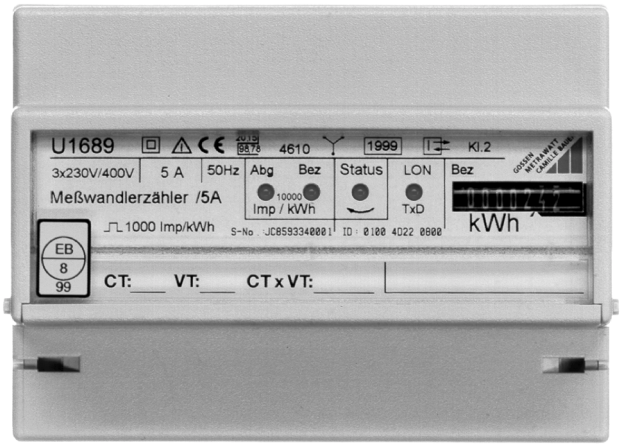
U1681 ... U1689 with LON Bus and U3681 ... U3689
Electric Meters for Active Energy

3-348-862-03
8/5.01

- Acquisition of active energy even in distorted networks
- Remote pulse transmission
  for energy import and export (S0 compatible)
- Remote transmission of meter readings,
  instantaneous power and error conditions via LON interface
- For use in household, industrial and light industrial applications
- Class 1 or class 2 certifiable, PTB certification,
  certifiable for energy import
- Direct connection or via transducer (identifier)
- Import energy display with 7 place drum type counter mechanism
  with reverse direction inhibitor
- LED display for energy import and export
- LED display for incorrect phase sequence and phase failure



LONWORKS®

Additional Features for LON Version (U1681 ... U1689)

- Data transmission via LON interface
  with FTT-10A transceiver and LONTALK® protocol
- Variables for imported energy (= drum type counter),
  exported energy, instantaneous power, error codes
- LED display for transmitted data packets

Applicable Regulations and Standards

DIN EN 50081-2	EMC Interference Emission
DIN EN 50082-2	EMC Interference Immunity
DIN VDE 0470-1 / EN 60529	Protection types through housing (IP Code)
DIN 43 856	Electric meters, tariff switching clocks and ripple-control receivers
DIN 43 864	Current interface for pulse transmission between pulse meters and tariff devices
IEC 68-2	Basic environmental test procedures
EC 255-4	High-frequency disturbance test
IEC 1036 / EN 61036 / VDE 0418 Part 7	Alternating current static watt hour-meters for active energy (classes 1 and 2)

