PMICRO
Powerlink Microelectronics

PL51T020

Low Power High Performance ADC/Touch Key Flash 8051 MCU

Product Description:

PL51T020 is 8-bit high performance microcontroller with fully integrated touch key functions eliminating the need for external components, 11-bit up to 8 channels ADC and other modules. With the flexible configurable options integrated, PL51T020 offers a reliable and easy way of implementing touch keys, ADC, multi- function combinations for their product applications.

PL51T020 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. The excellent noise immunity and ESD protection ensure reliable operations in the adverse electrical environments.

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, PL51T020 provides a simple and effective means of implementing touch switches in a wide range of applications.

With integrating up to 16 flexible touch keys (which including 4 touch keys could be shift from P2.7~P2.4 to P0.0~P0.3), PL51T020 offers the customers a reliable and easy way of implementing touch keys for the product applications.

For high reliability and low cost issues, PL51T020 builds in reliable watchdog timer (WDT) low power detect and low voltage reset (LPD/LVR) function.

PL51T020 also supports three low power modes, idle mode, stop mode and sleep mode, to reduce power consumption. It supports to be wakeup speedy by touch Key action when work in the low power mode.

For easy usage, POWERLINK provides the debugger and writer.

In-Circuit-Programming (ICP) supports the users to upgrade the program code and data in circuit without removing the microcontroller from the actual application board.

PL51T020 is communicating with the outside world with UART, I2C and SPI interfaces.

Besides the 4K bytes Flash program memory, other memory includes 256 bytes RAM and 128 bytes data EEPROM.

Key Features:

- 1T Enhanced 8-Bit ET8051
- Fully integrated up to 16+4(shift) touch keys
- Operation Frequency@Voltage:
  ~4MHz@2.0~5.5V;
  ~8MHz@2.4~5.5V;
  ~12MHz@2.7~5.5V
- Operation Temperature: -40℃ ~+85℃
- Supports Crystal Oscillator, internal 32KHz and high precision RC oscillator(4/8/12MHz,±2%), external clock input
- Programmable System Clock
- Up to 22 bidirectional GPIO
- Four Priority Levels with 14 interrupt sources
- 8 Keyboard Interrupts
- 2 External Interrupts
- Support POR/LVR/LPD
- Three 16-bit Timers/Counters
- Four 12-bit PWM: PWM0/1/2/3
- Watchdog Timer with Prescaler
- Support UART/SPI/I2C interface
- Integrated Analog Comparator
- Integrated 11-bit 8 channels ADC
- Multi-mode Operation: Normal, Green, Stop, Sleep mode
- Support In-Circuit Programming
- Package: 24/20/16/8 PINs
- Memory Permission Control
- Flash Cycling: 100K @25℃
- EEPROM Cycling: 500K @25℃
- Data retention: 40 years @25℃

Applications:

- Wireless Mice, Keyboards and Game Controllers
- RF Remote Controller
- Small Home Appliances

RoHS GREEN

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 Series													
PL51T020	SSOP24/ QFN24	4KB	128B	256B	3	4+1	~ 4M@2.0~5.5V ~ 8M@2.4~5.5V ~12M@2.7~5.5V	22	1/1/1	1	1	16+4*3/16	11b/8ch
	TSSOP20	4KB	128B	256B	3	4+1		18	1/1/1	1	1	12+4*2/16	11b/4ch
	SOP16/ QFN16	4KB	128B	256B	3	4+1		14	1/1/1	-	1	8+4*2/12	11b/4ch
	SOP8	4KB	128B	256B	3	4+1		6	-	1*4	1	3+2*2/5	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

PL51T020 series are a single-chip microcontroller based on a high performance 1T architecture 80C51 CPU which have a fully compatible instruction set with standard 80C51 series microcontroller, and execute instructions in 1~4 clock cycles (about 7~8 times the rate of a standard 8051 chip), In-Circuit-Programming (ICP) support the users to upgrade the program code and data in circuit without removing the microcontroller from the actual application board. The PL51T020 series have a 22 bi-direction GPIO, a 14-source (including 2 external interrupt sources), 4-priority-level interrupt structure, a fully integrated touch key function without the need for external components.

Special algorithms are employed to reduce the possibility of false touch action identifications, improving the touch key application reliability under adverse environmental conditions. With supporting auto calibration configuration, touch key could be working at a wide range of dynamic capacitance with low power consumption and high sensitivity identification.

