

## WS7938D

<http://www.sh-willsemi.com>

### CMOS wide band LTE LNA

#### Descriptions

The WS7938D is a low noise amplifier (LNA) for LTE receiver applications, available in a small 6-pin DFN package. The WS7938D requires only one external inductor for input matching.

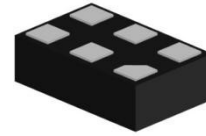
The WS7938D is designed to achieve low power dissipation and good performance. It is designed and optimized for the LTE medium and high band: 1805MHz to 2200MHz; 2300MHz to 2690MHz.

#### Features

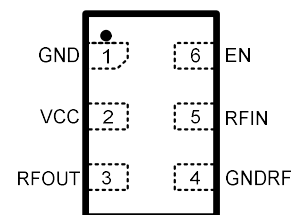
- Operating frequency: 1805MHz to 2200MHz; 2300 MHz to 2690 MHz
- Noise figure = 1.0 – 1.3 dB
- Gain = 11.0 – 13.5 dB
- Input 1 dB compression point = -5.0 dBm
- In-band input IP3 = +4.0 dBm
- Supply voltage: 1.8 V to 3.1 V
- Integrated supply decoupling capacitor
- Supply current: 5.8 mA
- Power-down mode leakage current < 1  $\mu$ A
- One external matching inductor required
- Output decoupled to ground
- ESD protection: HBM > 2.0 kV for all pins
- Integrated output matching
- Package: 6-pin DFN, 1.1 x 0.7 x 0.55 mm<sup>3</sup>
- Process: CMOS

#### Applications

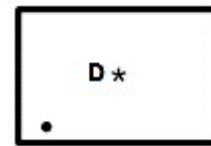
- Cell phones
- Tablets
- Other RF front-end modules



**DFN1107-6L (Bottom view)**



**Pin configuration (Top view)**



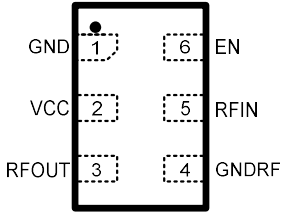
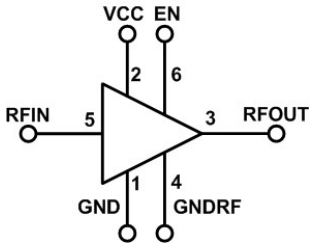
D = Device code  
\* = Month code (A~Z)

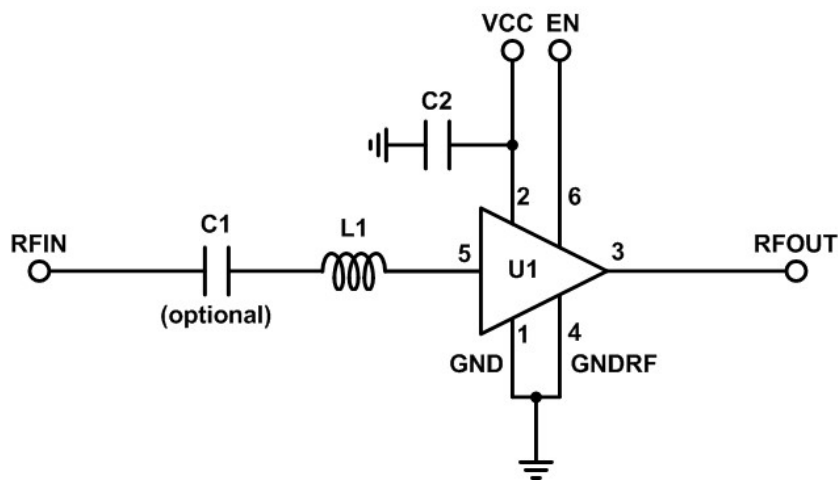
**Marking (Top view)**

#### Order information

| Device       | Package    | Shipping        |
|--------------|------------|-----------------|
| WS7938D-6/TR | DFN1107-6L | 10000/Reel&Tape |

**Pinning information**

| Pin | Description | Transparent top view  | Symbol view   |
|-----|-------------|---|---|
| 1   | GND         |  |  |
| 2   | VCC         |   |   |
| 3   | RFOUT       |   |   |
| 4   | GNDRF       |   |   |
| 5   | RFIN        |   |   |
| 6   | EN          |   |   |

