

# HYG190C04LA1D4

## 40V Complementary MOSFET

### Feature

#### N- Channel

$V_{ds} = 40V$

23 A ( $V_{gs} = 10V$ )

17 m $\Omega$  ( $V_{gs} = 10V$ )

22 m $\Omega$  ( $V_{gs} = 4.5V$ )

#### P - Channel

$V_{ds} = -40V$

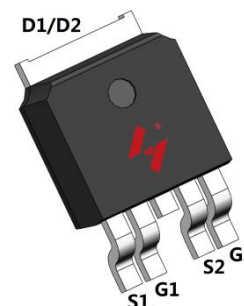
-16.5 A ( $V_{gs} = -10V$ )

35 m $\Omega$  ( $V_{gs} = -10V$ )

50 m $\Omega$  ( $V_{gs} = -4.5V$ )

- 100% Avalanche Tested
- Reliable and Rugged
- Halogen Free and Green Devices Available (RoHS Compliant)

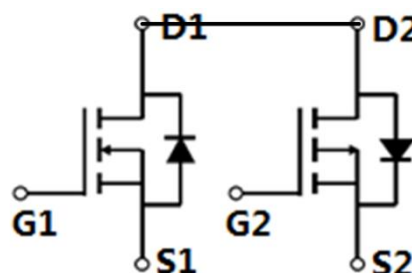
### Pin Description



TO-252-4L

### Applications

- Synchronous Rectifiers
- Wireless Power
- H-bridge Motor Drive



N-Channel

P-Channel

### Ordering and Marking Information

 D4  
G190C04  
XYMXXXXXX

Package Code  
D4: TO-252-4L

Date Code  
XYMXXXXXX

Note: HUAYI lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish, which are fully compliant with RoHS. HUAYI lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020 for MSL classification at lead-free peak reflow temperature. HUAYI defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

HUAYI reserves the right to make changes, corrections, enhancements, modifications, and improvements to this product and/or to this document at any time without notice.

## Absolute Maximum Ratings

| Symbol           | Parameter                                              |          | N- Channel | P- Channel | Unit |
|------------------|--------------------------------------------------------|----------|------------|------------|------|
|                  | <b>Common Ratings</b> (Tc=25°C Unless Otherwise Noted) |          |            |            |      |
| V <sub>DSS</sub> | Drain-Source Voltage                                   |          | 40         | -40        | V    |
| V <sub>GSS</sub> | Gate-Source Voltage                                    |          | ±20        |            | V    |
| T <sub>J</sub>   | Junction Temperature Range                             |          | -55 to 175 |            | °C   |
| T <sub>STG</sub> | Storage Temperature Range                              |          | -55 to 175 |            | °C   |
| I <sub>S</sub>   | Source Current-Continuous(Body                         | Tc=25°C  | 23         | -16.5      | A    |
|                  | <b>Mounted on Large Heat Sink</b>                      |          |            |            |      |
| I <sub>DM</sub>  | Pulsed Drain Current *                                 | Tc=25°C  | 69         | -49.5      | A    |
| I <sub>D</sub>   | Continuous Drain Current                               | Tc=25°C  | 23         | -16.5      | A    |
|                  |                                                        | Tc=100°C | 16.2       | -11.6      | A    |
| P <sub>D</sub>   | Maximum Power Dissipation                              | Tc=25°C  | 21.4       | 21.4       | W    |
|                  |                                                        | Tc=100°C | 10.7       | 10.7       | W    |
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case                   |          | 7          | 7          | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient                |          | 110        | 110        | °C/W |
| E <sub>AS</sub>  | SinglePulsed-Avalanche Energy **                       | L=0.3mH  | 23.8       | 26.2       | mJ   |

Note: \* Repetitive rating; pulse width limited by max.junction temperature.

\*\* Limited by T<sub>Jmax</sub>, starting T<sub>J</sub>=25°C, L = 0.3mH, R<sub>G</sub>= 25Ω, V<sub>GS</sub> =10V (N- Channel) /V<sub>GS</sub> =-10V (P- Channel) .

**N-Mosfet Electrical Characteristics** (T<sub>c</sub> =25°C Unless Otherwise Noted)

| Symbol                 | Parameter                        | Test Conditions                                           | HYG190C04LA1          |      |      | Unit |
|------------------------|----------------------------------|-----------------------------------------------------------|-----------------------|------|------|------|
|                        |                                  |                                                           | Min                   | Typ. | Max  |      |
| Static Characteristics |                                  |                                                           |                       |      |      |      |
| BV <sub>DSS</sub>      | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V,I <sub>DS</sub> =250μA                | 40                    | -    |      | V    |
| I <sub>DSS</sub>       | Drain-to-Source LeakageCurrent   | V <sub>DS</sub> =40V,V <sub>GS</sub> =0V                  | -                     | -    | 1    | μA   |
|                        |                                  |                                                           | T <sub>J</sub> =125°C | -    | -    | 50   |
| V <sub>GS(th)</sub>    | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA | 1                     | 1.8  | 3    | V    |
| I <sub>GSS</sub>       | Gate-Source Leakage Current      | V <sub>GS</sub> =±20V,V <sub>DS</sub> =0V                 | -                     | -    | ±100 | nA   |
| R <sub>DS(ON)</sub> *  | Drain-Source On-State Resistance | V <sub>GS</sub> =10V,I <sub>DS</sub> =10A                 | -                     | 17   | 21   | mΩ   |
|                        |                                  | V <sub>GS</sub> =4.5V,I <sub>DS</sub> =8A                 |                       | 22   | 29   |      |
| Diode Characteristics  |                                  |                                                           |                       |      |      |      |
| V <sub>SD</sub> *      | Diode Forward Voltage            | I <sub>SD</sub> =1A,V <sub>GS</sub> =0V                   | -                     | 0.71 | 1.0  | V    |
| t <sub>rr</sub>        | Reverse Recovery Time            | I <sub>SD</sub> =10A,dI <sub>SD</sub> /dt=100A/μs         | -                     | 6.3  | -    | ns   |
| Q <sub>rr</sub>        | Reverse Recovery Charge          |                                                           | -                     | 2.3  | -    | nC   |

