

# ***11-VM148***

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## ***130mA, 10Bit Current Sinking VCM Driver with I<sup>2</sup>C Interface***



新竹市展業一路9號7樓之1

SILICON TOUCH TECHNOLOGY INC.

9-7F-1, Prosperity Rd I, Science-Based Industrial Park

Hsin-Chu, Taiwan 300, R.O.C.

Tel : 886-3-5645656

Fax : 886-3-5645626

11-VM148

## *130mA, 10-Bit Current Sinking VCM Driver with I<sup>2</sup>C Interface*

### General Specifications

The 11-VM148 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 2.4V to 5.5V. 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 11-VM148 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
- I<sup>2</sup>C serial interface
- DAC with 10-BIT resolution
- 2.4V – 5.5V power source
- Low voltage control for digital pin PD, SDA, and SCL(i.e., V<sub>IH</sub> = 1.54V @ VDD = 2.8V)
- Power off operation
- Automatic power on reset
- Small package: DFN10 (3\*3\*0.8 mm), WLCSP(0.99\*1.87\*0.5 mm)

### Ordering Information

| Part Number    | Package     | Marking      |
|----------------|-------------|--------------|
| 11-VM148 WLCSP | WLCSP, 8Pin | GXX* or HXX* |
| 11-VM148 DFN   | DFN, 10Pin  | XXXX**G      |

\*XX reserved for a data code

\*\*XXXX reserved for a date code

## Terminology

### Resolution

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

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

### Differential Nonlinearity (DNL) error

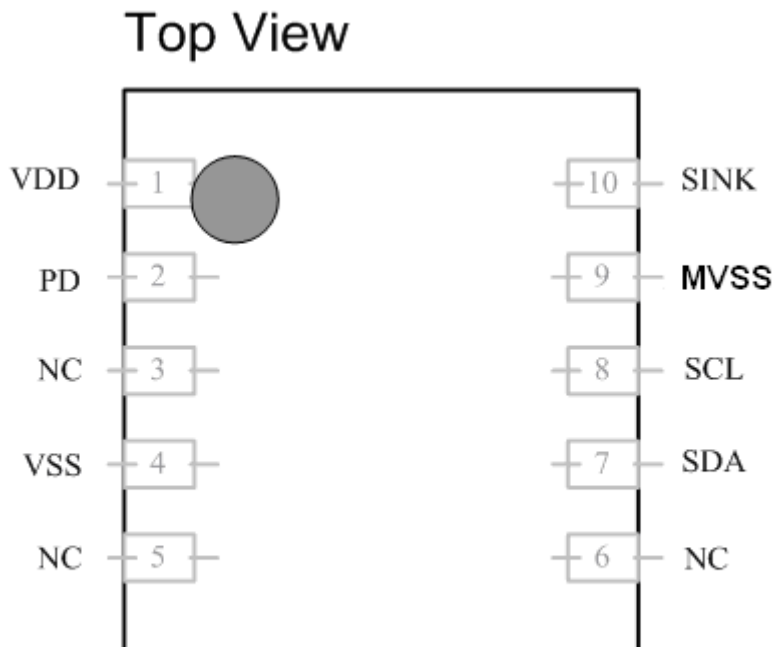
The variation in analog step sizes away from 1 LSB by any two adjacent codes. Usually, gain and offset errors have been removed.

### Integral Nonlinearity (INL)

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

## Pin Assignment

### Pin Assignment of DFN10 (3\*3\*0.8 mm)



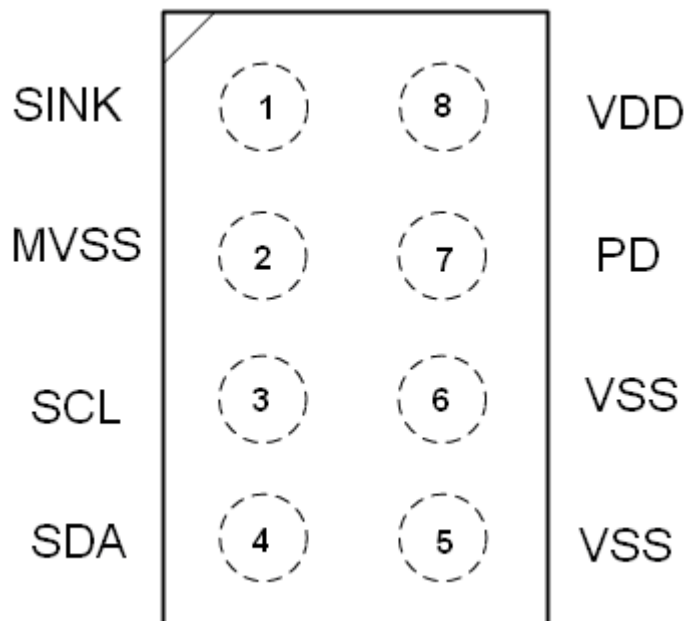
## Pin Descriptions

| Pin NO. | Pin Name | Description                                                                                  |
|---------|----------|----------------------------------------------------------------------------------------------|
| 1       | VDD      | Input Power Pin                                                                              |
| 2       | PD       | Digital Input: Power off Mode<br>(When PD=High ,chip disable)<br>( When PD=Low ,chip enable) |
| 3       | NC       |                                                                                              |
| 4       | VSS      | Input Ground Pin                                                                             |
| 5       | NC       |                                                                                              |
| 6       | NC       |                                                                                              |
| 7       | SDA      | I <sup>2</sup> C Interface Data(Serial Data Line)                                            |
| 8       | SCL      | I <sup>2</sup> C Interface Data(Serial Clock Line)                                           |
| 9       | MVSS     | Input Motor driver GND Pin                                                                   |
| 10      | SINK     | Analog Output : Output current Sink Pin                                                      |

- The 7 address bits of 11-VM148 for I<sup>2</sup>C slave true port is 0001-1xx.

