AC/DC Converter
Convertidor CA/CC
Conversor CA/CC

CTW04
DC CONVERTER

User´s Guide

Guia del Usuario

Manual do usuário

AC/DC
CONVERTER MANUAL

Series: CTW-04

Software: version 1.1X

0899.5255 E/2

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☞ ATTENTION!

It is very important to check if the converter software version is the same as indicated above.

The information below describes all revisions made to this Manual.

Revision	Description	Section
1	First Edition	-
2	General revision	-

Quick Parameter Reference, Fault and Error Messages

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QUICK PARAMETER REFERENCE, FAULT AND ERROR MESSAGES

Software: V1.1X
Application:
Model:
Serial Number:
Responsible:
Date: / / .

I. Programming Parameters by Adjust Order

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
	OPERATION MODE PARAMETERS					
P000	Parameter Saving (EEPROM)	0 to 4=Not Used 5=It Saves Programing 6 to 9=Not Used 10=It Saves Factory Selting	0	-		74
P002(1)	Field Current Control Loop–I_C	0=CTW-04 Control 1=External Control	0	-		74
P004(1)	Operation Mode	0=Undefined 1=Defined	0	-		75
P005(1)(3)	Converter Type	0=Unidirectional 1=Antiparallel	0			75
P007(1)	Torque Control	0=Normal (Current + Speed Control) 1=Current Regulator	0			75
P008(1)	Firing Angle Control	0=Normal 1=Direct (Without Regulators)	0	-		75
P009(1)	Deceleration Ramp Time	0=Defined at Parameter 1=P033=0	0	-		75
P011(1)	Relay Output of n = 0	0=NC contact (Normal Closed) 1=NO contact (Normal Open)	1	-		75
P013	Operation Mode Changing	0=No 1=Yes	0	-		76
P014(1)	Ramp Setting Range	0=0 to 180 (Δ = 1.0s) 1=0 to 18 (Δ = 0.1s)	0	s		76
P015(1)	Zero Speed Disable (Stop Logic)	0=Inactive 1=Active	0	-		76
P016(1)	Output Mode by Zero Speed Disable	0=Output With n_3^* > 0 or n > 0 1=Output With n_3^* > 0	0	-		76
P017(1)	I_A > I_X Detector (See P071)	0=Active 1=Inactive During Acceleration or Braking	0	-		76
P018(1)	Fault Detector of DC Tachogenerator or Incremental Encoder	0=Active 1=Inactive	0	-		76

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P024(1)(2)(9)	Speed Reference Selection	0=0 to 10V (10bits) 1=4 to 20mA (10bits) 2=0 to 10V (12bits)(2) 3=4 to 20mA (12bits)(2) 4=**P056** and **P057** 5=PE - Electronic Potentiometer	0	-		76
P025(1)(2)(4)	Speed Feedback Selection	0=Back-EMF 1=DC Tachogenerator 4=Incremental Encoder(2)	0	-		77
P028(1)(7)	AI1 Input Function (Auxiliary 1)	0=Not Used 1=n_{AUX}* After Ramp 2=I_{AUX}* (Signal ≥ 0) 3=External Current Limiting	0	-		77
P029(1)	AI2 Input Function (Auxiliary 2)	0=Not Used 1=n_{AUX}* After Ramp 2=I_{AUX}* (signal ≥ 0)	0	-		
	Serial Communication					
P019(1)	Speed Reference	0=Defined by P024 1=Serial or Fieldbus	0	-		77
P020(1)	General Disabling Selection, Disabling by Ramp and Fault Reset	0=DI 1=Serial or Fieldbus	0	-		77
P021(1)	Selection of Direction of Rotation	0= DI 1=Serial or Fieldbus	0	-		77
P022(1)	Jog+, Jog- Command Selection	0=DI 1=Serial or Fieldbus	0	-		77
P065(1)	DI Function (XC1:37)	0=Gain Selection of speed Regulator: P039, P040 or P048, P049 1=Commands via Serial (WEGBus) or DI 2=Special Functions 3=Commands via FieldBus or DI	0	-		
P083(1)	Serial WEGBus	0=Inactive 1=Active at 9600	0	bps		78
P084(1)	Converter Address	1 to 30	1	-		78
P085(1)	FieldBus	0=nactive 1=Profibus-DP 2 I/O 2= Profibus-DP 4 I/O 3=Profibus-DP 6 I/O 4=DeviceNet 2 I/O 5=DeviceNet 4 I/O 6=DeviceNet 6 I/O	0	-		
P086(1)	Type of Disabling with E29/E30	0=Deactivating via Ramp Disabling 1=Deactivating via General 2=Not Used	0	-		
	Converter Data					
P026(1)(5)	Selection of the Rated Armature Voltage	0=230V (A_220Vac) 1=260V (U_220Vac) 2=400V (A_380Vac) 3=460V (A_440Vac / U_380Vac) 4=520V (U_440Vac)	0	-		

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P027(1)(6)	Selection of the Rated Armature Current	0=10/20 1=50 2=63 3=90 4=106 5=125 6=150 7=190 8=265 9=480 10=640 11=1000 12=1320 13=1700	0	A		
	Overload (I x t)					
P067(1)	Overload Current - I x t	0 to 125 of **P027**	125	%		78
P068(1)	Max. Current without Overload - I x t	0 to 125 of **P027**	100	%		78
P069(1)	Actuation Time - I x t	005 to 600	384	s		78
P070(1)	Function of the Programmable DO (XC1:38)	0=I x t or Locked Rotor 1=n = n* or Locked Rotor 2=Bridge A/B or Locked Rotor 3=I x t 4=n = n* 5=A / B Bridge	0	-		
	REGULATION PARAMETERS					
	Analog Outputs					
P030	Output AO - D/A(8 bits) Function	0=n_2^* 1=(n_2^* + AI1 + AI2 + JOG+ + JOG-) = n_3^* 2=(n_3^* – n) 3=I_1^* 4=Firing Angle 5=U_A 6=Interruptions 7=Current Regulator Output 8=Back-EMF 9=Current Limitation as Function of n	8	-		
P046(2)(4)	Output AO1 - D/A(12 bits) Function	0=A/D(12 bits) Conversion Result 1=n_2^* 2=(n_2^* + AI1 + AI2 + JOG+ + JOG-) = n_3^* 3=I_1^* 4=(n_3^* – n) 5=n 6=I_A 7=Back-EMF 8=Power = (Back-EMF x I_A)	0	-		
P047(2)(4)	Output AO2 - D/A(12 bits) Function	0= A/D(12 bits) Conversion Result 1=n_2^* 2=(n_2^* + AI1 + AI2 + JOG+ + JOG-) = n_3^* 3=I_1^* 4=(n_3^* – n) 5=n 6=I_A 7=Back-EMF 8=Power = (Back-EMF x I_A)	0	-		

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P078	Output AO Gain D/A(8 bits)	0.0 to 9.99	1.0	-		80
P079[2][4]	Output AO1 Gain D/A(12 bits)	0.0 to 9.99	1.0	-		80
P080[2][4]	Output AO2 Gain D/A(12 bits)	0.0 to 9.99	1.0	-		80
	Ramps					
P032	Acceleration Time	0.0 to 18.0 (P014 = 1) 0 to 180 (P014 = 0)	1.0	s		80
P033	Deceleration Time	0.0 to 18.0 (P014 = 1) 0 to 180 (P014 = 0)	1.0	s		80
	Speed Reference					
P034	Minimun Speed	0.0 to 100	0.0	%		81
P037	JOG+	0.0 to 100	0.0	%		81
P038	JOG–	0.0 to 100	0.0	%		81
P056[9]	Speed Reference n_1*	0.0 to 100. (Δ = 0.1)	0.0	%		81
P057[9]	Speed Reference n_1*	0.0 to 100. (Δ = 10.0)	0.0	%		81
P076[8]	Offset Reference	-999 to +999	0	-		81
	Nx, Ny, Ix, N=0, N=N*					
P035	n = n* Actuation	0.0 to 100	2.0	%		81
P036	n = 0 Actuation	1.0 to 10.0	1.0	%		81
P071	Ix Current (see P017)	0.0 to 125	125	%		82
P072	Ny Speed	0.0 to 100	0.0	%		82
P073	Nx Speed	0.0 to 108	100	%		82
	Speed Regulator					
P039	Proportional Gain	0.0 to 99.9	4.0	-		82
P040	Integral Gain	0.0 to 2.00	0.12	s		82
P041	Differential Gain	0.0 to 9.99	0.0	-		82
P048	Proportional Gain - P065 (Speed Regulator) (See P065)	0.0 to 99.9	0.0	-		82
P049	Integral Gain - P065 (Speed Regulator) (See P065)	0.0 to 2.00	0.0	s		82
	Current Regulator					
P042	Proportional Gain	0.0 to 9.99	0.26	-		83
P043	Integral Gain (Intermittent)	0 to 999	35	ms		83
P044	Integral Gain (Continuous)	0 to 999	70	ms		83
P045	Variation Rate I* (dI* / dt)	0 to 999	20	ms		83
P054	Current Limiting (+I) (See **P028**)	2.0 to 125. (Δ = 1.0)	25.0	%		83
P055	Current Limiting (–I) (See **P028**)	2.0 to 125. (Δ = 1.0)	25.0	%		83
	Analogs Inputs					
P050	Input Gain AI1 (Auxiliary 1)	0.0 to 9.99	1.0	-		84
P051	Input Gain AI2 (Auxiliary 2)	0.0 to 9.99	1.0	-		84

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
	Incremental Encoder					
P052(2)	Max. Frequency – Hundred	0 to 999	0	Hz		84
P053(2)	Max. Frequency – Thousand	0 to 480	021	kHz		84
	Back-EMF Regulator					
P031	R_A Compensation = **P031**/1000	0 to 999	0	-		84
P058	Proportional Gain	0.0 to 9.99	1.50	-		85
P059	Integral Gain	0.0 to 6.00	0.25	s		85
P066	Signal Gain	0.10 to 2.50	1.00	-		85
	Field Regulator Current					
P060	Rated Current	0.1 to 30.0	2.6	A		85
P061	Minimun Current	0.1 to 30.0	0.6	A		85
P100	Economy Current	0.0 to 30.0	0.6	A		85
P063	Proportional Gain	0.0 to 3.99	0.2	-		85
P064	Integral Gain	0.0 to 3.99	0.1	s		85
	Current Limiting as Function of n					
P074	Current I_{mim}	2.0 to 125.	125.	%		86
P075	Speed n_1	10.0 to 100.	100.	%		86

II. Read Only Parameters

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P023	Software Version (Read Only)	0.0 to 9.99	-	-		86
P056	Speed Reference - n_1^*	0.0 to 100.	-	%		86
P057	Speed Reference - n_1^*	0.0 to 100.	-	%		86
P062	Field Current - I_C	0.0 to 30.0	-	A		86
P081	Phase fault per network cycle (Hundred)	0 to 999	-	-		86
P082	Phase fault per network cycle (Thousand)	0 to 999	-	-		86
P087	Total Speed Reference - n_3^*	0.0 to 100	-	%		86
P088	Motor Speed - n	0.0 to 110. (P025 = 0 or 1) 0.0 to 150 (P025 = 4)	-	%		86
P089	Armature Current - I_A	0.0 to 125.	-	%		87
P090	Armature Voltage - U_A	0.0 to 100.	-	%		87
P091	Input Signal AI1 (Auxiliary 1)	0.0 to 100. (n_{AUX}^*) 0.0 to 125. (I^*) 0.0 to 125. (I_{LIM})	-	-		87
P092	Input Signal AI2 (Auxiliary 2)	0.0 to 100. (n_{AUX}^*) 0.0 to 125. (I^*)	-	%		87
P093	Fault Memory - Last Fault	F02 to F10	-	-		87
P094	Fault Memory - Second Previous Fault	F02 to F10	-	-		87
P095	Fault Memory - Third Previous Fault	F02 to F10	-	-		87
P096	Fault Memory - Fourth Previous Fault	F02 to F10	-	-		87
P097	Phase Sequence	0=(RST) 12=(RTS)	-	-		87
P098	DI's Status	0 to 255	-	-		87
P099	Hundred of A/D(10 bits) or A/D(12 bits) Remote Reference	0 to 999	-	-		88

P.S.: The description of notes **(1)**, **(2)**, **(3)**, **(4)**, **(5)**, **(6)**, **(7)**, **(8)**, **(9)**,is available at the end of the item Parameters in Numerical Order.

III. Parameters by Numeric Order

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P000	Parameter Saving (EEPROM)	0 to 4=Not Used 5=It Saves Programing 6 to 9=Not Used 10=It Saves Factory Selting	0	-		74
P002(1)	Field Current Control Loop–I_C	0=CTW-04 Control 1=External Control	0	-		74
P004(1)	Operation Mode	0=Undefined 1=Defined	0	-		75
P005(1)(3)	Converter Type	0=Unidirectional 1=Antiparallel	0	-		75
P007(1)	Torque Control	0=Normal (Current Regulator + Speed Regulator) 1=Current Regulator	0	- -		75
P008(1)	Firing Angle Control	0=Normal 1=Direct (Without Regulators)	0	-		75
P009(1)	Deceleration Ramp Time	0=Defined at Parameter 1=P033=0	0	-		75
P011(1)	Relay Output of n = 0	0=NC Contact (Normal Closed) 1=NO Contact (Normal Open)	1	-		75
P013	Operation Mode Changing	0=No 1=Yes	0	-		76
P014(1)	Ramp Setting Range	0=0 to 180 (Δ = 1.0) 1=0 to 18 (Δ = 0.1)	0	s		76
P015(1)	Zero Speed Disable (Stop Logic)	0=Inactive 1=Active	0	-		76
P016(1)	Output Mode by Zero Speed Disable	0=Output with n_3^* > 0 or n > 0 1=Output with n_3^* > 0	0	-		76
P017(1)	$I_A > I_X$ Detector (See **P071**)	0=Active 1=Inactive During Acceleration or Braking	0	-		76
P018(1)	Fault Detector of DC Tachogenerator or Incremental Encoder	0=Active 1=Inactive	0	-		76
P019(1)	Speed Reference	0=Defined by P024 1=Serial or Fieldbus	0	-		77
P020(1)	General Disabling Selection, Disabling by Ramp and Fault Reset	0=DI 1=Serial or Fieldbus	0	-		77
P021(1)	Selection of Direction of Rotation	0=DI 1=Serial or Fieldbus	0	-		77
P022(1)	Jog+, Jog- Command Selection	0=DI 1=Serial or Fieldbus	0	-		77
P023	Software Version (Read Only)	0.0 to 9.99	-	-		87
P024(1)(2)(9)	Speed Reference Selection	0=(0 to 10)V (10bits) 1=(4 to 20)mA (10bits) 2=(0 to 10)V (12bits)(2) 3=(4 to 20)mA (12bits)(2) 4=**P056** and **P057** 5=PE - electronic potentiometer	0	-		76

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P025(1) (2)(4)	Speed Feedback Selection	0=Back-EMF 1=DC Tachogenerator 4=Incremental Encoder(2)	0	-		77
P026(1)(5)	Selection of the Rated Armature Voltage (Converter Data)	0=230V (A_220Vac) 1=260V (U_220Vac) 2=400V (A_380Vac) 3=460V (A_440Vac / U_380Vac) 4=520V (U_440Vac)		-		78
P027(1)(6)	Selection of the Rated Armature Current (Converter Data)	0=10/20 | 7=190 1=50 | 8=265 2=63 | 9=480 3=90 | 10=640 4=106 | 11=1000 5=125 | 12=1320 6=150 | 13=1700	0	A		78
P028(1)(7)	AI1 Input Function (Auxiliary 1)	0=Not Used 1=n_{AUX}* After Ramp 2=I_{AUX}* (Signal ≥ 0) 3=External Current Limiting	0	-		77
P029(1)	AI2 Input Function (Auxiliary 2)	0=Not Used 1=n_{AUX}* After Ramp 2=I_{AUX}* (Signal ≥ 0)	0	-		77
P030	Output AO – D/A(8 bits) - Function	0=n_2^* 1=(n_2^* + AI1 + AI2 + JOG+ + JOG-) = n_3^* 2=(n_3^* – n) 3=I^* 4=Firing angle 5=U_A 6=Interruptions 7=Current Regulator Output 8=Back-EMF 9=Current Limitation as Function of n	8	-		80
P031	R_A Compensation = **P031**/1000	0 to 999	0	-		84
P032	Acceleration Time	0.0 to 18.0 (P014 = 1) 0 to 180 (P014 = 0)	1.0	s		80
P033	Deceleration Time	0.0 to 18.0 (P014 = 1) 0 to 180 (P014 = 0)	1.0	s		80
P034	Minimum Speed	0.0 to 100	0.0	%		81
P035	n = n^* Actuation	0.0 to 100	2.0	%		81
P036	n = 0 Actuation	1.0 to 10.0	1.0	%		81
P037	JOG +	0.0 to 100	0.0	%		81
P038	JOG -	0.0 to 100	0.0	%		81
P039	Proportional Gain (Speed Regulator)	0.0 to 99.9	4.0	-		82
P040	Integral Gain (Speed Regulator)	0.0 to 2.00	0.12	s		82
P041	Differential Gain (Speed Regulator)	0.0 to 9.99	0.0	-		82
P042	Proportional Gain (Current Regulator)	0.0 to 9.99	0.26	-		83

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P043	Integral Gain (Intermittent) (Current Regulator)	0 to 999	35	ms		83
P044	Integral Gain (Continuous) (Current Regulator)	0 to 999	70	ms		83
P045	Variation Rate I^* (dI^* / dt) (Current Regulator)	0 to 999	20	ms		83
P046[2][4]	Output AO1 - D/A(12 bits) Function	0=A/D (12 bits) Conversion Result 1=n_2^* 2=(n_2^* + AI1 + AI2 + JOG+ + JOG-) = n_3^* 3=I_1^* 4=(n_3^* – n) 5=n 6=I_A 7=Back-EMF 8=Power = Back-EMF x I_A	0	-		80
P047[2][4]	Output AO2 – D/A(12 bits) Function	0=A/D(12 bits) Conversion Result 1=n_2^* 2=(n_2^* + AI1 + AI2 + JOG+ + JOG-) = n_3^* 3=I_1^* 4=(n_3^* – n) 5=n 6=I_A 7=Back-EMF 8=Power Back-EMF x I_A	0	-		80
P048	Proportional Gain – P065 (Speed Regulator) (See **P065**)	0.0 to 99.9	0.0	-		82
P049	Integral Gain – P065 (Speed Regulator) (See **P065**)	0.0 to 2.00	0.0	s		82
P050	Input Gain AI1 (Auxiliary 1)	0.0 to 9.99	1.0	-		84
P051	Input Gain AI2 (Auxiliary 2)	0.0 to 9.99	1.0	-		84
P052[2]	Max. Frequency - Hundred (Incremental Encoder)	0 to 999	0	Hz		84
P053[2]	Max. Frequency - Thousand (Incremental Encoder)	000 to 480	21	KHz		84
P054	Current Limiting (+I) (See **P028**)	2.0 to 125. (Δ = 1.0)	25.0	%		83
P055	Current Limiting (-I) (See **P028**)	2.0 to 125. (Δ = 1.0)	25.0	%		83
P056[9]	Speed Reference n_1*	0.0 to 100. (Δ = 0.1)	0.0	%		81
P057[9]	Speed Reference n_1*	0.0 to 100. (Δ = 10.0)	0.0	%		81
P058	Proportional Gain (Back-EMF Regulator)	0.0 to 9.99	1.5	-		85
P059	Integral Gain (Back-EMF Regulator)	0.0 to 6.00	0.25	s		85
P060	Rated Current (Field Current Regulator)	0.1 to 30.0	2.6	A		85
P061	Minimum Current (Field Current Regulator)	0.1 to 30.0	0.6	A		85

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P062	Field Current – I_C (Read Only)	0.0 to 30.0	-	A		86
P063	Proportional Gain (Field Current Regulator)	0.0 to 3.99	0.2	-		85
P064	Integral Gain (Field Current Regulator)	0.0 to 3.99	0.10	s		85
P065(1)	DI Function (XC1:37) (Serial Communication)	0=Gain Selection of Speed Regulator: P039, P040 or P048, P049 1=Commands via Serial (WEGBus) or DI 2=Special Functions 3=Commands via FieldBus or DI	0	-		77
P066	Signal Gain (Back-EMF Regulator)	0.10 to 2.50	1.0	-		85
P067(1)	Overload Current (I x t)	0 to 125 of **P027**	125	%		78
P068(1)	Max. Current without Overload (I x t)	0 to 125 of **P027**	100	%		78
P069(1)	Actuation Time (I x t)	005 to 600	384	s		78
P070(1)	Function of the Programmable DO (XC1:38)	0=I x t or Locked Rotor 1=n = n* or Locked Rotor 2=Bridge A/B or Locked Rotor 3=I x t 4=n = n* 5=A/B Bridge	0	-		79
P071	Ix Current (See P017)	0.0 to 125.	125.	%		82
P072	Ny Speed	0.0 to 100.	0.0	%		82
P073	Nx Speed	0.0 to 108.	100.	%		82
P074	Current I_{mlm}	2.0 to 125.	125.	%		86
P075	Speed n_1	10.0 to 100.	100.	%		86
P076(8)	Reference Offset	-999 to +999	0	-		81
P078	Output AO Gain D/A(8 bits)	0.0 to 9.99	1.00	-		80
P079(2)(4)	Output AO1 Gain D/A(12 bits)	0.0 to 9.99	1.00	-		80
P080(2)(4)	Output AO2 Gain D/A(12 bits)	0.0 to 9.99	1.00	-		80
P081	Phase Fault per Network Cycle (Hundred) (Read Only)	0 to 999	-	-		86
P082	Phase Fault per Network Cycle (Thousand) (Read Only)	0 to 999	-	-		86
P083(1)	Serial WEGBus	0=Inactive 1=Active at 9600	0	bps		86
P084(1)	Converter Address	1 to 30	1	-		86
P085(1)	FieldBus	0=Inactive 1=Profibus-DP 2 I/O 2=Profibus-DP 4 I/O 3=Profibus-DP 6 I/O 4=DeviceNet 2 I/O 5=DeviceNet 4 I/O 6=DeviceNet 6 I/O	0	-		78

Parameter	Function	Adjustable Range	Factory Setting	Unit	User's Setting	Pag.
P086(1)	Type of Disabling with E29/E30	0=Deactivating via Ramp Disabling 1=Deactivating via General Disabling 2=Not Used	0			78
P087	Total Speed Reference – n_3^* (Read Only)	0.0 to 100.	-	%		86
P088	Motor Speed – n (Read Only)	0.0 to 110. (P025 = 0 or 1) 0.0 to 150. (P025 = 4)	-	% %		86
P089	Armature current – I_A (Read Only)	0.0 to 125.	-	%		87
P090	Armature Voltage – U_A (Read Only)	0.0 to 100.	-	%		87
P091	Input Signal AI1 (Auxiliary 1) (Read Only)	0.0 to 100. (n_{AUX}^*) 0.0 to 125. (I^*) 0.0 to 125 (I_{LIM})	-	%		87
P092	Input Signal AI2 (Auxiliary 2) (Read Only)	0.0 to 100. (n_{AUX}^*) 0.0 to 125. (I^*)	-	%		87
P093	Fault Memory - Last Fault (Read Only)	F02 to F10	-	-		87
P094	Fault Memory - Second Previous Fault (Read Only)	F02 to F10	-	-		87
P095	Fault Memory - Third Previous Fault (Read Only)	F02 to F10	-	-		87
P096	Fault Memory - Fourth Previous Fault (Read Only)	F02 to F10	-	-		87
P097	Phase Sequence (Read Only)	000=(RST) 12=(RTS)	-	-		87
P098	DI's Status (Read Only)	0 to 255	-	-		87
P099	Hundred of A/D(10 bits) or A/D(12 bits) Remote reference (Read Only)	0 to 999	-	-		88
P100	Economy Field Current	0.0 to 30	0.6	A		85

Notes available in the Quick Parameters Reference:

(1) Operation Mode Parameters (these parameters can be changed only when P004 = 0, if P004 ≠ 0, set P013 = 1, see Chapter 4).
(2) They are available only for Models CTWX4XXXXTX**F**TXXXXXZ.
(3) According to Converter Model:
CTWU4XXXXTXXXXXZ – Unidirectional;
CTWA4XXXXTXXXXXZ – Antiparallel.
(4) Selection of P024 = 2 or 3, P025 = 4, functions of P046 and P047 should be used only with Converter Models:
CTWX4XXXXTXXXFXZ – Full.
(5) According to Converter Model:
CTWU4XXXXT22XXXZ – Unidirectional & 220Vac;
CTWU4XXXXT38XXXZ – Unidirectional & 380Vac;
CTWU4XXXXT44XXXZ – Unidirectional & 440Vac;
CTWA4XXXXT22XXXZ – Antiparallel & 220Vac;
CTWA4XXXXT38XXXZ – Antiparallel & 380Vac;
CTWA4XXXXT44XXXZ – Antiparallel & 440Vac.

(6) According to Converter Model:

CTWX40010TXXXXXZ – 10A;	CTWX40190TXXXXXZ – 190A;
CTWX40020TXXXXXZ – 20A;	CTWX40265TXXXXXZ – 265A;
CTWX40050TXXXXXZ – 50A;	CTWX40480TXXXXXZ – 480A;
CTWX40063TXXXXXZ – 63A;	CTWX40640TXXXXXZ – 640A;
CTWX40090TXXXXXZ – 90A;	CTWX41000TXXXXXZ – 1000A;
CTWX40106TXXXXXZ – 106A;	CTWX41320TXXXXXZ – 1320A;
CTWX40125TXXXXXZ – 125A;	CTWX41700TXXXXXZ – 1700A.
CTWX40150TXXXXXZ – 150A;	

(7) When P208=3, the parameters P054 and P055 are available only for reading.

(8) The indication of P076 ≤ 100 is displayed without (-) signal.

(9) The parameters P056 and P057 have the function of speed-reading parameters when P024 ≠ 4 and have the function of Speed Reference (via key), when P024 = 0 to 3 or 5.

X – represents any character.

IV. Indications

Indication	Description	Page
F01	DI – (BL_G) General Disabling	91

V. Fault Messages

Fault	Description	Page
F02	DI – (Error_Ext) – External Fault (Fault Chain)	91
F03	Phase Loss or Line Loss: Time ≤ Line Cycle	91
	Line Loss: Line Cycle ≤ Time ≤ 48.0ms Phase Loss: Permanent Time	91
	Line Loss: Permanent Time	91
F04	±15V Loss on Control Board	91
F05	Line Undervoltage	91
F06	Locked Rotor	91
F07	Overload – Function [I x t]	91
F08	Tachogenerator Fault	91
F09	Fault in the Filed Current Loop	91
F10	Synchronization Signal Loss	91

VI. Error Messages

Error	Description	Page
E02	A/D (10 bits) Conversion Problem	88
E03	Timer Problem	88
E04	Problem in the Synchronization Signal with the Line	88
E05	EEPROM Saving Problem	88
E06	Programming Error	88
E25	Inexistent Variable or Parameter	106
E26	Set value out of allowed range	106
E27	Read-Only Variable or Logic Command is disabled	106
E28	Serial Communication Inactive	106
E29, E30	FieldBus connection Inactive	106

SAFETY INSTRUCTIONS

This Manual contains all necessary information for the correct use of the CTW-04.
This Manual has been written for qualified personnel with suitable training or technical qualification to start-up or troubleshooting this equipment.

1.1 SAFETY NOTICES IN THE MANUAL

The following Safety Notices will be used in this Manual:

DANGER!
If these recommended safety Instructions are not strictly observed, it can lead to serious or fatal personal injuries and/or equipment damage.

ATTENTION!
Failure to observe these recommended safety procedures can lead to material damage.

NOTE!
The content of this manual supplies important information for the correct understanding of operation and proper equipment performance.

1.2 SAFETY NOTICES ON THE PRODUCT

The following symbols may be attached to the product, serving as safety notice:

High Voltages

Sensitive Components to electrostatic discharge.
Do not touch them without following proper grounding procedures.

Mandatory connection to ground protection (PE).

Shield connection to the ground.

1.3 PRELIMINARY RECOMMENDATIONS

DANGER!
Only qualified personnel and familiar with CTW-04 converter should plan or implement the installation, start-up, operation and maintenance of this equipment.
These personnel must follow all safety instructions indicated in this manual and/or defined by local regulations.
Failure to comply with these instructions may result in personal injury and/or equipment damage.

NOTE!
According to this Manual, qualified personnel are defines as people that are trained to:

1. Install, ground, power-up and operate the CTW-04 according to this Manual and the local required Safety Procedures;
2. Use the safety equipment according to the local regulations;
3. Administer Cardio Pulmorary Resuscitation (CPR) and First Aid.

DANGER!
Always disconnect the main power supply before touching any electrical component inside the converter.

DANGER!
Always disconnect the power supply before touching any electrical component inside de converter.
Many components can remain changed with high voltages, even after the incoming AC power supply has been disconnected or switched OFF. Wait at least 10 minuts to garantee the total discharge of the power capacitors.
Always connect the frame of the equipment to the ground (PE) at the suitable connection point.

ATTENTION!
There are many components at electronic boards that are sensitive to electrostatic discharges. Never touch directly on any component or connector. If necessary to do so, touch before at the properly grounded metallic frame or use a suitable grounded strap.

Do not apply High Voltage (High Pot) test on CTW-04!
If this test is required, contact the manufacturer.

NOTE!
AC/DC Converters may interfere with other electronic equipment.
In order to reduce this interference, adopt the measures recommended in Section 3 (Installation).

NOTE!
Read carefully the entire Manual before installing or operating this converter.

GENERAL INFORMATION

This chapter defines the contents and purpose of this manual and describes the main features of the AC/DC CTW-04 converter and its identification. In addition, this chapter also gives information about the receiving and storing requirements.

2.1 ABOUT THIS MANUAL

This Manual is divided into 9 chapters, providing information to the user on how to receive, install, start-up and operate the CTW-04:

Chapter 1 - Safety Notices;
Chapter 2 - General Information and Receiving the CTW-04;
Chapter 3 - Information about installing and connecting the CTW-04 (Power and Control Circuit);
Chapter 4 - Information about the CTW-04 start-up (steps to follow);
Chapter 5 - Information about how to use the Keypad (HMI = Human-Machine- keypad + display);
Chapter 6 - Detailed CTW-04 Parameter Description;
Chapter 7 - Diagnostics and Troubleshooting, instructions about cleaning and preventive maintenance;
Chapter 8 - Description of the technical equipment features and Installation of CTW-04 Options and Accessories;
Chapter 9 - Tables and technical information about the CTW-04 Power line;

This Manual provides information for the correct use of the CTW-04. As the CTW-04 is very flexible, it permits also other operation modes than those described in this Manual. As the CTW-04 can be applied in several ways, it is impossible to describe here all application possibilities. Thus WEG does not accept any responsibility, when the CTW-04 is not used according to this Manual.

2.2 VERSION OF THE SOFTWARE

It is important to note the Version of the Software installed in the CTW-04, since it defines the functions and parameter setting. This Manual refers to the Version of the Software indicated on the inside cover. For instance, Version 1.0X applies to versions 1.00 to 1.09, where “X” is a variable that will change due to some minor software revisions covered by this version of the manual.

2.3 ABOUT THE CTW-04

The version of the Software can be read at Parameter P023.

The CTW-04 series is intended for driving of DC-motors with independent excitation by changing and controlling the speed in 1 or 4 quadrants (see Note **(1)**) according to the torque x speed curve. The main characteristics of this drive are:

- ☑ It operates at any sequence of the supply phase (RST - RTS);
- ☑ It operates at 50/60 Hz three-phase lines;
- ☑ HMI (Human-Machine-Interface);
- ☑ It indicates the four last faults;
- ☑ Isolated digital inputs (bi-directional current);
- ☑ Isolated digital outputs;
- ☑ Differential analog inputs from - (0 to 10)V or from (4 to 20)mA - 10 and 12 bits (see Note **(2)**);

- ☑ Analog outputs – 8 and 12 bits (see Note **(4)**);
- ☑ Digital relay outputs;
- ☑ Field Current Control – Ic;
- ☑ Speed feedback by: back-EMF, DC-tachogenerator or incremental encoder (see Note **(3)**);
- ☑ Feedback inputs by DC-tachogenerator for tachogenerator voltages from 9 to 350Vdc;
- ☑ 24Vdc isolated sources available for the user (DI's and DO's);
- ☑ Power supply from 0 to 10V available for the user (AI's);
- ☑ Field weakening – +EC (see Note **(4)**);
- ☑ Field supply up to 440V;
- ☑ Fieldbus communication networks (Profibus-DP and DeviceNet);
- ☑ RS-232 serial communication.

NOTES!

(1) - The 1 quadrant or 4 quadrants CTW-04 converter is determined by the intelligent product code:
1 quadrant – Unidirectional. Ex: CTW**U**4XXXXTXXXXXZ
4 quadrants – Antiparallel. Ex: CTW**A**4XXXXTXXXXXZ
(as described in this Chapter: "How to specify the CTW-04 model")

(2) - The CTW-04 converter provides:
4 AI's [10 bits];
1 AI [12 bits];
3 AO's [8 bits];
2 AO's [12 bits].

12 bits Inputs and Outputs are available only in the models where the CCW4.00 - Full (**F** – full version) control board is specified.
Ex: CTWX4XXXXTXXX**F**XZ

(3) - When speed feedback with incremental encoder is required, CTW-04 converter must be fitted with CCW4.00 – Full (**F** – full version) control board. Ex: CTWX4XXXXTXXX**F**XZ

(4) - Operation in the Filed Weakening area (+EC) can be carried out only when the speed feedback is **not** realized by back-EMF.

For more details about the product models and other technical information, see Chapter 9.

The block diagram below provides a general overview of the CTW-04 converter.

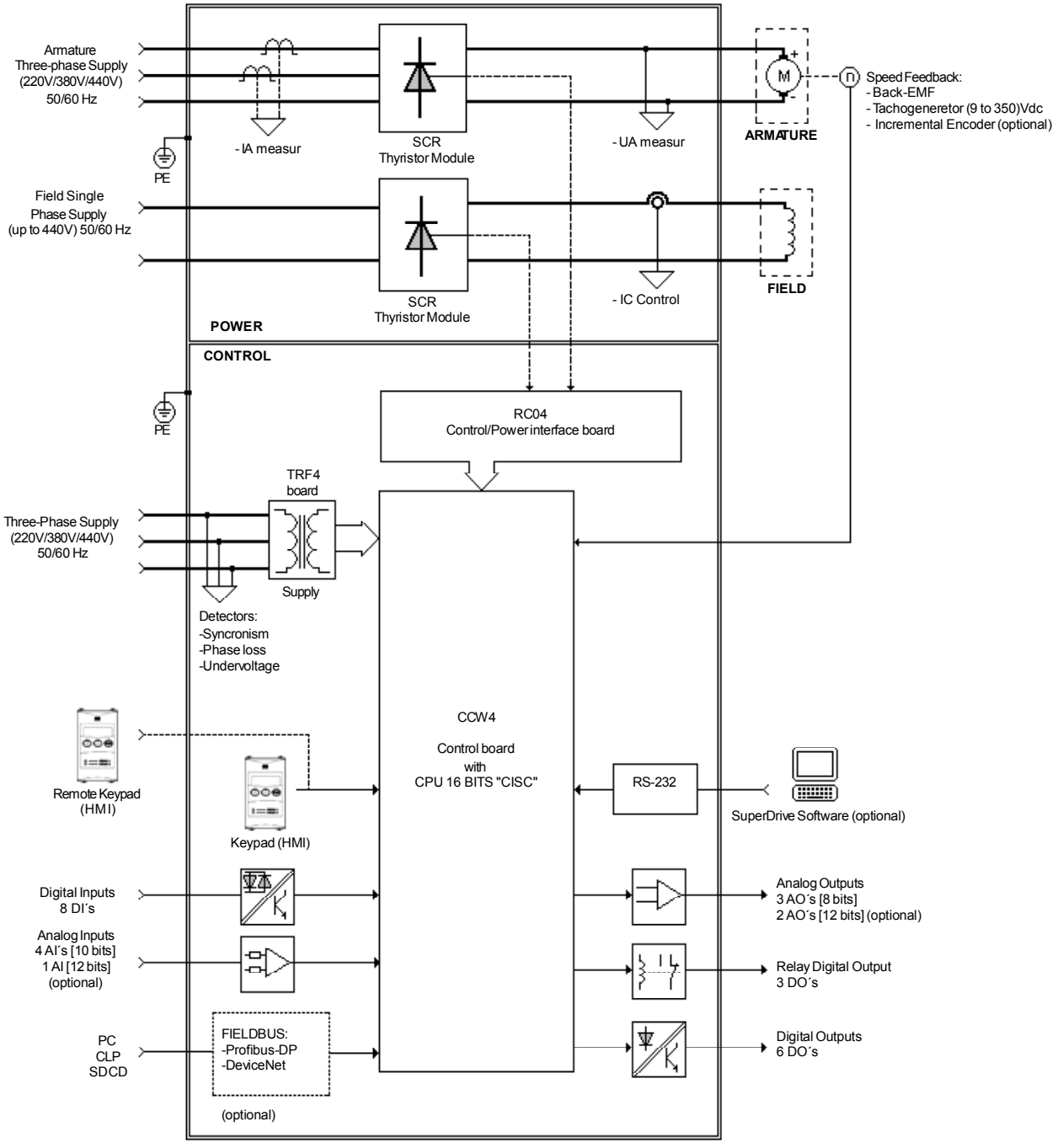


Figure 2.1 *- Block Diagram of the CTW-04*

2.4 CTW-04 NAMEPLATE

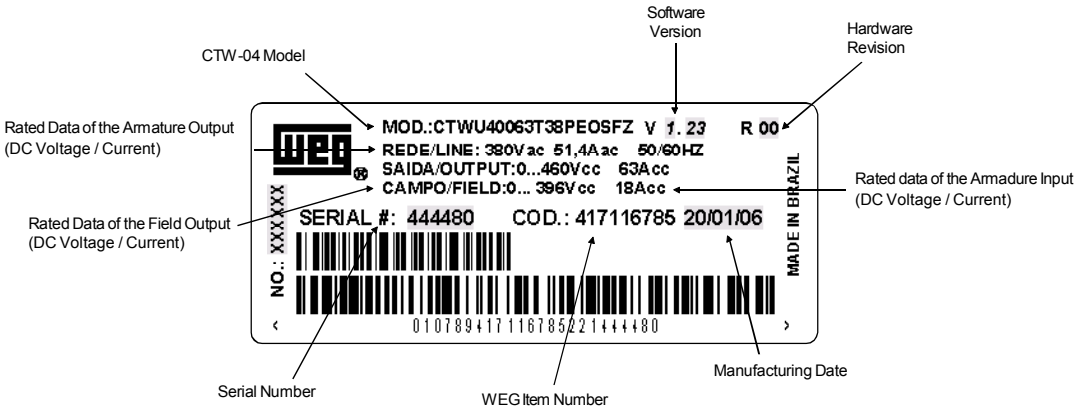


Figure 2.2 - *Product Nameplate*

NOTE!
Up to 440V, the field supply is single-phase.

