# Product Specification

## QN4406AY

30V N-Channel MOSFET

# FEATURES

30V, 13A

$R_{DS(ON)}$ = 9.5mΩ @ $V_{GS}$ = 10V

$R_{DS(ON)}$ = 14.5mΩ @ $V_{GS}$ = 4.5V

Advanced Trench Technology

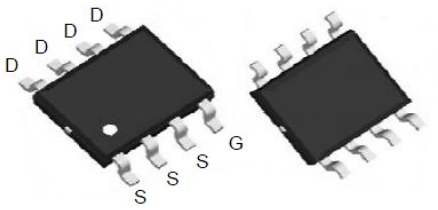
Excellent $R_{DS(ON)}$ and Low Gate Charge

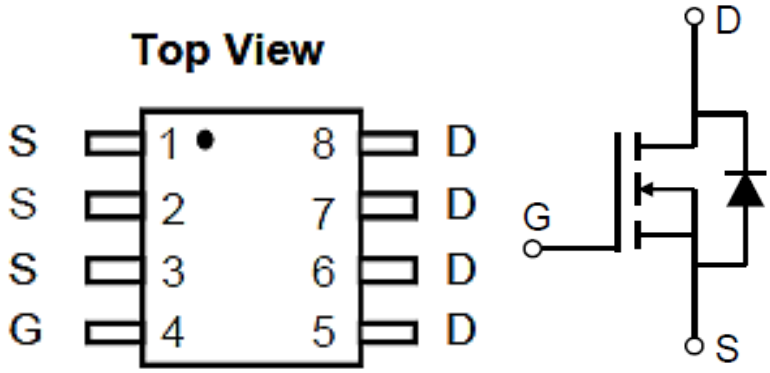
Lead Free

# Applications

- Load Switch
- PWM Application
- Power Management

# Pin Description




| NO. | Symbol | Description |
|---|---|---|
| 1 | S | SOURCE |
| 2 | S | SOURCE |
| 3 | S | SOURCE |
| 4 | G | GATE |
| 5 | D | DRAIN |
| 6 | D | DRAIN |
| 7 | D | DRAIN |
| 8 | D | DRAIN |

# Absolute Maximum Ratings

(@ $T_C$ = 25℃ unless otherwise specified)

| Symbol | Parameter | | Value | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | | 30 | V |
| $V_{GS}$ | Gate-to-Source Voltage | | ±20 | V |
| $I_D$ | Continuous Drain Current | $T_A$ = 25℃ | 13 | A |
| | | $T_A$ = 100℃ | 8 | |
| $I_{DM}$ | Pulsed Drain Current (1) | | 52 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (2) | | 36 | mJ |
| $P_D$ | Power Dissipation | $T_A$ = 25℃ | 1.6 | W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient(3) | | 77 | ℃/W |
| $T_J$, $T_{STG}$ | Junction & Storage Temperature Range | | -55 to 150 | ℃ |

# Electrical Characteristics

($T_J$=25℃ unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $I_D$=250uA, $V_{GS}$=0V | 30 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=30V, $V_{GS}$=0V | - | - | 1.0 | uA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$=0V, $V_{GS}$=±20V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=250uA | 1.2 | 1.6 | 2.2 | V |
| $R_{DS(ON)}$ | Static Drain-Source ON-Resistance(4) | $V_{GS}$=10V, $I_D$=13A | - | 9.5 | 12 | mΩ |
| | | $V_{GS}$=4.5V, $I_D$=10A | - | 14.5 | 20 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V,$V_{DS}$=15V, f=1MHz | - | 1002 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 131 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 105 | - | pF |
| $Q_g$ | Total Gate Charge | $V_{GS}$=0~10V, $V_{DD}$=15V, $I_D$=13A | - | 20 | - | nC |
| $Q_{gs}$ | Gate Source Charge | | - | 4 | - | nC |
| $Q_{gd}$ | Gate Drain("Miller") Charge | | - | 5 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On DelayTime | $V_{GS}$=10V,$V_{DD}$=15V $I_D$=13A, $R_{GEN}$=3Ω | - | 6 | - | ns |
| $t_r$ | Turn-On Rise Time | | - | 19 | - | ns |
| $t_{d(off)}$ | Turn-Off DelayTime | | - | 22 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 5 | - | ns |
| **Drain-Source Diode Characteristics and Max Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 13 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 52 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$=0V, $I_S$=13A | - | - | 1.2 | V |
| trr | Body Diode Reverse Recovery Time | $I_F$=13A, di/dt=100A/μs | - | 8 | - | ns |
| Qrr | Body Diode Reverse Recovery Charge | | - | 2 | - | nC |

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.

