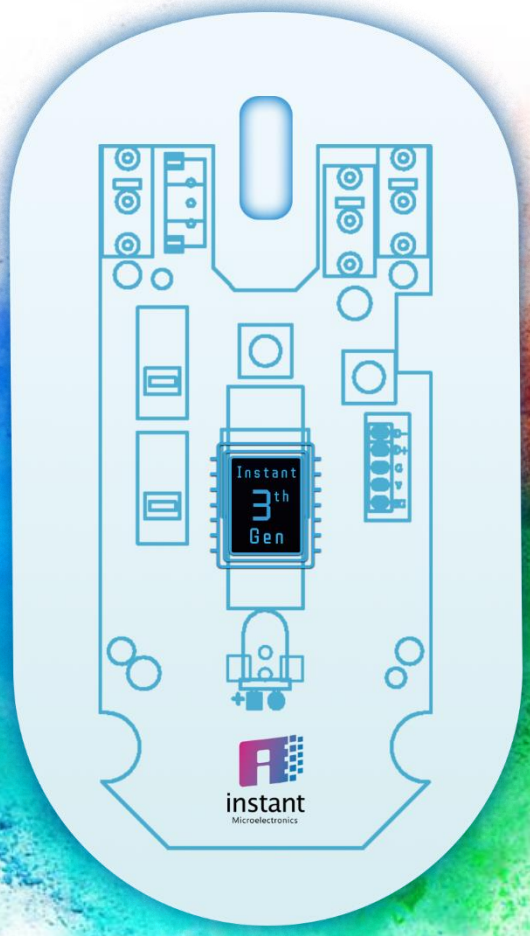
Instant

A704E USB Optic Mouse

DATASHEET



Instant Microelectronics Co., Ltd.

Version：V1.03

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1. General Description

A704E is a high performance single chip CMOS process optical mouse sensor. This chip solution is used to implement a non-mechanical tracking engine for USB computer mouse.

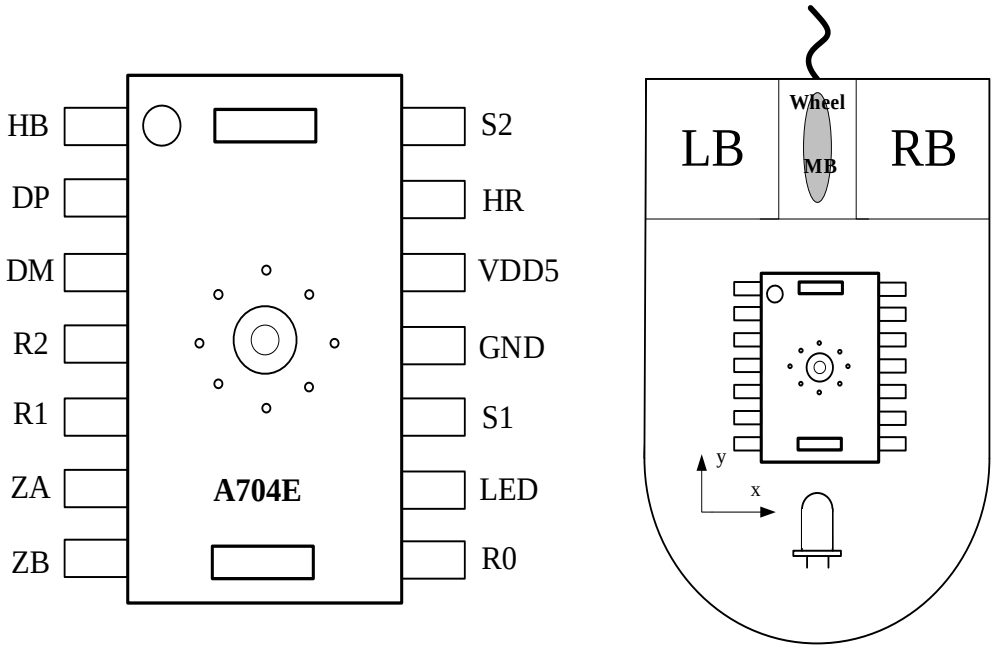
A704E is based on algorithm which measures changes of sequential surface images and then determines the movement. It has the basic mouse function (L/M/R button, X/Y motion and Z axis wheel) and additional support for some advanced functions (with driver). A704E supports 4-level CPI resolution (800/1200/1600/2400).

