LM2758 采用 DSBGA 封装的开关电容闪光 LED 驱动器

1 特性

- 输出电流高达 700mA
- 90% 的峰值效率
- 指示灯、手电筒和闪光灯模式
- 超时电路可将闪光持续时间限制为 814 毫秒（典型值）
- 自适应增益（1× 和 1.5×），可实现效率最大化
- 真正的关断
- 内部软启动，可消除浪涌电流
- 超小型解决方案尺寸
  - 无需电感，只需使用 4 个电容和 1 个电阻
  - 2.022mm × 1.527mm × 0.6mm 薄型芯片尺寸球栅阵列 (DSBGA) 封装

2 应用

- 手机摄像头闪光灯
- 数码相机闪光灯

3 说明

LM2758 器件是一款带有稳压电流阱的低噪声、高电流开关电容集成 DC-DC 转换器。由单节锂离子电池供电时，该器件最高可驱动 700mA 负载。该器件会根据 LED 正向电压和电流需求主动选择适当增益，从而在整个输入电压范围内实现效率最大化。

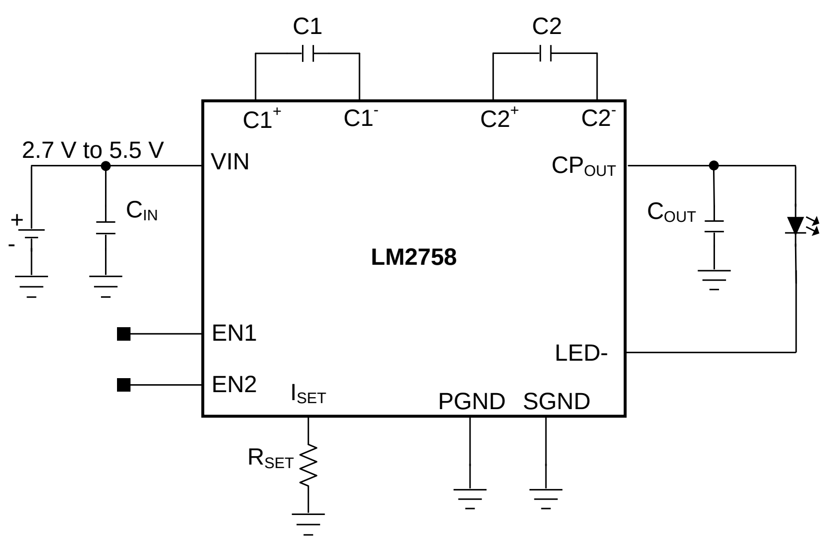
该器件通过外接一个低功耗电阻设置指示灯、手电筒和闪光灯三种模式所需的电流。LM2758 内置一个超时电路。该电路能够在器件因故障长时间处于闪光灯模式时将其关断，从而保护器件和闪光灯 LED。内置的软启动电路可在器件启动时限制浪涌电流。

器件信息[(1)]

器件型号	封装	封装尺寸（最大值）
LM2758	DSBGA (12)	2.022mm x 1.527mm

(1) 要了解所有可用封装，请参见数据表末尾的可订购产品附录。

典型应用电路



目录

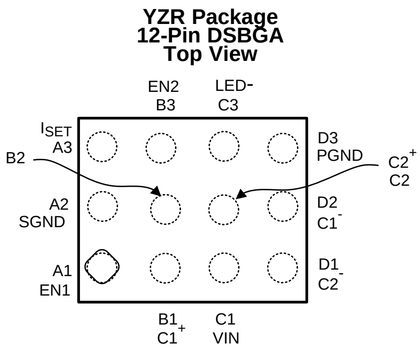
4 修订历史记录

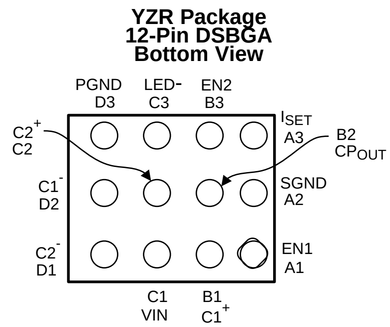
注：之前版本的页码可能与当前版本有所不同。

Changes from Revision D (May 2013) to Revision E	**Page**
• 已添加 *器件信息以及引脚配置和功能部分，ESD 额定值表，特性 描述，器件功能模式，应用和实施，电源相关建议，布局，器件和文档支持以及机械、封装和可订购信息部分*	1
• Added *Thermal Information* table with revised $R_{\theta JA}$ value (from 56°C/W to 93.6°C/W) and additional thermal values.	4

Changes from Revision C (May 2013) to Revision D	**Page**
• Changed layout of National Data Sheet to TI format	16

5 Pin Configuration and Functions





Pin Functions

PIN		TYPE	DESCRIPTION
NO.	NAME		
A1	EN1	Input	The EN2 pins is used to select the modes (torch, indicator, flash), as well as to put the part into shutdown mode.
A2	SGND	Ground	Analog and control ground for charge pump. Connect this pin directly to a low impedance ground plane.
A3	I_{SET}	Power	LED current programming resistor pin. A resistor connected between this pin, and GND is used to set torch, flash and indicator currents.
B1	C1+	Power	Flying capacitor pin — connect a 1-µF ceramic capacitor from C1+ to C1−
B2	CP_{OUT}	Output	Charge pump regulated output. A 2.2-µF ceramic capacitor is required from CP_{OUT} to GND. Connect flash LED anode to this pin.
B3	EN2	Input	The EN1 pin is used to select the modes (torch, indicator, flash), as well as to put the part into Shutdown mode.
C1	VIN	Input	Supply voltage connection
C2	C2+	Power	Flying capacitor pins — connect a 1-µF ceramic capacitor from C2+ to C2−.
C3	LED−	Output	Regulated current source output. Connect flash LED cathode to this pin.
D1	C2−	Power	Flying capacitor pin — connect a 1-µF ceramic capacitor from C2+ to C2−.
D2	C1−	Power	Flying capacitor pin — connect a 1-µF ceramic capacitor from C1+ to C1−
D3	PGND	Ground	Power ground for the charge pump and the current source. Connected the pin directly to a low-impedance ground plane.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1][2][3]

	MIN	MAX	UNIT
VIN, CP_{OUT} pins: voltage to GND	–0.3	6	V
EN1, EN2 pins: Voltage to GND	–0.3	(V_{IN} + 0.3) w/ 6 V maximum	V
Continuous power dissipation			
Junction temperature, T_{J-MAX}		150	°C
Maximum lead temperature (soldering)		See[4]	
Storage temperature, T_{stg}	–65°C	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) If Military/Aerospace specified devices are required, contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(3) All voltages are with respect to the potential to the GND pin.
(4) For detailed soldering specifications and information, see *AN-1112 DSBGA Wafer Level Chip Scale Package* (SNVA009).

