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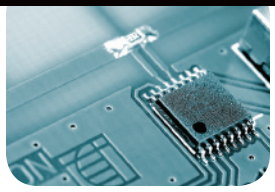
IA4231/32

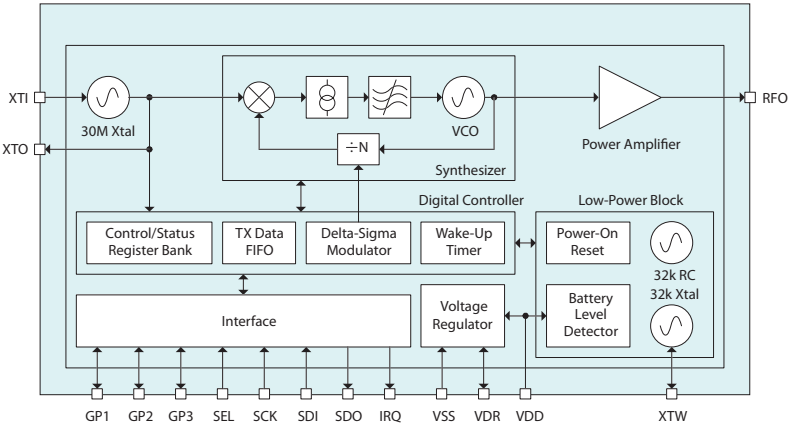
Universal FSK/GFSK/OOK Transmitter



DESCRIPTION

Integration's IA4231 and IA4232 transmitters are members of the new EZRadioPRO™ product family. While retaining all the attractive features of the earlier products such as high integration, low cost, flexibility, low BOM and easy design-in, they are targeted to more sophisticated applications and offer several enhanced parameters and features including output power up to +20 dBm. They provide continuous frequency coverage from 240MHz to 960MHz. When used in any one of the standard ISM bands which fall within this range, the devices comply with the relevant FCC and ETSI requirements if a properly designed antenna matching and filter network is used. Apart from this, only a 30MHz crystal and supply bypass capacitors are necessary as external components, making the devices ideal for high volume production in applications where size and cost are important. At the application level, the built-in features like wake-up timer, low battery detector, transmit data FIFO, power-on reset circuit and general purpose digital I/Os simplify the task of the system designer and allow the usage of lower end microcontrollers.

FUNCTIONAL BLOCK DIAGRAM



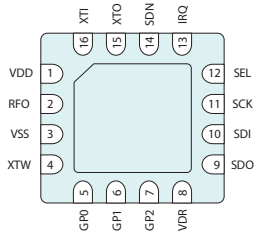
PRODUCT FEATURES

- Fully integrated: low BOM, easy design-in, no production alignments
- Wide range of operating conditions: supply voltage, temperature, frequency
- Fast settling, high resolution synthesizer: quick turn-on, fast frequency hopping capability
- FSK modulation with accurate, programmable frequency deviation
- Optional watch crystal connection for more accurate timing
- Alternative modes: GFSK for reduced occupied bandwidth, OOK for reduced consumption
- Built-in 64-byte data FIFO: can hold entire packet with retransmit capability
- Automatic preamble, packet header and CRC generation options
- Highly efficient power amplifier with programmable output power
- Programmable, very low current wake-up timer and battery voltage detector

TYPICAL APPLICATIONS

- Remote control
- Home security and alarm
- Wireless PC peripherals
- Toy control
- Remote keyless entry
- Tire pressure monitoring
- Telemetry
- Personal data logging
- Remote meter reading

PIN DIAGRAM



QFN-16

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OPERATING MODES

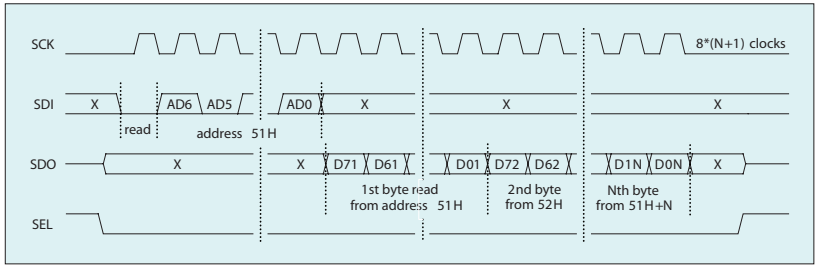
The Operating Modes table on the facing page summarizes the various active and power saving modes, indicating which block(s) are enabled ("ON") in the corresponding mode. These modes can be dynamically selected by sending the appropriate commands over the interface in order to optimize the average current consumption. An exception is the shutdown mode which is controlled by a dedicated input pin. Also this mode is the only one when contents of the control registers and the data FIFO are lost. These contents are retained in all other modes.

An "X" in any cell means that in the given mode that block can be independently programmed to be either "ON" or "OFF", without noticeably affecting the current consumption. The wake-up timer, when enabled, runs from the internal 32.768kHz RC oscillator by default. It can be reprogrammed to use the 32.768kHz crystal if that is available and more accurate timing is necessary.

