M0007034C

SANMOTION

MOTION CONTROLLER

C

Automation System

Project Engineering Manual

SANYO DENKI

E

ENGLISH

Notes on This Manual

At various points in this manual you will see notes and precautionary warnings regarding possible hazards. The meaning of the symbols used is explained below.

⚠ DANGER

- **DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING

- **WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

⚠ CAUTION

- **CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

CAUTION

- **CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property injury.**



This symbol reminds you of the possible consequences of touching electrostatically sensitive components.

Note

Notes on use of equipment and useful practical tips are identified by the "Notice" symbol. Notices do not contain any information that draws attention to potentially dangerous or harmful functions.

History

Modification from / to	Date	Modified pages	Description	Author
V1.0 /	200505		new	meis
V1.0 / V 1.1	270505	47 - 60	changes to chapter "Operting behavior"	meis
V1.1 / V 1.2	130605	15	new chapter "Mounting rail"	meis
V1.2 / V 1.3	230605	41	new modules in chapter "Power consumption of modules"	meis
V1.3 / V 1.4	280605	52	Error E207, E210 and E211 deleted	meis
V1.4 / V 1.5	290605	46 - 59	Update chapter "Operating behavior"	meis
V1.5 / V 1.6	280705	10 – 18	New chapter "Brief Description of CPUs and Modules"	meis
V1.6 / V 1.7	201205		Various changes	meis
V1.7 / V 1.8	030306	54	Changes to chapter "Compact Flash"	meis
V1.8 / V 1.9	100706		Various changes	meis
V1.9 / V 1.91	120906		Bending radii for cables added	meis

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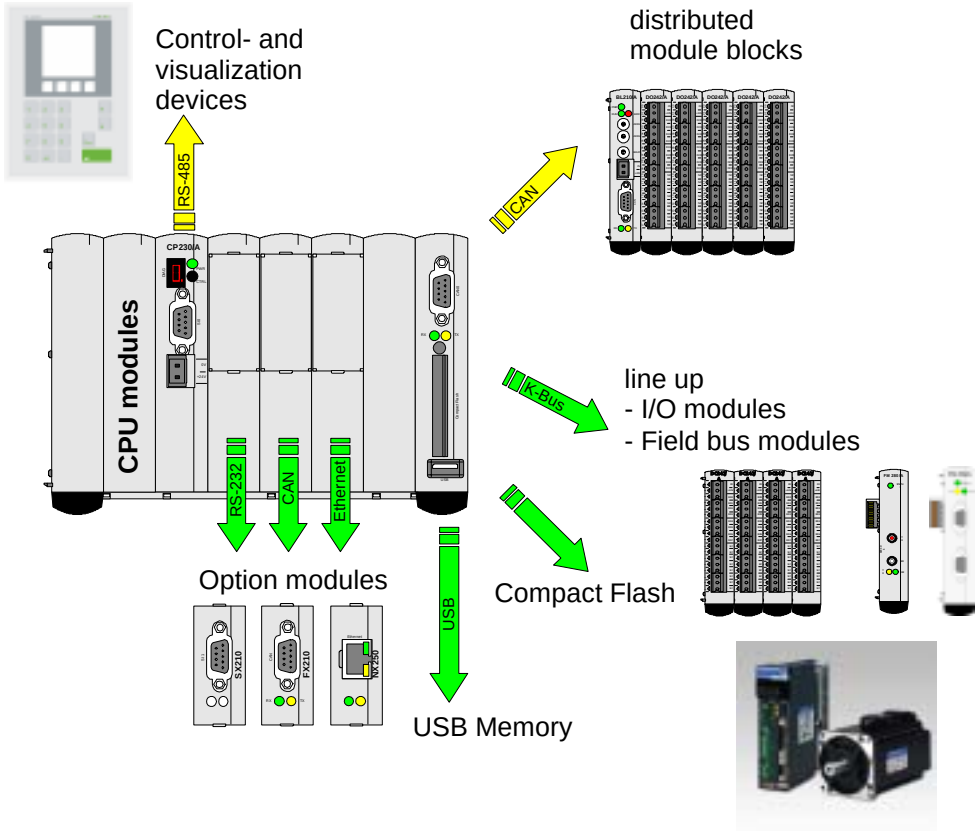
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Overview of the system structure of the SANMOTION C

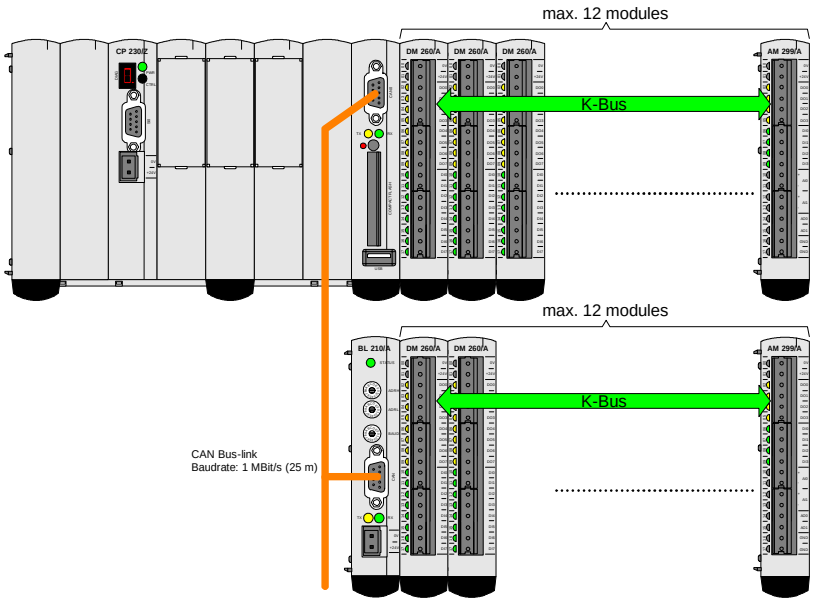
The field of application of the SANMOTION C system is the general automation of machines and plants. The system is based on a modular concept and can be structured according to specific functional requirements. It consists essentially of a selection of CPU-modules, I/O-modules and operating and display instruments. CPU and I/O-modules are joined together and form a control block that can then be installed into a control cabinet. The operating and display devices can be arranged at a suitable located somewhere on the machine/plant. For the adoption to various different interfaces, option modules are slotted into the CPU-modules. The casing provides mechanical protection, the inner construction of the module guarantees EMC shielding.



Example of a system structure with central processor module and periphery

The module clusters can be triggered in different ways:

Connection via CAN (25 meters at 1 Mbit)



SANMOTION C modules in alphabetically order

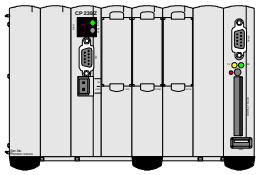
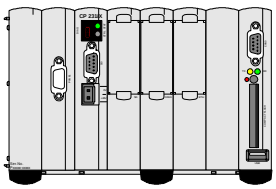
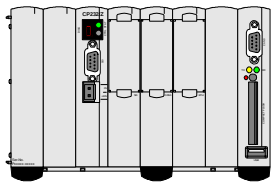
The following list shows all available modules of the SANMOTION C system:

Product name	Function
AM 299/A	Analog / digital I/O module
AM 299/B	Analog / digital / PWM I/O modules
BL 210/A	CAN bus link module
CP 230/Z	266MHz CPU module
CP 231/X	266MHz CPU module with graphic interface
CP 232/Z	400MHz CPU module
DM 260/A	Digital I/O module
DM 262/A	Digital I/O module
DM 276/A	Digital I/O module
FM 280/A	SERCOS Master interface module
FM 299/A	GA1060 Field bus master module
FX 200/A	CAN PHY option module
MM 240/A	Technology module with 2 Encoder interfaces
NX 250/A	Ethernet PHY option module 10/100Mbit
SM 210/A	Serial interface module (RS232)
SM 230/A	Serial interface module (RS485)
SX 210/A	RS232 PHY option module
SX 230/A	RS485 PHY option module

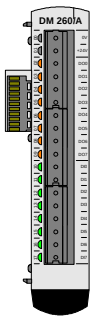
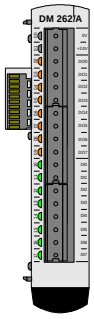
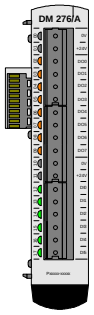
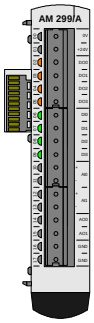
Brief Description of CPUs and Modules

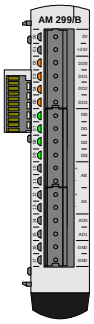
The following lists briefly describe the components to be used in the SANMOTION C system, sorted according to groups with the same purpose of use.
For more details, please refer to the corresponding project engineering manuals.

Central processor units (CPUs)

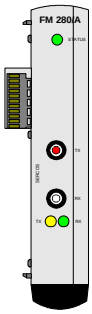
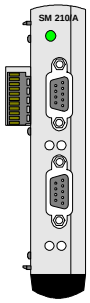
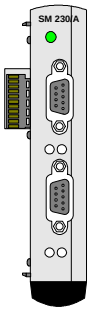
	Product name / picture	Brief description
	CP 230/Z 	**Central processor module** • Motorola PowerPC 266 MHz • 16 MB RAM • Interfaces: CANopen, RS-485, USB • Slots for CANopen, Ethernet and RS-232-C or RS-485/RS-422-A • Compact Flash slot • Dimensions (HxWxD) in mm: 120x180x100
	CP 231/X 	**Central processor module** • Motorola PowerPC 266 MHz • 64 MB RAM • Interfaces: CANopen, RS-485, USB • LVDS-Graphic interface • Slots for CANopen, Ethernet and RS-232-C or RS-485/RS-422-A • Compact Flash slot • Dimensions (HxWxD) in mm: 120x180x100
	CP 232/Z 	**Central processor module** • Motorola PowerPC 400 MHz • 64 MB RAM • Interfaces: CANopen, RS-485, USB • Slots for CAN, Ethernet and RS-232-C or RS-485/RS-422-A • Compact Flash slot • Dimensions (HxWxD) in mm:120x180x100

Input/Output modules (digital, analog)

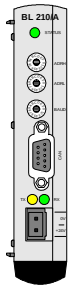
	Product name / picture	Brief description
	DM 260/A 	**Digital input/output module** • 8 digital inputs, of which 2 are interruptible • 8 digital outputs 1 A at 50 % coincidence, short-circuit and overload protected • Dimensions (HxWxD) in mm: 120x22.5x100
	DM 262/A 	**Digital input/output module** • 8 digital inputs, of which 2 are interruptible • 8 digital outputs 2 A at 50 % coincidence, short-circuit and overload protected • Dimensions (HxWxD) in mm: 120x22.5x100
	DM 276/A 	**Digital input/output module** • 6 digital inputs, of which 2 are interruptible • 8 digital outputs 2 A at 50 % coincidence, short-circuit and overload protected • Dimensions (HxWxD) in mm: 120x22.5x100
	AM 299/A 	**Digital/analog input/output module** • 2 analog inputs differential +/-10 V, resolution: 12 Bit, sensor failure detection • 2 analog outputs +/-10 V, resolution: 12 Bit • 4 digital inputs • 4 digital outputs 1 A at 50 % coincidence, short-circuit and overload protected • Dimensions (HxWxD) in mm: 120x22.5x100

