LMV242x 450MHz to 2GHz, 50dB, Log RF Power Detectors With PA Control Outputs

1 Features

- 450MHz to 2GHz operation
- 50dB log RF detector
- Integrated ramp filter
- External loop compensation option
- Accurate temperature compensation
- Shutdown mode for power save in R_X slot
- GPRS compliant
- Support of InGaP HBT, bipolar technology
- WSON package: 3mm × 3mm

2 Applications

- GSM, GPRS, TDMA, TD-SCDMA mobile phone
- Pulse RF control
- Wireless LAN
- GSM and GPRS power amplifier module
- Transmit module

3 Description

The LMV2421 and LMV242 (LMV242x) are single-output and dual-output power amplifier (PA) controllers. These devices are intended for use within an RF transmit power control loop for RF PA control, and in GSM and GPRS mobile phones. The LMV242x support all single-supply PAs, including InGaP, HBT, and bipolar power amplifiers. The devices operate with a single supply from 2.6V to 5.5V.

Included in the LMV2421 PA controller are a log RF detector, a ramp filter, and an output driver that functions as an error amplifier.

The dual-output LMV242 includes two selectable output drivers for control of two different PAs. The LMV2421 input interface consists of two analog and one digital inputs; two digital inputs for the LMV242. The analog inputs are the RF input and the ramp voltage input. The digital inputs perform the function of *Shutdown/Transmit Enable* and *Band Select (LMV242 only)*. The LMV242x is active when TX_EN = high. When TX_EN = low, the device is in a low-power-consumption shutdown mode. During shutdown, the outputs are pulled low to the minimum output voltage. The *Band Select (LMV242 only)* function enables either of two outputs, namely OUT1 when BS = high, or output OUT2 when BS = low. The output that is not enabled is pulled low to the minimum output voltage. Individual PA characteristics are accommodated by a user-selectable external RC combination.

The LMV242x are offered in a 10-lead WSON package. The LMV242x are an excellent choice for small-footprint, PA modules systems.

Device Information

PART NUMBER	CHANNEL COUNT	PACKAGE[1]
LMV2421	Single	NGY (WSON, 10) 3mm × 3mm[2]
LMV242	Dual	

(1) For more information, see Section 10.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.

Typical Applications

Table of Contents

Product Folder Links: *LMV242 LMV2421*

4 Pin Configuration and Functions

Figure 4-1. LMV242: NGY Package, WSON-10 (Top View)
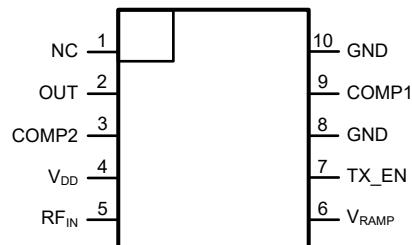
Figure 4-2. LMV2421: NGY Package, WSON-10 (Top View)

Table 4-1. Pin Functions

PIN			TYPE[1]	DESCRIPTION
NAME	NO.			
	LMV242	LMV2421		
BS	8	—	Digital input[2]	Schmitt-triggered band select pin. When BS = H, channel 1 (OUT1) is selected, when BS = L, channel 2 (OUT2) is selected.
COMP1	9	9	Compensation	Connects an external RC network between the COMP1 pin and the COMP2 pin for an overall loop compensation and to control the closed loop frequency response. Conventional loop stability techniques can be used in selecting this network, such as bode plots. A good starting value for the RC combination is C = 68pF and R = 0Ω.
COMP2	3	3	Compensation	Frequency compensation pin. The BS signal (LMV242 only) switches this pin either to OUT1 or to OUT2.
GND	10	8, 10	Ground	Power ground
NC	—	1	—	No connect. Leave this pin floating.
OUT	—	2	Output	This pin is connected to the PA.
OUT1	1	—	Output	This pin is connected to the PA of either channel 1 or channel 2.
OUT2	2	—	Output	This pin is connected to the PA of either channel 1 or channel 2.
RF_{IN} [3]	5	5	Analog input	RF input connected to the coupler output with optional attenuation to detect the power amplifier (PA) and antenna RF power levels.
TX_EN	7	7	Digital input[2]	Schmitt-triggered logic input. A low shuts down the whole chip for battery-saving purposes. A high enables the chip.
V_{DD}	4	4	Power supply	Positive supply voltage
V_{RAMP} [3]	6	6	Analog input	Sets the RF output power level. The useful input voltage range is from 0.2V to 1.8V, although voltages from 0V to V_{DD} are allowed.

(1)   All inputs and outputs are referenced to GND (pin 10).
(2)   For the digital inputs, a low is < 0.8V and a high is > 1.8V.
(3)   RF power detection performed internally in the LMV242x; use an RF power coupler with optional extra attenuation.

Product Folder Links: *LMV242 LMV2421*

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1]

		VALUE
Supply voltage	V_{DD} – GND	6.5V max
ESD tolerance [2]	Human body model	2kV
	Machine model	200V
Storage temperature		−65°C to +150°C
Junction temperature [3]		150°C max
Mounting temperature	Infrared or convection (20s)	235°C

(1) *Absolute Maximum Ratings* indicate limits beyond which damage to the device can occur. *Recommended Operating Conditions* indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For specifications and the test conditions, see the Section 5.3.
(2) Human body model: 1.5kΩ in series with 100pF.
(3) The maximum power dissipation is a function of $T_{J(MAX)}$, $θ_{JA}$ and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} − T_A) / θ_{JA}$. All numbers apply for packages soldered directly into a printed circuit board (PCB).

5.2 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)[1]

	VALUE
Supply voltage	2.6V to 5.5V
Operating temperature	−40°C to +85°C
V_{RAMP} voltage	0V to 2V
RF frequency	450MHz to 2GHz

(1) *Absolute Maximum Ratings* indicate limits beyond which damage to the device can occur. *Recommended Operating Conditions* indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For specifications and the test conditions, see the Section 5.3.

5.3 Electrical Characteristics for 2.6V

all limits specified to T_J = 25°C and V_{DD} = 2.6V (unless otherwise noted); **boldface** limits apply at temperature extremes [1]

PARAMETER		CONDITION	MIN	TYP	MAX	UNITS
I_{DD}	Supply current	V_{OUT} = (V_{DD} – GND) / 2		6.9	9 **12**	mA
		In shutdown (TX_EN = 0V) V_{OUT} = (V_{DD} – GND) / 2		0.2	**30**	µA
V_{HIGH}	Logic level to enable power	See [2]	**1.8**			V
V_{LOW}	Logic level to disable power	See [2]			**0.8**	V
T_{ON}	Turn-on time from shutdown			3.6	6	µs
I_{EN}, I_{BS}	Current into TX_EN and BS pin			0.03	**5**	µA
RAMP AMPLIFIER						
V_{RD}	V_{RAMP} deadband		155	206	265	mV
1/R_{RAMP}	Transconductance	See[3]	**70**	96	**120**	µA/V
$I_{OUT RAMP}$	Ramp amplifier output current	V_{RAMP} = 2V	**100**	162		µA
RF INPUT						
P_{IN}	RF input power range [4]	20kΩ ‖ 68pF between COMP1 and COMP2			−50 0	dBm
					−63 −13	dBV

