# 8-Channel Motor Driver for BD-Player AM9268Q

The AM9268Q is 8-Channel motor driver IC which has 2 Channel PWM drivers for sledge motor, 2 Channel BTL drivers for collimator motor, 3 channel actuator drivers and 1 tray driver. The PWM control system for sledge is used to reduce IC power dissipation. This IC also has 1 independent precision voltage regulator with enable control. Output voltage adjustable range is from 1.2V to 4.0V.It has built-in thermal-shut-down circuit. Package material is Pb free.

- **Applications**

BD-player

- **Features**

1) Direct-PWM-driving system
2) Current limit circuit
3) Built-in thermal-shut-down circuit
4) One built-in voltage regulator (1.2V~4.0V)
5) Built-in Thermal-shut-down
6) Low consumption
7) The mode is able to be selected by the two control terminals.
   - ON/OFF of loading, and other 8 channels and standby mode

- **Absolute Maximum Ratings (Ta = 25℃)**

| Parameter | Symbol | Limits | Unit |
|---|---|---|---|
| 5V voltage supply | VCC5 | 13 | V |
| VMCOL Power supply | VMCOL | 13 | V |
| 12V voltage supply | VCC12 | 15 | V |
| Sledge output current | IoSL | 0.5 | A |
| Actuator output current | IoACT | 1.0 | A |
| Collimator output current | IoCO | 1.0 | A |
| Tray output current | IoTY | 1.0 | A |
| Power dissipation | Pd | *3.59 | W |
| Operating temperature | Topr | -40 to +85 | ℃ |
| Storage temperature | Tstg | **-50 to +150 | ℃ |

*When mounted on a 76.2mm×114.6mm×1.6mm 2 layers FR4 board.

*Reduced by 28.73mW for each increase in $T_a$ of 1℃ over 25℃.

**Should not exceed Pd or ASO and $T_j$=150℃ values

## Recommended Operating Conditions

(Set the power supply voltage taking allowable dissipation into considering)

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| VCC5 Power supply | VCC5 | 4.5 | 5 | 7 | V |
| VMCOL Power supply | VMCOL | 4.5 | - | 13.2 | V |
| VCC12 power supply | VCC12 | 7.5 | 12 | 13.2 | V |
| Sledge output current | IoSL | - | 0.25 | 0.5 | A |
| Actuator output current | IoACT | - | 0.5 | 0.8 | A |
| Collimator output current | IoCO | - | 0.5 | 0.8 | A |
| Tray output current | IoTY | - | 0.5 | 0.8 | A |
| PWM carrier frequency | Fosc | 30 | - | 120 | KHz |

## Electrical Characteristics

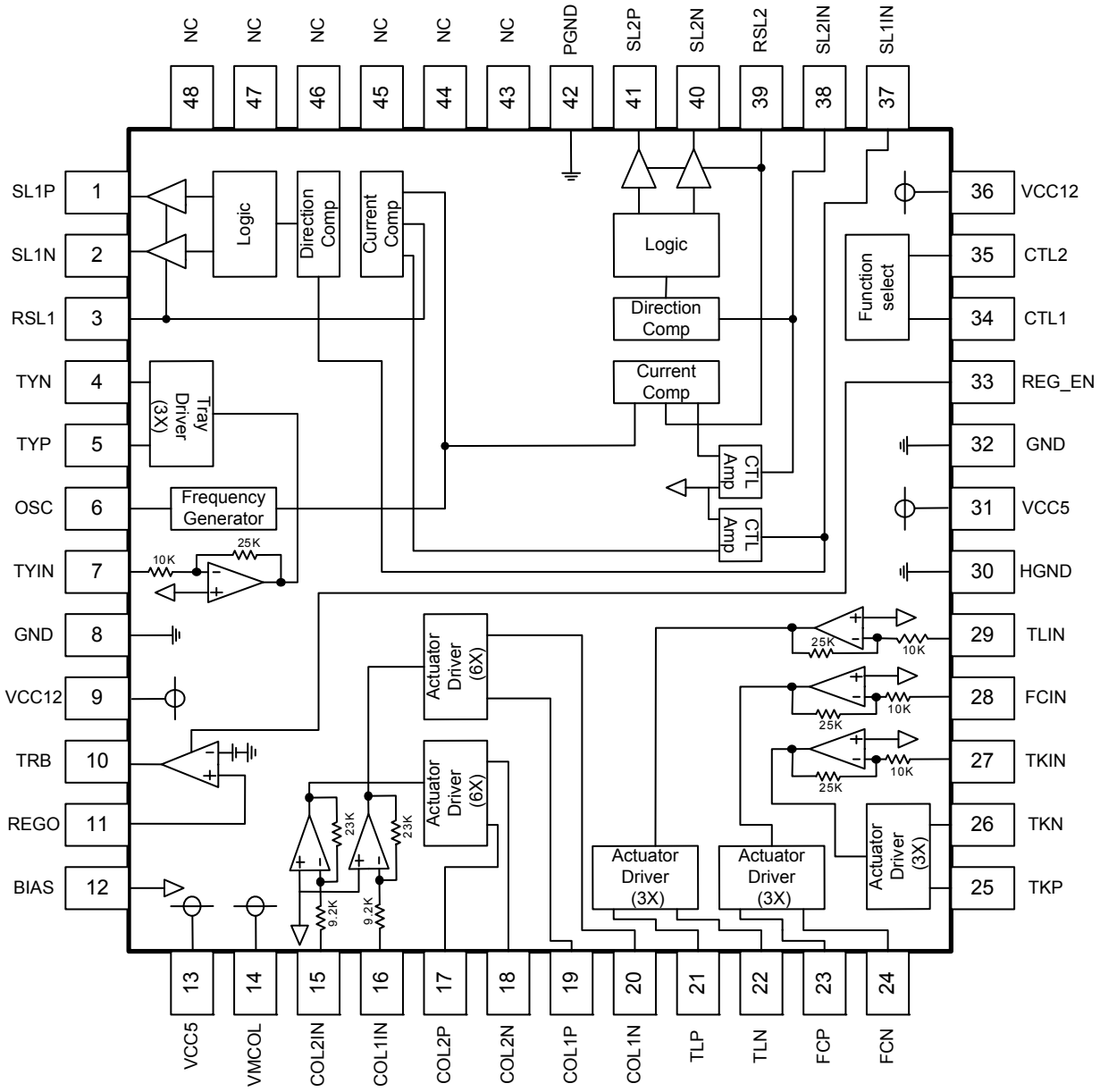
(Unless otherwise specified, Ta=25℃, VCC5=VMCOL=5V, VCC12=12V, RSL=2Ω,BIAS=1.65V)

