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# FAN7601

## Green Current Mode PWM Controller

### Features

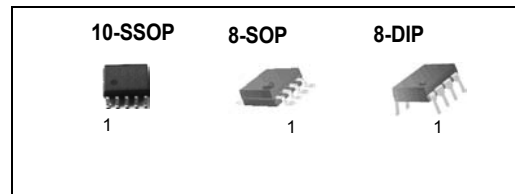
- Green Current Mode PWM Control
- Low Operating Current: Max 4mA
- Burst Mode Operation
- Internal High Voltage Start-up Switch
- Under Voltage Lockout (UVLO): 12V/8V
- Latch Protection & Soft Start Function
- Over Voltage Protection: 19V
- Operating Frequency up to 300kHz
- Max Duty Cycle: 95%

### Typical Applications

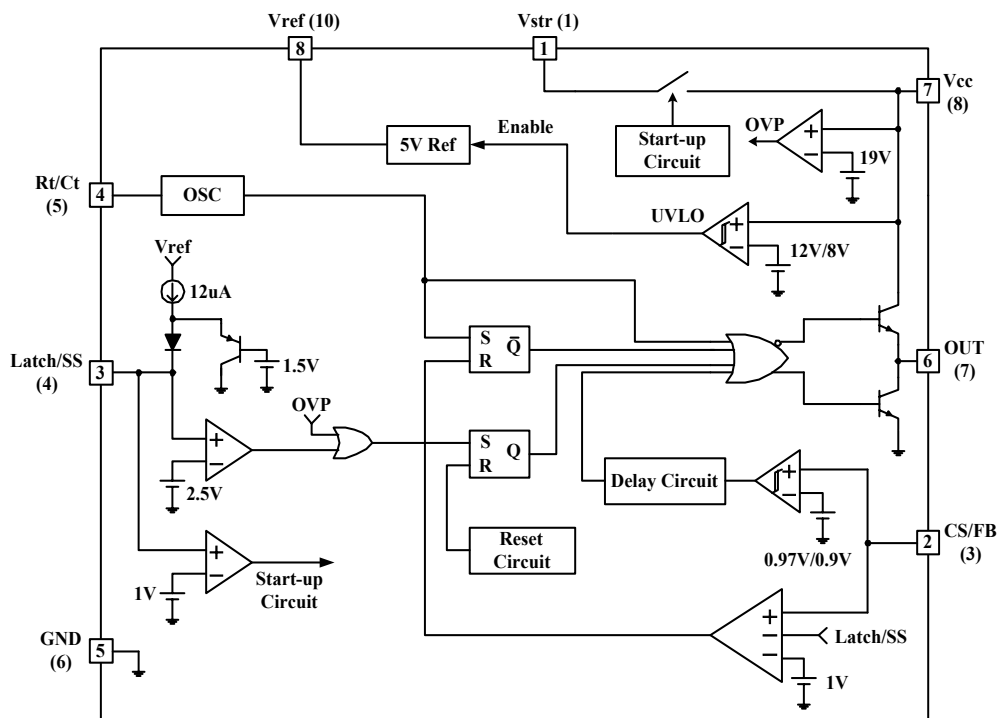
- Off-Line Adapter Applications
- Auxiliary Power Supplies

### Description

The FAN7601 is a green programmable frequency current mode PWM controller. It is specially designed for the off-line adapter application and the auxiliary power supplies which require high efficiency at a light load and no load. The internal high voltage start-up switch and the burst mode reduce the power loss. The FAN7601 includes some protections such as latch protection and over voltage protection. The latch protection can be used for over voltage protection and/or thermal protection and so on. And the soft start prevents the output voltage over shoot at start up.

