11-MD215

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VCM Driver for Mobile Phone

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11-MD215

VCM Driver for Mobile Phone

General Specifications

The 11-MD215 is a 1ch voice coil motor driver which provides a controllable constant current via external PWM input signal control. With miniature package, it is suitable for reduced -space mounting in camera module application and other portable device.

Features and Benefits

- Low supply voltage operation
- Low saturation voltage
- Low operating current
- Zero standby current
- Low digital pin (PD) control voltage (i.e., V_{IH} = 1.6V @ VDD = 2.8V)
- Built-in a freewheeling diode
- Constant current control
- PWM input control with low input current
- Ultra-small package (WLCSP, 0.79*1.19*0.5 mm)

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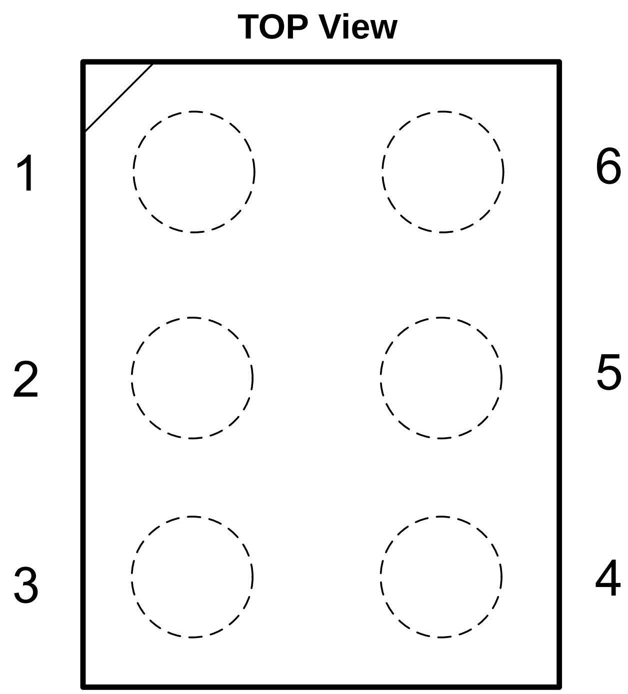
Pin Assignment

Pin Assignment of WLCSP (0.79*1.19*0.5mm)



Pin NO.	Pin Name	Description
1	VDD	Power supply pin for controller.
2	IN	Constant current setting pin
3	OUT	Motor output pin
4	AGND	Analog ground
5	GND	Controller ground
6	PD	Power down. Asynchronous power down signal

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Absolute Maximum Ratings *(Unless otherwise noted, T_A= 25℃)*

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	5.5	V
Input Voltage	V_{IN}	V_{DD}+0.4	V
Maximum output current	I_{OUT}	250	mA
Power Dissipation	P_D	300	mW
Operating Temperature Range	T_{OPR}	-40 ~ 125	°C
Storage Temperature Range	T_{STG}	-65 ~ 150	°C

Electrical Characteristic

(Unless otherwise noted, T_A= 25℃ & V_{DD} = 2.8V, VCM= 28.5 Ω, 460μH)

Item	Sym.	Condition	Limit			Unit
			Min.	Typ.	Max.	
Whole circuits						
Supply Voltage	V_{DD}		2.0	2.8	5.5	V
Supply Current (I_{DD})	I_{STB}	PD = L (Standby mode)		0.1	1	μA
	I_{DD1}	PD = H (Operation mode)		0.6	1	mA
Power down						
Input Voltage 'H'	V_{PDH}	-	0.57*V_{DD}	-	V_{DD}+0.4	V
Input Voltage 'L'	V_{PDL}	-	-0.4	-	0.2*V_{DD}	V
Input Current 'H'	I_{PDH}	V_{PD} = 2.8V(built-in pull low resistor 300k)	-	10	20	μA
Input Current 'L'	I_{PDL}	V_{PD} = 0 V	-	-	±1	μA
Constant Current Output Terminal						
Output constant current	I_{OUT}		-	-	200	mA
Output current during PD	$I_{OUT,PD}$	PD = L	-	-	1	μA
Saturation Voltage ($V_{OUT->AGND}$)	V_{SAT}	I_{OUT} = 80 mA	-	0.3	0.35	V
Output Current Settling Time	t_s	VDD = 2.8V, C_L=0.1 μF , I_{OUT} = 0 -> 100mA		20	50	μs