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101[2]	±200	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)[1]

	MIN	MAX	UNIT
Input voltage	2.7	5.5	V
Junction temperature, T_J	–40	125	°C
Ambient temperature, T_A [2]	–40	85	°C

(1) All voltages are with respect to the potential at the GND pin.
(2) In applications where high power dissipation and/or poor package thermal resistance is present, the maximum ambient temperature may have to be derated. Maximum ambient temperature (T_{A-MAX}) is dependent on the maximum operation junction temperature ($T_{J-MAX-OP}$ = 125°C), the maximum power dissipation of the device in the application (P_{D-MAX}), and the junction-to ambient thermal resistance of the part/package in the application ($R_{\theta JA}$), as given by the following equation: $T_{A-MAX} = T_{J-MAX-OP} - (R_{\theta JA} \times P_{D-MAX})$.

6.4 Thermal Information

THERMAL METRIC[1]		LM2758 YZR (DSBGA) 12 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	93.6	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	0.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	16.1	°C/W
ψ_{JT}	Junction-to-top characterization parameter	2.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	16.0	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

6.5 Electrical Characteristics

Unless otherwise specified, aspecifications apply to the *Figure 8* with V_{IN} = 3.6 V, V_{EN1} = V_{IN}, V_{EN2} = 0 V, C1 = C2 = 1 µF, C_{IN} = C_{OUT} = 2.2 µF, R_{SET} = 20 kΩ, T_J = 25°C.(1)(2)(3)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{LED}	LED current accuracy	I_{LED} = 500 mA, flash mode		500		
		I_{LED} = 500 mA, flash mode –40°C ≤ T_J ≤ 125°C	450		550	mA
V_{SET}	I_{SET} pin voltage			1.3		V
I_D/I_{SET}	LED current to set current ratio	Flash mode		7650		
		Torch mode		1639		
$I_{LED\text{-}IND}$	Indicator current level	Indicator mode 32-kHZ PWM mode		1/32 × $I_{LED\text{-}TORCH}$		mA
V_{GDX}	1× to 1.5× gain transition voltage threshold on V_{LED}–	I_{OUT} = 500 mA		300		mV
V_{OUT}	Output voltage	1× mode, I_{OUT} = 0 mA		V_{IN}		V
		1.5× mode, I_{OUT} = 0 mA(4)		4.8		
		1.5× mode, I_{OUT} = 0 mA –40°C ≤ T_J ≤ 125°C(4)			5.3	
R_{OUT}	1× mode output impedance	I_{OUT} = 200 mA, V_{IN} = 3.3 V –40°C ≤ T_J ≤ 125°C		0.33		Ω
		I_{OUT} = 200 mA, V_{IN} = 3.3 V(5)			0.53	
	1.5× mode output impedance	I_{OUT} = 500 mA, V_{IN} = 3.3 V(5)		1.5	2.0	
F_{SW}	Switching frequency			1.25		MHz
		–40°C ≤ T_J ≤ 125°C	0.8		1.5	
I_Q	Quiescent current	I_{OUT} = 0 mA 1× mode, –40°C ≤ T_J ≤ 125°C		0.7		mA
		I_{OUT} = 0 mA 1x mode			0.8	
		I_{OUT} = 0 mA 1.5× mode		4		
		I_{OUT} = 0 mA 1.5× mode, –40°C ≤ T_J ≤ 125°C			5	
I_{SD}	Shutdown current	Device disabled(6)		0.01		µA
		Device disabled, –40°C ≤ T_J ≤ 125°C(6)			1	
T_{OUT}	Timeout duration	–40°C ≤ T_J ≤ 125°C, see(7)		814		msec
		See(7)	640		1000	
V_{IH}	Input logic high	Pins: EN1, EN2, –40°C ≤ T_J ≤ 125°C	1.2			V
V_{IL}	Input logic low	Pins: EN1, EN2, –40°C ≤ T_J ≤ 125°C			0.4	V

(1) All voltages are with respect to the potential at the GND pin.
(2) Minimum (MIN) and maximum (MAX) limits are specified by design, test, or statistical analysis. Typical (TYP) numbers are not ensured, but do represent the most likely norm. Unless otherwise specified, conditions for TTYP specifications are: V_{IN} = 3.6 V and T_A = 25°C.
(3) C_{IN}, C_{OUT}, C1, C2: Low-ESR surface-mount ceramic capacitors (MLCCs) used in setting electrical characteristics.
(4) Output voltage is internally limited not to exceed maximum specified value.
(5) These table entries are specified by design. These parameters are not ensured by production testing. The temperature limits for test are (–40°C ≤ T_A ≤ +85°C).
(6) The temperature limits for I_{SD} (shutdown current) test are -40°C ≤ T_A ≤ +85°C, as in shutdown mode ambient temperature is equal to junction temperature.
(7) The timeout specifications are calculated values based on the switching frequency spread.

6.6 Typical Characteristics

Unless otherwise specified: T_A = 25°C, V_{IN} = 3.6 V, C_{IN} = C_{OUT} = 2.2 µF, C1 = C2 = 1 µF. Capacitors are low-ESR multi-layer ceramic capacitors (MLCCs). Luxeon PWF1 Flash LED.

