

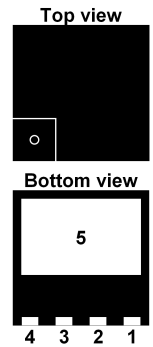
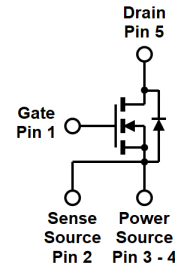
# ICE12N60L N-Channel Enhancement Mode MOSFET

## Features

- LOW  $r_{DS(on)}$
- Ultra Low Gate Charge
- High dv/dt capability
- High Unclamped Inductive Switching (UIS) capability
- High peak current capability
- Increased transconductance performance
- Optimized design for high performance power systems



| Product Summary |                          |      |     |
|-----------------|--------------------------|------|-----|
| $I_D$           | $T_A=25^{\circ}\text{C}$ | 12A  | Max |
| $V_{(BR)DSS}$   | $I_D=250\mu\text{A}$     | 600V | Min |
| $r_{DS(on)}$    | $V_{GS}=10\text{V}$      | 0.23 | Typ |
| $Q_g$           | $V_{DS}=480\text{V}$     | 48nC | Typ |



DFN8x8

- 1 = Gate  
2 = Sense Source  
3 - 4 = Power Source  
5 = Drain

ICEMOS OWNS THE FUNDAMENTAL PATENTS FOR SUPERJUNCTION MOSFETS. THE MAJORITY OF THESE PATENTS HAVE 17 to 20 YEARS OF REMAINING LIFE. THIS PORTFOLIO HAS GRANTED PATENTS ISSUED IN USA, CHINA, KOREA, JAPAN, TAIWAN & EUROPE.

**Maximum ratings**<sup>a</sup>, at  $T_j=25^{\circ}\text{C}$ , unless otherwise specified

| Parameter                         | Symbol                | Conditions                                                             | Value       | Unit               |
|-----------------------------------|-----------------------|------------------------------------------------------------------------|-------------|--------------------|
| Continuous drain current          | $I_D$                 | $T_c=25^{\circ}\text{C}$                                               | 12          | A                  |
|                                   |                       | $T_c=100^{\circ}\text{C}$                                              | 8           |                    |
| Pulsed drain current              | $I_{D, \text{pulse}}$ | $T_c=25^{\circ}\text{C}$                                               | 36          | A                  |
| Avalanche energy, single pulse    | $E_{AS}$              | $I_D=8\text{A}$                                                        | 400         | mJ                 |
| Avalanche current, repetitive     | $I_{AR}$              | limited by $T_{j,max}$                                                 | 8           | A                  |
| MOSFET dv/dt ruggedness           | dv/dt                 | $V_{DS}=480\text{V}$ , $I_D=12\text{A}$ ,<br>$T_j=125^{\circ}\text{C}$ | 50          | V/ns               |
| Gate source voltage               | $V_{GS}$              | Static                                                                 | $\pm 20$    | V                  |
|                                   |                       | AC ( $f>1\text{Hz}$ )                                                  | $\pm 30$    |                    |
| Power dissipation                 | $P_{tot}$             | $T_c=25^{\circ}\text{C}$                                               | 128         | W                  |
| Operating and storage temperature | $T_j, T_{stg}$        |                                                                        | -55 to +150 | $^{\circ}\text{C}$ |

<sup>a</sup> limited by  $T_{j,max}$

| Parameter | Symbol | Conditions | Values |     |     | Unit |
|-----------|--------|------------|--------|-----|-----|------|
|           |        |            | Min    | Typ | Max |      |

### Thermal characteristics

|                                                             |            |                                     |   |   |      |      |
|-------------------------------------------------------------|------------|-------------------------------------|---|---|------|------|
| Thermal resistance, junction-case <sup>a</sup>              | $R_{thJC}$ |                                     | - | - | 0.97 | °C/W |
| Thermal resistance, junction-ambient <sup>a</sup>           | $R_{thJA}$ | leaded                              | - | - | 62   |      |
| Soldering temperature, wave soldering only allowed at leads | $T_{sold}$ | 1.6mm (0.063in.) from case for 10 s | - | - | 260  | °C   |

