# 11-VM148

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|---|---|
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# *130mA, 10Bit Current Sinking VCM Driver with $I^2C$ Interface*


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11-VM148

# *130mA, 10-Bit Current Sinking VCM Driver with I²C Interface*

## General Specifications

The 11-VM148 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 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
- I²C 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., $V_{IH}$ = 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 -> $2^N$ distinct analog levels

### Differential Nonlinearity (DNL) error

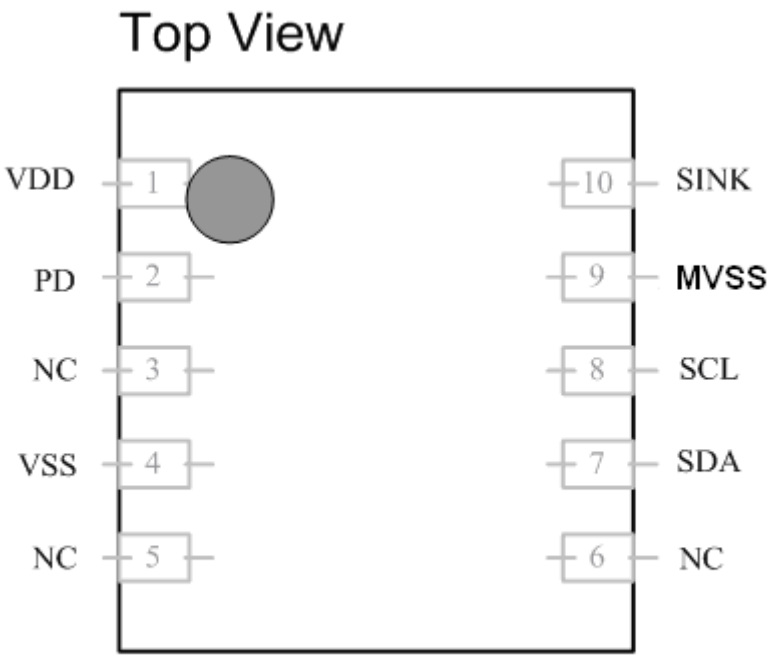
The variation in analog step sizes away from 1 LSB by any two adjacent codes. Usually, gain and offset errors have been removed.

### 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)***



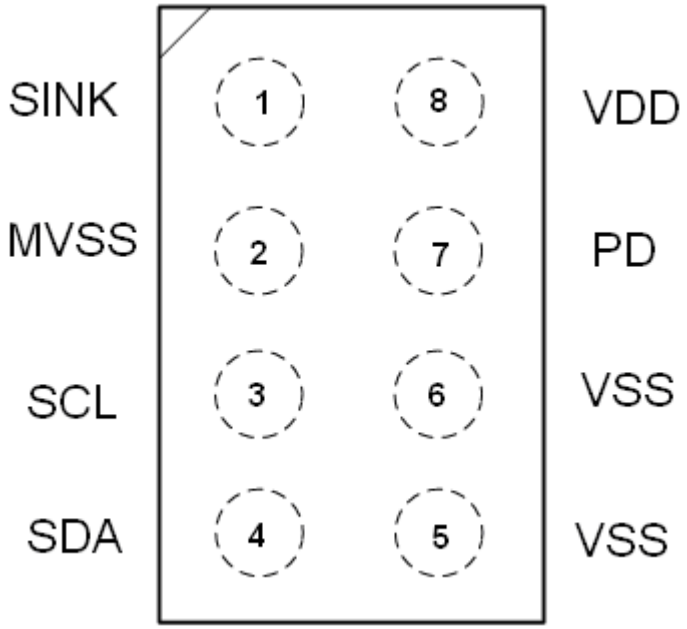

## Pin Descriptions

| 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 | $I^2C$ Interface Data(Serial Data Line) |
| 8 | SCL | $I^2C$ Interface Data(Serial Clock Line) |
| 9 | MVSS | Input Motor driver GND Pin |
| 10 | SINK | Analog Output : Output current Sink Pin |

