Low Voltage Regulation System LVRSys® for Outdoor Installation

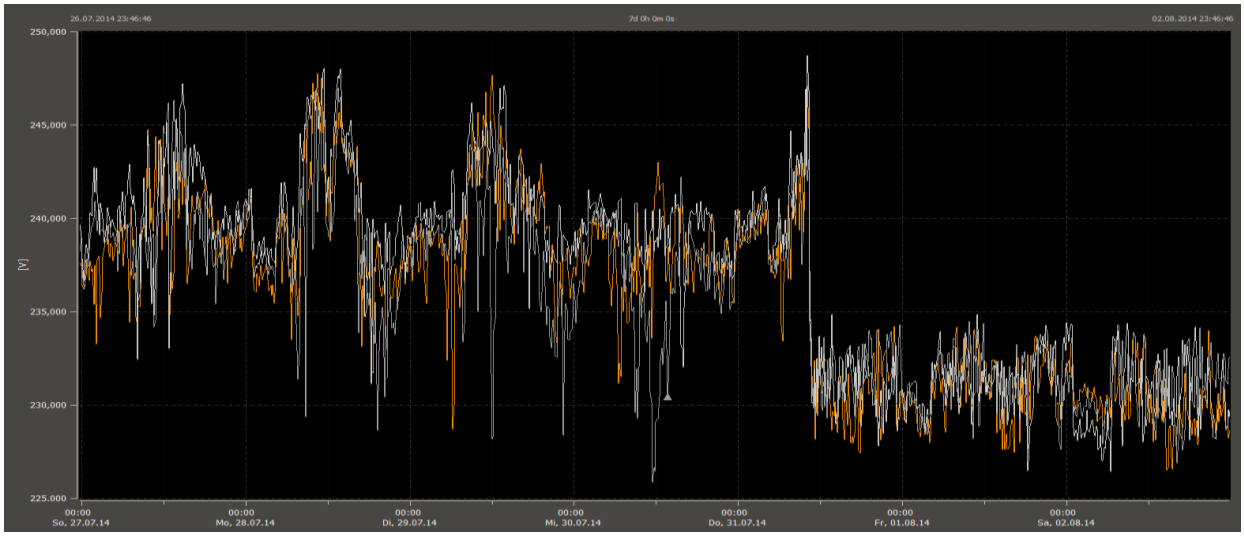
- Rated Current: 32 A to 910 A
- Control Ranges: ± 6 % … ± 20 %
- Number of Steps: 9
- Efficiency: 99.4 % to 99.8 %
- Phase-Independent Regulation
- No Grid Interference
- Increase of single-phase short-circuit power through pre-stage up to 63 A

Challenges in the Distribution Grid

The challenges in the distribution grid are increasing enormously. Voltage band violations are becoming more frequent. Photovoltaic systems in the low-voltage grid raise the voltage level. The increase in heat pumps and electromobility are lowering the voltage level. Voltage increases and decreases typically occur at different times. PV-systems dominate the voltage level during the day. Heat pumps and electric vehicles dominate the voltage level in the evening and at night. Many electric vehicles are single-phase charged at home. Besides, asymmetries in the three-phase voltages are becoming more common.

Cost-effective Solution for the Distribution Grid

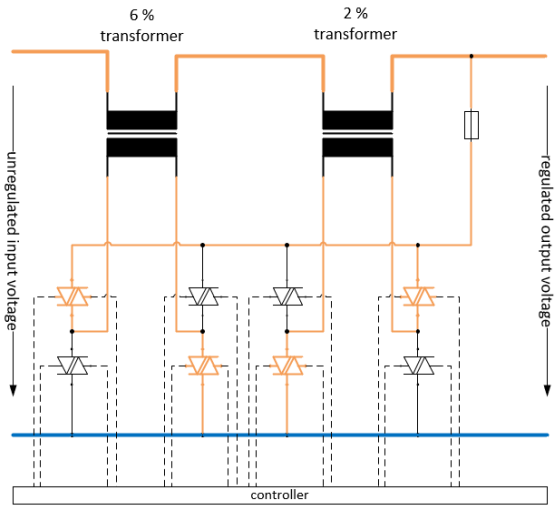
LVRSys® postpones and avoids the need for cable and line expansion. Its economical use is worthwhile in nearly all low-voltage networks. Investments in new lines tie up the capital invested for decades. LVRSys® requires comparatively low investments, which are also flexible and location independent. If conditions in the distribution grid change fundamentally, the system can be easily relocated.



