

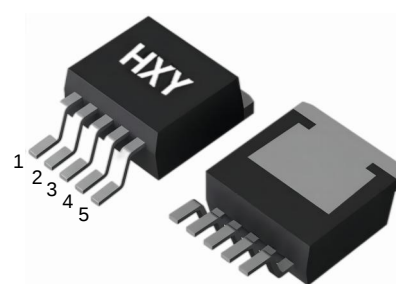


## General Description

The LM2596S is a series of easy to use fixed and adjustable step-down (buck) switch-mode voltage regulators. These devices are available in fixed output voltage of 3.3V, 5V, 12V and an adjustable output version. Both versions are capable of driving a 3.5A load with excellent line and load regulation.

Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed-frequency oscillator.

The output voltage is guaranteed to  $\pm 3\%$  tolerance under specified input voltage and output load conditions. The oscillator frequency is guaranteed to  $\pm 15\%$ . External shutdown is included, featuring typically 80  $\mu\text{A}$  standby current. Self protection features include a two stage frequency reducing current limit for the output switch and an over temperature shutdown for complete protection under fault conditions.



5 ON/OFF  
4 Feedback  
3 Gnd  
2 Output  
1 Vin

**TO-263-5L  
(DDPAK)**

## Features

- 3.3V, 5V, 12V and adjustable output versions
- Output adjustable from 1.23v to 37V
- Fixed 150KHz frequency internal oscillator
- Guaranteed 3.5A output load current
- Input voltage range up to 45V
- Low power standby mode,  $I_Q$  typically 80  $\mu\text{A}$
- TTL shutdown capability
- Excellent line and load regulation
- Requires only 4 external components
- High efficiency
- Thermal shutdown and current limit protection

| Name     | Description                                    |
|----------|------------------------------------------------|
| Vin      | Input supply voltage                           |
| Output   | Switching output                               |
| Gnd      | Ground                                         |
| Feedback | Output voltage feedback                        |
| ON/OFF   | ON/OFF shutdown<br>Active is "Low" or floating |