Positioning of the nameplate on the CTW-04:

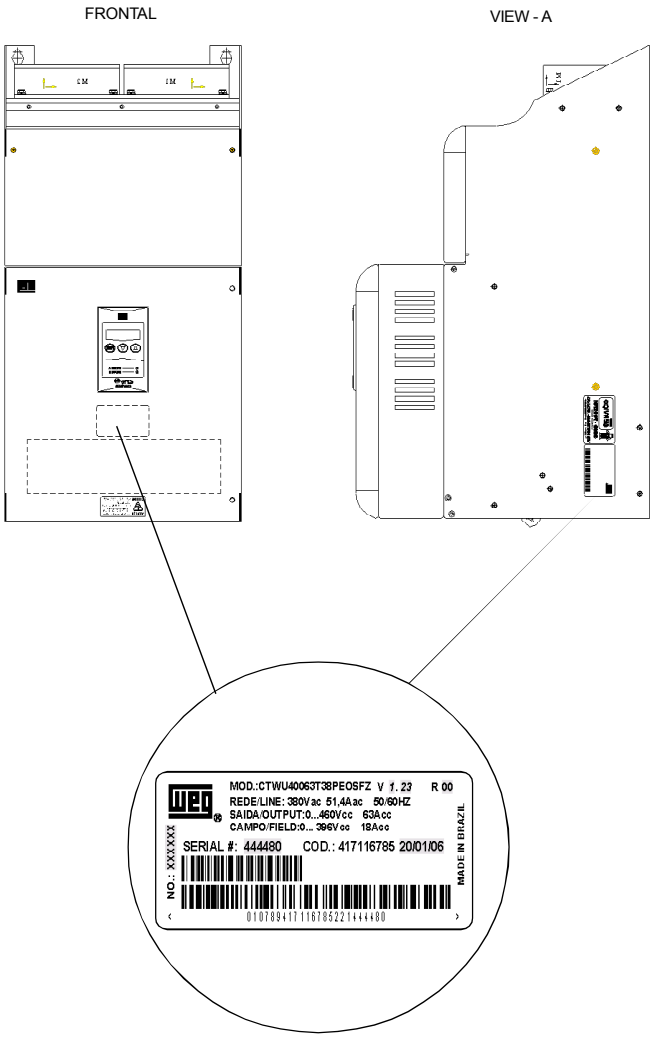


Figure 2.3 - *Positioning of the CTW-04 Nameplate*

HOW TO SPECIFY THE CTW-04 MODEL:

CTW	*U*	*4*	*0010*	*T*	*22*	*P*	*F*	*O*	*__*	*__*	*__*	*Z*
AC/DC WEG Converter	U = Unidirectional A = Antiparallel	Series 4	Rated Output Current: 0010 = 10A 0020 = 20A 0050 = 50A 0063 = 63A 0090 = 90A 0106 = 106A 0125 = 125A 0150 = 150A 0190 = 190A 0265 = 265A 0480 = 480A 0640 = 640A 1000 = 1000A 1320 = 1320A 1700 = 1700A	Three-Phase	Armature Supply Voltage: 22 = 220Vac 38 = 380Vac 44 = 440Vac	Manual Language: P = Portuguese E = English S = Spanish	F = Full Version of the Control (with incremental encoder and 12 bits outputs) E = Empty Simplified version of the Control Board (without incremental encoder and 12 bits outputs)	O = with optional functions S = Standard	Communication Network Board: Blank = Standard DN = DeviceNet PD = Profibus DP	Special Hardware : Blank = Standard	Special Software: Blank = Standard	End of the code

NOTES!

The filed "Options" (S or O) defines if the CTW-04 will be supplied in standard version or with options. If supplied in standard version, the cod ends here. Always indicate the letter Z at the end. For instance:

CTWU40010T22PFSZ = CTW-04 10A Unidirectional converter, the armature supply voltage is three-phase 220V. The Manual is in Portuguese language. The control board is complete in standard version.

If converter should be supplied with options, fill in all filed in correct sequence up to the last option. Then the code is ended with the letter Z. For instance, if you want the product of the example above with DeviceNet network board:

CTWU40010T22PFODNZ = CTW-04 10A Unidirectional Converter, three-phase 220V armature supply voltage. Manual in Portuguese, complete version of the Control Board, with DeviceNet network board.

2.5 RECEIVING AND STORING

The outside package is marked with an identification label that is the same fixed on the CTW-04. Please check if the data match the data of the purchase order.
Check:

☑ If the CTW-04 identification label matches the ordered converter model;

☑ If the equipment has not been damaged during the transport.
(If any problem is detected, contact the carrier immediately).

Store the equipment in a clean and dry room (temperature between - 25°C and 60°C and relative air humidity between 10% and 90%).

INSTALLATION AND CONNECTION

This chapter describes the procedures for electrical and mechanical installation of the CTW-04. These guidelines must be followed for proper CTW-04 operation.

3.1 MECHANICAL INSTALLATION

3.1.1 Environment

The location of the CTW-04 installation is an important factor to ensure good equipment performance and long components life. For proper converter installation, avoid:

☑ Direct exposure to sunlight, rain, high moisture and sea air;
☑ Exposure to explosive or corrosive gases and liquids;
☑ Exposure to excessive vibration, dust, oil or any conductive air suspended particles.

Required Environmental Conditions:

☑ Temperature: 0ºC to 40ºC (32ºF to 104ºF) - nominal conditions.
From 40ºC to 50ºC (104ºF to 122ºF) – 1% current de-rating for each Celsius degree above 40ºC.

☑ Relative air humidity: 10% to 90%, non-condensing.

☑ Maximum Altitude: 1000m (3,300 ft) - nominal conditions.
1000m (3,300 ft) to 4000m (13,200 ft) - with 1% current derating for each 100m (212 ft) above 1000m (3,300 ft).

☑ Pollution Degree: 2 (according to EN50178) (according to UL508C)

Normally, only non-conductive pollution.
Condensation shall not cause conduction in the pollution.

☑ Degree of Protection: IP 00.

3.1.2 Dimension of the CTW-04 Models

NOTE!
When converters are installed in panels or closed metallic boxes, provide proper cooling to ensure that the temperature around the converter does not exceed the maximum allowed temperature.

a) Size 01 (10A to 20A)

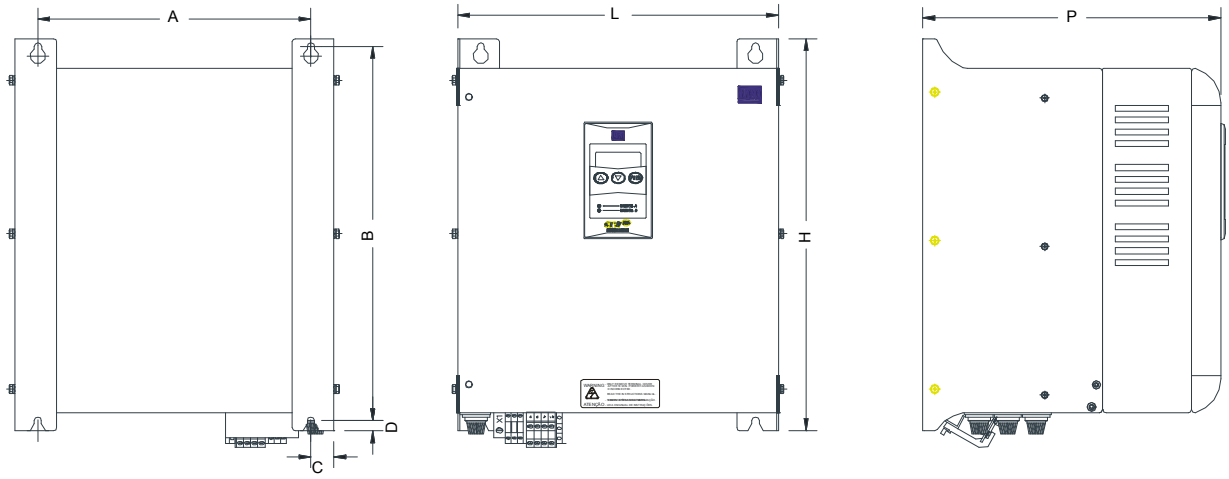


Figure 3.1 a) *– Dimensions of the CTW-04 converter*

b) Size 02 (50A to 125A)

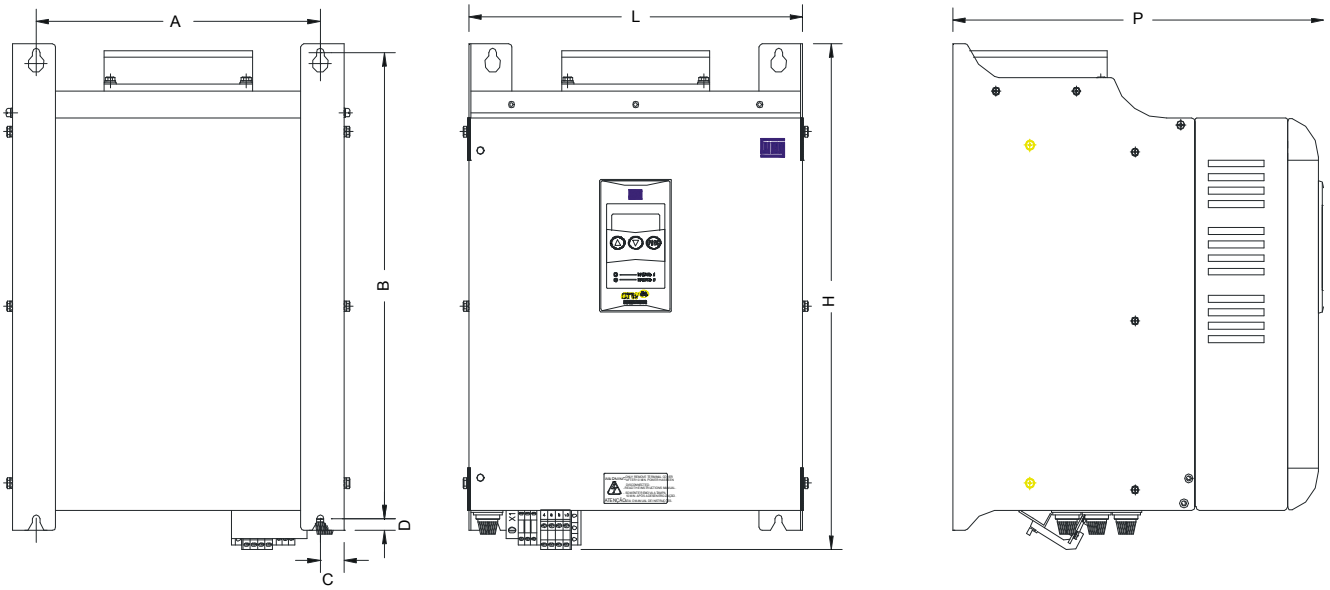


Figure 3.1 b) *– Dimensions of the CTW-04 converter - Size 02*

NOTE!
50A model is not fitted with forced cooling.

c) Size 03 (150A to 265A)

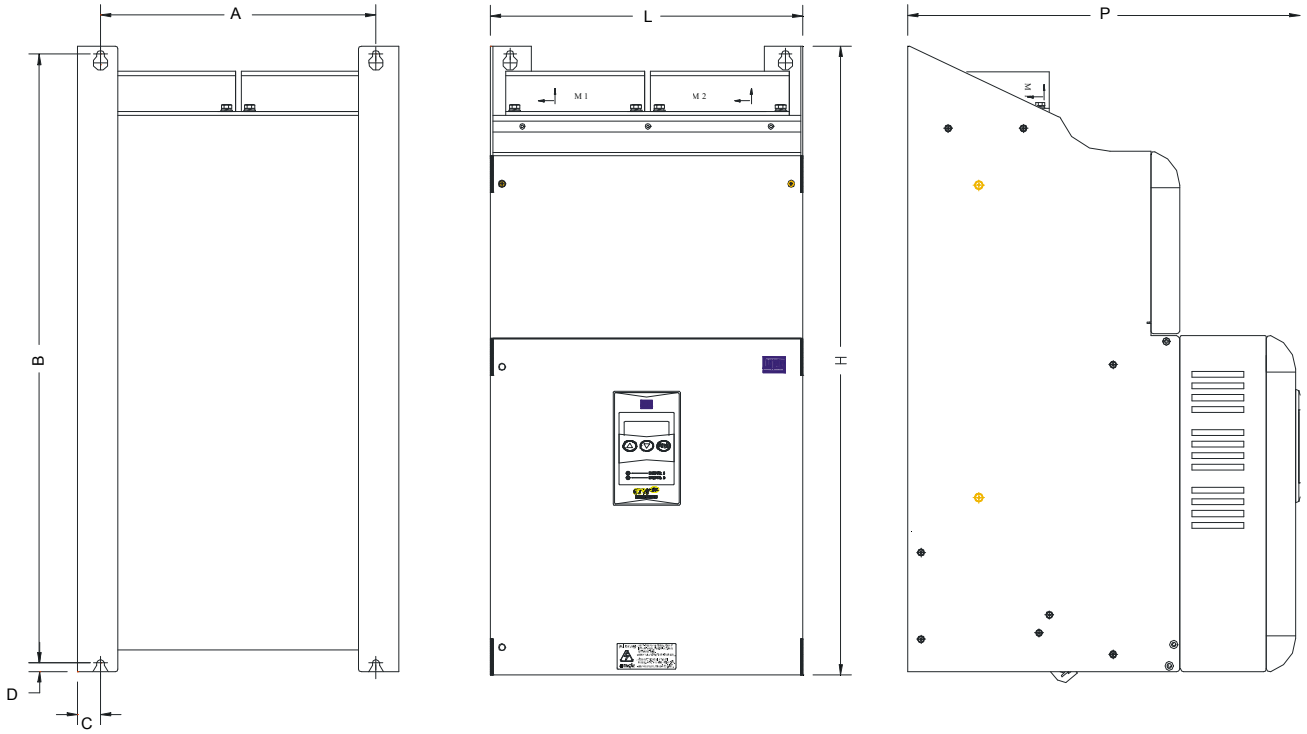


Figure 3.1 c) *– Dimensions of the CTW-04 converter - Size 03*

NOTE!
Size 03 for the 265A model is not available for the Antiparallel Model (CTWA4).

d) Size 04 (Antiparallel 265A)

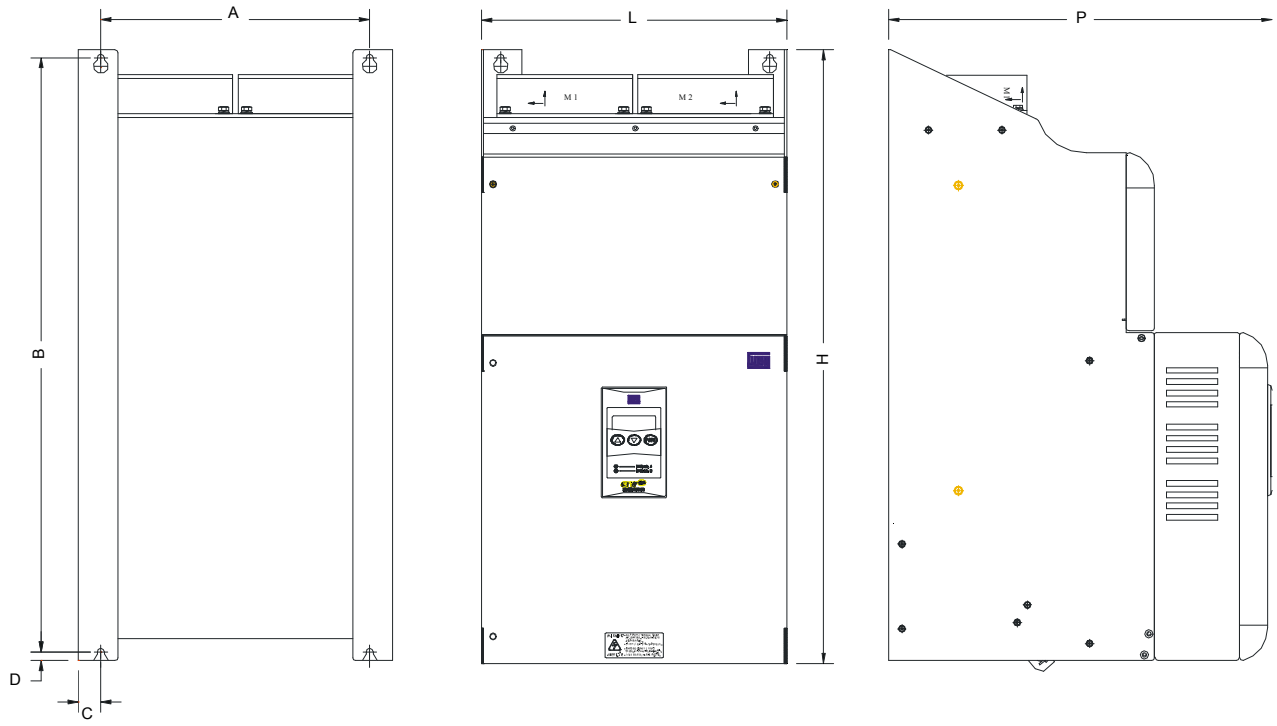


Figure 3.1 d) *– Dimensions of the CTW-04 converter - Size 04*

e) Size 05 (480A to 640A)

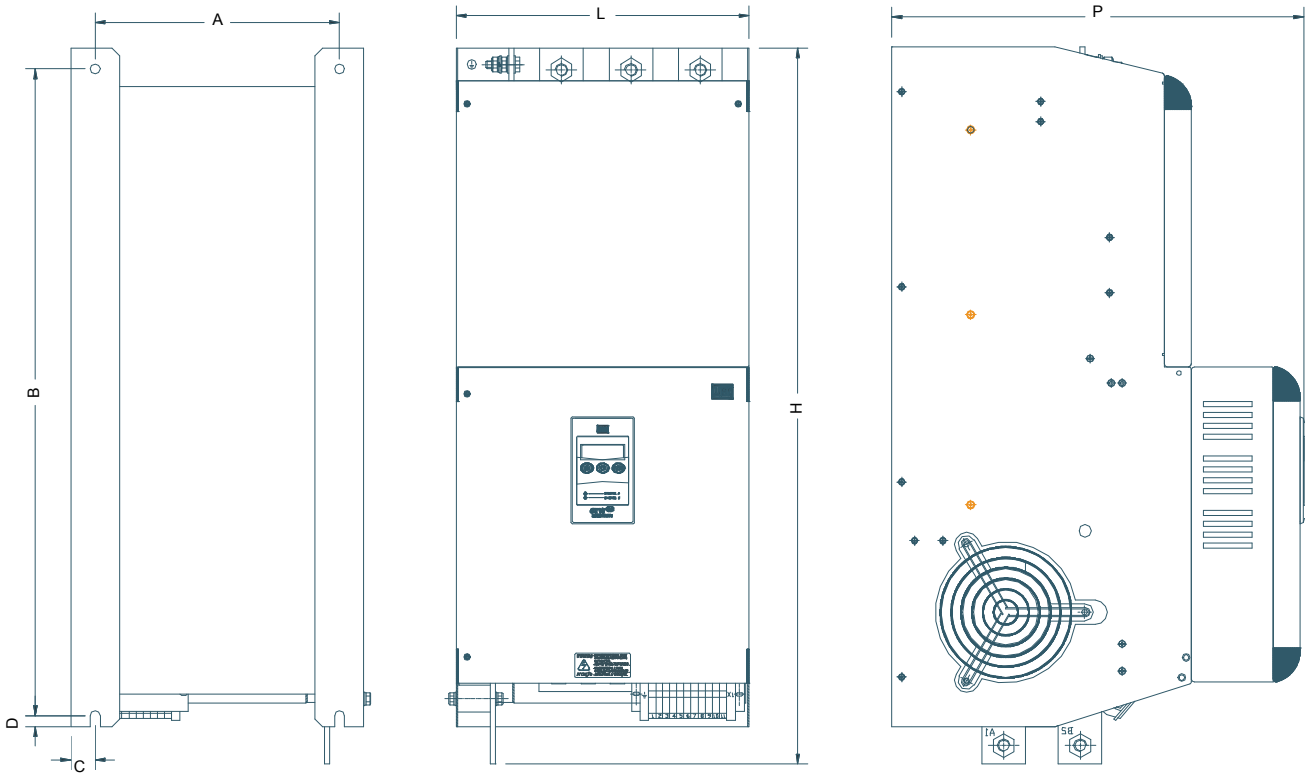


Figure 3.1 e) *– Dimensions of the CTW-04 converter - Size 05*

f) Size 06 (1000A Unidirection/Antiparallel)

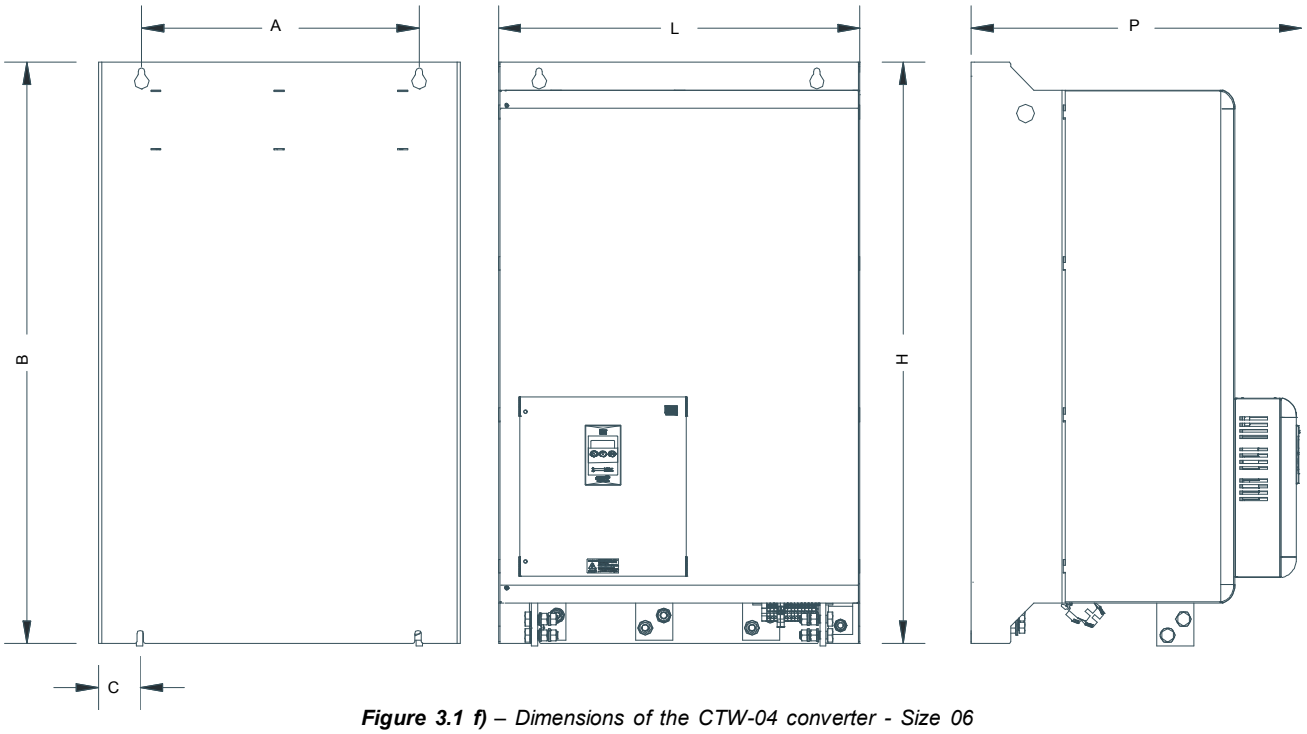


Figure 3.1 f) *– Dimensions of the CTW-04 converter - Size 06*

	CTW-04 Data		Model Dimensions [mm - in]							Mounting Screw mm in	Weight [kg] CTWU4/CTWA4 kg lb
	In [A]	Power [W]	A	B	C	D	L	H	P		
Size 01	10	60	230 9.05	320 12.6	20 0.79	10 0.39	270 10.63	330 12.99	260 10.24	M6 1/4	11,0/11,9 24.25/26.23
	20	100	230 9.05	320 12.6	20 0.79	10 0.39	270 10.63	330 12.99	260 10.24	M6 1/4	11,0/11,9 24.25/26.23
Size 02	50	203	230 9.05	350 13.78	20 0.79	10 0.39	270 10.63	380 14.96	300 11.81	M6 1/4	15,0/15,9 33.06/35.05
	63	272	230 9.05	350 13.78	20 0.79	10 0.39	270 10.63	380 14.96	300 11.81	M6 1/4	17,2/18,1 37.92/39.9
	90	316	230 9.05	350 13.78	20 0.79	10 0.39	270 10.63	380 14.96	300 11.81	M6 1/4	17,2/18,1 37.92/39.9
	106	342	230 9.05	350 13.78	20 0.79	10 0.39	270 10.63	380 14.96	300 11.81	M6 1/4	17,2/18,1 37.92/39.9
	125	417	230 9.05	350 13.78	20 0.79	10 0.39	270 10.63	380 14.96	300 11.81	M6 1/4	17,2/18,1 37.92/39.9
Size 03	150	570	230 9.05	500 19.68	20 0.79	10 0.39	270 10.63	550 21.65	340 13.38	M6 1/4	20,7/21,0 45.63/46.30
	190	780	230 9.05	500 19.68	20 0.79	10 0.39	270 10.63	550 21.65	340 13.38	M6 1/4	21,0/21,8 46.30/48.06
	265	960	230 9.05	500 19.68	20 0.79	10 0.39	270 10.63	550 21.65	340 13.38	M6 1/4	23,0/ 50.71/
Size 04	265	960	230 9.05	530 20.87	20 0.79	10 0.39	270 10.63	600 23.62	340 13.38	M6 1/4	/25,8 /56.88
Size 05	480	1819	230 9.05	600 23.62	10 0.39	25 0.98	270 10.63	660 25.98	380 14.96	M8 5/16	35,5/40,0 78.26/88.18
	640	2579	230 9.05	600 23.62	10 0.39	25 0.98	270 10.63	660 25.98	380 14.96	M8 5/16	37,0/42,0 81.57/92.59
Size 06	1000	≅3400	450 17.72	925 36.41	68 2.68	15 0.59	586 23.07	940 37	535 21.06	M10 3/8	110,0/140,0 242.51/308.65

* The 265A model of Size 03 covers only the Unidirectional CTW-04. Due to the dimensional variations between the two models, the antiparallel 265A Model has a specific size – Size 04.

Table 3.1 *– Installation Data*

NOTE!
The 1320A and 1700A models are supplied in panels.

3.1.3 Positioning and Mounting

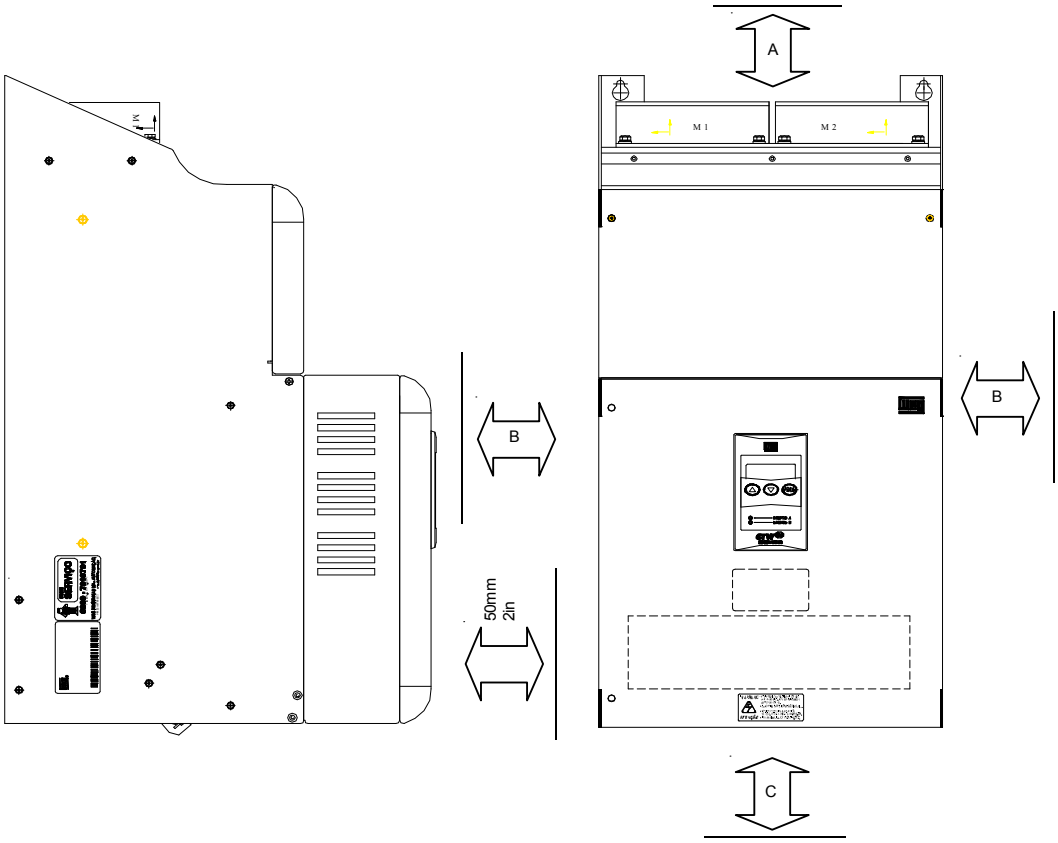


Figure 3.2 *– Free Spaces for cooling*

	A mm in	B mm in	C in mm
Size 01	60 2.36	30 1.18	100 3.9
Size 02	60 2.36	30 1.18	100 3.9
Size 03	100 3.9	30 1.18	130 5.12
Size 04	100 3.9	30 1.18	130 5.12
Size 05	100 3.9	100 3.9	130 5.12
Size 06	300 11.81	100 3.9	300 11.81

Table 3.2 *- Recommended free spaces*

Install converter in vertical position:

- ☑ Leave at least the recommended free space around the converter, as shown in figure 3.2 and table 3.2;
- ☑ Do not install heat sensitive components immediately above the converter;
- ☑ When converters are installed side by side, maintain at least the recommended distance of 2B. When converters are installed top and bottom, maintain the minimum recommended distance A + C and deflect the hot air coming from the converter below;
- ☑ Install the converter on a flat surface;
- ☑ External dimensions and mounting holes, etc. are shown on figure 3.1 and table 3.1;
- ☑ Provide independent conduits for signal, control and power conductors (refer to Electrical Installation). Lay the motor cables separately from the other cables.

CTW-04 mounting procedures on flat surfaces:

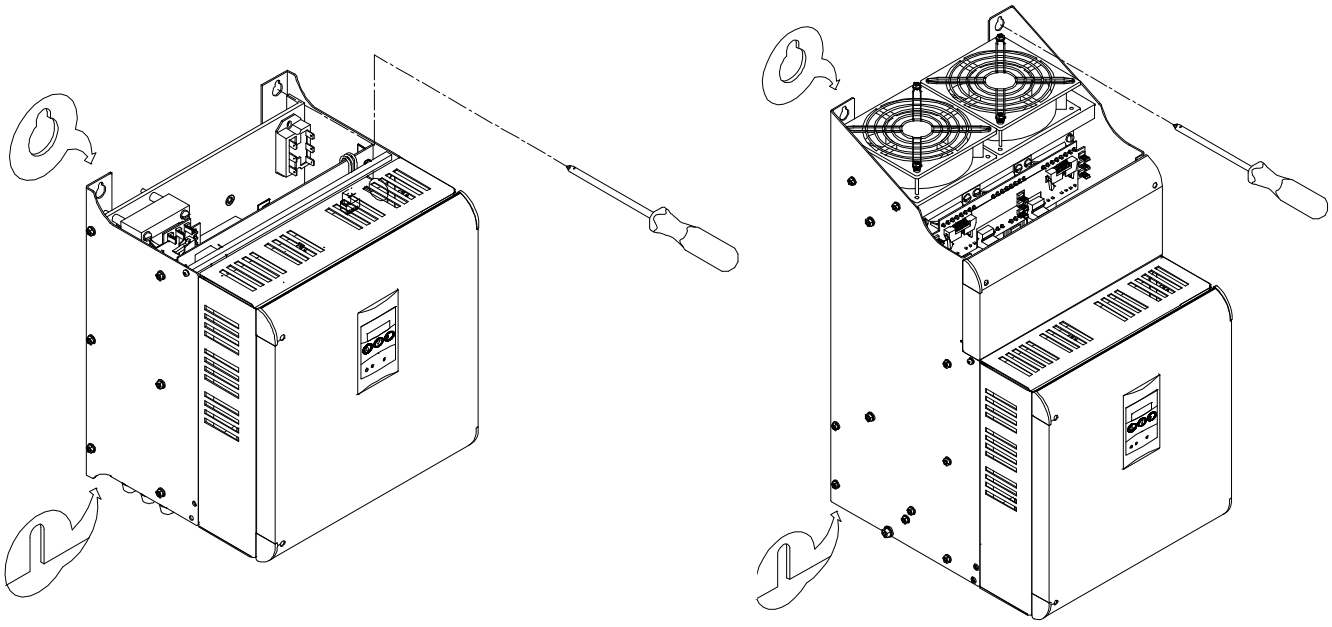


Figure 3.3 – *CFW-04 Mounting Procedures on flat surfaces*

CTW-04 Keypad and Cover Removal Procedures:

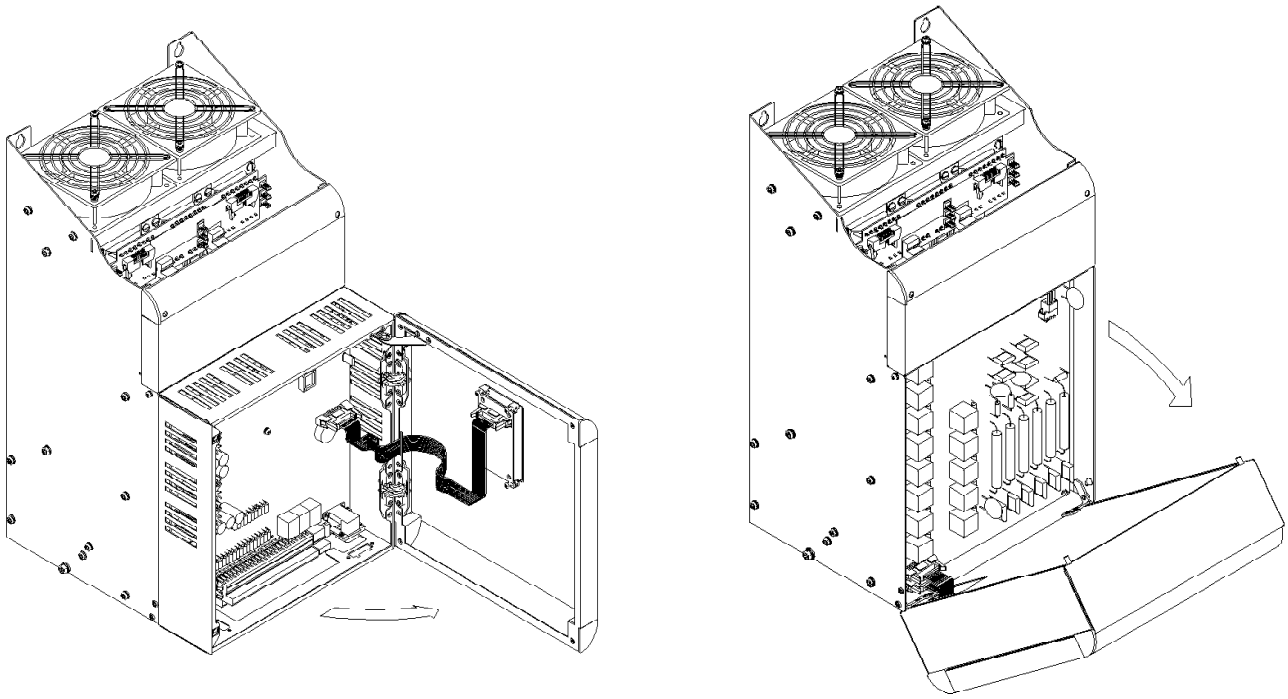


***Figure 3.4** – CTW-04 Keypad and Cover Removal Procedures*

3.2 ELECTRICAL INSTALLATION

3.2.1 Power Connections

ATTENTION!
For CTW-04 technical informations and dimensioning, see chapter 9.

DANGER!
This equipment cannot be used as emergency stop device.

ATTENTION!
Be sure that the AC input power live is disconnected before making any terminal connection.

DANGER!
The information below will be a guide to make a proper installation. Follow also all applicable regulations for electrical installation.

ATTENTION!
Provide at least 0.25m (10in) spacing between sensitive equipments and converter wiring, power and control cables between the motor and the converter. Example: PLCs, temperature controller, thermocouple cables, etc.

ATTENTION!
Ensure that the phase connected to the electronics R input is also connected to the power R input.
Adopt the same procedures for the other phases.

NOTE!
For voltage transient suppression, connect RC-filter to the contactor coil terminals.

