

1. General Description

The EKM8022 is an Mouse Controller designed to **control both USB & PS/2 Mouse device with 400/800 dpi selector for XY Quadrature**. This Mouse Controller can auto detect USB or PS/2 mode, and supports X,Y,Z three axes with 400/800 dpi, and L, R, M three 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) 3 Key (L,R,M) input.
- ◆ Support Z/2 mechanical and Z/4 Photo(eKM8022B) Z-axis input type.
- ◆ Support Agilent HDNS-2000 、ADNS2051 、ELAN eKL0001 、PixArt PAN101BOI/BSI Optical Mouse Sensor.
- ◆ Applications :
 - 3D, 3 Buttons USB and PS/2 Combo Mouse with 400/800 dpi.
- ◆ Package :
 - ◇ DIP18 — eKM8022AP
 - ◇ SOP18 — eKM8022AM
 - ◇ DIP20 — eKM8022BP
 - ◇ SOP20 — eKM8022BM

3. Pin assignment

◆eKM8022A (18-Pin)

L KEY	1 ●	18	X1
IR_C	2	17	X2
Z1	3	16	Y1
Z2	4	15	Y2
R KEY	5	14	M KEY
D_SEL	6	13	D+/CLK
VSS	7	12	D-/Data
V3.3	8	11	VDD
OSCI	9	10	OSCO

Symbol	I/O	PIN	Function
OSCI	I	9	6MHz ceramic resonator input.
OSCO	I/O	10	Return path for 6-MHz ceramic resonator.
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.
X1	I	18	X axis Input 1
X2	I	17	X axis Input 2
Y1	I	16	Y axis Input 1
Y2	I	15	Y axis Input 2
Z1	I	3	Z axis Input 1
Z2	I	4	Z axis Input 2
R	I	5	Right Key Input
M	I	14	Middle Key Input
L	I	1	Left Key Input
IR_C	I/O	2	IR Control Pin.
D_SEL	I	6	400DPI : Floating , 800DPI : Ground
D+ / CLK	I/O	13	USB D+ or PS/2 CLK I/O
D- / DATA	I/O	12	USB D- or PS/2 Data I/O
V _{DD}	-	11	5 V Power Input
V _{SS}	-	7	GND

◆eKM8022B (20-Pin)

L KEY	1 ●	20	X1
IR_C	2	19	X2
Z1	3	18	Y1
Z2	4	17	Y2
R KEY	5	16	M KEY
D_SEL	6	15	IR_C2
VSS	7	14	D+/CLK
VSS	8	13	D-/Data
V3.3	9	12	VDD
OSCI	10	11	OSCO

Symbol	I/O	PIN	Function
OSCI	I	10	6MHz ceramic resonator input.
OSCO	I/O	11	Return path for 6-MHz ceramic resonator.
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.
X1	I	20	X axis Input 1
X2	I	19	X axis Input 2
Y1	I	18	Y axis Input 1
Y2	I	17	Y axis Input 2
Z1	I	3	Z axis Input 1
Z2	I	4	Z axis Input 2
R	I	5	Right Key Input
M	I	16	Middle Key Input
L	I	1	Left Key Input
IR_C	I/O	2	IR Control Pin.
IR_C2	I/O	15	IR Control Pin
D_SEL	I	6	400DPI : Floating , 800DPI : Ground
D+ / CLK	I/O	14	USB D+ or PS/2 CLK I/O
D- / DATA	I/O	13	USB D- or PS/2 Data I/O
V _{DD}	-	12	5 V Power Input
V _{SS}	-	7,8	GND

4. Function description

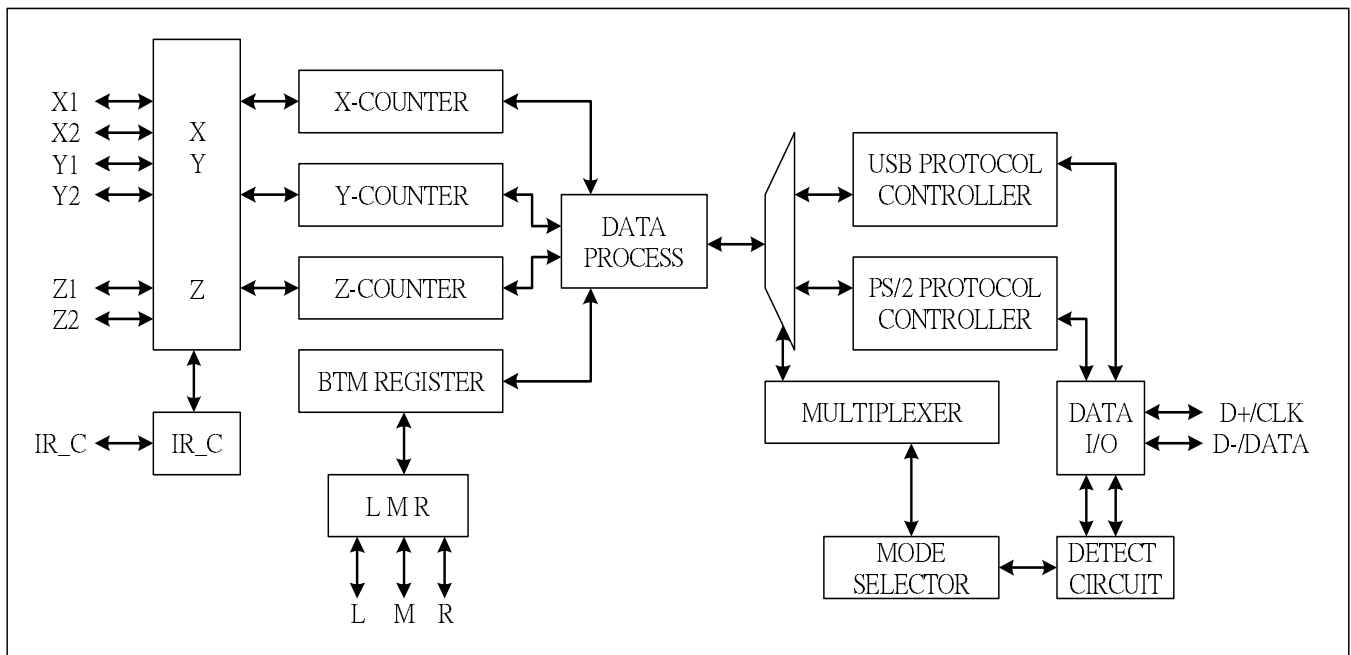


Fig-1 : Function block

◆PS/2 function description

◇PS/2 Mouse Commands Description

Hex Code	Command	EKM8022 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

(A) Entering procedure: Except in WRAP mode, while eKM8022 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) Operating:

- 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:

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

(C) Exiting Microsoft scrolling 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