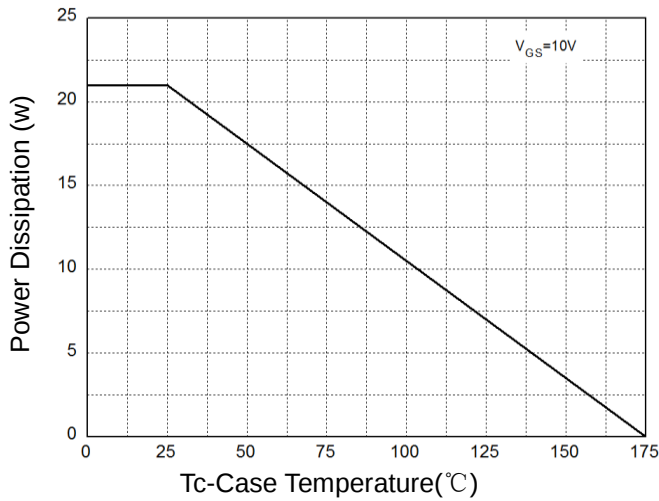
**N-Mosfet Electrical Characteristics (Cont.)** (T<sub>c</sub> =25°C Unless Otherwise Noted)

| Symbol                      | Parameter                                | Test Conditions                                                                       | HYG190C04LA1 |      |     | Unit |
|-----------------------------|------------------------------------------|---------------------------------------------------------------------------------------|--------------|------|-----|------|
|                             |                                          |                                                                                       | Min          | Typ. | Max |      |
| Dynamic Characteristics     |                                          |                                                                                       |              |      |     |      |
| R <sub>G</sub>              | Gate Resistance                          | V <sub>GS</sub> =0V,V <sub>DS</sub> =0V,<br>Frequency=1.0MHz                          | -            | 3.8  | -   | Ω    |
| C <sub>iss</sub>            | Input Capacitance                        | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =25V,<br>Frequency=1.0MHz                     | -            | 631  | -   | pF   |
| C <sub>oss</sub>            | Output Capacitance                       |                                                                                       | -            | 63   | -   |      |
| C <sub>rss</sub>            | Reverse Transfer Capacitance             |                                                                                       | -            | 46   | -   |      |
| t <sub>d(ON)</sub>          | Turn-on Delay Time                       | V <sub>DD</sub> =10V,R <sub>G</sub> =4Ω,<br>I <sub>DS</sub> =10A,V <sub>GS</sub> =10V | -            | 6.4  | -   | ns   |
| T <sub>r</sub>              | Turn-on Rise Time                        |                                                                                       | -            | 22.8 | -   |      |
| t <sub>d(OFF)</sub>         | Turn-off Delay Time                      |                                                                                       | -            | 15.7 | -   |      |
| T <sub>f</sub>              | Turn-off Fall Time                       |                                                                                       | -            | 4.6  | -   |      |
| Gate Charge Characteristics |                                          |                                                                                       |              |      |     |      |
| Q <sub>g</sub>              | Total Gate Charge(V <sub>G</sub> S=10V)  | V <sub>D</sub> S =15V, V <sub>G</sub> S=10V,<br>I <sub>D</sub> =10A                   | -            | 14.3 | -   | nC   |
| Q <sub>g</sub>              | Total Gate Charge(V <sub>G</sub> S=4.5V) |                                                                                       | -            | 8.5  | -   |      |
| Q <sub>gs</sub>             | Gate-Source Charge                       |                                                                                       | -            | 2.5  | -   |      |
| Q <sub>gd</sub>             | Gate-Drain Charge                        |                                                                                       | -            | 4.7  | -   |      |

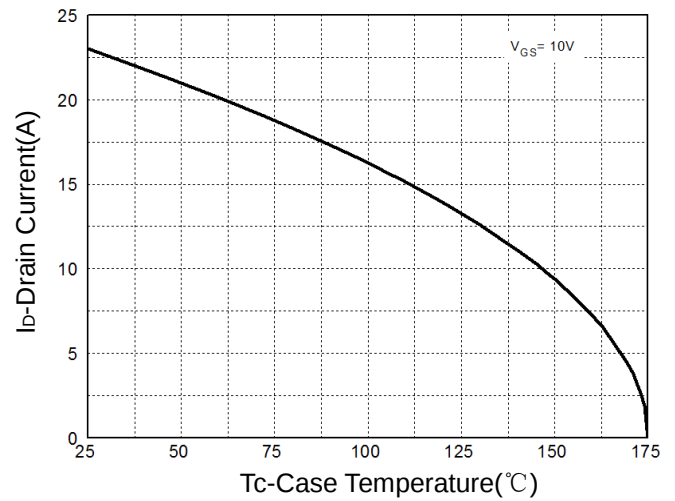
Note: \*Pulse test, pulse width ≤ 300us, duty cycle ≤ 2%