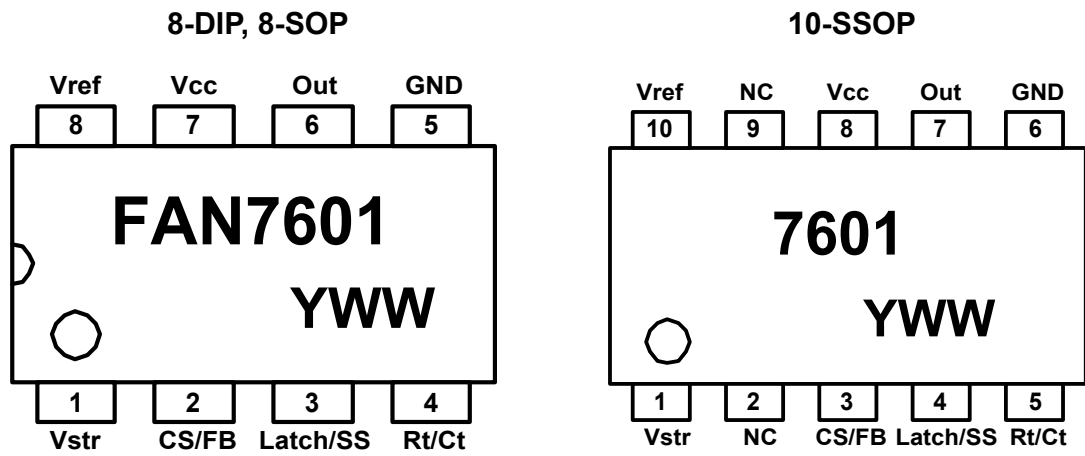


### Internal Block Diagram



\* ( ) is 10-SSOP PIN Number

## Pin Assignments



## Pin Definitions

| Pin Number | Pin Name | Pin Function Description        |
|------------|----------|---------------------------------|
| 1 (1)      | Vstr     | Start-up                        |
| 2 (3)      | CS/FB    | Current Sense and Feedback      |
| 3 (4)      | Latch/SS | Latch Protection and Soft Start |
| 4 (5)      | Rt/Ct    | Oscillator Timing               |
| 5 (6)      | GND      | Ground                          |
| 6 (7)      | Out      | Gate Drive Output               |
| 7 (8)      | VCC      | IC Power Supply                 |
| 8 (10)     | Vref     | Voltage Reference               |

\*() is 10-SSOP PIN Number

## Absolute Maximum Ratings

(Ta = 25°C, unless otherwise specified)

| Characteristics   | Symbol  | Value       | Unit |
|---|---------|-------------|------|
| Supply Voltage  | VCC     | 20          | V    |
| Input Voltage CS/FB   | VCS/FB  | -0.3 to 20  | V    |
| Operating Temperature                                       | TOPR    | -25 to +125 | °C   |
| Storage Temperature   | TSTG    | -55 to +150 | °C   |
| Junction Temperature  | Tj      | 150         | °C   |
| Output Current  | IO      | 250         | mA   |
| Vstr Input Voltage  | Vstr    | 500         | V    |
| ESD Capability, HBM Model<br>(All pins except Vcc and Vstr) | -       | 2.0         | kV   |
| ESD Capability, Machine Model                               | -       | 300         | V    |
| Thermal Resistance, Junction to Air                         | 8-DIP   | 100         | °C/W |
|   | 8-SOP   | 180         |      |
|   | 10-SSOP | 130         |      |

## Electrical Characteristics

( $T_a = -25^{\circ}\text{C} \sim 125^{\circ}\text{C}$ ,  $V_{CC} = 14\text{V}$ ,  $R_t = 9.5\text{k}\Omega$ ,  $C_t = 2.2\text{nF}$  unless otherwise specified)

