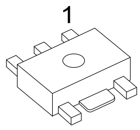
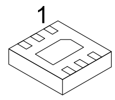
# 1.0A FAST ULTRA LOW DROPOUT LINEAR REGULATOR




SOT-89-5




DFN2020-6

## ■ DESCRIPTION

The UTC **LR1805/LR1805AD** operate from a +1.5V ~ +6V input supply as fast ultra low-dropout linear regulators. Wide output voltage range options are available. The fast response characteristic to make UTC **LR1805/LR1805AD** suitable for low voltage microprocessor application. The low quiescent current operation and low dropout quality caused by the CMOS process.

The UTC **LR1805/LR1805AD** has low dropout voltage. The ground pin current is typically 60uA.

Output Voltage Precision: Multiple output voltage options are available and ranging from 1.0V ~ 5.0V at room temperature with a guaranteed accuracy of ±2%, and ±3.0% when varying line and load.

The output voltage types of UTC **LR1805-xx** are fixed one in the IC and UTC **LR1805AD** are adjustable one.

## ■ FEATURES

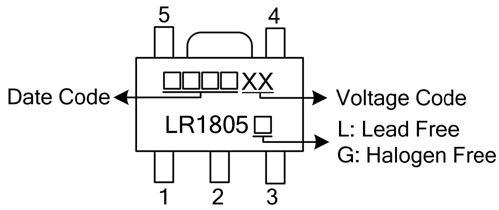
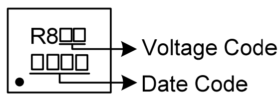
* Low Dropout Voltage
* The Guaranteed Output Current is 1A DC
* Output Voltage Accuracy ± 2%
* Over temperature Protection And Over current Protection

## ■ ORDERING INFORMATION

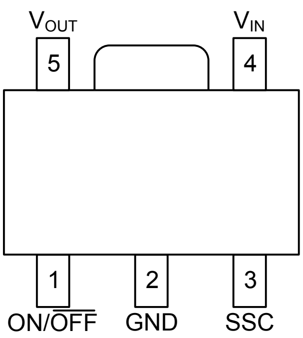
| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| LR1805L-xx-AB5-R | LR1805G-xx-AB5-R | SOT-89-5 | Tape Reel |
| LR1805L-xx-K06-2020-R | LR1805G-xx-K06-2020-R | DFN2020-6 | Tape Reel |

| LR1805G-xx-AB5-R | |
|---|---|
| (1)Packing Type | (1) R: Tape Reel |
| (2)Package Type | (2) AB5: SOT-89-5, K06-2020: DFN2020-6 |
| (3)Output Voltage Code | (3) xx: refer to Marking Information |
| (4)Green Package | (4) G: Halogen Free and Lead Free, L: Lead Free |

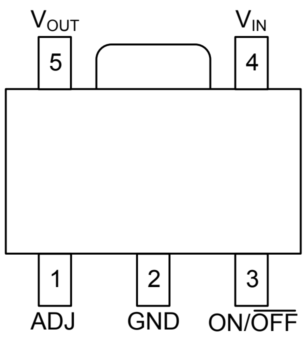
## ■ MARKING INFORMATION

| PACKAGE | VOLTAGE CODE | MARKING |
|---|---|---|
| SOT-89-5 | 12: 1.2V<br>15 : 1.5V<br>18: 1.8V<br>25: 2.5V<br>30: 3.0V<br>33: 3.3V<br>50: 5.0V<br>AD: ADJ |   |
| DFN2020-6 | AD: ADJ |   |

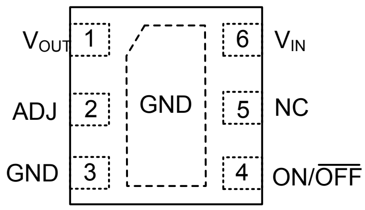
## ■ PIN CONFIGURATION




SOT-89 (Fixed)




SOT-89 (Adjustable)



