User's Manual: M40097.V11

M40097.V11 Torque Measuring Unit

Conte	ents:	Page
1. 1.1 1.2	Functions Measuring task Display of measuring results	2 2 2
2.	Construction	2
3.	Connection elements	3 - 4
4.	Programming F5 AUTO/SETUP Selection of expertion modes SETUR or AUTOMATIC	5 5 - 8
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8	F1 Settings F2 Measuring values to disk F3 Chart to disk F4 Backup/restore settings F8 Set zero Gain adjustment IN-Test OPTION: Import of job number and drawing/material number via barcode scanner	9 - 11 11 12 12 12 12 13 13
5.	Automatic	14
6.	Connection schematics	14 - 19
7. 7.1 7.2 7.2.1 7.2.2 7.2.3 7.3 7.4	Settings of function modules USB Interface module 5326.620/630 I/O Module 16-Bit input/output module 5304.610 32-Bit profibus module 5315.610 16-Bit input/output module 5304.610 or profibus module 5327.630 DAC module 5314.630 4-channel strain gauge measuring amplifier 5305.630	20 20 - 21 22 23 24 25 26 27
Tech	nical data and security instructions acc. to VDE 0411	28

Please note that some functions and adjustments described in this manual may not be available for every model or in all program releases.

1. Functions

1.1 Measuring task

Examination of the torque of axial joints.

The following parameters are monitored in detail for compliance with their tolerances:

- start-torque
- torque MAX; Xavg=(MAX+MIN)/2; MAX-MIN
- angular rotation

1.2 Display of measuring results

The measured value of each tested characteristic is displayed as numeric value. In addition, the result of the classification, i.e. GOOD / NO GOOD, is displayed.

Furthermore, the signal sequence is displayed as curve torque over angle:

- diagram for the course of the start torque
- diagram for the course of the torque

In order to evaluate the settings, the measuring windows in which the measurement takes place are shown as vertical marks in the diagrams.

2. Construction

- 1x strain gauge measuring amplifier torque
- 1x profibus interface to PLC with 32Bit input, 32Bit output
- analysis software

The following variations are available:

Compact Measuring Computer A&V 8861 for control cabinet installation on top hat rail **without monitor**, with VGA output, **webserver function (see below):** in top hat rail case WxHxD approximately 335x133x200, weight 3kg, power supply 24VDC

Measuring computer A&V 8817.653.0 or A&V 8817.655 in table case with 10,4" colour monitor with touchscreen, ext. VGA output in table case WxHxD 335x200x220, weight 5kg, power supply 115/230VAC 50/60Hz

Webserver function for remote control:

The unit has got a human-machine interface and acts as an internet server with an individual address. Status information as well as inputs and outputs are not carried out on the device, but via an external computer via ETHERNET interface and a browser program, e.g. Internet Explorer. The measuring device may be displayed through the PC browser program by entering its address. The measuring units contain their own firewall in order to repel unauthorized access via the ETHERNET interface.

User's Manual: M40097.V11

3. Connection elements

Back of case:

Type 1 (Parallel input angular transmitter):



X408	15-pole plug MIN D
X404	PS-2 socket
X407	RJ45 socket
X403	USB socket
X413	USB socket
X423	USB socket
X412	Internal USB
X312	37-pole socket MIN D
X314	9-pole socket MIN D
X315	6-pole socket 680
X316	37-pole socket MIN D
T1-4/1	5-pole socket 680
X401	8-pole plug

Output VGA monitor Keyboard/mouse input Ethernet interface USB connection USB connection USB connection Test socket (DO NOT USE) Rotation Right/Left to transverter Profibus interface +/-10V output to transverter Parallel input angular transmitter Input torque gauge bar Power supply 24V DC

BDL 40097V11E.DOC11/2018Page 3 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: M40097.V11

Type 2 (Profibus input angular transmitter):



