TEST REPORT

UL 1557

Electrically Isolated Semiconductor Devices

Report Number..... :	**HXT240501310860**
Test by (name+signature)..... :	Carl Wang
Compiled by (+signature)..... :	Tim Chen
Approved by (+signature)..... :	Andy Zhang
Date of issue..... :	May ,23 2024
Testing laboratory ..... :	Shenzhen Huaxu Testing Technology Co., Ltd.
Address ..... :	106, building B12, Yintian Industrial Zone, Yantian community, Xixiang street, Bao'an District, Shenzhen
Testing location ..... :	As above
Applicant's name..... :	SHENZHEN GOODWORK ELECTRONICS CO., LTD
Address..... :	Unit 1006-1010, Block C, Digital Innovation Center, 328 Mintang Road, Minzhi Street, Longhua District, Shenzhen, Guangdong
Test specification:	
Standard..... :	UL 1557- 2022
Test procedure..... :	N/A
Non-standard test method……..:	N/A
Test Report Form No..... :	UL1557A
Test Report Form(s) Originator..... :	Hua xu
Master TRF..... :	N/A

Product Name	:	Diodes and triodes
Trade Mark	:	GK
Manufacturer	:	Jiangsu Goodwork Microelectronics Technology Co., LTD
Address	:	Building 1, No. 3 Yancheng Economic and Technological Development Road, Yancheng City, Jiangsu Province
Model/Type reference	:	GBU1010, KBP, GBP, D3K, GBL, KBU, GBU, KBL, KBJ, KBPC, KBPC-W, GBPC, GBPC-W, WOL, WOB, DBS, DB1, UMSB, HBS, ULBF, SMF5.0-440(C)A, SMAJ5.0-440(C)A, SMAFJ5.0-440(C)A, SMBJ5.0-440(C)A, SMCJ5.0-440(C)A, SMDJ5.0-440(C)A, 3.0SMDJ5.0-440(C)A, 5.0SMDJ11-440(C)A, P2KE5.0-440(C)A, P4KE6.8-440(C)A, P6KE6.8-600(C)A, 1.5KE6.8-440(C)A, 5KP5.0-440(C)A, 3KP5.0-440(C)A, P4SMA5.0-440(C)A, P6SMA5.0-440(C)A, P6SMB5.0-440(C)A, SM8S10-43A
Product information	:	1000Vac 10A

Summary of testing:	
Tests performed (name of test and test clause): - UL 1557-2022 The submitted samples were found to comply with the requirements of above specification.	Testing location: Shenzhen Huaxu Testing Technology Co., Ltd. 106, building B12, Yintian Industrial Zone, Yantian community, Xixiang street, Bao'an District, Shenzhen

Test item particulars.....:	
Temperature.....:	23°C±2°C
Relative humidity.....:	≤55%
Atmospheric pressure.....:	(9.0±0.2)kPa
Mass of the equipment (kg).....:	See instruction
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing.....:	
Date of receipt of test item.....:	May 08, 2024
Date (s) of performance of tests.....:	May 08, 2024 to May 23, 2024

General remarks:

The test results presented in this report relate only to the object tested.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

"(See Enclosure #)" refers to additional information appended to the report.

"(See appended table)" refers to a table appended to the report.

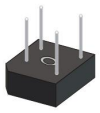
Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

Clause numbers between brackets refer to clauses in EN1557- 2022

Attachment No. 1: photo.

General product information:

1.The product is Diodes and triodes

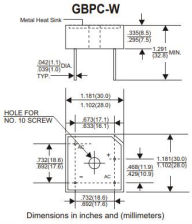


VOLTAGE RANGE
50 to 1000 Volts
CURRENT
50.0 Ampere

FEATURES

* Superior thermal design
* 450 amperes surge capability
* Mounting: Hole thru for #8 screw

GBPC-W



Dimensions in inches and (millimeters)

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating 25℃ ambient temperature unless otherwise specified.
Single phase half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

TYPE NUMBER	GBPC5001W	GBPC5001W	GBPC5002W	GBPC5004W	GBPC5006W	GBPC5008W	GBPC5010W	UNITS
Maximum Recurrent Peak Reverse Voltage	50	100	200	400	600	800	1000	V
Maximum RMS Voltage	35	70	140	280	420	560	700	V
Maximum DC Blocking Voltage	50	100	200	400	600	800	1000	V
Maximum Average Forward Rectified Current .375"(9.5mm) Lead Length at Tc=50℃	50.0							A
Peak Forward Surge Current, 8.3 ms single half sine-wave superimposed on rated load (JEDEC method)	450							A
Maximum Forward Voltage Drop per Bridge Element at25A D.C.	1.2							V
Maximum DC Reverse Current Ta=25℃	10							A
at Rated DC Blocking Voltage Ta=100℃	100							A
Operating Temperature Range, TJ	-65 — +150							℃
Storage Temperature Range, TSTG	-65 — +150							℃

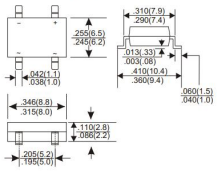
DB201S THRU DB207S
SINGLE PHASE 2.0 AMP SURFACE MOUNT BRIDGE RECTIFIERS

VOLTAGE RANGE
50 to 1000 Volts
CURRENT
2.0 Ampere

FEATURES

* Ideal for printed circuit board
* Reliable low cost construction utilizing molded plastic technique
* High surge current capability
* Polarity: marked on body
* Mounting position: Any
* Weight: 1.0 grams

DB-S



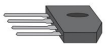
Dimensions in inches and (millimeters)

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating 25℃ ambient temperature unless otherwise specified.
Single phase half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

TYPE NUMBER	DB201S	DB202S	DB203S	DB204S	DB205S	DB206S	DB207S	UNITS
Maximum Recurrent Peak Reverse Voltage	50	100	200	400	600	800	1000	V
Maximum RMS Voltage	35	70	140	280	420	560	700	V
Maximum DC Blocking Voltage	50	100	200	400	600	800	1000	V
Maximum Average Forward Rectified Current .375"(9.5mm) Lead Length at Ta=25℃	2.0							A
Peak Forward Surge Current, 8.3 ms single half sine-wave superimposed on rated load (JEDEC method)	60							A
I^2t Rating for Fusing (1ms < t < 8.3ms)	15							A^2S
Maximum Forward Voltage Drop per Bridge Element at 1.5A D.C.	1.0							V
Maximum DC Reverse Current Ta=25℃	5							μA
at Rated DC Blocking Voltage Ta=125℃	500							μA
Operating Temperature Range, TJ	-65 — +150							℃
Storage Temperature Range, TSTG	-65 — +150							℃

