# 1A Single Chip Li-Ion and Li-Polymer Charger

## General Description

The LP4072 is highly integrated Single-Cell linear charger, it offers integrated MOSFET, high-accuracy voltage regulation, temperature regulator, charge termination and charge indicator.

The battery is charged in three phases: trickle current, constant current and constant voltage.it automatically recharge if battery voltage falls below an internal recharge voltage threshold.

The charger supports charge current up to 1A, the device accepts an input voltage up to 28V, but it is disabled while the input voltage exceeds the input over voltage protection threshold, typically 7V. And accepts a battery voltage up to 15V, which designed for protect the chip from over-shoot voltage in single-cell LI-on/Li-Pol application.

## Features

- Input Voltage up to 28V
- Input Over Voltage Protection：7V
- Short-circuit protection
- Programmable Charge Current up to 1A
- 1μA Battery Reverse Current
- Over temperature Sensing Protection
- Protection of Reverse Connection of Battery
- Constant-Current/Constant-Voltage Operation with Thermal Regulation
- TDFN-8 Package
- RoHS Compliant and 100% Lead (Pb)-Free

## Applications

- Portable Media Players/Game
- Power Bank
- Bluetooth Applications
- PDA/MID

## Order Information

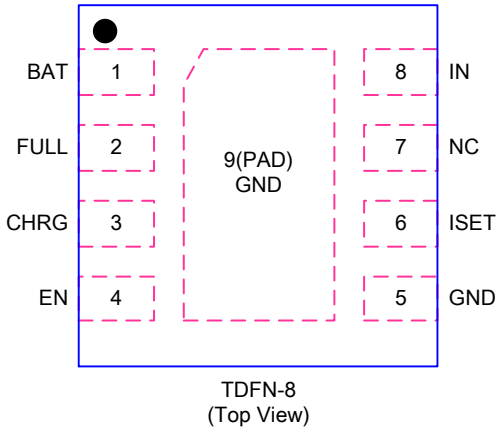
LP4072 □□ □

- F: Pb-Free
- Package Type QV: TDFN-8

## Marking Information

| Device | Marking | Package | Shipping |
|---|---|---|---|
| LP4072QVF | LPS<br>LP4072<br>YWX | TDFN-8 | 5K/REEL |
| Marking indication:<br>Y:Production year W:Production week X: Series Number | | | |

## Functional Pin Description

| Package Type | Pin Configurations |
|---|---|
| TDFN-8 |  |

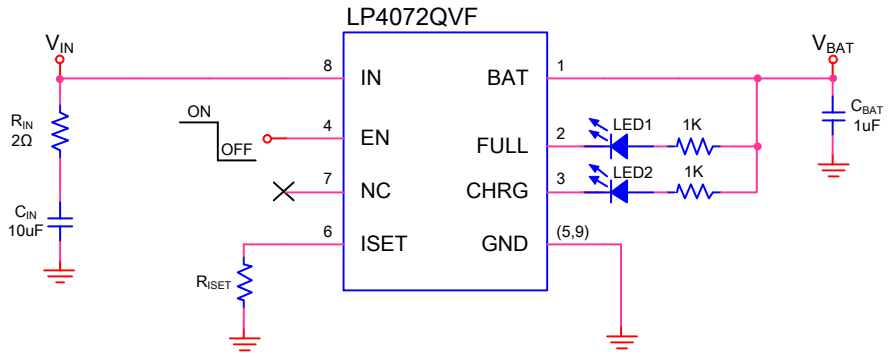


TDFN-8
(Top View)

