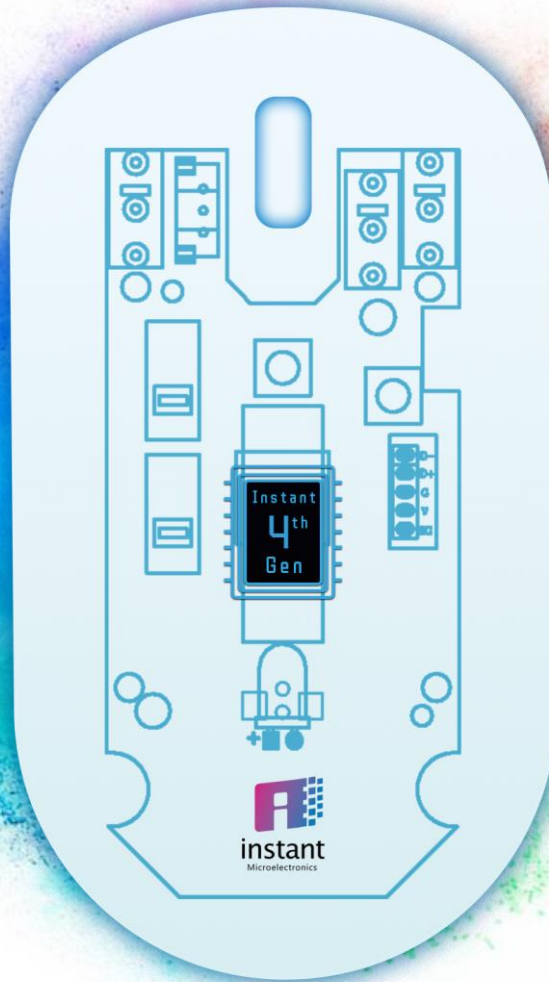


# Instant

## **A704F** Gaming Mouse SOC

***DATASHEET***



Instant Microelectronics Co., Ltd.

Version: V1.00

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## 1. General Description

A704F is a high performance CMOS process optical mouse SOC. It is based on Instant 4<sup>th</sup> generation Optical Navigation Technology with high-precision algorithm which measures changes of sequential surface images, and provides higher precision positioning than any previous generation. It's real CPI resolution is up to **7200 CPI**. Max frame rate is **7000 fps**. Max speed is **60 inch/s**. Max acceleration is **20 g**.

It supports standard five mouse buttons (L,M,R,B4,B5) and also four extra buttons for advanced functions. A704F supports 4-level CPI resolution, and provides two sets of resolutions (H-CPI:1200/2400/4800/7200; L-CPI:1200/1600/2400/3200) to choose from. In driver mode, it also supports 4-level CPI resolution, each CPI level is assigned from 17 available values.

## 2. Feature

- ◆ 5V Power Supply, internal crystal-less oscillator and on-chip LED driver
- ◆ 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
- ◆ 4-level CPI resolution, two sets of CPIs for selection
- ◆ Supporting Single and Double CPI mode
- ◆ Support 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-.
- ◆ Supports three special buttons: Boss, DB and Fire (see Section 6.2 for details)
- ◆ Supports L/M/R/B4/ B5 buttons and X/Y/Z three axis
- ◆ IDIP-14 package and RoHS Compliant
- ◆ Supports soft driver(an application programmer for A704F).

