# 2.4GHz GFSK/MSK/2-FSK/OOK TRANSCEIVER MODULE

Description

- OS-TR2.4PA is a highly integrated multi-channel RF Transceiver designed for low-power wireless application in the 2.4GHz Industrial Scientific Medical(ISM)band
- Very small footprint TR2.4PA comes in a 30X12mm,8pin through hole and SMD post card pin out
- OS-TR2.4PA has many powerful digital features allow building a high-performance RF system using an inexpensive microcontroller
- Wake-on-radio functionality for automatic low-power RX polling
- Very low power consumption.(RX:62.2mA,TX:94.3mA @21dBm output power)
- Burst mode data transmission with high over-the-air data reduces current consumption
- Fast start-up times reduce average current consumption. Excellent radio performance
- Programmable data rate from1.2-500kbps
- Robust solution with excellent selectivity and blocking performance
- Programmable output power up to +21dBm
- Ideal for multi-channel operation (50-800KHz channels)
- Full packet handling including preamble generation, sync word insertion/detection, address check, flexible packet length and automatic CRC.
- Programmable Carrier Sense indicator and digital RSSI output enables adaptive channels selection with increased robustness of the communication link
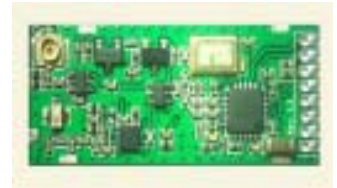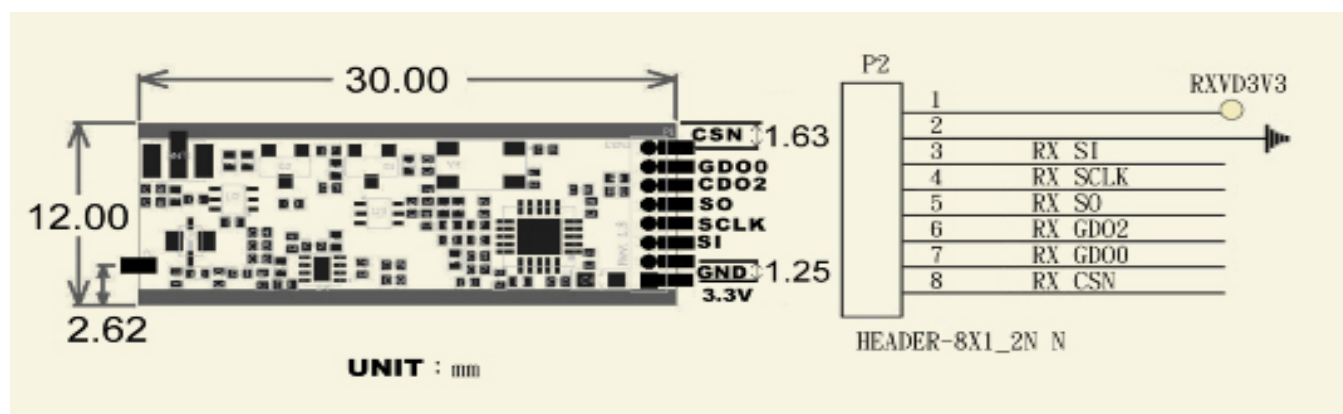
Features:

- SPI interface for configuration and data communication. Configuration data retained in power down
- Full packet handling including preamble generation, sync word insertion/detection, address check, flexible packet length and automatic CRC
- Separate 64-byte RX and TX data FIFOs for burst mode data transmission. No limit on packet length during transmission
- Programmable Carrier Sense indication and digital RSSI output
- Optional Forward Error Correction with interleaving, for enhanced link reliability and reduced need to retransmit packets
- Optional data whitening/dewhitening
- Programmable receiver channel filter bandwidth
- Very fast start-up time from power down (0.5ms) saves power consumption
- Ideal for frequency hopping systems due to a fast setting frequency synthesizer.
  (hop time of100us)
- GFKS,2-FSK,MSK AND OOK Support
- Programmable Preamble Quality Indicator for detecting preambles and improved protection against sync word detection in random noise
- Support for automatic Clear Channel Assessment (CCA) makes the ST-TR2.4PA ideal for Listen-Before-Talk (LBT) systems
- Support for per-packaged Link Quality Indication
- Support for asynchronous transparent receive/transmit mode for backwards compatibility with existing radio communication protocols
- In a typical system, the TR2.4PA will be used together with a Silicon Labs microcontroller
- Reference designs compliant with ETSIEN 300 400(Europe), FCC CFR47, Part 15(US), and
- ARIB STD-T66(JAPAN)
- RoHS compliant
- Wake-up-radio functionality for automatic low power RX polling

