Single Output LNB Supply and Control Voltage Regulator

General Description
The RT5047 is a highly integrated voltage regulator and interface IC, specifically designed for supplying power and control signals from advanced satellite set-top box (STB) modules to the LNB down-converter in the antenna dish or to the multi-switch box.

The device consists of the independent current-mode boost controller and low dropout linear regulator along with the circuitry required for 22kHz tone shaping to support DiSEqC™1.x communications.

The RT5047 has fault protection (over-current, over-temperature and under-voltage lockout).

The RT5047 are available in a SOP-8 (Exposed Pad) package to achieve optimized solution for thermal dissipation.

Ordering Information
RT5047

- Package Type
  SP : SOP-8 (Exposed Pad-Option 2)

- Lead Plating System
  G : Green (Halogen Free and Pb Free)

Note:
Richtek products are:
- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Features
- Wide Input Supply Voltage Range : 8V to 16V
- Output Current Limit of 550mA with 45ms timer
- Low Noise LNB Output Voltage (13.3V and 18.3V by SEL Pin, 14.3V and 19.3V by COMP Pin)
- ±3% High Accuracy for 0mA to 500mA Current Output
- Push-Pull Output Stage minimizes 13.3V to 18.3V and 18.3V to 13.3V Output Transition Time
- External 22kHz Tone Input
- Meet DiSEqC™1.x Protocol
- Output Short Circuit Protection
- Over-Temperature Protection

Applications
- LNB Power Supply and Control for Satellite Set-Top Box
- Analog and Digital Satellite Receivers/Satellite TV, Satellite PC cards

Pin Configuration
(TOP VIEW)

Simplified Application Circuit
Marking Information

RT5047GSPYMDNN

RT5047 : Product Number
YMDNN : Date Code

Functional Pin Description

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Pin Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LNB</td>
<td>Output voltage for LNB.</td>
</tr>
<tr>
<td>2</td>
<td>BOOST</td>
<td>Boost output and tracking supply voltage to LNB.</td>
</tr>
<tr>
<td>3</td>
<td>LX</td>
<td>Switching node of DC-DC boost converter.</td>
</tr>
<tr>
<td>4</td>
<td>VIN</td>
<td>Power supply input.</td>
</tr>
<tr>
<td>5</td>
<td>EN</td>
<td>LNB output enable.</td>
</tr>
<tr>
<td>6</td>
<td>SEL</td>
<td>LNB output voltage selection pin (Low is for 13.3V, high is for 18.3V).</td>
</tr>
<tr>
<td>7</td>
<td>COMP</td>
<td>LNB output voltage compensate pin.</td>
</tr>
<tr>
<td>8</td>
<td>TONE</td>
<td>22kHz TONE input.</td>
</tr>
<tr>
<td>9 (Exposed Pad)</td>
<td>GND</td>
<td>Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation.</td>
</tr>
</tbody>
</table>

Functional Block Diagram
Operation
The RT5047 integrates a current mode boost converter and linear regulator. Use the SEL pin to control the LNB voltage and the boost converter track is at least greater 850mV than LNB voltage. The boost converter is the high efficiency PWM architecture with 700kHz operation frequency. The linear regulator has the capability to source current up to 550mA during continuous operation. All the loop compensation, current sensing, and slope compensation functions are provided internally.

OCP
Both the boost converter and the linear regulator have independent current limit. In the boost converter (OCP1), this is achieved through cycle-by-cycle internal current limit (typ. 3A). In the linear regulator (OCP2), when the linear regulator exceeds OCP more than 48ms, the LNB output will be disabled and re-start after 1.8s.

Tone Circuit
This circuit is used for tone generation. Use the TONE pin to control output amplitude of LNB.

OTP
When the junction temperature reaches the critical temperature (typically 150°C), the boost converter and the linear regulator are immediately disabled.

UVLO
The UVLO circuit compares the VIN with the UVLO threshold (7.7V rising typically) to ensure that the input voltage is high enough for reliable operation. The 350mV (typ.) hysteresis prevents supply transients from causing a shutdown.