**Pin Assignment of WLCSP (0.99\*1.87\*0.5mm)**

**TOP View**



| Pin Number | Pin Name | Description                                                                                  |
|------------|----------|----------------------------------------------------------------------------------------------|
| 1          | SINK     | Analog Output : Output Current Sink Pin                                                      |
| 2          | MVSS     | Input Motor Driver GND Pin                                                                   |
| 3          | SCL      | I <sup>2</sup> C Interface Data(Serial Clock Line)                                           |
| 4          | SDA      | I <sup>2</sup> C Interface Data(Serial Data Line)                                            |
| 5          | VSS      | Input Ground Pin                                                                             |
| 6          | VSS      | Input Ground Pin                                                                             |
| 7          | PD       | Digital Input: Power off Mode<br>(When PD=High ,chip disable)<br>( When PD=Low ,chip enable) |
| 8          | VDD      | Input Power Pin                                                                              |

**Absolute Maximum Ratings**

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

| Characteristic              | Symbol            | Rating               | Unit |
|-----------------------------|-------------------|----------------------|------|
| Supply Input Voltage        | V <sub>DD</sub>   | 5.5                  | V    |
| Input Voltage               | V <sub>IN</sub>   | V <sub>DD</sub> +0.4 | V    |
| Maximum Sink Current        | I <sub>SINK</sub> | 150                  | mA   |
| Operating Temperature Range | T <sub>OPR</sub>  | -40 ~ 125            | °C   |
| Storage Temperature Range   | T <sub>STG</sub>  | -65 ~ 150            | °C   |

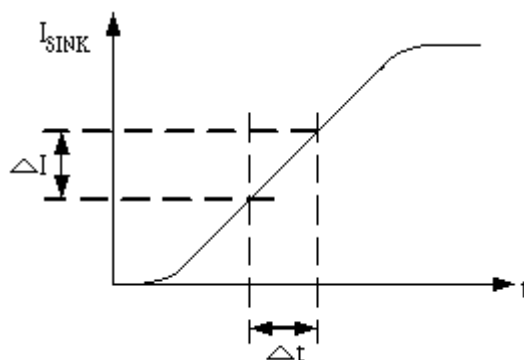
## Electrical Characteristic

Unless otherwise noted,  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 2.8\text{ V}$  and  $V_{CM} \approx 18\Omega$ ,  $460\mu\text{H}$ .

| Item                                  | Sym.             | Condition                                                                       | Limit                |        |                      | Unit  |
|---------------------------------------|------------------|---------------------------------------------------------------------------------|----------------------|--------|----------------------|-------|
|                                       |                  |                                                                                 | Min.                 | Typ.   | Max.                 |       |
| Power Supply                          |                  |                                                                                 |                      |        |                      |       |
| Supply Voltage                        | V <sub>DD</sub>  |                                                                                 | 2.4                  | 2.8    | 5                    | V     |
| Supply Current<br>( I <sub>DD</sub> ) | I <sub>PD</sub>  | PD = High (chip disable)                                                        | -                    | -      | 0.5                  | uA    |
|                                       | I <sub>DD</sub>  | PD = Low, SPD= High                                                             | -                    | -      | 0.1                  | mA    |
|                                       | I <sub>DD1</sub> | PD = Low, SPD= Low                                                              |                      |        | 0.5                  | mA    |
| PD, SDA, SCL digital control pin      |                  |                                                                                 |                      |        |                      |       |
| Input Voltage High                    | V <sub>IH</sub>  | -                                                                               | 0.55*V <sub>DD</sub> | -      | V <sub>DD</sub> +0.4 | V     |
| Input Voltage Low                     | V <sub>IL</sub>  | -                                                                               | -0.4                 | -      | 0.2*V <sub>DD</sub>  | V     |
| Parameters                            |                  |                                                                                 |                      |        |                      |       |
| DAC Resolution                        |                  |                                                                                 |                      | 10     |                      | Bits  |
| DNL                                   |                  |                                                                                 |                      | +/-0.8 | +/-1                 | LSB   |
| INL                                   |                  |                                                                                 |                      | +/-1   | +/-5                 | LSB   |
| Output Offset Current                 | I <sub>OS</sub>  | PD = L, SPD= logic H                                                            |                      |        | 5                    | uA    |
| Current Slew Rate                     | SR               | SR = ΔI / Δt (*1)                                                               |                      | 3      |                      | mA/us |
| Output Constant Current Settling Time | t <sub>s</sub>   | VDD = 2.8V, I <sub>SINK</sub> = 100mA                                           |                      | 40     | 80                   | us    |
| Voltage Drop                          | ΔV               | ΔV = V <sub>SINK</sub> - V <sub>MVSS</sub> (*2)<br>(@I <sub>SINK</sub> = 80 mA) | -                    | 0.32   | 0.35                 | V     |

