

# ***Operating Manual***

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***EX120-SCA1***

***EX121-SCA1***

***EX122-SCA1***

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## ***CANopen SI units***

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## 1. System overview

### 1.1. CANopen network protocol

*Comment:*

*In order to avoid confusion, the commonly-used CAN expressions and abbreviations have been used in this operating manual.*

CANopen is an open, manufacturer-independent network protocol. It promises a profile family based on a communication profile and a number of device profiles.

Based on the OSI model, the lower levels are defined by ISO standard 11898.

CANopen is based on CAL (Can Application Layer = Level 7), but is more strictly controlled than CAL for use in special applications.

The CANopen profile uses part of the communication service of CAL. As an example, CANopen uses extended NMT (Network Management) for its network management. Identifier allocation via DBT (Distributor) is possible.

The CANopen communication profile is the CiA DS-301 (CAL - based Communication Profile for Industrial Systems), while the CANopen device profile for input/output modules is the CiA DS-401 (CAL-based Device Profile for I/O modules).

CANopen offers so-called PDO (Process Data Object) communication, a fast real-time process data transfer which runs unconfirmed without Protocol Overhead.

Telegrams running in the network are prioritized by their Identifier (Lower ID = higher priority). When the network is heavily loaded, an arbitration procedure ensures that important telegrams are rapidly transmitted. PDOs can be up to 8 data bytes long and can be compiled and configured for specific application by the user.

There are also different Transmission types for process data.

### 1.2. EX#12-SCA1 Device

By using the SI unit, it is possible to control SMC solenoid valves via the CANopen protocol. All three housing types, EX120, EX121 and EX122, contain the same electronics, but differ only in the type of housing assembly.

<u>Housing type:</u>	<u>Type of connection:</u>	<u>For SMC valve types:</u>
EX120	Directly mounted without RC, without DIN rails	VQ
EX121	DIN rail mounting via RC (= ribbon cable)	SY
EX122	Directly mounted on DIN rails, without RC	SY

## 2. System structure

### **2.1. Schematic structure of a CAN network**

A network manager (NMT master, e.g., PC, PLC with CAN card, etc.) configures and monitors the modules; it can also contain the control logic (or a part thereof). The NMT master is also responsible for the orderly booting-up in the initialization phase. If the CAN participants are designated as master, they send their data (PDOs) autonomously into the network, as at, for example, a status change in the device profile.

If the participants are designated as slaves, transmitting PDOs depends on a signal from the master. Such a signal could be a time pulse (sync) or a remote request to the module generated by the master.

When the PLC system is used in CANopen, one speaks of master and slaves; otherwise one uses the terms nodes and participants.

In CAN every participant can exercise a master function, sending messages or telegrams which all other participants can receive (Multi-Master, Broadcast Communication).

#### **Structure of a CAN network (Topology principle)**

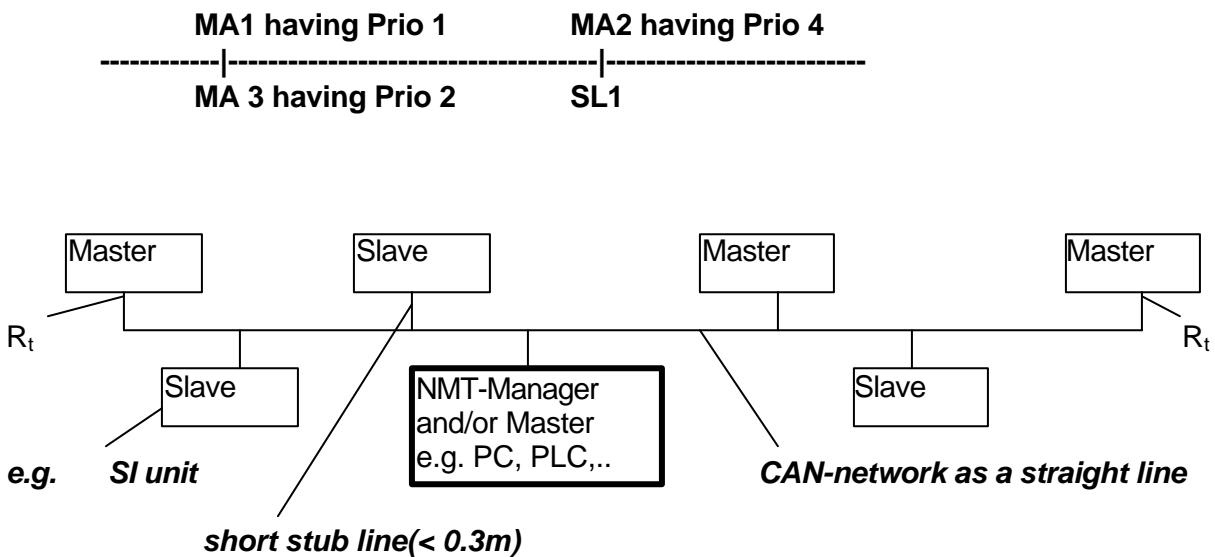
The Topology of the CAN bus system should, as far as is possible, assume a line structure. At a speed of 500 bits/sec., the theoretically maximum allowable stub line length is 6m, and the maximum sum of all stub lines is 30m.

For transmission speeds up to 1Mbit/sec, the max. allowable stub line is 0,3m.

MA: CAN master

SL: CAN slave

Prio: priority



$R_t$  = terminating resistor between CAN\_L and CAN\_H; normally 120 $\Omega$  / 1%.

### 3. Technical data

#### 3.1. General technical data, SI unit

Working temperature	0 ~ +50 °C
Storage temperature	- 20 ~ +85 °C
Air relative humidity (RH)	10-95 % (without condensation)
CE certification	Provided
Protection class	IP 20 (DIN 40050/IEC 144)

#### 3.2. Technical data, CANopen

Protocol	CANopen CiA DS-301 and CiA DS-401																		
Max. no. of network participants	127 participants(master, slaves) in CANopen 255 in CAL																		
Baudrate [Bits/sec. = Baud]	<p>Baudrates prescribed in the CiA DS 301 standard and the maximum line length resulting therefrom are given below:</p> <table border="0"> <thead> <tr> <th><u>Baudrate:</u></th> <th><u>max. buscable length:</u></th> </tr> </thead> <tbody> <tr> <td>1000 kBit/s</td> <td>25 m</td> </tr> <tr> <td>800 kBit/s</td> <td>50 m</td> </tr> <tr> <td>500 kBit/s</td> <td>100 m</td> </tr> <tr> <td>250 kBit/s</td> <td>250 m</td> </tr> <tr> <td>125 kBit/s (default)</td> <td>500 m</td> </tr> <tr> <td>50 kBit/s</td> <td>1000 m</td> </tr> <tr> <td>20 kBit/s</td> <td>1000 m</td> </tr> <tr> <td>10 kBit/s</td> <td>1000 m</td> </tr> </tbody> </table> <p>As a practical rule of thumb: <b>Max. line length * baudrate &lt;= 20 * 1 Mbit/sec.</b></p> <p>Notes: 1. The actual characteristics of connectors, cables, etc., used can reduce the max. allowable line length. 2. The CANopen SI unit has no automatic baudrate recognition.</p> <p>For further information and bit timing tables, see CiA DS 301 V3.0 , chap. 11 , p 11-1ff)</p>	<u>Baudrate:</u>	<u>max. buscable length:</u>	1000 kBit/s	25 m	800 kBit/s	50 m	500 kBit/s	100 m	250 kBit/s	250 m	125 kBit/s (default)	500 m	50 kBit/s	1000 m	20 kBit/s	1000 m	10 kBit/s	1000 m
<u>Baudrate:</u>	<u>max. buscable length:</u>																		
1000 kBit/s	25 m																		
800 kBit/s	50 m																		
500 kBit/s	100 m																		
250 kBit/s	250 m																		
125 kBit/s (default)	500 m																		
50 kBit/s	1000 m																		
20 kBit/s	1000 m																		
10 kBit/s	1000 m																		
Cabling Type	Shielding 2-wire cable according to ISO 11898 /2/.																		



The SI unit can control 16 single-solenoid valves or 8 double-solenoid valves (and combinations thereof); it has no sensor inputs.

The solenoid valve manifolds are internally prewired. This means that only the bus (9 pin D Sub connector) and the +24 DC power supply (5 pin round connector) need be connected to the SI unit.

The two rotary switches ( H and L) on the cover plate are for setting the node addresses or node ID (see section 5).

The valve status (ON/OFF) in the event of an error can be programmed.

### **3.4. EMC (Electromagnetic Compatibility)**

EX120-SCA1, EX121-SCA1 and EX122-SCA1 SI-units has passed all necessary EMC-tests at accredit EMC-test labor due to EN 50081-1, i.e. stronger Emission standards for living areas and due to EN 50082-2, i.e. stronger Immunity standards for industrial areas.