Product Folder Links: *LMV242 LMV2421*

5.3 Electrical Characteristics for 2.6V (continued)

all limits specified to T_J = 25°C and V_{DD} = 2.6V (unless otherwise noted); **boldface** limits apply at temperature extremes [1]

PARAMETER		CONDITION	MIN	TYP	MAX	UNITS
Logarithmic slope [5]		At 900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.74		µA/dB
		At 1800MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.62		
		At 1900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.60		
		At 2000MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.59		
Logarithmic intercept [5]		At 900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−50.4		dBm
		At 1800MHz, 20kΩ ‖ 68pF if between COMP1 and COMP2		−52.3		
		At 1900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−51.9		
		At 2000MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−52.3		
R_{IN}	DC resistance	See [3]		55.7		Ω
ERROR AMPLIFIER						
GBW	Gain-bandwidth product	See [3]		5.1		MHz
V_O	Output swing from rail	From positive rail, sourcing, I_O = 7mA		47	90 **115**	mV
		From negative rail sinking, I_O = −7mA		52	90 **115**	
I_O	Output short-circuit current [6]	Sourcing, V_O = 2.4V	**10**	29.5		mA
		Sinking, V_O = 0.2V	**10**	27.1		
e_n	Output-referred noise	$f_{MEASURE}$ = 10kHz, RF input = 1800MHz, −10dBm, 20kΩ ‖ 68pF between COMP1 and COMP2, V_{OUT} =1.4V, set by V_{RAMP} [3]		700		nV/√Hz
SR	Slew rate		2.1	4.4		V/µs

(1) Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that $T_J = T_A$. No specification of parametric performance is indicated in the electrical tables under conditions of internal self-heating where $T_J > T_A$.
(2) All limits are specified by design or statistical analysis.
(3) Typical values represent the most likely parametric norm.
(4) Power in dBV = dBm + 13 when the impedance is 50Ω.
(5) Slope and intercept calculated from graphs V_{OUT} vs RF input power where the current is obtained by division of the voltage by 20kΩ.
(6) The output is not short-circuit protected internally. External protection is necessary to prevent overheating and destruction or adverse reliability.

5.4 Electrical Characteristics for 5V

all limits specified to T_J = 25°C and V_{DD} = 5V (unless otherwise noted); **boldface** limits apply at temperature extremes [1].

SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
I_{DD}	Supply current	V_{OUT} = (V_{DD} − GND) / 2		7.8	12 **15**	mA
		In Shutdown (TX_EN = 0V) V_{OUT} = (V_{DD} − GND) / 2		0.4	**30**	µA
V_{HIGH}	Logic level to enable power	See [2]	**1.8**			V
V_{LOW}	Logic level to disable power	See [2]			**0.8**	V
T_{ON}	Turn-on-time from shutdown			1.5	6	µs
I_{EN}, I_{BS}	Current into TX_EN and BS pin			0.03	**5**	µA
RAMP AMPLIFIER						
V_{RD}	V_{RAMP} deadband		155	206	265	mV
1/R_{RAMP}	Transconductance	See [3]	**70**	96	**120**	µA/V

5.4 Electrical Characteristics for 5V (continued)

all limits specified to T_J = 25°C and V_{DD} = 5V (unless otherwise noted); **boldface** limits apply at temperature extremes [1].

SYMBOL	PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
$I_{OUT\ RAMP}$	Ramp amplifier output current	V_{RAMP} = 2V	**100**	168		µA
RF INPUT						
P_{IN}	RF input power range [4]	20kΩ ‖ 68pF between COMP1 and COMP2		−50 0		dBm
				−63 −13		dBV
	Logarithmic slope [5]	At 900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.79		µA/dB
		At 1800MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.69		
		At 1900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.67		
		At 2000MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−1.65		
	Logarithmic intercept [5]	At 900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−50.2		dBm
		At 1800MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−52.5		
		At 1900MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−52.5		
		At 2000MHz, 20kΩ ‖ 68pF between COMP1 and COMP2		−52.9		
R_{IN}	DC resistance	See [3]		55.7		Ω
ERROR AMPLIFIER						
GBW	Gain-bandwidth product	See [3]		5.7		MHz
V_O	Output swing from rail	From positive rail, sourcing, I_O = 7mA		31	80 **105**	mV
		From negative rail sinking, I_O = −7mA		35	80 **105**	
I_O	Output short circuit current [6]	Sourcing, V_O = 4.8V	**15**	31.5		mA
		Sinking, V_O = 0.2V	**15**	31.5		
e_n	Output referred noise	$f_{MEASURE}$ = 10kHz, RF input = 1800MHz, −10dBm, 20kΩ ‖ 68pF between COMP1 and COMP2, V_{OUT} = 1.4V, set by V_{RAMP} [3]		770		nV/$\sqrt{\text{Hz}}$
SR	Slew rate			2.5	4.9	V/µs

(1) Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that T_J = T_A. No specification of parametric performance is indicated in the electrical tables under conditions of internal self-heating where T_J > T_A.
(2) All limits are specified by design or statistical analysis.
(3) Typical values represent the most likely parametric norm.
(4) Power in dBV = dBm + 13 when the impedance is 50Ω.
(5) Slope and intercept calculated from graphs V_{OUT} vs RF input power where the current is obtained by division of the voltage by 20kΩ.
(6) The output is not short-circuit protected internally. External protection is necessary to prevent overheating and destruction or adverse reliability.

5.5 Timing Diagram

To meet the time mask specifications for GSM, a good timing between the control signals and the RF signal is essential. According to the specifications the PA RF output power needs to ramp within 28µs with minimum overshoot. To achieve this, ramp the output of the PA controller at the same time as the RF signal from the baseband. The ramp signal sets the controllers output to the required value, where the loop requires a certain time to set this output. Therefore, set the V_{RAMP} pin to the desired value some time before the desired output. How much time depends on the setup and the PA used. If the controllers shutdown functionality is used, then set the shutdown high about 6µs before the ramp is set high.

The control loop can be configured by the following variables:

- Lead time TX_EN event vs start GSM burst
- Lead time V_{RAMP} vs start GSM burst
- Ramp profile
- Loop compensation
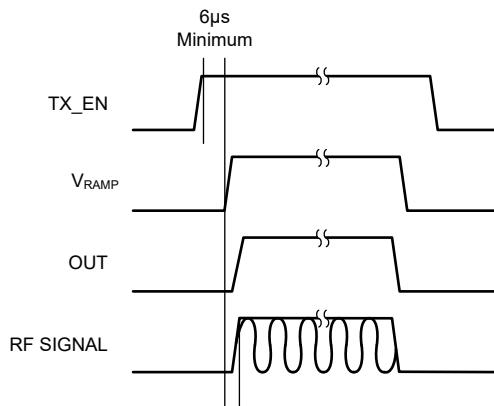
Figure 5-1. Timing V_{RAMP} vs RF Signal

