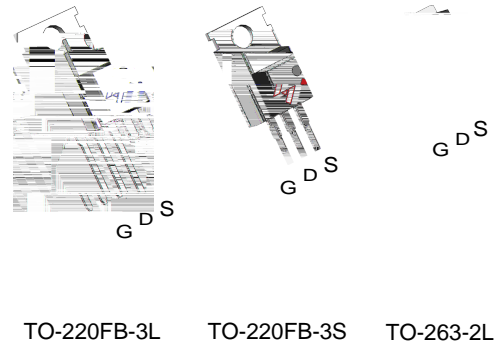


## N-Channel Enhancement Mode MOSFET

### Feature

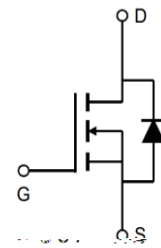
- 40V/90A  
 $R_{DS(ON)} = 4.7m$  (typ.)@ $V_{GS} = 10V$   
 $R_{DS(ON)} = 5.7m$  (typ.)@ $V_{GS} = 4.5V$
- 100% Avalanche Tested
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

### Pin Description



### Applications

- Switching application
- Power Management for Inverter Systems



N-Channel MOSFET

### Ordering and Marking Information

|   |   |
|---|---|
| <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <div style="background-color: black; width: 20px; height: 10px; margin: 0 auto;"></div> <p>P</p> <p><b>HY1904</b></p> <p>YYXXXJWW G</p> </div> <div style="text-align: center;"> <div style="background-color: black; width: 20px; height: 10px; margin: 0 auto;"></div> <p>B</p> <p><b>HY1904</b></p> <p>YYXXXJWW G</p> </div> <div style="text-align: center;"> <div style="background-color: black; width: 20px; height: 10px; margin: 0 auto;"></div> <p>M</p> <p><b>HY1904</b></p> <p>YYXXXJWW G</p> </div> </div> | <p>Package Code</p> <p>P:TO-220FB-3L      B:TO-263-2L</p> <p>T K V U E G G E Ø Ó È H Ù</p> <p>Date Code                      Assembly Material</p> <p>YYXXX WW                      G:Lead Free</p> |
|---|---|

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.

# HY1904P/B/M

## Absolute Maximum Ratings

| Symbol   | Parameter                               | Rating     | Unit |    |
|--|---|------------|------|----|
| <b>Common Ratings</b> (Tc=25°C Unless Otherwise Noted) |   |            |      |    |
| V <sub>DSS</sub>                                       | Drain-Source Voltage                    | 40         | V    |    |
| V <sub>GSS</sub>                                       | Gate-Source Voltage                     | ±25        | V    |    |
| T <sub>J</sub>   |   |            |      |    |
| T <sub>STG</sub>                                       | Storage Temperature Range               | -55 to 175 |      |    |
| I <sub>S</sub>   | Source Current-Continuous(Body Diode)   | 90         | A    |    |
| <b>Mounted on Large Heat Sink</b>                      |   |            |      |    |
| I <sub>DM</sub>  | Pulsed Drain Current *                  | 324        | A    |    |
| I <sub>D</sub>   | Continuous Drain Current                | 90         | A    |    |
|  |   | 62         | A    |    |
| P <sub>D</sub>   | Maximum Power Dissipation               | 100        | W    |    |
|  |   | 50         | W    |    |
| R <sub>θJC</sub>                                       | Thermal Resistance, Junction-to-Case**  | 1.5        | °C/W |    |
| R <sub>θJA</sub>                                       | Thermal Resistance, Junction-to-Ambient | 62.5       | °C/W |    |
| E <sub>AS</sub>  | SinglePulsed-Avalanche Energy ***       | L=0.3mH    | 184  | mJ |

Note: \* Repetitive rating pulse width limited by max.junction temperature. Drain current is limited by junction temperature  
 \*\* Limited by T<sub>Jmax</sub> , starting T<sub>J</sub>=25°C, L = 0.3mH, V<sub>D</sub>= 32V, V<sub>GS</sub> =10V.  
 \*\*\* Limited by T<sub>Jmax</sub> , starting T<sub>J</sub>=25°C, L = 0.3mH, V<sub>D</sub>= 32V, V<sub>GS</sub> =10V.

