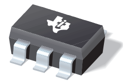


60mA, 5.0V, Buck/Boost Charge Pump in ThinSOT-23 and ThinQFN

FEATURES

- **Wide Input Range: 1.8V to 5.5V**
- **Automatic Step-Up/Step-Down Operation**
- **Low Input Current Ripple**
- **Low Output Voltage Ripple**
- **Minimum Number of External Components—No Inductors**
- **1MHz Internal Oscillator Allows Small Capacitors**
- **Shutdown Mode**
- **Thermal and Current Limit Protection**
- **Six Output Voltages Available:**
  - **5.5V, 5.0V, 3.3V, 3.0V, 2.7V, 2.5V**
- **Small Packages:**
  - **SOT23-6**
  - **TSOT23-6 (REG71055 and REG71050 Only)**
  - **TQFN-6 (2×2×0.8mm; REG71050 Only)**
- **Evaluation Modules Available:**
  - **REG710EVM-33, REG710EVM-5**

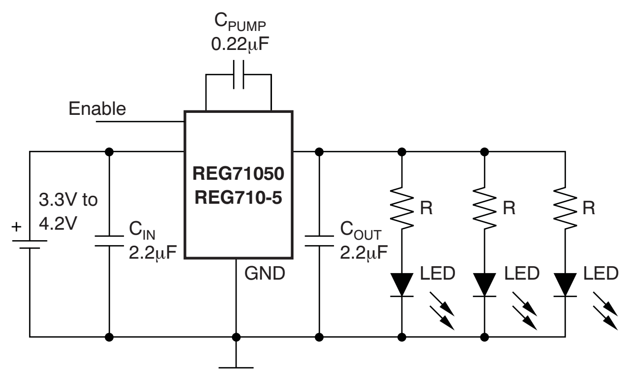
APPLICATIONS

- **Smart Card Readers**
- **SIM Card Supplies**
- **Cellular Phones**
- **Portable Communication Devices**
- **Personal Digital Assistants**
- **Notebook and Palm-Top Computers**
- **Modems**
- **Electronic Games**
- **Handheld Meters**
- **PCMCIA Cards**
- **Card Buses**
- **White LED Drivers**
- **LCD Displays**
- **Battery Backup Supplies**

DESCRIPTION

The REG710 is a switched capacitor voltage converter that produces a regulated, low-ripple output voltage from an unregulated input voltage. A wide input supply voltage of 1.8V to 5.5V makes the REG710 ideal for a variety of battery sources, such as single-cell Li-Ion, or two- and three-cell nickel- or alkaline-based chemistries.

The input voltage may vary above and below the output voltage and the output remains in regulation. It works equally well for step-up or step-down applications without the need for an inductor, providing low EMI dc/dc conversion. The high switching frequency allows the use of small surface-mount capacitors, saving board space and reducing cost. The REG710 is thermally protected and current limited, protecting the load and the regulator during fault conditions. Typical ground pin current (quiescent current) is 65µA with no load, and less than 1µA in shutdown mode.



REG710 Used in White LED Backlight Application

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ORDERING INFORMATION(1)

PRODUCT	OUTPUT VOLTAGE	PACKAGE-LEAD	PACKAGE DESIGNATOR	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING(2)	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
5.5V Output							
REG71055DDC	5.5V	TSOT23-6	DDC	–40°C to +85°C	R10H	REG71055DDCT	Tape and Reel, 250
						REG71055DDCR	Tape and Reel, 3000
5V Output							
REG710NA-5	5.0V	SOT23-6	DBV	–40°C to +85°C	R10B	REG710NA-5/250	Tape and Reel, 250
						REG710NA−5/3K	Tape and Reel, 3000
REG71050DDC	5.0V	TSOT23-6	DDC	–40°C to +85°C	GAAI	REG71050DDCT	Tape and Reel, 250
						REG71050DDCR	Tape and Reel, 3000
REG71050DRV	5.0V	TQFN-6	DRV	–40°C to +85°C	CFF	REG71050DRVT	Tape and Reel, 250
						REG71050DRVR	Tape and Reel, 3000
3.3V Output							
REG710NA-3.3	3.3V	SOT23-6	DBV	–40°C to +85°C	R10C	REG710NA-3.3/250	Tape and Reel, 250
						REG710NA-3.3/3K	Tape and Reel, 3000
3V Output							
REG710NA-3	3.0V	SOT23-6	DBV	–40°C to +85°C	R10D	REG710NA-3/250	Tape and Reel, 250
						REG710NA-3/3K	Tape and Reel, 3000
2.7V Output							
REG710NA-2.7	2.7V	SOT23-6	DBV	–40°C to +85°C	R10F	REG710NA-2.7/250	Tape and Reel, 250
						REG710NA-2.7/3K	Tape and Reel, 3000
2.5V Output							
REG710NA-2.5	2.5V	SOT23-6	DBV	–40°C to +85°C	R10G	REG710NA-2.5/250	Tape and Reel, 250
						REG710NA-2.5/3K	Tape and Reel, 3000

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Voltage is marked on reel. Add on row with the following data: Product: REG71050DRV Output Voltage: 5.0V Package-Lead: TQFN Package Designator: DRV Specified Temp range: -40C to +85C Package marking: CFF Ordering Number: REG71050DRVT (Tape and Reel, 250) REG71050DRVR (Tape and Reel, 3000)

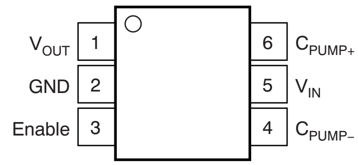
ABSOLUTE MAXIMUM RATINGS(1)

	REG710	UNIT
Supply voltage	–0.3 to +6.0	V
Enable input	–0.3 to V_{IN}	V
Output short-circuit duration	Indefinite	
Operating temperature range	–55 to +125	°C
Storage temperature range	–65 to +150	°C
Junction temperature	–55 to +150	°C
Lead temperature (soldering, 3s)	+240	°C

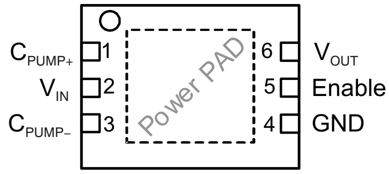
(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

PIN CONFIGURATIONS

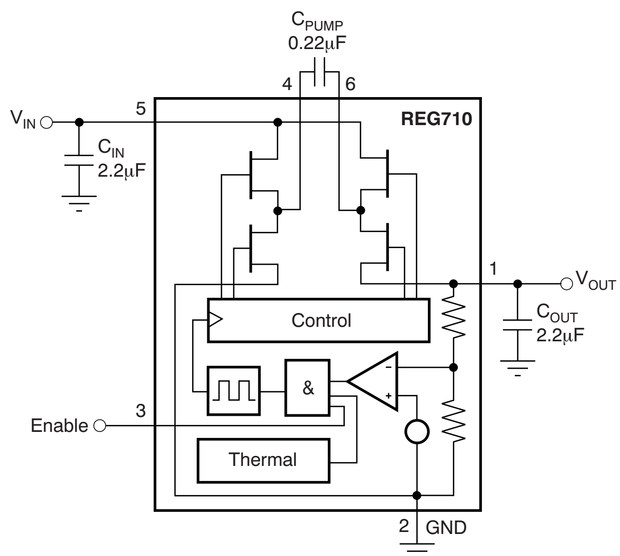
TSOT23/SOT23
(TOP VIEW)



TQFN
(TOP VIEW)



SIMPLIFIED BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Boldface limits apply over the specified temperature range, **T_A = –40°C to +85°C.**
At T_A = +25°C, V_{IN} = V_{OUT}/2 + 0.75V, I_{OUT} = 10mA, C_{IN} = C_{OUT} = 2.2µF, C_{PUMP} = 0.22µF, and V_{ENABLE} = 1.3V, unless otherwise noted.

