Fully Integrated Linear Single Cell Li-Ion Battery Charger for Portable Applications

General Description

The RT9505 is a fully integrated low cost single-cell Li-Ion battery charger ideal for portable applications. The RT9505 is capable of being powered up from AC adapter inputs. The RT9505 enters sleep mode when supplies is removed.

The RT9505 optimizes the charging task by using a control algorithm including preconditioning mode, fast charge mode and constant voltage mode. The charging task is terminated as the charge current drops below the preset threshold. The AC adapter charge current can be programmed up to 1A with an external resister. The internal thermal feedback circuitry regulates the die temperature to optimize the charge rate for all ambient temperatures.

The RT9505 features 18V and 7V maximum rating voltages for AC adapter. The other features are under voltage protection, over voltage protection for AC adapter supply, battery temperature monitoring, power supply status indicators and charge status indicator.

Ordering Information

RT9505□ □

Package Type
QW : WDFN-10L 3x3 (W-Type)

Operating Temperature Range
P : Pb Free with Commercial Standard
G : Green (Halogen Free with Commercial Standard)

Note :

RichTek Pb-free and Green 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.
- 100% matte tin (Sn) plating.

Features

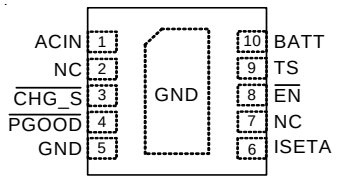
- **Automatic Input Supplies Selection**
- **18V Maximum Rating for AC Adapter**
- **Internal Integrated Power FETs**
- **AC Adapter Power Good Status Indicator**
- **Charge Status Indicator**
- **Under Voltage Protection**
- **Over Voltage Protection**
- **Automatic Recharge Feature**
- **Battery Temperature Monitoring**
- **Small 10-Lead WDFN Package**
- **Thermal Feedback Optimizing Charge Rate**

Applications

- Digital Cameras
- Cellular Phones
- Personal Data Assistants (PDAs)
- MP3 Players
- Hand Held PCs

Pin Configurations

(TOP VIEW)

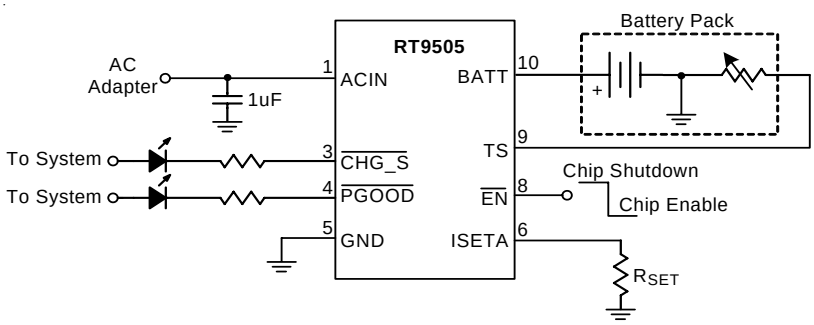


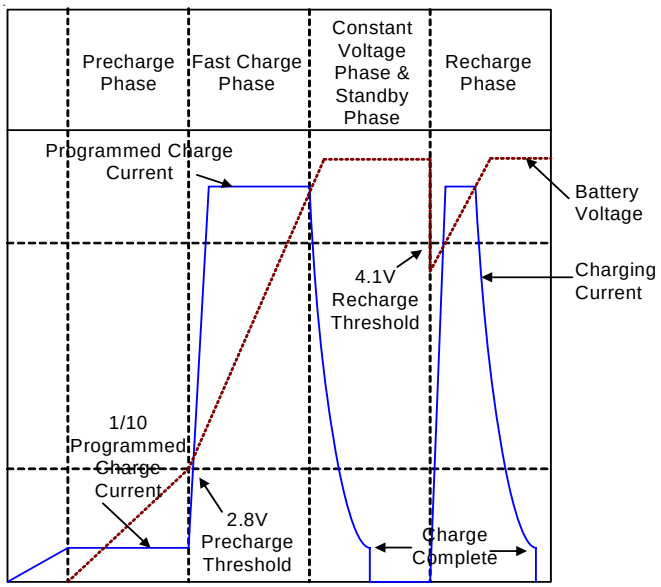
WDFN-10L 3x3

Marking Information

For marking information, contact our sales representative directly or through a RichTek distributor located in your area, otherwise visit our website for detail.

