

# PCN

## AO-PCN-2022-015-A

### Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

01.07.2022

Dear Customer,

please review this **PCN** and provide your feedback in the **Customer approval form** (at the end of this PCN document) to your ams OSRAM sales partner before **05.08.2022** \*).

Please take note, that this PCN is published for the introduction of **additional source(s)**.

Your prompt reply will help ams OSRAM to assure a smooth and well executed transition. If ams OSRAM does not hear from your side by the due date, we will assume your (if you are a Distributor: and your customer's) full acceptance to this proposed change and its implementation.

ams OSRAM understands the time requirements your organization needs to approve this PCN. However, if you can provide ams OSRAM an estimated date your organization will have finalized this PCN review, ams OSRAM can use this date to plan continued production to secure your order needs during the expansion with additional source(s).

Your attention and response to this matter is highly appreciated.

**Please direct your inquiries to your local Sales office.**

\*) ams OSRAM aligns with the widely recognized JEDEC/ECIA/IPC Joint Standard No. 46, which stipulates:

- Customers should acknowledge receipt of the PCN within 30 days of delivery of the PCN.
- Lack of acknowledgement of the PCN within 30 days constitutes acceptance of the change.
- After acknowledgement, lack of additional response within the 90 day period constitutes acceptance of the change. If the customer requires additional time to perform sample testing, beyond the 90 day review period, an extension must be negotiated with the supplier.

|   |  |  |
|---|--|--|
| <b>Subject of change:</b>   | Introduction of 2 <sup>nd</sup> source for classic InGaAlP chip for PointLED and additional location for released plater   |  |
| <b>Affected products:</b>   | <b>Standard:</b><br>LO P476<br><b>Low current:</b><br>LS P47K, LO P47K, LY P47K, LG P47K   |  |
| <b>Reason for change:</b>   | <ul style="list-style-type: none"> <li>• Secure continuous supply</li> <li>• Introduction of additional supplier chips</li> <li>• Introduction of additional production location of released plater</li> </ul> |  |
| <b>Description of change:</b>   | <u>Current status</u>  | <u>New status</u>  |
|   | Inhouse chips  | Inhouse chips + 2 <sup>nd</sup> (and 3 <sup>rd</sup> ) source chips provided by supplier(s)  |
|   | Plater location: Wuxi/China  | Plater location: Wuxi & Shanghai/China (same provider as currently)  |
|   | For details refer to file 2_cip_AO-PCN-2022-015-A  |  |
| <b>Time schedule for PCN material:</b><br>(after implementation of change): | Final qualification report:  | 01.08.2022   |
|   | Samples available:   | 01.08.2022 <sup>*)</sup><br><small>*) For details refer to file 2_cip_AO-PCN-2022-015-A</small>  |
|   | Intended Start of delivery:  | 01.12.2022 <sup>**)</sup><br><small>***) or earlier if released by customer and upon mutual agreement</small>  |
|   | Customer Review Finalization:  | 01.07.2023 <sup>***)</sup><br><small>***) Expected final feedback of customer. Released order volume is related to deliveries of material from both previous and additional source(s).</small> |
| <b>Assessment:</b>  | <b>No change in fit, form and reliability → no change in Datasheets</b>  |  |
| <b>Documentation:</b>   | Customer information package 2_cip_AO-PCN-2022-015-A<br>3_cip_AO-PCN-2022-015-A_Qual   |  |

**Note:**

Pre-PCN material: Products of current status, means before implementation of the changes as described in the PCN.

PCN material: Products with implementation of the changes as described in the PCN.

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## Customer approval form AO-PCN-2022-015-A

### Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

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Please list product(s) affected in your application(s):

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Please check the appropriate box below:

- |  |   |
|--|---|
| <input type="radio"/> <b>Approval:</b><br>We agree with the proposed change and accept start of the shipment upon availability of PCN material | <input type="radio"/> <b>Not relevant:</b><br>Change is not relevant for products in use. |
|--|---|

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**Change cannot be accepted:**

- We have objections:**
- We request following Information:**
- We request following Samples:**
- Expected approval date:**
- Volume requirements for Pre-PCN material:**

---

**Remarks:**

---

**Sender:**

---

**Company:**

---

**Address / Location:**

---

**Signature:**

**Date:**

---

Please return this approval form to your Sales partner.