PARAMETER		TEST CONDITIONS	REG710 MIN	TYP	MAX	UNIT
INPUT VOLTAGE						
Tested Startup						
REG71055		See conditions under Output Voltage with a resistive load no lower than typical V_{OUT}/I_{OUT}.	**3.0**		**5.5**	V
REG710-5			**2.7**		**5.5**	V
All other models			**1.8**		**5.5**	V
OUTPUT VOLTAGE						
REG71055		I_{OUT} ≤ 10mA, 3.0V ≤ V_{IN} ≤ 5.5V	**5.2**	5.5	**5.8**	V
		I_{OUT} ≤ 30mA, 3.25V ≤ V_{IN} ≤ 5.5V	**5.2**	5.5	**5.8**	V
REG710-5, REG71050		I_{OUT} ≤ 10mA, 2.7V ≤ V_{IN} ≤ 5.5V	**4.7**	5.0	**5.3**	V
		I_{OUT} ≤ 30mA, 3.0V ≤ V_{IN} ≤ 5.5V	**4.7**	5.0	**5.3**	V
		I_{OUT} ≤ 60mA, 3.3V ≤ V_{IN} ≤ 4.2V	**4.6**	5.0	**5.4**	V
REG710-3.3		I_{OUT} ≤ 10mA, 1.8V ≤ V_{IN} ≤ 5.5V	**3.10**	3.3	**3.50**	V
		I_{OUT} ≤ 30mA, 2.2V ≤ V_{IN} ≤ 5.5V	**3.10**	3.3	**3.50**	V
REG710-3		I_{OUT} ≤ 10mA, 1.8V ≤ V_{IN} ≤ 5.5V	**2.82**	3.0	**3.18**	V
		I_{OUT} ≤ 30mA, 2.2V ≤ V_{IN} ≤ 5.5V	**2.82**	3.0	**3.18**	V
REG710-2.7		I_{OUT} ≤ 10mA, 1.8V ≤ V_{IN} ≤ 5.5V	**2.54**	2.7	**2.86**	V
		I_{OUT} ≤ 30mA, 2.0V ≤ V_{IN} ≤ 5.5V	**2.54**	2.7	**2.86**	V
REG710-2.5		I_{OUT} ≤ 10mA, 1.8V ≤ V_{IN} ≤ 5.5V	**2.35**	2.5	**2.65**	V
		I_{OUT} ≤ 30mA, 2.0V ≤ V_{IN} ≤ 5.5V	**2.35**	2.5	**2.65**	V
OUTPUT CURRENT						
Nominal			30			mA
Short-circuit(1)				100		mA
OSCILLATOR FREQUENCY(2)				1.0		MHz
EFFICIENCY(3)		I_{OUT} = 10mA, V_{IN} = 1.8V, REG710-3.3		90		%
RIPPLE VOLTAGE(4)		I_{OUT} = 30mA		35		mV_{PP}
ENABLE CONTROL		V_{IN} = 1.8V to 5.5V				
Logic high input voltage			**1.3**		**V_{IN}**	V
Logic low input voltage			**–0.2**		**0.4**	V
Logic high input current					100	nA
Logic low input current					100	nA
THERMAL SHUTDOWN						
Shutdown temperature				160		°C
Shutdown recovery				140		°C
SUPPLY CURRENT						
(Quiescent current)		I_{OUT} = 0mA		65	100	µA
In shutdown mode		V_{IN} = 1.8V to 5.5V, Enable = 0V		0.01	1	µA
TEMPERATURE RANGE						
Specified ambient temperature	T_A		–40		+85	°C
Operating ambient temperature	T_A		–55		+125	°C
Storage ambient temperature	T_A		–65		+150	°C
Thermal resistance	θ_{JA}	SOT23-6		200		°C/W
		TSOT23-6		220		°C/W
		TQFN-6		75		°C/W

(1) The supply current is twice the output short-circuit current.
(2) The converter regulates by enabling and disabling periods of switching cycles. The switching frequency is the oscillator frequency during an active period.
(3) See efficiency curves for other V_{IN}/V_{OUT} configurations.
(4) Effective series resistance (ESR) of capacitors is < 0.1Ω.

TYPICAL CHARACTERISTICS

At T_A = +25°C, V_{IN} = V_{OUT}/2 + 0.75V, I_{OUT} = 5mA, C_{IN} = C_{OUT} = 2.2µF, C_{PUMP} = 0.22µF, and V_{ENABLE} = 1.3V, unless otherwise noted.

EFFICIENCY vs V_{IN}

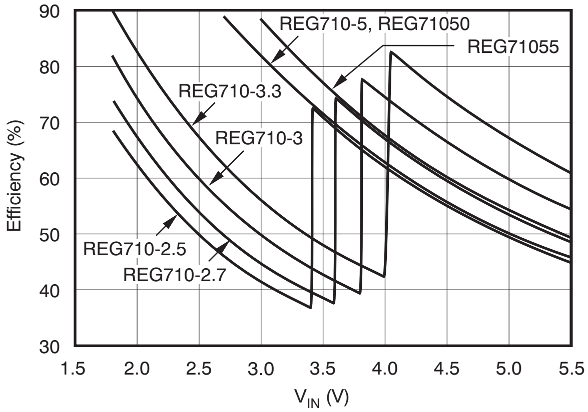


Figure 1.

EFFICIENCY vs LOAD CURRENT (REG710-5V, REG71050)

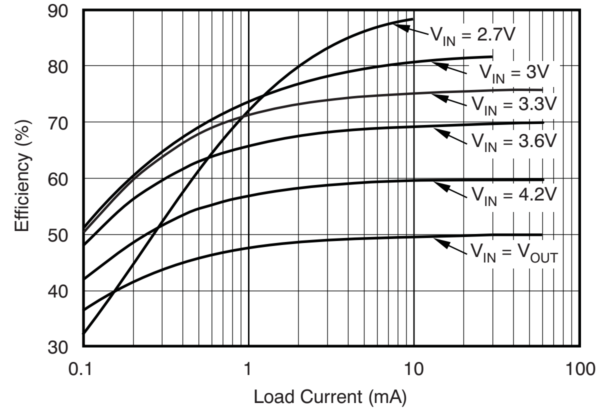


Figure 2.

EFFICIENCY vs LOAD CURRENT (REG710-3.3V)

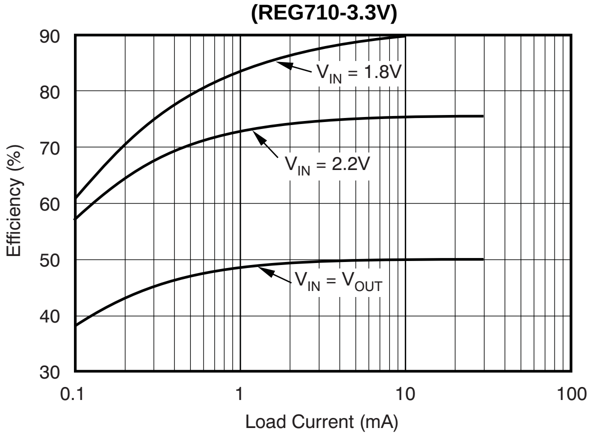


Figure 3.

EFFICIENCY vs LOAD CURRENT (REG710-3V)

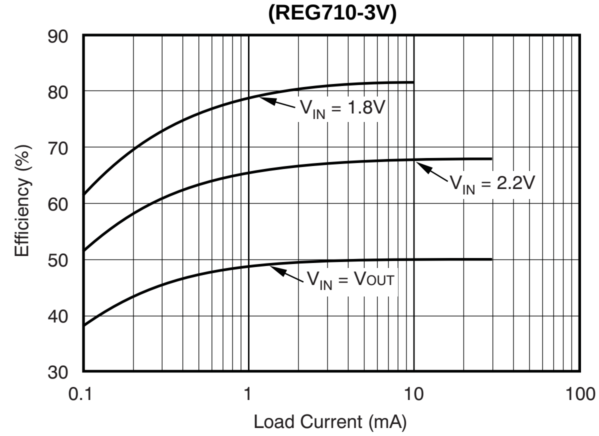


Figure 4.

EFFICIENCY vs LOAD CURRENT (REG710-2.7V)

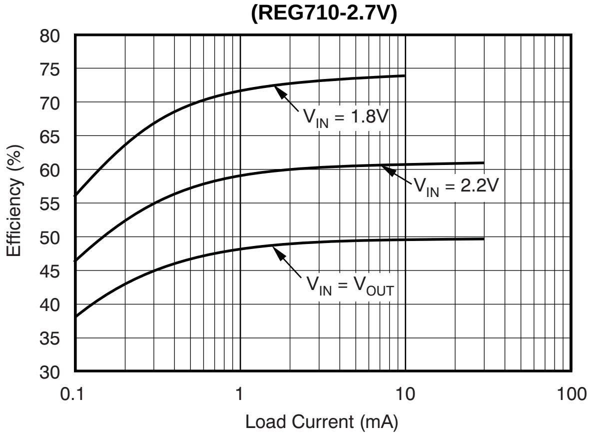


Figure 5.

EFFICIENCY vs LOAD CURRENT (REG710-2.5V)

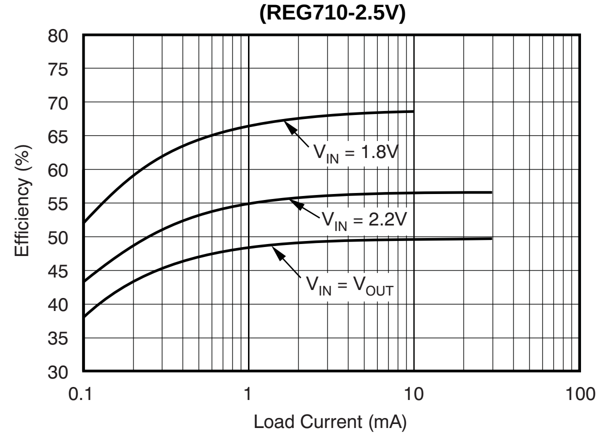


Figure 6.