	Product name / picture	Brief description
	AM 299/B 	**Digital/analog input/output module** • 2 analog inputs with 10 V reference voltage output (for resistance transducer) resolution: 12 Bit, sensor failure detection • 2 analog outputs +/-10 V, resolution: 12 Bit • 4 digital inputs • 4 digital outputs that can be used as 2 motor bridges, short-circuit and overload protected • Dimensions (HxWxD) in mm: 120x22.5x100

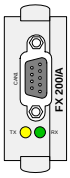
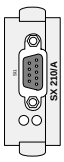
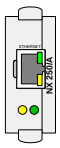
Field bus modules

	Product name / picture	Brief description
	FM 280/A 	**Sercos-interface module** • Sercos connection • Dimensions (HxWxD) in mm: 120x22.5x100
	SM 210/A 	**Serial interface module** • RS 232 • Dimensions (HxWxD) in mm: 120x22.5x100
	SM 230/A 	**Serial interface module** • RS 485/422 • Dimensions (HxWxD) in mm: 120x22.5x100

Bus Connection and Power input modules

	Product name / picture	Brief description
	BL 210/A 	**Bus link module** • CANopen-coupler for K2-200 module cluster • Transmission rate: 1 Mbit/s • Cable length: max. 25 m • Dimensions (HxWxD) in mm: 120x22.5x100

Interface modules

	Product name / picture	Brief description
	FX 200/A 	CAN sub module, Transmission rate: 1Mbit/s
	SX 210/A 	RS-232-C submodule, serial interface module
	SX 230/A 	RS 485 submodule, serial interface module
	NX 250/A 	Ethernet Interface 10/100Mbit

General safety instructions

The SANMOTION C documentation provides the information required for planning the use of the SANMOTION C hardware.

Familiarity with and correct application of the information contained in these manuals is a prerequisite for successful planning and safe installation, commissioning and maintenance of automation systems. Only properly qualified personnel have the required specialist knowledge to correctly interpret and implement the instructions given in this manual.

For reasons of clarity, not every single detail of every version of the products described is listed nor can every conceivable practical situation be taken into consideration. Should you require additional information, please contact your local SANYODENKI representative.

When installing, commissioning and servicing SANMOTION C products, the instructions given in the relevant SANMOTION C documentation must be observed.

These documents are intended for use by **qualified personnel**. These are persons with the relevant technical knowledge in the area of automation systems technology appropriate to the operations they are required to perform.

Handling instructions



When removed from the rack, the modules used in the system are sensitive to electrostatic discharge. Before handling modules, touch a grounded metal object in order to discharge any static electricity from your body.

CAUTION

- **Turn off the power supply before inserting or removing the modules. Otherwise, the modules could be destroyed or undefined signals could damage the control system.**

⚠ CAUTION

- **Unqualified interventions in the control may cause abnormal behavior of the machine/plant or personal injury or damage to the equipment. Only especially qualified staff may perform interventions in the control system.**

Safety instructions for project planning

⚠ CAUTION

- **The instructions contained in these manuals must be precisely followed in all circumstances. Failure to do so could result in the creation of potential sources of danger or the disabling of safety features integrated in the SANMOTION C system.**
- **Apart from the safety instructions given in these manuals, the safety precautions and accident prevention measures appropriate to the situation in question must also be observed.**
- **The 24V power supply for the equipment must be safeguarded by safe isolation of the low-voltage circuits from any hazardous voltage circuits.**
- **Measures must be taken to ensure that, in the event of power dips or power failures, an interrupted program can be properly restarted. In such situations, no dangerous operating conditions must be allowed to occur even temporarily.**
- **Emergency stop systems must remain operational in all automation system operating modes. Resetting an activated emergency stop facility must not result in uncontrolled start-up of machines or installations.**
- **In all situations where faults occurring on the automation system could cause personal injury or significant damage to machinery and equipment, additional external safety measures must be taken in order to ensure the system as a whole remains in a safe operating condition even in the event of a fault.**

Intended use of SANMOTION C products

The products/system components referred to in these manuals may only be used for the types of use described in the technical descriptions and only in conjunction with recommended/approved third-party equipment/installations.

The products referred to have been developed, manufactured, tested and documented in accordance with the appropriate safety standards. Provided, therefore, that the instructions and safety precautions relating to the intended use are properly observed, under normal circumstances the products do not represent any danger to the health of personnel or a risk of damage to other property or equipment.

Requirement for UL-certification

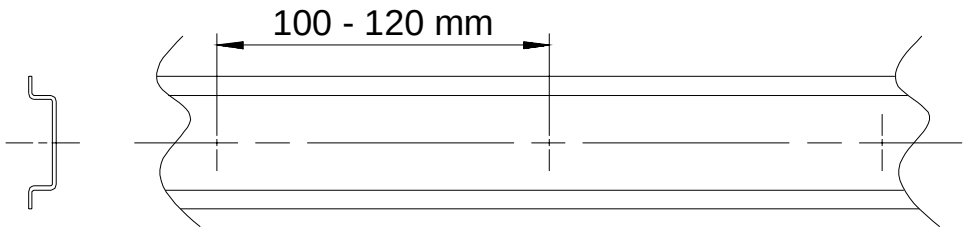
The modules of the SANMOTION C system are "open type equipment"

All modules with a front-side voltage supply must be secured with a series fuse.

Mounting and installation instructions

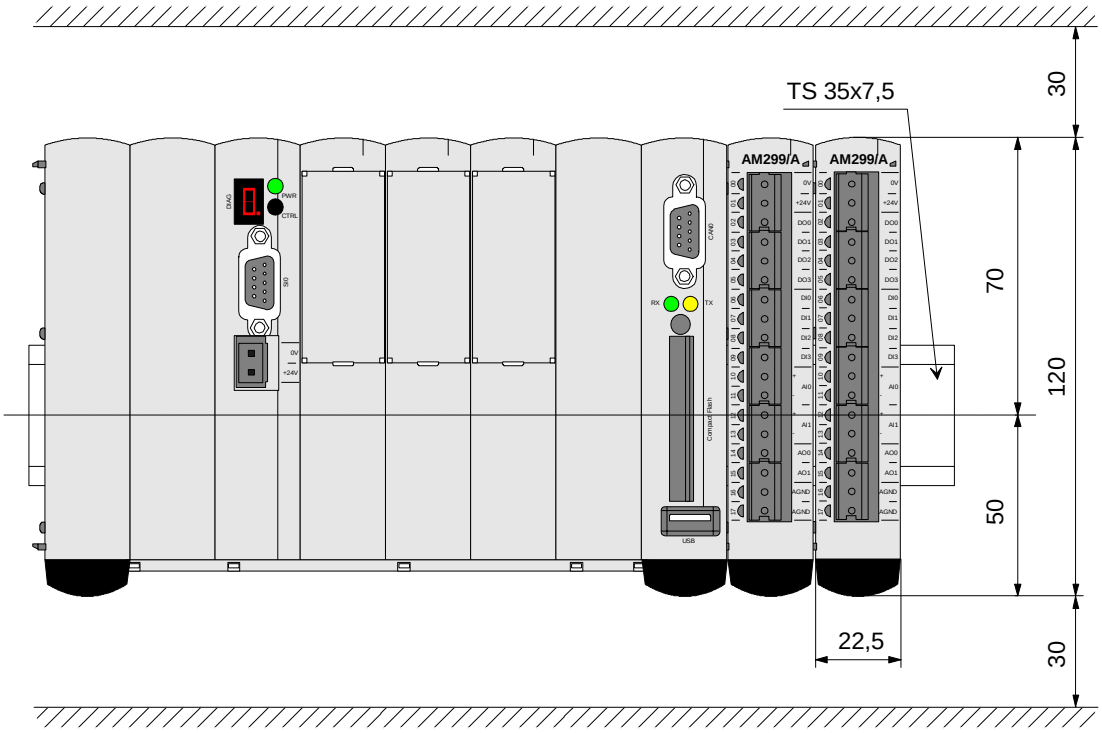
Mounting rail

Because of the stability the screw distance must not exceed 100 - 120 mm (as shown below).



Screw distance for mounting rail

Footprint



Mounting sketch

To ensure air circulation, a free space of at least 30 mm must be maintained over and underneath the modules.

Arrangement of the modules

Up to 12 modules (I/O-, technology or field bus modules) can be lined up next to each other to the right side of the central processor module. The connection between the central processor module and the modules is established via a parallel K-Bus. The entire package is snapped onto a mounting rail (mounting rail TS 35x7,5).

Mounting/dismounting the boards and modules

Mounting:

The individual modules are lined up next to each other and connected to one another via the K-Bus plug. Each line is completely prepared this way before being installed on the mounting rail (TS 35x7.5) as complete package.

Procedure:

Unpack module

Remove all side lids on the K-Bus plug except for the one on the module to the extreme right.

Set address switch with a suitable screwdriver to the setting configured in the application software. The same modules (i.e. those with the same type designation) must be differentiated by the setting of the address switch.

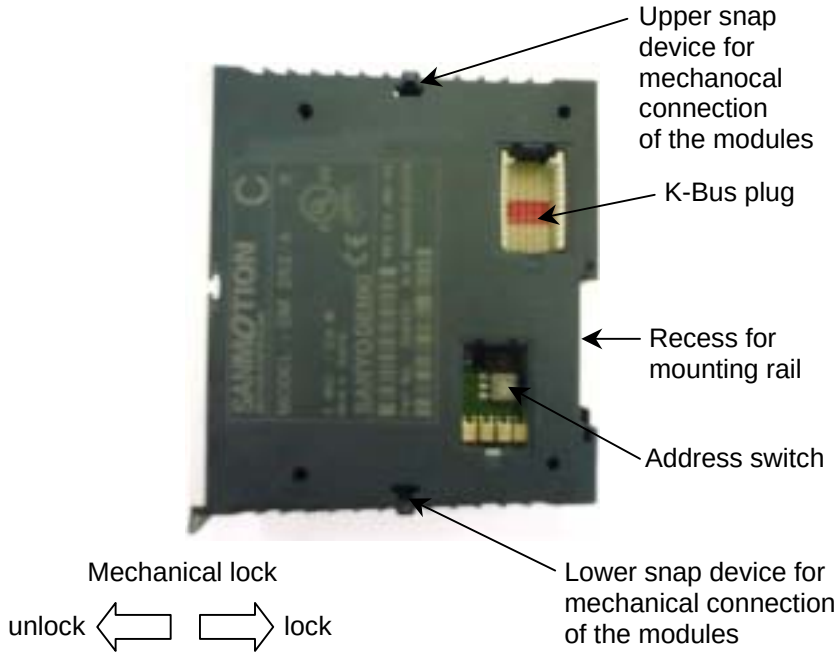
CAUTION

- **Attention must be given when setting the address switch with the screwdriver that none of the surrounding components is damaged.**

Join together the module with the central processor module to form one control block. The central processor module must be positioned to the extreme left, while all the other modules are added on to the right.

