PAW3702DL-TXNT: 3in1 SOC Low Power 2.4GHz Wireless Optical Mouse

General Description

The PAW3702 is a high integration integrated circuit (IC) including 2.4GHz RF, MCU and optical mouse navigation engine in a single chip. It is a high performance and low power chip targeting in wireless optical mouse application. This wireless system is operated in 2.4GHz ISM frequency band. To make up a total solution of 2.4GHz optical wireless mouse, the PAR2402 is the 2.4GHz Wireless Receiver chip in the USB dongle to be paired with the PAW3702 in the mouse.

Key Features

- Single chip for 2.4GHz wireless optical mouse
- Integrated 8051 microprocessor
- Built in OTP and SRAM
- GFSK transceiver
- Accurate motion estimation over wide range of surfaces
- High speed motion detection up to 30 inches/sec
- High resolution up to 2000 CPI
- Power saving mode during times of no movement
- Adaptive frame rate control for extra power saving during motion
- Supports outputs up to six buttons (L, M, R, CPI, B4, B5) and three axes (X, Y, Z)
- One LED indicator for Power/CPI/Low battery detection
- Low external BOM

Applications

- Wireless mouse

Key Parameters

Parameter	Value
Temperature range	0°C ~40°C
VDD Supply Voltage	2.1 V ~ 3.6 V
Frequency Band	2403~2479 MHz
TX Output Power	+4/0/-6 dBm
RX Sensitivity	-91dBm
Optical Lens	Normal/Specular lens
Tracking Speed	Up to 30 inches/sec
Acceleration	Up to 10 g
Resolution CPI	800/1000/1200/1600/2000
Frame Rate	Up to 2400 frame/sec
Run Mode Current w/o LED driving @ 2.7v	High Speed: 1.8 mA Medium Speed: 1.8 mA Low Speed: 1.6 mA
Sleep Mode Current w/o LED driving @ 2.7v	Sleep1: 35 µA Sleep2: 21 µA
Power Down Current	15 µA
Low Power Detector Voltage	Two-batteries: 2.2V/ 2.1V/2.0V/1.95V Single-battery: 1.2V/1.1V/1.0V/0.95V
Shutdown Alert Voltage	Two-batteries: 2.1V/2.0V/1.9V/OFF Single-battery: 1.05V/0.95V/0.85V/OFF

Ordering Information

Part Number	Package Type
PAW3702DL-TXNT	iDIP 14

RoHS compliant

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PAR2402QK-RB: 2.4GHz Wireless Receiver for USB Dongle

General Description

The PAR2402 is the 2.4GHz Wireless Receiver chip in the USB dongle to be paired with the PAW3702 in the mouse. It is a SOC with integrated 2.4GHz radio transceiver , microprocessor, USB interface and built-in OTP, MTP and SRAM for design flexibility on custom setting as well as low external BOM. The USB interface is compliance to Universal Serial Bus• spec V2.0 and USB HID spec V1.11 compatibility.

Key Features

- Integrated 8051 microprocessor
- Built in OTP, MTP and SRAM
- Supply MTP settings for customer application
  - PID, VIP, PSTR
  - Wakeup mode
  - Sensor Angle
  - CPI
  - Low battery indicator voltage
  - Sensor's sleep entry time and frequency
- GFSK transceiver
- Full speed USB2.0 compliant on PAR2402 chip
- Low external BOM

Applications

- Wireless Transceiver

Key Parameters

Parameter	Value
Temperature range	0°C ~40°C
VDD Supply Voltage	4 V ~ 5.25 V
Frequency Band	2403~2479 MHz
TX Output Power	+4/0/-6 dBm
RX Sensitivity	-91dBm
Current on Normal mode	23.5 mA
Current on Suspend mode	2 mA

Ordering Information

Part Number	Package Type
PAR2402QK-RB	QFN32 5x5x1mm

RoHS compliant

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1.0 Introduction

1.1 Overview

The PAR2402 chip in the USB dongle can receive command and echo status or data format from the mouse. The USB interface in PAR2402 is compliance to Universal Serial Bus• spec V2.0 and USB HID spec V1.11 compatibility.

