PAW3203DI WIRELESS OPTICAL MOUSE SINGLE CHIP

General Description

The PAW3203DI optical mouse sensor is a CMOS wireless mouse single chip that serves as a non-mechanical motion estimation engine for implementing a wireless mouse.

Features

- Single power supply
- 27MHz FSK wireless protocol
- No mechanical parts
- Complete 2-D motion sensor
- Precise optical motion estimation technology
- Accurate motion estimation over a wide range of surfaces
- High resolution up to 1000 CPI
- High speed motion detection up to 28 inches/sec
- Supports five buttons (R, M, L, B4, B5) and three axes (X, Y, Z) output
- Mouse operation condition, RF protocol timing and sensor chip turn function can be power-up loaded from external EEPROM
- Support I^2C^{TM} EEPROM interface
- Battery low detection

Key Specification

Power Supply Range	1.73V ~ 1.87V (VDDD,VDDA, VDD) 2.5V ~ 2.9V (VDD)
Optical Lens	1:1
Interface	27 MHz FSK wireless protocol
System Clock	27 MHz
Frame Rate	3000 frames/sec
Speed	28 inches/sec
Acceleration	TBD
Resolution	400/600/800(default)/1000 CPI
Operating Current	5mA @Mouse moving (Normal) 800uA @Mouse not moving (Sleep1) 150uA @Mouse not moving (Sleep2)
Package	Shrunk DIP24

Ordering Information

Order Number	Resolution (CPI)
PAW3203DI	800

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1. Pin Configuration

1.1 Pin Description

Pin #	Name	Type	Definition
1	ZY1	IN	Z axis, scroller input, internal pull-low (50k), support mechanical encoder only
2	ZY2	IN	Z axis, scroller input, internal pull-low (50k), support mechanical encoder only
3	BL	IN	Button left key input, internal pull-high (50k), press connect to low
4	B4	IN	Button 4 key input, internal pull-high (50k), press connect to low
5	LED	I/O	LED driver control
6	OSCOUT	OUT	Oscillator output, connect to 27 MHz crystal
7	OSCIN	IN	Oscillator input, connect to 27 MHz crystal
8	VDDD	PWR	Digital circuit voltage power, 1.8V
9	VSS	GND	Chip ground
10	VDD	PWR	Chip I/O power voltage, 1.73V ~ 1.87V(V_{dd1}) or 2.5V ~ 2.9V(V_{dd2})
11	VDDA	PWR	Analog circuit voltage power, 1.8V
12	VREF	BYPASS	Analog circuit voltage reference
13	B5	IN	Button 5 key input, internal pull-high (50k), press connect to low
14	NC	-	No connection
15	ISCK	IN	I^2C serial clock, internal pull-high (5k)
16	ISDA	I/O	I^2C bi-directional input/output pin, internal pull-high (5k)
17	RFID	IN	RFID resynchronization, internal pull-high (50k), press connect to low
18	RFDATA	OUT	RF data output, CMOS output
19	RFEN	OUT	RF power control, CMOS output
20	BR	IN	Button right key input, internal pull-high (50k), press connect to low
21	BM	IN	Button middle key input, internal pull-high (50k), press connect to low
22	NC	-	No connection
23	RFU	IN	Reserve for future use
24	BATLow	IN	Battery low detection input

1.2 Pin Assignment

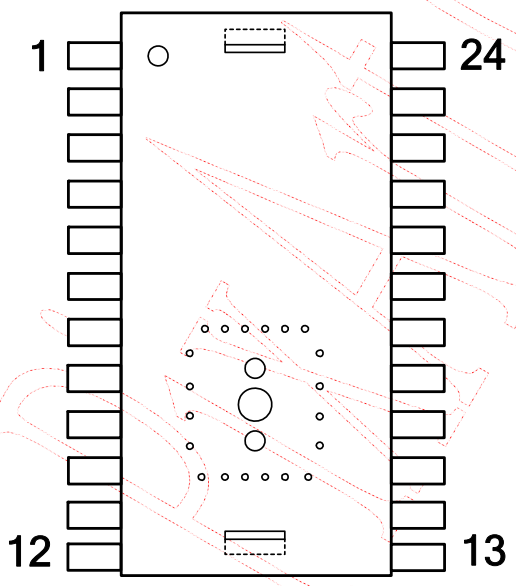

Figure 1. Top View Pinout

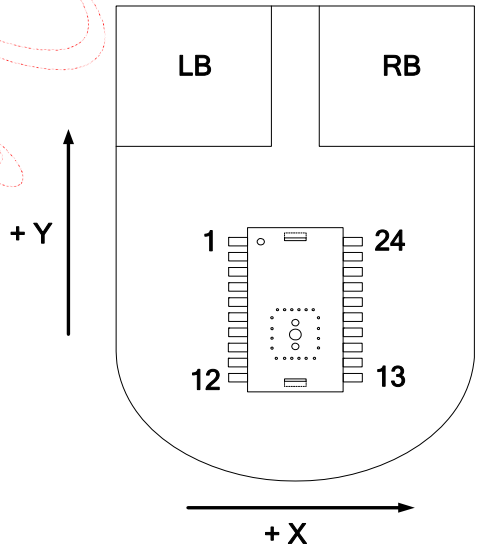

Figure 2. Top View of Mouse

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2. Block Diagram and Operation

