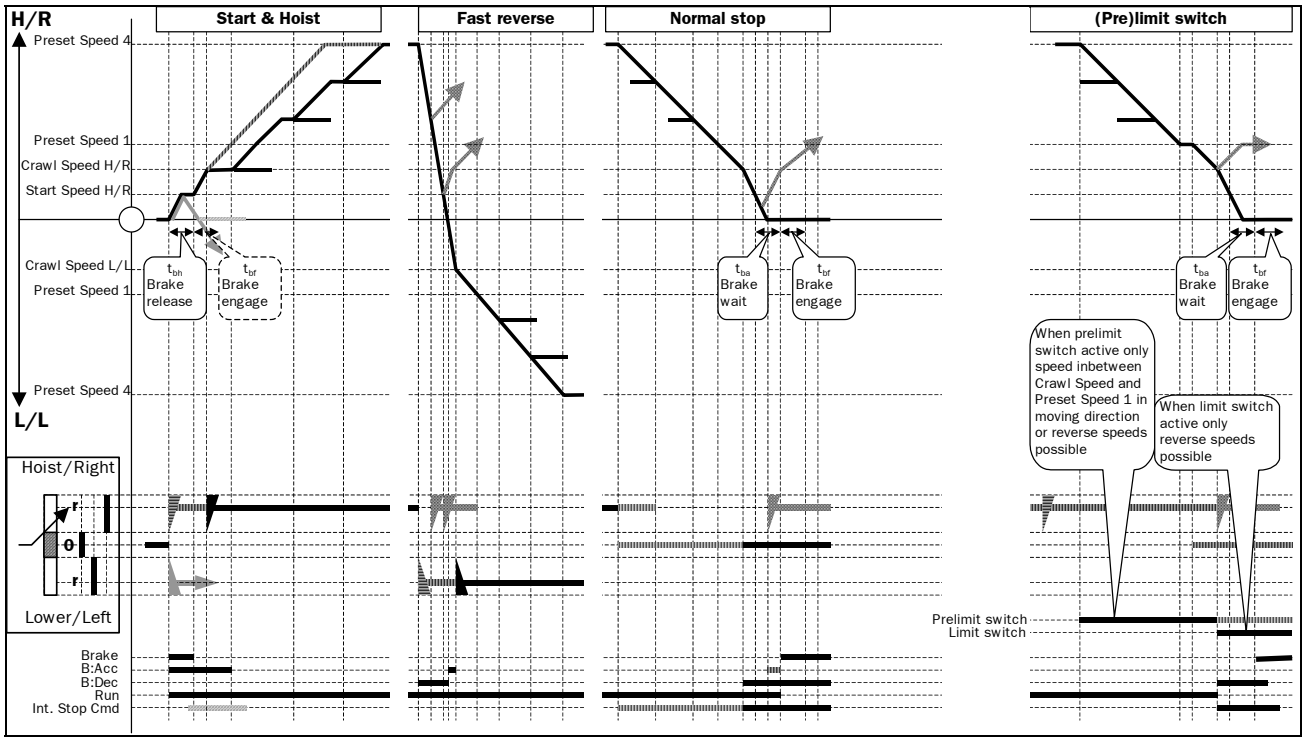


Fig. 25: General diagram for analogue control operation.

9.1 Windows for setting up analogue control operation

Window	Function/Selection
282	Analogue

326	Prelimit switch speed
329	Preset Speed 4
32A	Crawl Speed H/R
32B	Crawl Speed L/L
32I	Start Speed

9.2 Windows for setting the brake functions

Window	Function/Selection
317	tbh Brake Release time
318	tbf Brake Engage time
319	tba Brake Wait time

9.3 Window for AnIn1 Setup

Window	Function/Selection
412	2-10V/4-20mA (if 4-20mA to be selected)

NOTE! The inputs E1, E2, V1, V2, R2 and NULL must connected to +24VDC (or 230V for Crane Interface) when not used.

