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REG710xx Buck-Boost Charge Pump with up to 60-mA Output Current

1 Features

- Wide Input Voltage Range: 1.8 V to 5.5 V
- Automatic Step-Up and Step-Down Operation
- Low Input Current Ripple
- Low Output Voltage Ripple
- Minimum Number of External Components—No Inductors
- 1-MHz Internal Oscillator Allows Small Capacitors
- Shutdown Mode
- Thermal and Current Limit Protection
- Six Fixed Output Voltages Available:
  - 2.5 V, 2.7 V, 3 V, 3.3 V, 5 V, 5.5 V

2 Applications

- White LED Driver
- Smart Card Readers
- SIM Cards
- Handheld devices
- Modems
- PCMCIA Cards
- LCD Displays
- Battery Backup Supplies

3 Description

The REG710 family of devices are switched capacitor voltage converters that generate regulated, low-ripple output voltage from an unregulated input voltage. A wide input supply voltage from 1.8 V to 5.5 V makes the REG710 family of devices ideal for a variety of battery sources, such as single-cell Li-Ion, or 2-cell and 3-cell nickel-based or alkaline-based chemistries.

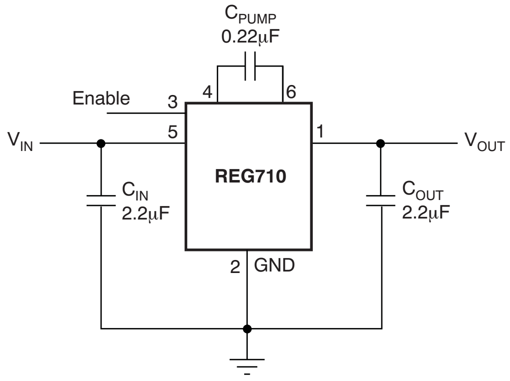
The input voltage may vary above and below the output voltage and the output remains in regulation. The device works as step-up or step-down converters without the need of an inductor, providing low EMI DC-DC conversion. The high switching frequency allows the use of small surface-mount capacitors, saving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

Device Information[1]

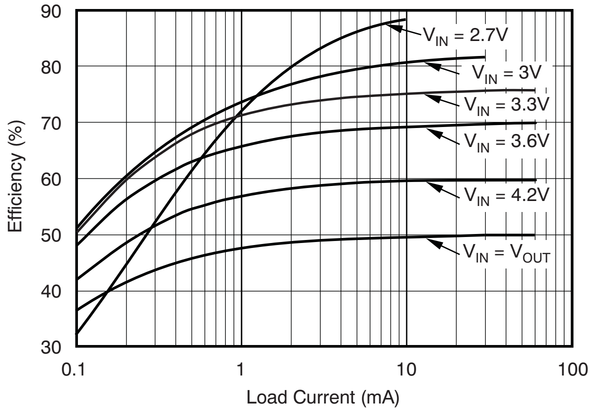
PART NUMBER	PACKAGE	BODY SIZE (NOM)
REG710	SOT-23 (6)	2.90 mm × 1.60 mm
REG71050	SOT (6)	2.90 mm × 1.60 mm
	SON (6)	2.00 mm × 2.00 mm
REG71055	SOT-23 (6)	2.90 mm × 1.60 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Operating Circuit



Efficiency vs Load Current



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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

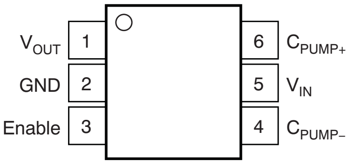
Changes from Revision G (January 2009) to Revision H	Page
• Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section	1

5 Device Comparison Table

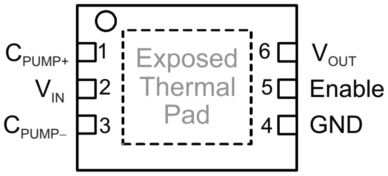
ORDER NUMBER	OUTPUT VOLTAGE
REG71055	5.5 V
REG710NA-5	5 V
REG71050	
REG710NA-3.3	3.3 V
REG710NA-3	3 V
REG710NA-2.7	2.7 V
REG710NA-2.5	2.5 V

6 Pin Configuration and Functions

DDC and DBV Package
6-Pin SOT and SOT-23
Top View



DRV Package
6-Pin SON With Exposed Thermal Pad
Top View



Pin Functions

PIN			I/O	DESCRIPTION
NAME	DDC/DBV	DRV		
C_{pump-}	4	3	–	Connect to the flying capacitor
C_{pump+}	6	1	–	Connect to the flying capacitor
Enable	3	5	I	Hardware Enable/Disable pin (high=enable)
GND	2	4	–	Ground
V_{in}	5	2	I	Input supply pin. Connect the input capacitor to this pin.
V_{out}	1	6	O	Output supply. Connect the output capacitor to this pin.

7 Specifications

7.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V_{IN}	Supply voltage	–0.3	6	V
Enable	Enable input	–0.3	V_{IN}	
	Output short-circuit duration	Indefinite		
T_A	Operating ambient temperature	–55	125	°C
T_J	Operating ambient temperature	–55	150	
T_{stg}	Storage temperature	–55	150	

7.2 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)	±500	

(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.

7.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
INPUT VOLTAGE					
Tested Startup (1)	REG71055	3		5.5	V
	REG710-5	2.7		5.5	V
	All other models	1.8		5.5	V
T_A	Operating ambient temperature range	–40		85	°C

(1) See conditions under Output Voltage with a resistive load no lower than typical V_{OUT}/I_{OUT} in *Electrical Characteristics*.

7.4 Thermal Information

THERMAL METRIC (1)		REG710			UNIT
		DRV	DDC	DBV	
		6 PINS	6 PINS	6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	119.1	204.6	184.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	110.5	50.5	124.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	88.7	54.3	30.6	°C/W
ψ_{JT}	Junction-to-top characterization parameter	7.7	0.8	22.1	°C/W
ψ_{JB}	Junction-to-board characterization parameter	89	52.8	30.1	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	61.8	n/a	n/a	°C/W

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

7.5 Electrical Characteristics

T_A = -40ºC to 85ºC, typical values are at T_A = 25°C (unless otherwise noted), V_{IN} = (V_{OUT} / 2 + 0.75 V), I_{OUT} = 10 mA, C_{IN} = C_{OUT} = 2.2 µF, C_{PUMP} = 0.22 µF, and V_{ENABLE} = 1.3 V, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY						
V_{IN}	Input voltage range. Tested Startup.	See conditions under Output Voltage with a resistive load no lower than typical V_{OUT}/I_{OUT}.				
	REG71055		3		5.5	V
	REG710-5		2.7		5.5	
	All other models		1.8		5.5	
I_Q	Operating quiescent current	I_{OUT} = 0 mA, T_A = 25°C		65	100	µA
I_{SD}	Shutdown current	V_{IN} = 1.8 V to 5.5 V, Enable = 0 V, T_A = 25°C		0.01	1	µA
CONTROL SIGNALS (ENABLE)						
	Logic high input voltage	V_{IN} = 1.8 V to 5.5 V	1.3		V_{IN}	V
	Logic low input voltage	V_{IN} = 1.8 V to 5.5 V	–0.2		0.4	V
	Logic high input current	V_{IN} = 1.8 V to 5.5 V, T_A = 25°C			100	nA
	Logic low input current	V_{IN} = 1.8 V to 5.5 V, T_A = 25°C			100	nA
OSCILLATOR FREQUENCY (1)				1		MHz

(1) The converter regulates by enabling and disabling periods of switching cycles. The switching frequency is the oscillator frequency during an active period.

Electrical Characteristics (continued)

