2.4-GHz *Bluetooth*® low energy System-on-Chip

Check for Samples: CC2540F128, CC2540F256

FEATURES

- **True Single-Chip BLE Solution: CC2540 Can Run Both Application and BLE Protocol Stack, Includes Peripherals to Interface With Wide Range of Sensors, Etc.**
- **6-mm × 6-mm Package**
- **RF**
  - ***Bluetooth* low energy technology Compatible**
  - **Excellent Link Budget (up to 97 dB), Enabling Long-Range Applications Without External Front End**
  - **Accurate Digital Received Signal-Strength Indicator (RSSI)**
  - **Suitable for Systems Targeting Compliance With Worldwide Radio Frequency Regulations: ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan)**
- **Layout**
  - **Few External Components**
  - **Reference Design Provided**
  - **6-mm × 6-mm QFN40 Package**
- **Low Power**
  - **Active Mode RX Down to 19.6 mA**
  - **Active Mode TX (–6 dBm): 24 mA**
  - **Power Mode 1 (3-μs Wake-Up): 235 μA**
  - **Power Mode 2 (Sleep Timer On): 0.9 μA**
  - **Power Mode 3 (External Interrupts): 0.4 μA**
  - **Wide Supply Voltage Range (2 V–3.6 V)**
  - **Full RAM and Register Retention in All Power Modes**
- **TPS62730 Compatible Low Power in Active Mode**
  - **RX Down to 15.8 mA (3 V Supply)**
  - **TX (-6 dBm): 18.6 mA (3 V Supply)**
- **Microcontroller**
  - **High-Performance and Low-Power 8051 Microcontroller Core**
  - **In-System-Programmable Flash, 128 KB or 256 KB**
  - **8-KB SRAM**
- **Peripherals**
  - **12-Bit ADC with Eight Channels and Configurable Resolution**
  - **Integrated High-Performance Op-Amp and Ultralow-Power Comparator**
  - **General-Purpose Timers (One 16-Bit, Two 8-Bit)**
  - **21 General-Purpose I/O Pins (19× 4 mA, 2× 20 mA)**
  - **32-kHz Sleep Timer With Capture**
  - **Two Powerful USARTs With Support for Several Serial Protocols**
  - **Full-Speed USB Interface**
  - **IR Generation Circuitry**
  - **Powerful Five-Channel DMA**
  - **AES Security Coprocessor**
  - **Battery Monitor and Temperature Sensor**
  - **Each CC2540 Contains a Unique 48-bit IEEE Address**

SOFTWARE FEATURES

- ***Bluetooth* v4.0 Compliant Protocol Stack for Single-Mode BLE Solution**
  - **Complete Power-Optimized Stack, Including Controller and Host**
    - **GAP – Central, Peripheral, Observer, or Broadcaster (Including Combination Roles)**
    - **ATT / GATT – Client and Server**
    - **SMP – AES-128 Encryption and Decryption**
    - **L2CAP**
  - **Sample Applications and Profiles**
    - **Generic Applications for GAP Central and Peripheral Roles**
    - **Proximity, Accelerometer, Simple Keys, and Battery GATT Services**
  - **Multiple Configuration options**
    - **Single-Chip Configuration, Allowing Application to Run on CC2540**
    - **Network Processor Interface for Applications Running on an External Microcontroller**
  - **BTool – Windows PC Application for Evaluation, Development, and Test**
- **Development Tools**
  - **CC2540 Mini Development Kit**
  - **SmartRF™ Software**
  - **Supported by IAR Embedded Workbench™ Software for 8051**

APPLICATIONS

- **2.4-GHz *Bluetooth* low energy Systems**
- **Mobile Phone Accessories**
- **Sports and Leisure Equipment**
- **Consumer Electronics**
- **Human Interface Devices (Keyboard, Mouse, Remote Control)**
- **USB Dongles**
- **Health Care and Medical**

