

## General Description

The WSF40N04 is the highest performance trench N-Channel MOSFETs with extreme high cell density, which provide excellent  $R_{DS(ON)}$  and gate charge for most of the synchronous buck converter applications.

The WSF40N04 meet the RoHS and Green Product requirement 100%  $E_{AS}$  guaranteed with full function reliability approved.

## Features

- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

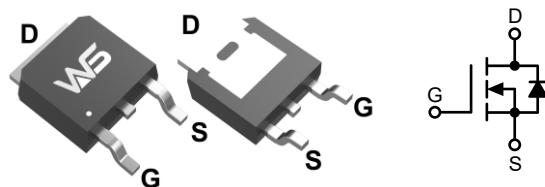
## Product Summery

| <b><math>BV_{DSS}</math></b> | <b><math>R_{DS(ON)}</math></b> | <b><math>I_D</math></b> |
|------------------------------|--------------------------------|-------------------------|
| 40V                          | 13mΩ                           | 40A                     |

## Applications

- Power Management in Desktop Computer or DC/DC Converters.

## TO-252-2L Pin Configuration



## Absolute Maximum Ratings ( $T_A=25^\circ C$ , Unless Otherwise Noted)

| Symbol          | Parameter                           |                   | Rating     | Units |
|-----------------|-------------------------------------|-------------------|------------|-------|
| $V_{DS}$        | Drain-Source Voltage                |                   | 40         | V     |
| $V_{GS}$        |                                     |                   | $\pm 20$   |       |
| $I_S$           | Diode Continuous Forward Current    | $T_C=25^\circ C$  | 40         | A     |
| $I_D$           |                                     | $T_C=25^\circ C$  | 40         |       |
| $I_D$           |                                     | $T_C=100^\circ C$ | 24         |       |
| $I_{DM}^1$      | Pulsed Drain Current                | $T_C=25^\circ C$  | 120        |       |
| $P_D$           |                                     | $T_C=25^\circ C$  | 41.7       |       |
| $P_D$           |                                     | $T_C=100^\circ C$ | 16.7       |       |
| $R_{\theta JC}$ | Thermal Resistance-Junction to Case | Steady State      | 3          | °C/W  |
| $I_D$           |                                     | $T_A=25^\circ C$  | 12.7       |       |
| $I_D$           |                                     | $T_A=70^\circ C$  | 10.2       |       |
| $P_D$           | Maximum Power Dissipation           | $T_A=25^\circ C$  | 2.8        | W     |
| $P_D$           |                                     | $T_A=70^\circ C$  | 1.8        |       |
| $R_{\theta JA}$ |                                     | $t \leq 10s$      | 20         | °C/W  |
| $R_{\theta JA}$ |                                     | Steady State      | 45         |       |
| $I_{AS}^2$      | Avalanche Current, Single pulse     | $L=0.1mH$         | 35         | A     |
| $E_{AS}^2$      |                                     | $L=0.1mH$         | 61         |       |
| $T_{STG}$       | Storage Temperature Range           |                   | -55 to 150 | °C    |
| $T_J$           | Maximum Junction Temperature        |                   | 150        |       |