Note:

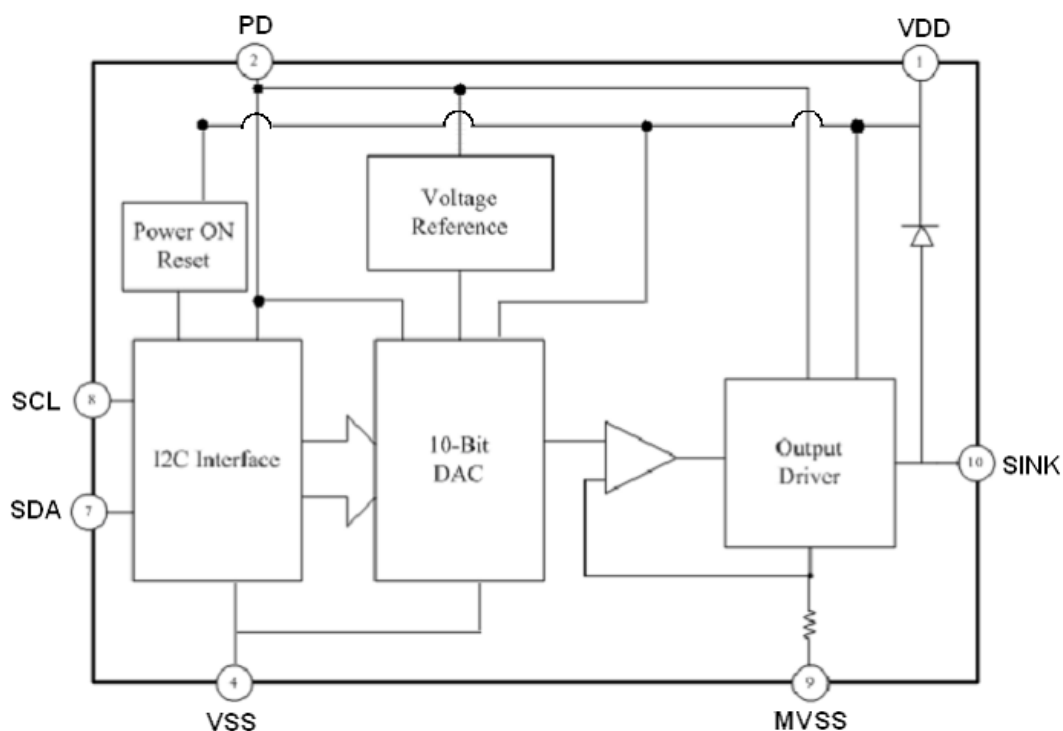
(\*1)  $SR = \Delta I / \Delta t$ ,  $I_{SINK}$  is the current of sink pin



(\*2):  $V_{SINK}$  is the voltage of sink pin and  $V_{MVSS}$  is the voltage of motor driver GND pin

## Block Diagram

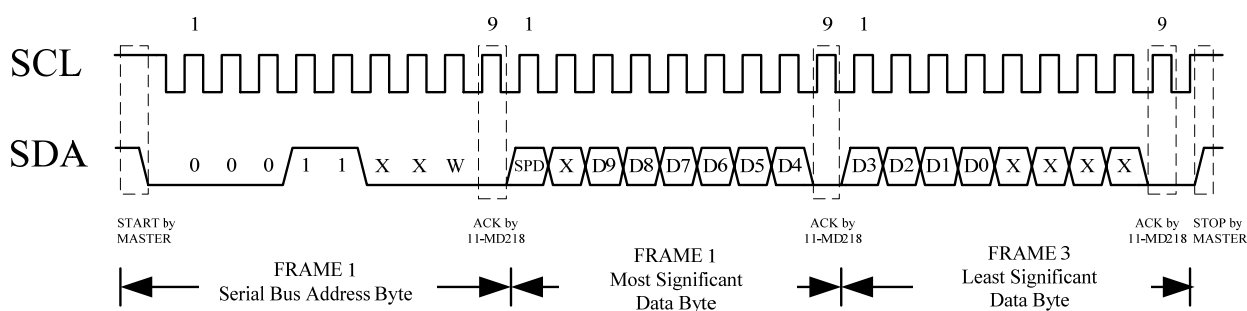
(DFN10)



## Data Format

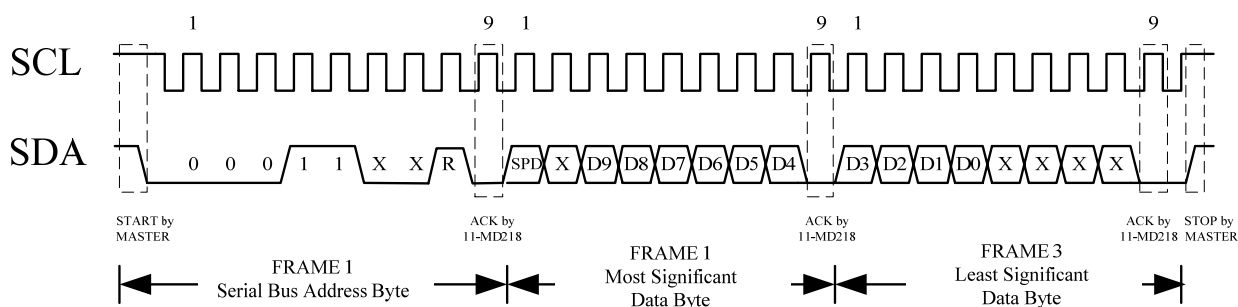
### 11-VM148 Write Mode

When in the write mode, data is written to the 11-VM148 and shifted byte-by-byte into a 16-bit input register. After all 16 bits of data have been shifted in, a STOP condition is transmit by master and the loaded data in the input register is transferred to the DAC.



