

## FQA30N40-VB Datasheet

## N-Channel 600V(D-S) Super Junction Power MOSFET

## PRODUCT SUMMARY

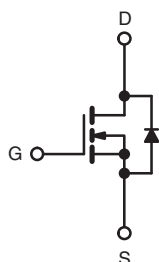
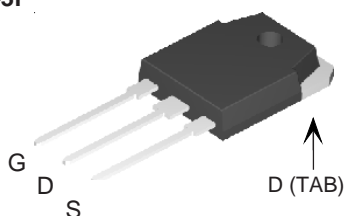
|                                    |                 |      |
|------------------------------------|-----------------|------|
| $V_{DS}$ (V) at $T_J$ max.         | 600             |      |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.06 |
| $Q_g$ max. (nC)                    | 273             |      |
| $Q_{gs}$ (nC)                      | 46              |      |
| $Q_{gd}$ (nC)                      | 79              |      |
| Configuration                      | Single          |      |

## FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



## TO-3P



N-Channel MOSFET

## APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Renewable energy
  - Solar (PV inverters)

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$  °C, unless otherwise noted)

| PARAMETER                                                 | SYMBOL           | LIMIT          | UNIT |
|-----------------------------------------------------------|------------------|----------------|------|
| Drain-Source Voltage                                      | $V_{DS}$         | 600            | V    |
| Gate-Source Voltage                                       | $V_{GS}$         | $\pm 30$       |      |
| Continuous Drain Current ( $T_J = 150$ °C)                | $V_{GS}$ at 10 V | $T_C = 25$ °C  | A    |
|                                                           |                  | $T_C = 100$ °C |      |
| Pulsed Drain Current <sup>a</sup>                         | $I_{DM}$         | 142            |      |
| Linear Derating Factor                                    |                  | 3.3            | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                | $E_{AS}$         | 1410           | mJ   |
| Maximum Power Dissipation                                 | $P_D$            | 415            | W    |
| Operating Junction and Storage Temperature Range          | $T_J, T_{stg}$   | -55 to +150    | °C   |
| Drain-Source Voltage Slope                                | $dV/dt$          | $T_J = 125$ °C | V/ns |
| Reverse Diode $dV/dt$ <sup>d</sup>                        |                  |                |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup> |                  | for 10 s       | °C   |


## Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DS} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 10$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.3  |      |