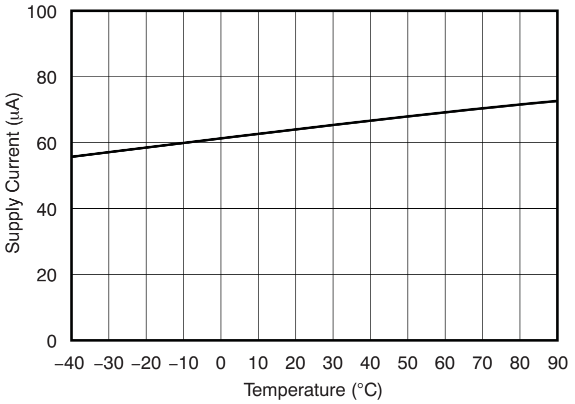
T_A = -40ºC to 85ºC, typical values are at T_A = 25°C (unless otherwise noted), V_{IN} = (V_{OUT} / 2 + 0.75 V), I_{OUT} = 10 mA, C_{IN} = C_{OUT} = 2.2 μF, C_{PUMP} = 0.22 μF, and V_{ENABLE} = 1.3 V, unless otherwise noted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OUTPUT					
REG71055	I_{OUT} ≤ 10 mA, 3 V ≤ V_{IN} ≤ 5.5 V	5.2	5.5	5.8	V
	I_{OUT} ≤ 30 mA, 3.25 V ≤ V_{IN} ≤ 5.5 V	5.2	5.5	5.8	V
REG710-5, REG71050	I_{OUT} ≤ 10 mA, 2.7 V ≤ V_{IN} ≤ 5.5 V	4.7	5	5.3	V
	I_{OUT} ≤ 30 mA, 3 V ≤ V_{IN} ≤ 5.5 V	4.7	5	5.3	V
	I_{OUT} ≤ 60 mA, 3.3 V ≤ V_{IN} ≤ 4.2 V	4.6	5	5.4	V
REG710-3.3	I_{OUT} ≤ 10 mA, 1.8 V ≤ V_{IN} ≤ 5.5 V	3.1	3.3	3.5	V
	I_{OUT} ≤ 30 mA, 2.2 V ≤ V_{IN} ≤ 5.5 V	3.1	3.3	3.5	V
REG710-3	I_{OUT} ≤ 10 mA, 1.8 V ≤ V_{IN} ≤ 5.5 V	2.82	3	3.18	V
	I_{OUT} ≤ 30 mA, 2.2 V ≤ V_{IN} ≤ 5.5 V	2.82	3	3.18	V
REG710-2.7	I_{OUT} ≤ 10 mA, 1.8 V ≤ V_{IN} ≤ 5.5 V	2.54	2.7	2.86	V
	I_{OUT} ≤ 30 mA, 2 V ≤ V_{IN} ≤ 5.5 V	2.54	2.7	2.86	V
REG710-2.5	I_{OUT} ≤ 10 mA, 1.8 V ≤ V_{IN} ≤ 5.5 V	2.35	2.5	2.65	V
	I_{OUT} ≤ 30 mA, 2 V ≤ V_{IN} ≤ 5.5 V	2.35	2.5	2.65	V
I_{out} Nominal output current	T_A = 25°C	30			mA
I_{sc} Short circuit output current	T_A = 25°C		100		mA
RIPPLE VOLTAGE (2)	I_{OUT} = 30 mA, T_A = 25°C		35		mV_{PP}
EFFICIENCY (3)	I_{OUT} = 10 mA, V_{IN} = 1.8 V, REG710-3.3, T_A = 25°C		90%		
THERMAL SHUTDOWN					
Shutdown temperature			160		°C
Shutdown recovery			140		°C

(2) Effective series resistance (ESR) of capacitors is < 0.1 Ω.
(3) See efficiency curves for other V_{IN}/V_{OUT} configurations.

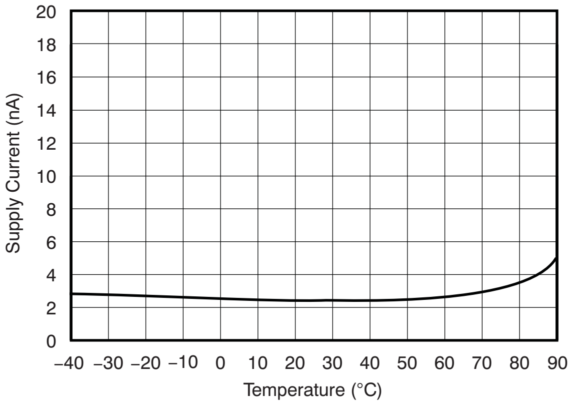
7.6 Typical Characteristics

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



No load

Figure 1. Supply Current vs Temperature



Not enabled

Figure 2. Supply Current vs Temperature

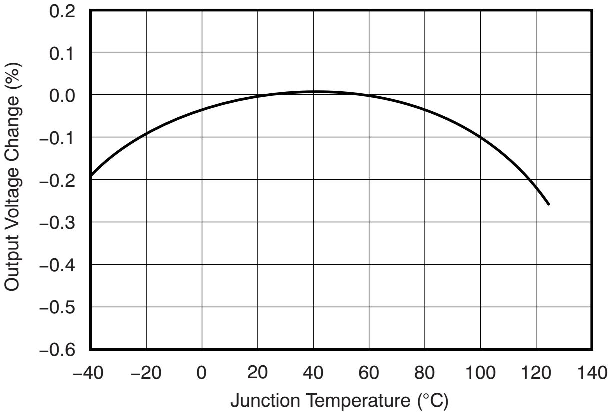


Figure 3. Output Voltage vs Temperature

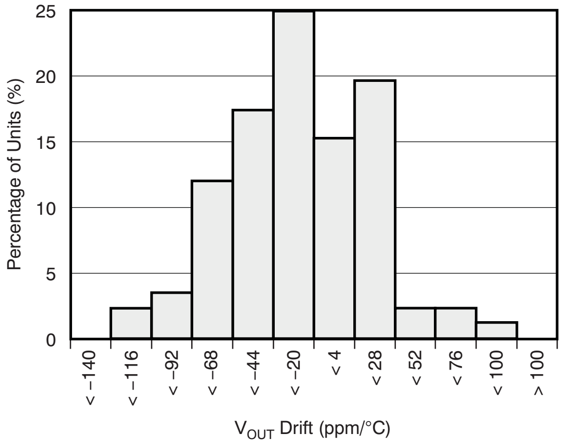


Figure 4. Output Voltage Drift Histogram

8 Detailed Description

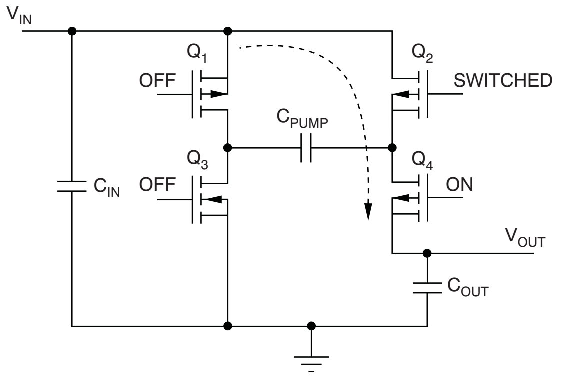
8.1 Overview

The REG710 regulated charge pump provides a regulated output voltage for input voltages which are not regulated with a value that can be lower or higher than the regulated output voltage. This is accomplished by automatic mode switching within the device. When the input voltage is greater than the required output, the device operates as a variable frequency switched-mode regulator. This operation is shown in Figure 5. 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 6.

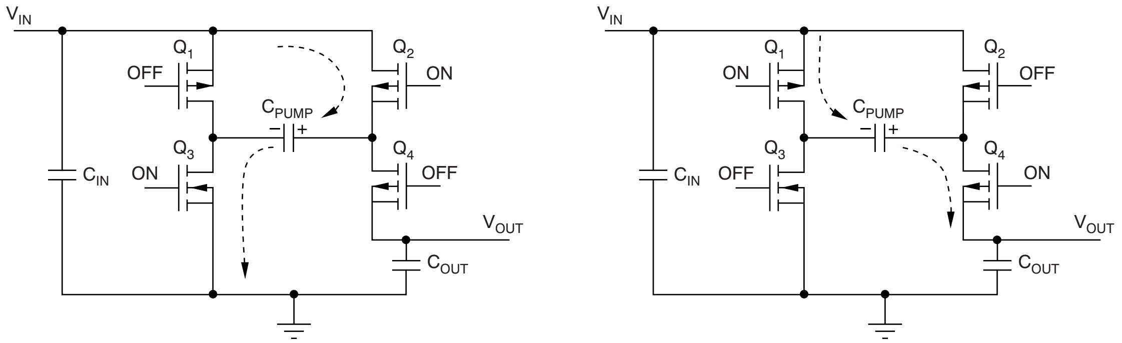
A conversion clock of 50% duty cycle is generated. During the first half cycle the FET switches are configured as shown in Figure 6 (A), and C_{PUMP} charges to V_{IN}.

During the second half cycle the FET switches are configured as shown in Figure 6 (B), and the voltage on C_{PUMP} is added to V_{IN}. The output voltage is regulated by skipping clock cycles as necessary.



Step-Down (Buck) Mode

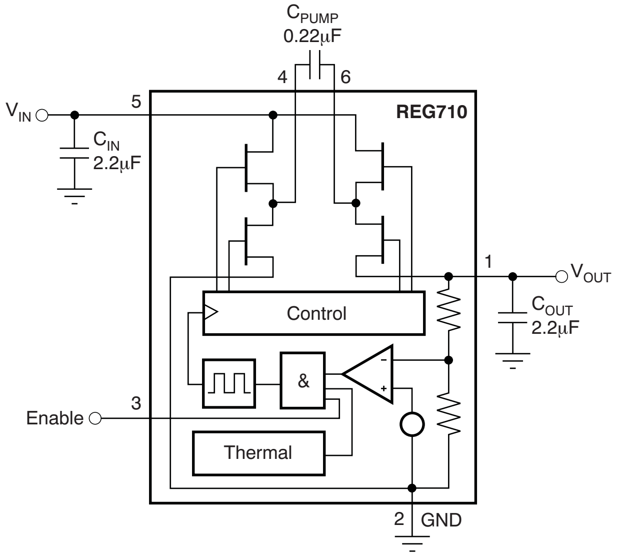
Figure 5. Simplified Schematic of the REG710 Operating in the Step-Down Mode



(A) Step-Up (Boost) Mode (B)

Figure 6. Simplified Schematic of the REG710 Operating in the Step-Up or Boost Mode

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Shutdown Mode

The EN pin enables the IC when pulled high and places it into energy-saving shutdown mode when pulled low. When in shutdown mode, the output is disconnected from the input and the quiescent current is reduced to 0.01 μA typical. This shutdown mode functionality is only valid when V_{IN} is above the minimum recommended operating voltage. The EN pin cannot be left floating and must be actively terminated either high or low.