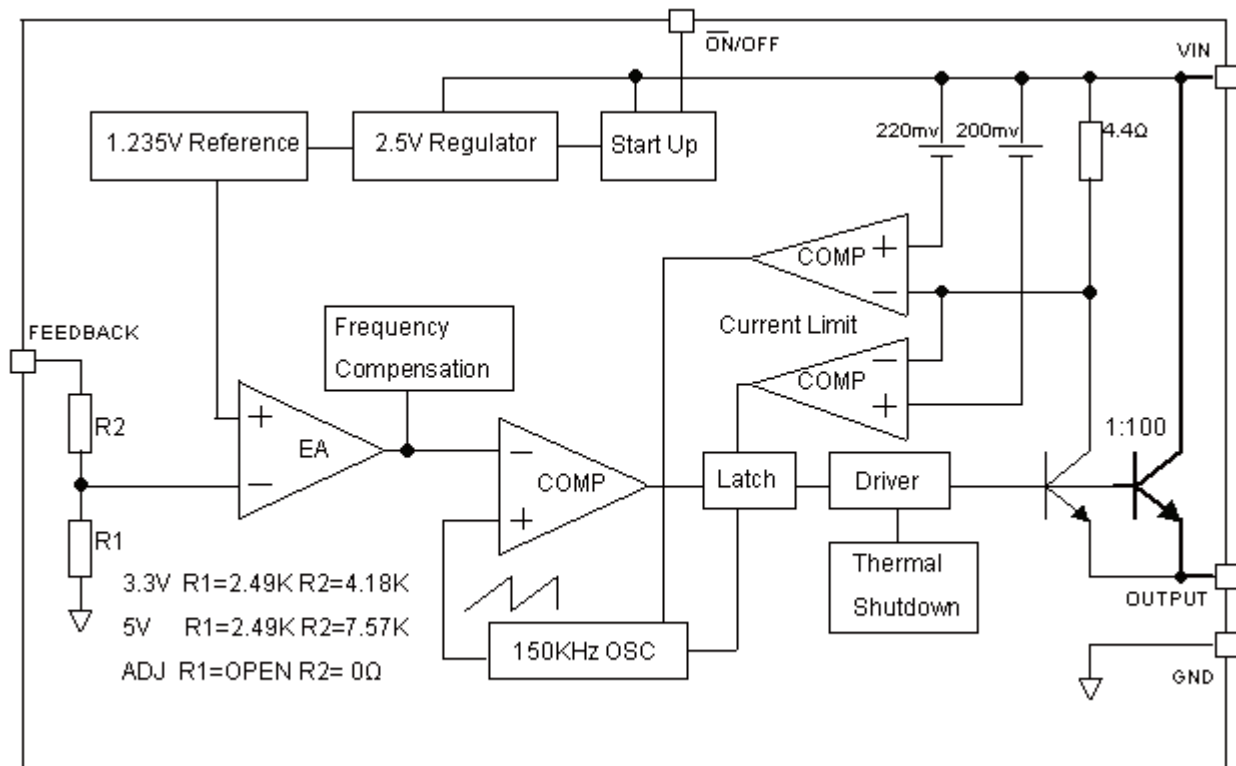
## Pin Descriptions

## Applications

- Simple High-efficiency step-down regulator
- On-card switching regulators
- Positive to negative converter
- LCD monitor and LCD TV
- DVD recorder and PDP TV
- Battery charger
- Step-down to 3.3V for microprocessors

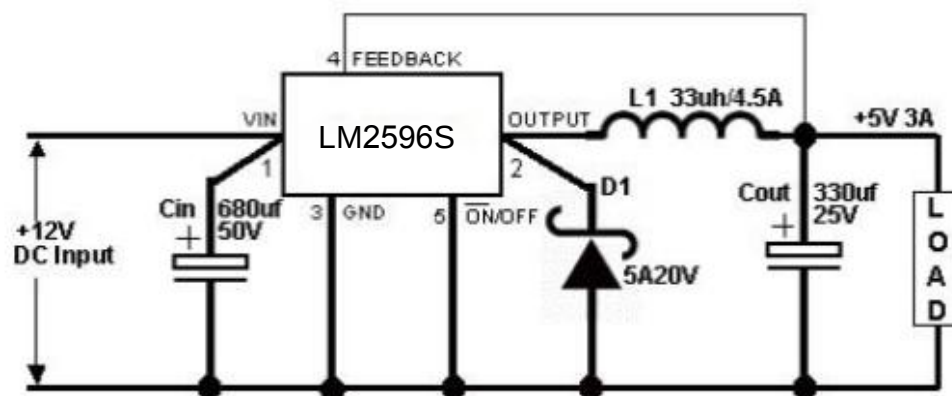


## Functional Block Diagram



Functional Block Diagram of LM2596S

## Typical Application (Fixed Output Voltage Versions)



Typical Application of LM2596S



## Absolute Maximum Ratings

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

| Parameter                                                 | Value                | Unit   |
|-----------------------------------------------------------|----------------------|--------|
| Supply Voltage $V_{in}$                                   | -0.3 to 45           | V      |
| Feedback VFB pin voltage                                  | -0.3 to $V_{in}+0.3$ | V      |
| ON/OFF Pin voltage                                        | -0.3 to $V_{in}+0.3$ | V      |
| Output pin voltage                                        | -0.3 to $V_{in}+0.3$ | V      |
| Output Voltage to Ground (Steady State)                   | -1                   | V      |
| Power Dissipation                                         | Internally limited   | W      |
| Operating Temperature Range                               | -40 to +125          | °C     |
| Storage Temperature                                       | -65 to +150          | °C     |
| Lead Temperature (Soldering, 10 sec)                      | 200                  | °C     |
| ESD(HM)                                                   | 2000                 | V      |
| Thermal Resistance-Junction to Ambient( $R_{\theta JA}$ ) | 85                   | °C / W |
| Thermal Resistance-Junction to Case( $R_{\theta JC}$ )    | 45                   | °C / W |

## Electrical Characteristics (All Output Voltage Versions)

Unless otherwise specified,  $T_a = 25^{\circ}\text{C}$ .

