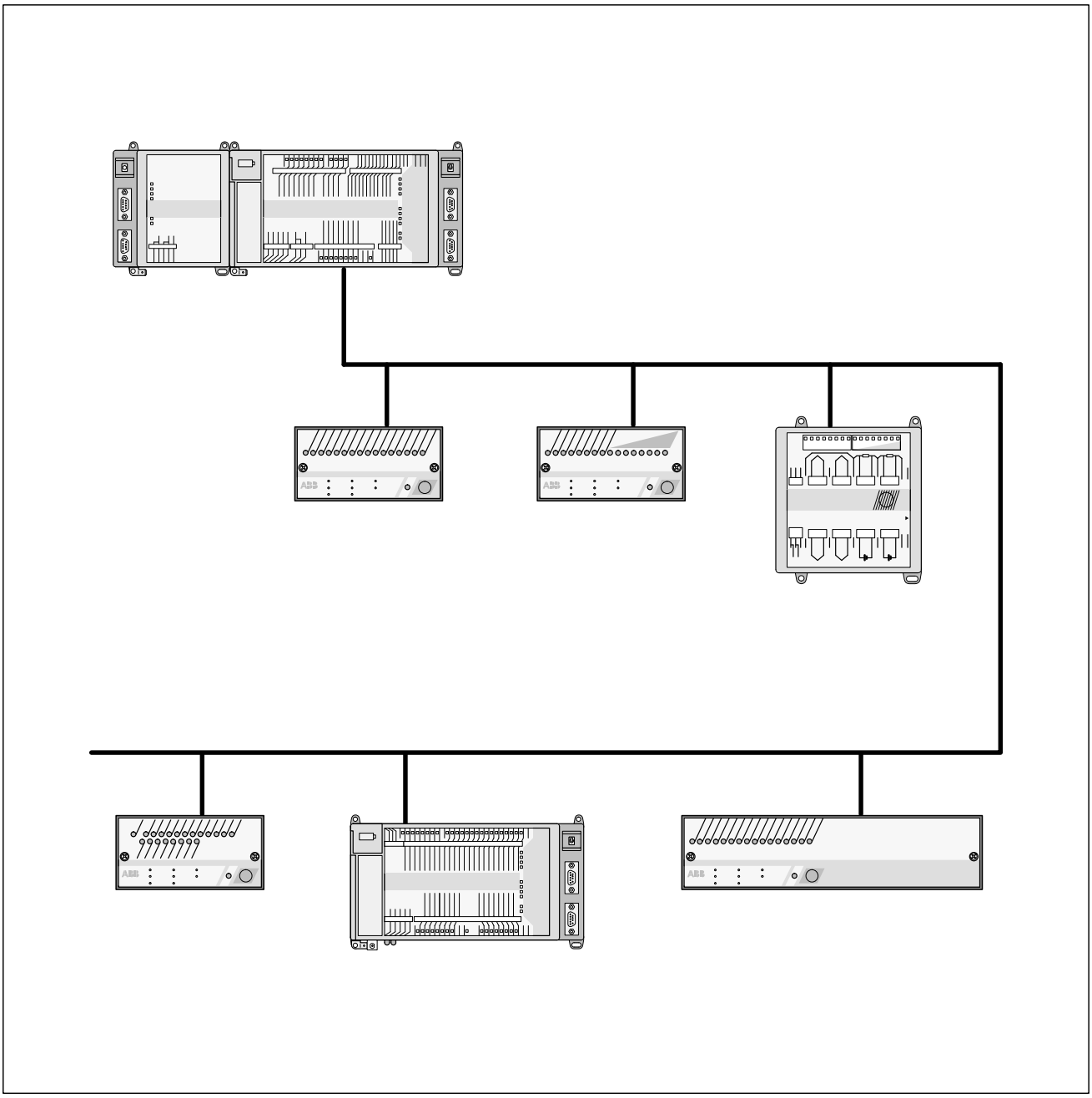
Appendix

ABB Procontic CS31
Intelligent Decentralized
Automation System

Central Units
07 KR 91,
07 KT 92 and 07 KT 93



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Appendix

A1 Processing times

The most important times for the application of the central units 07 KR 91 / 07 KT 92 / 07 KT 93 with or without connected remote modules are:

- The **reaction time t_{kk}** is the time between a signal transition at the input terminal and the signal response at the output terminal.

  In case of binary signals, the reaction time consists of the input delay t_D, the cycle time t_C of the program processing and the bus transmission time, if the system is expanded by remote modules.

- The **cycle time t_C** determines the time intervals after which the processor starts the execution of the user program again.

  The cycle time has to be specified by the user. It should be greater than the program processing time t_{UP} of the user program, the data transfer times and the related waiting times.

  The cycle time is also the time base for some time-controlled functions, such as for the PID controller.

- The **program processing time t_{UP}** is the net time for processing the user program.

For the configuration and for determining the reaction time t_{kk}, the following steps are necessary:

– Determining the program processing time t_{UP}

– Addition of the other times which are within the cycle time t_C

– Specification of the cycle time t_C

– Determining the bus cycle time t_b, if there are any remote modules connected to the central unit

– Reaction time t_{kk} as the sum of the input delay t_v, 2 x bus cycle time t_b and 2 x cycle time t_C and output delay t_{DO}.

In addition to calculating the cycle time t_C in accordance with chapter A1.2 (Appendix) it is possible to measure the capacity utilization on the programmed central unit – with the RUN/STOP switch set to RUN. The menu item of ”Display PLC status” in the programming software 907 PC 331 can be used for this purpose. Increase the cycle time t_C until the capacity utilization is below 80 %.

A1.1 Program processing time t_{UP}

- **Binary instructions of the type:**

  !M /M &M =M
  !NM /NM &NM =NM
  Processing time for 1000 instructions: 2 ms

  !M /M &M =SM
  !NM /NM &NM =RM
  Processing time for 1000 instructions: 2.2 ms

- **Word instructions of the type:**

  !MW +MW –MW =MW
  !–MW –MW +MW =–MW
  Processing time for 1000 instructions: 4.1 ms

  !MW *MW :MW =MW
  !–MW *–MW :–MW =–MW
  Processing time for 1000 instructions: 5.4 ms

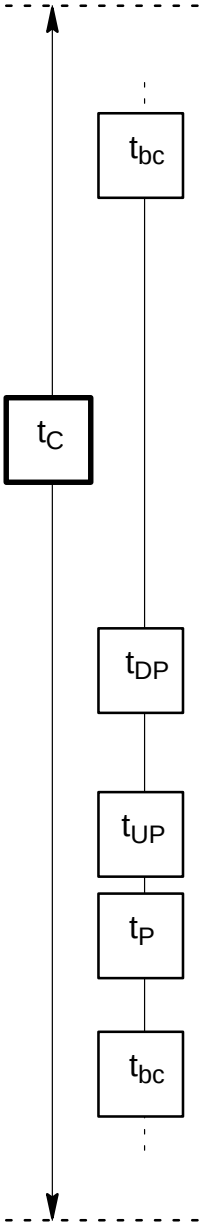
- **Mixed instructions**

  – 65 % binary: !, /, &, =
  – 20 % word: !, +, –, =
  – 15 % word: !, *, :, =

  Processing time for 1000 instructions: 3 ms

- The program processing times of all the function blocks are specified in the documentation of the programming software 907 PC 331.

A1.2 Set cycle time t_C



Times to be taken into consideration when the central unit 07 KR 91 / 07 KT 92 / 07 KT 93 is used as:			
Stand-alone and slave, inputs and outputs of its own	Bus master, inputs and outputs of its own	Bus master, inputs and outputs via remote modules	Explanation
t_{bc} = 0.4 ms	t_{bc} = max. 3.1 ms (1.5 ms) *	t_{bc} = max. 3.1 ms (1.5 ms) *	Block copy time, time for copying the input signals or the out-put signals from/to the transfer memory. It includes: – Net copy time 0.2 ms – 2 interface interrupts of 0.1 ms each – If expanded by remote mod-ules, waiting time for access authorization: binary mod. only: 1.1 ms, also analog mod.: 2.7 ms (2 x interrogation time on the CS31 system bus)
t_{DP} = 0.1 ms	t_{DP}	t_{DP}	Time for depacking. For each binary group (16 bits with common address) 0.05 ms. To be omitted for analog values.
t_{UP}	t_{UP}	t_{UP}	Program processing time, see next page
t_P = 0.05 ms	t_P	t_P	Time for packing. For each binary group 0.05 ms. To be omitted for analog values.
t_{bc} = 0.4 ms	t_{bc} = max. 3.1 ms (1.5 ms) *	t_{bc} = max. 3.1 ms (1.5 ms) *	Block copy time, see above.

* only binary modules which are connected to the CS31 system bus

Fig. 2–20: 07 KR 91 / 07 KT 92 / 07 KT 93, processing times

The cycle time t_C has to be preset by the user taking the following equation into consideration:

$$t_C \geq t_{bc} + t_{DP} + t_{UP} + t_p + t_{bc}$$

This equation assumes that the processor always gets access in the most unfavourable moment.

The cycle time t_C is stored in KD 00,00 and can be selected in 5 ms time steps. If the selected cycle time is too short, the processor will not be able to fulfill the tasks assigned to it. It will come in default then.

If this lack of time is getting too large over several cycles, the processor will abort the program execution and output an error (FK2).

Using some function blocks, such as the PID controller, the error-free execution depends on an exact timing sequence. Make sure that there is a larger time reserve.

The correct setting of the cycle time can be checked by the following procedure:

– Loading the user program into the central unit.

– If the operating mode has been switched over from stand-alone to bus master: Power ON or menu item ”Enable PLC mode” in the programming software.

– Interrogation of the capacity utilization using the menu item of ”Display PLC status”.

– Changing the cycle time t_C until the capacity utilization is below 80 %.

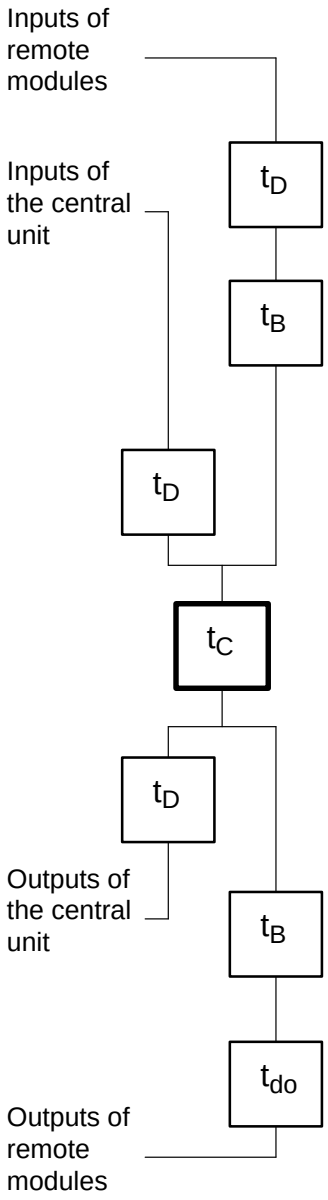
Example: Bus master central unit + 1 binary input module + 1 binary output module + 2 analog input modules

Block copy time:	t_{bc}	= 3.1 ms
20 bin.inputs of the central unit, 16 bin. inputs of the remote module, 3 groups (addresses): 62, 63, 8	t_{DP}	= 0.2 ms
user program:	t_{UP}	= 5 ms
12 binary outputs of the central unit, 8 bin. outputs of the remote module, 2 groups (addresses): 62, 10	t_P	= 0.1 ms
Block copy time:	t_{bc}	= 3.1 ms
	Total	11.5 ms

The calculation results in a cycle time setting of t_C = 15 ms.

A1.3 Reaction time

in case of binary signals



Times to be taken into consideration when the central unit 07 KR 91 / 07 KT 92 / 07 KT 93 is used as:			
Stand-alone and slave, inputs and outputs of its own	Bus master, inputs and outputs of its own	Bus master, inputs and outputs via remote modules	Explanation
–	–	t_D = (8 ms)	Input signal delay t_D of binary remote modules, normally typ. 8 ms
–	–	t_B > 2 ms	Cycle time t_B of the CS31 system bus, depending on number and type of the remote modules, see vol. 2, system data
t_D = typ. 7 ms or 8 µs	t_D = typ. 7 ms or 8 µs	–	Delay time t_D of binary inputs of the central unit: E 62,00...E 63,03: typ. 7 ms E 63,14 a. E63,15: typ. 0.02 ms
$t_C \geq$ 5 ms	$t_C \geq$ 10 ms	$t_C \geq$ 10 ms	Cycle time t_C, to be set by the user
t_D = 0	t_D = 0	–	Delay time t_D of the outputs of the central unit: negligible
–	–	t_B > 2 ms	Cycle time t_B of the CS31 system bus, depending on number and type of the remote modules, see vol. 2, system data
–	–	t_{do} (<1 ms)	Output signal delay time of binary remote modules: normally < 1 ms

Fig. 2–21: 07 KR 91 / 07 KT 92 / 07 KT 93, reaction time

The maximum reaction time t_{kk} (input terminal to output terminal) results from the asynchronicity of the operations:

- Central unit via its own inputs and outputs

$$t_{kk} = t_D + 2 \cdot t_C$$

- Bus master central unit via inputs and outputs of remote modules

$$t_{kk} = t_D + 2 \cdot t_B + 2 \cdot t_C + t_{do}$$

In case of analog signals, the refresh times are to be entered in the formula instead of the delay times.

