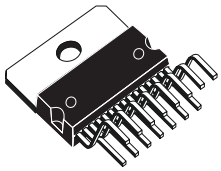
L4954

Quad multifunction voltage regulator for car radio

Features

- 4 regulators:
  - 10 V (40 mA) low dropout
  - 8.5 V (175 mA)
  - 5 V (650 mA)
  - 5 V (100 mA) standby
- 3 high side drivers:
  - 2 A (HSD1)
  - 0.3 A (HSD2 & HSD3)
- No external charge pump capacitors are required
- Standby mode controlled by 3 input pins:
  - EN1 for REG1, REG2, REG3 and HSD1
  - EN2 for HSD2
  - EN3 for HSD3
- Individual thermal shutdown
- Logic outputs for supply undervoltage:
  - LVWARN
  - Reset
- Independent current limiting
- Overvoltage shutdown
- Short circuit protection
- Load dump protection and overvoltage
- Shutdown



Multiwatt15

Description

L4954 is a quad output voltage regulator and a three output high side driver.

The IC includes monitoring circuitry to warn the microprocessor of a low voltage condition: the LVWarn, output, sensing the slow dropping of STCAP pins voltage, gives the microprocessor time to store data.

A reset output is generated at REG4's decay.

External protection must be provided for reverse battery protection.

Table 1. Device summary

Order code	Package	Packing
L4954	Multiwatt15	Tube

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1 Block and pins connection diagrams

Figure 1. Block diagram

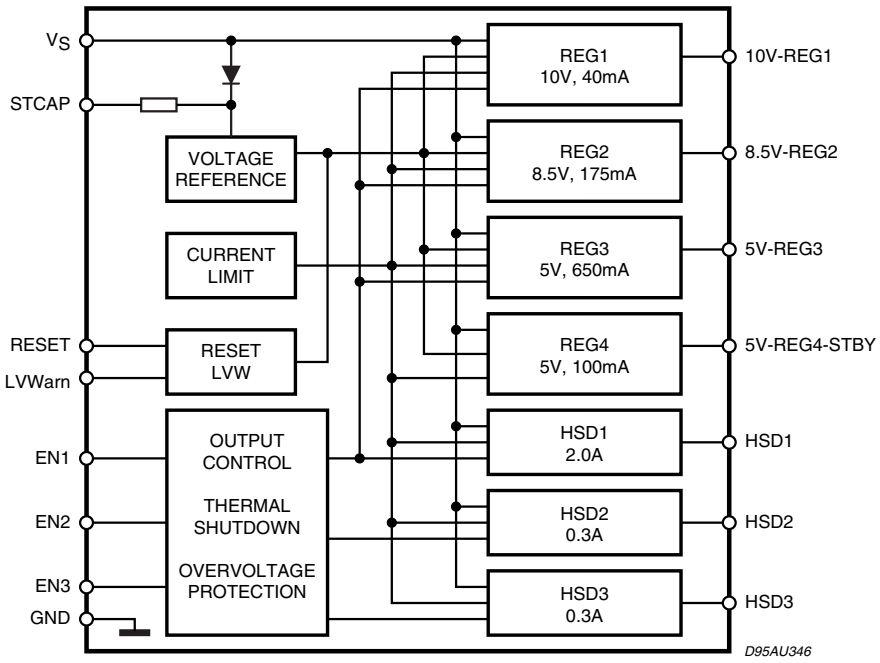
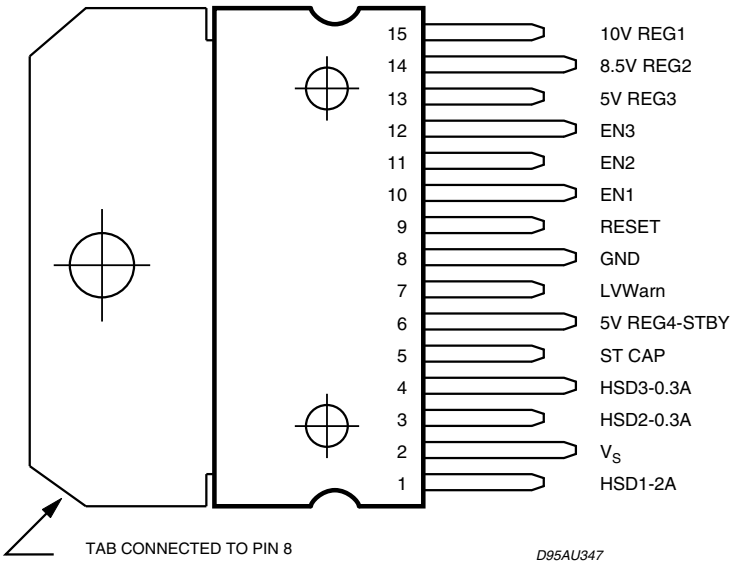