X408	15-pole plug MIN D	Output VG
X404	PS-2 socket	Keyboard/
X407	RJ45 socket	Ethernet in
X403	USB socket	USB conn
X413	USB socket	USB conn
X423	USB socket	USB conn
X412	Internal USB	Test socke
X312	37-pole socket MIN D	Rotation R
X314	9-pole socket MIN D	Profibus ir
X315	6-pole socket 680	+/- 10V ou
X316	9-pole socket MIN D	profibus in
	COM 9-pole plug MIN D	test plug
T1-4/1	5-pole socket 680	Input torqu
X401	8-pole plug	Power sup

Output VGA monitor Keyboard/mouse input Ethernet interface USB connection USB connection Test socket (DO NOT USE) Rotation Right/Left to transverter Profibus interface +/- 10V output to transverter profibus input angular transmitter test plug Input torque gauge bar Power supply 24V DC

BDL 40097V11E.DOC11/2018Page 4 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: M40097.V11

4. Programming

Switch on unit. After loading the program, the unit is in the operation mode AUTOMATIC and ready to operate. In order to make entries, the operation mode needs to be switched to SETUP by entering the password.

The sub-operating modes appear in the menu bar:

F1 Settings

F2 Measuring values to disk

F3 Chart to disk

F4 Backup/restore settings

F5 AUTO/SETUP

F8 Set zero

F5 AUTO/SETUP Selection of operation modes SETUP or AUTOMATIC

The password window opens. The unit will only switch into the SETUP mode after entering the correct password. Switching back to AUTOMATIC may be done without entering any password.



BDL 40097V11E.DOC11/2018Page 5 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: M40097.V11

If F5 is selected by touchscreen or mouse, an enhanced password query opens.

inputs Start meas.	settings	result start-torque Nm	1	drawing no.
centre SETUP	ring.Unit:Password nter 8-digit password: 2 7 Create ne	3 4 8 9	5	<pre> rct </pre>
Arndt & Voß M40057.V11 Version: 318-DABFEV/XW/HJ	F5 F1:setings AVE-1405 F5 AUTO /	F8 F2 meas val. to USB F3 chart to USI) F4:Backup/Fie	utore

In order to define a new password, please activate "Create new password" before entering the current password.

By entering the 8-digit password, the unit switches into SETUP mode.

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It is possible to change the password after activating the option "Create new password". It is, however, necessary to enter the new password by mouse or touchscreen. The option button "Create new password" is marked in yellow, indicating that this option has been activated.

inputs settings result Start meas start-torque Nm g no Torque.Measuring.Unit:Password contr. Please enter old 8-digit password: out startpo 2 1 3 4 5 centre 6 7 8 9 0 SETUP Create new password F8 F5 Amdt & Vo8 M40097.V11 F1:settings F2:meas.val. to USB F3:chart to USB F4:Backup/Restore Version: 318-DABFEVAWHWVE-1405 F5:AUTO/SETUP F8:statistics(AUTO)/set Zero(SETUP)

First of all, the old password must be entered (password prompt marked in yellow).

Arndt & Voß GmbHUser's Manual:Elektronik - Meßtechnikм40097.v11

Then, a new 8-digit password may be defined (password prompt marked in white).

						×
inp	uts	settings		result		
Start m	eas.			start-tongue Nm	1	drawing no.
٠	Torque Measuring	s.Unit:Password				
contr. I						
٠	Please enter	r new 8-digit p	password:			
outs						
startpo						
٠				-10		
centre	1	2	э	4	5	
٠	6	7	8	9		
SETUP		<u> </u>				
٠						
		0	cale new par	rword		
					,	
						tse.
			F5 I			
Andt & V Version: 3	18 M40097.V11 318.DABFEVRW/HW/VE	1405 F	1 setting: F2 se 5.AUTO/SETUP	as val. to USB F3: shart to F8: statistics (AUTO (//set.)	USB Fit Backup/Re Zws(SETUP)	esicae

The new password must be repeated (password prompt marked in green).

npula	retere	neruit				
metaz.		start-torque	Nm	1	drawing no.	
Torque Measuring.	Unit:Password					×
Please repea	t new 8-digit pa	ssword:				
po						
				5		
•				_		
6	7	8 9		0		
-						
	Create	new paceword				
						_
	_					
	F	5 78				

The new password is saved and the unit switches into SETUP mode.

