# Single Cell Li-Ion Battery Charger with Adjustable Charging Current for Portable Applications

## General Description

The RT9527L is a low cost single-cell Li-ion charger for low current charge applications.

The RT9527L can be powered up by an AC adapter or USB (Universal Serial Bus) port inputs. The RT9527L enters sleep mode when VIN power is removed. The RT9527L optimizes the charging task by using a control algorithm, which includes pre-charge mode, fast-charge mode and constant voltage mode. The charging task is kept in constant voltage mode to hold the battery in a full charge condition. The charge current is adjustable via an external resistor. The internal thermal feedback circuitry regulates the die temperature to optimize the charge rate for all ambient temperatures. The RT9527L features 28V maximum rating voltages for VIN. Other features include under-voltage protection and over-voltage protection for the AC adapter supply.

The RT9527L is available in the small thermally enhanced WDFN-8L 2x2 package. The recommended junction temperature range is –40°C to 125°C, and the ambient temperature range is –40°C to 85°C.

## Ordering Information

RT9527L□□

Package Type
QW : WDFN-8L 2x2 (W-Type)

Lead Plating System
G : Richtek Green Policy Compliant

Note :

Richtek products are Richtek Green Policy compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.

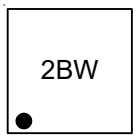
## Features

- **28V Maximum Rating for AC Adapter**
- **Internal Integrated Power FETs**
- **Adjustable Charging Current**
- **Programmable Safe Charge Timer**
- **NTC Thermistor Input**
- **Battery Reverse Protection**
- **ISET Pin Short Protection**
- **Charge Status Indicator**
- **AC Adapter Power Good Status Indicator**
- **End of Charge Current is 10% of Fast-Charge Current**
- **Under-Voltage Protection**
- **Over-Voltage Protection**
- **Thermal Feedback Optimized Charge Rate**
- **RoHS Compliant and Halogen Free**

## Applications

- Cellular Phones
- Digital Cameras
- PDAs and Smart Phone
- Portable Instruments

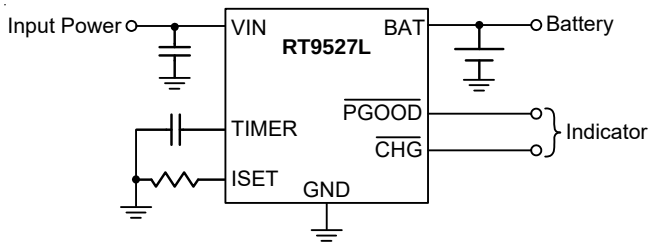
## Marking Information




2B : Product Code

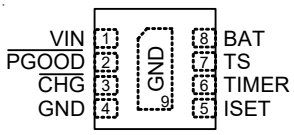
W : Date Code

## Simplified Application Circuit



## Pin Configuration

(TOP VIEW)

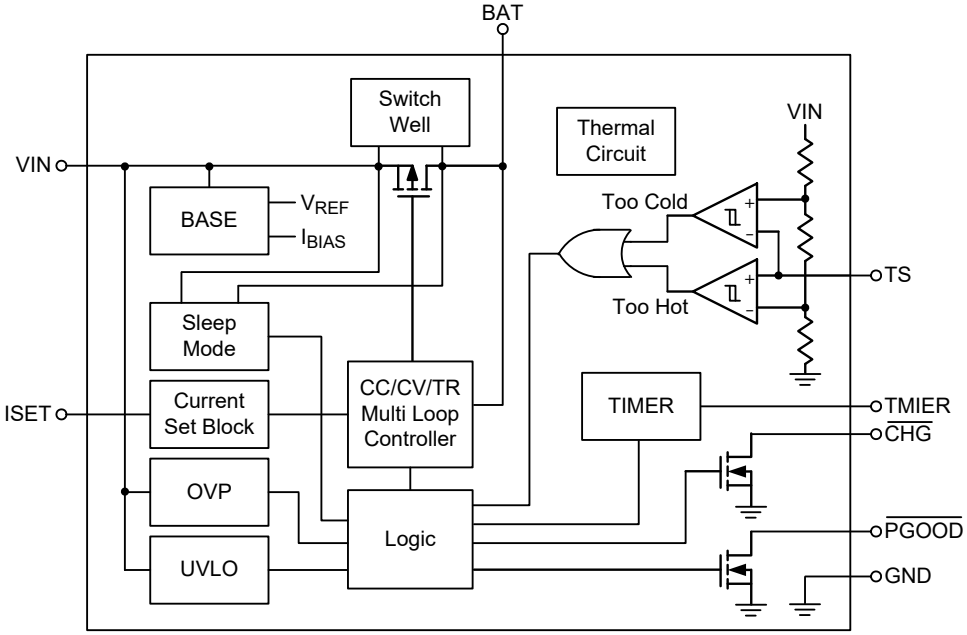



WDFN-8L 2x2

## Functional Pin Description

| Pin No. | Pin Name | Pin Function |
|---|---|---|
| 1 | VIN | Supply voltage input. VIN can withstand up to 28V input. |
| 2 | $\overline{\text{PGOOD}}$ | Power good indicator output. Active-low, open-drain output. |
| 3 | $\overline{\text{CHG}}$ | Charger status output. Active-low, open-drain output. |
| 4, 9 (Exposed Pad) | GND | Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation. |
| 5 | ISET | Charge current setting. |
| 6 | TIMER | Safe-charge timer setting. |
| 7 | TS | Temperature sense input. The TS pin connects to a battery's thermistor to determine whether the battery is too hot or too cold for charging operation. If the battery's temperature is out of range, charging is paused until it re-enters the valid range. |
| 8 | BAT | Charge current output for battery. |

## Functional Block Diagram



## Operation

The RT9527L is a Li-ion charger that can support the input voltage range from 4.4V to 6V. It provides a wide fast-charge current setting ranging from 10mA up to 600mA.

### Change Current Setting

The charging current is adjustable via an external resistor between the ISET and GND pins.

### UVLO

If the input voltage (VIN ) is lower than the threshold voltage $V_{UVLO} - \Delta V_{UVLO}$, the charger will stop charging until VIN is higher than $V_{UVLO}$.

### OVP

If the input voltage (VIN) is higher than the threshold voltage $V_{OVP}$, the internal OVP signal will go high and the charger will stop charging until VIN is below $V_{OVP} - \Delta V_{OVP}$.

### Switch Well

The switch well will choose the highest voltage between VIN and BAT to prevent the power switch from damage.

