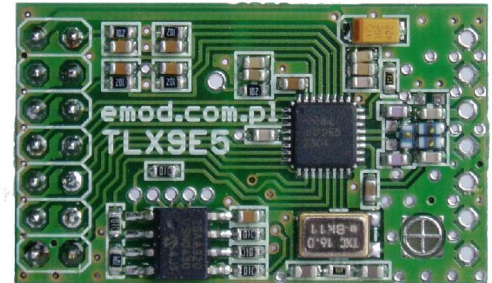


## 433/868/915MHz RF Transceiver with Embedded 8051 Compatible Microcontroller and 4 Input, 10 Bit ADC

TLX9E5 is a true single chip system with fully integrated RF transceiver, 8051 compatible microcontroller and a 4-input 10bit 80ksps AD converter. The transceiver of the system supports all the features available in the nRF9E5 chip including Shockburst™, which automatically handles preamble, address and CRC. The circuit has embedded voltage regulators, which provides maximum noise

immunity and allows operation on a single 1.9V to 3.6V supply. By embedding all high speed signal processing related to RF protocol in the transceiver, the internal RF parts offers the microcontroller a simple SPI interface. Data rate is decided by the interface-speed the micro controller itself sets up. By allowing the digital part of the application to run at low speed, while maximizing the data rate on the RF link, the nRF9E5 ShockBurst™ mode reduces the average current consumption in applications. In ShockBurst™ receive mode, Address Match (AM) and Data Ready (DR) notifies the MCU when a valid address and payload is received respectively. In ShockBurst™ transmit mode, the nRF9E5 automatically generates preamble and CRC. Data



Ready (DR) notifies the MCU that the transmission is completed. All together, this means reduced memory demand and more available resources in the MCU, as well as reduced software development time.

### FEATURES

- 433/868/915 MHz transceiver
- 8051 compatible microcontroller
- 4 input, 10bit 80ksps ADC
- Single 1.9V to 3.6V supply
- Small (33,5 x 20,0 mm) package
- Internal VDD monitoring
- 2.5µA standby with wakeup on timer or external pin
- Adjustable output power up to 8dBm
- Channel switching time less than 650ms
- Low TX supply current, typical 11mA @-10dBm
- Low RX supply current typical 12.5mA peak
- Low MCU supply current, typ. 1mA at 4MHz @3volt
- Suitable for frequency hopping
- Carrier Detect for "listen before transmit protocol"

### APPLICATIONS

- Sports and leisure equipment
- Industrial sensors
- Alarm and security system
- Remote control
- Surveillance
- Automotive
- Telemetry
- Keyless entry
- Toys

## Basic Parameters

### RF Part

Operating frequency	433 MHz, 868MHz / 915 MHz
Modulation	GFSK
Frequency deviation	±50 kHz
Output power	-12...8 dBm (software adjustable)
Antenna	50 ohm single ended
Effective data rate	50 kbit/s
Sensitivity, BR=50kbit/s, BER<0,1%	-100 dBm
Channel spacing @ 433MHz	100 kHz
Supply voltage	1,9 - 3,6 V
Supply current in receive mode	12,5 mA
Supply current @ 10dBm output power	30 mA
Supply current @ -10dBm output power	11 mA

### CPU

Core	8051 (4-clock core)
Clock frequency	0,5...16,0 MHz
Program memory	4 kB
Data memory	128B + 128B
Current consumption (0,5 MHz)	0,125 mA
Current consumption (16,0 MHz)	4,0 mA
High drive sink current for P06, P04, P02 and P00 @ VOL = 0.4V	10 mA
High drive source current for P07, P05, P03 and P01 @ VOH = VDD-0.4V	10 mA
Peripherals	ADC, PWM, UART, WDT, LF clock, RTC Wakup timer

### AD converter

Resolution	10 bits
Internal reference	1,22 V
Internal reference voltage drift	100 ppm/°C
Reference voltage input (external ref)	0,8...1,5 V
Conversion rate (Conversion rate is dependant on resolution)	83,3 kHz @ 10 bit
Supply current ADC operation	1,0 mA

