



1. General Description

The eKM8053 is a Mouse Controller designed to control both USB & PS/2 Optical Mouse device. This Mouse Controller can auto detect USB or PS/2 mode, and supports X,Y,Z three axes , and L, R, M, P and N five buttons under both USB and PS2 mode.

2. Features

Universal Serial Bus Specification, version 1.1

USB HID Specification, version 1.1

Auto-detecting PS/2 port or USB port.

Compatible with Microsoft 3D PS/2 mouse.

Support 3D (X,Y,Z) 5 Key (L,R,M,P,N) input.

Support Z/2 Z-axis input type.

Support Agilent HDNS-2051 & 2610 & 2620 Optical Mouse Sensor.

Firmware simulates 800DPI for 2610/2620 Optical Sensor.

Applications :

3D, 3 Buttons USB and PS/2 Combo Mouse

3D, 5 Buttons USB and PS/2 Combo Mouse.

Package :

18 Pin PDIP (300MIL) eKM8053BP 3D 3K

18 Pin SOP (300MIL) eKM8053BM 3D 3K

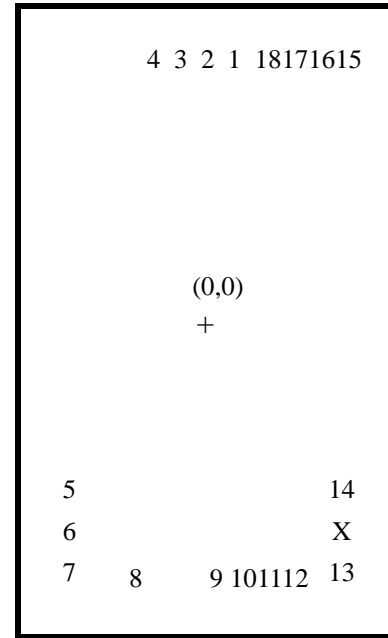
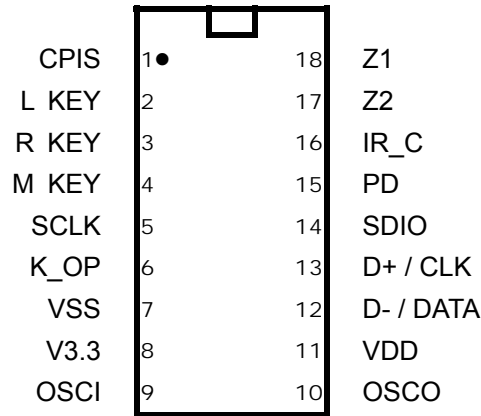
20 Pin PDIP (300MIL) eKM8053CP 3D 5K

20 Pin SOP (300MIL) eKM8053CM 3D 5K



3. Pin assignment

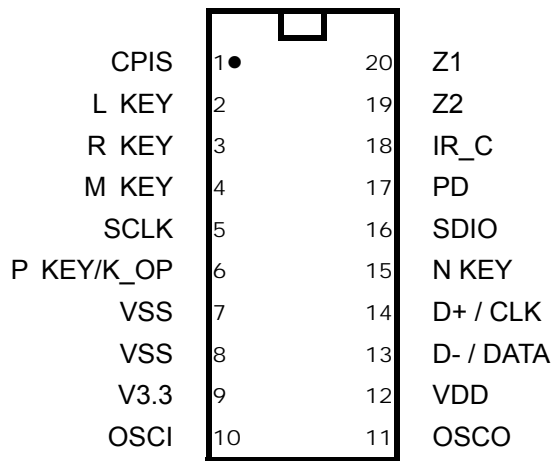
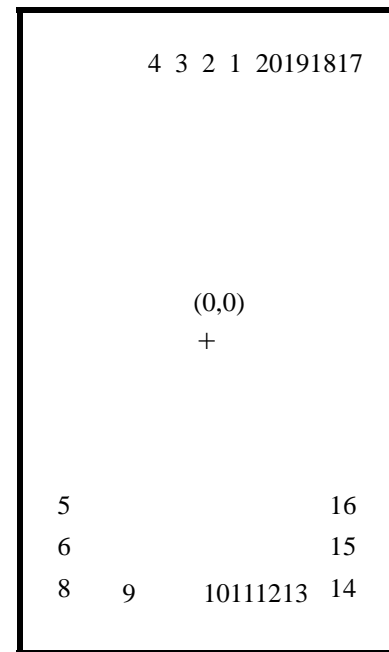
eKM8053B (18-Pin) for 3D3Buttons



eKM8053B (18-Pin)

Bounding PAD

Symbol	I/O	PIN	Function
CPIS	I	1	400/800 CPI Selection Pin , V3.3 : 800 CPI ; GND : 400 CPI
L KEY	I	2	Left Key Input
R KEY	I	3	Right Key Input
M KEY	I	4	Middle Key Input
SCLK	I/O	5	Serial Clock to Agilent sensor IC SCLK
K_OP	I	6	3D3K/3D5K Selection Pin , Connect to V3.3 for 3D3K ; Pull Low 1Mohm to GND for 3D5K
V _{SS}	-	7	GND
V _{3.3V}	O	8	3.3V DC voltage output from internal regulator. This pin has to be tied to a 4.7 μ F capacitor.
OSCI	I	9	6MHz ceramic resonator input.
OSCO	I/O	10	Return path for 6-MHz ceramic resonator.
V _{DD}	-	11	5 V Power Input
D- / DATA	I/O	12	USB D- or PS/2 Data I/O
D+ / CLK	I/O	13	USB D+ or PS/2 CLK I/O
SDIO	I/O	14	Serial Data from Agilent sensor IC SDIO
PD	I	15	2051 Power Down Pin
IR_C	I/O	16	IR Control Pin#1
Z2	I	17	Z axis Input 2
Z1	I	18	Z axis Input 1

eKM8053C (20-Pin) for 3D5Buttons

eKM8053C (20-Pin)

Bounding PAD

Symbol	I/O	PIN	Function
CPIS	I	1	400/800 CPI Selection Pin ; V3.3 : 800 CPI ; GND : 400 CPI
L KEY	I	2	Left Key Input
R KEY	I	3	Right Key Input
M KEY	I	4	Middle Key Input
SCLK	I/O	5	Serial Clock to Agilent sensor IC SCLK
K_OP	I	6	3D3K/3D5K Selection Pin , Connect to V3.3 for 3D3K ; Pull Low 1Mohm to GND for 3D5K
P KEY	I	6	Previous KEY Input
V _{SS}	-	7,8	GND
V _{3.3V}	O	9	3.3V DC voltage output from internal regulator. This pin has to be tied to a 4.7 μ F capacitor.
OSCI	I	10	6MHz ceramic resonator input.
OSCO	I/O	11	Return path for 6-MHz ceramic resonator.
V _{DD}	-	12	5 V Power Input
D- / DATA	I/O	13	USB D- or PS/2 Data I/O
D+ / CLK	I/O	14	USB D+ or PS/2 CLK I/O
N KEY	I	15	Next KEY Input
SDIO	I/O	16	Serial Data from Agilent sensor IC SDIO
PD	I	17	2051 Power Down Pin
IR_C	I/O	18	IR Control Pin#1
Z2	I	19	Z axis Input 2
Z1	I	20	Z axis Input 1

