Qi Compliant Wireless Power Transmitter Manager

Check for Samples: bq500210

FEATURES

- Intelligent Control of the Power Transfer between Base Station and Mobile Device
- Conforms to the Wireless Power Consortium (WPC) Wireless Power Transfer 1.0.2 Specification
- Digital Demodulation Significantly Simplifies Solution Over bq500110
- Improved Parasitic Metal Object Detection (PMOD) Promotes Safety During Wireless Power Transfer
- Enhanced Charge Status Indicator
- Operating Modes Status Indicators
  - Standby
  - Power Transfer (visual and audio)
  - Charge Complete
  - Fault
- Over Temperature Protection

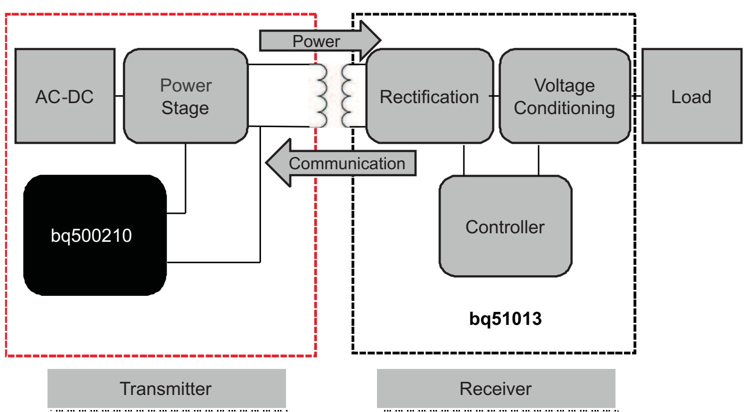
APPLICATIONS

- WPC 1.0.2 Compliant Wireless Chargers for:
  - Mobile and Smart Phones
  - MP3 Players
  - Global Positioning Devices
  - Digital Cameras
- Other Wireless Power Transmitters in:
  - Cars and Other Vehicles
  - Hermetically Sealed Devices, Tools, and Appliances
  - Furniture Built-In Wireless Chargers
  - Toy Power Supplies and Chargers
- See www.ti.com/wirelesspower for More Information on TI's Wireless Charging Solutions

DESCRIPTION

The bq500210 is a second generation Wireless Power dedicated digital controller that integrates the logic functions required to control Wireless Power Transfer in a single channel WPC compliant contactless charging base station. The bq500210 is an intelligent device that periodically pings the surrounding environment for available devices to be powered, monitors all communication from the device being wirelessly powered, and adjusts power applied to the transmitter coil per feedback received from the powered device. The bq500210 also manages the fault conditions associated with the power transfer and controls the operating modes status indicator. The bq500210 supports improved Parasitic Metal Object Detection (PMOD). The controller in real time analyzes the efficiency of the established power transfer using Rectified Power Packets and protects itself and the power receiver from excessive power loss and heat associated with parasitic metal objects placed in the power transfer path.

The bq500210 is available in an area saving 48-pin, 7mm x 7mm QFN package and operates over a temperature range from –40°C to 110°C.



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.

ORDERING INFORMATION[1]

OPERATING TEMPERATURE RANGE, T_A	ORDERABLE PART NUMBER	PIN COUNT	SUPPLY	PACKAGE	TOP SIDE MARKING
-40°C to 110°C	bq500210RGZR	48 pin	Reel of 2500	QFN	bq500210
	bq500210RGZT	48 pin	Reel of 250	QFN	bq500210

(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.

ABSOLUTE MAXIMUM RATINGS[1]

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

	VALUE		UNIT
	MIN	MAX	
Voltage applied at V33D to DGND	–0.3	3.8	V
Voltage applied at V33A to AGND	–0.3	3.8	V
Voltage applied to any pin [2]	–0.3	3.8	V
Storage temperature, T_{STG}	–40	150	°C

(1) Stresses beyond 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-rated conditions for extended periods may affect device reliability.
(2) All voltages referenced to GND.

THERMAL INFORMATION

THERMAL METRIC[1]		bq500210	UNITS
		RGZ	
		48 PINS	
θ_{JA}	Junction-to-ambient thermal resistance[2]	28.4	°C/W
$\theta_{JC(top)}$	Junction-to-case(top) thermal resistance [3]	13.9	
θ_{JB}	Junction-to-board thermal resistance [4]	5.3	
ψ_{JT}	Junction-to-top characterization parameter [5]	0.2	
ψ_{JB}	Junction-to-board characterization parameter [6]	5.2	
$\theta_{JC(bottom)}$	Junction-to-case(bottom) thermal resistance [7]	1.4	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.
(2) The junction-to-ambient thermal resistance under natural convection is obtained in a simulation on a JEDEC-standard, high-K board, as specified in JESD51-7, in an environment described in JESD51-2a.
(3) The junction-to-case (top) thermal resistance is obtained by simulating a cold plate test on the package top. No specific JEDEC-standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.
(4) The junction-to-board thermal resistance is obtained by simulating in an environment with a ring cold plate fixture to control the PCB temperature, as described in JESD51-8.
(5) The junction-to-top characterization parameter, ψ_{JT}, estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining θ_{JA}, using a procedure described in JESD51-2a (sections 6 and 7).
(6) The junction-to-board characterization parameter, ψ_{JB}, estimates the junction temperature of a device in a real system and is extracted from the simulation data for obtaining θ_{JA} , using a procedure described in JESD51-2a (sections 6 and 7).
(7) The junction-to-case (bottom) thermal resistance is obtained by simulating a cold plate test on the exposed (power) pad. No specific JEDEC standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.

RECOMMENDED OPERATING CONDITIONS

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

		MIN	NOM	MAX	UNIT
V	Supply voltage during operation, V33D, V33A	3.0	3.3	3.6	V
T_A	Operating free-air temperature range	–40		125	°C
T_J	Junction temperature			125	°C

