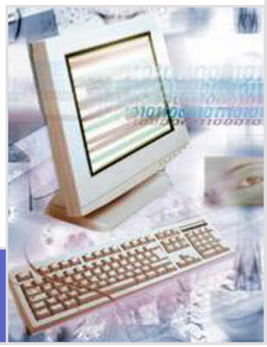
Help

DCC800

DC Drives



Crane software features, part 1 G567e Part 2

eLearning

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BasicCraneFeatures_01R0101. page 1

Welcome to the crane software features training module part 1 for the DCS800, ABB DC drives.

If you need help navigating this module, please click the Help button in the top right-hand corner. To view the presenter notes as text, please click the Notes button in the bottom right corner.

Help

DCC800 Crane training overview

- Module 1:
  Crane Drive Basics
- Module 2:
  Crane software features 1
- Module 3:
  Crane software features 2
- Exercise:
  Commissioning of a crane drive

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BasicCraneFeaturesS01R0101. page 2

The following is an overview of DCC800 crane training modules.

- Module 1 is about crane drive basics
- Module 2 is part 1 of crane software features
- Module 3 is part 2 of crane software features
- The last part is an exercise, which describes the commissioning process of a crane drive.

Help

Objectives

This module is about:

- Used parameter groups for crane drives
- Software hierarchy
- Crane stand-alone mode
- Crane fieldbus control
- Control logic of crane drive
- Radio control and step joystick mode

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BasicCraneFeaturesS01R0101. page 3

This module is about:

- Used parameter groups for crane drives
- Software hierarchy
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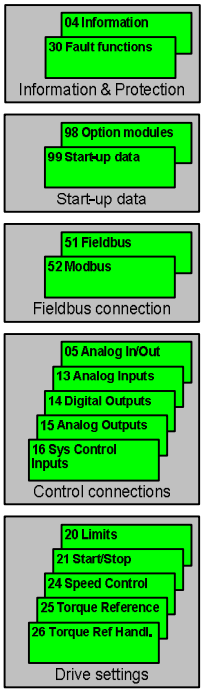
- Crane fieldbus control mode
- Control logic of crane drive
- Radio control and step joystick mode

Help

Parameter groups (1)



- Information & Protection
- Start-up data
- Fieldbus connection
- Control connections
- Drive settings

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BasicCraneFeaturesS01R0101. page 4

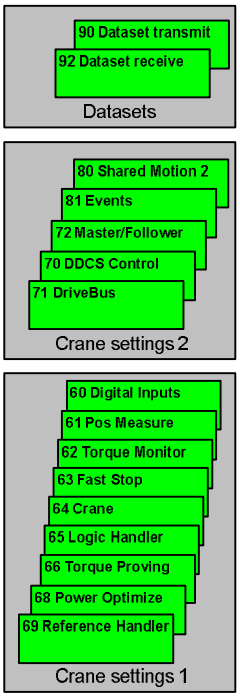
The Crane drive uses most of the parameter groups from the standard firmware.

They can be split into information & protection, start-up data, fieldbus connection, control connections and principal drive settings. A detailed description of these parameters can be found in the DCS800 firmware manual.

Note that the number of used crane functions depends on the crane type and the requirements.

Help

Parameter groups (2)



- Datasets
- Crane settings 1
- Crane settings 2

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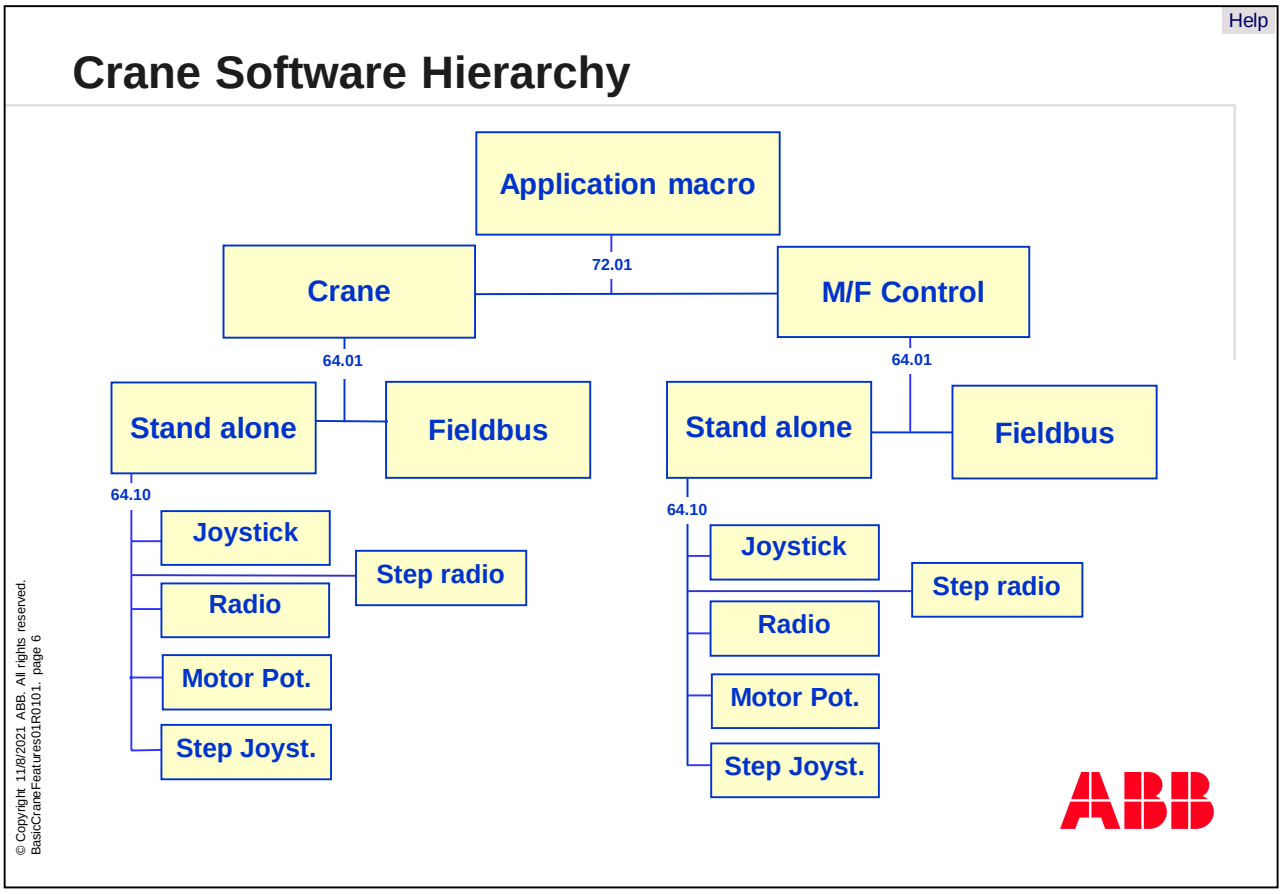
BasicCraneFeatures01R0101. page 5