Z/4 : 4 dots per count. the wheel should stay at Z1=0, Z2=0 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
	67	12	10	02	01	00	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	00	01	00	01	22	48
	00							
Endpoint	07	05	81	03	08	00	0A	
HID Report Descriptor	05	01	09	02	A1	01	05	09
	19	01	29	04	15	00	25	01
	95	04	75	01	81	02	95	01
	75	04	81	03	05	01	09	01
	A1	00	09	30	09	31	15	81
	25	7F	75	08	95	02	81	06
	C0	09	38	95	01	81	06	09
	3C	15	00	25	01	75	01	95
	01	B1	22	95	07	B1	01	C0

◇USB Mouse Report Data Type

Byte0	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	0	0	0	0	0	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							

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

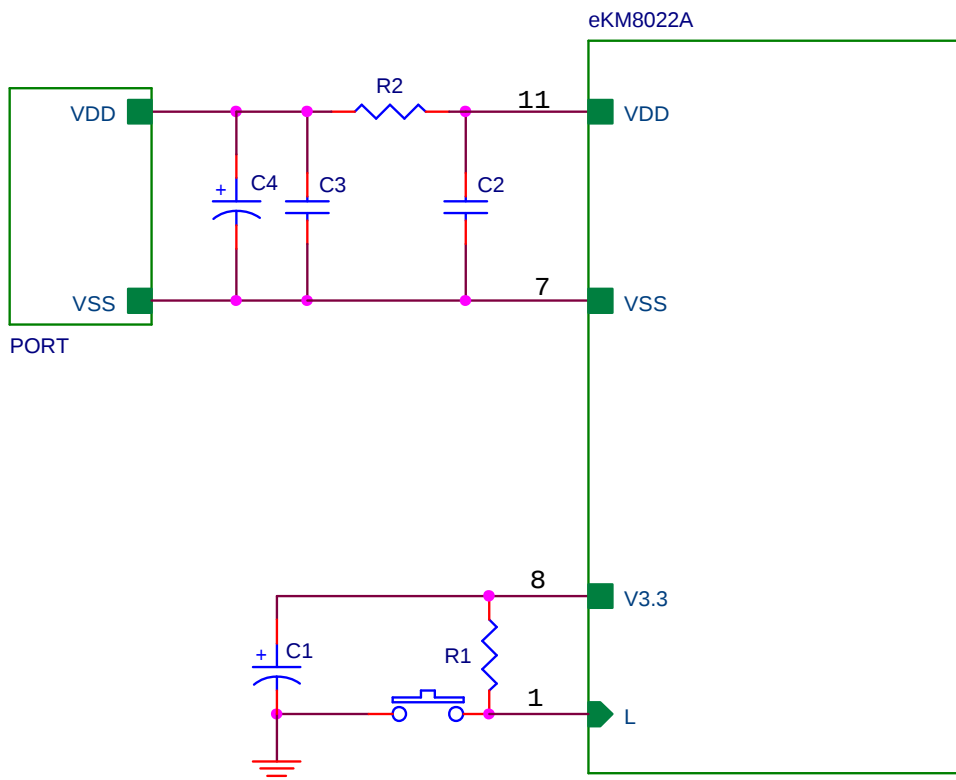
6. Electrical Characteristic

(T = 0°C ~70°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		-20%	1.5	+20%	kΩ