Note
When adding extension modules to a central processor module or to an already given add-on module make sure that the locking pins are properly engaged.
Furthermore, ensure that the entire package (central processor module and add-on modules) is secured on either side with device end clamps to prevent it from being displaced and/or protected against vibration.
If the package is not mounted accordingly its functionality may be impaired.

Pull out (unlock) all locking levers on the mounting rail.



Mount control block to mounting rail.

Press in (lock) all locking levers on the mounting rail.

You can now wire-connect the interfaces and the inputs/outputs.

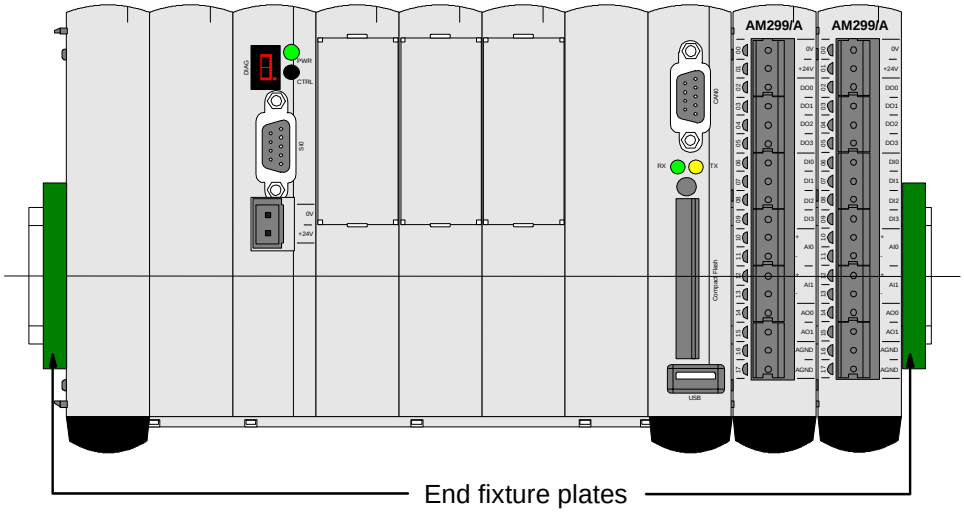
Removing:

Switch of the SANMOTION C system and unplug from mains supply.

Go through all the mounting steps in reverse order.

End fixture

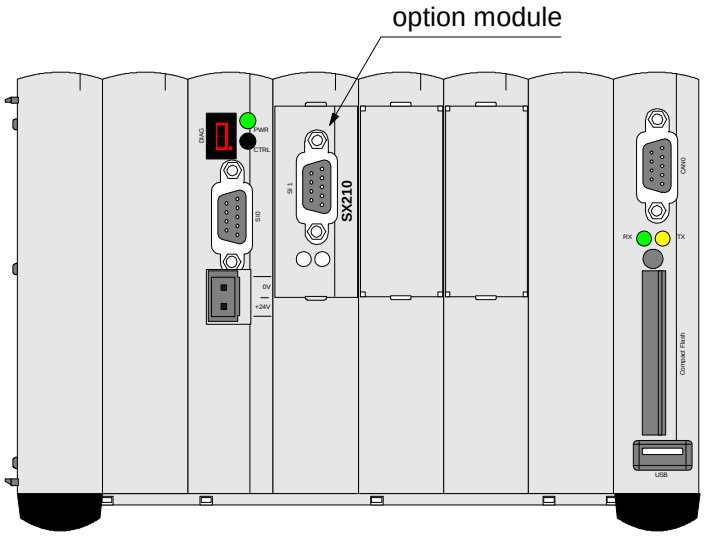
To prevent the modules from slipping on the mounting rail or joggling through vibration, an end fixture plate must be mounted on the left and right side of the mounting rail.
An end fixture plate must be mounted surely so that a gap doesn't form between the module and the module, because the modules malfunctions by contact failure of a connector when a gap forms between the module and the module.
An end fixture plate doesn't attach to a product.



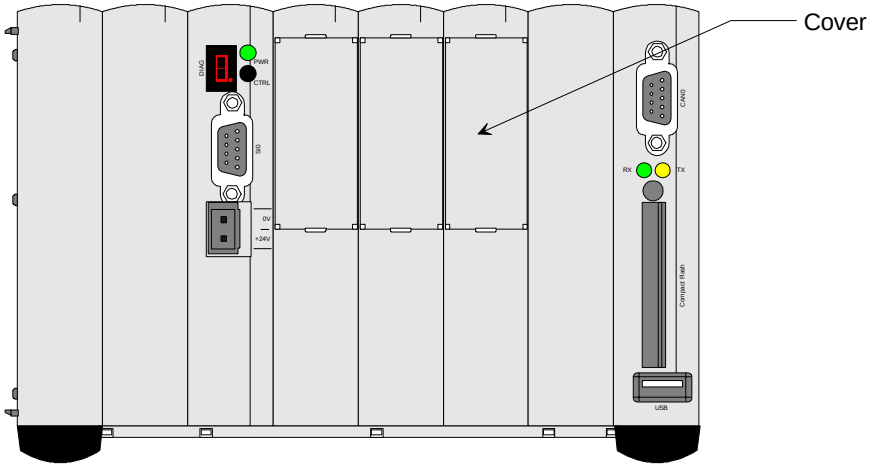
End fixture plates

Inserting option modules

The option modules (used to adapt to the different interfaces) are inserted into the slots provided on the central processor module.



See also the descriptions in the project engineering manuals of the central processor modules.
If no option modules are inserted the respective openings must be covered with covers.



Air conditioning, ventilation

At the top and at the bottom of the modules, there are ventilation holes for dissipating the heat. If the permissible ambient temperature is not exceeded, no external fan will be needed. Make sure that the ventilation holes are not covered.

Note
To guarantee the dissipation of heat, it is advisable to leave a free space of at least 30 mm above and below the modules.

CAUTION

- **The operating temperature inside the control cabinet must not exceed the permissible ambient temperature of the modules. If this cannot be guaranteed through natural heat dissipation, an air conditioning of the control cabinet must be provided.**
- **When installed in a control cabinet attention must be given that the area around the temperature inputs is not exposed to any temperature changes. (e.g. no air conditioners with intermittent operating hours)**

For further information about the calculation of the total power loss in the control cabinet, refer to chapter Power supply of modules.

Use of air filters

Note:
The control must be installed in an appropriate housing to guarantee that no degree of soiling greater than 2 arises.

It is recommended to install the control modules in a dustproof, closed control cabinet. The ventilation holes of the control cabinet must be equipped with air filters. The filter elements must be cleaned or replaced regularly.

EMC and wiring guidelines

Personnel safety

Protective earthing

The protective earthing is specified for all equipment with conductive housing if high voltage can occur inside the equipment. Relevant official directives (e.g. ÖVE, VDE) control the version of the protective earthing in most countries.

If a fault occurs in the equipment, a short circuit to earth will be caused and the power supply will be interrupted via the series connected protection device (fuse, fault-current circuit breaker,...).

⚠ WARNING

- **All parts of the system that must be supplied with a voltage higher than safety extra-low voltage (SELV according to IEC61131) and has touchable metal parts, must be earthed. Otherwise, the series connected protection devices are ineffective.**

Safety extra-low voltage

All modules in the SANMOTION C system are operated with safety extra-low voltage.

EMC

Why EMC-resistant wiring?

The interference immunity of an electrical system is crucially dependent on EMC-resistant wiring and shielding. Experience in service shows that inadequate wiring and shielding of plant components are the most frequent causes of faults and plant failures.

Faults caused by EMC are much more unpleasant than "conventional" failures:

Due to the type of symptom which occurs, they mostly cannot be recognized as such and often resembles a fault in a module that is actually working correctly.

They mostly occur intermittently and are difficult to reproduce.

The troubleshooting is correspondingly complex and expensive.

Thus, pay attention from the outset to careful wiring and shielding in accordance with the guidelines described below.

Which EMC measures must be taken?

EMC measures are concentrated in the areas:

Shielding

Potential equalization between plant components

It is important to carry out the practical measures described in the following sections correctly. The most frequent causes of failures are poor contact of the ground and shield connections. This is the reason why attention must be paid to all of the following generally accepted points:

Contacting of ground and shield connections

Low impedance connection of the part. This also means good conductance at high frequencies and is achieved through:
- large connection areas,
- grounding conductors that are as short as possible,
- use of wide grounding ribbons instead of wires if possible.

Surface contact of bare metal must be available.

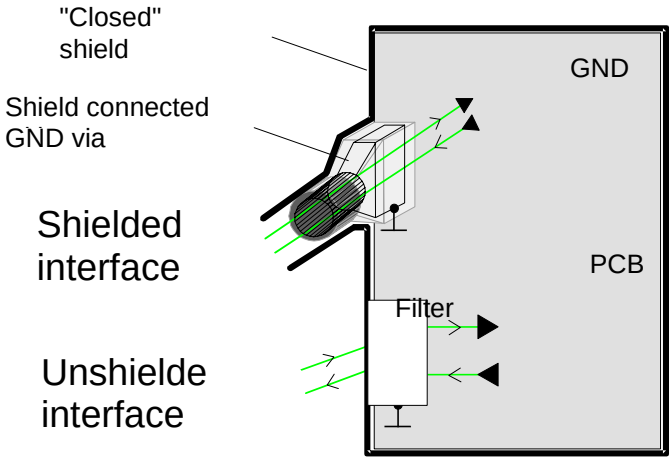
Contact surfaces must be protected against corrosion.

Use toothed washers on all connection points if possible for connecting painted parts or parts with rough surfaces.

The grounding of an electrical system is not an adequate EMC measure and serves mainly to protect against electric shock when touching conductive parts.

Basic structure of EMC measures

The EMC-concept for the entire SANMOTION C control family is designed in such a way that each module can independently withstand the influences that occur in an electro-magnetically affected industrial environment.
A closed shield cover is assumed. This shield cover is correspondingly expanded by shielded interfaces or, if unshielded interfaces are used, the open shield cover is “closed” again via a filter (see figure).



Corresponding connections on the modules are provided for shielded interfaces. It is not necessary therefore, to connect this cable shield with the system via additional shield clamps.

Unshielded interfaces are filtered at their connection points according to their useful signal. Thus, it is not necessary to additionally filter these lines.

EMC tests carried out

The entire control family was tested according to IEC61131-2.

EFI emission – field strength / voltage according to CISPR 11

In order to ensure interference immunity in industrial environments subject to interference, the **interference levels** were selected to be **partially higher than stipulated in the norm**.
The modules are sufficiently interference immune to ESD as long as the housing is not opened.

Checklist of EMC measures

Shielded communication lines (CAN, USB, ...)

