AMKASYN
Servo inverter KE/KW
Option card PLC
KU-PLC2 / KW-PLC2

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- Information located on the ID plate of the devices
- the software version
- the device setup and application
- the type of malfunction, suspected cause of failure
- the diagnostic messages (error messages)

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Content

1 Abbreviations and explanations

AE-PLC	**A**MKASYN **E**xtention PLC (for example KU-PLC, KW-PLC)
AMK Tools	Auxiliary programs for transferring .ccf files
Arbitration	Bus access procedure; method by which access to the bus is controlled. Conflict resolution if several stations simultaneously want to send a message.
Broadcasting	Describes the possibility to address all network participants simultaneously.
CAN	**C**ontroller **A**rea **N**etwork
ccb	**C**AN **C**onfiguration **B**inary File Type *.ccb
ccf	**C**AN **C**onfiguration **F**ile *.ccf
CiA	**C**AN **i**n **A**utomation, international users and manufacturers group.
Emergency Service	Mode for erroneous bus behaviour in the event of failure of one or several participants.
Telegram header	Header information of a message (for example the priority)
ID number	Parameter for parameterisation of the AMKASYN system
NMT service	Network management service (network initialisation, bus error monitoring, status monitoring) for the individual devices.
Node Guarding	Network node guarding, performed by the NMT master.
NVRAM	**N**on **V**olatile **R**andom **A**ccess **M**emory
Parameter	(ID no) used to parameterise AMKASYN systems
KE/KW	AMKASYN **Compact power supply module / Compact inverter module**
KU	AMKASYN Single drive series **KU**
KU-PLC	AMKASYN option card for the KU system
KW-PLC	AMKASYN KE/KW option card PLC (**p**rogrammable **l**ogic **c**ontroller)
KW-PLC1	AMKASYN KE/KW option card PLC1 (**p**rogrammable **l**ogic **c**ontroller)
KW-PLC2	AMKASYN KE/KW option card PLC2 (**p**rogrammable **l**ogic **c**ontroller)
Life Guarding	NMT slave monitors whether the network node guarding is performed by the NMT master.
PDO	**P**rocess **D**ata **O**bject
PLC	**P**rogrammable **L**ogic **C**ontroller
R-PDO	**R**eceive **PDO**
SDO	**S**ervice **D**ata **O**bject
T-PDO	**T**ransmit **PDO**

2 Short description

The KU-/KW-PLC2 (**KW P**rogrammable **L**ogic **C**ontroller) is an option card for the AMKASYN drive systems KE/KW and KU. It can be used with controller cards from version KU-/KW-R02 upwards. The option card is plugged into one of the option slots and inserted into a compact inverter as plug-in unit.

Installation of the option card PLC2:

KU inverter: **KU-PLC2 (AMK Part No.: O772) on controller card from KU-R02 upwards** in slot 2

KW inverter: **KW-PLC2 (AMK Part No.: O750) on controller card from KW-R02** upwards in slot 1 or 2.

The KU-/KW-PLC2 has an integrated programmable logic controller (PLC) for programming drive-related tasks, in accordance with IEC 61131-3. Additionally the option card offers a hardware-synchronised CANopen interface, named CAN-S, for connection to a CAN Bus network.

Two “fast” binary inputs, which can be used as interrupt inputs, support PLC functions such as register control, measuring functions, etc.

In addition to the program and data memories, the application memory of the PLC provides a RETAIN memory (NVRAM non-volatile memory) for application data. If the supply voltage of the PLC option card drops below a certain limit, all RETAIN variable values are saved in the NVRAM and will be available again when the PLC program is powered again (POWER ON).

An RS422 interface is available, for example for connecting an external operating panel (such as a touch screen). The interface enables data exchange between the PLC and the external operating panel by means of the MODBUS protocol.

2.1 CAN BUS interface

The CAN interface corresponds to the CiA CAN 2.0B standard, and the CANopen protocol corresponds to the DS301 standard, version 4.01.