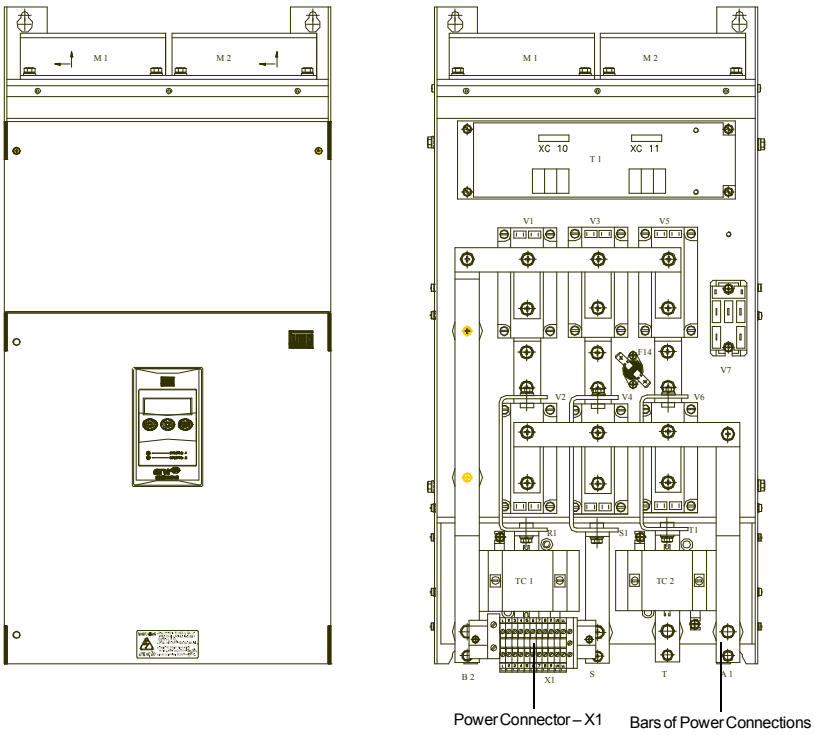


Figure 3.5 *– Identification of the power connections*

3.2.1.1 Connections of the Power Connector – X1 for models from 10A to 640A

X1:1	⇒	R - Three-phase AC power input of the Control
X1:2	⇒	S - Three-phase AC power input of the Control
X1:3	⇒	T - Three-phase AC power input of the Control
X1:4,5	⇒	Single-phase AC power supply of the motor field
X1:6	⇒	DC voltage output of the motor field (-)
X1:7	⇒	DC voltage output of the motor field (+)
X1:8,9	⇒	Thermostat of the motor armature rectifier
X1:10,11	⇒	Single-phase AC supply input for the fan motor
X1: ⏚	⇒	Converter grounding

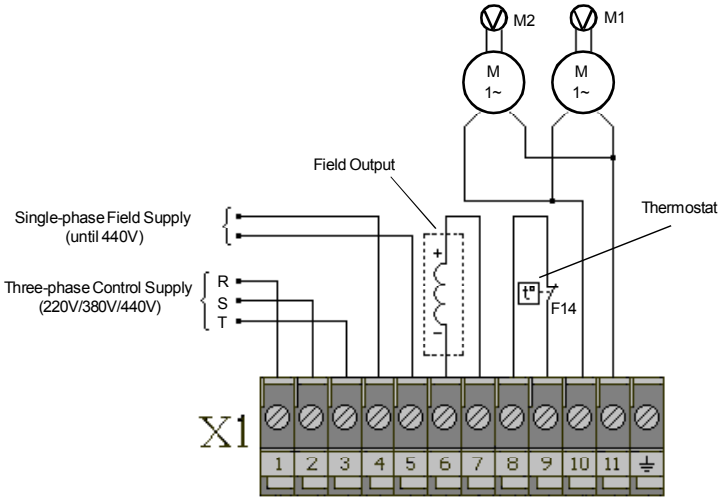


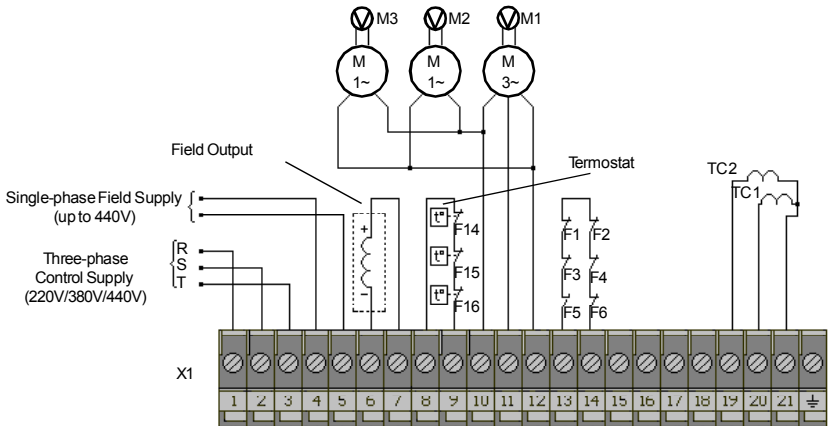
Figure 3.6 *- Connection of the X1-connector for models from 10A to 640A*

NOTE!

- ☑ For converter models CTWX40010TXXPXSZ, CTWX40020TXXPXSZ, CTWX40050TXXPXSZ pins 8, 9, 10 and 11 are not mounted.
- ☑ M2 monted in the following models: CTWX40150TXXXXXZ, CTWX40190TXXXXXZ, CTWX40265TXXXXXZ.

3.2.1.2 Connection of the Connector - X1 for models from 1000A to 1700A

X1:1 ⇒ R - Three-phase AC power input of the Control
X1:2 ⇒ S - Three-phase AC power input of the Control
X1:3 ⇒ T - Three-phase AC power input of the Control
X1:4,5 ⇒ Single-phase AC power supply of the motor field
X1:6 ⇒ DC voltage output of the motor field (-)
X1:7 ⇒ DC voltage output of the motor field (+)
X1:8,9 ⇒ Thermostat of the motor armature rectifier
X1:10,11,12 ⇒ Supply input for the fan motor
X1:13,14 ⇒ Detector of U.R. fuse blow of power arms (F1 to F6)
X1:15,16 ⇒ Not connected
X1:17,18 ⇒ Not connected
X1:19,20,21 ⇒ Connection of the Power CT´s [*exclusive WEG use*]
X1: ⏚ ⇒ Converter Grounding



Notes:
Mounted M2 and M3 in the CTWX4**1000**TXXXXXZ
Mounted M1 in the CTWX4**1320**TXXXXXZ
Mounted M1 in the CTWX4**1700**TXXXXXZ

Figure 3.7 *– Connections of the X1 - connector for models from 1000A to 1700A*

NOTE!
In the 1000A model the X1 connector is available up to terminal strip number 14.

3.2.1.3 Power Bars Connections - X1

R ⇒ R - Three-phase AC power input of the Armature
S ⇒ S - Three-phase AC power input of the Armature
T ⇒ T - Three-phase AC power input of the Armature
A1 ⇒ DC voltage output of the motor armature (-)
B1 ⇒ DC voltage output of the motor armature (+)

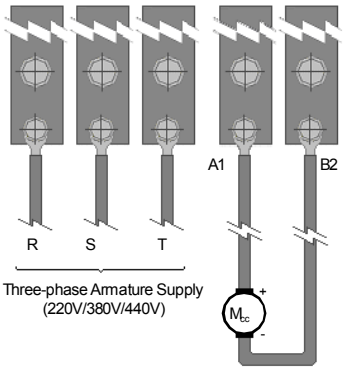


Figure 3.8 *– Power Connections – X1*

3.2.2 Grounding

ATTENTION!

Do not use the neutral wire for grounding purpose.
The converter supply line should have neutral connector grounded solidly.

- ☑ Converter grounding to a protection earth is mandatory (PE). The herth or ground connection must comply with the local regulations. For grounding, use cable cross-section ≥4mm². Make ground connection to a specific grounding bar or to the general grounding point (resistance of 10 ohms). Do no share the ground wiring with other equipment that operates with high current (for instance, high voltage motors, welding machines, etc.).

Make the grounding connection of the CTW-04 control and power as shown below:

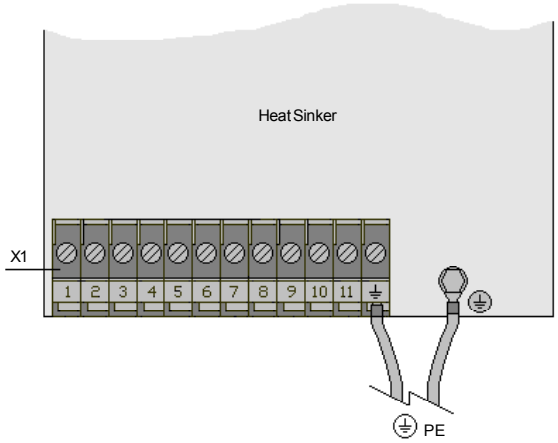


Figure 3.9 *– Control and Power Grounding Connection*

NOTE!

- ☑ The AC input voltage must be compatible with the converter rated voltage (see models on item 2.4);

- ☑ When electromagnetic interference (EMI), generated by the converter, causes problems with other equipment, use shielded wires, or install the motor wires in metallic conduits. Connect on end of the shielding to the converter grounding point and the other end to the motor frame;

- ☑ Capacitors for power factor correction are not required at the input and they must not be connected at the converter output.

- ☑ Always ground the motor frame. Ground the motor in the panel, where the converter is installed, or ground it to the converter. The converter output wiring must be laid separately from the input wiring, and also from the control and signal cables.

3.2.3 Recommended Wiring/ Fuses

The table below shows the recommended wiring/fuses of the armature:

Armature rated current A_{AC}	Armature input current A_{DC}	Armature output cables mm^2 (AWG/MCM)	Armature input cables mm^2 (AWG/MCM)	Grounding cables mm^2 (AWG/MCM)	Ultra-rapid Semiconductor Fuse for **CTWU4 and CTWA4** Protection A_{AC}	Ultra rapid Semductor Fuse for **CTWA4** A_{DC}	Fuse I^2t [A^2s] @25°C/ 77 F
10	8,2	2,5 (12)	2,5 (12)	2,5 (12)	16	16	510
20	16,3	6 (10)	4 (12)	4 (10)	25	25	510
50	40,8	16 (6)	10 (6)	4 (10)	63	63	1.100
63	51,4	25 (4)	16 (6)	10 (6)	80	80	1.100
90	73,5	35 (2)	25 (2)	16 (4)	100	100	5.000
106	86,6	50 (1)	35 (2)	16 (4)	125	125	11.000
125	102,1	70 (2/0)	50 (1)	25 (2)	125	160	13.000
150	122,5	70 (3/0)	70 (1/0)	35 (1)	160	160	20.000
190	155,1	95 (4/0)	70 (3/0)	35 (1)	250	250	103.750
265	216,4	150 (400)	120 (300)	70 (3/0)	315	315	149.000
480	391,9	3x120 (3x 300)	2x120 (2x350)	120 (300)	500	550	181.000
640	522,6	3x150 (3x500)	2x150 (2x600)	150 (350)	700	700	321.000
1000	816,5	4x150 (4x700)	3x150 (3x750)	150 (350)	Circ. Breaker	Circ. Breaker	600.000
1320	1078,0	5x150 (5x1000)	4x150 (4x900)	2x150 (2x350)	Circ. Breaker	Circ. Breaker	600.000
1700	1388,0	6x150 (7x1000)	5x150 (7x1000)	2x150 (2x350)	Circ. Breaker	Circ. Breaker	3.000.000

***Table 3.3** - Recommended cables and fuses for product connection (Armature)*

NOTE!

High speed fuses shall be used at the armature output (DC side) for the antiparallel models – CTW**A**4XXXXTXXXXXZ.
Protection circuit breakers shall be used with models from 1000A to 1700A, because the CTW-04 converter has internal fuses in each arm.

Recommended cables and fuses for the field:

Converter rated current [A_{AC}]	Field Current – Ic [A_{DC}]	Field Wiring mm^2 (AWG)	Ultra-rapid Fuses [A_{DC}]	Fuse I^2t [A^2s] @ 25°C
10	18	2.5 (12)	25	410
20	18	2.5 (12)	25	410
50	18	2.5 (12)	25	410
63	18	2.5 (12)	25	410
90	18	2.5 (12)	25	410
106	18	2.5 (12)	25	410
125	18	2.5 (12)	25	410
150	18	2.5 (12)	25	410
190	18	2.5 (12)	25	410
265	18	2.5 (12)	25	410
480	25	4.0 (10)	35	5.000
640	25	4.0 (10)	35	5.000
1000	25	4.0 (10)	35	5.000
1320	25	4.0 (10)	35	5.000
1700	25	4.0 (10)	35	5.000

***Table 3.4** – Recommended wiring and fuses for product connection (Field)*

ATTENTION!

The used fuse should be of UR type(ultra-rapid) with i²t of an equal or smaller value than indicated in the tables.

Recommended wiring and fuses for the control:

Rated converter Current – [A_{AC}]	Control Current [mA]	Control wiring mm² [AWG]	Glass fuse 6x32 – [mA]
10 to 1700	250	1,5 (14)	500

Table 3.5 *– Recommended wiring/fuses for product connection (Control)*

NOTE!
The wire gauges are reference values only.
The installation conditions and the maximum accepted voltage drop shall be considered for proper wiring sizing.

3.2.4 Signal and Control Wiring

The signal (analog inputs/outputs) and the control connections (digital inputs/outputs, relay outputs, tachogenerator) are made on the following connectors of the CCW4 electronic control board as presented in Figure 3.10.

NOTE!
The label inside the equipment cover identifies the control connections.

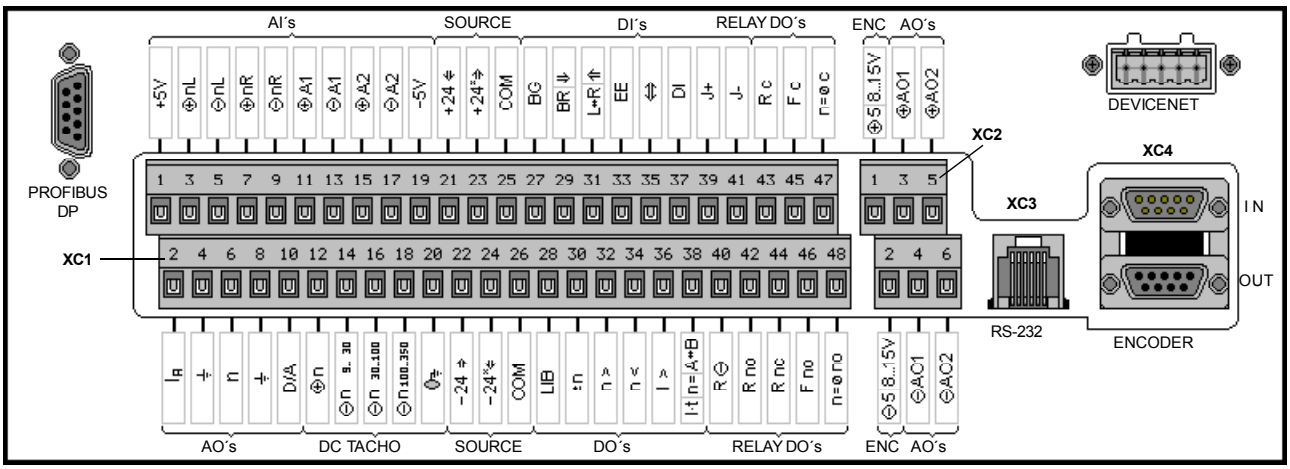
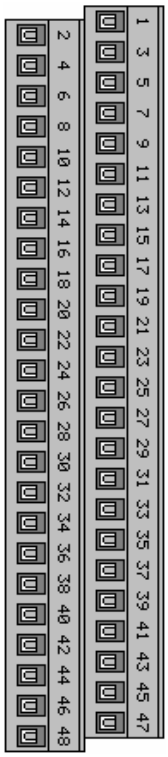


Figure 3.10 *- Signal and control connectors of CTW-04 converter*

3.2.4.1 Description of the signal and control connector – XC1

Pins	Group	Description	Specifications
2	AO´s	I_A (Non – Programmable)	(0 to 10)V @ ≤2mA RL ≥ 5kΩ (max. load) Resolution: 8 bits
4		⏚	
6		N Non - Programmable	
8		⏚	
10		D/A Programmable	
12	DC Tacho	(+)n	(9 to 350)V (differential) Impedance: 30 kΩ (9 to 30)V 100 kΩ (30 to 100)V 300 kΩ (100 to 350)V
14		(-)n 9 to 30	
16		(-)n 30 to 100	
18		(-)n 100 to 350	
20		⏚	
22	Sources	0V ⇨	Input Supply - DO's [+24 V (-)]
24		0V* ⇦	+24V @ ≤170mA Isolated **See Note (2)**
26		COM	Common point of digital inputs
28	DO's	LIB	Supply voltage: +24V Output voltage: 0V (activated) 24V (deactivated) Inominal: 12mA **See Note (1)**
30		±n	
32		n>	
34		n<	
36		I>	
38		I.t | n= | A⇔B	
40	Relay DO's	R (-)	Contact capacity: 250Vrms 1A
42		R NO	
44		R NC	
46		F NO	
48		n=0 NO	



Specifications	Description	Group	Pins
	+10V	AI's	1
(0 to +10)V @ ≤10mA RL ≥ 1kΩ (max. load)	(+) nL		3
	(-) nL		5
	(+) nR		7
	(-) nR		9
(0 to 20)mA/ (4 to 20)mA (500Ω) (0 to +10)V (200kΩ)	(+) AI1		11
	(-) AI1		13
	(+) AI2		15
	(-) AI2		17
	0V		19
Input Supply - DO's (+24 V (+))	+24 ⇦	Sources	21
Source (+) +24V @ ≤170mA Isolated **See Note (2)**	+24* ⇨		23
Common point of digital inputs	COM		25
24V @ 11mA Isolated Min. high level: 18V Max. low level: 3V Max. voltage: 30V Input filter: 4,0ms	BG	DI's	27
	BR | ⇓		29
	L⇔R | ⇑		31
	EE		33
	⇔		35
	DI		37
	J+		39
	J–		41
Contact capacity: 250Vrms 1A	Rc	DO's to the Relay	43
	Fc		45
	n=0 c		47

***Table 3.6** – Description of the signal and control connector – XC1*

NOTES!

(1) Transistor output in open collector with free-wheel diode;
Output voltage with Imáx.: 1V ;
Imax. Per output: 100mA (activated output) with external source;
Isolated;

(2) The internal +24V* source can not be used if the total load current is higher than 170mA. In this case, use an external source by connecting:
XC1:21 to the positive of the external source;
XC1:22 to the common of this source.

3.2.4.1.1 Analog Inputs - AI's

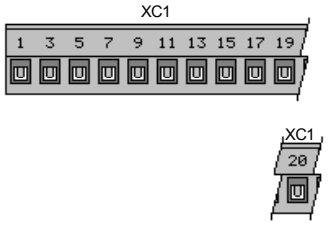


Figure 3.11 - *Pins of the XC1 connector relating to the Analog Inputs [AI's]*

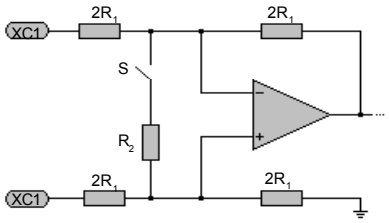


Figure 3.12 - *Electronic diagram of the Analog Inputs [AI's]*

Specifications:

- ☑ Isolated differential power supply for AI's: 0V to 10V @ ≤ 10mA, RL ≥ 1kΩ (max. load).
- ☑ 04 differential analog inputs (nL, nR, AI1, AI2): 0V to 10V (impedance: 500Ω), (0 to 20) mA/(4 to 20) mA (impedance: 200kΩ), resolution: 10 bits.

Functions of the Analog Inputs:

XC1	Function
1 and 19	**Isolated differential power supply for AI's 0V to 10V:** 0V to 10V @ ≤ 10mA, RL ≥ 1kΩ (max. load).
3 and 5	**nL (Local speed reference):** The parameter setting of the variation range of the speed reference is made at P024 (0 or 1).
7 and 9	**nR (Remote speed reference):** The parameter setting of the variation range of the speed reference is made at P024 (0 or 1).
11 and 13	**AI1 (Auxiliary Input 1):** Programmable, the value of the auxiliary input AI1 can be read at parameter P091. The function of this input is set at P028 and the gain of this signal is set at parameter P050.
15 and 17	**AI2 (Auxiliary Input 2):** Programmable, the value of the auxiliary input (AI2) can be read at parameter P092. The function of this input is set at P029 and the gain of this signal is set at parameter P051.

NOTE!

For the models of the CTW-04 converter where the control board CCW4.00 - Full (CTWX4XXXXTXXX**F**XZ – full version) is specified, the parameter of Remote speed reference is set at P024 (2 or 3) with a 12 bits resolution.

Configurations:
To select the AI's at 0V to 10V, consider:

Remote speed reference (nR)	⇒	S1:1 = OFF
Local speed reference (nL)	⇒	S1:2 = OFF
Auxiliary Input (AI1)	⇒	S2:1 = OFF
Auxiliary Input (AI2)	⇒	S2:2 = OFF

To select the AI's at (0 to 20)mA / (4 to 20)mA, consider:

Remote speed reference (nR)	⇒	S1:1 = ON
Local speed reference (nL)	⇒	S1:2 = ON
Auxiliary Input (AI1)	⇒	S2:1 = ON
Auxiliary Input (AI2)	⇒	S2:2 = ON

Options for Analog Input Connections:

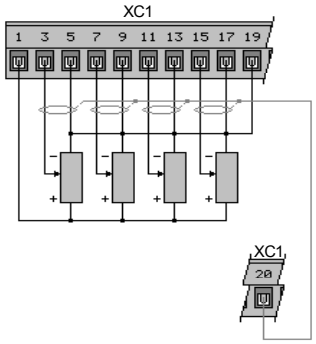


Figure 3.13 - *Internal Power Supply with* 5kΩ Potentiometer

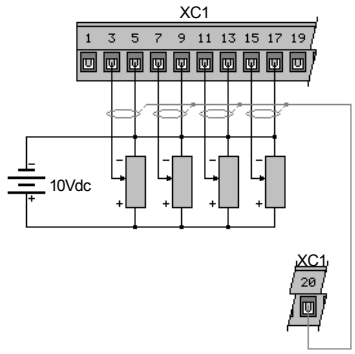


Figure 3.14 - *External Power Supply with* 5kΩ Potentiometer

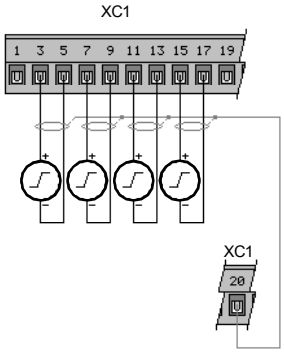


Figure 3.15 - *External Reference*

3.2.4.1.2 Digital Inputs - DI's

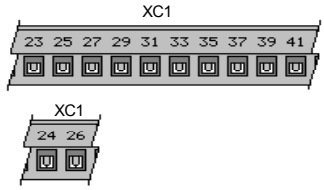


Figure 3.16 - *XC1 Connector Pins Relating to the Digital Inputs [DI's]*

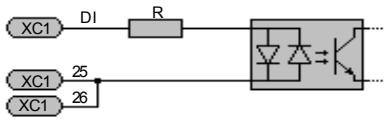


Figure 3.17 - *Digital Input Diagram*

Specifications:

☑ 08 isolated Digital Inputs (BG, BR or ⇓, L⇔R or ⇑, EE, ⇔, DI, J+, J-): 18V (min. high level), 3V (max. low level), 30V (Max. voltage) and 4.0ms input filter.

DI's status:

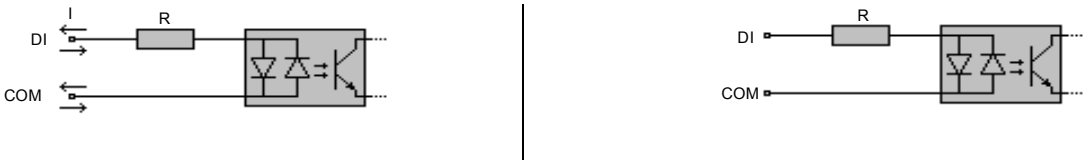


Figure 3.18 - *DI's status*

Functions of the Digital Inputs:

XC1	Funtion
27	**BG (General Disable):** 0V (Active) ⇒ shows F01 on the Display. If the disable through stop logic is active, it deactivates the output XC1:28 (Release), disables the ramp and the regulators, and after ½ network cycle it disables the firing. If any key is activated, the indication of F01 on the display is replaced by the previous indication (the one that was being displayed before the occurrence of the General Disable). ± 24V (Inactive) ⇒ removing the general disable command will cause a delay of about 0.1s for releasing the speed ramp, regulators, firing and the activation of the digital output XC1:28. The indication on the display is replaced by the previous indication (the one that was being presented before the occurrence of the General Disable).
29	**BR or ⇓ (Ramp disable or decelerates P.E.):** BR (Ramp disable) ⇒ Quick ramp disable (P009 = 1) or slow ramp disable (P009 = 0). Active with 24V. ⇓ (Decelerates P.E.) ⇒ Active with 0V (P024 = 5). The quick/slow disable resets the ramp input/output, respectively.
31	**L⇔ R or ⇑ (Local/Remote Speed Reference or Accelerates P.E.):** L ⇔ R (Local/Remote Speed Reference) ⇒ selects the origin of the analog speed reference (0V = remote, 24V = local). ⇑ (Accelerates P.E.) ⇒ Active with +24V
33	**EE (External Error):** This input can monitor, for instance, the heatsink thermostat, the thermostat of the DC motor, the ultra-rapid fuse blow-out, etc. For this purpose, connect the sensor contacts in series (0V = defective, 24V = no defective).
35	**⇔ (direction of rotation):** It reverses the polarity of the speed reference (0V = clockwise, ± 24V = counter-clockwise).
37	**DI (Programmable Digital Input):** DI programmable via Parameter P065
39	**J+ (Jog +):** +24V – adds the positive value set at P037 to the speed reference signal (0V does not act).
41	**J- [Jog -]:** +24V – adds the negative value set at P038 to the speed reference signal (0V does not act).

Options for Digital Input connections:

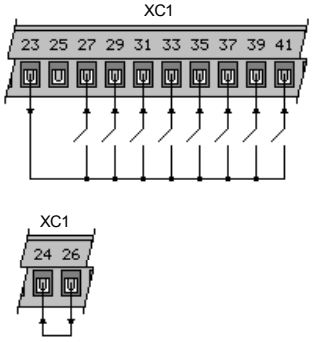


Figure 3.19 - *Internal Power Supply (+24V)*

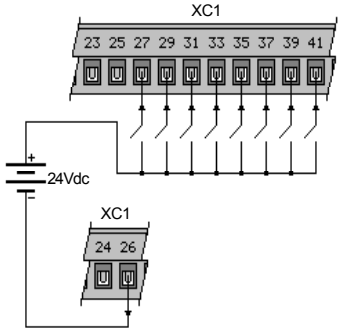


Figure 3.20 - *External Power Supply (-24V)*

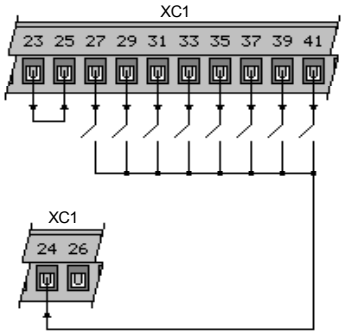


Figure 3.21 - *Internal Power Supply (-24V)*

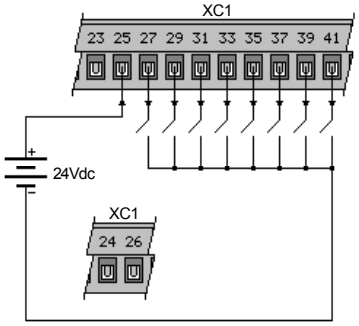


Figure 3.22 - *External Power Supply (+24V))*

3.2.4.1.3 Analog Outputs - AO's

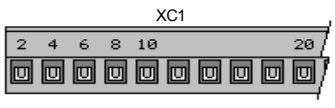


Figure 3.23 - *XC1 connector pins relating to the Analog Outputs [AO's]*

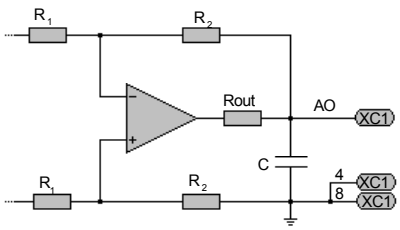


Figure 3.24 - *Electronic diagram of the Analog Outputs [AO's]*

Specifications:

☑ 03 Analog Outputs (I_a, n, D/A): Output Signal of 0V to 10V @ ≤ 2mA, RL ≥ 5kΩ (Max. load), resolution 8 bits.

Functions of the Analog Outputs:

XC1	Function
2	**I_A [Armature Current]:** It shows the effective armature current. The value is given by following formula: $I_A = \frac{Vm\ ^{(*1)}\ (V)\ xI_{máx}\ ^{(*2)}}{10\ (V)}\ A$
4	⏚
6	**N [Motor speed]:** It shows the effective motor speed, given by the formula: $N = \frac{Vm\ \ (V) xN_{máx}\ ^{(*3)}}{10(V)} rpm$
8	⏚
10	**D/A: - XC1:10 en negrito** AO programmable through Parameter P030.

(*1) Vm = Measured value in the Analog Outputs
(*2) Imax. = 1.25 x Irated
(*3) Nmax. = Maximum motor speed

Analog Output Connections:

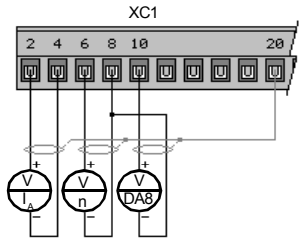


Figure 3.25 - *Analog Output Connections*

3.2.4.1.4 DC - Tachogenerator

Figure 3.26 - *XC1 Connector Pins relating to the DC Tachogenerator Inputs*

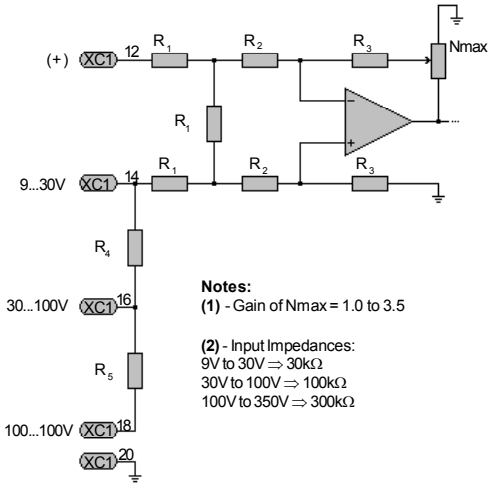


Figure 3.27 - *DC Tachogenerator Input Diagram [DC Tacho]*

Specifications:

☑ 03 Differential Inputs for the DC Tachogenerator [(-) n 9 to 30, (-) n 30 to 100, (-) n 100 to 350] ⇒ voltage signal input generated by the DC Tachogenerator.

Functions of the DC Tachogenerator Inputs:

XC1	Function
12	**[+] n:** Positive differential input of the DC tachogenerator voltage signal.
14	**[-] n 9 to 30:** Differential input of the voltage signal from 9V to 30V of the DC tachogenerator (impedance: 30kΩ).
16	**[-] n 30 to 100:** Differential input of the voltage signal from 30V to 100V of the DC tachogenerator (impedance: 100kΩ).
18	**[-] n 100 to 350 :** Differential input of the voltage signal from 100V to 350V of the DC tachogenerator (impedance: 300kΩ).
20	⏚

Input connections of the DC Tachogenerator:

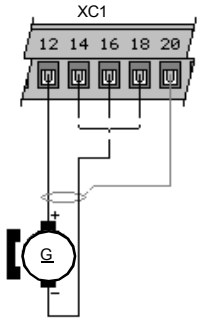


Figure 3.28 - *DC Tachogenerator Connections*

3.2.4.1.5 Digital Outputs - DO's

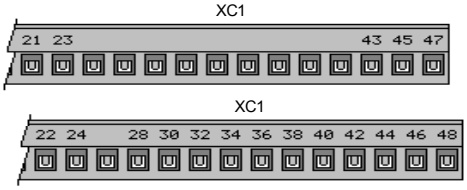


Figure 3.29 - *XC1 connector pins relating to the Digital Outputs [DO's]*

Specifications:

- ☑ Isolated power supply for DO's: 24V @ ≤ 170mA .
- ☑ Input for the external power supply of the DO's: +24V@11mA.
- ☑ 06 isolated Digital Output [LIB, ±n, n>, n<, I>, I.t | n= | A⇔B]: transistorized output with open collector and free-wheel diode, +24V [supply voltage], 12mA [Inominal], 1V [output voltage with Imáx], 100mA activated output [Imáx. for each output with external power supply].
- ☑ 02 digital relay output + 01 Programmable (F NO, n=0 NO, R NO or R NC): 250 Vrms and 1A (Contact capacity).

NOTE!

Output voltage: 0V [activated], 24V [deactivated].
The internal +24V* power supply can not be used if the total load current is higher than 170mA.
In this case, use the external power supply by connecting XC1:21 to the positive pole of the external power supply and XC1:22 to the common point of this power supply.

Isolated Digital Outputs:

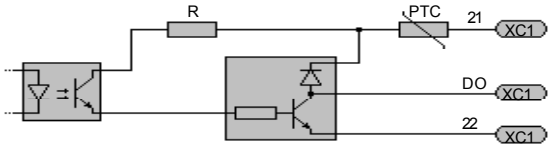


Figure 3.30 - *Diagram of the Digital Outputs [DO's]*

Digital Relay Outputs:

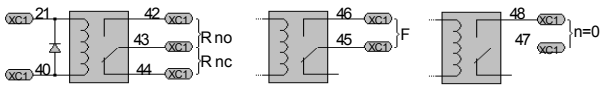


Figure 3.31 - *Diagram of the Digital Relay Outputs [DO's]*

Functions of the Digital Outputs:

XC1	Function
28	**LIB (Released):** 0V (When there is none of the faults F02 to F09; no diagnosis error in the power-on or activation of the General Disable is detected) or 24V (when any condition above is detected).
30	**±n (Motor Direction of Rotation):** 0V (counter-clockwise, -n) or 24V (clockwise, +n).
32	**n> (n> N_X):** 0V (when motor speed > N_X) or 24V (for motor speed ≤ N_X). N_X is set in parameter P073.
34	**n< (n< N_Y):** 0V (when motor speed < N_Y) or 24V (for motor speed ≥ N_Y). N_Y is set in parameter P072.
36	**I> (I_A > I_X):** 0V (I_A > I_X) or 24V (I_A ≤ I_X). This function can be disabled during the acceleration/braking process or be always enabled depending on the setting at Parameter P017. The display of I_A > I_X is made after 28.0ms of permanence in this condition. I_X is set at P071.
38	**I.t | n= | A⇔ B (Ixt and locked rotor R.B., n = n*, Bridge under conduction A⇔B] :** Programmable by the user via parameter P070. There are the following options: 0 - with Ixt and locked rotor R.B. 1 - n = n* and R.B. 2 - Bridge under conduction A⇔B and R.B. 3 - Ixt 4 - n = n* 5 - Bridge under conduction A⇔B Ixt ⇒0V (Ixt is not disabling the converter) or 24V (converter is disabled due to Ixt actuation, during 5 minutes). Locked Rotor ⇒ 0V (does not disable the converter) or 24V (locked rotor) When RI is not proper compensated, parameter P031, and the speed feedback is realized through back-EMF, the function Locked Rotor doesn't act. n = n*(reached speed) ⇒ 0V (while the percentage difference between the motor speed and the speed reference is ≤ than the value set at parameter P035) or 24V (for percentage differences higher than the value set at P035). Bridge under conduction A⇔B ⇒ 0V (bridge B, green LED of the HMI) or 24V (bridge A, red LED of the HMI).

Functions of the Digital Relay Outputs:

XC1	Function
40,42 and 44	**R no or R nc (Relay programmable – R no = NA, R nc = NF):** Relay programmable via actuation of the Digital Outputs (LIB, ±n, n>, n<, I>, I.t | n= | A⇔B).
45 and 46	**F no (General Fault):** Relay is deactivated when occurs diagnosis error in power-on, or when a fault (F02 to F08) is detected.
47 and 48	**n = 0 no:** This function compares the total reference and the effective speed to the value set at P036, to indicate when the speed is equal to zero. If: ⇒(P011 = 1) n = 0 - Open contact n ≠0 - Closed contact ⇒ (P11 = 0) n = 0 - Open contact n ≠ 0 - Closed contact

Connection Options for the Digital Outputs:

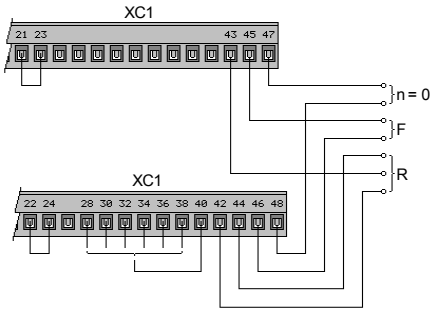


Figure 3.32 - *Internal Power Supply (+24V)*

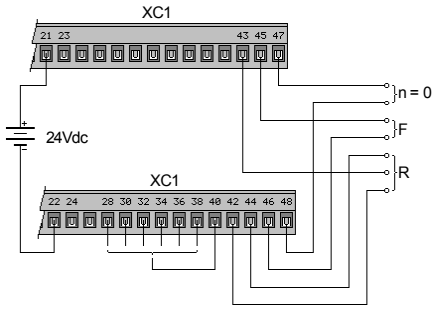


Figure 3.33 - *External Power Supply (+24V)*

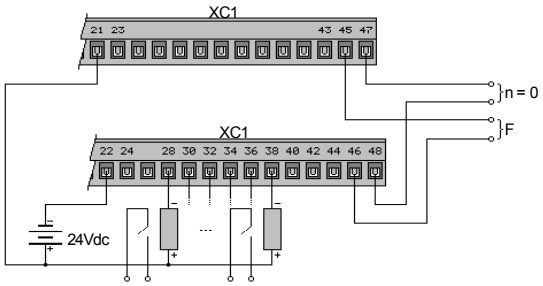


Figure 3.34 - *External Power Supply (+24V) and external Relay Connection*

3.2.4.2 Description of the Signal and Control Connector - XC2

NOTE!

XC2-Signal and Control Connector is only available on the models of the CTW-04 converters where the CCW4.00 - Full (**F** – full version) control board is specified according to the intelligent Product Code.
Ex: CTWX4XXXXTXXX**F**XZ

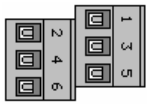
Pins	Group	Description	Specification	XC2	Specification	Group	Description	Pins
2	Encoder	0V	Encoder External Supply: 0V to +5V (S3 = ON) 0 + (8 to 15) V (S3 = OFF)		Encoder External Supply: 0V to +5V (S3 = ON) 0 + (8 to 15)V (S3 = OFF)	Encoder	+ 5V or +(8V to 15)V	1
4	AO's (12 bits)	- AO1	0 to ± 10V @ ≤ 2mA RL ≥ 5kΩ (max load) Resolution: 12 bits		0 to ± 10V @ ≤ 2mA RL ≥ 5kΩ (max load) Resolution: 12 bits	AO's (12 bits)	+ AO1	3
6		- AO2					+ AO2	5

Table 3.7 - *Description of the Signal and Control Connector XC2*

3.2.4.2.1 Alimentação Externa do Encoder

Figure 3.36 - *XC2 Connector Pins relating to the Encoder Supply*

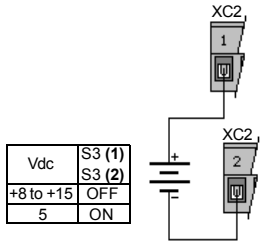


Figure 3.37 - *Connection of the external power supply to the Encoder*

Specifications:

☑ Input of the external power supply for the Encoder: +5V or +8 to 15V/220mA.

XC2	Function
1	[+] input of the Encoder Power Supply
2	[-] input of the Encoder Power Supply

NOTE!

The encoder must be supplied by an external power supply. If this supply if equal to 5V, set switch S3 = ON (S3 : 1 and 2), however if the supply is equal to 8V to 15V set switch to S3 = OFF (S3: 1 and 2).
The factory setting for the switch is S3 = OFF (S3: 1 and 2).

3.2.4.2.2 Analog Output 12 bits - AO's 12 bits

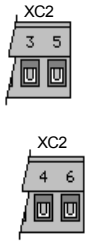


Figure 3.38 - *Pins of the XC2 Connector relating to the 12 bits Analog Outputs*

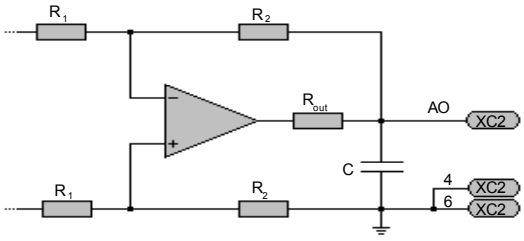


Figure 3.39 - *Electronic diagram of the Analog Outputs (AO's 12 bits)*

Specifications:

☑ 02 differential Analog Outputs (AO1 and AO2): output signal from 0V to ±10V @ ≤ 2mA, RL ≥ 5kW (Max. load), resolution 12 bits.

