

# FMR23N50ES

FUJI POWER MOSFET

## Super FAP-E<sup>3S</sup> series

N-CHANNEL SILICON POWER MOSFET

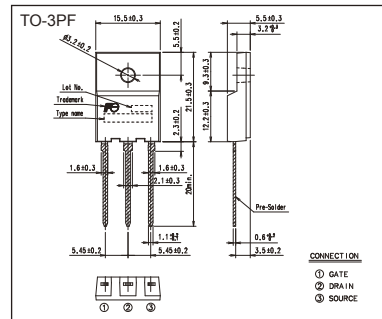
### ■ Features

- Maintains both low power loss and low noise
- Lower R<sub>DS(on)</sub> characteristic
- More controllable switching dv/dt by gate resistance
- Smaller V<sub>GS</sub> ringing waveform during switching
- Narrow band of the gate threshold voltage (4.2±0.5V)
- High avalanche durability

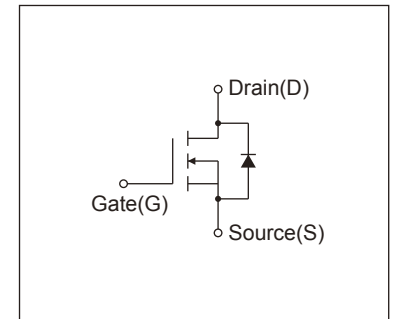
### ■ Applications

- Switching regulators
- UPS (Uninterruptible Power Supply)
- DC-DC converters

### ■ Outline Drawings [mm]



### ■ Equivalent circuit schematic



### ■ Maximum Ratings and Characteristics

#### ● Absolute Maximum Ratings at T<sub>c</sub>=25°C (unless otherwise specified)

| Description   | Symbol            | Characteristics | Unit  | Remarks                |
|---|-------------------|-----------------|-------|------------------------|
| Drain-Source Voltage                                    | V <sub>DS</sub>   | 500             | V     |                        |
|   | V <sub>D SX</sub> | 500             | V     | V <sub>GS</sub> = -30V |
| Continuous Drain Current                                | I <sub>D</sub>    | ±23             | A     |                        |
| Pulsed Drain Current                                    | I <sub>D P</sub>  | ±92             | A     |                        |
| Gate-Source Voltage                                     | V <sub>GS</sub>   | ±30             | V     |                        |
| Repetitive and Non-Repetitive Maximum Avalanche Current | I <sub>AR</sub>   | 23              | A     | Note*1                 |
| Non-Repetitive Maximum Avalanche Energy                 | E <sub>AS</sub>   | 767.3           | mJ    | Note*2                 |
| Repetitive Maximum Avalanche Energy                     | E <sub>AR</sub>   | 15              | mJ    | Note*3                 |
| Peak Diode Recovery dv/dt                               | dv/dt             | 5.4             | kV/μs | Note*4                 |
| Peak Diode Recovery -di/dt                              | -di/dt            | 100             | A/μs  | Note*5                 |
| Maximum Power Dissipation                               | P <sub>D</sub>    | 3.13            | W     | T <sub>a</sub> =25°C   |
|   |                   | 130             |       | T <sub>c</sub> =25°C   |
| Operating and Storage Temperature range                 | T <sub>ch</sub>   | 150             | °C    |                        |
|   | T <sub>stg</sub>  | -55 to + 150    | °C    |                        |
| Isolation Voltage                                       | V <sub>ISO</sub>  | 2               | kVrms | t = 60sec, f = 60Hz    |

