



LG
Brand NEW Solar

NeoN High Power N-type Solar Module

What's the Advantage?

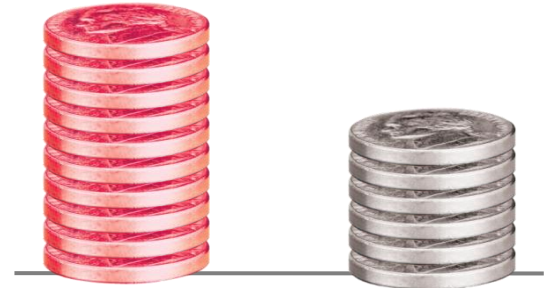
More benefit to the Customer

High Efficiency
cut installation cost

High Performance
maximize output power



More Profit



NeoN

Conventional

NeoN Technology

What does NeoN stand for?

NeoN = Neo + N-type

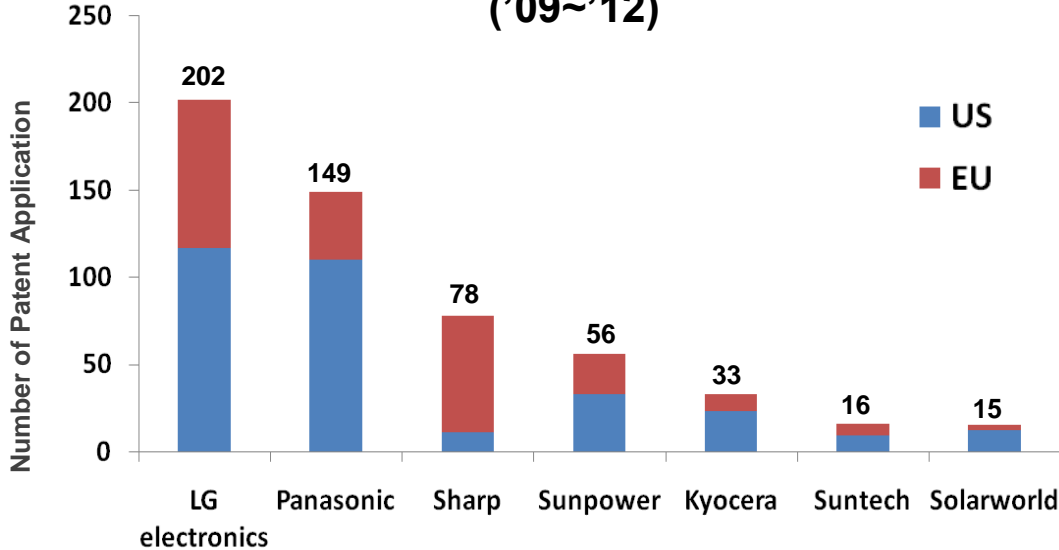
LG's State-of-Art N-type solar module

MonoX™ NeoN

Who developed NeoN?

LG is technology leader and developed NeoN technology itself

Patent application from major companies ('09~'12)



NeoN
6 x 10 Frame



What are the differences?

Integrated advanced solar technologies

1

**Nano Level Control
Technology**

2

**Extremely Low LID
Material**

3

**Double-sided Cell
Structure**

4

**Light Engineering
Design**

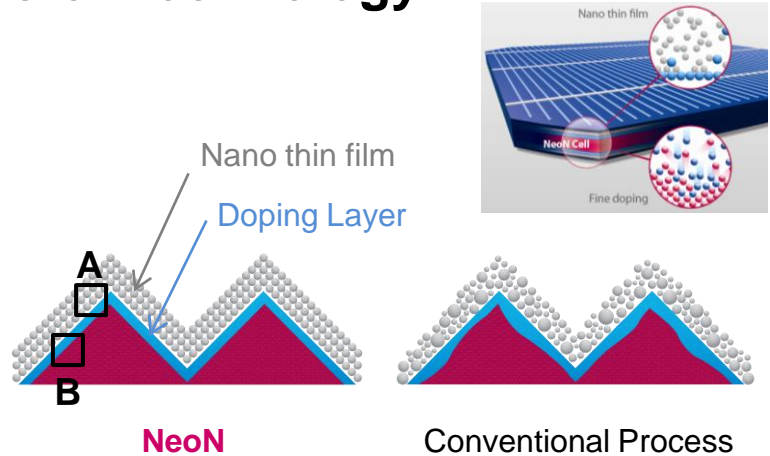
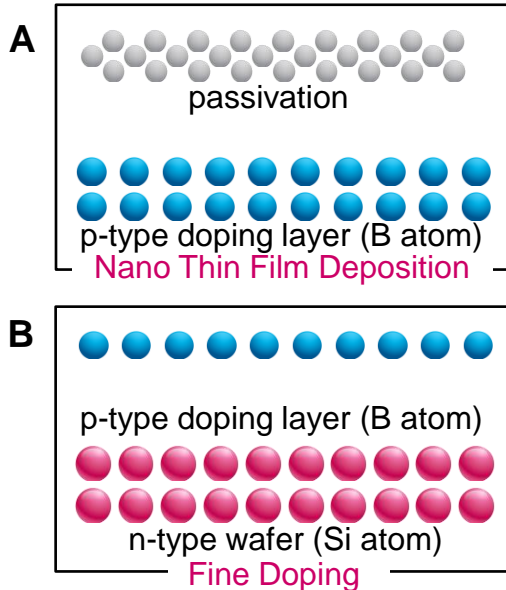
NeoN