8.3.2 Protection

The regulator includes thermal shutdown circuitry protecting the device 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 operating the regulator into thermal shutdown can degrade reliability. The regulator also provides current limit to protect itself and the load.

8.4 Device Functional Modes

8.4.1 Peak Current Reduction

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

8.4.2 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:

Device Functional Modes (continued)

$$\text{Efficiency (\%)} = V_{OUT} \,/\, (2 \times V_{IN}) \times 100$$
(step-up operating mode)
or
$$\frac{V_{OUT}}{V_{IN}} \times 100$$
(step-down operating mode) (1)

Table 1. Operating Mode Change versus V_{IN}

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

Table 1 lists the approximate values of the input voltage at which the device changes internal operating mode. See efficiency curves in *Typical Characteristics* for various loads and input voltages.

9 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.

9.1 Application Information

The REG710 is a switched capacitor voltage converter that produces a regulated, low-ripple output voltage from an unregulated input voltage range from 1.8 V to 5.5 V. The high switching frequency allows the use of small surface-mount capacitors. The following section gives guidance to choose external components to complete the power supply design. Application curves are included for the typical application shown below.

9.2 Typical Applications

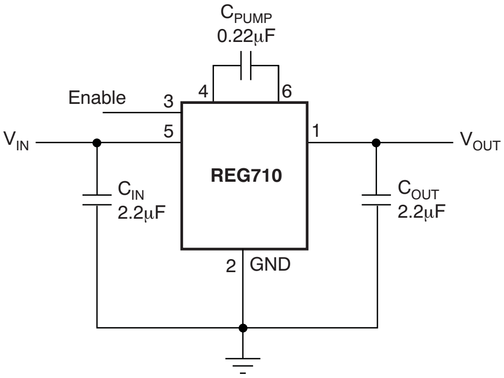


Figure 7. Typical Operating Circuit

9.2.1 Design Requirements

The REG710 family of switched capacitor voltage converters offers a variety of regulated fixed output voltages. This family supports unregulated input voltages which can have values that are lower or higher than the regulated output voltage. Only input and output capacitors as well as a pump capacitor are required to have a fully functional converter. The following design procedure is adequate for the whole V_{IN}, V_{OUT} and load current range of REG710.

9.2.2 Detailed Design Procedure

9.2.2.1 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 7 for component values.

With light loads or higher input voltage, a smaller 0.1-μF pump capacitor (C_{PUMP}) and smaller 1-μF 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 10 μF or larger.

The capacitors listed in Table 2 can be used with the REG710. This table is only a representative list of compatible parts.

Table 2. Suggested Capacitors

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

9.2.3 Application Curves

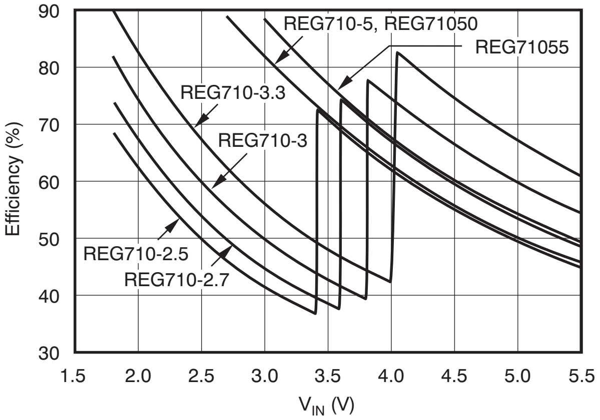
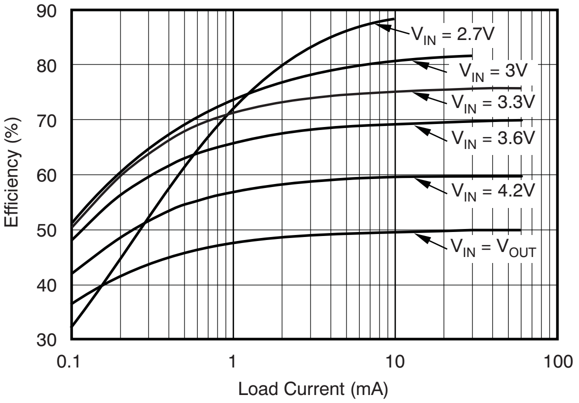
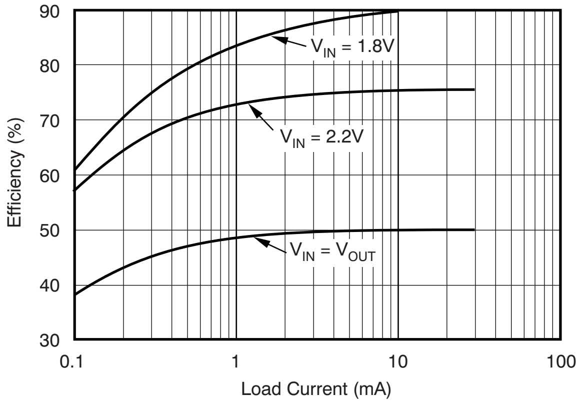


