

ABN 94606513160 Unit 2 662 Stuart Hwy Berrimah NT PH 89 474999 Email <u>seca@secaust.com.au</u>

NORTHERN TERRITORY OF AUSTRALIA

STRUCTURAL ENGINEERING CERTIFICATE OF COMPLIANCE

SECA REFERENCE: 17327 SECA REPORT NO: 17327.2 REV: A 10 January 2018

Static Load Strength Testing of LG Solar Panel Module, Model No#: LG 330N1C-A5

LG ELECTRONICS AUSTRALIA PTY LTD 2 WONDERLAND DRIVE, EASTERN CREEK NSW 2766 AUSTRALIA

Attention: Markus Lambert

RE: Design Certification of LG Solar Panel Module, LG 330N1C-A5 with support points 800mm & 1200mm apart using the Clenergy PV-EZ Rack Solar Mounting System

Documents Attached:

- Appendix A: Test Results & Testing Photographs
- Appendix B: LG Panel Data Sheet & VDE Mechanical Properties

Dear Sir;

This Certificate of Compliance verifies that the LG Solar Panel Module, LG 330N1C-A5 can resist vertical loads with the corresponding support points as listed in Table 1.

Structural Engineering Consultants Australia (SECA) Pty Ltd were engaged by Markus Lambert (National Manager, Solar Sales) of LG Electronics Australia Pty Ltd, to carry out and witness two individual mechanical load tests (simulated static, wind load strength tests) for the above mentioned solar panel module(s) and configuration(s). The test procedure followed was similar to the method outlined in AS4040.2:1992, Static Strength Test Regime.

The solar panel module(s) were mounted frontside up and were free to deflect, this was to imitate a real-world situation. The electrical continuity or the cells themselves were not monitored during each of the tests.



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The load was applied by an airbag which was located at the back of the panel and the centre (vertical) deflection was monitored and logged at 1kPa intervals while the load was applied by slowly inflating the airbag. The air pressure was increased until either failure of the panel and or failure of the system is achieved or if the required design value was achieved.

The tests were observed by Ray Colley & Nicholas Kastellorizios on the 30 September 2017 at 2/ 24 McCourt Road Yarrawonga NT. A total of two solar panel modules were tested, 1 supported at 800mm centres and 1 supported at 1200mm centres, each test was carried out once for each situation.

The applied factor for variability in accordance with AS/NZS 1170.0 Table B1 when determining the allowable design capacity is 1.46.

Table 1 below outlines the Recommended Ultimate Design strength for the LG Solar Panel Module, Model: LG 330N1C-A5. Note that there was no visually obvious structural failure or structural defect observed during the testing of the panels.

Test No.1:

The panel was mounted to the test rig with support points at 800 mm apart on each side with a cantilever/ overhang of 443 mm at each end. The solar panel was observed to be able to support an equivalent 10 kPa with a centre vertical deflection of 48 mm being recorded. However, the solar panel module did not appear to fail under the maximum load, there were also no visually obvious signs of structural failure or defects to the major framing elements of the panel.

Test No.2:

The panel was mounted to the test rig with support points at 1200 mm apart on each side with a cantilever/ overhang of 243 mm at each end. The solar panel was observed to be able to support an equivalent 10 kPa with a centre vertical deflection of 26.5 mm being recorded. However, the solar panel module did not appear to fail under the maximum load, there were also no visually obvious signs of structural failure or defects to the major framing elements of the panel.

It also appeared that the solar panel module(s) performed better with support points at 1200 mm centres when compared with the data & observations from the same panel(s) being tested with support points at 800 mm centres.

Please refer to Appendix A For Test Results & Testing Photographs and Appendix B for LG Panel Data Sheet & VDE Mechanical Properties.



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Table 1: Recommended Ultimate Design Strength, Limit Design Capacity

Test	Panel Manufacturer, Model & Size (mm)	Support Points (mm)	Maximum Applied Load (kPa)	Material Variability Factor AS/NZS 1170.0 Table B1 – kt	Recommended Ultimate Design Strength Limit State Design Capacity (kPa)
No.1	LG 300N1CA5 (1686x1016x40) Serial No. 705K3JU1B1JX	800	10	1.46	6.85
No.2	LG 300N1CA5 (1686x1016x40) Serial No. 705K3EL1B1T2	1200	10	1.46	6.85

The table above outlines the Recommended Ultimate Design Strength, Limit Design Capacity & the applied Material Variability Factor for the tested solar modules, in accordance with AS/NZS 1170.0 Table B1. Where no reliable data for the co-efficient of variation of structural characteristics (Vsc) are available, a value of 10.0% maybe adopted for roof assembly cyclic testing, as recommended in Clause 6.1 of the Draft Guide to LHL Cyclic Testing (Version 1), dated 9 April 2009 and issued by the Cyclone Testing Station.