PWM Controller
The loop compensation, current sensing, and slope compensation functions are provided internally.
### Absolute Maximum Ratings

- Supply Input Voltage, $V_{IN}$: -0.3V to 28V
- Output Voltage LNB, LX and BOOST Pins: -0.3V to 30V
- Others Pin to GND: -0.3V to 6V
- Power Dissipation, $P_D @ T_A = 25^\circ$C: 3.44W
- SOP-8 (Exposed pad): 8 (Exposed pad)
- Package Thermal Resistance, $\theta_{JA}$: 29°C/W
- Package Thermal Resistance, $\theta_{JC}$: 2°C/W
- Lead Temperature (Soldering, 10 sec.): -65°C to 150°C
- Junction Temperature: -65°C to 150°C
- Storage Temperature Range: -65°C to 150°C
- ESD Susceptibility, (Note 3) HBM (Human Body Model): -2kV

### Recommended Operating Conditions

- Supply Input Voltage: 8V to 16V
- Ambient Temperature Range: -40°C to 85°C
- Junction Temperature Range: -40°C to 125°C

### Electrical Characteristics

$(V_{IN\ (typ.)} = 12V, V_{IN} = 8V$ to 16V, $T_A = 25^\circ$C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
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<tbody>
<tr>
<td>General</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNB Output Accuracy, Load and Line Regulation</td>
<td>$E_{RR}$</td>
<td>Relative to selected $V_{LNB}$ target level, $I_{LNB} = 0$ to 450mA</td>
<td>-3</td>
<td>--</td>
<td>3</td>
<td>%</td>
</tr>
<tr>
<td>Supply Current</td>
<td>$I_{IN_OFF}$</td>
<td>$EN = 0$, LNB output disabled</td>
<td>--</td>
<td>0.3</td>
<td>0.5</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>$I_{IN_ON}$</td>
<td>$EN = 1$, $V_{LNB} = 18.3V$, Tone = 0V</td>
<td>--</td>
<td>10</td>
<td>18</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>$I_{IN_ON}$</td>
<td>$EN = 1$, $V_{LNB} = 18.3V$, 22kHz TONE Input</td>
<td>--</td>
<td>16</td>
<td>28</td>
<td>mA</td>
</tr>
<tr>
<td>Boost Switch On Resistance</td>
<td>$R_{DS(ON)}$</td>
<td>$I_{LNB} = 450mA$</td>
<td>--</td>
<td>150</td>
<td>300</td>
<td>mΩ</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>$f_{SW}$</td>
<td>$V_{IN} = 10V$, $V_{LNB} = 20.5V$</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>kHz</td>
</tr>
<tr>
<td>Switch Current Limit</td>
<td>$I_{LIN_MSW}$</td>
<td>$V_{IN} = 10V$, $V_{LNB} = 20.5V$</td>
<td>--</td>
<td>3</td>
<td>--</td>
<td>A</td>
</tr>
<tr>
<td>Linear Regulator Voltage Drop</td>
<td>$V_{DROP}$</td>
<td>$V_{BOOST-V_{LNB}}$, $I_{LNB} = 450mA$</td>
<td>--</td>
<td>0.85</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage Rise Time</td>
<td>$T_{R_LNB}$</td>
<td>For $V_{LNB} = 13.3V$→18.3V, $C_{LNB} = 100nF$, $I_{LNB} = 450mA$</td>
<td>--</td>
<td>3</td>
<td>10</td>
<td>ms</td>
</tr>
<tr>
<td>Output Voltage Pull-Down Time</td>
<td>$T_{F_LNB}$</td>
<td>For $V_{LNB} = 18.3V$→13.3V, $C_{LNB} = 100nF$, $I_{LNB} = 0mA$</td>
<td>--</td>
<td>3</td>
<td>10</td>
<td>ms</td>
</tr>
<tr>
<td>Parameter</td>
<td>Symbol</td>
<td>Test Conditions</td>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
<td>Unit</td>
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<td>---------------------------------</td>
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<td>----------------------------------------------------------------------------------</td>
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<td>-----</td>
<td>-------</td>
</tr>
<tr>
<td>Ripple and Noise on LNB Output</td>
<td>( V_{\text{RIP_PP}} )</td>
<td>20MHz bandwidth limit (GBD)</td>
<td>--</td>
<td>20</td>
<td>--</td>
<td>mVPP</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>( V_{\text{OUT_LOAD}} )</td>
<td>( V_{\text{LNB}} = 13.3\text{V}, I_{\text{LNB}} = 50\text{mA to 450mA} )</td>
<td>--</td>
<td>38</td>
<td>76</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{\text{LNB}} = 18.3\text{V}, I_{\text{LNB}} = 50\text{mA to 450mA} )</td>
<td>--</td>
<td>45</td>
<td>90</td>
