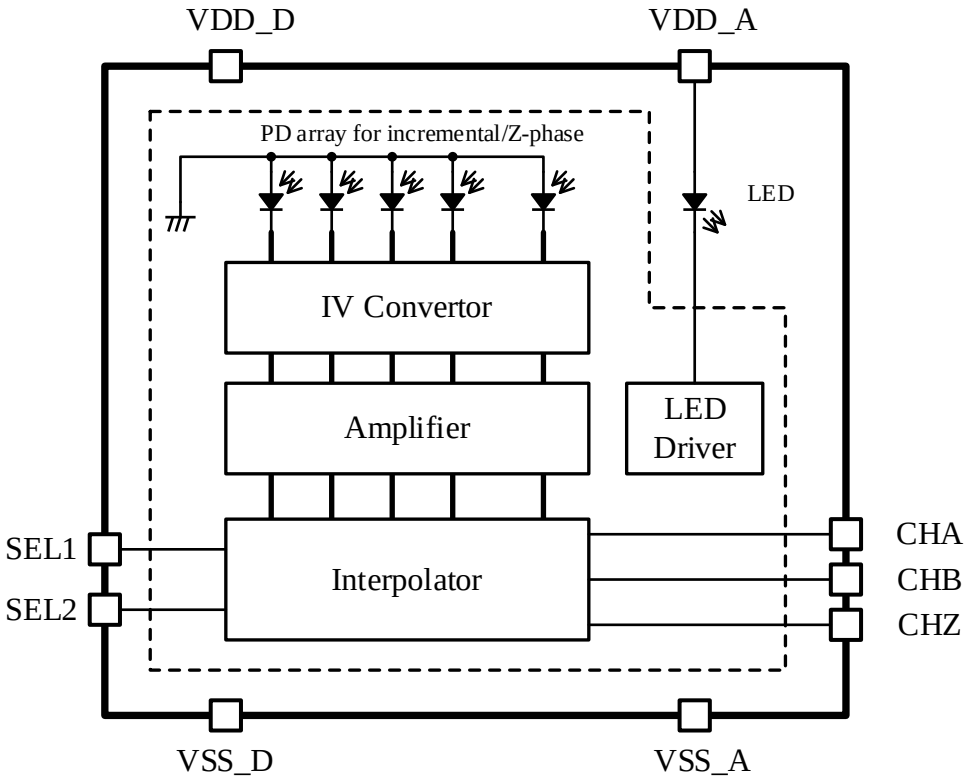
1. OVERVIEW

The SME-08BDx is a 3-channel optical encoder IC with digital output.
The SME-08BDx consists of an LED and an OEIC (Opto-Electric Integrated Circuit) in a single package.
The light emitted from the LED is projected onto the code wheel, and the reflected light is received by a photodiode to detect the relative movement between the SME-08BDx and the code wheel. In addition, Z-phase, the origin signal, is output by setting a pattern on the code wheel for origin detection.
The resolution can be adjusted with a built-in interpolation circuit.

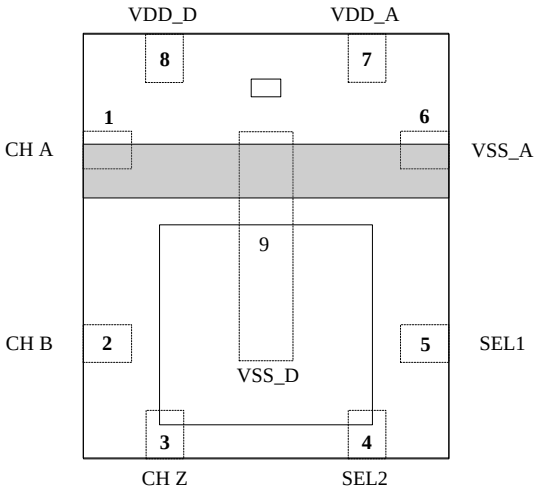
2. FEATURES

- Compact clear molded package (L=3.95mm W=3.4mm H=1.0 mm)
- 80µm resolution (When interpolation factor is 1)
- LED and OEIC fabricated in a single package
- 3-channel digital output
- Bult-in interpolation circuit (Interpolation factor can be selected from 4, 8, 16)
- Supports 3.3 V and 5 V supply voltages
- 27mA current consumption
- LED wavelength: 850nm

