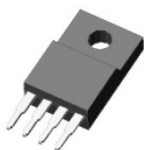
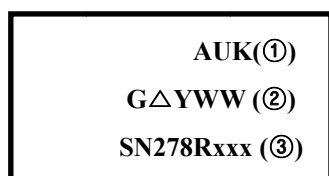

**TO-252-5L**

**TO-220F-4SL**

## ORDERING INFORMATION

| Product     | Marking  | Package     |
|-------------|----------|-------------|
| SN278RxxD   | SN278Rxx | TO-252-5L   |
| SN278RxxPIC | SN278Rxx | TO-220F-4SL |

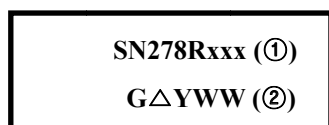
### ▲ Marking Detail Information

[ TO-220F-4SL PKG Marking ]



- ① AUK Logo
- ② Grade & M Code & Year & Week Code
- ③ Device Code

[ TO-252-5L PKG Marking ]



- ① Device Code
- ② Grade & M Code & Year & Week Code

# SN278Rxxx

## Low Dropout Voltage Regulator (2.0A Series)

### Description

The SN278Rxx is an efficient linear low dropout voltage regulator for various electronic equipment. It is designed to provide very low dropout voltage, and better than 2.5% output voltage accuracy.

And the SN278Rxx has various key features such as current limiting, over temperature shut-down, over voltage protection, enable pin, and low noise performance with an low noise option.

Furthermore, it is available in adjustable or fixed output voltages in TO-252-5L, TO-220F-4SL packages.

### Application

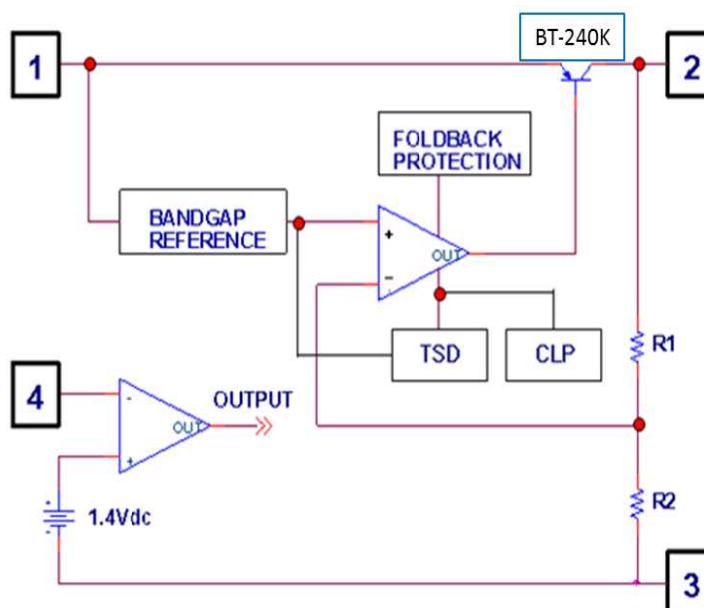
- ◆ Consumer and personal electronics
- ◆ SMPS post-regulator / dc-to-dc modules
- ◆ High-efficiency linear power supplies

### Features and Benefits

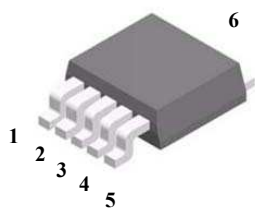
- ◆ Low Dropout Voltage for 2.0A Output : [ Max. 500mV ]
- ◆ Built in Thermal shut down circuit
- ◆ Built in OVP, CLP circuit
- ◆ Low Quiescent Current
- ◆ Ultra High level of ESD [ Built in ESD Protection Cell ]