2. $E_{AS}$ condition: Starting $T_J$=25℃, $V_{DD}$=15V, $V_G$=10V, $R_G$=25Ω, L=0.5mH, $I_{AS}$=12A

3. $R_{\theta JA}$ is measured with the device mounted on a 1 inch$^2$ pad of 2oz copper FR4 PCB

4. Pulse Test: Pulse Width≤300us, Duty Cycle≤0.5%.

# Typical Performance Characteristics

Figure 1: Output Characteristics

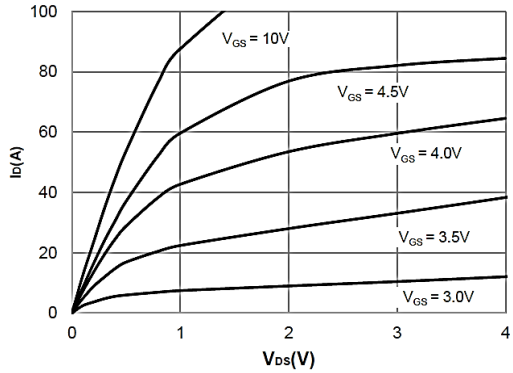



Figure 2: Typical Transfer Characteristics

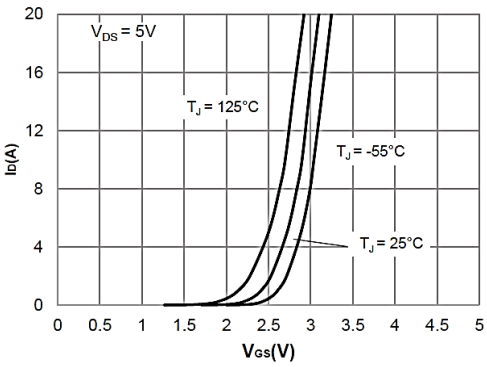



Figure 3: On-resistance vs. Drain Current

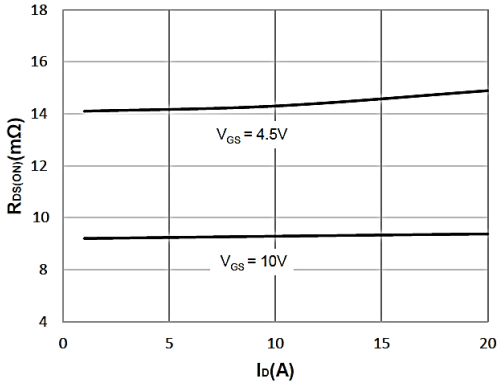



Figure 4: Body Diode Characteristics

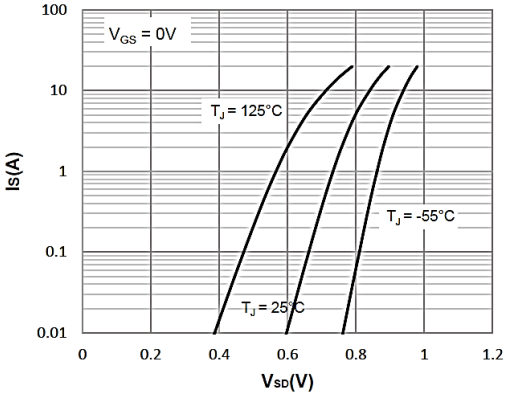



Figure 5: Gate Charge Characteristics