Cell:	Monocrystalline (mono-cSi LC6MG5-XXX)/ N-type	
Cell Quantity:	(6x10) = 60	
Dimensions:	1,686 x 1,016 x 40 mm	
Weight:	18kg	
Front Material:	Low iron patterned tempered Glass 2,8mm, AR-Coated Solar Glass / ACHT	
Encapsulation Material:	EF2T/ SKC (to glass) & EF2N/ SKC (to back sheet)	
Back sheet:	BQ3RE 30 / SKC	
Frame Adhesive:	SS4080 / KCC	
Frame:	Anodised aluminium with protective black coating,	
Connector Type:	Genuine MC4, IP68 (Male: PV-KST4) (Female: PV-KBT4)	
Module Fire Rating:	Class C	

Table 2: Solar Panel Module Mechanical Data:

Note that the table above outlines the Mechanical Properties (provided by LG Electronics) for each of the LG 330N1C-A5 solar panel modules that were tested. Refer to both the LG Panel Data Sheet & VDE Mechanical Properties, Certificate No. 40045983, Annex 600 for further information.



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The Recommended Ultimate Design Strength, Limit Design Capacity of the LG 330N1C-A5 solar panel module(s) with their corresponding support centres is summarized in Table1. However, in summary, the capacity of the overall system is likely to not be limited by the solar module, but by the connection of the rail fixing to the immediate support structure. Note that these Limit Design Capacities are only applicable for the solar module tested.

We hereby certify that the LG 330N1C-A5 Solar Panel Module(s) with support points at both 800mm and 1200mm centres, with an equal cantilever at each end, can resist the vertical design loads as listed in Table 1 above for the corresponding support points.

Please note: The panel fixing clamps, the support rail or either or their associated fixings may limit the structural design intent of the total system.

This certificate of compliance has been prepared on behalf of and for the exclusive use of LG Electronics Australia Pty Ltd and forms part of the A.I.P certificate of compliance. This certificate is no longer valid if any of the applicable Mechanical Properties used in the manufacture of these solar panel modules is changed or altered in any way.

Yours Sincerely STRUCTURAL ENGINEERING CONSULTANTS AUSTRALIA (SECA) PTY LTD

Nicholas Kastellorizios Structural Engineer NT BPB Number: 196514ES

Nominee for SECA PTY LTD NT BPB Number: 5229ES



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Appendix A: Test Results & Testing Photographs

Test Pressure/ Load Applied (kPa)	Test No.1, 800mm C/C Supports:	Test No.2, 1200mm C/C Supports:
	Recorded Deflection (mm)	Recorded Deflection (mm)
1	1.8	1.8
2	8	7.1
3	13.9	11.9
4	17.6	14.8
5	26	17
6	28	18.9
7	34	21.6
8	39	22.9
9	43	24.05
10	48	26.5



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Appendix B: LG Panel Data Sheet & VDE Mechanical Properties



The High Performer

LG NeON®2

LG325/330N1C-A5

UP TO 19.3% MODULE EFFICIENCY



THE NeON[®] 2 - THE PANEL OF THE FUTURE AVAILABLE TODAY

The LG NeON[®] 2 has seen many improvements, from longer warranties and higher efficiency to stronger frames and better wind loading. This panel is ideal for homes seeking a visually pleasing solar panel and for roofs where space is tight or where future system expansions are considered e.g. to incorporate battery storage.

The LG NeON[®] modules with their double sided cells and CELLO technology absorb light from the front and the back of the cell. This technology sets a new standard for innovation and was recognised with the 2015 Photovoltaic Innovation Award at the Intersolar Industry Event in Germany. LG also won the 2016 Intersolar award for our new NeON BiFacial range.



Great Visual Appearance

LG NeON® 2 panels have been designed with appearance in mind. Their black cells, black frames and thinner wire busbars give an aesthetically pleasing uniform black appearance. Your home deserves the LG NeON® 2.



