

# VM149C

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*120mA, 10Bit Current Sinking VCM Driver  
with I<sup>2</sup>C Interface*



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## *120mA, 10-Bit Current Sinking VCM Driver with I<sup>2</sup>C Interface*

### General Specifications

The VM149C is a VCM (Voice Coil Motor) driver IC with I<sup>2</sup>C 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 2.3V to 3.6V. The DAC is controlled by a signal transmit through a 2-wire I<sup>2</sup>C serial interface which operates in an I<sup>2</sup>C fast mode (400 kHz). The VM149C is designed for applications such as image stabilization, autofocus in camera phones, and other portable devices.

### Features and Benefits

- Programmable sinking output current
- I<sup>2</sup>C serial interface
- DAC with 10-bit resolution
- 2.3V – 3.6V power source
- Selective Output Slew Rate Control (SRC)
- Low voltage control for digital pin PS, SDA, and SCL
- Power saving mode
- Automatic power on reset
- Ultra small package: WLCSP (0.78mm\*1.27mm\*0.35mm)

### Ordering Information

| Part Number | Package     | Marking |
|-------------|-------------|---------|
| VM149C      | WLCSP, 6Pin | TBD     |

## Terminology

### Resolution

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

N-bit resolution  $\rightarrow 2^N$  distinct digitized levels

### Differential Nonlinearity (DNL) error

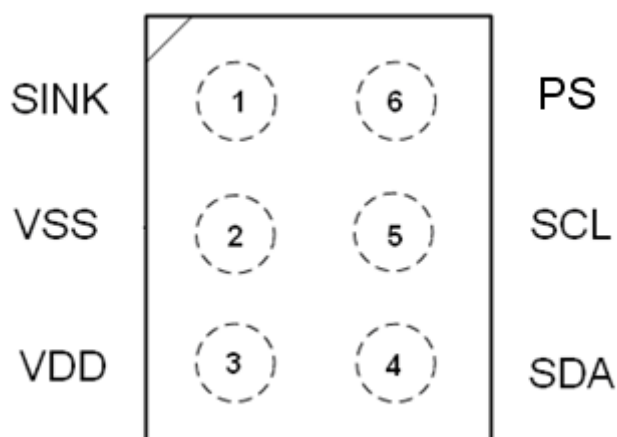
The variation in digitized step value away from 1 LSB by any two adjacent digitized levels, gain and offset errors removed.

### 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

### TOP View



| Pin Number | Pin Name | Description                                                                                               |
|------------|----------|-----------------------------------------------------------------------------------------------------------|
| 1          | SINK     | Analog Output : Current Sink Pin                                                                          |
| 2          | VSS      | Ground Pin                                                                                                |
| 3          | VDD      | Power Input Pin                                                                                           |
| 4          | SDA      | I <sup>2</sup> C Interface Data Line (Serial Data Line)                                                   |
| 5          | SCL      | I <sup>2</sup> C Interface Clock Line (Serial Clock Line)                                                 |
| 6          | PS       | Digital Input: Power Saving Control<br>(When PS=Low, chip is disabled)<br>(When PS=High, chip is enabled) |

## Absolute Maximum Ratings

Unless otherwise noted, T<sub>A</sub> = 25°C

| Characteristic        | Symbol            | Rating                      | Unit |
|-----------------------|-------------------|-----------------------------|------|
| Supply Voltage        | V <sub>DD</sub>   | -0.4 ~ 3.6                  | V    |
| Input Signal Voltage  | V <sub>IN</sub>   | -0.4 ~ V <sub>DD</sub> +0.4 | V    |
| Maximum Sink Current  | I <sub>SINK</sub> | 130                         | mA   |
| Operating Temperature | T <sub>OPR</sub>  | -40 ~ 85                    | °C   |
| Storage Temperature   | T <sub>STG</sub>  | -55 ~ 150                   | °C   |

## Electrical Characteristic

Unless otherwise noted,  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 2.8\text{ V}$  and  $V_{CM} \approx 32\Omega$ ,  $460\mu\text{H}$ .