## Electrical Characteristics(Tc =25°C Unless Otherwise Noted)

| Symbol                        | Parameter                      | Test Conditions                             | HY1904 |      |     | Unit |
|-------------------------------|--------------------------------|---|--------|------|-----|------|
|                               |                                |   | Min    | Typ. | Max |      |
| <b>Static Characteristics</b> |                                |   |        |      |     |      |
| BV <sub>DSS</sub>             | Drain-Source Breakdown Voltage | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA | 40     | -    | -   |      |

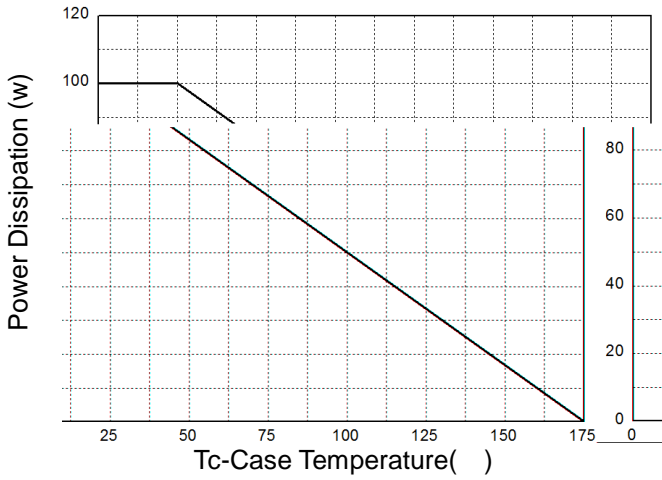
# HY1904P/B/M

## Electrical Characteristics (Cont.) (Tc =25°C Unless Otherwise Noted)

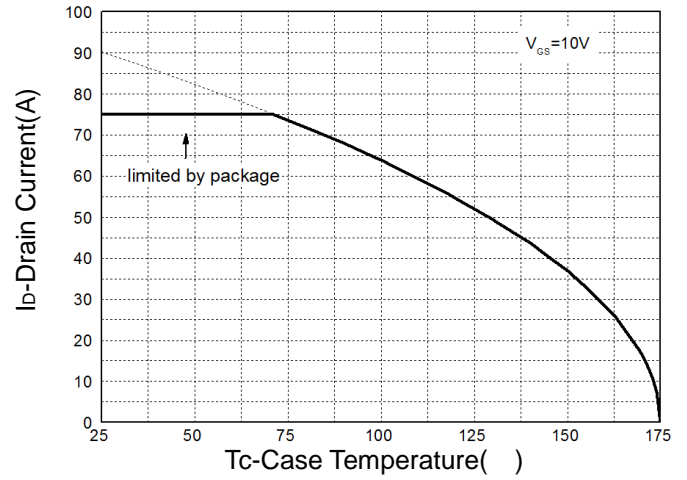
| Symbol                             | Parameter                    | Test Conditions  | HY1904   |      |     | Unit |
|------------------------------------|------------------------------|--|--|------|-----|------|
|                                    |                              |  | Min  | Typ. | Max |      |
| <b>Dynamic Characteristics</b>     |                              |  |  |      |     |      |
| R <sub>G</sub>                     | Gate Resistance              | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz                   | -  | 1.6  | -   |      |
| C <sub>iss</sub>                   | Input Capacitance            | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =25V,<br>Frequency=1.0MHz  | -  | 2274 | -   | pF   |
| C <sub>oss</sub>                   | Output Capacitance           |  | -  | 194  | -   |      |
| C <sub>rss</sub>                   | Reverse Transfer Capacitance |  | -  | 70   | -   |      |
| t <sub>d(ON)</sub>                 | Turn-on Delay Time           |  | V <sub>DD</sub> =20V, R <sub>G</sub> =6 Ω,<br>I <sub>DS</sub> =45A, V <sub>GS</sub> =10V | -    | 8   | -    |
| T <sub>r</sub>                     | Turn-on Rise Time            | -  |  | 40   | -   |      |
| t <sub>d(OFF)</sub>                | Turn-off Delay Time          | -  |  | 29   | -   |      |
| T <sub>f</sub>                     | Turn-off Fall Time           | -  |  | 20   | -   |      |
| <b>Gate Charge Characteristics</b> |                              |  |  |      |     |      |
| Q <sub>g</sub>                     | Total Gate Charge            | V <sub>DS</sub> =32V, V <sub>GS</sub> =10V,<br>I <sub>D</sub> =45A | -  | 52   | -   | nC   |
| Q <sub>gs</sub>                    | Gate-Source Charge           |  | -  | 6    | -   |      |
| Q <sub>gd</sub>                    | Gate-Drain Charge            |  | -  |      | -   |      |