**Electrical Characteristics (T<sub>A</sub>=25°C, Unless Otherwise Noted)**

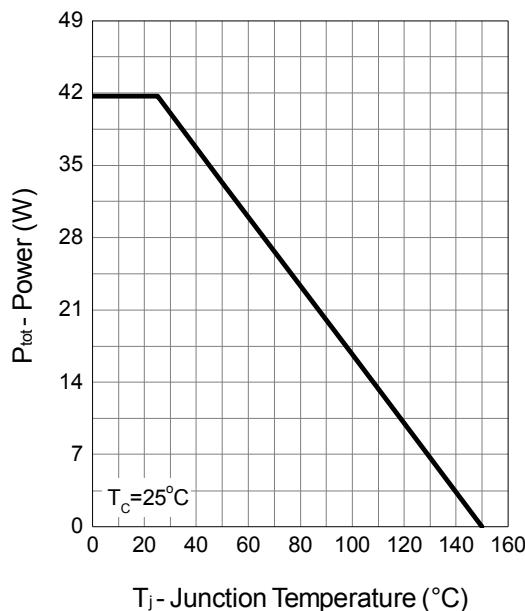
| Symbol                             | Parameter                        | Conditions  | Min. | Typ. | Max. | Units |
|------------------------------------|----------------------------------|---|------|------|------|-------|
| <b>Static Characteristics</b>      |                                  |   |      |      |      |       |
| BV <sub>DSS</sub>                  | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA   | 40   | ---  | ---  | V     |
| R <sub>DS(ON)</sub> <sup>3</sup>   | Drain-Source On-state Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =30A  | ---  | 13   | 17   | mΩ    |
|                                    |                                  | T <sub>J</sub> =125°C   | ---  | 17.2 | ---  |       |
|                                    |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =15A   | ---  | 17   | 21.5 |       |
| V <sub>GS(th)</sub>                | Gate Threshold Voltage           | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>DS</sub> =250μA   | 1.5  | 1.8  | 2.5  | V     |
| I <sub>DSS</sub>                   | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =32V, V <sub>GS</sub> =0V   | ---  | ---  | 1.0  | μA    |
|                                    |                                  | T <sub>J</sub> =85°C  | ---  | ---  | 30   |       |
| I <sub>GSS</sub>                   | Gate 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>DS</sub> =15A   | ---  | 30   | ---  | S     |
| <b>Gate Charge Characteristics</b> |                                  |   |      |      |      |       |
| Q <sub>g</sub>                     | Total Gate Charge                | V <sub>DS</sub> =20V, V <sub>GS</sub> =4.5V, I <sub>DS</sub> =30A   | ---  | 9.4  | 11.2 | nC    |
| Q <sub>g</sub>                     | Total Gate Charge                | V <sub>DS</sub> =20V, V <sub>GS</sub> =10V, I <sub>DS</sub> =30A  | ---  | 20   | 24   |       |
| Q <sub>gth</sub>                   | Threshold Gate Charge            |   | ---  | 1.4  | ---  |       |
| Q <sub>gs</sub>                    | Gate-Source Charge               |   | ---  | 3.1  | ---  |       |
| Q <sub>gd</sub>                    | Gate-Drain Charge                |   | ---  | 5.0  | ---  |       |
| <b>Dynamic Characteristics</b>     |                                  |   |      |      |      |       |
| R <sub>G</sub>                     | Gate Resistance                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1.0MHz  | 0.7  | 1.1  | 1.8  | Ω     |
| T <sub>d(ON)</sub>                 | Turn-On Delay Time               | V <sub>DD</sub> =20V, R <sub>L</sub> =20Ω, I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V, R <sub>G</sub> =1Ω | ---  | 12.8 | ---  | ns    |
| T <sub>r</sub>                     | Turn-On Rise Time                |   | ---  | 10.4 | ---  |       |
| T <sub>d(OFF)</sub>                | Turn-Off Delay Time              |   | ---  | 24   | ---  |       |
| T <sub>f</sub>                     | Turn-Off Fall Time               |   | ---  | 5.6  | ---  |       |
| C <sub>iss</sub>                   | Input Capacitance                | V <sub>GS</sub> =0V, V <sub>DS</sub> =20V, Frequency = 1.0MHz   | ---  | 1120 | ---  | pF    |
| C <sub>oss</sub>                   | Output Capacitance               |   | ---  | 132  | ---  |       |
| C <sub>rss</sub>                   | Reverse Transfer Capacitance     |   | ---  | 75   | ---  |       |
| <b>Diode Characteristics</b>       |                                  |   |      |      |      |       |
| V <sub>SD</sub> <sup>3</sup>       | Diode Forward Voltage            | I <sub>SD</sub> =10A, V <sub>GS</sub> =0V   | ---  | 0.9  | 1.1  | V     |
| t <sub>rr</sub>                    | Reverse Recovery Time            | I <sub>SD</sub> =10A, dI <sub>SD</sub> /dt=100A/μs  | ---  | 13.8 | ---  | ns    |
| t <sub>a</sub>                     | Charge Time                      |   | ---  | 9.8  | ---  |       |
| t <sub>b</sub>                     | Discharge Time                   |   | ---  | 4.0  | ---  |       |
| Q <sub>rr</sub>                    | Reverse Recovery Charge          |   | ---  | 8.0  | ---  |       |

