

ZC535

Voice Coil Motor Driver IC with 10KB EEPROM

General Description

The ZC535 is a voice coil motor (VCM) driver with 10KB EEPROM for autofocus applications. Designed for linear control of VCM, its operating voltage range is from 2.6V to 3.6V and its maximum output current is 100mA.

The 10bit DAC is controlled by I²C serial interface up to 400KHz clock rate.

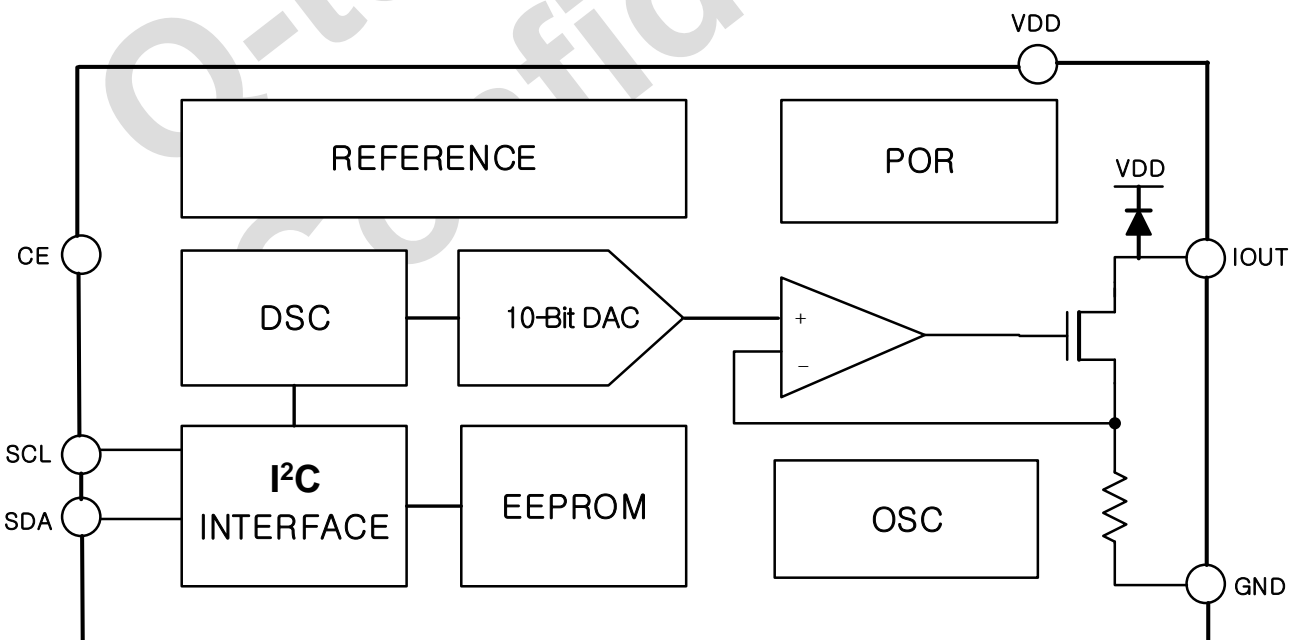
DSC and AIP are applied to minimize the mechanical ringing. DSC and AIP enable users to achieve fast mechanical settling time.

The ZC535 is suitable for various autofocus applications such as smartphone, tablet, drone, AR, security, etc.

Features

- 10-bit resolution sink current of 100mA
- Fast setting AF function :
 - DSC (Damping Smart Control)
 - AIP (Auto Initial Position)
- Embedded 10K byte EEPROM
- Operating voltage range : from 2.6V to 3.6V
- I²C interface :
 - 400KHz data transfer rate available in 1.8V input level
- POR (Power on Reset)
- Power Down (H/W, S/W)
- Support dual AF cameras
- WLCSP package (L x W x H) : 0.74mm x 1.29mm x 0.30mm

Block Diagram



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Revision History

Date	Version	Description	Issued By
Sep. 2016	0.0	Initial Version	GB Shin
Jun. 2019	1.0	Change Electrical Characteristics spec.	Kenny Hyun

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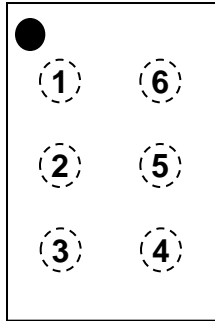
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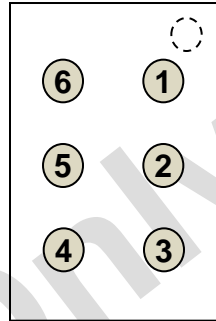


Pin Information

1. Pin Configuration



Top view
(Bump side down)



Bottom view
(Bump side up)

2. Pin Description

WLCSP Pin No.	Symbol	I/O	Description
1	IOOUT	O	Current Output
2	GND	-	Analog & Digital Ground
3	VDD	Power	Power
4	SDA	I/O	I ² C Interface signal (Data)
5	SCL	I	I ² C Interface signal (Clock)
6	CE	I	Chip Enable / Disable

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Absolute Maximum Ratings

Characteristic	Symbol	Min.	Typ.	Max.	Unit
VDD Voltage to GND	VDD	-0.3		4.0	V
IOUT Voltage to GND	IOUT	-0.3		VDD+0.3	V
Digital Input Voltage Range	V _{IN}	-0.3		VDD+0.3	V
Lead Soldering Temperature (10ns)				300	°C
Junction Temperature				125	°C
Storage Temperature				150	°C
Operating Ambient Temperature Range	T _A	-40	25	85	°C



ESD Caution

Electrostatic Discharge sensitive device. Highly accumulated electronic charges on the human body and the test equipment can discharge without detection. Although this device features proprietary ESD detection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

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Electrical Characteristics

* $T_A = 25^\circ\text{C}$, $V_{DD} = 2.8\text{V}$, unless otherwise noted.