**Typical Operating Characteristics**

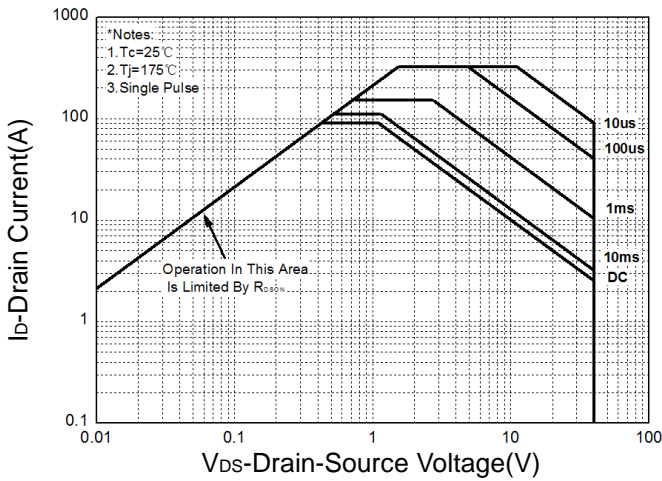
**Figure 1: Power Dissipation**



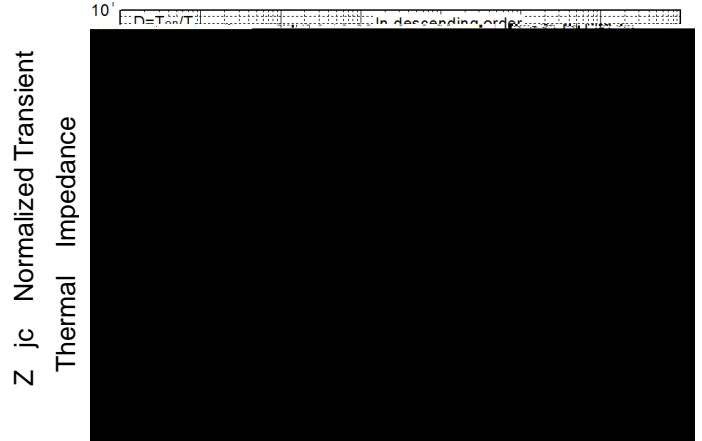
**Figure 2: Drain Current**



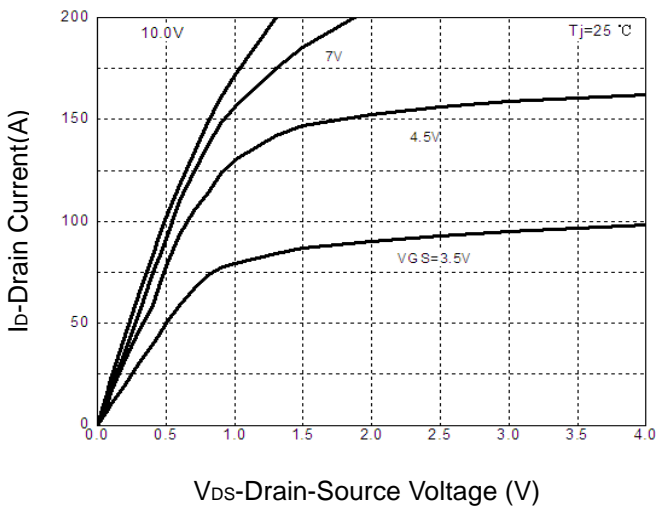
**Figure 3: Safe Operation Area**



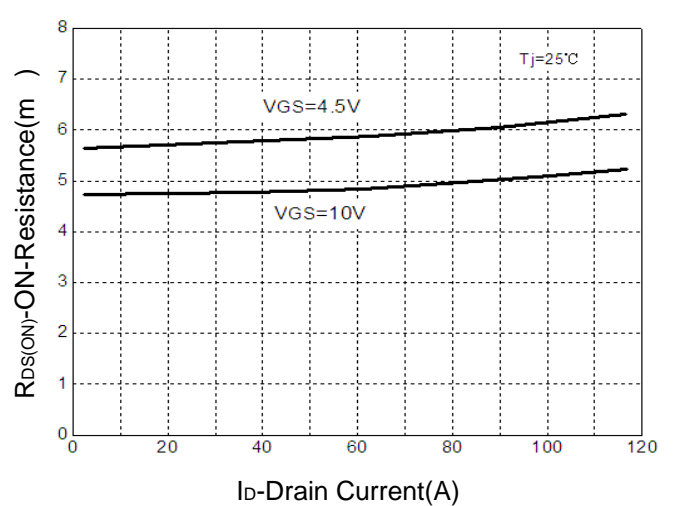
**Figure 4: Thermal Transient Impedance**



**Figure 5: Output Characteristics**



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



# HY1904P/B/M

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## Typical Operating Characteristics(Cont.)