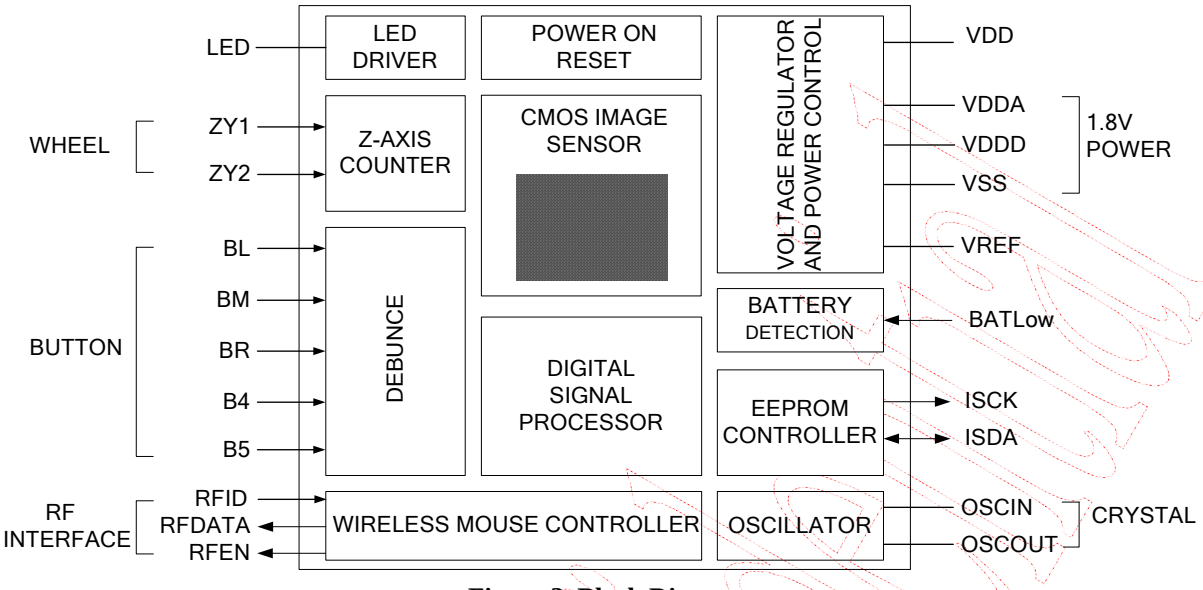

Figure 3. Block Diagram

The PAW3203DI is a 27 MHz wireless CMOS optical mouse single chip that serves as a non-mechanical motion estimation engine for implementing a wireless mouse. PAW3203DI supports X, Y, Z three axes, and L, R, M, B4, and B5 five buttons.

PAW3203DI is in a 24-pin optical package and comes with the resolution of 800 counts per inch (CPI) and the rate of motion up to 28 inches per second. PAW3203DI embedded mouse controller in it so that no additional controller and its component needed.

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3. Specifications

3.1 Absolute Maximum Ratings

Stresses above those listed under "Absolute Maximum Rating" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min.	Max.	Unit	Notes
T_{STG}	Storage Temperature	-40	85	°C	
TA	Operating Temperature	-15	55	°C	
V_{DC}	DC Supply Voltage	-0.5	V_{dd1} + 0.2	V	
		-0.5	V_{dd2} + 0.3	V	
V_{IN}	DC Input Voltage	-0.5	V_{DC}	V	All I/O pin
	Lead Solder Temp		260	°C	For 10 seconds, 1.6mm below seating plane
ESD	-		2	kV	All pins, human body model MIL 883 Method 3015

3.2 Recommend Operating Condition

Symbol	Parameter	Min.	Typ.	Max.	Unit	Notes
T_A	Operating Temperature	0		40	°C	
V_{dd1}	Power Supply Voltage	1.73	1.8	1.87	V	VDDD, VDDA, VDD short
V_{dd2}		2.5	2.7	2.9		VDD
V_N	Supply Noise			100	mV	Peak to peak within 0 - 100 MHz
Z	Distance From Lens Reference Plane to Surface	2.3	2.4	2.5	mm	Refer to Figure 4
R	Resolution	400	800	1000	CPI	
A	Acceleration			TBD	g	
F_{CLK}	Clock Frequency	26.995	27.042	27.245	MHz	Set by crystal
FR	Frame Rate		3000		frames/s	
S	Speed			28	inches/sec	

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3.3 DC Electrical Characteristics

Electrical characteristics over recommended operating conditions. Typical values at 25 °C, V_{dd1} = 1.8 V, F_{CLK} = 27 MHz

Symbol	Parameter	Min.	Typ.	Max.	Unit	Notes
Type: Mouse Power						
I_{DD}	Supply Current Mouse Moving (Normal)		5		mA	
I_{DD}	Supply Current Mouse Not Moving (Sleep1)		800		uA	
I_{DD}	Supply Current Mouse Not Moving (Sleep2)		150		uA	
Type: BL, BM, BR, B4, B5, RFID						
R_{PH}	Internal Pull-up Resistance		50		Kohm	
Type: ZY1, ZY2						
R_{PD}	Internal Pull-down Resistance		50		Kohm	
Type: ISCK, ISDA						
R_{PH}	Internal Pull-up Resistance		5		Kohm	
Type: BL, BM, BR, B4, B5						
V_{IH}	Input High Voltage	1.3			V	
V_{IL}	Input Low Voltage			0.5	V	
Type: LED						
V_{OL}	Output Voltage Low			300	mV	@I_{OL} = 25mA

