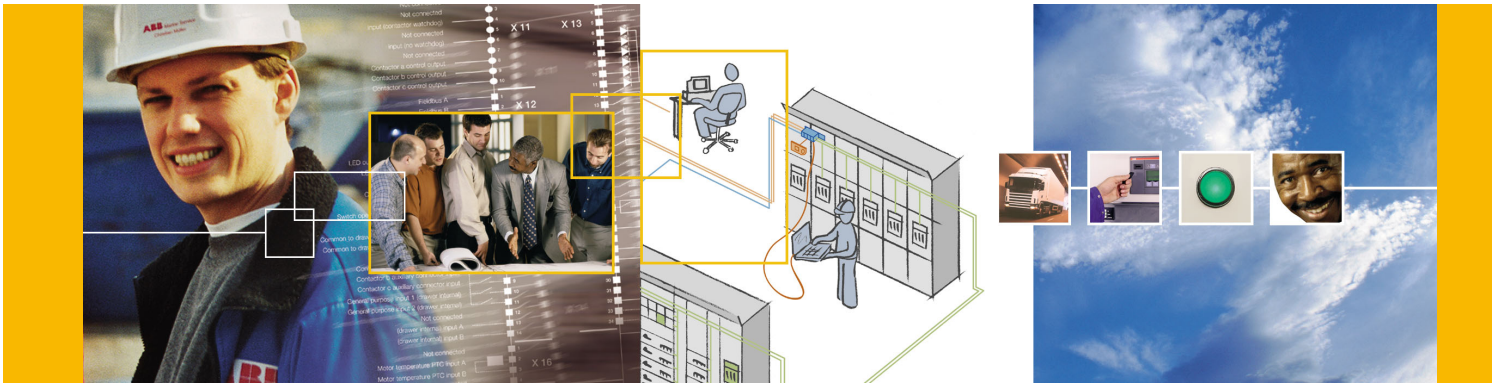
Protect^{IT} – MNS Motor Management INSUM®

Network Management Guide
Version 2.3



INSUM®
Network Management Guide

Version 2.3

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Reference document 1TGB 350010 R1.5

INSUM®
Network Management Guide
SW Version 2.3

Notes:

1 General

1.1 Objective

Although LON allows a quite free addressing scheme, the addresses of the INSUM system are restricted. These restrictions are described in the following paper. The purpose of these limitations is achieving a user friendly easy to use system that gives minimum impact of LON knowledge to the user. Using a fixed addressing scheme gives many benefits that are not available in standard LON applications as:

- Installing new nodes without need of any network management tool
- Assigning subnet / node addresses direct from MMI by selecting from scrollbar
- Indication of free node addresses for new devices
- Indication of node addresses already used
- Automatic detection of new devices and inserting to life list
- Supervision of existing nodes and alarm indication in case of removing
- No download of bindings needed for standard applications
- Installing new devices by simply pressing a push button on MMI

1.2 Related Documentation

1TGC 901007 B0201 INSUM Technical Information
1TGC 901021 M0201 INSUM MCU Users Guide
1TGC 901026 M0201 INSUM MCU Parameter Description
1TGC 901034 M0201 INSUM MMI Operating Instruction
1TGC 901030 M0201 INSUM MMI Quick Guide
1TGC 901042 M0201 INSUM Modbus Gateway Manual
1TGC 901052 M0201 INSUM Profibus Gateway Manual
1TGC 901060 M0201 INSUM Ethernet Gateway Manual
1TGC 901080 M0201 INSUM System Clock Manual
1TGC 901090 M0201 INSUM Control Access Guide
1TGC 901091 M0201 INSUM Failsafe Guide
1TGC 901092 M0201 INSUM Dual Redundancy Guide
SACE RH 0080 Rev.I PR112/ PD-L LON Works Interface V2.0
1SEP 407948 P0001 Users Manual Intelligent Tier Switch (ITS)

