

NCH120R123PT4



N-Channel Silicon Carbide MOSFET

Voltage: 1200 Volts

Current: 156 Amperes

Package: TO-247-4L

Features

- NH'S Advanced Silicon Carbide MOSFET Technology
- High Blocking Voltage And Low Capacitances
- High-Speed Switching For Very Low Switching Losses
- Excellent  $Q_g \cdot R_{ds(on)}$  Product(FOM)

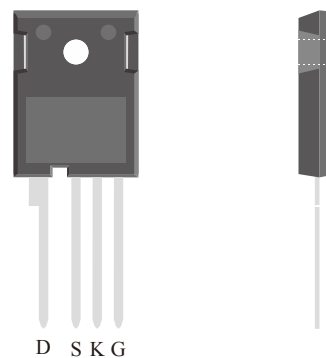
Typical Applications

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

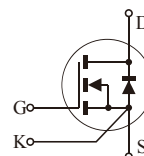
Product Summary

|                                                   |      |    |
|---------------------------------------------------|------|----|
| V <sub>DS</sub> Min.@T <sub>j</sub>               | 1200 | V  |
| I <sub>D</sub> Min.@Ta                            | 156  | A  |
| R <sub>DS(ON)</sub> (TYP)@18V,T <sub>j</sub> =25℃ | 12.3 | mΩ |

Diagram:



Polarity:



\*100% UIS TESTED

\*100% ΔV<sub>DS</sub> TESTED

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

| Parameter                                                                    | Test Conditions                                                                  | Symbol               | Ratings | Unit |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------|---------|------|
| Drain-Source Voltage                                                         |                                                                                  | V <sub>DS</sub>      | 1200    | V    |
| Gate-Source Voltage                                                          |                                                                                  | V <sub>GS</sub> MAX. | -10/+22 | V    |
|                                                                              |                                                                                  | V <sub>GS</sub> O.P. | -4/+18  |      |
| Continuous Drain Current (Note 1)                                            | Ta= 25 ℃                                                                         | I <sub>D</sub>       | 156     | A    |
|                                                                              | Ta= 100 ℃                                                                        |                      | 125     |      |
| Drain Current-Pulse (Note 1)                                                 | T <sub>j</sub> < 175 ℃                                                           | I <sub>DM</sub>      | 359     | A    |
| Maximum Power Dissipation Power<br>Dissipation Derating Factor Above 25℃     | Ta= 25 ℃                                                                         | P <sub>D</sub>       | 577     | W    |
|                                                                              | Ta= 100 ℃                                                                        |                      | 288     |      |
| Derating Factor                                                              |                                                                                  | D <sub>F</sub>       | 3.85    | W/℃  |
| Avalanche Current,Single Pulse (Note 1)                                      | L= 10.0 mH                                                                       | I <sub>AS</sub>      | 4.0     | A    |
| Single Pulse Avalanche Energy (Note 1)<br>Test Circuit & Waveform See Fig.22 | L= 10.0 mH<br>IAS= 4.0 A,RG= 10.0 Ω<br>Starting T <sub>j</sub> =25 ℃,VG = 18.0 V | E <sub>AS</sub>      | 80      | mJ   |

Thermal Characteristics (Ta=25℃ Unless Otherwise Specified)

| Parameter                                                   | Test Conditions                                     | Symbol           | Typ.       | Unit |
|-------------------------------------------------------------|-----------------------------------------------------|------------------|------------|------|
| Junction Temperature                                        |                                                     | T <sub>J</sub>   | -55 to 175 | ℃    |
| Storage Temperature Range                                   |                                                     | T <sub>STD</sub> | -55 to 175 | ℃    |
| Thermal Resistance Junction To Ambient<br>With Steady-State | Still Air Environment<br>With Ta=25℃                | R <sub>θJA</sub> | 40         | ℃/W  |
| Thermal Resistance Junction-Case<br>With Steady-State       | Device Mounted On<br>75mm x 45mm x 2.5mm Alu. Heat. | R <sub>θJC</sub> | 0.26       |      |

