## Description

The LSF0204 is a 4-channel bidirectional multi-voltage level translator for open-drain and push-pull applications. This device is a universal level translator with A port operating from 0.8V to 4.5V (Vref_A) and B port from 1.8V to 5.5V (Vref_B). This range allows for bidirectional voltage translations between 0.8V and 5.0V. Be aware that Vref_B is recommended to be at 1.0V higher than Vref_A for the best signal integrity.

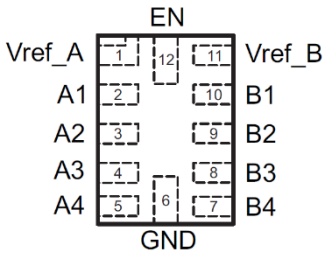
The EN pin is used to activate the device. When EN is HIGH, the translator switch is on. Otherwise, if EN is LOW, the translator switch is off, and a high-impedance state exists between ports. The EN input circuit is designed to be supplied by Vref_A. EN must be LOW to ensure the high-impedance state during power-up or power-down to avoid misoperation.

Please note that an external Rpu (pullup resistor) is required on port A and B for push-pull and open-drain application because a pull-high state can avoid misoperation during the power sequence. About the Rpu, the smaller value can result in the larger driving current. Overall, the LSF0204 is designed for easy-to-use with auto direction. So, there is no need for a direction pin to minimize system effort. This device supports 5V tolerant I/O pins for compatibility with TTL levels in a variety of applications which require a proper voltage translation.

## Features

- External Rpu (Pullup Resistor) to Set Driving Current in Both Push-Pull and Open-Drain Applications
- Up & Down Translation
  - ≤ 100MHz; $C_L$ = 15pF, 30pF
  - ≤ 50MHz; $C_L$ = 50pF
- Bidirectional Voltage Level Translation Between:
  - 0.8V and 1.8V, 2.5V, 3.3V and 5.0V
  - 1.2V and 1.8V, 2.5V, 3.3V and 5.0V
  - 1.8V and 2.5V, 3.3V and 5.0V
  - 2.5V and 3.3V and 5.0V
  - 3.3V and 5.0V
- ESD Protection Exceeds JESD 22
  - 2000V HBM (A114)
  - 1000V CDM (C101)
- Latchup Exceeds 100mA per JESD 17
- Specified from -40°C to +125°C
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

## Pin Assignments




**U-QFN1720-12 (Type CJ)**

## Applications

- GPIO, MDIO, SDIO, SVID, UART
- PMBus™, SMBus™, I2C, and other interfaces
- Telecom infrastructures
- Industrial
- High-performance computing
- Wide array of products such as:
  - PCs, networking, notebooks
  - Smart phones
  - Tablets

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Pin Descriptions

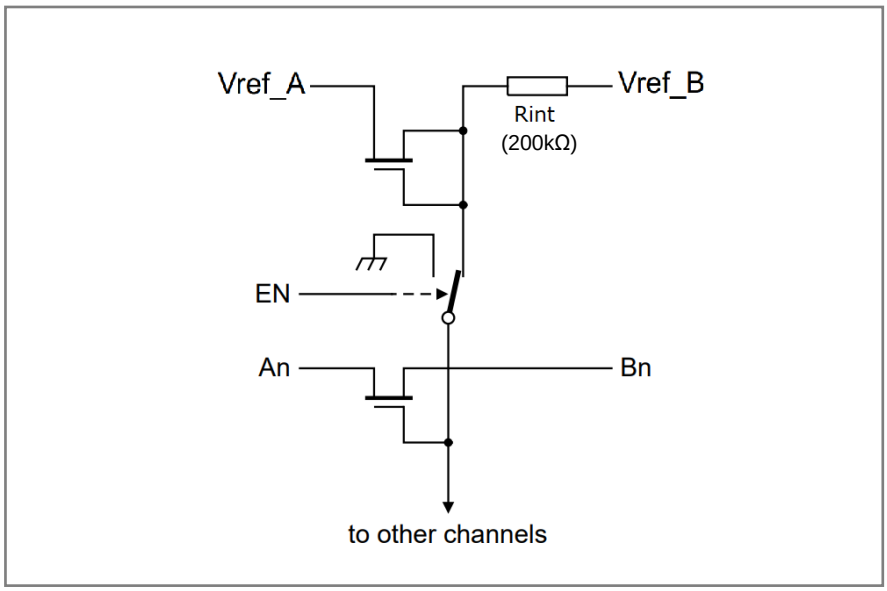
| Pin Name | Pin Number | Function |
|---|---|---|
| $V_{ref\_A}$ | 1 | Reference supply voltage; A port |
| A1 | 2 | Input/output 1 |
| A2 | 3 | Input/output 2 |
| A3 | 4 | Input/output 3 |
| A4 | 5 | Input/output 4 |
| GND | 6 | Ground |
| B4 | 7 | Input/output 4 |
| B3 | 8 | Input/output 3 |
| B2 | 9 | Input/output 2 |
| B1 | 10 | Input/output 1 |
| $V_{ref\_B}$ | 11 | Reference supply voltage; B port |
| EN | 12 | Switch enable input; EN is high-active. |

