# Data Sheet

# HLMP-3953-MQ000

## 5-mm AlInGaP Green LEDs

## Description

The Broadcom® non-diffused T1-3/4 LED lamps use the new AlInGaP die material which has superior light output. They can be used for general-purpose indicator applications requiring a higher intensity performance not achievable with GaP die material.

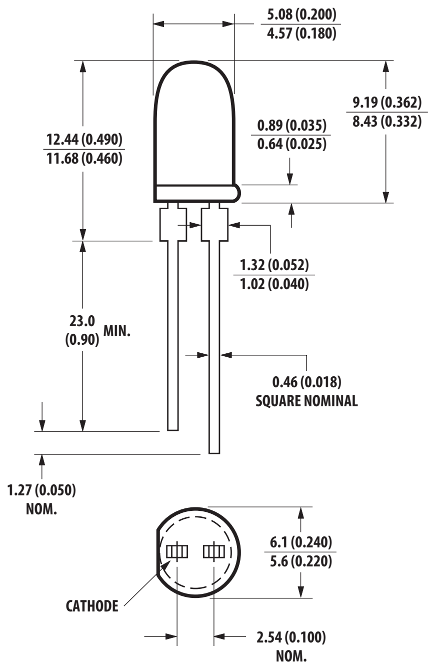
## Features

- Improved brightness
- Improved color performance
- Color: High Performance Green
- Reliable and rugged

## Applications

- Lighted switches
- Backlighting front panels
- Light pipe sources
- Keyboard indicator

**Figure 1: Package Drawing**




**NOTE:**

1. All dimensions are in millimeters (mm).
2. Epoxy meniscus may extend up to maximum 1 mm (0.40 in.) down the leads.
3. For PCB hole recommendations, see Precautionary Notes.

# Device Selection Guide ($T_J$ = 25°C, $I_F$ = 20 mA)

| Part Number | Color | Viewing Angle (°) Typ. | Luminous Intensity, $I_V$ (mcd)[a, b, c] | |
|---|---|---|---|---|
| | | | Min. | Max. |
| HLMP-3953-MQ000 | AlInGaP Green | 15 | 289 | 2700 |

a. The luminous intensity, $I_V$ is measured at the mechanical axis of the package and it is tested with a single current pulse condition.

b. The optical axis is closely aligned with the mechanical axis of the package.

c. Maximum tolerance for each bin limit is ±18%.

# Absolute Maximum Ratings

| Parameters | AlInGaP Green | Units |
|---|---|---|
| DC Forward Current[a] | 30 | mA |
| Peak Forward Current[b] | 90 | mA |
| Power Dissipation | 74 | mW |
| LED Junction Temperature | 110 | °C |
| Operating Temperature Range | –40 to +100 | °C |
| Storage Temperature Range | –40 to +100 | °C |

a. Derate linearly as shown in Figure 6.

b. Duty factor = 30%, frequency = 1 kHz.

# Optical and Electrical Characteristics ($T_J$ = 25°C, $I_F$ = 20 mA)

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Forward Voltage[a] | $V_F$ | 1.7 | 2.0 | 2.4 | V | $I_F$ = 20 mA |
| Reverse Voltage[b] | $V_R$ | 5 | — | — | V | $I_R$ = 100A |
| Dominant Wavelength[c] | $\lambda_d$ | 550 | — | 565 | nm | $I_F$ = 20 mA |
| Peak Wavelength | $\lambda_{PEAK}$ | — | 560 | — | nm | Peak of wavelength of spectral distribution at $I_F$ = 20 mA |
| Spectral Half Width | $\Delta\lambda_{1/2}$ | — | 12 | — | nm | Wavelength width at spectral distribution ½ power point at $I_F$ = 20 mA |
| Thermal Resistance[d] | $R_{\theta J\text{-}P}$ | — | 210 | — | °C/W | LED junction-to-pin |
| Luminous Efficacy[e] | $\eta_V$ | — | 661 | — | lm/W | Emitted luminous power/ emitted radiant power |

a. Forward voltage tolerance is ± 0.05V.

b. Indicates product final test condition. Long term reverse bias is not recommended.

c. The dominant wavelength, $\lambda_d$ is derived from the CIE Chromaticity Diagram and represents the perceived color of the device.

d. Thermal resistance from LED junction to pin.

e. The radiant intensity, Ie in watts per steradian may be found from the equation $Ie = I_V / \eta_V$ where $I_V$ is the luminous intensity in candelas and $\eta_V$ is the luminous efficacy in lm/W.

