Description

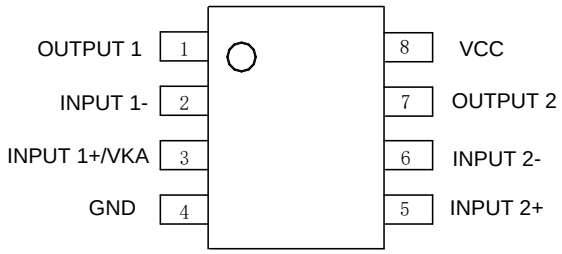
The AP4310E is a monolithic IC specifically designed to regulate the output current and voltage levels of switching battery chargers and power supplies.

The device contains two Op Amps and a 2.5V precision shunt voltage reference. Op Amp 1 is designed for voltage control with its non-inverting input internally connected to the output of the shunt regulator. Op Amp 2 is for current control with both inputs uncommitted. The IC offers the power converter designer a control solution that features increased precision with a corresponding reduction in system complexity and cost. The AP4310E has more stringent reference voltage tolerance and offset.

The AP4310E is available in the standard SO-8 package.

Pin Assignments

(Top View)



SO-8

Applications

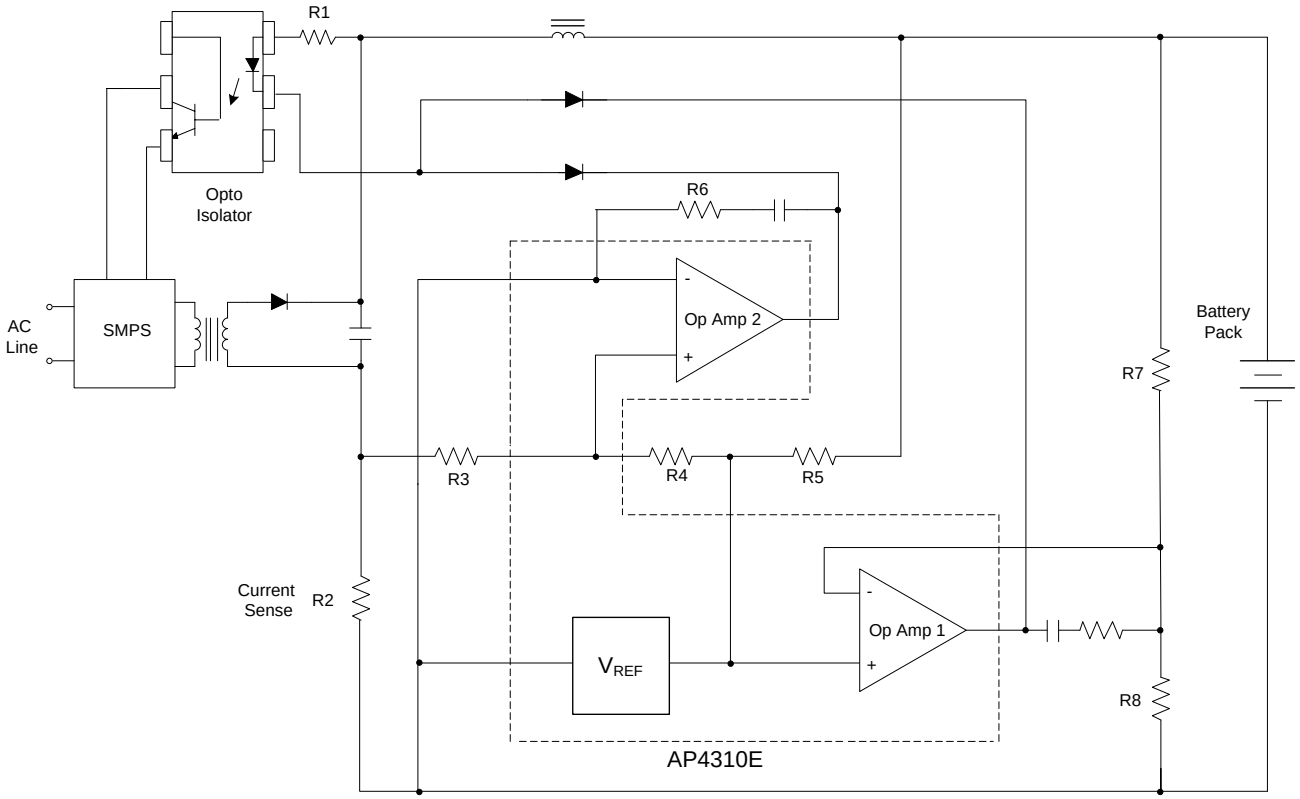
- Battery chargers
- Switching power supplies