TYPICAL CHARACTERISTICS (continued)

At T_A = +25°C, V_{IN} = V_{OUT}/2 + 0.75V, I_{OUT} = 5mA, C_{IN} = C_{OUT} = 2.2µF, C_{PUMP} = 0.22µF, and V_{ENABLE} = 1.3V, unless otherwise noted.

SUPPLY CURRENT vs TEMPERATURE (No Load)

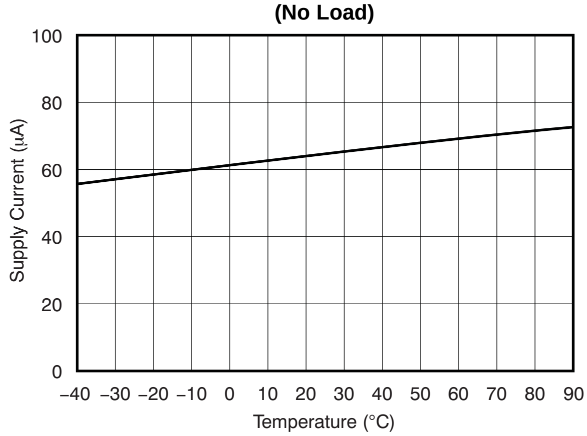


Figure 7.

LOAD TRANSIENT RESPONSE

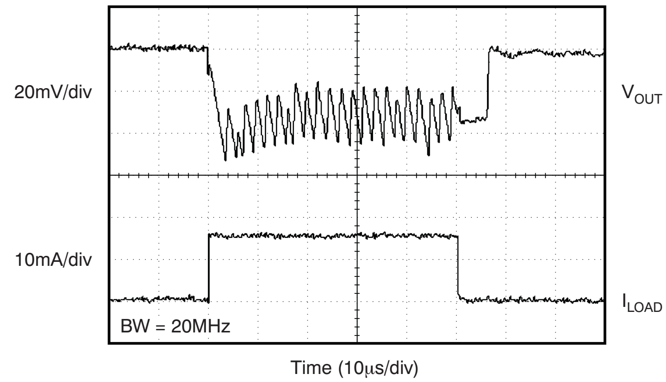


Figure 8.

SUPPLY CURRENT vs TEMPERATURE (Not Enabled)

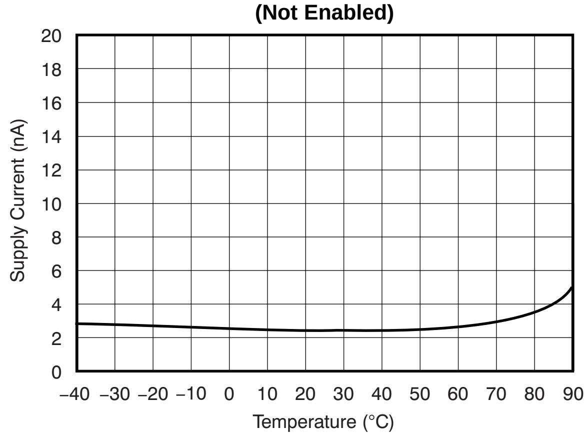


Figure 9.

LINE TRANSIENT RESPONSE

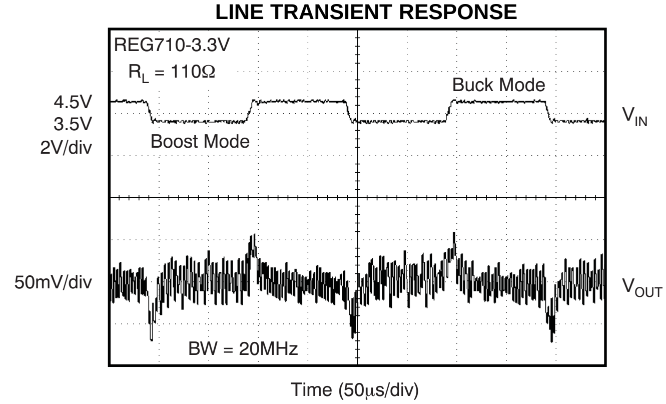


Figure 10.

OUTPUT VOLTAGE vs TEMPERATURE

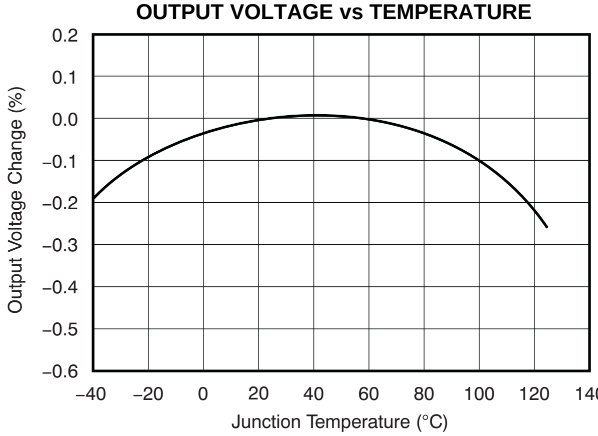


Figure 11.

OUTPUT VOLTAGE DRIFT HISTOGRAM

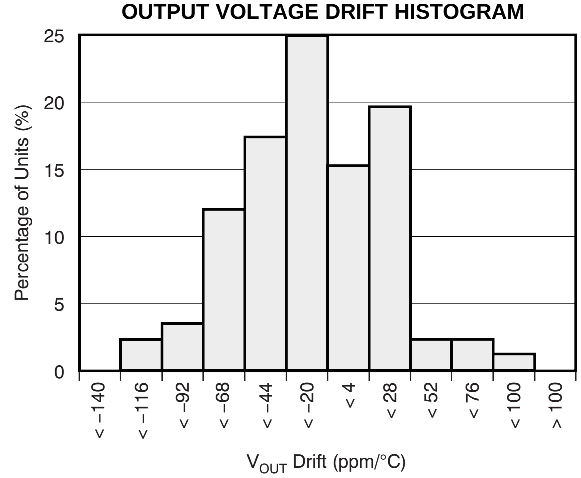


Figure 12.

TYPICAL CHARACTERISTICS (continued)

At T_A = +25°C, V_{IN} = V_{OUT}/2 + 0.75V, I_{OUT} = 5mA, C_{IN} = C_{OUT} = 2.2μF, C_{PUMP} = 0.22μF, and V_{ENABLE} = 1.3V, unless otherwise noted.

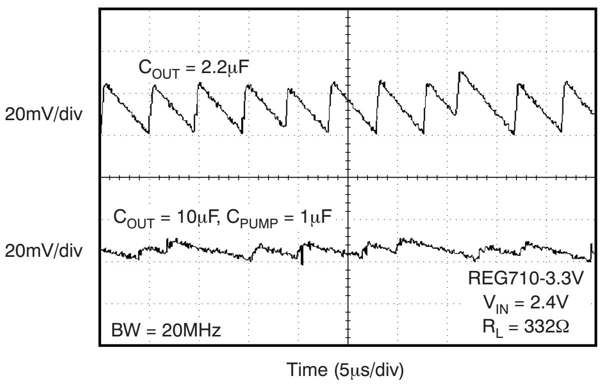


Figure 13.

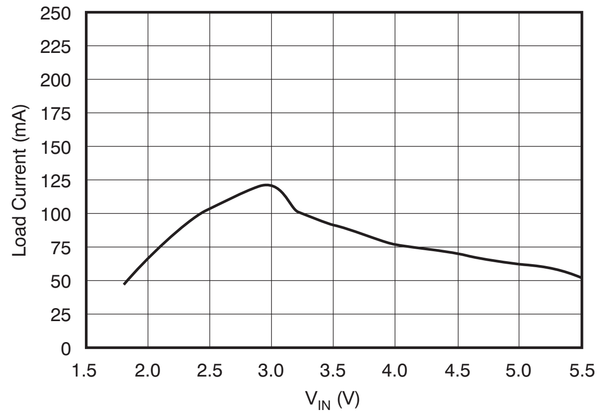


Figure 14.

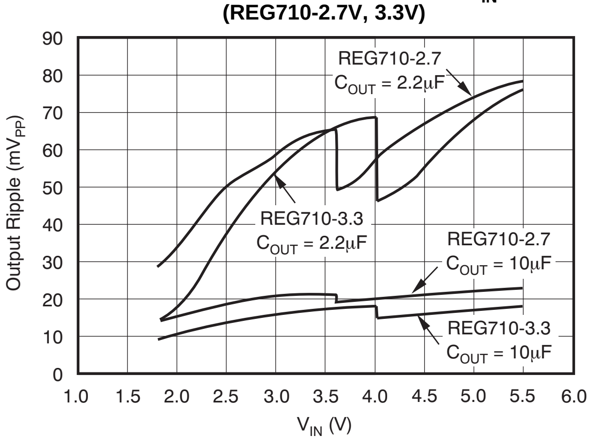


Figure 15.

