

To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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MOS FIELD EFFECT TRANSISTOR NP60N03SUG

SWITCHING N-CHANNEL POWER MOS FET

DESCRIPTION

The NP60N03SUG is N-channel MOS Field Effect Transistor designed for high current switching applications.

ORDERING INFORMATION

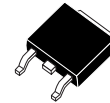
| PART NUMBER | LEAD PLATING | PACKING | PACKAGE |
|----------------------------------|---------------|------------------|-----------------------------|
| NP60N03SUG-E1-AY ^{Note} | Pure Sn (Tin) | Tape 2500 p/reel | TO-252 (MP-3ZK) typ. 0.27 g |
| NP60N03SUG-E2-AY ^{Note} | | | |

Note Pb-free (This product does not contain Pb in external electrode.)

FEATURES

- Channel temperature 175 degree rated
- Super low on-state resistance
 $R_{DS(on)} = 3.8 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 30 \text{ A)}$
- High current rating
 $I_{D(DC)} = \pm 60 \text{ A}$
- Low input capacitance
 $C_{iss} = 5000 \text{ pF TYP.}$
- Designed for automotive application and AEC-Q101 qualified

(TO-252)



ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

| | | | |
|---|-----------------------|-------------|----|
| Drain to Source Voltage (V _{GS} = 0 V) | V _{DSS} | 30 | V |
| Gate to Source Voltage (V _{DS} = 0 V) | V _{GSS} | ±20 | V |
| Drain Current (DC) (T _c = 25°C) | I _{D(DC)} | ±60 | A |
| Drain Current (pulse) ^{Note1} | I _{D(pulse)} | ±240 | A |
| Total Power Dissipation (T _c = 25°C) | P _{T1} | 105 | W |
| Total Power Dissipation (T _A = 25°C) | P _{T2} | 1.2 | W |
| Channel Temperature | T _{ch} | 175 | °C |
| Storage Temperature | T _{stg} | -55 to +175 | °C |
| Repetitive Avalanche Current ^{Note2} | I _{AR} | 41 | A |
| Repetitive Avalanche Energy ^{Note2} | E _{AR} | 168 | mJ |

Notes 1. PW ≤ 10 μs, Duty Cycle ≤ 1%

2. T_{ch} ≤ 150°C, R_G = 25 Ω

THERMAL RESISTANCE

| | | | |
|---------------------------------------|-----------------------|------|------|
| Channel to Case Thermal Resistance | R _{th(ch-C)} | 1.43 | °C/W |
| Channel to Ambient Thermal Resistance | R _{th(ch-A)} | 125 | °C/W |

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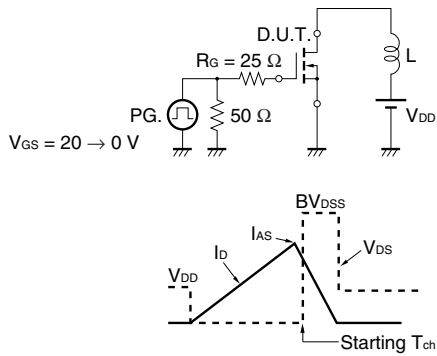
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ELECTRICAL CHARACTERISTICS (T_A = 25°C)