1. The 7 address bits of 11-VM148 for $I^2C$ 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 | $I^2C$ Interface Data(Serial Clock Line) |
| 4 | SDA | $I^2C$ 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*, $T_A$= 25℃

| Characteristic | Symbol | Rating | Unit |
|---|---|---|---|
| Supply Input Voltage | $V_{DD}$ | 5.5 | V |
| Input Voltage | $V_{IN}$ | $V_{DD}$+0.4 | V |
| Maximum Sink Current | $I_{SINK}$ | 150 | mA |
| Operating Temperature Range | $T_{OPR}$ | -40 ~ 125 | °C |
| Storage Temperature Range | $T_{STG}$ | -65 ~ 150 | °C |

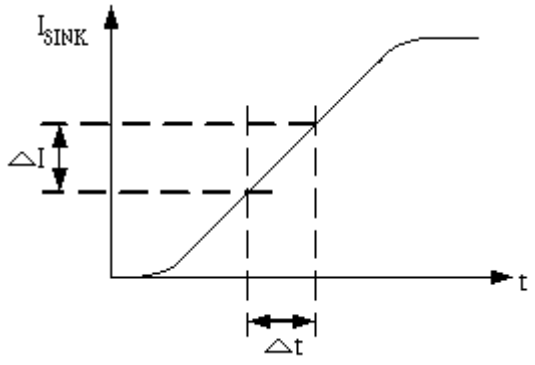
## Electrical Characteristic

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

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

Note:

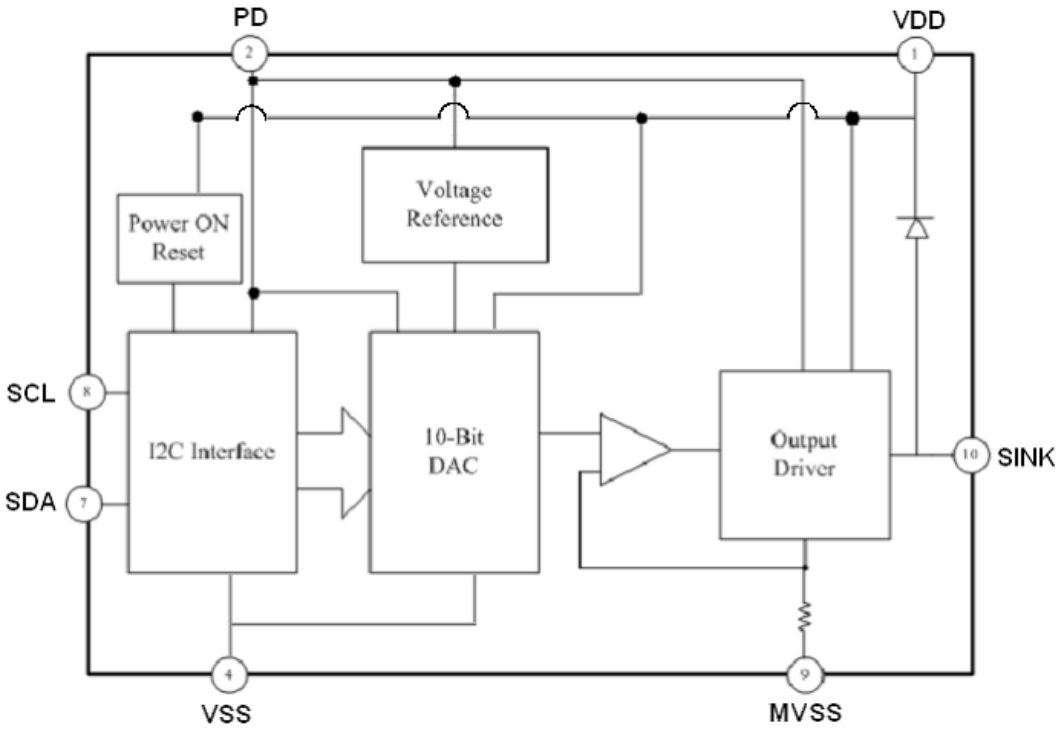
(*1) $SR = \Delta I / \Delta t$ , $I_{SINK}$ is the current of sink pin