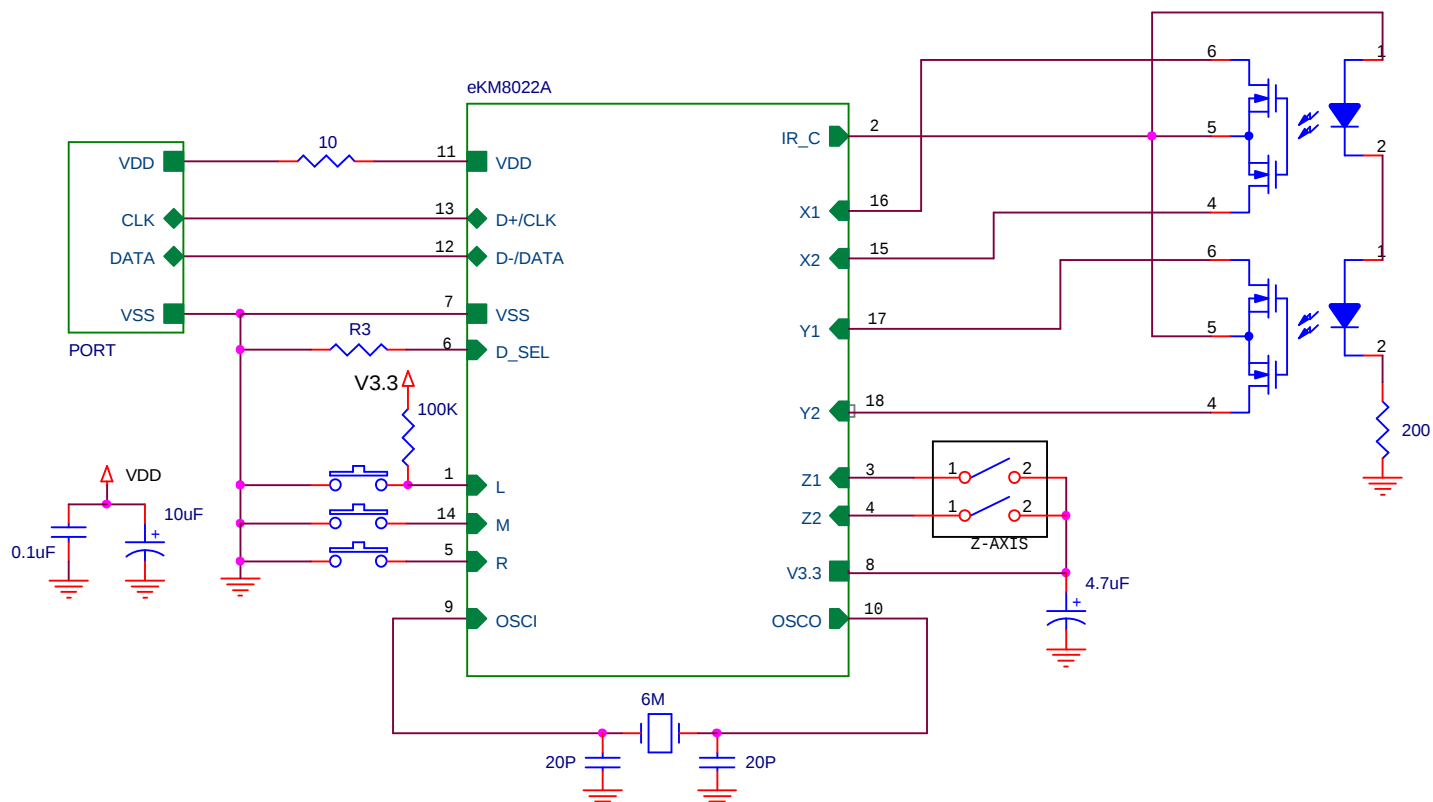
7. Application circuit

◆NOTICE



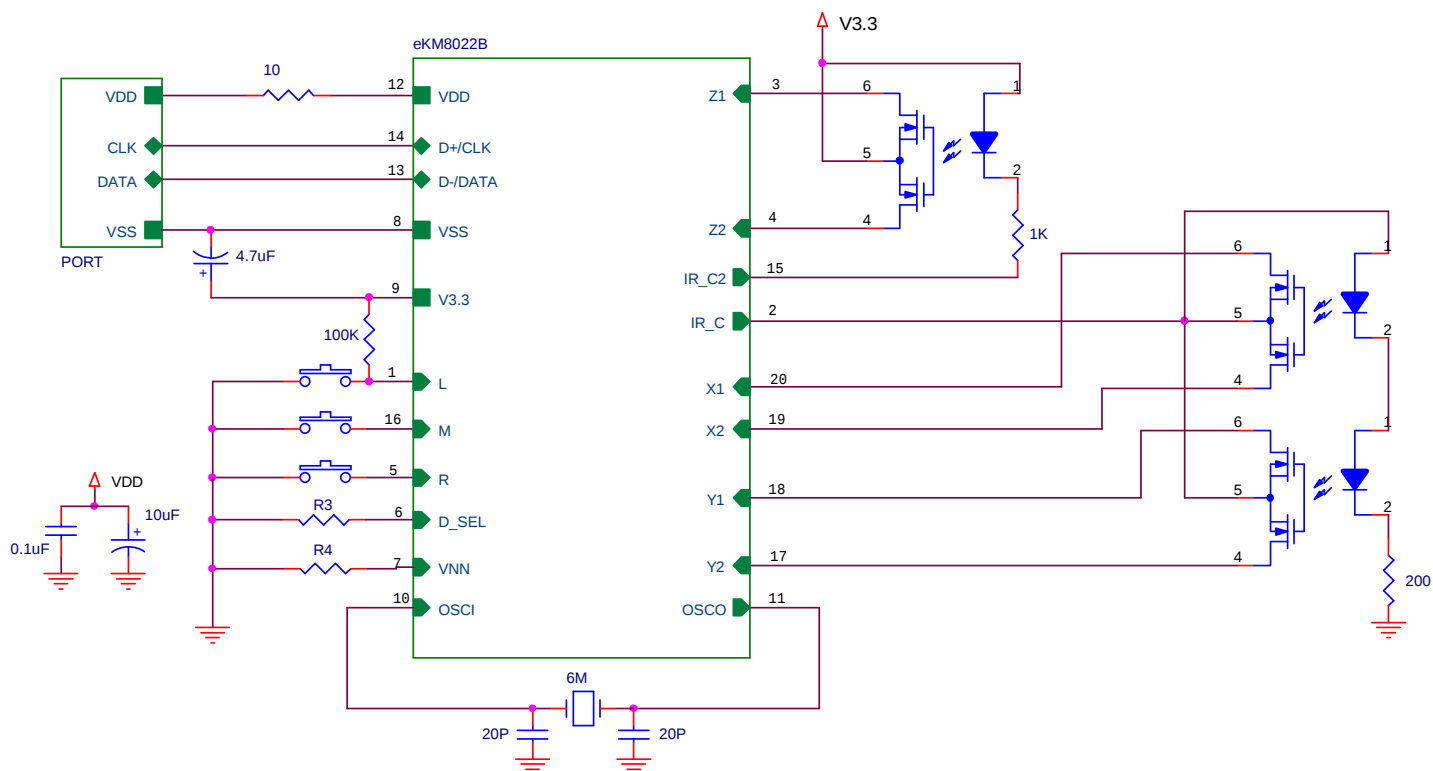
- ◇ $R1 = 100K\Omega$ For eKM8022 MTP
- ◇ $R2 = 10\Omega$ For Keeping From EST
- ◇ $C1 = 4.7\mu F$ Should Be Close To V3.3
- ◇ $C2 = 10\mu F$ Should Be Close To eKM8022 For Keeping From ESD
- ◇ $C3 = 0.1\mu F$ Should Be close To Port For Keeping From ESD
- ◇ $C4$ Is Reserved For Keeping From EMI

◆eKM8022A_Mechanical Z/2 Application For Ball Type

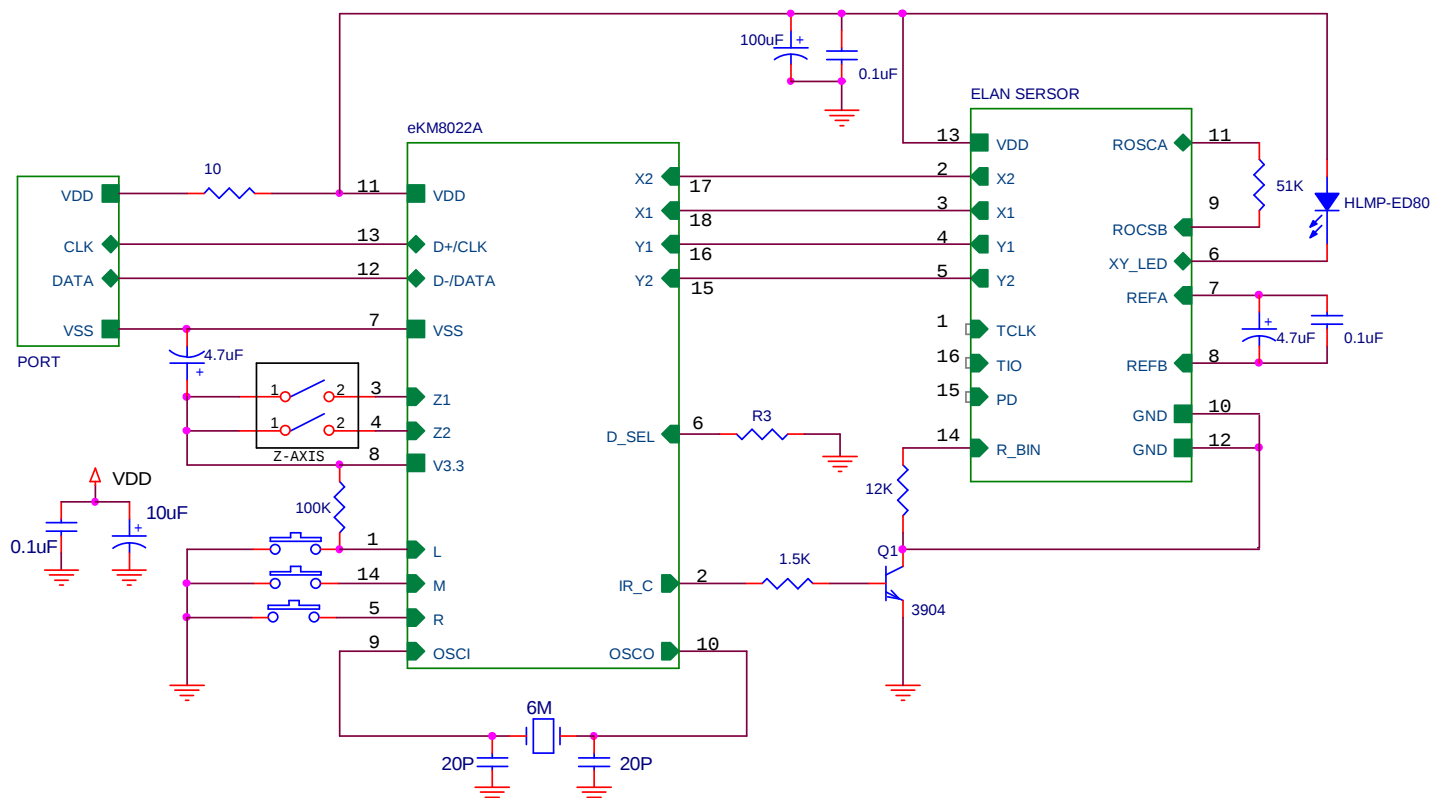


NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI .

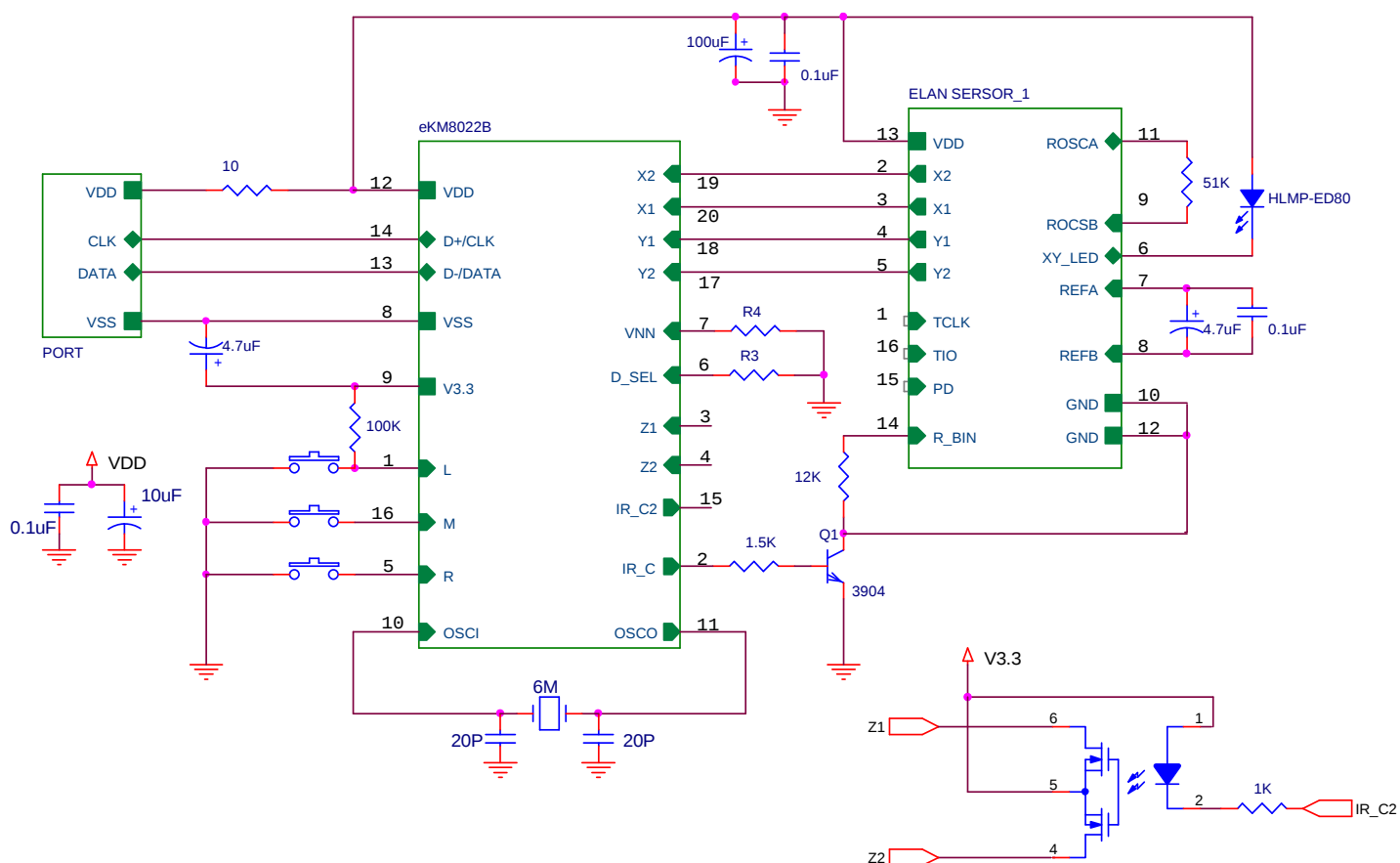
◆eKM8022B Photo_Z/4 Application For Ball Type



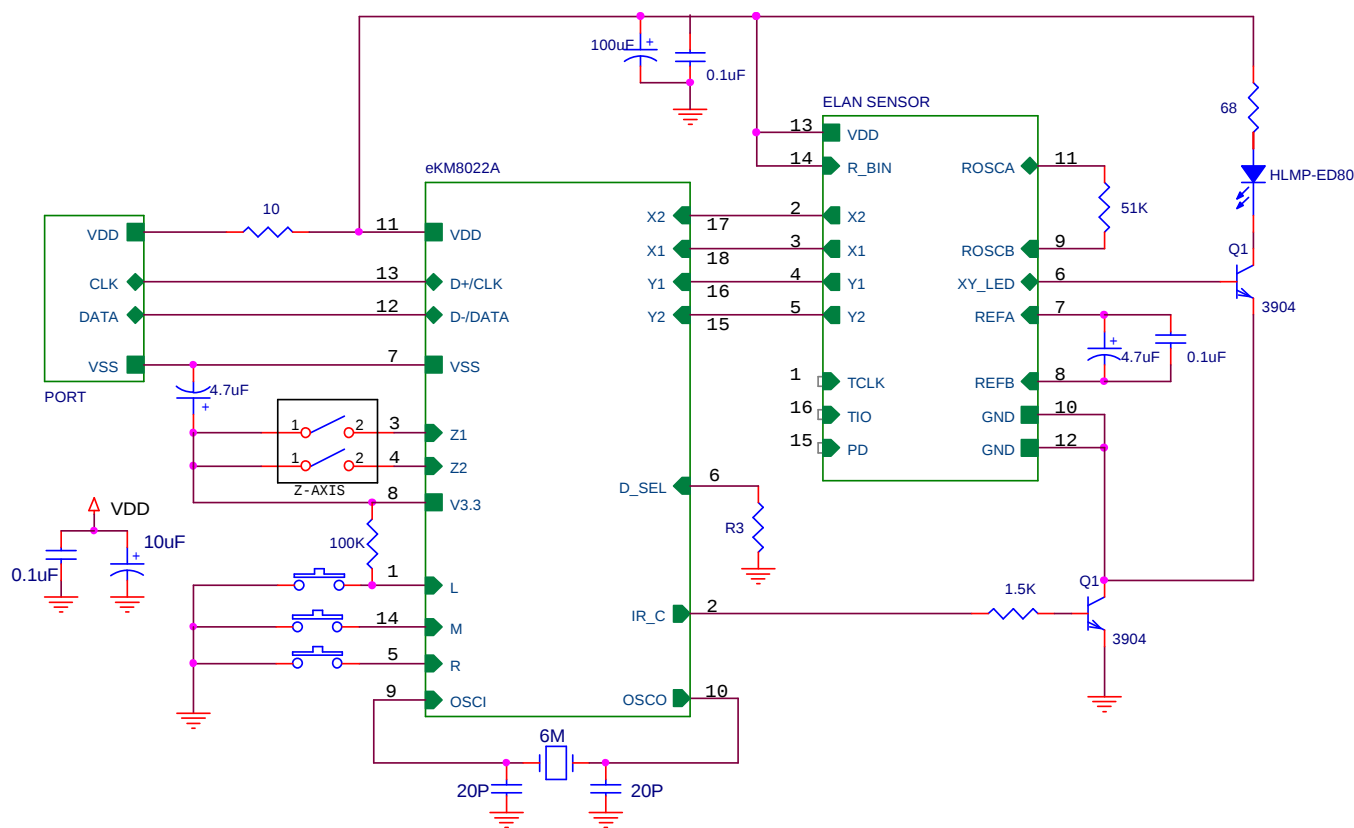
NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI ; R4 GND AND L KEY PULL HIGH 100K FOR MTP .