Further parameter groups are used to transfer the datasets coming from the overriding control system to the correct destination. Actual values will also be sent via datasets back to the external PLC.

Dedicated crane drive settings are possible in parameter groups 60 to 69. Further crane settings can be modified in groups 70 to 81. Please read the crane drive manual for more information about the functionality of those parameters.

Note that parameter groups 60 to 69 as well as 80 to 81 are only visible when the Memory Card with the crane software is activated, because these are special crane drive parameters in addition to the standard firmware parameters.



The software hierarchy for the crane drive is displayed on the slide.

- The first step is to set-up the application macro with parameter 72.01 between master-follower control and crane control.
- If crane control is activated, parameter 64.01 is used to select between stand-alone mode, which means the crane control is done via the drive, or fieldbus mode, which means the crane control is outside the drive in an external PLC.
- In stand-alone mode parameter 64.10 selects the main control mode
    - Joystick,
    - Step radio,
    - Radio,
    - Motor potentiometer or
    - Step joystick

The same selection applies for the master-follower control.

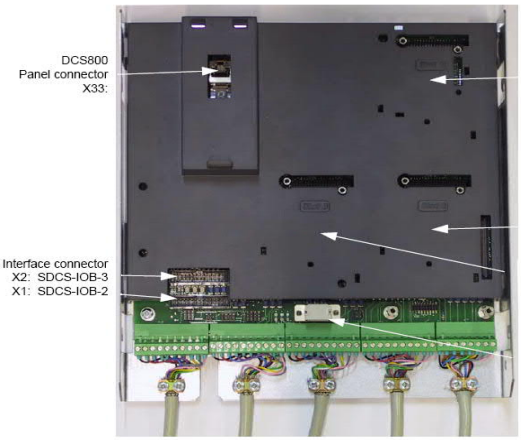
A detailed explanation of the crane modes will be given in the following slides.

Help

Alternative control locations

Location R-Extension and Interface Modules

Connect the signal cables as described below. Tighten the screws to secure the extension modules.



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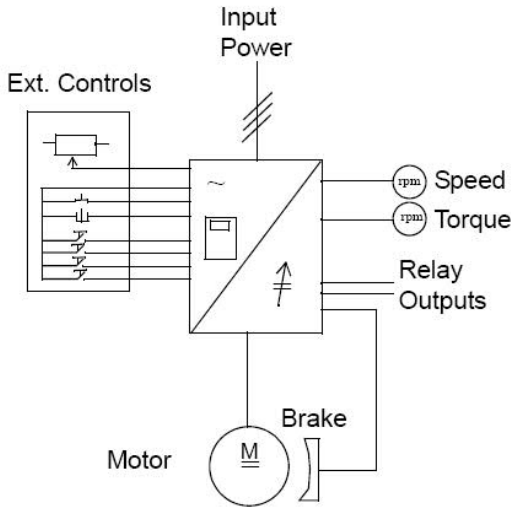
BasicCraneFeatures01R0101. page 7

The DCS800 provides alternative control locations, which can be found on the CON-4 board.

- Slot 1 is used to connect fieldbus adapters or extension modules from the R-series.
- Slot 2 and 3 can be also used to connect extension modules from the R-series.
- Slot 3 is the only slot used to connect the COM-8 interface board for DDCS communication.
- Connectors X1 and X2 are used to connect the flat cables to the IOB-2 and IOB-3 boards.
- X33 and X34 are connectors for the DCS800 control panel and the DriveWindow light tool, as well as the firmware download tool.