9.4 Connection example for 4-20mA analogue control operation

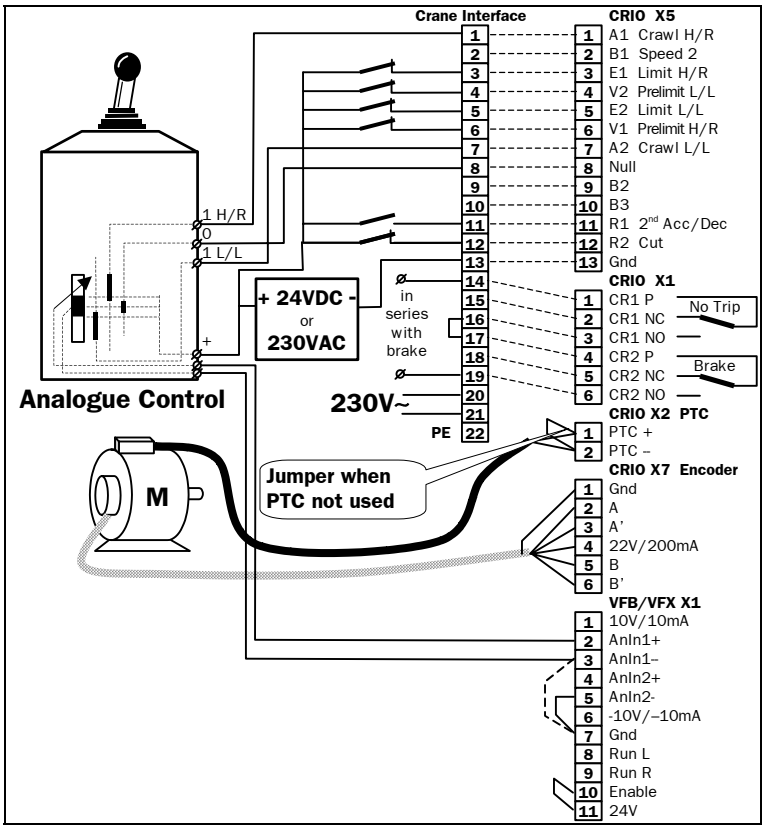


Fig. 26: Connection diagram for 4-20mA analogue control operation

10. SETUP MENU LIST

VFB/VFX type	
Serial number	
Software version VFB/VFX	
Software version CRIO	
Brake resistor P [kW]	
R [Ω]	
δ [%]	
Motor type	
Encoder type	

Name
Date
Company
Project
Drive

Bold = Changed default for CRIO
Deviation function activated by **J101**. (For hoisting applications strongly recommended).
Select window 211 Drive Mode = V/Hz Mode for multi-motor operation (for riding applications). For hoisting applications multi-motor operation is not recommended.

				Default	Custom	
100	**START-UP WINDOW**					
	110	* 1st Line		Speed		
	120	* 2nd Line		Torque		
200	**MAIN SETUP**					
	210	Operation				
		211	Drive Mode	Speed		Set to V/Hz for multi-motor operation (riding only!)
		212	Ref Control	**Option**		Automatically when CRIO=On [281]
		213	Run/Stop Ctrl	**Option**		Automatically when CRIO=On [281]
		214	Rotation	R+L		
		215	Level/Edge	Level		
	220	Motor Data				
		221	Motor Power	P_{NOM}		
		222	Motor Voltage	U_{NOM}		
		223	Motor Frequency	50		
		224	Motor Current	I_{NOM}		
		225	Motor Speed	n_{MOT}		
		226	Motor Cosphi	(P_{NOM})		Depends on P_{NOM}.
		227	Motor Ventilation	Self		
		228	Motor ID-run	Off		Use short ID-run only!
	230	Utility				
		231	* Language	English		
		232	* Lock Code?	0291		Locking after Set up recommended.
		233	* Copy Set	A>B		After setting up Copy B>A.
		234	* Select Set	A		
		235	Load Default	A		
		236	* Copy to CP	CPM1		
		237	CP>All Sets	CPM1		
		238	CP>Active Set	CPM1		
		239	CP>Settings	CPM1		
	240	Auto restart				
		241	Number of trips	0		
		242	Overtemperature	No		
		243	Overcurrent	No		
		244	Overvoltage D	No		
		245	Overvoltage G	No		
		246	Overvoltage L	No		
		247	Motortemp	No		
		248	External trip	No		
		249	Motor lost	No		