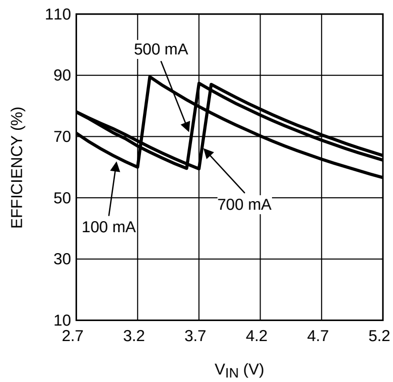


Figure 1. Efficiency vs V_{IN}

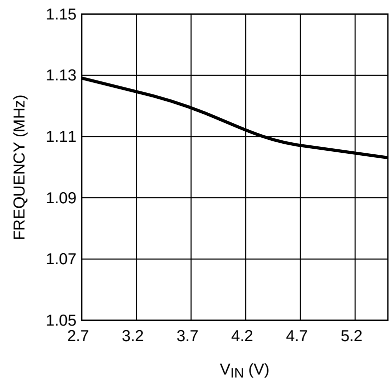


Figure 2. Oscillator Frequency vs V_{IN}

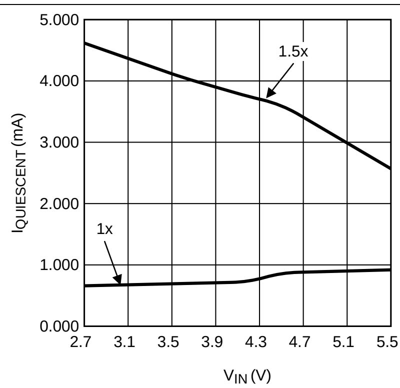


Figure 3. Quiescent Current vs V_{IN}

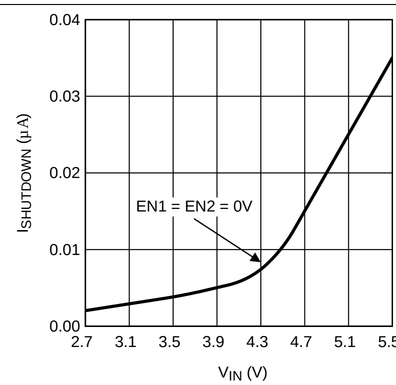


Figure 4. Shutdown Current vs V_{IN}

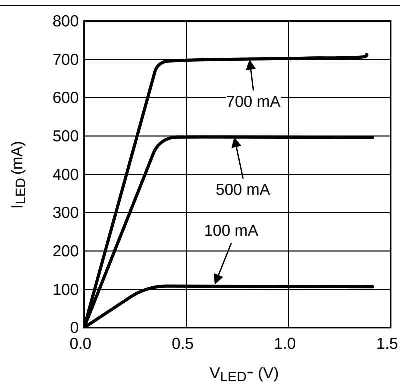


Figure 5. I_{LED} vs V_{LED-}

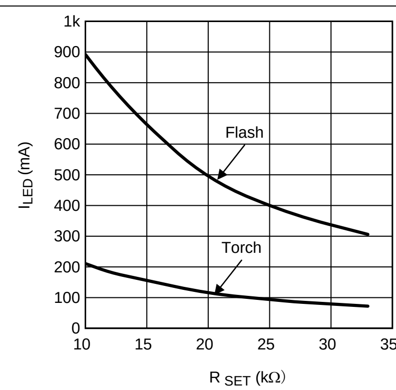


Figure 6. LED Current vs R_{SET}

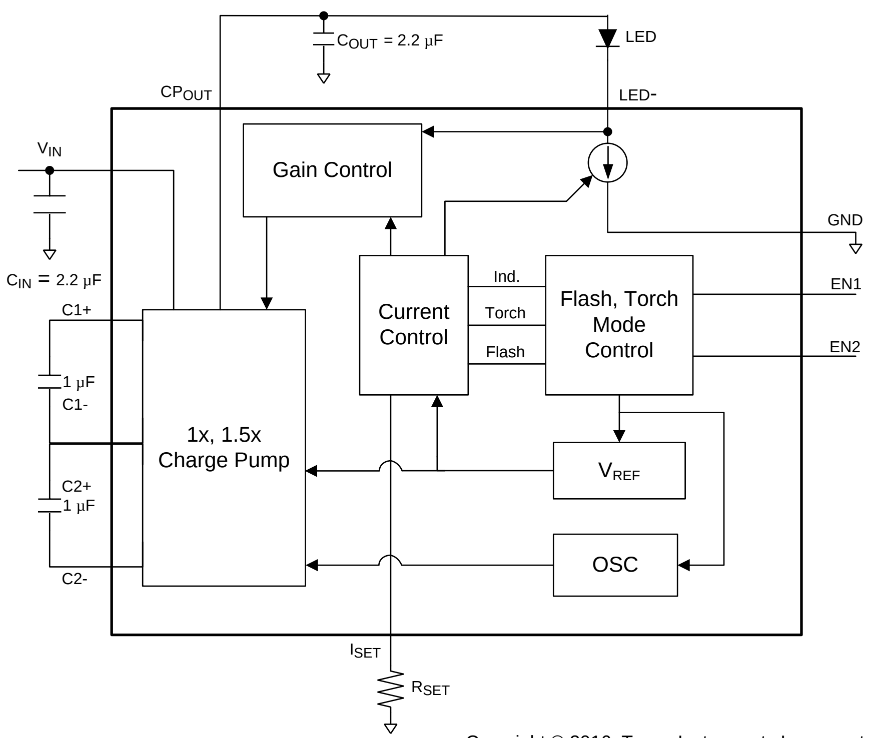
7 Detailed Description

7.1 Overview

The LM2758 is an adaptive 1× and 1.5× CMOS charge pump, optimized for driving flash LEDs in camera phones and other portable applications. It provides a constant current of 500 mA (typical) for flash mode and 107 mA (typical) for torch mode with R_{SET} = 20 kΩ. These current can change (see *Setting LED Currents*).

There are four modes of operation for LM2758: the flash mode, torch mode, indicator mode, and shutdown mode (see Table 1). Torch and flash modes sink a constant DC current while indicator mode operates in pulsating DC at 1/32 positive duty cycle with same current magnitude as torch mode. The LED is driven from CP_{OUT} and connected to the current sink. LED drive current mode is programmed by connecting a resistor, R_{SET}, to the current set pin, I_{SET}. The LM2758 device also controls CP_{OUT} with variable gain (1× or 1.5×) and adjustable impedance (R_{OUT}) to provide an output voltage that would account for LED forward voltage drop and headroom for the current sink to drive desired current through LED.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Charge Pump and Gain Transitions

The input to the 1×/1.5× charge pump is connected to the V_{IN} pin, and the loosely regulated output of the charge pump is connected to the CP_{OUT} pin. In 1× mode, as long as the input voltage is less than 4.7 V, the output voltage is approximately equal to the input voltage. When input voltage is over 4.7 V the output voltage is regulated to 4.7 V. In 1.5× mode, the output voltage is always less than or equal to 4.7 V over entire input voltage range.

