

## P-Channel Enhancement Mode MOSFET

### 1. Product Information

#### 1.1 Features

- ☒ Advanced trench cell design
- ☒ Low Thermal Resistance

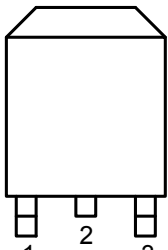
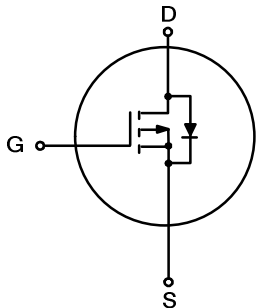
#### 1.2 Applications

- ☒ Motor drivers
- ☒ DC - DC Converter

#### 1.3 Quick reference

- ☒  $BV \geq -40\text{ V}$
- ☒  $P_{\text{tot}} \leq 104\text{ W}$
- ☒  $I_D \leq -58\text{ A}$
- ☒  $R_{\text{DS(ON)}} \leq 13\text{ m}\Omega @ V_{\text{GS}} = -10\text{ V}$
- ☒  $R_{\text{DS(ON)}} \leq 22\text{ m}\Omega @ V_{\text{GS}} = -4.5\text{ V}$

### 2. Pin Description

| Pin | Description | Simplified Outline                                                                                             | Symbol                                                                                |
|-----|-------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1   | Gate(G)     |  <p>Top View<br/>TO-252</p> |  |
| 2   | Drain(D)    |                                                                                                                |                                                                                       |
| 3   | Source(S)   |                                                                                                                |                                                                                       |

### 3. Limiting Values

| Symbol               | Parameter                               | Conditions                                                | Min  | Max      | Unit                 |
|----------------------|-----------------------------------------|-----------------------------------------------------------|------|----------|----------------------|
| $V_{DS}$             | Drain-Source Voltage                    | $T_C = 25\text{ }^{\circ}\text{C}$                        | -40  | -        | V                    |
| $V_{GS}$             | Gate-Source Voltage                     | $T_C = 25\text{ }^{\circ}\text{C}$                        | -    | $\pm 20$ | V                    |
| $I_D^{****}$         | Drain Current ( DC )                    | $T_C = 25\text{ }^{\circ}\text{C}, V_{GS} = -10\text{ V}$ | -    | -58      | A                    |
|                      |                                         | $T_C = 100\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$ | -    | -41      | A                    |
| $I_{DM}^{*,***}$     | Pulsed Source Current                   | $T_C = 25\text{ }^{\circ}\text{C}, V_{GS} = -10\text{ V}$ | -    | -120     | A                    |
| $P_{tot}^*$          | Total Power Dissipation                 | $T_C = 25\text{ }^{\circ}\text{C}$                        | -    | 104      | W                    |
| $T_{stg}$            | Storage Temperature                     |                                                           | - 55 | 150      | $^{\circ}\text{C}$   |
| $T_J$                | Junction Temperature                    |                                                           | -    | 150      | $^{\circ}\text{C}$   |
| $I_S$                | Diode Forward Current                   | $T_C = 25\text{ }^{\circ}\text{C}$                        | -    | -58      | A                    |
| $E_{AS}^*$           | Single Pulsed Avalanche Energy          | $V_{DD} = -40\text{ V}, L = 1\text{ mH}$                  | -    | 200      | mJ                   |
| $R_{\theta JA}^{**}$ | Thermal Resistance- Junction to Ambient |                                                           | -    | 37       | $^{\circ}\text{C/W}$ |
| $R_{\theta JC}^{**}$ | Thermal Resistance- Junction to Case    |                                                           | -    | 1.2      |                      |

Notes :

\* Surface Mounted on 1 in<sup>2</sup> pad area,  $t \leq 10\text{ sec}$

\*\* Pulse width  $\leq 10\text{ }\mu\text{s}$ , duty cycle  $\leq 1\%$

\*\*\* Limited by bonding wire

### 4. Marking Information

| Product Name | Marking                                                          |
|--------------|------------------------------------------------------------------|
| N50P04K      | <div>50P04</div> <div>YWWXXX</div> <div>YWW:<br/>Date Code</div> |