5.6 Typical Characteristics

at V_{DD} = 2.6V and T_J = 25°C (unless otherwise noted)
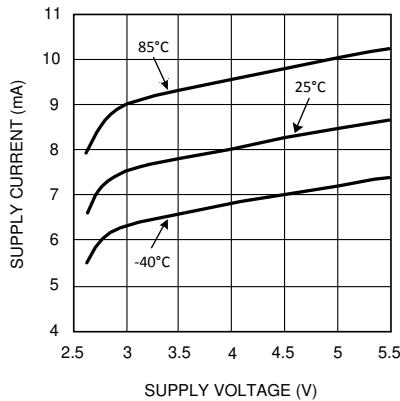
Figure 5-2. Supply Current vs Supply Voltage
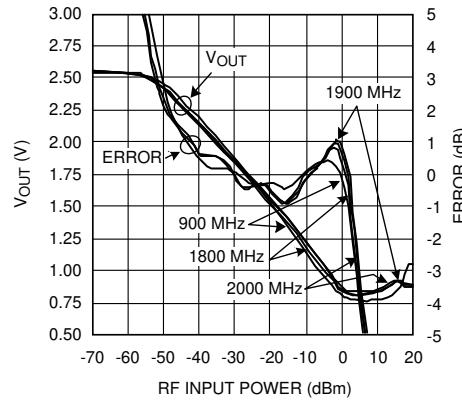
**Figure 5-3. V_{OUT} and Log Conformance vs RF Input Power**
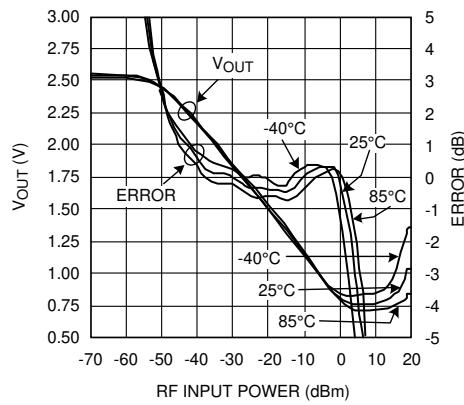
**Figure 5-4. V_{OUT} and Log Conformance vs RF Input Power at 900MHz**
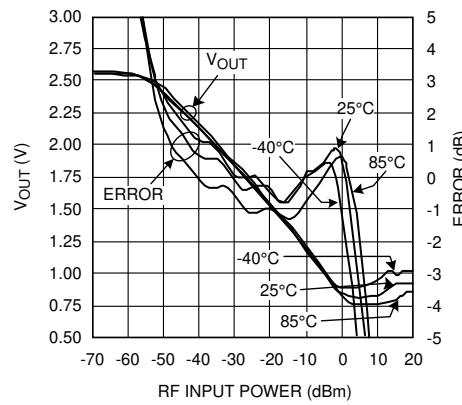
**Figure 5-5. V_{OUT} and Log Conformance vs RF Input Power at 1800MHz**
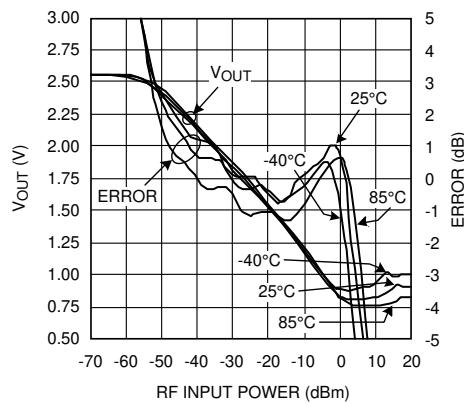
**Figure 5-6. V_{OUT} and Log Conformance vs RF Input Power at 1900MHz**
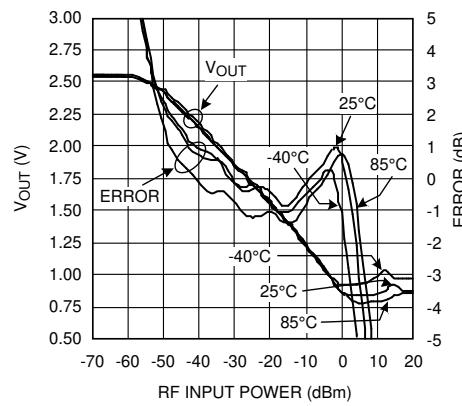
Figure 5-7. V_{OUT} and Log Conformance vs RF Input Power at 2000MHz

Product Folder Links: *LMV242 LMV2421*

5.6 Typical Characteristics (continued)

at V_{DD} = 2.6V and T_J = 25°C (unless otherwise noted)
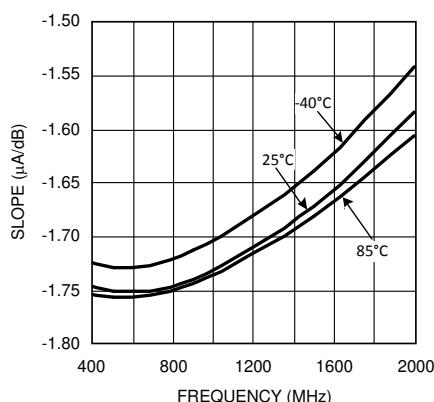
Figure 5-8. Logarithmic Slope vs Frequency
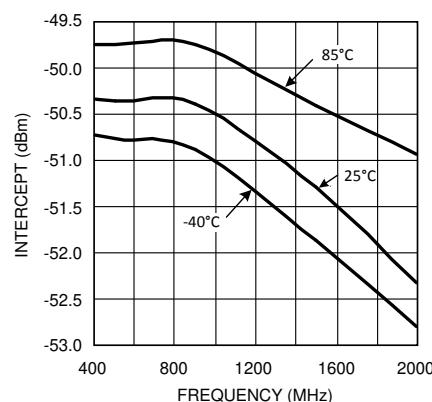
Figure 5-9. Logarithmic Intercept vs Frequency
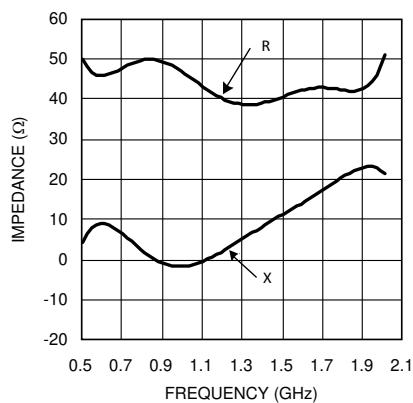
Figure 5-10. RF Input Impedance vs Frequency at Resistance and Reactance
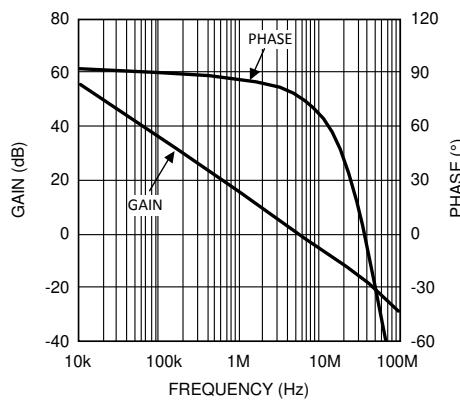
Figure 5-11. Gain and Phase vs Frequency
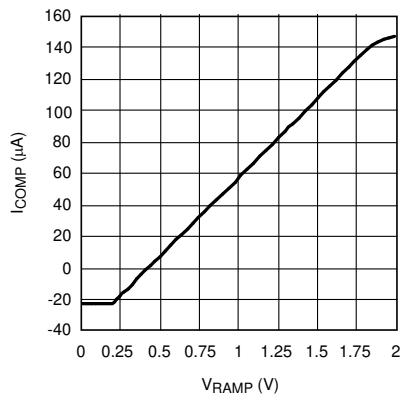
Figure 5-12. I_{COMP} vs V_{RAMP}
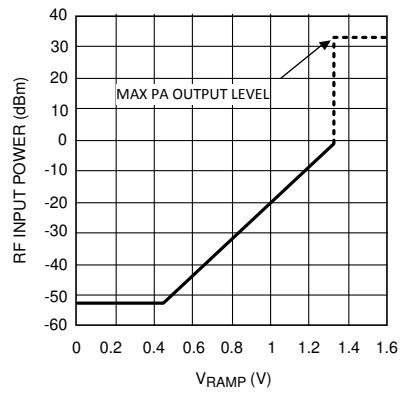
Figure 5-13. P_{IN} vs V_{RAMP}