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Test Conditions /Comments
1. Input Supply Section						
Input Supply Voltage	VDD	2.6	2.8	3.6	V	
2. Operating Condition						
Quiescent Current	IQC		0.65	0.7	mA	CE= V_{DD} , DAC = h'000
Power Down Current	IPD			1	μA	CE=Low or S/W Power down
3. Output Section						
Zero Code Error	E_ZC	-1		1	μA	All 0s loaded DAC
Relative Accuracy	INL	-4		+4	LSB	
Differential Nonlinearity	DNL	-1		1	LSB	
Maximum Sink Current	IOMAX	97	100	103	mA	$V_{DD}=2.6\text{V} \sim 3.6\text{V}$
Output Current Resolution	RES		10		Bit	1LSB=97 μA
Total Resistance of the Output (Sensing Register + Tr On Resistance)				1.5	Ω	@Output current=100mA
Output Current During Power Down	IOPD			1	μA	
Power On Time	TPO	2.0			ms	

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Electrical Characteristics

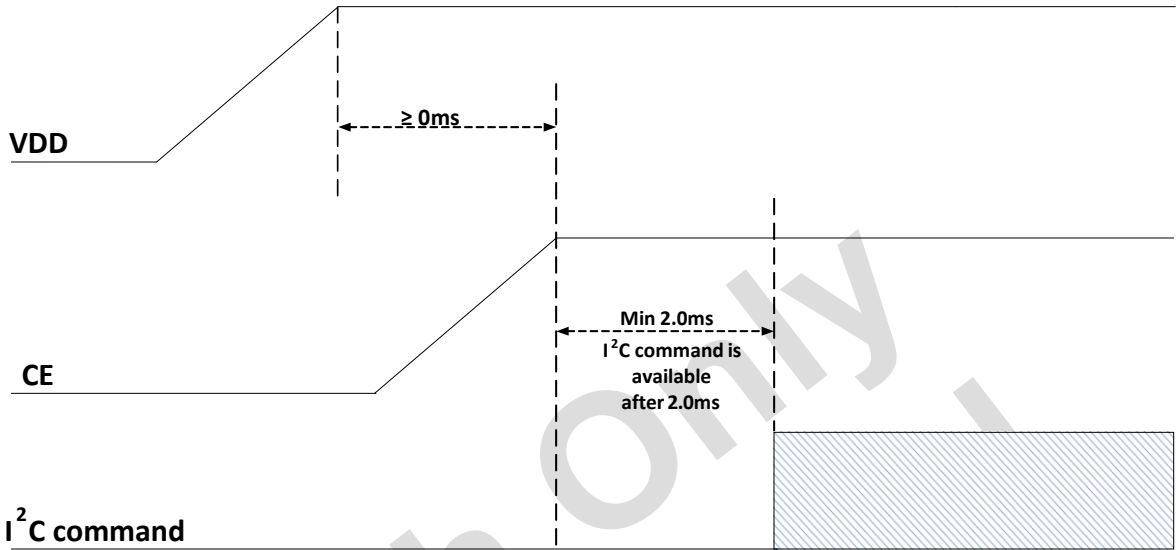
* $T_A = 25^\circ\text{C}$, $V_{DD} = 2.8\text{V}$, unless otherwise noted.

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Test Conditions /Comments
4. Logic Input (PC)						
Low Level Input Voltage	VIL_I2C			0.54	V	
High Level Input Voltage	VIH_I2C	1.26			V	
Pulse Width of Spike Rejection	TPSS		50		ns	
Low Level Output Voltage	VOL1			0.4	V	IOUT=3mA
	VOL2			0.6	V	IOUT=6mA
Input Current	IC	-1		1	uA	
5. Logic Input (CE)						
Low Level Input Voltage	VIL_CE			0.54	V	
High Level Input Voltage	VIH_CE	1.26			V	
Input Current	IC_CE	-1		1	uA	
6. EEPROM						
Supply Voltage	VDD_R	2.5	2.8	3.1	V	
	VDD_W	2.6	2.8	3.1	V	
Memory Capacity			80k		bit	
Data Retention			10		Years	
Endurance			1,000		Cycles	
Erase Time	PET	3.0			ms	Page erase time
	AET	3.0			ms	All erase time
Write Time		6.0			ms	

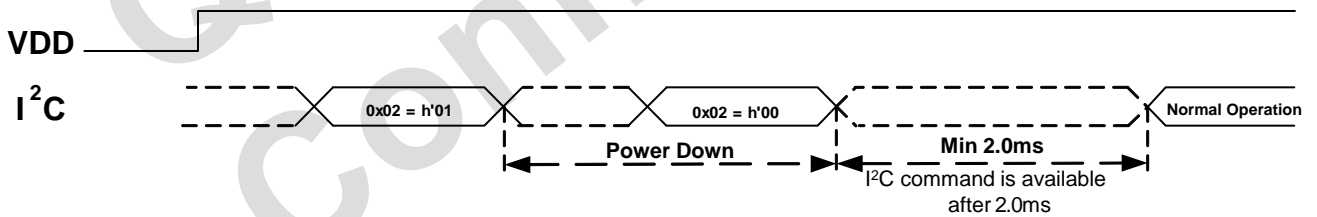
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Power On Sequence