Figure 7: On-Resistance vs. Temperature

Figure 8: Source-Drain Diode Forward

$T_j$ -Junction Temperature ( )

$V_{SD}$ -Source-Drain Voltage(V)

Figure 9: Capacitance Characteristics

Figure 10: Gate Charge Characteristics

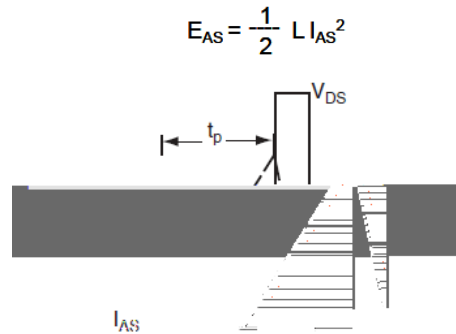
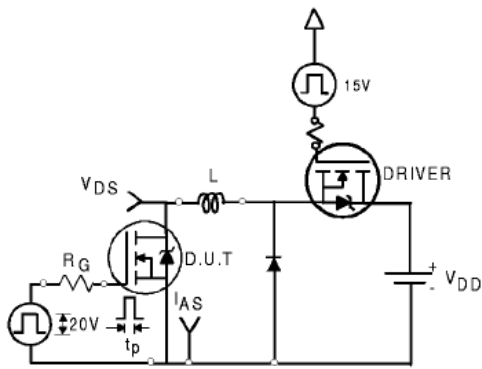
C-Capacitance(pF)

$V_{DS}$ -Drain-Source Voltage (V)

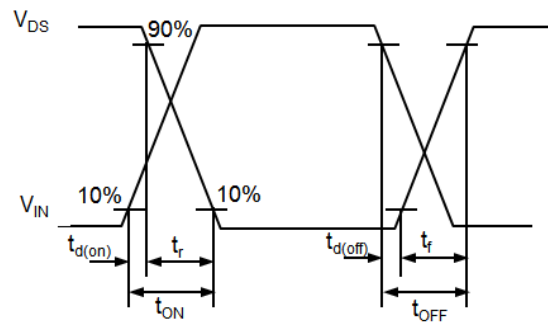
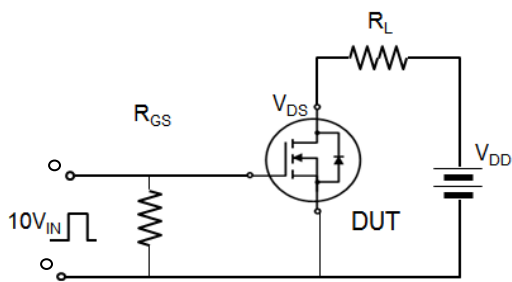
$V_{GS}$ -Gate-