4. Function description

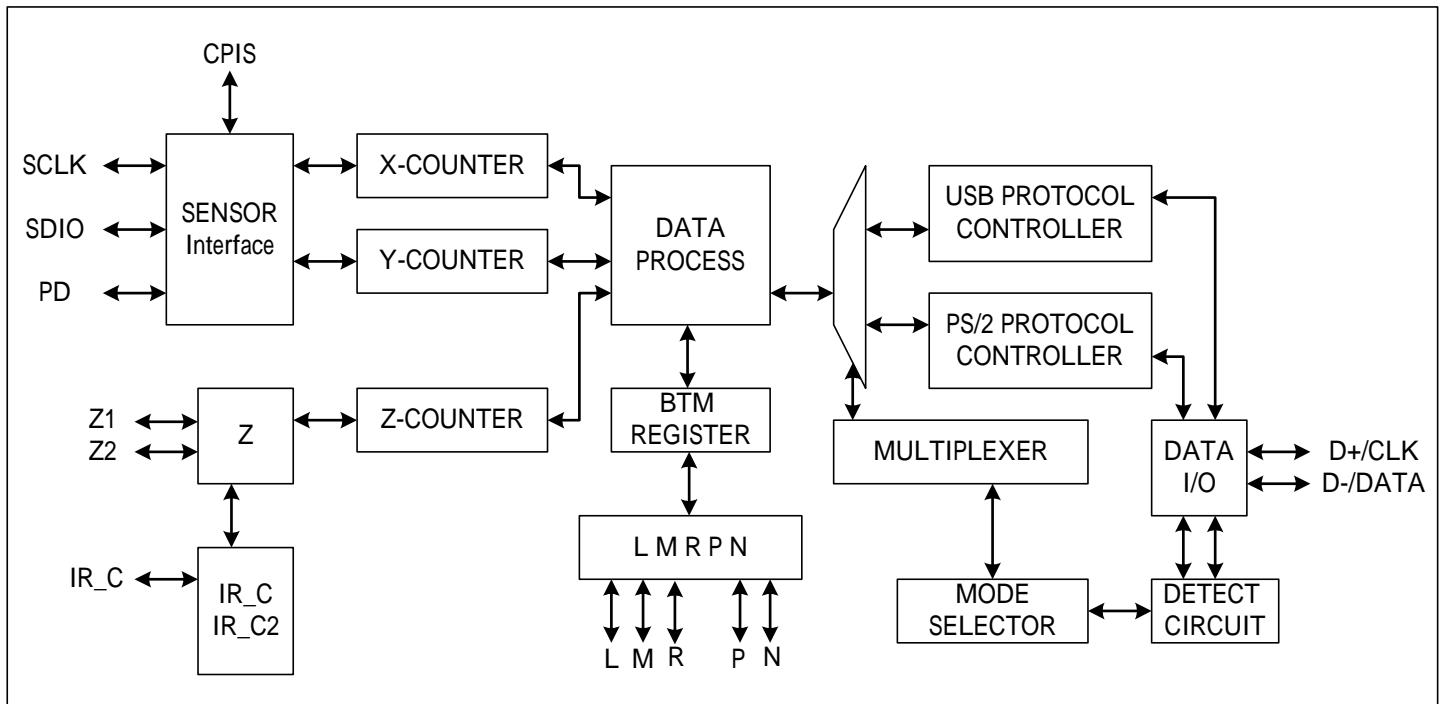
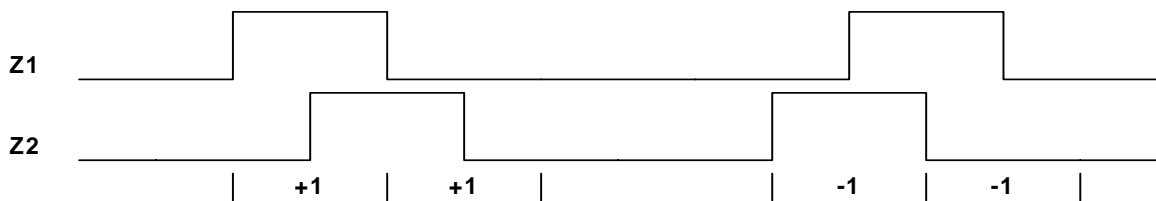


Fig-1 : Function block

Quadrature Signal Timing Diagram

Z Axis Counting

Z/2 COUNTING



Quadrature Output Crossed Width Limit



Note : For Z Axis ,T > 1ms

PS/2 function description

PS/2 Mouse Commands Description

Hex Code	Command	eKM8051 echo code
FF	Reset	FA,AA,00
FE	Resend	XX,(XX,XX)
F6	Set Default	FA
F5	Disable	FA
F4	Enable	FA
F3,XX	Set Sampling Rate	FA,FA
F2	Read Device Type	FA,00
F0	Set Remote Mode	FA
EE	Set Wrap Mode	FA
EC	Reset Wrap Mode	FA
EB	Read Data	FA,XX,XX,XX
EA	Set Stream Mode	FA
E9	Status Request	FA,XX,XX,XX
E8	Set Resolution	FA,FA
E7	Set Autospeed	FA
E6	Reset Autospeed	FA

Microsoft PS/2 scrolling mouse & 3D5K mode

- (A) Entering procedure of PS/2 scrolling mouse: Except in WRAP mode, while eKM8051 received the following consecutive command.
- i. F3 C8 ---- set sampling rate 200/sec
 - ii. F3 64 ---- set sampling rate 100/sec
 - iii. F3 50 ---- set sampling rate 80/sec
- (B) Entering procedure of 3D5K mode: after eKM8051 enter scrolling mouse mode (Mouse ID = 03), while eKM8051 received the following consecutive command.eKM8051 will enter 3D5K mode (Mouse ID:04)
- i F3 C8 ----- set sampling rate 200/sec
 - ii F3 C8 ---- set sampling rate 200/sec
 - iii F3 50 ---- set sampling rate 80/sec
- (C) Operating in PS/2 scrolling mouse:
- a. All of the commands in legacy mode still be valid.
 - b. The ID code of read device type command (F2) will changed from "00" to be "03".
 - c. Data report will be four bytes format:

【3D3Buttons Data Format】

Byte	Bit	Description
1	0	Left button status; 1 = pressed
	1	Right button status; 1 = pressed
	2	Middle button status; 1 = pressed
	3	Reserve to 1
	4	X data sign; 1 = negative
	5	Y data sign; 1 = negative
	6	X data overflow; 1 = overflow
2	7	Y data overflow; 1 = overflow
	0-7	X data (D0-D7)
	0-7	Y data (D0-D7)
3	0-7	Y data (D0-D7)
4	0-7	Z data (D0-D7)

(D) Operating in 3D5K mode:

- a. All of the commands in legacy mode still be valid.
- b. The ID code of read device type command (F2) will changed from "03" to be "04".
- c. Data report will be four bytes format:

【3D5Buttons Data Format】

Byte	Bit	Description
1	0	Left button status; 1 = pressed
	1	Right button status; 1 = pressed
	2	Middle button status; 1 = pressed
	3	Reserve to 1
	4	X data sign; 1 = negative
	5	Y data sign; 1 = negative
	6	X data overflow; 1 = overflow
2	7	Y data overflow; 1 = overflow
	0-7	X data (D0-D7)
	0-7	Y data (D0-D7)
3	0-7	Y data (D0-D7)
4	0-3	Z data (D0-D3)
4	4	P KEY status; 1 = pressed
4	5	N KEY status; 1 = pressed
4	6,7	Reserve to 0

(E) Exiting Microsoft scrolling mode & 3D5K mode:

There are two ways to exit:

- a. Power off.
- b. Reset command (FF).

Z-axis Input Function : The Z0-Z7 limit value is ± 7

Z-axis counter accumulates the Z1, Z2 phase changed by movement. This mode includes noise immunity.

Z/2 : 2 dot per count. The wheel should stay at Z1=0, Z2=0 or Z1=1, Z2=1 Phase



USB function Description

【Each Descriptor in USB Mode】

Descriptor Type	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Device Descriptor	12	01	10	01	00	00	00	08
	VID1	VID0	PID1	PID0	REV1	REV0	00	02
	00	01						
Configuration Descriptor	09	02	22	00	01	01	00	A0
	32							
Interface Descriptor	09	04	00	00	01	03	01	02
	00							
HID Descriptor	09	21	11	01	00	01	22	34
	00							
Endpoint	07	05	81	03	04	00	0A	
HID Report Descriptor	05	01	09	02	A1	01	09	01
	A1	00	05	09	19	01	29	KEY1
	15	00	25	01	95	KEY1	75	01
	81	02	95	01	75	KEY2	81	03
	05	01	09	30	09	31	09	38
	15	80	25	7F	75	08	95	03
	81	06	C0	C0				

*VID : Vendor ID (Default = 0x04F3)

*PID : Product ID (3D3K MOUSE = 0x0213 , 3D5K MOUSE = 0x0214)

*REV : Revision Number = 0x5300

*KEY1 : 3D3K MOUSE = 3, 3D5K MOUSE = 5

*KEY2 : 3D3K MOUSE = 5, 3D5K MOUSE = 3

【USB Mouse Report Data Type】

Byte0	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	0	0	0	N	P	M	R	L
Byte1	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	X-AXIS							
Byte2	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	Y-AXIS							
Byte3	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	Z-AXIS							

*3D3K MODE , P = N = 0.

5. Absolute Maximum Rating

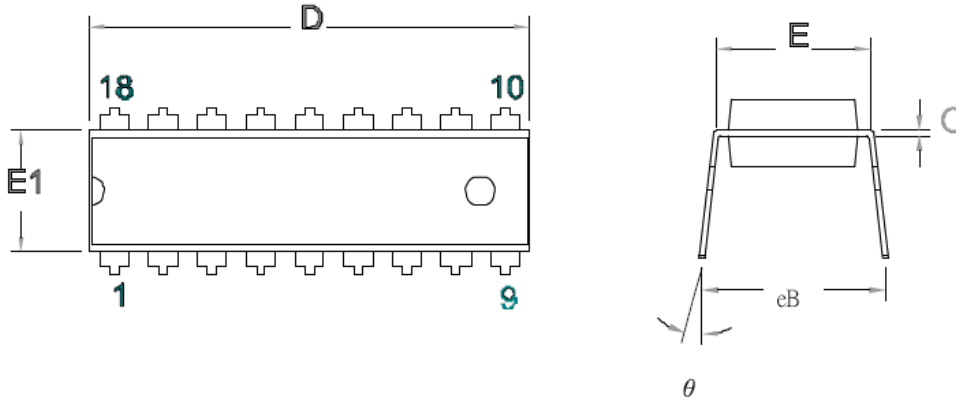
Symbol	min	Max	unit
Temperature under bias	0	70	°C
Storage temperature	-65	150	°C
Input voltage	-0.5	6.0	V
Output voltage	-0.5	6.0	V

6. Electrical Characteristic

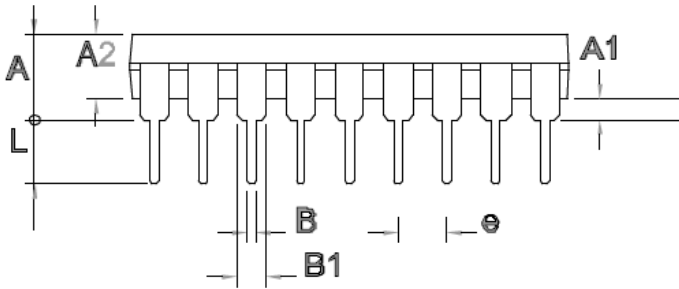
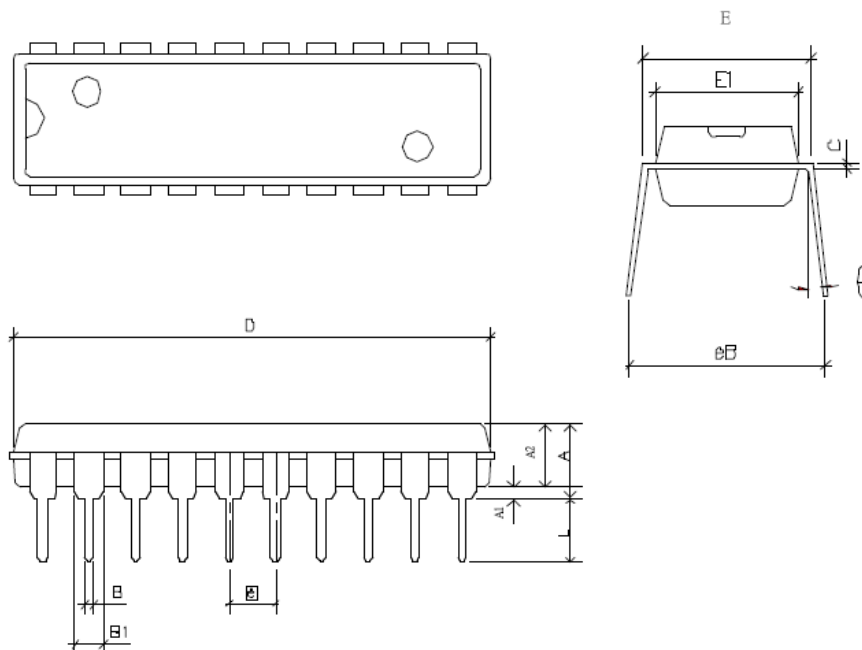
(T = 25°C, V_{DD}=4.4~5.2V, V_{SS}=0V)