#### **Immunity (Interference resistance)**

##### **Electrostatic discharge, ESD:**

Basic Standard: EN 61000-4-2 (10.94)  
EN 50082-2

##### **Interference resistance to electromagnetic fields**

Basic Standard: ENV 50140 (2.95)  
EN 50082-2 Irradiated with 10 V/m

##### **Bursts on mains lines**

Basic Standard: EN 61000-4-4 (10.94)  
EN 50082-2

##### **Bursts on data, signal and control lines**

Basic Standard: EN 61000-4-4 (10.94)  
EN 50082-2

##### **Transients in control lines 1,2/50-8/20 ms**

Basic Standard: EN 61000-4-5 (10.93)  
EN 50082-2

##### **Interference resistance to line-conducted interference variables, induced by high-frequency fields**

Basic Standard: EN 61000-4-6 (12.93)  
EN 50082-2

#### **Emission (Spurious radiation)**

##### **Spurious radiation**

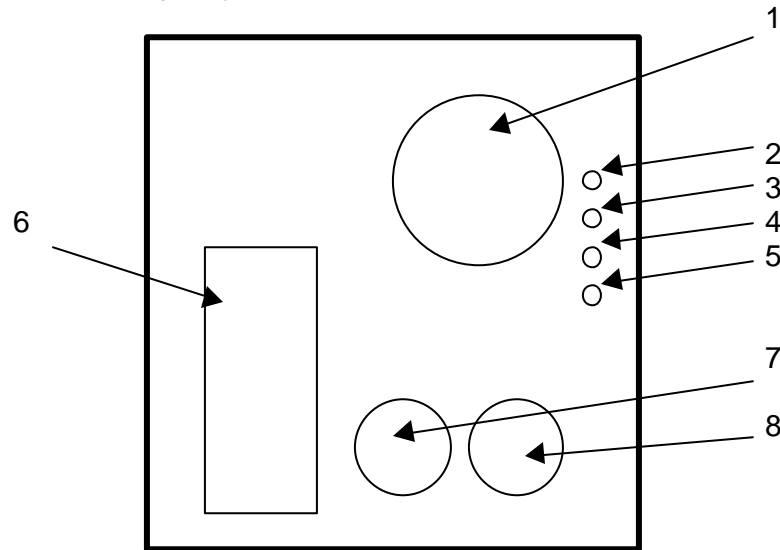
Basic Standard: EN 55011/55022 (1.92)  
EN 50081-1

### **4. Description of SI unit EX 12#-SCA1**

## 4.1. Description of components

Components of the cover plate)

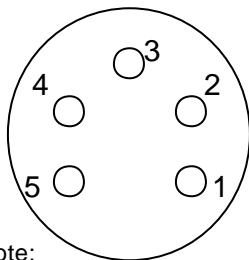
- not to scale -



- 1 5 pin round connector for power supply, according to DIN45322
- 2 PWR LED (green) for power supply to the SI unit
- 3 BUS LED (green, red, orange) multifunction display (see 4.2)
- 4 ERR LED (red) short-circuiting of one or more solenoid outputs
- 5  $U_L$  (green) for valve solenoid power supply (load)
- 6 9 pin D Sub connector for network connection (CAN bus)
- 7 Node ID, high valve position (H, high significance), decimal
- 8 Node ID, low valve position (L, low significance), decimal

### 4.1.1. 5 pin round connector

#### Top view



- |        |                                 |
|--------|---------------------------------|
| PIN 1: | + 24VDC load (valve solenoids)  |
| PIN 2: | 0V electronics (SI unit)        |
| PIN 3: | PE, functional Protective Earth |
| PIN 4: | + 24VDC electronics (SI unit)   |
| PIN 5: | 0V load (valve solenoids)       |

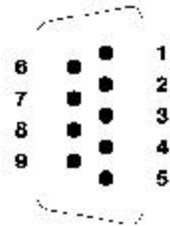
Note:

The +24VDC load voltage and the + 24VDC supply voltage are not electrically separated from one another.  
**PIN 3(PE) must be connected to the shielding connection of the round connector plug socket.**

#### 4.1.2. 9 pin D sub socket

##### Connection to the network (CAN bus)

The diagram below shows the pin assignment of Sub D connectors X1 and X2. Six of the nine pins are assigned as per CiA-DS-102 version 2.0 standard. The table details pin assignment. EX12#-SCA1 is provided with male 9-pole Sub D connector due to DS-102.



##### Pin assignment of 9 pin Dsub connector according to CiA DS 102

Pin Number	Symbol	Description
1	---	Reserved
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	CAN Ground
4	---	Reserved
5	(CAN_SHLD)	Optional CAN shielding
6	(GND)	Optional CAN ground
7	CAN_H	CAN_H bus line (dominant high)
8	---	Reserved (error line)
9	(CAN_V+)	Optional power supply (e.g., for transceiver and opto-coupler if the bus nodes are electrically separated. This is not supported by the SI unit.)

As a minimum, the un-bracketed symbols above (Pins 2,7 & 7) must at least be connected, i.e. these are mandatory CAN-bus signals and has to be connected in any case.

The 9 pin D sub connector conforms to DIN 41652. Pins 3 and 6 must be connected inside the module. All pins must be connected to their corresponding pin-numbers in devices containing two connections, and within T-plugs.

## 4.2. Diagnostic LEDs (Status LEDs)

The status of the SI unit is indicated by the Status LEDs **PWR**, **BUS**, **ERR** and **U<sub>L</sub>**.

<i>LED</i>	<i>status</i>	<i>Interpretation</i>
PWR	lights up green	Power supply (+24V DC) for the SI unit electronics is ON (pin 4 of the 5 pin round connector)
	lights up weakly or not at all	Power supply is either weak or not present.
BUS	lights up orange	SI unit is in CANopen status Pre-Operational or in CAL status Connecting (acc. to Node ID: see address setting in 4.1)  The SI unit goes to the above state after a Reset Communication, Reset Node or Power On Boot-up. Only SDO Communication is possible with the SI unit.
	lights up green	The SI unit is in Operational state. PDOs and SDOs are processed and the station is in functioning mode in the net.
	lights up red	Error condition. The station has detected a communication error, and has returned to the pre-programmed safe state. The behavior of individual outputs depends on the chosen Fault Mode and State settings (fixed bit sample, „freezing“ of last valid condition or all outputs go to zero (OFF)). On error correction (e.g., restarting Node guarding protocol), the error state is exited, and the BUS LED lights up orange or green (according to communication status).
	blinks red	See baudrate adjustment by rotary switch: 4.2.1.
ERR	lights up red	Shows short-circuiting of one or more outputs.  Note: The ERR-LED corresponds to Error-Code 2301 hex „Current Output too high“ (see chapter 4.3)
U <sub>L</sub>	lights up green	Indicates adequate power supply for the valve solenoids (+24 VDC on pin 1 of the round connector).  Note: UL LED corresponds to Error-Code 3330 hex „Output voltage missing“ (see chapter 4.3)

### 4.3. Network diagnostic

The SI unit supports EMCY (Emergency) Frames conforming to CiA DS-301 standard.

<i>Error-Code (hex.)</i>	<i>CiA designation</i>	<i>Interpretation</i>
2310	Current at output too high	over-current/short circuit
3330	Output voltage missing	Field voltage not present
0000	No error	Is transmitted after EMCY Frames after error correction (Quitting)
8100	Communication error	Communication error (e.g., error in Node guarding protocol).

(See CiA DS 301 V3.0 , section 7.3 , p. 7-3ff)

### 4.4. Boot-up

#### 4.4.1. CAL/CANopen implementation

##### *CANopen Boot-up*

The Minimum Capability Device Boot-up, described in CiA-DS-301, as well as the normal Extended NMT Slave Boot-up, is supported by the SI unit.

This is implemented as follows: after initialization, The SI unit places itself in the PREOPERATIONAL state, which corresponds to the state of a Minimum Capability Device. If, when in this state, a Disconnect Remote Node Request from an NMT master is received, the module falls back to a CONNECTING state, and an Extended NMTBoot-up can be performed.

It must be noted that the Minimum Capability Device Boot-up, and thereby the Predefined Master Slave connection Set, can only be used when the Node ID is < 128.

If the Node ID is >= 128, the SI unit will not go to the PREOPERATIONAL state, but into the CONNECTING state.

It is then necessary to do an Extended NMT Slave Boot-up with dynamic Identifier allocation via DBT.

For Node IDs >= 128 , the Parameter k in Prepare Remote Node Request (cf. NMT Protocol Specification CiA-DS-203-2) is meaningless, as the SI unit demands all Identifiers from the DBT Master.

