NEW PRODUCT

SINGLE STAGE PRIMARY SIDE REGULATION PFC CONTROLLER FOR DIMMABLE LED DRIVER

Description

The AP1690 is a high performance AC/DC universal input Primary Side Regulation Power Factor Controller for dimmable LED driver applications.

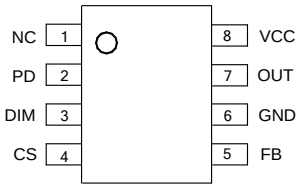
The AP1690 provides accurate constant current (CC) regulation while removing the opto-coupler and secondary control circuitry. It also eliminates the need of loop compensation circuitry while maintaining stability. The AP1690 achieves excellent regulation and high efficiency, yet meets the requirement of IEC61000-3-2 harmonic standard.

The AP1690 features low start-up current, low operation current and high efficiency. It also has rich protection features including over voltage, short circuit, over current, over temperature protection etc. In order to regulate the output current of LED current with the phase of dimmer, pin 2 and pin 3 are used to set the peak current of transformer according to the voltage applied to these two pins.

The AP1690 is available in SO-8 package.

Pin Assignments

(Top View)



(SO-8/ M Package)

Features

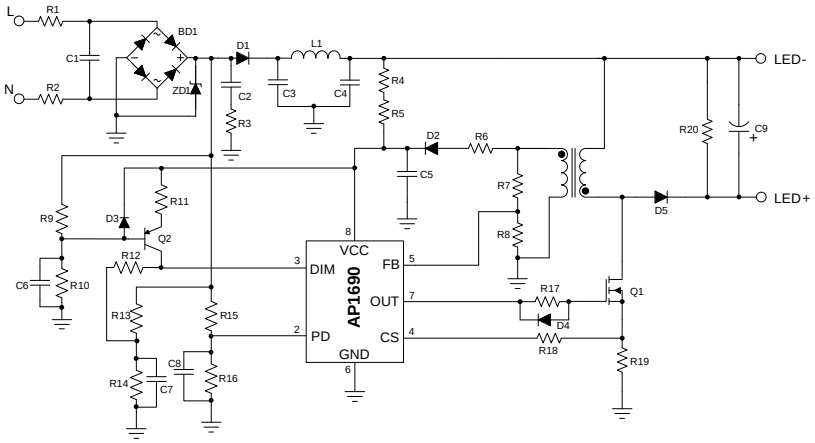
- Primary Side Control for Output Current Regulation Without Opto-coupler and Secondary CV/CC Control Circuitry
- Low Start-up Current
- Good Dimmer Compatibility
- Tight CC Regulation Performance for Universal Input Mains Voltage Range
- Eliminates Control Loop Compensation Circuitry
- Built-in Acceleration Start
- LED Open Protection
- LED Short Circuit Protection
- Over Temperature Protection
- Over Current Protection
- Cost Effective for Dimmable LED Driver Solution
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

- Single Stage Power Factor Correction Power Supply for Dimmable LED Lighting

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Applications Circuit



Non-isolated

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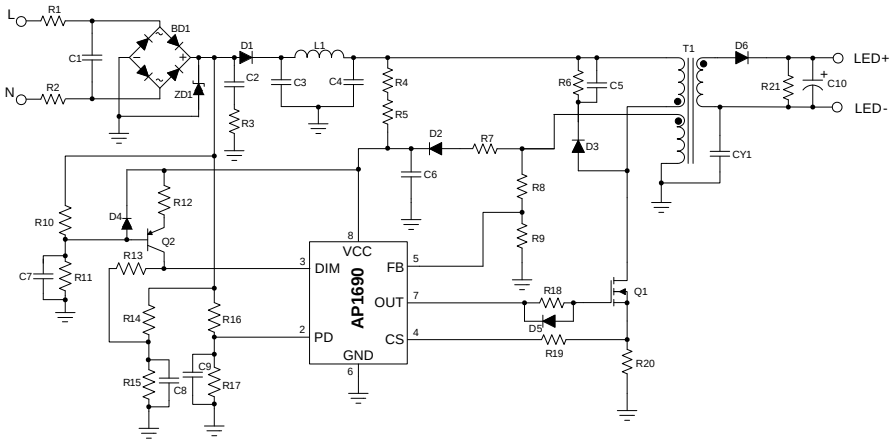
Typical Applications Circuit (Cont.)