ELECTRICAL CHARACTERISTICS

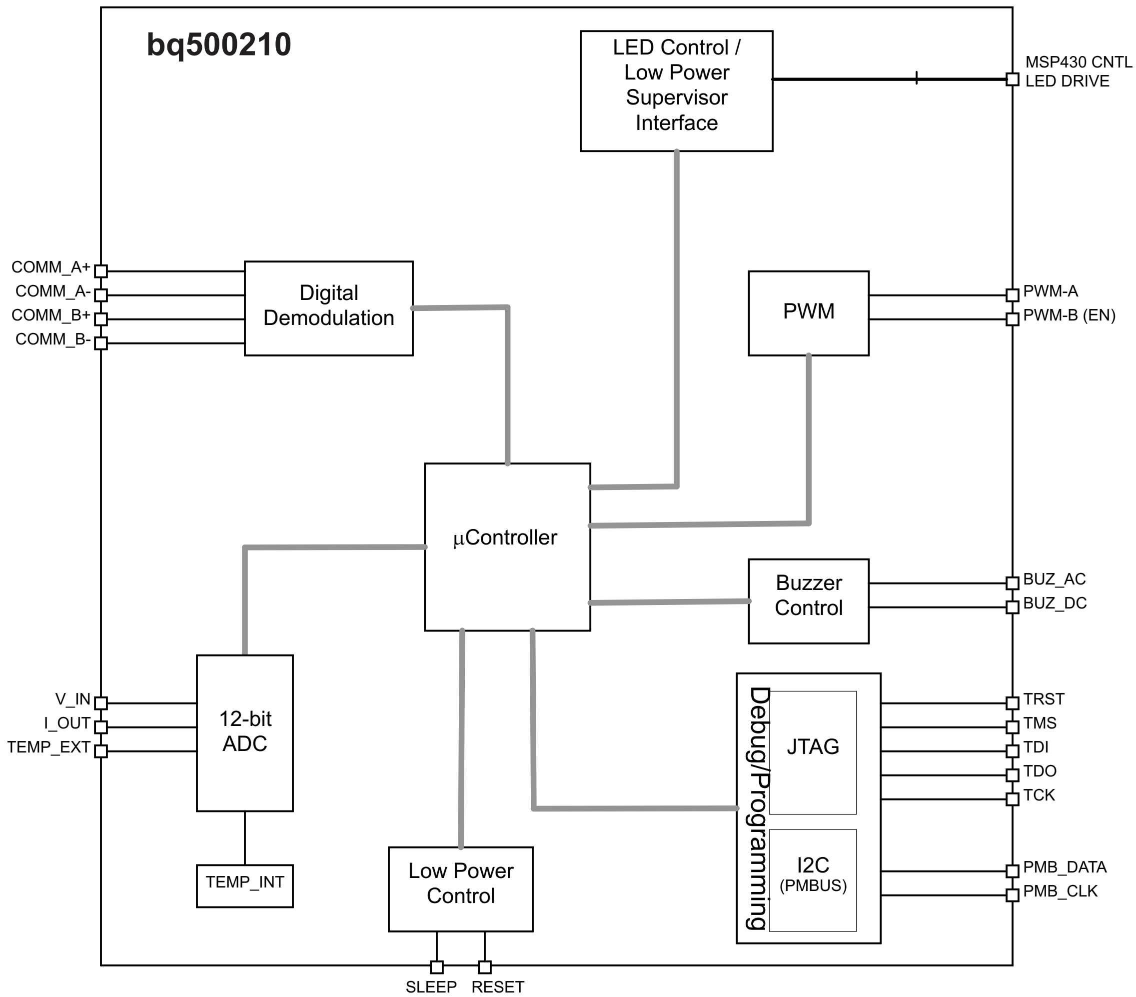
over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	NOM	MAX	UNIT
SUPPLY CURRENT						
I_{V33A}	Supply current	V33A = 3.3 V		8	15	mA
I_{V33D}		V33D = 3.3 V		42	55	
I_{V33D}		V33D = 3.3 V while storing configuration parameters in flash memory		53	65	
INTERNAL REGULATOR CONTROLLER INPUTS/OUTPUTS						
V33	3.3-V linear regulator	Emitter of NPN transistor	3.25	3.3	3.6	V
V33FB	3.3-V linear regulator feedback			4	4.6	
I_{V33FB}	Series pass base drive	V_{IN} = 12 V; current into V33FB pin		10		mA
Beta	Series NPN pass device		40			
EXTERNALLY SUPPLIED 3.3 V POWER						
V33D	Digital 3.3-V power	T_A = 25°C	3		3.6	V
V33A	Analog 3.3-V power	T_A = 25°C	3		3.6	V
V33Slew	V33 slew rate	V33 slew rate between 2.3V and 2.9V, V33A = V33D	0.25			V/ms
MODULATION AMPLIFIER INPUTS EAP-A, EAN-A, EAP-B, EAN-B						
V_{CM}	Common mode voltage each pin		–0.15		1.631	V
EAP-EAN	Modulation voltage digital resolution			1		mV
R_{EA}	Input Impedance	Ground reference	0.5	1.5	3	MΩ
I_{OFFSET}	Input offset current	1 kΩ source impedance	–5		5	µA
ANALOG INPUTS V_IN, I_IN, TEMP_IN, I_COIL, LED_MODE, PMOD_THR						
V_{ADDR_OPEN}	Voltage indicating open pin	LED_MODE, PMOD_THR open	2.37			V
V_{ADDR_SHORT}	Voltage indicating pin shorted to GND	LED_MODE, PMOD_THR shorted to ground			0.36	V
V_{ADC_RANGE}	Measurement range for voltage monitoring	Inputs: V_IN, I_IN, TEMP_IN, I_COIL	0		2.5	V
INL	ADC integral nonlinearity		-2.5		2.5	mV
I_{lkg}	Input leakage current	3V applied to pin			100	nA
R_{IN}	Input impedance	Ground reference	8			MΩ
C_{IN}	Input capacitance				10	pF
DIGITAL INPUTS/OUTPUTS						
V_{OL}	Low-level output voltage	I_{OL} = 6 mA [(1)], V33D = 3 V			DGND1 + 0.25	V
V_{OH}	High-level output voltage	I_{OH} = -6 mA [(2)], V33D = 3 V	V33D - 0.6V			V
V_{IH}	High-level input voltage	V33D = 3V	2.1		3.6	V
V_{IL}	Low-level input voltage	V33D = 3.5 V			1.4	V
I_{OH}(MAX)	Output high source current				4	mA
I_{OL}(MAX)	Output low sink current				4	mA
SYSTEM PERFORMANCE						
V_{RESET}	Voltage where device comes out of reset	V33D Pin	2.3		2.4	V
t_{RESET}	Pulse width needed for reset	$\overline{RESET}$ pin	2			µs
F_{SW}	Switching Frequency		110		205	kHz
t_{detect}	Time to detect presence of device requesting power				0.6	sec
$t_{retention}$	Retention of configuration parameters	T_J = 25°C	100			Years
Write_Cycles	Number of nonvolatile erase/write cycles	T_J = 25°C	20			K cycles

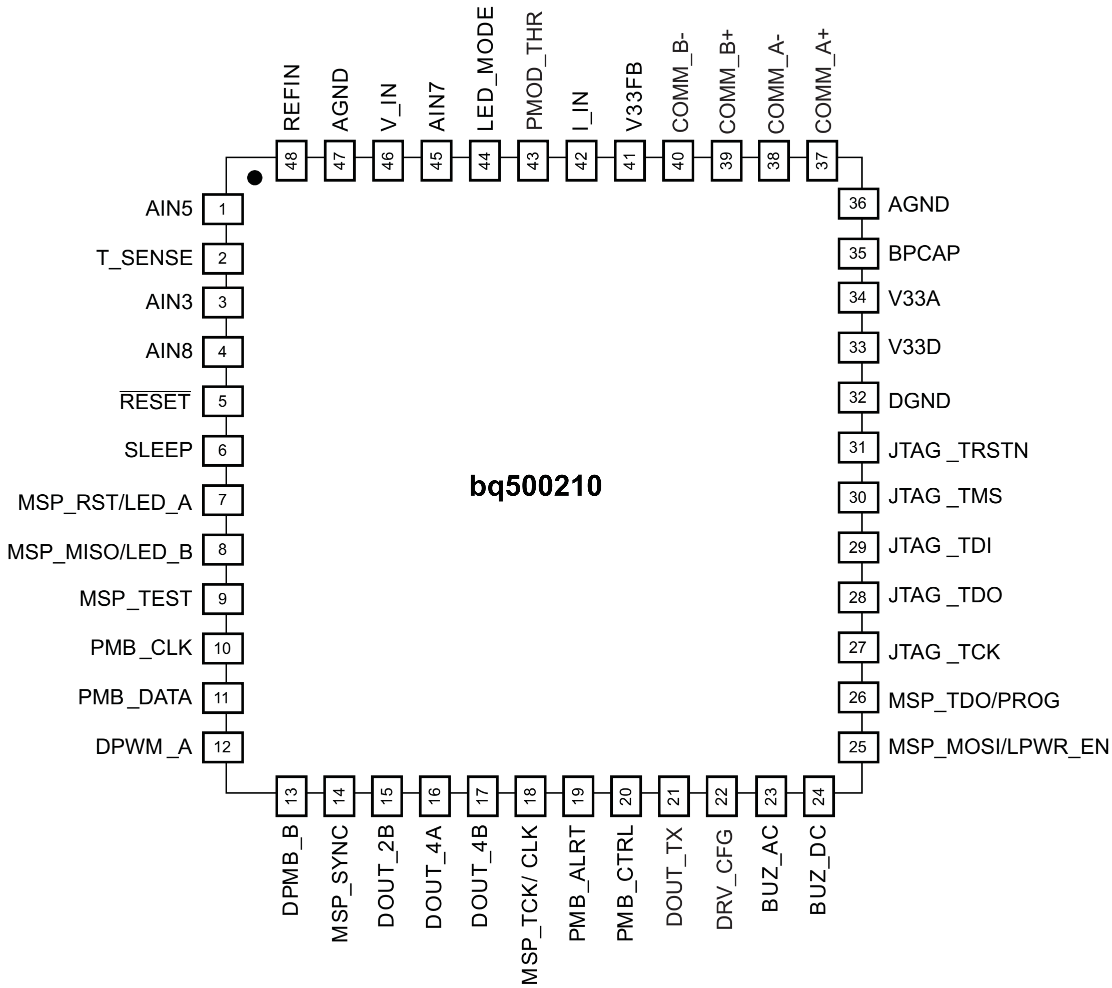
(1) The maximum I_{OL}, for all outputs combined, should not exceed 12 mA to hold the maximum voltage drop specified.
(2) The maximum I_{OH}, for all outputs combined, should not exceed 48 mA to hold the maximum voltage drop specified.