In case the password is lost, please contact our technical support.

BDL 40097V11E.DOC11/2018Page 8 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: M40097.V11

4.1 F1 Settings

Torque.Measuring.Unit			×
Torque.Measuring.Unit:settings		X	
model-no. 32	step o	ontrol	700.040.24
tolerance limits	zero-angle deg. 178	return angle L 27	.789.012.34
	max.torque R/L Nm 15	return angle R 27	erial
start-torque UCL Nm 25			
	meas.window torque	Class.: 0-Xev 1=MIN 0	789012
MAX UCL Nm 15	angle beginning 7	progr.: 0=normal 1=short 1	lace
Xev LCL Nm 1	angle ending 27		d
MAX-MIN UCL Nm 4.5	zeropoint	Working place prueffeld	No. of values 38709
angle UCL deg. 55	Offset angle deg.	Order No. 123456789012	Inspect
angle LCL deg. 45	Offset sttorque 0	drawing no. 123.456.789.012.34	
Go On: Key "TAB" ACCEPT:	Key "ENTER"	description testmaterial	
On Screen Keyboard ON	ACCEPT	ACCEPT ACCEPT	
			Inspect
Andt & Voß M40097.V11 Version: 318-DABFEVAWHwVE-1405	F1:settings:F2:meas.val.tol F5:AUTO/SETUP F8:statist	USB F3:chart to USB F4:Backup/Restore ics(AUTO)/set Zero(SETUP)	

The parameters are entered into the input fields one after the other. By pressing the TAB key, the next field is selected.

If the respective value is darkly marked, it may be overwritten by entering the new value. The old value may be kept by pressing ENTER. After all fields have been edited, the input menu is closed by pressing ACCEPT.

Meaning of the individual fields:

Model No.: Number of the part model whose nominal values are selected. A maximum of 32 models can be administered. In the automatic mode, the model number is pre-selected by the round table control.

Tolerance limits:	
Start-torque UCL:	upper control limit for the start-torque
MAX UCL:	upper tolerance limit for maximum torque value
MAX UL:	upper tolerance limit for maximum torque value VERY HIGH
	(OPTION)
MIN LCL:	lower tolerance limit for maximum torque value. If the evaluation mode Xav was selected in the step control, the following values appear instead:
Xav LCL:	lower tolerance limit for torque Xav=(MAX+MIN)/2
MAX-MIN UCL:	upper tolerance limit for torque difference MAX-MIN
Angle UCL:	upper tolerance limit for tilting angle
Angle LCL:	lower tolerance limit for tilting angle

The following fields may only be changed if the control process is changed as well!

-	-
Cton	control
Slep	CONTROL.

Zero-angle:	Nominal value of angular transmitter for the zero position of the measuring mechanics		
Max. torque R/L:	The engine control is compulsorily switched off if this value is exceeded.		
Stop angle centre:	Preset for the brake control of the enginge (OPTION)		
Return angle left:	Direction change LEFT		
Return angle right:	Direction change RIGHT		
ATTENTION: The this is	return angles must be set as deviation from the zero-angle. Normally, s half the value of the upper tolerance limit of the angle.		
Stop angle left/right:	Preset for the brake control of the engine		
Classification:	Selection between Xav and MIN		
Process:	Selection between short or long cycle		
	Short: centre-right-left-centre		
	Long: centre-right-left-right-centre		
Measuring window to	orque:		
Angle beginning:	Beginning of torque measurement during left-right measuring cycle (cf. also 5. AUTOMATIC)		
	This value must also be set as difference to the max, torque left		

Angle ending:This value must also be set as difference to the max. torque left!Angle ending:End of torque measurement during left-right measuring cycle (cf. also5. AUTOMATIC)This value must also be set as difference to the max. torque left!

Zeropoint:

Offset angle:	Correction value for the measured angle value
-	This value is deducted from the measured value.
Offset start-torque:	Correction value for the measured value of the start-torque.
	This value is deducted from the measured value.