| Parameter | Symbol | Limit | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| **Common** | | | | | | |
| Stand-by current | $I_{sc}$ | - | 5.3 | - | mA | CTL1=CTL2=0V |
| Quiescent current | $I_{cc}$ | - | 34 | - | mA | CTL1=CTL2=5V |
| CTL1/CTL2 terminal low voltage | CTL1L/CTL2L | 0 | - | 0.8 | V | CTL1/CTL2 |
| CTL1/CTL2 terminal high voltage | CTL1H/CTL2H | 2.5 | - | 5 | V | CTL1/CTL2 |
| CTL1/CTL2 terminal input current | ICTL1/ICTL2 | - | - | 500 | uA | CTL1/CTL2=5V |
| REG_EN terminal low voltage | REG_ENL | 0 | - | 0.8 | V | REG_EN |
| REG_EN terminal high voltage | REG_ENH | 2.5 | - | 5 | V | REG_EN |
| REG_EN terminal input current | IREG_EN | - | - | 500 | uA | REG_EN =5V |
| PWM carrier frequency | $F_{osc}$ | - | 65 | - | KHz | OSC: with 330pF |
| Reference voltage range | $V_{BIAS}$ | 1.0 | - | 3.3 | V | |
| **Sledge1,2** | | | | | | |
| Dynamic range of output | Vdyc | - | 5.7 | - | V | Io=0.5[A] at VCC12= 7.5[V] RSL=0.9Ω |
| | | 9.8 | 10.3 | - | V | Io=0.5[A] at VCC12= 12[V] RSL=0.9Ω |
| Control voltage dead zone | Vdead- | -80 | -40 | 0 | mV | SL1IN,SL2IN<BIAS |
| | Vdead+ | 0 | +40 | +80 | mV | SL1IN,SL2IN> BIAS |
| Control gain | Gvosl | 0.85 | 1.0 | 1.15 | V/V | Gio=Gvo/Rs[A/V] |
| Control limit | Vlimsl | 0.43 | 0.5 | 0.58 | V | Ilim=Vlim/Rs[A] |
| Output leakage current | Ileak | -100 | - | 100 | μA | CTL1=CTL2=0V |

