

**Gaming Mouse with Horse-Race Lamp**

**A725 DATASHEET**

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**USB OPTICAL MOUSE**

**Version 1.01**

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## 1. General Description

A725 Gaming Mouse Sensor 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 mice. It supports Horse-Race Lamp and provides many customized features.

The A725 is based on Instant 3rd Optical Navigation Technology, which measures changes in position by optically capturing sequential surface images and mathematically determining the direction and magnitude of movement.

Customization includes both function and backlight. The function involves two aspects such as function (normal or special) for button/wheel and resolution setting. Among them, special function consists of MACRO, multimedia, and Group switch in functions. While resolution setting consists of level, value and indicative color. The number of resolution levels is up to 6, and there are 12 values which are available for each level, in addition, users can specify any LED color to indicate each level.

In backlight application, the A725 supports up to 10 kinds of backlight modes (including synchronization, horse-race and reaction mode), and backlight color customization, which provide users with rich application options. In addition, users can define a specific function key to switch the backlight mode.

The A725 provides more than 32kb storage capacity. Using the driver software, users can customize button function, resolution (CPI), and backlight color etc. These settings are stored in the chip, and it keeps the settings from losing when power is turned off. The A725 supports 4 groups of settings, and users can customize a specific key to switch one group to another (for example: Office settings(Group1) -> Game settings I(Group2) -> Game settings II (Group3)-> Multimedia Settings(Group4) -> Office settings(Group1).

In A725, VID/PID and mouse DIRECTION can be customized according to the needs of customer.

A725 package type is optical DIP12 package, and it has a built-in LED driver and internal oscillator to minimize the external components.

## 2. Feature

- Optical Navigation Technology, Max FPS 6000, Max acceleration 15g, Max moving speed 60inch/s.
- Compliant with USB2.0 and USB HID Specification V1.1.
- Support Windows system, MAC OS, and Android system, driver software (a given application software) only used in windows systems, but the A725 configured in Windows can support applications in other systems.

- Up to six-level resolutions can be switched by CPI button; each resolution is selected from 12 available values 200/400/600/800/1000/1200/1600/2000/2400/3200/4000/4800.
- Support Horse Race Lamp, support 10 kinds of backlight modes (including synchronization, horse-race and reaction mode)
- Support independent button to switch between multiple backlight modes
- Support independent button to switch between the four built-in configurations (Group), or directly to a specified configuration.
- Support storage, support customization of VID, PID and mouse direction
- Supports K1~K9 and Z wheel buttons with customized function.
- Small form factor 12-pin PDIP package available, ROHS standard