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

## Block Diagram

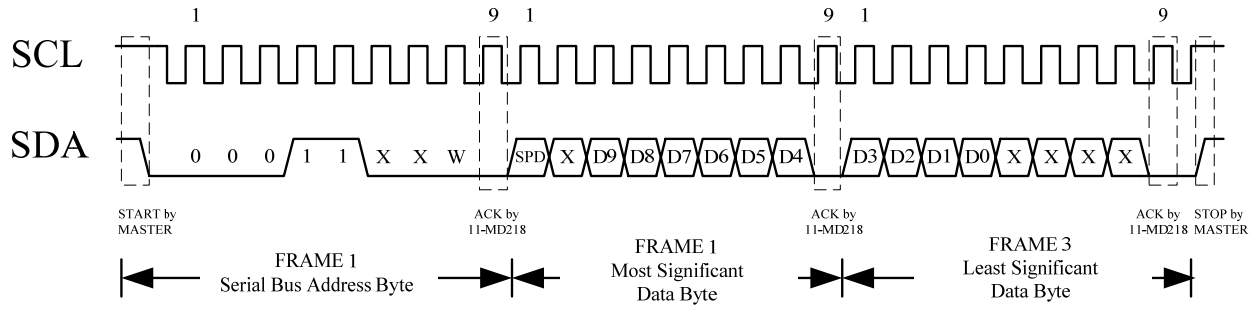
(DFN10)



## Data Format

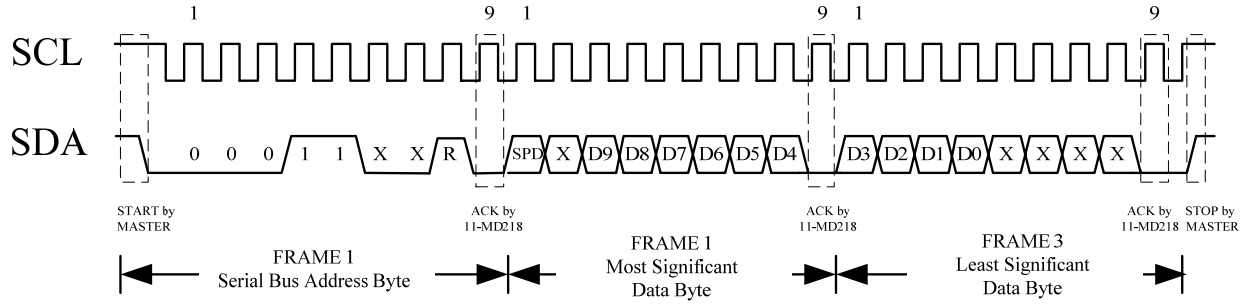
### 11-VM148 Write Mode

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 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***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*** | SPD | X | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | X | X | X | X |

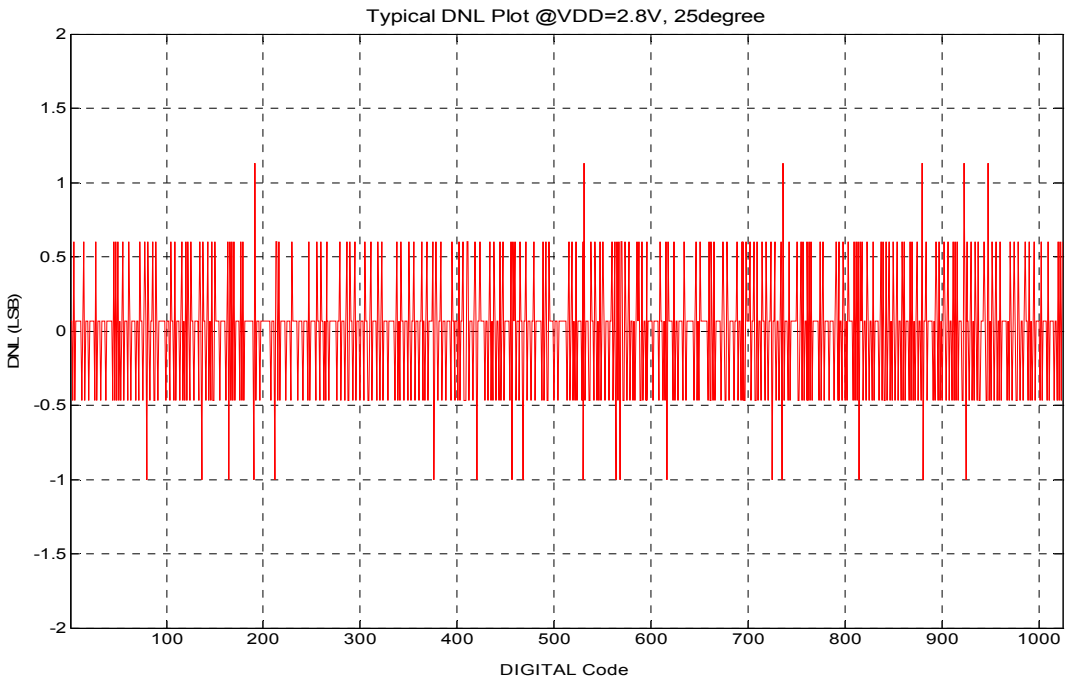
- SPD (Soft Power off, 2nd standby mode): IC power off controlled by software.
- X denotes “Don’t care/Unused”.
- Regarding to all kinds of IC operation situations please refers to following table.