#### ● Electrical Characteristics at T<sub>c</sub>=25°C (unless otherwise specified)

| Description                      | Symbol               | Conditions  | min. | typ.  | max.  | Unit |
|----------------------------------|----------------------|---|------|-------|-------|------|
| Drain-Source Breakdown Voltage   | BV <sub>DSS</sub>    | I <sub>D</sub> =250μA, V <sub>GS</sub> =0V                      | 500  | -     | -     | V    |
| Gate Threshold Voltage           | V <sub>GS</sub> (th) | I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>         | 3.7  | 4.2   | 4.7   | V    |
| Zero Gate Voltage Drain Current  | I <sub>DSS</sub>     | V <sub>DS</sub> =500V, V <sub>GS</sub> =0V                      | -    | -     | 25    | μA   |
|                                  |                      | V <sub>DS</sub> =400V, V <sub>GS</sub> =0V                      | -    | -     | 250   |      |
| Gate-Source Leakage Current      | I <sub>GSS</sub>     | V <sub>GS</sub> =±30V, V <sub>DS</sub> =0V                      | -    | 10    | 100   | nA   |
| Drain-Source On-State Resistance | R <sub>DS</sub> (on) | I <sub>D</sub> =11.5A, V <sub>GS</sub> =10V                     | -    | 0.209 | 0.245 | Ω    |
| Forward Transconductance         | g <sub>fs</sub>      | I <sub>D</sub> =11.5A, V <sub>DS</sub> =25V                     | 8.5  | 17    | -     | S    |
| Input Capacitance                | C <sub>iss</sub>     | V <sub>DS</sub> =25V  | -    | 2700  | 4050  | pF   |
| Output Capacitance               | C <sub>oss</sub>     | V <sub>GS</sub> =0V   | -    | 330   | 495   |      |
| Reverse Transfer Capacitance     | C <sub>rss</sub>     | f=1MHz  | -    | 20    | 30    |      |
| Turn-On Time                     | td(on)               | V <sub>cc</sub> =300V   | -    | 42    | 63    | ns   |
|                                  | tr                   | V <sub>GS</sub> =10V  | -    | 36    | 54    |      |
| Turn-Off Time                    | td(off)              | I <sub>D</sub> =11.5A   | -    | 94    | 141   |      |
|                                  | tf                   | R <sub>GS</sub> =10Ω  | -    | 17    | 25.5  |      |
| Total Gate Charge                | Q <sub>G</sub>       | V <sub>cc</sub> =250V   | -    | 73    | 109.5 | nC   |
| Gate-Source Charge               | Q <sub>GS</sub>      | I <sub>D</sub> =23A   | -    | 24    | 36    |      |
| Gate-Drain Charge                | Q <sub>GD</sub>      | V <sub>GS</sub> =10V  | -    | 27    | 40.5  |      |
| Gate-Drain Crossover Charge      | Q <sub>SW</sub>      |   | -    | 10    | 15    |      |
| Avalanche Capability             | I <sub>AV</sub>      | L=1.16mH, T <sub>ch</sub> =25°C                                 | 23   | -     | -     | A    |
| Diode Forward On-Voltage         | V <sub>SD</sub>      | I <sub>F</sub> =23A, V <sub>GS</sub> =0V, T <sub>ch</sub> =25°C | -    | 0.90  | 1.35  | V    |
| Reverse Recovery Time            | t <sub>rr</sub>      | I <sub>F</sub> =23A, V <sub>GS</sub> =0V                        | -    | 0.5   | -     | μs   |
| Reverse Recovery Charge          | Q <sub>rr</sub>      | -di/dt=100A/μs, T <sub>ch</sub> =25°C                           | -    | 8.0   | -     | μC   |

#### ● Thermal Characteristics

| Description        | Symbol                 | Test Conditions    | min. | typ. | max.  | Unit |
|--------------------|------------------------|--------------------|------|------|-------|------|
| Thermal resistance | R <sub>th</sub> (ch-c) | Channel to Case    |      |      | 0.830 | °C/W |
|                    | R <sub>th</sub> (ch-a) | Channel to Ambient |      |      | 40.0  | °C/W |

Note \*1 : T<sub>ch</sub>≤150°C.

Note \*2 : Stating T<sub>ch</sub>=25°C, I<sub>AS</sub>=10A, L=14.1mH, V<sub>cc</sub>=50V, R<sub>G</sub>=50Ω.