DIGITAL INTERFACE

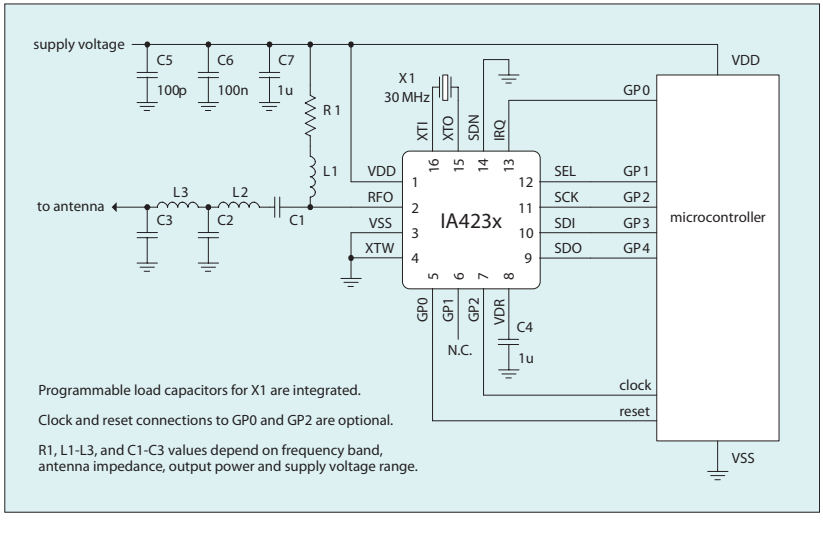
Communication with the device is by means of an SPI compatible 4-wire bidirectional serial interface, with the device always being the slave. All parameters are set using addressable 8-bit control registers. Except when indicated otherwise, registers are read/write. Read-only status registers are provided to access device status information. A write-only pseudo-register and the associated address is used to write data into the transmit FIFO.

Data transfer is byte oriented with MSB first. The first byte of each data packet contains a read/write select bit (MSB) and a 7-bit address field, always sent by the master. Actual data are in the following byte(s). Multiple data bytes can be read/written consecutively, the register address being auto-incremented internally after every 8 data bits. The example to the left shows a block read operation.



APPLICATION EXAMPLE

This is a typical low-BOM configuration, where the wake-up timing accuracy is not critical so no watch crystal is connected. The microcontroller does not need a dedicated crystal either as clock is provided by the radio device. Transmit data are sent over the SPI interface using the FIFO and the internal baud rate generator. This minimizes the number of connections and only 5 microcontroller port pins are used. Moreover, GP1 on the radio device is free for any application level utilization.



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OPERATING MODES

MODE	VOLTAGE REGULATOR	WAKE-UP TIMER	BATTERY DETECTOR	30 MHZ OSCILLATOR	SYNTHESIZER	POWER AMPLIFIER
Shutdown	OFF	OFF	OFF	OFF	OFF	OFF
Standby	ON	OFF	OFF	OFF	OFF	OFF
Sleep	ON	ON	X	OFF	OFF	OFF
Idle	ON	X	X	ON	OFF	OFF
Tuning	ON	X	X	ON	ON	OFF
Transmit	ON	X	X	ON	ON	ON

OPERATING CONDITIONS

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
V_{DD}	Supply voltage (referenced to ground pad potential)	1.8	3.3	3.6	V
T_{OP}	Operating ambient temperature	-40	+25	+125	°C

DC CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS / NOTES			MIN	TYP	MAX	UNIT
I_{DD}	Supply current	Transmit mode at full power and V_{DD}=3.3V	IA4231 (+13dBm)	FSK modulation		21		mA
				OOK modulation		14*		mA
			IA4232 (+20dBm)	FSK modulation		60		mA
				OOK modulation		37*		mA
		Tuning mode				7	8.5	mA
		Idle mode				0.25	0.4	mA
		Sleep mode		Excluding leakage		0.6	1	µA
		Standby mode				0.3	0.5	µA
		Shutdown mode (leakage)		At T_{OP} = +25°C		1	100	nA
				Over T_{OP} range			4	µA
V_{LB}	Low battery detect voltage	Nominal value (programmable in 0.05V steps)			1.75		3.25	V
		Accuracy (relative to nominal)			-2.5		2.5	%

** Note: Supply current using OOK modulation is depicted as an average value when transmitting an equal number of ones and zeros.*

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AC CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS / NOTES		MIN	TYP	MAX	UNIT
f_{OUT}	Frequency range	Low band, frequency resolution 156.25 Hz		240		480	MHz
		High band, frequency resolution 312.5 Hz		480		960	MHz
P_{OUT}	Maximum output power	Using optimal matching network Can be scaled back in 3 dB steps	IA4231		+13		dBm
			IA4232		+20		dBm
f_{REF}	Reference frequency	Using parallel resonance crystal			30		MHz
t_{SX}	Reference startup time	Crystal with C0=5 pF, RS=50 ohm, C_{LOAD}=18 pF				1	ms
t_{SP}	PLL startup time	Crystal oscillator running, excluding lock time			55		µs
t_{SET}	PLL settling time	After 1 MHz frequency step			30		µs
Δf_{FSK}	FSK deviation	Programmable in 625 Hz steps		0		159	kHz
BR	Modulation data rate			0		128	kb/s
P_{SPR}	Spurious emission	Frequency offset from carrier (absolute value)	< 1MHz			-50	dBc
			> 1MHz			-70	dBc
L_{OUT}	Output phase noise		100kHz		-85		dBc/Hz
			1MHz		-110		dBc/Hz
Δt_{WK}	Wake-up timer accuracy	RC oscillator, calibrated at actual temperature		-0.25		+0.25	%
f_{SPI}	Interface clock frequency			0		10	MHz
f_{CLK}	Microcontroller clock output frequency	Fast clock, 30MHz/N, N=1,2,3,7.5,10,15,30		1		30	MHz
		Slow clock, can be used in sleep mode as well			32.768		kHz

Note: Total startup time from standby or sleep to transmit is $t_{SX} + t_{SP} + t_{SET}$

transmitter

INTEGRATION

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