Isolated

Pin Descriptions

Pin Number	Pin Name	Function
1	NC	No connection
2	PD	The rectified input voltage sensing pin. The pin is detecting the phase of dimmer
3	DIM	The rectified input voltage sensing pin. The pin is detecting the average AC input voltage
4	CS	Primary current sensing
5	FB	This pin captures the feedback voltage from the auxiliary winding. FB voltage is used to control no load output voltage and determine acceleration stop point at start-up phase
6	GND	Ground. Current return for gate driver and control circuits of the IC
7	OUT	Gate driver output
8	VCC	Supply voltage of gate driver and control circuits of the IC

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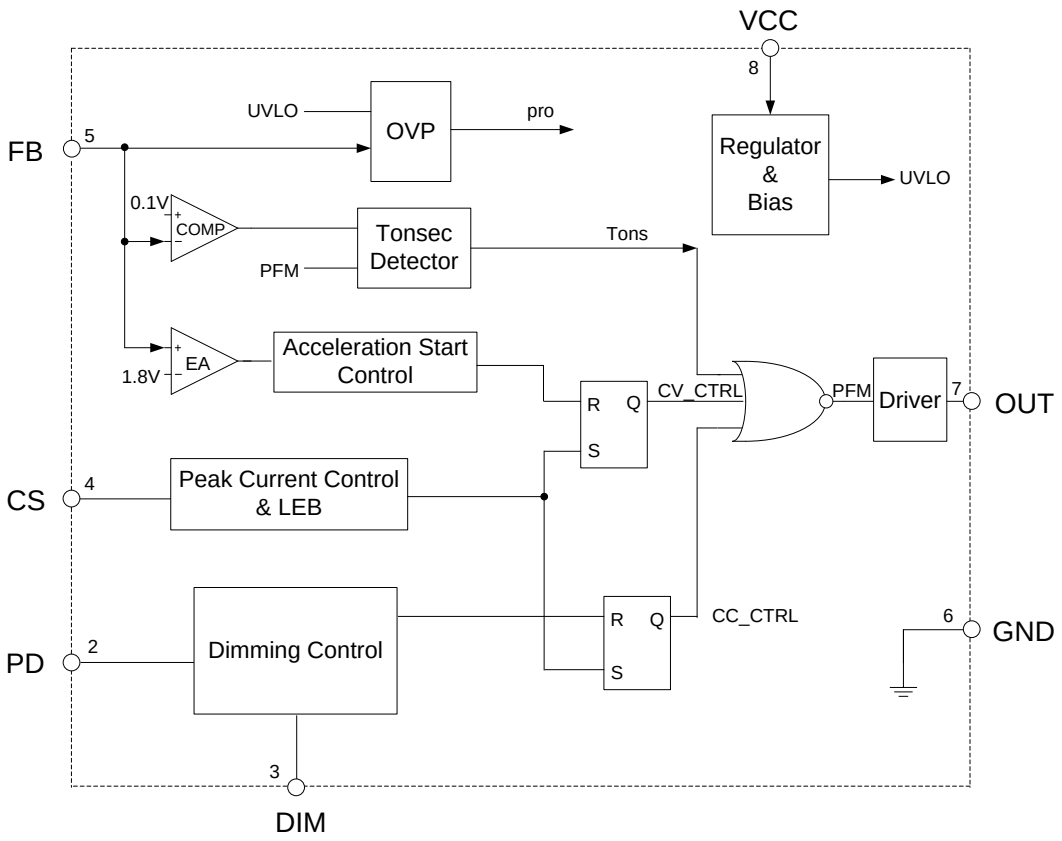
Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply Voltage	-0.3 to 30	V
I_{OUT}	Driver Output Current	300	mA
V_{PD}, V_{DIM}, V_{CS}	Voltage at PD, DIM, CS	-0.3 to 7	V
V_{FB}	FB Input Voltage	-40 to 10	V
T_J	Operating Junction Temperature	+150	ºC
T_{STG}	Storage Temperature	-65 to +150	ºC
T_{LEAD}	Lead Temperature (Soldering, 10 sec)	+300	ºC
P_D	Power Dissipation at T_A = +50°C	0.65	W
θ_{JA}	Thermal Resistance (Junction to Ambient)	190	°C/W
–	ESD (Machine Model)	200	V
–	ESD (Human Body Model)	3000	V