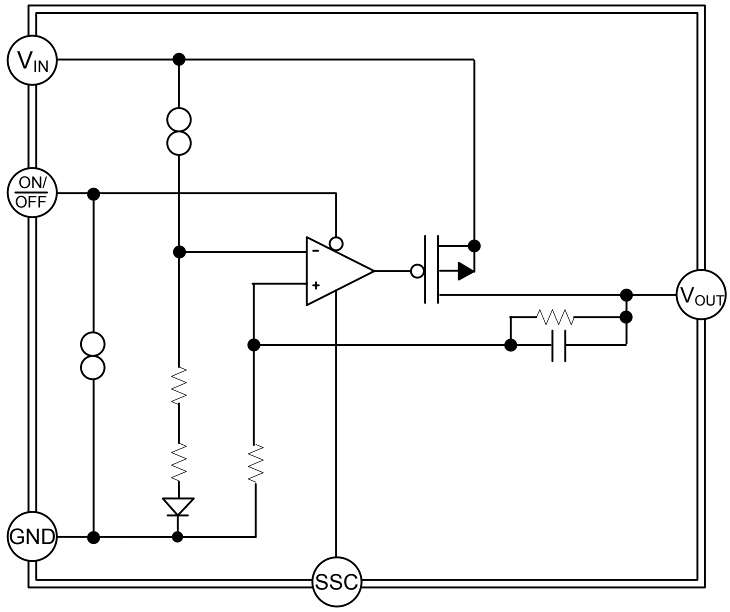

DFN2020-6
(Top View)

## ■ PIN DESCRIPTION

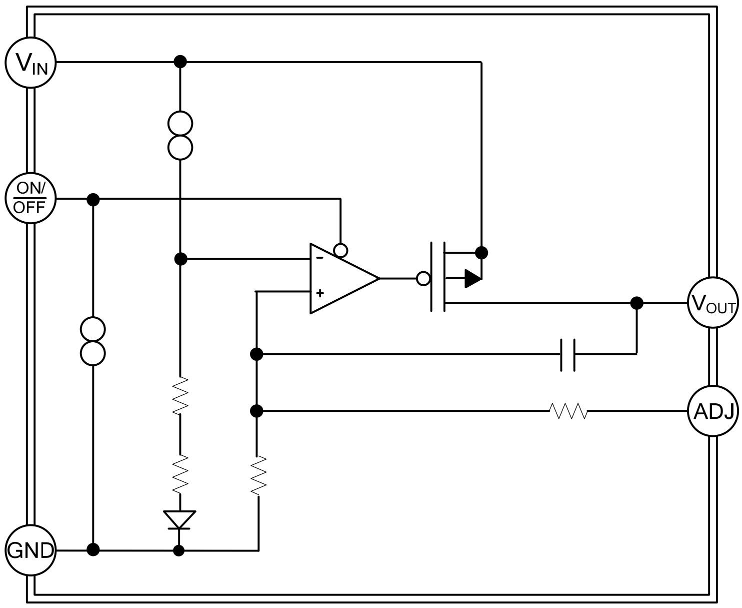
| PIN NO. | | | PIN NAME | DESCRIPTION |
|---|---|---|---|---|
| SOT-89 (Fixed) | SOT-89 (Adjustable) | DFN2020-6 | | |
| 1 | 3 | 4 | ON/ $\overline{OFF}$ | ON/OFF select pin, Active High |
| 2 | 2 | 3 | GND | Grounded |
| 3 | - | - | SSC | Inrush current limit pin |
| 4 | 4 | 6 | $V_{IN}$ | Input Voltage |
| 5 | 5 | 1 | $V_{OUT}$ | Output Voltage |
| - | 1 | 2 | ADJ | Adjustable Pin |
| - | - | 5 | NC | No Connection |
| - | - | Thermal Pad | GND | Grounded |

■ BLOCK DIAGRAM

**Fixed Output Voltage**




**Adjustable Output Voltage**



## ■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 6.5 | V |
| Shutdown Input Voltage | $V_{IN(SHDN)}$ | $V_{IN}$ | V |
| Maximum Operating Current (DC) | | 1 | A |
| Power Dissipation (Note 3) | $P_D$ | Internally Limited | |
| Junction Temperature | $T_J$ | +125 | °C |
| Storage Temperature | $T_{STG}$ | -65 ~ +150 | °C |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

## ■ THERMAL DATA

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Junction to Ambient | SOT-89-5 | $\theta_{JA}$ | 185 | °C/W |
| | DFN2020-6 | | 90 (Note) | °C/W |
| Junction to Case | SOT-89-5 | $\theta_{JC}$ | 85 | °C/W |
| | DFN2020-6 | | 25 (Note) | °C/W |

Note: The data tested by surface mounted on a 2 inch2 FR-4 board with 2OZ copper.