## N-Mosfet Typical Operating Characteristics

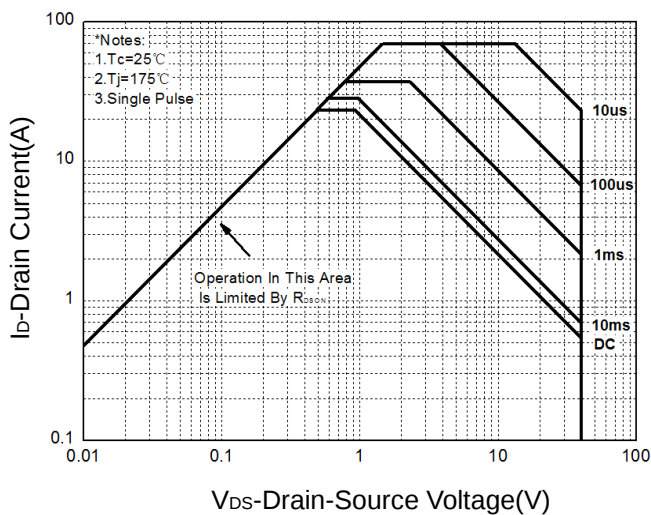
**Figure 1: Power Dissipation**



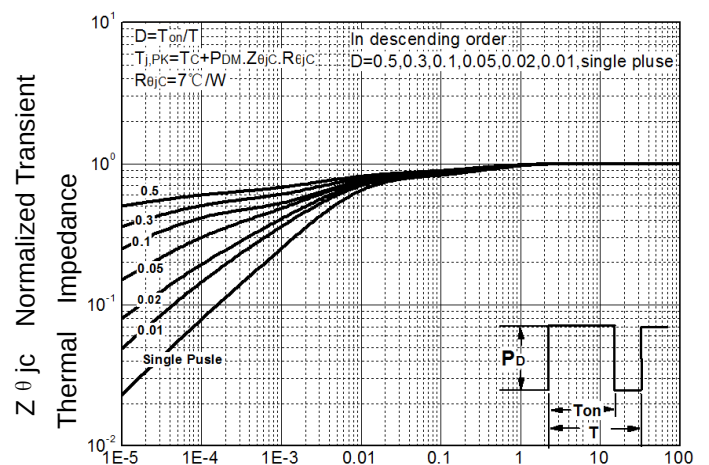
**Figure 2: Drain Current**



**Figure 3: Safe Operation Area**

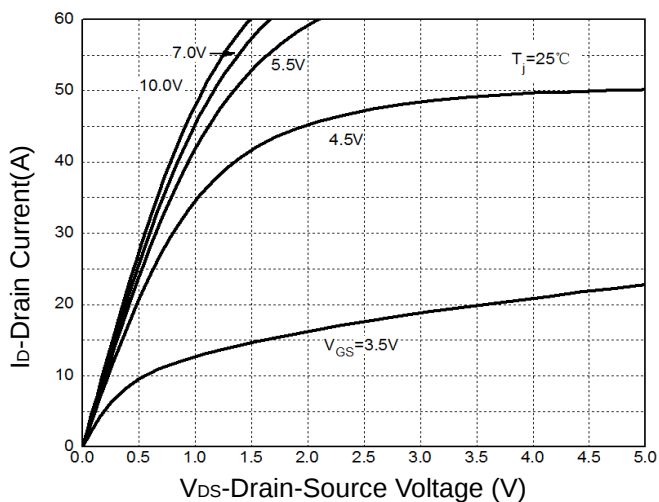


**Figure 4: Thermal Transient Impedance**

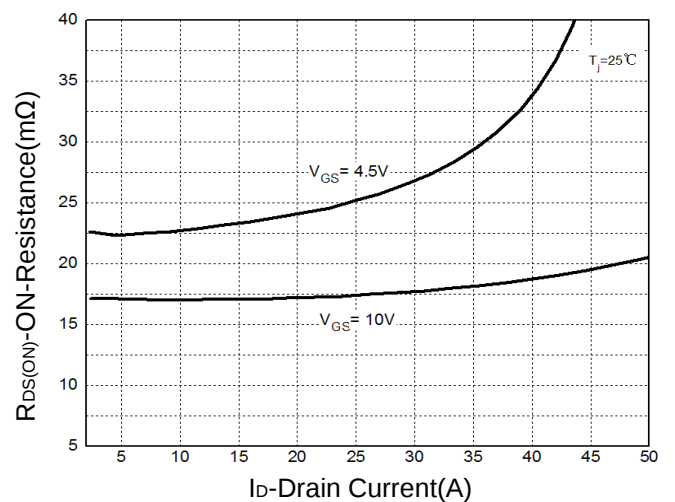


Maximum Effective Transient Thermal Impedance, Junction-to-Case

**Figure 5: Output Characteristics**



**Figure 6: Drain-Source On Resistance**



## N-Mosfet Typical Operating Characteristics

Figure 7: On-Resistance vs. Temperature

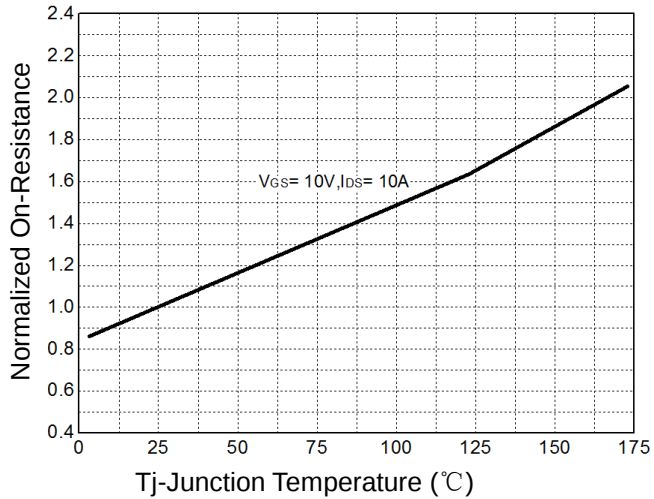


Figure 8: Source-Drain Diode Forward

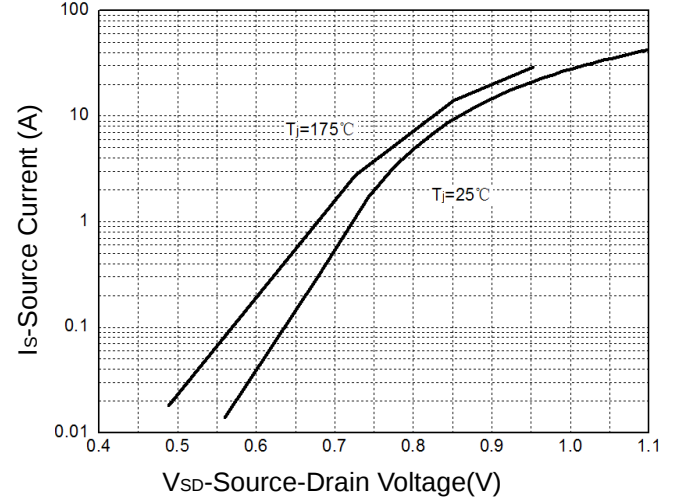


Figure 9: Capacitance Characteristics

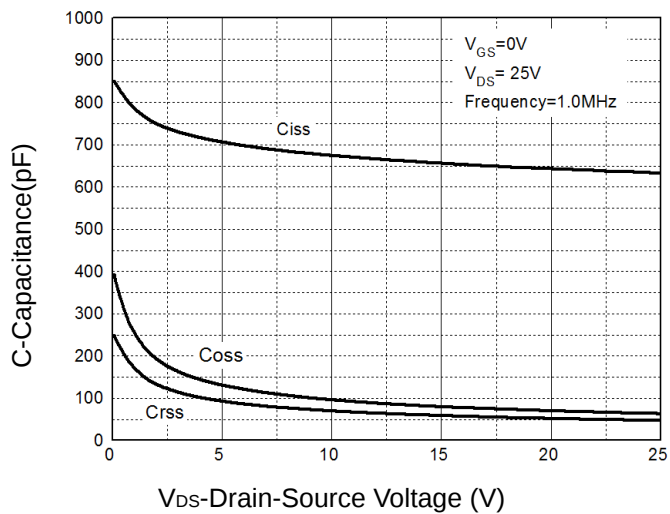
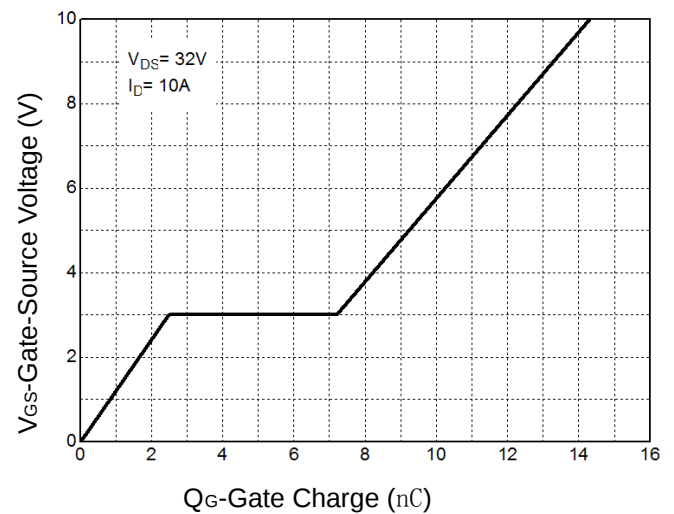
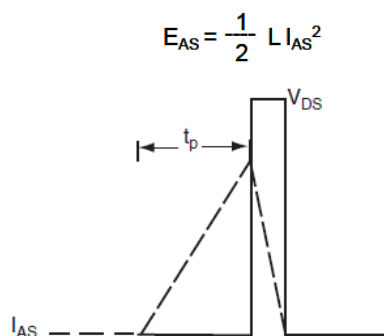
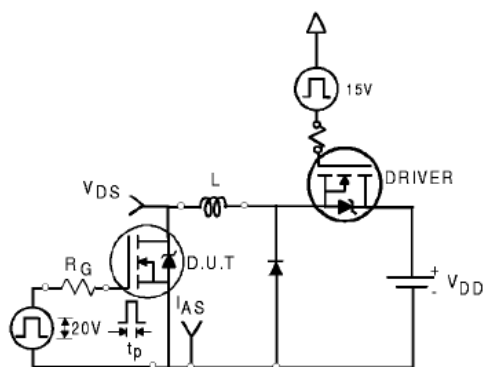


