AMK

AMKASYN

VARIABLE SPEED DRIVES

AMKASYN

Digital Inverters in Modular Construction
Series AN / AZ / AW

Inverter Modules AW

Technical manual

2002/22.E

Part-No.: 26894

AMK

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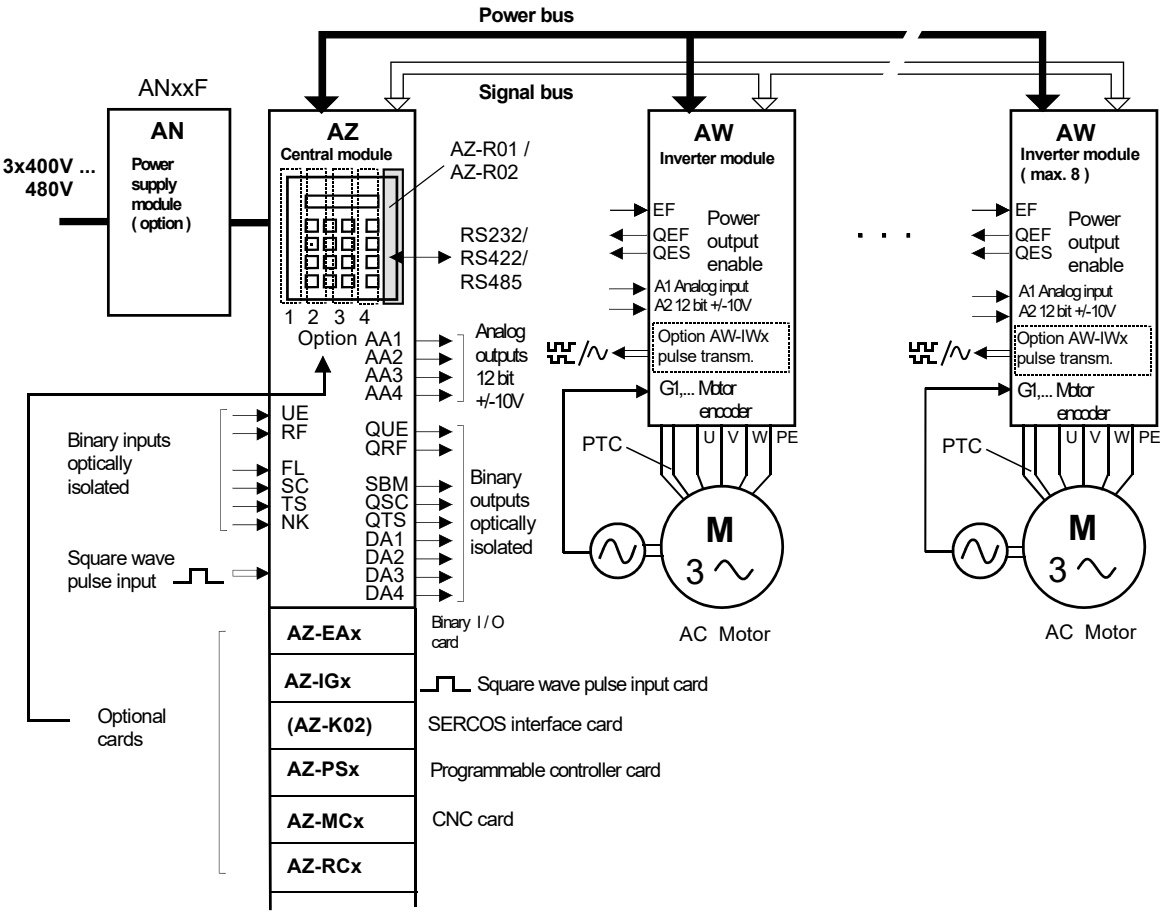
1 AMKASYN System overview



Abbreviations:

UE	DC-Bus enable	**QUE**	DC-Bus ready handshake	**EF**	Power output enable
RF	Inverters on (all)	**QRF**	Inverters ready handshake (all)	**QEF**	Power output enabled
FL	Error reset	**SBM**	System ready	**QES**	Power output disabled
SC	Status code call	**QSC**	SC handshake		
TS	Status code clock	**QTS**	TS handshake		
NK	Cam (Ref. L.S.)	**DA1**...			
		DA4	Data output DA1...DA4		

The AMKASYN series is a drive system of modular construction for feeding AMK AC motors. The digital inverters regulate the drives in 4 quadrant mode precisely and with high dynamic response. The feed is direct from a 400V three-phase power supply. The inverter modules are supplied from a common DC-bus. The latest power semiconductor technology in conjunction with high-grade integration guarantees high reliability.

2 Safety instructions

Please read and observe additionally the „Safety instructions for AMKASYN Inverters“.

Meaning of the used symbols:

Danger

Possible consequences: Dead or severest injuries!

Warning

Possible consequences: Severe injuries or death!

Warning

The operation of the drive system in a manner that does not conform to its purpose and intended use can be dangerous and can cause severe injury, up to loss of life, to the user/operator. Misuse can also cause damage to the machinery/equipment of the enduser.

In order to minimize the risk of accidents and damage it is necessary that installation, start-up, maintenance and repairs are performed diligently by trained and experienced specialists.

Drive system parameters may only be set or modified by the machine manufacturer!
Entry of non- conforming parameter values is effecting the drive behaviour and increasing the risk of accidents and damage!

Danger

Each time before working on the AMKASYN drive system: Interrupt power supply using the MASTER SWITCH!
Working under voltage is dangerous to life!
More than ONE LIVE CIRCUIT! See diagram! (2 line circuits on AZ module X01, X03).
After POWER OFF:
Because of capacitor charge don’t touch electrical connections immediately! DC voltage at terminals UZP and UZN is dangerous to life!
Before working on the modules wait for discharge time longer than 3 minutes after turning power off!

The option cards and all plug connectors must only be inserted or removed when the modules are voltage-free!

Never losen or tighten terminals under voltage!

3 Inverter modules AW specifications

AW 2/4...AW 14/24:

Type	AW 2/4-2/...-3	AW 4/8-2/...-3	AW 8/16-2/...-3	AW 14/24-2/...-3	*)
Nominal input voltage range	540V DC ... 650V DC				
Output voltage	up to 3 x 350V for sinusoidal output currents				
Output frequency	0 Hz to 800 Hz				
Nominal output rating	2kVA	4kVA	8kVA	14kVA	
Peak output rating	4kVA	8kVA	16kVA	24kVA	
Nominal output current	3.3A	6.6A	13.2A	23.1A	
Peak output current max. time	6.6A / 25s	13.2A / 25s	26.4A /25s	39.6A / 38s	
Efficiency	>0.96				
Cooling	forced air cooling				
Fan voltage	230VAC	230VAC	230VAC	230VAC	
Fan rating	2.5W	5W	30W	35W	
Protective functions	Overcurrent protection				
Control procedure	PWM				
Switching frequency	8kHz				
recommended cable cross sections [mm^2]/AWG	cable cross sections according to „Conductor Table 53.2 UL508C“ Use copper wires (75°C) only				
AW motor X51 (shielded cable)	4x1.5 / AWG14	4x1.5 / AWG14	4x1.5 / AWG14	4 x 4 / AWG10	
AW PTC resistor X54 (shielded cable)	2x0.5 / AWG20	2x0.5 / AWG20	2x0.5 / AWG20	2x0.5 /AWG20	
PE connection	4 / AWG10	4 / AWG10	6 / AWG8	6 / AWG8	
Dimensions [mm] H x W x D [“]	415 x 55 x 357 16.34x2.17x14.06	415 x 55 x 357 16.34x2.17x14.06	415 x 90 x 357 16.34x3.54x14.06	415 x 130 x 357 16.34x5.12x14.06	
Weight [kg] / [lb] without packing with packing	 4.7 / 10.4 6.1 / 13.5	 5.0 / 11.1 6.4 / 14.2	 8.1 / 17.9 9.5 / 21	 11.8 / 26.1 13.4 / 29.6	

***)** The two different AW modules are marked with suffix „-2“ respectively „-3“:

„-2“: New AW modules. Signal connections through D-SUB connectors

„-3“: New AW modules pin compatible with previous AW version. Signal connections through PHOENIX plug-in terminal blocks.