## ■ ELECTRICAL CHARACTERISTICS ($T_J$ = 25°C, unless otherwise specified.)

**For LR1805xx**

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | | 1.5 | | 6 | V |
| Output Voltage (Note 3) | $V_{OUT(E)}$ | $V_{IN}=V_{OUT(S)}+1V$<br>$I_{OUT}=100mA$ | $1.0V\le V_{OUT(S)}<1.5V$ | $V_{OUT(S)}$ × 0.98 | $V_{OUT(S)}$ | $V_{OUT(S)}$ × 1.02 | V |
| | | | $1.5V\le V_{OUT(S)}\le 5.0V$ | $V_{OUT(S)}$ × 0.98 | $V_{OUT(S)}$ | $V_{OUT(S)}$ × 1.02 | V |
| Output Voltage Line Regulation | $\triangle V_{OUT1}/(\triangle V_{IN}\times V_{OUT})$ | $V_{OUT(S)}+0.5V\le V_{IN}\le 5.5V$, $I_{OUT}=100mA$ | | | 0.05 | 0.2 | %/V |
| Output Voltage Load Regulation | $\triangle V_{OUT2}$ | $V_{IN}=V_{OUT(S)}+0.5V$<br>$1mA\le I_{OUT}\le 300mA$ | | -20 | | 20 | mV |
| Dropout Voltage(Note 4) | $V_{drop}$ | $I_{OUT}=300mA$ | $1.2V\le V_{OUT(S)}<1.5V$ | | 0.34 | 0.38 | V |
| | | | $1.5V\le V_{OUT(S)}<2.6V$ | | 0.15 | 0.20 | |
| | | | $2.6V\le V_{OUT(S)}\le 5.0V$ | | 0.07 | 0.1 | |
| | | $I_{OUT}=1000mA$ | $1.2V\le V_{OUT(S)}<1.5V$ | | 0.7 | | |
| | | | $1.5V\le V_{OUT(S)}<2.0V$ | | 0.50 | | |
| | | | $2.0V\le V_{OUT(S)}<2.6V$ | | 0.38 | | |
| | | | $2.6V\le V_{OUT(S)}\le 5.0V$ | | 0.30 | | |
| Output Current(Note 5) | $I_{OUT}$ | $V_{IN}\ge V_{OUT(S)}+1V$ | | 1000 (Note 7) | | | mA |
| Ground Pin Current In Normal Operation Mode | $I_{SS1}$ | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, No Load | | | 60 | 90 | uA |
| Ground Pin Current In Power-off Mode | $I_{SS2}$ | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=OFF, No Load | | | 0.1 | 1.0 | uA |
| Short Circuit Current | $I_{SC}$ | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, $V_{OUT}=0V$ | | | 0.5 | | A |
| ON/$\overline{OFF}$ Pin Input Voltage "H" | $V_{SH}$ | $V_{IN}=V_{OUT(S)}+1V$, $R_L=1.0K\Omega$<br>Determinied by $V_{OUT}$ output level | | 1.0 | | | V |
| ON/$\overline{OFF}$ Pin Input Voltage "L" | $V_{SL}$ | | | | | 0.3 | |
| ON/$\overline{OFF}$ Pin Input Current "H" | $I_{SH}$ | $V_{IN}=V_{OUT(S)}+1V$, $V_{ON/\overline{OFF}}$ =5.5V | | | 1.0 | | uA |
| ON/$\overline{OFF}$ Pin Input Current "L" | $I_{SL}$ | $V_{IN}=V_{OUT(S)}+1V$, $V_{ON/\overline{OFF}}$ =0V | | -0.1 | | 0.1 | uA |
| Inrush current limit time | Trush | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, $I_{OUT}$=1000mA,Css=0 nF | | | 0.4 | | mS |
| | | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, $I_{OUT}$=1000mA,Css=1.0 nF | | | 0.7 | | |
| Ripple Rejection | \|RR\| | $V_{IN}=V_{OUT(S)}+1V$,<br>f=1khz,<br>$\triangle V_{rip}$=0.5Vrms,<br>$I_{OUT}=100mA$ | $1.2V\le V_{OUT(S)}<3.0V$ | | 65 | | dB |
| | | | $3.0V\le V_{OUT(S)}\le 3.5V$ | | 60 | | |
| | | | $3.5V\le V_{OUT(S)}\le 5.0V$ | | 55 | | |
| Thermal Shutdown detection temperature | $T_{SD}$ | Junction temperature | | | 150 | | °C |
| Thermal Shutdown release temperature | $T_{SR}$ | Junction temperature | | | 120 | | °C |

■ ELECTRICAL CHARACTERISTICS (Cont.)