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

**NCH120R123PT4**
**N-Channel Silicon Carbide MOSFET**

**Electrical Characteristics (Ta=25°C Unless Otherwise Specified )**

| Parameter                                                  | Test Conditions                                                       | Symbol              | Min.                | Typ. | Max.   | Unit |    |
|------------------------------------------------------------|-----------------------------------------------------------------------|---------------------|---------------------|------|--------|------|----|
| Static Off Characteristics                                 |                                                                       |                     |                     |      |        |      |    |
| Drain-Source Breakdown Voltage                             | VGS=0V,ID=100uA                                                       | BV <sub>DSS</sub>   | 1200                | --   | --     | V    |    |
| Zero Gate Voltage Drain Current                            | VDS= 1200 V,VGS=0V,Tj=25℃                                             | I <sub>DSS</sub>    | --                  | 0.1  | 20     | uA   |    |
|                                                            | VDS= 1200 V,VGS=0V,Tj=175℃                                            |                     | --                  | 3    | --     |      |    |
| Gate To Source Leakage Current                             | VGS= 22.0 V,VDS=0V                                                    | I <sub>GSS</sub>    | --                  | --   | 100    | nA   |    |
| Source To Gate Leakage Current                             | VGS= -10.0 V,VDS=0V                                                   | I <sub>SGS</sub>    | --                  | --   | 100    | nA   |    |
| Forward Transconductance                                   | ID= 70.0 A,VDS= 20 V                                                  | g <sub>fs</sub>     | --                  | 48   | --     | S    |    |
| Static On Characteristics                                  |                                                                       |                     |                     |      |        |      |    |
| Gate Threshold Voltage                                     | VGS= VDS, ID=10mA ,Tj=25℃                                             | V <sub>GS(TH)</sub> | 2.6                 | 3.1  | 3.6    | V    |    |
|                                                            | VGS= VDS, ID=10mA ,Tj=175℃                                            |                     | --                  | 2.2  | --     |      |    |
| Drain-Source On Resistance                                 | ID= 70.0 A,VGS= 18.0 V,Tj=25℃                                         | R <sub>DS(ON)</sub> | --                  | 12   | 16     | mΩ   |    |
|                                                            | ID= 70.0 A,VGS= 18.0 V,Tj=175℃                                        |                     | --                  | 22   | --     |      |    |
|                                                            | ID= 70.0 A,VGS= 15.0 V,Tj=25℃                                         |                     | --                  | 17   | 22     |      |    |
|                                                            | ID= 70.0 A,VGS= 15.0 V,Tj=175℃                                        |                     | --                  | 27   | --     |      |    |
| Dynamic Characteristics                                    |                                                                       |                     |                     |      |        |      |    |
| Gate Resistance                                            | VGS=0V,VDS=0V,Freq.=1MHz                                              | R <sub>g</sub>      | --                  | 6.5  | --     | Ω    |    |
| Input Capacitance                                          | VDS= 1040 V<br>VGS= 0 V<br>F= 1 MHZ                                   | C <sub>iss</sub>    | --                  | 5725 | --     | pF   |    |
| Output Capacitance                                         |                                                                       | C <sub>oss</sub>    | --                  | 195  | --     | pF   |    |
| Reverse Transfer Capacitance                               |                                                                       | C <sub>rss</sub>    | --                  | 12.5 | --     | pF   |    |
| Coss Stored Energy                                         |                                                                       | C <sub>oss</sub>    | --                  | 120  | --     | uJ   |    |
| Switching Paramters (Test Circuit & Waveform See Fig.20)   |                                                                       |                     |                     |      |        |      |    |
| Turn-On Delay Time                                         | VDS= 800.0 V<br>ID= 70.0 A<br>VGS= -4/+18 V<br>RG= 2.4 Ω<br>L= 200 μH | Tj=25℃              | t <sub>d(on)</sub>  | --   | 32.5   | --   | ns |
| Turn-On Rise Time                                          |                                                                       | Tj=25℃              | t <sub>r</sub>      | --   | 45     |      | ns |
| Turn-Off Delay Time                                        |                                                                       | Tj=25℃              | t <sub>d(off)</sub> | --   | 88     |      | ns |
| Turn-Off Rise Time                                         |                                                                       | Tj=25℃              | t <sub>f</sub>      | --   | 17     |      | ns |
| Turn-On Switching Loss                                     |                                                                       | Tj=25℃              | E <sub>on</sub>     | --   | 1170.0 | --   | μJ |
| Turn-Off Switching Loss                                    |                                                                       | Tj=25℃              | E <sub>off</sub>    | --   | 700.0  | --   | μJ |
| Total Switching Energy                                     |                                                                       | Tj=25℃              | E <sub>tot</sub>    | --   | 1870.0 | --   | μJ |
| Gate Charge Paramters (Test Circuit & Waveform See Fig.21) |                                                                       |                     |                     |      |        |      |    |
| Total Gate Charge                                          | VDS= 800 V<br>VGS= -4/+18 V<br>ID= 70.0 A                             | Q <sub>g</sub>      | --                  | 245  | --     | nC   |    |
| Gate-Source Charge                                         |                                                                       | Q <sub>gs</sub>     | --                  | 65   | --     | nC   |    |
| Gate-Drain Charge                                          |                                                                       | Q <sub>gd</sub>     | --                  | 88   | --     | nC   |    |

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



**Electrical Characteristics (Ta=25°C Unless Otherwise Specified )**

| Parameter                                                                                              | Test Conditions                                       | Symbol                 | Min. | Typ.           | Max.       | Unit      |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------|------|----------------|------------|-----------|
| <b>Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit &amp; Waveform See Fig.23)</b> |                                                       |                        |      |                |            |           |
| Max. Diode Forward Current<br>tp Limited by Tj(max)                                                    | Tj= 25 °C<br>Tj= 100 °C                               | <b>I<sub>S</sub></b>   | --   | --             | 156<br>125 | <b>A</b>  |
| Max. Pulsed Forward Current                                                                            |                                                       | <b>I<sub>SM</sub></b>  | --   | --             | 312        | <b>A</b>  |
| Diode Forward Voltage                                                                                  | ID= 70.0 A, VGS=-0V<br>Tj=25°C<br>Tj=175°C            | <b>V<sub>SD</sub></b>  | --   | 4.3<br>3.7     | --         | <b>V</b>  |
| Reverse Recovery Time                                                                                  | IS= 70.0 A<br>di/dt= 1000 A/us<br>Tj=25°C<br>Tj=175°C | <b>t<sub>rr</sub></b>  | --   | 24<br>27.1     | --         | <b>ns</b> |
| Reverse Recovery Charge                                                                                | VGS= 0.0 V<br>VDS= 800 V<br>Tj=25°C<br>Tj=175°C       | <b>Q<sub>rr</sub></b>  | --   | 430<br>494.5   | --         | <b>nC</b> |
| Reverse Recovery Current                                                                               | Tj=25°C<br>Tj=175°C                                   | <b>I<sub>rrm</sub></b> | --   | 29.0<br>30.0   | --         | <b>A</b>  |
| Reverse Recovery Energy                                                                                | Tj=25°C<br>Tj=175°C                                   | <b>E<sub>rr</sub></b>  | --   | 278.4<br>325.4 | --         | <b>μJ</b> |