MM : 400V ↑ / HBM 4KV ↑

### Equivalent Circuit

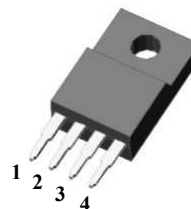


## ◆ Pin Configuration



**TO-252-5L**

- 1:  $V_{IN}$
- 2: GND
- 3:  $V_{OUT}$
- 4:  $V_{CTL}$
- 5: NC
- 6:  $V_{OUT}$



**TO-220F-4SL**

- 1:  $V_{IN}$
- 2:  $V_{OUT}$
- 3: GND
- 4:  $V_{CTL}$

## ◆ Product Line-up

| Product Name | $V_{OUT}$ | Junction Operating Temperature | Package     |
|--------------|-----------|--------------------------------|-------------|
| SN278R33D    | 3.3V      | -40~150°C                      | TO-252-5L   |
| SN278R35D    | 3.5V      | -40~150°C                      | TO-252-5L   |
| SN278R05D    | 5.0V      | -40~150°C                      | TO-252-5L   |
| SN278R06D    | 6.0V      | -40~150°C                      | TO-252-5L   |
| SN278R08D    | 8.0V      | -40~150°C                      | TO-252-5L   |
| SN278R09D    | 9.0V      | -40~150°C                      | TO-252-5L   |
| SN278R12D    | 12V       | -40~150°C                      | TO-252-5L   |
| SN278R15D    | 15V       | -40~150°C                      | TO-252-5L   |
| SN278R33PIC  | 3.3V      | -40~150°C                      | TO-220F-4SL |
| SN278R35PIC  | 3.5V      | -40~150°C                      | TO-220F-4SL |
| SN278R05PIC  | 5.0V      | -40~150°C                      | TO-220F-4SL |
| SN278R06PIC  | 6.0V      | -40~150°C                      | TO-220F-4SL |
| SN278R08PIC  | 8.0V      | -40~150°C                      | TO-220F-4SL |
| SN278R09PIC  | 9.0V      | -40~150°C                      | TO-220F-4SL |
| SN278R12PIC  | 12V       | -40~150°C                      | TO-220F-4SL |
| SN278R15PIC  | 15V       | -40~150°C                      | TO-220F-4SL |

## ◆ Absolute Maximum Ratings ( $T_a = 25^{\circ}\text{C}$ )

| Parameter                    |             | Symbol    | Limits          |            | Unit               |
|------------------------------|-------------|-----------|-----------------|------------|--------------------|
| Input Voltage                |             | $V_{IN}$  | 35.0            |            | V                  |
| Power Dissipation            | TO-220F-4SL | $P_D$     | 1.5(Note1)      | 15(Note2)  | W                  |
|                              | TO-252-5L   |           | 1.3(Note1)      | 2.7(Note2) |                    |
| Junction Temperature         |             | $T_J$     | 150             |            | $^{\circ}\text{C}$ |
| Operate Junction Temperature |             | $T_{opr}$ | $-40 \sim +150$ |            | $^{\circ}\text{C}$ |
| Storage Temperature Range    |             | $T_{stg}$ | $-55 \sim +150$ |            | $^{\circ}\text{C}$ |

Note 1 : No Heat-sink

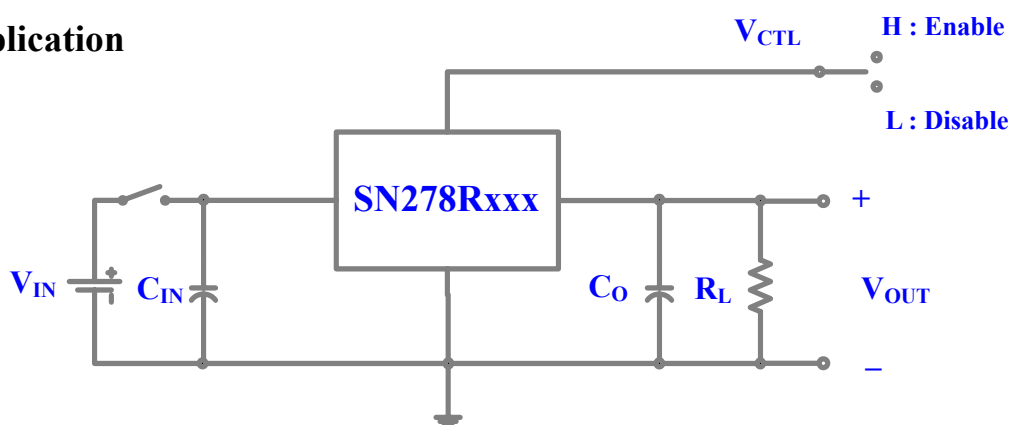
Note 2 : Infinite Heat-sink(TO-220F) / FR-4 PCB (25.4\*25.4mm) for SMD PKG

Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its operating ratings. The maximum allowable power dissipation is a function of the maximum junction temperature,  $T_{J(max)}$ , the junction-to-ambient thermal resistance,  $\theta_{JA}$ , and the ambient temperature,  $T_A$ .