Note:

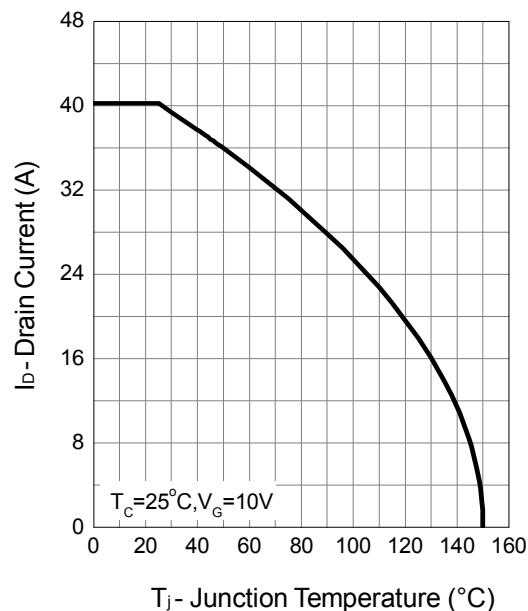
- Max. current is limited by bonding wire.
- UIS tested and pulse width limited by maximum junction temperature 150°C (initial temperature T<sub>J</sub>=25°C).
- Pulse test ; pulse width≤300ms, duty cycle≤2%.