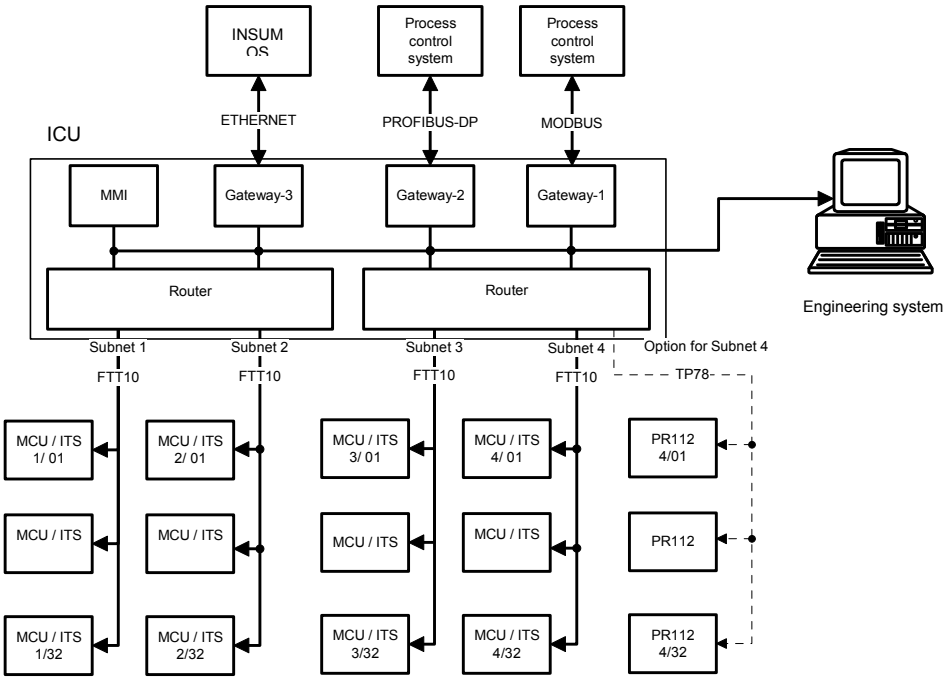
Notes:

2 Structure of the INSUM system

2.1 System structure

The standard INSUM system may handle up to 128 field devices and 16 ICU (SU)- devices. This is the absolute maximum amount of devices.

Any violation to this may lead to unpredictable behavior of the whole system.
The MMI will indicate this on the display giving the chance to remove supernumerous devices.



Picture 1. INSUM system structure

2.2 Address ranges

INSUM uses the following addressing scheme as default

- Subnet_01 : Motor starters & ITS, with node address range from 1 to 32
- Subnet_02 : Motor starters & ITS, with node address range from 1 to 32
- Subnet_03 : Motor starters & ITS, with node address range from 1 to 32
- Subnet_04 : Motor starters , ITS or CB ** with node address range from 1 to 32
- Subnet_99 : 9 spare devices Motor starters , ITS or CB ** with node address range from 90 to 99
- Subnet_05 : SU devices (MMI, GW, Router, ...) with node address range from 1 to 100

** Restrictions see following page

Notes:

Table 1. INSUM address map

Device	Subnet / node 1250 kBit/s	Subnet / node 78 kBit/s
MMI	5 / 20..29	--
MODBUS GW	5 / 10..13	--
PROFIBUS GW L1/2	5 / 16	--
PROFIBUS GW L3/4	5 / 17	--
TCP/IP GW	5 / 35..39	--
OS	5 / 30 ..34	--
System Clock	5 / 05	--
Other SU devices	5 / 40	--
Router L1/2	5 / 1 , 5 / 2	1/ 100 , 2 / 100
Router L3/4	5 / 3 , 5 / 4	3/ 100 , 4 / 100
MCU 1/2	--	1..4 / 1 ..32
ITS	--	1..4 / 1 ..32
CB**	--	4 / 1 ..32
Spare 'online' devices	--	99 / 90 ..98
MCU factory setting	--	99 / 99

**** Restrictions :**

PR112 circuit breaker uses XP (bus topology) transceiver instead of FTT10 (free topology) for communication link. Due to this physical differences devices cannot be mixed and a complete bus line must be reserved for PR112 CB's.