With integrating up to 16 flexible touch keys (which including 4 touch keys could be shift from P2.7~P2.4 to P0.0~P0.3), PL51T020 offers the customers a reliable and easy way of implementing touch keys for the product applications.

PL51T020 integrates low and high frequency oscillators to operate and switch dynamically between a range of operating modes using different clock sources to optimize microcontroller operation and minimize power consumption.

PL51T020 is communicating with the outside world with UART, I2C and SPI interfaces. The excellent noise immunity and ESD protection ensure reliable operations in the adverse electrical environments. Besides the flash program memory, other memory includes RAM Data Memory as well as EEPROM memory is integrated.

For high reliability and low cost issues, PL51T020 builds in reliable watchdog timer (WDT) and low power detect (LPD) and low voltage reset (LVR) function. In order to reduce power consumption, PL51T020 could be work in three low power modes, green mode, stop mode and sleep mode, it supports to be wakeup speedy by keyboard action when work in the low power mode.

For easy usage, POWERLINK provides the debugger and writer.

PL51T020 is targeting at home appliance such as Wireless Mice, Keyboards and Game Controllers, RF Remote Controller, Induction cooker, Microwave oven, Washing machine, Clothes dryer, Dishwasher, Refrigerator, Air conditioner and etc.

2 Features

Basic

- 1T 8-bit ET8051 core
- Fully integrated 16 touch key functions with no external components
- Operating Voltage @ Frequency:
  - ~4MHz@2.0~5.5V
  - ~8MHz@2.4~5.5V
  - ~12MHz@2.7~5.5V
- Oscillator Type
  - Crystal Oscillator: 400KHz to 12MHz
  - Internal RC Oscillator: 4/8/12MHz (±2%) and 32KHz
  - External Clock: 400KHz to 12MHz
- Up to 22 bidirectional General Purpose I/O
  - Input-Only with configurable pull high resistor
  - Push-Pull Output Drive Capacity: 20mA (@5V, Total: <100mA)
- Operation Temperature: -40℃ to +85℃

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
- Four LVR threshold Level by Fuse:
  - 2.1/2.4/3.7/4.3 V
- Two LPD threshold Level by Fuse:
  - 2.7/4.0 V
- 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
  - ✓ SOP8/SOP16/TSSOP20/SSOP24
  - ✓ QFN16/QFN24