Voltage profile of a grid feeder before and after the commissioning of LVRSys®

Functionality

The operating principle of the LVRSys® is based on a longitudinal regulator. By switching on and off two transformers, it is possible to regulate the output voltage in 9 stages. The thyristors are intelligently activated, allowing for a transition between stages without grid interference.



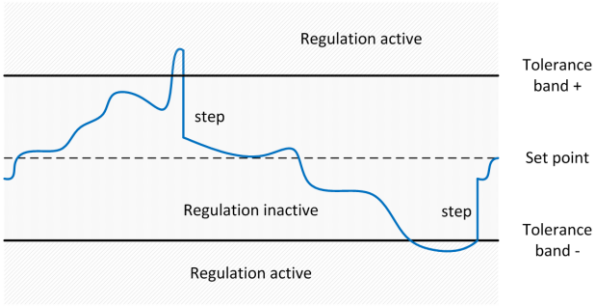
Example of 4 % voltage reduction

Step	Transformer 2%	Transformer 6%
+8 %	+2 %	+6 %
+6 %	0 %	+6 %
+4 %	-2 %	+6 %
+2 %	+2 %	0 %
0 %	0 %	0 %
-2 %	-2 %	0 %
-4 %	+2 %	-6 %
-6 %	0 %	-6 %
-8 %	-2 %	-6 %

Generation of voltage levels, e. g. System ± 8 %

Control parameters

- Setpoint (voltage value)
- Tolerance band +
  (upper limits of the tolerance band range)
- Tolerance band –
  (lower limits of the tolerance band range)
- Reaction time
- Load-dependent regulation (grid impedance)
- Phase voltage balancing

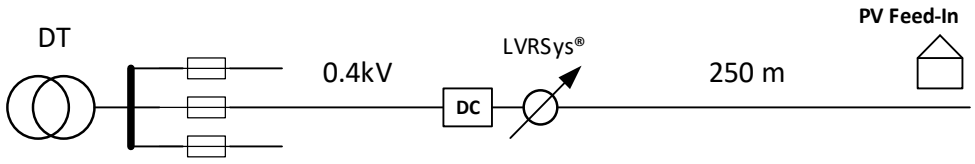


Tolerance band ranges

Load-dependent regulation

The load-dependent voltage value at the network's end is calculated from measuring the network current and the parameterized grid impedance. The regulation can thereby be optimized without additional communication facilities.

When there is a load, the calculated (regulated) voltage value is reduced; during feedback (e. g. PV feed-in), the calculated (regulated) voltage value is increased.



Example: Grid feeder with 250 m cable distance between LVRSys® and PV Feed-In

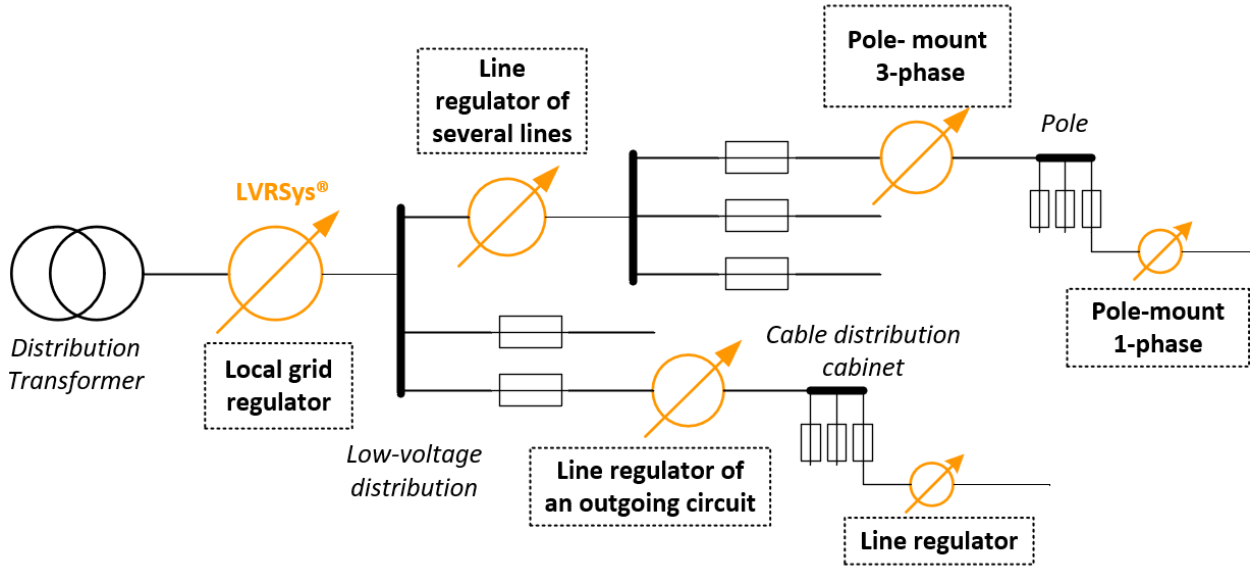
In this example grid extension, power is fed into the grid by the PV system. Through the load-dependent regulation, the voltage drop along the cable is now included in the regulation. The LVRSys® regulates now the calculated voltage at the network extension (cable end) within the tolerance bands. This expands the regulation function and stabilizes the desired network node.