| Characteristics                         | Symbol                   | Conditions   | Min. | Typ. | Max. | Unit          |
|---|--------------------------|--|------|------|------|---------------|
| <b>REFERENCE SECTION</b>                |                          |  |      |      |      |               |
| Reference Output Voltage                | $V_{\text{ref}}$         | $I_O = 1\text{mA}$   | 4.85 | 5.00 | 5.15 | V             |
| Line Regulation                         | $\Delta V_{\text{ref1}}$ | $V_{CC} = 10\text{V} \sim 18\text{V}$                      | -    | 10   | 20   | mV            |
| Load Regulation                         | $\Delta V_{\text{ref2}}$ | $I_O = 1\text{mA} \sim 10\text{mA}$                        | -    | 20   | 30   | mV            |
| <b>OSCILLATOR SECTION</b>               |                          |  |      |      |      |               |
| Initial Accuracy                        | FOSC                     | -  | 90   | 100  | 110  | kHz           |
| Voltage Stability                       | STV                      | $V_{CC} = 10\text{V} \sim 18\text{V}$                      | -    | 1.0  | 1.5  | %             |
| Amplitude                               | VOCS                     | $V_{\text{pin4}}$ peak-to-peak                             | -    | 1.25 | -    | V             |
| <b>PWM SECTION</b>                      |                          |  |      |      |      |               |
| CS/FB Threshold Voltage1                | VCS/FB1                  | -  | 0.9  | 1.0  | 1.1  | V             |
| Maximum Duty Cycle                      | DMAX                     | $T_a = 25^{\circ}\text{C}$                                 | 92   | 95   | 98   | %             |
| Minimum Duty Cycle                      | DMIN                     | -  | -    | -    | 0    | %             |
| <b>BURST MODE SECTION</b>               |                          |  |      |      |      |               |
| CS/FB Threshold Voltage2 <sup>(1)</sup> | VCS/FB2                  | -  | 0.77 | 0.97 | 1.17 | V             |
| CS/FB Threshold Voltage3 <sup>(1)</sup> | VCS/FB3                  | -  | 0.7  | 0.9  | 1.1  | V             |
| <b>SOFT START SECTION</b>               |                          |  |      |      |      |               |
| Soft Start Current                      | ISS                      | $V_{\text{pin3}} = \text{GND}$                             | 9    | 12   | 15   | $\mu\text{A}$ |
| Soft Start Limit Voltage <sup>(2)</sup> | VSL                      | $I_{SS} = 1\mu\text{A}$                                    | 1.2  | 1.5  | 1.8  | V             |
| <b>PROTECTION SECTION</b>               |                          |  |      |      |      |               |
| Latch Voltage                           | VLATCH                   | -  | 2.25 | 2.5  | 2.75 | V             |
| Over Voltage Protection                 | VOVP                     | -  | 18   | 19   | 20   | V             |
| <b>UVLO SECTION</b>                     |                          |  |      |      |      |               |
| Start Threshold Voltage                 | $V_{\text{tH}}$          | -  | 11   | 12   | 13   | V             |
| Minimum Operating Voltage               | $V_{\text{tL}}$          | -  | 7    | 8    | 9    | V             |
| <b>TOTAL CURRENT SECTION</b>            |                          |  |      |      |      |               |
| Operating Supply Current                | IOP                      | -  | -    | 3    | 4    | mA            |
| <b>OUTPUT SECTION</b>                   |                          |  |      |      |      |               |
| Low Output Voltage                      | VOL                      | $T_a = 25^{\circ}\text{C}$ , $I_O = 100\text{mA}$          | -    | 2    | 2.5  | V             |
| High Output Voltage                     | VOH                      | $T_a = 25^{\circ}\text{C}$ , $I_O = -100\text{mA}$         | 11.5 | 12   | 14   | V             |
| Rising Time <sup>(1)</sup>              | $T_r$                    | $T_a = 25^{\circ}\text{C}$ , $C_l = 1\text{nF}$            | -    | 45   | 150  | ns            |
| Falling Time <sup>(1)</sup>             | $T_f$                    | $T_a = 25^{\circ}\text{C}$ , $C_l = 1\text{nF}$            | -    | 35   | 150  | ns            |
| <b>START UP SECTION</b>                 |                          |  |      |      |      |               |
| VSTR Start-up Current                   | Istr                     | $V_{\text{str}} = 30\text{V}$ , $T_a = 25^{\circ}\text{C}$ | 0.5  | 1    | 1.5  | mA            |

### Note:

1. These parameters, although guaranteed, are not 100% tested in production.
2. It is recommended to connect  $1\text{M}\Omega$  resistor between the Latch/SS pin and GND to prevent abnormal operation of the latch protection by noise coupling.