A704E is in a 14-pin optical DIP package. It has a built-in LED driver and internal oscillator to minimize the external components.

2. Feature

- Optical Navigation Technology,
- Compliant with USB2.0 and USB HID Specification V1.1.
- Support Winxp/Win2003/Win2008/Vista/Win7/Win8/Win10/Linux system, MAC OS, and Android system
- 5V Power Supply, Internal crystal-less oscillator and on-chip LED Driver
- Supports L/M/R/B4/ B5 buttons and X/Y/Z three axis
- Supports three additional multi-function keys: Boss, DB and Fire (see Section 6.2 for details)
- Supports 4-level resolution (800/1200/1600/2400) ,the default is 800
- Supports Single and Double CPI mode
- Supports 4-level brightness of LED to indicate 4-level CPI
- Supports 4-Color LED indicator to match with each CPI resolution
- Backlight LED Mode (4-Color Breathing, Color-locked Breathing, MUTE) can be switched by combination button K4/K5+CPI/CPI-.
- IDIP-14 package and RoHS Compliant

3. Pin Assignment



Topview of Pinout **Topview of Mouse**

Figure 1. Pinout

4. Pin Description

Pin No.	Pin Name	Type	Description
1	HB	OUT	Backlight LED output. Blue LED driver
2	DP	IN/OUT	USB D+
3	DM	IN/OUT	USB D-
4	R2	IN	Button array scan in，Single or double CPI select
5	R1	IN	Button array scan in
6	ZA	IN	Z axis in
7	ZB	IN	Z axis in
8	R0	IN	Button array scan in
9	LED	OUT	LED open drain output
10	S1	OUT	Button array scan out
11	GND	GND	GROUND
12	VDD5	POWER	Power 5v input
13	HR	OUT	Backlight LED output. Red LED driver
14	S2	OUT	Button array scan out

5. Block Diagram

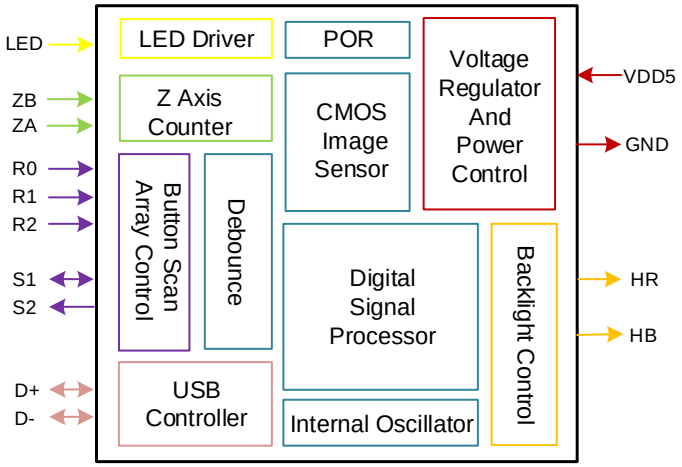


Figure 2. Block Diagram

6. Function Description

6.1 Button Array

The location of the keys in the array:

PIN	GND	S1	S2
R0	**K1**	**K4**	**K7**
R1	**K2**	**K5**	**K8**
R2	**K3**	**K6**	**K9**

The functions of the buttons are show in the table below. In Double CPI Mode, there are two CPI related buttons (CPI-/CPI+). While in Single CPI Mode, only one CPI related button (CPI).

Key	Single CPI Mode	Double CPI Mode
K1	L	L
K2	M	M
K3	R	R
K4	B4 (Backward)	B4(Backward)
K5	B5 (Forward)	B5 (Forward)
K6	CPI	CPI-
K7	BOSS	BOSS
K8	DOUBLE	CPI+
K9	FIRE	FIRE

Note: 1. When R2 has no pull-up resistance to power supply, the mouse is in single CPI mode. .

2. When R2 has pull-up resistance to power supply, the mouse is in dual CPI mode.

6.2 Special Keys

Key Name	Function Description
BOSS	Switch between the current application screen and desktop
DB	A pressing is equivalent to double click
FIRE	Pressing down this button is equivalent to continuing to click the left button

6.3 Driver Mode

A704E supports extra advanced customized functions in driver mode. Through the driver, a special application programmer, A704E can provide more controls and customized functions (such as multimedia, more CPI levels, MACRO, etc.). See the driver Application Manual for details.