Note 4: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

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Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{CC}	Power Supply Voltage	9	21	V
T_A	Ambient Temperature	-40	+105	ºC

Electrical Characteristics (@V_{CC} = 15V, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
UVLO Section						
V_{TH} (ST)	Start-up Threshold	–	18	19	20	V
V_{OPR} (Min)	Minimal Operating Voltage	After turn on	7	8	9	
V_{CC_OVP}	VCC OVP Voltage	–	28	32	36	
Standby Current Section						
I_{ST}	Start-up Current	V_{CC} = V_{TH} (ST)-0.5V, Before start up	–	–	100	µA
I_{CC} (Max)	Maximum Operating Current	V_{PD} = V_{DIM} = 3V	–	1500	2000	
Drive Output Section						
V_{OH}	Output High Level Voltage	$I_{GD-SOURCE}$ = 20mA V_{CC} = 12V	10	–	–	V
V_{OL}	Output Low Level Voltage	$I_{GD-SINK}$ = 20mA V_{CC} = 12V	–	–	1	V
t_R	Output Voltage Rise Time	C_L = 1nF	100	140	190	ns
t_F	Output Voltage Fall Time	C_L = 1nF	30	60	90	ns
$V_{O-CLAMP}$	Output Clamp Voltage	$I_{GD-SOURCE}$ = 5mA V_{CC} = 20V	12	13.5	15	V
Current Sense Section						
t_{ON} (Min)	Minimum On Time	–	500	750	1000	ns
V_{SOCP}	Short Circuit Protection Voltage	–	3	4	–	V
Feedback Input Section						
I_{FB}	FB Pin Input Leakage Current	V_{FB} = 4V	–	2	8	µA
V_{FB} (ACC)	Acceleration Start Threshold	–	1.4	1.8	2.2	V
V_{FB} (OVP)	Over Voltage Protection	–	4.5	6	7.5	V
Dimming Section						
V_{IN}	PD Pin and DIM Pin Input Voltage Range	–	–	3	6	V

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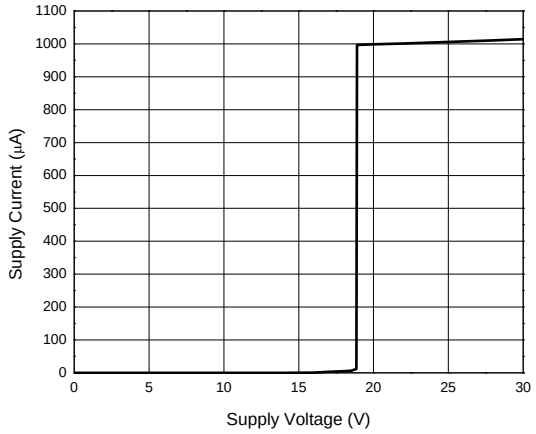
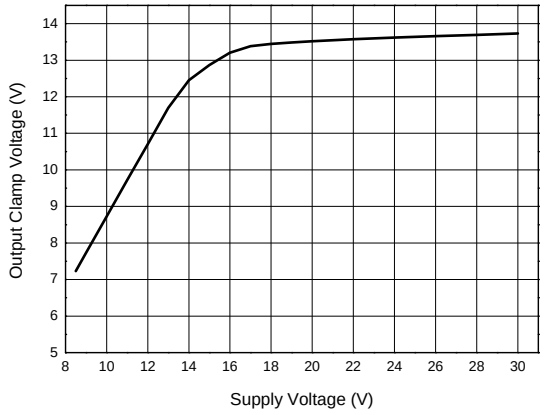
Performance Characteristics