			Default	Custom		
	24A	Alarm	No			
	24B	Locked rotor	No			
	24C	Power fault	No			
250	Option: Encoder					Commission first without encoder,
	251	Encoder	Off			Then activate encoder (when connected), when inverter
	252	Encoder pulses	1024			in torque limit. Test the signals.
260	Option: Serial Communication					
	261	Baud rate	9600			
	262	Address	1			
270	Option: PTC card					
	271	PTC Card	Off			On when PTC connected to CRIO X2.
280	Option: CRIO Card					
	281	CRIO Card	**Off**			
	282	CRIO Control	**4speed**			Control selection.
	283	CRIO Relay 2	**Brake**			For control of mechanical brake.
	284	Dev. Time	**200**			Deviation time
	285	Set Load	**100**			Above this load the field weakening operation is active
300	**PARAMETER SETS**					
310	* Run/Stop			**A**	**B**	
	311	* Acc Time	2			Increase to suit application.
	312	* Acc Ramp	Lin			S-Curve may be advantageous.
	313	* Dec Time	2			Increase to suit application.
	314	* Dec Ramp	Lin			S-Curve may be advantageous.
	315	* Start Mode	Normal			
	316	* Stop Mode	Decel			
	317	* tbh Brake rel.	**0.5**			Time to release mechanical brake.
	318	* tbf Brake eng.	**0.5**			Time to engage mechanical brake.
	319	* tba Wait brake	**0.5**			Time to hold the load before mechanical brake engages.
	31A	* Vector brake	Off			
	31B	* Q-Stop time	0.0			
	31C	* Spin start	Off			
320	* Speeds					
	321	* Min Speed	0			Must remain set to 0rpm!
	322	* Max Speed	Sync			
	323	* Min Spd Mode	Scale			
	324	* Speed Direction	R+L			
	325	* MotPot function	Nonvola			
	326	* Preset Speed 1	**100**			Prelimit switch speed
	327	* Preset Speed 2	**600**			Preset Speed 2
	328	* Preset Speed 3	**1000**			Preset Speed 3
	329	* Preset Speed 4	**1500**			Preset Speed 4
	32A	* Preset Speed 5	**150**			Crawl speed H/R
	32B	* Preset Speed 6	**150**			Crawl Speed L/L
	32C	* Preset Speed 7	**100**			Deviation bandwidth
	32D	* Skip Spd 1 LO	0			
	32E	* Skip Spd 1 HI	0			
	32F	* Skip Spd 2 LO	0			
	32G	* Skip Spd 2 HI	0			
	32H	* Jog Speed	50			
	32I	* Start Speed	**10**			Speed during tbh Brake Release Time
330	* Torques					
	331	* Max Torque	150			
340	* Controllers					
	341	* Spd PI Auto	Off			
	342	* Speed P Gain	5.0			To suit application.

			Default	Custom	
	343	* Speed I Time	0.1		To suit application.
	344	* Flux Optimise	Off		
	345	* PID Controller	Off		
	346	* PID P Gain	1.0		
	347	* PID I Time	1.00		
	348	* PID D Time	0.00		
350	* Limits/Protections				
	351	* Low Volt OR	Off		On when Mains Dips expected.
	352	* Rotor locked	Off		
	353	* Motor lost	**Trip**		Safety item for hoisting drives
	354	* Motor I^2t Type	Trip		
	355	* Motor I^2t I	I_{NOM}		
	356	* OverV Ctrl	On		Set to Off when braking by brake resistor only
400	**I/O**				
410	Analogue Inputs				
	411	AnIn1 Function	Speed		Used for Analogue Control or scaling.
	412	AnIn1 Set up	0-10V/ 0-20mA		
	413	AnIn1 Offset	0		
	414	AnIn1 Gain	1.00		
	415	AnIn1 Bipolar	Off		
	416	AnIn2 Function	Off		
	417	AnIn2 Set up	0-10V/ 0-20mA		
	418	AnIn2 Offset	0		
	419	AnIn2 Gain	1.00		
	41A	AnIn2 Bipolar	Off		
420	Digital Inputs				
	421	DigIn 1	Off		
	422	DigIn 2	Off		
	423	DigIn 3	Off		
	424	DigIn 4	Off		
430	Analogue Outputs				
	431	* AnOut 1 Funct	Speed		
	432	* AnOut 1 Set up	0-10V/ 0-20mA		
	433	* AnOut 1 Offset	0		
	434	* AnOut 1 Gain	1.00		
	435	* AnOut 1 Bipolar	Off		
	436	* AnOut 2 Funct	Torque		
	437	* AnOut 2 Set-up	0-10V/ 0-20mA		
	438	* AnOut 2 Offset	0		
	439	* AnOut 2 Gain	1.00		
	43A	* AnOut 2 Bipolar	Off		
440	Digital Outputs				
	441	* DigOut 1 Funct	Run		
	442	* DigOut 2 Funct	Brake		
450	Relays				Relays on Control Board.
	451	* Relay 1 Funct	Ready		
	452	* Relay 2 Funct	Trip		
500	**SET/VIEW REFERENCE VALUE**				
600	**VIEW OPERATION**				
610	Speed				
620	Torque				
630	Shaft power				
640	Electrical power				