**Application information**


| Symbol | Description | Footprint                    | Value  | Supplier     | Comment           |
|--------|-------------|------------------------------|--------|--------------|-------------------|
| U1     | WS7938D     | 1.1x0.7x0.55 mm <sup>3</sup> | NA     | Will-Semi    | DUT               |
| C1     | Capacitor   | 0402                         | 1 nF   | Various      | DC blocking       |
| C2     | Capacitor   | 0402                         | 1 nF   | Various      | Supply decoupling |
| L1     | Inductor    | 0402                         | 6.2 nH | Murata LQW15 | Input matching    |

### Quick reference data

freq = 2350 MHz;  $V_{CC} = 2.8\text{ V}$ ;  $V_{EN} > 2V_{CC}/3$ ; Temp = 25°C; input matched to 50Ω with a 6.2nH inductor. The condition is applied unless otherwise specified.

| Symbol     | Parameter                           | Condition | Min | Typ  | Max | Unit |
|------------|-------------------------------------|-----------|-----|------|-----|------|
| $V_{CC}$   | Supply voltage                      |           | 1.8 | 2.8  | 3.1 | V    |
| $I_{CC}$   | Supply current                      |           |     | 5.8  |     | mA   |
| $G_p$      | Power gain                          |           |     | 13.0 |     | dB   |
| NF         | Noise figure                        |           |     | 1.0  |     | dB   |
| $IP_{1dB}$ | Input power at 1dB gain compression |           |     | -5.0 |     | dBm  |
| $IIP_3$    | Input third-order intercept point   |           |     | +4.0 |     | dBm  |

### Recommended operating conditions

| Symbol   | Parameter                   | Condition | Min         | Typ      | Max        | Unit |
|----------|-----------------------------|-----------|-------------|----------|------------|------|
| $V_{CC}$ | Supply voltage              |           | 1.8         |          | 3.1        | V    |
| Temp     | Ambient temperature         |           | -40         | +25      | +85        | °C   |
| $V_{EN}$ | Input voltage on pin 6 (EN) | OFF state |             | 0        | $V_{CC}/3$ | V    |
|          |                             | ON state  | $2V_{CC}/3$ | $V_{CC}$ |            | V    |

### Absolute maximum ratings

Maximum ratings are absolute ratings, exceeding only one of these values may cause irreversible damage to the integrated circuit.

| Symbol      | Parameter                  | Condition              | Min  | Max   | Unit |
|-------------|----------------------------|------------------------|------|-------|------|
| $V_{CC}$    | Supply voltage             |                        | -0.3 | 3.1   | V    |
| $V_{EN}$    | Input voltage on pin EN    |                        | -0.3 | 3.1   | V    |
| $V_{RFIN}$  | Input voltage on pin RFIN  |                        | -0.3 | 3.1   | V    |
| $V_{RFOUT}$ | Input voltage on pin RFOUT |                        | -0.3 | 3.1   | V    |
| $P_{in}$    | RF input power             |                        |      | 0     | dBm  |
| $T_{STG}$   | Storage temperature        |                        | -65  | +150  | °C   |
| $T_J$       | Junction temperature       |                        |      | 150   | °C   |
| $V_{ESD}$   | ESD capability all pins    | Human Body Model (HBM) |      | ±2000 | V    |

**Characteristics**

Freq = 1805MHz to 2200MHz, 2300MHz to 2690MHz;  $V_{CC} = 2.8\text{ V}$ ;  $V_{EN} > 2V_{CC}/3$ ; Temp = 25°C; input mated to 50  $\Omega$  with a 6.2 nH inductor; The condition is applied unless otherwise specified.