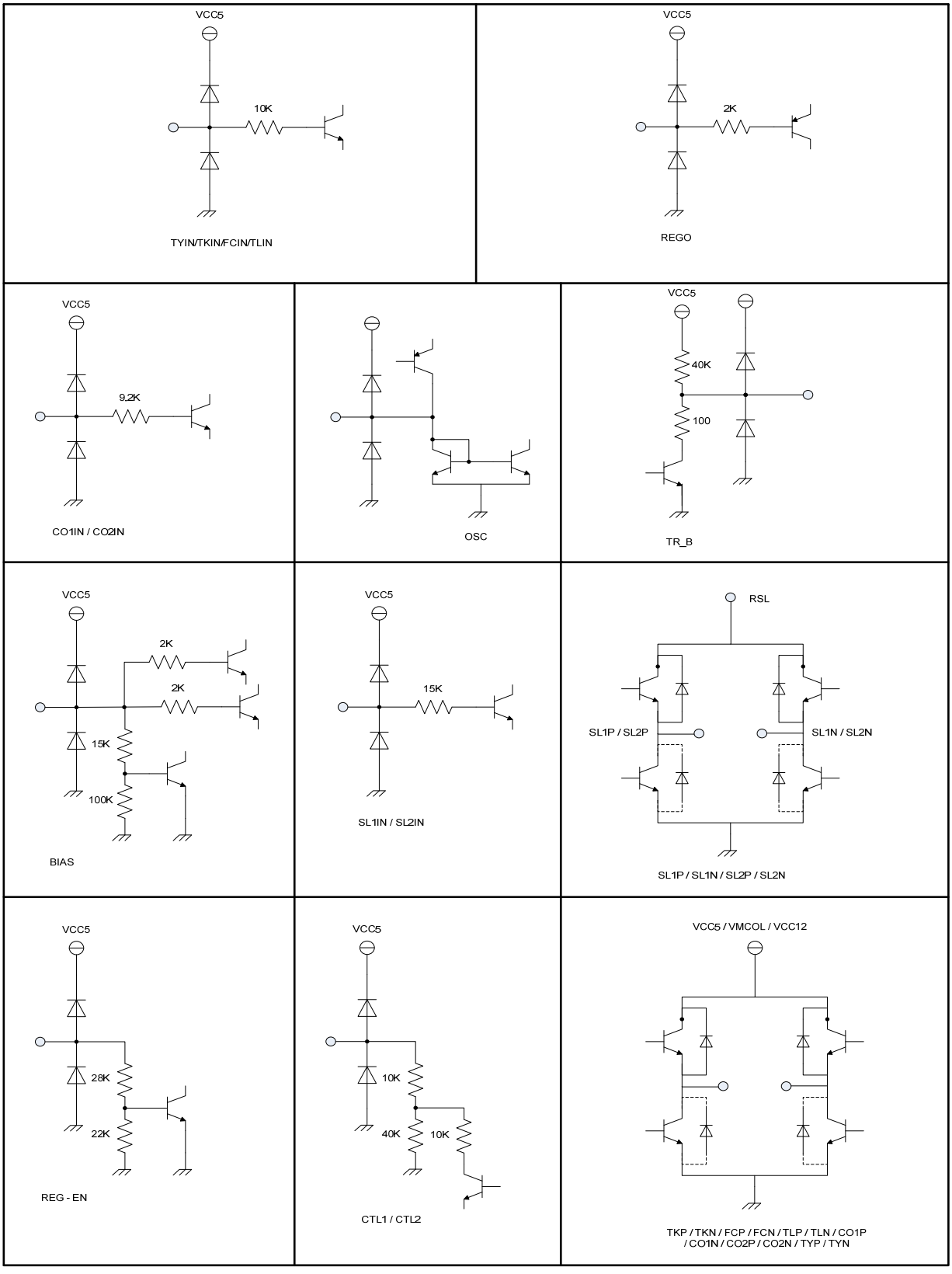
| | | | | | | |
|---|---|---|---|---|---|---|
| **Actuator drivers** | | | | | | |
| Output offset voltage | $V_{OO}$ | -50 | - | 50 | mV | |
| Maximum output voltage | $V_{OM}$ | - | 3.5 | - | V | @10ΩLoad |
| Voltage gain | $G_V$ | 16 | 17.5 | 19 | dB | VIN=BIAS+0.2Vpp ac @1KHz |
| **Collimator drivers** | | | | | | |
| Output offset voltage | $V_{OOCL}$ | -50 | - | 50 | mV | |
| Maximum output voltage | $V_{OMCL}$ | 3.6 | 4.0 | - | V | @20ΩLoad VMCOL=5V |
| Voltage gain | $G_{VCL}$ | 22.5 | 23.5 | 24.5 | dB | VIN=BIAS+0.2Vpp ac @1KHz |
| **Tray driver** | | | | | | |
| Output offset voltage | $V_{OOTY}$ | -50 | 0 | 50 | mV | |
| Maximum output voltage | $V_{OM}$ | - | 8.1 | - | V | @20ΩLoad |
| Voltage gain | $G_{VTY}$ | 16 | 17.5 | 19 | dB | VIN=BIAS+0.2Vppac @1KHz |
| **Regulator**** | | | | | | |
| Output voltage | Vreg | 1.20 | | 4.0 | V | $I_L$=500mA** |
| Output load differential | $\triangle V_{RL}$ | -50 | 0 | 50 | mV | $I_L$=0~500mA |
| Power supply voltage differential | $\triangle V_{VCC}$ | -25 | 0 | 25 | mV | (VCC=4.5~7V) $I_L$=500mA |

*This device is not designed for protection against radioactive rays.
**It is based on SS8550D PNP application
***The parameter, although guaranteed, is not 100% tested in production.