### 11-VM148 Read Mode

When 11-VM148 is in the read 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>         | SPD | X   | D9  | D8  | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | X   | X   | X   | X   |

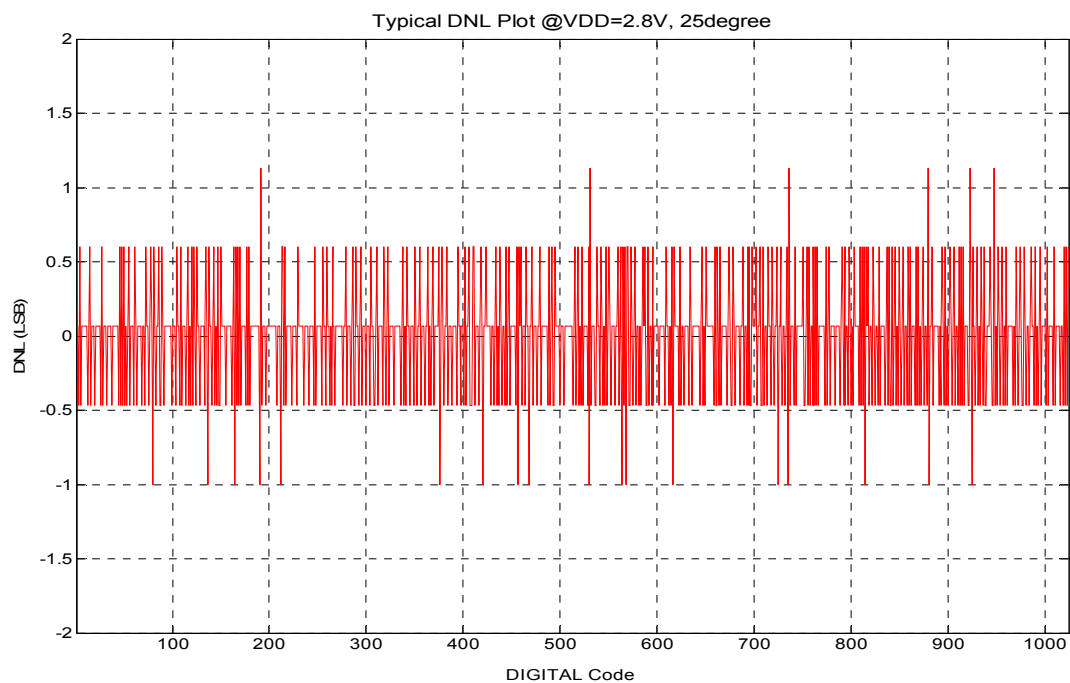
- SPD (Soft Power off, 2<sup>nd</sup> standby mode): IC power off controlled by software.
- X denotes “Don’t care/Unused”.
- Regarding to all kinds of IC operation situations please refers to following table.

| PD   | SPD  | IC status      |
|------|------|----------------|
| High | -    | Power off      |
| Low  | Low  | IC Active      |
|      | High | Soft power off |

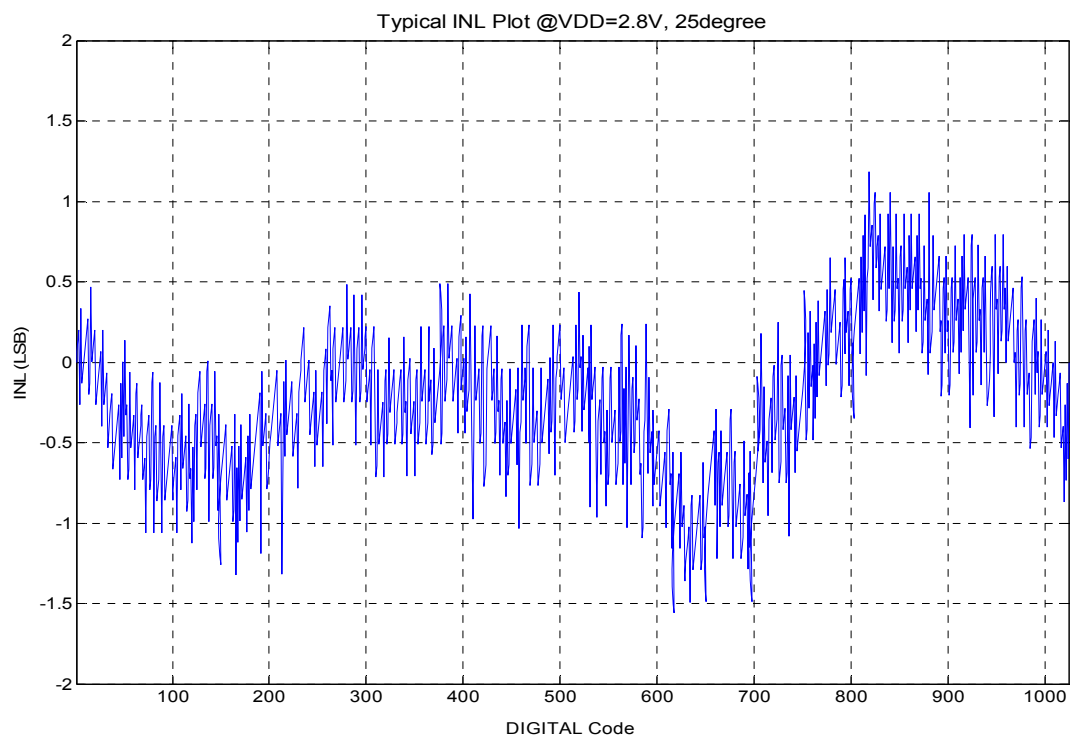
The PD pin is the power off pin of 11-VM148. Logic low level (PD = Low) is for IC operation. On the other hand, its logic high level (PD = High) puts the chip into power off mode for power saving. It is recommended to keep PD at high level (PD = H) before while the chip is no operation to save power, especially for applications in portable devices.