6.4 CPI setting

6.4.1 CPI Sets and Selection

A704E supports 4-level resolution, the default is 800. The CPI level can be switched via pressing CPI related buttons (CPI /CPI-/CPI+).

- In Single CPI mode: CPI can be switched by CPI button in the following order:

  800(def)->1200->2000->2400->800

- In Double CPI mode: CPI can be switched to 2400 by CPI+ button and 800 by CPI- button

6.4.2 LED Indicator For CPI-Level

CPI-Level	4-Color Breathing LED			Single-Color LED
	HR	HB	Color	Brightness
800	**Off**	**On**	Blue	**Off**
1200	**On**	**On**	Pink	**Weak**
1600	**On**	**Off**	Red	**Middle**
2400	**On/2**	**On**	Purple	**Strong**

Note: On/2 is half of full brightness, and the color refor to RB(red and blue) LED.

6.5 Backlight LED

6.5.1 LED Mode

A704E has 3 kinds of LED effects (mode): 4-Color Breathing, FIX-Color Breathing, MUTE. User can switch LED mode by pressing a combination button (B4/B5+CPI/CPI-), the switching sequence is: 4-Color Breathing→ Color-locked Breathing→MUTE→ 4-Color Breathing.

In 4-Color Breathing mode, backlight LED breathes in up to 4 colors, and may change one color after a breathing cycle. And in Color-locked Breathing mode, backlight LED breathes in the color which LED breathes in when the mode switching (from 4-Color Breathing to this mode) happens. In MUTE, LED is off.

In 4-Color Breathing mode, when CPI level switching happens, backlight LED will show as CPI indicator in the matched color for 6 seconds and then return to 4-Color Breathing mode. While in Color-locked Breathing mode, backlight LED will flash 1~4 times to represent CPI level1~level4 correspondingly when CPI switching, but will not change color. In MUTE mode, LED will keep the light off whether CPI is changed or not.

6.5.2 LED Components Selected

In A704E, common anode LEDs must be used. In addition to the recommend color matching method (see Section 6.4), A704E also supports the following color matching methods:

If using RG (red and green) LED, HR is connected to LED's red pin, HB is connected to LED's green pin, the 4-Color sequence is: green, yellow, red, chartreuse.

4-Color Breathing LED		
HR	HG	Color
Off	On	Green
On	On	Yellow
On	Off	Red
On/2	On	Chartreuse

Note: The recommend color matching method is used in the circuit of Section 9.

7. Electrical Characteristics

7.1 Absolute Maximum Rating

Parameters	Symbol	Min	Max	Unit	Notes
Supply Voltage	VDD	-0.5	5.5	V	
Operating Temperature	To	-15	55	ºC	
Storage Temperature	Ts	-40	85	ºC	
Lead Solder Temperature			260	ºC	
Input Voltage	V_{in}	-0.5	5.5	V	
ESD	V_{ESD}		2	KV	All pins, Human Body Model

7.2 Recommend Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units
Supply Voltage	VDD	4.5	5.0	5.5	V
Operating Temperature	T_A	0	25	40	ºC
System Clock	CLK	-	48	-	MHz
Speed	S	-	-	60	Inch/Sec
Resolution	R	800	1200	2400	CPI
Acceleration	A	-	-	15	G
Frame Rate	Fr	-	-	6000	fps
Distance from the Bottom of Lens to the Working Surface	Z	2.1	2.2	2.3	mm

7.3 DC Electrical Characteristic (VDD = 5.0V, Temperature = 25℃)

Parameter	Symbol	Min	Typical	Max	Units
Supply Current(Motion)	I_{DD}	-	16.5	-	mA
Supply Current(Static)	I_{DD1}	-	7.8	-	mA
Input Voltage High(Input port)	V_{IH1}	2.0	-	-	V
Input Voltage Low(Input port)	V_{IL1}	-	-	0.8	V
Input Voltage High(I/O port)	V_{IH2}	2.0	-	-	V
Input Voltage Low(I/O port)	V_{IL2}	-	-	0.8	V
Output Voltage High(I/O port)	V_{OH1}	2.8	-	3.6	V
Output Voltage Low(I/O port)	V_{OL1}	0	-	0.3	V