## Absolute Maximum Ratings (Note 4)

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| ESD HBM | Human Body Model ESD Protection | ±2 | kV |
| ESD CDM | Charged Device Model ESD Protection | ±1 | kV |
| $V_{REF}$ | Supply Reference Voltage Range | -0.5 to +6.0 | V |
| $V_I$ | Input Voltage Range | -0.5 to +6.0 | V |
| $V_O$ | Voltage Range Applied to Any Output in the High-Z or Power-Off State | -0.5 to +6.0 | V |
| $I_{CH}$ | Continuous Channel Current | 128 | mA |
| $I_{IK}$ | Input Clamp Current, $V_I < 0$ | -50 | mA |
| $T_J$ | Operating Junction Temperature | -40 to +150 | °C |
| $T_{STG}$ | Storage Temperature | -65 to +150 | °C |

Note: 4. Stresses greater than those listed under *Absolute Maximum Ratings* can 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 Ratings* for extended periods can affect device reliability.

## Functional Diagram



## Recommended Operating Conditions (@$T_A$ = +25°C, unless otherwise specified.)

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{REF}$ | Reference Voltage, A & B Ports | 0.8 | 5.5 | V |
| $V_{I/O}$ | Input/Output Voltage | 0.8 | 5.5 | V |
| $V_{EN}$ | Enable Voltage | 0 | 5.5 | V |
| $I_{PASS}$ | Pass Transistor Current | — | 64 | mA |
| $T_A$ | Operating Free-Air Temperature | -40 | +125 | °C |

