

Product Bulletin

TRF6900/TRF4900 – Highly Integrated ISM-Band RF Solutions

A new family of low-power ISM band RF devices from Texas Instruments (TI) gives designers the ability to combine highly integrated RF functionality with other TI products to create advanced designs for a wide range of end applications. The challenge was to develop an RF

solution that incorporated a very fast, frequency-hopping, spread spectrum enabler, while keeping the external component count to a minimum and allowing for the greatest design flexibility. With these key concepts in mind as well as providing a low-power solution, TI developed the



Key Features

TRF6900 single-chip UHF transceiver and TRF4900 single-chip transmitter:

- 850 to 950 MHz operating range
- FSK/FM operating mode
- Low power consumption due to ultra-fast turn-off/turn-on times (<1 ms)
- On-chip fully programmable DDS synthesizer with 230-Hz frequency resolution
- VCO and reference oscillator enable fast, frequency-hopping, spread spectrum enabler
- Programmable LNA and power amplifier
- Fully integrated RSSI and data slicer
- Easily integrates with any DSP or microcontroller platform
- Easy-to-use due to application reports, schematics, Gerber files, evaluation kits and optional design support from third parties

TRF6900 and TRF4900, fully integrated transceiver and transmitter parts.

The TRF6900, a low-power transceiver operating from 850 to 950 MHz is an ideal solution for portable wireless communication systems. Another device, the TRF4900, provides the same low-power features in a transmitter only function.

Both devices have an integrated direct digital synthesizer (DDS), voltage-controlled oscillator (VCO) and reference oscillator that enable channelized systems. The fully programmable low-power DDS system provides a very fine frequency resolution of 230 Hz with virtually instantaneous phase-continuous switching of frequencies.

The TRF6900 is a single-chip 850 to 950 MHz UHF transceiver with operating modes that include Frequency Shift Keying (FSK) and narrowband FM, along with integrated features such as a DDS, VCO, PLL and data slicer, which greatly simplify frequency hopping in spread-spectrum designs. In addition, the TRF6900 integrates an adjustable transmit power amplifier (PA) to provide the necessary output power level needed. The TRF6900 is designed for low-power operation to ensure long battery life for wireless applications such as security systems, barcode readers, utility metering equipment and toys. Designers can program a micro-controller or processor to selectively turn on or off each

major functional block. In addition, the transceiver features ultra-fast system turn-on and turn-off times to keep battery drain at a minimum as well as a received signal strength indicator (RSSI) to “wake-up” the processor. The TRF6900 consumes a typical 0.5 μ A in standby mode and operates from a 2.2- to 3.6-V power supply. By keeping the external component count low, the single-chip integration makes it possible to reduce system complexity and cost. For systems that do not require a microcontroller, the TRF6900 can be used as a stand-alone radio frequency device.

The TRF4900 is a highly integrated ISM-band transmitter with

quick switching times that make it well suited for battery-powered applications such as remote controllers, security systems and toys. The TRF4900 can be used either as a transmitter or solely for its DDS functionality as a local oscillator source. The single-chip transmitter operates down to 2.2 V and is designed to maximize low-power consumption. With a typical frequency resolution of 230 Hz, the TRF4900 functions in both narrowband and wideband applications. In addition, it offers two fully programmable operation modes that allow extremely fast switching between two pre-programmed settings. The ability to separately power the PA, as well as the versatility to select one of three attenuation modes, adds to the flexibility of this part in wireless applications.

The diagram illustrates the internal architecture of the TRF6900, a monolithic IC. Key components include:

- RF Front-End:** LNA (Low Noise Amplifier), RF Amplifier Buffer, RF Mixer, and 1st IF Amplifier.
- Baseband Processor:** 2nd IF Amplifier/Limiter, RSSI (Receive Signal Strength Indicator), and FM/FSK Demodulator.
- Power Section:** PA (Power Amplifier) and PLL (Phase-Locked Loop) with VCO (Voltage-Controlled Oscillator).
- Control and Logic:** Direct Digital Synthesizer and Power-Down Logic, and Serial Interface.