Support of PR112 CB's is given by using a special Router for line 3 / 4 (Ordering number 1TGB3 02001 R 3413).

Attention: In this case line 4 is reserved for PR112 CB's and cannot be used for Motor starters or ITS.

Notes:

3 Network Installation

3.1 Installing new field devices

New MCU devices are delivered with factory setting of subnet / node address “99 / 99“. The use of this address outside the normal range allows that new devices can be inserted into the system without getting in conflict with existing addresses. After inserting a new node, the operator should first assign a valid address to the device. This can be done by selecting on the MMI <MAIN MENU> the submenu <SYSTEM INSTALLATION>. With the decoder wheel, an address that is indicated as “FREE” can be selected. After pressing the “INSTALL” button, the user is requested to press the service pin of the appropriate device. If the device is used as online spare part, the address can be set to a “parking” position in subnet 99. Only ten devices are foreseen as online spare part. The user should make sure that the total amount of field devices including subnet 99 devices will not exceed the maximum number of 128.

Assigning addresses to ITS and PR112 is done in the same manner. Attention has to be paid on restrictions mentioned on page 6.

For details with regard to PR 112 and ITS see the following documents:

- PR112 SACE 601933/001 and RH0080 j
- ITS 1SEP 407948 P0001

3.2 Loading default bindings

Next installation step is activating the “Default Bindings“ selecting the device from the list in the <SYSTEM INSTALLATION> menu and pressing the button “DEFAULT” on MMI. This will set the MCU bindings to their default value. After this, the MCU is ready for use in the INSUM system. All information is now passed to MMI, OS and Gateways.

Note:
PR112 circuit breaker releases with firmware V2.00 onwards also support the INSUM default bindings.
PR112 circuit breaker releases with earlier versions (e.g. V1.02) do not support the default bindings as shown above. For those devices binding must be downloaded in conventional way using a network management tool. Based on the INSUM system structure the same binding can be used for all CB's independent of the assigned address.

3.3 Setting MMI / Gateway address and bindings

Setting the MMI / Gateway address and loading the Default binding set is done in the same way as for field devices. Within this menu you may even change the MMI address of it’s own. Just select the new address from list pressing the “INSTALL” button and after request pressing the service pin.

3.4 Find a device with wink command

For verify the address setting and also just to find the location of the MCU you can send a “WINK” command to the selected MCU by pressing the “WINK” button in the <SYSTEM INSTALLATION> menu.

3.5 Trouble shooting while installation

Inserting already configured devices may result in having two devices with the same LON address on the bus. This will lead to instable monitoring of status, alarms and other measured values. To find such devices the "Wink" command can be send to suspicious devices. If more then one device reacts on the wink command, an address conflict is pending. To solve see chapter 3.1.
Incorrect binding may also cause strange system behavior as partly or complete missing data of devices. When measured values are indicated as 'Not updated' on MMI its good practice to initiate the default binding again.

Notes:

4 System related functions and parameters

4.1 Data Transmission

Basic concept inside LON is the event driven data transmission. This lead to the disadvantage that newly inserted monitoring devices (as MMI) cannot report information of devices until the information has changed. To overcome this drawback all INSUM devices supports so called heartbeats that upgrades information in a background task even if data has not changed.
Furthermore, the monitoring of heartbeat data allows creating lifelist in monitoring (MMI) and control (Gateway) devices. All related timers can be adjusted in the system group of device parameters.

4.1.1 MCU

The most important information inside the INSUM system is the motor status. For this reason the motor status has it's own heartbeat timer "*status heartbeat*" that is adjustable from 1 /s to 1 /60s in steps of 1s.
All other data (alarms and measured values) are upgraded according a second timer "*nv heartbeat base*" that's also adjustable from 1 /s to 1 /60s in steps of 1s.
All network variables inside this group are updated in time slots defined as multiples of the "*nv heartbeat base"* . The time slots are defined as 4xT, 12xT and 72T.