## Typical Characteristics

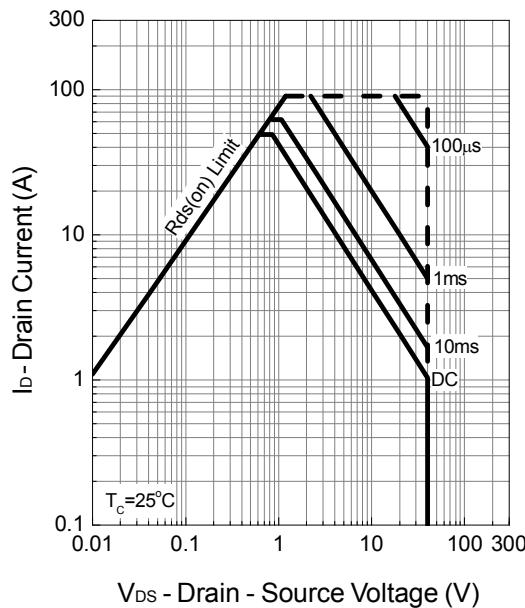
**Power Dissipation**



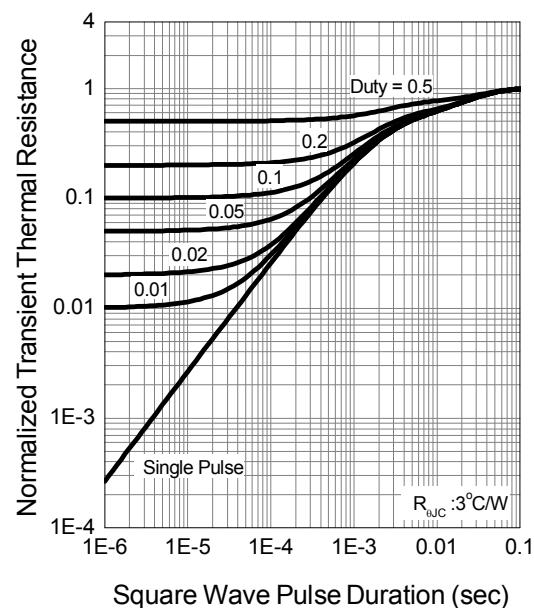
**Drain Current**



**Safe Operation Area**

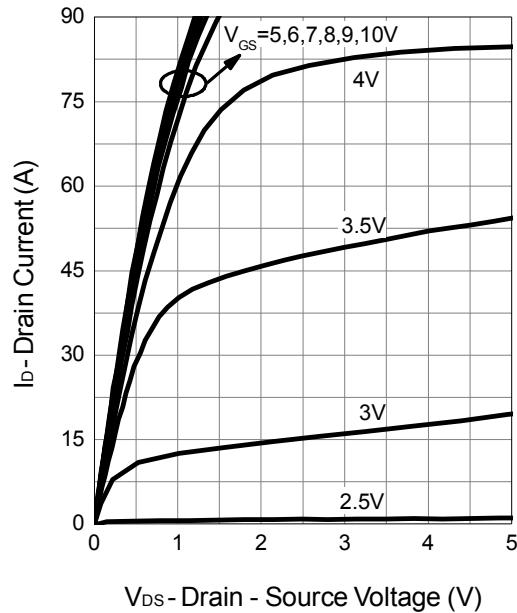


**Thermal Transient Impedance**

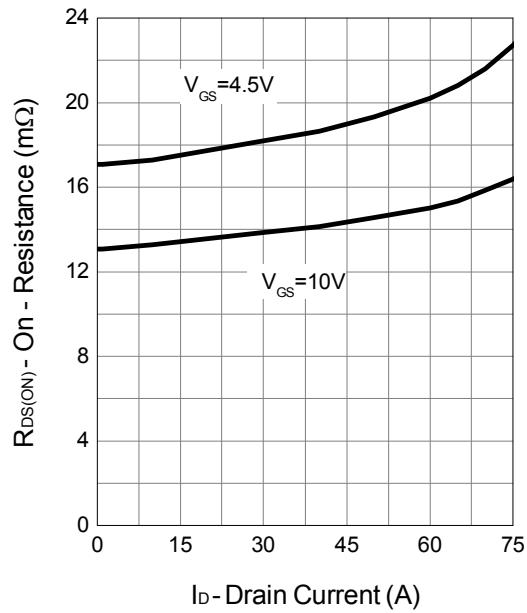


## Typical Characteristics (Cont.)

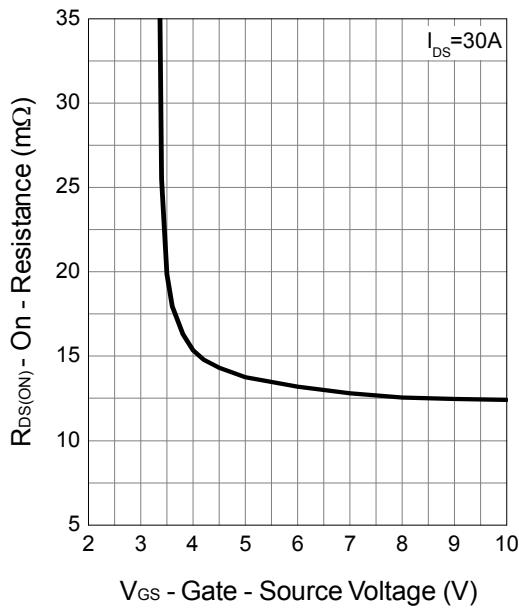
### Output Characteristics



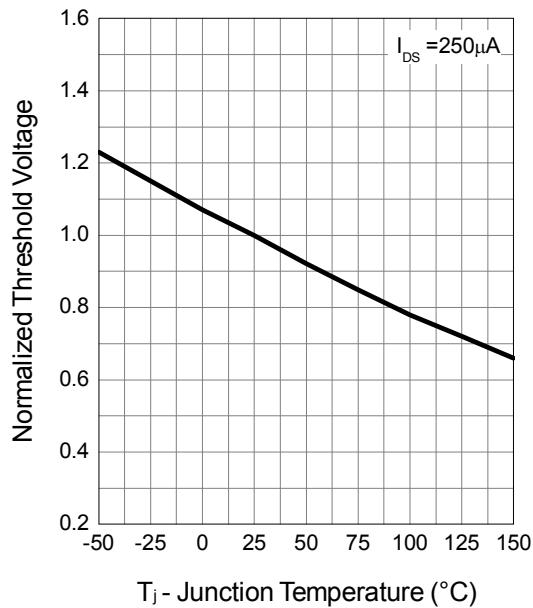
### Drain-Source On Resistance



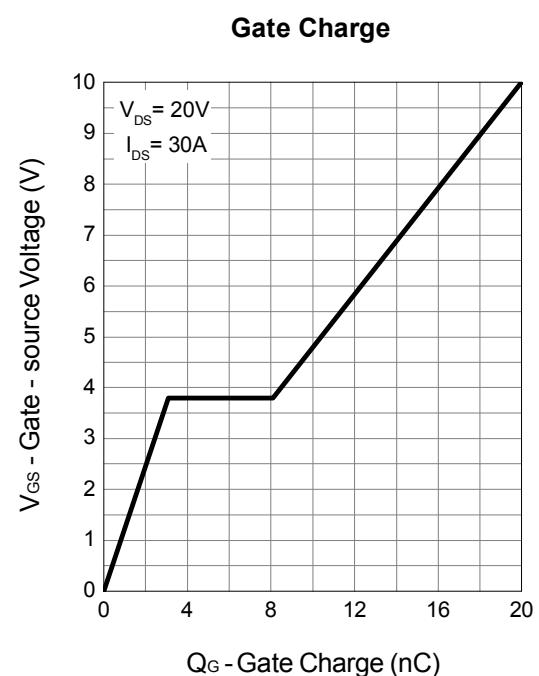
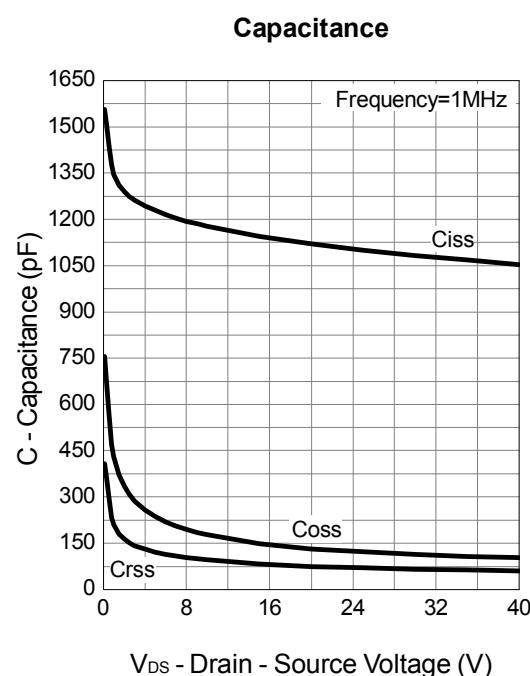
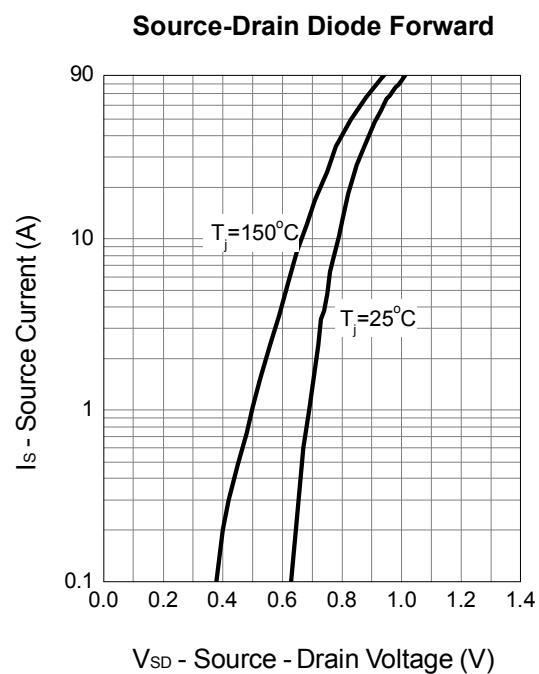
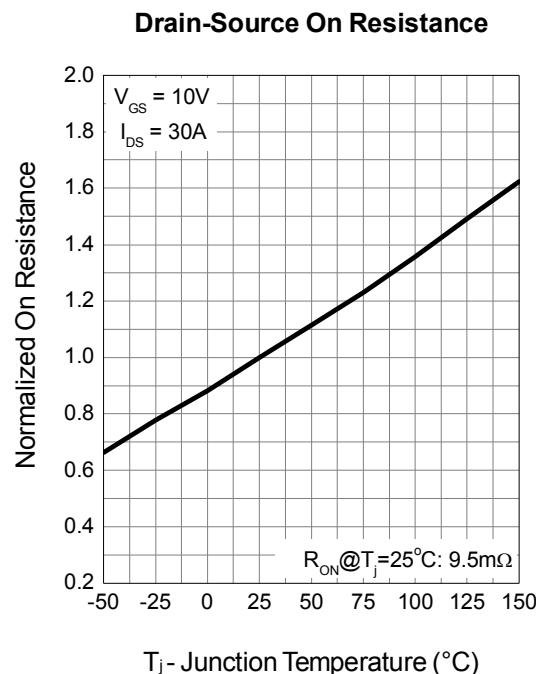
### Gate-Source On Resistance