Voltage balancing

The phase-independent regulation enables the *"balancing"* of the three-phase voltages and thus improves the grid power quality. Three-phase loads, such as motors, operate more efficiently with symmetric voltage and have a longer product lifecycle.

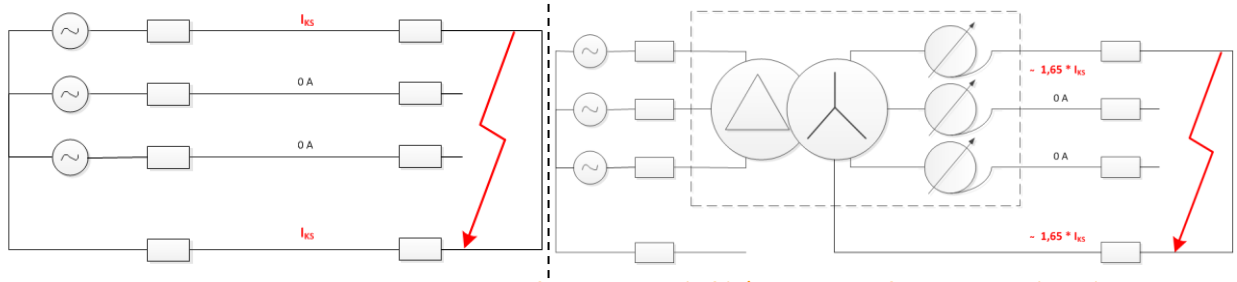
Perfect scaling for the low voltage grid

Specifically for the low-voltage grid, power classes ranging from 22 kVA to 630 kVA (3-phase) or 7.5 to 35 kVA (1-phase) are available.



Possible applications of LVRSys® for grid operators

Increase in single-phase short-circuit power (additional option up to 63 A)



Single-phase short-circuit current without LVRSys® + pre-stage (left) / with LVRSys® + pre-stage (right)

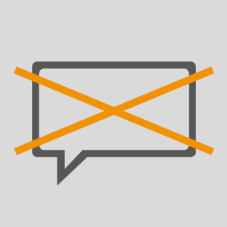
At the end of very long cables the single-phase short-circuit power is very low. The triggering criteria of the used fuses cannot be met in the case of a single-pole short circuit.

By using the LVRSys®, in combination with pre-stage, the short-circuit power is increased by approximately 65%. Network expansion measures due to insufficient short-circuit power can thus be avoided.

LVRSys® - Flexible and Robust for Any Application

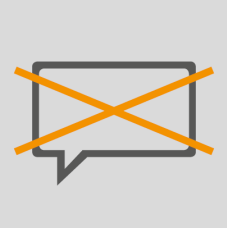
Robust

- Twenty billion switching operations
- Short circuit proofed up to 50 kA
- High resistance to over voltages, direct and indirect lightning strikes
- Overloading (like NH fuse)



Grid compatibility

- No grid interference, causes neither flicker nor harmonics
- Balancing of the voltage via phase-independent regulation
- Existing fuse concept can be retained
- Guaranteed uninterrupted voltage supply (*Automatic Bypass*)