### 5. Ordering Code

| Product Name | Package | Reel Size | Tape width | Quantity | Note |
|--------------|---------|-----------|------------|----------|------|
| N50P04K      | TO252   |           |            | 2500     |      |

Note: JS HD defines “ Green ” as lead-free ( RoHS compliant ) and halogen free ( Br or Cl does not exceed 900 ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500 ppm by weight; Follow IEC 61249-2-21 and IPC / JEDEC J-STD-020C )

## 6. Electrical Characteristics (T<sub>C</sub> = 25 °C Unless Otherwise Noted)

| Symbol                                   | Parameter                        | Conditions                                                                                                                   | Min  | Typ  | Max   | Unit |
|------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|------|-------|------|
| Static Characteristics                   |                                  |                                                                                                                              |      |      |       |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA                                                                              | -40  | -    | -     | V    |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>DS</sub> = -250 μA                                                                | -1.5 | -    | -2.5  | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Source Current | V <sub>DS</sub> = -32V, V <sub>GS</sub> = 0 V                                                                                | -    | -    | -1    | μA   |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> = ± 20 V, V <sub>DS</sub> = 0 V                                                                              | -    | -    | ± 100 | nA   |
| R <sub>DS(ON)</sub> <sup>a</sup>         | Drain-Source On-State Resistance | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -15A                                                                               | -    | 11   | 13    | mΩ   |
|                                          |                                  | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -10 A                                                                             | -    | 18   | 22    | mΩ   |
| Diode Characteristics                    |                                  |                                                                                                                              |      |      |       |      |
| V <sub>SD</sub> <sup>a</sup>             | Diode Forward Voltage            | I <sub>SD</sub> = -15A, V <sub>GS</sub> = 0 V                                                                                | -    | -    | -1.3  | V    |
| t <sub>rr</sub>                          | Reverse Recovery Time            | I <sub>SD</sub> = -15A, dI <sub>SD</sub> /dt = 100 A/μs                                                                      | -    | 18   | -     | nS   |
| Q <sub>rr</sub>                          | Reverse Recovery Charge          |                                                                                                                              | -    | 12   | -     | nC   |
| Dynamic Characteristics <sup>b</sup>     |                                  |                                                                                                                              |      |      |       |      |
| C <sub>iss</sub>                         | Input Capacitance                | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -20 V<br>Frequency = 1 MHz                                                          | -    | 3375 | -     | pF   |
| C <sub>oss</sub>                         | Output Capacitance               |                                                                                                                              | -    | 233  | -     |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance     |                                                                                                                              | -    | 184  | -     |      |
| t <sub>d(on)</sub>                       | Turn-on Delay Time               | V <sub>DS</sub> = -20V, V <sub>GEN</sub> = -10 V,<br>R <sub>G</sub> = 3.9 Ω, R <sub>L</sub> =1.33Ω,<br>I <sub>D</sub> = -15A | -    | 9.6  | -     | nS   |
| t <sub>r</sub>                           | Turn-on Rise Time                |                                                                                                                              | -    | 40   | -     |      |
| t <sub>d(off)</sub>                      | Turn-off Delay Time              |                                                                                                                              | -    | 72   | -     |      |
| t <sub>f</sub>                           | Turn-off Fall Time               |                                                                                                                              | -    | 57   | -     |      |
| Gate Charge Characteristics <sup>b</sup> |                                  |                                                                                                                              |      |      |       |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> = -20V, V <sub>GS</sub> = -10 V,<br>I <sub>DS</sub> = -15A                                                   | -    | 55   | -     | nC   |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                                                                              | -    | 15   | -     |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                                                                              | -    | 7.4  | -     |      |

