PMICRO
Powerlink Microelectronics

PL51WT020

Low Power High Performance ADC/Touch Key 2.4GHz RF SOC

Product Description:

PL51WT020 is an optimized true low power high performance 2.4GHz wireless system-on-chip (SOC) solution with data rates up to 1Mbps built with low bill-of-material cost, which is designed for operation in the world wide ISM frequency band at 2.400~2.4835GHz. With the flexible configurable options integrated, PL51WT020 offers a reliable and easy way of implementing touch keys, ADC, multi-function combinations for their product applications.

PL51WT020 combines the excellent performance of a leading 2.4GHz RF transceiver with a single-cycle enhanced 8051 compliant CPU, 4KB in-system programmable flash memory, 128B EEPROM data memory, 256B RAM, up to 15 General-Purpose I/O pins and many other powerful features.

This single chip wireless transceiver integrated including: RF synthesizer, Power Amplifier, Crystal Oscillator, Modem and etc.

With built in FHSS and accurate digital RSSI, this transceiver achieves a good capability of anti-interference, so that, it can work under every complicated environment with high performance.

It also support address and data check out; FEC, CRC function; and Auto-Ack & Auto-Resend function.

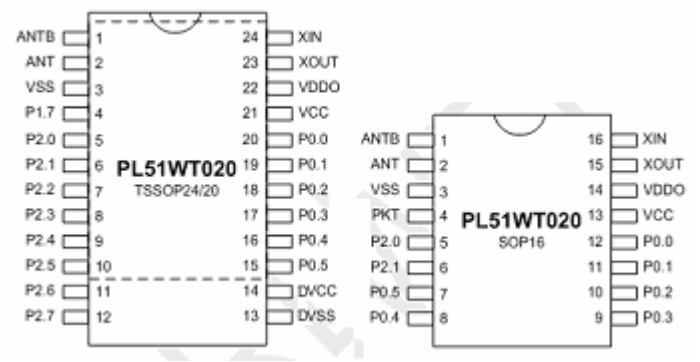
The output power of the chip can be set up to 5.5dBm and the receive sensitivity can achieve -88dBm.

The 680K resistor and two 15pF capacitances are built in for 12MHz RF Crystal Oscillator.

The 10K pull-down resistor is built in for ANT and ANTB antenna.

PL51WT020 is communicating with the outside world with UART, I2C and SPI interfaces.

Pin Configuration:



Key Features:

- 2.4GHz RF Flash 8051 SOC
- Built in Hardware Link Layer
- Built in Accurate Digital RSSI
- Support Auto-Ack and Auto-Resend Functions
- Built in Address and Data Checkout, FEC, CRC Functions
- Data Rate over the air：1Mbps
- Support HFSS
- 12MHz RF Crystal Oscillator
- Support Micro-Strip Inductor and Two Layer PCB Boards
- Fully integrated up to 9+4(shift) touch keys
- CPU Operation Freq.@Voltage: ~4MHz@2.0~3.6V; ~8MHz@2.4~3.6V; ~12MHz@2.7~3.6V
- Operation Temperature: -40℃ ~+85℃
- Supports Crystal Oscillator, internal 32KHz and high precision RC oscillator(4/8/12MHz,±2%), external clock input
- Up to 15 bidirectional GPIO
- Three 16-bit Timers/Counters
- Four 12-bit PWM: PWM0/1/2/3
- Support UART/SPI/I2C interface
- Integrated 11-bit 8 channels ADC
- Package: SOP16, TSSOP20/24
- Flash Cycling: 100K @25℃
- EEPROM Cycling: 500K @25℃
- Data retention: 40 years @25℃

Applications:

- Proprietary 2.4GHz Systems
- Wireless Mice, Keyboards and Game Controllers
- RF Remote Controller
- Home and Commercial Automation