DEVICE INFORMATION

Functional Block Diagram



48-PIN QFN PACKAGE
(TOP VIEW)



PIN FUNCTIONS

PIN		I/O	DESCRIPTION
NO.	NAME		
1	AIN5	I	Connect this pin to GND
2	T_SENSE	I	Thermal Sensor Input
3	AIN3	I	Connect this pin to GND
4	AIN8	I	Connect this pin to GND
5	RESET	I	Device reset
6	SLEEP	O	Low-power mode start logic output
7	MSP_RST/LED_A	I	MSP – Reset, LED-A
8	MSP_MISO/LED_B	I	MSP – TMS, SPI-MISO, LED-B
9	MSP_TEST	I	MSP – Test
10	PMB_CLK	I/O	PMBus Clock
11	PMB_DATA	I/O	PMBus Data
12	DPWM_A	O	PWM Output A
13	DPMB_B	O	PWM Output B
14	MSP_SYNC	O	MSP SPI_SYNC
15	DOUT_2B	O	Optional Logic Output 2B. Leave this pin floating.
16	DOUT_4A	O	Optional Logic Output 4A. Leave this pin floating.

PIN FUNCTIONS (continued)

PIN		I/O	DESCRIPTION
NO.	NAME		
17	DOUT_4B	O	Optional Logic Output 4B. Leave this pin floating.
18	MSP_TCK/CLK	I/O	Disable Diagnostic Output. Leave this pin floating to inhibit diagnostic.
19	PMB_ALERT	O	PMBus Interface
20	PMB_CTRL	I	PMBus Interface
21	DOUT_TX	I	Leave this pin floating
22	DRV_CFG	I	Pull this input to V33D
23	BUZ_AC	O	AC Buzzer Output
24	BUZ_DC	O	DC Buzzer Output
25	MSP_MOSI/LPWR_EN	I/O	MSP-TDI, SPI-MOSI, Low Power Enable
26	MSP_TDO/PROG	I/O	MSP-TDO, Programmed Indicator
27	JTAG_TCK	I/O	JTAG Interface
28	JTAG_TDO	I/O	JTAG Interface
29	JTAG_TDI	I/O	JTAG Interface
30	JATG_TMS	I/O	JTAG Interface
31	JTAG_TRSTN	I/O	JTAG Interface
32	DGND	—	Digital GND
33	V33D	—	Digital Core 3.3V Supply
34	V33A	—	Analog 3.3V Supply
35	BPCAP	—	Bypass Capacitor Connect Pin
36	AGND	—	Analog GND
37	COMM_A+	I	Digital demodulation noninverting input A
38	COMM_A-	I	Digital demodulation inverting input A
39	COMM_B+	I	Digital demodulation noninverting input B
40	COMM_B-	I	Digital demodulation inverting input B
41	V33FB	I	3.3V Linear-Regulator Feedback Input. Leave this pin floating.
42	I_IN	I	Transmitter Input Current
43	PMOD_THR	I	Input to Program Metal Object Detection Threshold
44	LED_MODE	I	Input to Select LED Mode
45	AIN7	I	Reserved Analog Input. Connect this pin to GND.
46	V_IN	I	Transmitter Input Voltage
47	AGND	—	Analog GND
48	REFIN	I	External Reference Voltage Input. Connect this Input to AGND.

TYPICAL CHARACTERISTICS

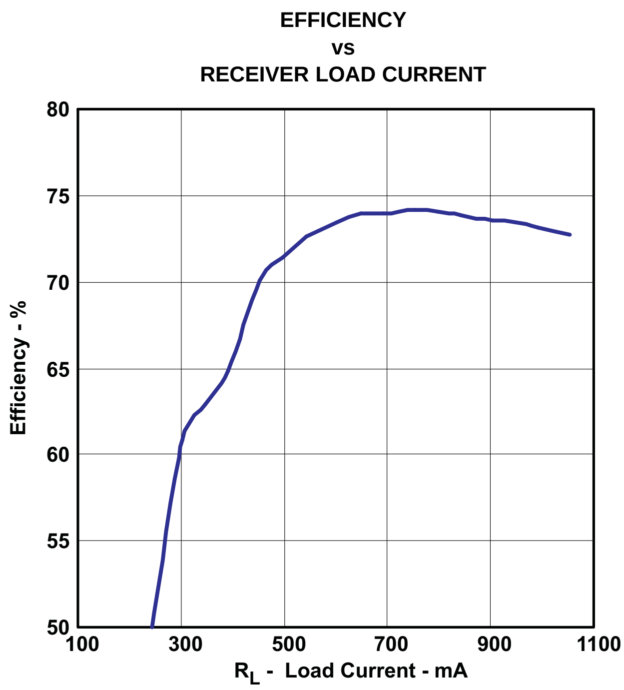


Figure 1.

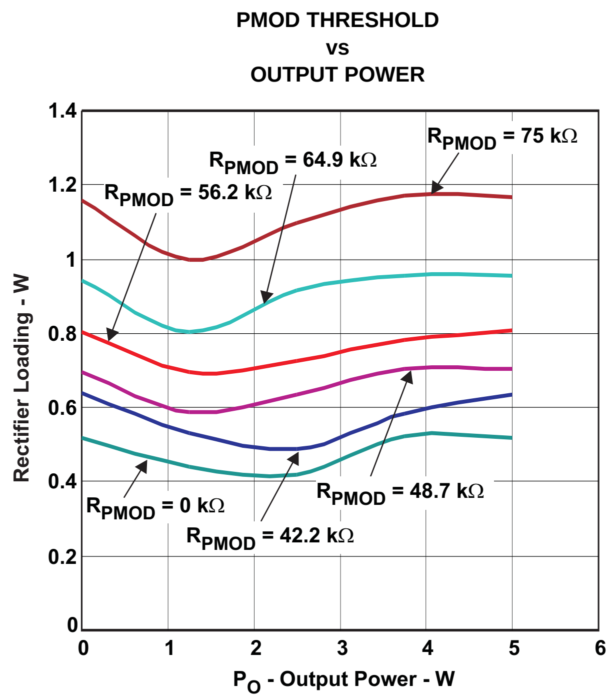


Figure 2.

FUNCTIONAL OVERVIEW

The typical Wireless Power Transfer System consists of primary and secondary coils that are positioned against each other in a way to maximize mutual coupling of their electromagnetic fields. Both coils have ferrite shields as part of their structures to even further maximize field coupling. The primary coil is excited with the switching waveform of the transmitter power driver that gets its power from an AC-DC wall adapter. The secondary coil is connected to the rectifier that can either directly interface the battery or can have an electronic charger or post-regulator connected to its output. The capacitors in series with the coils are tuned to create resonance in the system. The system being in resonance facilitates better energy transfer compared to inductive transfer. Power transfer in the resonant system can also be easily controlled with the variable frequency control approach. To limit operating frequency variation the bq500210 uses both frequency and PWM methods to control power transfer. When the operating frequency approaches a 205kHz limit and the receiver still commands lower power, the bq500210 will reduce the PWM cycle in discrete steps to maintain the output in regulation.