## Electrical Characteristics (Note 5) (@$T_A$ = +40°C to +125°C, unless otherwise specified.)

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{ref\_A}$ | A Port Supply Voltage | — | | 0.8 | — | 4.5 | V |
| $V_{ref\_B}$ | B Port Supply Voltage | — | | 1.8 | — | 5.5 | V |
| $V_{IK}$ | — | $I_I$ = -18mA, $V_{EN}$ = 0 | | -1.2 | — | — | V |
| $I_{IH}$ | — | $V_I$ = 5V, $V_{EN}$ = 0 | | — | — | 5.0 | µA |
| $I_{CCBA}$ | Leakage from Vref_B to Vref_A | $V_{ref\_B}$ = 3.3V, $V_{ref\_A}$ = 1.8V, $V_{EN}$ = $V_{ref\_A}$, $I_O$ = 0<br>$V_I$ = 3.3V or GND | | — | — | 3.5 | µA |
| $I_{CCA}$ + $I_{CCB}$ | Total Current Through GND | $V_{ref\_B}$ = 3.3V, $V_{ref\_A}$ = 1.8V, $V_{EN}$ = $V_{ref\_A}$, $I_O$ = 0<br>$V_I$ = 3.3V or GND | | — | 0.2 | — | µA |
| $I_{IN}$ | Control Pin Current | $V_{ref\_B}$ = 5.5V, $V_{ref\_A}$ = 4.5V, $V_{EN}$ = 0 to $V_{ref\_A}$, $I_O$ = 0 | | — | — | ±1 | µA |
| $I_{off}$ | Power Off Leakage Current | $V_{ref\_B}$ = $V_{ref\_A}$ = 0, $V_{EN}$ = GND, $I_O$ = 0, $V_I$ = 5V or GND | | — | — | ±1 | µA |
| $C_I$ (ref_A/B/EN) | — | $V_I$ = 3V or 0 | | — | 7 | — | pF |
| $C_{io}$ (off) | — | $V_O$ = 3V or 0, $V_{EN}$ = 0 | | — | 5.0 | 6.0 | pF |
| $C_{io}$ (on) | — | $V_O$ = 3V or 0, $V_{EN}$ = $V_{ref\_A}$ | | — | 10.5 | 13 | pF |
| $V_{IH}$ (EN) | High-Level Input Voltage | $V_{ref\_A}$ = 1.5V to 4.5V | | 0.7×$V_{ref\_A}$ | — | — | V |
| $V_{IL}$ (EN) | Low-Level Input Voltage | $V_{ref\_A}$ = 1.5V to 4.5V | | — | — | 0.3×$V_{ref\_A}$ | V |
| $V_{IH}$ (EN) | High-Level Input Voltage | $V_{ref\_A}$ = 1.0V to 1.5V | | 0.8×$V_{ref\_A}$ | — | — | V |
| $V_{IL}$ (EN) | Low-Level Input Voltage | $V_{ref\_A}$ = 1.0V to 1.5V | | — | — | 0.3×$V_{ref\_A}$ | V |
| Δt/Δv (EN) | Input Transition Rise or Fall Rate for EN Pin | — | | — | 10 | — | ns/V |
| $R_{on}$ | — | $V_I$ = 0, $I_O$ = 64mA | $V_{ref\_A}$ = $V_{EN}$ = 3.3V; $V_{ref\_B}$ = 5V | — | 3 | — | Ω |
| | | | $V_{ref\_A}$ = $V_{EN}$ = 1.8V; $V_{ref\_B}$ = 5V | — | 4 | — | |
| | | $V_I$ = 0, $I_O$ = 32mA | $V_{ref\_A}$ = $V_{EN}$ = 1.0V; $V_{ref\_B}$ = 5V | — | 5 | — | Ω |
| | | | $V_{ref\_A}$ = $V_{EN}$ = 1.8V; $V_{ref\_B}$ = 5V | — | 4 | — | |
| | | $V_I$ = 0, $I_O$ = 32mA, $V_{ref\_A}$ = $V_{EN}$ = 2.5V; $V_{ref\_B}$ = 5V | | — | 3 | — | Ω |
| | | $V_I$ = 1.8V, $I_O$ = 15mA, $V_{ref\_A}$ = $V_{EN}$ = 3.3V; $V_{ref\_B}$ = 5V | | — | 5 | — | Ω |
| | | $V_I$ = 1.0V, $I_O$ = 10mA, $V_{ref\_A}$ = $V_{EN}$ = 1.8V<br>$V_{ref\_B}$ = 3.3V | | — | 8 | — | Ω |
| | | $V_I$ = 0, $I_O$ = 10mA, $V_{ref\_A}$ = $V_{EN}$ = 1.0V; $V_{ref\_B}$ = 3.3V | | — | 6 | — | Ω |
| | | $V_I$ = 0, $I_O$ = 10mA, $V_{ref\_A}$ = $V_{EN}$ = 1.0V; $V_{ref\_B}$ = 1.8V | | — | 6 | — | Ω |

Note: 5. All typical values are at $T_A$ = +25°C. Measured by the voltage drop between the A and B terminals at the indicated current through the switch. On-state resistance is determined by the lowest voltage of the two (A or B) terminals. The actual supply current for LSF0204 is $I_{CCA}$ + $I_{CCB}$; the leakage from Vref_B to Vref_A can be measured on Vref_A and Vref_B pins.

## EN Pin Characteristics (Note 6) (@$T_A$ = +40°C to +125°C, unless otherwise specified.)

**Translating Down, 3.3V to 1.8V**

| Parameter | From EN Pin | To Port A or B | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLZ}$ (LOW to OFF) | | | 13 | 20 | 12 | 20 | 11 | 20 | ns |
| $t_{PZL}$ (OFF to LOW) | | | 35 | 50 | 30 | 40 | 25 | 40 | ns |
| Test Conditions: $V_{ref\_A}$ = 1.8V, $V_{ref\_B}$ = 3.3V, $V_M$ = 0.9V, $V_{EN}$ = 1.8V, $V_{EXT}$ = $V_{ref\_A}$, Rpu = NA, $V_{IH}$ = 3.3V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Up, 1.8V to 3.3V**