The Figure 1 shows the architecture block diagram of the PAR2402 respectively. Refer to the subsequent chapters for detailed information on the functionality of the different interface blocks.

Figure 1. PAR2402 Functional Block Diagram

1.2 Terminology

Term	Description
GND	Ground
BiDir	Bi-Directional
PWM	Pulse Width Modulation
HID	Human Interface Device
GPIO	General Purpose Input / Output

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1.3 Pin Assignment and Signal Description

Figure 2. PAR2402 Pin Configuration

Table 1. PAR2402 Signal Pins Description

Pin No.	Signal Name	Type	Description
1	VDD_OUT	Power	3.3V VDD output, recommend to place a 0.1uF capacitor close to Pin1
2	VDD_USB	Power	USB VDD input
3	VDD_DIG	Power	Digital VDD input, recommend to place a 0.1uF capacitor close to Pin3
4	USB_D+	BiDir	USB D+
5	USB_D-	BiDir	USB D-
6	NC		No Connection
7	VPP_OTP/RESETB	Power	Debug mode: 6.75V input for OTP download FW mode: Reset pin
8	NC		No Connection
9	NC		No Connection
10	P0.0/RXD/CS	BiDir	GPIO/UART/SPI
11	P0.1/TXD	BiDir	GPIO/UART
12	NC		No Connection
13	P0.2/SCLK	BiDir	GPIO/SPI
14	P0.3/SDIO	BiDir	GPIO/SPI
15	P0.4/SDO	BiDir	GPIO/SPI
16	P0.5	BiDir	GPIO
17	PROG	IN	Trapping to VDD: Debug mode, Trapping to GND: FW mode

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Pin No.	Signal Name	Type	Description
18	NC		No Connection
19	VDD_MTP	Power	MTP VDD input
20	NC		No Connection
21	NC		No Connection
22	ANT	BiDir	RF port Positive
23	NC		No Connection
24	NC		No Connection
25	NC		No Connection
26	NC		No Connection
27	NC		No Connection
28	DEC1	IN	De-couple Cap, recommend to place a 0.1uF capacitor close to Pin28
29	DEC2	IN	De-couple Cap, recommend to place a 0.1uF capacitor close to Pin29
30	NC		No Connection
31	XO	OUT	Oscillator output, connect to 16MHz resonator
32	XI	IN	Oscillator input, connect to 16MHz resonator

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2.0 Operating Specifications

2.1 Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit	Notes
USB Supply Voltage	V_{USB}	-0.3	5.75	V	For PAR2402
ESD Human Body Mode	ESD_{HBM}		2	kV	Human Body Model refer to MIL 883 Method 3015
ESD Machine Mode	ESD_{MM}		200	V	Machine Body Model refer to JEDEC EIA/JESD22-A115

Notes:

1. Maximum Ratings are those values beyond which damage to the device may occur.
2. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability.
3. Functional operation under absolute maximum-rated conditions is not implied and should be restricted to the Recommended Operating Conditions.

2.2 Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Temperature	T_A	0	-	40	°C	
Power Supply Voltage	V_{DD}	4.0	5.0	5.25	V	USB Power Domain
Supply Noise	V_{Np-p}	-	-	100	mV	Peak to peak within 10K - 80 MHz

Note: PixArt does not guarantee the performance if the operating temperature is beyond the specified limit.

2.3 Thermal Specifications

Table 4. Thermal Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Storage Temperature	T_S	-40	-	85	°C	
Lead-free Solder Temperature	T_P	-	-	260	°C	For 10seconds, 1.6mm below seating plane.