### Sleep Mode

When the voltage difference between VIN and BAT is under $V_{OS\_L}$, the charger will enter sleep mode to save the system power consumption.

### CC/CV/TR Multi Loop Controller

There are constant current loop, constant voltage loop and thermal regulation loop to control the charging current.

### Too Hot or Too Cold

The temperature sense input TS pin can be connected to a thermistor to determine whether the battery is too hot or too cold for charging operation. If the battery's temperature is out of range, charging is paused until it re-enters the valid range.

### $\overline{\text{PGOOD}}$

The $\overline{\text{PGOOD}}$ pin is an open-drain output used to indicate the input voltage status. $\overline{\text{PGOOD}}$ will assert low when VIN is in the proper working range.

### $\overline{\text{CHG}}$

The $\overline{\text{CHG}}$ pin is an open-drain output. $\overline{\text{CHG}}$ will assert low when the charger starts to charge the battery and become high impedance when the termination current is reached.

### TIMER

The charger contains a safety timer. When the charging time is longer than $t_{PCHG}$ in the pre-charge mode or $t_{FCHG}$ in the fast-charge mode, time fault happens. Then, the charger will be turned off and the $\overline{\text{CHG}}$ pin will become high impedance.

## Absolute Maximum Ratings (Note 1)

- Supply Input Voltage, VIN ---------- –0.3V to 28V
- $\overline{CHG}$, $\overline{PGOOD}$, TS ---------- –0.3V to 28V
- Other Pins ---------- –0.3V to 6V
- Power Dissipation, $P_D$ @ $T_A$ = 25°C
  WDFN-8L 2x2 ---------- 2.19W
- Package Thermal Resistance (Note 2)
  WDFN-8L 2x2, $\theta_{JA}$ ---------- 45.5°C/W
  WDFN-8L 2x2, $\theta_{JC}$ ---------- 11.5°C/W
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature ---------- 150°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) ---------- 2kV
  MM (Machine Model) ---------- 200V

## Recommended Operating Conditions (Note 4)

- Supply Input Voltage, VIN ---------- 4.4V to 6V
- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

## Electrical Characteristics

($V_{IN}$ = 5V, $V_{BAT}$ = 4V, $T_J$ = 25°C, unless otherwise specified)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Supply Input** | | | | | | |
| VIN Under-Voltage Lockout Threshold | $V_{UVLO}$ | $V_{IN}$ = 0V to 5V | 3.1 | 3.3 | 3.5 | V |
| VIN Under-Voltage Lockout Hysteresis | $\Delta V_{UVLO}$ | $V_{IN}$ = 5V to 0V | -- | 240 | -- | mV |
| VIN – BAT VOS Rising | $V_{OS\_H}$ | | -- | 100 | 200 | mV |
| VIN – BAT VOS Falling | $V_{OS\_L}$ | | 10 | 50 | -- | mV |
| VIN Standby Current | $I_{STANDBY}$ | $V_{BAT}$ = 4.5V | -- | 1 | 2 | mA |
| BAT Sleep Leakage Current | $I_{SLEEP}$ | $V_{IN}$ = 0V | -- | -- | 1 | μA |
| **Voltage Regulation** | | | | | | |
| Battery Voltage Regulation | $V_{REG}$ | $T_J$ = 0°C to 85°C | 4.118 | 4.16 | 4.202 | V |
| Re-Charge Threshold | $\Delta V_{REGCHG}$ | Battery Regulation – Recharge Level | 60 | 100 | 140 | mV |
| VIN Power FET On-Resistance | $R_{DS(ON)}$ | $I_{BAT}$ = 450mA | -- | 0.8 | -- | Ω |
| **Current Regulation** | | | | | | |
| VIN Charge Setting Range | $I_{CHG}$ | | 10 | -- | 600 | mA |
| Fast-Charge Current Factor | $K_{CHG\_F1}$ | $I_{CHG\_F1} = K_{CHG\_F1} / R_{ISET}$, $I_{CHG\_F1}$ = 10mA to 50mA | 510 | 600 | 690 | AΩ |
| | $K_{CHG\_F2}$ | $I_{CHG\_F2} = K_{CHG\_F2} / R_{ISET}$, $I_{CHG\_F2}$ = 50mA to 600mA | 570 | 600 | 630 | |

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Pre-Charge Current Factor | $K_{CHG\_P}$ | $I_{CHG\_P} = K_{CHG\_P} / R_{ISET}$ | 30 | 60 | 90 | AΩ |
| **Pre-Charge** | | | | | | |
| BAT Pre-Charge Threshold | $V_{PRECH}$ | $V_{BAT}$ Falling | 2.7 | 2.8 | 2.9 | V |
| BAT Pre-Charge Threshold Hysteresis | $\Delta V_{PRECH}$ | | -- | 200 | -- | mV |
| **Charge Termination** | | | | | | |
| Termination Current Ratio | $I_{TERMI}$ | $V_{BAT} > V_{PREC}$, $I_{CHG} < I_{TERMI}$, $\overline{CHG}$ = L to H | 5 | 10 | 15 | % |
| **Protection** | | | | | | |
| Thermal Regulation | $T_{REG}$ | | -- | 125 | -- | °C |
| Over-Voltage Protection | $V_{OVP}$ | | 6.2 | 6.5 | 6.8 | V |
| Over-Voltage Protection Hysteresis | $\Delta V_{OVP}$ | | -- | 0.2 | -- | V |
| ISET Pin Short Protection | $R_{SHORT}$ | | 375 | 500 | 625 | Ω |
| **NTC** | | | | | | |
| Cold Temperature Fault Threshold Voltage | $V_{COLD}$ | Rising Threshold | 60 | 61 | 62 | $\%V_{IN}$ |
| Cold Temperature Fault Threshold Hysteresis | $\Delta V_{COLD}$ | | -- | 2 | -- | $\%V_{IN}$ |
| Hot Temperature Fault Threshold Voltage | $V_{HOT}$ | Falling Threshold | 29 | 30 | 31 | $\%V_{IN}$ |
| Hot Temperature Fault Threshold Hysteresis | $\Delta V_{HOT}$ | | -- | 2 | -- | $\%V_{IN}$ |
| **Timer** | | | | | | |
| Pre-Charge Fault Time | $t_{PCHG}$ | $C_{TIMER}$ = 1μF (1 / 8 x $t_{FCHG}$) | 1440 | 1800 | 2160 | s |
| Fast-Charge Fault Time | $t_{FCHG}$ | $C_{TIMER}$ = 1μF | 11520 | 14400 | 17280 | s |
| **Other** | | | | | | |
| $\overline{PGOOD}$ Pull-Down Voltage | $V_{\overline{PGOOD}}$ | $I_{\overline{PGOOD}}$ = 5mA | -- | 200 | -- | mV |
| $\overline{CHG}$ Pull-Down Voltage | $V_{\overline{CHG}}$ | $I_{\overline{CHG}}$ = 5mA | -- | 200 | -- | mV |
| $\overline{PGOOD}$ Deglitch Time | $t_{\overline{PGOOD}}$ | Time measured from the edge $V_{IN}$ = 0V to 5V in 1μs to $\overline{PGOOD}$ = L | -- | 2 | -- | ms |
| Input Over-Voltage Blanking Time | $t_{OVP}$ | | -- | 50 | -- | μs |
| Input Over-Voltage Recovery Time | $t_{OVP\_R}$ | | -- | 2 | -- | ms |
| Pre-Charge to Fast-Charge Deglitch Time | $t_{PF}$ | | -- | 25 | -- | ms |
| Fast-charge to Pre-Charge Deglitch Time | $t_{FP}$ | | -- | 25 | -- | ms |
| Termination Deglitch Time | $t_{TERMI}$ | | -- | 25 | -- | ms |
| Recharge Deglitch Time | $t_{RECHG}$ | | -- | 100 | -- | ms |
| Sleep Deglitch Time | $t_{NO-IN}$ | | -- | 25 | -- | ms |
| Pack Temperature Fault Detection Deglitch Time | $t_{TS}$ | | -- | 25 | -- | ms |