CC2540 WITH TPS62730

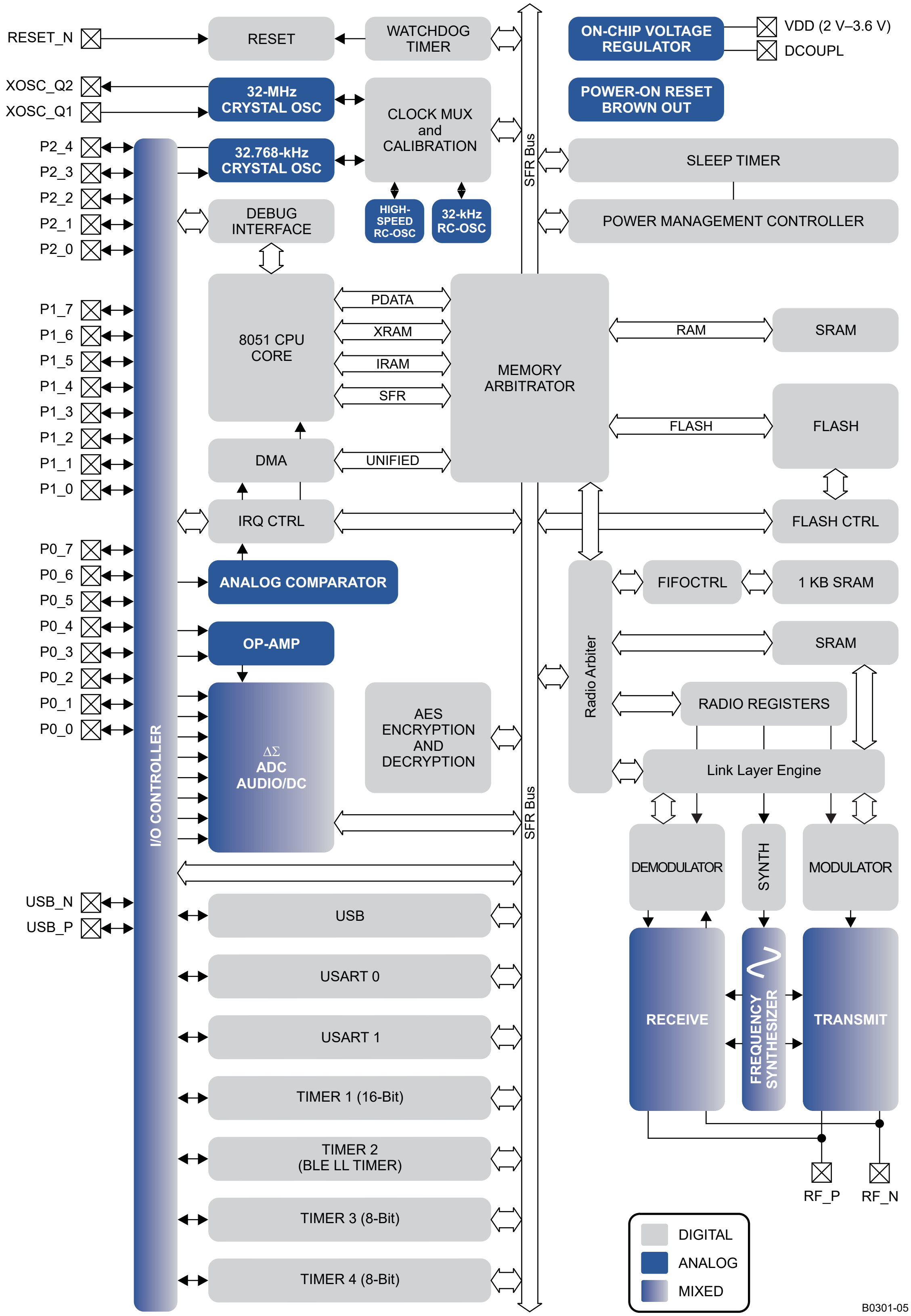
- **TPS62730 is a 2 MHz Step Down Converter with Bypass Mode**
- **Extends Application Run Time by up to 20%**
- **Reduced Current in TX and RX**
- **30 nA Bypass Mode Current to Support Low Power Modes**
- **RF Performance Unchanged**
- **Small Package Allows for Small Solution Size**
- **CC2540 Controllable**

DESCRIPTION

The CC2540 is a cost-effective, low-power, true system-on-chip (SoC) for *Bluetooth* low energy applications. It enables robust BLE master or slave nodes to be built with very low total bill-of-material costs. The CC2540 combines an excellent RF transceiver with an industry-standard enhanced 8051 MCU, in-system programmable flash memory, 8-KB RAM, and many other powerful supporting features and peripherals. The CC2540 is suitable for systems where very low power consumption is required. Very low-power sleep modes are available. Short transition times between operating modes further enable low power consumption.

