# USB8131, USB8141

*Product Preview*

# Common Mode Filter with ESD Protection

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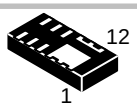



**UDFN12**
**CASE 517DE**

### Functional Description

The USB81x1 is a family of Common Mode Filters (CMF) with integrated ESD protection tailored for USB Application. Differential signaling for USB can now have both common mode filtering and ESD protection, with a dedicated TVS protection in one package.

USB81x1 is well−suited for protecting USB3.x systems

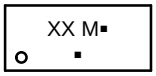
### Features

- Large Differential Mode Pass Band Frequency:
  $f_{3dB}$ > 5 GHz (USB8141), $f_{3dB}$ > 2.5 GHz (USB8131)
- High Common Mode Stop Band Attenuation:
  > 30 dB at 2.4 GHz to Protect High−band LTE, WCDMA, Wi−Fi, GPS Antenna (USB8141)
  > 30 dB at 750 MHz to Protect Low−band LTE and GSM Antenna (USB8131)
- Low Channel Resistance: 6.0 Ω
- Provides ESD Protection to:
  IEC61000−4−2 Level 4, ±15 kV Contact on D+, D− pins
  IEC61000−4−2 Level 4, ±30 kV Contact on Vbus pin
  IEC61000−4−2 Level 4, ±25 kV Contact on ID pin
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

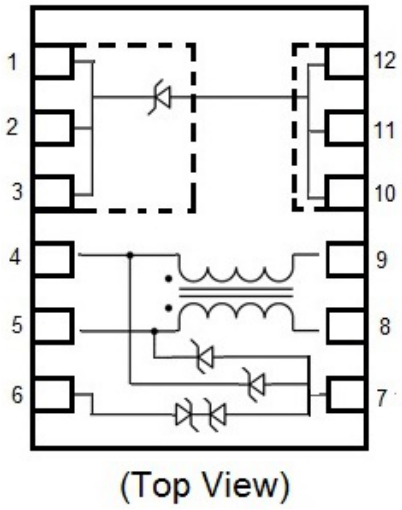
- USB 3.x

### MARKING DIAGRAM




XX = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

### ELECTRICAL SCHEMATIC




(Top View)

### ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| USB8131MUTAG | UDFN12 (Pb−Free) | 3000 / Tape & Reel |
| USB8141MUTAG | UDFN12 (Pb−Free) | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

## PIN FUNCTION DESCRIPTION

| Pin Name | Device Pin | | Type | Description |
|---|---|---|---|---|
| | USB8131 | USB8141 | | |
| Vbus | 1, 2, 3 | 1, 2, 3 | Bus | Uni−Directional Vbus Pin TVS Protection (External) |
| D+_In | 4 | 4 | I/O | CMF Channel 1+ to Connector (External) |
| D−_In | 5 | 5 | I/O | CMF Channel 1− to Connector (External) |
| Id | 6 | 6 | Id | Bi−Directional ID Pin Protection (External) |
| $V_N$ | 7, 10−12 | 7, 10−12 | GND | Ground |
| D−_Out | 8 | 8 | I/O | CMF Channel 1− to ASIC (Internal) |
| D+_Out | 9 | 9 | I/O | CMF Channel 1+ to ASIC (Internal) |

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Operating Temperature Range | $T_{OP}$ | −40 to +85 | °C |
| Storage Temperature Range | $T_{STG}$ | −65 to +150 | °C |
| Maximum Lead Temperature for Soldering Purposes (1/8” from Case for 10 seconds) | $T_L$ | 260 | °C |
| DC Current per Line | $I_{LINE}$ − I/O pins | 100 | mA |
| IEC61000−4−2 Contact (ESD − External) Pins: D+, D− (Note 1) | ESD − I/O pins | ±15 | kV |
| IEC61000−4−2 Contact (ESD − Internal) Pins: D+, D− (Note 1) | ESD − I/O pins | ±8 | kV |
| IEC61000−4−2 Contact (ESD) ID Pin (Note 1) | ESD − ID pin | ±25 | kV |
| IEC61000−4−2 Contact (ESD) BUS Pin (Note 1) | ESD − Bus pin | ±30 | kV |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Standard IEC61000−4−2 with $C_{Discharge}$ = 150 pF, $R_{Discharge}$ = 330, GND grounded.