3. BLOCK DIAGRAM



4. PIN LAYOUT



Top View

5. PIN DESCRIOTION

No.	Name	I/O	Function
1	CHA	O	A-phase digital incremental signal
2	CHB	O	B-phase digital incremental signal
3	CHZ	O	Z-phase digital origin signal
4	SEL2	I	Interpolation setting input 2
5	SEL1	I	Interpolation setting input 1
6	VSS_A	-	Ground
7	VDD_A	-	Supply voltage
8	VDD_D	-	Supply voltage
9	VSS_D	-	Ground

I/O type I: Input O: Output

6. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Rating	Unit	note
Supply voltage	V_{DD}	VDD_A, VDD_D pins	-0.3 to 7.0	V	*1
Input voltage	V_{IN}	SEL1, SEL2 pins	-0.3 to V_{DD}+0.3	V	*1
Output voltage	V_{OUT}	CHA, CHB, CHZ pins	-0.3 to V_{DD}+0.3	V	*1,*2
Storage temperature	T_{STG}		-40 to 85	℃	*3

*1: Parameters must not exceed ratings, not even momentarily. If a rating is exceeded, there is a risk of IC failure, deterioration in characteristics, and decrease in reliability.
*2: V_{DD} in absolute value ratings refers to the recommended operating voltage V_{DD} value.
*3: Stored separately in Nitrogen (N_2) atmosphere or vacuum.

7. RECOMMENDED OPERATING CONDITIONS

V_{SS}=0V codewheel R_{OP}:11mm

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Supply voltage	V_{DD}	Between VDD and VSS terminals VDD_A=VDD_D VSS_A=VSS_D	4.5	5	5.5	V
			3.0	3.3	3.6	
Operating temperature	T_a	-	-40	25	85	℃
Code wheel radial misalignment	E_R		-0.2		+0.2	mm
Code wheel tangential misalignment	E_T		-0.2		+0.2	mm
Code wheel Gap	G		0.5	0.75	1.0	mm

* Operation outside the recommended operating conditions may adversely affect reliability. Use only within specified ratings

8. ELECTRIC CHARACTERISTIC

8.1. DC Characteristics

V_{SS}=0V、T_a=25°C

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
Current consumption	I_{DD1}	Include LED load current At no output load	-	27	40	mA
High-level output voltage	V_{OH}	I_{OH}=1.5mA	V_{DD}-0.4		V_{DD}	V
Low-level output voltage	V_{OL}	I_{OL}=-1.5mA	V_{SS}		0.4	V

*Under our installation conditions and typical recommended operating conditions

8.2. AC Characteristics

V_{SS}=0V、T_a=25°C

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
Output frequency	F_{OUT}	SEL1 = H, SEL2 = H Interpolation factor: 4	-	-	240	kHz
		SEL1 = L, SEL2 = L Interpolation factor: 8	-	-	480	
		SEL1 = H, SEL2 = L Interpolation factor: 16	-	-	960	
Output signal rise time	t_r	C_L≦50pF	-	-	100	ns
Output signal fall time	t_f	C_L≦50pF		-	100	ns
Output stable latency	t_{wait}		1	-	-	ms

*Under our installation conditions and typical recommended operating conditions

9. FUNCTION DESCRIPTION

The light emitted from the LED is projected onto the code wheel, and the reflected light is received by a photodiode to detect the relative movement between the SME-08BDx and the code wheel. In addition, Z-phase, the origin signal, is output by setting a pattern on the code wheel for origin detection.
The SME-08BDx also has a built-in interpolation circuit, which can be set using the SEL1 and SEL2 pins.

