# blueplanet 750/875/1000 TL3 M1 GM ID DEXy

User Manual

## ■ English version

These user manual form part of the product and must be observed. They must also be stored in a place which is freely accessible at all times.

The copyright for these user manual is held solely by KACO new energy.

# Operation Instructions

**for Installation Engineers and Operators**

# Contents


**1 GENERAL NOTES ..... 5**

1.1 About this documentation .....5

1.2 Name plate .....7

1.3 Intended use.....8

1.4 Safety instruction .....9

**2 SERVICE..... 11**

**3 UNIT DESCRIPT..... 13**

3.1 Technical data .....13

3.2 Dimension.....33

3.3 Components inside the inverter .....36

**4 TRANSPORTATION DELIVERY..... 39**

4.1 Delivery.....39

4.2 Transportation .....39

4.3 Centre of Gravity of the Inverter .....40

**5 STORAGE/INSTALLATION / START-UP ..... 43**

5.1 Storage .....43

5.2 Transporting the unit to the installation location .....44

5.3 Selecting the installation location.....47

5.4 Connecting the conduit.....48

5.5 Electrical connection..... 51

5.6 Start-up..... 56

5.7 Operation..... 58

5.8 User interface ..... 62

5.9 HMI menu structure and details..... 64

5.10 HMI main menu ..... 65

5.11 HMI submenus..... 68

5.12 Connecting to inverter via Wi-Fi in local. 86

**6 FAULT AND WARNINGS ..... 93**

6.1 Warning ..... 93

6.2 Fault..... 94

6.3 Solution for Error code..... 97

6.3.1 Warnings ..... 97

6.3.2 Fault..... 99

**7 MAINTENANCE/CLEANING ..... 105**

7.1 Maintenance intervals..... 106

7.2 Cleaning & Replacing the fans..... 107

**8 PARAMETERS ..... 111**

8.1 Parameters ..... 112

8.1.1 PV Array Parameters..... 112

8.1.2 Inverter Parameters....113
8.1.3 Grid Parameters....114
8.1.4 Time Parameters....118
8.1.5 Digital Parameters....119
8.1.6 Analog Parameters....120
8.1.7 Controller Parameters....120
8.1.8 Trace Parameters....124
8.1.9 Offset Parameters....125
8.1.10 Gain Parameters....126
8.2 Functions....127
8.2.1 MPPT(Maximum Power Point Tracking) Function....127
8.2.2 Operating DC voltage range....128
8.2.3 Power Derating....129
8.2.4 Grid Support (COSPHI Control)....132
8.2.5 FDPR(Frequency Dependant Power Reduction)....139
8.2.6 VDPR(Voltage Dependant Power Reduction)....140
8.2.7 Anti-Islanding Methods....142
8.2.8 FRT(Fault Ride-Through)....145
8.2.9 Protection....149
8.2.10 Communication between Components.152
8.2.11 RPO(Reactive Power outside of feed-in Operation)....155
8.3 PQ Diagram....156
8.3.1 BP1000-TL3-ID....156
8.3.2 BP875-TL3-ID....157
8.3.3 BP750-TL3-ID....158
**9 USER INTERFACE....159**
9.1 Digital Input/Output....160
9.1.1 Digital input....161
9.1.2 Digital output....162
9.2 RS485 Interface....163
9.2.1 RS485-1 interface....163
9.2.2 RS485-2 interface....164
9.2.3 Settings for RS485 interfaces....165
**10 OVERVIEW CIRCUIT DIAGRAM....167**
**11 DECOMMISSIONING /DISMANTLING....169**
**12 DISPOSAL....171**

# 1 General Notes

## 1.1 About this documentation

| | |
|---|---|
| | ⚠ **WARNING** |
| | **Improper Handling of the inverter can be dangerous.**<br>You must read and understand the operating instructions before you can install and use the inverter safely. |

### Other applicable documents

During installation, observe all assembly and installation instructions for components and other parts of the system. These instructions are delivered together with the respective components and other parts of the system. Some of the documents which are required to register your photovoltaic system and have it approved are included with the operating instructions.

### Retention of documents

These instructions and other documents must be stored near the system and be available whenever they are needed.

### Product name notation

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEXy

y* = Model name according to option

- KACO blueplanet 750/875/1000 TL3 M1 ID DEX0 => With 12 DC inputs and 250A fuses
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX1 => With 9 DC inputs and 400A fuses
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX2 => With 12 DC inputs and 250A fuses + SOR
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX3 => With 9 DC inputs and 400A fuses + SOR
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX4 => With 12 DC inputs and 250A fuses + RPO mode + SOR + NG
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX5 => With 9 DC inputs and 400A fuses + RPO mode + SOR + NG
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX6 => With 12 DC inputs and 250A fuses + RPO mode + SOR
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX7 => With 9 DC inputs and 400A fuses + RPO mode + SOR
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX8 => With 9 DC inputs and 400A fuses + SOR + NG
- KACO blueplanet 750/875/1000 TL3 M1 ID DEX9 => With 12 DC inputs and 250A fuses + SOR + NG.

## Description of safety instructions

| | |
|---|---|
| | **DANGER** |
| | **Imminent danger**<br>Failure to observe this warning will lead directly to serious bodily injury or death. |

| | |
|---|---|
| | **WARNING** |
| | **Potential danger**<br>Failure to observe this warning may lead to serious bodily injury or death. |

| | |
|---|---|
| | **CAUTION** |
| | **Low-risk hazard**<br>Failure to observe this warning may lead to minor or moderate bodily injury. |

| | |
|---|---|
| | **ATTENTION** |
| | **Hazard with risk of property damage**<br>Failure to observe this warning will lead to property damage. |

| | |
|---|---|
| | **NOTE** |
| | Useful information and notes. |

## Symbols used in this document

General danger symbol

Information

High voltage

Risk of burns

Risk of fire and explosion

## Description of actions

**Action**

1. Perform this action
2. Possibly additional actions

The result of your action(s)

### Abbreviations

| | |
|---|---|
| **HMI** | Human Machine Interface |
| **PEBB** | Power Electronics Building Block |
| **PSI** | PEBB Signal Interface board |
| **ASI** | Analog Signal Interface board |
| **GUI** | Graphic User Interface |
| **MPPT** | Maximum Power Point Tracking |
| **MPP** | Maximum Power Point |
| **Vdc** | PV Voltage |
| **FRT** | Fault Ride Through |
| **CEI 0-16** | Italia grid code |
| **RPC** | Remote Power Control |
| **APS** | Anti –islanding method(Automatic Phase-Shift) |
| **ACI protocol** | Advanced Communication Interface<br>(KACO Communication protocol) |
| **PLL** | Phase Locked Loop |
| **XCU** | XP Control Unit (Inverter control system) |
| **CAN** | Controller Area Network |
| **FPGA** | Field-Programmable Gate Array |
| **DSP** | Digital Signal Processor |
| **ADC** | Analog to Digital Converter |
| **NVSRAM** | Non-volatile Static RAM |

## 1.2 Name plate

The name plate is located on the inside of the each door and the front of housing for DC cable connection.

## 1.3 Intended use

The inverter converts the DC power generated by the photovoltaic (PV) modules into AC power and feeds this into the power grid. The inverter is built according to the state of the art and recognized safety rules. Nevertheless, improper use may cause lethal hazards for the operator or third parties, or may result in damage to the unit and other property. The inverter may be operated only with a permanent connection to the public power grid. In the event that the inverter is not provided with full protection against shock hazard on the PV array shall be provided with installation instructions requiring that the inverter and the array must be installed in closed electrical operating areas and indicating which forms of shock hazard protection are and are not provided integral to the inverter.

### Earthing of PV array

The type of inverter must be chosen depending on earthing of PV array.

| Earthing of PV array | Type of PV inverter |
|---|---|
| Frame ground(Isolation) | All type(IS,NG,PG) |
| Negative ground | Negative ground type(NG) |
| Positive ground | Positive ground type(PG) |

## 1.4 Safety instruction

| | |
|---|---|
| | **⚠ DANGER** |
| | **Lethal voltages are still present in the terminals and lines of the inverter even after the inverter has been switched off and disconnected!**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open, install and maintain the inverter.<br>▪ Keep all doors and covers dosed when the unit is in operation.<br>▪ Do not touch the lines and terminals when switching the unit on and off! |

| | |
|---|---|
| | **⚠ WARNING** |
| | **Lethal voltage in the PV system**<br>When the photovoltaic array is exposed to light, it supplies a DC voltage to the inverter. |

The electrician is responsible for observing all existing standards and regulations.

- Above all, be sure to observe standard IEC 60364-7-712:2002, “Requirements for Special Installations or Locations – Solar Photovoltaic (PV) Power Supply Systems”.
- Be sure to be responsible for knowing and understanding local standards and regulations as well as utility interconnection requirements.
- Ensure operational safety by providing for proper earthing, conductor dimensioning and appropriate protection against short circuiting.
- Observe the safety instructions located on the inner sides of the doors.
- Switch off all voltage sources and secure them against being inadvertently switched back on before performing visual inspections and maintenance.
- When taking measurements while the inverter is live:

  Do not touch the electrical connections.

  Remove jewelry from your wrists and fingers.

  Make sure that the testing equipment is in good and safe operating condition.
- Stand on an insulated surface when working on the inverter.
- Performing any modifications or changes on the inverter is generally prohibited. Performing any changes or modifications to the installation of the inverter is only permitted if in compliance with national standards and performed by qualified personnel.
- Modifications to the surroundings of the inverter must comply with national and local standards

# 2 Service

If you need help fixing a technical problem with one of our KACO products, please contact our service hotline. Please have the following information ready so that we can help you quickly and efficiently:

- Inverter type/Serial number
- Error message shown on the display/Description of the fault/Did you notice anything Unusual /What has already been done to analyze the fault
- Module type and string circuit
- Date of installation/Start-up report
- Consignment identification/Delivery address/Contact person (with telephone number)

## Service hotlines

| | |
|---|---|
| **Tel/E-mail** | Tel:+1 (415) 931-2046 /<br>Fax:+1 (415) 931-1688<br>E-mail: kacoinfor@kaco-newenergy.com |
| **Hotline hours** | Monday to Friday, 9:00 a.m. to 6:00 p.m. |

# 3 Unit Descript

## 3.1 Technical data

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX0

With 12 DC inputs and 250A fuses

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [1)]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 12 (250A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |

[1] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [2]2000m | | |
| Cooling | Forced Fan | | |
| Audible noise | [3]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Isolation ground type | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [4]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[2] Power de-rating above MSL 2000m under MSL 5000m

[3] Measurement from 10M distance

[4] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX1

With 9 DC inputs and 400A fuses

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [5)]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 9 (400A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [6)]2000m | | |
| Cooling | Forced Fan | | |

[5] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[6] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [7]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Isolation ground type | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [8]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[7] Measurement from 10M distance

[8] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX2

With 12 DC inputs and 250A fuses + SOR

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [9]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 12 (250A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [10]2000m | | |
| Cooling | Forced Fan | | |

[9] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[10] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [11]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Isolation ground type | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [12]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[11] Measurement from 10M distance

[12] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX3

With 9 DC inputs and 400A fuses + SOR

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [13)]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 9 (400A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [14)]2000m | | |
| Cooling | Forced Fan | | |

[13] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[14] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [15]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Isolation ground type | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [16]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[15] Measurement from 10M distance

[16] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX4

With 12 DC inputs and 250A fuses + RPO mode + SOR + NG

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [17)]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 12 (250A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [18)]2000m | | |
| Cooling | Forced Fan | | |

[17] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[18] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [19]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Negative ground type | Yes | | |
| RPO mode(Reactive Power Outside of Feed-in Operation) | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [20]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[19] Measurement from 10M distance

[20] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX5

With 9 DC inputs and 400A fuses + RPO mode + SOR + NG

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [21]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 12 (250A fuses plus and minus) / 9 (400A fuse plus and minus- Option) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [22]2000m | | |
| Cooling | Forced Fan | | |

[21] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[22] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [23]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Negative ground type | Yes | | |
| RPO mode(Reactive Power Outside of Feed-in Operation) | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [24]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[23] Measurement from 10M distance

[24] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX6

With 12 DC inputs and 250A fuses + RPO mode + SOR

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [25)]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 12 (250A fuses plus and minus) / 9 (400A fuse plus and minus- Option) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [26)]2000m | | |
| Cooling | Forced Fan | | |

[25] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[26] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [27]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Isolation ground type | Yes | | |
| RPO mode(Reactive Power Outside of Feed-in Operation) | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [28]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[27] Measurement from 10M distance

[28] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX7

With 9 DC inputs and 400A fuses + RPO mode + SOR

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [29]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 9 (400A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [30]2000m | | |
| Cooling | Forced Fan | | |

[29] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[30] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [31]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Isolation ground type | Yes | | |
| RPO mode(Reactive Power Outside of Feed-in Operation) | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [32]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[31] Measurement from 10M distance

[32] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX8

With 9 DC inputs and 400A fuses + SOR + NG

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [33]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 9 (400A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [34]2000m | | |
| Cooling | Forced Fan | | |

[33] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[34] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [35]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Negative ground type | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [36]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[35] Measurement from 10M distance

[36] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

KACO blueplanet 750/875/1000 TL3 M1 GM ID DEX9

With 12 DC inputs and 250A fuses + SOR + NG

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| **DC Input** | | | |
| PV Max. generator Power | 788kW | 919kW | 1050kW |
| PV input operating voltage range | 550V ~ 1000V | | |
| MPP range | 550V ~ 830V | | |
| Max. permissible DC voltage (No load) | [37]1100V | | |
| Max. permissible DC current | 1433A | 1671A | 1910A |
| Number of DC inputs | 12 (250A fuses plus and minus) | | |
| **AC Output** | | | |
| Max. output power / Rated power | 1000kVA / 750kW | 1000kVA / 875kW | 1000kVA / 1000kW |
| Grid voltage | 3*370V (±10%) | | |
| Maximum output current | 1560A | | |
| Grid frequency | 50/60Hz | | |
| THD of grid current | <3% at rated power | | |
| Power factor at rated power(cos θ) | ≥0.75 | ≥0.875 | ≥0.9 |
| Power factor range | 0 leading … 0 lagging(Adjustable) | | |
| **Power Consumption** | | | |
| Internal consumption in operation | <1% of rated power(<1700W) | | |
| Internal consumption in stand-by | <Approx. 160W | | |
| **Efficiency** | | | |
| Max. efficiency | 98.6% | 98.6% | 98.6% |
| Euro efficiency | 98.4% | 98.4% | 98.4% |
| **Environmental Parameters** | | | |
| Operating temperature range | -20℃ ~ +50℃ | | |
| Storage temperature range | -20℃ ~ +70℃ | | |
| Relative humidity | 0 ~ 95%(non condensing) | | |
| Max. altitude above mean sea level | [38]2000m | | |
| Cooling | Forced Fan | | |

[37] 1100Vdc is no-load voltage. Start-up at DC voltage is under 1000Vdc and max. operating voltage is 1000Vdc

[38] Power de-rating above MSL 2000m under MSL 5000m

| Model | BP 750 TL3 ID DE | BP 875 TL3 ID DE | BP 1000 TL3 ID DE |
|---|---|---|---|
| Audible noise | [39]<70 dB | | |
| Degree of protection | IP21 (indoor use only according IEC 60529:2001) | | |
| Protection class | I | | |
| Overvoltage category (PV side/Grid side) | OVC2/OVC3 | | |
| **Physical Parameters** | | | |
| Dimensions(H/W/D) in mm | 2100*3125*1000 | | |
| Weight | 2700kg | | |
| Power Density | 0.114W/㎤ | 0.133W/㎤ | 0.152W/㎤ |
| **Standard** | | | |
| EMC | EN61000-6-2, EN 61000-6-4, EN 61000-3-11, EN 61000-3-12 | | |
| Certificates and approvals | CE<br>BDEW Medium-voltage Guideline TR3,TR4,TR8(in progress) | | |
| **Features** | | | |
| Ground fault detection | Yes | | |
| Heating | Yes | | |
| Emergency stop | Yes | | |
| Overvoltage protection device(DC side) | Yes | | |
| Overvoltage protection for Ethernet | Yes | | |
| Negative ground type | Yes | | |
| Shunt opening release (AC side) | Yes | | |
| **Interfaces** | | | |
| Argus string-monitor connection | RS485 | | |
| [40]User Digital Input/ Output | 1 / 1 | | |
| Display | HMI (with 4.3“ color TFT LCD with Touch panel) | | |
| Communication | 2× RS485 / Ethernet /Wi-Fi/USB | | |
| Protocol | Modbus (with Sunspec), SOAP (Simple Object Access Protocol)<br>KACO RS485 Protocol | | |
| Monitoring Tools | Smart phone(iPhone, Android Phone), Tablet pc (iPad),<br>XP-JAVA(Web), CMT (PC) | | |

[39] Measurement from 10M distance

[40] UDIO: User Digital Input - 1x Start/Stop signal of the inverter. User Digital Output – 1x External fault signal.

## 3.2 Dimension

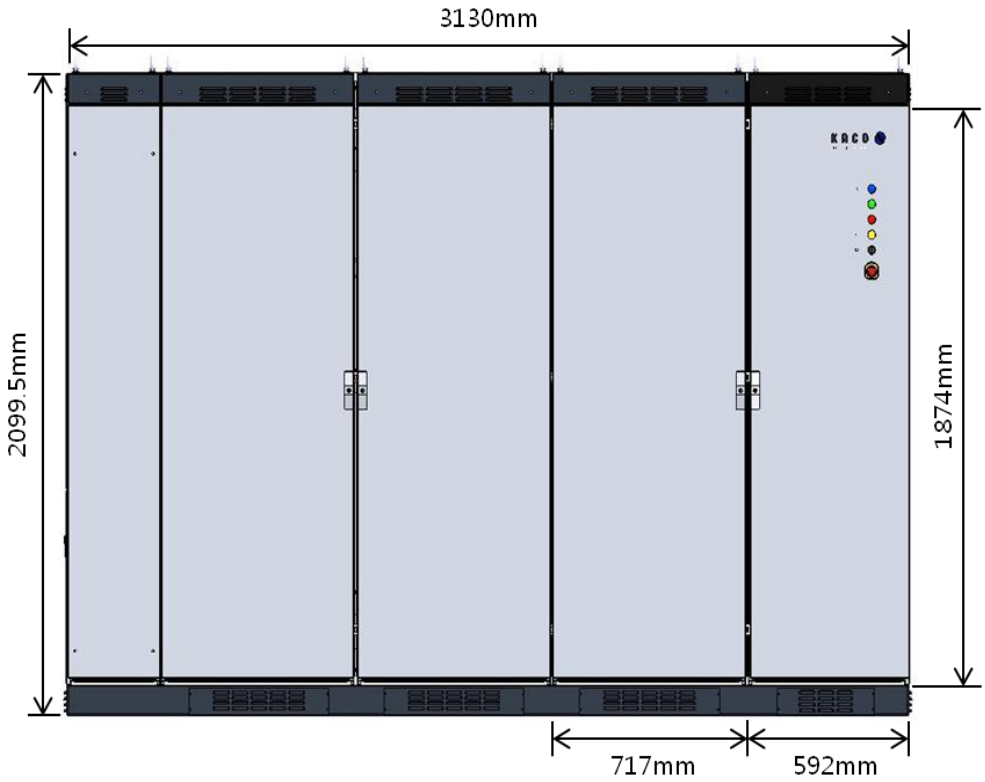



Figure 1: Dimension of the inverter

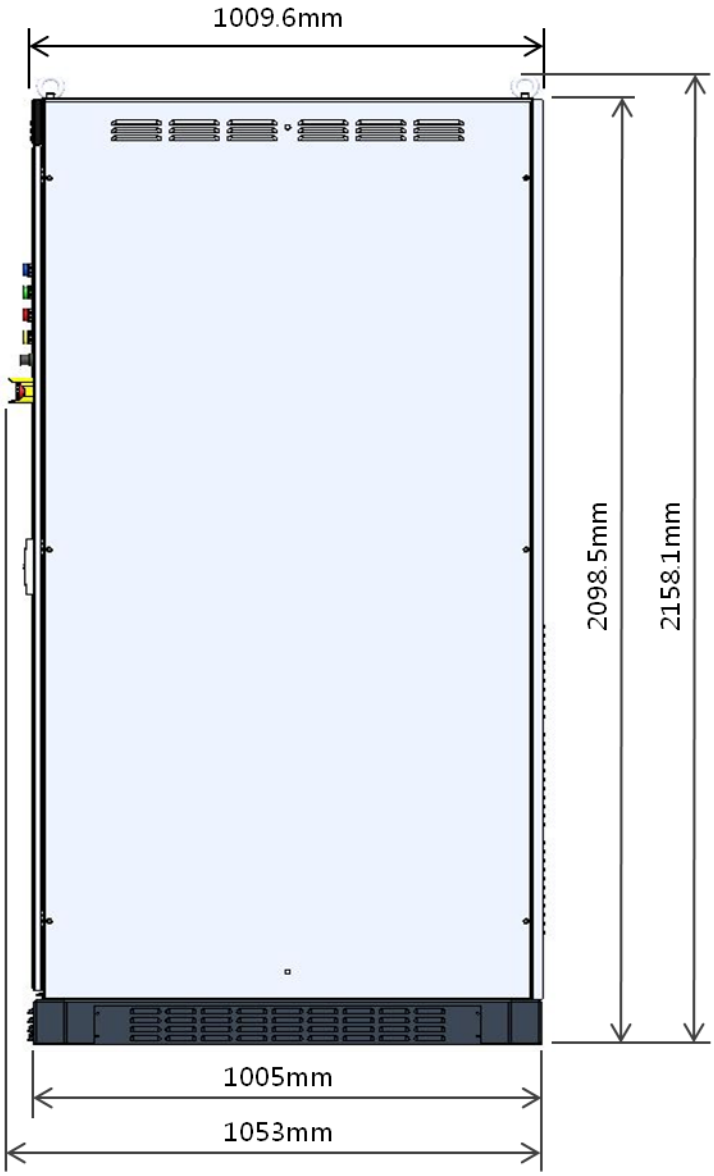



Figure 2: Dimension of the side inverter

Figure 3: Cable entry size of the inverter (Bottom View)

Figure 4: Dimension of Anchor Bolt Hole (Bottom View)

| | NOTE |
|---|---|
| | The least free space should be assigned for maintenance, ventilation and escape route in case of fire |

## 3.3 Components inside the inverter

### Front side

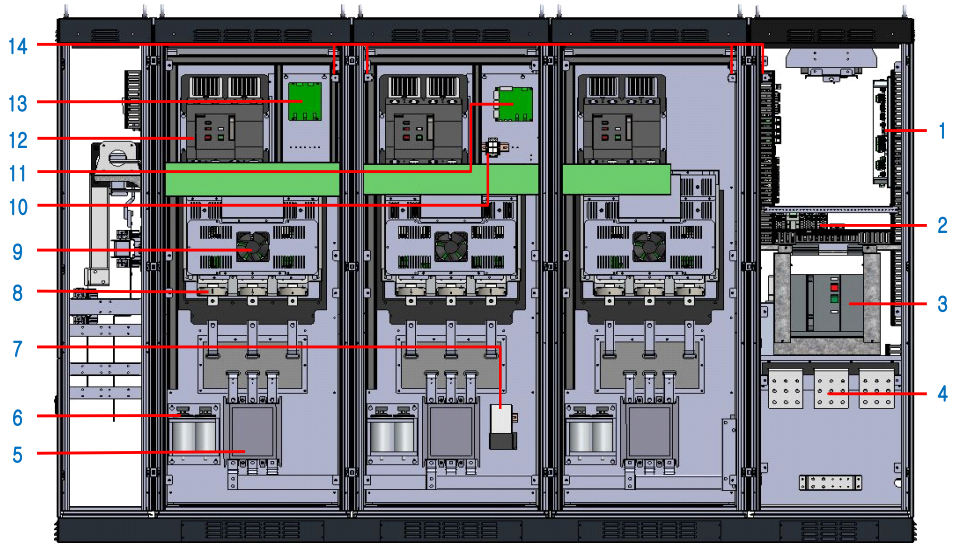



Figure 5: Components inside the inverter(front side)

| Key | |
|---|---|
| 1. XCU Module | 8. AC current transformer |
| 2. SMPS | 9. PSFAN |
| 3. CB20(MCCB for AC grid connection) | 10. Fuse for DC voltage detection |
| 4. AC connection | 11. PSIM(Master control for interface) |
| 5. MC21(Contactor for grid connection) | 12. DS10(Disconnect switch for 1100V DC side) |
| 6. LC filter(capacitor) | 13. GFD(Ground fault detection) |
| 7. Heater | 14. Door sensor |

## Back side

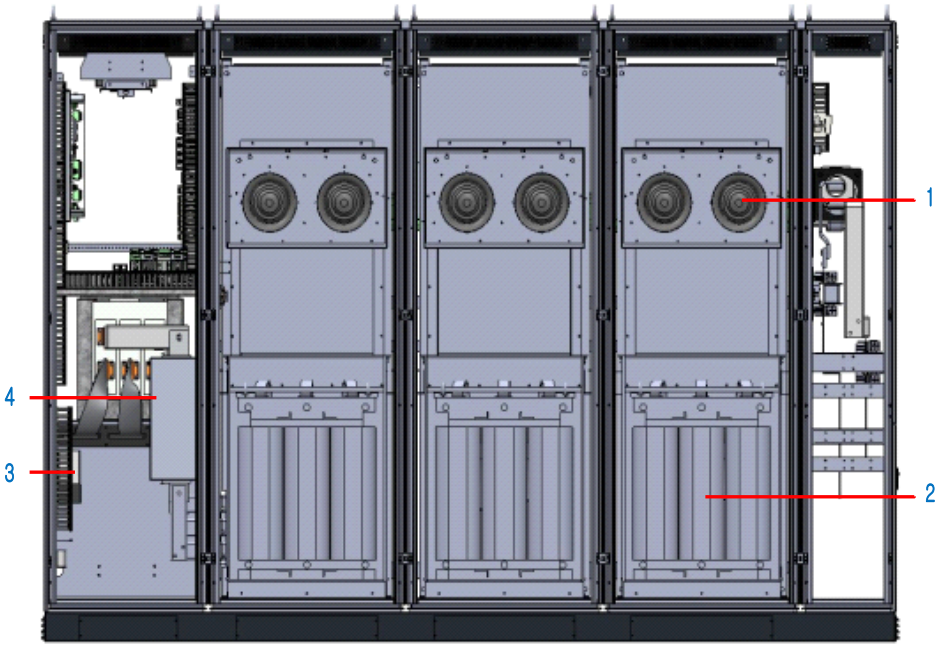



Figure 6: Components inside the inverter(back side)

| Key | |
|---|---|
| 1. PFAN(Fan for PEBB Cooling) | |
| 2. LC filter(line choke) | |
| 3. Heater | |
| 4. EMC2(EMC filter on AC) | |

## DC input side

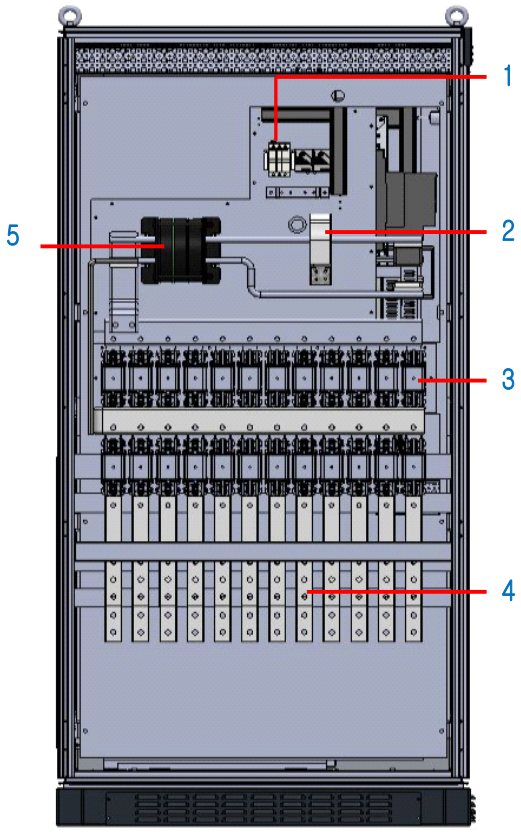



Figure 7: Components inside the inverter(DC input side)

| Key | |
|---|---|
| 1. Overvoltage protection(SP1-DC side) | 4. DC connection |
| 2. DC current transformer | 5. EMC1(EMC filter on DC) |
| 3. Fuse protection for voltage supply | |

# 4 Transportation delivery

## 4.1 Delivery

The inverters leave our factory in proper electrical and mechanical condition. Special packaging ensures that they are transported safely. The shipping company is responsible for any damage that occurs during transportation.

### Scope of delivery

- BP750/875/1000 TL3 ID DE
- Documentation

**Check your delivery**

1. Inspect the inverter thoroughly.
2. Notify the shipping company immediately if you discover any damage to the packaging which indicates that the inverter may have been damaged or if you discover any visible damage to the inverter.
3. Send the damage report to the shipping company right away. It must be received by them within six days following receipt of the inverter. We will be glad to help you, if necessary.

## 4.2 Transportation

The inverter should be shipped using the original packaging to ensure that it is transported safely. The inverter cabinet is delivered on a pallet.

| | ⚠ CAUTION |
|---|---|
| | **Impact hazard, risk of breakage to the inverter**<br>**The centre of gravity is located in the upper part of the inverter.**<br>▪ Transport the converter in an upright position. |

Weight of the packaged product is about 2,700kg. Packaging materials consist of wood, paper and foil. When carrying the product, please make sure that there are not hazard around the carrying route

## 4.3 Centre of Gravity of the Inverter

The centre of gravity of the inverter is not in the middle of the BP1000/875/750 TL3 ID DE . Take this into consideration when transporting the BP1000/875/750 TL3 ID DE.

The centre of gravity of the inverter is marked with the centre of gravity symbol on the packaging and the enclosure.

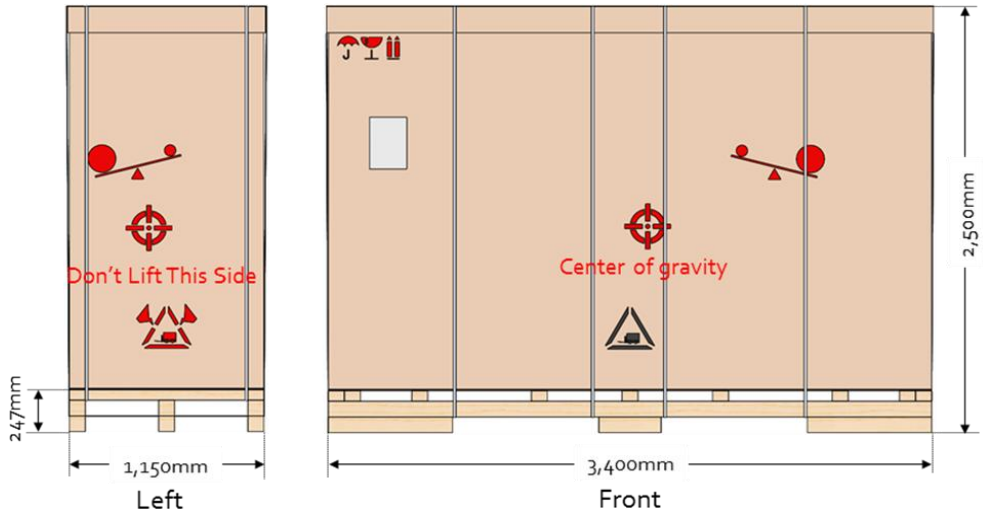



Figure 8: Centre of gravity by Front side

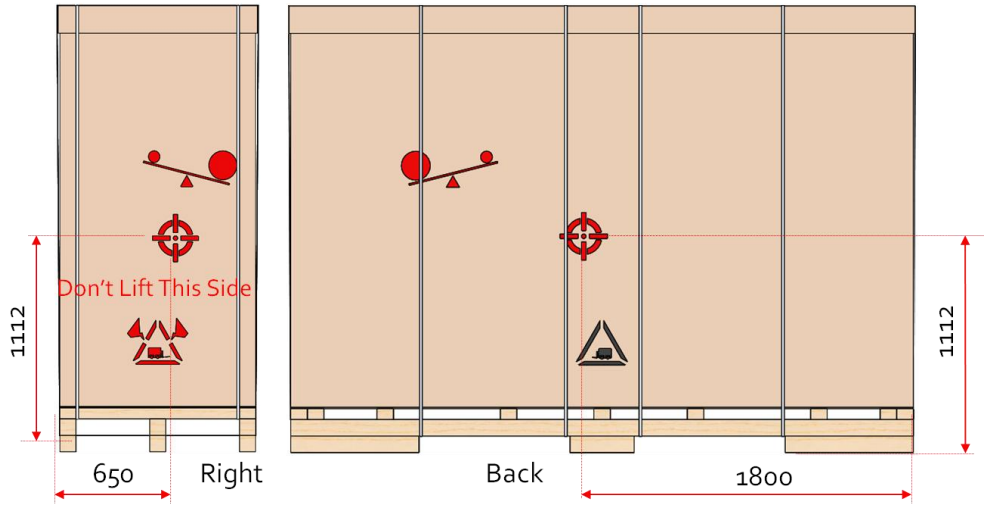



Figure 9: Centre of gravity by Rear side

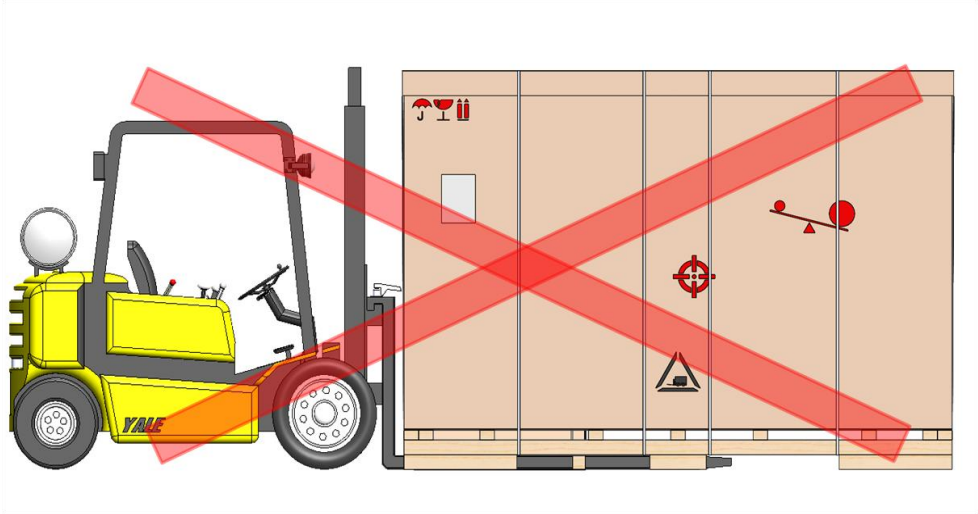
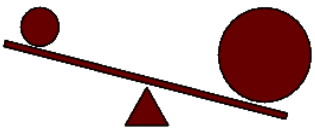



Figure 10: Don't lift by left side

Table 1: Symbols on the Packaging

| Symbol | Explanation |
|---|---|
| | Centre of gravity of the inverter. |
| | Can lift from this side of inverter. |
| | Don't lift from this side of inverter. |
|  | The centre of gravity is not center of inverter. |

# 5 Storage/Installation / Start-up

## 5.1 Storage

When inverter is stored the following conditions are required. If not, this may cause failures. The company will not be responsible for the problems if following condition is not observed.

- The unit should be stored indoor in its original packaging when it's being stored more than 6 months. If its original packaging is removed, it should be stored indoor in a cool, dry place.
- When the unit is stored outdoor, please keep the remained original packaging and do not leave the unit outside more than 3 days.
- Storage temperature: -20℃~+70℃
- When inverter is stored under high humidity condition for long term period, it has to be dried out sufficiently more than 1 day before connecting to the power.

| | ⚠ **CAUTION** |
|---|---|
| | **Inverter Storage Caution**<br>Inverters need to be stored at the correct temperature and correct humidity. If not, this may cause failures. |

## 5.2 Transporting the unit to the installation location

Once it has arrived at the installation location, the inverter may be transported using the designated crane or fork-lift. Please see below for references.

| | ⚠ CAUTION |
|---|---|
| | **Impact hazard, risk of breakage to the inverter**<br>The centre of gravity is located in the upper part of the inverter.<br>▪ Transport the converter in an upright position. |

### Transporting the inverter

**Transporting the inverter using fork-lift**

1. Remove the front and rear cover of base frame

**Transporting the inverter using the lift holes**

1. Installation is Possible in rain or snow
2. But Please refrain from installing the product in bad weather such as storm, heavy rain and heavy snow
3. Transport the inverter in an upright position
4. Position the crane at the middle of the unit
5. Hook suitable lifting ropes in the crane
6. Connect the rope to the eight holes on the top
7. The rope length : 700mm or over, 30deg or less

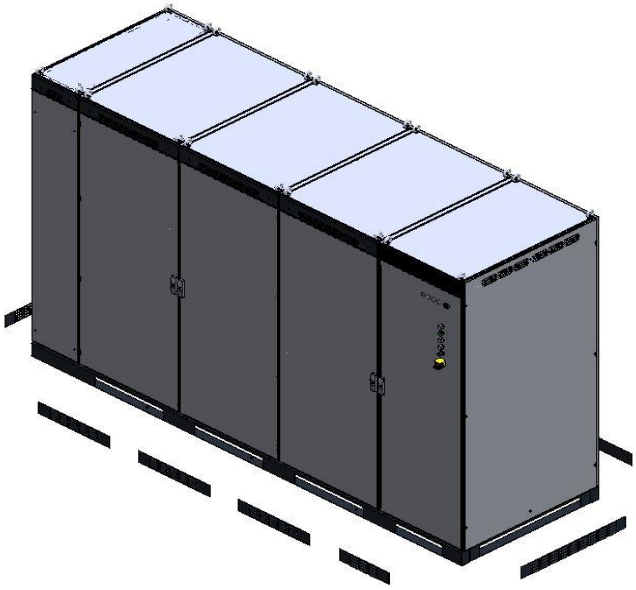


Figure 11: Transporting the inverter using fork-lift.

