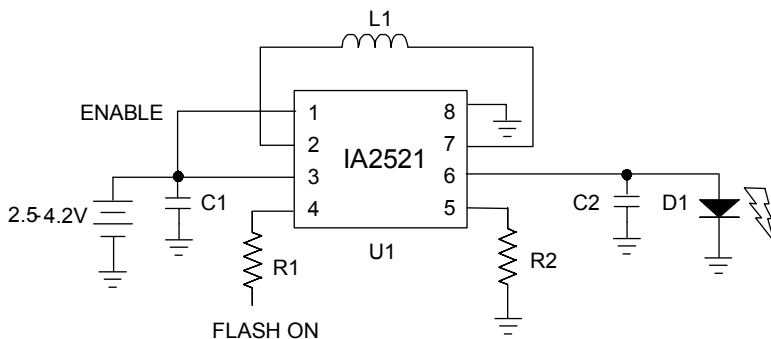


IA2521 Camera Flash LED Driver

DESCRIPTION

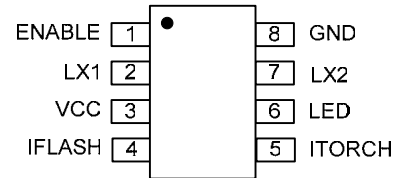
IA2521 is a low-cost integrated synchronous buck-boost converter IC specifically designed for driving camera flash LEDs, both for flash and for flashlight (torch) operation. It can be operated from a single Lithium cell or two alkaline cells, and drives a single LED with high efficiency at up to 2W of continuous power, with pulses up to 4W. The IA2521 device has its torch-mode output current controlled by a resistor to ground, flash-mode current controlled by a resistor to logic, and pulse time controlled by an ENABLE signal. Full flash brightness is reached as quickly as a xenon tube. The IA2521 incorporates spread-spectrum switching to minimize EMI, is self-protected against open-string conditions and thermal overloads, and is available in an MSOP-8 and QFN16 3x3 packages.

TYPICAL APPLICATION DIAGRAM

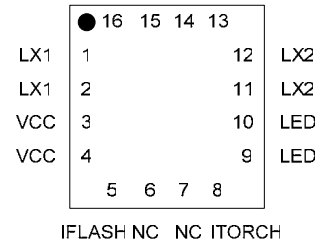


IA2521

PIN ASSIGNMENT



ENABLE GND GND GND

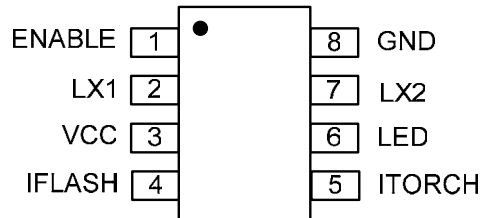


See back page for ordering information.

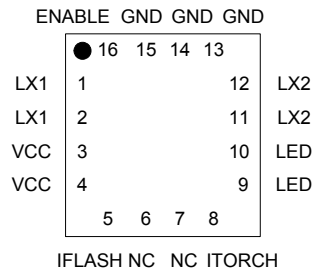
FEATURES

- Buck-boost converter for LED camera flash
- Full flash brightness in 100µsec
- High-efficiency synchronous operation, no diodes; up to 95% efficiency
- Battery voltage higher or lower than LED voltage
- Flashlight mode
- Spread-spectrum switching for EMI control
- Up to 2W continuous, 4W pulse output power
- 2.5V to 5.5V input voltage range
- Single resistor for each brightness setting
- Self-protected against open string and thermal overload
- Inductor current is automatically current-limited
- 1µA maximum shutdown current
- MSOP-8 and QFN16 3x3 packages