<td>mV</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>( V_{\text{OUT_LINE}} )</td>
<td>( V_{\text{IN}} = \text{9 to 14V}, V_{\text{LNB}} = 13.3\text{V}, )</td>
<td>--10</td>
<td>--</td>
<td>10</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{LNB}} = 50\text{mA} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{\text{IN}} = \text{9 to 14V}, V_{\text{LNB}} = 18.3\text{V}, )</td>
<td>--10</td>
<td>--</td>
<td>10</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{LNB}} = 50\text{mA} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection</td>
<td>( I_{\text{LIM_LNB1}} )</td>
<td>( V_{\text{LNB}} = 13.3\text{V/18.3V} )</td>
<td>500</td>
<td>550</td>
<td>650</td>
<td>mA</td>
</tr>
<tr>
<td>Output Over-Current Limit</td>
<td>( T_{\text{DIS_ON}} )</td>
<td>( V_{\text{LNB}} ) short to GND</td>
<td>--</td>
<td>45</td>
<td>--</td>
<td>ms</td>
</tr>
<tr>
<td>Output Over-Current Disable Time</td>
<td>( T_{\text{DIS_OFF}} )</td>
<td>( V_{\text{LNB}} ) short to GND (GBD)</td>
<td>--</td>
<td>1800</td>
<td>--</td>
<td>ms</td>
</tr>
<tr>
<td>VIN Under-Voltage Lockout Threshold</td>
<td>( V_{\text{UVLO}} )</td>
<td>( V_{\text{IN}} ) falling</td>
<td>--</td>
<td>7.35</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>VIN Turn On Threshold</td>
<td>( V_{\text{IN_TH}} )</td>
<td>( V_{\text{IN}} ) rising</td>
<td>--</td>
<td>7.7</td>
<td>8</td>
<td>V</td>
</tr>
<tr>
<td>VIN Under-Voltage Lockout Hysteresis</td>
<td>( V_{\text{UVLOHYS}} )</td>
<td></td>
<td>--</td>
<td>350</td>
<td>--</td>
<td>mV</td>
</tr>
<tr>
<td>OTP Threshold</td>
<td>( T_{\text{TOP}} )</td>
<td></td>
<td>--</td>
<td>140</td>
<td>--</td>
<td>°C</td>
</tr>
<tr>
<td>OTP Hysteresis</td>
<td>( T_{\text{OTPHYS}} )</td>
<td></td>
<td>--</td>
<td>15</td>
<td>--</td>
<td>°C</td>
</tr>
<tr>
<td>TONE</td>
<td>( F_{\text{TONE}} )</td>
<td></td>
<td>20</td>
<td>22</td>
<td>24</td>
<td>kHz</td>
</tr>
<tr>
<td>TONE Amplitude, Peak to Peak</td>
<td>( V_{\text{TONE_PP}} )</td>
<td>( I_{\text{LNB}} = \text{50 to 450mA, } C_{\text{LNB}} = 200nF )</td>
<td>550</td>
<td>700</td>
<td>900</td>
<td>mVPP</td>
</tr>
<tr>
<td>TONE Duty Cycle</td>
<td>( D_{\text{TONE}} )</td>
<td>( I_{\text{LNB}} = \text{0 to 450mA, } C_{\text{LNB}} = 570nF )</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>%</td>
</tr>
<tr>
<td>TONE Rise Time</td>
<td>( T_{\text{RTONE}} )</td>
<td>( I_{\text{LNB}} = \text{0 to 450mA, } C_{\text{LNB}} = 570nF )</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>μs</td>
</tr>
<tr>
<td>TONE Fall Time</td>
<td>( T_{\text{FTONE}} )</td>
<td>( I_{\text{LNB}} = \text{0 to 450mA, } C_{\text{LNB}} = 570nF )</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>μs</td>
</tr>
<tr>
<td>TONE Logic Input</td>
<td>( V_{\text{TONE}_H} )</td>
<td></td>
<td>1.2</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>TONE Input Leakage</td>
<td>( I_{\text{TONELKG}} )</td>
<td></td>
<td>--</td>
<td>5</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>EN Logic Input</td>
<td>( V_{\text{EN}_H} )</td>
<td>1.2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>EN Input Leakage</td>
<td>( I_{\text{ENLKG}} )</td>
<td>--</td>
<td>--</td>
<td>0.4</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>SEL Logic Input</td>
<td>( V_{\text{SEL}_H} )</td>
<td>1.2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>SEL Input Leakage</td>
<td>( I_{\text{SELLKG}} )</td>
<td>--</td>
<td>--</td>
<td>0.4</td>
<td>--</td>
<td>V</td>
</tr>
</tbody>
</table>
Note 1. Stresses beyond those listed “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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Note 2. \( \theta_{JA} \) is measured at \( T_A = 25^\circ C \) on a high effective thermal conductivity four-layer test board per JEDEC 51-7. \( \theta_{JC} \) is measured at the exposed pad of the package.