Time slot	Data updated
4xT	Actual CA1
	Alarm
	Current report
12xT	Voltage report
	Rotation report
	Power report
72xT	Operation counter CCc
	Operation counter CCa
	Operation counter CCb
	Motor run hours
	Event
	Thermal capacity
	GPI1 feedback
	GPI2 feedback
	GPO1 feedback
	GPO2 feedback
	Configuration CRC
	Time to trip
	Time to reset

Background update cycle defined by NV heartbeat base (T) parameter

Note:
The settings of the heartbeat timers have significant influence on the network load. The load on the 1.25 Mbit net should not exceed 200 - 250 p/s in normal operation in order to have reserve for additional events. Maximum sustained load is about 500 p/s and peak load is about 700 p/s. Due to the nature of the LON bus the collision rate increases with the number of p/s. Therefore, it's good practice to keep the background load as low as possible. Beside the settings of the heartbeat timers, the number of devices connected to the system has deep influence to the busload.

Notes:

Rough calculation is possible with following formula:

$TBL = N_D$ x D-p/s with TBL = Total busload (mean value without events)
N_D = number of devices connected to the bus
D-p/s = number of packets send per node and second

D-p/s= (1 / status heartbeat value) + (1 / nv heartbeat base)

To allow the INSUM system to be plug and play the background status heartbeat is used to recognize newly inserted MCU's and at the same time to supervise the presence of the MCU's.

4.1.2 ITS

Similar to MCU ITS provides a status and nv heartbeat that can be configured from MMI in the system settings menu. The settings apply to the same restrictions as for the MCU's.

4.1.3 PR112

With PR112 firmware version 2.0 onwards all measured and counter values are supported by background heartbeats. Those can be found in the <System> menu of the INSUM MMI:

- Status heartbeat 1…60s
- Counters heartbeat 0…60s
- Current heartbeat 0…60s
- I trip heartbeat 0…60s
- CA heartbeat 0…60s

Note:
With earlier PR112 firmware versions (e.g. V1.02) not all measured values of PR112 are updated with nv heartbeat base. So for newly inserted devices some measured values are indicated as ' Not updated ' until the first time a change in the value happened.

4.2 Supervision of INSUM devices

4.2.1 Field devices

For supervising the presence of INSUM devices, a special procedure is implemented in all Gateways and MMI.
With parameter ' field device timeout ' a time window can be set that's common for all field devices. As long as a field device sends as least one status update within the time window, the device and the communication link will be recognized as fully operational. If there is no update within this time period, the device will be indicated as removed (broken bus links leads to same indication). Newly inserted devices will be automatically recognized also temporary removed modules.
To avoid wrong indications the setting for ' field device timeout' parameter should be at least 3 times the status heartbeat.

Field device timeout = 3 x status heartbeat value

Its good practice to set the status heartbeat of all field devices to the same value. In addition, the field device timeout of all Gateways and MMI should be the same.

4.2.2 Gateways

Similar to the field devices a supervision of all SU devices is implemented. For this purpose all Gateways supports a periodically updated network variable ' SU-Lifesign heartbeat '. The update rate of this variable can be configured in the system settings menu of the appropriate SU devices.
This 'Lifesigns' are monitored by all other SU devices. If the 'Lifesign' of one device is not updated within a selectable timeout, the device will be removed from the lifelist. The timeout variable ' SU-Lifesign timeout ' can also be configured in the system settings menu of the appropriate devices.