## Performance Characteristics

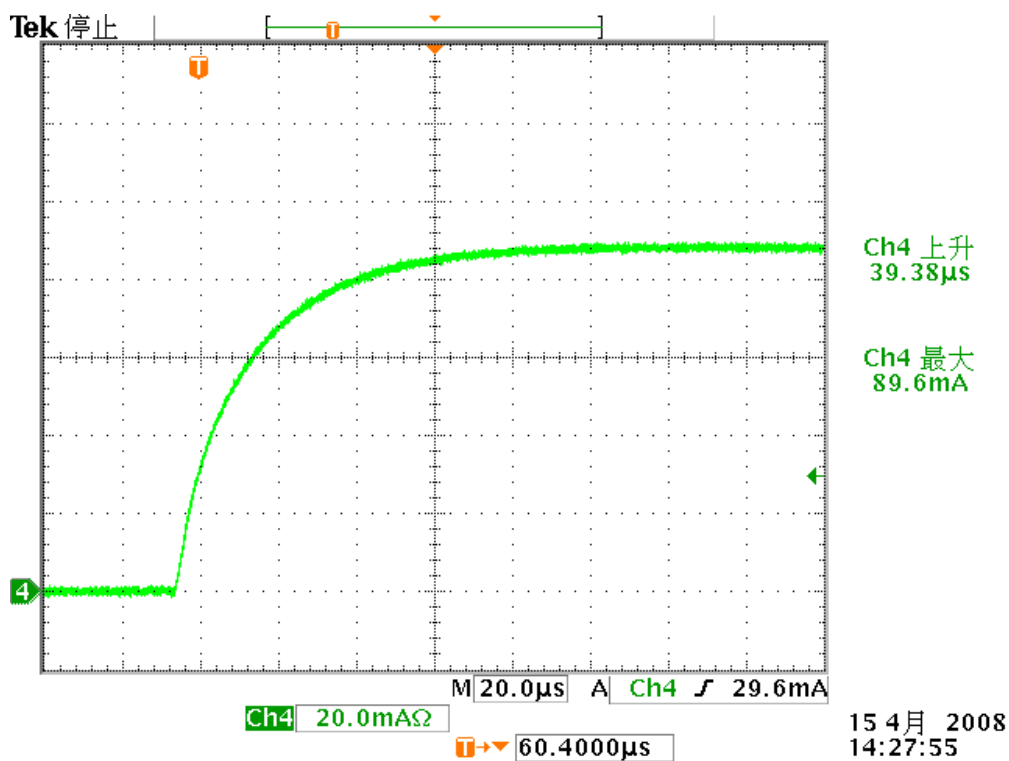
### 1. DNL Plot



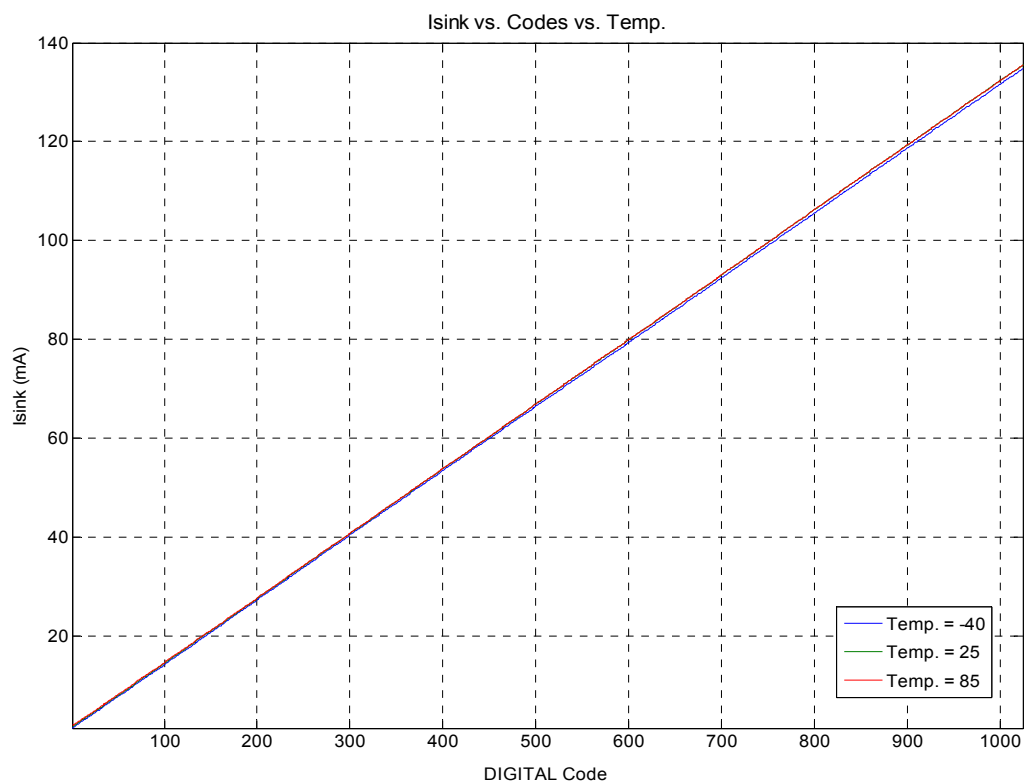
### 2. INL Plot



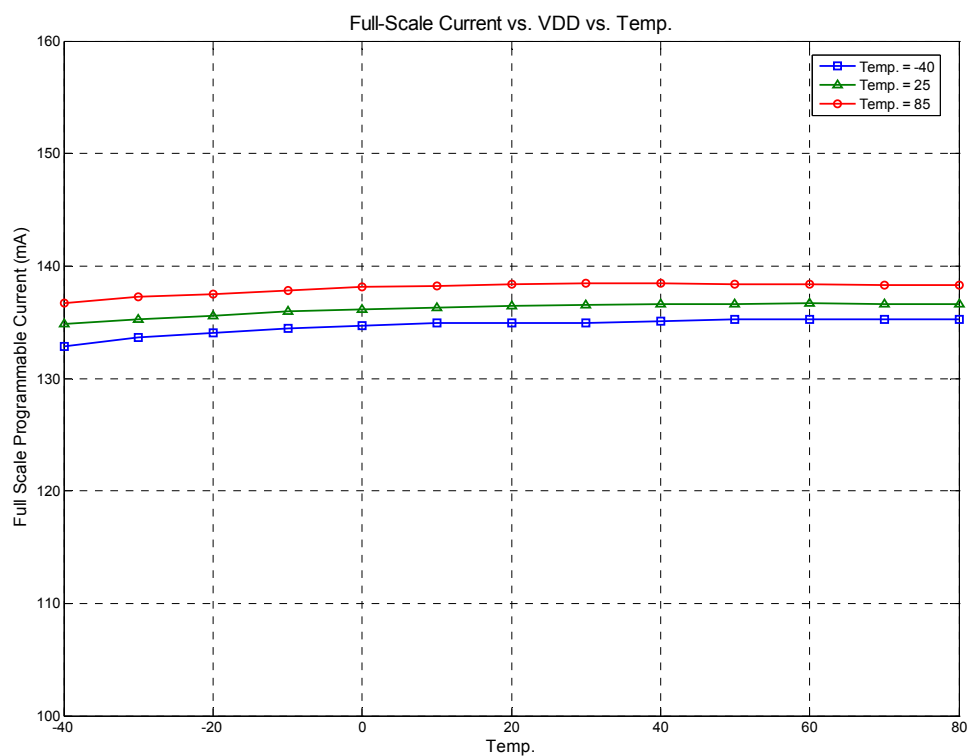
3. Settling Time ( $V_{DD} = 2.8V$ ,  $V_{CM} = 270\Omega$  with  $430\mu H@500Hz$ ,  $550\mu H@1kHz$ , respectively,  $C_L = 0.1\mu F$  @Temp. = 25)



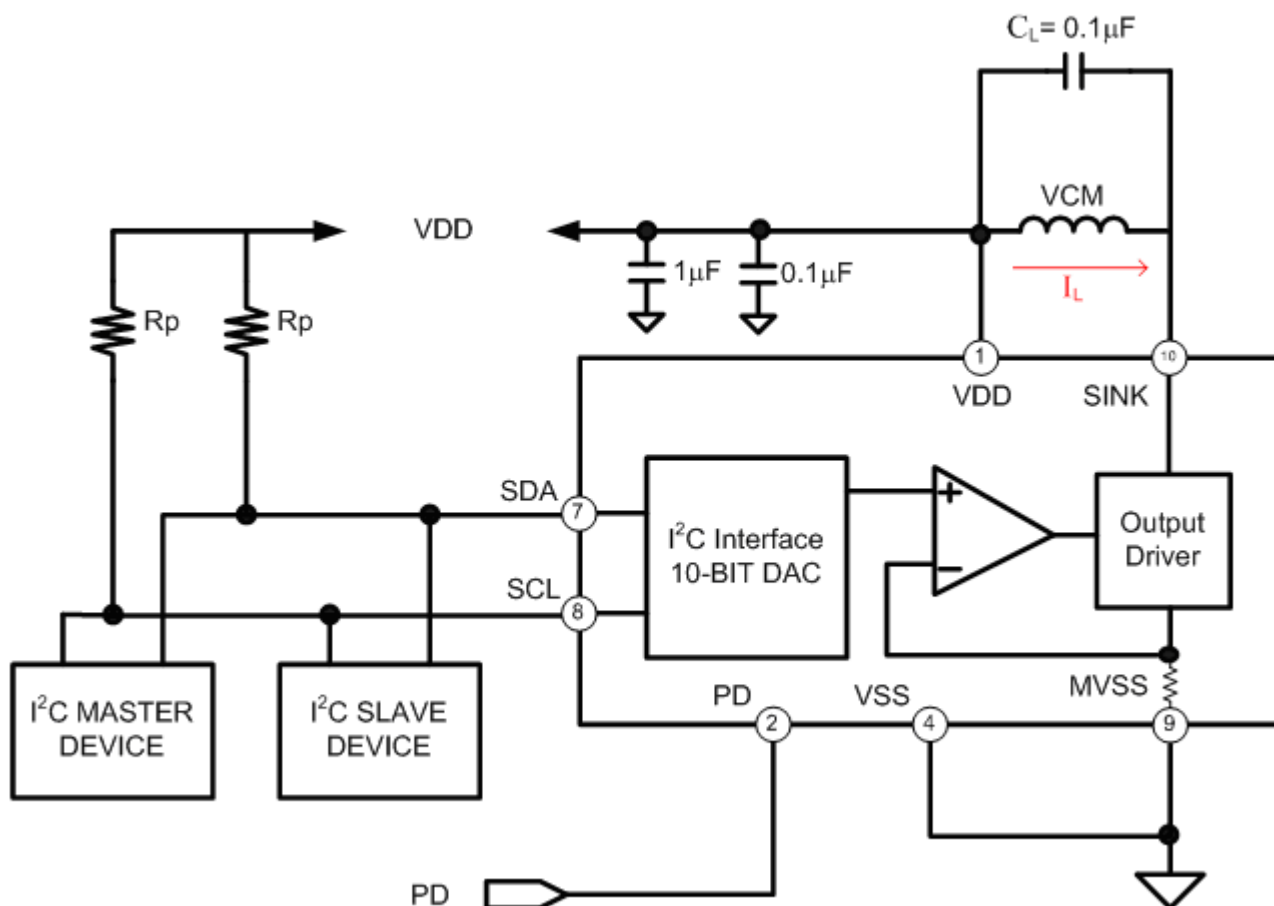
4. Sink Current vs. Codes vs. Temp.



## 5. Full-Scale Programmable Current vs. Temp. vs. VDD



## Application Circuit

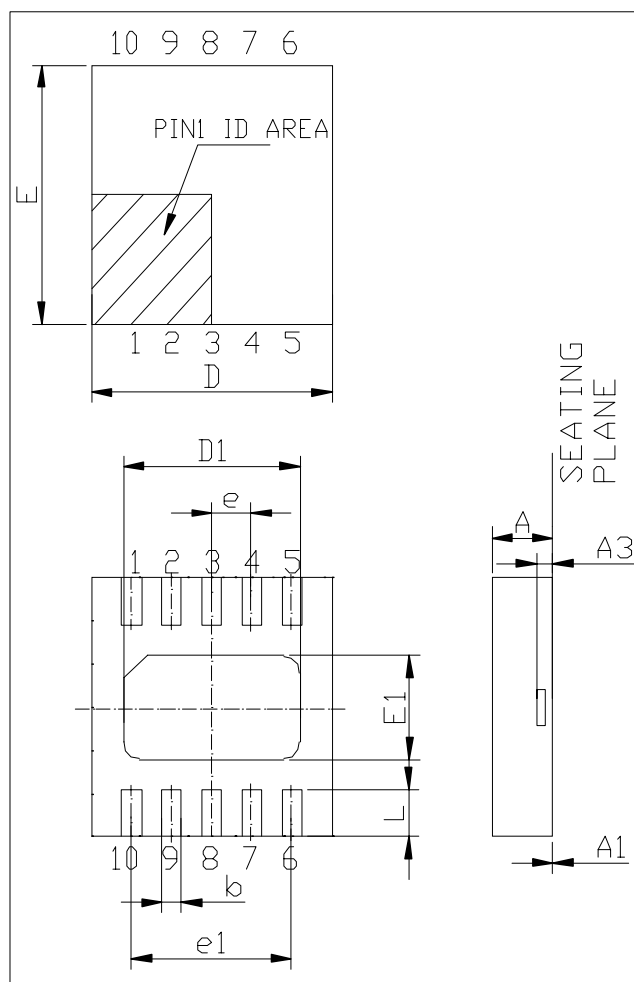


## Application Notes

- The 11-VM148 is a constant current driving IC for applications in Auto-Focus. The supply voltage range VDD of 11-VM148 is from 2.4V to 5.5V. The input range of digital control pin PD, and digital I/O pins SCL and SDA, are defined such that logic “High” is from  $0.55 \times VDD$  to  $VDD + 0.4V$  and logic “Low” is from  $-0.4V$  to  $0.2 \times VDD$ . Therefore, the three digital pins are suitable controlled by 1.8V ISP.
- The PD pin is the power off pin of 11-VM148. Logic low level (PD = Low) is for IC operation. On the other hand, its logic high level (PD = High) puts the chip into power off mode for power saving. It is recommended to keep PD at high level (PD = H) before while the chip is no operation to save power, especially for applications in portable devices.
- In order to ensure the stability of output current, a compensation capacitance  $C_L$  is suggested placing across the two terminals of VCM. The suggested value of  $C_L$  is about 0.1~0.22 $\mu F$  and could be fine tuned for different VCM.