Figure 2. Pins connection diagram (top view)



2 Electrical specifications

2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_S	DC operating supply voltage	-0.6 to 26.5	V
V_S	Transient supply overvoltages, rise time = 10 ms ,delay time = 115 ms	34	V
$V_{S,ovs}$	Overvoltage shutdown	27	V
V_{in}	Input voltages (EN1, EN2, EN3)	-0.6 to 6.0	V
V_{out}	Output voltages (LVWarn, RESET)	-0.6 to 6.0	V
T_{op}	Operating temperature range	-40 to 85	°C
T_{stg}	Storage temperature range	-40 to 150	°C

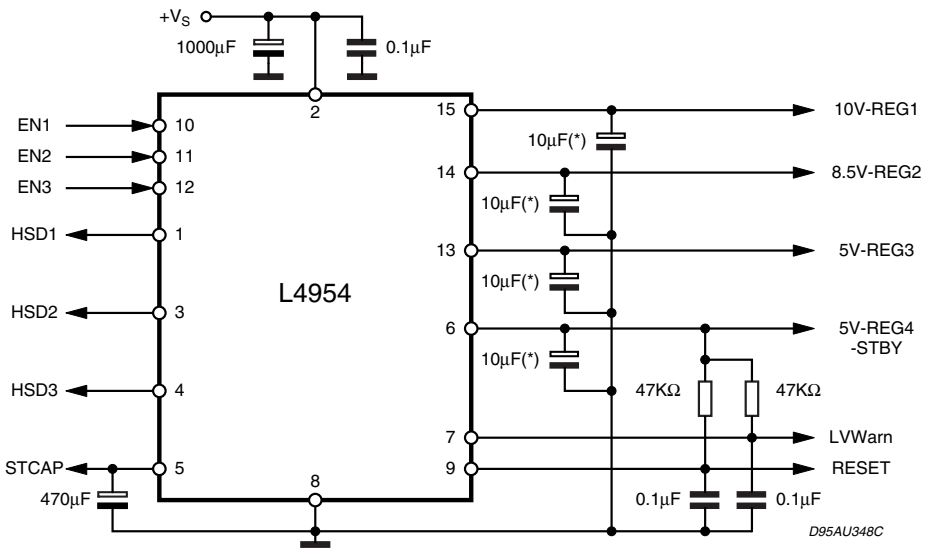
2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{th\ j\text{-}case}$	Thermal resistance junction-to-case	2	°C/W

2.3 Application circuit

Figure 3. Application circuit



(*)ESR of output capacitors should be between 0.2Ω to 5.0Ω

2.4 Electrical characteristics

Refer to the *Figure 3: Application circuit*, V_S = 14.4 V; T_{amb} = 25 °C; I_{OUT10} = 5 mA; $I_{OUT8.5}$ = 5 mA; I_{OUT5} = 5 mA; $I_{OUT5\ ST\text{-}BY}$ = 0.5 mA; R_{HSD1} = 16 Ω, $R_{HSD2,3}$ = 107 Ω, unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_S	Operating supply voltage	-	11	-	16	V
I_q	Maximum quiescent current	I_{OUT10} = 40 mA; $I_{OUT8.5}$ = 175 mA; I_{OUT5} = 650 mA; $I_{OUT5ST\text{-}BY}$ = 100mA; R_{HSD1} = 8 Ω; $R_{HSD2,3}$ = 53 Ω	-	10	-	mA
$I_{q,ST\text{-}BY}$	Standby quiescent current	EN1, EN2, EN3 = 0 $I_{OUT5,\ ST\text{-}BY}$ = 50 mA	-	420	-	mA
		EN1, EN2, EN3 = 0 $I_{OUT5,\ ST\text{-}BY}$ = 2 mA	-	300	-	mA
V_{ENL}	EN1, EN2, EN3 input low voltage	-	0	-	0.8	V
V_{ENH}	EN1, EN2, EN3 input high voltage (outputs active)	-	2	-	5	V
10 V / 40 mA reg 1 output						
V_{OUT10}	Output voltage	I_{OUT10} = 40 mA	-	10	-	V
ΔV_{line}	Line regulation	V_S = 11 to 26 V	-	2	-	mV
ΔV_{load}	Load regulation	I_{OUT10} = 5 to 40 mA	-	2	-	mV
$V_{DROPOUT}$	Dropout voltage	$V_S = V_{OUT10}$ + 0.1 V I_{OUT10} = 5 mA	-	100	200	mV
		$V_S = V_{OUT10}$ + 0.5 V I_{OUT10} = 40 mA	-	500	600	mV
I_{q1}	Reg 1 quiescent current	I_{OUT10} = 5 mA	-	7	-	mA
		I_{OUT10} = 40 mA	-	7	-	mA
I_{lim1}	Current limit	-	-	100	-	mA
SVR1	Reg 1 supply voltage rejection	f = 0.12 to 10 kHz; I_{OUT10} = 25 mA; V_{RIP} =1 Vpp	-	55	-	dB
8.5V / 175 mA reg 2 output						
$V_{OUT8.5}$	Output voltage	$I_{OUT8.5}$ = 175 mA	-	8.5	-	V
ΔV_{line}	Line regulation	V_S = 11 to 26 V	-	2	-	mV
ΔV_{load}	Load regulation	$I_{OUT8.5}$ = 5 to 175 mA	-	10	-	mV
$V_{DROPOUT}$	Dropout voltage	$V_S = V_{OUT8.5}$ + 0.3 V $I_{OUT8.5}$ = 5 mA	-	300	400	mV
		$V_S = V_{OUT8.5}$ +1 V $I_{OUT8.5}$ = 175 mA	-	-	1.1	V