7.4 AC Electrical Characteristic (VDD = 5.0V, Temperature = 25 ºC)

Parameter	Symbol	Min	Typical	Max	Units	Notes
Internal Ring Oscillator Frequency	F_{ROSC}		10		khz	
Power-Up Reset delay	T_{PU}	-	10	-	us	POR signal from 0 to 3.5
Debounce Time on Button	T_{DB}	9.5	11.5	13.5	ms	
Z-axis Sampling Time	T_Z	-	125	-	us	

8. Sensor Pixel Array Mapping

306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323
288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305
270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269
234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251
216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233
198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215
180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197
162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179
144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161
126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	51	53
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

9. Typical Application Circuit

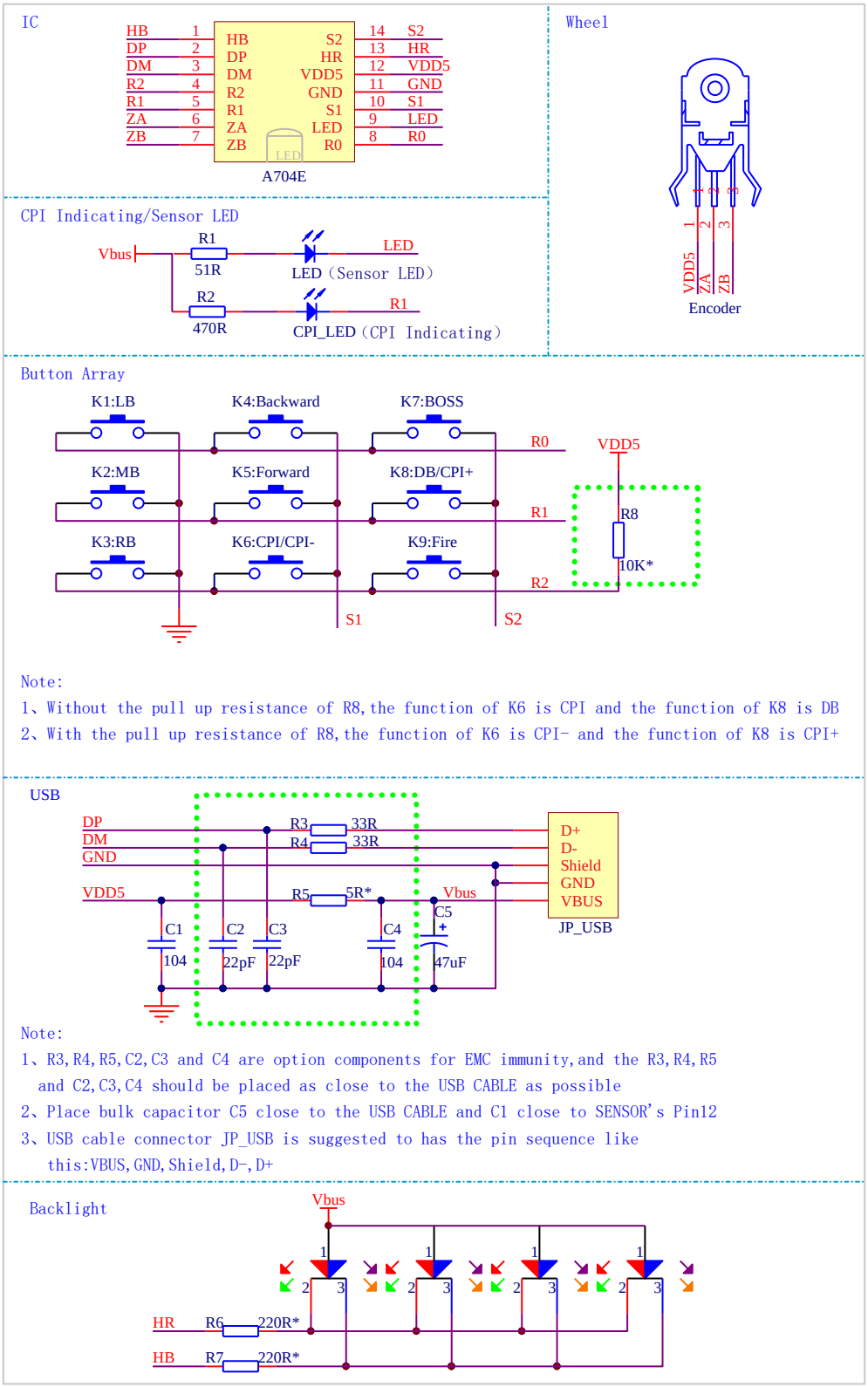
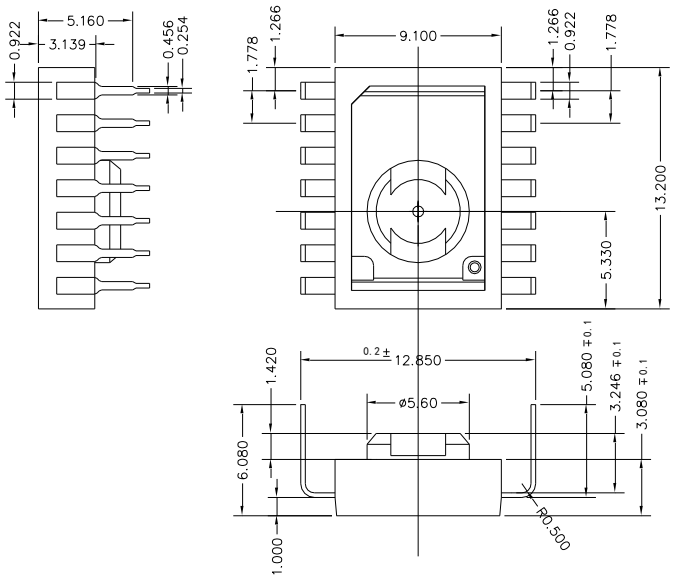