## Typical Performance Characteristics

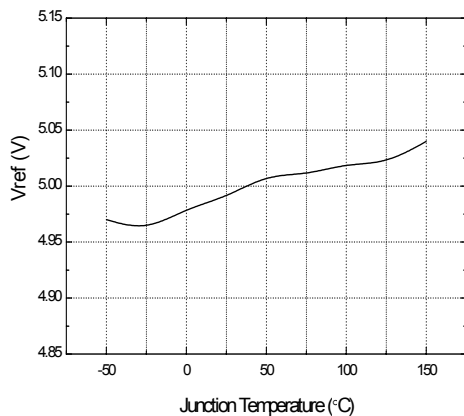


Figure 1. Trimmed Reference Voltage

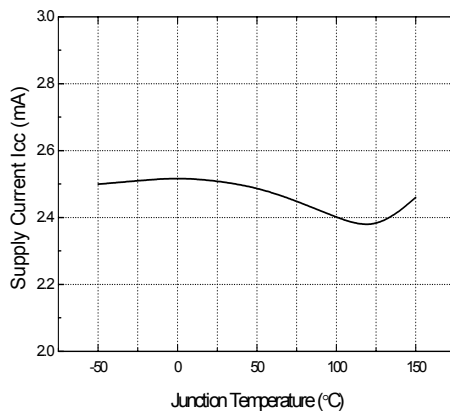


Figure 2. Supply Current

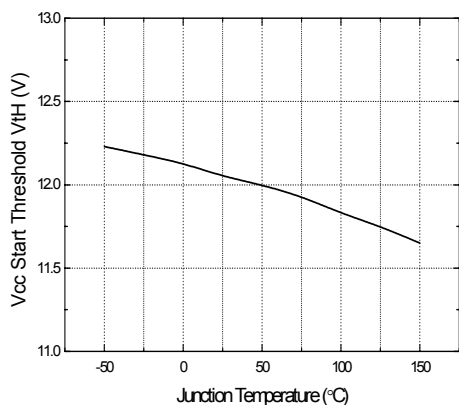


Figure 3. Vcc Start Threshold Voltage

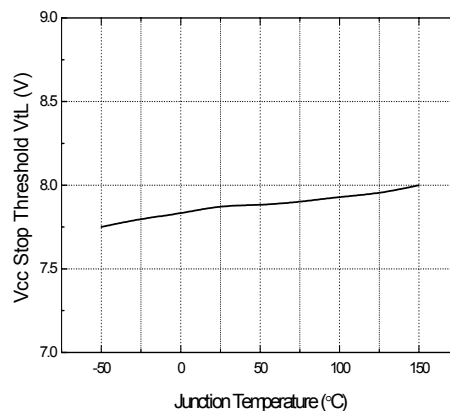


Figure 4. Vcc Stop Threshold Voltage

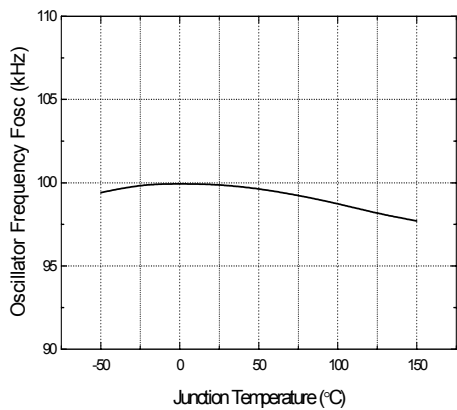


Figure 5. Oscillator Frequency

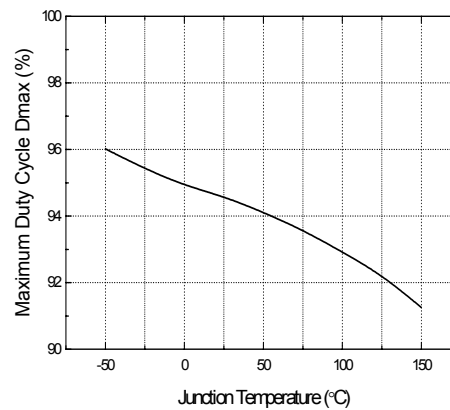


Figure 6. Maximum Duty Cycle

Typical Performance Characteristics (Continued)