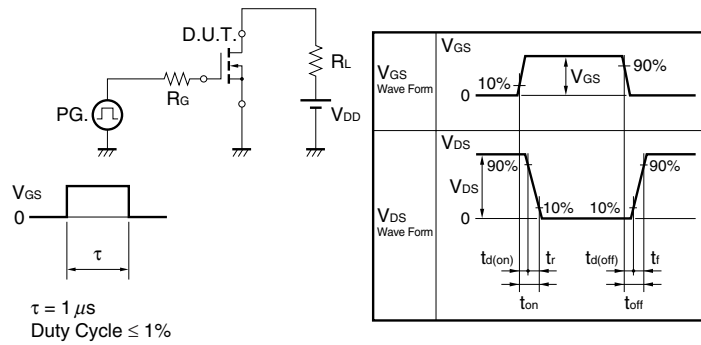
| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|---|------|------|------|------|
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 30 V, V _{GS} = 0 V | | | 1 | μA |
| Gate Leakage Current | I _{GSS} | V _{GS} = ±20 V, V _{DS} = 0 V | | | ±100 | nA |
| Gate to Source Threshold Voltage | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | 2.0 | 3.0 | 4.0 | V |
| Forward Transfer Admittance ^{Note} | y _{fs} | V _{DS} = 5 V, I _D = 30 A | 25 | 41 | | S |
| Drain to Source On-state Resistance ^{Note} | R _{DS(on)} | V _{GS} = 10 V, I _D = 30 A | | 3.0 | 3.8 | mΩ |
| Input Capacitance | C _{iss} | V _{DS} = 25 V, | | 5000 | 7500 | pF |
| Output Capacitance | C _{oss} | V _{GS} = 0 V, | | 600 | 900 | pF |
| Reverse Transfer Capacitance | C _{rss} | f = 1 MHz | | 420 | 760 | pF |
| Turn-on Delay Time | t _{d(on)} | V _{DD} = 15 V, I _D = 30 A, | | 32 | 64 | ns |
| Rise Time | t _r | V _{GS} = 10 V, | | 20 | 49 | ns |
| Turn-off Delay Time | t _{d(off)} | R _G = 0 Ω | | 64 | 128 | ns |
| Fall Time | t _f | | | 13 | 30 | ns |
| Total Gate Charge | Q _G | V _{DD} = 24 V, | | 90 | 135 | nC |
| Gate to Source Charge | Q _{GS} | V _{GS} = 10 V, | | 24 | | nC |
| Gate to Drain Charge | Q _{GD} | I _D = 60 A | | 31 | | nC |
| Body Diode Forward Voltage ^{Note} | V _{F(S-D)} | I _F = 60 A, V _{GS} = 0 V | | 0.9 | 1.5 | V |
| Reverse Recovery Time | t _{rr} | I _F = 60 A, V _{GS} = 0 V, | | 42 | | ns |
| Reverse Recovery Charge | Q _{rr} | di/dt = 100 A/μs | | 43 | | nC |