Memory

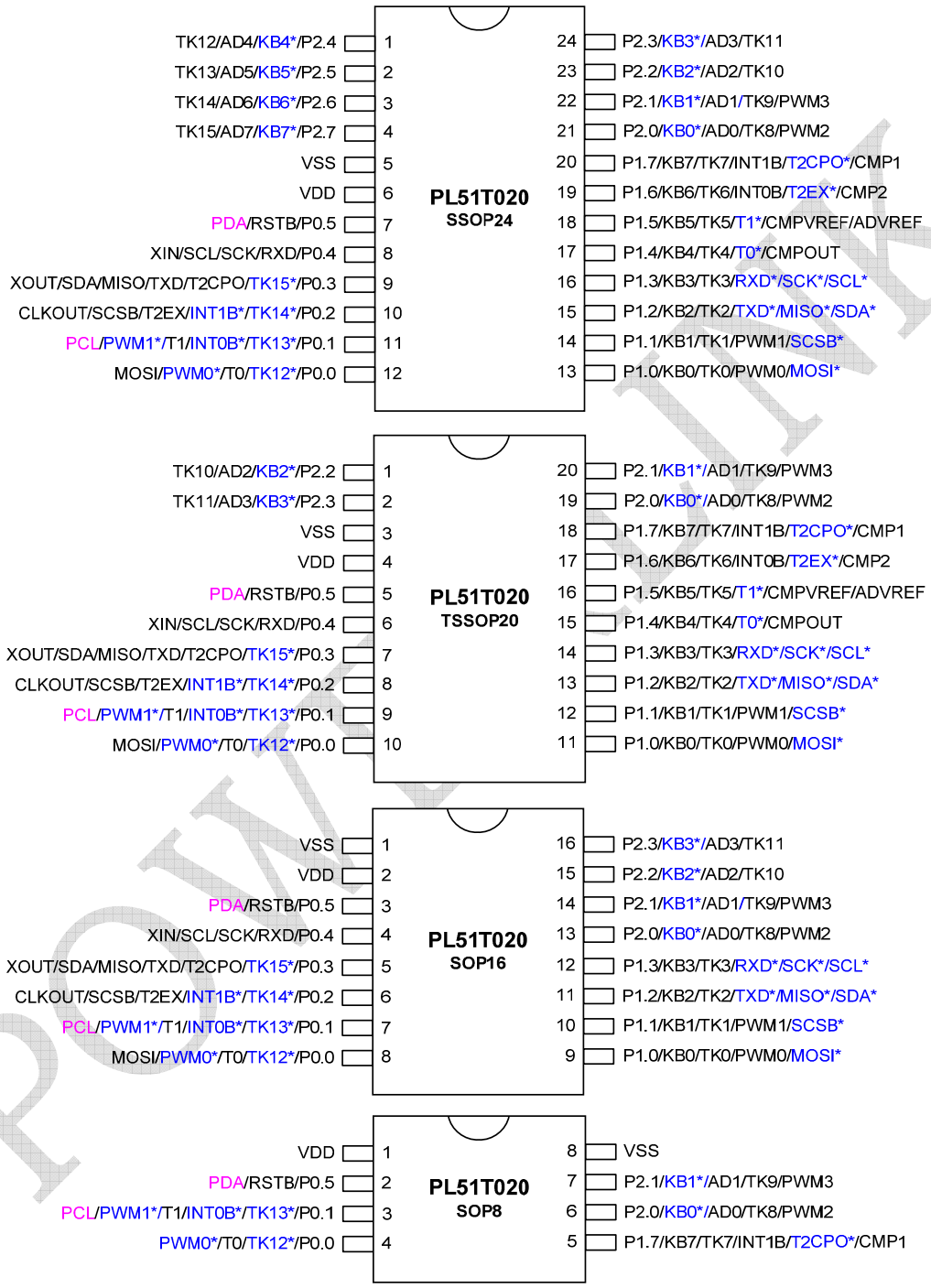
- ✧ 4K bytes Program Flash
- ✧ 128 bytes Data EEPROM（byte/page operation, 1page=32bytes)
- ✧ 256 bytes internal scratch-pad RAM
- ✧ Memory Programming Permission Control
- ✧ Flash Cycling: 100K @25℃
- ✧ EEPROM Cycling: 500K @25℃
- ✧ Data retention: 40 years @25℃