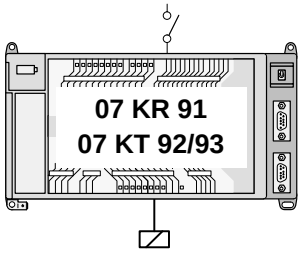
Example: Bus master central unit + 1 binary input module + 1 binary output module + 2 analog input modules, reaction time for binary signals via the remote modules:

Input delay time:	$1 \cdot t_D$	= 8 ms
2 · bus cycle time: 2 · (2 ms + 387 µs + 323 µs + 1355 µs + 1355 µs)	$2 \cdot t_B$	= 10.8 ms
2 · cycle time:	$2 \cdot t_C$	= 30 ms
output delay time:	$1 \cdot t_{do}$	= 1 ms
Terminal-to-terminal reaction time		ca. 49.8 ms

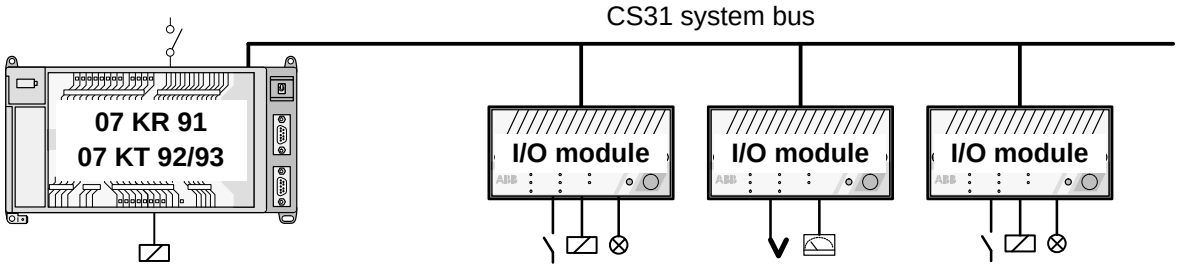
A2 Addressing with 07 KR 91 / 07 KT 92 / 07 KT 93 as bus master

A2.1 Introduction

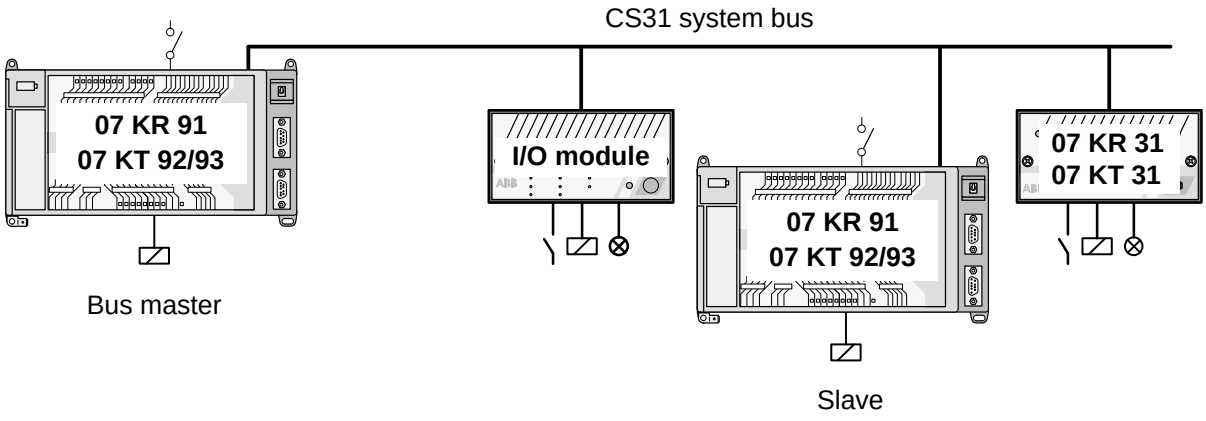
Structure examples with 07 KR 91 / 07 KT 92 / 07 KT 93 as bus master



Example 1: 07 KR 91, 07 KT 92 or 07 KT 93 used as stand–alone PLC



Example 2: 07 KR 91, 07 KT 92 or 07 KT 93 used as bus master on the CS31 system bus, as remote modules only I/O modules are used



Example 3: 07 KR 91, 07 KT 92 or 07 KT 93 as bus master and as slave on the CS31 system bus, 07 KR/KT 31 used as slave, in addition I/O modules

Without regard to the address ranges, the following modules can be connected to a CS31 system bus:

- **max. 1 bus master**
- **max. 31 remote modules / slaves**

Further restrictions result from the address range of the central units 07 KR 91 / 07 KT 92/93:

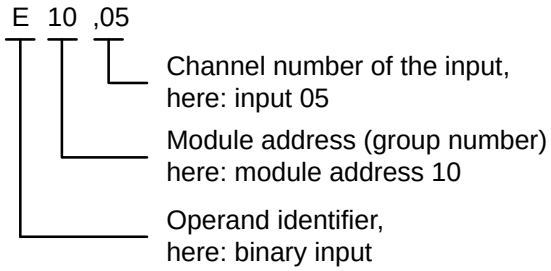
- **max. 12 analog input modules**
- **max. 12 analog output modules**
- **max. 31 binary input modules**
- **max. 31 binary output modules**

There may be further restrictions according to the structure of the installation and the type of remote modules. For the recommended addresses, see chapter A2.2.

Structure of the input and output addresses in the remote modules

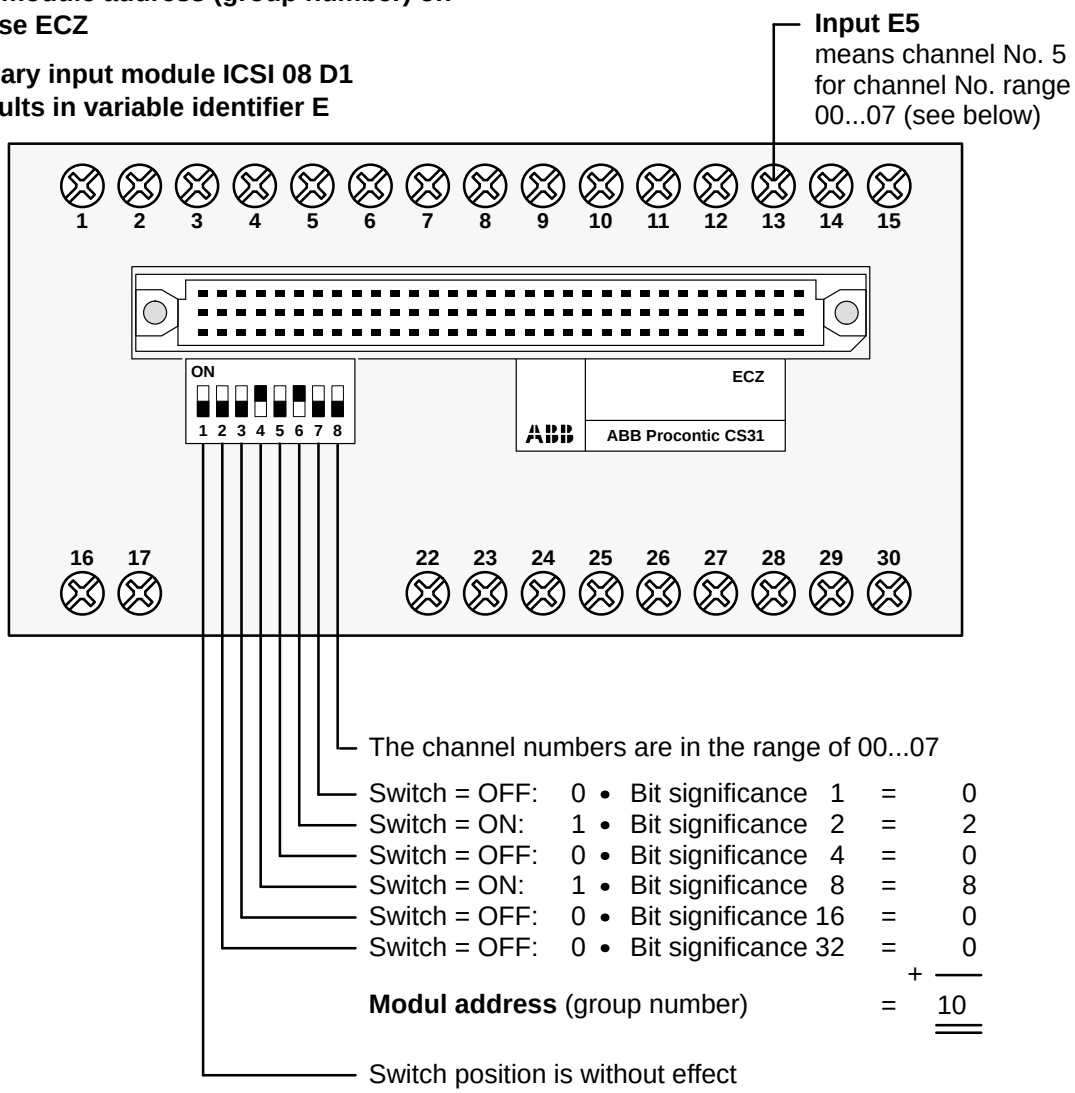
The binary input module ICSI 08 D1 will be explained here as an example.

The bus master central unit reads the input signals as operands. The complete address of an input signal has the following structure:



Setting of the module address (group number) on the plug-in base ECZ

Example: Binary input module ICSI 08 D1 results in variable identifier E



Note: Some of other modules may have a more or less different address setting, see the following chapters.

A2.2 Recommended module addresses on the CS31 system bus with several remote modules and central units connected as slaves

The standard addressing has the purpose of
– simplifying and schematizing the setting of addresses on the CS31 system bus
– simplifying diagnosis and troubleshooting.

The standard addressing makes sure that there will be no address overlappings even for modules with a bigger amount of data.

Recommendation:

- Assign a specific module address for each module/each slave central unit, that means the giving up the possibility of double assignment of module addresses by binary and analog modules
- Module addresses for binary remote modules and central units: 8, 10, ..., 58, 60 (all even numbers), see also chapter A2.6 Central units connected as slaves to the CS31 system bus
- Module addresses for analog remote modules: 0...5
- Address switch No. 8 on the plug-in base ECZ always set to OFF (≤7)

A2.3 Address setting for the modules

Input and output modules connected as slaves to the CS31 system bus

The remote modules are mounted on the plug-in base ECZ. This plug-in base is equipped with an address switch (DIL switch) for setting the module address.

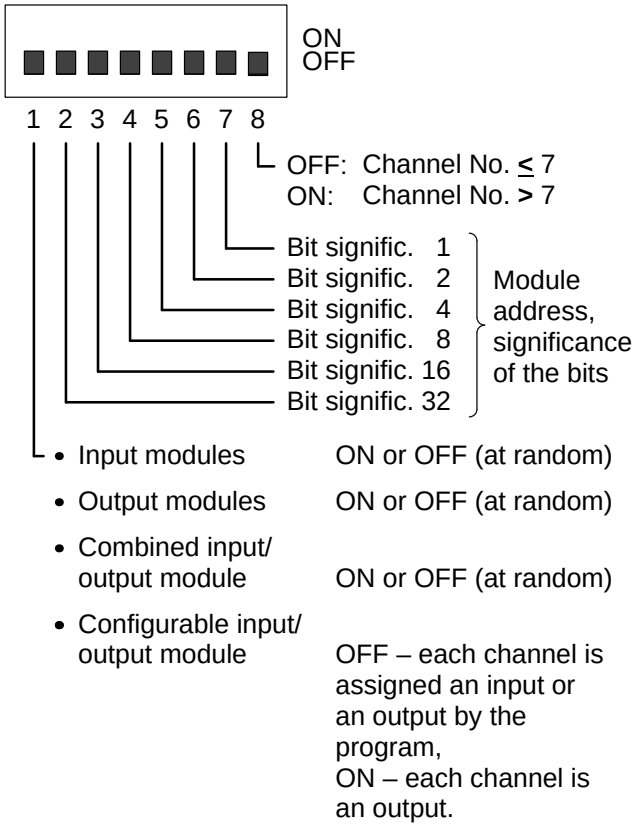
The combination of module type, module address and channel number results in the variable address used by the bus master central unit.

Setting the address switch for binary modules

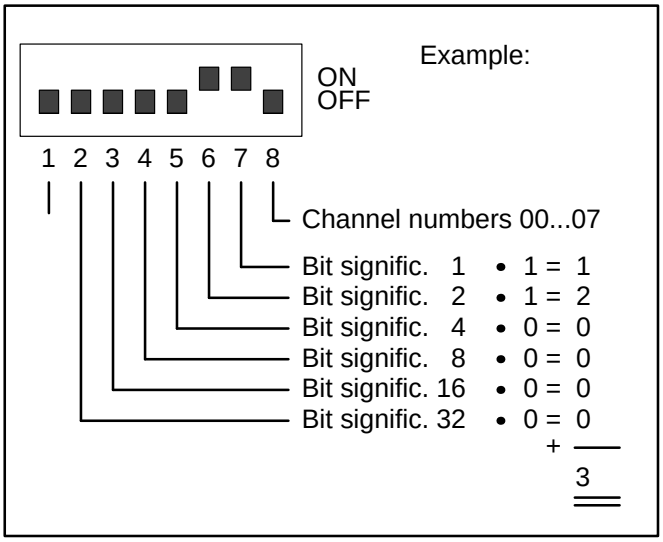
The possible range of module addresses when using the central units 07 KR 91 / 07 KT 92 / 07 KT 93 is:

0...61

The function of the address switches is as follows:



Note: If the configurable input/output module ICFC 16 L1 is used, the complete addressing has to be performed on the left-hand plug-in base.



Setting the address switches in case of analog modules

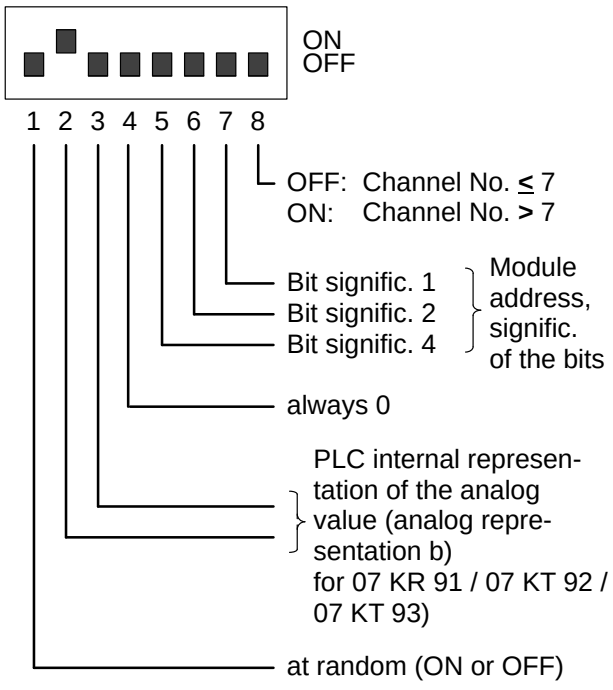
If analog modules are used, their module addresses can be set to

0...5

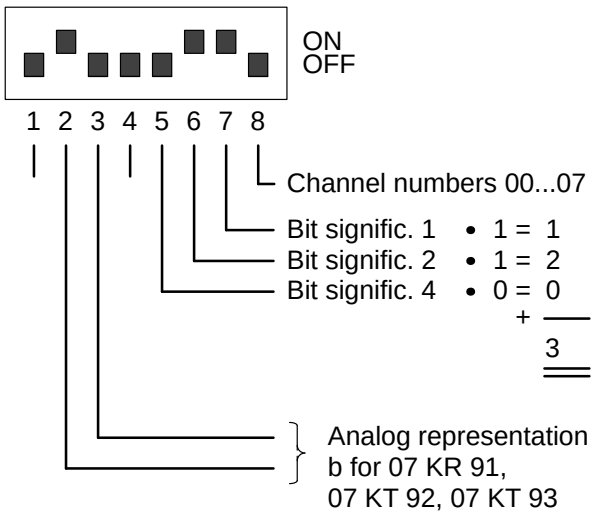
when the central units 07 KR 91 / 07 KT 92 / 07 KT 93 are used as bus master.

The analog representation in the 07 KR 91 / 07 KT 92 / 07 KT 93 is fixed. The analog modules have to supply their values in a suitable form and therefore to be set to the analog representation **b**. For the analog representation, see the general description of the analog modules (volume 2).

The function of the address switches is as follows:



Example:



A2.4 07 KR 91 / 07 KT 92 / 07 KT 93 used as stand-alone central units

If the central units 07 KR 91 / 07 KT 92 / 07 KT 93 are to be used without the CS31 system bus connected, perform the following setting when programming in the user program:

System constant KW 00,00 = –2

This value is the factory setting.

For the 07 KT 92 used as stand-alone central unit, see chapter A2.1 Introduction, Example 1.

A2.5 07 KR 91 / 07 KT 92 / 07 KT 93 used as bus master central unit

If remote modules (slaves) are connected to the central units 07 KR 91 / 07 KT 92 / 07 KT 93 via the CS31 system bus, proceed as follows:

1. Change the system constant: KW 00,00 = –1
2. Save the PLC program in the Flash EPROM
3. Activate the new PLC mode by:
   - Calling the menu item ”Enable PLC mode” in the ABB programming and test system or
   - entering the command WARM <CR> in terminal mode or
   - power ON or
   - cold start.