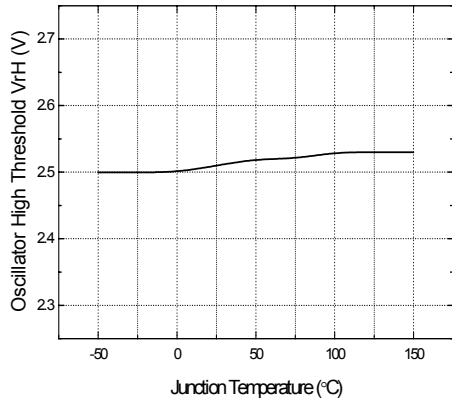


Figure 7. Oscillator High Threshold Voltage

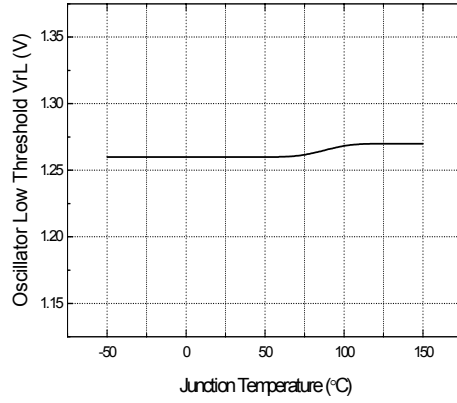


Figure 8. Oscillator Low Threshold Voltage

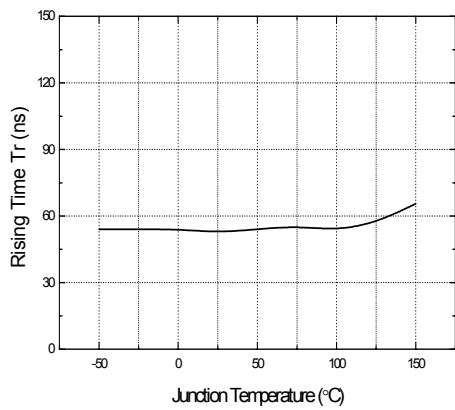


Figure 9. Output Rising Time

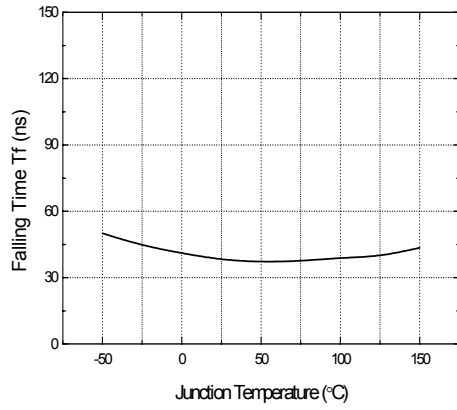


Figure 10. Output Falling Time

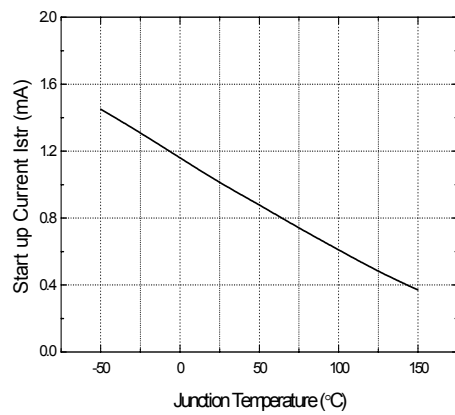


Figure 11. Start-up Current

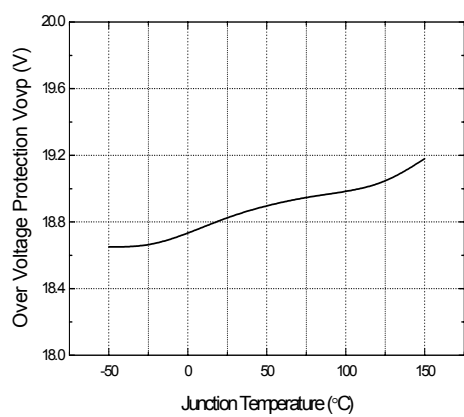