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



### Typical Characteristics Curves

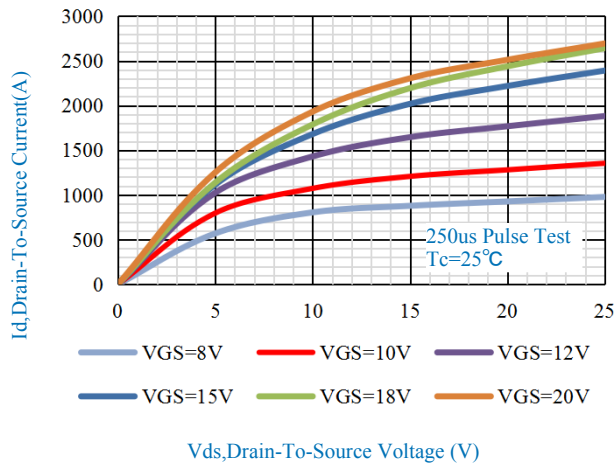


Fig.1-Output Characteristic@Tj=25°C

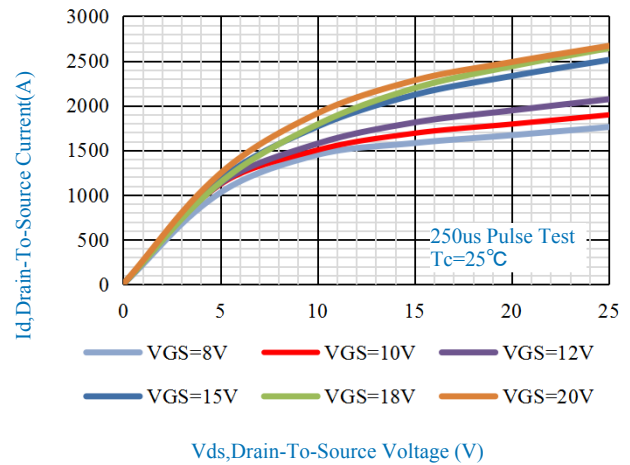


Fig.2-Output Characteristic@Tj=175°C

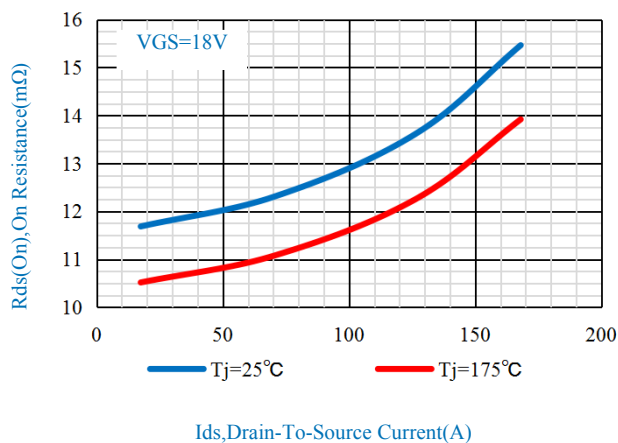


Fig.3-On Resistance Vs. Drain Current

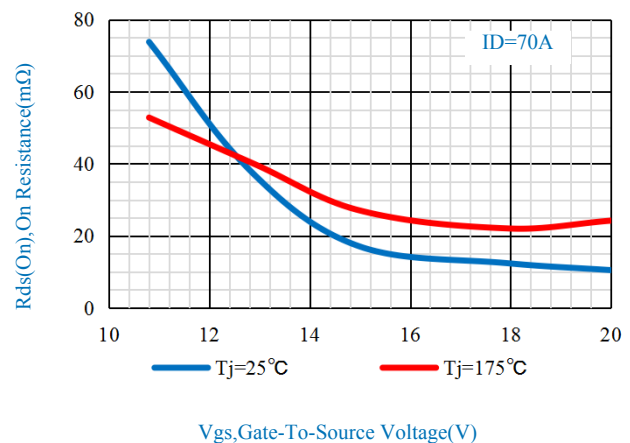


Fig.4-On Resistance Vs. Gate Source Voltage

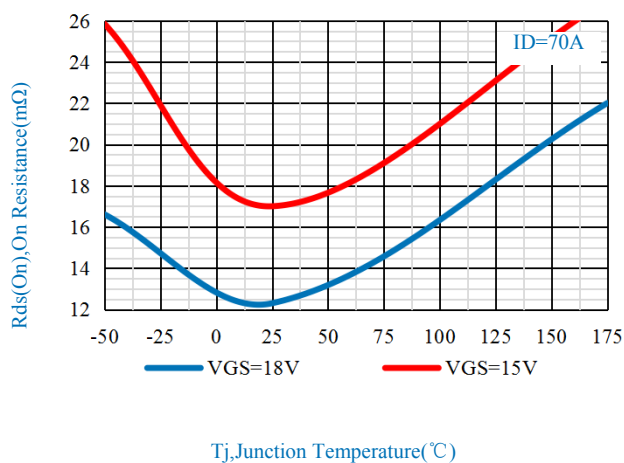


Fig.5-On Resistance Vs. Junction Temperature

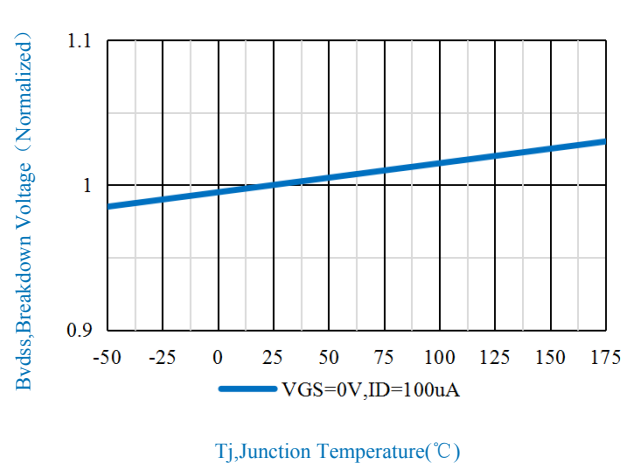


Fig.6-Breakdown Voltage Vs. Junction Temperature

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