### 3. Pin Assignment

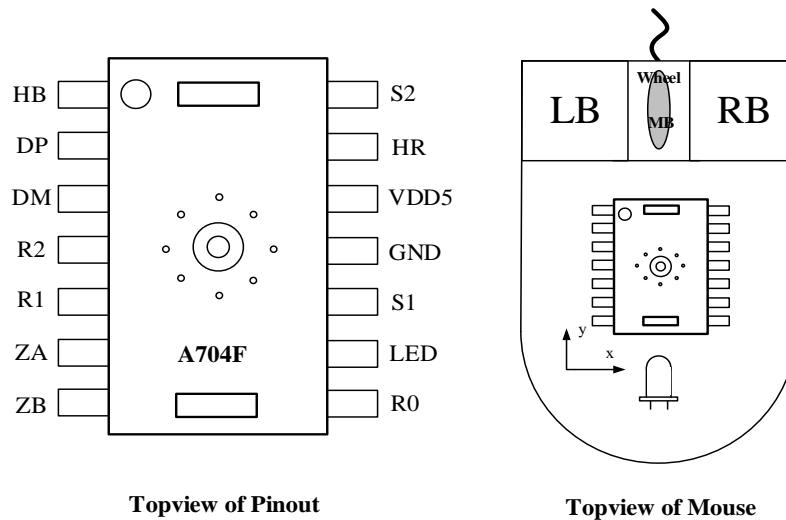


Figure 1. Pinout

### 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

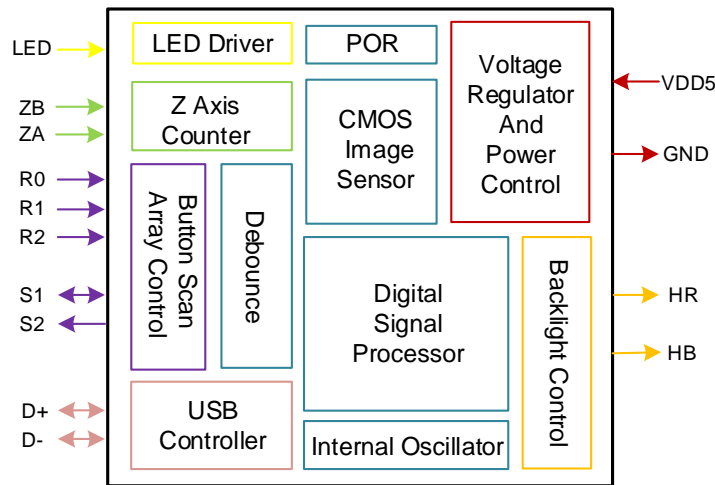


Figure 2. Block Diagram

## 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

## 6.2 Special Keys

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

## 6.3 Driver Mode

A704F supports extra advanced customized functions in driver mode. Through the driver, a special application programmer, A704F 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

A704F supports 4-level resolution, the default is 1200. The CPI level can be switched via pressing CPI related buttons (CPI /CPI-/CPI+).

A704F provides two sets of CPIs (H-CPI,L-CPI), H-CPI is selected with a pull-up resistor in circuit and L-CPI is selected without the resistor.

CPI Set	Lev1	Lev2	Lev3	Lev2
H-CPI	1200	2400	4800	7200
L-CPI	1200	1600	2400	3200

In driver mode, also supports 4-level CPI, and each CPI level can be assigned from 17 available values(200/400/600/800/1000/1200/1400/1600/1800/2000/2200/2400/3200/4000/4800/5600/6400/7200).

### 6.4.2 LED Indicator For CPI-Level

There are two kinds of LED indicators for CPI-level : 4-Color Breathing LED and Single-Color LED. Single-Color LED uses four levels of brightness to indicate different CPI resolutions. 4-Color Breathing LED shows as backlight effect in general, and can only be used as CPI indicator by changing its color when CPI level is being switched. After holding this color for a while, it will return to last backlight effect before switching. As CPI indicator, it's different colors represent different CPI levels.

CPI-Level		4-Color Breathing LED			Single-Color LED
L-CPI	H-CPI	HR	HB	Color	Brightness
1200	1200	Off	On	Blue	Off
1600	2400	On	On	Pink	Weak
2400	4800	On	Off	Red	Middle
3200	7200	On/2	On	Purple	Strong

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

## 6.5 Backlight LED

### 6.5.1 LED Mode

A704F has 3 kinds of LED effects (mode): 4-Color Breathing, Color-locked 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 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 level 1~level 4 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 A704F, common anode LEDs must be used. In addition to the recommend color matching method (see Section 6.4), A704F 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	°C	
Storage Temperature	Ts	-40	85	°C	
Lead Solder Temperature			260	°C	
Input Voltage	V <sub>in</sub>	-0.5	5.5	V	
ESD	V <sub>ESD</sub>		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 <sub>A</sub>	0	25	40	°C
System Clock	CLK	-	48	-	MHz
Speed	S	-	-	60	Inch/Sec
Resolution(H-CPI)	R	1200	1200	7200	CPI
Resolution(L-CPI)	R	1200	1200	3200	CPI
Acceleration	A	-	-	20	G
Frame Rate	Fr	-	-	7000	fps
Distance from the Bottom of Lens to the Tracking Surface	Z	2.1	2.2	2.3	mm

## 7.3 DC Electrical Characteristic (VDD = 5.0V, Temperature = 25°C)

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

## 7.4 AC Electrical Characteristic (VDD = 5.0V, Temperature = 25 °C)

Parameter	Symbol	Min	Typical	Max	Units	Notes
Internal Ring Oscillator Frequency	F <sub>ROSC</sub>		10		khz	
Power-Up Reset delay	T <sub>PU</sub>	-	10	-	us	POR signal from 0 to 3.5
Debounce Time on Button	T <sub>DB</sub>	9.5	11.5	13.5	ms	
Z-axis Sampling Time	T <sub>Z</sub>	-	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