With the KU-/KW-PLC2 option card, it is possible to connect to a CAN Bus network as CAN Master or as CAN Slave.

Systems in which the KU-/KW-PLC2 is implemented can be used as either centralised or decentralised intelligent stations in the CAN network.

To meet the demands in the field of drive technology, the CAN interface of AMK offers - in addition to the standard CAN data channel - a sync clock signal as a supplement. This is called CAN-S. With CAN-S, the internal processing cycles of various AMK bus stations are synchronised to each other, with jitter <1ms.

BUS stations can easily be added to or removed from the CAN BUS network.

In the CAN network, the KU-/KW-PLC2 networks decentralised single-axle drives with various tasks. This network offers data transmission in real time, for example a synchronised set value and the corresponding current actual values of the participating axles.

The CAN-S interface consists of the CAN data channel and a sync clock signal that is used to synchronise all AMK bus stations to the same master clock.

2.2 PLC programming in accordance with the IEC 61131-3 standard

The PLC is programmed using the programming languages of the IEC 61131-3 and a Windows-based software (CoDeSys, a product of the 3S-Smart Software Solutions GmbH).

Thanks to the integration of the AMK libraries, the programmer has an extensive range of drive-related functions (positioning functions, table interpolation, PID controller, cam control unit, register mark control etc.) at his disposal. The AMK PLC function libraries are fine-tuned to the target system KU-/KW-PLC2.

The PLC communicates with the PC by means of the RS232 interface (COM1 or 2 connected to the serial interface on the controller card of the AMKASYN system).

Technical data:	Performance:	approx. 4250 commands/ms (STL instructions/ms, Z:=X AND Y → 3 STL instructions)
	Processor:	ST10F276 technology
	ROM (Flash):	384 kB program memory
	RAM:	128 kB data memory (volatile)
	NVRAM:	32kB RETAIN memory (non-volatile data memory)
	Ext. interfaces:	CAN-S (CANopen), RS422

3 Installing the KU-/KW-PLC2 option card

3.1 Important information for handling

Avoid touching the electrical connections and contacts on the solder and component side of the option card; static discharge can destroy components. Before handling the option card, discharge by touching the PE.

3.2 Installation instructions for the KU-/KW-PLC2

NOTICE

Electronic components could be destroyed through static discharge!

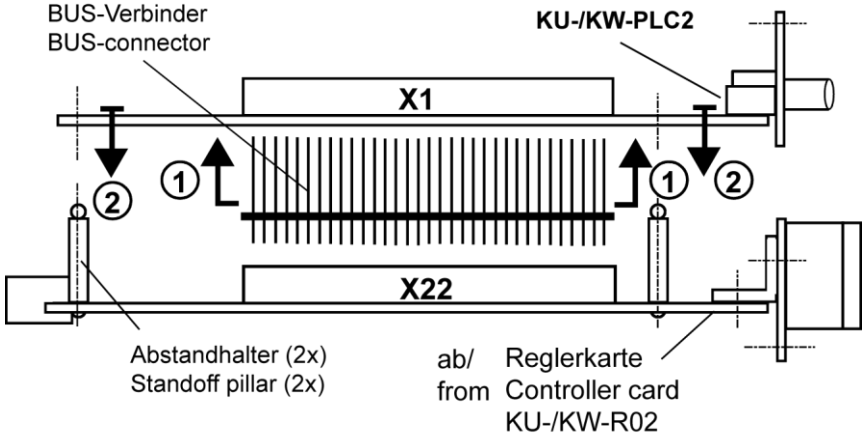
Therefore touching of the electrical connections on the card (e.g. option card, controller cards) must be avoided.

Steps to prevent:

Before handling the electronic component discharge yourself by touching PE.