Nano Level Control

Deposition & Doping are key processes

Semiconductor Technology



- ✓ **Maximize uniformity**
- ✓ **Minimize defects**

- ✓ **Normal layers**
- ✓ **More defects**

N-type wafers avoid LID effect

2

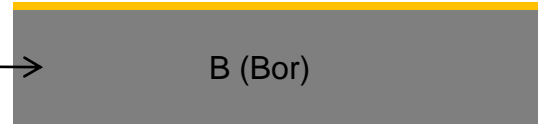
Almost no LID effect of NeoN cells due to n-type wafer material

Keine B-O Verbindungen, kein PID

B-O Verbindungen, LID!



← Wafer →



N-type



P-type



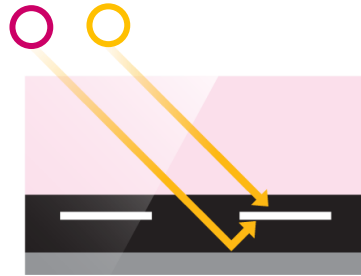
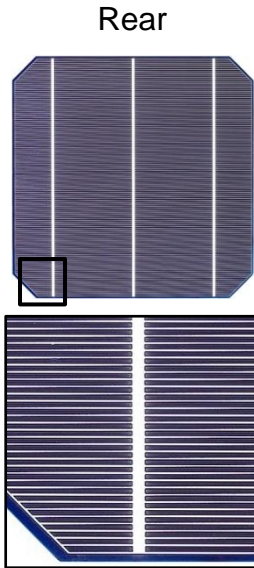
*LID (Light Induced Degradation)

LG Mono X NeoN modules are virtually LID free. All LG Solar modules take potential LID effects into consideration. As a consequence, LG provides a 25-year linear power warranty as one of the few PV manufacturers.

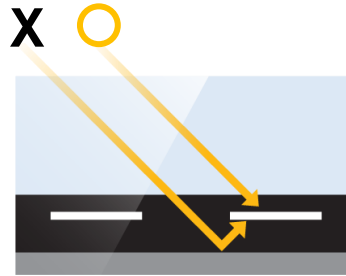
Double-sided Cell

Enhanced module efficiency and yield(kWh/kW)