$Q_G$ -Gate Charge ( )

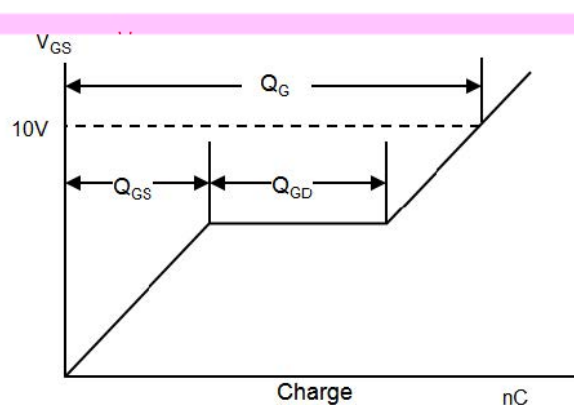
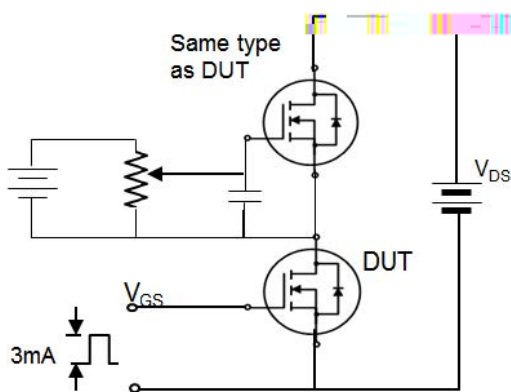
### Avalanche Test Circuit



### Switching Time Test Circuit



### Gate Charge Test Circuit

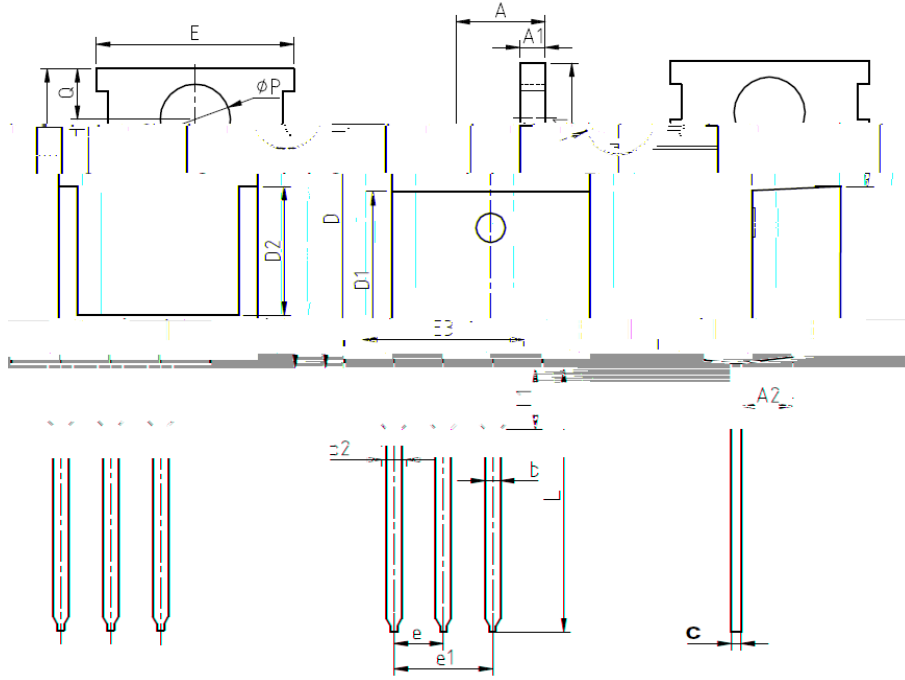


## Device Per Unit

| Package Type | Unit | Quantity |
|--------------|------|----------|
| TO-220FB-3L  | Tube | 50       |
| TO-263-2L    | Tube | 50       |
| TO-220FB-3S  | Tube | 50       |