Figure 12. Over Voltage Protection Level

Typical Performance Characteristics (Continued)

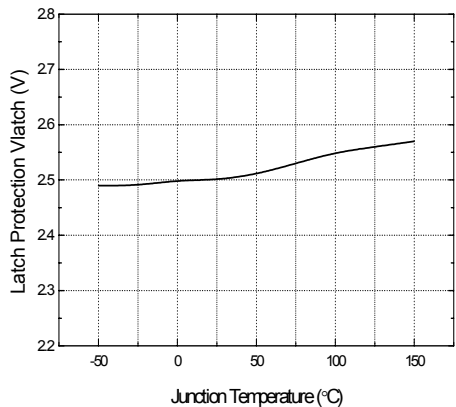


Figure 13. Latch Protection Voltage

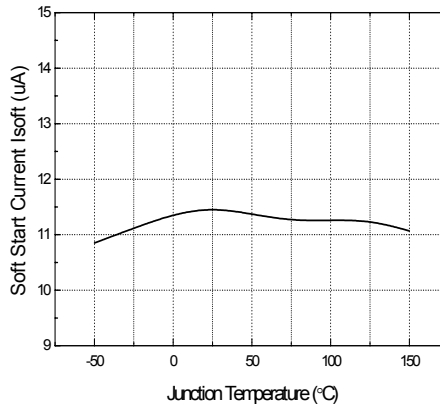


Figure 14. Soft Start Current

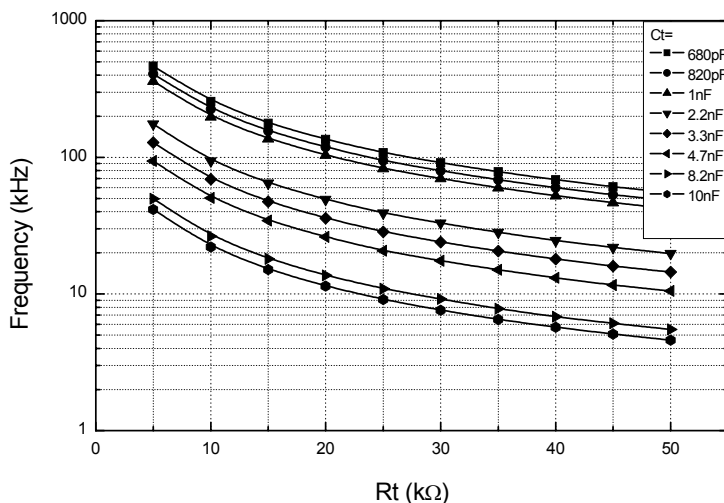
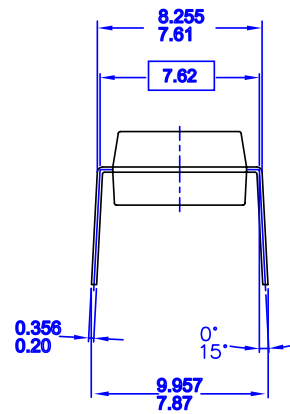
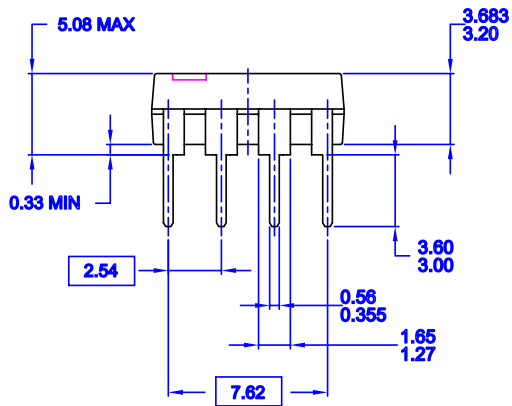
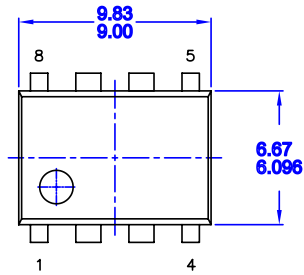