- ❏ Shield at both cable ends connected in a plane with metal plugs?
- ❏ Shield present throughout? (Caution in the case of wall ducts!)
- ❏ Is the communication partner used suitable for industrial environments with interference?

Analog lines

- ❏ Twisted pair wire used?
- ❏ Cable shield connected via line with 0 V clamp of the analog module in order to shield the 50 Hz fields?

Interfaces

In principle, the fact that no special laying of the cable is necessary applies to all interfaces of the SANMOTION C system.

CAN

CAN-line between central processor module and additional CAN-modules

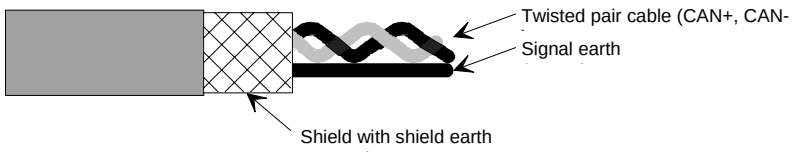
A central processor module can be connection with further bus modules via a CAN-line. Decentralized module clusters are connected to the CAN-circuit in the SANMOTION C system via a bus link module.

Cable type

The CAN connection must be made with a suitable line. We recommend a data cable in accordance with ISO/DIS 11898 (CAN norm).

Structure

Twisted pair, shielded with signal ground.



A multi-core twisted cable can also be used. At the same time, it is important to note that the CAN+ and the CAN- lines are guided in a common twisted pair of wires.

Surge impedance:	min. 108 Ω, typically 120 Ω, max. 132 Ω.
Line resistance:	typically 70 mΩ/m
Specific line delay:	typically 5 ns/m

Plug type

9-pole D-SUB socket connector with completely conductive shell.

The cable shielding must be connected in a plane with the shield cover of the plug. An additional connection of the shield and the ground is not necessary.

Cable manufacture

See the corresponding project engineering manual for the CAN-modules.

Cable length

The maximum cable length is dependent on the baud rate of the CAN bus transmission.

Bending radius

Min. bending radius for installation: 48 mm
Min, bending radius for an installed cable: 24 mm

Connecting CAN modules with modules (without an optocoupler)

Baud rate	Max. cable length typical		Max. cable length guaranteed	
	6 ns/m run time	5.2 ns/m run time	6 ns/m run time	5.2 ns/m run time
125 kbit/s	561 m	647 m	542 m	625 m
250 kbit/s	269 m	311 m	250 m	289 m
500 kbit/s	124 m	143 m	104 m	120 m
800 kbit/s	61 m	70 m	42 m	48 m
1 Mbit/s	40 m	46 m	21 m	24 m

Note:
The length specifications in the table are maximum values based on ideal conditions. The practical cable length is reduced by poor shielding contact, strong interference, stub lines and poor cable quality.

Furthermore, the cable length is dependent on the properties of the remaining CAN bus modules and on the optocouplers used (if present).

We recommend dimensioning the CAN cable so that it is only as long as absolutely necessary.

RS 232 C

Cable type

Shielded standard cable.

Plug type

9-pole D-SUB socket connector with completely conductive shell.

The cable shielding must be connected in a plane with the shield cover of the plug. An additional connection of the shield and the ground is not necessary.

Cable manufacture

See the corresponding project engineering manual for the interface-modules.

Cable length

Max. 15 m.

Bending radius

Min. bending radius for installation: 60 mm
Min, bending radius for an installed cable: 50 mm

RS -485/422

Cable type

Shielded, twisted pair data cables with a characteristic impedance of 100 – 120 Ohm.

Plug type

9-pole D-SUB socket connector with completely conductive shell.

The cable shielding must be connected in a plane with the shield cover of the plug.
An additional connection of the shield and the ground is not necessary.

Cable manufacture

See the corresponding project engineering manual for the interface-modules.

Cable length

Maximum cable length is dependent on the transmission rate:
115 kBit/s: max. 1200 m.

Bending radius

Min. bending radius for installation: 60 mm
Min, bending radius for an installed cable: 50 mm

Ethernet

Cable type

The shielded connection was tested with the following cable type:

Manufacturer:	**DRAKA Multimedia**
Designation:	"Silverline Gold" Cat. 7 patch cable, S/STP 4x2x0.14qmm
Item number:	CNS796031

This, or a qualitatively equivalent, cable must be used for the connection (twisted pair and shielded data cables with a characteristic impedance of 100 Ohm +/- 15%).

Plug type

Please use the following connector or an equivalent article for the manufacturing of plug connections.

Manufacturer:	**Coble Enterprise Co.Ltd**
Designation:	RJ45 connector
Item number:	#T8S COB-2E MP8P8_SHORT.SHD 5
Designation:	Cap
Item number:	SR0813(60)“Y“

Cable manufacture

See chapter: "Manufacturing an RJ45 connection cable".
An additional connection of the shield and the ground is not necessary.

Cable length

A 100 Mbit/s Ethernet transmission is specified up to a maximum of 100 m according to IEEE 802.3. The maximum possible transmission distance can be shorter in an EMC-interfered industrial environment.

Bending radius

Min. bending radius for installation: 60 mm
Min, bending radius for an installed cable: 50 mm

USB

The USB-interfaces are used to connect different media (e.g. in the context of maintenance work). They are, however, not suited for unmonitored continuous operation as the connection plug does not have a strain relief.

***Note**: The use of USB-enabled devices from the computer world may result in unexpected system behavior or system failures, as these devices are not normally designed for operation in an environment with industrial interferences.*

Cable type

Shielded USB cable, twisted pair data cables with a characteristic impedance of 90 Ohm +/- 15%.

Plug type

Standard USB connector with fully conductive shell.
The cable shielding must be connected in a plane with the shield cover of the plug. An additional connection of the shield and the ground is not necessary.

Cable length

Max. 5 m.

Inputs/Outputs

Front panel connectors

The front panels of the SANMOTION C modules are equipped with male connectors. As counter plugs, suitable female connectors must be used.

Grids

The grid 5.08 mm is used. Only female connectors by Phoenix Contact and Weidmüller may be used for the SANMOTION C system. Connectors of other manufacturers may only be used if the manufacturer can guarantee a reliable connection.

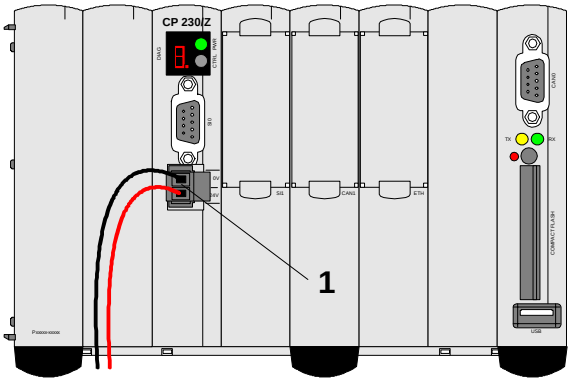
24 V module supply

Cable type

Unshielded cable. The cable cross section must match the power requirements of the module.

Plug type

Standard female connectors with grid dimension 5.08 mm.



1 … Female connectors (two block)

Only standard female connectors from the manufacturers Phoenix Contact and Weidmüller are permitted for the connection to the SANMOTION C system. All other types may only be used if the manufacturer can guarantee a reliable connection.

Graphic interface

Cable type

Shielded connection with the following cable type:

Manufacturer:	**DRAKA Multimedia**
Designation:	"Silverline Gold" Cat. 7 patch cable, S/STP 4x2x0.14qmm
Item number:	CNS796031

This, or a qualitatively equivalent, cable must be used for the connection (twisted pair and shielded data cables with a characteristic impedance of 100 Ohm +/- 15%).

Plug type

9-pole D-SUB socket connector with completely conductive shell.

Cable manufacture

See the corresponding project engineering manual for modules with LVDS-graphic interfaces.

Cable length

The maximum possible length of the connection is 5 meters.

Bending radius

Min. bending radius for installation: 60 mm
Min, bending radius for an installed cable: 50 mm

Digital input

Cable type

Unshielded cable.

Plug type

Standard female connectors with a grid dimension of 5.08 mm as in the 24V module power supply. It is recommended to arrange the sub-units in such a way that the corresponding signals are positioned each on one plug.

Digital output

Cable type

Unshielded cable.

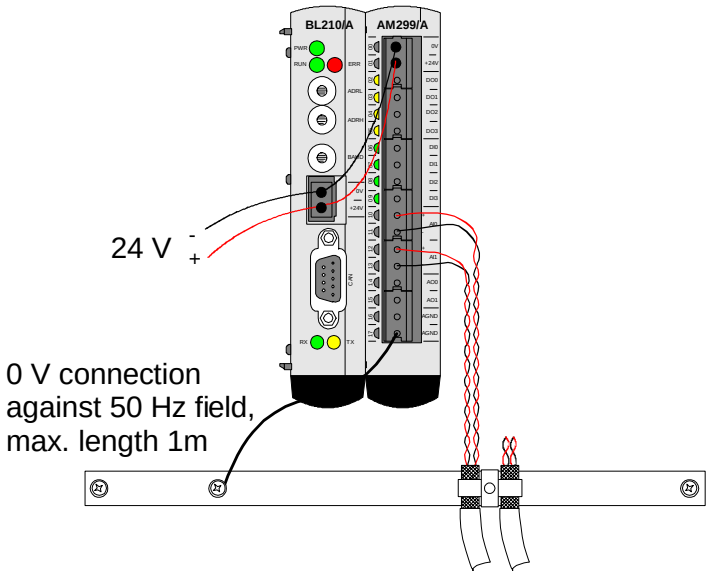
Plug type

Standard female connectors with a grid dimension of 5.08 mm as in the 24V module power supply. It is recommended to arrange the sub-units in such a way that the corresponding signals are positioned each on one plug.

Analog input (current or voltage input)

Cable type

Twisted pair cable with shielding against low frequency 50 Hz fields.
This shield serves only for the shielding of electrical low frequency 50 Hz fields and is not an HF shield. Thus, not so much attention must be paid to the type of shield coating as in the fast data interfaces. The shield can also be carried via a single wire (see figure). The twisting of the cable pair is effective against magnetic low frequency 50 Hz fields interference and the differential inputs of the modules.



Example: Connection of the analog inputs to a AM 299/A

Plug type

Female connectors with a grid dimension of 5.08 mm as in the 24V module power supply. It is recommended to arrange the sub-units in such a way that the corresponding signals are positioned each on one plug.

Short-circuiting unused pre-cabled inputs

In the case of already pre-cabled inputs that are not yet used, the wires at the end of the cable must be short-circuited to avoid noise injection.

Analog output (current or voltage output)

Cable type

Twisted pair cable, with shielding against low frequency 50 Hz fields. See chapter "Analog input (current or voltage input)".

Plug type

Female connectors with a grid dimension of 5.08 mm as in the 24V module power supply. It is recommended to arrange the sub-units in such a way that the corresponding signals are positioned each on one plug.

Encoder supply output and reference voltage output

Cable type

Twisted cable pair, with shielding against low frequency 50 Hz fields.
See chapter "Analog input (current or voltage input)".