The CC2540 comes in two different versions: CC2540F128/F256, with 128 and 256 KB of flash memory, respectively.

Combined with the *Bluetooth* low energy protocol stack from Texas Instruments, the CC2540F128/F256 forms the market's most flexible and cost-effective single-mode *Bluetooth* low energy solution.


RESET_N
RESET
WATCHDOG TIMER
ON-CHIP VOLTAGE REGULATOR
VDD (2 V–3.6 V)
DCOUPL
XOSC_Q2
XOSC_Q1
32-MHz CRYSTAL OSC
CLOCK MUX and CALIBRATION
POWER-ON RESET BROWN OUT
P2_4
P2_3
P2_2
P2_1
P2_0
32.768-kHz CRYSTAL OSC
SFR Bus
SLEEP TIMER
DEBUG INTERFACE
HIGH-SPEED RC-OSC
32-kHz RC-OSC
POWER MANAGEMENT CONTROLLER
P1_7
P1_6
P1_5
P1_4
P1_3
P1_2
P1_1
P1_0
8051 CPU CORE
PDATA
XRAM
IRAM
SFR
MEMORY ARBITRATOR
RAM
SRAM
FLASH
FLASH
DMA
UNIFIED
IRQ CTRL
FLASH CTRL
P0_7
P0_6
P0_5
P0_4
P0_3
P0_2
P0_1
P0_0
ANALOG COMPARATOR
FIFOCTRL
1 KB SRAM
OP-AMP
SRAM
Radio Arbiter
AES ENCRYPTION AND DECRYPTION
RADIO REGISTERS
ΔΣ ADC AUDIO/DC
Link Layer Engine
I/O CONTROLLER
SFR Bus
DEMODULATOR
SYNTH
MODULATOR
USB_N
USB_P
USB
USART 0
RECEIVE
FREQUENCY SYNTHESIZER
TRANSMIT
USART 1
TIMER 1 (16-Bit)
TIMER 2 (BLE LL TIMER)
RF_P
RF_N
TIMER 3 (8-Bit)
DIGITAL
ANALOG
MIXED
TIMER 4 (8-Bit)
B0301-05

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.

ABSOLUTE MAXIMUM RATINGS(1)

		MIN	MAX	UNIT
Supply voltage	All supply pins must have the same voltage	–0.3	3.9	V
Voltage on any digital pin		–0.3	VDD + 0.3, ≤ 3.9	V
Input RF level			10	dBm
Storage temperature range		–40	125	°C
ESD(2)	All pads, according to human-body model, JEDEC STD 22, method A114		2	kV
	According to charged-device model, JEDEC STD 22, method C101		750	V

(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) CAUTION: ESD sensitive device. Precautions should be used when handing the device in order to prevent permanent damage.

RECOMMENDED OPERATING CONDITIONS

	MIN	MAX	UNIT
Operating ambient temperature range, T_A	–40	85	°C
Operating supply voltage	2	3.6	V

ELECTRICAL CHARACTERISTICS

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{core}	Core current consumption	Power mode 1. Digital regulator on; 16-MHz RCOSC and 32-MHz crystal oscillator off; 32.768-kHz XOSC, POR, BOD and sleep timer active; RAM and register retention		235		μA
		Power mode 2. Digital regulator off; 16-MHz RCOSC and 32-MHz crystal oscillator off; 32.768-kHz XOSC, POR, and sleep timer active; RAM and register retention		0.9		μA
		Power mode 3. Digital regulator off; no clocks; POR active; RAM and register retention		0.4		μA
		Low MCU activity: 32-MHz XOSC running. No radio or peripherals. No flash access, no RAM access.		6.7		mA
I_{peri}	Peripheral current consumption (Adds to core current I_{core} for each peripheral unit activated)	Timer 1. Timer running, 32-MHz XOSC used		90		μA
		Timer 2. Timer running, 32-MHz XOSC used		90		μA
		Timer 3. Timer running, 32-MHz XOSC used		60		μA
		Timer 4. Timer running, 32-MHz XOSC used		70		μA
		Sleep timer, including 32.753-kHz RCOSC		0.6		μA
		ADC, when converting		1.2		mA