Product Folder Links: *LMV242 LMV2421*

5.6 Typical Characteristics (continued)

at V_{DD} = 2.6V and T_J = 25°C (unless otherwise noted)
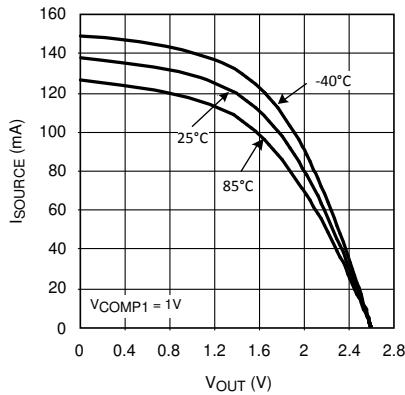

**Figure 5-14. Sourcing Current vs Output Voltage**
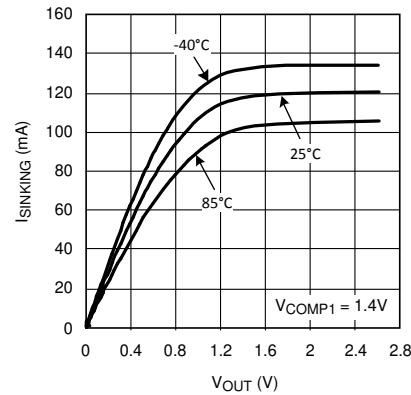
Figure 5-15. Sinking Current vs Output Voltage
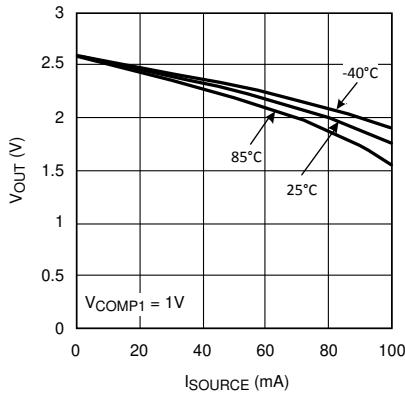
Figure 5-16. Output Voltage vs Sourcing Current
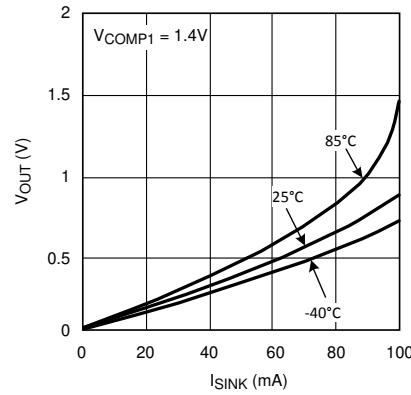
Figure 5-17. Output Voltage vs Sinking Current
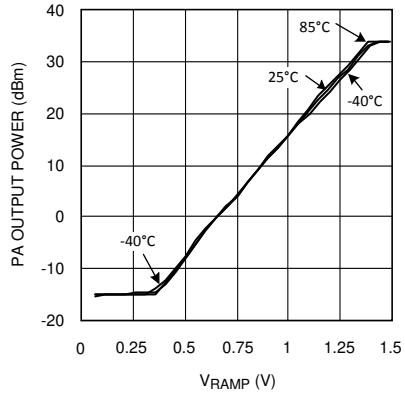
See Section 7.1.3 for attenuation configuration between the PA output and RF$_{IN}$

Figure 5-18. Closed Loop P$_{OUT}$ (PA) vs V$_{RAMP}$ at GSM 900MHz Band
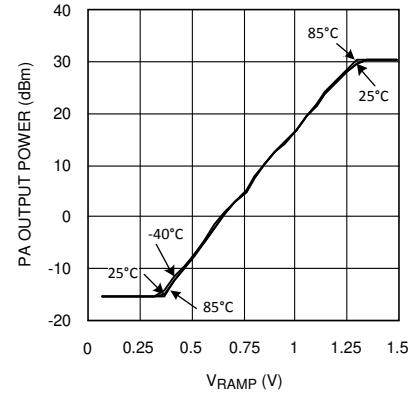
See Section 7.1.3 for attenuation configuration between the PA output and RF$_{IN}$

Figure 5-19. Closed Loop P$_{OUT}$ (PA) vs V$_{RAMP}$ at DCS 1800MHz Band

Product Folder Links: *LMV242 LMV2421*

5.6 Typical Characteristics (continued)

at V_{DD} = 2.6V and T_J = 25°C (unless otherwise noted)
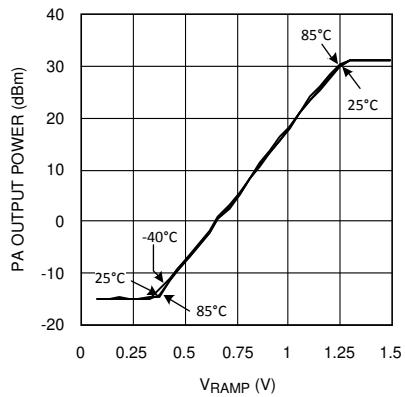
See Section 7.1.3 for attenuation configuration between the PA output and RF_{IN}