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PCN

AO-PCN-2022-015-A

Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

Customer information package

S&MK EM FQE/OS Q CQM A ITR  
2022-07-01

# Agenda

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# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED





### Reason for change

| Item | Description   |
|------|---|
| 1.   | Secure continuous supply  |
| 2.   | Introduction of additional supplier chips                         |
| 3.   | Introduction of additional production location of released plater |
|      |   |
|      |   |
|      |   |
|      |   |
|      |   |
|      |   |
|      |   |

# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### Description of change for standard chips


| Item                                    | Current status  | 2 <sup>nd</sup> source chip A   | 2 <sup>nd</sup> source chip B   | 2 <sup>nd</sup> source chip C   |
|---|---|---|---|---|
| Wafer size [mm]                         | 100   | 100   |   |   |
| Wafer substrate                         | GaAs  | GaAs  |   |   |
| Height [ $\mu\text{m}$ ]                | 220   | 180   |   |   |
| Chip dicing process                     | Sawing  | Sawing  |   |   |
| Picture (schematic)                     |  |  |  |  |
| Chip size [ $\mu\text{m}$ ]             | 200 x 200   | 200 x 200   | 180 x 180   | 180 x 180   |
| Front metal type                        | Al  | Au  |   |   |
| Front metal thickness [ $\mu\text{m}$ ] | 1.5   | 2.25 - 2.9  |   |   |
| Back metal type                         | Au  | Au  |   |   |
| Back metal thickness [ $\mu\text{m}$ ]  | 0.25  | 0.05 - 0.50   |   |   |
| Bond pad size [ $\mu\text{m}$ ]         | 100   | 100   |   |   |



# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### Description of change for low current chips

| Item                                    | Current status  | 2 <sup>nd</sup> source chip D   | 2 <sup>nd</sup> source chip E   |
|---|---|---|---|
| Wafer size [mm]                         | 100   | 100   |   |
| Wafer substrate                         | GaAs  | GaAs  |   |
| Height [ $\mu\text{m}$ ]                | 190   | 180   |   |
| Chip dicing process                     | Sawing  | Sawing  |   |
| Picture (schematic)                     |  |  |  |
| Chip size [ $\mu\text{m}$ ]             | 170 x 170   | 160 x 160   | 170 x 170   |
| Front metal type                        | Al  | Au  |   |
| Front metal thickness [ $\mu\text{m}$ ] | 1.5   | 2.25-2.9  |   |
| Back metal type                         | Au  | Au  |   |
| Back metal thickness [ $\mu\text{m}$ ]  | 0.25  | 0.35-0.50   |   |
| Bond pad size [ $\mu\text{m}$ ]         | 100   | 90  | 100   |

# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### Description of change for all devices

| Current status                 | New status   |
|--------------------------------|--|
| Plater location:<br>Wuxi/China | Plater location:<br>Wuxi & Shanghai/China (same provider as currently) |

# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### Changes in the datasheets

No change in fit, form and function of affected devices → no change in Datasheets

# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### List of affected products

| Brand    | Standard | Low current |
|----------|----------|-------------|
| PointLED | LO P476  | LS P47K     |
|          |          | LO P47K     |
|          |          | LY P47K     |
|          |          | LG P47K     |
|          |          |             |



Due to complexity not all device/chip source combinations will be available at start of series production.

# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### PCN Samples

| Standard | Low current |
|----------|-------------|
| LO P476  | LS P47K     |
|          | LO P47K     |
|          | LY P47K     |
|          | LG P47K     |

Color code:  available from 01.08.2022  on request

# AO-PCN-2022-015-A

## Introduction of 2<sup>nd</sup> source for classic InGaAlP chip for PointLED

### Time schedule

| for PCN material ( <u>after</u> implementation of change): |                |   |
|--|----------------|---|
| Final qualification report                                 | 01.08.2022     |   |
| Samples available  | 01.08.2022     |   |
| Intended Start of delivery                                 | 01.12.2022*)   | *) or earlier if released by customer and upon mutual agreement   |
| Customer Review Finalization:                              | 01.07.2023 **) | ***) Expected final feedback of customer. Released order volume is related to deliveries of material from both previous and additional source(s). |

Note:

PCN material: Products with implementation of the changes as described in the PCN.