S/W Power Down Sequence



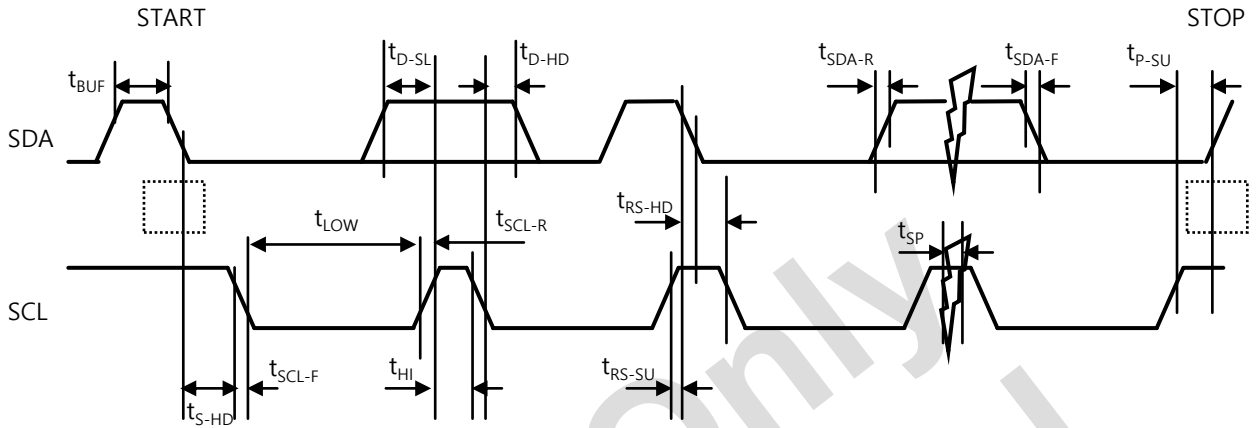
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I²C Interface Timing Specifications

* $T_A = 25^\circ\text{C}$, $V_{DD} = 2.8\text{V}$, unless otherwise noted.



Symbol	Description	Min.	Max.	Unit
f_{SCL}	SCL clock frequency		400	KHz
t_{BUF}	Bus free time between STOP and START condition	1.3		us
t_{LOW}	Low period of the SCL clock	1.3		us
t_{HI}	High period of the SCL clock	0.6		us
t_{RS-SU}	Setup time for START condition	0.6		us
t_{S-HD}	Hold time for START condition	0.6		us
t_{D-SU}	Data setup time	100		ns
t_{D-HD}	Data hold time		0.9	us
t_{SCL-R}	Rise time of SCL signal	$20+0.1C_b$	300	ns
t_{SCL-F}	Fall time of SCL signal	$20+0.1C_b$	300	ns
t_{SDA-R}	Rise time of SDA signal	$20+0.1C_b$	300	ns
t_{SDA-F}	Fall time of SDA signal	$20+0.1C_b$	300	ns
t_{P-SU}	Setup time for STOP condition	0.6		us
C_B	Capacitive load for SDA and SCL line		400	pF
t_{SP}	Pulse width of spike suppressed	0	50	ns

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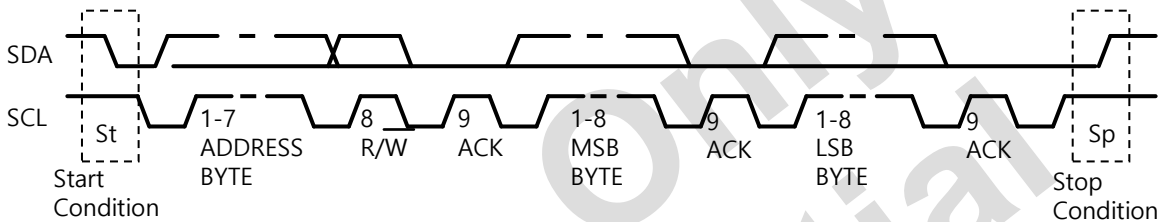


I²C Interface Data Format(VCM)

< Slave Address Option >

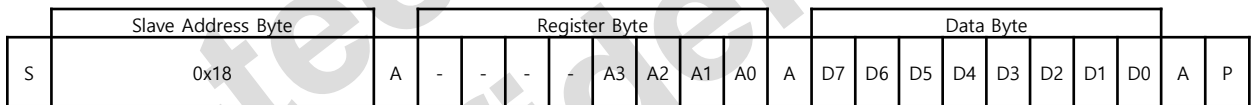
Register 0x1C	EEPROM Slave Address	VCM Slave Address	Note
h'00	0xA0	0x18	
h'01	0xA0	0x1C	
h'02	0xB0	0x18	default
h'03	0xB0	0x1C	