Arndt & Voß GmbH User's Manual: Elektronik - Meßtechnik M40097.V11

Workstation:	In the measuring unit, 10 characters are defined as designation for the workstation in a parameter file c:\daten\arbeitsplatz.dat. It is not possible for the user to change this file in the measuring program. If this file exists in the unit, it is not possible to change the settings (F1) for the workstation.
Job number:	12 digits are mandatory for this field. A plausibility check for numerical input is carried out.
Drawing number:	Input for the selected model No. The material or drawing number is formatted according to the formula xxx.xxx.xxx.xxx. The 14 digits (in this example "x") are mandatory fields and the 3 dots as well as the dash are predefined. A plausibility check for numerical input is carried out.
Designation:	Designation of the selected model number.

4.2 F2 Measuring values to disk

Selection only possible in SETUP mode! The measuring values will be stored onto the external USB storage medium in PPQ5 format.

4.3 F3 Chart to disk

Selection only possible in SETUP mode!

In case of technical problems, the measuring value courses may be stored onto the external USB storage medium for analysis purposes.

4.4 F4 Backup/restore settings

Selection only possible in SETUP mode! The sub-menu opens:

inputs	zettings	result							
itart meas.		start-torque Nm	1	drawing no.					
•		0.0	UL.	127.341.22	21.001test part				
ontr. release	start-torque UCL Nm	MAX Nm	2	description					
•	7.8		u.						
		Xav Nm	3	Order No					
outputs			u.						
tartposition	torque.measuring.unit	:F4:	×	Working place					
•	F4: BACKUP								
entre				model-no.	No. of values				
•	F5: RESTORE		_ _	32	5				
ETUP		F9: Cancel	rqu	rque Nm Trapact					
	angle LCL deg.	step	180.0	180.5 181.0 18	1.5 182.0 182.5				
	12.0		torque Nm	1	Inspec				
			5-						
			4-3-						
			2-						
	F4 F5		1-0	, , .					

F4 Backup settings

The parameters are stored onto the external USB storage medium.

F5 Restore settings

The parameters are restored from the external USB storage medium.

<u>F9 Cancel</u> Close sub-menu.

<u>4.5 F8 Set zeros</u> Selection only possible in SETUP mode! The actual torque value is set to zero.

4.6 Gain adjustment

Discharge torque gauge bar and set actual torque value to zero with key F8 (cf. 4.5). Set defined torque e.g. via weight with lever arm. If the actual value displayed deviates from the nominal value, it may be fine-tuned with the hidden adjuster at the input plug T1-4/1 (cf. 3. Connection elements). If a measuring amplifier A&V 5305 (T1-T4) is exchanged, the gain adjustment needs to be checked and corrected if necessary.

BDL 40097V11E.DOC11/2018Page 12 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual:

M40097.V11

4.7 IN-Test

The function key IN-Test opens an IN-test panel for diagnosis purposes. The max. 8 measuring inputs, 0...7 input bits as well as the currently used program release and the name of the measuring computer are displayed.

Steuereingang Wart: 0 Wart-Nr. <
Steuereingang Wort: 0 Wort-Nr. <
Steuereingang Wort: 0 Wart-Nr. < 000000000000000000000000000000000000
1 2 3 4 5 6 7 8 -3 -13 -3 -6 -6 -3 -6
1 2 3 4 5 6 7 8 -3 -13 -3 -6 -6 -3 -6
1 2 3 4 5 6 7 8 -13 -13 -6 -6 -3 -6
1 2 3 4 5 6 7 8 -3 -13 -3 -6 -6 -3 -6
1 2 3 4 5 6 7 8 -3 -13 -3 -6 -6 -3 -6
3 -13 -3 -6 -6 -3 -6
Y
Version: 318-DABFEVAWHWVE-1405
8861-224
Aind: & Vo81-D-TEST

4.8 OPTION: Import of job number and drawing/material number via barcode scanner This program option makes it possible to import job numbers and drawing/material numbers from barcodes via barcode scanner. The barcode scanner is attached to the measuring unit via USB interface. The barcode information is read and imported by the measuring program.