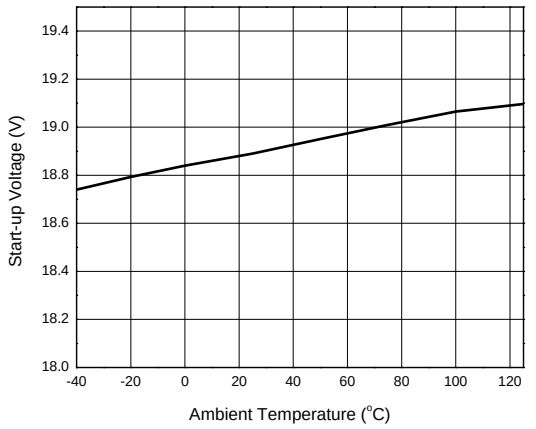
Supply Current vs. Supply Voltage



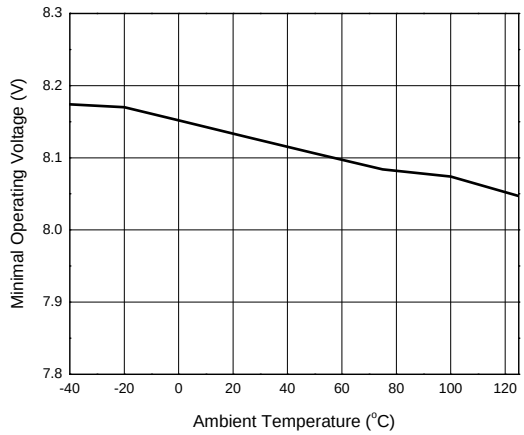
Output Clamp Voltage vs. Supply Voltage



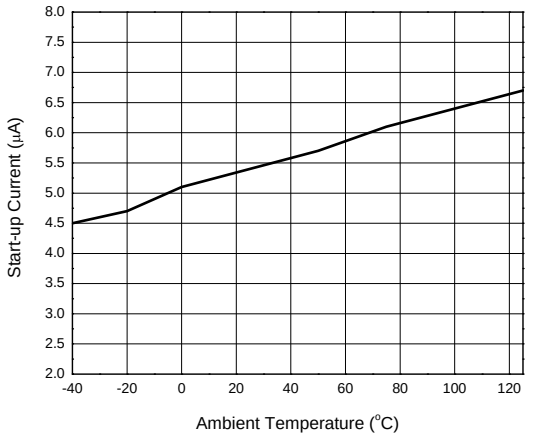
Start-up Voltage vs. Ambient Temperature



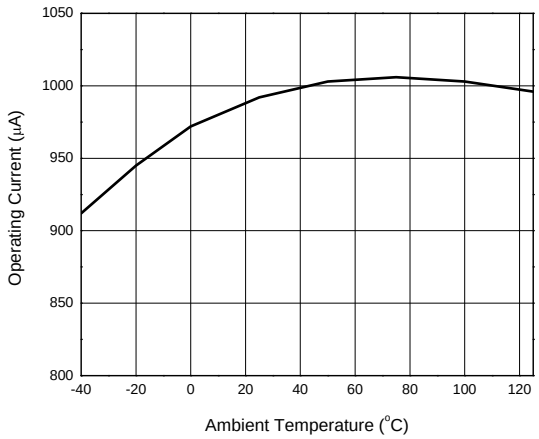
Minimal Operating Voltage vs. Ambient Temperature