The option card must be plugged into the controller card (KU-/KW-R02 and upwards) and inserted into one of the slots (both slots are covered by a blind plate at delivery):

1. Make sure that the AMKASYN system is free of voltage.
2. Remove the blind plate by loosening the two captive screws.
3. After you have loosened both captive screws (on the right edge), pull out the controller card. If one of the option slots is already occupied, loosen the collar screws at the left edge of the front panel and carefully pull out the unit formed by the controller card and the option card. Put the removed plug-in card down on a non-conductive, cushioned surface only.
4. Press the two lockable plastic standoff pillars into the corresponding bore holes on the circuit board of the controller.
5. Press the longer pins of the bus connector entirely into the socket of the KU-/KW-PLC2 option card.
6. Plug the short pins of the BUS connector on the KU-/KW-PLC2 into the socket on the controller card, and simultaneously press the standoff pillar into the bore holes on the circuit board of the KU-/KW-PLC2.

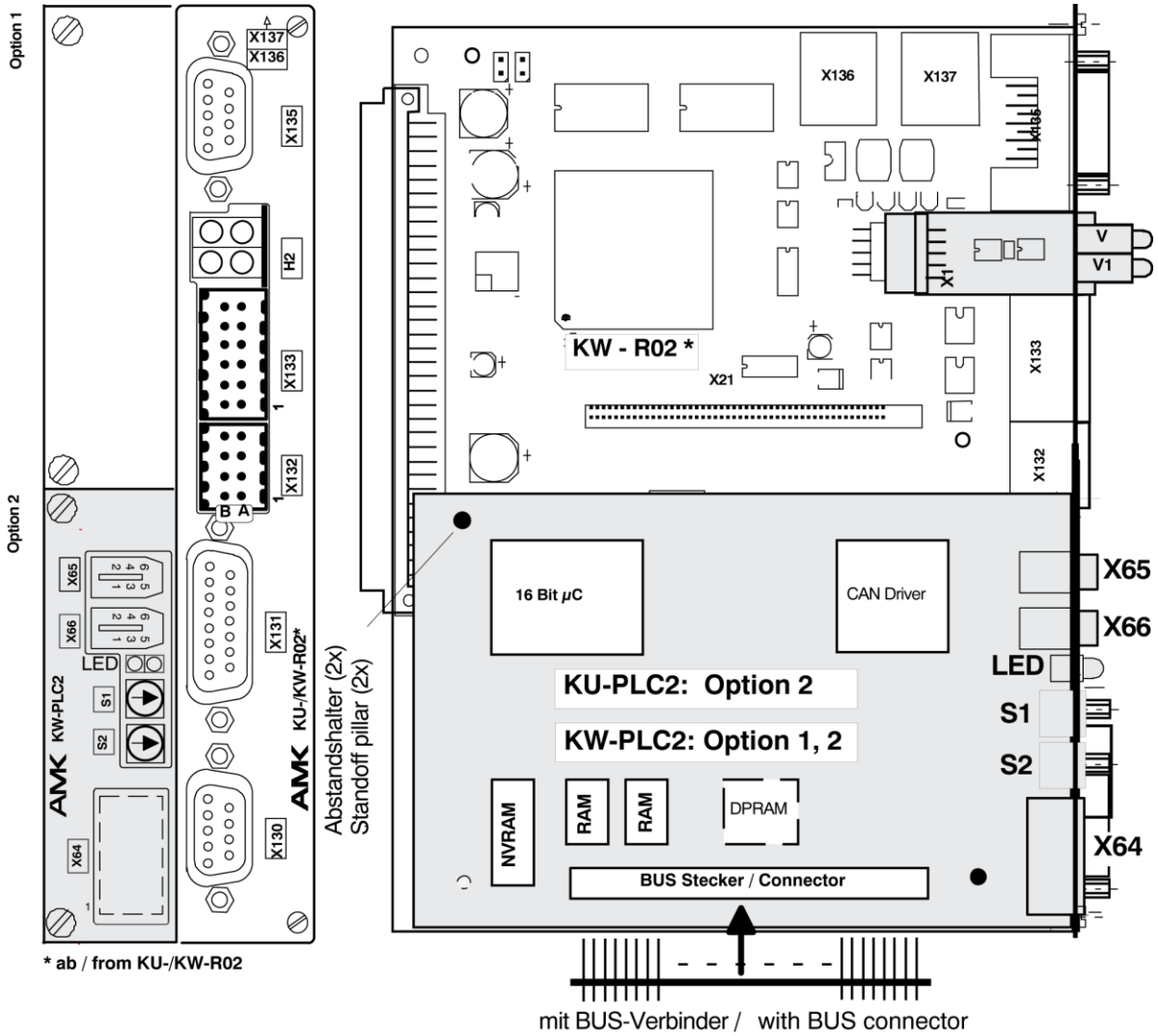


picture name: ZCH_KUKW_PLC2

7. Carefully slide the unit formed by controller card and the PLC2 option card into the card slot, until the controller card is firmly positioned in the slot.
8. Tighten the captive screws on the controller card and the PLC2 card.

3.3 Structure of the front panel and the circuit board

KU-/KW-PLC2: Structure of the front panel and the circuit board



picture name: KUKW_PLC2_Frontplatte

4 Interfaces and pin assignment

4.1 CAN Bus interface

KU-/KW-PLC2:
X65 CAN-S input
X66 CAN-S output

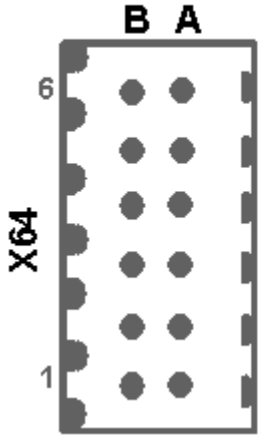
IEEE1394 socket