| Item                                  | Sym.               | Condition                                                                       | Limit |        |                      | Unit |
|---------------------------------------|--------------------|---------------------------------------------------------------------------------|-------|--------|----------------------|------|
|                                       |                    |                                                                                 | Min.  | Typ.   | Max.                 |      |
| Power Supply                          |                    |                                                                                 |       |        |                      |      |
| Supply Voltage                        | V <sub>DD</sub>    | -                                                                               | 2.3   | 2.8    | 3.6                  | V    |
| Supply Current<br>( I <sub>DD</sub> ) | I <sub>PS</sub>    | PS = Low (chip is disabled)                                                     | -     |        | < 1                  | uA   |
|                                       | I <sub>DD0</sub>   | PS = High, SPS(*1)= High                                                        | -     |        | < 1                  | uA   |
|                                       | I <sub>DD1</sub>   | PS = High, SPS(*1)= Low                                                         | -     | 1.8    | 2.3                  | mA   |
| PS, SDA, SCL digital pin              |                    |                                                                                 |       |        |                      |      |
| Input Voltage High                    | V <sub>IH</sub>    | -                                                                               | 1.26  | -      | V <sub>DD</sub> +0.4 | V    |
| Input Voltage Low                     | V <sub>IL</sub>    | -                                                                               | -0.4  | -      | 0.54                 | V    |
| Input Current High                    | I <sub>IH</sub>    | -                                                                               |       |        | ±1                   | uA   |
| Input Current Low                     | I <sub>IL</sub>    | -                                                                               |       |        | ±1                   | uA   |
| Parameters                            |                    |                                                                                 |       |        |                      |      |
| DAC Resolution                        |                    | -                                                                               | -     | 10     | -                    | Bits |
| DNL                                   |                    | -                                                                               | -     | +/-0.7 | +/-1                 | LSB  |
| INL                                   |                    | -                                                                               | -     | +/-1.5 | +/-4                 | LSB  |
| Maximum<br>Output Sink Current        | I <sub>S,max</sub> | D[9:0]=3FF(*2)                                                                  |       | 120    |                      | mA   |
| Zero Code<br>Output Sink Current      | I <sub>S,min</sub> | D[9:0]=000(*2)                                                                  | -     | 0.1    | 1                    | uA   |
| Output Offset Current                 | I <sub>OS</sub>    | PS = H, SPS(*1)= H                                                              | -     | 0.1    | 1                    | uA   |
| Voltage Drop                          | ΔV                 | ΔV = V <sub>SINK</sub> – V <sub>MVSS</sub> (*3)<br>(@I <sub>SINK</sub> = 85 mA) | -     | 0.08   |                      | V    |

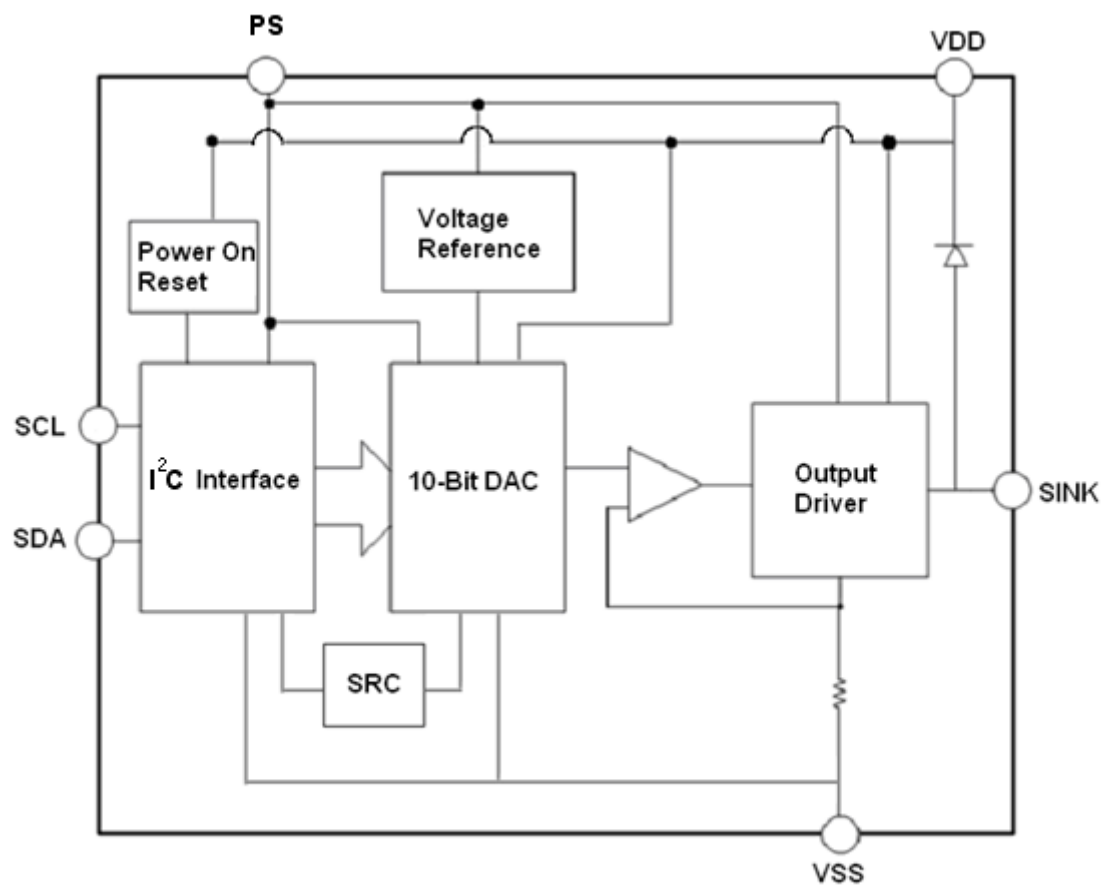
Note:

(\*1): SPS (Soft Power Saving, 2<sup>nd</sup> 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

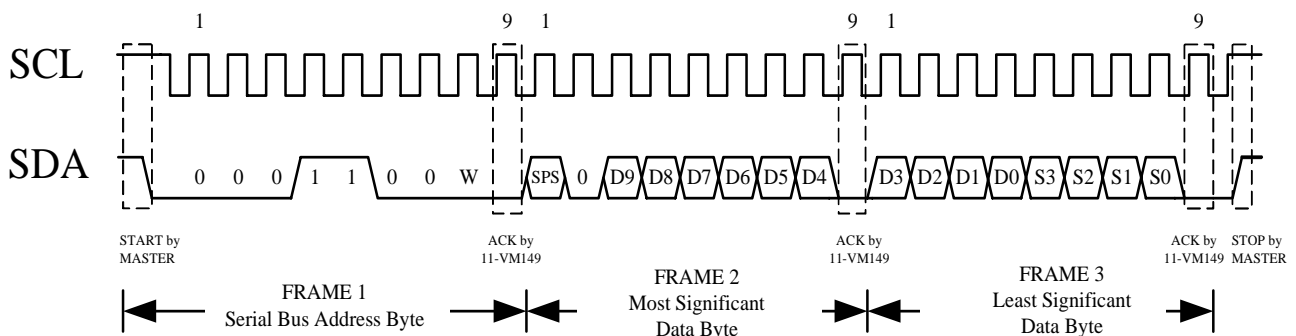
## Block Diagram



## Data Format

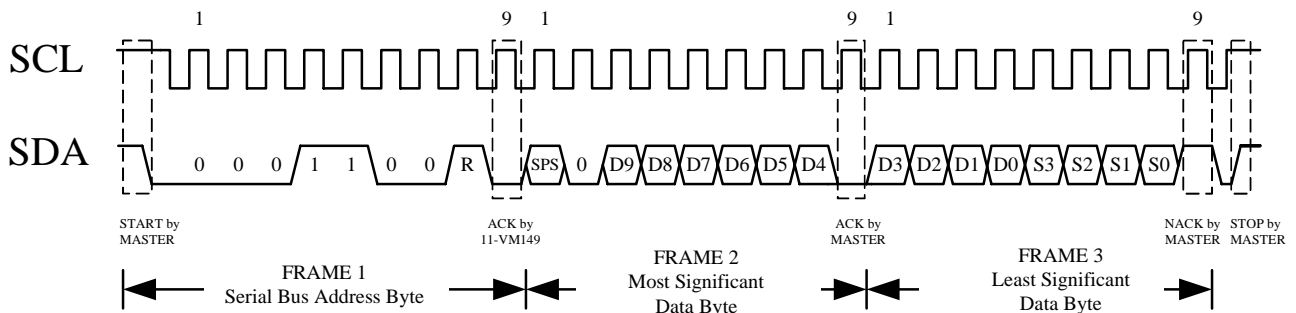
### VM149C Write Mode

In the writing mode, data is written to the VM149C 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.



### VM149C Read Mode

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



**Table**

|                         | MSB |     |     |     |     |     |     |     | LSB |     |     |     |     |     |     |     |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Serial Data Bits</b> | 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   | 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| <b>Input Register</b>   | R15 | R14 | R13 | R12 | R11 | R10 | R09 | R08 | R07 | R06 | R05 | R04 | R03 | R02 | R01 | R00 |
| <b>Function</b>         | SPS | 0   | D9  | D8  | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | S3  | S2  | S1  | S0  |

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

The operations are defined by the following table.

