

# N- AND P-Channel Enhancement Mode Power MOSFET

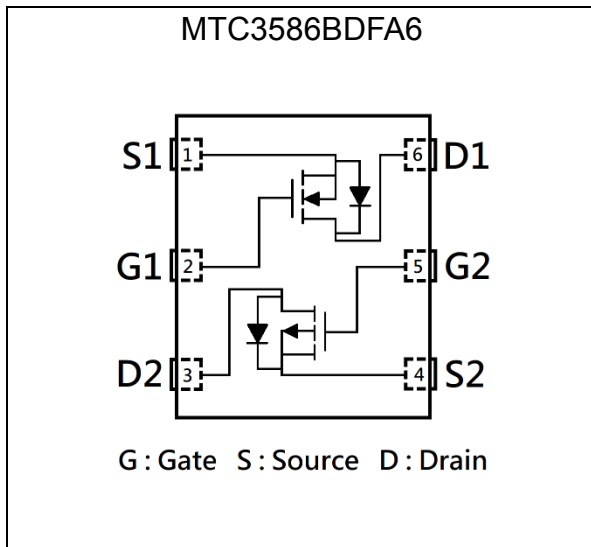
## MTC3586B DFA6

### Features

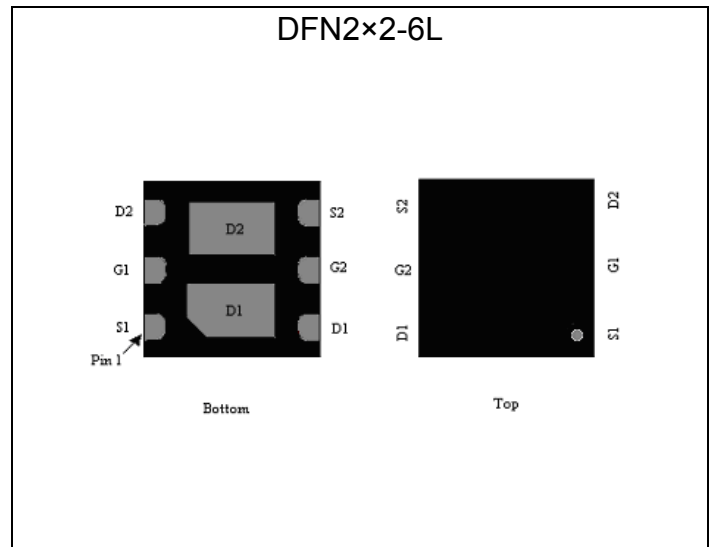
- Low On Resistance
- Low Gate Charge
- Fast Switching Characteristic

|                                      | N-CH         | P-CH          |
|--------------------------------------|--------------|---------------|
| $BV_{DSS}$                           | 20V          | -20V          |
| $I_D@V_{GS}=(-)4.5V, T_C=25^\circ C$ | 8A           | -5.6A         |
| $I_D@V_{GS}=(-)4.5V, T_A=25^\circ C$ | 4.6A         | -3.2A         |
| $R_{DS(ON)typ.}@V_{GS}=(-)4.5V$      | 24m $\Omega$ | 60m $\Omega$  |
| $R_{DS(ON)typ.}@V_{GS}=(-)2.5V$      | 28m $\Omega$ | 80m $\Omega$  |
| $R_{DS(ON)typ.}@V_{GS}=(-)1.5V$      | 55m $\Omega$ | 160m $\Omega$ |

### Equivalent Circuit

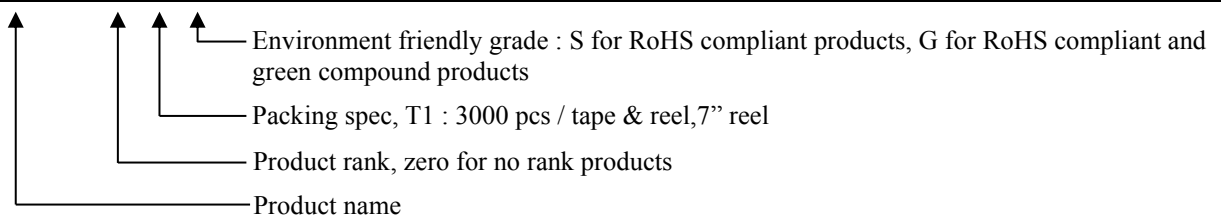


### Outline



### Ordering Information

| Device               | Package  | Shipping               |
|----------------------|--|------------------------|
| MTC3586B DFA6-0-T1-G | DFN2x2-6L<br>(RoHS compliant & Halogen-free package) | 3000 pcs / Tape & Reel |





**Absolute Maximum Ratings (TA=25°C)**

| Parameter  | Symbol                | Limits                            |          | Unit |      |
|--|-----------------------|-----------------------------------|----------|------|------|
|  |                       | N-CH                              | P-CH     |      |      |
| Drain-Source Voltage   | V <sub>DS</sub>       | 20                                | -20      | V    |      |
| Gate-Source Voltage  | V <sub>GS</sub>       | ±8                                | ±8       |      |      |
| Continuous Drain Current @ V <sub>GS</sub> =(-)4.5V, T <sub>C</sub> =25°C  | *a                    | I <sub>D</sub>                    | 8        | A    |      |
| Continuous Drain Current @ V <sub>GS</sub> =(-)4.5V, T <sub>C</sub> =100°C | *a                    |                                   | 5.1      |      | -3.5 |
| Continuous Drain Current @ V <sub>GS</sub> =(-)4.5V, T <sub>A</sub> =25°C  | *b                    |                                   | 4.6      |      | -3.2 |
| Continuous Drain Current @ V <sub>GS</sub> =(-)4.5V, T <sub>A</sub> =70°C  | *b                    |                                   | 3.7      |      | -2.6 |
| Pulsed Drain Current   | *c                    | I <sub>DM</sub>                   | 32       | -22  |      |
| Continuous Body Diode Forward Current @ T <sub>C</sub> =25°C               | *a                    | I <sub>S</sub>                    | 3.3      | -3.3 |      |
| Avalanche Current @ L=0.1mH  |                       | I <sub>AS</sub>                   | 8        | -8   |      |
| Avalanche Energy @ L=0.5mH   |                       | E <sub>AS</sub>                   | 6        | 6    | mJ   |
| Total Power Dissipation  | T <sub>C</sub> =25°C  | P <sub>D</sub>                    | 4        |      | W    |
|  | T <sub>C</sub> =100°C |                                   | 1.6      |      |      |
|  | T <sub>A</sub> =25°C  |                                   | 1.3      |      |      |
|  | T <sub>A</sub> =70°C  |                                   | 0.8      |      |      |
| Operating Junction and Storage Temperature Range                           |                       | T <sub>J</sub> , T <sub>stg</sub> | -55~+150 |      | °C   |

**Thermal Data**

| Parameter                               | Symbol              | Steady State | Unit |
|---|---------------------|--------------|------|
| Thermal Resistance, Junction-to-case    | R <sub>θJC</sub>    | 31           | °C/W |
| Thermal Resistance, Junction-to-ambient | *b R <sub>θJA</sub> | 95           |      |

Note:

- \*a. The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=150°C, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.
- \*b. The value of R<sub>θJA</sub> is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2 oz. copper, in a still air environment with T<sub>A</sub>=25°C. The power dissipation P<sub>D</sub> is based on R<sub>θJA</sub> and the maximum allowed junction temperature of 150°C. The value in any given application depends on the user's specific board design.
- \*c. Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150°C. Ratings are based on low frequency and low duty cycles to keep initial T<sub>J</sub>=25°C.