GBU10005 GBU1010 THRU
SINGLE PHASE 10 AMP BRIDGE RECTIFIERS

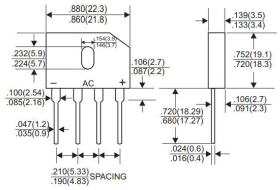


VOLTAGE RANGE
50 to 1000 Volts
CURRENT
10 Amperes

FEATURES

* Ideal for printed circuit board
* Low forward voltage
* Low leakage current
* Polarity: marked on body
* Mounting position: Any

GBU



Dimensions in inches and (millimeters)

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating 25℃ ambient temperature unless otherwise specified.
Single phase half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

TYPE NUMBER	GBU1000S	GBU1001	GBU1002	GBU1004	GBU1006	GBU1008	GBU1010	UNITS
Maximum Recurrent Peak Reverse Voltage	50	100	200	400	600	800	1000	V
Maximum RMS Voltage	35	70	140	280	420	560	700	V
Maximum DC Blocking Voltage	50	100	200	400	600	800	1000	V
Maximum Average Forward Rectified Current .375"(9.5mm) Lead Length at Tc=70℃	10							A
Peak Forward Surge Current, 8.3 ms single half sine-wave superimposed on rated load (JEDEC method)	200							A
Maximum Forward Voltage Drop per Bridge Element at 5.0A D.C.	1.1							V
Maximum DC Reverse Current Ta=25℃	5.0							μA
at Rated DC Blocking Voltage Ta=100℃	500							μA
Operating Temperature Range, TJ	-65 — +150							℃
Storage Temperature Range, TSTG	-65 — +150							℃

SMCJ SERIES
SURFACE MOUNT TRANSIENT VOLTAGE SUPPRESSORS

FEATURES

* For surface mount application
* Built-in strain relief
* Excellent clamping capability
* Low profile package
* Fast response time: Typically less than 1.0ps from 0 volt to BV min.
* Typical Ie less than 1μA above 10V
* High temperature soldering guaranteed: 260℃ / 10 seconds at terminals

MECHANICAL DATA

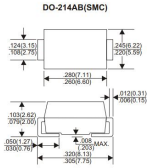
* Case: Molded plastic
* Epoxy: UL 94V-0 rate flame retardant
* Lead: Solderable per MIL-STD-202, method 208 guranteed
* Polarity: Color band denotes cathode end except Bidirectional
* Mounting position: Any
* Weight: 0.21 grams

VOLTAGE RANGE

5.0 to 440 Volts

1500 Watts Peak Power

DO-214AB(SMC)



Dimensions in inches and (millimeters)

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating 25℃ ambient temperature unless otherwise specified.
Single phase half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

RATINGS	SYMBOL	VALUE	UNITS
Peak Power Dissipation at TA=25℃, TP=1ms(NOTE 1)	PPK	Minimum 1500	Watts
Peak Forward Surge Current at 8.3ms Single Half Sine-Wave superimposed on rated load (JEDEC method) (NOTE 3)	IFSM	200	Amps
Maximum Instantenous Forward Voltage at 35.0A for Unidirectional only	VF	3.5	Volts
Typical Thermal Resistance Between junction and case	RθJ-C	15	℃/W
Typical Thermal Resistance Between junction and Air	RθJ-A	75	℃/W
Operating and Storage Temperature Range	TJ, TSTG	-55 to +150	℃

NOTES:
1. Non-repetitive current pulse per Fig. 3 and derated above TA=25℃ per Fig. 2.
2. Mounted on Copper Pad area of 8.0mm²(.013mm Thick) to each terminal.
3. 8.3ms single half sine-wave, duty cycle = 4 pulses per minute maximum.

- "GK" represents the brand name
- "XXX" represents the periodic code
- "YY" represents the product type marking

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
1	Scope		--
2	Components		--
3	Units of Measurement		--
4	Referenced Publications		--
5	Glossary		--
6	CONSTRUCTION		P
6.1	A semiconductor shall be constructed in compliance with Sections 7 – 10.		P
6.2	See Annex A for semiconductor modules that incorporate thermistor type devices.		P
7	Insulating Materials		P
7.1	Encapsulants (e.g. silicone gel), encapsulated materials, and materials that are hermetically sealed		P
7.1.1	Encapsulants (e.g. silicone gel), encapsulated materials, and materials that are hermetically sealedshall be subjected to the Dielectric Voltage-Withstand Test, Section 12, and if the generic temperatureindex of the material is exceeded by the insulating material operating temperature, the Limited Thermal Aging Test, Section 13. The generic thermal index shall be in accordance with the Standard for PolymericMaterials – Long Term Property Evaluations, UL 746B.		P
7.1.2	When the manufacturer's specified storage temperature exceeds the insulating material operating temperature of a device, the storage temperature shall be considered the insulating material operating temperature for the purpose of these requirements.	storage temperature: -65 - +150℃ operating temperature: -65 - +150℃	P
7.1.3	The insulating material operating temperature shall be the rated maximum junction temperature, or shall be the highest rated continuous operating junction temperature if the maximum junction temperature is assigned a duration or duty cycle in addition to a continuous rating, for the following devices:		P