The pinout is as follows:

Pin	Function
1	LNA_GND
2	LNA_IN
3	LNA_GND
4	PA_VCC
5	PA_OUT
6	PA_GND
7	PLL_GND
8	PD_SET
9	PD_OUT2
10	PD_OUT1
11	LOCKDET
12	PLL_VCC
13	VCO_TANK 1
14	VCO_TANK 2
15	DDS_GND
16	STDBY
17	MODE
18	DDS_VCC
19	TX_DATA
20	DIG_VCC
21	DIG_GND
22	GND
23	XOSC1
24	XOSC2
25	STROBE
26	CLOCK
27	DATA
28	DATA_OUT
29	S&H_CAP
30	AMP_OUT
31	AMP_CAP
32	AMP_IN
33	RSSI_OUT
34	DEM_TANK
35	DEM_TANK
36	DEM_VCC
37	VREF
38	DEM_GND
39	IF2_IN
40	IF_GND
41	IF1_OUT
42	IF1_IN
43	MIX_GND
44	MIX_OUT
45	MIX_VCC
46	MIX_IN
47	LNA_OUT
48	LNA_VCC

Mixed-Signal RF Family Selection Guide

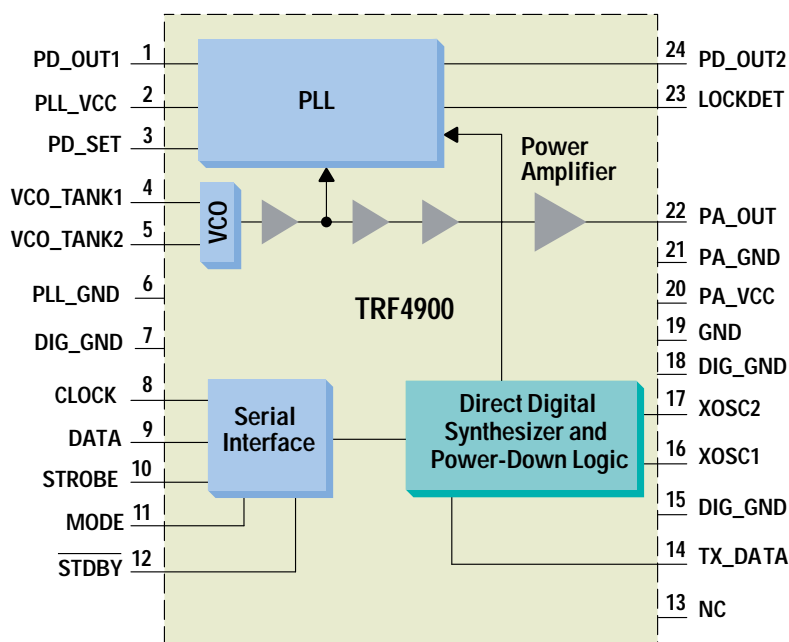
Part Number (Operation Frequency)	Function	Current Consumption STDBY Active*		Output Power	DDS	Transmit	DDS Lock Time Standby Standby to Rec to Xmit		Package
TRF6900 (850 to 950 MHz)	Transceiver	0.5 μ A	21 mA	4.5 dBm	Yes	FM/FSK	600 μ s	500 μ s	48-pin PQF
TRF4900 (850 to 950 MHz)	Transmitter	2 μ A	22 mA	5 dBm	Yes	FM/FSK	N/A	500 μ s	24-pin TSSOP
TRF4400 (433 MHz)	Transmitter	0.5 μ A	22 mA	7 dBm	Yes	FM/FSK	N/A	500 μ s	24-pin TSSOP

*PA set to 20-dB attenuation

TRF6900 and TRF4900 Key Benefits

- High-performance, channelized system offering a bi-directional RF data link in a reliable frequency band
- Digital FSK and FM modulation modes
- Single-chip transceiver integration lowers the total system cost, increases reliability and simplifies design
- Integrated VCO and power amplifier
- Data rates exceeding 100 Kbps
- Programmable on-chip DDS provides precision frequency control and fast channel hopping (spread spectrum)
- Ultra-fast system turn-on and turn-off times offer a quick response time and low power consumption by allowing the device to remain in standby mode longer
- No external adjustment points required, which lowers production costs
- Using dual varactor configuration, can operate from 850 to 950 MHz by S/W programming and no external component changes

TRF4900 Transmitter Block Diagram



Ultra-Low-Power Microcontroller/Processors and RF Solutions

The flexibility, low external component count and no required adjustment points of the TRF6900 and the TRF4900 enable cost-effective integration with TI's MSP430 ultra-low-power microcontrollers, speech chips or DSPs. By combining the devices with these processors, customers can design a wide variety of leading-edge wireless applications such as, utility metering, data logging, smart toys, home networking, remote controllers and security systems.