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4. Z and 2D Assembly

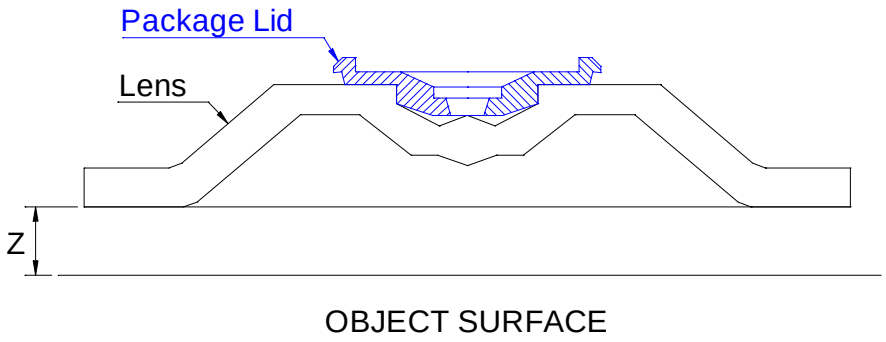

Figure 4. Distance from Lens Reference Plane to Surface

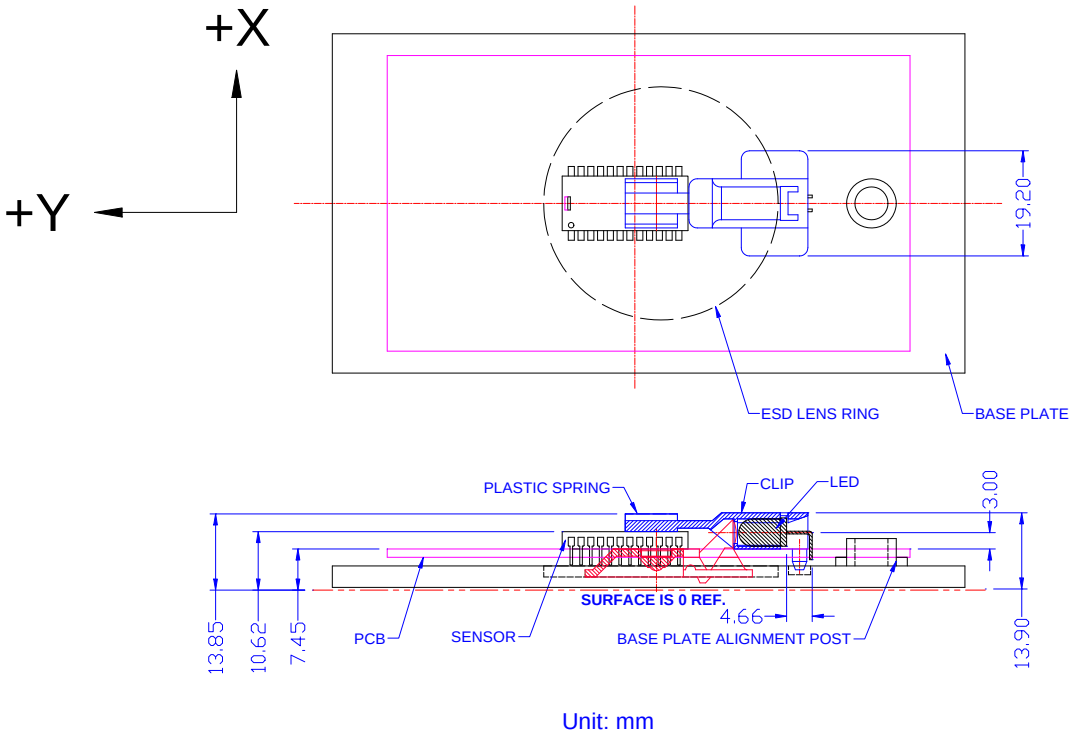

Figure 5. 2D Assembly

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5. Referencing Application Circuit

5.1 1.8V Application Circuit (with Red LED)