PIN	X65 CAN-S IN	X66 CAN-S OUT
1	GNDx	GNDx
2	GND	GND
3	CAN_S_H	CAN_H
4	CAN_S_L	CAN_L
5	CAN_H	CAN_S_H
6	CAN_L	CAN_S_L

The CAN BUS network must be terminated with a 120 W bus-terminating resistor between CAN_L and CAN_H, as well as CAN_S_L and CAN_S_H, at the first and last station.

4.2 RS422 Serial interface / binary inputs

Connector:
WEIDMÜLLER, 12 poles, male



B6	E2-	**A6**	E2+	$0V_{ext}$ / $+24V_{ext}$, Binary input E2
B5	E1-	**A5**	E1+	$0V_{ext}$ / $+24V_{ext}$, Binary input E1
B4	5P	**A4**	GND	+5V / GND, max. 1A
B3	TxD-	**A3**	TxD+	- / +, Transmit Data
B2	RxD-	**A2**	RxD+	- / +, Receive Data
B1	Ter-	**A1**	Ter+	RS 422 termination RxD by jumper between A1 - B1

picture name: ZCH_KUKW_PLC_serielleSchnittstelle

The RS422 interface can be set to the required communication mode (e. g. MODBUS for an external operating panel) by means of the PLC user program.

The two 24V DC binary inputs, E1 and E2, are optically isolated from the internal voltage supply.

A real-time registration of the two binary inputs (≤ 200ns) in the PLC program is possible if the associated function block is activated.

4.3 Rotary coding switch

The bus station's address can be set on the front panel, by means of the hexadecimal coded rotary switch. A value between 0 and 127 can be selected. The numeric value that has been set is recognised as bus station address when the bus is initialised, and is adopted into parameter ID34023.

S1 → low NibbleS2 → high Nibble

If both switches has been set to 0, the value in ID34023 “Bus station address” is valid. Addresses 2 - 127 are permitted as slave addresses (address 1 is reserved for the master). The selected addresses must match those of the CAN description file, in the “CAN Configuration File” (.ccf).