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

If PS is at logic low level; the chip is forced to shut down all power. If PS is at logic high 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 low level (PS = L) 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].

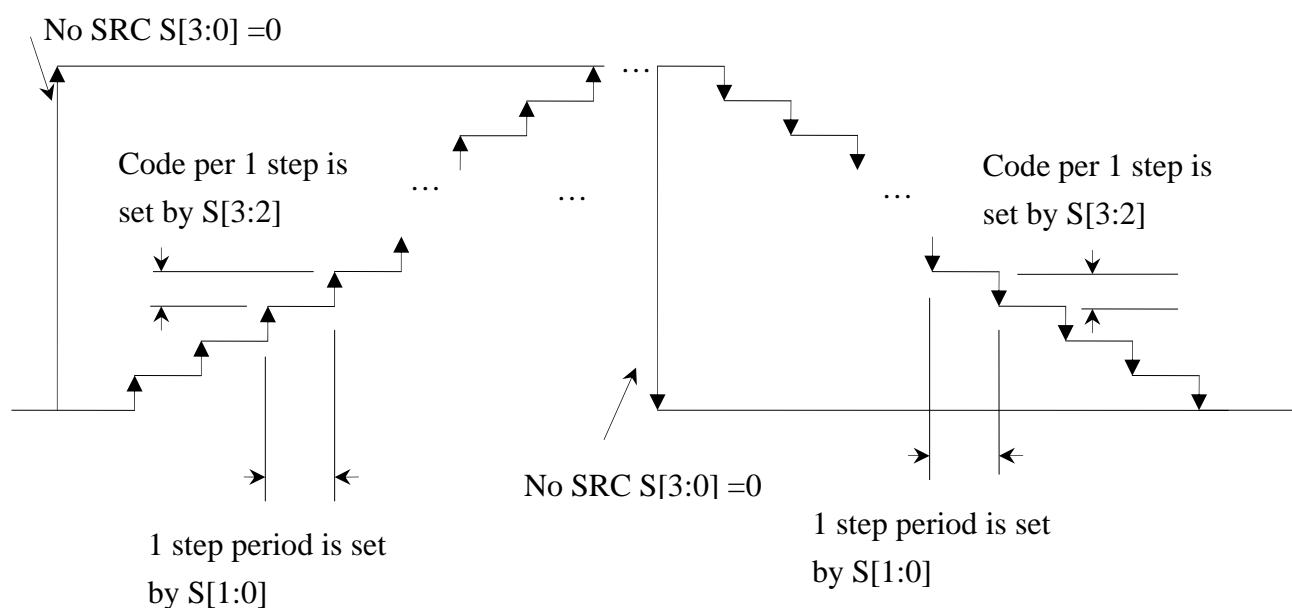
- **S[3:0]:** Output Current Slew Rate Control: The output current slew rate can be set by S[3:2] : as step control and S[1:0] as step period.