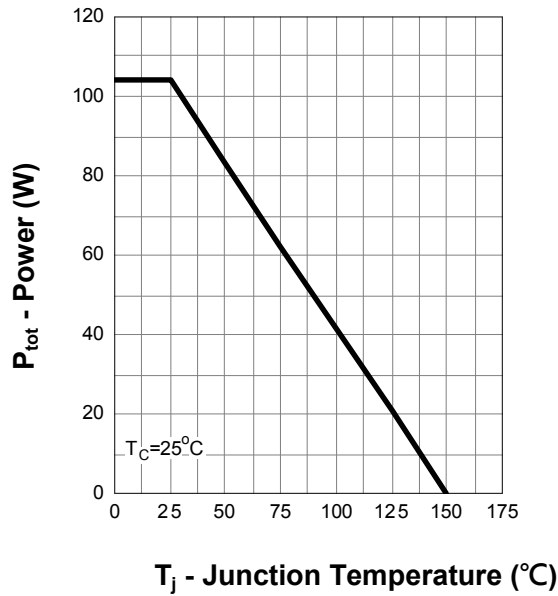
Notes :

a : Pulse test ; pulse width ≤ 300 μs, duty cycle ≤ 2 %

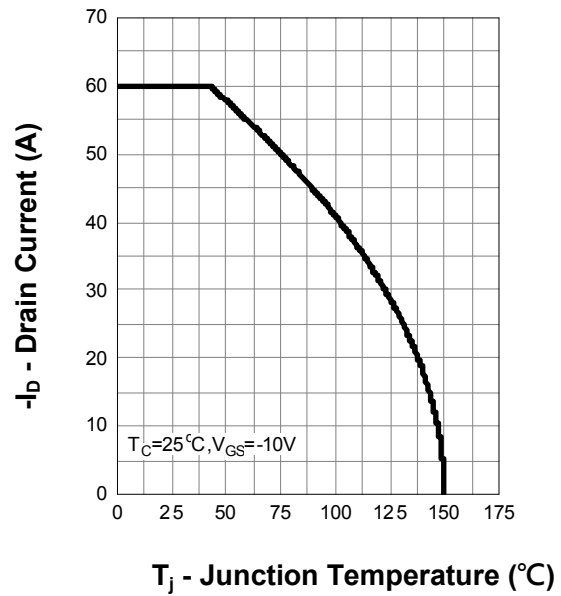
b : Guaranteed by design, not subject to production testing