**N-Channel Electrical Characteristics (T<sub>A</sub>=25°C, unless otherwise specified)**

| Symbol                    | Min. | Typ. | Max. | Unit | Test Conditions  |
|---------------------------|------|------|------|------|--|
| <b>Static</b>             |      |      |      |      |  |
| BV <sub>DSS</sub>         | 20   | -    | -    | V    | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA   |
| V <sub>GS(th)</sub>       | 0.3  | -    | 1    |      | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                             |
| G <sub>FS</sub>           | -    | 7    | -    | S    | V <sub>DS</sub> =5V, I <sub>D</sub> =3A  |
| I <sub>GSS</sub>          | -    | -    | ±100 | nA   | V <sub>GS</sub> =±8V, V <sub>DS</sub> =0V  |
| I <sub>DSS</sub>          | -    | -    | 1    | μA   | V <sub>DS</sub> =16V, V <sub>GS</sub> =0V  |
| R <sub>DS(ON)</sub>       | -    | 24   | 34   | mΩ   | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A  |
|                           | -    | 28   | 42   |      | V <sub>GS</sub> =2.5V, I <sub>D</sub> =1A  |
|                           | -    | 55   | 140  |      | V <sub>GS</sub> =1.5V, I <sub>D</sub> =0.5A  |
| <b>Dynamic</b>            |      |      |      |      |  |
| C <sub>iss</sub>          | -    | 450  | -    | pF   | V <sub>DS</sub> =10V, V <sub>GS</sub> =0V, f=1MHz                                    |
| C <sub>oss</sub>          | -    | 65   | -    |      |  |
| C <sub>rss</sub>          | -    | 60   | -    |      |  |
| R <sub>g</sub>            | -    | 1    | -    | Ω    | f=1MHz   |
| Q <sub>g</sub> *1,2       | -    | 6.7  | -    | nC   | V <sub>DS</sub> =10V, I <sub>D</sub> =3A, V <sub>GS</sub> =4.5V                      |
| Q <sub>gs</sub> *1,2      | -    | 0.7  | -    |      |  |
| Q <sub>gd</sub> *1,2      | -    | 1.5  | -    |      |  |
| t <sub>d(ON)</sub> *1,2   | -    | 4    | -    | ns   | V <sub>DS</sub> =10V, I <sub>D</sub> =1A, V <sub>GS</sub> =5V, R <sub>GS</sub> =3.3Ω |
| t <sub>r</sub> *1,2       | -    | 15.5 | -    |      |  |
| t <sub>d(OFF)</sub> *1,2  | -    | 28   | -    |      |  |
| t <sub>f</sub> *1,2       | -    | 5    | -    |      |  |
| <b>Source-Drain Diode</b> |      |      |      |      |  |
| V <sub>SD</sub> *1        | -    | 0.85 | 1.2  | V    | I <sub>S</sub> =3A, V <sub>GS</sub> =0V  |
| t <sub>rr</sub>           | -    | 5.5  | -    | ns   | I <sub>F</sub> =3A, dI <sub>F</sub> /dt=100A/μs                                      |
| Q <sub>rr</sub>           | -    | 2    | -    | nC   |  |

Note:

- \*1. Pulse Test : Pulse Width ≤300μs, Duty Cycle≤2%
- \*2. Independent of operating temperature



**P-Channel Electrical Characteristics (T<sub>A</sub>=25°C, unless otherwise specified)**

| Symbol                    | Min. | Typ.  | Max. | Unit | Test Conditions   |
|---------------------------|------|-------|------|------|---|
| <b>Static</b>             |      |       |      |      |   |
| BV <sub>DSS</sub>         | -20  | -     | -    | V    | V <sub>GS</sub> =0V, I <sub>D</sub> =-250μA   |
| V <sub>GS(th)</sub>       | -0.3 | -     | -1   |      | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                               |
| G <sub>FS</sub>           | -    | 6     | -    | S    | V <sub>DS</sub> =-5V, I <sub>D</sub> =-2A   |
| I <sub>GSS</sub>          | -    | -     | ±100 | nA   | V <sub>GS</sub> =±8V, V <sub>DS</sub> =0V   |
| I <sub>DSS</sub>          | -    | -     | -1   | μA   | V <sub>DS</sub> =-16V, V <sub>GS</sub> =0V  |
| R <sub>DS(ON)</sub>       | -    | 60    | 84   | mΩ   | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2.5A   |
|                           | -    | 80    | 120  |      | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2A   |
|                           | -    | 160   | 400  |      | V <sub>GS</sub> =-1.5V, I <sub>D</sub> =-0.5A   |
| <b>Dynamic</b>            |      |       |      |      |   |
| C <sub>iss</sub>          | -    | 660   | -    | pF   | V <sub>DS</sub> =-10V, V <sub>GS</sub> =0V, f=1MHz                                      |
| C <sub>oss</sub>          | -    | 60    | -    |      |   |
| C <sub>rss</sub>          | -    | 58    | -    |      |   |
| R <sub>g</sub>            | -    | 13.7  | -    | Ω    | f=1MHz  |
| Q <sub>g</sub> *1, 2      | -    | 7.8   | -    | nC   | V <sub>DS</sub> =-10V, I <sub>D</sub> =-2A, V <sub>GS</sub> =-4.5V                      |
| Q <sub>gs</sub> *1, 2     | -    | 1     | -    |      |   |
| Q <sub>gd</sub> *1, 2     | -    | 1.6   | -    |      |   |
| t <sub>d(ON)</sub> *1, 2  | -    | 5     | -    | ns   | V <sub>DS</sub> =-10V, I <sub>D</sub> =-1A, V <sub>GS</sub> =-5V, R <sub>GS</sub> =3.3Ω |
| t <sub>r</sub> *1, 2      | -    | 17    | -    |      |   |
| t <sub>d(OFF)</sub> *1, 2 | -    | 48    | -    |      |   |
| t <sub>f</sub> *1, 2      | -    | 6     | -    |      |   |
| <b>Source-Drain Diode</b> |      |       |      |      |   |
| V <sub>SD</sub> *1        | -    | -0.85 | -1.2 | V    | I <sub>S</sub> =-2A, V <sub>GS</sub> =0V  |
| t <sub>rr</sub>           | -    | 6.2   | -    | ns   | I <sub>F</sub> =-2A, dI <sub>F</sub> /dt=100A/μs  |
| Q <sub>rr</sub>           | -    | 2.3   | -    | nC   |   |