A2.6 Intelligent I/O remote modules (central units) as slaves on the am CS31 system bus

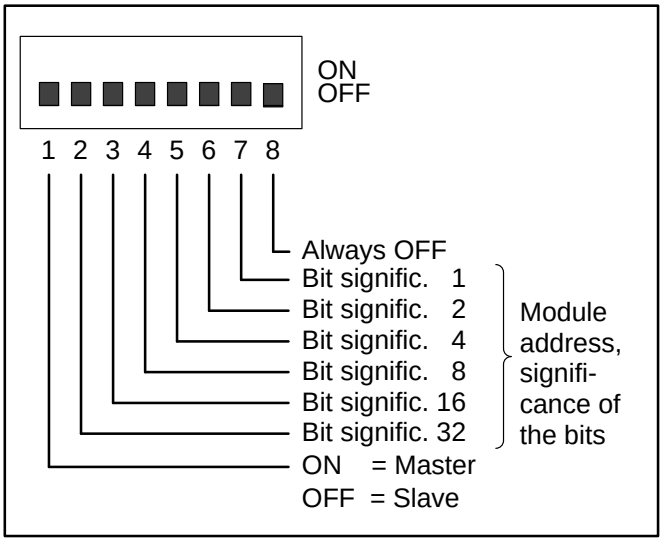
The central units 07 KR 91, 07 KT 92, 07 KT 93, 07 KR 31 and 07 KT 31 can also be used as slaves at the CS31 system bus, see chapter A2.1, Addressing, Introduction, Example 3.
The central units 07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KR 31 / 07 KT 31 may be used both in the binary range and in the word range.

The address can be set to a value from 0 to 61. The maximum permissible address depends on the size of the set transmit and receive range. The larger you choose the transmit or the receive range, the smaller is the maximum permissible address (see examples 1...3).

If you want to switch over to the ”slave mode”, proceed as follows:

1. Change the system constant: KW 00,00 = 0...61.
   Only for 07 KR 31 and 07 KT 31: If KW 00,00 = 100, the address is set on the DIL switch of the plug-in base in the same way as with the standard modules, the address range is 0...61.

Meaning of the DIL switches:



2. Save the PLC program in the EEPROM
3. Activate the new PLC mode by:
   – Calling the menu item ”Enable PLC mode” in the ABB programming and test system or
   – entering the command WARM <CR> in terminal mode or
   – power ON or
   – cold start.

There is no direct access to the inputs and outputs of the slave central unit via the CS31 system bus. The communication between master and slave is performed using input and output operands.

All the master data are consistently transferred to the slave, and all the slave data are consistently transferred to the master.

The slave PLC can be used *either* in the binary range *or* in the word range of the CS31 system bus. The transmit and receive ranges of the slave can be adapted to the application-specific requirements by means of the two system constants KW 00,10 and KW 00,11 (see also chapter ”System constants”).

You can set:

– The size of the transmit and receive ranges and
– the mode of employment of the slave (in the binary or the word range).

Default condition:

If the central units 07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KR 31 / 07 KT 31 are switched over to the ”slave mode”, they behave like binary input and output modules with 32 inputs and 32 outputs when connected to the CS31 system bus.

This means that the default setting of the transmit and receive ranges is within the binary range of the master. Their size is 32 bits each (4 bytes).

Example 1:

Default configuration of the slave (binary range):
KW 00,10 = 0: Slave transmit range: 4 bytes
(4 bytes * 8 channels = 32 binary O)

KW 00,11 = 0: Slave receive range: 4 bytes
(4 bytes * 8 channels = 32 binary I)

Note:
The default configuration is the same as the the configuration KW 00,10 = KW 00,11 = 4.

07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KR 31 / 07 KT 31 as bus master	↔	07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KR 31 / 07 KT 31 as slave with: KW 00,10 = 0 or 4 KW 00,11 = 0 or 4
Receive or transmit using E/A operands (I/O operands)		Transmit or receive using E/A operands I/O operands
E n ,00	←	A 00,00
:		:
E n ,15		A 00,15
E n+1,00		A 01,00
:		:
E n+1,15	←	A 01,15
A n ,00	→	E 00,00
:		:
A n ,15		E 00,15
A n+1,00		E 01,00
:		:
A n+1,15	→	E 01,15

n: Module address of the slave central unit, for this example: 0 ≤ n ≤ 60)

For the slave address of n = 12 the following applies, for example:
The output signal A 00,00 of the 07 KR 91 used as slave is the input signal E 12,00 for the 07 KR 91 used as bus master.

Example 2:

Configuration of the slave for the binary range:

KW 00,10 =15: Slave transmit range: 15 bytes
(15 bytes * 8 channels = 120 binary O)

KW 00,11 = 06: Slave receive range: 6 bytes
(6 bytes * 8 channels = 48 binary I)

07 KR 31 / 07 KT 31 07 KR 91 / 07 KT 92 / 07 KT 93 as bus master	↔	07 KR 31 / 07 KT 31 07 KR 91 / 07 KT 92 / 07 KT 93 as slave with: KW 00,10 = 15 KW 00,11 = 6
Receive or transmit using E/A operands (I/O operands)		Transmit or receive using E/A operands I/O operands
E n ,00	←	A 00,00
:		:
E n ,15		A 00,15
:		
E n+7,00		A 07,00
:		:
E n+7,07		A 07,07
A n ,00	→	E 00,00
:		:
A n ,15		E 00,15
:		:
A n+2,00		E 02,00
:		:
A n+2,15		E 02,15

Notes:

The upper 8 input channels of the address n+7

E n+7,08...E n+7,15

can be assigned to another binary *8 bit input module (excluding KR/KT)* on the CS31 system bus.

The output channels starting from the address n+3

A n+3,00...A n+7,15

can be assigned to other *output devices (including KR/KT)* on the CS31 system bus.

n: Module address of the slave PLC, for this example: 0 ≤ n ≤ 54)

For the slave address of n = 12 the following applies, for example:
The output signal A 00,00 of the 07 KR 91 used as slave is the input signal E 12,00 for the 07 KR 91 used as bus master.

Example 3:

Configuration of the slave for the word range:

KW 00,10 = 101: Slave transmit range: 1 word
(1 word = 1 word output)

KW 00,11 = 108: Slave receive range: 8 words
(8 words = 8 word inputs)

07 KR 31 / 07 KT 31 07 KR 91 / 07 KT 92 / 07 KT 93 as bus master	⟷	07 KR 31 / 07 KT 31 07 KR 91 / 07 KT 92 / 07 KT 93 as slave with: KW 00,10 = 101 KW 00,11 = 108
Receive or transmit using EW/AW operands		Transmit or receive using EW/AW operands
EW n,00	←	AW 00,00
AW n,00 : AW n,07	→	EW 00,00 : EW 00,07

Notes:

If a slave KR/KT is configured for the word range, only the lower 8 channels of the address n are assigned to it on the CS31 system bus.

(EW n,00...EW n,07 and AW n,00...AW n,07).

The upper 8 channels of the address n

EW n,08...EW n,15 and
AW n,08...AW n,15

can be assigned to another *analog module (excluding KR/KT)* on the CS31 system bus, for example.

n: Module address of the slave PLC,
for this example: $0 \leq n \leq 5$)

For the slave address of n = 4 the following applies, for example:
The output signal AW 00,00 of the 07 KR 91 used as slave is the input signal EW 04,00 for the 07 KR 91 used as bus master.

A2.7 Special modules used as slave on the CS31 system bus

- **Robot coupler ICBG32L7 and ICBG64L7**

The Robot coupler ICBG32L7 (ICBG64L7) behaves on the CS31 system bus like a binary input/output module equipped with 16 (32) inputs and 16 (32) outputs.

The module address can be set by means of the DIL switch on the printed circuit board.

The meaning of the DIL switch is the same as that on the plug-in base ECZ, see chapter A2.3. Switch No. 8 is always set to OFF.

Please note that the set module address and also the following address are assigned by the Robot coupler ICBG64L7.

For the signal names in the user program of the central unit, please see the description of the Robot couplers.

- **Festo valve island / installation island**

The Festo valve island and the Festo installation island behave on the CS31 system bus like binary input and output modules. For the scope of assigned data, please see chapter A2.9.

The module addresses are set by means of the address switches located below the cover of the ”field bus node”. The upper switch is provided for the unit digit, the lower switch for the tens digit.

A2.8 Complex structure examples including addresses

- **Categorization of the modules with respect to the I/O terminals**

There are the following two main module types:

– Binary modules. These modules are controlled by means of binary I/O operands (E or A, respectively). The Robot couplers ICBG 32 L7 and ICBG 64 L7 (always used as slave) belong also to them, as well as the central units 07 KR 91, 07 KT 92, 07 KT 93, 07 KR 31 and 07 KT 31, if they are used as slaves.

– Analog modules. These modules are controlled by means of word I/O operands (EW or AW, respectively). The central units 07 KR 91, 07 KT 92, 07 KT 93 belong to them as well as the high-speed counter ICSF 08 D1, which receives its preset data as word data, for example.

The following table contains an overview of the module types. These designations will be used in example 6.

Please note that the configurable binary modules ICSC 08 L1 and ICFC 16 L1 behave differently according to the performed setting.

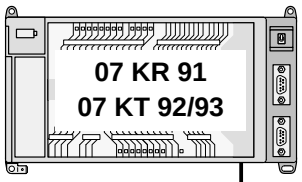
A2.9 Module examples (slaves connected to the CS31 system bus)

Module types, with regard to I/O terminals	Module examples
Binary input modules with 8 inputs	ICSI 08 D1, ICSI 08 E1, ICSI 08 E4
Binary input modules with 16 inputs	ICSI 16 D1, ICSI 16 E1
Binary output modules with 8 outputs	ICSO 08 R1, ICSO 08 Y1; ICSC 08 L1, if switch No. 1 is set to ON
Binary output modules with 16 outputs	ICFC 16 L1, if switch No. 1 is set to ON, Festo valve island with up to 8 valves
Binary output modules with 32 outputs	Festo valve island with more than 8 valves
Binary modules with 8 inputs and 8 outputs	ICSC 08 L1, if switch No. 1 is set to OFF
Binary modules with 16 inputs and 16 outputs (a) or 16 signals each from/to the CS31 bus (b)	(a) ICSK 20 F1, ICDG 32 L1, if switch No. 1 is set to ON, ICFC 16 L1, if switch No.1 is set to OFF, Festo installation island with up to 6 valves, (b) ICBG 32 L7
Binary modules with 32 inputs and 32 outputs (a) or 32 signals each from/to the CS31 bus (b)	(a) Festo installation island with more than 6 valves, (b) ICBG 64 L7, ICDG 32 L1, if switch No. 1 is set to OFF
Binary modules with 120 signals each from/to the CS31 system bus	07 KR 91 as slave 07 KT 92 as slave 07 KT 93 as slave 07 KR 31 as slave 07 KT 31 as slave
Analog input modules with 8 inputs	ICSE 08 A6, ICSE 08 B5, ICST 08 A8, ICST 08 A9

Module types, with regard to I/O terminals	Module examples
Analog output modules with 8 outputs	ICSA 04 B5
Analog modules with up to 4 inputs and 4 outputs	ICSM 06 A6 (4 EA, 2 AA, therefore addressing gaps which cannot be assigned)
Analog modules (word modules) with up to 8 inputs and 8 outputs	ICSF 08 D1 (high–speed counter), 07 KR 91, 07 KT 92, 07 KT 93, 07 KR 31, 07 KT 31

Examples for the assignment of module addresses,

Example 4

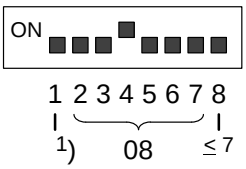
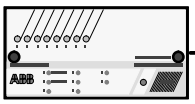
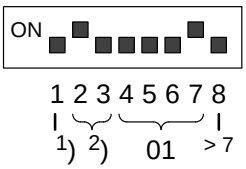
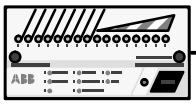


CS31 system bus

07 KR 91	07 KT 92	07 KT 93
E 62,00	E 62,00	E 62,00
:	:	:
E 62,15	E 62,11	E 62,15
E 63,00	A 62,00	E 63,00
:	:	:
E 63,03	A 62,07	E 63,07
A 62,00	EW 06,00	A 62,00
:	:	:
A 62,11	EW 06,03	A 62,15
	AW 06,00	

Addresses of the inputs and outputs on the bus master central unit

Bus master central unit

Address switch (DIL switch) on the plug-in base ECZ	Remote module	Address in the program of the master CPU	
		A 08,00	1st binary output
		A 08,01	2nd binary output
		:	:
	8 binary outputs	A 08,07	8th binary output
		EW 01,00	1st analog input
		EW 01,01	2nd analog input
		:	:
	8 analog inputs	EW 01,07	8th analog input

Remote modules (slaves)

1) at random (ON or OFF)

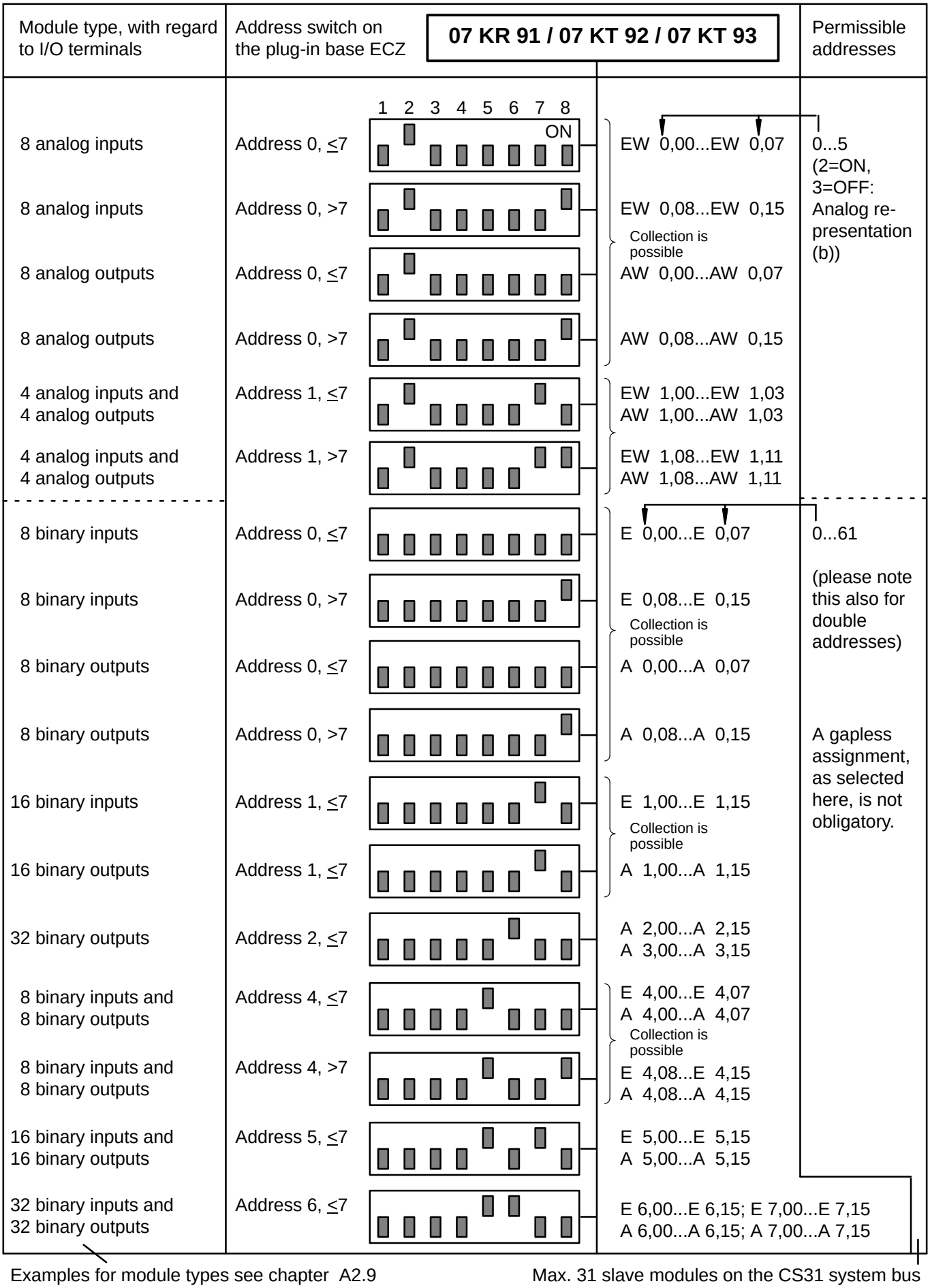
2) If analog modules are connected to 07 KR 91 / 07 KT 92 / 07 KT 93 the analog representation is **b**, see the general description of the analog modules in volume 2.