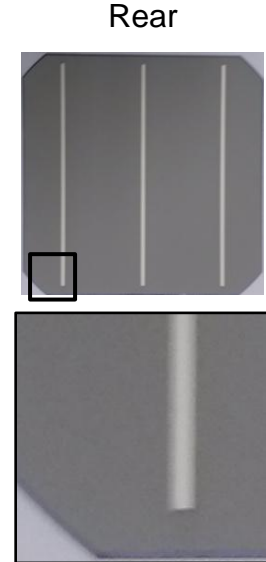
Maximize Light Absorption



NeoN



Conventional

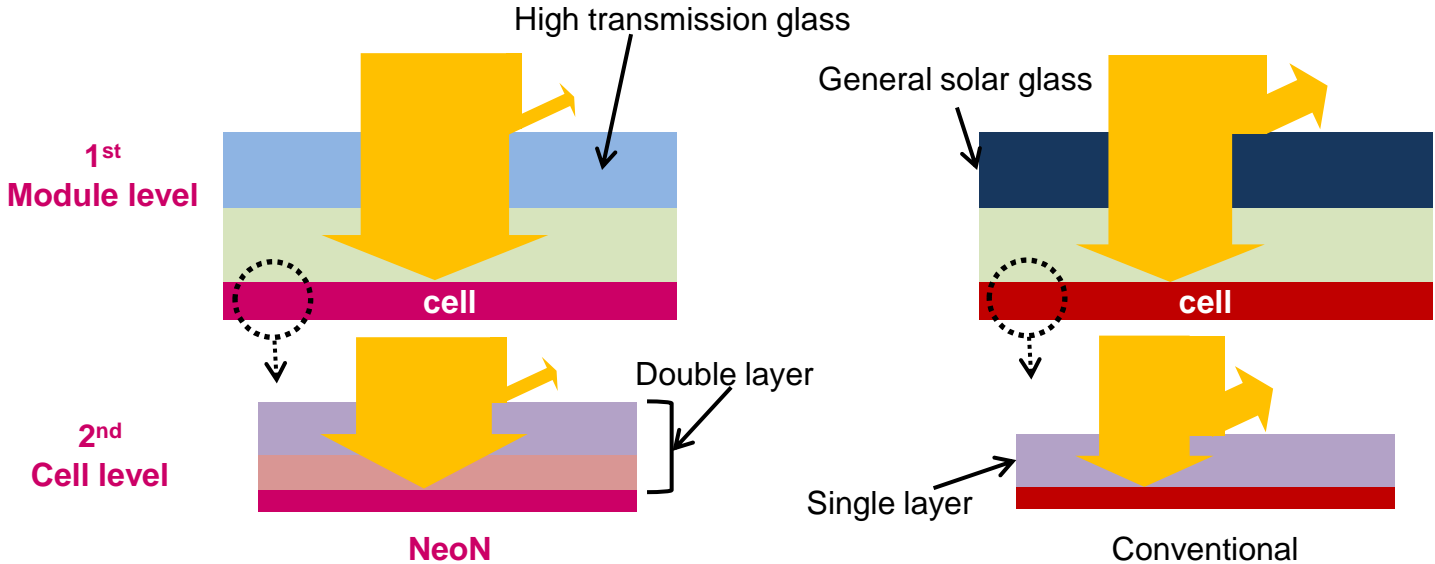


- ✓ Improve module efficiency
- ✓ Big impact in the morning & evening hours

Light Engineering

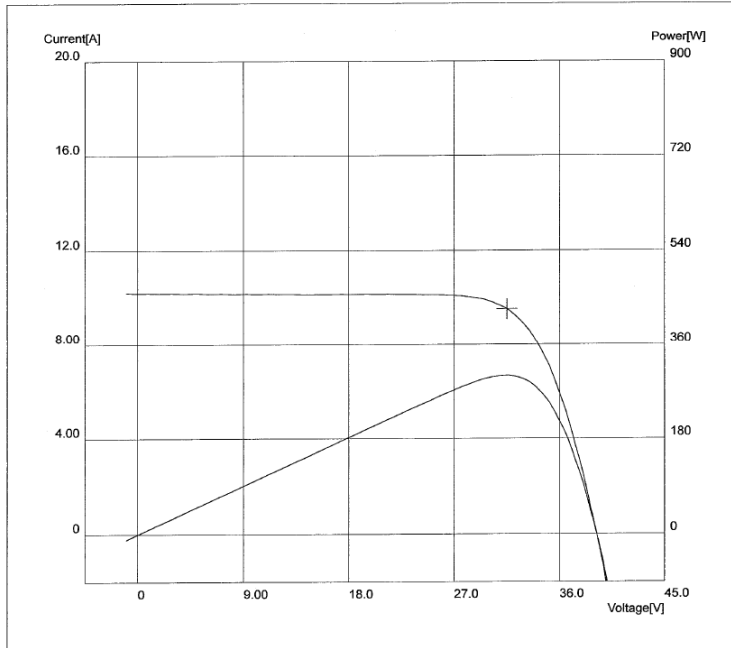
Enhanced Anti-Reflective (AR) cell coating and AR glass

Light Absorption Design



300W Module Power Reached

Achieved 21.3% cell efficiency and 300W module power



IV Tester Ver. 9.06eKTL

| | |
|-----------|------------------|
| Isc | 10.21 [A] |
| Voc | 39.18 [V] |
| Pm | 300.4 [W] |
| Ipm | 9.535 [A] |
| Vpm | 31.51 [V] |
| FF | 75.13 [%] |
| Eff | 18.34 [%] |
| Rsh | 55.16 [ohm] |
| Rs | 0.4605 [ohm] |
| LTI | 3.041 [%] |
| STI | 0.3183 [%] |
| Cell Area | 1.638E+04 [cm2] |
| Cells | 1 |
| Area | 1.638E+04 [cm2] |
| MTemp | 24.80 [deg] |
| MTemp2 | 25.10 [deg] |
| Model | LG |
| Ref.Cal | 50.6 [mA.m2/kW] |
| Ref.Cell | VLSI KG3 |
| Mirr | 99.75 [mW/cm2] |
| DIrr | 100.0 [mW/cm2] |
| DTemp | 25.00 [deg] |

300.4 [W]

Note:
Date: 2012/08/20 14:14:27
File: 1_200ms_n to p_001.ivd

August 20th, 2012



KTL(Korea Testing Laboratory)