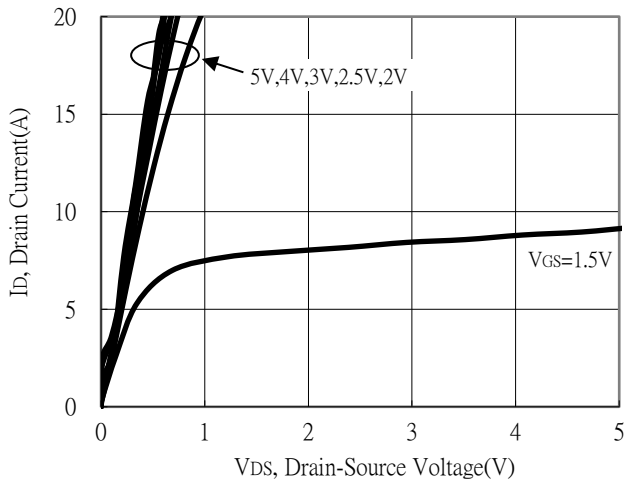
Note:

- \*1. Pulse Test : Pulse Width ≤300μs, Duty Cycle≤2%
- \*2. Independent of operating temperature

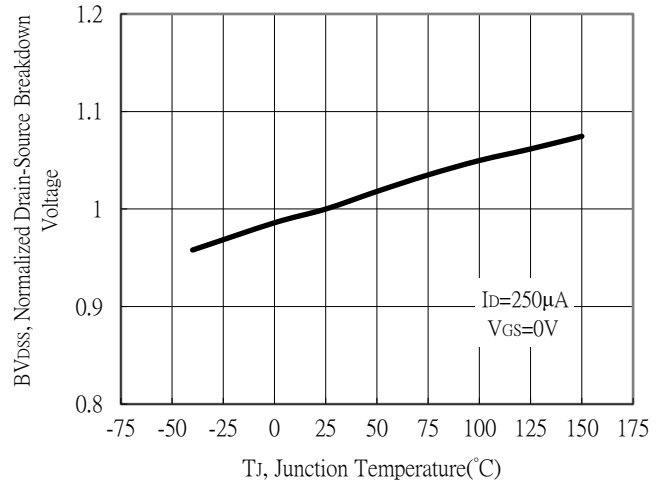


### Typical Characteristics : Q1( N-channel )

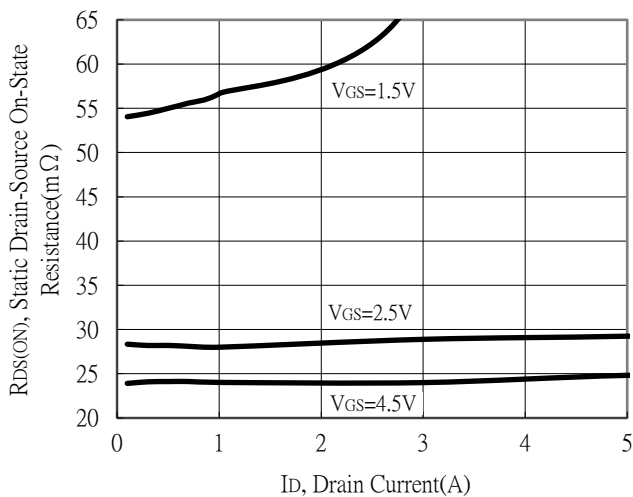
Typical Output Characteristics



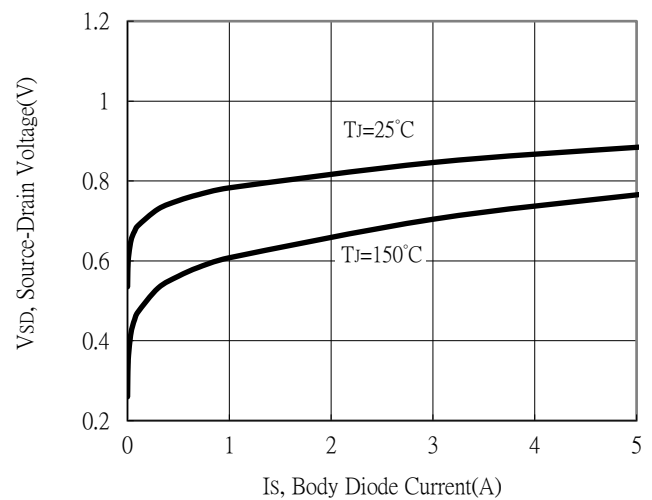
Breakdown Voltage vs Ambient Temperature



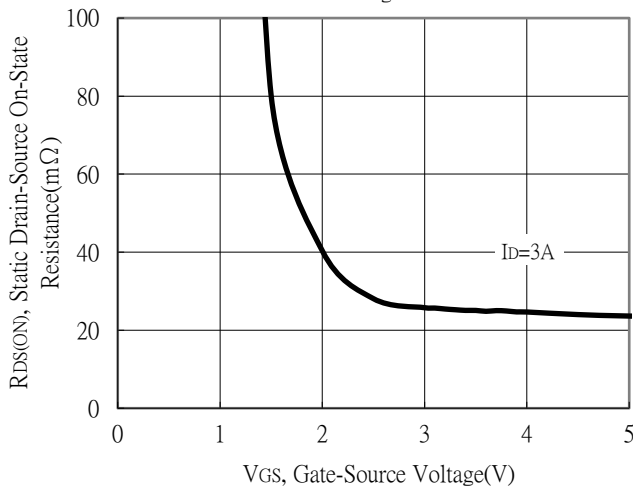
Static Drain-Source On-State resistance vs Drain Current



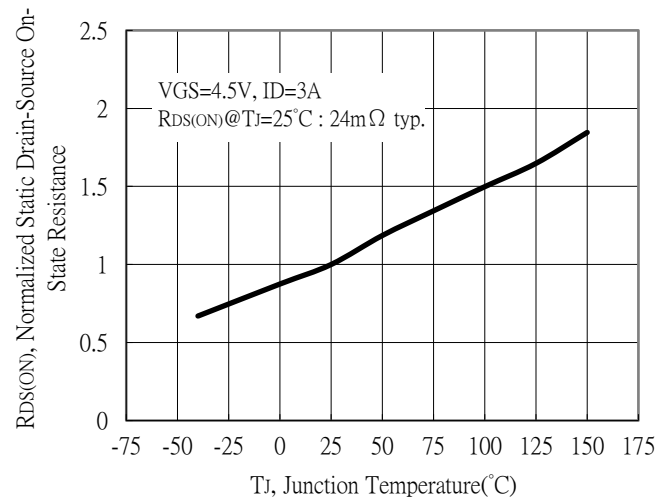
Body Diode Current vs Source-Drain Voltage