Note 3. Devices are ESD sensitive. Handling precaution is recommended.

Note 4. The device is not guaranteed to function outside its operating conditions.

Note 5. Operation at \( V_{IN} = 16V \) may be limited by power loss in the linear regulator.
Note:

1. D2, D3, D4, D5 are used for surge protection.
2. The capacitor C3 should not be less than 1μF for the power stability.
3. EN, TONE and SEL are connected to microcontroller directly.
Typical Operating Characteristics

Boost Efficiency vs. Output Current

System Efficiency vs. Output Current

Tone Amplitude vs. Temperature

Tone Amplitude vs. Output Current

Output Voltage vs. Temperature

Output Voltage vs. Output Current

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Over Current Protect vs. Temperature

Under Voltage Lockout vs. Temperature

Tone Output

Output Voltage Transition Rising

Output Voltage Transition Falling

Power On Sequence

VIN = 12V, VLN_B = 13.3V

VIN = 12V

VIN
(10V/Div)

VBOOST
(10V/Div)

VLNB
(10V/Div)

Time (5ms/Div)

V_IN = 12V, V_SEL from 3.3V to 0V, 
CLNB = 1μF, V_LNB from 18V to 13V

V_IN = 12V

V_SEL
(2V/Div)

V_LNB
(5V/Div)

Time (500μs/Div)

V_LNB
(5V/Div)

V_SEL
(2V/Div)

Time (500μs/Div)

VIN = 12V

VIN
(10V/Div)

VBOOST
(10V/Div)

VLNB
(10V/Div)

Time (5ms/Div)

VIN = 12V

VIN
(10V/Div)

VBOOST
(10V/Div)

VLNB
(10V/Div)

Time (5ms/Div)

VIN = 12V

VIN
(10V/Div)

VBOOST
(10V/Div)

VLNB
(10V/Div)

Time (5ms/Div)
**Over Current Protection**

- $V_{\text{BOOST}}$ (5V/Div)
- $V_{\text{LNB}}$ (5V/Div)
- $I_{\text{LNB}}$ (500mA/Div)

$V_{\text{IN}} = 12V$

Time (500ms/Div)
Application Information

Boost Converter/Linear Regulator

The 5047 integrates a current-mode boost converter and linear regulator. Use the SEL pin to control the LNB voltage and the boost converter track is at least greater 800mV than the LNB voltage. The boost converter is high efficiency PWM architecture with 700kHz operation frequency. The linear regulator has the capability to source current up to 550mA during continuous operation. All the loop compensation, current sensing, and slope compensation functions are provided internally.

The RT5047 has current limiting on the boost converter and the LNB output to protect the IC against short circuits. The internal MOSFET will turn off when the LX current is higher than 3A cycle-by-cycle. The LNB output will turn off when the output current higher than the 550mA and 45ms and turn-on after 1800ms automatically.

Input Capacitor Selection

The input capacitor reduces voltage spikes from the input supply and minimizes noise injection to the converter. A 30µF capacitance is sufficient for most applications. Nevertheless, a higher or lower value may be used depending on the noise level from the input supply and the input current to the converter. Note that the voltage rating of the input capacitor must be greater than the maximum input voltage.

Inductor Selection

The inductance depends on the maximum input current. As a general rule, the inductor ripple current range is 20% to 40% of the maximum input current. If 40% is selected as an example, the inductor ripple current can be calculated according to the following equations:

\[
I_{\text{IN(MAX)}} = \frac{V_{\text{OUT}} \times I_{\text{OUT(MAX)}}}{\eta \times V_{\text{IN}}}
\]

\[
I_{\text{RIPPLE}} = 0.4 \times I_{\text{IN(MAX)}}
\]

where \(\eta\) is the efficiency of the converter, \(I_{\text{IN(MAX)}}\) is the maximum input current, and \(I_{\text{RIPPLE}}\) is the inductor ripple current. The input peak current can then be obtained by adding the maximum input current with half of the inductor ripple current as shown in the following equation:

\[
I_{\text{PEAK}} = 1.2 \times I_{\text{IN(MAX)}}
\]

note that the saturated current of the inductor must be greater than \(I_{\text{PEAK}}\). The inductance can eventually be determined according to the following equation:

\[
L = \frac{\eta \times (V_{\text{IN}})^2 \times (V_{\text{OUT}} - V_{\text{IN}})}{0.4 \times (V_{\text{OUT}})^2 \times I_{\text{OUT}(\text{MAX})} \times f_{\text{OSC}}}
\]

where \(f_{\text{OSC}}\) is the switching frequency. For better system performance, a shielded inductor is preferred to avoid EMI problems.

