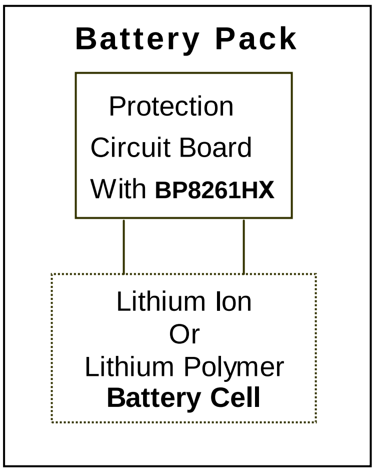
## General Description

The BP8261HX is protector for lithium-ion and lithium polymer rechargeable battery with high accuracy voltage detection. It can be used for protecting single cell packs from overcharge , overdischarge, over current and short circuit. The IC has suitable protection delay functions and low power consumption property.

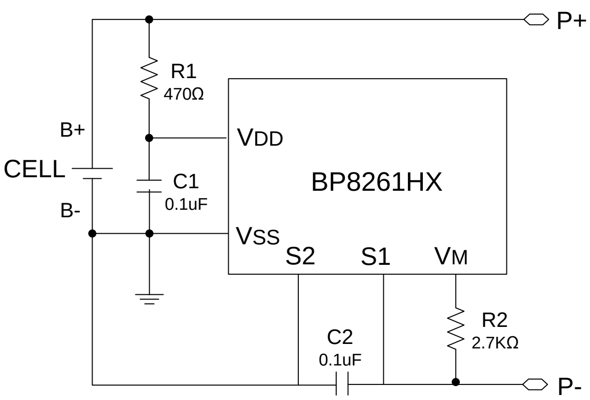
## Applications




## Features

- **Overcharge Detection Voltage**
  - 4.425V
  - Accuracy ±50mV (Ta=25℃)
- **Overdischarge Detection Voltage**
  - 2.470V
  - Accuracy ±100mV (Ta=25℃)
- **Discharge Overcurrent Detection Voltage**
  - 0.150V ($V_{DD}$ = 3.300V)
  - Accuracy ±30mV (Ta=25℃)
- **Short Circuit Detection Voltage**
  - Typ. 0.9V ($V_{DD}$ = 3.300V)
  - Accuracy ±300mV (Ta=25℃)
- **Low Current Consumption**
  - Standard working current
    Typ. 3.0uA ($V_{DD}$ = 3.500V, Ta=25℃)
  - With auto wake up
    Typ. 0.5uA ($V_{DD}$ = 1.8V, Ta=25℃)
- **Auto Wake up function is allowed**
- **0V charge function is allowed**
- **Small Package**
  - DFN2.2*2.9-6LT
- **FET general characteristics**
  - $V_{DS}$=20V
  - $R_{SS(ON)}$<40 mΩ ($V_{GS}$=3.7V, $I_D$=1A)
  - ESD Rating: 2000V HBM

## Typical Application Circuits




$R_1$ and $C_1$ are to stabilize the supply voltage of the BP8261HX. $R_1 C_1$ is hence regarded as the time constant for $V_{DD}$ pin. $R_1$ and $R_2$ can also be a part of current limit circuit for the BP8261HX.

Recommended values of these elements are as follows:

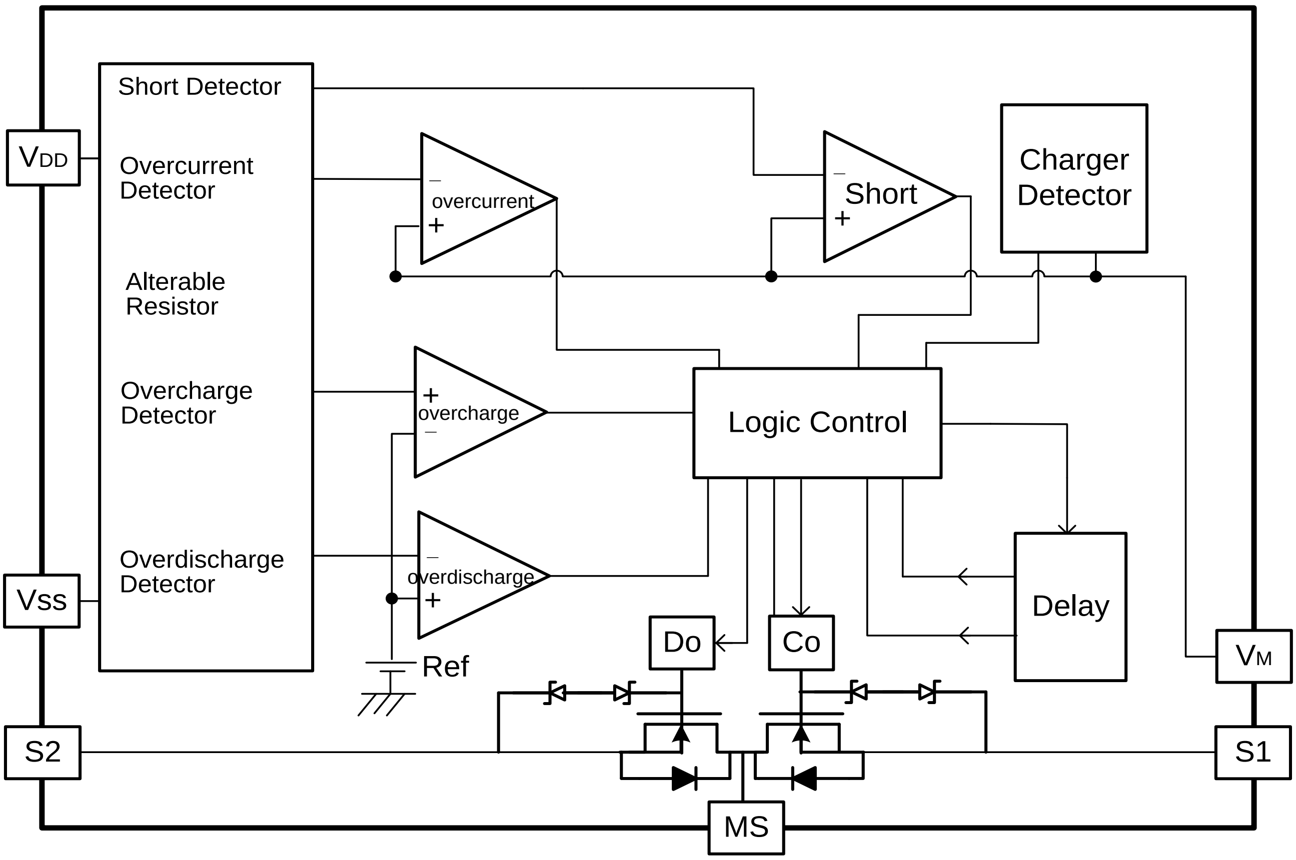
- $R_1$ < 1KΩ. A larger value of $R_1$ results in higher detection voltage, introducing errors.
- 1.5KΩ < $R_2$ < 4KΩ. A larger value of $R_2$ possibly prevents resetting from Overdischarge even with a charger.
- $R_1$+ $R_2$ > 1.6KΩ. Smaller values may lead to power consumption over the maximum dissipation rating of the BP8261HX.

The requirement or resistors and capacitors and the value of constants should be decided depending upon the system function and characteristics.