The following Boot-up variants are also possible with the SI unit:

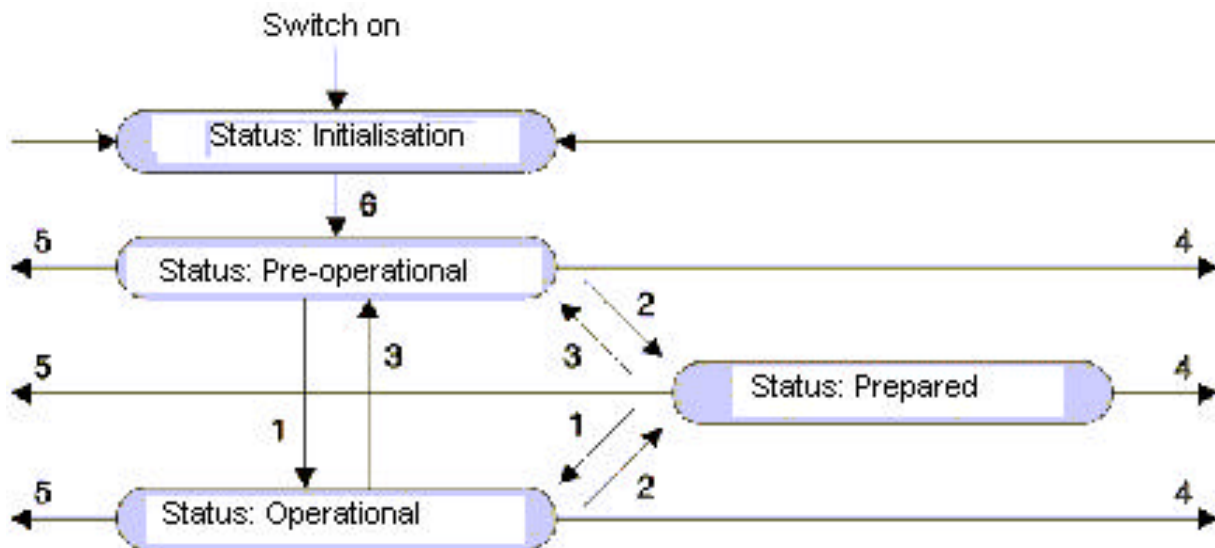
- a) Minimum Capability Device Boot-up with static Identifier determination using the Predefined Master Slave Connection Set (for Node IDs from 1 to 127).
- b) Extended NMT Slave Boot-up with static Identifier determination using the Predefined Master Slave Connection Set (for Node IDs from 1 to 127).
- c) Extended NMT Slave Boot-up with dynamic Identifier allocation using DBT (for Node IDs from 1 to 255).

#### 4.4.2. Minimum Capability Device Boot-up

The CAN system Boot-up procedure is relatively complex, therefore, in addition to the Full/Extended Capability Device Boot-up, a Minimum Boot-up is provided, which confines itself to the following functions:

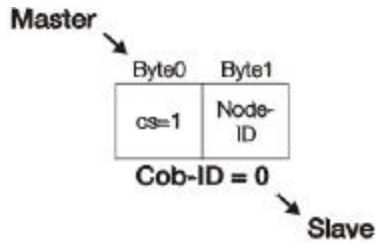
- The CANopen device has only a Module ID (no Node names)
- At least one SDO (Server SDO) is available
- Two Tx PDOs and two Rx PDOs (the latter is not required for SI units)
- Predefined ID allocation, which depends on the Module ID (Predefined Connection Set)
- Only simplified boot-up (Minimum Boot-up), i.e., the simplified Node State Diagram and the NMT slave support only Network Services

When the SI unit is driven as a "Minimum Capability Device" (see CiA DS-301, section 8.3), it operates as per the status diagram below:

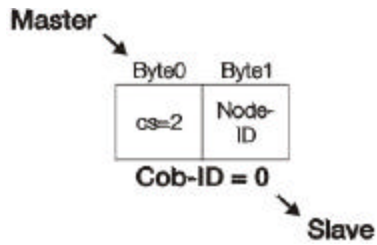


The following CANopen Services are required when switching from one status to another (or they can be independently performed by the module):

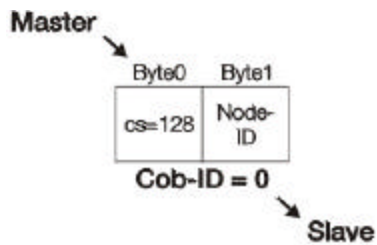
1) Start Remote Node (Start CAN Node)



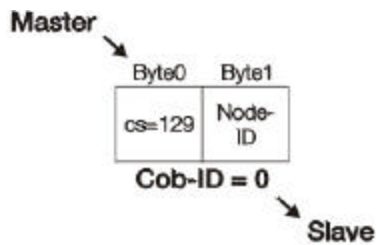
2) Stop Remote Node (Stop CAN Node)



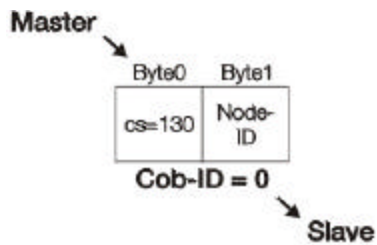
3) Enter Pre-Operational (Switch to „Pre-Operational“)



4) Reset Node (Reset all CAN Nodes)



5) Reset Communication (Reset CAN Node Communication)



6) Initialisation Finished (Automatic Status change to "Pre-Operational")

<u>Status:</u>	<u>Further information:</u>
- Reset Application	Loads the stored values or Default Values for entry into Manufacturer Specific Area and Standardized Device Profile Area of the Object Index.
- Reset Communication	Loads the stored values or Default Values for entry into the Communication Profile Area of the Object Index.
- Init	Application-specific Basis Initialisation of Nodes is performed. After Power On all stored values or Default Values for all parameters are loaded.
- Pre-Operational	This is not a PDO Communication (only, e.g., SDO, Sync, Node Guard, Emergency). This state is automatically assumed after initialisation. SDO Communication, Emergency and SYNC are allowed (but not PDO).
- Prepared	The module is defective at the time. This is a relatively new CAN status definition, and is defined by bit samples. Communication via SDO, PDO and Emergency is not allowed (no Alarm OFF); Guarding and NMT Services are allowed.
- Operational	The actual operational status; Communication via all Objects is allowed.

For a description of the Extended NMT Slave Boot-Up, refer to CAN literature available on the open market.

#### **4.5. Defaults and definitions**

In the section following, Features of CAL, CANopen, ISO11898, etc., which are not defined (or incompletely defined), are described.

##### *Baudrate*

The pre-set transmission rate (default baudrate) of the SI unit is 125 kbits/s. This baudrate can be changed via the corresponding LMT service or the hex switch (see section 5.2).

##### **CAUTION:**

**All modules in a CANopen network must be set to the same baudrate!  
The CANopen SI units EX12#-SCA1 are not provided with automatic Baudrate detection.**

### *Connection Set*

The SI unit supports both the CANopen Predefined Master Slave Connection Set (CiA-DS-301, section 8.3 for Node IDs = 1....127) and the complete CAL DBT Slave Functionality. Only the Default PDO, however, is demanded by the DBT.

When using extended Boot-up, the CAL/CANopen Manager decides whether to use the Default Connection Set or the DBT Master Identifier, based on the parameter k in Node Prepare Request (see NMT Protocol Specification CiA-DS203-2). When k = 0, all Identifiers are demand by the DBT Master; when k is not 0, local Identifier determination occurs according to CiA DS-301, section 8.3.

If the dynamic Identifier allocation via DBT is used, precautions must be taken that no retroactive Distribution of Identifiers by DBT is supported by a second 'PREPARING'-phase.

### *Delay times*

After unconfirmed Management Services, such as NMT Start, NMT Stop, NMT Disconnect, or LMT Switch Mode, a time delay is necessary for SI unit internal status change before further Master access is possible.

This delay time must be at least 20 ms.