Example 5

Address setting in the master: KW 0,0 = –1	07 KR 91	07 KT 92	07 KT 93	
	E 62,00...E 62,15 E 63,00...E 63,03 A 62,00...A 62,11 —— ——	E 62,00...E 62,11 —— A 62,00...A 62,07 EW 6,00...EW 6,03 AW 6,00	E 62,00...E 62,15 E 63,00...E 63,07 A 62,00...A 62,15 —— ——	Inputs/outputs on the central unit

Address switch on the plug-in base ECZ	Remote module		Address in the program of the master CPU	Remarks
ON 1 2 3 4 5 6 7 8 * 03 I ≤ 7	ICSE 08 A6 8 analog inputs	E0 : E7	EW 03,00 : EW 03,07	– Permissible range of module addresses for analog modules: 0...5 – * Analog representation b – 2 analog input modules with 8 channels each can be assigned to one address (16 channels together) – The same address (as for the analog input modules) may also be used for the connection of analog output modules (as shown to the left). Since the module has only 4 channels, AW 03,04...AW 03,07 (or AW 03,12...AW 03,15) cannot be used. The same corresponds to the module ICSM 06 A6.
ON 1 2 3 4 5 6 7 8 * 03 I > 7	ICSE 08 A6 8 analog inputs	E0 : E7	EW 03,08 : EW 03,15	
ON 1 2 3 4 5 6 7 8 * 03 I ≤ 7	ICSA 04 B5 4 analog outputs	A0 : A3	AW 03,00 : AW 03,03	
ON 1 2 3 4 5 6 7 8 06 I ≤ 7	ICSI 16 E1 16 binary inputs	E00 : E15	E 06,00 : E 06,15	– Permissible range of module addresses for binary modules: 0...61, recommendation: 6...60 – The following might be done, but does not bring you any advantage: • using the same addresses for binary modules as for analog modules • collecting 2 modules with 8 bits each under one address • collecting input and output modules under one address
ON 1 2 3 4 5 6 7 8 06 I ≤ 7	ICSO 08 R1 8 binary outputs	A0 : A7	A 06,00 : A 06,07	
ON 1 2 3 4 5 6 7 8 06 I > 7	ICSO 08 R1 8 binary outputs	A0 : A7	A 06,08 : A 06,15	
07 KR 91 / 07 KT 92 / 07 KT 93: KW 0,0 = 4 up to 120 binary inputs and up to 120 binary outputs or up to 8 word inputs and up to 8 word outputs			KR/KT in binary range: E 04,00...E 11,07 A 04,00...A 11,07 or KR/KT in word range: EW 04,00...EW 04,07 AW 04,00...A 04,07	– Slave KR/KT with 120 E and/or 120 A occupies the set address **and** the following 7 addresses (only half of the 7th, though). For address 4 of the example: – Next free address for KR/KT: binary range: 12, word range: 5 – Max. settable KR/KT address: binary range: 54, word range: 5

Example 6


Module type, with regard to I/O terminals
Address switch on the plug-in base ECZ
07 KR 91 / 07 KT 92 / 07 KT 93
Permissible addresses
1 2 3 4 5 6 7 8
ON
8 analog inputs
Address 0, ≤7
EW 0,00...EW 0,07
0...5 (2=ON, 3=OFF: Analog representation (b))
8 analog inputs
Address 0, >7
EW 0,08...EW 0,15
Collection is possible
8 analog outputs
Address 0, ≤7
AW 0,00...AW 0,07
8 analog outputs
Address 0, >7
AW 0,08...AW 0,15
4 analog inputs and 4 analog outputs
Address 1, ≤7
EW 1,00...EW 1,03
AW 1,00...AW 1,03
4 analog inputs and 4 analog outputs
Address 1, >7
EW 1,08...EW 1,11
AW 1,08...AW 1,11
8 binary inputs
Address 0, ≤7
E 0,00...E 0,07
0...61
(please note this also for double addresses)
8 binary inputs
Address 0, >7
E 0,08...E 0,15
Collection is possible
8 binary outputs
Address 0, ≤7
A 0,00...A 0,07
8 binary outputs
Address 0, >7
A 0,08...A 0,15
A gapless assignment, as selected here, is not obligatory.
16 binary inputs
Address 1, ≤7
E 1,00...E 1,15
Collection is possible
16 binary outputs
Address 1, ≤7
A 1,00...A 1,15
32 binary outputs
Address 2, ≤7
A 2,00...A 2,15
A 3,00...A 3,15
8 binary inputs and 8 binary outputs
Address 4, ≤7
E 4,00...E 4,07
A 4,00...A 4,07
Collection is possible
8 binary inputs and 8 binary outputs
Address 4, >7
E 4,08...E 4,15
A 4,08...A 4,15
16 binary inputs and 16 binary outputs
Address 5, ≤7
E 5,00...E 5,15
A 5,00...A 5,15
32 binary inputs and 32 binary outputs
Address 6, ≤7
E 6,00...E 6,15; E 7,00...E 7,15
A 6,00...A 6,15; A 7,00...A 7,15
Examples for module types see chapter A2.9
Max. 31 slave modules on the CS31 system bus

A3 I/O configuration

A3.1 Purpose of the I/O configuration of I/O modules

Dependent on the type of I/O modules the following can be configured:

- in case of binary I/O modules, an input delay different from the factory setting,
- in case of binary modules with combined I/O channels, these channels can also be defined as input only or output only,
- in case of binary modules, open-circuit monitoring at inputs and outputs,
- in case of analog modules, measuring or output ranges which differ from the factory setting.

Switching over of inputs and outputs, switching on the diagnosis functions and changing the measuring and output ranges are performed as follows, depending on the module type:

- Performing the I/O configuration via the CS31 system bus, either by means of the user program of the bus master central unit or by means of a terminal
- Setting of switches on the plug-in base ECZ or on the rear side of the input/output module
- External wiring on the input/output module terminals.

In some cases, there is a relation between the settings made on the remote module and the information and diagnosis messages which can be interrogated at the remote module or via the CS31 system bus. This relation will be explained in the following chapters.

There is no need for you to perform an I/O configuration via the CS31 system bus if the factory setting is sufficient. Once an I/O configuration has been performed, it will remain stored in the corresponding I/O module until it is changed again. Even in case of power OFF it will not be deleted.

A3.2 Settings and diagnosis on binary modules

The following tables give you an overview on the I/O configurations and the diagnosis functions related to them for the different module types.

Binary modules, settings and diagnosis									
I/O configurable functions	–	–	–	–	CI	CO	ID	IO	OO
Diagnosis functions according to module type a) always present	UE	BE	OL	SC					
b) if configured					CI	CO	–	–	–
Readable on the module by pressing the test button [1]) a) Diagnosis messages	–	–	OL	SC	CI	CO			
b) Settings								IO	OO
Available for the bus master user program, readable on the terminal a) cyclic transmission	–	–	OL	SC	CI	CO			
b) interrogable							ID	IO	–
Module type									
ICSI 08 D1	●	●			●		●		
ICSI 16 D1	●	●			●		●		
ICSI 08 E1	●	●					●		
ICSI 16 E1	●	●					●		
ICSI 08 E4	●	●					●		
ICSO 08 R1	●	●							
ICSO 08 Y1	●	●	●	●					
ICSO 16 N1	●	●	●	●					
ICSK 20 F1	●	●							
ICSK 20 N1	●	●	●	●					
ICSC 08 L1	●	●	●	●	●	●	●	●	●
ICSC 16 L1	●	●	●	●	●	●	●	●	●
ICSF 08 D1	●	●							
ICDG 32 L1	●	●	●	●					
Robot coupler	●	●							
Festo devices	●	●	●	●					
07 KR 91	●	●							
07 KT 92	●	●	●	●					
07 KT 93	●	●	●	●					
07 KR 31	●	●							
07 KT 31	●	●	●	●					

Explanation

● Feature is completely available. Settings and errors can be interrogated from the involved channel.

(●) Feature is partly available, see module description.

[1]) Concerning the interrogation of settings and diagnosis data, see the module description and chapter ”Reading I/O configuration and diagnosis data at the module” (see below).

BE Bus Error = Bus malfunction, always monitored. The module does not receive a call from the bus master, e.g. because of a broken bus line.

CI Cut Wire of Inputs = Open circuit (monitoring) at inputs, if configured. Each input circuit to be monitored has to be equipped with a resistor of 20...30 kΩ, e.g. in parallel to the signalling contact.

CO Cut Wire of Outputs = Open circuit (monitoring) at outputs, if configured. Each output expects a minimum load of approx. 40 mA when an ON signal is output.

ID Input Delay = Change of the signal delay time at inputs.

IO Input only = Each terminal (channel) can be configured so that it works only as an input (not as combined input/output).

OO Output only = This mode is set by means of a switch on the plug-in base ECZ. Setting is not possible by I/O configuration, see the module description.

OL Overload (is always monitored).

SC Short circuit (is always monitored).

UE Unit error = internal error (fault) of the module (always monitored in so far as the internal processor can detect this).

A3.3 I/O configuration, changing of measuring ranges and diagnosis on analog modules

Analog modules, settings and diagnosis											
Selectable ranges: I/O configurable **(K)** by means of switches **(S)** or wiring **(V)**				0–10 V	±10 V	0–20 mA	±20 mA	4–20 mA	other range	rough display of the value
Module type										
ICSE 08 A6	●	●		A	–	A	–	K	K	●
ICSE 08 B5	●	●		–	A	–	S,K	S,K	S,K	●
ICSA 04 B5	●	●	●	–	A	S	–	S,K *	–	●
ICSM 06 A6, inputs	●	●		A	–	A,V	–	K	A,K	●
ICSM 06 A6, outputs				–	A	A	–	K		●
Diagnosis functions according to the module type										
a) always available	UE	BE								
b) if configured			OE							
Can be read from the module by pressing the test button [1])										
a) Diagnosis messages	UE	BE								
b) Settings (only switches and I/O configuration)			OE	●	●	●	●	●		
Available for bus master user program, can be read on the terminal										
a) transferred cyclically	UE	BE								
b) can be interrogated			OE					●		

Explanation:

[1]) Concerning the interrogation of settings and diagnosis data, see the module description and chapter ”Reading I/O configuration and diagnosis data at the module” (see below).

*) Changing range by switch, activating the open-circuit monitoring by I/O configuration

BE Bus Error = Bus malfunction, always monitored. The module does not receive a call from the bus master, e.g. because of a broken bus line.

OE Output Error = Error in the output circuit.
ICSA 04 B5: Open circuit at outputs configured to 4...20 mA.
ICSM 06 A6: Short circuit at outputs configured to ± 10 V.

UE Unit error = internal error (fault) of the module (always monitored in so far as the internal processor can detect this).

A Factory setting

K Changing the range by means of the I/O configuration via the CS31 system bus

S Changing the range by means of DIL switches on the rear side of the module

V Change-over between voltage and current by means of an additional external jumper. No specification if only another terminal has to be used.

A3.3.1 Performing and reading the I/O configuration

There are the following possibilities for system structures when using 07 KR 91, 07 KT 92 or 07 KT 93 as bus master:

- Performing and reading the I/O configuration via the user program of the bus master central unit 07 KR 91, 07 KT 92 or 07 KT 93,
- Performing and reading the I/O configuration by means of the terminal or
- Reading the I/O configuration from the remote modules.

Performing and reading the I/O configuration via the user program

The function block CS31CO is available for the I/O configuration of the modules. This function block is part of the programming software 907 PC 331 and is described in the corresponding documentation.

Performing and reading the I/O configuration by means of the terminal or TCZ

This method is based on the fact that the central units 07 KR 91, 07 KT 92 and 07 KT 93 use a dialogue language at the programming interface which allows the I/O configuration to be performed and interrogated by means of simple protocols; see volume 7.3, chapter 3, ”MAIL command”.

07 KR 91 and 07 KT 92/93 are generally equipped with the special function for I/O configuration.

The following devices can be used as terminal:

- A commercially available terminal equipped with an EIA–232 interface, such as VT100.
- A PC equipped with the programming software 907 PC 331. All the interface data are correctly set under the main menu item of ”PLC communication 2”, sub-item ”Terminal emulation”.
- The service device TCZ in the operating mode 1 = TERMINAL, 2 = CHAR.MODE, N = transmission speed unchanged, 9600 Baud.

Reading I/O configuration and diagnosis data at the remote module

Reading the I/O configuration and the diagnosis data for an I/O terminal of a remote module will be shown in the following for the device ICSC 08 L1 as an example. The test button ④ and the LED displays ① of the module have to be used for this purpose.

When the test button is pressed for the first time, channel E/A0 (input/output 0) is selected: LED 0 flashes. After releasing the button, the diagnosis data of this channel are shown by the yellow LEDs 0 to 7 for approx. 3 seconds.

The LEDs have the following meaning:

0 UE = Unit error
1 BE = Bus error
2 not used
3 CI/CO = Cut wire of inputs/outputs
4 OL = Overload
5 SC = Short circuit
6 Configuration as output
7 Configuration as input

If the LEDs 6 and 7 light up at the same time, the channel is configured as a combined input/output.

The meaning of the LEDs ② is also printed onto the front panel of the module.

The operation is repeated for the other channels each time the test button is pressed and released.

After the last channel E/A7 (input/output 7) has been scanned, pressing the test button again causes a lamp test (LED test) to be performed. All the 8 LEDs should light up. After the button has been released, the LEDs will show the setting of the DIL switch on the plug-in base for approx. 5 seconds. LED 0 shows the position of switch No. 1 (LEDs 0...7 are assigned to the switches No. 1...8).

All error messages are stored in the module and can only be deleted by pressing the test button for 10 seconds or by power OFF/ON.

A4 Diagnosis

A4.1 Introduction

The diagnosis system of the 07 KR 91 / 07 KT 92 / 07 KT 93 is designed to ensure a quick and efficient troubleshooting. For this purpose, it is classified:

- ”vertically” in diagnosis, error flags, reactions, LED displays and acknowledgement, see chapter A4.7. There are interrelations between the bus master central unit and the remote modules. The central unit reads the diagnosis data which the remote modules have found out. An acknowledgement in the central unit also causes the stored error messages in the remote modules to be deleted.
- ”horizontally” in 4 error classes, in correspondence with the severity of the error, see chapter A4.7.