Application:

- Remote controller
- Wireless game controllers
- Sport and leisure equipment
- Consumer electronics
- Wireless audio

Mechancial Dimension

Pin Descriptions

Pin No	Pin Name	Pin Type	Description
1	VCC	Power	1.8V-3.6V digital power supply for digital I/O's and for the digital core voltage regulator
2	GND	Ground	GND
3	RX SI	Digital Input	Serial configuration interface, data input
4	RX SCLK	Digital Input	Serial configuration interface, clock input
5	RX SO	Digital Output	Serial configuration interface, data output. Optional general output pin when CSN is high
6	RX GDO2	Digital Output	Digital output pin for general use: • Test signals • FIFO status signals • Clear Channel Indicator • Clock output, down-divided from • Serial output RX data
7	RX GDO0	Digital I/O	Digital output pin for general use: • Test signals • FIFO status signals • Clear Channel Indicator • Clock output, down-divided from XOSC • Serial output RX data • Serial input TX data Also used as analog test I/O for prototype/production testing
8	RX CSN	Digital Input	Serial configuration interface, chip select

2 Absolute Maximum Ratings

Under no circumstances must the absolute maximum ratings given in Table 1 be violated. Stress exceeding one or more of the limiting values may cause permanent damage to the device.
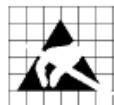
Caution! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.

Parameter	Min	Max	Units	Condition
Supply voltage	−0.3	3.6	V	All supply pins must have the same voltage
Voltage on any digital pin	−0.3	VDD+0.3, max 3.6	V	
Voltage on the pins RF_P, RF_N and DCOUPL	−0.3	2.0	V	
Input RF level		TBD	dBm	
Storage temperature range	−50	150	°C	
Solder reflow temperature		260	°C	T = 10 s
ESD		2	kV	All pads (excluding RF) have 2kV HBM ESD protection

Table 1: Absolute Maximum Ratings

3 Operating Conditions

The operating conditions for OS-TR2.4G are listed Table 2 in below.

Parameter	Min	Max	Unit	Condition
Operating temperature	−40	85	°C	
Operating supply voltage	1.8	3.6	V	All supply pins must have the same voltage

Table 2: Operating Conditions

4 Electrical Specifications

Tc = 25°C, VDD = 3.0V if nothing else stated. Measured on Chipcon's **CC2500** EM reference design.

Parameter	Min	Typ	Max	Unit	Condition
Current consumption		8.7		µA	Automatic RX polling once each second, using low-power RC oscillator, with 460Hz filter bandwidth and 250kbps data rate, PLL calibration every 4th wakeup. Average current with signal in channel *below* carrier sense level.
		35		µA	Same as above, but with signal in channel *above* carrier sense level, 1.9ms RX timeout, and no preamble/sync word found.
		1.4		µA	Automatic RX polling every 15th second, using low-power RC oscillator, with 460kHz filter bandwidth and 250kbps data rate, PLL calibration every 4th wakeup. Average current with signal in channel below carrier sense level.
		16		µA	Same as above, but with signal in channel *above* carrier sense level, 14ms RX timeout, and no preamble/sync word found.
		1.8		mA	Only voltage regulator to digital part and crystal oscillator running (IDLE state)
		7.6		mA	Only the frequency synthesizer running (after going from IDLE until reaching RX or TX states, and frequency calibration states)
		15.6		mA	Receive mode, input near sensitivity limit (RX state)
		13.3		mA	Receive mode, input 30dB above sensitivity limit (RX state)
		11.5		mA	Transmit mode, –12dBm output power (TX state)
		15.4		mA	Transmit mode, -6dBm output power (TX state)
		21.6		mA	Transmit mode, 0dBm output power (TX state)
Current consumption in power down modes		180		µA	Voltage regulator to digital part on, all other modules in power down (XOFF state)
		100		µA	Voltage regulator to digital part off, register values retained, XOSC running (SLEEP state with MCSM0.OSC_FORCE_ON set)
		900		nA	Voltage regulator to digital part off, register values retained, low-power RC oscillator running (SLEEP state with WOR enabled)
		500		nA	Voltage regulator to digital part off, register values retained (SLEEP state)

Table 3: Electrical Specifications

5 General Characteristics

Parameter	Min	Typ	Max	Unit	Condition/Note
Frequency range	2400		2483.5	MHz	
Data rate	1.2		500	kbps	Modulation formats supported: (Shaped) MSK (differential offset QPSK, up to 500kbps) 2-FSK (up to 250kbps) OOK/ASK (up to 250kbps) Optional Manchester encoding (halves the data rate).