☑ Circuit tolerance = ±1mV.

Analog Output Function:

XC2	Function
3 and 4	**AO1 – Programmable 12-bits Analog Output: 0 to ±10V** AO1 is programmable via parameter P046. The gain for the analog output AO1 is set in parameter P079.
5 and 6	**AO2 – Programmable 12-bits Analog Output: 0 to ±10V** AO2 is programmable via parameter P047. The gain for the analog output AO2 is set in parameter P080.

NOTE!

The trimpots of the AO's are set by WEG:

AO1	RA1 Gain set
	RA2 Offset set
AO2	RA3 Gain set
	RA4 Offset set

Table 3.8 - *Trimpots are set by WEG*

Connection of the Analog Outputs:

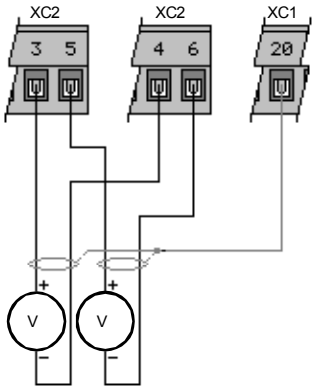


Figure 3.40 - *Connection of the 12 bits Analog Outputs*

3.2.4.3 Description of the Serial Communication Connector RS-232 – XC3

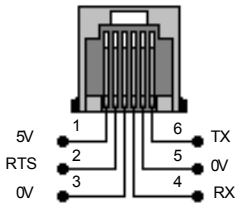


Figure 3.40 - *XC3 serial communication connector*

The CTW-04 can be controlled, set and monitored through the RS-232 serial interface. The communication protocol is based on the enquiry/ response type, according to ISO 1745, ISO 646, with ASCII character exchange between the converters and a master (network controller may be a PLC, PC, etc.). The max. transfer rate is 9600 bps. The RS-232 serial interface is point-to-point and is not galvanic isolated against 0V (which is grounded in the converter electronics) and allows installation at distances up to 10m.
The connection of the RS-232 serial communication is realized through the RJ12 - XC3 connector, available on the CCW4 control board, via serial cable. See Chapter 8 for more details.

3.2.4.4 Description of the Incremental Encoder Connector - XC4

NOTE!
The XC4 signal and control connector is only available on the CTW-04 converter models, where the CCW4.00 - Full (**F** – Full Version) control board is specified – according to intelligent product code.
Ex: CTWX4XXXXTXXX**F**XZ

In the applications where higher speed accuracy is required, the speed feedback of the motor shaft must be realized by means of Incremental Encoder.

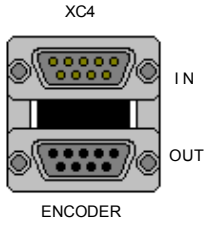


Figure 3.41 - *XC4-Incremental Encoder Connector*

The required encoder should have the following characteristics:

- ☑ Supply voltage: +5V or +8V to +15V, with consumption lower than 200mA;
- ☑ 2 quadrature channels (90º) + zero pulse with supplementary outputs (differential): Signals A, A', B, B', Z and Z';
- ☑ "Linedriver" or "Push-Pull" output circuit type (+5 to +15V);
- ☑ Electronic circuit isolated against encoder frame;
- ☑ Recommended number of pulses per turn: 1024 ppr.

Required Encoder signal sequence (motor running on clockwise):

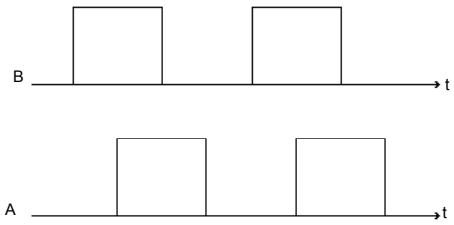
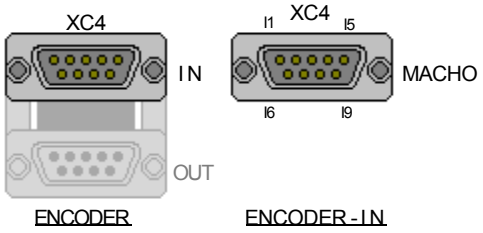


Figure 3.42 - *Required Encoder signal sequence*

For mounting the Encoder on the motor, proceed as follows:

- ☑ Couple the encoder direct on the motor shaft (by using a flexible coupling, without torsion flexibility);
- ☑ Both encoder shaft and metallic encoder frame must be electrically isolated from the motor (min. spacing: 3 mm);
- ☑ Use couplings of reasonable quality, which prevents mechanical oscillation or backlash;
- ☑ Electrical connection must be realized with shielded cables. Maintain a min. distance (>25cm) from the other wirings (power, control, etc.). If possible, install them into metallic conduits.

Incremental Encoder Input:



DB9 - Male Connector - IN	Description
I1	B
I2	A'
I3	A
I4	+5V or +8V to +15V
I5	⏚
I6	COM
I7	Z'
I8	Z
I9	B'

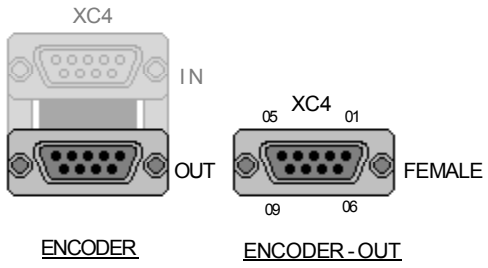
Figure 3.43 - *XC4 Connector Pins relating to the Incremental Encoder Input (top DB9 Male Connector - IN)*

- ☑ The connection to the converter is made through XC4 connector (DB9 - IN Top Male Connector) on the CCW4 control board;
- ☑ The encoder is supplied by an external +5V or +8V to 15V/220mA (XC2:1 and XC2:2) power supply, according to the connection described in figure 3.37;
- ☑ Reference to earth via 1μF capacitor parallel connected to a 1kΩ resistor;
- ☑ The network termination has a serial RC impedance, where C = 470pF and R = 249Ω;
- ☑ It presents 2 quadrature channels (90º) + zero pulse with supplementary outputs (differential): Signals A, A', B, B', Z and Z';

NOTE!

If the external power supply is +5V, set the DIP switch S3 to ON (S3:1 and 2). However, if the power supply is from +8V to +15V set the DIP switch S3 to OFF (S3:1 and 2). The factory default for the DIP switch S3 is OFF (S3:1 and 2).

Repetition of the Incremental Encoder:



DB9 Female Connector - OUT	Description
O1	B
O2	A'
O3	A
O4	+5V to +15V
O5	⏚
O6	COM
O7	Z'
O8	Z
O9	B'

Figure 3.44 - *Pins of the XC4 connector relating to the Repetition of the Incremental Encoder (Bottom DB9 female connector - OUT)*

The encoder repetition connection is realized through XC4 connector (bottom DB9 – OUT female connector) on the CCW4 control board;

- ☑ The encoder repetition circuit is supplied by an external +5V to +15V power supply via DB9 connector (XC4:O4 and XC4:O6);
- ☑ Consumption: 200mA @ 15V;
- ☑ Reference to earth via 1μF capacitor parallel connected to a 1kΩ;
- ☑ It presents 2 quadrature channels (90º) + zero pulse with supplementary outputs (differential): Signals A, A', B, B', Z and Z') and an output circuit "Linedriver" or "Push Pull" (+5V to +15V).

NOTE!

During start-up it's necessary to program the parameters below to operate the drive through incremental encoder speed feedback:

P025 ⇒ Type of Speed Feedback = 04.

P052, P053 ⇒ Max. Frequency of the Pulse Tachogenerator (FTM): make setting according to the number of pulse per turn of encoder (ppr) andaccording to the max. motor speed (vmm).

Example: Encoder with 1024 ppr and vmm = 2100 rpm, then:

$$FTM = \frac{2100}{60} \cdot 4 \cdot 1024 = 143.360 \ pulses$$

Thus: P053 = 143 and P052 = 360.

Example of pin location of the HS35B encoder cable - Dynapar:

When other encoder models are used, check correct pin connections to meet the required sequence.

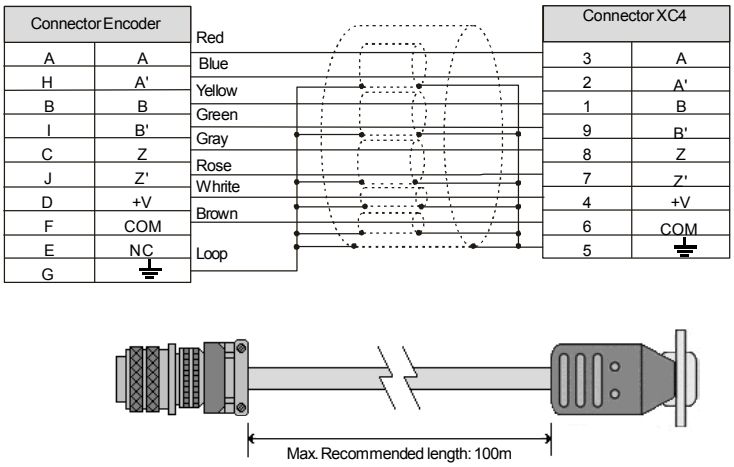


Figure 3.45 - *HS35B Dynapar Encoder Cable*

Location of the Setting Components:

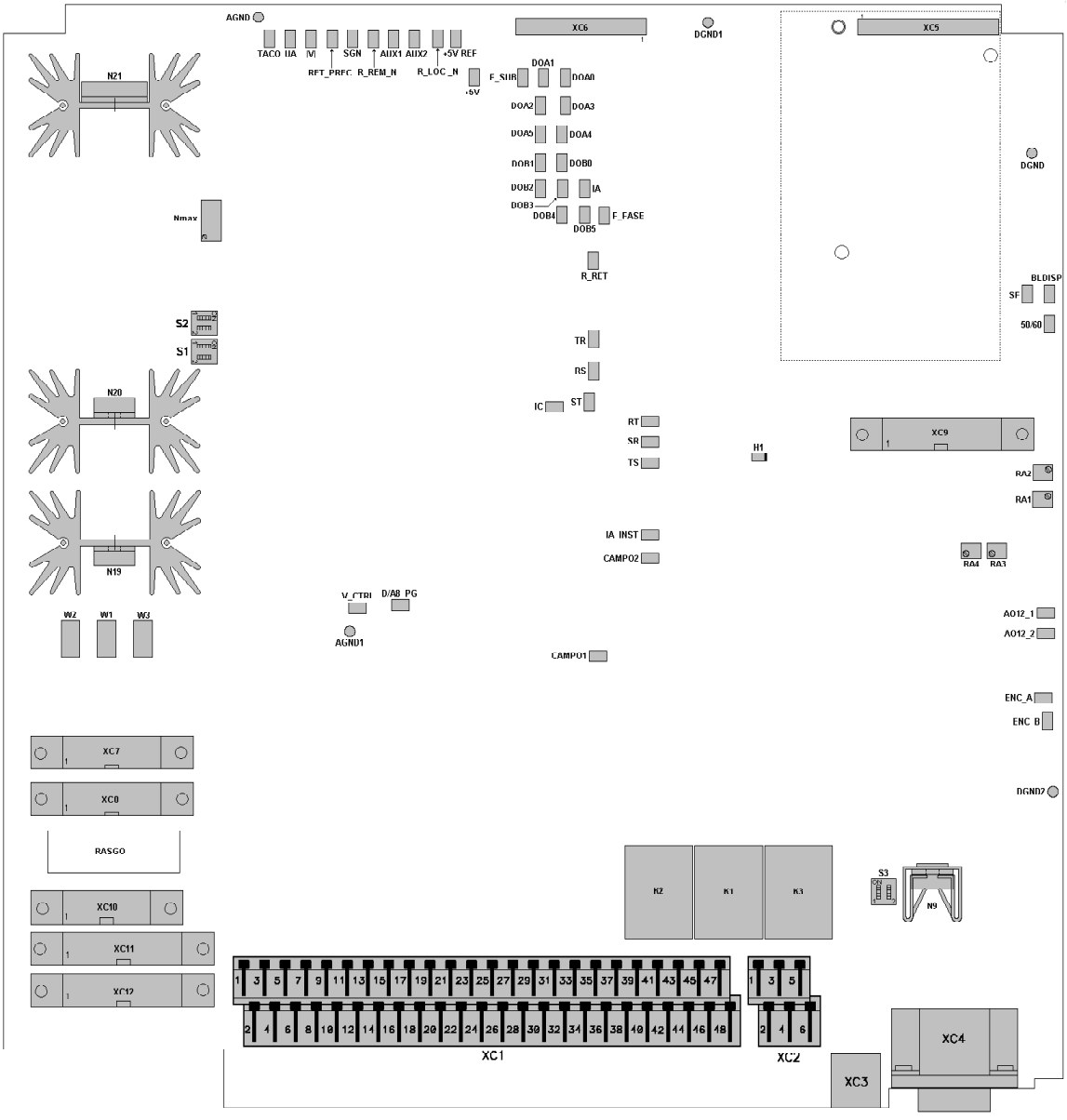
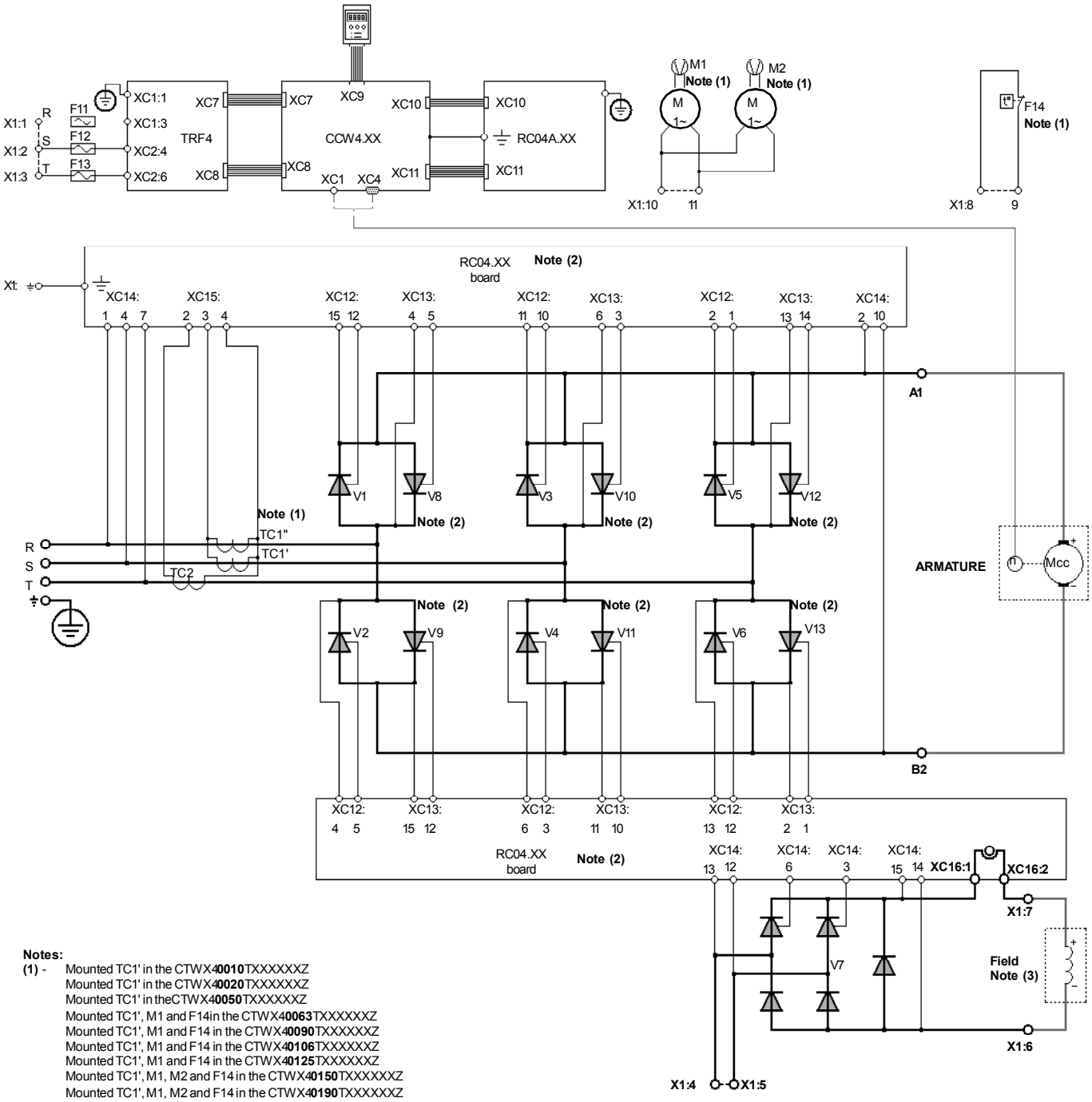


Figure 3.46 - *Location of the Setting Components*

3.2.5 Converter Connections

The figures below show the general connections of the CTW-04 converter by considering the different models of the line:



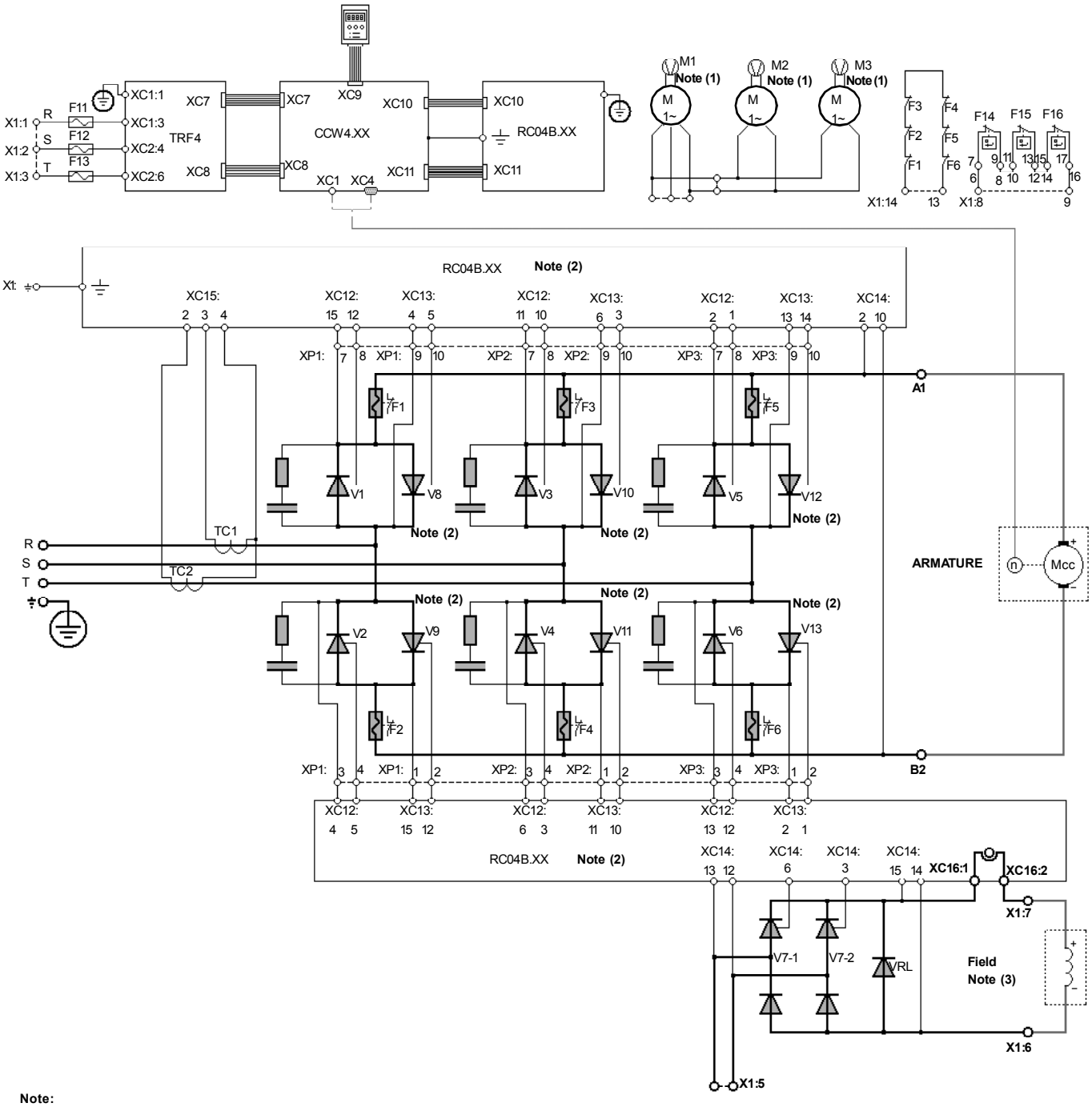
Notes:

(1) - Mounted TC1' in the CTWX4**0010**TXXXXXXZ
Mounted TC1' in the CTWX4**0020**TXXXXXXZ
Mounted TC1' in theCTWX4**0050**TXXXXXXZ
Mounted TC1', M1 and F14in the CTWX4**0063**TXXXXXXZ
Mounted TC1', M1 and F14 in the CTWX4**0090**TXXXXXXZ
Mounted TC1', M1 and F14 in the CTWX4**0106**TXXXXXXZ
Mounted TC1', M1 and F14 in the CTWX4**0125**TXXXXXXZ
Mounted TC1', M1, M2 and F14 in the CTWX4**0150**TXXXXXXZ
Mounted TC1', M1, M2 and F14 in the CTWX4**0190**TXXXXXXZ
Mounted TC1', M1, M2 and F14 in the CTWX4**0265**TXXXXXXZ
Mounted TC1', M1 and F14 in the CTWX4**0480**TXXXXXXZ
Mounted TC1', M1 and F14 in the CTWX4**0640**TXXXXXXZ

(2) - **Not** monted V8, V9, V10, V11, V12, V13 and XC13 in the CTW**U**4XXXXTXXXXXZ
monted V8, V9, V10, V11, V12, V13 and XC13 in the CTW**A**4XXXXTXXXXXZ

(3) - P002 = 1, Don't connect: X1: 4, 5, 6 and 7

Figure 3.47 *– General connection of the CTW-04 from 10A to 640A*



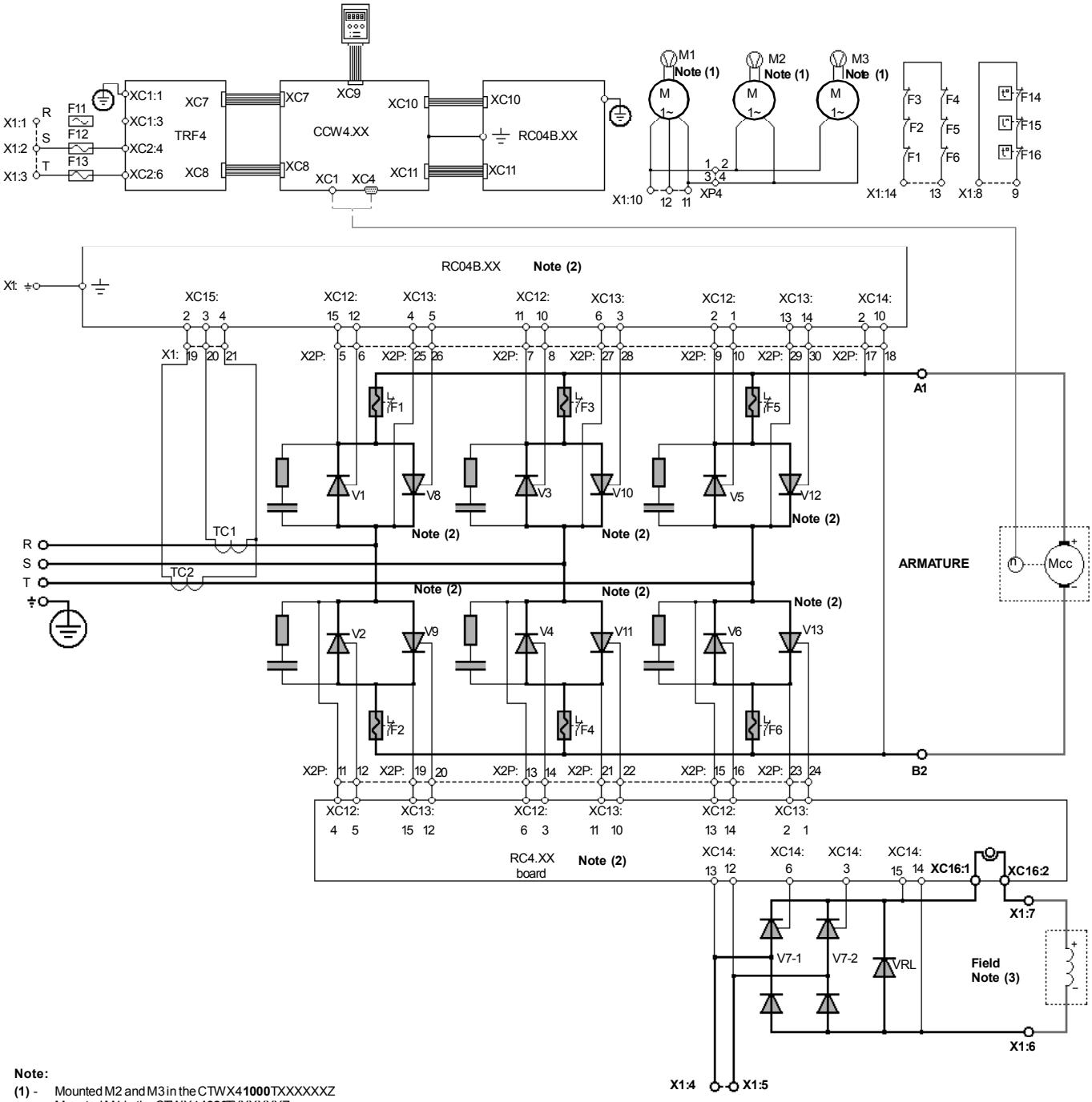
Note:

(1) - Mounted M2 and M3 in the CTW X4**1000**TXXXXXXZ
Mounted M1 in the CTW X4**1320**TXXXXXXZ
Mounted M1 in the CTW X4**1700**TXXXXXXZ

(2) - **Not** Mounted V8, V9, V10, V11, V12, V13 and XC13 in the CTW **U**4XXXXTXXXXXZ
Mounted V8, V9, V10, V11, V12, V13 and XC13 in the CTW **A**4XXXXTXXXXXZ

(3) - P002 = 1, Don't connected: X1: 4, 5, 6 and 7

Figure 3.48 *–General connection of the CTW-04 1000A*



Note:

(1) - Mounted M2 and M3 in the CTWX4**1000**TXXXXXXZ
Mounted M1 in the CTWX4**1320**TXXXXXXZ
Mounted M1 in the CTWX4**1700**TXXXXXXZ

(2) - **Not** Mounted V8, V9, V10, V11, V12, V13 and XC13 in the CTW**U**4XXXXTXXXXXZ
Mounted V8, V9, V10, V11, V12, V13 and XC13 in the CTW**A**4XXXXTXXXXXZ

(3) - P002 = 1, Don't connected: X1: 4, 5, 6 and 7

Figure 3.49 *– General connection of the CTW-04 from 1320 to 1700A*

3.2.6 Suggestive Connections for the CTW-04

3.2.6.1 Suggestive Connections for the Three-phase CTW-04 (one quadrant)

DANGER!
Q1 shall be disconnected when performing maintenance in the circuit, which guarantees that the circuit is not energized.

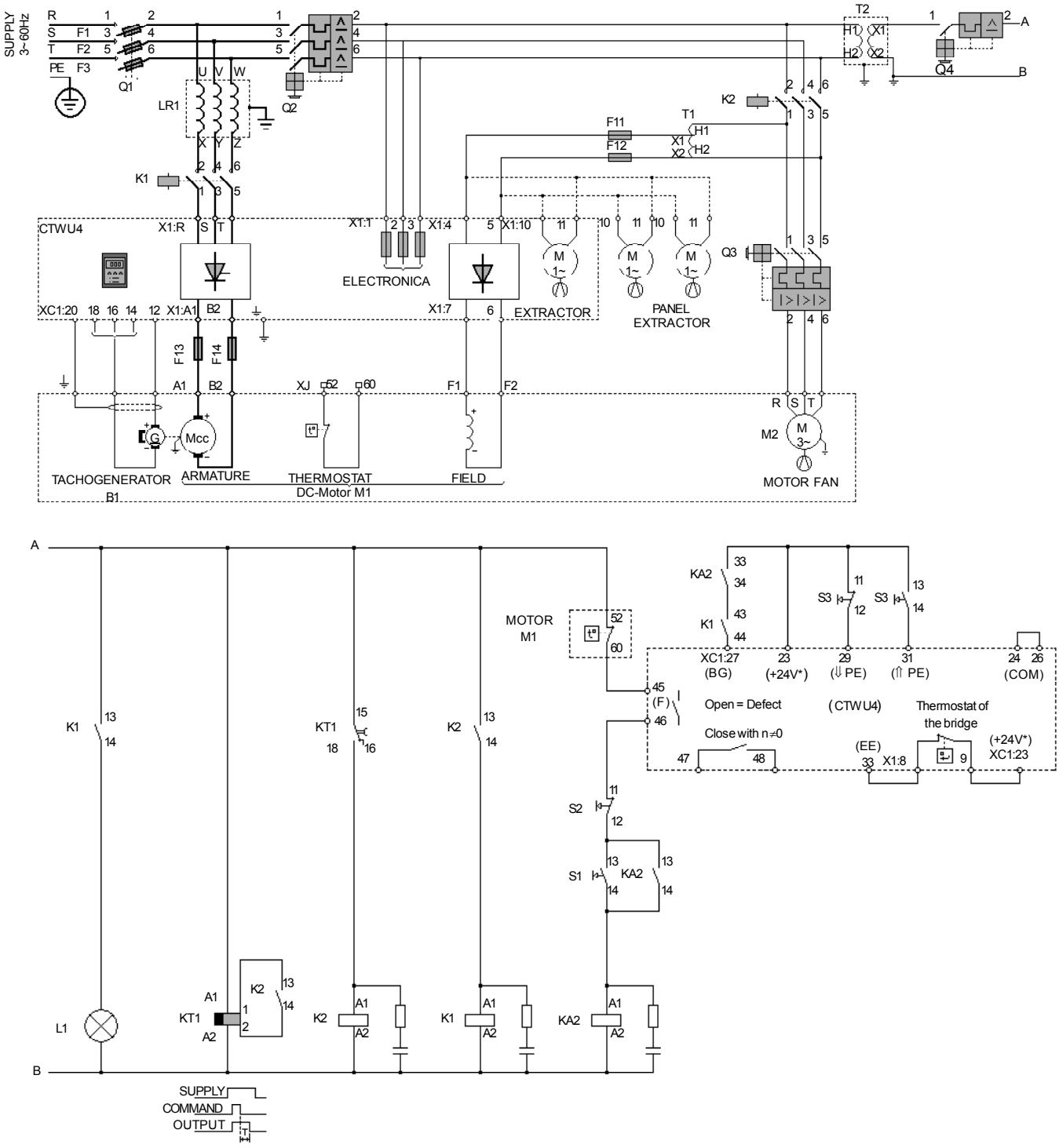


Figure 3.50 - *Three-phase unidirectional CTWU4 Operation (one quadrant)*

3.2.6.2 Suggestive Connections for the Three-phase CTW-04 (four quadrants)

DANGER!
Q1 shall be disconnected when performing maintenance in the circuit, which guarantees that the circuit is not energized.

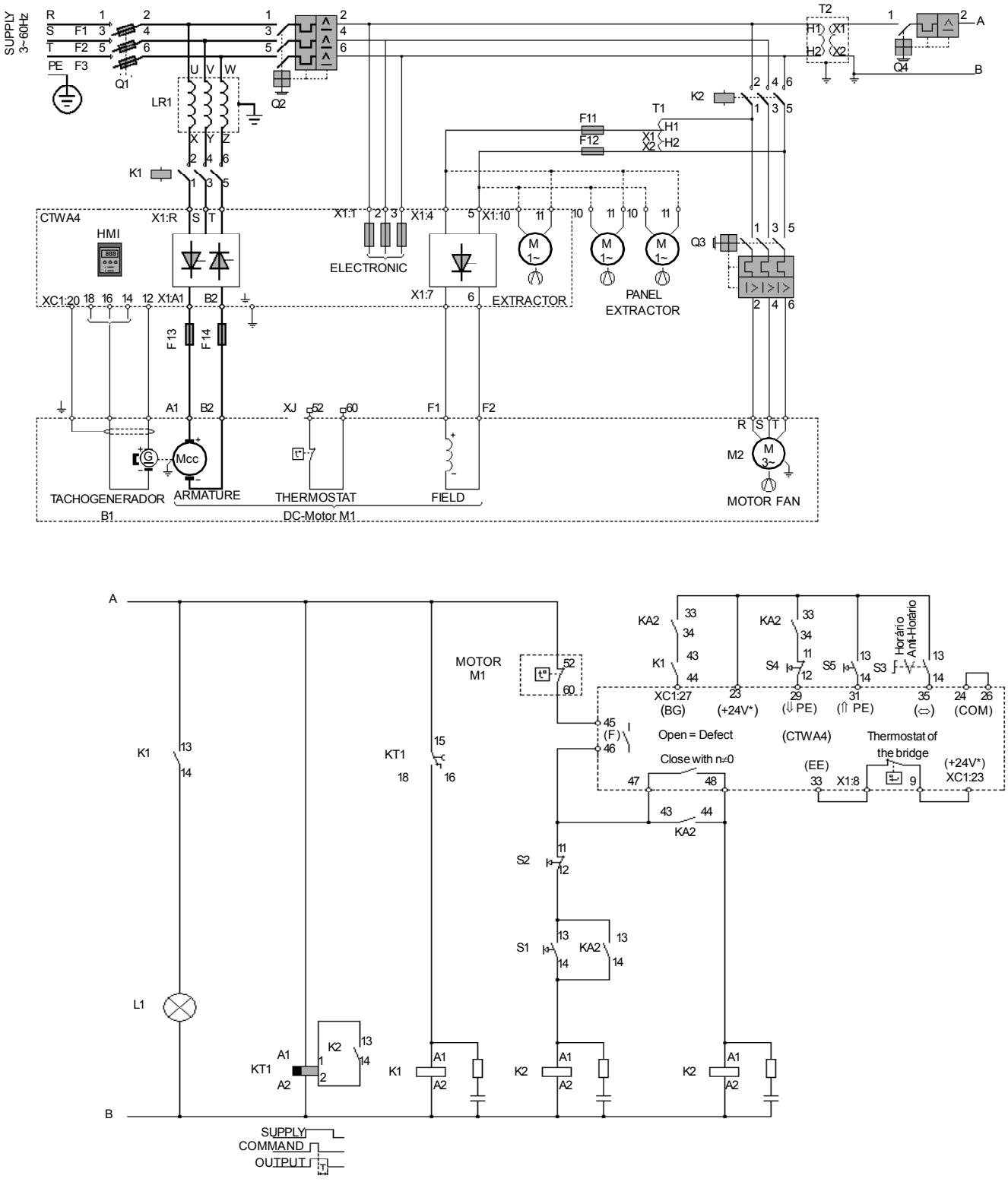


Figure 3.51 - *Three-phase antiparallel CTWA4 Operation (four quadrants)*

START-UP

This chapter provides the following information:

- ☑ How to check and prepare the converter for power-up;
- ☑ How to power-up and check for proper operation;
- ☑ How to operate the converter when installed according to typical connections.

4.1 POWER-UP PREPARATION

The converter must be installed according to Chapter 3 – Installation. Also if the drive design is different from the typical suggested operation, proceed as follows:

DANGER!
Always disconnect the AC input power, before making any connection.

ATTENTION!
Check if the phases R, S, T are connected in the same order in the control and in the power bar.

1. Check all Connections.
   Check if the power, grounding and control connections are correct and well tightened.

2. Clean the inside of the inverter.
   Remove all chipping material from the inside of the converter or drive.

3. Check if the correct converter has been selected.

4. Check the motor.
   Check all motor connections and verify if its voltage, current and frequency match the converter specifications.

5. Uncouple the load from the motor.
   If the motor cannot be uncoupled, make sure that the direction of rotation (FWD/REV) cannot cause personal or machine damages.

6. Check Converter Nameplate Data.
   Check if the electronics, armature and field supply matches the data of the converter nameplate.

7. Close the converter cover or cabinet doors.

8. Check fan operation (motor and converter).

4.2 POWER-UP/ START-UP

Procedures to be adopted for CTW-04 converter start up:

1. POWER-UP

- ☑ Power-up **only** the electronics of the product (X1:1,2,3);
- ☑ Converter must be disabled (General Disable → XC1:27 = 0V), F01 indication.
- ☑ Set P002 = 1 (external field control), to disable the current supply of the DC-motor field.

DANGER!
Do not power-up the armature.

2. PARAMETER CHANGE

- ☑ To change the parameters of the Operation mode, set P004 = 0.
  If P004 = 1, then set P013 = 1. This procedure changes P004 to 0 automatically and makes available the parameter change of the Operation Mode.
- ☑ The Regulation Parameters may be changed at any time indifferent the setting at P004.
- ☑ After parameter has been changed, set P004 = 1.
- ☑ To save the change, set P000 = 0005.

☞ **NOTE!**
Detailed description of the Parameter change are shown at chapter 8.

3. SET THE PARAMETERS ACCORDING TO THE APPLICATION

- ☑ Set the Parameters by using the "Quick Parameter Reference" and the Chapter 6: "Detailed Parameter Description", according to the converter application.

4. SET THE FIELD PARAMETERS

- ☑ Change the filed parameters according to the DC-motor nameplate data.
  P060 = Rated current
  P061 = Minimum Field current
  P100 = Economy field current
- ☑ Field current read at Parameter P062.
- ☑ Set P002 = 0, to release the DC-Motor field.
- ☑ Supply the Armature (X1:A1 and B2).

5. CHECK THE DIRECTION OF ROTATION

- ☑ Set the Speed Reference to 5% of the rated armature voltage (X1:A1 and B2).
- ☑ Enable the converter:
  General Disable → XC1:27 = 24V
  Ramp Disable → XC1:29 = 24V
  External Error → XC1:33 = 24V
- ☑ Check if the motor is running in the correct direction of rotation.

TO REVERSE THE DIRECTION OF ROTATION:

- ☑ Disable the Converter (General Disable → XC1:27 = 0V):

☞ **NOTE!**
In the models CTWA4XXXXTXXXXXZ the direction of rotation can be inverted via digital input XC1:35(⇔).

- ☑ Reverse the direction of rotation, according to speed feedback:

BACK-EMF (P025 = 0): Reverse the field or the armature connection.
DC-Tachogenerator (P025 = 1): Reverse the field or the armature connection and the DC-Tachogenerator connection.
Incremental Encoder (P025 = 4): Reverse the field or the armature connection and the lines A, A', B and B' of the encoder cable.