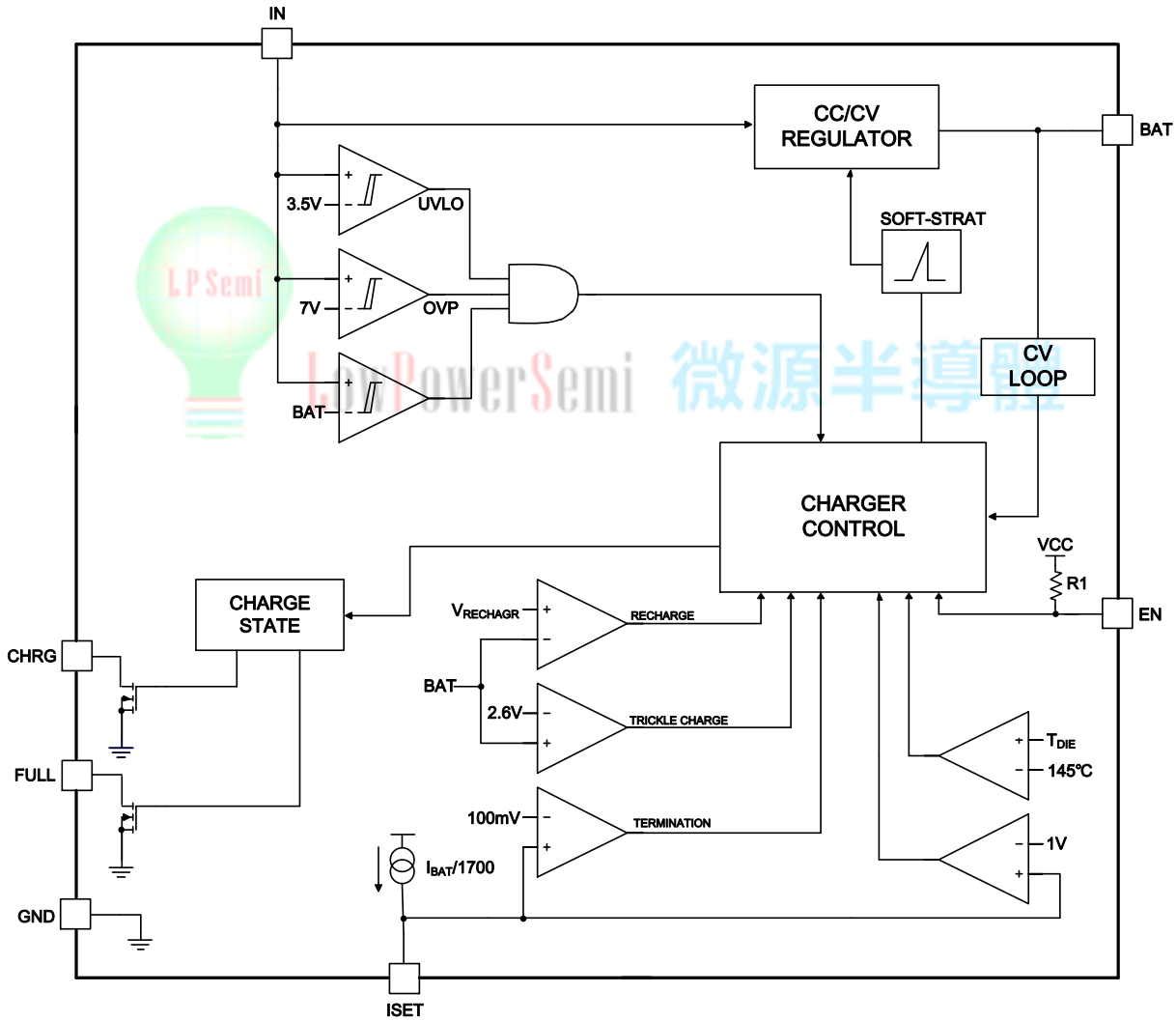
## Pin Description

| No. | NAME | DESCRIPTION |
|---|---|---|
| 1 | BAT | BAT is the connection to the battery. Typically a 10μF Tantalum capacitor is needed for stability when there is no battery attached. When a battery is attached, only a 1uF ceramic capacitor is required. |
| 2 | FULL | Open-Drain Charge Status Output. When the battery is charging, the FULL pin could be pulled High by an external pull high resistor. When the charge cycle is completed, the pin is pulled Low by an internal N-MOS. |
| 3 | CHRG | Open-Drain Charge Status Output. When the battery is charging, the CHRG pin is pulled low by an internal N-MOS. When the charge cycle is completed, the pin could be pulled High by an external pull high resistor. |
| 4 | EN | Charge Enable Input (Active high). |
| 5,9 | GND | Ground. |
| 6 | ISET | Charge Current Program. The charge current is programmed by connecting a 1% resistor ($R_{ISET}$) to ground. $$I_{BAT} = \frac{1700 \times V_{ISET}}{R_{ISET}}$$ |
| 7 | NC | No Connector. |
| 8 | IN | IN is the input power source. Connect to a wall adapter. |

