

DATA SHEET

SA57000-XX

CapFREE™ 150 mA, low-noise, low dropout
regulator with thermal protection

Product data
Supersedes data of 2001 Jul 12
File under Integrated Circuits, Standard Analog

2001 Aug 27

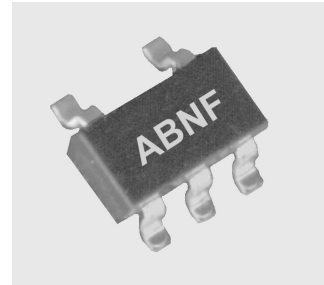
CapFREE™ 150 mA, low-noise, low dropout regulator with thermal protection

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GENERAL DESCRIPTION

The CapFREE™ SA57000 is the first in a new family of unique low dropout regulators. It needs no external capacitors, offers a low output noise voltage of $30 \mu\text{V}_{\text{RMS}}$, and an ultra-low dropout voltage of $55 \text{ mV} @ 50 \text{ mA}$ output current. To accommodate high density layouts, it is packaged in the small footprint 5 leaded SOT23-5 (SO5). It is ideal for all portable and cellular phone applications.

Additional features include power and thermal shutdown, output current limitation, power OK status, thermal warning, and external logic-controlled on-off via the PWRON pin.



FEATURES

- CapFREE: No output capacitor needed, stable for all capacitive loads, regardless of ESR
- Low $30 \mu\text{V}_{\text{RMS}}$ noise without noise bypass capacitor
- Preset output voltages to 2.5 V, 2.8 V, 3.0 V, 3.3 V and 3.6 V; other voltages available upon request. 2% output voltage accuracy
- 150 mA maximum output current with current limitation
- Typical dropout voltage $55 \text{ mV} @ 50 \text{ mA}$ output current
- $85 \mu\text{A}$ typical ground current
- Thermal-overload and short-circuit protection
- PWROK pin: both power status and thermal warning indicator
- PWRON pin offers logic-controlled shutdown
- Maximum line regulation: $0.1\%/V$
- Maximum load regulation: $0.02\%/mA$.

APPLICATIONS

- Cordless and mobile phones
- Industrial and medical equipment
- Other battery-powered equipment.