### Typical Characteristics Curves

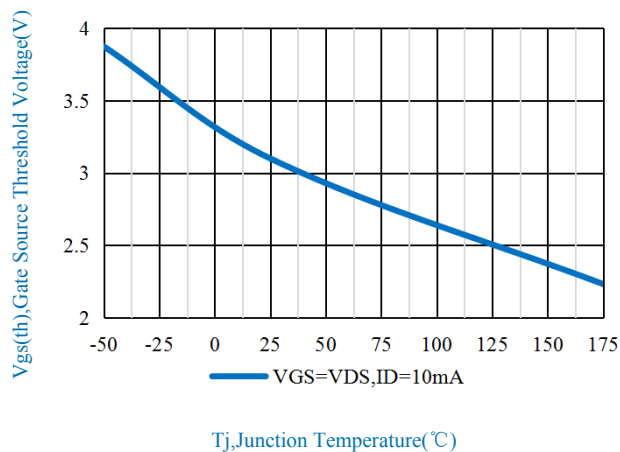


Fig.7-Gate Source Threshold Voltage Vs. Junction Temperature

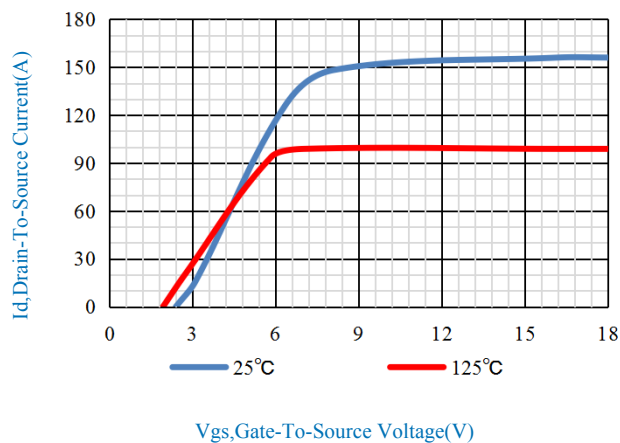


Fig.8-Transfer Characteristic

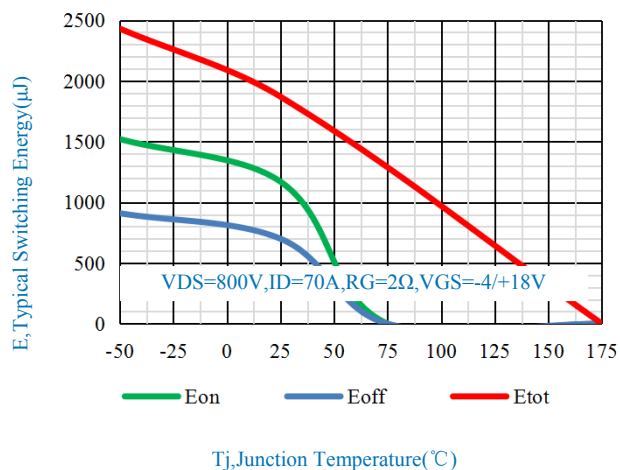


Fig.9-Typical Switching Energy Vs. Junction Temperature

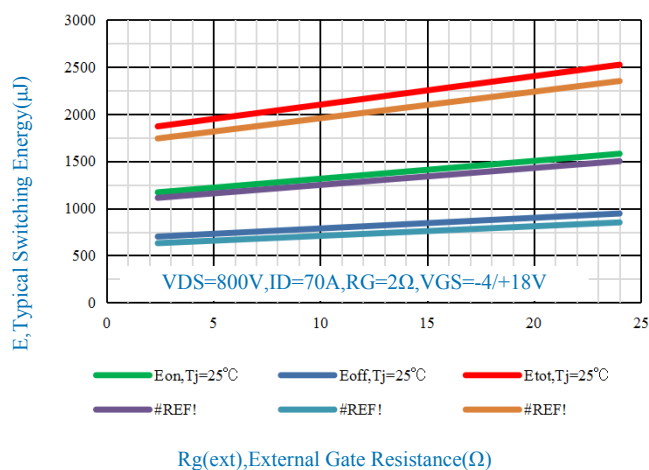


Fig.10-Typical Switching Energy Vs. External Gate Resistance

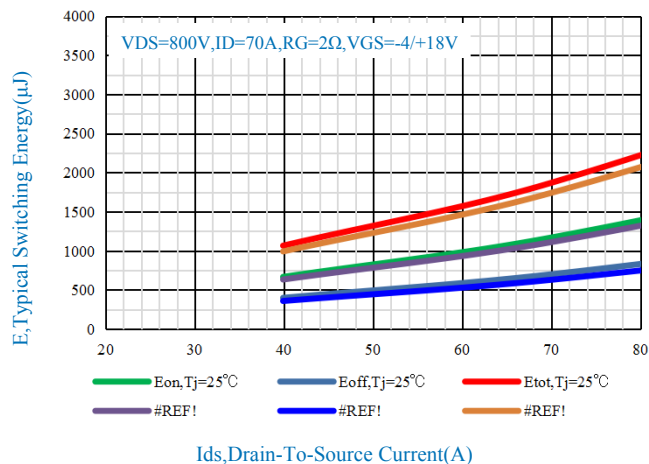


Fig.11-Typical Switching Energy Vs. Drain Source Current

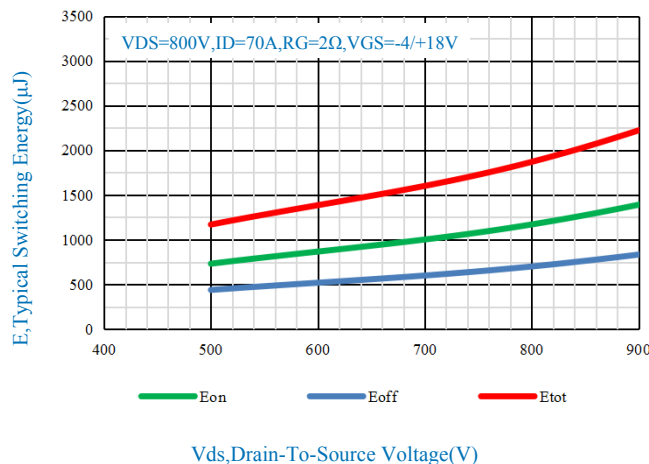


Fig.12-Typical Switching Energy Vs. Drain Source Voltage