### Electrical characteristics <sup>b</sup>, at $T_j=25^{\circ}\text{C}$ , unless otherwise specified

#### Static characteristics

|                                  |               |                                                                 |     |      |       |               |
|----------------------------------|---------------|-----------------------------------------------------------------|-----|------|-------|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=250\mu\text{A}$                         | 600 | 640  | -     | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$                             | 2.1 | 3    | 3.9   |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=600\text{V}, V_{GS}=0\text{V}, T_j=25^{\circ}\text{C}$  | -   | 0.1  | 1     | $\mu\text{A}$ |
|                                  |               | $V_{DS}=600\text{V}, V_{GS}=0\text{V}, T_j=150^{\circ}\text{C}$ | -   | 100  | -     |               |
| Gate source leakage current      | $I_{GSS}$     | $V_{GS}=\pm 20\text{ V}, V_{DS}=0\text{V}$                      | -   | -    | 100   | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{V}, I_D=6\text{A}, T_j=25^{\circ}\text{C}$      | -   | 0.25 | 0.295 | $\Omega$      |
|                                  |               | $V_{GS}=10\text{V}, I_D=6\text{A}, T_j=150^{\circ}\text{C}$     | -   | 0.66 | -     |               |
| Gate resistance                  | $R_G$         | $f=1\text{ MHz}, \text{open drain}$                             | -   | 3    | -     | $\Omega$      |

#### Dynamic characteristics

|                              |              |                                                                |                       |   |      |   |    |
|------------------------------|--------------|----------------------------------------------------------------|-----------------------|---|------|---|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V},$<br>$f=1\text{ MHz}$                       | $V_{DS}=25\text{ V}$  | - | 1440 | - | pF |
| Output capacitance           | $C_{oss}$    |                                                                | $V_{DS}=100\text{ V}$ | - | 68   | - |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                | $V_{DS}=25\text{ V}$  | - | 12   | - |    |
| Transconductance             | $g_{fs}$     | $V_{DS}>2*I_D*R_{DS}, I_D=6A$                                  |                       | - | 10   | - | S  |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DS}=380V, V_{GS}=10V,$<br>$I_D=6A, R_G=4\Omega$ (External) |                       | - | 19   | - | ns |
| Rise time                    | $t_r$        |                                                                |                       | - | 9    | - |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                |                       | - | 82   | - |    |
| Fall time                    | $t_f$        |                                                                |                       | - | 5.2  | - |    |

| Parameter | Symbol | Conditions | Values |     |     | Unit |
|-----------|--------|------------|--------|-----|-----|------|
|           |        |            | Min    | Typ | Max |      |

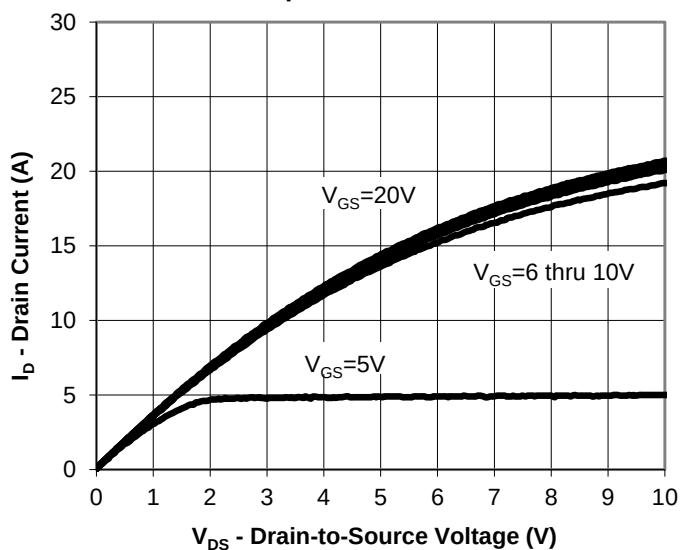
### Gate charge characteristics

|                       |                      |                                                                             |   |     |   |    |
|-----------------------|----------------------|-----------------------------------------------------------------------------|---|-----|---|----|
| Gate to source charge | $Q_{gs}$             | $V_{DS}=480\text{ V}, I_D=12\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 8   | - | nC |
| Gate to drain charge  | $Q_{gd}$             |                                                                             | - | 18  | - |    |
| Gate charge total     | $Q_g$                |                                                                             | - | 48  | - |    |
| Gate plateau voltage  | $V_{\text{plateau}}$ |                                                                             | - | 5.4 | - | V  |