Figure 5-20. Closed Loop P_{OUT} (PA) vs V_{RAMP} at PCS 1900MHz Band
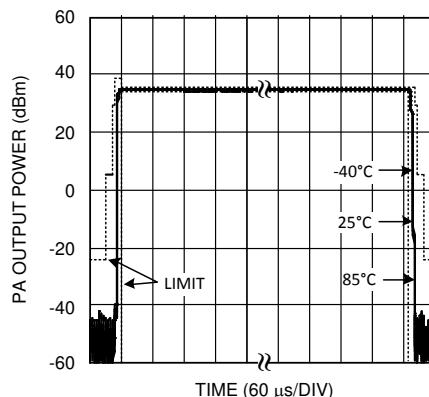
Figure 5-21. Closed Loop GSM- 900MHz Band
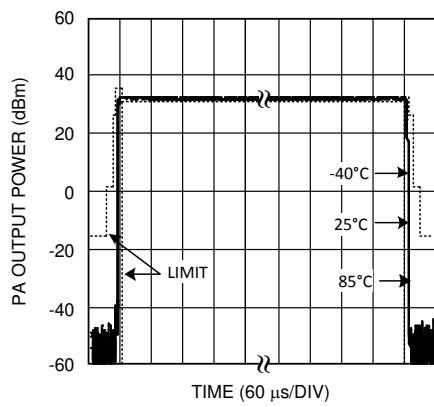
Figure 5-22. Closed Loop DCS-1800MHz Band
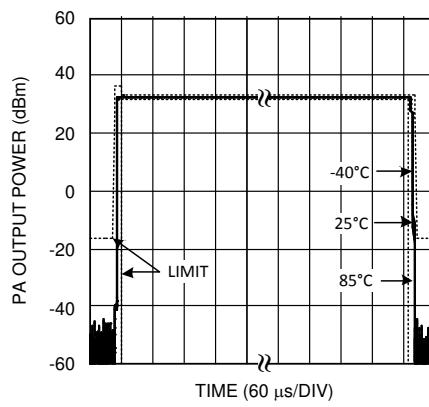
Figure 5-23. Closed Loop PCS-1900MHz Band

6 Detailed Description

6.1 Functional Block Diagram
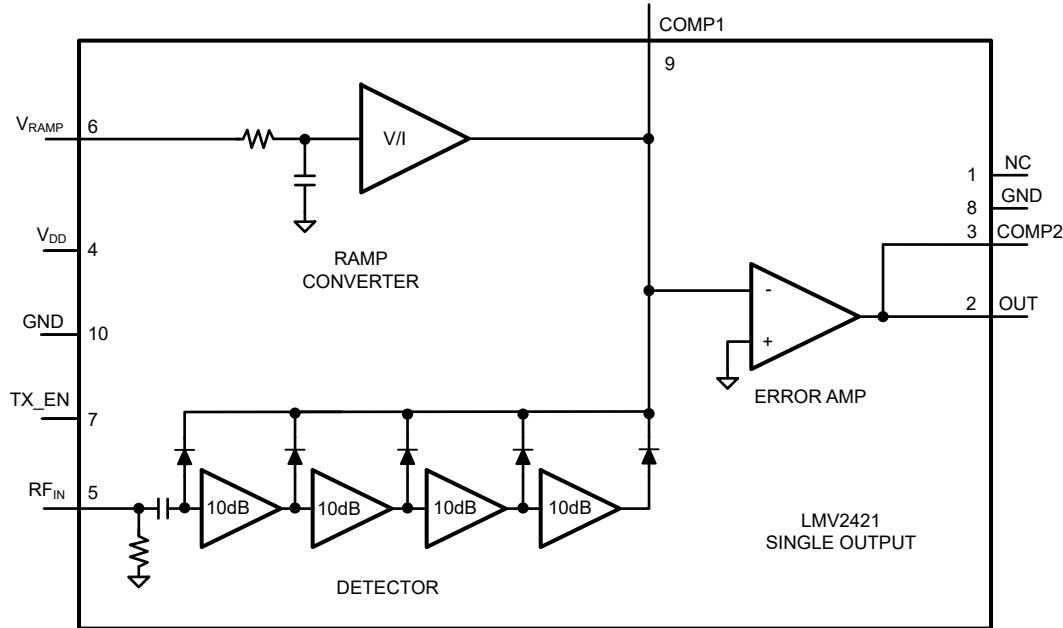
Figure 6-1. LMV2421

Figure 6-2. LMV242

Product Folder Links: *LMV242 LMV2421*
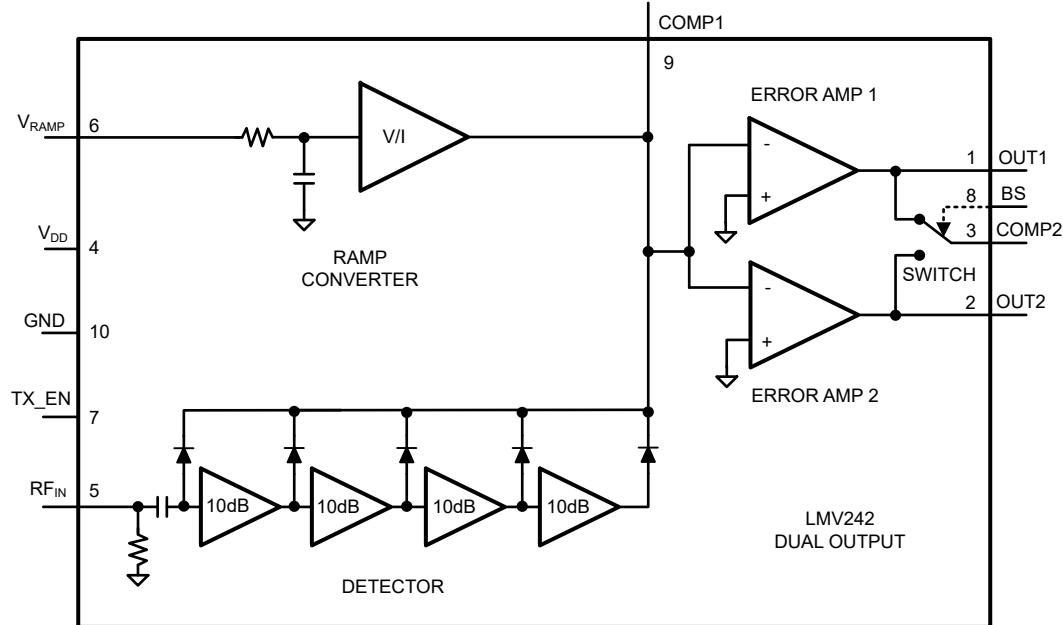
# 7 Application and Implementation

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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, as well as validating and testing their design implementation to confirm system functionality.

7.1 Application Information

7.1.1 Power-Control Principles

The LMV242x are members of TI's RF power detector with PA controller family for quad-band TDMA and GSM systems. Section 7.2 demonstrates a basic approach for implementing the quad-band design example around an RF power amplifier (PA) using the LMV242. The LMV242x contain a 50dB log RF detector and interface directly with the directional coupler.

The LMV242x baseband (control) interface consists of three signals: TX_EN to enable the device, BS (LMV242 only) to select either output 1 or output 2, and V_{RAMP} to set the RF output power to the specified level. The LMV242x give maximum flexibility to meet GSM frequency and time-mask criteria for many different single-supply PA types, such as HBT or MESFET in GaAs, SiGe, or Si technology. These criteria are met by the programmable ramp characteristic from the baseband and the TX_EN signal along with the external compensation capacitor.

7.1.2 Power Amplifier Controlled Loop

This section gives a general overview and understanding of how a typical PA control loop works, and how to solve the most common problems confronted in the design.

7.1.2.1 General Overview

The key benefit of a PA control-loop circuit is immunity to changes in the PA gain-control function. When a PA controller is used, the relationship between gain and gain control voltage (V_{APC}) of the PA is of no consequence to the overall transfer function. The overall transfer function is a function of the V_{RAMP} voltage of the controller. Based upon the value of V_{RAMP}, the PA controller sets the gain control voltage of the PA to a level that is necessary to produce the desired output level. Any temperature dependency in the PA gain control function is eliminated. Also, nonlinearity in the gain transfer function of the PA do not appear in the overall transfer function (P_{OUT} vs V_{RAMP}). The only requirement is that the gain control function of the PA has to be monotonic. To achieve this monotonic gain control function, ensure that the LMV242x detector is temperature stable.