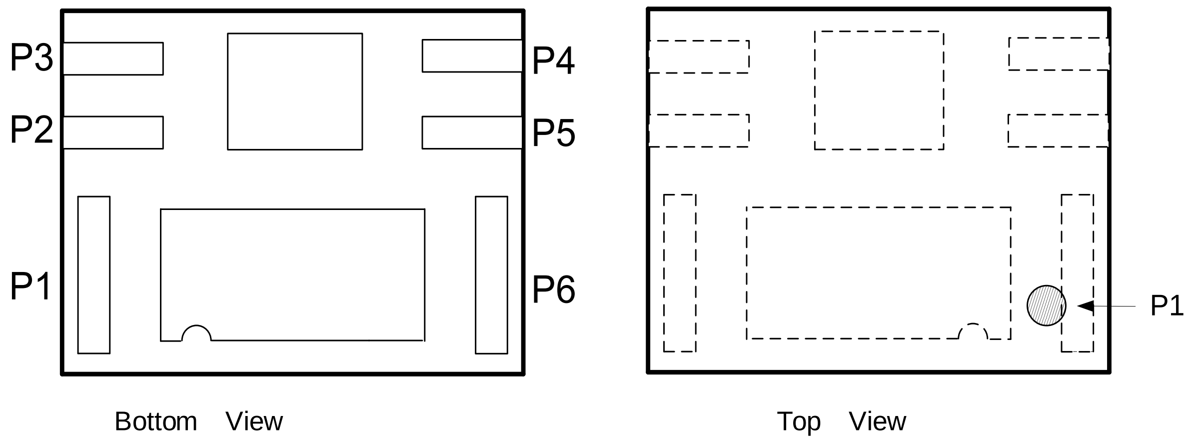
## Marking Contents

| Part number | Marking | Package | Quantity perreel |
|---|---|---|---|
| BP8261HX | VBEB | DFN2.2*2.9 - 6LT | 3000 |

## Block Diagram



## Pin Description




| Pin | Symbol | Description |
|---|---|---|
| P1 | S2 | The source terminal of MOSFET switch for discharge control |
| P2 | $V_{SS}$ | Ground |
| P3 | $V_{DD}$ | Power supply |
| P4 | NC | No Connection |
| P5 | $V_M$ | Connected to charger's negative pin |
| P6 | S1 | The source terminal of MOSFET switch for charge control |
| P7 | IS | The substrate of IC, IS should be floating |
| P8 | MS | The common drain terminal of MOS, MS should be floating |

## Electrical Characteristics

($T_{OPT}$=25$^o$C unless otherwise specified)

| Symbol | Item | Conditions | Min. | TYP. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DETECTION VOLTAGE AND DELAY TIME** | | | | | | |
| Vdet1 | Overcharge Detection Voltage | | 4.375 | **4.425** | 4.475 | V |
| Vrel1 | Release Voltage For Overcharge Detection | | 4.155 | **4.225** | 4.295 | V |
| Vdet2 | Overdischarge Detection Voltage | | 2.370 | **2.470** | 2.570 | V |
| Vrel2 | Release Voltage For Overdischarge | | 2.950 | **3.100** | 3.250 | V |
| Vdet3 | Discharge Overcurrent Detection Voltage | $V_{DD}$ = 3.30V | 0.120 | **0.150** | 0.180 | V |
| Vshort | Short Protection Voltage | $V_{DD}$ = 3.30V | 0.6 | **0.9** | 1.2 | V |
| Tvdet1 | Overcharge Detection Delay Time | $V_{DD}$ = 4.0V→4.5V | 1.02 | **1.28** | 1.54 | s |
| Tvdet2 | Overdischarge Detection Delay Time | $V_{DD}$ = 3.0→2.0V | - | **24** | 100 | ms |
| Tvdet3 | Discharge Overcurrent Detection Delay Time | $V_{DD}$ = 3.30V | - | **12** | 20 | ms |
| Tshort | Short Detection Delay Time | $V_{DD}$ = 3.30V | - | **375** | 550 | us |
| **OUTPUT VOLTAGE AND $V_M$ INTERNAL RESISTANCE** | | | | | | |
| $Vc_{OL}$ | CO Pin L Voltage | $I_{OL}$=50uA, $V_{DD}$ =4.4V | 0.150 | **0.200** | 0.250 | V |
| $Vc_{OH}$ | CO Pin H Voltage | $I_{OH}$=-50uA, $V_{DD}$=3.9V | 3.750 | **3.700** | 3.650 | V |
| $V_{DOL}$ | DO Pin L Voltage | $I_{OL}$=50uA, $V_{DD}$=2.0V | 0.050 | **0.070** | 0.090 | V |
| $V_{DOH}$ | DO Pin H Voltage | $I_{OH}$=-50uA, $V_{DD}$ =3.9V | 3.850 | **3.830** | 3.810 | V |
| $R_{VMD}$ | Resistance between $V_M$ and $V_{DD}$ | $V_{DD}$=2.0V, $V_M$=0V | 150 | **300** | 600 | KΩ |
| $R_{VMS}$ | Resistance between $V_M$ and $V_{SS}$ | $V_{DD}$=3.3V, $V_M$=1V | 60 | **130** | 260 | KΩ |
| **OPERRATION VOLTAGE AND CURRENT CONSUMPTION** | | | | | | |
| $V_{DD}$ | Operating Input Voltage | $V_{DD}$-Vss | 1.6 | **$V_{DD}$** | 7.0 | V |
| $V_M$ | Operating Input Voltage | $V_{DD}$-$V_M$ | 1.5 | **-** | 18.0 | V |
| $I_{DD}$ | Supply Current | $V_{DD}$ = 3.5V, $V_M$ = 0V | - | **3.0** | 6.0 | uA |
| $I_{STANDBY}$ | Standby Current( with Auto wake up) | $V_{DD}$ =VM= 1.8V | - | - | 0.5 | uA |