1. I²C Interface Timing Diagram

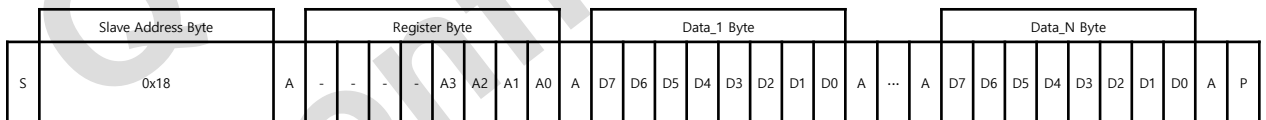


2. I²C Interface Data Format(VCM)

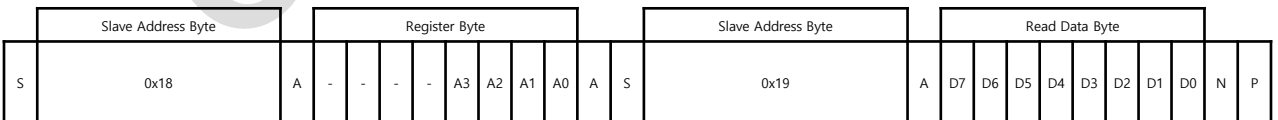
◆ Single Byte Write



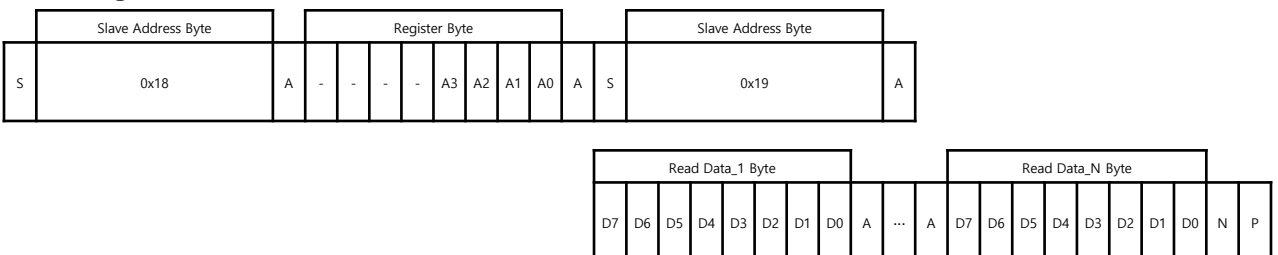
◆ Multi Byte Write



◆ Single Register Read



◆ Multi Register Read



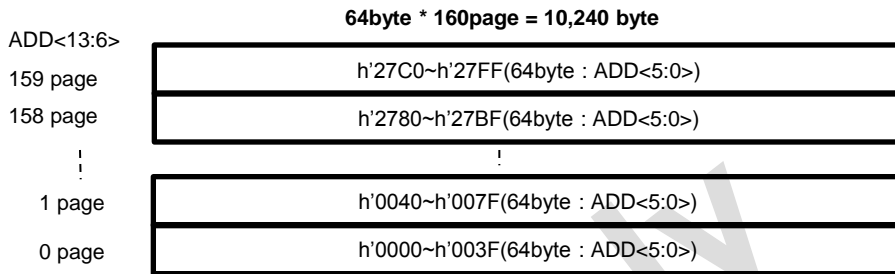
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I²C Interface Data Format(EEPROM)

1. EEPROM Structure



< EEPROM Structure >

2. EEPROM Register Format

Data	EEPROM Data1								EEPROM Data2								EEPROM Data3							
	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
Function	C1	C0	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0

* C<1:0> : EEPROM Command bits

- 00 : EEPROM Read
- 01 : EEPROM Write
- 10 : EEPROM Page Erase
- 11 : EEPROM All Erase

* A<13:6> : EEPROM Page Address(0~159 page)

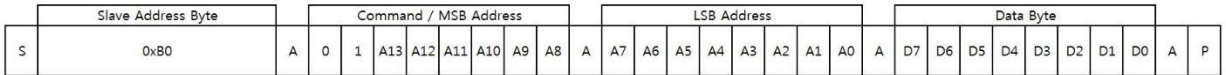
* A<5:0> : EEPROM Byte Address(0~63 byte)

* D<7:0> : EEPROM 1 Byte Data

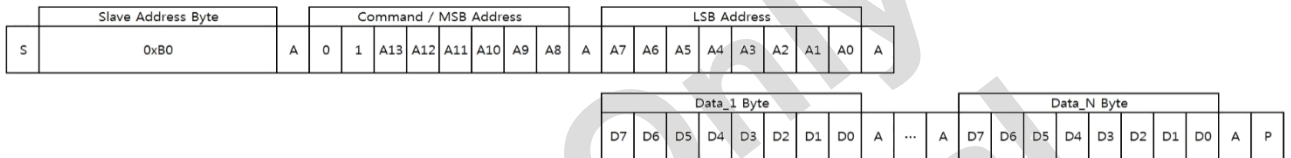
I²C Interface Data Format(EEPROM)

2. I²C EEPROM Interface Data Format(EEPROM)

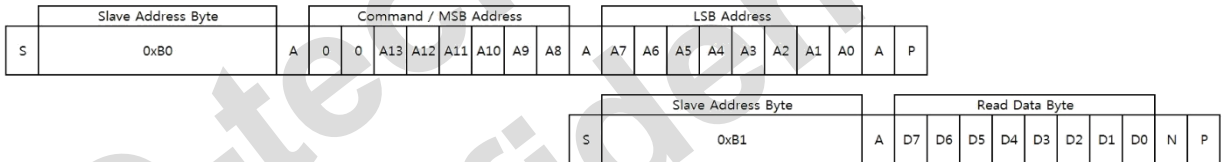
◆ EEPROM Single Byte Write



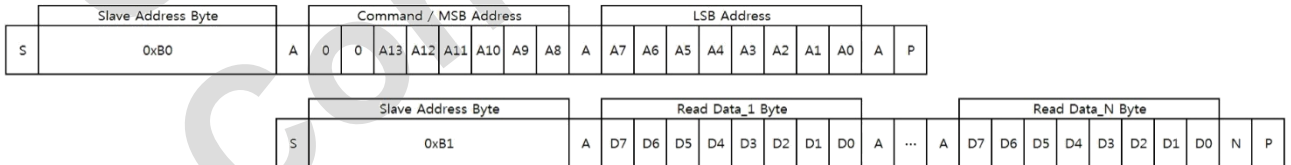
◆ EEPROM Multi Byte Write



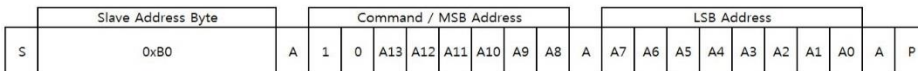
◆ EEPROM Single Register Read



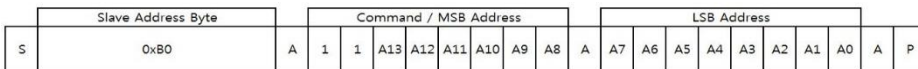
◆ EEPROM Multi Register Read



◆ EEPROM Page Erase



◆ EEPROM All Erase



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Register Map

Register Name	Register Address	Register Bit Name								Default	Access Type
		D7	D6	D5	D4	D3	D2	D1	D0		
Power Down	0x02	-	-	-	-	-	-	-	PD	0x00	W
Position Data	0x03	-	-	-	-	-	-	DIN<9>	DIN<8>	0x00	R / W
	0x04	DIN<7>	DIN<6>	DIN<5>	DIN<4>	DIN<3>	DIN<2>	DIN<1>	DIN<0>	0x00	R / W
Drive Mode	0x05	-	-	-	-	-	DM<2>	DM<1>	DM<0>	0x00	R / W
DSC Gain	0x06	VDP<7>	VDP<6>	VDP<5>	VDP<4>	VDP<3>	VDP<2>	VDP<1>	VDP<0>	0x00	R / W
AIP Data	0x07	AIPD<7>	AIPD<6>	AIPD<5>	AIPD<4>	AIPD<3>	AIPD<2>	AIPD<1>	AIPD<0>	0x00	R / W
AIP Time	0x08	-	-	-	-	-	-	AIPT<1>	AIPT<0>	0x00	R / W