MSP430 and TRF6900/TRF4900 Chipset — Two Chips Provide a Low-Power Solution

The MSP430 generation of microcontrollers is designed

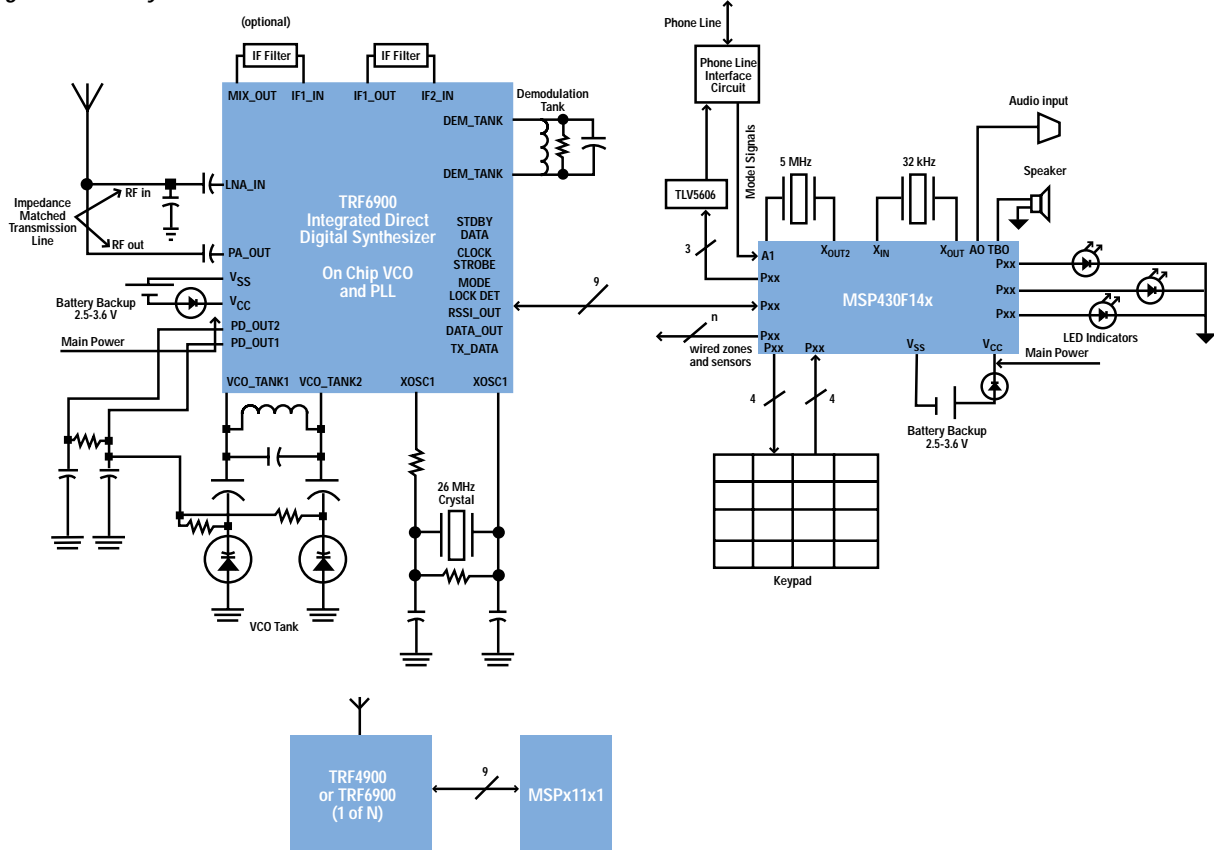
for an unmatched ratio of ultra-low-power operation and high performance — a critical capability for demanding RF applications. The MSP430 features a 16-bit RISC core with a performance of up to eight million instructions per second (MIPS), which is much more powerful than standard 4- and 8-bit microcontrollers. The MSP430 is designed with a highly orthogonal structure. The device complements this high performance with ultra-low power consumption of just 250 μA in active mode, 0.8 μA in standby mode and 0.1 μA in shutdown mode. In addition, the MSP430's very fast 6 μs wake-up time further assists in system power management.