Figure 8. Efficiency vs V_{IN}



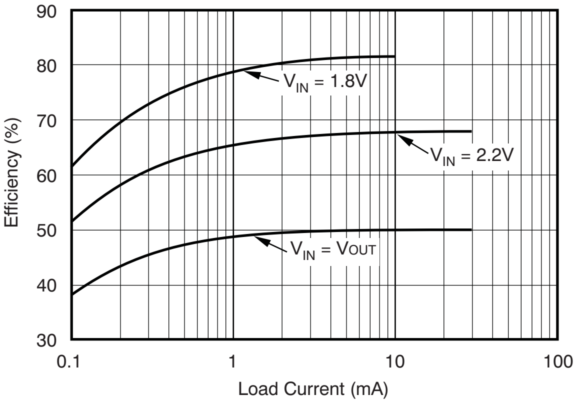
REG710-5V,
REG71050

Figure 9. Efficiency vs Load Current



REG710-3.3V

Figure 10. Efficiency vs Load Current



REG710-3.3V

Figure 11. Efficiency vs Load Current

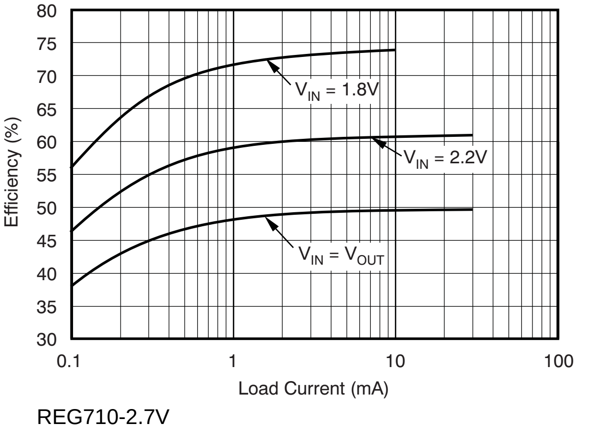


Figure 12. Efficiency vs Load Current

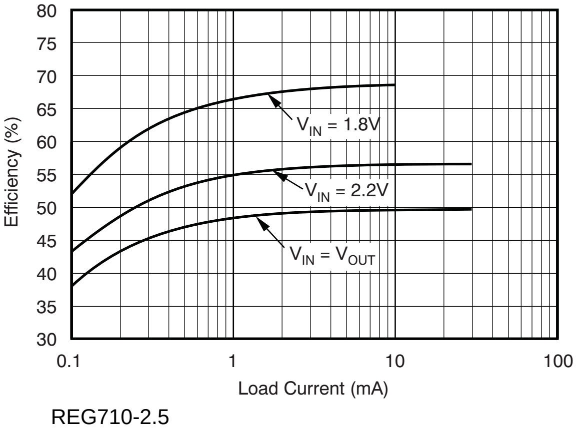


Figure 13. Efficiency vs Load Current

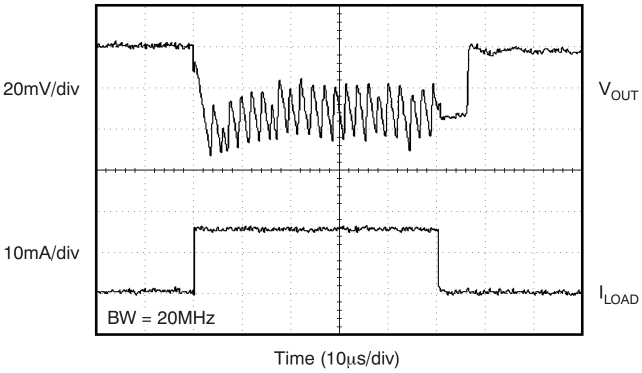


Figure 14. Load Transient Response

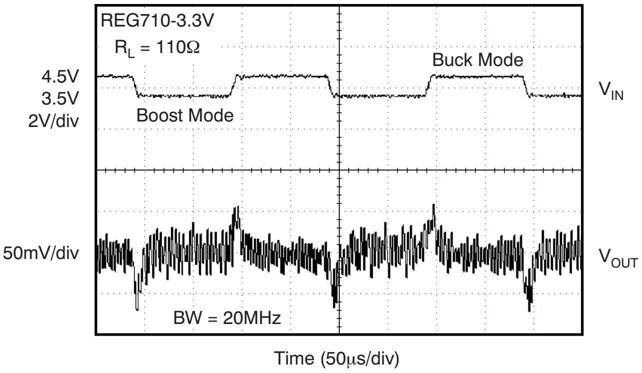


Figure 15. Line Transient Response

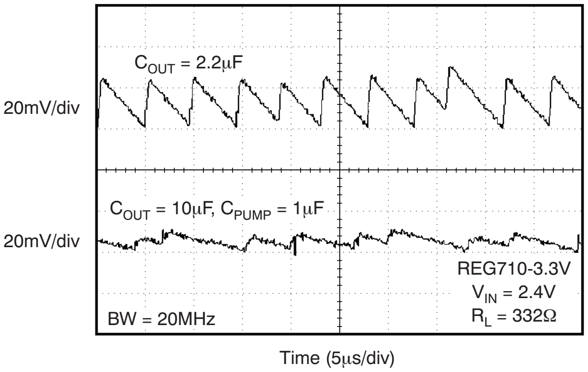


Figure 16. Output Ripple Voltage

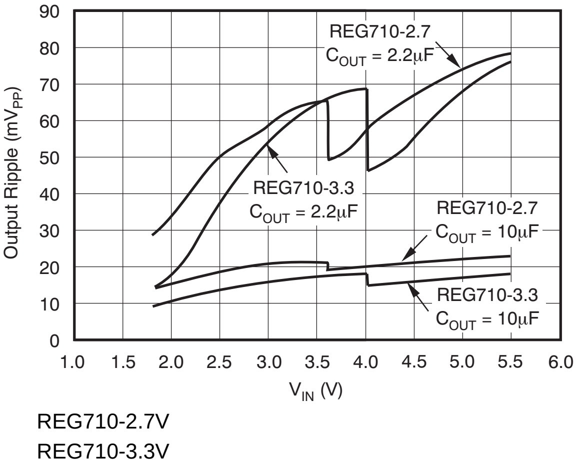
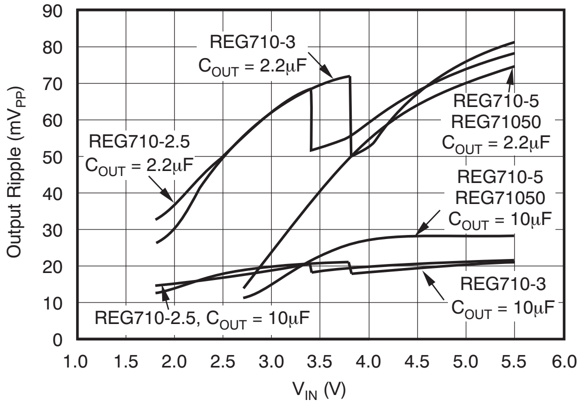


Figure 17. Output Ripple Voltage vs V_{IN}



REG710-2.5   REG710-5

REG710-3

Figure 18. Output Ripple Voltage vs V_{IN}

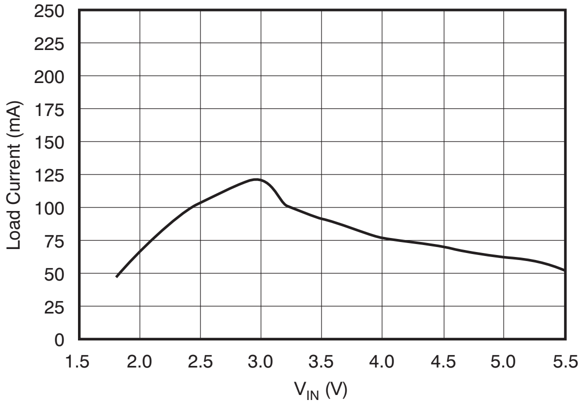


Figure 19. Short-Circuit Load Current vs V_{IN}

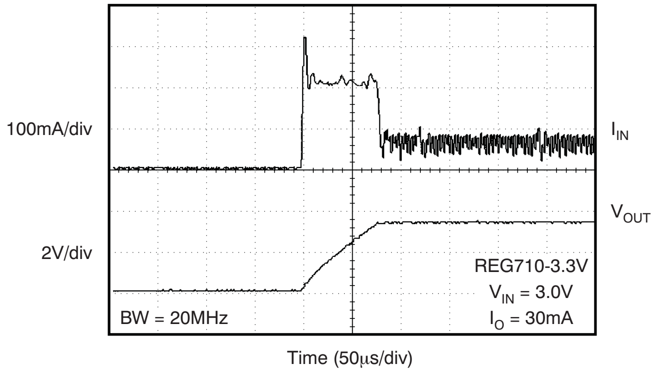


Figure 20. Input Current at Turn-On

9.3 System Examples

9.3.1 1.8 V to 5.0 V With 10-mA Output Current

The REG710 family of charge pumps can be cascaded to reach higher output voltages, as shown in Figure 21.

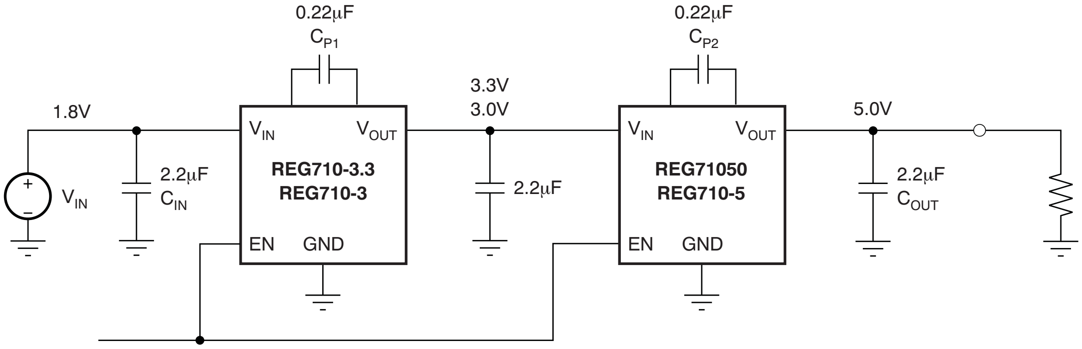


Figure 21. REG710 Circuit for Step-Up Operation From 1.8 V to 5 V With 10-mA Output Current

This application circuits operates from 1.8 V input voltage and generates 5 V output voltage supporting 10 mA load current.

Higher output voltages can be achieved when two REG710 devices are connected in cascade. When cascading two devices from the REG710 family, the relationship between output current and input voltage must be taken into account. (see *Electrical Characteristics*). In this case, REG710 can deliver a maximum of 10 mA. REG710-3.3 or REG710-3 can be used. A second charge pump, REG71050 or REG710-5, steps up the voltage from 3 V or 3.3 V to 5 V. Connect both Enable pins together.

System Examples (continued)

9.3.2 Doubling the Output Current

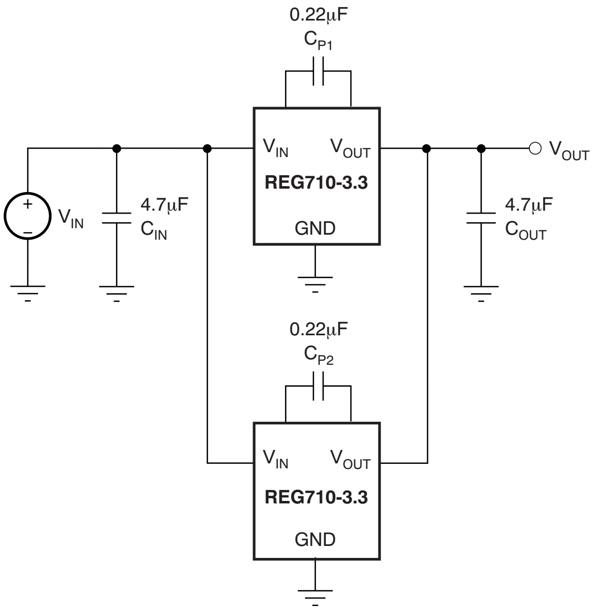


Figure 22. REG710 Circuit for Doubling the Output Current

When higher output currents are required, the REG710 family can be paralleled to double the output current. When paralleling two devices the relationship between output current and input voltage must be taken into account (see *Electrical Characteristics*).

This particular application can deliver 20 mA for an input voltage from 1.8 V to 5.5 V, or 60-mA output for an input voltage from 2.2 V to 5.5 V. The output voltage is 3.3 V.

9.3.3 Driving LEDs

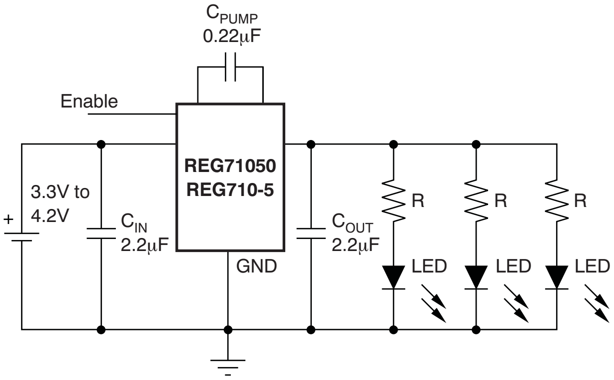


Figure 23. REG710 Circuit for Driving LEDs

The REG710 family can be used to drive LEDs. The feed forward voltage of the chosen LED determines the required output voltage. In this application, the charge pump can drive multiple LEDs up to 60 mA in total.

$$R = \frac{5V - V_{LED}}{I_{LED}} \tag{2}$$

10 Power Supply Recommendations

The input supply to the REG710 must have a current rating according to the supply voltage, output voltage and output current of the REG710.