Typical Application Circuit

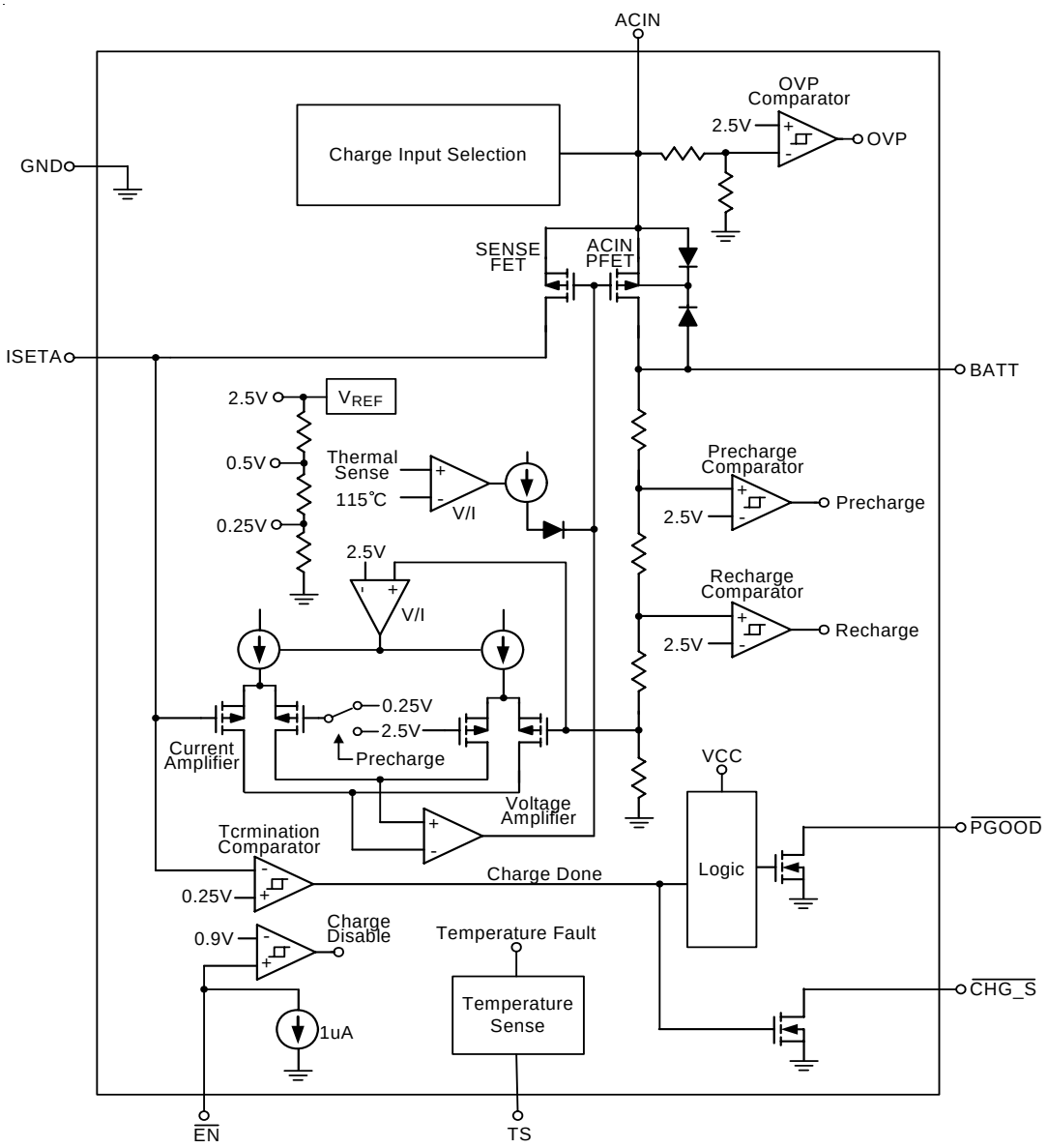




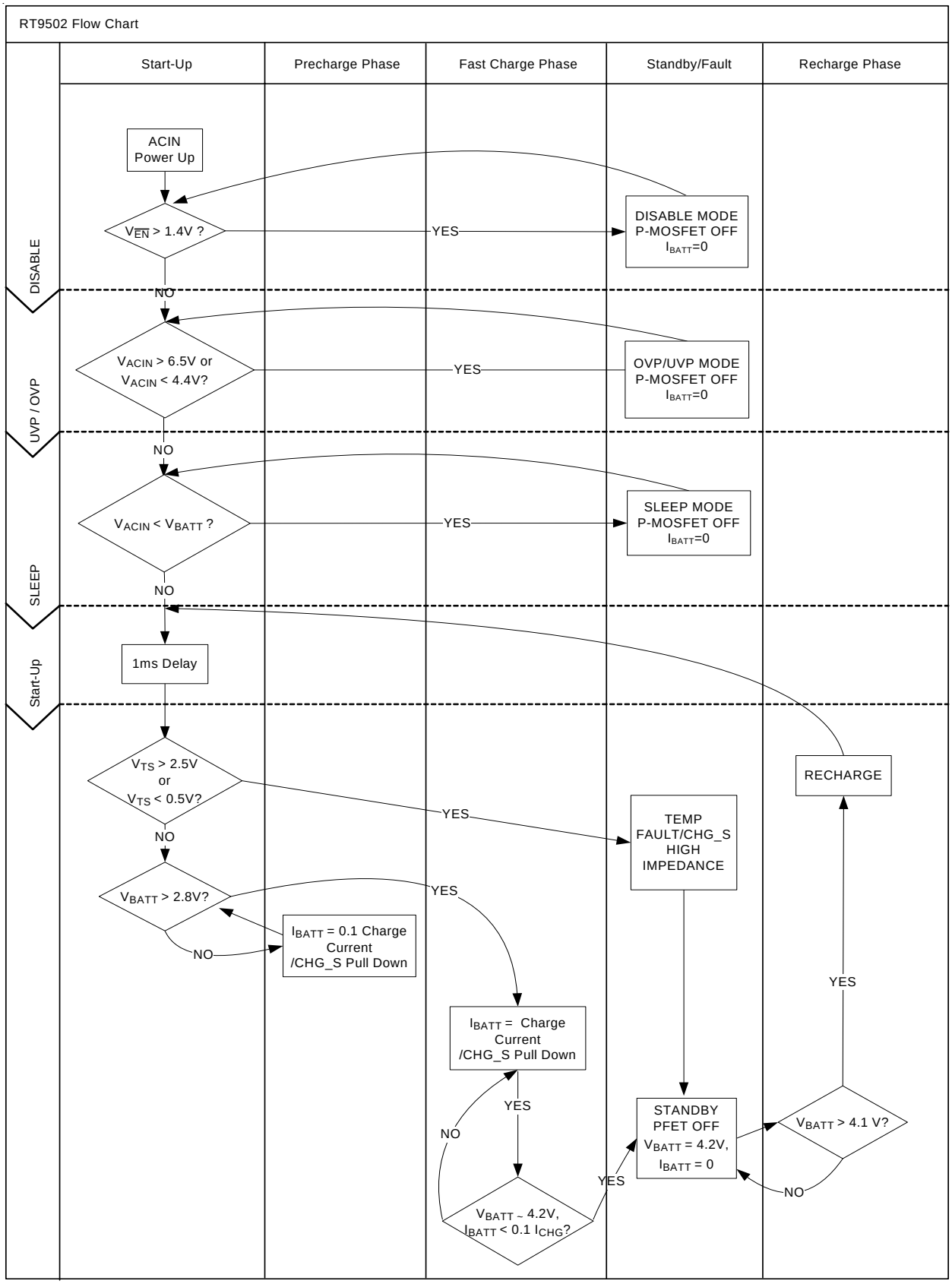
Functional Pin Description

Pin Number	Pin Name	Pin Function
1	ACIN	Wall Adaptor Charge Input Supply
2, 7	NC	No Internal Connect
3	$\overline{\text{CHG\_S}}$	Charge Status Indicator Output (open drain)
4	$\overline{\text{PGOOD}}$	Power Good Indicator Output (open drain)
5	GND	Ground
6	ISETA	Wall Adaptor Supply Charge Current Set Point
8	$\overline{\text{EN}}$	Charge Enable Input (active low)
9	TS	Temperature Sense Input
10	BATT	Battery Charge Current Output.
Exposed Pad	GND	Exposed pad should be soldered to PCB board and connected to GND