The maximum allowable power dissipation at any ambient temperature is calculated using:

$P_{D(max)} = (T_{J(max)} - T_A) \div \theta_{JA}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

## Typical Application



- 1)  $C_{IN}$  should be required if regulators are located far from power supply filter
- 2)  $C_O$  improves output stability and transient response (  $C_O \geq 47\mu\text{F}$  )

## ◆ Electrical characteristics

( Vin=(Note 1): I<sub>o</sub> = 1.0A, V<sub>CT(High)</sub>=2.7V, T<sub>a</sub> = 25°C, unless otherwise specified )

| Electric Characteristic   | Symbol                    | Conditions                      | Min. | Typ.  | Max. | Unit    |
|---------------------------|---------------------------|---------------------------------|------|-------|------|---------|
| Output Voltage            | V <sub>O</sub>            | SN278R33                        | -    | 3.22  | 3.3  | 3.38 V  |
|                           |                           | SN278R35                        | -    | 3.41  | 3.5  | 3.59 V  |
|                           |                           | SN278R05                        | -    | 4.88  | 5.0  | 5.12 V  |
|                           |                           | SN278R06                        | -    | 5.85  | 6.0  | 6.15 V  |
|                           |                           | SN278R08                        | -    | 7.80  | 8.0  | 8.20 V  |
|                           |                           | SN278R09                        | -    | 8.78  | 9.0  | 9.22 V  |
|                           |                           | SN278R12                        | -    | 11.70 | 12.0 | 12.30 V |
|                           |                           | SN278R15                        | -    | 14.60 | 15.0 | 15.40 V |
| Line Regulation           | $\Delta V_{O(\Delta VI)}$ | (Note2)                         | -    | 0.5   | 2.5  | %       |
| Load Regulation           | $\Delta V_{O(\Delta IL)}$ | 5mA ≤ I <sub>o</sub> ≤ 2.0A     | -    | 0.1   | 2.0  | %       |
| Quiescent Current         | I <sub>QC</sub>           | I <sub>o</sub> =0mA             | -    | -     | 10   | mA      |
| Ripple Rejection Ratio    | RR                        | I <sub>o</sub> =50mA, f=120Hz   | 45   | 55    | -    | dB      |
| Dropout Voltage           | V <sub>DROP</sub>         | I <sub>o</sub> =1.0A            | -    | -     | 0.3  | V       |
|                           |                           | I <sub>o</sub> =2.0A            | -    | -     | 0.5  | V       |
| Control Voltage High      | V <sub>CT(High)</sub>     | I <sub>o</sub> =0mA, Output ON  | 2.0  | -     | -    | V       |
| Control Voltage Low       | V <sub>CT(Low)</sub>      | I <sub>o</sub> =0mA, Output OFF | -    | -     | 0.8  | V       |
| Control Bias Current High | I <sub>CT(High)</sub>     | V <sub>CT(High)</sub> = 2.7V    | -    | -     | 20   | μA      |
| Control Bias Current Low  | I <sub>CT(Low)</sub>      | V <sub>CT(Low)</sub> = 0.4V     | -    | -     | -0.4 | mA      |

Note 1)

|                                |                                |
|--------------------------------|--------------------------------|
| SN278R33: V <sub>I</sub> =5.3V | SN278R35: V <sub>I</sub> =5.5V |
| SN278R05: V <sub>I</sub> =7.0V | SN278R06: V <sub>I</sub> =8.0V |
| SN278R08: V <sub>I</sub> =10V  | SN278R09: V <sub>I</sub> =15V  |
| SN278R12: V <sub>I</sub> =18V  | SN278R15: V <sub>I</sub> =21V  |