Static Drain-Source On-State Resistance vs Gate-Source Voltage

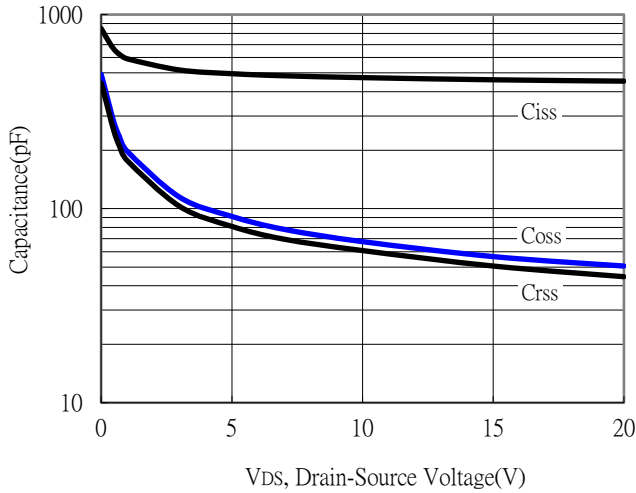


Drain-Source On-State Resistance vs Junction Temperature

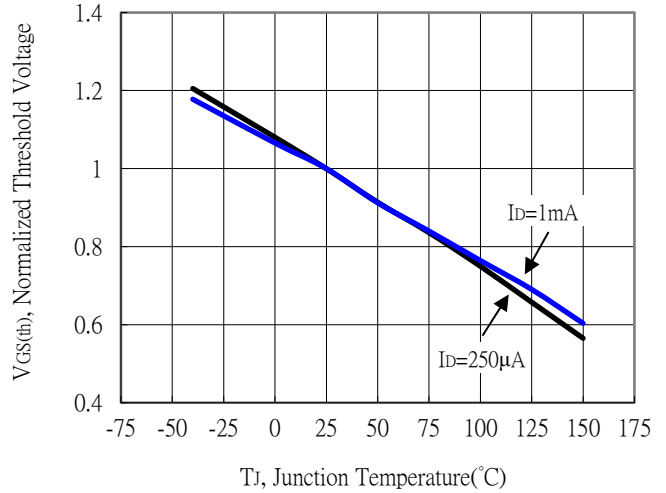


## Typical Characteristics (Cont.) : Q1( N-channel)

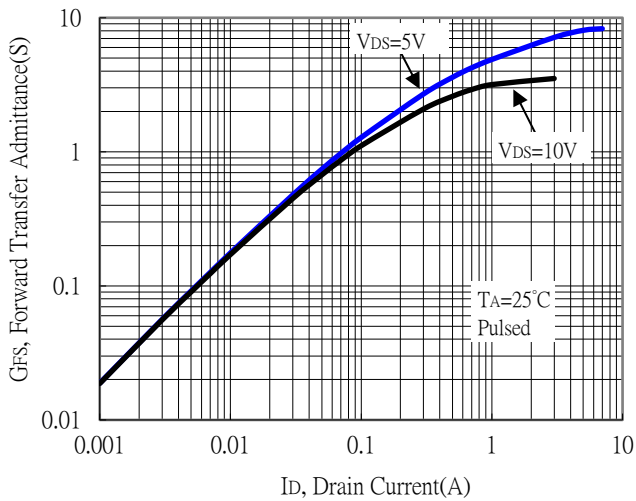
Capacitance vs Drain-to-Source Voltage



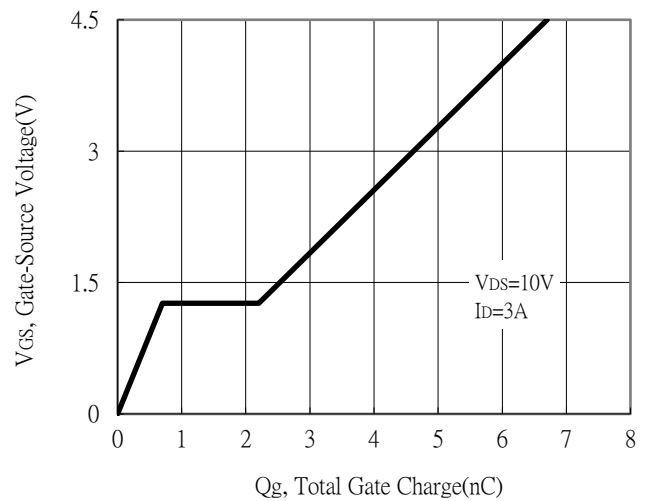
Threshold Voltage vs Junction Temperature



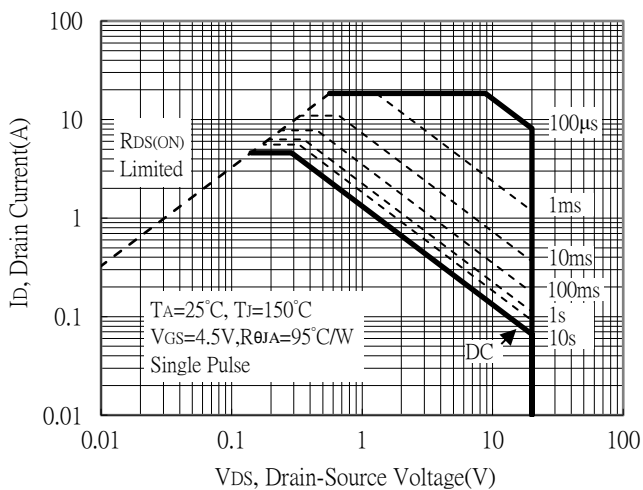
Forward Transfer Admittance vs Drain Current



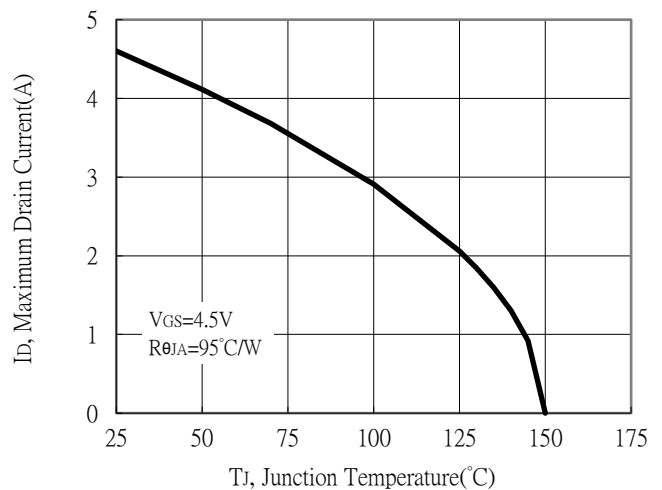
Gate Charge Characteristics



Maximum Safe Operating Area



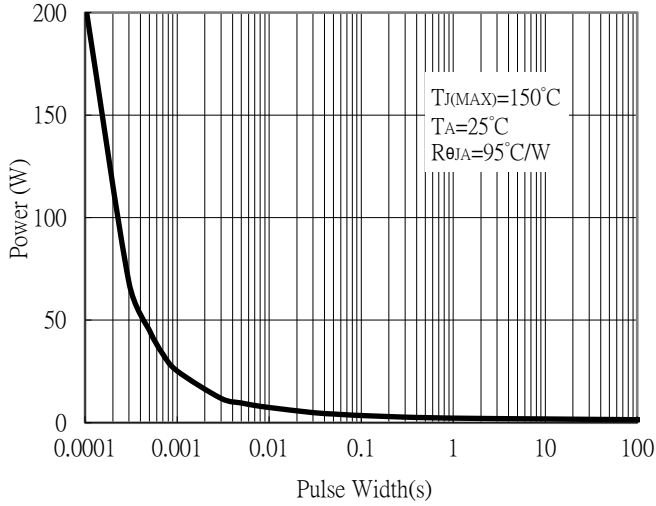
Maximum Drain Current vs Junction Temperature



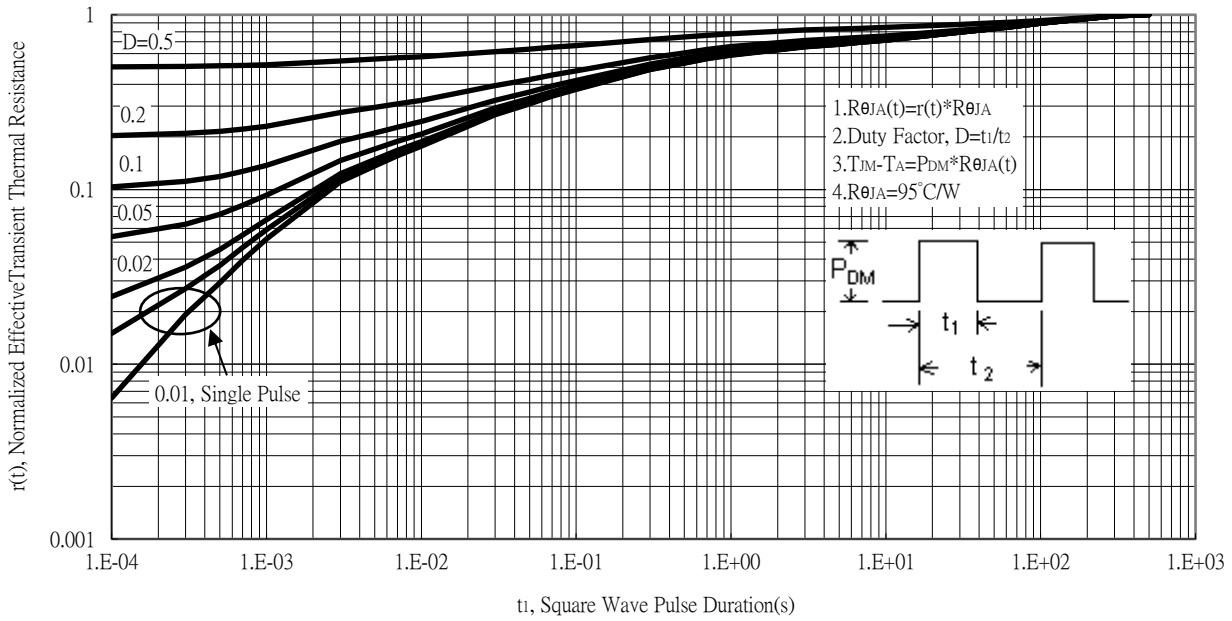


### Typical Characteristics (Cont.) : Q1( N-channel)

Single Pulse Power Rating, Junction to Ambient



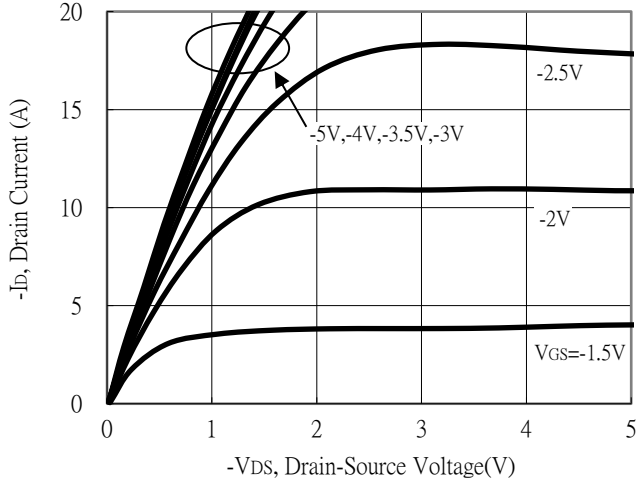
Transient Thermal Response Curves



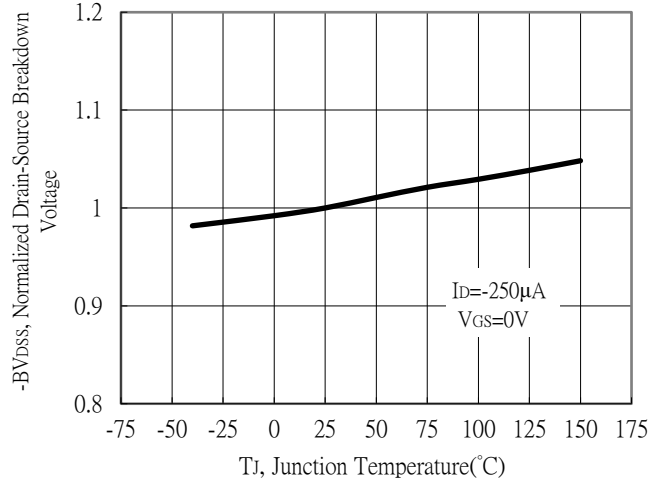


**Typical Characteristics : Q2( P-channel)**

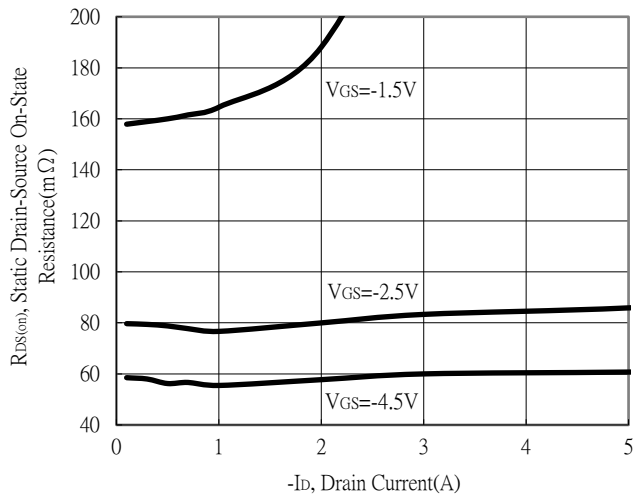
Typical Output Characteristics



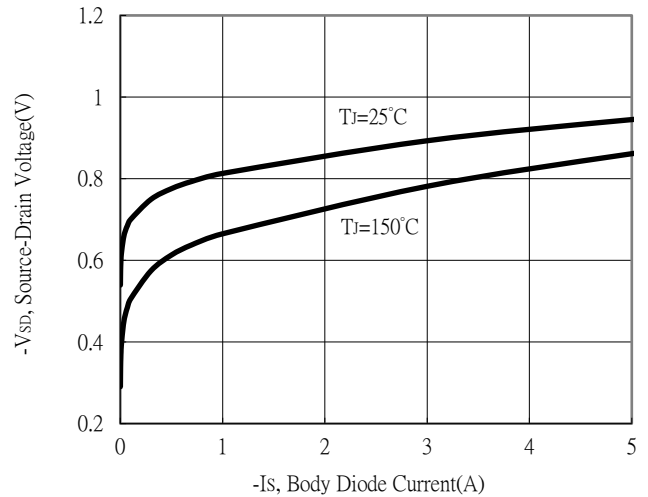
Breakdown Voltage vs Ambient Temperature