The rectifier output voltage is monitored by the secondary side microcontroller that generates signals to control the modulation circuit to pass coded information from the secondary side to the primary side. The coded information is organized into information packets that have Preamble bytes, Header bytes, message bytes and Checksum bytes. Per the WPC specification, information packets can be related to Identification, Configuration, Control Error, Rectified Power, Charge Status, and End of Power Transfer information. For detailed information on the WPC specification, visit the Wireless Power Consortium website at http://www.wirelesspowerconsortium.com/.

There are two ways the coupled electromagnetic field can be manipulated to achieve information transfer from the secondary side to the primary side. With the resistive modulation approach shown in Figure 3, the communication resistor periodically loads the rectifier output changing system Q factor, and as a result the value of the voltage on the primary side coil. With the capacitive modulation approach shown in Figure 4, a pair of communication capacitors are periodically connected to the receiver coil network. These extra capacitance application changes slightly the resonance frequency of the system and its response on the current operating frequency, which in turn leads to coil voltage variation on the primary side.

With both modulation techniques primary side coil waveform variations are detected with a Digital Demodulation algorithm in the bq500210 to restore the content of the information packets and adjust controls to the transmitter.

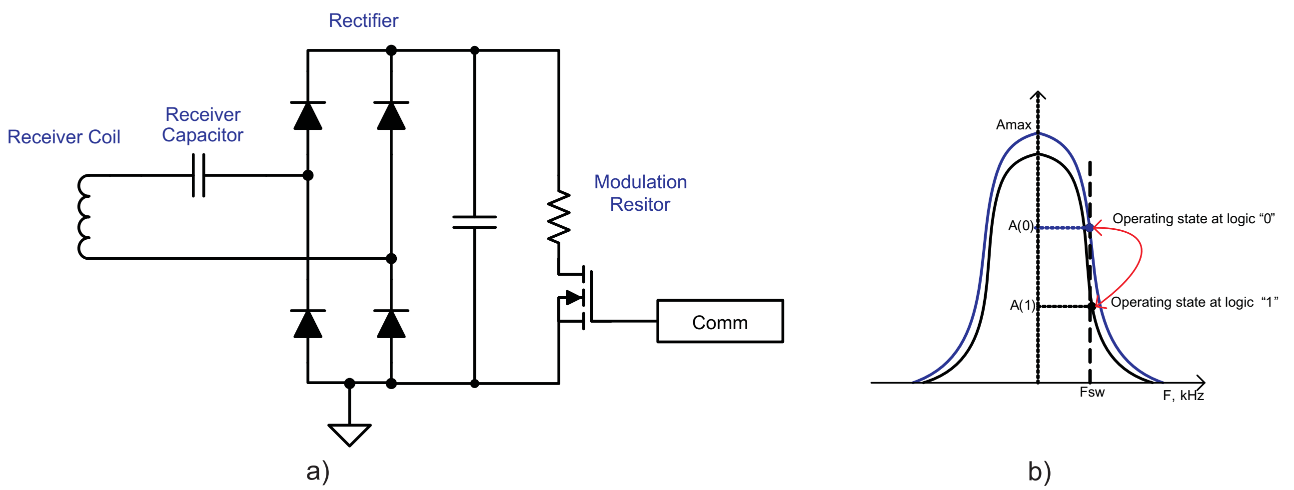


Figure 3. Resistive Modulation Circuit

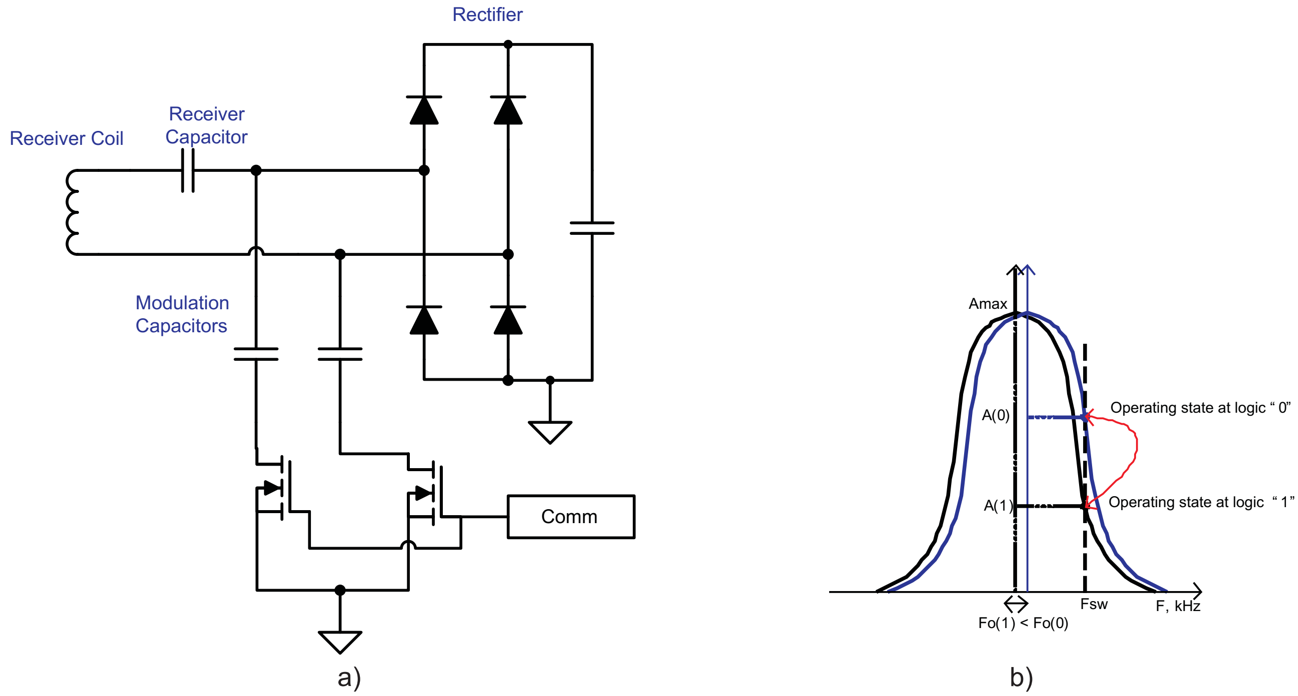


Figure 4. Capacitive Modulation Circuit

The bq500210 is a second generation wireless power dedicated transmitter controller that simplifies integration of wireless power technology into consumer electronics, such as digital cameras, smart phones, MP3 players, and global positioning systems, along with infrastructure applications such as furniture and cars.

The bq500210 is a specialized digital power microcontroller that controls WPC A1, single coil, transmitter functions such as analog ping, digital ping, variable frequency output power control, parasitic metal object detection, over temperature protection of the transmitter top surface, and indication of the transmitter operating states.

The bq500210 digital demodulation inputs receive scaled down voltages from the transmitter resonant components. The digital demodulation algorithm is a combination of several digital signal processing techniques that decodes information packets sent by the power receiving device and provides necessary changes to power drive signals facilitating closed loop regulation. The controller analog inputs monitor input DC voltage, input current, and the thermal protection input. These analog inputs support monitoring and protective functions of the controller.

The bq500210 controls two LEDs to indicate transmitter operating and fault states. Having the LEDs connected directly to the controller simplifies the transmitter electrical schematic and provides a cost effective solution.

Option Select Pins

Two pins (43, 44) in the bq500210 are allocated to program the PMOD mode and the LED mode of the device. At power-up, a bias current is applied to pins LED_MODE and PMOD_THR and the resulting voltage measured in order to identify the value of the attached programming resistor. The values of the operating parameters set by these pins are determined using Option Select Bins. For LED_MODE, the selected bin determines the LED behavior based on LED Modes; for the PMOD_THR, the selected bin sets a threshold used for parasitic metal object detection (see Metal Object Detection (PMOD) section).