2.4 DC Characteristics

Table 5. DC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
PAR2402 Power Consumption[2]						
Current on normal mode	I_{DDN}		23.5		mA	
Current on suspend mode	I_{DDS}		2		mA	

Notes:

1. Electrical Characteristics are defined under recommended operating conditions.
2. All the parameters are tested under operating conditions: V_{DD_USB} = 5V at T_A = 25°C

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2.5 AC and Timing Characteristics

2.5.1 16MHz Crystal Oscillator

The 16MHz Pierce crystal oscillator is designed for low power consumption and high stability operation. The 16MHz oscillator can be trimmed without external capacitors. Two digital controlled trimming loading capacitors are integrated and designed for the 12pF XTAL. Digital controlled capacitors could ease and speed up tuning procedure of XTAL frequency accuracy.

Table 6. 16MHz Crystal Oscillator Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Crystal Oscillator Frequency	F_{X16M}		16		MHz	
Crystal Oscillator Frequency tolerance	F_{X16M_TOL}		±20		ppm	Frequency tolerance depends on XTAL Spec.
Loading Capacitor	C_{L_X16M}		12		pF	Built in digital controlled trimming loading cap, no external cap needed.

Notes: Electrical Characteristics are defined under recommended operating conditions.

2.5.2 32kHz RC Oscillator

The 32kHz RC oscillator is designed for low cost applications without additional external 32kHz XTAL. Due to characteristic of RC oscillator, calibration is needed before switching to 32kHz RC oscillator mode.

Table 7. 32kHz RC Oscillator Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
RC Oscillator Frequency	F_{RC32k}		32		kHz	
RC Oscillator Frequency tolerance, Calibrated	F_{RC32k_TOL}			±1	%	Calibration needed before switching to RC oscillator mode
Start Up Time	T_{START_X16M}		100	1	µs	

Notes: Electrical Characteristics are defined under recommended operating conditions

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2.6 RF Specifications

2.6.1 Transmitter RF Specifications

Table 8. Transmitter Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Frequency Range	FR_{TX}	2403	-	2479	MHz	
Default Output Power	$P_{O,DEF}$	-	0	-	dBm	
Output Power Adjust Range	$P_{O,ADJ}$	-6	-	+4	dBm	
Output Power Variation	$P_{O,VAR}$	-	1	-	dBm	All channel TX power variation
TX 20dB Bandwidth	BW_{20dB}	-	1100	-	kHz	
1st Adjacent Channel Power@±1MHz	P_{ACP1}	-	-20	-	dBc	Frequency Deviation: 250kHz Data rate: 1Mbps
2nd Adjacent Channel Power@±2MHz	P_{ACP2}	-	-40	-	dBc	Frequency Deviation: 250kHz Data rate: 1Mbps
Frequency Deviation Set 250kHz	Δf_D	-	±250	-	kHz	Data rate: 1Mbps
2ndHarmonics Power Level	Har_{2nd}	-	-40	-	dBm	@Pout = 0dBm
3rdHarmonics Power Level	Har_{3rd}	-	-45	-	dBm	@Pout = 0dBm

Notes: Electrical Characteristics are measured under recommended operating conditions

2.6.2 Receiver RF Specification

Table 9. Receiver Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Frequency Range	FR_{RX}	2403		2479	MHz	
Maximum Input Power	RX_{MAX}		0		dBm	
Sensitivity	SEN_{IDEAL}		-91		dBm	BER<0.1%
C/I and Selectivity						
C/I Co-Channel	C/I_{CO}		9		dB	Note(1)
C/I Adjacent ±1MHz	C/I_{1M}		-1		dB	
C/I Adjacent ±2MHz	C/I_{2M}		-35		dB	
C/I Adjacent ±3MHz	C/I_{3M}		-30		dB	
C/I Adjacent > |±6MHz|	C/I_{NM}		-40		dB	
C/I Adjacent > |±25MHz|	C/I_{NM}		-50		dB	
Inter-Modulation Performance						
Input power of IM interferers at 3/4/5 and 6/7/8 MHz distance from wanted signal	IMD		-33		dBm	Note(2)

Notes:

1. ACR testing: Wanted power is -67dBm and interference is modulated signal. The input power of interferers where the sensitivity equals BER = 0.1% is presented.
2. Intermodulation testing: Wanted signal level at Pin = -64 dBm. Two interferers with equal input power are used. The interferer closest in frequency is un-modulated, the other interferer is modulated equal with the wanted signal. The input power of interferers where the sensitivity equals BER = 0.1% is presented.