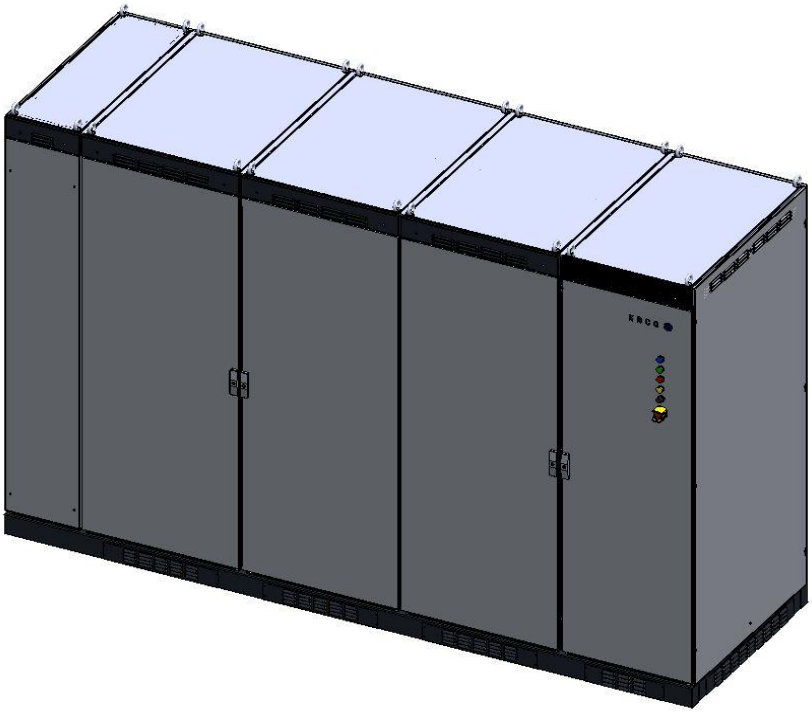


Figure 12: Transporting the inverter using crane_1

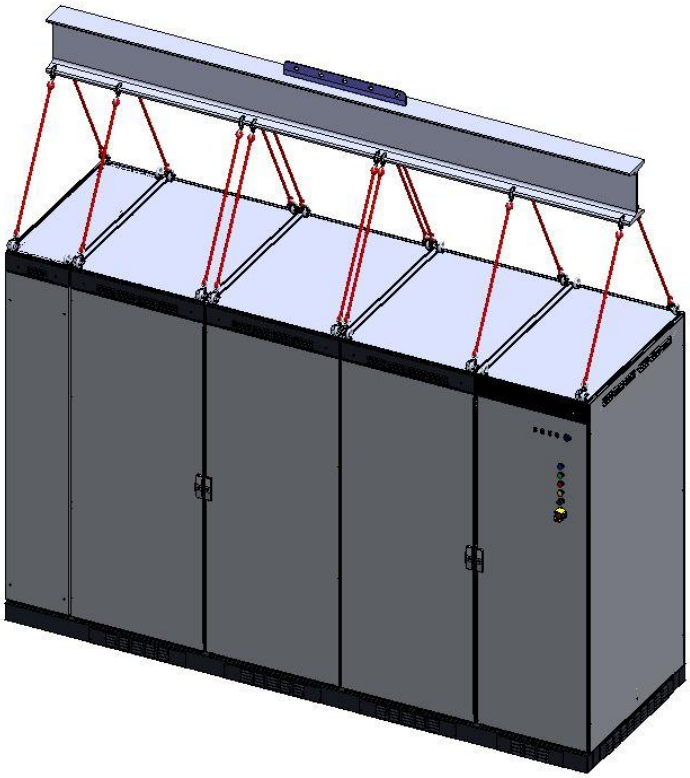


Figure 13: Transporting the inverter using crane _2

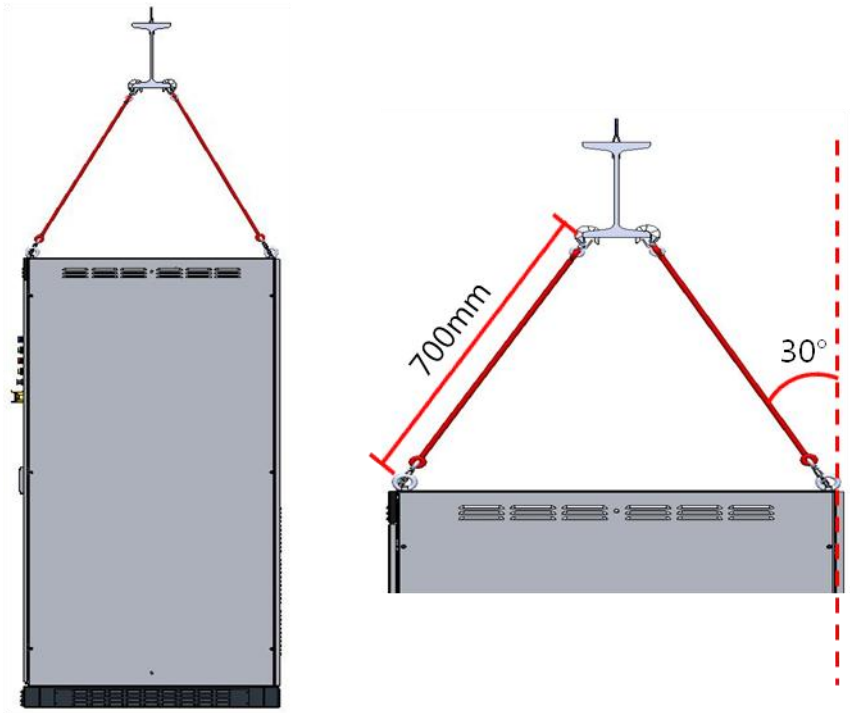



Figure 14: Transporting the inverter using crane _3

## 5.3 Selecting the installation location

| | NOTE |
|---|---|
| | Before installation, please check load capacity and clean surface on the floor<br>The place of installation must ensure proper heat dissipation.<br>The maximum flow rate of the cooling air is 6,300m3 per hour<br>Please keep this value in mind when you select the installation location. |

| | DANGER |
|---|---|
| | **Risk of fatal Injury from fire or explosions**<br>Fire caused by flammable or explosive materials in the vicinity of the inverter can lead to serious injuries.<br>▪ Do not mount the inverter in an area at risk of explosion or in the vicinity of highly flammable materials. |

Figure 15: Ventilation for the inverter.

## 5.4 Connecting the conduit

In this section, see how to insert the cables in the inverter and where to punch the holes for the conduit fittings.

| | NOTE |
|---|---|
| | When installing, please be cautious that water is not able to enter into the inside of the cabinet.<br>Moisture can affect the performance of the inverter through improper conduit or hubs.<br>Conduit area has to be sealed to protect from dust and water.<br>(according to IEC60529 IP21.) |

There are two ways of connecting cables shown in the following figures.

The field wiring area is designed for DC cable, AC cable and data cables.

The conduit entry points can be used for any cables. Example: DC conduit is on bottom of left side and AC conduit is on bottom of right side.

**Using the DC conduit panel and AC conduit panel for cables.**

1. Remove the bolts which secure the plate to the inverter.
2. Remove the plate.
3. Mark all the holes for the conduit. You need conduit for AC, DC and data cables.
4. Punch holes for the conduit.
5. Attach the plate to the inverter.
6. Attach the bolts and tighten.
7. Ensure that proper conduit duct sealant is used to prevent rodent and insect infestation.
8. The bottom plate must be secured in place during operation. If conduit is used, the proper conduit fittings must be used.

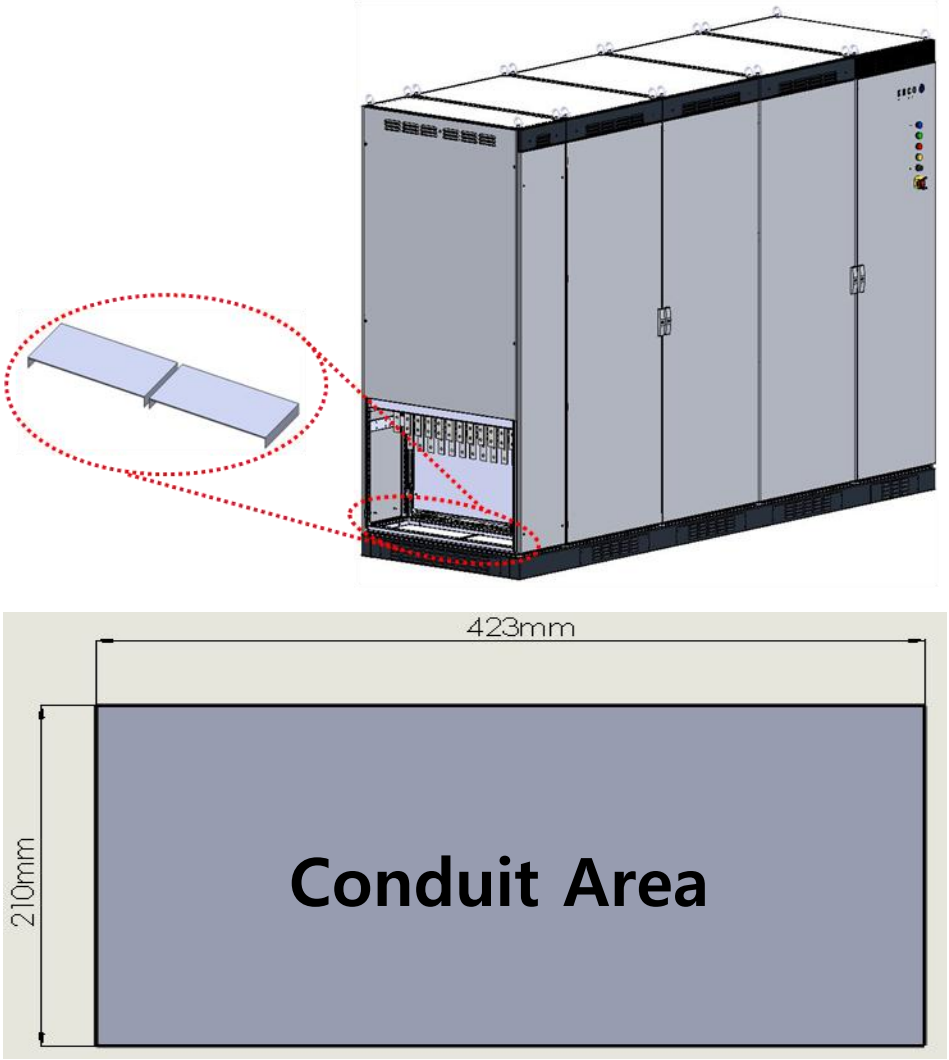



Figure 16: DC conduit is on bottom of left side. (Thickness : 1.6mm)

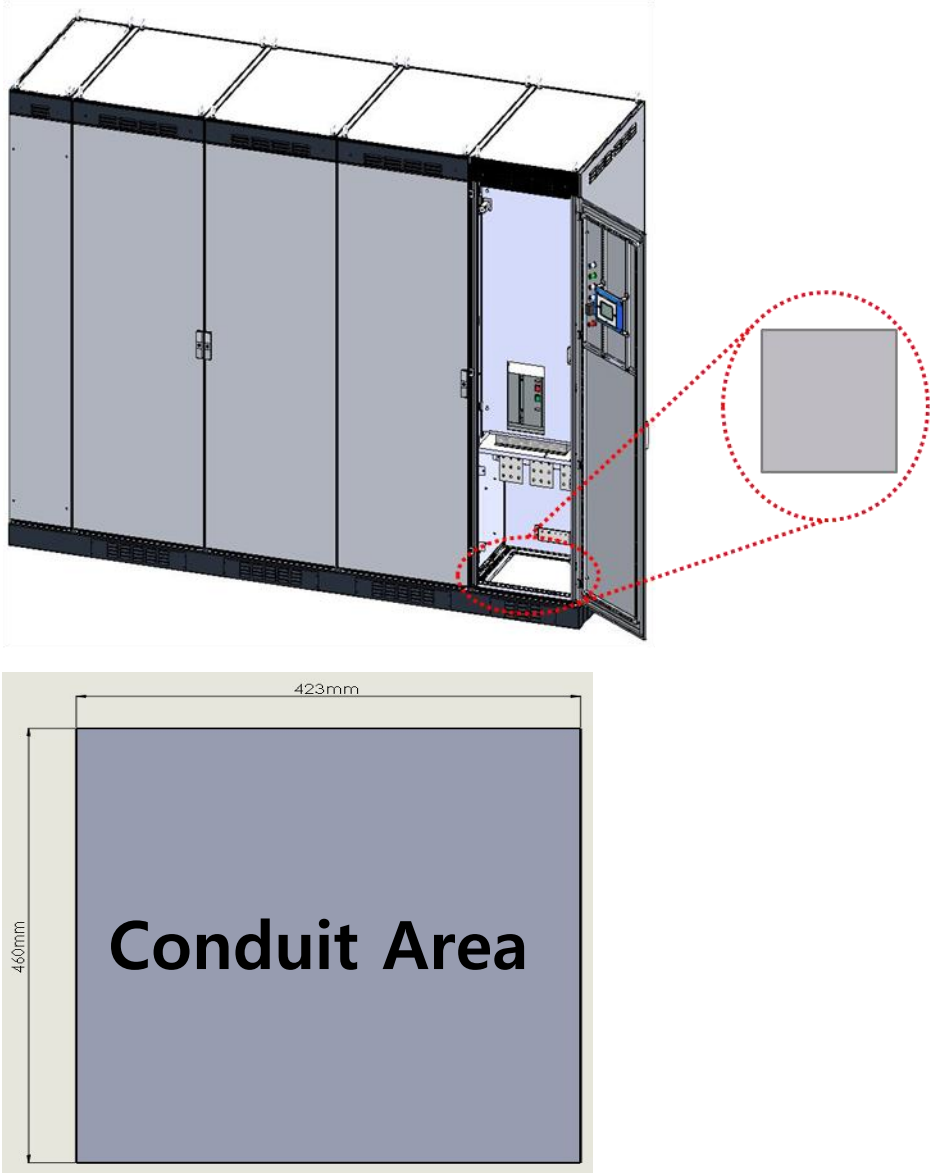



Figure 17: AC conduit is on bottom of right side. (Thickness : 1.6mm)

## 5.5 Electrical connection

| | DANGER |
|---|---|
| | **Lethal voltages are still present in the terminals and lines of the converter even after the converter has been switched off and disconnected!**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open, install and maintain the inverter.<br>▪ Use extreme caution when working on the unit.<br>▪ Disconnect the generator and grid sides.<br>▪ Secure them against being inadvertently switched back on.<br>▪ Connect the converter only after the aforementioned steps have been taken. |

### Protective earth connection

The protective earth connection is located in the right side of the housing, at the bottom.

PE cable must be chosen according to local requirements.

### Connection data

| | |
|---|---|
| Cable lug hole size | 10mm ~ 12mm |

**Earth the inverter**

1. Determine the lay-out of the permanent wiring.
2. Secure the protective earths (tightening torque for PE terminals: 25Nm). Do not use plug connections.
3. Check whether all connected cables are securely attached and protected from mechanical forces.
4. Attach the cover.

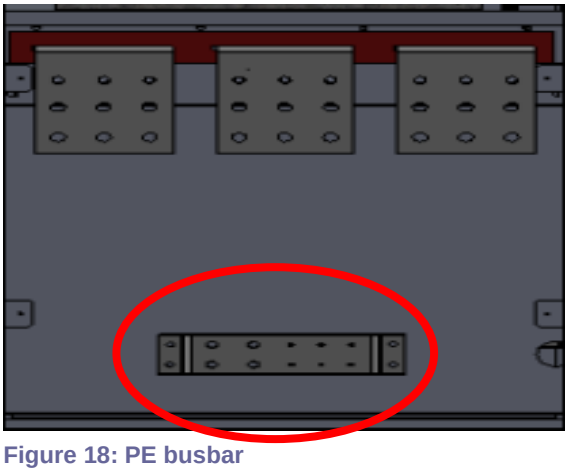


Figure 18: PE busbar

## Connecting to the external transformer (AC connection)

The inverter is connected to the power grid using a 3-phase connection. The connection for the power grid is located in the right side of the housing, at the bottom.

Use the screws that are supplied to screw down the bus bars on both sides.

We declare the inverter BP1000/875/750 TL3 ID DE be connected only to supply with system impedance no more than 0.0045ohm. Restrictions to connection may be imposed by the supply authority on the use of equipment if the actual system impedance at the interface point on the user's premises exceeds 0.0045ohm.

## Connection data

| | |
|---|---|
| Number of AC Cables (U,V,W) | 3 |
| Max. Cable diameter for each phase | 240mm$^2$ x 6 |
| Tightening torque for AC terminal connections | 43Nm |
| Cable lug hole size | 12mm ~ 14mm |

### Connect the cables

Each cable corresponds to one phase.

1. Guide the cables through the opening. Be sure to connect each of the cables to the correct terminal.
2. Screw down the cables.
3. Check to make sure that all of the cables are securely attached.

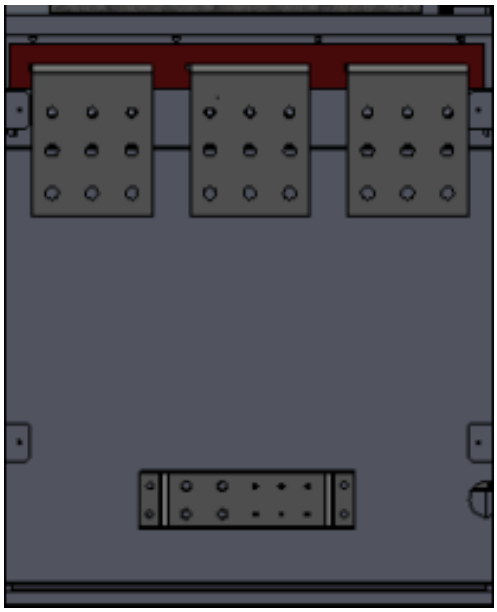


Figure 19: AC connection

## Requirements for cable routing between transformer and inverter (AC connection)

| | ⚠ WARNING |
|---|---|
| | **Fire hazard due to overheating of cables**<br>Differing cable lengths result in overheating of the cables.<br>▪ All line conductors from the inverter to the transformer must be of the same length. |

The followings are requirements for avoiding current imbalances and cable overheating;

- The minimum size of conductor must be designed based on table24 of IEC62109-1 2010.
- The AC cables must be bundled in a three-phase system.(Required to use cables of the equal type, diameter and length)
- Between the transformer and the inverter there must be four separate cable routes for the AC cables.
- Lay one A, B and C line conductor in each cable route. Ensure that the distance between the cable bundles at least doubles the cable diameter.

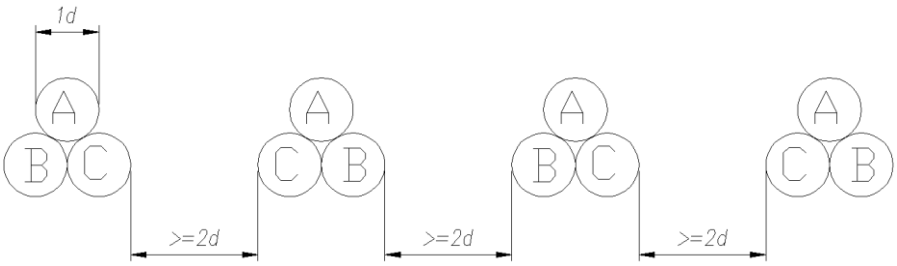



Figure 20: Arrangement of AC cables with 4-cable-per-line conductor (example)

## Connection for the PV generator (DC connection)

The DC connection is located in the left side of the housing, at the bottom.

## Connection data

| | |
|---|---|
| Tightening torque for DC terminal connections | 43Nm |
| Max. Cable diameter for each fuse | 240mm$^2$ x 2 |
| Cable lug hole size | 12mm ~ 14mm |
| Fuse protection for DC connection | Up to 250A, 1100V<br>12 fuses each for DC+/DC- |

## Option (400A)

| | |
|---|---|
| Tightening torque for DC terminal connections | 43Nm |
| Max. Cable diameter for each fuse | 300$mm^2$ x 2 |
| Cable lug hole size | 12mm ~ 14mm |
| Fuse protection for DC connection | Up to 400A, 1100V<br>9 fuses each for DC+/DC- |

**DANGER**

**Lethal voltages in the PV system**

Lethal voltages are present in the PV system.

- Make absolutely sure that the + and – are properly insulated.

### Connect the cables

Each cable corresponds to a specific pole.

1. Connect the cables to the poles. Make sure the polarity is correct.
2. Screw down the cables.
3. Check to make sure that all of the cables and seals are securely attached.

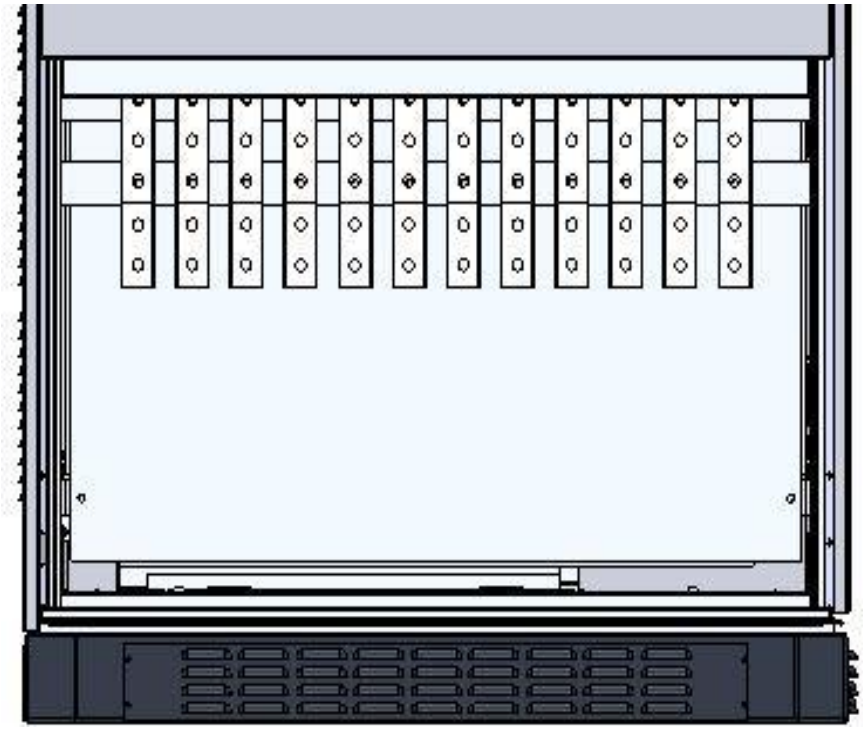


Figure 21: DC connection

| | NOTE |
|---|---|
| | Use only optional earthing kit to earth the PV generator |

## Design Guide of MVT

The selected medium voltage transformer that is connected to the BP 1000/875/750 TL3 ID DEXy must comply with the following technical specification: "Design guide of MVT for KACO Central Inverter".

## 5.6 Start-up

Before starting the inverter, if components are condensed inside the inverter or have been stored in a highly humid air for a long time, it has to be dried out completely for more than a day, otherwise it will cause failure. After that the circuit breakers must be switched ON to start the inverter, which also switches on the control circuits.

| | DANGER |
|---|---|
| | **Lethal voltages are still present in the terminals and lines of the inverter even after the inverter has been switched off and disconnected!**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open, install and maintain the inverter.<br>▪ Keep all doors and covers closed when the unit is in operation.<br>▪ Do not touch the lines and terminals when switching the unit on and off! |

### Switch on the circuit breakers

| Step | Check | Action |
|---|---|---|
| 1. Fuse F1,2,30,31,38,39<br>Circuit breakers CB32,34,35, 40 | ON | ▪ Proceed to Step 2 |
| | OFF | ▪ Switch on,<br>Then proceed to Step2 |
| 2. Circuit breakers MCB21<br>Disconnect switch<br>DS10-1, DS10-2, DS10-3<br>Circuit breakers CB20 | ON | ▪ Proceed to Step 3 |
| | OFF | ▪ Switch on,<br>Then proceed to Step3 |
| 3. Circuit breaker CB37 | | ▪ Switch on<br>Then proceed to Step4 |
| 4. Key switch | ON | ▪ Inverter ON |
| | OFF | ▪ Inverter OFF |

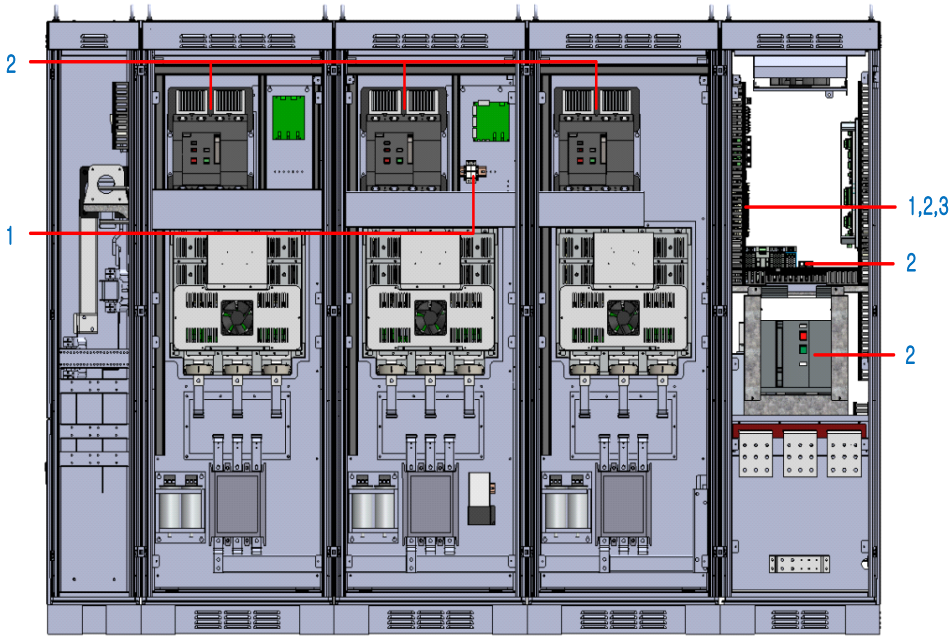



Figure 22: BP1000/875/750 TL3 ID DEXy (interior view)

| Key |
|---|
| 1. Fuse F1,2,30,31,38,39<br>Circuit breakers CB32,34,35, 40 |
| 2. Circuit breakers MCB21<br>Disconnect switch<br>DS10-1, DS10-2, DS10-3<br>Circuit breakers CB20 |
| 3. Circuit breaker CB37 |

When voltage is present at the inverter, it can be started up. Use the HMI interface to start up the inverter.

The inverter begins operation in a specified sequence. For more information, see section 5.2 (“Transporting the unit to the installation location”)

If a fault occurs, the inverter cannot begin operation. For more information on faults, see section 6 (“Faults and Warnings”).

| | NOTE |
|---|---|
| | If the fault cannot be reset using “Fault reset” please contact our service department. |

## 5.7 Operation

| | DANGER |
|---|---|
| | **Lethal voltages are still present in the terminals and lines of the inverter even after the inverter has been switched off and disconnected!**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open, install and maintain the inverter.<br>▪ Keep all doors and covers closed when the unit is in operation.<br>▪ Do not touch the lines and terminals when switching the unit on and off! |

### Operating states

The KACO inverter has ten operating states. The explanations about each state are below.

1. **Disconnected (default):** Before operation has commenced the inverter is in the disconnected state. In this state, the inverter is totally isolated from the utility grid.

   **One of “Wait” or “Connecting to PV Array” sequence is determined according to DS10.**

2. **Manual DS10 - Wait:** When the inverter is in the "Disconnected" state and the DC switch is closed, the ‘Key Switch On’ command is operated and the PV voltage is kept above 400V for 5 seconds, the system enters into the “Wait” state.

3. **Automatic DS10 - Connecting to the PV array:** When the inverter is in the "Disconnected" state, the ‘Inverter On’ command is operated and the PV voltage is kept above 400V for 5 seconds, the system turns on the PV Array side contactor (PV_MC).

4. **Pre-sync. to grid:** When the inverter is in the "Wait" state and the PV voltage is kept above the value "MPPT V start" parameter during the time set by "MPPT T start" parameter, the inverter system enters into the "Pre-sync. to grid" state. In this state, the inverter voltage synchronized with grid voltage during “IINV PLL Stabilize Time” by setting parameter.

5. **Connecting to Grid:** when the inverter is in the "Pre-Sync. to grid" and above the set time "IINV PLL Stabilize Time", the contactor on the grid side is turned on. The inverter keeps this state for 0.5 seconds.

6. **Initializing MPP:** The inverter calculates the MPPT start voltage which is product of measurement of PV voltage and the parameter “MPP Factor”. After 5 seconds, the inverter system enters into the "MPP start" state.

7. **MPP start:** In this state, the inverter controls the PV voltage. Reference of the PV voltage is determined by MPPT start voltage which is calculated at “Initializing MPP” state.

8. **MPPT:** If the PV voltage approximates the MPP start voltage (value of “MPPT V Start” parameter), the MPPT will start. The inverter follows the MPP target value automatically, which is varied by irradiance values. If the MPP target value is out of the allowable MPPT range ([MPP start voltage – MPP Range lower] ~ [MPP start voltage + MPP range upper]), the system will return to the “Initializing MPP” state and will recalculate the MPPT start voltage.

9. **System stop:** When the “Key Switch Off” command is operated, the Grid side contactors are turned off and the system stops. If the output power of inverter is kept below value of “MPPT P stop” parameter during time of “MPPT T stop” parameter, connection to the grid is terminated.

10. **Fault:** If a fault occurs during operation, the system stops. The system resets the fault and tries to remove the fault. In the case that system removes a fault successfully, system restarts all by itself. The system tries to remove the fault at intervals of “MPPT Start” parameter since the last try until trial count reaches to the number set in an “Auto Fault Reset Count” parameter. After the number reaches to the “Auto Fault Reset Count” parameter, the system will log an error and the system will not try to restart.

| | **NOTE** |
|---|---|
| | If The System doesn't try to remove the fault, please contact our service hotline |

## Overview of operating states

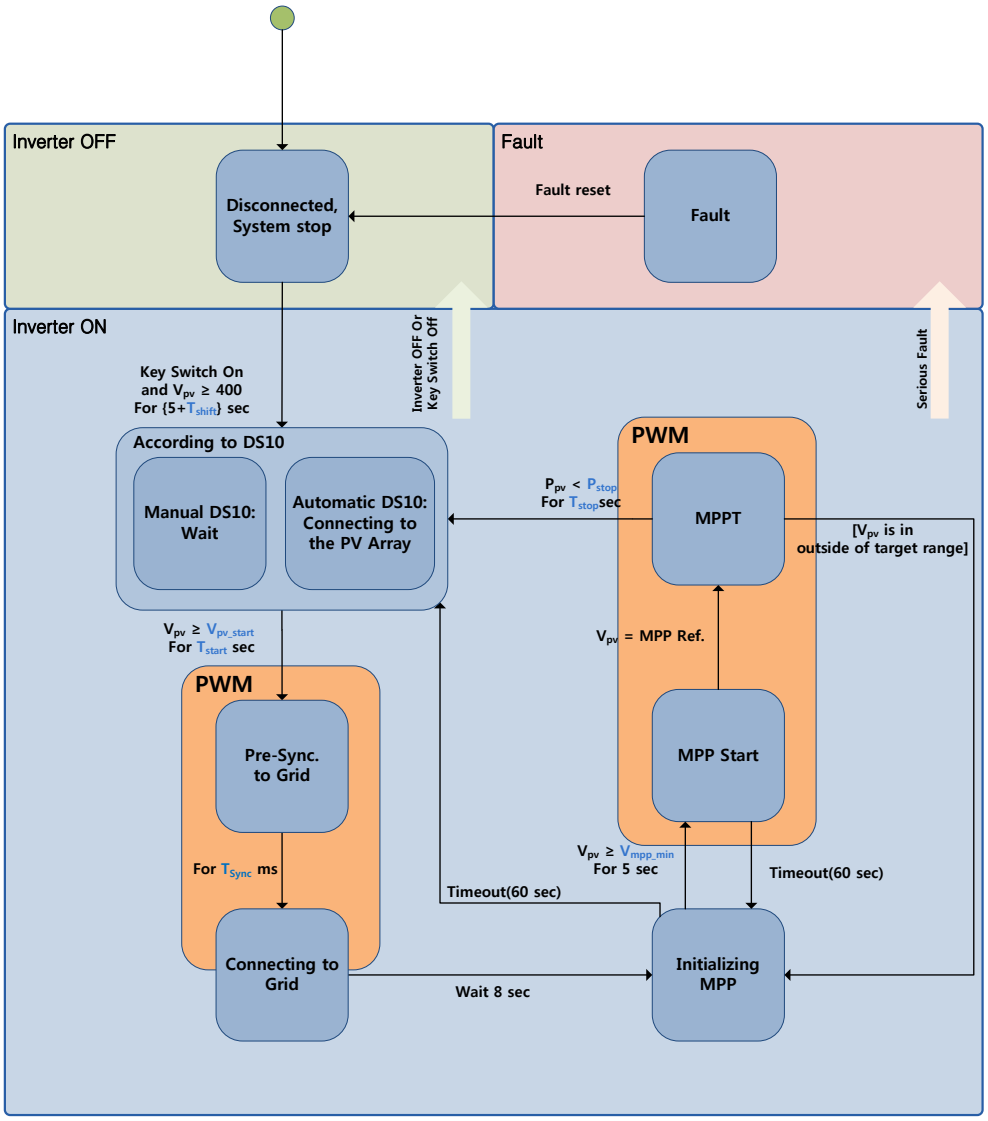



Figure 23: Overview of operating states

Table 2: Parameters of operating states

| Tab | Name | Number | Parameter | Min | Max | Unit |
|---|---|---|---|---|---|---|
| PV Array | Vpv_start | 2 | MPPT V Start | 200 | 800 | V |
| | Tstart | 3 | MPPT T Start | 0 | 3600 | sec |
| | Pstop | 4 | MPPT P Stop | 0 | 10000 | W |
| | Tstop | 5 | MPPT T Stop | 0 | 600 | sec |
| | Vmpp_min | 6 | MPPT V Minimum | 200 | 800 | V |
| Grid | Tshift | 9 | Time Shift | 0 | 6000 | sec |

## Run/Stop Condition

The outdoor type inverter supports On/Off function using Key Switch and CMT software. The states about each condition are below sequence diagram.

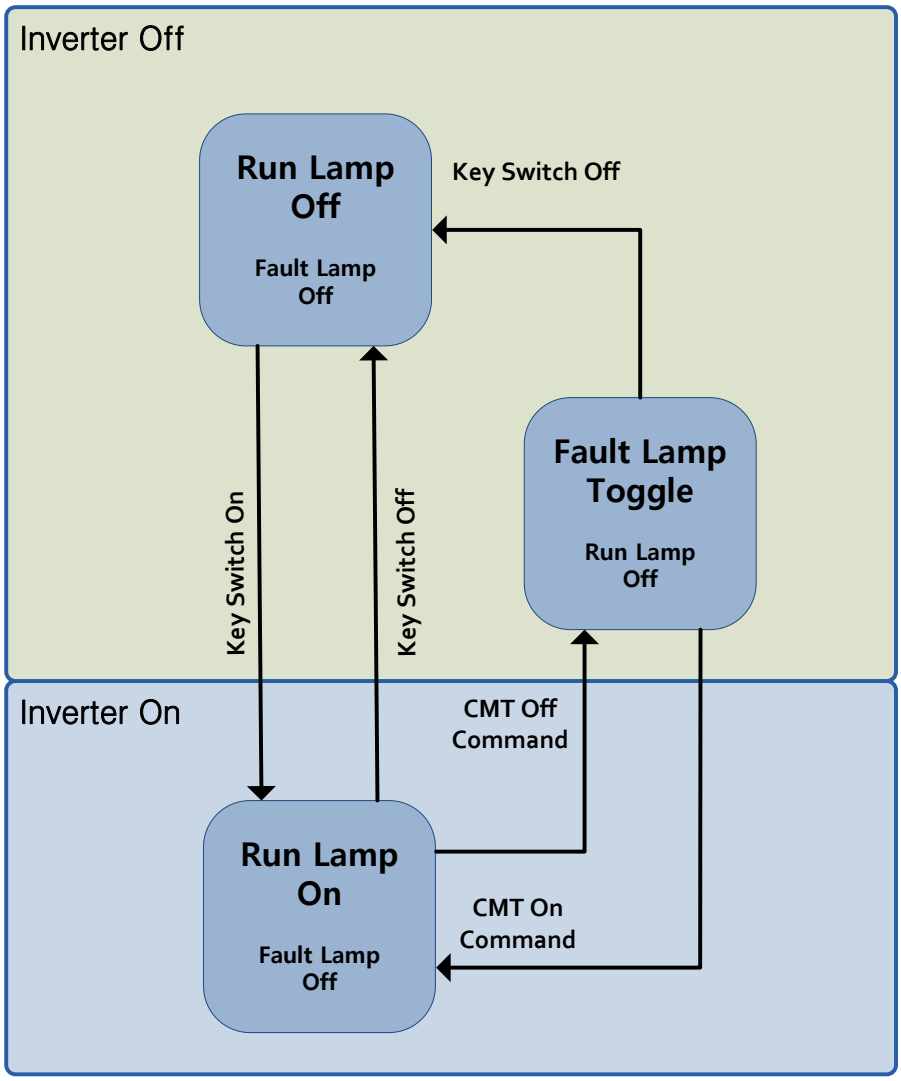



Figure 24: Run & Stop Condition about Key Switch & CMT

The KACO inverter can be turned on & off using only Key Switch, and can be turned off through 'Off' command of CMT. If the inverter is turned off by 'Off' command of CMT, the Fault Lamp is toggled. Because the Key Switch is on state. And it is turned on by 'On' command of CMT or to turn off & on by Key Switch.

