Contents

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg
Germany

Tel. +49 9372 132-8976
Fax +49 9372 132-406
E-Mail support-tronic@wika.de
www.wika.de

1. Quick Start Guide

- Connect the CAN interface to your PC (e.g. PEAK PCAN-USB) and to the pressure transmitter and start the CAN-Software (e.g. PEAK PCAN-View). Ensure you use the correct bitrate and Node-ID of the pressure transmitter.

- When the P-3x is powered up it sends a *Boot-Up Message*

ID	DLC	Byte0
700h + NodeID	1	00h

The pressure transmitter is now in PRE-OPERATIONAL mode and ready to be configured by SDO (if necessary).[1]

- In order to send PDO-messages (pressure values) the transmitter has to be set to OPERATION mode [2]

Master software has to send:

ID	DLC	Byte0	Byte1
00h	2	01h	Node-ID (0 = all slaves)

The pressure transmitter is now in OPERATION mode

- Depending on the configured transmission type there are three possibilities to get measuring values:[3]
  - Synchronous transmission (default setting):
    Object 1800h subindex 2 (transmission type) has to be 1 ... 240
    (The pressure transmitter sends a PDO message every n-th SYNC object)

    Master software has to send a SYNC object:

ID	DLC
80h	0

    The pressure transmitter answers:

ID	DLC	Byte0	Byte1	Byte2	Byte3
180h + NodeID	4	LSB			MSB

  - Asynchronous acyclic transmission:
    Object 1800h subindex 2 (transmission type) has to be 253
    (The pressure transmitter sends a PDO message after a RTR (Remote Transmission Request))

  - Asynchronous cyclic transmission:
    Object 1800h subindex 2 (transmission type) has to be 254
    (The pressure transmitter sends a PDO message after the event timer elapses.
    The event timer can be configured via object 1800h subindex 5)

[1] For detailed information refer to chapter “2. Service Data Object (SDO)”
[2] Refer to chapter “9. Network Management Objects”
[3] Refer to chapter „3. Process Data Object (PDO)“

2. Service Data Object (SDO)

Service Data Objects are used to access the entries of a device's object dictionary.

2.1 Read Object

Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h + Node-ID	8	CS = 40h	LSB Index	MSB	Sub-Index	00h	00h	00h	00h

Transmitter answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS	LSB Index	MSB	Sub-Index	LSB Data			MSB

CS	Nr. of valid bytes
4Fh	1 (Byte4)
4Bh	2 (Byte4 - Byte5)
47h	3 (Byte4 - Byte6)
43h	4 (Byte4 – Byte7)

2.2 Write Object

Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h + Node-ID	8	CS	LSB Index	MSB	Sub-Index	LSB Data			MSB

CS	Nr. of valid bytes
2Fh	1 (Byte4)
2Bh	2 (Byte4 - Byte5)
27h	3 (Byte4 - Byte6)
23h	4 (Byte4 – Byte7)

Transmitter answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS = 60h	LSB Index	MSB	Sub-Index	00h	00h	00h	00h

2.3 Abort SDO Transfer

If an error occurred while reading or writing an object, the transmitter answers:

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS = 80h	LSB Index	MSB	Sub-Index	LSB Abort Code			MSB

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www.wika.de

2.4 SDO Abort Codes

Abort Code	Description
0504 0000h	SDO protocol timed out
0504 0001h	client/server command specifier not valid or unknown
0504 0002h	invalid block size (block mode only)
0504 0004h	CRC error (block mode only)
0504 0005h	out of memory
0601 0001h	attempt to read a write only object
0601 0002h	attempt to write a read only object
0602 0000h	object does not exist in the object dictionary
0604 0041h	object cannot be mapped to the PDO
0604 0042h	the number and length of the objects to be mapped would exceed PDO length
0604 0043h	general parameter incompatibility reason
0606 0000h	access failed due to an hardware error
0607 0010h	data type does not match, length of service parameter does not match
0609 0011h	sub-index does not exist
0609 0030h	value range of parameter exceeded (only for write access)
0609 0031h	value of parameter written too high
0609 0032h	value of parameter written too low
060a 0023h	no resources available
0800 0000h	general error
0800 0020h	data cannot be transferred or stored to the application
0800 0022h	data cannot be transferred or stored to the application because of the present device state.

