

Bloc 1

BLOC 1 / CAPTEURS ET MISE EN FORME

Mission 1 - Abaisser une tension

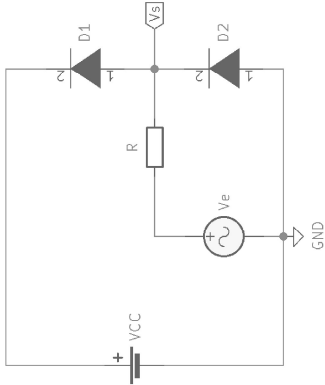
Proposer un circuit permettant d'abaisser une tension d'un facteur k .
 $0 < k < 1$

Mission 2 - Élever une tension

Proposer un circuit permettant d'élever une tension d'un facteur k .
 $k > 1$

Mission 3 - Limiter une tension

Rappeler le fonctionnement d'une diode.
Décrire le fonctionnement du montage suivant :

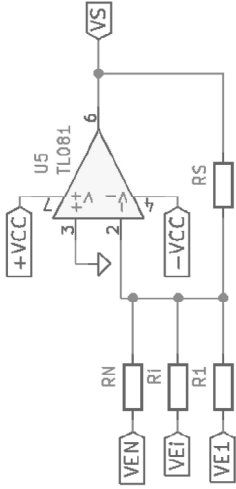


Mission 4 - Amplifier un signal

Proposer un circuit permettant d'amplifier un signal de $27dB$, tout en garantissant une bande-passante de $400kHz$.
On utilisera des amplificateurs linéaires intégrés de type TL071 (documentation partielle donnée en annexe).

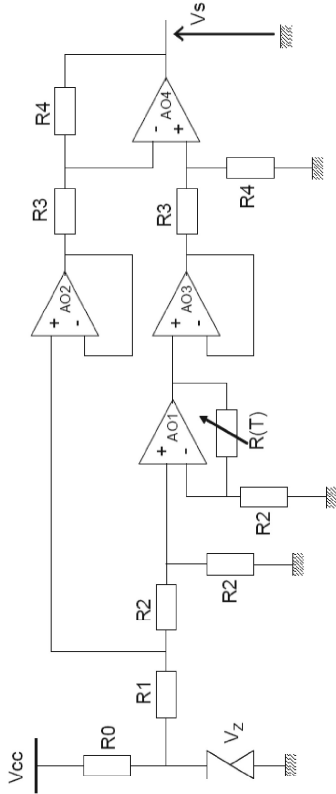
Mission 5 - Additionner des signaux

On se propose d'étudier le circuit suivant :



Mission 6 - Mettre en forme un capteur de température

On se propose d'étudier le circuit suivant :



La thermistance utilisée est de type PT100. La relation entre sa résistance (en Ohms) et la température (en °C) est la suivante :

$$R(T) = 100 (1 + 3.90810^{-3}T - 5.80210^{-7}T^2)$$

Une partie de la documentation de diodes Zener est fournie en annexe.

TL08xx JFET-Input Operational Amplifiers

1 Features

- Low Power Consumption: 1.4 mA/ch Typical
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias Current: 30 pA Typical
- Low Input Offset Current: 5 pA Typical
- Output Short-Circuit Protection
- Low Total Harmonic Distortion: 0.003% Typical
- High Input Impedance: JFET Input Stage
- Latch-Up-Free Operation
- High Slew Rate: 13 V/ μ s Typical
- Common-Mode Input Voltage Range Includes V_{CC+}

2 Applications

- Tablets
- White goods
- Personal electronics
- Computers

3 Description

The TL08xx JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset currents, and low offset-voltage temperature coefficient.