## Typical Application Circuit




## Functional Block Diagram



## Absolute Maximum Ratings Note 1

- ✧ Input Voltage to GND ---------- -0.3V to 28V
- ✧ BAT Voltage to GND ---------- - 5V to 15V
- ✧ Other pin to GND ---------- -0.3V to 6.5V
- ✧ Maximum Junction Temperature($T_J$) ---------- 150℃
- ✧ Maximum Soldering Temperature (at leads, 10 sec) ---------- 260℃
- ✧ Operating Junction Temperature Range ---------- -20℃ to 85℃
- ✧ Storage Temperature ---------- -65℃ to 165℃

## Thermal Information

- ✧ Maximum Power Dissipation ( $P_D$,$T_A$=25°C) ---------- 1.5W
- ✧ Thermal Resistance ($\theta_{JA}$) ---------- 65℃/W

## ESD Susceptibility

- ✧ HBM(Human Body Model) ---------- 2KV
- ✧ MM(Machine Model) ---------- 200V

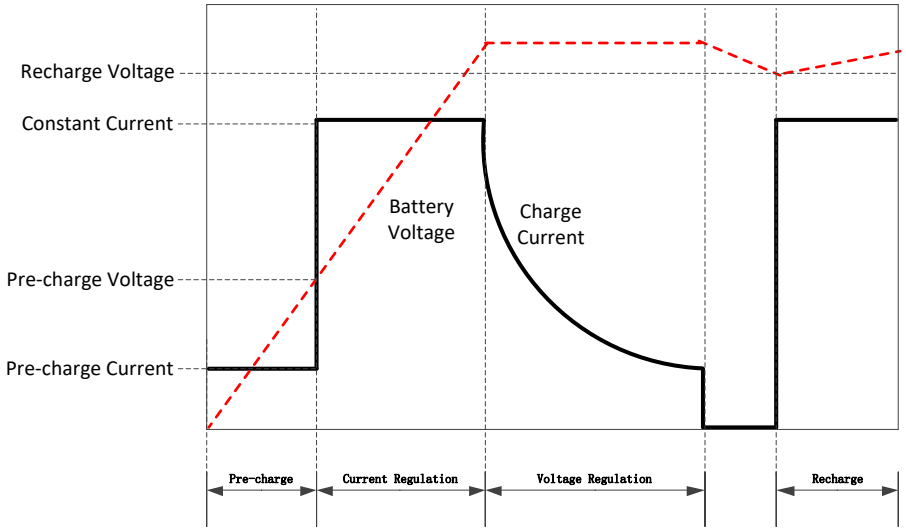
**Note 1.** Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied.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

## Electrical Characteristics

($T_A$=25°C, $V_{IN}$ =5V, unless otherwise noted.)