S[3:2] : code step control

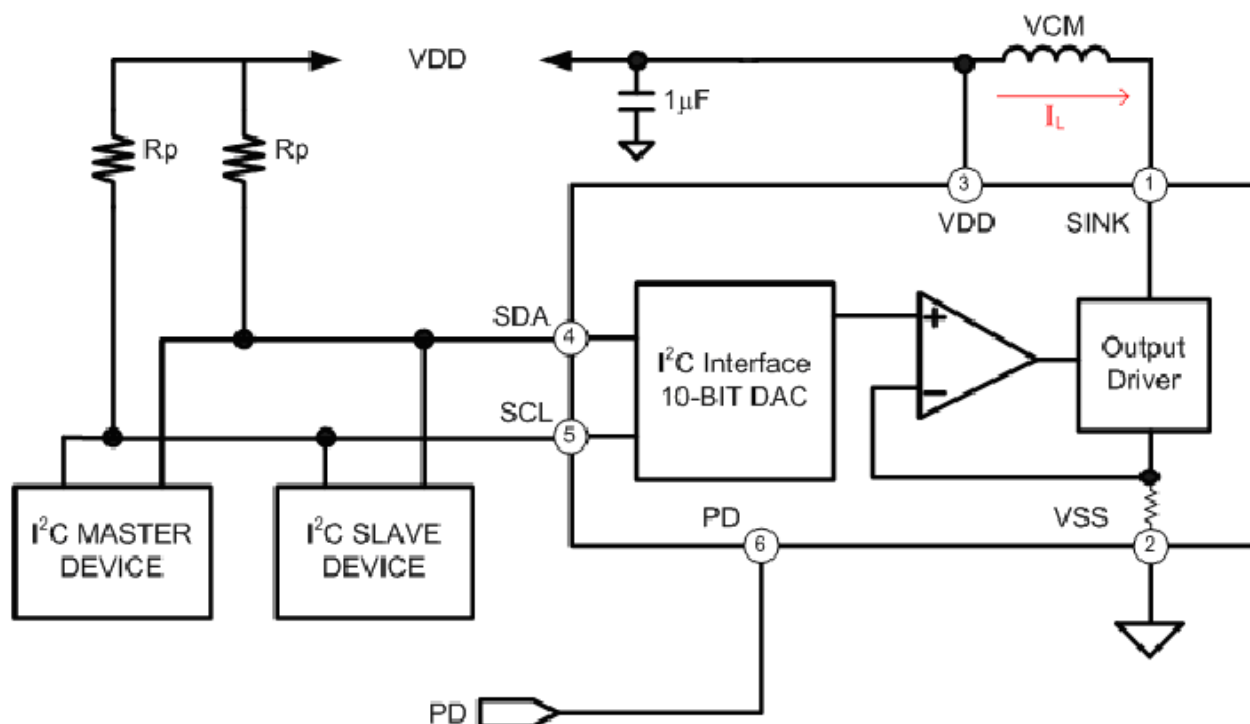
| S[3:2] | Code per step |
|--------|---------------|
| 0      | 0 (no SRC)    |
| 1      | 1             |
| 2      | 2             |
| 3      | 4             |

S[1:0] :SRC step period

| S[1:0] | Period (us) |
|--------|-------------|
| 0      | 64          |
| 1      | 128         |
| 2      | 256         |
| 3      | 512         |



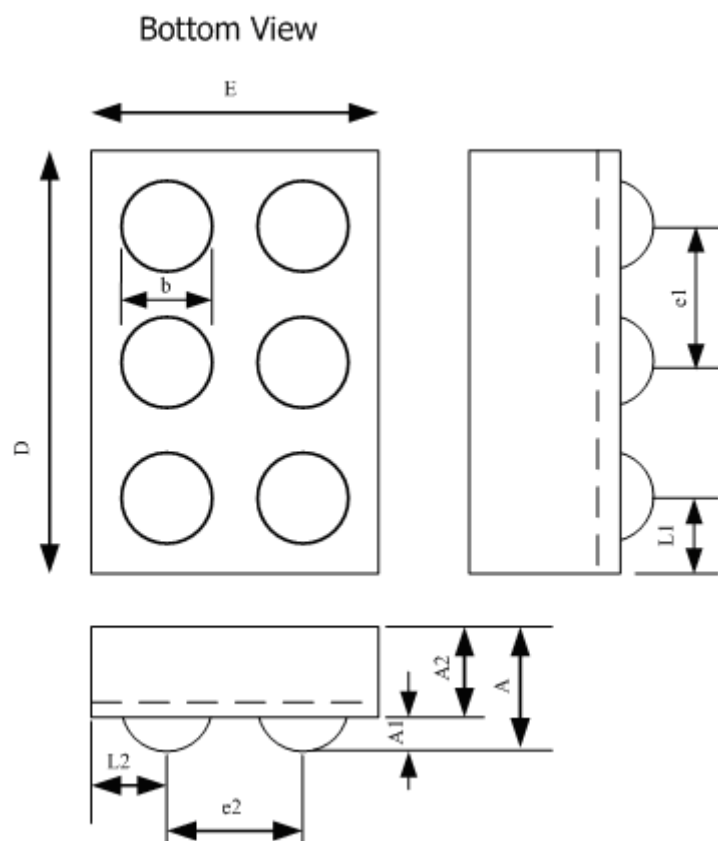
## Application Circuit



## Application Notes

- The VM149C is a constant current driving IC for applications in Auto-Focus. The supply voltage range VDD of VM149C is from 2.3V to 3.6V. The input range of digital control pin PS, and digital I/O pins SCL and SDA, are defined such that logic "High" is from 1.26V to VDD+0.4V and logic "Low" is from -0.4V to 0.54V. 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 0.1~0.22μF to match different VCMs.

## Package Specifications (WLCSP): (0.78mm\*1.27mm\*0.35mm)



| SYMBOL | DIMENSION<br>(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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