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Product Types

Product Name	Package	Program Flash	Data EEPROM*5	RAM	Timer	PWM	Freq@Voltage	I/O	Interface UART/SPI/I2C	ACMP	T.S.	Touch Key*1 /Wakeup(Max)	ADC*1
Touch Key with RF Series													
PL51WT020	TSSOP24	4KB	128B	256B	3	4+1	~ 4M@2.0~3.6V	15	1/1/1	1*4	1	9+4*3/9	11b/8ch
	TSSOP20	4KB	128B	256B	3	4+1	~ 8M@2.4~3.6V	13	1/1/1	1*4	1	7+4*3/5+4	11b/6ch
	SOP16	4KB	128B	256B	3	4+1	~12M@2.7~3.6V	8	1/1/1	-	1	2+4*2/6	11b/2ch

Note: *1: Touch Key can't work with ADC at the same time, but can be set to work separately at different time slice.

*2: Shift Touch Keys <15:12> can be assigned as the touch keys <15:12> with wake-up function.

*3: Shift touch keys <15:12> or Original ones can be set to work separately at different time slice. Only Shift touch keys <15:12> or Original ones can be assigned as wake-up keys, separately.

*4: ACMP source, only between CMP1 and INTVREF (1.2V).

*5: In order to ensure that the Data EEPROM can be programmed stably, the LVR needs to be enabled and set to work greater than or equal to 2.4V(≥).

1 Overview

PL51WT020 is an optimized true low power high performance 2.4GHz wireless system-on-chip (SOC) solution with data rates up to 1Mbps built with low bill-of-material cost, which is designed for operation in the world wide ISM frequency band at 2.400~2.4835GHz. With the flexible configurable options integrated, PL51WT020 offers a reliable and easy way of implementing touch keys, ADC, multi-function combinations for their product applications.

PL51WT020 combines the excellent performance of a leading 2.4GHz RF transceiver with a single-cycle enhanced 8051 compliant CPU, 4KB in-system programmable flash memory, 128B EEPROM data memory, 256B RAM, up to 15 General-Purpose I/O pins and many other powerful features.

PL51WT020 also supports three low power modes, idle mode, stop mode and sleep mode, to reduce power consumption. With on chip regulator and advanced power management function, the current consumption in sleep mode can be reduced to nearly 2uA.

PL51WT020 has efficient power modes with RAM retention, making it highly suited for low-duty-cycle systems where ultra low power consumption is required. Short transition times between operating modes further ensure low energy consumption.

This single chip wireless transceiver integrated including: RF synthesizer, Power Amplifier, Crystal Oscillator, Modem and etc.

All of the Output Power, Channel Selection, and Protocol of RF block can be configured through SPI Interface by ET8051 core.

With built in FHSS and accurate digital RSSI, this transceiver achieves a good capability of anti-interference, so that, it can work under every complicated environment with high performance.

It also support address and data check out; FEC, CRC function; and Auto-Ack & Auto-Resend function.

The output power of the chip can be set up to 5.5dBm and the receive sensitivity can achieve -88dBm.

The 680K resistor and two 15pF capacitances are built in for 12MHz RF Crystal Oscillator.

The 10K pull-down resistor is built in for ANT and ANTB antenna.

PL51WT020 internal integrates high precision RC oscillator to operate and switch dynamically between a range of operating modes using different clock sources to optimize microcontroller operation and minimize power consumption.

Special algorithms are employed to reduce the possibility of false detections, increasing the touch switch application reliability under adverse environmental conditions. With auto-calibration, low operating current and low power one-key operating state, PL51WT020 provides a simple and effective means of implementing touch switches in a wide range of applications.

With integrating up to 9+4(shift) flexible touch keys (which including 4 touch keys could be shift from P2.7~P2.4 to P0.0~P0.3), PL51WT020 offers the customers a reliable and easy way of implementing touch keys for the product applications.

For high reliability and low cost issues, PL51WT020 builds in reliable watchdog timer (WDT) low power detect and low voltage reset (LPD/LVR) function.

