VM147

Version : A.001
Issue Date : 2010/06/08
File Name : SP-VM147-A.001.doc
Total Pages : 13

110mA, 10Bit Current Sinking VCM Driver with I^2C Interface

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VM147

110mA, 10-Bit Current Sinking VCM Driver with I²C Interface

General Specifications

The VM147 is a VCM(Voice Coil Motor) driver IC with I²C interface control that is capable of programmable sinking output current. It has a built-in internal voltage reference and operates with a supply voltage range from 2.4V to 5.5V. The DAC is controlled by a signal transmit through a 2-wire I²C serial interface which operates in an I²C fast mode (400 kHz). The VM147 is designed for applications such as image stabilization, auto-focus, optical zoom in camera phones, and other portable module devices.

Features and Benefits

- Programmable sinking output current
- I²C serial interface
- DAC with 10-BIT resolution
- 2.4V – 5.5V power source
- Selective Output Slew Rate Control(SRC)
- Low voltage control for digital pin PS, SDA, and SCL(i.e., V_{IH} = 1.68V @ VDD = 2.8V)
- Power saving mode leakage current 2.4uA max.
- Power saving mode
- Automatic power on reset
- Ultra small package: WLCSP (0.78*1.27*0.35mm)

Ordering Information

Part Number	Package	Marking
VM147 WLCSP	WLCSP, 6Pin	7XX*

*XX reserved for a data code

Terminology

Resolution

The DAC resolution is defined by the power factor of 2, which defines the number of distinct digitized levels.

N-bit resolution -> 2^N distinct digitized levels

Differential Nonlinearity (DNL) error

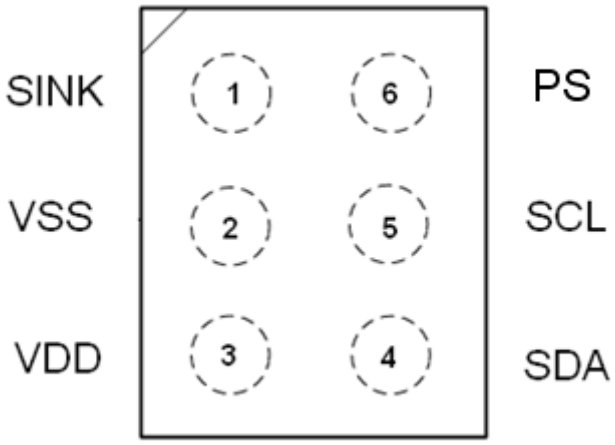
The variation in digitized step value away from 1 LSB by any two adjacent digitized levels, gain and offset errors removed.

Integral Nonlinearity (INL)

INL is a deviation of the actual transfer response from a straight line. Usually, INL error is referred to the maximum INL error.

Pin Assignment of WLCSP (0.78*1.27*0.35mm)

TOP View



Pin Number	Pin Name	Description
1	SINK	Analog Output : Current Sink Pin
2	VSS	Ground Input Pin
3	VDD	Power Input Pin
4	SDA	I^2C Interface Data Line(Serial Data Line)
5	SCL	I^2C Interface Clock Line(Serial Clock Line)
6	PS	Digital Input: Power saving control (When PS=High ,chip is disabled) (When PS=Low ,chip is enabled)

Absolute Maximum Ratings

Unless otherwise noted, T_A= 25℃

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	-0.4 ~ 5.5	V
Input Signal Voltage	V_{IN}	-0.4 ~ V_{DD}+0.4	V
Maximum Sink Current	I_{SINK}	127	mA
Operating Temperature	T_{OPR}	-40 ~ 85	°C
Storage Temperature	T_{STG}	-55 ~ 150	°C

Electrical Characteristic

Unless otherwise noted, T_A= 25℃, V_{DD} = 2.8 V and VCM ≈ 18Ω, 460uH.