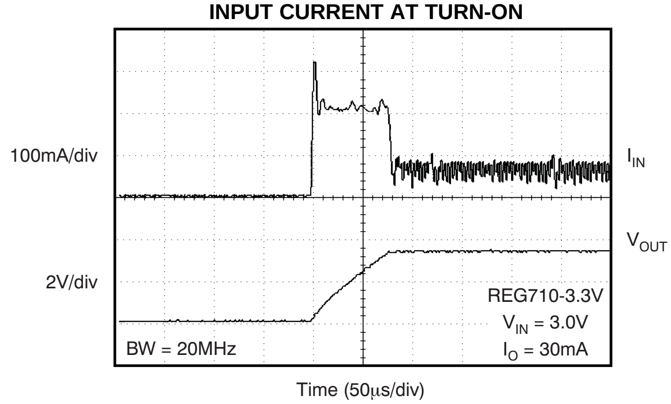


Figure 16.

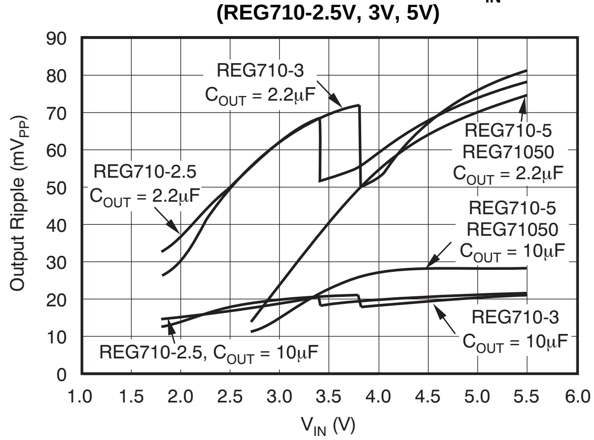


Figure 17.

THEORY OF OPERATION

The REG710 regulated charge pump provides a regulated output voltage for input voltages ranging from less than the output to greater than the output. This is accomplished by automatic mode switching within the device. When the input voltage is greater than the required output, the unit functions as a variable frequency switch-mode regulator. This operation is shown in Figure 18. Transistors Q_1 and Q_3 are held off, Q_4 is on, and Q_2 is switched as needed to maintain a regulated output voltage.

When the input voltage is less than the required output voltage, the device switches to a step-up or boost mode of operation, as shown in Figure 19.

A conversion clock of 50% duty cycle is generated. During the first half cycle the FET switches are configured as shown in Figure 19A, and C_{PUMP} charges to V_{IN}.

During the second half cycle the FET switched are configured as shown in Figure 19B, and the voltage on C_{PUMP} is added to V_{IN}. The output voltage is regulated by skipping clock cycles as necessary.

PEAK CURRENT REDUCTION

In normal operation, the charging of the pump and output capacitors usually leads to relatively high peak input currents which can be much higher than that of the average load current. The regulator incorporates circuitry to limit the input peak current, lowering the total EMI production of the device and lowering output voltage ripple and input current ripple. Input capacitor (C_{IN}) supplies most of the charge required by input current peaks.

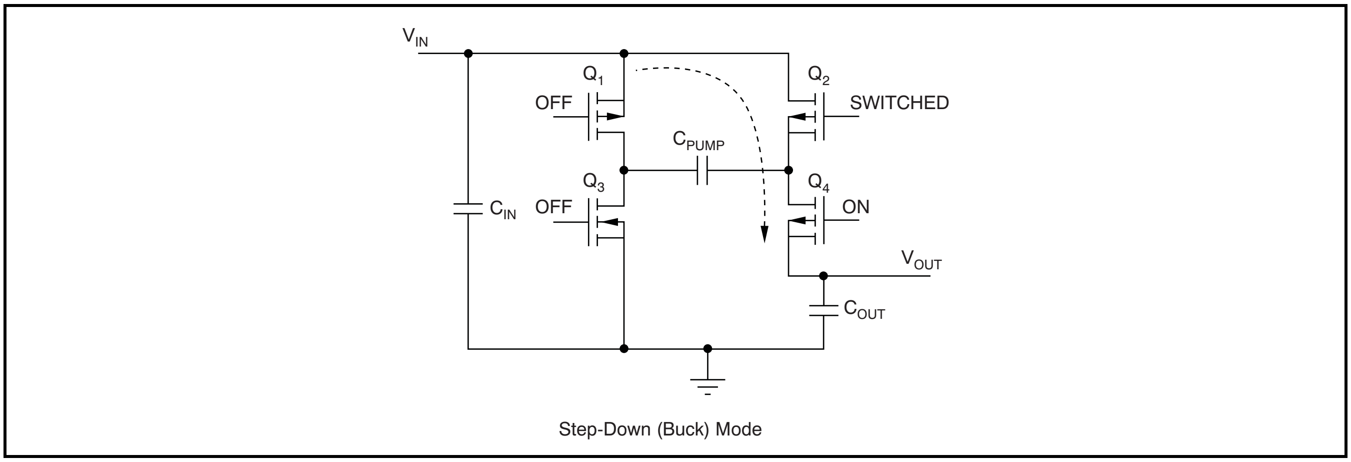


Figure 18. Simplified Schematic of the REG710 Operating in the Step-Down Mode

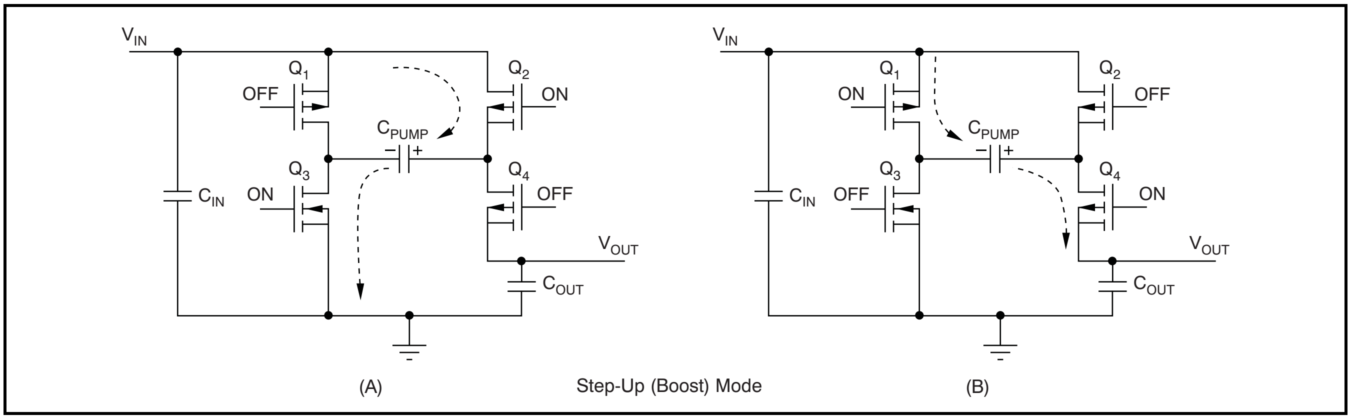


Figure 19. Simplified Schematic of the REG710 Operating in the Step-Up or Boost Mode

PROTECTION

The regulator has thermal shutdown circuitry that protects it from damage caused by overload conditions. The thermal protection circuitry disables the output when the junction temperature reaches approximately +160°C, allowing the device to cool. When the junction temperature cools to approximately +140°C, the output circuitry is automatically reenabled. Continuously running the regulator into thermal shutdown can degrade reliability. The regulator also provides current limit to protect itself and the load.

SHUTDOWN MODE

A control pin on the regulator can be used to place the device into an energy-saving shutdown mode. In this mode, the output is disconnected from the input as long as V_{IN} is greater than or equal to minimum V_{IN} and the input quiescent current is reduced to 1μA maximum.

CAPACITOR SELECTION

For minimum output voltage ripple, the output capacitor C_{OUT} should be a ceramic, surface-mount type. Tantalum capacitors generally have a higher effective series resistance (ESR) and may contribute to higher output voltage ripple. Leaded capacitors also increase ripple due to the higher inductance of the package itself. To achieve best operation with low input voltage and high load current, the input and pump capacitors (C_{IN} and C_{PUMP}, respectively) should also be surface-mount ceramic types. In all cases, X7R or X5R dielectric are recommended. See the typical operating circuit shown in Figure 20 for component values.