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



### Typical Characteristics Curves

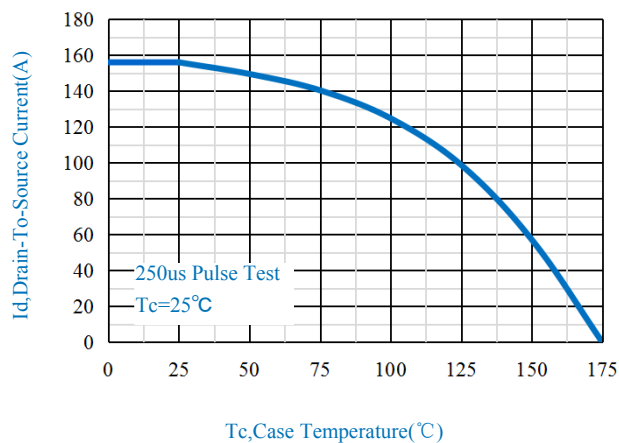


Fig.13-Maximum Continuous Drain Current Vs. Case Temperature

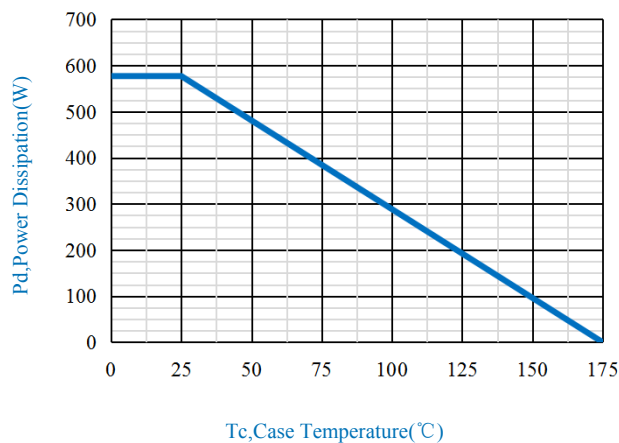


Fig.14-Maximum Power Dissipation Vs. Case Temperature

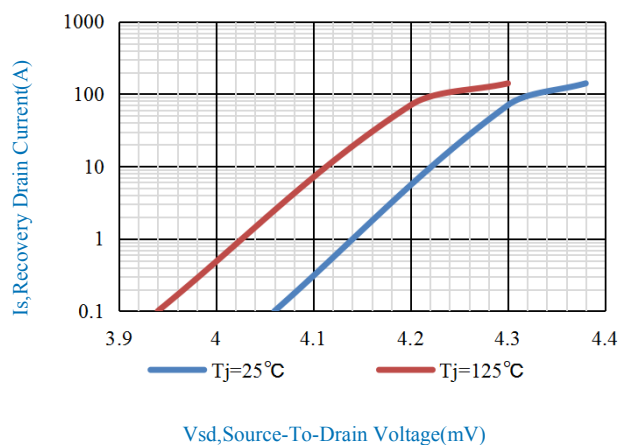


Fig.15-Source-To-Drain Diode Forward Voltage

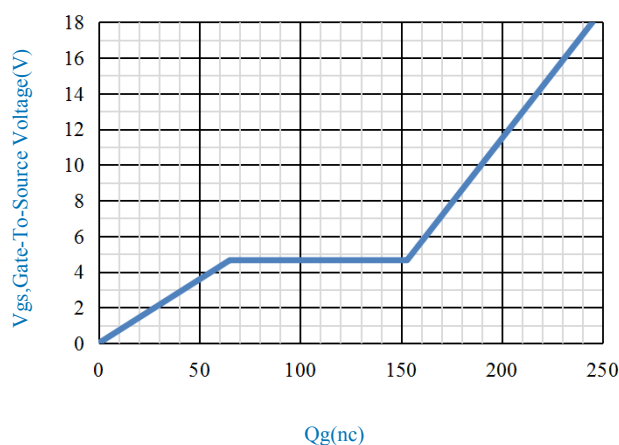


Fig.16-Gate Charge Waveform

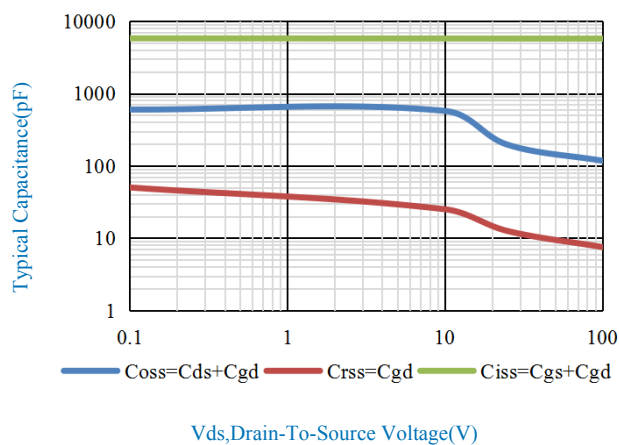


Fig.17-Typical Capacitance Vs. Drain-To-Source Voltage

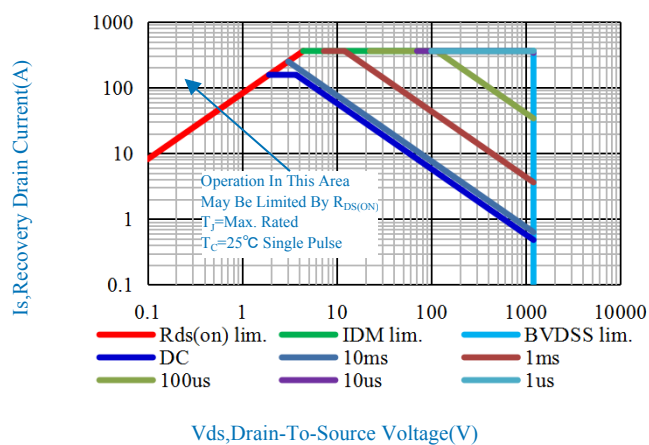


Fig.18-Maximum Safe Operating Area(SOA)