Figure 10: Gate Charge Characteristics

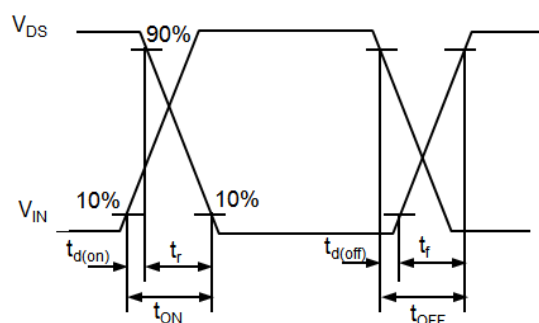
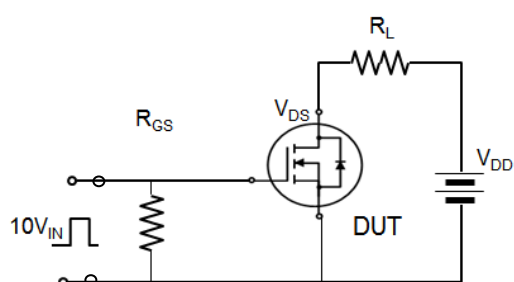


# HYG190C04LA1D4

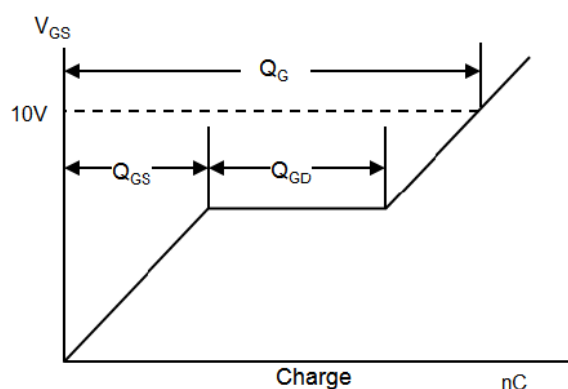
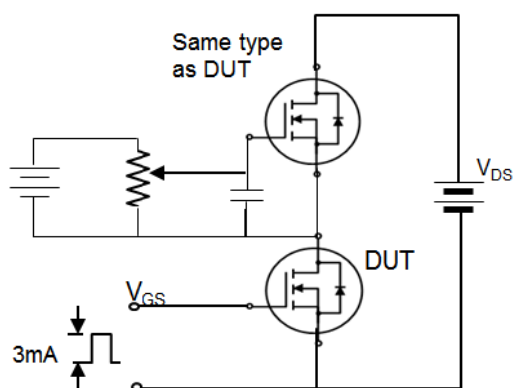
## Avalanche Test Circuit



## Switching Time Test Circuit



## Gate Charge Test Circuit



**P-Mosfet Electrical Characteristics** (T<sub>c</sub> =25°C Unless Otherwise Noted)

| Symbol                 | Parameter                        | Test Conditions                                            | HYG190C04LA1          |       |      | Unit |
|------------------------|----------------------------------|------------------------------------------------------------|-----------------------|-------|------|------|
|                        |                                  |                                                            | Min                   | Typ.  | Max  |      |
| Static Characteristics |                                  |                                                            |                       |       |      |      |
| BV <sub>DSS</sub>      | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =-250μA               | - 40                  | -     |      | V    |
| I <sub>DSS</sub>       | Drain-to-Source LeakageCurrent   | V <sub>DS</sub> =-40V, V <sub>GS</sub> =0V                 |                       | -     | -1   | μA   |
|                        |                                  |                                                            | T <sub>J</sub> =125°C |       | -    | -50  |
| V <sub>GS(th)</sub>    | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =-250μA | -1                    | -1.6  | -3   | V    |
| I <sub>GSS</sub>       | Gate-Source Leakage Current      | V <sub>GS</sub> =± 20V, V <sub>DS</sub> =0V                | -                     | -     | ±100 | nA   |
| R <sub>DS(ON)</sub> *  | Drain-Source On-State Resistance | V <sub>GS</sub> =-10V, I <sub>DS</sub> =-6A                | -                     | 35    | 40   | mΩ   |
|                        |                                  | V <sub>GS</sub> =-4.5V, I <sub>DS</sub> =-4A               |                       | 50    | 62   |      |
| Diode Characteristics  |                                  |                                                            |                       |       |      |      |
| V <sub>SD</sub> *      | Diode Forward Voltage            | I <sub>SD</sub> =-1A, V <sub>GS</sub> =0V                  | -                     | -0.75 | -1.0 | V    |
| t <sub>rr</sub>        | Reverse Recovery Time            | I <sub>SD</sub> =-6A, dI <sub>SD</sub> /dt=100A/μs         | -                     | 10    | -    | ns   |
| Q <sub>rr</sub>        | Reverse Recovery Charge          |                                                            | -                     | 5     | -    | nC   |