| Parameter | From EN Pin | To Port A or B | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLZ}$ (LOW to OFF) | | | 13 | 20 | 12 | 20 | 11 | 20 | ns |
| $t_{PZL}$ (OFF to LOW) | | | 35 | 50 | 30 | 40 | 25 | 40 | ns |
| Test Conditions: $V_{ref\_A}$ = 1.8V, $V_{ref\_B}$ = 3.3V, $V_M$ = 0.9V, $V_{EN}$ = 1.8V, $V_{EXT}$ = $V_{ref\_A}$, Rpu = NA, $V_{IH}$ = 3.3V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

## Translating Down Characteristics (Note 6) (@$T_A$ = +40°C to +125°C, unless otherwise specified.)

**Translating Down, 5.0V to 1.8V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | B | A | 0.6 | 5.1 | 0.5 | 5.1 | 0.3 | 5.0 | ns |
| $t_{PHL}$ | | | 1.1 | 4.8 | 0.9 | 4.5 | 0.5 | 4.4 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.8V, $V_{ref\_B}$ = 5.0V, $V_M$ = 2.15V, $V_{EN}$ = 1.8V, Switch = S2, $V_{IH}$ = 5.0V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Down, 3.3V to 1.8V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | B | A | 0.7 | 5.5 | 0.5 | 5.3 | 0.3 | 5.2 | ns |
| $t_{PHL}$ | | | 0.9 | 4.9 | 0.7 | 4.7 | 0.5 | 4.5 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.8V, $V_{ref\_B}$ = 3.3V, $V_M$ = 1.15V, $V_{EN}$ = 1.8V, Switch = S2, $V_{IH}$ = 3.3V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Down, 3.3V to 1.2V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | B | A | 0.8 | 4.1 | 0.5 | 3.9 | 0.3 | 3.8 | ns |
| $t_{PHL}$ | | | 0.9 | 4.7 | 0.7 | 4.5 | 0.6 | 4.3 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.2V, $V_{ref\_B}$ = 3.3V, $V_M$ = 0.85V, $V_{EN}$ = 1.2V, Switch = S2, $V_{IH}$ = 3.3V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

Note: 6: All typical values are measured at $T_A$ = +25°C. Logic levels: $V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz; $Z_O$ = 50Ω. Definitions test circuit: $C_L$ = Load capacitance including jig and probe capacitance; Rpu = pullup resistor as load resistance; S1/S2 = Test selection switch.

## Translating Down Characteristics (continued) (Note 6) (@$T_A$ = +40°C to +125°C, unless otherwise specified.)

**Translating Down, 1.8V to 1.2V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | B | A | 1.3 | 4.6 | 1.1 | 4.4 | 1.0 | 4.1 | ns |
| $t_{PHL}$ | | | 1.4 | 5.3 | 1.3 | 5.1 | 1.2 | 4.7 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.2V, $V_{ref\_B}$ = 1.8V, $V_M$ = 0.65V, $V_{EN}$ = 1.2V, Switch = S2, $V_{IH}$ = 1.8V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Down, 1.8V to 0.8V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | B | A | 1.5 | 4.7 | 1.2 | 4.5 | 1.1 | 4.3 | ns |
| $t_{PHL}$ | | | 1.7 | 5.6 | 1.6 | 5.3 | 1.3 | 5.0 | ns |
| $f_{MAX}$ | | | 50 | | 80 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 0.8V, $V_{ref\_B}$ = 1.8V, $V_M$ = 0.55V, $V_{EN}$ = 0.8V, Switch = S2, $V_{IH}$ = 1.8V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

## Translating Up Characteristics (Note 6) (@$T_A$ = +40°C to +125°C, unless otherwise specified.)

**Translating Up, 1.8V to 5.0V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | A | B | 0.6 | 5.7 | 0.4 | 5.3 | 0.2 | 5.2 | ns |
| $t_{PHL}$ | | | 1.3 | 6.7 | 1.0 | 6.4 | 0.7 | 5.3 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.8V, $V_{ref\_B}$ = 5.0V, $V_M$ = 2.05V, $V_{EN}$ = 1.8V, Switch = S1, Rpu = 500Ω, $V_{EXT}$ = 5.0V, $V_{IH}$ = 1.8V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Up, 1.8V to 3.3V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | A | B | 0.6 | 5.7 | 0.4 | 5.3 | 0.2 | 5.2 | ns |
| $t_{PHL}$ | | | 1.3 | 6.7 | 1.0 | 6.4 | 0.7 | 5.3 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.8V, $V_{ref\_B}$ = 5.0V, $V_M$ = 2.05V, $V_{EN}$ = 1.8V, Switch = S1, Rpu = 500Ω, $V_{EXT}$ = 5.0V, $V_{IH}$ = 1.8V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Up, 1.2V to 3.3V**

| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | A | B | 0.7 | 7.3 | 0.4 | 7.1 | 0.2 | 6.9 | ns |
| $t_{PHL}$ | | | 1.6 | 7.1 | 1.3 | 6.5 | 1.0 | 5.4 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.2V, $V_{ref\_B}$ = 3.3V, $V_M$ = 0.75V, $V_{EN}$ = 1.2V, Switch = S1, Rpu = 500Ω, $V_{EXT}$ = 3.3V, $V_{IH}$ = 1.2V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

Note: 6: All typical values are measured at $T_A$ = +25°C. Logic levels: $V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz; $Z_O$ = 50Ω. Definitions test circuit: $C_L$ = Load capacitance including jig and probe capacitance; Rpu = pullup resistor as load resistance; S1/S2 = Test selection switch.

## Translating Up Characteristics (continued) (Note 6) (@$T_A$ = +40°C to +125°C, unless otherwise specified.)

**Translating Up, 1.2V to 1.8V**

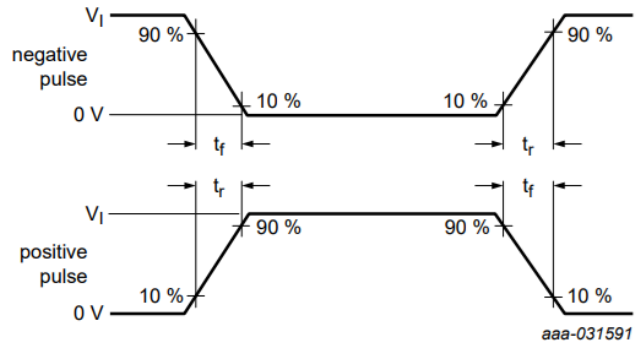
| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | A | B | 0.7 | 7.3 | 0.4 | 7.1 | 0.2 | 6.9 | ns |
| $t_{PHL}$ | | | 1.6 | 7.1 | 1.3 | 6.5 | 1.0 | 5.4 | ns |
| $f_{MAX}$ | | | 50 | | 100 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 1.2V, $V_{ref\_B}$ = 3.3V, $V_M$ = 0.75V, $V_{EN}$ = 1.2V, Switch = S1, Rpu = 500Ω, $V_{EXT}$ = 3.3V, $V_{IH}$ = 1.2V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

**Translating Up, 0.8V to 1.8V**

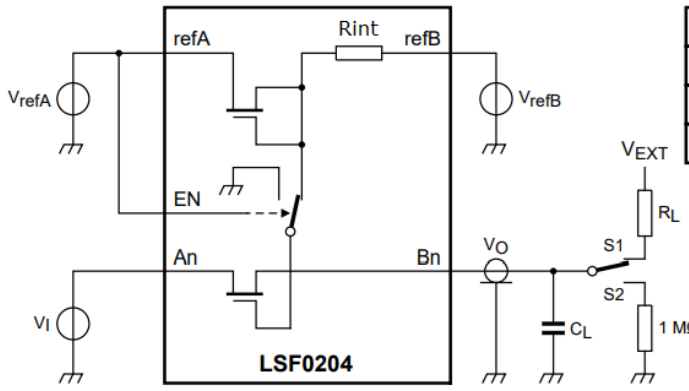
| Parameter | From (Input) | To (Output) | $C_L$ = 50pF | | $C_L$ = 30pF | | $C_L$ = 15pF | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Typ | Max | Typ | Max | Typ | Max | |
| $t_{PLH}$ | A | B | 0.7 | 7.3 | 0.5 | 7.2 | 0.3 | 6.9 | ns |
| $t_{PHL}$ | | | 1.6 | 7.1 | 1.4 | 6.6 | 1.0 | 5.4 | ns |
| $f_{MAX}$ | | | 40 | | 80 | | 100 | | MHz |
| Test Conditions: $V_{ref\_A}$ = 0.8V, $V_{ref\_B}$ = 1.8V, $V_M$ = 0.55V, $V_{EN}$ = 0.8V, Switch = S1, Rpu = 500Ω, $V_{EXT}$ = 1.8V, $V_{IH}$ = 0.8V, $V_{IL}$ = 0, PRR = 10MHz (unless otherwise noted, see Figure 1) | | | | | | | | | |