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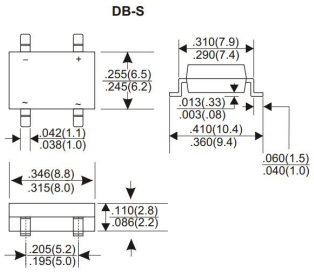
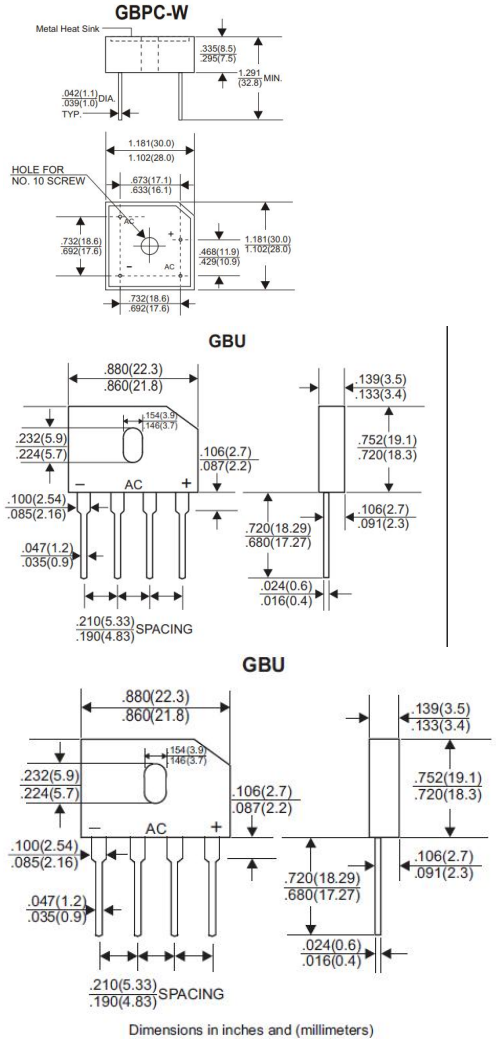
Clause	Requirement + Test	Result - Remark	Verdict
	a) Molded devices that are free-standing (no dedicated mounting surface), see Annex B, Figure B.1 for an example.		N/A
	b) Molded devices that are intended to be mounted to a metal surface in such a way that the heat transfer is done via mold, see Annex B, Figure B.2 for an example.		N/A
	c) Molded devices or frame-based devices that use an insulated metal substrate for heat transfer, where the insulating material of the insulated metal substrate is a polymeric material (may be ceramic filled or glass filled) or printed wiring board material, see Annex B, Figure B.3 and Figure B.7 (respectively) for examples.		P
	d) Framed-based pressure contact semiconductor devices, see Annex B, Figure B.5 for an example.		N/A
7.1.4	The insulating material operating temperature shall be considered the rated case temperature for molded devices or frame-based devices that use ceramic as an insulating material, see Annex B, Figure B.4, Figure B.6 and Figure B.8 for examples.		P
7.1.5	The thermal index of ceramic shall be considered unlimited, therefore the insulating material operating temperature of ceramic is not considered.		P
7.2	Insulating materials other than encapsulants, encapsulated materials, and materials that are hermetically sealed, e.g. case material		P
7.2.1	Insulating materials that are in contact with or less than 0.8 mm (0.031 in) from live parts shall have a CTI in accordance with requirements in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A. The CTI for each insulating material shall be specified by the manufacturer. The CTI shall be specified as a performance level category (i.e. 0, 1, 2, 3, or 4) or specified as an ASTM CTI tracking index range corresponding to the PLC (e.g. 175 – 249, which corresponds to PLC 3). See 16.5 for specification requirements.		N/A