## 5.8 User interface

The HMI has a graphic interface which you use to monitor and control the inverter. The HMI has the following functional features:

- HMI is located on the inside of inverter. In order to view the HMI LCD screen, Using CMT or Key-Switch to Stop inverter. And then open the AC part door.

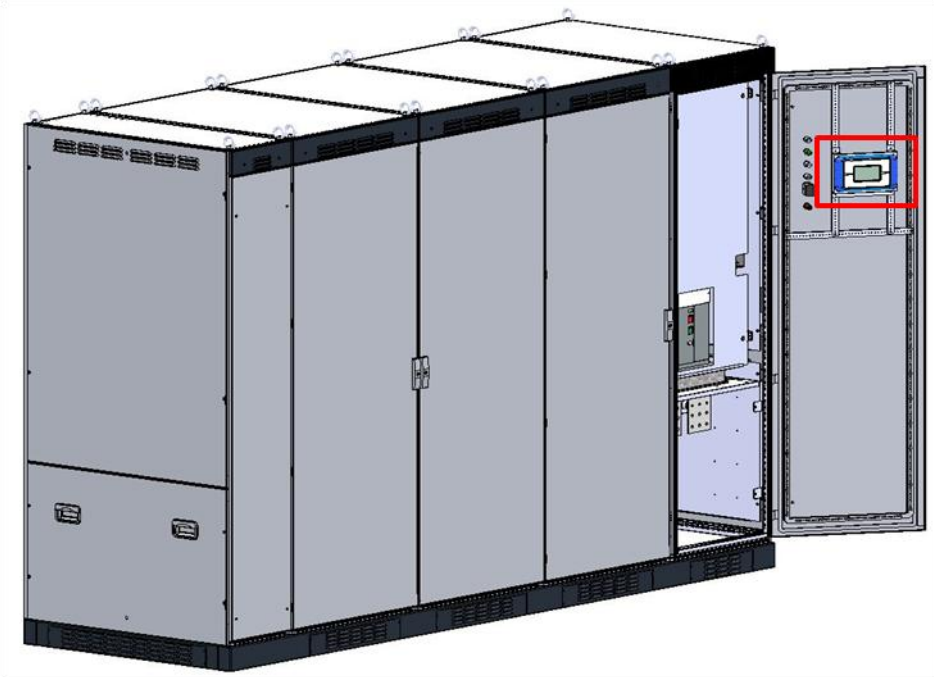


Figure 25: Installed position of HMI

- The LCD screen displays the states of inverter, along with voltages, currents, frequencies, temperatures, output powers, status of errors/warning messages, and events. Pressing the HMI touch screen switches on the LCD backlight. If the display is not activated within five minutes, the LCD backlight switches automatically off.
- Touch screen for navigating through the menus SD card: the HMI continually records data to the SD card. When recording once every 10 minutes (around the clock), the maximum amount of data per year is 360 KB. When the SD card is full, the oldest data is overwritten.
- Configuration of country-specific settings (power grid standard, maximum/minimum voltage/ frequency)
- Ethernet interface for monitoring and service, network connection for remote use
- RS485 interface for logging and transferring data
- USB interface for connecting external units (e.g. laptop computer)

Figure 26: Front of the HMI

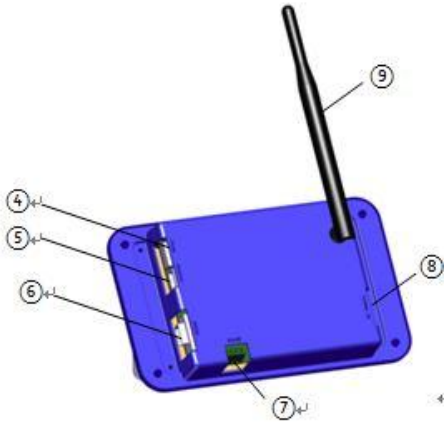



Figure 27: Rear of the HMI

| Key | |
|---|---|
| 1 Protective cover | 6 RS232 interface (internal interface) |
| 2 HMI touch screen, LCD | 7 RS485 interface |
| 3 USB interface | 8 SD card |
| 4 Power connection | 9 Wi-Fi Antenna |
| 5 Ethernet interface | |

## 5.9 HMI menu structure and details

The HMI menu is structured hierarchically.

The blue areas (rounded corners) are functions that are activated by pressing a button.

The green areas (square corners) are windows with additional content, such as submenus, measured values and buttons. These functions are reserved for authorized electricians.

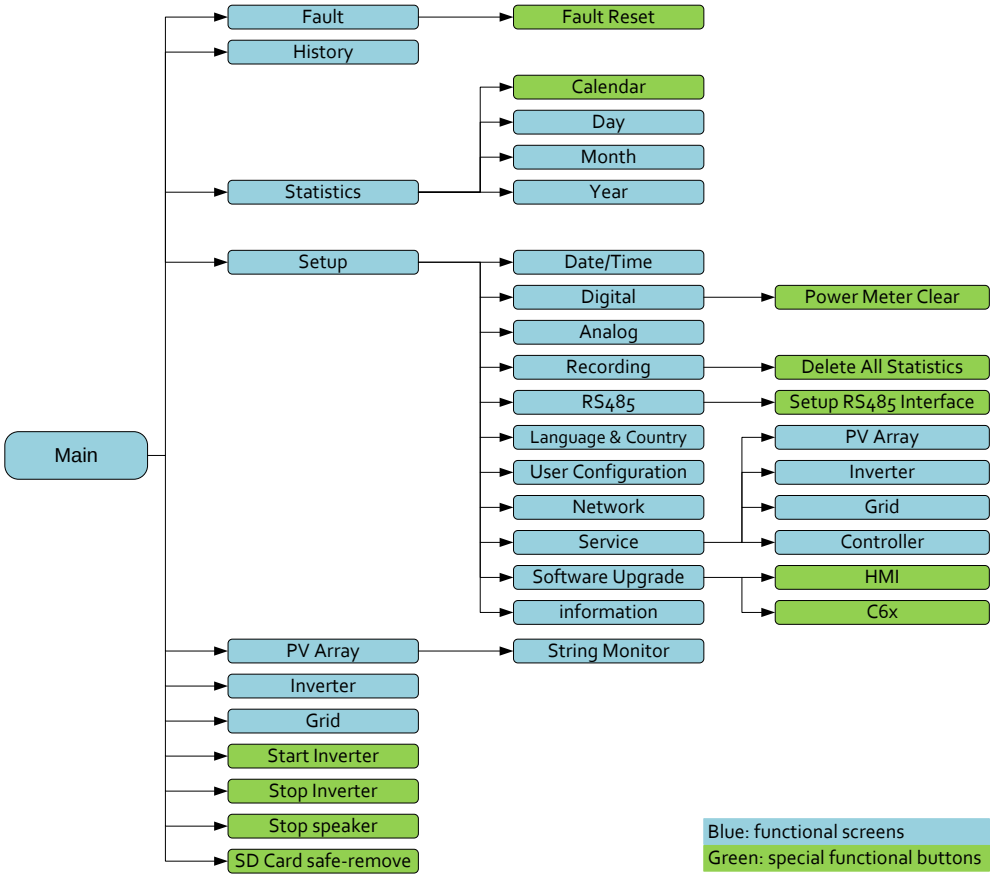



Figure 28: HMI menu structure

## 5.10 HMI main menu

Figure 29: Display when the HMI starts up

Table 3: Displayed button colors

| Color | Meaning |
|---|---|
| **Green** | Normal Operation |
| **Red** | Fault (not for switches DS10, MC21, CB20) |
| **Gray** | Not in use |

## Changing the SD card, status display

| | DANGER |
|---|---|
| | **Lethal voltages are still present in the terminals and lines of the inverter even after the inverter has been switched off and disconnected!**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open. Install and maintain the inverter.<br>▪ Do not touch the lines and terminals when view the HMI screen. |

If you want to view the HMI screen, you have to turn inverter off using the Key Switch and open the AC part door. After HMI screen check, Please close the inverter and start it up using the Key Switch.

**Insert the SD card**
**“No SD in slot” icon**

1. Open the inverter. The inverter shuts down.
2. Slide the SD card into the slot until it locks into place.
3. Close the inverter and start it up.
4. Press the ON button. The inverter starts up.

**“SD card in slot” icon**

**The inverter checks the card. If the SD card was detected, the “SD card in slot” icon appears in the lower right-hand corner of the display.**

1. Press the SD card icon.
2. Wait until the SAFE icon is displayed.

**Remove the SD card**
**“Data was saved to the SD card” icon**

**You can remove the SD card. The icon is displayed for one minute.**

1. Open the inverter.
2. Remove the SD card by gently pressing and then releasing it. The SD card will pop out slightly. You can now remove it.
3. Close the inverter and start it up

| | NOTE |
|---|---|
| | Do not remove the SD card until the SAFE icon is displayed so that it will be detected by the HMI when reinsert it. |

## Status display for speaker

| | |
|---|---|
| | Audible signal when you press the LCD screen |
| | No signal |

## Using the main menu

Table 4: button function

| Press button | Result/Function |
|---|---|
| **PV Array** | The measured values for the PV generator are displayed |
| **Inverter** | The measured values for the inverter are displayed |
| **Power grid (AC connection)** | The measured values for the power grid are displayed |
| **ON** | Switches on the inverter |
| **OFF** | Switches off the inverter |
| **Speaker** | Switches speaker on/off |

## 5.11 HMI submenus

### PV Array

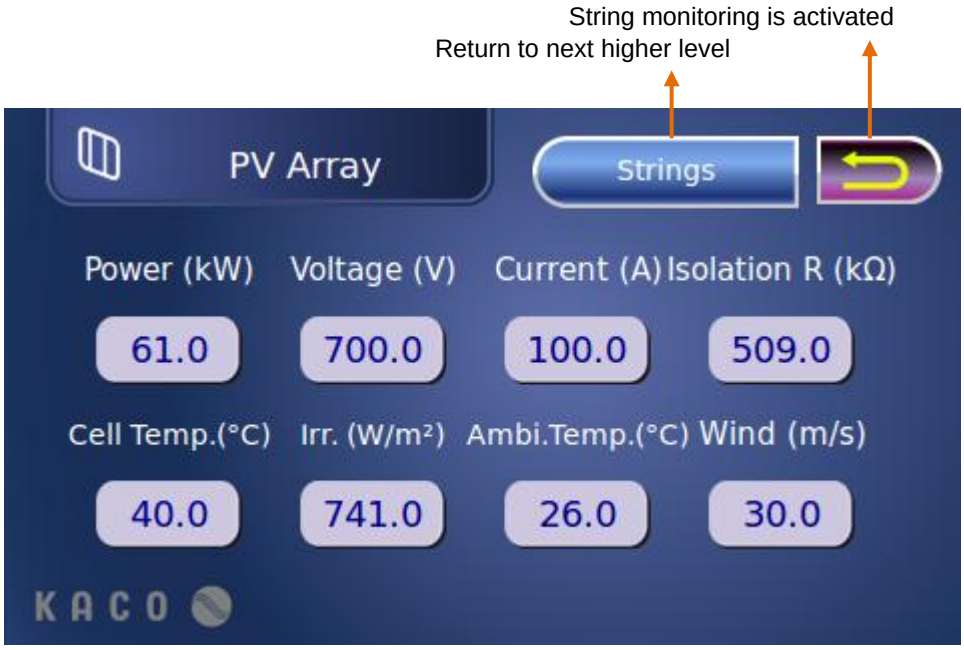



Figure 30: “PV Array” screen

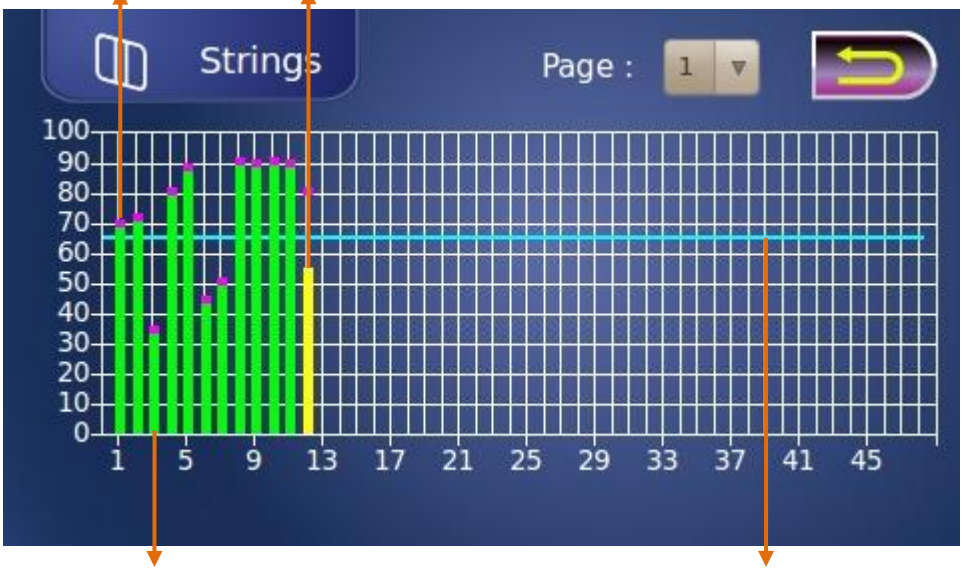
| Display | Meaning |
|---|---|
| **Measured values** | Current measured values for the PV Array |
| **Strings** | String monitoring is activated |

## String monitoring

Changes to the configuration for the current sensors first become effective after five minutes.

Magenta dots
Actual current values

Yellow bars
Average current values, faulty channel




Green bars
Average current values, functioning channel

Light blue line
Average of all channels

Figure 31: “String monitoring” screen

| Item | Description |
|---|---|
| **Current actual values (Magenta)** | Only current actual values are displayed during the first five minutes after the function has been activated. |
| **Average current values of the channels (Green)** | The actual values for the last five minutes are recorded (sampling period: every 30 seconds) |
| **Average of all current values(channels) (Light blue)** | Average of all current values (channels) |

If the average of one channel deviates from the average of all channels by more than the specified range of tolerance and if this persists for longer than a specified delay period, this channel is assumed to be defective.

## Inverter

Display measured values for the inverter.

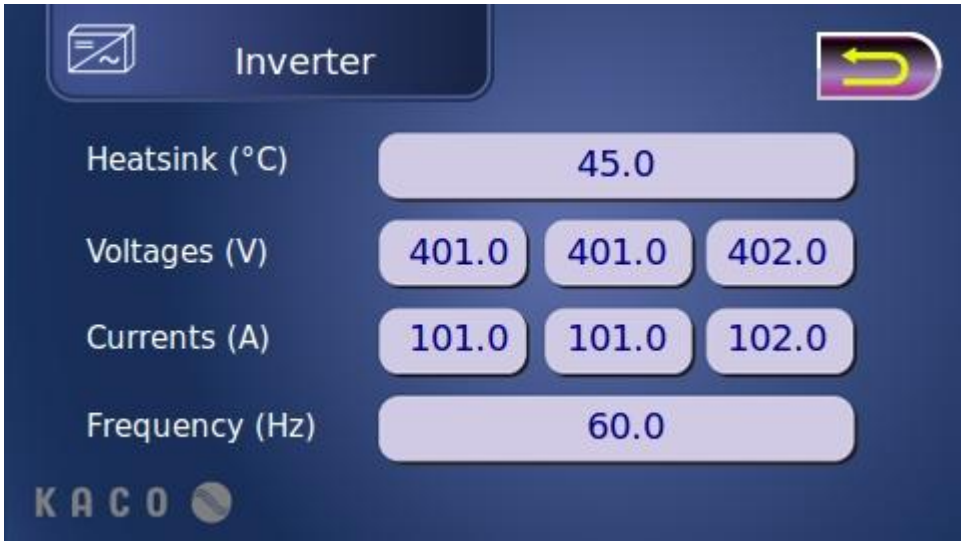



Figure 32: “Inverter” screen

## Power grid

Display measured values for the power grid.

Figure 33: “(Power) Grid” screen

## Faults and warnings

Display current faults and warnings.

Arrows, Scroll through several pages

Symbols for types of errors

Figure 34: “Fault” screen

### Correct current faults

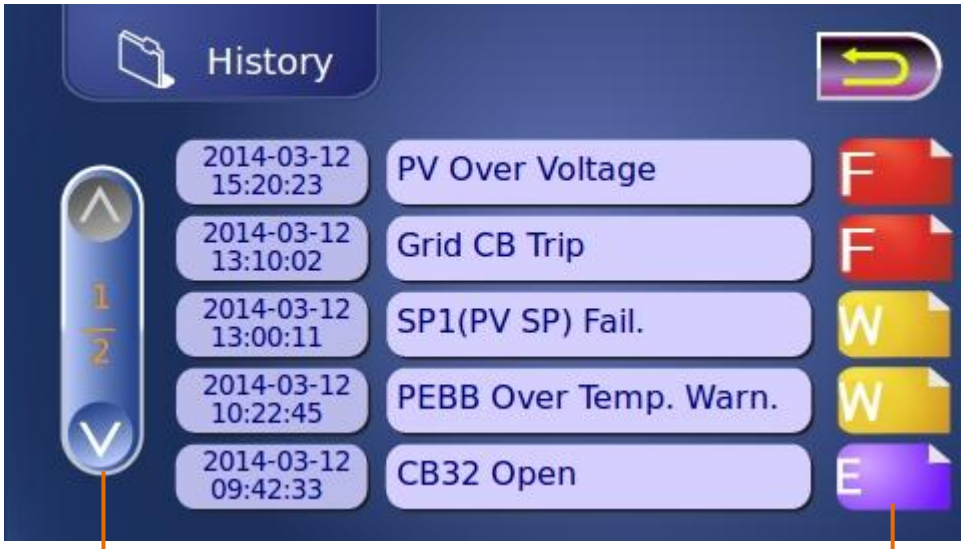
1. Press “Fault reset”

The control unit is instructed to correct current faults. After a few seconds have passed, the fault list is empty.

| Icon | Fault type |
|---|---|
| **F (red)** | Serious fault |
| **W (yellow)** | Warning |

## History

This screen displays a list with a maximum of 100 faults, warnings and events that most recently occurred in the inverter.




Arrows, Scroll through several pages

Symbols for types of events

Figure 35: “History” screen

| Icon | Fault type |
|---|---|
| **E (purple)** | Event |
| **F (red)** | Serious fault |
| **W (yellow)** | Warning |

## Statistics

The statistics function displays the data that was recorded on the SD card as a diagram.

Figure 36: “Statistics” screen

### Select time period

1. Select one of the three combination fields.
   - Day(daily statistics)
   - Month (monthly statistics)
   - Year (annual statistics)
2. Select a specific date.

Table 5: Statistic display

| Parameter | Day | Month | Year |
|---|---|---|---|
| Grid power | O | O | O |
| PV power | O | O | O |
| PV voltage | O | - | - |
| PV current | O | - | - |
| PV temperature | O | - | - |
| Insolation | O | - | - |
| Line voltage | O | - | - |

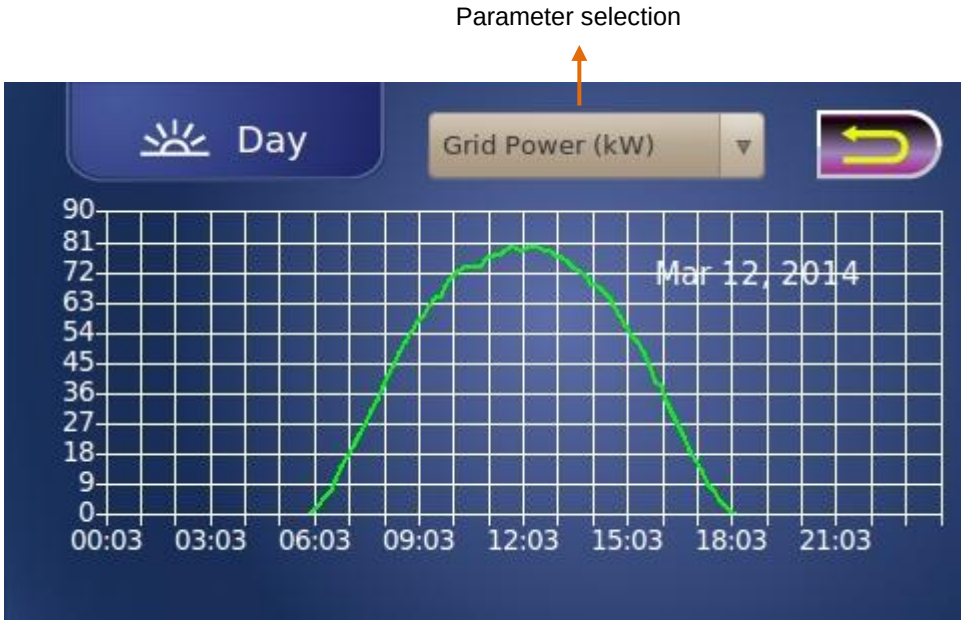



Figure 37: “Day” screen with daily statistics

Statistics are available as long as the relevant parameters were recorded. Recording is activated for all values by default. Monthly and annual statistics are recorded over the time period as cumulative values.

## Monthly statistics

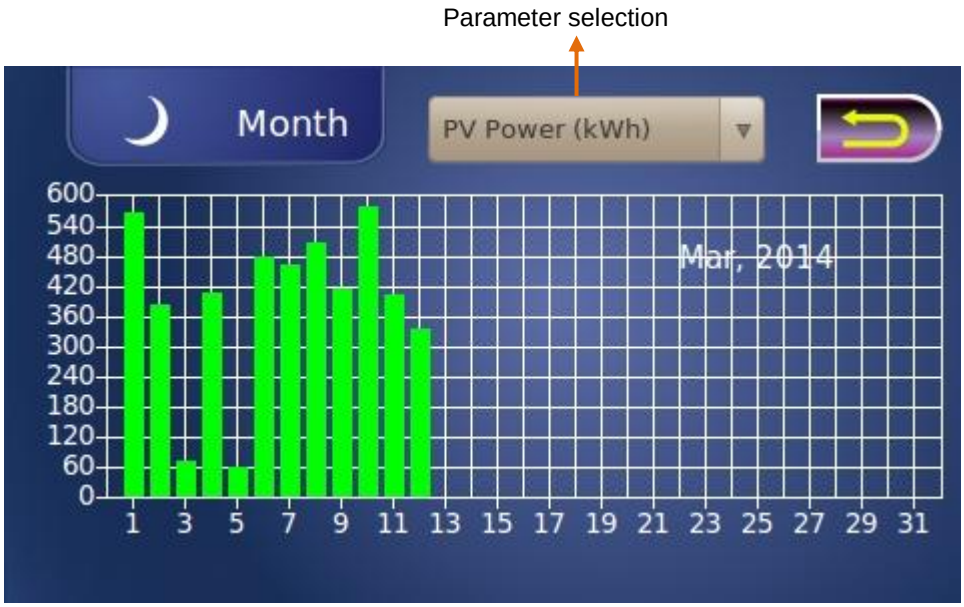



Figure 38: “Month” screen with monthly statistics

## Annual statistics

Figure 39: “Year” screen with annual statistic

## Settings

**Change settings**

1. Use this menu to change the settings that influence how the inverter operates.
2. Use the buttons in the upper right-hand corner to switch between the two screens.

Figure 40: “Setup (1/2)” screen

Figure 41: “Setup (2/2)” screen

## Date/Time

| | NOTE |
|---|---|
| | Set the current date and local time. This setting affects the logging functions(eventlog and statistics). |

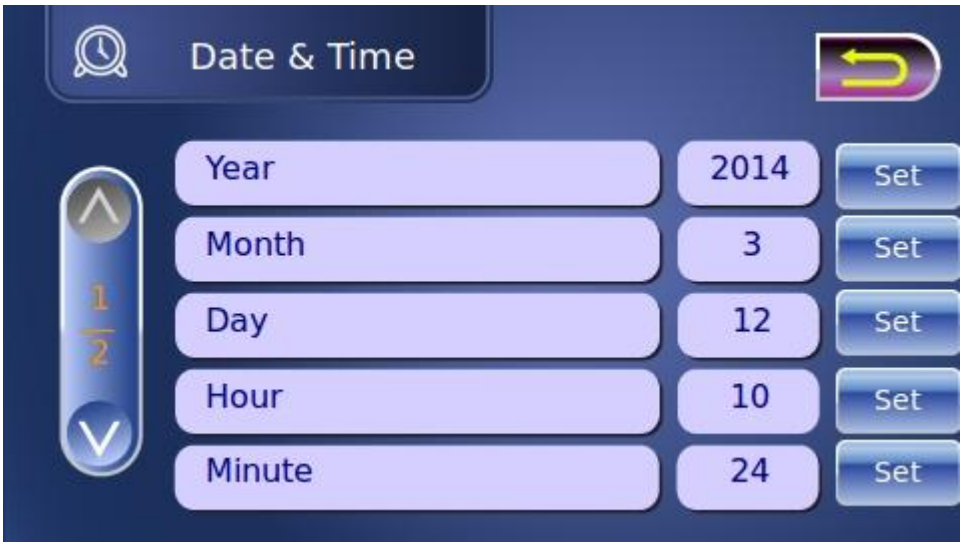



Figure 42: “Date/Time” screen

### Change system time

1. This is where you set the current date and local time.

After the values have been changed, it takes up to one minute for the time data that is displayed in the main menu to be updated.

## Recording

**Specify which values will be recorded**

1. Set the recording interval(in minutes)
2. On pages 1 and 2 you specify which values are to be recorded.

You can use this menu item to delete all of the statistics data on the SD card (if necessary).

Figure 43: “Recording” screen

## Recording settings

Table 6: Recording settings

| ID | Name | Unit | Factory setting | Min. | Max. |
|---|---|---|---|---|---|
| 0 | Recording Interval | minute | 10 | 10 | 60 |
| 1 | Grid Power | | ON | OFF | ON |
| 2 | PV Power | | ON | OFF | ON |
| 3 | PV Voltage | | ON | OFF | ON |
| 4 | PV Current | | ON | OFF | ON |
| 5 | PV Temperature | | ON | OFF | ON |
| 6 | Irradiation | | ON | OFF | ON |
| 7 | Grid Voltage | | ON | OFF | ON |
| 8 | Delete All Statistics | | N/A | - | - |

## Language and country settings

| | NOTE |
|---|---|
| | Improper parameters will render the system inoperable.<br>Make only the country-specific settings for your country. |

Figure 44: “Language & Country” screen

### Set languages

1. Press the appropriate button for your language. This sets the display language for the HMI.
   - Available languages: English, German, Spanish, Korean, French, Italian, Japanese.

### Set country-specific parameters

1. The country setting of the inverter is protected by password.
   - The Login session will be expired after 30 minutes.
   - Information regarding to password, Please contact KACO GSD.
2. Press the button that shows the flag of your country.
   - The parameters for the country-specific power grids are stored.
   - Available country : Germany, Spain, France, Italy, Korea, Greece, Czech, Cyprus, China, United Kingdom, Japan

## Network

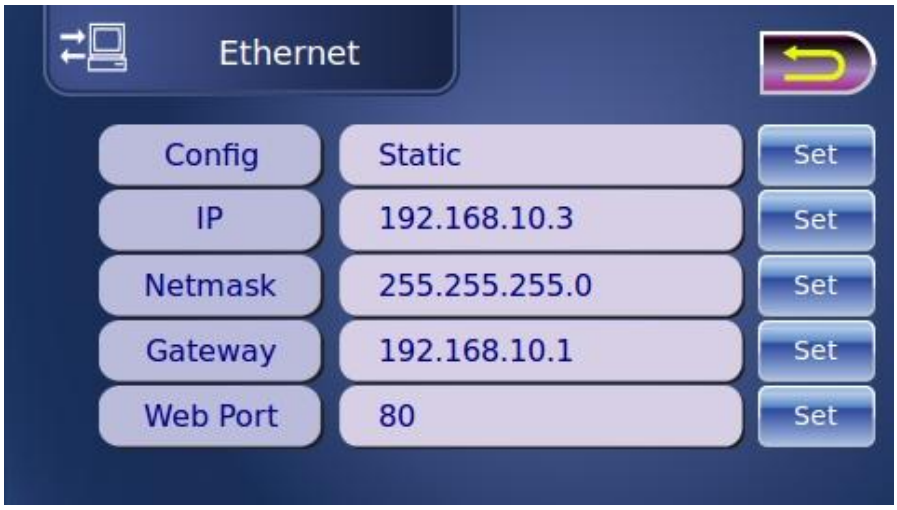



Figure 45: “Ethernet” screen

**Configure the network for the HMI**

1. Select static and dynamic IP addresses via DHCP service requests.
2. Change the web port used for monitoring the inverter via the web.
3. Open the web monitoring service using the HMI`s IP address and web port (e.g. http://192.168.10.3:80).

Figure 46: “WiFi” screen

**Configure the WiFi for the HMI**

1. Change the SSID used for monitoring the inverter via the Wireless.

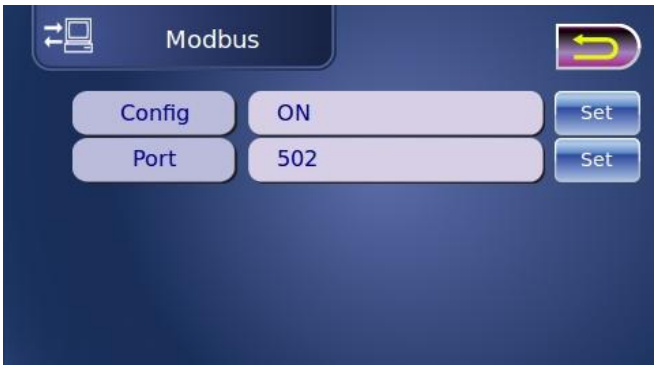



Figure 47: “Modbus” screen

### Configure the Modbus for the HMI

1. Open the Modbus communication service using the HMI`s IP address and port. (e.g. 192.168.10.3:502).

## Software upgrade

If an update is available (for example, when new functions are added), use the SD card to update the inverter software.

| | NOTE |
|---|---|
| SD SAFE | Do not remove the SD card until the SAFE icon is displayed so that it will be detected by the HMI when you reinsert it. |

### Update the HMI software

Perform the following steps in the indicated sequence:

1. Copy the software image file (*.img) to the SD card.
2. Insert the SD card into the HMI.
3. Select “Setup”-> “Software upgraded”
4. Select “HMI” and press “Start”
5. A dialog box is then displayed.

Confirm the message to indicate that you understand that this process cannot be undone and HMI will start upgrading.

6. Press the “Yes” button.

A dialog box for opening files is then displayed.

7. Select the image file that you copied earlier.
8. Press the “OK” button.

The HMI displays the progress of the upgrade. After a short period of time, the system is restarted.

| | NOTE |
|---|---|
| | If the image file is faulty, an error message is displayed and normal operation is resumed. |

Figure 48: Software upgrade screen

Figure 49: Confirm dialog box

Figure 50: Dialog box for opening files

Figure 51: HMI upgrade screen

| | ATTENTION |
|---|---|
| | **Software damage due to an interruption of the synchronization process**<br>If the synchronizing of the flash file system and the content of the SD card is interrupted (e.g. due to a power failure), the software can be damaged and the HMI may not be able to restart. |

## Update the C6x software

| | NOTE |
|---|---|
| | Do not remove the SD card until the SAFE icon is displayed so that it will be detected by the HMI when you reinsert it. |

### Update the C6x software

Perform the following steps in the indicated sequence:

1. Make sure that the RS232 cable between the HMI and the control unit is connected.
2. Switch off the inverter. To do so, press the OFF button in the main menu.
3. Copy the software file (*.hex) to the SD card.
4. Insert the SD card into the HMI.
5. Select “Setup” → “Software upgrade”.
6. Select “C6x” and press “Start”.

A dialog box for opening files is then displayed.

7. Select the file that you copied earlier.
8. Press the “Open” button.

The HMI transfers the file to the control unit. If the file transfer was successful, the following message will appear:
“HMI has finished upgrading XCU.”
The control unit has now been successfully upgraded.
An error message indicates that the process was not successfully completed.

9. Press the ON button in the main menu to activate system operation.

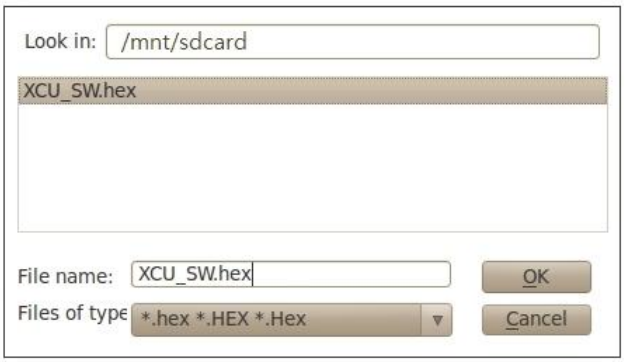



Figure 52: Dialog box for opening files

Figure 53: C6x upgrade screen

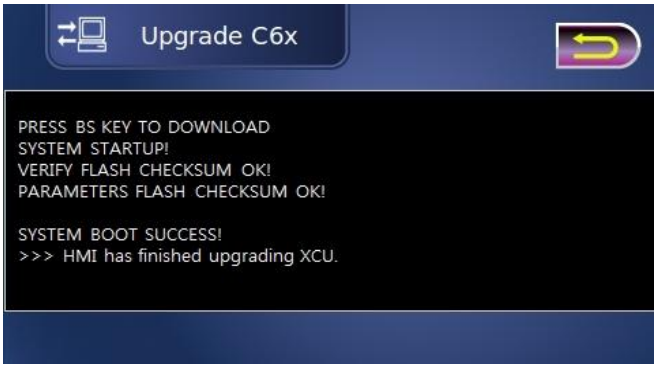



Figure 54: C6x upgrade screen (complete)

| | NOTE |
|---|---|
| | Communication between the HMI and the control unit (XCU) is interrupted during the upgrade process and automatically resumes once the download is complete. |

## Other menus and details

Some menus can only be accessed by service technicians from KACO new energy Inc. and are therefore not described in this manual.

## 5.12 Connecting to inverter via Wi-Fi in local

HMI has Wi-Fi module that can operating AP mode. Smart Device can connect HMI AP.

### IPhone CMT Application

After carry out App. Store, type “kaco” in the research tap. After you go into the set-up of Wi-Fi network, choose ‘Model Name_Serial No.’

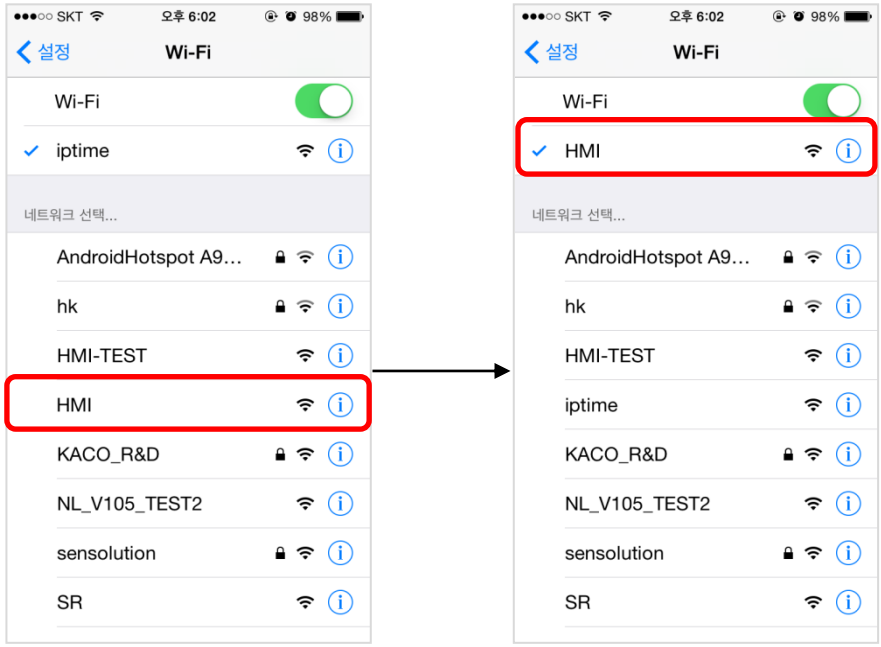



Figure 55: Wi-Fi setup screen

After you execute CMT, touch the ‘SETTING’ button on the screen. Enter the HMI WIFI IP Address and port number (Default WIFI IP is 192.168.0.1 and Port is 80 in HMI V1.05 or under version, in case of HMI V1.06 or later version you may use the changed WIFI IP and port) then touch ‘Saved’ button. After that, you can use variety function via app.

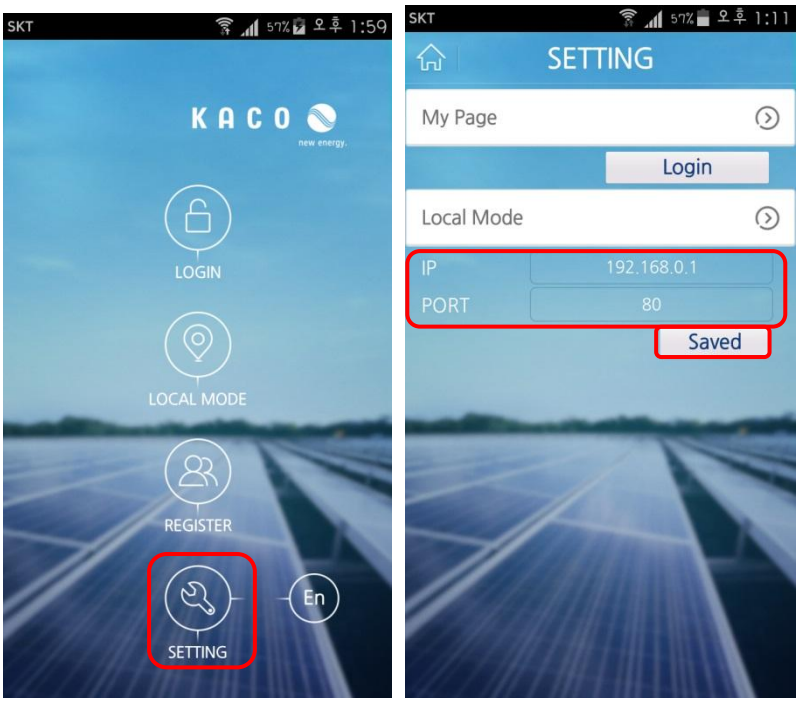



Figure 56: Local-connection setup screen

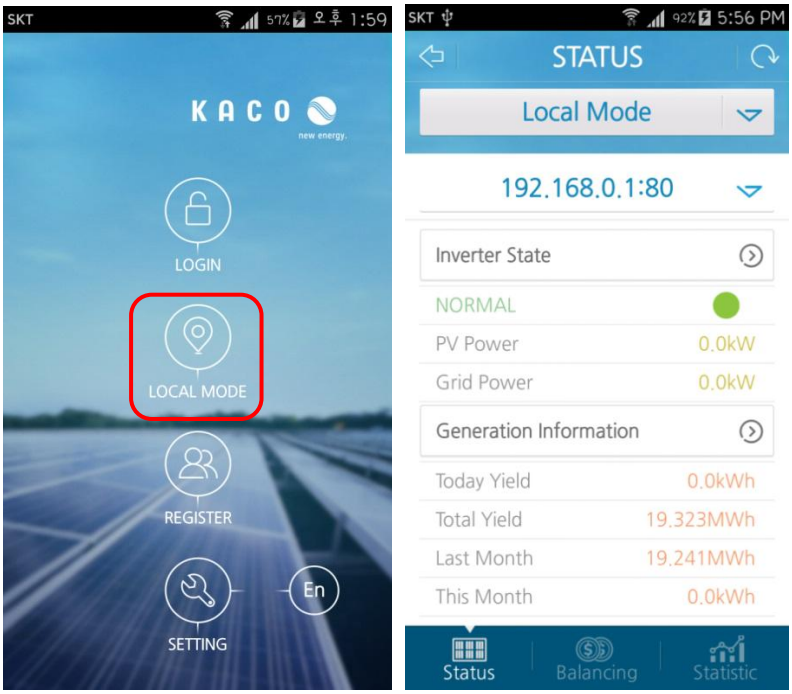



Figure 57: Local Mode screen

The status screen shows the trouble of the inverter, the amount of the electricity produced. The statistic screen displays the statistic data saved in the inverter. You touch the function that you want, it is diverted to the pertinent function.

Figure 58: “Status” screen/ “Statistic” screen

## IPad CMT Application

After carry out App. Store, type “kaco” in the research tap. After you go into the set-up of Wi-Fi network, choose ‘Model Name_Serial No.’

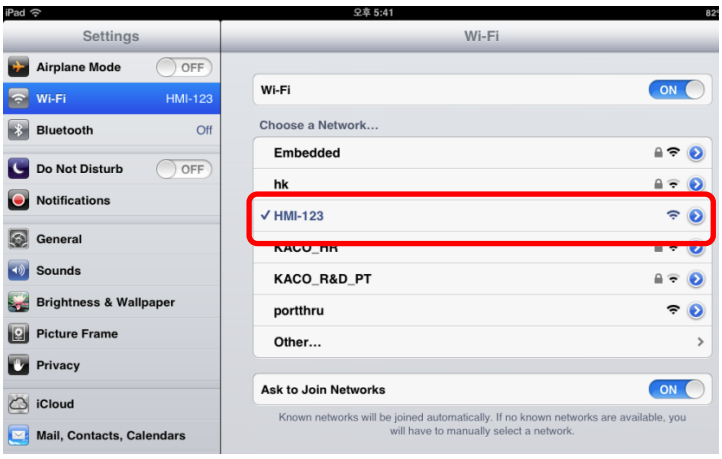



Figure 59: Wi-Fi setup screen

The status screen shows the status of the inverter, CO2 savings and sensors and the amount of the electricity produced. It is the function list of CMT. If you touch the function that you want in the navigators of the screen bottom, display screen is converted to the face book, the home, the statistics, the fault, the local-connection and the setup.

Figure 60: “Main” screen

It prints out the statistical data per diem in detail. It is possible to move the date using the left and right scroll on the graph. Or otherwise it is possible to selection of a date.

Figure 61: “Statistics” screen

If the inverter is broken down, trouble details are printed out as a list. In case that there are a lot of trouble details, you can check on the list using the up and down scroll.

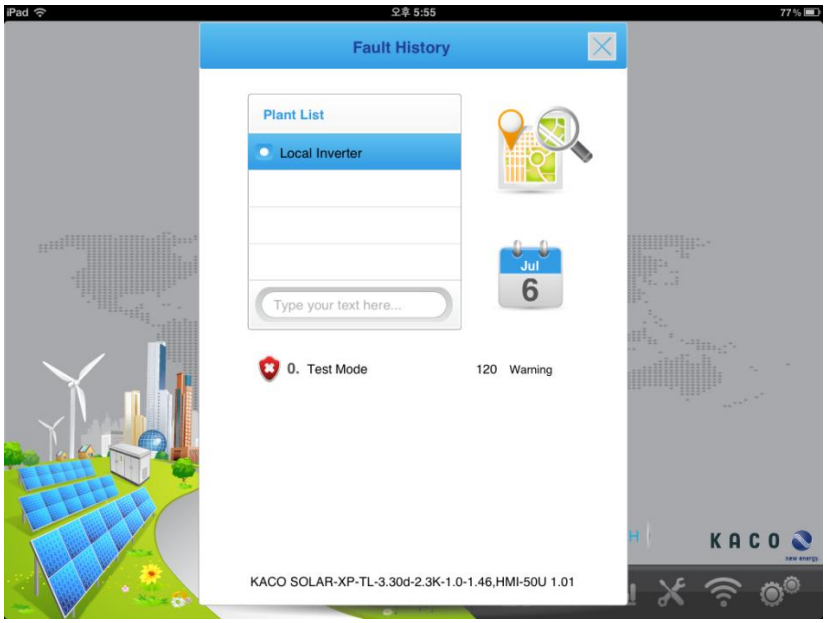



Figure 62: “Fault” screen

It is the function to check on the balance of the electricity produced easily. If you input the standard price per kWh on the text box located on the top, the balance is shown.

*Due to the fact that it is calculated based on the amount of the produced electricity that is computed in software, it is not complies with the actual balance.

*A unit price is input once and is saved until it will be changed.

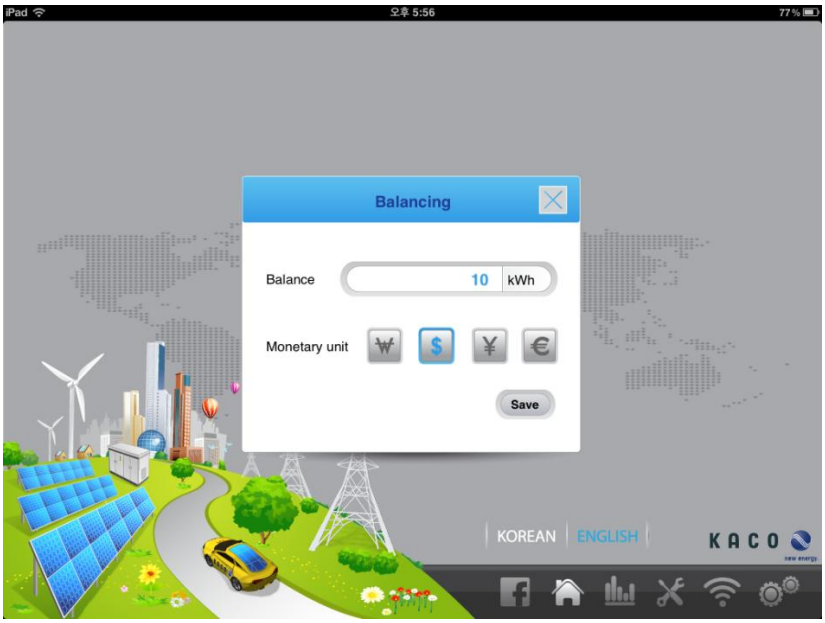



Figure 63: “Balancing” screen

# 6 Fault and Warnings

- **Indoor type inverter:** When a problem occurs in the system, the inverter will beep and inform the user on the display device screen. The inverter displays two basic error messages. The first, the fault, is a serious problem that causes the inverter to stop running. The second, a warning, is a minor problem that does not cease the system operation. The display device screen will indicate faults in red and warnings in yellow. The user can find a description of the different fault and warnings in the following Tables.
- **Outdoor type inverter:** When a problem occurs in the system, the inverter will inform the user on the Fault Lamp. The inverter displays two basic error messages in the CMT. (Support the PC and the Mobile version) The first, the fault, is a serious problem that causes the inverter to stop running. The second, a warning, is a minor problem that does not cease the system operation. The CMT will indicate faults in red and warnings in yellow. The user can find a description of the different fault and warnings in the following Tables.

## 6.1 Warning

| Message | Code | Description |
|---|---|---|
| SP1(PV SP) Failure | 81 | Failure of the PV side surge protector(SP1) |
| CB10 (PV Contactor) Failure | 82 | PV side contactor (DS10) failure |
| PV Fuse Failure | 83 | PV side Fuse failure(option) |
| Ground Fault Warning | 84 | The insulation resistance of the PV falls short of the limit set in the ground fault monitoring for Alert1(option) |
| PV Over Voltage | 85 | PV voltage exceeds the parameter [DC over voltage Level] |
| PEBB Over Temp. Warning | 100 | The temperature of the PEBB(Power Electronics Building Block) over 85℃(185℉) |
| PEBB Fan Failure | 101 | Failure of a PEBB(Power Electronics Building Block) fan |
| PEBB Temperature Unbalance | 102 | The Difference of each PEBB temperature exceeds the operational parameter [PEBB Temperature Unbalance Level] |
| SP2(Grid SP) Failure | 110 | Failure of the grid side surge protector(SP2) |
| ASYNC Warning | 111 | Not synchronized between Inverter Voltage and Grid Voltage at Grid Interconnection |
| Test Mode | 120 | The system is working in test mode |
| Watchdog | 121 | Abnormalities detection in the DSP |
| Invalid Parameter | 125 | Parameter is invalid value. |
| Reconnection Condition Warning | 126 | The grid voltage or frequency exceeds the reconnection condition when reconnection to grid during operational parameter [Reconnection Condition Warning Delay] seconds |
| Reactor Fan Failure | 128 | Failure of a Reactor FAN |
| Enclosure(Top) Fan Failure | 129 | Failure of a Enclosure(Top) FAN |
| Enclosure(Cabinet) Over Temp. Warning | 130 | The temperature of the cabinet over the parameter [Cabinet Temperature Maximum] |
| Enclosure(Cabinet) Under Temp. Warning | 131 | The temperature of the cabinet falls below the parameter [Cabinet Temperature Minimum] |

| Message | Code | Description |
|---|---|---|
| SP3(Control Power SP) Failure | 132 | Failure of the control side surge protector(SP3) |
| CB32 Open | 133 | Failure of the top fan or power supply |
| SMPS Warning | 134 | Failure of the control SMPS (Switching Mode Power Supply) |
| CAN TX Failure | 135 | CAN bus communication transmission failure |
| CAN RX Failure | 136 | CAN bus communication reception failure |
| CAN EP Failure | 137 | CAN bus communication Error-Passive error |
| CAN Bus-Off | 138 | CAN bus communication Bus-off error |
| CAN Wrong Message | 139 | Reception of Wrong message in CAN bus communication |
| CAN Time Out | 140 | Time out in CAN bus communication |
| CAN Multiple Master | 141 | There are multiple Masters in CAN bus communication |

## 6.2 Fault

| Message | Code | Description |
|---|---|---|
| PV Over Voltage | 1 | PV voltage exceeds the parameter [DC over voltage Level] |
| PV Over Current | 2 | PV current exceeds the parameter [DC over current Level] |
| CB10 (PV CB) Trip | 4 | PV side circuit breaker(DS10) tripped |
| PV Polarity Failure | 5 | Polarity (+, -) of PV side is reversed |
| Ground Fault | 6 | PV side ground fault |
| Inv. Over Current (PEBB1) | 7 | BP Model: Inverter Output Current over one-third of the parameter [Inverter Over Current Level] |
| Inv. Over Current (PEBB2) | 8 | BP Model: Inverter Output Current over one-third of the parameter [Inverter Over Current Level] |
| Inv. Over Current (PEBB3) | 9 | BP Model: Inverter Output Current over one-third of the parameter [Inverter Over Current Level] |
| Inv. Over Voltage | 10 | Inverter side Voltage over the parameter [Grid Over Voltage Level2] |
| Inv. Under Voltage | 11 | Inverter side Voltage under the parameter [Grid Under Voltage Level2] |
| Inv. Over Frequency | 12 | Inverter side Frequency over the parameter [Grid over Frequency Level2] |
| Inv. Under Frequency | 13 | Inverter side Frequency under the parameter [Grid under Frequency Level2] |
| Inv. Over Current | 14 | Inverter side Current over the parameter [Inverter Over Current Level] |
| MC21(Inv. MC of PEBB1) Failure | 15 | XP Model: Inverter side contactor (MC21) failure<br>BP Model: Inverter side contactor (MC21 of PEBB1) Failure |
| Inv. Phase Order | 16 | Phase order failure on the inverter side, wrong phase rotation |
| Inductor or TR Over Temp. | 18 | Inductor or Transformer temperature over 150℃ |

| Message | Code | Description |
|---|---|---|
| Inv. Current Unbalance | 19 | The unbalanced current of inverter side. |
| PEBB(1) IGBT Fault | 20 | PEBB 1 IGBT failure |
| PEBB(2) IGBT Fault | 21 | PEBB 2 IGBT failure |
| PEBB(3) IGBT Fault | 22 | PEBB 3 IGBT failure |
| PEBB Over Temp. Analog | 24 | The temperature of the heat-sink over the parameter [Heatsink OT Level] (Analog) |
| PEBB Over Temp. Digital | 25 | The temperature of the heat-sink over 100℃ (Digital) |
| Grid Phase Jump | 26 | Grid side Voltage phase delay accident |
| Grid Phase Open | 27 | Grid side Voltage phase open accident |
| MC21(Inv. MC of PEBB2) Failure | 28 | BP Model: Inverter side contactor (MC21 of PEBB2) failure |
| MC21(Inv. MC of PEBB3) Failure | 29 | BP Model: Inverter side contactor (MC21 of PEBB3) failure |
| Grid Over Voltage 1 | 30 | Grid side Voltage over the parameter [Grid Over Voltage Level1] |
| Grid Under Voltage 1 | 31 | Grid side Voltage under the parameter [Grid Under Voltage Level1] |
| Grid Over Frequency 1 | 32 | Grid side Frequency over the parameter [Grid Over Frequency Level1] |
| Grid Under Frequency 1 | 33 | Grid side Frequency under the parameter [Grid Under Frequency Level1] |
| Grid CB Trip | 34 | CB20 (AC Disconnect/Grid circuit breaker) was tripped during operation |
| Grid Over Voltage 2 | 35 | Grid side Voltage over the parameter [Grid Over Voltage Level2] |
| Grid Under Voltage 2 | 36 | Grid side Voltage Under the parameter [Grid Under Voltage Level2] |
| Grid Under Frequency 2 | 37 | Grid side Frequency Under the parameter [Grid Under Frequency Level2] |
| Grid Over Frequency 2 | 38 | Grid side Frequency Over the parameter [Grid Over Frequency Level2] |
| Inv. Over current (RMS) | 39 | Inverter side Current Over the Parameter [Inverter Slow Over Current Level] |
| Parameters Version Error | 40 | Different version between the NVSRAM parameter table and the program parameter table |
| Flash Memory Failure | 41 | C6000 DSP program flash memory failure in XCU (main control) board |
| FPGA Failure | 42 | FPGA failure in XCU (main control) board |
| DSP28x Failure | 43 | F2000 DSP failure in XCU (main control) board |
| ADC Failure | 44 | ADC block failure in XCU (main control) board |
| NVSRAM Failure | 45 | NVSRAM Failure in XCU (main control) board or invalid parameter setting |
| Asynchronous | 46 | Synchronous fail of Grid and Inverter |
| CAN Failure | 47 | CAN bus communication failure |
| Emergency Stop | 50 | The door is open / The emergency stop button is pressed |
| Master Slave Fault | 52 | Master Slave operation Failure |

| Message | Code | Description |
|---|---|---|
| PEBB Current Unbalance(R) | 53 | The unbalanced current between PEBBs(R Phase) |
| PEBB Current Unbalance(S) | 54 | The unbalanced current between PEBBs(S Phase) |
| PEBB Current Unbalance(T) | 55 | The unbalanced current between PEBBs(T Phase) |
| Grid Over Frequency Level3 | 57 | Grid side Frequency over the parameter [Grid Over Frequency Level3] |
| Grid Under Frequency Level3 | 58 | Grid side Frequency under the parameter [Grid Under Frequency Level3] |
| Grid Over Voltage Slow | 59 | Grid side Voltage over the parameter [Grid Over Voltage Level Slow] (RMS average value per 10 min) |
| SP3(Control Power SP) Failure | 60 | If parameter [Inverter Stop by SPD] is set,<br>XP Model: Failure of the control side surge protector(SP3) |
| SP2(Grid SP) Failure | 61 | If parameter [Inverter Stop by SPD] is set,<br>XP Model: Failure of the grid side surge protector(SP2) |
| SP1(PV SP) Failure | 62 | If parameter [Inverter Stop by SPD] is set,<br>XP Model: Failure of the PV side surge protector(SP1) |
| HMI-XCU Communication Error | 63 | HMI-XCU communication Error |

## 6.3 Solution for Error code

- **Indoor type inverter:** When a problem occurs in the system, the inverter will beep and inform the user on the display device screen. The inverter displays two basic error messages. The first, the fault, is a serious problem that causes the inverter to stop running. The second, a warning, is a minor problem that does not cease the system operation. The display device screen will indicate faults in red and warnings in yellow. The user can find a description of the different fault and warnings in the following Tables.
- **Outdoor type inverter:** The inverter can detect faults during operation. The inverter will display the fault in the CMT. Faults are indicated in the CMT with an error code, and a plain text message with the error code and system plant name in the text line will be sent to the system operator (only available if purchased and configured during setup). This section describes how to recognize the types of faults and how to correct these faults.

### 6.3.1 Warnings

| Code | Message | Warning description | Possible problem and Solution(s) |
|---|---|---|---|
| 81 | SP1(PV SP) Failure | Failure of the PV side surge protector (SP1) | **Possible problem**<br>▪ Lightning strike on or near the PV system wiring<br>**Solution(s)**<br>▪ Visual inspection<br>▪ Change the SPD |
| 100 | PEBB Over Temp. Warning | The temperature of the PEBB(Power Electronics Building Block) over 85℃(185℉) | **Possible problem**<br>▪ PEBB Fan Failure<br>**Solution(s)**<br>▪ Clean the filters or PEBB heat-sink fins<br>▪ Change the PEBB Fan |
| 101 | PEBB Fan Failure | Failure of a PEBB(Power Electronics Building Block) fan | **Possible problem**<br>▪ PEBB Fan Failure<br>**Solution(s)**<br>▪ Change the PEBB Fan |
| 120 | Test Mode | The system is working in test mode | **Possible problem**<br>▪ The system is working in test mode<br>**Solution(s)**<br>▪ Change the parameters in the GUI |
| 128 | Reactor Fan Failure | BP Model: Reactor fan failure | **Possible problem**<br>▪ Failure of the reactor fan<br>**Solution(s)**<br>▪ Check the reactor fan connector<br>▪ Change the reactor fan |
| 129 | Enclosure(Top) Fan Failure | BP Model: Enclosure fan failure | **Possible problem**<br>▪ Failure of the enclosure(top) fan<br>**Solution(s)**<br>▪ Check the enclosure(top) fan connector<br>▪ Change the enclosure(top) fan |

| Code | Message | Warning description | Possible problem and Solution(s) |
|---|---|---|---|
| 130 | Cabinet Over Temp. Warning | The temperature of the cabinet over the parameter [Cabinet Temperature Maximum] | **Possible problem**<br>▪ Cabinet Fan Failure<br>**Solution(s)**<br>▪ Clean the air filters<br>▪ Change the cabinet fan |
| 131 | Cabinet Under Temp. Warning | The temperature of the cabinet falls below operational parameters [Cabinet Temperature Minimum] | **Possible problem**<br>▪ Ambient temperature is too low for operation |
| 134 | SMPS Warning | Failure of the control SMPS | **Possible problem**<br>▪ Failure of the control SMPS<br>**Solution(s)**<br>▪ Change the control SMPS |
| 135 | CAN TX Failure | CAN bus communication transmission failure | **Possible problem**<br>▪ CAN bus communication Failure<br>**Solution(s)**<br>▪ Check the CAN bus Connection<br>▪ Check the CAN bus terminal registers |
| 136 | CAN RX Failure | CAN bus communication reception failure | |
| 137 | CAN EP Failure | CAN bus communication Error-Passive error | |
| 138 | CAN Bus-Off | CAN bus communication Bus-off error | |
| 139 | CAN Wrong Message | Reception of Wrong message in CAN bus communication | |
| 140 | CAN Time Out | Time out in CAN bus communication | |
| 141 | CAN Multiple Master | There are multiple Masters in CAN bus communication | **Possible problem**<br>▪ CAN ID is duplicated.<br>**Solution(s)**<br>▪ Change the parameters in the GUI |

### 6.3.2 Fault

| Code | Message | Warning Description | Possible problem and Solution(s) |
|---|---|---|---|
| 1 | PV Over Voltage | PV voltage exceeds the parameter<br>[DC over voltage Level] | **Possible problem**<br>▪ The voltage of the solar generator is too high<br>**Solution(s)**<br>▪ Check the input voltage<br>▪ Check module wiring and system |
| 2 | PV Over Current | PV current exceeds the parameter<br>[DC over current Level] | **Possible problem**<br>▪ The current of the solar generator is too high<br>▪ PV system wiring short<br>**Solution(s)**<br>▪ Check the input current<br>▪ Check module wiring and system |
| 4 | CB10 (PV CB) Trip | PV side circuit breaker(DS10) tripped | **Possible problem**<br>▪ DS10 disconnect switch is open<br>▪ Auxiliary switch is inoperable, DS10 contactor failed closed<br>**Solution(s)**<br>▪ Check the wiring connection<br>▪ Change the DS10, replace DS10 contactor |
| 5 | PV Polarity Failure | Polarity (+, -) of PV side is reversed | **Possible problem**<br>▪ Polarity of PV side is reversed<br>**Solution(s)**<br>▪ Check the wiring connection and change if necessary |
| 6 | Ground Fault | PV side ground fault | **Possible problem**<br>▪ Positive/Negative Grounding Type(Grounding-Type): PV side grounding or short-circuit fault.<br>▪ PCB-board Type(Isolation Type): The unbalance of measured PV voltage causing PV side grounding or short-circuit fault.<br>**Solution(s)**<br>▪ Grounding-Type: If circuit breaker or fuse of GFD is open, check the PV grounding or short circuit fault. After then, there is no problem, replace the fuse of GFD or invert the circuit breaker status (in case of FGFD board, F3 and F4 fuse is opened for safety. If MC21 is not operated, check the RY5)<br>▪ Isolation Type: check the PV side grounding or short-circuit fault. (F1 and F2 fuse is opened for safety) |
| 7 | Inv. Over Current (PEBB1) | **BP Model:** Inverter Output Current over one-third of the parameter [Inverter | **Possible problem**<br>▪ Short circuit in the IGBT |

| Code | Message | Warning Description | Possible problem and Solution(s) |
|---|---|---|---|
| | | OverCurrent Level] | ▪ Short circuit in the Grid<br>**Solution(s)**<br>▪ Check the grid connection<br>▪ Check the inverter connection |
| 8 | Inv. Over Current (PEBB2) | **BP Model:** Inverter Output Current over one-third of the parameter [Inverter OverCurrent Level] | |
| 9 | Inv. Over Current (PEBB3) | **BP Model:** Inverter Output Current over one-third of the parameter [Inverter OverCurrent Level] | |
| 10 | Inv. Over Voltage | Inverter side Voltage over the parameter [Grid Over Voltage Level2] | **Possible problem**<br>▪ The inverter voltage is too high<br>**Solution(s)**<br>▪ Check the inverter voltage<br>▪ Check the inverter parameter |
| 11 | Inv. Under Voltage | Inverter side Voltage under the parameter [Grid Under Voltage Level2] | **Possible problem**<br>▪ The inverter voltage is too low<br>**Solution(s)**<br>▪ Check the inverter voltage<br>▪ Check the inverter parameter<br>▪ Check the MC21 |
| 12 | Inv. Over Frequency | Inverter side Frequency over the parameter [Grid over Frequency Level2] | **Possible problem**<br>▪ The grid frequency is outside the permitted range<br>**Solution(s)**<br>▪ Check the grid frequency |
| 13 | Inv. Under Frequency | Inverter side Frequency under the parameter [Grid under Frequency Level2] | **Possible problem**<br>▪ The grid frequency is outside the permitted range<br>**Solution(s)**<br>▪ Check the grid frequency |
| 14 | Inv. Over Current | Inverter side Current over the parameter [Inverter Over Current Level] | **Possible problem**<br>▪ Short circuit in the IGBT<br>▪ Short circuit in the Grid<br>**Solution(s)**<br>▪ Check the grid connection<br>▪ Check the inverter connection |
| 15 | MC21(Inv. MC of PEBB1) Failure | Inverter side contactor (MC21 of PEBB1) failure | **Possible problem**<br>▪ MC21 contactor is open<br>▪ Auxiliary switch is inoperable<br>**Solution(s)**<br>▪ Check the wiring connection<br>▪ Change the MC21 |
| 16 | Inv. Phase Order | Phase order failure on the inverter side | **Possible problem**<br>▪ Phase order failure on the inverter<br>▪ Wrong phase rotation<br>**Solution(s)**<br>▪ Check the wiring connection<br>▪ Reverse two phases |
| 18 | Inductor or TR Over Temp | Inductor or Transformer temperature over 150℃ | **Possible problem**<br>▪ Cabinet fan failure |

| Code | Message | Warning Description | Possible problem and Solution(s) |
|---|---|---|---|
| | | | **Solution(s)**<br>▪ Cleaning the filters<br>▪ Change the cabinet Fan |
| 20 | PEBB(1) IGBT Fault | PEBB IGBT U failure | **Possible problem**<br>▪ Short circuit in the IGBT<br>**Solution(s)**<br>▪ Visual inspection<br>▪ Change the PEBB |
| 21 | PEBB(2) IGBT Fault | PEBB IGBT V failure | |
| 22 | PEBB(3) IGBT Fault | PEBB IGBT W failure | |
| 24 | PEBB Over Temp. Analog | The temperature of the heat-sink over the parameter [Heatsink OT Level] (Analog) | **Possible problem**<br>▪ PEBB fan failure<br>**Solution(s)**<br>▪ Clean the filters<br>▪ Inspect and if necessary clean the heat-sink fins<br>▪ Change the PEBB Fan |
| 25 | PEBB Over Temp. Digital | The temperature of the heat-sink over 100℃ (Digital) | **Possible problem**<br>▪ PEBB Fan Failure<br>**Solution(s)**<br>▪ Inspect and if necessary clean the heat-sink fins Change the PEBB Fan |
| 26 | Grid Phase Jump | Grid side voltage phase delay exceed value of [Phase Jump Theta Deadband] | **Possible problem**<br>▪ Grid side voltage phase delay<br>**Solution(s)**<br>▪ Check grid parameter table |
| 27 | Grid Phase Open | Grid side voltage phase open accident | **Possible problem**<br>▪ Grid side one phase is open<br>**Solution(s)**<br>▪ Check the wiring connection |
| 28 | Inv. MC(PEBB2 MC21) Failure | Inverter side contactor (MC21 of PEBB2) failure | **Possible problem**<br>▪ MC21 contactor is open<br>▪ Auxiliary switch is inoperable<br>**Solution(s)**<br>▪ Check the wiring connection<br>▪ Change the MC21 |
| 29 | Inv. MC(PEBB3 MC21) Failure | Inverter side contactor (MC21 of PEBB3) failure | |
| 30 | Grid Over Voltage level1 | Grid side Voltage over the parameter [Grid Over Voltage Level1] | **Possible problem**<br>▪ The grid voltage is too high<br>**Solution(s)**<br>▪ Check the grid voltage<br>▪ Check the grid parameter |
| 31 | Grid Under Voltage level1 | Grid side Voltage under the parameter [Grid Under Voltage Level1] | **Possible problem**<br>▪ The grid voltage is too low<br>**Solution(s)**<br>▪ Check the grid voltage<br>▪ Check the grid parameter<br>▪ Check the MCB21 |
| 32 | Grid Over Frequency level1 | Grid side Frequency over the parameter [Grid Over Frequency Level1] | **Possible problem**<br>▪ The grid frequency is outside the permitted rang |

| Code | Message | Warning Description | Possible problem and Solution(s) |
|---|---|---|---|
| | | | **Solution(s)**<br>▪ Check the grid frequency<br>▪ Check the grid parameter |
| 33 | Grid Under Frequency level1 | Grid side Frequency under the parameter [Grid Under Frequency Level1] | **Possible problem**<br>▪ The grid frequency is outside the operation range<br>**Solution(s)**<br>▪ Check the grid frequency<br>▪ Check the grid parameter |
| 34 | Grid CB Trip | CB20 (AC Disconnect/Grid circuit breaker) was tripped during operation | **Possible problem**<br>▪ Short circuit in the grid<br>**Solution(s)**<br>▪ Check the wiring connections |
| 35 | Grid Over Voltage Level2 | Grid side Voltage over the parameter [Grid Over Voltage Level2] | **Possible problem**<br>▪ The grid voltage is too high<br>**Solution(s)**<br>▪ Check the grid voltage<br>▪ Check the grid parameter |
| 36 | Grid Under Voltage Level2 | Grid side Voltage Under the parameter [Grid Under Voltage Level2] | **Possible problem**<br>▪ The grid voltage is too low<br>**Solution(s)**<br>▪ Check the grid voltage<br>▪ Check the grid parameter |
| 37 | Grid Under Frequency Level2 | Grid side Frequency Under the parameter [Grid Under Frequency Level2] | **Possible problem**<br>▪ The grid frequency is outside the operation range<br>**Solution(s)**<br>▪ Check the grid frequency |
| 38 | Grid Over Frequency Level2 | Grid side Frequency Over the parameter [Grid Over Frequency Level2] | **Possible problem**<br>▪ The grid frequency is outside the permitted range<br>**Solution(s)**<br>▪ Check the grid frequency |
| 39 | Inv. Over Current (RMS) | Inverter side Current Over the parameter [Inverter Slow Over Current Level] | **Possible problem**<br>▪ The inverter output current is higher than the permitted range<br>**Solution(s)**<br>▪ Check the wiring connection<br>▪ Check the inverter parameter |
| 40 | Parameters Version Error | Different version between the NVSRAM parameter table and the program parameter table | **Possible problem**<br>▪ Different version between the NVSRAM parameter table and the program parameter table<br>**Solution(s)**<br>▪ Initialize the parameter menu setting in the GUI and reset faulted parameter<br>▪ Change the PCB module |
| 41 | Flash Memory Failure | C6000 DSP program flash memory failure in XCU (main control) board | **Possible problem**<br>▪ Internal C6000 error<br>**Solution(s)** |

| Code | Message | Warning Description | Possible problem and Solution(s) |
|---|---|---|---|
| | | | ▪ Change the PCB module |
| 42 | FPGA Failure | FPGA failure in XCU (main control) board | **Possible problem**<br>▪ Internal FPGA error<br>**Solution(s)**<br>▪ Change the PCB module |
| 43 | DSP28x Failure | F2000 DSP failure in XCU (main control) board | **Possible problem**<br>▪ Internal F2000 error<br>**Solution(s)**<br>▪ Change the PCB module |
| 44 | ADC Failure | ADC block failure in XCU (main control) board | **Possible problem**<br>▪ Internal Analog to Digital converter error<br>**Solution(s)**<br>▪ Change the PCB module |
| 45 | NVSRAM Failure | NVSRAM failure in XCU (main control) board or invalid parameter | **Possible problem**<br>▪ Internal NVSRAM error<br>▪ Invalid parameter<br>**Solution(s)**<br>▪ Initialize the parameter menu setting in the GUI<br>▪ Change the PCB module |
| 47 | CAN Failure | CAN bus communication failure | **Possible problem**<br>▪ CAN bus communication Failure<br>**Solution(s)**<br>▪ Check the CAN bus Connection<br>▪ Check the CAN bus terminal registers |
| 50 | Emergency Stop | The door is open / The emergency stop botton is pressed | **Possible problem**<br>▪ Front door is open<br>▪ Broken or out of alignment door switch<br>**Solution(s)**<br>▪ Close the door<br>▪ Align or replace door switch |
| 52 | Master Slave Fault | Master Slave operation Failure | **Possible problem**<br>▪ Wrong CAN ID<br>▪ CAN bus communication Failure<br>**Solution(s)**<br>▪ Check the parameters<br>▪ Check the CAN bus Connection<br>▪ Check the CAN bus terminal registers |
| 57 | Grid Over Frequency Level3 | Grid side Frequency over the parameter [Grid Over Frequency Level3] | **Possible problem**<br>▪ The grid frequency is outside the permitted range<br>**Solution(s)**<br>▪ Check the grid frequency<br>▪ Check the grid parameter |
| 58 | Grid Under Frequency Level3 | Grid side Frequency under the parameter [Grid Under Frequency Level3] | **Possible problem**<br>▪ The grid frequency is outside the operation range<br>**Solution(s)** |

| Code | Message | Warning Description | Possible problem and Solution(s) |
|---|---|---|---|
| | | | ▪ Check the grid frequency<br>▪ Check the grid parameter |
| 59 | Grid Over Voltage Slow | Grid side Voltage over the parameter [Grid OverVoltage Level Slow] (RMS average value per 10 min) | **Possible problem**<br>▪ The grid voltage is outside the operation range<br>**Solution(s)**<br>▪ Check the grid voltage<br>▪ Check the grid parameter |
| 60 | SP3(Control Power SP) Failure | If parameter [Inverter Stop by SPD] is set,<br>XP Model: Failure of the control side surge protector(SP3) | **Possible problem**<br>▪ The control side SPD is damaged<br>▪ Connection is damaged<br>**Solution(s)**<br>▪ Check the control power side SPD<br>▪ Check the connection of SPD |
| 61 | SP2(Grid SP) Failure | If parameter [Inverter Stop by SPD] is set,<br>XP Model: Failure of the grid side surge protector(SP2) | **Possible problem**<br>▪ The grid side SPD is damaged<br>▪ Connection is damaged<br>**Solution(s)**<br>▪ Check the grid side SPD<br>▪ Check the connection of SPD |
| 62 | SP1(PV SP) Failure | If parameter [Inverter Stop by SPD] is set,<br>XP Model: Failure of the PV side surge protector(SP1) | **Possible problem**<br>▪ The PV side SPD is damaged<br>▪ Connection is damaged<br>**Solution(s)**<br>▪ Check the PV side SPD<br>▪ Check the connection of SPD |
| 63 | HMI-XCU Communication Error | HMI-XCU communication Error | **Possible problem**<br>▪ HMI-XCU Communication Error<br>**Solution(s)**<br>▪ Check HMI-XCU communication connectivity |

# 7 Maintenance/Cleaning

Maintenance must be performed on the inverter at regular intervals (below is the maintenance schedule).

| | DANGER |
|---|---|
| | **Lethal voltages are still present in the terminals and lines of the inverter even after the inverter has been switched off and disconnected.**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open, install and maintain the inverter.<br>▪ Do not touch the lines and terminals when switching the unit on and off. Do not touch exposed contact connections.<br>▪ Always shut down the inverter prior to cleaning or maintenance |

### Switch off the inverter

1. Using CMT or Key switch to Stop the inverter.
2. Switch the Power grid switch to OFF (disconnect the inverter from the grid).
3. Switch the DC disconnector to OFF (disconnect the inverter from the PV generator).
4. Make sure that the inverter is disconnected from all voltage sources.
5. Please open the door, switch the CB33 to OFF
6. Wait at least ten minutes before working on the inverter.

### Switch on the inverter

1. Switch the CB33 to ON
2. Switch the Power grid switch to ON (connect the inverter to the grid).
3. Switch the DC disconnector to ON (connect the inverter to the PV generator).
4. Turn ON the key switch.
5. Please close the door, press the CMT or HMI ON button

## 7.1 Maintenance intervals

| | NOTE |
|---|---|
| | Even between maintenance intervals, pay attention to any unusual behavior that the inverter displays during operation, and fix the problem immediately. |

Table 7: Maintenance intervals

| Recommended Maintenance- intervals | Maintenance work | |
|---|---|---|
| **6 months *** | Cleaning or replacement | Filter mats in the air intake filter |
| **6 months** | Cleaning | Inside of the cabinet<br>Fans |
| **12 months *** | Function check | Emergency stop (OFF) |
| **12 months** | Cleaning | Power section of the heat sink |
| | Visual inspection | Contact connection<br>Fuses<br>Switches<br>Overvoltage protection<br>Redundant auxiliary power supplies<br>Check all parts in the cabinet for<br>▪ Heavy dust deposits and soiling<br>▪ Moisture(especially water that has permeated from the outside) |
| | Visual inspection (and replacement, if necessary) | All warning labels |
| | Function check | Fans<br>Door contacts<br>Operating lights and fault lights |
| **12 months** | Torque check | Input, output, Check the status of the screws |

*Maintenance-intervals can be changed depending on the place of installation.

## 7.2 Cleaning & Replacing the fans

The inverter is equipped with seven fans. One of the fans are installed in the right-top side of the housing to provide ventilation of enclosure. Three of the fans are installed in the front of the housing to provide circulation of PEBB. Six of the fans are installed in the rear of the housing to provide ventilation of heat sink and reactor. The fans must be cleaned on a regular basis to ensure maximum performance. If there are any problems with the fans, repair or replace them.

### Accessing the fans

**Cleaning & Replacing the AC inverter fans**

1. Switch off the inverter
2. Open the AC part door
3. Cleaning or replacing the fans
4. Close the AC door
5. Switching on the inverter

**Cleaning & Replacing the rear PFANs.**

1. Switch off the inverter
2. Open the rear cover
3. Cleaning or replacing the fans
4. Close the rear cover
5. Switching on the inverter

**Cleaning & Replacing the front PSFANs**

1. Switch off the inverter
2. Open the front door
3. Cleaning or replacing the fans on the PEBB module
4. Close the front door
5. Switching on the inverter

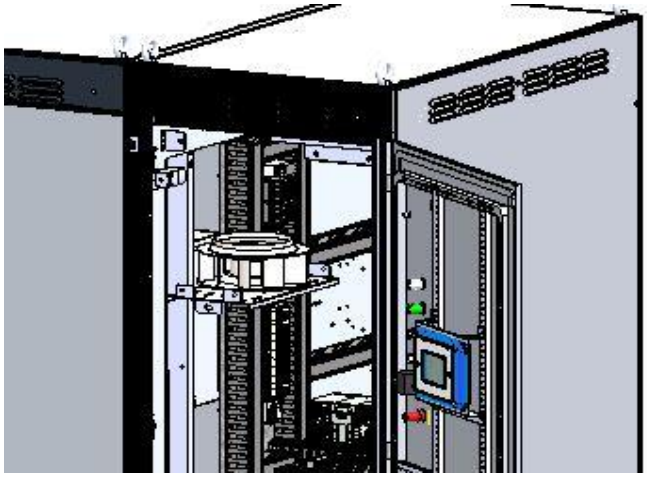


Figure 64: Cleaning & Replacing the AC top fan

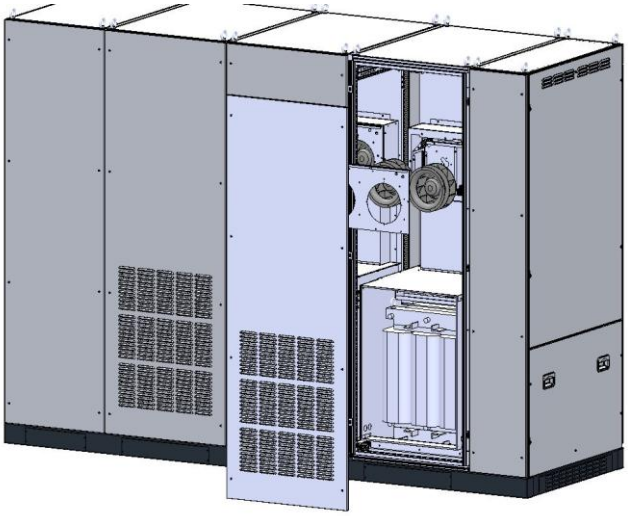


Figure 65: Cleaning & Replacing the rear PFANs

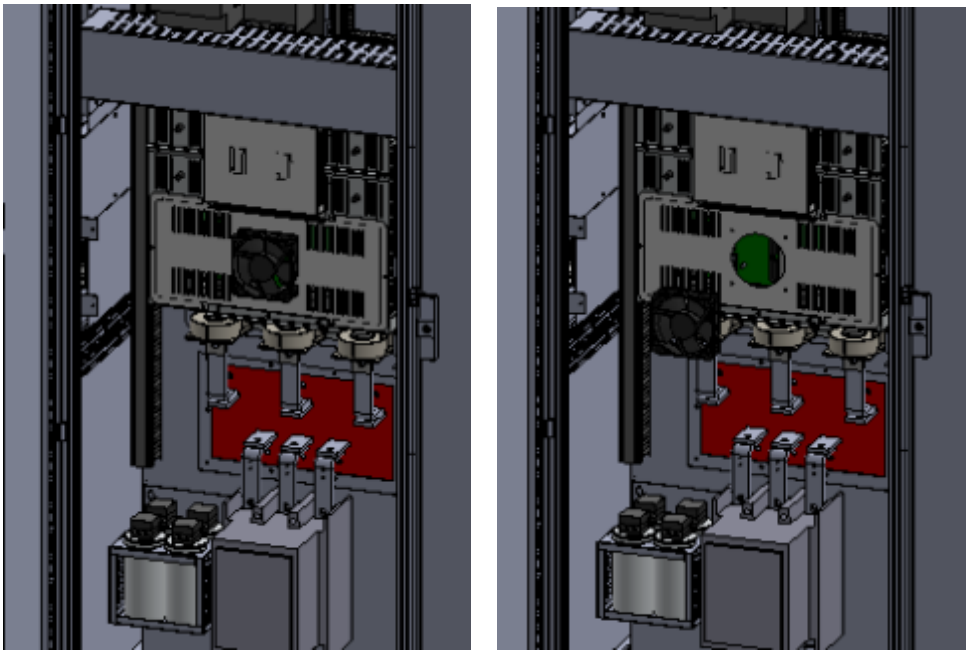


Figure 66: Cleaning & Replacing the front PSFANs

# 8 Parameters

The KACO inverter parameters are pre-configured for operation. It is a beneficial to adapt a number of the KACO inverter parameters to the solar generator. Default value of parameters can be changed as Model.

The KACO inverter parameters are subdivided into ten:

- PV Array

  Setting values for MPPT control and startup of inverter
- Inverter

  Setting values for inverter rate and cabinet temperature
- Grid

  Setting values for abnormal and rated levels of grid
- Time

  Setting values for the current time
- Digital

  Setting values for digital interface
- Analog

  Setting values for analog interface
- Controller

  Setting values for inverter control
- Trace

  Setting values for inverter fault analysis
- Offset

  Setting values for sensing offset calibration
- Gain

  Setting values for sensing gain calibration

# 8.1 Parameters

## 8.1.1 PV Array Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **MPPT Enable** | 0 | 1 | - | 1 : MPPT is enabled<br>0 : MPPT is disabled |
| **MPPT V Maximum** | 0 | 830 | $V_{dc}$ | Maximum voltage to run MPPT |
| **MPPT V Start** | 200 | 800 | $V_{dc}$ | MPPT wake-up voltage |
| **MPPT T Start** | 0 | 3600 | sec | Time delay for MPPT wake-up |
| **MPPT P Stop** | 0 | 10000 | W | Disconnect inverter from Grid when PV output power is lower than the setting value of {MPPT P Stop}. |
| **MPPT T Stop** | 0 | 600 | sec | Time delay while inverter decides if PV output power is lower than the setting value of {MPPT P Stop}. |
| **MPPT V Minimum** | 200 | 800 | $V_{dc}$ | Minimum voltage to run MPPT Exception) |
| **DC OverVoltage Level** | 300 | 1020 | $V_{dc}$ | Upper limit for PV over voltage fault |
| **DC OverCurrent Level** | 0 | 150 | % | Upper limit for PV over current fault |
| **MPP Factor** | 0 | 1 | - | Maximum power point factor |
| **MPP Range Upper** | 10 | 300 | $V_{dc}$ | Upper limit of maximum power point |
| **MPP Range Lower** | 10 | 300 | $V_{dc}$ | Lower limit of maximum power point |
| **PV Operation Level** | 900 | 1020 | $V_{dc}$ | Maximum PV operation level |
| **PD Over DC V Mode** | 0 | 1 | - | Inverter output reduction in the DC input voltage range from [MPPT V Maximum] to [PV Operation Level]<br>0 : Disable<br>1 : Enable |
| **Ground Type** | 0 | 2 | - | PV side Grounding Type<br>0 : Isolation Type<br>1 : Negative Type<br>2 : Positive Type |
| **PV Power Check Time** | 0 | 3600 | sec | Inverter operation mode is changed if PV output power is lower than the setting value of {MPPT P Stop} during time delay of {PV Power Check Time} (When {RPO Enable} is '1: Enable') |
| **PV Voltage Check Time** | 0 | 3600 | sec | Inverter operation mode is changed if PV output voltage is higher than the setting value of {MPPT V Start} during time delay of {PV Voltage Check Time} (When {RPO Enable} is '1: Enable') |
| **RPO Enable** | 0 | 1 | - | 0: RPO Mode Disable<br>1: RPO Mode Enable |
| **DC Voltage LPF** | 0 | 999 | Hz | DC Voltage Low Pass-Filter Cut-off Frequency |
| **MPPT V Step** | 0 | 50 | Vdc | Voltage Step for MPPT Algorithm |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **MPPT T Step** | 1 | 10 | sec | Time Period for MPPT Algorithm |

### 8.1.2 Inverter Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Transformer & Type** | 0 | 1054 | N/A | This parameter determines device specific information such as a switch type on DC side and whether the inverter has an internal transformer. |
| **Inverter Capacity** | 100 | 1000 | kW | Power Capacity of the inverter |
| **Inverter Over Current Level** | 0 | 200 | % | Upper limit for inverter over current fault |
| **Current Limit** | 0 | 150 | % | Limit of current which produces from the inverter |
| **Cabinet Temperature Maximum** | 30 | 70 | ℃ | Upper limit for cabinet over temperature warning |
| **Cabinet Temperature Minimum** | -25 | 10 | ℃ | Lower limit for cabinet under temperature warning |
| **PEBB Temperature Unbalance Level** | 5 | 30 | ℃ | Limit of Temperature gap between PEBBs |
| **Test Protection Function Mode** | 0 | 1 | N/A | Grid voltage and frequency protection level test mode using AC Simulator<br>(Only Transformer-Less model) |
| **PEBB Temperature Warning Level** | 50 | 150 | ℃ | Upper limit of the maximum temperature of PEBB<br>(warning level) |
| **Inverter Sub Capacity** | 70 | 999 | kW | Inverter capacity to support the diversification of model |
| **Sampling Delay Theta** | -100 | 100 | N/A | Compensation for sampling delay |
| **PEBB Current Unbalance Limit** | 0 | 100 | % | Limit of current gap between PEBBs |
| **Inverter Slow Over Current Level** | 0 | 150 | % | Upper limit for inverter over current (RMS) fault |
| **Inverter Slow Over Current Trip Time** | 0 | 3000 | Sec | Time for inverter over current(RMS) fault |

### 8.1.3 Grid Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Rated Grid Voltage** | 208 | 400 | V | Rated value of the grid voltage |
| **Rated Grid Frequency** | 50 | 60 | Hz | Rated value of the grid frequency |
| **Grid Over Voltage Level 1** | 105 | 130 | % | Upper limit expressed as a percentage of the rated grid voltage for grid overvoltage level 1 |
| **Grid Under Voltage Level 1** | 75 | 100 | % | Lower limit expressed as a percentage of the rated grid voltage for grid under voltage Level 1 |
| **Grid Over Frequency Level 1** | 0 | 3 | Hz | Upper limit for grid over frequency level 1 |
| **Grid Under Frequency Level 1** | 0 | 3 | Hz | Lower limit for grid under frequency level 1 |
| **Frequency Dependant Power Reduction Mode** | 0 | 2 | - | Power reduction function dependant on frequency rise<br>0 : Disable<br>1 : Enable |
| **Power Gradient Mode** | 0 | 5 | - | Power gradient function when inverter start<br>0 : Disable<br>1 : Activated when connected to grid after fault (Germany Medium Voltage Requirements)<br>2 : Activated according to VDE-AR-N 4105 (Germany Low Voltage Requirements)<br>3 : Activated whenever connected to grid (Italy TERNA Grid Code) |
| **Power Gradient Ramp** | 0 | 600 | sec | Ramp time for power gradient |
| **Time Shift** | 0 | 6000 | sec | Delay time for inverter start |
| **Gate-way Enable** | 0 | 1 | - | Reserved |
| **Grid Level 2 Protection Enable** | 0 | 1 | - | Grid level 2 protection function<br>0 : Disable<br>1 : Enable |
| **Grid Over Voltage Level 2** | 105 | 130 | % | Upper limit expressed as a percentage of the rated grid voltage for grid overvoltage level 2 |
| **Grid Under Voltage Level 2** | 15 | 100 | % | Lower limit expressed as a percentage of the rated grid voltage for grid under voltage Level 2 |
| **Grid Under Frequency Level 2** | 0 | 3.5 | Hz | Lower limit for grid under frequency level 2 |
| **Grid Over Voltage Level 1 Trip Time** | 100 | 10000 | ms | Time for grid over voltage level 1 trip |
| **Grid Over Voltage Level 2 Trip Time** | 40 | 2000 | ms | Time for grid over voltage level 2 trip |
| **Grid Under Voltage Level 1 Trip Time** | 100 | 10000 | ms | Time for grid under voltage level 1 trip |
| **Grid Under Voltage Level 2 Trip Time** | 40 | 3000 | ms | Time for grid under voltage level 2 trip |
| **Grid Under Frequency Level 1 Trip Time** | 100 | 20000 | ms | Time for grid under frequency level 1 trip |
| **Grid Under Frequency** | 40 | 3000 | ms | Time for grid under frequency level 2 trip |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Level 2 Trip Time** | | | | |
| **Grid Over Frequency Level 1 Trip Time** | 40 | 3000 | ms | Time for grid over frequency level 1 trip |
| **FRT Enable** | 0 | 2 | - | FRT(Fault Ride Through) Function<br>0 : Disable<br>1 : Enable<br>2: Enable(Added Pre-fault Reactive Current Mode during Voltage Fault: Germany Medium Voltage Requirements) |
| **Grid Over Voltage FRT Enable** | 0 | 1 | | Over Voltage FRT Function<br>0 : Disable<br>1 : Enable |
| **Power Reduction Gradient Level** | 0 | 100 | %/Hz | Gradient level for frequency dependant power reduction |
| **Power Reduction Deactivation Frequency** | 0 | 0.3 | Hz | Frequency limit for frequency dependant power reduction deactivation |
| **Grid Over Frequency Level 2** | 0 | 3 | Hz | Upper limit for grid over frequency level 2 |
| **Grid Over Frequency Level 2 Trip Time** | 40 | 2000 | ms | Time for grid over frequency Level 2 trip |
| **Reconnection Condition Mode** | 0 | 3 | - | Reconnection Condition Function<br>0 : Disable<br>1 : Checked before connected to grid (Germany Medium Voltage Requirements)<br>2 : Checked according to VDE-AR-N 4105 (Germany Low Voltage Requirements)<br>3 : Checked according to CEI 0-16 (Italy Low Voltage Requirements) |
| **Reconnection Condition Upper Voltage** | -1 | 130 | % | This parameter represents the upper voltage in the range of “Reconnection condition” as a percentage of the rated value.<br>The negative value represents that the relevant condition is not checked when an inverter decides “Reconnection condition”. |
| **Reconnection Condition Lower Voltage** | -1 | 100 | % | This parameter determines the lower voltage of “Reconnection condition” range as a percentage of the rated value.<br>The negative value represents that the relevant condition is not checked when an inverter decides “Reconnection condition”. |
| **Reconnection Condition Upper Frequency** | -1 | 3 | Hz | This parameter determines the upper frequency of “Reconnection condition” range as an increment from the rated value.<br>The negative value represents that the relevant condition is not checked when an inverter decides “Reconnection condition”. |
| **Reconnection Condition Lower Frequency** | -1 | 3 | Hz | This parameter determines the lower frequency of “Reconnection condition” range as a decrement from the rated value.<br>The negative value represents that the relevant condition is not checked when an inverter decides “Reconnection condition”. |
| **Reconnection Condition Check Time Normal** | 0 | 1800 | sec | This parameter is used for time check during “Reconnection condition” for all the time |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| | | | | except after fault. |
| **Reconnection Condition Check Time After Fault** | 0 | 1800 | sec | This parameter is used for time check during “Reconnection condition” for after fault only. |
| **Grid Over Frequency Level 3** | 0 | 3 | Hz | Upper limit for grid over frequency level 3 |
| **Grid Over Frequency Level 3 Trip Time** | 40 | 2000 | ms | Time for grid over frequency Level 3 trip |
| **Grid Over Voltage Level Slow** | 105 | 115 | % | This parameter represents Upper limit for the average RMS value of grid voltage as a percentage of the rated grid voltage.<br>If the average RMS value of grid voltage exceeds this parameter setting, fault will be occurred.<br>VDE-AR-N 4105(Germany Low Voltage Requirements) |
| **Grid Over Voltage Level Slow Shift Average Time** | -1 | 3000 | sec | This parameter determines how long the average RMS value of grid voltage will be calculated.<br>(Low Voltage Requirements: 600 seconds duration)<br>Negative value means that the relevant function (Grid Over Voltage level slow) is disabled. |
| **Reconnection Condition Warning Delay** | 0 | 600 | sec | Time delay for Reconnection Condition Warning |
| **Grid Under Frequency Level 3** | 0 | 3 | Hz | Lower limit for grid over frequency level 3 |
| **Grid Under Frequency Level 3 Trip Time** | 0 | 30000 | ms | Time for grid over frequency Level 3 trip |
| **Upper Deadband PPN** | 100 | 110 | % | Voltage Level for activation of P/Pn function when selected CEI 0-21 grid code |
| **Lower Deadband PPN** | 90 | 100 | % | Voltage Level for deactivation of P/Pn function when selected CEI 0-21 grid code |
| **Upper Deadband QV** | 10 | 100 | % | Active Power Level for activation of Q(V) function when selected CEI 0-21 grid code |
| **Lower Deadband QV** | 1 | 20 | % | Active Power Level for deactivation of Q(V) function when selected CEI 0-21 grid code |
| **QV Voltage1** | 100 | 110 | % | Voltage upper dead band of Q(V) function when selected CEI 0-21 grid code |
| **QV Voltage2** | 90 | 100 | % | Voltage lower dead band of Q(V) function when selected CEI 0-21 grid code |
| **QV Voltage3** | 100 | 110 | % | Voltage upper level to calculate ramp of Q(V) function when selected CEI 0-21 grid code |
| **QV Voltage4** | 90 | 100 | % | Voltage lower level to calculate ramp of Q(V) function when selected CEI 0-21 grid code |
| **QV Inductive Max** | 0 | 48 | % | Reactive Power inductive maximum value of Q(V) function |
| **QV Capacitive Max** | 0 | 48 | % | Reactive Power capacitive maximum value of Q(V) function |
| **Phase Open Detection Level** | 0 | 100 | % | Level of grid voltage phase open fault detection |
| **Phase Open Trip Time** | 0.1 | 999.9 | sec | Trip time of grid voltage phase open fault |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| | | | | detection |
| **PJD Mode** | 0 | 2 | N/A | Grid voltage phase jump fault detection mode |
| **PJD Level** | 3 | 360 | degree | Dead band of grid voltage phase jump fault detection |
| **PJD Trip Time** | 0 | 30000 | ms | Trip time of grid voltage phase jump fault detection |
| **Active Damping Enable** | 0 | 2 | N/A | Active damping enable |
| **Virtual Resister** | 0 | 29.999 | Ohm | Virtual register for active damping |
| **IQ Ramp After FRT** | 0 | 30000 | ms | Gating-off time after recovering from low voltage accident |
| **Frequency Dependant Power Reduction Check Time** | 0 | 30000 | sec | Frequency holding time for deactivation of power limitation against to grid frequency increase<br>(CEI 0-16 grid code only) |
| **Voltage Dependant Power Reduction Mode** | 0 | 2 | N/A | Limitation of power according to grid voltage increase<br>1: Step reduction<br>2: Linear reduction |
| **Voltage Dependant Power Reduction Voltage Level1** | 0 | 999 | % | Voltage level 1 for power limitation function against to grid voltage increase |
| **Voltage Dependant Power Reduction Voltage Level2** | 0 | 999 | % | Voltage level 2 for power limitation function against to grid voltage increase |
| **Voltage Dependant Power Reduction Ramp** | 0 | 30000 | sec | Power reduction response time at power limitation function activation against to grid voltage increase |
| **Voltage Dependant Power Reduction Level** | 0 | 100 | % | Amount of power limitation at power limitation function activation against to grid voltage increase |
| **Variable Rated Current Enable** | 0 | 1 | N/A | Rated current level increase function when grid voltage decrease |
| **Variable Rated Current Check Time** | 0 | 999 | sec | Rated current level increase function holding time when grid voltage decrease |
| **Variable Rated Current Ramp** | 0 | 999 | sec | Rated current level recovery response time at “Variable Rated Current” function deactivation |
| **Moving Average RMS Time Window** | 0 | 60 | sec | Time window for moving average RMS calculation of grid voltage |
| **QV Mode Select** | 0 | 3 | N/A | Q(V) mode selection |
| **Grid Over Voltage Level1 Trip Time Scale** | 1 | 9999 | N/A | Time scale for grid over voltage Level 3 trip |
| **Active Damping Limit** | 0 | 999 | N/A | Limit value of active current value change amount when using active damping function |
| **Power Factor Limit** | 0.01 | 1 | N/A | Limit value can be set using Fixed COSΦ control |
| **Reactive Current Ramp** | 0 | 9999 | sec | Slop of inverter output reactive power<br>(Apply when using Fixed Q, Fixed COSΦ control) |
| **RPV Q** | -99.9 | 99.9 | % | Reactive power variation value for Anti-Islanding(RPV) |
| **RPV Time** | 0.001 | 9.999 | Period | Reactive power variation period for Anti-Islanding(RPV) |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| | | | | (Based on one cycle) |
| **RPV Active Period** | 1 | 100 | Period | Reactive power variation activation period for Anti-Islanding(RPV) |
| **RPV Period** | 1 | 100 | Period | Total period of reactive power variation for Anti-Islanding(RPV)<br>(activate period + deactivate period) |
| **RPV Q Limit** | 0 | 10 | % | Limit value of reactive power variation for Anti-Islanding(RPV) |
| **PJD R-Time** | 5 | 30 | sec | PWM stop time in case of grid voltage phase delay fault detection |
| **APS Coeff. 1** | 1 | 5 | N/A | Proportion constant 1 of reactive power infusion capability against to the frequency variation for Anti-Islanding(APS) |
| **APS Coeff. 2** | 0.01 | 0.5 | N/A | Proportion constant 2 of reactive power infusion capability against to the frequency variation for Anti-Islanding(APS) |
| **Band Stop Filter Ratio** | 0 | 9.999 | N/A | Proportion constant of band stop filter |
| **Band Stop Filter Bandwidth** | 0 | 999.9 | Hz | Bandwidth of Band stop filter |
| **Band Stop Filter Cut-off Frequency** | 0 | 999 | Hz | Cut-off frequency of band stop filter |
| **Grid Frequency Step Up Level** | 0 | 9.9 | Hz | This parameter determines the frequency variation whether step-up or not. |
| **Grid Frequency Step Up Active Time** | 0 | 30000 | ms | Time for grid frequency step-up variation trip |
| **Gate Block Enable During FRT** | 0 | 1 | N/A | Gate block enable during FRT<br>0: Disable<br>1: Enable |
| **FRT Gate Block Time** | 0 | 999.9 | ms | Gate block holding time during FRT |
| **Grid Over Frequency Level2 Trip Time Scale** | 1 | 9999 | N/A | This parameter is used to increase the grid over frequency level 2 trip time |
| **Frequency Dependant Power Reduction LPF** | 0.1 | 999.9 | Hz | Frequency low pass filter cut-off frequency for frequency dependant power reduction |
| **FRT Target Voltage Average Time** | 1 | 3000 | sec | This parameter determines how long the average RMS value of grid voltage will be calculated for FRT situation |

### 8.1.4 Time Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Year** | 2000 | 3000 | - | The present year |
| **Month** | 1 | 12 | - | The present month |
| **Day** | 1 | 31 | - | The present date |
| **Time** | 0 | 23 | - | The present hour |
| **Minute** | 0 | 59 | - | The present minute |
| **Second** | 0 | 59 | - | The present second |

### 8.1.5 Digital Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **DI1 Select** | 0 | 20 | N/A | DI1(Digital Input) selection<br>0: Disable DI1<br>1: Reserved<br>2: Reserved<br>3: Start/Stop operation of the inverter by DI1 (Recognition pattern : 1sec – Stop, 2sec – Start)<br>4: Start/Stop operation of the inverter by DI1 (Recognition pattern : 200msec – Stop, 400msec – Start)<br>5: Stop operation of the inverter by DI1 (Inverter turn off when DI1 signal over {DI1 Check Period} msec |
| **DO1 Select** | 0 | 20 | N/A | DO1(Digital output) selection<br>0: Fault state is output to DO1 |
| **RPC Mode Select** | 0 | 2 | N/A | The COSPHI control function of the Inverter operates when this parameter is 2.<br>0: Disable<br>2: Enable |
| **Power Meter** | 0 | 999999 99 | kWh | PV generation amount check |
| **RS485 Protocol** | 0 | 999 | - | RS485 communications' protocol<br>0 : ACI protocol<br>1 : Communication with prolog<br>2 : Communication with PVI-go |
| **RS485 ID** | 0 | 999 | - | ID for RS485 communication |
| **CAN ID** | 0 | 999 | - | ID for CAN communication |
| **Argus Box 1 Address** | 0 | 30000 | - | Argus Box 1 address and type setup |
| **Argus Box 2 Address** | 0 | 30000 | - | Argus Box 2 address and type setup |
| **Argus Box 3 Address** | 0 | 30000 | - | Argus Box 3 address and type setup |
| **Argus Box 4 Address** | 0 | 30000 | - | Argus Box 4 address and type setup |
| **Argus Box 5 Address** | 0 | 30000 | - | Argus Box 5 address and type setup |
| **Argus Box 6 Address** | 0 | 30000 | - | Argus Box 6 address and type setup |
| **Argus Box 7 Address** | 0 | 30000 | - | Argus Box 7 address and type setup |
| **Argus Box 8 Address** | 0 | 30000 | - | Argus Box 8 address and type setup |
| **Prolog Positive Sequence Enable** | 0 | 1 | - | Provide positive sequence for grid voltage as prolog |
| **Prolog Expanded Total Yield** | 0 | 1 | - | Provide expanded total yield to Prolog |
| **S0 Pulse Rate** | 1 | 100 | N/A | Output pulse rate of the S0 Interface according to inverter power generation (Pulse/kWh) |
| **DI1 Check Period** | 200 | 5000 | msec | Required time for inverter turn off when selecting {DI1 Select} parameter to '5' |

### 8.1.6 Analog Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **PV Volt Offset(for RPO)** | -300 | 300 | - | PV volt offset for RPO |
| **PV Volt Gain(for RPO)** | -300 | 300 | - | PV volt gain for RPO |
| **AI2 OffSet** | -300 | 300 | - | AI (Analog Input) 2 offset |
| **AI2 Gain** | -300 | 300 | - | AI (Analog Input) 2 gain |
| **AI3 OffSet** | -300 | 300 | - | AI (Analog Input) 3 offset |
| **AI3 Gain** | -300 | 300 | - | AI (Analog Input) 3 gain |
| **AI4 OffSet** | -300 | 300 | - | AI (Analog Input) 4 offset |
| **AI4 Gain** | -300 | 300 | - | AI (Analog Input) 4 gain |
| **AI1 Low Limit** | 0 | 10 | - | Reserved |
| **AI2 Low Limit** | 0 | 10 | - | Reserved |
| **AI3 Low Limit** | 0 | 10 | - | Reserved |
| **AI4 Low Limit** | 0 | 10 | - | Reserved |

### 8.1.7 Controller Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **VC P Gain** | 0 | 299.99 | N/A | PV voltage controller's P Gain |
| **VC I Gain** | 0 | 299.99 | N/A | PV voltage controller's I Gain |
| **Voltage Detection LPF** | 0 | 9999 | Hz | Grid Voltage and Inverter voltage filter of dq axis |
| **CC P Gain** | 0 | 29.999 | N/A | Inverter output current controller's P Gain |
| **CC I Gain** | 0 | 299.99 | N/A | Inverter output current controller's I Gain |
| **CC di/dt** | 1 | 9999 | p.u. | Slope of inverter rated current generation |
| **Ramp** | 0 | 30000 | msec | Slope of PV voltage generation (time for 100V change) |
| **Li** | 0 | 30000 | uH | Inductance value of inverter output LC filter |
| **Vdc Reference** | 0 | 999.9 | Vdc | DC voltage reference when it is not in MPPT range |
| **CC Period** | 100 | 400 | usec | Inverter switching frequency |
| **PLL P Gain** | 0 | 999.99 | N/A | Grid voltage PLL's P Gain |
| **PLL I Gain** | 0 | 999.99 | N/A | Grid voltage PLL's I Gain |
| **Auto Fault Reset Count** | 0 | 20 | times | The maximum count of auto reset function |
| **Heatsink OT Level** | 50 | 150 | °C | The maximum value of PEBB temperature |
| **Power Compensation** | 0 | 1 | - | Power compensation for MPPT control |
| **Test mode** | 0 | 30000 | N/A | The value for function test mode |
| **Options** | 0 | 30000 | N/A | Outside option board setup |
| **Deviation Tolerance Time** | 1 | 25 | 20msec | Level1 trip time use when level2 protection disable |
| **Reactive Power** | -30 | 30 | % | The control value for reactive power degree of accuracy |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Variable MPP Vmin Enb** | 0 | 1 | - | The setup value for inverter operation rage maximization |
| **T_CLOUD** | 0 | 3600 | sec | Time for declines of PV generation due to cloud |
| **T_CLOUD_CNT** | 0 | 20 | times | Count for declines of PV generation due to cloud |
| **Remote Power Control** | 0 | 100 | % | Inverter active power which can be controlled from outside device |
| **PEBB2 Temperature** | 0 | 150 | °C | PEBB2 temperature (Read only) |
| **PEBB3 Temperature** | 0 | 150 | °C | PEBB3 temperature (Read only) |
| **Current Unbalance Limit** | 0 | 100 | % | Unbalanced current level |
| **Cabinet FAN PWM** | 0 | 100 | - | Reserved |
| **Remote Power Control Ramp** | 0 | 600 | sec | The slope of inverter output active poser when remote power is controlled |
| **Total Yield** | 0 | 30000 | kWh | Check total yield of generation (Read only) |
| **Today Yield** | 0 | 30000 | kWh | Check day yield of generation (Read only) |
| **IIVCD P Gain** | 0 | 299.99 | - | d-axis P gain of inverter output voltage controller for initial voltage build-up |
| **IIVCD I Gain** | 0 | 299.99 | - | d-axis I gain of inverter output voltage controller for initial voltage build-up |
| **IIVCQ P Gain** | 0 | 299.99 | - | q-axis P gain of inverter output voltage controller for initial voltage build-up |
| **IIVCQ I Gain** | 0 | 299.99 | - | q-axis I gain of inverter output voltage controller for initial voltage build-up |
| **AAI(Active Anti-Islanding) Mode** | 0 | 3 | - | Anti-Islanding control mode selection<br>0: disable<br>1: APS enable<br>2: RPV enable<br>3: APS + RPV enable |
| **APS Upper DB** | 0.02 | 3 | Hz | Upper limit of frequency for APS |
| **Reactive Power Limit** | 0 | 299.99 | - | Reactive power limits of reactive power infusion capability against to the frequency variation for Anti-Islanding(APS) |
| **Wind Speed** | 0 | 299.99 | - | Reserved |
| **Power Derating Enable** | 0 | 1 | - | The use of power decline controller according to PEBB temperature, Yes(1) NO(0) |
| **Power Derating Enable Temperature** | 50 | 100 | - | Temperature level which starts decreasing power according to PEBB temperature |
| **Power Derating Disable Temperature** | 40 | 90 | - | Temperature level which stops decreasing power according to PEBB temperature |
| **Power Derating Reference Temperature** | 45 | 95 | - | PEBB temperature reference value |
| **Power Derating P Gain** | 0 | 10 | - | Power declining controller's P gain according to PEBB temperature |
| **Grid IIR Filter Cutoff Frequency** | 0 | 10 | Hz | Filter cutoff frequency used for RMS value detection of grid voltage |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Asynchronous Fault Count** | 0 | 100 | - | Reserved |
| **Asynchronous Fault Enable** | 0 | 1 | - | Reserved |
| **Grid Positive Sequence** | 0 | 999.9 | V | Positive sequence value of grid |
| **COSPHI Control Mode** | 0 | 5 | - | Reactive power supply method in Internal mode and RPC mode<br>0: disabled<br>1: fixed P<br>2: fixed cosφ<br>3: fixed Q<br>4: Cosφ(P/Pn)<br>5: Q(U) |
| **COSPHI Power Factor Internal** | -1 | 1 | - | Power factor reference in internal mode |
| **COSPHI Reactive Power Internal** | -99.9 | 99.9 | % | Reactive power reference in internal mode (Percent for rated one) |
| **COSPHI Power Factor Actual** | -1 | 1 | - | The actual power factor value that is applied (Read only) |
| **COSPHI Power Factor RPC** | -1 | 1 | - | Power factor reference in RPC mode |
| **COSPHI Reactive Power RPC** | -99.9 | 99.9 | % | Reactive power reference in RPC mode. (percent for rated one) |
| **COSPHI Stray Ratio** | 0 | 2 | | The setup value for COSPHI control. |
| **Positive Sequence PLL Enable** | 0 | 1 | - | The use of grid voltage of positive sequence at PLL |
| **FRT K Factor** | 0 | 10 | - | The setup constant during FRT control. |
| **FRT IQ Ramp** | 0 | 30000 | msec | The slope of active power supply during FRT control. |
| **FRT IQ Ramp Time** | 0 | 30000 | msec | The time that use a slope changed by FRT IQ ramp parameter. |
| **Positive Sequence LPF** | 0 | 999.9 | Hz | The cutoff frequency for RMS value of positive sequence. |
| **PLL Freq LPF** | 0 | 999.9 | Hz | The cutoff frequency for frequency value detection of PLL |
| **Q(V) Control Target Voltage** | 208 | 440 | V | Value of Q(V) Control Target Voltage |
| **Q(V) Control K Factor** | 0 | 50 | - | A setup constant for voltage control of BDEW. |
| **Q(V) Control Deadband** | 0 | 100 | % | Non-applicable voltage range during voltage control of BDEW. |
| **Q(V) Control Ramp Time** | 0 | 30000 | sec | The slope of reactive current increase during voltage control of BDEW. |
| **FRT Asynchronous Level** | 0 | 100 | V | The voltage level in order to separate Asynchronous and synchronous. Inverter will recognize as Asynchronous if the difference between inverter sensing output voltage and RMS value of positive value is less then this parameter level. |
| **COSPHI (P/Pn) Ramp Time** | 0 | 30000 | sec | The slope setup value for PF's answering time in Cosφ(P/Pn). |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **COSPHI_1** | -1 | 1 | - | The variable power factor reference according to active power P_1. |
| **P1** | 0 | 100 | % | The active power setup conference for COSPHI_1. |
| **COSPHI_2** | -1 | 1 | - | The variable power factor reference according to active power P_2. |
| **P2** | 0 | 100 | % | The active power setup conference for COSPHI_2. |
| **COSPHI_3** | -1 | 1 | - | The variable power factor reference according to active power P_3. |
| **P3** | 0 | 100 | % | The active power setup conference for COSPHI_3. |
| **COSPHI_4** | -1 | 1 | - | The variable power factor reference according to active power P_4. |
| **P4** | 0 | 100 | % | The active power setup conference for COSPHI_4. |
| **COSPHI_5** | -1 | 1 | - | The variable power factor reference according to active power P_5. |
| **P5** | 0 | 100 | % | The active power setup conference for COSPHI_5. |
| **COSPHI_6** | -1 | 1 | - | The variable power factor reference according to active power P_6. |
| **P6** | 0 | 100 | % | The active power setup conference for COSPHI_6. |
| **COSPHI_7** | -1 | 1 | - | The variable power factor Reference according to active power P_7. |
| **P7** | 0 | 100 | % | The active power setup conference for COSPHI_7. |
| **COSPHI_8** | -1 | 1 | - | The variable power factor reference according to active power P_8. |
| **P8** | 0 | 100 | % | The active power setup conference for COSPHI_8. |
| **COSPHI_9** | -1 | 1 | - | The variable power factor reference according to active power P_9. |
| **P9** | 0 | 100 | % | The active power setup conference for COSPHI_9. |
| **COSPHI_10** | -1 | 1 | - | The variable power factor Reference according to active power P_10. |
| **P10** | 0 | 100 | % | The active power setup conference for COSPHI_10. |
| **IINV Voltage Build Up Time** | 0 | 9999 | msec | Since the time of this parameter after “Initial Voltage Build-up” is started, check synchronization of between inverter and grid voltage |
| **IINV PLL Stabilization Time** | 0 | 9999 | msec | Check the voltage phase between inverter and grid during the time of this parameter |
| **IINV PLL P Gain** | 0 | 299.99 | - | P gain of grid voltage PLL used at “Initial Voltage Build-up” |
| **IINV PLL I Gain** | 0 | 299.99 | - | I gain of grid voltage PLL used at “Initial Voltage Build-up” |

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **IINV Synchronization Tolerance** | 1 | 20 | degree | Determine the threshold value of the synchronization between inverter and grid voltage at “Initial Voltage Build-up” state |
| **FRT Overcurrent Protection Time** | 0 | 5000 | msec | The power generation is stopped for this parameter value after fault clear in FRT situation. |
| **Power Control Enable** | 0 | 1 | - | Use Power Control structure |
| **APS Lower DB** | 0.02 | 3 | Hz | Lower limit of frequency Anti-Islanding(APS) |
| **CC PI Cutoff Freq.** | 0 | 100 | Hz | Cutoff frequency of current controller PI-gain |
| **Dual Controller Enable** | 0 | 1 | N/A | Dual current controller Enable<br>0: Disable<br>1: Enable |
| **CC A Gain** | 0 | 299.99 | N/A | Current controller anti-wind-up gain. |
| **FRT Deadband** | 0 | 0.2 | p.u. | If the grid voltage is lower than this parameter, it means FRT situation. |

### 8.1.8 Trace Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **Trace Mode** | 0 | 10 | N/A | 0: Fault Trace Data<br>11: Trace Data After Pre-sync. to the grid |
| **Trace Sample Time** | 0 | 9999 | CCP | Sampling Time of Trace Data |
| **Trace 1** | 0 | 999 | N/A | Select Trace Data 1 Value |
| **Trace 2** | 0 | 999 | N/A | Select Trace Data 2 Value |
| **Trace 3** | 0 | 999 | N/A | Select Trace Data 3 Value |
| **Trace 4** | 0 | 999 | N/A | Select Trace Data 4 Value |
| **Trace 5** | 0 | 999 | N/A | Select Trace Data 5 Value |
| **Trace 6** | 0 | 999 | N/A | Select Trace Data 6 Value |
| **Trace 7** | 0 | 999 | N/A | Select Trace Data 7 Value |
| **Trace 8** | 0 | 999 | N/A | Select Trace Data 8 Value |
| **Trace 9** | 0 | 999 | N/A | Select Trace Data 9 Value |
| **Trace 10** | 0 | 999 | N/A | Select Trace Data 10 Value |
| **Trace 11** | 0 | 999 | N/A | Select Trace Data 11 Value |
| **Trace 12** | 0 | 999 | N/A | Select Trace Data 12 Value |

### 8.1.9 Offset Parameters

| Parameters | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **PV Voltage** | -100 | 100 | N/A | Offset of PV Voltage |
| **PV Current** | -100 | 100 | N/A | Offset of PV Current |
| **Inverter Phase Current R** | -100 | 100 | N/A | Reserved |
| **Inverter Phase Current T** | -100 | 100 | N/A | Reserved |
| **Isolation Resistance** | -100 | 100 | N/A | Reserved |
| **Stack Temperature** | -100 | 100 | N/A | Offset of Stack Temperature |
| **Cabinet Temperature** | -100 | 100 | N/A | Offset of Cabinet Temperature |
| **Inverter Phase Current S** | -100 | 100 | N/A | Reserved |
| **Current Offset LPF** | 0 | 999.9 | Hz | Cut-off Frequency of IIR Filter |
| **Inverter Phase Current R1** | -100 | 100 | N/A | Offset of Inverter R-Phase Current of PEBB 1 |
| **Inverter Phase Current S1** | -100 | 100 | N/A | Offset of Inverter S-Phase Current of PEBB 1 |
| **Inverter Phase Current T1** | -100 | 100 | N/A | Offset of Inverter T-Phase Current of PEBB 1 |
| **Inverter Phase Current R2** | -100 | 100 | N/A | Offset of Inverter R-Phase Current of PEBB 2 |
| **Inverter Phase Current S2** | -100 | 100 | N/A | Offset of Inverter S-Phase Current of PEBB 2 |
| **Inverter Phase Current T2** | -100 | 100 | N/A | Offset of Inverter T-Phase Current of PEBB 2 |
| **Inverter Phase Current R3** | -100 | 100 | | Offset of Inverter R-Phase Current of PEBB 3 |
| **Inverter Phase Current S3** | -100 | 100 | | Offset of Inverter S-Phase Current of PEBB 3 |
| **Inverter Phase Current T3** | -100 | 100 | | Offset of Inverter T-Phase Current of PEBB 3 |
| **Grid Over Voltage Level1 Time Offset** | 0 | 3000 | ms | Offset of Grid Over Voltage Level1 Trip Time |
| **Grid Over Voltage Level2 Time Offset** | 0 | 3000 | ms | Offset of Grid Over Voltage Level2 Trip Time |
| **Grid Under Voltage Level1 Time Offset** | 0 | 3000 | ms | Offset of Grid Under Voltage Level1 Trip Time |
| **Grid Under Voltage Level2 Time Offset** | 0 | 3000 | ms | Offset of Grid Under Voltage Level2 Trip Time |
| **Grid Over Frequency Level1 Time Offset** | 0 | 3000 | ms | Offset of Grid Over Frequency Level1 Trip Time |
| **Grid Over Frequency Level2 Time Offset** | 0 | 3000 | ms | Offset of Grid Over Frequency Level2 Trip Time |
| **Grid Over Frequency Level3 Time Offset** | 0 | 3000 | ms | Offset of Grid Over Frequency Level3 Trip Time |
| **Grid Under Frequency Level1 Time Offset** | 0 | 3000 | ms | Offset of Grid Under Frequency Level1 Trip Time |
| **Grid Under Frequency Level2 Time Offset** | 0 | 3000 | ms | Offset of Grid Under Frequency Level2 Trip Time |
| **Grid Under Frequency Level3 Time Offset** | 0 | 3000 | ms | Offset of Grid Under Frequency Level3 Trip Time |
| **Inverter Slow Over Current Time Offset** | 0 | 3000 | ms | Offset of Inverter Slow Over Current Trip Time |

### 8.1.10 Gain Parameters

| Parameter | Min | Max | Unit | Descriptions |
|---|---|---|---|---|
| **PV Voltage** | -100 | 100 | N/A | Gain of PV Voltage |
| **PV Current** | -100 | 100 | CCP | Gain of PV Current |
| **PV Voltage 2** | -100 | 100 | N/A | Reserved |
| **Inverter Linear Voltage L1** | -100 | 100 | N/A | Offset of Inverter R-Phase Voltage |
| **Inverter Linear Voltage L2** | -100 | 100 | N/A | Offset of Inverter S-Phase Voltage |
| **Inverter Linear Voltage L3** | -100 | 100 | N/A | Offset of Inverter T-Phase Voltage |
| **Inverter Phase Current R** | -100 | 100 | N/A | Reserved |
| **Inverter Phase Current T** | -100 | 100 | N/A | Reserved |
| **Grid Line Voltage L1** | 0 | 999.9 | Hz | Grid R-Phase Voltage Gain of PEBB 1 |
| **Grid Line Voltage L2** | -100 | 100 | N/A | Grid S-Phase Voltage Gain of PEBB 1 |
| **Grid Line Voltage L3** | -100 | 100 | N/A | Grid R-Phase Voltage Gain of PEBB 1 |
| **Isolation Resistance** | -100 | 100 | N/A | Reserved |
| **Stack Temperature** | -100 | 100 | N/A | Gain of Stack Temperature |
| **Cabinet Temperature** | -100 | 100 | N/A | Gain of Cabinet Temperature |
| **Inverter Phase Current S** | -100 | 100 | N/A | Reserved |
| **Inverter Phase Current R1** | -100 | 100 | N/A | Inverter R-Phase Current Gain of PEBB 1 |
| **Inverter Phase Current S1** | -100 | 100 | N/A | Inverter S-Phase Current Gain of PEBB 1 |
| **Inverter Phase Current T1** | -100 | 100 | N/A | Inverter T-Phase Current Gain of PEBB 1 |
| **Inverter Phase Current R2** | -100 | 100 | N/A | Inverter R-Phase Current Gain of PEBB 2 |
| **Inverter Phase Current S2** | -100 | 100 | N/A | Inverter S-Phase Current Gain of PEBB 2 |
| **Inverter Phase Current T2** | -100 | 100 | N/A | Inverter T-Phase Current Gain of PEBB 2 |
| **Inverter Phase Current R3** | -100 | 100 | N/A | Inverter R-Phase Current Gain of PEBB 3 |
| **Inverter Phase Current S3** | -100 | 100 | N/A | Inverter S-Phase Current Gain of PEBB 3 |
| **Inverter Phase Current T3** | -100 | 100 | N/A | Inverter T-Phase Current Gain of PEBB 3 |

## 8.2 Functions

### 8.2.1 MPPT(Maximum Power Point Tracking) Function

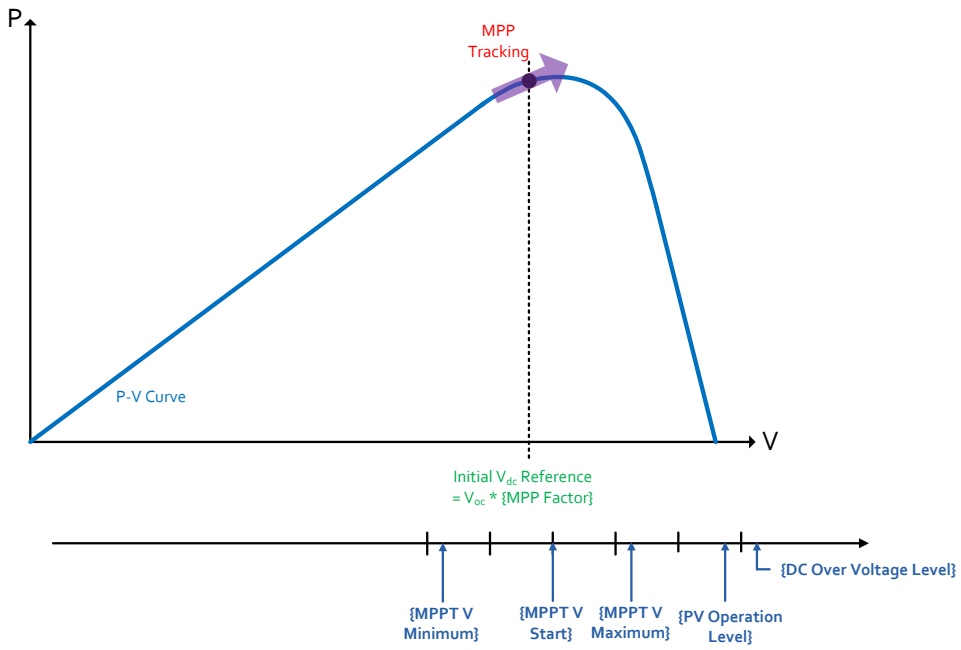



Figure 67: Characteristic of PV Curve

The KACO inverter start operation when Voc(open circuit voltage) is higher than {MPPT V Start} during {MPPT T Start} and initial MPP Voltage is start at {MPP Factor} * Voc, and MPP voltage is changed within the MPP range to generate maximum power. Default value of MPPT Parameters can be changed by Model.

**Related Parameters (ex. BP1000 Model)**

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| PV Array | 0 | MPPT Eanble | 0 | 1 | 1 |
| | 1 | MPPT V Maximum | 0 | 830 | 830 V |
| | 2 | MPPT V Start | 200 | 800 | 700 Vc |
| | 3 | MPPT T Start | 0 | 3600 | 900 sec |
| | 6 | MPPT V Minimum | 200 | 800 | 505 V |
| | 7 | DC Over Voltage Level | 300 | 1020 | 1020 V |
| | 9 | MPP Factor | 0 | 1 | 0.8 |
| | 12 | PV Operation Level | 900 | 1020 | 1000 V |

### 8.2.2 Operating DC voltage range

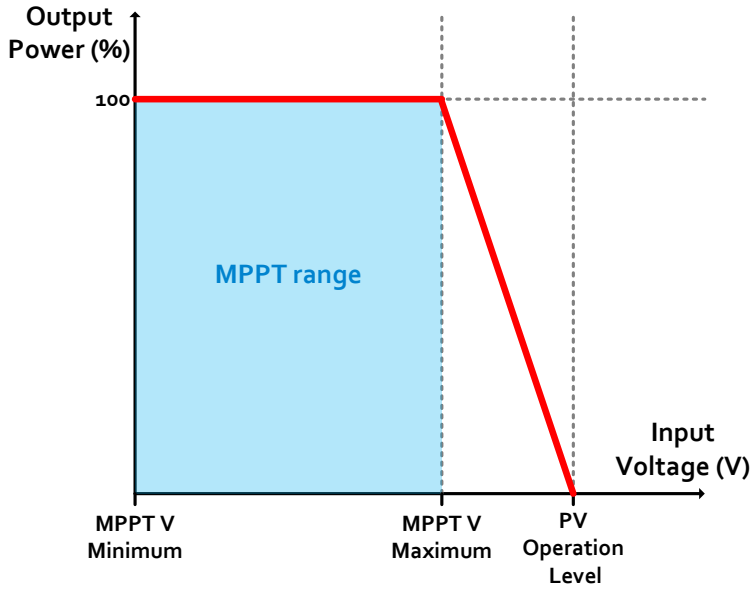



Figure 68: Inverter Operating PV Voltage Range

The range of possible operational input voltage is from {MPPT V Minimum} to {PV Operation Level}. The picture above shows that the output power decreases linearly where the input power is from {MPPT V Maximum} to {PV Operation Level}.

**Related Parameters (ex. BP1000 Model)**

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| PV Array | 1 | MPPT V Maximum | 0 | 830 | 830 V |
| | 6 | MPPT V Minimum | 200 | 800 | 505 V |
| | 12 | PV Operation Level | 900 | 1020 | 1000 V |
| | 13 | PV Over DC V Mode | 0 | 1 | 1 |

### 8.2.3 Power Derating

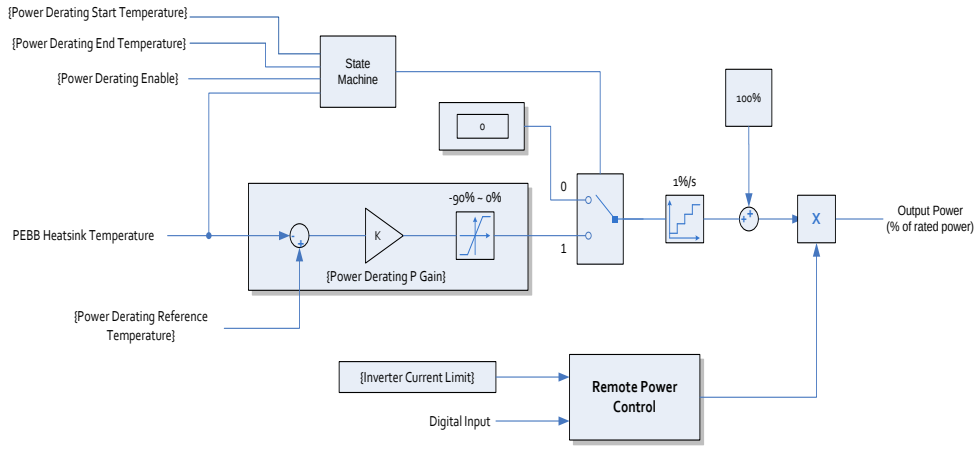



Figure 69: Block Diagram of Power Derating

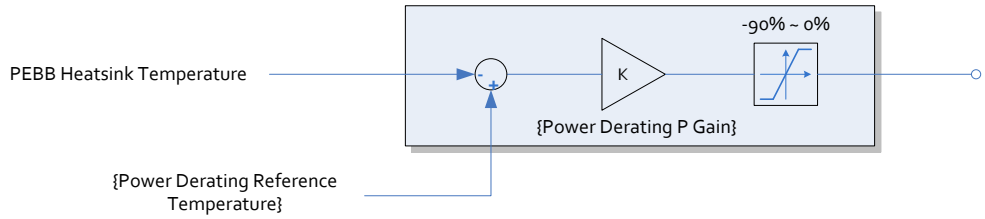



Figure 70: Decreasing rate

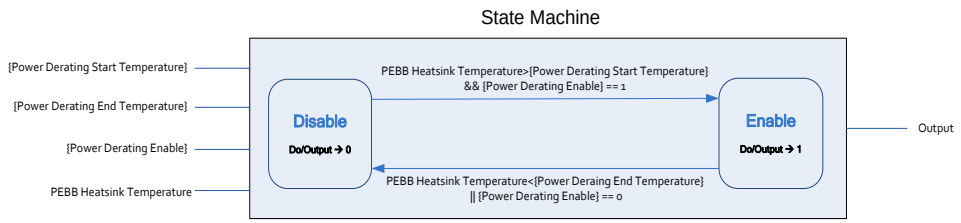



Figure 71: State Machine

Power derating is enabled or disabled by an output of state machine which is decided by 4 inputs. And while the output of state machine is 1, a decreasing rate affects an output power.

A decreasing rate is calculated by multiplying factor K({Power Derating P Gain}) and a difference between reference temperature({Power Derating Reference Temperature}) and PEBB heatsink temperature}.

An output of state machine depends on the state in which state machine is running. A transfer between states happens when defined conditions are satisfied. Basically, if {Power Derating Enable} is 0, the state is “Disable”. And If {Power Derating Enable} is 1, transfer is done according to PEBB heatsink temperature.

Following examples show power derating by default parameter.

Descriptions for sections of Example of Power Derating are:

T1: Inverter produces energy and PEBB temperature rises.

T2: When PEBB temperature is higher than 90℃, power derating is activated. And inverter controls output power according to expression, until power derating is deactivated.

T3: Output power decrease and PEBB temperature drops. When PEBB temperature is lower than 70℃, power derating is deactivated. And inverter doesn't decrease output power.

## Example of Power Derating

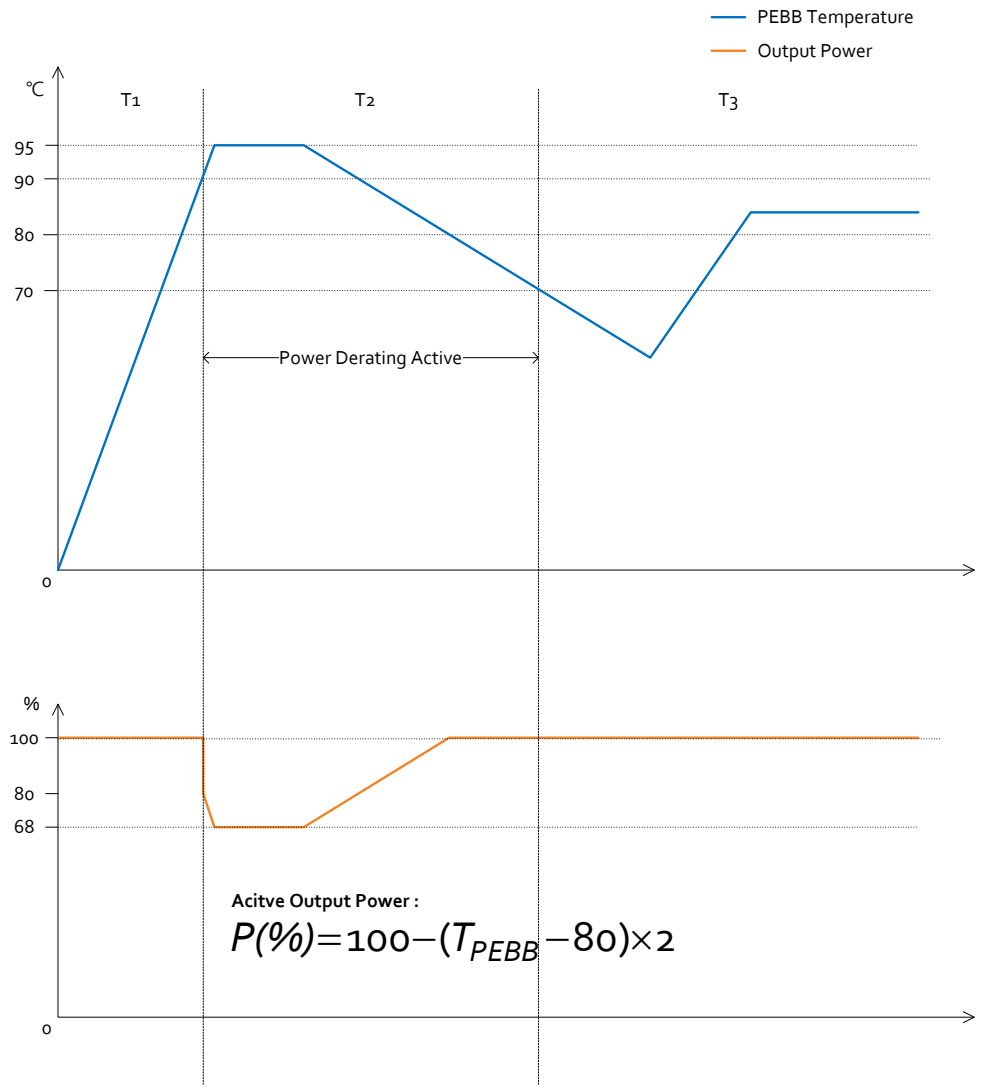



Figure 72: Concept of KACO inverter Power Derating

## Conceptual Relation between Output Power and Temperature

Below graph represents conceptual relation between inverter output power and heat sink temperature. The output power is reduced in proportion to heat sink temperature but keep in mind that the power derating is activated at 90℃ and deactivated at 70℃. (The activation/deactivation temperature can be tunable by parameter)

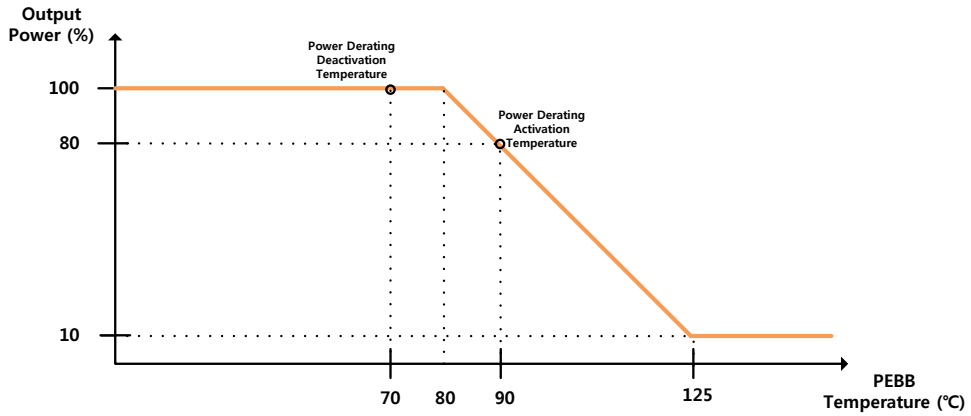



Figure 73: Relation between output power and temperature

### Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| Controller | 38 | Power Derating Enable | 0 | 1 | 1 |
| | 39 | Power Derating Enable Temperature | 50 | 100 | 90 |
| | 40 | Power Derating Disable Temperature | 40 | 90 | 70 |
| | 41 | Power Derating Disable Reference Temperature | 45 | 95 | 80 |
| | 42 | Power Derating P gain | 0 | 10 | 2 |

### 8.2.4 Grid Support (COSPHI Control)

## Fixed P Mode

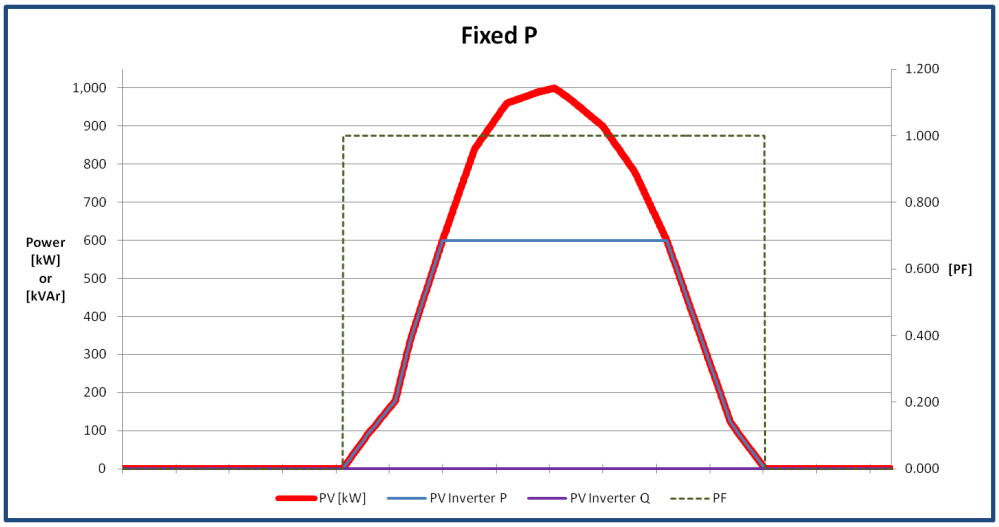



Figure 74: One of the example about Fixed P

The KACO inverter has a function to limit active power. Above the figure, the red-line is apparent power, blue-line is active power, purple-line is reactive power, and the green-dot line is power factor. If {Current Limit} parameter is 60 %, inverter can limit the active power as the above figure. Fixed P mode is active when {COSPHI Control Mode} value is set to from 1 to 5.

**Related Parameters (ex.BP1000 Model)**

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| Inverter | 3 | Current Limit | 0 | 100 | 100 % |
| Controller | 27 | Remote Power Control Ramp | 0 | 600 | 10 sec |
| | 47 | COSPHI Control Mode | 0 | 5 | 2* |

*Value for Enable of Fixed P : 1~5

## Fixed PF Mode

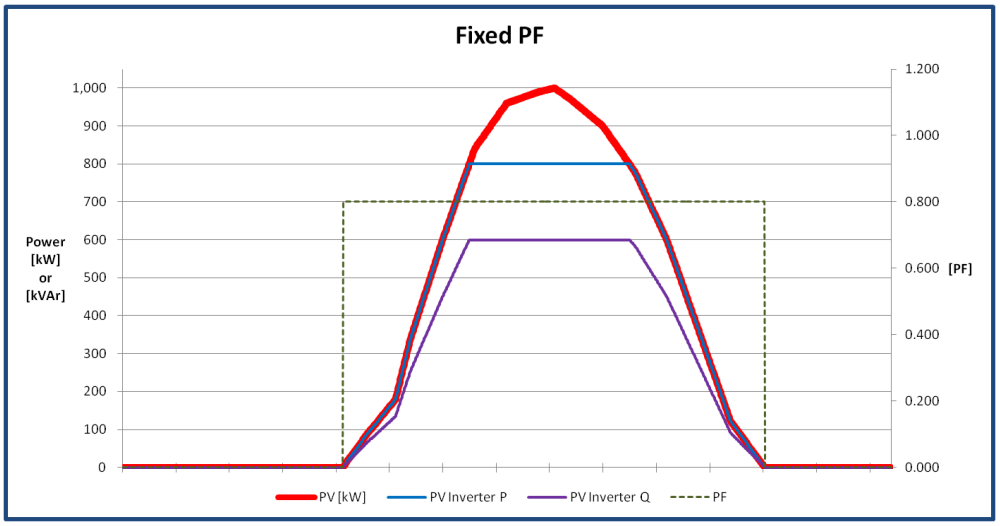



Figure 75: One of the example about Fixed PF

The KACO inverter has a function to control the power factor. Above the figure, the red-line is apparent power, blue-line is active power, purple-line is reactive power, and the green-dot line is power factor. If {COSPHI Reactive Power Factor Internal} parameter is set to 0.8, Inverter can control the power factor as the above figure. If apparent power exceed 1MVA by power factor, active power decreases to maintain apparent power. Fixed PF mode is active when {COSPHI Control Mode} value is set to 2.

### Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 74 | Reactive Power Ramp | 1 | 30000 | 10 sec |
| Controller | 47 | COSPHI Control Mode | 0 | 5 | 2* |
| | 48 | COSPHI Reactive Power Factor Internal | -1 | 1 | 1 |

*Value for Enable of Fixed PF : 2

## Fixed Q Mode

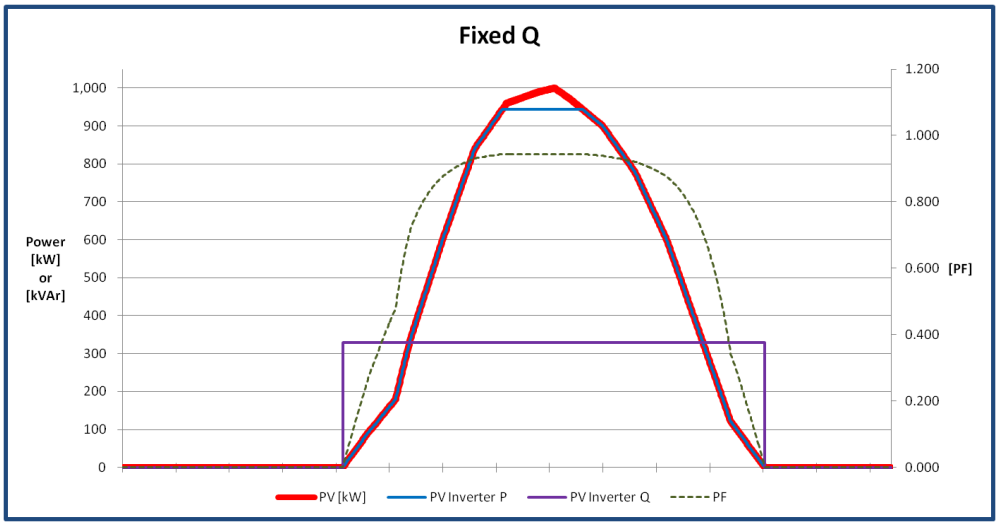



Figure 76: One of the Example about Fixed Q

The KACO inverter has a function to control the reactive power. Above the figure, the red-line is apparent power, blue-line is active power, purple-line is reactive power, and the green-dot line is power factor. If {COSPHI Reactive Power Internal} parameter is set to 15%, Inverter can control the reactive power as the above figure. If apparent power exceed 1MVA by changing reactive power, active power decreases to maintain apparent power. Fixed Q mode is active when {COSPHI Control Mode} value is set to 3.

### Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 74 | Reactive Power Ramp | 1 | 30000 | 10 sec |
| Controller | 47 | COSPHI Control Mode | 0 | 5 | 2* |
| | 49 | COSPHI Reactive Power Internal | -99.9 | 99.9 | 0 |

*Value for Enable of Fixed Q : 3

## Cosphi(P/Pn) Mode

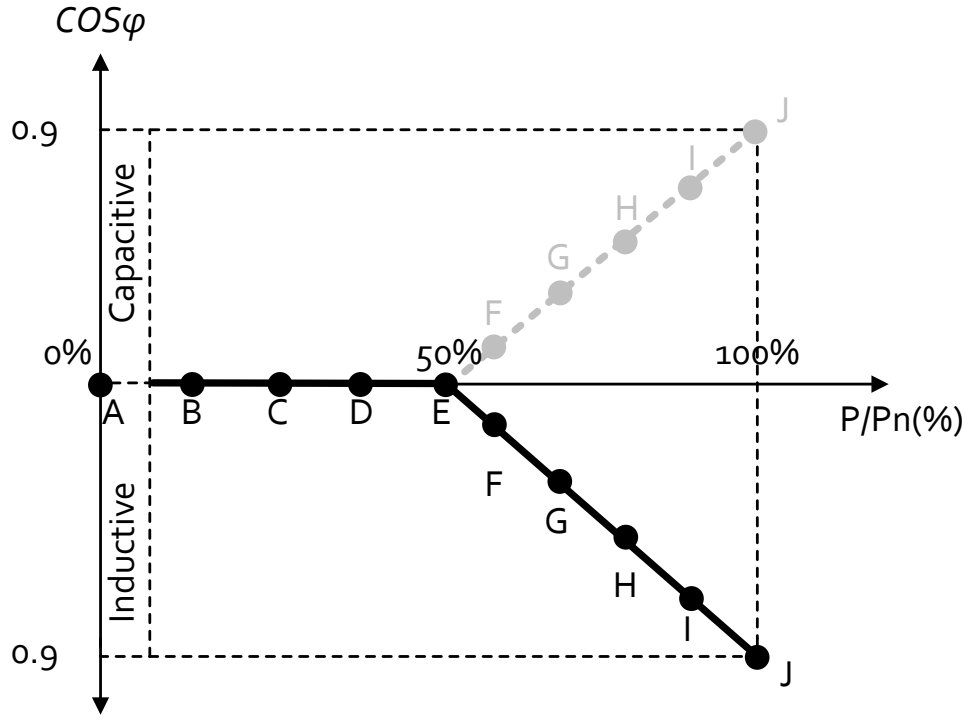



Figure 77: One of the Example about Cosphi(P/Pn) Mode

The KACO inverter has a function to control the power factor according to the active power to grid. The maximum setup point of both PF and active power is 10 points and the maximum required value of PF for Cosphi(P/Pn) is 0.9

### Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Control | 47 | COSPHI Control Mode | 0 | 5 | 2 |
| | 65 | COS (P/Pn) Ramp Time | 0 | 30000 | 10 |
| | 66 | COSPHI_1 | -1 | 1 | 1 |
| | 67 | P2 | 0 | 100 | 0 % |
| | 68 | COSPHI_1 | -1 | 1 | 1 |
| | 69 | P2 | 0 | 100 | 50 % |
| | 70 | COSPHI_3 | -1 | 1 | 1 |
| | 71 | P3 | 0 | 100 | 50 % |
| | 72 | COSPHI_4 | -1 | 1 | 1 |
| | 73 | P4 | 0 | 100 | 50 % |
| | 74 | COSPHI_5 | -1 | 1 | 1 |
| | 75 | P5 | 0 | 100 | 50 % |
| | 76 | COSPHI_6 | -1 | 1 | 1 |
| | 77 | P6 | 0 | 100 | 50 % |
| | 78 | COSPHI_7 | -1 | 1 | 1 |
| | 79 | P7 | 0 | 100 | 50 % |

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| | 80 | COSPHI_8 | -1 | 1 | 1 |
| | 81 | P8 | 0 | 100 | 50 % |
| | 82 | COSPHI_9 | -1 | 1 | 1 |
| | 83 | P9 | 0 | 100 | 50 % |
| | 84 | COSPHI_10 | -1 | 1 | 1 |
| | 85 | P10 | 0 | 100 | 100 % |

*Value for Enable of Cosphi(P/Pn) : 4

## Q(V) Mode

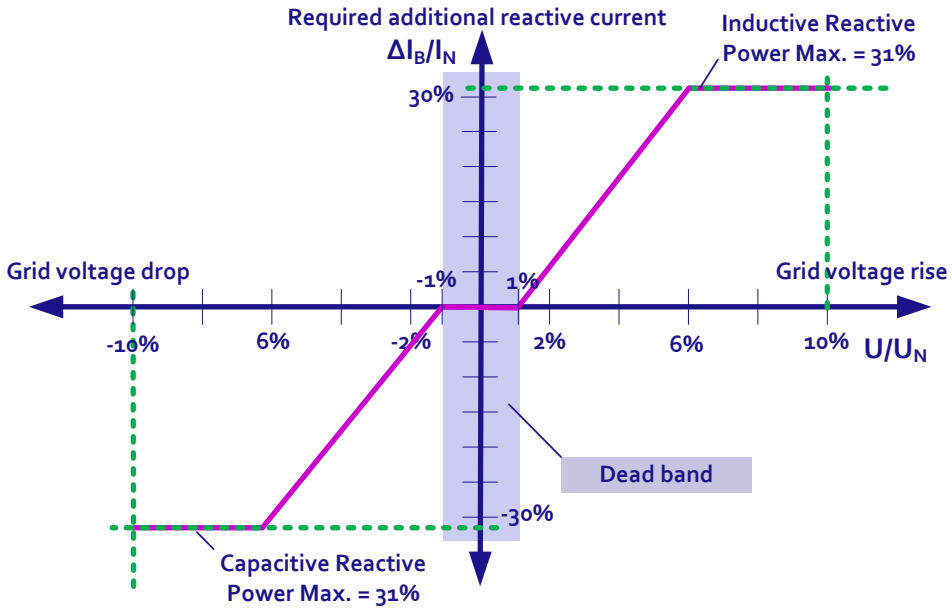



Figure 78: Q(V) Mode using K-Factor

The KACO inverter has a function to control the reactive power according to the grid voltage. When the grid voltage increases or decreases between rated range, KACO inverter control the reactive power to stabilize the grid. The grid voltage range where Q(V) function is possible is determined by {Q(V) Control Deadband} and {Q(V) Control K-Factor}.

### Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 46 | QV Voltage1 | 100 | 110 | 101 |
| | 47 | QV Voltage2 | 90 | 100 | 99 |
| | 48 | QV Voltage3 | 100 | 110 | 106 |
| | 49 | QV Voltage4 | 90 | 100 | 94 |
| | 50 | QV Inductive Max | 0 | 48 | 31 % |
| | 51 | QV Capacitive Max | 0 | 48 | 31 % |
| | 70 | QV Mode Select | 0 | 3 | 0** |
| Control | 47 | COSPHI Control Mode | 0 | 5 | 2* |
| | 60 | Q(V) Control Target Voltage | 208 | 440 | 370 |
| | 61 | Q(V) Control K Factor | 0 | 50 | 3.1 |
| | 62 | Q(V) Control Deadband | 0 | 100 | 1 % |
| | 63 | Q(V) Control Ramp Time | 0 | 30000 | 60 sec |

*Value for Enable of Q(V) : 5
**Selection of Q(V) Mode

### Selection of Q(V) Mode

| Q(V) Mode Select Value | Q(V) Control Mode |
|---|---|
| 0 | Q(V) Mode using K-Factor<br>ΔU is representative of instant RMS Value of grid |
| 1 | Q(V) Mode using Point(V,Q)<br>ΔU is representative of instant RMS Value of grid |
| 2 | Q(V) Mode using K-Factor<br>ΔU is representative of moving average RMS Value of grid |
| 3 | Q(V) Mode using Point(V,Q)<br>ΔU is representative of moving average RMS Value of grid |

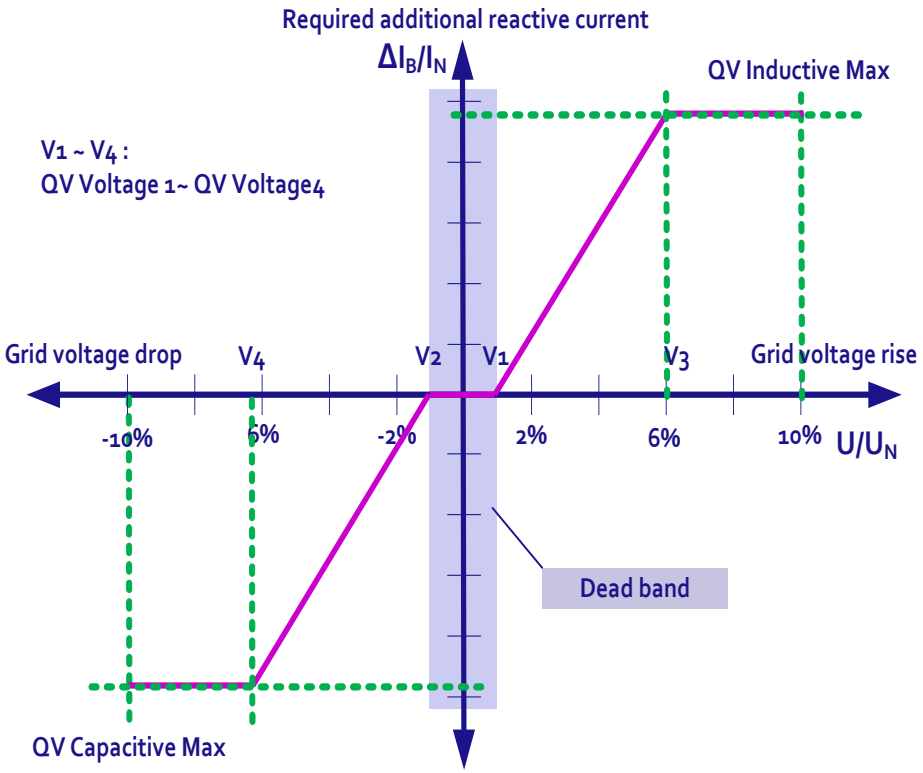



Figure 79: Q(V) Mode using Point (V,Q)

As you can see in the above picture, this Q(V) Control function is for the reactive power infusion even if grid is in normal range(90~110%). Dead band range is UTarget±1% and can be set to {QV Voltage1} and {QV Voltage2}.

Here, you can set the maximum value of ΔQ to {QV Inductive Max} and {QV Capacitive Max}, slope for Q(V) Control as shown in the above picture is determined by relationship between {QV Inductive Max}, {QV Capacitive Max}, and {QV Voltage 1 ~ 4}. This method is applicable when {QV Mode Select} is set to ‘1’ or ‘3’.

### 8.2.5 FDPR(Frequency Dependant Power Reduction)

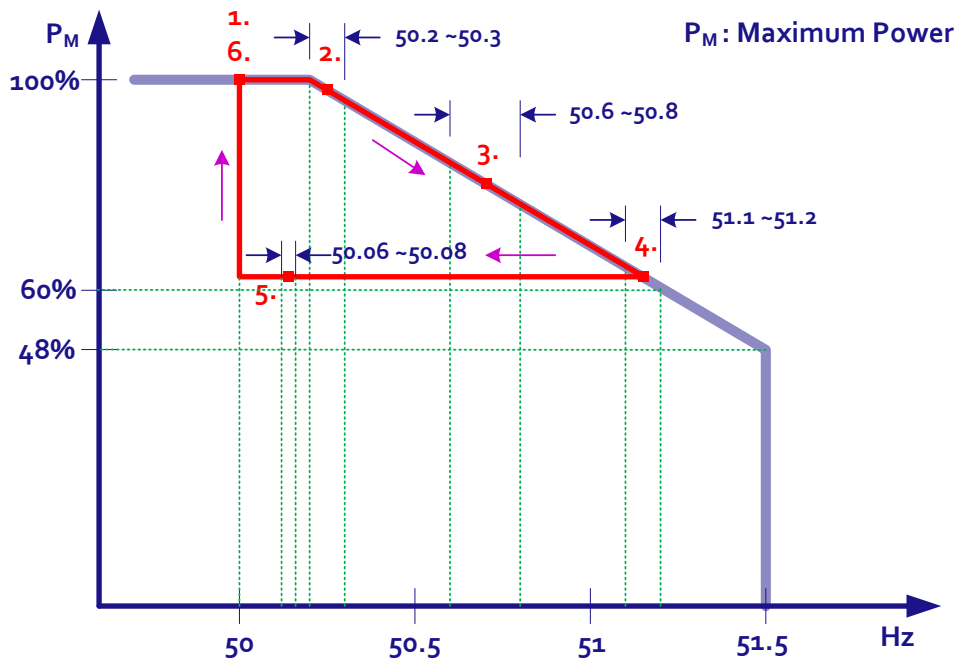



Figure 80: FDPR Function in case of rated frequency 50 Hz

The KACO inverter has a function to limit the active power when the grid frequency increases. If grid frequency variation is higher than {Power Reduction Deactivation Frequency} parameter, the inverter limits the active power. The limitation level is determined by {Power Reduction Gradient Level}. If the grid frequency exceeds {Grid Over Frequency Level 2}, the inverter will be stopped by 'Over Frequency Protection'. If the frequency variation is lower than {Power Reduction Deactivation Frequency} during {Frequency Dependant Power Reduction Check Time}, the inverter will stop the FDPR.

**Related Parameters (ex.BP1000 Model)**

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 4 | Grid Over Frequency Level 1 | 0 | 3 | 0.2 |
| | 6 | Frequency Dependant Power Reduction Mode | 0 | 2 | 0 |
| | 24 | Power Reduction Gradient Level | 0 | 100 | 40%/Hz |
| | 25 | Power Reduction Deactivation Frequency | 0 | 0.3 | 0.05 Hz |
| | 26 | Grid Over Frequency Level 2 | 0 | 3 | 1.5 |
| | 60 | Frequency Dependant Power Reduction Check Time | 0 | 30000 | 300 sec |

### 8.2.6 VDPR(Voltage Dependant Power Reduction)

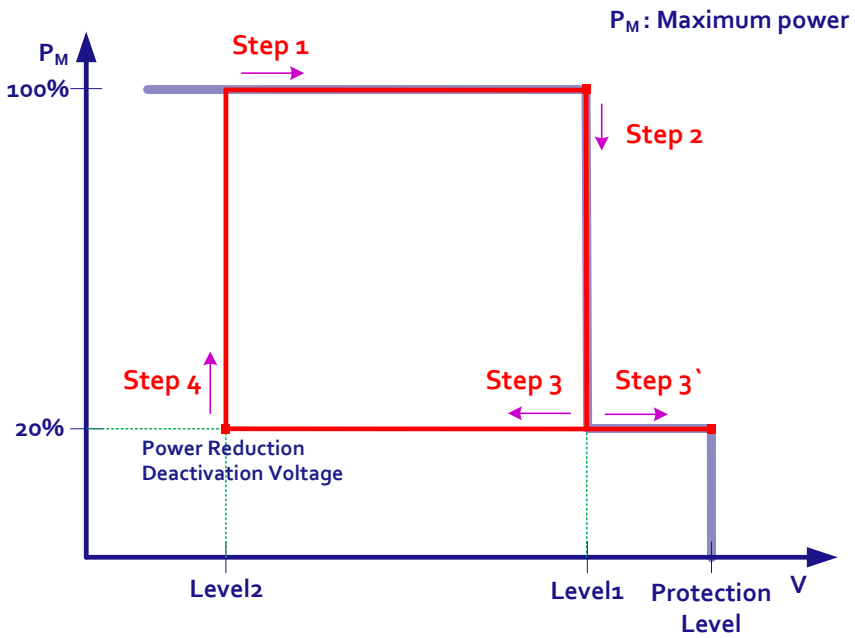



Figure 81: The graph of VDPR in Stop Decrease Mode

The KACO inverter has a function to limit the active power when the grid voltage increases. If the grid voltage increases to {Voltage Dependant Power Reduction Voltage Level 1}, the output power of inverter is reduced at 20 % of maximum power. PM is present Maximum power. If the grid voltage rises to {Voltage Dependant Power Reduction Voltage Level 1} at step 1, the active output power of inverter is limited at step 2. After that, when the grid voltage decreases to {Voltage Dependant Power Reduction Voltage Level 2} at step 3. At that time, the inverter will cancel the output power limitation and the inverter will generate normally. Although the active output power of inverter is limited, the gird voltage will increase continuously. In this situation, the inverter will be stopped by over voltage protection.

**Related Parameters (ex.BP1000 Model)**

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 61 | Voltage Dependant Power Reduction Mode | 0 | 2 | 0* |
| | 62 | Voltage Dependant Power Reduction Voltage Level 1 | 0 | 999 | 112 % |
| | 63 | Voltage Dependant Power Reduction Level 2 | 0 | 999 | 108 % |
| | 64 | Voltage Dependant Power Ramp | 0 | 30000 | 600 sec |
| | 65 | Voltage Dependant Power Reduction Level | 0 | 100 | 20 % |

*Selection of VDPR Mode
0: Step Mode / 1: Linear Mode

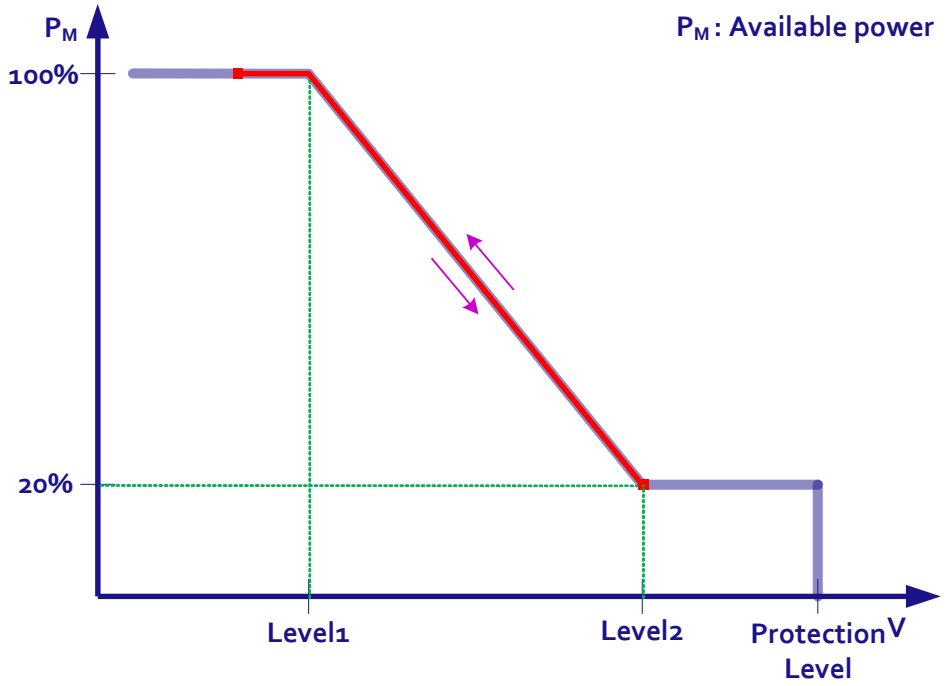
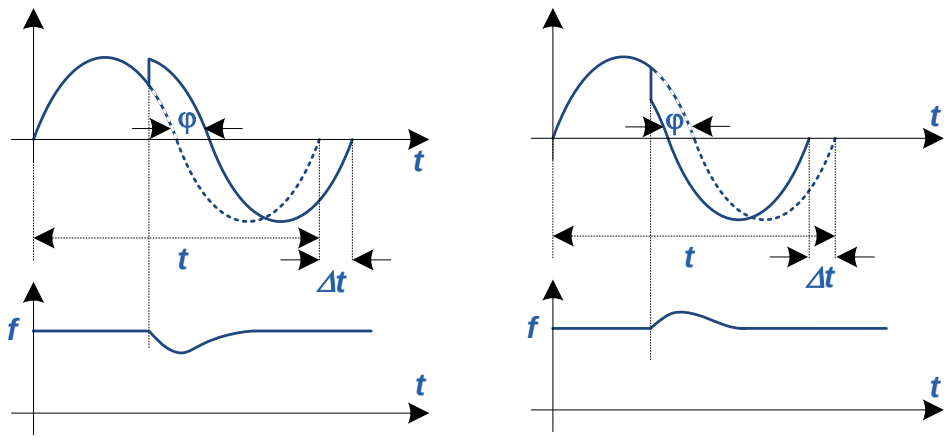



Figure 82: The graph of VDPR in Stop Decrease Mode

If {Voltage Dependant Power Reduction Mode} value is ‘1’, VDPR Mode is linear mode. Above the figure, if the grid voltage rises to {Voltage Dependant Power Reduction Voltage Level 1}, the output power of inverter decreases linearly. Although the active output power of inverter is limited, the gird voltage will increase continuously. the Inverter will be stopped by over voltage protection

### 8.2.7 Anti-Islanding Methods

#### Passive Method




(a) Phase Lag (b) Phase Lead

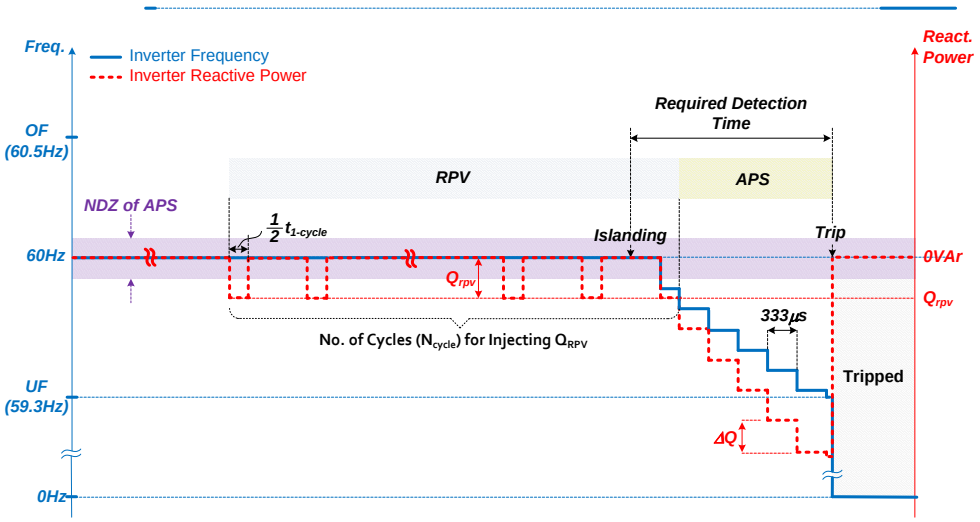
Figure 83: the graph of phase jump detection method

The KACO inverter can detect the anti-islanding situation by Phase Jump Detection Method. In case of phase-angle jumping detection, the inverter will block the gating signal in a presised setting-time. During the time of blocking gating signal, if the grid voltage and grid frequency is recovered within the normal operation range, the inverter will be restart. The KACO inverter is monitored each 10 cycle. If the phase-angle error exceeds the pre-set phase angle during {PJD Trip Time}, inverter will block the gating signal.

Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 54 | PJD Mode | 0 | 2 | 0 |
| | 55 | PJD Level | 3 | 360 | 60 degree |
| | 56 | PJD Trip Time | 3 | 30000 | 10 ms |

## Active Method




*RPV: Reactive power variation
**APS: Automatic phase -shift

**Figure 84: the graph of RPV* and APS** Method Integration**

The KACO inverter can detect the anti-islanding situation by RPV and APS Method integration. RPV method is to inject the reactive power to the grid. The amount of the QRPV and Ncycle can be adjusted by {RPV Q} and {RPV Active Period} parameters. When islanding is occurred, the RPV keep injecting the QRPV reactive power. Because of this, the load frequency will be changed and exceeds the NDZ of APS. At this time, the APS will be activated and injects a reactive power corresponding to the frequency range. This will increase (or decrease) the resonant frequency and the over-frequency (or under-frequency) trip will be reached.

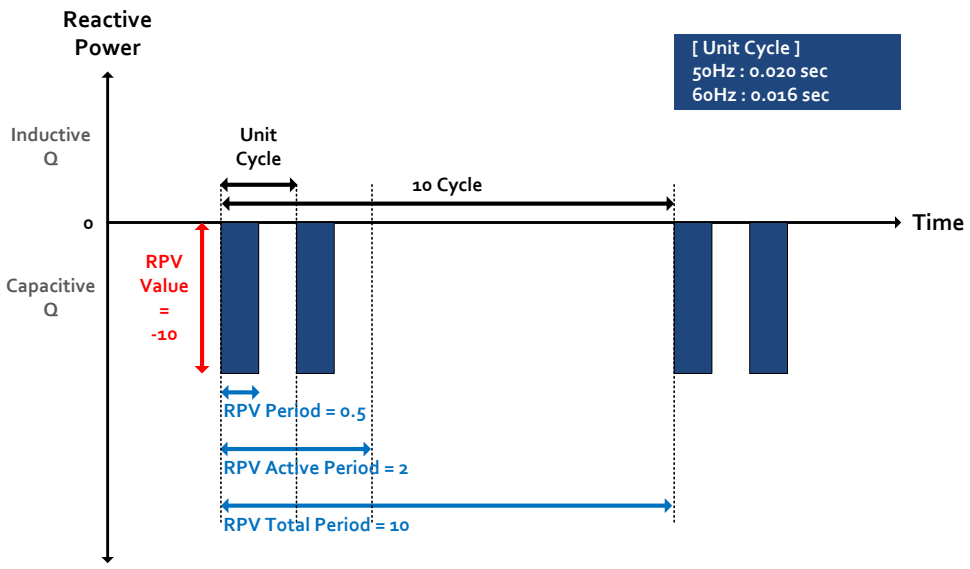



Figure 85: the graph of RPV Method

Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Control | 34 | AAI(Active Anti-Islanding) Mode | 0 | 3 | 0* |
| | 35 | APS Upper DB | 0.02 | 3 | 0.11 Hz |
| | 36 | Reactive Power Limit | 0 | 299.99 | 0.06 |
| | 93 | APS Lower DB | 0.02 | 3 | 0.07 Hz |
| Grid | 75 | RPV Q | -99.9 | 99.9 | -10 % |
| | 76 | RPV Time | 00001 | 9.9999 | 0.5 Period |
| | 77 | RPV Active Period | 1 | 100 | 3 Period |
| | 78 | RPV Period | 0 | 100 | 20 Period |
| | 79 | RPV Q Limit | 0 | 10 | 10 % |

*Selection of AAI Mode
0: Disable
1: APS Enable
2: RPV Enable
3: APS+RPV Enable

### 8.2.8 FRT(Fault Ride-Through)

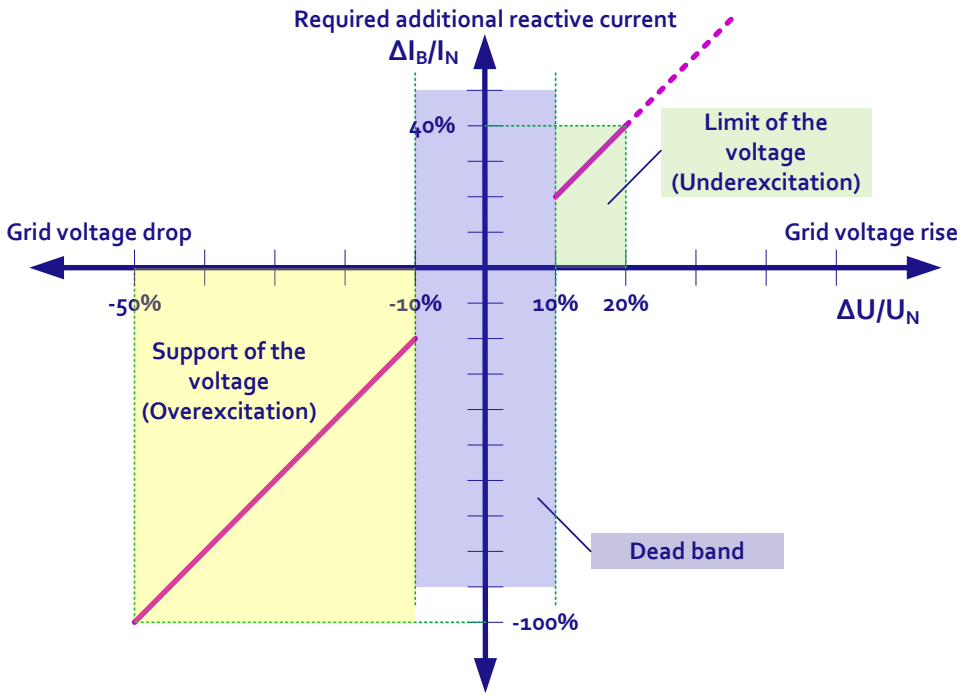



Figure 86: Control Grid Voltage during Inverter Failure (FRT K Factor=2)

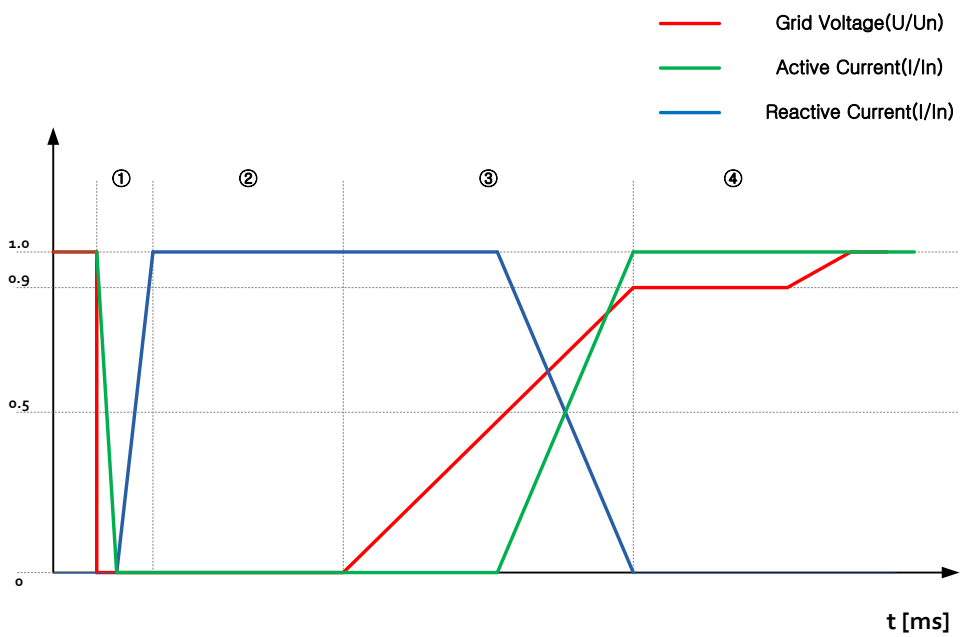



Figure 87: 0% Drop of Grid Voltage 0%

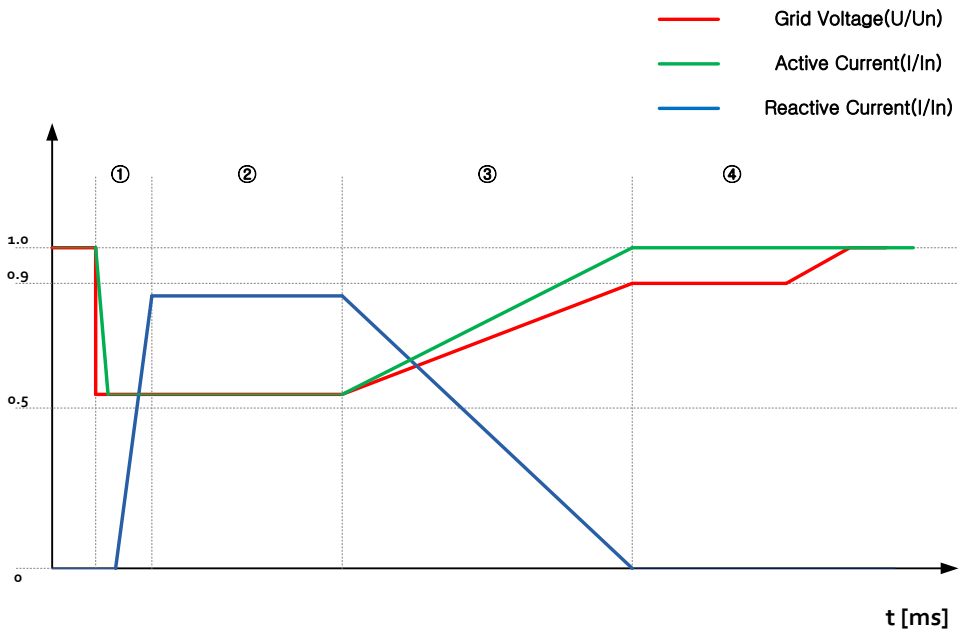



Figure 88: Grid Voltage 60% Drop

The above graphs show the change of electrical values during FRT (Fault Ride Through) control, and the detailed description for each section is as follows.

## Section ①

- If Grid Voltage drops below standard FRT value (0.9P.U) set by parameter, inverter will convert its mode to FRT.
- The occurrence of Over Current is decided by the slope and depth, and if when over current occurs, inverter will stop PWM Modulation for one cycle.
- Inverter will infuse the reactive power to grid according to parameter setting.
- Since the reactive power value is proportional to the parameter setting value, you can infuse reactive power to grid as much as possible.

## Section ②

- Infuse active power and reactive power to grid according to parameter setting.

## Section ③

- The occurrence of Over Current is decided by the slope and depth, and if when over current occurs, inverter will stop PWM Modulation for one cycle.
- Infuse active power and reactive power to grid according to parameter setting.

## Section ④

- If Grid voltage rises above standard FRT value (0.9P.U) set by parameter, inverter will convert its mode to normal and stop reactive current infusion.

  The operation for FRT (Fault Ride Through) control is possible to set by parameter as follows.

- Grid Under Voltage Levels

  Grid Under Voltage Level1 – Transfer to FRT mode.

  Grid Under Voltage Level2 – Inverter stops its operation with ‘Grid Under Voltage Level2 Fault’ when the grid voltage below ‘Grid Under Voltage Level2’ sustains over “Grid Under Voltage Trip Time2”.

  Grid Under Voltage Trip Time1 – Permissible grid voltage under ‘Grid under Voltage Level1’ time.

  Grid Under Voltage Trip Time2 – Permissible grid voltage under ‘Grid Under Voltage Level2’ time.

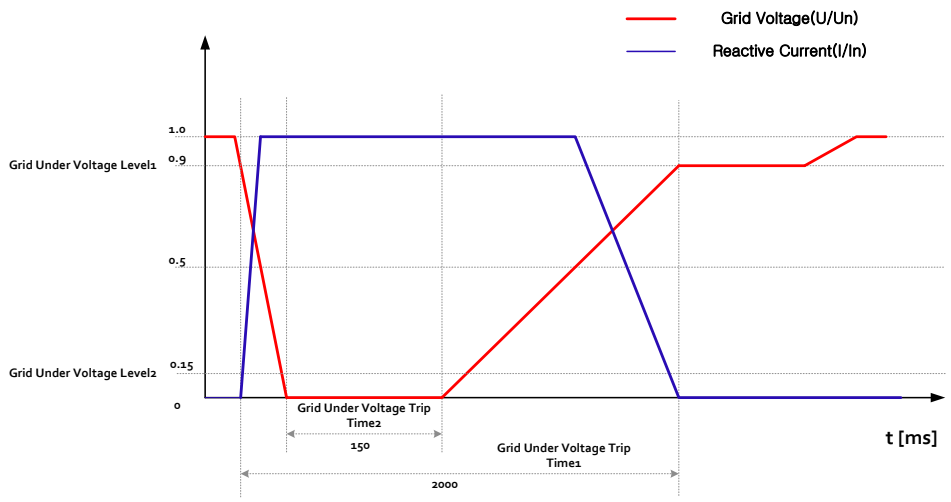



Figure 89: FRT Parameters

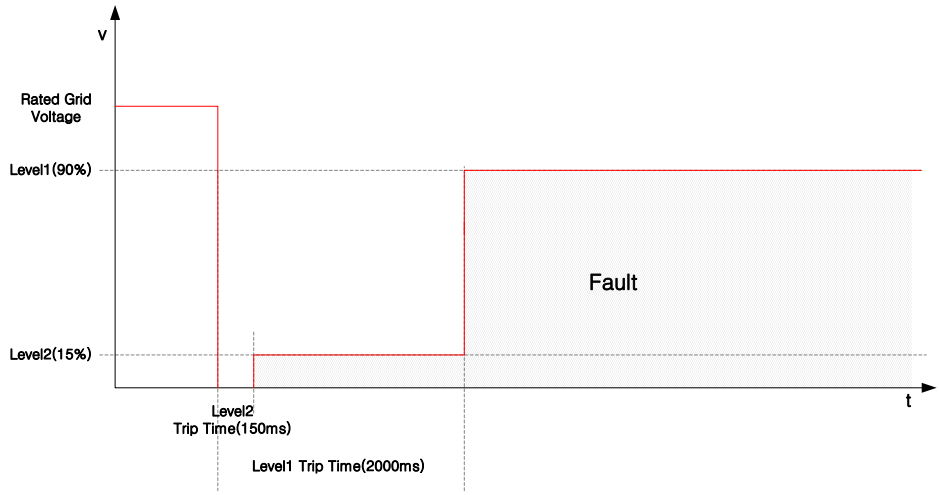



**Figure 90: Grid under voltage**

- U < 0.9*Urated, t > 2s → Grid Under Voltage Level1 Fault
- U < 0.15*Urated, t > 150ms → Grid Under Voltage Level2 Fault

**Related Parameters (ex.BP1000 Model)**

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 3 | Grid Under Voltage Level 1 | 75 | 100 | 90 % |
| | 17 | Grid Under Voltage Level 1 Trip Time | 0 | 10000 | 5000 ms |
| | 18 | Grid Under Voltage Level 2 Trip Time | 40 | 3000 | 500 ms |
| | 35 | Grid Under Voltage Level 2 | 15 | 100 | 80 % |
| | 22 | FRT Enable | 0 | 2 | 0* |

*Selection of FRT Enable
0: UV/OV Protection / 1 or 2: FRT Enable

### 8.2.9 Protection

If the function of {FRT Enable} is not active, KACO inverter parameters for abnormal grid is as follows. The detail operation of grid frequency and voltage should be confirmed according to related parameters and country setting of HMI.

## Grid Under/Over Frequency

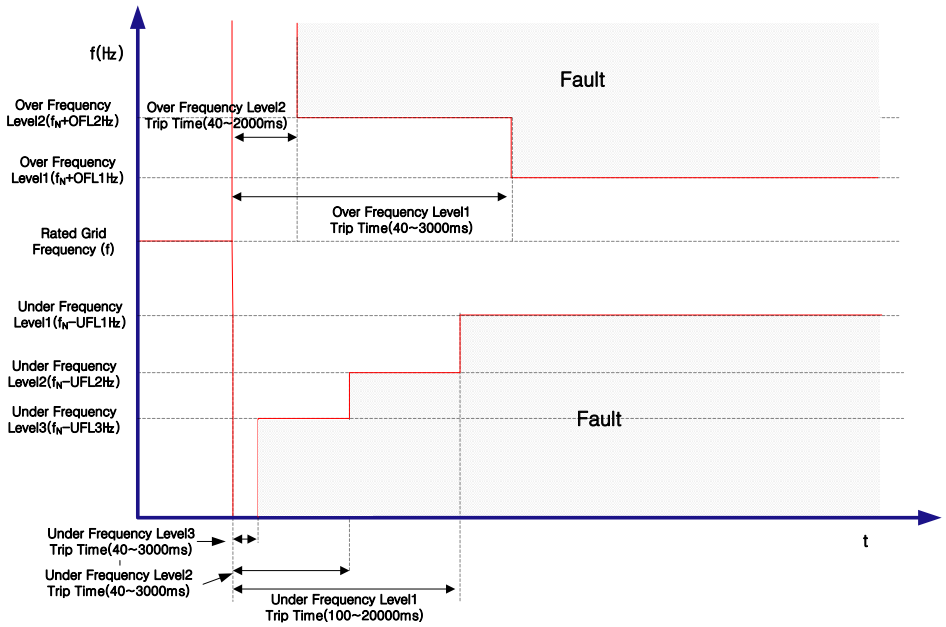



Figure 91: Grid under/over frequency

For example, the protection will be performed like as followed.

- If both f $\leq$($f_N$–UFL3Hz) and t≥ (UF Level3 Trip Time), the inverter will indicate error such as. “Grid Under Frequency Level3 Fault”
- If both f $\leq$($f_N$–UFL2Hz) and t≥ (UF Level2 Trip Time), the inverter will indicate error such as. “Grid Under Frequency Level2 Fault”
- If both f $\leq$($f_N$–UFL1Hz) and t≥ (UF Level1 Trip Time), the inverter will indicate error such as. “Grid Under Frequency Level1 Fault”
- If both f $\geq$($f_N$+OFL2Hz) and t≥ (OF Level2 Trip Time), the inverter will indicate error such as. “Grid Over Frequency Level2 Fault”
- If both f $\geq$($f_N$+OFL1Hz) and t≥ (OF Level1 Trip Time), the inverter will indicate error such as. “Grid Over Frequency Level1 Fault”
- The over frequency level 3 must be equal or greater than level2’s value.

## Grid Under Voltage

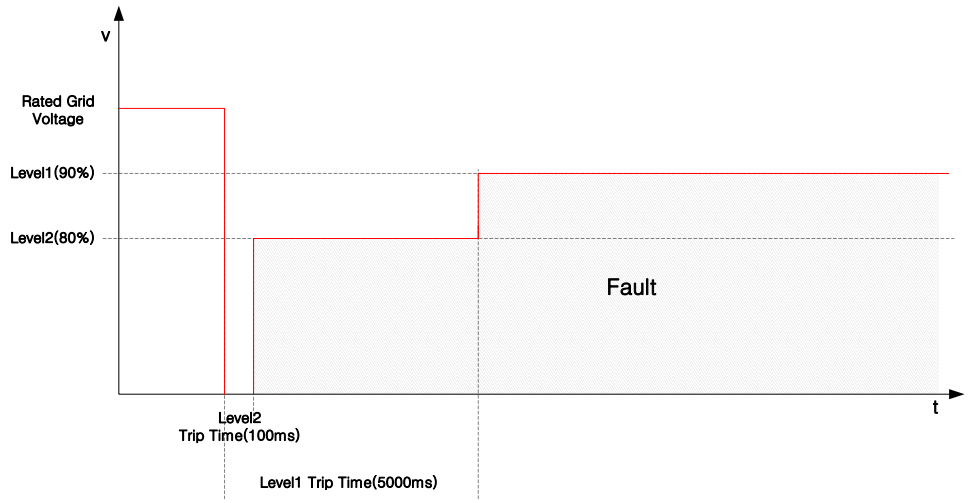



Figure 92: Grid under voltage

- U < 0.9*Urated, t > 5s → Grid Under Voltage Level1 Fault
- U < 0.8*Urated, t > 100ms → Grid Under Voltage Level2 Fault

## Grid Over Voltage

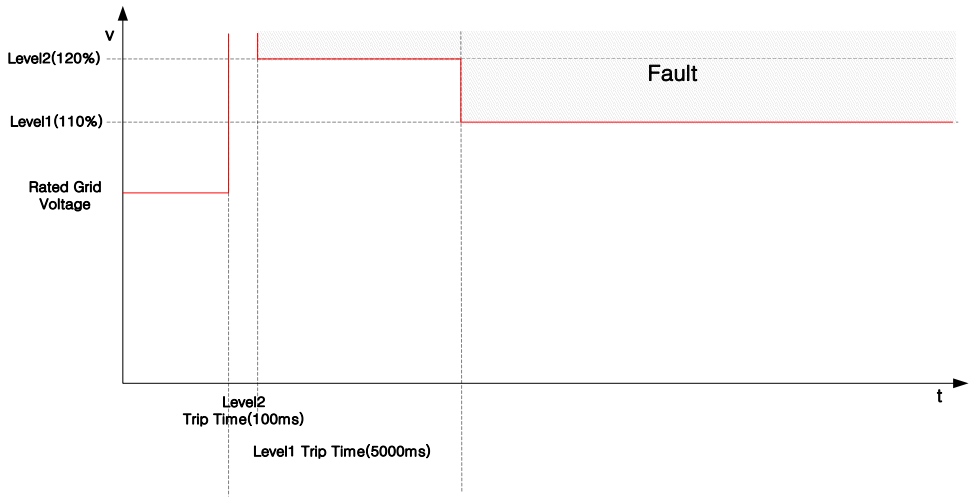



Figure 93: Grid over voltage

- U > 1.1*Urated, t > 5s → Grid Over Voltage Level1 Fault
- U > 1.2*Urated, t > 100ms → Grid Over Voltage Level2 Fault

### Related Parameters (ex.BP1000 Model)

| Tab | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|
| Grid | 2 | Grid Over Voltage Level 1 | 105 | 130 | 110 % |
| | 3 | Grid Under Voltage Level 1 | 75 | 100 | 90 % |
| | 4 | Grid Over Frequency Level 1 | 0 | 3 | 0.2 Hz |
| | 5 | Grid Under Frequency Level 1 | 0 | 3 | 2 Hz |
| | 12 | Grid Over Voltage Level 2 | 105 | 130 | 120 % |
| | 13 | Grid Under Voltage Level 2 | 15 | 100 | 80 % |
| | 14 | Grid Under Frequency Level 2 | 0 | 3.5 | 2.5 Hz |
| | 15 | Grid Over Voltage Level 1 Trip Time | 40 | 30000 | 100 msec |
| | 16 | Grid Over Voltage Level 2 Trip Time | 40 | 30000 | 100 msec |
| | 17 | Grid Under Voltage Level 1 Trip Time | 40 | 30000 | 100 msec |
| | 18 | Grid Under Voltage Level 2 Trip Time | 40 | 30000 | 100 msec |
| | 19 | Grid Under Frequency Level 1 Trip Time | 40 | 30000 | 100 msec |
| | 20 | Grid Under Frequency Level 2 Trip Time | 40 | 30000 | 100 msec |
| | 21 | Grid Over Frequency Level 1 Trip Time | 40 | 30000 | 100 msec |
| | 26 | Grid Over Frequency Level 2 | 0 | 3 | 1.5 Hz |
| | 27 | Grid Over Frequency Level 2 Trip Time | 40 | 30000 | 100 msec |
| | 35 | Grid Over Frequency Level 3 | 0 | 3 | 2 Hz |
| | 36 | Grid Over Frequency Level 3 Trip Time | 40 | 30000 | 100 msec |
| | 40 | Grid Under Frequency Level 3 | 0 | 3 | 2.5 Hz |
| | 41 | Grid Under Frequency Level 3 Trip Time | 40 | 30000 | 100 msec |

### 8.2.10 Communication between Components

#### COSPHI Control

COSPHI Control function is for controlling active and reactive power which is infused from KACO inverter to the grid with Prolog, HMI, and XCU at long distance.