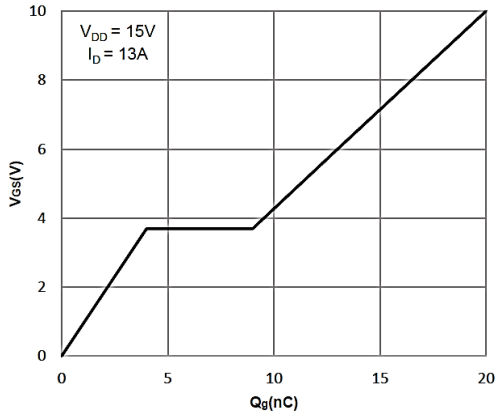



Figure 6: Capacitance Characteristics

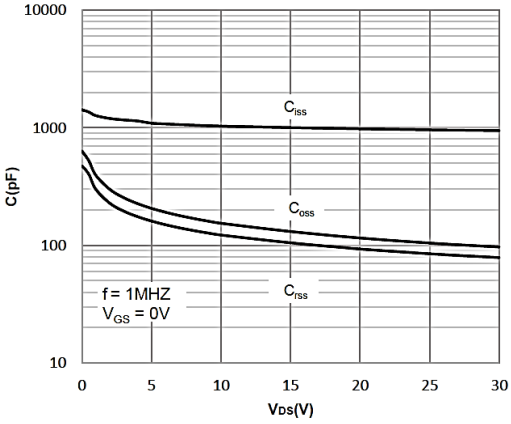



Figure 7: Normalized Breakdown voltage vs. Junction Temperature

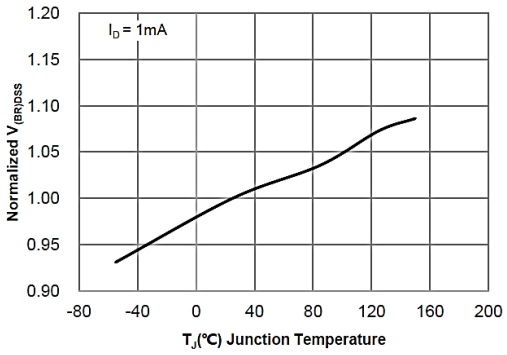



Figure 8: Normalized on Resistance vs. Junction Temperature

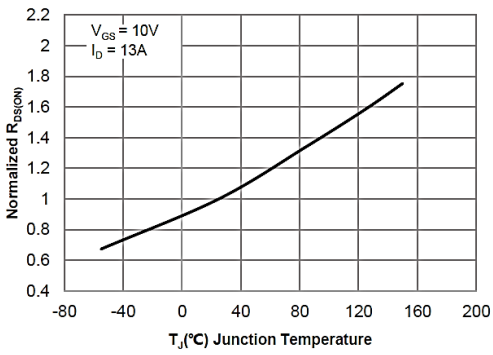


Figure 9: Maximum Safe Operating Area

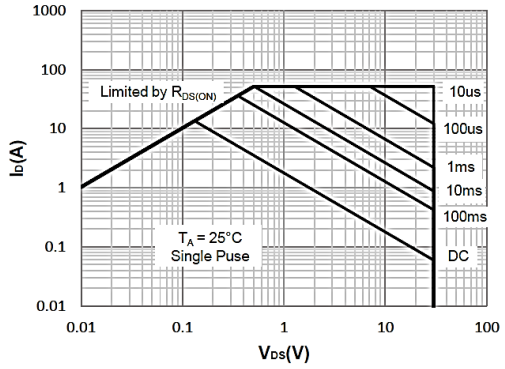



Figure 10: Maximum Continuous Drian Current vs. Ambient Temperature

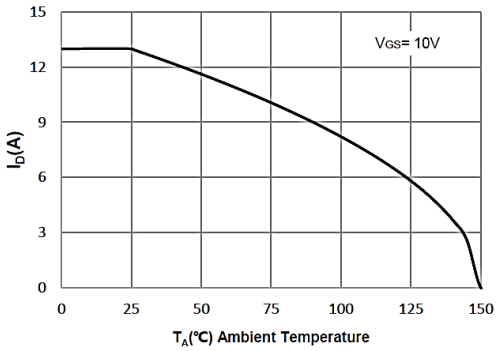



Figure 11: Normalized Maximum Transient Thermal Impedance

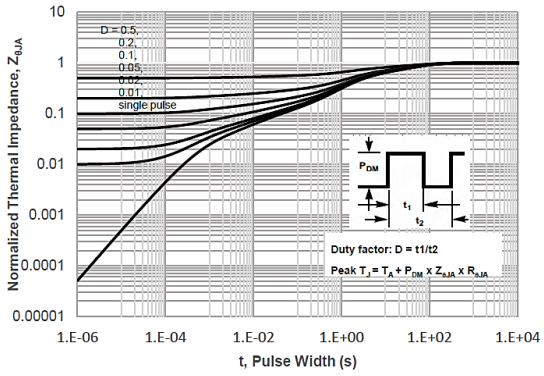
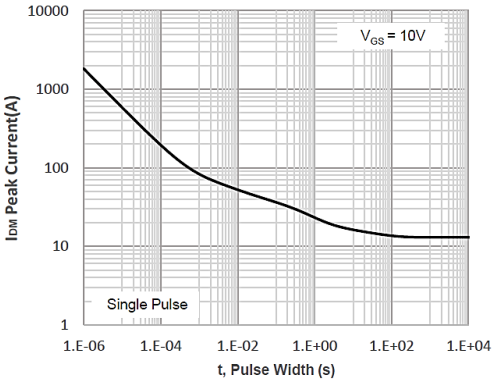