11 Layout

11.1 Layout Guidelines

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 24. The trace lengths from the input and output capacitors have been kept as short as possible.

11.2 Layout Example

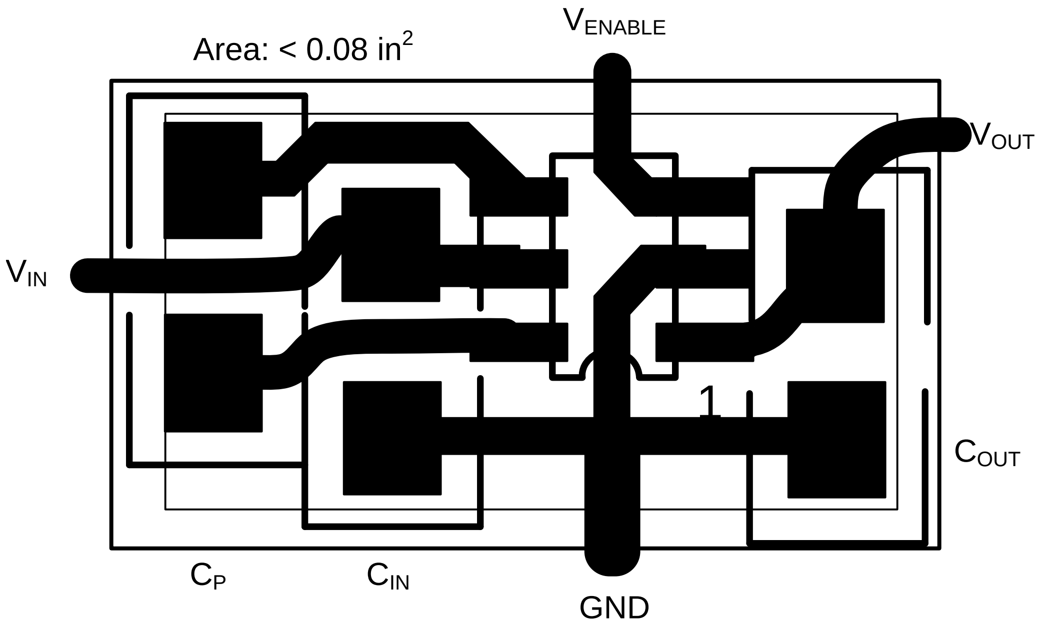


Figure 24. Suggested PCB Design for Minimum Ripple

12 Device and Documentation Support

12.1 Device Support

12.1.1 Third-Party Products Disclaimer

TI'S PUBLICATION OF INFORMATION REGARDING THIRD-PARTY PRODUCTS OR SERVICES DOES NOT CONSTITUTE AN ENDORSEMENT REGARDING THE SUITABILITY OF SUCH PRODUCTS OR SERVICES OR A WARRANTY, REPRESENTATION OR ENDORSEMENT OF SUCH PRODUCTS OR SERVICES, EITHER ALONE OR IN COMBINATION WITH ANY TI PRODUCT OR SERVICE.

12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 3. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
REG71050	Click here	Click here	Click here	Click here	Click here
REG71055	Click here	Click here	Click here	Click here	Click here

12.3 Community Resources

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.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

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

12.4 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.5 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

12.6 Glossary

SLYZ022 — *TI Glossary*.

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

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
REG71050DDCR	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	GAAI	Samples
REG71050DDCRG4	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	GAAI	Samples
REG71050DDCT	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	GAAI	Samples
REG71050DDCTG4	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	GAAI	Samples
REG71050DRVR	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CFF	Samples
REG71050DRVRG4	ACTIVE	WSON	DRV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CFF	Samples
REG71050DRVT	ACTIVE	WSON	DRV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CFF	Samples
REG71055DDCR	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10H	Samples
REG71055DDCRG4	ACTIVE	SOT	DDC	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10H	Samples
REG71055DDCT	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10H	Samples
REG71055DDCTG4	ACTIVE	SOT	DDC	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10H	Samples
REG710NA-2.5/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10G	Samples
REG710NA-2.5/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10G	Samples
REG710NA-2.5/3K	OBSOLETE	SOT-23	DBV	6		TBD	Call TI	Call TI	-40 to 85	R10G	
REG710NA-2.5/3KG4	OBSOLETE	SOT-23	DBV	6		TBD	Call TI	Call TI	-40 to 85		
REG710NA-2.7/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10F	Samples
REG710NA-3.3/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10C	Samples
REG710NA-3.3/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10C	Samples

PACKAGE OPTION ADDENDUM

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
REG710NA-3.3/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10C	Samples
REG710NA-3/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10D	Samples
REG710NA-3/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10D	Samples
REG710NA-3/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10D	Samples
REG710NA-3/3KG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10D	Samples
REG710NA-5/250	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10B	Samples
REG710NA-5/250G4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10B	Samples
REG710NA-5/3K	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10B	Samples
REG710NA-5/3KG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	R10B	Samples

(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.

[4] There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

[5] Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

[6] Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF REG71055 :

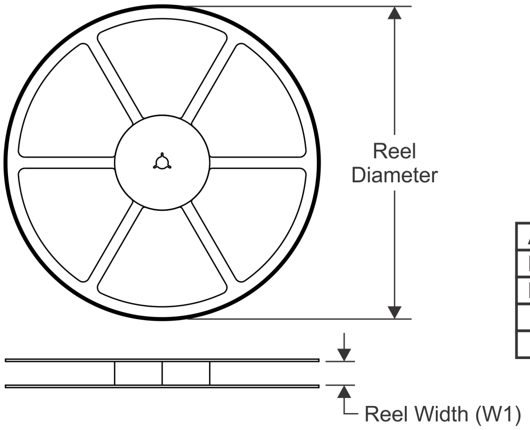
- Automotive: REG71055-Q1

NOTE: Qualified Version Definitions:

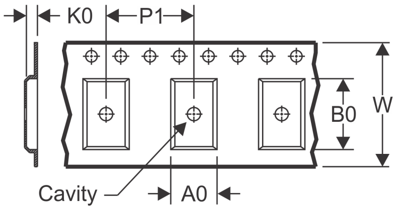
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

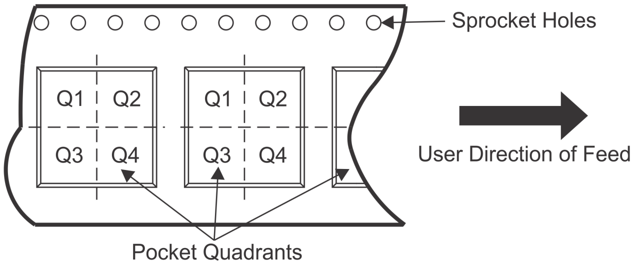


TAPE DIMENSIONS



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

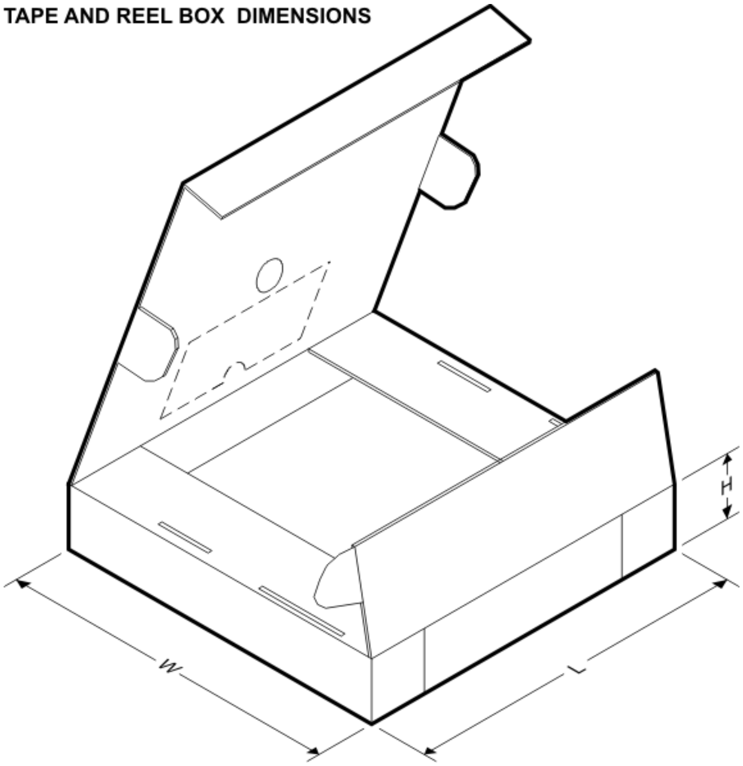


*All dimensions are nominal

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	WSON	DRV	6	3000	179.0	8.4	2.2	2.2	1.2	4.0	8.0	Q2
REG71050DRVT	WSON	DRV	6	250	179.0	8.4	2.2	2.2	1.2	4.0	8.0	Q2
REG71050DRVT	WSON	DRV	6	250	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
REG71055DDCR	SOT	DDC	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG71055DDCT	SOT	DDC	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-2.5/250	SOT-23	DBV	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-2.7/250	SOT-23	DBV	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-3.3/250	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG710NA-3.3/3K	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG710NA-3.3/3K	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-3/250	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG710NA-3/250	SOT-23	DBV	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-3/3K	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-3/3K	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
REG710NA-5/250	SOT-23	DBV	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
REG710NA-5/250	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3