NeoN Advantage

5 NeoN USPs at a Glance

1

Reduces system costs due to very high module Efficiency (17,1 – 18,3% module efficiency)

2

Generates very stable energy yields by avoiding LID and PID effects

3

Provides higher energy yields by double AR effect (AR module glass + double layer AR-cell)

4

Increases safety to other back-contact cells by tackling hot spot effects

5

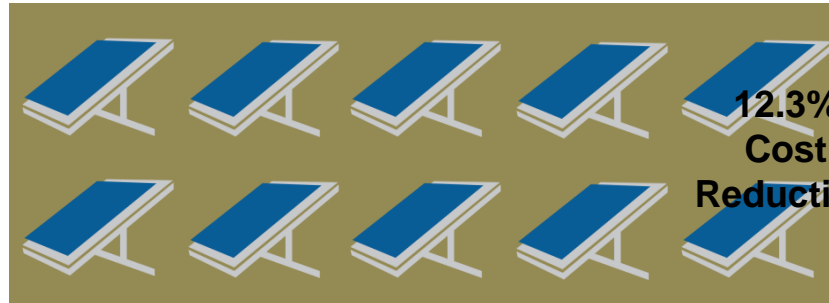
Allows cost savings by convenient series string connection (20 modules in 1 string possible)

Higher Efficiency

Reduced installation cost



NeoN 300W



- Module
- Mount System
- Land
- Labor



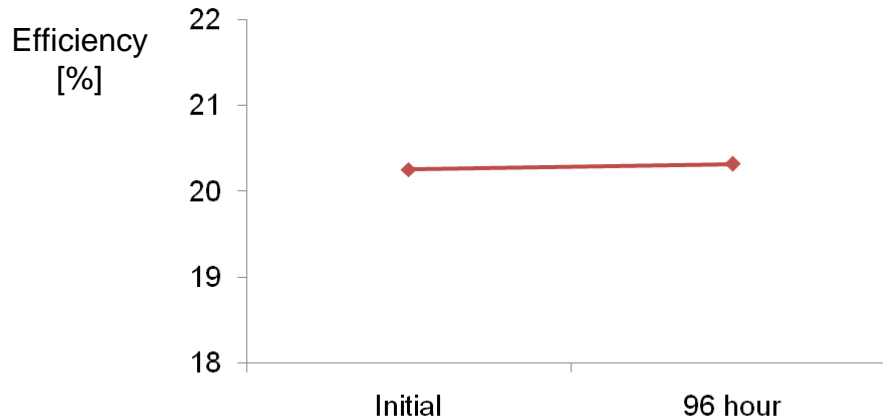
Less modules to install

Extremely Low LID

Zero LID for NeoN cell

2

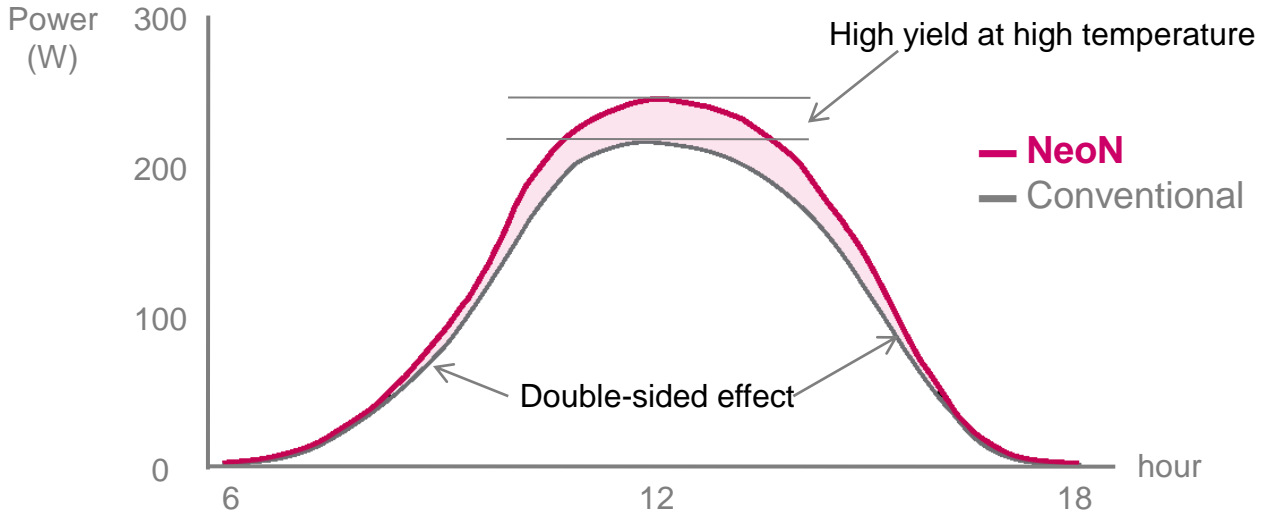
NeoN Cell LID Test Result*



*IEC 60904-11 Draft B test condition

Higher Performance

Due to Double-sided cell & lower temperature coefficient