PACKAGE PIN DEFINITIONS



MSOP-8



QFN16 3x3

Pin Number (MSOP-8)	Pin Number (QFN)	Pin Name	Pin Function
1	16	ENABLE	Enable. Pulling this pin high turns on the IC.
2, 7	1-2, 11-12	LX	Switch Node. Connections to internal power MOSFETs. Attach to inductor.
3	3, 4	VCC	VCC. Battery input to run the IC and power the LED.
4	5	IFLASH	Flash-Mode Current Set. A resistor to ground sets the additional output current. Pulling this pin high, or open, turns off the additional current.
5	8	ITORCH	Torch-Mode Current Set. A resistor to ground sets the output current.
6	9, 10	LED	LED Anode. Output power. Connect this pin to the anode of the LED, along with a capacitor.
8	13-15	GND	Ground.

ELECTRICAL SPECIFICATION

Absolute Maximum Ratings

Parameter	Min	Max	Units
VCC	-0.3	+6.5	V
LX	-0.3	+6.5	V
All other pins	-0.3	VCC + 0.3	V
Max current LX, VCC, LED pins		2	A
Max current other pins	-50	50	mA
Continuous power dissipation (70°C) - <i>MSOP</i> (Derate above 70°C)		445 8.1	mW mW/°C
Continuous power dissipation (70°C) - <i>QFN</i> (Derate above 70°C)		900 16.4	mW mW/°C
Ambient operating temperature	-40	+85	°C
Avalanche energy		Power Limited	J
Storage temperature		- 65 to +150	°C
Max lead temperature during soldering (5 sec.)		260	°C

Note 1. Operation beyond absolute maximum rating or improper use may result in permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods or to conditions beyond absolute maximum rating conditions may adversely affect device reliability. Functional operation under absolute maximum rating conditions is not implied.

Note 2. Devices are ESD sensitive. Handling precautions recommended.

Operating Ratings

Parameter	Min	Max	Units
Supply voltage	3.0	4.3	V
Continuous Output Current		250	mA
Pulse Output Current		1	A
LX Voltage		5	V

Note 3. The device is not designed to function outside its operating ratings.

Electrical Characteristics

Test conditions $T_A = 25\text{ }^\circ\text{C}$, $V_{CC}=3.5\text{V}$, unless otherwise noted.

The • denotes specifications which apply over the full operating temperature range.

Parameters	Condition	Min	Typ	Max	Units	
VCC						
Leakage Current	ENABLE = Low	•		3	μA	
ENABLE						
Threshold	Low-to-High High-to-Low	• •	0.8	2.6	V V	
Input Current	ENABLE = High ENABLE = Low	• •	-1	1	μA	
Torch Mode Turn-on Time			300		μsec	
Flash Mode Turn-on Time			100		μsec	
LX						
Switch Resistance	High-Side Low-Side		215 185		m Ω m Ω	
Current Limit		•	2	2.2	A	
ITORCH						
Current Output	ITORCH = 150K Ω , IFLASH Open		170	250	320	mA
Current Temperature Variation	ITORCH = 150K Ω , IFLASH Open	•		± 5		%
ITORCH Range	ITORCH = 1M Ω to 120K Ω , IFLASH Open		40		350	mA
IFLASH						
Current Output	IFLASH = 50K Ω , ITORCH = 150k Ω		700	1000	1300	mA
Current Temperature Variation	IFLASH = 50K Ω , ITORCH = 150k Ω	•		± 5		%
IFLASH Range	IFLASH = 1M Ω to 70K Ω , ITORCH = 150k Ω		150		1000	mA
Rise Time	ILED 200mA to 1A			85		μsec
OTHER						
Switching frequency			400	500	600	kHz
Frequency Temperature Variation		•		± 10		%
Frequency Dither				± 20		%
Dither Dwell				128		Cycles
Efficiency	ILED = 200mA ILED = 700mA			95 89		% %
Maximum Duty Cycle				80		%
Open Circuit Output Voltage Clamp				6.0		V
Thermal Shutdown				150		$^\circ\text{C}$
Thermal Shutdown Hysteresis				30		$^\circ\text{C}$