Intuitive and Safe

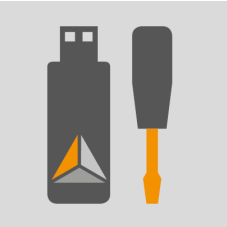
- Installation like cable distribution cabinets
- Common connection via NH-switch disconnectors
- Commissioning and decommissioning via NH-switch disconnectors
- Fully encapsulated system for maximum touch protection

Reliable and Economical

- High efficiency
- Passive cooling even under direct sunlight
- Operation temperature -40 °C to +50 °C ambient temperature
- Electronics housed moisture-proof in the internal control cabinet (IP66)

Flexible and Fast

- Adjustable response time of the controller < 30 ms up to 100 s
- Adaption of the control algorithms to different applications
- Line drop compensation, without additional communication
- Independent tolerance bands



Simple

- Data export via USB stick to, for example, MS Excel
- Firmware update via USB stick or remote access
- Common communication interfaces *Modbus TCP, IEC 60870-5-104*
- Drag indicator in the display

Execution of cabinet variants

Grid operators can choose from several cabinet variants:

- GRP (Glass Fiber Reinforced Plastic) cabinet + GRP earth base
- Aluminium-cabinet + concrete earth base
- Pole-mounted

Design of the cabinet variants: GRP distribution cabinet; aluminium distribution cabinet; Pole mounted cabinet

Transport and Installation of Systems

The control cabinets, which are placed on an earth base, are equipped with crane lugs. In aluminium cabinets, the crane lugs are located under the weather protection roof.

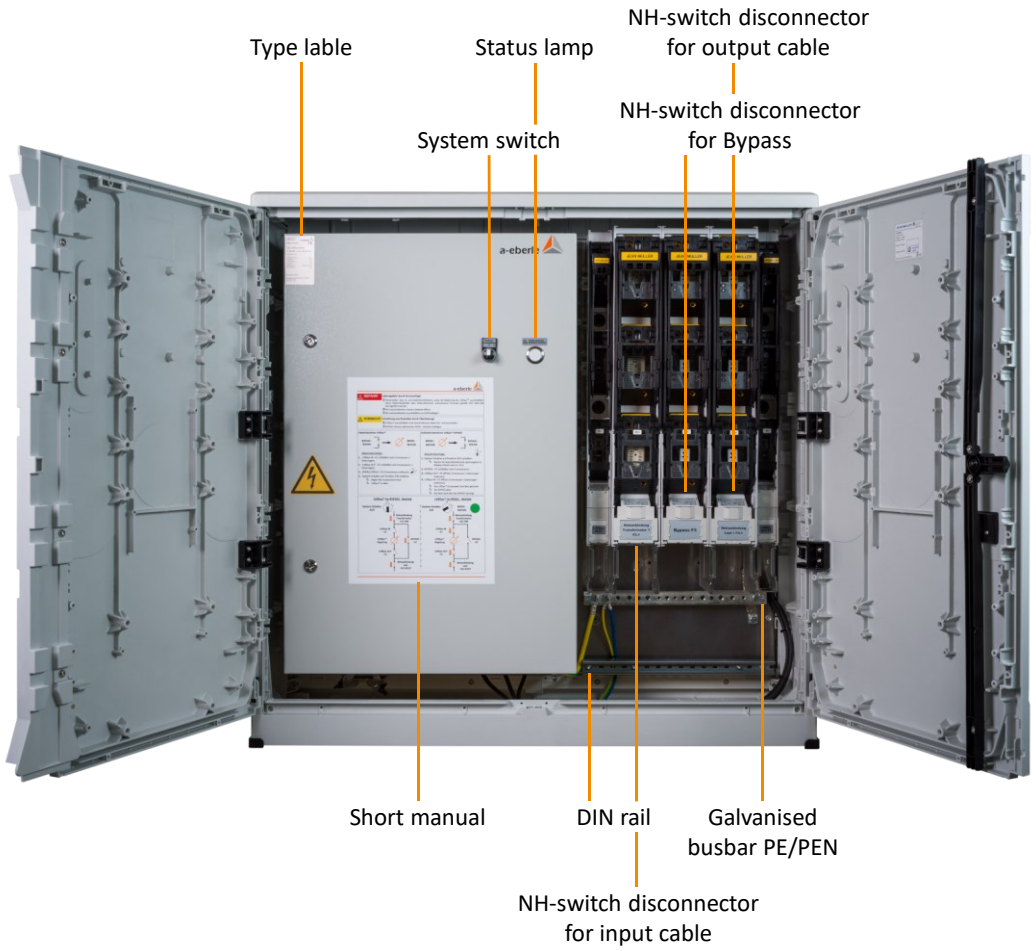
The pole-mounted systems are equipped with crane lugs and mounting clamps. The mounting clamps are adjusted to the mast thickness.