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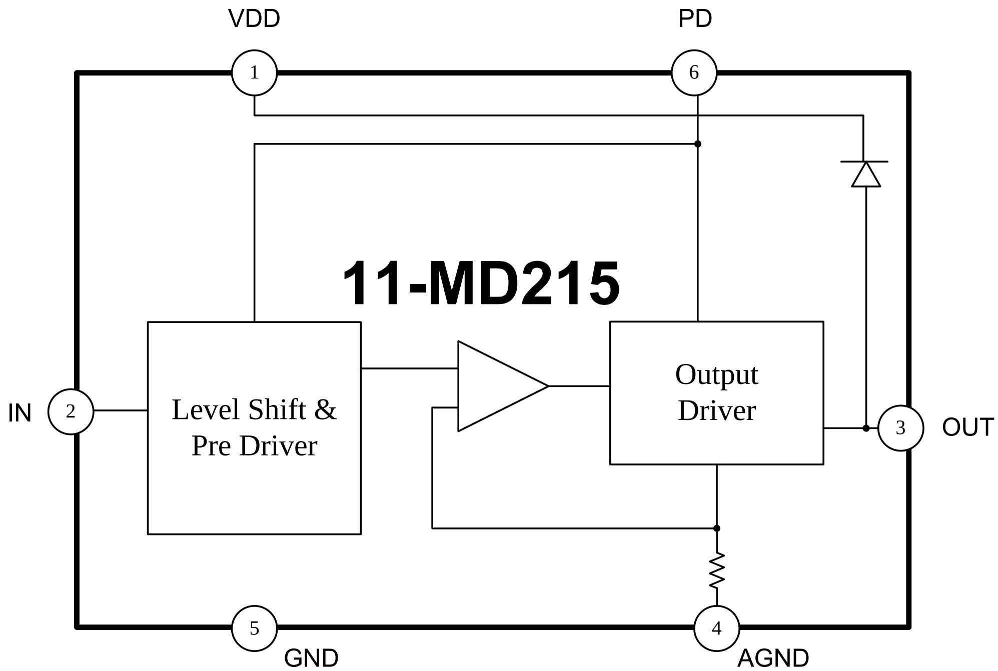
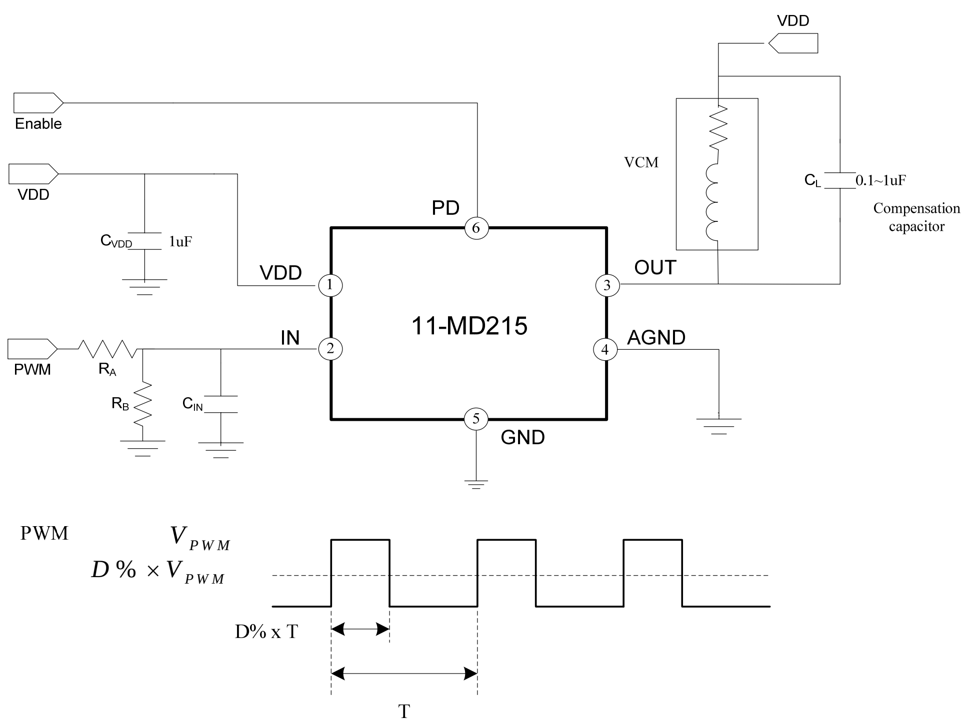
Block Diagram



Application Circuit

1. PWM control



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Application Notes

- The 11-MD215 is constant current control for use in Auto-Focus. The range of supply voltage of 11-MD215, VDD is from 2.0V to 5.5V. The 11-MD215 digital control pin, PD, its input range is defined that logic “H” is from 0.57*VDD to VDD+0.4V and logic “L” is from –0.4V to 0.2*VDD. So the digital PD pin is suitable to be controlled by 1.8V ISP.

- The power down pin (PD) is the enable pin of 11-MD215, which logic high level (PD = H) is for IC operation. On the other hand, its logic low level (PD = L) puts the chip into standby mode for power saving. Internal pull low resistor, 300k, prevents IC from abnormal operation when PD is open. Therefore, it is easy to switch the working status by controlling PD pin, and it is recommended that keeps PD at low level (PD = L) before operation to reach the maximum efficiency of power saving, especially in the application of portable device.

- Constant current operation of 11-MD215 provides the current, which can be evaluated by the formula $I = \frac{V_{IN}}{15}\ (\mathrm{A})$. It is convenient to get constant output current by controlling input dc voltage, V_{IN}. Therefore, by adjusting the resistance of R_A, R_B, and the capacitance C_{IN}, with appropriately PWM frequency will get the suitable and stable input voltage level, V_{IN}, for setting constant current in the output.