Sensing is life

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# Qualification Results overview 220120C1

|                              |  |
|------------------------------|--|
| Subject                      | Qualification for 2nd source Chip introduction for classic InGaAlP PointLED devices                          |
| Date                         | 01.07.2022   |
| Tested device                | Chip A: LO P476<br>Chip B: LO P476<br>Chip C: LS P47K, LY P47K, LG P47K<br>Chip D: LS P47K, LO P47K, LG P47K |
| Brand (including sub brands) | PointLED   |
| Applies to                   | LO P476, LG P47K, LO P47K, LS P47K, LY P47K  |



Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102 AEC-Q102 #A1

LO P476 (Chip A)

| Test Performed   | Condition  | Duration | Sample Size | Failures                    |                             |                             |
|--|--|----------|-------------|-----------------------------|-----------------------------|-----------------------------|
|  |  |          |             | El.                         | Opt.                        | Vis                         |
|  |  |          |             | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E0</small> |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2a<br/>Test PCB: IMS-AI</small> | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 95^\circ\text{C}$ ; $T_j = 110^\circ\text{C}$<br>$I_F = 30\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 3x26        | 0                           | 0                           | 0                           |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2b<br/>Test PCB: FR4</small>    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 3x26        | 0                           | 0                           | 0                           |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br><small>AEC-Q102 #A3a<br/>Test PCB: IMS-AI</small>              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 3x26        | 0                           | 0                           | 0                           |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br><small>AEC-Q102 #A4a<br/>Test PCB: FR4</small>                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 3x26        | 0                           | 0                           | 0                           |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br><small>AEC-Q102 #B1a<br/>Test PCB: IMS-AI</small>      | $T_A = 85^\circ\text{C}$ ; $T_s = 95^\circ\text{C}$<br>$T_j = 110^\circ\text{C}$ ; $I_F = 30\text{ mA}$  | 1000 h   | 3x26        | 0                           | 0                           | 0                           |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br><small>AEC-Q102 #B3<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$<br>$I_F = 80\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 3x26        | 0                           | 0                           | 0                           |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br><small>AEC-Q102#C7<br/>Test PCB: FR4</small>  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 3x26        | 0                           | 0                           | 0                           |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br><small>AEC-Q102 #C10</small>   | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 3x10        | -                           | -                           | 0                           |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br><small>AEC-Q102 #C12<br/>Test PCB: FR4</small>                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 3x26        | 0                           | 0                           | 0                           |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br><small>AEC-Q102 #C13<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 3x26        | 0                           | 0                           | 0                           |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br><small>AEC-Q102 #C14<br/>Test PCB: FR4</small>                           | 2 mm   | 1x       | 3x10        | 0                           | 0                           | 0                           |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br><small>AEC-Q102 #E3<br/>Test PCB: FR4</small>        | Human Body Model   | 2000 V   | 3x10        | 0                           | 0                           | 0                           |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 3x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition  | Duration | Sample Size | Failures |      |     |
|-------------------------------|--|----------|-------------|----------|------|-----|
|                               |  |          |             | El.      | Opt. | Vis |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Machine Model<br>Test PCB: FR4 | 200 V    | 3x10        | 0        | 0    | 0   |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 20$ mA)                                     | $> 2,35$ V; $\pm 10\%$ from initial value                   |
| Optical failures:    | $I_v$ ( $I_f = 20$ mA)<br>$\lambda_{dom}$ ( $I_f = 20$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                      |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.

Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102 AEC-Q102 #A1

LO P476 (Chip B)

| Test Performed   | Condition  | Duration | Sample Size | Failures     |              |              |
|--|--|----------|-------------|--------------|--------------|--------------|
|  |  |          |             | EI.          | Opt.         | Vis          |
|  |  |          |             | AEC-Q102 #E1 | AEC-Q102 #E1 | AEC-Q102 #E0 |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br>AEC-Q102 #A2a<br>Test PCB: IMS-AI | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 95^\circ\text{C}$ ; $T_j = 110^\circ\text{C}$<br>$I_F = 30\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 3x26        | 0            | 0            | 0            |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br>AEC-Q102 #A2b<br>Test PCB: FR4    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 3x26        | 0            | 0            | 0            |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br>AEC-Q102 #A3a<br>Test PCB: IMS-AI              | $T_A = -40^\circ\text{C}/+85^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 110^\circ\text{C}$<br>$I_F = 30\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 3x26        | 0            | 0            | 0            |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br>AEC-Q102 #A4a<br>Test PCB: FR4                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 3x26        | 0            | 0            | 0            |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br>AEC-Q102 #B1a<br>Test PCB: IMS-AI      | $T_A = 85^\circ\text{C}$ ; $T_s = 100^\circ\text{C}$<br>$T_j = 115^\circ\text{C}$ ; $I_F = 30\text{ mA}$   | 1000 h   | 3x26        | 0            | 0            | 0            |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br>AEC-Q102 #B3<br>Test PCB: FR4                      | $T_A = 25^\circ\text{C}$<br>$I_F = 80\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 3x26        | 0            | 0            | 0            |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br>AEC-Q102#C7<br>Test PCB: FR4  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 3x26        | 0            | 0            | 0            |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br>AEC-Q102 #C10  | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 3x10        | -            | -            | 0            |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br>AEC-Q102 #C12<br>Test PCB: FR4                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 3x26        | 0            | 0            | 0            |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br>AEC-Q102 #C13<br>Test PCB: FR4                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 3x26        | 0            | 0            | 0            |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br>AEC-Q102 #C14<br>Test PCB: FR4                           | 2 mm   | 1x       | 3x10        | 0            | 0            | 0            |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br>AEC-Q102 #E3<br>Test PCB: FR4        | Human Body Model   | 2000 V   | 3x10        | 0            | 0            | 0            |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 3x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition  | Duration | Sample Size | Failures |      |     |
|-------------------------------|--|----------|-------------|----------|------|-----|
|                               |  |          |             | El.      | Opt. | Vis |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Machine Model<br>Test PCB: FR4 | 200 V    | 3x10        | 0        | 0    | 0   |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 20$ mA)                                     | > 2,35 V; $\pm 10\%$ from initial value                     |
| Optical failures:    | $I_v$ ( $I_f = 20$ mA)<br>$\lambda_{dom}$ ( $I_f = 20$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                      |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.

Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102 AEC-Q102 #A1

LS P47K (Chip C)

| Test Performed   | Condition  | Duration | Sample Size | Failures     |              |              |
|--|--|----------|-------------|--------------|--------------|--------------|
|  |  |          |             | EI.          | Opt.         | Vis          |
|  |  |          |             | AEC-Q102 #E1 | AEC-Q102 #E1 | AEC-Q102 #E0 |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br>AEC-Q102 #A2a<br>Test PCB: IMS-AI | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 95^\circ\text{C}$ ; $T_j = 110^\circ\text{C}$<br>$I_F = 20\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 1x26        | 0            | 0            | 0            |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br>AEC-Q102 #A2b<br>Test PCB: FR4    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 1x26        | 0            | 0            | 0            |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br>AEC-Q102 #A3a<br>Test PCB: IMS-AI              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 1x26        | 0            | 0            | 0            |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br>AEC-Q102 #A4a<br>Test PCB: FR4                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 1x26        | 0            | 0            | 0            |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br>AEC-Q102 #B1a<br>Test PCB: IMS-AI      | $T_A = 85^\circ\text{C}$ ; $T_s = 95^\circ\text{C}$<br>$T_j = 110^\circ\text{C}$ ; $I_F = 20\text{ mA}$  | 1000 h   | 1x26        | 0            | 0            | 0            |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br>AEC-Q102 #B3<br>Test PCB: FR4                      | $T_A = 25^\circ\text{C}$<br>$I_F = 50\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 1x26        | 0            | 0            | 0            |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br>AEC-Q102#C7<br>Test PCB: FR4  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 1x26        | 0            | 0            | 0            |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br>AEC-Q102 #C10  | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 1x10        | -            | -            | 0            |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br>AEC-Q102 #C12<br>Test PCB: FR4                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 1x26        | 0            | 0            | 0            |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br>AEC-Q102 #C13<br>Test PCB: FR4                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 1x26        | 0            | 0            | 0            |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br>AEC-Q102 #C14<br>Test PCB: FR4                           | 2 mm   | 1x       | 1x10        | 0            | 0            | 0            |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br>AEC-Q102 #E3<br>Test PCB: FR4        | Human Body Model   | 2000 V   | 1x10        | 0            | 0            | 0            |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 1x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition  | Duration | Sample Size | Failures |      |     |
|-------------------------------|--|----------|-------------|----------|------|-----|
|                               |  |          |             | El.      | Opt. | Vis |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Machine Model<br>Test PCB: FR4 | 200 V    | 3x10        | 0        | 0    | 0   |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 2$ mA)                                    | $> 2,2$ V; $\pm 10\%$ from initial value                    |
| Optical failures:    | $I_v$ ( $I_f = 2$ mA)<br>$\lambda_{dom}$ ( $I_f = 2$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                    |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.

**Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102** AEC-Q102 #A1 **LY P47K (Chip C)**

| Test Performed   | Condition  | Duration | Sample Size | Failures                    |                             |                             |
|--|--|----------|-------------|-----------------------------|-----------------------------|-----------------------------|
|  |  |          |             | El.                         | Opt.                        | Vis                         |
|  |  |          |             | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E0</small> |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2a<br/>Test PCB: IMS-AI</small> | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 90^\circ\text{C}$ ; $T_j = 110^\circ\text{C}$<br>$I_F = 20\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2b<br/>Test PCB: FR4</small>    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br><small>AEC-Q102 #A3a<br/>Test PCB: IMS-AI</small>              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br><small>AEC-Q102 #A4a<br/>Test PCB: FR4</small>                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br><small>AEC-Q102 #B1a<br/>Test PCB: IMS-AI</small>      | $T_A = 85^\circ\text{C}$ ; $T_s = 90^\circ\text{C}$<br>$T_j = 110^\circ\text{C}$ ; $I_F = 20\text{ mA}$  | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br><small>AEC-Q102 #B3<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$<br>$I_F = 50\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br><small>AEC-Q102#C7<br/>Test PCB: FR4</small>  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 1x26        | 0                           | 0                           | 0                           |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br><small>AEC-Q102 #C10</small>   | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 1x10        | -                           | -                           | 0                           |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br><small>AEC-Q102 #C12<br/>Test PCB: FR4</small>                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 1x26        | 0                           | 0                           | 0                           |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br><small>AEC-Q102 #C13<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 1x26        | 0                           | 0                           | 0                           |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br><small>AEC-Q102 #C14<br/>Test PCB: FR4</small>                           | 2 mm   | 1x       | 1x10        | 0                           | 0                           | 0                           |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br><small>AEC-Q102 #E3<br/>Test PCB: FR4</small>        | Human Body Model   | 2000 V   | 1x10        | 0                           | 0                           | 0                           |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 1x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition  | Duration | Sample Size | Failures |      |     |
|-------------------------------|--|----------|-------------|----------|------|-----|
|                               |  |          |             | El.      | Opt. | Vis |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Machine Model<br>Test PCB: FR4 | 200 V    | 3x10        | 0        | 0    | 0   |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 2$ mA)                                    | $> 2,2$ V; $\pm 10\%$ from initial value                    |
| Optical failures:    | $I_v$ ( $I_f = 2$ mA)<br>$\lambda_{dom}$ ( $I_f = 2$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                    |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.



**Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102** AEC-Q102 #A1 **LG P47K (Chip C)**

| Test Performed   | Condition  | Duration | Sample Size | Failures                    |                             |                             |
|--|--|----------|-------------|-----------------------------|-----------------------------|-----------------------------|
|  |  |          |             | EI.                         | Opt.                        | Vis                         |
|  |  |          |             | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E0</small> |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2a<br/>Test PCB: IMS-AI</small> | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 90^\circ\text{C}$ ; $T_j = 115^\circ\text{C}$<br>$I_F = 20\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2b<br/>Test PCB: FR4</small>    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br><small>AEC-Q102 #A3a<br/>Test PCB: IMS-AI</small>              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br><small>AEC-Q102 #A4a<br/>Test PCB: FR4</small>                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br><small>AEC-Q102 #B1a<br/>Test PCB: IMS-AI</small>      | $T_A = 85^\circ\text{C}$ ; $T_s = 90^\circ\text{C}$<br>$T_j = 115^\circ\text{C}$ ; $I_F = 20\text{ mA}$  | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br><small>AEC-Q102 #B3<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$<br>$I_F = 50\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br><small>AEC-Q102#C7<br/>Test PCB: FR4</small>  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 1x26        | 0                           | 0                           | 0                           |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br><small>AEC-Q102 #C10</small>   | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 1x10        | -                           | -                           | 0                           |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br><small>AEC-Q102 #C12<br/>Test PCB: FR4</small>                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 1x26        | 0                           | 0                           | 0                           |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br><small>AEC-Q102 #C13<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 1x26        | 0                           | 0                           | 0                           |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br><small>AEC-Q102 #C14<br/>Test PCB: FR4</small>                           | 2 mm   | 1x       | 1x10        | 0                           | 0                           | 0                           |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br><small>AEC-Q102 #E3<br/>Test PCB: FR4</small>        | Human Body Model   | 2000 V   | 1x10        | 0                           | 0                           | 0                           |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 1x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition  | Duration | Sample Size | Failures |      |     |
|-------------------------------|--|----------|-------------|----------|------|-----|
|                               |  |          |             | El.      | Opt. | Vis |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Machine Model<br>Test PCB: FR4 | 200 V    | 3x10        | 0        | 0    | 0   |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 2$ mA)                                    | $> 2,2$ V; $\pm 10\%$ from initial value                    |
| Optical failures:    | $I_v$ ( $I_f = 2$ mA)<br>$\lambda_{dom}$ ( $I_f = 2$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                    |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.

**Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102** AEC-Q102 #A1 **LS P47K (Chip D)**

| Test Performed   | Condition  | Duration | Sample Size | Failures                    |                             |                             |
|--|--|----------|-------------|-----------------------------|-----------------------------|-----------------------------|
|  |  |          |             | EI.                         | Opt.                        | Vis                         |
|  |  |          |             | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E0</small> |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2a<br/>Test PCB: IMS-AI</small> | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 90^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 20\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2b<br/>Test PCB: FR4</small>    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br><small>AEC-Q102 #A3a<br/>Test PCB: IMS-AI</small>              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br><small>AEC-Q102 #A4a<br/>Test PCB: FR4</small>                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br><small>AEC-Q102 #B1a<br/>Test PCB: IMS-AI</small>      | $T_A = 85^\circ\text{C}$ ; $T_s = 90^\circ\text{C}$<br>$T_j = 105^\circ\text{C}$ ; $I_F = 20\text{ mA}$  | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br><small>AEC-Q102 #B3<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$<br>$I_F = 50\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br><small>AEC-Q102#C7<br/>Test PCB: FR4</small>  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 1x26        | 0                           | 0                           | 0                           |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br><small>AEC-Q102 #C10</small>   | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 1x10        | -                           | -                           | 0                           |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br><small>AEC-Q102 #C12<br/>Test PCB: FR4</small>                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 1x26        | 0                           | 0                           | 0                           |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br><small>AEC-Q102 #C13<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 1x26        | 0                           | 0                           | 0                           |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br><small>AEC-Q102 #C14<br/>Test PCB: FR4</small>                           | 2 mm   | 1x       | 1x10        | 0                           | 0                           | 0                           |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br><small>AEC-Q102 #E3<br/>Test PCB: FR4</small>        | Human Body Model   | 2000 V   | 1x10        | 0                           | 0                           | 0                           |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 1x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition                           | Duration      | Sample Size | Failures |      |     |   |
|-------------------------------|-------------------------------------|---------------|-------------|----------|------|-----|---|
|                               |                                     |               |             | El.      | Opt. | Vis |   |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Test PCB: FR4 | Machine Model | 200 V       | 3x10     | 0    | 0   | 0 |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 2$ mA)                                    | $> 2,2$ V; $\pm 10\%$ from initial value                    |
| Optical failures:    | $I_v$ ( $I_f = 2$ mA)<br>$\lambda_{dom}$ ( $I_f = 2$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                    |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.

**Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102** AEC-Q102 #A1 **LO P47K (Chip D)**

| Test Performed   | Condition  | Duration | Sample Size | Failures                    |                             |                             |
|--|--|----------|-------------|-----------------------------|-----------------------------|-----------------------------|
|  |  |          |             | EI.                         | Opt.                        | Vis                         |
|  |  |          |             | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E0</small> |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2a<br/>Test PCB: IMS-AI</small> | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 90^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 20\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2b<br/>Test PCB: FR4</small>    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br><small>AEC-Q102 #A3a<br/>Test PCB: IMS-AI</small>              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br><small>AEC-Q102 #A4a<br/>Test PCB: FR4</small>                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br><small>AEC-Q102 #B1a<br/>Test PCB: IMS-AI</small>      | $T_A = 85^\circ\text{C}$ ; $T_s = 90^\circ\text{C}$<br>$T_j = 105^\circ\text{C}$ ; $I_F = 20\text{ mA}$  | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br><small>AEC-Q102 #B3<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$<br>$I_F = 50\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br><small>AEC-Q102#C7<br/>Test PCB: FR4</small>  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 1x26        | 0                           | 0                           | 0                           |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br><small>AEC-Q102 #C10</small>   | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 1x10        | -                           | -                           | 0                           |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br><small>AEC-Q102 #C12<br/>Test PCB: FR4</small>                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 1x26        | 0                           | 0                           | 0                           |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br><small>AEC-Q102 #C13<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 1x26        | 0                           | 0                           | 0                           |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br><small>AEC-Q102 #C14<br/>Test PCB: FR4</small>                           | 2 mm   | 1x       | 1x10        | 0                           | 0                           | 0                           |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br><small>AEC-Q102 #E3<br/>Test PCB: FR4</small>        | Human Body Model   | 2000 V   | 1x10        | 0                           | 0                           | 0                           |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 1x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition                           | Duration      | Sample Size | Failures |      |     |   |
|-------------------------------|-------------------------------------|---------------|-------------|----------|------|-----|---|
|                               |                                     |               |             | El.      | Opt. | Vis |   |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Test PCB: FR4 | Machine Model | 200 V       | 3x10     | 0    | 0   | 0 |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 2$ mA)                                    | $> 2,2$ V; $\pm 10\%$ from initial value                    |
| Optical failures:    | $I_v$ ( $I_f = 2$ mA)<br>$\lambda_{dom}$ ( $I_f = 2$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                    |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.