GENERAL CHARACTERISTICS

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
WAKE-UP AND TIMING					
Power mode 1 → Active	Digital regulator on, 16-MHz RCOSC and 32-MHz crystal oscillator off. Start-up of 16-MHz RCOSC		4		µs
Power mode 2 or 3 → Active	Digital regulator off, 16-MHz RCOSC and 32-MHz crystal oscillator off. Start-up of regulator and 16-MHz RCOSC		120		µs
Active → TX or RX	Crystal ESR = 16 Ω. Initially running on 16-MHz RCOSC, with 32-MHz XOSC OFF		410		µs
	With 32-MHz XOSC initially on		160		µs
RX/TX turnaround			150		µs
RADIO PART					
RF frequency range	Programmable in 2-MHz steps	2402		2480	MHz
Data rate and modulation format	1 Mbps, GFSK, 250 kHz deviation				

RF RECEIVE SECTION

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C, VDD = 3 V, f_c = 2440 MHz
1 Mbps, GFSK, 250-kHz deviation, *Bluetooth* low energy mode, and 0.1% BER(1)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Receiver sensitivity(2)	High-gain mode		–93		dBm
Receiver sensitivity(2)	Standard mode		–87		dBm
Saturation(3)			6		dBm
Co-channel rejection(3)			–5		dB
Adjacent-channel rejection(3)	±1 MHz		–5		dB
Alternate-channel rejection(3)	±2 MHz		30		dB
Blocking(3)			–30		dBm
Frequency error tolerance(4)	Including both initial tolerance and drift	–250		250	kHz
Symbol rate error tolerance(5)		–80		80	ppm
Spurious emission. Only largest spurious emission stated within each band.	Conducted measurement with a 50-Ω single-ended load. Complies with EN 300 328, EN 300 440 class 2, FCC CFR47, Part 15 and ARIB STD-T-66		–75		dBm
Current consumption	RX mode, standard mode, no peripherals active, low MCU activity, MCU at 250 kHz		19.6		mA
	RX mode, high-gain mode, no peripherals active, low MCU activity, MCU at 250 kHz		22.1		mA

(1) 0.1% BER maps to 30.8% PER
(2) The receiver sensitivity setting is programmable using a TI BLE stack vendor-specific API command. The default value is standard mode.
(3) Results based on standard gain mode
(4) Difference between center frequency of the received RF signal and local oscillator frequency
(5) Difference between incoming symbol rate and the internally generated symbol rate

RF TRANSMIT SECTION

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C, VDD = 3 V and f_c = 2440 MHz

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output power	Delivered to a single-ended 50-Ω load through a balun using maximum recommended output power setting		4		dBm
	Delivered to a single-ended 50-Ω load through a balun using minimum recommended output power setting		–20		
Programmable output power range	Delivered to a single-ended 50 Ω load through a balun		24		dB
Spurious emissions	Conducted measurement with a 50-Ω single-ended load. Complies with EN 300 328, EN 300 440 class 2, FCC CFR47, Part 15 and ARIB STD-T-66(1)		–41		dBm
Current consumption	TX mode, –23-dBm output power, no peripherals active, low MCU activity, MCU at 250 kHz		21.1		mA
	TX mode, –6-dBm output power, no peripherals active, low MCU activity, MCU at 250 kHz		23.8		
	TX mode, 0-dBm output power, no peripherals active, low MCU activity, MCU at 250 kHz		27		
	TX mode, 4-dBm output power, no peripherals active, low MCU activity, MCU at 250 kHz		31.6		
Optimum load impedance	Differential impedance as seen from the RF port (RF_P and RF_N) toward the antenna		70 + j30		Ω

(1) Designs with antenna connectors that require conducted ETSI compliance at 64 MHz should insert an LC resonator in front of the antenna connector. Use a 1.6-nH inductor in parallel with a 1.8-pF capacitor. Connect both from the signal trace to a good RF ground.