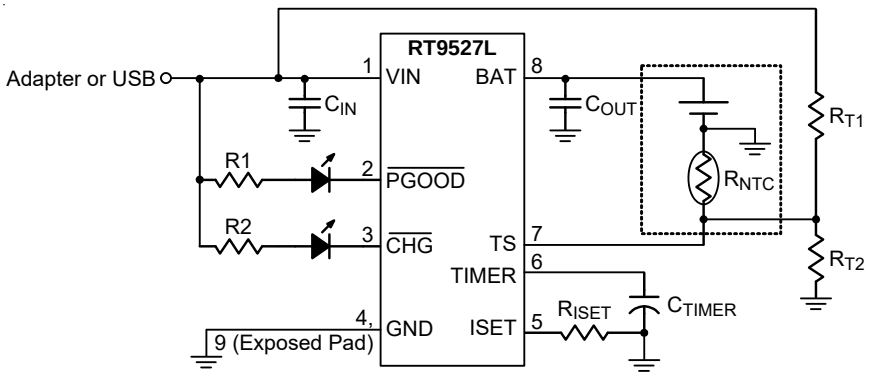
**Note 1.** Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

**Note 2.** $\theta_{JA}$ is measured at $T_A$ = 25°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 precautions are recommended.

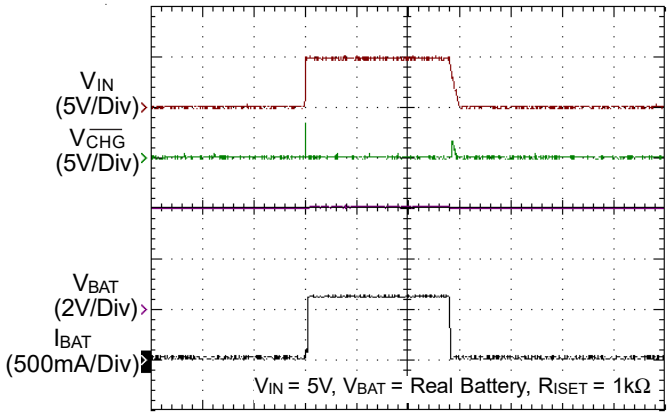
**Note 4.** The device is not guaranteed to function outside its operating conditions.