◆eKM8022A_Mechanical Z/2 Application For OM01(ADNS2051 Compatible)


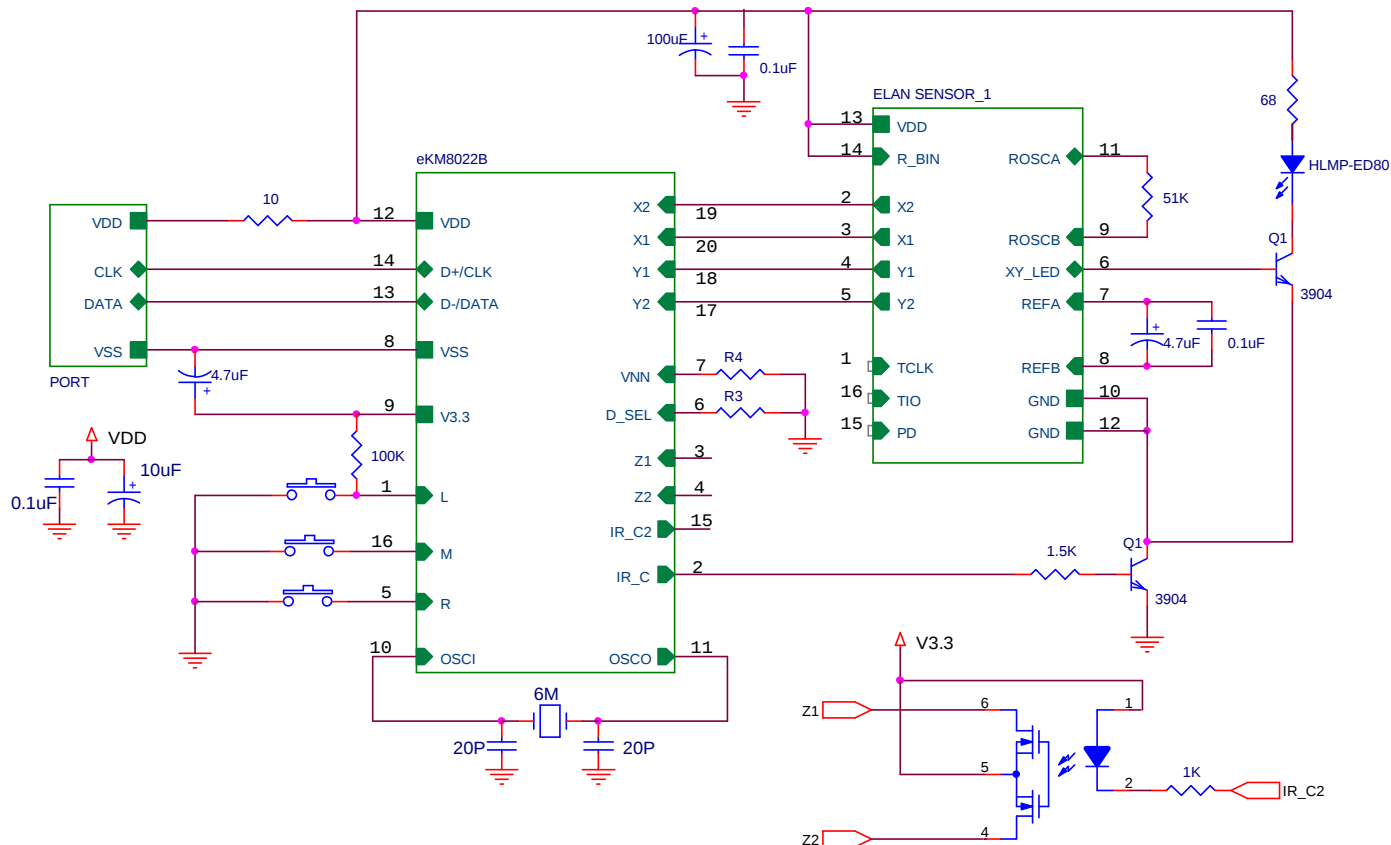
NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI .

◆eKM8022B_Photo Z/4 Application For e OM01 (ADNS2051 Compatible)