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.2	Insulating materials that are in contact with or less than 0.8 mm (0.031 in) from live parts shall have high current arc resistance to ignition (HAI) in accordance with requirements for in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A and a flammability classification in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. The minimum HAI value shall be in accordance with Table 7.1 based on the material flame class rating.	V-0	P
	<table><tr><th></th><th colspan="2">UL 746A PLC</th></tr><tr><th>UL 94 Flame Class</th><th>HWI</th><th>HAI</th></tr><tr><td>HB</td><td>2</td><td>1</td></tr><tr><td>V-2, VTM-2</td><td>2</td><td>2</td></tr><tr><td>V-1, VTM-1</td><td>3</td><td>2</td></tr><tr><td>V-0, VTM-0</td><td>4</td><td>3</td></tr></table>		P
7.2.3	Insulating materials that are 0.8 mm or farther from live parts shall:		P
	a) Have a high current arc resistance to ignition (HAI) in accordance with requirements in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A and a flammability classification in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94; and the minimum HAI value shall be in accordance with Table 7.1 based on the material flame class rating; or		P
	b) Have a high current arc resistance to ignition (HAI) in accordance with requirements in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A and a flammability classification in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94; and the manufacturer shall specify the flame class and HAI performance level category for each material. See 16.6 for specification requirements; or		P
	c) If the material does not have a flame class or does not have an HAI PLC, the manufacturer shall indicate the material as such. See 16.6 for specification requirements.		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.4	Insulating materials that are in contact with or less than 0.8 mm (0.031 in) from live parts shall:	V-0	P
	a) Have a hot wire ignition (HWI) in accordance with requirements in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A and a flammability classification in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94; and the minimum HWI value shall be in accordance with Table 7.1 based on the material flame class rating; or		P
	b) Have a hot wire ignition (HWI) in accordance with requirements in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A and a flammability classification in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94; and the manufacturer shall specify the flame class and HWI performance level category for each material. See 16.7 for specification requirements; or		P
	c) If the material does not have a flame class or does not have an HWI PLC, the manufacturer shall either comply with the Glow Wire End Product Test of UL 746C and specify the glow-wire temperature (see Table 12.1 of UL 746C) or indicate the material does not have an HWI value. See 16.7 and 16.8 for specification requirements.		P
7.2.5	Insulating materials shall have an electrical thermal index or generic thermal index in accordance with the requirements in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B. The thermal index shall not be less than the device's specified storage temperature. For an insulating material that is also a case material, the thermal index shall not be less than the device's specified case temperature. For other parts, the higher of the electrical relative thermal index or generic thermal index shall be specified. See 16.9 for specification requirements.		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.6	An insulating barrier or liner employed to provide the required declared spacings between uninsulated live parts of opposite polarity and between such parts and any other uninsulated metal parts according to 10.1 shall be at least 0.71 mm (0.028 in), except that 0.33 mm (0.013 in) is acceptable where used in conjunction with an air space of at least one-half of the required clearance.		P
7.2.7	The case or body of a discrete semiconductor device providing isolation to its surroundings shall also comply with the requirements of insulating barrier in 7.2.6.		P
8	Live Parts		P
8.1	Metal employed for current-carrying parts shall be of stainless steel, silver, gold, copper, nickel, aluminum, an alloy of the same, or an equivalent material.		P
9	Wiring Terminals		P
9.1	A semiconductor shall be provided with a means for factory wiring for circuit wiring connections such as wire binding screws, pressure connectors, stud and nut-type connectors, solder connections, quickconnectors, wire leads, or the like.	Solder connections	P
9.2	A quick-connect terminal shall be evaluated as described in the Standard for Electrical QuickConnect Terminals, UL 310.		P
10	Spacings		P
10.1	The following spacings through air and over surface (clearance and creepage respectively) for live parts that are not internal to an encapsulated or hermetically sealed device shall be based on the end product requirement or the device manufacturer shall declare the values. When declared, the spacings shall not be less than those declared.	DB201S-DB207S  Dimensions in inches and (millimeters)	P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
	a) Between uninsulated live parts of opposite polarity; and	 Dimensions in inches and (millimeters)	P
	b) Between uninsulated live parts and any other uninsulated metal parts.		P
	Exception No. 1: The spacing requirements of (a) or (b), above, do not apply between terminals of discrete semiconductor devices. For example, among collector, emitter, and base of a transistor or among anode, cathode, and gate of an SCR, and the like.		P
10.2	If the device manufacturer declares values, see 16.4 for marking requirements.		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
10.3	For a discrete semiconductor device providing isolation to its surroundings, the spacings from any live part on the surface of the device, such as terminals or leads for connection to printed wiring board assemblies, to any adjacent surface shall comply with end product spacings.		P
11	PERFORMANCE		P
11.1	Samples of semiconductors shall be tested as described in the Dielectric Voltage-Withstand Test, Section 12, and the Limited Thermal Aging Test, Section 13.		P
11.2	All testing shall be carried out under ambient laboratory conditions that fall within the ranges noted in the table below		P
	<table><tr><th>Temperature °C (°F)</th><th>Relative Humidity[a] (%)</th><th>Air Pressure[a] kPa (mbar)</th><th>Altitude[a] m (ft)</th></tr><tr><td>15 – 35 (59 – 95)</td><td>25 to 75</td><td>86 to 106 (860 to 1060)</td><td>0 to 2,000 (0 to 6562)</td></tr><tr><td colspan="4">a These values are inclusive.</td></tr><tr><td colspan="4">NOTE: The values are consistent with those of IEC 60068-1</td></tr></table>		P
12	Dielectric Voltage-Withstand Test		P
12.1	Following each of the conditionings indicated in 12.4 – 12.6, a semiconductor device shall be capable of withstanding without breakdown for 60 seconds a 48 – 62 Hz essentially sinusoidal potential equal to the rated isolation rms voltage applied between metal mounting surface and all of the device terminals. For this test, all of the terminals are to be connected together.		P
12.2	The test potential is to be obtained from any convenient source having either a capacity of at least 500 VA or a lower capacity source with the meter connected in the output circuit. The voltage is to be gradually increased until the required test level is reached and is to be held at that value for one minute.The increase in the applied potential is to be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.	500 VA	P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
12.3	The test shall be done as soon as practicable, but within 10 minutes or in a time such that the temperature of the module is no less than the insulating material operating temperature, after the oven conditioning of 12.5. If alternate heating means, such as a heating plate, are used after the modules are removed from the oven to maintain the module temperate at or above the insulating material operating temperature, the tests may be conducted in any convenient time. The test shall be done as soon as practicable following the conditioning in 12.4 and 12.6.		P
12.4	Six samples are to be subjected to the dielectric test procedure in the as-received condition.	After test, No break down	P
12.5	Six samples are to be exposed to the maximum rated junction temperature for 7 hours.	After test, No break down	P
12.6	Six samples are to be exposed to 0.0 ±2.0 °C (32.0 ±3.6 °F) for 7 hours.	After test, No break down	P
12.7	For a discrete semiconductor device providing isolation to its surroundings, all surfaces that do not have dead metal intended for mounting of live parts such as terminals and leads for connection to printed wiring board assemblies shall be tightly wrapped in a conductive foil. The dielectric test shall be conducted between the terminals and conductive foil.		P
13	Limited Thermal Aging Test		P
13.1	Three samples of the material described in 7.1.1 shall be aged in a full-draft circulating-air oven at a temperature and time chosen from Table 13.1 or Table 13.2, using the index line that corresponds to the maximum operating temperature of the insulating material or the maximum storage temperature of the device, whichever is greater. Linear interpolation of Table 13.1 and Table 13.2 is permitted.		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
13.2	As soon as practicable, but within 10 minutes or in a time such that the temperature of the module is no less than the insulating material operating temperature, after this oven conditioning, all three samples of the device shall be capable of withstanding the rated isolation rms voltage when tested as described in 12.1 and 12.2. If alternate heating means, such as a heating plate, are used after the modules are removed from the oven to maintain the module temperate at or above (but within 10 °C [18 °F] of) the insulating material operating temperature throughout the test, the tests of 12.1 and 12.2 may be conducted in any convenient time.		P
13.3	The air oven is to be essentially as indicated in the Standard Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation, ANSI/ASTM D5423 (Type I ovens) and the Standard Test Methods for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation, ANSI/ASTM D5374. A portion of the air may be recirculated, but a substantial amount of fresh air is to be admitted continuously to maintain an essentially normal air content surrounding the samples. The oven is to be adjusted to achieve 5 – 20 complete fresh-air changes per hour.	219℃, 300hours.	P
			--

Aging hours	Required temperature rating °C (°F)							
	105 (221)	110 (230)	115 (239)	125 (257)	130 (266)	140 (284)	150 (302)	155 (311)
	Oven temperature °C (°F)							
300	176 (349)	181 (358)	186 (367)	195 (383)	200 (392)	209 (408)	219 (426)	223 (433)
400	171 (340)	176 (349)	181 (358)	190 (374)	195 (383)	205 (401)	214 (417)	219 (426)
500	168 (334)	172 (342)	177 (351)	187 (369)	191 (376)	201 (394)	210 (410)	215 (419)
600	165 (329)	169 (336)	174 (345)	184 (363)	188 (370)	198 (388)	208 (406)	212 (414)
700	162 (324)	167 (333)	172 (342)	181 (358)	186 (367)	196 (385)	205 (401)	210 (410)
750	161 (322)	166 (331)	171 (340)	180 (356)	185 (365)	195 (383)	204 (399)	209 (408)
800	160 (320)	165 (329)	170 (338)	179 (354)	184 (363)	194 (381)	203 (397)	208 (406)
900	158 (316)	163 (325)	168 (334)	177 (351)	182 (360)	192 (378)	201 (394)	206 (403)
1000	156 (313)	161 (322)	166 (331)	176 (349)	180 (356)	190 (374)	200 (392)	205 (401)
1250	152 (306)	158 (316)	163 (325)	172 (342)	177 (351)	187 (369)	196 (385)	201 (394)
1500	150 (302)	155 (311)	160 (320)	169 (336)	174 (345)	184 (363)	194 (381)	199 (390)
1750	148 (298)	153 (307)	157 (315)	167 (333)	172 (342)	182 (360)	192 (378)	196 (385)
2000	146 (295)	151 (304)	155 (311)	165 (329)	170 (338)	180 (356)	190 (374)	194 (381)
2500	142 (288)	147 (297)	152 (306)	162 (324)	167 (333)	177 (351)	186 (367)	191 (376)
3000	140 (284)	145 (293)	149 (300)	159 (318)	164 (327)	174 (345)	184 (363)	189 (372)
3500	137 (279)	142 (288)	147 (297)	157 (315)	162 (324)	172 (342)	182 (360)	187 (369)