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3. Process Data Object (PDO)

ID	DLC	Byte0	Byte1	Byte2	Byte3
ID	4	LSB			MSB
		process value			

The structure of the synchronous and asynchronous PDO is identical.
The identifier of the PDO can be set via object 1800h.
Factory-set: 180h + NID

Byte 0 to byte 3 contains the currently configured process value.

The default settings are configured to object 9130h subindex 1.
The coding corresponds to DS301, chapter 7.1.4.6 “Signed Integer”

The user can switch the mapping to object 6130h subindex 1 (process value as float).
Then the coding corresponds to DS301, chapter 7.1.4.7 “Floating Point Numbers”

For further information about the data types see description below.

3.1 Data Types

3.1.1 Signed Integer

	Byte0	Byte1	Byte2	Byte3
Integer32	$b_7..b_0$	$b_{15}..b_8$	$b_{23}..b_{16}$	$b_{31}..b_{24}$

The data is represented as bit sequence of length 32.

The bit sequence $b = b_0 .. b_{31}$ is assigned the value

$INTEGER32(b) = b_{30}*2^{30} + \ldots + b_1*2^1 + b_0*2^0$ if $b_{31}=0$

and, performing two’s complement arithmetic,

$INTEGER32(b) = - INTEGER32(\hat{}b)-1$ if $b_{31}=1$

3.1.2 Floating Point Numbers

	Byte0	Byte1	Byte2	Byte3
Real32	$b_7..b_0$	$b_{15}..b_8$	$b_{23}..b_{16}$	$b_{31}..b_{24}$

The data type *REAL32* is represented as bit sequence of length 32.
The encoding of values follows the IEEE 754-1985 Standard for single precision floating-point.

The bit sequence $b = b_0 .. b_{31}$ is assigned the value

$REAL32(b) = (-1)^S * 2^{E-127} * (1+F)$

Here

$S = b_{31}$ is the sign.

$E = b_{30}*2^7 + \ldots + b_{23}*2^0$; $0 < E < 255$; is the un-biased exponent.

$F = 2^{-23}*(b_{22}*2^{22} + \ldots + b_1*2^1 + b_0*2^0)$ is the fractional part of the number.

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3.2 Change of PDO-Mapping:

- Destroy Transmit-PDO by setting bit “valid” to 1_b (Index 1800h, sub-index 01_h)

e.g.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
601h	8	23h	00h	18h	01h	81h	01h	00h	80h
			Index			Data			

- Disable mapping by setting index 1A00h, sub-index 00h to 00h.

e.g.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
601h	8	2Fh	00h	1Ah	00h	00h	00h	00h	00h
			Index			Data			

- Modify mapping by changing the values of the corresponding sub-indices.

e.g. change mapped object to 6130.1

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
601h	8	23h	00h	1Ah	01h	20h	01h	30h	61h
			Index			Data			

- Enable mapping by setting sub-index 00h to the number of mapped objects.

e.g.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
601h	8	2Fh	00h	1Ah	00h	01h	00h	00h	00h
			Index			Data			

- Create Transmit-PDO by setting bit “valid” to 0_b (Index 1800h, sub-index 01_h)

e.g.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
601h	8	23h	00h	18h	01h	81h	01h	00h	00h
			Index			Data			

3.3 PDO Transmission Types (Object 1800h, subindex 2)

3.3.1 Synchronous Transmission:

A transmission type of n (1 … 240) means that the message is transmitted with every n-th SYNC object.

3.3.2 Asynchronous Transmission:

A transmission type of 253 means that the message will be sent after a RTR.

A transmission type of 254 means that the message will be sent after the event timer elapses. The **event timer** can be configured via object 1800h subindex 5.