## 7. Typical Characteristics

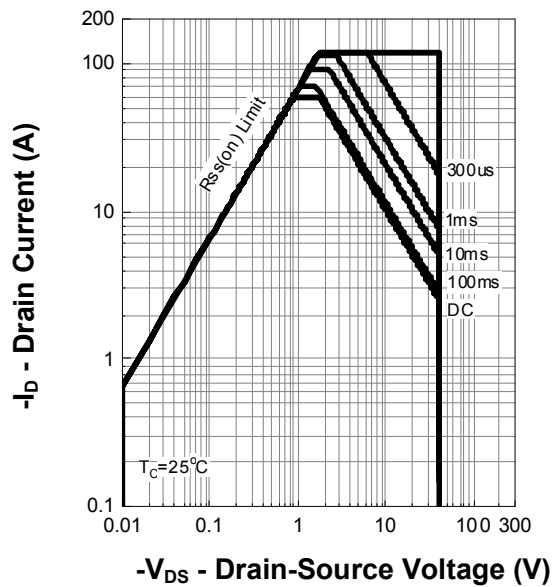
Power Capability



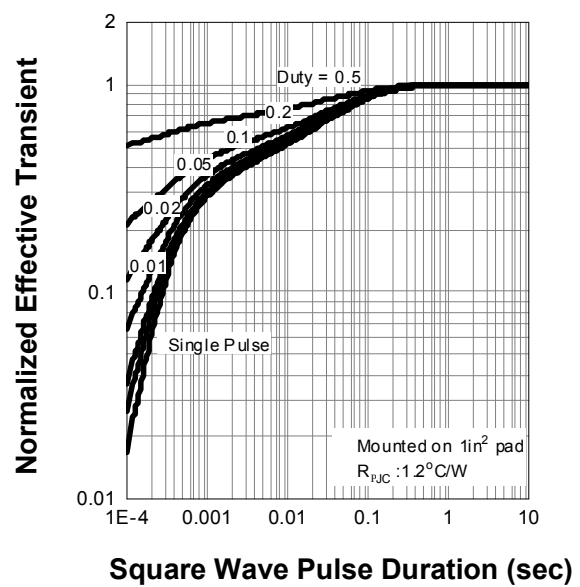
Current Capability



Safe Operation Area



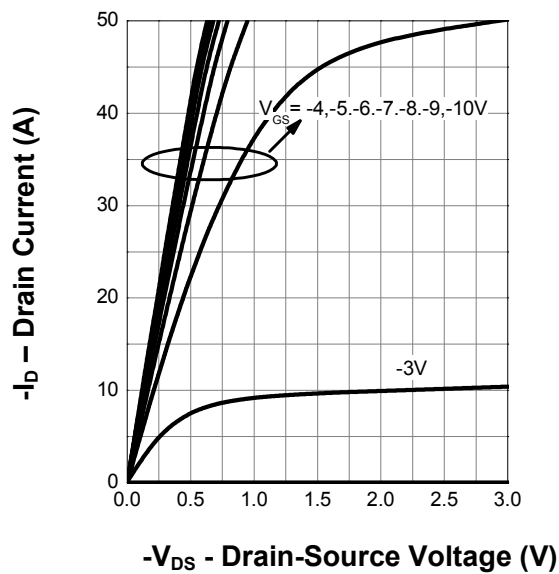
Thermal Transient Impedance



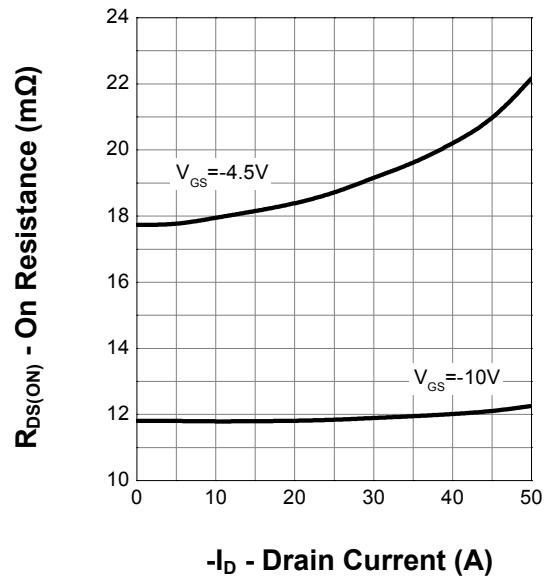


## 7. Typical Characteristics (cont.)

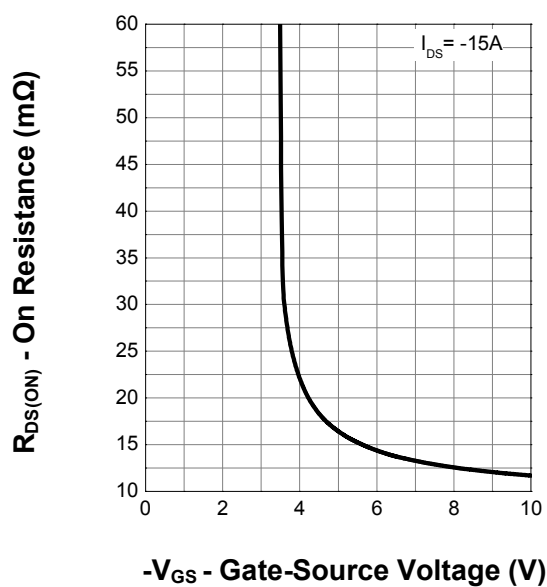
Output Characteristics



