

## General Description

The HSP6016A is the high cell density trench N-ch MOSFETs, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications.

The HSP6016A meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

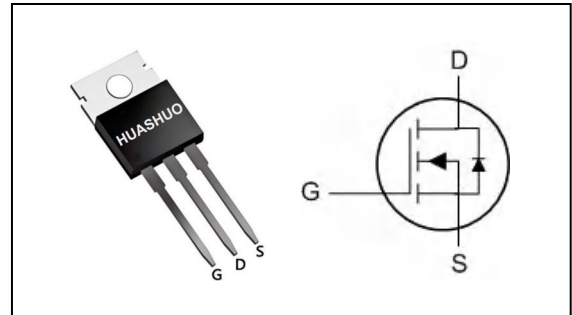
## Features

- Super Low Gate Charge
- 100% EAS Guaranteed
- Green Device Available
- Excellent CdV/dt effect decline
- Advanced high cell density Trench Technology

## Product Summary

|                  |    |    |
|------------------|----|----|
| $V_{DS}$         | 60 | V  |
| $R_{DS(ON),typ}$ | 9  | mΩ |
| $I_D$            | 60 | A  |

## TO-220 Pin Configuration



## Absolute Maximum Ratings

| Symbol                      | Parameter                                  | Rating     | Units            |
|-----------------------------|--------------------------------------------|------------|------------------|
| $V_{DS}$                    | Drain-Source Voltage                       | 60         | V                |
| $V_{GS}$                    | Gate-Source Voltage                        | $\pm 20$   | V                |
| $I_D@T_C=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10V^1$ | 60         | A                |
| $I_D@T_C=100^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 38         | A                |
| $I_D@T_A=25^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10V^1$ | 9.2        | A                |
| $I_D@T_A=70^\circ\text{C}$  | Continuous Drain Current, $V_{GS} @ 10V^1$ | 7.5        | A                |
| $I_{DM}$                    | Pulsed Drain Current <sup>2</sup>          | 135        | A                |
| EAS                         | Single Pulse Avalanche Energy <sup>3</sup> | 73         | mJ               |
| $I_{AS}$                    | Avalanche Current                          | 38         | A                |
| $P_D@T_C=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>       | 86.8       | W                |
| $P_D@T_A=25^\circ\text{C}$  | Total Power Dissipation <sup>4</sup>       | 2          | W                |
| $T_{STG}$                   | Storage Temperature Range                  | -55 to 150 | $^\circ\text{C}$ |
| $T_J$                       | Operating Junction Temperature Range       | -55 to 150 | $^\circ\text{C}$ |

## Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit               |
|-----------------|--------------------------------------------------|------|------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 62   | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 1.44 | $^\circ\text{C/W}$ |



**Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**

| Symbol                              | Parameter                                      | Conditions                                                                               | Min. | Typ.  | Max. | Unit  |
|-------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------|------|-------|------|-------|
| BV <sub>DSS</sub>                   | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V, I <sub>D</sub> =250uA                                               | 60   | ---   | ---  | V     |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | BV <sub>DSS</sub> Temperature Coefficient      | Reference to 25°C, I <sub>D</sub> =1mA                                                   | ---  | 0.052 | ---  | V/°C  |
| R <sub>DS(ON)</sub>                 | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =10V, I <sub>D</sub> =30A                                                | ---  | 9     | 12   | mΩ    |
| V <sub>GS(th)</sub>                 | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA                                 | 2    | 3     | 5    | V     |
| ΔV <sub>GS(th)</sub>                | V <sub>GS(th)</sub> Temperature Coefficient    |                                                                                          | ---  | -5.76 | ---  | mV/°C |
| I <sub>DSS</sub>                    | Drain-Source Leakage Current                   | V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C                          | ---  | ---   | 1    | uA    |
|                                     |                                                | V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =55°C                          | ---  | ---   | 5    |       |
| I <sub>GSS</sub>                    | Gate-Source Leakage Current                    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                               | ---  | ---   | ±100 | nA    |
| g <sub>fs</sub>                     | Forward Transconductance                       | V <sub>DS</sub> =5V, I <sub>D</sub> =30A                                                 | ---  | 42    | ---  | S     |
| R <sub>g</sub>                      | Gate Resistance                                | V <sub>DS</sub> =0V, V <sub>GS</sub> =0V, f=1MHz                                         | ---  | 1.5   | ---  | Ω     |
| Q <sub>g</sub>                      | Total Gate Charge (4.5V)                       | V <sub>DS</sub> =48V, V <sub>GS</sub> =4.5V, I <sub>D</sub> =15A                         | ---  | 33    | ---  | nC    |
| Q <sub>gs</sub>                     | Gate-Source Charge                             |                                                                                          | ---  | 10.5  | ---  |       |
| Q <sub>gd</sub>                     | Gate-Drain Charge                              |                                                                                          | ---  | 9.9   | ---  |       |
| T <sub>d(on)</sub>                  | Turn-On Delay Time                             | V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, R <sub>G</sub> =3.3Ω,<br>I <sub>D</sub> =15A | ---  | 10.4  | ---  | ns    |
| T <sub>r</sub>                      | Rise Time                                      |                                                                                          | ---  | 9.2   | ---  |       |
| T <sub>d(off)</sub>                 | Turn-Off Delay Time                            |                                                                                          | ---  | 63    | ---  |       |
| T <sub>f</sub>                      | Fall Time                                      |                                                                                          | ---  | 4.8   | ---  |       |
| C <sub>iss</sub>                    | Input Capacitance                              | V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, f=1MHz                                        | ---  | 2188  | ---  | pF    |
| C <sub>oss</sub>                    | Output Capacitance                             |                                                                                          | ---  | 260   | ---  |       |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance                   |                                                                                          | ---  | 167   | ---  |       |