* "-" should be set to "0"

Register Map Description

Register Name	Register Address	Register Bit Name								Access Type
		D7	D6	D5	D4	D3	D2	D1	D0	
Power Down	0x02	-	-	-	-	-	-	-	PD	W

* PD : Power down mode (Default : h'00)
0 : Normal operation
1 : Power down

Register Name	Register Address	Register Bit Name								Access Type
		D7	D6	D5	D4	D3	D2	D1	D0	
Position Data	0x03	-	-	-	-	-	-	DIN<9>	DIN<8>	R / W
	0x04	DIN<7>	DIN<6>	DIN<5>	DIN<4>	DIN<3>	DIN<2>	DIN<1>	DIN<0>	R / W

* DIN<9:0> : Input DAC data.(Default : h'000)
Output Current = DIN<9:0> / 1023 X 100mA.

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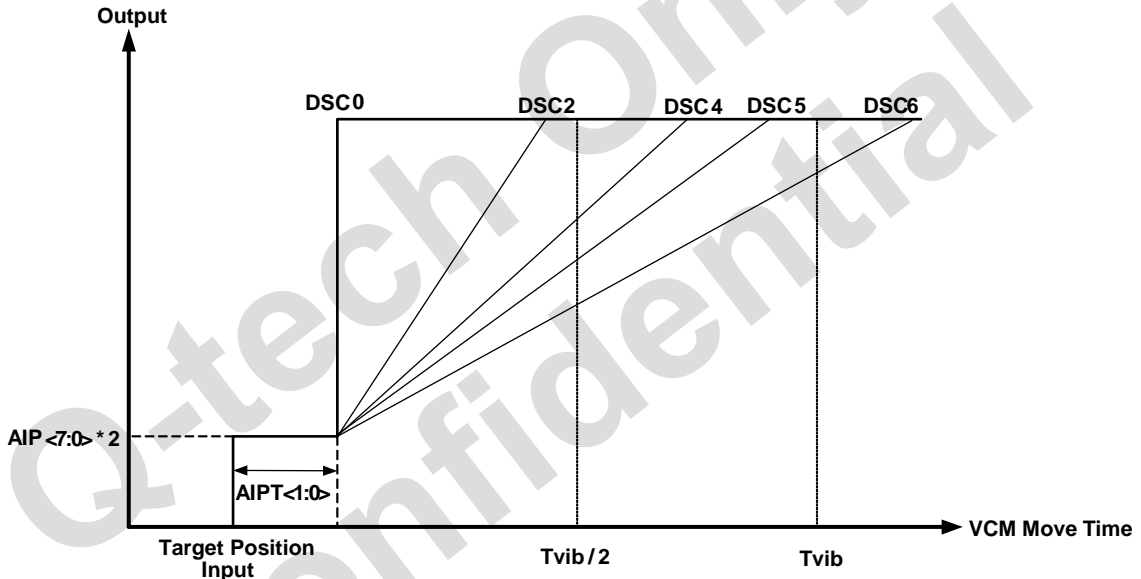


Register Map Description

Register Name	Register Address	Register Bit Name								Access Type
		D7	D6	D5	D4	D3	D2	D1	D0	
Drive Mode	0x05	-	-	-	-	-	DM<2>	DM<1>	DM<0>	R / W

* DM<2:0> : Drive mode select (Default : h'00)

DSC[2:0]		Mode
000	h'00	Direct mode
010	h'02	DSC2 (Max 48%)
100	h'04	DSC4 (Max 72%)
101	h'05	DSC5 (Max 92%)
110	h'06	DSC6 (Max 120%)



Register Name	Register Address	Register Bit Name								Access Type
		D7	D6	D5	D4	D3	D2	D1	D0	
DSC Gain	0x06	VDP<7>	VDP<6>	VDP<5>	VDP<4>	VDP<3>	VDP<2>	VDP<1>	VDP<0>	R / W

* VDP<7:0> : DSC Gain (Default : h'00)

ex> Gain = 10

$$100(\text{h}'64) \times 0.1 = 10$$

Register Name	Register Address	Register Bit Name								Access Type
		D7	D6	D5	D4	D3	D2	D1	D0	
AIP Data	0x07	AIPD<7>	AIPD<6>	AIPD<5>	AIPD<4>	AIPD<3>	AIPD<2>	AIPD<1>	AIPD<0>	R / W

* AIPD<7:0> : VCM Initial position data (Default : h'00)

ex> AIPD<7:0> = b'0011 0010 (h'32)

$$\text{Position data code for Initial position} = \text{AIPD}<7:0> * 2 = (\text{h}'32) * 2 = \text{h}'064$$

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Voice Coil Motor Driver IC with 10KB EEPROM



Register Map Description

Register Name	Register Address	Register Bit Name								Access Type
		D7	D6	D5	D4	D3	D2	D1	D0	
AIP Time	0x08	-	-	-	-	-	-	AIPT<1>	AIPT<0>	R / W

* AIPT<1:0> : VCM AIP current step period.