AW 25/38...AW 50/75:

Type	**AW 25/38-2/...-3**	**AW 40/60-2/...-3 *)**	**AW 50/75-2/...-3**
Nominal input voltage range	540V DC ... 650V DC		
Output voltage	up to 3 x 350 V for sinusoidal output currents		
Output frequency	0 Hz to 800 Hz		
Nominal output rating	25kVA	40kVA	50kVA
Peak output rating	37.5kVA	60kVA	75kVA
Nominal output current	41.5A	66A	83A
Peak output current max. time	62A / 60s	99A / 60s	125A / 60s
Efficiency	>0.96		
Cooling	forced air cooling		
Fan voltage	230VAC	230VAC	
Fan rating	45W	85W	
Protective functions	Overcurrent protection		
Control procedure	PWM		
Switching frequency	8kHz		
recommended cable cross sections [mm^2]/AWG	cable cross sections according to „Conductor Table 53.2 UL508C“ Use copper wires (75°C) only		
AW motor X51 (shielded cable)	4x10 / AWG8	4x25 / AWG2	4 x 35/AWG1 **)
AW PTC resistor X54 (shielded cable)	2x0.5 / AWG20	2x0.5 / AWG20	2 x 0.5/AWG20
PE connection	16 / AWG6	25 / AWG2	25/AWG2
Dimensions [mm] H x W x D [“]	415 x 170 x 357 16.34 x 6.69 x 14.06	595 x 170 x 357 23.43 x 6.69 x 14.06	
Weight [kg] / [lb] without packing with packing	14.8 / 32.7 16.4 / 36.2	19.7 / 43.5 24 / 53	

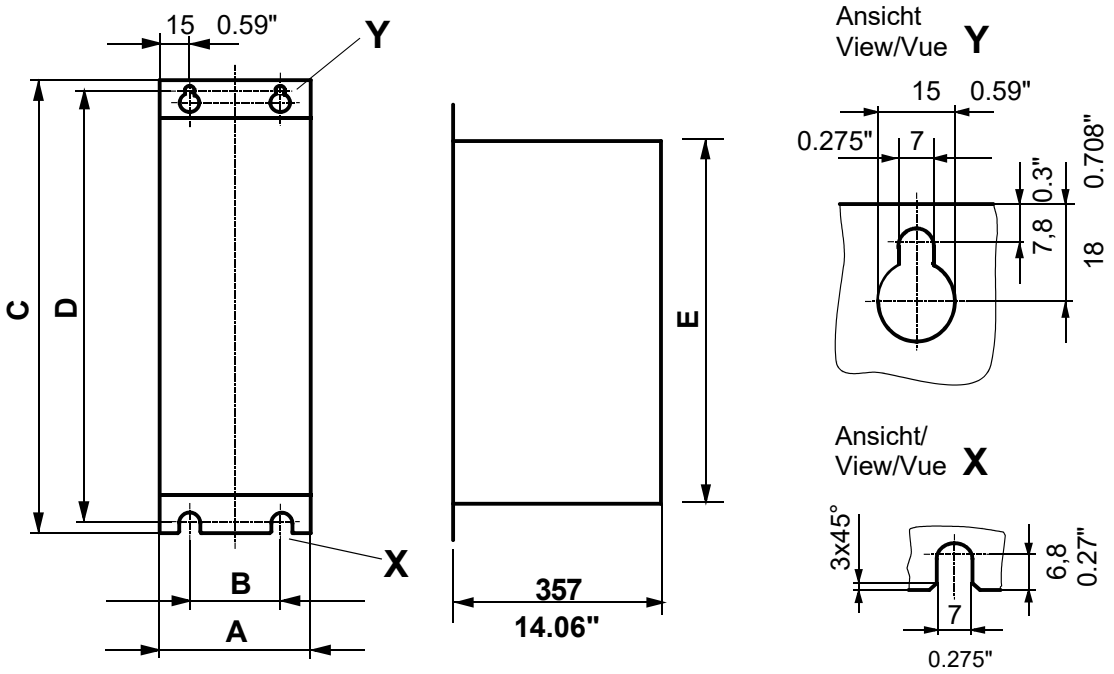
***)** The two different AW modules are marked with suffix „-2“ respectively „-3“:

„-2“: New AW modules. Signal connections through D-SUB connectors

„-3“: New AW modules pin compatible previous AW version. Signal connections through PHOENIX plug-in terminal blocks.

**) End of wire with pin-end connector

4 Dimensions AW modules AW xx / yy



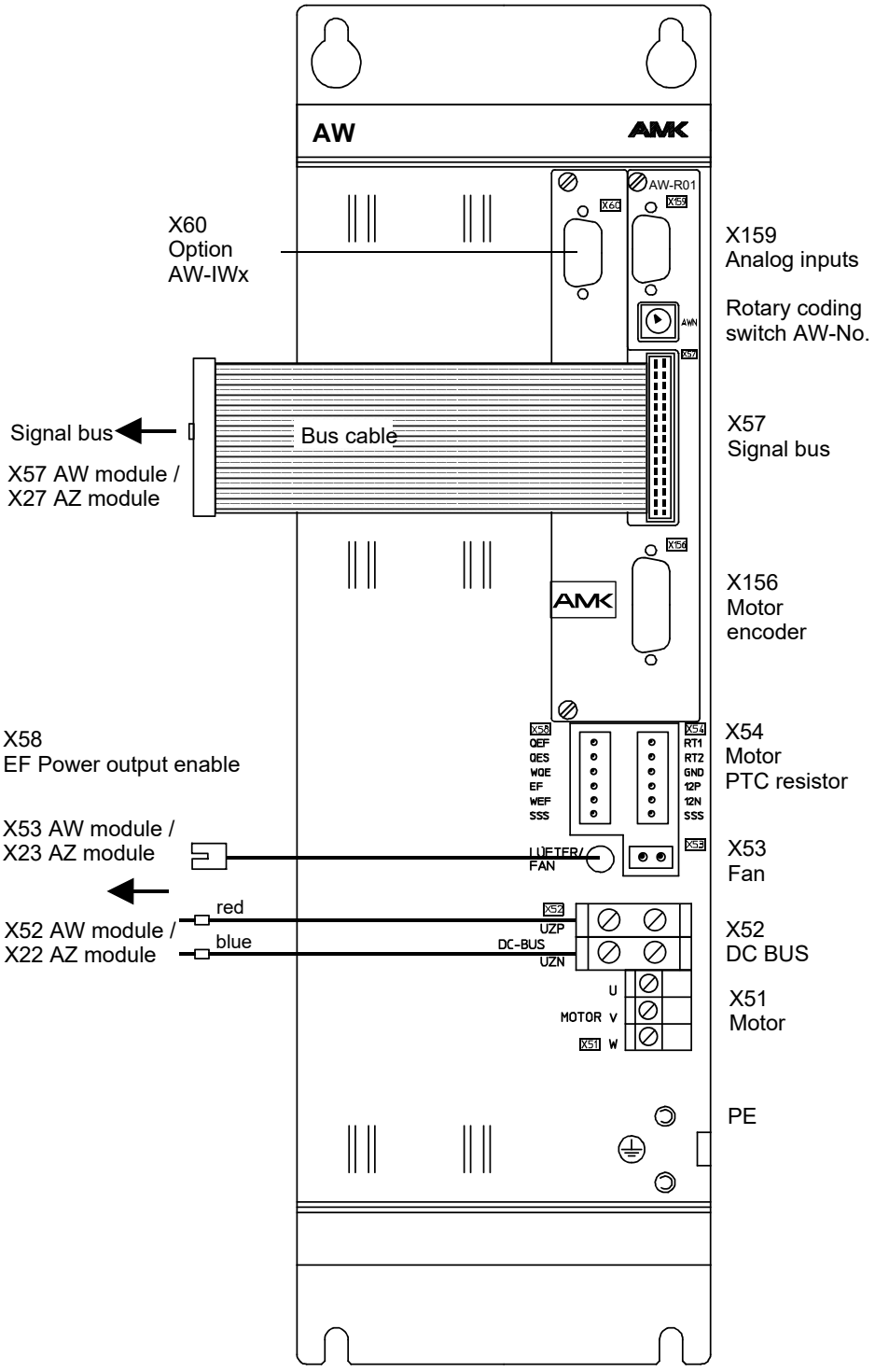
Type	A	B	C	D	E
AW2/4	55 (2.17")	*)	415 (16.34")	400 (15.75")	358 (14.09")
AW4/8	55 (2.17")	*)	415 (16.34")	400 (15.75")	358 (14.09")
AW8/16	90 (3.54")	60 (2.36")	415 (16.34")	400 (15.75")	358 (14.09")
AW14/24	130 (5.12")	100 (3.94")	415 (16.34")	400 (15.75")	358 (14.09")
AW25/38	170 (6.69")	140 (5.51")	415 (16.34")	400 (15.75")	358 (14.09")
AW40/60 AW50/75-2/3	170 (6.69")	140 (5.51")	595 (23.43")	580 (22.84")	538 (21.18")
AW50/75	370 (14.57")				