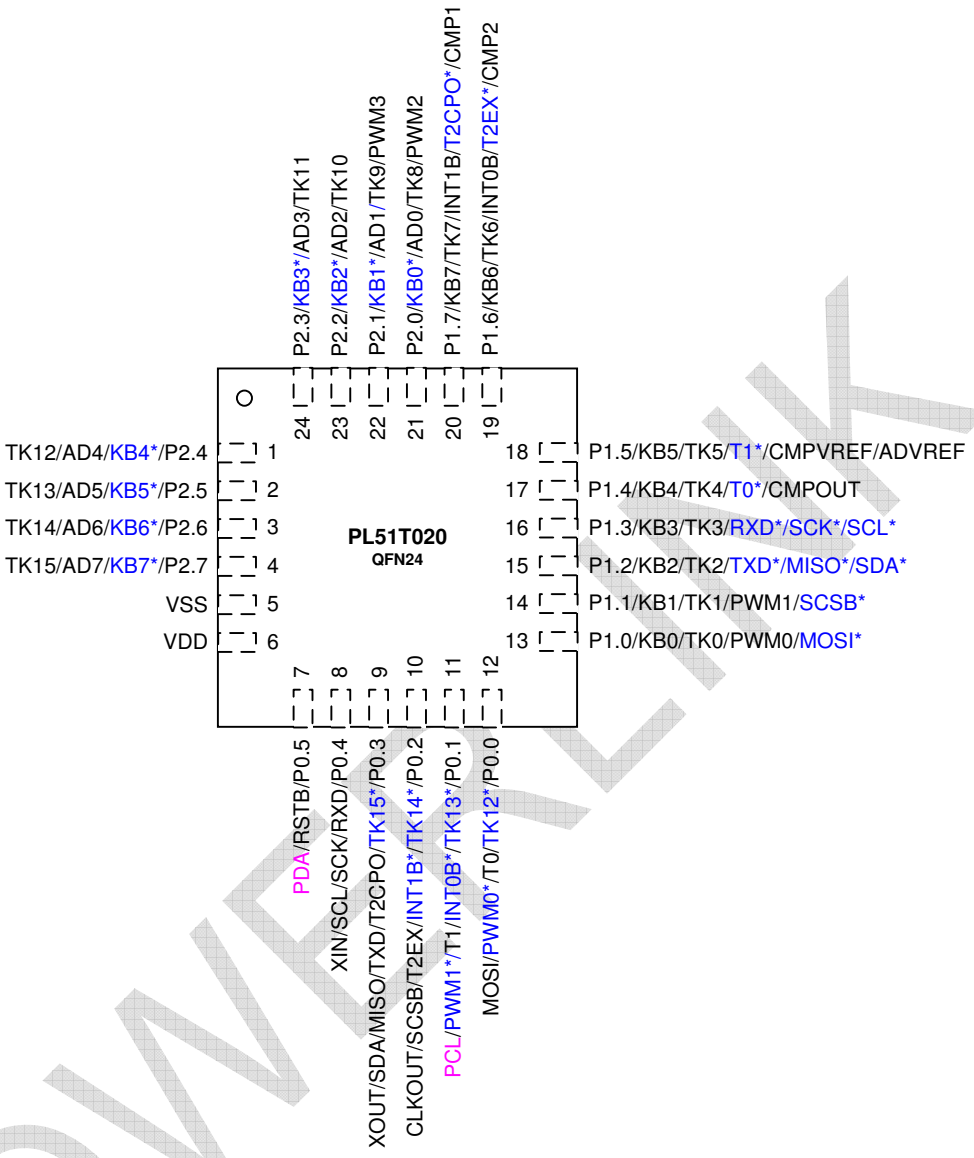
3 Quick Reference Data

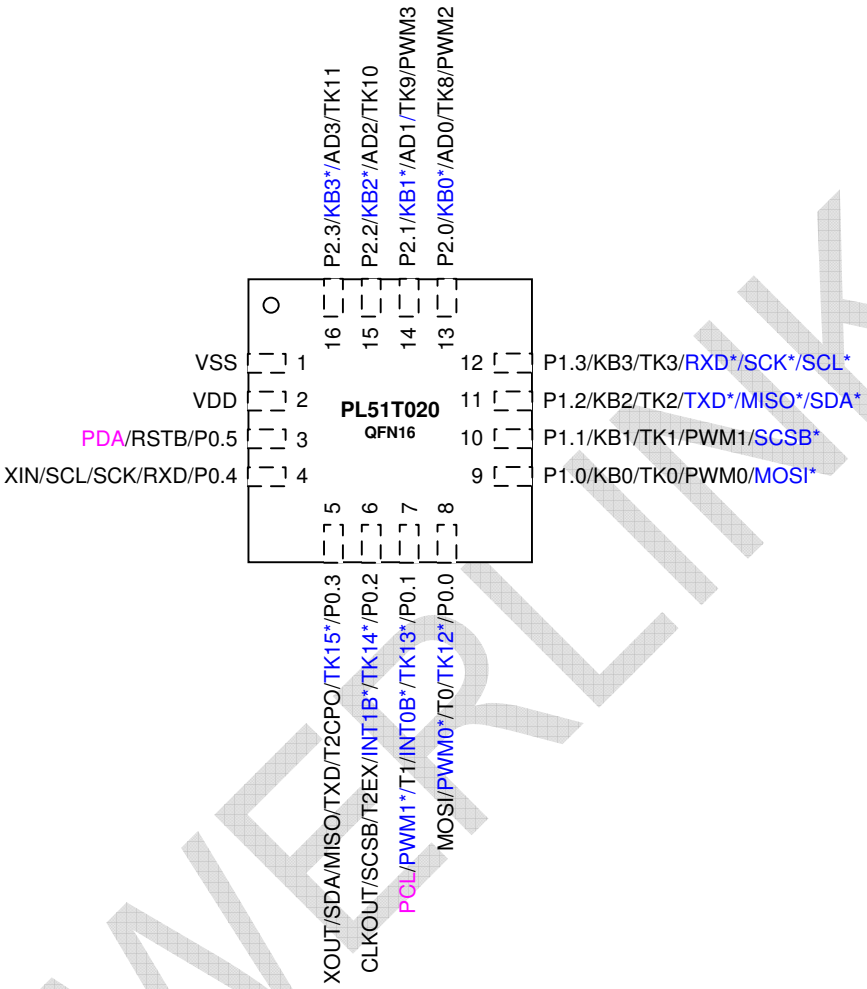
Parameter	Value	Units
Min Supply Voltage	2.0	V
Operating Temperature Range	-40 to +85	℃
Internal RC OSC Frequency	4/8/12	MHz
Internal RC OSC Precision @ 25℃	±2	%
Internal RC OSC Precision @ -40℃~+85℃	±5	%
Push-Pull Output Drive Capacity @ 5V	20	mA
Push-Pull Output Drive Capacity @ 3.3V	10	mA
Total Push-Pull Output Drive Capacity	<100	mA
Current Consumption @ Sleep Mode	1	uA