DETAILED DESCRIPTION

The IA2521 device is a low-cost integrated synchronous buck-boost converter IC specifically designed for driving camera flash LEDs, both for flash and for flashlight (torch) operation. It can be operated from a single lithium cell or two alkaline cells, and drives a single LED with high efficiency at up to 2W of continuous power, with pulses up to 4W. The IA2521 device has its torch-mode output current controlled by a resistor to ground, flash-mode current controlled by a resistor to logic, and pulse time controlled by an ENABLE signal. Full flash brightness is reached as quickly as a xenon tube. The IA2521 incorporates spread-spectrum switching to minimize EMI, is self-protected against open-string conditions and thermal overloads, and is available in an MSOP-8 and QFN16 3x3 packages.

Startup

The IA2521 device does not require a soft-start. It has a current limit that is designed to avoid damage to the IC even by a short circuit. At startup, then, it simply runs at maximum current until the output capacitor is charged to the voltage necessary to get the current set for the LED, at which time it enters normal operation.

In normal operation, it is anticipated that the IA2521 will be started up in torch mode.

Normal Operation

In normal operation, the IA2521 device either boosts or bucks the input voltage to another DC voltage, whichever is necessary to obtain the set LED current. The current is regulated by measuring internally the output current, and regulating the DC output voltage to be such that the current is as set.

Output current is set by the combination of the two resistors attached to the two ISET pins. The ITORCH pin must always have a resistor to ground. The IFLASH pin may be open, or have a resistor to ground; it may be attached directly to a logic level control.

When the IFLASH pin is open, the output current of the IA2521 is:

$$I = 125mA \times \frac{280K\Omega}{R_{TORCH}}$$

When the IFLASH pin has a resistor to ground, the output current of the IA2521 is:

$$I = \left(125mA \times \frac{280K\Omega}{R_{TORCH}} \right) + \left(500mA \times \frac{70K\Omega}{R_{FLASH}} \right)$$

Since the torch mode is nominally at 250mA, the torch mode resistor will be nominally at 140KΩ.

Flash-Mode Operation

To operate the IA2521 as a camera flash driver, recommended operation is to first enable the IC, with the IFLASH resistor open. The IA2521 will come up and regulate the LED current at the torch-mode setting in approximately 300μsec. After that, the IFLASH resistor may be pulled to ground. The output current to the LED will step from its torch-mode setting to its flash-mode setting in approximately 100μsec, the same rise time as seen in typical xenon-flash tubes.

Input Capacitor

It may be desirable to include an input capacitor to this circuit. Even when the input to the converter is a battery, batteries have limited ability to source high-frequency currents. Thus, there may be significant voltage drops at the input unless an input capacitor is used.

NOTE: The input capacitor must be rated to take the AC ripple current.

Output Capacitor

Typical usage will require a ceramic capacitor at the output of the converter. The output capacitor of a boost converter sees high ripple current. The capacitor must be rated to take this current.

Enable

The IA2521 device can be turned off by pulling the ENABLE pin low. In this condition, there is extremely low leakage current into the IC, and no current into the LED.

Open LED

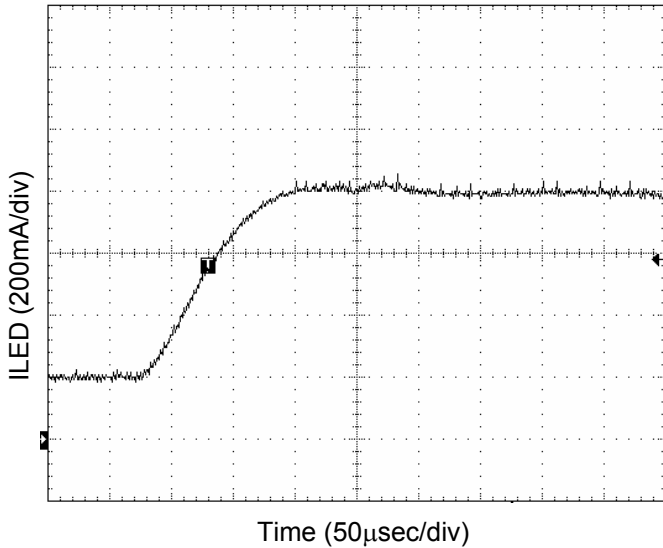
If the output of the IA2521 device is open, as might happen if the LED fails open, the output voltage of the IA2521 will go up to approximately 6V. The IC will not be damaged by this condition.