| Symbol         | Parameter                 | Conditions                            | Min. | Typ. | Max. | Unit |
|----------------|---------------------------|---------------------------------------|------|------|------|------|
| $I_b$          | Feedback bias current     | Adjustable only, $V_{FB}=1.3\text{V}$ |      | 10   | 50   | nA   |
| $I_Q$          | Quiescent current         | $V_{FB}=12\text{V}$ force driver off  |      | 5    | 10   | mA   |
| $I_{STBY}$     | Standby quiescent current | ON/OFF=5V, $V_{IN}=36\text{V}$        |      | 80   | 200  | uA   |
| $F_{OSC}$      | Oscillator frequency      |                                       | 127  | 150  | 173  | KHz  |
| $V_{SAT}$      | Saturation voltage        | $I_{OUT}=3.5\text{A}$                 |      | 1.2  | 1.4  | V    |
| $I_{CL}$       | Current Limit             | Peak Current ( $V_{FB}=0\text{V}$ )   |      | 4.5  | 5.5  | A    |
| $I_L$<br>$I_L$ | Output leakage current    | Output=0V ( $V_{FB}=12\text{V}$ )     |      |      | 50   | uA   |
|                | Output leakage current    | Output=-1V ( $V_{IN}=36\text{V}$ )    |      | 2    | 30   | mA   |
| $V_{IL}$       | ON/OFF pin logic input    | Low (Regulator ON)                    |      | 1.3  | 1.6  | V    |



|                  |                                                      |                                                                                |       |      |       |               |
|------------------|------------------------------------------------------|--------------------------------------------------------------------------------|-------|------|-------|---------------|
| $V_{IH}$         | Threshold voltage                                    | High (Regulator OFF)                                                           | 2.0   | 1.3  |       | V             |
| $I_H$<br>$I_L$   | ON/OFF pin input current                             | $V_{LOGIC}=2.5V$ (Regulator OFF)                                               |       | 5    | 15    | $\mu A$       |
|                  |                                                      | $V_{LOGIC}=0.5V$ (Regulator ON)                                                |       | 0.02 | 5     | $\mu A$       |
| $\theta_{JC}$    | Thermal Resistance<br>Junction to Case               |                                                                                |       | 3.5  |       | $^{\circ}C/W$ |
| $\theta_{JA}$    | Thermal Resistance<br>Junction to Ambient<br>(Note1) |                                                                                |       | 23   |       | $^{\circ}C/W$ |
| LM2596<br>S-ADJ  | Vout: Output Voltage                                 | $11V \leq V_{IN} \leq 45V$ , $0.2A \leq I_{LOAD} \leq 3.5A$ , $V_{OUT}$ for 9V | 1.193 | 1.23 | 1.267 | V             |
|                  | $\eta$ : Efficiency                                  | $V_{IN}=12V$ , $V_{OUT}=9V$ , $I_{LOAD}=3.5A$                                  |       | 88   |       | %             |
| LM2596<br>S-3.3V | Vout: Output Voltage                                 | $4.75V \leq V_{IN} \leq 45V$ , $0.2A \leq I_{LOAD} \leq 3.5A$                  | 3.168 | 3.3  | 3.432 | V             |
|                  | $\eta$ : Efficiency                                  | $V_{IN}=12V$ , $I_{LOAD}=3.5A$                                                 |       | 76   |       | %             |
| LM2596<br>S-5V   | Vout: Output Voltage                                 | $7V \leq V_{IN} \leq 45V$ , $0.2A \leq I_{LOAD} \leq 3.5A$                     | 4.8   | 5.0  | 5.2   | V             |
|                  | $\eta$ : Efficiency                                  | $V_{IN}=12V$ , $I_{LOAD}=3.5A$                                                 |       | 83   |       | %             |
| LM2596<br>S-12V  | Vout: Output Voltage                                 | $15V \leq V_{IN} \leq 45V$ , $0.2A \leq I_{LOAD} \leq 3.5A$                    | 11.5  | 5.0  | 12.5  | V             |
|                  | $\eta$ : Efficiency                                  | $V_{IN}=25V$ , $I_{LOAD}=3.5A$                                                 |       | 90   |       | %             |

Specifications with **boldface type** are for full operating temperature range, the other type are for  $T_J=25^{\circ}C$ .

Note1: Thermal resistance with copper area of approximately 3 in<sup>2</sup>.