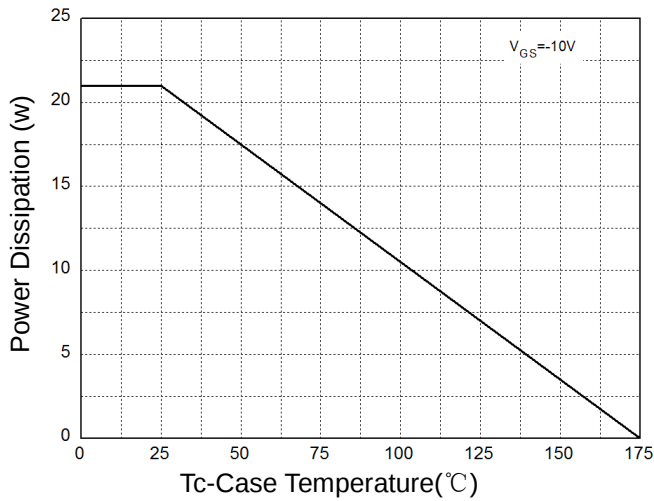
**P-Mosfet Electrical Characteristics (Cont.)** (T<sub>c</sub> =25°C Unless Otherwise Noted)

| Symbol                      | Parameter                                 | Test Conditions                                                                         | HYG190C04LA1 |      |     | Unit |
|-----------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------|--------------|------|-----|------|
|                             |                                           |                                                                                         | Min          | Typ. | Max |      |
| Dynamic Characteristics     |                                           |                                                                                         |              |      |     |      |
| R <sub>G</sub>              | Gate Resistance                           | V <sub>GS</sub> =0V,V <sub>DS</sub> =0V,<br>Frequency=1.0MHz                            | -            | 18   | -   | Ω    |
| C <sub>iss</sub>            | Input Capacitance                         | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =-25V,<br>Frequency=1.0MHz                      | -            | 1012 | -   | pF   |
| C <sub>oss</sub>            | Output Capacitance                        |                                                                                         | -            | 79   | -   |      |
| C <sub>rss</sub>            | Reverse Transfer Capacitance              |                                                                                         | -            | 63   | -   |      |
| t <sub>d(ON)</sub>          | Turn-on Delay Time                        | V <sub>DD</sub> =-20V,R <sub>G</sub> =4Ω,<br>I <sub>DS</sub> =-6A,V <sub>GS</sub> =-10V | -            | 6.8  | -   | ns   |
| T <sub>r</sub>              | Turn-on Rise Time                         |                                                                                         | -            | 17   | -   |      |
| t <sub>d(OFF)</sub>         | Turn-off Delay Time                       |                                                                                         | -            | 38   | -   |      |
| T <sub>f</sub>              | Turn-off Fall Time                        |                                                                                         | -            | 35   | -   |      |
| Gate Charge Characteristics |                                           |                                                                                         |              |      |     |      |
| Q <sub>g</sub>              | Total Gate Charge (V <sub>GS</sub> =-10V) | V <sub>DS</sub> =-32V,<br>I <sub>D</sub> =-6A                                           | -            | 20.1 | -   | nC   |
| Q <sub>g</sub>              | Total Gate Charge(V <sub>GS</sub> =-4.5V) |                                                                                         | -            | 10.5 | -   |      |
| Q <sub>gs</sub>             | Gate-Source Charge                        |                                                                                         | -            | 3.8  | -   |      |
| Q <sub>gd</sub>             | Gate-Drain Charge                         |                                                                                         | -            | 4.4  | -   |      |

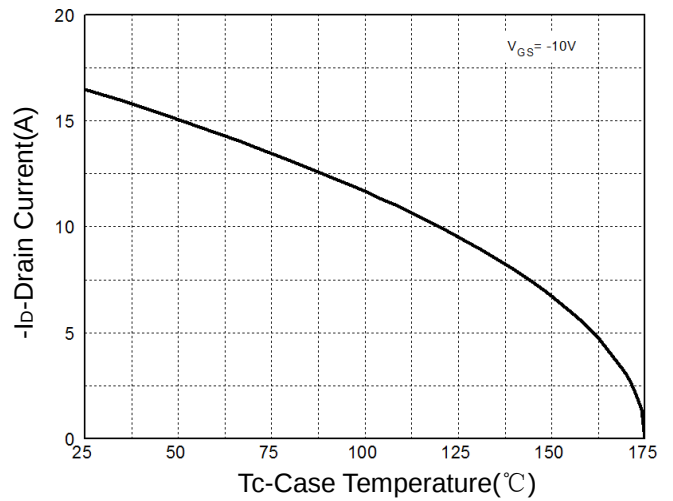
Note: \*Pulse test, pulse width ≤ 300us, duty cycle ≤ 2%