7. SET THE SPEED FEEDBACK

☑ Enable the converter without load:
General Disable → XC1:27 = 24V
Ramp Disable → XC1:29 = 24V
External error → XC1:33 = 24V
☑ Set max. speed (according to the speed reference type set at P024).

BACK-EMF (P025 = 0):
☑ Monitor the armature voltage (X1:A1 and B2);
If the armature voltage does not correspond to the min. value (according to P026), set P066 (Signal Gain – U_A);
☑ Apply the load;
☑ With enabled converter, check if the DC-motor speed is the rated one;
If the reached speed does not correspond to the rated one, set P031 (Compensation R_A = P031/1000), monitoring the speed up to the rated speed.

DC-Tachogenerator (P025 = 1):
☑ Calculate the voltage of the DC-Tachogenerator to obtain the Max. voltage that should be reached.
Example: DC Converter Data = 0.06 V/rpm
Max. desired speed for the DC motor = 4000 rpm
Nominal DC motor speed = 2100rpm

NOTE!
Check the max. speed allowed for the DC Motor.
Thus, 0.06V → 1 rpm
V_{TACO} → 4000rpm ∴ V_{TACO} = 0,06 x 4000 ∴ V_{TACO} = 240V

☑ Connect de DC tachogenerator according to the determined value at the respective input for this voltage range:
XC1:12 → (+)
XC1:14 → (-) 9 to 30Vdc
XC1:16 → (-) 30 to 100Vdc
XC1:18 → (-) 100 to 350Vdc

As V_{TACHO} = 240V, connect de DC tachogenerator to the input XC1:12 (+) and XC1:18(-)
☑ Check the V_{TACHO} Voltage:
(Desired speed) 4000 rpm → 100%
(Rated speed) 2100 rpm → X % → X = 52,5%
☑ Set the speed reference to 52.5% of the speed.
Measure V_{TACHO} = 126 V (52.5% x 240 V = 126V)
☑ Set the feedback gain by means of the trimpot N_{max} (on the CCW4 control board) until the measured voltage is equal to the rated voltage. (example: 126V).

Incremental Encoder (P025 = 4):
☑ Check if the speed is equal to the rated speed;
☑ Check if the setting at P052 and P053 is correct;
☑ Monitor the armature voltage (X1:A1 and B2);
If the armature voltage is not equal to the rated voltage (according to P026), set P066 (Signal Gain – U_A).

8. SET THE SPEED REGULATOR (STATIC)

☑ Set the speed reference until the 50% of the Max. value is obtained and compare the signal stability with the fixed reference.
If the voltage is not stable, set the Proportional Gain P039.

With Tachogenerator (P025 = 1 or 4):
☑ Monitor the voltage at the terminals XC1: 6 and 8.

Without Tachogenerator (P025 = 0):
☑ Monitor the armature voltage at the terminals XC1: A1 and B2.

9. SAVE PARAMETERS

☑ Set P004 = 1;
☑ And P000 = 5.

4.3 OPTIMIZING THE REGULATORS

NOTE!
For optimizing the Current and the Speed Regulators, set initially the Parameters as described before in "Procedures for Commissioning".

1. SET CURRENT REGULATOR

- ☑ Converter disabled:
  General Disable → XC1:27 = 0V
  Ramp Disable → XC1:29 = 0V
- ☑ Set P002 = 1 (field control is inactive);
  To change the parameters of the Operation Mode set P004 = 0.
  If P004 = 1, then set P013 = 1, this procedure changes P004 to 0 automatically.
- ☑ Set P070 > 2 (protection against locked rotor is inactive);
- ☑ Set P039 = 1, P040 = 0 and P041 = 0;
- ☑ Set the supply current to 100% of the rated motor current;
  If P028 = 3, setting is made via AI1. If P028 ≠ 3, setting is made via P054 = P055 = 100%.
- ☑ Set the Acceleration ramps and the Deceleration Ramps to 0 sec. (P032 = P033 =0);
- ☑ Monitor with oscilloscope the test points "IA_INST" and "AGND" on the CCW4 board;
- ☑ Set the Speed Reference to the max. value;
- ☑ Release Speed Ramp (Ramp Disable → XC1:29 = 24V);
- ☑ Release General Disable (General Disable → XC1:27 = 24V) during a time shorter than 3 sec.;
- ☑ Check measured signal:

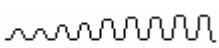
a) Gain too low.
Increase the Proportional Current Gain, P042, and/or decrease the Integral Current Gain, P044.

b) Ideal Gain.

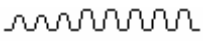
c) Gain too high.
Decrease the Proportional Current Gain, P042, and/or increase the Integral Current Gain, P044.

- ☑ Set P042 and P044, to obtain the measured signal **b)**;
- ☑ Disable the Speed Ramp (Ramp Disable → XC1:29 = 0V);
- ☑ Set Speed Reference at minimum;
- ☑ Release the Speed Ramp (Ramp Disable → XC1:29 = 24V);
- ☑ Set Speed Reference to obtain an intermittent current in the oscilloscope;
- ☑ Disable the Speed Ramp (Ramp Disable → XC1:29 = 0V) and wait for some seconds;
- ☑ Enable the converter:
  General Disable → XC1:27 = 24V
  Ramp Disable → XC1:29 = 24V
- ☑ Check the measured signal:

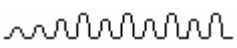
a) Decrement the Integral Gain of the intermittent current, P043.



b) Ideal Gain.



c) Increment the Integral Gain of the intermittent current, P043.

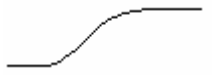


- ☑ Set P043, to obtain the measured signal **b)**;
- ☑ **Optimized Current Regulator**;
- ☑ Disable the Converter:
  General Disable → XC1:27 = 0V
  Ramp Disable → XC1:29 = 0V
- ☑ Save the Parameters (P004 = 1 and P000 = 5).

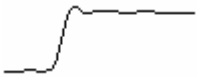
2. SET SPEED REGULATOR

- ☑ Converter disabled:
  General Disable → XC1:27 = 0V
  Ramp Disable → XC1:29 = 0V
- ☑ Set P002 = 1 (field control is inactive);
  To change the parameters of the Operation Mode, set P004 = 0.
  If P004 = 1 then set P013 = 1, this procedure changes P004 to 0 automatically.
- ☑ Install the DC-Motor;
- ☑ Set P039 = 4.0 and P040 = 0.12;
- ☑ Set P002 = 0 (the field control is active);
- ☑ Take measurements with oscilloscope (XC1: 6 and 4),
- ☑ Set the acceleration time (P032) and the Deceleration time (P033), according to the application;
- ☑ Set the speed reference to 75% of the maximum value;
- ☑ Enable the converter:
  General Disable → XC1:27 = 24V
  Ramp Disable → XC1:29 = 24V
- ☑ Check the measured signal:

a) Gain too low.
Increase the Proportional Speed Gain, P039, and/or decrease the Integral Current Gain, P040.



b) Ideal Gain.



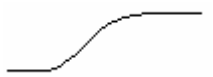
c) Gain too high.
Decrease the Proportional Speed Gain, P039, and/or increase the Integral Current Gain, P040.

- ☑ Set P039 and P040, to obtain the measured signal **b);**
- ☑ **Optimized Speed Regulator;**
- ☑ Save the Parameters (P004 = 1 and P000 = 005);
- ☑ **Operation Converter.**

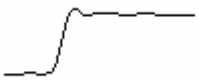
3. SET FIELD CURRENT REGULATOR

- ☑ Supply the field of the DC motor;
- ☑ Switch-Off the armature supply;
- ☑ Monitor with oscilloscope the Ic signal (test point on the CCW4 control board);
- ☑ Deactivate (0V) and then activate (24V) the General Disable, checking the measured signal:

a) Gain too low.
Set P063 and/or P064.



b) Ideal Gain.



c) Gain too high.
Set P063 and/or P064.

4. SET THE BACK-EFM REGULATOR

- ☑ DC motor in operation;
- ☑ Set speed to 100%;
- ☑ Monitor with oscilloscope the Ic signal (test point on the CCW4 control board);
- ☑ For stabilizing the Ic signal, set Integral Gain (P059).

NOTE!
If the DC motor acceleration is too low after the back-EMF has been set (it is not responding to the value that has been set at P033, in case of P009=1), this is due to the fact that the proportional gain (P058) is too low.

Converter is ready for operation !

KEYPAD (HMI) OPERATION

This Chapter describes the converter operation via Human-Machine Interface (HMI), providing the following information:

- ☑ General HMI Description;
- ☑ HMI Dimensions;
- ☑ Use of the HMI;
- ☑ Converter Parameter Organization;
- ☑ Parameter Programming Mode;
- ☑ Description of the status and signaling indication.

5.1 DESCRIPTION OF THE HMI

The CTW-04 HMI has a 4 digit, seven-segment LED display, 2 LEDs and 3 keys.

Figure 5.1 shows the front view of the HMI:

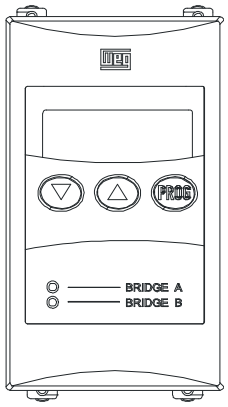


Figure 5.1 *– CTW-04 Human-Machine Interface (HMI)*

Functions of the LED Display:
The LED display shows the fault codes and drive status (see Quick Parameter Reference Error Messages and Fault Status), the parameter number and its content.

Functions of the LEDs "Bridge A" and "Bridge B":
Converter drives machine as motor:
Red LED is ON (Bridge A) and green LED is OFF.

Converter drives machine as generator:
Green LED is ON (Bridge B) and red LED is OFF.

NOTE!
The green LED may be ON only for The CTW-04 Converter Models CTW-04: CTW**A**4XXXXTXXXXXZ – Antiparallel (operation in 4 quadrants).

Figure 5.2 shows the HMI display, LEDs and key location:

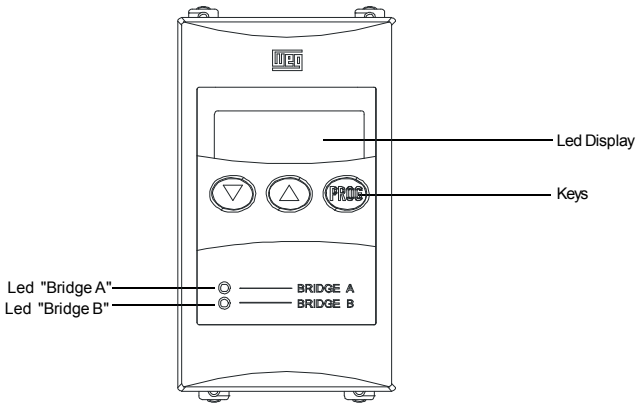


***Figure 5.2**- HMI display, LEDs and key location*

Basic Functions of the Keys:

PROG — Toggles the LED Display between Parameter number and its value (location/ number).

▲ — Increases the speed, parameter number or parameter value.

▼ — Decreases the speed, parameter number or parameter value.

5.2 HMI DIMENSIONS

Figure 5.3 shows the dimensions for installactions of the HMI in panel:

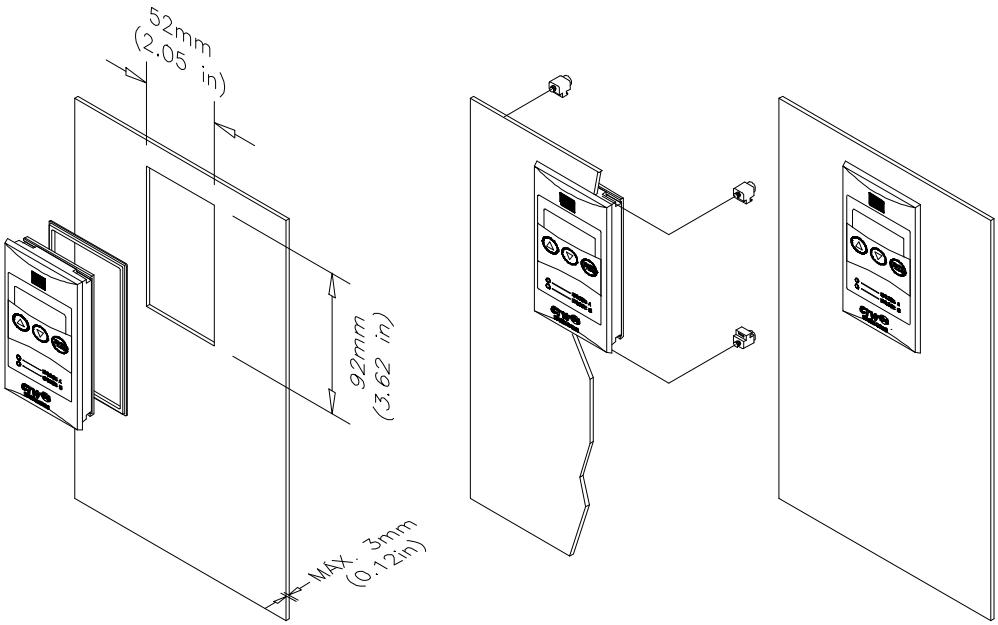


***Figure 5.3** – HMI Dimensions for CTW-04*

5.3 USE OF THE HMI

The HMI is an interface used for programming and operating the converter, allowing the following functions:

- ☑ Indication of the converter status and its main variables;
- ☑ Error and Fault Messages;
- ☑ Viewing and programming of parameters PROG , ▼ and ▲ .

5.4 INDICATIONS ON THE HMI DISPLAY

Converter Status:

During converter power-up (approx. 3s).

Converter is ready to be started.

Fault and Error Messages:

General Disable Message.

Faults “F002 to F009”, eliminate the cause of the problem.

NOTE!
See Chapter 7 and Fault List in the Quick Parameter Reference.

Errors “E002 to E005”, do not proceed.
Contact Servicing from WEG indústrias – Automação.
Error “E006”, Programming Error (see table 5.1 - Parameters Incompatibility).

NOTE!
See Chapter 7 and Error List in the Quick Parameter Reference.

Display is flashing:
The display flashes only when the parameters are being saved (P000=005).

5.5 PARAMETER VIEWING/ PROGRAMMING

All converter settings are made through Parameters.
The parameters are shown on the Display by the letter “P” followed by a number.
Example: P027

27 = Parameter Number.

Each parameter is associated to a numerical value (parameter content) that corresponds to the option selected among those options that are available for this parameter.
The values of the parameters define the converter programming or the value of a variable. For converter programming you must change the content of the parameter(s).

5.6 PROCEDURES FOR PARAMETER PROGRAMMING

1) To program the Regulation Parameters or to change the Operation Mode:

NOTE!
This procedure is only valid for parameter programming of the Operation Mode, when converter parameters have not been saved yet (P004=0).

ACTION	HMI DISPLAY	DESCRIPTION
Use the ▲ and ▼ keys		Select the desired parameter
Press the PROG key		Numeric value associated to the parameter
Use the ▲ and ▼ keys		Set the new desired value
Press the PROG key		The new parameter value has been set **NOTE!** Change the contents of the other desired parameters
Use the ▲ and ▼ keys		Select Parameter “P004”
Press the PROG key		Numeric value associated to the parameter
Use the ▲ and ▼ keys		Set the value to 1 (P004 = 1)
Press the PROG key		The new value of the parameter is set

TO SAVE CHANGED PARAMETERS		
ACTION	HMI DISPLAY	DESCRIPTION
Use the ▲ and ▼ keys		Select the parameter "P000"
Press the PROG key		Numeric value associated to the parameter
Use the ▲ and ▼ keys		Set the value to 5 (P000 = 5)
Press the PROG key		Display flashes while the parameters are being saved
Display returns to "P000" automatically		Parameters have been saved

NOTE!

The parameters will be saved correctly only when all prescribed steps are followed.

If do you not want to save the parameters changes, don´t execute "Save Parameter Changes".

If parameters are not compatible, display indicates "E06" (as shown in table 5.1).

2) Operation Mode Parameter Changing:

NOTE!

(1) This procedure is only valid for parameters programming of the Operation Mode, when converter parameters have been already saved (P004=1).

(2) Programming the Operation Mode parameters is only possible when general disabling is inactive (XC1:27=24V).

ACTION	HMI DISPLAY	DESCRIPTION
Use the ▲ and ▼ keys		Select the Parameter "P013"
Press the PROG key		Numeric value associated to the parameter
Use the ▲ and ▼ keys		Set the value to 1 (P013 = 1)
Display indicates		Wait
Display indicates		Operation executed

ACTION	HMI DISPLAY	DESCRIPTION
Press the PROG key	P000	Operation has been performed
Use the ▲ and ▼ keys	P002	Select the desired parameter
Press the PROG key	0	Numeric value associated to the parameter
Use the ▲ and ▼ keys	1	Set the new desired value
Press the PROG key	P002	The new desired value has been set **NOTE!** Program the other desired parameters
Use the ▲ and ▼ keys	P004	Select the Parameter "P004"
Press the PROG key	0	Numeric value associated to the parameter
Use the ▲ and ▼ keys	1	Set the value to 1 (P004 = 1)
Press the PROG key	P004	The value of the parameter has been set

TO SAVE CHANGED PARAMETERS

ACTION	HMI DISPLAY	DESCRIPTION
Use the ▲ and ▼ keys	P000	Select the Parameter "P000"
Press the PROG key	0	Numeric value associated to the parameter
Use the ▲ and ▼ keys	5	Set the value to 5 (P000 = 5)
Press the PROG key	5	Display flashes while parameters are being saved
Display returns to "P000" automatically	P000	Parameters have been saved

NOTE!

The parameters will be saved correctly only when all prescribed steps are followed.

If you don't want to save the parameters changes, don´t execute “Save Parameter Changes”.

If parameters are not compatible, display indicates “E06” (as shown in table 5.1).

Error	Description	Avoid
E06	Programing Error	Avoid the following combinations: P007 = 1 and P008 = 1; P005 = 1 and P007 = 1; P004 = 0 and P000 = 5; P085 ≠ 0 and P065 ≠ 3.

Table 5.1 *– Non-Compatibility between Parameters*

DETAILED PARAMETER DESCRIPTION

This chapter describes in detail all converter parameters. In order to simplify the explanation, the parameters have been grouped by characteristics and functions:

Operation Mode Parameters	These Parameters define the converter characteristics and functions that will be executed. These Parameters are: P000 to P022, P024 to P029, P065, P067 to P070 and P083 to P086. These Parameters can be changed only when P004 = 0, excepting P000, P086 and P013 that can be changed only when P004 = 1.
Regulation Parameters	These Parameters are used for the converter functions: P030 to P061, P063, P064, P066, P071 to P080, P100. The Parameters P056 and P057 can be changed through the HMI only when P024=4.
Read Parameters	These Parameters can be viewed on the HMI, but cannot be changed. These Parameters are: P023, P056, P057, P062, P081, P082, P087 to P099.

6.1 OPERATION MODE PARAMETERS

Parameter	Range [Factory Setting] Unit	Description / Notes
P000 Parameter Saving	0 to 255 [**0**] -	5 = This operation copies the current parameter content of the Operation and Regulation Mode to the non-volatile memory (EEPROM), i. e. it saves the converter parameters. Procedures: 1) Set P000 = 5; 2) Press PROG key; 3) Display 0005 flashes; 4) After saving has been concluded, the HMI display changes to P000 and its content is reset automatically. 10 = This operations transfers the Factory Setting (WEG default) to the memory (EEPROM), i. e. it loads the Factory Setting to the converter. Procedures: 1) Set P000 = 10; 2) Press PROG key; 3) Display flashes showing "0010"; 4) Converter reset is started after saving has been concluded (Power-on). Operation mode is defined (P004 = 0). ☑ The setting of P000 = 10 will not be executed, when the General Disabling is inactive; ☑ When an error occurs during copying to EEPROM, the HMI displays E05.

Parameter	Range [Factory Setting] Unit	Description / Notes
P002 (1) Field Current Control	0,1 [**0**] -	☑ It defines the power supply of the field circuit.

P002	Description
0	Field current control is made by the converter. In this case, the supervision of F09 (Fault in the field current loop) is active.
1	Filed current control is extern to the converter. The F09 monitoring becomes inactive.

***Table 6.1** - Description of the field current control*

☑ While P004 = 0, F09 monitoring is inactive.

P004 (1) Operation Mode	0,1 [**0**] -	☑ It has the function to disable or enable the Parameters changes in the Operation Mode.

P004	Description
0	All parameters of the Operation Mode may be changed. Only the programming routine of the HMI is active.
1	Parameters of the Operation Mode are defined. Only P000, P013 and P086 may be still changed.

***Table 6.2** - Description of the Operation Mode*

☑ The current configuration will be lost if converter is switched OFF before Parameters saving. (P000=5).

P005 (1) Converter Type	0,1 [**0**] -	☑ Indicates the number of bridges in the converter.

P005	Type of Control
0	Unidirectional (Bridge A)
1	Antiparallel (Bridge A/Bridge B)

***Table 6.3** - Type of converter and bridges configuration*

P007 (1) Torque Control	0,1 [**0**] -	☑ Indicates which regulators are active.

P007	Type of Torque
0	Speed regulator is active.
1	Speed regulator is inactive (only with torque control).

***Table 6.4 -** Active regulators*

☑ Function valid only when P005 = 0;
☑ It permits using the Speed Reference for motor torque control;
☑ The ramps remain active;
☑ To activate the torque control of the Antiparallel Converter (P005 = 1), you must to:
1) Convert the PID Speed Regulator to P Regulator, by setting P039 = 1.0 and P040 = P041 = 0;
2) P007 = 0.
☑ When operation with Speed Regulation and Torque Regulation is desired alternatively, set:
1) P065 = 0;
2) P048 = 1.0 and P049 = 0.0 (Torque Regulator);
3) P039, P040 and P041 (Speed Regulator);
☑ The DI (XC1:37) will make the commutation between the regulation modes.

Parameter	Range [Factory Setting] Unit	Description / Notes
P008 (1) Firing Angle Control	0,1 [**0**] -	☑ It selects how the firing angle is controlled.

P008	Firing Angle Control
0	through the Regulators (WEG standard).
1	Through speed reference with inactive regulators.

Table 6.5 – *Control of firing angle*

☑ Used to check the rectifier bridge operation.
☑ If P005 = 1, check if the digital input that defines the direction of rotation is defined to CW rotation.

NOTE!
It is not recommended to set P008 = 1, because the protections become inactive.

P009 (1)
Time of the Deceleration Ramp

0,1
[**0**]
-

☑ It selects if the content of the Parameter P033 is active.

P009	Time of the Deceleration Ramp
0	P033 defines the deceleration time.
1	Deceleration time is zero. The setting of P033 is inactive.

Table 6.6 *– Adjustment of Deceleration Ramp*

P011 (1)
Relay contact of n = 0

0,1
[**0**]
-

☑ It selects the relay contact status when the speed is zero (n = 0).

P011	Relay contact of n = 0
0	Normally Closed Contact (NC)
1	Normally Open Contact (NO)

Table 6.7 *– Contato de Relé de n = 0*

☑ It uses the speed feedback signal to command the relay.

P013
Operation Mode Changing

0,1
[**0**]
-

☑ It is used to permit changing the converter Operation Mode. P013 = 1 can be set only if P004 =1.
☑ After P013 content changes from 0 → 1, occurs immediate converter reset (Power-on). During this P004 and P013 became equal to 0.
☑ The other parameters retain the values contained in the EEPROM.

P014 (1)
Ramp Setting Range

0,1
[**0**]
-

☑ It permits selecting the Max. ramp time.

P014	Ramp Setting Range
0	Max. time of 180.0 sec.
1	Max. time of 18.0 sec

Table 6.8 – *Range for the ramp*

Parameter	Range [Factory Setting] Unit	Description / Notes
P015 (1) Disabling by Zero Speed (Stop Logic)	0,1 [**0**] -	<table><tr><th>P015</th><th>Disabling by Zero Speed (Stop Logic)</th></tr><tr><td>0</td><td>Inactive</td></tr><tr><td>1</td><td>Active</td></tr></table> ***Table 6.9 -*** *Zero speed blocking* ☑ When it is active, it acts as general converter disabling if the Speed Reference and the Speed Feedback are lower than the value set at P036 (P036 - 0.6%). ☑ The converter is enabled again, when the condition selected at P016 is higher then the value set at P036 (P036 + 0.5%). ☑ F01 indication is not displayed. ☑ The field current retains the value of P060.
P016 (1) Exit of the Disabling by Zero Speed	0,1 [**0**] -	<table><tr><th>P016</th><th>Exit of the Disabling by Zero Speed</th></tr><tr><td>0</td><td>n_3* (P087) > 0 (P036) or n (P088) > 0 (P036)</td></tr><tr><td>1</td><td>n_3* (P087) > 0 (P036)</td></tr></table> ***Table 6.10 -*** *Exit from disabling by zero speed* ☑ In the first case, when load ties to drag the motor and the speed (n) becomes higher than (P036 + 0.5%) with n_3* (P087) = 0, then the converter acts to stop the motor. ☑ In the second case, the load drags the motor without converter hindering.
P017 (1) I_A>I_XDetector	0,1 [**0**] -	☑ It permits to deactivate the I_A>I_X function during acceleration or braking. I_X is set at P071. <table><tr><th>P017</th><th>I_A>I_X Detector</th></tr><tr><td>0</td><td>Active</td></tr><tr><td>1</td><td>Inactive during acceleration or braking.</td></tr></table> ***Table 6.11 -*** *I_A >I_X Detector*
P018 (1) Tachogenerator Fault Detector	0,1 [**0**] -	☑ It permits to deactivate the fault detection function of the speed feedback. ☑ Valid for P025 > 0. <table><tr><th>P018</th><th>Tachogenerator Fault Detector</th></tr><tr><td>0</td><td>Active</td></tr><tr><td>1</td><td>Inactive</td></tr></table> ***Table 6.12*** *- Tachogenerator fault Detector*

Parameter	Range [Factory Setting] Unit	Description / Notes
P024 (1) Speed reference Selection	0 to 5 [**0**] -	

P024	Speed reference Selection	Rango
0	Analog Input (10bits)	0 to ±10V (via XC1:3,5 or XC1:7,9).
1	Analog Input (10bits)	(0 to 20)mA/(4 to 20)mA (via XC1:3,5 or XC1:7,9) (2)
2	Analog Input (12bits) (2)	0 to ±10V (via XC1:7,9). (2)
3	Analog Input (12bits) (2)	(0 to 20)mA/(4 to 20)mA (via XC1:7,9).
4	P056, P057 (Keys)	-
5	Electronic Potentiometer (PE)	(See figure 6.16)

Table 6.13 *– Speed reference selection*

☑ Signals (0 to 20)mA (4 to 20)mA - see S1 and S2 in Item 3.2.4.1.1 of Chapter 3.

P025 (1)
Speed Feedback Selection
0, 1, 4
[**0**]
-

P025	Speed Feedback Selection	Description
0	back-EMF (armature back-EMF)	The nominal value is set through Parameter P066.
1	DC-Tachogenerator	The nominal value is set through the trimpot R319 (N_{MAX}). (see figure 3.46)
4	Incremental Encoder (2)	The nominal value is set through Parameters P052 and P053. (2)

Table 6.14 - *Speed feedback selection*

P028 (1)
Function of the A1 Input (Auxiliary 1)
0 to 3
[**0**]
-

P028	Function of the A1 Input (Auxiliary 1)	Description
0	Not used	-
1	after ramp n_{aux}*	May be used as additional speed reference, for instance, in applications where working beams are used.
2	Iaux* (≥ 0)	May be used as additional torque current reference.
3	Extern current limiting	It permits the control of the current limiting (P054 and P055) through analog input AI1 (XC1:11,13). With this setting, P054 and P055 become Read Only Parameters.

Table 6.15 *- Function of the Analog Input AI1*

P029 (1)
Function of the A2 input (Auxiliary 2)
0 to 2
[**0**]
-

P029	Function of the A2 input (Auxiliary 2)	Description
0	Not used	-
1	after ramp n_{aux}*	May be used as additional speed reference, for instance, in applications where working beams are used.
2	I_{aux}* (≥0)	May be used as additional torque current reference.

Table 6.16 - *Function of the Analog Input AI2*

Parameter	Range [Factory Setting] Unit	Description / Notes

Serial Communication

P019 (1)
Speed Reference

0,1
[**0**]
-

☑ It determines if the Speed Reference is enabled to be controlled by serial channel or Fieldbus.

P019	Speed Reference
0	Disabled for Serial or Fieldbus
1	Enabled for Serial or Fieldbus

Table 6.17 *– Speed reference*

P020 (1)
General Disabling. Disabling by Ramp or Fault Reset

P021 (1)
Direction of Rotation

P022 (1)
Jog+ and Jog- Command

0,1
[**0**]
-

☑ It defines that the command is enabled to be controlled by serial channel or Fieldbus.

P020	General Disabling, Disabling by Ramp or Fault Reset
0	Disabled for Serial or Fieldbus
1	Enabled for Serial or Fieldbus

Table 6.18 *– Commands enabled via Serial or Fieldbus*

☑ Parameter P065 must be programmed to:
1 = Serial, or
3 = Fieldbus.

NOTE!
The general disabling command via digital input is always active, also when the commands source is programmed for serial or fieldbus. In this case the digital input of general disabling must be activated to liberate the converter by serial or fieldbus.

P065 (1)
DI Function (XC1:37)

0 to 3
[**0**]
-

P065	DI Function	Description
0	Selection of the speed regulator gains	This function enables the speed regulator to operate with 2 distinct sets of PI gains (according to the application example mentioned in Parameter P007). When DI is open (0V), the gains of P039 and P040 are used. When DI is closed (+24V), the PI gains of the regulator are those defined at P048 and P049.
1	Selection of commands via Serial or via DI's	Permits commutation between Serial defined at P019 to P022 to command via DI's. (0V - commands via DI; 24V - command via serial).
2	Special functions	(reserved to special Software functions).
3	Command selection via Fieldbus or via DI's.	It permits the commutation between Fieldbus defined at P019 to P022, to command via DI's. (0V - command via DI; 24V - command via Fieldbus).

Table 6.19 – *Function of the Digital Input DI (XC1:37)*

Parameter	Range [Factory Setting] Unit	Description / Notes
P083 (1) Serial WEGBus	0,1 [**0**] -	P083 | Serial WEGBus 0 | Serial WEGBus is active 1 | Serial WEGBus is active and operates with a transfer range of 9600bps (bits/sec) ***Table 6.20*** *- WEG Bus Serial Communication* ☑ When serial is Active set P065 = 1 only if some parameter from P019 to P022 is equal to 1.
P084 (1) Converter Address	1 to 30 [**1**] -	☑ When a connection of the converter to a network is desired, see chapter 8 of this manual.
P085 (1) Fieldbus	0 to 6 [**0**] -	P085 | Fieldbus 0 | Fieldbus Inactive 1 to 6 | It defines the Fieldbus standard to be used (Profibus-DP or DeviceNet) and the number of variables to be interchanged with the master. See item 8.1. ***Table 6.21 -*** *Fieldbus Communication*
P086 (1) Disable with E29	0 to 2 [**0**] -	P086 | Disable with E29 0 | Deactivates via Ramp Disable 1 | Deactivates via General Disable 2 | Inactive ***Table 6.22 -*** *E29 blocking* ☑ It determines which action the converter will adopt when the physical connection to the master of the Fieldbus network is interrupted (displaying E29).

Converter Data

P026 (1) Selection of Armature rated voltage	0 to 4 [**0**] -	P026 | Selection of Armature rated voltage 0 | 230V (For 220Vac line and antiparallel converter) 1 | 260V (For 220Vac line and unidirectional converter) 2 | 400V (For 380Vac line and antiparallel converter) 3 | 460V (For 380Vac line and unidirectional converter) or 440Vac line and antiparallel converter) 4 | 520V (For 440Vac line and unidirectional converter) ***Table 6.23 -*** *Selection of the Armature Rated Voltage*

Parameter	Range [Factory Setting] Unit	Description / Notes
P027 (1) Selection of the Rated Converter Current	0 to 13 [**0**] -	

P027	Selection of the Rated Converter Current
0	10A / 20A
1	50A
2	63A
3	90A
4	106A
5	125A
6	150A
7	190A
8	265A
9	480A
10	640A
11	1000A
12	1320A
13	1700A

Table 6.24 *- Converter Rated Current*

Overload [I x t]

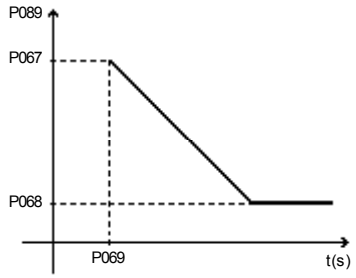
P067 (1) Overload Current	0 to 125 [**125**] 1%	
P068 (1) Current without Overload	0 to 125 [**100**] 1%	
P069 (1) Time of actuation	5 to 600 [**384**] 1s	

Figure 6.1 *- Overload Activation (I²t)*

- ☑ Used to protect converter or motor against overload (Ixt – F07). The factory settings protect converter against overload.
- ☑ The current without overload (P068) defines the current value from which the Ixt function starts to actuate.
- ☑ The Ixt function will remain inactive while the content of P067 is lower or equal to the value at P068.
- ☑ When P068 < P089 ≤ P067, the actuation time is given by: t = P069 x (P067 ÷ P089) (sec.)

P070 (1) Function of the programmable DO (XC1:38)	0 to 5 [**0**] -	

P070	Function of the programmable DO (XC1:38)
0	It signalizes the actuation of the Ixt function or Locked Rotor
1	n = n* (reached speed) or Locked Rotor
2	Bridge A or B, or Locked Rotor
3	It signalizes the actuation of the Ixt function
4	n = n*
5	Bridge A or B

Table 6.25 - *Programmable Digital Output (XC1:38)*

Parameter	Range [Factory Setting] Unit	Description / Notes

☑ Locked Rotor Function – F06:
The disabling through F06 occurs, when the armature current reaches the current limiting value, read at P054 or P055 and the motor shaft stops during 2.0 seconds.
Condition for actuation of this functions is:
1) P070 ≤ 2;
2) Speed reference > 1%;
3) Effective speed < 1%;
4) I* = P054 or P055;
5) I_A > 2%.

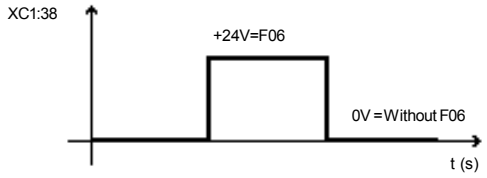


***Figure 6.2** - Programmable Digital Output (XC1:38)*

☑ I x t Function - F07:
See parameters P067 to P069.

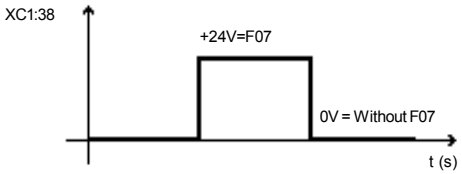


***Figure 6.3** - Indication of F07 through the Digital Output (XC1:38)*

☑ Function n = n* – see parameter P035.
☑ Function the Bridge A or Bridge B:

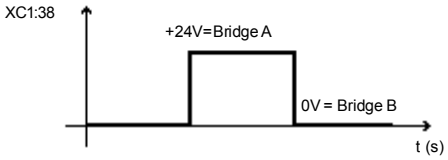


***Figure 6.4** - Indication of operating bridge through the Digital Output (XC1:38)*

6.2 REGULATION PARAMETERS

Parameter	Range [Factory Setting] Unit	Description / Notes

Analog Output

P030
Function of the AO
Output - D/A(8 bits)

0 to 9
[**8**]
-

P046 (2)
Function of the AO1
Output - D/A(12 bits)

0 to 8
[**0**]
-

P047 (2)
Function of the AO2
Output - D/A(12 bits)

0 to 8
[**0**]

P078
AO Output Gain
D/A(8 bits)

0.00 to 9.99
[**1.00**]
0.01

P079 (2)
AO1 Output Gain
D/A(12 bits)

0.00 to 9.99
[**1.00**]
0.01

P080 (2)
AO2 Output Gain
D/A(12 bits)

0.00 to 9.99
[**1.00**]
0.01

	P030 (AO)	P046 (AO1)	P047 (AO2)
a) Sped Reference – n_2*	0	1	1
b) Total Reference – n_3*	1	2	2
c) Speed Error (n_3*-n)	2	4	4
d) Torque Reference – I*	3	3	3
e) Firing Angle - α	4	-	-
f) Armature Voltage – U_A	5	-	-
g) Interruptions	6	-	-
h) Speed - n	-	5	5
i) Armature Current – I_A	-	6	6
j) Back-EMF	8	7	7
k) Power	-	8	8
l) Current Reg. Output- α	7	-	-
m) A/D Conversion (12bits)	-	0	0
n) Limiting I as function of n	9	-	-

Table 6.26 *– Functions of the analog outputs*

Signal scale at Analog Outputs:

a, b, c) Speed Reference: 10V = Maximum Reference;

d) Torque Reference (I_1^*): Full scale: 1.25 x P027 = 10V;

e) Firing Angle: 8V = 150º - 0,5V = 12º;

f) Armature Voltage (U_A): 9,1V = Rated Voltage;

g) Interruptions: Sequence of Interruptions;

h) Speed Feedback: 9,1V = Maximum Speed;

i) Armature Current (I_A): Full scale: 1.25 x P027 = 10V;

Parameter	Range [Factory Setting] Unit	Description / Notes
		j) Back-EMF Signal: P030: 10V = Rated P046/P047: 9,1V = Rated; k) Power: Full scale: 9,1V = Maximum Power. POWER = $\frac{\text{Back - EMF} \bullet I_A}{10V}$ l) Current Regulator Output: 9,0V = (a = 12º); m) A/D Conversion: Full scale: 10V = Maximum Speed Reference (n_2^*) (valid for P024 = 2 or 3).

Ramps

P032 Acceleration Time (P014 = 0) (P014 = 1) **P033** Deceleration Time (P014 = 0) (P014 = 1)	0 to 180 [**1.0**] 1.0s 0.0 to 18.0 [**1.0**] 1.0s 0 to 180 [**1.0**] 1.0s 0.0 to 18.0 [**1.0**] 1.0s	☑ 0.0s Setting means setting without ramp; It defines the time for linear acceleration from 0 to max. speed or the time for linear deceleration from max. speed to 0.

Speed Reference

P034 Minimum Speed	0.0 to 100 [**0.0**] 1.0%	☑ It defines the min. motor speed when converter is enabled; ☑ The min. speed does not act when P024 = 4.
P037 JOG+ Speed Reference **P038** JOG- Speed Reference	0.0 to 100 [**0.0**] 1.0% 0.0 to 100 [**0.0**] 1.0%	☑ When the JOG+ or JOG- function is activated by applying +24V at the respective DI's, the speed reference set at P037 or at P038 will be added, without speed ramp, to the other references.