9.1. Interporation Function

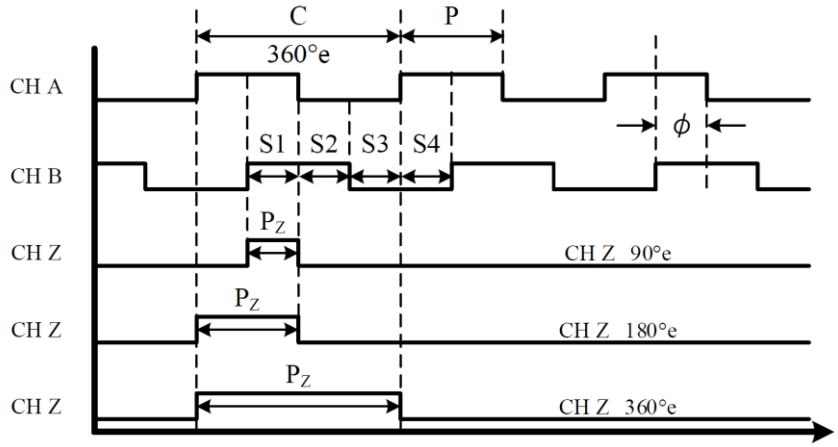
The interpolation factors can be set by the SEL1 and SEL2 pins.

SEL1	SEL2	Interpolation factor
H	H	4
L	L	8
H	L	16

9.2. LED Auto Power Control (APC) Brightness Adjustment Function

The SME-08BDx has a built-in automatic LED brightness adjustment function (Auto Power Control) to compensate for LED brightness variations and temperature fluctuations.

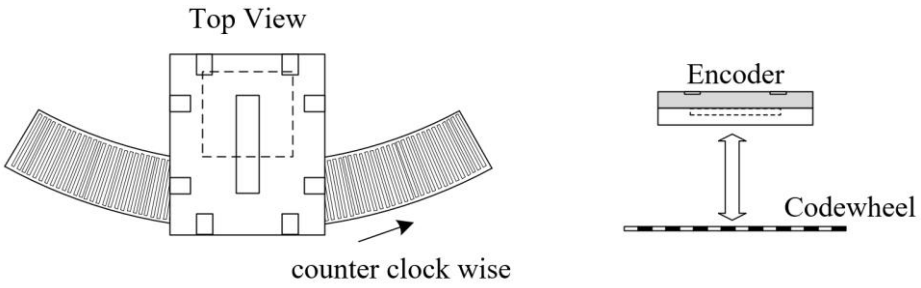
10. TIMING DIAGLAM



Direction of code wheel rotation: CCW

* The Z-phase pulse width is determined by each product.

Product name	Z-phase pulse width
SME-08BD1	90°e
SME-08BD2	180°e
SME-08BD3	360°e



Parameter Definition

Parameter	Symbol	
Output cycle	C	Phase A and B output 1 cycle 360°e
Output cycle error	ΔC	Output cycle deviation
Pulse width (Duty)	P	Output signal duty ratio
Pulse width (Duty) error	ΔP	Deviation of the pulse width from the ideal value of 180°e
State	S	Phase A/B rising (falling) edge interval. 4 states per output cycle, ideal value is 90°e
State error	ΔS	Deviation of each state width from 90°e
Phase difference	φ	The distance between the center of the High state of phase A and the center of the High state of phase B. Ideal value 90°e
Phase error	Δφ	Deviation from the ideal phase value of 90°e
Optical Radius	R_{OP}	Distance from the center of rotation of the code wheel to the optical center of the encoder IC
Z-phase pulse width	P_Z	Z-phase pulse width