## P-Mosfet Typical Operating Characteristics

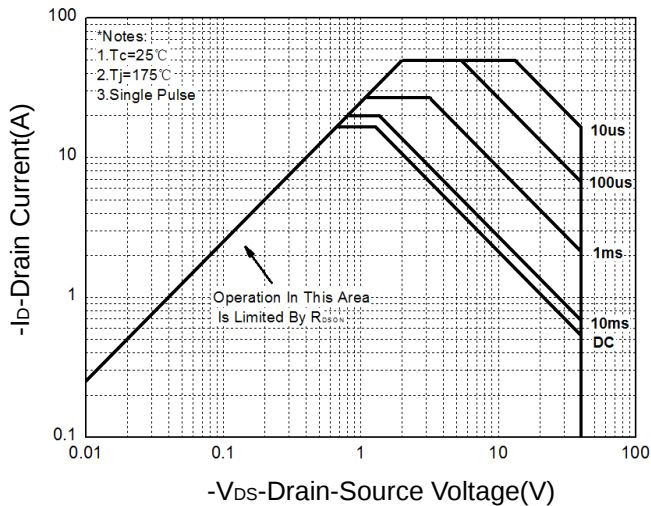
**Figure 1: Power Dissipation**



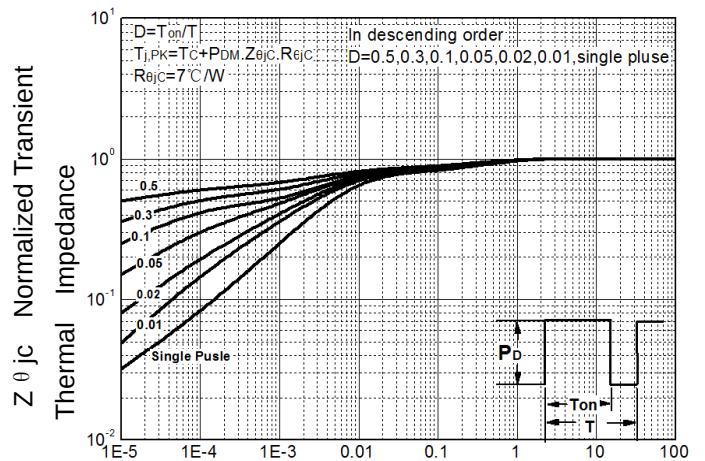
**Figure 2: Drain Current**



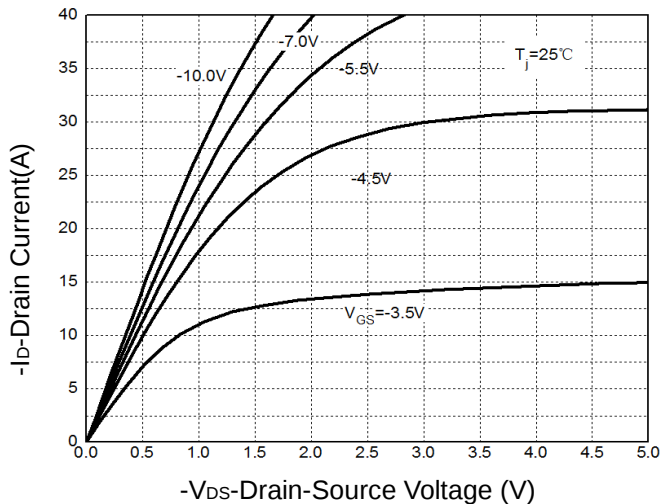
**Figure 3: Safe Operation Area**



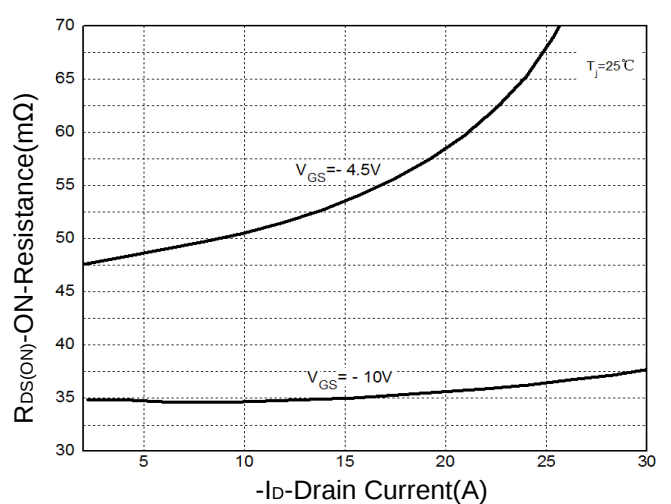
**Figure 4: Thermal Transient Impedance**



**Figure 5: Output Characteristics**

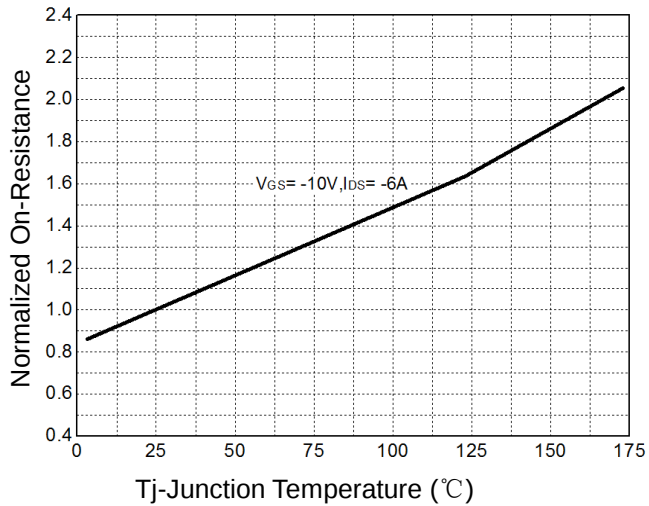


**Figure 6: Drain-Source On Resistance**

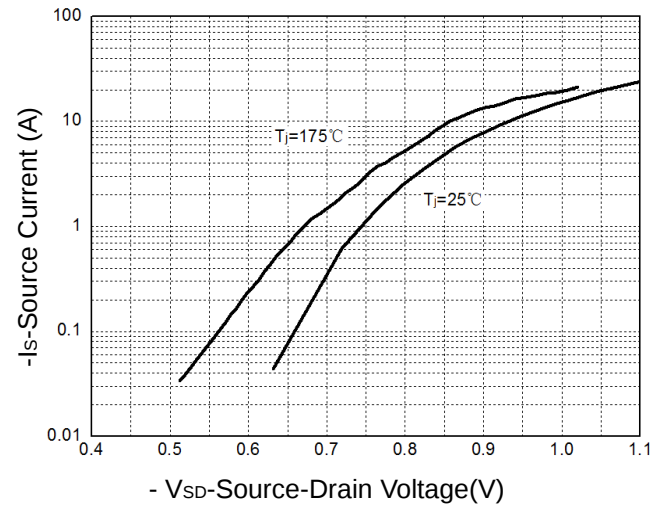


## P-Mosfet Typical Operating Characteristics

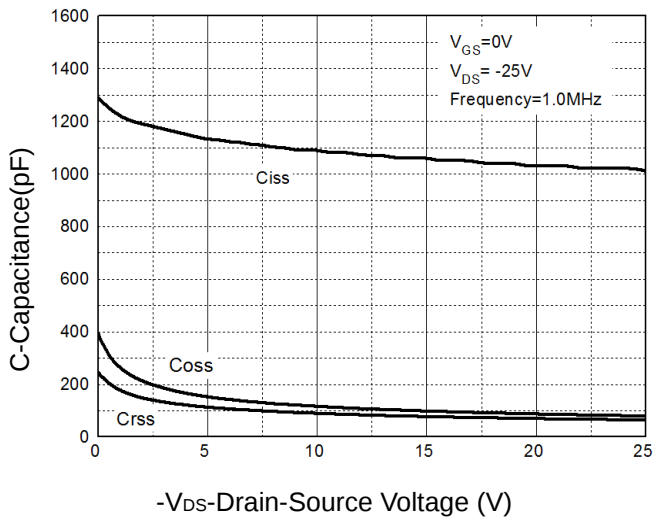
**Figure 7: On-Resistance vs. Temperature**



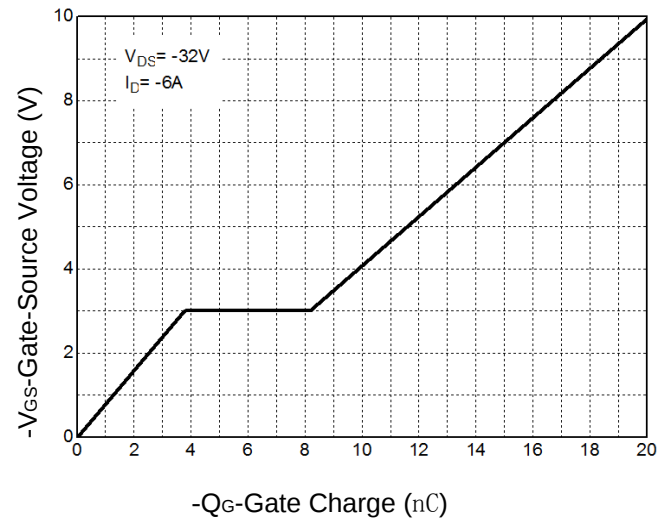
**Figure 8: Source-Drain Diode Forward**