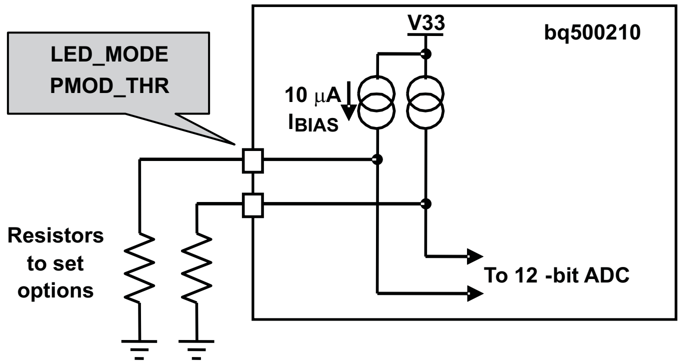


Figure 5. Option Programming

Table 1. Option Select Bins

BIN NUMBER	RESISTANCE (kΩ)	LED OPTION	PMOD THRESHOLD (mW)(1)
0	GND	0	500
1	42.2	1	600
2	48.7	2	700
3	56.2	3	800
4	64.9	4	900
5	75.0	5	1000
6	86.6	6	1100
7	100	7	1200
8	115	8	1300
9	133	9	1400
10	154	10	1500
11	178	11	1600
12	205	12	1700
13	open	13	OFF

(1) Threshold numbers are approximate. See Figure 2.

LED Modes

The bq500210 can directly control two LED outputs (pins 7 and 8). They are driven based on one of the selectable modes. The resistor connected between pin 44 and GND selects one of the desired LED indication schemes presented in Table 2.

Table 2. LED Modes

LED Control Option	LED Selection Resistor	Description	LED	Operational States					Support CS–100	Support CS–90	Support CS–6Min
				Standby	Power Transfer	Charge Complete	Fault	PMOD Warning			
0	<36.5 kΩ	Reserved for test	LED1, Green	–	–	–	–	–	–	–	–
			LED2, Red	–	–	–	–	–			
1	42.2 kΩ	Generic+ CS100 + CS90 + CS6min	LED1, Green	OFF	BLINK SLOW	ON	OFF	OFF	YES	YES	YES
			LED2, Red	OFF	OFF	OFF	ON	BLINK FAST			
2	48.7 kΩ	Generic	LED1, Green	OFF	BLINK SLOW	ON	OFF	OFF	NO	NO	NO
			LED2, Red	OFF	OFF	OFF	OFF	BLINK FAST			
3	56.2 kΩ	Generic + CS100	LED1, Green	OFF	BLINK SLOW	ON	ON	OFF	YES	NO	NO
			LED2, Red	OFF	OFF	OFF	ON	BLINK FAST			
4	64.9 kΩ	Generic + CS100 + CS90	LED1, Green	OFF	BLINK SLOW	ON	OFF	OFF	YES	YES	NO
			LED2, Red	OFF	OFF	OFF	ON	BLINK FAST			
5	75 kΩ	Generic+ CS100 + CS6min	LED1, Green	OFF	BLINK SLOW	ON	OFF	OFF	YES	NO	YES
			LED2, Red	OFF	OFF	OFF	ON	BLINK FAST			
6	86.6 kΩ	Suggested	LED1, Green	ON	BLINK SLOW	ON	OFF	OFF	NO	NO	NO
			LED2, Red	ON	OFF	OFF	ON	BLINK FAST			
7	100 kΩ	Suggested + CS100	LED1, Green	ON	BLINK SLOW	ON	OFF	OFF	YES	NO	NO
			LED2, Red	ON	OFF	OFF	ON	BLINK FAST			
8	115 kΩ	Suggested + CS100 + CS90	LED1, Green	ON	BLINK SLOW	ON	OFF	OFF	YES	YES	NO
			LED2, Red	ON	OFF	OFF	ON	BLINK FAST			
9	133 kΩ	Suggested+ CS100 + CS6min	LED1, Green	ON	BLINK SLOW	ON	OFF	OFF	YES	NO	YES
			LED2, Red	ON	OFF	OFF	ON	BLINK FAST			
10	154 kΩ	Suggested+ CS100 + CS90 + CS6min	LED1, Green	ON	BLINK SLOW	ON	OFF	OFF	YES	NO	NO
			LED2, Red	ON	OFF	OFF	ON	BLINK FAST			
11	178 kΩ	Reserved	LED1, Green	–	–	–	–	–	–	–	–
			LED2, Red	–	–	–	–	–			
12	205 kΩ	Reserved	LED1, Green	–	–	–	–	–	–	–	–
			LED2, Red	–	–	–	–	–			
13	>237 kΩ	Reserved	LED1, Green	–	–	–	–	–	–	–	–
			LED2, Red	–	–	–	–	–			

Thermal Protection

The bq500210 can provide thermal protection to the transmitter. An external NTC resistor can be placed in the most thermally challenged area, which usually is the center of the transmitting coil, and connected between the dedicated pin 2 and GND. The threshold on pin 2 is set to 1.00V. The NTC resistor and the resistor from pin 2 to V_{CC} create a temperature sensitive divider. The user has full flexibility choosing the NTC resistor and the value of the resistor from pin 2 to V_{CC} to set the desired temperature when the system shuts down.

$$R_{TEMP\_IN} = 2.3 \times R_{NTC}(T_{MAX}) \quad (1)$$

The system will attempt to restore normal operation after approximately five minutes of being in the suspended mode due to tripping the over-temperature threshold, or if the receiver is removed. The bq500210 has a built-in thermal sensor that prevents the die temperature from exceeding 135°C. This sensor has ~10°C hysteresis.

Audible Notification on Power Transfer Begin

The bq500210 is capable of activating two types of buzzers to indicate that power transfer has begun. Pin 24 outputs a high logic signal for 0.4s that is suitable to activate DC type buzzers with built in tone generators, or other types of sound generators, or custom indication systems. Pin 23 outputs for 0.4 seconds a 4 kHz square wave signal suitable for inexpensive AC type ceramic buzzers.

Power-On Reset

The bq500210 has an integrated power-on reset (POR) circuit that monitors the supply voltage. At power-up, the POR circuit detects the V33D rise. When V33D is greater than V_{RESET}, the device initiates an internal startup sequence. At the end of the startup sequence, the device begins normal operation.

External Reset

The device can be forced into a reset state by an external circuit connected to the $\overline{\text{RESET}}$ pin. A logic low voltage on this pin holds the device in reset. To avoid an erroneous trigger caused by noise, a 10kΩ pull up resistor connected to 3.3V is recommended.

Parasitic Metal Object Detection (PMOD)

As a safety feature, the bq500210 can be configured to detect the presence of a parasitic metal object placed in the vicinity of the magnetic field. The bq500100 uses the Rectified Power Packet information and the measured transmitter input-power to calculate parasitic losses in the system. When an excessive power loss is detected, the device will blink the red LED to warn about this undesirable condition. If during a twenty second warning time the parasitic metal object is not removed, the controller will disable power transfer. After being in halt for five minutes, the bq500210 will attempt normal operation. If the object that caused excessive power dissipation is still present, the sequence will be repeated over and over again. If the metal object is removed during this twenty second warning time, then normal operation will be restored promptly.

To facilitate the parasitic loss function, the bq500210 monitors the input voltage and the input current supplied to the power drive circuit.

The PMOD_THR pin is used to set the threshold at which the PMOD is activated. The highest bin, the pin is left floating, disables the PMOD feature.

Note: The WPC Specification V1.0 does not define the requirements and thresholds for the PMOD feature. Hence, metal object detection may perform differently with different products. Therefore, the threshold setting is determined by the user. In most desktop wireless charger applications, a PMOD threshold setting of 0.8W has shown to provide acceptable results in stopping power transfer and preventing small metal objects like coins, pharmaceutical wraps, etc. from becoming dangerously hot when placed in the path of the wireless power transfer. Figure 2 depicts PMOD performance measured on a bq500210 EVM with a bq51013 EVM. The parasitic metal loss is emulated by loading the output of the rectifier in the bq51013 EVM.

ADVANCED CHARGE INDICATION SCHEMES

The WPC specification provides an End of Power Transfer message (EPT–01) to indicate charge complete. Upon receipt of the charge complete message, the bq500210 will change the LED indication as defined by the LED_MODE pin (normally solid green LED output), and halt power transfer for 5 minutes.