7.1.2.2 Typical PA Closed Loop Control Setup

Figure 7-1 depicts a typical setup of a power amplifier (PA) control loop. Beginning at the output of the PA, this input is input to a detector, typically through a directional coupler. The error between detector output current I_{DET} and ramp current I_{RAMP}, representing the selected power setting, drives the inverting input of an op amp configured as an integrator. A reference voltage drives the noninverting input of the op amp. Finally, the output of the integrator op amp drives the gain control input of the power amplifier, which sets the output power. The loop stabilizes when I_{DET} is equal to I_{RAMP}.
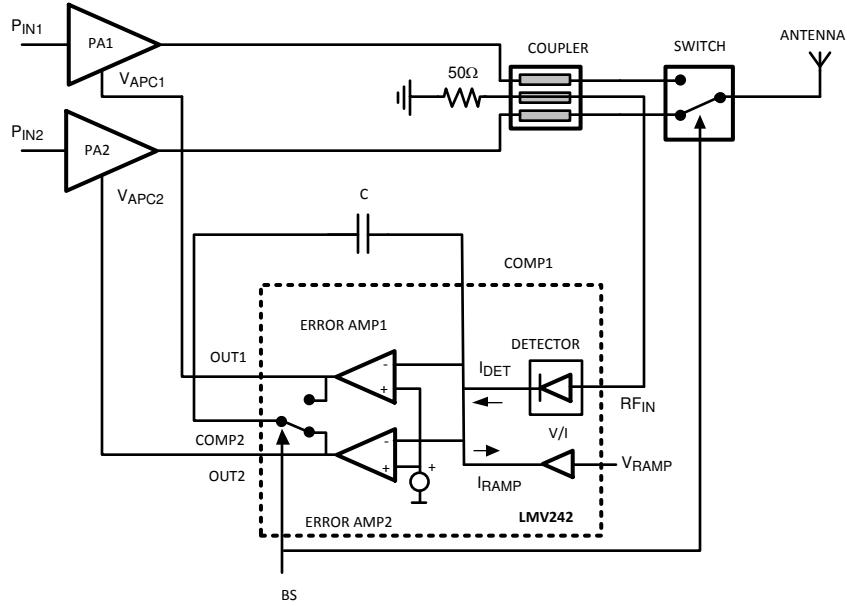
Figure 7-1. PA Control Loop

Assume initially that the output of the PA is at some low level, and that the V_{RAMP} voltage is at 1V. The V/I converter converts the V_{RAMP} voltage to a sinking current, I_{RAMP}. This current can only come from the integrator capacitor C. Current flow from this direction increases the output voltage of the integrator. The output voltage, which drives the V_{APC} of the PA, increases the gain (assume that the PA gain control input has a positive sense; that is, increasing voltage increases gain). The gain increases, thereby increasing the amplifier output level until the detector output current equals the ramp current, I_{RAMP}. At that point, the current through the capacitor decreases to zero and the integrator output holds constant, thereby settling the loop. If capacitor charge is lost over time, output voltage decreases. However, this leakage is quickly corrected by additional current from the detector. The loop stabilizes to $I_{DET} = I_{RAMP}$, thereby creating a direct relation between the V_{RAMP} set voltage and the PA output power, independent of the PA V_{APC}-P_{OUT} characteristics.

7.1.2.2.1 Power Control Over Wide Dynamic Range

The circuit is designed to produce a temperature-independent output power level. If the detector has a high dynamic range, the circuit precisely sets the PA output levels over a wide power range. To set a PA output power level, the reference voltage (V_{RAMP}) is varied. To estimate the response of P_{OUT} vs V_{RAMP}, first examine P_{IN} vs V_{RAMP} of the LMV242x ($P_{OUT} = P_{IN}$ + attenuation; see also Section 7.1.3).

The relation between P_{IN} and V_{RAMP} is constructed out of two curves:

- I_{COMP} vs V_{RAMP}
- V_{OUT} vs RF input power (detection curve)

To calculate I_{OUT}, divide the V_{OUT} of the detection curve by the feedback resistor used for measuring. With the knowledge that $I_{COMP} = I_{OUT}$ in a closed loop, Figure 7-2 shows the resulting function of P_{IN} vs V_{RAMP}. Insert extra attenuation between the PA output and the LMV242x P_{IN} to match dynamic ranges.

Product Folder Links: *LMV242 LMV2421*
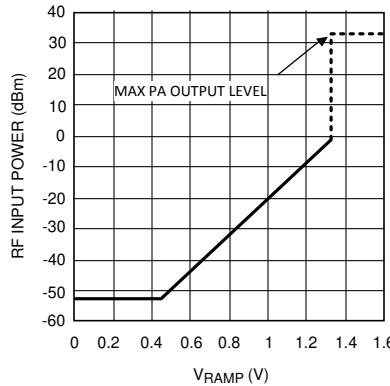
Figure 7-2. P$_{IN}$ vs V$_{RAMP}$

Using a closed loop to control the PA has benefits over the use of a directly controlled PA. Nonlinearity and temperature variations present in the PA transfer function do not appear in the overall transfer function, P$_{OUT}$ vs V$_{RAMP}$. Figure 7-3 gives the response of a typical closed loop. The shape of this curve is determined by the response of the controller detector. Therefore, ensure that the detector is accurate, temperature stable, and preferably linear in dB to achieve an accurately controlled output power. The only requirement for the control loop is that the gain control function of the PA is monotonic. With a linear in dB detector, the relation between V$_{RAMP}$ and PA output power becomes linear in dB as well, which makes system calibration easy.
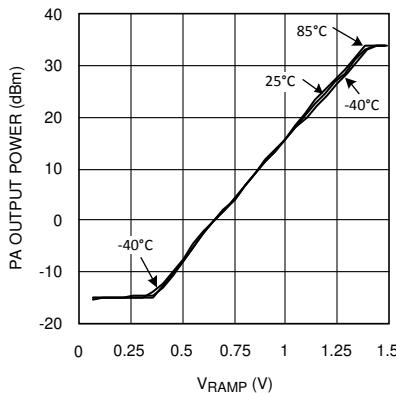

Figure 7-3. Closed-Loop Response

The response time of the loop is controlled by varying the RC time constant of the integrator. Setting the RC time constant at a low level results in fast output settling, but potentially results in ringing in the output envelope. Setting the RC time constant to a high value gives the loop good stability, but increases settling time.

7.1.3 Attenuation Between the Coupler and LMV242x Detector

Figure 7-4 shows a practical RF power control loop realized by using TI's LMV242x with integrated RF detector. The RF signal from the PA passes through a directional coupler on the way to the antenna. Directional couplers are characterized by the coupling factor, which is in the 10dB to 30dB range, typically 20dB. Because the coupled output has to deliver some power (in this case, to the detector), the coupling process takes some power from the main output. This coupling process manifests as insertion loss, with the insertion loss being higher for lower coupling factors.