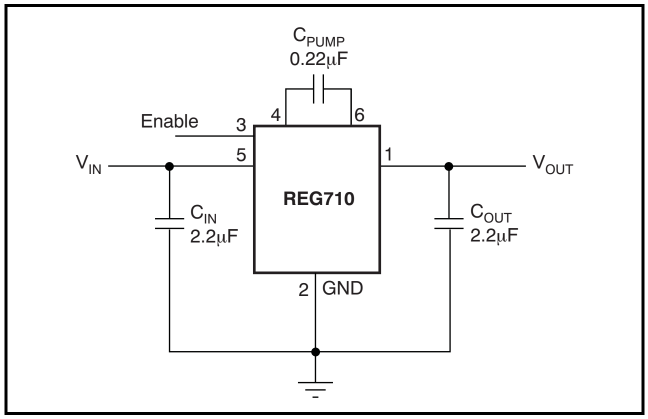


Figure 20. Typical Operating Circuit

With light loads or higher input voltage, a smaller 0.1μF pump capacitor (C_{PUMP}) and smaller 1μF input and output capacitors (C_{IN} and C_{OUT}, respectively) can be used. To minimize output voltage ripple, increase the output capacitor, C_{OUT}, to 10μF or larger.

The capacitors listed in Table 1 can be used with the REG710. This table is only a representative list of parts that are compatible.

Table 1. Suggested Capacitors

MANUFACTURER	PART NUMBER	VALUE	TOLERANCE	DIELECTRIC MATERIAL	PACKAGE SIZE	RATED WORKING VOLTAGE
Kemet	C1206C255K8RAC	2.2μF	±10%	X7R	1206	10V
	C1206C224K8RAC	0.22μF	±10%	X7R	1206	10V
Panasonic	ECJ−2YBOJ225K	2.2μF	±10%	X5R	805	6.3V
	ECJ−2VBIC224K	0.22μF	±10%	X7R	805	16V
	ECJ−2VBIC104	0.1μF	±10%	X7R	805	16V
Taiyo Yuden	EMK316BJ225KL	2.2μF	±10%	X7R	1206	16V
	TKM316BJ224KF	0.22μF	±10%	X7R	1206	25V

EFFICIENCY

The efficiency of the charge pump regulator varies with the output voltage version, the applied input voltage, the load current, and the internal operation mode of the device.

The approximate efficiency is given by:

$$\text{Efficiency (\%)} = V_{OUT}/(2 \times V_{IN}) \times 100$$

(step-up operating mode)

or

$$\frac{V_{OUT}}{V_{IN}} \times 100$$

(step-down operating mode)

Table 2 lists the approximate values of the input voltage at which the device changes internal operating mode. See efficiency curves in the Typical Characteristics section for various loads and input voltages.

Table 2. Operating Mode Change versus V_{IN}

PRODUCT	OPERATING MODE CHANGES AT V_{IN} OF
REG710-2.5	> 3.2V
REG710-2.7	> 3.4V
REG710-3	> 3.7V
REG710-3.3	> 4.0V
REG710-5, REG71050, REG71055	Step-up only

LAYOUT

Large transient currents flow in the V_{IN}, V_{OUT}, and GND traces. To minimize both input and output ripple, keep the capacitors as close as possible to the regulator using short, direct circuit traces.

A suggested printed circuit board (PCB) routing is shown in Figure 21. The trace lengths from the input and output capacitors have been kept as short as possible.

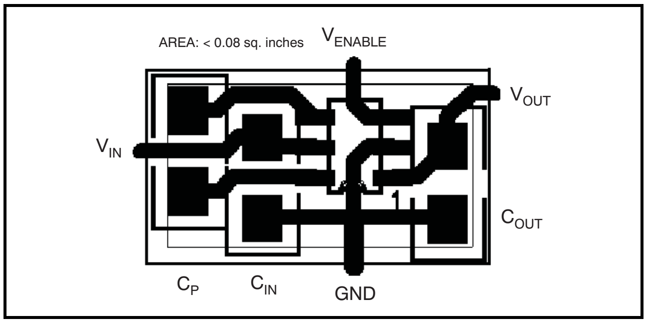


Figure 21. Suggested PCB Design for Minimum Ripple

APPLICATION CIRCUITS

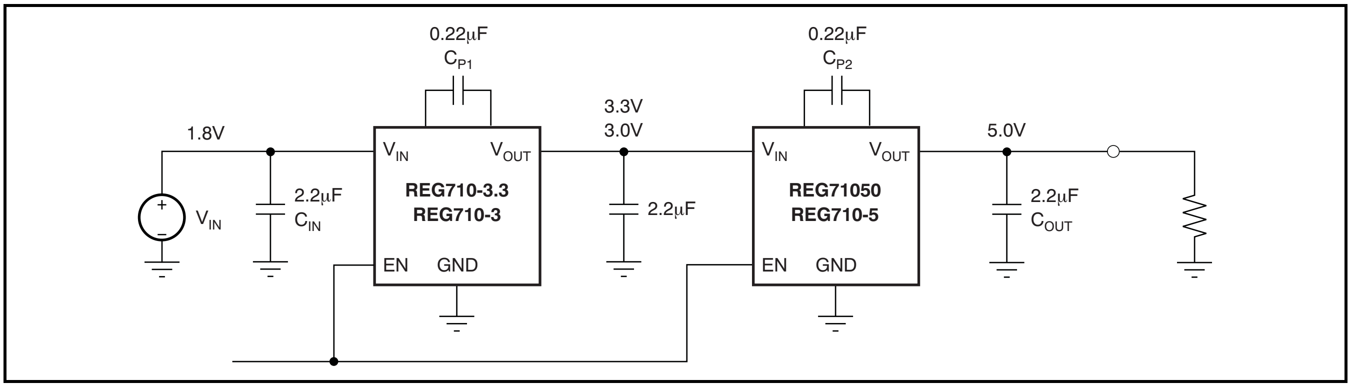


Figure 22. REG710 Circuit for Step-Up Operation from 1.8V to 5.0V with 10mA Output Current