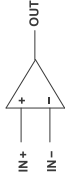
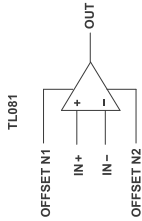
Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|--------------------|
| TL084XD | SOIC (14) | 8.65 mm × 3.91 mm |
| TL08xxFK | LCCC (20) | 8.89 mm × 8.89 mm |
| TL084xJ | CDIP (14) | 19.56 mm × 6.92 mm |
| TL084xN | PDIP (14) | 19.3 mm × 6.35 mm |
| TL084xNS | SO (14) | 10.3 mm × 5.3 mm |
| TL084xPW | TSSOP (14) | 5.0 mm × 4.4 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Schematic Symbol

TL081
TL082 (EACH AMPLIFIER)
TL084 (EACH AMPLIFIER)



6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | MIN | MAX | UNIT |
|-----------|---|-----------|------|
| V_{CC+} | Supply voltage ⁽²⁾ | | |
| | | 18 | V |
| V_{CC-} | | -18 | V |
| V_O | Differential input voltage ⁽³⁾ | | |
| | | ±30 | V |
| V_I | Input voltage ⁽²⁾⁽⁴⁾ | | |
| | | ±15 | V |
| | Duration of output short circuit ⁽⁵⁾ | | |
| | | Unlimited | |
| | Continuous total power dissipation | | |
| | See Dissipation Rating Table | | |
| T_A | Operating free-air temperature | | |
| | TL08_C | 0 | 70 |
| | TL08_AC | | |
| | TL08_BC | -40 | 85 |
| | TL08_J | -40 | 125 |
| | TL084Q | -40 | 125 |
| | TL08_M | -55 | 125 |
| | Operating virtual junction temperature | | |
| | TL08_M | 150 | °C |
| T_C | Case temperature for 60 seconds | | |
| | FK package | 260 | °C |
| | J or JG package | 300 | °C |
| T_{stg} | Storage temperature | | |
| | | -65 | 150 |
| | | | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
- (3) Differential voltages are at I_N+ , with respect to I_N- .
- (4) The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
- (5) The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

6.2 ESD Ratings

| | VALUE | UNIT |
|-----------|---|------|
| V_{ESD} | Electrostatic discharge | |
| | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | 1000 |
| | Charged-device model (CDM), per JEDEC specification JESD22-C10 ⁽²⁾ | 1500 |
| | | V |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | MIN | MAX | UNIT |
|-----------|---------------------|---------------|------|
| V_{CC+} | Supply voltage | | |
| | 5 | 15 | V |
| V_{CC-} | Supply voltage | | |
| | -5 | -15 | V |
| V_{CM} | Common-mode voltage | | |
| | $V_{CC-} + 4$ | $V_{CC+} - 4$ | V |
| T_A | Ambient temperature | | |
| | TL08xM | -55 | 125 |
| | TL08xQ | -40 | 125 |
| | TL08xI | -40 | 85 |
| | TL08xC | 0 | 70 |
| | | | °C |

Electrical Characteristics for TL08xC, TL08xxC, and TL08xI (continued)

$V_{CC2} = \pm 15$ V (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | $T_A^{(1)}$ | TL081C, TL082C, TL084C | TL081AC, TL082AC, TL084AC | TL081BC, TL082BC, TL084BC | TL081I, TL082I, TL084I | UNIT |
|---------------------------------------|---------------------|-------------|------------------------|---------------------------|---------------------------|------------------------|------|
| Supply current (each amplifier) | $V_O = 0$, No load | 25°C | MIN TYP MAX | MIN TYP MAX | MIN TYP MAX | MIN TYP MAX | |
| I_{CC} | | | 1.4 2.8 | 1.4 2.8 | 1.4 2.8 | 1.4 2.8 | nA |
| V_{OI}/V_{O2} crosstalk attenuation | $A_{VO} = 100$ | 25°C | 120 | 120 | 120 | 120 | dB |