Features

- **OP Amp**
  - Input Offset Voltage: 0.5mV
  - Supply Current: 75μA per OP Amp at 5.0V Supply Voltage
  - Unity Gain Bandwidth:1MHz
  - Output Voltage Swing: 0 to V_{CC}-1.5V
  - Power Supply Range: 3 to 36V
- **Voltage Reference**
  - Fixed Output Voltage Reference: 2.5V
  - Reference Voltage Tolerance: ±0.4%
  - Sink Current Capability: 0.05 to 80mA
  - Typical Output Impedance: 0.2Ω
- **Totally Lead-free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

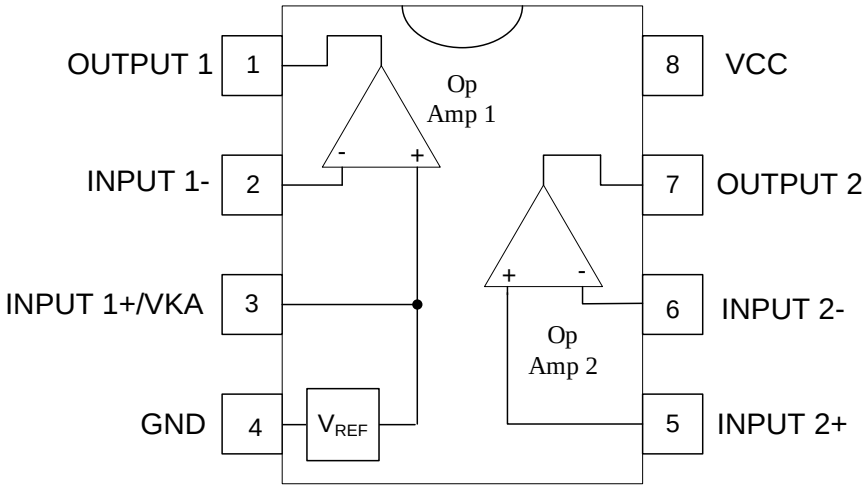
Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- 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



Application of AP4310E in a Constant Current and Constant Voltage Charger

Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply Voltage (VCC to GND)	40	V
V_{IN}	Op Amp1 and 2 Input Voltage Range (Pins 2, 5, 6)	-0.3 to V_{CC}+0.3	V
V_{ID}	Op Amp 2 Input Differential Voltage (Pins 5, 6)	40	V
I_K	Voltage Reference Cathode Current (Pin 3)	100	mA
P_D	Power Dissipation (T_A = +25°C)	500	mW
T_J	Operating Junction Temperature	+150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_{LEAD}	Lead Temperature (Soldering 10sec)	+260	°C
ESD	Human Body Model	2000	V
ESD	Charged Device Model	1000	V

Note: 4. Stresses greater than those listed under *Absolute Maximum Ratings* can 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 can affect device reliability.

Recommended Operating Conditions (Note 5)

Parameter	Min	Max	Unit
Supply Voltage	3	36	V
Ambient Temperature	-40	+105	°C

Note: 5. Qualified for SMD on the underside of a PCB by processing the PCB through a wave soldering operation.

Electrical Characteristics (@V_{CC} = 5V, T_A = +25°C, unless otherwise specified.)