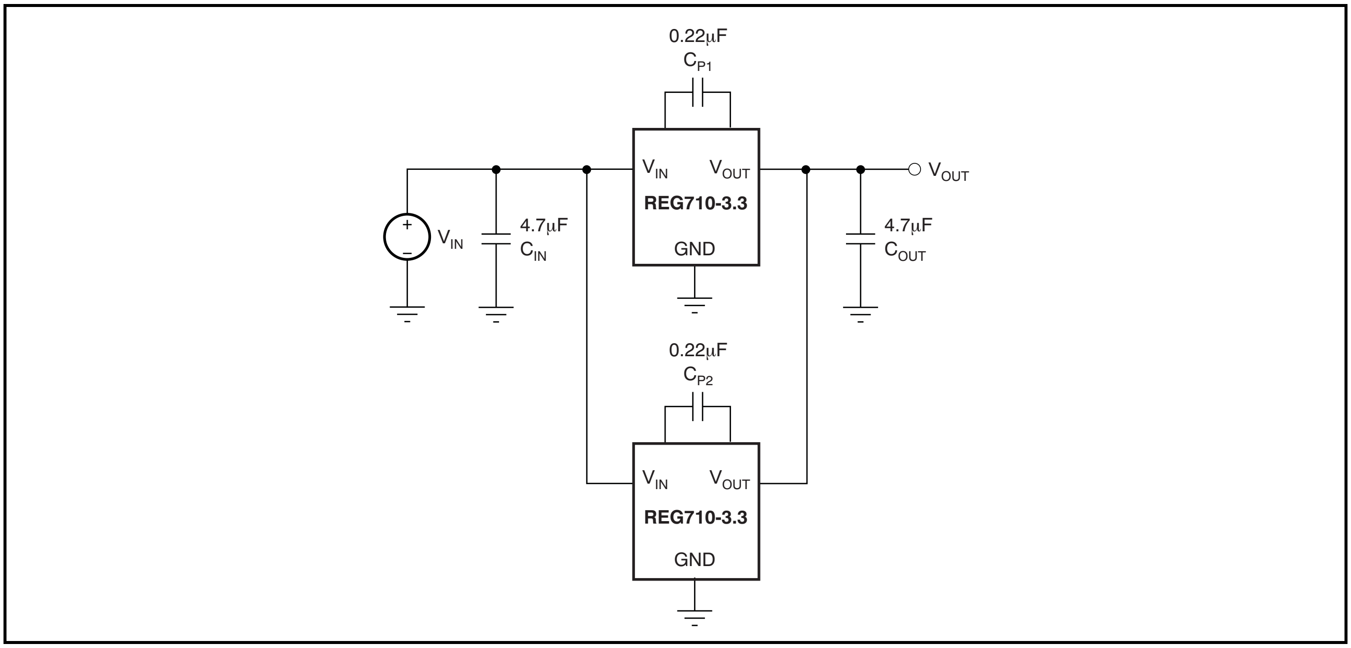


Figure 23. REG710 Circuit for Doubling the Output Current

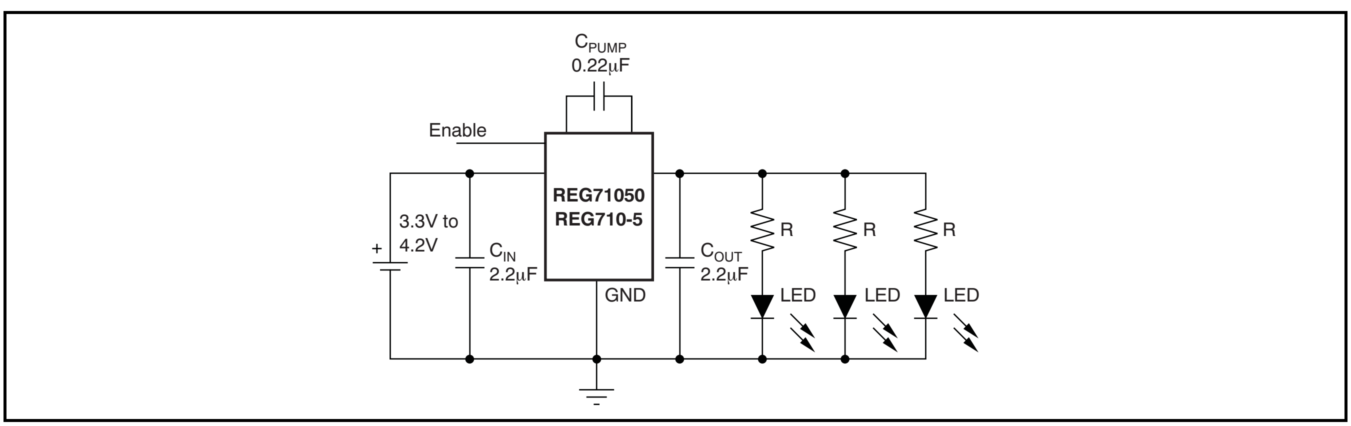


Figure 24. REG710 Circuit for Driving LEDs

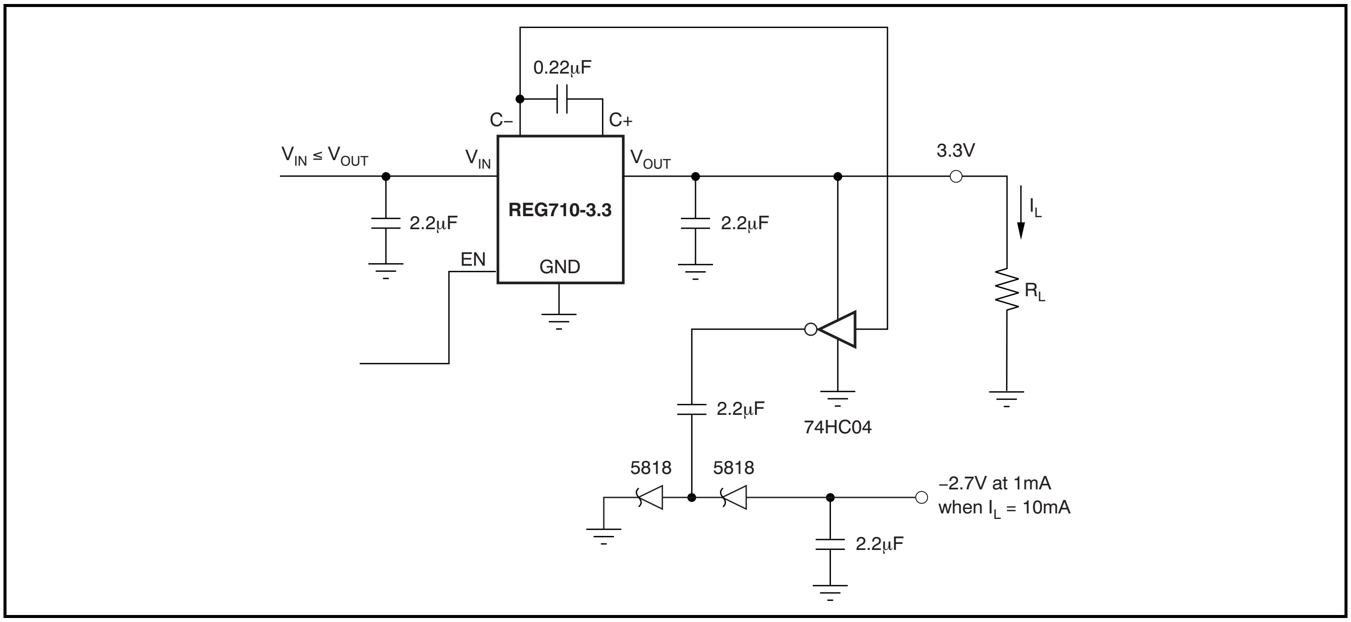


Figure 25. REG710 with Negative Bias Supply

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
REG71050DDCR	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71050DDCRG4	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71050DDCT	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71050DDCTG4	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71050DRVR	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
REG71050DRVRG4	ACTIVE	SON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
REG71050DRVT	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
REG71050DRVTG4	ACTIVE	SON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
REG71055DDCR	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71055DDCRG4	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71055DDCT	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG71055DDCTG4	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-2.5/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-2.5/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-2.5/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-2.5/3KG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-2.7/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-2.7/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3.3/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3.3/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3.3/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3.3/3KG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-3/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
REG710NA-3/3KG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-5/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-5/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-5/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
REG710NA-5/3KG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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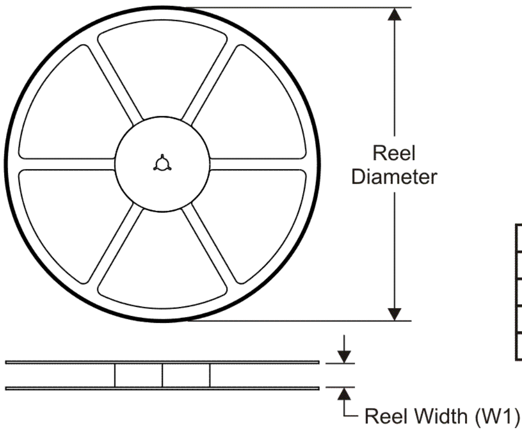
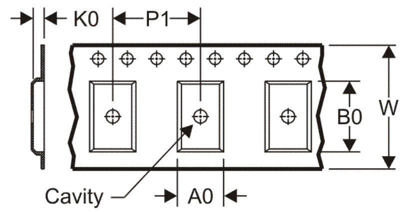
TAPE AND REEL INFORMATION

REEL DIMENSIONS

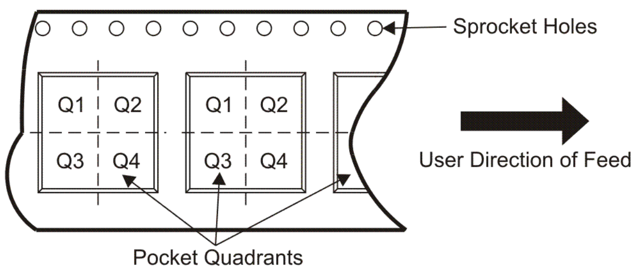


TAPE DIMENSIONS



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

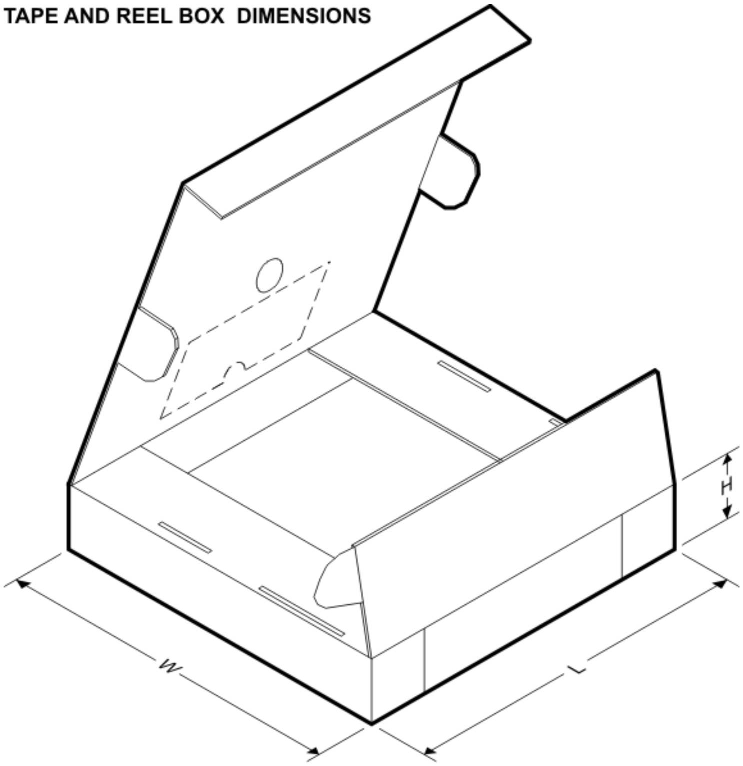
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
REG71050DDCR	SOT	DDC	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG71050DDCT	SOT	DDC	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG71050DRVR	SON	DRV	6	3000	330.0	12.4	2.2	2.2	1.1	8.0	12.0	Q2
REG71050DRVT	SON	DRV	6	250	180.0	12.4	2.2	2.2	1.1	8.0	12.0	Q2
REG710NA-5/250	SOT-23	DBV	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-5/3K	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