4.4 Light-emitting diodes

The two LEDs on the front panel indicate the current status of the CAN interface as well as the PLC software:

LED	Colour	Explanation
1	Red	KU-/KW-PLC2 in Error Mode: Read out the error number, e.g. by using the operating panel, then get further information from "Diagnostic messages" documentation
2	Green	**Via ID32799 PLC function: ON** LED is reset at the start of a PLC cycle LED is set at the end of a PLC cycle **Via ID32799 PLC function: OFF, CAN-S: ON** The status indicator flashes every 2 s, as follows: 1x CAN Initialisation 2x PREOPERATIONAL 3x CAN STOPPED 4x OPERATIONAL Short flashing impulses (ON for 50 ms) between the status indications signal that messages are being transmitted.

5 Parameter settings

To synchronise the CAN master with the slaves, all drives have to have the same cycle time settings. This is then guaranteed if all stations are assigned the same value in ID2 “SERCOS cycle time” and ID32958 “Cycle time, 16bit position setpoint value”.

The “Bus transmission rate” (ID34024) also must be the same for all stations.

5.1 Communication parameters

See also ID32799 configuration periphery for activate/deactivate field bus and/or programmable controller PS functionality.

ID-Number	Name	Value	Designation
ID34023	Bus participant address	e.g. 5h	e.g. 5h 1)
ID34024	Bus transmission rate [kbit/s]		range: 10kBaud – 1 Mbaud 3)
ID34025	Bus mode	0h 2h	Bit 1 = 0: CAN Slave Bit 1 = 1: CAN Master
ID34026	Bus mode attribute		4)
ID34027	Bus failure behaviour		see ID34027
ID34028	Bus output rate		not yet supported

1. The Bus participant address is valid, if the hexadecimal rotary coding switches S1 and S2 on the option card Kx-PSC/PLC are set to zero. Is the value unequal to zero the value of S1, S2 will be set to ID34023. The range of participant addresses is (01h to 7Fh) 1 … 127.
2. Entry of value 2h sets this axis as CAN BUS master
3. Permissible values:

1000,001Mbaud;
500,00 500kbaud
250,00 250kbaud
125,00 125kbaud
50,00 50kbaud
20,00 20kbaud
10,00 10kbaud

If invalid value is entered the transmission rate will be set to the default value of 20 kbaud.

4) ID34026 "Bus mode attribute"

this parameter defines the differentiating features of the CAN Bus

Bit-No.	Value	Meaning
1	0	**Signal receiver: Receive hardware SYNC signal** Inactive
	1	Active
2	0	**Signal receiver: Check hardware SYNC signal** Inactive
	1	Active (Error message is generated if synchronization is lost)
3	0	**Hardware synchronization cycle sender** Inactive
	1	Active (signal is sent)
4	0	**The master monitors the presence of slave nodes while rebooting ACC-Bus** All configured nodes must be present, else an error message is generated.
	1	Missing nodes are not initialised and no error message is generated.

Bit-No.	Value	Meaning
5	0	**AMK Service: PGT in place of CANopen SYNC Message COB-ID80** Synchronous messages are sent upon receipt of the SYNC object COB-ID80
	1	Synchronous messages are sent as a result of the hardware synchronisation signal; no SYNC object COB-ID80 is required.
6	0	**Reinitialisation of ACC-bus with "Delete error"** If errors occur that do not affect the ACC-Bus, it remains active despite these errors. No CAN bus initialisation after "Delete error"
	1	The ACC-Bus is automatically reinitialised with "Delete error"
9	0	**Slaves are waiting for initialisation by the NMT master** Slave waits 60 seconds for initialisation by the NMT master. An error message is then generated
	1	Slave waits unlimited time for initialisation by the NMT master. (For use with masters with very long boot times).
11	0	**CAN network with NMT master** Network consists of several slaves and one NMT master
	1	**CAN network without NMT master** Devices without bus master (NMT master) are activated in slave mode and the ACC bus is switched to "preoperational mode". This facilitates SDO transfer (For use in connecting PC software (e.g. AIPEX or CoDeSys to a KU/KW device via CANopen)).
12 – 15		**Bus master (NMT network management): startup delay** [1)] Queue time prior to initialisation of slaves in seconds (max. Fh = 15 s)

1) During bus initialisation the master can find only devices which are in "Pre-operational" state. Each slave changes automatically into "Pre-operational" state after successful initialisation. The time delay for initialisation must be set so that the slave initialisation is ready before the master initialises. The following table shows the initialisation times for different devices with different encoders types. Meassured is the time from 24VDC ON until state "Pre-operational" is reached.