*) nur eine Befestigungsbohrung mittig
only one central mounting bolt hole
un seul orifice de fixation au centre

5 Front view inverter modules AW

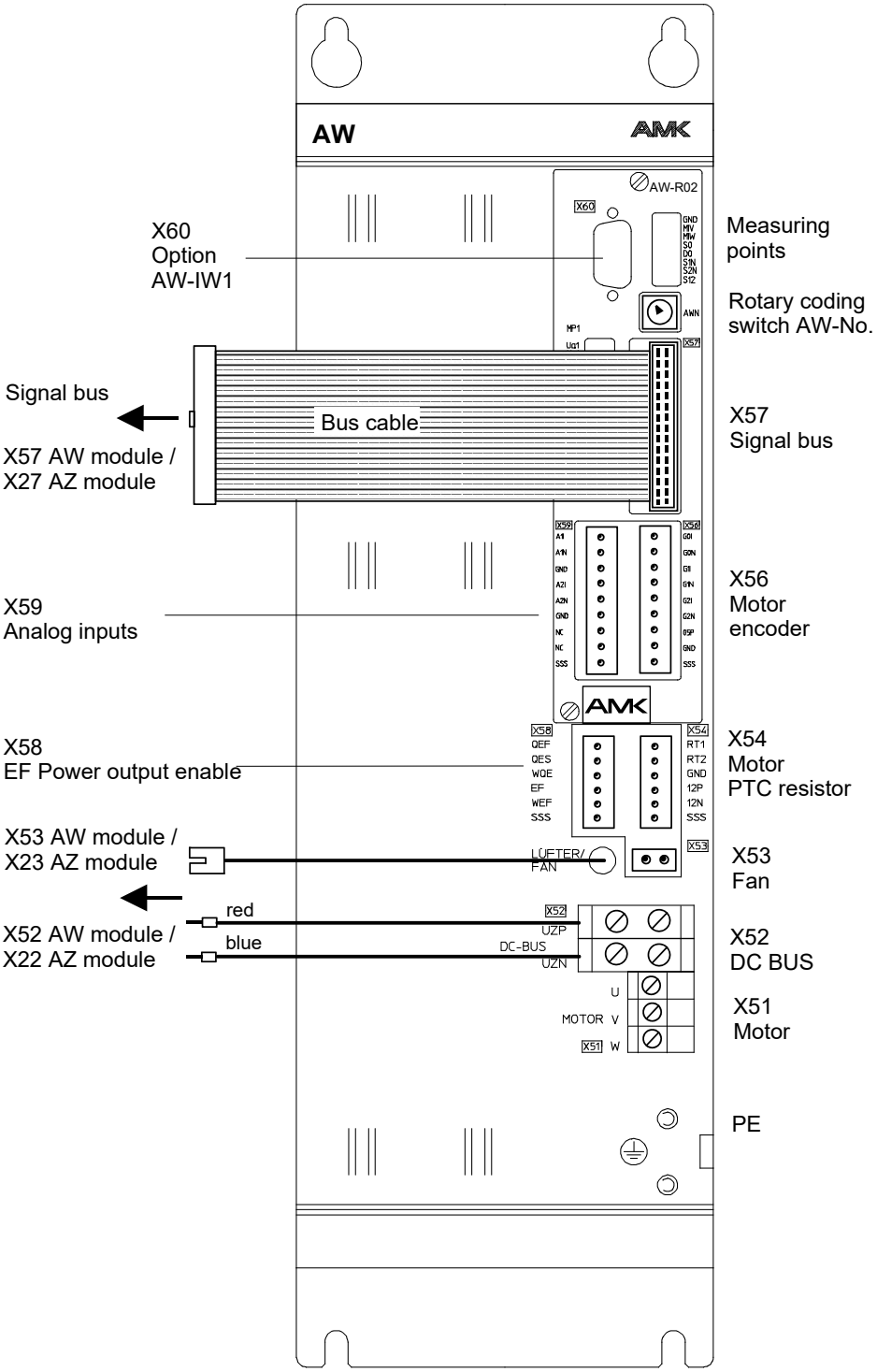
5.1 Inverter modules AW xx/yy-2

Front view



5.2 Inverter modules AW xx/yy-3

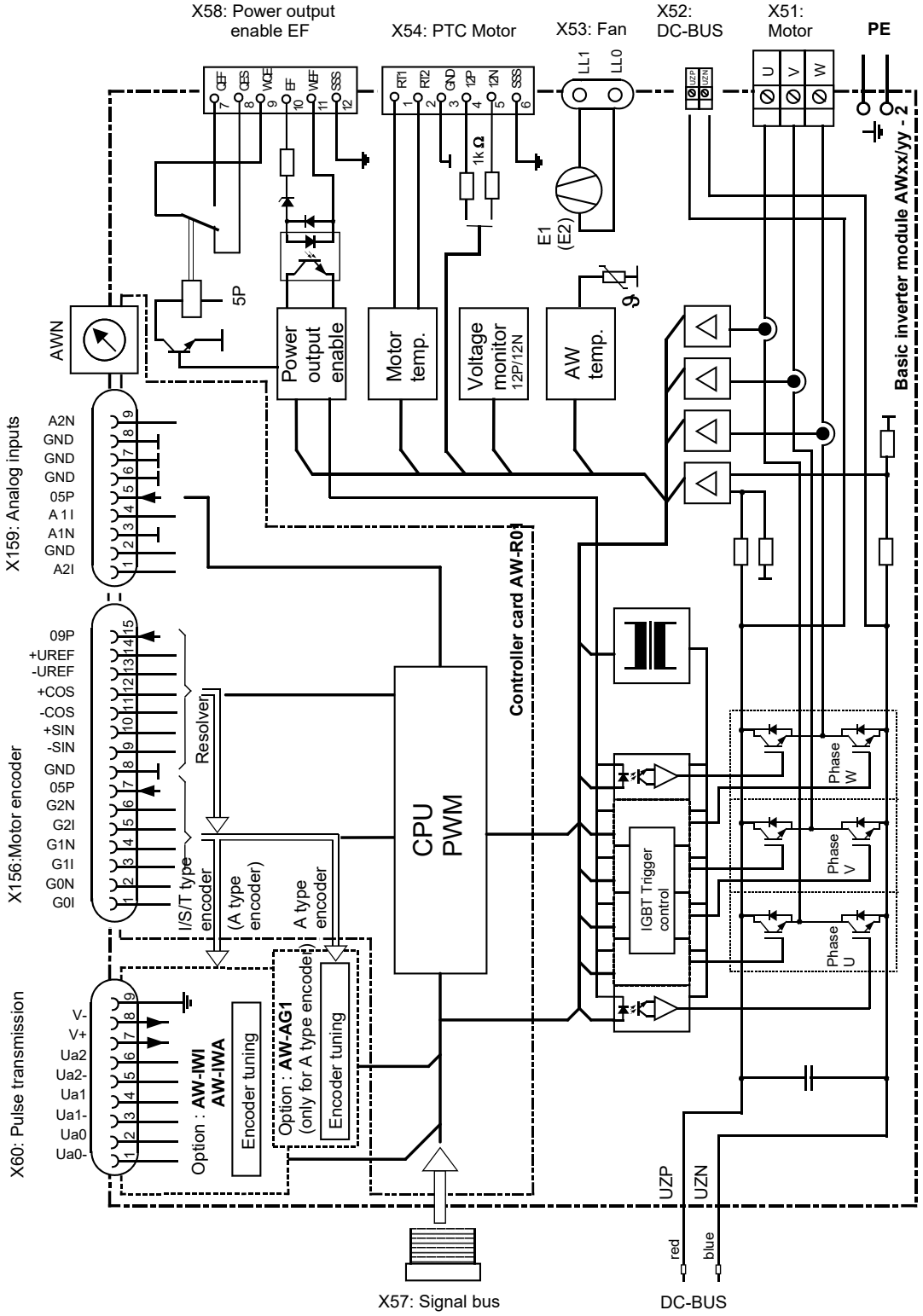
Front view



6 Inverter module AW block diagram

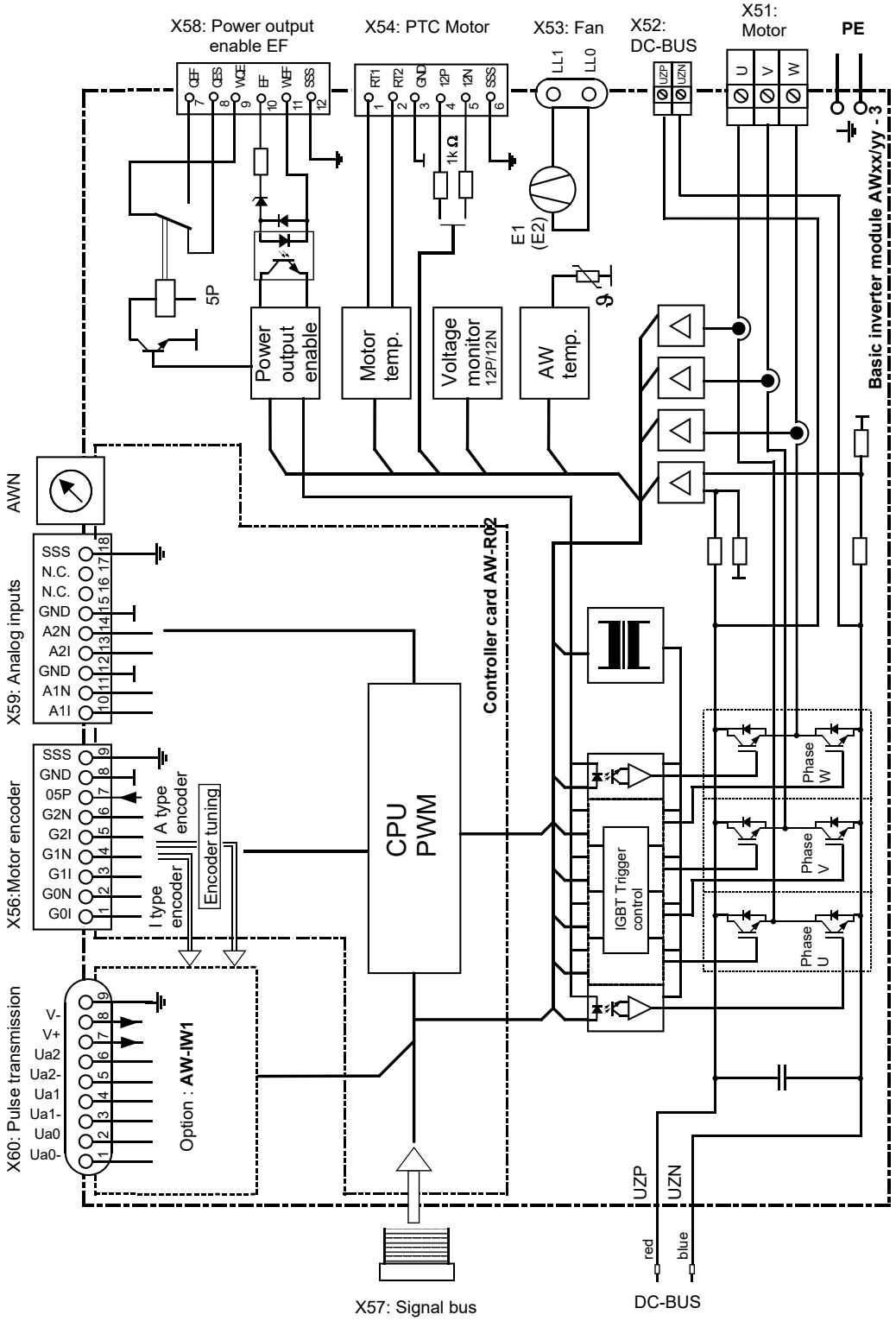
6.1 Inverter modules AW xx/yy-2

Block diagram