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3.0 Mechanical Specifications

3.1 Mechanical Dimension

NOTE:

1.THE TERMINAL #1 IDENTIFIER IS A LASER MARKED FEATURE

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
C	——	0.20 REF.	——
D	4.90	5.00	5.10
D2	3.05	3.10	3.15
E	4.90	5.00	5.10
E2	3.05	3.10	3.15
e	——	0.50	——
L	0.35	0.40	0.45
y	0.00	——	0.075

Figure 3. PAR2402 Package Outline Diagram

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3.2 Package Marking

Table 10. Package Marking Rule

Package	Marking Label	Description
PAR2402	Line C	Product Part Number
	Line D AZYWWXXXCC	AZ, XXXCC = PixArt Reference YWW = Date Code

PAR2402

Figure 4. Package Marking Diagram

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4.0 System Description

The PAR2402 chip is the low power and high performance 2.4GHz Low Energy SOC which is integrated with 8051 microprocessor and radio transceiver and memory.

4.1 8051 Microprocessor Core

The PAR2402 integrates 8-bit MCU that supports the normal 8051 instruction set. It provides low power consumption and minimal code of the processor to enable developers in achieving 8-bit performance. With its friendly architecture, applications can be developed easily and quickly.

4.2 Memory

- Program MTP: 64B MTP is reserved for programming code.
- Program OTP: 16kB OTP is reserved for programming code.
- Executing RAM: 256B internal RAM and 2kB external RAM is reserved for temporal data
- TRX composer RAM: 128B RAM is reserved for transmission data

4.3 Radio Transceiver

Both the PAR2402 is integrated with high performance 2.4GHz radio transceiver to be wireless chips. With the built-in on-chip balun, PAR2402 system design does not need external balun circuit thus can have minimize BOM. The integrated high efficiency PA can transmit up to +4dBm RF power for class 2 operation, while the integrated low-IF receiver can provide excellent sensitivity up to -91dBm and outstanding interference rejection capability.

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4.4 Interface

4.4.1 UART

The PAR2402 has one set of UART interface for serial asynchronous communication between devices. 8-n-1 is standard data frame configuration as eight (8) data bits, no (N) parity bit, and one (1) stop bit shown figure below.

Figure 5. UART Data Frame

Table 11. UART Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Baud Rate	BR	1200		57600	bps	
Baud Rate Accuracy	BR_{ACCU}			0.64	%	

4.4.2 SPI

The PAR2402 provides 2-wire SPI interface, SCLK (clock), SDIO (bi-directional Data). The PAR2402 serves as a slave device. One SPI command consists of two bytes: 1st byte is address phase, 2nd byte is data phase.

Figure 6. Write Command: Wr(1-bit), Address(7-bits), Data(8-bits)

Figure 7. Read Command: Rd(1-bit), Address(7-bits), Data(8-bits)

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5.0 Design References

5.1 Reference Schematics

The circuit design of PAR2402 is easy as the EBOM is very simple.

Figure 8. PAR2402 Reference Application Circuit

5.2 Design Guidelines

5.2.1 Layout Design

Taking precaution in printed circuit layout is critical in optimizing the design to minimize parasitical capacitance and line inductance. The following layout guidelines are recommended to achieve optimum performance.