In some battery charging applications there is a benefit to continue the charging process in trickle charge mode to top off the battery. There are several information packets in the WPC specification related to the levels of battery charge – Charge Status. The bq500210 uses these commands in association with some of the LED modes described in Table 2 to enable the top-off charging pattern. When CS100 LED mode is enabled, the bq500210 will change the LED indication to reflect charge complete when a Charge Status = 100% message is received, but unlike the response to an EPT, it will not halt power transfer while the LED is solid green. The mobile device can use a CS100 packet to enable trickle charge mode.

Note that all options related to CS100 have an effect on the LEDs only; they do not have any impact on actual power transfer which continues uninterrupted.

Two more optional modes are available which can be used to change the LED mode back to indicate charging after the CS100 has forced the charge complete output:

- If CS90 is enabled, a Charge Status message indicating less than 90% charge will force the LED output to indicate charging (typically a slow blinking green LED).
- When CS6MIN is enabled, and if the bq500210 does not detect another CS100 packet for six minutes, it will assume the receiver charge has dropped significantly and will turn on charging status indication.

APPLICATION INFORMATION

The application diagram for the transmitter with reduced standby power consumption is shown in Figure 6.

The standard application diagram for the transmitter is shown in Figure 7.

Power reduction is achieved by periodically turning off the bq500210 and delegating LED control functions to U4 – the low-cost, low quiescent current microcontroller MSP430G2001. When U4 is present in the circuit (indicated by a pull-up resistor on pin 25), the bq500210 at first power-up boots the MSP430 with the necessary code and the two chips operate in tandem. When the bq500210 issues SLEEP command, Q12 pulls the TLV70033 ENA pin low, therefore removing power from the bq500210, and the MSP430 maintains the LED indication states. The timeout the bq500210 is inhibited is set by the network of R25, C38. Per WPC specifications the bq500210 awakes every 0.4s to produce an analog ping and check if there is a device to be powered.

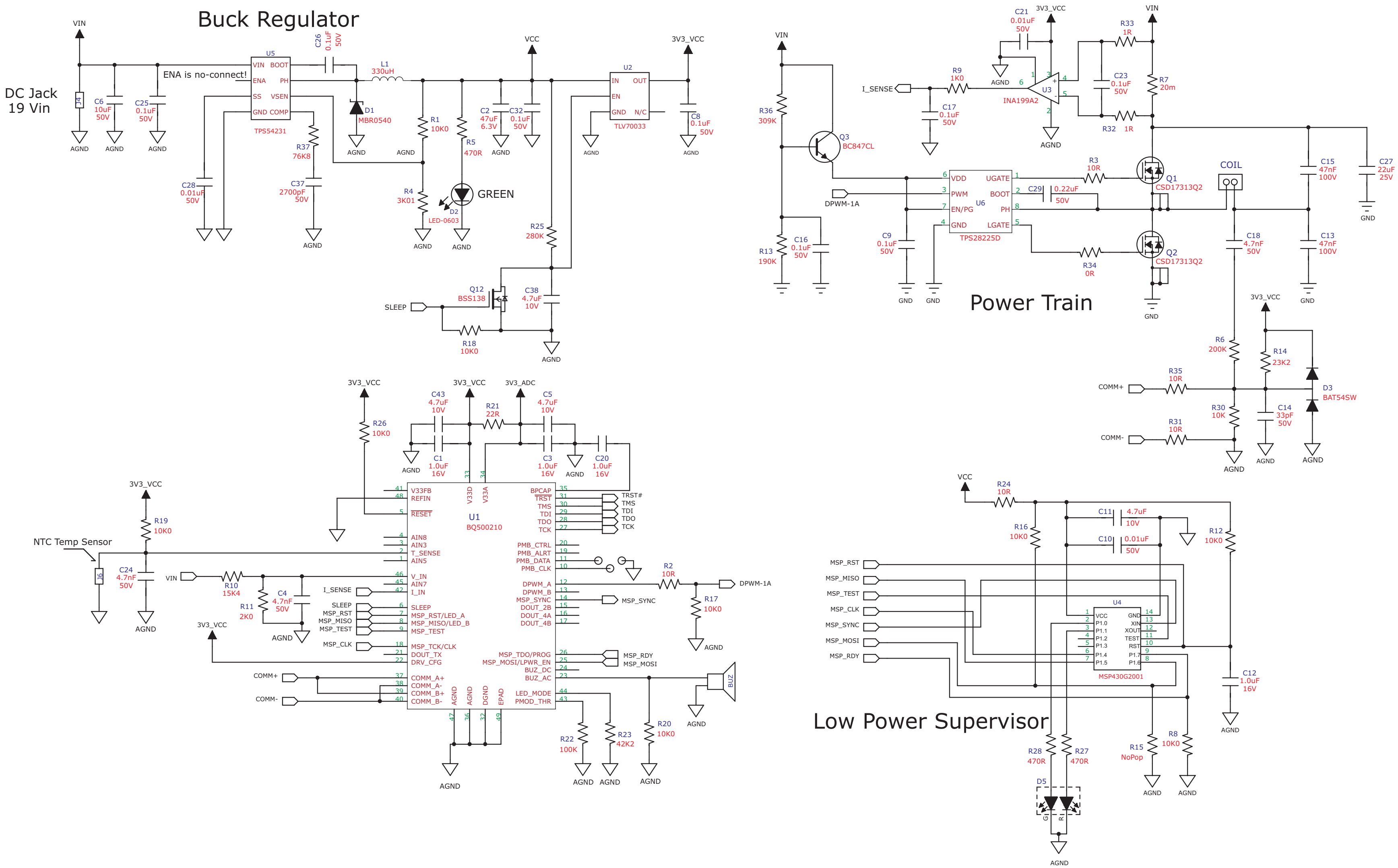


Figure 6. Typical Application Diagram for Wireless Power Transmitter with Reduced Standby Power

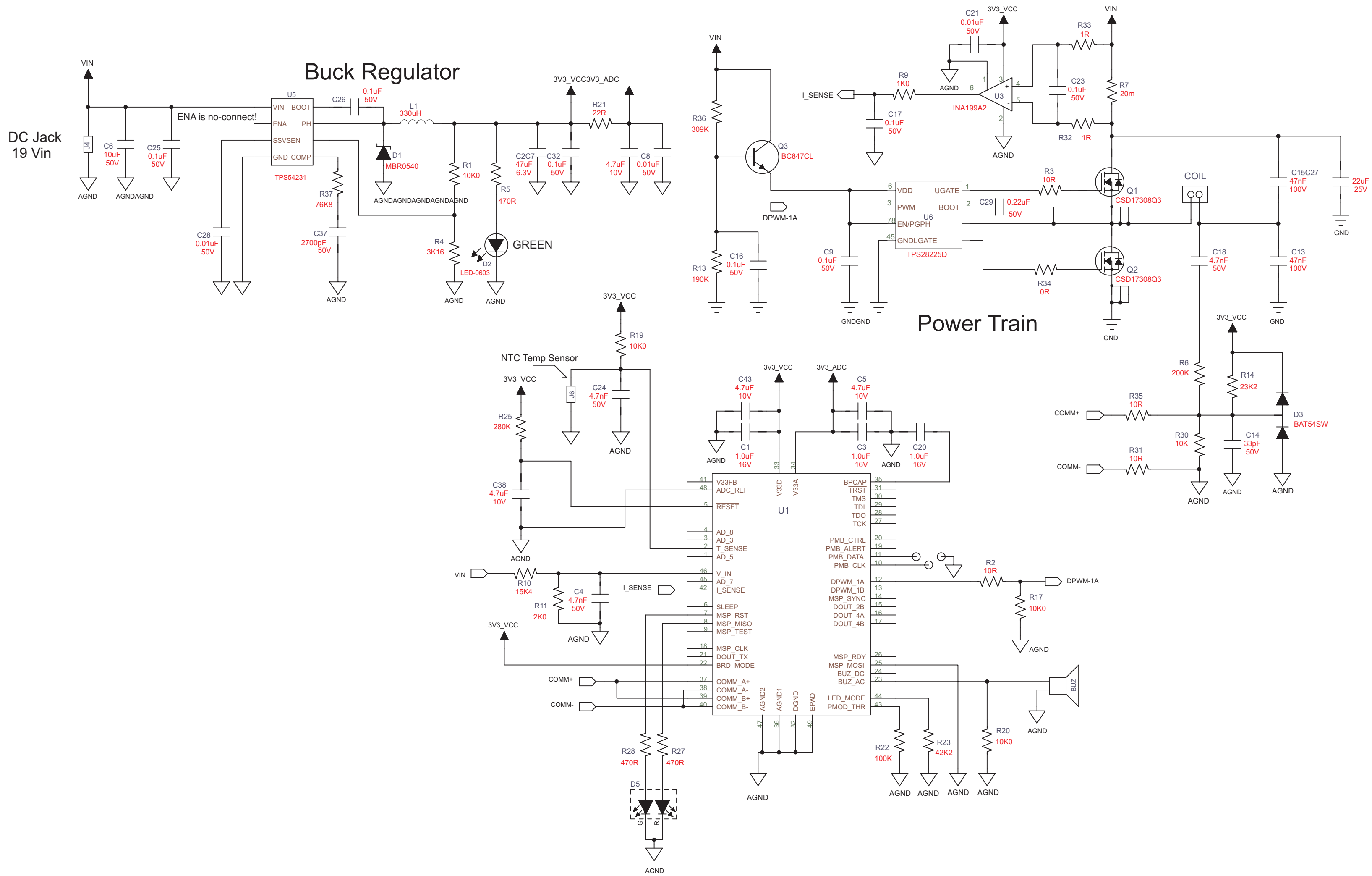


Figure 7. Typical Application Diagram for Wireless Power Transmitter

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
BQ500210RGZR	ACTIVE	VQFN	RGZ	48	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	
BQ500210RGZT	ACTIVE	VQFN	RGZ	48	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	

(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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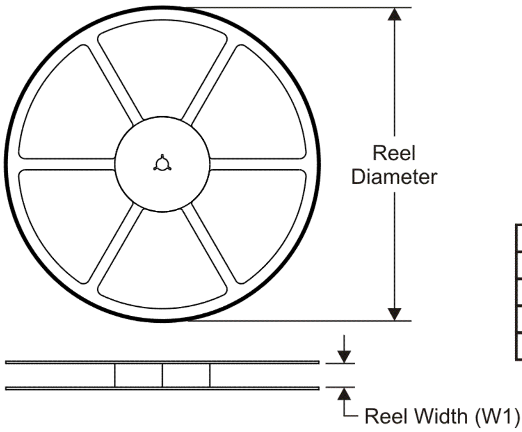
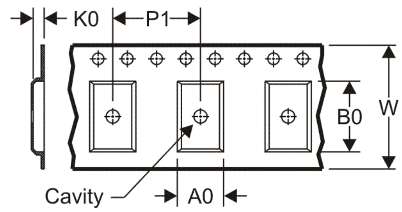
TAPE AND REEL INFORMATION

REEL DIMENSIONS

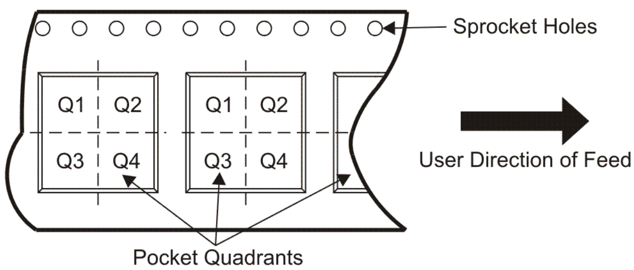


TAPE DIMENSIONS



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

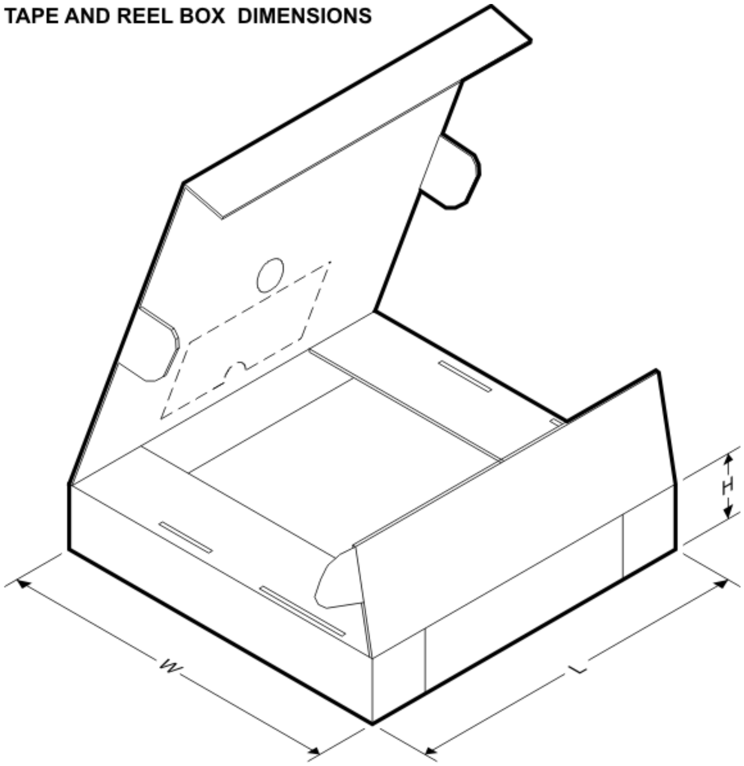
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
BQ500210RGZR	VQFN	RGZ	48	2500	330.0	16.4	7.3	7.3	1.5	12.0	16.0	Q2
BQ500210RGZT	VQFN	RGZ	48	250	180.0	16.4	7.3	7.3	1.5	12.0	16.0	Q2

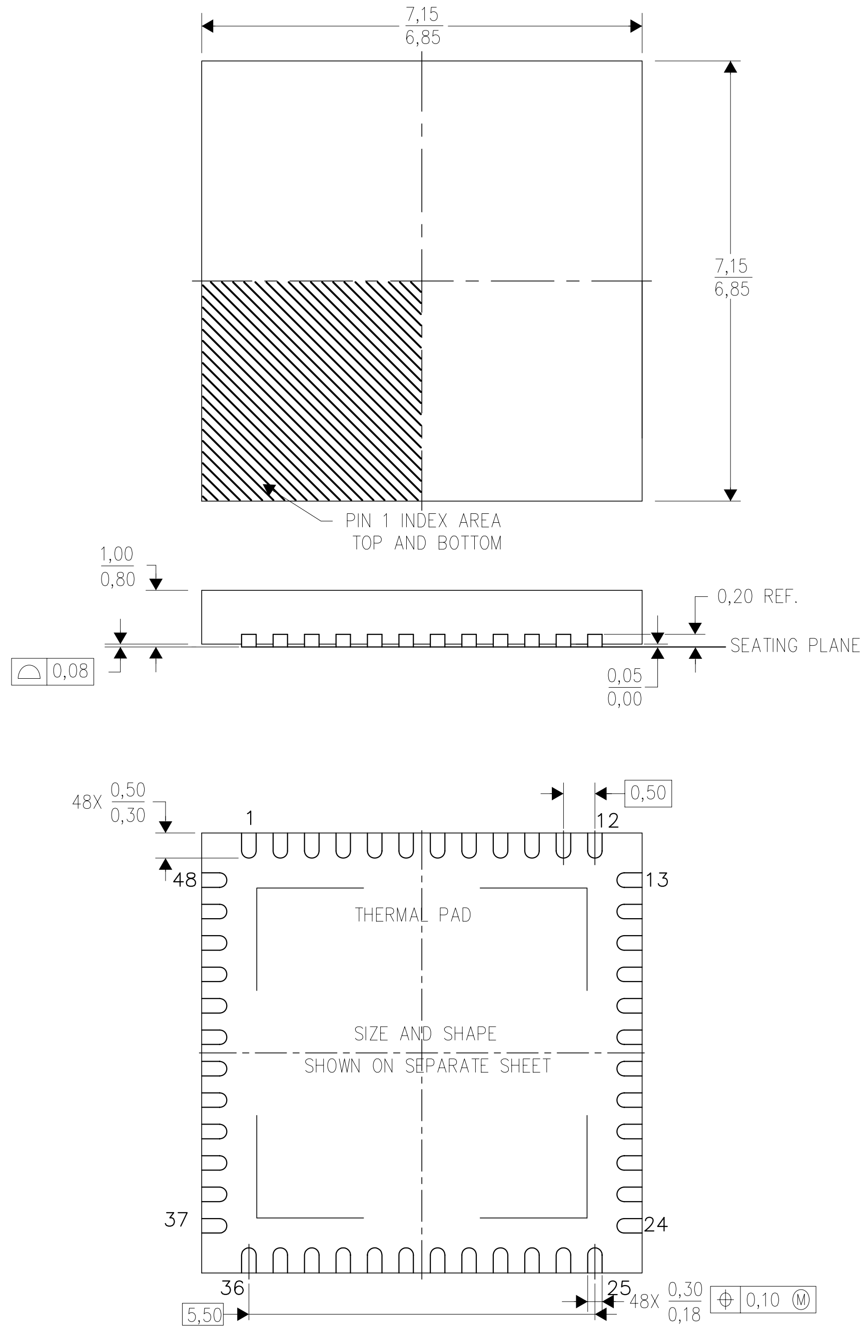
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ500210RGZR	VQFN	RGZ	48	2500	346.0	346.0	33.0
BQ500210RGZT	VQFN	RGZ	48	250	190.5	212.7	31.8