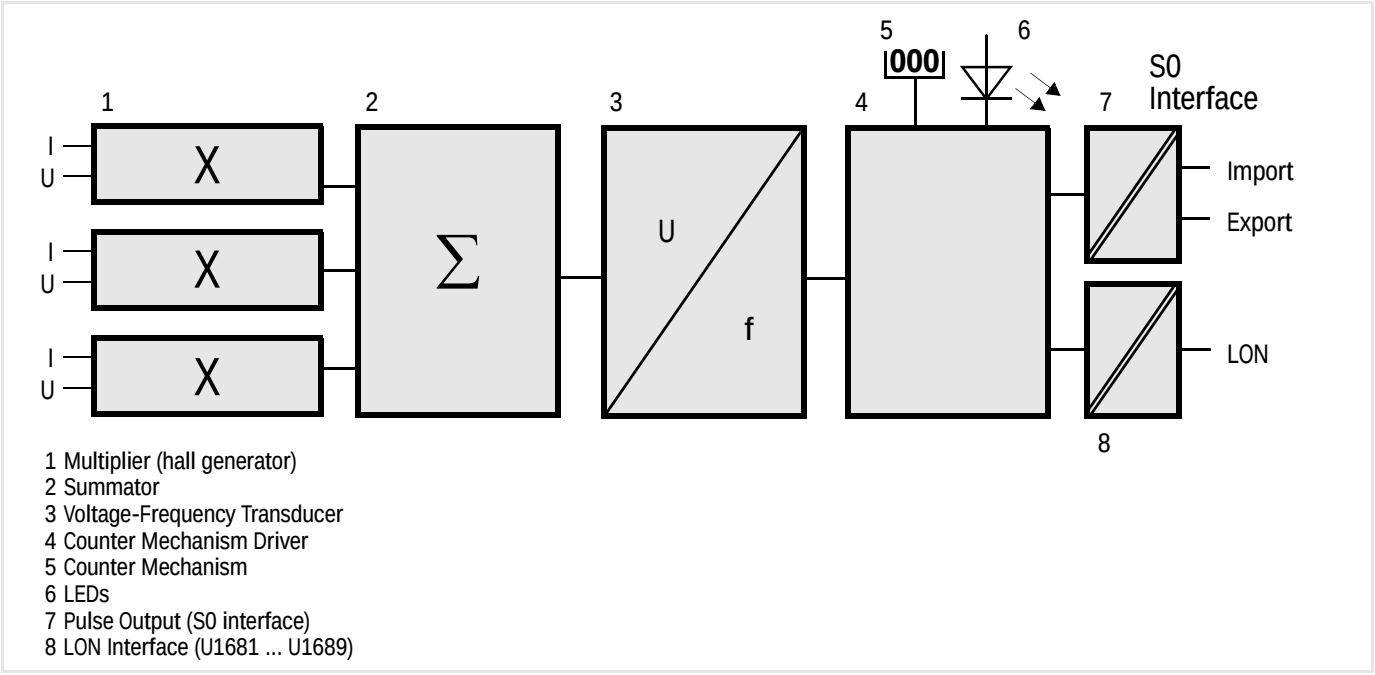
Applications

The electronic electric meter registers energy consumption in alternating and three-phase current systems. Its compact, rugged design allows for universal implementation in industrial systems, at construction sites, in the office, at leisure facilities and in the household. The meter can be mounted in any position on a top-hat rail per EN 50 022, or fastened to the wall with screws.

Installation of the electric meter directly at the load component provides for targeted monitoring of energy costs. If necessary the meter can be certified for third party billing. The potential-free pulse outputs for energy import and export allow for remote transmission of meter readings as well as for use in automatic billing systems or for peak load optimization.

Separate meter readings for energy import and export, current installed load and error conditions such as incorrect phase sequence or phase failure can all be directly queried from one evaluation system via the LON bus. Interconnection of several physically separated meters is easily accomplished with a 2-wire cable, which substantially reduces wiring efforts as compared to solutions using pulse outputs.

U1681 ... U1689 with LON Bus and U3681 ... U3689
Electric Meters for Active Energy



1 Multiplier (hall generator)
2 Summator
3 Voltage-Frequency Transducer
4 Counter Mechanism Driver
5 Counter Mechanism
6 LEDs
7 Pulse Output (S0 interface)
8 LON Interface (U1681 ... U1689)

Fig. 1 Block Diagram

Description

Electric meters based on the Hall generator principle are especially well suited for measurements in highly distorted low-voltage systems. Furthermore, the meters are also suited for all applications which previously fell into the domain of Ferraris meters or AC coupled static energy metering systems.

Especially good frequency response substantially expands applications possibilities for distorted networks.

Block Diagram (example: U1689), see figure 1:

Active power is continuously ascertained based on input voltages and input currents in the 3 Hall generators (1).

Power fractions are summed (2) and fed to a voltage-frequency transducer (3).

The output frequency is directly proportional to the power ratio at the primary side. The power-proportional pulse sequence is then fed to a counter mechanism (5), as well as to the corresponding import or export LED (6), and the appropriate optocoupler (7).

The optocoupler output signal is potential-free and is in compliance with the S0 standard per DIN 43 864.

A LON interface (8) is provided for bus compatible transmission of measurement values.

Symbols and their Meanings

Symbol	Meaning
CT	Current Transformer Transformation Ratio (Current Transfer)
CT × VT	CT Factor x VT Factor
f	Frequency
I	Effective Value, Current
I_B	Nominal Current (Basic Current)
I_{max}	Maximum current
U	Effective Value, Voltage
U_r	Input Voltage Rated Value
VT	Voltage Transformer Transformation Ratio (Voltage Transfer)
X	Multiplier (Hall Generator)