Note 2)

|                                    |                                    |
|------------------------------------|------------------------------------|
| SN278R33: V <sub>I</sub> =4.3V~12V | SN278R35: V <sub>I</sub> =4.5V~12V |
| SN278R05: V <sub>I</sub> =6V~12V   | SN278R06: V <sub>I</sub> =7V~15V   |
| SN278R08: V <sub>I</sub> =9V~25V   | SN278R09: V <sub>I</sub> =10V~25V  |
| SN278R12: V <sub>I</sub> =13V~29V  | SN278R15: V <sub>I</sub> =16V~32V  |

## Electrical Characteristic Curves

Fig.1  $I_O$  vs.  $V_O$

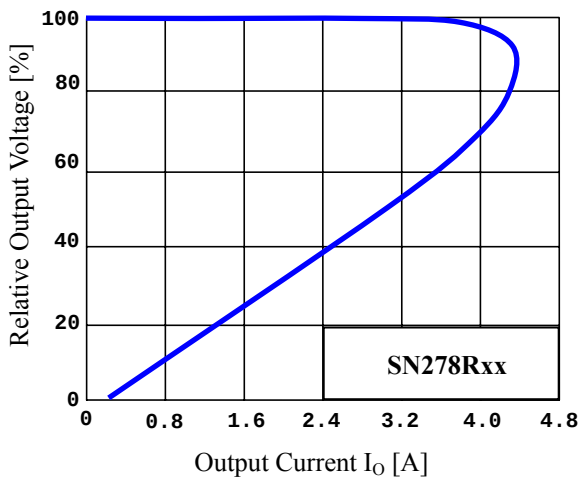


Fig.2  $T_a$  vs.  $P_D$

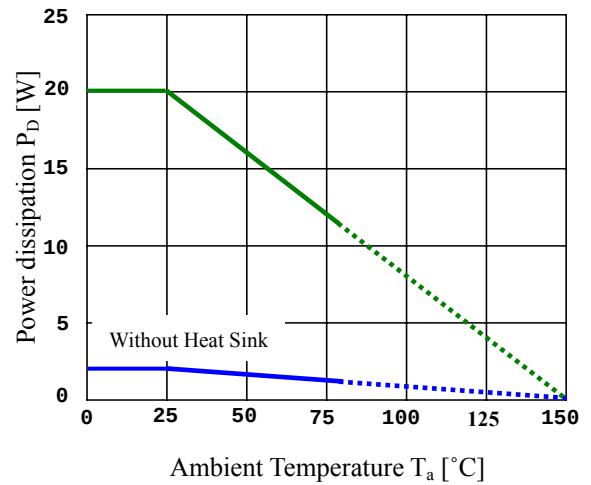


Fig.3  $V_I$  vs.  $I_{QC}$

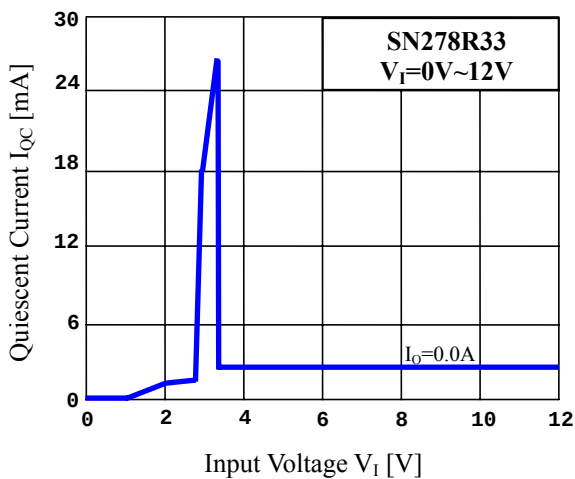


Fig.4  $V_I$  vs.  $I_{QC}$

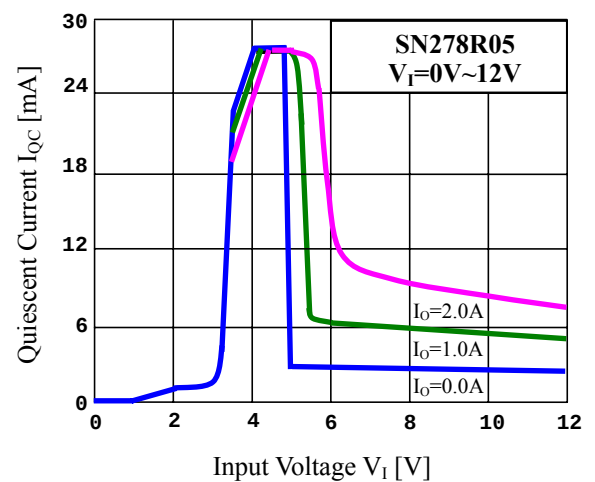


Fig.6  $V_I$  vs.  $I_{QC}$

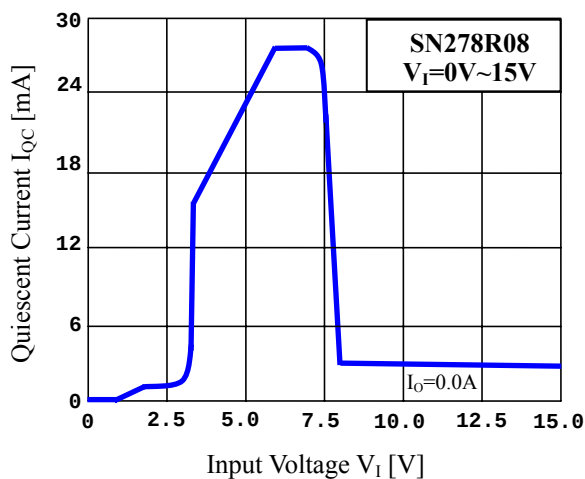
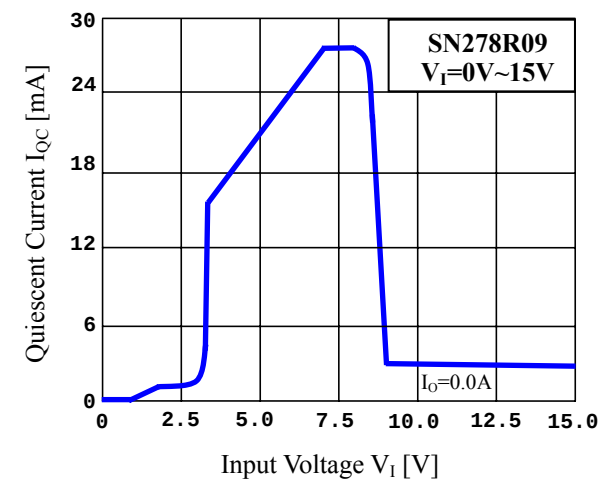