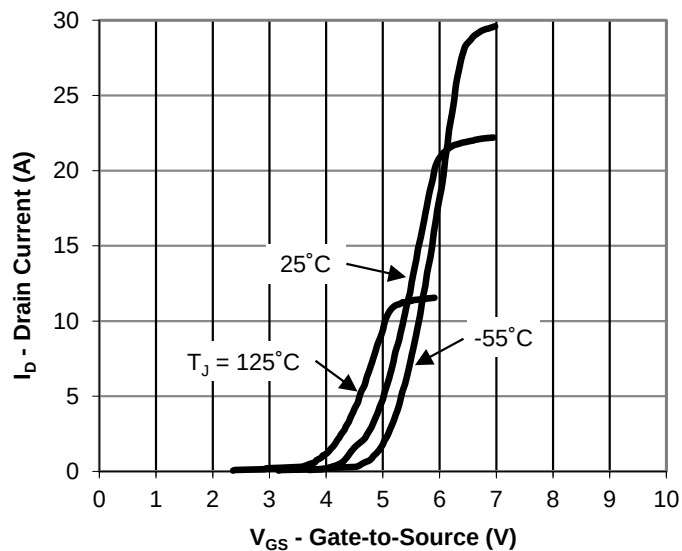
### Reverse Diode

|                               |          |                                                                          |   |     |     |               |
|-------------------------------|----------|--------------------------------------------------------------------------|---|-----|-----|---------------|
| Continuous forward current    | $I_S$    | $V_{GS}=0\text{ V}$                                                      | - | -   | 12  | A             |
| Diode forward voltage         | $V_{SD}$ | $V_{GS}=0\text{ V}, I_S=I_F$                                             | - | 0.9 | 1.2 | V             |
| Reverse recovery time         | $t_{rr}$ | $V_{RR}=300\text{ V}, I_S=I_F,$<br>$d_{iF}/d_t=100\text{ A}/\mu\text{S}$ | - | 320 | -   | ns            |
| Reverse recovery charge       | $Q_{rr}$ |                                                                          | - | 4.7 | -   | $\mu\text{C}$ |
| Peak reverse recovery current | $I_{rm}$ |                                                                          | - | 29  | -   | A             |