Enhanced Power Output

Location: Gumi, Korea

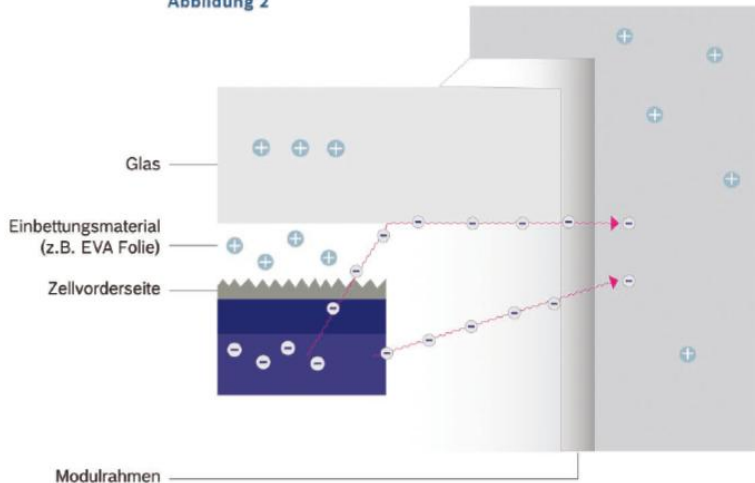
Higher performance

How do PID effects happen? Can they be avoided?

3

PID Mechanism

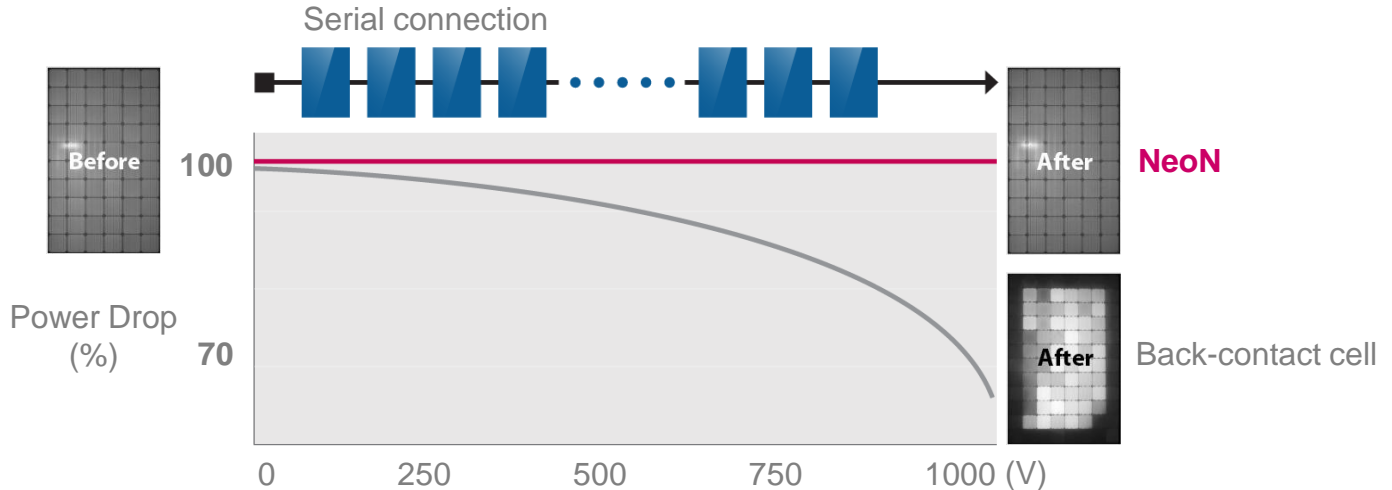
Abbildung 2



If solar generators (modules or systems) have a positive potential, then negative loads may move to the cell surface. Normally, these loads should flow to the back contact of the cell and support the electricity production. However, these loads may flow to the EVA embedding material and also to the front glass and to the module frame. Thus, they do not support the electricity production. PID effects are seen in systems with high system voltages, high temperature and high humidity and some back-contact or thin film technologies. LG has developed measures to prevent all Mono X and Mono X NeoN modules from PID effects. LG was also the winner of a Fraunhofer PID test in 2012.