| Symbol            | Parameter                               | Conditions                  | Min | Typ  | Max | Unit          |
|-------------------|---|-----------------------------|-----|------|-----|---------------|
| I <sub>cc</sub>   | Supply current                          | On state                    |     | 5.8  |     | mA            |
|                   |   | Off state                   |     |      | 1   | $\mu\text{A}$ |
| G <sub>p</sub>    | Power gain                              | f = 1850 MHz                |     | 13.0 |     | dB            |
|                   |   | f = 2150 MHz                |     | 13.5 |     | dB            |
|                   |   | f = 2350 MHz                |     | 13.0 |     | dB            |
|                   |   | f = 2650 MHz                |     | 11.0 |     | dB            |
| RL <sub>in</sub>  | Input return loss                       | f = 1850 MHz                |     | 5.0  |     | dB            |
|                   |   | f = 2150 MHz                |     | 7.0  |     | dB            |
|                   |   | f = 2350 MHz                |     | 8.0  |     | dB            |
|                   |   | f = 2650 MHz                |     | 7.0  |     | dB            |
| RL <sub>out</sub> | Output return loss                      | f = 1850 MHz                |     | 6.5  |     | dB            |
|                   |   | f = 2150 MHz                |     | 10.0 |     | dB            |
|                   |   | f = 2350 MHz                |     | 15.0 |     | dB            |
|                   |   | f = 2650 MHz                |     | 10.0 |     | dB            |
| ISL               | Reverse isolation                       | f = 1850 MHz                |     | 35.0 |     | dB            |
|                   |   | f = 2150 MHz                |     | 34.0 |     | dB            |
|                   |   | f = 2350 MHz                |     | 34.0 |     | dB            |
|                   |   | f = 2650 MHz                |     | 33.5 |     | dB            |
| NF                | Noise figure                            | f = 1850 MHz                |     | 1.1  |     | dB            |
|                   |   | f = 2150 MHz                |     | 1.0  |     | dB            |
|                   |   | f = 2350 MHz                |     | 1.0  |     | dB            |
|                   |   | f = 2650 MHz                |     | 1.3  |     | dB            |
| IP <sub>1dB</sub> | Input power at 1 dB gain compression    | f = 1850 MHz                |     | -5.0 |     | dBm           |
|                   |   | f = 2150 MHz                |     | -5.0 |     | dBm           |
|                   |   | f = 2350 MHz                |     | -5.0 |     | dBm           |
|                   |   | f = 2650 MHz                |     | -5.0 |     | dBm           |
| IIP <sub>3</sub>  | Input third-order intercept point       | f = 1850 MHz <sup>[1]</sup> |     | +4.0 |     | dBm           |
|                   |   | f = 2150 MHz <sup>[2]</sup> |     | +4.0 |     | dBm           |
|                   |   | f = 2350 MHz <sup>[3]</sup> |     | +4.0 |     | dBm           |
|                   |   | f = 2650 MHz <sup>[4]</sup> |     | +4.0 |     | dBm           |
| K                 | Rollett stability factor <sup>[5]</sup> |                             | 1   |      |     |               |
| t <sub>on</sub>   | Turn-on time                            |                             |     |      | 5   | $\mu\text{s}$ |
| t <sub>off</sub>  | Turn-off time                           |                             |     |      | 5   | $\mu\text{s}$ |

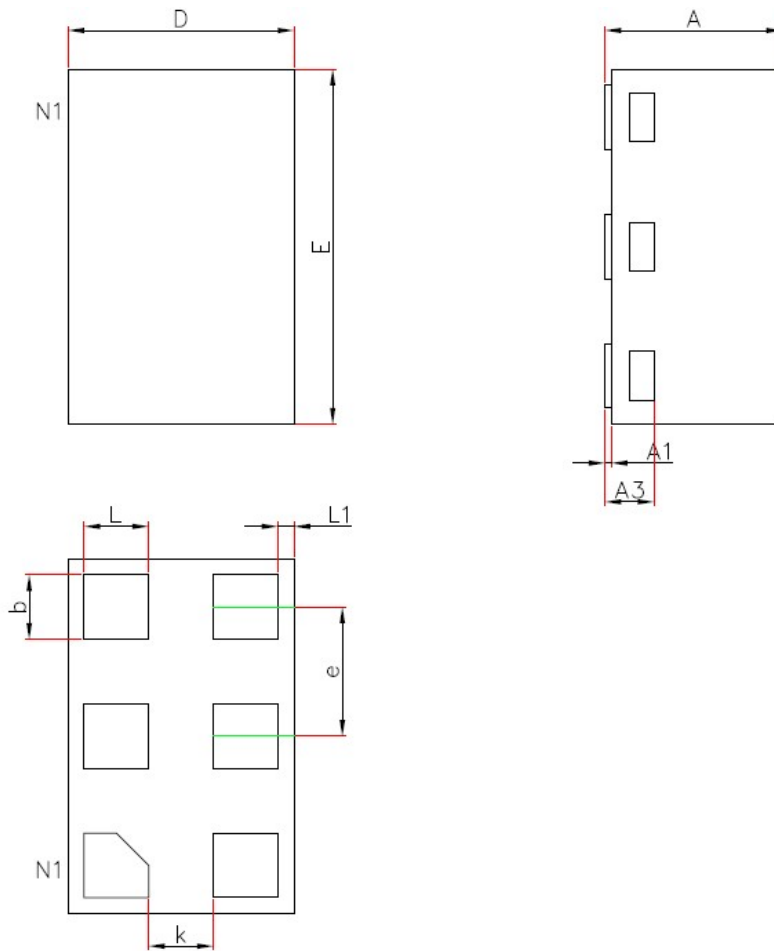
[1] f<sub>1</sub> = 1840 MHz, f<sub>2</sub> = 1850 MHz, P<sub>in</sub> = -25 dBm