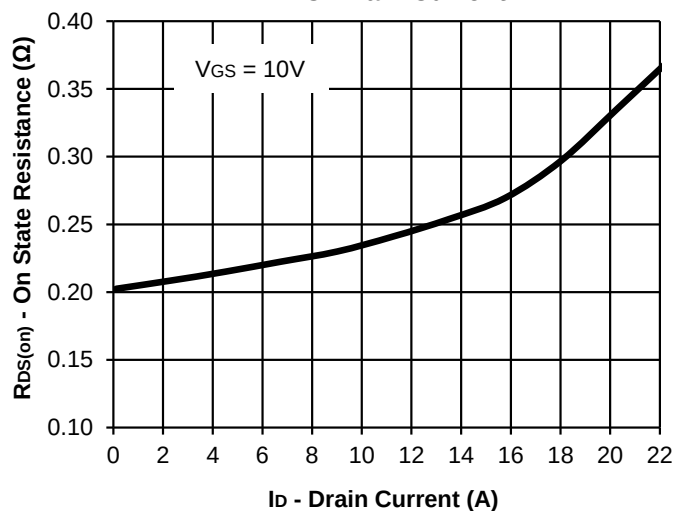
### Output Characteristics



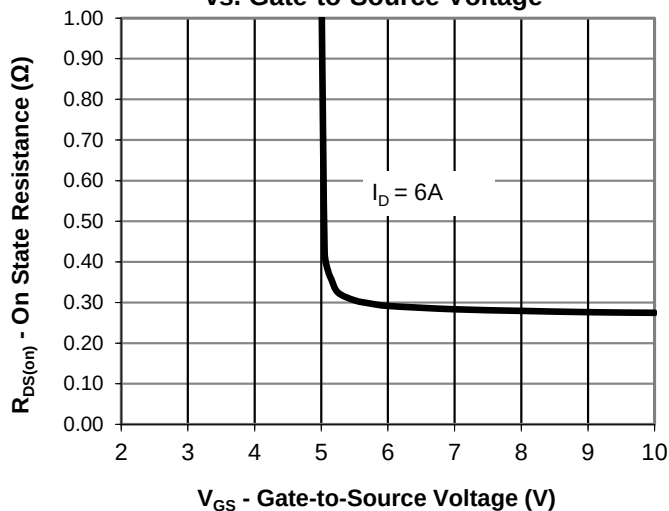
### Transfer Characteristics



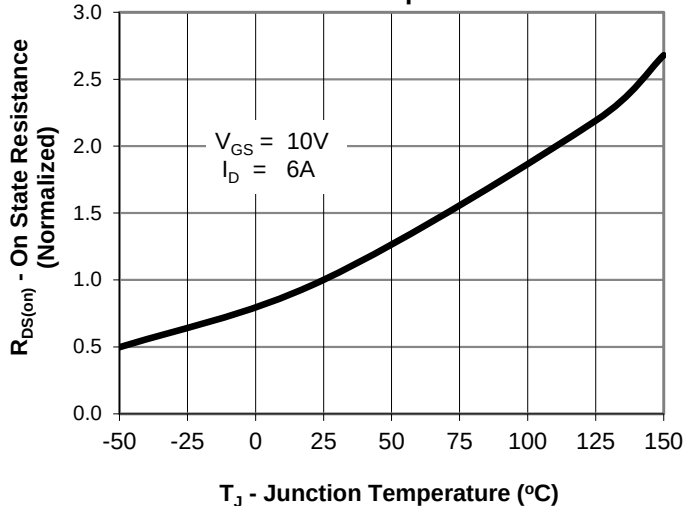
### Drain - Source On-State Resistance vs. Drain Current



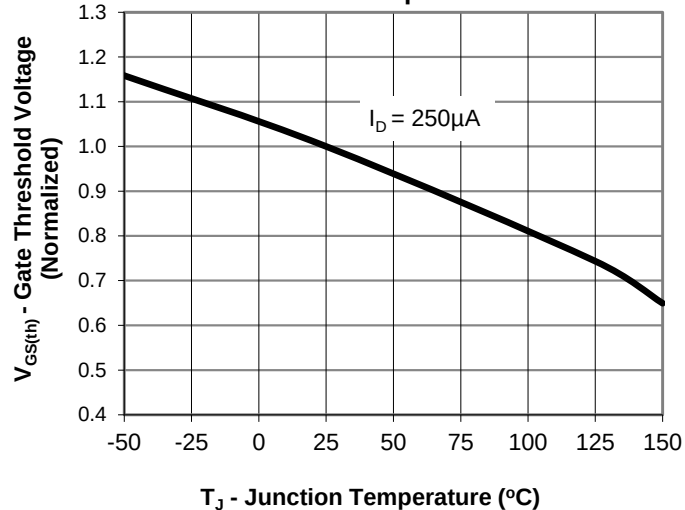
### Drain-Source On-State Resistance vs. Gate-to-Source Voltage



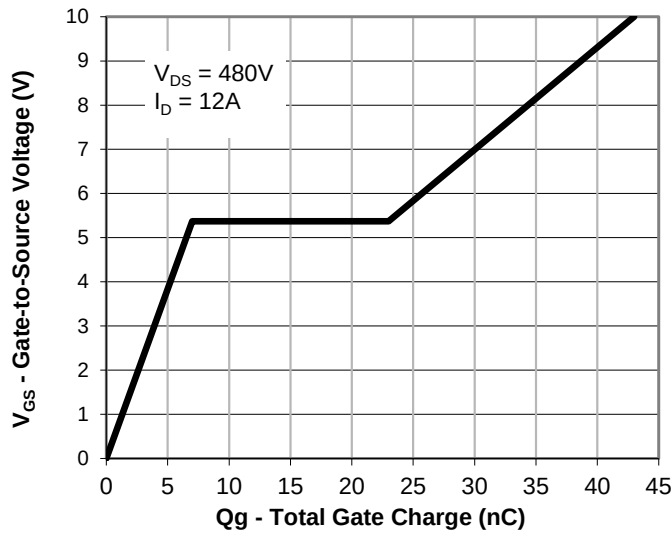
### Drain-Source On State Resistance vs. Junction Temperature