### Mechanical dimensions / Pin Out

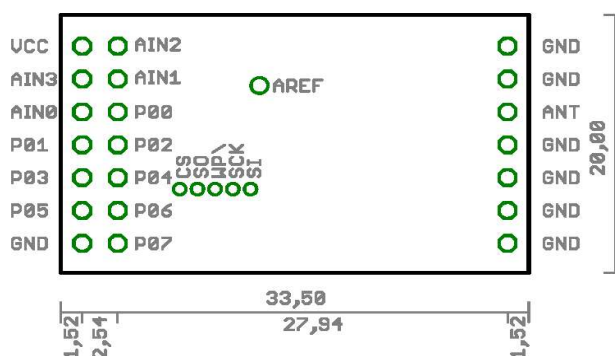


Fig. 1 TLX9E5 (top view). All dimensions are in millimeters

## Pin Description

Description	Function
GND	Ground (0V)
+VCC	Power supply 1,9...3,6 V
P00...P07	GPIO pins (P00...P07)
AIN0...AIN3	ADC inputs
AREF	ADC External Reference Voltage
ANTENNA	Ready for single ended 50 ohm antenna
CS	SPI interface for EEPROM programming (only for programming, it is not recommended to use this pins for other SPI devices)
SO	
WP	
SCK	
SI	

## Software tools

Because the TLX9E5 microcontroller is instruction set compatible with the industry standard 8051 all standard '51 software tools can be used. Some limitations occur with software simulators as instruction timing is slightly different from the industry standard, typically each instruction will use from 4 to 20 clock cycles, compared with 12 to 48 for the "standard". Additionally SFRs and peripherals specific for TLX9E5 are not implemented in simulators.

## Program Format in External EEPROM

Before downloading \*.bin or \*.hex files generated by linker must be modified. Bootloader implemented in TLX9E5 expects additional data in a few first bytes of EEPROM according to format presented in the following table

	7	6	5	4	3	2	1	0
0	Version (now 00)		Reserved (now 00)		SPEED	XO_FREQ		
1	Offset to start of user program (N)							
2	Number of 256 byte blocks in user program (includes block 0 that is not full)							
...	Optional User data, not interpreted by boot loader							
...	...							
N	First byte of user program, goes into ERAM at 0x0000							
N + 1	Second byte of user program, goes into ERAM at 0x0001							
...	...							

The contents of the 4 lowest bits in the first byte is used by the boot loader to set the correct SPI frequency. These fields are encoded as shown below:

SPEED (bit 3): EEPROM max speed (TLX9E5 supports both)

0 = 0.5MHz

**1 = 1MHz**

XO\_FREQ (bits 2,1 and 0): Crystal oscillator frequency. It must be 011 for TLX9E5.

000 = 4MHz,

001 = 8MHz,

010 = 12MHz,

011 = 16MHz,  
100 = 20MHz

The program eeprep.exe (available on [www.nvlsi.no](http://www.nvlsi.no) and [www.emod.com.pl](http://www.emod.com.pl)) can be used to add this header to a program file. Command format:

**eeprep [options] <infile> <outfile>**

<infile> is the output file of an assembler or compiler

<outfile> is a file suitable for programming the EEPROM (above format with no user data).

Both files are "Intelhex" format. For the TLX9E5 there is no need to specify non default values with option switches. The options available for eeprep are:

-c n Set crystal frequency in MHz. Valid numbers are 4, 8, 12, 16 (default), 20

-i Ignore checksums

-p n Set program memory size (default 4096 bytes)

-s Select slow EEPROM clock (500KHz). Default when omitted is 1MHz

## Hardware tools (EEPROM programmers)

Any standard EEPROM programmer which supports 25AA320 SPI memory and 3V levels can be used to program EEPROM on TLX9E5. Be careful - low cost programmers, even switched to low voltage memory still fed 5V. 25AA320 memory installed on TLX9E5 will survive but radio chip will be destroyed. The best way is to check voltages on all pins in programmer's socket with oscilloscope before you connect it with TLX9E5. Necessary connections between programmer and TLX9E5 are shown in table below.

25AA320 pin	1	2	3	4	5	6	7	8
Function	CS\	SO	WP\	Vss	SI	SCK	HOLD\	Vcc
TLX9E5	CS\	SO	WP\	GND	SI	SCK	NC	Vcc

## Ordering Information

Ordering code	Operating frequency	Connector configuration
TLX9E5-433-S	433 MHz	straight pins
TLX9E5-433-R	433 MHz	right angled pins for vertical mountings
TLX9E5-868-S	868 / 915 MHz	straight pins
TLX9E5-868-R	868 / 915 MHz	right angled pins for vertical mountings

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