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
REG710NA-5/3K	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	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

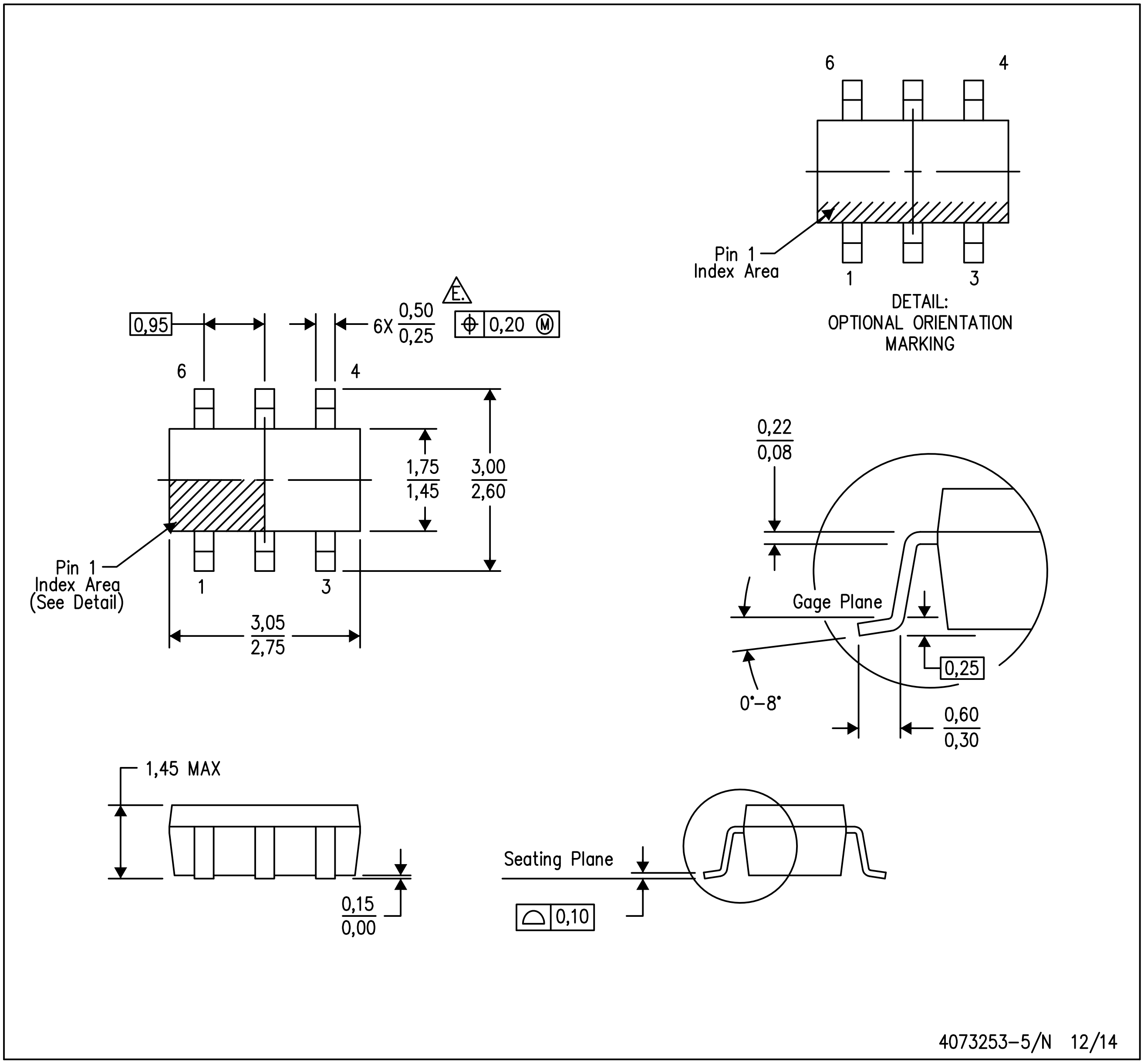


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
REG71050DDCR	SOT	DDC	6	3000	203.0	203.0	35.0
REG71050DDCT	SOT	DDC	6	250	203.0	203.0	35.0
REG71050DRVR	WSON	DRV	6	3000	195.0	200.0	45.0
REG71050DRVT	WSON	DRV	6	250	195.0	200.0	45.0
REG71050DRVT	WSON	DRV	6	250	210.0	185.0	35.0
REG71055DDCR	SOT	DDC	6	3000	203.0	203.0	35.0
REG71055DDCT	SOT	DDC	6	250	203.0	203.0	35.0
REG710NA-2.5/250	SOT-23	DBV	6	250	203.0	203.0	35.0
REG710NA-2.7/250	SOT-23	DBV	6	250	203.0	203.0	35.0
REG710NA-3.3/250	SOT-23	DBV	6	250	180.0	180.0	18.0
REG710NA-3.3/3K	SOT-23	DBV	6	3000	180.0	180.0	18.0
REG710NA-3.3/3K	SOT-23	DBV	6	3000	203.0	203.0	35.0
REG710NA-3/250	SOT-23	DBV	6	250	180.0	180.0	18.0
REG710NA-3/250	SOT-23	DBV	6	250	203.0	203.0	35.0
REG710NA-3/3K	SOT-23	DBV	6	3000	203.0	203.0	35.0

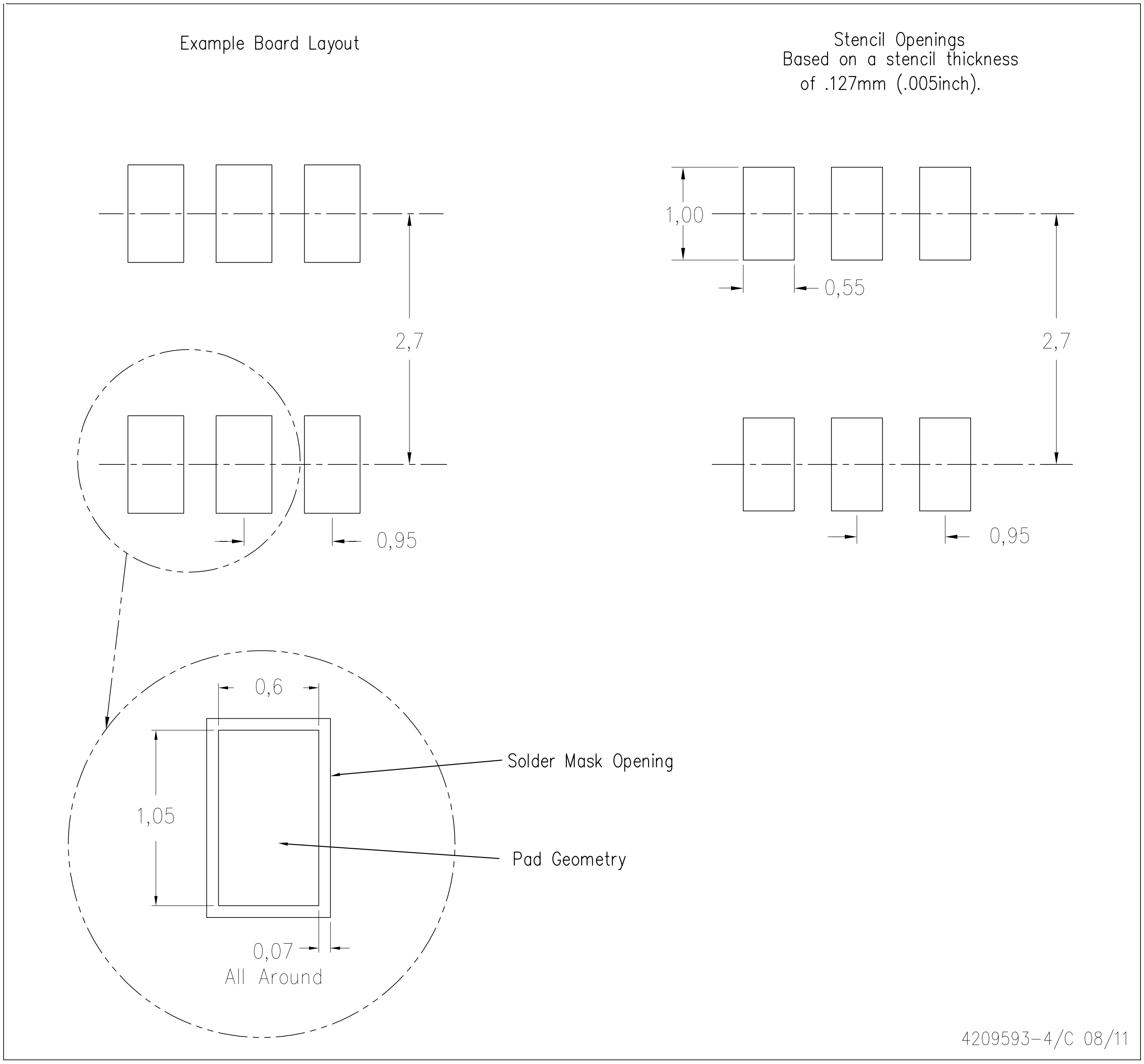
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
REG710NA-3/3K	SOT-23	DBV	6	3000	180.0	180.0	18.0
REG710NA-5/250	SOT-23	DBV	6	250	203.0	203.0	35.0
REG710NA-5/250	SOT-23	DBV	6	250	180.0	180.0	18.0
REG710NA-5/3K	SOT-23	DBV	6	3000	180.0	180.0	18.0
REG710NA-5/3K	SOT-23	DBV	6	3000	203.0	203.0	35.0