## 4.6. The Object Index Communication Profile

(acc. to CiA DS-301 Ver. 3.0)

Index (hex)	Object	Name	Type	Attr.	M/O
1000	VAR	device type	Unsigned32	const	M
1001	ARRAY	error register	Unsigned8	ro	M
1004	ARRAY	number of PDOs supported	Unsigned32	ro	O
1005	VAR	COB-ID Sync-Message	Unsigned32	rw	O
1008	VAR	manufacturer device name	Vis-String	const	O
1009	VAR	manufacturer hardware version	Vis-String	const	O
100A	VAR	manufacturer software version	Vis-String	const	O
100B	VAR	Node-ID	Unsigned32	ro	O
100C	VAR	Guard time	Unsigned32	rw	O
100D	VAR	life time factor	Unsigned32	rw	O
100E	VAR	Guard ID	Unsigned32	rw	O
100F	VAR	Number of SDOs supported	Unsigned32	ro	O
1010	VAR	Store Parameters	Unsigned32	rw	O
1011	VAR	Restore Default Parameters	Unsigned32	rw	O
1014	VAR	COB-ID Emergency	Unsigned32	ro	O
<b>Server SDO Parameter (22H)</b>					
1200	RECORD	1. Server SDO Parameter	SDOParameter	ro	O
1201	RECORD	2. Server SDO Parameter	SDOParameter	rw	O
1202	RECORD	3. Server SDO Parameter	SDOParameter	rw	O
1203	RECORD	4. Server SDO Parameter	SDOParameter	rw	O
<b>Receive PDO Communication Parameter (20H)</b>					
1400	RECORD	1. receive PDO Parameter	PDOCommPar	rw	O
1401	RECORD	2. receive PDO Parameter	PDOCommPar	rw	O
1402	RECORD	3. receive PDO Parameter	PDOCommPar	rw	O
...	...	...	...	...	...
1409	RECORD	10. receive PDO Parameter	PDOCommPar	rw	O
<b>Receive PDO Mapping Parameter (21H)</b>					
1600	ARRAY	1. receive PDO mapping	PDOMapping	rw	O
1601	ARRAY	2. receive PDO mapping	PDOMapping	rw	O
1602	ARRAY	3. receive PDO mapping	PDOMapping	rw	O
...	...	...	...	...	...
1609	ARRAY	10. receive PDO mapping	PDOMapping	rw	O
<b>Transmit PDO Communication Parameter (20H)</b>					
1800	RECORD	1. transmit PDO Parameter	PDOCommPar	rw	O
1801	RECORD	2. transmit PDO Parameter	PDOCommPar	rw	O
<b>Transmit PDO Mapping Parameter (21H)</b>					
1A00	ARRAY	1. transmit PDO mapping	PDOMapping	rw	O
1A01	ARRAY	2. transmit PDO mapping	PDOMapping	rw	O

#### 4.7. The Object Index Device Profile, 16 Outputs

(acc. to CiA DS-401)

Index (hex)	Sub (hex)	Object	Name	Type	Attr.
<b>6200</b>		<b>Array</b>	<b>Write State 8 Output Lines</b>	<b>Unsigned8</b>	
	01		Write State 8 Output Lines 1H-8H	Unsigned8	rw
	02		Write State 8 Output Lines 9H-10H	Unsigned8	rw
<b>6206</b>		<b>Array</b>	<b>Fault Mode 8 Output Lines</b>	<b>Unsigned8</b>	
	01		Fault Mode 8 Output Lines 1H-8H	Unsigned8	rw
	02		Fault Mode 8 Output Lines 9H-10H	Unsigned8	rw
<b>6207</b>		<b>Array</b>	<b>Fault State 8 Output Lines</b>	<b>Unsigned8</b>	
	01		Fault State 8 Output Lines 1H-8H	Unsigned8	rw
	02		Fault State 8 Output Lines 9H-10H	Unsigned8	rw
<b>6220</b>		<b>Record</b>	<b>Write State 1 Output Line</b>		
	01		Write State 1 Output Line 1H	Boolean	rw
	...		...	Boolean	rw
	10		Write State 1 Output Line 10H	Boolean	rw
<b>6250</b>		<b>Record</b>	<b>Fault Mode 1 Output Line</b>		
	01		Fault Mode 1 Output Line 1H	Boolean	rw
	...		...	Boolean	rw
	10		Fault Mode 1 Output Line 10H	Boolean	rw
<b>6260</b>		<b>Record</b>	<b>Fault State 1 Output Line</b>		
	01		Fault State 1 Output Line 1H	Boolean	rw
	...		...	Boolean	rw
	10		Fault State 1 Output Line 10H	Boolean	rw
<b>6300</b>		<b>Record</b>	<b>Write State 16 Output Lines</b>		
	01		Write State 16 Output Lines 1H-10H	Unsigned16	rw
<b>6306</b>		<b>Record</b>	<b>Fault Mode 16 Output Lines</b>		
	01		Fault Mode 16 Output Lines 1H-10H	Unsigned16	rw
<b>6307</b>		<b>Record</b>	<b>Fault State 16 Output Lines</b>		
	01		Fault State 16 Output Lines 1H-10H	Unsigned16	rw

Comments:

- For reason of clarity, the Subindex "00" (which each Index has) has been omitted in the Device Index Table above.  
These contain the "Number\_of\_Sub\_Indicies", which is read-only, and play no part in parameterizing the SI unit.
- The Fields "..." represent a field with all entries between 1H und 10H (1-16 dec.).

#### 4.8. Process Data Objects, PDOs

The SI unit can work with a maximum of 10 Rec PDOs and 2 Trx PDOs; the Default Master/Slave Connection Set is supported by Rec PDO1.

The first data byte of the Receive PDO1 is mapped defaultwise onto the first output byte of the SI unit, the second data byte onto the second output byte.

If one reconfigures the COB ID, the module returns to the Default value by setting the PDO COB ID to 0 (see Tables Predefined Master/Slave Connection Set).

The maximum number of mappable Objects is 64 per PDO.

As a PDO can be at most 8 bytes long, one can assign to a PDO the theoretical maximum number of Objects (64 1 Bit Objects).

The SI unit supports PDO Transmission Types 0 (sync), 1 (cyclic), 253 (remote request - only for TrxPDOs) and 255 (event driven).

The Transmission Types of individual PDOs are independent; this means that synchronous and asynchronous PDOs can be used in a mixed operation, if desired.

CMS Priority of the PDOs:

The CMS priority level of the PDOs is 3 (default); this cannot be altered.

Inhibit Time of the PDOs:

Setting of PDO Inhibit Times is not supported, i.e. values not equal to 0 are not allowed.

#### **Predefined Master/Slave Connection Set Table for PDOs**

(see CiA DS 301 V3.0 , section 8.4.1 , p. 8-11ff )

object	function code (bin.)	resulting COB IDs (dec.)	CommParameters at Index (hex.)	CMC Priority Group
transmit				
PDO1 (tx)	0011	385-511	[1800]	1,2
PDO2 (tx)	0101	641-767	[1801]	2,3
receive				
PDO1 (rx)	0100	513-639	[1400]	2
PDO2 (rx)	0110	769-895	[1401]	3,4

## 4.9. PDO Mapping

The following Objects are mappable:

Name	Index	Subindex	Direction
Error Register	1001H	-	Transmit
Write State 1	6220H	1...n	Receive
Write State 8	6200H	1...n	Receive
Write State 16	6300H	1...n	Receive
Dummy Mapping Boolean	0001H	-	Receive
Dummy Mapping Integer8	0002H	-	Receive
Dummy Mapping Integer16	0003H	-	Receive
Dummy Mapping Integer32	0004H	-	Receive
Dummy Mapping Unsigned8	0005H	-	Receive
Dummy Mapping Unsigned16	0006H	-	Receive
Dummy Mapping Unsigned32	0007H	-	Receive

The SI unit completely supports variable PDO Mapping.

This means that data in a RecPDO can be freely assigned to the Outputs. The SI unit can manage up to 64 separated Objects per PDO.

### ***Example of PDO Mapping (SI unit Default Mapping)***

Given: The SI unit has the Node ID 1.

A PDO having two data bytes as content is to be received; the first data byte is to be given to the first output byte and the second data byte to the second output byte.

The PDO to be received and processed by the SI unit has the COB ID 300 and is to be managed in the SI unit as PDO1.

- 1) The Object Indx entry [1400,01] contains the COB ID of the RecPDO1 as variable parameter. By default, the COB ID = 513(dec.) when the Node ID = 1 (see Table Predefined Master/Slave Connection Set for PDOs, p. 17)  
There one writes, per SDO access (using COB ID 1537, see SDOs, p.19), the COB ID of the PDOs to be received, namely 300.
- 2) In mapped Objects of the RecPDO1 are found in Object Index entry [1600], with sub indices 01 and 02. The Adreses of both Output bytes of the SI unit must be written in here:  
[1600,01] > 62000108 (i.e. Index 6200, Sub 01, data length 08 bits)  
[1600,02] > 62000208 (i.e. Index 6200, Sub 02, data length 08 bits).  
This gives the information as to where the SI unit should write the data coming in via the PDO.
- 3) It is obvious that the above order can also be inverted, so that the first byte of the PDO can be written to the second Output byte of the SI unit. Furthermore, it is possible to mix the arrangement of bits, bytes and word lengths freely, both in the configuration of a PDO and in its resolution in the SI unit. Here the maximum data field size of 8 bytes per PDO must be observed.