## Absolute Maximum Ratings

($Ta=25^{o}C, V_{SS}=0\ V$)

| Item | Symbol | Ratings | Unit |
|---|---|---|---|
| Supply Voltage | $V_{DD}$ | -0.3 to 7 | V |
| $V_M$ Pin Input Voltage | $V_M$ | $V_{DD}$ -18 to $V_{DD}$ +0.3 | V |
| Gate-Source Voltage | $V_{GS}$ | ±10 | V |
| Drain- Source Voltage | $V_{DS}$ | 20 | V |
| Drain Current | ID | 6 | A |
| Co Pin Output Voltage | $V_{CO}$ | $V_{DD}$ -18 to $V_{DD}$ +0.3 | V |
| Do Pin Output Voltage | $V_{DO}$ | Vss-0.3 to $V_{DD}$ +0.3 | V |
| Power Dissipation | Pd | 150 | mW |
| Operating Temperature Range | Topt | -30 to 80 | ℃ |
| Storage Temperature Range | Tstg | -55 to 125 | ℃ |

**Caution: These values must not be exceeded under any conditions.**

## Electrical Characteristics

(25 ºC,GND=0V unless otherwise specified)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|
| Drain current at cut off of MOS-FET | $I_{DSS}$ | | | 1 | uA | Vds=20V |
| Source -source on state resistance 1 | $R_{SS(on)}1$ | 21 | 33 | 45 | mΩ | Vdd=2.6V , $I_D$=1.0A |
| Source -source on state resistance 2 | $R_{SS\ (on)}2$ | 20 | 30 | 40 | mΩ | Vdd=3.7V , $I_D$=1.0A |
| Source -source on state resistance 3 | $R_{SS\ (on)}3$ | 19 | 29 | 39 | mΩ | Vdd=4.2V , $I_D$=1.0A |
| Body Diode-Forward Voltage | $V_{SD}$ | 0.60 | 0.74 | 1.20 | V | Is=1.0A , $V_{GS}$=0V |

## Function Description

### Normal Condition:

$V_{DD}$ is between the Overdischarge Detection Voltage (Vdet2) and Overcharge Detection Voltage (Vdet1) and the $V_M$ voltage is between VSS and the Discharge Overcurrent Detection Voltage (Vdet3), therefore the MOS-FET of charge and discharge are all on. Charging and discharging can be carried out freely.