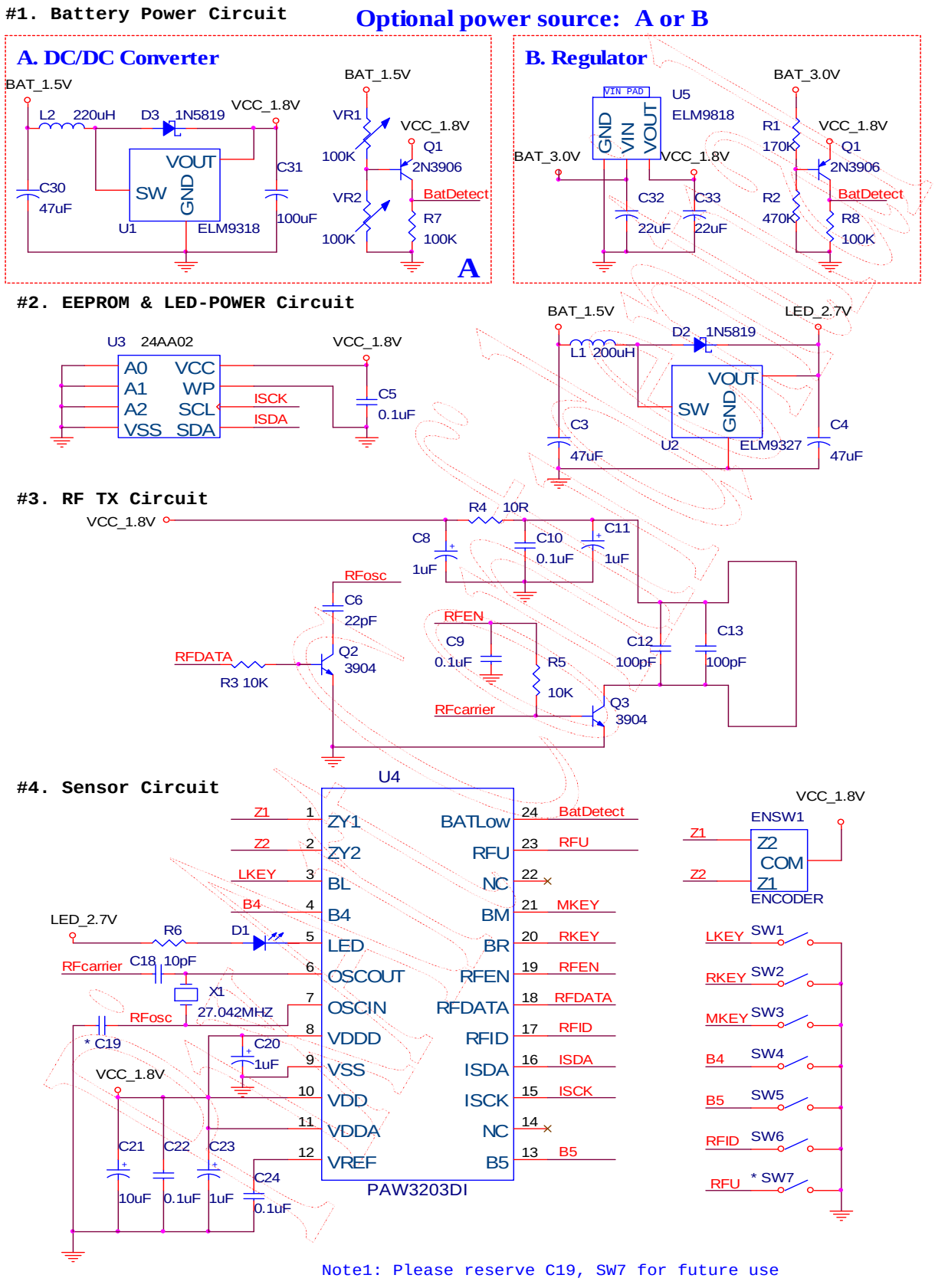

Figure 6. Application Circuit for 1.8V (with Red LED)

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5.2 1.8V Application Circuit (with IR LED)

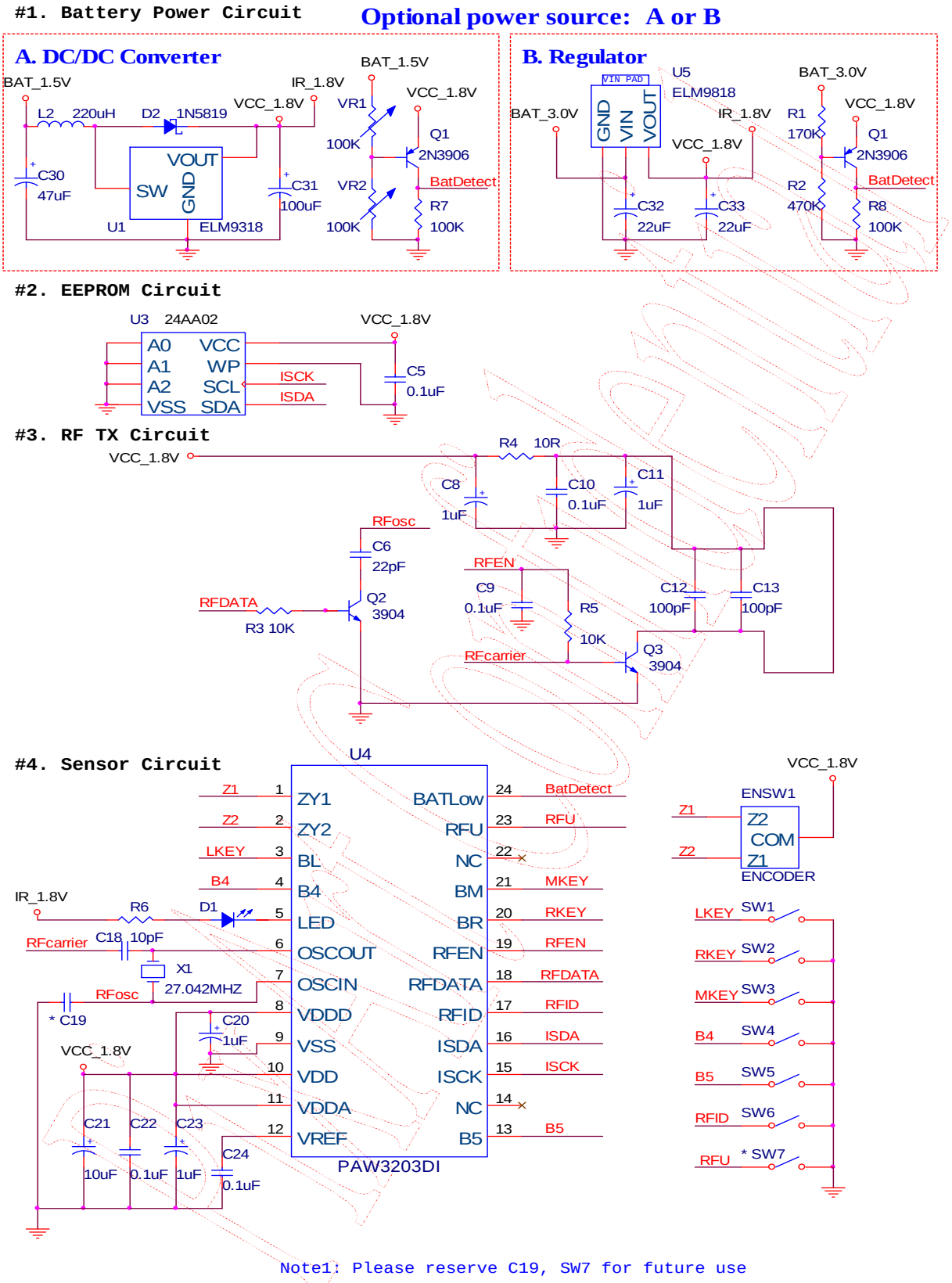

Figure 7. Application Circuit for 1.8V (with IR LED)