6.2 Inverter modules AW xx/yy-3

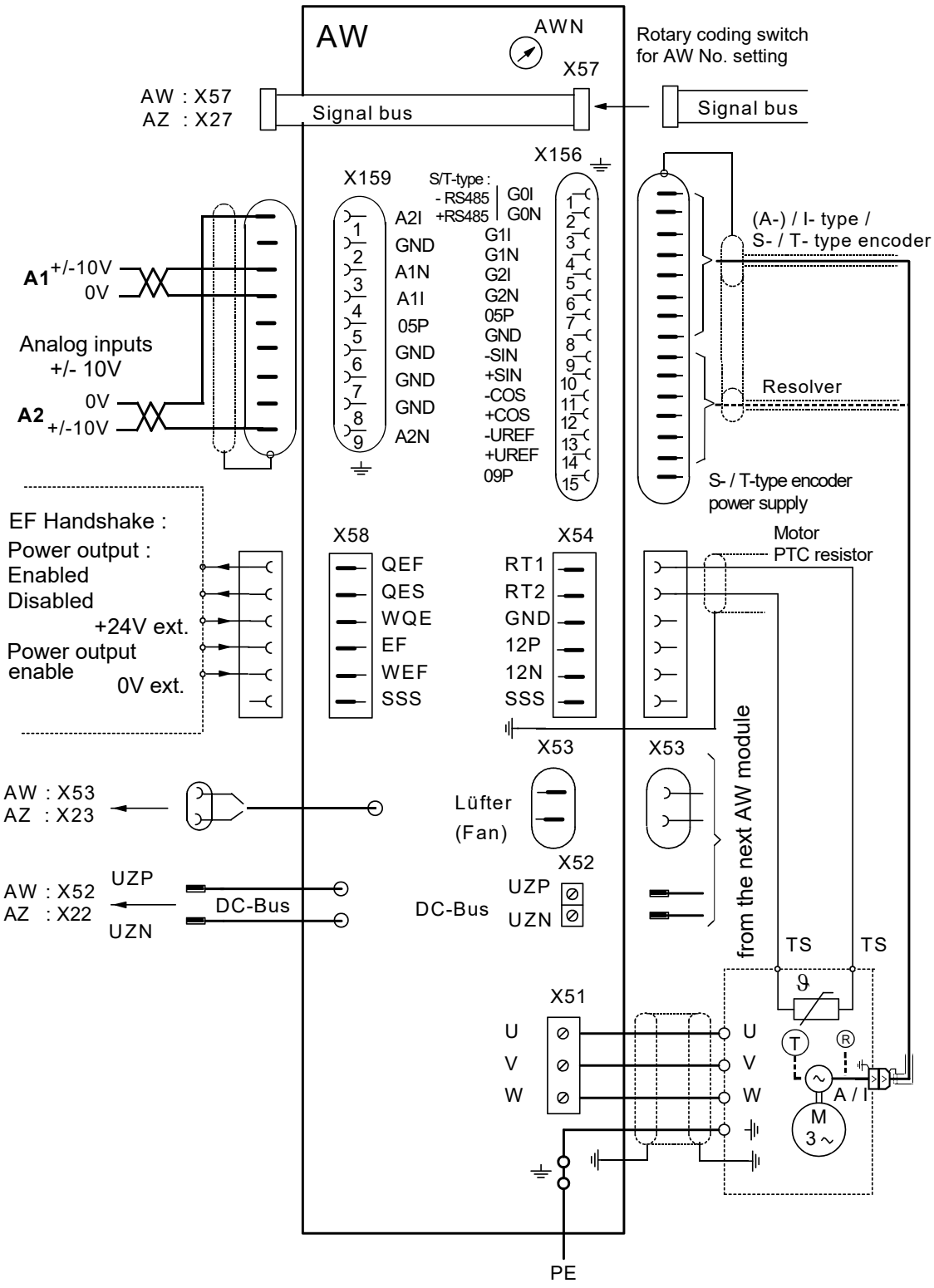
Block diagram



7 Connection drawing of inverter module AW

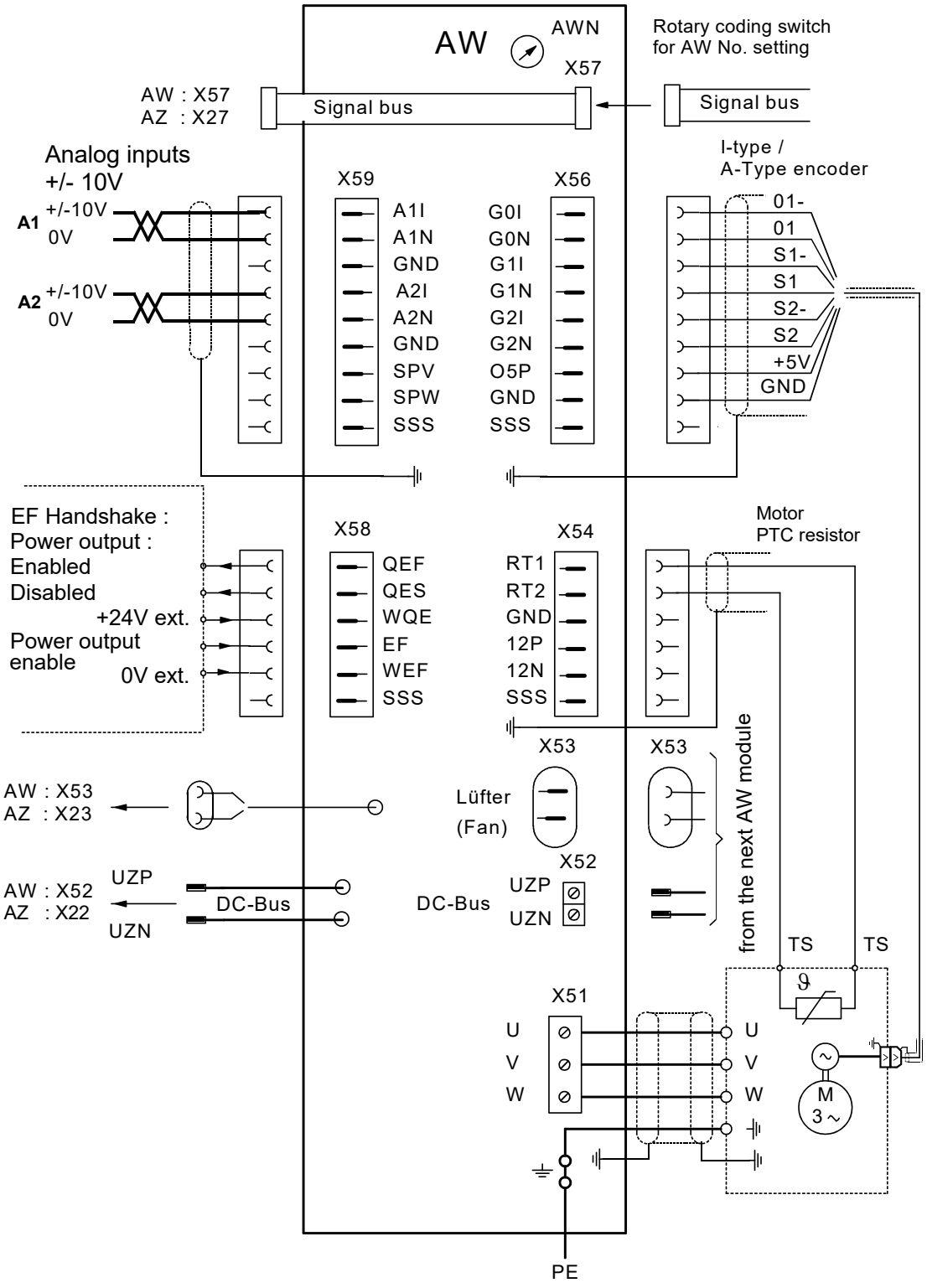
7.1 Inverter modules AW xx/yy-2

Connection drawing



7.2 Inverter modules AW xx/yy-3

Connection drawing



Test pins allocation
(only with AW xx/yy-3)

All test points are protected with 10 kΩ against short circuit.

Test point GND:	Reference potential for test signals
Test point MIV:	Test signal actual current value phase V (see imaging scale)
Test point MIW:	Test signal actual current value phase W (see imaging scale)
Test point SO:	Differential signal GON / GOI (reference pulse)
Test point DO:	Digital motor encoder reference pulse
Test point S1N:	Motor encoder channel 1 (sinusoidal signal)
Test point S2N:	Motor encoder channel 2 (sinusoidal signal)
Test point S12:	Sum signal S1 and S2