Help

Stand alone mode



- Enable Stand-Alone-Mode if P64.01 = TRUE
- Everything that is necessary for crane control is inside the drive
- Drive control by connected
  - Analog inputs
  - Digital inputs
  - DCS800 Control Panel
- Mechanical brake control
- Analog outputs are used to show
  - Actual Speed
  - Actual Torque

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BasicCraneFeatures01R0101. page 8

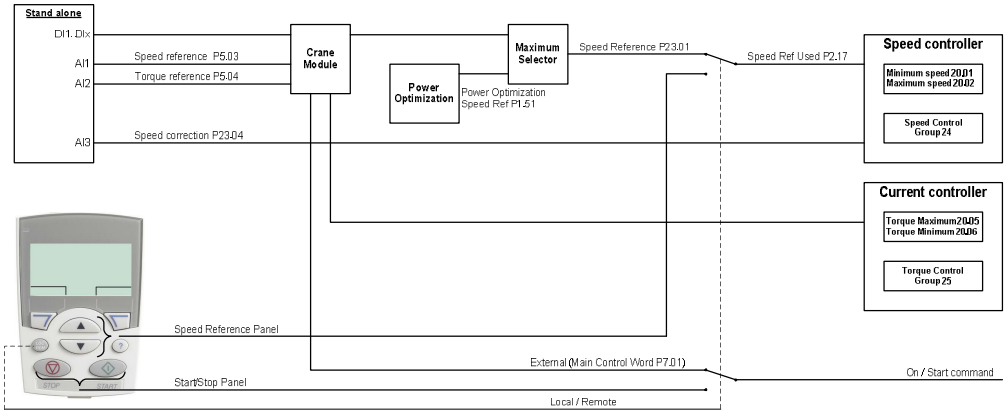
The crane drive can be used as a standalone solution, if parameter 64.01 is set to TRUE. Everything that is necessary for crane drive control is inside the drive. All drive commands and reference settings can be given from analog inputs, digital inputs or alternatively from the DCS800 control panel. The active control location is selected with the LOC/REM key on the DCS800 control panel. The drive is then speed controlled. In external controls, the control location is the basic I/O. The reference signal is connected to analog input 1 and ON and START. Direction signals are generated from digital inputs 2 to 8.

The mechanical brake is controlled by a digital output and the brake acknowledgement is connected to a digital input.

Analog outputs are used to show the actual speed and torque or current.

Help

Signal overview for stand alone mode



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BasicCraneFeaturesS01R0101. page 9

The principle software overview for standalone mode is shown in the picture. The crane drive software uses the standard DCS800 firmware. Therefore for the stand-alone-mode, the digital inputs and the analog inputs of the drive will be used to control the drive.

The crane module, the power optimization module and the maximum selector are special crane software functions, which are available on the crane software memory card. The result of the maximum selector will be written to speed reference parameter 23.01. Additionally, analog input 3 can be used for speed correction. This writes directly to parameter 23.04.

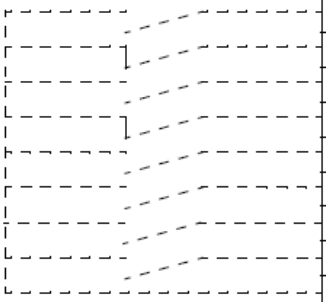
Start and on command coming from the crane module are connected to main control word, parameter 7.01.

The drive can also be handled by DCS800 control panel, if the panel is set to local mode. Then the start command and speed reference are given by the panel.

Help

Connection of digital inputs (1)

Connections at the I/O boards in Stand alone mode, Joystick control



Terminal IOB-21 & CON-4		Function
X6:1	DI 1	Converter Fan ackn.
X6:2	DI 2	Zero Pos
X6:3	DI 3	Main Contactor Ackn.
X6:4	DI 4	Electrical disconnect
X6:5	DI 5	Programmable
X6:6	DI 6	Brake ackn. (def.)
X6:7	DI 7	Start Dir A
X6:8	DI 8	Start Dir B
X7:3,4	+48 V	IOB-21: 48 Vdc, max 50 mA
X6:9	+48 V	CON-4: 48 Vdc, max 50 mA

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BasicCraneFeatures01R0101. page 10

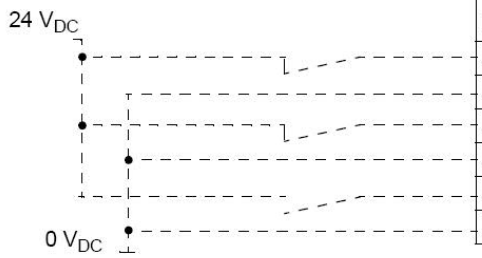
The digital inputs are used to connect control to the drive and to connect acknowledge signals from contactors.

Note that electrical disconnect and start commands direction A and B are fixed inputs. All other inputs can be freely programmed via parameters.

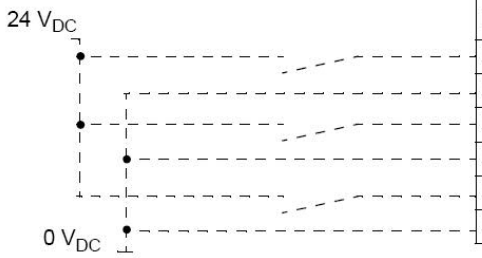
The IOB-21 board is used for galvanic isolated inputs. CON-4 board connections are not always isolated and connected with ground.