[2] f<sub>1</sub> = 2140 MHz, f<sub>2</sub> = 2150 MHz, P<sub>in</sub> = -25 dBm

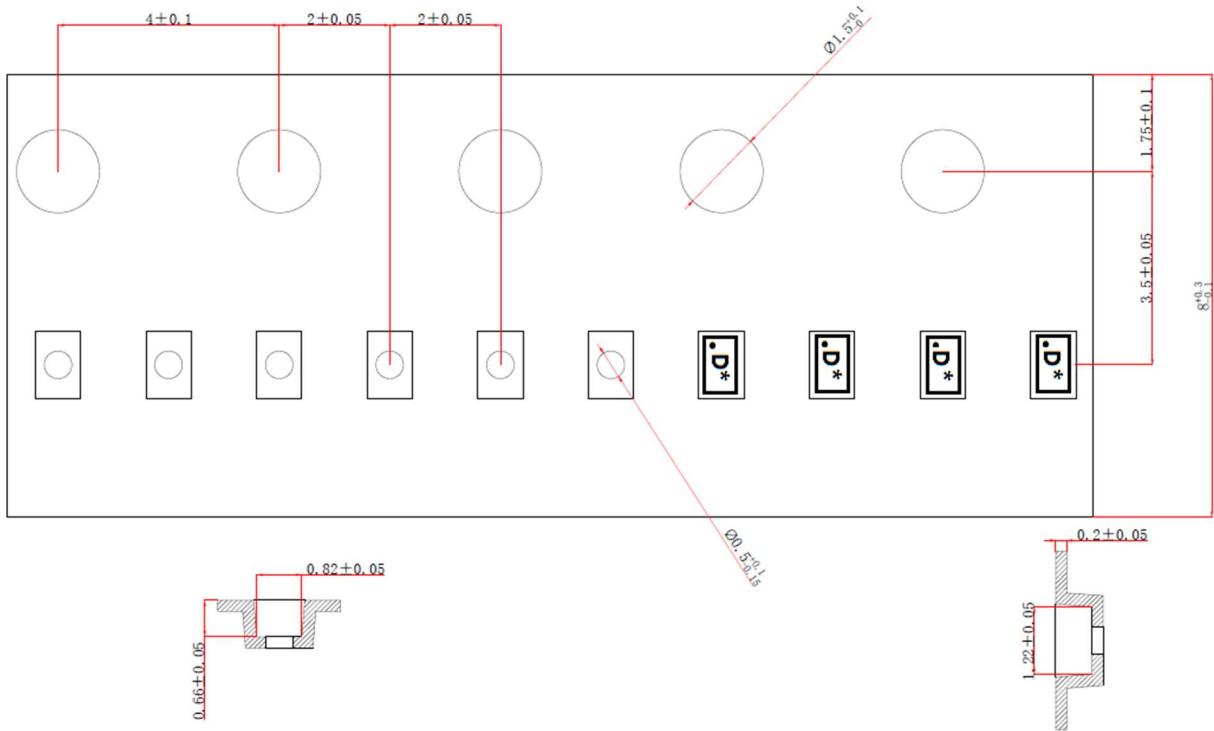
[3] f<sub>1</sub> = 2340 MHz, f<sub>2</sub> = 2350 MHz, P<sub>in</sub> = -25 dBm

[4] f<sub>1</sub> = 2640 MHz, f<sub>2</sub> = 2650 MHz, P<sub>in</sub> = -25 dBm

[5] 10M~20GHz

**Package outline dimensions**
**DFN1107-6L**


| Symbol | Dimensions In Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | Min.                      | Typ.  | Max.  |
| A      | 0.500                     | 0.550 | 0.600 |
| A1     | 0.000                     | 0.025 | 0.050 |
| A3     | 0.152REF                  |       |       |
| b      | 0.150                     | 0.200 | 0.250 |
| D      | 0.600                     | 0.700 | 0.800 |
| E      | 1.000                     | 1.100 | 1.200 |
| e      | 0.400BSC                  |       |       |
| k      | 0.200REF                  |       |       |
| L      | 0.124                     | 0.200 | 0.276 |
| L1     | 0.050REF                  |       |       |

**Tape & Reel dimensions**

**610 · 948 · 8499**  
**CGP8 · 845 · 019**