# Part Numbering System

| H | L | M | P | - | 3 | 9 | 5 | 3 | - | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Code | Description | Option | |
|---|---|---|---|
| $x_1$ | Minimum Intensity Bin | Refer to the Intensity Bin Limits (CAT) table | |
| $x_2$ | Maximum Intensity Bin | | |
| $x_3$ | Color Bin Option | 0 | Full Distribution |
| $x_4$ $x_5$ | Packing Option | 00 | Loose packaging |

## Part Number Example

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$x_1$: M – Minimum intensity bin M
$x_2$: Q – Maximum intensity bin Q
$x_3$: 0 – Full distribution color bin (that is, Bin 1, 2, 3, 4, or 5)
$x_4$ $x_5$: 00 – Loose packaging

# Bin Information

## Intensity Bin Limits (CAT)

| Bin ID | Luminous Intensity, IV (mcd) | |
|---|---|---|
| | Min. | Max. |
| M | 289 | 417 |
| N | 417 | 680 |
| O | 680 | 1100 |
| P | 1100 | 1800 |
| Q | 1800 | 2700 |

Maximum tolerance for each bin limit = ± 18%.

## Color Bin Limits (BIN)

| Bin ID | Dominant Wavelength, $\lambda_d$ (nm) | |
|---|---|---|
| | Min. | Max. |
| 1 | 550 | 553 |
| 2 | 553 | 556 |
| 3 | 556 | 559 |
| 4 | 559 | 562 |
| 5 | 562 | 565 |

Tolerance = ± 0.5 nm.

Example of bin information on packaging label:

CAT: M – Intensity bin M
BIN: 1 – Color bin 1

**Figure 2: Spectral Power Distribution**

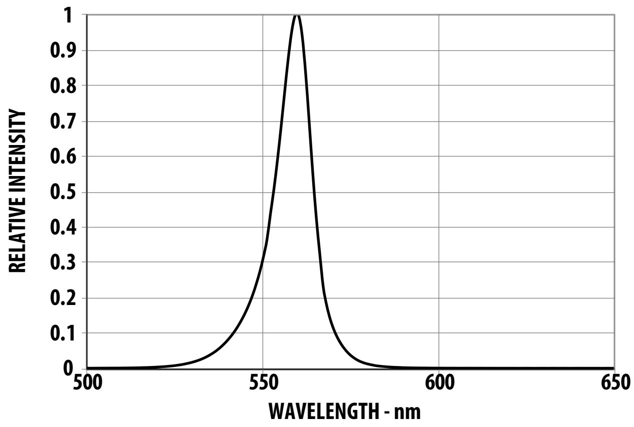



**Figure 3: Forward Current vs. Forward Voltage**

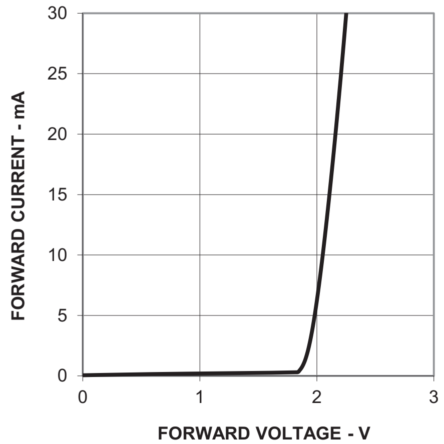



**Figure 4: Relative Intensity vs. Forward Current**

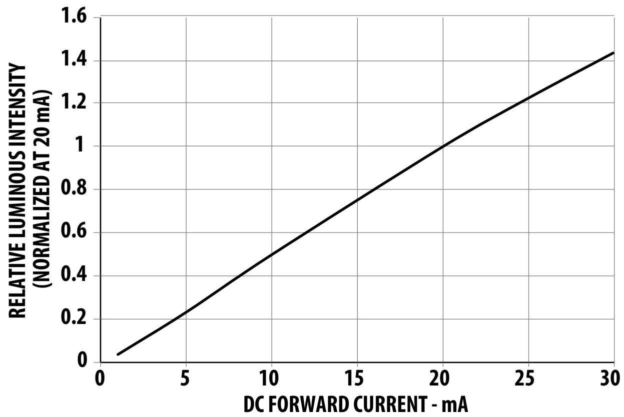



**Figure 5: Radiation Pattern**

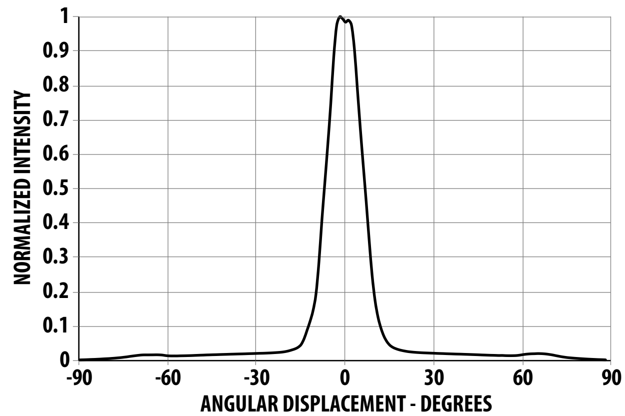
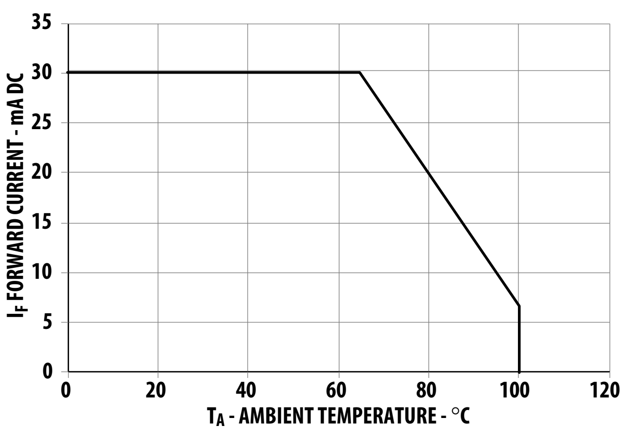



**Figure 6: Maximum Forward Current vs. Ambient Temperature**



# Precautionary Notes

## Soldering and Handling Precautions

- Set and maintain the wave soldering parameters according to the recommended temperature and dwell time. Perform daily checks on the profile to ensure that it always conforms to the recommended conditions. Exceeding these conditions will over-stress the LEDs and cause premature failures.
- Use only bottom preheaters to reduce thermal stress experienced by the LEDs.
- Recalibrate the soldering profile before loading a new type of PCB. PCBs with a different size and design (component density) will have different heat capacity and might cause a change in temperature experienced by the PCB if the same wave soldering setting is used
- Do not perform wave soldering more than once.
- Any alignment fixture used during wave soldering must be loosely fitted and must not apply stress on the LEDs. Use non-metal material because it will absorb less heat during the wave soldering process.
- At elevated temperatures, the LEDs are more susceptible to mechanical stress. Allow the PCB to be sufficiently cooled to room temperature before handling. Do not apply stress to the LED when it is hot.
- Use wave soldering to solder the LED. Use hand soldering only for rework or touch up if unavoidable, but it must be strictly controlled to following conditions:
  - Soldering iron tip temperature = 315°C maximum.
  - Soldering duration = 2 seconds maximum.
  - Number of cycle = 1 only
  - Power of soldering iron = 50W maximum.
- For ESD-sensitive devices, apply proper ESD precautions at the soldering station. Use only an ESD-safe soldering iron.
- Do not touch the LED package body with the soldering iron except for the soldering terminals because it may cause damage to the LED.
- Confirm beforehand whether the functionality and performance of the LED is affected by soldering with hand soldering.
- Keep the heat source at least 1.6 mm away from the LED body during soldering.
- Design the appropriate hole size to avoid problems during insertion or clinching (for auto-insertable devices).