Notes:

5 Failsafe

5.1 Failsafe philosophy

In the INSUM systems, all devices are interfaced with serial busses. Failure in the bus connections are caused by short circuit, open links or defects in the bus interface of the device. In case the communication bus fails, control of all devices is lost. Although the protection functionality of the INSUM devices is not influenced by communication loss – all device provide completely stand alone protection – it's no longer possible to run a secure process and therefore the system must be brought into a safe state. While incoming feeders (PR112) and switch fuses will remain in the same status it's important for the process that the motors are active driven into a safe state. For this reason Failsafe functionality is only applicable for MCU's. The safe state for a motor depends from the needs of the process and may be different for each motor. Safe states for motors are defined as follows:

- Stop of a running drive
- start of a drive
- start of a drive in reverse direction
- remain in actual state (NOP)

This Failsafe modes can be parameterized individual for each MCU. In case of ' Failsafe ' the MCU will run the motors according to this predefined state.

5.2 Failsafe implementation

The dedicated fail-safe master (mostly the Gateway connected to the PLC) generates cyclically broadcast messages to all connected devices. The update cycle of this message can be set by parameter Failsafe heartbeat in the system parameter section of the appropriate Gateway. This messages resets internal timers in the MCU's. In case of communication loss these timers expires and the MCU's will run the motors into the predefined state. The timeout can be set individually for each MCU (parameter Failsafe timeout) but it's good practice to set all MCU's to the same value. The relationship between Failsafe heartbeat in Gateway and Failsafe timeout in MCU's should be at least :

Failsafe timeout = 3 x Failsafe heartbeat **
(Higher factors than 3 are recommended)

**A too restricted setting of the fail-safe timeout may cause an unwanted shut down of the motors in case of short communication losses due to EMI .

Particularities:

- The PROFIBUS Gateway supports only 48 motor starters (two lines 24 MCU's each). For a fully equipped system 2 Gateways are necessary. In this case each Gateway only sends Failsafe commands to its related MCU's.
- After power on the Failsafe functionality is not active until MCU first receives a Failsafe update from the Gateway.
- The link to PLC is supervised by the Gateway by similar algorithm. A timeout can be set by parameter.
- In redundant configurations the use of Failsafe is not recommended.
- Failsafe supervision in MCU is not active when set to LOCAL.
- If an Ethernet Gateway is used for PLC communication the failsafe handling with multiple Ethernet clients has to be clarified prior to PLC implementation.

Notes:

6 Control Access

For details please refer to INSUM Control Access Guide.

6.1 CA Philosophy

The unique structure of the INSUM system allows several instances (Gateways, MMI, OS, local control) for controlling motor starters in parallel and at the same time. Nevertheless, for a particular motor control should be only possible from one instance at a given time. These access rights are normally handled outside the system by external means. INSUM offers a build-in arbitration of control – the so-called Control Access (CA). Without activating CA all Su devices (Gateway, MMI,OS) have the same rights. With CA a hierarchy between the controlling devices can be implemented by parameter settings. With this Parameter a priority level from 2..13 is assigned to each SU device.

CA offers following aspects:

- Control of each MCU can be distributed to any SU device separately
- At any given time a MCU can be controlled only from one SU device (CAOwner)
- Su device with higher priority may pass control rights (CAPass) to a device with lower priority
- Su device with higher priority may withdraw control rights from device with lower priority at any time
- To withdraw CA the device with higher priority makes a CAPass to itself
- CAPass to devices with higher priority are not possible
- MCU accepts only CAPass to devices that are marked as active in the SU-LifeList
- If the device that actual controls the MCU is removed from SU-LifeList Ca is released from MCU
- The CAOwner can release CA in MCU by passing CAPass =0x0000

6.2 Restrictions

- MMI, OS, MODBUS Gateway and Ethernet Gateway are supporting CA on control level
- PROFIBUS Gateway does not support CA
- MCU and PR112 are supporting CA on field device level
- ITS does not support CA (device allows only manual operation)
- MMI and OS support in addition CARequest algorithm

6.3 Set-up of CA in INSUM

6.3.1 Defining the priority of ICU (SU) devices

First step in set-up is defining the ranking of SU devices in the system:

Priority	Device	Dom/Subnet/Node
1	Local Hardware (always highest priority = fixed)	--
2	SU device with highest priority (GW)	0/___/___
3	SU device with 2nd highest priority (GW)	0/___/___
4	SU device with 3rd highest priority (GW)	0/___/___
5	"	0/___/___
6	"	0/___/___
7	"	0/___/___
8	"	0/___/___
9	"	0/___/___
10	"	0/___/___
11	"	0/___/___
12	"	0/___/___
13	"	0/___/___
14	Local Software(lowest priority = fixed)	--
15	nc	--
16	CA in use (Bit internally used by Gateways)	--

Notes:

6.3.2 Set-up of MCU / PR112 Parameters

The following parameters are to be set:

- CA in use = Yes
- Set-up of address list according to 6.3.1 (only addresses which are in use must be set)
- Lifelist timeout
- PR112 V2.0: CA heartbeat

Remark: although individual settings are possible it is recommended to establish the same settings for all MCUs/ PR112 !!

6.3.3 Set-up of ICU (SU) Device Parameters

The following parameters are to be set:

- Assign priority according to 6.3.1
- Key in CA username (for indication on MMI)
- Set SU-Lifelist heartbeat
- Set SU-Lifesign heartbeat
- Set SU-Lifesign timeout (= 3 x SU-Lifesign send time)

Note: Only the Su device with highest priority sends SU-Lifelist by broadcast to all MCU's. If this device fails the SU device with the 2nd high priority automatically takes over the functionality and so on..

6.3.4 Controlling devices by CAPass

For passing CA a CAPass message must be send containing the bit pattern assigned to the new CAOwner (according the table –only one bit is set at time)

Priority	Code hex
1	--
2	0x0002
3	0x0004
4	0x0008
5	0x0010
6	0x0020
7	0x0040
8	0x0080
9	0x0100
10	0x0200
11	0x0400
12	0x0800
13	0x1000
14	0x2000
15	--
16	--
Release	***0x0000***

In order to get back control a SU-device (with higher priority than the actual CAOwner) may send a CA-Pass to its own priority level.

Notes:

Annex A - INSUM Terms and Abbreviations

Abbreviation	Term	Explanation / Comments
	Alarm	Alarm is defined as status transition from any state to abnormal state. Status transition to abnormal state can be data crossing over the predefined alarm limit.
	Backplane	INSUM backbone, holds following INSUM devices: Router, Gateways, Clock, Power Supply. Part of the INSUM Communication Unit, see ICU
CA	Control Access	A function of INSUM system that allows definition of operating privileges for each device level (e.g. PCS, Gateway, field device)
CAT	Control Access Table	Table containing control access privileges
CB	Circuit Breaker	Circuit breaker unit (here: ABB SACE Emax with electronic release PR112-PD/LON)
CT	Current Transformer	Current Transformer
DCS	Distributed Control System	see also PCS
Eth	Ethernet	Ethernet is a local area network (LAN) technology. The Ethernet standard specifies the physical medium, access control rules and the message frames.
	Event	An event is a status transition from one state to another. It can be defined as alarm, if the state is defined as abnormal or as warning as a pre-alarm state.
FD	Field Device	Term for devices connected to the LON fieldbus (e.g. motor control units or circuit breaker protection)
FU	Field Unit	see Field Device
GPI	General Purpose Input	Digital input on MCU for general use
GPO	General Purpose Output	Digital output on MCU for general use
GPS	Global Positioning System	System to detect local position, universal time and time zone, GPS technology provides accurate time to a system
GW	Gateway	A Gateway is used as an interface between LON protocol in INSUM and other communication protocols (e.g. TCP/IP, PROFIBUS, MODBUS)
HMI	Human Machine Interface	Generic expression for switchgear level communication interfaces to field devices, either switchboard mounted or hand held
ICU	INSUM Communications Unit	INSUM Communications Units consists of devices such as backplane, Gateways, routers, system clock and power supply. It provides the communication interface within INSUM and between INSUM and control systems. Formerly used expressions: SGC, SU
INSUM	INSUM	Integrated System for User optimized Motor Management. The concept of INSUM is to provide a platform for integration of smart components, apparatus and software tools for engineering and operation of the motor control switchgear
INSUM OS	INSUM Operator Station	Tool to parameterize, monitor and control devices in the INSUM system
ITS	Integrated Tier Switch	The Intelligent Tier Switch is an ABB SlimLine switch fuse with integrated sensors and microprocessor based electronics for measurement and surveillance
LON	Local Operating Network	LON is used as an abbreviation for LonWorks network. A variation of LON is used as a switchgear bus in the INSUM 2 system
LonTalk	LonTalk protocol	Fieldbus communication protocol used in LonWorks networks