Thermal Shutdown

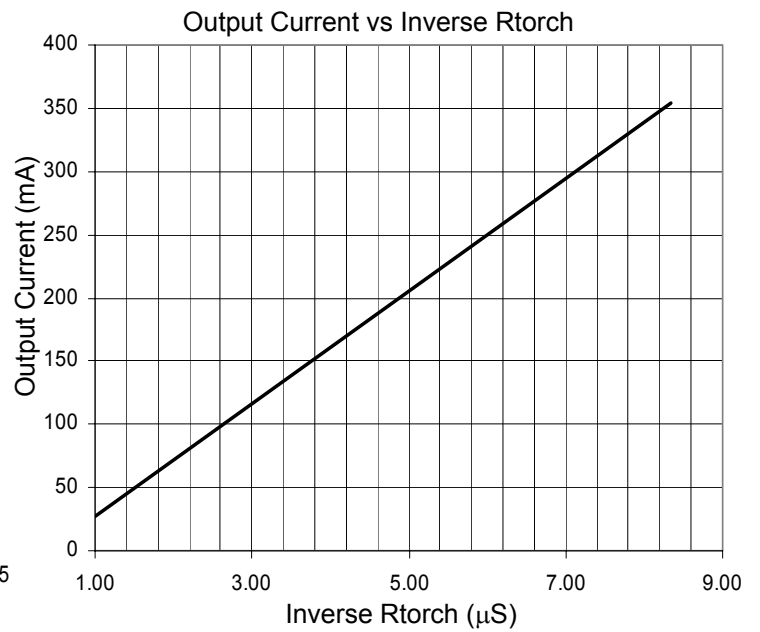
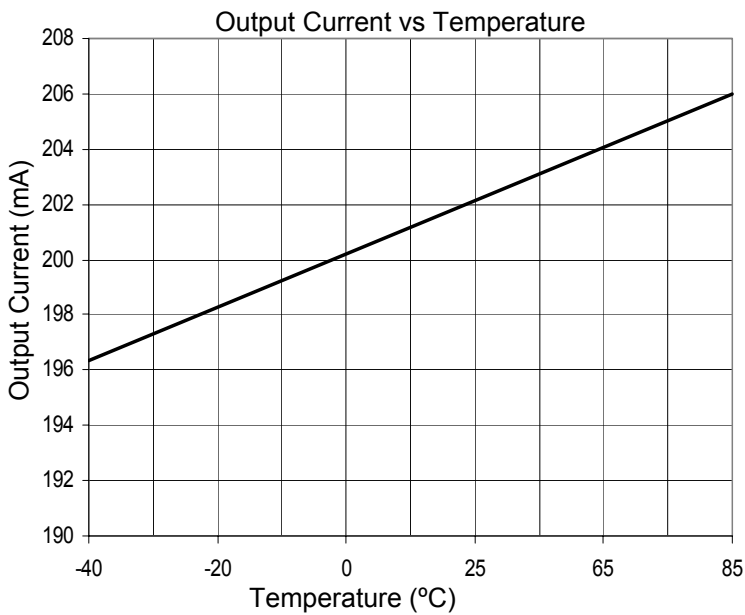
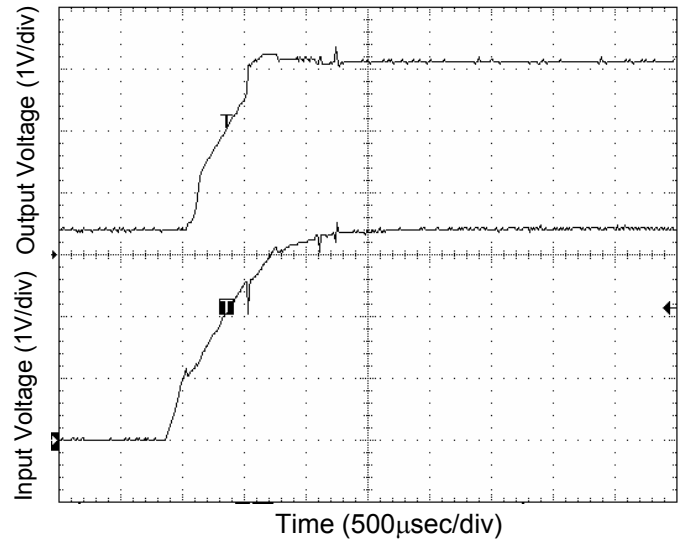
If the IA2521 device die becomes excessively hot, the IC will shut itself down. It will then resume normal operation after cooling down sufficiently.