**Figure 7: Recommended PCB Through Hole Size**

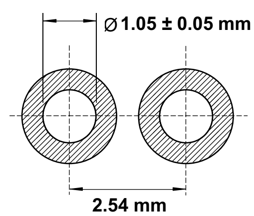
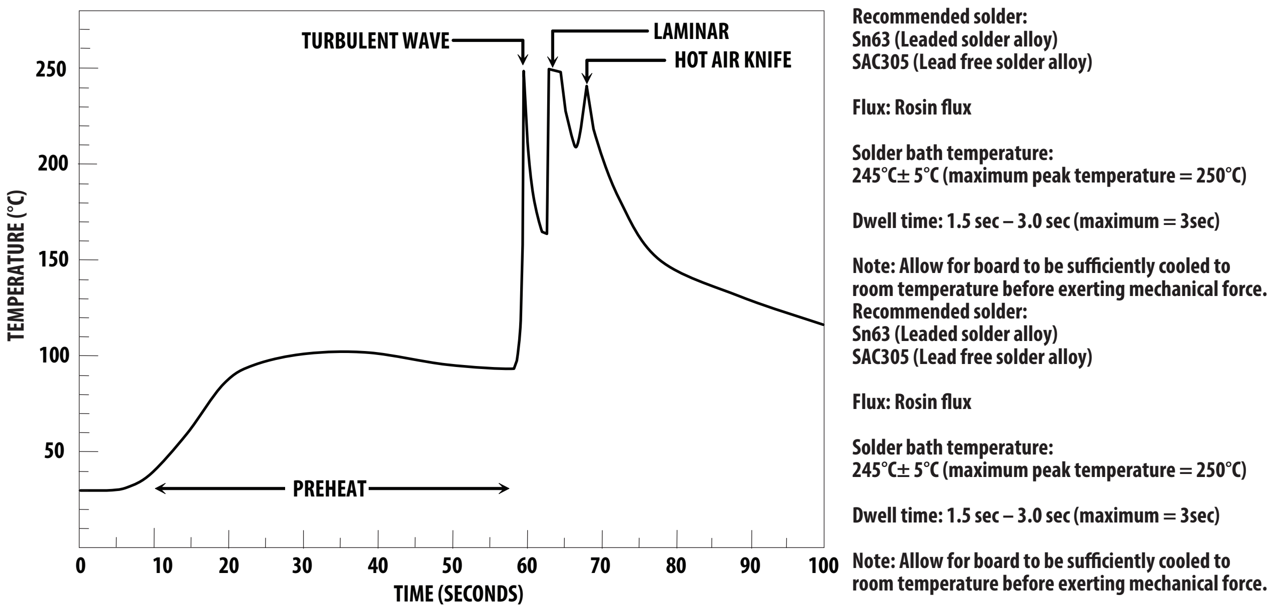


**Figure 8: Recommended Wave Soldering Profile**




**NOTE:** Refers to measurements with the thermocouple mounted at the bottom of the PCB.

Refer to Application Note AN 5334 for more information on soldering and handling of TH LED lamp.

## Lead Forming

- To pre-form or cut the leads prior to insertion and soldering onto the PCB, use the proper tool instead of doing it manually.
- Do not bend the leads at the location less than 3 mm from the LED body.
- Do not use the base of the LED body as a fulcrum for lead bending. Secure the leads properly before bending.
- If manual lead cutting is unavoidable, cut the leads after soldering to reduce stress to the LED body.

## Application Precautions

- The drive current of the LED must not exceed the maximum allowable limit across temperature as stated in the data sheet. Constant current driving is recommended to ensure consistent performance.
- Circuit design must cater to the whole range of forward voltage ($V_F$) of the LEDs to ensure the intended drive current can always be achieved.
- The LED exhibits slightly different characteristics at different drive currents, which may result in a larger variation of performance (meaning: intensity, wavelength, and forward voltage). Set the application current as close as possible to the test current to minimize these variations.
- The LED is not intended for reverse bias. Use other appropriate components for such purposes. When driving the LED in matrix form, ensure that the reverse bias voltage does not exceed the allowable limit of the LED.
- Avoid rapid changes in ambient temperature, especially in high-humidity environments, because they cause condensation on the LED.

## Eye Safety Precautions

LEDs may pose optical hazards when in operation. Do not look directly at operating LEDs because it might be harmful to the eyes. For safety reasons, use appropriate shielding or personal protective equipment.

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