Plug type

Female connectors with a grid dimension of 5.08 mm as in the 24V module power supply.

Incremental encoder input

Cable type

Shielded standard cable.

Plug type

9-pole D-SUB connector with completely conductive shell.
The cable shielding must be connected in a plane with the shield cover of the plug. An additional connection of the shield and the ground is not necessary.

PWM output

Cable type

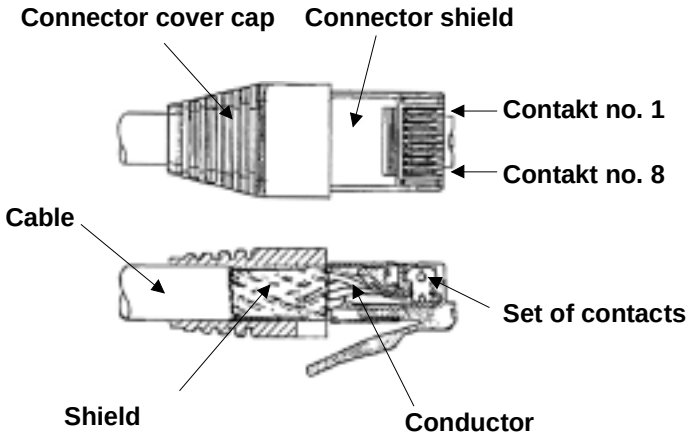
Unshielded cable.

Plug type

Standard female connectors with a grid dimension of 5.08 mm as in the 24V module power supply.

Manufacturing an RJ45 connection cable

Connector structure



Different colors of the plug cover cap prevent confusion and serve for plug safety.
Ethernet yellow.

Preparing the cable connection

Pull the plug protection cap back along the round cable and remove approx. 30 mm of the cable isolation.

Be careful not to cut the shield!

It is recommended to use the PN 525421-8 data cable stripper.



Fold back the mesh of the outer shield and slide plug shield over the shield mesh (if necessary rotate the plug shield).



Separate cable pairs and inner shield and leave approx. 4.0 -6.0 mm of the inner shield for each pair as measured from the end of the sheath.



Cable configuration

The wires of the cable are shielded twisted pairs as follows:

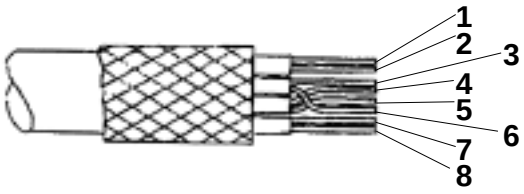


ws & gn
ws & or
ws& bl
ws & bn

ws & gn .....white (or white/green) and green
ws & or .....white (or white/orange) and orange
ws & bl .....white (or white/blue) and blue
ws & bn .....white (or white/brown) and brown

The connections of the crossed Ethernet, i.e. the cable arrangement on plug 1 must be different from that of plug 2.

Arrange the cable according to the following signal connection list:



.

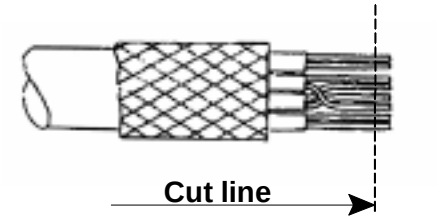
Cable configuration for plug 1 (for crossed Ethernet connection):

	Wire color	**Signal**
1	white/green	Tr. Data +
2	green	Tr. Data -
3	white/orange	Re. Data +
4	blue	Bi – Data +
5	white/blue	Bi – Data -
6	orange	Re. Data -
7	white/brown	Bi – Data +
8	brown	Bi – Data -

Cable configuration for plug 2 (for crossed Ethernet connection):

	Wire color	**Signal**
1	white/orange	Re. Data +
2	orange	Re. Data -
3	white/green	Tr. Data +
4	blue	Bi – Data +
5	white/blue	Bi – Data -
6	green	Tr. Data -
7	white/brown	Bi – Data +
8	brown	Bi – Data -

Cut the conductors to the same length in order to ease insertion into the contact set.

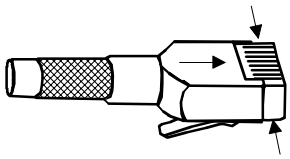


Push in and crimp the cable

Push the wires into the contact set.



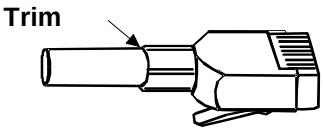
Hold the plug tight and push the plug shield onto the plug.



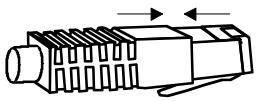
Insert the plug into the crimping tool and crimp. At the same time, push the plug against the crimping tool so that the cable can be fixed in the right position.



Trim the remaining cable shield and cable cover.



Push the plug protection cap onto the crimped plug.



General limits for wire cross sections

Minimum cross section according to norm

The minimum cross sections in mechanical engineering are defined in EN60204 "Electrical and electronic equipment and systems" in chapter "Conductors, cables, wires" and in chapter 14 "Wiring technology", particularly under "Wiring outside of housings".

Extract from EN60204-1:1997:
"...
13.6 Minimum cross section

To guarantee sufficient mechanical strength, the conductor cross section should not be smaller than that given in table 6. Wherever it is regarded as necessary, conductors with smaller cross sections as given in table 6 may be used in the equipment, under the condition that, sufficient mechanical strength is achieved in another way and trouble free function is not impaired.

Table 6: Minimum cross sections for copper conductors

Order	*Application*	*Description of conductors, cables and lines*				
		One core, multi-core	*One core, solid*	*Two-core, shielded*	*Two-core, unshielded*	*Three or more core, shielded or not*
Outside the housing	*Not flexible, main circuit*	*1*	*1.5*	*0.75*	*0.75*	*0.75*
	Connection to machine parts that are subject to frequent movement	*1*	*-*	*1*	*1*	*1*
	Connection in control circuit	*1*	*1.5*	*0.3*	*0.5*	*0.3*
	Wiring in data transmission system	*-*	*-*	*-*	*-*	*0.08*
Inside the housing	*Not flexible, main circuit*	*0.75*	*0.75*	*0.75*	*0.75*	*0.75*
	Connection in control circuit	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
	Wiring in data transmission system	*-*	*-*	*-*	*-*	*0.08*
Footnote: All cross sections are given in mm².						

..."
For the minimum cross sections in plant construction, the constructions of EN50178: "Equipping power plants with electronic apparatus" must be observed.
Further instructions for wiring are stated in EN61131 "Programmable controllers" Part 4 "User guidelines".

Minimum cross sections from the guidelines of terminal manufacturers

Spacing 5.08 mm: 0.2 mm² (AWG 24)

Minimum cross sections from electrical general conditions

The actual reliable wire cross section is given by the electrical conditions of the connected equipment:

maximum load current and possible heat dissipation

permissible voltage drop for error-free operation of the connected equipment.

These limits must be taken into consideration for the calculation of wire cross sections in the respective application.

Maximum cross section

The maximum conductor cross section is limited by the female connectors used as follows:

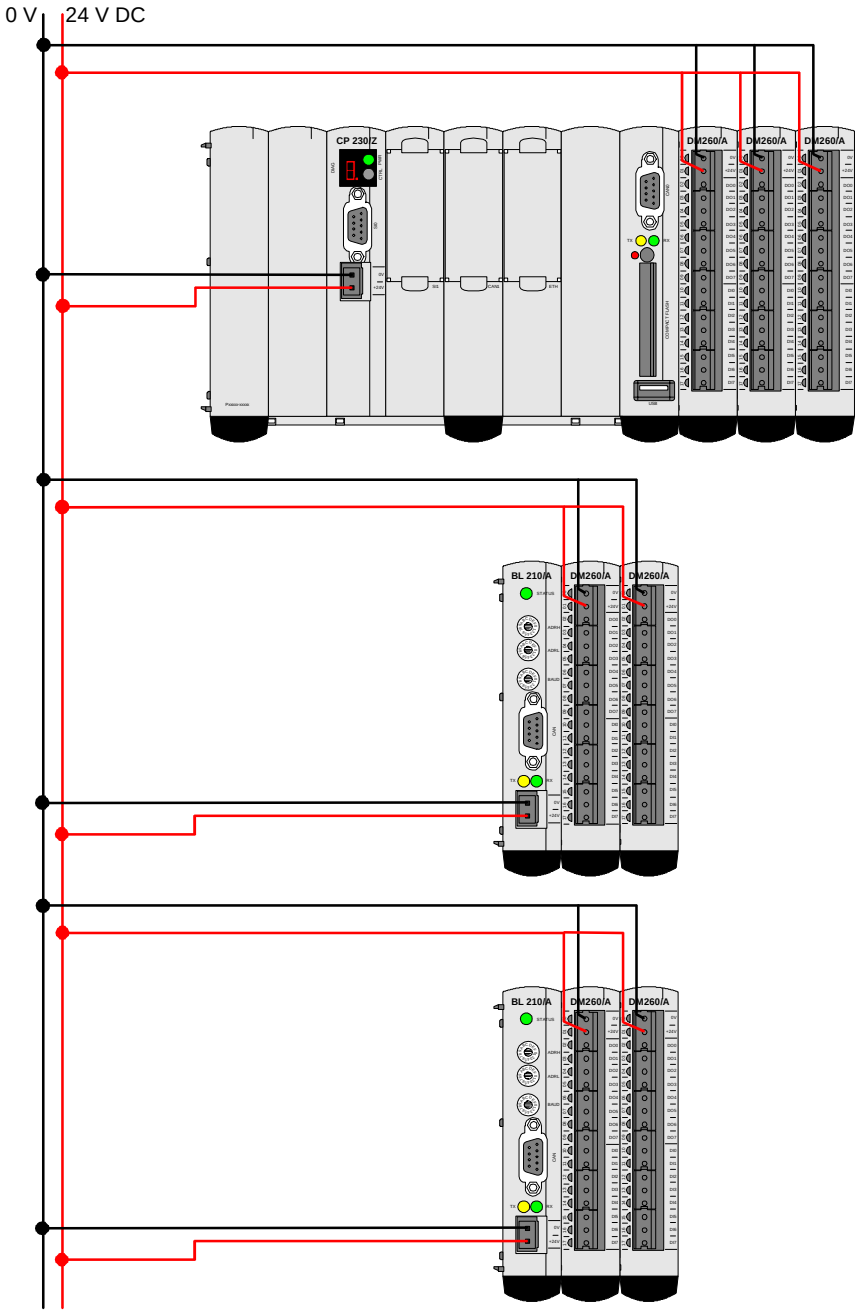
Spacing 5.08 mm: 2.5 mm² (AWG 12)

Test of interference immunity

Immunity interference is tested according to **EN61000-4-2**.
See also the technical data in the project engineering handbooks for the corresponding modules.

Power supply of modules

The modules are supplied with voltage via the K-Bus plugs. For a module formation with a central processor modules this is done via the bus supply of the module. Within the decentralized module clusters this function is allocated to the input transceiver. Each of these couplers has its own DC/DC-converter that will convert voltages to the appropriate internal voltage.