Boost Output Capacitor Selection

The RT5047 boost regulator is internally compensated and relies on the inductor and output capacitor value for overall loop stability. The output capacitor is in the 30µF to 50µF range with a low ESR, as strongly recommended. The voltage rating on this capacitor should be in the 25V to 35V range since it is connected to the boost \(V_{\text{OUT}}\) rail.

The output ripple voltage is an important index for estimating chip performance. This portion consists of two parts. One is the product of the inductor current with the ESR of the output capacitor, while the other part is formed by the charging and discharging process of the output capacitor. As shown in Figure 1, \(\Delta V_{\text{OUT1}}\) can be evaluated based on the ideal energy equalization. According to the definition of \(Q\), the \(Q\) value can be calculated as the following equation:

\[
Q = \frac{1}{2} \times \left[ \left( \frac{I_{\text{IN}}}{V_{\text{OUT}}} + \frac{1}{2} \frac{\Delta I_{\text{L}}}{I_{\text{OUT}}} \right) + \left( I_{\text{IN}} - \frac{1}{2} \frac{\Delta I_{\text{L}}}{I_{\text{OUT}}} \right) \right] \times \frac{V_{\text{IN}}}{V_{\text{OUT}}} \times \frac{1}{f_{\text{OSC}}} = C_{\text{OUT}} \times \Delta V_{\text{OUT1}}
\]

where \(f_{\text{OSC}}\) is the switching frequency and \(\Delta I_{\text{L}}\) is the inductor ripple current. Bring \(C_{\text{OUT}}\) to the left side to estimate the value of \(\Delta V_{\text{OUT1}}\) according to the following equation:

\[
\Delta V_{\text{OUT1}} = \frac{D \times I_{\text{OUT}}}{\eta \times C_{\text{OUT}} \times f_{\text{OSC}}}
\]
where D is the duty cycle and η is the boost converter efficiency. Finally, take ESR into consideration, the overall output ripple voltage can be determined by the following equation:

$$\Delta V_{OUT} = I_{IN} \times ESR + \frac{D \times I_{OUT}}{\eta \times C_{OUT} \times f_{OSC}}$$

The output capacitor, $C_{OUT}$, should be selected accordingly.

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**Schottky Diode Selection**

Schottky diodes are chosen for their low forward-voltage drop and fast switching speed. However, when making a selection, important parameters such as power dissipation, reverse voltage rating, and pulsating peak current should all be taken into consideration. A suitable Schottky diode’s reverse voltage rating must be greater than the maximum output voltage and its average current rating must exceed the average output current. The chosen diode should also have a sufficiently low leakage current level, since it increases with temperature.

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**Under-Voltage Lockout (UVLO)**

The UVLO circuit compares the input voltage at VIN with the UVLO threshold (7.7V rising typically) to ensure that the input voltage is high enough for reliable operation. The 350mV (typ.) hysteresis prevents supply transients from causing a shutdown. Once the input voltage exceeds the UVLO rising threshold, start-up begins. When the input voltage falls below the UVLO falling threshold, all IC internal functions will be turned off by the controller.

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**Over-Current Protection**

The RT5047 features an over-current protection function to prevent chip damage from high peak currents. Both the boost converter and the linear regulator have independent current limit. In the boost converter, this is achieved through cycle-by-cycle internal current limit. During the ON-period, the chip senses the inductor current that is flowing into the LX pin. The internal NMOS will be turned off if the peak inductor current reaches the current-limit value of 3A (typ.). When the linear regulator exceeds 550mA (typ.) more than 45ms, the LNB output will be disabled. During this period of time, if the current limit condition disappears, the OCP will be cleared and the part restarts. If the part is still in current limit after this time period, the linear regulator and boost converter will automatically disable to prevent the part from overheating.

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**Short Circuit Protection**

If the LNB output is shorted to ground, and more than 45ms, the RT5047 will be disabled 1.8s then enable automatically.