**Pre-conditioning according to Jedec Level II where applicable as per AEC-Q102** AEC-Q102 #A1 **LG P47K (Chip D)**

| Test Performed   | Condition  | Duration | Sample Size | Failures                    |                             |                             |
|--|--|----------|-------------|-----------------------------|-----------------------------|-----------------------------|
|  |  |          |             | EI.                         | Opt.                        | Vis                         |
|  |  |          |             | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E1</small> | <small>AEC-Q102 #E0</small> |
| Wet High Temperature Operating Life<br>WHTOL1<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2a<br/>Test PCB: IMS-AI</small> | $T_A = 85^\circ\text{C}$ ; r.H. = 85%;<br>$T_s = 90^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 20\text{ mA}$<br>$T_{\text{on/off}} = 30\text{ min}$      | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Wet High Temperature Operating Life<br>WHTOL2<br><i>JESD22-A101</i><br><small>AEC-Q102 #A2b<br/>Test PCB: FR4</small>    | $T_A = 85^\circ\text{C}$ ; r.H. = 85%<br>$I_F = 5\text{ mA}$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Powered Temperature Cycle<br>PTC<br><i>JESD22-A105</i><br><small>AEC-Q102 #A3a<br/>Test PCB: IMS-AI</small>              | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>$T_s = 100^\circ\text{C}$ ; $T_j = 105^\circ\text{C}$<br>$I_F = 5\text{ mA}$<br>$t_{\text{on/off}} = 5\text{ min}$ | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| Temperature Cycling<br>TC<br><i>JESD22-A104</i><br><small>AEC-Q102 #A4a<br/>Test PCB: FR4</small>                        | $T_A = -40^\circ\text{C}/+100^\circ\text{C}$<br>15 min each extreme  | 1000 c   | 1x26        | 0                           | 0                           | 0                           |
| High Temperature Operating Life<br>HTOL1<br><i>JESD22-A108</i><br><small>AEC-Q102 #B1a<br/>Test PCB: IMS-AI</small>      | $T_A = 85^\circ\text{C}$ ; $T_s = 90^\circ\text{C}$<br>$T_j = 105^\circ\text{C}$ ; $I_F = 20\text{ mA}$  | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Pulsed Operating Life<br>PLT<br><i>JESD22-A108</i><br><small>AEC-Q102 #B3<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$<br>$I_F = 50\text{ mA}$ ; $t_p = 0,1\text{ms}$ ;<br>$D = 3\%$   | 1000 h   | 1x26        | 0                           | 0                           | 0                           |
| Dew<br>DEW<br><i>AEC-Q102-001</i><br><small>AEC-Q102#C7<br/>Test PCB: FR4</small>  | $T_{A,\text{min}} = 10^\circ\text{C}$<br>$T_{A,\text{max}} = 80^\circ\text{C}$<br>r.H. = 53-100%   | 10 c     | 1x26        | 0                           | 0                           | 0                           |
| Solderability<br>SD<br><i>IEC 60068-2-58</i><br><small>AEC-Q102 #C10</small>   | $T_A = 235^\circ\text{C}$<br>method 2 (reflow simulation)  | 1x       | 1x10        | -                           | -                           | 0                           |
| Hydrogen Sulphide<br>H2S<br><i>IEC 60068-2-43</i><br><small>AEC-Q102 #C12<br/>Test PCB: FR4</small>                      | 15 ppm $\text{H}_2\text{S}$<br>$40^\circ\text{C}/90\%$ r.H.  | 336 h    | 1x26        | 0                           | 0                           | 0                           |
| Flowing Mixed Gas<br>FMG<br><i>IEC 60068-2-60</i><br><small>AEC-Q102 #C13<br/>Test PCB: FR4</small>                      | $T_A = 25^\circ\text{C}$ ,<br>r.H. = 75%<br>Test method 4  | 500 h    | 1x26        | 0                           | 0                           | 0                           |
| Board Flex Test<br>BF<br><i>AEC-Q102-002</i><br><small>AEC-Q102 #C14<br/>Test PCB: FR4</small>                           | 2 mm   | 1x       | 1x10        | 0                           | 0                           | 0                           |
| Electrostatic Discharge<br>HBM<br><i>ANSI/ESDA/ JEDEC JS-001</i><br><small>AEC-Q102 #E3<br/>Test PCB: FR4</small>        | Human Body Model   | 2000 V   | 1x10        | 0                           | 0                           | 0                           |