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict

	Aging hours	Required temperature rating °C (°F)							
		105 (221)	110 (230)	115 (239)	125 (257)	130 (266)	140 (284)	150 (302)	155 (311)
		Oven temperature °C (°F)							
	4000	136 (277)	140 (284)	145 (293)	155 (311)	160 (320)	170 (338)	180 (356)	185 (365)
	4500	134 (273)	139 (282)	144 (291)	154 (309)	158 (316)	168 (334)	178 (352)	183 (361)
	5000	132 (270)	137 (279)	142 (288)	152 (306)	157 (315)	167 (333)	177 (351)	182 (360)
	7500	127 (261)	132 (270)	137 (279)	147 (297)	151 (304)	161 (322)	171 (340)	176 (349)
	10000	123 (253)	128 (262)	133 (271)	143 (289)	148 (298)	158 (316)	167 (333)	172(342)
	[a] Linear interpolation of this table is allowed.									--

	Aging hours	Required temperature rating								
		160 (320)	170 (338)	175 (347)	180 (356)	190 (374)	195 (383)	200 (392)	210 (410)	220 (428)
		Oven temperature								
	300	228 (442)	238 (460)	242 (468)	247 (477)	261 (502)	268 (514)	275 (527)	285 (545)	295 (563)
	400	224 (435)	233 (451)	238 (460)	243 (469)	256 (493)	263 (505)	270 (518)	280 (536)	290 (554)
	500	220 (428)	230 (446)	234 (453)	239 (462)	253 (487)	259 (498)	266 (511)	276 (529)	286 (547)
	600	217 (423)	227 (441)	232 (450)	236 (457)	250 (482)	256 (493)	263 (505)	273 (523)	283 (541)
	700	215 (419)	224 (435)	229 (444)	234 (453)	247 (477)	254 (489)	260 (500)	271 (520)	281 (538)
	750	214 (417)	223 (433)	228 (442)	233 (451)	246 (475)	253 (487)	259 (498)	269 (516)	280 (536)
	800	213 (415)	222 (432)	227 (441)	232 (450)	245 (473)	252 (486)	258 (496)	268 (514)	278 (532)
	900	211 (412)	221 (430)	225 (437)	230 (446)	243 (469)	250 (482)	256 (493)	266 (511)	276 (529)
	1000	209 (408)	219 (426)	224 (435)	229 (444)	242 (468)	248 (478)	255 (491)	265 (509)	275 (527)
	1250	206 (403)	216 (421)	221 (430)	226 (439)	238 (460)	245 (473)	251 (484)	261 (502)	271 (520)
	1500	203 (397)	213 (415)	218 (424)	223 (433)	235 (455)	242 (468)	248 (478)	258 (496)	268 (514)
	1750	201 (394)	211 (412)	216 (421)	221 (430)	233 (451)	239 (462)	245 (473)	256 (493)	266 (511)	--

	Aging hours	Required temperature rating								
		160 (320)	170 (338)	175 (347)	180 (356)	190 (374)	195 (383)	200 (392)	210 (410)	220 (428)
		Oven temperature								
	2000	199 (390)	209 (408)	214 (417)	219 (426)	231 (448)	237 (459)	243 (469)	253 (487)	264 (507)
	2500	196 (385)	206 (403)	211 (412)	216 (421)	228 (442)	234 (453)	240 (464)	250 (482)	260 (500)
	3000	194 (381)	203 (397)	208 (406)	213 (415)	225 (437)	231 (448)	237 (459)	247 (477)	257 (495)
	3500	191 (376)	201 (394)	206 (403)	211 (412)	223 (433)	229 (444)	235 (455)	245 (473)	255 (491)
	4000	190 (374)	199 (390)	204 (399)	209 (408)	221 (430)	227 (441)	233 (451)	243 (469)	253 (487)
	4500	188 (370)	198 (388)	203 (397)	208 (406)	219 (426)	225 (437)	231 (448)	241 (466)	251 (484)
	5000	187 (369)	196 (385)	201 (394)	206 (403)	218 t(424)	224 (435)	229 (444)	239 (462)	249 (480)
	7500	181 (358)	191 (376)	196 (385)	201 (394)	212 (414)	218 (424)	223 (433)	233 (451)	243 (469)
	10000	177 (351)	187 (369)	192 (378)	197 (387)	208 (406)	214 (417)	219 (426)	229 (444)	239 (462)
	[a] Linear interpolation of this table is allowed.									--

	MANUFACTURING AND PRODUCTION-LINE TEST		--
14	Dielectric Voltage-Withstand Test		--
14.1	Each product shall withstand without electrical breakdown, as a routine production-line test, the application of a potential at a frequency within the range of 40 – 70 Hz between live parts and accessible dead metal parts.		--
14.2	The production-line test potential shall be the rated isolation rms voltage for 60 seconds or 120 % of the rated isolation rms voltage for one second.		--
	a) 1.414 times the rated isolation rms voltage for one minute, or b) 1.414 X 1.2 times the rated isolation rms voltage for one second.	1410V, 60Hz, 1mins	--