The gain of the charge pump is selected depending on the headroom voltage across the current sink of LM2758. When headroom voltage V_{LED-} (at the LED pin) drops below 300 mV (typical) the charge-pump gain transition happens from 1× to 1.5× to maintain current regulation across the LED. Once the charge pump transition to a higher gain, it remains at that gain for as long as the device remains enabled. Shutting down and then re-enabling the device resets the gain mode to the minimum gain required to maintain the load.

Feature Description (continued)

7.3.2 Soft Start

The LM2758 contains internal soft-start circuitry to limit inrush currents when the part is enabled. Soft start is implemented internally with a controlled turnon of the internal voltage reference.

7.3.3 Current Limit Protection

The LM2758 charge pump contains current limit protection circuitry that protects the device during V_{OUT} fault conditions where excessive current is drawn. Output current is limited to 1.2 A typically.

7.3.4 Flash Time-out Feature

Flash time-out protection circuitry disables the current sinks when the signal on EN1 and EN2 is held high for more than 814 msec (typical). This prevents the device from self-heating due to the high power dissipation during flash conditions. During the time-out condition, voltage is still present on CP_{OUT} but the current sinks are shut off, resulting in no current through the flash LED. When the device goes into a time-out condition, placing a logic low signal on EN1 and EN2 resets the timeout; a subsequent logic high signal on EN1 or EN2 returns the device to normal operation.

7.3.5 Setting LED Currents

The current through the LED can be set by connecting an appropriately sized resistor R_{SET} between the I_{SET} pin of the LM2758 and GND.

The LED current in torch mode is approximately 1639 times greater than the current of I_{SET}, while the LED current in flash mode is approximately 7650 times of the same I_{SET} current. The feedback loop of an internal amplifier sets the voltage of the I_{SET} pin to 1.3 V (typical). The statements above are simplified in Equation 1:

$$I_{LED} = GAIN_{FLASH/TORCH} \times (1.3 / R_{SET}) \quad (1)$$

The maximum recommended current through LED is 500 mA in torch mode / 700 mA in flash mode.

NOTE

If the I_{SET} for torch mode setting at 500 mA, the flash mode would be over 700 mA (maximum). See Figure 6. Using the device in conditions where the junction temperature might rise above the rated maximum requires that the operating ranges and/or conditions be de-rated. The printed circuit board also must be carefully laid out to account for high thermal dissipation in the part.

Feature Description (continued)

7.3.6 Analog Brightness Control

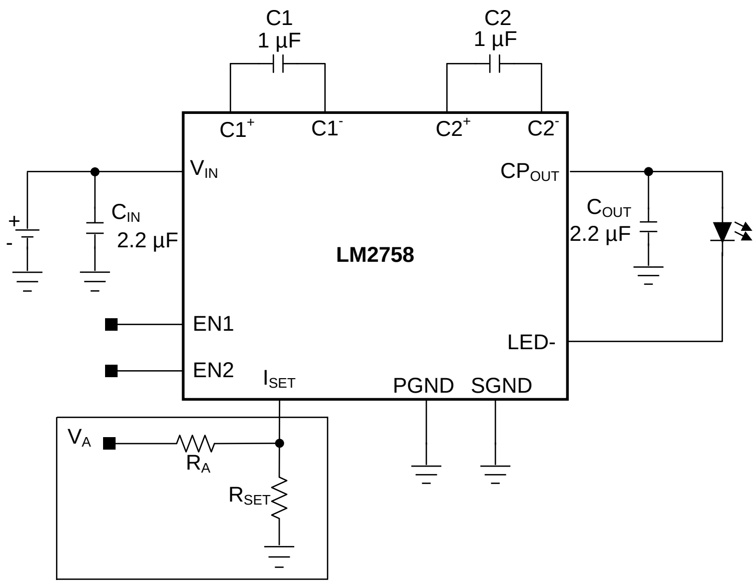


Figure 7. Analog Brightness Control

The current through the LED can be varied dynamically by changing the I_{SET} current. Figure 7 shows the circuit. The current though the LED can be calculated with Equation 2:

$$I_{LED} = Gain_{TORCH/FLASH}\left[\frac{1.3V}{R_{SET}} - \frac{V_A - 1.3V}{R_A}\right] \quad (2)$$

7.3.7 Thermal Protection

Internal thermal protection circuitry disables the LM2758 when the junction temperature exceeds 150°C (typical). This feature protects the device from being damaged by high die temperatures that might otherwise result from excessive power dissipation. The device recovers and operates normally when the junction temperature falls below 140°C (typical). It is important that the board layout provide good thermal conduction to keep the junction temperature within the specified operating ratings.

7.4 Device Functional Modes

7.4.1 Modes

There are four modes of operation for LM2758: the flash mode, torch mode, indicator mode and shutdown mode (see Table 1). Torch and flash modes sink a constant DC current while indicator mode operates in pulsating DC at 1/32 positive duty cycle with same current magnitude as torch mode.

7.4.2 Logic Control Pins

The LM2758 has two logic pins, EN1 and EN2. There is a 500-kΩ (typical) pulldown resistor connected from EN1 to GND and from EN2 to GND. The operating modes of the part function according to Table 1:

Table 1. EN1 and EN2 Truth Table

EN1	EN2	MODE
0	0	Shutdown
1	0	Indicator
0	1	Torch
1	1	Flash

8 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The LM2758 can drive one flash LED at currents up to 700 mA. The multi-gain charge-pump boost regulator allows for the use of small value discrete external components.