PL51WT020 is communicating with the outside world with UART, I2C and SPI interfaces.

For easy usage, POWERLINK provides the debugger and writer.

To facilitate programming and verification, the Flash memory inside the PL51WT020 series allow the program memory to be programmed and read electronically. Once the code is confirmed, the user can protect the code for security.

PL51WT020 is targeting at the proprietary 2.4GHz systems such as Human Interface Devices, Wireless Mice, Keyboards and Game Controller, RF Remote Controller, Home and Commercial Automation and etc.

2 Features

RF

- True Low Power High Performance Single Chip 2.4GHz Transceiver
- Built in Hardware Link Layer
- Built in Accurate Digital RSSI
- Support Auto-Ack and Auto-Resend Functions
- Built in Address and Data Checkout, FEC, CRC Functions
- Data Rate over the air：1Mbps
- Support HFSS
- Support Micro-Strip Inductor and Two Layer PCB Boards
- Built-in 680K resistor and two 15pF CAP for 12MHz RF Crystal Oscillator
- Built-in 10K pull-down resistor for ANT and ANTB antenna

Basic

- 1T 8-bit ET8051 compatible with MCS-51
- Fully integrated up to 9+4(shift) touch key functions with no external components
- CPU core Operation Frequency@Voltage: ~4MHz@2.0~3.6V; ~8MHz@2.4~3.6V; ~12MHz@2.7~3.6V
- Operation Temperature: -40℃ to +85℃
- CPU core Oscillator Type:
  - ✧ Crystal Oscillator: 400KHz to 12MHz
  - ✧ Internal RC Oscillator: 4/8/12MHz (±2%) and 32KHz
  - ✧ External Clock: ~12MHz
- Up to 15 bidirectional General Purpose I/O
  - ✧ Input-Only with configurable pull high resistor
  - ✧ Push-Pull Output Drive Capacity: 10mA (@3V, Total: <100mA)

Peripheral Features

- Four Priority Levels with 14 interrupt sources
  - ✧ Two External Interrupt: INT0B and INT1B
  - ✧ T0&T1 Overflow Interrupt
  - ✧ T2 Overflow, Reload, Compare/Capture Interrupt
  - ✧ UART Transmit and Receive Interrupt
  - ✧ EEPROM Write Finished Interrupt
  - ✧ Analog Comparator Interrupt
  - ✧ Keyboard Interrupt
  - ✧ Touch Key Interrupt
  - ✧ SPI Interrupt
  - ✧ I2C Interrupt
  - ✧ ADC Finish Converting Interrupt
- POR/LVR/LPD support
- Two LVR threshold Level by Fuse: 2.1/2.4V

- LPD threshold Level by Fuse: 2.7V
- Register Timed Access Protection
- Programmable System Clock
- Multi-mode Operation: Normal/Idle/Stop/Sleep
- 16-bit Timers/Counters:
  - ✧ 80C51-like Timer 0 & 1
  - ✧ 8052-like Timer 2 with Compare/Capture Unit (CCU)
- Four 12-bit PWM: PWM0/1/2/3
- Watchdog Timer with Additional Configurable Prescaler: WDT
- UART/SPI/I2C Interface
- Analog Digital Converter: ADC
  - ✧ 11-bit resolution
  - ✧ Up to 8 multiplexed channels
  - ✧ support scan mode & continuous converting
  - ✧ support external input VREF
- Analog Comparator: ACMP
- Support In-Circuit Programming: ICP
- ESD: >2KV (HBM)
- EFT: >4KV
- Package Types: SOP16, TSSOP20/24

Memory

- 4K bytes Program Flash
- 128 bytes Data EEPROM（byte/page operation, 1page=32bytes)
- 256 bytes internal scratch-pad RAM
- Memory Programming Permission Control
- Flash Cycling: 100K @25℃
- EEPROM Cycling: 500K @25℃
- Data retention: 40 years @25℃

