# NCK80R480S

N-Channel Silicon Carbide MOSFET

Pb-Free RoHS COMPLIANT

| Voltage: | 800 | Volts | Current: | 5.1 | Amperes | Package: | TO-252 |
|---|---|---|---|---|---|---|---|

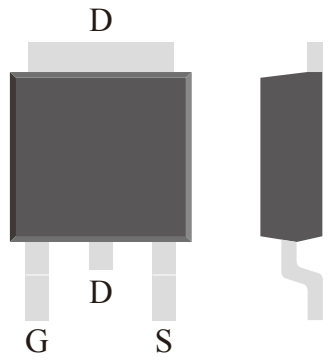
## Features

- NH'S Advanced Silicon Carbide MOSFET Technology
- High Blocking Voltage And Low Capacitances
- High-Speed Switching For Very Low Switching Losses
- Excellent Qg*Rds(on) Product(FOM）

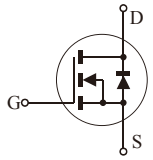
## Typical Applications

- High Voltage DC/DC Converters
- Adaptor And Charger
- Battery Chargers And Motor Drives
- LED Drives And LED Lighting

**Diagram:**




**Polarity:**




## Product Summary

| | | |
|---|---|---|
| VDS Min.@$T_j$ | 800 | **V** |
| $I_D$ Min.@Ta | 5.1 | **A** |
| RDS(ON)(TYP)@18V,Tj=25℃ | 480 | **mΩ** |

***100% UIS TESTED**

***100% ΔVDS TESTED**

## Absolute Maximum Ratings (Ta=25℃ Unless Otherwise Specified )

| Parameter | Test Conditions | Symbol | Ratings | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 800 | V |
| Gate-Source Voltage | | $V_{GS\ MAX.}$ | -10/+22 | V |
| | | $V_{GS\ O.P.}$ | 0/+15 | |
| Continuous Drain Current (Note 1) | Ta= 25 ℃ | $I_D$ | 5.1 | A |
| | Ta= 100 ℃ | | 4.1 | |
| Drain Current-Pulse (Note 1) | $T_J$< 175 ℃ | $I_{DM}$ | 9.2 | A |
| Maximum Power Dissipation Power | Ta= 25 ℃ | $P_D$ | 36 | W |
| Dissipation Derating Factor Above 25℃ | Ta= 100 ℃ | | 18 | |
| Derating Factor | | $D_F$ | 0.24 | W/℃ |
| Avalanche Current,Single Pulse (Note 1) | L= 0.5 mH | $I_{AS}$ | 6.0 | A |
| Single Pulse Avalanche Energy (Note 1) Test Circuit & Waveform See Fig.22 | L= 0.5 mH<br>IAS= 6.0 A,RG= 10.0 Ω<br>Starting Tj=25 ℃,VG = 18.0 V | $E_{AS}$ | 9 | mJ |

## Thermal Characteristcs (Ta=25℃ Unless Otherwise Specified)

| Parameter | Test Conditions | Symbol | Typ. | Unit |
|---|---|---|---|---|
| Junction Temperature | | $T_J$ | -55 to 175 | ℃ |
| Storage Temperature Range | | $T_{STD}$ | -55 to 175 | ℃ |
| Thermal Resistance Junction To Ambient With Steady-State | Still Air Environment With Ta=25℃ | $R_{\theta JA}$ | 100 | ℃/W |
| Thermal Resistance Junction-Case With Steady-State | Device Mounted On 1 in2 FR-4 Board With 2oz. Copper | $R_{\theta JC}$ | 4.16 | |

Notes: 1.Pulse Width Limited By Max. Junction Temperature. (See Fig. 19).

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## Electrical Characteristcs (Ta=25℃ Unless Otherwise Specified )

| Parameter | Test Conditions | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **Static Off Characteristics** | | | | | | | |
| Drain-Source Breakdown Voltage | VGS=0V,ID=100uA | | $BV_{DSS}$ | 800 | -- | -- | V |
| Zero Gate Voltage Drain Current | VDS= 800 V,VGS=0V,Tj=25℃ | | $I_{DSS}$ | -- | 0.1 | 50 | uA |
| | VDS= 800 V,VGS=0V,Tj=175℃ | | | -- | 1 | -- | |
| Gate To Source Leakage Current | VGS= 22.0 V,VDS=0V | | $I_{GSS}$ | -- | -- | 250 | nA |
| Source To Gate Leakage Current | VGS= -10.0 V,VDS=0V | | $I_{SGS}$ | -- | -- | 250 | nA |
| Forward Transconductance | ID= 2.5 A,VDS= 20 V | | gfs | -- | 2 | -- | S |
| **Static On Characteristics** | | | | | | | |
| Gate Threshold Voltage | VGS= VDS, ID=10mA ,Tj=25℃ | | $V_{GS(TH)}$ | 3 | 3.5 | 5 | V |
| | VGS= VDS, ID=10mA ,Tj=175℃ | | | -- | 2.5 | -- | |
| Drain-Source On Resistance | ID= 2.5 A,VGS= 18.0 V,Tj=25℃ | | $R_{DS(ON)}$ | -- | 480 | 650 | mΩ |
| | ID= 2.5 A,VGS= 18.0 V,Tj=175℃ | | | -- | 670 | 850 | |
| | ID= 2.5 A,VGS= 15.0 V,Tj=25℃ | | | -- | 624 | 950 | |
| | ID= 2.5 A,VGS= 15.0 V,Tj=175℃ | | | -- | 730 | 1050 | |
| **Dynamic Characteristics** | | | | | | | |
| Gate Resistance | VGS=0V,VDS=0V,Freq.=1MHz | | $R_g$ | -- | 45 | -- | Ω |
| Input Capacitance | VDS= 694 V | | $C_{iss}$ | -- | 115 | -- | pF |
| Output Capacitance | VGS= 0 V | | $C_{oss}$ | -- | 9 | -- | pF |
| Reverse Transfer Capacitance | F= 1 MHZ | | $C_{rss}$ | -- | 1 | -- | pF |
| **Switching Paramters (Test Circuit & Waveform See Fig.20)** | | | | | | | |
| Turn-On Delay Time | VDS= 500.0 V<br>ID= 2.5 A | Tj=25℃ | $t_{d(on)}$ | -- | 13 | -- | ns |
| | | Tj=175℃ | | -- | 12 | -- | |
| Turn-On Rise Time | VGS= 0/+15 V<br>RG= 15.0 Ω | Tj=25℃ | $t_r$ | -- | 15 | -- | ns |
| | | Tj=175℃ | | -- | 15 | -- | |
| Turn-Off Delay Time | L= 4 mH | Tj=25℃ | $t_{d(off)}$ | -- | 15 | -- | ns |
| | | Tj=175℃ | | -- | 19 | -- | |
| Turn-Off Rise Time | | Tj=25℃ | $t_f$ | -- | 30 | -- | ns |
| | | Tj=175℃ | | -- | 28 | -- | |
| Turn−On Switching Loss | | Tj=25℃ | $E_{on}$ | -- | 37 | -- | μJ |
| | | Tj=175℃ | | -- | 38 | -- | |
| Turn−Off Switching Loss | | Tj=25℃ | $E_{off}$ | -- | 4 | -- | μJ |
| | | Tj=175℃ | | -- | 5 | -- | |
| Total Switiching Energy | | Tj=25℃ | $E_{tot}$ | -- | 41 | -- | μJ |
| | | Tj=175℃ | | -- | 43 | -- | |