4. Object Dictionary – Communication Profile Area

See html-Documentation object 1000h-1A00h (see Software-CD or download at www.wika.com)

5. Object Dictionary – Manufacturer Specific Area

See html-Documentation object 2006h – 2330h (see Software-CD or download at www.wika.com)

6. Object Dictionary – Device Profile Area

See html-Documentation object 6110h – 9149h (see Software-CD or download at www.wika.com)

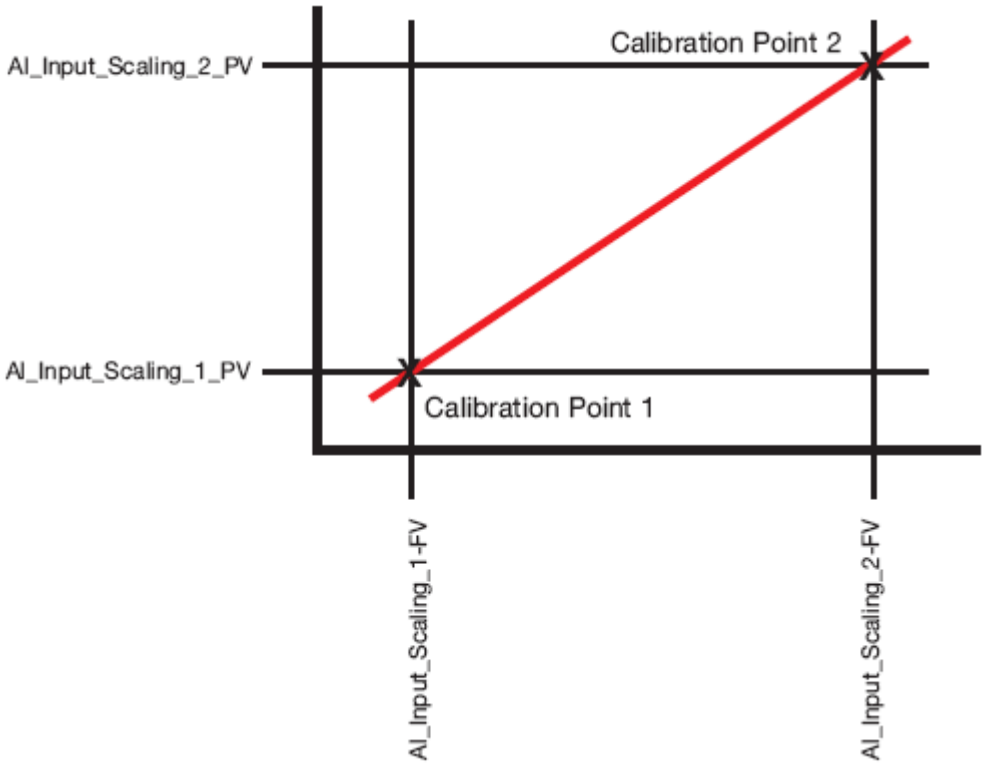
7. Calibration

7.1 Input Scaling

- 6121h AI Input Scaling 1 PV
- 6123h AI Input Scaling 2 PV
- 9120h AI Input Scaling 1 FV
- 9122h AI Input Scaling 2 FV

The calibration is carried out via objects 6121h and 6123h. The objects 9120h and 9122h are read only.

The device is recalibrated by addressing 2 measuring points and sending the respective set value to the device. The device offsets the set value specified against the actual pressure value. The 2 measuring points ideally correspond to lower limit of range and upper limit of range which however might not be possible in each case (e.g. -1 .. x bar).



Changed parameters are not automatically stored, but they have to be stored via object 1010h Store Parameters. Furthermore the device can be reset to the factory settings via object 1011h Restore Default Parameters.

7.1.1 Example 1:

Pressure Range: -1 … 2.5 bar (=> -100,000 … 250,000 Pa output value)

Calibration Point 1:

Pressure applied (reference value): -0.9 bar

The user writes the value that the device is supposed to indicate under the pressure currently applied to object 6121h subindex 1 (AI_Input_Scaling_1_PV), i.e. in this example -90,000 Pa (=> C2 B4 00 00 h float)

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h + Node-ID	8	CS = 23h	21h	61h	01h Subindex	00h	00h	B4h	C2h
			Index 6121h			desired value (as float)			

The pressure transmitter confirms the successful service by:

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS = 60h	21h	61h	01h Subindex	00h	00h	00h	00h
			Index 6121h						

Calibration Point 2:

Pressure applied (reference value): 2.5 bar

The user writes the value that the device is supposed to indicate under the pressure currently applied to object 6123h subindex 1 (AI_Input_Scaling_2_PV), i.e. in this example 250,000 Pa (=> 43 7A 00 00 h float)

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h + Node-ID	8	CS = 23h	23h	61h	01h Subindex	00h	00h	7Ah	43h
			Index 6123h			desired value (as float)			

The pressure transmitter confirms the successful service by:

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS = 60h	23h	61h	01h Subindex	00h	00h	00h	00h
			Index 6123h						

7.2 Input Offset

6124h AI_Input_Offset

For manual offset correction the detected offset is sent to the device, e.g. the device (pressure range 10 bar / 1,000,000 Pa) indicates 0.01 bar / 10,000 Pa at ambient pressure.

The user writes the determined offset to object 6124h subindex 1 (AI_Input_Offset_1),
i.e. in this example 10,000 Pa (=> 41 20 00 00 h float)

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h + Node-ID	8	CS = 23h	24h	61h	01h Subindex	00h	00h	20h	41h
			Index 6124h			desired value (as float)			

The pressure transmitter confirms the successful service by:

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS = 60h	24h	61h	01h Subindex	00h	00h	00h	00h
			Index 6124h						

Changed parameters are not automatically stored, but they have to be stored via object 1010h Store Parameters. Furthermore the device can be reset to the factory settings via object 1011h Restore Default Parameters.

7.3 Input Autozero

6125h AI_Input_Autozero

The zero (pressure = 0) is changed to the actual pressure.

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
600h + Node-ID	8	CS = 23h	25h	61h	01h Subindex	7Ah	65h	72h	6F
			Index 6125h			“zero” (ASCII)			

The pressure transmitter confirms the successful service by:

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
580h + Node-ID	8	CS = 60h	25h	61h	01h Subindex	00h	00h	00h	00h
			Index 6125h						

Changed parameters are not automatically stored, but they have to be stored via object 1010h Store Parameters. Furthermore the device can be reset to the factory settings via object 1011h Restore Default Parameters.

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
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8. Emergency Object (EMCY)

Object description

Transmitter sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
80h + NodeId	8	LSB Emergency Error Code	MSB	Error Register (1001h)	Manufacturer specific Error Field				

The following Emergency Error Codes are supported:

- 0000h Error Reset or No Error
- 1000h Generic Error
- 8130h Life guard error or hearbeat error

Error Register:
Contains the current contents of object 1001h Error Register

Manufacturer specific Error Field:

Byte3	Byte4	Byte5	Byte6	Byte7
		00h	00h	00h

not used (always 0)

xxxx xxx1 : Error while EEPROM write
xxxx xx1x : not used
xxxx x1xx : Max. allowed pressure exceeded
xxxx 1xxx : not used
xxx1 xxxx : Max. allowed temperature exceeded

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9. Network Management Objects

9.1 Module Control Services

Through Module Control Services, the NMT master controls the state of the NMT slaves. The state attribute is one of the values {STOPPED, PRE-OPERATIONAL, OPERATIONAL and INITIALISING}. The Module Control Services can be performed with a certain node or with all nodes simultaneously. The NMT master controls its own NMT state machine via local services, which are implementation dependent.

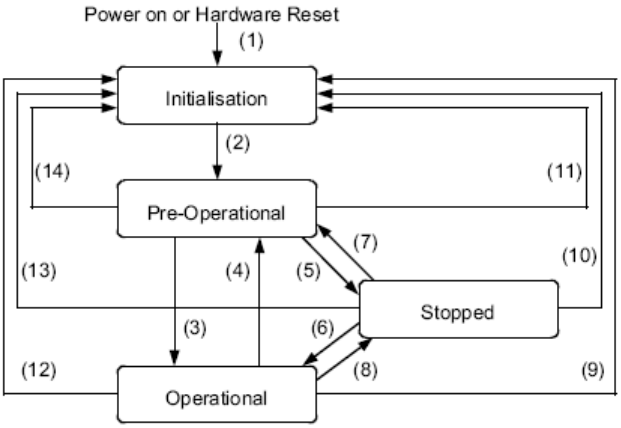


Table 31: Trigger for State Transition

(1)	At Power on the initialisation state is entered autonomously
(2)	Initialisation finished - enter PRE-OPERATIONAL automatically
(3),(6)	Start_Remote_Node indication
(4),(7)	Enter_PRE-OPERATIONAL_State indication
(5),(8)	Stop_Remote_Node indication
(9),(10),(11)	Reset_Node indication
(12),(13),(14)	Reset_Communication indication

9.1.1 Module Control Protocol

NMT Master request

ID	DLC	Byte0	Byte1
00h	2	CS	Node-ID (0 = all slaves)

CS: NMT command specifier

NMT services are unconfirmed.