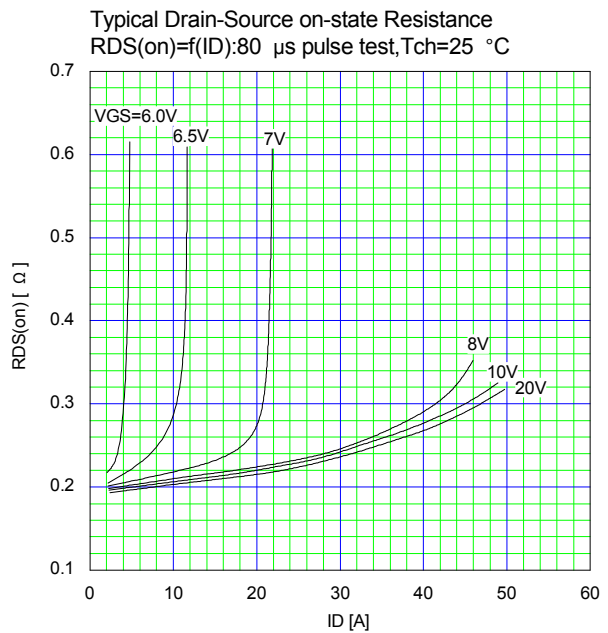
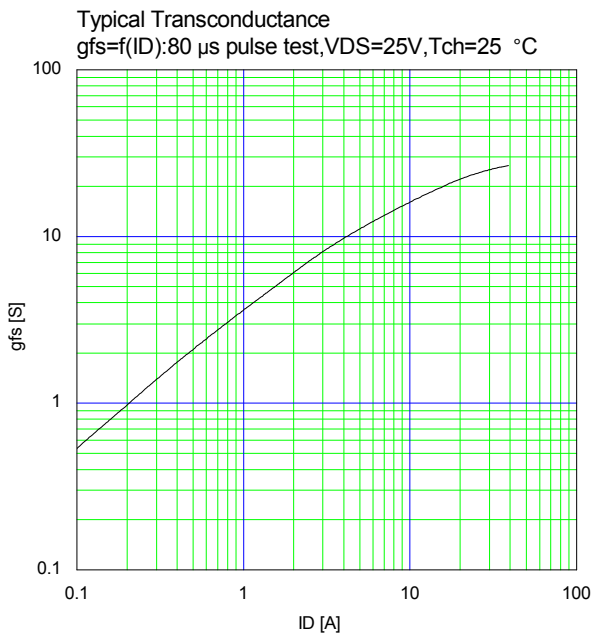
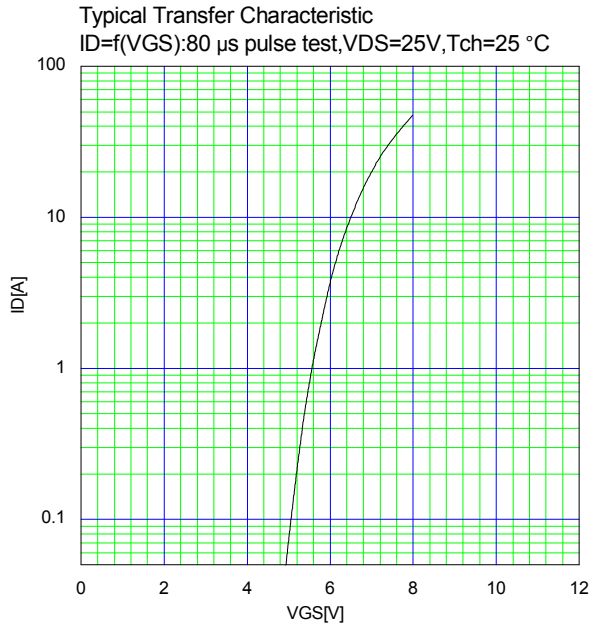
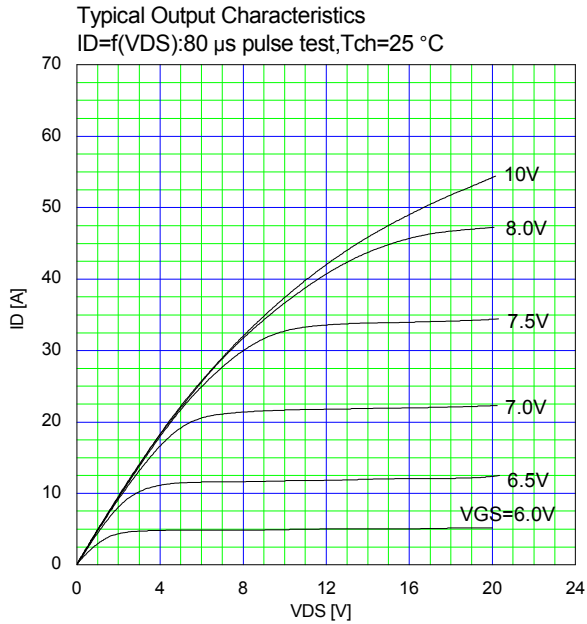
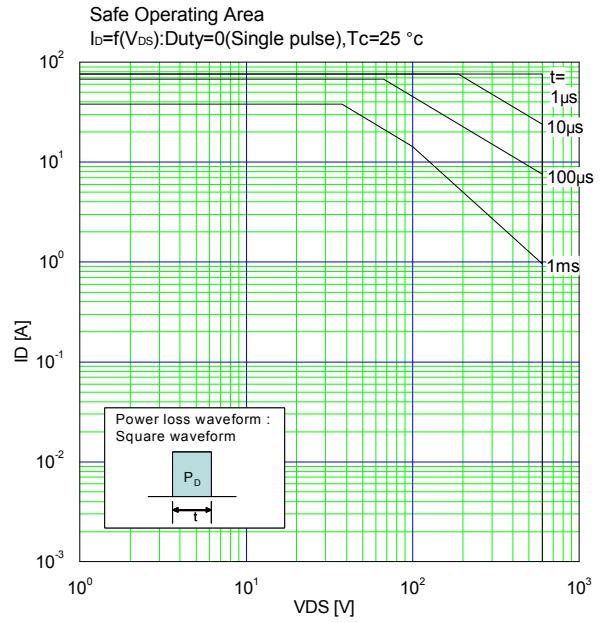
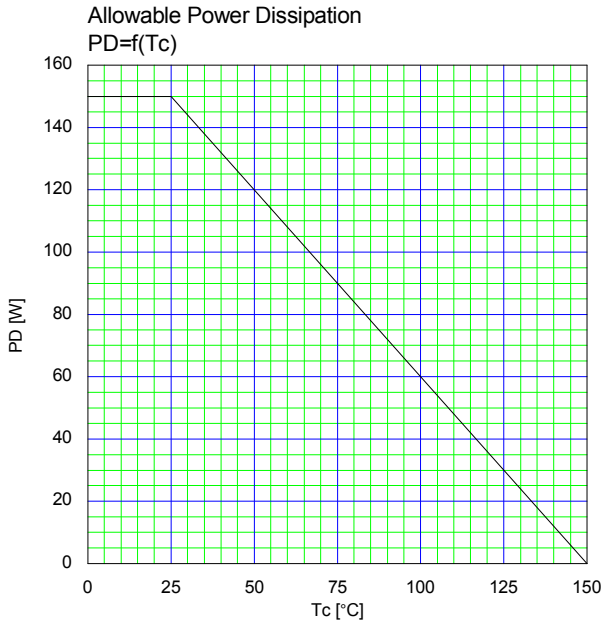
E<sub>AS</sub> limited by maximum channel temperature and avalanche current.  
See to 'Avalanche Energy' graph.

Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.

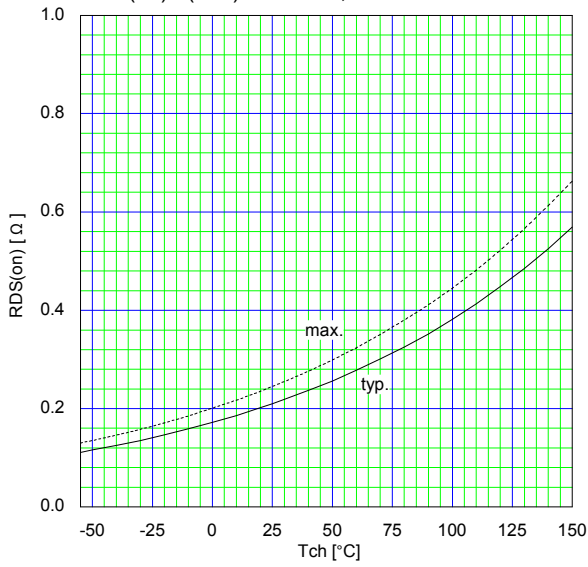
See to the 'Transient Thermal Impedance' graph.

Note \*4 : I<sub>F</sub>≤I<sub>D</sub>, -di/dt=100A/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.

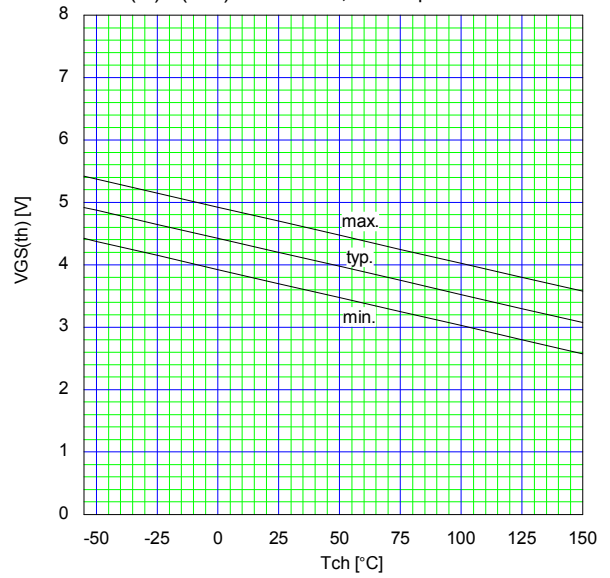
Note \*5 : I<sub>F</sub>≤I<sub>D</sub>, dv/dt=5.4kV/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.