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## Electrical Characteristcs (Ta=25℃ Unless Otherwise Specified )

| Parameter | Test Conditions | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **Gate Charge Paramters (Test Circuit & Waveform See Fig.21)** | | | | | | | |
| Total Gate Charge | VDS= 500 V | | $Q_g$ | -- | 7.5 | -- | nC |
| Gate-Source Charge | VGS= 0/+15 V | | $Q_{gs}$ | -- | 2.5 | -- | nC |
| Gate-Drain Charge | ID= 2.5 A | | $Q_{gd}$ | -- | 1.5 | -- | nC |
| **Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.23)** | | | | | | | |
| Max. Diode Forward Current | Tj= 25 ℃ | | $I_S$ | -- | -- | 5.1 | A |
| tp Limited by $T_J$(max) | Tj= 100 ℃ | | | -- | -- | 4.1 | |
| Max. Pulsed Forward Current | | | $I_{SM}$ | -- | -- | 10.2 | A |
| Diode Forward Voltage | ID= 1.2 A,VGS=-0V | Tj=25℃ | $V_{SD}$ | -- | 3.5 | -- | V |
| | | Tj=175℃ | | -- | 3.0 | -- | |
| Reverse Recovery Time | IS= 2.5 A<br>di/dt= 1100 A/us | Tj=25℃ | $t_{rr}$ | -- | 6.5 | -- | ns |
| | | Tj=175℃ | | -- | 7.0 | -- | |
| Reverse Recovery Charge | VGS= 0.0 V<br>VDS= 500 V | Tj=25℃ | $Q_{rr}$ | -- | 16.5 | -- | nC |
| | | Tj=175℃ | | -- | 18.0 | -- | |
| Reverse Recovery Current | | Tj=25℃ | $I_{rrm}$ | -- | 4.0 | -- | A |
| | | Tj=175℃ | | -- | 4.5 | -- | |
| Reverse Recovery Energy | | Tj=25℃ | $E_{rr}$ | -- | 0.2 | -- | µJ |
| | | Tj=175℃ | | -- | 0.3 | -- | |

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## Typical Characteristics Curves