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **I/O Pins** | | | | | | |
| $V_{RWM}$ | Reverse Working Voltage | (Note 2) | | 3.3 | | V |
| $V_{BR}$ | Breakdown Voltage | $I_T$ = 1 mA; (Note 3) | 4.0 | | 9.0 | V |
| $I_{LEAK}$ | Channel Leakage Current | $V_{IN}$ = 3.3 V, GND = 0 V | | | 1.0 | μA |
| $R_{CH}$ | Channel Resistance (Pins 4−9, 5−8) | | | 6.0 | | Ω |
| $DM_{LOSS}$ | Differential Mode Insertion Loss<br>USB8131<br>USB8141 | @ 1.0 GHz | | <br>1.5<br>1.2 | <br>3.0<br>3.0 | dB |
| $f_{3dB}$ | Differential Mode Cut-off Frequency<br>USB8131<br>USB8141 | 50 Ω Source and Load Termination | <br>1.0<br>1.0 | <br>2.4<br>5.0 | | GHz |
| $F_{atten}$ | Common Mode Stop Band Attenuation | | | 15 | | |
| | USB8131 | 750 − 900 MHz | 25 | | | dB |
| | | 1.3 − 2.4 GHz | | 10 | | dB |
| | | 2.4 − 2.7 GHz | 10 | | | dB |
| | USB8141 | 750 − 900 MHz | 15 | | | dB |
| | | 1.3 − 2.4 GHz | | 20 | | dB |
| | | 2.4 − 2.7 GHz | 25 | | | dB |
| TLP $V_{CL}$ | TLP Clamping Voltage | $I_{PP}$ = 8 A<br>$I_{PP}$ = 16 A<br>$I_{PP}$ = −8 A<br>$I_{PP}$ = −16 A | | 7.26<br>11.8<br>−3.5<br>−6.7 | | V |
| **VBUS Pin** | | | | | | |
| $V_{RWM}$ | Reverse Working Voltage | (Note 2) | | | 10 | V |
| $V_{BR}$ | Breakdown Voltage | $I_T$ = 1 mA; (Note 3) | 12 | | | V |
| $I_{LEAK}$ | Channel Leakage Current | $V_{IN}$ = 10 V, GND = 0 V | | | 1.0 | μA |
| $I_{pp}$ | Surge 8/20 μs | Surge 8/20 μs | 70 | | | A |
| $V_{CL}$ | Clamping Voltage Surge 8/20 μs | @ 1 A<br>@ 70 A | | | 15<br>25 | V |
| **ID Pin** | | | | | | |
| $V_{RWM}$ | Reverse Working Voltage | (Note 2) | | | ±5.0 | V |
| $V_{BR}$ | Breakdown Voltage | $I_T$ = 1 mA; (Note 3) | ±6.0 | | | V |
| $I_{LEAK}$ | Channel Leakage Current | $V_{IN}$ = ±5 V, GND = 0 V | | | 1.0 | μA |
| $C_J$ | Junction Capacitance | $V_R$ = 0 V, f = 1 MHz | | | 20 | pF |
| $I_{pp}$ | Surge 8/20 μs | Surge 8/20 μs | 6.0 | | | A |
| $V_{CL}$ | Clamping VoltageSurge 8/20 μs | @ 6 A | | | 12 | V |
| TLP $V_{CL}$ | TLP Clamping Voltage | @ 16 A | | | 12 | V |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. TVS devices are normally selected according to the working peak reverse voltage ($V_{RWM}$), which should be equal to or greater than the DC or continuous peak operating voltage level.
3. $V_{BR}$ is measured at pulse test current $I_T$.