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
14.3	The product may be in a heated or unheated condition for the test.		--
14.4	For an ac test, the test equipment shall include a transformer having an essentially sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic feature that rejects any unacceptable unit.		--
14.5	If the output of the test-equipment transformer is less than 500 VA, the equipment shall include a voltmeter in the output circuit to indicate the test potential directly.		--
	If the output of the test-equipment transformer is 500 VA or more, the test potential may be indicated: a) By a voltmeter in the primary circuit; b) By a selector switch marked to indicate the test potential; or c) In the case of test equipment that has a single output potential, by a marking in a readily visible location to indicate the test potential.		--
	When marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.		--
14.7	Test equipment other than that described in 14.4 – 14.6, may be used if found acceptable to accomplish the intended factory control.		--
14.8	During the test, the terminals are to be connected together and to one terminal of the equipment, and the second test-equipment terminal is to be connected to accessible dead metal.		--
	RATING		P
15.1	Each device shall be rated in maximum ON-state current.		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
	Each device shall have either: a) A curve of ON-state or forward current versus case temperature; or b) A maximum case temperature		P
15.3	Each device shall be provided with an rms isolation-voltage rating according to 12.1. This rating shall state clearly if the isolation-voltage rating applies to a mounting surface or to the device surroundings, or both. If the isolation is provided to the device surroundings, this may be stated as a case insulation-voltage rating or similar.		P
15.4	Each device shall have a rated maximum junction temperature. Modules containing multiple semiconductor devices shall have a rated maximum junction temperature for each type of semiconductor.		P
15.5	Each device shall have a maximum storage temperature.		P
	MARKING		P
16.1	Each device shall be marked with the manufacturer's name or trademark and model number. This marking shall appear on the device itself or on the smallest shipping carton in which the devices are shipped.		P
16.2	The terminals shall be identified to indicate their function. This marking shall appear on the device or the marking shall be provided as part of the manufacturer's specifications		P
16.3	Ratings according to Section 15 and the installation instructions shall be provided in the manufacturer's specifications.		P
16.4	If the manufacturer declares the spacing value in accordance with 10.2, the installation instructions or specification/data sheet shall specify between which parts or circuits the spacings apply and the minimum spacing, either as through air or over surface, or clearance or creepage respectively.		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
16.5	The CTI shall be provided as part of the manufacturer's specifications. Where the CTI for more than one part is required and the CTI values are different, the manufacturer shall specify each CTI by part or shall specify the lowest CTI (in reference to performance).		N/A
16.6	When required by 7.2.3(b), the manufacturer shall specify the flame class and HAI PLC for the material. Where the HAI for more than one part is required and the HAI values are different, the manufacturer shall specify each HAI by part or shall specify the lowest HAI (in reference to performance). When a material does not have a flame class or does not have an HAI PLC in reference to 7.2.3(c), the manufacturer shall specify "HAI: –" or similar for that material.		N/A
16.7	When required by 7.2.4(b), the manufacturer shall specify the flame class and HWI PLC for the material. Where the HWI for more than one part is required and the HWI values are different, the manufacturer shall specify each HWI by part or shall specify the lowest HWI (in reference to performance). When a material does not have a flame class or does not have an HWI PLC in accordance with 7.2.5(c), the manufacturer shall specify "HWI: –" or similar for that material.		N/A
16.8	When the manufacturer conducts the glow-wire end product test in accordance with 7.2.5(c), the manufacturer shall specify the glow-wire temperature used for the test.		N/A
16.9	In accordance with 7.2.5, for parts other than the case, the manufacturer shall specify the insulating material thermal index.		N/A
ANNEX A	SEMICONDUCTOR DEVICES INCORPORATING THERMISTOR TYPE DEVICES		N/A
A1	Scope		N/A

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
A1.1	These requirements cover semiconductor devices that incorporate sensing type thermistor devices and include the optional marking as in A5.1. The semiconductor device shall comply with the requirements in Sections 6 – 16, inclusive supplemented by and in some cases amended by the requirements in this Annex.	No NTC or PTC	N/A
A2	Glossary		N/A
A3	Termistor Type Devices		N/A
A3.1	When marked as in A5.1 the electrically isolated semiconductor device shall incorporate a sensing thermistor type device that complies with the Standard for Thermistor Type Devices, UL 1434. The thermistor shall be suitable for use in safety circuits and have a calibration class of C4 or better.		N/A
A4	Rating		N/A
A4.1	When marked as in A5.1, each electrically isolated semiconductor device shall be provided with the complete electrical rating of the thermistor type device contained in the device per Table A4.1.		N/A
	Thermistor type[a] Characteristic / PTC[b] / NTC[b] Beta value (β) / – / X[c] Calibration class number / R / R Resistance – R_{25} and tolerance / R / R Temperature – maximum operating ambient / R / R Temperature – switching (T_{SW}) or trip (T_T) / R / – Voltage – insulation rating / R[d] / R[d] Notes: 1 The "R" designation indicates ratings for the device that are required to be provided by the manufacturer. 2 The "X" designation indicates characteristics of the device that the manufacturer shall declare and is verified by testing. [a] These apply to sensing type thermistors only. The range of ambient temperature shall be specified. [b] The range of ambient temperature shall be specified. [c] A beta value (ß) is not required. [d] For devices declared by the manufacturer as insulated.		N/A
A5	Marking		N/A
A5.1	When employing a thermistor type device evaluated to the Standard for Thermistor Type Devices, UL 1434, the electrically isolated semiconductor may be marked "Provided with a UL 1434 Thermistor Type Device". This marking shall appear on the electrically isolated semiconductor itself or on the smallest shipping carton in which the devices are shipped.		N/A

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
A5.2	When marked as in A5.1, the electrically isolated semiconductor device shall be marked with the complete electrical ratings of the thermistor type device per Rating, Section A4. This marking shall appear on the electrically isolated semiconductor or the marking shall be provided as part of the manufacturer's specifications.		N/A
ANNEX B	EXAMPLES OF SEMICONDUCTOR DEVICE CONSTRUCTIONS		P
	The figures in this Annex are intended to provide reference for specific device construction requirements used in the body of this standard.		P
ANNEX C	END PRODUCT SPACING REQUIREMENTS		P
C1	Scope		P
C1.1	This is an informative annex summarizing requirements for spacings (clearances and creepages) from the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840 and Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests, IEC 60664-1, which are standards most commonly referenced for spacings in end products that typically use semiconductor devices or modules.		P
C1.2	This annex is a summary of requirements intended for general reference only. It does not contain all requirements from either standard. Furthermore, end product standards may modify, delete, or add to the requirements of either of these standards for application to the end product. This annex does not take into account additions, deletions, or modifications to requirements in end product standards.		P
C2	Glossary		--
C3	Spacings based on UL 840		P