Table 4: General Characteristics

6 RF Receive section

Parameter	Min	Typ	Max	Unit	Condition/Note
Differential input impedance		200		Ω	Optimised for matching to both 50Ω single-ended load and PCB antennas with higher impedance.
Receiver sensitivity		TBD		dBm	500kbps data rate (MSK), 1% packet error rate, 16 bytes packet length, 650kHz digital channel filter bandwidth.
		−88		dBm	250kbps data rate (2-FSK), 1% packet error rate, 16 bytes packet length, 460kHz digital channel filter bandwidth.
		−98		dBm	10kbps data rate (2-FSK), 1% packet error rate, 16 bytes packet length, 232kHz digital channel filter bandwidth.
Saturation		−15		dBm	
Digital channel filter bandwidth	58		650	kHz	User programmable. The bandwidth limits are proportional to crystal frequency (given values assume a 26.0MHz crystal).
Adjacent channel rejection		20-25 (TBD)		dB	Desired channel 3dB above the sensitivity limit. Depends on channel spacing and digital channel filter bandwidth.
Alternate channel rejection		25-35 (TBD)		dB	Desired channel 3dB above the sensitivity limit. Depends on channel spacing and digital channel filter bandwidth.
Image channel rejection		30 (TBD)		dB	Desired channel 3dB above the sensitivity limit. Depends on intermediate frequency (IF), channel spacing and digital channel filter bandwidth. Image channel rejection can be limited by adjacent channel rejection or alternate channel rejection when using low IF (<100kHz). Optimum IF depends on data rate and related chip configurations provided by SmartRF® Studio software.
Selectivity at 1MHz offset		−27		dB	Desired channel at −80dBm.
Selectivity at 2MHz offset		−27		dB	Desired channel at −80dBm.
Selectivity at 5MHz offset		−36		dB	Desired channel at −80dBm. Compliant to ETSI EN 300 440 class 2 receiver requirements.
Selectivity at 10MHz offset		−51		dB	Desired channel at −80dBm. Compliant to ETSI EN 300 440 class 2 receiver requirements.
Selectivity at 20MHz offset		−54		dB	Desired channel at −80dBm. Compliant to ETSI EN 300 440 class 2 receiver requirements.
Selectivity at 50MHz offset		−55		dB	Desired channel at −80dBm. Compliant to ETSI EN 300 440 class 2 receiver requirements.
Spurious emissions			−57	dBm	25MHz – 1GHz
			−47	dBm	Above 1GHz

Table 5: RF Receive Section

7 RF Transmit Section

Tc = 25°C, VDD = 3.0V if nothing else stated. Measured on Chipcon's *CC2500* EM reference design.

Parameter	Min	Typ	Max	Unit	Condition/Note
Differential load impedance		200		Ω	Optimised for matching to both 50Ω single-ended load and PCB antennas with higher impedance.
Output power, highest setting		1		dBm	Output power is programmable. Delivered to 50Ω single-ended load via Chipcon reference RF matching network.
Output power, lowest setting		−30		dBm	Output power is programmable. Delivered to 50Ω single-ended load via Chipcon reference RF matching network.
Adjacent channel power		−26		dBc	The given values are for 1MHz channel spacing (±1MHz from carrier) and 500kbps MSK.
Alternate channel power		−45		dBc	The given values are for 1MHz channel spacing (±2MHz from carrier) and 500kbps MSK.
Spurious emissions			−36	dBm	25MHz – 1GHz
			−54	dBm	47-74, 87.5-118, 174-230,470-862MHz
			−47	dBm	1800MHz-1900MHz (restricted band in Europe)
			−41	dBm	At 2·RF and 3·RF (restricted bands in USA)
			−30	dBm	Otherwise above 1GHz

Table 6: RF Transmit Parameters

Remark:

1. About Detail Specifications, Please check with CC2500 Data sheet .(www.chipcon.com)
2. Any inquiry for the sample code, please feel free to contact with (marketing@summitek.com.tw)