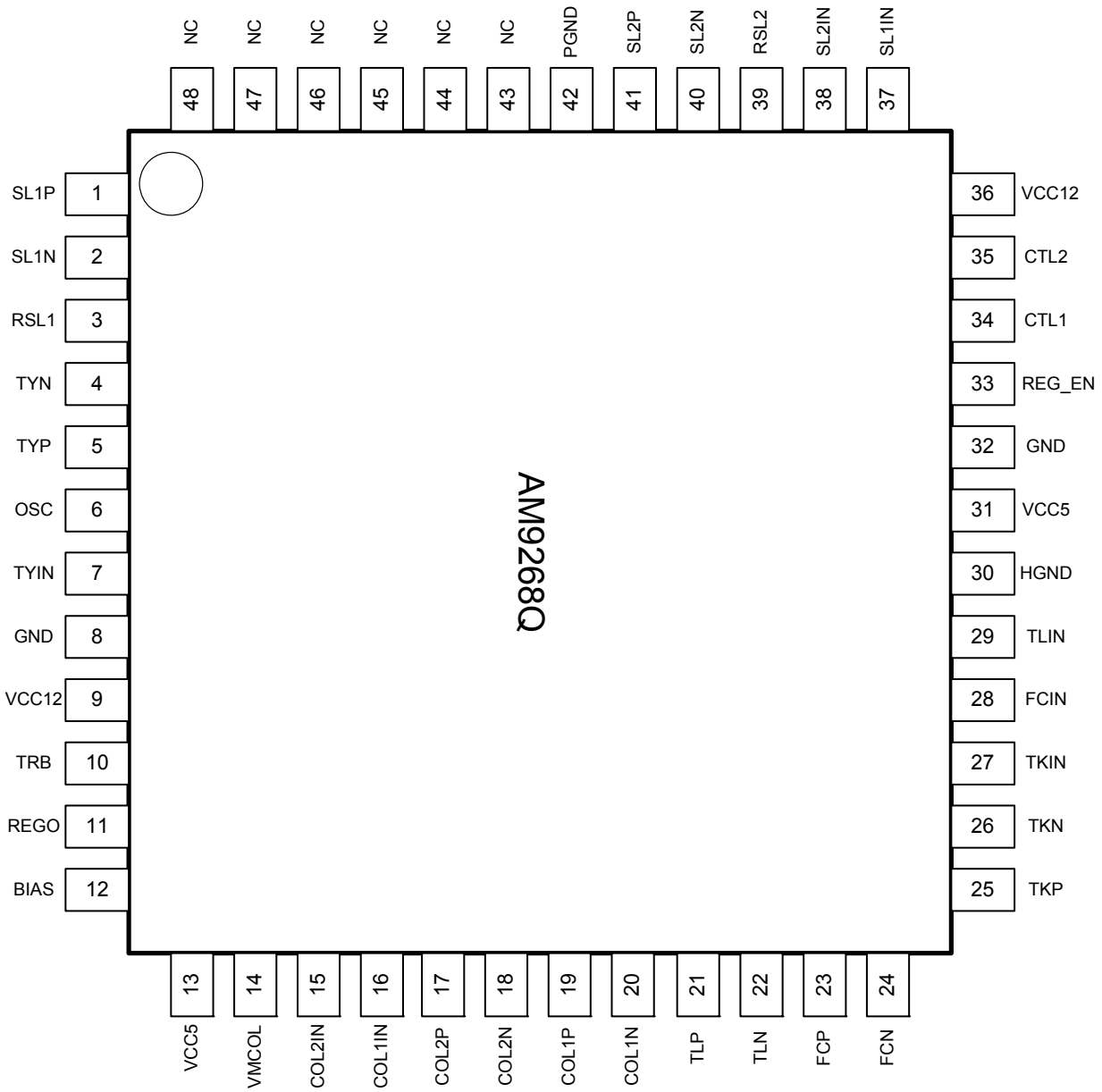
- **Block diagram**



- **I / O circuit**


VCC5
10K
TYIN/TKIN/FCIN/TLIN
VCC5
2K
REGO
VCC5
9.2K
CO1IN / CO2IN
OSC
VCC5
40K
100
TR_B
VCC5
2K
2K
15K
100K
BIAS
VCC5
15K
SL1IN / SL2IN
RSL
SL1P / SL2P
SL1N / SL2N
SL1P / SL1N / SL2P / SL2N
VCC5
28K
22K
REG - EN
VCC5
10K
40K
10K
CTL1 / CTL2
VCC5 / VMCOL / VCC12
TKP / TKN / FCP / FCN / TLP / TLN / CO1P
/ CO1N / CO2P / CO2N / TYP / TYN