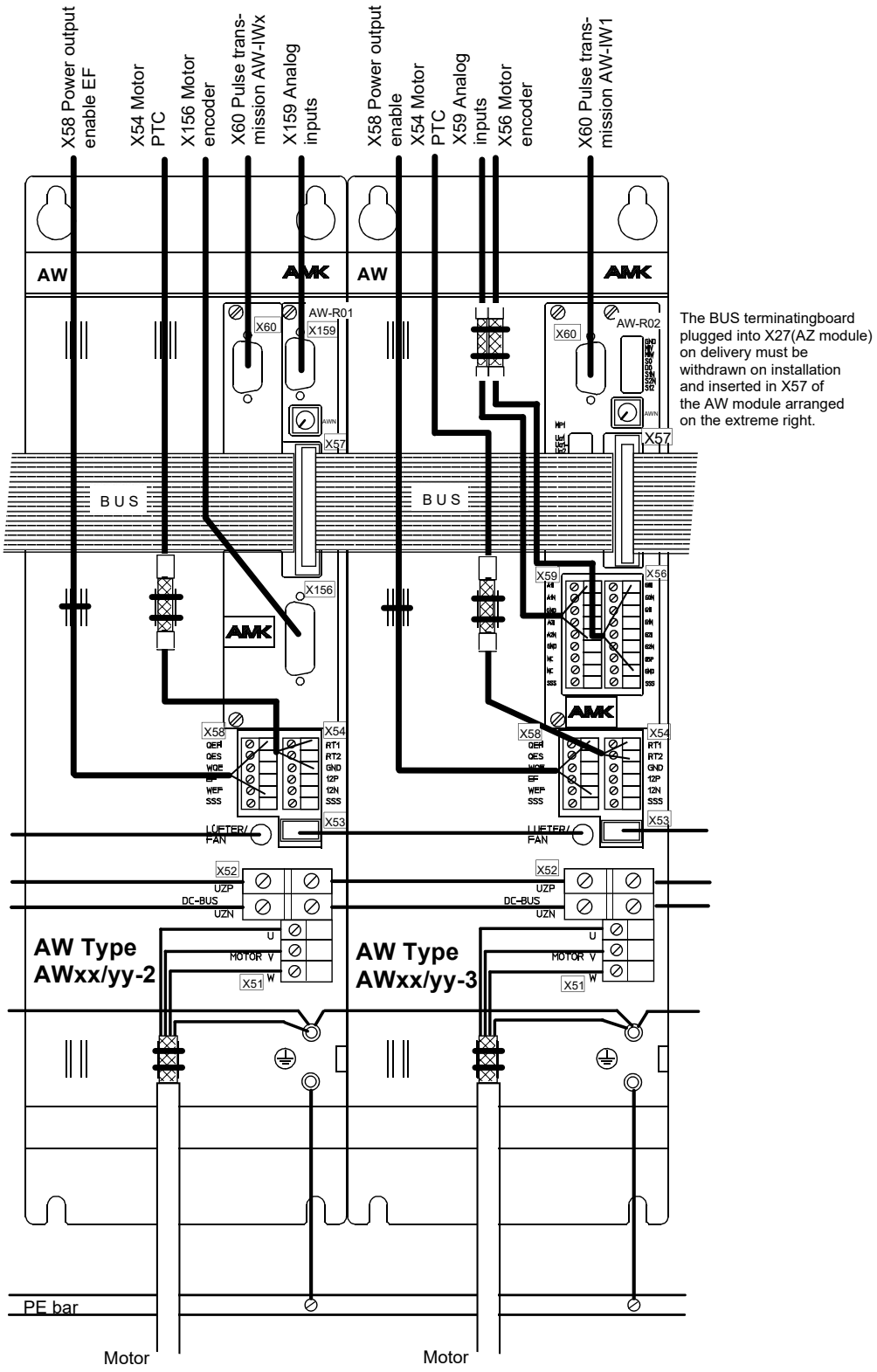
Imaging scaling

Actual current value:

AW 2/4-3:	10 A correspond to 3,64V
AW 4/8-3:	10 A correspond to 1,82V
AW 8/16-3:	10 A correspond to 0,97V
AW 14/24-3:	10 A correspond to 0,62V
AW 25/38-3:	10 A correspond to 0,40V
AW 40/60-3:	10 A correspond to 0,25V
AW 50/75-3:	10 A correspond to 0,20V

Voltages correspond to instantenous
current values (peak values)

8 Wiring


X58 Power output enable EF
X54 Motor PTC
X156 Motor encoder
X60 Pulse transmission AW-IWx
X159 Analog inputs
X58 Power output enable
X54 Motor PTC
X59 Analog inputs
X56 Motor encoder
X60 Pulse transmission AW-IW1
AW
AMK
AW-R01
AW-R02
X60
X159
X57
BUS
X156
X59
X56
X58
X54
X53
X52
X51
AW Type AWxx/yy-2
AW Type AWxx/yy-3
PE bar
Motor
Motor
The BUS terminatingboard plugged into X27(AZ module) on delivery must be withdrawn on installation and inserted in X57 of the AW module arranged on the extreme right.

9 Functional description of inverter module AW

The inverter module AW contains the following functional groups:

- Microcontroller for: Field orientation
  Motor encoder evaluation and monitoring
  Speed control
  Closed loop position control
  Power semiconductor triggering
  Current control
  Monitoring
- Converter, equipped with IGBT power semiconductors

The plug-in module „Controller card AW-R0x“ is inserted in the card slot at the top right in the inverter module AW.

Important notice: The inverter module and the controller card are supplied by AMK as a single unit. The controller card is registered under the AW module serial number.
The controller card must not be exchanged in the field! Warranty void if replaced!

The microcomputer calculates cyclically the instantaneous values of the nominal currents for the phases from the specified setpoint, the actual phase currents as well as the rotor position.

The power semiconductor (IGBT) triggering is synchronized with the basic clock of 8 kHz in the form that the motor windings carry sinusoidal currents when stationary. The entire control system is digital. Logic and power units are galvanically separated by optocouplers. The converter currents are I^2t monitored. The inverter output is protected against overcurrent.

The speed and position control circuits are implemented by the micro controller. This system derives the actual values for speed and position from the motor encoder signals. Motor encoder types „I“, “S” and „T“ can be connected directly. For encoder type „A“ an electronic interface module is required (AW-AG1).
In operation, the encoder signals are monitored. On failure of the encoder , the „System ready“ SBM is reset, the clock pulses are blocked, the drive coasts.

2 analogue setpoint inputs 10V are integrated in the AW module. The effect of the analog setpoint is determined by parameters.
Analogue input A1 serves as setpoint input (speed, torque). Change of the torque limit is possible through A2 by altering the analog voltage.

Numerical or pulse setpoints must be input through AZ module. They are distributed from there via the internal bus system to the individual inverter modules AW.

Each inverter module AW in an AMKASYN drive system receives its own number. This must be set on the rotary coding switch „AWN“ using a small screwdriver before start up (AWN1...8, for a system with 8 drives). Multiple allocation of a AWN number is not permissible.

10 Interfaces, signal description of inverter module AW

10.1 DC-Bus voltage supply (DC-BUS X52):

The single wires UZP (red) and UZN (blue) are in each case connected to the adjoining module (AZ or AW) at the terminals UZP and UZN.
The DC-bus voltage is provided for the next AW module at the terminals UZP and UZN (X52).