Parameter	Range [Factory Setting] Unit	Description / Notes
P056 Speed Reference (via keys)	0.0 to 100 [**0.0**] 0.1%	☑ Programming is permitted when P024 = 4.
P057 Speed Reference (via keys)	0.0 to 100 [**0.0**]	
P076 Reference Offset	-999 to +999 [**0**] 1	☑ It may be used to compensate the undesired offsets of the analog inputs; ☑ When P025 = 0 or 1, 999 correspodes to 6.7% of the rated speed; ☑ When P025 = 4, 999 corresponds to 6.0% of the rated speed;

Nx, Ny, Ix, N = 0

P035 Range for n = n* (Reached Speed)	0.0 to 100 [**2.0**] 1.0%	☑ It determines the max. speed error that ensures the display at the digital output (XC1:38) for the condition (n = n*). See item 3.2.4.1.
P036 Speed n = 0	1.0 to 10.0 [**1.0**] 0.1%	☑ It determines the min. speed value before being considered equal to zero. ☑ Used for the Digital Output display n = 0 (XC1:48) and for the disabling by zero speed. See P015 and P016.

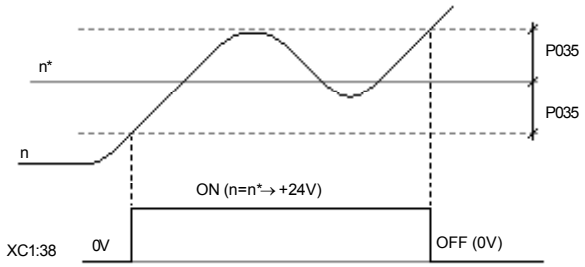


***Figure 6.5** - Indication of the Digital Output when n = n* (XC1:38)*

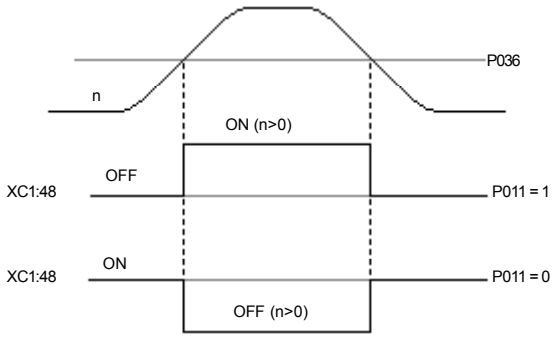


***Figure 6.6** - Indication of n=0 via DO (XC1:38)*

Parameter	Range [Factory Setting] Unit	Description / Notes
P071 Current I_x	0.0 to 125 [**125**] 1.0%	☑ Used in the Digital Output function $I_A > I_x$ (XC1:36); ☑ $I_A > I_x$ signaling occur when this conditions lasts more then 0,028s; ☑ This function may be disabled during the acceleration or braking process (P005 = 1) se P017 = 1.
P072 Ny Speed	0.0 to 100 [**0.0**] 1.0%	☑ Used for the Digital Output functions: n > Ny (XC1:32).
P073 Nx Speed	0.0 to 108 [**0.0**] 1%	☑ Used in the n > N_x (XC1:32) function of the digital output.

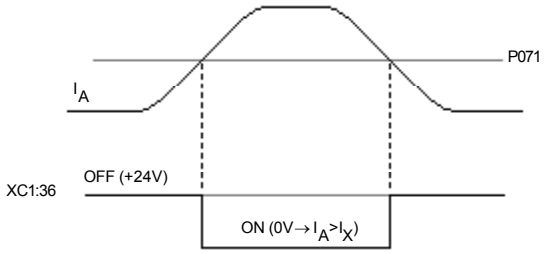


Figure 6.7 - *Indication of Ix via DO (XC1:36)*

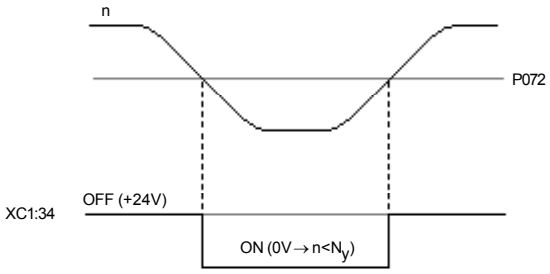


Figure 6.8 - *Indication of n < Ny (XC1:34)*

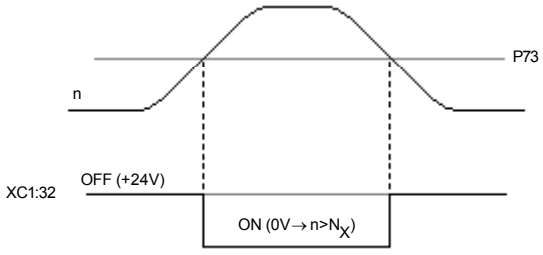


Figure 6.9 - *Indication of n > Nx (XC1:32)*

Parameter	Range [Factory Setting] Unit	Description / Notes

Speed Regulator

P039 Proportional Gain Gp	0.0 to 99.9 [**4.0**] 0.1	☑ Implemented in the parallel configuration (gains are independent each other); ☑ The integration time may be measured, by: 1) P032 = P033 =P039 = P048 = 0; 2) P054 = P055 = 125%; 3) P056 = 100% (P024 = 4), resulting in: T_{in} = P040 (P049) x 1.25.
P040 Integral Gain - Gi	0.00 to 2.00 [**0.12**] 0.0	
P041 Diferential Gain - Gd	0.00 to 9.99 [**0.0**] 0.0	☑ Actuation time (Gd) and selection of the Proportional and Integral Gain:
P048 Proportional Gain	0.0 to 99.9 [**00.0**] 0.1	
P049 Integral Gain	0.00 to 2.00 [**0.00**] 0.1	

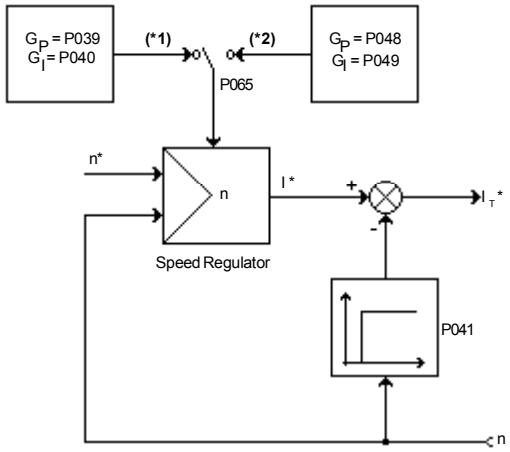


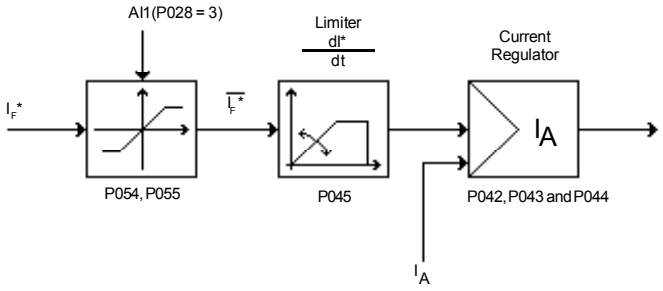
Figura 6.10 - *Configuration of the Speed Regulator*

(*1) P039 and P040 are used when:
1) P065 > 0 or
2) P065 = 0 and XC1:37 = 0V;

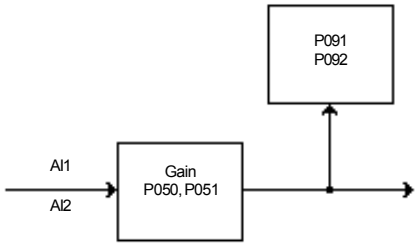
(*2) P048 and P049 are used when:
1) P065 = 0 and XC1:37 = +24V.

Current Regulator

P042 Proportional Gain	0.00 to 9.99 [**0.20**] 0.01	☑ Implemented in the parallel configuration.

Parameter	Range [Factory Setting] Unit	Description / Notes
P043 Integral Gain Intermittent **P044** Ganho Integral Continuous	0 to 999 [**35**] 1ms 0 to 999 [**70**] 1ms	☑ It permits regulator behavior optimization, when motor is without load; ☑ It optimizes the regulator when motor is on load condition; ☑ The integration time can be measured by setting: 1) P039 = 1.0; 2) P040 = P042 = P045 = 0, thus obtaining: T_{ic} = P043 (P044) x 2.
P045 I* [dI*/dt] variation rate **P054** Current Limiting (+I) **P055** Current Limiting (-I)	0 to 999 [**20**] 1ms 2.0 to 125 [**25.0**] 1.0% 2.0 to 125 [**25.0**] 1.0%	☑ It defines the time to change the signal I_F^* from 0V to 10V (maximum) (P054 = P055 = 125%).  ***Figura 6.11 -*** *Configuration of the Current Regulator* ☑ When P028 = 3 (AI1 = external current limiting), parameters P054 and P055 are available as read only parameters.

Analog Input

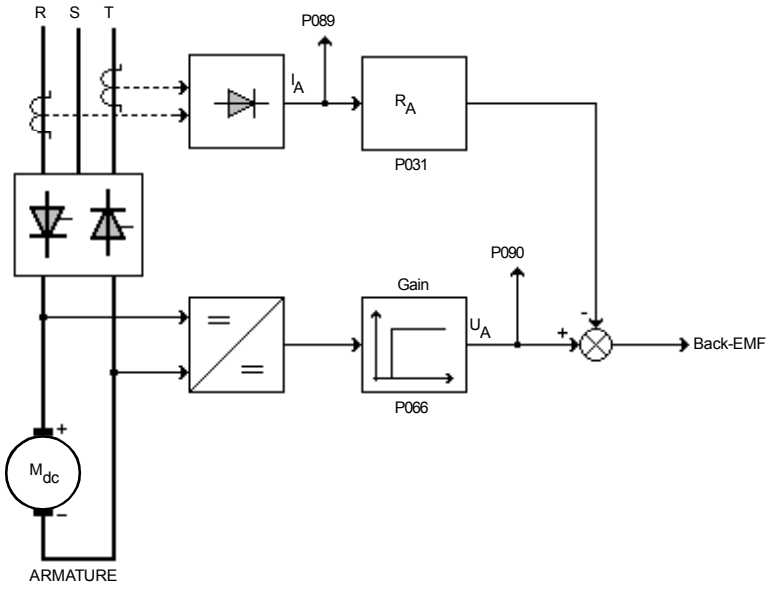
P050 Input Gain AI1 **P051** Input Gain AI2	0.00 to 9.99 [**1.00**] 0.01 0.00 to 9.99 [**1.00**] 0.01	 ***Figura 6.12 -*** *Configuration of the Analog Inputs*

Parameter	Range [Factory Setting] Unit	Description / Notes

Incremental Encoder

P052 (2) Max. Frequency (Hundred)	0 to 999 [**000**] 1Hz	☑ Parameters valid when P025 = 4; ☑ For programming, consider the following: 1) Number of encoder pulses (ppr); 2) Maximum speed of the motor to be driven (VMM); 3) Frequency of the supply line (f); By using: $P053,P052 = 4 \times \frac{VMM}{f} \times ppr$ Example: Supposing that ppr = 1024 ppr, VMM = 2100 rpm and f = 60Hz, we will obtain: P053,P052 = 143.360 Thus: P053 = 143 and P052 = 360
P053 (2) Max. Frequency (Thousand)	0 to 480 [**021**] 1kHz	

BACK-EMF Regulator

P031 Armature Resistance Compensation- Ra	0 to 999 [**0**] 1	☑ This compensation is used to correct the back-EMF, when motor is submitted to the rated load.  ***Figura 6.13 -*** *Configuration of the Back-EMF regulator* ☑ Set at P031 (R_A), so the back-EMF signal is maintained constant at any load condition.

Parameter	Range [Factory Setting] Unit	Description / Notes
P058 Proportional Gain	0.0 to 9.99 [**1.5**] 0.0	☑ This regulator is implemented in the parallel configuration.
P059 Integral Gain	0.0 to 6.0 [**0.25**] 0.01s	
P066 Signal Gain	0.1 to 2.50 [**1.00**] 0.0	☑ It permits the connection of the indication P090 (Armature Voltage) when motor runs at no-load condition. For instance, when the Speed Reference is 50%, of the nominal speed set P066, if necessary, until P090 indicates 50%. Where: The Nominal Speed = Max. Speed without field weakening. The Nominal Speed < Max. Speed with field weakening.

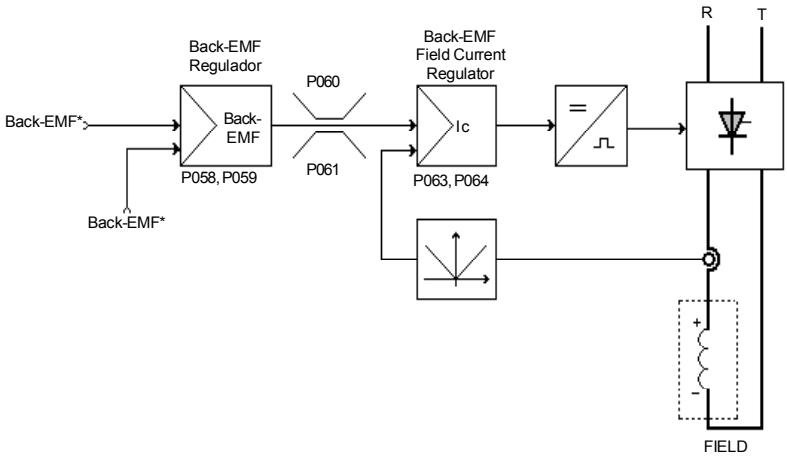


Figura 6.14 - *Configuration of the Back-EMF regulator and field current regulator*

Field Current Regulator

P060 Rated Current	0.1 to 30.0 [**2.6**] 0.1A	☑ Current value for motor speed equal or lower than the rated speed.
P061 Min. Current	0.1 to 30.0 [**0.6**] 0.1A	☑ Current value for the maximum speed condition.

Parameter	Range [Factory Setting] Unit	Description / Notes
P063 Proportional Gain	0.0 to 3.99 [**0.20**] 0.01	☑ Regulator is implemented in the parallel configuration.
P064 Integral Gain	0.0 to 3.99 [**0.10**] 0.01	
P100 Economy Field Current	0.0 to 30.0 [**0.6**] 0.1	☑ Current value applied to the motor field, when any of the following conditions occurs: 1) General Disabling Active, F01 is displayed; 2) Faults are detected (F02 to F08).

Regulador de Corrente em função de n

P074 Min. Current I_{min}	2.0 to 125 [**125**] 1%	☑ This function allows decreasing the limiting current value to speed values higher than P075, according to curve below:
P075 Speed n_1	10.0 to 100 [**100**] 1.0%	

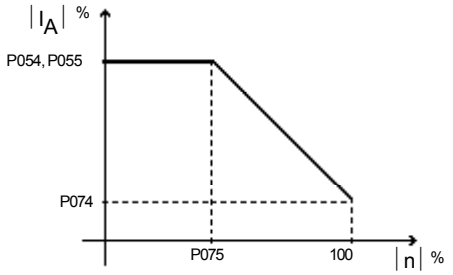


Figura 6.15 *- Current Limitation as a function of n*

☑ This function will be inactive if one of the following conditions is present:
1) P075 ≥ 100% or
2) P074 ≥ P54.

6.3 READ PARAMETERS

Parameter	Range [Factory Setting] Unit	Description / Notes
P023 Software Version	XXX [-] -	☑ It indicates the Software version contained in the EPROM's of the Control Board.
P056 Speed Reference	0.0 to 100% [-] 1%	☑ It shows the speed reference value, in percentage, selected in P024.
P057 Speed Reference	0.0 to 100% [-] 1%	
P062 Field Current	0.0 to 30.0 [-] 0.1A	☑ It indicates the current which flows through the motor field when P002 = 0.
P081 Phase Loss per Line Cycle (Hundred)	0 to 999 [-] 1	☑ It indicates how many times phase loss had occurred, with a duration shorter than the period of one line cycle.
P082 Phase Loss per Line Cycle (Thousand)	0 to 999 [-] 1	
P087 Speed Reference	0.0 to 100 [-] 1.0%	☑ It shows the total speed reference (n_3*), as percentage. (see figure 6.17).
P088 Motor Speed (P025 = 0 or 1) (P025 = 4)	0.0 to 110 [-] 1.0% 0.0 to 150 [-] 1.0%	☑ It indicates the motor speed value, as percentage; ☑ Filtered signal with 0.5s.
P089 Armature Current	0.0 to 125 [-] 1%	☑ It shows the armature current as percent of the rated converter current; ☑ 100% corresponds to the value set at P027; ☑ Filtered signal around 0.06s.

Parameter	Range [Factory Setting] Unit	Description / Notes
P090 Armature Voltage	0.0 to 110 [-] 1%	☑ 100% corresponds to the value set at P026.
P091 AI1 Input Signal (P028 = 1) (P028 = 2) (P028 = 3) **P092** AI2 Input Signal (P029 = 1) (P029 = 2)	0.0 to 100 [-] 1% 0.0 to 125 [-] 1% 0.0 to 125 [-] 1% 0.0 to 100 [-] 1% 0.0 to 125 [-] 1%	☑ Shows the signal value at the Analog Inputs AI1 and AI2, as percentage of the full scale. ☑ The shown values are already multiplied by the gains at P050, P51 respectively.
P093 Last Fault **P094** Second Previous Fault **P095** Third Previous Fault **P096** Fourth Previous Fault	F02 to F10 [**0**] - F02 to F10 [**0**] - F02 to F10 [**0**] - F02 to F10 [**0**] -	☑ It shows the code (02 to 10) of the fourth previous occurred faults. ☑ The parameter update that shows the faults is made in following sequence: 1) P095 → P096; 2) P094 → P095; 3) P093 → P094; 4) Fxy → P093.
P097 Phase Sequence	0 or 12 [-] -	☑ 0 = RST; 12 = RTS. ☑ Indicates which phase sequence supplies the control cabinet. ☑ These signals must be synchronized with the power signals.

Parameter	Range [Factory Setting] Unit	Description / Notes
P098 Status of the Digital Inputs DI's	0 to 255 [-] -	☑ Indicates the decimal value corresponding to the status of the 8 Digital Inputs. The variable has the following structure:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	DI (P065)	JOG-	JOG+	External Error	Local/Remote or Accelerates PE	Direction of Rotation	Ramp Disable or Decelerates PE	General Disable
Power	128	64	32	16	8	4	2	1

***Table 6.27** - Status of the Digital Inputs*

☑ The shown value will be equal to the power sum, in decimal, of the active functions.
Example: If JOG+, Ramp Disable and General Disable are active, then:
P098 = 32+2+1 = 35

P099 Hundred of the A/D conversion (10 or 12bits)	0 to 999 [-] 1	☑ It shows the conversion hundred of the A/D remote reference (XC1:7, 9). **Example:** 1) A/D 10 bits: Conversion result: 1023, P099 shows: 023 2) A/D 12 bits: Conversion result: 4096, P099 shows: 096.

(1) Operation Mode Parameters (these parameters can be changed only when P004 = 0, if P004 ≠ 0, set P013 = 1) (see Chapter 4).
(2) They are available only for Models CTWX4XXXXTX**F**XXXXXZ.

Electronic Potentiometer (PE):

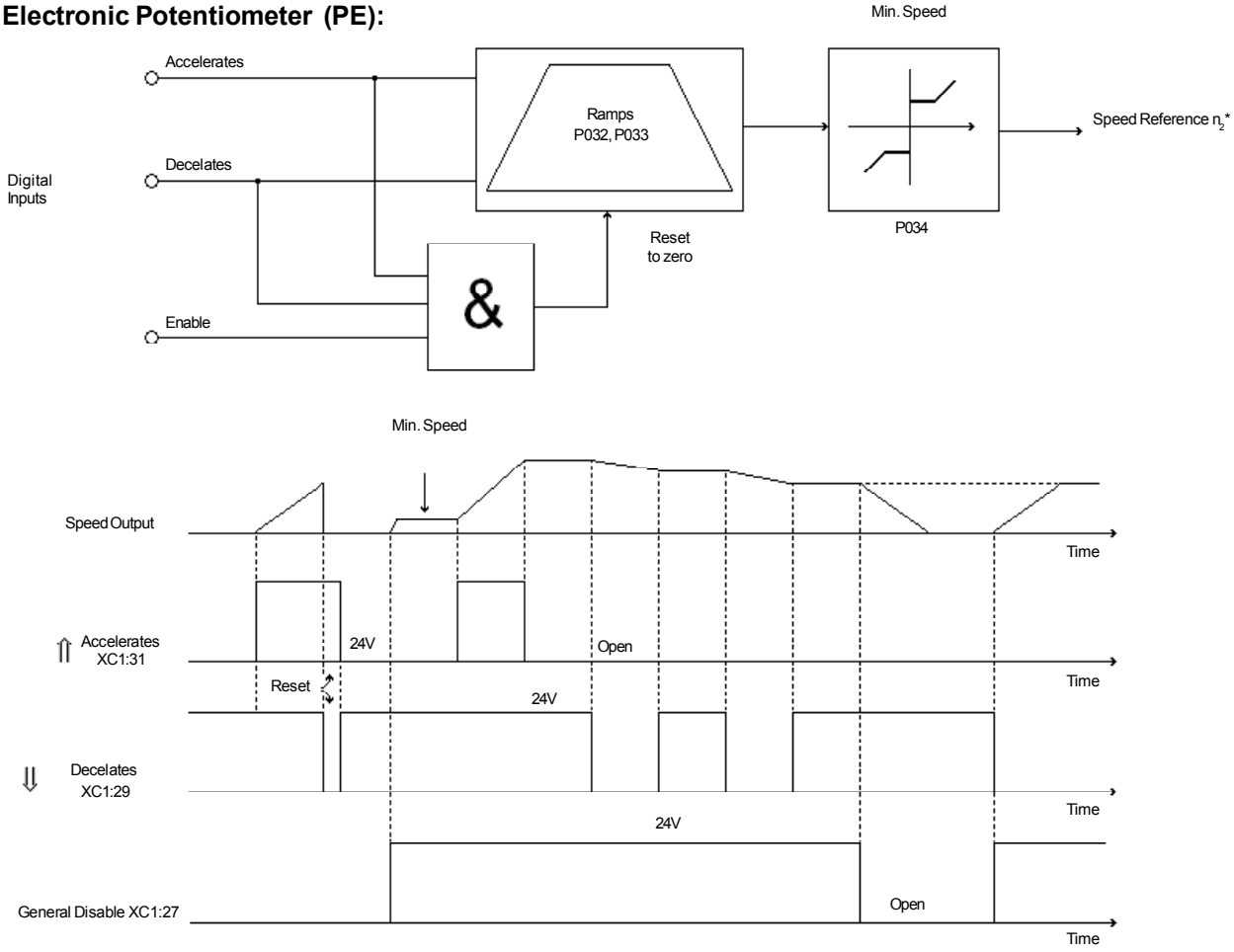


Figure 6.16 *– Electronic Potentiometer (PE)*

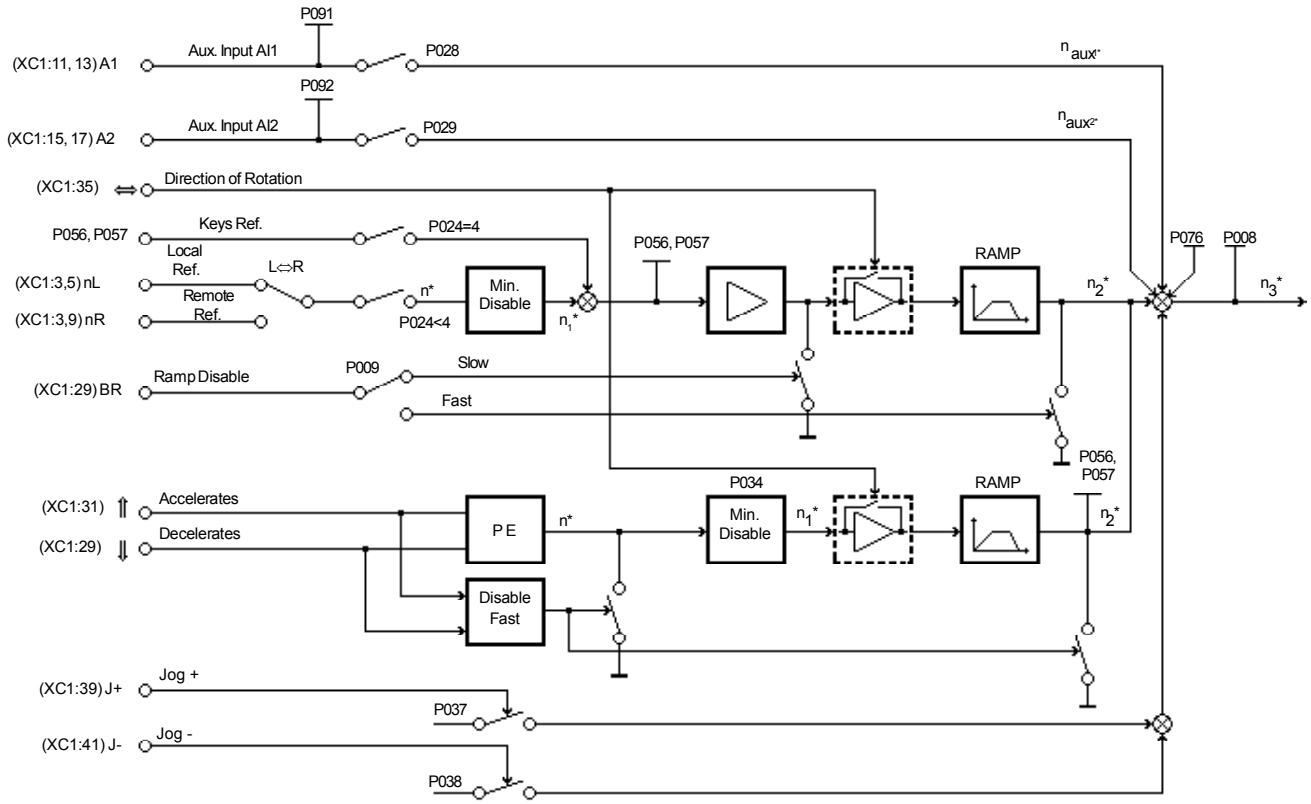


Figure 6.17 *– Block Diagram of the Speed Reference*

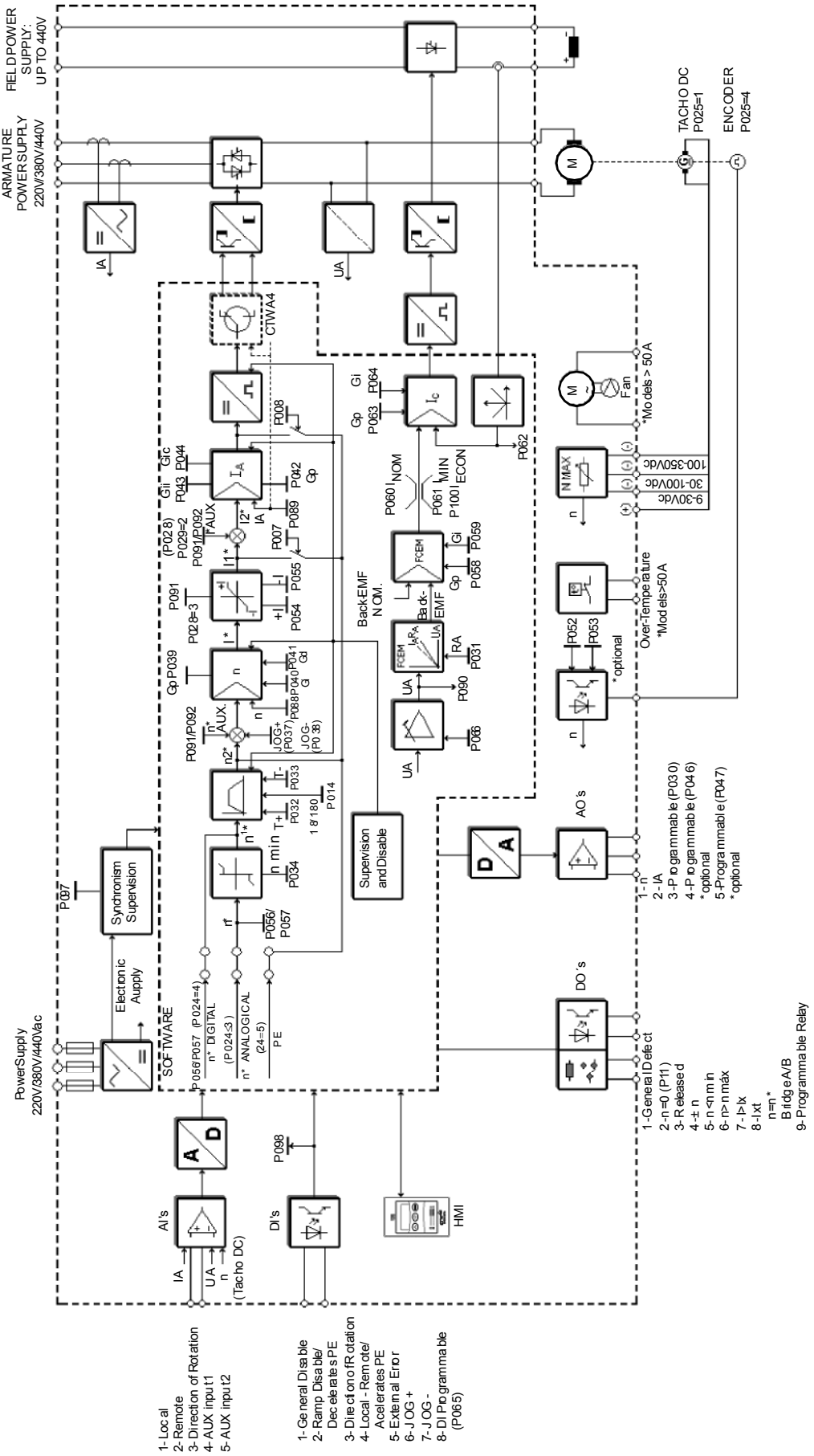


Figure 6.18 *- Block Diagram of the CTW-04 control*

DIAGNOSTICS AND TROUBLESHOOTING

This chapter assists the user to identify and correct possible faults that may occur during the CTW-04 operation. Guidance on Periodical Inspection, Preventive Maintenance and Cleaning Procedures are also provided.

7.1 ERRORS/FAULTS AND POSSIBLE CAUSES

When an error or a fault is detected, the converter is disabled and the Error/Fault Code is displayed on the readout in the EXX or FXX. To restart the converter after an error/fault has occurred, the converter must be reset. The reset can be made as follows:

☑ Disconnecting and reapplying AC power (Power-on reset);
☑ Automatic reset after some time has elapsed (Auto-reset);
☑ Via Digital Input: EE (XC1:33).

7.1.1 Errors and Possible Causes

Self-diagnose of some signals is executed (during approx. 3s) after converter is powered up, as follows:

☑ +5V power supply tolerance;
☑ Actuation of the external counter;
☑ Synchronism with line voltage.

Error/Fault Code E02 to E05 is displayed, if some problem is detected and the converter is disabled.
For details about errors and possible causes, refer to Table below:

ERROR	RESET	POSSIBLE CAUSES
E02 Conversion error A/D (10 bits)	☑ Contact Technical Assistance of WEG Industrias – Automação.	
E03 External Counter Error		
E04 Signal error in the Line Synchronism		
E05 EEPROM Saving Error		
E06 Programming Error	☑ This Code extinguishes automatically after incompatible parameters have been corrected.	☑ Setting attempt of an incompatible parameter. See table 5.1.

Table 7.1 - *Error Display*

7.1.2 Faults and Possible Causes

After diagnose routine has been concluded, converter start to monitor the signals and functions (as shown in table 7.2). If a fault is detected, the Fault Code F02 to F10 will be displayed. The number associated to Fault will be saved at the Parameters P093 to P096, up to a limit of 4 Faults.

NOTE!
The code F01 indicates the status of the General Disable Digital Input (XC1:27).

Table below shows details about the Fault and their possible causes:

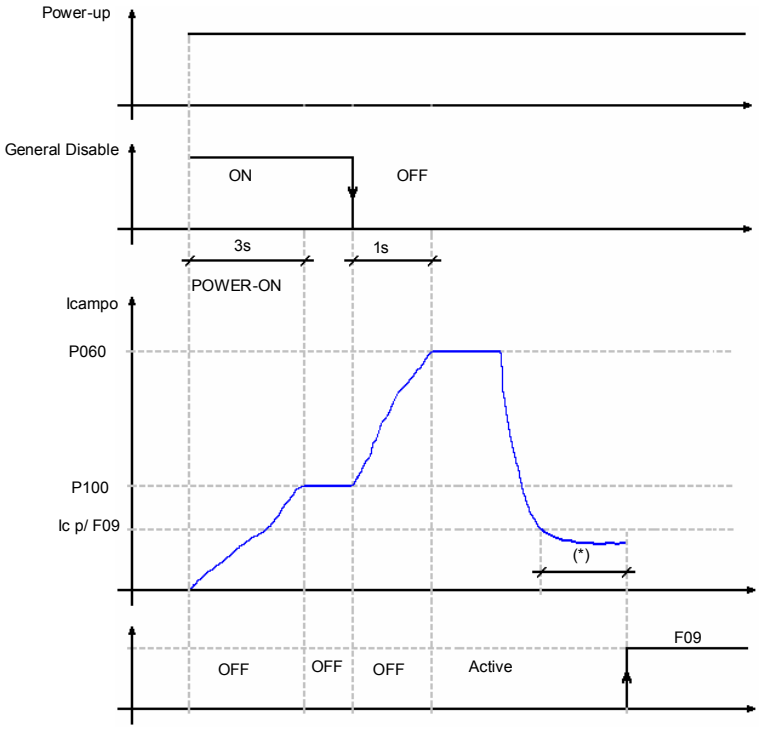
LOSS	RESET	POSSIBLE CAUSES
F02 External Error (Loss Chain)	☑ DI	☑ External DI Error (XC1:33) is open (not connected to +24V). ☑ Sensor connected to the External DI Error (XC1:33) is active.
F03 Phase Loss or Line Loss	☑ Auto-reset	☑ Phase Loss at the converter input.
F04 ±15V Loss on the Control Board	☑ Power-on	☑ ±15V power supply is not active. ☑ XC8 Cable connection.
F05 Line Undervoltage	☑ Auto-reset, when: V_{supply} > 198V for 220V models V_{supply} > 342V for 380V models V_{supply} > 396V for 440V models	☑ Power supply is lower than the minimum permitted value: V_{supply} < 176V for 220V models; V_{supply} < 304V for 380V models; V_{supply} < 352V for 440V models.
F06 Locked rotor	☑ Auto-reset	☑ Field Loss (P002 = 1). ☑ Locked rotor. ☑ Too high load on motor shaft.
F07 Overload (I x t)	☑ Auto-reset	☑ Setting at P067, P068 and P069 is too low for used motor. ☑ Too high load on motor shaft.
F08 Tachogenerator Loss	☑ Auto-reset	☑ Tachogenerator cables are inverted (DC-Tachogenerator or Incremental Encoder). ☑ Broken wiring.
F09 Loss in the Field Current Loop	☑ New power-up	☑ Field supply loss (X1:4, 5). ☑ Connection of the field current control (P002 = 0) at the connector XC16 of the RC04 Board. ☑ Field supply fuses. ☑ Field loss (P002 = 0). ☑ Motor field conection (X1:6,7). **NOTE!** **It monitors after General Disabling is inactive.**
F10 Synchronism Signal Loss	☑ Auto-reset	☑ Momentary line loss.

***Table 7.2** - Fault Displays*

Fault Actuation Form:

FAULT	ACTUATION FORM	
F02 External Error (Fault chain)	☑ Deactivates DO – Fault Relay (F): ☑ Deactivates DO – Released (LIB); ☑ Disables Ramp; ☑ Disables Regulators; ☑ Disables HMI keypad; ☑ Disables firing after ½ Line Cycle.	
F03 Phase Loss	☑ Phase Loss or Line Loss (Time ≤ Line Cycle)	☑ Disables Regulators during 60.0ms; ☑ Disables Firing during 60.0ms; ☑ Does not disable Ramp; ☑ Doe not display F03; ☑ Does not save at P093, P094, P095 and P096; ☑ Increments P081 and P082; ☑ Releases Regulators after 60.0ms; ☑ Releases Firing after 60.0ms.
	☑ Line Loss (line cycle ≤ Time ≤ 48.0ms) or ☑ Phase Loss (Permanent time)	☑ Deactivates DO - Fault Relay (F); ☑ Deactivates DO - Released (LIB); ☑ Disables Ramp; ☑ Disables Regulators; ☑ Disables HMI Keypad; ☑ Disables Firing; ☑ Converter is released after 5min.
	☑ Line Loss (Permanent Time):	☑ Does not display F03; ☑ Does not save at P093, P094, P095 and P096;
F04 ±15V Loss on the Control Board	☑ Deactivates DO – Fault Relay (F); ☑ Deactivates DO – Released (LIB); ☑ Disables HMI Keypad; ☑ Disables Firing; ☑ Requires new power-up.	
F05 Line Undervoltage	☑ Deactivates DO – Fault Relay (F); ☑ Deactivates DO – Released (LIB); ☑ Disables Ramp; ☑ Disables Regulators; ☑ Disables HMI Keypad; ☑ Disables Firing after ½ line cycle; ☑ Auto- reset with 0,9V nominal supply.	
F06 Locked Rotor	☑ Deactivates DO – Fault Relay (F); ☑ Deactivates DO – Released (LIB); ☑ Disables Ramp; ☑ Disables Regulators; ☑ Disables HMI Keypad; ☑ Disables Firing after ½ line cycle; ☑ When the armature current is equal to the current limitation and the motor shaft remains stopped during 2.0s, the drive is blocked for 5 minutes. After this time the drive is automatically enabled. This function is executed in the following situations: 1) Content of P070<3; 2) Saturated speed regulator; 3) Speed regulator >1%; 4) Real speed <1%; 5) Armature current >2%.	
F07 Overload [I x t]	☑ Deactivates DO – Fault Relay (F); ☑ Deactivates DO – Released (LIB); ☑ Disables Ramp; ☑ Disables Regulators; ☑ Disables HMI Keypad; ☑ Disables Firing after ½ line cycle; ☑ Converter is released after 5 min.	
F08 Tachogenerator Fault	☑ Deactivates DO – Fault Relay (F); ☑ Deactivates DO – Released (LIB); ☑ Disables HMI Keypad; ☑ Disables Firing after ½ line cycle; ☑ Converter is released after 30s.	

***Table 7.3** - Fault Actuation Forms*

<table>
<tr><th>FAULT</th><th>ACTUATION FORM</th></tr>
<tr><td>F09
Loop Fault at the Field Current</td><td>
☑ It monitors the field current fault after General Disabling is inactive;
☑ Deactivates DO – Fault Relay (F);
☑ Deactivates DO – Released (LIB);
☑ Disables Firing;
☑ Saves at P093, P094, P095 and P096;
☑ New Power-up is required.