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{q2}	Reg 2 quiescent current	$I_{OUT8.5}$ = 5 mA	-	7	-	mA
		$I_{OUT8.5}$ = 175 mA	-	7	-	mA
I_{lim2}	Current limit		-	300	-	mA
5 V / 650 mA reg 3 output						
V_{OUT5}	Output voltage	I_{OUT5} = 650 mA	-	5	-	V
ΔV_{line}	Line regulation	V_S = 7 to 26 V	-	2	-	mV
ΔV_{load}	Load regulation	I_{OUT5} = 5 to 650mA	-	9	-	mV
$V_{DROPOUT}$	Dropout voltage	$V_S = V_{OUT5}$ + 0.3 V I_{OUT5} = 5 mA	-	300	400	mV
		$V_S = V_{OUT5}$ +1 V I_{OUT5} = 650mA	-	1	1.1	V
I_{q3}	Reg 3 quiescent current	I_{OUT5} = 5 mA	-	7	-	mA
		I_{OUT5} = 650 mA	-	7	-	mA
I_{lim3}	Current limit	-	-	1.25	-	A
SVR3	Reg 3 supply voltage rejection	f = 0.12 to 10 kHz; I_{OUT5} = 325 mA; V_{RIP} =1 Vpp	-	55	-	dB
5V / 100 mA standby reg 4 output						
$V_{OUT5STBY}$	Output voltage	$I_{OUT5STBY}$ = 100 mA	-	5	-	V
ΔV_{line}	Line regulation	V_S = 7 to 26 V	-	0.8	-	mV
ΔV_{load}	Load regulation	I_{out} = 0.5 to 100 mA	-	3.5	-	mV
$V_{DROPOUT}$	Dropout voltage	$V_S = V_{REG5STBY}$ + 0.1 V $I_{out5STBY}$ = 5mA	-	100	200	mV
		$V_S = V_{REG5STBY}$ + 0.5 V $I_{out5STBY}$ = 100 mA	-	500	600	mV
I_{q4}	Reg 4 quiescent current	$I_{OUT5STBY}$ = 2 mA	-	0.25	-	mA
		$I_{OUT5STBY}$ = 100 mA	-	0.35	-	mA
I_{lim4}	Current limit	-	-	190	-	mA
SVR4	Reg 4 supply voltage rejection	f = 0.12 to 10 kHz $I_{out5STBY}$ = 50 mA; V_{RIP} =1 Vpp	-	55	-	dB
2 A HSD1						
$V_{sat,peak}$	Maximum output current saturation voltage	R_{HSD1} = 8 Ω	-	600	-	mV
I_q	Quiescent current	-	-	9	-	mA
I_{lim}	Current limit	R_{HSD1} = 0.5 Ω	-	3.5	-	A
I_{leak1}	Output leakage current	All driver outputs are off	-	20	-	mA