**Diode Characteristics**

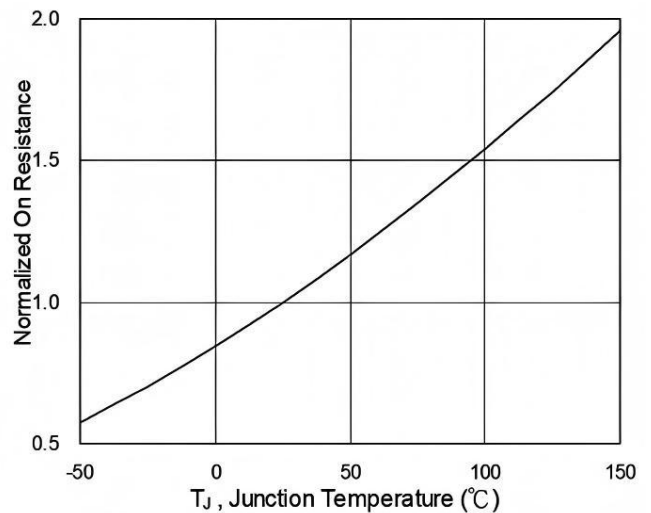
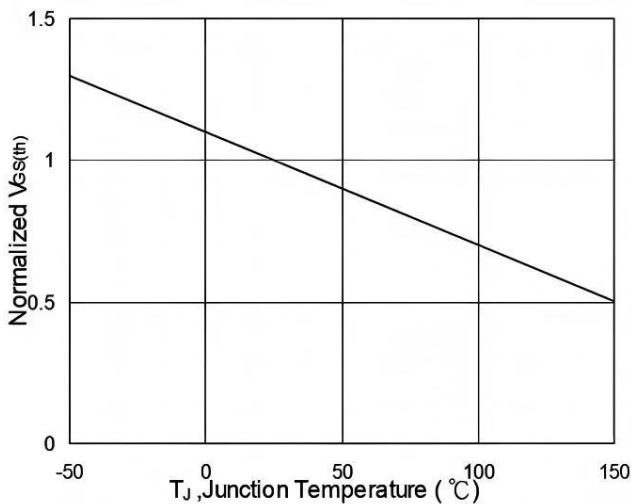
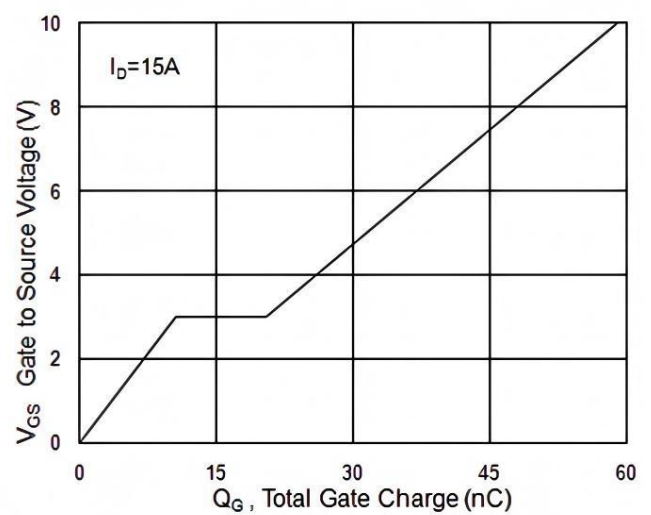
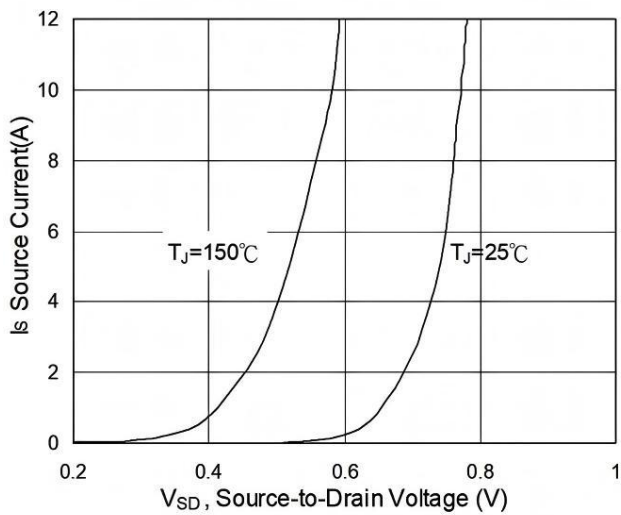
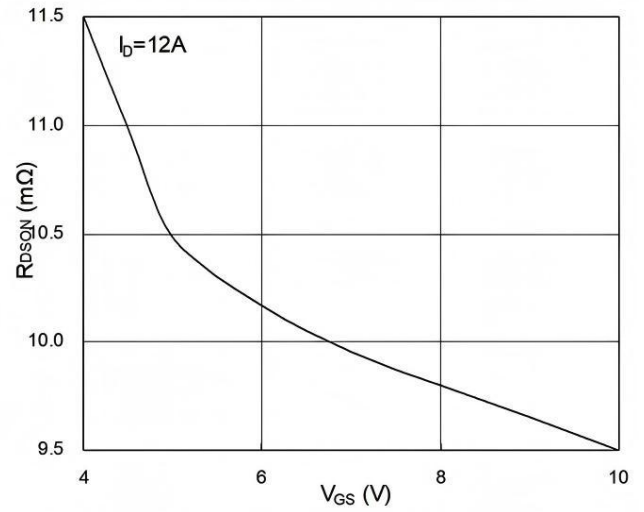
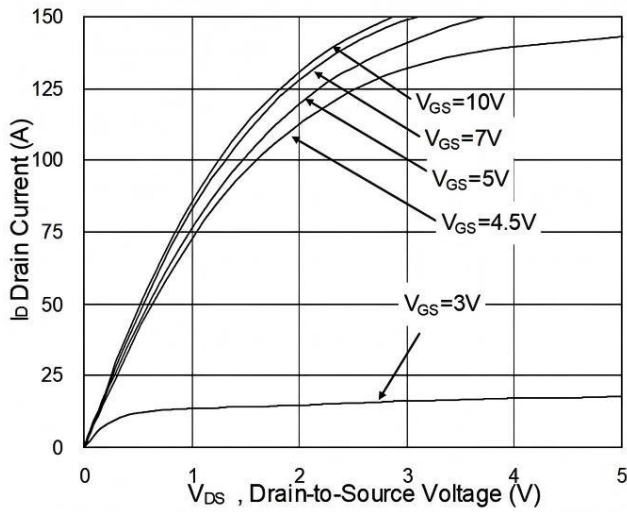
| Symbol          | Parameter                                | Conditions                                                   | Min. | Typ. | Max. | Unit |
|-----------------|------------------------------------------|--------------------------------------------------------------|------|------|------|------|
| I <sub>S</sub>  | Continuous Source Current <sup>1,5</sup> | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current            | ---  | ---  | 60   | A    |
| I <sub>SM</sub> | Pulsed Source Current <sup>2,5</sup>     |                                                              | ---  | ---  | 135  | A    |
| V <sub>SD</sub> | Diode Forward Voltage <sup>2</sup>       | V <sub>GS</sub> =0V, I <sub>S</sub> =A, T <sub>J</sub> =25°C | ---  | ---  | 1.2  | V    |
| t <sub>rr</sub> | Reverse Recovery Time                    | I <sub>F</sub> =15A, dI/dt=100A/μs, T <sub>J</sub> =25°C     | ---  | 18   | ---  | nS   |
| Q <sub>rr</sub> | Reverse Recovery Charge                  |                                                              | ---  | 14   | ---  | nC   |