<table>
<tr><th rowspan="2">P027</th><th colspan="2">(*)</th></tr>
<tr><th>I for F09 activacion (A)</th><th>Time for activation of F09 (ms)</th></tr>
<tr><td>0 = 10/20A</td><td>0,12</td><td>~145</td></tr>
<tr><td>1 = 50A</td><td>0,22</td><td>~240</td></tr>
<tr><td>2 = 63A</td><td>0,25</td><td>~260</td></tr>
<tr><td>3 = 90A</td><td>0,31</td><td>~290</td></tr>
<tr><td>4 = 106A</td><td>0,35</td><td>~310</td></tr>
<tr><td>5 = 125A</td><td>0,38</td><td>~330</td></tr>
<tr><td>6 = 150A</td><td>0,42</td><td>~360</td></tr>
<tr><td>7 = 190A</td><td>0,47</td><td>~380</td></tr>
<tr><td>8 = 265A</td><td>0,56</td><td>~475</td></tr>
<tr><td>9 = 480A</td><td>0,74</td><td>~570</td></tr>
<tr><td>10 = 640A</td><td>0,86</td><td>~660</td></tr>
<tr><td>11 = 1000A</td><td>1,05</td><td>~760</td></tr>
<tr><td>12 = 1320A</td><td>1,19</td><td>~850</td></tr>
<tr><td>13 = 1700A</td><td>1,33</td><td>~945</td></tr>
</table>
</td></tr>
<tr><td>F10
Synchronism Signal Fault</td><td>
☑ Does not disable Ramp;
☑ Disables Regulators during 60.0ms;
☑ Disables Firing during 60.0ms;
☑ Does not display F10;
☑ Saves at P093, P094, P095 and P096;
☑ Releases Regulators after 60.0ms;
☑ Releases Firing after 60.0ms.
</td></tr>
</table>

Table 7.3 (cont.) – *Fault Actuation Forms*

7.2 SOLUTION FOR MORE FREQUENT PROBLEMS

PROBLEM	POINTS TO BE CHECKED	CORRECTIVE ACTION
Motor does not run	Wiring	☑ Check if converter is powered-up correctly (AC voltage levels and matching of RST phases between electronics and power input). ☑ Check all power and control connections (Digital Inputs programmed with General Disable, Ramp Disable or External Fault connected to +24V).
	Fuses	☑ Check armature and Field UR-fuses; ☑ Check all power and control fuses;
	Armature Circuit or Field is open	☑ Check if circuit-breaker of the of the AC fan motor is closed; ☑ Check if the thermostat of the thyristor bridge and of the DC motor are closed;
	Error	☑ Check if inverter has been disabled due to an error condition or detected fault (see table 7.1 and 7.2);
	Speed reference	☑ Check speed reference setting. If it is set at minimum, motor does not start; ☑ Check wiring;
	Current Limiting	☑ Check setting of current limiting (P054 and P055). If they are set at minimum, motor does not start.
	Locked rotor	☑ Check if the rotor is locked mechanically;
	Programming	☑ Check, if parameters have been set correctly for the application;
UR Fuses blew during powering-up	Armature Circuit	☑ Check if the armature circuit is short-circuited (blown thyristor);
	Ground isolation	☑ Check if motor or converter have ground insulation problems;
	Fuses	☑ Check if fuses are according to specification; ☑ Check fuses 11, 12 and 13 of the electronics power supply;
	Programming	☑ Check, if parameters have been set correctly for the application;
UR Fuses blew during braking process (CTWA4)	Short-Circuit / Line / Voltage Loss	☑ Check if thyristor is short-circuited; ☑ Check if there is line loss (even if only during 1 cycle); ☑ Check if the armature voltage too high relating to the rated voltage at maximum speed;
UR Fuses blew when load changes or motor accelerates/brakes (CTWA4)	Current limiting and regulator	☑ Check if the current limit is not too high; ☑ Check if the current regulator dynamic has been set correctly; ☑ Check as described above (UR-fuses blew during braking process);
Incorrect Speed Control	Current	☑ Check if motor is operating at current limit; ☑ Check and ensure that the rated motor current, nor the max. converter current is exceed at continuous operation;
	Reference	☑ Check if there are speed reference problems (P024 Reference Type);
	Feedback	☑ Check if there is speed feedback loss; ☑ If feedback is executed by tachogenerator, check connections by comparing with the rated voltage and check if connections are interrupted; ☑ Check parameter which defines the speed feedback P025;
	Field	☑ Check if field voltage oscillates;
Current and/or Motor Speed Oscillation	Regulators	☑ Check if current or speed regulators are set correctly;
	Tachogenerator	☑ Check if tachogenerator makes noise; ☑ Check brushes, brush-holders and commutators; ☑ Check tachogenerator coupling; ☑ Check tachogenerator wiring [shielded cable];
	Reference	☑ Check if speed reference is noisy;
	Fuses	☑ Check fuses of the electronics F11 ... F13;
Display OFF during Power-up	Connection	☑ Check XC9 cable.

***Table 7.4** - Solution for more frequent problems*

7.3 TELEPHONE / FAX / E-MAIL FOR CONTACT (TECHNICAL ASSISTANCE)

NOTE!

When contacting WEG for Service or Technical Assistance, please have following data on hand:

- ☑ Converter Model;
- ☑ Serial number, manufacturing date and hardware version revision as indicated on the converter Nameplate;
- ☑ Installed Software Version;
- ☑ Information about the application and converter programming.

7.4 PREVENTIVE MAINTENANCE

DANGER!

Always disconnect the AC power supply before touching any component of the converter.
Even after switching off the converter, high voltages may be present.
Always connect the equipment frame to a suitable ground (PE) point.

ATTENTION!

There are some components sensitive to electrostatic discharge at the eletronic board.
Never touch the components or connectors directly. If this is unavoidable, first touch the metallic frame or use a suitable ground strap.

Never apply high voltage test on the converter!
If this is necessary, contact WEG.

To avoid operation problems caused by unfavorable ambient conditions, such as high temperature, moisture, dirt, vibration or premature aging of the components, periodical inspections of the converter and installations are recommended.

COMPONENT	PROBLEM	CORRECTIVE ACTION
Terminal Blocks, Connectors	Loose screws	Tighten them (2)
	Loose connectors	
Blowers (1) / Cooling System	Blowers are dirty	Clean them (2)
	Abnormal acoustic noise	Replace the blower
	Blower is not running	
	Abnormal vibration	
	Dust in the air filters	Clean or replace them (2)
Printed Circuit Boards	Dust, oil or moisture accumulation, etc.	Clean them (2)
	Smell	Replace them
Power Module / Power connections	Dust, oil or moisture accumulation, etc.	Clean them (2)
	Connection Screws are loose	Tighten them (2)

***Table 7.5** – Periodic Inspections after Start-up*

NOTES!

(1) It is recommended to replace the blowers after each 40,000 hours of operation.
(2) Every 6 months.
(3) Two times each month.

7.4.1 Cleaning Instructions

When required, clean the converter by following the instructions below:

a) Cooling System:

☑ Remove AC power form converter and wait at least 10 minutes;
☑ Remove all dust from the ventilation openings by using a plastic brush or a soft cloth;
☑ Remove all dust accumulated on the heat sink fins and from the blower blades with compressed air.

b) Electronic Boards:

☑ Remove AC power from converter and wait at least 10 minutes;
☑ Remove all dust from the electronic boards by using a antistatic brush or remove it with an ionized compressed air gun. For instance: Charges Burtes Ion Gun (non nuclear) reference A6030-6DESCO. If necessary, remove the boards from the converter. Use always a ground strap.

OPTIONS AND ACCESSORIES

This chapter describes the optional devices that are available for the CTW-04 converter. These optional devices are: Fieldbus network communication kit, RS-232 communication kit to PC and blank covers.

8.1 FIELDBUS NETWORK COMMUNICATION

The CTW-04 can be connected to Fieldbus networks allowing its control and parameter setting. For this purpose you need to include an optional electronic board according to the desired Fieldbus standard: Profibus-DP or DeviceNet.

NOTE!
The chosen Fieldbus option can be specified in the suitable field of the CTW-04 coding:

DN = DeviceNet
PD = Profibus DP

EX: CTWX4XXXXTXXXXODNZ = CTW-04 converter with optional DeviceNet.

In this case the CTW-04 will be supplied with all needed components already installed for the Fieldbus communication.
For later installation you must order and install the desired Fieldbus communication kit (Profibus-DP or DeviceNet).

8.1.1 Protibus-DP Kit

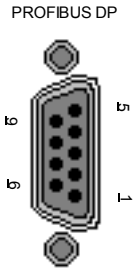


***Figure 8.1** – Profibus-DP connector*

8.1.1.1 Installation

The electronic board Anybus that forms the Fieldbus kit Porfibus-DP is installed directly onto the CCW4 control board, connected to the XC5 connector and fixed by spacers.

Figure 8.2 shows the devices and the Fieldbus kit Profibus-DP:

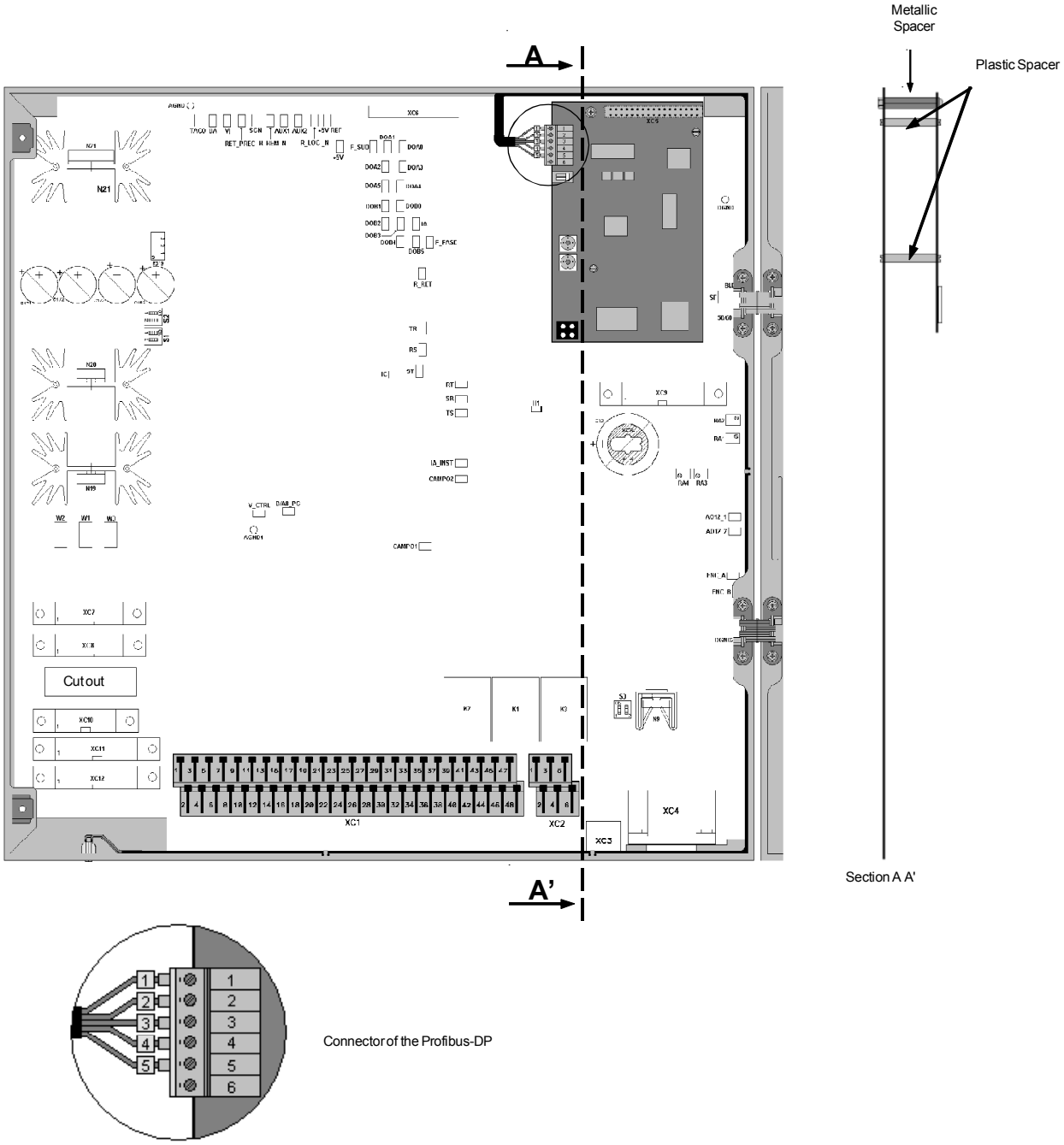


Figure 8.2 *– Devices and installation of the Fieldbus kit Profibus-DP*

- ☑ Fix the spacers on the CCW4 control board;
- ☑ Insert the metallic spacer into the metalized hole and fix through bolt. In the other 2 non-metalized holes insert the plastic spacer;
- ☑ Insert Anybus board carefully through the pin bar connector to the XC5 female connector of the CCW4 control board;
- ☑ Press Anybus board near to the XC5 and on the lower right edge until the connector and the plastic spacer insert completely;
- ☑ Fix Anybus board to the metallic spacer through bolt;
- ☑ Connect the Profibus-DP cable to the 6 ways connector of the Anybus board. Way 6 is not used;
- ☑ Insert the DB9 connector of the Profibus-DP cable into the left bottom edge of the cabinet;
- ☑ Fix the DB9 connector to the cabinet through two bolts.

8.1.1.2 Introduction

The converter that is fitted with the Profibus-DP kit operates in slave mode, allowing the reading/writing of the parameters through the master. The converter does not start the communication with other nodes, it only responds to the master. A twisted pair of shielded copper cable realizes the connection the Fieldbus (RS-485), allowing the data transfer at rates between 9.6kbits/s to 12Mbits/s.

Figure 8.3 gives a general overview of a Profibus-DP network:

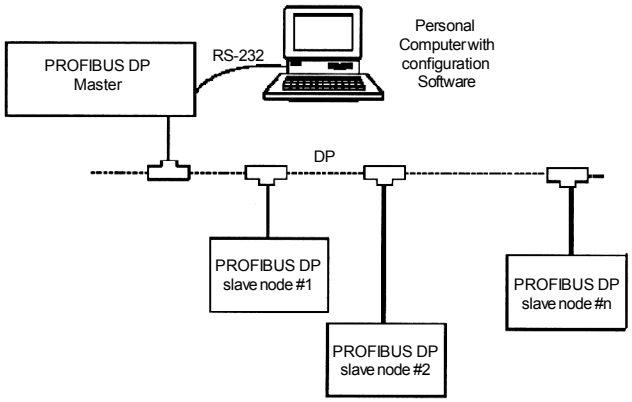


***Figure 8.3** - Profibus-DP network*

- Fieldbus Type: PROFIBUS-DP EN 50170 (DIN 19245);
- Protocol Version: see 1.10;
- Supplier of the Protocol Stack: Siemens.

Transmission means: Profibus bus line, type A or B as specified in EN50170.
- Topology: Master-Slave communication;
- Insulation: the bus is supplied by a DC/DC inverter and isolated galvanically from remaining electronics and the signals A and B are isolated by optocouplers;
- It allows the connection/disconnection of only one node without affecting the network.

Fieldbus connector of the Converter User:
- Connector DB9 - female pins;
- Pin location.

Pin	Name	Function
1	Not connected	-
2	Not connected	-
3	B-Line	RxD/TxD positive, according to the RS-485 specification
4	Not connected	-
5	GND	0V isolated against RS-485 circuit
6	+5V	+5V 0V isolated against RS-485 circuit
7	Not connected	-
8	A-Line	RxD/TxD negative, according to the RS-485 specification
9	Not connected	-
Frame	Shield	Connected to the ground protection (PE)

***Table 8.1 -** Pin connection (DB9) to the Profibus-DP*

8.1.1.3 Technical Interface

Line Termination
The initial and the end points of the network must be terminated with the characteristic impedance in order to prevent reflections. The DB9 male connector of the cable has the suitable termination. When the converter is the first or the last of the network, you must set the termination switch to “ON”. Otherwise set the switch to “OFF”. The terminating switch of the PROFIBUS-DP board must be set always to 1 (OFF).

Transfer Rate (Baudrate)
The transfer rate of a Profibus-DP network is defined during the Master configuration and only one rate is permitted on the same network. The Profibus-DP board has automatic baudrate detection and the user does not need to configure it on the board. The supported baudrates are: 9.6 kbits/s, 19.2 kbits/s, 45.45 kbits/s, 93.75 kbits/s, 187.5 kbits/s, 500 kbits/s, 1.5 Mbits/s, 3 Mbits/s, 6 Mbits/s and 12 Mbits/s.

Node Address
The node address is established by means of two rotating switches on the electronic Profibus-DP board, permitting the addressing from 1 to 99 addresses. Looking onto the front view of the board with the converter in normal position, the switch at left sets the set of ten of the address, while the switch at right set the unit of the address:

Address = (set left rotary switch x 10) + (set right rotary switch x 1)

Configuration File (GSD File)
Each element of the Profibus-DP board is associated to a GSD file that has all information about the element. This file is used by the program of the network configuration. Use this file with the extension .gsd stored on the floppy disk contained in the Fieldbus kit.

Signaling
The electronic board has a bicolor “LED” at the right topside, indicating the status of the Fieldbus according to the table below:

Color LED	Frequency	Status
Red	2Hz	Fault during the test of the ASIC and Flash ROM
Green	2Hz	Board has not been initialized
Green	1Hz	Board has been initialized and is operating
Red	1Hz	Fault during the RAM test
Red	4Hz	Fault during the DPRAM test

***Table 8.2** – Signaling LED of the Fieldbus board status*

Note:
The red fault indications mean Hardware problem of the electronic board. The reset is realized by switching OFF/ON the converter. If the problem persists, replace the electronic board.
The electronic board is also fitted with four other bicolor LED´s placed at the right bottom side, indicating the Fieldbus status according to the figure 8.4 and Table 8.3 below:

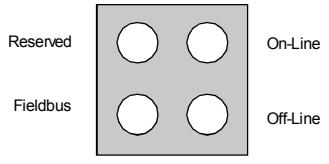


***Figure 8.4** – LED’s indicating the status of the Profibus-DP network*

LED	Color	Function
Fieldbus diagnostics	Red	Indicates certain fault at the Fieldbus: **Flashing 1Hz** – Configuration error; the IN/OUT area size set at the board enabling is different from the size set during the network configuration. **Flashing 2Hz** – Error in the User's Parameter Data: the size or the content of the User-Parameter data set at the board enabling is different from the size/content set during the network configuration. **Flashing 4Hz** – Enabling error of the Profibus Communication ASIC. **OFF** – no problems.
Online	Green	Indicates that the board is Online at the Fieldbus: **ON** - board is Online and data exchange is possible. **OFF** - board is not Online.
Offline	Red	Indicates that the board is Offline at the Fieldbus: **ON** - board is Offline and data exchange is not possible. **OFF** - board is not Offline.

Table 8.3 *– Signaling LED's indicating the status of the Profibus-DP network*

8.1.2 Kit DeviceNet

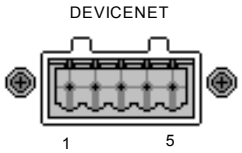


Figure 8.5 *- DeviceNet Connector*

8.1.2.1 Installation

The electronic board Anybus that is part of the Kit Fieldbus DeviceNet is installed directly on the CCW4 control board, connected to the connector XC5 and fixed by spacers.

Figure 8.6 shows the devices and installation of the Kit Fieldbus DeviceNet:

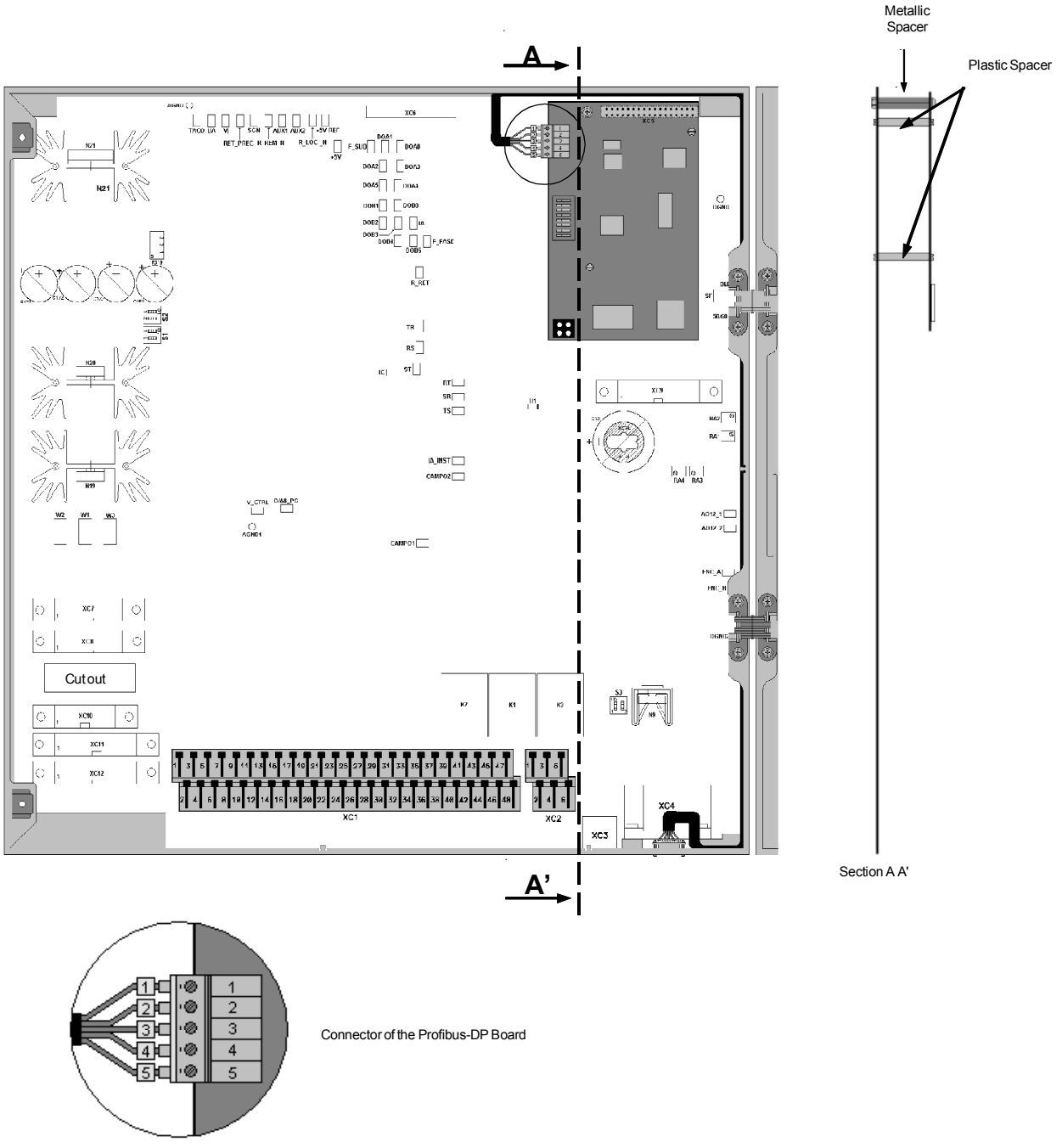


Figure 8.6 *– Devices and installation of the kit Fieldbus DeviceNet*

- ☑ Fix the spacers on the CCW4 control board;
- ☑ Insert the metallic spacer into the metalized hole and fix through bolt. In the other 2 non-metalized holes insert the plastic spacer;
- ☑ Insert Anybus board carefully through the pin bar connector to the XC5 female connector of the CCW4 control board;
- ☑ Press Anybus board near to the XC5 and on the lower right edge until the connector and the plastic spacer insert completely;
- ☑ Fix Anybus board to the metallic spacer through bolt;
- ☑ Connect the DeviceNet cable to the 5 ways connector of the Anybus board;
- ☑ Insert the connector of the DeviceNet into the left bottom edge of the cabinet;
- ☑ Fix the connector to the cabinet through two bolts.

8.1.2.2 Introduction

The DeviceNet communication is used for industrial automation mainly for the control of valves, sensors, input/output units and automation equipment. The DeviceNet communication link is based on a communication protocol "broadcast oriented", the Controller Area Network (CAN). The connection to the DeviceNet network is realized by means of a shielded cable comprising a twisted pair and two-wire cable connected to the external power supply. The baudrate can be set to 125k, 250k or 500kbits/s.

Figure 8.7 gives a general view of a DeviceNet network:

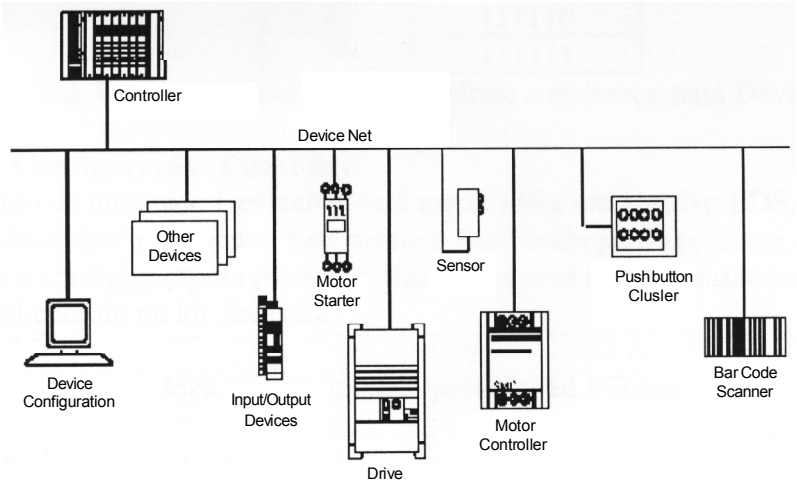


***Figure 8.7** - DeviceNet Network*

8.1.2.3 Technical Interface

Fieldbus connector of the Converter User:
- Connector: 5 ways-connector of plug-in type with screw terminal.
- Pins:

Pin	Color	Description
1	Black	V-
2	Blue	CAN_L
3	Silver	Shield
4	White	CAN_H
5	Red	V+

***Table 8.4** – Connection of the pins to the DeviceNet*

Line Termination:
To prevent deflection, the initial and the end points of the network must be terminated with the characteristic impedance in order to prevent reflexions. Thus a 120 ohms/0.5W resistor must be connected between the pins 2 and 4 of the Fieldbus connector.

Baudrate / Node address:
There are three different baudrates for the DeviceNet: 125k, 250k or 500kbits/s. Select one of these baudrates by setting the DIP switches on the electronic board, before configuration is made. The node address is selected through the six DIP switches on the electronic board, permitting an addressing from 0 to 63 addresses.

Baudrate (bits/s)	DIPs 1 and 2
125 k	00
250k	01
500k	10
Reserved	11

Address	DIP3 to DIP8
0	000000
1	000001
2	000010
.	.
61	111101
62	111110
63	111111

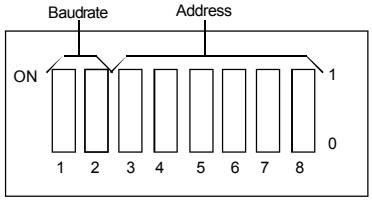


***Figure 8.8** – Baudrate configuration and addressing to the DeviceNet*

Configuration File (EDS File)
Each element of a DeviceNet network is associated to an EDS file, that has all information about the element. This file is used by the program of the network configuration during it configuration. Use the file with extension .eds stored on the floppy disk contained in the Fieldbus kit.

NOTE!
The PLC (master) must be programmed for Polled I/O connection.

Signaling
The electronic board has a bicolor LED at the right topside indicating the status of the Fieldbus according to table 8.2.

Note:
The red fault indications mean hardware problems on the electronic board. The reset is performed by switching ON/OFF the inverter. If the problem persists, replace the electronic board.
The electronic board is also fitted with other four bicolor LEDs mounted at the right bottom side, indicating the DeviceNet status according to figure 8.9 and Table 8.5.

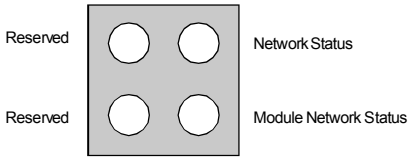


***Figure 8.9** – LED's for status indication of the DeviceNet network*

LED	Color	Description
Module Network Status	OFF	Without supply
	Red	Fault not recoverable
	Green	Board operating
	Red flashing	Minor fault
Network Status	OFF	Without supply/off-line
	Green	Link operating, connected
	Red	Critical fault at link
	Green flashing	On-line – not connected
	Red flashing	Time-out of the connection

***Table 8.5** - LED's indicating the status of the DeviceNet network*

8.1.3 Use of the Fieldbus/ related Parameters of the CTW-04

There are two main parameters: P085 and P086.

P085 - defines the used standard Fieldbus (Profibus-DP or DeviceNet) and the number of (I/O) variables exchanged with the Master (2, 4 or 6).

The Parameter P085 has the following functions:

0 = Inactive;
1 = Profibus-DP 2I/O,
2 = Profibus-DP 4I/O,
3 = Profibus-DP 6I/O,
4 = DeviceNet 2I/O,
5 = DeviceNet 4I/O,
6 = DeviceNet 6I/O.

P086 - defines the converter behavior when the physical connection with the Master is interrupted and/or Fieldbus board is inactive (E29/E30 indicated on the HMI display).

The parameter P086 has the following functions:

0 = disables the converter by using the Ramp Disable command, via deceleration ramp (if P005 = 1).
1 = disables the converter by using the General Enable, stop by inertia
2 = the inverter status is not changed.

8.1.3.1 Variables Read From Converter

1. The variables are read in the following sequence:
1- Logical Status of the converter;
2- Motor speed, for option P085 = 1 or 4 (2I/O) – it reads 1 and 2;
3- Status of the Digital Inputs (P098);
4- Parameter status, for option P085 = 2 or 5 (4I/O) – it reads 1, 2, 3 and 4;
5- Armature current (P089);
6- Motor Field Current (P062), for option P085 = 3 or 6 (6I/O) – it reads 1, 2, 3, 4, 5 and 6.

Logical Status (E.L.):
The Word that defines the E.L. is formed by 16 bits, being 8 bits of high order and 8 bits of lower order. It has the following structure:

High-Order Bits – they indicate the status of the associated function

EL.15 – Not used;
EL.14 – JOG command- : 0 = Inactive, 1 = Active;
EL.13 – JOG command+ : 0 = Inactive, 1 = Active;
EL.12 – Fault active: 0 = Yes, 1 = No;
EL.11 – Error active: 0 = Yes, 1 = No;
EL.10 – Direction of rotation: 0 = Counter-Clockwise, 1 = Clockwise;
EL.09 – General Disable: 0 = Active, 1 = Inactive;
EL.08 – Disable by Ramp: 0 = Inactive, 1 = Active.

Low-Order Bits – they indicate the fault code number (i.e. 02 to10). See item 7 - Faults and Possible Causes.

2. Motor Speed:
This variable is shown by using a 4 bits resolution plus signal. I.e., when the parameter P088 (Motor Speed) shows 100% (motor operating without field weakening), the value read at pos. 2 will be equal to 16383(3FFFh) for clockwise rotation, or –16383(C001h) for Counter-Clockwise rotation.

3. Status of the Digital Inputs:
It indicates the content of the parameter P098, where level 1 indicates active input (with +24V) , and the level 0 indicates inactive input (with 0V). The digital inputs are so distributed in this byte:

Bit.7 – XC1:37 status (DI programmable);
Bit.6 – XC1:41 status (JOG -);
Bit.5 – XC1:39 status (JOG +);
Bit.4 – XC1:33 status (External Error);
Bit.3 – XC1:31 status (Accelerates PE, Loc/Rem);
Bit.2 – XC1:35 status (Direction of rotation);
Bit.1 – XC1:29 status (Ramp Disable or Decelerates PE);
Bit.0 – XC1:27 status (General Disable).

4. Parameter Content status:
Through this position you can read any converter parameter that is selected at Position 4 - parameter number to be read, of "Variables written to the converter". The read values have the same order as those described in the Product Manual or displayed at the HMI.

The values are read without decimal dot, i. e., the HMI indication is multiplied by 10 at the parameters: P032, P033, P036, P039 to P042, P048 to P051, P052 to P061, P063, P064, P066, P078 to P080.

The read values are multiplied by 100 at the parameters: P032, P033 when P014=1.

Example:
a) HMI displays 12.3, the read via Fieldbus will be 123.

5. Armature Current:
The armature current (P89) is displayed without decimal dot. A 0,06 sec. filter is fitted.

6. Field Current:
This position indicates the content of Parameter P062, disregarding the decimal point.

8.1.3.2 Variables written to the Converter

The variables are written in the following order:
1 - Logical Command;
2 - Motor speed reference, for option P085 = 1 or 4 (2I/O) - writes in 1 and 2;
3 - Status of the Digital Outputs;
4 - Number of parameters to be read, for option P085 = 2 or 5 (4I/O) – writes in 1, 2, 3 and 4;
5 - Number of Parameter to be changed;
6 - Content of the parameter to be changed, selected at the previous position, for option P085 = 3 or 6 (6I/O) – writes in 1, 2, 3, 4, 5 and 6.

1. Logical Command (C.L.):
The Word that defines the C.L. is formed by 16 bits, being 8 bits of high-order and 8 bits of lower-order. It has the following structure:

High-Order Bits – they select the function that should be enabled when the bit is set to 1.

CL.15 – Reset of the converter faults;
CL.14 – Not used;
CL.13 – Not used;
CL.12 – JOG - command ;
CL.11 – JOG + command;
CL.10 – Command of Direction of Rotation;
CL.09 – Command of General Disable;
CL.08 – Command of Ramp Disable.

Low-Order Bits – they determine the status desired for the selected function at the high-order bits.

CL.7 – Reset of the converter faults: always when transition 0 → 1 occurs, the converter reset will be enabled.
CL.6 – Not used;
CL.5 – Not used;
CL.4 – Command JOG - : 0 = Inactive, 1 = Active;
CL.3 – Command JOG + : 0 = Inactive, 1 = Active;
CL.2 – Direction of Rotation: 0 = counter-clockwise, 1 = clockwise;
CL.1 – General Disable: 0 = Active, 1 = Inactive;
CL.0 – Ramp Disable: 0 = Active, 1 = Inactive.

To enable the Fieldbus to control the Speed Reference and/or functions: Logical Command (fault reset, JOG+, JOG-, Direction of Rotation, General Disable, and Ramp Disable), you must select the desired option through following parameters:

a) Speed reference = P019;
b) Direction of rotation = P021;
c) General Disable, and Ramp Disable = P020;
d) JOG+/JOG-selection = P022;
e) P065 = 3.

NOTE!
For controling the parameters selected at P019 to P022 via Fieldbus, the progammable DI (XC1:37) must be active (24V).

2. Motor Speed Reference:
This variable is displayed by using a 14 bits resolution. When Parameter P087 (total Speed Reference) shows 100% (motor operating without field weakening), the Speed Reference will be 16.383 (3FFFh) and always positive. To reverse the direction of rotation, use bits CL.10 and CL.2 from Logical Command.

3. Not used.

4. Parameter Number to be read:
Through this setting you can read any converter parameter. For this purpose you must enter the number of the desired parameter and its content will be displayed at pos. 4 of the Read Converter Variables".

5. Parameter Number to be changed:
(Changing Parameter Content)

This Position works jointly with Position 6 below. If no Parameter changing is desired, insert at this Position code **999**.

During the changing process you must:
1) Program the desired content at Pos. 6 below;
2) Replace the code 999 by the number of the parameter to be changed.

The change checking can be made through the HMI or only reading the parameter content.

NOTE!
The Parameter Content should be maintained during 15.0 ms by the Master. Only after this time a new value can be sent or a new parameter programmed.

6. Parameter Content to be changed, selected at pos. 5. (Parameter Number to be changed)
The Value format to be set at this position should be that described in the Manual, but this value should be written without the ten dot.

8.1.3.3 Error Indication

During the read/write process via Fieldbus the following variable indications in the Logical Status can occur:

Indications of the Logical Status variable:

E24 – Parameter changing only permitted when P004 = 0.

E25 – Caused by:
- Read Parameter inexistent, or
- Write Parameter inexistent, or
- Write attempt P000 = 10 via Fieldbus .

E26 – The desired content is out of permitted range.

E27 – Caused by:
a) The function selected in the Logical Control is not enabled for the Fieldbus, or
b) The parameter write is read-only.

The error indication described above will be removed from the Logical Status when the desired action is sent correctly.
The removal of the Error indication from E.L. described above, can also be realized by writing the Code 999 in Pos. 5. of the "Variables written in the converter".

NOTE!
The errors E24, E25, E26 and E27 do not cause any change in the converter operation status.

HMI Displays:

E29 - Fieldbus connection is inactive.
This display appears when the physical connection of the converter to the Master is interrupted. You can program in the Parameter P086 the action that the converter shall execute when the error E29 is detected. When any key of the HMI is pressed, the E29 Error indication is removed from the display.

E30 - The Fieldbus board is inactive.
This error is displayed when:
1) P085 is programmed different than Inactive, without the respective Fieldbus board at the connector XC5 of the CCW4 control board; or
2) The Fieldbus board is inserted, but it is defective; or
3) The Fieldbus board is inserted, but the standard programmed at P085 is not equal to the standard of the used board.

You can program in the Parameter P86 the action that the converter shall execute when the error E30 is detected. When any key of the HMI is pressed, the E30 Error indication is removed from the display.

8.1.3.4 Addressing of the CTW-04 variables in the Fieldbus Devices

The variables are arranged in the memory of the Fieldbus device, starting at the address 00h, both for writing and reading process. The address differences are corrected by the protocol and by the communication board. The way the variables are arranged at each address in the memory of the Fieldbus depends on the equipment that is used as Master. For instance: in the PLC A the variables are arranged as High and Low, and in the PLC B the variables are arranged as Low and High.

8.2 SERIAL COMMUNICATION

8.2.1 Introduction

The basic objective of the serial communication is the physical connection of inverters in a configured equipment network, as shown below:

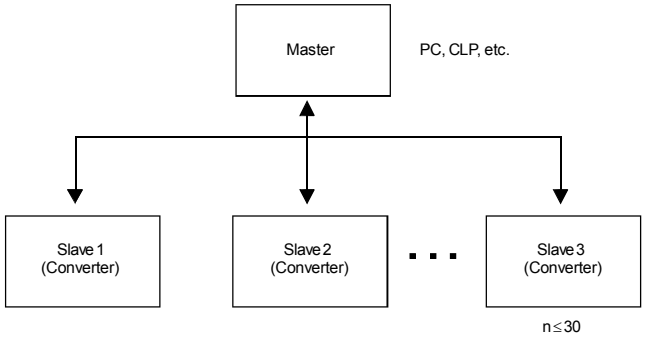


Figure 8.10 *– Network configuration via serial communication*

The inverters possess a control software for the transmission/reception of data through the serial interface, to facilitate the data reception sent by the master and the sending of data requested by this one.
The transfer rate is 9600 bits/s, following a exchange protocol, question/ answer type by using ASCII characters.
The master is able to realize the following operations related to each converter:

- IDENTIFICATION:
☑ Network number;
☑ Converter type;
☑ Software version.

- CONTROL:
☑ General enabling/disabling;
☑ Enabling/disabling by ramp;
☑ Direction of rotation;
☑ JOG+, JOG-;
☑ Speed Reference;
☑ Error RESET.

