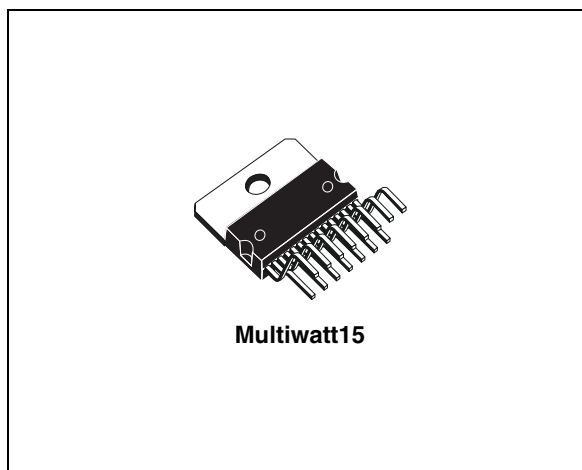


## Quad multifunction voltage regulator for car radio

### 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



### 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

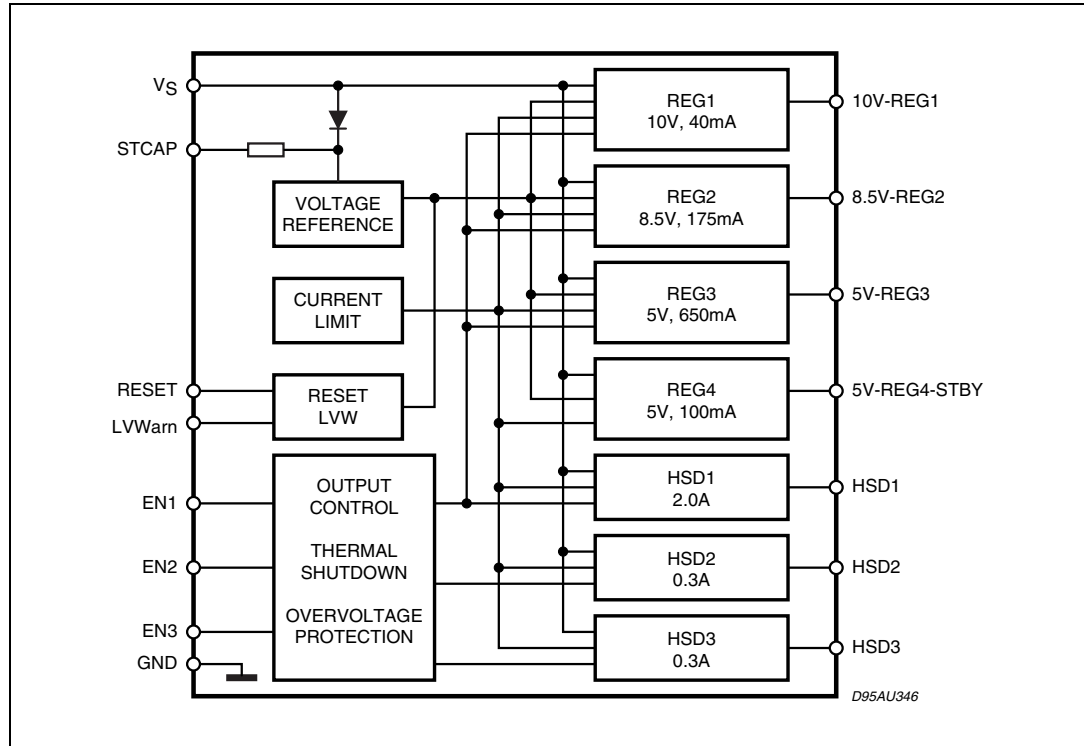
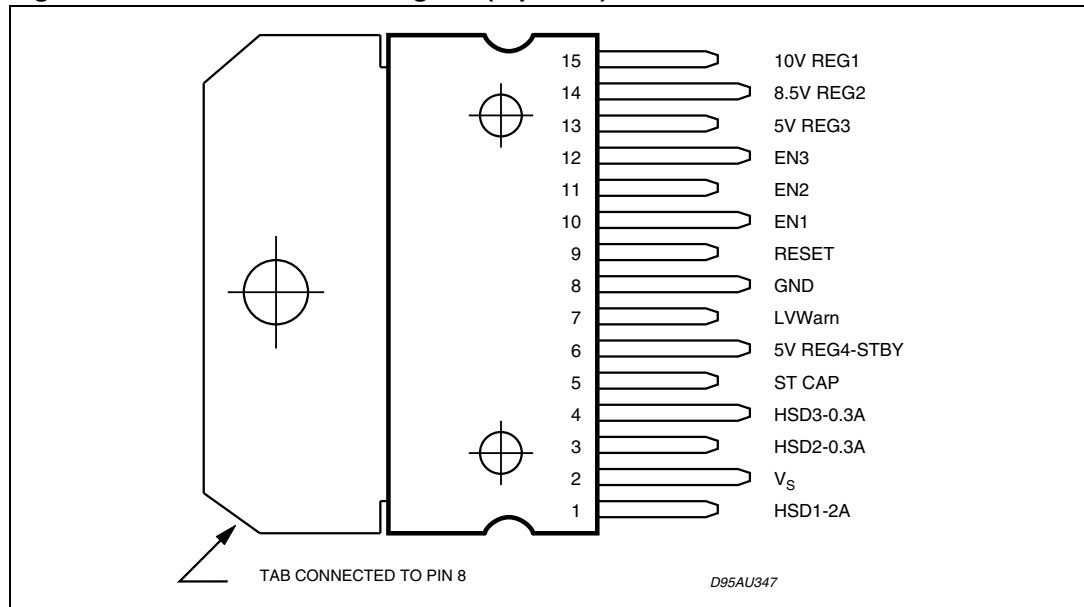