## Typical Application Circuit

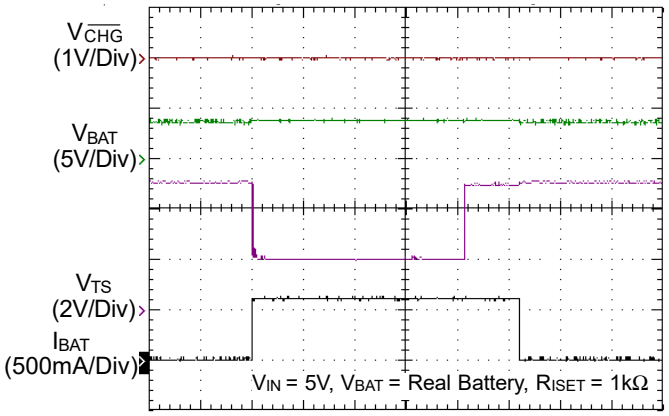


## Typical Operating Characteristics

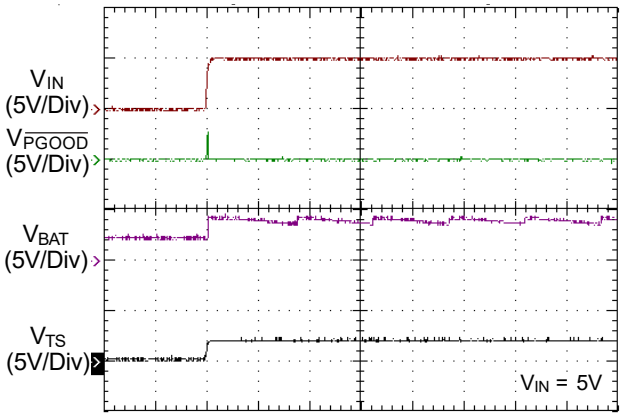
### Charge On/Off Control from VIN



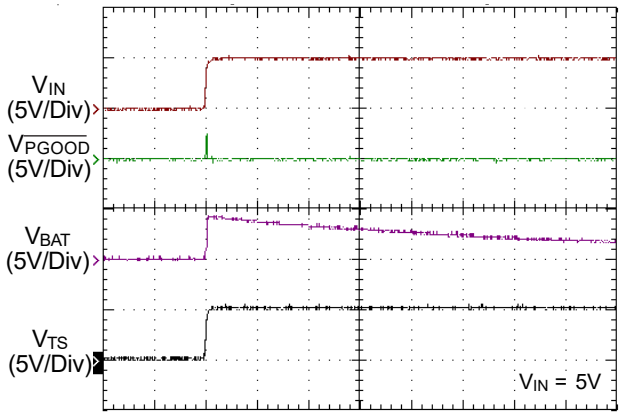

### TS Inserted/Removed



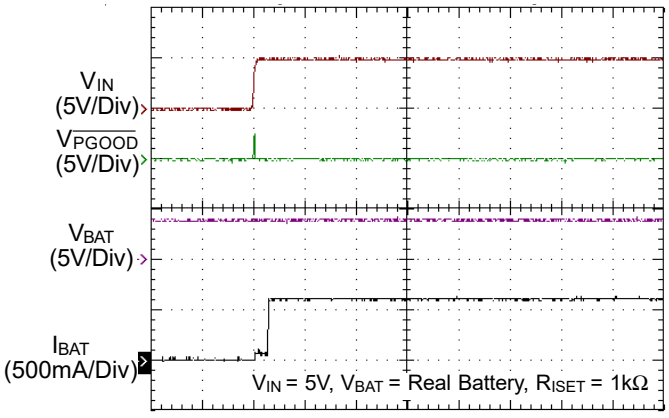

### VIN Hot-Plug with NTC/Without Battery



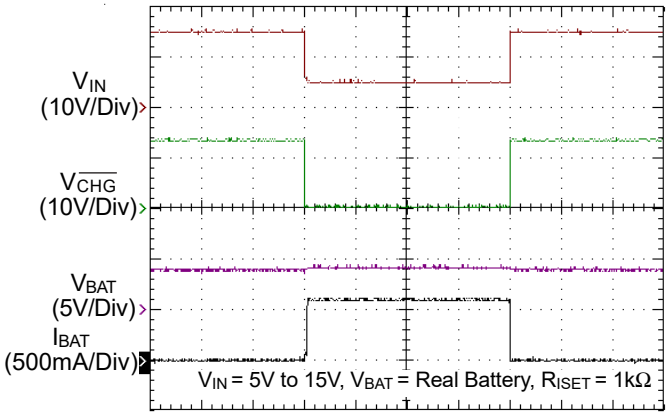

### VIN Hot-Plug Without NTC/Battery



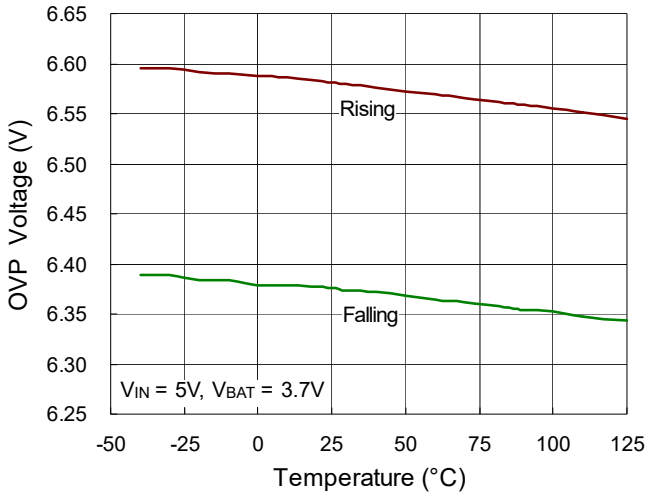

### VIN Hot-Plug with NTC/Battery



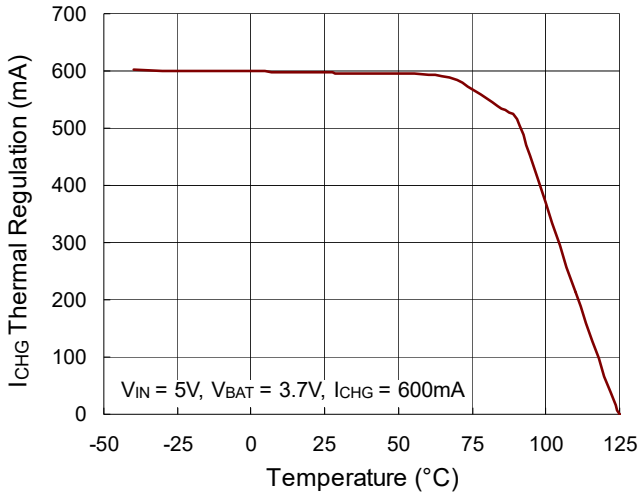

### VIN Over Voltage Protection



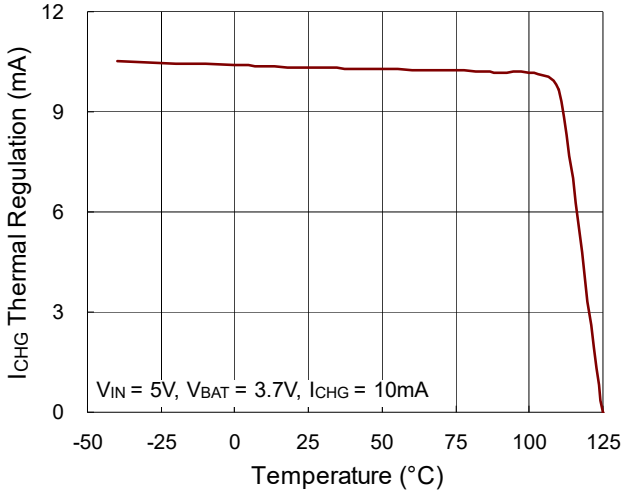
### OVP Threshold Voltage vs. Temperature