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| PARAMETER                                                 | SYMBOL              | TEST CONDITIONS                                                                                                                                          |                                               | MIN. | TYP. | MAX.      | UNIT                        |
|-----------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------|------|-----------|-----------------------------|
| Static                                                    |                     |                                                                                                                                                          |                                               |      |      |           |                             |
| Drain-Source Breakdown Voltage                            | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                   |                                               | 600  | -    | -         | V                           |
| $V_{DS}$ Temperature Coefficient                          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$                                                                                          |                                               | -    | 0.70 | -         | $\text{V}/^{\circ}\text{C}$ |
| Gate-Source Threshold Voltage (N)                         | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                       |                                               | 2    | -    | 4         | V                           |
| Gate-Source Leakage                                       | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                                               |                                               | -    | -    | $\pm 100$ | nA                          |
|                                                           |                     | $V_{GS} = \pm 30\text{ V}$                                                                                                                               |                                               | -    | -    | $\pm 1$   | $\mu\text{A}$               |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{DS} = 650\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                          |                                               | -    | -    | 1         | $\mu\text{A}$               |
|                                                           |                     | $V_{DS} = 520\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                                    |                                               | -    | -    | 25        |                             |
| Drain-Source On-State Resistance                          | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$                                                                                                                                   | $I_D = 24\text{ A}$                           | -    | 0.06 | -         | $\Omega$                    |
| Forward Transconductance                                  | $g_{fs}$            | $V_{DS} = 30\text{ V}$ , $I_D = 24\text{ A}$                                                                                                             |                                               | -    | 16.7 | -         | S                           |
| Dynamic                                                   |                     |                                                                                                                                                          |                                               |      |      |           |                             |
| Input Capacitance                                         | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 100\text{ V}$ ,<br>$f = 1\text{ MHz}$                                                                               |                                               | -    | 5682 | -         | pF                          |
| Output Capacitance                                        | $C_{oss}$           |                                                                                                                                                          |                                               | -    | 251  | -         |                             |
| Reverse Transfer Capacitance                              | $C_{rss}$           |                                                                                                                                                          |                                               | -    | 1    | -         |                             |
| Effective Output Capacitance, Energy Related <sup>a</sup> | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 520\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                           |                                               | -    | 192  | -         |                             |
| Effective Output Capacitance, Time Related <sup>b</sup>   | $C_{o(tr)}$         |                                                                                                                                                          |                                               | -    | 665  | -         |                             |
| Total Gate Charge                                         | $Q_g$               | $V_{GS} = 10\text{ V}$                                                                                                                                   | $I_D = 24\text{ A}$ , $V_{DS} = 520\text{ V}$ | -    | 182  | 273       | nC                          |
| Gate-Source Charge                                        | $Q_{gs}$            |                                                                                                                                                          |                                               | -    | 46   | -         |                             |
| Gate-Drain Charge                                         | $Q_{gd}$            |                                                                                                                                                          |                                               | -    | 79   | -         |                             |
| Turn-On Delay Time                                        | $t_{d(on)}$         | $V_{DD} = 520\text{ V}$ , $I_D = 6\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$                                                     |                                               | -    | 47   | 94        | ns                          |
| Rise Time                                                 | $t_r$               |                                                                                                                                                          |                                               | -    | 87   | 131       |                             |
| Turn-Off Delay Time                                       | $t_{d(off)}$        |                                                                                                                                                          |                                               | -    | 156  | 234       |                             |
| Fall Time                                                 | $t_f$               |                                                                                                                                                          |                                               | -    | 103  | 206       |                             |
| Gate Input Resistance                                     | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                          |                                               | -    | 0.64 | -         | $\Omega$                    |
| Drain-Source Body Diode Characteristics                   |                     |                                                                                                                                                          |                                               |      |      |           |                             |
| Continuous Source-Drain Diode Current                     | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> |                                               | -    | -    | 47        | A                           |
| Pulsed Diode Forward Current                              | $I_{SM}$            |                                                                                                                                                          |                                               | -    | -    | 139       |                             |
| Diode Forward Voltage                                     | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 24\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                         |                                               | -    | 0.9  | 1.2       | V                           |
| Reverse Recovery Time                                     | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = I_S = 24\text{ A}$ ,<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 25\text{ V}$                             |                                               | -    | 753  | 1506      | ns                          |
| Reverse Recovery Charge                                   | $Q_{rr}$            |                                                                                                                                                          |                                               | -    | 14   | 28        | $\mu\text{C}$               |
| Reverse Recovery Current                                  | $I_{RRM}$           |                                                                                                                                                          |                                               | -    | 28   | -         | A                           |