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

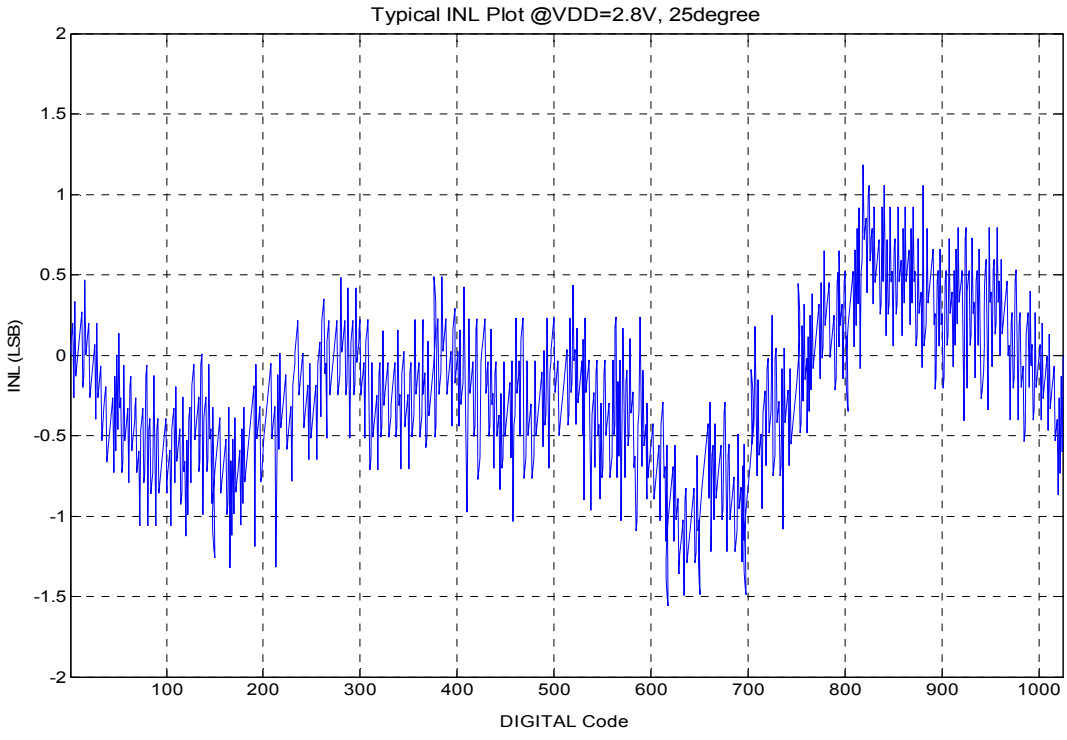
The PD pin is the power off pin of 11-VM148. Logic low level (PD = Low) is for IC operation. On the other hand, its logic high level (PD = High) puts the chip into power off mode for power saving. It is recommended to keep PD at high level (PD = H) before while the chip is no operation to save power,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