**For LR1805AD**

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | 1.5 | | 6 | V |
| Reference Voltage for Adjustable Voltage Regulator | $V_{OUT}$ | $V_{OUT}=V_{ADJ}$, $V_{IN}=2.0V$, $I_{OUT}=100mA$ | 0.98 | 1.0 | 1.02 | V |
| Output Voltage Range | $RV_{OUT}$ | | 1.0 | | 5.0 | V |
| Internal Resistance Value of Adjust Pin | $R_{IC}$ | | | 1.0 | | MΩ |
| Output Voltage Line Regulation | $\triangle V_{OUT1}/(\triangle V_{IN}\times V_{OUT})$ | $V_{OUT(S)}+0.5V\le V_{IN}\le 5.5V$, $I_{OUT}=100mA$ | | 0.05 | 0.2 | %/V |
| Output Voltage Load Regulation | $\triangle V_{OUT2}$ | $V_{IN}=V_{OUT(S)}+1V$, $1mA\le I_{OUT}\le 300mA$ | -20 | | 20 | mV |
| Dropout Voltage(Note 4) | $V_{drop}$ | $V_{OUT}=V_{ADJ}$, $I_{OUT}=300mA$ | | 0.54 | 0.58 | V |
| | | $V_{OUT}=V_{ADJ}$, $I_{OUT}=1000mA$ | | 0.90 | | V |
| Output Current(Note 5) | $I_{OUT}$ | $V_{IN}\ge V_{OUT(S)}+1V$ | 1000 (Note 7) | | | mA |
| Ground Pin Current In Normal Operation Mode | $I_{SS1}$ | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, No Load | | 60 | 90 | uA |
| Ground Pin Current In Power-off Mode | $I_{SS2}$ | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=OFF, No Load | | 0.1 | 1.0 | uA |
| Short Circuit Current | $I_{SC}$ | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, $V_{OUT}=0V$ | | 0.5 | | A |
| ON/$\overline{OFF}$ Pin Input Voltage "H" | $V_{SH}$ | $V_{IN}=V_{OUT(S)}+1V$, $R_L=1.0K\Omega$ Determinied by $V_{OUT}$ output level | 1.0 | | | V |
| ON/$\overline{OFF}$ Pin Input Voltage "L" | $V_{SL}$ | | | | 0.3 | V |
| ON/$\overline{OFF}$ Pin Input Current "H" | $I_{SH}$ | $V_{IN}=V_{OUT(S)}+1V$, $V_{ON/\overline{OFF}}=5.5V$ | | 1.0 | | uA |
| ON/$\overline{OFF}$ Pin Input Current "L" | $I_{SL}$ | $V_{IN}=V_{OUT(S)}+1V$, $V_{ON/\overline{OFF}}=0V$ | -0.1 | | 0.1 | uA |
| Inrush current limit time | Trush | $V_{IN}=V_{OUT(S)}+1V$, ON/$\overline{OFF}$ pin=ON, $I_{OUT}=1000mA$ | | 0.4 | | mS |
| Ripple Rejection | \|RR\| | $V_{IN}=V_{OUT(S)}+1V$, f=1khz, $\triangle V_{rip}=0.5Vrms$, $I_{OUT}=100mA$; $1.2V\le V_{OUT(S)}<3.0V$ | | 65 | | dB |
| | | $V_{IN}=V_{OUT(S)}+1V$, f=1khz, $\triangle V_{rip}=0.5Vrms$, $I_{OUT}=100mA$; $3.0V\le V_{OUT(S)}\le 3.5V$ | | 60 | | dB |
| Thermal Shutdown detection temperature | $T_{SD}$ | Junction temperature | | 150 | | °C |
| Thermal Shutdown release temperature | $T_{SR}$ | Junction temperature | | 120 | | °C |

Notes: 1. The UTC **LR1805** output must be diode-clamped to ground. If used in a dual-supply system where the regulator load is returned to a negative supply.