Device	initialisation time [s]										
encoder type	**B**	**C**	**E**	**F**	**I**	**P**	**Q**	**R**	**S**	**T**	**others**
KW-R03, KU-R03	-	-	5	5	4	-	-	3	5	4	-
KW-R04	-	-	-	-	-	-	-	3	-	-	-
KWZ	-	-	-	-	-	9	9	9	-	-	-
IDT	9	9	-	-	-	-	-	-	-	-	-
KE, KES	-	-	-	-	-	-	-	-	-	-	5

After the delay time for master initialisation according ID34026 is over, the master switchs all slaves into state "operational". The initialisation time can be calculated like that:

$T_{V,Master} > MAX(T_{H,\ Slave}) - T_{H,Master}$

$T_{V,Master}$: initialisation delay time master

$T_{H,Slave}$: initialisation time slave

$T_{H,Master}$: initialisation time master Master

Example:

The example configuration includes the following devices with the attendant initalisation times:

Master/Slave	Device	Initialisation time[s]
Slave	1x KE	5
Slave	1x KW-R04	3
Slave	1x KW-R03 mit F-Geber	5
Slave	2x IDT mit B-Geber	9
Master	KW-R03 mit T-Geber	4

$MAX(T_{H, Slave}) = 9s$, $T_{H,Master} = 4s$

$T_{V,Master} > 5s$

All connected slaves will be detected from the master if the master initialisation is delayed for more than 5s.

Example parameter setting ID34026

Master:

ID34026 = 7048h- 7 sec. delay time for initialisation
- all configured nodes are checked of presence
- new initialisation of the bus after error reset
- hardware synchronization ON

Slave:

ID34026 = 6h - Hardware synchronisation slave ON
- Check synchronisation slave ON

5.2 System parameters

ID32799 Configuration of peripherals

These parameters define the following:

- Pulse form at the square-wave input channel
- Activation/deactivation of PLC function
- Activation/deactivation of CAN-S Bus function

Bit-No.	Value (hex)	Meaning according to ID32799
0 - 1	0	**Setting code for squarewave pulses input (X34)** 2 squarewave pulses in quadrature (90° offset between track 1 and 2)
	1	Counting pulses track 1, direction signal track 2
	2	Forward pulses track 2, backward pulses track 2
2 - 15		Reserved
16 - 19	0	**PLC function on the PLC option card** PLC function deactivated (default) if the PLC option card is plugged in, error message 1376 is generated, hint to activate or deactivated the plc function
	1	PLC on the PLC optin card KW-PLCx is active
	2 – E	Reserved
	F	PLC on the KW-PLCx is deactivated, no error message will be generated
20 - 23	0	**CAN-S Bus on the PLC option card** CAN-S bus on the PLC option card is deactivated (default). If the PLC option card is plugged in, error message 1376 is generated, hint to activate or deactivate the CAN-S bus on the PLC option card
	1	CAN-S bus on the PLC option card active
	2 – E	Reserved
	F	CAN-S bus on the PLC option card is deactivated, no error message will be generated
24 - 31		Reserved

Example:

ID32799 = 00 11 00 00h

- 2 square-wave pulses in quadrature (90° offset)
- CAN-S active
- PLC active

☞ All square wave input signals must have a defined level, else the listed functions cannot be guaranteed.

5.3 Position parameters

ID32958 Cycle time, 16 bit position setpoint

The scanning procedure for the 16 bit position setpoints (for example the set pulses for synchronous operation) can be specified in steps of 0.5 ms.

☞ If the “16 bit position setpoint” source is selected (for example by the PLC card), it is necessary to enter the matching value to ID2 “SERCOS cycle time” in ID32958.

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