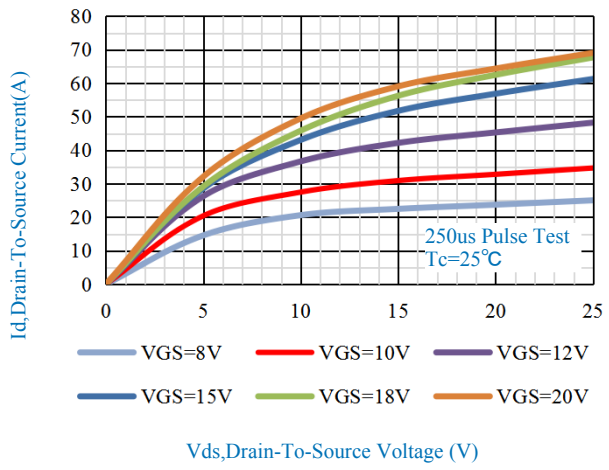



Fig.1-Output Characteristic@Tj=25℃

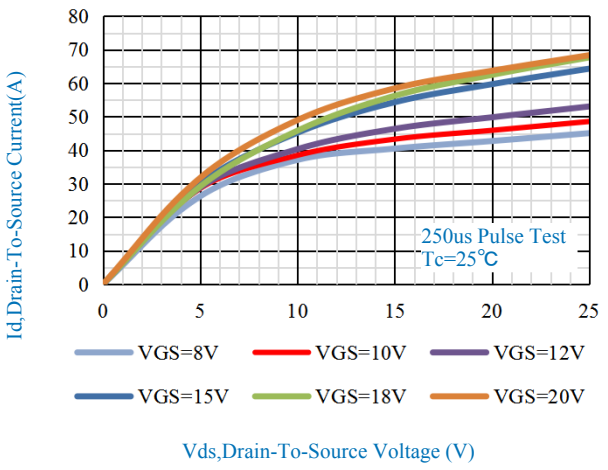



Fig.2-Output Characteristic@Tj=175℃

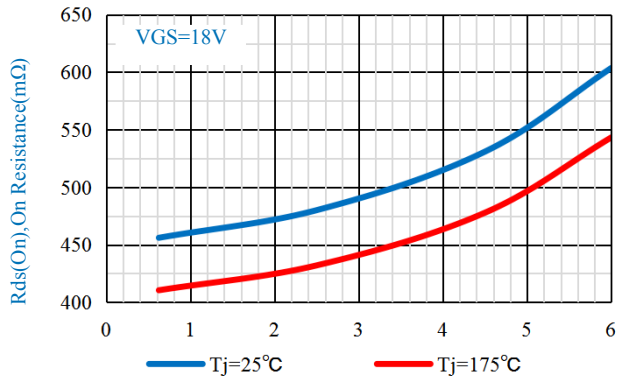



Fig.3-On Resistance Vs. Drain Current

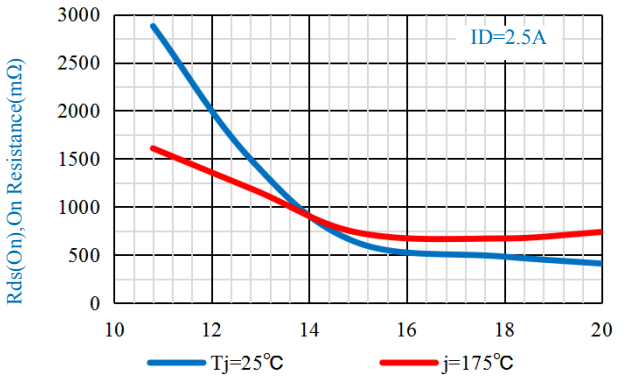



Fig.4-On Resistance Vs. Gate Source Voltage

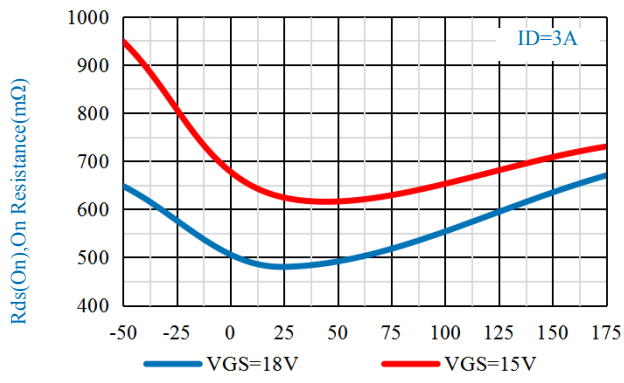



Fig.5-On Resistance Vs. Junction Temperature

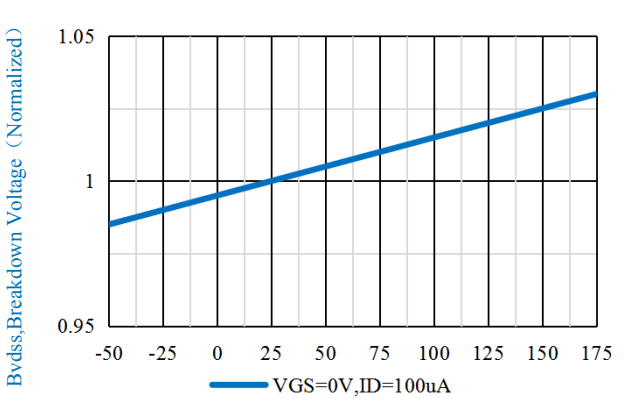



Fig.6-Breakdown Voltage Vs. Junction Temperature

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## Typical Characteristics Curves