Symbol	Parameter	Condition	Min	Type	Max	Unit
3.3V Regulator						
V _{Rag}	Output voltage of 3.3v Regulator	V _{DD} = 4.2V ~ 5.2V	3.0	3.3	3.6	V
V _{ResetL}	Low Power Reset detecting low Voltage			-	2.3	V
V _{ResetH}	Low Power Reset detecting high Voltage		2.4	-		V
MCU operating						
I _{IL}	Input Leakage Current for input pins	V _{IN} =V _{DD} ,V _{SS}	-	-	1	μA
V _{IHX}	Clock Input High Voltage	OSCI	2.5	-	-	V
V _{ILX}	Clock Input Low Voltage	OSCI	-	-	1.0	V
GPIO Pins						
V _{HL}	High/Low level transfer point	Input		1.1	-	V
V _{OH}	Output High Voltage	I _{Drive} = 5.0mA	2.4	-	-	V
V _{OL}	Output Low Voltage	I _{Sink} = 5.0mA	-	-	0.4	V
I _{PH}	Input current with pull-high resister	The input pin with internal pull-high resistor of Port6 or port7 is connected to V _{SS} .	-	25	-	μA
I _{PL}	Input current with pull-low resister	The input pin with internal pull-low resistor of Port6 is connected to V _{DD} .	-	330	-	μA
USB Interface						
V _{OH}	Static Output High	USB operation Mode	2.8	-	3.6	V
V _{OL}	Static Output Low		-	-	0.3	V
V _{DI}	Differential Input Sensitivity		0.2	-	-	V
V _{CM}	Differential Input Command Mode Range		0.8	-	2.5	V
V _{SE}	Single Ended Receiver Threshold	USB operation Mode	0.8	-	2.0	V
C _{IN}	Transceiver Capacitance		-	-	20	pF
V _{RG}	Output Voltage of Internal Regulator		3.0	-	3.6	V
R _{PH}	Internal Pull-high Resistor (USB Spec 5%)		-20%	1.5	+20%	k

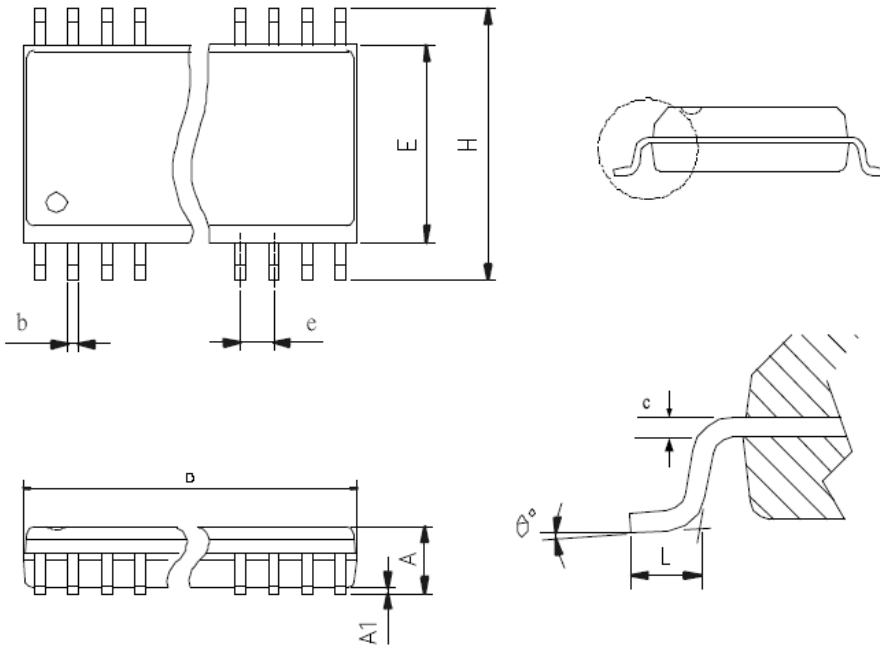
7. Package Diagram

PDIP-18L 300MIL PACKAGE OUTLINE DIMENSION(Unit:mm)


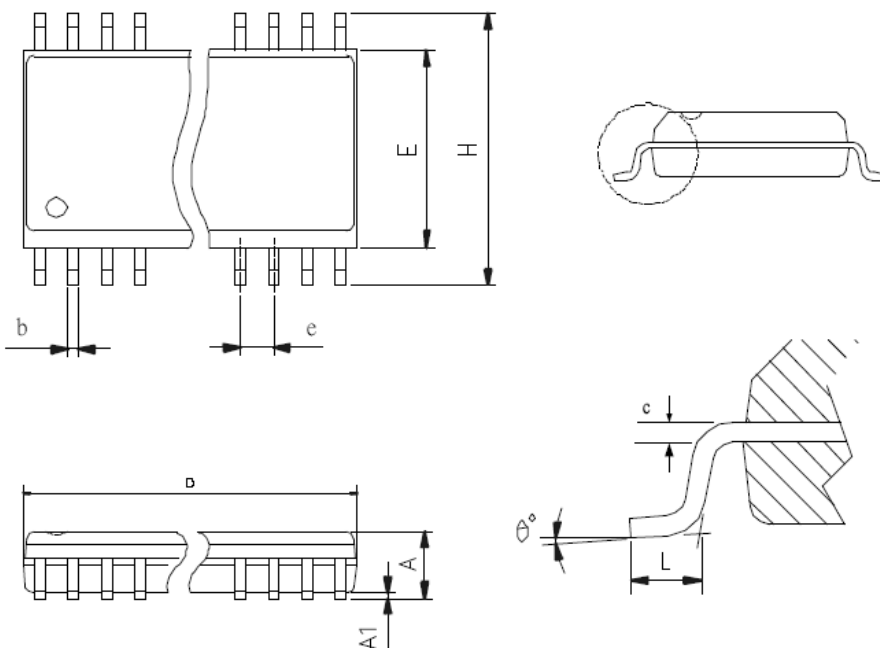
Symbol	Min	Normal	Max
A			4.450
A1	0.381		
A2	3.175	3.302	3.429
c	0.203	0.254	0.356
D	22.610	22.860	23.110
E1	6.220	6.438	6.655
E	7.370	7.620	7.870
eB	8.510	9.020	9.530
B	0.356	0.457	0.559
B1	1.143	1.524	1.778
L	3.048	3.302	3.556
e	2.540(TYP)		
θ	0		15