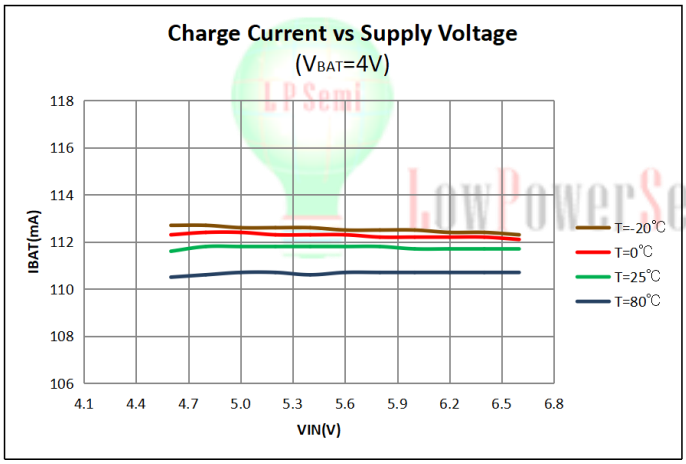
| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP. | MAX | UNITS |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | | 4.5 | 5 | 6.5 | V |
| $I_{IN}$ | Input Supply Current | $R_{ISET}$=17K,Charge Mode | | 300 | | μA |
| | | $V_{BAT}$=4.2V, Charge Terminated | | 160 | | μA |
| | | $R_{ISET}$=NC,Shutdown Mode | | 200 | | μA |
| $V_{FLOAT}$ | Regulated Output (Float) Voltage | $I_{BAT}$=40mA, | 4.158 | 4.2 | 4.242 | V |
| $V_{UV}$ | VIN Under Voltage Lockout Threshold | From $V_{IN}$ Low to High | | 3.5 | | V |
| $V_{UV\_HYS}$ | Under Voltage Lockout Hysteresis | | | 110 | | mV |
| $V_{OVP}$ | Input Voltage OVP | $V_{IN}$ Rising | | 7 | | V |
| $V_{OVP\_HYS}$ | OVP Hysteresis | | | 150 | | mV |
| $I_{BAT}$ | BAT Pin Current | $R_{ISET}$=3.4k, Current Mode | | 500 | | mA |
| | | $R_{ISET}$=17k, Current Mode | | 100 | | mA |
| | | $V_{BAT}$=4.2V ( $V_{IN}$=float or 0V ) | | 1 | | μA |
| $I_{TRIKL}$ | Trickle Charge Current | $V_{BAT}$<$V_{TRIKL}$ , $R_{ISET}$=10k, Charge Mode | | 10 | | %$I_{BAT}$ |
| $V_{TRIKL}$ | Trickle Charge Threshold Voltage | $V_{BAT}$ Rising | | 2.6 | | V |
| $V_{TRIKL-HYS}$ | Trickle Charge Hysteresis Voltage | | | 150 | | mV |
| $I_{TERM}$ | Termination Current Threshold | | | 10 | | %$I_{BAT}$ |
| $V_{ISET}$ | ISET Pin Voltage | $R_{ISET}$=10k, Current Mode | | 1 | | V |
| $I_{CHRG}$ | CHRG Pin Sink Current | $V_{CHRG}$=5V | | | 1 | μA |
| $I_{FULL}$ | FULL Pin Sink Current | | | | | μA |
| $V_{CHRG}$ | CHRG Pin Output Low Voltage | $I_{CHRG}$=5mA | | | 0.5 | V |
| $V_{FULL}$ | FULL Pin Output Low Voltage | $I_{FULL}$ = 5mA | | | 0.5 | V |
| $\Delta V_{RECHRG}$ | Recharge Battery Threshold Voltage | $V_{FLOAT}$-$V_{RECHRG}$ | | 150 | | mV |
| $V_{ASD}$ | $V_{IN}$ - $V_{BAT}$ Lockout Threshold Voltage | $V_{BAT}$=3.5V,$V_{IN}$ Rising | | 150 | | mV |
| $V_{EN\_ON}$ | EN Logic-High Voltage Threshold | | 1.4 | | | |
| $V_{EN\_OFF}$ | EN Logic-Low Voltage Threshold | | | | 0.4 | V |
| $t_{TERM}$ | Charge termination Filtering Time | | | 1 | | ms |
| $T_{CTM}$ | Junction Temperature in Constant Temperature Mode | | | 145 | | °C |