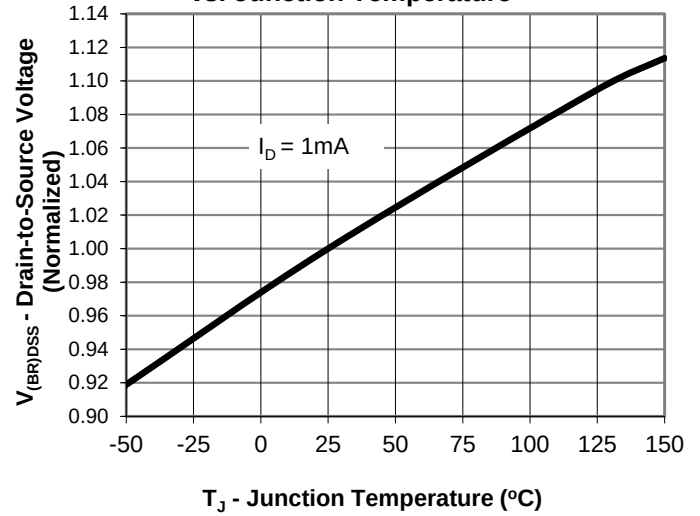
### Gate Threshold Voltage vs. Junction Temperature



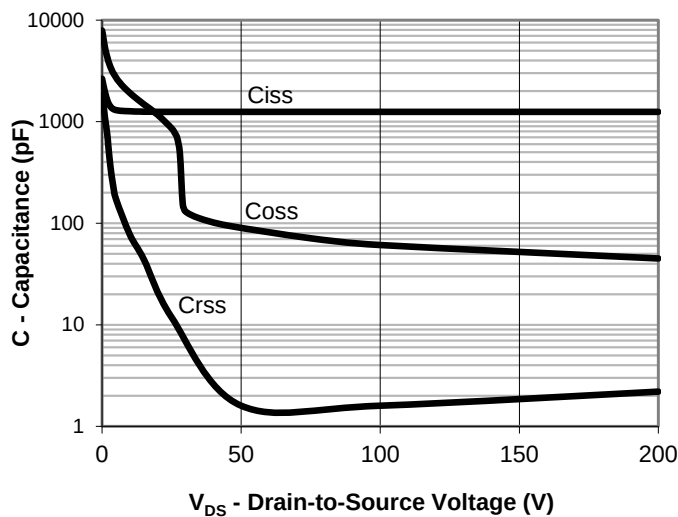
**Gate Charge**



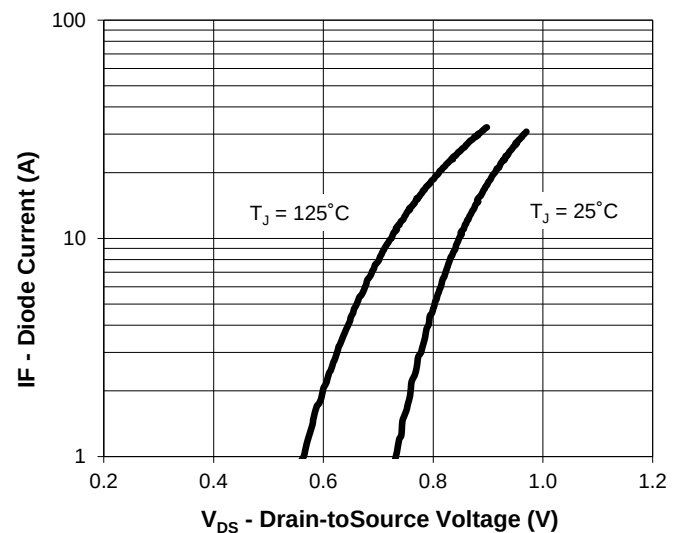
**Drain-to-Source Breakdown Voltage vs. Junction Temperature**