## Package Information

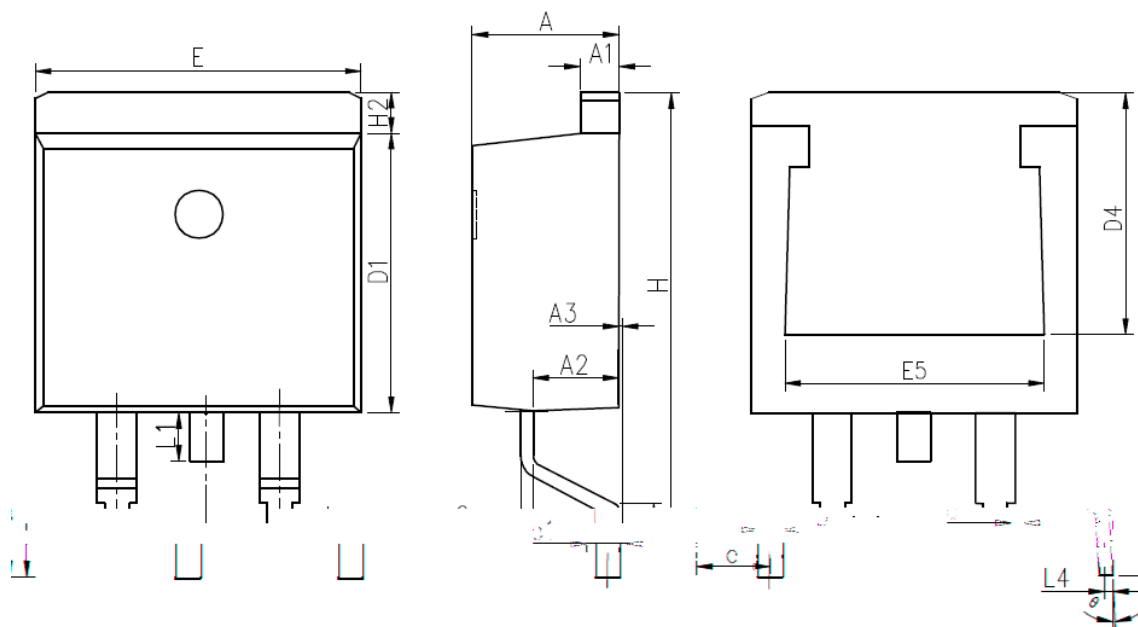
### TO-220FB-3L



COMMON DIMENSIONS

| SYMBOL | mm       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| A      | 4.37     | 4.57  | 4.77  |
| A1     | 1.25     | 1.30  | 1.45  |
| A2     | 2.20     | 2.40  | 2.60  |
| b      | 0.70     | 0.80  | 0.95  |
| b2     | 1.17     | 1.27  | 1.47  |
| c      | 0.40     | 0.50  | 0.65  |
| D      | 15.10    | 15.60 | 16.10 |
| D1     | 8.80     | 9.10  | 9.40  |
| D2     | 5.50     | -     | -     |
| E      | 9.70     | 10.00 | 10.30 |
| E3     | 7.00     | -     | -     |
| e      | 2.54 BSC |       |       |
| e1     | 5.08 BSC |       |       |
| H1     | 6.25     | 6.50  | 6.85  |
| L      | 12.75    | 13.50 | 13.80 |
| L1     | -        | 3.10  | 3.40  |
| P      | 3.40     | 3.60  | 3.80  |
| Q      | 2.60     | 2.80  | 3.00  |