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict

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Phase-to-ground[b] rated system voltage (rms and dc)				Rated impulse withstand voltage peak, kV[d]	Clearance, mm[a]			
Overvoltage category[c]					Pollution degree[f]			
I	II	III	IV		1	2	3	4
50	–	–	–	0.33	0.01	0.2	0.8	1.6
100	50	–	–	0.50	0.04	0.2	0.8	1.6
150	100	50	–	0.80	0.10	0.2	0.8	1.6
300	150	100	50	1.5	0.5	0.5	0.8	1.6
600	300	150	100	2.5	1.5	1.5	1.5	1.6
1000	600	300	150	4.0	3.0	3.0	3.0	3.0
1500	1000	600	300	6.0	5.5	5.5	5.5	5.5
–	1500	1000	600	8.0	8.0	8.0	8.0	8.0
–	–	1500	1000	12.0	14.0	14.0	14.0	14.0
–	–	–	1500	16.0	19.4	19.4	19.4	19.4

[a] The minimum values for pollution degrees 2, 3, and 4 are premised on the concept that pollution which may be present in these micro-environments may bridge small clearances.

[b] For ungrounded systems or systems with one phase grounded, the phase-to-ground voltage is considered to be the same as the phase-to-phase voltage for the purposes of using this table.

[c] Typical examples of categories for products are given below. Users of this standard will need to establish that rated impulse voltage values are appropriate for the expected applications of the products covered.

Category IV – Primary Supply Level. Overhead lines and cable systems including distribution and its associated overcurrent protective equipment (equipment installed at the service entrance).

Category III – Distribution Level. Fixed wiring and associated equipment (not electrical loads) connected to the primary supply level, Category IV.

Category II – Load Level. Appliances and portable equipment and the like connected to the distribution level, Category III.

Category I – Signal Level. Special equipment or parts of equipment such as low-voltage electronic logic systems, remote controls, signaling and power limited (per NEC Article 725) circuits connected to the load level, Category II.

[d] Value to use based on the rating of the overvoltage protection means.

[e] Linear interpolation of the values is permitted.

[f] See C3.1.2.

C3.2	Creepages		P

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Operating voltage, volts ac rms or dc[d]	Creepage distances for equipment subject to long-term stress, mm										
	Pollution degree 1	Pollution degree 2			Pollution degree 3				Pollution degree 4		
	All material groups	Material group[b]			Material group[b]				Material group[b]		
		I	II	IIIa,b	I	II	IIIa	IIIb	I	II	IIIa
10	0.08	0.4	0.4	0.4	1.0	1.0	1.0	1.0	1.6	1.6	1.6
12.5	0.09	0.42	0.42	0.42	1.05	1.05	1.05	1.05	1.6	1.6	1.6
16	0.1	0.45	0.45	0.45	1.1	1.1	1.1	1.1	1.6	1.6	1.6
20	0.11	0.48	0.48	0.48	1.2	1.2	1.2	1.2	1.6	1.6	1.6
25	0.125	0.5	0.5	0.5	1.25	1.25	1.25	1.25	1.7	1.7	1.7
32	0.14	0.53	0.53	0.53	1.3	1.3	1.3	1.3	1.8	1.8	1.8
40	0.16	0.56	0.8	1.1	1.4	1.6	1.8	1.8	1.9	2.4	3.0
50	0.18	0.6	0.85	1.2	1.5	1.7	1.9	1.9	2.0	2.5	3.2
63	0.2	0.63	0.9	1.25	1.6	1.8	2.0	2.0	2.1	2.6	3.4
80	0.22	0.67	0.95	1.3	1.7	1.9	2.1	2.1	2.2	2.8	3.6
100	0.25	0.71	1.0	1.4	1.8	2.0	2.2	2.2	2.4	3.0	3.8
125	0.28	0.75	1.05	1.5	1.9	2.1	2.4	2.4	2.5	3.2	4.0
160	0.32	0.8	1.1	1.6	2.0	2.2	2.5	2.5	3.2	4.0	5.0
200	0.42	1.0	1.4	2.0	2.5	2.8	3.2	3.2	4.0	5.0	6.3
250	0.56	1.25	1.8	2.5	3.2	3.6	4.0	4.0	5.0	6.3	8.0
320	0.75	1.6	2.2	3.2	4.0	4.5	5.0	5.0	6.3	8.0	10.0
400	1.0	2.0	2.8	4.0	5.0	5.6	6.3	6.3	8.0	10.0	12.5
500	1.3	2.5	3.6	5.0	6.3	7.1	8.0	8.0	10.0	12.5	16.0
630	1.8	3.2	4.5	6.3	8.0	9.0	10.0	10.0	12.5	16.0	20.0
800	2.4	4.0	5.6	8.0	10.0	11.0	12.5	c	16.0	20.0	25.0
1000	3.2	5.0	7.1	10.0	12.5	14.0	16.0	c	20.0	25.0	32.0
1250	4.2	6.3	9.0	12.5	16.0	18.0	20.0	c	25.0	32.0	40.0
1600	5.6	8.0	11.0	16.0	20.0	22.0	25.0	c	32.0	40.0	50.0
2000	7.5	10.0	14.0	20.0	25.0	28.0	32.0	c	40.0	50.0	63.0
2500	10.0	12.5	18.0	25.0	32.0	36.0	40.0	c	50.0	63.0	80.0
3200	12.5	16.0	22.0	32.0	40.0	45.0	30.0	c	63.0	80.0	100.0
4000	16.0	20.0	28.0	40.0	50.0	56.0	63.0	c	80.0	100.0	125.0
5000	20.0	25.0	36.0	50.0	63.0	71.0	80.0	c	100.0	125.0	160.0
6300	25.0	32.0	45.0	63.0	80.0	90.0	100.0	c	125.0	160.0	200.0
8000	32.0	40.0	56.0	80.0	100.0	110.0	125.0	c	160.0	200.0	250.0
10000	40.0	50.0	71.0	100.0	125.0	140.0	160.0	c	200.0	250.0	320.0

[a] Linear interpolation of the values is permitted.

[b] See C3.2.2.

[c] Material group IIIb shall not be used for application in pollution degree 3 above 630 volts.