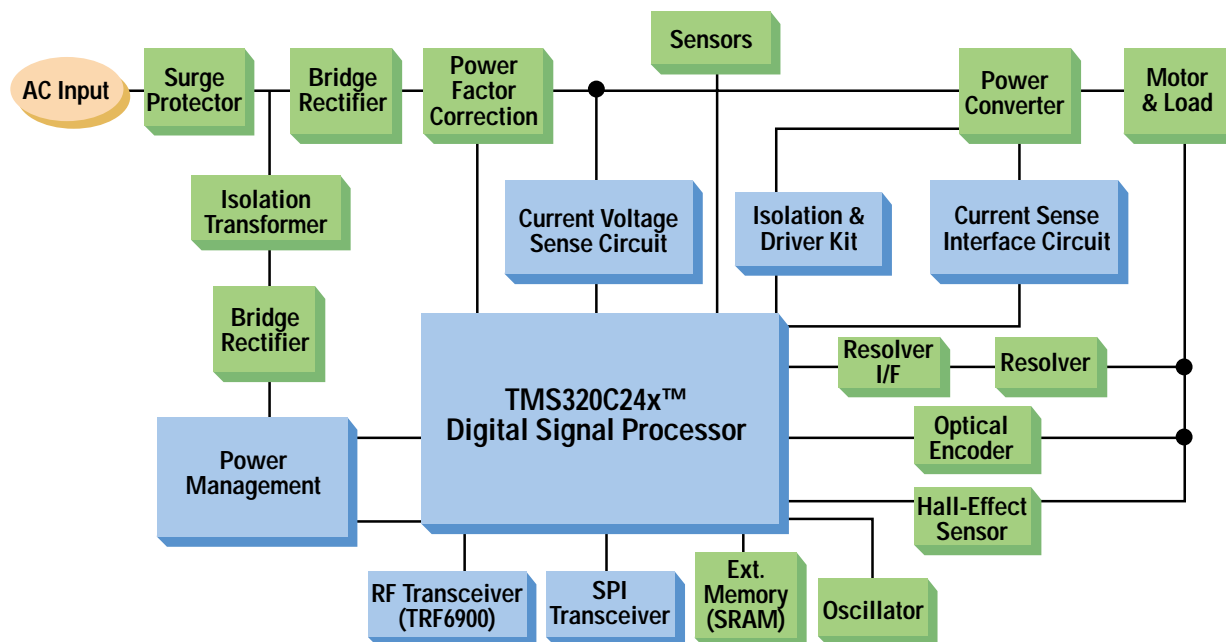
The MSP430 devices control all settings of the RF device through a simple parallel digital interface and can process and generate the

TRF6900/MSP430 benefits

- Operation in the 850 to 950 MHz band
- Fast Received Signal Strength Indicator (RSSI) for fast carrier sense detection and microcontroller wake-up
- Easy-to-use because of high integration, resulting in low external component count
- Total system solution for low system cost
- Low power consumption for longer battery life (0.5 μA typical standby current for the TRF6900A and 1.3 μA for the MSP430)
- Fully programmable operating modes and frequency control
- Ready to use MSP430 software baseband routines

High End Security Panel





received or transmitted data. The MSP430 can switch the TRF6900 into standby or shutdown mode to reduce power consumption, while consuming virtually no power of its own. In addition to this core performance, devices in the family are available with a wide range of integrated peripheral options, including various configurations of Flash memory, a 14-bit analog-to-digital converter (ADC), liquid crystal display (LCD) driver, universal synchronous asynchronous receiver transmitter (USART) and several different timer configurations. For more information on the MSP430 please visit the website at: www.ti.com/sc/msp430

To assist designers with TRF6900/TRF4900 applications, TI provides extensive support materials, including a TRF6900/MSP430 Evaluation Kit, schematics, software utilities, MSP430 software routines, datasheets, application notes and examples to program the TRF6900 to setup a complete RF link.