Example of the drawing number structure: 027.060.030.203-02 or 027.060.030.203 Example of the job number structure: 42136391

The length of the job number with 8, 12 or 16 digits may be parametrized. A plausibility check of the scanned data for numerical input and number of digits is carried out. Scanning of barcodes is possible in SETUP as well as in AUTOMATIC mode.

User's Manual: M40097.V11

a. Automatic				
orque.measuring.unit				
inputs	settings	result		
Start meas.		start-torque Nm	1	drawing no.
•		0.0	u.	127.341.221.001test part12
contr. release	start-torque UCL Nm	MAX Nm	2	description
•	7.8		UL.	
		Xav Nm	3	Order No
outputs			UL.	
startposition	MAX UCL Nm	MAX-MIN Nm	4	Working place
•	4.6		u.	
centre	Xav LCL Nm	angle deg.	5	model-no. No. of values
•	1.6		UL.	32 5
SETUP	MAX-MIN UCL Nm	act. torque value Nm	start-tor	que Nm [nspect
•	2.8	-0.2	63.	
	angle UCL deg.	angle deg.(act.val.)	4	Max = start-torque
	19.0	0.0	2	$L_1 \sim m \sim m$
	angle LCL deg.	step	04-	
	12.0	0	torque I	180.5 161.0 161.5 162.0 162.5
	15	F8	5- 4- 3- 2- 1- 0 176	MAX MIN 2 3 178 180 182 184
Andt & Voß M40037.V11 Version: 310W1404	F1:settings F2:meas.val. to USB F3 F5:AUT0/SETUP F8:statistics(AUT	chart to USB F4:Backup/Restore [0]/set Zero(SETUP)		

The measuring computer awaits the starting signal from the PLC. The following parameters are displayed:

Measuring value and classification of all characteristics The measuring value course of start-torque and torque of the previous measurement Status: 0: ready for measuring

al): Cur	rent value of the torque gauge bar							
actual): Cur	Current value of the angular transmitter (absolute value)							
Valu	Value of the range - 3 - in the torgue diagram:							
ang	le of left to right stop of the joint							
- 1 -	- is the range of the measuring window in which the							
max	kimum value of the torque is recorded and stored as							
star	t-torque.							
Starting point:	centre position (zero position) of the joint							
Ending point:	pre-programmed angle (min. 5 degrees)							
- 2 -	- is the range of the measuring window in which the							
max	kimum and minimum value of the torque are recorded							
and	stored.							
Starting point: Ending point:	cf. 4.1 measuring window torque - angle beginning cf. 4.1 measuring window torque - angle ending							
	al): Cur actual): Cur Valu ang - 1 - max star Starting point: Ending point: - 2 - max and Starting point: Ending point: Ending point:							

6. Connection schematics

User's Manual:

Arndt & Voß GmbH Elektronik - Meßtechnik

M40097.V11





User's Manual:

M40097.V11



User's Manual:

Arndt & Voß GmbH Elektronik - Meßtechnik

M40097.V11



User's Manual: M40097.V11



BDL 40097V11E.DOC11/2018Page 18 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