Choose the correct attenuation between PA output and detector input to achieve power control over the full output power range of the PA. A typical value for the output power of the PA is +35.5dBm for GSM and +30dBm for PCS/DCS. To accommodate these levels into the LMV242x detection range, the minimum required total attenuation is approximately 35dB (see also Section 5.6 and Figure 7-2). A typical coupler factor is 20dB. Insert an extra attenuation of approximately 15dB.

Product Folder Links: *LMV242 LMV2421*

To achieve extra attenuation Z between the coupler and the RF input of the LMV242x, use two resistors. R_X and R_Y. according to Figure 7-3

where

$$Z = 20\ LOG\ (R_{IN}\ /\ [R_{IN} + R_Y]) \tag{1}$$

or

$$R_Y = R_{IN} \cdot \left(10^{-\frac{Z}{20}} - 1\right) \tag{2}$$

For example, $R_Y = 300\Omega$ results in an attenuation of 16.9dB.

To prevent reflection back to the coupler, ensure that the impedance seen by the coupler is 50Ω (R_O). The impedance consists of R_X in parallel with $R_Y + R_{IN}$. Calculate R_X with the following formula:

$$R_X = [R_O \times (R_Y + R_{IN})]\ /\ R_Y \tag{3}$$

$$R_X = 50 \times [1 + (50\ /\ R_Y)] \tag{4}$$

For example, with $R_Y = 300\Omega$, $R_{IN} = 50\Omega \rightarrow R_X = 58\Omega$.
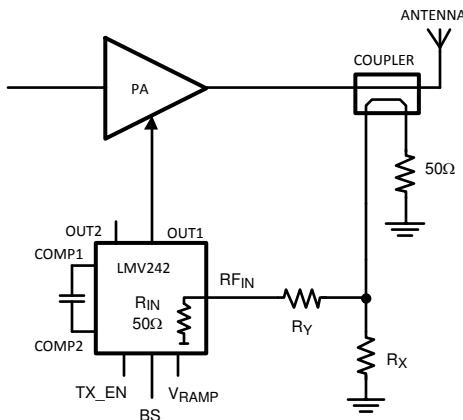
Figure 7-4. Simplified PA Control Loop With Extra Attenuation

7.1.4 Control of the LMV242x

The LMV242 (LMV2421) has three (two) controlled inputs:

- V_{RAMP} signal (baseband DAC ramp signal)
- TX_EN is a digital signal (performs the function *Shutdown/Transmit Enable*).
- Band select (BS) (LMV242 only)

7.1.4.1 V_{RAMP} Signal

The actual V_{RAMP} input value sets the RF output power of the system. By applying a certain mask shape to the V_{RAMP} pin, the output voltage level of the LMV242x is adjusting the PA control voltage to get a power level (P_{OUT}/dBm) out of the PA, which is proportional to the single ramp voltage steps. The recommended V_{RAMP} voltage range for RF power control is 0.2V to 2.0V. The V_{RAMP} input tolerates voltages from 0V to V_{DD} without malfunction or damage. The V_{RAMP} input does not change the output level until the level reaches approximately 206mV; therefore offset voltages in the DAC or amplifier supplying the V_{RAMP} signal do not cause excess RF signal output and increased power consumption.

7.1.4.2 Transmit Enable

Power-consumption requirements are supported by the TX_EN function. This function puts the entire chip into a power-saving mode to enable maximum standby and talk time while minimizing excessive output glitch during power-up and power-down. The device is active when TX_EN = high; otherwise, the device goes into a low-power-consumption shutdown mode. During shutdown, the output is pulled low to minimize the output voltage.

7.1.4.3 Band Select (LMV242 Only)

The LMV242 is an excellent choice for PA control loops with two PAs. Control the two outputs that steer the V_{APC} of the PAs with the band select (BS) pin. When the BS pin is high, OUT1 is selected. When the BS pin is low, OUT2 is selected. The output that is not selected is pulled low.

7.1.4.4 Analog Output

The output is driven by a rail-to-rail amplifier capable of both sourcing and sinking. Several curves are given in Section 5.6 regarding the output. The output voltage versus sourcing and sinking current curves show the typical voltage drop from the rail over temperature. The sourcing and sinking current versus output voltage characteristics show the typical charging and discharging currents, which the output is capable of delivering at a certain voltage. The output is free from glitches when enabled by TX_EN. When TX_EN is low, the selected output voltage is fixed or near ground.

7.1.5 Frequency Compensation

To compensate and prevent the closed loop arrangement from oscillations and overshoots at the output of the RF detector/error amplifier of the LMV242x, the system can be adjusted by means of external RC components connected between COMP1 and COMP2. Exact values heavily depend on PA characteristics. A good starting point is R = 0Ω and C = 68pF. The vast combination of PAs and couplers available preclude a generalized formula for choosing these components. Additional frequency compensation of the closed loop system can be achieved by adding a resistor (and if needed an inductor) between the LMV242x output and the V_{APC} input of the PA. Contact TI for additional support.

7.2 Typical Application
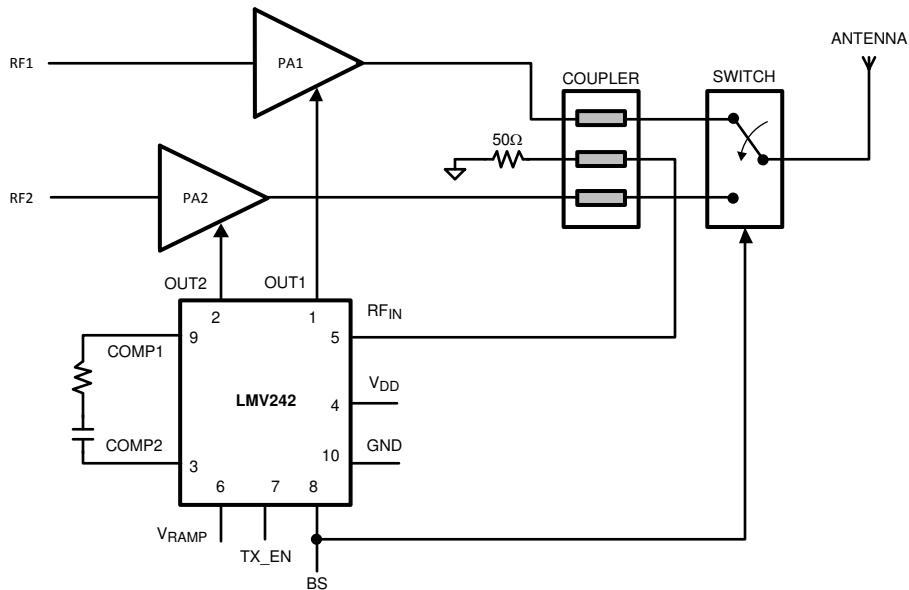
Figure 7-5. Typical Application with LMV242

8 Device and Documentation Support

8.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.2 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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8.3 Trademarks

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8.4 Electrostatic Discharge Caution

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.

8.5 Glossary

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

9 Revision History

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

10 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.