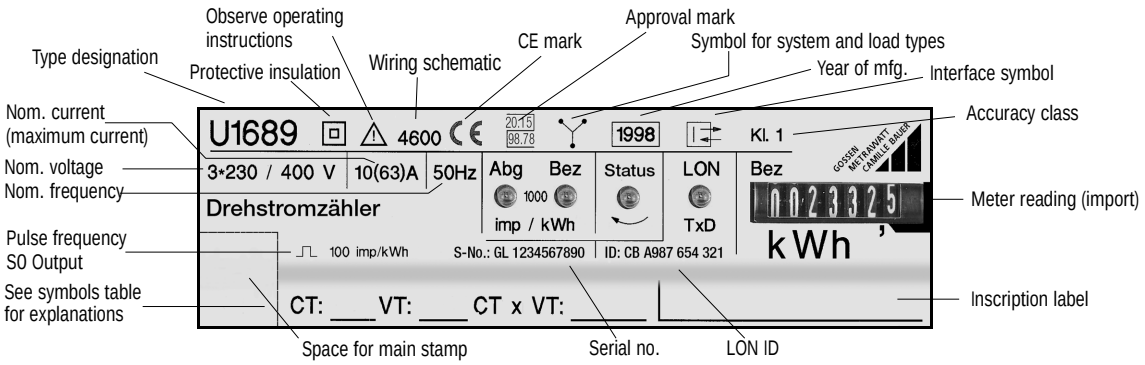


Fig. 2 Serial Plate Printing

Technical Data

Measuring Ranges

Voltages		
See Order Information		
Allowable Deviation	+ 15% / – 20%	

Currents		
Direct Reading I_B	10 A	
Starting Current	Class 2: 0.5 % I_B	Class 1: 0.4 % I_B
Direct Reading I_{max}	63 A	
Current Transformer I_B	5 A or 1 A	
Starting Current	Class 2: 0.3 % I_B	Class 1: 0.2 % I_B
Current Transformer I_{max}	6 A or 2 A	

Frequency Range	
Nominal Frequency	50 Hz
Maximum Frequency	45 Hz ... 55 Hz

Accuracy Class	
Standard	1 or 2 per IEC 1036, depending upon features

Overload Capacity

All Counters	unlimited 1.15 U_r and I_{max}
Direct Connection	5 times 3 s U_r and 100 A (interval: 5 min)
Direct Connection	1 times 1 s U_r and 250 A
Connection via CT	0.5 s 20 x I_{max}

Pulse Output

The electric meters are equipped with a pulse output as standard equipment, see figure 3. The pulse output is electrically isolated from the measuring circuit via optocoupler.

Electrical Values

Pulse Generator Const., Direct	100 pulses / kWh	
Pulse Generator Constants, Current Transformer Meters	1,000 pulses / kWh 2,000 pulses / kWh	I_B = 5 A I_B = 1 A
Pulse Duration	100 ms + 50%	
Interpulse Period	> 50 ms	
U_{ext}	max. 40 V	
Switched Current	max. 27 mA	

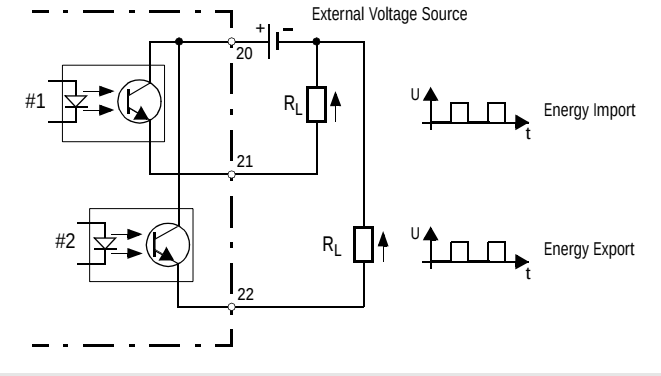


Fig. 3 Pulse Output

LON Interface

Access Procedure	CSMA / CA
Network Protocol	LONTALK®
Transmission Medium	Echelon FTT-10A transceiver, transformer coupled, reverse polarity protected, twisted 2-wire cable
Transmission Speed	78 kbit / s
Number of Nodes per Network	max. 32385
Number of Nodes per Segment	max. 64
Cable Lengths	max. 500 m with free wiring, single-end bus termination max. 2,700 m with bus-type wiring, double-end bus termination
Bus Termination	external
Terminals	screw terminals
Function Display	LED blinks for each transmitted packet
Data Preservation	meter reading, min. 10 years
Write Cycles	10000 system state variables (nci...) in the EEPROM at NEURON® chip

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Display

Counter Mechanism (secondary counter mechanism, kWh or kVarh)	
Direct Connection	sequence processor, 6+1 places
Connection via Current Transf.	sequence processor, 5+2 places

LED	Signals	
Abg	Export (Meter with direct connection)	red LED, 1000 pulses / kWh
Bez	Import (Meter with direct connection)	red LED, 1000 pulses / kWh
Abg	Export (Meter with connection via current transformer, 5 A)	red LED, 10000 pulses / kWh
Bez	Import (Meter with connection via current transformer, 5 A)	red LED, 10000 pulses / kWh
Abg	Export (Meter with connection via current transformer, 1 A)	red LED, 20000 pulses / kWh
Bez	Import (Meter with connection via current transformer, 1 A)	red LED, 20000 pulses / kWh
Status	Status (all meters)	red LED, pulses / counting mechanism step
	Phase failure (3 & 4-wire current system)	red LED
	Phase sequence error (4-wire current system)	red LED, approx. 1 pulse / s
LON	LON operation (only for U168X)	red LED
Anlauf	Start-up (only for U368X)	red LED

Auxiliary Voltage

All required auxiliary voltages are generated from meas. voltage.