6.6 Electrical Characteristics for TL08xM and TL084x

$V_{CC2} = \pm 15$ V (unless otherwise noted)

| PARAMETER | TEST CONDITIONS ⁽¹⁾ | T_A | TL081M, TL082M | TL084Q, TL084M | UNIT |
|--|--|------------|---|---|------------------|
| V_{IO} Input offset voltage | $V_O = 0$, $R_S = 50\ \Omega$ | 25°C | MIN TYP MAX | MIN TYP MAX | mV |
| | | Full range | 3 6 9 | 3 3 15 | |
| α_{VO} Temperature coefficient of input offset voltage | $V_O = 0$, $R_S = 50\ \Omega$ | Full range | 18 | 18 | $\mu V/^\circ C$ |
| I_{IO} Input offset current ⁽²⁾ | $V_O = 0$ | 25°C | 5 100 | 5 100 | pA |
| | | 125°C | 20 | 20 | pA |
| I_{IB} Input bias current ⁽²⁾ | $V_O = 0$ | 25°C | 30 200 | 30 200 | pA |
| | | 125°C | 50 | 50 | nA |
| V_{ICR} Common-mode input voltage range | | 25°C | -12 11 15 | -12 10 15 | V |
| V_{OM} Maximum peak output voltage swing | $R_L = 10\ k\Omega$ $R_L \geq 10\ k\Omega$ $R_L \geq 2\ k\Omega$ | 25°C | ± 12 ± 13.5 ± 12 ± 10 ± 12 | ± 12 ± 13.5 ± 12 ± 10 ± 12 | V |
| A_{VO} Large-signal differential voltage amplification | $V_O = \pm 10$ V, $R_L \geq 2\ k\Omega$ | 25°C | 25 200 | 25 200 | V/mV |
| B_1 Unity-gain bandwidth | | 25°C | 3 | 3 | MHz |
| f_i Input resistance | | 25°C | 10^{12} | 10^{12} | Ω |
| CMRR Common-mode rejection ratio | $V_{IC} = V_{ICM}$, $V_O = 0$, $R_S = 50\ \Omega$ | 25°C | 80 86 | 80 86 | dB |
| k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC2}/\Delta V_O$) | $V_{CC} = \pm 15$ V to ± 9 V, $V_O = 0$, $R_S = 50\ \Omega$ | 25°C | 80 | 80 | dB |
| I_{CC} Supply current (each amplifier) | $V_O = 0$, No load | 25°C | 1.4 2.8 | 1.4 2.8 | nA |
| V_{OI}/V_{O2} Crosstalk attenuation | $A_{VO} = 100$ | 25°C | 120 | 120 | dB |

- (1) All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.
- (2) Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 13. Pulse techniques must be used that maintain the junction temperatures as close to the ambient temperature as possible.

6.7 Operating Characteristics

$V_{CC2} = \pm 15$ V, $T_A = 25^\circ C$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|----------------------------|---|------------------|-----|-----|------------|
| SR Slew rate at unity gain | $V_I = 10$ V, $R_S = 2\ k\Omega$, $C_L = 100$ pF, See Figure 19 | 8 ⁽¹⁾ | 13 | | V/ μs |
| | $V_I = 10$ V, $R_S = 2\ k\Omega$, $C_L = 100$ pF, $T_A = -55^\circ C$ to $125^\circ C$, See Figure 19 | 5 ⁽¹⁾ | | | |

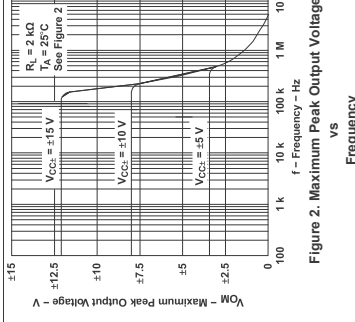
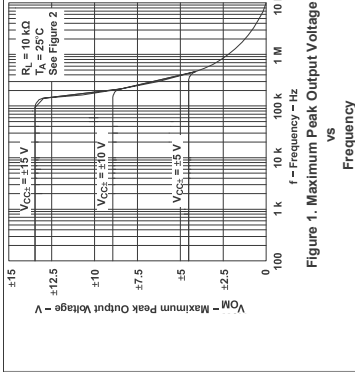
- (1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

6.9 Typical Characteristics

Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. The Figure numbers referenced in the following graphs are located in *Parameter Measurement Information*.