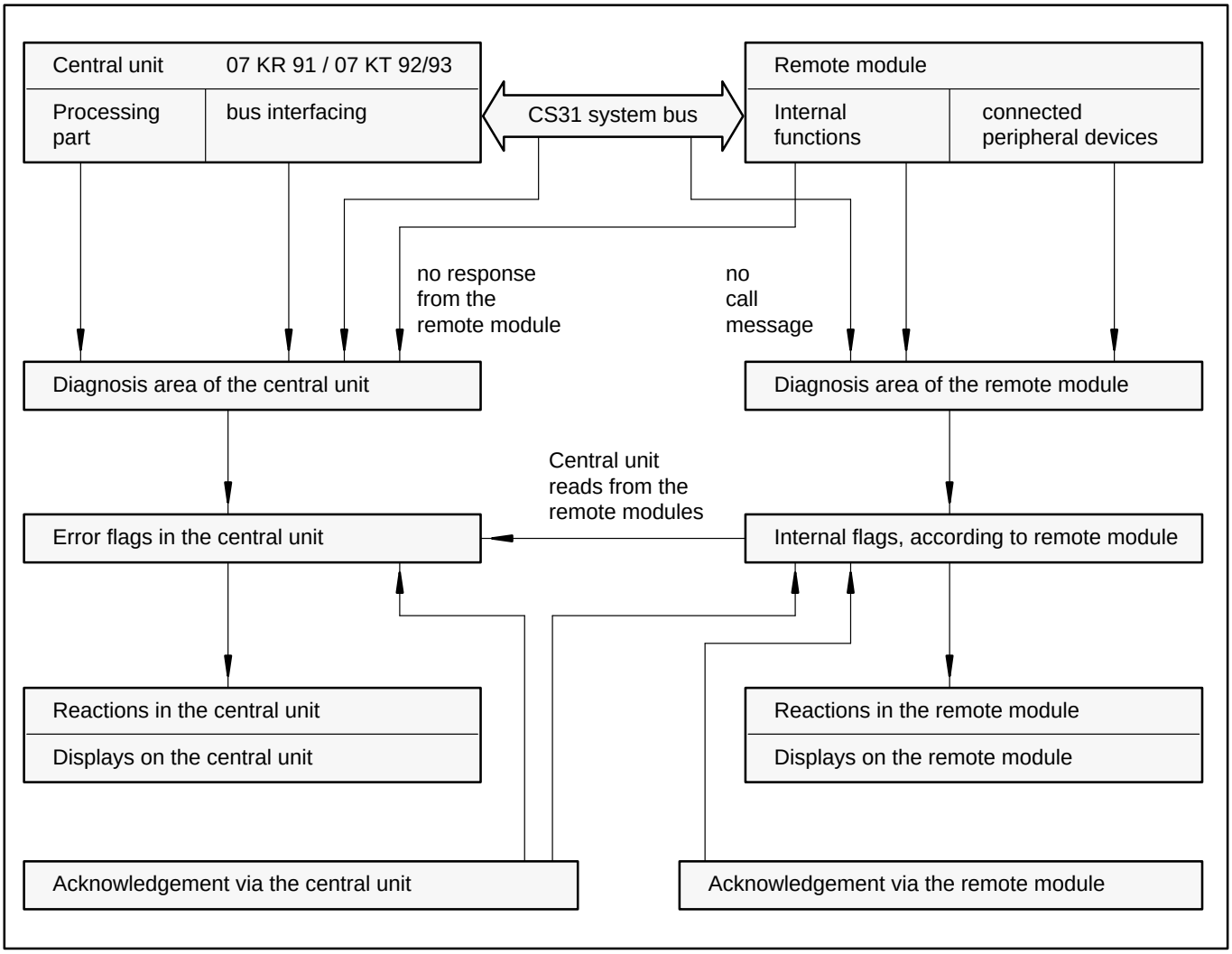
This concept is based on a system structure consisting of a bus master central unit and several remote modules, and remote processors as well. The diagnosis system detects the following errors:

- Errors in the bus master central unit
- Errors on the CS31 system bus
- Errors in the remote modules
- Errors in the wiring of the remote modules on the process side

The troubleshooting is performed as follows:

- The LEDs on the central unit 07 KR 91, 07 KT 92 and 07 KT 93 give first hints, see chapter A4.3. The errors detected by the remote modules are also displayed here.
- If these hints are not sufficient, the error flags have to be read out. For the meaning of the error flags, see chapters A4.7 and A4.10.
- The status register EW 07,15 in the central unit supplies additional information to be used for the diagnosis, see chapter A4.9.
- The remote modules indicate errors occurring in their area. Detailed information can be obtained by pressing the test key on the modules, see chapter A4.4.

A4.2 Structure of the diagnosis



A4.3 Troubleshooting by means of LED displays on the central unit

The LED displays on the front panel of the central unit supply initial information on the errors which occurred:

- BA = CS31 bus processor active
- BE = Bus Error (error on the CS31 system bus)
- RE = Remote Unit Error (error in/on a remote module)
- SE = Serial Unit Error (error in the CS31 bus interfacing of the central unit)
- RUN = User program is running (no error)
- FK1 = Error class 1 (fatal error)
- FK2 = Error class 2 (serious error)
- FK3 = Error class 3 (light error)
- Supply = Supply voltage available
- Battery = Battery is effective
- K = Overload/short circuit on at least one direct binary output of the central unit ZE 07 KT 92 or 07 KT 93

If no LED lights up, the central unit has not found any error. Exception: LED Battery (battery is missing); the battery is only necessary for certain applications.

LEDs for CS31 system bus and bus interfacing

LED / CPU	BA gn	BE rd	RE rd	SE rd	Meaning	Remedy
Stand-alone–CPU, master CPU or slave CPU	☆	□	□	□	Everything ok.	—
	□	X	X	X	A fatal error occurred. The watchdog switched off the CS31 system bus. All outputs are in OFF condition.	• Power OFF/ON. If unsuccessful, device is defective. • Evaluate the error flags.
	☆	□	□	☆	Dual–port RAM defective	• Power OFF/ON. If unsuccessful, device is defective. • Evaluate the error flags.
	□	☆	☆	☆	Initialization phase after power ON or after cold start.	—
Master CPU	☆	☆	□	□	Master CPU does not find any remote modules on the CS31 system bus after power ON or after cold start.	• Install remote modules. • Check the CS31 bus line. • Check the supply voltage of the remote modules. • Evaluate the error flags.
	☆	□	☆	□	Error message from a remote module	• Evaluate the error flags. • Check the remote modules.
	☆	☆	☆	□	1 remote module can suddenly not be controlled by the master CPU anymore.	• Evaluate the error flags. • Check the supply voltage of the remote module. • Check the CS31 bus line. • Check the remote module.
	☆	☆	□	□	There are at least 3 remote modules on the CS31 system bus. 2 remote modules can suddenly not be controlled by the master CPU anymore.	• Evaluate the error flags. • Check the supply voltage of the remote modules. • Check the CS31 bus line. • Check the remote modules.
	☆	☆	☆	☆	There are at least 2 remote modules on the CS31 system bus. Suddenly no remote module can be controlled by the master CPU anymore.	• Evaluate the error flags. • Check the supply voltage of the remote modules. • Check the CS31 bus line. • Check the remote modules.
Slave CPU	☆	□	⁂	□	CS31 system bus does not work.	• Check the CS31 bus line. • Check master central unit.

□ = LED off, ☆ = LED on, ⁂ = LED flashes, X = LED on or off, gn = green, rd = red

LEDs for user program and error display

LED / CPU	RUN gn	FK1 rd	FK2 rd	FK3 rd	Meaning	Remedy
Stand-alone CPU, master CPU or slave CPU	☆	□	□	□	User program is running.	—
	☆	□	□	☆	User program is running, but a light error occurred.	• Evaluate the error flags and eliminate the error.
	□	□	□	□	The user program does not run.	• Start the user program.
	□	□	□	☆	A light error occurred which caused the user program to be aborted automatically because – the system constant KW 0,7 is not equal to 0, – the ”ABORT” block is not configured.	• Evaluate the error flags and eliminate the error.
	□	□	☆	□	A serious error occurred which caused the user program to be aborted automatically.	• Evaluate the error flags and eliminate the error, if possible.
	□	☆	□	□	A fatal error occurred. The user program cannot be started.	• Evaluate the error flags. • Power OFF/ON. If unsuccessful, device is defective.
	□	□	☆	☆	A light and a serious error occurred.	• Evaluate the error flags and eliminate the error, if possible.
	☆	☆	☆	☆	Initialization phase, power ON, cold start	—

□ = LED off, ☆ = LED on, ⁂ = LED flashes, X = LED on or off, gn = green, rd = red

LEDs for supply voltage and battery

LED / CPU	Supply gn	Battery rd	Meaning	Remedy
Stand-alone CPU, master CPU or slave CPU	☆	□	Supply voltage available **and** battery is effective.	—
	☆	☆	Supply voltage available and battery is **not** effective.	—
	□	□	Supply voltage is not available.	• Switch power ON. • Check the supply voltage.

□ = LED off, ☆ = LED on, ⁂ = LED flashes, X = LED on or off, gn = green, rd = red

LED K for overload/short circuit on at least one direct binary output A 62,00...A 62,07 (A 62,15) (for 07 KT 92 and 07 KT 93 only)

LED / CPU	K rt	Meaning	Remedy
Stand-alone CPU, master CPU or Slave CPU	☆	Overload/short circuit on at least one of the direct binary outputs A 62,00...A 62,07 (A 62,15).	• Eliminate overload/short circuit.
	□	There is no overload/short circuit.	—

□ = LED off, ☆ = LED on, ⁂ = LED flashes, X = LED on or off, gn = green, rd = red

A4.4 Troubleshooting on the remote modules

Diagnosis functions for the remote modules

The remote modules are equipped with a number of diagnosis functions. Some of these functions become active only if they have been set by means of the I/O configuration.

Diagnosis, display and messages to the central unit						
Diagnosis functions according to the module						
a) always available	UE	BE	OL	SC		
b) if configured					CI	CO
Readable on the module by pressing the test button [1])						
a) Diagnosis messages	UE	BE	OL	SC	CI	CO
Available for bus master user program, readable on the terminal						
a) cyclic transmission	–	–	OL	SC	CI	CO
Module type						
ICSI 08 D1	●	●			●	
ICSI 16 D1	●	●			●	
ICSI 08 E1	●	●				
ICSI 16 E1	●	●				
ICSI 08 E4	●	●				
ICSO 08 R1	●	●				
ICSO 08 Y1	●	●	●	●		
ICSO 16 N1	●	●	●	●		
ICSK 20 F1	●	●				
ICSK 20 N1	●	●	●	●		
ICSC 08 L1	●	●	●	●	●	●
ICSC 16 L1	●	●	●	●	●	●
ICSF 08 D1	●	●				
ICDG 32 L1	●	●	●	●		
ICSE 08 A6	●	●				
ICSE 08 B5	●	●				
ICSA 08 B5	●	●				●
ICSM 06 A6	●	●		●		
Robot coupler	●	●				
Festo devices	●	●	●	●		
07 KR 91	●	●				
07 KT 92	●	●	●	●		
07 KT 93	●	●	●	●		
07 KR 31	●	●				
07 KT 31	●	●	●	●		

Explanation:

- ● Feature is completely available. Settings and errors can be interrogated from the involved channel.

(●) Feature is partly available, see module description.

[1]) Concerning the interrogation of settings and diagnosis data, see the module description and chapter A3.3 ”Reading I/O configuration and diagnosis data at the module”.

BE Bus Error = Bus malfunction, always monitored. The module does not receive a call from the bus master. This may have the following reasons:

– The CS31 system bus line is broken, short-circuited or wired with reversed polarity.

– The central unit has< not been set as buster master, see also system constant KW 00,00 in chapter A7.3.

CI Cut Wire of Inputs = Open circuit (monitoring) at inputs, if configured. Each input circuit to be monitored has to be equipped with a resistor of 20...30 kΩ, e.g. in parallel to the signalling contact.

CO Cut Wire of Outputs = Open circuit (monitoring) at outputs, if configured. Each output expects a minimum load of approx. 40 mA when an ON signal is output.

OL Overload (is always monitored).

SC Short circuit (is always monitored).

UE Unit error = internal error (fault) of the module (always monitored in so far as the internal processor can detect this).

Troubleshooting in the remote modules

The LED (3) lights up, if the remote module has detected an error.

The remote module supplies detailed error information via the 8 LEDs (1), it the test button (4) is pressed; see also the module descriptions.

The procedure will be explained in the following for the module ICSC 08 L1 as an example.

After the test button has been pressed for the first time, channel E/A0 (input/output 0) is selected: LED0 flashes. After the button has been released, The diagnosis data of this channel are shown via the yellow LEDs 0 to 7 for approx. 3 seconds.

The LEDs have the following meaning:

0 Error in the module (UE = Unit error)
1 Error on the bus (BE = Bus error)
2 not used
3 CI/CO = Cut wire of inputs/outputs
4 OL = Overload
5 SC = Short circuit
6 Configuration as output
7 Configuration as input

If the LEDs 6 and 7 light up at the same time, the channel is configured as a combined input/output.

The meaning of the LEDs (2) is also printed onto the front panel of the module.

The operation is repeated for the other channels each time the test button is pressed and released.

After the last channel E/A7 (input/output 7) has been scanned, pressing the test button again causes a lamp test (LED test) to be performed. All the 8 LEDs should light up. After the button has been released, the LED will show the setting of the DIL switch on the plug-in base for approx. 5 seconds. LED 0 shows the position of switch No. 1 (LEDs 0...7 are assigned to switches No. 1...8).

All the error messages are stored in the module and can only be deleted by pressing the test button for 10 seconds or by power OFF/ON.

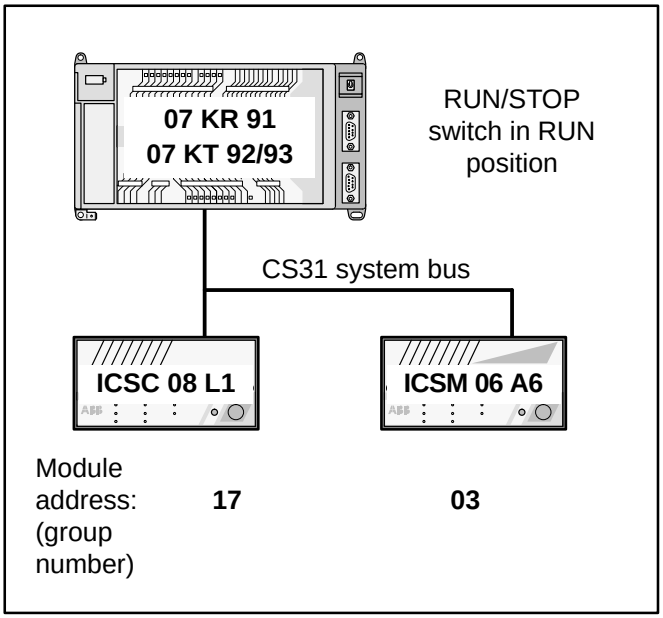
A4.5 Acknowledgement of error messages in the remote modules

The remote modules store and display the error messages detected independently of the central unit. The error messages can be acknowledged

- on the remote module by pressing the test button
- in the user program by means of the function block CS31QU (this also deletes the error message stored in the central unit)
- in the terminal mode by means of the command MAIL, see volume 7.3, chapter 3.