### Overcharge Condition:

When $V_{DD}$ increases and passes Vdet1 during charging under the normal condition, the charge control FET turns off after Overcharge Detection Delay Time (Tvdet1),discharging is stopped. It calls overcharge protection.

### Overcharge Protection Release Condition:

The charging state can be reset and charge control FET will turn on ,as follow condition:

(1) When the $V_M$ voltage is between Vdet3 and VSS, $V_{DD}$ becomes lower than the Overcharge Release Voltage (Vrel1) ,the charge control FET turns on.

(2) When a charger is disconnected with the battery pack and a load is connected, and the $V_{DD}$ level is lower than Vdet1, the charge control FET turns on.

Note: when a charger keep connecting, even if $V_{DD}$ level is lower than Vrel1, the overcharge state will not release and charge control FET keep off until disconnect the charger with the battery pack.

### Overdischarge Condition:

While discharging, after $V_{DD}$ lowers below Overdischarge Detection Voltage (Vdet2), the discharge control FET turns off after Overdischarge Detection Delay Time (Tvdet2), discharging is stopped. It calls overdischarge protection.

### Overdischarge Protection Release Condition:

When IC is in overdischarge condition, if a charger is connected to the battery pack, and the battery supply voltage becomes higher than Vdet2, the discharge control FET turns on, allowing discharging action.

The discharging state also can be reset and the output of Do becomes high when $V_{DD}$ becomes higher than the Overdischarge Release Voltage (Vrel2), $V_M$ is between $V_{SS}$ and $V_{DD}$.

When a charger is connected from the battery pack, while the $V_{DD}$ level is lower than Vdet2, the battery pack makes charger current allowable through the internal parasitic diode.

### Discharge Overcurrent Protection:

During discharging, the current varies with load, and $V_M$ increases with the rise of the discharging current. Once $V_M$ rises up to the Discharge Overcurrent Detection Voltage (Vdet3) or higher and stays longer than the Discharge Overcurrent Delay Time (Tvdet3), IC will turn off the discharge control FET. After that Discharge Overcurrent state is removed, i.e. $V_M$ < Vdet3, and the circuit recovers to normal condition. The current of Discharge Overcurrent protection is related to Vdet3 and the ON resistance of the two FETs ($R_{SS\ (on)}$).

**Short Circuit Protection:**

This function has the same principle as the overcurrent protection. But, the Short Circuit Protection Delay Time (Tshort) is far shorter than Tvdet3, and the Short Protection Detection Voltage (Vshort) is far higher than Vdet3. When the circuit is shorted, $V_M$ increases rapidly. Once $V_M \geq$ Vshort, IC will turn off the discharge control FET. After the short circuit state is removed, i.e. $V_M <$ Vdet3, the circuit recovers to the normal condition. The short circuit peak current is related to Vshort and the ON resistance of the two FETs ($R_{SS\ (on)}$).

**0V Battery Charge Function:**

This function is used to recharge the connected battery whose voltage is 0V due to the self-discharge. When the 0 V battery charge starting charger voltage (V0cha) or higher is applied between P+ and P− pins (in the Typical Application Circuits of Page1) by connecting a charger, the charge control FET gate is fixed to $V_{DD}$ pin voltage. When the voltage between the gate and source of the charge control FET becomes equal to or higher than the turn-on voltage by the charger voltage, the charge control FET turns on to start charging. At this time, the discharge control FET is off and the charging current flows through the internal parasitic diode in the discharge control FET. When the battery voltage becomes equal to or higher than the Overdischarge Detection Voltage (Vdet2), the IC enters the normal condition.