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



### Typical Characteristics Curves

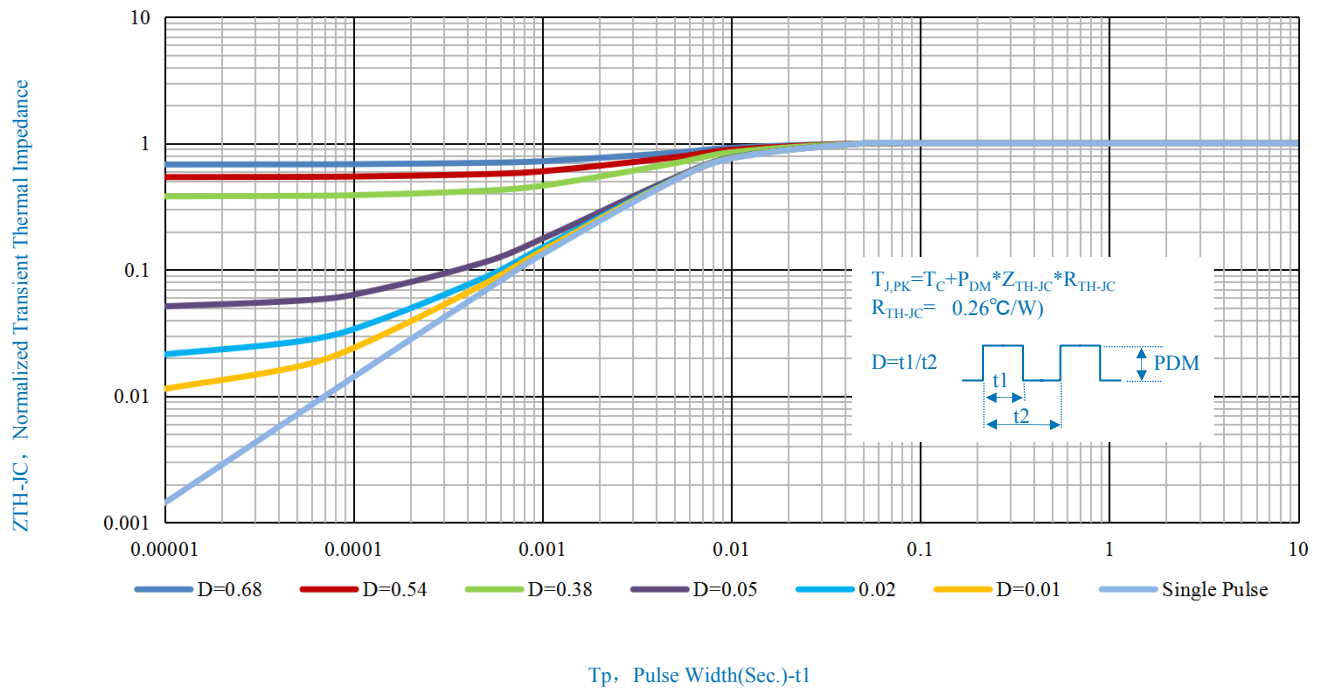


Fig.19- Normalized Maximum Transient Thermal Impedance Vs.Pulse Width

### Test Circuit & Waveform

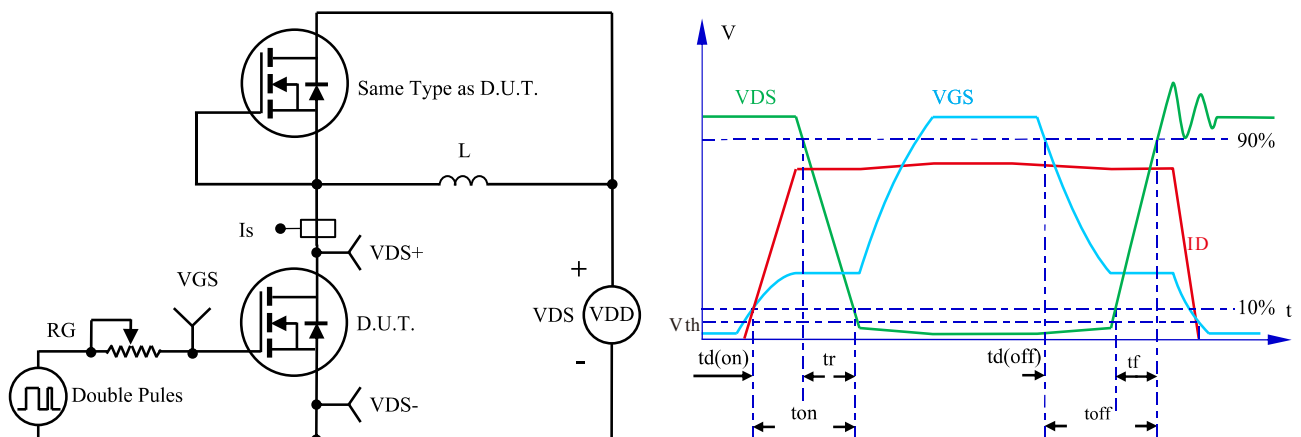


Fig.20- Inductive Switching Test Circuit & Waveform

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



Test Circuit & Waveform

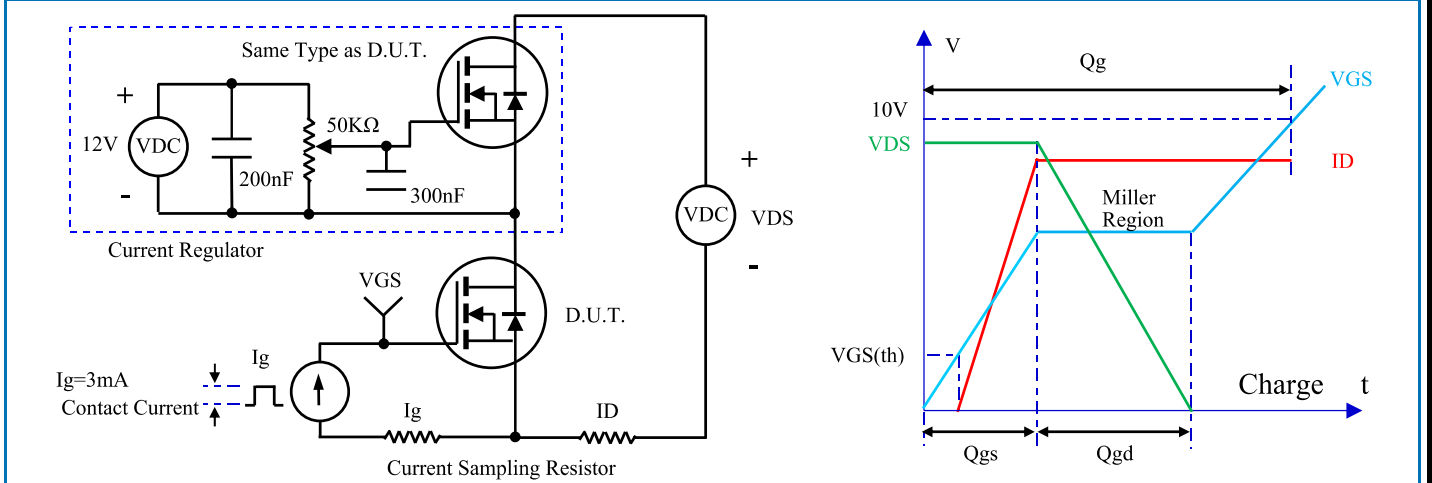


Fig.21-Gate Charge Test Circuit & Waveform

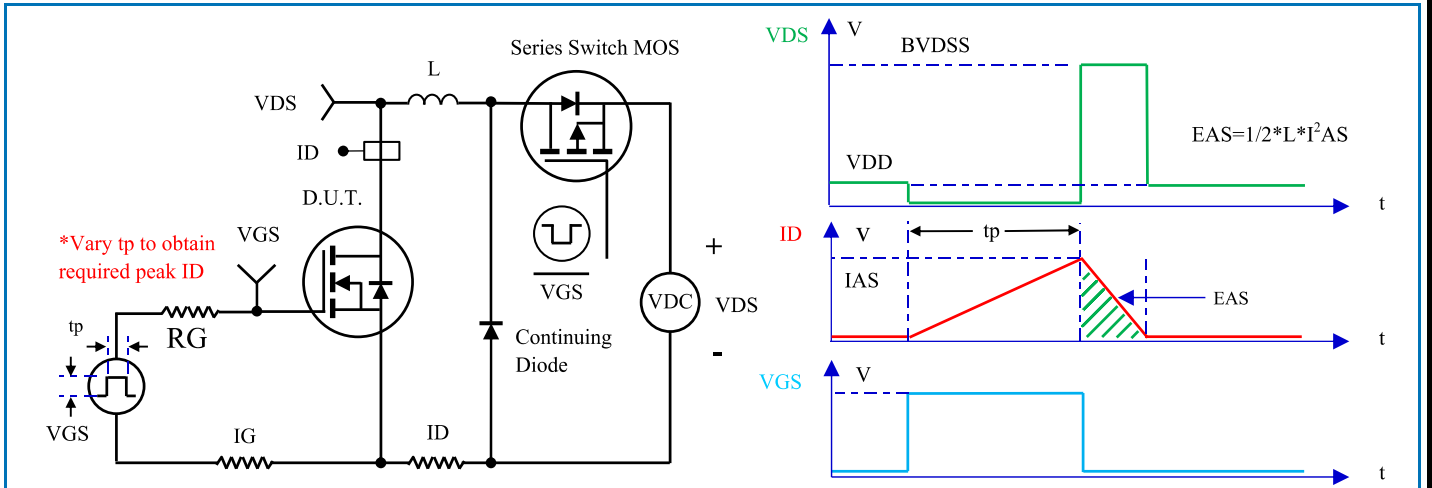


Fig.22- Unclamped Inductive Switching (UIS) Test Circuit & Waveform

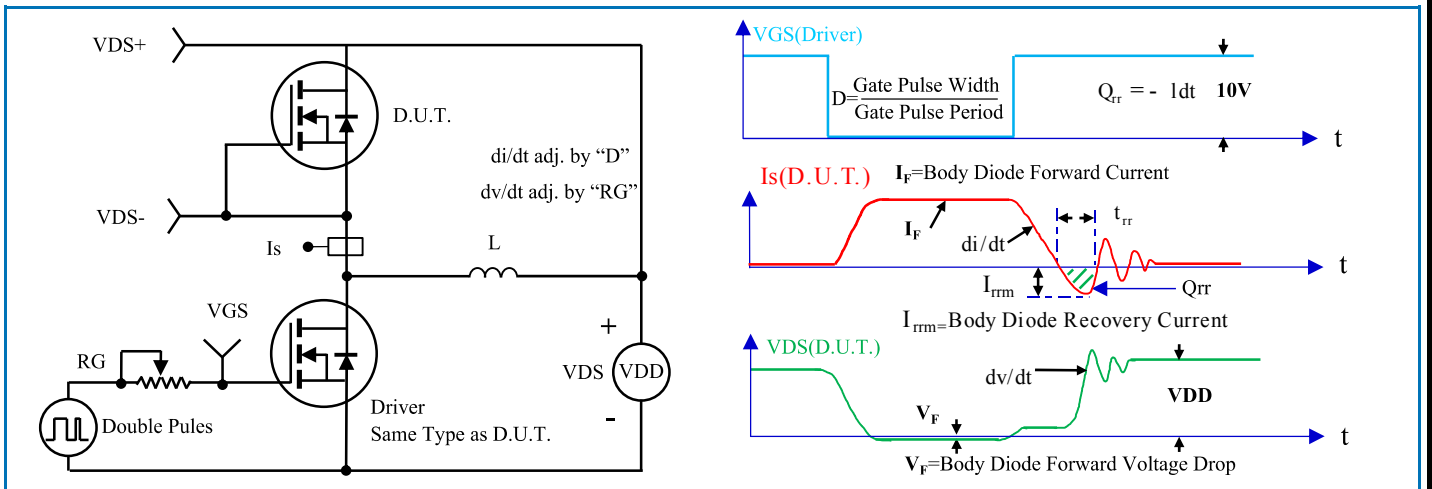


Fig.23- Diode Recovery Test Circuit & Waveform

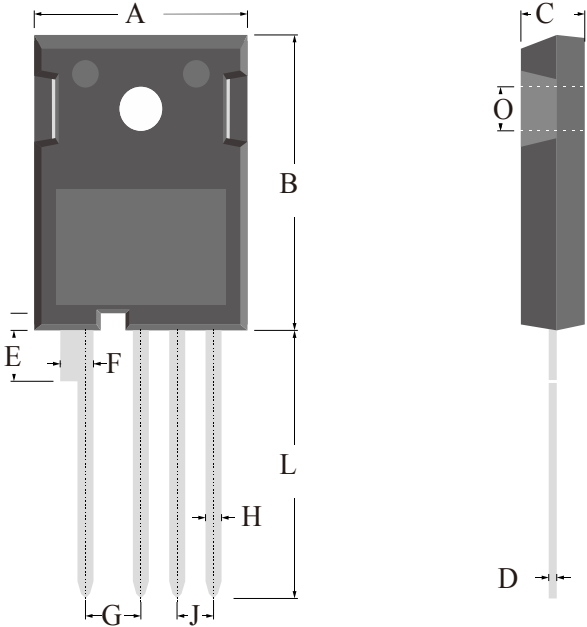
NCH120R123PT4

N-Channel Silicon Carbide MOSFET



OUTLINE DRAWINGS

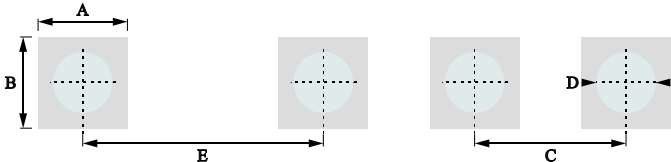
TO-247-4L



| OUTLINE DIMENSIONS |            |      |       |        |      |        |
|--------------------|------------|------|-------|--------|------|--------|
| Dim.               | Milimeters |      |       | Inches |      |        |
|                    | Min.       | Typ. | Max.  | Min.   | Typ. | Max.   |
| A                  | 15.25      | -    | 16.75 | 0.6004 | -    | 0.6594 |
| B                  | 20.50      | -    | 22.50 | 0.8071 | -    | 0.8858 |
| C                  | 4.50       | -    | 5.10  | 0.1772 | -    | 0.2008 |
| D                  | 0.40       | -    | 0.80  | 0.0157 | -    | 0.0315 |
| E                  | 4.00       | -    | 4.45  | 0.1575 | -    | 0.1752 |
| F                  | 2.40       | -    | 2.75  | 0.0945 | -    | 0.1083 |
| G                  | 4.50       | -    | 5.50  | 0.1772 | -    | 0.2165 |
| H                  | 1.00       | -    | 1.40  | 0.0394 | -    | 0.0551 |
| J                  | 2.20       | -    | 2.80  | 0.0866 | -    | 0.1102 |
| L                  | 18.50      | -    | 20.50 | 0.7283 | -    | 0.8071 |
| O                  | 2.85       | -    | 3.15  | 0.1122 | -    | 0.1240 |

RECOMMEDND LAYOUT DRAWINGS

TO-247-4L



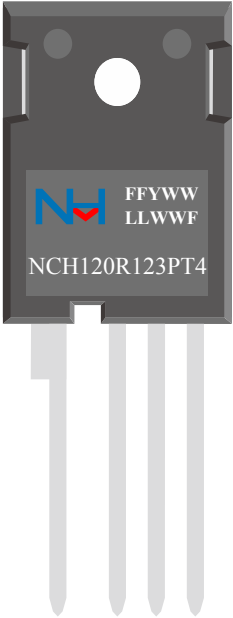