Note Pulsed test

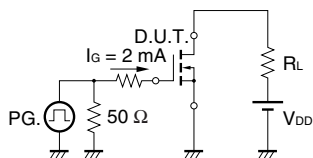
TEST CIRCUIT 1 AVALANCHE CAPABILITY



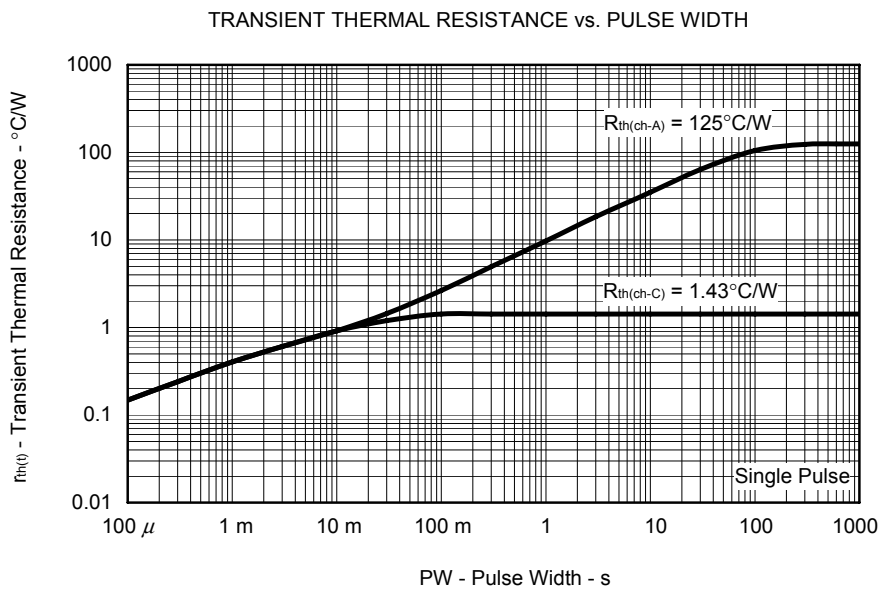
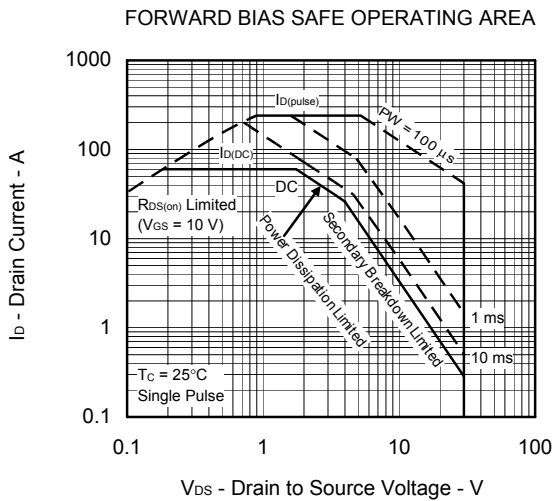
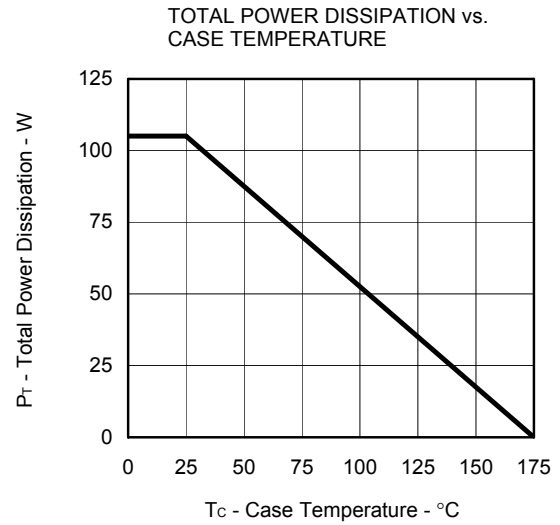
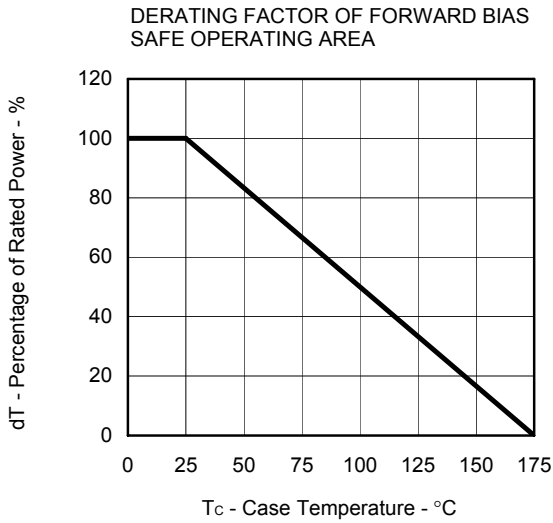
TEST CIRCUIT 2 SWITCHING TIME



