



## Description

The Si4178DY-T1-GE3 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.

## General Features

$V_{DS} = 30V$   $I_D = 8.5A$

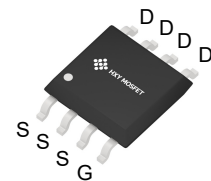
$R_{DS(ON)} < 18m\Omega$  @  $V_{GS}=10V$

## Application

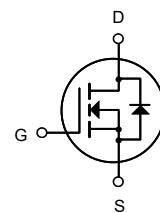
Battery protection

Load switch

Uninterruptible power supply



SOP-8  
(SOIC-8)



N-Channel MOSFET

## Package Marking and Ordering Information

| Product ID      | Pack          | Brand      | Qty(PCS) |
|-----------------|---------------|------------|----------|
| Si4178DY-T1-GE3 | SOP-8(SOIC-8) | HXY MOSFET | 3000     |

## Absolute Maximum Ratings ( $T_A = 25^\circ C$ unless otherwise noted)

| Symbol                   | Parameter                                                         | Rating     | Units        |
|--------------------------|-------------------------------------------------------------------|------------|--------------|
| $V_{DS}$                 | Drain-Source Voltage                                              | 30         | V            |
| $V_{GS}$                 | Gate-Source Voltage                                               | $\pm 20$   | V            |
| $I_D @ T_A = 25^\circ C$ | Continuous Drain Current <sup>1</sup>                             | 8.5        | A            |
| $I_D @ T_A = 70^\circ C$ | Continuous Drain Current <sup>1</sup>                             | 5.6        | A            |
| $I_{DM}$                 | Pulsed Drain Current <sup>2</sup>                                 | 35         | A            |
| EAS                      | Single Pulse Avalanche Energy <sup>3</sup>                        | 20         | mJ           |
| $I_{AS}$                 | Avalanche Current                                                 | 20         | A            |
| $P_D @ T_A = 25^\circ C$ | Total Power Dissipation <sup>4</sup>                              | 1.5        | W            |
| $T_{STG}$                | Storage Temperature Range                                         | -55 to 150 | $^\circ C$   |
| $T_J$                    | Operating Junction Temperature Range                              | -55 to 150 | $^\circ C$   |
| $R_{\theta JA}$          | Thermal Resistance Junction-ambient <sup>1</sup> ( $t \leq 10s$ ) | 85         | $^\circ C/W$ |
|                          | Thermal Resistance Junction-ambient <sup>1</sup>                  | 25         | $^\circ C/W$ |