Item	Sym.	Condition	Limit			Unit
			Min.	Typ.	Max.	
Power Supply						
Supply Voltage	V_{DD}		2.4	2.8	5.5	V
Supply Current (I_{DD})	I_{PS}	PS = High (chip is disabled)	-	0.3	1	uA
	I_{DD0}	PS = Low, SPS(*1)= High	-	0.3	0.5	mA
	I_{DD1}	PS = Low, SPS(*1)= Low	-	1.6	2.3	mA
PS, SDA, SCL digital pin						
Input Voltage High	V_{IH}	-	0.5*V_{DD}	-	V_{DD}+0.4	V
Input Voltage Low	V_{IL}	-	-0.4	-	0.1*V_{DD}	V
Parameters						
DAC Resolution			-	10	-	Bits
DNL			-	+/-0.7	+/-1	LSB
INL			-	+/-1.5	+/-4	LSB
Maximum Output Sink Current	$I_{S,max}$	D[9:0]=3FF(*2)		102		mA
Zero Code Output Sink Current	$I_{S,min}$	D[9:0]=000(*2)	-	1	4	mA
Output Offset Current	I_{OS}	PS = L, SPS(*1)= H	-	0.1	1	uA
Voltage Drop	ΔV	$\Delta V = V_{SINK} - V_{MVSS}$ (*3) (@I_{SINK} = 80 mA)	-	0.35	0.44	V

Note:

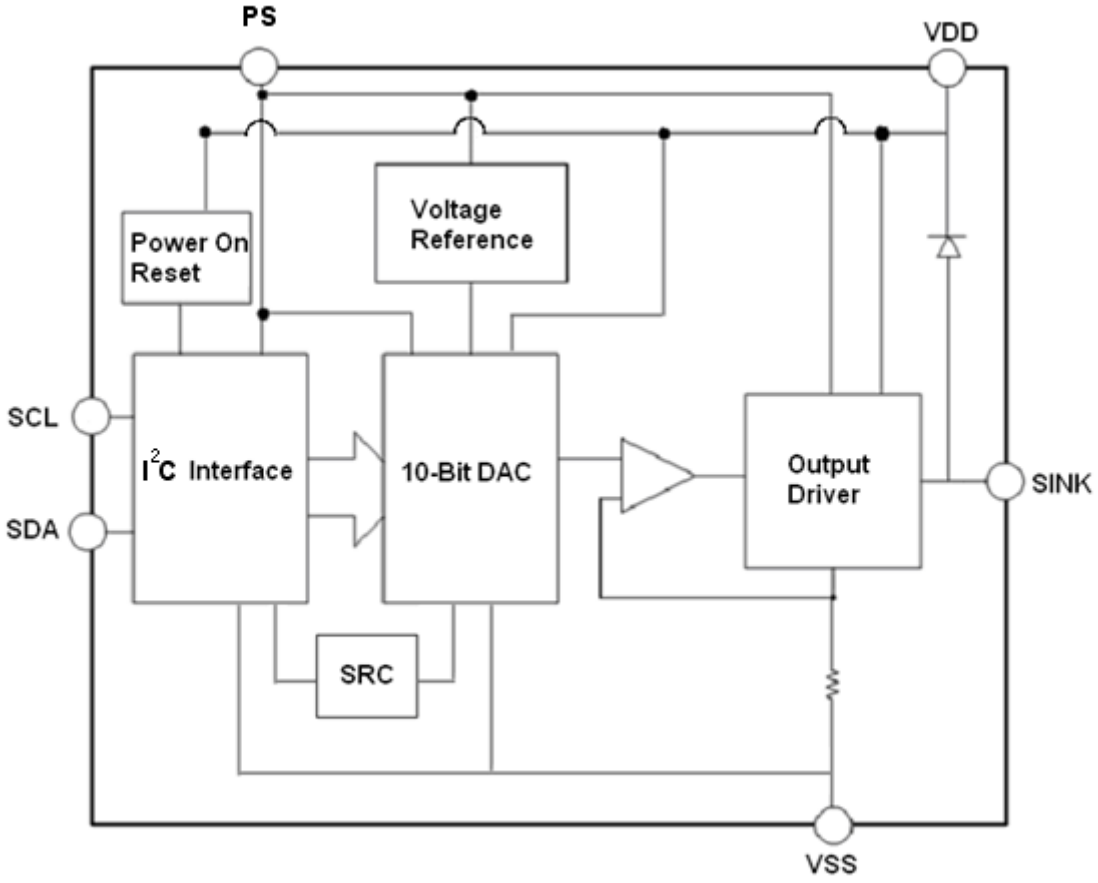
(*1): SPS (Soft Power Saving, 2nd standby mode): IC power saving mode, controlled by software.

(*2): The value of sink current through pin SINK is set by D[9:0] linearly.

(*3): V_{SINK} is the voltage of SINK pin, and V_{MVSS} is the voltage of motor driver VSS pin

Block Diagram

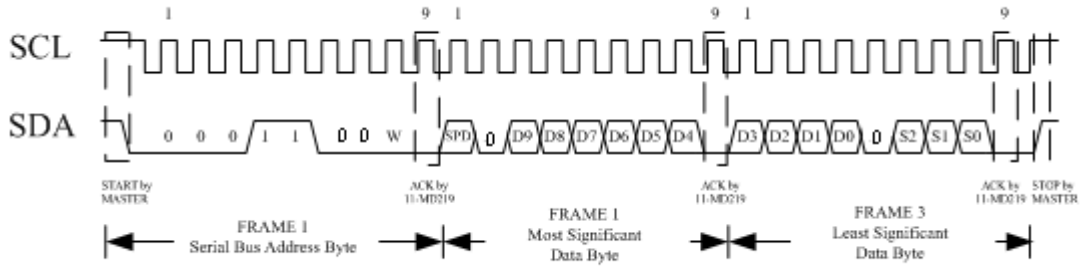
(WLCSP)



Data Format

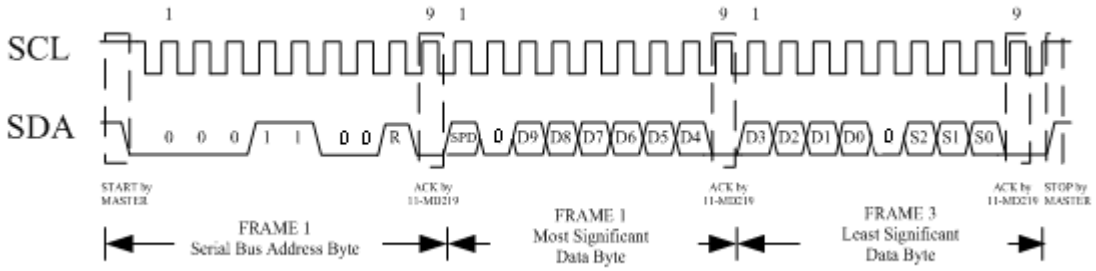
VM147 Write Mode

In the writing mode, data is written to the VM147 and shifted into a 16-bit input register. After all 16 bits of data have been shifted in, a STOP signal is generated by master controller. The data in the input register is transferred to the DAC at the same time.



VM147 Read Mode

In reading mode, data is read from IC to a master controller in the same bit order.



Table

	MSB								LSB							
Serial Data Bits	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Input Register	R15	R14	R13	R12	R11	R10	R09	R08	R07	R06	R05	R04	R03	R02	R01	R00
Function	SPS	0	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	0	S2	S1	S0

- **SPS (Soft Power Saving, 2nd standby mode):** IC power saving, controlled by software.

The operations are defined by the following table.

PS	SPS	IC status
High	-	Power saving
Low	Low	Normal
	High	Soft power saving

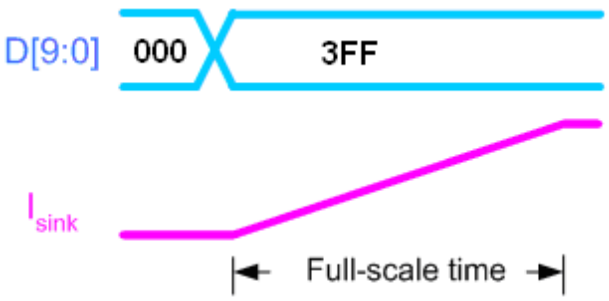
If PS is at logic high level; the chip is forced to shut down all power. If PS is at logic low level, the chip will be controlled by the SPS bit(the R15 bit of the register) to perform normally(SPS=Low) or to softly power off the IC(SPS=High). It is recommended to keep PS at high level (PS = H) while the chip is in no operation mode to save power for all applications.