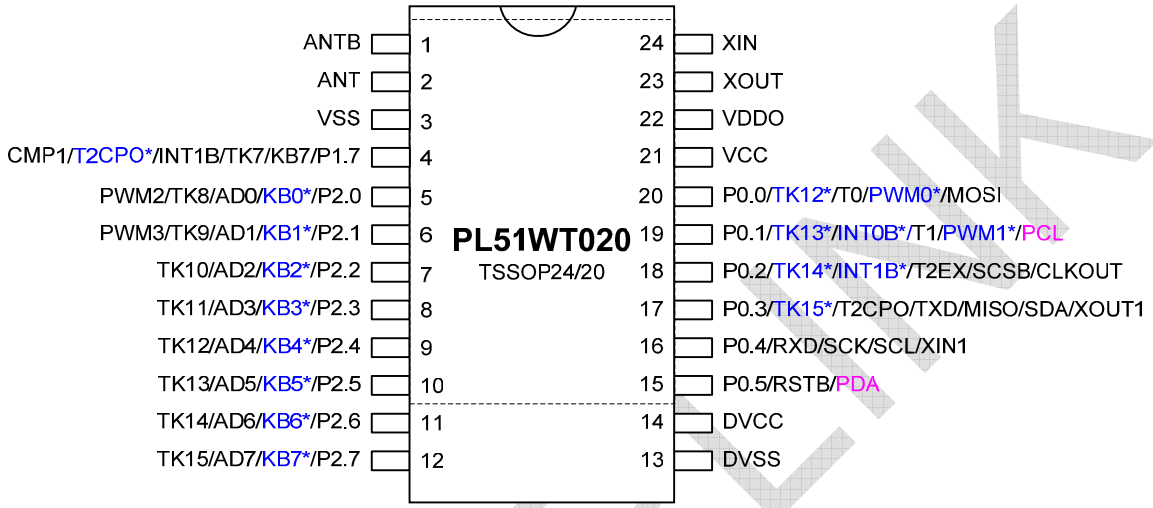
3 Quick Reference Data

Parameter	Value	Units
Min Supply Voltage	2.0	V
Max Output Power	3.3	dBm
Data Rate	1	Mbps
Current Consumption (0dBm) @TX Mode	16	mA
Current Consumption @RX Mode	17	mA
Operating Temperature Range	-40 to +85	℃
RX Sensitivity	-88	dBm
RF Crystal Oscillator	12	MHz
CPU core Internal RC OSC Frequency	4/8/12	MHz
CPU core Internal RC OSC Precision	±2	%
Current Consumption @ Sleep Mode	2	uA

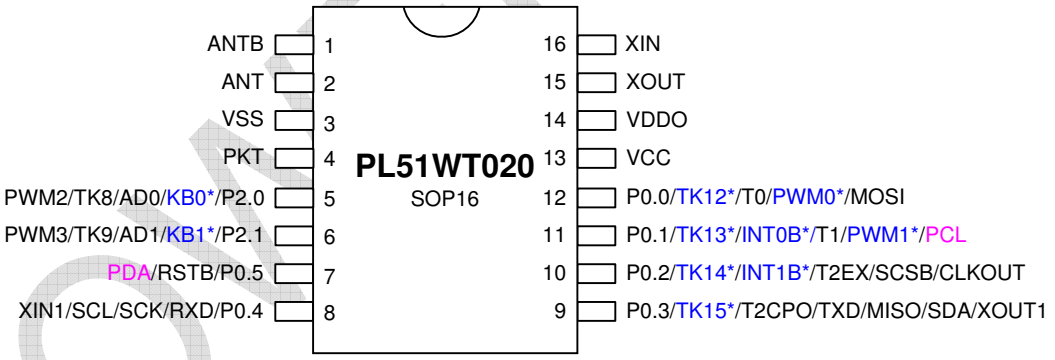
4 Pin Configurations

4.1 Pin Diagrams

The pin map is shown as below for TSSOP24/20 pins.