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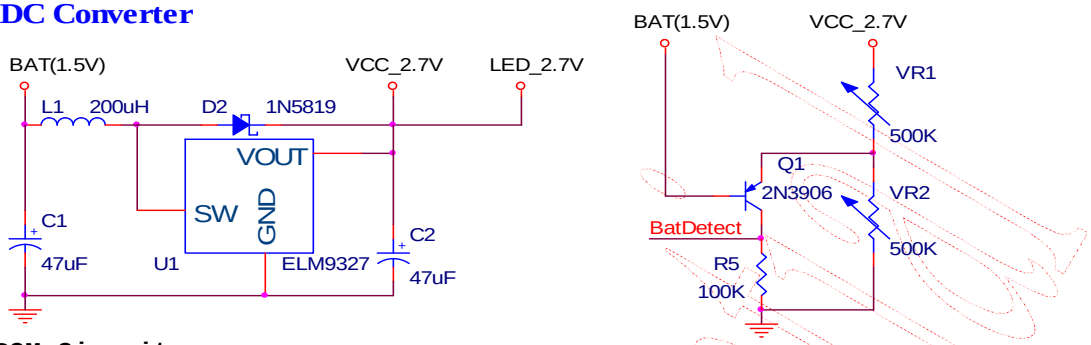
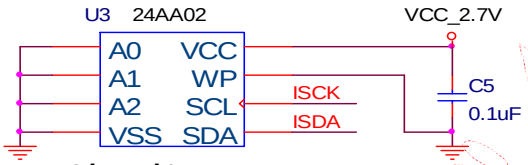
5.3 2.7V Application Circuit (with Red LED)

#1. Battery Power Circuit

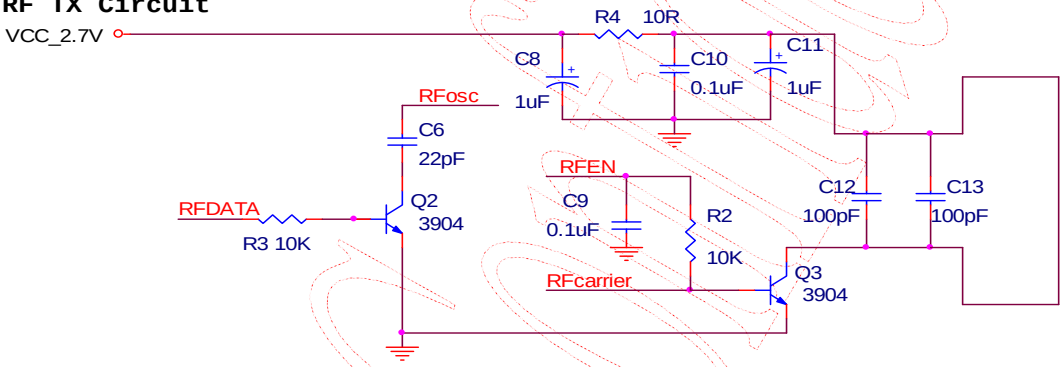
DC/DC Converter



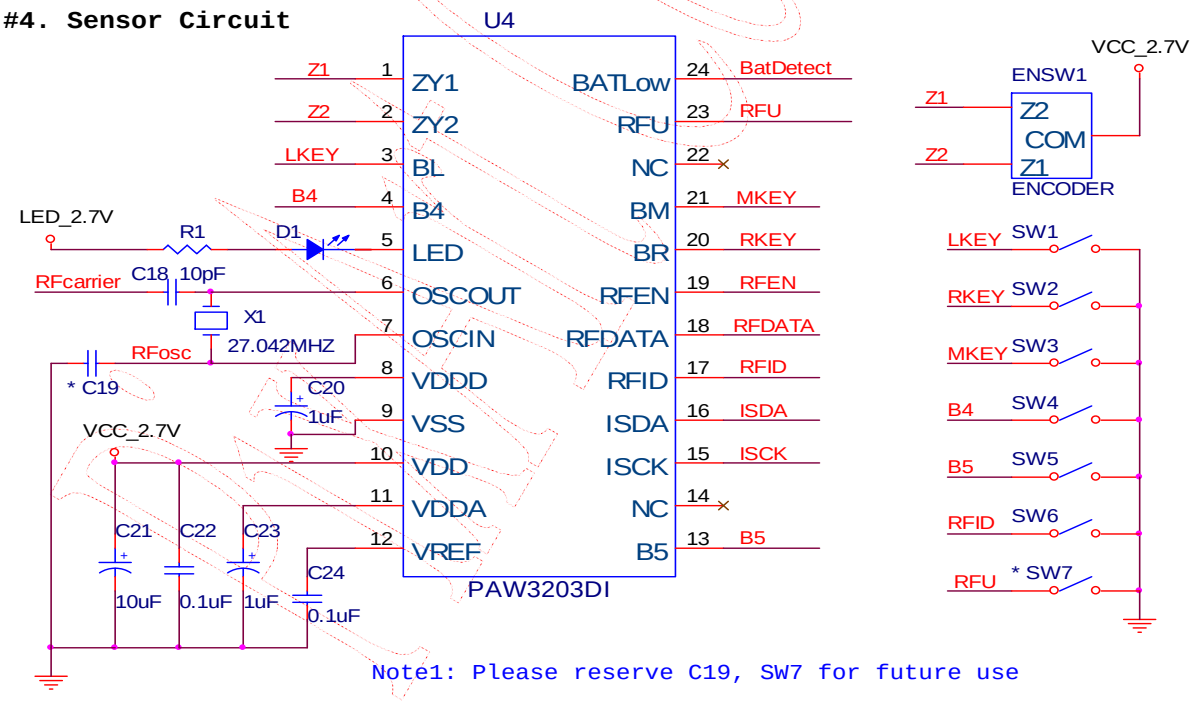
#2. EEPROM Circuit



#3. RF TX Circuit



#4. Sensor Circuit



Note1: Please reserve C19, SW7 for future use

Figure 8. Application Circuit for 2.7V (with Red LED)