Function Block Diagram



Table


RT9502 Flow Chart
Start-Up
Precharge Phase
Fast Charge Phase
Standby/Fault
Recharge Phase
DISABLE
UVP / OVP
SLEEP
Start-Up
ACIN Power Up
VEN > 1.4V ?
YES
DISABLE MODE P-MOSFET OFF IBATT=0
NO
VACIN > 6.5V or VACIN < 4.4V?
YES
OVP/UVP MODE P-MOSFET OFF IBATT=0
NO
VACIN < VBATT ?
YES
SLEEP MODE P-MOSFET OFF IBATT=0
NO
1ms Delay
VTS > 2.5V or VTS < 0.5V?
YES
TEMP FAULT/CHG_S HIGH IMPEDANCE
NO
VBATT > 2.8V?
YES
NO
IBATT = 0.1 Charge Current /CHG_S Pull Down
IBATT = Charge Current /CHG_S Pull Down
YES
NO
VBATT ~ 4.2V, IBATT < 0.1 ICHG?
YES
STANDBY PFET OFF VBATT = 4.2V, IBATT = 0
VBATT > 4.1 V?
NO
YES
RECHARGE

Absolute Maximum Ratings (Note 1)

- AC Input Voltage ---------- –0.3V to 18V
- EN Input Voltage ---------- –0.3V to 6V
- $\overline{\text{Output}}$ Current ---------- 1.2A
- Power Dissipation, P_D @ T_A = 25°C
  WDFN-10L 3x3 ---------- 0.926W
- Package Thermal Resistance (Note 4)
  WDFN-10L 3x3, θ_{JA} ---------- 108°C/W
  WDFN-10L 3x3, θ_{JC} ---------- 8.2°C/W
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature ---------- 150°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 2)
  HBM (Human Body Mode) ---------- 2kV
  MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 3)

- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

Electrical Characteristics

(ACIN = 5V, T_A = 27°C, Unless Otherwise specification)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Input						
ACIN Input Voltage Range	V_{ACIN}		4.5	--	6	V
ACIN UVP Rising Threshold Voltage	$V_{UV(HIGH)}$		4.3	4.4	4.5	V
ACIN UVP Hysteresis	$V_{UV(LOW)}$		80	100	120	mV
ACIN Standby Current	I_{STBY}	V_{BATT} = 4.5V	--	300	500	μA
ACIN Shutdown Current	I_{SHDN}	$V_{\overline{EN}}$ = HIGH;	--	50	100	μA
ACIN UVP Current	I_{UVP}	V_{ACIN} = 4V; V_{BATT} = 3V ;	--	150	250	μA
BATT Sleep Leakage Current	I_{SLEEP}	V_{ACIN} = 4V; V_{BATT} = 4.5V ;	--	2	5	μA
Voltage Regulation						
BATT Regulation Voltage	V_{REG}	I_{BATT} = 60mA	4.158	4.2	4.242	V
Regulation Voltage Accuracy			–1	--	+1	%
ACIN MOSFET	$R_{DS(ON)\_ACIN}$	I_{BATT} = 500mA	--	600	--	mΩ
Current Regulation						
ISETA Set Voltage (Fast Charge Phase)	V_{ISETA}	V_{BATT} = 3.5V	2.45	2.5	2.55	V
Full Charge setting range	$I_{CHG(AC)}$		100	--	1200	mA
AC Charge Current accuracy	$I_{CHG(AC)}$	V_{BATT} = 3.8V; R_{ISET} = 1.5kΩ	--	500	--	mA
Precharge						
BATT Pre-charge Rising Threshold	V_{PRECH}		2.7	2.8	2.9	V
BATT Pre-charge Threshold Hysteresis	ΔV_{PRECH}		80	100	120	mV