Figure 3. Application Circuit

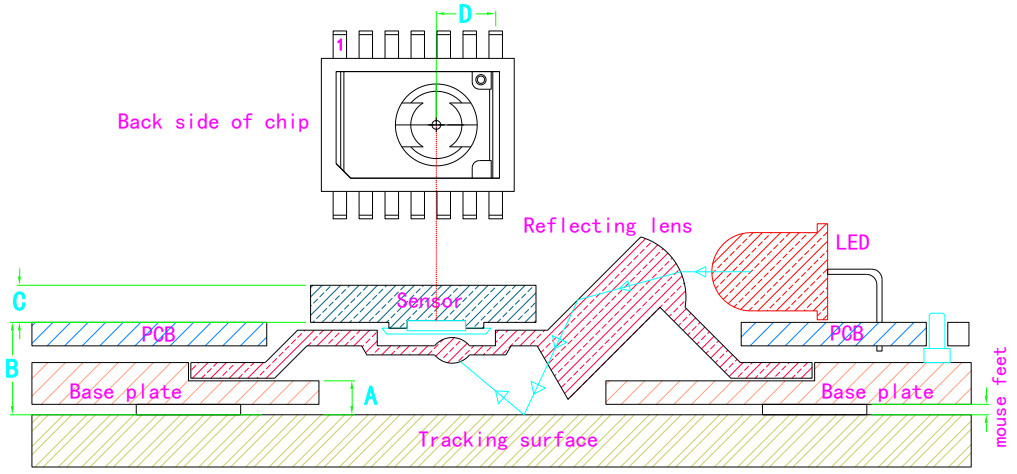
10. Package



Note: Unit： mm

Figure 4. Package Outline Drawing

11. Assembly Drawing



符号	说明	最小	典型	最大	单位
A	Lens reference plane to tracking surface (Z-Height)	2.1	2.2	2.3	mm
B	Top of PCB to tracking surface	7.3	7.5	7.7	mm
C	Chip Thickness	2.980	3.080	3.180	mm
D	Optical center to chip’s pin7	-	4.064	-	mm

Figure 5. Assembly drawing of A704E

12. Revision History

Version	Description	Date
A704E_SPEC_EN.V1.00	Create Preliminary Version	2019/07/18
A704E_SPEC_EN.V1.01	Modify the encoder 1 pin in the application circuit to VDD5	2019/12/25
A704E_SPEC_EN.V1.02	Modify the Application Circuit and Assembly drawing	2021/06/30
A704E_SPEC_EN.V1.03	Modify the Recommend Operating Conditions	2022/03/06