#### 4.10. Service Data Objects, SDOs

The SI unit supports 4 parallel SDO Servers.

The Default SDO compiles with the Predefined Connection Set (see CiA DS 301 V3.0 , section 8.4.1 , p. 8-11ff).

Object	COB-ID	CMS priority group
SDO (tx)	1409 - 1535	6
SDO (rx)	1537 - 1663	6,7

*Example: SDO (rx) COB-ID = 1537 - 1 + Node ID*

The Default SDO Parameter is found in Object 1200H in the Object Index. Further SDOs are inactivate by default, but can be parameterized and activated via Objects 1201H...1203H.

### 5. Settings

#### 5.1. Address Setting (Node ID)

The SI unit addresses are set with the help of the two hexadecimal rotary switches.

**Attention:** Each address can only be allocated once in the network. "0" is not allowed as an address, as "0"-addressed messages communicate with all Nodes.

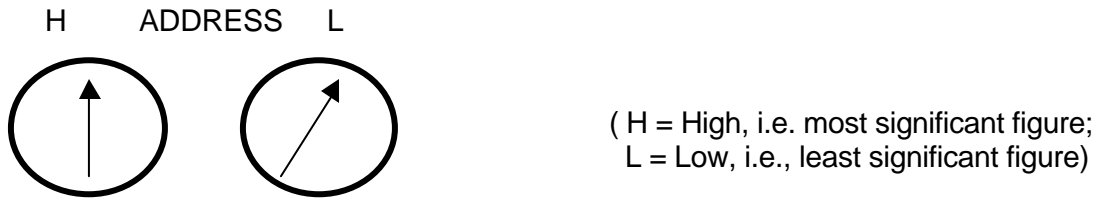
If, after Power On Init, the Nodes could find themselves in Pre-operational state (CANopen), then the Node Addresses must lie in the range of 1...127.

The Predefined Master/Slave Connection Set is only defined for Node IDs in the range of 1...127.

The Node Addresses can, however, be set up to 255.

If the Node is given an address in the range of 128...255, after Power On Init the Node will be in the CAL state „Connecting”, and will expect the Extended NMT Slave Boot-up .

### 5.1.1. **Setting the Node addresses by rotary switch**



The two rotary switches code the address in hexadecimal.

(Example: Node-ID 10 decimal → set H to “1”, L to “0”)

A change of address via the rotary switches is only acknowledged by electronics after a new start-up (Power On Init), and is then first stored in the internal EEPROM.

### 5.1.2. **Setting the Node addresses via Software (SDO access)**

The Configure Module ID Protocol (LMT cs=17) is not supported by the SI unit.

## 5.2. Baudrate

### 5.2.1. Setting of the baudrate using the rotary switch

#### a) Resetting of the Default baudrate (125 kBit/s)

Should an SI unit be set at an unknown baudrate (transfer rate), the Default baudrate of 125 kbits/s can easily be re-set as follows:

1. Without any voltage applied, set Node ID 00h (H=0, L=0).
2. Apply voltage to the SI unit. The Bit Timing values will be set to the Default baudrate of 125 kBits/s and will be stored in the serial EEPROM. Successful storage of the Default baud-rate will be indicated by a **5 second long** blinking of the "BUS"-LED (blink frequency 2 Hz). After this, the "BUS"-LED shines orange.
3. Next disconnect the SI unit +24VDC supply voltage, set the correct Node ID and reapply supply voltage. As an alternative procedure, the correct Node ID can be set during 5-second red blinking of the "BUS"-LED. After this, the module is again ready for operation.

#### b) Setting the CiA-specified Baudrate

1. Without any voltage applied, set Node ID 00h.
2. Apply voltage to the SI unit: a **5 second** blinking of the red "BUS"-LED will follow (blink frequency 2 Hz).
3. During this 5 second long blinking, the Node ID must be set to the value **F0h** to enable the baudrate to be programmed.
4. As soon as the blinking of the red "BUS"-LED stops, a time **10 seconds** is available for resetting the baudrate Index to a value between **0 and 8** as per the table below using the low value Node ID switch (Marked „L“)  
The rotary switch will have a value of between F0h and F8h at the end of the 10 second period.

*Standard CiA Bit Timing Table (CiA DS 102, section 6.4, p.4)*

Index	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
Baudrate (kBit/sec)	1000	800	500	250	125	100	50	20	10

5. The red "BUS"-LED will indicate successful transfer of the baudrate set by blinking (blink frequency 1 Hz). 0 to 8 blinks occur, according to the Index set.

6. The end of the programming is indicated by a **5 second long** rapid blinking of the red "BUS"-LED (blink frequency 5 Hz). The "BUS"-LED then shines orange.

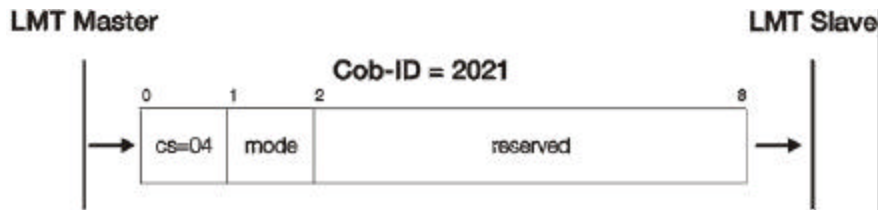
7. Remove the SI unit voltage, set correct Node ID, then restore the control voltage. Alternatively, the correct Node ID can be set while the red "BUS"-LED blinks for 5 seconds. The module is then ready for operation.

**5.2.2. Setting the baudrate via Software**

(see CiA DS 205-2 , section. 5)

**1. Switch Mode Global**

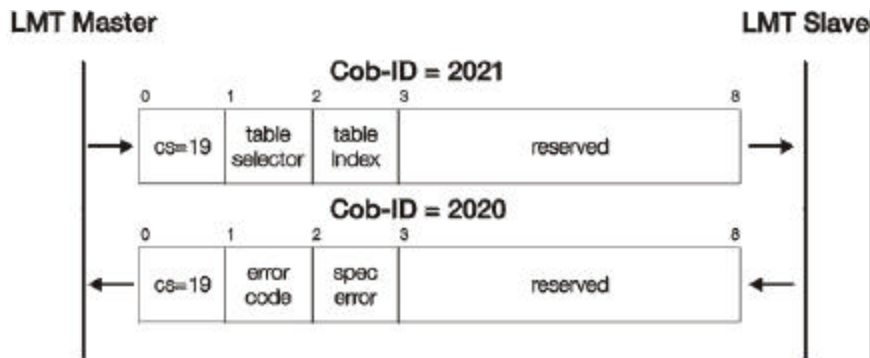
The Node must first be switched to the "Configuration Mode".



cs: LMT command specifier  
 mode: 0 = Operation Mode  
       1 = Configuration Mode

**2. Configure Bit Timing Parameters**

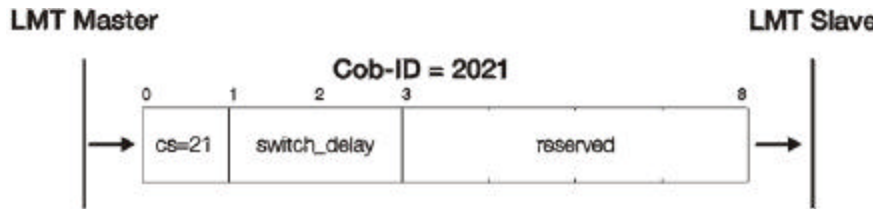
The LMT service "Configure Bit Timing Parameters" is used to change the baudrate via SDO access.



cs: LMT command specifier  
 table\_selector: Selects the appropriate Bit Timing Table  
                   0 = Standard CiA Bit Timing Table (see setting by rotary switch)  
 table\_index: Selects the desired Bit Timing from the Table  
                   selected above (see setting by rotary switch)  
 error\_code: 0 = successfully completed  
               1 = Bit Timing not supported  
               2...254 = reserved  
               255 = implementation error

### 3. Activate Bit Timing Parameters

Activation of the changed Parameter.



cs: LMT command specifier  
 switch\_delay: 0 (this Parameter has no function)

## 6. Installation

Installation of - and maintenance on - the SI unit and the pneumatic valves must only be done by qualified control- and automation technicians!

For the installation of CANopen systems, SMC recommend the use of the VDE (Society of German Engineers - or local equivalent) recommendations covering low-branching transmission systems (e.g., VDE0113 Part 1 or EN60204 Part 1).

Both the power- and the compressed air supply must be switched off before installation or maintenance work on the SI valve manifold.

All connectors must be connected before starting up the system.

The valve block (max. 16 single solenoids or 8 double solenoids) has been pre-wired by SMC.