- **Pin configuration**

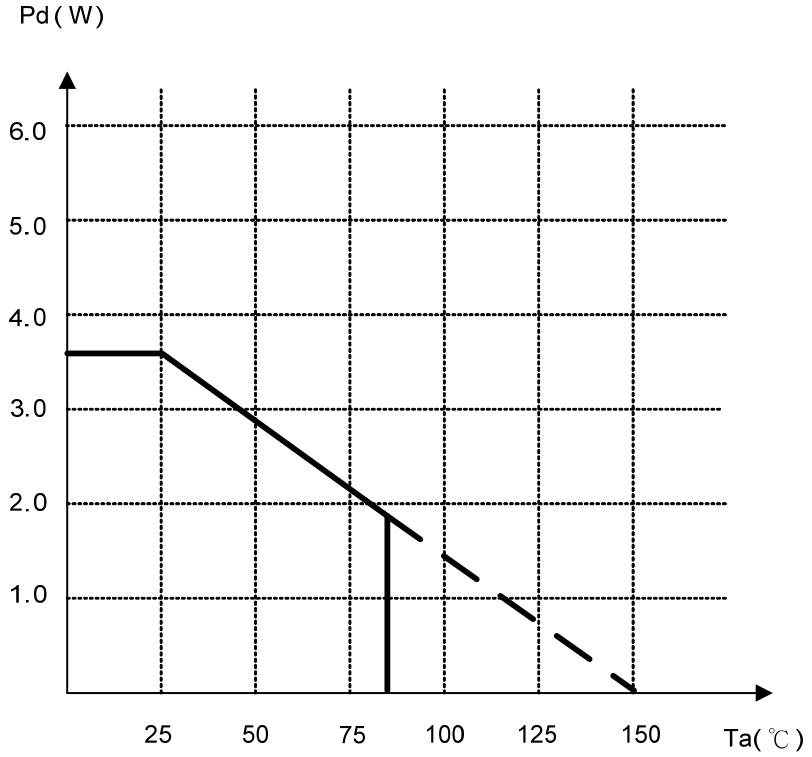


- **Pin Description**

| PIN No | Pin Name | Function |
|---|---|---|
| 1 | SL1P | Sledge positive output 1 |
| 2 | SL1N | Sledge negative output 1 |
| 3 | RSL1 | Sledge current sense1 |
| 4 | TYN | Tray negative output |
| 5 | TYP | Tray positive output |
| 6 | OSC | PWM carrier oscillation set |
| 7 | TYIN | Tray driver input |
| 8 | GND | GND for Tray and Sledge |
| 9 | VCC12 | Tray driver Power Supply |
| 10 | TRB | Connect to external transistor base |
| 11 | REGO | Regulator voltage output, connect to external transistor collector |
| 12 | BIAS | Input for reference voltage |
| 13 | VCC5 | Digital circuit Power Supply |
| 14 | VMCOL | Collimator driver Power Supply |
| 15 | CO2IN | CO2 driver input |
| 16 | CO1IN | CO1 driver input |
| 17 | CO2P | CO2 positive output |
| 18 | CO2N | CO2 negative output |
| 19 | CO1P | CO1 positive output |
| 20 | CO1N | CO1 negative output |
| 21 | TLP | Tilt positive output |
| 22 | TLN | Tilt negative output |
| 23 | FCP | Focus positive output |
| 24 | FCN | Focus negative output |
| 25 | TKP | Tracking positive output |
| 26 | TKN | Tracking negative output |
| 27 | TKIN | Tracking driver input |
| 28 | FCIN | Focus driver input |
| 29 | TLIN | Tilt driver input |
| 30 | HGND | Analog GND |
| 31 | VCC5 | Actuator driver Power Supply |

| | | |
|---|---|---|
| 32 | GND | Analog GND |
| 33 | REG_EN | Regulator control pin |
| 34 | CTL1 | Control terminal 1 |
| 35 | CTL2 | Control terminal 2 |
| 36 | VCC12 | Sledge driver Power Supply |
| 37 | SL1IN | Sledge control input 1 |
| 38 | SL2IN | Sledge control input 2 |
| 39 | RSL2 | Sledge current sense 2 |
| 40 | SL2N | Sledge negative output 2 |
| 41 | SL2P | Sledge positive output 2 |
| 42 | PGND | Power GND |
| 43 | NC | NC |
| 44 | NC | NC |
| 45 | NC | NC |
| 46 | NC | NC |
| 47 | NC | NC |
| 48 | NC | NC |