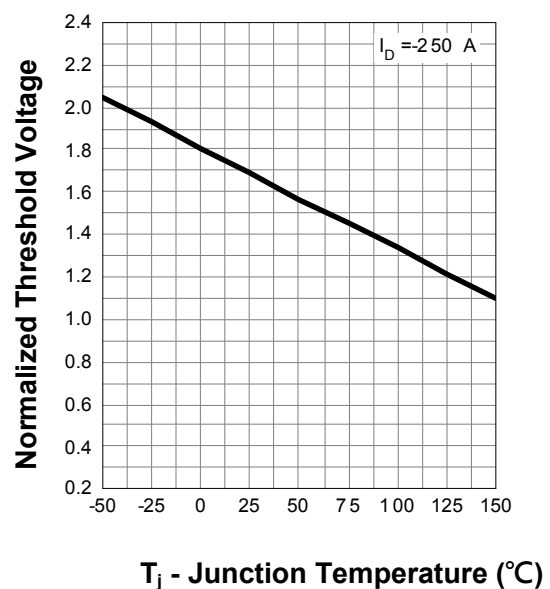
Drain-Source On Resistance



Transfer Characteristics

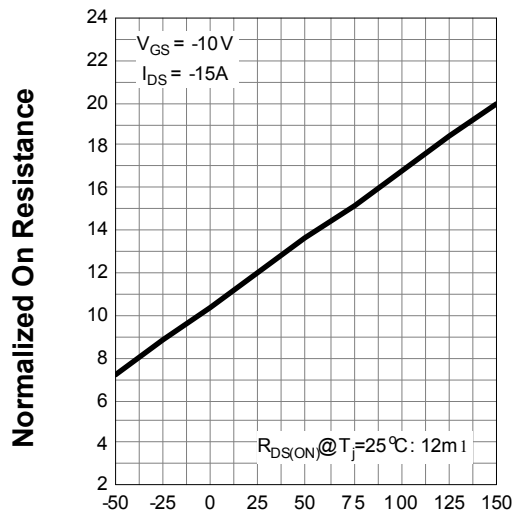


Gate Threshold Voltage



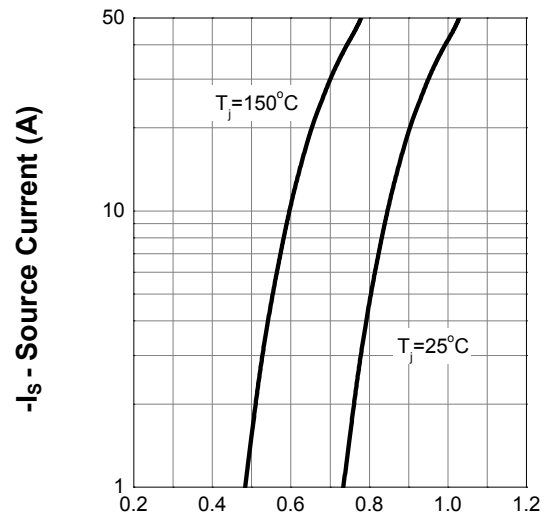
## 7. Typical Characteristics (cont.)

**Drain-Source On Resistance**



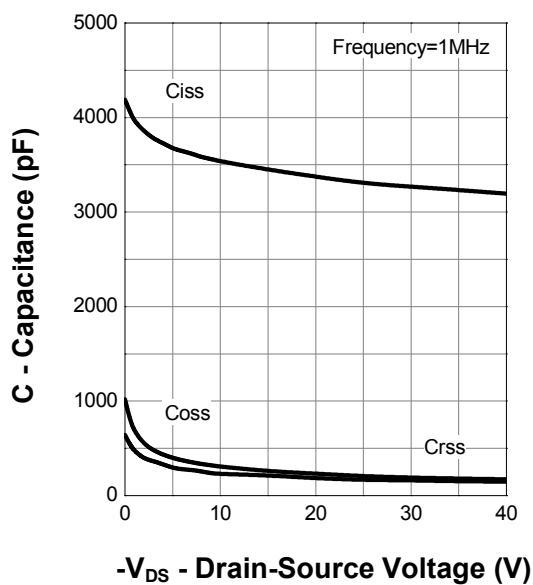
$T_j$  - Junction Temperature ( $^{\circ}\text{C}$ )