## Test Circuits

### (1) Overcharge detection voltage and overcharge release voltage (Test circuit 1)

The Overcharge Detection Voltage (Vdet1) is the voltage between $V_{DD}$ and $V_{SS}$ to which when V1 increases and keeps the condition for overcharge delay time, The charging control FET turns off, $Vs_1$ is the threshold of a diode, The Overcharge Release Voltage (Vrel1) is the voltage between $V_{DD}$ and $V_{SS}$ to which when V1 decreases, The charging control FET turns on, $Vs_1$=0V.

### (2) Overdischarge detection voltage and Overdischarge release voltage (Test circuit 1)

The Overdischarge Detection Voltage (Vdet2) is the voltage between $V_{DD}$ and $V_{SS}$ to which when V1 decreases and keep the condition for overdischarge delay time, The discharging control FET turns off, $Vs_1$=V1. The overdischarge Release Voltage (Vrel2) is the voltage between $V_{DD}$ and $V_{SS}$ to which when V1 increases, The discharging control FET turns on, $Vs_1$=0V.

### (3) Discharge overcurrent detection voltage and short circuit detection voltage (Test circuit 2)

The Discharge Overcurrent Detection Voltage (Vdet3) is the voltage between $V_M$ and $V_{SS}$ to which when $V_M$ increases and keep the condition for Discharge Overcurrent Delay Time (Tvdet3), The discharging control FET turns off, $Vs_1$=V1.

The Short Circuit Detection Voltage (Vshort) is the voltage between $V_M$ and $V_{SS}$ to which when $V_M$ increases and keep the condition for Short Circuit Delay Time (Tshort), The discharging control FET turns off, $Vs_1$=V1.

### (4) Normal operation current consumption and power down current consumption (Test circuit 2)

Set V1=3.9V and V2=0V under normal condition, the current $I_{DD}$ flowing through $V_{DD}$ pin is the normal operation consumption current ($I_{DD}$).

Set V1=3.9V and V2=0V，let IC work in normal condition, set V1 from 3.9V to 2.0V, then let VM floating under overdischarge condition, the current $I_{DD}$ flowing through $V_{DD}$ pin is the power down current consumption ($I_{STANDBY}$).

### (5) Overcharge detection delay time and overdischarge detection delay time (Test circuit 3)

If V1 increases to be Vdet1 or over Vdet1 and keeps the condition for some time, the charging control FET will turn off, $Vs_1$ is the threshold of a diode, The time is called overcharge detection delay time. It is used to judge whether overcharge happens indeed.

If V1 decreases to be Vdet2 or below Vdet2 and keeps the condition for some time, the discharging control FET will turn off, $Vs_1$=V1. The time is called overdischarge detection delay time. It is used to judge whether overdischarge happens indeed.

### (6) Discharge overcurrent detection delay time and short circuit detection delay time (Test circuit 4)

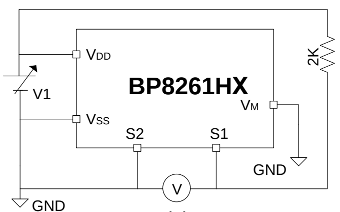
If V2 increases to be Vdet3 or over Vdet3 and keeps the condition for some time, the discharging control FET will turn off, $Vs_1$=V1. The time is called Discharge Overcurrent Delay Time. It is used to judge whether Discharge Overcurrent happens indeed.

If V2 increases to be Vshort or over Vshort and keeps the condition for some time, the discharging control FET will turn off, $Vs_1$=V1. The time is called short circuit delay time. It is used to judge whether short circuit happens indeed.

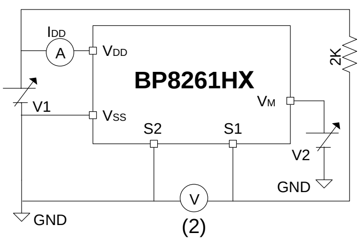
### (7) Internal resistance $V_M$-$V_{DD}$ and $V_M$-$V_{SS}$ (Test circuit 4)

Set V1=2.0 V, V2=0 V, V1/$I_{VM}$ is the internal resistance $R_{VMD}$.