Notes:

Abbreviation	Term	Explanation / Comments
LonWorks	LonWorks network	A communication network built using LonWorks network technology, including e.g. Neuron chip and LonTalk protocol
MCU	Motor Control Unit	Motor Control Unit is a common name for a product range of electronic motor controller devices (field device) in INSUM. A MCU is located in a MNS motor starter, where its main tasks are protection, control and monitoring of motor and the related motor starter equipment.
MMI	Man Machine Interface	The switchgear level INSUM HMI device to parameterize and control communication and field devices.
MNS	MNS	ABB Modular Low Voltage Switchgear
	MODBUS, MODBUS RTU	Fieldbus communication protocol
NV,nv	LON Network Variable	Network variable is a data item in LonTalk protocol application containing max. 31 bytes of data.
Nvi, nvi	LON Network Variable input	LON bus input variable
Nvo, nvo	LON Network Variable output	LON bus output variable
OS	Operator Station	see INSUM OS
PCS	Process Control System	High level process control system
PLC	Programmable Local Controller	Low level control unit
PR	Programmable Release	Circuit breaker protection/release unit (here: ABB SACE Emax PR112-PD/LON)
	PROFIBUS DP	Fieldbus communication protocol with cyclic data transfer
	PROFIBUS DP-V1	Fieldbus communication protocol, extension of PROFIBUS DP allowing a-cyclic data transfer and multi master.
PTB	Physikalisch-Technische Bundesanstalt	Authorized body in Germany to approve Ex-e applications.
PTC	Positive Temperature Coefficient	A temperature sensitive resistor used to detect high motor temperature and to trip the motor if an alarm level is reached.
RCU	Remote Control Unit	Locally installed control device for motor starter, interacting directly with starter passing MCU for local operations.
	Router	Connection device in the LON network to interconnect different LON subnets. Part of the INSUM Communications Unit.
RTC	Real Time Clock	Part of the INSUM System Clock and optionally time master of the INSUM system
SCADA	Supervisory Control and Data Acquisition	
SGC	Switchgear Controller	Former term used for INSUM Communications Unit
SU	Switchgear Unit	Former term used for INSUM Communications Unit
	System Clock	INSUM device providing time synchronization between a time master and all MCUs. Part of the INSUM Communication Unit, see ICU
TCP/IP	Transmission Control Protocol /Internet Protocol	TCP/IP is a high-level, connection oriented, reliable, full duplex communication protocol developed for integration of the heterogenous systems.
TFLC	Thermal Full Load Current	See MCU Parameter Description for explanation
TOL	Thermal Overload	See MCU Parameter Description for explanation
	Trip	A consequence of an alarm activated or an external trip command from another device to stop the motor or trip the circuit breaker.

Notes:

Abbreviation	Term	Explanation / Comments
UTC	Coordinated Universal Time	Coordinated Universal Time is the international time standard, formerly referred to as Greenwich Meridian Time (GMT). Zero (0) hours UTC is midnight in Greenwich England, which lies on the zero longitudinal meridian. Universal time is based on a 24 hours clock.
VU	Voltage Unit	Voltage measurement and power supply unit for MCU 2
	Wink	The Wink function enables identification of a device on the LON network. When a device receives a Wink-message via the fieldbus, it responds with a visual indication (flashing LED)

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