			Default	Custom	
	650	Current			
	660	Voltage			
	670	Frequency			
	680	DC-Link Voltage			
	690	Heat sink temperature			
	6A0	FI Status			Displays the inverter status.
	6B0	Digital input status			Displays status of Digital Inputs on Control Board.
	6C0	Analogue input status			Displays the status of the Analogue Inputs.
	6D0	Run Time			
	6D1	* Reset RUN Tm	No		
	6E0	Mains Time			
	6F0	Energy			
	6F1	* Reset Energy	No		
	6G0	Process Speed			
	6G1	* Set Prc Unit	None		
	6G2	* Set Prc Scale	1.000		
	6H0	Warnings			Displays the actual warning.
700	**VIEW TRIP LOG**		**Cause**	**Time**	
	710	Trip 1			
	720	Trip 2			
	730	Trip 3			
	740	Trip 4			
	750	Trip 5			
	760	Trip 6			
	770	Trip 7			
	780	Trip 8			
	790	Trip 9			
	7A0	Trip 10			
	7B0	Reset Trip Log	No		
800	**MONITOR**				
	810	Alarm Functions			
	811	* Alarm select	Off		
	812	* Ramp enable	Off		
	813	* Start delay	2		
	814	* Alarm delay	0.1		
	815	* Auto Set	No		
	816	* Max Alarm	150		
	817	* Max Pre-alarm	110		
	818	* Min Alarm	0		
	819	* Min Pre-alarm	90		
	820	Comparators			
	821	* CA1 Value	Speed		
	822	* CA1 Constant	300rpm		
	823	* CA2 Value	Torque		
	824	* CA2 Constant	10%		
	825	* CD1	Run		
	826	* CD2	DigIn1		
	830	Logic Y			
	831	* Y Comp 1	CA1		
	832	* Y Operator 1	&		
	833	* Y Comp 2	!A2		
	834	* Y Operator 2	&		
	835	* Y Comp 3	CD1		
	840	Logic Z			
	841	* Z Comp 1	CA1		
	842	* Z Operator 1	&		

			Default	Custom
	843	* Z Comp 2	!A2	
	844	* Z Operator 2	&	
	845	* Z Comp 3	CD1	
900	**VIEW SYSTEM DATA**			
	910	Inverter Type		
	920	Software		

NOTE! At starting the inverter with CRIO operates in Parameter Set B, because the 2nd Ramps are active. After setting up, Parameter Set B is to be copied in Parameter Set A, see window 233 and, if necessary, the different settings for Parameter Set B can be programmed.

NOTE! When different maximum speeds are programmed, the largest one should be programmed in Parameter Set A. It is however recommended to keep all parameters in Parameter Set A and B equal and, if necessary, to only make the acceleration time [311] and deceleration time [313] different.

11. INDEX

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REPRESENTATIVES

Emotron AB
Box 222 25
SE-250 24 HELSINGBORG
Sweden
Tel. +46 42 169900
Fax +46 42 169949

Emotron Antriebssysteme GmbH
Goethestrasse 6
D-38855 WERNIGERODE
Germany
Tel. +49 3943 92050
Fax +49 3943 92055

Emotron B.V.
P.O. Box 132
5530 AC BLADEL
The Netherlands
Tel. +31 497 389222
Fax +31 497 386275

Emotron Drives (UK) Ltd
Unit 18 Steel fabs Industrial Est
Victoria Crescent, Burton on Trent
Staffordshire, DE14 2QD
Tel. +44 1283 500 808
Fax +44 1283 500 420

Emotron El-Fi SA
Aribau 229, Ent 1a
E-08021 BARCELONA
Spain
Tel. +34 93 209 14 99
Fax +34 93 209 12 45

Emotron Inc.
3440 Granite Circle
TOLEDO, OH 43617
USA
Tel. +1 (419) 841-7774
Fax +1 (419) 843-5816

K.K. El-Fi
2-18-4 Hagoromocho
0900021 Tachakawa
J-TOKYO
Japan
Tel. +81 42 528 8820
Fax +81 42 528 8821

For more information please contact your local sales outlet or Emotron company, or visit our website

www.emotron.com