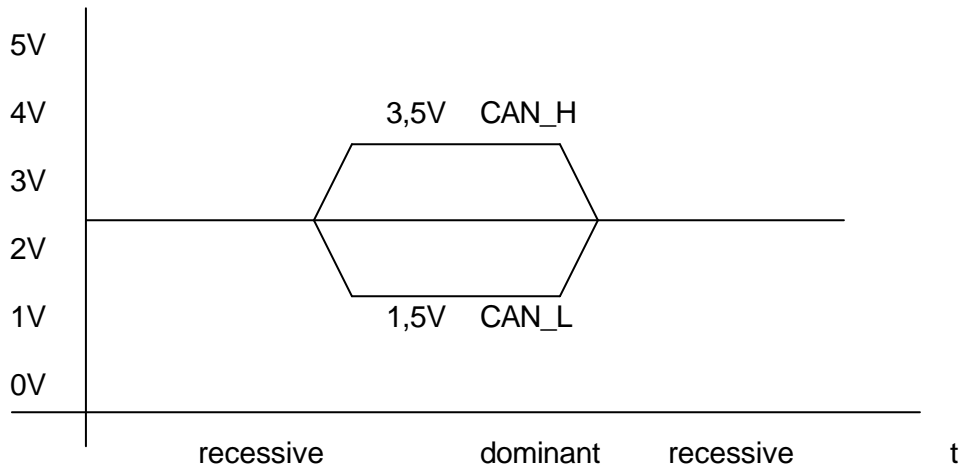
### 6.1. Network connection

For pin assignment of the 9 pin D Sub connector according to CiA norms, see section 3.1.2

The physical layer (Layer 2) is described in ISO Standard 11898 (CAN Standard)

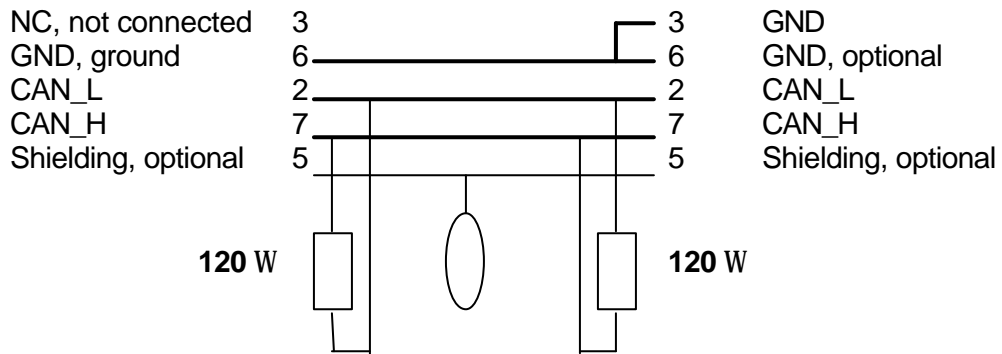
The connection to the network (CAN bus) is done via a 9 pin D sub connector (acc. to CiA Recommendation DS 102) plugged into the equipment. Further Nodes should be connected by tees and very short stub lines (<0.3m).

Nominal bus voltage level according to ISO11898:



**Example of wiring (simple termination and shielding concept,  $R_t = 120\Omega$ ):**

NMT Manager, e.g., PC (9 pin D Sub connector)	Pin	Pin	EX12#-SCA1 (9 pin D Sub connector)
--	-----	-----	---------------------------------------

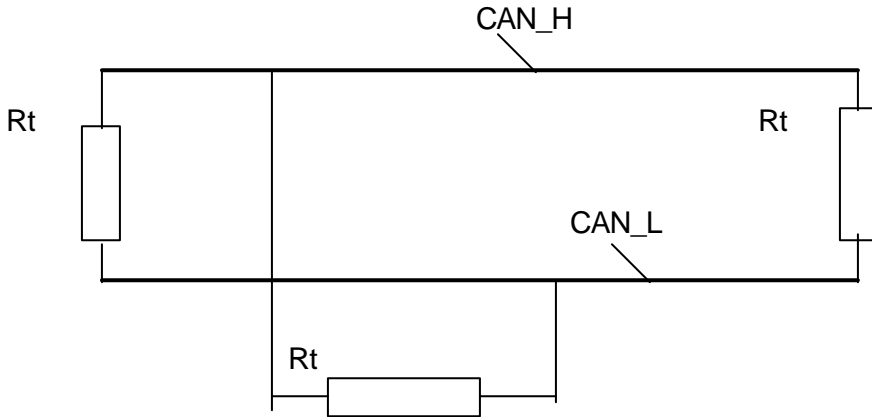


Notes:

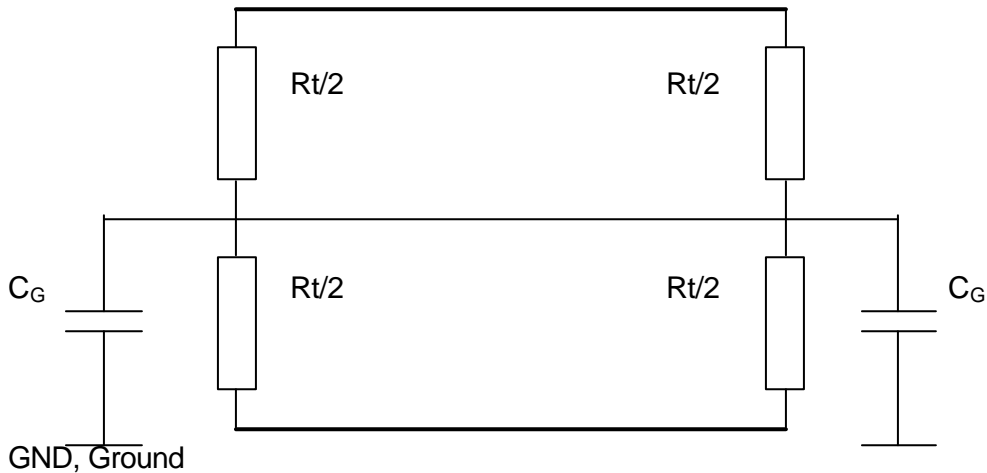
- 2 x 120 $\Omega$ , 1%, 0.25W resistors, one at each end, integrated into the respective D Sub housing as bus terminating resistors (important when using long lines and high baudrates).
- Do not connect the cable shielding or pin 5 to either GND or optional GND.
- Connect pins 3 and 6 only on the SI unit side, not on the PC side.

Following alternative concepts (see [6]):

Concept of multiple termination (here  $R_t = 180\Omega$ ):



Concept of split terminating resistors ( $R_t/2 = 62\Omega$ ,  $C_G = 10\text{nF} \sim 100\text{nF}$ ):



The main feature of these termination variants is that the Common Mode Signal between the terminating resistors can be used. In the ideal case where the Common Mode Signal is a constant voltage, this middle connection can be connected to the Ground using a condenser  $C_G$  of 10nF to 100nF capacitance.

If the terminating resistors are within a Node, the Ground is connected to the Connector Ground. This solution optimizes the system properties, especially in the higher frequency range. For the lower and middle frequency range, only one of the two split terminating resistors should be connected to Ground (see [6] for further recommendations).

Which of the above concepts is the most suitable depends on your application, the local external interference and the demands made on the transmission system.

Refer to the CAN system literature in the appendix for further options.

## 6.2. Network cable

see section 3.2: Technical data, CANopen

- Transmission medium: superimposed, twisted 2-wire cable with terminating resistors.
- RS485 can be used, but only the version conforming to CAN Standard: ISO DIN 11898

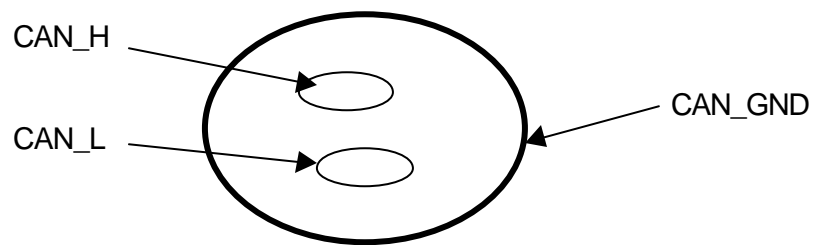
## 6.3. Terminating resistance

see 3.2 Technical data, CANopen

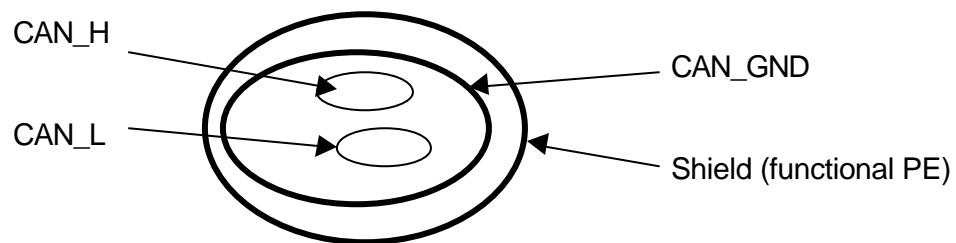
- 120  $\Omega$  at both ends of a line topology to prevent signal reflections when using high baudrates (max. 1 Mbit/s) and relatively long lines.