**Body Diode Characteristics**



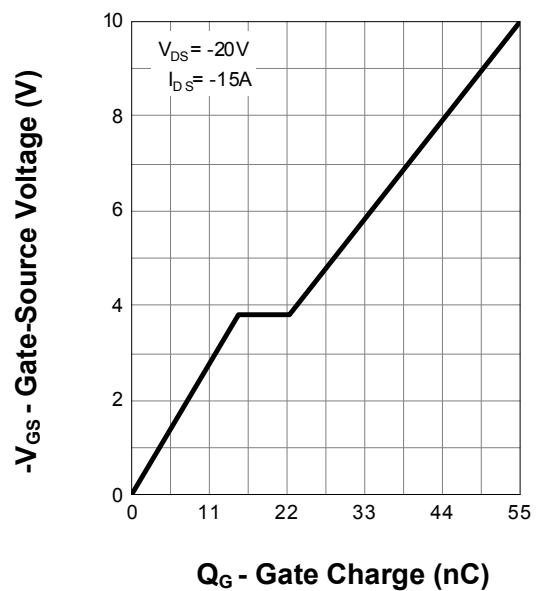
$-V_{SD}$  - Source-Drain Voltage (V)

**Capacitance**



$-V_{DS}$  - Drain-Source Voltage (V)

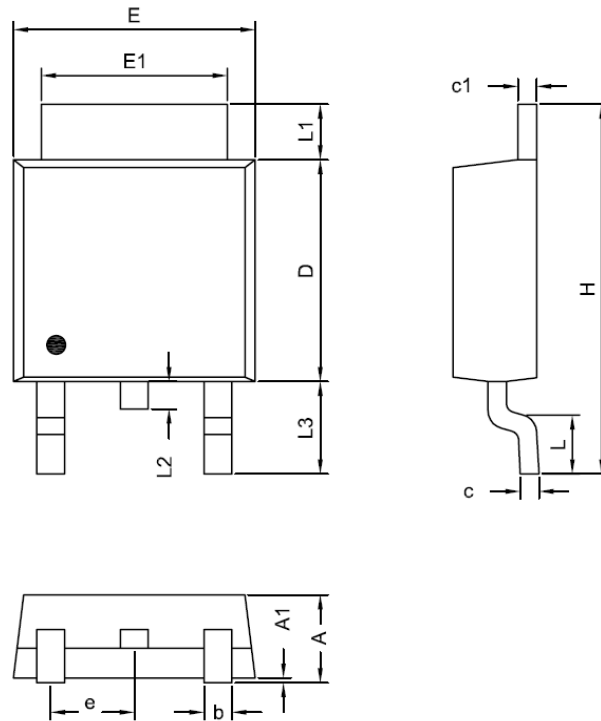
**Gate Charge**



$Q_G$  - Gate Charge (nC)

## 8.Package Dimensions

### TO252-2L



| Symbol | Dimensions In Millimeters |       |
|--------|---------------------------|-------|
|        | MIN.                      | MAX.  |
| A      | 2.19                      | 2.38  |
| A1     | 0.02                      | 0.13  |
| D      | 5.30                      | 6.40  |
| E      | 6.35                      | 6.80  |
| E1     | 5.20                      | 5.50  |
| c      | 0.40                      | 0.60  |
| c1     | 0.40                      | 0.60  |
| b      | 0.55                      | 0.85  |
| e      | 2.30 BCS                  |       |
| L      | 1.00                      | 1.80  |
| L1     | 0.70                      | 1.80  |
| L2     | 0.70 BCS                  |       |
| L3     | 2.40                      | 2.80  |
| H      | 9.20                      | 10.40 |