### 3. Pin Assignment

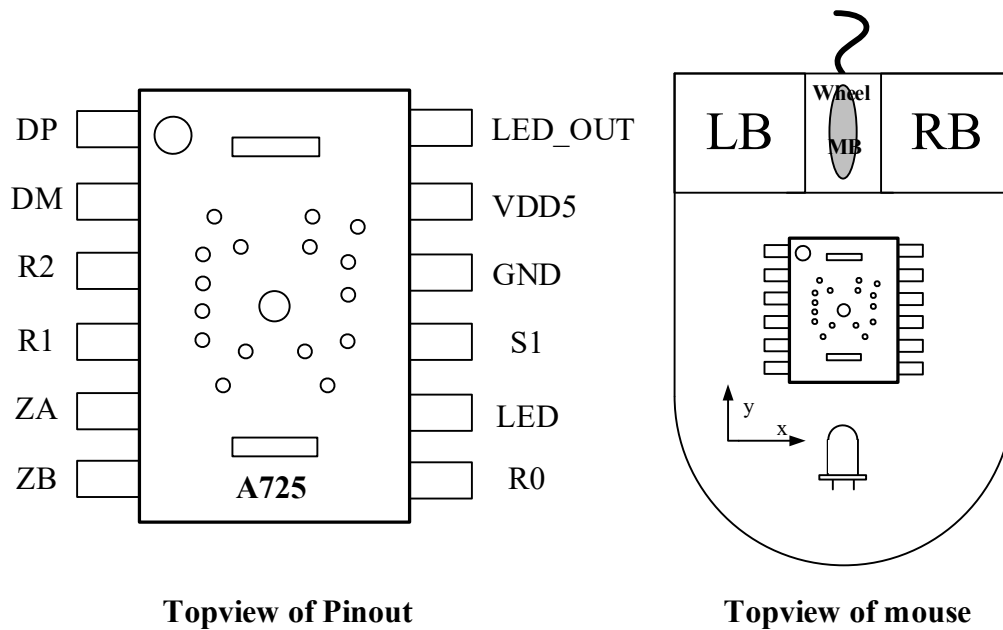


Figure 1. Pinout

## 4. Pin Description

	Pin Name	Type	Description
1	DP	IN/OUT	USB D+
2	DM	IN/OUT	USB D-
3	R2	IN	Key array scan in
4	R1	IN	Key array scan in
5	ZA	IN	Z axis input
6	ZB	IN	Z axis input
7	R0	IN	Key array scan in
8	LED	OUT	LED open drain output
9	S1	OUT	Key array scan out
10	GND	GND	Ground
11	VDD5	PWR	Power 5v input
12	LED_OUT	OUT	Horse Race Lamp output. LED driver

## 5. Block Diagram

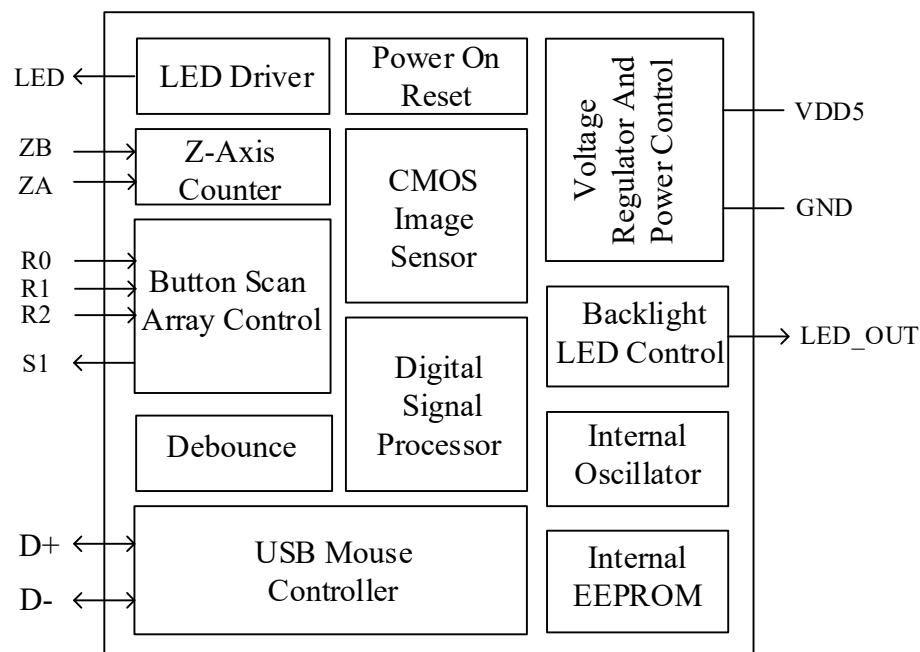


Figure 2. Block Diagram

## 6. Application Note

### 6.1 Buttons Matrix Definition

Distribution of 9 physical keys in key array:

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

### 6.2 Customized Function Buttons

The functions of 9 physical buttons can be customized arbitrarily, and these functions consist of into mouse key, keyboard key, multimedia key and MARCO key (includes office shortcuts).

Assigning a keyboard key function to a physical button of mouse means that, the physical button has a keyboard function, and the pressing/releasing operation is exactly as same as the one of the keyboard.

MARCO key function is a combination of mouse and keyboard functions. The mouse functions maybe include a number of mouse keys and motions, and the motions is helpful for finding exact locations in game (for example, changing ballistic parameters in a gun battle game).

Function Type	Function Selection
Mouse Function	L, M, R, Forward, Backward, CPI(CPI+/CPI-), Boss, Fire, Double click
Keyboard Function	A-Z, F1-F12, 0-9, Shift, Ctrl, Alt, Win etc.
Multimedia Function	Web, Media, Mail, Vol+, Vol-, Next, Previous, Mute, Play/Pause etc.
Shortcut Function	Copy, Paste, Cut, All select, Undo, Find, Close window, My computer, Lock window, Calculator, Command Line etc.
MACRO Function	PUBG MARCO,LOL MARCO,CF MARCO etc.

### 6.3 CPI Setting

#### 6.3.1 CPI Switching

The number of resolutions can be set from 1 to 6. Each resolution can choose one of the 12 available values, with a range 200/400/600/800/1000/1200/1600/2000/2400/3200/4000/4800.