To be continued

Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
ISETA Set Voltage (Pre-Charge Phase)		V_{PISET}	V_{BATT} = 2V; R_{ISET} = 1.5kΩ	0.225	0.25	0.275	V
Pre-Charge Current		I_{PCHG}	V_{BATT} = 2V	9	10	11	%
Recharge Threshold							
BATT Re-charge Falling Threshold Hysteresis		$\Delta V_{RECH(L)}$	$V_{REG} - V_{BATT}$	70	100	130	mV
Charge Termination Detection							
ISETA Charge Termination Set Voltage		V_{TERM}	V_{BATT} = 4.2V	225	250	275	mV
Termination Current Ratio (default)		I_{TERM}	V_{BATT} = 4.2V	--	10	--	%
Logic Input/Output							
$\overline{CHG\_S}$ Pull Down Voltage		$V_{\overline{CHG\_S}}$	TBD; $I_{\overline{CHG\_S}}$ = 5mA	--	65	--	mV
$\overline{PGOOD}$ Pull Down Voltage		$V_{\overline{PGOOD}}$	TBD; $I_{\overline{PGOOD}}$ = 5mA	--	220	--	mV
$\overline{EN}$ Threshold	Logic-High Voltage	V_{IH}		1.5	--	--	V
	Logic-Low Voltage	V_{IL}		--	--	0.4	V
$\overline{EN}$ Pin Input Current		$I_{\overline{EN}}$	$V_{\overline{EN}}$ = 2V	--	--	1.5	μA
Battery Temperature Sense							
TS Pin Source Current		I_{TS}	V_{TS} = 1.5V	94	100	106	μA
TS Pin Threshold	High Voltage	$V_{TS(HIGH)}$	Falling	0.485	0.5	0.515	V
	Low Voltage	$V_{TS(LOW)}$	Rising	2.45	2.5	2.55	V
Protection							
Thermal Regulation				--	115	--	°C
OVP SET			Internal Default	--	6.5	--	V

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

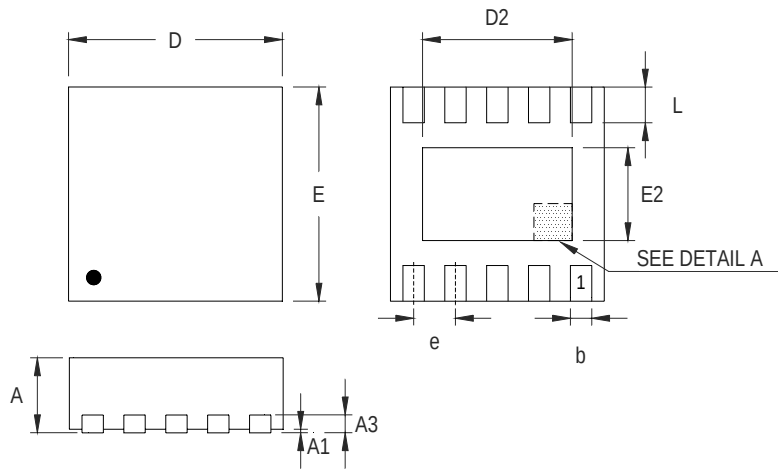
Note 3. The device is not guaranteed to function outside its operating conditions.

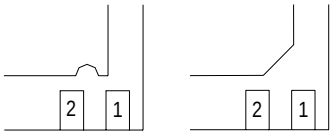
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective thermal conductivity test board (4 layers, 1S) of JEDEC 51-7 thermal measurement standard. The case point of θ_{JC} is on the expose pad for the QFN package.

Datasheet Revision History

Version	Data	Page No.	Item	Description
00C	2007/2/16			First edition

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	0.180	0.300	0.007	0.012
D	2.950	3.050	0.116	0.120
D2	2.300	2.650	0.091	0.104
E	2.950	3.050	0.116	0.120
E2	1.500	1.750	0.059	0.069
e	0.500		0.020	
L	0.350	0.450	0.014	0.018

W-Type 10L DFN 3x3 Package

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