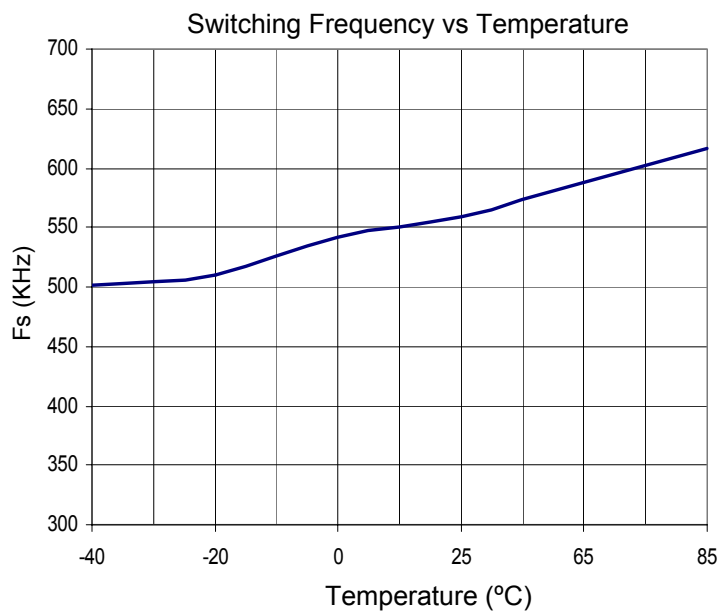
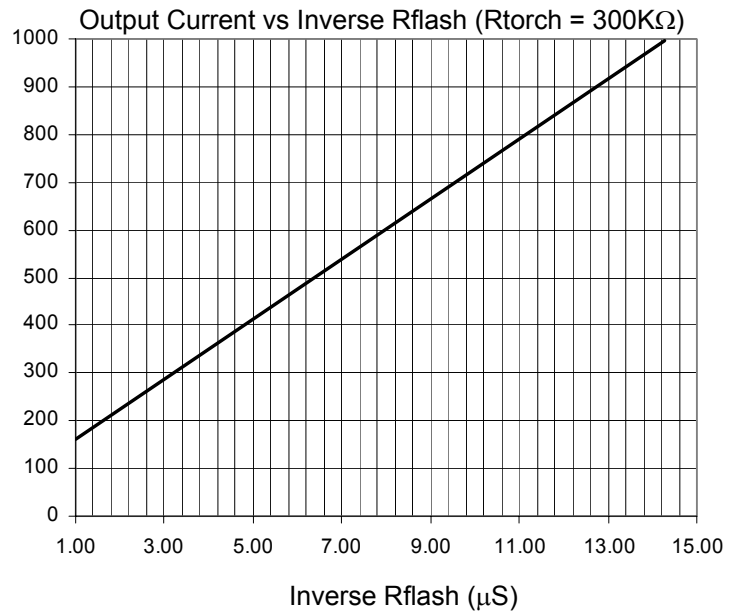
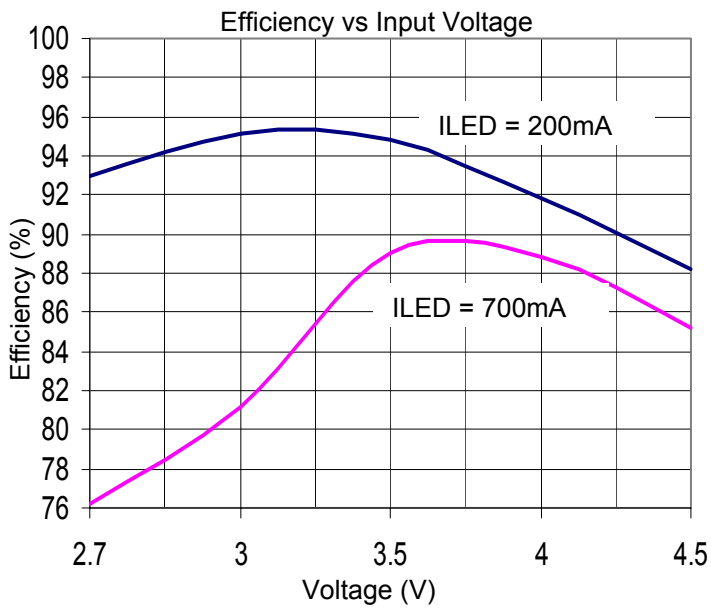
TYPICAL CHARACTERISTICS