Start-up Current vs. Ambient Temperature



Operating Current vs. Ambient Temperature



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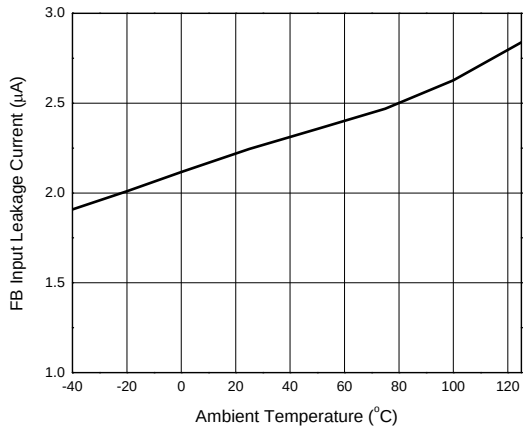
Performance Characteristics (Cont.)

FB Input Leakage Current vs. Ambient Temperature



Ordering Information

AP1690 X XX - G1

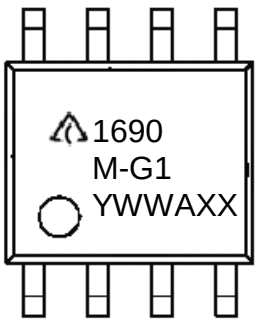
Product Name	Package	Packing	RoHS/Green
	M : SO-8	TR : Tape & Reel	G1 : Green

Diodes IC's Pb-free products with "G1" suffix in the part number, are RoHS compliant and green.

Package	Temperature Range	Part Number	Marking ID	Packing
SO-8	-40 to +105°C	AP1690MTR-G1	1690M-G1	4000/13''Tape & Reel

Marking Information

(Top View)



First and Second Lines: Logo and Marking ID
(See Ordering Information)
Third Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.

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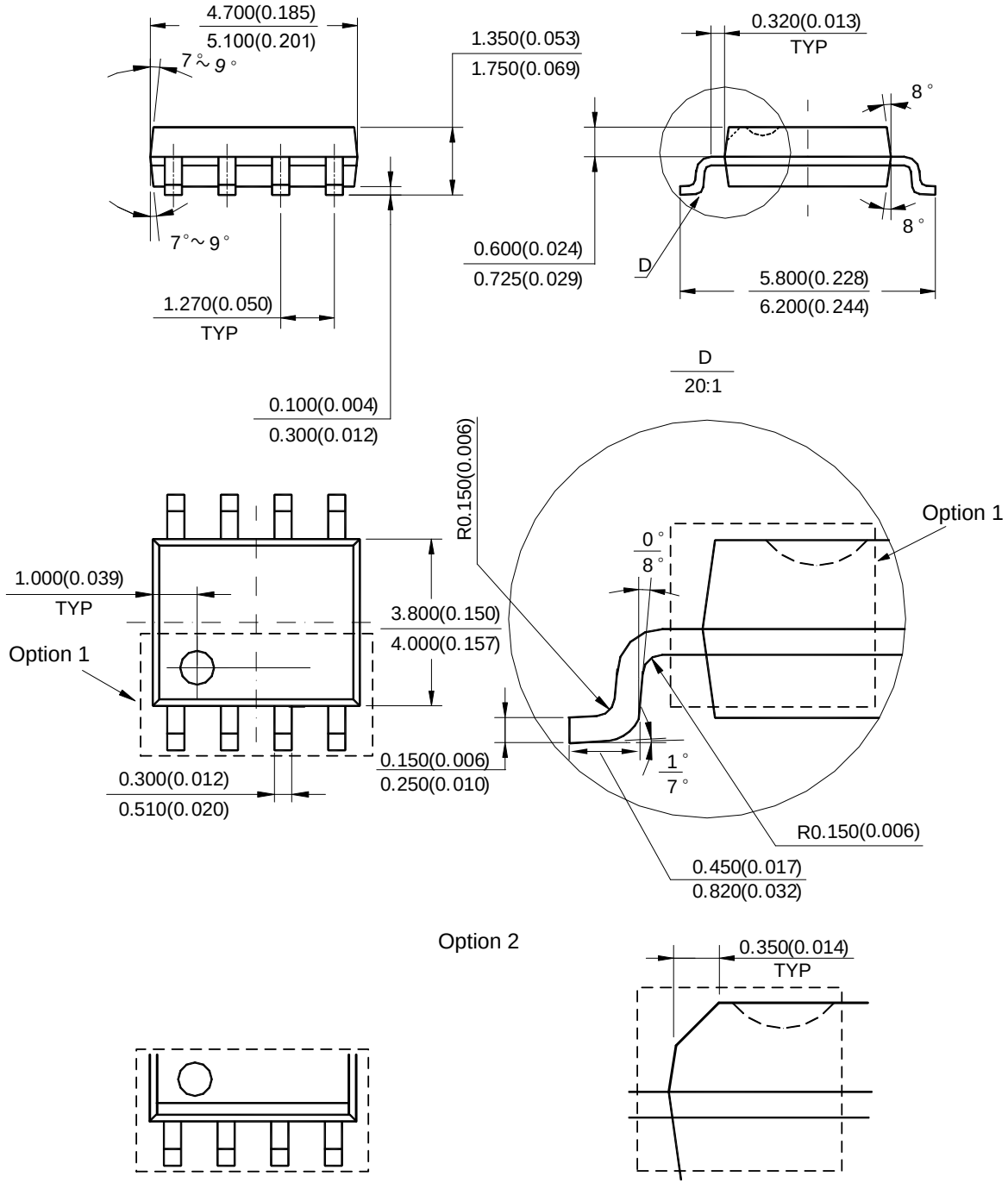
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: SO-8