PDIP-20L 300MIL PACKAGE OUTLINE DIMENSION(Unit:mm)


Symbol	Min	Normal	Max
A			4.450
A1	0.381		
A2	3.175	3.302	3.429
c	0.203	0.254	0.356
D	25.883	26.060	26.237
E1	6.220	6.438	6.655
E	7.370	7.620	7.870
eB	8.510	9.020	9.530
B	0.356	0.457	0.559
B1	1.143	1.524	1.778
L	3.048	3.302	3.556
e	2.540(TYP)		
θ	0		15

SOP-18L 300MIL PACKAGE OUTLINE DIMENSION(Unit:mm)


Symbol	Min	Normal	Max
A	2.350		2.650
A1	0.102		0.300
b	0.406(TYP)		
c	0.230		0.320
E	7.400		7.600
H	10.000		10.650
D	11.350		11.750
L	0.406	0.838	1.270
e	1.27(TYP)		
θ°	0		8

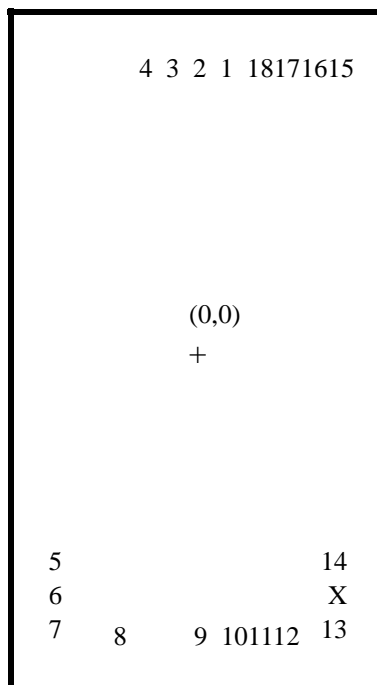
SOP-20L 300MIL PACKAGE OUTLINE DIMENSION(Unit:mm)


Symbol	Min	Normal	Max
A	2.350		2.650
A1	0.102		0.300
b	0.406(TYP)		
c	0.230		0.320
E	7.400		7.600
H	10.000		10.650
D	11.350		11.750
L	0.406	0.838	1.270
e	1.27(TYP)		
θ°	0		8



8. Pad List Information

eKM8053B Pad Configuration

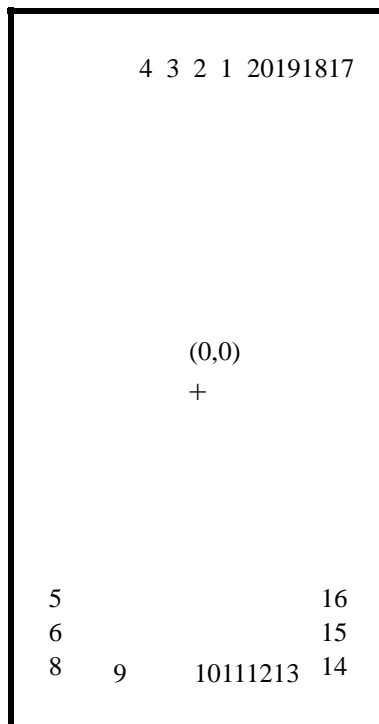


eKM8053B Pad Name & Coordinate Table

Chip Size : 1520*2580 UM		
Pad Number	Pad Name	Pad Coordinate (X, Y)
1	CPIS	196.5, 1176.7
2	L_KEY	91.5, 1176.7
3	R_KEY	-13.5, 1176.7
4	M_KEY	-118.5, 1176.7
5	SCLK	-652.7, -785
6	K_OP	-652.7, -890
7	VSS	-652.7, -997.5
8	V3.3	-304.45, -1182.6
9	OSCI	44.3, -1182.6
10	OSCO	149.3, -1182.6
11	VDD	256.9, -1182.6
12	D_MNS	364.4, -1182.6
13	D_PLUS	647.3, -1015.8
	NC	647.3, -901.6
14	SDIO	647.3, -796.6
15	PD	616.5, 1176.7
16	IR_C	511.5, 1176.7
17	Z2	406.5, 1176.7
18	Z1	301.5, 1176.7