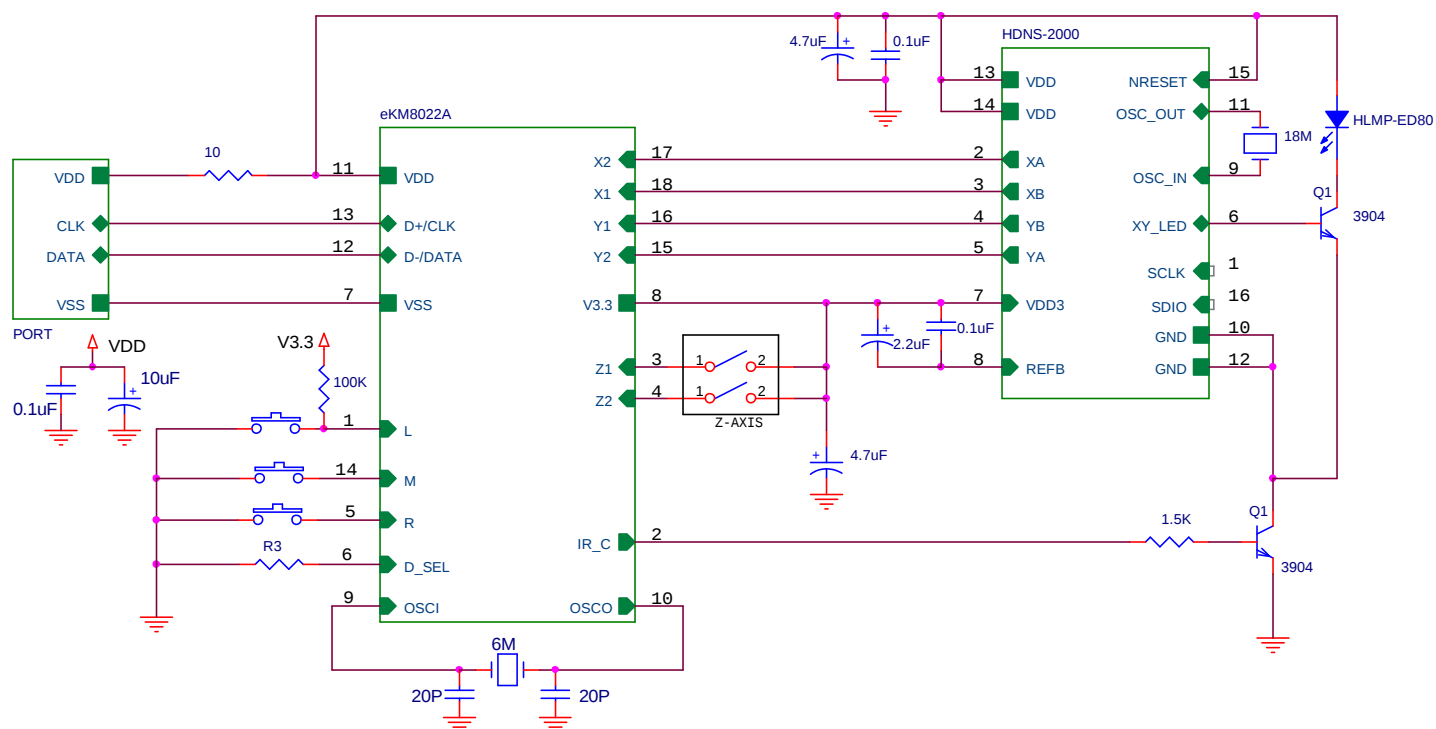
NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI ; R4 GND AND L KEY PULL HIGH 100K FOR MTP .

◆eKM8022A_Mechanical Z/2 Application For OM01 (HDNS2000 Compatible)


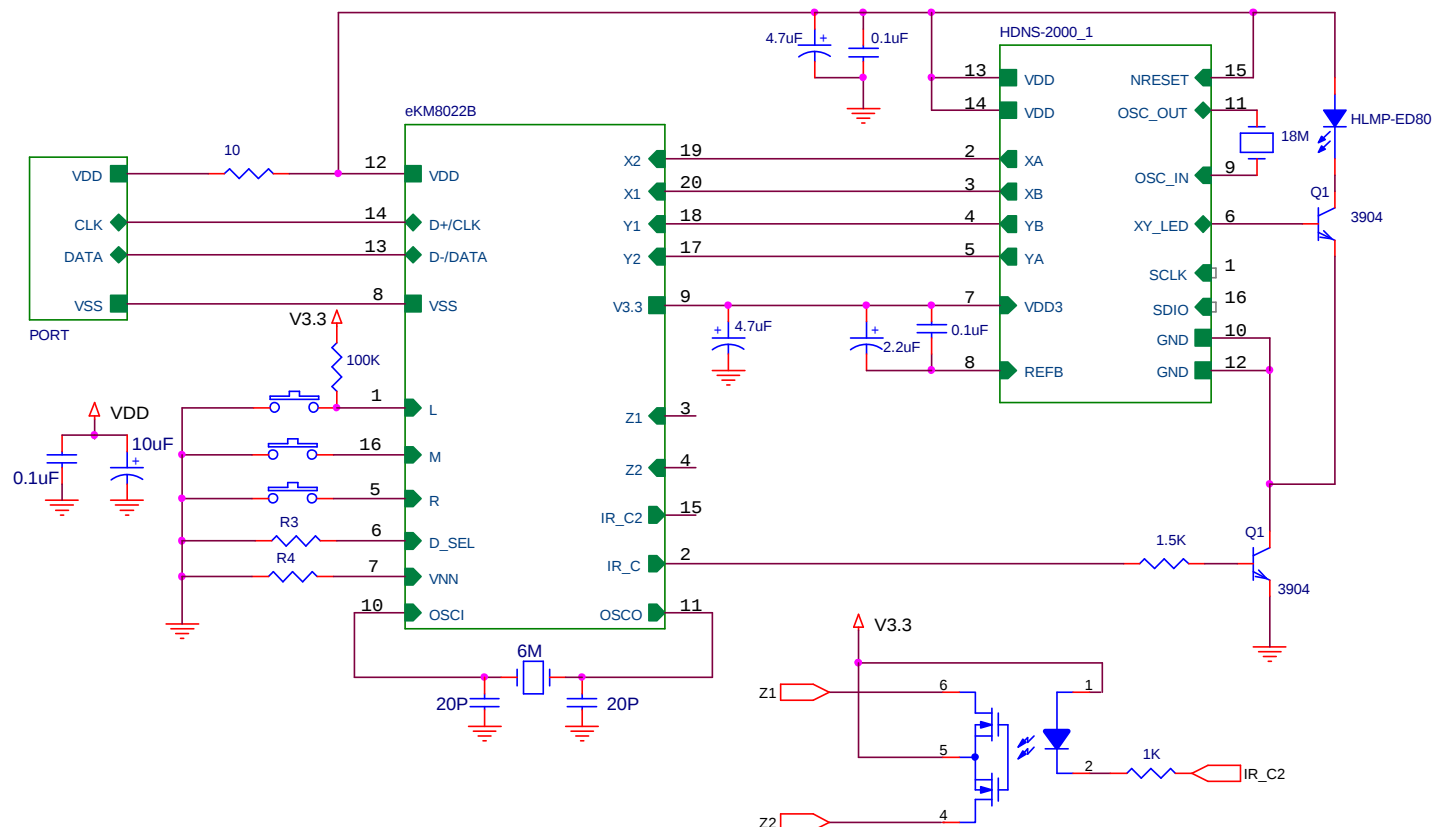
NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI .

◆eKM8022B_Photo Z/4 Application For OM01 (HDNS2000 Compatible)


NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI ; R4 GND AND L KEY PULL HIGH 100K FOR MTP .