If the error has not been eliminated, the error message appears again.

A4.6 Example of an error message



Errors which occurred:

The bus line to the remote module having the module address 3 has been broken during operation.

Error flags in the central unit
07 KR 91 / 07 KT 92 / 07 KT 93:

It is assumed that the error flags have been set to 0 by acknowledgement/deletion before the error occurred. In the following, only those error flag will be listed the contents of which changes.

- M 255,10 = 1 Summation error message
- M 255,13 = 1 Error class message (FK3 error)
- MW 255,00 = 15 Error detection: remote module is disconnected
- MW 255,01 = 05 Module type: analog input and output
- MW 255,02 = 03 Group number (module address)
- MW 255,03 = 0
- MW 255,04 = 0 not concerned, as well as
- MW 255,05 = 0 all the other error flags
- MW 255,06 = 0 which have not been
- MW 255,07 = 0 mentioned

LED displays on the bus master central unit 07 KR 91 / 07 KT 92 / 07 KT 93:

- BA lights up → CS31 bus processor is active. The data communication with the remote module having the address 17 is continued.
- BE lights up → Bus Error, error on the CS31 system bus.
- RE lights up → Remote Unit Error, error on a remote module.
- SE off → Serial Unit Error, CS31 bus interfacing in the central unit works correctly.
- RUN lights up
- FK3 lights up → light error

Reaction of the bus master central unit 07 KR 91 / 07 KT 92 / 07 KT 93

The processing program and the bus operation continue running (if KW 0,7 = 0).
Reaction of the remote module ICSM 06 A6: All of the outputs turn to 0.
Reaction of the remote module ICSC 08 L1: Data exchange with the bus master central unit 07 KR 91 / 07 KT 92 / 07 KT 93.

Status word EW 07,15 in the central unit 07 KR 91 / 07 KT 92 / 07 KT 93

–	Bit 0	= 1	no class 2 error
–	Bit 1	= 0	only applicable for 07 KR 91 / 07 KT 92 / 07 KT 93 used as slave
–	Bit 2	= 1/0	Date/time of the real-time clock valid / not valid
–	Bit 3	= 1/0	Battery effective / not effective
–	Bit 4...7		not used
–	Bit 8...15	= 2	max. number of modules connected to the CS31 system bus which have been found since the last power-on operation. Will not be altered by the error which has occurred in the meantime.

Acknowledgement of the error flags in the central unit 07 KR 91 / 07 KT 92 / 07 KT 93

Eliminate the error before acknowledgement. Otherwise the error message will appear again.

The bit flags M 255,10 and M 255,13 can be acknowledged by:

- power ON
- program ”Start” (on-line in the programming software 907 PC 331)
- cold start (menu item in 907 PC 331)
- setting the RUN/STOP switch to RUN
- overwriting the flag M 255,13 with ”0” in the user program
- overwriting the flag M 255,13 with ”0” by means of the operating function ”Overwrite”, see volume 7.3, chapter 3
- using the function block CS31QU in the user program. The block is applicable only for errors which concern the CS31 system bus. It also deletes the error message in the remote module.

The relevant LEDs turn off upon the acknowledgement.

The word flags MW 255,00...MW 255,07 can only be deleted by overwriting them. They are overwritten by newly occurring errors.

Acknowledgement of error flags in the remote module ICSM 06 A6

- on the module by pressing the test button for a longer time
- in the user program of the central unit using the CS31QU block
- in the terminal mode by means of the MAIL command, see volume 7.3, chapter 3.

A4.7 Error flags in the central unit, error classification

The central unit offers error messages for the user program which are classified into 4 error classes (FK1...FK4) according to their severity. The error messages are stored in error flags and can be used in the user program and be read by the programming system.

The following table gives you an overview of the error flags.

Error class	**FK1** = fatal error	**FK2** = serious error	**FK3** = light error	**FK4** = warning
General feature of the error class, examples	Save operation of the operating system is no longer ensured. Error examples: – Checksum error in the operating system EPROM – Write/read error when testing the operating system RAM	The operating system works correctly, but the error-free processing of the user program is not guaranteed. Error examples: – Checksum error in the user program (Flash EPROM) – Write/read error when testing the user RAM	The choice whether the user program has to be aborted by the operating system or not depends on the application. The user decides which reactions are to be initiated. Error examples: – Flash EPROM cannot be programmed – Dual port RAM to the CS31 part (LED SE) is faulty – Remote module has failed (LED RE)	Errors which occur on peripheral devices or which will show their effect only in the future. The user decides which reactions are to be initiated. Error examples: – Short circuit on a remote module
Summation error message [1]	M 255,10			
Error class message (if 1, an error exists)	M 255,11	M 255,12	M 255,13	M 255,14
Error detection (word) [2]	MW 254,00	MW 254,08	MW 255,00	MW 255,08
Detailed info 1 (word) [2]	MW 254,01	MW 254,09	MW 255,01	MW 255,09
Detailed info 2 (word) [2]	MW 254,02	MW 254,10	MW 255,02	MW 255,10
Detailed info 3 (word) [2]	MW 254,03	MW 254,11	MW 255,03	MW 255,11
Detailed info 4 (word) [2]	MW 254,04	MW 254,12	MW 255,04	MW 255,12
Detailed info 5 (word) [2]	MW 254,05	MW 254,13	MW 255,05	MW 255,13
Detailed info 6 (word) [2]	MW 254,06	MW 254,14	MW 255,06	MW 255,14
Detailed info 7 (word) [2]	MW 254,07	MW 254,15	MW 255,07	MW 255,15
LED displays after initialization	FK1 lights up or LED RUN does not go on, if RUN/STOP switch is set to RUN	FK2 lights up or LED RUN does not go on, if RUN/STOP switch is set to RUN	FK3 lights up. In addition, according to error type: LED BE (Bus Error) LED RE (Remote Unit Error) LED SE (Serial Unit Error)	LED RE (Remote Unit Error) lights up
Reaction when switching on the central unit / Reaction during operation	All the outputs remain set to 0 or are set to 0. The programming system does not have access. **Attention:** Both processors of the central unit monitor each other mutually, thus facilitating a powerful diagnosis. If the safety requirements are higher, use specially approved controllers.	All the outputs remain set to 0 or are set to 0. The programming system can get access. The user program is not started or is aborted.	You can choose in case of an error: – Just report the error: Evaluate the error flag M 255,13 – Abort the user program: Set system constant KW 0,7 = 1 (FK3_REAK) or M 255,13 to the function block ABORT	Evaluation of the error messages using the user program
Acknowledgement of the summation error message / of the error class message	– Power ON – Cold start	– Power ON – Cold start	– Power ON / cold start – Set the RUN/STOP switch to RUN – Start the program using 907 PC 331 – Set M 255,13 or M 255,14 to 0 – In case of CS31 error: function block CS31QU	

[1] The summation error flag M 255,10 becomes 1, if at least one of the error class flags is set to 1.
If M 255,10 = 0, the central unit has not found any error.
The summation error flag is deleted automatically when the error class flags are acknowledged.

[2] The central unit enters the last found error into the relevant error flag record for each error class. The entry is made at the end of the program cycle and remains unchanged during the next running program cycle. The word flags can only be acknowledged by overwriting them with ”0”.

A4.8 Acknowledgement of error messages in the central unit

Error messages remain stored and will be displayed until they are acknowledged. The following applies:

- The summation error message, the error class messages (bit flags) and the relevant LEDs FK1, FK2 and FK3 are reset with power ON, for example. For other possibilities for resetting/acknowledging them, see chapters A4.5 to A4.8.

- The error identifiers and the detailed information (word flags) have to be reset by means of the user program or by means of the operating function ”Overwrite”, see volume 7.3, chapter 3. They are also reset when a cold start is performed or by a power-fail, if no back-up battery is effective.

The error message will appear again, if the error has not been eliminated.

A4.9 Additional diagnosis functions

Status word EW 07,15

The following data are continuously updated in the status word EW 07,15:

– Bit 0: This bit is valid for the stand-alone PLC, for the master PLC and for the slave PLC.
  Bit 0 = 1, There is *no error* of class 2.
  Bit 0 = 0, There is *an error* of class 2.

– Bit 1: This bit is valid only for the slave PLC.
  Bit 1 = 1, The slave PLC is adopted into the bus cycle of the master PLC.
  Bit 1 = 0, The slave PLC is *not* adopted into the bus cycle of the master PLC.

– Bit 2: This bit is valid for the stand-alone PLC, for the master PLC and for the slave PLC.
  Bit 2 = 1, Date and time of the real-time clock *are valid.*
  Bit 2 = 0, Date and time of the real-time clock *are not valid.*

– Bit 3: This bit is valid for the stand-alone PLC, for the master PLC and for the slave PLC.
  Bit 3 = 1, Battery is *effective.*
  Bit 3 = 0, Battery is *not effective.*

– Bits 4..7 are not used

– Bits 8...15: *Maximum* number of remote modules which have been existing in the CS31 bus cycle of the master PLC since the last power-ON or since the last cold start. Their number may be larger than the number of the remote modules which are *currently* existing in the CS31 bus cycle.

A4.10 Meaning of the contents of the error word flags

Explanation of the following table:

– Address = Memory address at which the error was detected.

– Group number = Module address of the remote module

– Channel number = Number of the faulty channel

– Module type Meaning

000	Binary input
001	Analog input
002	Binary output
003	Analog output
004	Binary input/output
005	Analog input/output
255	Bus master or slave central unit in which the error has occurred and is stored.

Error class	Error description	Error identifier in MW 254,00 **D**ec **H**ex	Detailed info **1** in MW 254,01	Detailed info **2** in MW 254,02	Detailed info **3** in MW 254,03	Further detailed infos in MW 254,04 : MW 254,07
FK1 Fatal error	Checksum error of the system EPROM	$\mathbf{1}_{D}$ $\mathbf{1}_{H}$	–	–	–	–
	Operating system of the central unit is defective, or a defective RAM is detected when a cold start is performed (complete RAM test)	$\mathbf{2}_{D}$ $\mathbf{2}_{H}$	Address	–	–	–

Error class	Error description	Error identifier in MW 254,08 **D**ec **H**ex	Detailed info **1** in MW 254,09	Detailed info **2** in MW 254,10	Detailed info **3** in MW 254,11	Further detailed info in MW 254,12 : MW 254,15
FK2 Serious error	RAM defective (user program or operand memory)	**128**$_D$ **80**$_H$	Address	–	–	–
	Illegal master-slave identifier	**129**$_D$ **81**$_H$	–	–	–	–
	A serious error has occurred when the CS31 bus interfacing was initialized. The CS31 bus processor does not give any response to the PLC side within the specified time.	**130**$_D$ **82**$_H$	–	–	–	–
	PLC is overloaded, cycle time is too short.	**131**$_D$ **83**$_H$	–	–	–	–
	An error which cannot specified in detail is detected by the operating system during the execution time.	**132**$_D$ **84**$_H$	–	–	–	–
	Checksum error in the Flash EPROM	**133**$_D$ **85**$_H$	–	–	–	–
	CS31 bus processor does not send an OK response to the PLC after a cold start command issued by the PLC.	**134**$_D$ **86**$_H$	–	–	–	–
	Error detection not used at the moment.	**135**$_D$ **87**$_H$	–	–	–	–
	CS31 bus processor reports an error via EW 07,15 bit 0. This bit is checked before each start of the PLC program.	**136**$_D$ **88**$_H$	–	–	–	–
	An illegal value has been configured (KW 00,10 or KW 00,11) for specifying the size of the I/O area between the master PLC and the slave PLC.	**137**$_D$ **89**$_H$	–	–	–	–
	More timers than available in the PLC were required during the execution time.	**257**$_D$ **101**$_H$	–	–	–	–
	An unknown operator/block is detected in the user program during the execution time.	**258**$_D$ **102**$_H$	–	–	–	–
	The CS31 bus processor does not work correctly. Therefore it does not authorize the operating processor to access the dual-port RAM.	**259**$_D$ **103**$_H$	–	–	–	–

Error class	Error description	Error identifier in MW 255,00 **D**ec **H**ex	Detailed info **1** in MW 255,01	Detailed info **2** in MW 255,02	Detailed info **3** in MW 255,03	Further detailed info in MW 255,04 : MW 255,07
FK3 Light error	Remote module disconnected	**15_D F_H**	Module type	Group number	–	–
	CS31 bus error (there is no remote module on the bus) **Note:** If there are only analog modules connected to the CS31 system bus, this error message may occur when the supply voltage is switched on although the analog modules have been correctly adopted into the CS31 bus cycle after a certain time. **Reason:** The analog modules have a long initialization time. After this time is over, they only now appear at the CS31 bus as remote modules. During the initialization time the master PLC cannot recognize them.	**16_D 10_H**	–	–	–	–
	The Flash EPROM is not programmable.	**128_D 80_H**	Address of defective memory cell	–	–	–
	The Flash EPROM cannot be deleted.	**129_D 81_H**	Address of the memory cell which cannot be deleted	–	–	–
	The PLC application mode configured in the system constant KW 00,00 has not been activated yet. Please perform activation (see also system constant KW 00,00).	**130_D 82_H**	Value of KW 00,00 activated last	Value of KW 00,00 not yet activated	–	–
	CRC error in Flash EPROM	**131_D 83_H**	Address of the block with CRC error	Segment address of the block with CRC error	–	–

Error class	Error description	Error identifier in MW 255,08 **D**ec **H**ex	Detailed info **1** in MW 255,09	Detailed info **2** in MW 255,10	Detailed info **3** in MW 255,11	Further detailed info in MW 255,12 : MW 255,15
FK4 Warning	Internal error of a remote module	**1**$_D$ **1**$_H$	Module type	Group number	Channel number	–
	Cut wire (open circuit)	**2**$_D$ **2**$_H$	Module type	Group number	Channel number	–
	Wrong level of an analog output	**3**$_D$ **3**$_H$	Module type	Group number	Channel number	–
	Overload	**4**$_D$ **4**$_H$	Module type	Group number	Channel number	–
	Overload + short circuit	**6**$_D$ **6**$_H$	Module type	Group number	Channel number	–
	Short circuit	**8**$_D$ **8**$_H$	Module type	Group number	Channel number	–
	Short circuit + cut wire	**10**$_D$ **A**$_H$	Module type	Group number	Channel number	–
	Overload + short circuit	**12**$_D$ **C**$_H$	Module type	Group number	Channel number	–
	Short circuit + overload + cut wire	**14**$_D$ **E**$_H$	Module type	Group number	Channel number	–
	There is no user program when the system is started.	**128**$_D$ **80**$_H$	–	–	–	–
	During start-up, the system detects that the program end is missing	**129**$_D$ **81**$_H$	–	–	–	–
	During start-up, the system detects that the number of block parameters has not been specified correctly for a certain block.	**130**$_D$ **82**$_H$	Program address of the block	Progr. addr. of the faulty block parameter	–	–
	During start-up, the system detects a syntax error in the user program.	**131**$_D$ **83**$_H$	Program address	–	–	–
	During start-up, the system detects that the historical value memory is too small.	**132**$_D$ **84**$_H$	–	–	–	–
	During start-up, the system detects that no cycle time has been set.	**133**$_D$ **85**$_H$	–	–	–	–
	During start-up, the system detects that there are bracketing errors in the user program.	**134**$_D$ **86**$_H$	Program address	–	–	–
	During start-up, the system detects that the target label for a conditional jump is missing.	**135**$_D$ **87**$_H$	Program address	–	–	–