Fig.7  $V_I$  vs.  $I_{QC}$



## Electrical Characteristic Curves

Fig.8  $V_I$  vs.  $I_{QC}$

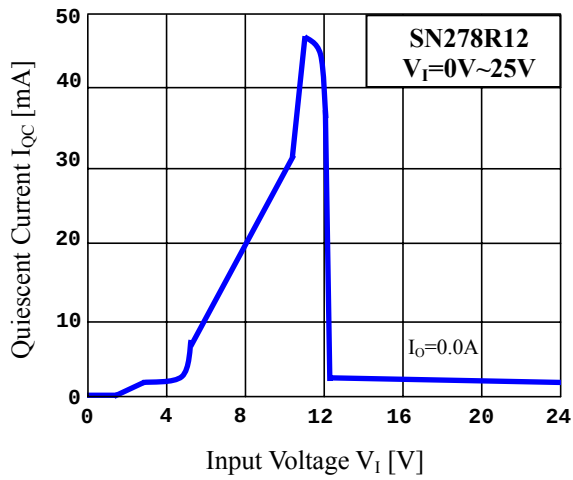


Fig.9  $T_j$  vs.  $I_{QC}$

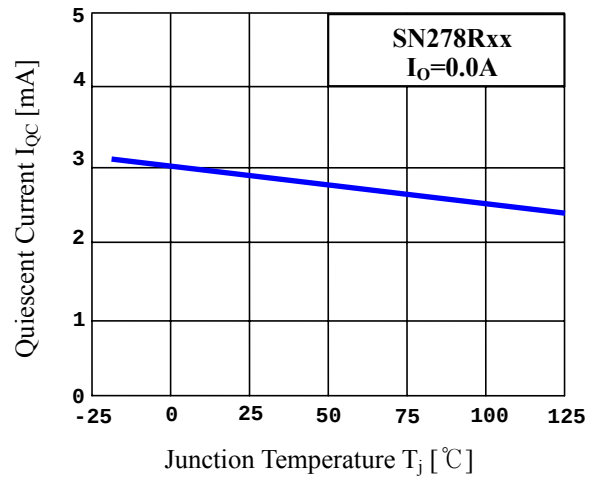