## 6.4. Shielding concepts for the bus line

### Simply-shielded cable



### Double-shielded cable



## 7. Programming

The address (Node ID) is set using two rotary switches (H and L) on the front cover of the SI unit. An address may only be used once in the network. The SI unit must be switched off before being connected to the CAN bus, the power supply and the valve manifold.

On being switched ON, the SI unit automatically sends an EMCY Telegram. The Telegram ID is 129dec. = 81hex. and its length is 0, as is its data content. Check the baudrate set in your CAN network (see section 5.2).

To initialise or start the SI valve manifold, a so-called START-REMOTE NODE Telegram must be generated and sent.

### First Step, example of Telegram for Node ID = 1:

-Initialisation, Start:

**Identifier=0; Data length=2 byte; byte0=1; byte1 = 1 (for Node ID = 1)**

On correct initialization, the red ERR LED of the SI unit goes off.

In order to be able to control the valves of an SI unit, a CANopen Telegram must be sent via the network to the SI unit. The Default setting of the SI unit is: **Identifier = 512 + Node ID, Node setting** Node ID=1 generates an Identifier of ID = 513dec. or 201hex., which must be set in the Telegram.

To control, for example, the first valve (single solenoid, 1 bit) immediately next to the SI unit using CANopen, a Telegram must be sent to the valve manifold containing the following content:

**Identifier=513dec; data length=2 byte; byte0 =1; byte1=0 (for Node ID = 1)**

Additionally, a RESET Telegram can be generated if required:

- Reset:

**Identifier=0; data length=2 Byte; byte0=130dec.=82hex.; byte1 = 1 (for Node ID=1)**

The red ERR LED lights up after a RESET Telegram.

After initialisation, individual valves can be switched on and off by generating the appropriate Telegrams.

Check both the description of the NMT Master used and its Software before programming.

## **7.1. Commands for default parameter „Save“ and default parameter „Restore“**

Parameter changes made by SDO access are only stored volatilyly.  
All changes made by the user are replaced by new Default values at the next Reset communication, Reset Node or Power On Boot-up.

With the SI unit it is possible, by command, to store the communication and/or application parameter permanently (i.e., non-volatilyly).

This is done by means of the Store Parameter Command (object 1010H Sub 1..3).

The command is carried out when one writes the entry:

Data content 0x65766173 (“save”)

in one of the sub-entries:

- 1010H Sub 1 saves all parameters.
  - 1010H Sub 2 saves all variable communication parameters.
  - 1010H Sub 3 saves all variable module parameters.
- (see CiA DS 301 V3.0 , section 10.3 , p 10-23ff).

Under certain conditions after many changes, the memory can become over loaded.  
To resolve this situation, the SI unit supports the Restore Default Parameter Command (object 1011H Sub 1..3).

Data content for the command: 0x64616F6C. (“load”)

The detailing of the Sub entries is as for the Store Command.

After the Store Default Parameter Command, a Reset Node must be given, followed by a Store Parameters Command to store the Default values.  
(see CiA DS 301 V3.0 , section 10.3 , p 10-25ff)

## **7.2. Error Handling**

### **7.2.1. Emergency Frames**

The COB IDs of the EMCY Telegrams originate in the Predefined Master/Slave Connection Set: 129 – 1 + NodeID

See also 3.3 *Diagnosis via the network* .

(CiA DS 301 V3.0 , section. 7.3 , p 7-3ff)

### **7.2.2. Node Guarding**

Node Guarding makes it possible to give a Network Manager information concerning the status of the CAN Nodes without „Event“ information. As a counter-effect, the CAN network participants are informed whether their network manager is still working normally and whether the network is still functioning securely.

With this guarding mechanism the NMT Master checks whether the Nodes are active (with the help of the Watchdog Timer).

Node Guarding is inactive in the Default state.

The objects required for activation and parameterization contain „0“ or the Default ID.

[100c] = Guard Time (in ms)

[100d] = Lifetime Factor (max. number of repeat attempts before Error status).

[100e] = Guard ID (from the Predefined Master/Slave Connection Set: 1793–1+NodeID)

On completion of parameterizing, Guarding becomes active after the first Remote Transmit Request (Guarding RTR) to the CAN Nodes.

After receiving the Telegram containing the RTR bit from the Network Manager, the Nodes in operational status must answer with the data content 5 within the set time (Lifetime x Time Factor). On the next request, the module must answer with data content 133 (8bit is toggled with an offset of 5). Thereafter it must answer with 5 again, and so on.

If the node is in the Pre-operational state, the data content of the reply telegrams varies to and to between 127 and 255 (8bit is toggled with offset 127).

If, within the preset time, no requests are received from the Network Manager, the SI unit switches to Error status; the configured Fault Output States are outputted.

If Guarding is again activated, the module independently exits the Error State (see CiA DS 301 V3.0 , section 9 , S. 9-1f)

### **7.2.3. Boot-Up Message**

After an Initialisation (Reset Communication, Reset Node or Power On Boot-up) a Boot-up Message is sent. This Message is an Emergency Frame without data field. Under certain conditions (e.g., voltage fluctuations in the power supply), the Network Manager may not be informed of a short-term trip out of a module. This could happen if the trip-out and the Initialisation of the module were to occur between two Guarding Frames, the module was previously in the Pre-Operational state and, lastly, the Toggle bit was 1.

Through the forced transmission of this Telegram after a Reset or an Initialisation, the Network Manager is informed of the situation.

### **7.2.4. Fault Mode / Fault State**

In the case of an Error (Error in Node Guarding Protocol), the Output states are parameterized using SDOs.

The object Index inputs used are:

- |                         |   |   |
|-------------------------|---|---|
| [6206,01] ... [6206,01] | – | for byte-wise parameterization of the Mode on Error   |
| [6207,01] ... [6207,01] | – | for byte-wise parameterization of Output on Error     |
| [6250,01] ... [6250,10] | – | for byte-wise parameterization of the Mode on Error   |
| [6260,01] ... [6260,10] | – | for byte-wise parameterization of the Output on Error |
| [6306,01]               | – | for word-wise parameterization of the Mode on Error   |
| [6307,01]               | – | for word-wise parameterization of the Output on Error |

Mode: Will the output adopt a programmed Error status (Value=1) or will its status be frozen (Value=0) ?

Output: Output High on Error (Value=1) or Low on Error (Value=0) ?

## 8. Appendix

### 8.1 Glossary

**Note:** *The descriptions given below are for general information and are tailored to the functionality of the SI unit. More exact definitions can be obtained from the CAL and CANopen specifications and recommendations.*

#### Terminating resistance ( $R_t$ )

This is the resistance at the end of a line, its purpose being both to avoid interference through signal reflection and line-matching. Terminating resistors must always be the last element in the line. See CiA DS 102, Section 6.3.3 : 120  $\Omega$  between CAN\_L and CAN\_H.

#### Baudrate / Bit Timing

The baudrate is the data transmission rate: 1 baud = 1bit/s. The baudrate is the result obtained from an actual Bit Timing over a fixed time period (usually 1s). (Bit Timing: parameter of a bit to be transmitted).

#### CAL

**CAN Application Layer.** From CiA as DS-201...-207 standardized Level 7 Protocol.  
DS: CiA Draft Standard

#### CAN

**Controller Area Network**

#### CANopen

A Profile family, based on CAL, for rapid data exchange.  
The Communication Profile has been standardized by CiA as DS 301.

#### CiA-CAN

**CAN in Automation e.V.** CAN bus manufacturers 'and users' organization.  
International Headquarters  
Am Weichselgarten 26  
D – 91058 Erlangen, Germany  
Telephone: +49-9131-601091  
Telefax: +49-9131-601092  
e-mail: [headquarters@can-cia.de](mailto:headquarters@can-cia.de)  
Internet: <http://www.can-cia.de>

#### CMS

**CAN based Message Specification.** One of the services of the Application Layer in CAN Reference Model. See Priority.

#### COB

**Communication Object.** A message in the CAN Network. All messages in CAN are transmitted using COBs.

### COB ID

**COB Identifier.** CAN message Identifier. To date, CANopen uses only Identifiers according to CAN Spec2.0A. These have a value range of from 0 to 2301. The COB ID determines the COB priority in the bus line.

### Communication Cycle Period

See SYNC.