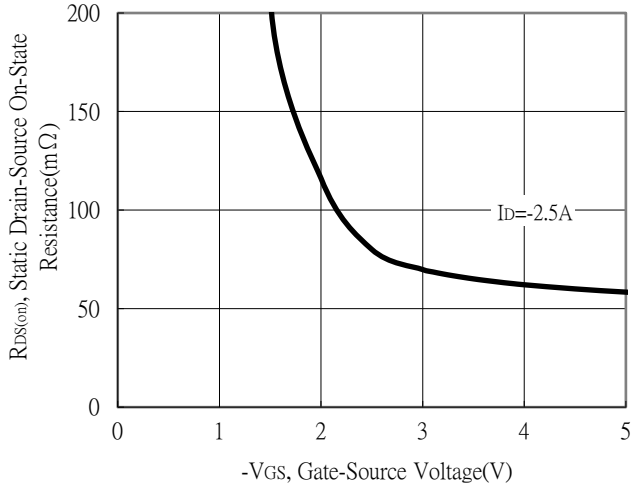
Static Drain-Source On-State resistance vs Drain Current



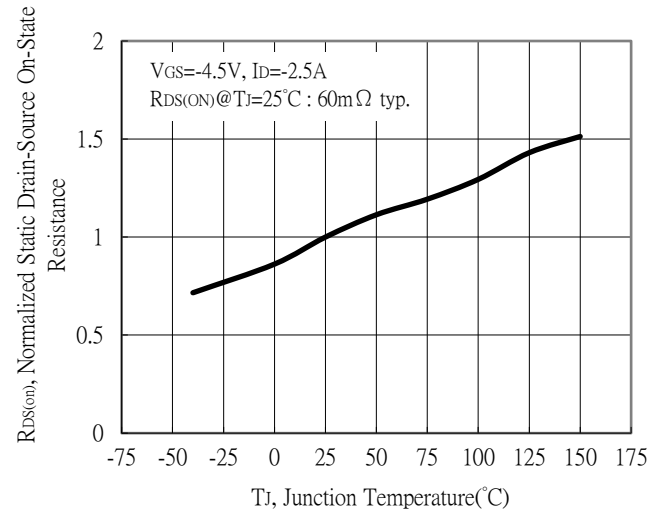
Body Diode Current vs Source-Drain Voltage



Static Drain-Source On-State Resistance vs Gate-Source Voltage



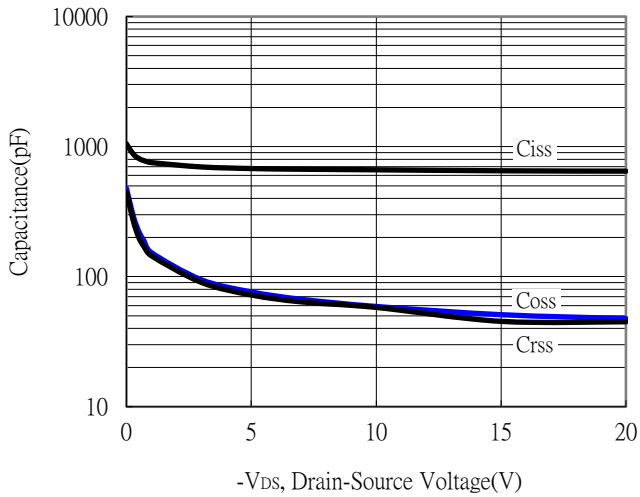
Drain-Source On-State Resistance vs Junction Temperature



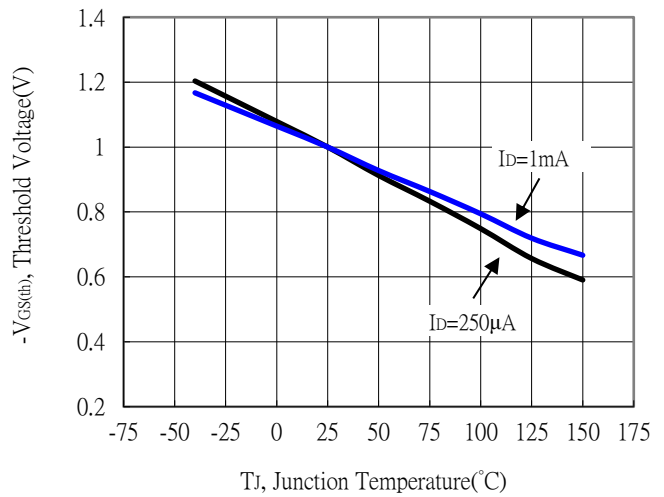


## Typical Characteristics (Cont.) : Q2(P-channel)

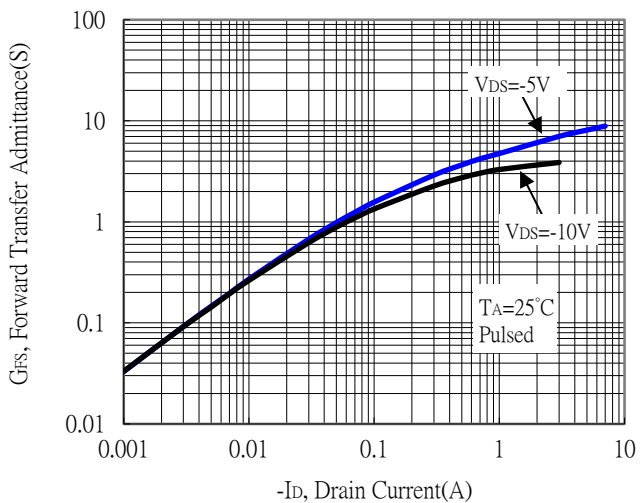
Capacitance vs Drain-to-Source Voltage



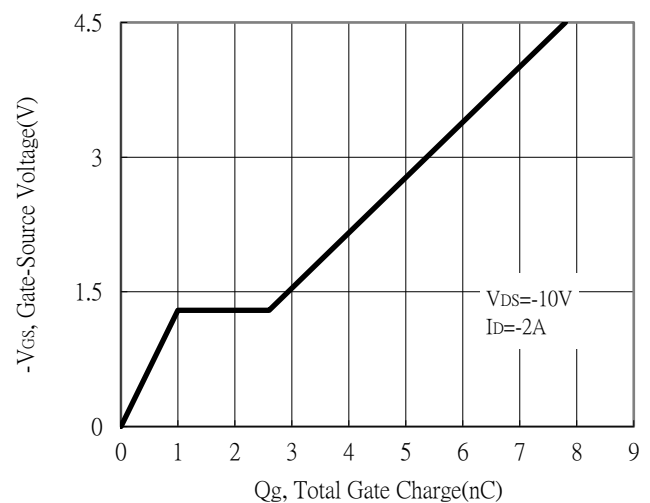
Threshold Voltage vs Junction Temperature