Internal Losses

Voltage Circuit	
Two-Wire Meter	< 5 VA
Three and Four-Wire Meters	< 3 VA per phase

Current Circuit	
at I_{max}	< 1 VA
at I_B = 1 A	< 0.05 VA
at I_B = 5 A	< 0.5 VA
at I_B = 10 A	< 0.02 VA

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Potential Isolation

Nominal Insulation Voltage	
Inputs	AC 300 V
Outputs	DC 50 V

Insulation Test Voltage	
Input <-> Output/Housing	AC 4 kV
Output <-> Housing	500 V

Electrical Safety

Protection Class	II
Overvoltage Category	III IEC 1036
Allowable Contamination Level	2

Electromagnetic Compatibility

Electromagnetic Compatibility per IEC 1036	
Surge Voltage	6 kV, 1.2 / 50 ms 10+ / 10– surges (IEC 255-4)
Burst	2 kV (DIN EN 61000-4-4)
Electromagnetic Fields	10 V / m (ENV 50141)
Electrostatic Discharge	15 kV (DIN EN 61000-4-2)

Ambient Conditions

Nominal Operating Temperature	–10 ... +45 °C
Max. Operating Temperature	–20 ... +55 °C
Storage Temperature	–25 ... +70 °C
Relative Humidity	< 75%, annual average
Height	up to 2000 m

Mechanical Design

Housing		
Material	LEXAN polycarbonate per UL94 class V0	
Dimensions	height overall depth width	≤ 90 mm ≤ 75 mm 125.5 $^{+0,5}$ mm
Weight	< 0.5 kg	
Mounting	top-hat rail per DIN EN 50 022 or wall mount	
Protection	IP 51	

Terminals	
Input Current	≤ 16 mm^2 without connector sleeve
Input Voltage	≤ 2,5 mm^2 with connector sleeve or ≤ 2 x 1,5 mm^2 without connector sleeve
SO Pulse Output / LON	≤ 2,5 mm^2 with connector sleeve or ≤ 2 x 1,5 mm^2 without connector sleeve
Protection	IP 20

Dimensional Drawing / Mounting

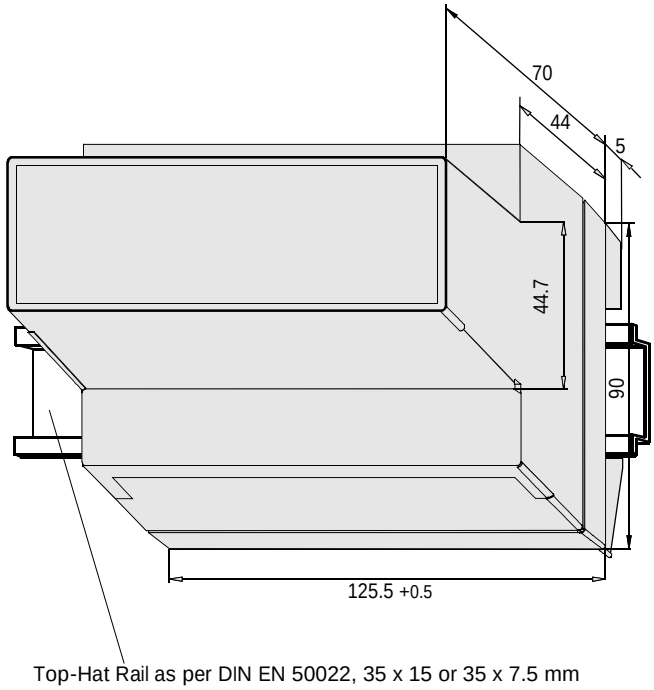


Fig. 4 Dimensional Drawing for Top-Hat Rail Mounting (front and side views)