| OUTLINE DIMENSIONS |            |      |      |        |        |      |
|--------------------|------------|------|------|--------|--------|------|
| Dim.               | Milimeters |      |      | Inches |        |      |
|                    | Min.       | Typ. | Max. | Min.   | Typ.   | Max. |
| A                  | -          | 2.00 | -    | -      | 0.0787 | -    |
| B                  | -          | 2.00 | -    | -      | 0.0787 | -    |
| C                  | -          | 2.50 | -    | -      | 0.0984 | -    |
| D                  | -          | 1.40 | -    | -      | 0.0551 | -    |
| E                  | -          | 5.00 | -    | -      | 0.1969 | -    |

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



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  
NCH120R123PT4=Model

PACKING INFORMATION

| Package Type | Package Code | Product Weight<br>Approx(g/Pcs) | Package Method | Quantity<br>(Pcs/Min. Pack.) | Quantity<br>(Pcs/Inner Box) | Quantity<br>(Pcs/Carton) |
|--------------|--------------|---------------------------------|----------------|------------------------------|-----------------------------|--------------------------|
| TO-247-4L    | P1           | 5.778                           | Tube           | 30                           | 600                         | 2400                     |

NCH120R123PT4



# N-Channel Silicon Carbide MOSFET

## 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 (T <sub>smax</sub> to T <sub>p</sub> )                                                                              | 3°C/second max.                  | 3°C/second max.                  |
|  | Preheat-Temperature Min (T <sub>S</sub> min)<br>-Temperature Max (T <sub>S</sub> max)<br>-Time(t <sub>s</sub> min to t <sub>s</sub> max) | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
|  | Time maintained above:<br>-Temperature (T <sub>L</sub> )<br>- Time (t <sub>L</sub> )                                                     | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