Connection diagram for +24 V power supply

⚠ WARNING

- **The supply voltages must comply with SELV in accordance with IEC61131.**

⚠ CAUTION

- **Always turn off the power supply before mounting and dismounting the module package.**

Power consumption of modules

	Module	Power consumption [W] (own consumption)	5V power supply [W] (for modules added-on)
CPU modules	CP 230/Z	13	11
	CP 231/X	14	10
	CP 232/Z	14	10
Transceiver	BL 210/A	4,5	8,5
		Power consumption (5V) [W]	**Power consumption (24V) [W]**
I/O-Modules	AM 299/A	0,7	1,9
	AM 299/B	0,7	1,9
	DM 260/A	1,0	0
	DM 262/A	1,0	0
	DM 276/A	0,4	1,9
	FM 280/A	1,4	0
	FM 299/A	1	0
	MM 240/A	0,6	0
	SM 210/A	0,4	0
	SM 230/A	0,5	0
		Power consumption (5V) [W]	
Option modules	FX 200/A	0,25	
	NX 250/A	0,5	
	SX 210/A	0,25	
	SX 230/A	0,25	

Example:

Modules with a total power consumption(5V) of 10W can be operated with a CP 232/Z.

CP 232/Z + FM 280/A + 6* AM 299/A + 2* DM 260/A
1,4 W + 6* 0,7 W + 2* 1,0 W = **7,6 W**

Operation and displays

Setting the module address

The modules in the system are addressed by means of a 16-position address switch. All modules within a control package (consisting of the central processor module and a maximum of 12 modules) can be distinguished.

The address switch is located on the side of the modules, underneath the K-Bus plug. The address must be set prior to the assembly of the package. See also the project engineering manual of the central processor module and the modules.

Note
Modules of the same type must have different address switch positions within one control package. Different modules in different control packages may have the same address switch positions.

Control-key (CTRL)

The CTRL-key on the central processor modules is located next to the 7-segment display.

The CTRL-key is used to execute the following functions:

Start application

Stop application

Re-install application

Setting the CPU (e.g. IP address) in combination with the debug adapter

Writing the status report

Deleting retain user data

Deleting the application and the configuration (create default status)

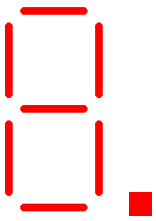
Power LED (PWR)

The green Power LED on the central processor modules is located above the CTRL-key.

Display:
green illuminated: supply voltage given
dark: no supply voltage

Diagnosis display (DIAG)

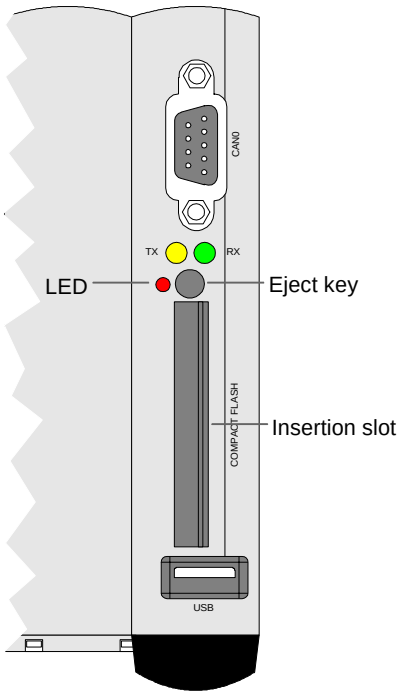
A single-digit 7-segment display on the front side of the central processor module indicates the start-up modes.



See chapter Operating behavior.

Compact Flash

The Compact Flash Disk is used for saving the system software and the application as well as for saving the machine and tool data, recipes, etc.



Position of the slot and the operating elements

Eject key:
The eject key is used to remove the Compact Flash. Use a screwdriver to operate the key.
LED display:
illuminated: Write-/read access on the Compact Flash in process
dark: no write-/read access

CAUTION

- **The Compact Flash card may not be plugged in or unplugged during operation.**

It cannot be used as removable medium as it also has system programs stored on it.

Operating behavior

Button and display, general information

Start-up, display and operation via the CTRL-key follows the same general guideline for all CPU-modules of the SANMOTION C product line. Depending on the build of the CPU the start-up and display possibilities may vary. Every CPU-modules has a 7-segment display and a CTRL-key.

For SANMOTION C:

	CPU modules
Display	Power LED, 7-segment
Button	CTRL-key
Start-up sequence	Boot system Firmware Application

General rules

For the 7-segment display (on CPU-modules) applies in general:

- Numbers >0 during the start-up denote the progress
- Different characters (e.g. ☐, **II**, ...) or capital letters denote the operating status after start-up
- The decimal point indicates the load during start-up. A flashing decimal point signals that the CPU's load capacity is not fully exhausted.
- Minor errors are indicated parallel to the states.
- The error display is always triggered with switching-through the status and a double- or triple-digit error/info sequence (e.g. "-,0,-,E,1,0"). Every character is displayed for 1 second.

Touch control during operation:

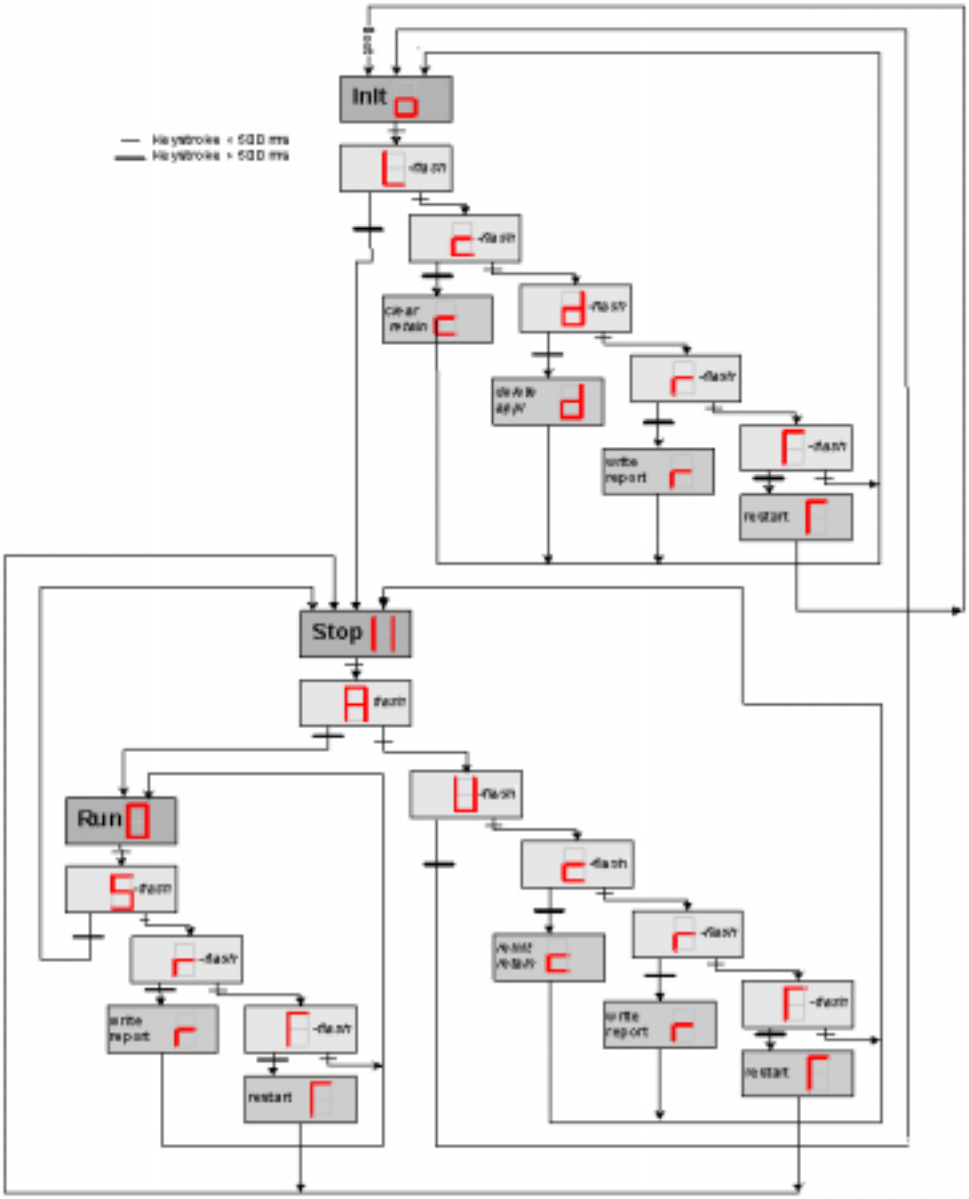
The CTRL-key is used as simple operating element for the control, with which the control can be switched into different operating modes and/or different commands can be issued.

- there are short (<500ms) and long keystrokes (>500ms)
- short keystrokes allow the user to switch and selected between the individual commands, while these commands are displayed by flashing in the 7-segment display. Once the initial status has been reached again this will be indicated without flashing.
- long keystrokes are used to execute a command and to change into the new status

Touch control at error display during operations:

If the 7-segment display indicates an error, the CTRL-key can be used to confirm this with a short keystroke.

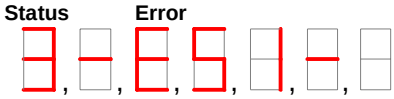
Key functions



Display of errors in the 7-segment display

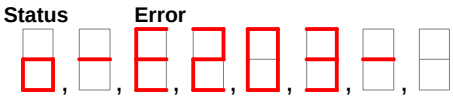
Errors can occur and/or be pending in and/or during the transition between the different operating modes of the control. These errors are signaled in the 7-segment display parallel to the status display. The latest error in a character sequence is always displayed at full second intervals. It consists of the status and the error status.

Display during the start-up of the boot block or the firmware:



signals for example the error 5 1 in status "Load Firmware" (no firmware found)

Display during the start-up of the application:



signals for example the error 203 in Status Init (Application Install failed)

The display of the error can be confirmed by activating the CTRL-key after which the normal status display re-appears.
Given the limited range of display options the errors are summarized into main- and sub-groups, so as to enable the user to make an initial diagnosis without having to read out the full error log.