Torch to Flash Rise Time



Turn-on Time





TYPICAL APPLICATIONS

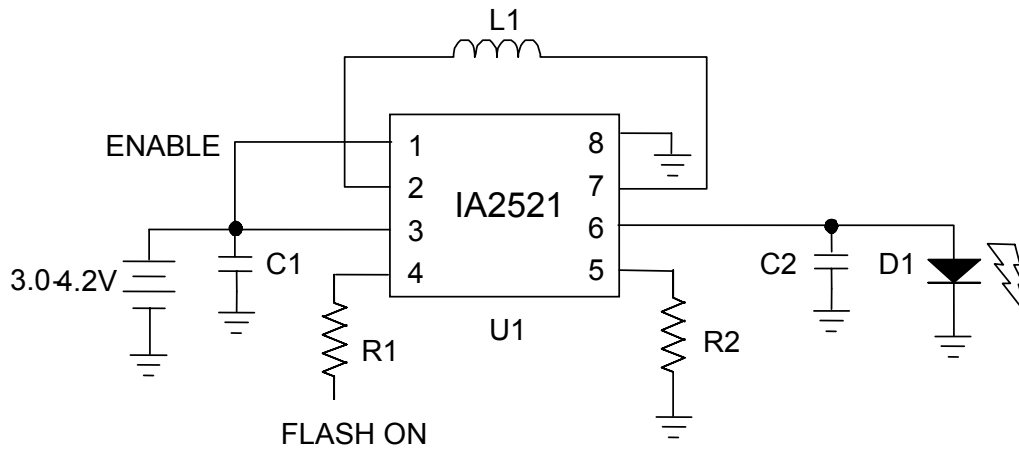


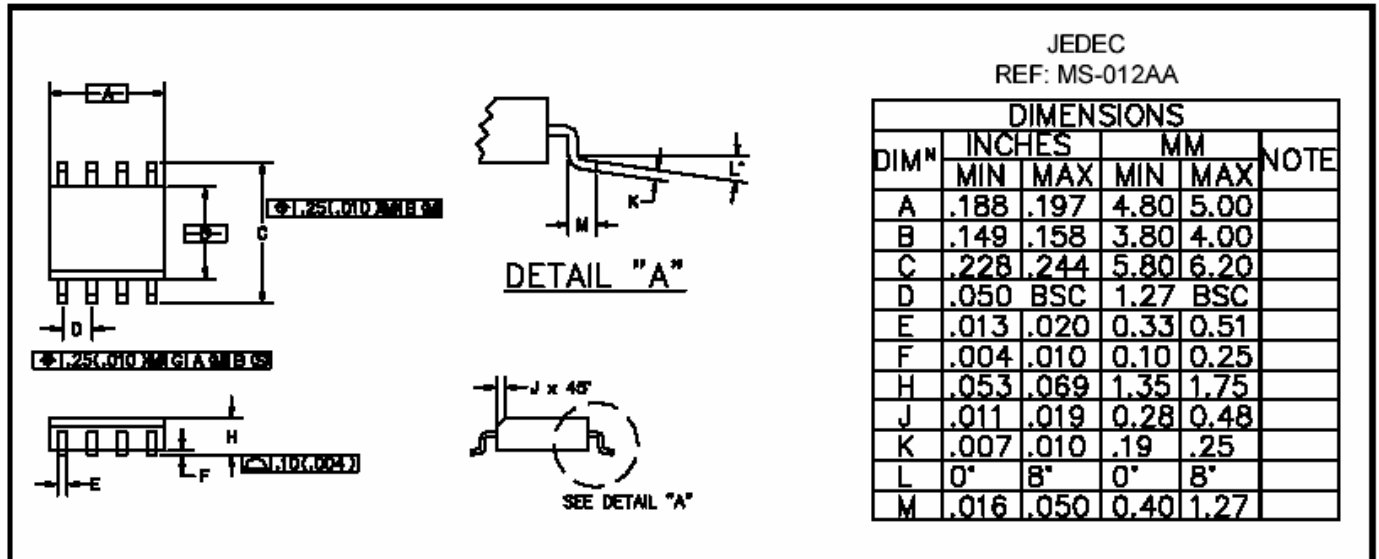
Figure 6: Application Circuit for 3W LED, 200mA Torch, 1A Flash for Cell Phone

Application Bill of Materials for Application Schematic Above:

Reference	Manufacturer Example Part #	Quantity	Description	Notes
C1-2	Any	2	2.2 μ F, 6.3V Ceramic Cap	0805
D1	Lumileds LXHL-PW09	1	3W Super-Bright White LED, Luxeon III Emitter	
R1	Any	1	100K Ω	
R2	Any	1	240K Ω	
L1	Any	1	1.5 μ H, 31m Ω	I _{SAT} > 1.8A
U1	IA2521	1	Camera Flash LED Driver IC	

PACKAGE INFORMATION

MSOP-8



MSOP-8 PACKAGE NOTES:

Dimensions and tolerance per ANSI Y14.5M-1982.

Dimensions A and B are datums and T is a datum surface.