- **D[9:0]:** The level of sink current through pin SINK is set by D[9:0].

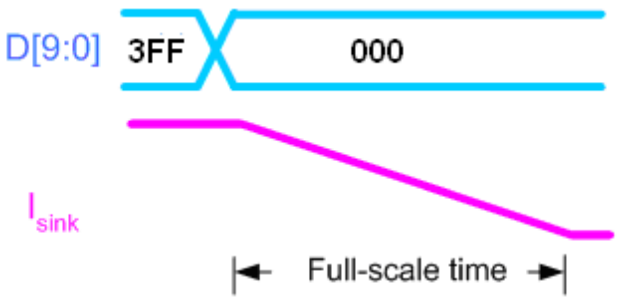
- **S[2:0]:** Output Current Slew Rate Control: The output current slew rate can be set by S[2:0] as defined below.

S[2:0]	Full Scale Transition Time (ms)			Ratio
	Min.	Typ.	Max.	
0 0 0	1.16	1.57	1.99	1X
0 0 1	37.2	50.2	64	32X
0 1 0	55.8	75.3	96	48X
0 1 1	74.3	100	128	64X
1 0 0	92.9	126	159	80X
1 0 1	111	151	191	96X
1 1 0	130	176	223	112X
1 1 1	149	201	255	128X