Fig.10  $V_{CT}$  vs.  $V_O$

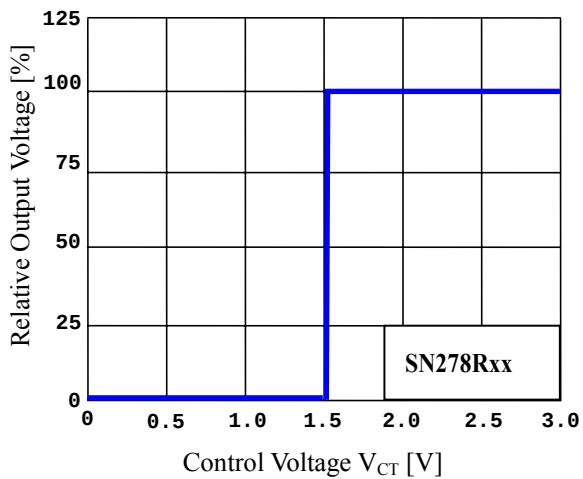
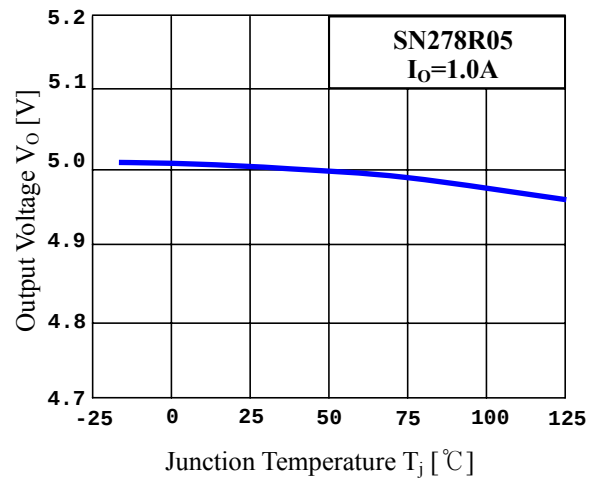
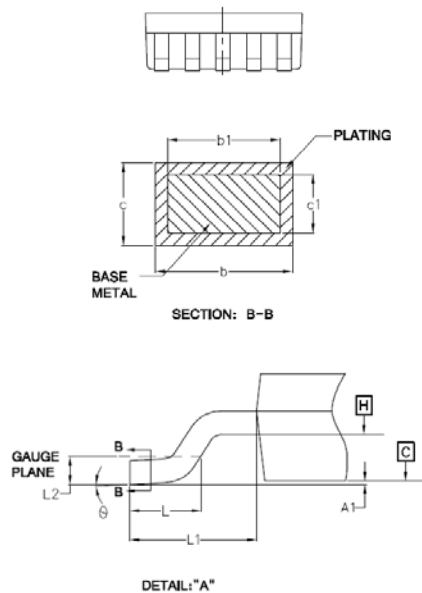
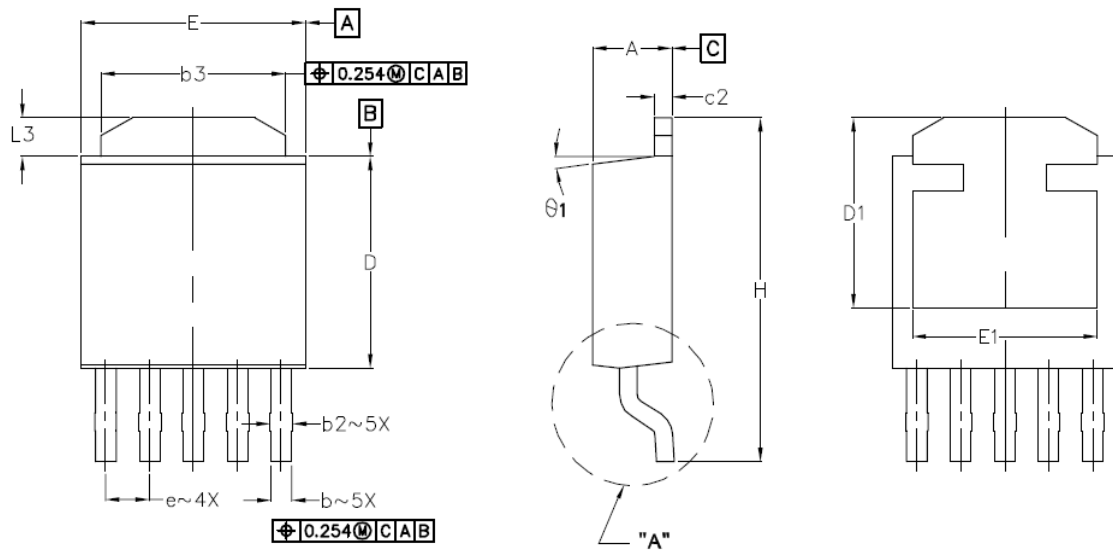