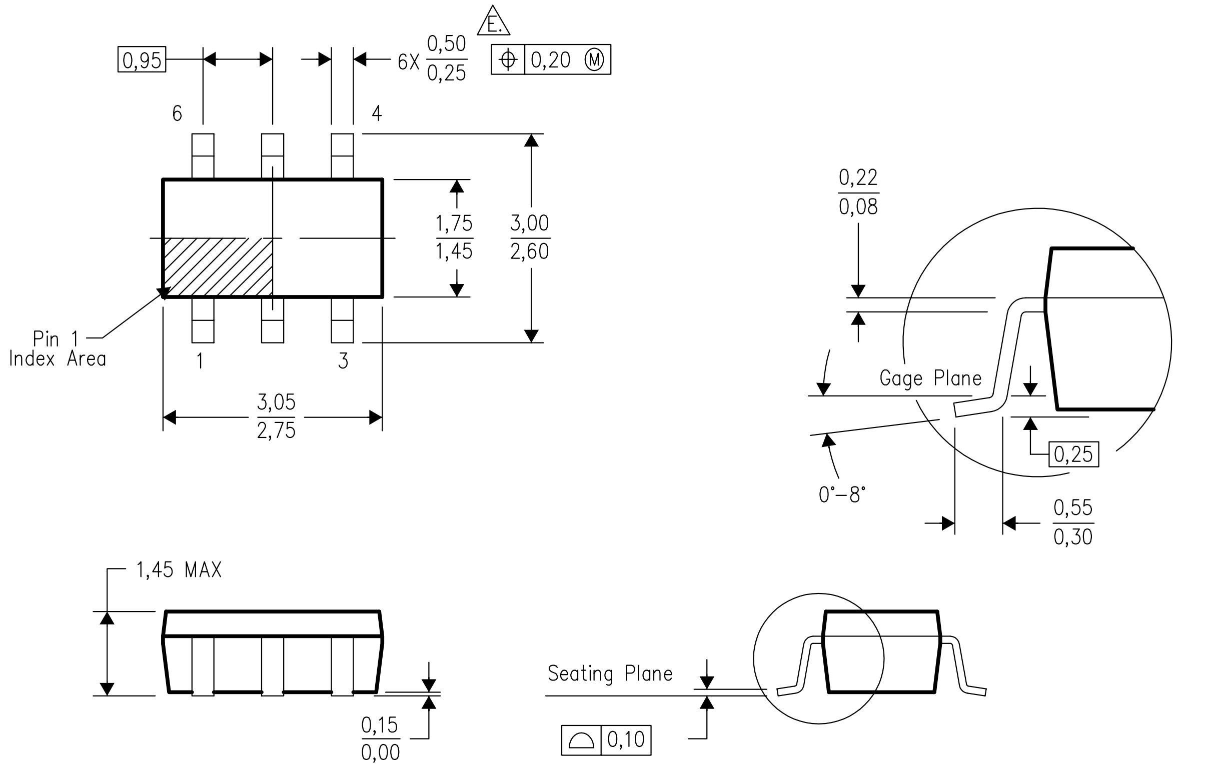
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
REG71050DDCR	SOT	DDC	6	3000	195.0	200.0	45.0
REG71050DDCT	SOT	DDC	6	250	195.0	200.0	45.0
REG71050DRVR	SON	DRV	6	3000	346.0	346.0	29.0
REG71050DRVT	SON	DRV	6	250	190.5	212.7	31.8
REG710NA-5/250	SOT-23	DBV	6	250	195.0	200.0	45.0
REG710NA-5/3K	SOT-23	DBV	6	3000	195.0	200.0	45.0

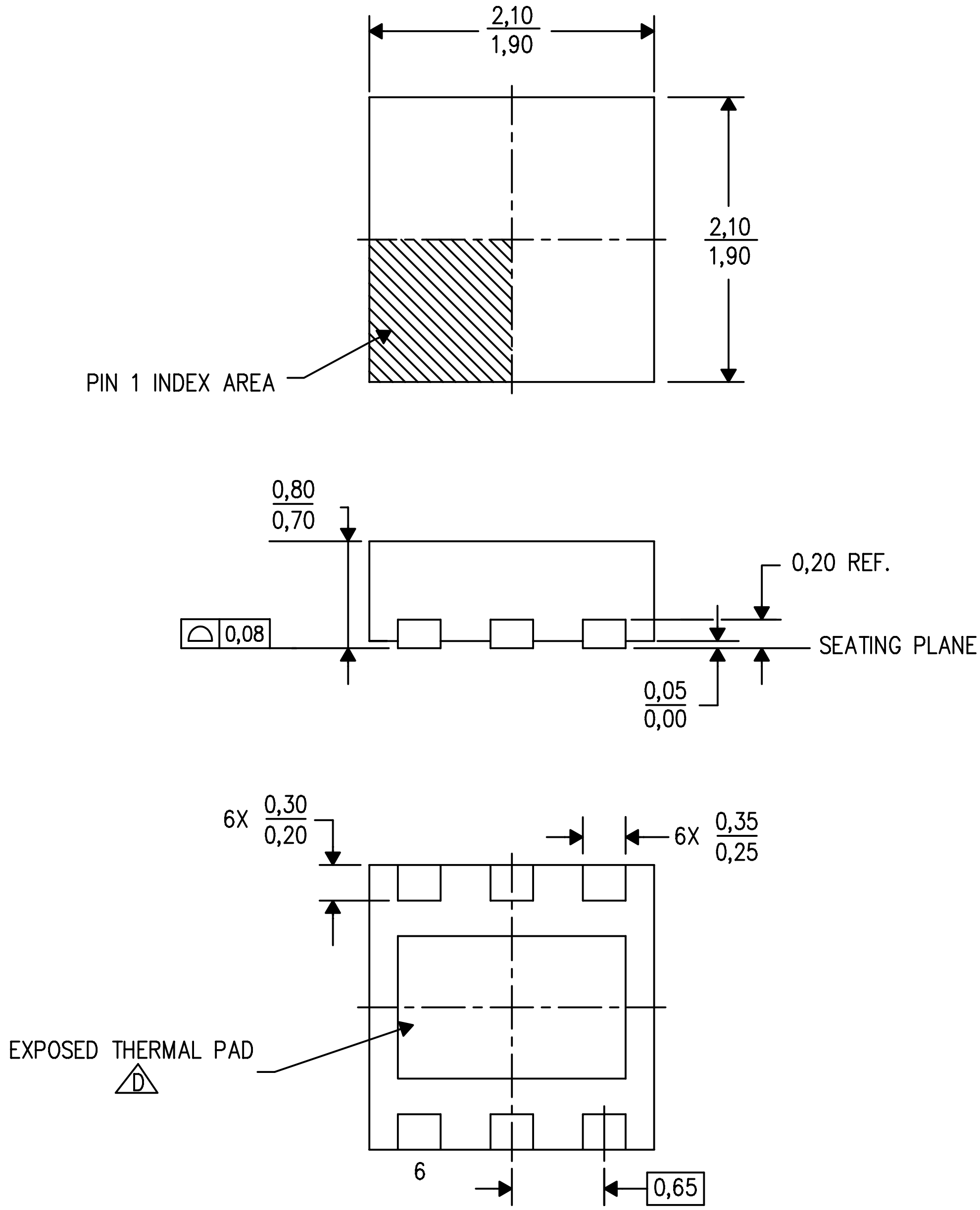
DBV (R–PDSO–G6) PLASTIC SMALL–OUTLINE PACKAGE



4073253–5/K 03/2006

NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- E. Falls within JEDEC MO–178 Variation AB, except minimum lead width.