Note: 6: All typical values are measured at $T_A$ = +25°C. Logic levels: $V_{OL}$ and $V_{OH}$ are typical output voltage levels that occur with the output load. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz; $Z_O$ = 50Ω. Definitions test circuit: $C_L$ = Load capacitance including jig and probe capacitance; Rpu = pullup resistor as load resistance; S1/S2 = Test selection switch.

## Parameter Measurement Information



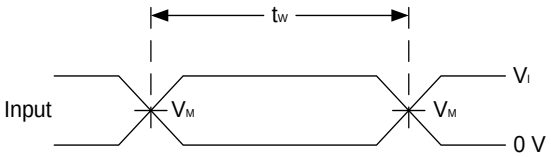

$V_I$ source waveform



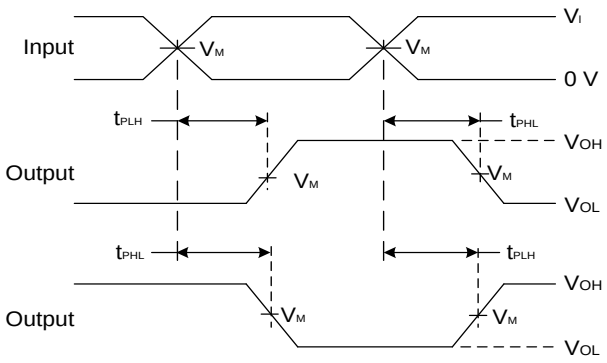

| Measurement | | switch |
|---|---|---|
| $t_{PHL}/t_{PLH}$, $f_{max}$ | Translating up | S1 |
| $t_{PHL}/t_{PLH}$, $f_{max}$ | Translating down | S2 |
| $t_{PZL}/t_{PLZ}$ | Translating up/down | S1 |

Test circuit

## Parameter Measurement Information (continued)




**Voltage Waveform Pulse Duration**




**Voltage Waveform Propagation Delay Times**
**Inverting and Non-Inverting Outputs**

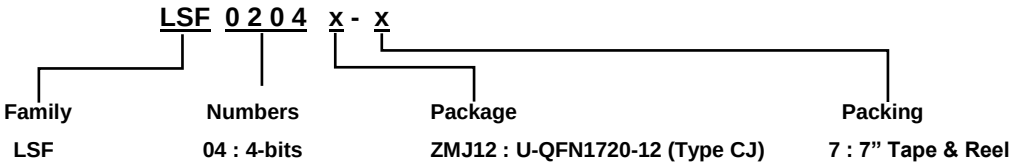
**Figure 1. Load Circuit and Voltage Waveforms, $R_L$ = 500Ω, $C_L$ = 15pF, 30pF, 50pF**

## Package Characteristics

| Symbol | Parameter | Package | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $\theta_{JA}$ | Thermal Resistance Junction-to-Ambient | U-QFN1720-12 (Type CJ) | Note 7 | — | 185 | — | °C/W |
| $\theta_{JC}$ | Thermal Resistance Junction-to-Case | U-QFN1720-12 (Type CJ) | Note 7 | — | 65 | — | |

Note: 7. Test condition for each of the 3 package types: device mounted on JEDEC standard PCB per JESD51, with minimum recommended pad layout.

## Ordering Information (Notes 8 & 9)



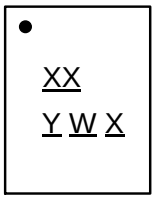

| Part Number | Part Number Suffix | Package Code | Package | Packing (Note 10) | |
|---|---|---|---|---|---|
| | | | | Qty. | Carrier |
| LSF0204ZMJ12-7 | -7 | ZMJ12 | U-QFN1720-12 (Type CJ) | 3,000 | 7" Tape and Reel |

Notes:
8. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.
9. Pad layout as shown in Diodes Incorporated's package outline PDFs, which can be found on our website at http://www.diodes.com/package-outlines.html.
10. The taping orientation is located on our website at https://www.diodes.com/assets/Packaging-Support-Docs/ap02007.pdf.