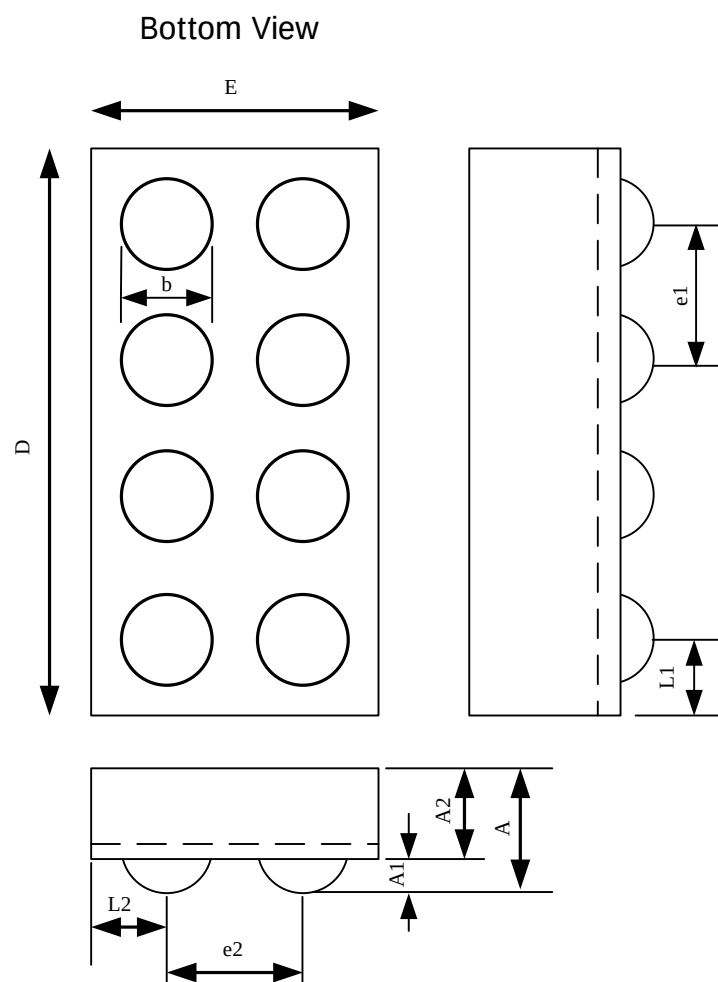
## Package Specification

### (DFN-10)



| SYMBOL | DIMENSION (mm) |      |      | DIMENSION (mil) |      |      |
|--------|----------------|------|------|-----------------|------|------|
|        | MIN.           | NOM. | MAX. | MIN.            | NOM. | MAX. |
| A      | 0.70           | 0.75 | 0.80 | 28              | 30   | 32   |
| A1     | 0.00           | 0.02 | 0.05 | 0               | 0.8  | 2    |
| A3     | 0.203 REF      |      |      | 8 REF           |      |      |
| b      | 0.18           | 0.25 | 0.30 | 7               | 10   | 12   |
| D      | 2.90           | 3.00 | 3.10 | 114             | 118  | 122  |
| D1     | 2.10           | 2.20 | 2.30 | 83              | 87   | 91   |
| E      | 2.90           | 3.00 | 3.10 | 114             | 118  | 122  |
| E1     | 1.10           | 1.20 | 1.30 | 86              | 87   | 91   |
| L      | 0.45           | 0.55 | 0.65 | 18              | 22   | 26   |
| e      | 0.50 BASIC     |      |      | 20 BASIC        |      |      |
| e1     | 2.00 BASIC     |      |      | 80 BASIC        |      |      |

## Package Specifications (WLCSP)



| SYMBOL | DIMENSION<br>(mm) |       |       |
|--------|-------------------|-------|-------|
|        | MIN.              | NOM.  | MAX.  |
| A      | 0.445             | 0.5   | 0.555 |
| A1     | 0.17              | 0.20  | 0.23  |
| A2     | 0.275             | 0.30  | 0.325 |
| b      | 0.24              | 0.26  | 0.28  |
| D      | 1.83              | 1.87  | 1.91  |
| E      | 0.95              | 0.99  | 1.03  |
| e1     |                   | 0.50  |       |
| e2     |                   | 0.50  |       |
| L1     | 0.160             | 0.185 | 0.210 |
| L2     | 0.220             | 0.245 | 0.270 |



The products listed herein are designed for ordinary electronic applications, such as electrical appliances, audio-visual equipment, communications devices and so on. Hence, it is advisable that the devices should not be used in medical instruments, surgical implants, aerospace machinery, nuclear power control systems, disaster/crime-prevention equipment and the like. Misusing those products may directly or indirectly endanger human life, or cause injury and property loss.

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