Figure 15. Oscillator Frequency Characteristic



# Mechanical Dimensions

## 8DIP



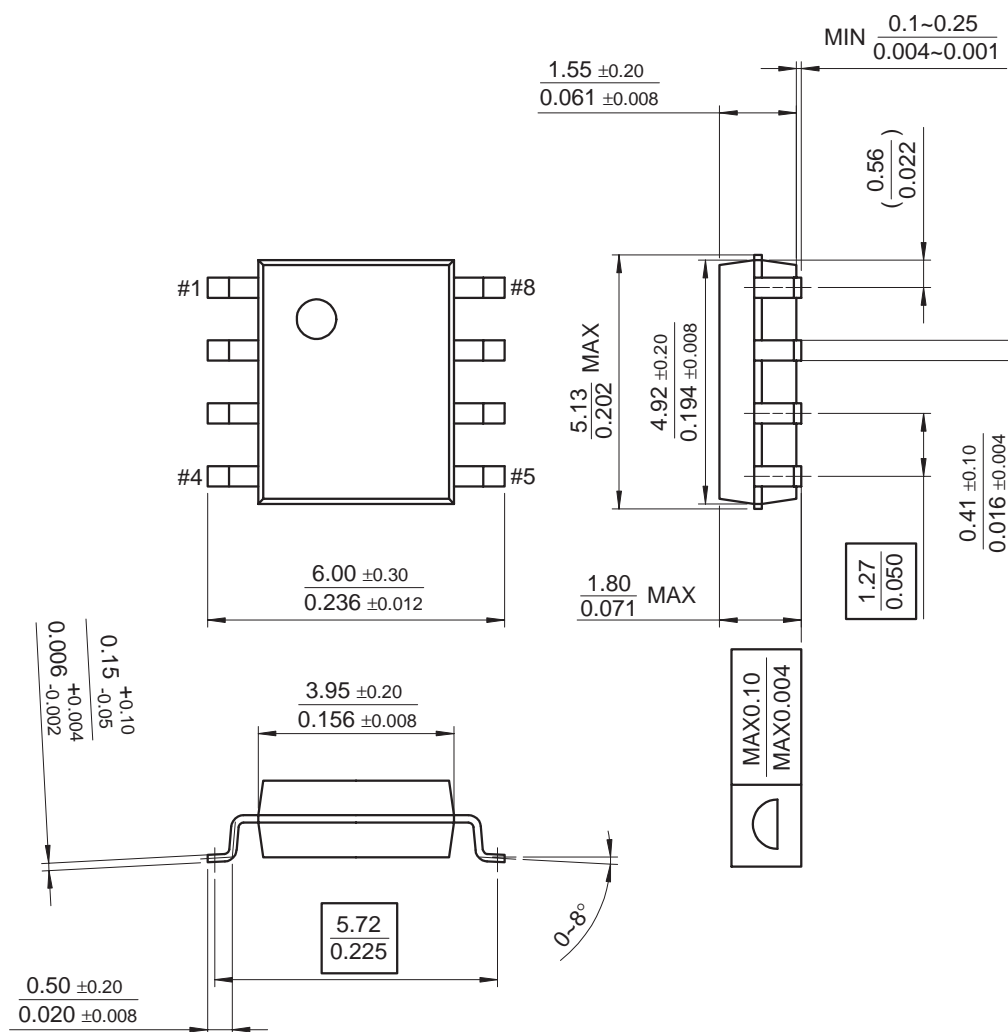
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  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
  - D) DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994