A725 has two following CPI operation modes to be chosen:

- CPI LOOP: set a button as CPI key. Users can change resolution circularly by clicking CPI button. For example, the shift order of CPI level is 1->2->3->4->5->6->1.
- CPI+/CPI-: Set a button CPI+ and another CPI-. Resolution increases to the top step by step by clicking CPI+ button. And CPI- button is on the opposite.

#### 6.3.2 CPI Indicating

To click CPI button, the CPI level changes, and the backlight LED indicates current CPI level after switched, one color corresponds to one CPI level, and an amount of time later the

backlight LED returns previous status.

A725 supports 16.8 million color. Users can customize CPI color by using a palette in a given application program.

## 6.4 Backlight Application

### 6.4.1 Horse Race Mode

Horse race mode includes 4 kinds of the backlight below.

- M-Color Flowing Light

Lights flow periodically, and the lights automatically change from one color to another when cycle ends. The number of color is up to 7, but users can disable some of them, and the colors are programmable in a given application program.

- S-Color Flowing Light

Lights flow periodically in single color. And the color is programmable in a given application program.

- Comet-Tail Flowing Light

The effect of light looks like a comet trailing its tail, and the light automatically change from one color to another when cycle ends.

- Ambilight Flowing Light

The flow of light is accompanied by the flow of color, that is, the colors change according to a certain rule, and at the same time it flows.

These lighting effects have some features which users can configure or choose, and the features are described in the table below. Among them, Symmetry describes an effect that lights on the left and right sides of the mouse have exactly the same behavior. While Asymmetry does not.

The feature “Positive” defines the direction of light which is from the head of the mouse to the tail; “Reverse” defines the direction of light which is from the tail of the mouse to the head; “Two-way” show that light flows in positive direction an amount of time and then flows in reverse direction. “Two-Way Changing Color” show that light flows in bidirection, and in this procedure the color changes to the next color in one flow cycle.

Backlight Mode		M-Color	S-Color	Comet-Tail	Ambilight
Asymmetry	Positive	✓	✓	✓	✓
	Reverse	✓	✓	✓	✓
	Two-Way	✓	✓	✓	
	Two-Way Changing Color	✓			
Symmetry	Positive	✓	✓	✓	✓
	Reverse	✓	✓	✓	✓
	Two-Way	✓	✓	✓	
	Two-Way Changing Color	✓			
Backlight Color Customize		✓	✓	✓	

Note: "✓" indicates support for this direction

#### 6.4.2 Synchronous Mode

Backlight Mode	Multicolor Breathing	CPI Color Breathing	Constantly Bright	Neon	Mute
Backlight Description	LED breathes, and switch one color per breathing cycle	LED breathes under the current CPI color	LED is on with same brightness, and in CPI color	LED is on with color changing	LED is off
Color Type	Color and number of colors (1~7) can be customized	Customizable ,up to 16.8 million colors	customizable, up to 16.8 million colors	NULL	NULL

#### 6.4.3 Reaction Mode

It is designed in response to button clicks. When the button click behavior is detected, the corresponding backlight mode is executed for a period of time, and the mode is selected from four modes (Multicolor Breathing, M-Color, S-Color, Comet-Tail). When there is no click action, the backlight is off and no backlight is effective.

In addition, whether the button supports the backlight response feature requires user to enable the function.



#### 6.4.4 Backlight Control Method

- Users can set the desired backlight through a given software. In the Horse-Race mode backlight, the light flow direction can be switched by the “K4/K5+CPI” combination key enabled by user. By pressing the combination key, user can control the direction of the light flow such as: Positive->reverse->Two-Way->Two-Way Changing Color->Mute->Positive. In addition, pressing CPI for more than three seconds (need to enable this function), User can also switch the backlight.
- Assign switch backlight function to a specified button, can switch up to 10 kinds of backlight.
- In Horse-Race mode, **16 is the maximum number of LED in PCB circuit application**, and the number of LED used can be customized according to users’ needs.

#### 6.5 Configuring Storage

The A725 provides more than 32kb storage capacity. Using a given software, users can customize button/wheel function, resolution (CPI), and backlight color. They are stored in the chip, and it keeps the settings from losing when power is turned off.

The A725 supports 4 groups of settings, and users can customize a specific key to switch one group to another (for example: Office settings(Group1) -> Game settings I(Group2) -> Game settings II (Group3)-> Multimedia Settings(Group4) -> Office settings(Group1).