AIPT<1:0>		Period
00	h'00	200us
01	h'01	300us
10	h'02	400us
11	h'03	500us

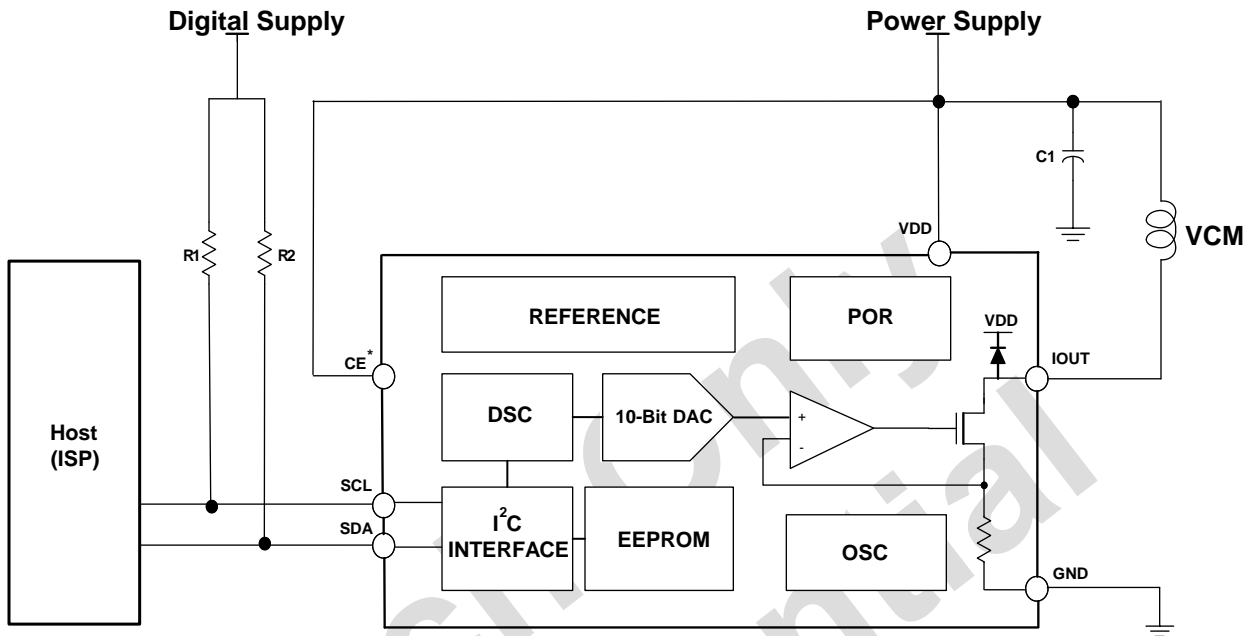
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Voice Coil Motor Driver IC with 10KB EEPROM



Typical Application Circuit



- C1 = 1 μ F
- R1 & R2 = 2.2K Ω (I²C Speed : 400KHz)
- CE (Chip Enable)
 - HIGH : Normal Operation Mode
 - LOW : Shutdown Mode

* Notes

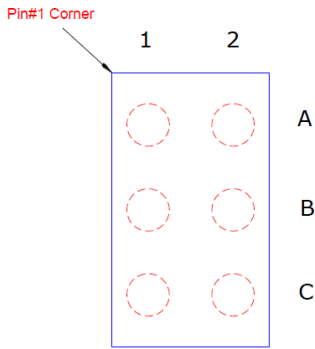
The user must place at least an 1 μ F capacitor(C1) as close as possible to the VDD and GND. PCB pattern of VDD, GND and IOU must be as short and wide as possible. CE must be controlled by GPIO. Otherwise it can be connected to VDD or GND.

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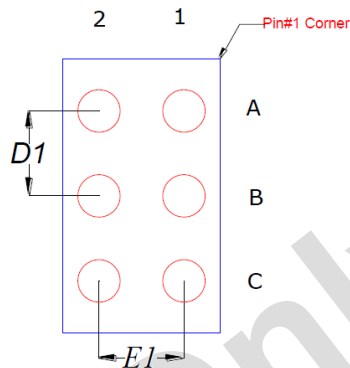
Voice Coil Motor Driver IC with 10KB EEPROM

WLCSP Dimensions

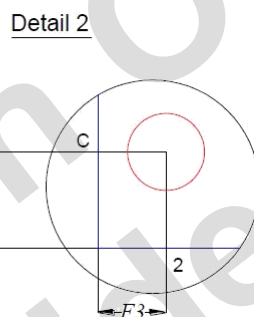
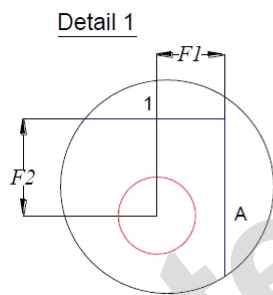
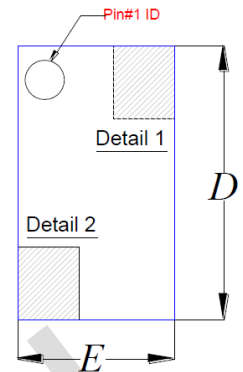
Top View- (Marking side up)



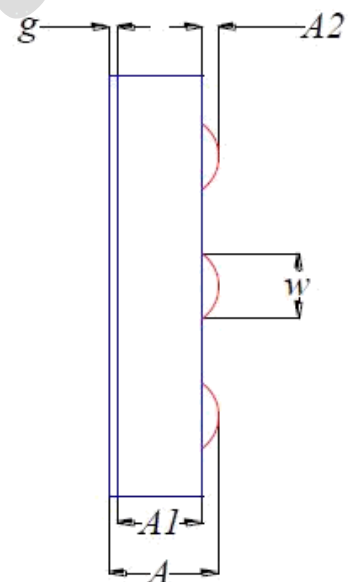
Bottom View(Bump side up)



Top View- (Marking side up)