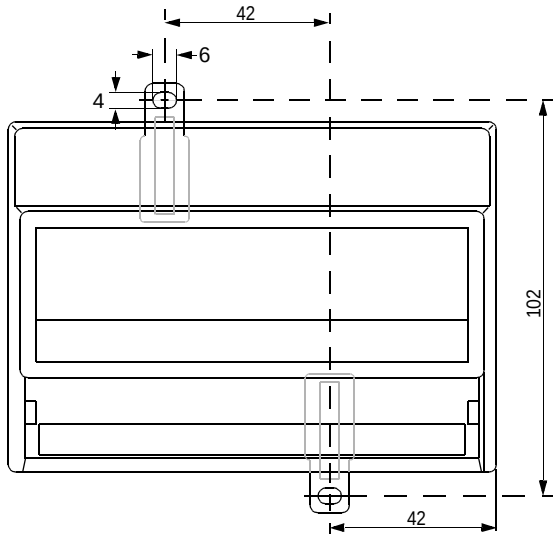


Fig. 5 Dimensional Drawing for Wall Mounting (front view)

Terminal Cover

A sealable terminal cover provides for contact protection.

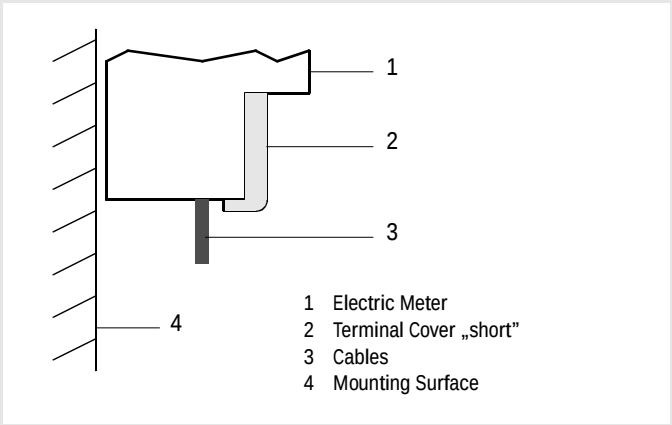


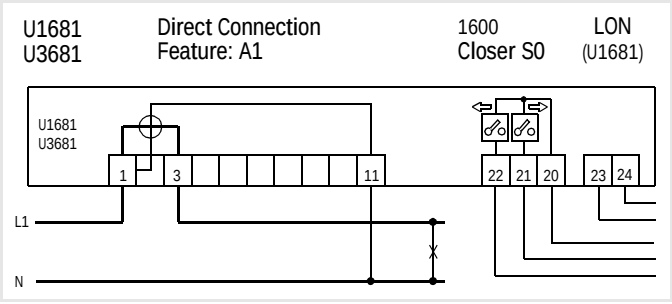
Fig. 6 Terminal Cover

Connector Pin Assignment

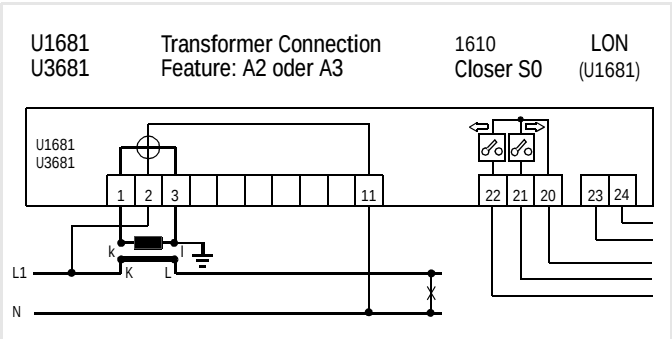
Connector elements are safety screw-terminals which are provided with a sealable terminal cover as standard equipment.

Electric Meter for Active Energy

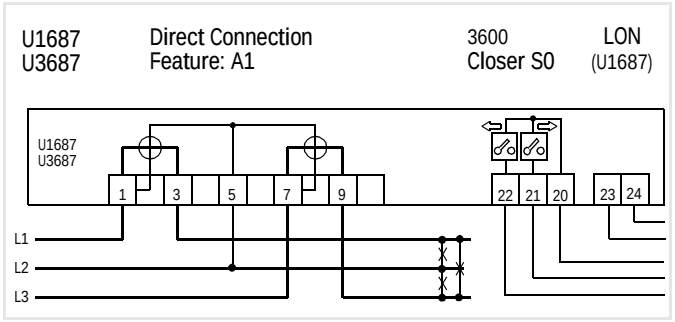
2-Wire Alternating Current System (without current transformer)