Error class	Error description	Error identifier in MW 255,08 **D**ec **H**ex	Detailed info **1** in MW 255,09	Detailed info **2** in MW 255,10	Detailed info **3** in MW 255,11	Further detailed info in MW 255,12 : MW 255,15
FK4 Warning	Internal error (non-maskable internal interrupt has occurred)	**136$_D$ 88$_H$**	–	–	–	–
	Internal error (an inhibited interrupt has occurred)	**137$_D$ 89$_H$**	–	–	–	–
	The PLC program is not started because the number of remote modules which are adopted into the CS31 bus cycle is smaller than the number configured in KW 00,09.	**138$_D$ 8A$_H$**	Configured number of remote modules (KW 00,09)	Actual number of modules connected to the CS31 bus cycle	–	–
	The PLC does not access the process inputs and outputs yet because the number of remote modules which are adopted into the CS31 bus cycle is smaller than the number configured in KW 00,09.	**139$_D$ 8B$_H$**	Configured number of remote modules (KW 00,09)	Actual number of modules connected to the CS31 bus cycle	–	–

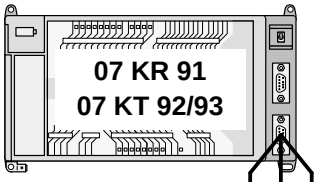
A4.11 Reaction on the bus master central unit and the remote modules in case of errors

No.	Error	Display/reaction of the bus master central unit	Display/reaction of the input/output remote modules	Display/reaction of the slave central units
1	Bus master central unit has failed, e.g. because of power failure	No display, all outputs are off.	LED ③ lights up. All the outputs are turned to 0.	07 KR 91 / 07 KT 92/93: – LED BA is on LED RE flashes – Bit 1 = 0 in the status word EW 07,15 07 KR 31 / 07 KT 31: – Error LED flashes – Bit 1 = 0 in the status word EW 07,15
2	Bus master function of the central unit (Serial Unit) has failed, e.g. the bus processor is defective	Displays: FK2 = Serious error RE = Remote Unit Error SE = Serial Unit Error Flags: M 255,10 = 1 M 255,12 = 1 for further flags see A4.7		
3a or 3b	CS31 system bus is disconnected (all the remote modules are disconnected) CS31 system bus is short-circuited	Displays: FK3 = Light error BE = Bus Error RE = Remote Unit Error SE = Serial Unit Error Flags: M 255,10 = 1 M 255,13 = 1 for further flags see A4.7		
4a	CS31 system bus is disconnected (the remote modules are only disconnected in part)	Displays: FK3 = Light error BE = Bus Error SE = Serial Unit Error Flags: M 255,10 = 1 M 255,13 = 1 for further flags see A4.7	Remote modules **without** connection to the bus master central unit: same as 1	Slave central units **without** connection to the bus master central unit: same as 1
4b			Remote modules **with** connection to the bus master central unit: no display/reaction	Slave central units **with** connection to the bus master central unit: no display/reaction
5a	A remote module has been lost on the CS31 system bus. Cause:	Displays: RE = Remote Unit Error Flags: M 255,10 = 1 M 255,13 = 1 for further flags see A4.7	Remote modules **with** connection to the bus master central unit: no display/reaction	Slave central units **with** connection to the bus master central unit: no display/reaction
5b	No connection to the CS31 system bus		Remote modules **without** connection to the bus master central unit: same as 1	Slave central unit **without** connection to the bus master central unit same as 1
5c	defective remote module		not clear	Error class FK1 / FK2, all outputs turn to 0.
5d	Power failure		all outputs turned to 0	all outputs turned to 0
6a	An error has occurred at the inputs or outputs of a remote module, e.g. a short circuit.	same as 5	Concerned remote module: LED ③ light up, the LEDs ① supply by means of the test button ④ detailed infos.	Concerned 07 KT 92/93: LED K = Short circuit 07 KT 31: Error LED is ON Flags (07 KT 92 / 07 KT 93/ 07 KT 31): M 255,10 = 1 M 255,14 = 1 for further flags see A4.7
6b			Not concerned remote modules: no display/reaction	Not concerned slave central units: no display/reaction

Reaction on the bus master central unit and the remote modules in case of errors (continued)

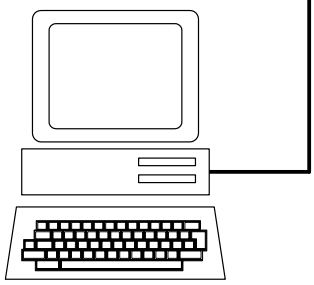
No.	Error	Display/reaction of the bus master central unit	Display/reaction of the input/output remote modules	Display/reaction of the slave central units
7a	Two remote input modules of the same type have been set to the same address.	The error is detected only when the signal statuses of the two modules become different. The message is faulty in this case, and the modules are considered to be disconnected. Display: RE = Remote Unit Error Flags: M 255,10 = 1 M 255,13 = 1 for other flags see A4.7 / A4.10	Concerned modules: same as 1 Other modules: no display/reaction	same as 1
7b	Two remote modules of the same type have been set to the same address.	No reaction, unless there is a large distance between the remote modules.	Faultless operation of the two modules, unless they are far apart from each other.	Not applicable because inputs and outputs are always present.
7c	Two remote modules of different types, but with overlapping ranges have been set to the same address, e.g. ICSI 16 D1 and ICSK 20 F1.	The error is already detected during the initialization. The two remote modules are not adopted into the bus cycle.	Concerned modules: same as 1 Other modules: no display/reaction	Concerned modules: same as 1 Other modules: no display/reaction
7d	Address 62 or 63 has been set to a binary remote module.	Is not detected.	– Output of the signals in parallel to the bus master – Input signals are ignored.	–
7e	An address higher than 5 has been set to an analog remote module.	Is not detected.	same as 1	–

A5 Programming and test

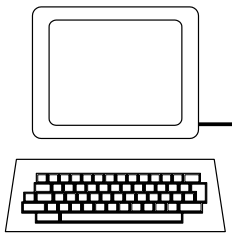


Central unit

07 SK 90
(07 SK 91)

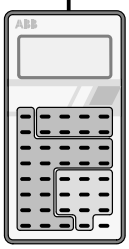


PC with ABB Procontic
programming software
907 PC 331



VT100 terminal

Supplied
cable



TCZ

- Creation of the user program

  using the programming languages

  – Extended instruction list (ext. IL)
  – Function block diagram (FBD) and
  – Ladder diagram (LD)

  Test in ext. IL, FBD and LD (see 907 PC 331)

- Test in terminal mode,

  e.g. in the programming software 907 PC 331
  (main menu ”PLC commun. 2”,
  submenu ”Terminal emulation”)

- Test

  The terminal interface has to be set to 9600 baud,
  8 data bits, no parity bit and 1 stop bit.

- Test

  Press the following <keys> in order to activate the terminal mode:

  <CR>,
  <1> for TERMINAL,
  <2> for CHAR. MODE and
  <N> for data rate unchanged.

  For the interfacing to the 07 KR 91 / 07 KT 92/93 see the following.

In order to establish the connection between the programming and test tools *and* the central unit 07 KR 91 / 07 KT 92 / 07 KT 93, the serial interface COM1 of the central unit 07 KR 91 / 07 KT 92 / 07 KT 93 has to be set to ”Active mode” in all cases, see chapter ”Serial interface COM1” in the description of the central unit.

A6 Man-machine communication (MMC)

A7 Operands of 07 KR 91, 07 KT 92 and 07 KT 93 (variables and constants)

A7.1 Freely available variables and constants

Inputs

E 00,00...E 61,15	:	Binary inputs, CS31 remote modules
E 62,00...E 63,03	:	Binary inputs of the central unit 07 KR 91
E 62,00...E 62,11	:	Binary inputs of the central unit 07 KT 92
E 62,00...E 63,07	:	Binary inputs of the central unit 07 KT 93
E 63,14 and E 63,15	:	High-speed binary inputs (T_D = 8 µs), signal is identical to E 62,00 and E 62,01
E 63,13	:	High-speed counter, interrogation of ”Zero crossing”
EW 00,00...EW 05,15	:	Analog inputs, CS31 remote modules
EW 06,00...EW 06,03	:	Analog inputs of the central unit 07 KT 92
EW 06,15	:	High-speed counter, interrogation of the counter content
EW 07,00...EW 07,07	:	reserved
EW 07,08...EW 07,14	:	Reading of the real-time clock
EW 07,15	:	Status for CS31 system bus, clock, battery

Outputs

A 00,00...A 61,15	:	Binary outputs, CS31 remote modules
A 62,00...A 62,11	:	Binary outputs of the central unit 07 KR 91
A 62,00...A 62,07	:	Binary outputs of the central unit 07 KT 92
A 62,00...A 62,15	:	Binary outputs of the central unit 07 KT 93
A 62,00	:	High-speed counter, direct output of ”Counter zero crossing” after activation
A 63,13...A 63,15	:	High-speed counter, enabling, activation of E 62,01 and A 62,00, adoption of start value
AW 00,00...AW 05,15	:	Analog outputs, CS31 remote modules
AW 06,00...AW 06,01	:	Analog outputs of the central unit 07 KT 92 (–10V...+10V)
AW 06,15	:	High-speed counter, ”Start value”

Internal operands

M 00,00...M 255,09	:	Binary flags
S 00,00...S 127,15	:	Steps
K 00,00...K 00,01	:	Binary constants
MW 00,00...MW 253,15	:	Word flags
KW 01,00...KW 39,15	:	Word constants
MD 00,00...MD 31,15	:	Double word flags
KD 00,01...KD 07,15	:	Double word constants

Time values for time functions

KD yy,xx : Time values for time functions such as ESV, ASV etc. are configured as *double word constants* or as
MD yy,xx : *double word flags.* Only integral multiples of 5 ms are permitted.

A7.2 System constants / diagnosis flags / CS31 status (overview)

Setting the operating modes

The constants KW 00,00...KW 00,15 are reserved as system constants. Even the constants KW 00,13...KW 00,15 which are not used yet may *under no circumstances* be used for other purposes.

KW 00,00 : Setting the PLC operating modes, (Stand-alone PLC, Master PLC, Slave PLC)
KW 00,01 : Initialization: bit flag area
KW 00,02 : Initialization: word flag area
KW 00,03 : Initialization: double word flag area
KW 00,04 : Initialization: step chain flag area
KW 00,05 : Initialization: historical values
KW 00,06 : Application modes of the serial interface COM 1
KW 00,07 : PLC reaction to class 3 errors

KW 00,08 : PLC reaction to an overload/short-circuit at the transistor outputs A 62,00...A 62,07 (A 62,15) (07 KT 92 and 07 KT 93 only)
KW 00,09 : Initialization of the CS31 system after power ON, warm start or cold start
KW 00,10 : Size of the transmitting area of the slave PLC
KW 00,11 : Size of the receiving area of the slave PLC
KW 00,12 : Automatic warm start after an FK2 error

Setting the cycle time

KD 00,00 : The cycle time of the PLC program is preset with this constant. The cycle time is given in the unit of measurement milliseconds. Only integral multiples of 5 ms are permitted.

Error diagnosis

Summation error display : M 255,10 indicates, that the PLC has detected an error
Fatal error, FK1 : M 255,11 = 1 i.e. error detected, detailed information in MW 254,00...MW 254,07
Serious error, FK2 : M 255,12 = 1 i.e. error detected, detailed information in MW 254,08...MW 254,15
Light error, FK3 : M 255,13 = 1 i.e. error detected, detailed information in MW 255,00...MW 255,07
Warning, FK4 : M 255,14 = 1 i.e. error detected, detailed information in MW 255,08...MW 255,15

First-cycle detection

M 255,15

This binary flag can be used for detection of the *first* program cycle after a program start. It is always set to ”zero” after each program start, independent of the initialization instructions given by the system constants. If this flag is read by the user program and then set to ”1”, it can be found out whether or not the user program was started once more.

CS31 status word

EW 07,15

Bit 0 = 1 : No class 2 error present.
Bit 1 = 1 : PLC has been adopted into the CS31 bus cycle (only relevant if used as a slave).
Bit 2 = 1 : Time and date are valid.
Bit 3 = 1 : Battery is effective.
Bit 4...7 : Not used.
Bit 8..15 : Maximum number of modules on the CS31 system bus, found out until now (only relevant if used as a master).

A7.3 System constants / Setting of operating modes

- **Definitions**

Cold start

– All of the RAM memories are tested and deleted.

– If there is *no user program* in the Flash–EPROM, the default values are set to all of the system constants (identical to the factory settings).

– If there is *a user program* in the Flash–EPROM, this program is loaded into the RAM including the system constants.

– The operating modes given by the system constants are set.

– The CS31 system bus is initialized again(only when used as a master on the CS31 system bus).

Performing a cold start

– Power OFF/ON, if there is *no* backup battery or

– Command KALT <CR> in terminal mode (see volume 7.3) or

– Menu field ”Cold start” in the programming system

Warm start

– All of the RAM memories, with the exception of the program memory and the operand memory (flags), are tested and deleted.

– If there is a *user program* in the Flash–EPROM, this program is loaded into the RAM including the system constants.

– The operating modes given by the system constants are set.

– The CS31 system bus is initialized again(only when used as a master on the CS31 system bus).

Performing a warm start

– Power OFF/ON, if there is a backup battery or
– Command WARM <CR> in terminal mode (see volume 7.3) or
– Menu field ”Release PLC mode” in the programming system

- **Operating mode: Master PLC, Slave PLC or Stand–alone PLC**
  – Absolute identifier: KW 00,00
  – Symbolic identifier: MAST_SLV
  – Meaning of the value of the constants:
    – Master PLC at the CS31 system bus –1 ($FFFF_H$)
    – Stand-alone PLC –2 ($FFFE_H$)
    – Slave PLC at the CS 31 system bus module address
    CS31 module addresses 0...61
– Range of values: –2, –1, 0...61
– Default value: –2 (Stand-alone)

Important!

The change of the PLC operation mode is carried out in three steps:

1. Change system constant KW 00,00 in the PLC
2. Save PLC program in the Flash EPROM
3. Activate new PLC operating mode with the following steps:
   – Call menu point ”Release PLC mode” in the ABB programming and test system or
   – perform a warm start or
   – perform a cold start.

- **Back-up of data areas**

  Back-up of data areas, i.e. saving of data during power OFF/ON, is only feasible with built-in battery. The following data can be backed, completely or partly:

  – Binary flags
  – Word flags
  – Double word flags
  – Step chains
  – Historical values

  In order to back-up certain data, they have to be excluded from initialization to 0.

- **Initialization of data areas**

  During *program start,* that data areas are initialized to 0 partly or completely, that are defined by system constants. The initialization works as shown in the following table.

If no battery is effective or if the system constants are in their default values (factory settings), all of the above mentioned data areas are completely set to 0 after power OFF/ON.