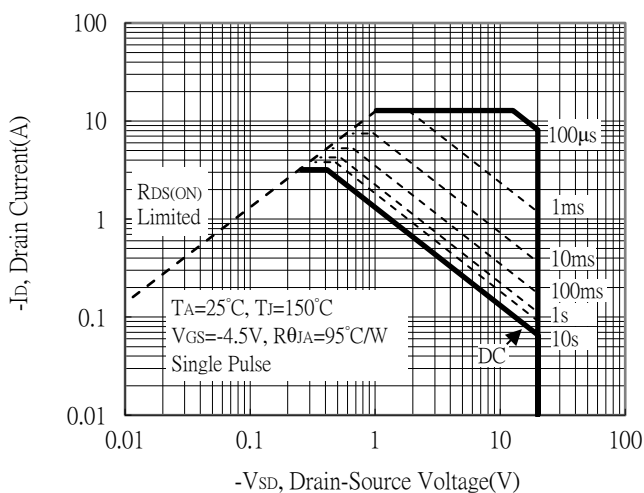
Forward Transfer Admittance vs Drain Current



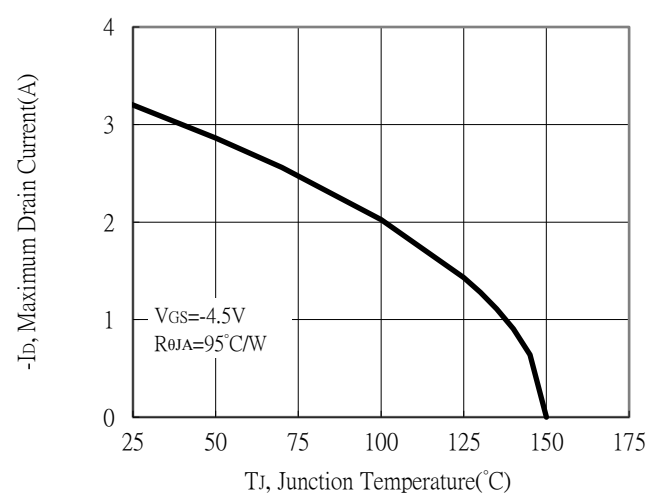
Gate Charge Characteristics



Maximum Safe Operating Area

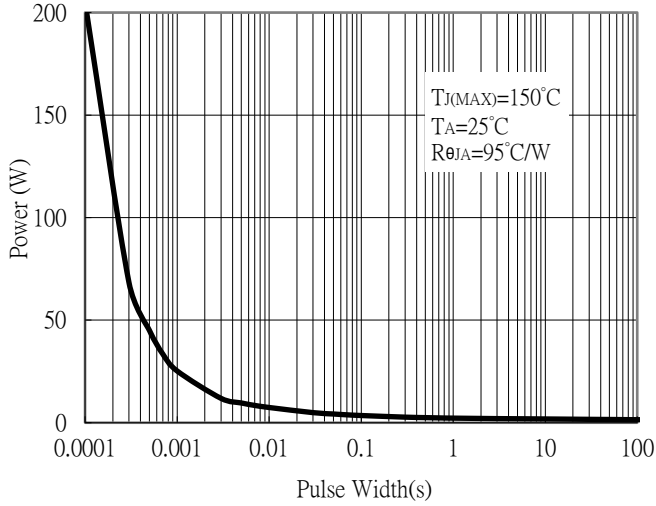


Maximum Drain Current vs Junction Temperature

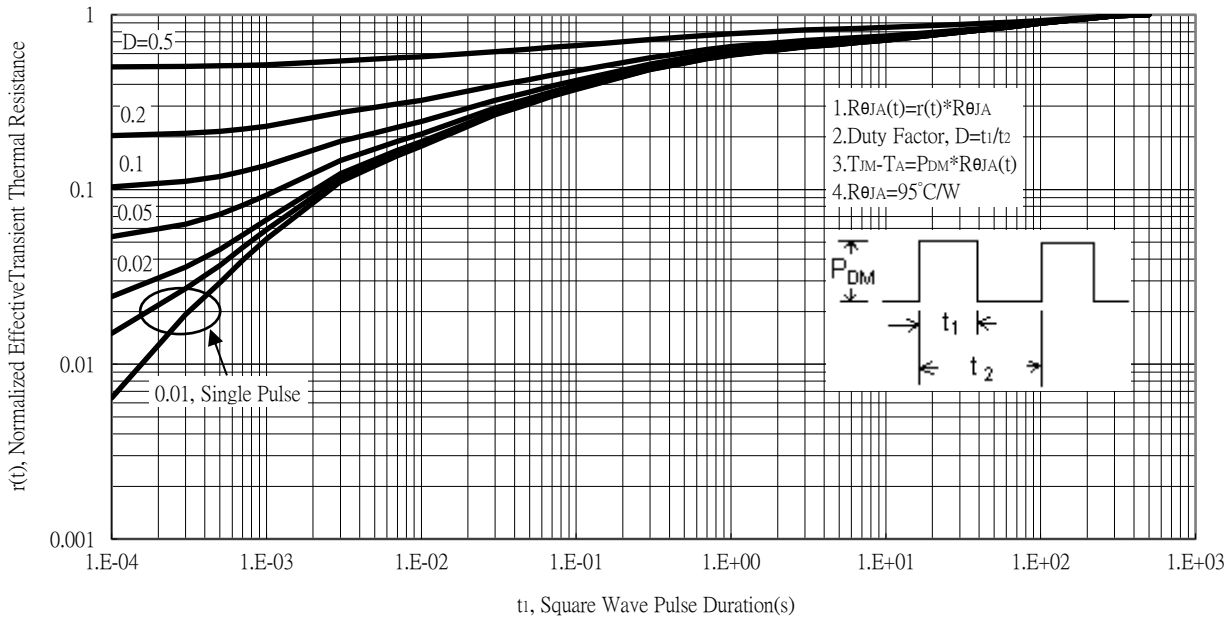


**Typical Characteristics (Cont.) : Q2(P-channel)**

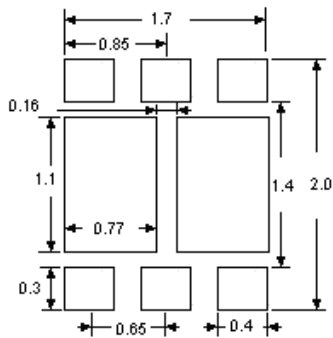
Single Pulse Power Rating, Junction to Ambient