8.2 Typical Application

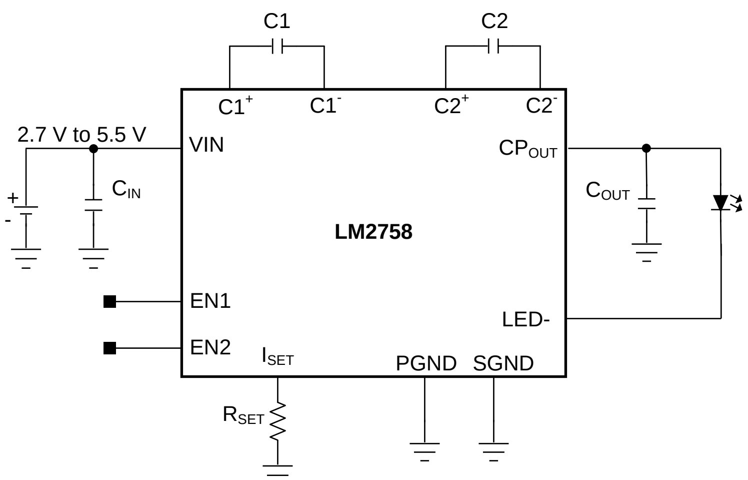


Figure 8. LM2758 Typical Application

8.2.1 Design Requirements

For typical switched-capacitor LED-driver applications, use the parameters listed in Table 2.

Table 2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Minimum input voltage	2.7 V
Maximum output current	700 mA

8.2.2 Detailed Design Procedure

8.2.2.1 Capacitor Selection

The LM2758 device requires 4 external capacitors for proper operation. Surface-mount multi-layer ceramic capacitors are recommended. These capacitors are small, inexpensive and have very low equivalent series resistance (ESR < 20 mΩ typical). Tantalum capacitors, OS-CON capacitors, and aluminum electrolytic capacitors are not recommended for use with the LM2758 due to their high ESR compared to ceramic capacitors. For most applications, ceramic capacitors with X7R or X5R temperature characteristic are preferred for use with the LM2758. Ceramic capacitors have tight capacitance tolerance (as good as ±10%) and hold their value over temperature (X7R: ±15% over –55°C to +125°C; X5R: ±15% over –55°C to +85°C). Capacitors with Y5V or Z5U temperature characteristic are generally not recommended for use with the LM2758. Capacitors with these temperature characteristics typically have wide capacitance tolerance (+80%, –20%) and vary significantly over temperature (Y5V: 22%, –82% over –30°C to +85°C range; Z5U: 22%, –56% over 10°C to 85°C range). Under some conditions, a nominal 1 µF Y5V or Z5U capacitor could have a capacitance of only 0.1 µF. Such detrimental deviation is likely to cause Y5V and Z5U capacitors to fail to meet the minimum capacitance requirements of the LM2758. The voltage rating of the output capacitor must be 6.3 V or more. For example, a 6.3-V, 0603, 2.2-µF output capacitor (TDK C1608X5R0J225) is acceptable for use with the LM2758, as long as the capacitance on the output does not fall below a minimum of 1 µF in the intended application. All other capacitors must have a voltage rating at or above the maximum input voltage of the application and a minimum capacitance of 1 µF.

Table 3. Suggested Capacitors And Suppliers

MANUFACTURER PART NUMBER	TYPE	MANUFACTURER	VOLTAGE RATING	CASE SIZE INCH (mm)
2.2 µF for C_{IN} and C_{OUT}				
C1608X5R0J225	Ceramic X5R	TDK	6.3 V	0603 (1608)
JMK107BJ225	Ceramic X5R	Taiyo-Yuden	6.3 V	0603 (1608)
1 µF for C1 and C2				
C1608X5R0J105	Ceramic X5R	TDK	6.3 V	0603 (1608)
JMK107BJ105M	Ceramic X5R	Taiyo-Yuden	6.3 V	0603 (1608)

8.2.2.2 Power Efficiency

Efficiency of LED drivers is commonly taken to be the ratio of power consumed by the LEDs (P_{LED}) to the power drawn at the input of the part (P_{IN}). With a 1×/1.5× charge pump, the input current is equal to the charge pump gain times the output current (total LED current). The efficiency of the LM2758 can be predicted as follows:

$$P_{LED} = V_{LED} \times I_{LED} \quad (3)$$

$$P_{IN} = V_{IN} \times I_{IN} \quad (4)$$

$$P_{IN} = V_{IN} \times (Gain \times I_{LED} + I_Q) \quad (5)$$

$$E = (P_{LED} \div P_{IN}) \quad (6)$$

For a simple approximation, the current consumed by internal circuitry (I_Q) can be neglected, and the resulting efficiency will become:

$$E = V_{LED} \div (V_{IN} \times Gain) \quad (7)$$

Neglecting I_Q results in a slightly higher efficiency prediction, but this impact will be negligible due to the value of I_Q being very low compared to the typical torch and flash current levels (100 mA to 500 mA). It is also worth noting that efficiency as defined here is in part dependent on LED voltage. Variation in LED voltage does not affect power consumed by the circuit and typically does not relate to the brightness of the LED. For an advanced analysis, it is recommended that power consumed by the circuit (V_{IN} × I_{IN}) be evaluated rather than power efficiency.

8.2.3 Application Curves

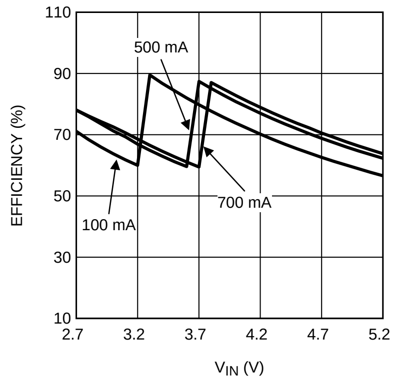
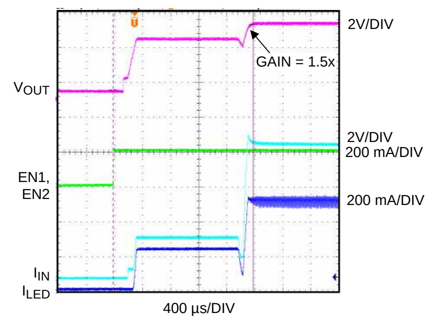
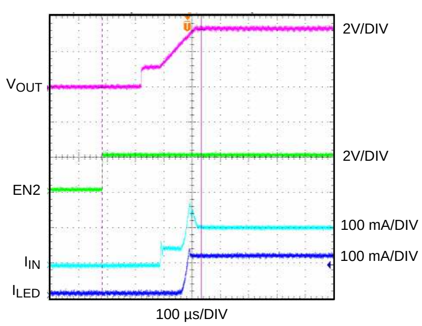