Figure 2. Pins connection diagram (top view)



## 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

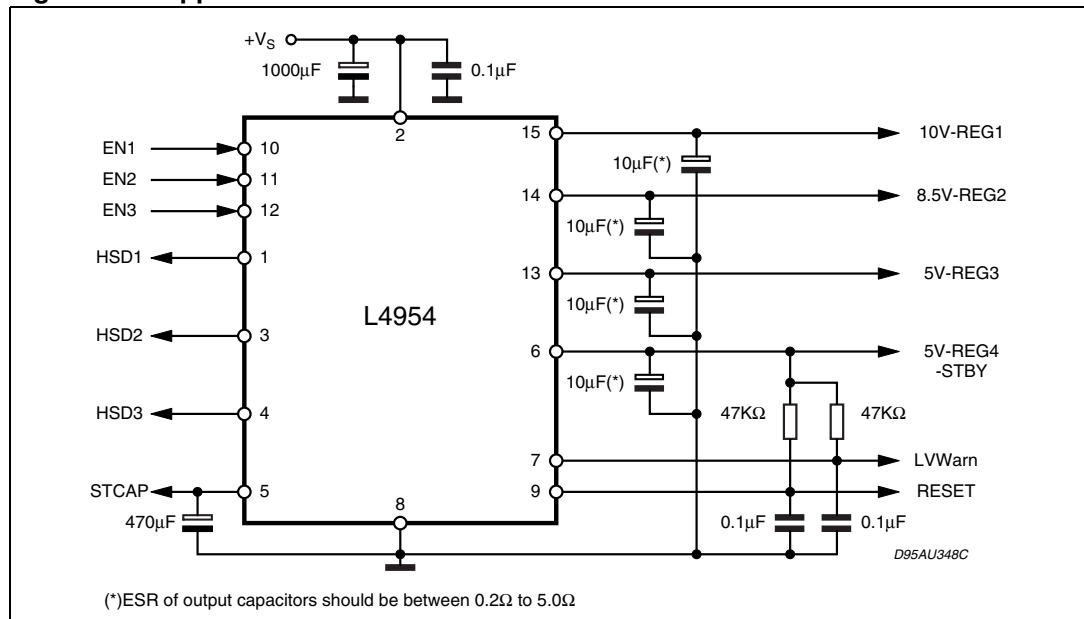
### 2.2 Thermal data

Table 3. Thermal data

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

### 2.3 Application circuit

Figure 3. Application circuit



## 2.4 Electrical characteristics

Refer to the [Figure 3: Application circuit](#),  $V_S = 14.4\text{ V}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ;  $I_{\text{OUT}10} = 5\text{ mA}$ ;  $I_{\text{OUT}8.5} = 5\text{ mA}$ ;  $I_{\text{OUT}5} = 5\text{ mA}$ ;  $I_{\text{OUT}5\text{ ST-BY}} = 0.5\text{ mA}$ ;  $R_{\text{HSD}1} = 16\ \Omega$ ,  $R_{\text{HSD}2,3} = 107\ \Omega$ , 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	$I_{\text{OUT}10} = 40\text{ mA}$ ; $I_{\text{OUT}8.5} = 175\text{ mA}$ ; $I_{\text{OUT}5} = 650\text{ mA}$ ; $I_{\text{OUT}5\text{ ST-BY}} = 100\text{ mA}$ ; $R_{\text{HSD}1} = 8\ \Omega$ ; $R_{\text{HSD}2,3} = 53\ \Omega$	-	10	-	mA
$I_{q,\text{ST-BY}}$	Standby quiescent current	EN1, EN2, EN3 = 0 $I_{\text{OUT}5, \text{ST-BY}} = 50\text{ mA}$	-	420	-	mA
		EN1, EN2, EN3 = 0 $I_{\text{OUT}5, \text{ST-BY}} = 2\text{ mA}$	-	300	-	mA
$V_{\text{ENL}}$	EN1, EN2, EN3 input low voltage	-	0	-	0.8	V
$V_{\text{ENH}}$	EN1, EN2, EN3 input high voltage (outputs active)	-	2	-	5	V