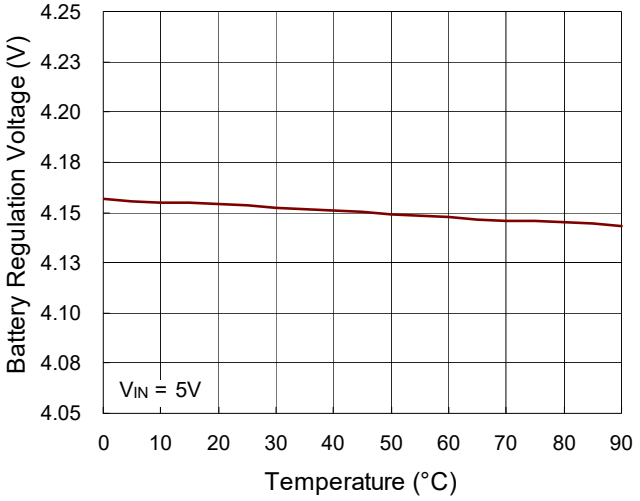

### $I_{CHG}$ Thermal Regulation vs. Temperature



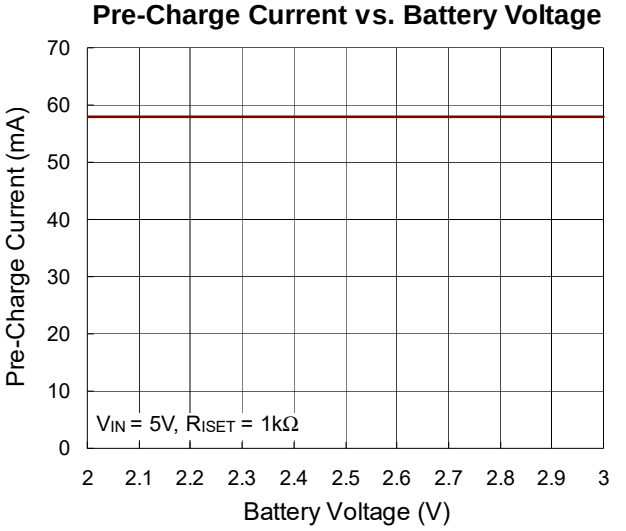

### $I_{CHG}$ Thermal Regulation vs. Temperature



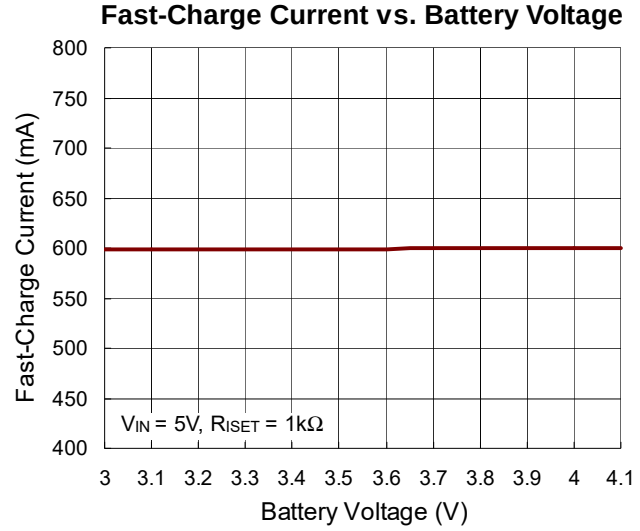

### Battery Regulation Voltage vs. Temperature




### Pre-Charge Current vs. Battery Voltage




### Fast-Charge Current vs. Battery Voltage



## Application Information

***Richtek's component specification does not include the following information in the Application Information section. Thereby no warranty is given regarding its validity and accuracy. Customers should take responsibility to verify their own designs and reserve suitable design margin to ensure the functional suitability of their components and systems.***

The RT9527L is a fully integrated low cost single-cell Li-ion battery charger ideal for portable applications. The internal thermal feedback circuitry regulates the die temperature to optimize the charge rate at all ambient temperatures. The RT9527L features 20V maximum rating voltages for VIN. Other features include under-voltage protection and over-voltage protection for AC adapter supply, as well as a charging time monitor.

### Pre-Charge Mode

When the output voltage becomes lower than 2.8V, the charging current reduces to 10% of the setting current to protect the battery life time as shown below :

$I_{CHG\_P} = K_{CHG\_P} / R_{ISET}$

where $K_{CHG\_P}$ is the pre-charge current factor.

### Fast-Charge Mode

When the output voltage becomes higher than 3V, the charging current will be equal to the setting current which is determined by $R_{ISET}$.

$I_{CHG\_F} = K_{CHG\_Fx} / R_{ISET}$

where $K_{CHG\_Fx}$ is the fast-charge current factor.

### Constant Voltage Mode

As the output voltage is near 4.16V, the charging current will be reduced to maintain the output voltage. The charger remains active and maintains the output voltage at 4.16V in order to keep the battery in a full charge state.

### Recharge Mode

When the chip is in charge termination mode, the charging current goes down to zero and the battery voltage drops to 4.06V. After a deglitch time of 100ms (typ.), the battery begins recharging. However, when recharge happens, the indicator $\overline{CHG}$ remains in logic high.

### $\overline{CHG}$ Indicator

The $\overline{CHG}$ pin is an open-drain output. $\overline{CHG}$ will assert low when the charger starts to charge the battery and become high impedance when the charge termination current is reached. The $\overline{CHG}$ signal is interfaced either with a microprocessor GPIO or an LED for indication.

| Charge State | $\overline{CHG}$ Output |
|---|---|
| Charging | Low (for first charger cycle) |
| Charging suspended by thermal loop | |
| Safety timers expired | High impedance |
| TS fault | Low (for first charger cycle) |
| Charging done | High impedance |
| Recharging after termination | |
| No valid input power | |

### $\overline{PGOOD}$ Indicator

This open-drain output pin is used to indicate the input voltage status. $\overline{PGOOD}$ output asserts low when

1. $V_{IN} > V_{UVLO}$
2. $(V_{IN} - V_{BAT}) > V_{OS\_H}$
3. $V_{IN} < V_{OVP}$

It can be used to drive an LED or communicate to the host processor. Note that "LOW" indicates the open-drain transistor is turned on and the LED is bright.

### Charge Termination

When the charge current is lower than the charge termination current ratio (10% = $I_{CHG} / I_{CHG\_F}$) for $V_{BAT}$ > 4.06V and the time is larger than the deglitch time (25ms), $\overline{CHG}$ transits from low to high. $\overline{CHG}$ will be latched high unless the power is re-toggled.

### ISET Pin Short Protection

After VIN power plugs in, the RT9527L will detect whether the ISET pin is shorted to ground or not. If RISET is smaller than $R_{SHORT}$, the RT9527L considers that the ISET pin is short to ground. Then, the RT9527L will disable charge function until VIN power reset.

If RISET is larger than $R_{SHORT}$, the RT9527L will charge. If the RT9527L begins charge status and the ISET pin is short to ground, thermal regulation will work to limit junction temperature around 125°C.

### Battery Connect Reverse

If battery is connected reversely, it causes that the voltage of BAT pin is negative. The RT9527L will disable charger function until battery voltage is normal.

### Temperature Regulation

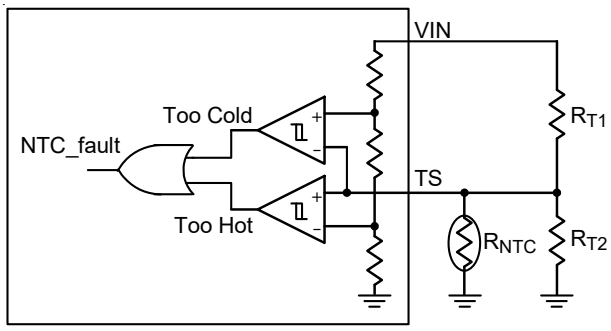
In order to maximize charge rate, the RT9527L features a junction temperature regulation loop. If the power dissipation of the IC results in junction temperature greater than the thermal regulation threshold (125°C), the RT9527L will cut back on the charge current and disconnect the battery in order to maintain thermal regulation at around 125°C. This operation continues until the junction temperature falls below the thermal regulation threshold (125°C) by the hysteresis level. This feature prevents the maximum power dissipation from exceeding typical design conditions.