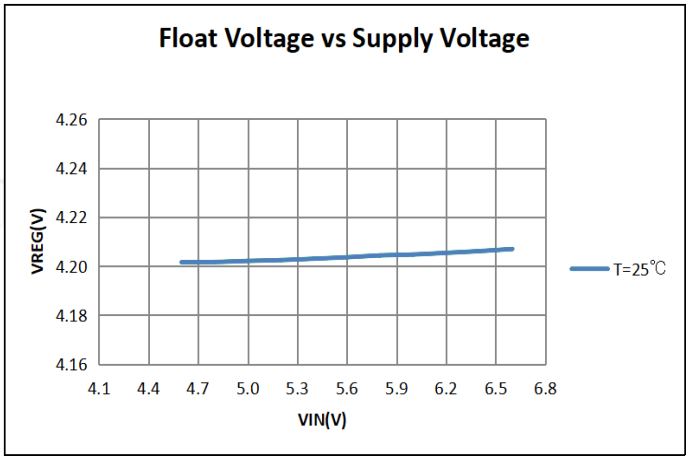
## Typical Charging Profile

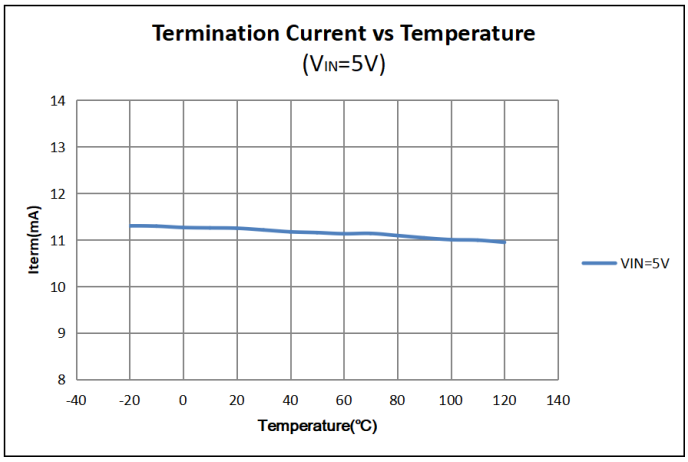


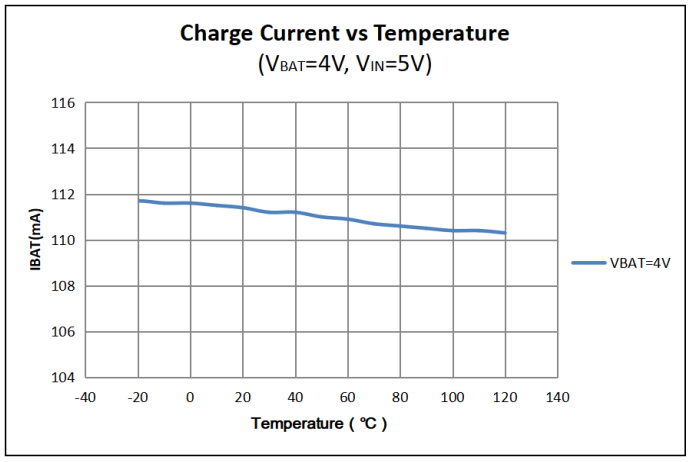

## Typical Performance Characteristics

(CIN=COUT=10uF,RISET=16.5K, unless otherwise noted)



# Application Information

The LP4072 has built-in input voltage surge protection as high as +28V. The charger IC will be automatically disabled when the input voltage is higher than 7V. A charge cycle begins when $V_{EN}$ is high level, the voltage at the IN pin rises above the UVLO threshold level and a program resistor is connected from the ISET pin to ground. If the $V_{BAT}$ is less than trickle voltage threshold, the charger enters trickle charge mode. In this mode, it supplies approximately 1/10 the ISET programmed charge current to bring the battery voltage up to a safe level for full current charging. When the $V_{BAT}$ rises above trickle voltage threshold, the charger enters constant-current mode, where the ISET programmed charge current is supplied to the battery. When the Battery Voltage approaches the final float voltage, the device enters constant-voltage mode and the charge current begins to decrease, the FULL pin goes high impedance when the charge current falls below the termination current threshold.

## Charge Termination

A charge cycle is terminated when the charge current falls to 1/10th the ISET programmed value after the final float voltage is reached. This condition is detected by using an internal, filtered comparator to monitor the ISET pin. When the ISET pin voltage falls below 100mV for longer than $t_{TERM}$ (typically 1ms), charging is terminated.

## Charge Current Program

The charge current ($I_{BAT}$) programed by a resistor ($R_{ISET}$) connecting from the ISET pin to GND. The relationship of the charge current and the programming resistance is established by the following equations ( $V_{ISET}$=1V ) .

$$I_{BAT} = \frac{1700 \times V_{ISET}}{R_{ISET}}$$

## Automatic Recharge

Once the charge cycle is terminated, the LP4072 continuously monitors the voltage on the BAT pin. A charge cycle restarts when the battery voltage falls below $V_{RECHRG}$ (which corresponds to approximately 80% to 90% battery capacity). This ensures that the battery is kept at or near a fully charged condition and eliminates the need for periodic charge cycle initiations.