CS	
01h	Start Remote Node
02h	Stop Remote Node
80h	Enter Pre-Operational
81h	Reset Node
82h	Reset Communication

9.2 Error Control Services

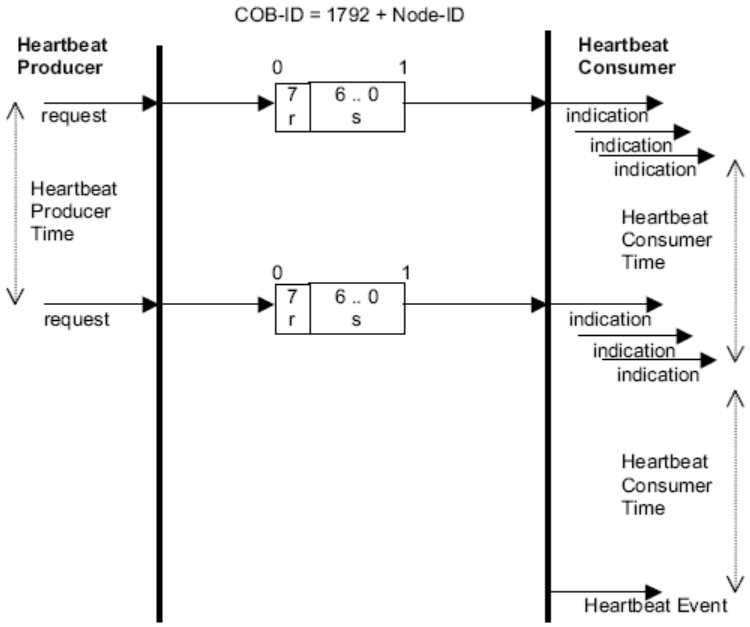
Through Error control services the NMT detects failures in a CAN-based Network. Local errors in a node lead to a change of state (PREOPERATIONAL). Error Control services are achieved principally through periodically transmitting of messages by a device. There exist two possibilities to perform Error Control.

The guarding is achieved through transmitting guarding requests (Node guarding protocol) by the NMT Master. If a NMT Slave has not responded within a defined span of time (node life time) or if the NMT Slave's communication status has changed, the NMT Master informs its NMT Master Application about that event. If Life guarding (NMT slave guarded NMT master) is supported, the slave uses the guard time and lifetime factor from its Object Dictionary to determine the node life time. If the NMT Slave is not guarded within its life time, the NMT Slave informs its local Application about that event. If guard time and life time factor are 0 (default values), the NMT Slave does not guard the NMT Master. Guarding starts for the slave when the first remote-transmit-request for its guarding identifier is received. This may be during the boot-up phase or later.

The heartbeat mechanism for a device is established through cyclically transmitting a message by a heartbeat producer. One or more devices in the network are aware of this heartbeat message. If the heartbeat cycle fails for the heartbeat producer the local application on the heartbeat consumer will be informed about that event.