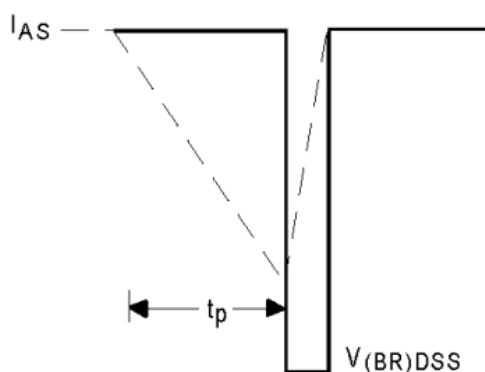
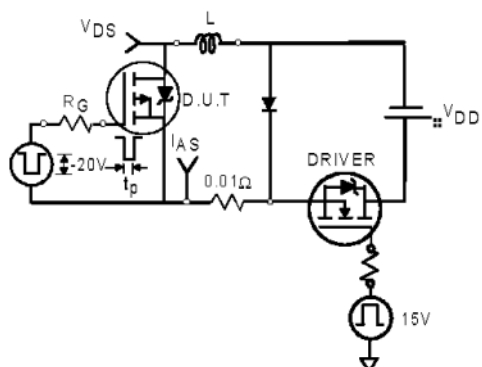
**Figure 9: Capacitance Characteristics**



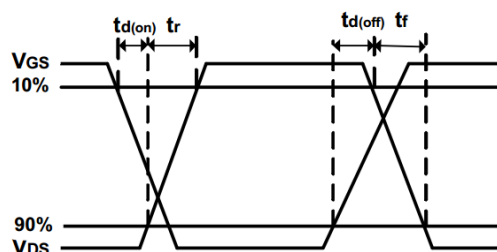
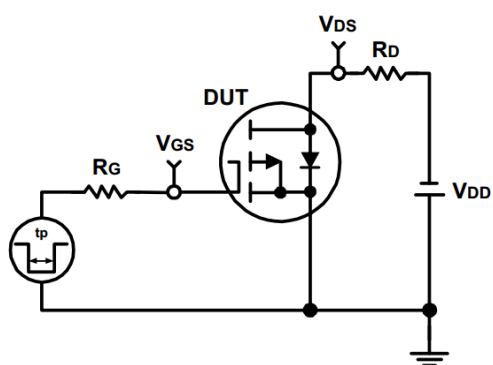
**Figure 10: Gate Charge Characteristics**



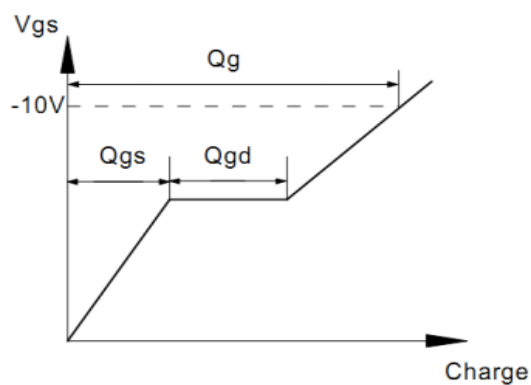
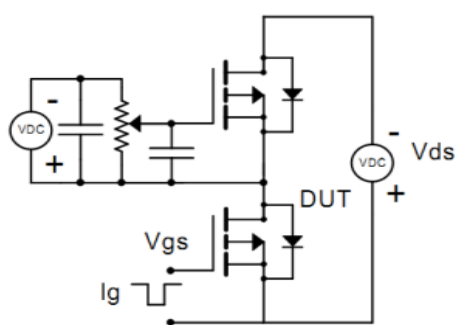
## Avalanche Test Circuit



## Switching Time Test Circuit



## Gate Charge Test Circuit



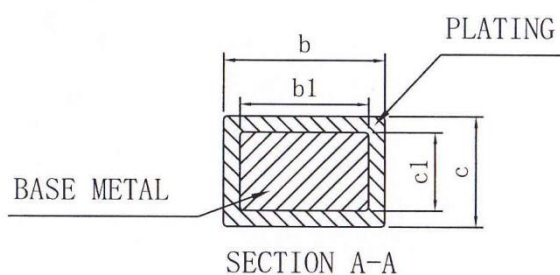
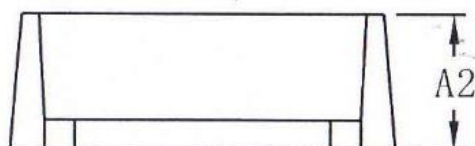
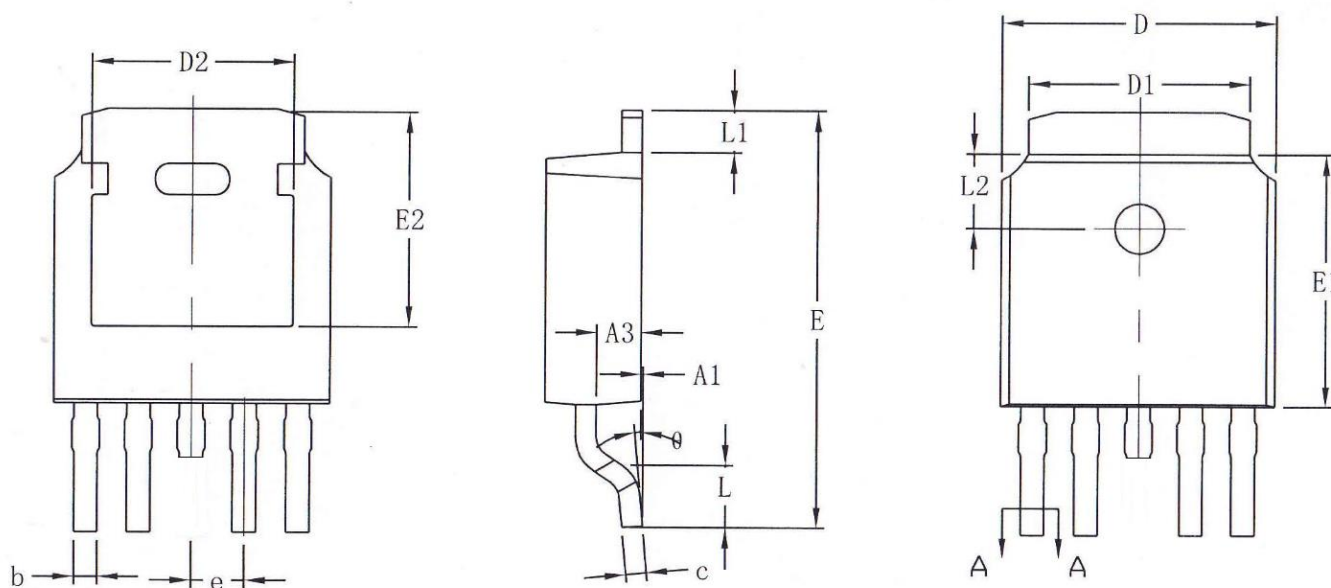
# HYG190C04LA1D4