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%
- 3.The EAS data shows Max. rating. The test condition is V<sub>DD</sub>=25V, V<sub>GS</sub>=10V, L=0.1mH, I<sub>AS</sub>=38A
- 4.The power dissipation is limited by 150°C junction temperature
- 5.The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.



## Typical Characteristics



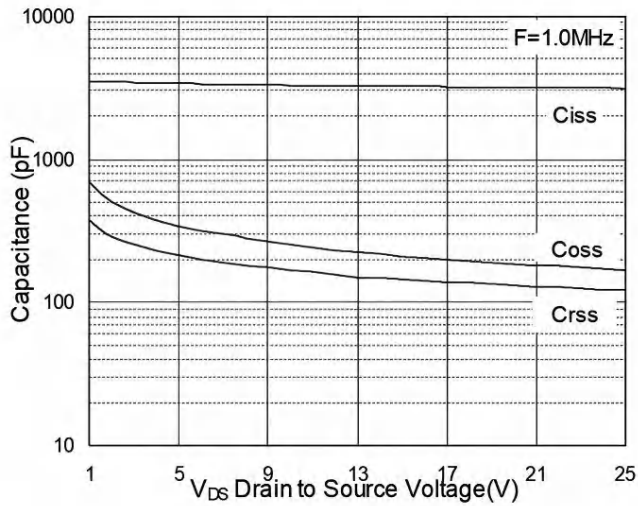


Fig.7 Capacitance

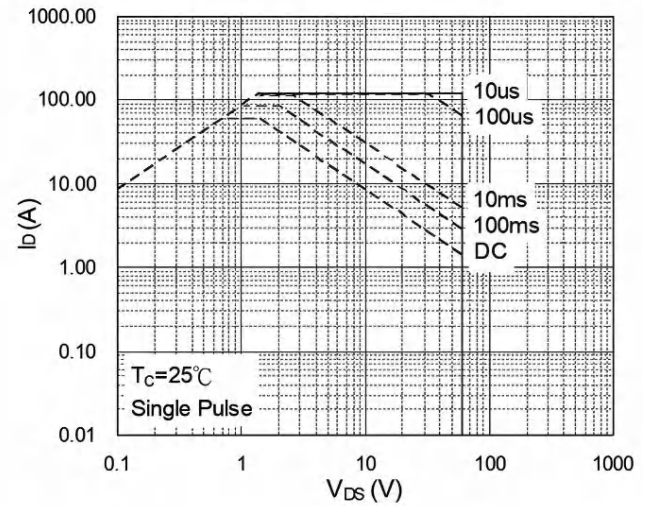


Fig.8 Safe Operating Area

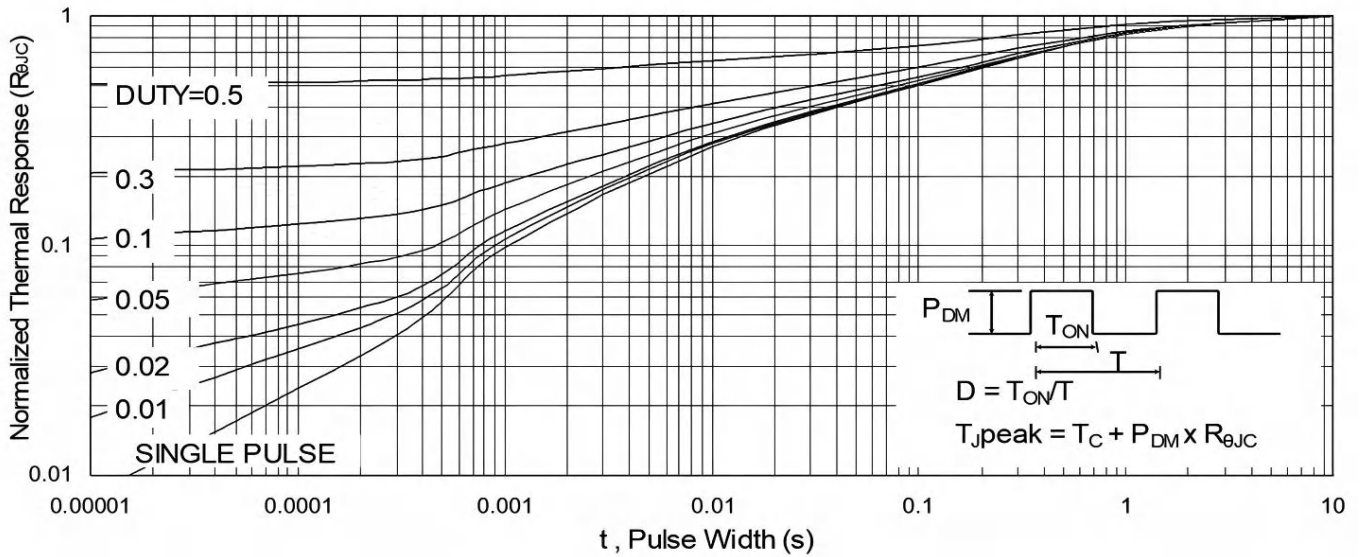


Fig.9 Normalized Maximum Transient Thermal Impedance

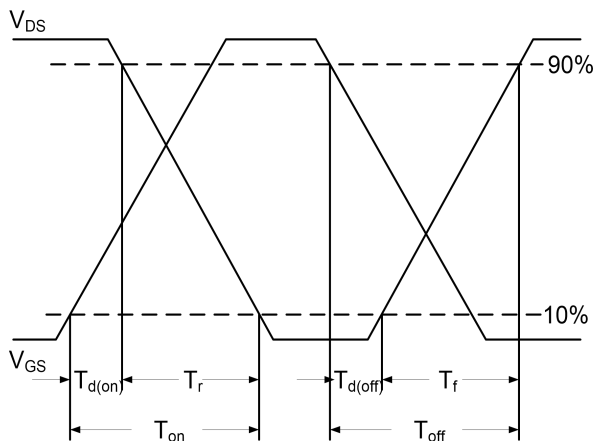


Fig.10 Switching Time Waveform

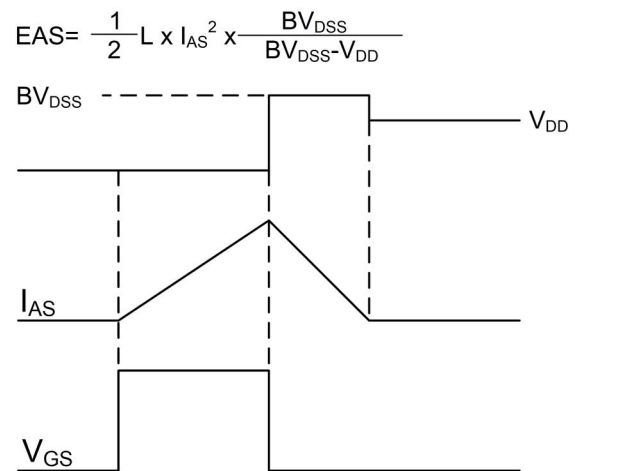


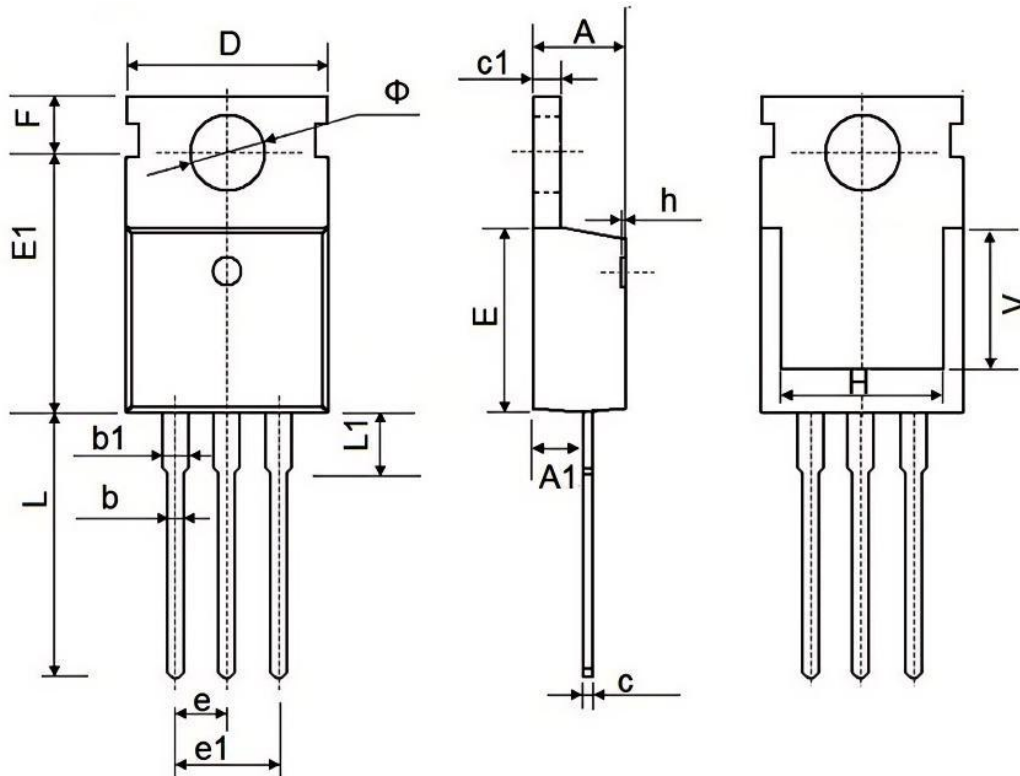
Fig.11 Unclamped Inductive Switching Waveform



## Ordering Information

| Part Number | Package code | Packaging |
|-------------|--------------|-----------|
| HSP6016A    | TO-220       | 1000/Box  |

TO-220 Package Outline



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 4.300                     | 4.700  | 0.169                | 0.185 |
| A1     | 2.200                     | 2.600  | 0.087                | 0.102 |
| b      | 0.700                     | 0.950  | 0.028                | 0.037 |
| b1     | 1.170                     | 1.410  | 0.046                | 0.056 |
| C      | 0.450                     | 0.650  | 0.018                | 0.026 |
| c1     | 1.200                     | 1.400  | 0.047                | 0.055 |
| D      | 9.600                     | 10.400 | 0.378                | 0.409 |
| E      | 8.8500                    | 9.750  | 0.348                | 0.384 |
| E1     | 12.650                    | 12.950 | 0.498                | 0.510 |
| e      | 2.540 TYP.                |        | 0.100TYP.            |       |
| e1     | 4.980                     | 5.180  | 0.196                | 0.204 |
| F      | 2.650                     | 2.950  | 0.104                | 0.116 |
| H      | 7.900                     | 8.100  | 0.311                | 0.319 |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| L      | 12.750                    | 14.300 | 0.502                | 0.563 |
| L1     | 2.850                     | 3.950  | 0.112                | 0.156 |
| V      | 7.500 REF.                |        | 0.295 REF.           |       |
| Φ      | 3.400                     | 4.000  | 0.134                | 0.157 |



## HSP6016A Marking:

