SolarEdge Safety in PV Systems

Presented by: Jason Kirrage

10/22/2018

bre PV Fire report

- 33 Historical incidents
- 47 New incidents
- 26 on site investigations
- 21 desktop investigations
- 7 laboratory examinations

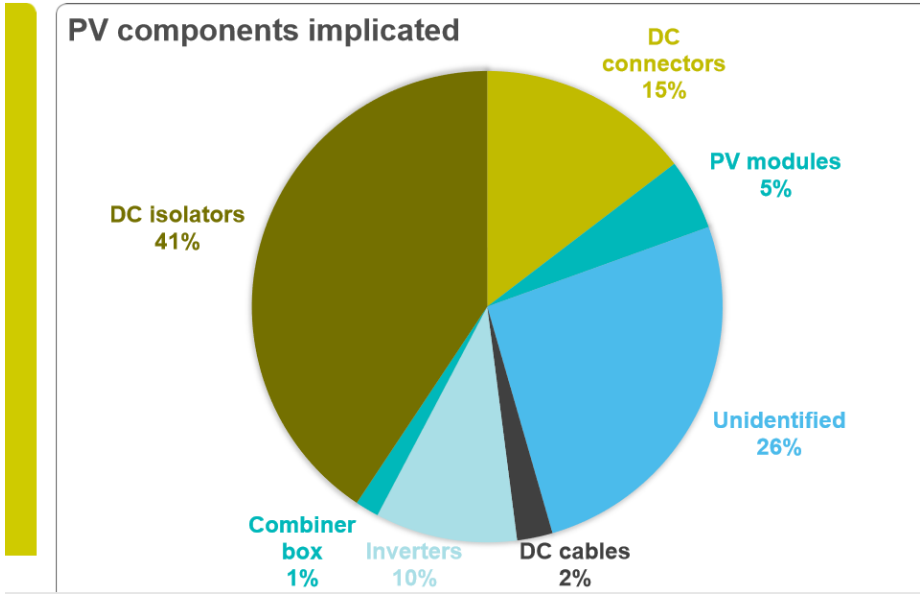
Recommendations

- Fault protection for DC circuits
- Automatic DC shut-off devices

PV Fire Workshop
Chris Coonick MSc MIET
BRE National Solar Centre
9th January 2018

bre

bre NATIONAL SOLAR CENTRE



Dealing with PV fires

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Dealing with PV fires

Issues noted by FRS:

- Potential for electrocution
- Fear of [roof] collapse
- Unable to isolate live PV cables.
- Problems accessing isolation devices [located in loft]
- Access issues to tackle fire
- Uncertainties on how to isolate systems
- Made safe systems of work for fire service unpredictable

Poor installation

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Poor installation

Likely causes of electrical arcing:

- Moisture ingress
- Incorrectly crimped connector contacts
- Incompatible plugs and sockets
- Plugs and sockets not fully engaged
- Loose screw terminals
- Poorly soldered joints
- Damaged components

Arc Fault Circuit Interruption (AFCI)

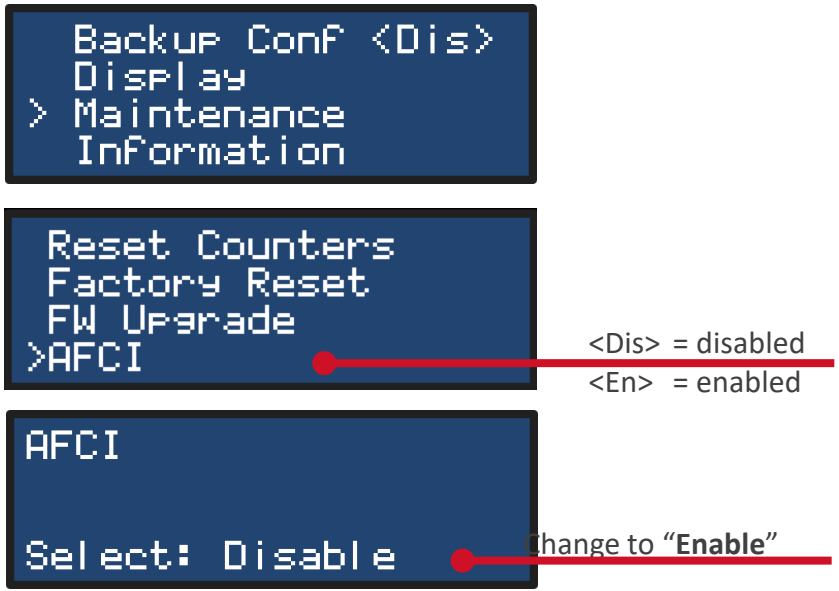
Presented by: SolarEdge

Arc Fault Detection

- An electric arc is an ongoing high-energy discharge, resulting from a current through a normally non-conductive material such as air
- When connecters or cables in a PV system are improperly connected or are damaged, the electric current may pass through the air, causing an electric arc
- Arcs generate heat which can cause fires and they also pose an electrocution risk to those working near them
- As PV systems age and connectors and cables degrade, the risk for electric arcs, while still low, increases
- Standard available for arc fault detection (however there are recommendations in installation standards, e.g. IEC 62548).
- Since the risk of arcs in PV systems exists everywhere, arc fault detection is recommended and may be required in the future.

AFCI Setting

- The arc fault circuit interruption (AFCI) option is disabled by default
- To enable AFCI, enter the „Maintenance“ menu
- Scroll down to the „AFCI“ menu
- Change „Disable“ to „Enable“ and confirm with a long push of the button
- Exit all menus



Manual and Auto Reconnect

- The inverter supports two modes of reconnection after an arc detection event:
  - Manual Reconnect - the system must be manually restarted on site following inverter shut down
  - Auto Reconnect - reconnects the system automatically after grid reconnection time according to the country setting.
- The default inverter reconnection mode is Manual Reconnect.
- To select Auto Reconnect:
  - Enter the „Maintenance“ menu, and then the „AFCI Mode“ menu
  - Select „Auto Reconnect“
  - Exit all menus

Accessories

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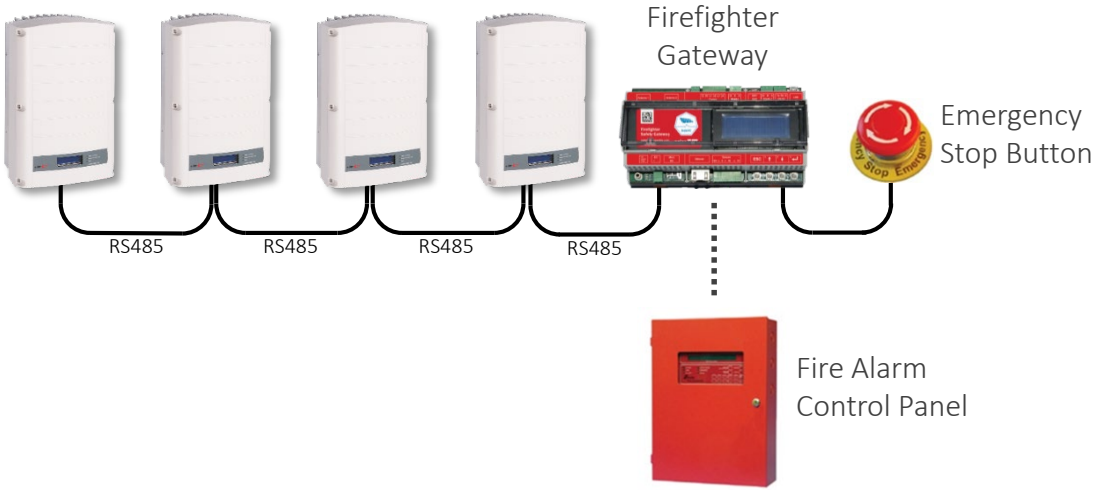
Firefighter Gateway

Safety	
	Remote controls the built-in SafeDC™ mechanism Enables system DC shutdown by pressing an emergency stop button or receiving an alarm from Fire Alarm Control Panel Real time indication of system DC voltage for safety assurance Remote indication of PV system status



Topology

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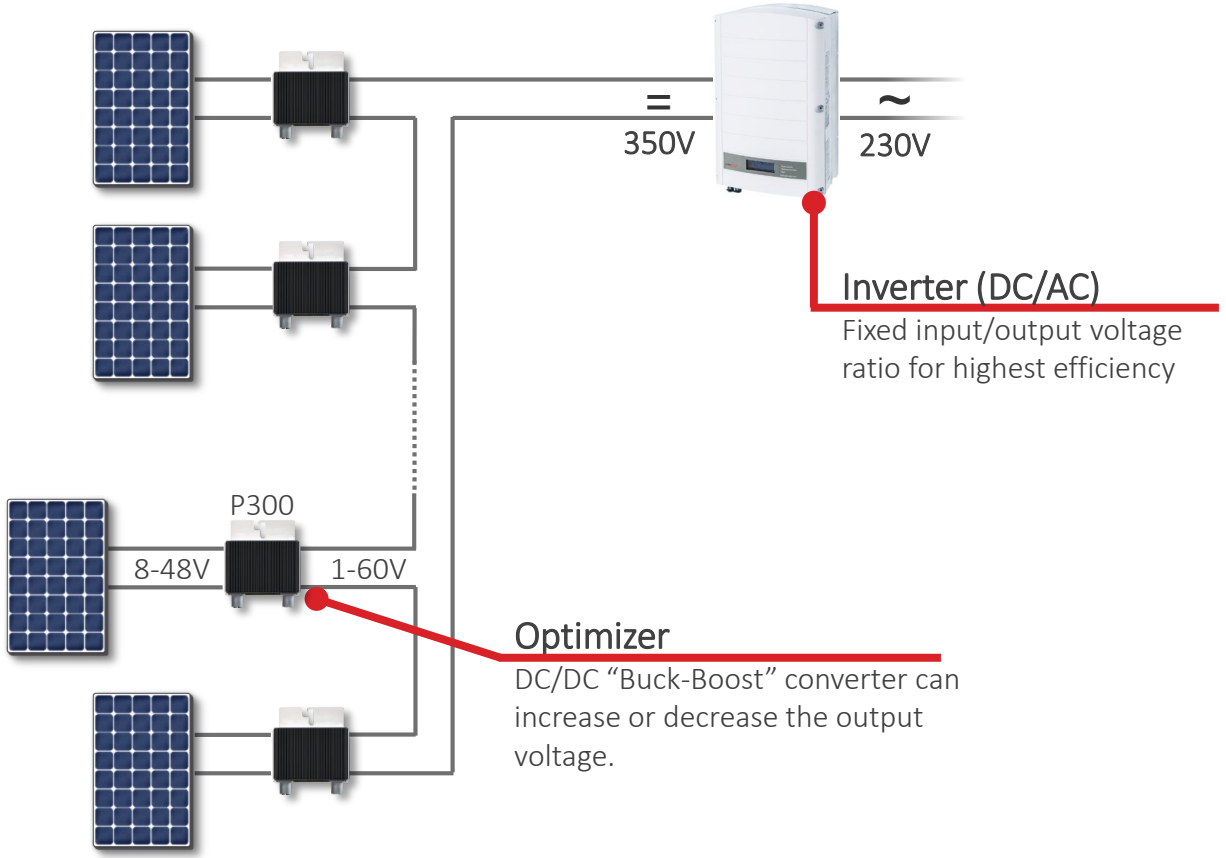
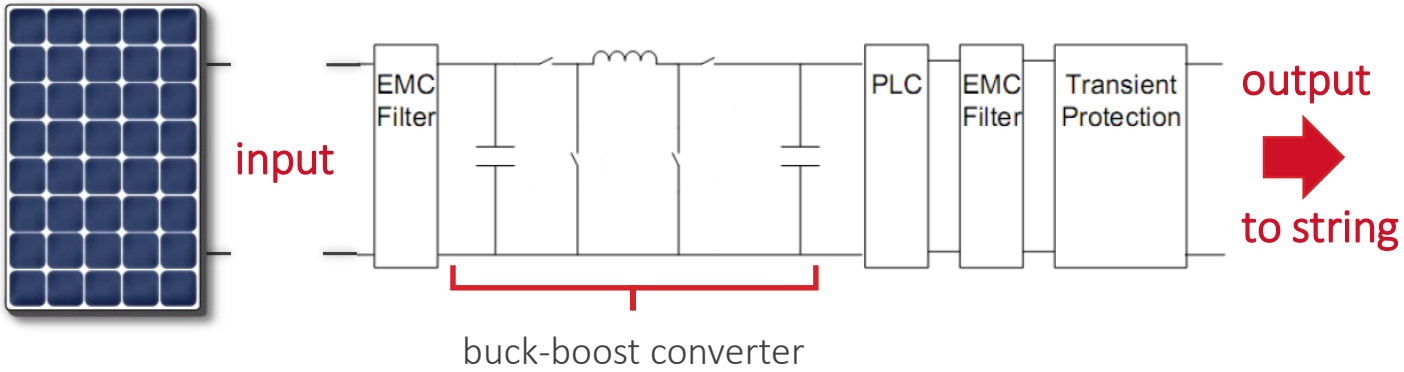
System Topology

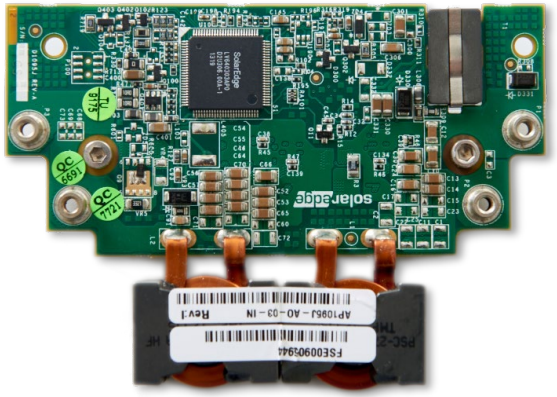


Inverter (DC/AC)
Fixed input/output voltage ratio for highest efficiency

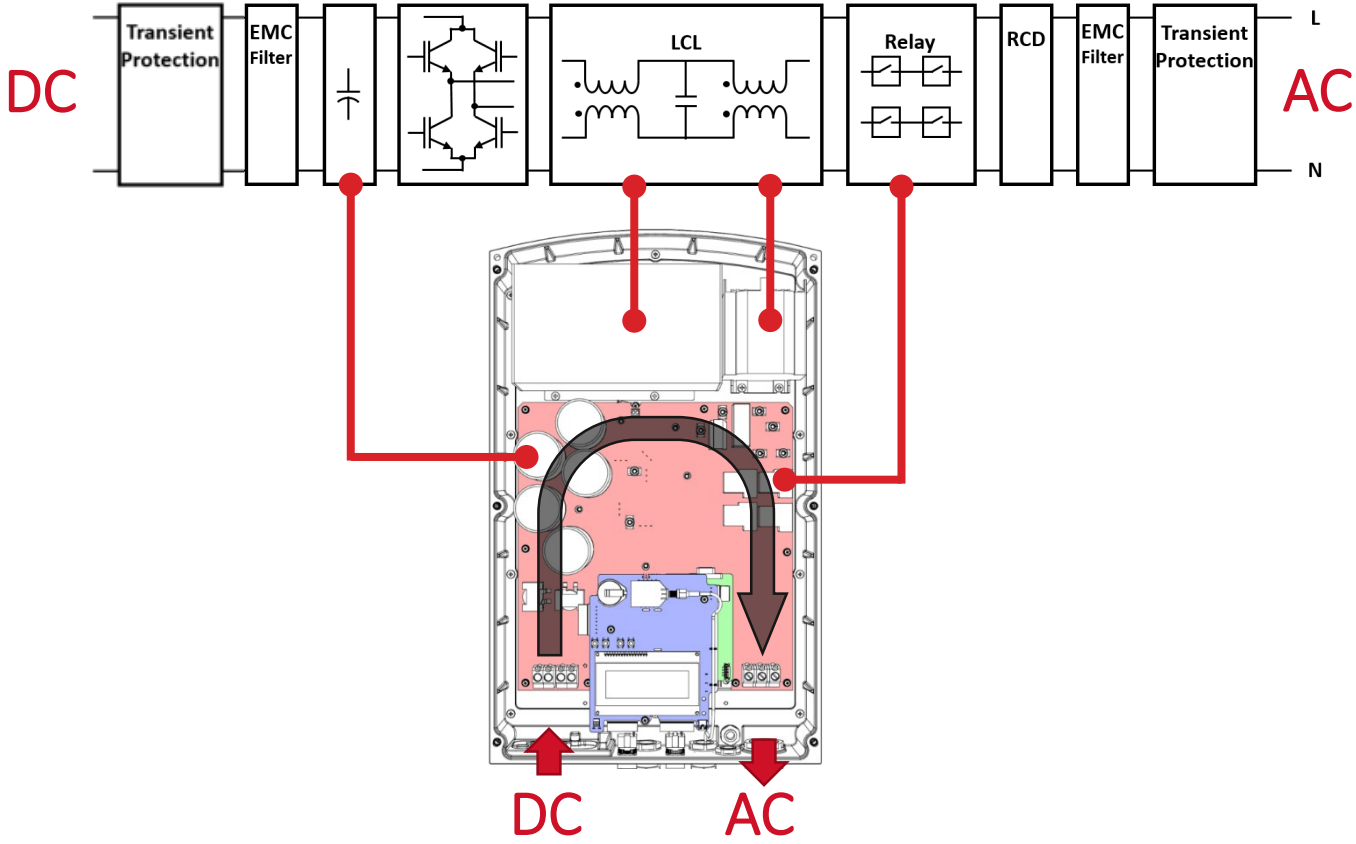
Optimizer
DC/DC “Buck-Boost” converter can increase or decrease the output voltage.

Optimizer

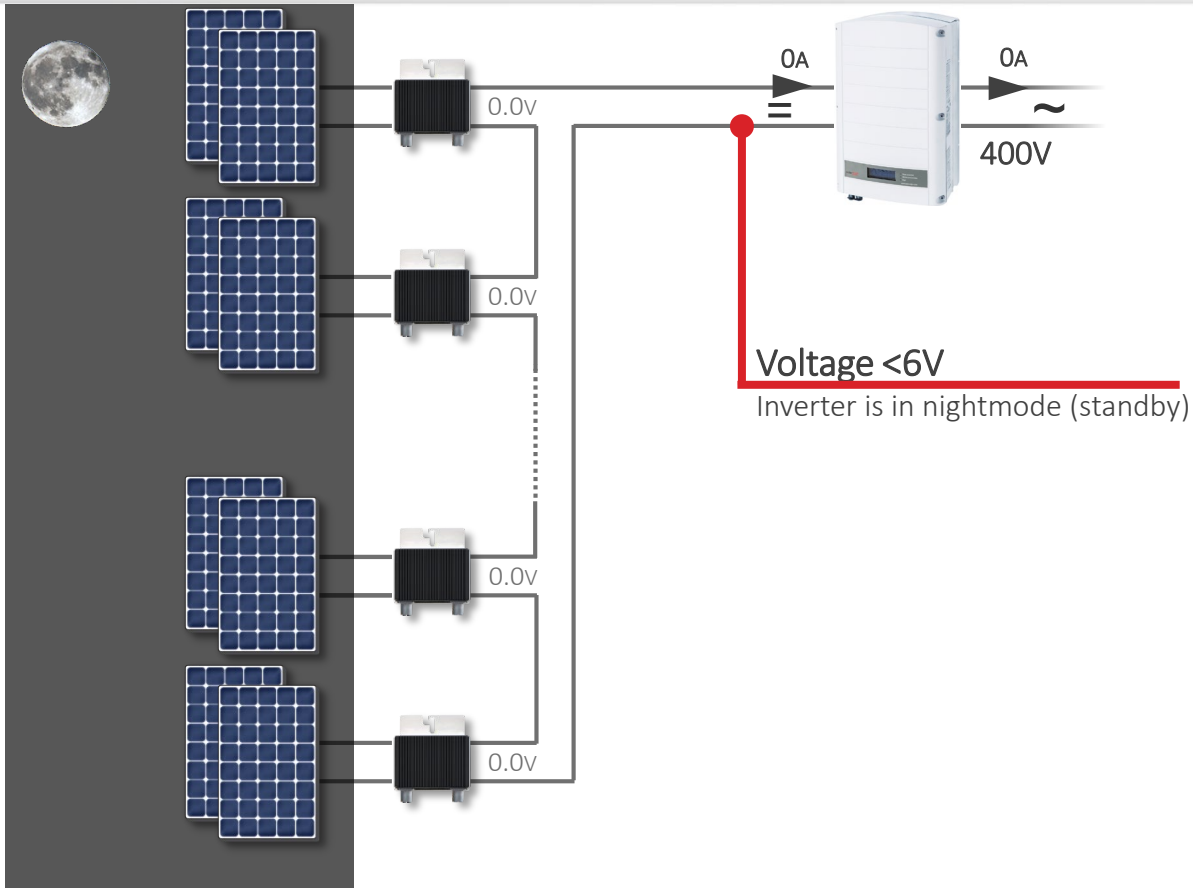




Single Phase Inverter Block Diagram



Wake-up Process



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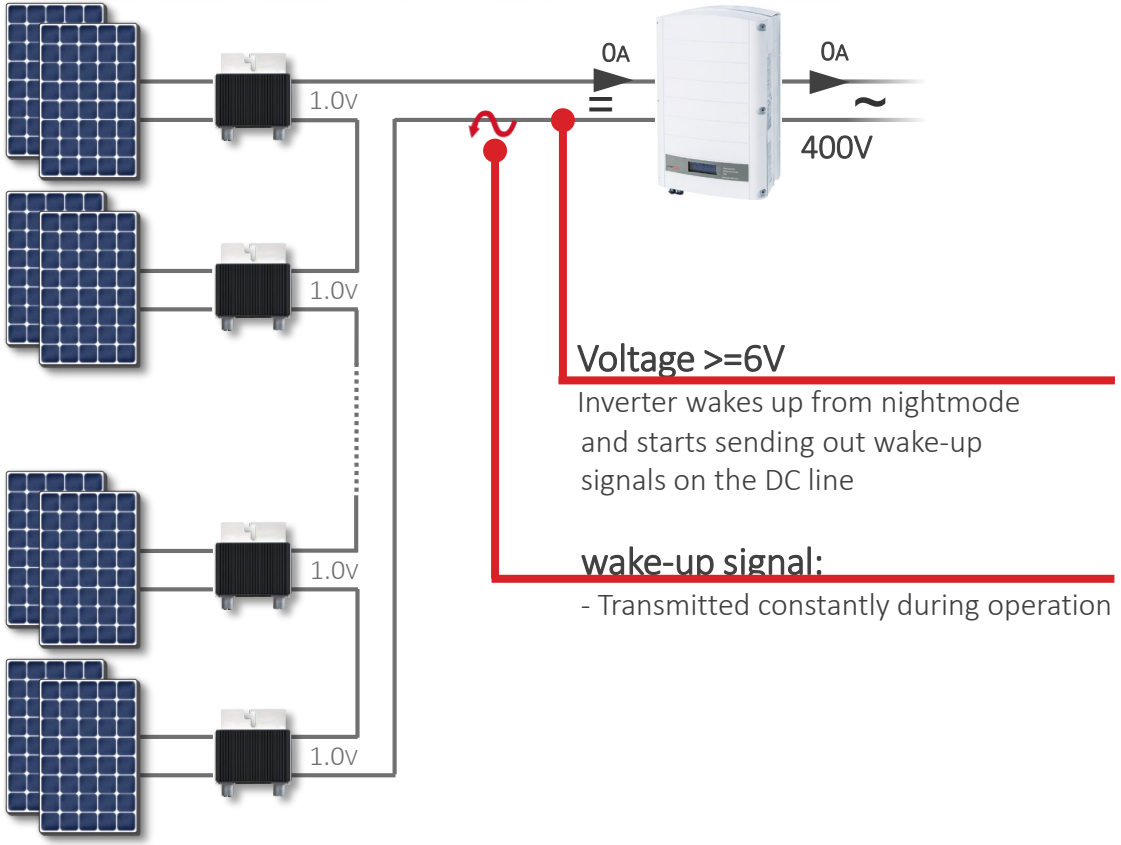


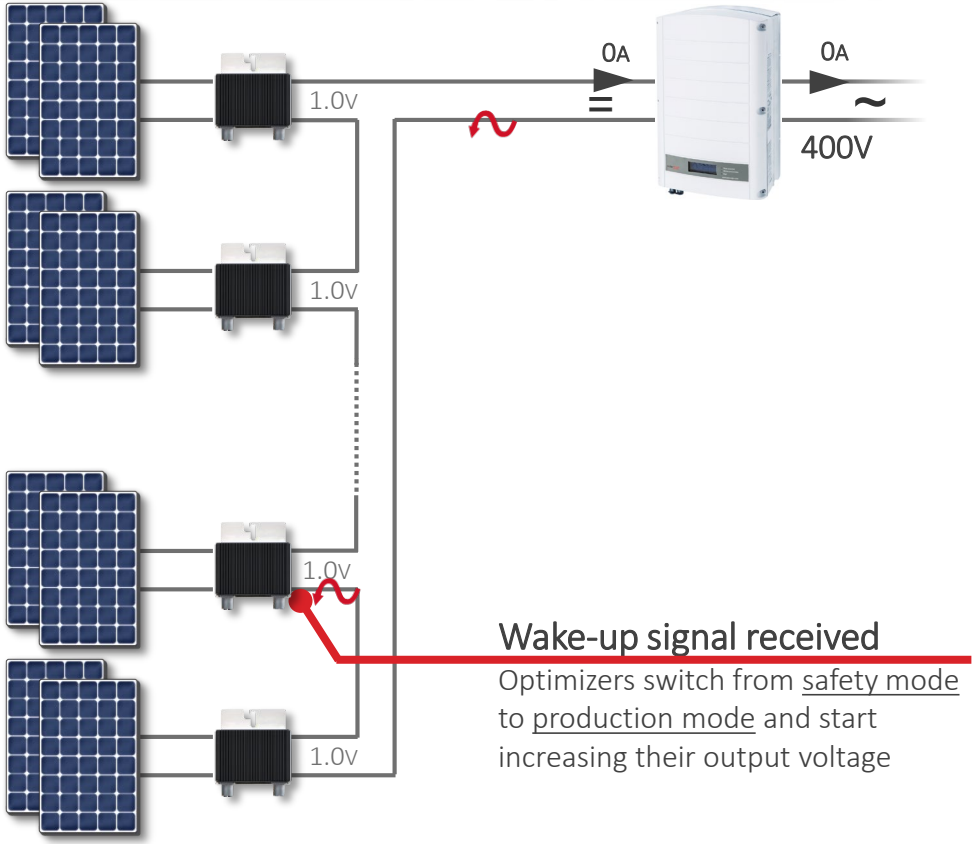
Voltage >=6V

Inverter wakes up from nightmode and starts sending out wake-up signals on the DC line

wake-up signal:

- Transmitted constantly during operation

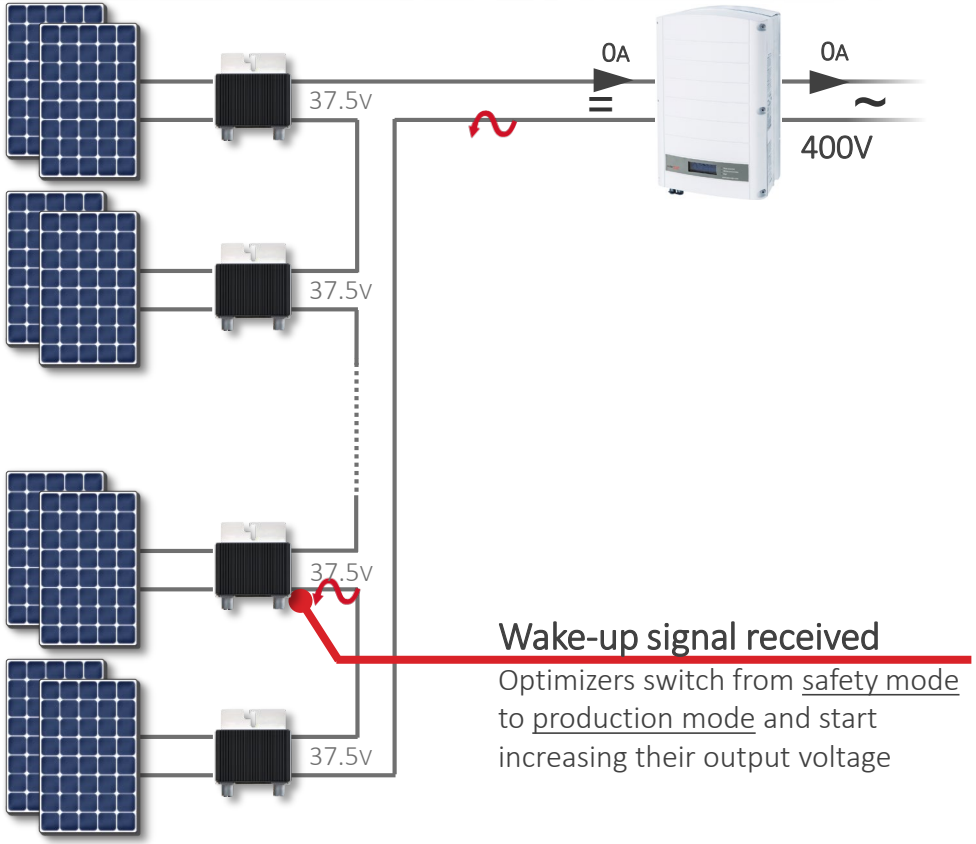
Wake-up Process



Wake-up signal received

Optimizers switch from safety mode to production mode and start increasing their output voltage

Wake-up Process



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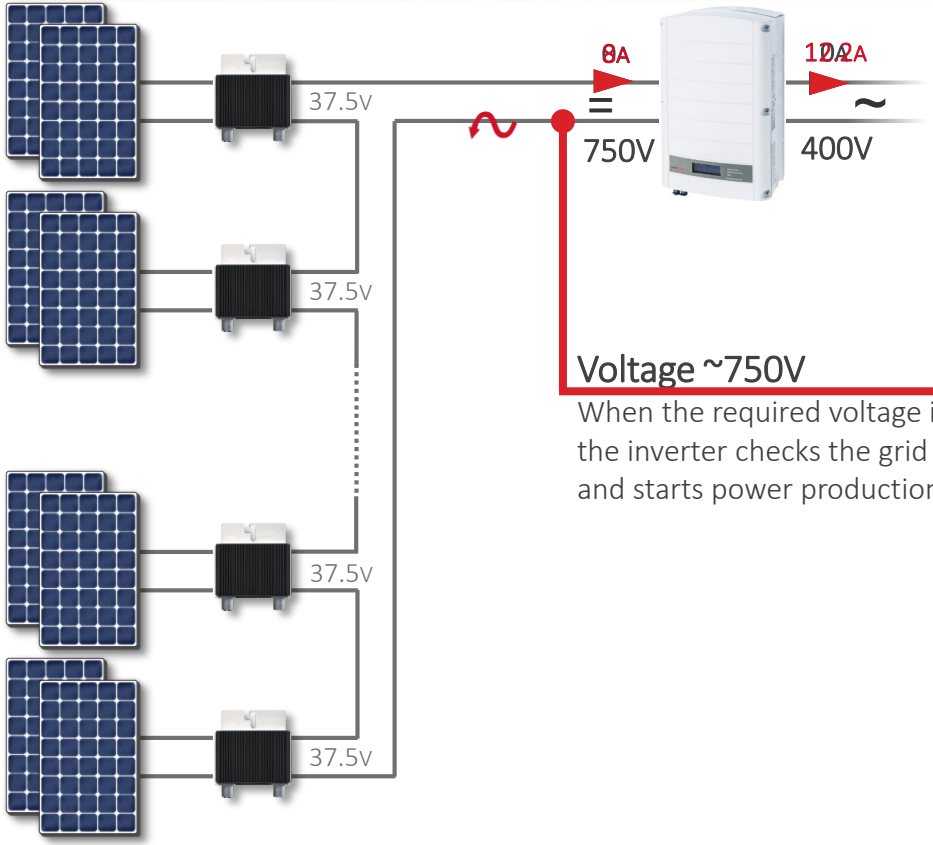
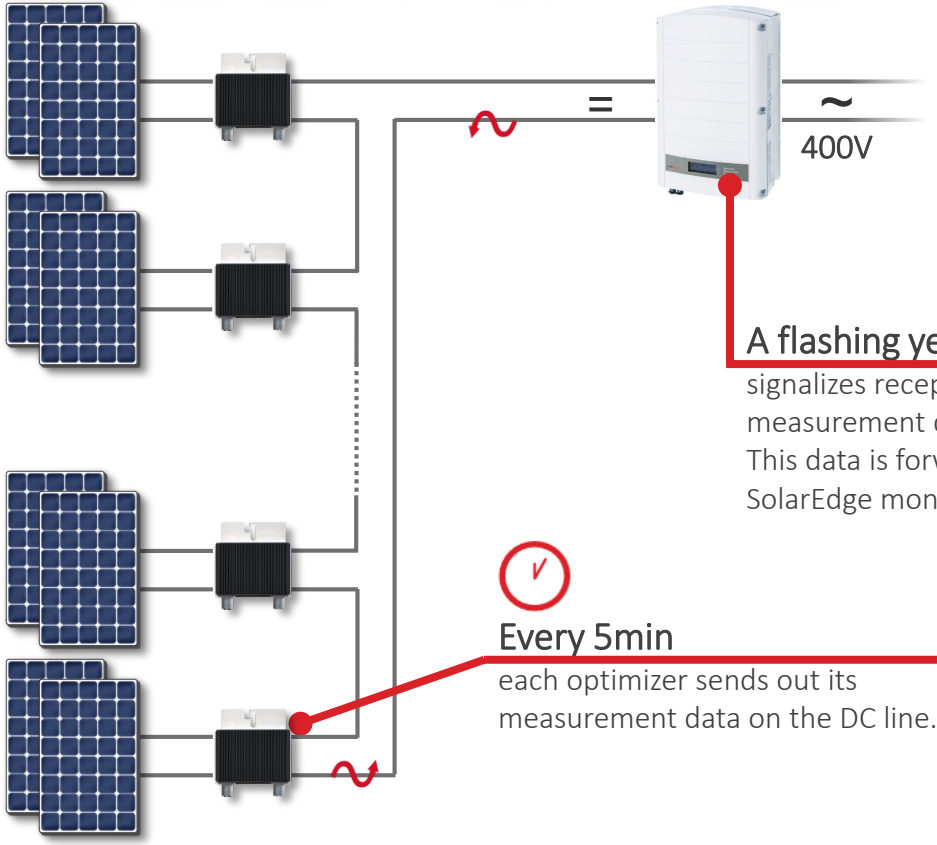


Monitoring Telemetries



A flashing yellow LED

signalizes reception of a measurement data set.
This data is forwarded to the SolarEdge monitoring server.

Every 5min

each optimizer sends out its measurement data on the DC line.