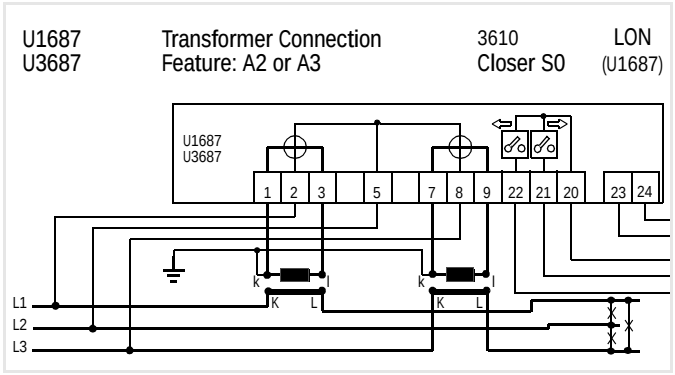
2-Wire Alternating Current System (with current transformer)



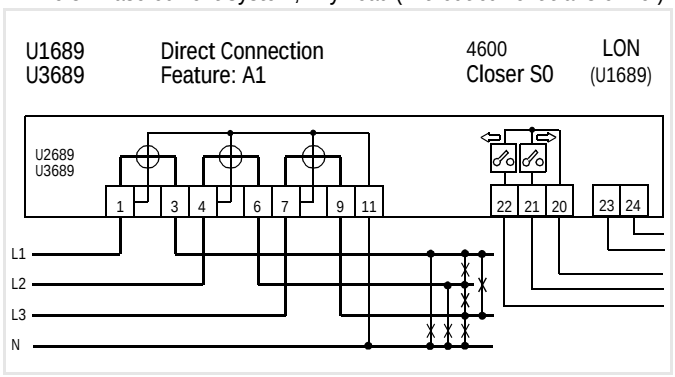
3-Wire 3-Phase Current System, Any Load (without current transformer)



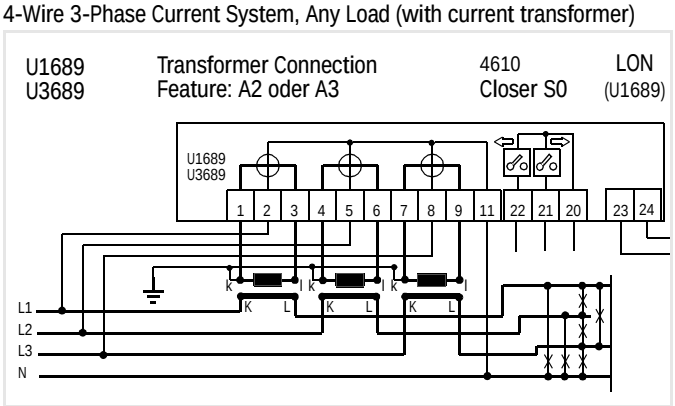
3-Wire 3-Phase Current System, Any Load (with current transformer)



4-Wire 3-Phase Current System, Any Load (without current transformer)



4-Wire 3-Phase Current System, Any Load (with current transformer)



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LON Network Variables

Nodes

nv#	Network Variable	Data Type	Comment
1	nviRequest	SNVT_obj_request	Status Query
2	nvoStatus	SNVT_obj_status	Status Message
3	nvo00NodeType	SNVT_str_asc	Device Type
4	nvo00Version	SNTV_count	Software Version
5	nvo00Date	SNVT_time_stamp	Manufacturing Date
6	nvo00Voltage	SNVT_volt	U_r
7	nvo00Current	SNVT_amp	I_b
8	nci00StsMaxSendT	SNVT_elapsed_tm	adjustable from 1 s ... 18 hr.

Electric Meter with Pulse Output

nv#	Network Variable	Data Type	Comment
9	nvo01EnergyInL	signed long whr	Energy Import in Wh
10	nvo01EnergyInF	SNVT_elec_whr_f	Energy Import in Wh
11	nvo01EnergyOutL	signed long whr	Energy Export in Wh
12	nvo01EnergyOutF	SNVT_elec_whr_f	Energy Export in Wh
13	nvo01PulseRate	SNVT_count	1 ... 20000 Pulses/kWh for Pulse Outputs
14	nvi01SetTime	SNVT_time_stamp	Time stamp triggers storage of meter readings
15	nvo01TimeStamp	SNVT_time_stamp	Time Stamp
16	nvo01EnergyInLp	signed long whr	Energy Import in Wh at Point in Time nvo01TimeStamp
17	nvo01EnergyInFp	SNVT_elec_whr_f	Energy Import in Wh at Point in Time nvo01TimeStamp
18	nvo01EnergyOutLp	signed long whr	Energy Export in Wh at Point in Time nvo01TimeStamp
19	nvo01EnergyOutFp	SNVT_elec_whr_f	Energy Export in Wh at Point in Time nvo01TimeStamp
20	nci01MaxSendT	SNVT_elapsed_tm	adjustable from 1 s ... 18 hr.
21	nci01MinSendT	SNVT_elapsed_tm	adjustable from 1 s ... 18 hr.
22	nci01MinDeltaF	signed long whr	adjustable derivation of meas. value from 1 Wh ... 1 MWh