SIMPLIFIED SYSTEM DIAGRAM

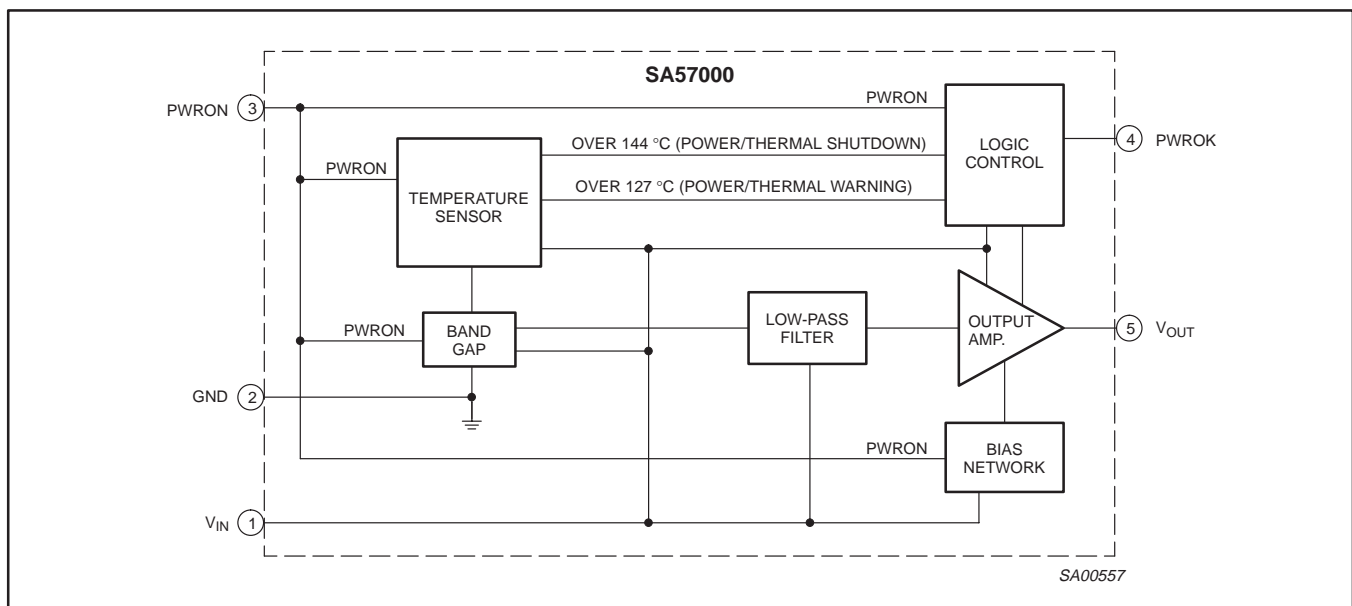


Figure 1. Simplified system diagram.

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ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | | TEMPERATURE RANGE |
|-------------|---------------------|--|----------|-------------------|
| | NAME | DESCRIPTION | VERSION | |
| SA57000-XXD | SOT23-5, SOT25, SO5 | plastic small outline package; 5 leads (see dimensional drawing) | SOT680-1 | -40 to +85 °C |

NOTE:

The device has five voltage output options, indicated by the **XX** on the Type Number.

| XX | VOLTAGE (Typical) |
|----|-------------------|
| 25 | 2.5 V |
| 28 | 2.8 V |
| 30 | 3.0 V |
| 33 | 3.3 V |
| 36 | 3.6 V |

Part number marking

Each package is marked with a four letter code. The first three letters designate the product. The fourth letter, represented by 'x', is a date tracking code.

| Part number | Marking |
|-------------|---------|
| SA57000-25D | A B K x |
| SA57000-28D | A B L x |
| SA57000-30D | A B M x |
| SA57000-33D | A B N x |
| SA57000-36D | A B P x |

PIN CONFIGURATION

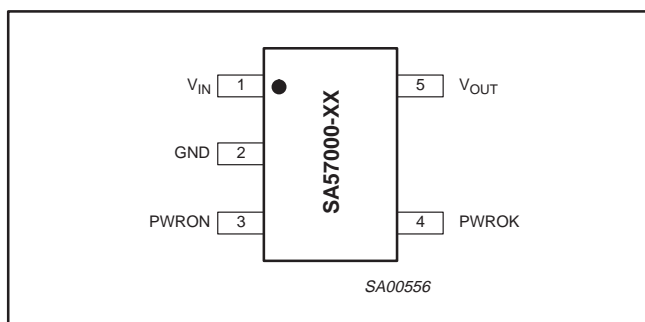


Figure 2. Pin configuration.

PIN DESCRIPTION

| PIN | SYMBOL | DESCRIPTION |
|-----|------------------|---|
| 1 | V _{IN} | Regulator input. V _{OUT(nom)} + 0.1 V to 5.5 V. No bypass capacitor required. |
| 2 | GND | Ground. |
| 3 | PWRON | Power-on input. Active-HIGH. A logic LOW powers down regulator. The shutdown quiescent current is typically 50 nA. Connect to V _{IN} for manual operation. |
| 4 | PWROK | Power OK indicator, including thermal warning. Trips (goes LOW) at 127 °C (±2°), or when power falls typically 6% below V _{OUT(nom)} . |
| 5 | V _{OUT} | Regulator output. Sources up to 150 mA. No bypass capacitors required. |

MAXIMUM RATINGS

| SYMBOL | PARAMETER | MIN. | MAX. | UNIT |
|----------------------|---|------|-----------------------|-----------------|
| V _{IN} | V _{IN} to GND voltage | -0.3 | 5.5 | V _{dc} |
| V _{PWRON} | PWRON to GND voltage | -0.3 | 5.5 | V _{dc} |
| V _{OUT} | OUT to GND voltage | -0.3 | V _{IN} + 0.3 | V _{dc} |
| T _{amb} | Operating ambient temperature | -40 | +85 | °C |
| T _j | Junction temperature | - | +150 | °C |
| T _{stg} | Storage temperature | -65 | +160 | °C |
| P | Power dissipation | - | 575 | mW |
| R _{th(j-a)} | Thermal resistance from junction to ambient | - | 140 | °C/W |

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CHARACTERISTICS

 $V_{IN} = V_{OUT(nom)} + 0.5 \text{ V}$. (Note 1.)