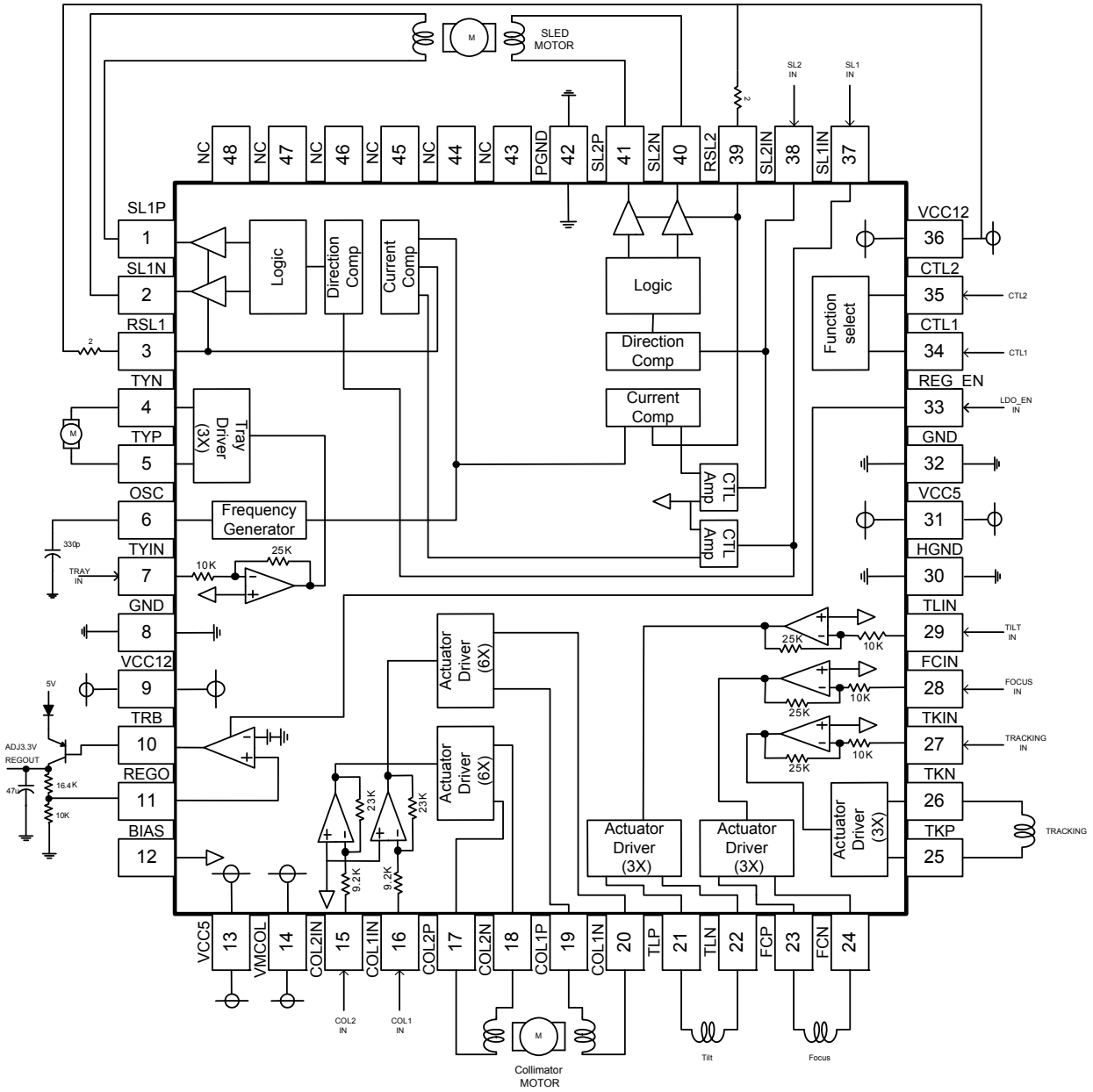
- **Power dissipation curve:**




*76.2mm×114.6mm×1.6mm 2layers FR4 board.

*De-rating is done at 28.73 mW/℃ for operating above $T_a$=25℃

- **Application Circuit**



- **Operation Notes**

1) Channel function is switched by CTL1 (pin34) and CTL2 (pin35); the operation is shown in the table as below.

| CTL1 | CTL2 | Tray | Track | Focus | Tilt | Sledge | Col |
|---|---|---|---|---|---|---|---|
| L | L | X | X | X | X | X | X |
| L | H | O | X | X | X | X | X |
| H | L | X | O | O | O | O | O |
| H | H | X | O | O | O | O | O |

Built-in regulator is controlled by REG_EN (pin33)

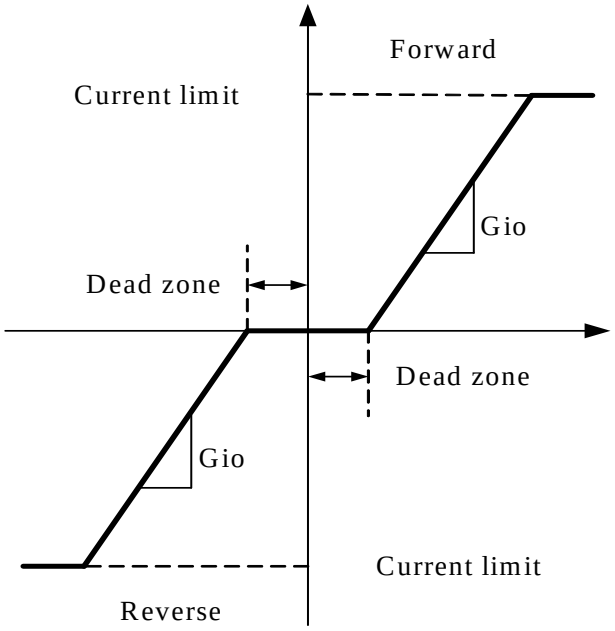
| REG_EN | Regulator |
|---|---|
| L | X |
| H | O |