1. Ensure that the RF 50ohm trace comes with GND continuation.
2. Place the ceramic bypass capacitors as near as possible to the input/output pins.
3. All feedback signals must first go through regulator capacitors.
4. Place the crystal closely to the oscillator pins.
5. Ensure that the ground plane under the oscillator and its components are of good quality.
6. Do not route any digital-signal lines on the other side of the PCB that under the RF trace and crystal area.
7. Keep other digital signal lines, especially clock lines and frequently switching signal lines, as far away from crystal/analog/RF connections as possible.
8. Place at least 9 GND vias directly under IC thermal PAD for good grounding and thermal dissipation.

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Document Revision History

Revision Number	Date	Description
0.6	17 June 2016	1st creation based on v0.6 DS

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1.0 Introduction

1.1 Overview

The PAW3702 is a highly integrated IC including 2.4GHz RF, MCU and optical mouse navigation engine. This single chip solution provides customers ease of manufacturing in designing an optical wireless mouse with minimum number of components. Moreover when PAW3702 is pairing with PAR2402 2.4GHz Wireless USB Receiver Chip, forming the best choice of a complete low cost and good performance total solution of Wireless Mouse.

The PAW3702 is housed in a 14-pins iDIP package as CMOS optical 2.4GHz wireless mouse single-chip that serves as a non-mechanical motion estimation engine for implementing a computer mouse. The XY motion-axes support various resolution options of 800/1000/1200/1600/2000 counts per inch (CPI) with motion detection of tracking speed up to 30 inches per second and acceleration up to 10g. The 8051 microprocessor is the central management to process the optical mouse XY motion axes and the 6 buttons status from L, M, R, CPI, B4 and B5, then output these data to the baseband modem and 2.4GHz radio transceiver for wireless transmission.

The Figure 1 shows the architecture block diagram of the PAW3702 respectively. Refer to the subsequent chapters for detailed information on the functionality of the different interface blocks.

Figure 1. PAW3702 Functional Block Diagram

1.2 Terminology

Term	Description
GND	Ground
BiDir	Bi-Directional
PWM	Pulse Width Modulation
HID	Human Interface Device
GPIO	General Purpose Input / Output

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1.3 Pin Assignment and Signal Description

Figure 2. PAW3702 Pin Configuration

Table 1. PAW3702 Signal Pins Description

Pin No.	Signal Name	Type	Description
1	BL_B4	IN	Share pin for Left key and B4(BB) key input
2	Z2	IN	Z axis, support mechanical scroll input
3	Z1	IN	Z axis, support mechanical scroll input
4	BM_CPI	IN	Share pin for Middle key and CPI key input
5	BR_B5	IN	Share pin for Right key and B5(FB) key input
6	LED (Mouse)	OUT	Mouse LED control
7	LED (Indicator)	OUT	LED Indicator
8	DEC	Power	De-couple Cap, recommend to place a 0.1uF capacitor close to Pi
9	XI	IN	Oscillator input, connect to 16MHz resonator
10	XO	OUT	Oscillator output, connect to 16MHz resonator
11	VBAT_Detector	IN	Battery detection.
12	VDD	Power	Chip power supply
13	GND	GND	Chip ground
14	ANT	BiDir	2.4GHz transceiver RF port, connected to antenna

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2.0 Operating Specifications

2.1 Absolute Maximum Ratings

Table 2. PAW3702 Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit	Notes
DC Supply Voltage	V_{DC}	-0.3	3.6	V	
DC Input Voltage	V_{IN}	-0.3	3.6	V	All I/O pin
ESD Human Body Mode	ESD_{HBM}		2	kV	Human Body Model refer to MIL 883 Method 3015
ESD Machine Mode	ESD_{MM}		200	V	Machine Body Model refer to JEDEC EIA/JESD22-A115

Notes:

1. Maximum Ratings are those values beyond which damage to the device may occur.
2. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability.
3. Functional operation under absolute maximum-rated conditions is not implied and should be restricted to the Recommended Operating Conditions.