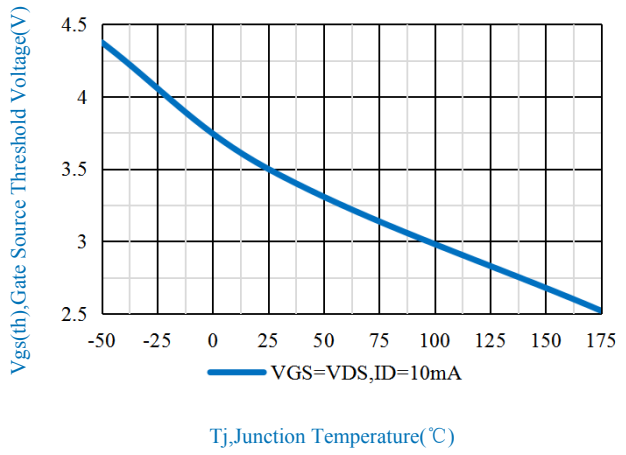



Fig.7-Gate Source Threshold Voltage Vs. Junction Temperature

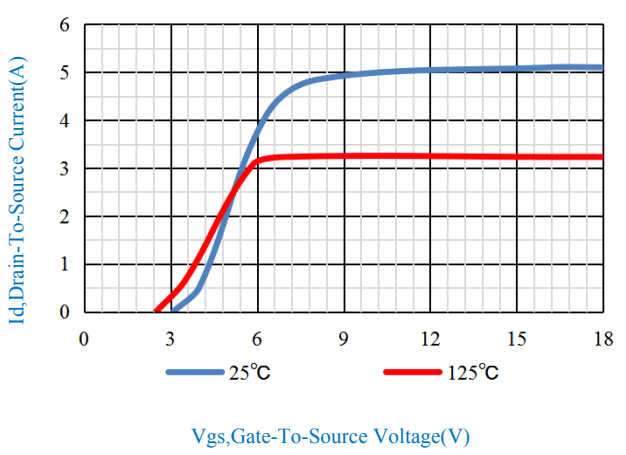



Fig.8-Transfer Characteristic

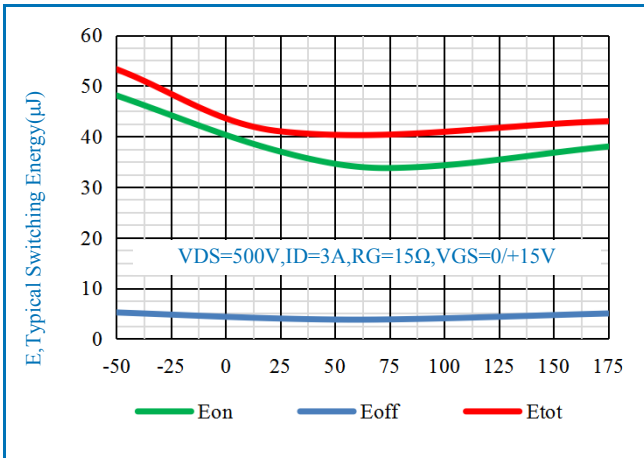



Fig.9-Typical Switching Energy Vs. Junction Temperature

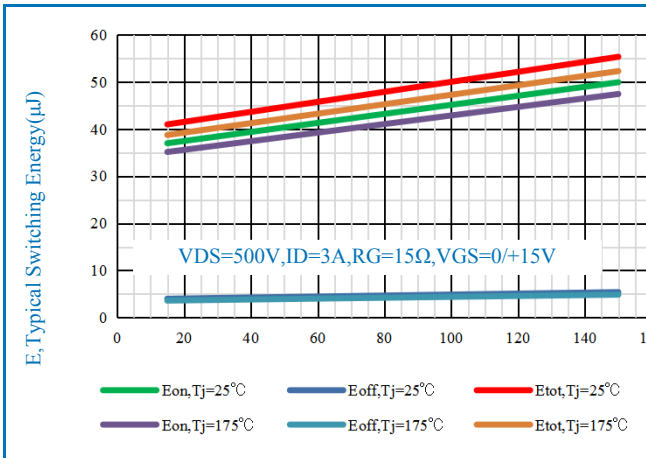



Fig.10-Typical Switching Energy Vs. External Gate Resistance

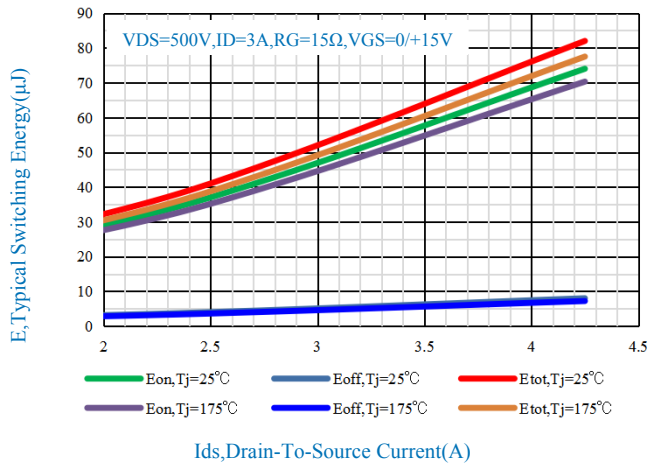



Fig.11-Typical Switching Energy Vs. Drain Source Current

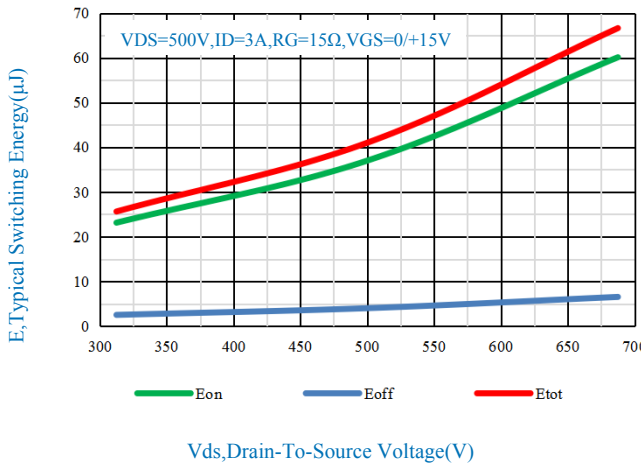



Fig.12-Typical Switching Energy Vs. Drain Source Voltage

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## Typical Characteristics Curves