Start-up

The start-up of a CPU is divided up into three main stages:

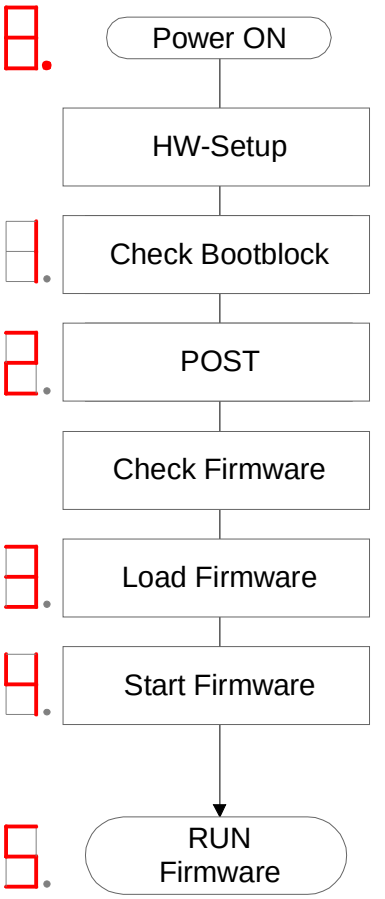
Boot system start-up

Start-up of control firmware

Start-up of application

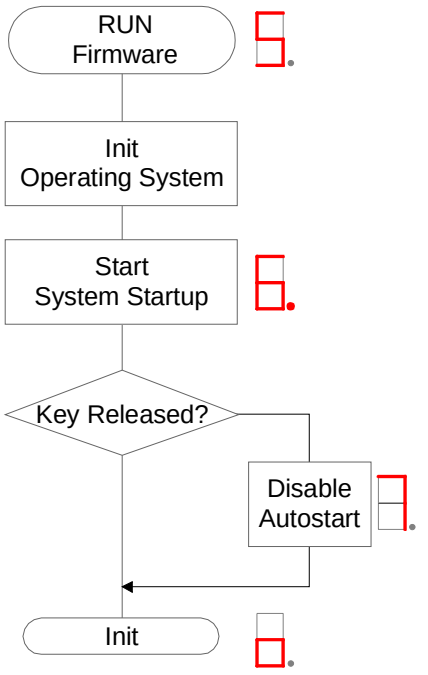
The progress in each stage is signaled via the 7-segment display. If errors are detected during the start-up an error message is activated. A short stroke of the CTRL-key will interrupt the start-up operation.

Display during start-up of the boot block



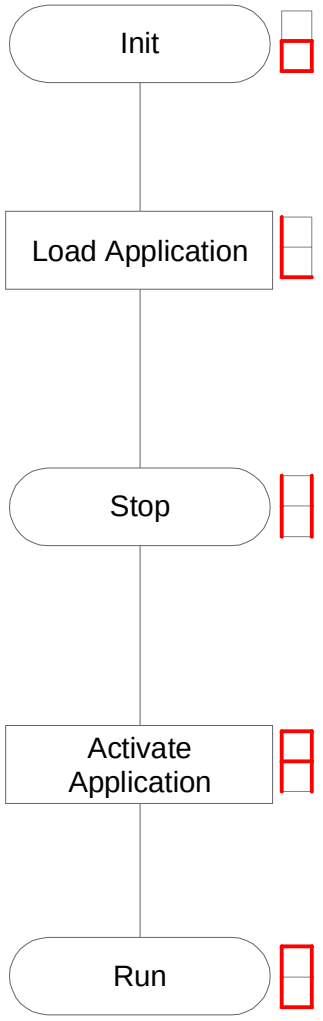
	Description	Error code	Error
		3 – E 5 1 -	
Power ON	supply voltage given		no firmware found
HW-Setup	Initialization of the module		
Check Bootblock	Checking the consistency of the bootblock		
POST	Power On Self Test, Checking the consistency of the module		
Check Firmware	Firmware on Compact Flash checked for consistency		
Load Firmware	Firmware is read from the Compact Flash into the DRAM		
Start Firmware	Starting the firmware		
RUN Firmware	Start-up of the bootblock completed		

Display during start-up of the firmware



	Description	Error code 6 – E 3 1 -	Error
RUN Firmware	Start-up of the boot-block completed		Error in the Hardware configuration
Init Operating System	Operating system was initialized and started		
Start System Startup	Start of the different firmware components (e.g. services, IO-Sys, Communication …)		
Key Released? / Disable Autostart			
Init	Start-up of the firmware completed		

Display during start-up of the application



Description
Application unloaded and memory released released
Load application into memory
Application loaded, but no processing
Start application
Application running

Error code	Error
E 1xx	Runtime error in firmware
E 102	Irt loading failed
E 103	Irt stopping failed
E 2xx	Runtime error SOM and IRT
E 202	Load Svl Files failed
E 203	IrtApplication Install failed
E 204	Load Isl Files failed
E 205	IrtApplication Start failed
E 206	IrtApplication Stop failed
E 208	IrtApplication Deinstall failed
E 209	IrtUnload SvlFiles failed
E 3xx	Runtime error HMS
E 301	Start HMS failed
E 302	Stop HMS failed
E 4xx	Runtime error in IO-System
E 401	Start IO failed
E 402	Release IO failed
E 403	Freeze IO failed
E 404	Stop IO failed
E 6xx	MCU-runtime error
E 601	MC Start failed
E 602	MC Init failed
E 603	MC Stop failed
E 604	Update Task stop failed
E 7xx	Runtime error in the TC-Application
E 701	TC Init failed
E 702	TC InitRpc failed
E 703	TC Load failed
E 705	TC Unload failed
E 706	TC Continue failed
E 707	TC Interrupt failed
E 9xx	Other runtime errors
E 901	Load measuring statistics failed
E 906	Write Starep failed
E 909	no function executed

Operating states

States

In normal operation the control can be switched into the following states:

Main states:

- **Init** – in this operating status the application program is unloaded and the memory released, the application is loaded during the transition to the Halt (Attention: a number of configuration changes are adopted after PowerOn), there is not exchange process date to I/O-card or other CPUs
- **Stop** – in this operating status the application program is loaded, the application is not being processed and process data are exchanged according to the configuration
- **Run** – in this operating status the application program is being processed and process data are exchanged according to the configuration

Help states:

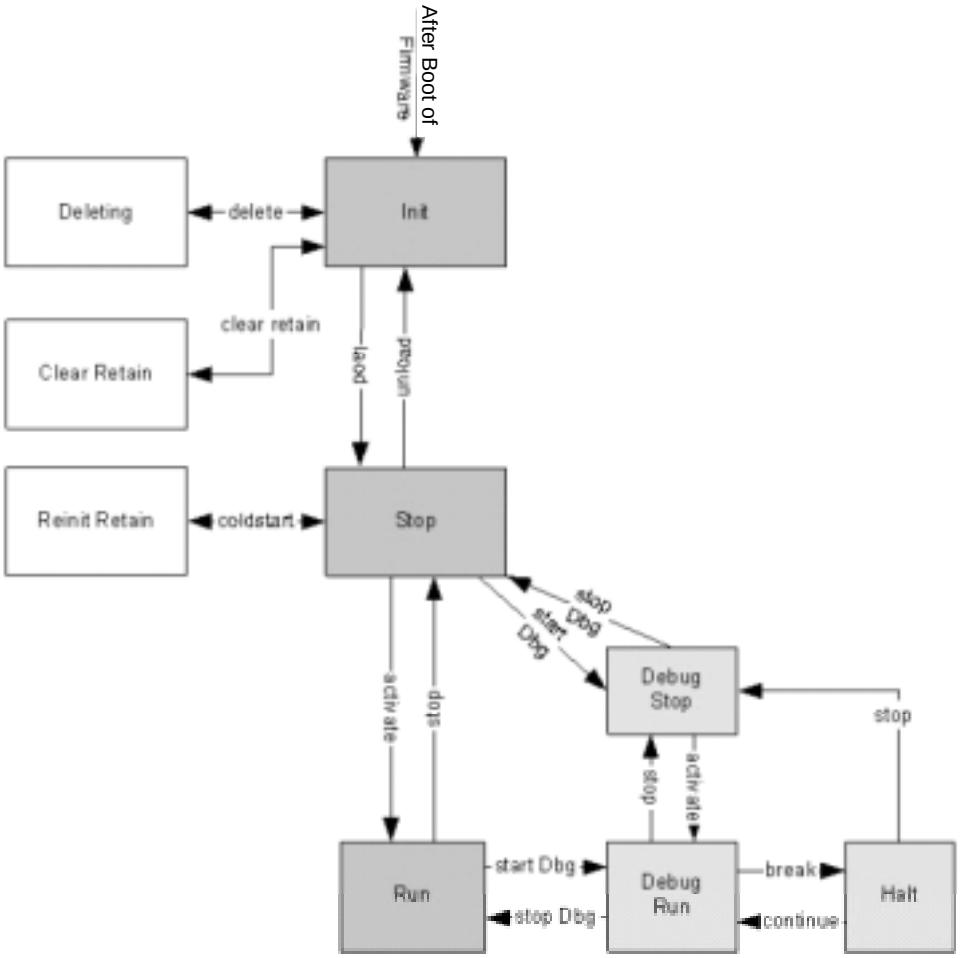
- **Debug Stop** and/or **Debug Run** – No function at present
- **Halt** – the IEC-application program is interrupted by a breakpoint and after a continue command the control goes back into Run
- **Firmwareupdate** – No function at present

Temporary states:

- **ReinitRetain/ClearRetain** – this status is temporarily adopted during the re-initialization of the retain data, the retain data are deleted and newly initialized
- **Deleting** – this status is temporarily adopted during the deletion of the entire application, it restores the original and/or delivery status of the CPU, all user date and logs are deleted

After the firmware has been booted the system will switch into the **Init** status; if the configuration is set to **Autoload** the system will automatically switch to **Stop**; if **Autostart** is set in addition the system will automatically switch to **Run.**

Status diagram



The transitions between Init, Stop, Run, Reinit Retain, Deleting and Clear Retain can be initiated by either the programming tools or a button. (See chapter “Display of the states” for the operation)

If an error occurs during a transition the system returns to the original status and the error display is activated.