Higher Performance

Receiving PID* Class A from Fraunhofer CSP



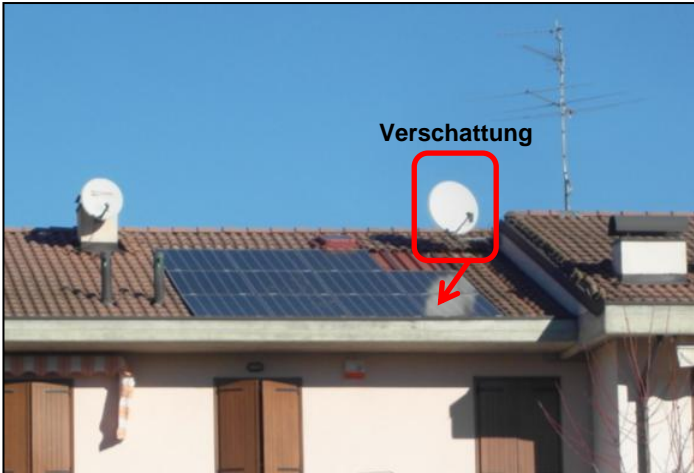
*PID (Potential Induced Degradation)

High level of module safety

How can hot spot effects happen?

4

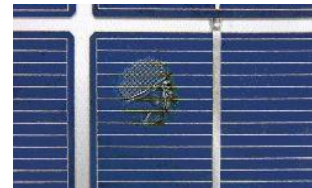
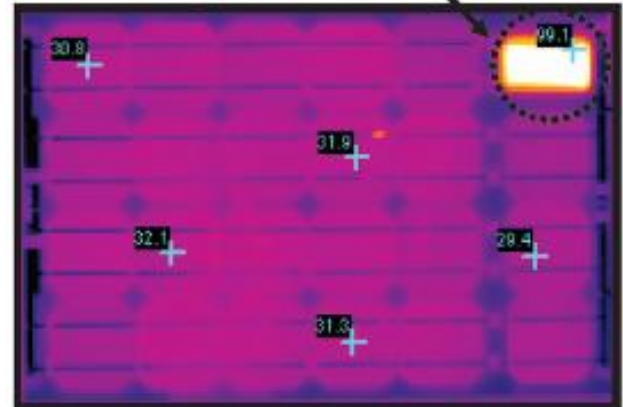
Source



Shading (e.g. bird excreta)

Effect (IR picture)

Low Isc(A) 1.24W 2.67A



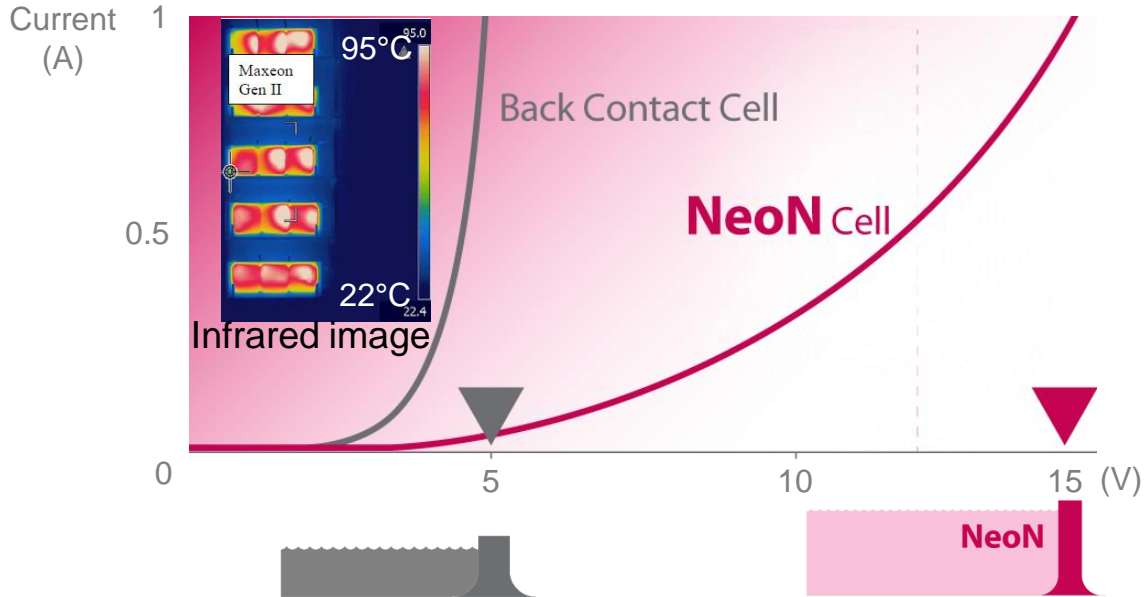
Defective module
(maybe risk of fire)

LG Mono X modules
Have the same safety
as Mono X Neon)

Hot-Spot Stability

NeoN is more stable compared to back-contact cell

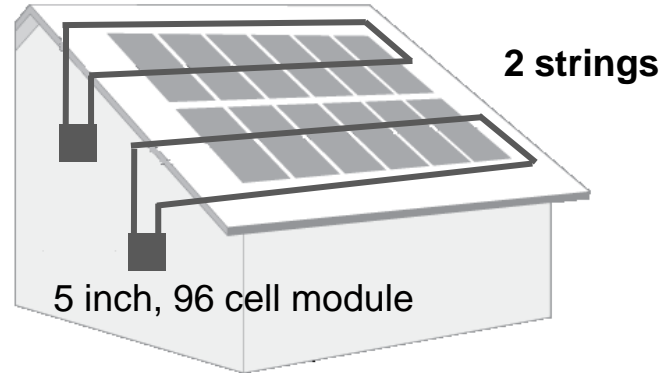
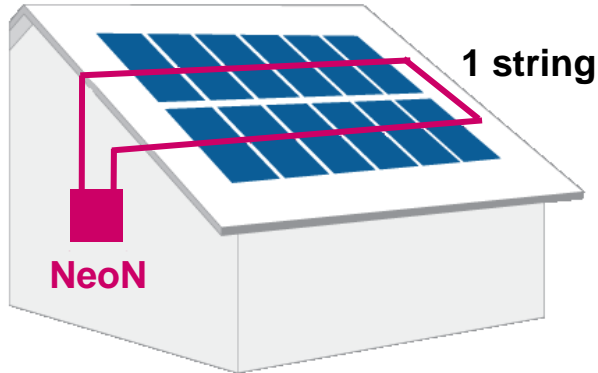
Breakdown Voltage



String Simplicity

Convenient Installation by reducing string length

5

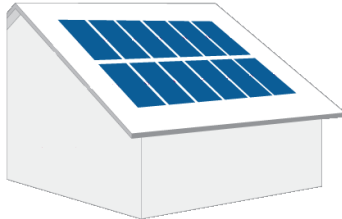


| | LG (NeoN) | Competitor |
|-----------------------------|-----------|------------|
| Voc of Module | 39 V | 65 V |
| Max. # of series connection | 20 ea. | 12 ea. |
| Power per string | 6,000 W | 3,924 W |
| Cable length | Short | Long |

- ✓ Max system voltage: 1000V
- ✓ Safety factor: 20%

Higher Power Generation

Maximize power on limited roof space

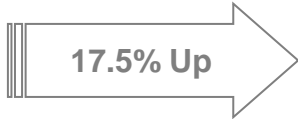
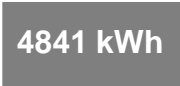


20 modules

**NeoN
6kW**



**Conventional
5.2 kW**

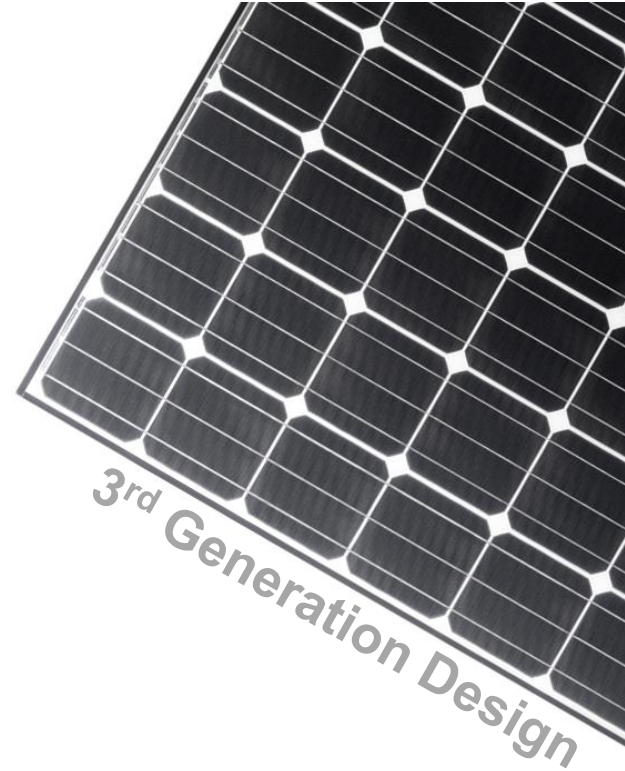


Comparison

| | NeoN | Conventional |
|-------------------------|-------------|---------------------|
| Power | 300 W | 260 W |
| Temperature Coefficient | -0.42 %/°C | -0.46 %/°C |

Summary of NeoN

- NeoN has been developed by LG's own R&D team
- High module efficiency reduces system costs.
- Using bifacial cells and double AR effect (cell + modules) increases system yields (more kWh/kWp)
- LG Mono X modules (up to 260 Wp) have the same module quality as Mono X NeoN modules. Decision whether to use Mono X or Mono X NeoN mainly depends on available space.





LG

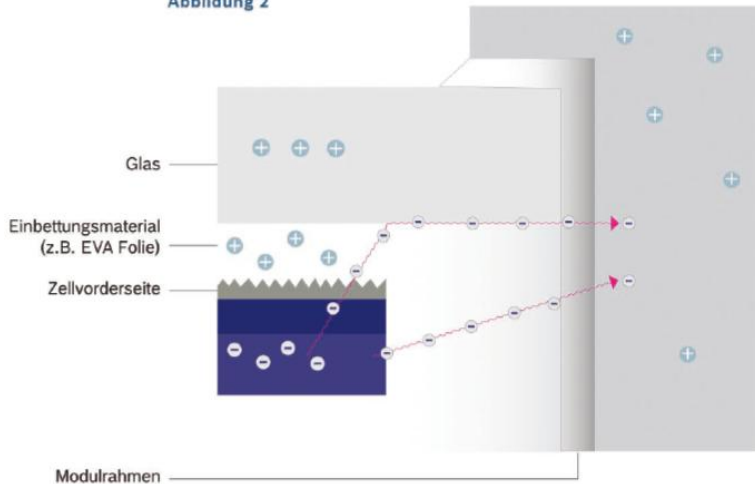
Life's Good



What is PID?

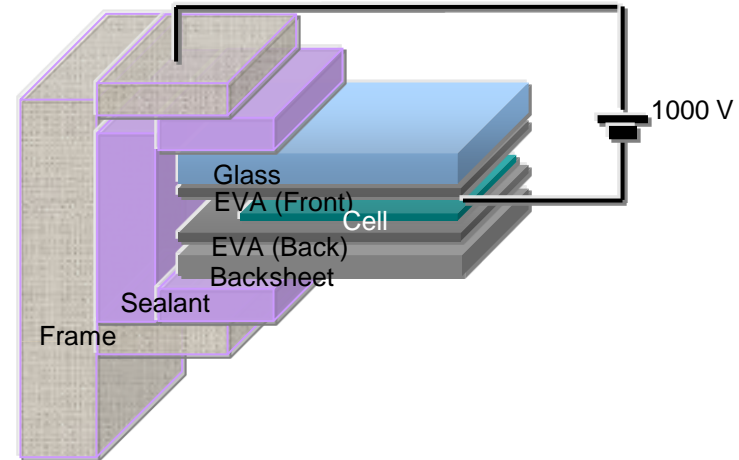
PID Mechanism

Abbildung 2



It may happen in a high temperature and high humidity circumstances

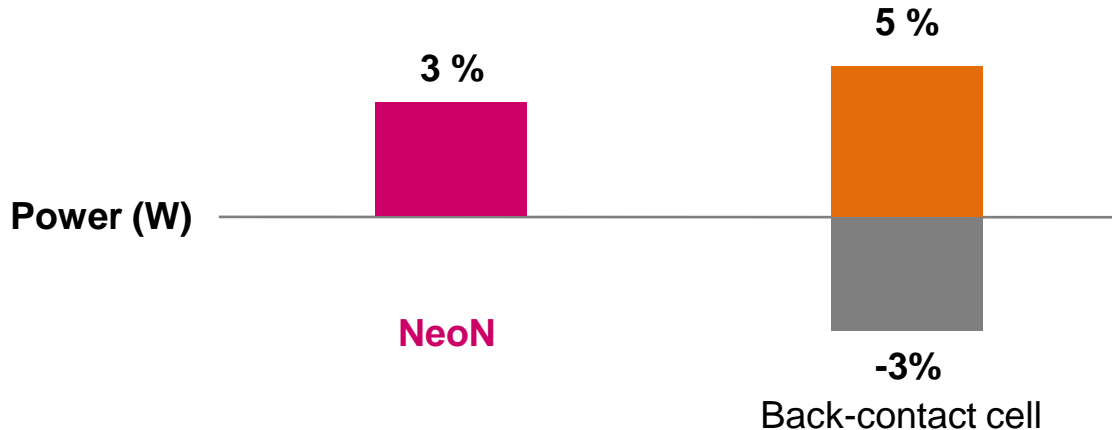
Test Image



Measuring changes of the power output by applying high voltage to the module in a high temperature and high humidity condition.

Positive Tolerance

Provides the watts customers pay for



- ✓ Meet customer's expectation in power generation
- ✓ Make mismatch loss negligible