The pin map is shown as below for SOP16 pins.



Note : *The outside pin function has the highest priority, and the inner pin function has the lowest priority. It means that if the higher priority function is enabled, the lower priority function can't be used even when the lower priority function is also enabled. The pin name colored blue with * denoted the shift ports, the pin function available only when the relative shift control bit in SFR "PSFT0~1" is set.*

4.2 Pin Description

Classify	Symbol	Type	Descriptions
Power	VCC	Power	Power Supply (2.0~3.6V)
	VSS	Power	Ground (0V)
	DVCC	Power	Power Supply (2.0~3.6V)
	DVSS	Power	Ground (0V)
	VDDO	Power	1.8V power output, connect to capacitor
RF Block	ANTB	RF	Antenna Interface
	ANT	RF	Antenna Interface
	XIN	Analog Input	12MHz Crystal Oscillator Input of RF
	XOUT	Analog Output	12MHz Crystal Oscillator Output of RF
	PKT	Digital Output	Transmit/Receive Packet Status Indicator Bit
RF Block Interface	P1.0	Digital Input	Interface of RF block SPI.SDO output
	P1.1	Digital Output	Interface of RF block SPI.SDI input
	P1.2	Digital Output	Interface of RF block SPI.SCK input
	P1.3	Digital Output	Interface of RF block SPI.SCSB input
	P1.4	Digital Input	Interface of RF block FIFO Flag output FIFO Status Indicator Bit
	P1.5	Digital Output	Interface of RF block RSTB input
	P1.6	Digital Input	Interface of RF block PKT Flag output Transmit/Receive Packet Status Indicator Bit
Ext Reset	RSTB	Digital Input	Reset Pin of CPU core, Active Low
Clock	XIN1	Analog Input	Crystal Oscillator Input of CPU core
	XOUT1	Analog Output	Crystal Oscillator Output of CPU core
	CLKOUT	Digital Output	Internal Clock Output of CPU core
UART	RXD	Digital Input	RXD of Serial Port
	TXD	Digital Output	TXD of Serial Port
SPI	MISO	Digital I/O	Master input slave output
	MOSI	Digital I/O	Master output slave input
	SCK	Digital Output	SPI clock output
	SCSB	Digital Output	SPI CS output, active low
I2C	SDA	Digital I/O	I2C data line

Classify	Symbol	Type	Descriptions
	SCL	Digital I/O	I2C clock line
Timer0	T0	Digital Input	Timer 0 Input
Timer1	T1	Digital Input	Timer 1 Input
Timer2	T2 EX	Digital Input	Timer 2 external reload or gate Input
	T2CPO	Digital Output	T2 compare or PWM output
Ext Interrupt	INT0B	Digital Input	External Interrupt 0
	INT1B	Digital Input	External Interrupt 1
PWM	PWM0	Digital Output	PWM 0 Output
	PWM1	Digital Output	PWM 1 Output
	PWM2	Digital Output	PWM 2 Output
	PWM3	Digital Output	PWM 3 Output
ACMP	CMP1	Analog Input	Comparator channel 1 Input
ADC	AD0~7	Analog Input	8 channels AD Input
Touch Key	TK7~15	Analog Input	9 channels Touch Key Inputs
Key Board	KB0~7	Analog Input	8 channels Keyboard Inputs
PORT0	P0.0~P0.5	Digital I/O	General purpose I/O Port 0
PORT1	P1.7	Digital I/O	General purpose I/O Port 1
PORT2	P2.0~P2.7	Digital I/O	General purpose I/O Port 2
ICP	PCL	Digital Input	Clock Input for ICP/ICD Mode
	PDA	Digital I/O	Data I/O for ICP/ICD Mode