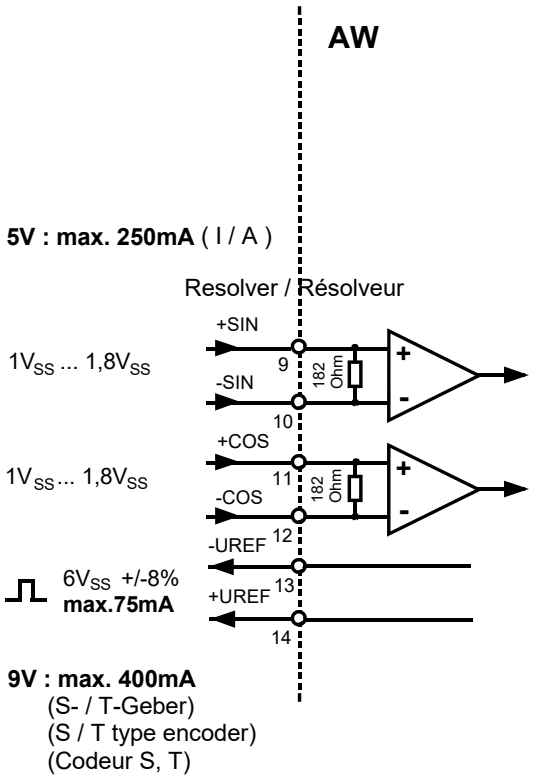
10.2 Motor encoder connection

10.2.1 Motor encoder connection X156

15 pole D-SUB female connector, for I-/S-/T-/A-type encoder or resolver (AW xx/yy-2 with controller card AW-R01)

Connector pin assignment:

X156	I / A	S / T	Resolver
1	G0I	-RS485	-
2	G0N	+RS485	-
3	G1I	G1I	-
4	G1N	G1N	-
5	G2I	G2I	-
6	G2N	G2N	-
7	05P	-	-
8	GND	GND	-
9	-	-	-SIN
10	-	-	+SIN
11	-	-	-COS
12	-	-	+COS
13	-	-	-UREF
14	-	-	+UREF
15	-	09P	-



The maximum input frequency from the motor encoder (I-/S-/T-/A-type) is 100 kHz.

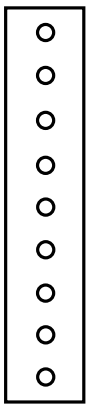
For motors with A-type encoders AW option card AW-AG1 (A-type encoder adaption) or AW-IWA (pulse transmission with A-type encoder adaption) must be installed into the card slot at the top right beside the controller card AW-R01.

For encoder connection a shielded cable must be used. The cable shield must be grounded at both ends !

10.2.2 Motor encoder connection X56

PHOENIX plug-in terminal block, for I-/A-type encoder (AW xx/yy-3 with controller card AW-R02)

X56



G0I	
G0N	
G1I	
G1N	
G2I	
G2N	
05P	
GND	
SSS	

The maximum input frequency from the motor encoder (I-/A-type) is 100 kHz.
For pulse transmission AW option card AW-IW1 must be installed on controller card AW-R02.

10.3 Power output enable X58 (Plug-in terminal block):

Terminal EF: Binary input „Power output enable“

Optically isolated input
Input nominal voltage: +24V_{ext}
Input nominal current: 8 mA

In normal operation, input „EF“ must be set so that the triggering pulses for the power semiconductors are enabled. Interruption of „EF“ with „Inverters on“ (RF) still energized leads to a system fault. The axis coasts.

Terminal WEF: Reference potential 0V_{ext} for EF input voltage.

Terminal QEF: Relay contact output (normally open contact). Handshake „Power output enabled (24V= min. 20 mA; max. 200 mA).
QEF reports that „Power output enable“ is set and the triggering pulses for the power transistors are released.

Terminal QES: Relay contact output (normally open contact). Handshake „Power output disabled (24V= min. 20 mA; max. 200 mA).
QES reports that the enable relay has dropped out and thus the triggering pulses are blocked. The drive is not energized.

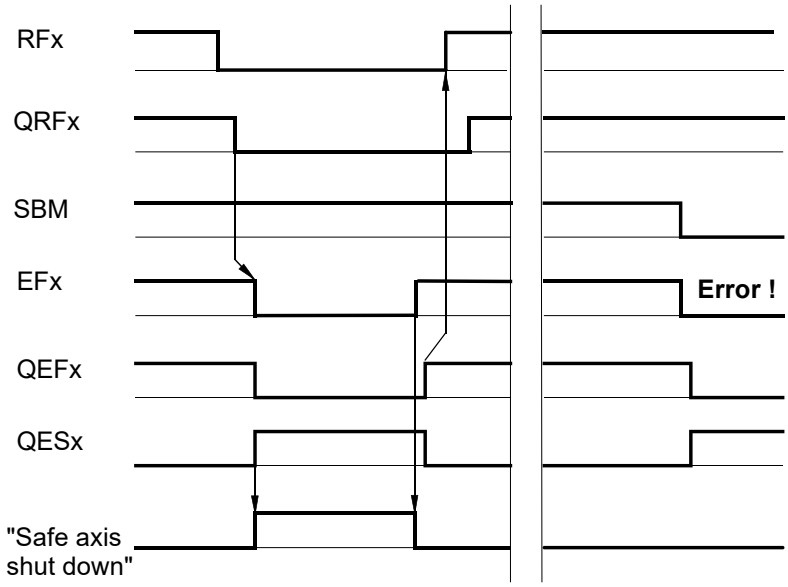
Terminal WQE: +24V_{ext}
24V supply of the relay contact (change-over contact) QEF/QES.

The power side of each inverter can be shut down safely by interrupting input EF and failsafe evaluating of the handshake signals QEF and QES (see table below) in the higher ranking controller.

Logical states for Power Output Enable EF with handshake signals QEF/QES

Control input EF Power output enable		Handshake Power Output QEF enabled	 QES disabled
inactive	0	0	1
active	1	1	0

Pulse diagram for use of „Power output enable EF“:



10.4 Motor PTC resistor X54 (Plug-in terminal block):

Terminal RT1, RT2: Connections for the motor PTC resistor
The resistance of the motor PTC resistor is approx. 170 Ω at approx. 20°/68°F.Thermal protecion through a positive temperature coefficient thermistor (PTC).

Ratings: R_{PTC} < 1650 Ω at 140°C -5°K
R_{PTC} > 3990 Ω at 140°C +5°K

Terminal 12P, 12N: For AMK service purposes only

Terminal SSS: Not used

10.5 Analog inputs

Analog inputs A1, A2, X159 (D-SUB, 9-pole, female connector)
(AW xx/yy-2 with controller card AW-R01):

Analog inputs A1, A2, X59 (plug-in terminal block)
(AW xx/yy-3 with controller card AW-R02):

Two analog inputs are provided for setpoint values and torque limiting via analog voltage ± 10V. They are designed as differential inputs.
The resolution is 12 bits for ± 10V. Interrogation by the microcomputer is performed cyclicly every 250 µs.
Depending on the selected operation mode analog input A1 serves as input for speed or torque setpoint value.
By variation of the input voltage at analog input A2 torque limitation is effected.

Maximum permissible input voltage at A1/A2 is ± 12V!

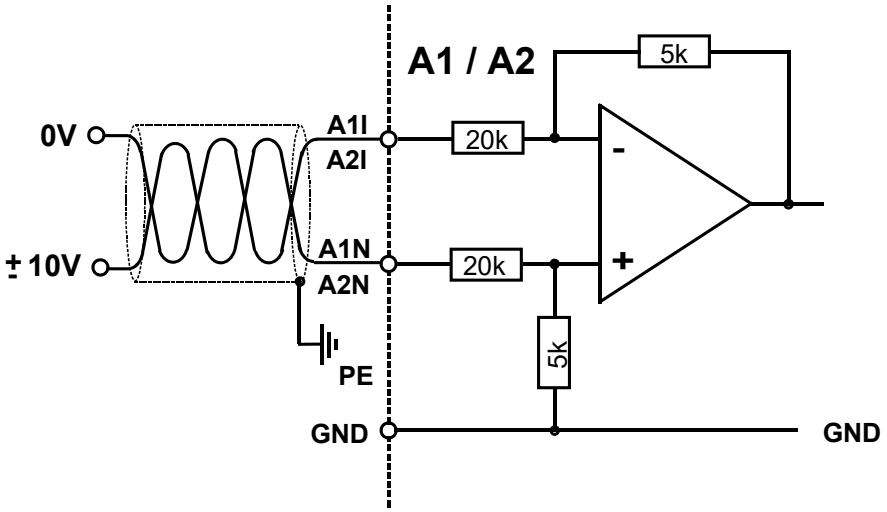
X159

Pin 4: A1I	Analog input A1 (inverting)
Pin 3: A1N	Analog input A1 (not inverting) (differential input)
Pin 1: A2I	Analog input A2 (inverting)
Pin 9: A2N	Analog input A2 (not inverting) (differential input)
Pin 5: 05P	
Pin 2: GND	
Pin 6: GND	
Pin 7: GND	
Pin 8: GND	

X59

A1I	
A1N	
GND	
A2I	
A2N	
GND	
not used:	**SPV**
not used:	**SPW**
not used:	**SSS**

Connection via twisted-pair shielded cable. The shield must be grounded at the AW end through the metallized D-SUB housing (X159) respectively the cable shield must be connected to the AW housing (X59).