Side View



Unit : mm

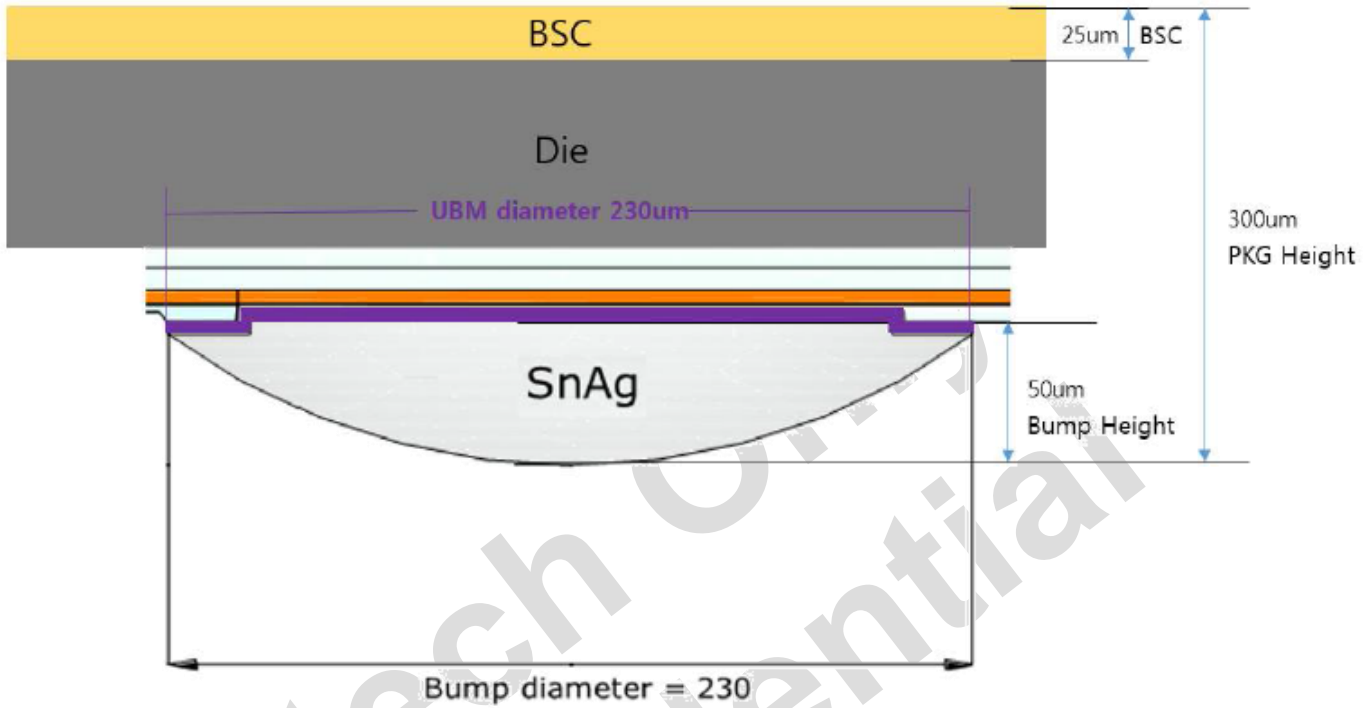
DIMENSION				
Symbols	MIN	NOM	MAX	NOTE
A	0.271	0.300	0.329	± 0.029
A 1	0.205	0.225	0.245	± 0.020
A 2	0.044	0.050	0.056	± 0.006
D		1.290		± 0.030
E		0.740		± 0.030
D1		0.400		
E1		0.400		
F1		0.170		Ball center to die edge
F2		0.245		Ball center to die edge
F3		0.170		Ball center to die edge
F4		0.245		Ball center to die edge
g	0.022	0.025	0.028	± 0.003
w	0.210	0.230	0.250	± 0.020

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Cross Section View



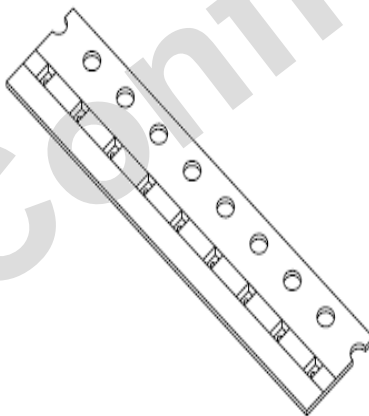
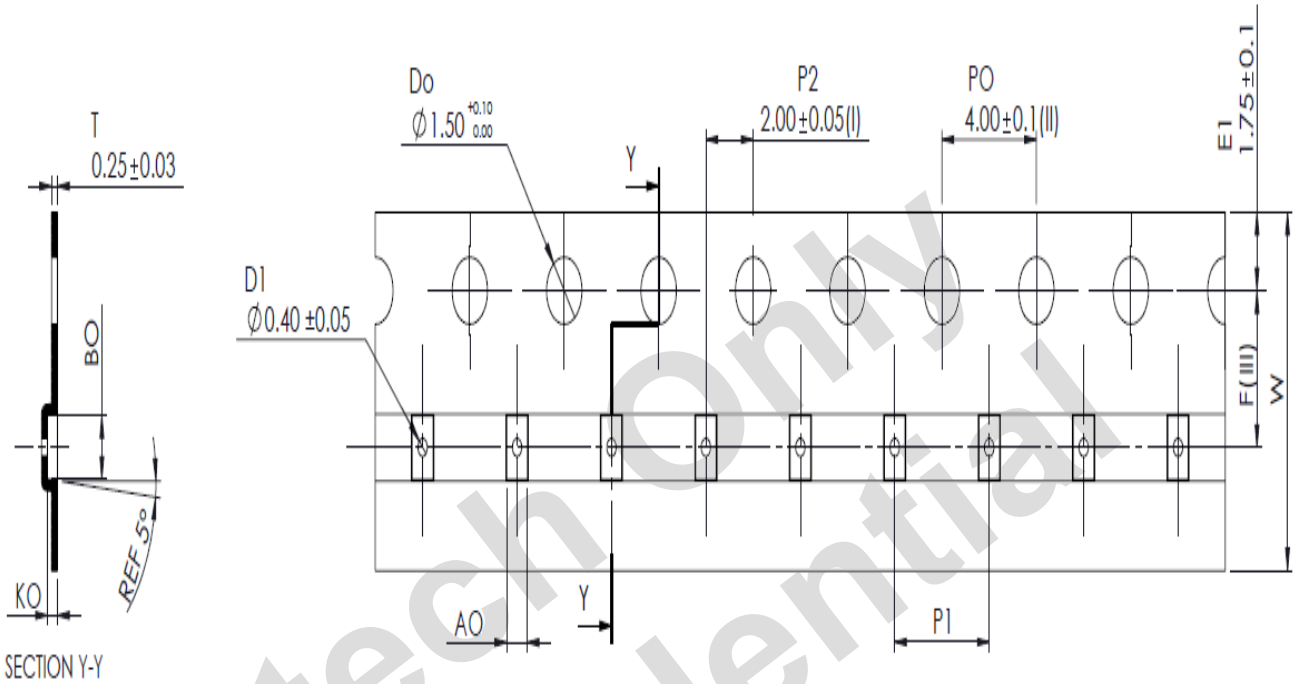
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Carrier Tape for WLCSP