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5.4 Typical Application for RF Receiver

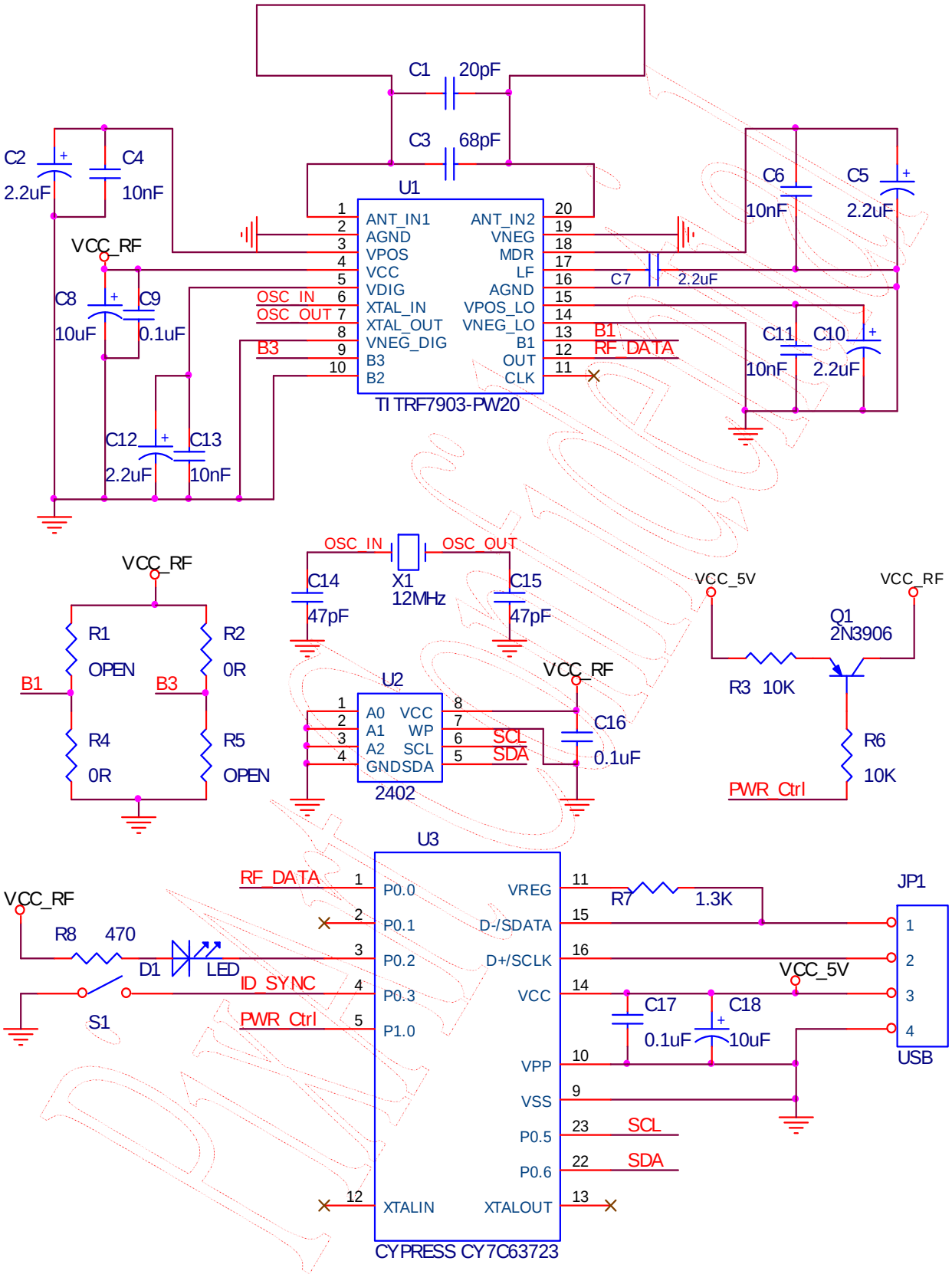

Figure 9. Application Circuit for RF Receive

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5.5 PCB Layout Consideration

- Caps for pins 8, 10, 11, 12 must have trace lengths less than **5mm**.
- The trace lengths of OSCOUT, OSCIN must less than **6mm**.
- The trace length of RFosc, RFcarrier must as short as possible.

5.6 Recommended Value for R1

5.6.1 Using Red LED

- Radiometric intensity of red LED

  Bin limits (mW/Sr at 20mA)

LED Bin Grade	Min.	Typ.	Max.
N	14.7	-	17.7
P	17.7	-	21.2
Q	21.2	-	25.4

Note: Tolerance for each bin will be ± 15%

- **Suggested R1:**

Red LED Bin Grade	Suggested R1 (ohm)
N	12
P	12
Q	12

5.6.2 Using IR LED

- **Suggested R1:**

IR LED Bin Grade	Suggested R1 (ohm)
TBD	0

It is not guaranteed that the performance of PAW3203DI with IR LED is as good as PAW3203DI with red LED. PAW3203DI is designed to a very good match with red LED, and this combination has the best performance.

5.6.3 Summary

Light Source	LED Bin Grade	VDD	R1 (ohm)
Red LED	N, P, Q	2.7	12
IR LED	TBD	1.8	0

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6. EEPROM Table

1. After power on, PAW3203DI will check EEPROM, if EEPROM address = 0x01 and data = 0xAA, continue to read EEPROM address 0x02.
2. When reading successive data is zero, PAW3203DI stops to read data from EEPROM.
3. Placing updated address and data continuously.