# Performance Characteristics

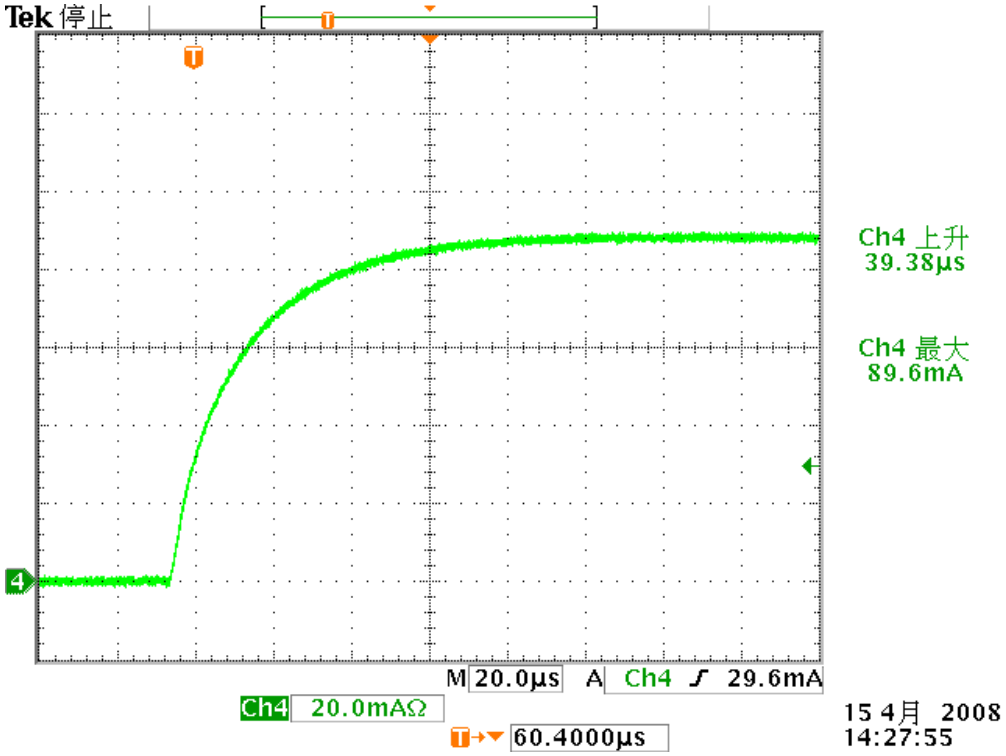
1. DNL Plot



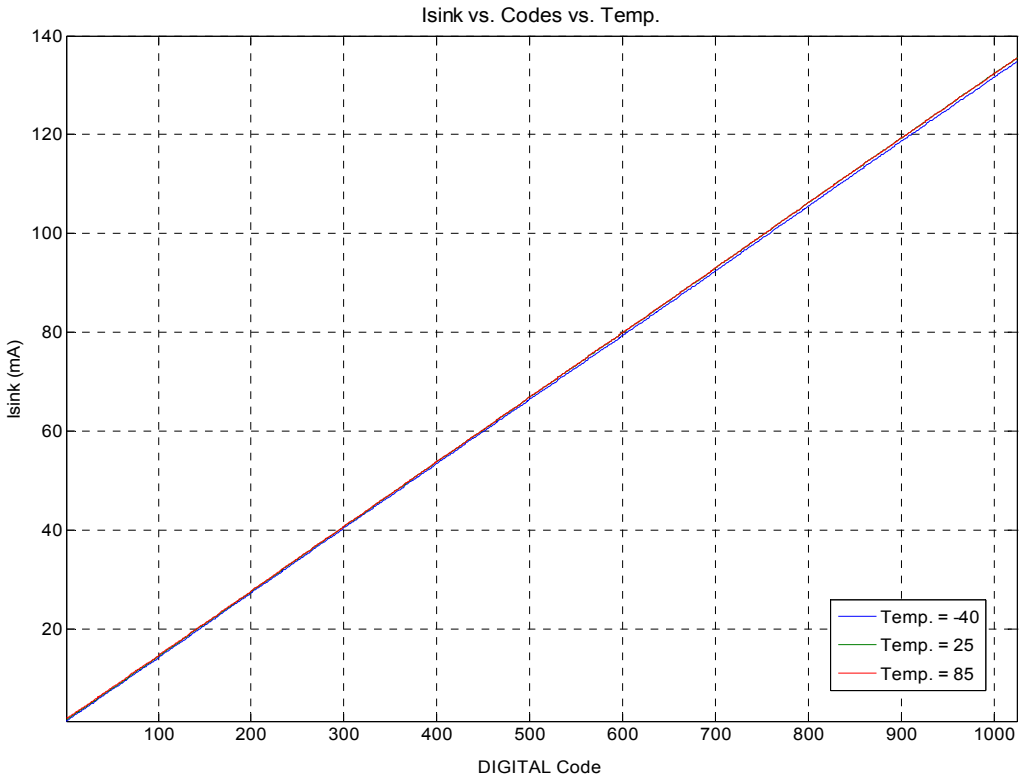

2. INL Plot