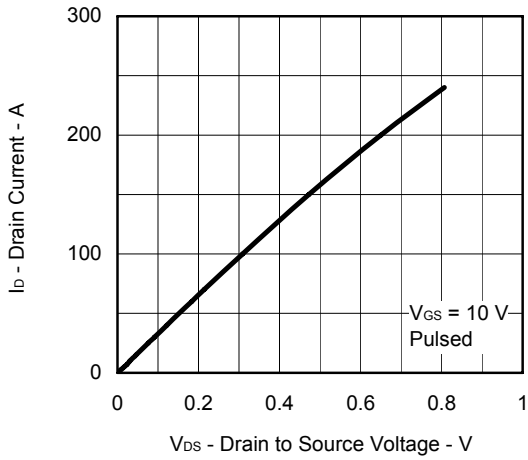
TEST CIRCUIT 3 GATE CHARGE



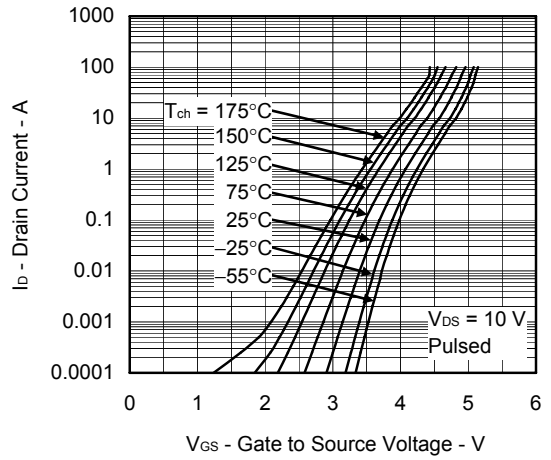
TYPICAL CHARACTERISTICS (T_A = 25°C)



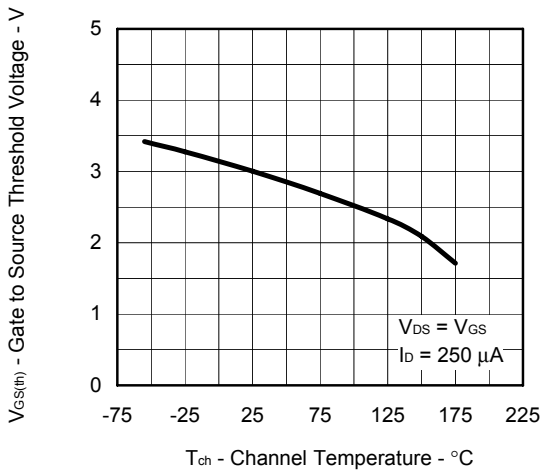
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



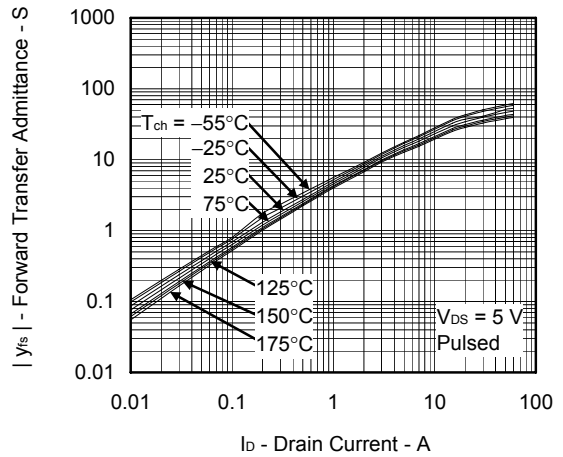
FORWARD TRANSFER CHARACTERISTICS



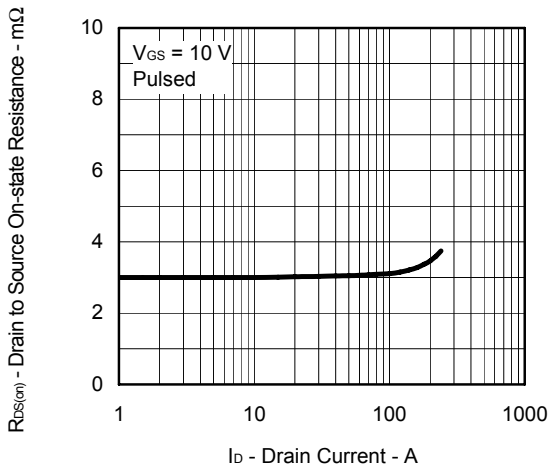
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



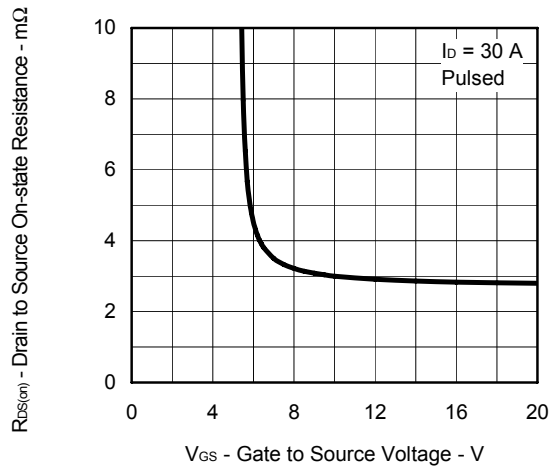
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