Parameters	Conditions		Min	Typ	Max	Unit
Total Supply Current, excluding Current in Voltage Reference	V_{CC} = 5V, no load, -40°C ≤ T_A ≤ +105°C		—	0.15	0.25	mA
	V_{CC} = 30V, no load, -40°C ≤ T_A ≤ +105°C		—	0.20	0.30	
Voltage Reference Section						
Reference Voltage	I_K = 10mA	T_A = +25°C	2.49	2.50	2.51	V
		-40°C ≤ T_A ≤ +105°C	2.48	2.50	2.52	
Reference Voltage Deviation over Full Temperature Range	I_K = 10mA, T_A = -40°C to +105°C		—	5	24	mV
Minimum Cathode Current for Regulation	—		—	0.01	0.05	mA
Dynamic Impedance	I_K = 1mA to 80mA, f < 1kHz		—	0.2	0.5	Ω
Op Amp 1 Section (V_{CC} = 5V, V_O = 1.4V, T_A = +25°C, unless otherwise noted.)						
Input Offset Voltage	T_A = +25°C		—	0.5	3	mV
	T_A = -40°C to +105°C		—	—	5	
Input Offset Voltage Temperature Drift	T_A = -40°C to +105°C		—	7	—	μV/°C
Input Bias Current (Inverting Input Only)	T_A = +25°C		—	20	150	nA
Large Signal Voltage Gain	V_{CC} = 15V, R_L = 2kΩ, V_O = 1.4V to 11.4V		85	100	—	dB
Power Supply Rejection Ratio	V_{CC} = 5V to 30V		70	90	—	dB

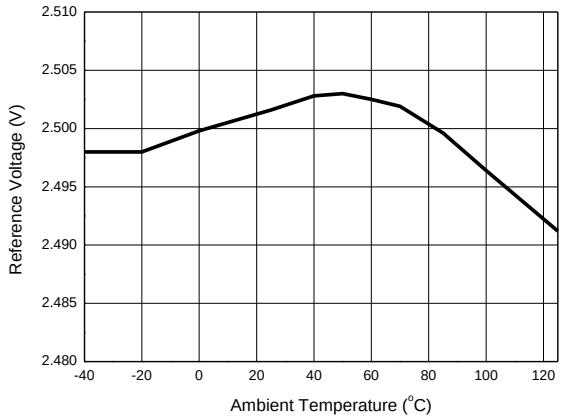
Electrical Characteristics (continued) (@V_{CC} = 5V, T_A = +25°C, unless otherwise specified.)

Parameters		Conditions	Min	Typ	Max	Unit
Output Current	Source	V_{CC} = 15V, V_{ID} = 1V, V_O = 2V	20	40	—	mA
	Sink	V_{CC} = 15V, V_{ID} = -1V, V_O = 2V	8	20	—	
Output Voltage Swing (High)		V_{CC} = 30V, R_L = 10kΩ, V_{ID} = 1V	27	28	—	V
Output Voltage Swing (Low)		V_{CC} = 30V, R_L = 10kΩ, V_{ID} = -1V	—	17	100	mV
Slew Rate		V_{CC} = 18V, R_L = 2kΩ, A_V = 1, V_{IN} = 0.5V to 2V, C_L = 100pF	0.2	0.5	—	V/μs
Unity Gain Bandwidth		V_{CC} = 30V, R_L = 2kΩ, C_L = 100pF	0.7	1.0	—	MHz
Op Amp 2 Section (V_{CC} = 5V, V_O = 1.4V, T_A = +25°C, unless otherwise noted.)						
Input Offset Voltage (Note 6)		T_A = +25°C, V_{CC} = 5V or 20V	—	0.5	2	mV
		T_A = -40°C to +105°C, V_{CC} = 5V or 20V	—	—	3	
Input Offset Voltage Temperature Drift		T_A = -40°C to +105°C	—	7	—	μV/°C
Input Offset Current		T_A = +25°C	—	2	30	nA
Input Bias Current		T_A = +25°C	—	20	150	nA
Input Voltage Range		V_{CC} = 0 to 36V	0	—	V_{CC}-1.5	V
Common Mode Rejection Ratio		T_A = +25°C, V_{CM} = 0 to 3.5V	70	85	—	dB
Large Signal Voltage Gain		V_{CC} = 15V, R_L = 2kΩ, V_O = 1.4V to 11.4V	85	100	—	dB
Power Supply Rejection Ratio		V_{CC} = 5V to 30V	70	90	—	dB
Output Current	Source	V_{CC} = 15V, V_{ID} = 1V, V_O = 2V	20	40	—	mA
	Sink	V_{CC} = 15V, V_{ID} = -1V, V_O = 2V	8	20	—	
Output Voltage Swing (High)		V_{CC} = 30V, R_L = 10kΩ, V_{ID} = 1V	27	28	—	V
Output Voltage Swing (Low)		V_{CC} = 30V, R_L = 10kΩ, V_{ID} = -1V	—	17	100	mV
Slew Rate		V_{CC} = 18V, R_L = 2kΩ, A_V = 1, V_{IN} = 0.5V to 2V, C_L = 100pF	0.2	0.5	—	V/μs
Unity Gain Bandwidth		V_{CC} = 30V, R_L = 2kΩ, C_L = 100pF	0.7	1.0	—	MHz