TO-263-2L



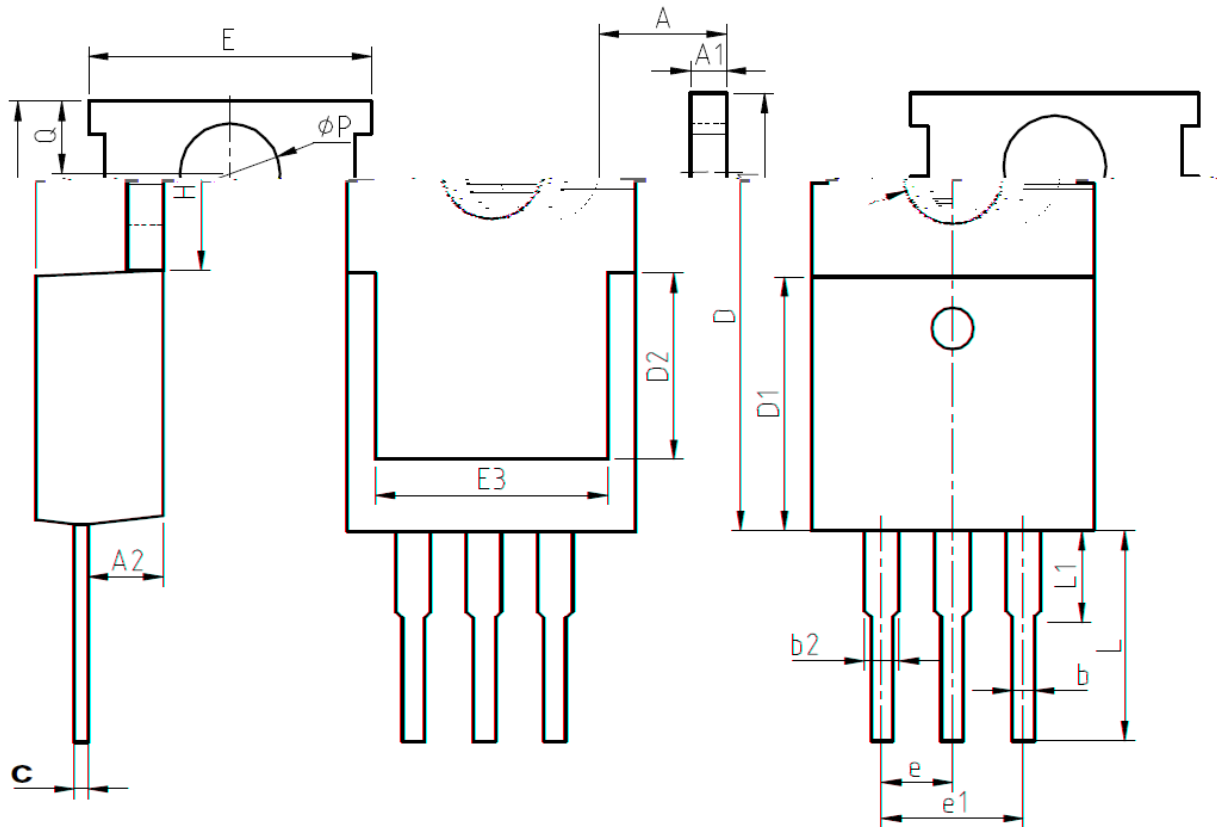
### COMMON DIMENSIONS

| SYMBOL | mm       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| A      | 4.37     | 4.57  | 4.77  |
| A1     | 1.22     | 1.27  | 1.42  |
| A2     | 2.49     | 2.69  | 2.89  |
| A3     | 0        | 0.13  | 0.25  |
| b      | 0.7      | 0.81  | 0.96  |
| b1     | 1.17     | 1.27  | 1.47  |
| c      | 0.3      | 0.38  | 0.53  |
| D1     | 8.5      | 8.7   | 8.9   |
| D4     | 6.6      | -     | -     |
| E      | 9.86     | 10.16 | 10.36 |
| E5     | 7.06     | -     | -     |
| e      | 2.54 BSC |       |       |
| H      | 14.7     | 15.1  | 15.5  |
| H2     | 1.07     | 1.27  | 1.47  |
| L      | 2        | 2.3   | 2.6   |
| L1     | 1.4      | 1.55  | 1.7   |
| L4     | 0.25 BSC |       |       |
|        | 0°       | 5°    | 9°    |