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
0.3 A HSD2 & HSD3						
V_{sat}	Maximum output current saturation voltage	$R_{HSD2,3}$ = 53 Ω	-	150	-	mV
I_q	Quiescent current	-	-	1.5	-	mA
I_{lim}	Current limit	$R_{HSD2.3}$ = 0.5 Ω	-	500	-	mA
$I_{leak2,3}$	Output leakage current	All driver outputs are off	-	10	-	µA
SVR2	Reg 1supply voltage rejection	f = 0.12 to 10 kHz; $I_{OUT8.5}$ = 100 mA; V_{RIP} =1Vpp	-	55	-	dB
LVWARN OUTPUT						
TH_{LVW}	LVW threshold on STCAP	-	-	7.5	-	V
V_{LVW}	LVW output voltage	STCAP < 7.5 V; V_{IL} = ”0”	0	-	0.4	V
		STCAP > 7.5 V V_{IH} = ”1”	2.75	-	5	V
t_{rise}	LVW output rise time	C_{LVW} = 0.1 µF	-	3.9	-	ms
t_{fall}	LVW output fall time		-	12.6	-	µs
Reset output						
T_{HRES}	Reset threshold on reg 4	-	-	4.5	-	V
V_{RES}	Reset output voltage	Set VS so that $V_{OUT5STBY}$ < 4.5 V; V_{IL} = ”0”	0	-	0.4	V
		Set V_S so that $V_{OUT5STBY}$ is not less than normal reg 4 output voltage; V_{IH} = ”1”	2.75	-	5	V
t_{rise}	Reset output rise time	C_{RESET} =0.1 µF	-	4.5	-	ms
t_{fall}	Reset output fall time		-	37	-	µs

3 Functional description

The L4954 includes a monitoring circuit to warn the microprocessor if a low voltage or no voltage condition is occurring.

When the voltage on the STCAP pin drops below 7.5 V (typ), the LVW output goes low. This tells the microprocessor to stop executing code and save vital information. The reset output goes low when REG4 (5 V - standby) drops below (V_{REG4} -250 mV) or 4.75 V is minimum value. The RESET output doesn't go above 0.4V until REG4 has gone back above 4.75 V (min).

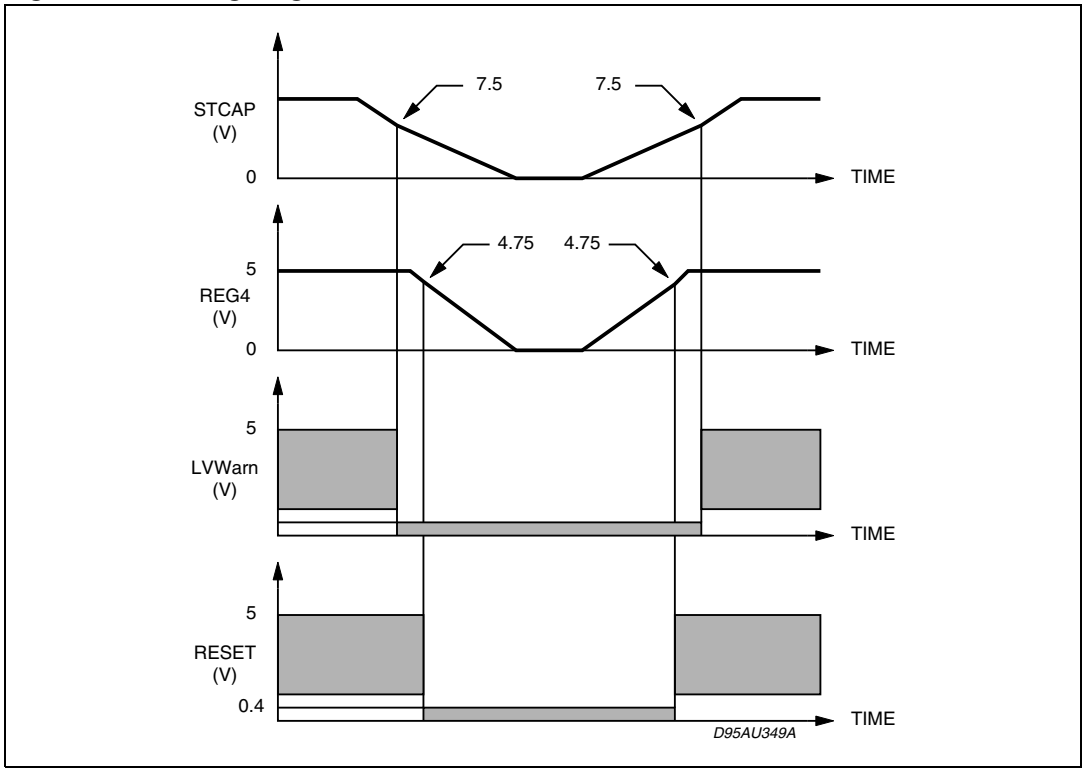
Any spike tells the microprocessor to start operating. Once the STCAP line passes 7.5 V (typ), the LVWarn output also returns to high state.