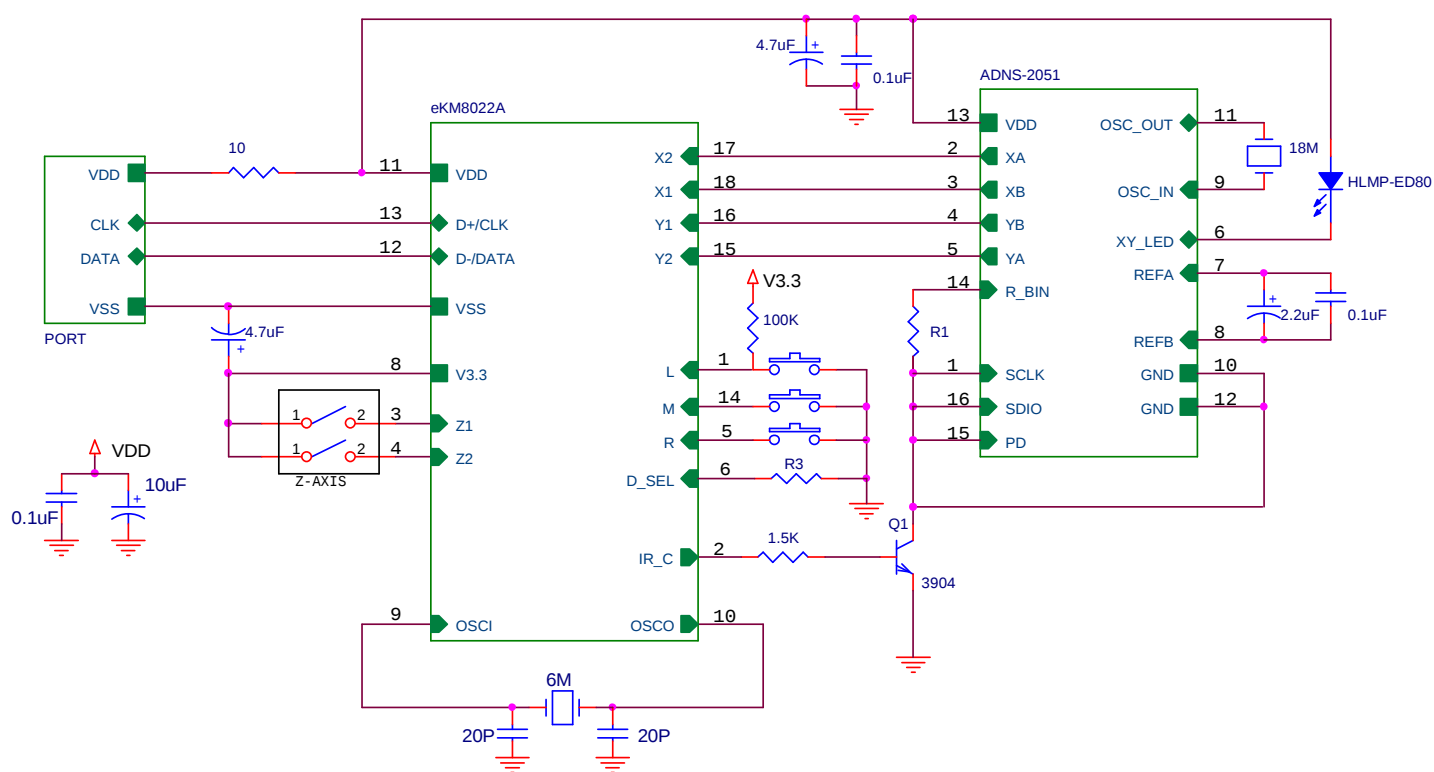
◆eKM8022A_Mechanical Z/2 Application For HDNS2000


NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI .

◆eKM8022B_Photo Z/4 Application For HDNS2000


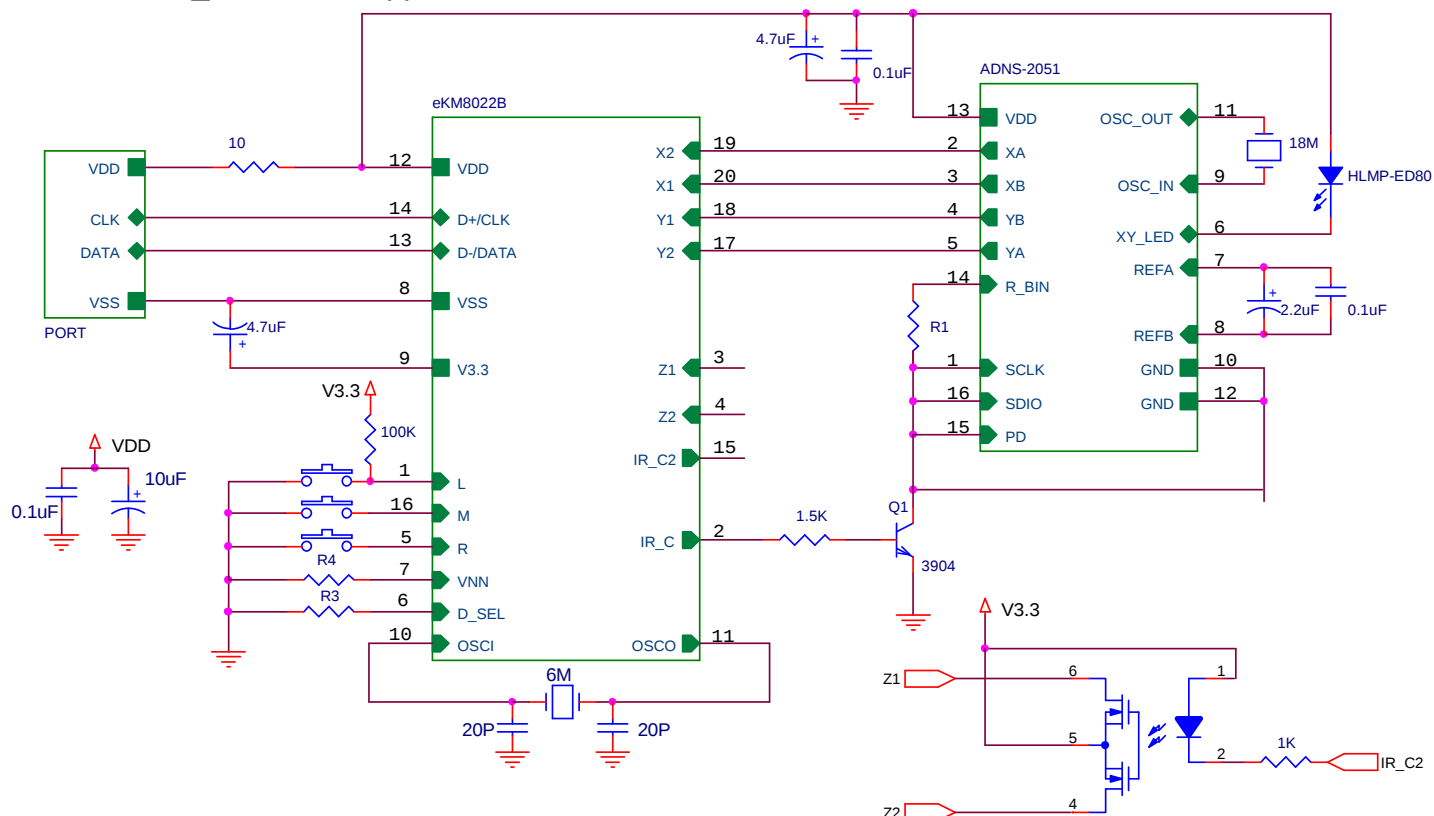
NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI ; R4 GND AND L KEY PULL HIGH 100K FOR MTP .