Concept of Operation

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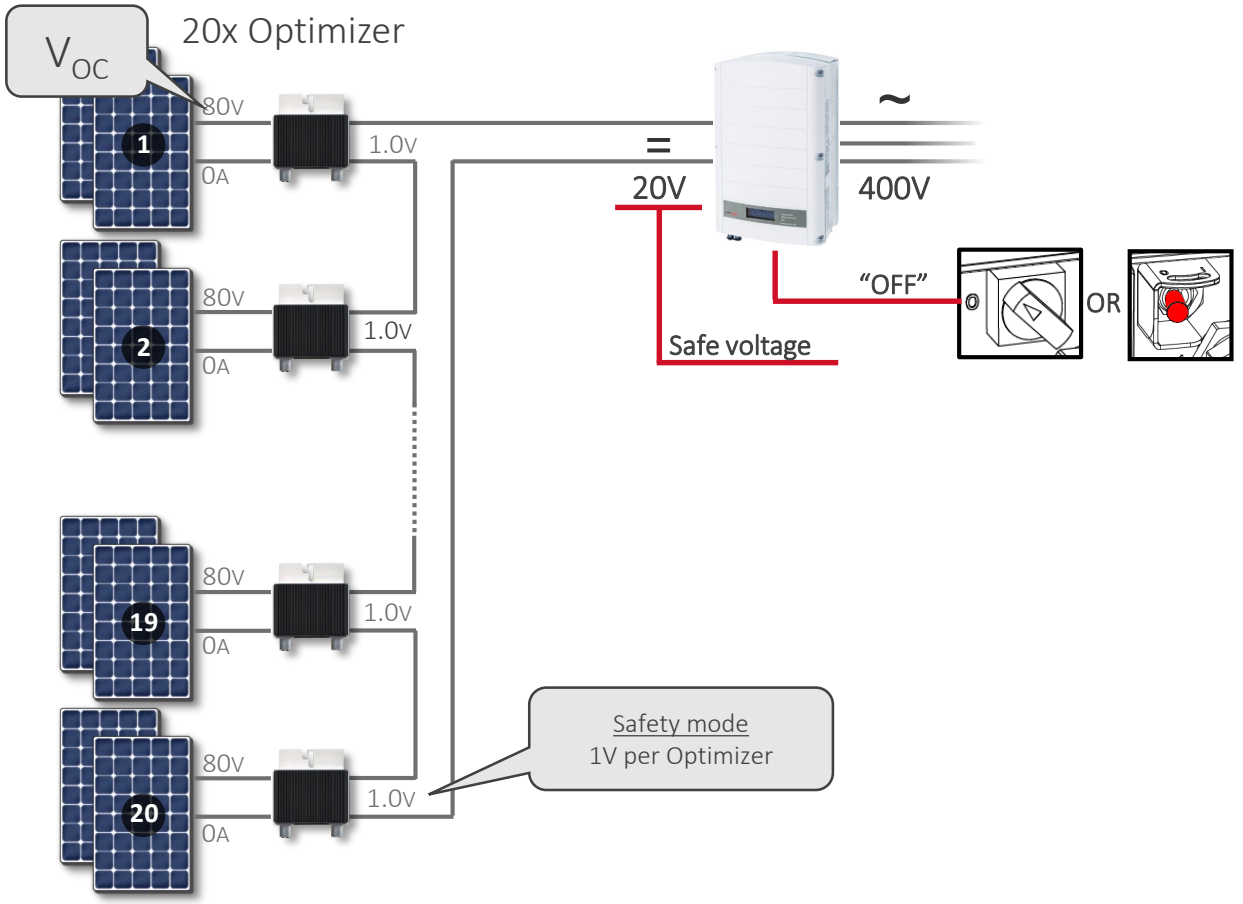
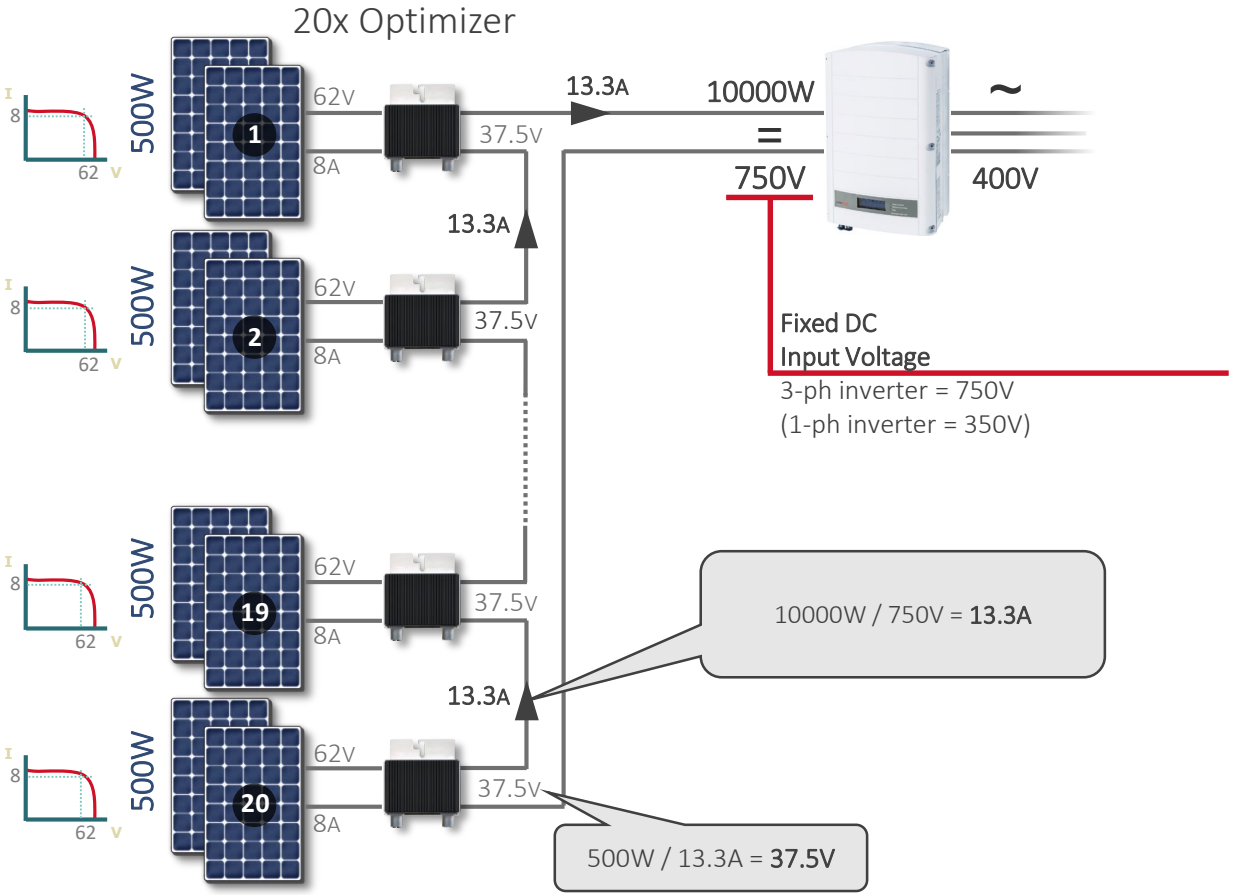
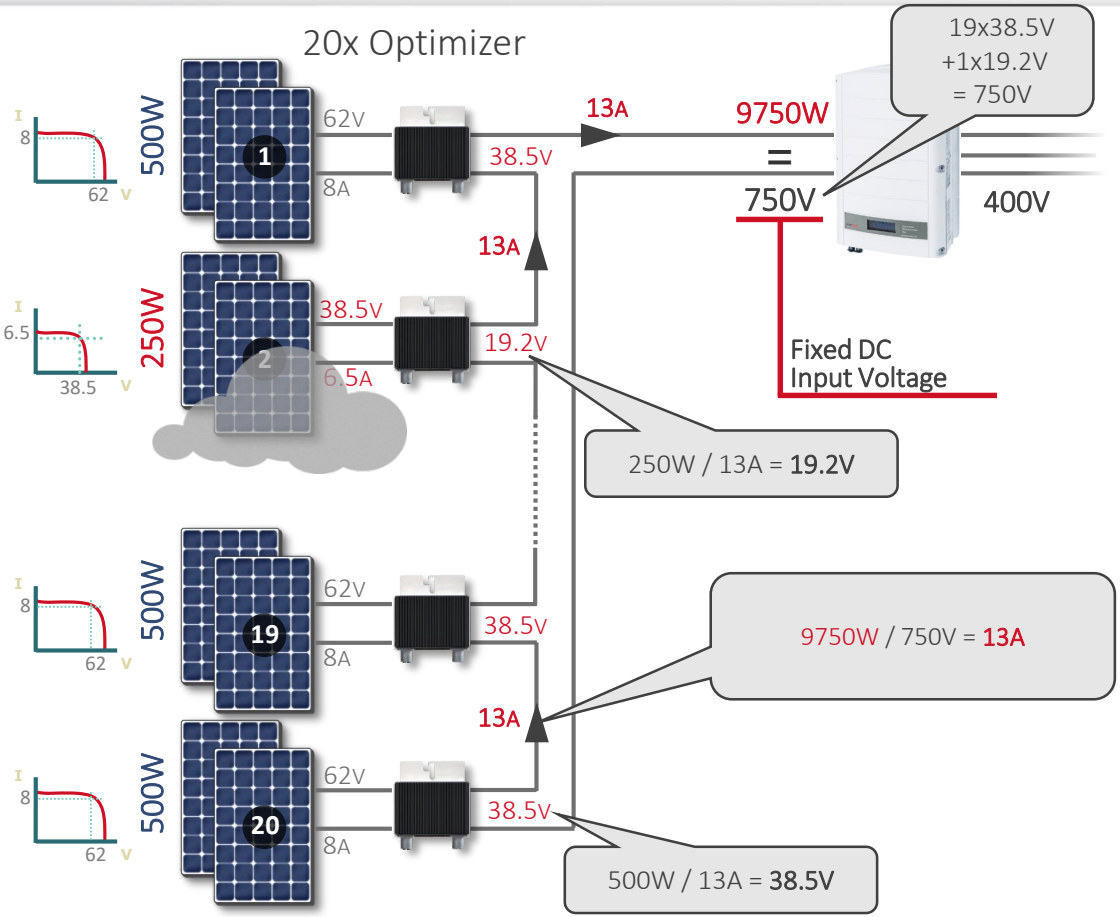
SolarEdge System – Safety Mode