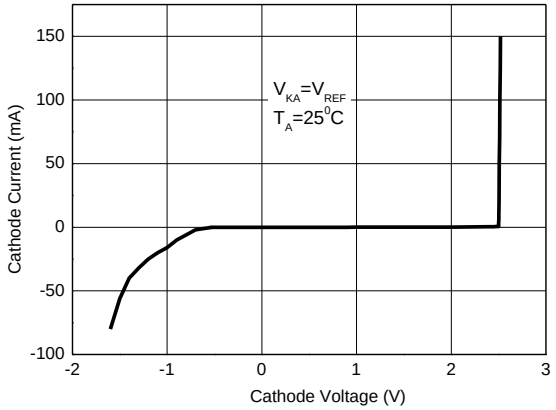
Note: 6. The full temperature feature is guaranteed by design.

Performance Characteristics

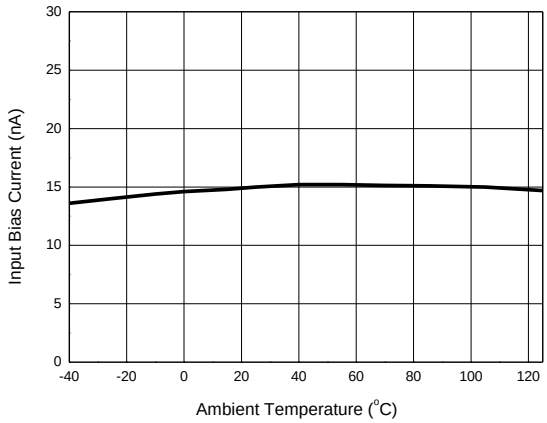
Reference Voltage vs. Ambient Temperature