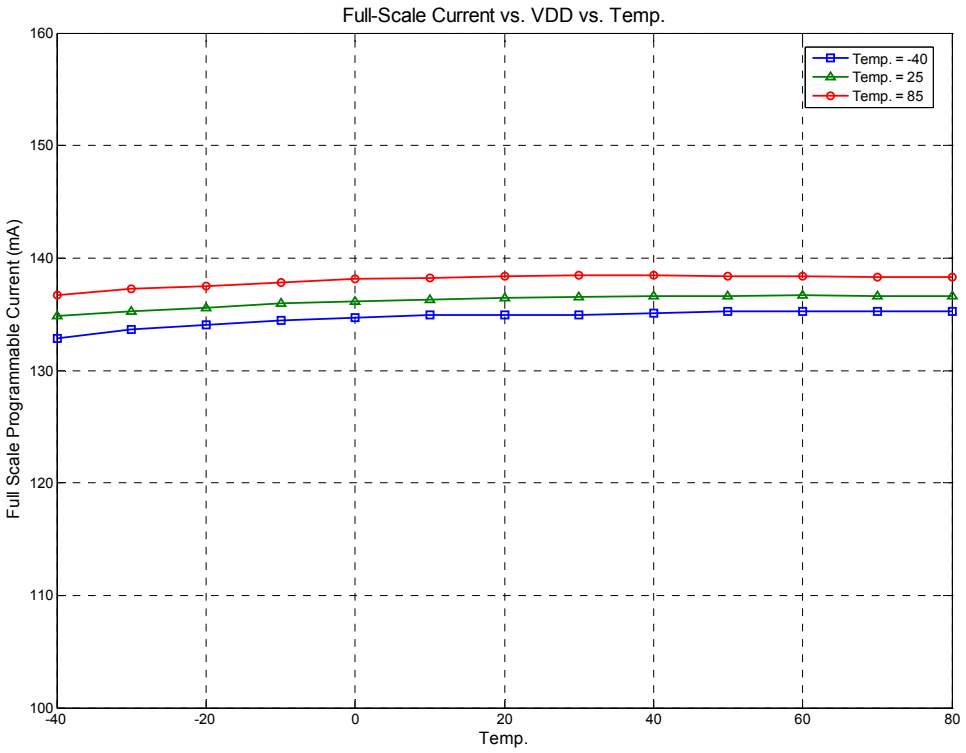
3. Settling Time (VDD = 2.8V, VCM = 27Ohm with 430uH@500Hz, 550uH@1kHz, respectively, $C_L$ = 0.1uF @Temp. = 25)