4 Pin Configurations

4.1 Pin Diagrams




PL51T020
QFN24
1 TK12/AD4/KB4*/P2.4
2 TK13/AD5/KB5*/P2.5
3 TK14/AD6/KB6*/P2.6
4 TK15/AD7/KB7*/P2.7
5 VSS
6 VDD
7 PDA/RSTB/P0.5
8 XIN/SCL/SCK/RXD/P0.4
9 XOUT/SDA/MISO/TXD/T2CPO/TK15*/P0.3
10 CLKOUT/SCSB/T2EX/INT1B*/TK14*/P0.2
11 PCL/PWM1*/T1/INT0B*/TK13*/P0.1
12 MOSI/PWM0*/T0/TK12*/P0.0
13 P1.0/KB0/TK0/PWM0/MOSI*
14 P1.1/KB1/TK1/PWM1/SCSB*
15 P1.2/KB2/TK2/TXD*/MISO*/SDA*
16 P1.3/KB3/TK3/RXD*/SCK*/SCL*
17 P1.4/KB4/TK4/T0*/CMPOUT
18 P1.5/KB5/TK5/T1*/CMPVREF/ADVREF
19 P1.6/KB6/TK6/INT0B/T2EX*/CMP2
20 P1.7/KB7/TK7/INT1B/T2CPO*/CMP1
21 P2.0/KB0*/AD0/TK8/PWM2
22 P2.1/KB1*/AD1/TK9/PWM3
23 P2.2/KB2*/AD2/TK10
24 P2.3/KB3*/AD3/TK11



Note:

1) 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.

2) 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

Symbol	Type	Descriptions
VDD	Power	Power Supply (2.0~5.5V)
VSS	Power	Ground (0V)
RSTB	Digital Input	Reset Pin, Active Low
XIN	Analog Input	Crystal Oscillator Input
XOUT	Analog Output	Crystal Oscillator Output
CLKOUT	Digital Output	Internal Clock Output
SCL	Digital Input	Clock Input for I2C Interface
SDA	Digital I/O	Data I/O for I2C Interface
SCSB	Digital Input	Enable Input for SPI Interface, active Low
SCK	Digital Input	Clock Input for SPI Interface
SDI	Digital Input	Data Input for SPI Interface
SDO	Digital Output	Data Output for SPI Interface (tri-state when not active)
RXD	Digital Input	RXD of Serial Port
TXD	Digital Output	TXD of Serial Port
T0	Digital Input	Timer 0 Input
T1	Digital Input	Timer 1 Input
T2EX	Digital Input	Timer 2 External Capture Input
T2CPO	Digital Output	Timer 2 Compare/PWM Ouput
INT0B	Digital Input	External Interrupt 0
INT1B	Digital Input	External Interrupt 1
PWM0	Digital Output	PWM 0 Output
PWM1	Digital Output	PWM 1 Output
PWM2	Digital Output	PWM 2 Output
PWM3	Digital Output	PWM 3 Output
CMP1	Analog Input	Comparator Positive 1 Input
CMP2	Analog Input	Comparator Positive 2 Input
CMPVREF	Analog Input	Comparator Reference Voltage Input
CMPOUT	Digital Output	Comparator Output
TK0~15	Analog Input	Touch Key Inputs
KB0~7	Analog Input	Keyboard Inputs
P0.0~P0.5	Digital I/O	General purpose I/O Port 0
P1.0~P1.7	Digital I/O	General purpose I/O Port 1
P2.0~P2.7	Digital I/O	General purpose I/O Port 2
PCL	Digital Input	Clock Input for ICP (In Circuit Program) Mode
PDA	Digital I/O	Data I/O for ICP (In Circuit Program) Mode
AD0~AD7	Analog Input	ADC Inputs