9.2.1 Heartbeat Protocol

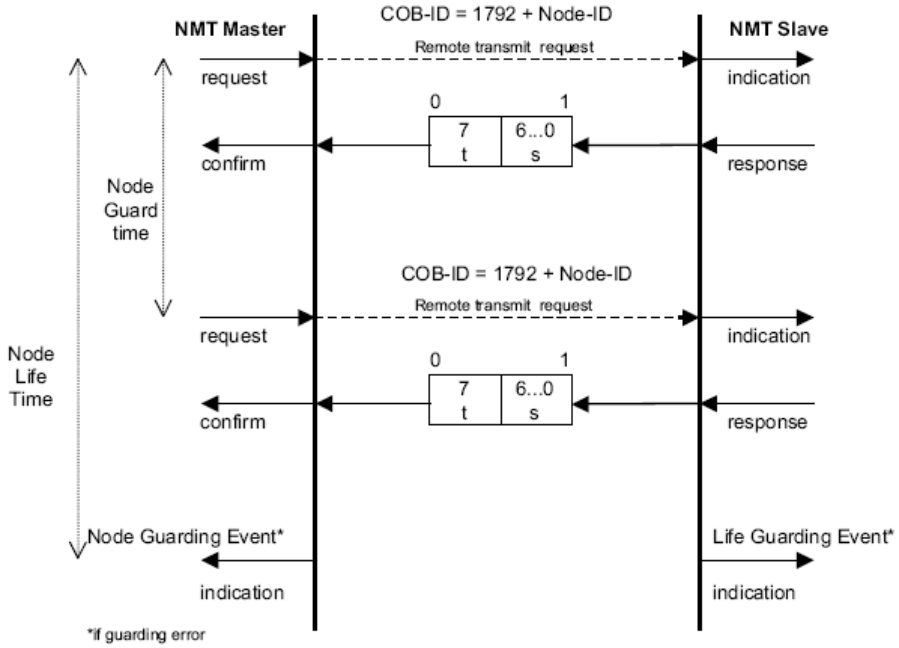
The Heartbeat Protocol defines an Error Control Service without need for remote frames. A Heartbeat Producer transmits a Heartbeat message cyclically. One or more Heartbeat Consumer receive the indication. The relationship between producer and consumer is configurable via the object dictionary. The Heartbeat Consumer guards the reception of the Heartbeat within the Heartbeat Consumer Time. If the Heartbeat is not received within the Heartbeat Consumer Time a Heartbeat Event will be generated.



r: reserved (always 0)
s: the state of the Heartbeat producer
0: BOOTUP
4: STOPPED
5: OPERATIONAL
127: PRE-OPERATIONAL
If the Heartbeat Producer Time is configured on a device the Heartbeat Protocol begins immediately. If a device starts with a value for the Heartbeat Producer Time unequal to 0 the Heartbeat Protocol starts on the state transition from INITIALISING to PRE-OPERATIONAL. In this case the Bootup Message is regarded as first heartbeat message. It is not allowed for one device to use both error control mechanisms Guarding Protocol and Heartbeat Protocol at the same time. If the heartbeat producer time is unequal 0 the heartbeat protocol is used.

9.2.2 Node Guarding Protocol

This protocol is used to detect remote errors in the network. Each NMT Slave uses one remote COB for the Node Guarding Protocol. This protocol implements the provider initiated Error Control services.



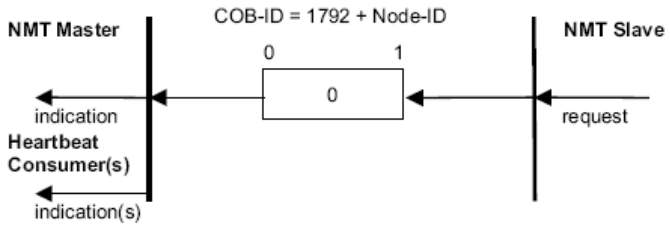
s: the state of the NMT Slave
4: STOPPED
5: OPERATIONAL
127: PRE-OPERATIONAL
t: toggle bit. The value of this bit must alternate between two consecutive responses from the NMT Slave. The value of the toggle-bit of the first response after the Guarding Protocol becomes active, is 0. The Toggle Bit in the guarding protocol is only reset to 0 when reset_communication is passed (no other change of state resets the toggle bit). If a response is received with the same value of the toggle-bit as in the preceding response then the new response is handled as if it was not received.