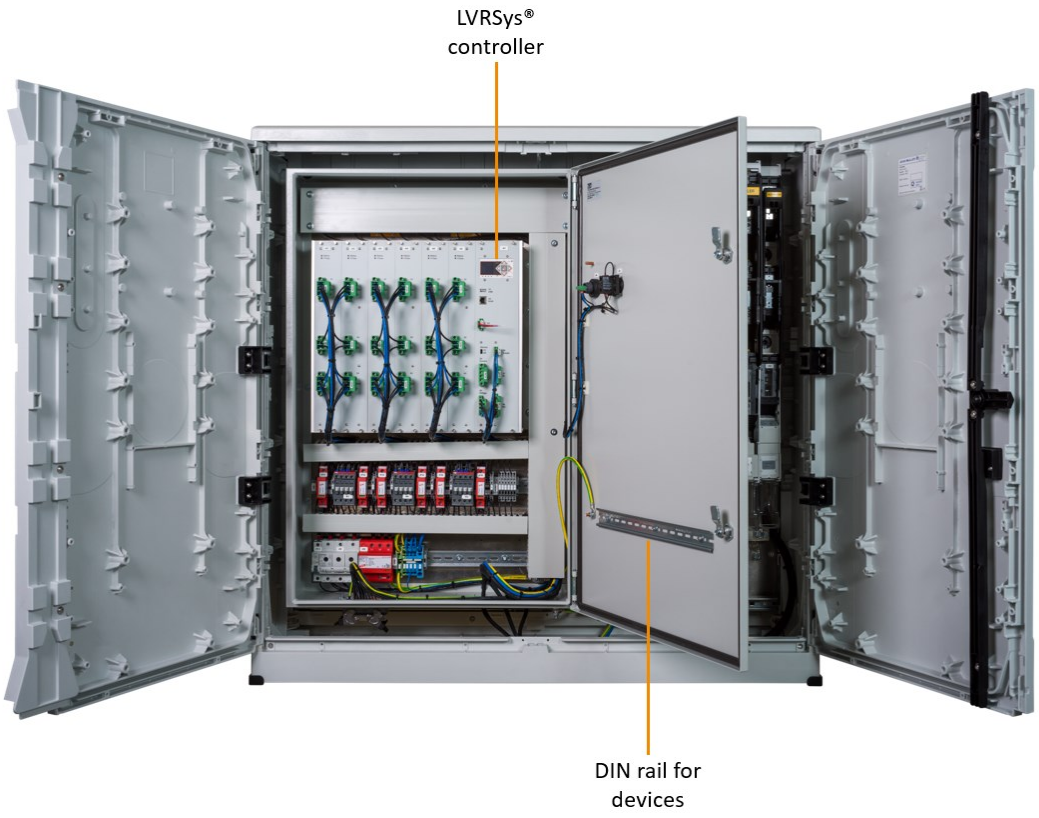
Installation and Commissioning

The installation of the system is like a conventional cable distribution cabinet:

1. Disconnect cable
2. Install the LVRSys® cable distribution cabinet
3. Connect the desired cables to the NH-switch disconnectors.
4. Reconnect the power supply.
5. Switch to operating mode via the bypass NH-switch disconnector.
6. Set system switch to ON (system controls with factory-set parameters, sufficient in 90% of cases)

The internal layout with NH-switch disconnectors is identical for GRP and aluminium cabinets. For pole-mounted systems, the connection is made via terminals. The bypass is realized via separation terminals.