<b>10 V / 40 mA reg 1 output</b>						
$V_{\text{OUT}10}$	Output voltage	$I_{\text{OUT}10} = 40\text{ mA}$	-	10	-	V
$\Delta V_{\text{line}}$	Line regulation	$V_S = 11\text{ to }26\text{ V}$	-	2	-	mV
$\Delta V_{\text{load}}$	Load regulation	$I_{\text{OUT}10} = 5\text{ to }40\text{ mA}$	-	2	-	mV
$V_{\text{DROPOUT}}$	Dropout voltage	$V_S = V_{\text{OUT}10} + 0.1\text{ V}$ $I_{\text{OUT}10} = 5\text{ mA}$	-	100	200	mV
		$V_S = V_{\text{OUT}10} + 0.5\text{ V}$ $I_{\text{OUT}10} = 40\text{ mA}$	-	500	600	mV
$I_{q1}$	Reg 1 quiescent current	$I_{\text{OUT}10} = 5\text{ mA}$	-	7	-	mA
		$I_{\text{OUT}10} = 40\text{ mA}$	-	7	-	mA
$I_{\text{lim}1}$	Current limit	-	-	100	-	mA
SVR1	Reg 1 supply voltage rejection	$f = 0.12\text{ to }10\text{ kHz}$ ; $I_{\text{OUT}10} = 25\text{ mA}$ ; $V_{\text{RIP}} = 1\text{ Vpp}$	-	55	-	dB
<b>8.5V / 175 mA reg 2 output</b>						
$V_{\text{OUT}8.5}$	Output voltage	$I_{\text{OUT}8.5} = 175\text{ mA}$	-	8.5	-	V
$\Delta V_{\text{line}}$	Line regulation	$V_S = 11\text{ to }26\text{ V}$	-	2	-	mV
$\Delta V_{\text{load}}$	Load regulation	$I_{\text{OUT}8.5} = 5\text{ to }175\text{ mA}$	-	10	-	mV
$V_{\text{DROPOUT}}$	Dropout voltage	$V_S = V_{\text{OUT}8.5} + 0.3\text{ V}$ $I_{\text{OUT}8.5} = 5\text{ mA}$	-	300	400	mV
		$V_S = V_{\text{OUT}8.5} + 1\text{ V}$ $I_{\text{OUT}8.5} = 175\text{ mA}$	-	-	1.1	V