Figure 9. Efficiency vs V_{IN}



V_{IN} = 3.6 V I_{LED} = 500 mA

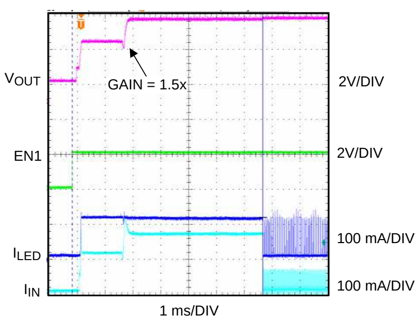
Figure 10. Shutdown to Flash Mode



V_{IN} = 3.6 V I_{LED} = 108 mA Gain = 1×

EN1 = 0 V

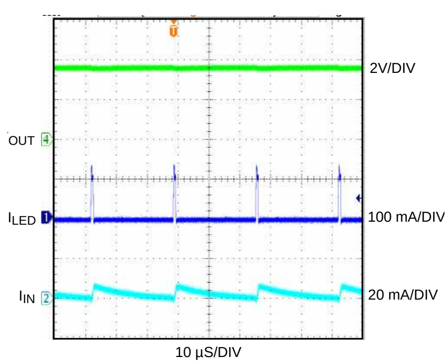
Figure 11. Shutdown to Torch Mode



V_{IN} = 3.6 V I_{LED} (torch) = 108 mA

EN2 = 0 V

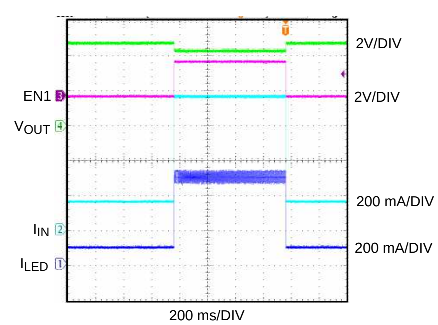
Figure 12. Shutdown to Indicator Mode



EN1 = V_{IN} = 3.6 V I_{LED} (torch) = 108 mA Gain = 1×

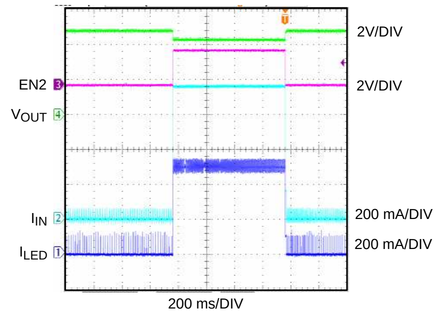
EN2 = 0 V

Figure 13. Indicator Mode



EN2 = V_{IN} = 3.6 V I_{LED} (flash) = 500 mA Gain = 1.5×

Figure 14. Torch to Flash Mode Transition



EN1 = V_{IN} = 3.6 V I_{LED} (flash) = 500 mA   Gain = 1.5×

Figure 15. Indicator to Flash Mode Transition

9 Power Supply Recommendations

The LM2758 is designed to operate from an input voltage supply range from 2.7 V to 5.5 V. This input supply must be well regulated and capable to supply the required input current. If the input supply is located far from the device, additional bulk capacitance may be required in addition to the ceramic bypass capacitors.

9.1 Power Dissipation

The power dissipation ($P_{DISSIPATION}$) and junction temperature (T_J) can be approximated with the equations below. P_{IN} is the power generated by the 1×/1.5× charge pump, P_{LED} is the power consumed by the LEDs, T_A is the ambient temperature, and $R_{\theta JA}$ is the junction-to-ambient thermal resistance for the 12-pin DSBGA package. V_{IN} is the input voltage to the LM2758, V_{LED} is the nominal LED forward voltage, and I_{LED} is the programmed LED current.

$$P_{DISSIPATION} = P_{IN} - P_{LED} \quad (8)$$

$$= (Gain \times V_{IN} \times I_{LED}) - (V_{LED} \times I_{LED}) \quad (9)$$

$$T_J = T_A + (P_{DISSIPATION} \times R_{J\theta A}) \quad (10)$$

The junction temperature rating takes precedence over the ambient temperature rating. The LM2758 may be operated outside the ambient temperature rating, so long as the junction temperature of the device does not exceed the maximum operating rating of 125°C. The maximum ambient temperature rating must be derated in applications where high power dissipation and/or poor thermal resistance causes the junction temperature to exceed 125°C.

10 Layout

10.1 Layout Guidelines

PC board layout is an important part of DC-DC converter design. Poor board layout can disrupt the performance of a DC-DC converter and surrounding circuitry by contributing to EMI, ground bounce, and resistive voltage loss in the traces. These can send erroneous signals to the DC-DC converter device, resulting in poor regulation or instability. Poor layout can also result in re-flow problems leading to poor solder joints between the DSBGA package and board pads. Poor solder joints can result in erratic or degraded performance.