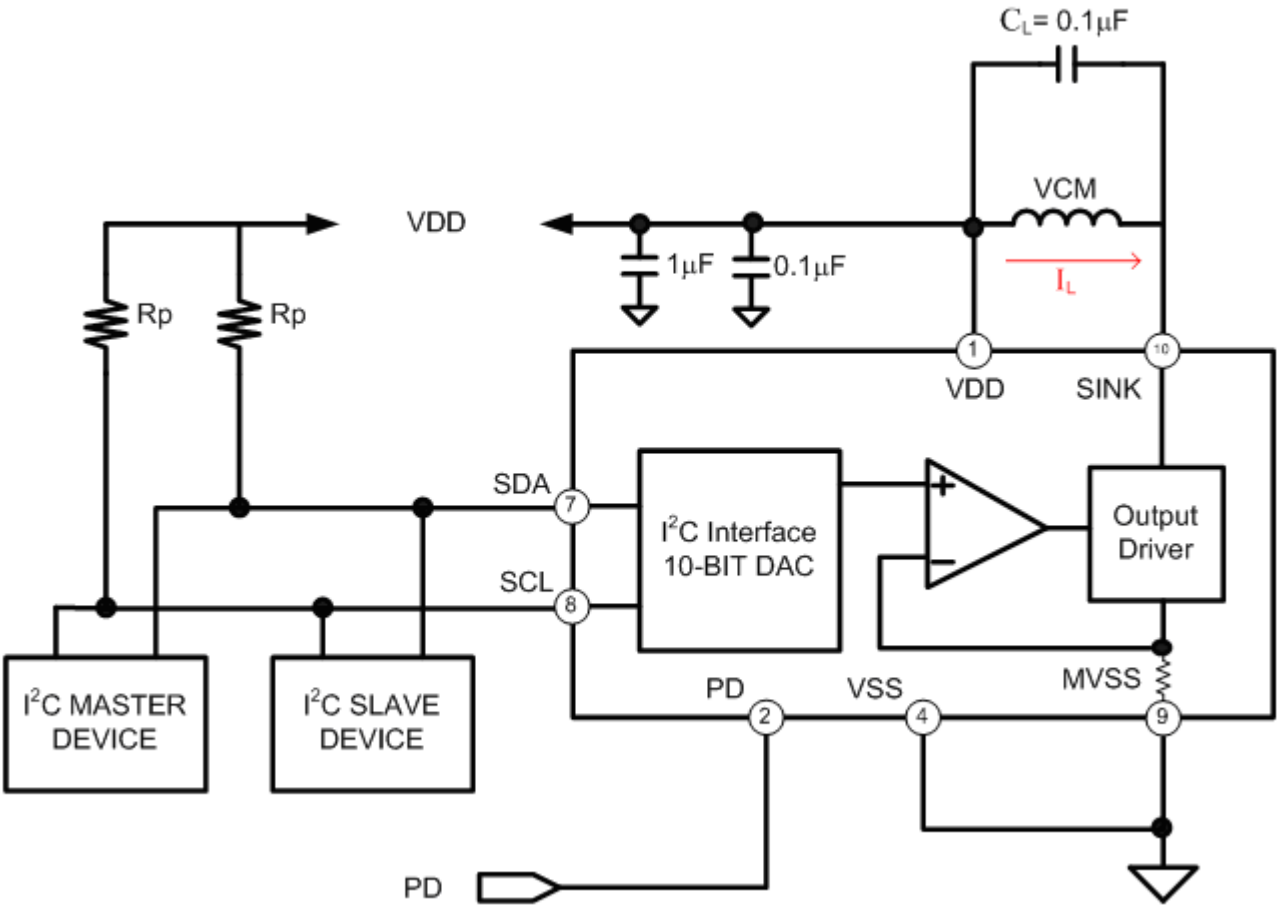

4. Sink Current vs. Codes vs. Temp.



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



## Application Circuit



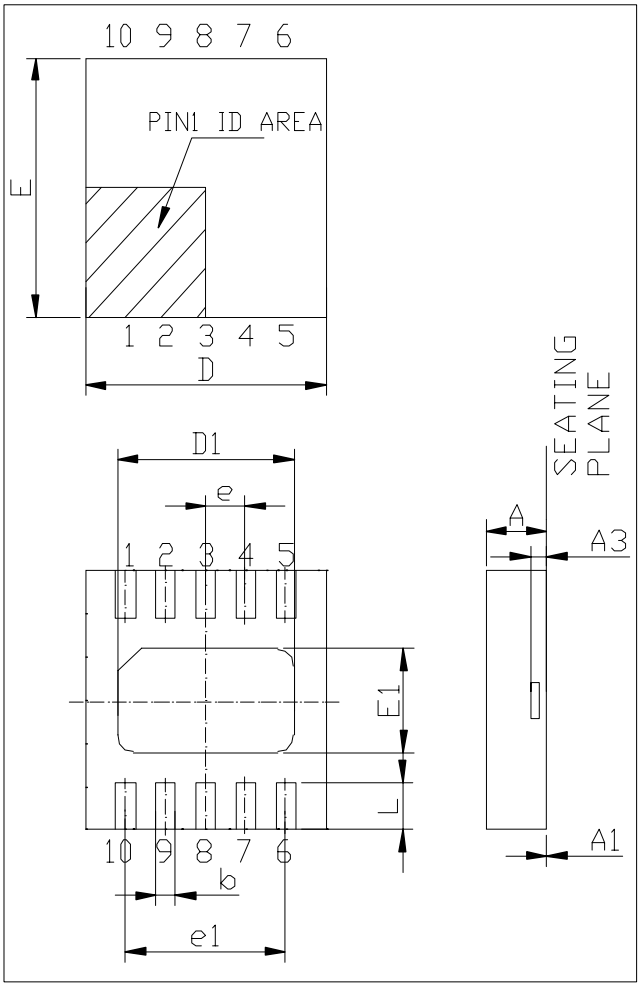
## Application Notes

- 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*VDD to VDD+0.4V and logic “Low” is from –0.4V to 0.2*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 