# HY1904P/B/M

TO-220FB-3S

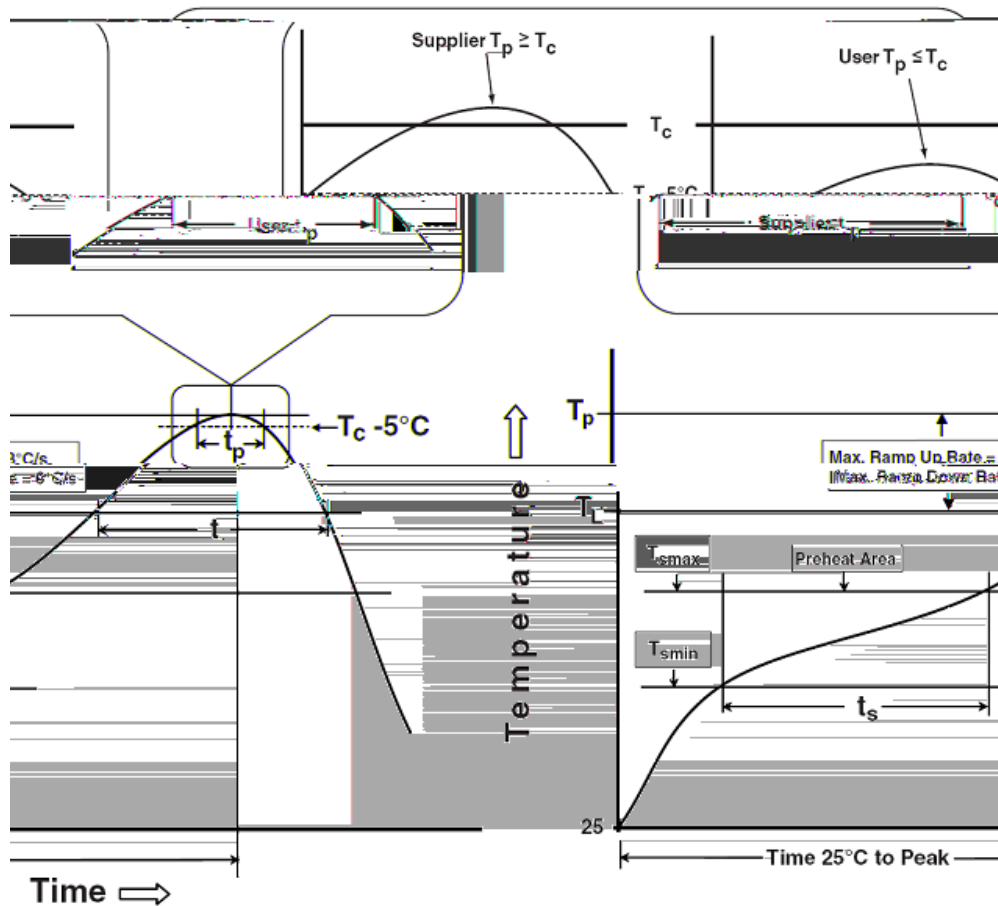


COMMON DIMENSIONS

| SYMBOL | mm   |      |      |
|--------|------|------|------|
|        | MIN  | NOM  | MAX  |
| A      | 4.37 | 4.57 | 4.77 |
| A1     | 1.25 | 1.30 | 1.45 |
| A2     | 2.20 | 2.40 | 2.60 |
| b      | 0.70 | 0.80 | 0.95 |
| b2     | 1.17 | 1.27 | 1.47 |
| c      | 0.40 | 0.50 | 0.65 |

D

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 $25^\circ\text{C}$ 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.

# HY1904P/B/M

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

| <b>Package Thickness</b> | <b>Volume mm &lt;350</b> | <b>Volume mm 350</b> |
|--------------------------|--------------------------|----------------------|
| 2.5 mm                   | 235 °C                   | 220 °C               |
| 2.5 mm                   | 220 °C                   | 220 °C               |

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

| <b>Package Thickness</b> | <b>Volume mm &lt;350</b> | <b>Volume mm 350-2000</b> | <b>Volume mm 2000</b> |
|--------------------------|--------------------------|---------------------------|-----------------------|
| <1.6 mm                  | 260 °C                   | 260 °C                    | 260 °C                |