Transient Thermal Response Curves



**Recommended Soldering Footprint**



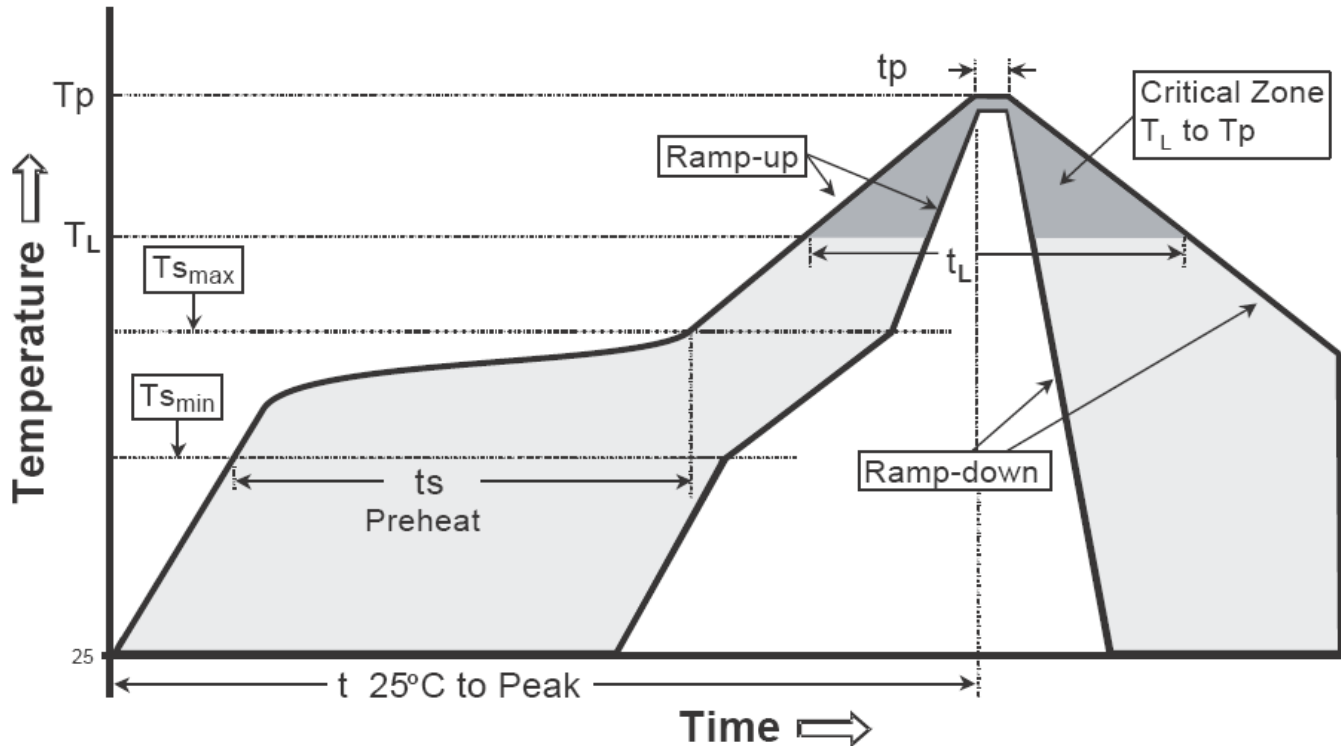
Unit : mm



**Recommended wave soldering condition**

|                 |                  |                 |
|-----------------|------------------|-----------------|
| Product         | Peak Temperature | Soldering Time  |
| Pb-free devices | 260 +0/-5 °C     | 5 +1/-1 seconds |

**Recommended temperature profile for IR reflow**



| Profile feature   | Sn-Pb eutectic Assembly | Pb-free Assembly |
|---|-------------------------|------------------|
| Average ramp-up rate (T <sub>smax</sub> to T <sub>p</sub> ) | 3°C/second max.         | 3°C/second max.  |
| Preheat   |                         |                  |
| -Temperature Min(T <sub>s min</sub> )                       | 100°C                   | 150°C            |
| -Temperature Max(T <sub>s max</sub> )                       | 150°C                   | 200°C            |
| -Time(t <sub>s min</sub> to t <sub>s max</sub> )            | 60-120 seconds          | 60-180 seconds   |
| Time maintained above:                                      |                         |                  |
| -Temperature (T <sub>L</sub> )                              | 183°C                   | 217°C            |
| - Time (t <sub>L</sub> )                                    | 60-150 seconds          | 60-150 seconds   |
| Peak Temperature(T <sub>P</sub> )                           | 240 +0/-5 °C            | 260 +0/-5 °C     |
| Time within 5°C of actual peak temperature(tp)              | 10-30 seconds           | 20-40 seconds    |
| Ramp down rate  | 6°C/second max.         | 6°C/second max.  |
| Time 25 °C to peak temperature                              | 6 minutes max.          | 8 minutes max.   |

Note : All temperatures refer to topside of the package, measured on the package body surface.

## DFN2x2-6L Dimension

TOP VIEW

SIDE VIEW

Marking:

D1 G2 S2

**586B**

□ □ □ □

S1 G1 D2

Device Code →

Date Code →

Style:

- Pin 1. Source1 (S1)
- Pin 2. Gate 1 (G1)
- Pin 3. Drain2 (D2)
- Pin 4. Source2 (S2)
- Pin 5. Gate2 (G2)
- Pin 6. Drain1 (D1)

Date Code(counting from left to right) :

1<sup>st</sup> code: year code, the last digit of Christian year

2<sup>nd</sup> code : month code, Jan→A, Feb→B, Mar→C, Apr→D, May→E, Jun→F, Jul→G, Aug→H, Sep→J, Oct→K, Nov→L, Dec→M

3<sup>rd</sup> and 4<sup>th</sup> codes : production serial number, 01~99

6-Lead DFN2x2-6L Plastic  
 Surface Mounted Package  
 CYStek Package Code: DFA6

| DIM | Millimeters |       | Inches |       | DIM | Millimeters |       | Inches |       |
|-----|-------------|-------|--------|-------|-----|-------------|-------|--------|-------|
|     | Min.        | Max.  | Min.   | Max.  |     | Min.        | Max.  | Min.   | Max.  |
| A   | 0.700       | 0.800 | 0.028  | 0.031 | E1  | 0.520       | 0.720 | 0.020  | 0.028 |
| A1  | 0.000       | 0.050 | 0.000  | 0.002 | k   | 0.200       | -     | 0.008  | -     |
| A3  | 0.203       | REF   | 0.008  | REF   | b   | 0.250       | 0.350 | 0.010  | 0.014 |
| D   | 1.900       | 2.100 | 0.075  | 0.083 | e   | 0.650       | TYP   | 0.026  | TYP   |
| E   | 1.900       | 2.100 | 0.075  | 0.083 | L   | 0.200       | 0.300 | 0.008  | 0.012 |
| D1  | 0.900       | 1.100 | 0.035  | 0.043 |     |             |       |        |       |

**Notes :** 1.Controlling dimension : millimeters.  
 2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.  
 3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

**Material :**

- Lead :Pure tin plated.
- Mold Compound : Epoxy resin family, flammability solid burning class:UL94V-0.

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