## TYPICAL CHARACTERISTICS

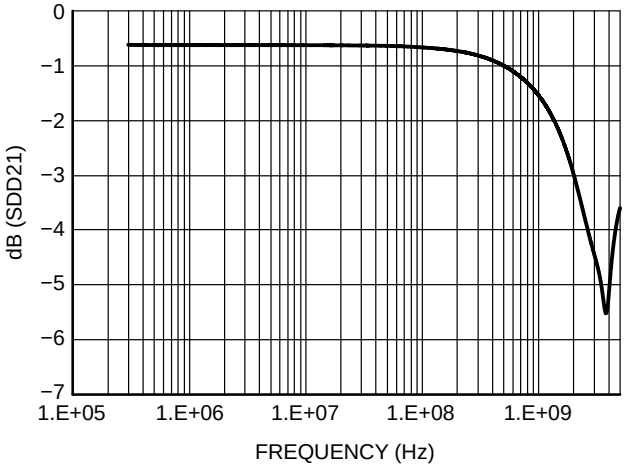



**Figure 1. Typical Differential Mode Attenuation vs. Frequency (USB8131)**

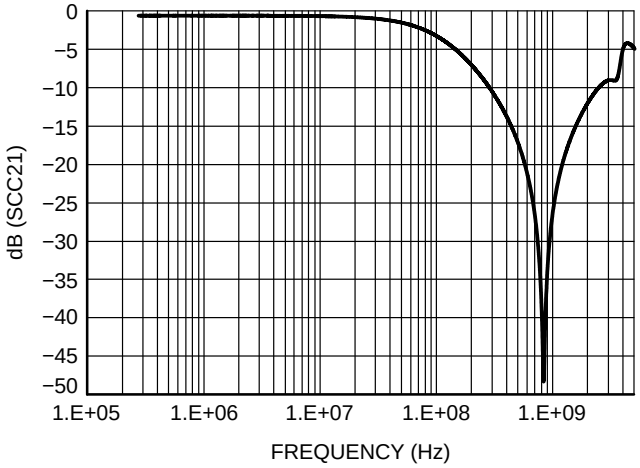



**Figure 2. Typical Common Mode Attenuation vs. Frequency (USB8131)**

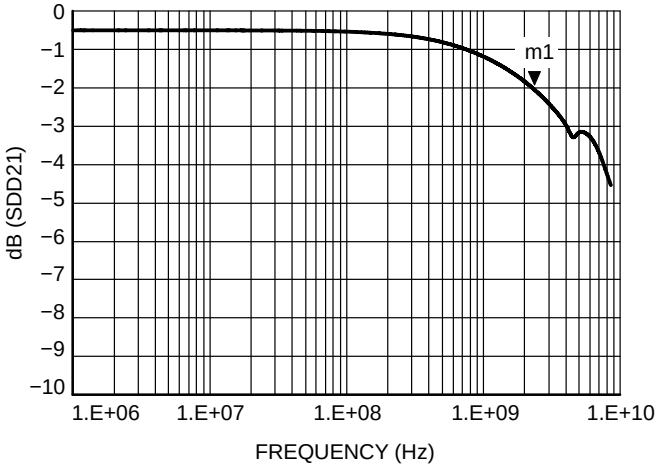



**Figure 3. Typical Differential Mode Attenuation vs. Frequency (USB8141)**

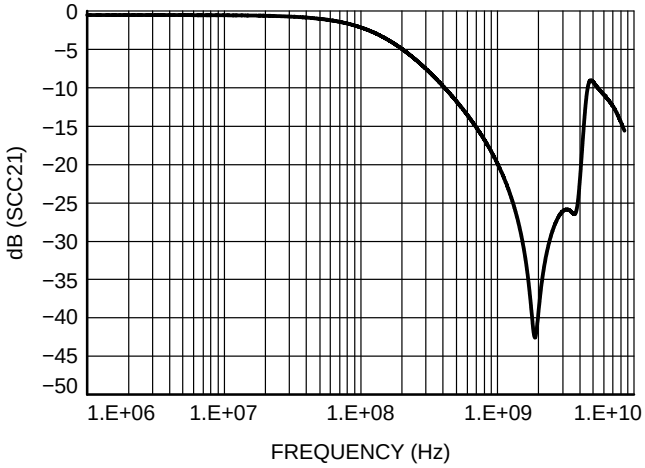



**Figure 4. Typical Common Mode Attenuation vs. Frequency (USB8141)**

## TRANSMISSION LINE PULSE (TLP) MEASUREMENTS

Transmission Line Pulse (TLP) provides current versus voltage (I−V) curves in which each data point is obtained from a 100 ns long rectangular pulse from a charged transmission line. A simplified schematic of a typical TLP system is shown in Figure 5. TLP I−V curves of ESD protection devices accurately demonstrate the product's ESD capability because the 10 s of amps current levels and under 100 ns time scale match those of an ESD event. This is illustrated in Figure 6 where an 8 kV IEC61000−4−2 current waveform is compared with TLP current pulses at 8 A and 16 A. A TLP curve shows the voltage at which the device turns on as well as how well the device clamps voltage over a range of current levels. Typical TLP I−V curves for the EMI814x are shown in Figure 5.