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|--|--|---------------------|--------------|---------------------|--------------------------------|
| V_{IN} | input voltage | | $V_{OUT(nom)}$ | – | 5.5 | V |
| | output voltage accuracy ² | $I_{OUT} = 1 \text{ mA}$ $T_{amb} = +25 \text{ °C}$ $-40 \text{ °C} \leq T_{amb} \leq +85 \text{ °C}$ | – –2.0 | ± 1 – | – 2.0 | % % |
| I_{LIM} | current limit | | 160 | 300 | – | mA |
| I_Q | ground pin current | $I_{OUT} = 1 \text{ mA to } 150 \text{ mA}$ | – | 85 | 150 | μA |
| | dropout voltage ³ | $I_{OUT} = 1 \text{ mA}$ | – | 1 | – | mV |
| | | $I_{OUT} = 50 \text{ mA}$ | – | 55 | 120 | mV |
| | | $I_{OUT} = 150 \text{ mA}$ | – | 165 | – | mV |
| ΔV_{LNR} | line regulation | $V_{IN} = (V_{OUT} + 0.1 \text{ V}) \text{ to } 5.5 \text{ V}; I_{OUT} = 20 \text{ mA}$ | – | – | 0.1 | %/V |
| ΔV_{LDR} | load regulation | $I_{OUT} = 1 \text{ mA to } 150 \text{ mA}$ | – | 0.01 | 0.02 | %/mA |
| e_n | output voltage noise | $f = 10 \text{ Hz to } 100 \text{ kHz}, C_{OUT} = 10 \mu\text{F}$ | – | 30 | – | μVRMS |
| Shutdown | | | | | | |
| V_{IH} | PWRON input threshold (HIGH ON-state) | $V_{IN} \rightarrow V_{OUT(nom)} \rightarrow 5.5 \text{ V}$ | $0.7 \times V_{IN}$ | – | – | V |
| V_{IL} | PWRON input threshold (HIGH ON-state) | $V_{IN} \rightarrow V_{OUT(nom)} \rightarrow 5.5 \text{ V}$ | – | – | $0.3 \times V_{IN}$ | V |
| I_{PWRON} | PWRON input bias current | $V_{PWRON} = V_{IN}$ $T_{amb} = +25 \text{ °C}$ $T_{amb} = +85 \text{ °C}$ | – – | 0.01 0.05 | 1 – | μA μA |
| $I_{Q(SHDN)}$ | shutdown supply current | $V_{OUT} = 0 \text{ V}$ $T_{amb} = +25 \text{ °C}$ $T_{amb} = +85 \text{ °C}$ | – – | 0.05 0.2 | 1 1 | μA μA |
| t_{PWRON} | power-on start-up time ⁴ | $I_{OUT} = 1 \text{ mA}, C_{OUT} = 100 \text{ nF}$ $T_{amb} = +25 \text{ °C}$ $T_{amb} = -40 \text{ to } +85 \text{ °C}$ | – – | 25 35 | 100 200 | μs μs |
| Thermal protection (Note 2) | | | | | | |
| T_{SHDN} | thermal shut-down temperature | | – | 144 | – | $^{\circ}\text{C}$ |
| ΔT_{SHDN} | thermal shut-down hysteresis | | – | 13 | – | $^{\circ}\text{C}$ |
| PWROK output (power and temperature OK) (Note 2) | | | | | | |
| | PWROK trip temperature | | – | 127 | – | $^{\circ}\text{C}$ |
| | PWROK trip temperature hysteresis | | – | 12 | – | $^{\circ}\text{C}$ |
| | PWROK trip as percentage of $V_{OUT(nom)}$ | | –3.5 | –6 | –8 | % |
| | PWROK hysteresis as percentage of $V_{OUT(nom)}$ | | – | 2 | – | % |
| | PWROK output (when tripped) | $I_{SINK} = 0.5 \text{ mA}$ | – | 0.1 | 0.4 | V |