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**Over-Temperature Protection**

When the junction temperature reaches the critical temperature (typically 140°C), the boost converter and the linear regulator are immediately disabled. When the junction temperature cools down to a lower temperature threshold specified, the RT5047 will be allowed to restart by normal start operation.

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**LNB Output Voltage**

The RT5047 has voltage control function on the LNB output. This function provides 4 levels for the common standards and compensation if the cable line has voltage drop. These voltage levels are defined in table 1. The rise time and fall time of the VLN is 3mS (typ.).
### Table 1

<table>
<thead>
<tr>
<th>SEL Pin Status</th>
<th>COMP Pin Status</th>
<th>LNB Output Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>13.3V</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>14.3V</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>18.3V</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>19.3V</td>
</tr>
</tbody>
</table>

### Tone Generation

The RT5047 provides the tone generation function, please refer to the Figure 2. Set the TONE pin with 22kHz logic signal, the LNB linear regulator output will carry a 22kHz, 700mV peak to peak signal for DiSEqC 1.x communication. It can meet base-band timings of 500µs (±100µs) for a one-third bit PWK coded signal period on a nominal 22kHz (±20%).

![Figure 2. Tone Generation Options](image)

### Pull-Down Rate Control

The output linear stage provides approximately 40mA of pull-down capability. This ensures that the output volts are ramped from 18.3V to 13.3V in a reasonable amount of time.

### Over-Current Disable Time

If the LNB output current exceeds 550mA, typical, for more than 45ms, then the LNB output will be disabled and device enters a TON = 45ms/TOFF = 1800ms routine. It will be returned to normal operation after a successful soft-start process.
Inrush Current

At start-up or during a LNB reconfiguration event, a transient surge current above the normal DC operating level can be provided by the IC. This current increase can be as high as 550mA, typical, for as long as required, up to a maximum of 45ms.

DC Current

The RT5047 can handle up to 500mA during continuous operation.

Thermal Considerations

For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following formula:

\[ P_{D(MAX)} = \frac{(T_{J(MAX)} - T_A)}{\theta_{JA}} \]

where \( T_{J(MAX)} \) is the maximum junction temperature, \( T_A \) is the ambient temperature, and \( \theta_{JA} \) is the junction to ambient thermal resistance. For recommended operating condition specifications, the maximum junction temperature is 125°C. The junction to ambient thermal resistance, \( \theta_{JA} \), is layout dependent. For SOP-8 (Exposed Pad) package, the thermal resistance, \( \theta_{JA} \), is 29°C/W on a standard JEDEC 51-7 four-layer thermal test board. The maximum power dissipation at \( T_A = 25°C \) can be calculated by the following formula:

\[ P_{D(MAX)} = \frac{(125°C - 25°C)}{(29°C/W)} = 3.44W \]

The maximum power dissipation depends on the operating ambient temperature for fixed \( T_{J(MAX)} \) and thermal resistance, \( \theta_{JA} \). The derating curve in Figure 3 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

Figure 3. Derating Curve of Maximum Power Dissipation
Layout Consideration

For high frequency switching power supplies, the PCB layout is important to get good regulation, high efficiency and stability. The following descriptions are the guidelines for better PCB layout.

- For good regulation, place the power components as close as possible. The traces should be wide and short enough especially for the high-current loop.
- Minimize the size of the LX node and keep it wide and shorter.
- The exposed pad of the chip should be connected to a strong ground plane for maximum thermal consideration.

D₃ and D₄ should be placed as closed as possible to VOUT for surge protection. The CIN, CBST and CLNB should be placed as closed as possible to the RT5047 for good filter. The exposed pad of the chip should be connected to the analog ground plane for thermal consideration.

The inductor should be placed as close as possible to the LX pin to minimize the noise coupling into other circuits. LX node copper area should be minimized for reducing EMI. Place the power components as close as possible. The traces should be wide and short especially for the high-current loop.

The TONE, SEL and EN pin should be connected to MCU or GND. Do not floating these pins.

Figure 4. PCB Layout Guide
### Outline Dimension

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Dimensions In Millimeters</th>
<th>Dimensions In Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>A</td>
<td>4.801</td>
<td>5.004</td>
</tr>
<tr>
<td>B</td>
<td>3.810</td>
<td>4.000</td>
</tr>
<tr>
<td>C</td>
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<td>1.753</td>
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<tr>
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<tr>
<td></td>
<td>Y</td>
<td>3.000</td>
</tr>
</tbody>
</table>

8-Lead SOP (Exposed Pad) Plastic Package