## Typical Performance Characteristics

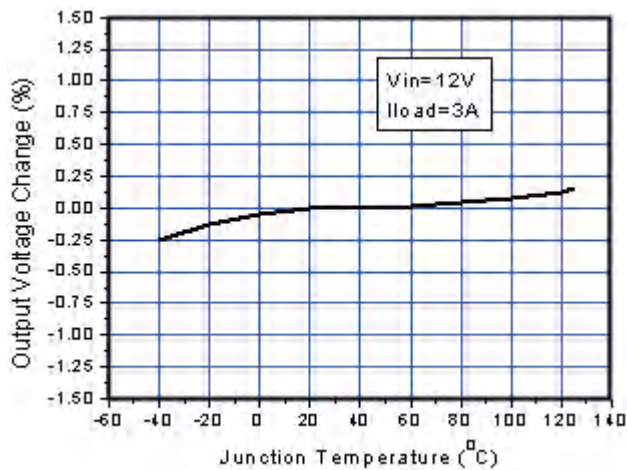


Figure 1. Output Voltage vs. Temperature

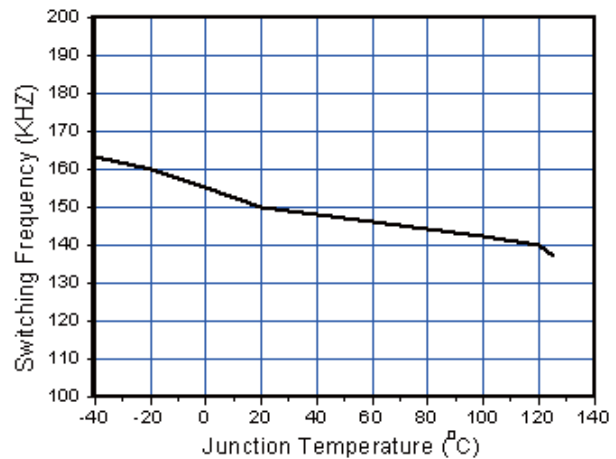


Figure 2. Switching Frequency vs. Temperature

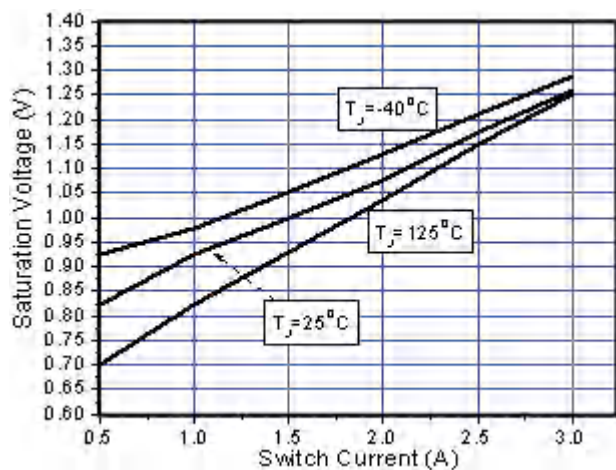


Figure 3. Output Saturation Characteristics