|                                     |                                      |   |    |                       |                               |
|-------------------------------------|--------------------------------------|---|----|-----------------------|-------------------------------|
| Constant Acceleration<br>CA         | <i>MIL-STD-750-2</i><br>AEC-Q102 #G1 | Method 2006<br>2000 gf; 1 min in x/y/z<br>(+/- direction)     | 1x | 1x10                  |                               |
| Vibration Variable Frequency<br>VVF | <i>JESD22-B103</i><br>AEC-Q102 #G2   | 20g, 20-2000Hz;<br>4min / cy; 4cy/axis<br>service condition 1 | 1x | sequential<br>samples | for uncasted<br>packages only |
| Mechanical Shock<br>MS              | <i>JESD22-B110</i><br>AEC-Q102 #G3   | 1500g for 0.5ms,<br>5 blows, 3 orientations                   | 1x | sequential<br>samples |                               |
| Hermeticity<br>HER                  | <i>JESD22-A109</i><br>AEC-Q102 #G4   | Leak Test: Fine & Gross                                       | 1x | sequential<br>samples |                               |

### Additional Tests to AEC Q102

| Test Performed                | Condition                           | Duration      | Sample Size | Failures |      |     |   |
|-------------------------------|-------------------------------------|---------------|-------------|----------|------|-----|---|
|                               |                                     |               |             | El.      | Opt. | Vis |   |
| Electrostatic Discharge<br>MM | <i>JESD22-A115</i><br>Test PCB: FR4 | Machine Model | 200 V       | 3x10     | 0    | 0   | 0 |

### Failure criteria:

|                      |  |   |
|----------------------|--|---|
| Electrical failures: | $V_f$ ( $I_f = 2$ mA)                                    | $> 2,2$ V; $\pm 10\%$ from initial value                    |
| Optical failures:    | $I_v$ ( $I_f = 2$ mA)<br>$\lambda_{dom}$ ( $I_f = 2$ mA) | absolute limit: $\pm 50\%$ max.<br>$\pm 2$ nm initial value |
| Visual failures:     | acc JEDEC JESD22-B101                                    |   |

**Conclusion:** The tested devices representing the product family as stated in the applies to section fulfill the reliability requirements of AEC-Q102 Initial/Rev-A.



## Disclaimer

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Further explanations:

**Data:** The Data used in this Document consider the reliability test results under the mentioned driving conditions only. For Product information on the maximum operating conditions and the OSRAM standard qualification profile please refer to the Product data sheet or contact your local sales partner.

**Conditions:** The conditions for the generation of the Data are as follows:

1. The Data and curves shown in this Document are based on experiments carried out under laboratory conditions on a random sample size of LED/IRED/Laser/Detector with readouts at discrete readout times (where applicable). Thus, the Data above represent a limited number of production lots only and may differ between different assembly lots over time (including chip or package changes). Thus, the behavior of the LED/IRED/Laser/Detector in the final application may differ from the Data. The behavior of the LED/IRED/Laser/Detector at conditions or readout times deviating from those stated above may not be deduced from the Data.

2. If applicable:

a) Extended driving conditions:

The tested driving conditions exceed the maximum limits stated in the Product data sheet. Therefore, a reduced lifetime or an accelerated degradation is expected. Failure limits noted in the Document refer to the testing condition according to the OSRAM standard Product qualification profile and not to the actual testing condition.

b) Extended testing duration:

The testing duration exceed the OSRAM standard qualification profile of the mentioned Product. Failure limits noted in the Document refer to the testing duration according to the OSRAM standard Product qualification profile and not to the actual testing duration.

c) Exceeding standard qualification conditions – (Product data sheet limits not affected):

The tested driving conditions exceed the OSRAM standard qualification profile of the mentioned Product. Therefore a reduced lifetime or an accelerated degradation is expected. Failure limits noted in the Document refer to the testing condition according to the OSRAM standard Product qualification profile and not to the actual testing condition.

3. For long term operation additional failure modes of the chip or package can occur which are not shown in this Document.

4. Possible differences in the thermal management of OSRAM and customer's setup may lead to a different aging behavior.

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