◆eKM8022A_Mechanical Z/2 Application For ADNS 2051

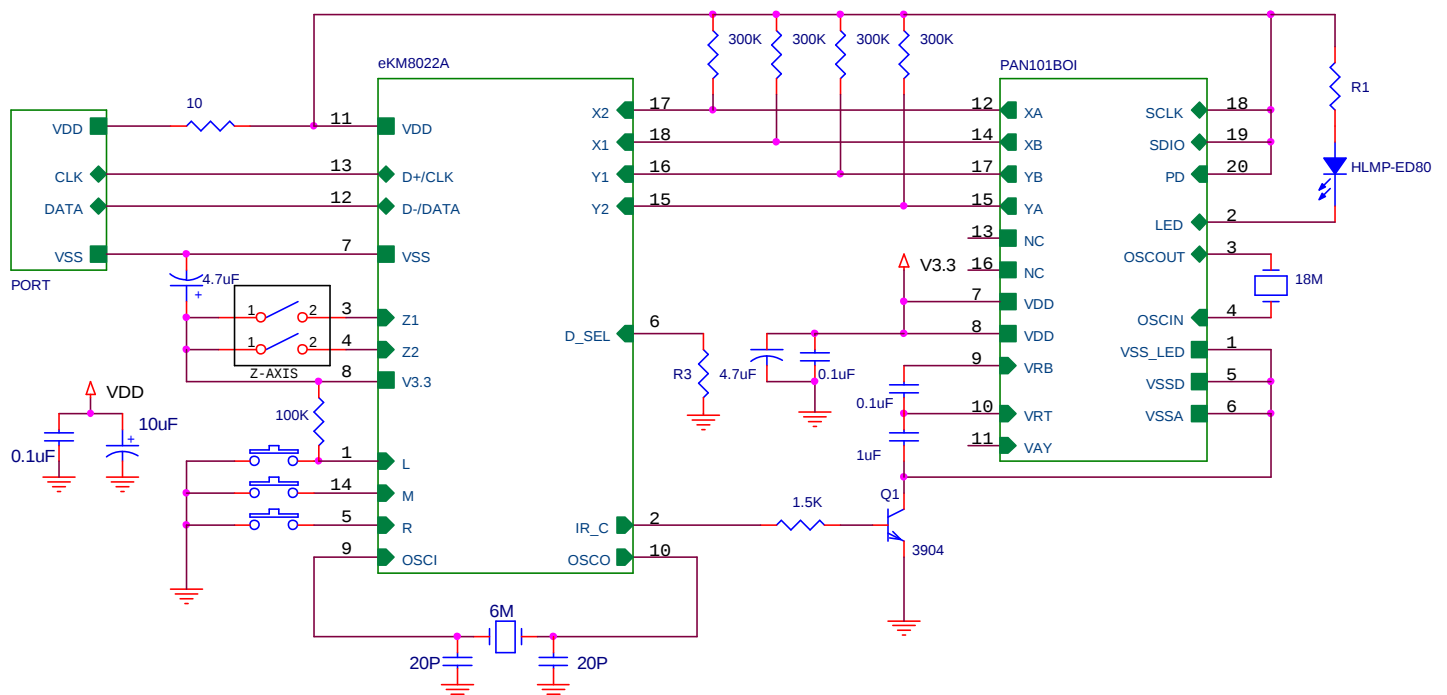


NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI .

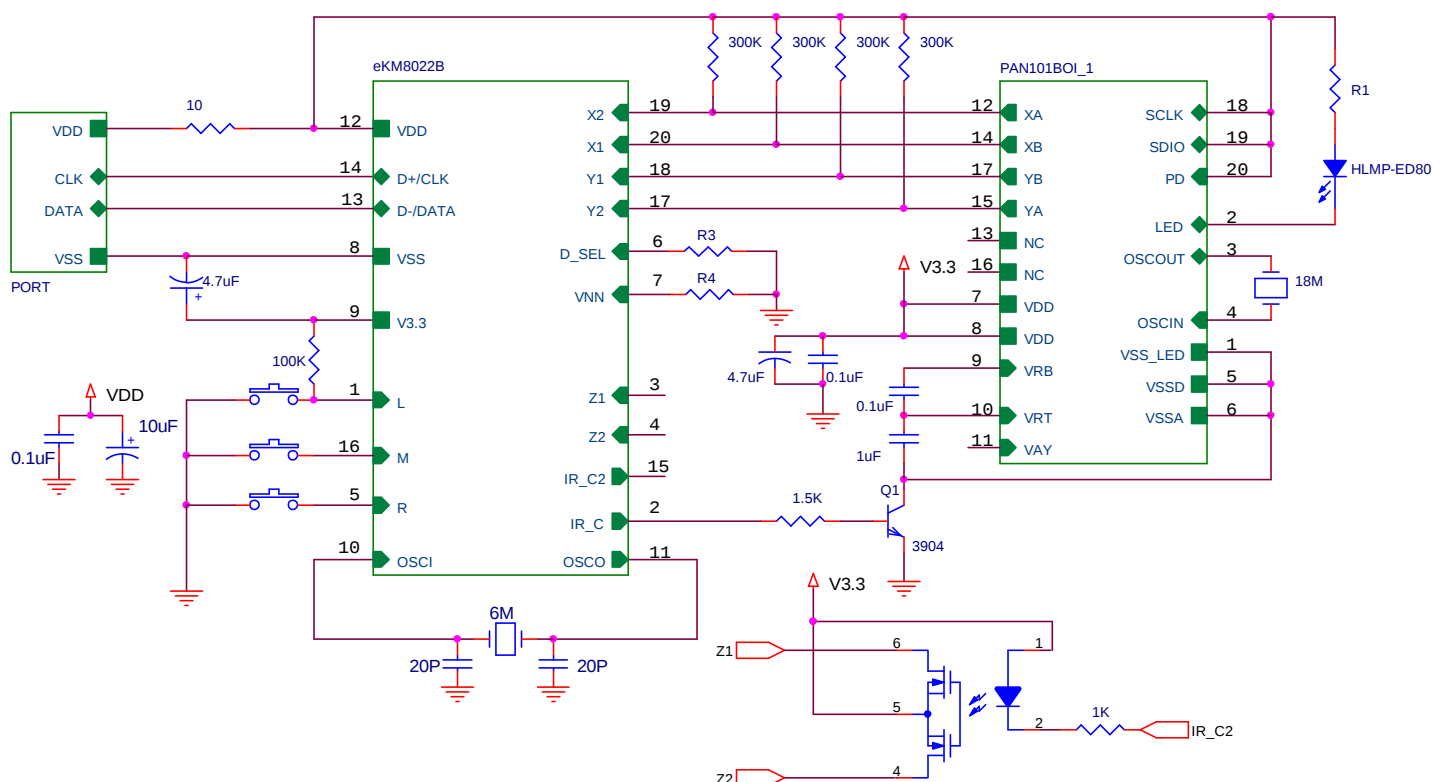
◆eKM8022B Photo Z/4 Application For ADNS 2051



NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI ; R4 GND AND L KEY PULL HIGH 100K FOR MTP .

◆eKM8022A_Mechanical Z/2 Application For PAN101BOI(PixArt)


NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI .

◆eKM8022B_Photo Z/4 Application For PAN101BOI(PixArt)


NOTE : R3 GND FOR 800DPI , FLOATING FOR 400DPI ; R4 GND AND L KEY PULL HIGH 100K FOR MTP .