Type lable
Status lamp
NH-switch disconnector
for output cable
System switch
NH-switch disconnector
for Bypass
Short manual
DIN rail
Galvanised
busbar PE/PEN
NH-switch disconnector
for input cable


LVRSys®
controller
DIN rail for
devices

Technical data

Design data		
Rated voltage U_N	400 V / 230 V ±30 % (L-L/L-N)	
Rated current I_N 3-phase/1-phase	**3-phase**	**1-phase**
	32 A (22 kVA System)	32 A (7,5 kVA System)
	63 A (44 kVA System)	63 A (15 kVA System)
	100 A (70 kVA System)	100 A (25 kVA System)
	160 A (110 kVA System)	160 A (35 kVA System)
	200 A (144 kVA System)	
	250 A (175 kVA System)	
	300 A (200 kVA System)	
	355 A (250 kVA System)	
	580 A (400 kVA System)	
	910 A (630 kVA System)	
Rated frequency f_N	50 Hz / 60 Hz	
Efficiency	99,4 % – 99,8 %	
Maximum Rating Duration	30 ms	
Control Ranges	± 6% of U_N in 9 steps of 1.5%	
	± 8% of U_N in 9 steps of 2.0%	
	± 10% of U_N in 9 steps of 2.5%	
	± 12% of U_N in 9 steps of 3.0%	
	± 14% of U_N in 9 steps of 3.5%	
	up to ± 20% of U_N (special design)	
Ambient Temperature	-40°C to +40°C (up to + 50°C special design)	
Maximum Allowable Air Temperature in the Control Cabinet	70 °C	
Elevation of Installation (NN)	Below 2000 meters	
Protection Class	IP44 - IP55/ Electronics IP66	
Max. Current Consumption Secondary Electronics	200 mA (230 V)	
Short-circuit impedance u_k	Approximately 0.3%	
Cooling	Passive (convection via switch cabinet cabinet)	

Limits		
Rated impulse voltage U_{Imp}	6 kV	
Rated Short time current resistance I_{cw} (1 s)	5 kA (till 160 A)	
	15 kA (200 A till 910 A)	
Rated conditional short-circuit current I_{cc}	20 kA (till 160 A)	
	50 kA (200 A till 910 A)	
Rated conditional short-circuit current I_{cf} protected by fuse	3 kA (32 A)	20 kA (250 A)
	5 kA (63 A)	25 kA (300 A)
	10 kA (100 A)	30 kA (355 A)
	14 kA (160 A)	50 kA (580 A)
	16 kA (200 A)	50 kA (910 A)
High rated peak withstand currents I_{pk}	20 kA (till 160 A)	20 kA (till 160 A)

	Measurements w/d/h	Weight	Power
Aluminium cabinet	120 cm/40 cm/135 cm	165 kg	till 355 A 8 %
	140 cm/50 cm/145 cm	220 kg	till 580 A
	160 cm/50 cm/155 cm	250 kg	till 910 A
GRP – cabinet	113 cm/32 cm/113 cm	100 kg	till 160 A
	146 cm/32 cm/113 cm	155 kg	till 355 A 8 %
Pole Mount	80 cm/30 cm/120 cm	110 kg – 130 kg	till 100 A
Concrete base	120 cm/40 cm/100 cm	260 kg	till 355 A 8 %
	140 cm/50 cm/100 cm	280 kg	till 580 A
	160 cm/50 cm/100 cm	300 kg	till 910 A
GRP - base	113 cm/32 cm/90 cm	30 kg	till 160 A
	146 cm/32 cm/90 cm	40 kg	till 355 A 8 %
Transformer block	40 cm/20 cm/ 85 cm	110 - 215 kg	32 – 160 A
	50 cm/22 cm/ 85 cm	190 - 370 kg	200 – 355 A 8%
	70 cm/30 cm/ 95 cm	315 - 610 kg	355 A 10% - 580 A 10%
	70 cm/39 cm/105 cm	400 - 680 kg	910 A

Fulfilled Guidelines	
EMC Immunity	DIN EN 61000-6-2
EMC Emission	DIN EN 61000-6-3
Construction Directive	DIN EN 61439-1/5
Low Voltage Directive	2014/35/EU
Noise Emissions	< 37 dB(A)

A. Eberle GmbH & Co. KG

Frankenstraße 160
D-90461 Nuremberg

Phone: +49 (0) 911 / 62 81 08 - 0
Fax: +49 (0) 911 / 62 81 08 - 99
E-Mail: info@a-eberle.de
Web: http://www.a-eberle.de

Edition of: 04/06/2024
Ver.: TD_LVRSys_Outdoor_EN_180.1000.2xxx_V_1_2.docx