More Power per Square Metre

LG NeON® 2's 330W are a similar physical size to many conventional 260W panels. This means with the LG NeON® 2 330W you get 27% more electricity per square metre than a 260W panel. So you can install more kW of solar on your roof with the LG NeON® 2.



12 Years Product Warranty (Parts & Labour)

The LG product warranty is 2 years longer than many competitors standard 10 years and covers 12 years. The Warranty is provided by LG Electronics Australia and New Zealand. The warranty includes replacement labour and transport.



Improved 25 Year Performance Warranty

The initial degradation of the module has been improved from -3% to -2%, in the 1st year and the annual rate of degradation has fallen from -0.7%/year to -0.55%/ year thereafter. This brings an 84.8% warranted output after 25 years, compared to 80.2% for many standard panels.



ABOUT LG SOLAR

LG Electronics embarked on a solar energy research programme in 1985, using our vast experience in semi-conductors, chemistry and electronics. LG Solar modules are now available in 32 countries. In 2013, 2015 and 2016 the LG NeON® range won the acclaimed Intersolar Award in Germany, which demonstrates LG Solar's lead in innovation and commitment to the renewable energy industry.

With over 200 lesser known brand panels selling in Australia, LG solar panels offer a peace of mind solution, as they are backed by an established global brand.

KEY FEATURES



Proven Field Performance

LG has been involved in a number of comparison tests of the LG panels against many other brand panels. LG NeON® 2 models are consistently among the best performing in these tests.



LG Corrosion Resistance Certification

LG NeON[®] 2 panels can be installed confidently right up to the coastline. The panels have received certification for Salt Mist Corrosion to maximum severity 6 and Ammonia Resistance.



Strict Quality Control Reliable for the Future

The quality control of LG world-class solar production is monitored and improved using Six Sigma techniques via 500+ monitoring points to effectively maintain and improve our uncompromising quality.



Multi Anti-reflective Coatings Increase Output

LG is using an anti-reflective coating on the panels glass as well as on the cell surface to ensure more light is absorbed in the panel and not reflected. More absorbed light means more electricity generation.



Improved High Temperature Performance

Solar panels slowly lose ability to generate power as they get hotter. LG NeON® 2, has an improved temperature co-efficient to standard modules, which means in hot weather LG NeON® 2 panels will deliver higher output.



"CELLO" Technology Increases Power

"CELLO" Multi wire busbar cell technology lowers electrical resistance and increases panel efficiency, giving more power per panel and provides a more uniform look to the panel.



Low LID

The N-type doping of the NeON® cells results in extremely low Light Induced Degradation (LID) when compared with the standard P-type cells. This means more electricity generation over the life of the panel, as the panel degrades less.



Extensive Testing Programme

LG solar panels are tested between 2 to 4 times the International Standards at our in-house testing laboratories, ensuring a very robust and longer lasting solar module.



Extreme Wind Load Resistance

LG modules have a strong double walled frame. When it comes to wind forces (rear load) many competitor modules are certified to 2400 Pascals. LG modules are certified to more than double -5400 Pascals, which provides at least double the strength and durability to a standard module.



Positive Tolerance (0/+3%)

If you buy a 330 Watt panel then the flash test of this panel will show somewhere between 330W and 340W. Some competitor panels have -/+ tolerance, so you could get a flash test result below the rated Watt, meaning you pay for Watts you never get.



Enhanced low light performance

LG NeON 2 panels will give better performance under low light, such as early morning or late afternoon compared to standard panels. At 200W/ m2 LG Neon 2 panel efficiency drop is -2% while many conventional panels reduce by -4%.



Fully Automated Production in South Korea

All LG solar panels are manufactured in a custom designed and fully automated production line by LG in Gumi, South Korea ensuring extremely low tolerances. This means great quality and build consistency between panels.

LG N_eON[®] 2

LG NeON® 2 – ENHANCED. MORE EFFICIENT. ADVANCED.

LG NeON[®] 2 solar modules now offer even more output. Featuring a classy design and with a total of 60 cells, it can withstand a load of 6,000 pascals. LG has lengthened its product warranty from 10 to 12 years and has improved its linear performance guarantee to 84.8 % of nominal output after 25 years. The LG NeON[®] 2 is an excellent choice for high performing long lasting solar systems.