The STCAP pin acts like a delay circuit. Due to the large capacitor (470 µF), the STCAP pin allows the battery voltage to decay slowly giving the microprocessor time to store data.

Also, during short low voltage or negative voltage conditions, the STCAP pin protects the 5 V standby output from dropping below the RESET and LVW trip points. The four outputs are expected to follow the battery voltage down to 11 V for REG1, 9 V for REG2, 6 V for REG3 and REG4.

The L4954 has a standby mode to keep the microprocessor and memories alive during ignition off conditions. The EN1 input pin is controlled by the microprocessor. A high on the EN1 input turns on REG1, REG2, REG3, and HSD1. A Low on EN1 places the part in stand-by mode with REG4 on. The high side driver outputs HSD2 and HSD3 are controlled by EN2 and EN3 respectively: a low on the control input turns the corresponding high side driver off.

Figure 4. Timing diagram



4 Package information

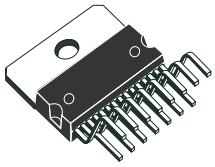
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.

ECOPACK® is an ST trademark.

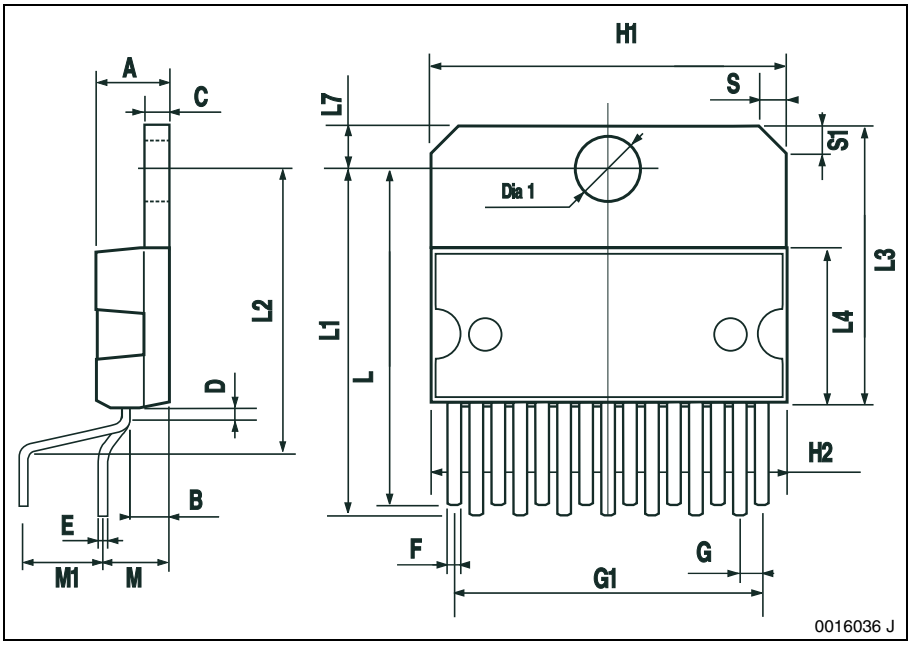
Figure 5. Multiwatt15 mechanical data and package dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A5						0.197
B			2.65			0.104
C			1.6			0.063
D		1			0.039	
E	0.49		0.55	0.019		0.022
F	0.66		0.75	0.026		0.030
G	1.02	1.27	1.52	0.040	0.050	0.060
G1	17.53	17.78	18.03	0.690	0.700	0.710
H1	19.6			0.772		
H2			20.2			0.795
L	21.9	22.2	22.5	0.862	0.874	0.886
L1	21.7	22.1	22.5	0.854	0.87	0.886
L2	17.65		18.1	0.695		0.713
L3	17.25	17.5	17.75	0.679	0.689	0.699
L4	10.3	10.7	10.9	0.406	0.421	0.429
L7	2.65		2.9	0.104		0.114
M	4.25	4.55	4.85	0.167	0.179	0.191
M1	4.73	5.08	5.43	0.186	0.200	0.214
S	1.9		2.6	0.075		0.102
S1	1.9		2.6	0.075		0.102
Dia1	3.65		3.85	0.144		0.152

OUTLINE AND MECHANICAL DATA



Multiwatt15 (vertical)



5 Revision history

Table 5. Document revision history

Date	Revision	Changes
12-Jul-2010	1	Initial release.
18-Sep-2013	2	Updated Disclaimer.