RGZ (S-PVQFN-N48) PLASTIC QUAD FLATPACK NO-LEAD



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. Quad Flatpack, No-leads (QFN) package configuration.
D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
F. Falls within JEDEC MO-220.

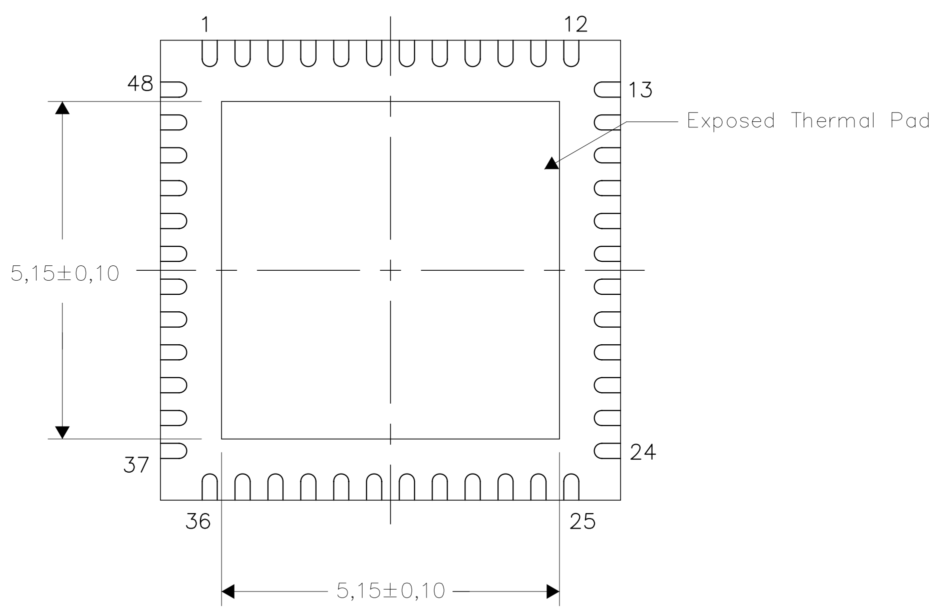
RGZ (S-PVQFN-N48) PLASTIC QUAD FLATPACK NO-LEAD

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.



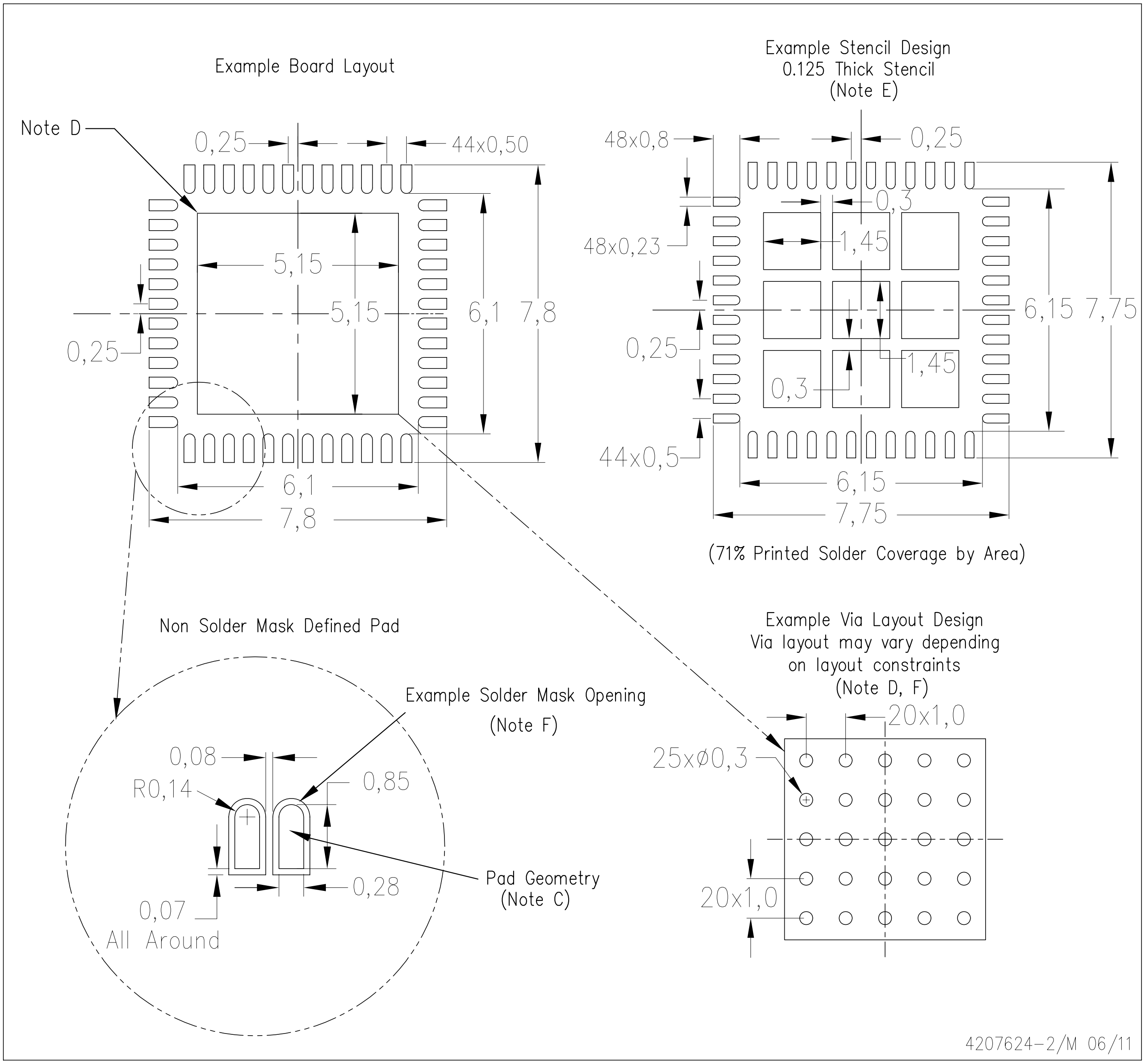
Bottom View

Exposed Thermal Pad Dimensions

4206354-2/Q 06/11

NOTE: All linear dimensions are in millimeters

RGZ (S–PVQFN–N48) PLASTIC QUAD FLATPACK 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, Quad Flat–Pack Packages, 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 recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

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