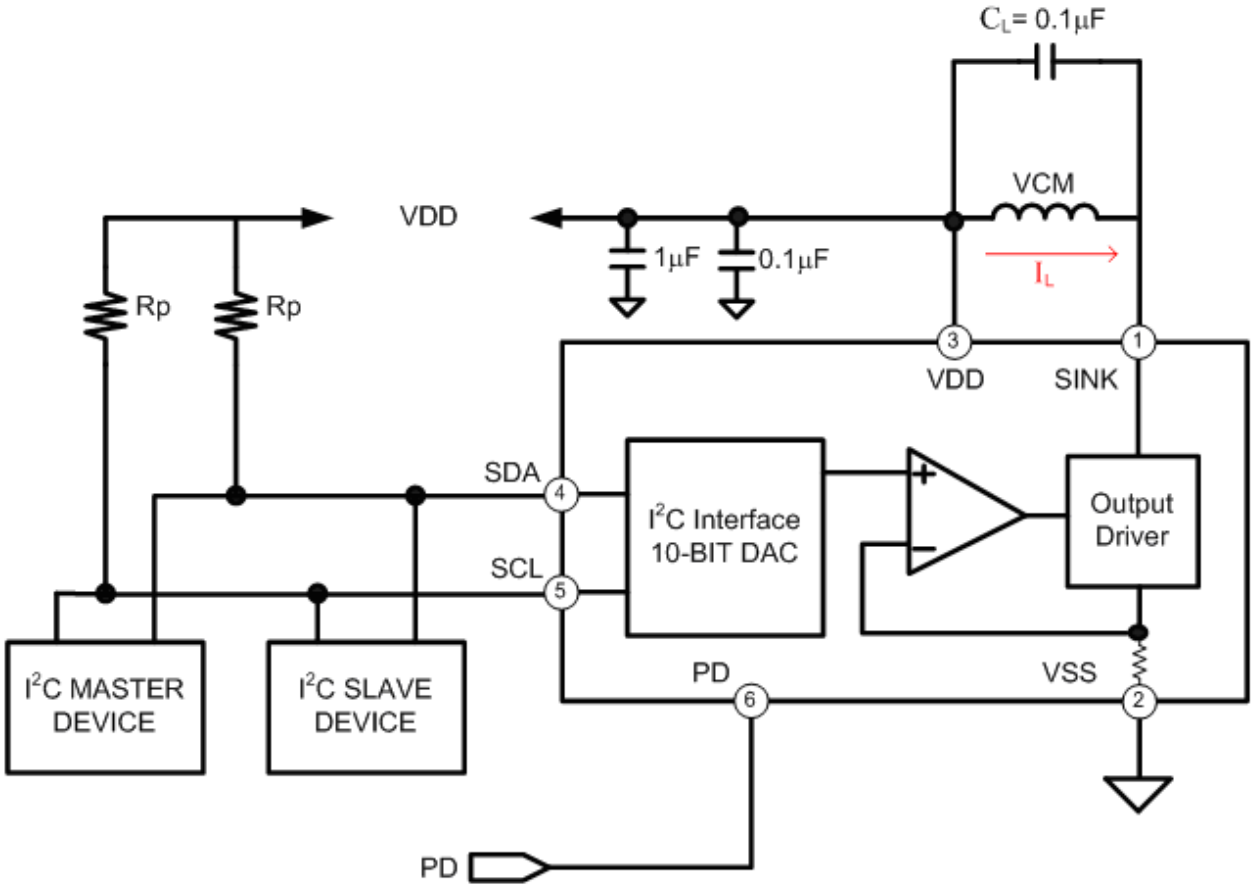
D[9:0]=000 ➔ 3FF



D[9:0]=3FF ➔ 000



Application Circuit

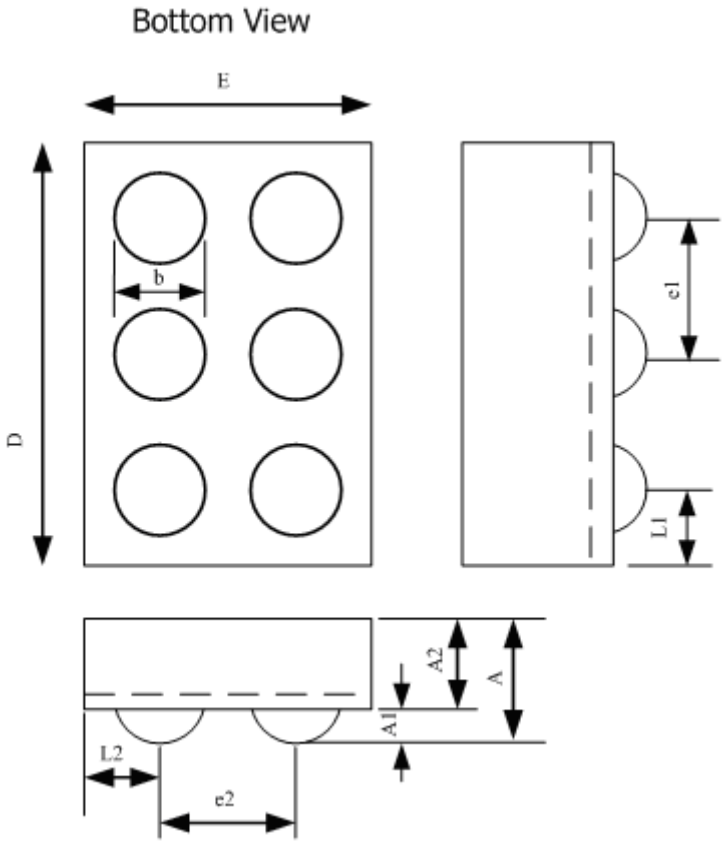


Application Notes

- The VM147 is a constant current driving IC for applications in Auto-Focus. The supply voltage range VDD of VM147 is from 2.4V to 5.5V. The input range of digital control pin PS, and digital I/O pins SCL and SDA, are defined such that logic “High” is from 0.6*VDD to VDD+0.4V and logic “Low” is from –0.4V to 0.1*VDD. Therefore, the three digital pins are suitable controlled by 1.8V ISP.

- In order to ensure the stability of output current, a capacitance C_L is suggested to be installed between the two terminals of VCM. The suggested value of C_L is in the range of 0.1~0.22uF to match different VCMs.

Package Specifications (WLCSP1): *(0.78*1.27*0.35mm)*



SYMBOL	DIMENSION (mm)		
	MIN.	NOM.	MAX.
A	0.325	0.350	0.375
A1	0.090	0.100	0.110
A2	0.235	0.250	0.265
b	0.234	0.260	0.286
D	1.255	1.270	1.285
E	0.765	0.780	0.795
e1	0.380	0.400	0.420
e2	0.380	0.400	0.420
L1	0.215	0.235	0.255
L2	0.170	0.190	0.210

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