### 7. Electrical Characteristic

#### 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	Notes
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	R	200	800	4800	CPI	
Acceleration	A	-	-	15	G	
Frame Rate	Fr	-	-	6000	fps	
Distance from the Bottom of Lens to the Working Surface	Z	2.2	2.3	2.4	mm	

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

Parameter	Condition	Symbol	Min	Typical	Max	Units	Notes
Supply Current	In 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

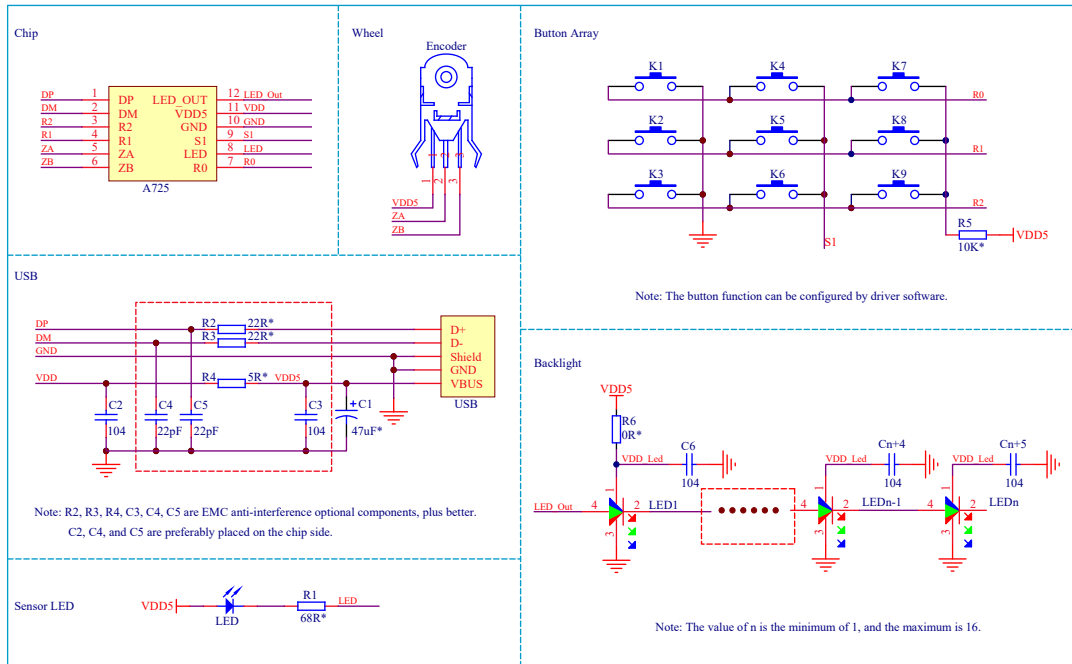


Figure 3. Application Circuit

## 10. Package

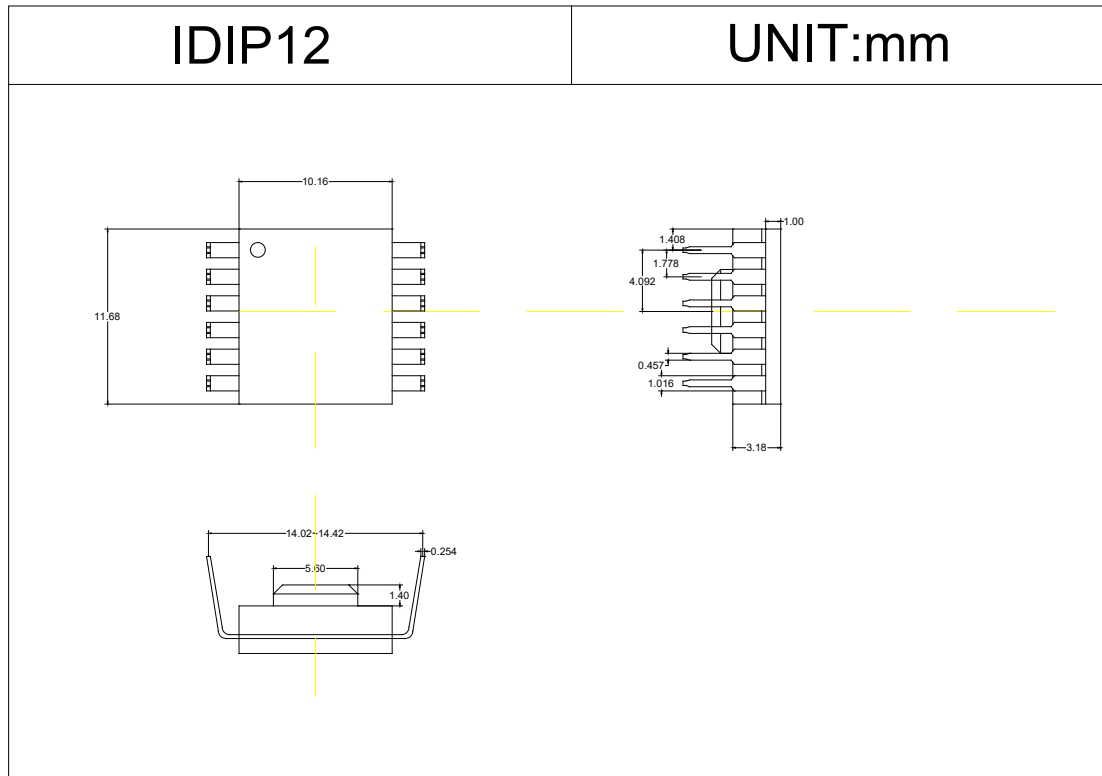


Figure 4. Package Outline Drawing

## 11. Assembly Drawing

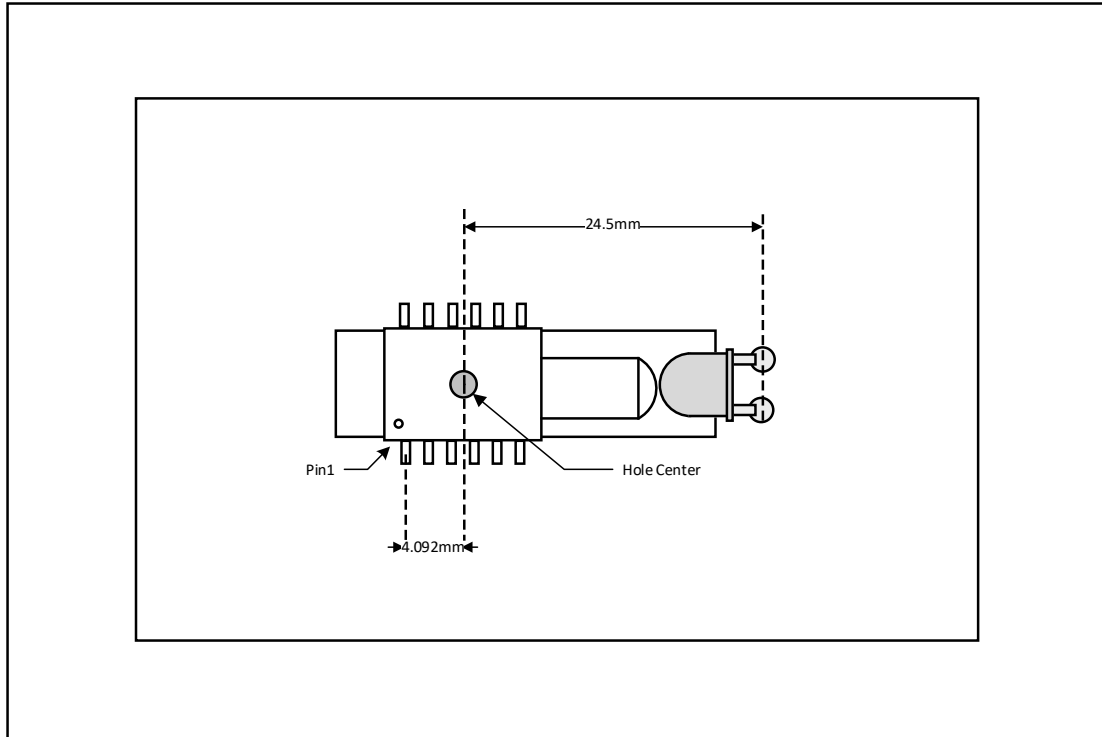


Figure 5. 2D Assembly drawing of A725 (Top and Side View)

## 12. Revision History

Version	Description	Date
A725_SPEC_EN.V1.00	Create Preliminary Version	2018/06/25
A725_SPEC_EN.V1.01	Correct partial description	2018/11/22