- STATUS RECOGNITION:
☑ Disable;
☑ Enable;
☑ Fault;
☑ Direction of rotation;
☑ JOG+, JOG-.

- PARAMETERS READING

- CHANGE OF PARAMETERS

8.2.2 Interface Description

WEG Protocol allows interconnection of up to 30 converters to one only Master (PC, PLC, etc.) attributing to each converter one address (1 to 30) which is set in each converter. In addition to these 30 addresses, two other addresses are available for execution of special tasks.

Adress 0: any network inverter is inquired, independently of its address. Only one inverter can be connected to the network (point-to-point) in order to prevent short- circuits in the line interface.
Adress 31: a control can be transmitted to all inverters in the network simultaneously, without acceptance recognition.

List of addresses and corresponding ASCII characters:

ADDRESS	ASCII		
	CHAR	DEC	HEX
0	@	64	40
1	A	65	41
2	B	66	42
3	C	67	43
4	D	68	44
5	E	69	45
6	F	70	46
7	G	71	47
8	H	72	48
9	I	73	49
10	J	74	4A
11	K	75	4B
12	L	76	4C
13	M	77	4D
14	N	78	4E
15	O	79	4F
16	P	80	50
17	Q	81	51
18	R	82	52
19	S	83	53
20	T	84	54
21	U	85	55
22	V	86	56
23	W	87	54
24	X	88	58
25	Y	89	59
26	Z	90	5A
27	]	91	5B
28	\	92	5C
29	[	93	5D
30	^	94	5E
31	–	95	5F

***Table 8.6** – ASCII Addresses and Characters*

Other ASCII characters that are used by the protocol:

ASCII		
CODE	DEC	HEX
0	48	30
1	49	31
2	50	32
3	51	33
4	52	34
5	53	35
6	54	36
7	55	37
8	56	38
9	57	39
=	61	3D
STX	02	02
ETX	03	03
EOT	04	04
ENQ	05	05
ACK	06	06
NAK	21	15

***Table 8.7** – ASCII characters used by the protocol*

The physical connection between the inverters and the network master is performed according to one of the standards below:

a. RS-232 (point-to-point, up to 10m);
b. RS-485 (multipoint, galvanic isolation, up to 1000m).

NOTE!
For connecting the CTW-04 converter in network, you must use a level module converter RS-232 to RS-485.

8.2.2.1 RS-232

In this case we have the connection of a master to an inverter (point-to-point). Data can be changed in a bi-directional way, but not simultaneous (HALF DUPLEX).
The logical levels meet STANDARD EIA RS-232C that determines the use of balanced signals.
In this case, one wire is used for transmission (TX), one for reception (RX) and one for return (0V) .This configuration is a three-wire economy model.

8.2.3 Definitions

The items of this chapter describe the protocol used for serial communication.

8.2.3.1 Used Terms

- ☑ Parameters: are those existing in the inverters whose visualization or alteration is possible through the HMI interface.
- ☑ Variables: are values that have specific inverter functions and that can be read and, in some cases, modified by the master.
- ☑ Basic variables: are those that can be accessed only through the serial interface.

SCHEMATIC DIAGRAM:

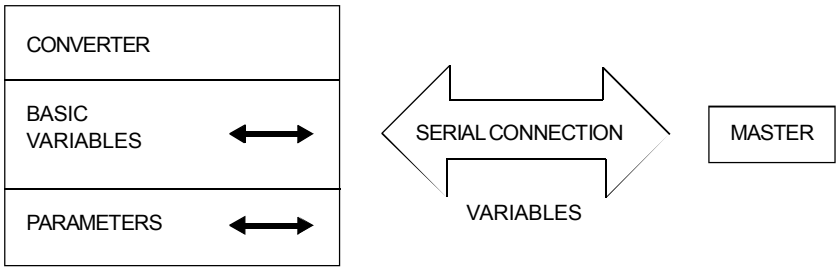


Figure 8.11 *– Schematic diagram serial communication*

8.2.3.2 Parameters/Variables Resolution

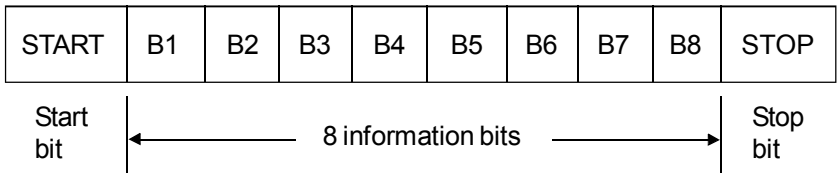
The decimal point will not be considered in the value received/sent in the telegram during the parameter read/changing.
For instance:

- ☑ Write: if the content of P032 has to be changed to 10.0s, you must sent 100 (the decimal point will not be considered);
- ☑ Read: When we read 180 at P033 (P014=1), this means 18.0 (the decimal point will not be considered).

8.2.3.3 Parameter Format

- ☑ Start bit;
- ☑ 8 information bits [they codify the text characters and the transmission characters, copied from the 7 bit code, according to ISO 646 and supplemented to even parity (octave bit)];
- ☑ Stop bit.

After the start bit follows the least significant bit:



8.2.3.4 Protocol

The transmission protocol meets ISO 1745 for code data transmission. Only text character sequences without heading are used. The error monitoring is carried out through the transmission related to the individual 7 bit character parity, in accordance with ISO 646.

The parity monitoring is carried out according to DIN 66219 (even parity). Two type of messages are used (by the master):

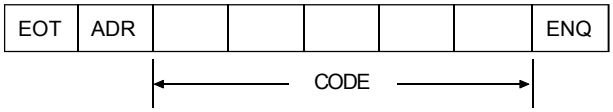
- ☑ **READ TELEGRAM**: for checking the content of the converter variables;
- ☑ **WRITE TELEGRAM**: for changing the content of the converter variables or for sending commands to the converter.

Note:
Transmission between two converters is not possible. The master has the access control to the bus bar.

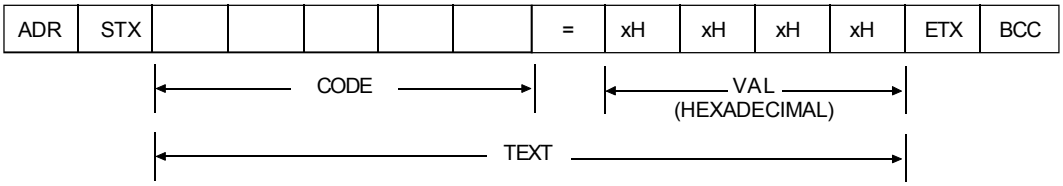
8.2.3.4.1 Read Telegram

This telegram allows the master to receive the content that corresponds to the requesting code. The data requested by the master will be transmitted by converter through the response telegram.

1) Master:



2) Converter:



Format of the Read Telegram:

EOT: control character End Of Transmission;
ADR: converter address (S+ASCII@, A, B, C, … (ADdRess);
CODE: Variable address of 5 ASCII codified digits;
ENQ: Control character ENQuiry.

Format of the converter response telegram:

ADR: 1 character - converter address;
STX: control character – start of Text;
TEXT: consists in:
☑ **CODE**: Variable address;
☑ **"="**: separation character;
☑ **VAL:** value in 4 HEXACEDIMAL digits;
ETX: control character - End of Text;
BCC: Byte of CheCksum – EXCLUSIVIE OR of all bytes between STX (excluded) and ETX (included).

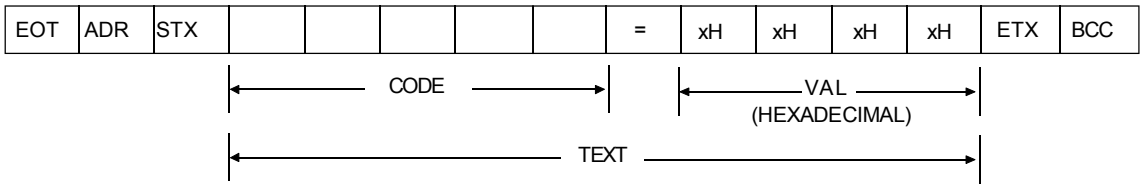
Note:
In some cases the converter can answer with:

ADR	NAK

8.2.3.4.2 Write Telegram

This telegram sends data to the converter variable. The converter will inform if the data have been accepted or not.

1) Master:



2) Converter:

ADR	NAK	or	ADR	ACK

Format of the write format:

EOT: control character End Of Transmission;
ADR: converter address;
STX: control character – start of Text;
TEXT: consists in:
☑ **CODE**: Variable address;
☑ **"="**: separation character;
☑ **VAL:** value in 4 HEXACEDIMAL digits;
ETX: control character - End of Text;
BCC: Byte of CheCksum – EXCLUSIVIE OR of all bytes between STX (excluded) and ETX (included).

Telegram format of the converter response:

Acceptance:
☑ **ADR:** converter address.
☑ **ACK**: ACKnowledge control character.
Rejection:
☑ **ADR:** converter address.
☑ **NAK**: Not AcKnowledge control character.
This means that the data have not been accepted and the addressed variables. Retain their previous value.

8.2.3.5 Telegram Execution and Testing

The converters and the master test the telegram syntax.
Please find below the responses for the respective verified conditions:

Read Telegram:

- ☑ no answer: telegram with wrong structure, control characters were wrong received or the converter address is wrong.
- ☑ NAK: code corresponds to an inexistent variable or to a write only variable;
- ☑ TEXT: with valid telegrams.

Write telegram:

- ☑ no answer: telegram with wrong structure, control characters were wrong received or the converter address is wrong.
- ☑ NAK: CODE corresponds to an inexistent variable, wrong BCC (Byte of CheCksum, a write only variable, VAL out of range for the respective variables, operation parameter out of changing mode;
- ☑ ACK: with valid telegrams.

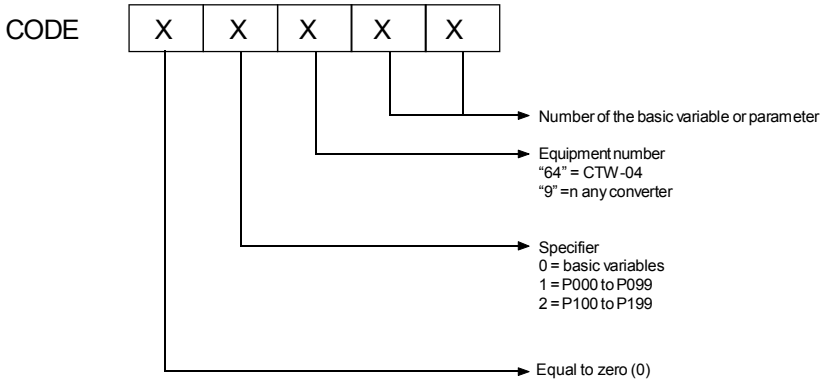
The master should maintain wait time between the transmissions of two variables to the same converter which is compatible with the used converter.

8.2.3.6 Telegram Sequence

The telegrams are processed by the converters within determined intervals. Thus you must ensure a pause between the telegram transmission to the same converter which is longer than the sum of the times $\mathbf{T}_{proc} + \mathbf{T}_{di} + \mathbf{T}_{txi}$ (see item 8.2.6).

8.2.3.7 Variable Codes

The fields designated with code contain the parameter and basic variable address consisting in 5 digits (ASCII characters), as shown below:



8.2.4 Telegram Examples

☑ Changing of the Speed Reference (P056/P057) to 100%b in the converter 2.
Ex.: Value = 100% (100/16383) = 16383 = 3FFH

1) Master:

EOT	G	STX	0	2	8	3	3	=	0H	2H	5H	8H	ETX	BCC

Code of NMÍN

end. 7

2) Converter

G	ACK

☑ Read of the converter output current 24.
(supposing that it was at 55.0 A when checked and Inom = 90,0A).
Value = (55.0/90.0)/(100/16383=10011=271BH

1) Master:

EOT	X	0	1	1	8	9	ENQ

Code COROUT

end. 24

2) Converter

X	STX	0	1	1	8	9	=	2H	7H	1H	BH	ETX	BCC

Code COROUT

P003=4EH=78=7.8/0.1

end. 24

8.2.5 Error variables of the Serial Communication

8.2.5.1 Basic Variables

8.2.5.1.1 V00 (code 00@00)

Indication of the converter model (read variable).
The reading of these variables allow converter type identification.
For the CTW-4 this value is 16, as defined in 8.2.3.7.

8.2.5.1.2 V01 (code 00@01)

Indication of the converter software version (read variable): 000 to 999
For example: Software Version x 100.
For version 3.10, the content of this variable will be 310.

8.2.5.1.3 V02 (code 00@02)

Indication of the converter logic status (read variable).
The bits will have following meaning:
☑ Logic status: byte-high
☑ Error of fault code: byte-low

BYTE HIGH; indicates the logic converter status, where:

Logic Status:

EL15	EL14	EL13	EL12	EL11	EL10	EL9	EL8

EL8: 0 = disable by active ramp
1 = disable by inactive ramp
EL9: 0 = general disable by active ramp
1 = general disable by inactive ramp
EL10: 0 = counter-clockwise (CWW)
1 = clockwise
EL11: 0 = with fault
1 = without fault
EL12: 0 = with fault
1 = without fault
EL13: 0 = JOG+ inactive
1 = JOG+ active
EL14: 0 = JOG- inactive
1 = JOG- active

} converter enabled EL8=EL9=1

BYTE LOW: indicates the Error or Fault Number in hexadecimal, if any.

Error or Fault Code:
Ex.: E00 to E06 or F02 to F08 or byte low will have 000 to 06 or 02 to 08 E22 to E27 or byte low will have 16H to 1BH.

The errors which are related to the serial communication will be reset automatically in the logic status variable after the first read or write operation without error. The indication in the display remains.

8.2.5.1.4 V03 (code 00@03)

Selection of the converter logic command.
Write variable, which bit have following meaning:

BYTE HIGH: mask for the desired action. The corresponding bit should be set to 1 for obtaining:

CL15	CL14	CL13	CL12	CL11	CL10	CL9	CL8

MSB LSB

☑ CL8: 1 = ramp disable
☑ CL9: 1 = general disable
☑ CL10: 1 = direction of rotation
☑ CL11: 1 = JOG+ active
☑ CL12: 1 = JOG- active
☑ CL13: = not used
☑ CL14: = not used
☑ CL15: 1 = Converter “RESET”

BYTE LOW: logic level of the intended action.

CL7	CL6	CL5	CL4	CL3	CL2	CL1	CL0
MSB							LSB

- ☑ CL0: 1 = enable
  0 = ramp disable
- ☑ CL1: 1 = enable
  0 = general disable
- ☑ CL2: 1 = clockwise direction of rotation
  0 = counter-clockwise direction of rotation
- ☑ CL3: 1 = JOG+ active
  0 = JOG+ inactive
- ☑ CL4: 1 = JOG- active
  0 = JOG- inactive
- ☑ CL5: not used
- ☑ CL6: not used
- ☑ CL7: transition from 0 to 1 in this bit causes converter "RESET", when it is in some error or fault condition

Note:
- ☑ External disable has priority over this disables;
- ☑ For converter enable via serial communication, CL0=CL1=1 must be set and the external disable must be inactive;
- ☑ When CL0=CL1=0 simultaneously , a general disable will occur;
- ☑ The reset command does not act when Fault F02 or F05 is detected.

8.2.5.2 Parameters related to the Serial Communication

Parameter number	Parameter description
P019	Speed Reference Selection
P020	Selection of the Logic Converter Command
P021	Selection of the Direction of Rotation
P022	JOG+, JOG- Selection
P065	Selection of the Programmable DI Function (XC1:37)
P083	Selection of the Serial WEGBus communication
P084	Address of the converter in the serial communication network (range: 1 to 30)

Table 8.8 – *Description of the parameters related to the Serial Communication*

8.2.5.3 Errors related to the Serial Communication

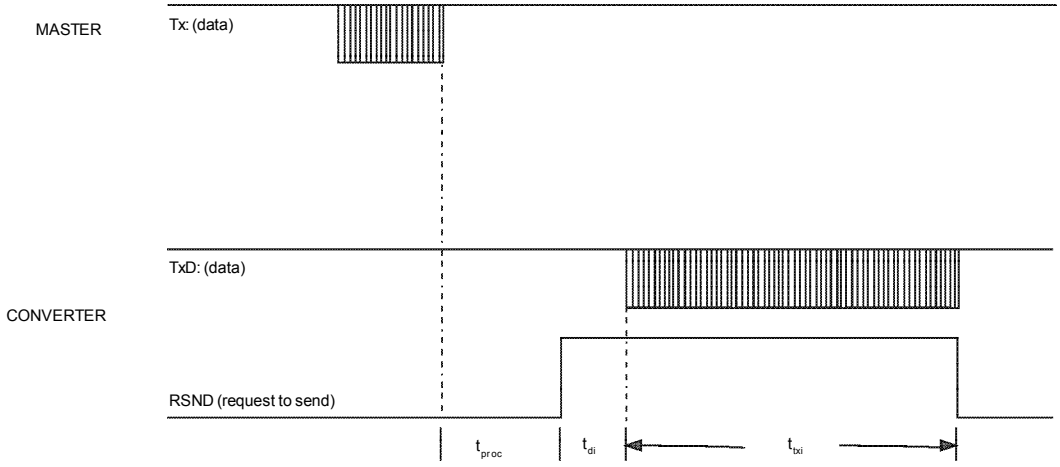
They operate as follows:
- ☑ they do not cause converter disable;
- ☑ they do not deactivate the fault relay;
- ☑ they do not inform the logic status in the word (V02).

Error Types
- ☑ E22: Longitutinal parity error (BCC);
- ☑ E24: parameter setting error (when some condition occurs as indicated in table 5.1 – Chapter 5 (incompatibility between parameters): Use of the HMI or if any changing attempt is made which is not permitted with running motor);
- ☑ E25: inexistent variable or parameter;
- ☑ E26: the desired value is out of range;
- ☑ E27: write attempt in read-only variable or logic command is disabled;
- ☑ E28: serial communication is inactive.

Note:
The telegram will be ignored if any parity error is detected by the converter during the data reception. The same occurs when syntax errors are detected.

Ex.:
- ☑ The code values are different from 0 to 9;
- ☑ Separation character different from "=", etc.

8.2.6 Times for Telegram Read/Write



Times (ms)		Typical
T_{proc}		10
T_{di}		5
$T_{t_{xi}}$	read	15
	write	3

8.3 KIT FOR SERIAL COMMUNICATION TO THE PC

The Kit for the RS-232 serial communication to the PC permits the connection of the CTW-04 to a PC through the RS-232 interface (connector XC3), comprising:

- ☑ 3m cable– RJ12 to DB9;
- ☑ Software "SUPERDRIVE" for Windows 95/98/NT that permits CTW-04 programming, operation and monitoring .

Connector of RS-232 Interface:

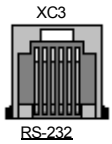


Figure 8.11 *– XC3 connector of RS-232 interface*

Connection cable for serial RS-232 communication:

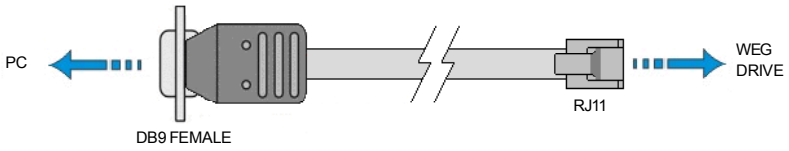
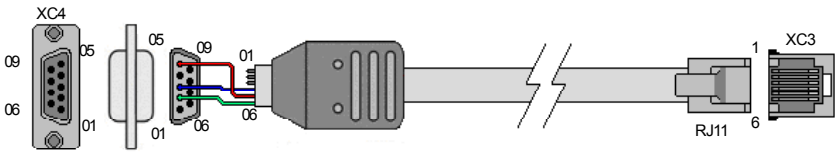


Figure 8.12 *– Cable for serial RS-232 communication*

Internal connections the communication cable of the serial RS-232 interface:



DB9	RJ	SINAL
01	-	-
02 ⇨	06 ⇨	TX
03 ⇨	04 ⇨	RX
04	-	-
05 ⇨	05 ⇨	0V
06	-	-
07	-	-
08	-	-
09	-	-

Figure 8.13 *– Internal cable connections of the serial RS-232 interface*

8.4 BLANK COVER KIT

The HMI can be mounted both on the converter and on the remote control. When remote control is used, a blank cover kit is supplied with the CTW-04 converter.

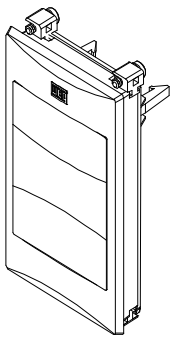


Figure 8.14 *– Blank cover*

The blank cover kit of the CTW-04 consists in:
- ☑ Blank cover;
- ☑ Sealing joints;
- ☑ Fixing Clips;
- ☑ Flat cable;
- ☑ Installation Manual.

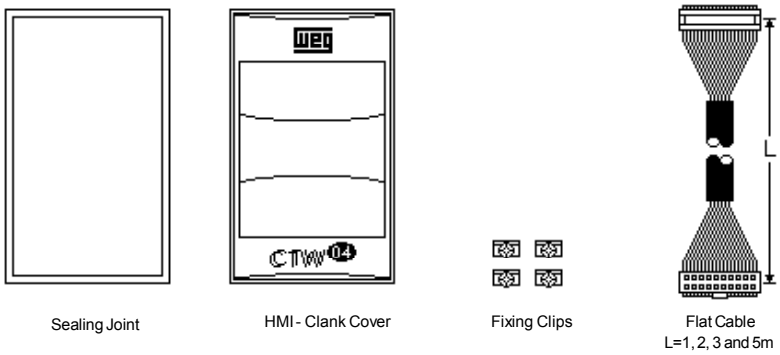


Figure 8.15 *– Blank cover kit - CTW-04*

NOTE!
The flat cable for remote HMI assembling can be supplied up to 5m length. See Table 8.6:

Cable length	Item WEG
01m	0307.7711
02m	0307.7712
03m	0307.7713
05m	0307.7833

Table 8.6 *– Connection Cable Length and Blank Cover Kit - CTW-04*

ATTENTION!
For correct installation of the Blank Cover kit, follow the instruction of the "Remote HMI Installation Manual – CTW-04" supplied with this device.

TECHNICAL SPECIFICATION

This chapter describes the technical specifications of the CTW-04 converter Line.

9.1 POWER DATA

☑ **Armature Supply Voltage:**
- According to Table 9.2;
- Voltage tolerances for rated outputs: -5%, +10%;
- Max. static voltage drop with corresponding output derating: -15%;
- Self-adjustment to the line frequency: 50/60 Hz ±4%.

☑ **Cooling:**

Rated Current [A_{dc}]	Cooling	
	Natural	Forced
10	✓	-
20	✓	-
50	✓	-
63	-	01 vent. 220-240V/1∅/0,14A
90	-	01 vent. 220-240V/1∅/0,14A
106	-	01 vent. 220-240V/1∅/0,14A
125	-	01 vent. 220-240V/1∅/0,14A
150	-	02 vent. 220-240V/1∅/0,14A
190	-	02 vent. 220-240V/1∅/0,14A
265	-	02 vent. 220-240/1∅/0,14A
480	-	01 vent. 220V/1∅/0,84A
640	-	01 vent. 220V/1∅/0,84A
1000	-	02 vent. 230V/1∅/0,6A
1320	-	01 vent. 440V/3∅/0,42A or 380V/3∅/0,66A(1)
1700	-	01 vent. 440V/3∅/0,42A or 380V/3∅/0,66A(1)

(1) According to the converter model

***Table 9.1** – CTW04 Cooling*

☑ **Degree of Protection:** IP00

☑ **Temperature:** 0ºC to 40ºC – standard conditions.
From 0ºC to 50ºC (1% current de-rating for each Celsius degree above 40ºC).

☑ **Relative Air Humidity:** 10% to 90%, non-condensing.

☑ **Max. Altitude:** 1000m – standard conditions
From 1000m to 4000m (1% current de-rating for each 100m above 1000m).

☑ **Pollution Degree:** 2 (according to EN50178) (according to UL508C).

Table 9.2 shows the power data:

Armature						Field			Dissipated Power [W]
Rated Current [A_{DC}]	Rated Voltage [V_{AC}]	Output Voltage [V_{DC}]		Power [kW]		Supply Voltage [V_{AC}]	Output Voltage [V_{DC}]	Field Current [$_{DC}$]	
		CTWU4	CTWA4	CTWU4	CTWA4				
10	220/380/440	260/460/520	230/400/460	5,2	4,6	≤440	≤396	≤18	60
20	220/380/440	260/460/520	230/400/460	10,4	9,2	≤440	≤396	≤18	100
50	220/380/440	260/460/520	230/400/460	26,0	23,0	≤440	≤396	≤18	203
63	220/380/440	260/460/520	230/400/460	32,8	29,0	≤440	≤396	≤18	272
90	220/380/440	260/460/520	230/400/460	46,8	41,4	≤440	≤396	≤18	316
106	220/380/440	260/460/520	230/400/460	55,1	48,8	≤440	≤396	≤18	342
125	220/380/440	260/460/520	230/400/460	65,0	57,5	≤440	≤396	≤18	417
150	220/380/440	260/460/520	230/400/460	78,0	69,0	≤440	≤396	≤18	570
190	220/380/440	260/460/520	230/400/460	98,8	87,4	≤440	≤396	≤18	780
265	220/380/440	260/460/520	230/400/460	137,8	121,9	≤440	≤396	≤18	960
480	220/380/440	260/460/520	230/400/460	249,6	220,8	≤440	≤396	≤25	1819
640	220/380/440	260/460/520	230/400/460	332,8	294,4	≤440	≤396	≤25	2579
1000	220/380/440	260/460/520	230/400/460	520,0	460,0	≤440	≤396	≤25	3400
1320	220/380/440	260/460/520	230/400/460	686,4	607,2	≤440	≤396	≤25	5000
1700	220/380/440	260/460/520	230/400/460	884,0	782,0	≤440	≤396	≤25	6500

***Table 9.2** - CTW-04 Power Data*

NOTE!
For additional information, refer to Chapter 03.

9.2 ELECTRONICS DATA

CONTROL	REGULATORS	☑ Current and speed regulators in full digital Software. Execution rate (60Hz): ☑ Current regulators: 2,7ms ☑ Speed regulators: 2,7ms ☑ Field regulator: 8ms ☑ Back-EMF regulator: 8ms
PERFORMANCE	SPEED CONTROL	☑ Speed accuracy with 20 to 100% ∆load : 0,025% (encoder); ☑ Regulation of 0,005% of Max. speed (with ∆line = 10% and T = 10°C); ☑ Back-EMF feedback: 1:30; ☑ Feedback by DC-tachogenerator: 1:100; ☑ Feedback by Incremental Encoder: 1:100; **Refer to Note (1).** ☑ Speed regulation (load variation from 20% to 100%): according to table 9.3.
INPUTS	ANALOG	☑ 04 Differential analog inputs (nL, nR, A1, A2): 0V to10V (impedance: 500Ω), (0 to 20)mA/(4 to 20)mA (impedance: 200kΩ), resolution: 10 bits. **Refer to Note (1).**
	DIGITAL	☑ 08 Isolated digital Inputs (BG, BR or ⇓, L ⇔ R or ⇑, EE, ⇔, DI, J+, J-): 18V (min. high level), 3V (Max. low level), 30V (Max. voltage) and 4,0ms input filter.
	DC TACHOGENERATOR	☑ 03 Differential inputs for DC tachogenerator: Input of the voltage signal generated by DC-tachogenerator: 30 kΩ (9V to 30V), 100 kΩ (30V to 100V) and 300 kΩ (100V to 350V).

	INCREMENTAL ENCODER	☑ Supply/feedback by incremental encoder , isolated source +5V or +8V to 15V, differential input, used as speed feedback for the speed regulator, digital measuring of speed, signals A, A', B, B', Z and Z'. **Refer to Note (1).**
OUTPUTS	ANALOG	☑ 03 Analog outputs (I_a, n, D/A): output signal from 0V to 10V @ ≤ 2mA, RL ≥ 5k Ω (Max. load), resolution 8 bits; ☑ 02 Differential analog outputs (AO1 and AO2): output signal from 0V to ±10V (-10V to +10V) @ ≤ 2mA, RL ≥ 5kΩ (Max. load), resolution 12 bits. **Refer to Note (1).**
	DIGITAL	☑ 06 Isolated digital outputs (LIB, ± n, n>, n<,I>, I.t | n= | A⇔B): Open collector transistor output with free-heel diode, +24V (supply voltage), 12mA (Inominal), 1V (output voltage with Imax), 100mA activated output (Imax. Per output with external source).
	RELAY	☑ 03 Digital relay outputs (R no or R nc = Programmable DI's, F no, n=0 no): 250 Vrms and 1A (Contact capacity).
SECURITY	PROTECTION	☑ Undervoltage: acts with voltage drop ≥ 18%; ☑ Line synchronization; ☑ Phase fault; ☑ -15V or +15V source fault; ☑ External error (fault string): external supervised detection [XC1:33]; ☑ Dissipator grounded on models up to 640A; ☑ Thermostats on the models from 63A on; ☑ Measurement of THE Armature Voltage; ☑ Control of the Field Current; ☑ Electronics protected by fuses; ☑ RC network for thyristor protection against transients; ☑ di/dt limiter for matching of electrical and magnetic characteristics of the motor; ☑ Galvanic isolation between power unit and the control electronics; ☑ Monitoring of the DC tachogeneratot or incremental encoder; ☑ I x t monitoring; ☑ Programming error.
HUMAN-MACHINE INTERFACE	HMI	☑ 03 keys: ☑ Display: 04 digits with 7 segments; ☑ Indication of the Operation Mode: "bridge A" and "Bridge B"; ☑ Indication of the converter status and operation, as well as indication of the main variables; ☑ Error and Fault indication; ☑ Displaying and changing of the programmable parameters; ☑ Possibility of external mounting, via available parallel cable in lengths up to 5m. **Refer to Note (2)**.
COMMUNICATION	SERIAL INTERFACE	☑ RS-232 serial Interface; ☑ Serial communication via PC with SuperDrive software. **Refer to Note (2).**
NETWORKS	FIELDBUS	☑ Profibus-DP; ☑ DeviceNet. **Refer to Note (2).**

NOTES!

Note (1)
Available only for the CTW-04 converter models, where the control board CCW4.00 - Full (CTWX4XXXXTXXX**F**XZ - is specified:

☑ Remote speed reference with 12 bits resolution;
☑ 02 analog outputs (with 12 bits resolution);
☑ Speed feedback by incremental Encoder.

Note (2)

Available as Kit or Optional Device for the CTW-04 (CTWX4XXXXTXXXX**O**XXXXZ) converter models:

- ☑ Fieldbus network: Profibus-DP or DeviceNet;
- ☑ Serial Communication via PC with SuperDrive software;
- ☑ Blank cover for assembling of remote HMI.

Static accuracy of the speed regulation (load variation from 20% to 100%):

- ☑ Back-EMF feedback (P025=0): 2% to 5% (variable with the motor);
- ☑ Feedback via DC THACO or ENCODER:

	P024 = 0 to 5 P025 = 1	P024 = 0, 1 P025 = 4	P024 = 2, 3 P025 = 4	P024 = 4, 5 P025 = 4	N* per serial P025 = 4
Linearity relating to the max. motor speed	≤ 0,2% non considering the DC tachogenerator linearity	≤ 0,2%	≤ 0,05%	≤ 0,024%	≤ 0,012%
Static regulation accuracy with load variation from 20% to 100% relating to the max. motor speed	≤ 0,1%	≤ 0,1%	≤ 0,024%	≤ 0,012%	≤ 0,012%

Table 9.3 *– Static Accuracy of the Speed Regulation*

9.3 DIMENSIONING OF THE CTW-04 CONVERTER

The CTW-04 converter dimensioning depends on several factors, such as, used DC-Motor, load cycle type, application, etc.
For the worst permitted 10 minute cycle, you should determine the converter rms, which cannot be higher than the rated armature DC current of the converter. In addition, the max. peak current during the load cycle cannot be higher than the rated armature current , multiplied by a 1.25 factor.
When the converter is operated at ambient temperature higher than 40°C and/or in altitude higher than 100m above sea level, set the DC-current as shown in the figure below:

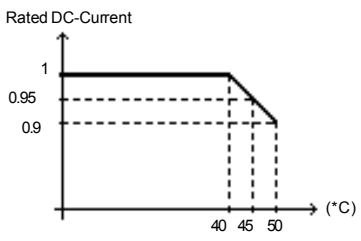


Figure 9.1 *- Ambient Temperature (ºC)*

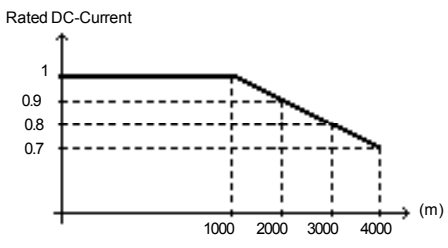


Figure 9.2 - *Altitude above sea level (m)*

Example of load cycle:
Assuming that the line voltage is 440Vac, the motor already chosen with a field: 310Vdc, max. ambient temperature: 40ºC, altitude: 500m and a load cycle type:

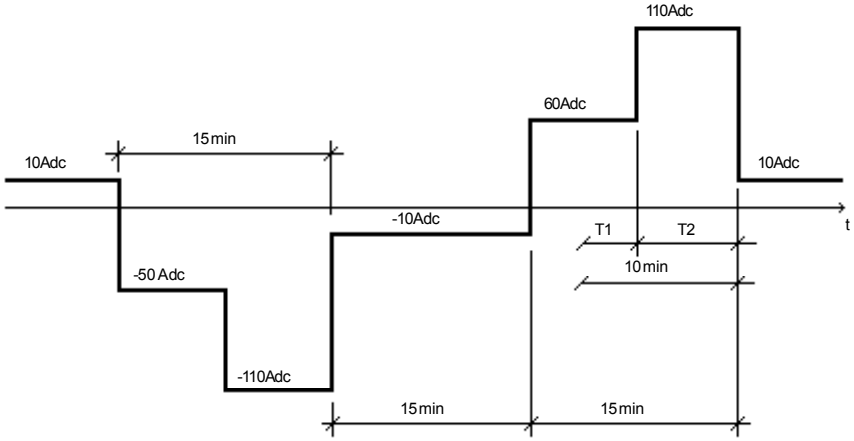


Figure 9.3 *- Load cycle*

The application requires the use of a converter able to operate in four-quadrants, with regenerative braking and able to support frequent reversals. By considering the application and the current conditions, the required converter model will be the CTWA4.
For the converter dimensioning, please consider the 10 minutes cycle, where the load current is the highest.
In this case we will have:

$$Ief = \sqrt{\frac{(60)^2 xT1 + (110)^2 xT2}{T1 + T2}}$$

Where: T1 = 2.5 minutes and T2 = 7.5 minutes. So Ief = 100A.

- ☑ The rated DC current of the converter should be (40°C): I > 100A_{DC}. Thus the converter model immediately above the 100 A_{DC} is the 106 A_{DC}.
- ☑ For the chosen converter we will have $I_{DC\ max}$ = 106 x 1.25 = 132.5 A. The max. current shown in the figure 9.3. load cycle is 110A, lower than the Idc max of the converter.
- ☑ The field current should be lower or equal to 18A;
- ☑ The field supply voltage is 380Vac;
- ☑ The armature voltage is 440Vac.

Thus the CTW-04 specified converter model should be: **CTWA40I06T44PFSZ**.

ATENTION!

The field supply must be execute following the table 9.4:

The field supply recommended:

Motor$_{DC}$ [Field - U_C]	Field Supply
U_C < 170V_{DC}	220V_{AC}
170V_{DC} < U_C < 310V_{DC}	380V_{AC}
310V_{DC} < U_C < 370V_{DC}	440V_{AC}

Table 9.4 *– Field Supply*

9.4 TABLE OF SPARE PARTS

Name	Item Number	Specification	Models														
			10	20	50	63	90	106	125	150	190	265	480	640	1000	1320	1700
			Quantity of parts per drive														
CCW4.00	4011.8773	Control Board – Full	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CCW4.01	4011.8774	Control Board – Empty	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RC04A.00	4011.8780	RC04A.00 – CTWA4 (10-640A)	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-
RC04A.01	4011.8781	RC04A.01 – CTWU4 (10-640A)	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-
RC04B.00	4011.8786	RC04B.00 – CTWA4 (1000-1700A)	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
RC04B.01	4011.8787	RC04B.01 – CTWU4 (1000-1700A)	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
TRF4	4011.8789	Board of the Supply Transformer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Profibus-DP	0305.1269	Profibus-DP Board	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DeviceNet	0305.1250	DeviceNet Board	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kit SuperDrive	417102505	Serial Communication Kit to the PC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kit Profibus-DP	417116705	Communication Kit in Fieldbus network	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kit DeviceNet	417116704	Communication Kit in Fieldbus network	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Blank Cover Kit	417116703	Remote HMI kit	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cable for Blank Cover – 1m	0307.7711	Cable for remote HMI assembling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cable for Blank Cover – 2m	0307.7712	Cable for remote HMI assembling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cable for Blank Cover – 3m	0307.7713	Cable for remote HMI assembling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cable for Blank Cover – 5m	0307.7833	Cable for remote HMI assembling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Armature Module	0303.7541	Thyristor Module – CTWU4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
Armature Module	0303.8106	Thyristor Module – CTWU4	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-
Armature Module	0303.8130	Thyristor Module – CTWU4	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
Armature Module	0303.7495	Thyristor Module – CTWU4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
Armature Module	0303.8238	Thyristor Module – CTWU4	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Armature Module	0303.9918	Thyristor Module – CTWA4	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Armature Module	0303.9900	Thyristor Module – CTWA4	-	-	6	6	6	6	-	-	-	-	-	-	-	-	-
Armature Module	0303.9896	Thyristor Module – CTWA4	-	-	-	-	-	-	6	6	-	-	-	-	-	-	-
Armature Module	0303.9617	Thyristor Module – CTWA4	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-
Armature Module	0303.8262	Thyristor Module – CTWU4	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-
Armature Module	0303.9323	Thyristor Module – CTWU4/CTWA4	-	-	-	-	-	-	-	-	-	-	-	3/6	-	-	-
Armature Module	0303.9552	Thyristor Module – CTWA4	-	-	-	-	-	-	-	-	-	6	6	-	-	-	-
Armature Module	7300.0238	Thyristor Module – CTWU4	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Armature Module	0400.2466	Thyristor Module – CTWA4	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Armature Module	7300.0203	Thyristor Module – CTWU4	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Armature Module	0400.2440	Thyristor Module – CTWA4	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Armature Module	7300.0211	Thyristor Module – CTWU4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Armature Module	0400.2407	Thyristor Module – CTWA4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Field Module	0303.7649	Semi-contolled bridge – CTWA4/CTWU4	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2
Field Module	0303.9293	Semi-contolled bridge – CTWA4 e CTWU4	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-
Internal UR Fuses	0208.0753	Internal UR Fuses 700A [F1 to F6]	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
Internal UR Fuses	0208.0761	Internal UR Fuses 900A [F1 to F6]	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-
Internal UR Fuses	0208.0770	Internal UR Fuses 1400A [F1 to F6]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6

***Table 9.5** – Table of Spare Parts*