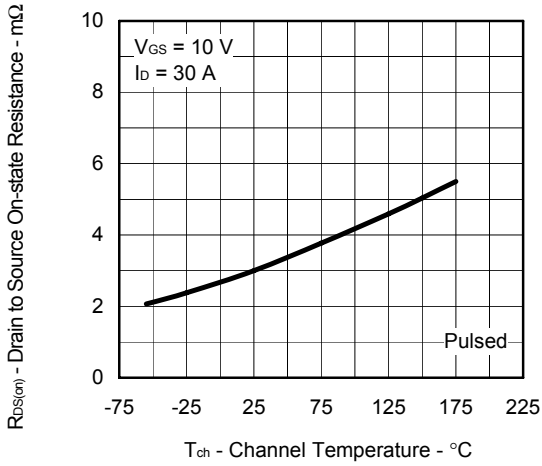
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



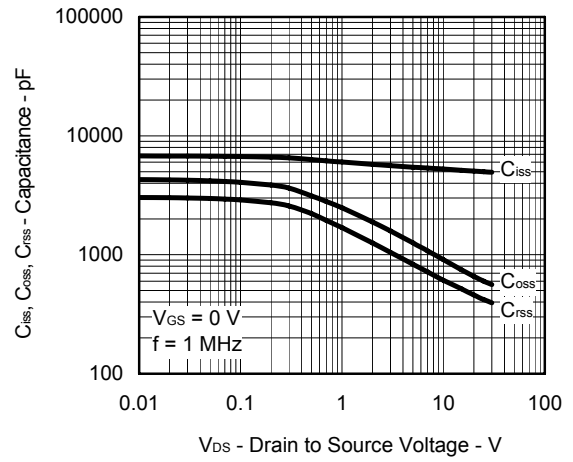
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



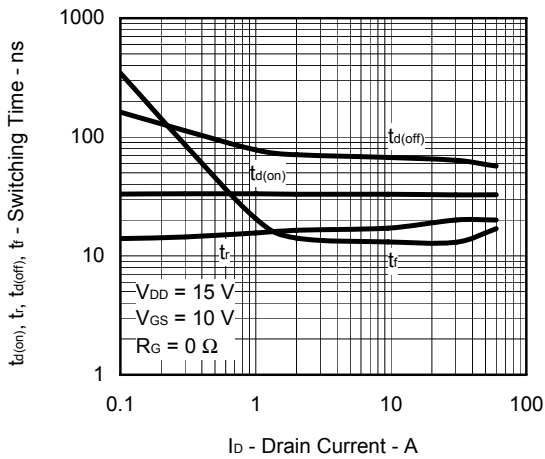
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



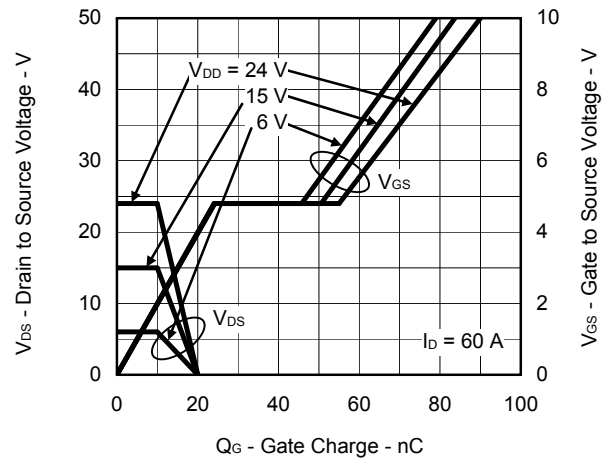
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