0.1~0.22uF and could be fine tuned for different VCM.

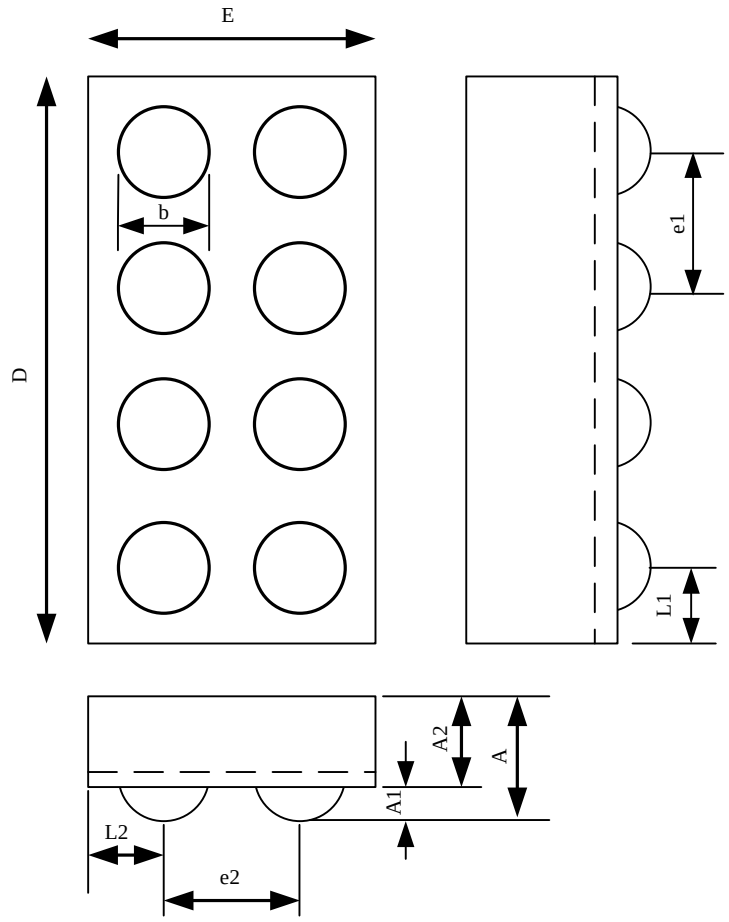
## Package Specification
## (DFN-10)




| 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)

Bottom View




| SYMBOL | DIMENSION (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 |

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