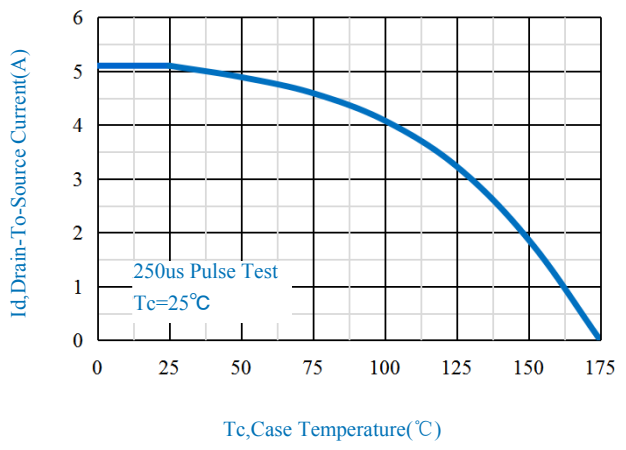



Fig.13-Maximum Continuous Drain Current Vs. Case Temperature

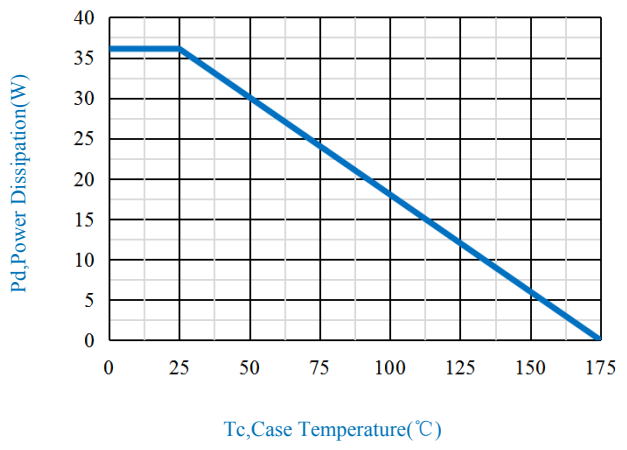



Fig.14-Maximum Power Dissipation Vs. Case Temperature

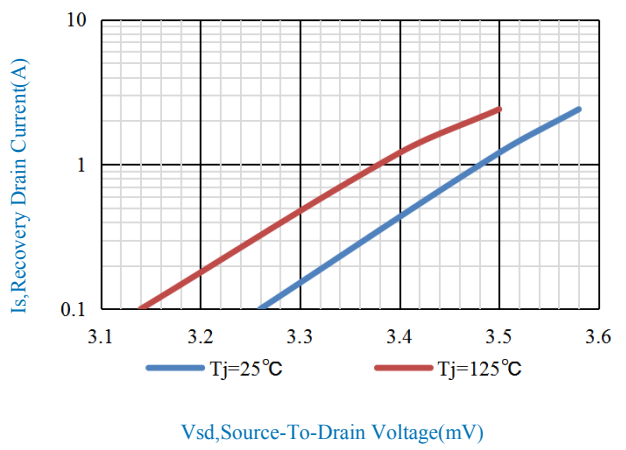



Fig.15-Source-To-Drain Diode Forward Voltage

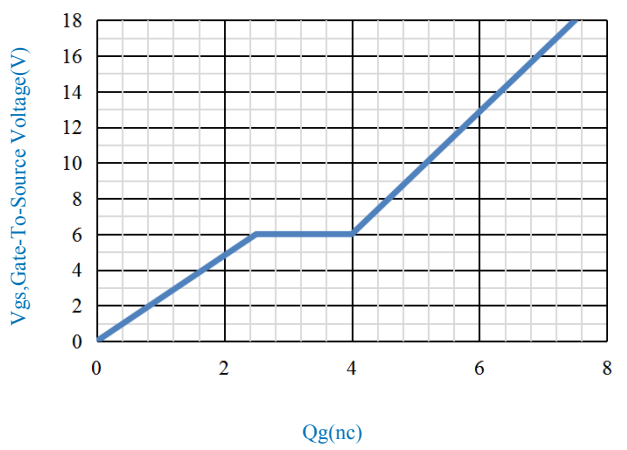



Fig.16-Gate Charge Waveform

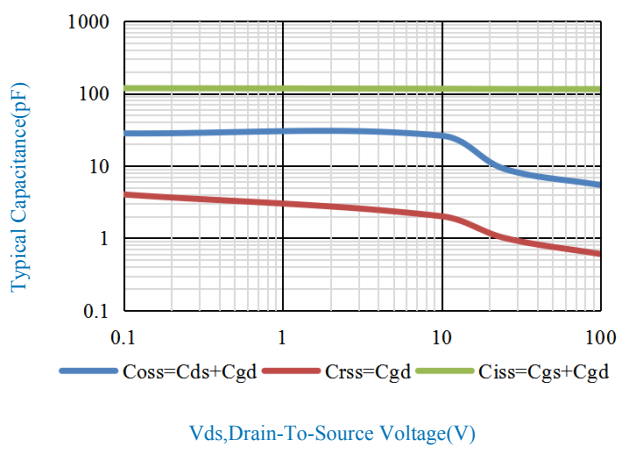



Fig.17-Typical Capacitance Vs. Drain-To-Source Voltage

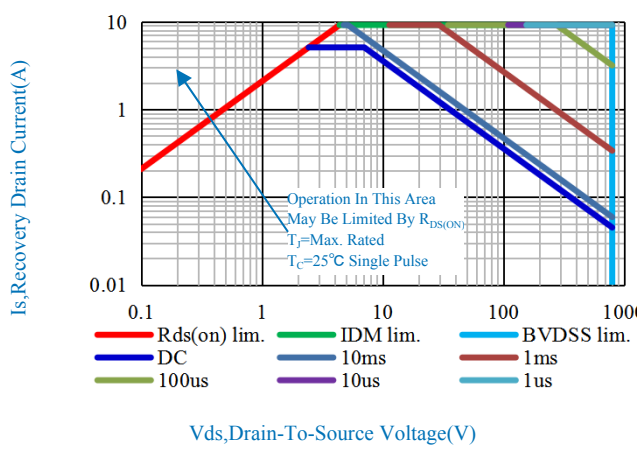



Fig.18-Maximum Safe Operating Area(SOA)

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## Typical Characteristics Curves