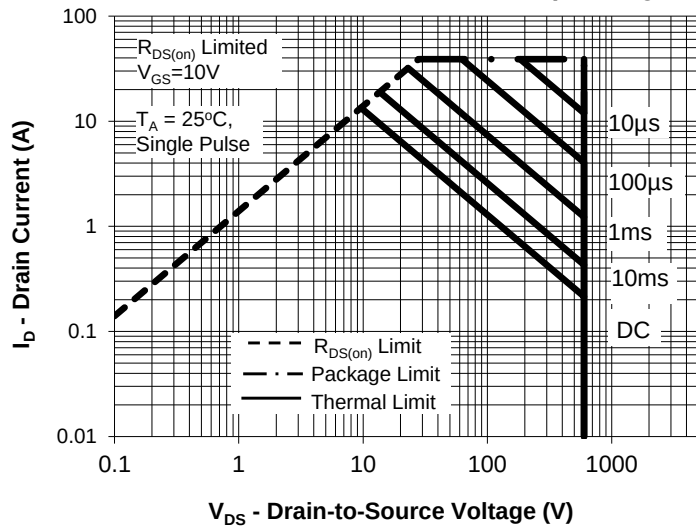
**Capacitance**



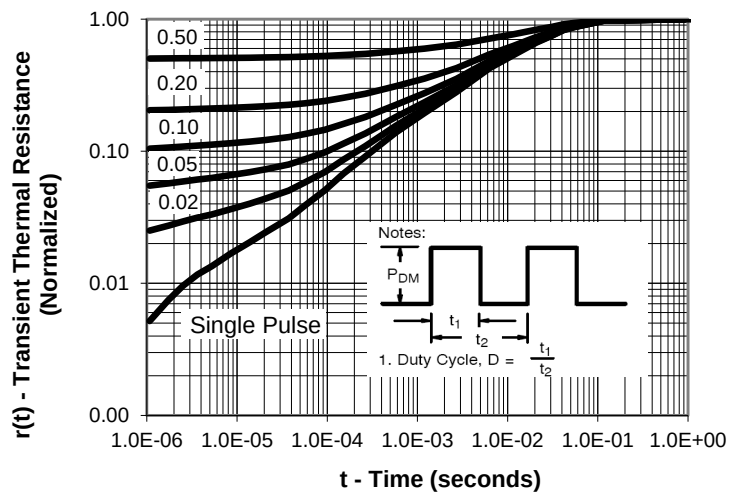
**Drain-Source Diode