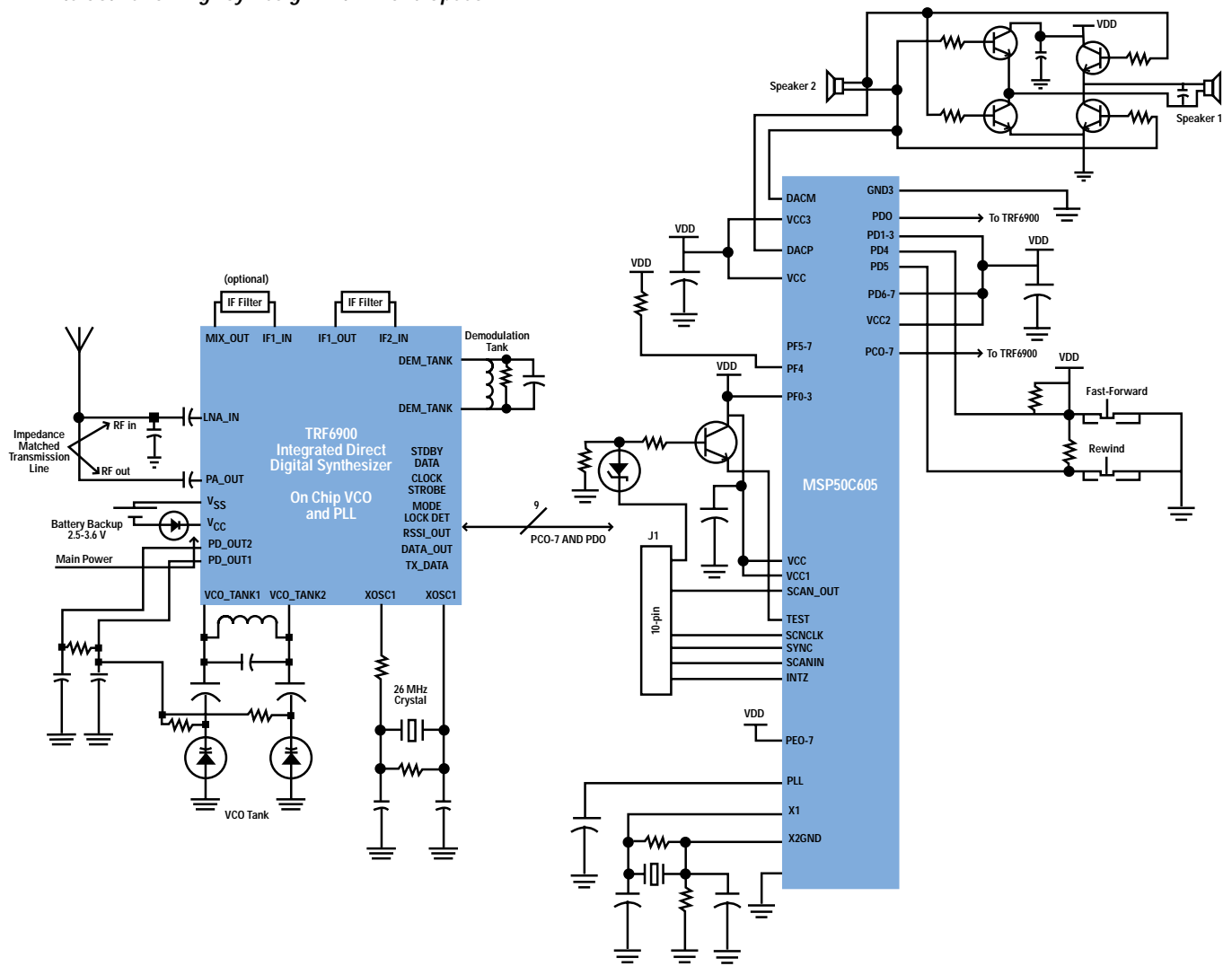
DSP and RF Solutions — TMS320VC54120 and TRF6900/TRF4900

Reduced system power, component count and time-to-market are vital success indicators in the fast-moving wireless market. By combining the TRF6900 or TRF4900 with TI's industry-leading DSPs, designers can successfully address all of these concerns. The TMS320C5000™ DSP platform and TRF6900/TRF4900 platforms provide the optimal combination of high performance signal processing functions, peripheral options, and small packaging. With a roadmap to power consumption as low as 0.05 mW/MIPS and performance up to 800 MIPS, the C5000™ platform is optimized for MIPS-intensive, power-sensitive next-generation wireless applications.