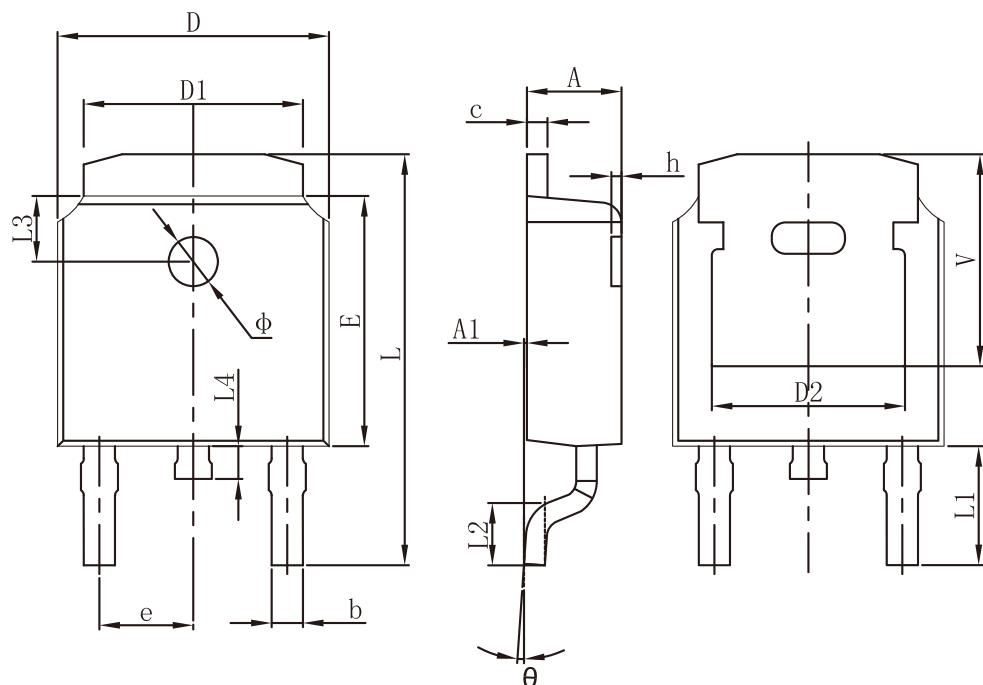


### Gate Threshold Voltage



## Typical Characteristics (Cont.)



**Packaging information**


| SYMBOL | MILLIMETERS |        | INCHES     |       |
|--------|-------------|--------|------------|-------|
|        | MIN.        | MAX.   | MIN.       | MAX.  |
| A      | 2.200       | 2.400  | 0.087      | 0.094 |
| A1     | 0.000       | 0.127  | 0.000      | 0.005 |
| b      | 0.635       | 0.770  | 0.025      | 0.030 |
| c      | 0.460       | 0.580  | 0.018      | 0.023 |
| D      | 6.500       | 6.700  | 0.256      | 0.264 |
| D1     | 5.100       | 5.460  | 0.201      | 0.215 |
| D2     | 4.830 REF.  |        | 0.190 REF. |       |
| E      | 6.000       | 6.200  | 0.236      | 0.244 |
| e      | 2.186       | 2.386  | 0.086      | 0.094 |
| L      | 9.712       | 10.312 | 0.382      | 0.406 |
| L1     | 2.900 REF.  |        | 0.114 REF. |       |
| L2     | 1.400       | 1.700  | 0.055      | 0.067 |
| L3     | 1.600 REF.  |        | 0.063 REF. |       |
| L4     | 0.600       | 1.000  | 0.024      | 0.039 |
| Φ      | 1.100       | 1.300  | 0.043      | 0.051 |
| θ      | 0°          | 8°     | 0°         | 8°    |
| h      | 0.000       | 0.300  | 0.000      | 0.012 |
| V      | 5.250 REF.  |        | 0.207 REF. |       |



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