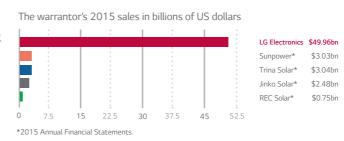
LOCAL WARRANTY, GLOBAL STRENGTH

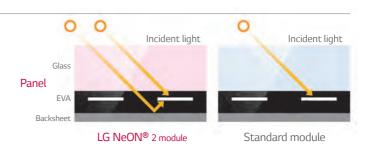
LG Solar is part of LG Electronics Inc., a global and financially strong company, with over 50 years of experience in technology.

Good to know: LG Electronics Australia Pty Ltd is the warrantor in Australia and NZ for your solar modules. So LG support, via offices in every Australian mainland state and NZ and through our 70 strong, Australia wide dealer network, is only a phone call away.

HIGHER OUTPUT, HIGHER YIELD

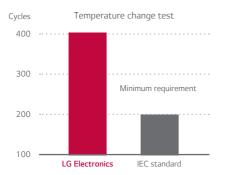
The NeON® Cell produces energy from both the front and the back of the cell. This innovative approach allows the absorption of light from the back of the cell which raises the panel's efficiency and power output. Standard panels only absorb light from the front.

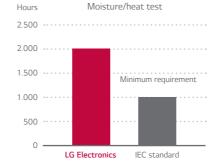




EXCELLENT QUALITY, INDEPENDENTLY TESTED

You can rely on LG. We test our products with at least double the intensity specified in the IEC standard. (International Quality Solar Standard).







Our panel range have won a string of International Awards.

POWERFUL DESIGN, GUARANTEED ROBUST

With reinforced frame design, the LG NeON 2 can endure a front load of 6000 Pa which is the equivalent of 1048 kg over the size of the module. The rear load/wind load of the module is 5400 Pa which is more than twice the wind load resistance of standard modules (2400 Pa).







Longer Product Warranty 10yrs+2yrs

LG offers a two year longer product warranty for parts and labour than many competitors. 10 years to an impressive 12 years.

Mechanical Properties

incentaniea i roperties	
Cells	6 x 10
Cell Vendor	LG
Cell Type	Monocrystalline / N-type
Cell Dimensions	161.7 x 161.7 mm
# of Busbar	12 (Multi Wire Busbar)
Dimensions (L x W x H)	1686 x 1016 x 40 mm
Front Load	6000 Pa
Rear Load	5400 Pa
Weight	18.0 kg
Connector Type	Genuine MC4, IP68 (Male: PV-KST4) (Female: PV-KBT4)
Junction Box	IP68 with 3 bypass diodes
Length of Cables	2 x 1000 mm
Front cover	High transmission tempered glass
Frame	Anodised aluminum with protective black coating

Certifications and Warranty

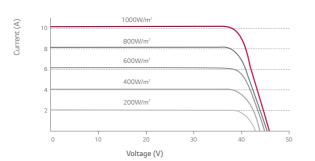
	ISO 9001	
Certifications	IEC 61215, IEC 61730-1/-2, UL1703	
Certifications	IEC 61701(Salt Mist Corrosion Test)	
	IEC 62716 (Ammonia Test)	
Module Fire Rating	Class C	
Product Warranty	12 Years	
Output Warranty of Pmax (Measurement Tolerance \pm 3%)	Linear Warranty ¹	

 1 1) 1st year 98%, 2) After 1st year 0.55%p annual degradation, 3) 84.8% for 25 years

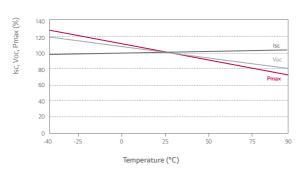
Temperature Characteristics

NOCT	45 ± 3 °C
Pmax	-0.37 %/°C
Voc	-0.27 %/°C
lsc	0.03 %/°C

Current – Voltage characteristics at various irradiance levels



Current – Voltage characteristics at various cell temperatures



LG Life's Good

LG Electronics Australia Pty Ltd Solar Business Group 2 Wonderland Drive, Eastern Creek, NSW 2766 Ph: (02) 88054038 E-Mail: solarsales@lge.com.au Web:lgenergy.com.au **Electrical Properties (STC²)**