Table 1. Table of Graphs

| | | Figure |
|----------|---|--|
| V_{OM} | Maximum peak output voltage versus Frequency versus Free-air temperature versus Load resistance versus Supply voltage | Figure 1, Figure 2, Figure 3 Figure 4 Figure 5 Figure 6 |
| A_{VO} | Large-signal differential voltage amplification versus Free-air temperature versus Load resistance | Figure 7 Figure 8 |
| P_D | Differential voltage amplification versus Frequency with feed-forward compensation | Figure 9 |
| I_{CC} | Total power dissipation versus Free-air temperature | Figure 10 |
| I_{IB} | Supply current versus Free-air temperature | Figure 11 Figure 12 |
| I_{IB} | Input bias current versus Free-air temperature | Figure 13 |
| V_O | Large-signal pulse response versus Time | Figure 14 |
| CMRR | Output voltage versus Elapsed time | Figure 15 |
| V_n | Common-mode rejection ratio versus Free-air temperature | Figure 16 |
| THD | Equivalent input noise voltage versus Frequency | Figure 17 |
| | Total harmonic distortion versus Frequency | Figure 18 |



Zener Diodes



FEATURES

- Silicon planar power Zener diodes
- For use in stabilizing and clipping circuits with high power rating
- Standard Zener voltage tolerance is $\pm 5\%$
- Material categorization:
for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Voltage stabilization

LINKS TO ADDITIONAL RESOURCES



| PRIMARY CHARACTERISTICS | | |
|------------------------------|---------------------|------|
| PARAMETER | VALUE | UNIT |
| V _Z range nom. | 3.3 to 75 | V |
| Test current I _{ZT} | 3.3 to 76 | mA |
| V _Z specification | Thermal equilibrium | |
| Circuit configuration | Single | |

| ORDERING INFORMATION | | |
|----------------------|-------------------------------|-------------------------------|
| DEVICE NAME | ORDERING CODE | MINIMUM ORDER QUANTITY |
| 1N4728A to 1N4761A | 1N4728A to 1N4761A-series-TR | 5000 per 13" reel |
| 1N4728A to 1N4761A | 1N4728A to 1N4761A-series-TAP | 5000 per ammpack (52 mm tape) |

| PACKAGE | WEIGHT | MOLDING COMPOUND FLAMMABILITY RATING | MOISTURE SENSITIVITY LEVEL | SOLDERING CONDITIONS |
|------------------|--------|--------------------------------------|-----------------------------------|------------------------------|
| DO-41 (DO-204AL) | 310 mg | UL 94 V-0 | MSL level 1 (according J-STD-020) | Peak temperature max. 260 °C |

| ABSOLUTE MAXIMUM RATINGS (T _{amb} = 25 °C, unless otherwise specified) | | | |
|--|---|-------------------|----------------|
| PARAMETER | TEST CONDITION | SYMBOL | UNIT |
| Power dissipation | Valid provided that leads at a distance of 4 mm from case are kept at ambient temperature | P _{tot} | mW |
| Zener current | | I _Z | mA |
| Thermal resistance junction to ambient air from case are kept at ambient temperature | | R _{thJA} | K/W |
| Junction temperature | | T _J | °C |
| Storage temperature range | | T _{stg} | -65 to +175 °C |
| Forward voltage (max.) | I _F = 200 mA | V _F | V |