### Sleep mode

The RT9527L enters sleep mode if both the AC and USB ports are removed from the input. This feature prevents draining the battery during the absence of an input supply.

### Battery Pack Temperature Monitoring

The RT9527L features an external battery pack temperature monitoring input. The TS input connects to the NTC thermistor in the battery pack to monitor battery temperature and prevent danger over-temperature conditions. If at any time the voltage at TS falls outside of the operating range, charging will be suspended. The timers maintain their values but suspend counting. When charging is suspended due to a battery pack temperature fault, the $\overline{CHG}$ pin remains low and continues to indicate charging.




$$R_{T2} = \frac{310R_{TC}R_{TH}}{117R_{TC} - 427R_{TH}}$$

$$R_{T1} = \frac{7R_{TH}R_{T2}}{3(R_{TH} + R_{T2})}$$

### Time Fault

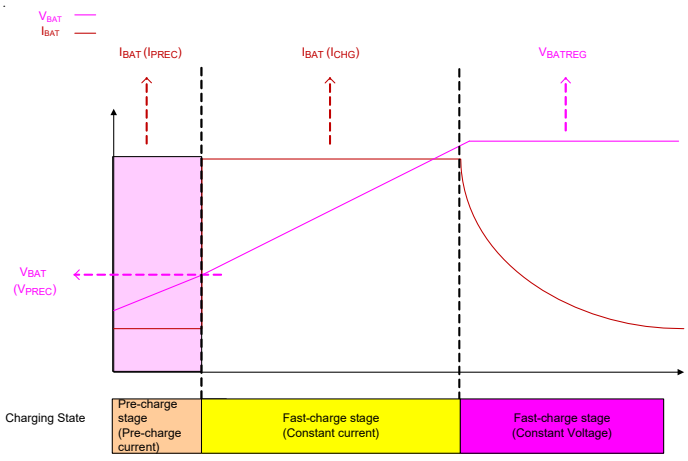
The Fast-Charge Fault Time is set according to the following equations :

Fast-Charge Fault Time : $t_{FCHG} = 14400 \times C_{TIMER}$ (s)

Pre-Charge Fault Time : $t_{PCHG} = 1 / 8 \times t_{FCHG}$ (s)

where the $C_{TIMER}$ unit is in µF.

When time fault happens, the charger cycle will be turned off and the $\overline{CHG}$ pin will become high impedance.




Charging Profile

### 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 :

$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$

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 WDFN-8L 2x2 package, the thermal resistance, $\theta_{JA}$, is 45.5°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 :

$P_{D(MAX)}$ = (125°C – 25°C) / (45.5°C/W) = 2.19W for WDFN-8L 2x2 package

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 1 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

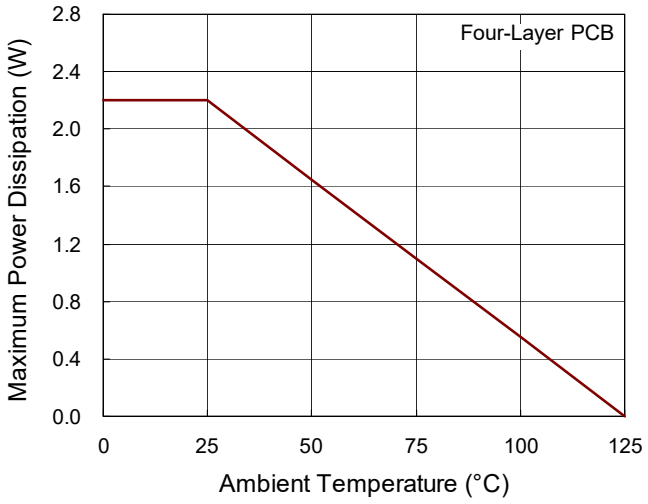



Figure 1. Derating Curve of Maximum Power Dissipation

### Layout Considerations

The RT9527L is a fully integrated low cost single cell Li-Ion battery charger ideal for portable applications. Careful PCB layout is necessary. For best performance, place all peripheral components as close to the IC as possible. A short connection is highly recommended. The following guidelines must be strictly followed when designing a PCB layout for the RT9527L.

- Input and output capacitors should be placed close to IC and connected to ground plane. The trace of input in the PCB should be placed far away from the sensitive devices and shielded by the ground.
- The GND and exposed pad should be connected to a strong ground plane for heat sinking and noise protection.
- The connection of $R_{ISET}$ should be isolated from other noisy traces. A short wire is recommended to prevent EMI and noise coupling.