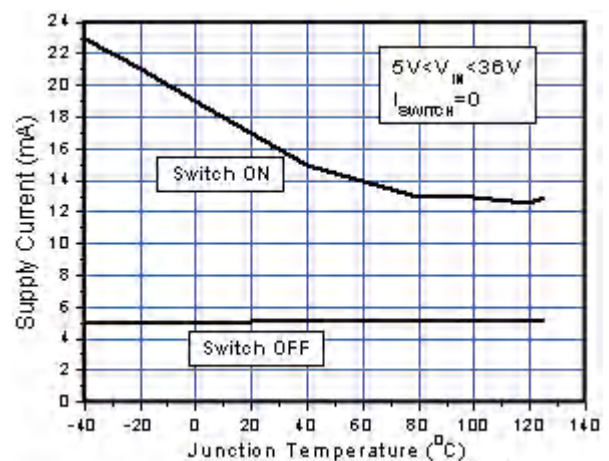


Figure 4. Quiescent Current vs. Temperature

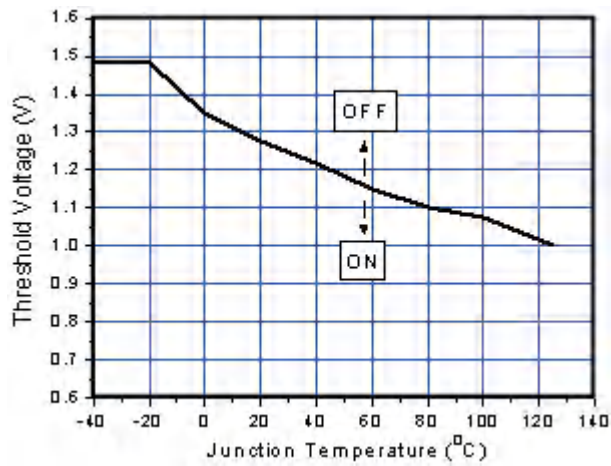


Figure 5. ON/OFF Pin Voltage

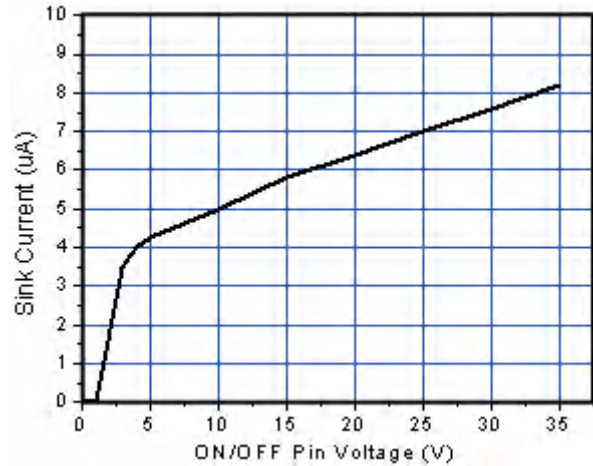


Figure 6. ON/OFF Pin Sink Current

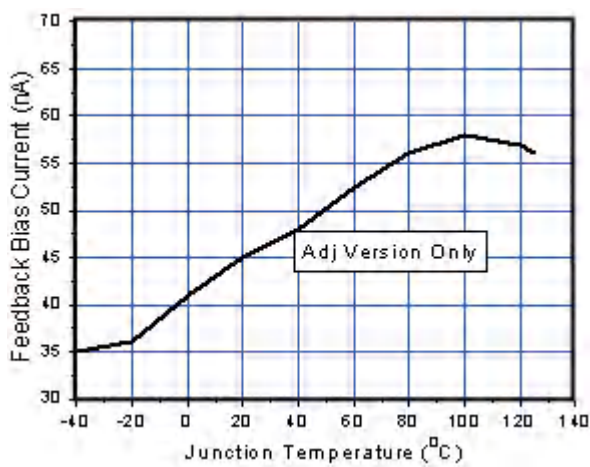
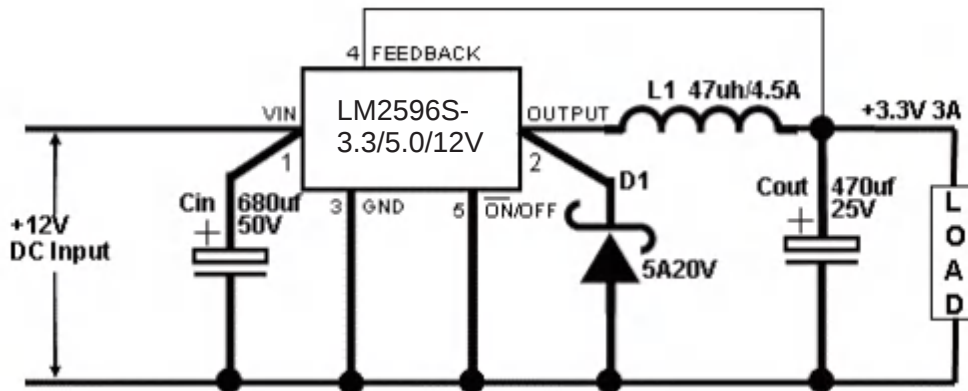


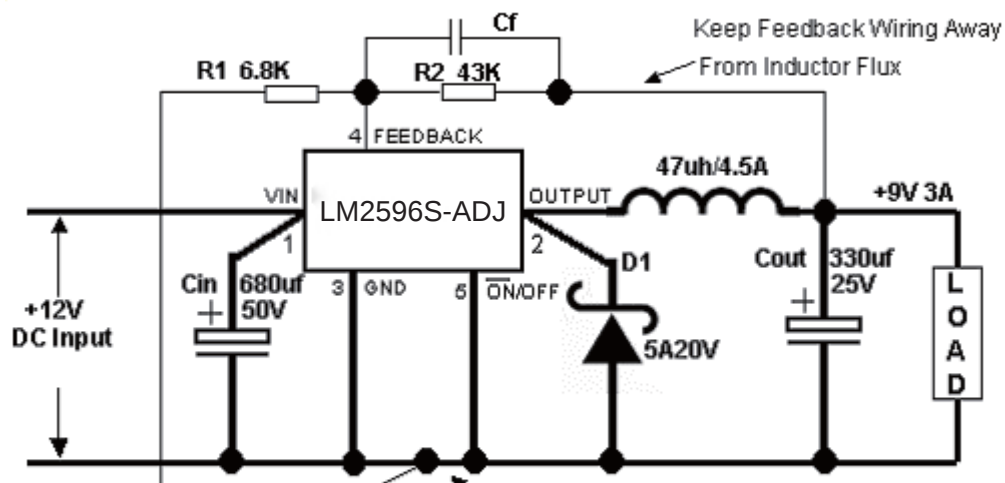
Figure 7. Output Saturation Characteristics



## Typical Application Circuit



Typical Application of LM2596S For 3.3V,5.0V,12V



Heavy Lines Must Be Kept Short And Use Ground Plane Construction For Best Results

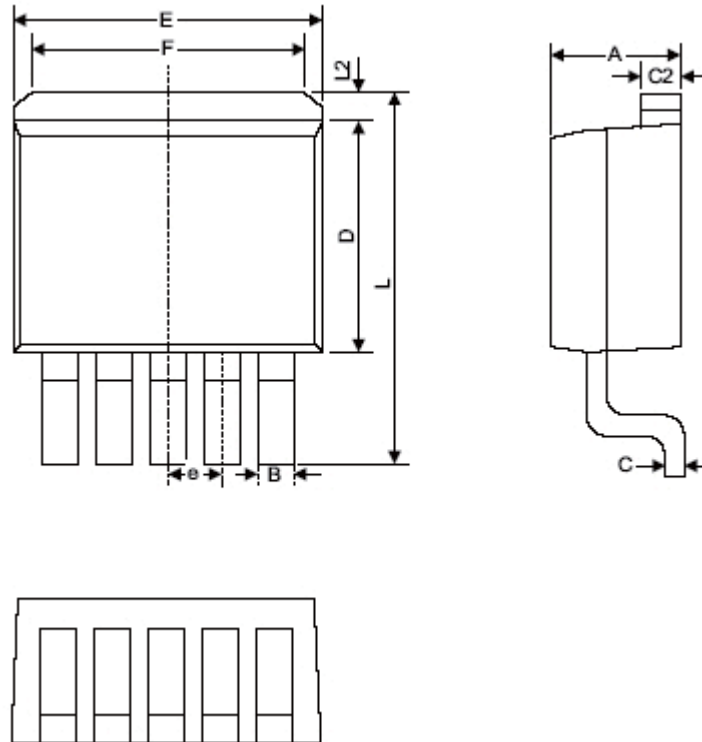
$$V_{out} = V_{ref}(1 + R2/R1) \quad (\text{Where } V_{ref}=1.23V; \quad C_f=1.5nF)$$

Typical Application of LM2596S For ADJ



## Package Information

### TO-263-5L (DDPAK)



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 4.06                      | 4.83  | 0.160                | 0.190 |
| B      | 0.76                      | 1.02  | 0.030                | 0.040 |
| C      | 0.36                      | 0.64  | 0.014                | 0.025 |
| C2     | 1.14                      | 1.40  | 0.045                | 0.055 |
| D      | 8.64                      | 9.65  | 0.340                | 0.380 |
| E      | 9.78                      | 10.54 | 0.385                | 0.415 |
| e      | 1.57                      | 1.85  | 0.062                | 0.073 |
| F      | 6.60                      | 7.11  | 0.260                | 0.280 |
| L      | 15.11                     | 15.37 | 0.595                | 0.605 |
| L2     | -                         | 1.40  | -                    | 0.055 |



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