## Device Per Unit

| Package Type | Unit | Quantity |
|--------------|------|----------|
| TO-252-4L    | Reel | 2500     |
| TO-252-4L    | Tube | 75       |

## Package Information

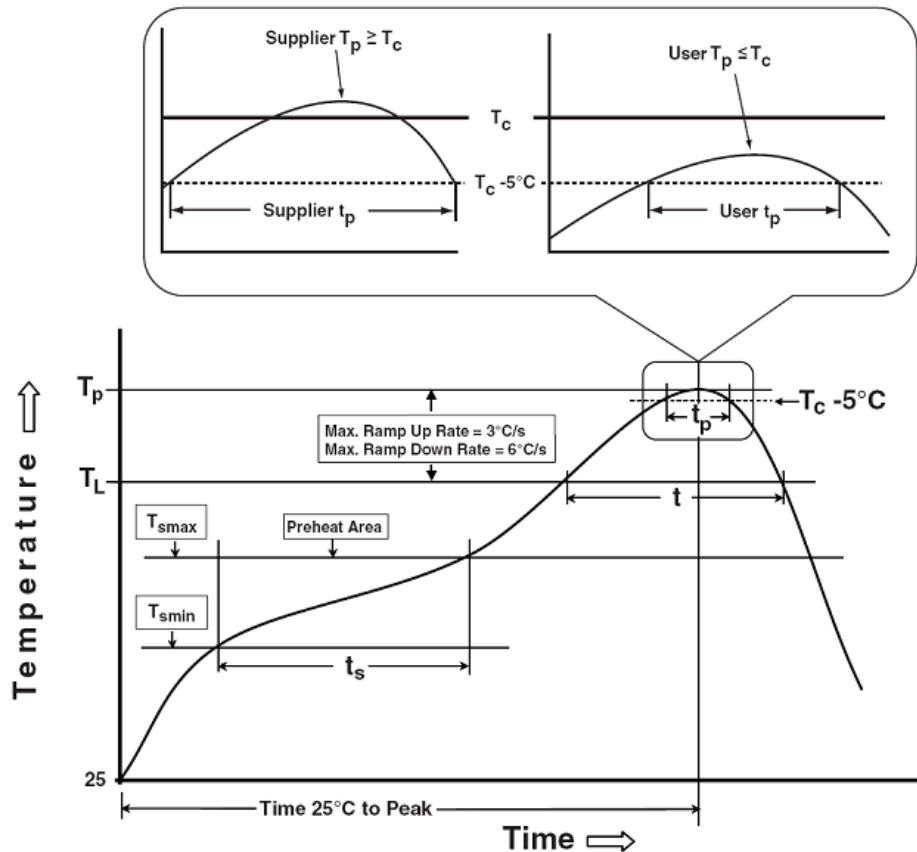
TO-252-4L



COMMON DIMENSIONS

| SYMBOL | mm      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| A1     | 0.00    | -     | 0.10  |
| A2     | 2.20    | 2.30  | 2.40  |
| A3     | 1.02    | 1.07  | 1.12  |
| b      | 0.54    | -     | 0.62  |
| b1     | 0.53    | 0.56  | 0.59  |
| c      | 0.51    | -     | 0.55  |
| c 1    | 0.50    | 0.51  | 0.52  |
| D      | 6.50    | 6.60  | 6.70  |
| D1     | 5.33REF |       |       |
| D2     | 4.83REF |       |       |
| E      | 9.90    | 10.10 | 10.30 |
| E1     | 6.00    | 6.10  | 6.20  |
| E2     | 5.30REF |       |       |
| e      | 1.27BSC |       |       |
| L      | 1.40    | 1.50  | 1.60  |
| L1     | 1.02REF |       |       |
| L2     | 1.70    | 1.80  | 1.90  |
| θ      | 0°      | -     | 8°    |

## Classification Profile



## Classification Reflow Profiles

| Profile Feature                                                                                                  | Sn-Pb Eutectic Assembly            | Pb-Free Assembly                   |
|------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| <b>Preheat &amp; Soak</b>                                                                                        |                                    |                                    |
| Temperature min ( $T_{smin}$ )                                                                                   | 100 °C                             | 150 °C                             |
| Temperature max ( $T_{smax}$ )                                                                                   | 150 °C                             | 200 °C                             |
| Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                                                      | 60-120 seconds                     | 60-120 seconds                     |
| Average ramp-up rate ( $T_{smax}$ to $T_P$ )                                                                     | 3 °C/second max.                   | 3°C/second max.                    |
| Liquidous temperature ( $T_L$ )                                                                                  | 183 °C                             | 217 °C                             |
| Time at liquidous ( $t_L$ )                                                                                      | 60-150 seconds                     | 60-150 seconds                     |
| Peak package body Temperature ( $T_P$ )*                                                                         | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ )                                | 20** seconds                       | 30** seconds                       |
| Average ramp-down rate ( $T_P$ to $T_{smax}$ )                                                                   | 6 °C/second max.                   | 6 °C/second max.                   |
| Time 25°C to peak temperature                                                                                    | 6 minutes max.                     | 8 minutes max.                     |
| *Tolerance for peak profile Temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.           |                                    |                                    |
| ** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum. |                                    |                                    |

Table 1.SnPb Eutectic Process – Classification Temperatures (Tc)

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>≥350 |
|-------------------|--------------------------------|--------------------------------|
| <2.5 mm           | 235 °C                         | 220 °C                         |
| ≥2.5 mm           | 220 °C                         | 220 °C                         |

Table 2.Pb-free Process – Classification Temperatures (Tc)

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>≥2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 °C                         | 260 °C                             | 260 °C                          |
| 1.6 mm – 2.5 mm   | 260 °C                         | 250 °C                             | 245 °C                          |
| ≥2.5 mm           | 250 °C                         | 245 °C                             | 245 °C                          |

## Reliability Test Program

| Test item     | Method        | Description                              |
|---------------|---------------|------------------------------------------|
| SOLDERABILITY | JESD-22, B102 | 5 Sec, 245°C                             |
| HTRB          | JESD-22, A108 | 168 Hrs \ 500Hrs\ 1000 Hrs, Bias @ 125°C |
| PCT           | JESD-22, A102 | 96 Hrs, 100%RH, 2atm, 121°C              |
| TCT           | JESD-22, A104 | 500 Cycles, -55°C~150°C                  |

### Customer Service

Worldwide Sales and Service: sales@hymexa.com

Technical Support: Technology@hymexa.com

Huayi Microelectronics Co., Ltd.

No.8928,Shangji Road,Economic and Technological Development Zone,Xi'an,China

TEL: (86-029) 86685706

FAX: (86-029) 86685705

E-mail: sales@hymexa.com

Web net: www.hymexa.com