	el	<t< th=""><th>r</th><th>D</th><th>n</th><th>ik</th><th>-</th><th>- 1</th><th>N</th><th>eſ</th><th>31</th><th>E</th><th>eC</th><th>r</th><th>n</th><th>ni</th><th>k</th><th></th><th></th><th></th><th></th><th>Μ4</th><th>00</th><th>97.V</th><th>11</th><th></th><th></th></t<>	r	D	n	ik	-	- 1	N	eſ	31	E	eC	r	n	ni	k					Μ4	00	97.V	11		
SPS	t-Nr. Wort 1	F		2	Melswert 14 Dft 3 Diae:		-						<u>-</u>	2		4 Vorzeichen: 0=+	15 Meßwert BEREIT (Einlesen FERTIG)		agung zur SPS							(ippmomentmesseinh. bignalverlauf	Jatenübertragung 0097.V11 Rev 0 Seite 5 von 5
Ausgänge zur	Nr. Wort 0 Bit	0 Grundstellung 0	1 Messung läuft 1	2 Ergebnis GUT 2	3 Losbrech > OT 3	4 Kipp MAX > OT 4	5 Kipp Xq < UT €	6 Kipp (MAX-MIN) > UT 6	/ VVInkel n.I.O	8 (Kipp MAX > 00T) 8	9 (Losbrech > 00T) 9	10	<u>-</u>	12 1	13	14 14	15 EINRICHTEN		Meßwertübertr Gebeuter	(In Detriepsart /	Nr. 5 Bit	en 12 Bit	t BEREIT			(Voß GmbH fstr. 7 - D 21255 Tostedt www.amdtundvoss.de	49 (0) 4182 289 -760 Fax761 1 nfo@amdtundvoss.de 04.07 at Artikel-Nr. M41 7.V1165
	t 1 Bit-I	0	nmer 5 Bit 1	ш) Б	m	4	0	4 3 Bit 1	7	-			en 7 Bit				nfordern t von SPS Bereit)				Meßstellen	Meßwert/Vorzeich	Meßwer	Meßwert ANF((Codenummer)		HEN, Messwert Arndt & neter Bereit Bits Eichhof izausgabe http://w	Tel. ++* email: ii Datum: 25 CAD-Nr. 4009
der SPS	Bit-Nr. Wor	۲ •	1 Positionsnur	2 Binär	m	4	5	6 Codenumme Binär	+	⊢	o (11 ASCII-Zeich	12	13	14	15 Messwert a (Einlesewer		SPS	5						29.05.07 EINRICH anford./Param 03.08.11 Toleran	ATIK Göße:A Maßstab:
Eingänge von (Wort 0	Start Messung	⁻ reigabe	Typnr. Bit 0	rypnr. Bit 1	Typnr. Bit 2	fypnr. Bit 3	Typnr. Bit 4									EINRICHTEN		ihertranınn von der (Betriebsart EINRICHTEN)	1+1 n+2 n+3]∟)⊏)┌		ei erfolgt bei: Fypnr. on EINRICHTEN auf AUTOM
	Bit-Nr.	。 。	-	2	ო	4	ເ	ωι	~		on 4	D1 :	÷	12	1 13 1	14	15	Г	Dateni		_ _	Å	X	Ϋ́́) —] []] _]	Speichern in Date 1.) Wechsel der 2.) Umschatten v
rgebene Daten (ASCII-Strin,	Stellenzahl (max.Positionsnr:31)		32	32	32	32	8 (Format 20070424)	tebene Daten (Binärzahl)	Bedeutung	Losbrechmoment MAX	Kippmoment MAX	Kippmoment Xquer	Kippmoment MAX-MIN	Winkel	Losbrechmoment MAX_C	Kinnmoment MAX_OT	Kippmoment Xquer UT	Kippmoment MAX-MIN_O	Winkel OT	Winkel UT	Zeichennummer	Typnr. 5 Bit	Codenr. 3 Bit	Zeichenposition 5 Bit	ASUI-ZEICHEN O DIT	Einlesen FERTIG	_
Von der SPS übe	Codenr. Bedeutung	0	1 Zeichnungsnr.	2 Bezeichnung	3 Auftragsnr.	4 Arbeitsplatz	5 Datum	An die SPS überg	Meßstellennr.	-	2	e	4	Ś	9) r	- 00	0	10	11					ŭ	Ī	

Arndt & Voß GmbH User's Manual:

7. Settings of function modules

The following pages give an overview of the function modules which are contained in the torque measuring unit M40097.V11 as well as of their specific settings.

7.1 USB Interface module 5326.620/630

The torque measuring unit contains a USB interface module 5326, either of version 620 or 630.

Version 5326.620



BDL 40097V11E.DOC11/2018Page 20 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: M40097.V11

Version 5326.630



Connection cable PC - measuring device: Pin1 of the cable on Pin1 of the USB interface

USB socket X412: Internal USB, test socket (DO NOT USE)

User's Manual: าik M40097.V11

7.2 I/O Modules

The torque measuring unit contains three I/O modules.