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

| Symbol                       | Parameter                                      | Conditions                                                | Min. | Typ.  | Max.      | Unit                |
|------------------------------|------------------------------------------------|-----------------------------------------------------------|------|-------|-----------|---------------------|
| $BV_{DSS}$                   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V$ , $I_D=250\mu A$                              | 30   | ---   | ---       | V                   |
| $\Delta BV_{DSS}/\Delta T_J$ | BVDSS Temperature Coefficient                  | Reference to $25^\circ\text{C}$ , $I_D=1mA$               | ---  | 0.034 | ---       | $V/^\circ\text{C}$  |
| $R_{DS(ON)}$                 | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=10V$ , $I_D=7A$                                   | ---  | 14    | 18        | $m\Omega$           |
|                              |                                                | $V_{GS}=4.5V$ , $I_D=4A$                                  | ---  | 20    | 26        |                     |
| $V_{GS(th)}$                 | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=250\mu A$                          | 1.2  | 1.5   | 2.5       | V                   |
| $\Delta V_{GS(th)}$          | $V_{GS(th)}$ Temperature Coefficient           |                                                           | ---  | -3.84 | ---       | $mV/^\circ\text{C}$ |
| $I_{DSS}$                    | Drain-Source Leakage Current                   | $V_{DS}=24V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$       | ---  | ---   | 1         | $\mu A$             |
|                              |                                                | $V_{DS}=24V$ , $V_{GS}=0V$ , $T_J=55^\circ\text{C}$       | ---  | ---   | 5         |                     |
| $I_{GSS}$                    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V$ , $V_{DS}=0V$                            | ---  | ---   | $\pm 100$ | nA                  |
| $g_{fs}$                     | Forward Transconductance                       | $V_{DS}=5V$ , $I_D=7A$                                    | ---  | 6.2   | ---       | S                   |
| $R_g$                        | Gate Resistance                                | $V_{DS}=0V$ , $V_{GS}=0V$ , $f=1MHz$                      | ---  | 1.04  | 2.1       | $\Omega$            |
| $Q_g$                        | Total Gate Charge (4.5V)                       | $V_{DS}=15V$ , $V_{GS}=4.5V$ , $I_D=7A$                   | ---  | 6     | 8.4       | nC                  |
| $Q_{gs}$                     | Gate-Source Charge                             |                                                           | ---  | 2.2   | 3.1       |                     |
| $Q_{gd}$                     | Gate-Drain Charge                              |                                                           | ---  | 2     | 2.8       |                     |
| $T_{d(on)}$                  | Turn-On Delay Time                             | $V_{DD}=15V$ , $V_{GS}=10V$ , $R_G=3.3\Omega$<br>$I_D=7A$ | ---  | 1.2   | 2.4       | ns                  |
| $T_r$                        | Rise Time                                      |                                                           | ---  | 40    | 72.0      |                     |
| $T_{d(off)}$                 | Turn-Off Delay Time                            |                                                           | ---  | 18    | 36.0      |                     |
| $T_f$                        | Fall Time                                      |                                                           | ---  | 7.2   | 14.4      |                     |
| $C_{iss}$                    | Input Capacitance                              | $V_{DS}=15V$ , $V_{GS}=0V$ , $f=1MHz$                     | ---  | 583   | 816.2     | pF                  |
| $C_{oss}$                    | Output Capacitance                             |                                                           | ---  | 77    | 107.8     |                     |
| $C_{rss}$                    | Reverse Transfer Capacitance                   |                                                           | ---  | 59    | 82.6      |                     |
| $I_S$                        | Continuous Source Current <sup>1,5</sup>       | $V_G=V_D=0V$ , Force Current                              | ---  | ---   | 7         | A                   |
| $I_{SM}$                     | Pulsed Source Current <sup>2,5</sup>           |                                                           | ---  | ---   | 35        | A                   |
| $V_{SD}$                     | Diode Forward Voltage <sup>2</sup>             | $V_{GS}=0V$ , $I_S=1A$ , $T_J=25^\circ\text{C}$           | ---  | ---   | 1.2       | V                   |
| $t_{rr}$                     | Reverse Recovery Time                          | $I_F=7A$ , $dI/dt=100A/\mu s$ , $T_J=25^\circ\text{C}$    | ---  | 7.2   | ---       | nS                  |
| $Q_{rr}$                     | Reverse Recovery Charge                        |                                                           | ---  | 2.9   | ---       | nC                  |

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed , pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
- 3.The EAS data shows Max. rating . The test condition is  $V_{DD}=25V$ ,  $V_{GS}=10V$ ,  $L=0.1mH$ ,  $I_{AS}=20A$
- 4.The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
- 5.The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.