Power Meter

nv#	Network Variable	Data Type	Comment
23	nvo02Power	SNVT_power_f	Instantaneous Power in W
24	nci02MaxSendT	SNVT_elapsed_tm	adjustable from 1 s ... 18 hr.
25	nci02MinSendT	SNVT_elapsed_tm	adjustable from 1 s ... 18 hr.
26	nci02MinDelta	SNVT_power_f	adjustable derivation of meas. value from 1 W ... 100 kW

signed long: 4 byte variable, corresponds to s32_type in Neuron-C

Default Settings upon Shipment from the Factory

Domain Index	Domain Size	Domain ID	Subnet	Node	Auth Key
0	1	00	1	1	FF FF FF FF FF FF
1	Unused				

Status

In response to the query nviRequest, a node sends its status (status and error bits) in network variable nvoStatus to the network. The following bits are used:

unsigned out_of_limits	becomes 1	where $P > P_{max}$
unsigned open_circuit	becomes 1	in case of phase failure
unsigned elektrical_fault	becomes 1	in case of incorrect phase sequencing
unsigned fail_self_test	becomes 1	in case of internal error

Transmission Conditions for Network Variables

The transmission status for a new value is determined by MaxSendTime, MinSendTime and MinDelta. A new value is not transmitted until deviation from the last value is equal to MinDelta, and a period equal to MinSendTime has elapsed. If no change occurs to a value, or if the change does not exceed the MinDelta threshold, it is transmitted after MaxSendTime.

Measurement Value Storage

If network value nvi01SetTime is transmitted to the meter, the meter stores its current meter readings together with a time stamp to permanent internal memory.

Download

The most up-to-date XIF file (1680.ZIP) is available from our website (http://www.gmc-instruments.com).

Order Information

Please note the preferred types in the price list.

Description		Identification				
Active Energy Electric Meter with LON Bus						
2-Wire System		U1681				
3-Wire System, Any Load			U1687			
4-Wire System, Any Load				U1689		
Connection						
Direct Connection 10 A (63 A) with Pulse Frequency Output	100 pulses / kWh	A1	A1	A1		
Transformer Connection / 5 A with Pulse Frequency Output	1000 pulses / kWh	A2	A2	A2		
Transformer Connection / 1 A (2 A) with Pulse Frequency Output	2000 pulses / kWh	A3	A3	A3		
Input Voltage						
Input Voltage Rated Value U_r (L1 – N for U1681, L1 – L2 for all other electric meters)	100 V		U3	U3		
	110 V		U4	U4		
	230 V	U5				
	400 V		U6	U6		
	500 V		U7	U7		
Accuracy Class						
	2	G0	G0	G0		
	1	G1	G1	G1		
Certification						
	none	P0	P0	P0		
	with	P1	P1	P1		

Description		Identification				
Active Energy Electric Meter						
2-Wire System		U3681				
3-Wire System, Any Load			U3687			
4-Wire System, Any Load				U3689		
Connection						
Direct Connection 10 A (63 A) with Pulse Frequency Output	100 pulses / kWh	A1	A1	A1		
Transformer Connection / 5 A with Pulse Frequency Output	1000 pulses / kWh	A2	A2	A2		
Transformer Connection / 1 A (2 A) with Pulse Frequency Output	2000 pulses / kWh	A3	A3	A3		
Input Voltage						
Input Voltage Rated Value U_r (L1 – N for U3681, L1 – L2 for all other electric meters)	100 V		U3	U3		
	110 V		U4	U4		
	230 V	U5				
	400 V		U6	U6		
	500 V		U7	U7		
Accuracy Class						
	2	G0	G0	G0		
	1	G1	G1	G1		
Certification						
	none	P0	P0	P0		
	with	P1	P1	P1		

Order Example: Active Energy Electric Meter with LON Bus, 3-Wire System, Any Load,
Transformer Connection /5 A 1000 pulses/kWh, Input Voltage 400 V, Accuracy Class 2, with Certification

Identification: U1687 A2 U6 G0 P1

Accessories

Feature	Identification
Door Mounting Kit (dimensional drawing incl.)	U270A

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Electric Meters for Active Energy