7.2.1 16-Bit input/output module 5304.610

Connection X312 37-pole socket MIN D: rotation Right/Left to transverter



Address jumper: 0

BDL 40097V11E.DOC11/2018Page 22 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: ∩İk M40097.V11

7.2.2 32-Bit profibus module 5315.610

Connection X314 9-pole socket MIN D: profibus interface



Example of profibus address: "02": X10 = 0, X1 = 2 Address jumper: 3 and 4

The profibus address is defined by the machine control !

For setting profibus address, please remove black cover caps.

For further information regarding this profibus module please refer to the manual under www.arndtundvoss.de/5315.610E.pdf .

BDL 40097V11E.DOC11/2018Page 23 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: NİK M40097.V11

7.2.3 16-Bit input/output module 5304.610 or Profibus module 5327.630

Depending on the model, the measuring unit contains either a second 16-Bit input/output module 5304.610 or a profibus module 5327.630.

16-Bit input/output module 5304.610

Connection X316 37-pole socket MIN D: parallel input angular transmitter



Address jumper: 1

BDL 40097V11E.DOC11/2018Page 24 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: าik M40097.V11

Profibus module 5327.630

Connection X316 9-pole socket MIN D: profibus input angular transmitter COM 9-pole plug MIN D: test plug



Address jumper: 1

For further information regarding this profibus module please refer to the manual under www.arndtundvoss.de/5327.630E.pdf .

BDL 40097V11E.DOC11/2018Page 25 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: M40097.V11

7.3 DAC module 5314.630

Connection X315 6-pole socket 680: +/- 10V output to transverter



When exchanging this module, the link plug on the new module has to be set exactly like on the old module.

BDL 40097V11E.DOC11/2018Page 26 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

User's Manual: Nik M40097.V11

7.4 4-channel strain gauge measuring amplifier 5305.630

Connection T1-T4 T1-4/ (1): 5-pole socket 680: input torque gauge bar



Default settings T1-T4 for torque measuring unit M40097.V11

BDL 40097V11E.DOC11/2018Page 27 of 28Arndt & VoßGmbH - Eichhofstr. 7 - D 21255 TostedtTelefon 04182-289 760Fax -289 761 email: info@arndtundvoss.dehttp://www.arndtundvoss.de

Technical data and security instructions according to VDE 0411

A&V Measuring Computer	A&V 8817.653 with colour monitor	A&V 8861.600 without monitor				
Warm-up time	20 min.	20 min.				
Max. ambient temperature	0+40 °C	0+40°C				
Atmospheric humidity	up to 75% rel.	up to 75% rel.				
Power supply voltage	230V/115 VAC 50/60 Hz	24 VDC				
Power consumption	19-20 W	17 W				
Protection classification	IP20	IP20				
Case dimensions WxHxD	335x200x220 mm	335x133x200 mm				
without connectors						
Case dimensions WxHxD	340x200x270 mm	340x180x260 mm				
incl. space for connectors						
Fixing	-	35 mm DIN top-hat rail				
Weight	approx. 5 kg	approx. 3 - 3,5 kg				
Security	according to VDE 0411,	according to VDE 0411,				
	protection class 1	protection class 1				

This unit is built and checked under DIN 57411 part 1/VDE 0411 part 1 and left the factory in a safe and perfect condition. To preserve this condition and to guarantee a safe working the user has to follow the comments and warnings which are given in this instructions. Before turning on the power you have to make sure, that the voltage of operation and the mains voltage correspond.

The mains plug may only be inserted into a socket with ground contact. The safety effect may not be abolished by an extension lead without ground connection. The opening of covers or removing of components, except if it is possible to do by hand, might uncover parts or connections under dangerous voltage. Racks may only be used inside a cover. If an adjustment, a maintenance or a repair at the opened unit under voltage is unavoidable, it may be done only by a qualified employee, who is well acquainted with the dangers involved.

ATTENTION:

After the end of those works, the unit has to be checked according to VDE 0411, part 1. You have to make sure, that only fuses of the given type and values are taken for replacement. The use of mended fuses or short-circuiting them is inadmissible. If it is presumed, that a safe work is not possible, you have to take this unit out of work. A safe work may not be possible,

- if there are visible damages at the unit.
- if the unit does not work.
- after longer storage under unfavourable circumstances.
- after heavy stress of transport.