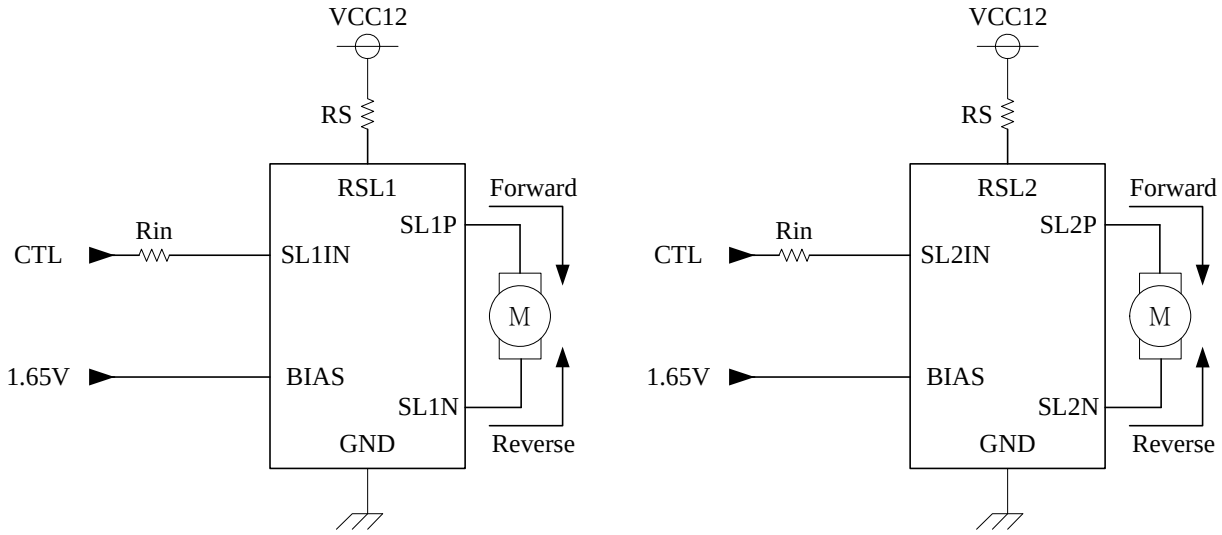
2) Sledge channel

The relationship between the differential voltage between SLIN and BIAS and the torque is shown in following Figure. The voltage gain [Gvo] is 1.0 [V/V]. The current gain is 2.0 [A/V] (at sensing resistor: 0.5Ω and R1=∞, R2=0Ω) in forward torque directions, and the dead zone is from 0mV to 80mV (at R1=∞, R2=0Ω).

The coil current gain under the reverse torque is the same with in forward torque directions. And the limitation function gets on when the differential voltage of VCC12 to RSL is 0.5V.

Therefore current-gain-control and current-limit of this IC is determined with sensing resister value.






The example of current-gain and current-limit of SLEDGE

| | | Gio*[A/V] |
|---|---|---|
| RS[Ω] | Ilim[A] | Rin=15kΩ |
| 0.50 | 1.00 | 1.00 |
| 0.75 | 0.66 | 0.66 |
| 1.00 | 0.50 | 0.50 |

Gio*=15k/[(Rin+15k)RS][A/V]

3) PWM carrier frequency setting

PWM carrier frequency is decided by charging and discharging capacitor that is connected to OSC terminal outer IC. Examination of the relationship the capacitor connected to OSC terminal and PWM carrier frequency is given in following table.

| **Capacitor[pF]** | 820 | 750 | 330 | 220 | 180 | 130 | 110 |
|---|---|---|---|---|---|---|---|
| **Carrier Frequency[kHz]** | 28 | 30 | 65 | 90 | 110 | 140 | 160 |

*This PWM carrier frequency is TYP value.

4) Phase delay circuit at sledge

Phase delay circuit is built in the IC to detect an output spike current, when the motor current direction is switching. In switching the motor current direction, Phase delay circuit switch-off all output transistor of H-bridge for 3 μsec.

5) The built-in thermal shutdown circuit mutes the output current when the chip temperature reaches 175℃ (typ.). The hysteresis is set to 25℃ (typ.), so the circuit will start up again when the chip temperature falling to 150℃ (typ.).

6) Bias pin (pin12) should be pulled up to more than 1V. In case the bias pin voltage is pulled down below 0.7V (typ.), the output current is muted.

7) Insert the bypass capacitor (~0.1μF) between VCC pin and GND pin as close as possible.

8) Heat dissipation fins are attached to the GND on the inside of the package. Make sure to connect them to the external GND.

9) Wiring for RSL
   Considering the wiring resistance, connect each detecting resistor as close as possible to the current detection terminals for the sledge motor drive RSL 1 (pin3) and 2 (pin39) of the IC.