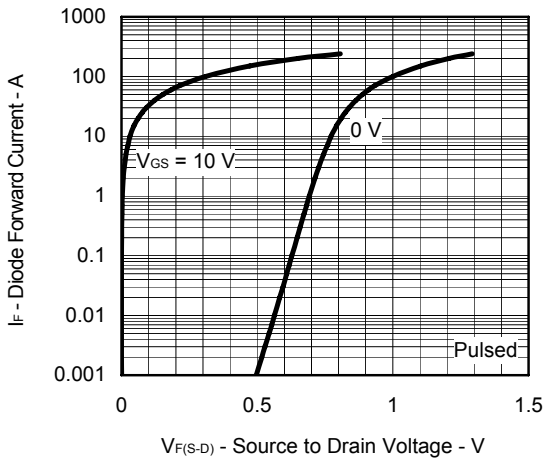
SWITCHING CHARACTERISTICS



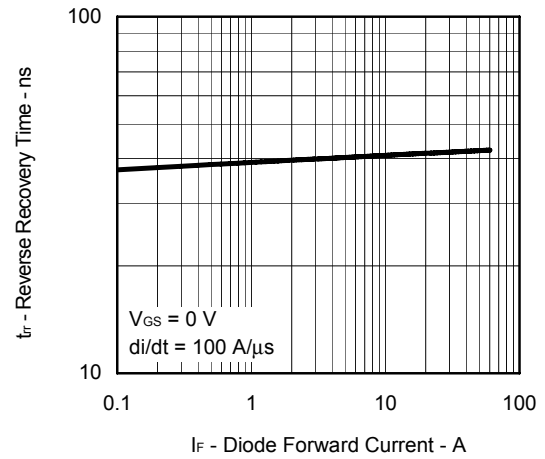
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

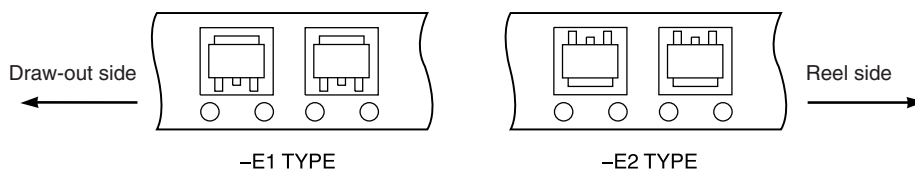


REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

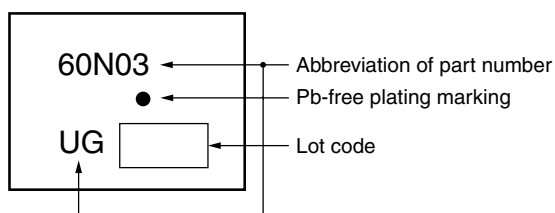


TAPE INFORMATION

There are two types (-E1, -E2) of taping depending on the direction of the device.



MARKING INFORMATION



RECOMMENDED SOLDERING CONDITIONS

The NP60N03SUG should be soldered and mounted under the following recommended conditions.

For soldering methods and conditions other than those recommended below, please contact an NEC Electronics sales representative.

For technical information, see the following website.

Semiconductor Device Mount Manual (<http://www.necel.com/pkg/en/mount/index.html>)

| Soldering Method | Soldering Conditions | Recommended Condition Symbol |
|------------------|--|------------------------------|
| Infrared reflow | Maximum temperature (Package's surface temperature): 260°C or below Time at maximum temperature: 10 seconds or less Time of temperature higher than 220°C: 60 seconds or less Preheating time at 160 to 180°C: 60 to 120 seconds Maximum number of reflow processes: 3 times Maximum chlorine content of rosin flux (percentage mass): 0.2% or less | IR60-00-3 |
| Partial heating | Maximum temperature (Pin temperature): 350°C or below Time (per side of the device): 3 seconds or less Maximum chlorine content of rosin flux: 0.2% (wt.) or less | P350 |

Caution Do not use different soldering methods together (except for partial heating).

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