Product Folder Links: *LMV242 LMV2421*

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LMV2421LDT	Active	Production	WSON (NGY) | 10	1000 | SMALL T&R	Yes	SN	Level-3-260C-168 HR	-40 to 85	2421L
LMV242LD/NOPB	Active	Production	WSON (NGY) | 10	1000 | SMALL T&R	Yes	SN	Level-3-260C-168 HR	-40 to 85	242LD
LMV242LD/NOPB.A	Active	Production	WSON (NGY) | 10	1000 | SMALL T&R	Yes	SN	Level-3-260C-168 HR	-40 to 85	242LD

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS
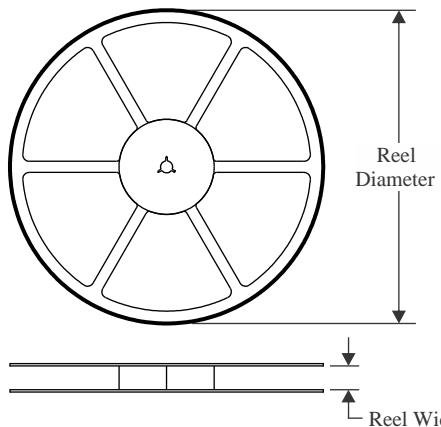
TAPE DIMENSIONS
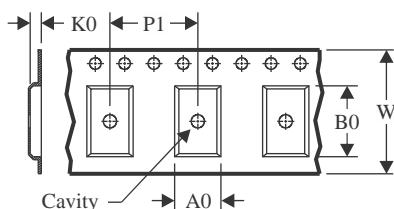
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE
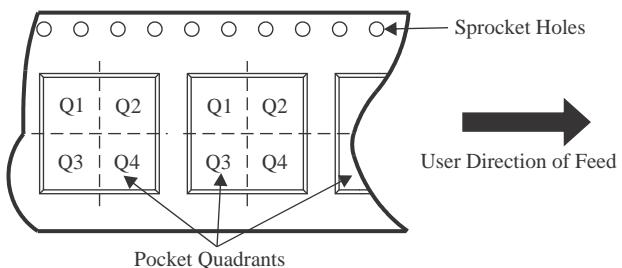
*All dimensions are nominal

| 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
LMV2421LDT	WSON	NGY	10	1000	177.8	12.4	3.3	3.3	1.0	8.0	12.0	Q1
LMV242LD/NOPB	WSON	NGY	10	1000	177.8	12.4	3.3	3.3	1.0	8.0	12.0	Q1

PACKAGE MATERIALS INFORMATION

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMV2421LDT	WSON	NGY	10	1000	208.0	191.0	35.0
LMV242LD/NOPB	WSON	NGY	10	1000	208.0	191.0	35.0

NGY0010A

(2)

(1.8)

(1.2)

(10X 0.5)

(10X 0.25)

(8X 0.5)

RECOMMENDED LAND PATTERN
1:1 RATION WITH PKG SOLDER PADS

DIMENSIONS ARE IN MILLIMETERS

PIN 1 INDEX AREA

3 ±0.1

3 ±0.1

B

A

C

0.8 MAX

(0.2)

PIN 1 ID

(0.25)

(0.25)

2 ±0.1

(0.1 TYP)

1

5

(0.2)

(0.2)

1.2 ±0.1

10

6

10X 0.5 ±0.1

10X 0.25 ±0.05

⊕ | 0.1 Ⓜ | C | A Ⓢ | B Ⓢ

2X 2

8X 0.5

LDA10A (Rev B)
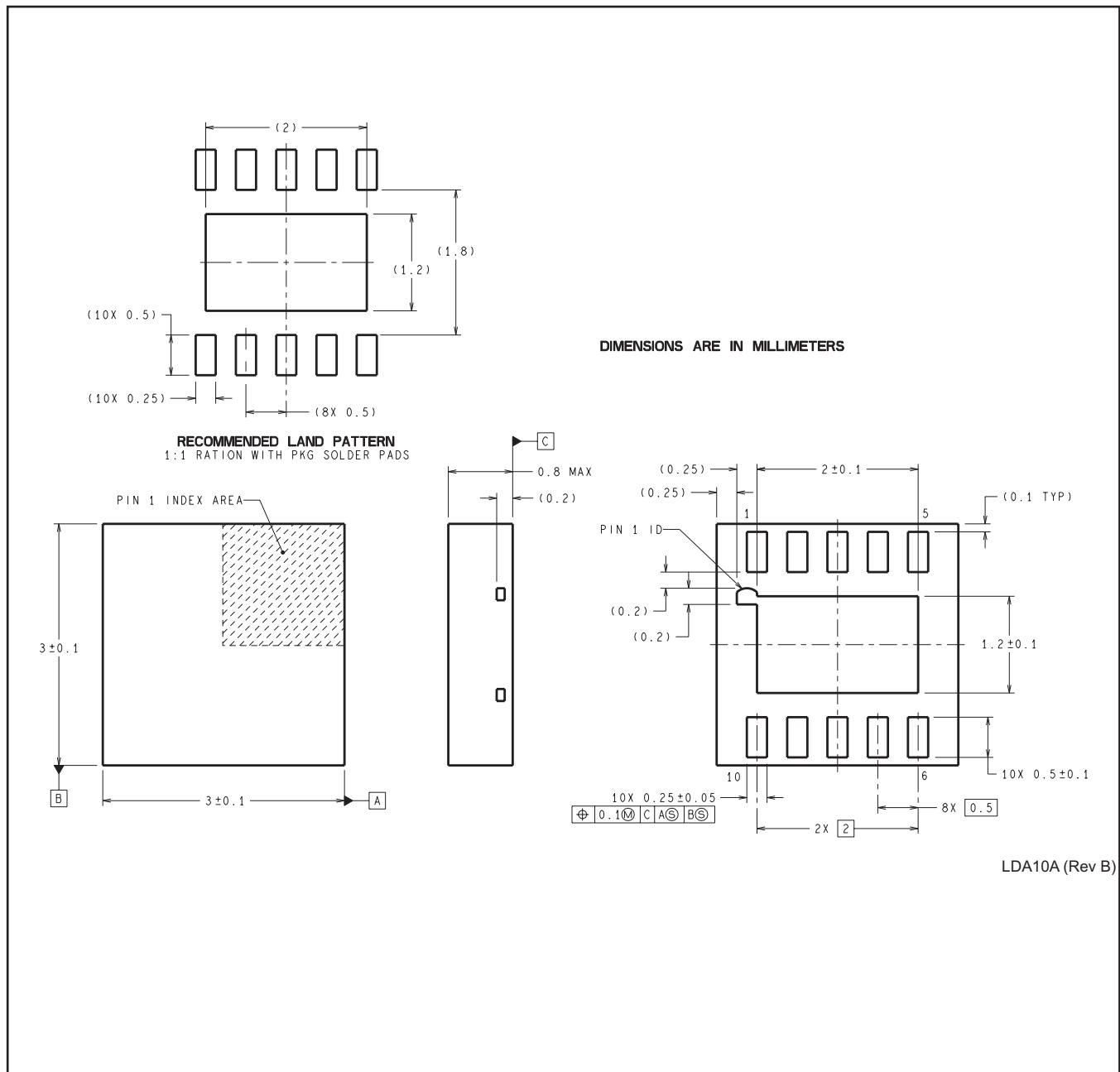
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