Encoder Output Characteristics Code wheel: R_{OP} = 11mm

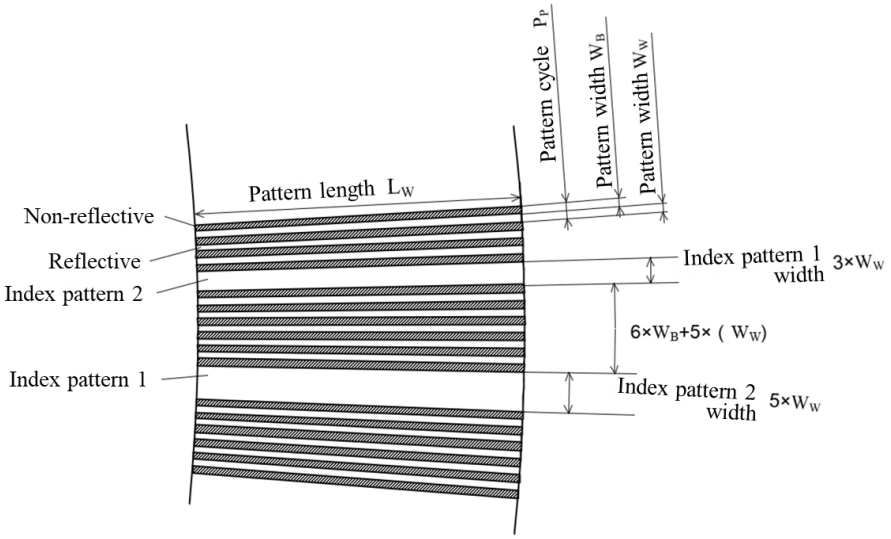
Parameter	Symbol	TYP			Unit
		Interpolation factor 4	Interpolation factor 8	Interpolation factor 16	
Output cycle error	ΔC	±17	±28	±35	°e
Pulse width (Duty) error	ΔP	±14	±18	±22	°e
Phase error	Δϕ	±5	±8	±9	°e
State error	ΔS	±8	±10	±13	°e
Z-phase pulse width (Gated 90°)	P_Z	90	90	90	°e
Z-phase pulse width (Gated 180°)	P_Z	180	180	180	°e
Z-phase pulse width (Gated 360°)	P_Z	360	360	360	°e

*Under our installation conditions and typical recommended operating conditions

11. RECOMMENDED CODE WHEEL CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Pattern width ratio (reflective/non-reflective)	W_W/W_B	0.9	1	1.1		
Incremental pattern cycle	P_P		80		μm	
Incremental pattern width	W_W,W_B		40		μm	
Pattern length	L_W	1.8	-	-	mm	
Reflectance (reflective part)	R_F	60	-	-	%	
Reflectance (non-reflective part)		-	-	10	%	