Fig.11  $T_j$  vs.  $V_O$

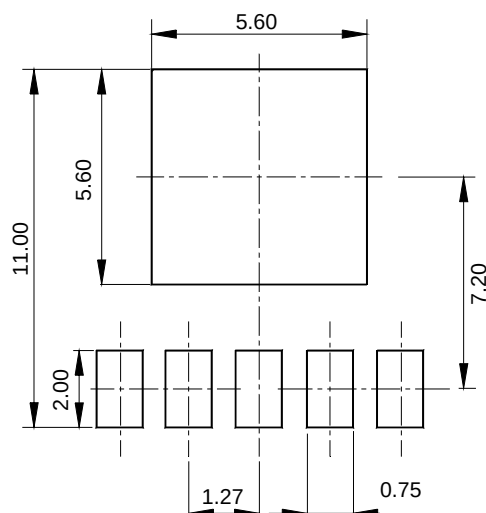


## ◆ TO-252-5L Outline Dimension (Unit : mm)

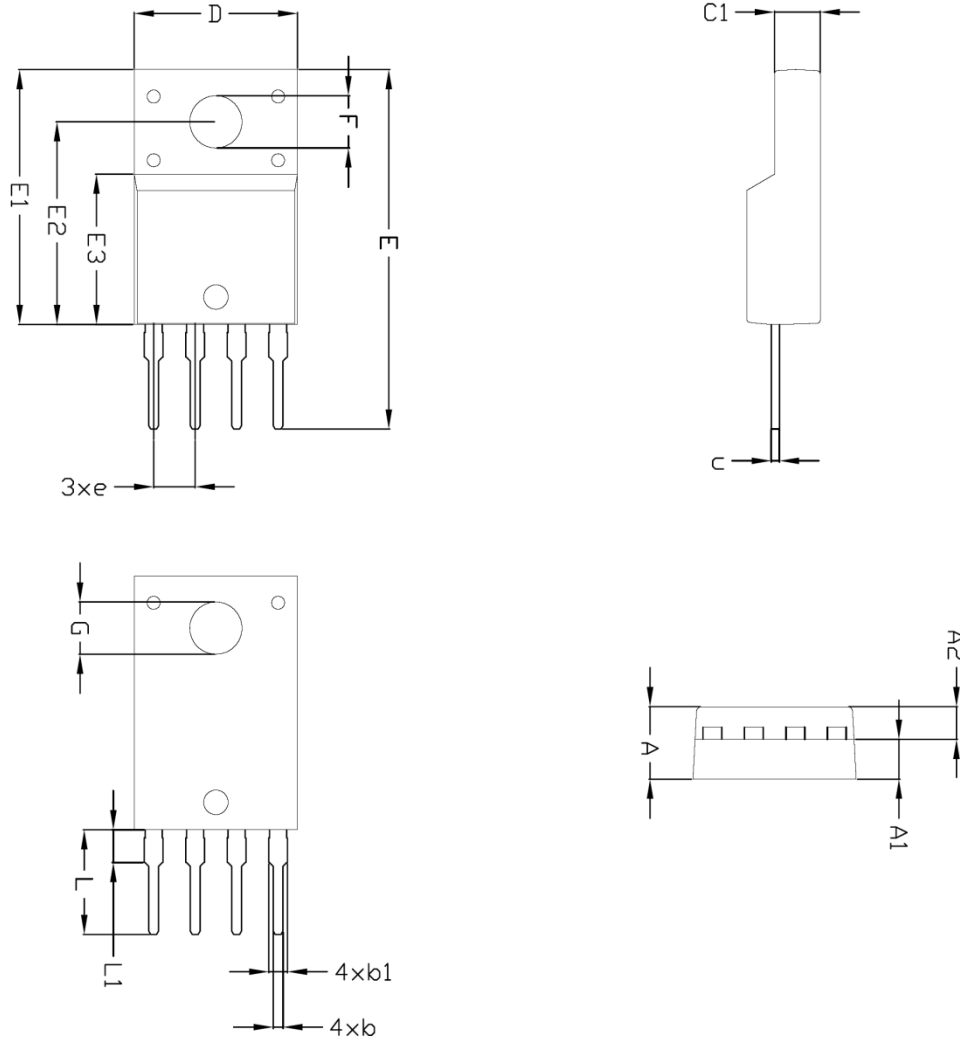


| SYMBOL     | MILLIMETERS |         |         | NOTE |
|------------|-------------|---------|---------|------|
|            | MINIMUM     | NOMINAL | MAXIMUM |      |
| A          | 2.184       | 2.286   | 2.387   |      |
| A1         | —           | —       | 0.127   |      |
| b          | 0.508       | 0.610   | 0.711   |      |
| b1         | 0.508       | 0.584   | 0.660   |      |
| b2         | 0.610       | 0.699   | 0.787   |      |
| b3         | 4.953       | 5.207   | 5.461   |      |
| c          | 0.460       | 0.535   | 0.610   |      |
| c1         | 0.410       | 0.485   | 0.559   |      |
| c2         | 0.460       | 0.675   | 0.889   |      |
| D          | 5.969       | 6.096   | 6.223   |      |
| D1         | 5.207       | —       | —       |      |
| E          | 6.350       | 6.541   | 6.731   |      |
| E1         | 4.318       | —       | —       |      |
| e          | 1.270 BSC   |         |         |      |
| H          | 9.398       | 9.906   | 10.414  |      |
| L          | 1.397       | 1.588   | 1.778   |      |
| L1         | 2.743 BSC   |         |         |      |
| L2         | 0.508 BSC   |         |         |      |