Help

Connection of digital inputs (2)



Terminal RDIO-xx		Function
X11:1	DI 9	Slow down limits = Slowdown-N
X11:2		
X12:1	DI 10	Fast stop-N
X12:2		
X12:3	DI11	STEP REF 2
X12:4		



Terminal RDIO-xx		Function
X11:1	DI 12	STEP REF 3
X11:2		
X12:1	DI 13	STEP REF 4
X12:2		
X12:3	DI14	
X12:4		

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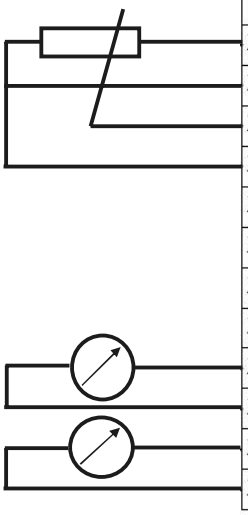
BasicCraneFeatures01R0101. page 11

For additional inputs, there is the possibility of expanding the digital inputs with option modules from type RDIO. The functionality of these inputs can be selected via parameters in group 60.

Two examples are step joystick mode and radio step joystick mode.

Help

Connection of analog inputs



Terminal IOB-3	Terminal CON-4		Function
X4:7	X4:4	Vref.	Reference voltage 10 VDC max 5 mA
X4:8	X4:3	GND	
X3:4	X3:6	AI 1+	Speed reference 0…10V <-> 0 …100%
X3:3	X3:5	AI 1-	
X3:6	X3:8	AI 2+	Torque reference 0…10V <-> 0 …Tmax
X3:5	X3:7	AI 2-	
X3:8	X3:10	AI3+	Speed Correction +/-10V <-> +/- 100%
X3:7	X3:9	AI3-	
X4:1	X4:7	AO1+	Speed -10V … +10V <-> -100 …100%
X4:2	X4:6	AO1-	
X4:3	X4:8	AO2+	Torque -10V …+10V <-> -Tn…+Tn
X4:4	X4:6	AO2-	

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BasicCraneFeaturesS01R0101. page 12

In stand-alone mode the analog inputs and outputs of the drive are used. There is the possibility of using the terminal block at the CON-4 board not potential-isolated or potential-isolated by optocouplers at the IOB-3 board.

The speed reference is given as an analog value by a potentiometer, which is connected to analog input 1. Note that the potentiometer only works unipolarly.

For a torque reference, a second potentiometer can be connected to analog input 2. This signal also only works unipolarly.

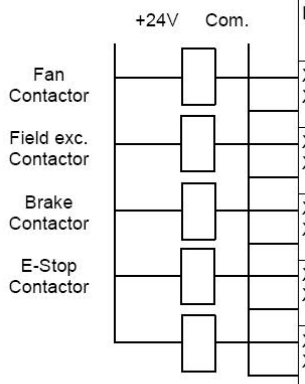
Analog input 3 is used for speed correction. This analog value works bipolarly to correct the speed in both directions.

To show the actual speed, a meter can be connected to analog output 1. This meter should be scaled for +/- 10 volts.

A second meter can be connected to analog output 2 to show the actual torque.

Help

Connection of digital outputs for stand-alone



Terminal IOB-21		Function
X4:1 X4:2	DO 1	Converter Fan order
X4:3 X4:4	DO 2	Field exciter order
X4:5 X4:6	DO 3	Main Contactor order X4:6
X4:7 X4:8	DO 4	Brake lift 1 (def.)
X5:1 X5:2	DO 5	Watchdog_N (def.)
X5:3 X5:4	DO 6	"programmable" (transistor output)
X5:5 X5:6	DO 7	"programmable" (transistor output)
X5:7 X5:8	DO 8	Brake lift 2 (def.)

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BasicCraneFeatures01R0101. page 13

As a default setting some outputs are predefined. But basically, all outputs can be configured by parameters. If using the IOB-2 board outputs, 1 to 5 and 8 are relay outputs. Output 6 and 7 are optocoupler outputs.

- DO 1 is connected to converter fan
- DO 2 is connected to field exciter contactor
- DO 3 is connected to main contactor
- DO 4 is used for brake lift 1 command
- DO 5 is used for watchdog monitoring
- DO 6 and 7 can be programmed freely
- DO 8 is used for brake lift 2 command

Help

Input and output signals overview

Input signals	Param.	Output signals	Parameter
Converter fan ackn. (DI1)	42.04	Analogue Output AO1: Not selected	15.01
Zero Pos: (DI2)	60.12	Analogue Output AO2: Not selected	15.06
Main contactor ackn. (DI3)	10.21	Relay Output DO4: Brake Lift 1	14.07
Electrical disconnect: (DI4)	Fixed	Relay Output DO5: Watchdog-N	14.09
Brake Ackn 1: (DI6)	10.08		
Start Dir A: (DI7)	Fixed		
Start Dir B: (DI8)	Fixed		
Slow Down-N: (DI9)	60.03		
Fast Stop-N: (DI10)	60.04		
Speed Rf: (AI1)	Fixed		
Torque Ref: (AI2)	Fixed		
Speed Corr: (AI3)	Fixed		

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BasicCraneFeatures01R0101. page 14

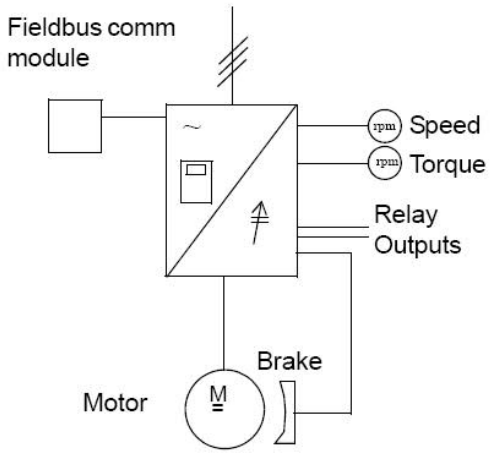
The crane program uses some input and output signals, which are defined by the program.