Address	Description	Default	
06H	Resolution	00H	00H = 800, 01H = 400, 02H = 400, 03H = 600, 20H = 1000
80H	Sleep1 entry time	17H	8.88ms * 23 = 200ms
81H	Sleep1 period	1CH	1ms * (28+2) = 30ms (Refer to the Figure 10)
82H	Sleep1 pd low time to check sensor motion status	05H	1ms * 5 = 5ms (Refer to the Figure 10)
83H	Sleep2 pd low time to check sensor motion status	05H	1ms * 5 = 5ms (Refer to the Figure 10)
84H	Sleep2 entry time	3CH	1s * 60 = 60s
85H	Sleep2 period (6bits, range: 0~63)	28H	8ms * (40 + 1) = 328ms (Refer to the Figure 10)
86H	Manchester code 1T time (8051 timer0 timer)	D8H	4us * (FFH - D8H) = 160us
87H	Preamble total time	0FH	1T * 15 = 15T
88H	Preamble counts	06H	2T * (6 - 1) = 10T
89H	Chip turn	55H	15H = -90˚, 55H = 0˚, D5H = +90˚
8DH	RFID timer	0FH	200ms * 15 = 3sec

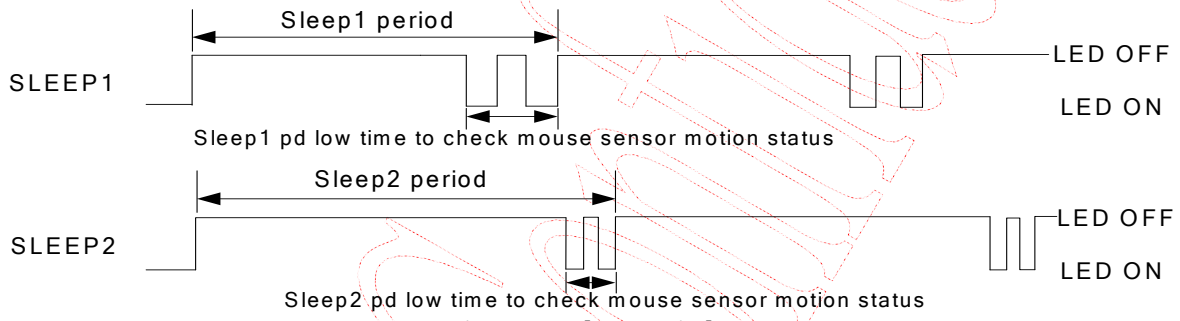

Figure 10. Sleep Period

For example:

EEPROM Address	Sensor Address	Data	Description
0	-	0xNN	RF ID code, 0xNN = 0x01 ~ 0xFF
1	-	0xAA	If the data is 0xAA, then PAW3203 continue to read EEPROM address 0x02, else stop to read any data from EEPROM
2, 3	0x06	0x00	800 CPI
4, 5	0x80	0x17	Sleep1 entry time
6, 7	0x81	0x1C	Sleep1 period
8, 9	0x82	0x05	Sleep1 pd low time to check sensor motion status
10, 11	0x83	0x05	Sleep2 pd low time to check sensor motion status
12, 13	0x84	0x3C	Sleep2 entry time
14, 15	0x85	0x28	Sleep2 period (6bits, range: 0 ~ 63)
16, 17	0x86	0xD8	Manchester code 1T time (8051 timer0 timer)
18, 19	0x87	0x0F	Preamble total time
20, 21	0x88	0x06	Preamble counts
22, 23	0x89	0x55	Chip turn 0˚
24, 25	0x8D	0x0F	RFID timer
26	-	0x00	Ending code
27	-	0x00	Ending code

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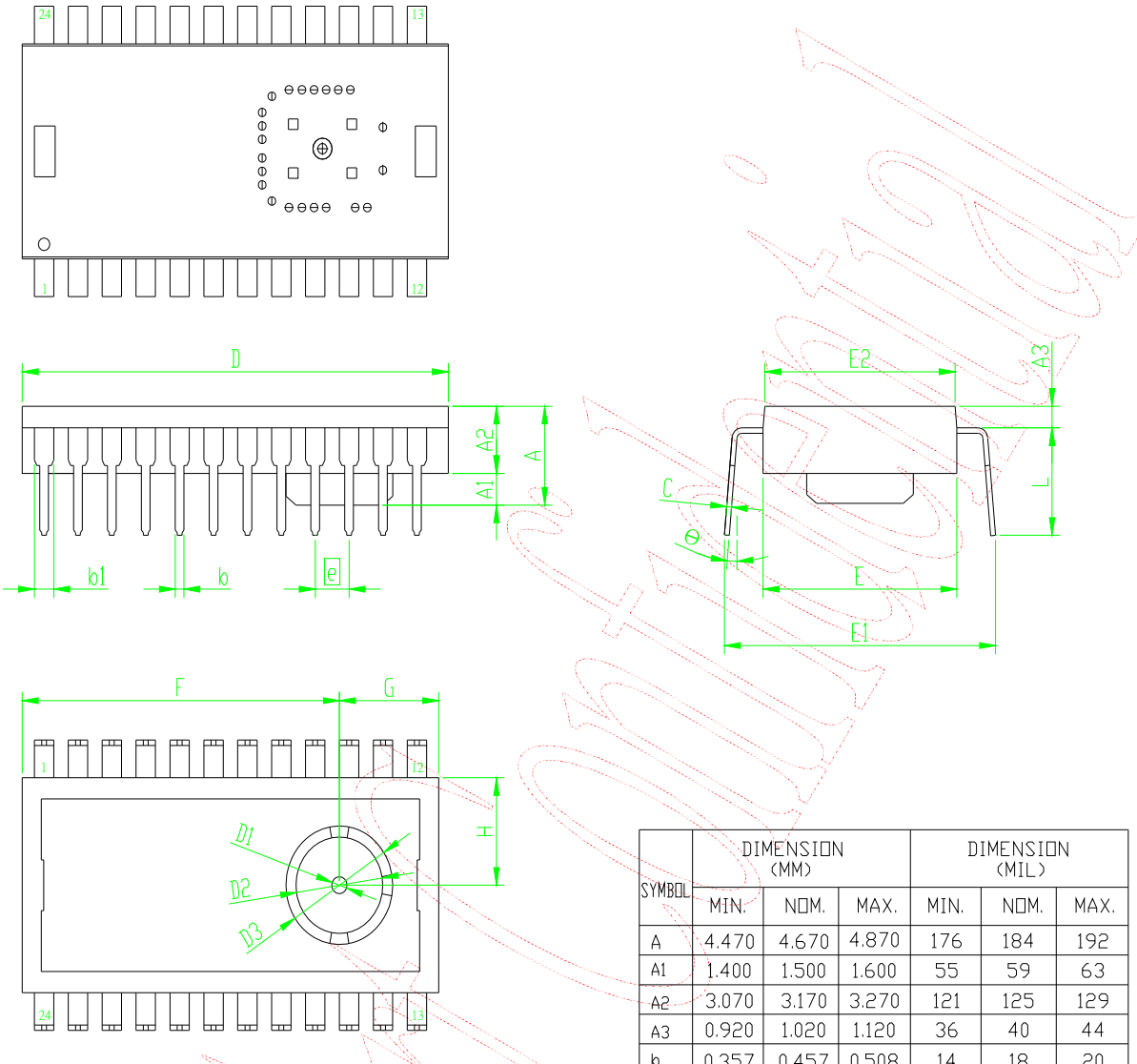
7. Package Information