| L3         | 0.889       | 1.080   | 1.270   |      |
| $\theta$   | 0°          | 5°      | 10°     |      |
| $\theta_1$ | 0°          | 7.5°    | 15°     |      |

※ Recommend PCB solder land [Unit : mm]



## ◆ TO-220F-4SL Outline Dimension (Unit : mm)



| SYMBOL | MILLIMETERS |         |         | NOTE |
|--------|-------------|---------|---------|------|
|        | MINIMUM     | NOMINAL | MAXIMUM |      |
| A      | -           | -       | 4.60    |      |
| A1     | 2.45        | 2.50    | 2.55    |      |
| A2     | 1.95        | 2.00    | 2.05    |      |
| b      | 0.50        | 0.60    | 0.70    |      |
| b1     | 0.85        | 1.05    | 1.25    |      |
| c      | 0.40        | 0.50    | 0.60    |      |
| c1     | 2.70        | 2.80    | 2.90    |      |
| D      | 9.90        | 10.00   | 10.10   |      |
| E      | 20.80       | -       | 21.40   |      |
| E1     | 15.50       | 15.60   | 15.70   |      |
| E2     | 12.30       | 12.40   | 12.50   |      |
| E3     | 9.15        | 9.20    | 9.25    |      |
| F      | 3.10        | 3.20    | 3.30    |      |
| G      | 3.30        | 3.40    | 3.50    |      |
| e      | 2.54 BSC    |         |         |      |
| L      | 5.20        | -       | 5.80    |      |
| L1     | 2.00 BSC    |         |         |      |



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