CURRENT CONSUMPTION WITH TPS62730

Measured on Texas Instruments CC2540TPS62730 EM reference design with T_A = 25°C, VDD = 3 V, and f_c = 2440 MHZ.
1 **Mbps, GFSK, 250 kHz deviation, Bluetooth™ low energy mode, 1% BER**(1)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Current Consumption	RX mode, standard mode, no peripherals active, low MCU activity, MCU at 1 MHZ		15.8		mA
	RX mode, high-gain mode, no peripherals active, low MCU activity, MCU at 1 MHZ		17.8		
	TX mode, -23 dBm output power, no peripherals active, low MCU activity, MCU at 1 MHZ		16.5		
	TX mode, -6 dBm output power, no peripherals active, low MCU activity, MCU at 1 MHZ		18.6		
	TX mode, 0 dBm output power, no peripherals active, low MCU activity, MCU at 1 MHZ		21		
	TX mode, 4 dBm output power, no peripherals active, low MCU activity, MCU at 1 MHZ		24.6		

(1) 0.1% BER maps to 30.8% PER

32-MHz CRYSTAL OSCILLATOR

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
	Crystal frequency			32		MHz
	Crystal frequency accuracy requirement(1)		–40		40	ppm
ESR	Equivalent series resistance		6		60	Ω
C_0	Crystal shunt capacitance		1		7	pF
C_L	Crystal load capacitance		10		16	pF
	Start-up time			0.25		ms
	Power-down guard time	The crystal oscillator must be in power down for a guard time before it is used again. This requirement is valid for all modes of operation. The need for power-down guard time can vary with crystal type and load.	3			ms

(1) Including aging and temperature dependency, as specified by [1]

32.768-kHz CRYSTAL OSCILLATOR

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
	Crystal frequency			32.768		kHz
	Crystal frequency accuracy requirement(1)		–40		40	ppm
ESR	Equivalent series resistance			40	130	kΩ
C_0	Crystal shunt capacitance			0.9	2	pF
C_L	Crystal load capacitance			12	16	pF
	Start-up time			0.4		s

(1) Including aging and temperature dependency, as specified by [1]

32-kHz RC OSCILLATOR

Measured on Texas Instruments CC2540 EM reference design with T_ω = 25°C and VDD = 3 V.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Calibrated frequency(1)			32.753		kHz
Frequency accuracy after calibration			±0.2%		
Temperature coefficient(2)			0.4		%/°C
Supply-voltage coefficient(3)			3		%/V
Calibration time(4)			2		ms

(1) The calibrated 32-kHz RC oscillator frequency is the 32-MHz XTAL frequency divided by 977.
(2) Frequency drift when temperature changes after calibration
(3) Frequency drift when supply voltage changes after calibration
(4) When the 32-kHz RC oscillator is enabled, it is calibrated when a switch from the 16-MHz RC oscillator to the 32-MHz crystal oscillator is performed while SLEEPCMD.OSC32K_CALDIS is set to 0.

16-MHz RC OSCILLATOR

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Frequency(1)			16		MHz
Uncalibrated frequency accuracy			±18%		
Calibrated frequency accuracy			±0.6%		
Start-up time			10		μs
Initial calibration time(2)			50		μs

(1) The calibrated 16-MHz RC oscillator frequency is the 32-MHz XTAL frequency divided by 2.
(2) When the 16-MHz RC oscillator is enabled, it is calibrated when a switch from the 16-MHz RC oscillator to the 32-MHz crystal oscillator is performed while SLEEPCMD.OSC_PD is set to 0.

RSSI CHARACTERISTICS

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Useful RSSI range(1)	High-gain mode		–99 to –44		dBm
	Standard mode		–90 to –35		
Absolute uncalibrated RSSI accuracy(1)	High-gain mode		±4		dB
Step size (LSB value)			1		dB

(1) Assuming CC2540 EM reference design. Other RF designs give an offset from the reported value.