Conditions, —> Action	Flags, step chains, and historical values which are initialized (set to 0)
No battery available, —> Power ON	all
Menu item —> Abort —> Cold start	all
Battery effective, RUN/STOP switch to RUN, —> Power ON	according to the values of the system constants (see below)
RUN/STOP switch, —> RUN	
Menu item —> Abort —> Start	

Initialization: Binary flags

– Absolute identifier: KW 00,01
– Symbolic identifier: INIT_M

Value **n** of the system constant KW 00,01	Binary flag areas which are initialized (set to 0)
n = 0 (default)	M 000,00...M 255,15
n = 1...255	M n,00...M 255,15
n < 0, n > 255	M 255,10...M 255,15

– Example: KW 00,01 = 52
  Initialized is: M 52,00...M 255,15
  Backed is: M 00,00...M 51,15
  Precondition: Battery is available

Initialization: Word flags

– Absolute identifier: KW 00,02
– Symbolic identifier: INIT_MW

Value **n** of the system constant KW 00,02	Word flag areas which are initialized (set to 0)
n = 0 (default)	MW 000,00...MW 253,15
n = 1...253	MW n,00...MW 253,15
n < 0, n > 253	no initialization

Initialization: Double word flags

– Absolute identifier: KW 00,03
– Symbolic identifier: INIT_MD

Value **n** of the system constant KW 00,03	Double word flag areas which are initialized (set to 0)
n = 0 (default)	MD 00,00...MD 31,15
n = 1...31	MD n,00...MD 31,15
n < 0, n > 31	no initialization

Initialization: Step chains

– Absolute identifier: KW 00,04
– Symbolic identifier: INIT_S

Value **n** of the system constant KW 00,04	Step chain areas which are initialized (set to 0)
n = 0 (default)	S 000,00...S 127,15
n = 1...127	S n,00...S 127,15
n < 0, n > 127	no initialization

Initialization: Historical values

– Absolute identifier: KW 00,05
– Symbolic identifier: INIT_VW

Value **n** of the system constant KW 00,05	Historical values which are initialized (set to 0)
n = 0 (default)	Initialization of all historical values
n < 0, n > 0	no initalization

- **Application mode: Serial interface COM1**
  – Absolute identifier: KW 00,06
  – Symbolic identifier: MODE_SST
  – Default value: 0

Table: Conditions for the settings of the operating modes of the COM1 interface

RUN/ STOP switch	System constant KW00,06	System cable/ device	Mode set by this
STOP	x	x	Active
RUN	1	x	Active
	2	x	Passive
	0, <0, >2	07 SK 90	Active
		07 SK 91, TCZ	Passive

x: without effect

  – A change of this system constant becomes effective:
    – immediately

- **SPS reaction to class 3 errors**
  – Absolute identifier: KW 00,07
  – Symbolic identifier: FK3_REAK
  – Meaning of the value of the constant:
    Just output error: 0
    Output error and abort PLC program: <0, >0
  – Range of values: <0, =0, >0
  – Default value: 0
    i.e. just output error
  – A change of this system constant becomes effective:
    – immediately

- **PLC reaction to the occurrence of an overload/ short circuit at the direct transistor outputs A 62,00...A 62,07...A 62,15 (07 KT 92 and 07 KT 93 only)**
  – Absolute identifier: KW 00,08
  – Symbolic identifier: ÜLAST_REAK
  – Meaning of the value of the constant:
    Overloaded output is switched on again automatically: 0
    Overloaded output is **not** switched on again automatically: 1
    If another value than 0 or 1 is given, the PLC selects the standard setting ”automatic reset”

– Range of values: 0, 1
– Default value: 0
i.e. the overloaded output is switched on again automatically by the PLC.

Important!

The change of the PLC reaction on an overload/short-circuit is carried out in three steps:

1. Change system constant KW 00,08 in the PLC
2. Save PLC program in Flash EPROM
3. Activate new PLC operating mode with the following steps:
   – perform a warm start or
   – perform a cold start.

- **Initialization of the CS31 system after power ON, warm start or cold start**
  – Absolute identifier: KW 00,09
  – Symbolic identifier: HOCHFAHR
  – This system constant is only effective if the central unit is configured as a bus master.
  – Meaning of the value of the constants:
    The user program is started. The central unit takes no notice of initialization of the CS31 remote modules and their adoption into the CS31 bus cycle: =0
    The user program is not started until at least *n* remote modules have been initialized and adopted into the CS31 bus cycle: =+n
    The user program is started. It does not handle the process inputs and outputs until at least *n* remote modules have been initialized and adopted into the CS31 bus cycle. However, the CS31 status information in EW 07,15 is available as early as with the program start. This is also valid for the dual port RAM image of the two high-speed inputs at terminals 02 and 03: =–n
  – Range of values: –31...+31
  – Default value: 0
    i.e. the user program is started immediately.

  A change of this system constant becomes effective:
  – with the next warm start or
  – with the next cold start.

- **Size of the transmitting area of the slave PLC**
  – Absolute identifier: KW 00,10
  – Symbolic identifier: SLV_SEND
  – Meaning of the value of the constants:
    The slave PLC can be used at the CS31 system bus *either* in the binary area *or* in the word area. The binary values are transferred byte by byte. It is possible to set the number of bytes (or words) which are to be sent from the slave PLC to the master PLC.
    – For use in the binary area:
      Transmitting: 0...15 bytes 0...15
    – For use in the word area:
      Transmitting 0...8 words 100...108
  – Default value: 0
  – Range of values: 0...15 and 100...108

  A change of this system constant becomes effective:
  – with the next warm start or
  – with the next cold start.

  Note:

  The default setting
  – in the binary area is:
    – transmit 4 bytes and
    – receive 4 bytes.

  This is defined by the default combination KW 00,10 = KW 00,11 = 0.
  The configured combination KW 00,10 = KW 00,11 = 4 has the same result as the default combination.

  The combination KW 00,10 = KW 00,11 = 100 *is inadmissible!* It would mean: Transmit 0 words and receive 0 words.

  When employed in the word area, the unused higher 8 channels of the address can be used by an analog modul (no KR/KT).

- **Size of the receiving area of the slave PLC**
  – Absolute identifier: KW 00,11
  – Symbolic identifier: SLV_REC
  – Meaning of the value of the constants:
    The slave PLC can be used at the CS31 system bus *either* in the binary area *or* in the word area. It is possible to set the number of bytes (or words) which are to be received by the slave PLC from the master PLC.
    – For use in the binary area:
      Receiving: 0...15 bytes 0...15
    – For use in the word area:
      Receiving: 0...8 words 100...108

– Default value: 0

– Range of values: 0...15 and 100...108

A change of this system constant becomes effective:

– with the next warm start or

– with the next cold start.

Note:

The default setting
– in the binary area is:
  – transmit 4 bytes and
  – receive 4 bytes.

This is defined by the default combination
KW 00,10 = KW 00,11 = 0.
The configured combination
KW 00,10 = KW 00,11 = 4 has the same result as the default combination.

The combination
KW 00,10 = KW 00,11 = 100
is inadmissible! It would mean:
Transmit 0 words and receive 0 words.

When employed in the word area, the unused higher 8 channels of the address can be used by an analog modul (no KR/KT).

- **Automatic warm start after an FK2 error**
(only for 07 KT 92)

  – Absolute identifier: KW 00,12

  – Symbolic identifier: SYSTEM

  – By means of the system constant KW 00,12 an automatic warm start can be configured after an FK2 error:

    Bit 0 of KW 00,12 = 0: no automatic warm start
    Bit 0 von Kw 00,12 = 1: automatic warm start

    The bits 1...15 of KW 00,12 have to be 0.

In the default setting KW 00,12 = 0 the module 07 KT 92 **R202/262** has the same behaviour as the module 07 KT 92 **R101** (no warm start after an FK2 error).

A change of this system constant becomes effective:

– with the next warm start.

- **PLC cycle time**

  – Absolute identifier: KD 00,00

  – Symbolic identifier: ZYKL_ZEIT

  – Meaning of the value of the constants:
  The PLC program is processed cyclically in the time intervals stated by the set cycle time.
  The entries are made in the unit of measurement [ms]. The smallest cycle time that can be entered is 5 ms. Only integral multiples of 5 ms are permissible.

  – Range of values: ≥ 5

  – Default value: 10

A change of this system constant becomes effective:

– with the next program start.

A8 The ARCnet system (**A**ttached **R**esource **C**omputer **Net**work)

- ARCnet is a system for data transmission in local networks
- The ARCnet protocol is based on the Token Passing principle.
- By passing an identifier (token) from station to station it is guaranteed, that only one station can start a data transmission (transmission without collisions).
- The order of sequence, in which the stations are accessed, is automatically adapted by the existing conditions in the network, i.e. that the network is reconfigured automatically each time a station is added to the network or switched off.

A8.1 The networking configurations

Linear ARCnet

- In the Linear ARCnet configuration, the stations are connected to one another directly, i.e. without using any distribution units.
- Each station is inserted into the network by using a T connector.
- Both cable ends must be terminated by termination resistors.
- A maximum of 8 stations can be connected to one linear ARCnet.
- The maximum length of the network is 300 m.
- An additional segment can be connected at the end of the wired segment via an Active Hub (active distribution unit), see next page.

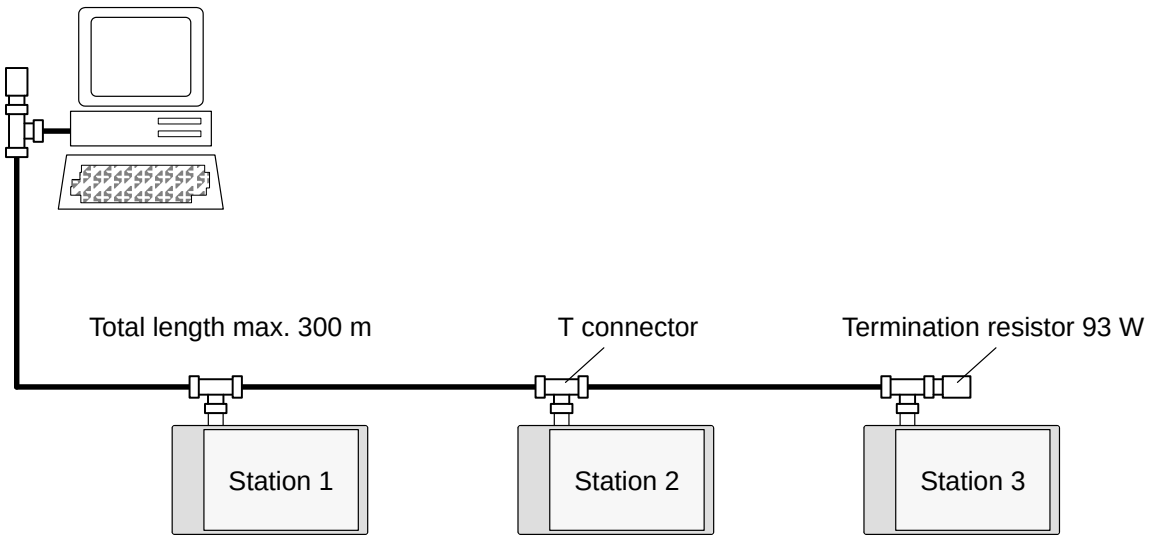


Fig.: Linear ARCnet

Linear ARCnet, expanded by active distribution units (Active Hubs)

- Active Hubs amplify the arriving signals. So they stabilize the network configuration and allow especially for high distances. The Active Hub decouples the station connectors from one another. Therefore, the entire network does not fail if one of the connections fails.
- The maximum length of the network is 6 km.
- A maximum of 255 stations can be used.

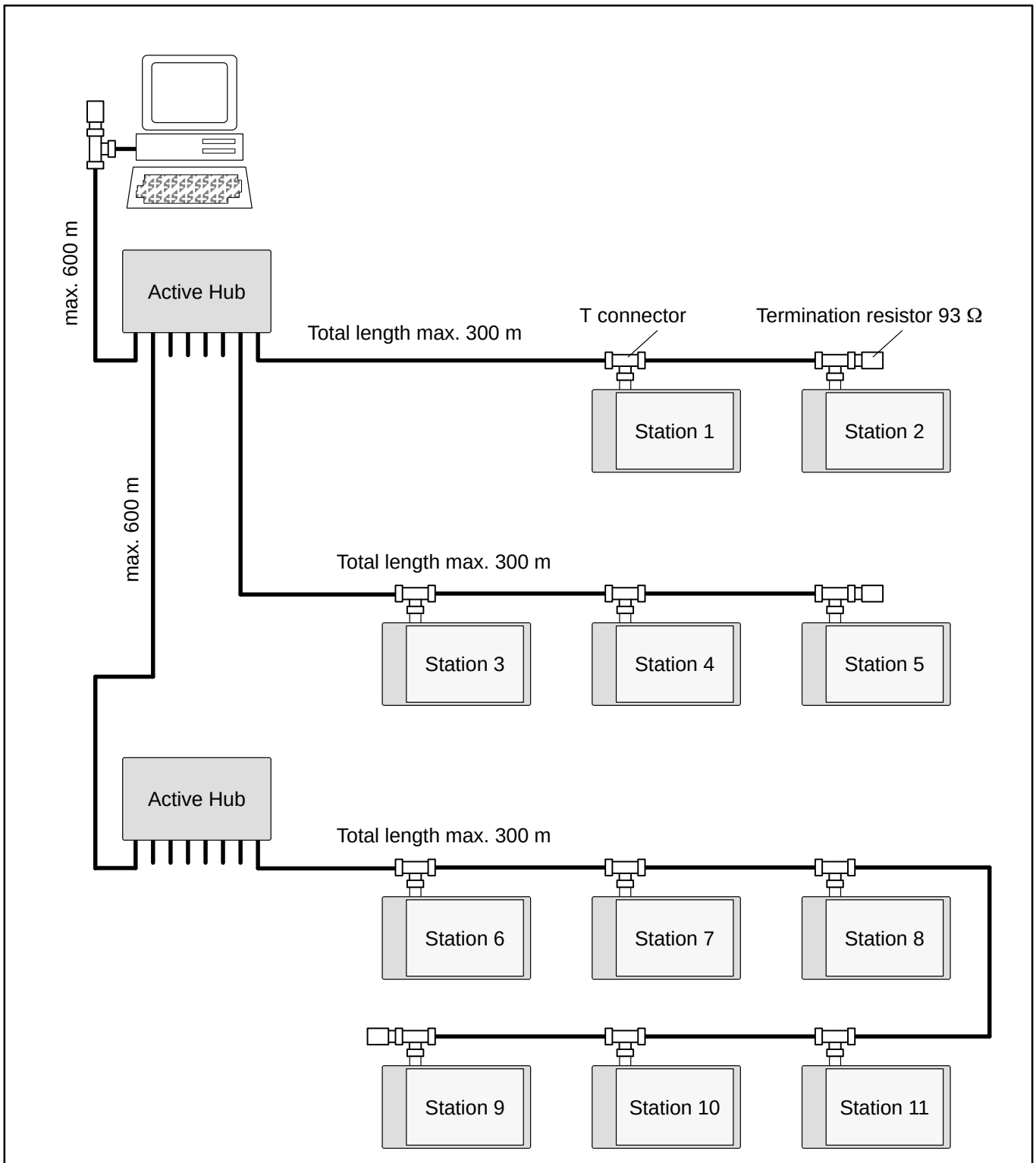


Fig.: Linear ARCnet, expanded by active distribution units (Active Hubs)

A8.2 The features of the ARCnet system

- Data transmission rate 2.5 MBit/s
- Coaxial cable of type RG62/U, 93 Ω
- Maximum number of stations: 255

Maximum distances

- The maximum distance between two stations amounts to 6 km.
- The maximum distance between an Active Hub and an ARCnet station or between two Active Hubs amounts to 600 m.
- The maximum distance between a Passive Hub and an ARCnet station or between an Active Hub and a Passive Hub is 30 m. A Passive Hub works like a resistor network which carries out the cable termination at the stations.
- The maximum distance within a Linear ARCnet is 300 m. A maximum of 8 stations can be connected.