eKM8053C Pad Configuration

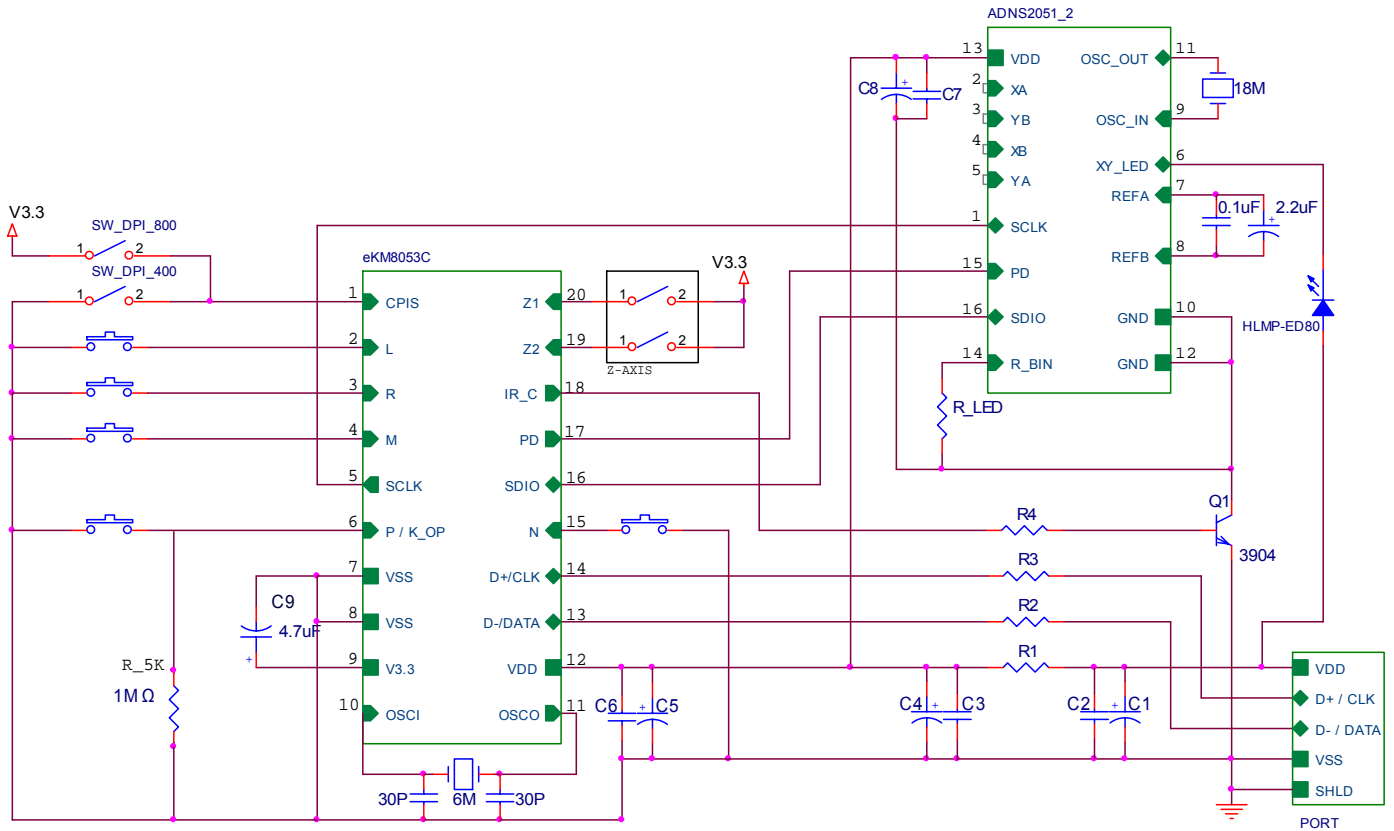


eKM8053C Pad Name & Coordinate Table

Chip Size : 1520*2580 UM		
Pad Number	Pad Name	Pad Coordinate (X, Y)
1	CPIS	196.5, 1176.7
2	L_KEY	91.5, 1176.7
3	R_KEY	-13.5, 1176.7
4	M_KEY	-118.5, 1176.7
5	SCLK	-652.7, -785
6	P_KEY/K_OP	-652.7, -890
7		
8	VSS	-652.7, -997.5
9	V3.3	-304.45, -1182.6
10	OSCI	44.3, -1182.6
11	OSCO	149.3, -1182.6
12	VDD	256.9, -1182.6
13	D_MNS	364.4, -1182.6
14	D_PLUS	647.3, -1015.8
15	N_KEY	647.3, -901.6
16	SDIO	647.3, -796.6
17	PD	616.5, 1176.7
18	IR_C	511.5, 1176.7
19	Z2	406.5, 1176.7
20	Z1	301.5, 1176.7

9. Application Circuit

NOTICE DIAGRAM



COMPONENTS IN DETAIL

	R1	R2	R3	R4	C1	C2	C3
NORMAL APPLICATION	10	-	-	1.5K	10uF	0.1uF(104)	-
EFT BETTER IMPROVEMENT		33	33				0.1uF(104)
	C4	C5	C6	C7	C8	C9	
NORMAL APPLICATION	-	10uF	0.1uF(104)	0.1uF(104)	4.7uF	4.7uF	
EFT BETTER IMPROVEMENT	10uF						

** C5 & C6 have to be closed to MCU(VDD)

** C7 & C8 have to be closed to Sensor(VDD).

** C9 has to be closed to MCU(V3.3)

** CPIS is HIGH LEVEL(3.3V) for 800DPI ; LOW LEVEL(GND) for 400DPI

** R_5K is connected to V3.3 for 3D3Key Type or 1M PULL-Low to GND for 3D5Key Type

R_LED For ADNS2051

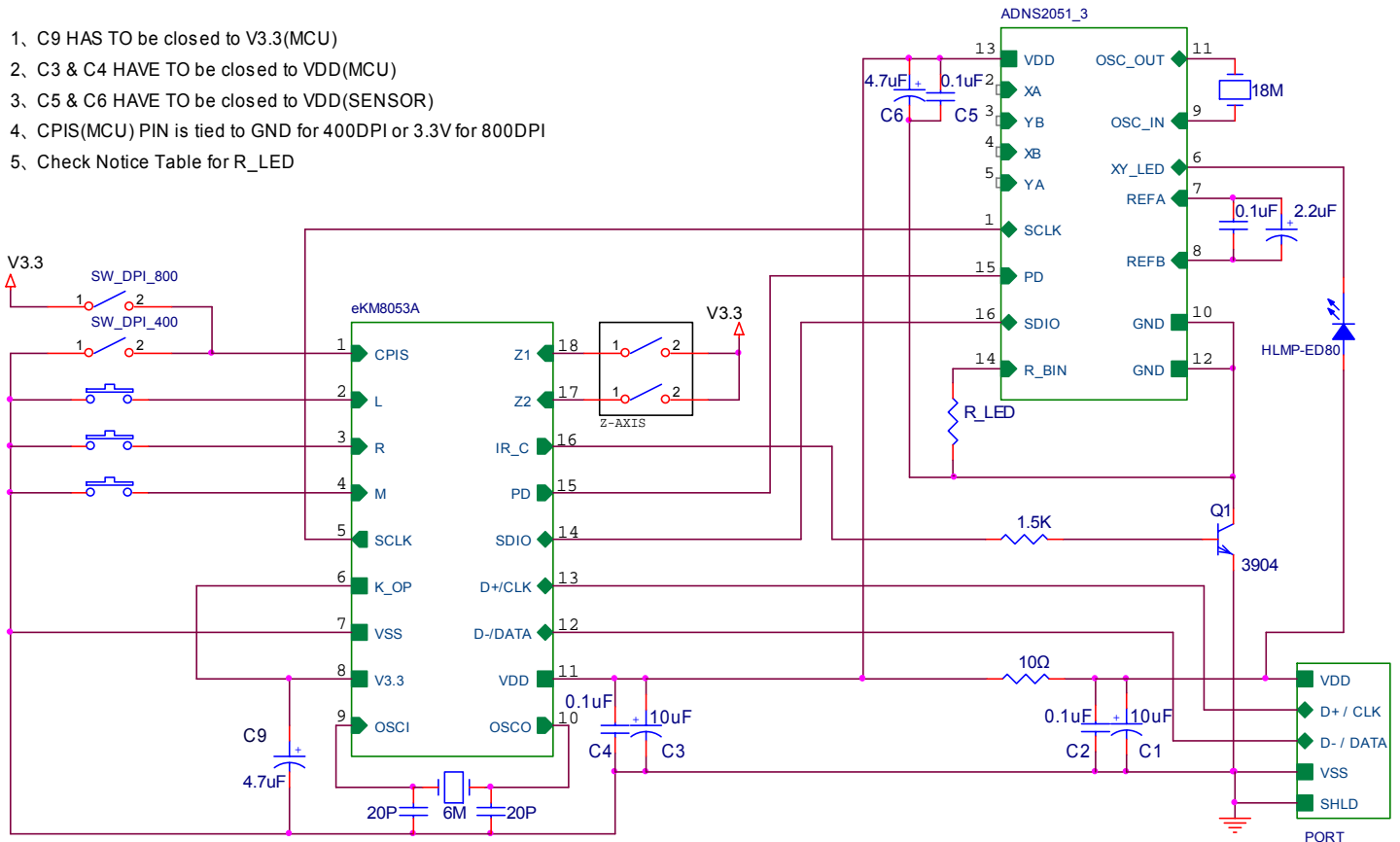
LED BIN	K / L / M / N / P	Q	R	S	T	U
R_LED(K)	15	15~18	15~22	15~27	15~33	15~37