MKT-N08FrevB

Mechanical Dimensions (Unit: mm) (Continued)

Package

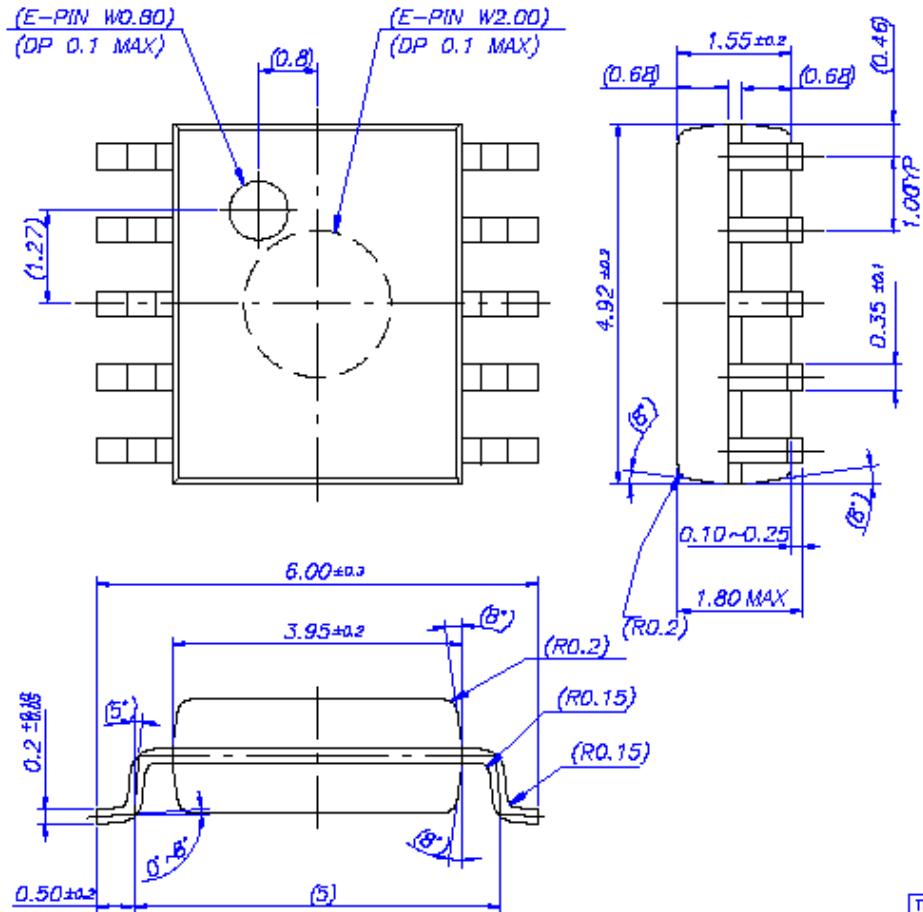
8-SOP



**Mechanical Dimensions (Unit: mm)** (Continued)

**Package**

**10-SSOP-225**



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## Ordering Information

| Device   | Package | Operating Temp. |
|----------|---------|-----------------|
| FAN7601N | 8-DIP   | -25°C ~ 125°C   |
| FAN7601M | 8-SOP   |                 |
| FAN7601G | 10-SSOP |                 |

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