Input signals are acknowledge signals of converter fan, main contactor and mechanical brake. Commands coming from the joystick like zero position, electrical disconnect, start command direction A or B, slow down command and fast stop can also be connected to digital inputs. Speed reference and torque reference values as well as speed correction signals will be connected to analog inputs of the drive.

Analog outputs can be defined via parameters to show for example actual speed and torque. Relay outputs can be used for brake lifting and watchdog signals.

Help

Fieldbus mode



- Disable Stand-Alone-Mode if P64.01 = FALSE
- Control program for the crane is outside the drive in an external PLC
- Mechanical brake control
- Relay outputs are used
- Analog outputs can be used to show
  - Actual Speed
  - Actual Torque

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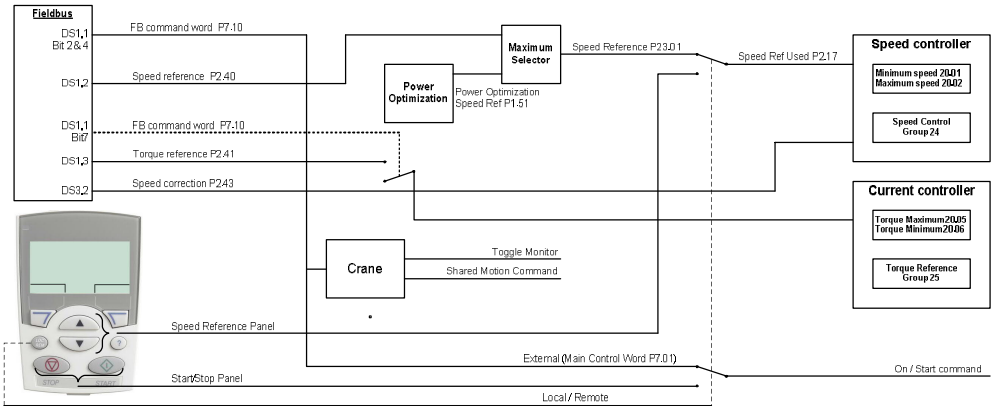
BasicCraneFeatures01R0101. page 15

The crane drive can be operated in fieldbus mode, if the stand-alone mode is disabled. The control program of the crane is in an external PLC outside the drive. But the mechanical brake control is run by the drive logic. The relay outputs are also used to connect acknowledge signals and control contactors. The analog outputs of the drive can be used to show actual speed and actual torque.

Help

Signal overview for fieldbus mode



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BasicCraneFeatures01R0101. page 16

The principle software overview of fieldbus mode is shown in the picture. The crane drive software also uses the standard DCS800 firmware. The control program for the crane is in an external PLC, which is connected to the DCS800. The drive is controlled via datawords, which are transferred between external PLC and Drive. Actual signals will be sent back from the drive to the PLC to do monitoring.

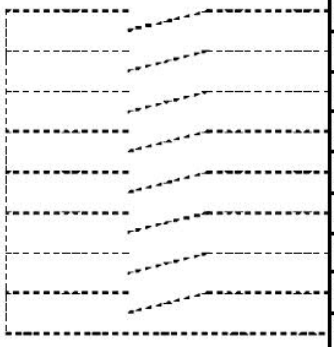
The power optimization module and the maximum selector are special crane software functions, which are available on the crane software DCC800 Memory Card. The result of the maximum selector will be written to speed reference parameter 23.01.

On and start commands sent from the crane module are connected to main control word, parameter 7.01.

The drive can also be controlled by the DCS800 control panel, if the panel is set to local mode. Then start command and speed reference are given by the panel.

Help

Connection of digital inputs for fieldbus



Terminal IOB-21 & CON-4		Function
X6:1	DI 1	Converter Fan ackn. (def.)
X6:2	DI 2	SnagLoad-N (def.)
X6:3	DI 3	Main Contactor Ackn. (def.)
X6:4	DI 4	Electrical disconnect (Fixed)
X6:5	DI 5	"programmable"
X6:6	DI 6	Brake Acknowledge 1 (def.)
X6:7	DI 7	Sync. (def.)
X6:8	DI 8	Brake Acknowledge 2 (def.)
X7:3,4	+48V	IOB-21: 48Vdc, max 50 mA
X6:9	+48V	CON-4: 48Vdc, max 50 mA

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BasicCraneFeaturesS01R0101. page 17

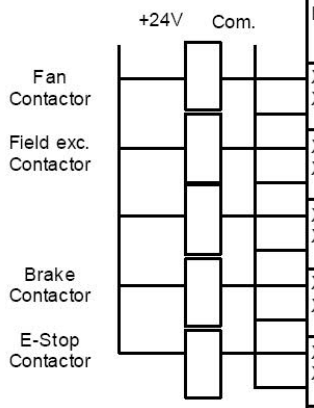
In fieldbus control mode the digital inputs are only used to connect acknowledge signals. The basic crane control comes from the fieldbus via datawords.