[d] It is appreciated that tracking or erosion will not occur on insulation subjected to a working voltage of 32 volts and below. However, the possibility of electrolytic corrosion has to be considered, and for this reason, minimum creepages have been specified.

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Operating voltage, volts ac rms or dc	Minimum creepage, mm	
	Pollution degree	
	1[b]	2[c]
10 – 50	0.025	0.04
63	0.04	0.063
80	0.063	0.1
100	0.1	0.16
125	0.16	0.25
160	0.25	0.4
200	0.4	0.63
250	0.56	1.0
320	0.75	1.6
400	1.0	2.0
500	1.3	2.5
630	1.8	3.2
800	2.4	4.0
1000	3.2	5.0

[a] Use Table C.2 for pollution degrees 3 and 4.

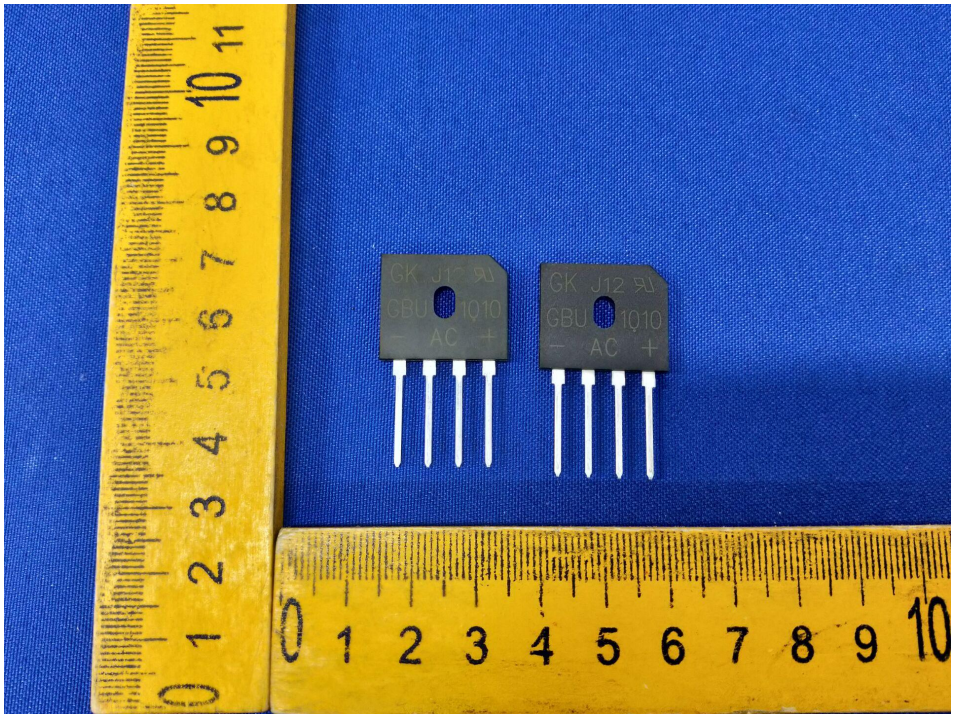
[b] Material Groups I, II, IIIa, IIIb.

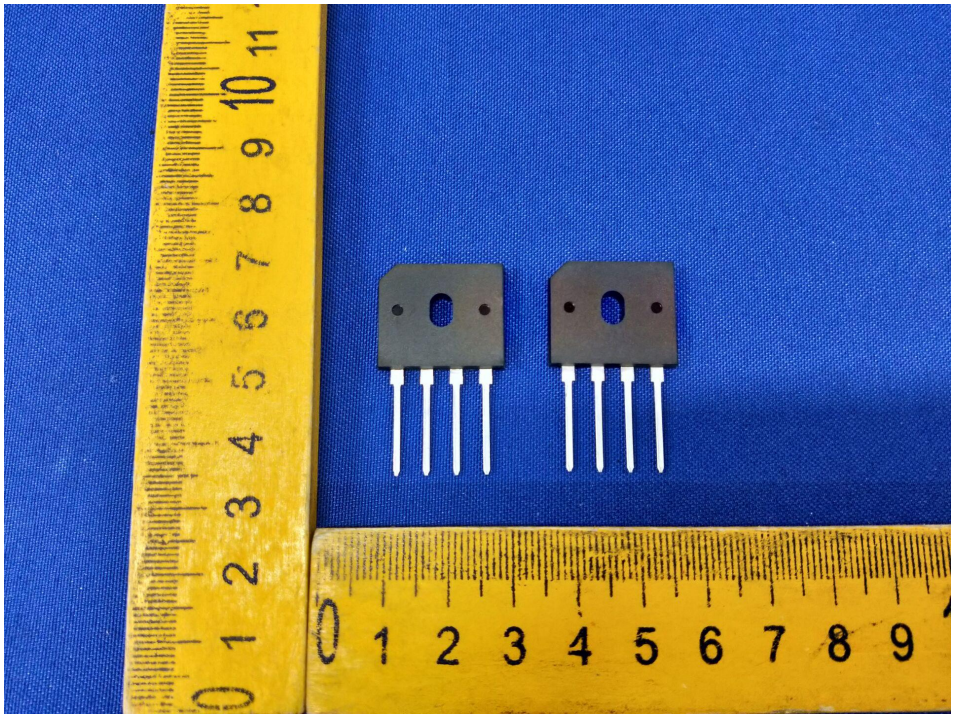
[c] Material Groups I, II, IIIa. For Material Group IIIb use Table C.2.

[d] Linear interpolation of the values is permitted.

EN 1557			
Clause	Requirement + Test	Result - Remark	Verdict
C3.2.2	The material groups of Table C.2 and Table C.3 are related to the CTI performance level category values of insulating materials that are specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, to be included in the group, as follows: Material Group: I – CTI ⩾ 600 (PLC = 0) II – 400 ⩽ CTI < 600 (PLC = 1) IIIa – 175 ⩽ CTI < 400 (PLC = 2 or 3) IIIb – 100 ⩽ CTI < 175 (PLC = 4)		P
C4	IEC 60664-1 Spacing Requirements		P
	The requirements of UL 840 and IEC 60664-1 are very similar, with UL 840 taking a more simplified approach. The requirements for clearances and creepages for Section C3 are considered representative of IEC 60664-1 with the following additional considerations.		P

Photos





*******End of the Report*******