2.2 Recommended Operating Conditions

Table 3. PAW3702 Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Temperature	T_A	0	-	40	°C	
Power Supply Voltage	V_{DD}	2.1	-	3.6	V	
Supply Noise	V_{Np-p}	-	-	100	mV	Peak to peak within 10K - 80 MHz
Distance From lens Reference Plane to Surface	Z	2.3	2.4	2.5	mm	
Resolution	R	800	-	2000	CPI	Counts per inch
Frame Rate	FR	-	-	2400	fps	Frames per second
Speed	S	0	-	30	ips	Inches per second
Acceleration	A	0	-	10	g	

Note: PixArt does not guarantee the performance if the operating temperature is beyond the specified limit.

2.3 Thermal Specifications

Table 4. Thermal Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Storage Temperature	T_S	-40	-	85	°C	
Lead-free Solder Temperature	T_P	-	-	260	°C	For 10seconds, 1.6mm below seating plane.

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2.4 DC Characteristics

Table 5. PAW3702 DC Electrical Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Low Battery indicator voltage from VDD for two batteries application	V_{LBD}	1.85	-	2.3	V	Select any setting of 2.2V,2.1V,2V,1.95V
Shut down indicator voltage from VDD for two batteries application	V_{SDD}	-	-	2.3	V	Select any setting of 2.2V,2.1V,2.0,OFF
Low Battery indicator voltage from VDD for single battery application	V_{LBD}	0.85	-	1.3	V	Select any setting of 1.2V,1.1V,1V,0.95V
Shut down indicator voltage from VDD for single battery application	V_{SDD}	-	-	1.15	V	Select any setting of 1.05V,0.95V,0.85,OFF
Accuracy of LED Indicator voltage detector from VDD	V_{DA}	-	±100	-	mV	
PAW3702 Power Consumption[2]						
Run Mode @ High Speed	I_{DDH}	-	1.8	-	mA	Not including Red LED current, testing with YL-W Lens on A4 size white printing paper
Run Mode @ Medium Speed	I_{DDM}	-	1.8	-	mA	
Run Mode @ Low Speed	I_{DDL}	-	1.6	-	mA	
Sleep1 Mode Current	I_{SLP1}	-	35	-	µA	
Sleep2 Mode Current	I_{SLP2}	-	21	-	µA	
Power Down Mode Current	I_{PD}	-	15	-	µA	

Notes:

1. Electrical Characteristics are defined under recommended operating conditions.
2. All the parameters are tested under operating conditions: V_{DD} = 2.7V at T_A = 25°C

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2.5 AC and Timing Characteristics

2.5.1 16MHz Crystal Oscillator

The 16MHz Pierce crystal oscillator is designed for low power consumption and high stability operation. The 16MHz oscillator can be trimmed without external capacitors. Two digital controlled trimming loading capacitors are integrated and designed for the 12pF XTAL. Digital controlled capacitors could ease and speed up tuning procedure of XTAL frequency accuracy.

Table 6. 16MHz Crystal Oscillator Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Crystal Oscillator Frequency	F_{X16M}		16		MHz	
Crystal Oscillator Frequency tolerance	F_{X16M_TOL}		±20		ppm	Frequency tolerance depends on XTAL Spec.
Loading Capacitor	C_{L_X16M}		12		pF	Built in digital controlled trimming loading cap, no external cap needed.

Notes: Electrical Characteristics are defined under recommended operating conditions.

2.5.2 32kHz RC Oscillator

The 32kHz RC oscillator is designed for low cost applications without additional external 32kHz XTAL. Due to characteristic of RC oscillator, calibration is needed before switching to 32kHz RC oscillator mode.