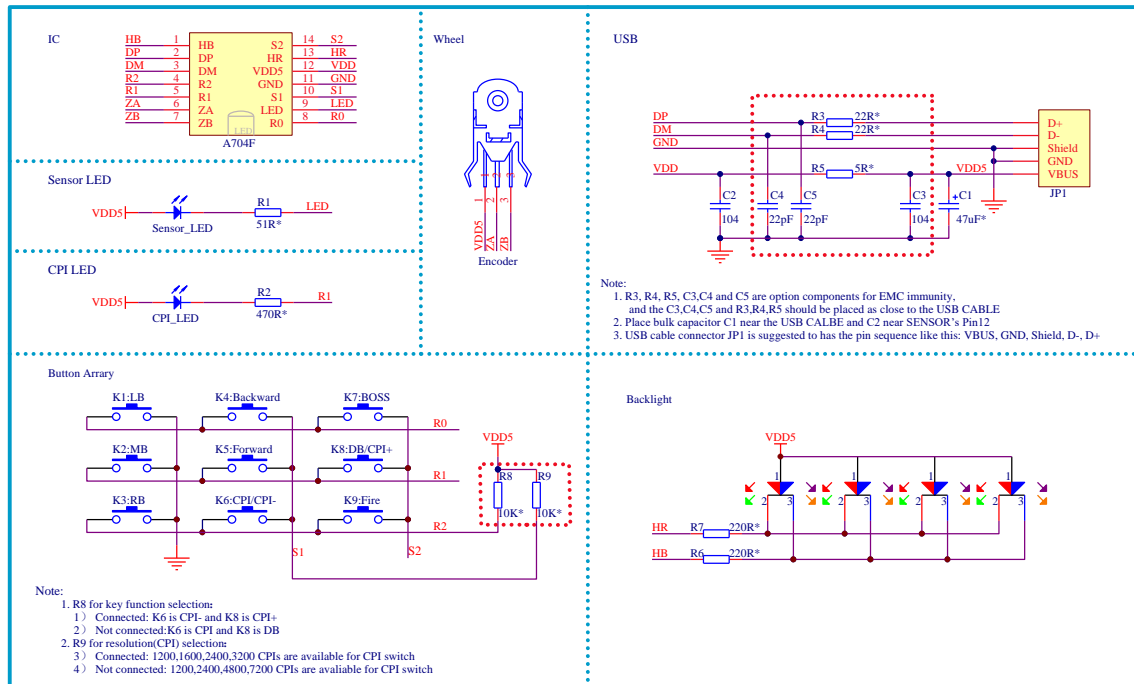
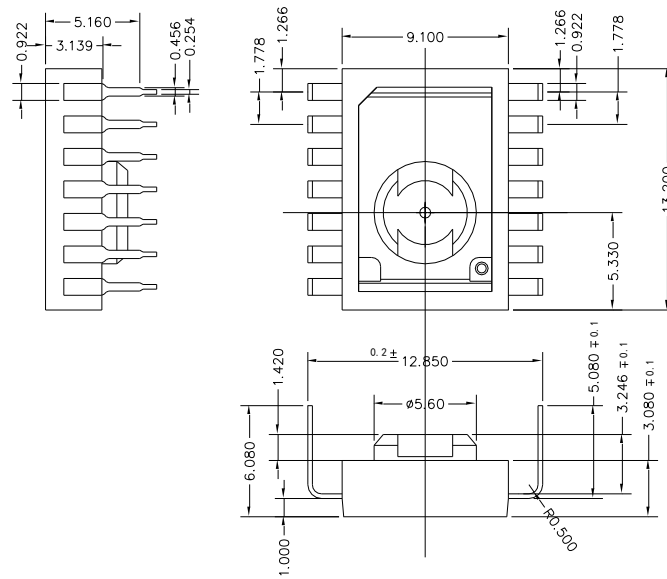


Figure 3. Application Circuit

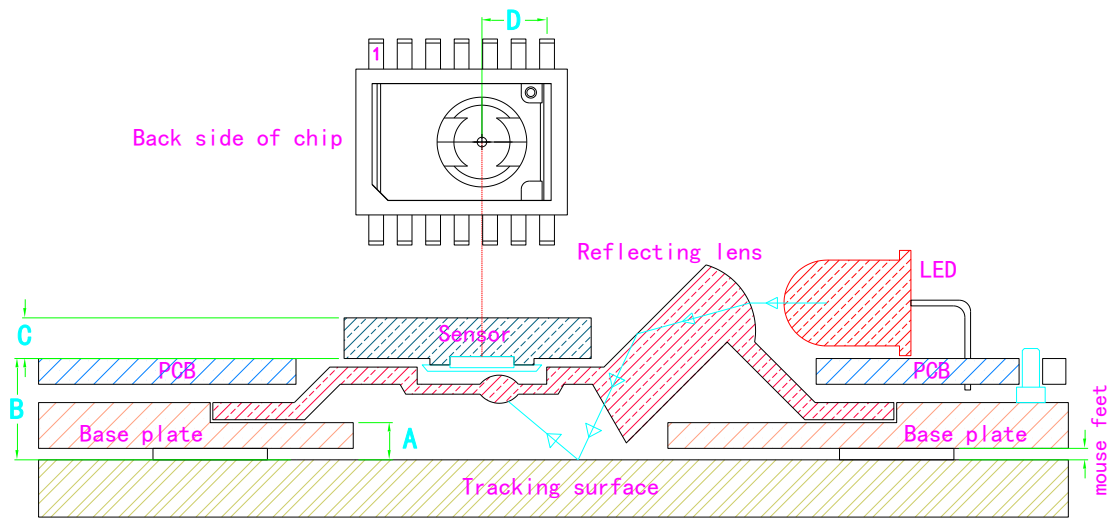
## 10. Package



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 A704F

## 12. Revision History

Version	Description	Date
A704F_SPEC_EN.V1.00	Create Preliminary Version	2018/09/18