## Marking Information

**U-QFN1720-12 (Type CJ)**

**(Top View)**



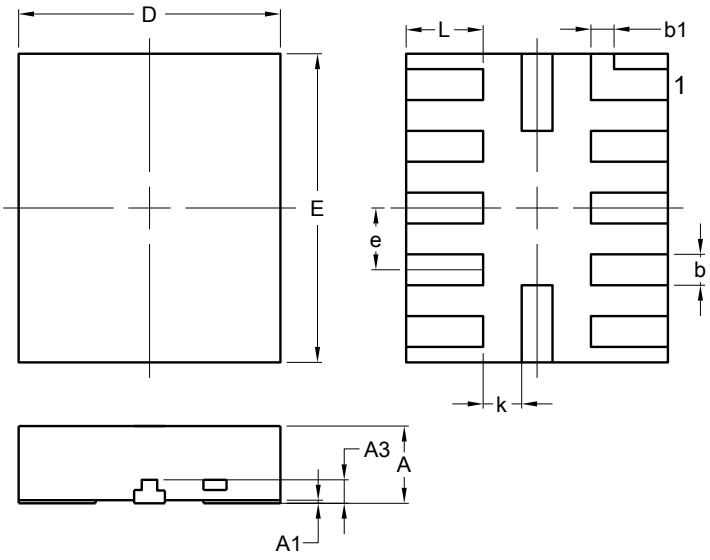

XX : Identification Code
Y : Year : 0 to 9 (ex: 3 = 2023)
W : Week : A to Z : week 1 to 26;
a to z : week 27 to 52; z represents week 52 and 53
X : Internal Code

| Part Number | Package | Identification Code |
|---|---|---|
| LSF0204ZMJ12-7 | U-QFN1720-12 (Type CJ) | J2 |

## Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

**U-QFN1720-12 (Type CJ)**

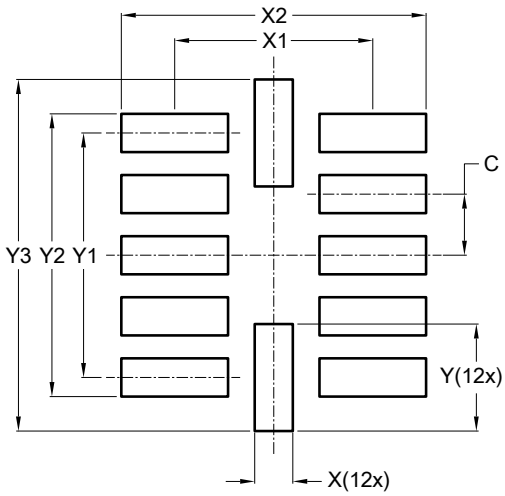



| X1-QFN1720-12 (Type CJ) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.450 | 0.550 | -- |
| **A1** | 0.00 | 0.050 | -- |
| **A3** | 0.152 REF | | |
| **b** | 0.150 | 0.250 | -- |
| **b1** | 0.150 REF | | |
| **D** | 1.600 | 1.800 | -- |
| **E** | 1.900 | 2.100 | -- |
| **e** | 0.400 BSC | | |
| **k** | 0.250 REF | | |
| **L** | 0.400 | 0.600 | -- |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

**U-QFN1720-12 (Type CJ)**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.400 |
| **X** | 0.250 |
| **X1** | 1.300 |
| **X2** | 2.000 |
| **Y** | 0.700 |
| **Y1** | 1.600 |
| **Y2** | 1.850 |
| **Y3** | 2.300 |

## Mechanical Data

**U-QFN1720-12 (Type CJ)**

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 21.5mg (Approximate)
- Max Soldering Temperature +260°C for 30 secs as per JEDEC J-STD-020

**IMPORTANT NOTICE**

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.

3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.

4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.

5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.

7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.

8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

9. This Notice may be periodically updated with the most recent version available at https://www.diodes.com/about/company/terms-and-conditions/important-notice



**www.diodes.com**