Table 7. 32kHz RC Oscillator Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
RC Oscillator Frequency	F_{RC32k}		32		kHz	
RC Oscillator Frequency tolerance, Calibrated	F_{RC32k_TOL}			±1	%	Calibration needed before switching to RC oscillator mode
Start Up Time	T_{START_X16M}		100	1	µs	

Notes: Electrical Characteristics are defined under recommended operating conditions

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2.6 RF Specifications

2.6.1 Transmitter RF Specifications

Table 8. Transmitter Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Frequency Range	FR_{TX}	2403	-	2479	MHz	
Default Output Power	$P_{O,DEF}$	-	0	-	dBm	
Output Power Adjust Range	$P_{O,ADJ}$	-6	-	+4	dBm	
Output Power Variation	$P_{O,VAR}$	-	1	-	dBm	All channel TX power variation
TX 20dB Bandwidth	BW_{20dB}	-	1100	-	kHz	
1st Adjacent Channel Power@±1MHz	P_{ACP1}	-	-20	-	dBc	Frequency Deviation: 250kHz Data rate: 1Mbps
2nd Adjacent Channel Power@±2MHz	P_{ACP2}	-	-40	-	dBc	Frequency Deviation: 250kHz Data rate: 1Mbps
Frequency Deviation Set 250kHz	Δf_D	-	±250	-	kHz	Data rate: 1Mbps
2ndHarmonics Power Level	Har_{2nd}	-	-40	-	dBm	@Pout = 0dBm
3rdHarmonics Power Level	Har_{3rd}	-	-45	-	dBm	@Pout = 0dBm

Notes: Electrical Characteristics are measured under recommended operating conditions

2.6.2 Receiver RF Specification

Table 9. Receiver Specifications

Parameters	Symbol	Min.	Typ.	Max.	Unit	Conditions
Frequency Range	FR_{RX}	2403		2479	MHz	
Maximum Input Power	RX_{MAX}		0		dBm	
Sensitivity	SEN_{IDEAL}		-91		dBm	BER<0.1%
C/I and Selectivity						
C/I Co-Channel	C/I_{CO}		9		dB	Note(1)
C/I Adjacent ±1MHz	C/I_{1M}		-1		dB	
C/I Adjacent ±2MHz	C/I_{2M}		-35		dB	
C/I Adjacent ±3MHz	C/I_{3M}		-30		dB	
C/I Adjacent > |±6MHz|	C/I_{NM}		-40		dB	
C/I Adjacent > |±25MHz|	C/I_{NM}		-50		dB	
Inter-Modulation Performance						
Input power of IM interferers at 3/4/5 and 6/7/8 MHz distance from wanted signal	IMD		-33		dBm	Note(2)

Notes:

1. ACR testing: Wanted power is -67dBm and interference is modulated signal. The input power of interferers where the sensitivity equals BER = 0.1% is presented.
2. Intermodulation testing: Wanted signal level at Pin = -64 dBm. Two interferers with equal input power are used. The interferer closest in frequency is un-modulated, the other interferer is modulated equal with the wanted signal. The input power of interferers where the sensitivity equals BER = 0.1% is presented.

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2.7 LED Specifications

Table 10. LED Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Peak Wavelength	λ_p		639		nm	
Radiometric Intensity for LED Bin Grade R	I_e	25.4	-	30.5	mW/Sr	Tested at 20mA. Tolerance for each bin will be ± 15%
Viewing Angle	$2\theta_{1/2}$	24	30	36	Deg	Refer to Figure 3. Radiation Characteristics for recommended Red LED Angle Criterion
Optical Power for Diffused Lens	$P_{Diffused}$	1600	-	-	µW	Tested at 2.7V. For recommended Red LED
Optical Power for Specular Lens	$P_{Specular}$	350	-	-	µW	Tested at 2.7V. For recommended Red LED
LED Supply Voltage	V_{LED}	2.1	-	3.6	V	

Notes:

1. Recommended using Everlight 7343USRC/S1029-1 Red LED.
2. Recommend using ADCMT power meter 8230E to measure the LED optical power.

Figure 3. Radiation Characteristics

Notes: Recommended using Chang-Yu LED goniophotometer V110 to measure the LED viewing angle.