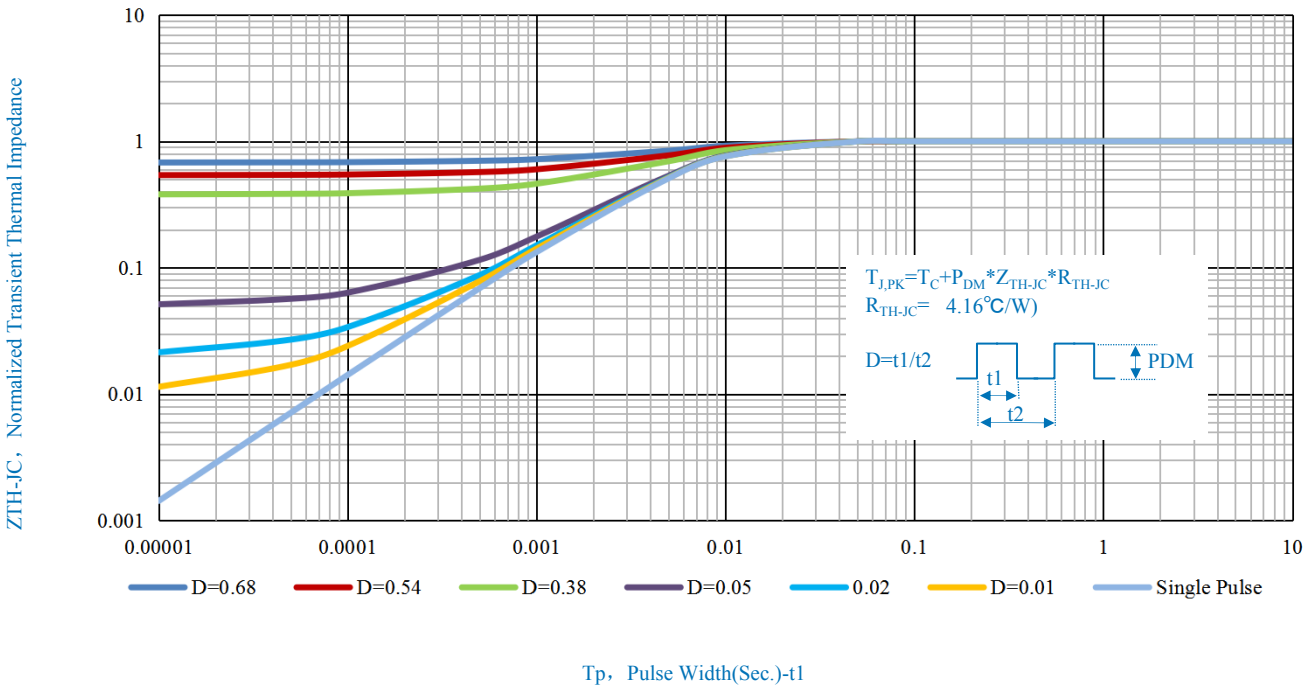



Fig.19- Normalized Maximum Transient Thermal Impedance Vs.Pulse Width

## Test Circuit & Waveform

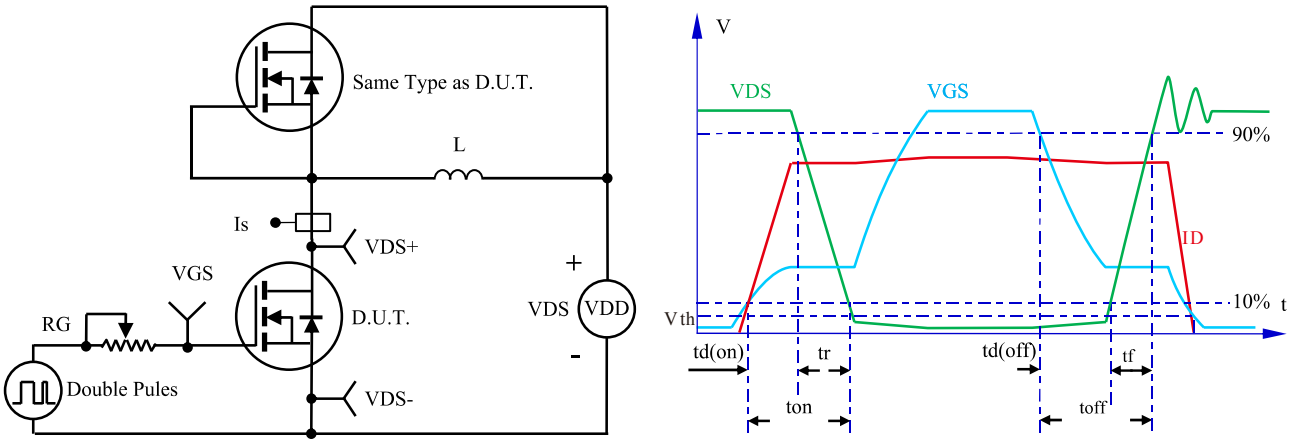


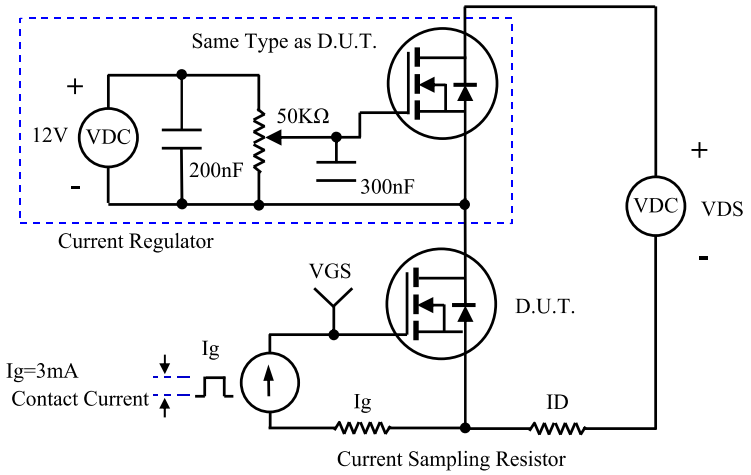

Fig.20- Inductive Switching Test Circuit & Waveform

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## Test Circuit & Waveform



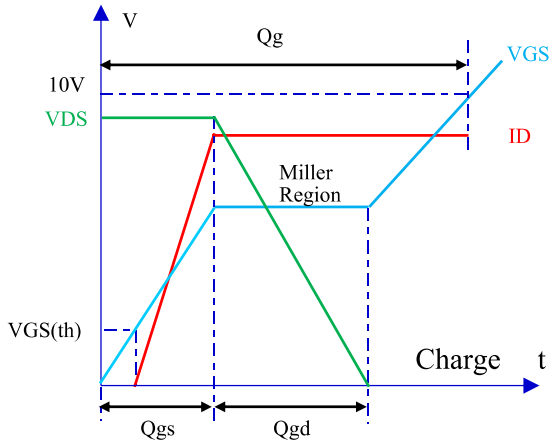
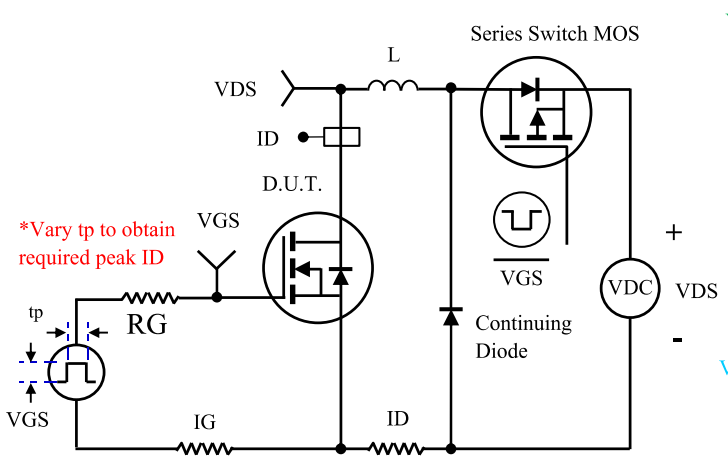