R_LED For ADNS26X0

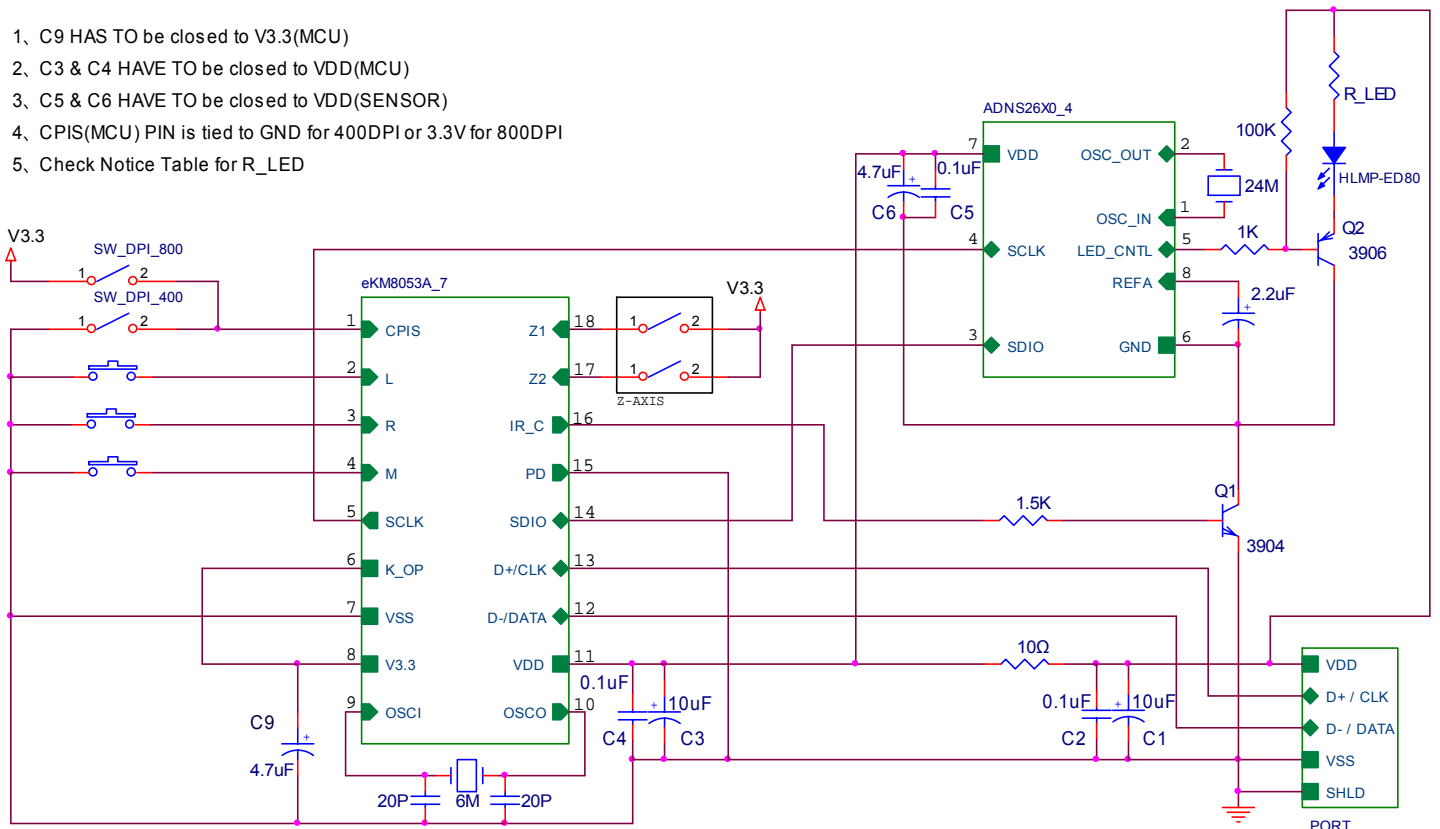
LED BIN	K / L / M / N	P	Q	R	S	T
R_LED()	68.9	78.9	93.1	113	137	169

eKM8053B_Mechanical Z/2 3D3Key Application For ADNS2051

- 1、C9 HAS TO be closed to V3.3(MCU)
- 2、C3 & C4 HAVE TO be closed to VDD(MCU)
- 3、C5 & C6 HAVE TO be closed to VDD(SENSOR)
- 4、CPIS(MCU) PIN is tied to GND for 400DPI or 3.3V for 800DPI
- 5、Check Notice Table for R_LED