## Typical Characteristics

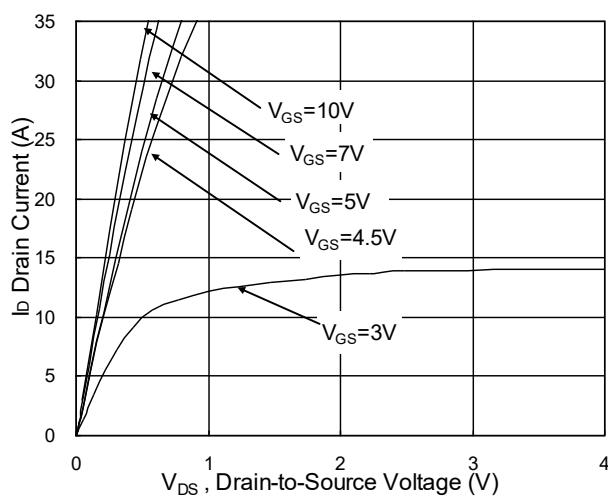


Fig.1 Typical Output Characteristics

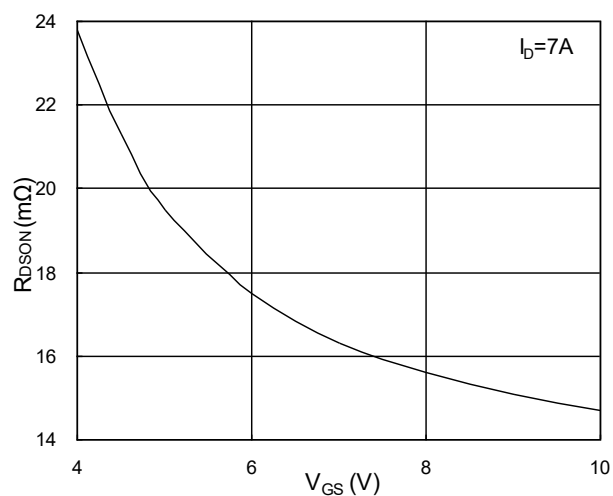


Fig.2 On-Resistance vs. Gate-Source

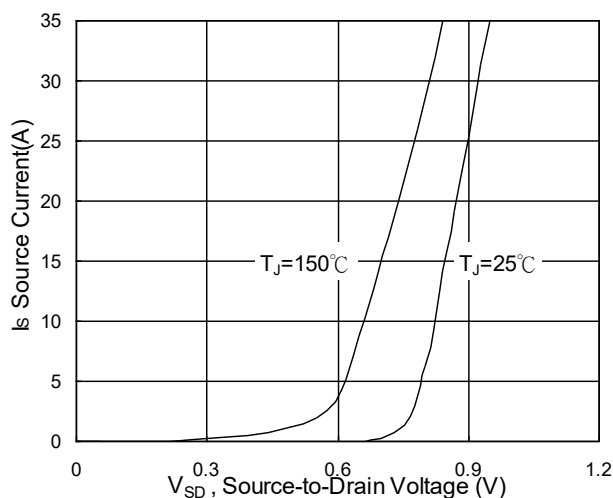


Fig.3 Forward Characteristics Of Reverse

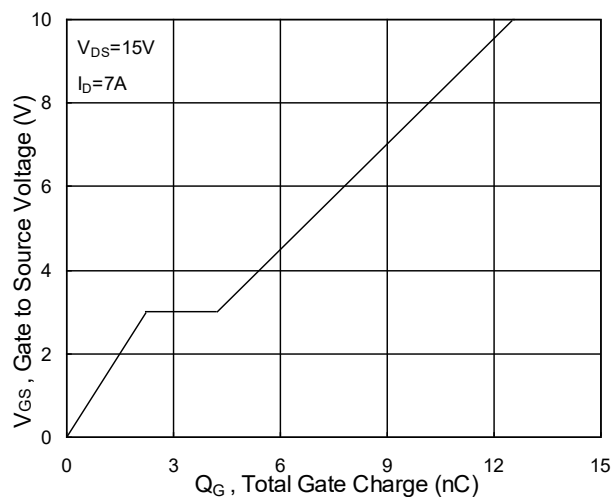


Fig.4 Gate-Charge Characteristics

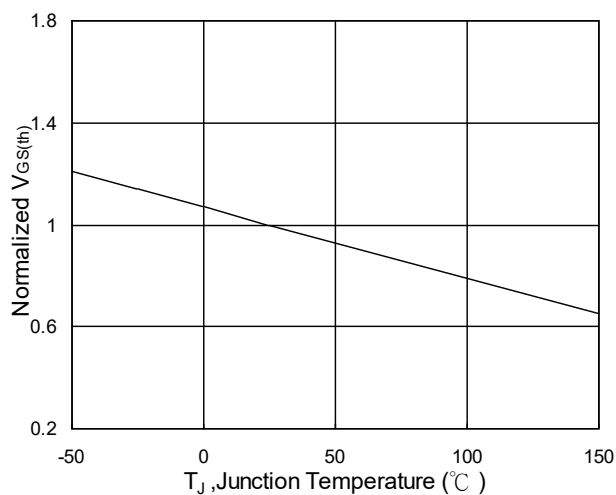


Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$

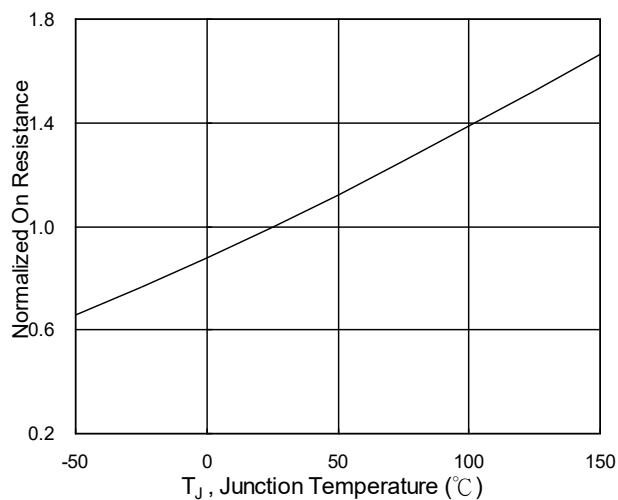


Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$

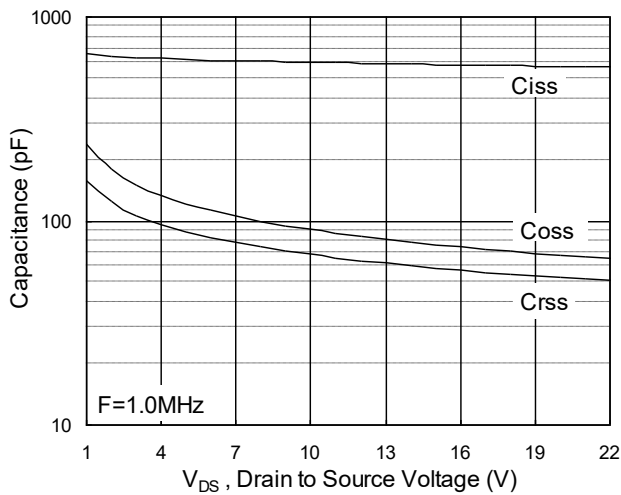


Fig.7 Capacitance

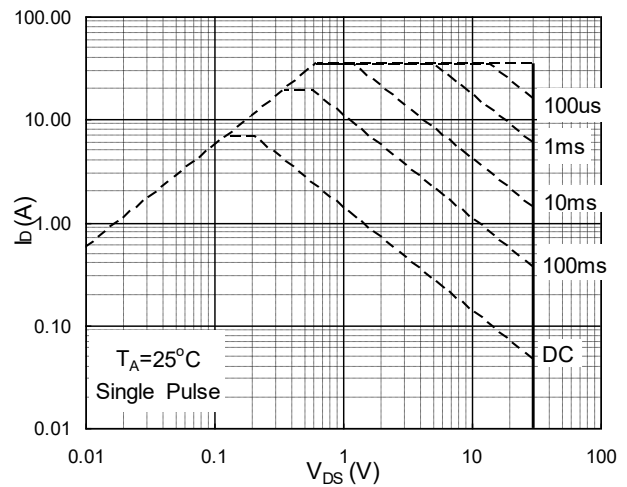


Fig.8 Safe Operating Area

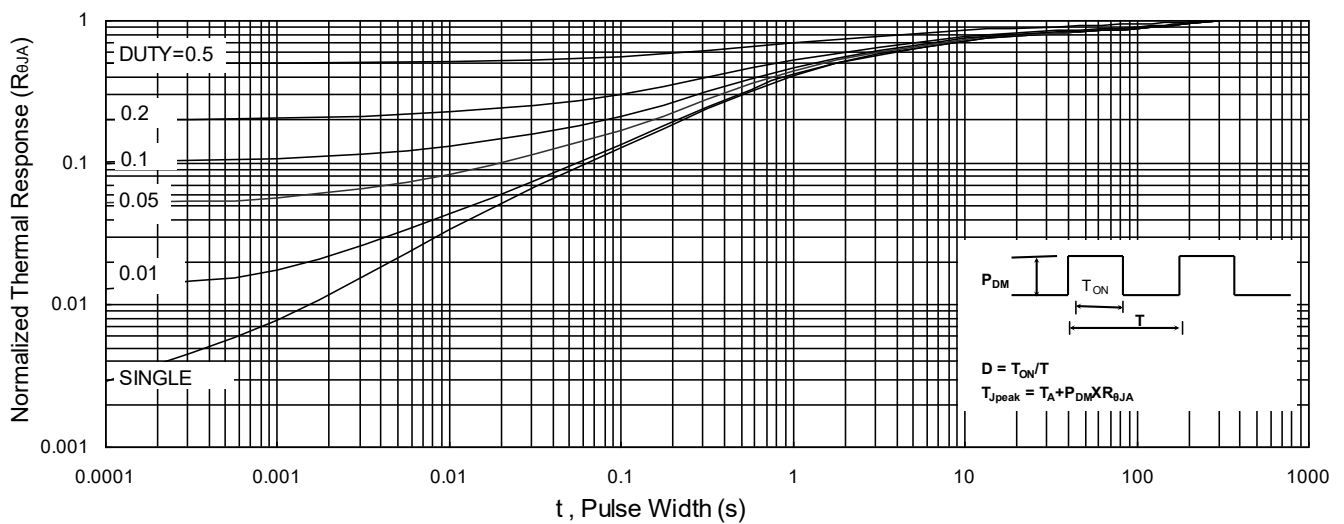


Fig.9 Normalized Maximum Transient Thermal Impedance

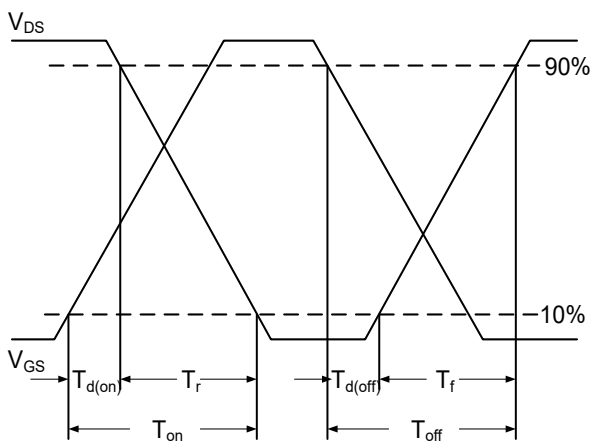


Fig.10 Switching Time Waveform

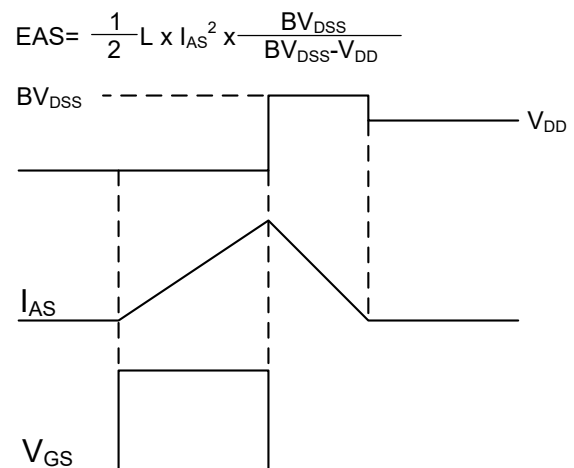


Fig.11 Unclamped Inductive Switching Waveform



## SOP-8(SOIC-8) Package Outline Dimensions



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.350                     | 1.750 | 0.053                | 0.069 |
| A1     | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2     | 1.350                     | 1.550 | 0.053                | 0.061 |
| b      | 0.330                     | 0.510 | 0.013                | 0.020 |
| c      | 0.170                     | 0.250 | 0.007                | 0.010 |
| D      | 4.800                     | 5.000 | 0.189                | 0.197 |
| e      | 1.270 (BSC)               |       | 0.050 (BSC)          |       |
| E      | 5.800                     | 6.200 | 0.228                | 0.244 |
| E1     | 3.800                     | 4.000 | 0.150                | 0.157 |
| L      | 0.400                     | 1.270 | 0.016                | 0.050 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |



Note:  
1. Controlling dimension; in millimeters.  
2. General tolerance:  $\pm 0.05\text{mm}$ .  
3. The pad layout is for reference purposes only.



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