**Fig.21-Gate Charge Test Circuit & Waveform**



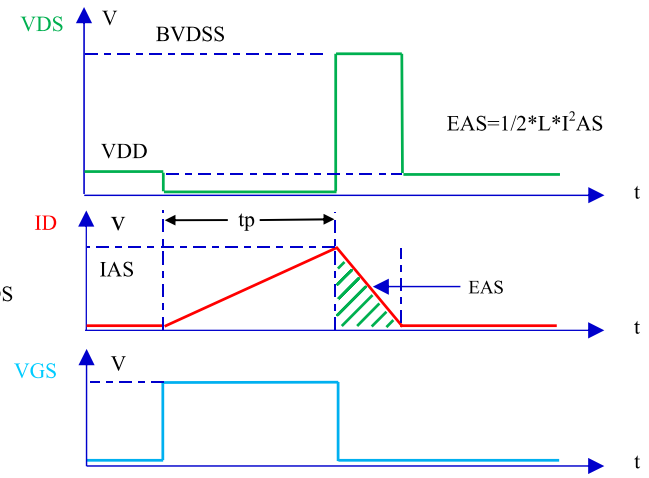
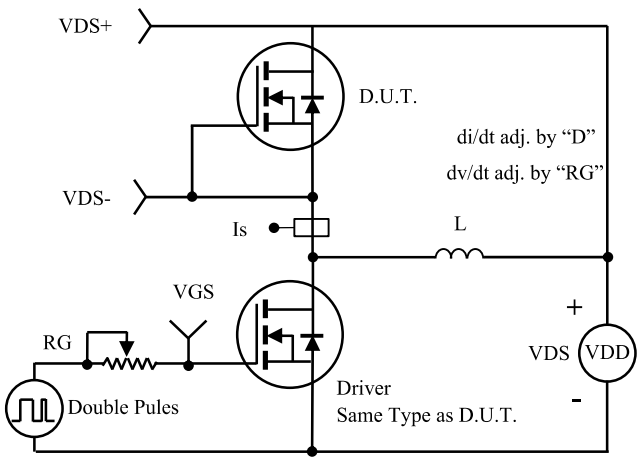




**Fig.22- Unclamped Inductive Switching (UIS) Test Circuit & Waveform**



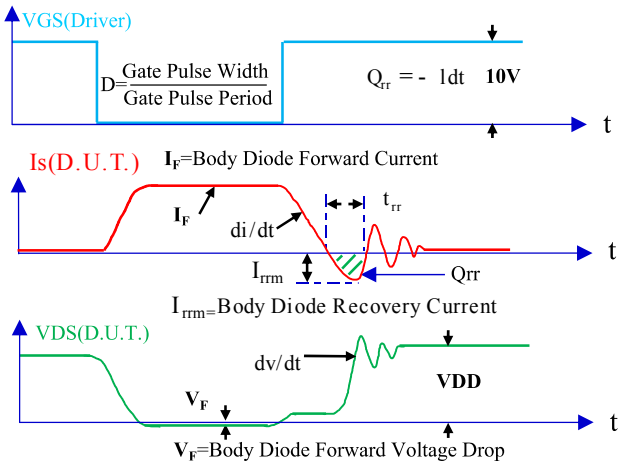



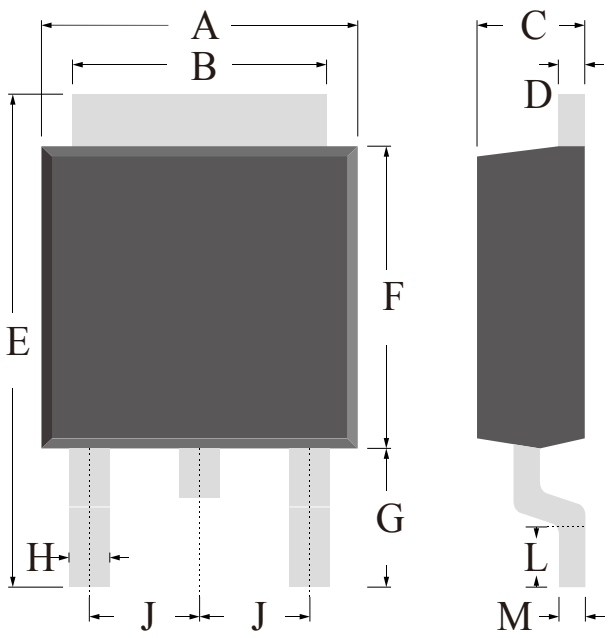

**Fig.23- Diode Recovery Test Circuit & Waveform**

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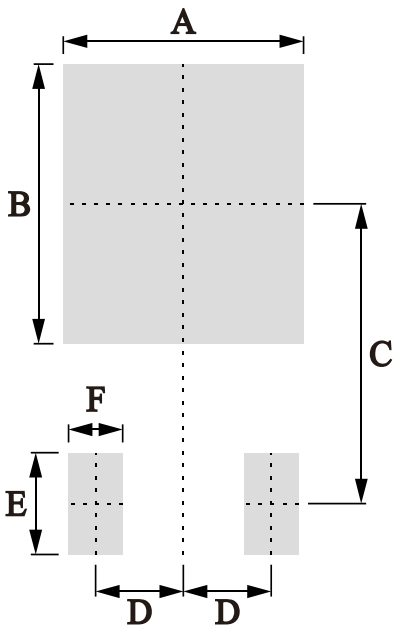
## OUTLINE DRAWINGS




## TO-252

| OUTLINE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Dim. | Milimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 6.10 | - | 7.10 | 0.2402 | - | 0.2795 |
| B | 4.80 | - | 5.80 | 0.1890 | - | 0.2283 |
| C | 1.95 | - | 2.55 | 0.0768 | - | 0.1004 |
| D | 0.35 | - | 0.75 | 0.0138 | - | 0.0295 |
| E | 9.25 | - | 10.75 | 0.3642 | - | 0.4232 |
| F | 5.60 | - | 6.60 | 0.2205 | - | 0.2598 |
| G | 2.50 | - | 3.10 | 0.0984 | - | 0.1220 |
| H | 0.55 | - | 0.85 | 0.0217 | - | 0.0335 |
| J | 2.10 | - | 2.50 | 0.0827 | - | 0.0984 |
| L | 1.00 | - | 1.40 | 0.0394 | - | 0.0551 |
| M | 0.35 | - | 0.75 | 0.0138 | - | 0.0295 |