10.2 Layout Example

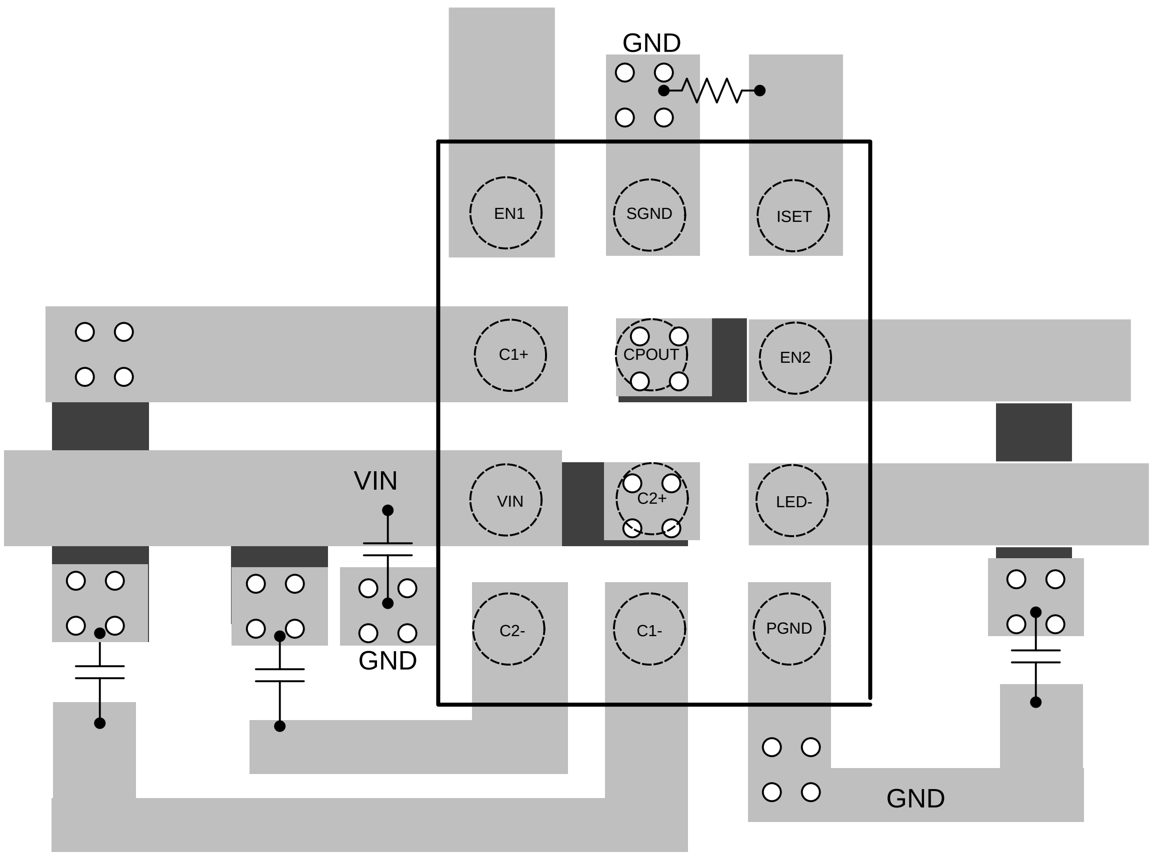


Figure 16. LM2758 Layout Example

10.3 DSBGA Package Assembly and Use

Use of the DSBGA package requires specialized board layout, precision mounting and careful re-flow techniques as detailed in *AN-1112 DSBGA Wafer Level Chip Scale Package* (SNVA009). Refer to the section *Surface Mount Assembly Considerations*" For best results in assembly, use alignment ordinals on the PC board to facilitate placement of the device. The pad style used with the DSBGA package must be the NSMD (non-solder mask defined) typical. This means that the solder-mask opening is larger than the pad size. This prevents a lip that otherwise forms if the solder mask and pad overlap, from holding the device off the surface of the board and interfering with mounting. See SNVA009 for specific instructions how to do this. The 12-pin package used for LM2758 has 300 micron solder balls and requires 10.82 mils pads for mounting on the circuit board. The trace to each pad should enter the pad with a 90° entry angle to prevent debris from being caught in deep corners. Initially, the trace to each pad should be 7 mil. wide, for a section approximately 7 mil. long or longer, as a thermal relief. Then each trace should neck up or down to its optimal width. The important criteria is symmetry. This ensures the solder bumps on the LM2758 re-flow evenly and that the device solders level to the board. In particular, special attention must be paid to the pads for bumps C1 and D3, because VIN and GND are typically connected to large copper planes, thus inadequate thermal relief can result in late or inadequate re-flow of these bumps.

The DSBGA package is optimized for the smallest possible size in applications with red or infrared opaque cases. Because the DSBGA package lacks the plastic encapsulation characteristic of larger devices, it is vulnerable to light. Backside metallization and/or epoxy coating, along with front side shading by the printed circuit board, reduce this sensitivity. However, the package has exposed die edges. In particular, DSBGA devices are sensitive to light, in the red and infrared range, shining on the exposed die edges of the package.

11 器件和文档支持

11.1 器件支持

11.1.1 Third-Party Products Disclaimer

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11.2 文档支持

11.2.1 相关文档

更多信息，请参见以下文档：

AN-1112《DSBGA 晶圆级芯片规模封装》（文献编号：SNVA009）

11.3 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

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Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

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ESD 的损坏小至导致微小的性能降级，大至整个器件故障。 精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

11.6 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

12 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM2758TL/NOPB	Active	Production	DSBGA (YZR) | 12	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	2758
LM2758TL/NOPB.A	Active	Production	DSBGA (YZR) | 12	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	2758
LM2758TLX/NOPB	Active	Production	DSBGA (YZR) | 12	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	2758
LM2758TLX/NOPB.A	Active	Production	DSBGA (YZR) | 12	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	2758

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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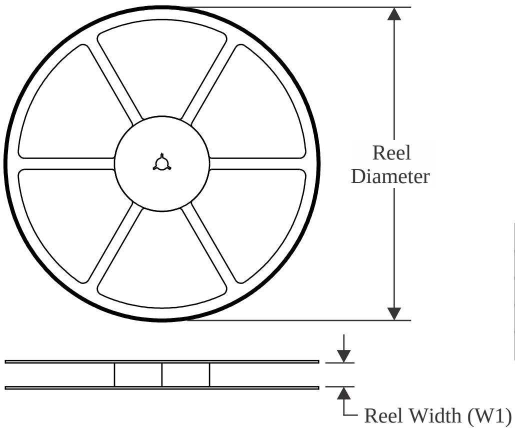
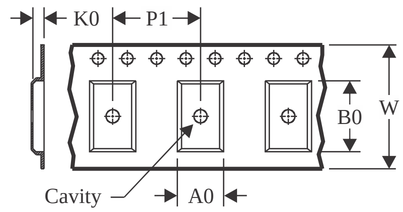
TAPE AND REEL INFORMATION