**Table 4. Electrical characteristics (continued)**

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



Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
<b>0.3 A HSD2 &amp; HSD3</b>						
$V_{sat}$	Maximum output current saturation voltage	$R_{HSD2,3} = 53 \Omega$	-	150	-	mV
$I_q$	Quiescent current	-	-	1.5	-	mA
$I_{lim}$	Current limit	$R_{HSD2,3} = 0.5 \Omega$	-	500	-	mA
$I_{leak2,3}$	Output leakage current	All driver outputs are off	-	10	-	$\mu$ A
SVR2	Reg 1 supply voltage rejection	$f = 0.12$ to $10$ kHz; $I_{OUT8,5} = 100$ mA; $V_{RIP} = 1$ Vpp	-	55	-	dB
<b>LVWARN OUTPUT</b>						
$TH_{LVW}$	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	$C_{LVW} = 0.1 \mu$ F	-	3.9	-	ms
$t_{fall}$	LVW output fall time		-	12.6	-	$\mu$ s
<b>Reset output</b>						
$T_{HRES}$	Reset threshold on reg 4	-	-	4.5	-	V
$V_{RES}$	Reset output voltage	Set $V_S$ 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	$C_{RESET} = 0.1 \mu$ F	-	4.5	-	ms
$t_{fall}$	Reset output fall time		-	37	-	$\mu$ s

### 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 ( $V_{REG4} - 250\text{ mV}$ ) 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).

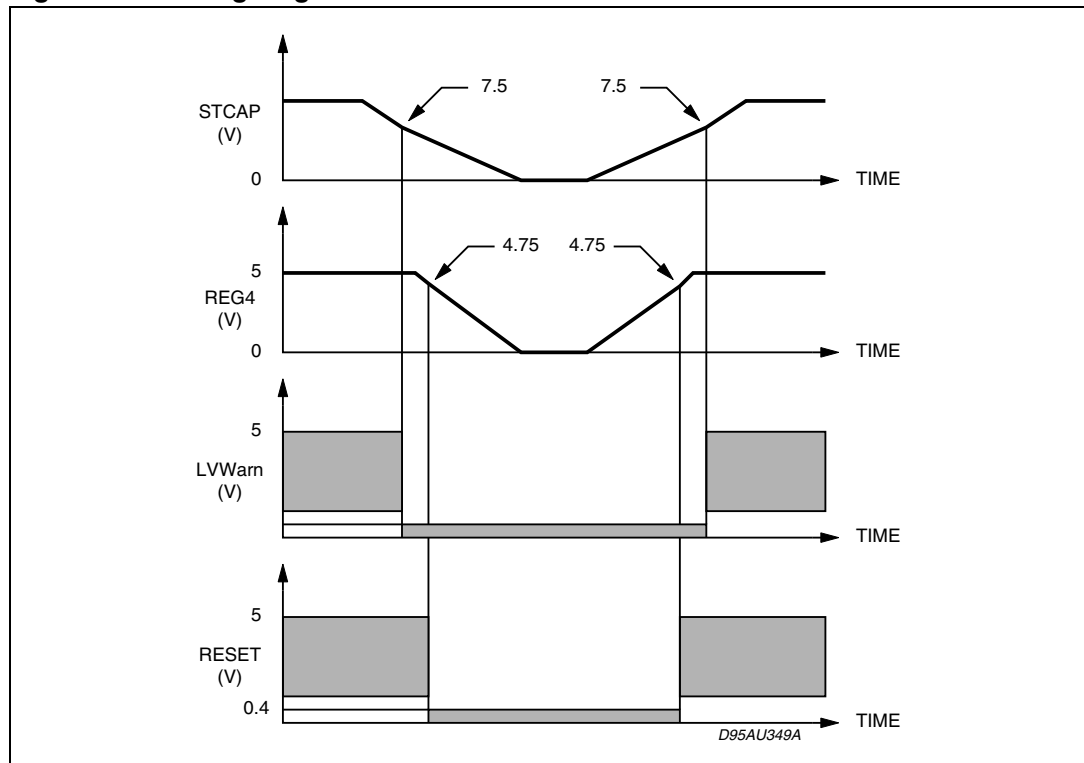
Any spike tells the microprocessor to start operating. Once the STCAP line passes 7.5 V (typ), the LVWarn output also returns to high state.