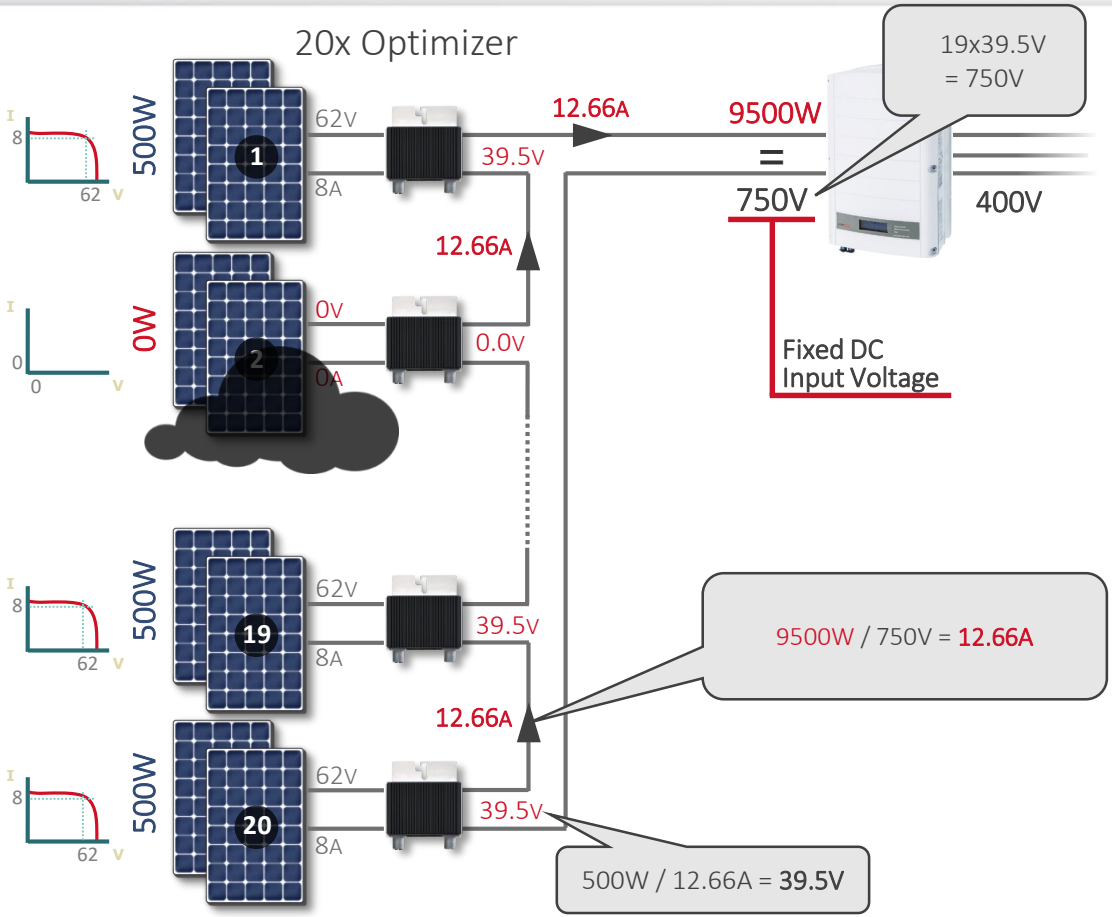
SolarEdge System – Ideal System



SolarEdge System – Shaded Module



SolarEdge System – Dead Module



Summary

- Enable the AFCI – this will detect arcs and Isolate the string voltage to below 50 volts DC.
- SolarEdge inverters all have a safe mode with a DC string voltage below 50 volts DC three phase and 25 volts DC in single phase.
- The optimiser will stay at 1 volt DC until the inverter tells it to wake up, and continually tells the optimisers to stay on.
- If the switch, AC/DC isolator are turned off, or the cable is cut, or connectors unplugged. The heartbeat signal will be cut.
- FFG will send a signal to the inverters, and these drop to below 50 volts DC

THANK YOU!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