Ao	0.87 +/- 0.05
Bo	1.42 +/- 0.05
Ko	0.42 +/- 0.05
F	3.50 +/- 0.05
P1	4.00 +/- 0.10
W	8.00 +/- 0.10

Tooling Code : 20
Estimated max. length :500 meter/13x10

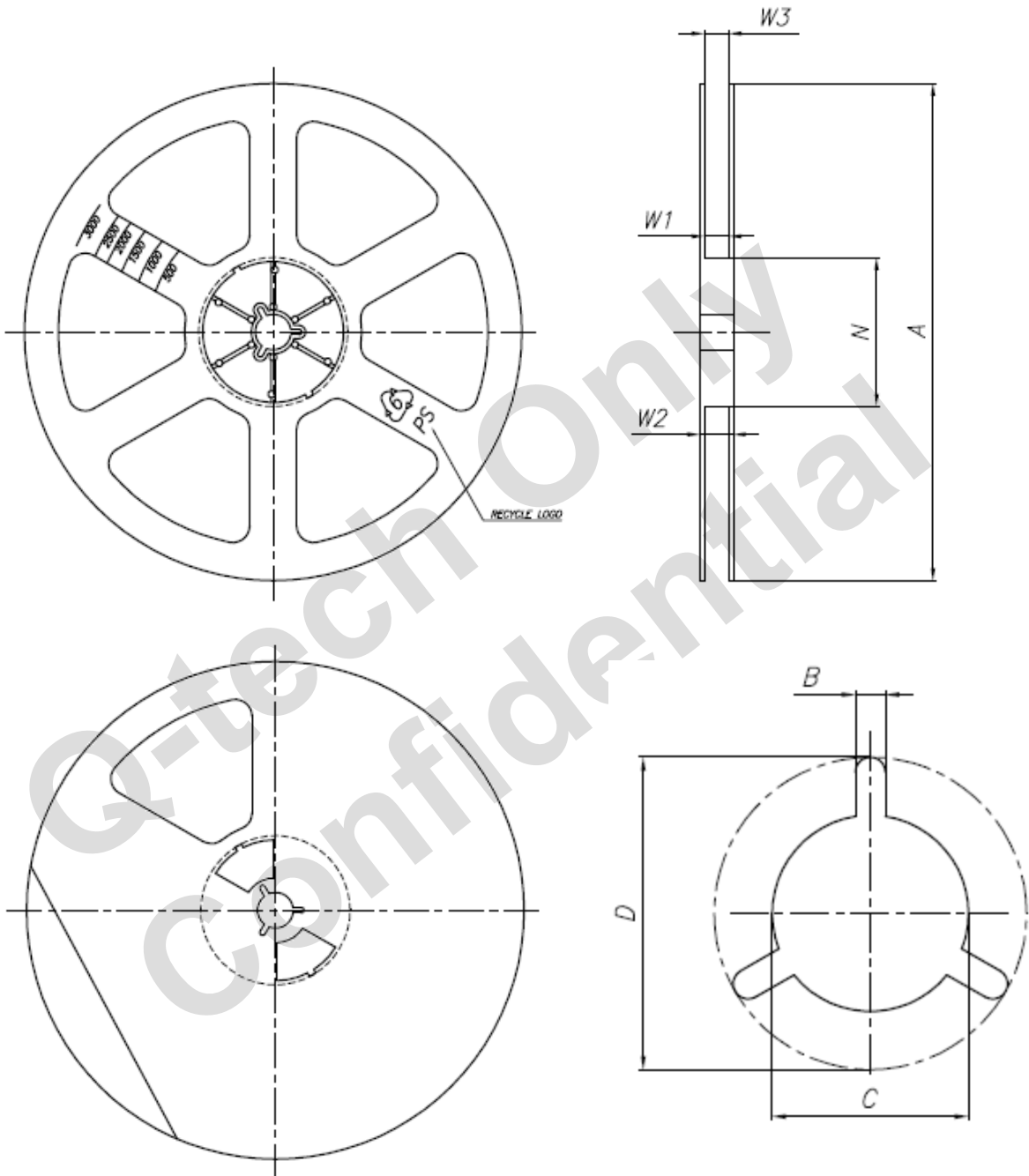
- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

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Voice Coil Motor Driver IC with 10KB EEPROM

7" Reel Drawing



PartNo	A	B	C	D	N	W1	W2	W3	COLOR	SURFACE RESISTANCY
KS-180X54-B	180 ^{+2.0} _{-2.0}	1.5min.	13.0 ^{+0.5} _{-0.2}	20.2min.	54.0 ^{+3.0} _{-0.0}	8.4 ^{+1.5} _{-0.0}	12.4 ^{+2.0} _{-2.0}	9.6 ^{+2.0} _{-2.0}	BLUE ANTI	MAX10 ¹¹ Ω/sq(conductive)

单击下面可查看定价，库存，交付和生命周期等信息

[>>ZINITIX\(纪斯\)](#)