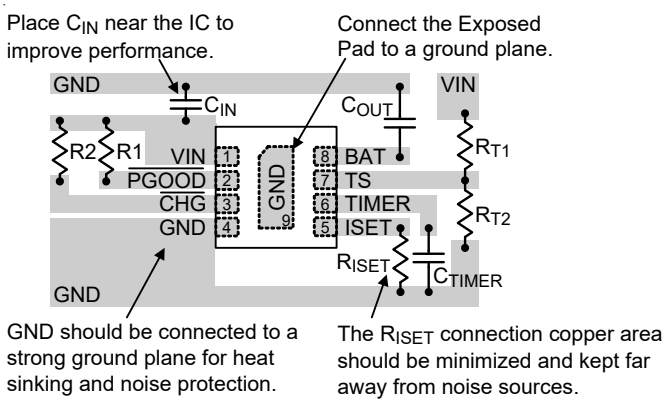
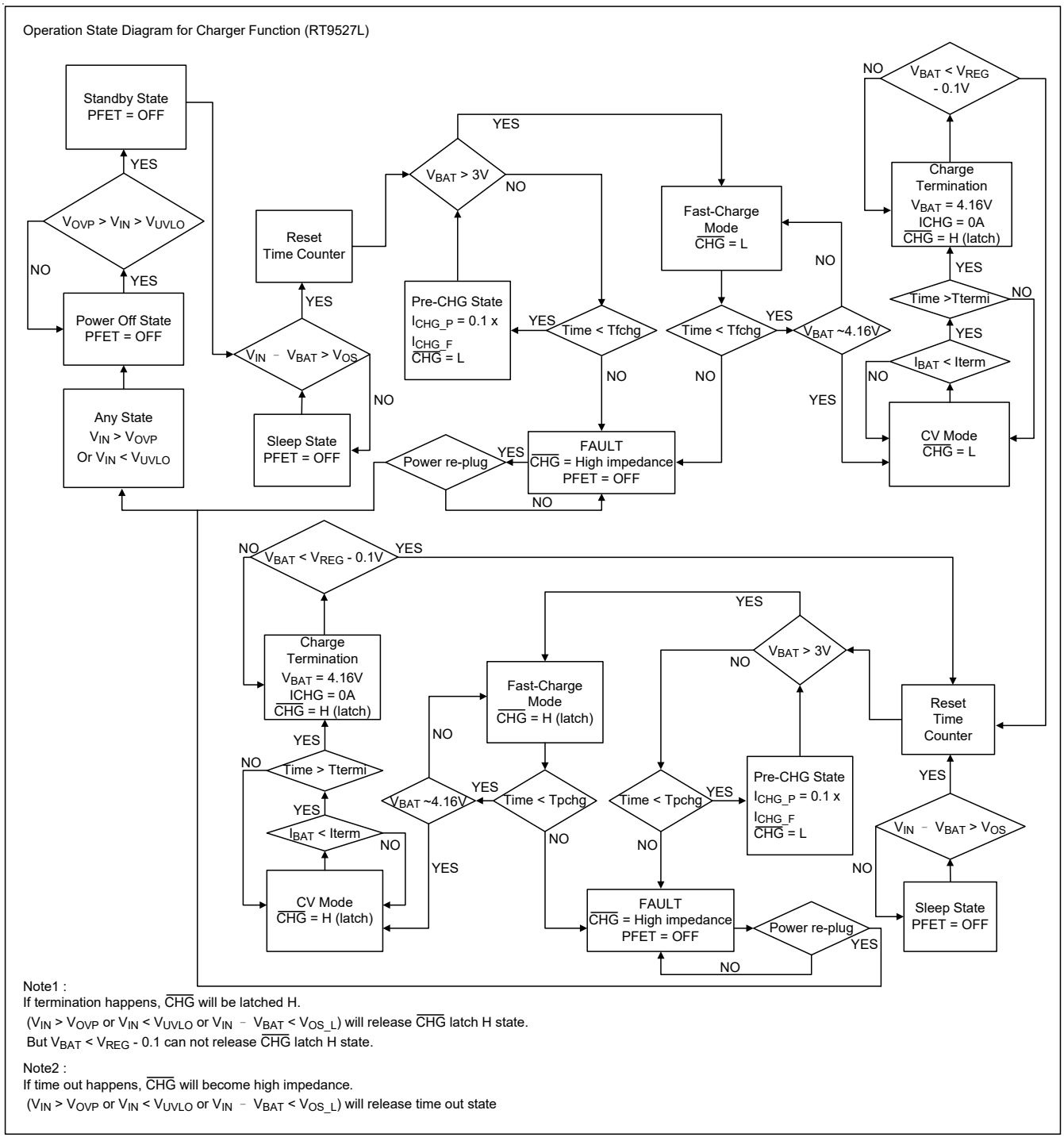



Figure 2. PCB Layout Guide

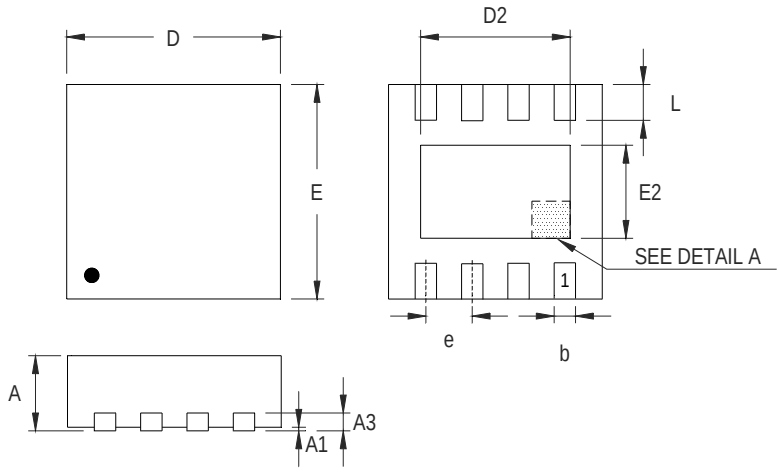


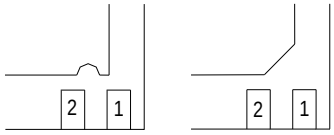

Note1 :
If termination happens, $\overline{CHG}$ will be latched H.
($V_{IN}$ > $V_{OVP}$ or $V_{IN}$ < $V_{UVLO}$ or $V_{IN}$ – $V_{BAT}$ < $V_{OS\_L}$) will release $\overline{CHG}$ latch H state.
But $V_{BAT}$ < $V_{REG}$ - 0.1 can not release $\overline{CHG}$ latch H state.

Note2 :
If time out happens, $\overline{CHG}$ will become high impedance.
($V_{IN}$ > $V_{OVP}$ or $V_{IN}$ < $V_{UVLO}$ or $V_{IN}$ – $V_{BAT}$ < $V_{OS\_L}$) will release time out state

Figure 3. Operation State Diagram for Charging

## Outline Dimension




**DETAIL A**

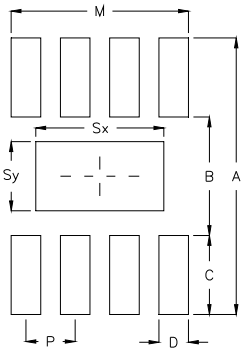
Pin #1 ID and Tie Bar Mark Options

Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.175 | 0.250 | 0.007 | 0.010 |
| b | 0.200 | 0.300 | 0.008 | 0.012 |
| D | 1.950 | 2.050 | 0.077 | 0.081 |
| D2 | 1.000 | 1.250 | 0.039 | 0.049 |
| E | 1.950 | 2.050 | 0.077 | 0.081 |
| E2 | 0.400 | 0.650 | 0.016 | 0.026 |
| e | 0.500 | | 0.020 | |
| L | 0.300 | 0.400 | 0.012 | 0.016 |