## Charge Status Indicator

After application of a 5V source, the input voltage rises above the UVLO and sleep thresholds ($V_{IN}$>$V_{BAT}$+$V_{ASD}$), but is less than OVP ($V_{IN}$<$V_{OVP}$), CHRG and FULL has two different states: strong pull-down (~5mA) and high impedance. The relationship between charge status and indicator status is as follows:

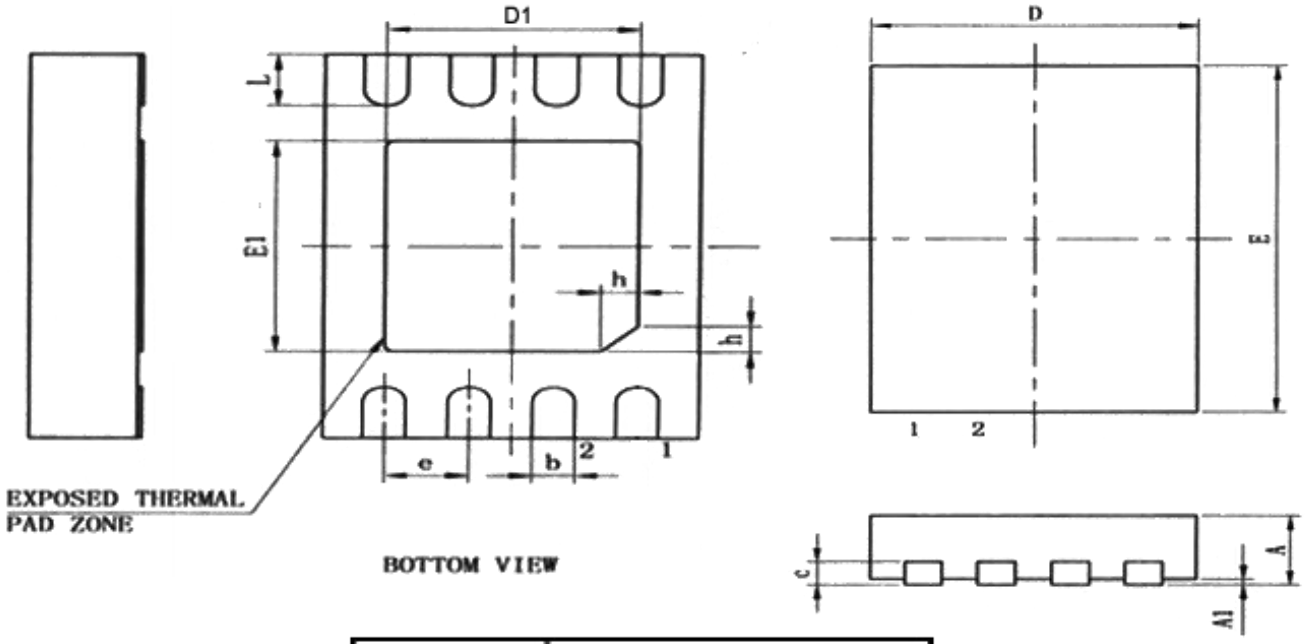
| Function | CHRG | FULL |
|---|---|---|
| Charging | Low | Hi-Z |
| Charge Finish | Hi-Z | Low |

## Thermal Limit

An internal thermal feedback loop reduces charge current if junction temperature attempts to rise above a preset value of approximately 145°C. This feature protects the device from excessive temperature and allows the user to push the limits of the power handling capability of a given circuit board without risk of damaging the device. The charge current can be set according to typical (not worst-case) ambient temperature with the assurance that the charger will automatically reduce the current in worst-case conditions.

## Packaging Information

### TDFN-8




| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 0.70 | 0.75 | 0.80 |
| A1 | — | 0.02 | 0.05 |
| b | 0.26 | 0.28 | 0.31 |
| c | 0.19 | 0.20 | 0.23 |
| D | 2.90 | 3.00 | 3.10 |
| D1 | 2.25 | 2.30 | 2.35 |
| e | 0.65BSC | | |
| E | 2.90 | 3.00 | 3.10 |
| E1 | 1.45 | 1.50 | 1.60 |
| L | 0.25 | 0.30 | 0.35 |
| h | 0.20 | 0.25 | 0.30 |