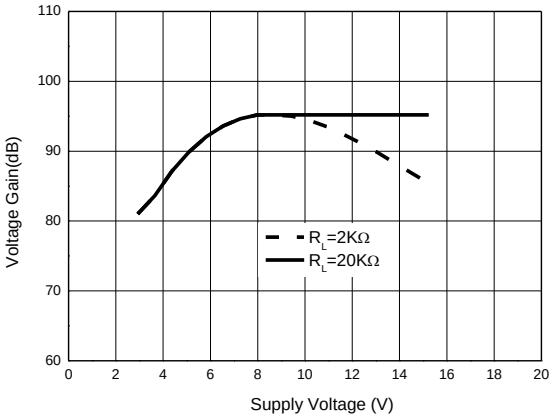
Cathode Current vs. Cathode Voltage



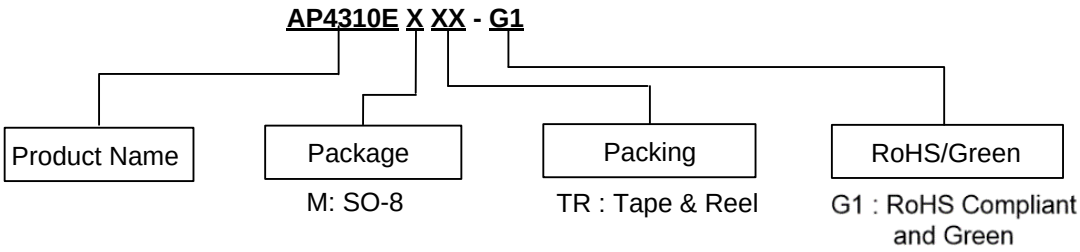
Input Bias Current vs. Ambient Temperature



Op Amp Voltage Gain



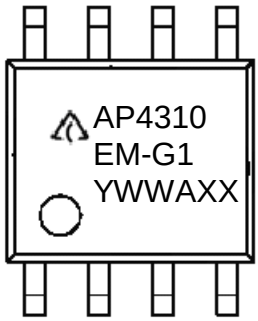
Ordering Information



Part Number	Temperature Range	Reference Voltage	Voltage Tolerance	Marking ID	Package	Packing	
						Qty.	Carrier
AP4310EMTR-G1	-40 to +105°C	2.5V	±0.4%	AP4310EM-G1	SO-8	4,000	Tape & Reel

Marking Information

(Top View)



First and Second Lines: Logo and Marking ID
Third Line: Date Code
Y: Year (ex: 4 = 2024)
WW: Work Week of Molding (01 to 53)
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.

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

Please see http://www.diodes.com/package-outlines.html for the latest version.

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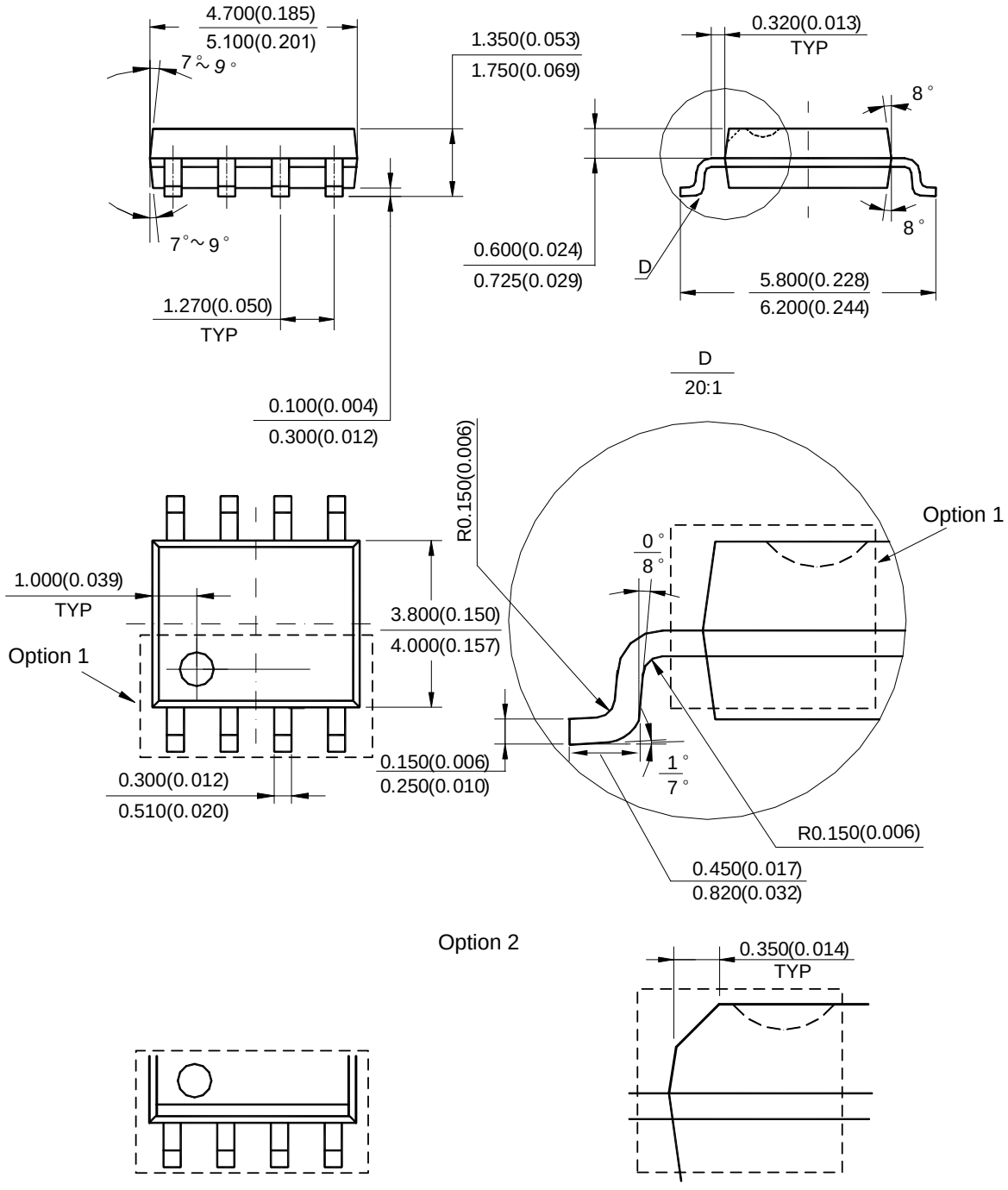