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3.0 Mechanical Specifications

3.1 Mechanical Dimension

Figure 4. PAW3702 Package Outline Diagram

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Package Marking

Table 11. Package Marking Rule

Package	Marking Label	Description
PAW3702	Line A	Product Part Number
	Line B AAZYWWXXCC	AAZ, XXCC = PixArt Reference YWW = Date Code

Figure 5. Package Marking Diagram

3.2 Assembly Drawing for PAW3702

Figure 6. Distance from Lens Reference Plane to Surface

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Figure 7. 2D Assembly of PAW3702 Mouse System

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Figure 8. 3D Assembly for Mounting Instructions of PAW3702 Mouse System

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4.0 System Description

The PAW3702 chips is the low power and high performance 2.4GHz Low Energy SOC. which is integrated 8051 microprocessor, radio transceiver, memory and optical mouse navigation engine.

4.1 Optical Mouse Navigation Engine

The PAW3702 has an optical mouse navigation engine with high precision surface tracking ability that capable in high-speed motion detection up to the velocity of 30 inches/sec and acceleration of 10g.It has low power architecture supporting automatic power management modes, configurable sleep and wake-up time which make it suitable for power-sensitive wireless mouse application.

4.2 8051 Microprocessor Core

The PAW3702 integrates 8-bit MCU that supports the normal 8051 instruction set. It provides low power consumption and minimal code of the processor to enable developers in achieving 8-bit performance. With its friendly architecture, applications can be developed easily and quickly.

4.3 Memory

- Program OTP: 16kB OTP is reserved for programming code.
- Executing RAM: 256B internal RAM and 768B external RAM is reserved for temporal data
- TRX composer RAM: 64B RAM is reserved for transmission data
- Optical Mouse Navigation RAM: 192B for motion data

4.4 Radio Transceiver

The PAW3702 is integrated with high performance 2.4GHz radio transceiver to be wireless chips. With the built-in on-chip balun, PAW3702 system design does not need external balun circuit thus can has minimize BOM. The integrated high efficiency PA can transmit up to +4dBm RF power for class 2 operation, while the integrated low-IF receiver can provide excellent sensitivity up to -91dBm and outstanding interference rejection capability.

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5.0 Design References

5.1 Reference Schematics

PAW3702DL-TXNT supports two type of power system applications: Two batteries and Single battery.

Button solutions \ Resistors		R1	R3	R4
(1)	Three buttons for BL/BM/BR	X	X	X
(2)	Pseudo shared buttons for BL/B4 and BR/B5	16K	16K	16K

Figure 9. Reference Circuit for PAW3702 Two Batteries Application

Button solutions \ Resistors		R1	R3	R4
(1)	Three buttons for BL/BM/BR	X	X	X
(2)	Pseudo shared buttons for BL/B4 and BR/B5	16K	16K	16K

Figure 10. Reference Circuit for PAW3702 Single Battery Application

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5.2 Design Guidelines

5.2.1 Layout Design

Taking precaution in printed circuit layout is critical in optimizing the design to minimize parasitical capacitance and line inductance. The following layout guidelines are recommended to achieve optimum performance.

1. Ensure that the RF 50ohm trace comes with GND continuation.
2. Place the ceramic bypass capacitors as near as possible to the input/output pins.
3. All feedback signals must first go through regulator capacitors.
4. Place the crystal closely to the oscillator pins.
5. Ensure that the ground plane under the oscillator and its components are of good quality.
6. Do not route any digital-signal lines on the other side of the PCB that under the RF trace and crystal area.
7. Keep other digital signal lines, especially clock lines and frequently switching signal lines, as far away from crystal/analog/RF connections as possible.
8. Place at least 9 GND vias directly under IC thermal PAD for good grounding and thermal dissipation.

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Document Revision History

Revision Number	Date	Description
0.61	18 Aug 2016	1st creation based on v0.61 DS

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