DRV (S-PDSO-N6) PLASTIC SMALL OUTLINE



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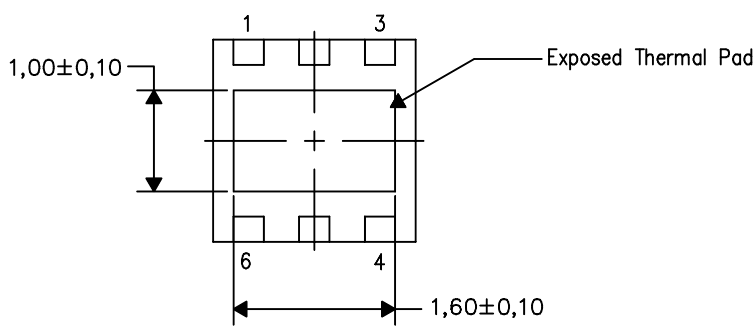
NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
B. This drawing is subject to change without notice.
C. Small Outline No-Lead (SON) package configuration.
D. The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, Quad Flatpack No-Lead Logic Packages, Texas Instruments Literature No. SCBA017. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.

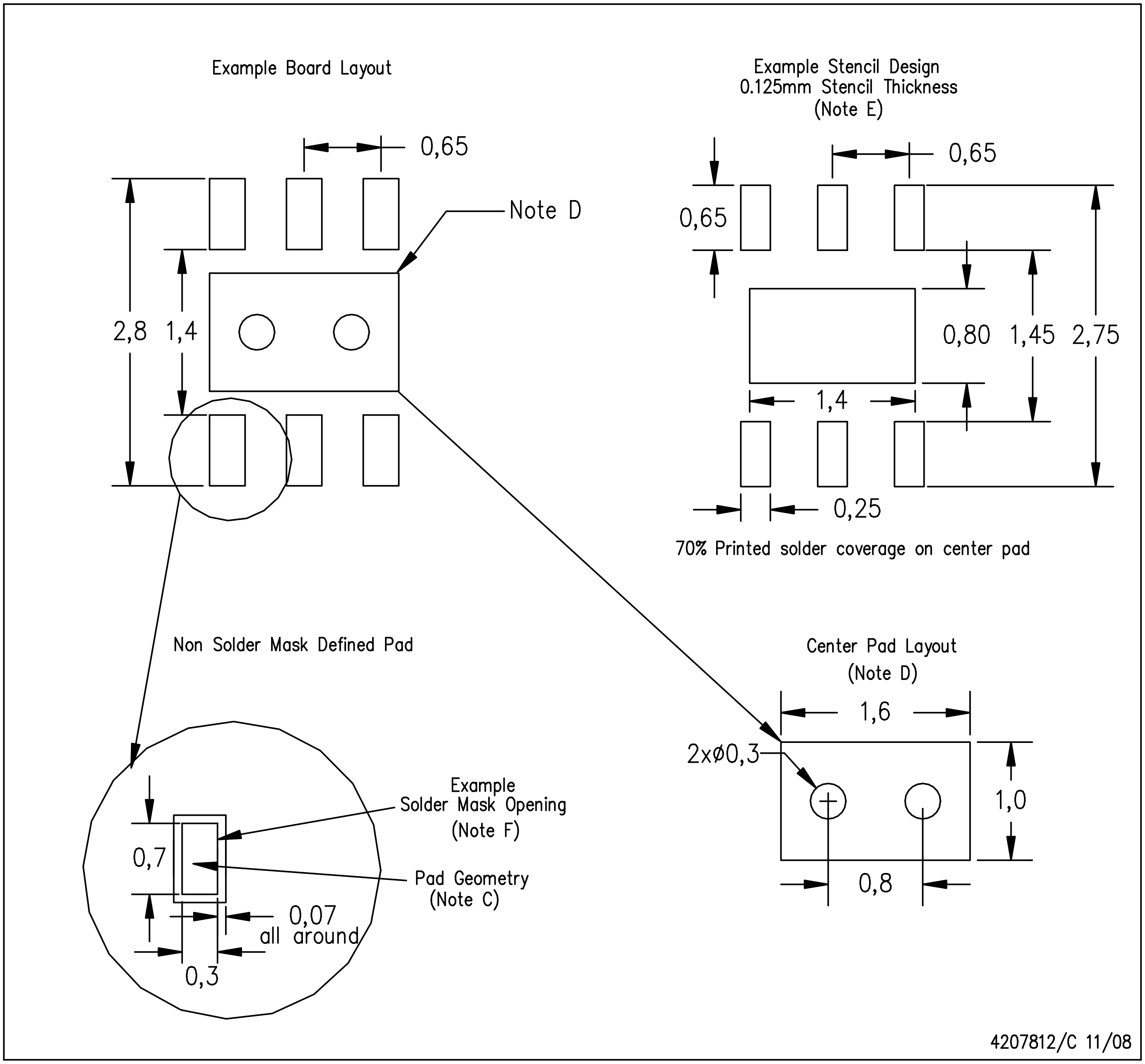


Bottom View

NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

DRV (S–PDSO–N6)



NOTES: A. All linear dimensions are in millimeters.

B. This drawing is subject to change without notice.

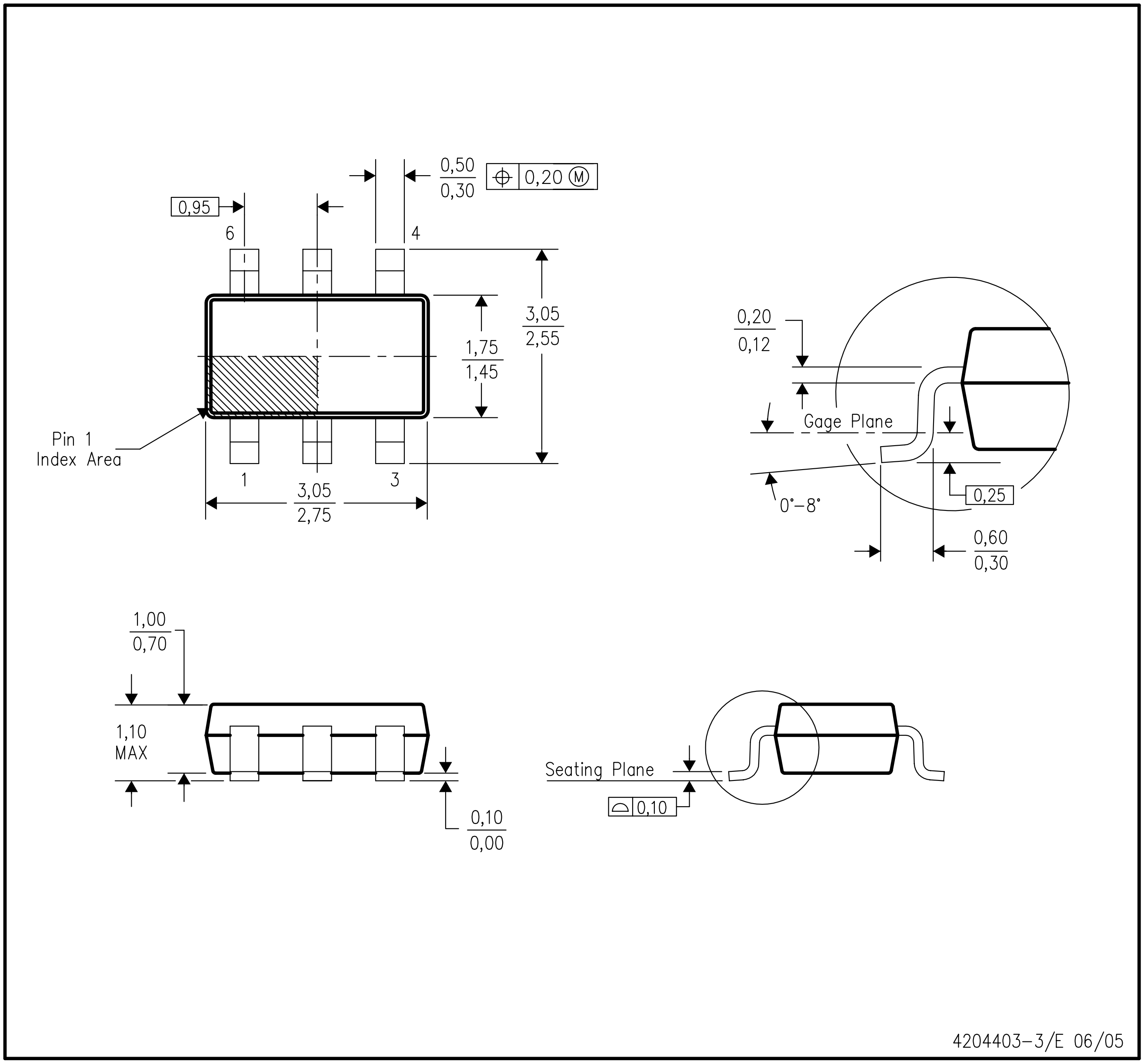
C. Publication IPC–7351 is recommended for alternate designs.

D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, QFN Packages, Texas Instruments Literature No. SCBA017, SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <http://www.ti.com>.

E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.

F. Customers should contact their board fabrication site for solder mask tolerances.

DDC (R–PDSO–G6) PLASTIC SMALL–OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–193 variation AA (6 pin).

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