|  | Peak Temperature(T <sub>P</sub> )                                                                                                        | 240 +0/-5 °C                     | 260 +0/-5 °C                     |
|  | Time within 5°C of actual peak temperature (t <sub>p</sub> )                                                                             | 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.

## Disclaimer

- Reproducing and modifying information of the document is prohibited without permission from Niuhang Electronics Technology Co., LTD
- Niuhang Electronics Technology Co., LTD. reserves the rights to make changes of the content herein the document anytime without notification.
- Niuhang Electronics Technology Co., LTD. disclaims any and all liability arising out of the application or use of any product including damages incidentally and consequentially occurred.
- Niuhang Electronics Technology Co., LTD. does not assume any and all implied warranties,including warranties of fitness for particular purpose,non-infringement and merchantability.
- Applications shown on the herein document are examples of standard use and operation.Customers are responsible in comprehending the suitable use in particular applications.Niuhang Electronics Technology Co., LTD.makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.
- The products shown herein are not designed and authorized for equipments requiring high level of reliability or relating to human life and for any applications concerning life-saving or life-sustaining,such as medical instruments,transportation equipment,aerospae machinery et cetera.Customers usin or selling these products for use in such applications do so at their own rish and agree to fully indemnify Niuhang Electronics Technology Co., LTD.for any damages resulting resulting from such improper use or sale.
- When the appearance of the product and chip size does not change, in order to product the customer. quality, change the internal structure and the production process Niuhang can not notify

NCH120R123PT4

N-Channel Silicon Carbide MOSFET



Specification Revision History

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