Transition Init – Stop:

- the user application is loaded and initialized
    - all global objects, system variables, motion blocks, … are loaded
    - IEC - all tasks and blocks are created and linked
    - TC – global-project is loaded
- The exchange of process date is started, but merely default values are issued (Freeze IO)

Error messages

- Wrong, faulty configuration
- Application files cannot be loaded (CRC wrong, too big, for another CPU-type,…)
- Missing link connection (system variables, tasks,…)

Transition Stop – Run:

- the technology components are started
- the user application is started
- the process output data are updated (Unfreeze IO)
- Visualization application is started (only if the CPU was previously in the Init-status)

Error messages (at the same time error at runtime)

- Serious application error (DivideByZero, PageFault,…)
- Application time monitoring reacts

Transition Run – Stop:

- the user application is stopped, stop the resources in the IEC, in TC all active routines are stopped
- the process output data are set to zero
- the visualization can still be operated
- MCU is stopped the path data are deleted

Transition Run – Debug:

- No function at present

Transition Debug – Halt:

- No function at present

Transition Stop – Reinit Retain - Stop:

- all retain data are newly initialized (as during cold start)

Error messages

- Error in application file

Transition Stop – Init:

- the user application is being unloaded (IEC, TC, SOM)
- Transmission of process data is stopped
- the visualization is unloaded
- HMI-services also for external systems such as OPC are becoming invalid

Transition Init – Clear Retain – Init:

- all retain user data in SRAM and/or on the CF are deleted

Transition Init – Delete – Init:

- all data of the user application are deleted including the configuration data => original status/delivery status of the control is re-established

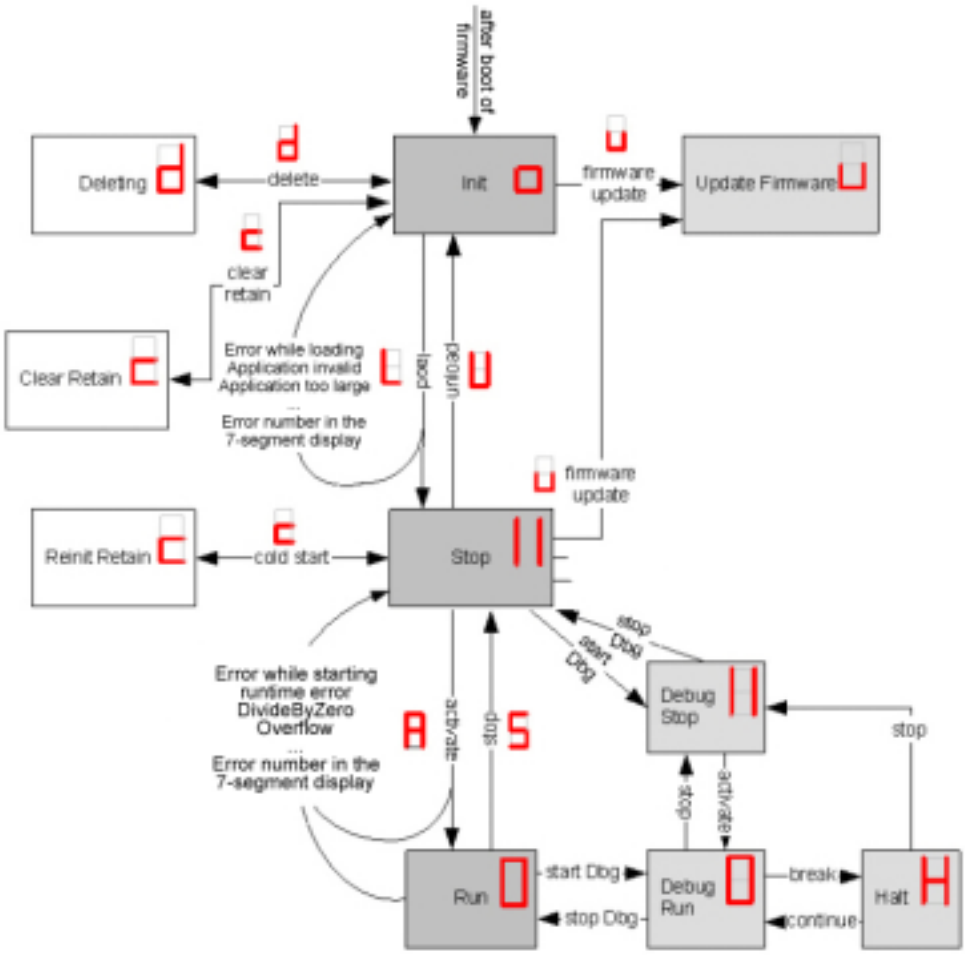
Transition Restart – Init/Stop/Run:

- No function at present
  (Error E909 "no function executed" will be returned)

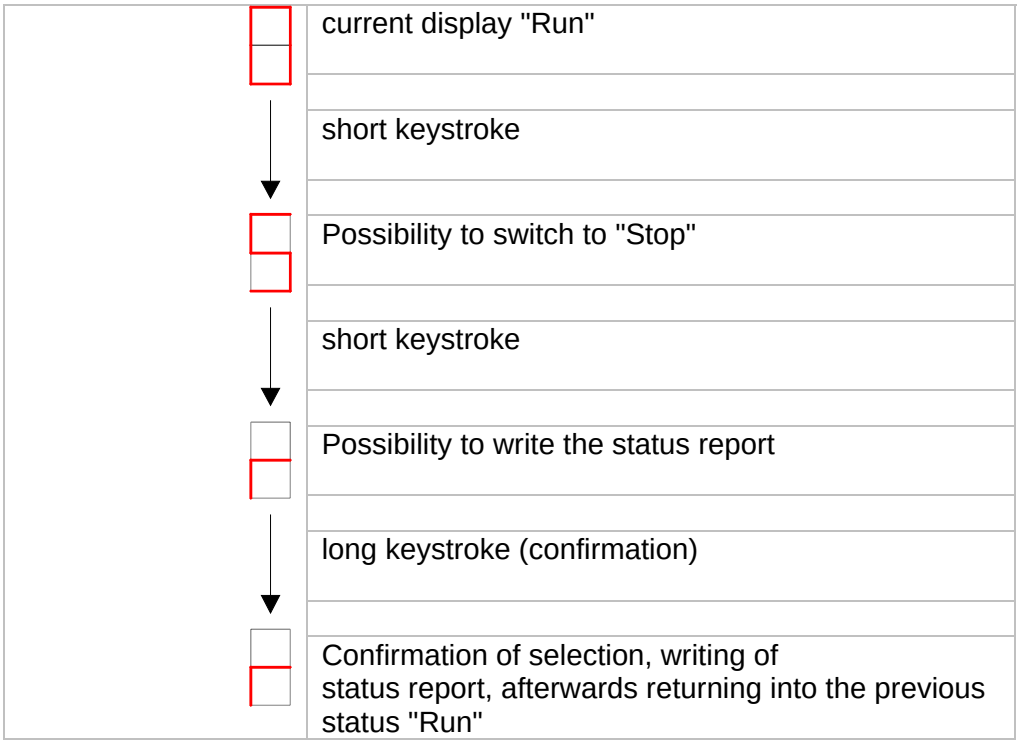
The module is restarted in all lines, modules with VxWorks operating systems this will be done by triggering a watchdog reset modules with Windows operating system this will be done by triggering Windows-service.

Display of the states

The states are signaled on a CPU to the outside via a 7-segment display. The following diagram lists additional the commands to the 7-segment display during button operation. During the transition from one status into the next the command to the 7-segment display is shown until completion.



Example: transition "Run" to "Write Statusreport":



Summary of displays

7-Seg displays	Error display	Error	Measure
8		PowerOn	
1		HW initialization	
2		Loading&Starting extended boot system	
3		Loading of firmware package	
	3 – E 5 1	Firmware package was not found	Check the file boot.cfg and the package file to be loaded
4		Start firmware	
5		Startup-code processed	
6		Operating system running	
	6 – E 3 1	Error in HW configuration	Contact SANYODENKI
7		System is being started	
o		System start-up completed, status ‘init’	
L		Application is being loaded	
II		Application loaded and stopped, Status ‘stop’	
A		Application is activated	
O		Application started, status ’run’	
	E 1xx	Runtime error in firmware	
	E 102	Irt loading failed	Contact SANYODENKI
	E 103	Irt stopping failed	Contact SANYODENKI
	E 2xx	Runtime error	

	E 202	Load Svl Files failed	1. Check whether correct CPU-type, correct device-type, ... has been entered. 2. Rebuild Project 3. Re-synchronize project
	E 203	IrtApplication Install failed	
	E 204	Load Isl Files failed	
	E 205	IrtApplication Start failed	Contact SANYODENKI
	E 206	IrtApplication Stop failed	Contact SANYODENKI
	E 208	IrtApplication Deinstall failed	Application does not exist so that it cannot be de-installed.
	E 209	IrtUnload SvlFiles failed	Contact SANYODENKI
	E 3xx	Runtime error HMS	
	E 301	Start HMS failed	Contact SANYODENKI
	E 302	Stop HMS failed	Contact SANYODENKI
	E 4xx	runtime error in IO-System	
	E 401	Start IO failed	Contact SANYODENKI
	E 402	Release IO failed	Contact SANYODENKI
	E 403	Freeze IO failed	Contact SANYODENKI
	E 404	Stop IO failed	Contact SANYODENKI
	E 6xx	MCU-runtime error	
	E 601	MC Start failed	Contact SANYODENKI
	E 602	MC Init failed	Contact SANYODENKI
	E 603	MC Stop failed	Contact SANYODENKI
	E 604	Update Task stop failed	Contact SANYODENKI
	E 7xx	Runtime error in the TC-application	
	E 701	Init failed	Contact SANYODENKI
	E 702	InitRpc failed	Contact SANYODENKI
	E 703	Load failed	Contact SANYODENKI
	E 705	Unload failed	Contact SANYODENKI
	E 706	Continue failed	Contact SANYODENKI
	E 707	Interrupt failed	Contact SANYODENKI
	E 9xx	other runtime errors	
	E 901	Loading of measurement statistics failed	Re-load Flash. If error remains: Contact SANYODENKI
	E 906	Write Starep failed	[maxStarepCnt] check, control whether Compact Flash is full
	E 909	no function executed	Contact SANYODENKI

Technical data

General information

Nominal supply voltage:	24 V DC
Supply voltage range:	19.2 V to 30 V (-15 % / +20 %, plus a maximum ripple of 5% AC)
Ingress protection rating:	III (according to IEC 61131-2)
Ingress protection rating	IP 20 for modules and open modules,

Dimensions of basic modules

Width	one width unit = 22.5 mm
Central processor modules (CPUs)	8 width units
I/O-Module	1 width unit
Coupler module	1 width unit

Environmental conditions

Operating temperature:	0 °C to 55 °C,
Average temperature over 24 h:	Open devices: 50 °C
Storage temperature:	-40 °C up to + 70 °C (except displays)
Relative humidity of air:	10 – 95 %
Vibration resistance:	3.5 mm amplitude for 5 $\leq$ f < 9 Hz and 1.0 g for 9 $\leq$ f < 150 Hz
Shock resistance:	Max. 15 g, 11 ms (half-sine)
Degree of soiling:	2, not conductive soiling, when moistened conductive for a short time
Altitude:	2.000 m for operations, 3.000 m for storage and transport

Standards:

The module conforms to the following standards:

General information	
UL 508	Certification in preparation
Product standard for programmable controllers:	
IEC 61131-1:2003	Programmable Controllers Part 1: General Information
IEC 61131-2:2003	Programmable Controllers Part 2: Equipment requirements and tests
Mechanical environmental influences	
IEC 60068-2-6	Vibration, test FC
IEC 60068-2-27	Shock

For further specifications, please refer to the technical data of the individual modules.

Release
Revision A Aug.2005
Revision B Mar.2008
Revision C Jun.2008

Precautions For Adoption

⚠ Cautions

The possibility of moderate or minor injury
and the occurrence of physical damage are assumed
when the precautions at right column are not observed.
Depending on the situation,
this may cause serious consequences.
Be sure to follow all listed precautions.

⚠ Cautions

- Be sure to read the instruction manual before using this product.
- Take sufficient safety measures and contact us before applying this product to medical equipment that may involve human lives.
- Contact us before adapting this product for use with equipment that could cause serious social or public effects.
- The use of this product in high motion environments where vibration is present, such as in vehicles or shipping vessels, is prohibited.
- Do not convert or modify any equipment components.

* Please contact our Business Division for questions and consultations regarding the above.

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*Remarks : Specifications Are Subject To Change Without Notice.