Set V1=3.3 V, V2=1 V, V2/$I_{VM}$ is the internal resistance $R_{VMS}$.



(1)



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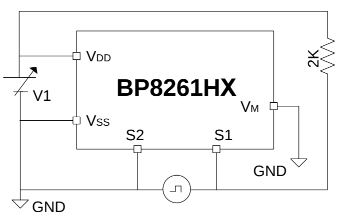

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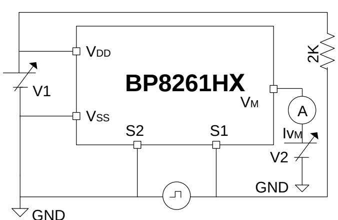
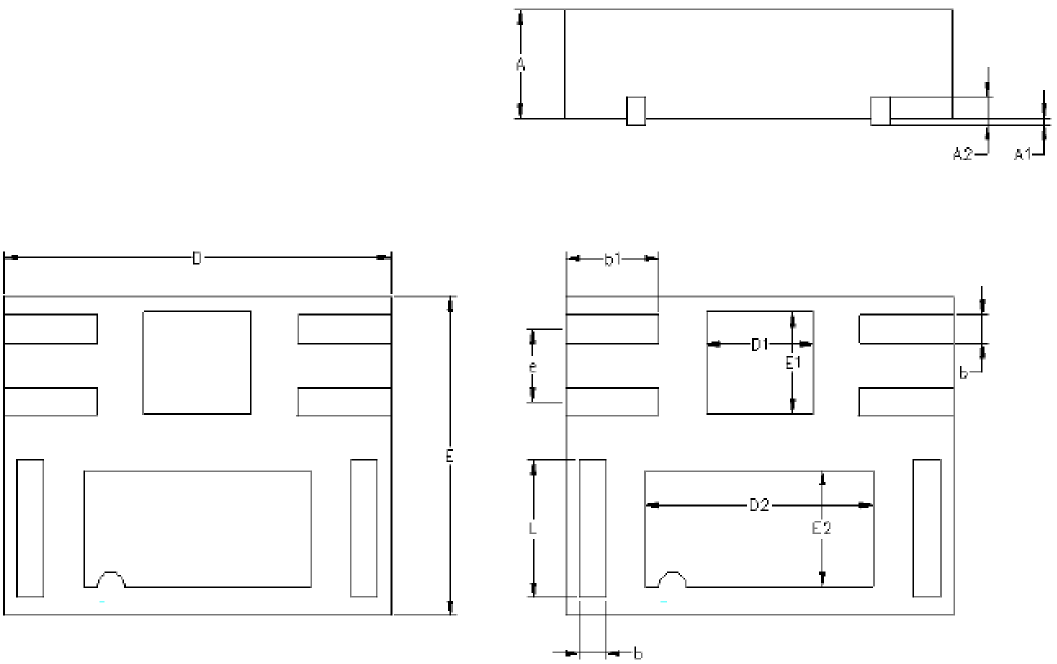


(4)

## Package Outline

**DFN 2.2*2.9-6LT**




**Dimensions (mm)**

| COMMON DEIMENSIONS(mm) | | | |
|---|---|---|---|
| RER | MIN | NOM | MAX |
| A | 0.45 | 0.50 | 0.55 |
| A1 | 0.00 | | 0.05 |
| A2 | 0.15REF | | |
| D | 2.85 | 2.90 | 2.95 |
| E | 2.15 | 2.20 | 2.25 |
| D1 | 0.75 | 0.80 | 0.85 |
| E1 | 0.65 | 0.70 | 0.75 |
| b | 0.15 | 0.20 | 0.25 |
| e | 0.50BSC | | |
| L | 0.90 | 0.95 | 1.00 |
| b1 | 0.65 | 0.70 | 0.75 |
| D2 | 1.65 | 1.70 | 1.75 |
| E2 | 0.75 | 0.80 | 0.85 |

## PCB Layout