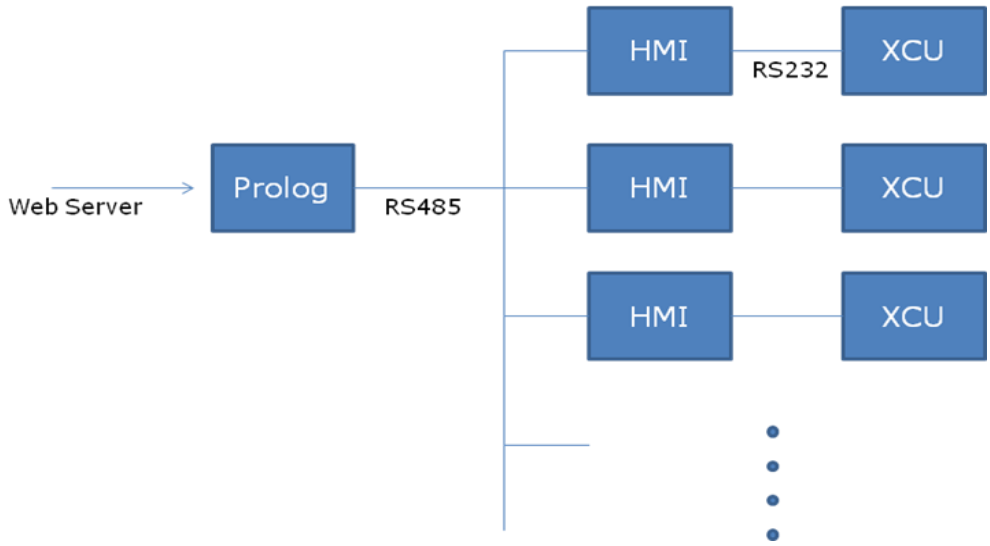



Figure 94:COSPHI Control composition

COSPHI Control enables remote control of reactive and active power by setting reference of reactive and active power by communication between Prolog, HMI, and XCU. Here are the communication methods between each component.

- User activates COSPHI Control by Prolog.
- Prolog sends a COSPHI Control massage at two-minute intervals.
- HMI interprets the COSPHI Control message from Prolog to modify parameters of XCU.
- XCU operates according to the modified parameter by HMI.
- COSPHI (limited to Fixed COSPHI and Fixed Q) has two overlapping parameters for RPC and Internal modes, and HMI modifies the parameter for RPC mode only. If the relative RPC mode parameter is not modified longer than five minutes, XCU will operate according to the parameter for internal mode.

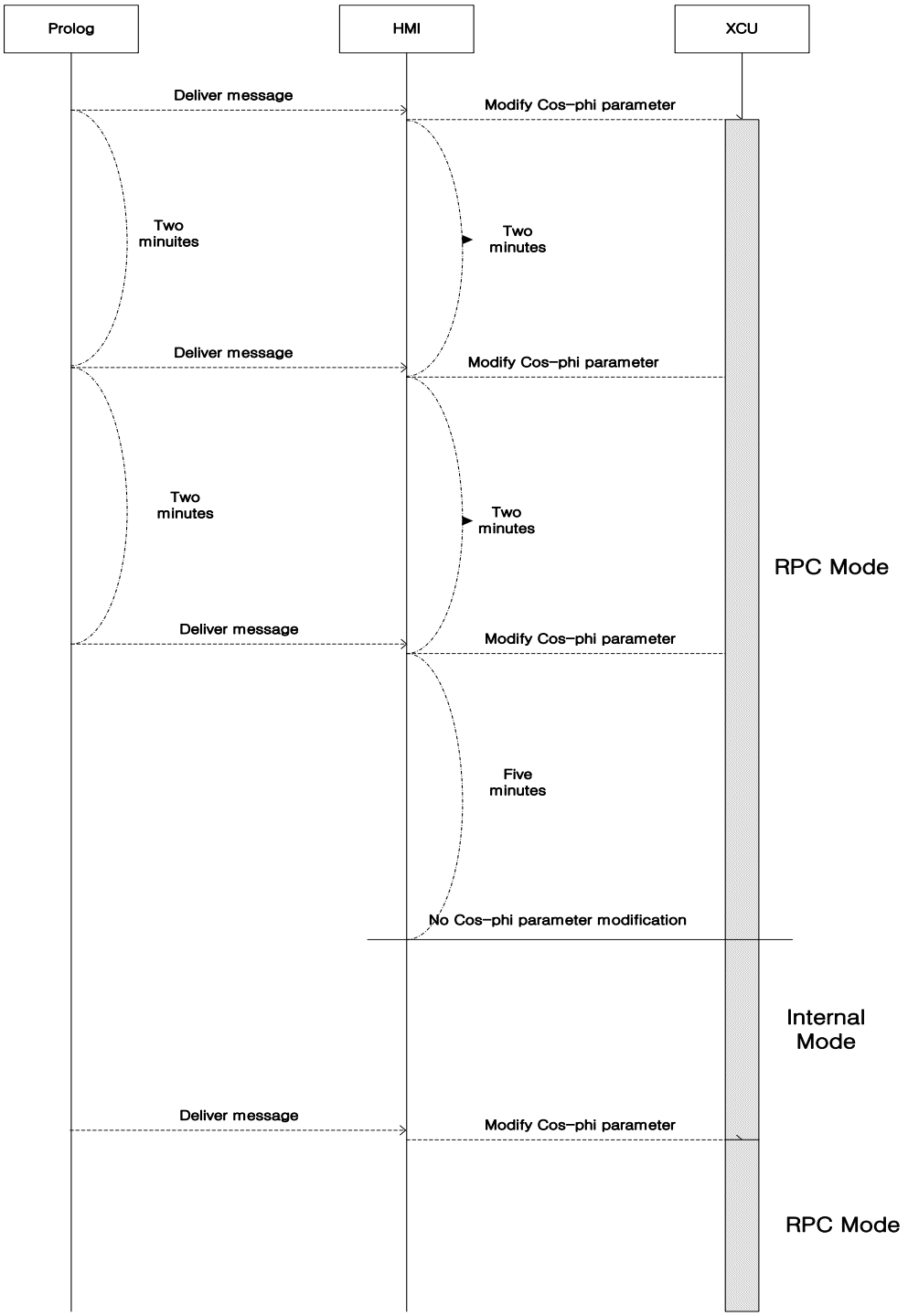



Figure 95:The communication Sequence between COSPHI Components

## Operation Mode

COSPHI Control operates in RPC (Remote Power Control) and internal modes according to communication status to control power with Fixed COSPHI and Fixed Q.

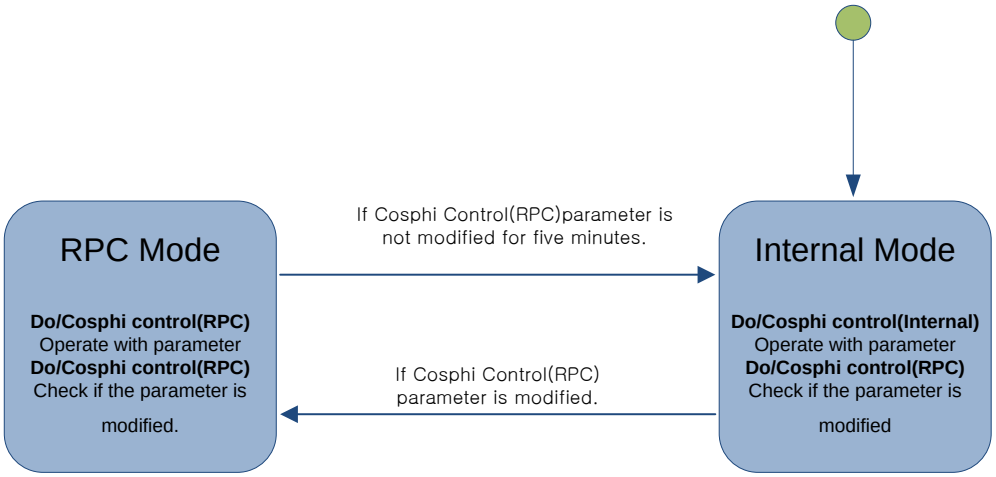



Figure 96: Transition of RPC mode and Internal Mode

- RPC mode

  While HMI is modifying XCU's {Remote Power Control}, {COSPHI Reactive Power RPC } and {COSPHI Power Factor RPC} parameters with two-minute interval, COSPHI Control operates in RPC mode. In RPC mode, it operates according to {Remote Power Control}, {COSPHI Reactive Power RPC}, and {COSPHI Power Factor RPC} modes.

- Internal mode

  If RPC mode parameter such as {Remote Power Control}, {COSPHI Reactive Power RPC }, and {COSPHI Power Factor RPC} is not be modified within five minutes, XCU will operate in Internal mode. In Internal mode, COSPHI control operates according to internal mode parameters such as {COSPHI Reactive Power Internal}, {COSPHI Power Factor Internal}, and {Current Limit}.

### 8.2.11 RPO(Reactive Power outside of feed-in Operation)

KACO blueplanet 1000/875/750 TL3 M1 IS ID DEXy Model has a function to inject the reactive power only to the grid at night and when PV power is low due to cloud. If the inverter generates the reactive power when PV module don't generates power, it can affect the grid stabilization.

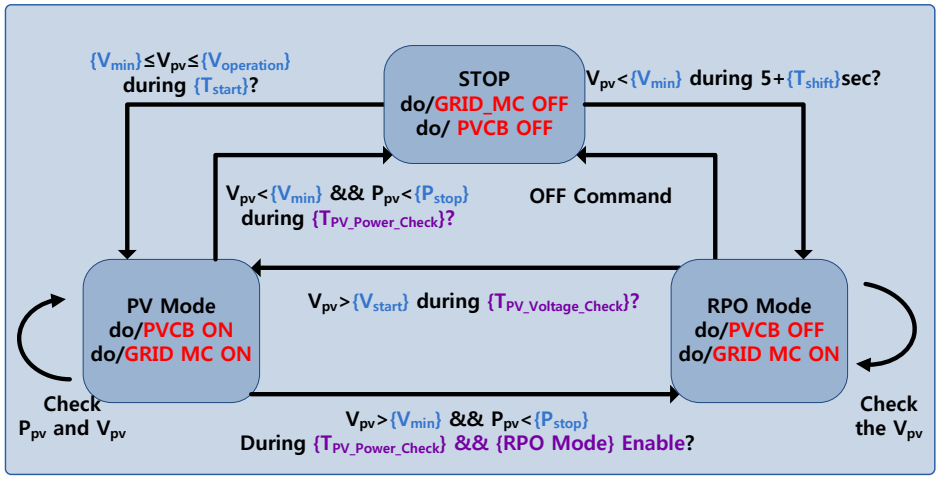



Figure 97: RPO Sequence

In above the figure, Mode Change has a condition as follows,

- From PV Mode to RPO Mode

  Vpv > Vmin && Ppv < {Pstop} during {TPV_Power_Check}

  Vpv < Vmin && Ppv < {Pstop} during {TPV_Power_Check}

- From RPO Mode to PV Mode

  Vpv > {Vstart} durning {TPV_Voltage_Check}

Inverter is in RPO Mode, we can adjust the reactive power by parameter without revising {COSPHI Control Mode}

**Related Parameters (ex.BP1000 Model)**

| Tab | Name | Number | Parameter | Min. | Max | Default Value |
|---|---|---|---|---|---|---|
| PV Array | Vstart | 2 | MPPT V Start | 200 | 800 | 700 V |
| | Pstop | 4 | MPPT P Stop | 0 | 3600 | 6000 W |
| | Vmin | 6 | MPPT V Minimum | 200 | 800 | 505 V |
| | TPV_Power_Check | 15 | PV Power Check Time | 0 | 3600 | 180 |
| | TPV_Voltage_Check | 16 | PV Voltage Check Time | 0 | 3600 | 3600 |
| | RPO Mode | 17 | RPO Mode | 0 | 1 | 0 |
| Controller | - | 47 | COSPHI Reactive Power Internal | -99.9 | 99.9 | 0 % |

## 8.3 PQ Diagram

### 8.3.1 BP1000-TL3-ID

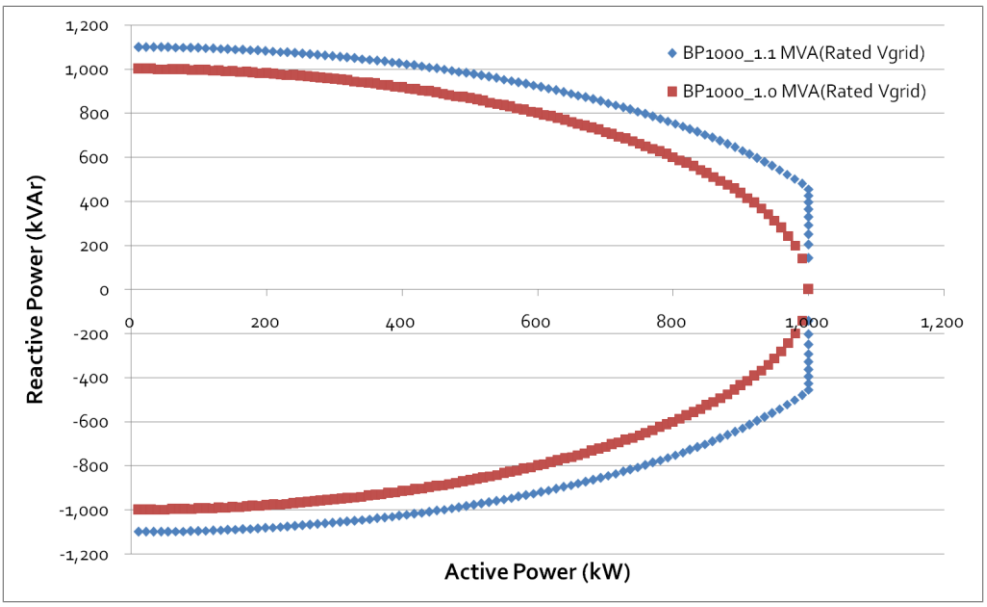



Figure 98: PQ Diagram of the KACO inverter

The output power limit is based on apparent power which is 1.0 MVA or 1.1 MVA. In other words, where the apparent power is over the rated power, active/reactive power is reduced at same rate respectively so that the final output power does not exceed 1.0 MVA or 1.1 MVA.

Case 1 (1.0 MVA): when changing the power factor from 1 to 0.9, the active power is down to 900 kW and the reactive power will be up from 0 kVAR to 436 kVAR since the final output apparent power should be remained at 1.0 MVA

Case 2 (1.1 MVA): when changing the power factor from 1 to 0.9, the active power is remained at 1000 kW and the reactive power will be up from 0 kVAR to 484.3 kVAR since the final output apparent power should be remained at 1.1 MVA. KACO inverter can operate when the grid voltage is equal to the rated grid voltage or higher (10%) than the rated grid voltage. In order to operate 1.1 MVA, DC-Link Voltage should be higher than 630 Vdc.

### 8.3.2 BP875-TL3-ID

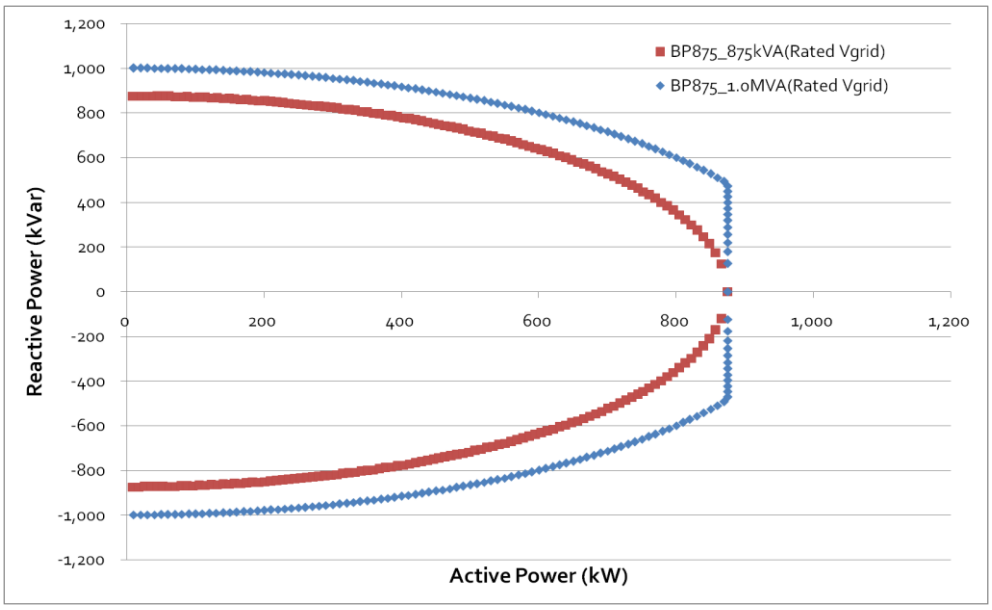



Figure 99: PQ Diagram of the KACO inverter

The output power limit is based on apparent power which is 1.0 MVA. In other words, where the apparent power is over the rated power, active/reactive power is reduced at same rate respectively so that the final output power does not exceed 1.0 MVA.

When changing the power factor from 1 to 0.87, the active power keeps 875 kW and the reactive power will be up from 0 kVAR to 484 kVAR since the final output apparent power should be remained at 1.0 MVA.

### 8.3.3 BP750-TL3-ID

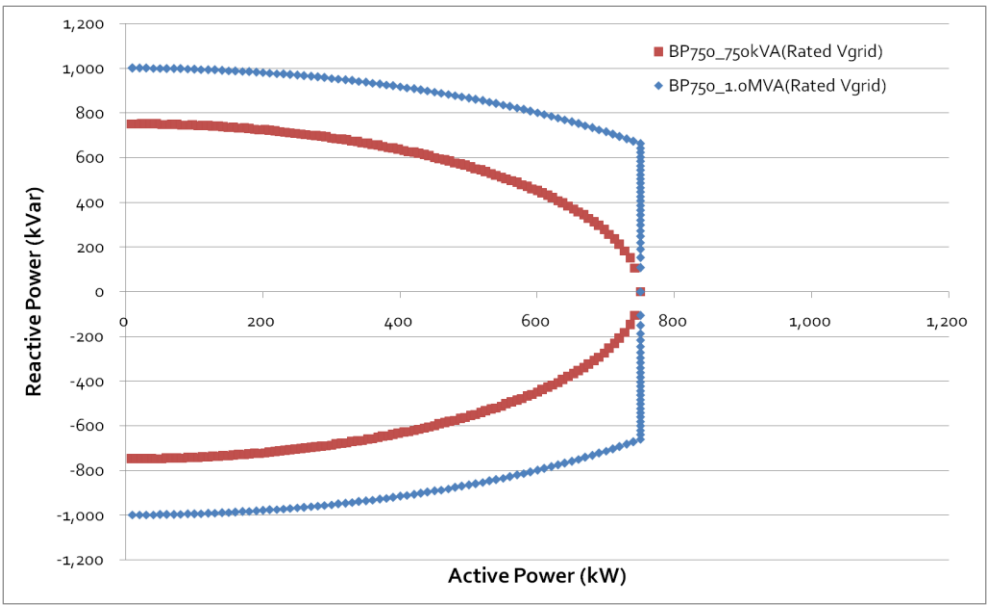



Figure 100: PQ Diagram of the KACO inverter

The output power limit is based on apparent power which is 1.0 MVA. In other words, where the apparent power is over the rated power, active/reactive power is reduced at same rate respectively so that the final output power does not exceed 1.0 MVA.

When changing the power factor from 1 to 0.75, the active power keeps 750 kW and the reactive power will be up from 0 VAR to 661 kVAR since the final output apparent power should be remained at 1.0 MVA.

# 9 USER INTERFACE

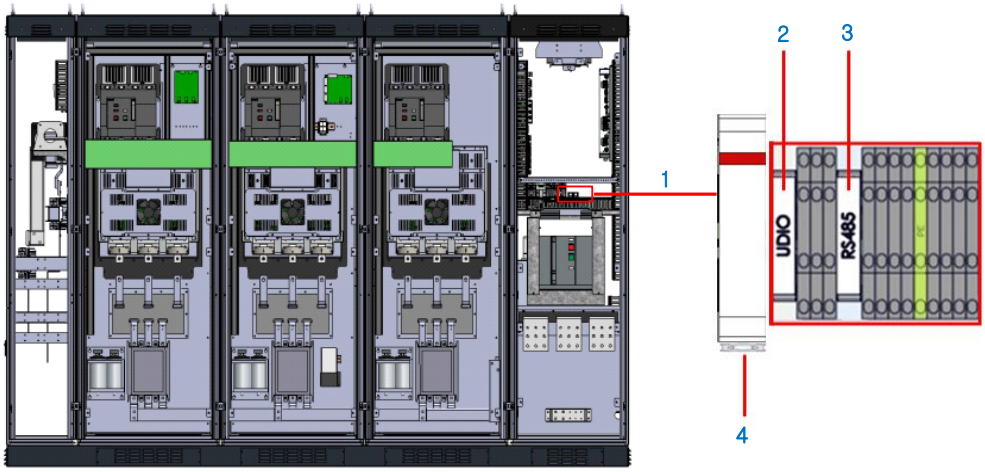



Figure 101: Connecting the user interface

| Key | |
|---|---|
| 1 | User Interface |
| 2 | UDIO(User digital input/output) |
| 3 | RS485 |
| 4 | Ethernet |

| | NOTE |
|---|---|
| | The digital, analogue, RS485 and Ethernet connections are designed for SELV.<br>Only external SELV circuits are permitted to be connected to the SELV circuit (user interface)of the inverter. |

## 9.1 Digital Input/Output

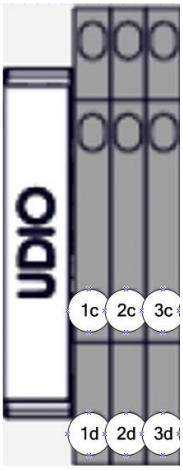



Figure 102: UDIO connection

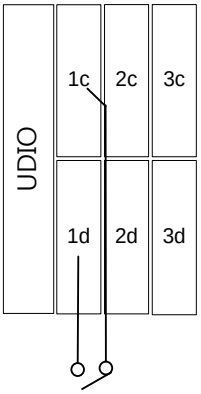



Figure 103: Circuit diagram for UDI1

Table 8: Connections for digital input

| Terminal number | Terminal designation | Specification | Wire cross-section |
|---|---|---|---|
| 1c | UDI1 P | Max. 27Vdc, 27mA | AWG 20 (0.518mm2) |
| 1d | UDI1 N | | |

### 9.1.1 Digital input

The system sends digital input signal in accordance with the setting of “DI1 Select” parameter in menu of HMI or parameter setup tool (CMT, AutoSetup).

| DI1 Select | Description | Note |
|---|---|---|
| 0 | Disable DI1 | |
| 1 | Reserved | |
| 2 | Reserved | |
| 3 | Start/Stop operation of the inverter by DI1<br>Recognition pattern :<br>Stop: Δt = 1sec<br>Start: Δt = 2sec | Recognition pattern is checked whenever DI1 input signal is at rising edge(T0) then it is determined according to how long the DI1 input signal has been stayed in high state. |
| 4 | Start/Stop operation of the inverter by DI1<br>Recognition pattern :<br>Stop: Δt = 200msec<br>Start: Δt = 400msec | |
| 5 | Stop operation of the inverter by DI1<br>Recognition pattern :<br>{DI1 Check Period} msec –<br>Stop operation | |

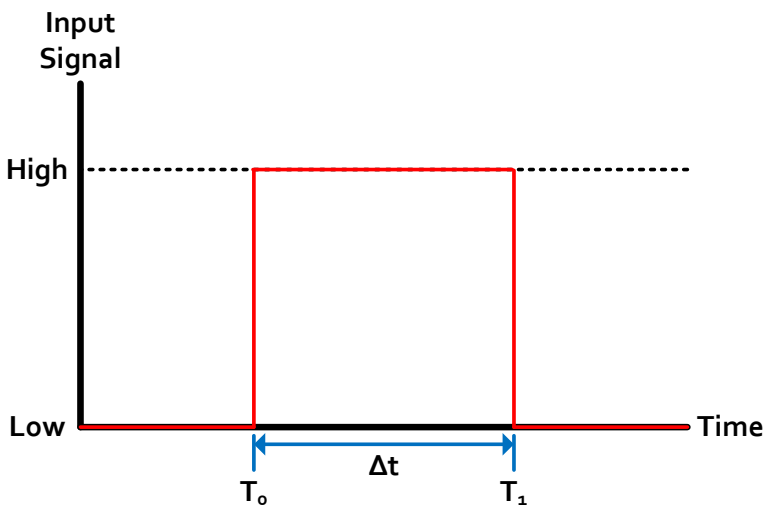



Figure 104: DI1 input signal

| | NOTE |
|---|---|
| | The {DI1 Check Period} is parameter in ‘8.5 Digital Parameters’ that mean recognition pattern period for inverter stop operation when selecting ‘DI1 Select’ to ‘5’ |

### 9.1.2 Digital output

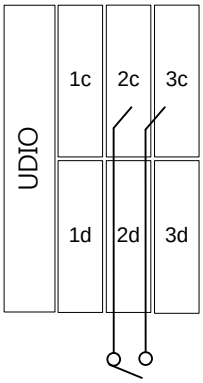



Figure 105: Circuit diagram for digital output (N/O contact)

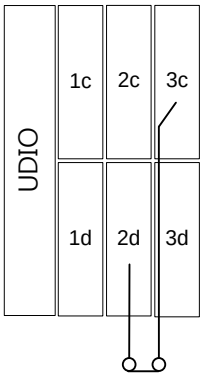



Figure 106: Circuit diagram for digital output (N/C contact)

Table 9: Connections for digital output

| Terminal number | Terminal designation | Specification | Wire cross-section |
|---|---|---|---|
| 2c | UDO1A | Potential-free output contact A | AWG20 (0.518 ㎟) |
| 2d | UDO1B | Potential-free output contact B | |
| 3c | UDIO1C | Potential-free, common output contact | |
| 3d | UDIO1D | - | |

## 9.2 RS485 Interface

The inverter has two RS485 connections.

- RS485-1

  Interface for the Powador Argus

  Interface for optional Powador-go

- RS485-2

  Interface for the HMI's internal data logger, or for the external Powador proLOG data logger

### 9.2.1 RS485-1 interface

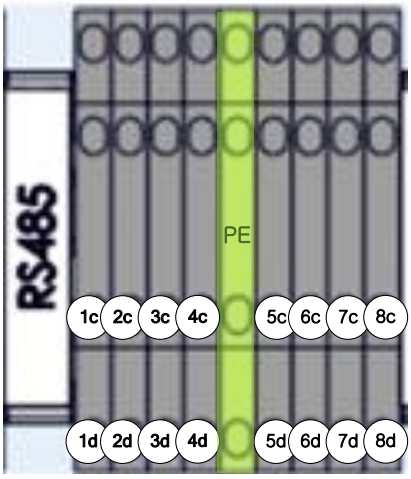



Figure 107: RS485-1 connection

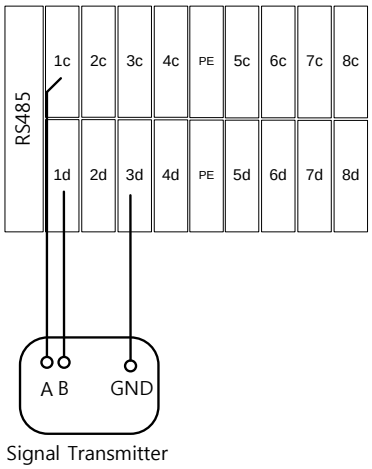



Figure 108: Circuit diagram for RS485-1 connection

Table 10: Connections for RS485-1

| Terminal number | Terminal designation | Specification | Wire cross-section |
|---|---|---|---|
| 1c | RS485 A1 | RS485 signal A1 | AWG22 (0.326 mm2) |
| 1d | RS485 B1 | RS485 signal B1 | |
| 3c | RS485 C1 | Termination resistor terminal | |
| 3d | RS485 G1 | RS485 data transmission GND 1 | |
| For termination disposal, you can use RS485 B1(1d) and RS485 C1(3c) with jumper because termination resistor is already installed inside of XCU board. | | | |

### 9.2.2 RS485-2 interface

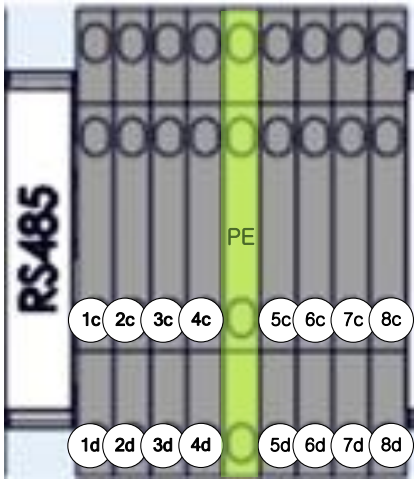



Figure 109: RS485-2 connection

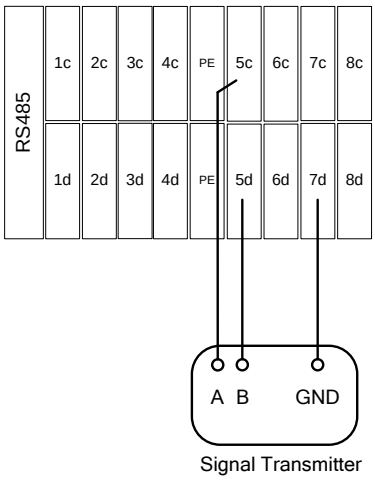



Figure 110: Circuit diagram for RS485-2 connection

Table 11: Connections for RS485-2

| Terminal number | Terminal designation | Specification | Wire cross-section |
|---|---|---|---|
| 5c | RS485 A2 | RS485 signal A2 | AWG22 (0.326 mm2) |
| 5d | RS485 B2 | RS485 signal B2 | |
| 7c | RS485 C2 | Termination resistor terminal | |
| 7d | RS485 G2 | RS485 data transmission GND 2 | |
| For termination disposal, you can use RS485 B2(5d) and RS485 C2(7c) with jumper because termination resistor is already installed inside of XCU board. | | | |

### 9.2.3 Settings for RS485 interfaces

Table 12: RS485 interface settings

| ID | Name | Unit | Default value | Min. | Max. |
|---|---|---|---|---|---|
| 0 | Activate Powador-proLOG | | OFF | OFF | ON |
| 1 | HMI address | | 0 | 0 | 31 |
| 2 | Change Powador-go address | | - | - | - |
| 3 | Activate Powador-go | | OFF | OFF | ON |
| 4 | Diff. tolerance | % | 10 | 10 | 100 |
| 5 | Fault trigger time | minutes | 120 | 10 | 240 |
| 6 | Address 0 string number | | 0 | 0 | 4 |
| 7 | Address 1 string number | | 0 | 0 | 4 |
| 8 | Address 2 string number | | 0 | 0 | 4 |
| .. | .. | | 0 | 0 | 4 |
| .. | .. | | 0 | 0 | 4 |
| 36 | Address 30 string number | | 0 | 0 | 4 |
| 37 | Address 31 string number | | 0 | 0 | 4 |

# 10 Overview Circuit Diagram

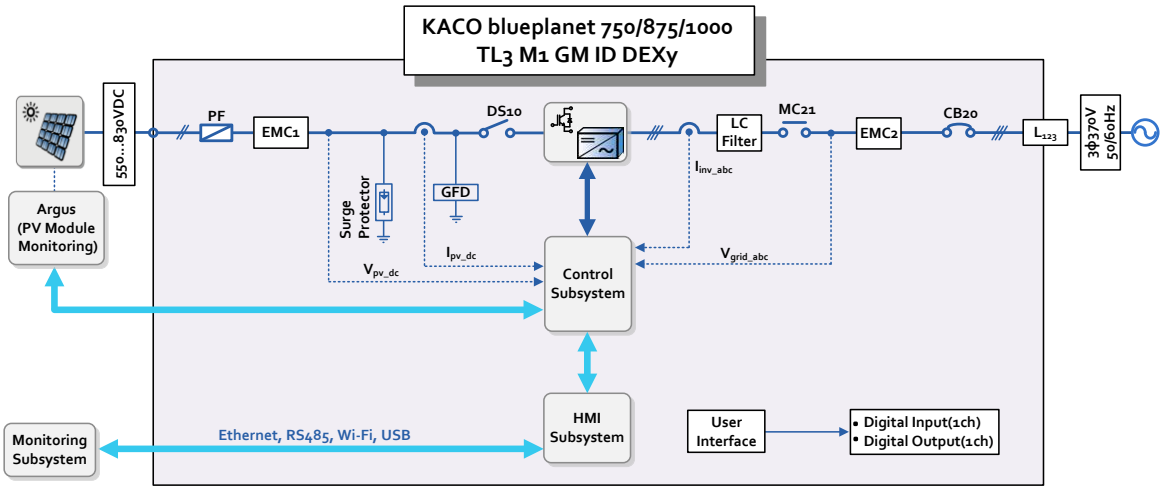



Figure 111: Configuration of the BP750/875/1000 TL3 ID DEXy

# 11 Decommissioning /Dismantling

| | DANGER |
|---|---|
| | **Lethal voltages are still present in the terminals and lines of the inverter even after the inverter has been switched off and disconnected!**<br>Coming into contact with the lines and terminals in the inverter will cause serious injury or death.<br>Only authorized electricians who are approved by the supply grid operator may open, install and maintain the inverter.<br>▪ Always shut down the inverter (in the sequence described below} before dismantling the unit.<br>▪ Do not touch exposed contact connections. |

### Switch off the inverter

1. Switch the main ON/OFF switch to OFF (stop the inverter).
2. Switch the power grid switch to OFF (disconnect the inverter from the grid).
3. Switch the DC disconnector to OFF (disconnect the inverter from the PV generator).
4. Make sure that the inverter is disconnected from all voltage sources.
5. Attach locking devices to the circuit breaker of the power grid connection and to the AC and DC disconnectors.
6. Wait at least ten minutes before working on the inverter.

### Decommission and dismantle the inverter

1. Disconnect all terminals and cable fittings.
2. Remove all DC and AC leads.
3. Disconnect the connections and bus bars between the cabinets.

# 12 Disposal

### Dispose of the packaging materials

The packaging for the inverter consists of a wooden pallet, plastic foil made of polypropylene, and the shipping container.

1. Dispose of the packaging materials in accordance with the applicable waste disposal regulations.

### Dispose of the inverter

1. After the inverter has reached the end of its service life, dispose of it in accordance with the applicable disposal regulations for electronic waste at your own expense or ask it to Kaco new energy Inc.,

The text and figures reflect the current technical state at the time of printing. Subject to technical changes. No liability for printing errors.

KACO new energy.

4-5th Floor, KD U_Tower, 70 Jeongui-ro, Songpa-gu, Seoul, South Korea, 05836

**TEL** +82-2-3016-1100 **FAX** +82-2-3016-1199 **www.kaco-newenergy.kr**