The NMT Master polls each NMT Slave at regular time intervals. This time-interval is called the guard time and may be different for each NMT Slave. The response of the NMT Slave contains the state of that NMT Slave. The node life time is given by the guard time multiplied by the life time factor. The node life time can be different for each NMT Slave. If the NMT Slave has not been polled during its life time, a remote node error is indicated through the 'Life Guarding Event' service.
A remote node error is indicated through the 'Node guarding event' service if:
– The remote transmit request is not confirmed within the node life time
– The reported NMT slave state does not match the expected state
If it has been indicated that a remote error has occurred and the errors in the guarding protocol have disappeared, it will be indicated that the remote error has been resolved through the 'Node Guarding Event' and 'Life Guarding Event' services.
For the guard time and the life time factor there are default values specified at the appropriate Object Dictionary entries.

9.1 Bootup Service

9.1.1 Bootup Event

Through this service, the NMT slave indicates that a local state transition occurred from the state INITIALISING to the state PRE-OPERATIONAL. The protocol uses the same identifier as the error control protocols.



10. Layer Setting Services (LSS)

LSS offers the possibility to change the settings of
- Node-ID
- Bit timing parameters of the physical layer (baud rate)

of a CANopen Slave.

An LSS Slave is identified by an LSS Address. This LSS Address consists of
- vendor-id,
- product-code,
- revision-number and
- serial-number.

These parameters are identical to the Identity-Object 1018h of the object dictionary.

10.1 Switch mode protocols

To configure a slave via LSS the device has to be configuration state

There are two ways to do this:

- Switch Mode Global switches all LSS Slaves between configuration and operation mode (used for configuration of the bit timing).

- Switch Mode Selective switches exactly one LSS Slave between configuration and operation mode
(used for configuration of the node-id)

10.1.1 Switch State Global

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 04h	mode	reserved					

cs: LSS command specifier
04 for Switch Mode Global

mode: The LSS mode to switch to:
0: switches to waiting state
1: switches to configuration state

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg
Germany

Tel. +49 9372 132-8976
Fax +49 9372 132-406
E-Mail support-tronic@wika.de
www.wika.de

10.1.2 Switch State Selective

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 40h	LSB Vendor-ID			MSB	reserved		

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 41h	LSB Product Code			MSB	reserved		

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 42h	LSB Revision Number			MSB	reserved		

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 43h	LSB Serial Number			MSB	reserved		

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS = 44h	reserved						

cs: LSS command specifiers;
40h to 44h for Switch Mode Selective

vendor-id: Vendor name part of the LSS address, with respect to index 1018h, subindex 1

product-code: Product name part of the LSS address, with respect to index 1018h, subindex 2

revision-number: Revision part of the LSS address, with respect to index 1018h, subindex 3

serial-number: Serial number part of the LSS address, with respect to index 1018h, subindex 4

10.2 Configuration protocols

10.2.1 Configure Node-ID Protocol

By means of this service the LSS Master configures the NMT-address parameter of a LSS Slave.

This service allows only one LSS Slave in configuration mode. The remote result parameter confirms the success or failure of the service.

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 11h	Node-ID	reserved					

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS = 11h	error code	reserved					

cs: LSS command specifier
11h for Configure Node-ID

NID: The new Node-ID to configure

error_code: 0 : protocol successfully completed
1 : Node-ID out of range

10.2.2 Configure Bit Timing Parameters Protocol

Configure Bit Timing Parameters
By means of the Configure Bit Timing Parameters service the LSS Master sets the new bit timing on a LSS Slave.

By means of the table_selector the bit timing parameter table to be used is specified. In the bit timing parameter table the bit timing parameters for different baud rates are specified. With table_selector value ´0´ the standard CiA bit timing parameter table is referenced. The table_index selects the entry (baud rate) in the selected table (value '0' refers to the highest baud rate).

Baud Rate (kBit)	Table Index
1000	0
800	1
500	2
250	3
125	4
100 (reserved)	5
50	6
20	7
10	8

This service has to be followed by an Activate Bit Timing Parameters service to activate the configured parameters. After execution of the Configure Bit Timing Parameters service the node may not execute any remote LSS services except the services Configure Bit Timing Parameters, Activate Bit Timing Parameters and Switch Mode.
The remote result parameter confirms the success or failure of the service.