Figure 12: Peak Current Capacity



# Test Circuit

**Figure 1: Gate Charge Test Circuit & Waveform**

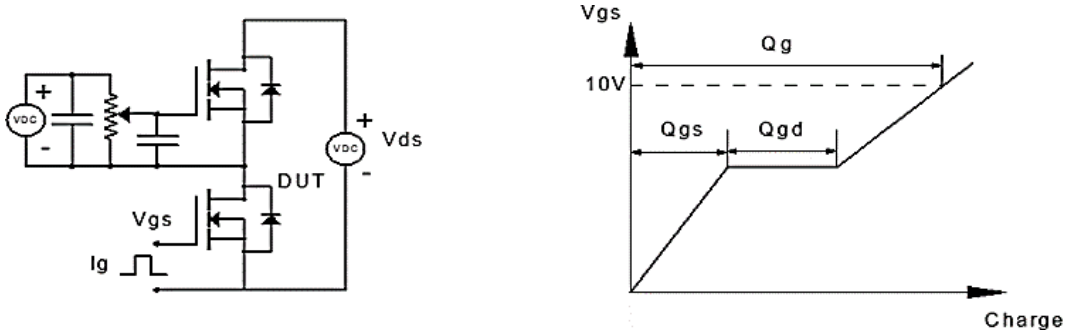



**Figure 2: Resistive Switching Test Circuit & Waveform**

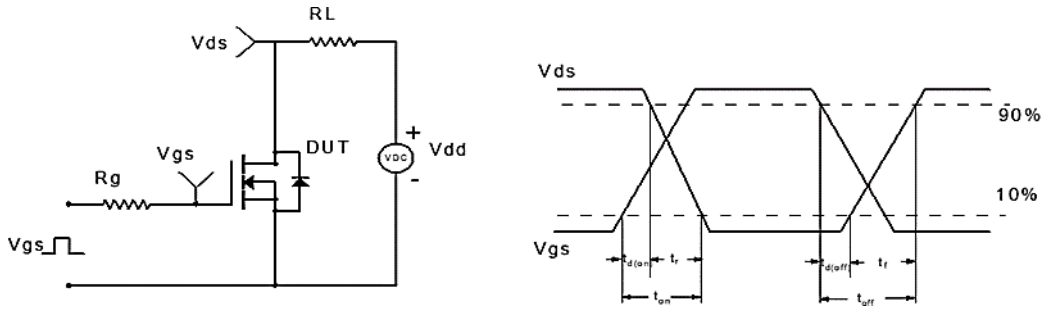



**Figure 3: Unclamped Inductive Switching Test Circuit& Waveform**

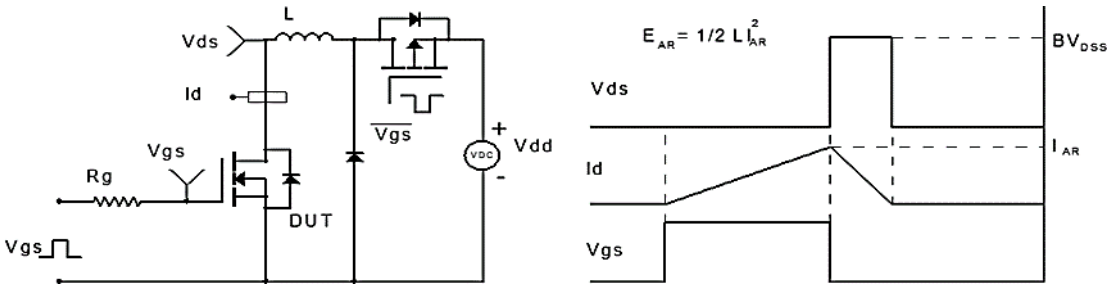
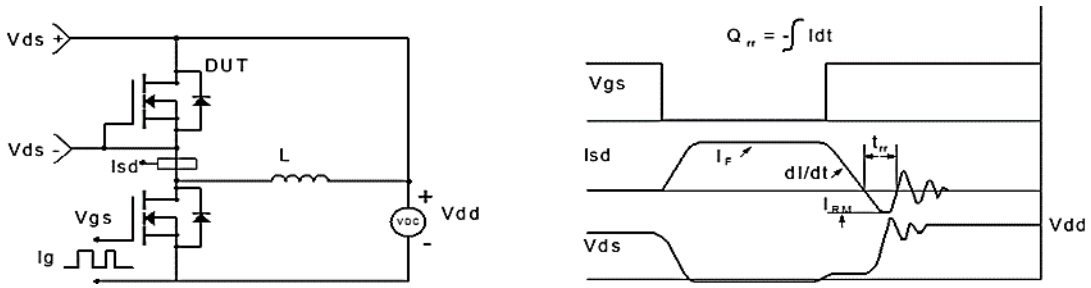
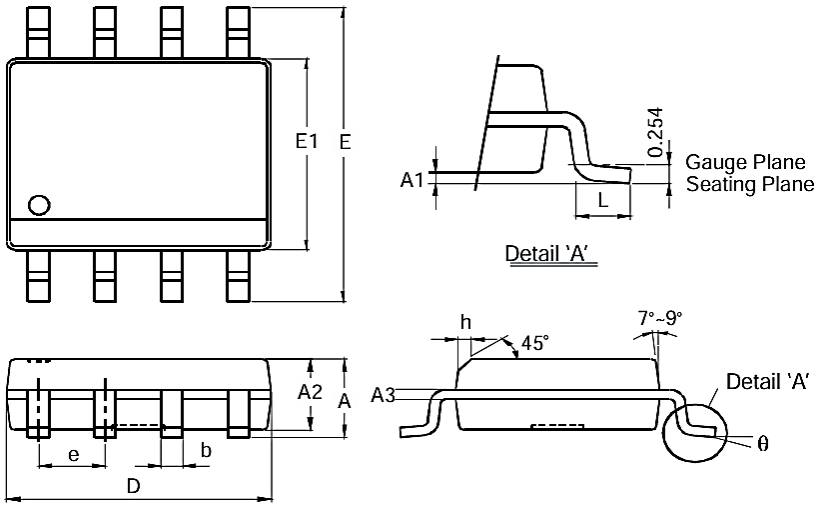



**Figure 4: Diode Recovery Test Circuit & Waveform**



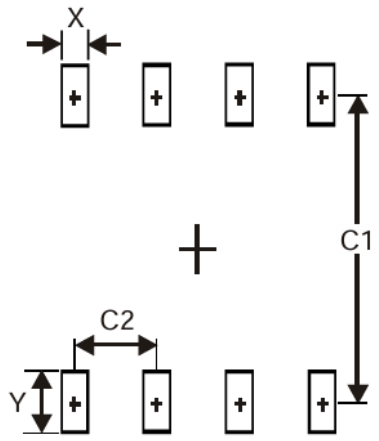
# Package Mechanical Data

## SOP-8




| Dim | Min(mm) | Max(mm) |
|---|---|---|
| A | - | 1.75 |
| A1 | 0.10 | 0.20 |
| A2 | 1.30 | 1.50 |
| A3 | 0.15 | 0.25 |
| b | 0.3 | 0.5 |
| D | 4.85 | 4.95 |
| E | 5.90 | 6.10 |
| E1 | 3.85 | 3.95 |
| e | 1.27 Typ | |
| h | - | 0.35 |
| L | 0.62 | 0.82 |
| θ | 0° | 8° |

## suggested Pad Layout




| Dimensions | Value(mm) |
|---|---|
| X | 0.60 |
| Y | 1.55 |
| C1 | 5.4 |
| C2 | 1.27 |

# Ordering information

| Order Code | Package | $V_{DS}$(V) | $I_D$(A) | $R_{DS(ON)}$( m Ω ) | |
|---|---|---|---|---|---|
| QN4406AY | SOP-8 | 30 | 13 | $V_{GS}$=10V | 9.5 |
| | | | | $V_{GS}$=4.5V | 14.5 |