2. Devices must be derated based on package thermal resistance at elevated temperatures.

3. $V_{OUT(S)}$: Specified output voltage

$V_{OUT(E)}$: Actual output voltage

Output voltage when fixing $I_{OUT}$(=100ma) and inputting $V_{OUT(S)}$+1.0V

4. Vdrop=$V_{IN1}-(V_{OUT3}\times 0.98)$

$V_{OUT3}$ is the output voltage when $V_{IN}=V_{OUT(S)}+1.0V$ and $I_{OUT}$=300mA, 1000mA.

5. The output current at which the output voltage becomes 95% of $V_{OUT(E)}$ after gradually increasing the output current.

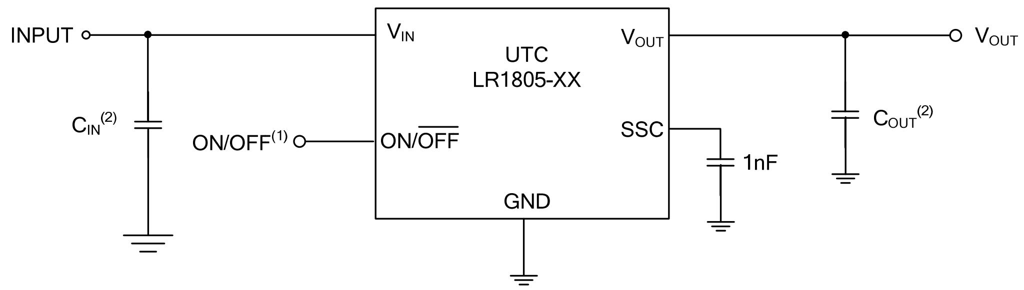
6. The output current can be at least this value.

Due to restrictions on the package power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation of the package when the output current is large.

This specification is guaranteed by design.

## ■ TYPICAL APPLICATION CIRCUIT

**Fixed Output Voltage**



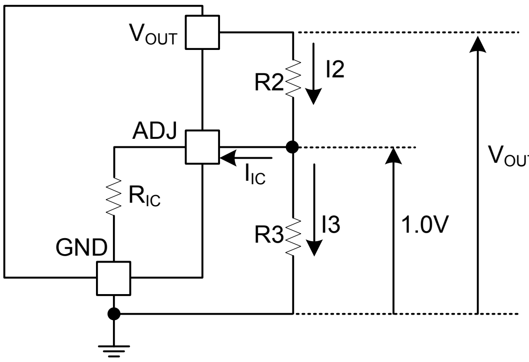

(1) ON/ $\overline{\text{OFF}}$ pins must be pulled high through a 10kΩ pull-up resistor.

(2) Generally a series regulator may cause oscillation, depending on the selection of external parts. The following conditions are recommended for this IC. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics.

Input capacitor ($C_{IN}$): 2.2μF or more
Output capacitor ($C_L$): 2.2μF or more

## ■ TYPICAL APPLICATION CIRCUIT (Cont.)

**Adjustable Output Voltage**




The Output Voltage may be adjustable for any output voltage between its 1.0V reference and its $V_{DD}$ setting level. An external pair of resistors is required, as shown above.

The complete equation for the output voltage is described step by step as follows;

$$I2 = I_{IC} + I3 \quad (1)$$

$$I3 = 1.0 / R3 \quad (2)$$

Thus,

$$I2 = I_{IC} + 1.0 / R3 \quad (3)$$

Therefore,

$$V_{OUT} = 1.0 + R2 \times I2 \quad (4)$$

Put Equation (3) into Equation (4), then

$$V_{OUT} = 1.0 + R2 ( I_{IC} + 1.0 / R3 )$$

$$= 1.0 (1 + R2 / R3 ) + R2 \times I_{IC} \quad (5)$$

In 2nd term, or $R2 \times I_{IC}$ will produce an error in $V_{OUT}$.
In Equation (5),

$$I_{IC} = 1.0 / R_{IC} \quad (6)$$

$$R2 \times I_{IC} = R2 \times 1.0 / R_{IC}$$

$$= 1.0 \times R2 / R_{IC} \quad (7)$$

For better accuracy, choosing R2 (<<$R_{IC}$) reduces this error.