Module Type	325 W	330 W	335 W
Maximum Power Pmax (W)	325	330	335
MPP Voltage Vmpp (V)	33.3	33.7	34.1
MPP Current Impp (A)	9.77	9.80	9.83
Open Circuit Voltage Voc (V)	40.8	40.9	41
Short Circuit Current Isc (A)	10.41	10.45	10.49
Module Efficiency (%)	19.0	19.3	19.6
Operating Temperature (°C)	-40 ~ +90		
Maximum System Voltage (V)	1000		
Maximum Series Fuse Rating (A)	20		
Power Tolerance (%)	0 ~ +3		

² STC (Standard Test Condition): Irradiance 1000 W/m², Module Temperature 25 °C, AM 1.5.

The nameplate power output is measured and determined by LG Electronics at its sole and absolute discretion.

Electrical Properties (NOCT³)

Module Type	325 W	330 W	335 W
Maximum Power Pmax (W)	240	243	247
MPP Voltage Vmpp (V)	30.8	31.2	31.5
MPP Current Impp (A)	7.78	7.81	7.83
Open Circuit Voltage Voc (V)	38.0	38.1	38.1
Short Circuit Current lsc (A)	8.38	8.41	8.44

 3 NOCT (Nominal Operating Cell Temperature): Irradiance 800 W/m², ambient temperature 20 °C, wind speed 1 m/s

Dimensions (mm)

LG Electronics Inc.

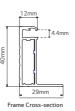
Seoul, 07336, Korea

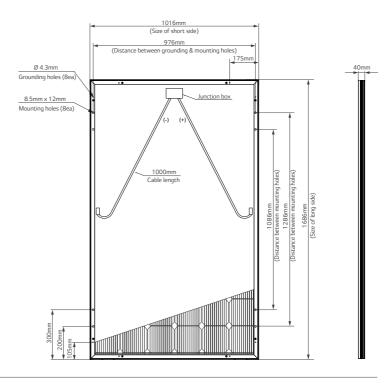
Solar Business Division

Twin Building, Western Tower, 11F,

www.lg.com/global/business

128, Yeoui-daero, Yeongdeungpo-gu,





Product specifications are subject to change without prior notice. Date: 04/2017



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VDE Prüf- und Zertifizierungsinstitut GmbH – VDE-Prüfstelle

VDE Testing and Certification Institute Merianstraße 28, D-63069 Offenbach a.M. Tel. (069) 8306-0 Fax (069) 8306-555

Aktenzeichen:

Ausweis Nr.: 40045983 Certificate No.: 40045983

File number: 524214-3	972-0001			
Aufbau-Übersicht für PV-Module Constructional data for PV-modules				
Beschreibung des Aufbaus Description of construction	A) LGxxxN2W-A5, LGxxxN2C-A5	B) LGxxxN1W-A5, LG-xxxN1C-A5		
Modul-Bemessungsleistung (P _{max}) <i>Rated output of module (P_{max})</i>	360 – 425 W	305 – 355 W		
Bemessungsspannung im Punkt maximaler Leistung (U _{mpp}) <i>Rated volt. at max. power point (U_{mpp})</i>	37,4 − 42,5 V	31,7 – 35,7 V		
Bemessungsstrom (I _{mpp}) Rated current (I _{mpp})	9,63 – 10,01 A	9,63 – 9,95 A		
Bemessungsleerlaufspannung (U _{OC}) Rated open circuit voltage (U _{OC})	48,5 – 49,8 V	40,4 – 41,4 V		
Bemessungskurzschlussstrom (I _{SC}) Rated short circuit current (I _{SC})	10,19 – 10,67 A	10,25 – 10,65 A		
Maximale Systemspannung Max. system voltage	1000 V	1000 V		
Modulabmessung <i>Dimensions</i>	2024 x 1024 x 40 mm	1686 x 1016 x 40 mm		
Gewicht Weight	20,7 kg	18,0 kg		
Zellenhersteller Manufacturer of cells	LG Electronics	LG Electronics		
Zelltyp Type of cells	High efficiency mono-cSi, LC6NG5-XXX	High efficiency mono-cSi, LC6NG5-XXX		
Anzahl Zellen pro Modul Number of cells per Module	72	60		
Cell connector	LS Cable& System 2) RWR 0.38, Sn62Pb36Ag2 17.5 um / KOS Global 3) RWR 0.38, SnPbAg 17.5 um / Sanko Korea 4) RWR 0.36, Sn63Pb37 17.5 um / LS Cable& System 5) RWR 0.36, Sn63Pb37 17.5 um / KOS Global 6) RWR 0.36, Sn63Pb37 17.5 / Sanko Korea	1) RWR 0.38, Sn62Pb36Ag2 17.5 um / LS Cable& System 2) RWR 0.38, Sn62Pb36Ag2 17.5 um / KOS Global 3) RWR 0.38, SnPbAg 17.5 um / Sanko Korea 4) RWR 0.36, Sn63Pb37 17.5 um / LS Cable& System 5) RWR 0.36, Sn63Pb37 17.5 um / KOS Global 6) RWR 0.36, Sn63Pb37 17.5 / Sanko Korea		
Stringverbinder String connector	0.3-5.0, Sn-Pb, 40µm / Sanko Korea	0.3-5.0, Sn-Pb, 40µm / Sanko Korea		
Front Material Front material	 Low iron patterned tempered Glass 8mm, SUNEXTRA (AR GLASS) / Flat Glass Group Low iron patterned tempered Glass 8mm, AR-Coated Solar Glass / ACHT 	1) Low iron patterned tempered Glass 2,8mm, SUNEXTRA (AR GLASS) / Flat Glass Group 2) Low iron patterned tempered Glass 2,8mm, AR-Coated Solar Glass / ACHT		
Verkapselung Encapsulation material	 S95 (to the Glass) & S94 (to the Backsheet) / Bridgestone EF2T (to the Glass) & EF2N (to the Backsheet) / SKC 	1) S95 (to the Glass) & S94 (to the Backsheet) / Bridgestone 2) EF2T (to the Glass) & EF2N (to the Backsheet) / SKC		
Rückseitenmaterial Backsheet material	PV-BS VGEW-SQH / DNP	PV-BS VGEW-SQH / DNP		
Anschlussdose Junction box	1) JL29x / JMTHY 2) GF20xy / Renhe	1) JL29x / JMTHY 2) GF20xy / Renhe		
Bypassdiode Bypass-diode	1) THY2550 JMTHY for Jbox 1) 2) PST4530/T / Renhe for Jbox 2)	1) THY2550 JMTHY for Jbox 1) 2) PST4530/T / Renhe for Jbox 2)		
Anschlussleitung Supply cord	Approved PV cable 1000 V, 4mm ² or Approved PV cable 1500 V, 4mm ²	Approved PV cable 1000 V, 4mm ² or Approved PV cable 1500 V, 4mm ²		
Anschlussstecker Connector	1) PV-KST4(male), PV-KBT4(female) / Multi Contact 2) PV-JM601A(male), PV-JM601A (female) / JMTHY 3) 05-8(male), 05-8(female) / Renhe	1) PV-KST4(male), PV-KBT4(female) / Multi Contact 2) PV-JM601A(male), PV-JM601A (female) / JMTHY 3) 05-8(male), 05-8(female) / Renhe		
Dosenkleber Junction box adhesive	PV-804 / Dow Corning	PV-804 / Dow Corning		

VDE Prüf- und Zertifizierungsinstitut GmbH – VDE-Prüfstelle

VDE Testing and Certification Institute Merianstraße 28, D-63069 Offenbach a.M. Tel. (069) 8306-0 Fax (069) 8306-555

Ausweis Nr.: 40045983 Certificate No.: 40045983

Aktenzeichen: 924214-3972-0001

Aufbau-Übersicht für PV-Module Constructional data for PV-modules			
Beschreibung des AufbausA)B)Description of constructionLGxxxN2W-A5, LGxxxN2C-A5LGxxxN1W-A5, LG-xxxN1C-A5			
Vergussmasse Anschlussdose Potting material J-box	PV-7326 / Dow Corning	PV-7326 / Dow Corning	
Rahmen Frame	Aluminum	Aluminum	
Rahmenkleber <i>Frame adhesive</i>	1) PV-8007 / Dow Corning 2) SS4080 / KCC	1) PV-8007 / Dow Corning 2) SS4080 / KCC	
Weitere Informationen Further information	N/A	N/A	

Offenbach, 2017-03-15

VDE Prüf- und Zertifizierungsinstitut GmbH VDE Testing and Certification Institute Abt./ *Dept*. ET2

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A. Roth