**W-Type 8L DFN 2x2 Package**

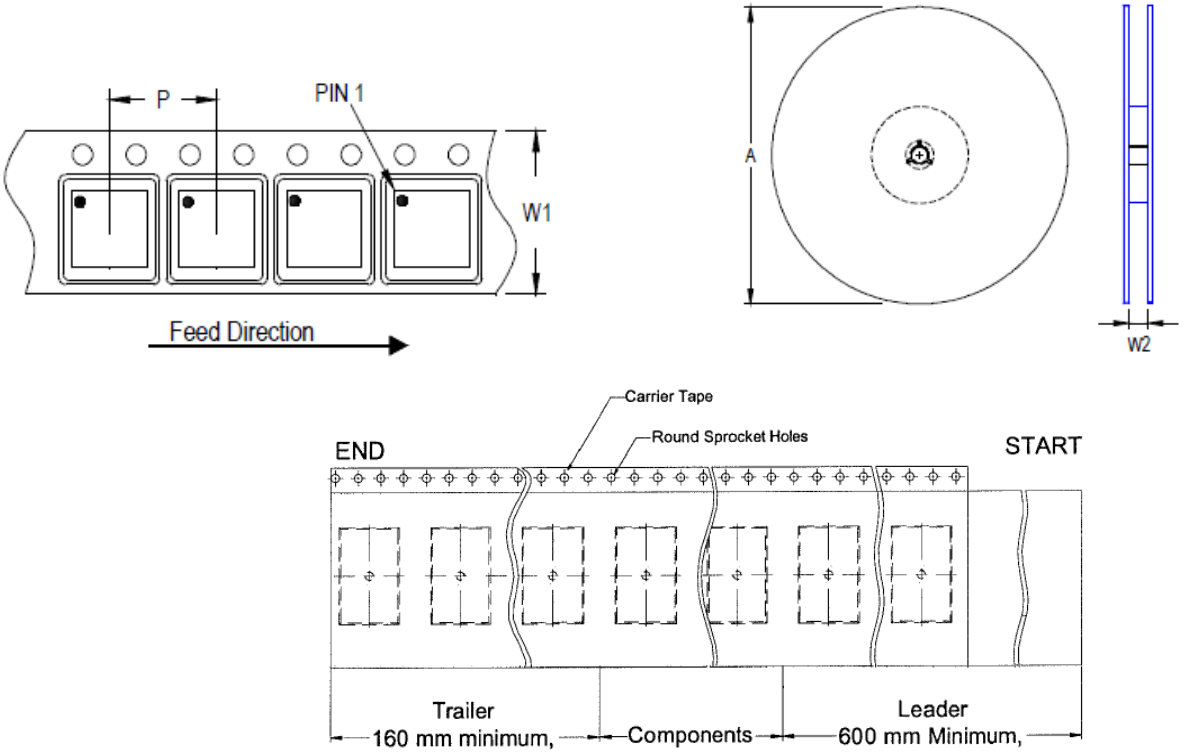
## Footprint Information



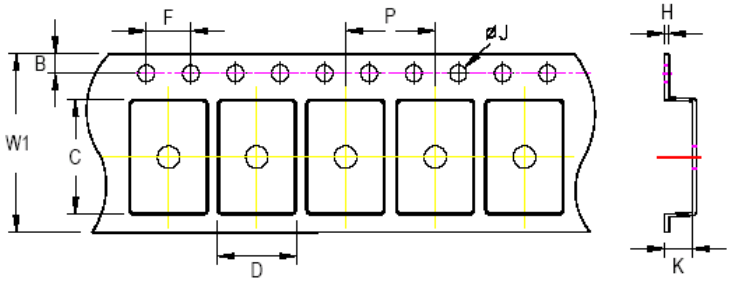

| Package | Number of Pin | Footprint Dimension (mm) | | | | | | | | Tolerance |
|---|---|---|---|---|---|---|---|---|---|---|
| | | P | A | B | C | D | Sx | Sy | M | |
| V/W/U/XDFN2*2-8 | 8 | 0.50 | 2.80 | 1.20 | 0.80 | 0.30 | 1.30 | 0.70 | 1.80 | ±0.05 |

## Packing Information

### Tape and Reel Data




| Package Type | Tape Size (W1) (mm) | Pocket Pitch (P) (mm) | Reel Size (A) | | Units per Reel | Trailer (mm) | Leader (mm) | Reel Width (W2) Min./Max. (mm) |
|---|---|---|---|---|---|---|---|---|
| | | | (mm) | (in) | | | | |
| QFN/DFN 2x2 | 8 | 4 | 180 | 7 | 2,500 | 160 | 600 | 8.4/9.9 |




**C, D and K are determined by component size. The clearance between the components and the cavity is as follows:**

**- For 12mm carrier tape: 0.5mm max.**

| Tape Size | W1 | P | | B | | F | | ØJ | | H |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Max. |
| 8mm | 8.3mm | 3.9mm | 4.1mm | 1.65mm | 1.85mm | 3.9mm | 4.1mm | 1.5mm | 1.6mm | 0.6mm |

## Tape and Reel Packing

| Step | Photo/Description | Step | Photo/Description |
|---|---|---|---|
| 1 |  Reel 7” | 4 |  3 reels per inner box **Box A** |
| 2 |  HIC & Desiccant (1 Unit) inside | 5 |  12 inner boxes per outer box |
| 3 |  Caution label is on backside of Al bag | 6 |  Outer box **Carton A** |

| Container / Package | Reel | | Box | | | | Carton | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Size | Units | Item | Size(cm) | Reels | Units | Item | Size(cm) | Boxes | Unit |
| QFN & DFN 2x2 | 7” | 2,500 | Box A | 18.3*18.3*8.0 | 3 | 7,500 | Carton A | 38.3*27.2*38.3 | 12 | 90,000 |
| | | | Box E | 18.6*18.6*3.5 | 1 | 2,500 | For Combined or Partial Reel. | | | |

### Packing Material Anti-ESD Property

| Surface Resistance | Aluminum Bag | Reel | Cover tape | Carrier tape | Tube | Protection Band |
|---|---|---|---|---|---|---|
| $\Omega/cm^2$ | **$10^4$ to $10^{11}$** | **$10^4$ to $10^{11}$** | **$10^4$ to $10^{11}$** | **$10^4$ to $10^{11}$** | **$10^4$ to $10^{11}$** | **$10^4$ to $10^{11}$** |

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## Datasheet Revision History

| Version | Date | Description | Item |
|---|---|---|---|
| 03 | 2023/10/11 | Modify | General Description on P1<br>Ordering Information on P1<br>Electrical Characteristics on P4<br>Application Information on P10<br>Footprint Information on P15<br>Packing Information on P16, 17, 18 |