11 AW module exchange

Important information:

1. **MASTER SWITCH OFF: Await DC BUS discharging time > 3 minutes!**
2. Remove module front cover.
3. Note position of the rotary coding switch „AWN“ (AW number).
4. Loosen strain relief and cable shield connection for all cables.
5. AW xx/yy-2: Remove D-SUB connector X156 (and X159 if used) after loosening of the fixing screws. Use extraction tool to disconnect plug-in terminal blocks X54, X58.

   AW xx/yy-3: Use extraction tool to disconnect plug-in terminals X54, X56, X58 (and X59 if used).
6. Loosen the ribbon cable connectors (bus cable) X27/X57 at the preceding module and X57 at the AW module by pressing the two locking clips to the left.
7. If AW-IWx is installed: Loosen fixing screws at D-SUB connector X60 and disconnect it.
8. Disconnect fan connector X53 from the following AW module and X23/X53 at the preceding. For this loosen the latching at the narrow connector edge by pressing with your fingers.
9. Unscrew DC BUS connections UZP (red) and UZN (blue) at X52 from the following AW module and X22/X52 at the preceding module.
10. Unscrew motor connection terminals U, V, W (X51). Be aware of clear wire marking.
11. Unscrew PE connections at AW module and loosen motor cable shield.
12. Loosen module fastening screws at the mounting panel.
13. Slightly lift the module and take it out towards you.
14. Insert the new AW module with the same specification, lower it and securely tighten the fastening screws.
15. Securely tighten PE connections at AW module and connect motor cable shield to the front cover.
16. Securely tighten motor connections U, V, W.

Warning

Pay attention to the correct phase-sequence! Incorrect phase-sequence reverses motor direction! By this false control direction!

Switching on with false phase sequence results in an uncontrolled rotation of the motor shaft with possible damages in the installation!

17.* Securely connect DC BUS UZP (red) and UZN (blue) at X52 and X22/X52 at the preceding module.

18.* Insert and latch fan connector X53 (from following module) and X23/X53 at the preceding module.

19. If AW-IWx is installed: Insert D-SUB connector X60 in AW-IWx socket and secure it by the two fixing screws.

20.* Insert ribbon cable connector (bus cable) X27/X57 at the preceding module and X57 at the AW module. For this raise both locking clips slightly and then plug-in the connector without force until locking clips close.

21. Insert plug-in terminal blocks X54, X58 into the respective sockets.
AW xx/yy-2: Insert D-SUB connector X156 (and X159 if used) and secure with both fixing screws.
AW xx/yy-3: Insert plug-in terminal blocks X54, X56, X58 (and X59 if used) into the respective sockets.

22. For strain relief and cable shield connection fix all cables to the bare metal front panel with cable ties.

23. Set the rotary coding switch „AWN“ to the same value (AW No.) as selected at the just removed AW module (as noted under item 3) using a small screw driver.

24. If the AW module in the extreme right position was exchanged, then withdraw the bus terminating card AW A from socket X57 (BUS) at the removed AW module and insert it into X57 at the new AW module.

25. Put in the module front cover.

26. MASTER SWITCH ON. Activate UE and RF.

27. **For motors with A type encoder the encoder adjustment procedure now must be initiated through AZB panel (c.f. chapter 13).**

* **Information for exchange of an inverter module AW 50/75 (old model with 370 mm / 13.39“ width) against an inverter module AW 50/75-3 (new model with 170 mm/ 6.69“width):**
For exchange the new module AW 50/75-3 is supplied with an additional adapter base. Thus the original fixing holes on the mounting plate in the control cabinet can be used again.
To override the width difference between the old and the new AW module a spare cable set AW 50/75 (T-Nr. 45866) is supplied, consisting of:

- Extension DC BUS, 325 mm / 12.8“ long
- Extension Fan BUS, 200 mm / 7.87“ long
- Extension Communication BUS, 200 mm / 7.87“ long

The extension „DC BUS“ is directly connected to the terminals at the AZ and at the AW module. The extensions „Fan BUS“ and „Communication BUS“ are simply interconnected.

12 Information for motor exchange

For all mechanical works contact the machine manufacturer, follow his instructions for motor disassembling and assembling again!

1. **MASTER SWITCH OFF: Await DC BUS discharging time > 3 minutes!**
2. Remove motor terminal box cover plate by loosening of the 4 screws.
3. Be aware of clear wire marking in the terminal box! Loosen motor connections U, V, W, PE, cable shield and PTC resistor connections.

   If used: Loosen connections for holding brake and motor fan.
4. Loosen all screwed cable glands.
   Pull out all cables including the cable glands of the terminal box.
5. Loosen knurled nut of circular motor encoder connector. Disconnect motor encoder connector.
6. **Disassemble motor, assemble new motor according to the instructions of the machine manufacturer.**
7. Insert cables with cable glands into motor terminal box. Tighten cable glands safely.
8. Carefully connect all wires to the corresponding terminals. Connect PE and cable shield.

Warning

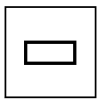
Caution:
Incorrect phase sequence U, V, W reverses motor direction, by this false control direction!

Switching on with false phase sequence results in an uncontrolled rotation of the motor shaft with possible damages in the installation!

9. Close tight the cover plate of the motor terminal box by tightening the 4 screws.
10. MASTER SWITCH ON.
11. Only for motors with encoder type A
    (motor designation DV [DH] -xx-yy-4**A**...,
    option card AW-AG1 / AW-IWA must be installed on controller card AW-R01 on AW xx/yy-2):
    Before start of the process the encoder adjustment procedure must be initiated through AZB panel (c.f. chapter 13).

13 Encoder adjustment

(Only for motors with "A" type encoder)



ENC.ADJUST.	SERVICE
ERR:RESET	SYSTEM

Shift

F3
F1

Password:
* * * * * *

(ENC.ADJUST.)

Enter password („1 2 3 4 5").

CR

Enter AW-No.	# 0

Enter AW-No.

CR

Rotate motor shaft	
MANUAL	JOGMODE

F4
F2

(JOGMODE)

Enter speed:
RPM

Enter low speed, e.g. 255 RPM.

CR

ABORT	
cw-rot.	ccw-rot.

As long as one of the softkeys F3 F1 (cw rotation) or F4 F2 (ccw. rotation) is pressed, the motor shaft is rotating. For safe operation the motor should be without load during encoder adjustment procedure.

CAUTION at operation with coupled load! It is the operators responsibility to prevent possible collisions!

Rotate motor shaft (if necessary with change of direction) until the following message is displayed:

Encoder data are stored

After acceptance of the new data into the EEPROM, the following message is output:

Successful enc. adjust
CONTINUE

Start of the normal operation.

14 Impressum

Title **AMKASYN Inverter Modules AW**

Objective Hardware description of the Inverter Modules AW

Part-Number 27862

History

Date
2000/44
2002/22

Disclaimer We reserve the right to change the contents of the documentation and the availability of products at any time without prior notice.

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- Nameplate data
- Software version
- System configuration and application
- Description of problem and presumed cause of failure
- Diagnostic message (error code)

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