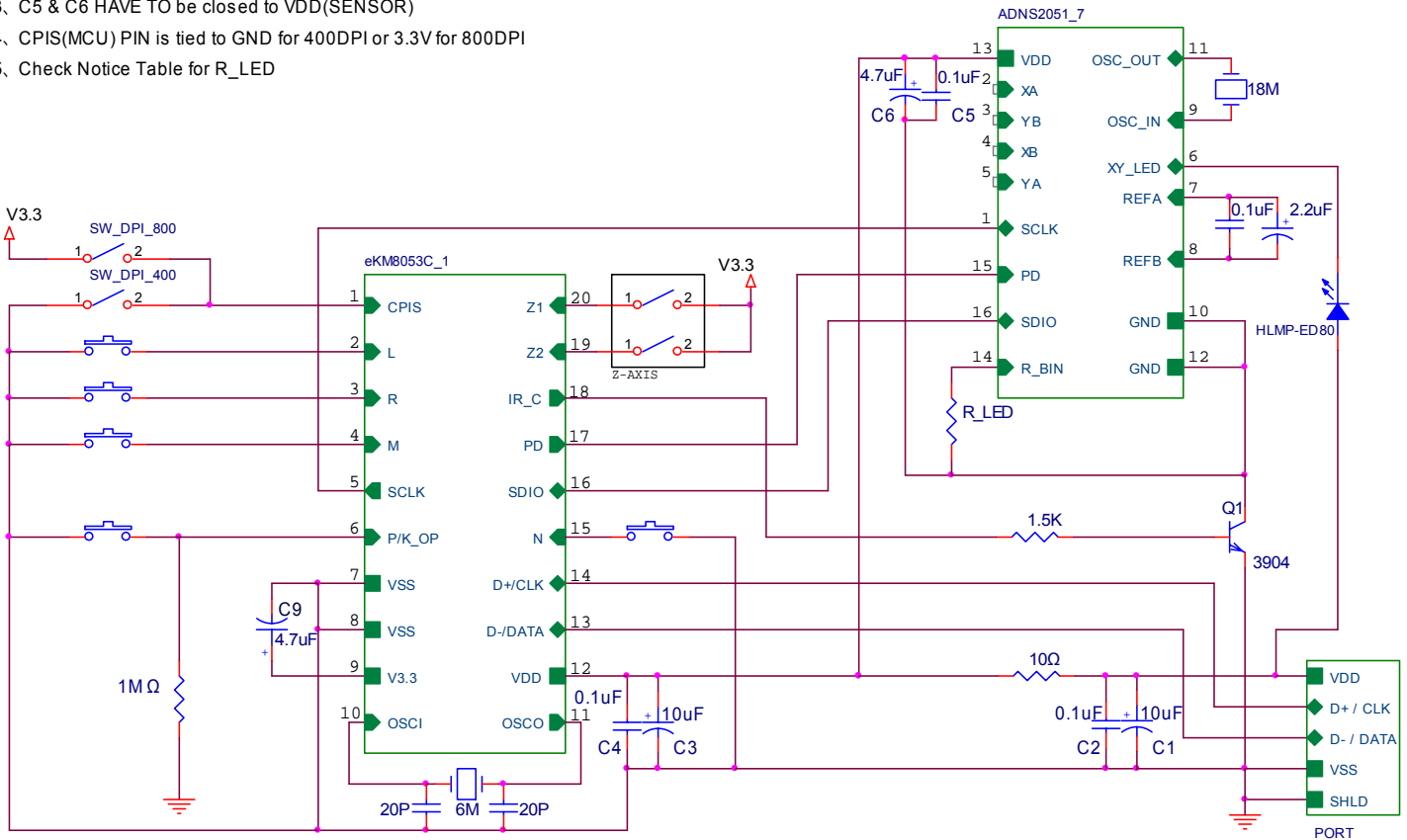

eKM8053B_Mechanical Z/2 3D3Key Application For ADNS26X0

- 1、C9 HAS TO be closed to V3.3(MCU)
- 2、C3 & C4 HAVE TO be closed to VDD(MCU)
- 3、C5 & C6 HAVE TO be closed to VDD(SENSOR)
- 4、CPIS(MCU) PIN is tied to GND for 400DPI or 3.3V for 800DPI
- 5、Check Notice Table for R_LED

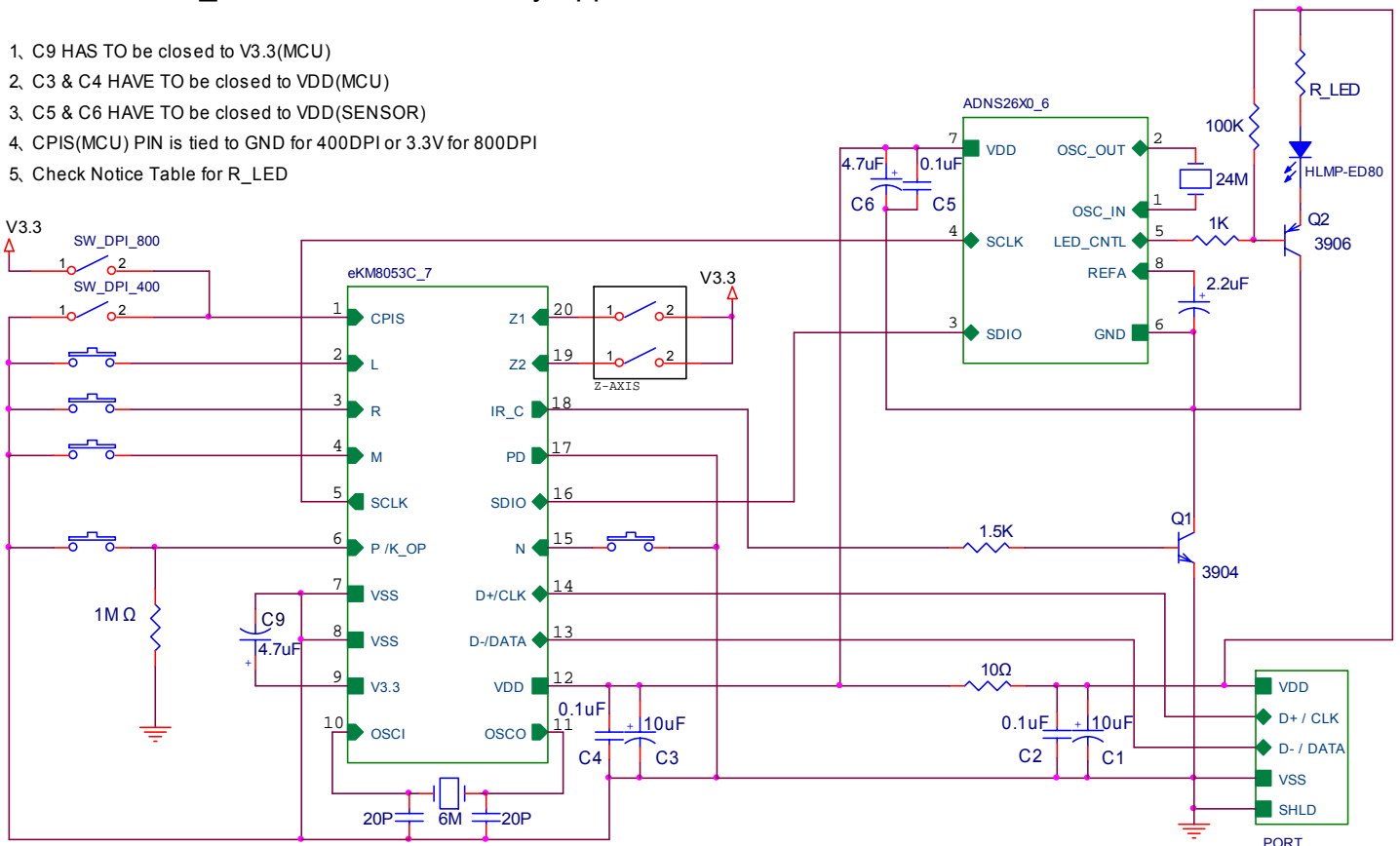


eKM8053C_Mechanical Z/2 3D5Key Application For ADNS2051

1. C9 HAS TO be closed to V3.3(MCU)
2. C3 & C4 HAVE TO be closed to VDD(MCU)
3. C5 & C6 HAVE TO be closed to VDD(SENSOR)
4. CPIS(MCU) PIN is tied to GND for 400DPI or 3.3V for 800DPI
5. Check Notice Table for R_LED


eKM8053C_Mechanical Z/2 3D5Key Application For ADNS26X0

1. C9 HAS TO be closed to V3.3(MCU)
2. C3 & C4 HAVE TO be closed to VDD(MCU)
3. C5 & C6 HAVE TO be closed to VDD(SENSOR)
4. CPIS(MCU) PIN is tied to GND for 400DPI or 3.3V for 800DPI
5. Check Notice Table for R_LED



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