The STCAP pin acts like a delay circuit. Due to the large capacitor (470  $\mu\text{F}$ ), 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**

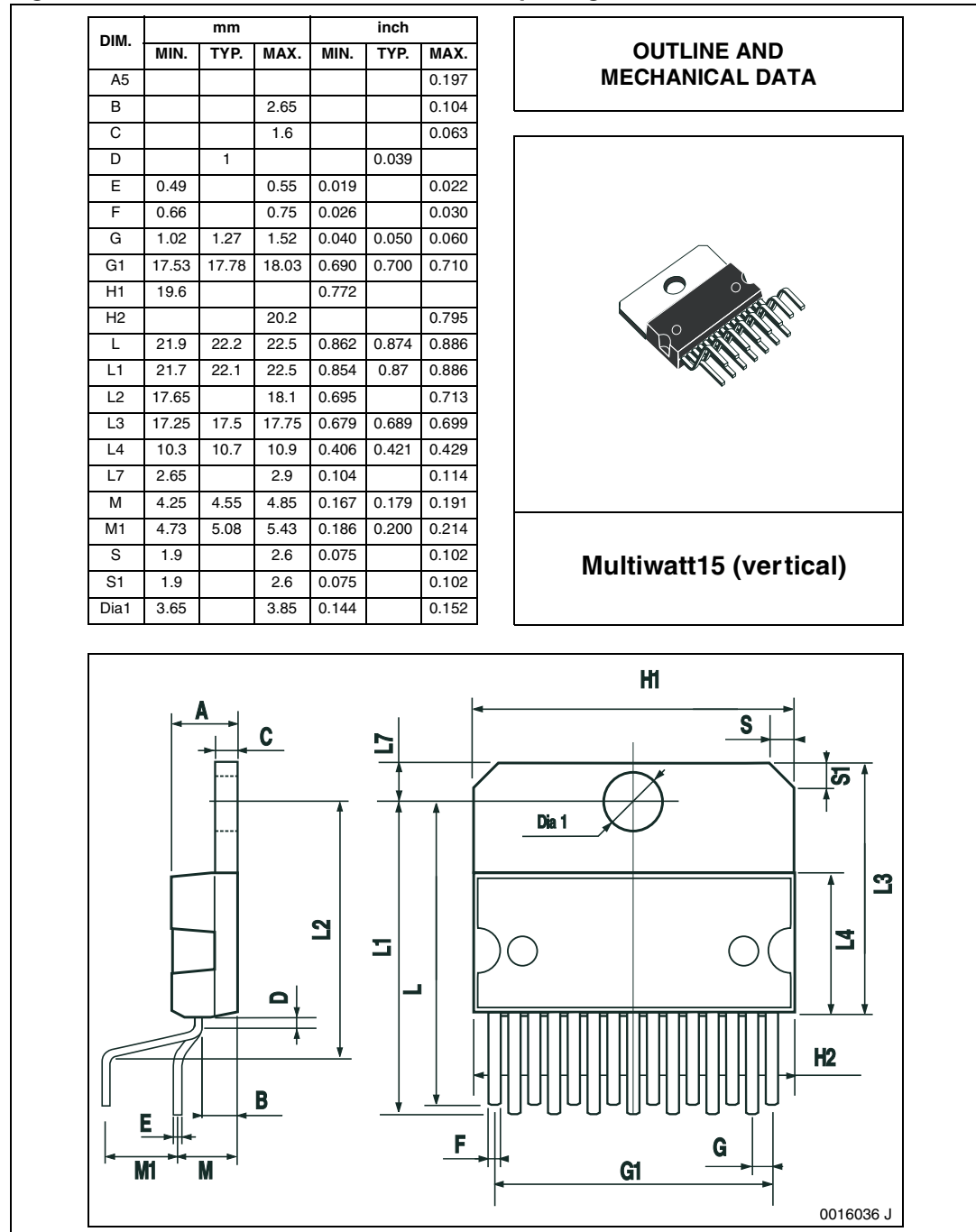


# 4 Package information

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](http://www.st.com).

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**Figure 5. Multiwatt15 mechanical data and package dimensions**



## 5 Revision history

**Table 5. Document revision history**

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

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