- In the application circuit diagram, the signal PWM, V_{PWM}, is filtered by a low pass filter which consists of R_A, R_B, and C_{IN}. The -3dB frequency ω_{3dB} and V_{IN} are given by

$$\omega_{3dB} = \frac{1}{(R_A // R_B)C_{IN}} \qquad (1)$$

$$V_{IN} = \frac{R_B}{R_A + R_B} D\% \times V_{PWM} \quad (\mathrm{V}),$$

, which D% is the duty ratio of PWM frequency. The corresponding of constant current at the output could be changed by setting different duty ratio of PWM, In order to confirm the accuracy and stable value of constant current, the amount of

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-3dB frequency ω_{3dB} is suggested lower than the 1/1000 of the PWM frequency. It is shown as follows,

$$\omega_{3dB} = \frac{1}{1000}\omega_{PWM} \tag{2}$$

- The following example explains how to design the low pass filter. For PWM frequency $f_{PWM} = 92.8kHz$, and desired maximum output constant current, I_{MAX}, is 80mA and V_{PWM} = 2.8V. Please determine C_{IN}, R_A and R_B.

  According to equation (1) & (2), we have

$$f_{3dB} = \frac{1}{2\pi\left(R_A // R_B\right)C_{IN}} = \frac{1}{1000} f_{PWM} = 92.8Hz$$

  By choosing $C_{IN} = 0.1uF$, we can get $\left(R_A // R_B\right) = 17.1k\Omega$.

  Owing to $I_{MAX} = \frac{V_{IN,MAX}}{15} \; (\mathrm{A}) = \frac{R_B}{15\left(R_A + R_B\right)} V_{DD} \left(\mathrm{A}\right)$,

  Then

$$R_A = 40k\Omega,\quad R_B = 30k\Omega$$

- In order to ensure the stabilization of output current, the compensation capacitance C_L is suggested placing in parallel with VCM. The suggestion value of C_L is about 0.1~1uF and maybe fine tune depending on the different VCM. It is the sense of frequency response compensation to confirm stability while VCM operating.

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- LPF Design Look Up Table

1. PWM = 24 KHz

V_{PWM} = 2.8V

Max. output current *I (mA)*	C_{IN} (μF)	R_A ($k\Omega$)	R_B ($k\Omega$)
70	0.1	177	106
80	0.1	155	116

2. PWM = 46 KHz

V_{PWM} = 2.8V

Max. output current *I (mA)*	C_{IN} (μF)	R_A ($k\Omega$)	R_B ($k\Omega$)
70	0.1	92	55
80	0.1	80	60

3. PWM = 92.8 KHz

V_{PWM} = 2.8 V

Max. output current *I (mA)*	C_{IN} (μF)	R_A ($k\Omega$)	R_B ($k\Omega$)
70	0.1	46	28
80	0.1	40	30

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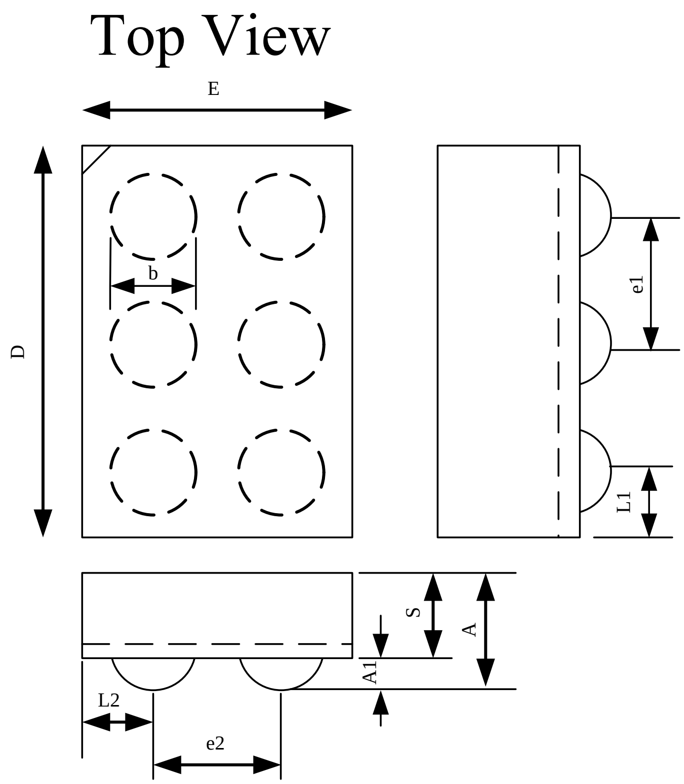
Package Specifications (WLCSP) *(size: 0.79*1.19*0.5 mm)*



SYMBOL	DIMENSION (mm)		
	MIN.	NOM.	MAX.
A	0.445	0.50	0.555
A1	0.17	0.20	0.23
S	0.275	0.30	0.325
b	0.24	0.26	0.28
D	1.14	1.19	1.24
E	0.74	0.79	0.84
e1		0.4	
e2		0.4	
L1	0.170	0.195	0.220
L2	0.170	0.195	0.220

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