## RECOMMEDNED LAYOUT DRAWINGS




## TO-252

| OUTLINE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Dim. | Milimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | - | 6.09 | - | - | 0.2398 | - |
| B | - | 7.57 | - | - | 0.2980 | - |
| C | - | 6.64 | - | - | 0.2614 | - |
| D | - | 2.30 | - | - | 0.0906 | - |
| E | - | 2.76 | - | - | 0.1087 | - |
| F | - | 1.42 | - | - | 0.0559 | - |

# NCK80R480S

N-Channel Silicon Carbide MOSFET

Pb-Free RoHS COMPLIANT

## MARKING INFORMATION




## MARKING INSTRUCTIONS

**NH=Niuhang Trademark**

**FF=Product Line Code,According To Actual Changes**

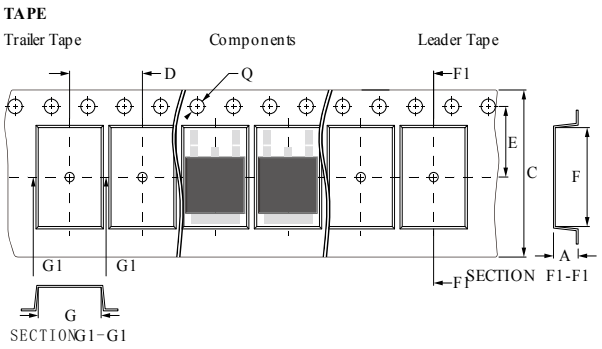
**YWW=Date Code,According To Actual Changes**

**LLWWF=Inernal Code,According To Actual Changes**

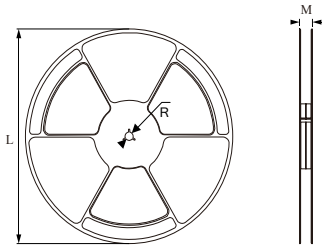
**NCK80R480S=Model**

## PACKAGING

**TAPE**




**REEL**




## TO-252

| OUTLINE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Dim. | Milimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| **TAPE** | | | | | | |
| A | 2.60 | - | 2.80 | 0.1024 | - | 0.1102 |
| C | 15.60 | - | 16.40 | 0.6142 | - | 0.6457 |
| D | 7.70 | - | 8.30 | 0.3031 | - | 0.3268 |
| E | 7.30 | - | 7.70 | 0.2874 | - | 0.3031 |
| F | 10.20 | - | 10.80 | 0.4016 | - | 0.4252 |
| G | 6.70 | - | 7.10 | 0.2638 | - | 0.2795 |
| Q Φ | 1.40 | - | 1.60 | 0.0551 | - | 0.0630 |
| **REEL** | | | | | | |
| L | 328.00 | - | 332.00 | 12.913 | - | 13.071 |
| R | 12.00 | - | 14.00 | 0.4724 | - | 0.5512 |
| M | 19.40 | - | 23.40 | 0.7638 | - | 0.9213 |

## PACKING INFORMATION

| Package Type | Package Code | Productor Weight Approx(g/Pcs) | Package Method | Quantity (Pcs/Min. Pack.) | Quantity (Pcs/Inner Box) | Quantity (Pcs/Carton) |
|---|---|---|---|---|---|---|
| TO-252 | P1 | 0.321 | 13" Reel | 2500 | 5000 | 30000 |
| TO-252 | P2 | 0.321 | 13" Reel | 2500 | 2500 | 25000 |

NCK80R480S

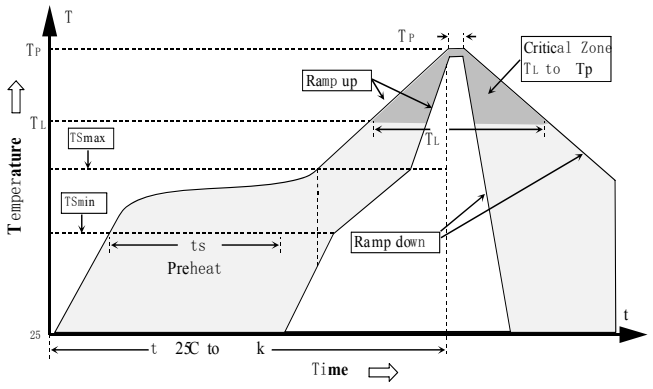
N-Channel Silicon Carbide MOSFET

Pb Pb-Free RoHS COMPLIANT

## Recommended wave soldering condition

| Product | Peak Temperature | Soldering Time |
|---|---|---|
| Pb-free devices | 260 +0/-5 °C | 5 +1/-1 seconds |

## Recommended temperature profile for IR reflow




| Profile feature | Sn-Pb eutectic Assembly | Pb-free Assembly |
|---|---|---|
| Average ramp-up rate (Tsmax to Tp) | 3°C/second max. | 3°C/second max. |
| Preheat−Temperature Min (TS min) −Temperature Max (TS max) −Time(ts min to ts max) | 100°C 150°C 60-120 seconds | 150°C 200°C 60-180 seconds |
| Time maintained above: −Temperature (TL) − Time (tL) | 183°C 60-150 seconds | 217°C 60-150 seconds |
| Peak Temperature(TP) | 240 +0/-5 °C | 260 +0/-5 °C |
| Time within 5°C of actual peak temperature (tp) | 10-30 seconds | 20-40 seconds |
| Ramp down rate | 6°C/second max. | 6°C/second max. |
| Time 25 °C to peak temperature | 6 minutes max. | 8 minutes max. |

Note : All temperatures refer to topside of the package, measured on the package body surface.

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NCK80R480S

N-Channel Silicon Carbide MOSFET

Pb-Free RoHS COMPLIANT

## Specification Revision History

| Rev. | Date | Changed Items | Pre-Changed Content | Changed Content |
|---|---|---|---|---|
| A/1 | 2025-10-20 | First Issue | | |

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