Note: Eject hole, oriented hole and mold mark is optional.

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

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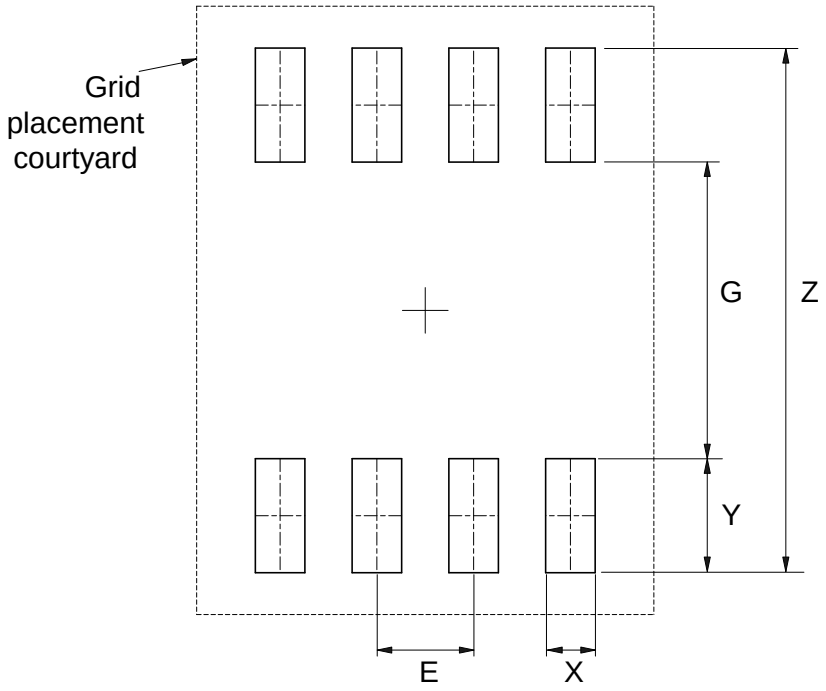

Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050

Mechanical Data

- Moisture Sensitivity: Level 1 per JESD22-A113
- Terminal Finish—Matte Tin Plated Leads; Solderable per JESD22-B102 e3
- Weight: 0.079 grams (Approximate)

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