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



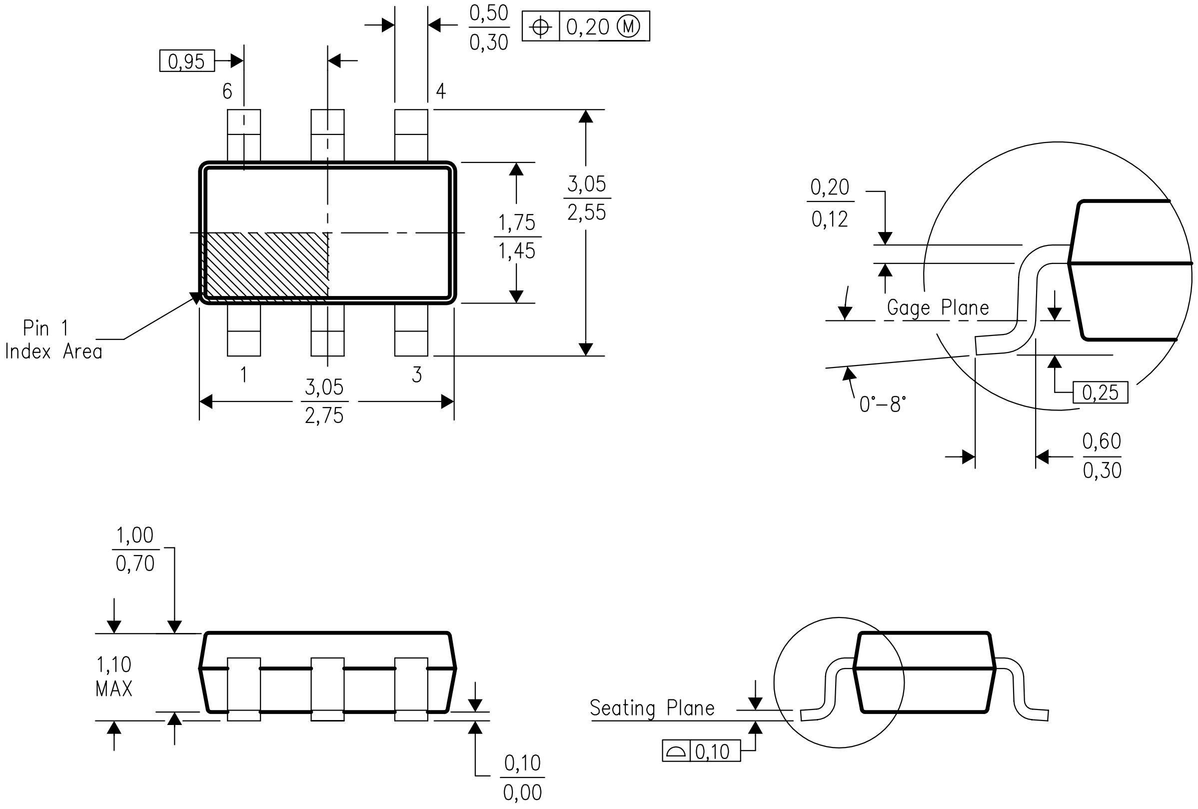
NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.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

DBV (R–PDSO–G6) PLASTIC SMALL OUTLINE



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
- D. Publication IPC–7351 is recommended for alternate designs.
- 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