| ELECTRICAL CHARACTERISTICS (T _{amb} = 25 °C, unless otherwise specified) | | | | | | | | | |
|---|------------------------------------|--|------------------|------------------|----------------------------------|------|-------------------------------------|-------------------------------------|-----------------------|
| PART NUMBER | ZENER VOLTAGE RANGE (1) | | TEST CURRENT | | REVERSE LEAKAGE CURRENT | | DYNAMIC RESISTANCE f = 1 kHz | | REGULATOR CURRENT (2) |
| | V _Z at I _{ZT1} | | I _{ZT1} | I _{ZT2} | I _R at V _R | | Z _{ZT} at I _{ZT1} | Z _{ZK} at I _{ZT2} | |
| | V | | mA | mA | μA | | Ω | Ω | |
| | NOM. | | | | MAX. | | TYP. | MAX. | |
| 1N4728A | 3.3 | | 76 | 1 | 100 | 1 | 10 | 400 | 1380 |
| 1N4729A | 3.6 | | 69 | 1 | 100 | 1 | 10 | 400 | 1260 |
| 1N4730A | 3.9 | | 64 | 1 | 50 | 1 | 9 | 400 | 1190 |
| 1N4731A | 4.3 | | 58 | 1 | 10 | 1 | 9 | 400 | 1070 |
| 1N4732A | 4.7 | | 53 | 1 | 10 | 1 | 8 | 500 | 970 |
| 1N4733A | 5.1 | | 49 | 1 | 10 | 1 | 7 | 550 | 890 |
| 1N4734A | 5.6 | | 45 | 1 | 10 | 2 | 5 | 600 | 810 |
| 1N4735A | 6.2 | | 41 | 1 | 10 | 3 | 2 | 700 | 730 |
| 1N4736A | 6.8 | | 37 | 1 | 10 | 4 | 3.5 | 700 | 660 |
| 1N4737A | 7.5 | | 34 | 0.5 | 10 | 5 | 4 | 700 | 605 |
| 1N4738A | 8.2 | | 31 | 0.5 | 10 | 6 | 4.5 | 700 | 550 |
| 1N4739A | 9.1 | | 28 | 0.5 | 10 | 7 | 5 | 700 | 500 |
| 1N4740A | 10 | | 25 | 0.25 | 10 | 7.6 | 7 | 700 | 454 |
| 1N4741A | 11 | | 23 | 0.25 | 5 | 8.4 | 8 | 700 | 414 |
| 1N4742A | 12 | | 21 | 0.25 | 5 | 9.1 | 9 | 700 | 380 |
| 1N4743A | 13 | | 19 | 0.25 | 5 | 9.9 | 10 | 700 | 344 |
| 1N4744A | 15 | | 17 | 0.25 | 5 | 11.4 | 14 | 700 | 304 |
| 1N4745A | 16 | | 15.5 | 0.25 | 5 | 12.2 | 16 | 700 | 285 |
| 1N4746A | 18 | | 14 | 0.25 | 5 | 13.7 | 20 | 750 | 250 |
| 1N4747A | 20 | | 12.5 | 0.25 | 5 | 15.2 | 22 | 750 | 225 |
| 1N4748A | 22 | | 11.5 | 0.25 | 5 | 16.7 | 23 | 750 | 205 |
| 1N4749A | 24 | | 10.5 | 0.25 | 5 | 18.2 | 25 | 750 | 190 |
| 1N4750A | 27 | | 9.5 | 0.25 | 5 | 20.6 | 35 | 750 | 170 |
| 1N4751A | 30 | | 8.5 | 0.25 | 5 | 22.8 | 40 | 1000 | 150 |
| 1N4752A | 33 | | 7.5 | 0.25 | 5 | 25.1 | 45 | 1000 | 135 |
| 1N4753A | 36 | | 7 | 0.25 | 5 | 27.4 | 50 | 1000 | 125 |
| 1N4754A | 39 | | 6.5 | 0.25 | 5 | 29.7 | 60 | 1000 | 115 |
| 1N4755A | 43 | | 6 | 0.25 | 5 | 32.7 | 70 | 1500 | 110 |
| 1N4756A | 47 | | 5.5 | 0.25 | 5 | 35.8 | 80 | 1500 | 95 |
| 1N4757A | 51 | | 5 | 0.25 | 5 | 38.8 | 95 | 1500 | 90 |
| 1N4758A | 56 | | 4.5 | 0.25 | 5 | 42.6 | 110 | 2000 | 80 |
| 1N4759A | 62 | | 4 | 0.25 | 5 | 47.1 | 125 | 2000 | 70 |
| 1N4760A | 68 | | 3.7 | 0.25 | 5 | 51.7 | 150 | 2000 | 65 |
| 1N4761A | 75 | | 3.3 | 0.25 | 5 | 56 | 175 | 2000 | 60 |

Notes
(1) Based on DC measurement at thermal equilibrium while maintaining the lead temperature (T_L) at 30 °C + 1 °C, 9.5 mm (3/8") from the diode body
(2) Valid provided that electrodes at a distance of 4 mm from case are kept at ambient temperature
(3) t_p = 10 ms.