FREQUENCY SYNTHESIZER CHARACTERISTICS

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C, VDD = 3 V and f_c = 2440 MHz

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Phase noise, unmodulated carrier	At ±1-MHz offset from carrier		–109		dBc/Hz
	At ±3-MHz offset from carrier		–112		
	At ±5-MHz offset from carrier		–119		

ANALOG TEMPERATURE SENSOR

Measured on Texas Instruments CC2540 EM reference design with T_A = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output	Measured using integrated ADC, internal band-gap voltage reference, and maximum resolution		1480		12-bit
Temperature coefficient			4.5		mv/°C
Voltage coefficient			1		/ 0.1 V
Initial accuracy without calibration			±10		°C
Accuracy using 1-point calibration			±5		°C
Current consumption when enabled			0.5		mA

OP-AMP CHARACTERISTICS

T_A = 25°C, VDD = 3 V, . All measurement results are obtained using the CC2540 reference designs post-calibration.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Chopping Configuration, Register APCFG = 0x07, OPAMPMC = 0x03, OPAMPC = 0x01						
	Output maximum voltage			VDD – 0.07		V
	Output minimum voltage			0.07		V
	Open-loop gain			108		dB
	Gain-bandwidth product			2		MHz
	Slew rate			107		V/µs
	Input maximum voltage			VDD + 0.13		V
	Intput minimum voltage			–55		mV
	Input offset voltage			40		µV
CMRR	Common-mode rejection ratio			90		dB
	Supply current			0.4		mA
	Input noise voltage	f = 0.01 Hz to 1 Hz		1.1		nV/√(Hz)
		f = 0.1 Hz to 10 Hz		1.7		
Non-Chopping Configuration, Register APCFG = 0x07, OPAMPMC = 0x00, OPAMPC = 0x01						
	Output maximum voltage			VDD – 0.07		V
	Output minimum voltage			0.07		V
	Open-loop gain			108		dB
	Gain-bandwidth product			2		MHz
	Slew rate			107		V/µs
	Input maximum voltage			VDD + 0.13		V
	Intput minimum voltage			–55		mV
	Input offset voltage			0.8		mV
CMRR	Common-mode rejection ratio			90		dB
	Supply current			0.4		mA
	Input noise voltage	f = 0.01 Hz to 1 Hz		60		nV/√(Hz)
		f = 0.1 Hz to 10 Hz		65		

COMPARATOR CHARACTERISTICS

T_A = 25°C, VDD = 3 V. All measurement results are obtained using the CC2540 reference designs, post-calibration.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Common-mode maximum voltage			VDD		V
Common-mode minimum voltage			–0.3		
Input offset voltage			1		mV
Offset vs temperature			16		µV/°C
Offset vs operating voltage			4		mV/V
Supply current			230		nA
Hysteresis			0.15		mV