- Digital input 1 is connected to converter fan acknowledge
- Digital input 2 is connected to snag-load detection. If snag-load will be detected, fast stop 2 mode will be activated as option.
- Digital input 3 is connected to main contactor acknowledge
- Digital input 4 is connected to electrical disconnect button
- Digital input 5 can be freely programmed
- Digital input 6 is connected to brake acknowledge signal motor 1
- Digital input 7 is connected to synchronization command
- Digital input 8 is connected to brake acknowledge signal motor 2 only for shared motion

Note, some of these inputs are fixed and some can be programmed depending on the functionality needed.

Help

Connection of digital outputs for joystick



Terminal IOB-21		Function
X4:1 X4:2	DO 1	Converter Fan order (def.)
X4:3 X4:4	DO 2	Field exciter order (def.)
X4:5 X4:6	DO 3	Main Contactor order (def.)
X4:7 X4:8	DO 4	Brake Lift 1 (def.)
X5:1 X5:2	DO 5	Watchdog_N (def.)
X5:3 X5:4	DO 6	"programmable" (transistor output)
X5:5 X5:6	DO 7	"programmable" (transistor output)
X5:7 X5:8	DO 8	Brake Lift 2 (def.)

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BasicCraneFeatures01R0101. page 18

In principle, the connection of digital outputs can be programmed freely. For the crane application some of the outputs are preselected.

- Digital output 1 is connected to converter fan contactor order
- Digital output 2 is connected to field exciter contactor order
- Digital output 3 is connected to main contactor order
- Digital output 4 is connected to brake lift motor 1 order
- Digital output 5 is connected to watchdog monitoring
- Digital output 6 and 7 can be freely programmed and
- Digital output 8 is connected to brake lift motor 2 order

Help

Input and output signals overview

Input signals	Param.	Output signals	Param.
Converter fan ackn. (DI1)	10.20	Analogue Output AO1: Not selected	15.01
SnagLoad-N: (DI2)	60.12	Analogue Output AO2: Not selected	15.06
Main contactor ackn. (DI3)	10.21	Relay Output DO4: Brake Lift 1	14.07
Electrical disconnect: (DI4, Fixed)	10.08	Relay Output DO5: Watchdog-N	14.09
Brake Ackn 1: (DI6)	42.02	Relay Output DO8: Brake Lift 2	14.15
Sync: (DI7)	60.06		
Brake Ackn 2: (DI8)	49.29		

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BasicCraneFeaturesS01R0101. page 19

Here is an overview about important input and output signals.

- Input signals are connected to digital inputs.

In principle these are:

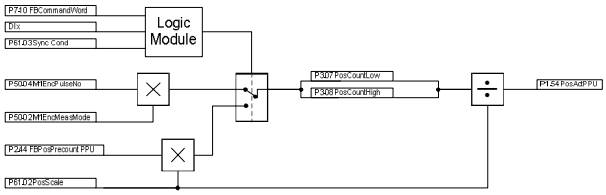
- Converter fan acknowledge
- Snag Load
- Main contactor acknowledge
- Electrical disconnect
- Brake acknowledge 1
- Synchronization command
- Brake acknowledge 2

Important output signals are connected to analog and digital outputs:

- Analog output 1 and 2 are unused
- Brake lift 1
- Watchdog
- Brake lift 2

Help

Position measurement



- Measure actual position from a pulse encoder
- Functionality is available
  - Stand-alone mode
  - Fieldbus mode
- Synchronization via
  - Hardware command
  - Fieldbus command

$$P61.02 = \frac{\text{motor speed} \cdot P50.04 \cdot P50.02}{\text{linear speed}}$$

Example:

Encoder: 1024 pulses, A+/-_B+/- evaluation

Motor: 1000 rpm corresponds to 20 m/min (=20000 mm/min)

$$P61.02 = \frac{1000\ \text{min}^{-1} \cdot 1024\ \text{pulses} \cdot 4}{20000\ \text{mm/min}} = 204{,}8\ \frac{\text{pulses}}{\text{mm}}$$

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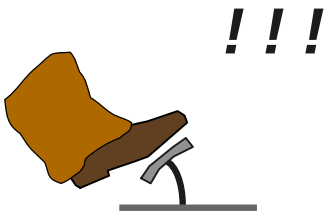
BasicCraneFeatures01R0101. page 20

The position measurement module is used to measure the actual position from a pulse encoder input. This functionality is available in stand-alone and fieldbus modes.

The measurement can be synchronized either by fieldbus command word or hardware input.

Help

Fast Stop (1)



- Safety functionality of the crane drive
- The crane stops as fast as possible
  - Mechanical overload occurs
  - Slack rope occurs
    Slack rope detection outside the crane drive
- The crane drive memorizes the direction when the fault occurs
- Then movement is only possible in the other direction

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BasicCraneFeaturesS01R0101. page 21

Fast stop is an important safety function in a crane drive system. The fast stop stops the hoist as fast as possible when overload or when slack rope occurs. It is also used for emergency situations, if the crane has to be stopped very fast to avoid further critical situations.

The direction of movement is saved in the control unit when the fault has occurred. Then it is possible to move the crane in the opposite direction.