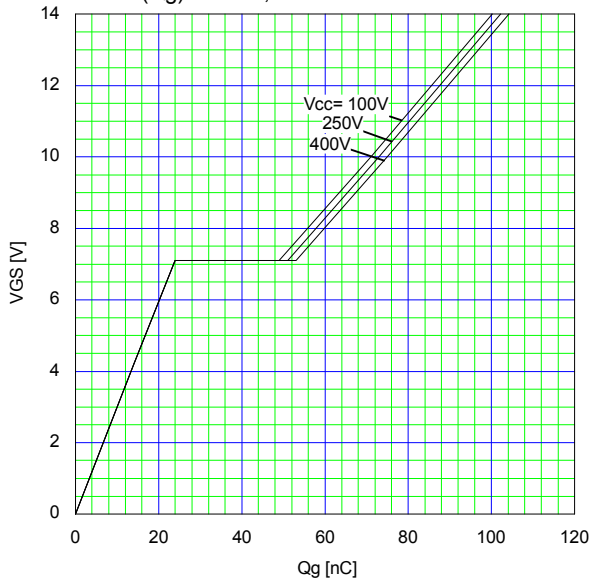
Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_{ch}) : I_D = 11.5A, V_{GS} = 10V$



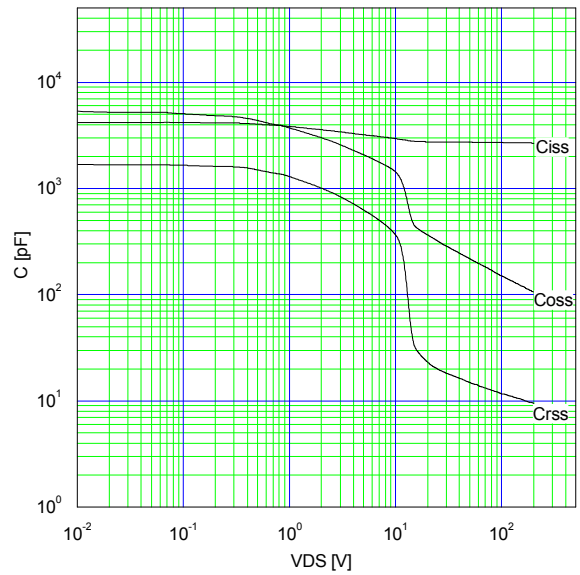
Gate Threshold Voltage vs. T<sub>ch</sub>  
 $V_{GS(th)} = f(T_{ch}) : V_{DS} = V_{GS}, I_D = 250\mu A$



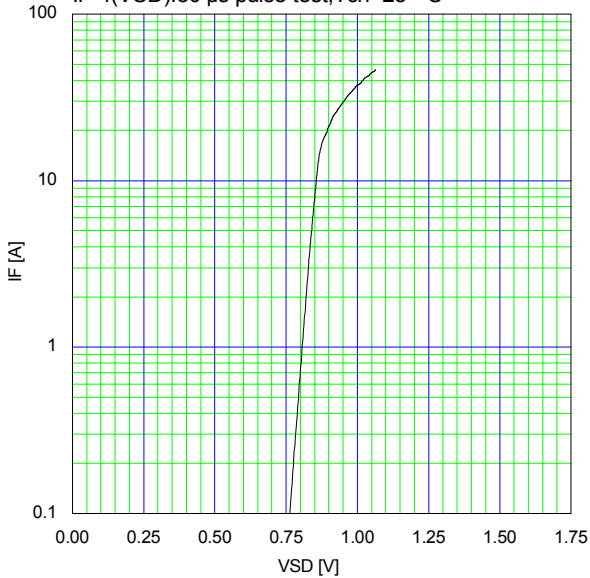
Typical Gate Charge Characteristics  
 $V_{GS} = f(Q_g) : I_D = 23A, T_{ch} = 25\text{ °C}$