NOTES:

- Limits are production tested at $T_{amb} = +25 \text{ °C}$. All devices are 100% production tested at 25 °C . Limits over the operating temperature are guaranteed by design.
- Accuracy $\pm 2 \text{ °C}$ over temperature range guaranteed by design and characterization.
- The dropout voltage is defined as $V_{IN} - V_{OUT}$ where V_{OUT} is 100 mV below the value of V_{OUT} for $V_{IN} = V_{OUT} + 0.5 \text{ V}$.
- Time needed for V_{OUT} to reach 95% of $V_{OUT(nom)}$.

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TYPICAL PERFORMANCE CURVES

Measurements taken with the SA57000-33 (3.3 volt output).

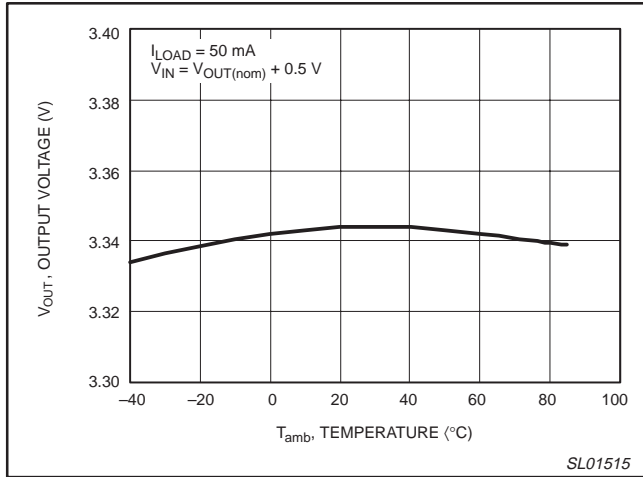


Figure 3. Output voltage versus temperature.

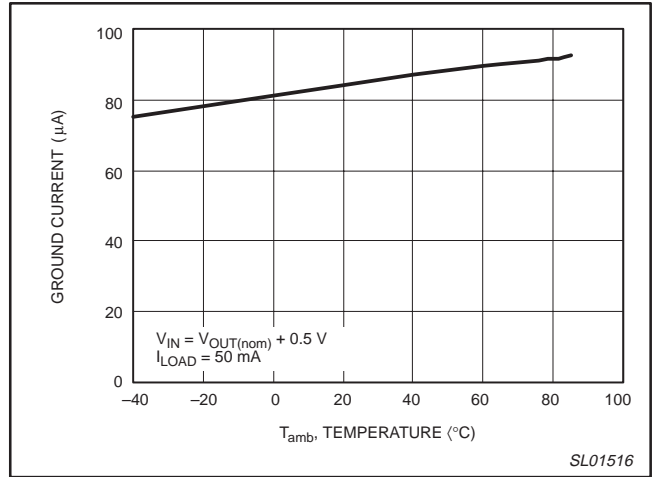


Figure 4. Ground current versus temperature.

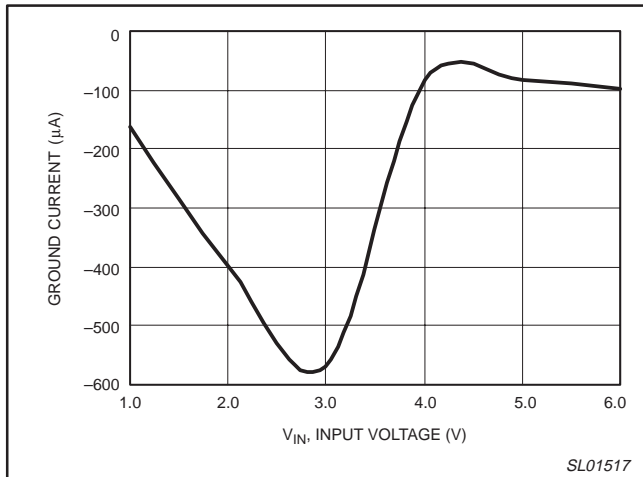


Figure 5. Ground current versus input voltage (no load).