Note: Eject hole, oriented hole and mold mark is optional.

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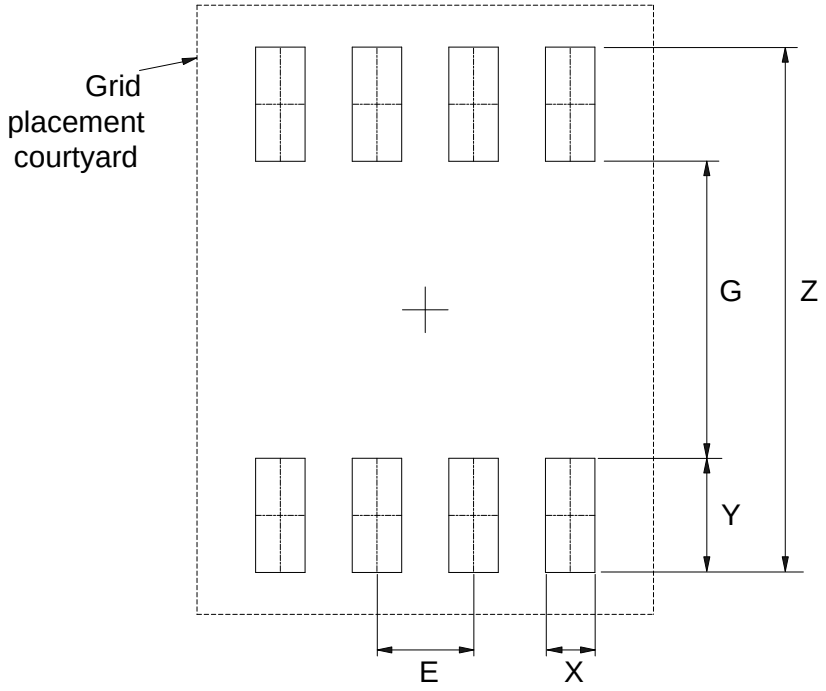
Suggested Pad Layout

(1) Package Type: SO-8



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050

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