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 13h	Table Selector	Table Index	Reserved				

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS = 13h	error code	reserved					

cs: LSS command specifier
13h for Configure Node-ID

table_selector: selects which bit timing parameters table has to be used
0: standard CiA bit timing table
1..255: reserved

table_index: selects the entry (bit timing parameters) in the standard CiA bit timings table

error_code:
0: protocol successfully completed
1: bit timing not supported
2..255: reserved

10.2.3 Activate Bit Timing Parameters Protocol

Activate Bit Timing Parameters
By means of the Activate Bit Timing Parameters service the LSS Master activates the bit timing as defined by the Configure Bit Timing Parameters service.

The switch_delay parameter specifies the length of two delay periods of equal length, which are necessary to avoid operating the bus with differing bit timing parameters. Each node performs the actual switch of the bit timing parameters ´switch_delay´ milliseconds after the reception of the command. After performing the switch, a node does not transmit any messages before the second time ´switch_delay´ has passed.

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 15h	Switch delay LSB	MSB	Reserved				

cs: LSS command specifier
15h for Activate Bit Timing Parameters

switch_delay:
The duration of the two periods of time to wait until the bit timing parameters switch is done (first period) and before transmitting any CAN message with the new bit timing parameters after performing the switch (second period). The time unit of switch delay is 1 ms.

10.2.4 Store Configuration Protocol

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS = 17h	Reserved						

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS = 17h	Error code	Spec. error	Reserved				

cs: LSS command specifier
17h for Store configuration

error_code:
0: protocol successfully completed
1: store configuration is not supported
2: storage media access error
3 to 254: reserved for further use by CiA,
255: implementation specific error occurred.

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg
Germany

Tel. +49 9372 132-8976
Fax +49 9372 132-406
E-Mail support-tronic@wika.de
www.wika.de

10.3 Inquiry protocols

10.3.1 Inquire LSS address protocols

10.3.1.1 Inquire identity vendor-ID protocol

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS 5Ah	0	0	0	0	0	0	0

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS 5Ah	Vendor-Id				0	0	0

10.3.1.2 Inquire identity product-code protocol

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS 5Bh	0	0	0	0	0	0	0

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS 5Bh	Product code				0	0	0

10.3.1.3 Inquire identity revision number protocol

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS 5Ch	0	0	0	0	0	0	0

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS 5Ch	Revision number				0	0	0

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg
Germany

Tel. +49 9372 132-8976
Fax +49 9372 132-406
E-Mail support-tronic@wika.de
www.wika.de

10.3.1.4 Inquire identity serial number protocol

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS 5Dh	0	0	0	0	0	0	0

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS 5Dh	serial number				0	0	0

10.3.2 Inquire node-ID protocol

LSS-Master sends

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E5h	8	CS 5Eh	0	0	0	0	0	0	0

LSS-Slave answers

ID	DLC	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
7E4h	8	CS 5Eh	NodeID	0	0	0	0	0	0

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg
Germany

Tel. +49 9372 132-8976
Fax +49 9372 132-406
E-Mail support-tronic@wika.de
www.wika.de

10.4 Example

10.4.1 Configure the node-ID of a slave:

- Set the device to stopped mode or pre-operational mode
- Change from LSS-waiting-state to configuration state via **Switch Mode Selective**
- Set the node ID via **Configure Node-ID Protocol**
- Store the changed configuration via **Store Configuration Protocol**
- Change from configuration state to waiting state via **Switch mode Global**

10.4.2 Configure the bit timing parameters:

- Set the device to stopped mode
- Change from LSS-waiting-state to configuration state via **Switch Mode Selective**
- Set new baud rate via **Configure Bit Timing Parameters Protocol**
- Store the changed configuration via **Store Configuration Protocol**
- Activate bit timing via **Activate Bit Timing Parameters Protocol**
- Change from configuration state to waiting state via **Switch mode Global**

11. References

ISO 11898 Controller area network (CAN)

CiA 301 V4.2.0 - CANopen Application Layer and Communication Profile

CiA 404 V1.2 - CANopen Device Profile Measuring Devices and Closed-Loop Controllers

CiA 303-1 V1.7.0 - CANopen Recommendation: Cabling and Connector Pin Assignment

CiA 303-2 V1.4.0 - CANopen Recommendation: Representation of SI units and prefixes

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CiA 305 DSP V2.2.0 - CANopen Layer Setting Services and Protocol (LSS)