As part of the C5000 family, the TMS320VC5402 fixed-point, DSP is ideal for low-power, high-

performance applications. The processor offers very low power consumption and the flexibility to support various system voltage configurations. The wide range of I/O voltages enable it to operate with a 1.8-V single power supply or with dual power supplies for mixed-voltage systems. This feature eliminates the need for external level shifting and reduces power consumption in emerging sub-3 V systems.

Low power consumption is critical for applications at both the low and high ends of the performance spectrum, such as motor control, audio, medical and high-quality voice. Many of the single-channel, frequency-hopping, spread spectrum systems that will be served by the C5402 and TRF6900/TRF4900 operate off portable batteries. Low-power dissipation is imperative for prolonging battery life from hours to weeks for these systems.



At the high end, where the performance capabilities of the C5421 are needed, multi-channel systems with highly dense circuitry often pack many DSPs in a small area. Low-power DSPs help assure the reliability of these systems by limiting the heat generated by the components and reducing the need for complex thermal dissipation schemes.

TI's integrated performance enable comprehensive wireless DSP solutions, which reduce system power consumption, component count and time-to-market.

Speech and RF Solutions

TI is the world leader in speech synthesis solutions, giving manufacturers the ability to cost-effectively give a voice to their products. TI speech synthesis products allow designers to cut cost and size by using smaller and fewer devices. Customers can choose from three speech-processing methods, including Linear Predictive Coding (LPC), Mixed Excitation Linear

Prediction (MELP) and Codebook Excited Linear Prediction (CELP) to produce natural sounding speech while using a relatively small amount of memory.

By combining TI speech synthesis products with the TRF6900 or TRF4900 RF devices, designers can add wireless voice to their applications using cost-effective components from TI.

Start Your Design Today With TI Development Tools

TI offers a range of TRF6900 and TRF4900 development tools to help speed designs to market. These include:

TRF6900/MSP430 Evaluation Kit, (MSP-EVKTRF6900; European version or MSP-US-TRF6900; U.S. version)

For designers who want to begin design with the TRF6900 and the MSP430 immediately, TI offers the TRF6900/MSP430 chipset Evaluation Kit (EVK). The easy-to-use Windows®-based software offers programming of the evaluation board via the MSP430P112 in module-oriented or binary code windows. The board connects directly to a PC's serial port and can give an introduction to the chipset. The EVK can also be used to custom program the TRF6900 chips for individual performance tests.



TRF6900/MSP430 Evaluation Kit

The TRF6900/MSP430 Evaluation Kit contents:

- PC-based evaluation board containing the TRF6900 and the MSP430P112
- TRF6900 Windows-based evaluation software
- MSP430 software baseband subroutines and examples for programming the TRF6900
- Documentation and application notes for the TRF6900 and MSP430x11

TRF6900 or TRF4900 Evaluation Kit, TRF6900EVM or TRF4900EVM

For designers who wish to interface to their own microcontroller or processor design and evaluate the RF functionality of the TRF6900 or TRF4900 two additional evaluation modules have been developed.

TRF6900 EVM



The TRF6900 Evaluation Module (TRF6900EVM) contents:

- PC-based evaluation board containing the TRF6900
- TRF6900 Windows-based evaluation software
- Documentation and application notes for the TRF6900 as well as schematics and Gerber files

TRF4900EVM Module



The TRF4900 Evaluation Module (TRF4900EVM) contents:

- PC-based evaluation board containing the TRF4900
- TRF4900 Windows-based evaluation software
- Documentation and application notes for the TRF4900 as well as schematics and Gerber files

For More Information

RF is becoming more and more important to differentiate applications with value-added features. The TRF6900 and TRF4900 from TI give designers a cost-effective and simplified way to add this valuable capability.

If you would like to learn more about how TI and the TRF6900 and/or TRF4900 can set your system apart, call your regional TI Product Information Center. Or you'll find more information on the TRF6900 and TRF4900 at: www.ti.com/sc/msrf

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