Help

Fast Stop (2)

- Fast Stop types
  - Fast Stop 1 → With torque limit only
  - Fast Stop 2 → With torque limit and mechanical braking
  - Fast Stop 3 → With mechanical braking only
- Fieldbus mode
  - P7.10 Fieldbus Command Word
    - Fast Stop 1 → 7.10 Bit 9
      → Fast Stop Type 1 is automatically selected
    - Fast Stop 11 → 7.10 Bit 10
      → Select Fast Stop Type with P63.01 FastStop Type 11
- Stand-alone mode
  - Activation by digital input
    - Fast Stop 12 → Select digital input P60.04 Fast Stop-N
      → Select Fast Stop Mode with P63.02 FastStop Type 12

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BasicCraneFeatures01R0101. page 22

There are 3 different fast stop types.

- Fast stop 1 is electrical braking with only torque limitation.
- Fast stop 2 is electrical braking with torque limitation and additionally the mechanical brake as well.
- Fast stop 3 is braking only with the mechanical brake.
  In fieldbus mode the fast stop is controlled from fieldbus command word 7.10.
- Fast stop 1 can be activated with bit 9 of parameter 7.10. In this case, fast stop type 1 is automatically selected.
- Fast stop 11 can be activated with bit 10 of parameter 7.10. In this case the fast stop type can be selected with parameter 63.01 FastStop type 11.

In stand-alone mode there is only one fast stop mode available. The fast stop type can be selected with parameter 63.02 FastStop type 12.

Help

Crane module

Parameter	Range/unit	Description
64.01 Stand Alone Sel	True; False	Stand alone select
64.02 Continuous Gear	True; False	Continuous gear
64.03 HighSpeedLevel 1	0.0 …100.0 %	High speed level 1
64.04 Dead Zone A	0 …100 %	Dead zone A
64.05 Dead Zone B	0 …100 %	Dead zone B
64.06 Reference Shape	0 …100	Reference shape
64.07 SlowDownsSpeedRef	0 …100 %	Slowdown speed reference
64.08 ZeroPosOk TD	0.0 …60.0 s	Zero position OK time delay
64.09 Torque Ref Scale	0 …4.00	Torque reference scaling
64.10 Control Type	JOYSTICK; RADIO CTRL; MOTOR POT; STEP JOYST; STEP RADIO	Control type selection
64.11 Minimum Ref	0.0 …100.0 %	Minimum reference
64.12 Joystick Warn TD	0 …5000 ms	Joystick warning time delay
64.13 Step Ref Level 1	0.0 …100.0 %	Step reference level 1
64.14 Step Ref Level 2	0.0 …100.0 %	Step reference level 2
64.15 Step Ref Level 3	0.0 …100.0 %	Step reference level 3
64.16 Step Ref Level 4	0.0 …100.0 %	Step reference level 4
64.18 Speed/Torq Ctrl	Speed; Torque; AI1 AND 2 LEVEL	Speed or torque control selection

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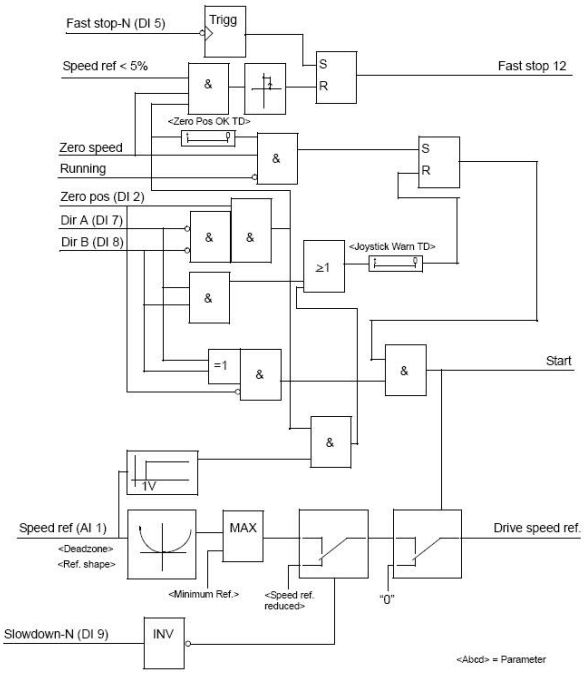
BasicCraneFeatures01R0101. page 23

The crane module is used, if the crane should be a stand-alone type. In this case, parameter 64.01 must be set to TRUE. The other settings depend on the control type used, for example joystick control. All settings in group 64 only handle stand-alone configurations.

Help

Stand-alone logic using a Joystick

Crane stand alone logic using Joystick control type.