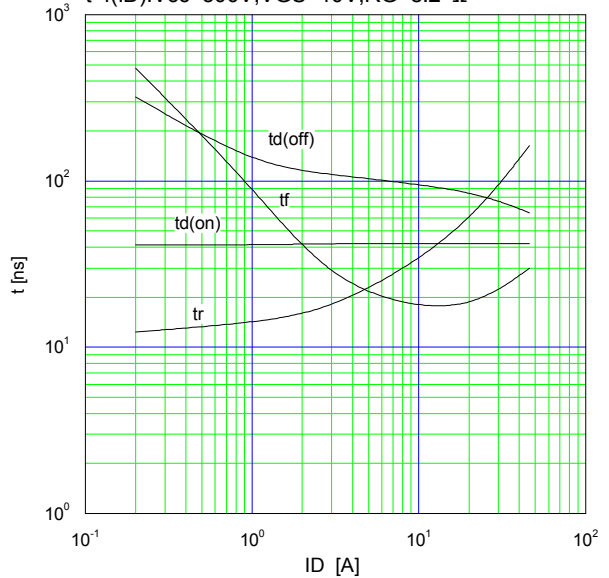
Typical Capacitance  
 $C = f(V_{DS}) : V_{GS} = 0V, f = 1MHz$



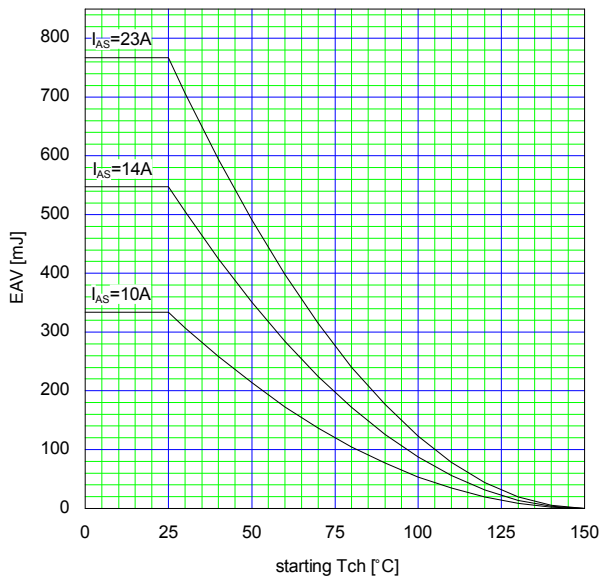
Typical Forward Characteristics of Reverse Diode  
 $I_F = f(V_{SD}) : 80\text{ }\mu s\text{ pulse test}, T_{ch} = 25\text{ °C}$



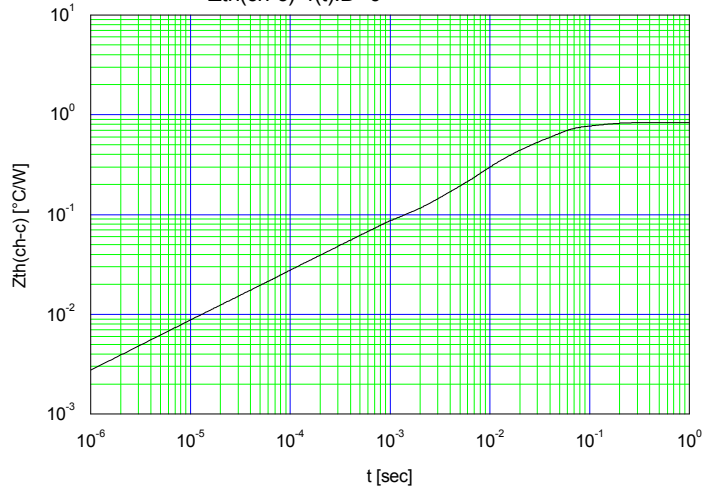
Typical Switching Characteristics vs. I<sub>D</sub>  
 $t = f(I_D) : V_{cc} = 300V, V_{GS} = 10V, R_G = 8.2\text{ }\Omega$



Maximum Avalanche Energy vs. starting Tch  
 $E(AV)=f(\text{starting Tch}):V_{CC}=50V, I(AV)\leq 23A$



Maximum Transient Thermal Impedance  
 $Z_{th}(ch-c)=f(t):D=0$



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