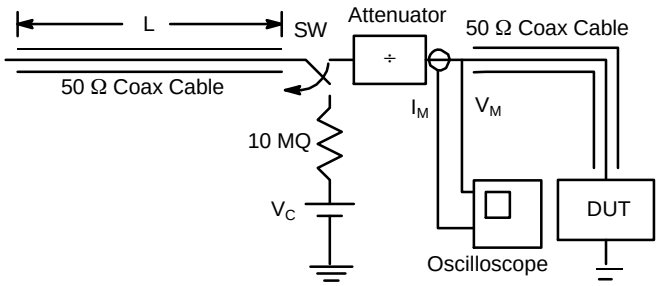



**Figure 5. Simplified Schematic of a Typical TLP System**

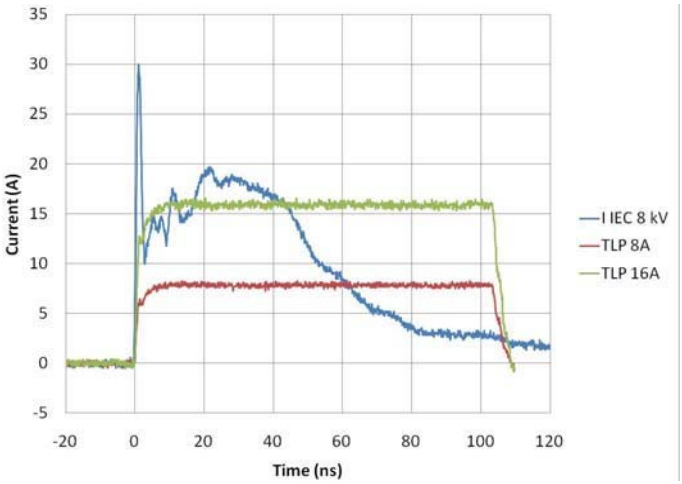



**Figure 6. Comparison Between 8 kV IEC61000-4-2 and 8 A and 16 A TLP Waveforms**

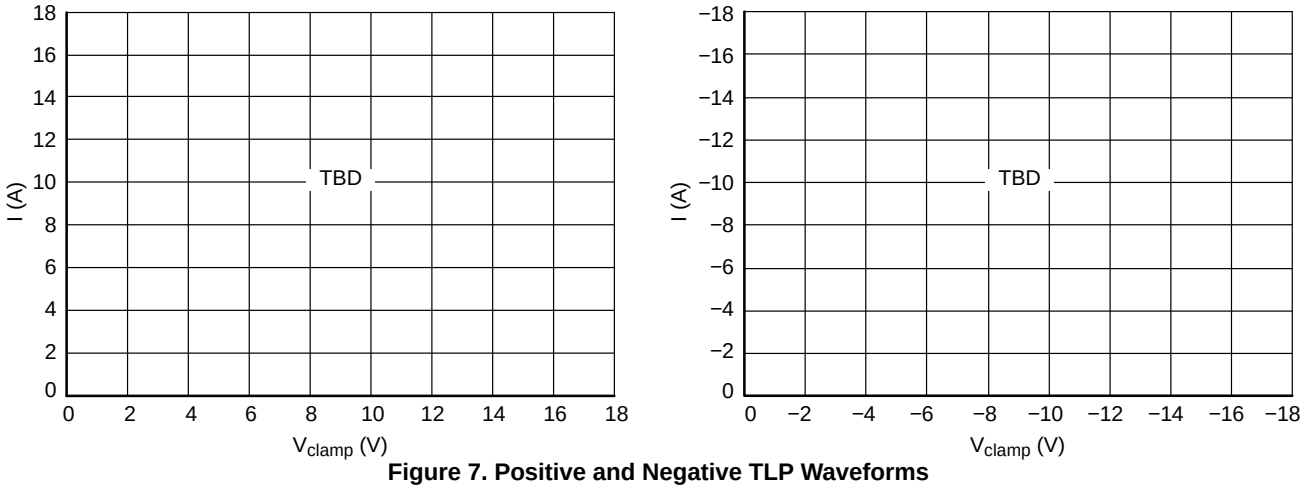
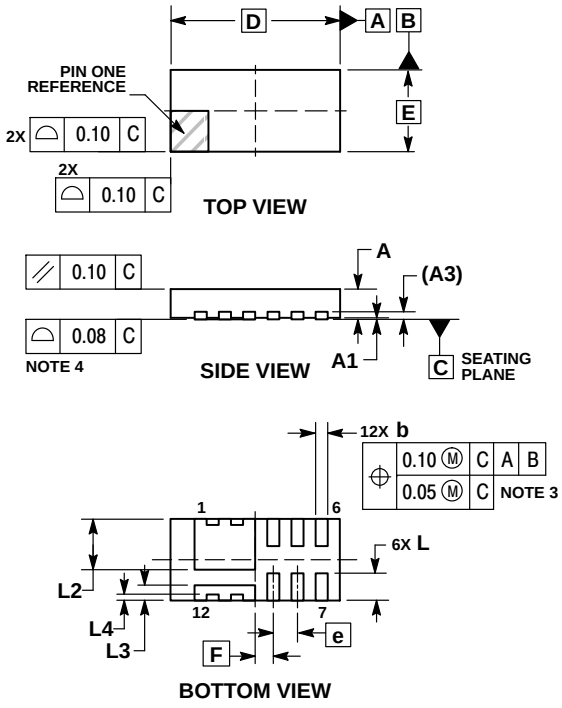



**Figure 7. Positive and Negative TLP Waveforms**

## PACKAGE DIMENSIONS

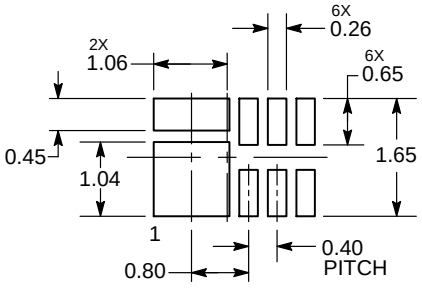
**UDFN12, 2.8x1.35, 0.4P**
CASE 517DE
ISSUE O




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A3 | 0.125 REF | |
| b | 0.15 | 0.25 |
| D | 2.80 BSC | |
| E | 1.35 BSC | |
| e | 0.40 BSC | |
| F | 0.30 BSC | |
| L | 0.35 | 0.55 |
| L2 | 0.74 | 0.94 |
| L3 | 0.15 | 0.35 |
| L4 | 0.10 REF | |

### RECOMMENDED SOLDERING FOOTPRINT*




DIMENSION: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



**PUBLICATION ORDERING INFORMATION**

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