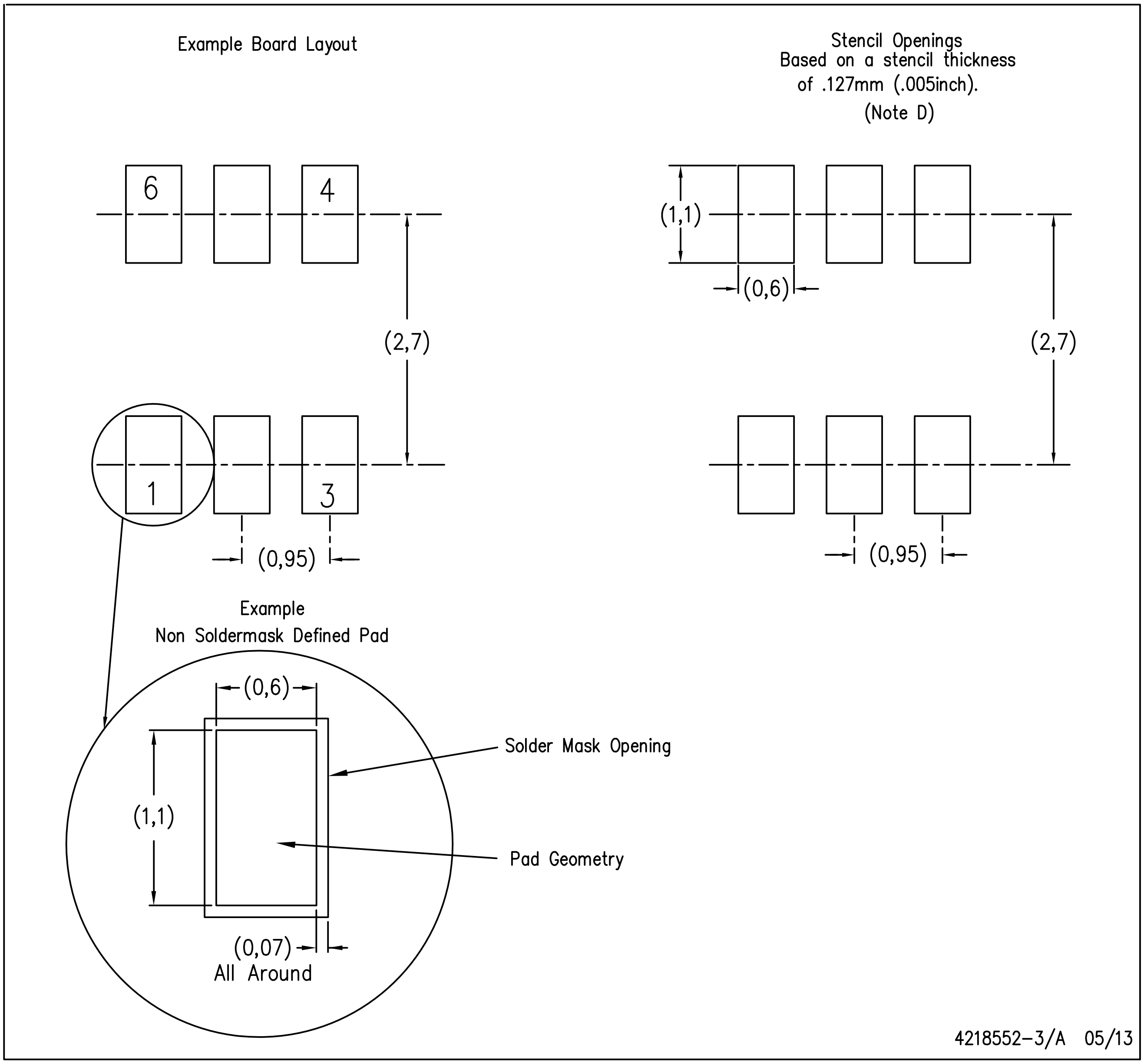
DDC (R-PDSO-G6) PLASTIC SMALL-OUTLINE



4204403-3/E 06/05

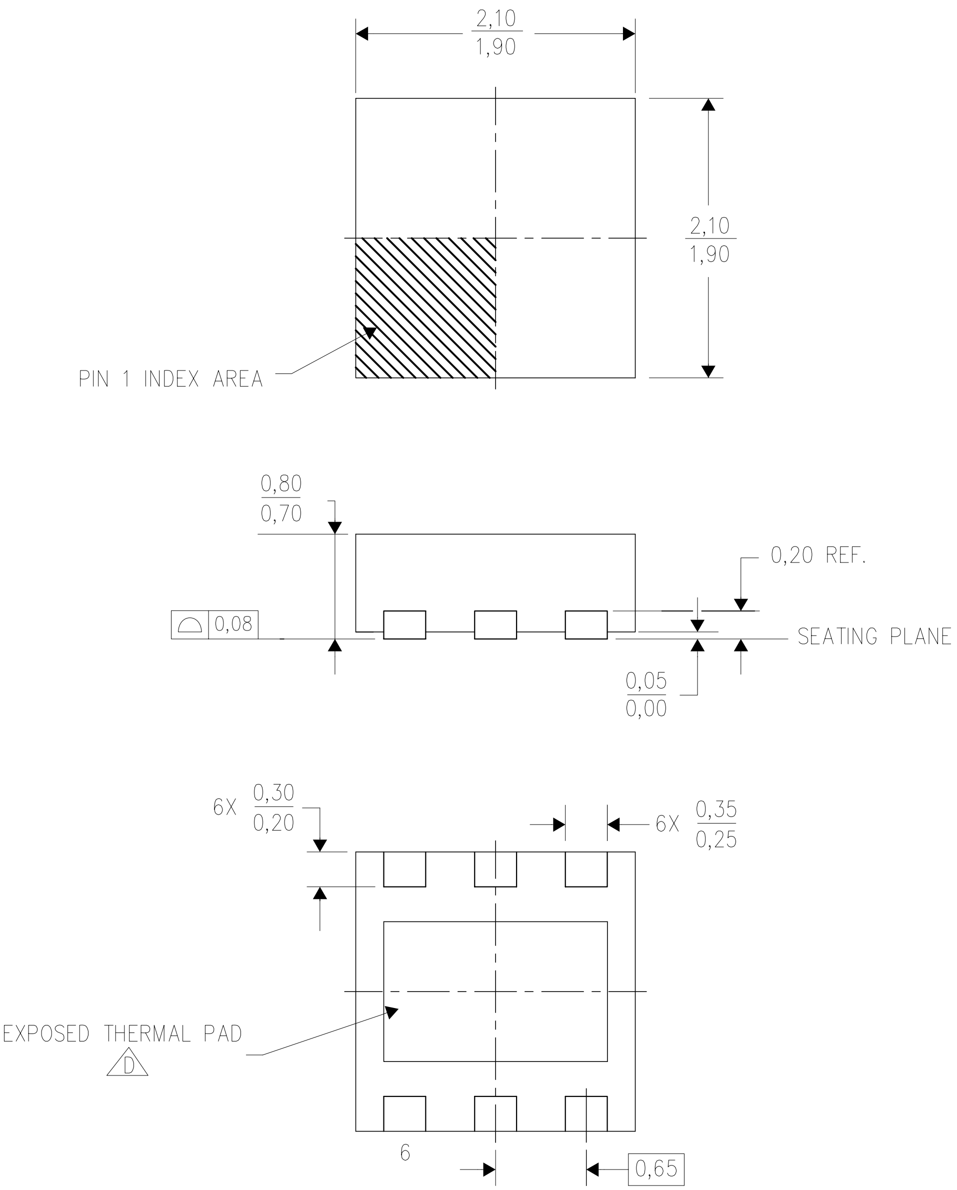
NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion.
- D. Falls within JEDEC MO-193 variation AA (6 pin).

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. Publication IPC–7351 is recommended for alternate designs.
- D. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

DRV (S-PWSON-N6) PLASTIC SMALL OUTLINE NO-LEAD



4206925/E 10/10

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.

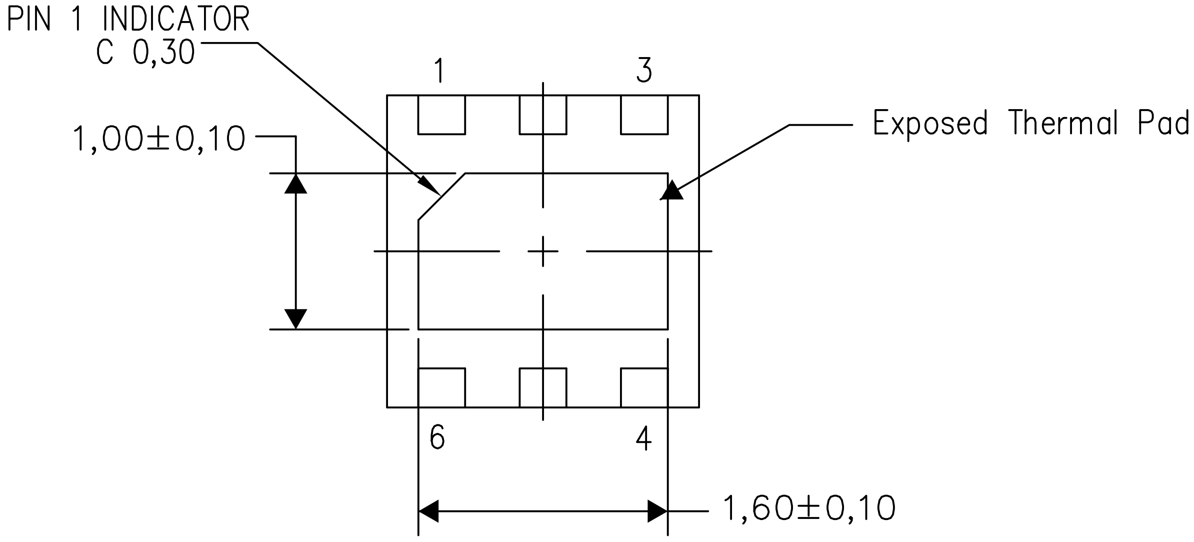
DRV (S-PWSON-N6) PLASTIC SMALL OUTLINE NO-LEAD

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, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

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



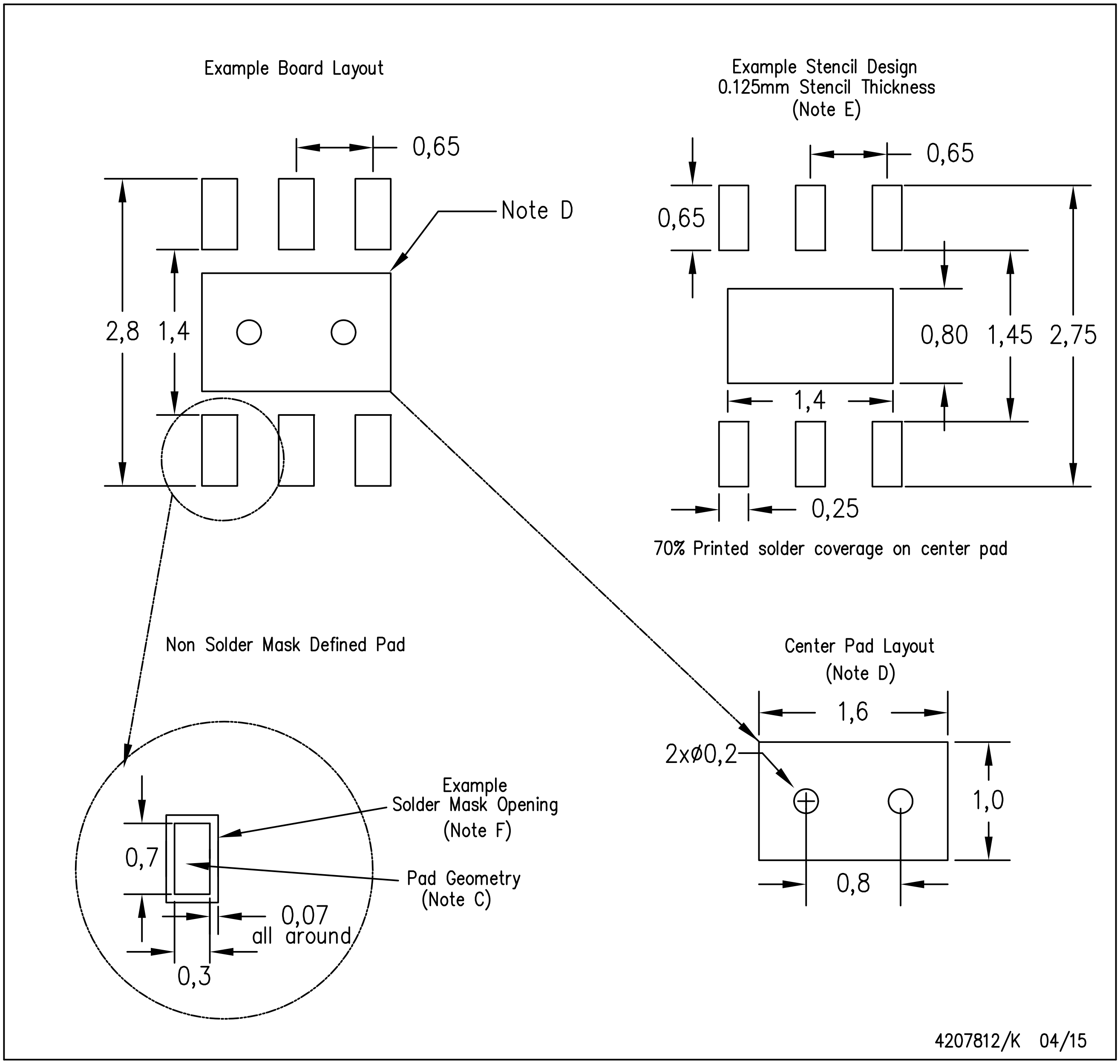
Bottom View

Exposed Thermal Pad Dimensions

4206926/Q 04/15

NOTE: All linear dimensions are in millimeters

DRV (S–PWSON–N6) PLASTIC SMALL OUTLINE NO–LEAD



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/SON PCB Attachment, Texas Instruments Literature No. 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.

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