Forward Voltage**



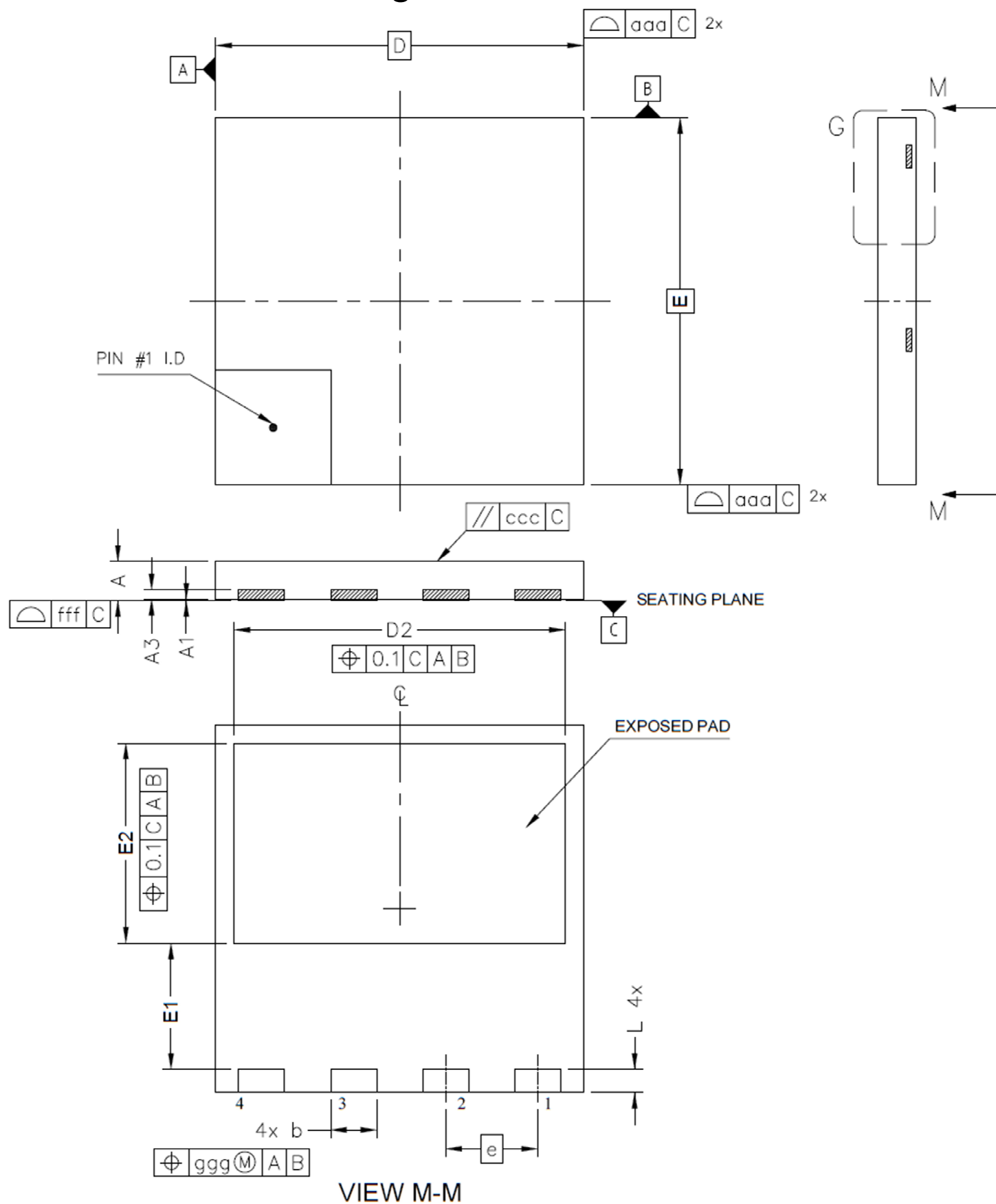
**Maximum Rated Forward Biased Safe Operating Area**