REEL DIMENSIONS

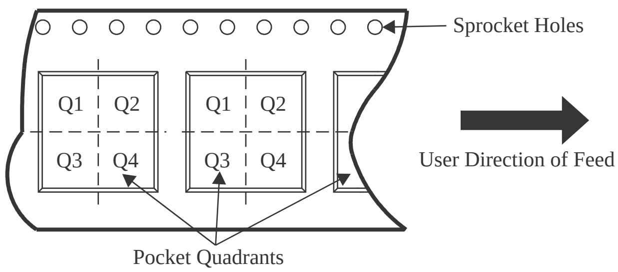


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

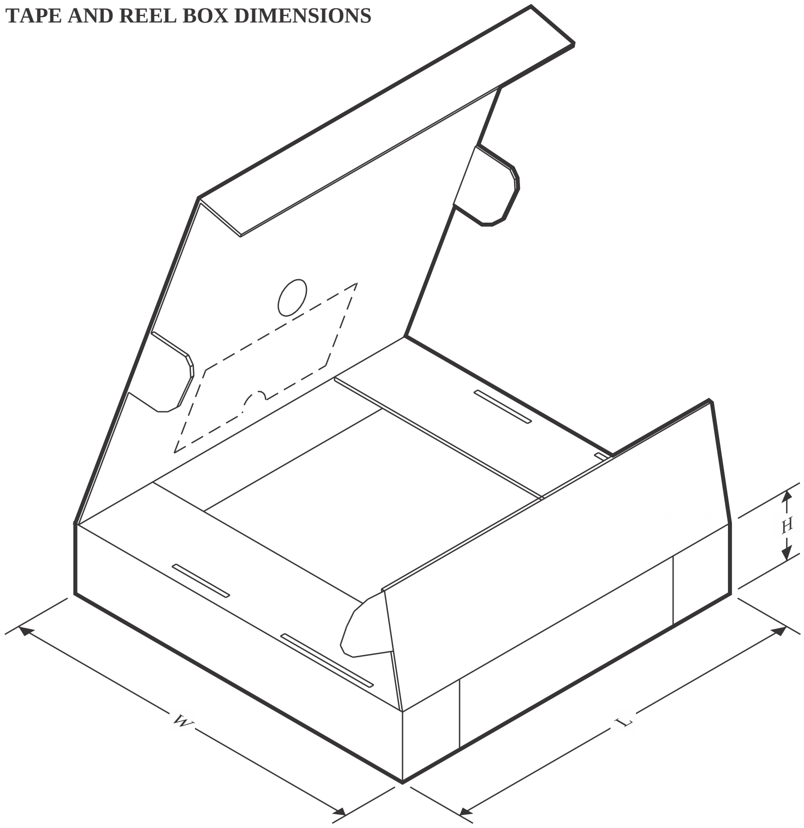
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM2758TL/NOPB	DSBGA	YZR	12	250	178.0	8.4	1.68	2.13	0.76	4.0	8.0	Q1
LM2758TLX/NOPB	DSBGA	YZR	12	3000	178.0	8.4	1.68	2.13	0.76	4.0	8.0	Q1

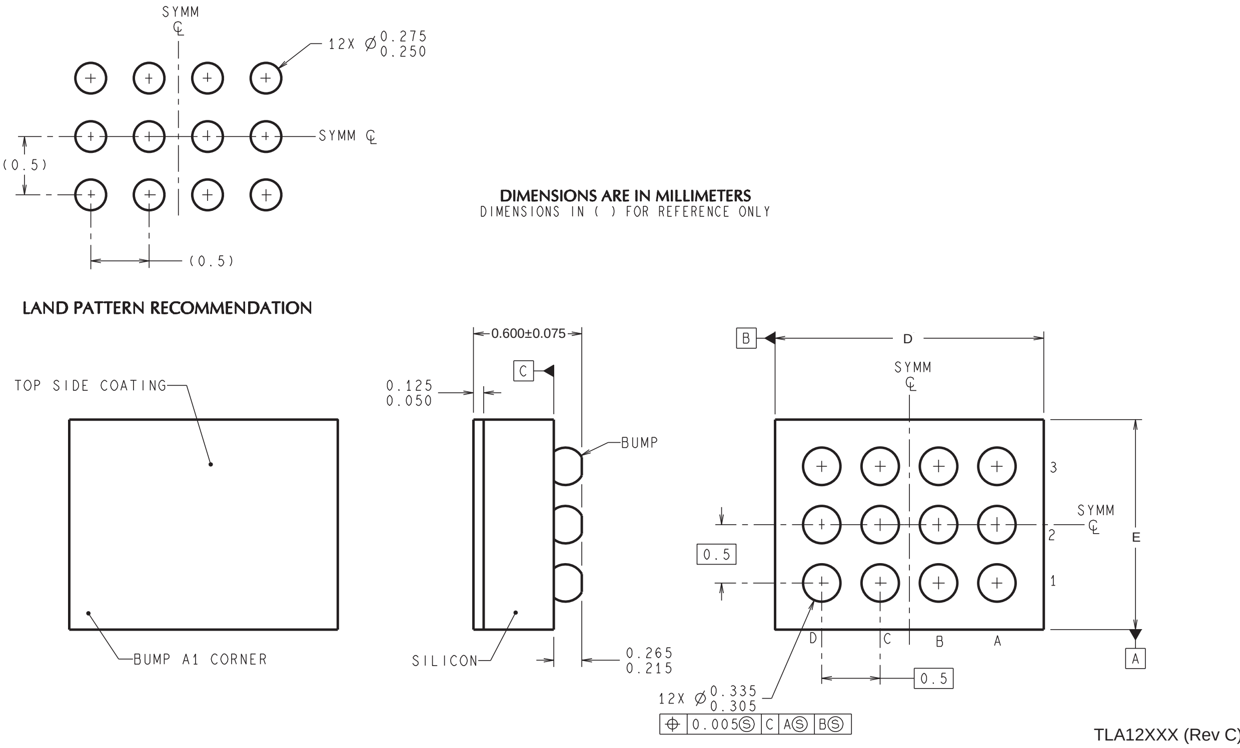
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2758TL/NOPB	DSBGA	YZR	12	250	210.0	185.0	35.0
LM2758TLX/NOPB	DSBGA	YZR	12	3000	210.0	185.0	35.0

YZR0012



D: Max = 2.022 mm, Min =1.962 mm

E: Max = 1.527 mm, Min =1.466 mm

4215049/A 12/12

NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
B. This drawing is subject to change without notice.

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