- **Condition of Soldering**

**1).Manual Soldering**

Pb-free: Time / Temperature ≤ 3 sec / 400 ± 10 °C （2 Times）

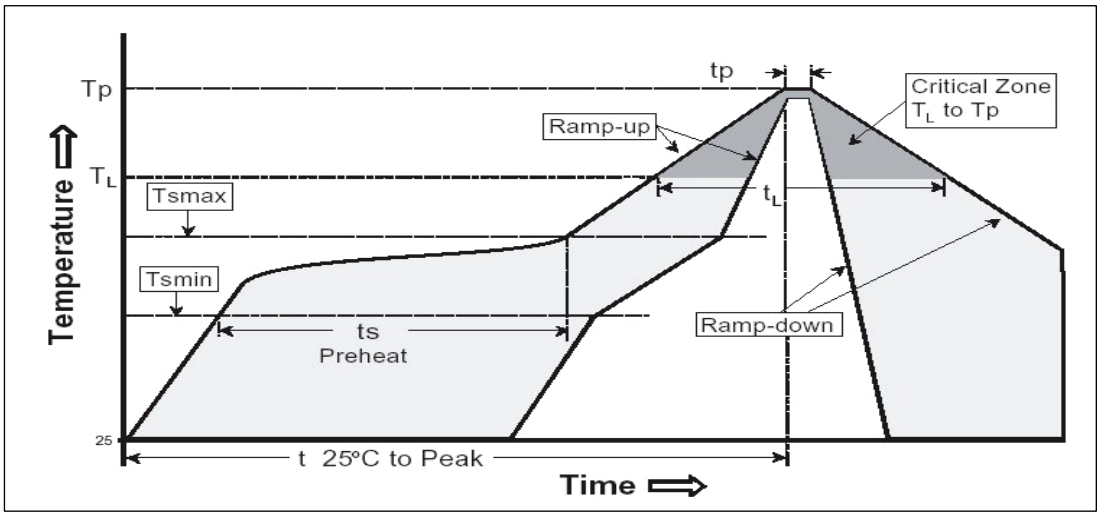
Test Results：0 fail/ 22 tested

Manual Soldering count：2 Times

**2).Re-flow Soldering (follow IPC/JEDEC J-STD-020D**)

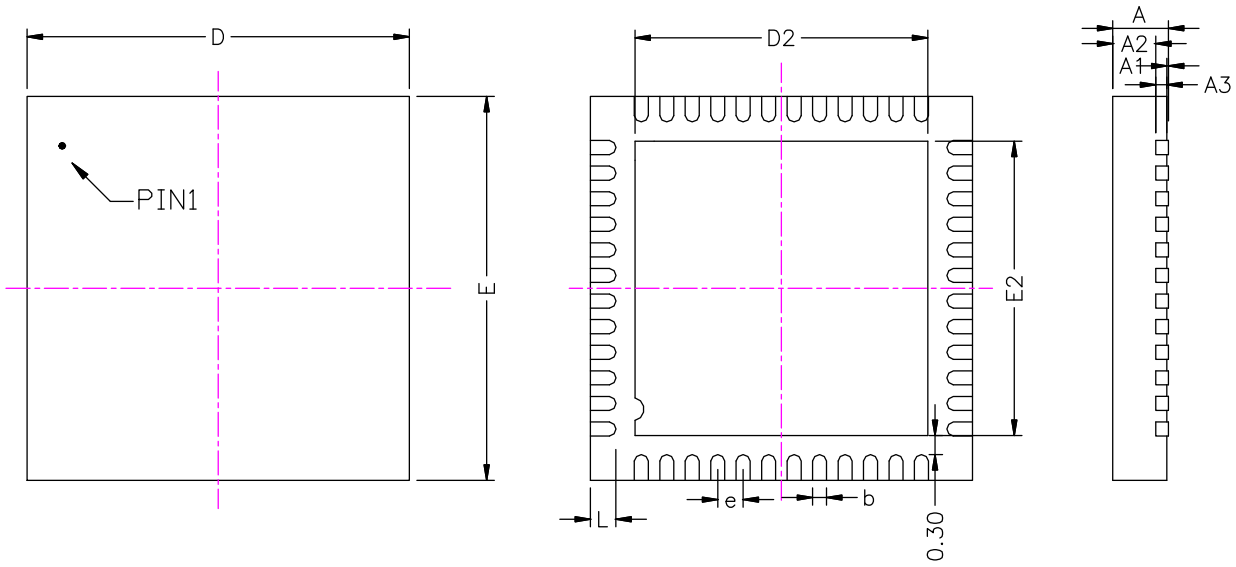
Classification Reflow Profile

| Profile Feature | Pb-Free Assembly |
|---|---|
| Average ramp-up rate ($T_L$ to $T_P$) | 3°C/second max. |
| Preheat<br>- Temperature Min (Ts min)<br>- Temperature Max (Ts max)<br>- Time (min to max) (ts) | <br>150°C<br>200°C<br>60-180 seconds |
| Ts max to $T_L$<br>- Temperature Min (Ts min) | <br>3°C/second max. |
| Time maintained above:<br>- Temperature ($T_L$)<br>- Time ($t_L$) | <br>217°C<br>60-150 seconds |
| Peak Temperature ($T_P$) | 260 +0/-5°C |
| Time with 5°C of actual Peak<br>- Temperature (tp) | 20-40 seconds |
| Ramp-down Rate | 6°C/second max. |
| Tme 25°C to Peak Temperature | 8 minutes max. |



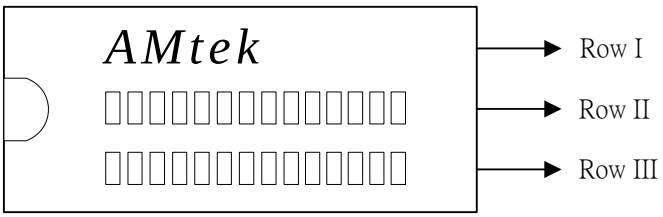

- Test Results：0 fail/ 32 tested
- Reflow count：3 cycles

● **Packaging outline** **Unit : mm**




| SYMBOL | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | - | 0.90 | - | 0.035 |
| A1 | - | 0.05 | - | 0.002 |
| A2 | - | 0.70 | - | 0.028 |
| A3 | 0.20 REF | | 0.008 REF | |
| b | 0.15 | 0.27 | 0.006 | 0.011 |
| D | 6.00 BSC | | 0.240 BSC | |
| E | 6.00 BSC | | 0.240 BSC | |
| D2 | 4.55 | 4.65 | 0.182 | 0.186 |
| E2 | 4.55 | 4.65 | 0.182 | 0.186 |
| L | 0.35 | 0.45 | 0.014 | 0.028 |
| e | 0.40 BSC | | 0.016 BSC | |

- **Marking Identification**




Row I

AMtek

Row II

AM9268Q

Row III

Lot number