**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .  
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

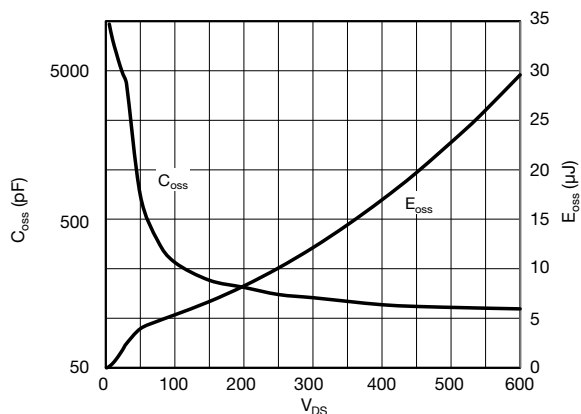
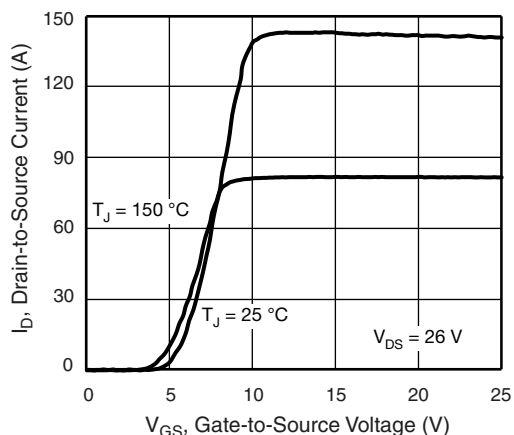
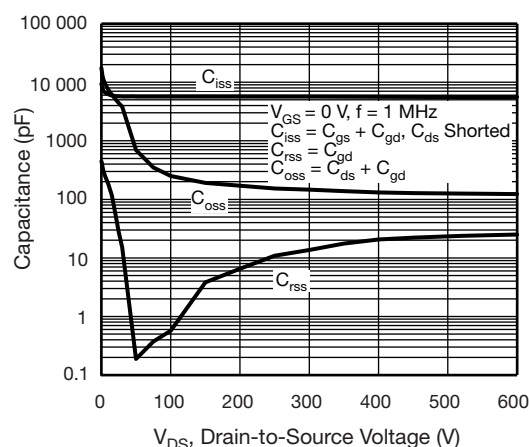
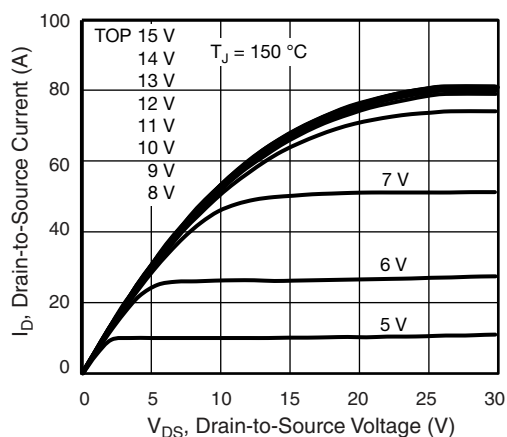
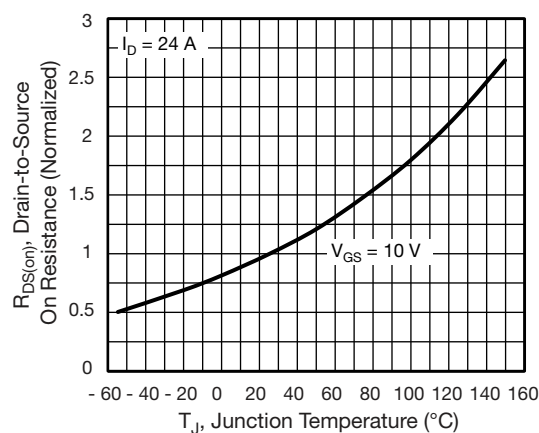
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)




Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage



Fig. 10 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Typical Source-Drain Diode Forward Voltage



Fig. 11 - Temperature vs. Drain-to-Source Voltage

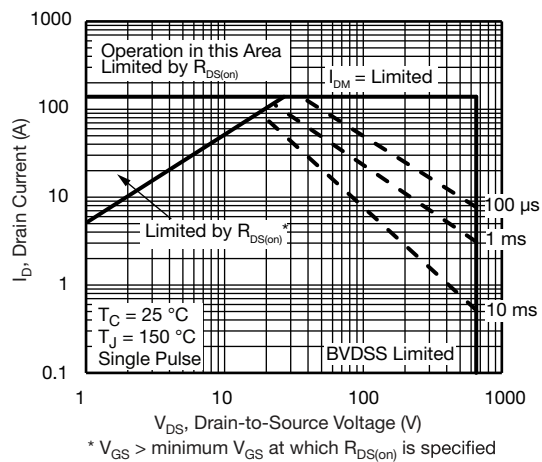


Fig. 9 - Maximum Safe Operating Area



Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case



Fig. 13 - Switching Time Test Circuit



Fig. 16 - Unclamped Inductive Waveforms



Fig. 14 - Switching Time Waveforms

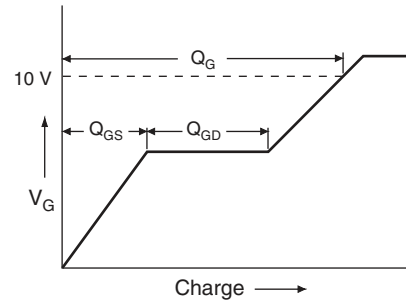


Fig. 17 - Basic Gate Charge Waveform



Fig. 15 - Unclamped Inductive Test Circuit

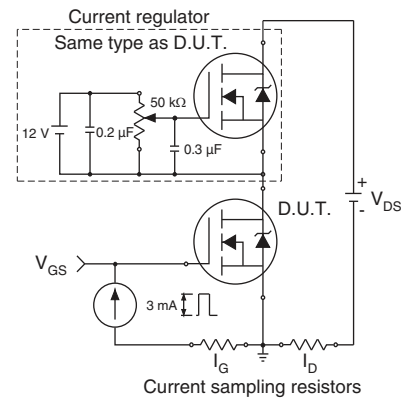


Fig. 18 - Gate Charge Test Circuit

**Note**

a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 19 - For N-Channel**

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