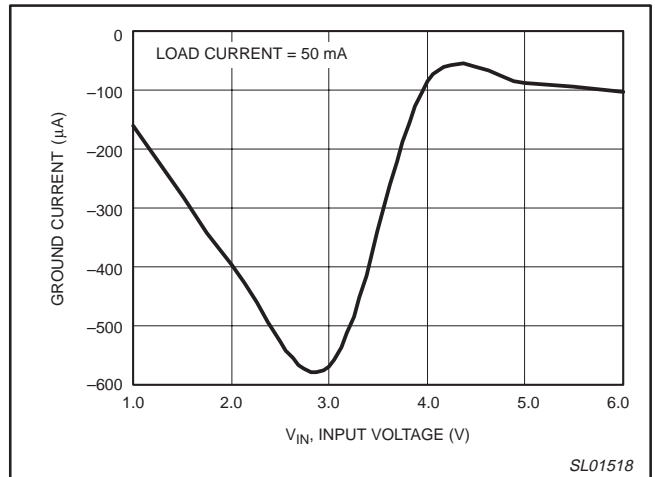


Figure 6. Ground current versus input voltage with load.

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PACKING METHOD

The SA57000-XX is packed in reels, as shown in Figure 7.

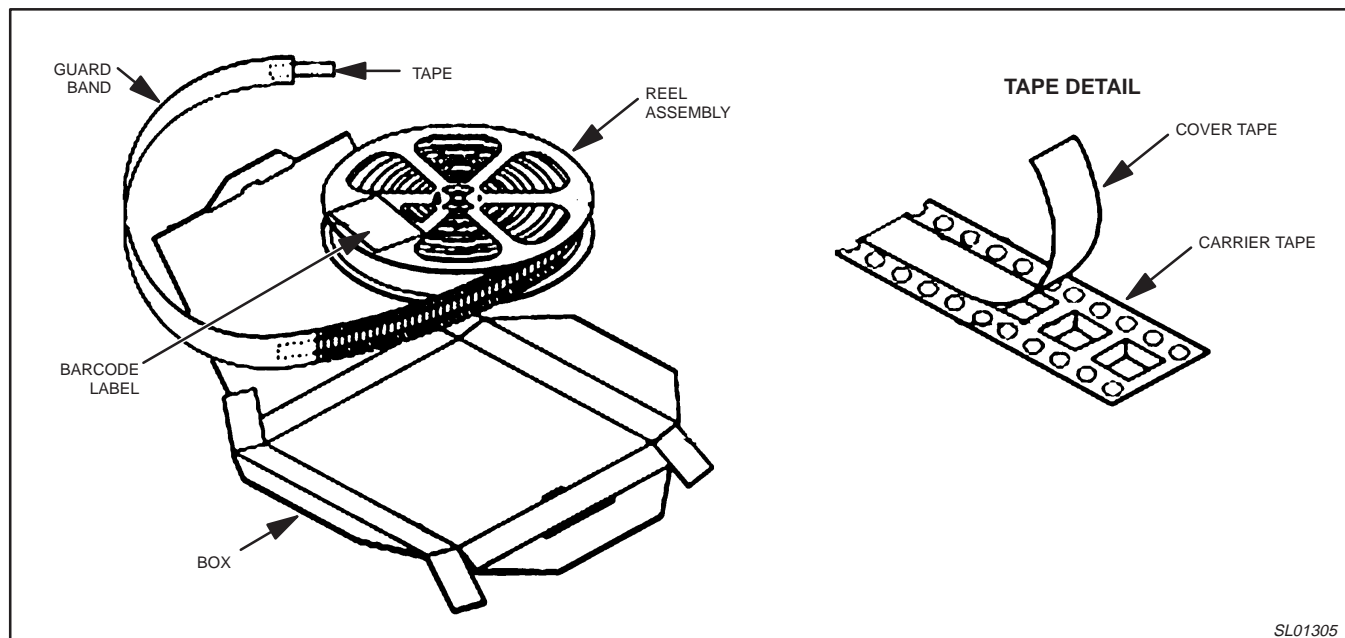


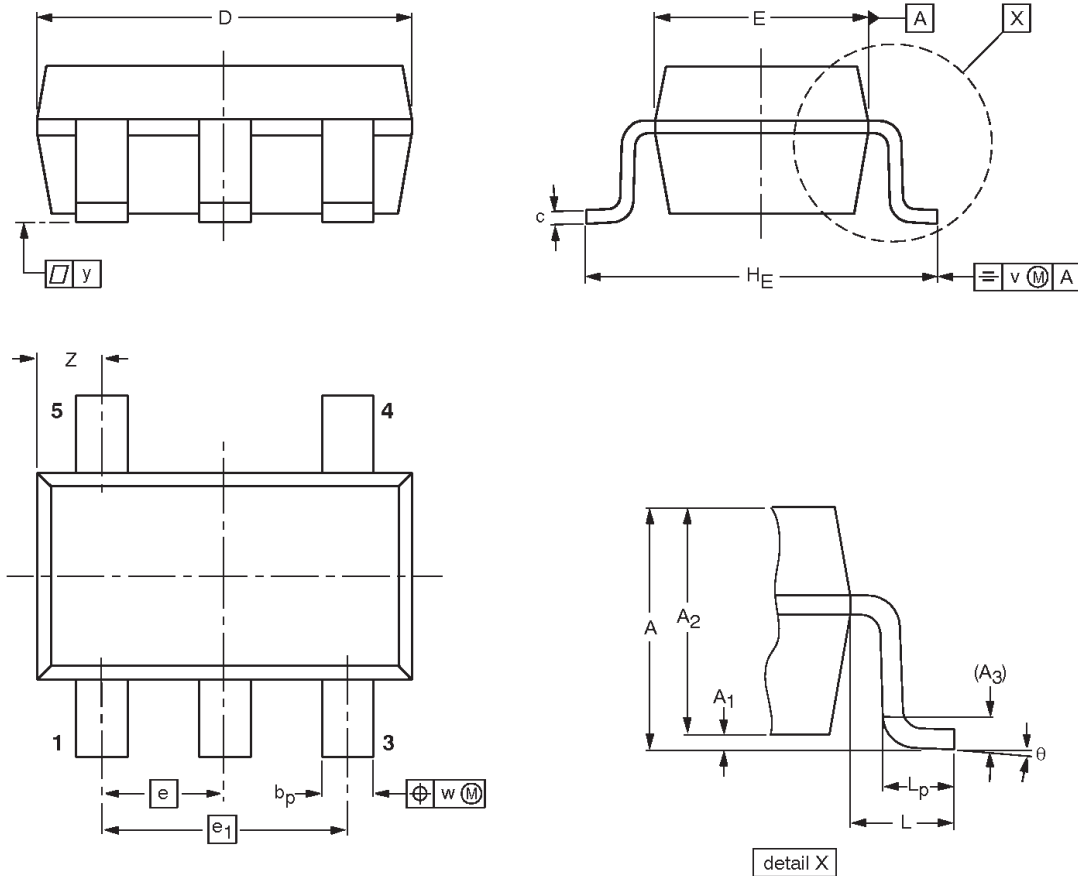
Figure 7. Tape and reel packing method

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S05: plastic small outline package; 5 leads; body width 1.6 mm

SOT680-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | e ₁ | H _E | L | L _p | v | w | y | Z | θ |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|------|----------------|----------------|------|----------------|-----|-----|-----|--------------|----------|
| mm | 1.45 | 0.05 0.15 | 1.3 0.9 | 0.20 | 0.50 0.30 | 0.22 0.08 | 3.05 2.75 | 1.75 1.45 | 0.95 | 1.90 | 3.00 2.60 | 0.60 | 0.60 0.30 | 0.2 | 0.2 | 0.1 | 0.75 0.25 | 8° 0° |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|--|---------------------|------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT680-1 | | MO-178 | | | | 01-03-22 |

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|----------------------------------|-------------------------------|--|
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