ADC CHARACTERISTICS

T_A = 25°C and VDD = 3 V

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
	Input voltage	VDD is voltage on AVDD5 pin	0		VDD	V
	External reference voltage	VDD is voltage on AVDD5 pin	0		VDD	V
	External reference voltage differential	VDD is voltage on AVDD5 pin	0		VDD	V
	Input resistance, signal	Simulated using 4-MHz clock speed		197		kΩ
	Full-scale signal(1)	Peak-to-peak, defines 0 dBFS		2.97		V
ENOB(1)	Effective number of bits	Single-ended input, 7-bit setting		5.7		bits
		Single-ended input, 9-bit setting		7.5		
		Single-ended input, 10-bit setting		9.3		
		Single-ended input, 12-bit setting		10.3		
		Differential input, 7-bit setting		6.5		
		Differential input, 9-bit setting		8.3		
		Differential input, 10-bit setting		10		
		Differential input, 12-bit setting		11.5		
		10-bit setting, clocked by RCOSC		9.7		
		12-bit setting, clocked by RCOSC		10.9		
	Useful power bandwidth	7-bit setting, both single and differential		0–20		kHz
THD	Total harmonic distortion	Single ended input, 12-bit setting, –6 dBFS(1)		–75.2		dB
		Differential input, 12-bit setting, –6 dBFS(1)		–86.6		
	Signal to nonharmonic ratio	Single-ended input, 12-bit setting(1)		70.2		dB
		Differential input, 12-bit setting(1)		79.3		
		Single-ended input, 12-bit setting, –6 dBFS(1)		78.8		
		Differential input, 12-bit setting, –6 dBFS(1)		88.9		
CMRR	Common-mode rejection ratio	Differential input, 12-bit setting, 1-kHz sine (0 dBFS), limited by ADC resolution		>84		dB
	Crosstalk	Single ended input, 12-bit setting, 1-kHz sine (0 dBFS), limited by ADC resolution		>84		dB
	Offset	Midscale		–3		mV
	Gain error			0.68%		
DNL	Differential nonlinearity	12-bit setting, mean(1)		0.05		LSB
		12-bit setting, maximum(1)		0.9		
INL	Integral nonlinearity	12-bit setting, mean(1)		4.6		LSB
		12-bit setting, maximum(1)		13.3		
		12-bit setting, mean, clocked by RCOSC		10		
		12-bit setting, max, clocked by RCOSC		29		
SINAD (–THD+N)	Signal-to-noise-and-distortion	Single ended input, 7-bit setting(1)		35.4		dB
		Single ended input, 9-bit setting(1)		46.8		
		Single ended input, 10-bit setting(1)		57.5		
		Single ended input, 12-bit setting(1)		66.6		
		Differential input, 7-bit setting(1)		40.7		
		Differential input, 9-bit setting(1)		51.6		
		Differential input, 10-bit setting(1)		61.8		
		Differential input, 12-bit setting(1)		70.8		

(1) Measured with 300-Hz sine-wave input and VDD as reference.

ADC CHARACTERISTICS (continued)

T_A = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Conversion time	7-bit setting		20		µs
	9-bit setting		36		
	10-bit setting		68		
	12-bit setting		132		
Power consumption			1.2		mA
Internal reference VDD coefficient			4		mV/V
Internal reference temperature coefficient			0.4		mV/10°C
Internal reference voltage			1.15		V

CONTROL INPUT AC CHARACTERISTICS

T_A = –40°C to 85°C, VDD = 2 V to 3.6 V.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
System clock, f_{SYSCLK} t_{SYSCLK} = 1/ f_{SYSCLK}	The undivided system clock is 32 MHz when crystal oscillator is used. The undivided system clock is 16 MHz when calibrated 16-MHz RC oscillator is used.	16		32	MHz
RESET_N low duration	See item 1, Figure 1. This is the shortest pulse that is recognized as a complete reset pin request. Note that shorter pulses may be recognized but do not lead to complete reset of all modules within the chip.	1			µs
Interrupt pulse duration	See item 2, Figure 1.This is the shortest pulse that is recognized as an interrupt request.	20			ns

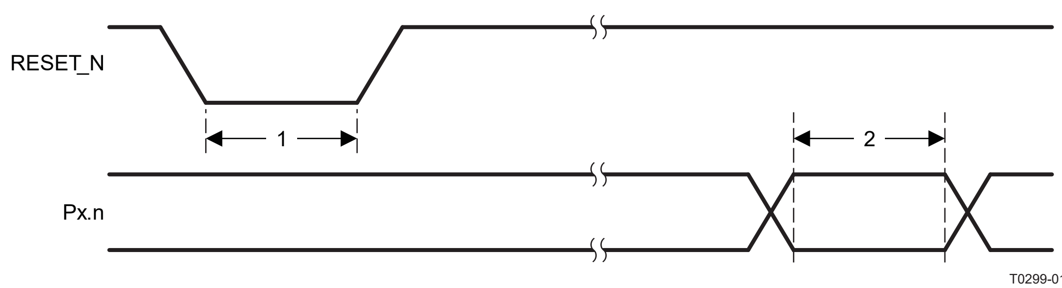


Figure 1. Control Input AC Characteristics