7.1 Package Outline Drawing



SYMBOL	DIMENSION (MM)			DIMENSION (MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	4.470	4.670	4.870	176	184	192
A1	1.400	1.500	1.600	55	59	63
A2	3.070	3.170	3.270	121	125	129
A3	0.920	1.020	1.120	36	40	44
b	0.357	0.457	0.508	14	18	20
b1	0.889	1.016	1.143	35	40	45
c	0.203	0.254	0.279	8	10	11
D	21.74	21.84	21.94	856	860	864
D1	0.700	0.800	0.900	28	32	36
D2	4.450	4.550	4.650	175	179	183
D3	5.500	5.600	5.700	217	221	224
E	10.060	10.160	10.260	396	400	404
E1	14.020	14.220	14.420	552	560	568
E2	9.880	9.980	10.080	389	393	397
F	16.537	16.637	16.737	651	655	659
G	5.107	5.207	5.307	201	205	209
H	4.980	5.080	5.180	196	200	204
e	1.778 BASIC			70 BASIC		
L	4.980	5.080	5.180	196	200	204
θ	———	———	12°	———	———	12°

Figure 11. Package Outline Drawing

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7.2 Recommended PCB Mechanical Cutouts and Spacing

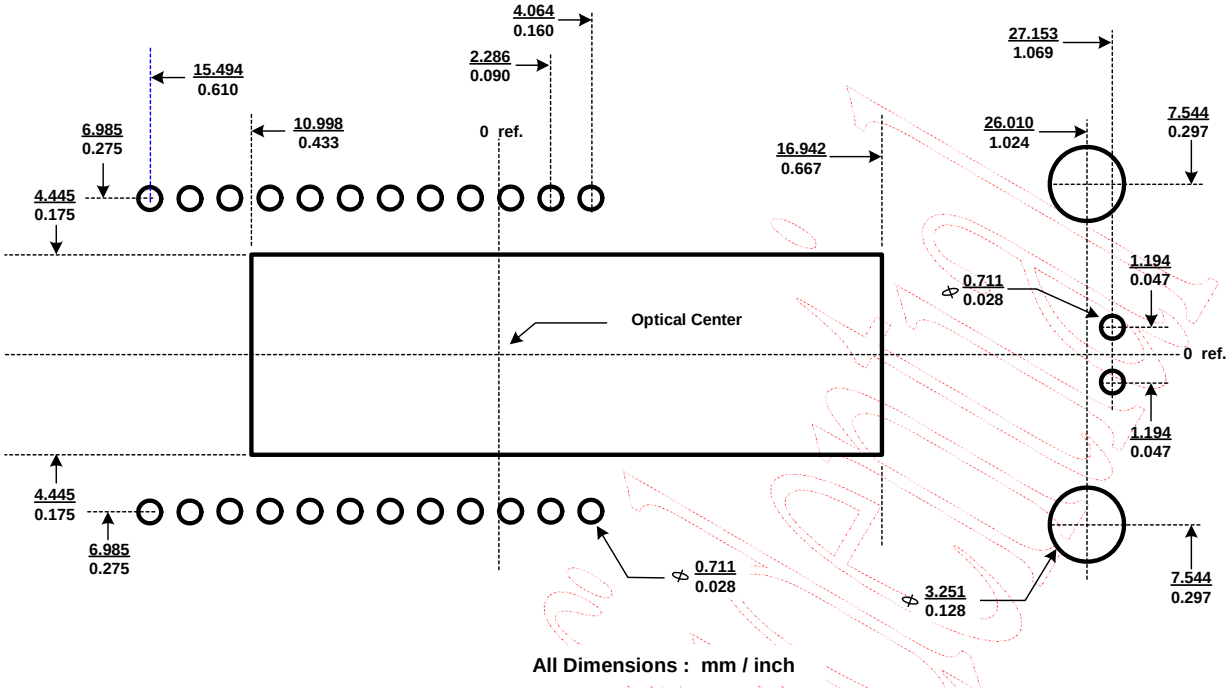

Figure 12. Recommended PCB Mechanical Cutouts and Spacing

8. Update History

Version	Update	Date
V0.2	Creation, Preliminary 1st version	08/25/2006
V0.3	Content revise	04/18/2008

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