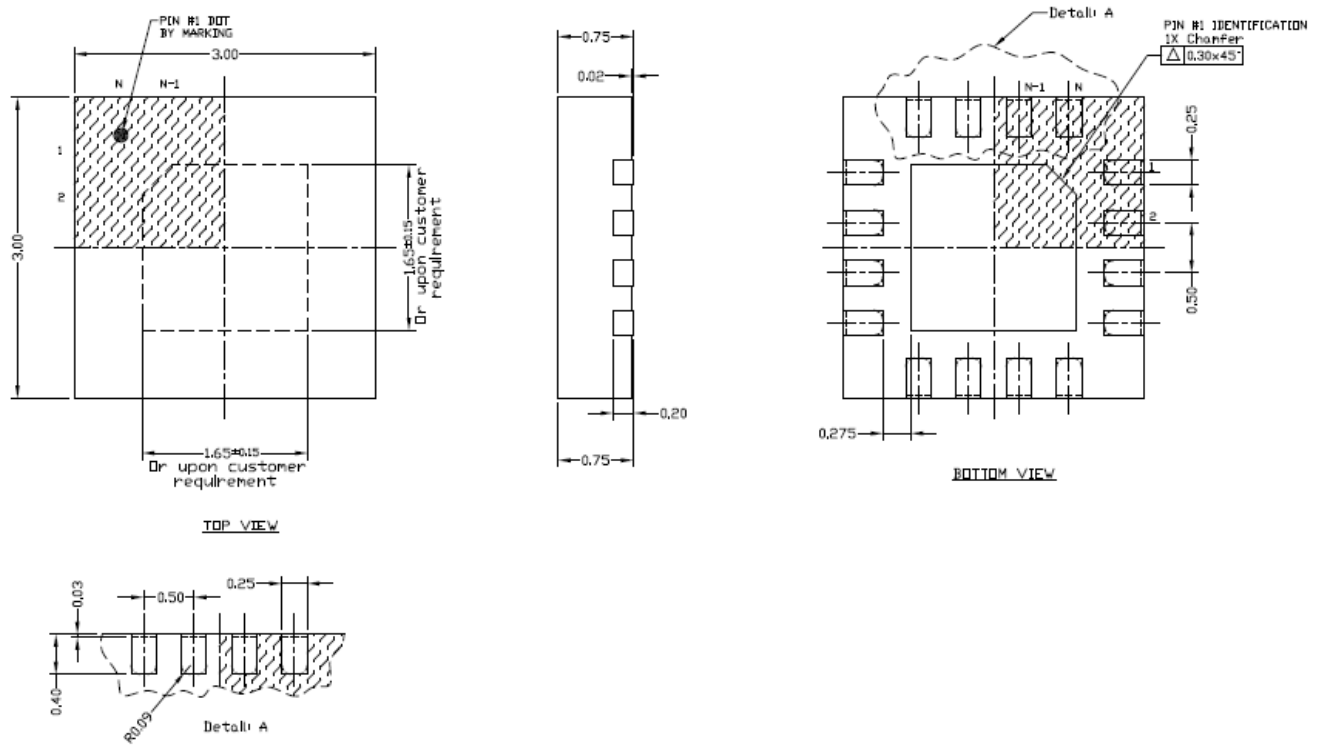
Controlling dimensions: Millimeters

Dimension A and B do not include mold flash. Mold flash shall not exceed 0.15mm [0.006] per side.

Dimension D does not include interlead flash. Interlead flash shall not exceed 0.25 mm [0.010].

PACKAGE INFORMATION

QFN16 3x3



QFN-16 PACKAGE NOTES:

Dimensions and tolerance per ANSI Y14.5M-1982.

Dimensions A and B are datums and T is a datum surface.

Controlling dimensions: Millimeters

Dimension A and B do not include mold flash. Mold flash shall not exceed 0.15mm [0.006] per side.

Dimension D does not include interlead flash. Interlead flash shall not exceed 0.25 mm [0.010].

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RELATED PRODUCTS AND DOCUMENTS

IA2521 Camera Flash LED Driver

DESCRIPTION	ORDERING NUMBER	Revision #
IA2521 MSOP-8	IA2521-IC CD8	Revision #
IA2521 QFN16 3x3	IA2521-IC CK16	Revision #

Demo Boards and Development Kits

DESCRIPTION	ORDERING NUMBER
TBD	See www.integration.com for details
TBD	See www.integration.com for details

Related Resources

DESCRIPTION	ORDERING NUMBER
TBD	See www.integration.com for details
TBD	See www.integration.com for details
TBD	See www.integration.com for details
TBD	See www.integration.com for details

Note: Volume orders must include chip revision to be accepted.

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