**Transient Thermal Response, Junction-to-Case**



## Package Outline: DFN8x8

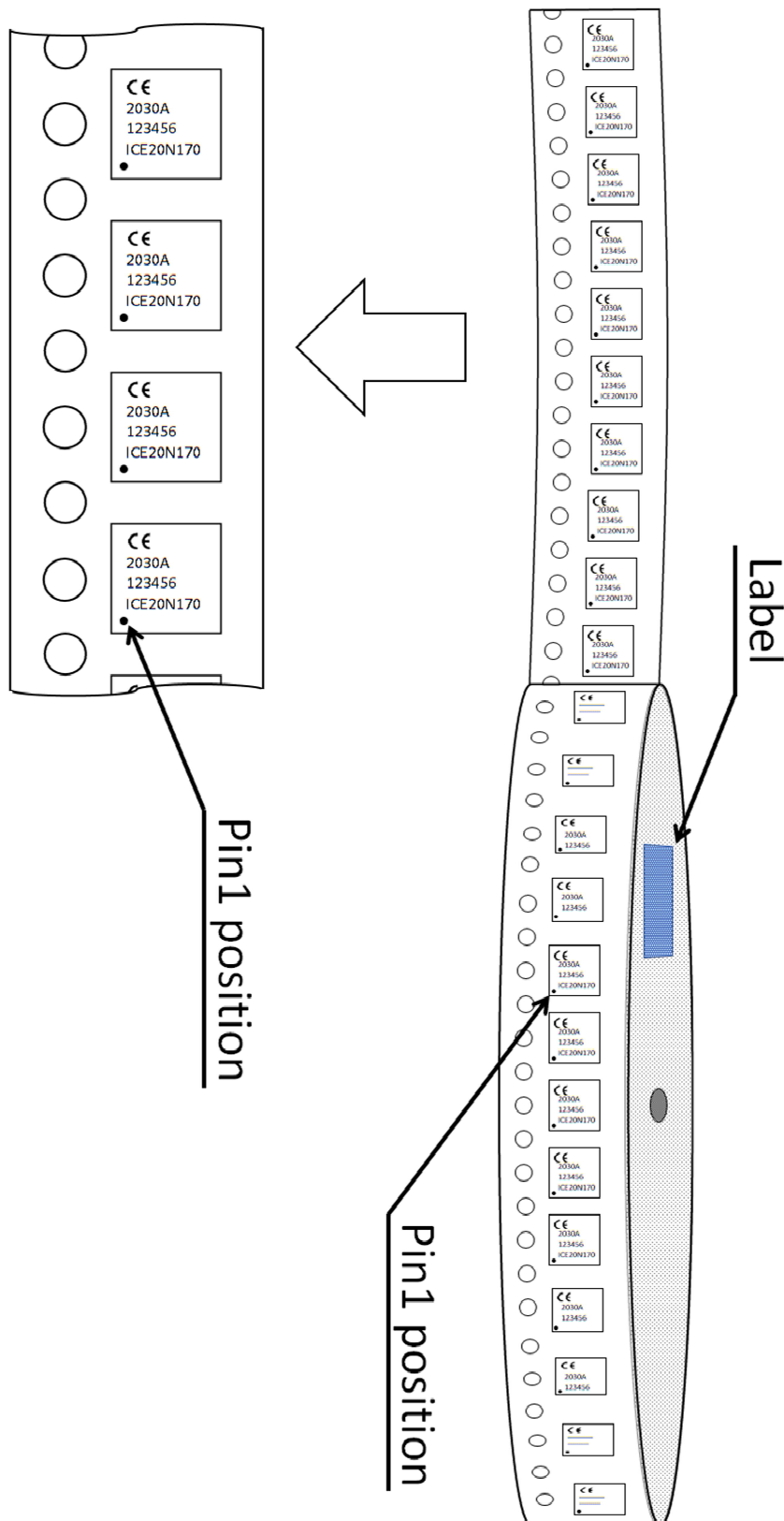


## Package Outline: DFN8x8

| SYMBOL | MIN      | MAX  | NOTES                                                                                                       |
|--------|----------|------|-------------------------------------------------------------------------------------------------------------|
| A      | 0.75     | 0.95 | 1.0 DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.                                                |
| A1     | 0.00     | 0.05 |                                                                                                             |
| A3     | 0.10     | 0.30 | 2.0 ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.                                               |
| b      | 0.90     | 1.10 |                                                                                                             |
| D      | 7.90     | 8.10 | 3.0 DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.90mm AND 1.10mm FROM TERMINAL TIP. |
| E      | 7.90     | 8.10 |                                                                                                             |
| D2     | 7.10     | 7.30 | 4.0 DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.                                                          |
| E1     | 2.65     | 2.85 |                                                                                                             |
| E2     | 4.25     | 4.45 | 5.0 COPLANARITY APPLIES TO THE EXPOSED HEAT SLUG AS WELL AS THE TERMINAL.                                   |
| e      | 2.00 BSC |      |                                                                                                             |
| L      | 0.40     | 0.60 | 6.0 RADIUS ON TERMINAL IS OPTIONAL.                                                                         |
| aaa    | 0.10     |      |                                                                                                             |
| ggg    | 0.05     |      |                                                                                                             |
| ccc    | 0.05     |      |                                                                                                             |
| fff    | 0.05     |      |                                                                                                             |
|        |          |      |                                                                                                             |

## Tape and Reel : DFN8x8

Reel size : 13 inch  
QTY per reel : 3000pcs





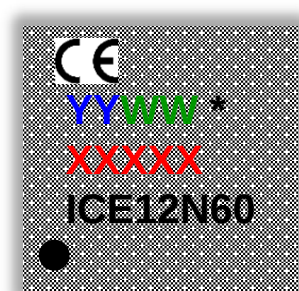
## Marking Information

**YY** = Last two digits of the year

**WW** = Work week

**\*** = Site ID

**XXXXXX** = Lot ID



**ICE12N60** = ICE is IceMOS logo and  
12N60 is a designated device part  
number

## Disclaimer

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