ECS Energy Control System

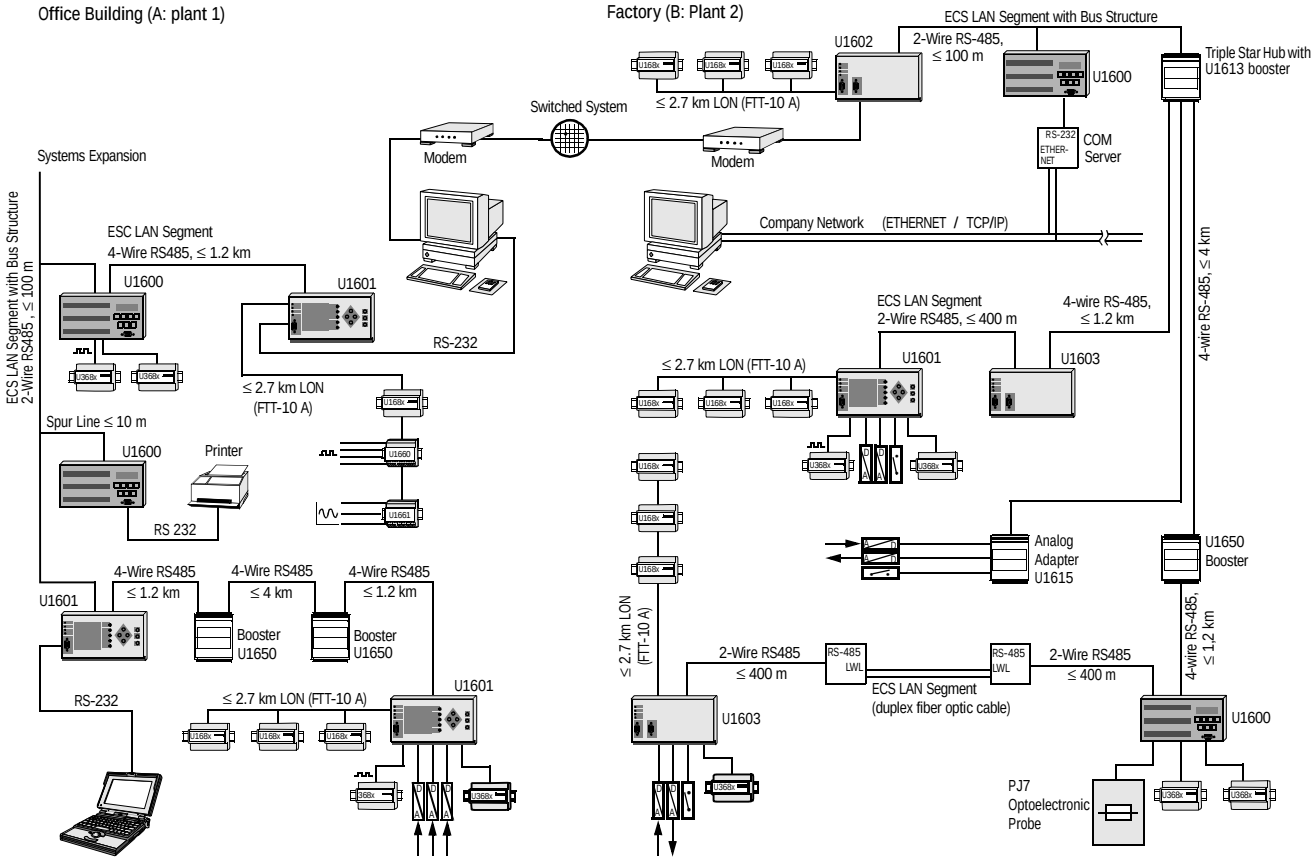
As a rule, the costs for electrical energy are assigned based on a standard formula for industry, government offices and apartment buildings.

In the face of ever increasing energy costs, it has nevertheless become necessary to continuously measure exact usage for specific cost centers, for a single product or production line, a department or a renter.

Energy consumption can best be determined with an electric meter, which is assigned to an individual user. Meter readings can either be read by outside personnel, or analyzed centrally with the ECS Energy Control System.

ECS Energy Control System Overview:

- Up to 63 U168x (LON) and up to12 U368x meters (S0) can be connected to each U1601 summator ($\sum < 64$), and up to 24 meters (e.g. U368x) can be connected to the U1600 summator
- Max. 255 users (summators) per bus
- Interconnection with line, star or bus topology
- 2 and 4-wire connections can be mixed within segments
- Transmission speed can be adapted to each segment
- Max distance between two summators is 1.2 km at 62.5 kBaud (with ECS LAN BOOSTER up to 4 km)



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