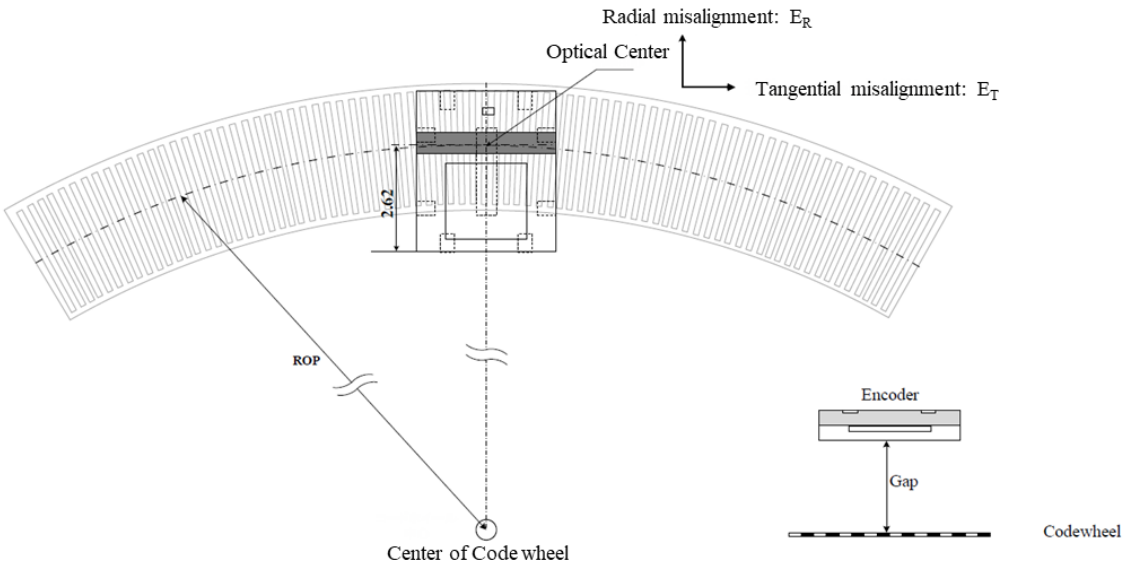
$R_{OP}=(PPR*P_P)/2\pi$



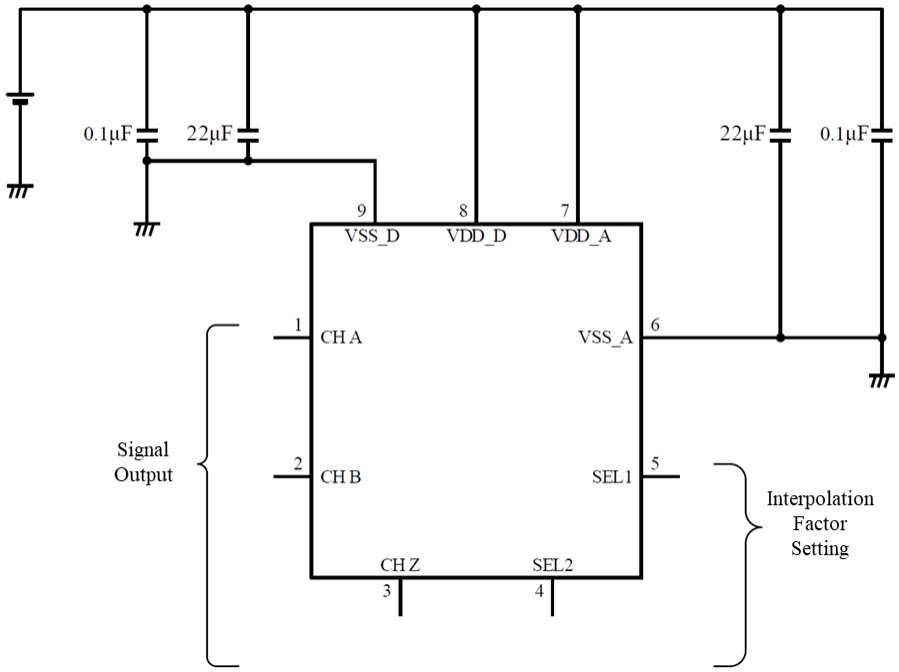
unit:mm

12. CODE WHEEL MOUNTING CONDITIONS

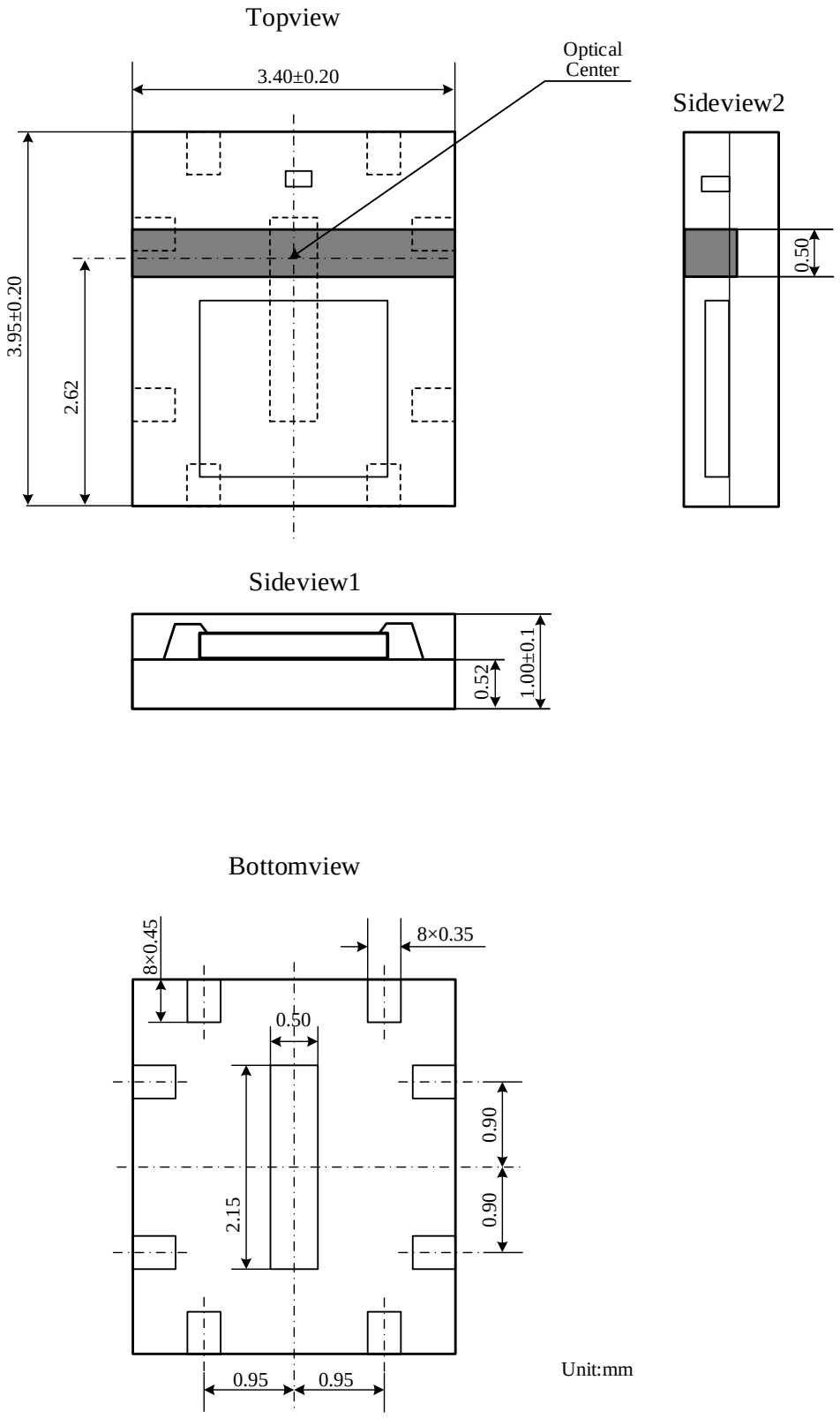
The optical center of the encoder IC should be aligned with the ROP.
Please evaluate the mounting conditions thoroughly before setting the encoder IC.



13. TYPICAL APPLICATIONS



14. PACKAGING DIMENSIONS



15. USAGE AND PRECAUTIONS

This product is designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools, and measurement equipment. This product is not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment.
If you wish to use this product in equipment requiring extremely high level of reliability, please contact our sales department or representative in advance.
In the event that this product is used in such equipment, please take scrupulous care and apply fail-safe techniques including redundancy and malfunction prevention in order to prevent damage to life, health, property, or infrastructure etc. in case there is some malfunction in the product.

Please pay your attention to the following points at time of using the products shown in this document.

1. The products shown in this document (hereinafter ”Products”) are designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools and measurement equipment. The Products are not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment. The Products are not designed and manufactured to be used for the apparatus that exerts harmful influence on the human lives due to the defects, failure or malfunction of the Products.
   If you wish to use the Products in that apparatus, please contact our sales section in advance.
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