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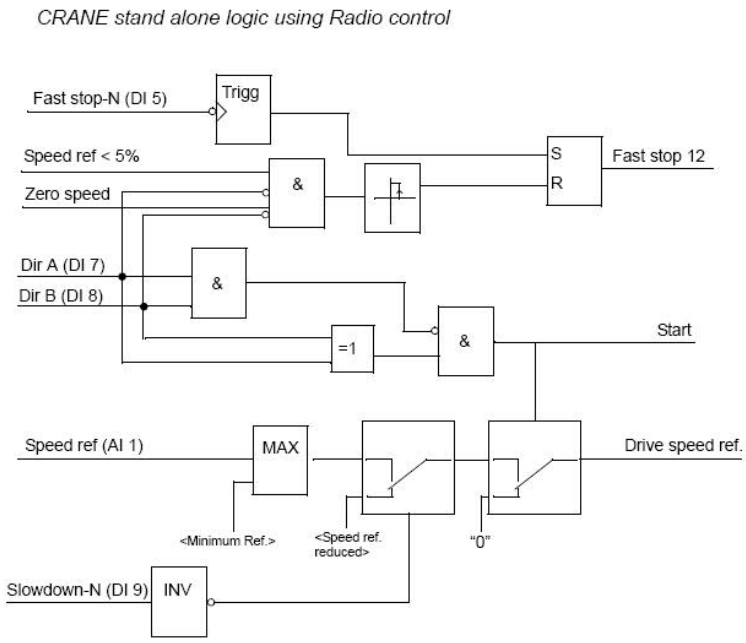
The stand-alone logic using a joystick is described on this slide.

Fast stop is triggered by digital input 5. Resetting fast stop is possible, if speed reference is smaller than 5%, zero speed signal is TRUE and direction A and B command as well as zero position from the joystick are all TRUE.

Start command depends on the correct handling of direction inputs. Speed reference from analog input 1 is outside the defined deadzone. All of these parameters can be adjusted by parameters.

Help

Stand-alone logic using Radio control



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BasicCraneFeatures01R0101. page 25

Stand-alone logic using radio control is described on this slide.

Fast stop is always overriding. Resetting fast stop is possible if direction A and B signals are FALSE, zero speed signal is TRUE and the speed reference is smaller than 5%.

Start command is given by a TRUE signal of direction A or B.

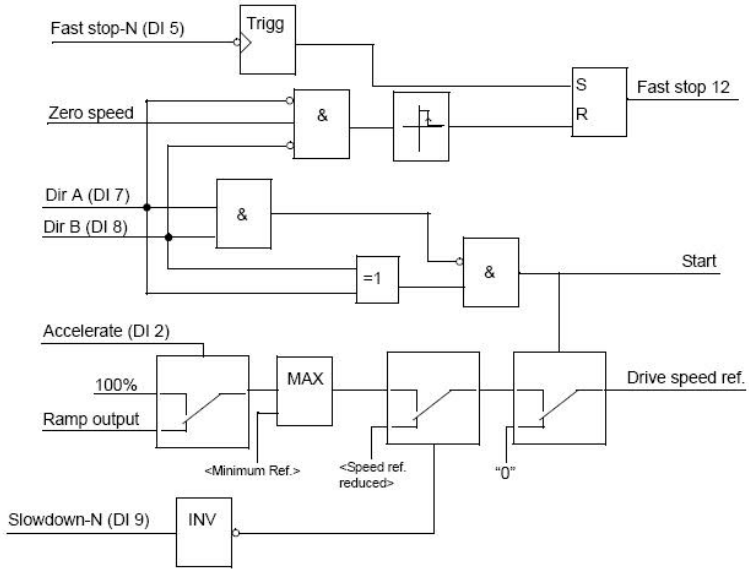
Speed reference comes from analog input 1, which is used as long as the reference is greater than the minimum reference and the reduced speed reference is not selected.

Radio control mode does not have zero position joystick monitor.

Help

Stand-alone logic using Motorized Potentiometer

Crane Stand alone logic using Motorized potentiometer control



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BasicCraneFeatures01R0101. page 26

Stand-alone logic using a motorized potentiometer is shown on this slide.

Fast stop is connected to digital input 5. Resetting fast stop 12 is possible if direction A and B are zero and zero speed is TRUE.

Start command is given by direction A or B command. If both directions are active, in case of a failure, start command will be disabled.

Speed reference of the drive is controlled by digital inputs, which correspond to fixed references. If the fixed references are not selected, then the ramp output will be used.

Help

Further control modes

- Step Joystick Reference mode
  - Activate with P64.10 to “StepJoystick”
  - Up to 4 different speed levels are supported
    - Activate speed level by digital input (60.08..60.10)
    - Set different speed levels (64.13..64.16)
  - Zero position signal is needed
  - Joystick monitoring is active!
- Step Radio Reference mode
  - Activate with P64.10 to “StepRadio”
  - Up to 4 different speed levels are supported
    - Same as described above
  - Zero position signal is not needed
  - Joystick monitoring is inactive!

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BasicCraneFeaturesS01R0101. page 27

Further control modes are “step joystick reference” and “step radio reference,” which are explained in this slide.

Step joystick reference mode should be chosen, if the joystick has reference contacts instead of an analog potentiometer. This functionality can be activated in parameter 64.10. In this mode up to 4 different speed levels are supported, which are activated by digital inputs. The different speed levels are given by the corresponding parameters. In this mode, a zero signal from the joystick is needed and the joystick monitoring is active as well.

Step radio reference mode should be chosen, if a radio controller or a PLC is used, which has step reference output contacts. This functionality can be activated in parameter 64.10. For step radio reference mode the same rules apply as described above. The difference is that there is no zero position signal needed and the joystick monitoring is inactive.

Help

Summary

Key points of this module

- Used parameter groups for crane drives
- Software hierarchy
- Crane stand-alone mode
- Crane fieldbus control
- Control logic of crane drive
- Radio control and step joystick mode

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BasicCraneFeaturesS01R0101. page 28

The key points of this module are:

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