### DBT

**Distributor.** Distribution authority in the network which assigns CAN Identifiers to the PDOs and SDOs.

In almost all CANopen networks the DBT is not necessary.

DBTs are typically used to assign COB IDs during the project phase.

When it is necessary to change the COB IDs relative to those held in the Predefined Master/Slave Connection Set, the settings are changed via SDOs using a configuration tool or the Configuration Master.

### EDS- and DCF-File

**EDS = Electronic Data Sheet.** This file contains the Default Settings of the CAN Nodes and gives information concerning the hardware capability. EDS is read-only.

EDS describes a CAN device from a particular manufacturer.

The name of the EDS-File for EX12#-SCA1 is: „SMC\_EX12.EDS“.

**DCF = Device Configuration File.** Corresponds to the EDS, but contains additionally - after a software-based reconfiguration (e.g., PDO Mapping, other COB IDs, Node Guarding, Fault Outputs,...) - user-set CAN Node parameters which deviate from the Defaults.

EDS and DCF are pure text files and simplify the configuration of a CAN device. Simply put, EDS corresponds to a form which has not been filled out (from manufacturer) and DCF to a form which has been filled out (user).

DCF describes a real, existing and configured device in an actual CANopen Network.

### Inhibit Time

Time within which another PDO may not be sent.

This function is not supported by the SI unit.

### Mapping

Mechanism for assigning variables to PDOs.

The SI unit supports variable PDO Mapping.

### NMT

**Network Management.** Every CANopen Network requires an NMT Master, which has - amongst others - the task of starting all Nodes and guarding the Nodes (Node Guarding).

### OD (Object Dictionary)

This is mainly an Index containing all objects of a device which can be addressed via CAN. Each CANopen device must have its own OD.

Access is obtained by addressing the objects as a 16 bit Index (e.g., Node ID >[100B]).

An object can either be a simple variable or, e.g., an array.

The elements of an array are addressed via an 8 bit subindex (e.g., [1800,01]).

The first element has the subindex 00, and always discloses the number of array elements.

### PDO

Process Data Object, a CAN message for transmitting process data.

### Priority

CAN defines the priority of a message by its Message Identifier. The highest priority is 0, the lowest 2031.

CAL and CANopen reserve a row of Identifiers and allocate the rest to priority classes 0 to 7 (CMS Priority Level):

CMS-level	ID range	Message/object
0	(ID 1 - 220)	Emergency (Error)
1	(ID 221 - 440)	Timing (SYNC, TIME) , further reserved IDs
2	(ID 441 - 660)	synchronous PDOs
3	(ID 661 - 880)	asynchronous PDOs
4	(ID 881 - 1100)	asynchronous PDOs
5	(ID 1101 - 1320)	asynchronous PDOs
6	(ID 1321 - 1540)	SDOs
7	(ID 1541 - 1760)	reserved (amongst others, for SDOs)

The CMS level of the PDOs of the SI unit Default=3 , no change or alteration is allowed.

### SDO

Service Data Object. Object for a point to point communication with access to the Object Index of a CAN participant. It is a confirmed service.

### CSMA/CA (Carrier Sense Multiple Access / Collision Arbitration)

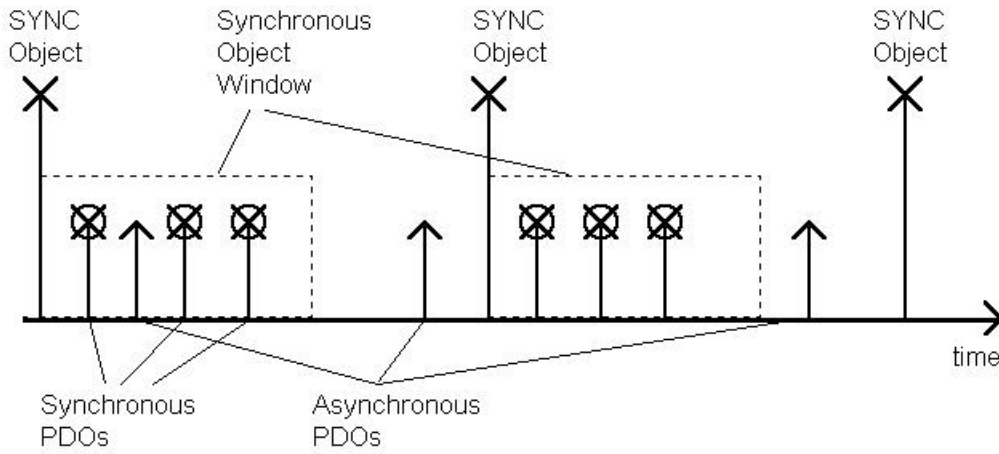
A process to avoid collision of messages between masters.

### SYNC

The SYNC Object is a message which is periodically sent from a station. With its help, device data having a time-duration distance can be transmitted. PDOs which react to the messages carry the Attribute Transmission Type synchronous (see Transmission Type).

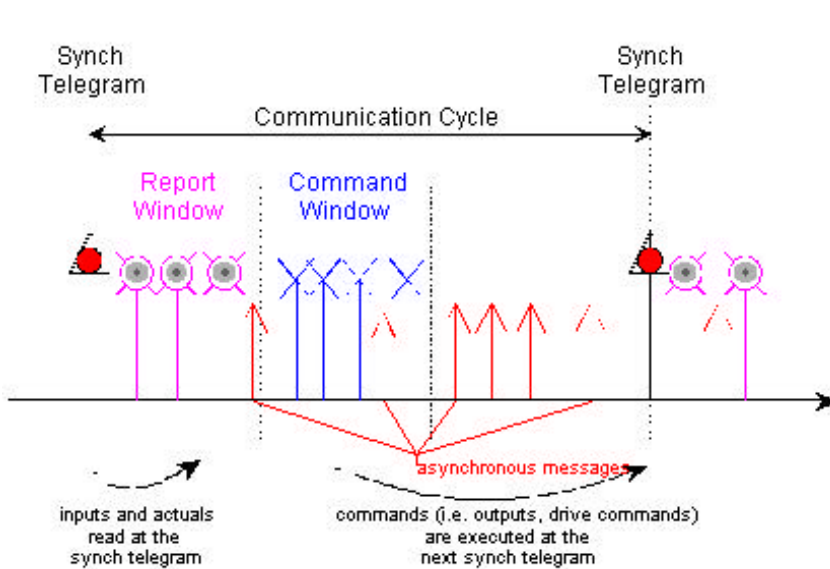
The figure below illustrates the relationships:

### Communication Cycle Period



(See CiA DS 301 V3.0 , section 5.2, p 5-5f)

The division into Report Window and Command Window can be seen in the figure below:



### Bus synchronisation

(See CiA DS 301 V3.0 , section. 6.1, p 6-1ff)  
*Synchronous Window Length*  
 See SYNC

OTP  
 One time programmable memory

### Transmission Type (TransType)

Transmission behavior of a PDO. CANopen defines a series of different Transmission Types. The SI unit supports the following:

- 1) TransType 0 = acyclic, synchronous (sync).  
The PDO is sent acyclically. It must then, however, be triggered by the global SYNC Impulse.
- 2) TransType 1 = cyclic, synchronous (cyclic)  
The PDO is sent cyclically in correlation with the global SYNC Impulse. This means that the PDO is sent even when there has been no change to an Object in the device profile.
- 3) TransType 253 = without notification (remote request).  
The PDO is only sent on request by Remote Transmission Request. Here one must differentiate between synchronous and asynchronous. This concerns the validation of the values. In the synchronous mode, the PDO is executed at the time by a SYNC Impulse, while in the asynchronous mode it is executed when there is a change in the value.
- 4) TransType 255 = asynchronous, according to device profile (event driven).  
The PDO is sent if there is a change to an Object in the device Profile. In simple terms, this means that when a mapped Input changes, a PDO is sent (and only then). This Transmission Type should always be used when no synchronization (of, e.g., device axes) is required. This avoids unnecessary bus traffic without any loss of information.

## ***8.2 Literature References***

- [1] DIN ISO 11898  
Controller Area Network                      Beuth Verlag, Berlin, Germany
  
- [2] CiA DS 102  
Physical Layer Recommendation      CiA, Erlangen, Germany
  
- [3] AN 96116  
Philips Application Note                      Hamburg, Germany
  
- [4] Prof. Etschberger  
CAN    Hanser-Verlag, Munich, Germany
  
- [5] Prof. Lawrenz  
CAN    Hüthig-Verlag, Heidelberg, Germany
  
- [6] Special publication of the  
technical journal:  
Elektronik-Praxis  
Controller Area Network  
Vogel-Verlag, Germany                      Hartwig Müller
  
- [7] Special publication  
1998 CAN Solutions                              Miller Freeman

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## 8.4 NOTES