



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

LV5681P — Monolithic Linear IC For Car Audio Systems Multi-Power Supply System IC

Overview

The LV5681P is a multi-power supply system IC that provides four regulator outputs and two high side switches as well as a number of protection functions including overcurrent protection, overvoltage protection and overheat protection. It is an optimal power supply IC for car audio and car entertainment systems and similar products.

Features

- Four regulator output systems
 - For microcontroller: 5.7V output voltage, 200mA maximum output current
 - For CD drive: 7.0V output voltage, 1300mA maximum output current
 - For illumination: 8 to 12V output voltage (output can be set with external resistors), 300mA maximum output current
 - For audio systems: 8 to 9V output voltage (output voltage can be set with external resistors), 300mA maximum output current
- Two V_{CC} -linked high side switch systems
 - EXT: 350mA maximum output current, 0.5V voltage difference between input and output.
 - ANT: 300mA maximum output current, 0.5V voltage difference between input and output.
- Two V_{DD} 5V-linked high side switch systems
 - SW5V: 200mA maximum output current, 0.2V voltage difference between input and output.
 - ACC (accessory voltage detection output): 100mA maximum output current, 0.2V voltage difference between input and output.
- Overcurrent protection function
- Overvoltage protection function, typ 21V (excluding V_{DD} 5V output)
- Overheat protection function, typ 175°C
- On-chip accessory voltage detection circuit
- P-channel LDMOS used for power output block

CAUTION)

The protection functions are provided in order to improve the ability of the ICs to withstand breakdown, and they are not intended to guarantee safety when used under conditions outside the safe operating area or rated operating conditions.

Use of the ICs under any conditions exceeding the safe operating area or above the I_{Omax} , and especially use in overcurrent protection areas or under conditions in which they are subject to thermal protection, may reduce their reliability and result in permanent breakdown.

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Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Conditions	Conditions	Ratings	Unit	
Supply voltage	V _{CC} max		36	V	
Peak supply voltage	V _{CC} peak	See below for the waveform applied.	50	V	
Allowable Power dissipation	Pd max	Independent IC	Ta ≤ 25°C	1.5	W
		Al heat sink *		5.6	W
		With an infinity heat sink		32.5	W
Junction temperature	Tj max		150	°C	
Operating ambient temperature	Topr		-40 to +85	°C	
Storage temperature	Tstg		-55 to +150	°C	

* : When the Aluminum heat sink (50mm × 50mm × 1.5mm) is used

Allowable Operating range at Ta = 25°C

Parameter	Conditions	Ratings	Unit
Operating supply voltage 1	V _{DD} output, SW output, ACC output	7.5 to 16	V
Operating supply voltage 2	ILM output at 10V	12 to 16	V
	ILM output at 8V	10 to 16	V
Operating supply voltage 3	Audio output at 9V	10 to 16	V
Operating supply voltage 4	CD output (CD output current = 1.3A)	10.5 to 16	V
	CD output (CD output current ≤ 1A)	10 to 16	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 14.4V

*: All the specifications are defined based on the tests that Tj is almost equal to Ta (=25°C). To suppress the rise of Tj in the junction temperature as much as possible, it tests by the pulse loading.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	I _{CC}	V _{DD} no load, CTRL1/2 = [L/L], ACC = 0V		400	800	μA
CTRL1 Input						
Low input voltage	V _{IL1}		0		0.4	V
M1 input voltage	V _{IM1}		0.8	1.1	1.4	V
M2 input voltage	V _{IM2}		1.9	2.2	2.5	V
High input voltage	V _{IH1}		2.9	3.3	5.5	V
Input impedance	R _{IH1}		350	500	650	kΩ
CTRL2 Input						
Low input voltage	V _{IL2}		0		0.5	V
M input voltage	V _{IM2}		1.1	1.65	2.1	V
High input voltage	V _{IH2}		2.5	3.3	5.5	V
Input impedance	R _{IH2}		350	500	650	kΩ
V_{DD} 5.7V Output *1 The V_{DD} 5.7V output supplies the output currents of SW 5.7V and ACC 5.7V.						
Output voltage 1	V _{O1}	I _{O1} = 200mA, I _{O7} , I _{O8} = 0A	5.4	5.7	6.0	V
Output voltage 2	V _{O1'}	I _{O1} = 200mA, I _{O7} = 200mA, I _{O8} = 100mA	5.4	5.7	6.0	V
Output total current	I _{to1}	V _{O1} ≥ 5.4V, I _{to1} = I _{O1} + I _{O7} + I _{O8}	500			mA
Line regulation	ΔV _{OLN1}	7.5V < V _{CC} < 16V, I _{O1} = 200mA *2		30	90	mV
Load regulation	ΔV _{OLD1}	1mA < I _{O1} < 200mA *2		70	150	mV
Dropout voltage 1	V _{DROP1}	I _{O1} = 200mA *2		1.0	1.5	V
Dropout voltage 2	V _{DROP1'}	I _{O1} = 100mA *2		0.7	1.05	V
Dropout voltage 3	V _{DROP1''}	I _{O1} + I _{O7} + I _{O8} = 500mA		2.5	3.75	V
Ripple rejection	R _{REJ1}	f = 120Hz, I _{O1} = 200mA *2	40	50		dB
CD Output ; CTRL2 = [H]						
Output voltage	V _{O2}	I _{O2} = 1000mA	6.65	7.0	7.35	V

*1 : The V_{DD} 5.7V output also supplies the output currents of SW 5.7V and ACC 5.7V. Therefore, the current supply capability of the V_{DD} 5.7V output and its other electrical characteristics are affected by the output statuses of SW 5.7V and ACC 5.7V.

*2 : SW 5V and ACC 5.7V are not subject to a load.

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output current	I_{O2}	$V_{O2} \geq 6.65V$	1300			mA
Line regulation	ΔV_{OLN2}	$10.5V < V_{CC} < 16V, I_{O2} = 1000mA$		50	100	mV
Load regulation	ΔV_{OLD2}	$10mA < I_{O2} < 1000mA$		100	200	mV
Dropout voltage 1	V_{DROP2}	$I_{O2} = 1000mA$		1.0	1.5	V
Dropout voltage 2	V_{DROP2}'	$I_{O2} = 500mA$		0.5	0.75	V
Ripple rejection	R_{REJ2}	$f = 120Hz, I_{O2} = 1000mA$	40	50		dB
AUDIO (8-9V) Output ; CTRL2 = [M]						
AUDIO_F pin voltage	V_{I3}		1.222	1.260	1.298	V
AUDIO_F pin inflow current	I_{IN3}		-1		1	μA
AUDIO output voltage 1	V_{O3}	$I_{O3} = 200mA, R2 = 30k\Omega, R3 = 5.6k\Omega *3$	7.65	8.0	8.35	V
AUDIO output voltage 2	V_{O3}'	$I_{O3}' = 200mA, R2 = 27k\Omega, R3 = 4.7k\Omega *3$	8.13	8.5	8.87	V
AUDIO output voltage 3	V_{O3}''	$I_{O3}'' = 200mA, R2 = 24k\Omega, R3 = 3.9k\Omega *3$	8.6	9.0	9.4	V
AUDIO output current	I_{O3}		300			mA
Line regulation	ΔV_{OLN3}	$10V < V_{CC} < 16V, I_{O3} = 200mA$		30	90	mV
Load regulation	ΔV_{OLD3}	$1mA < I_{O3} < 200mA$		70	150	mV
Dropout voltage 1	V_{DROP3}	$I_{O3} = 200mA$		0.3	0.45	V
Dropout voltage 2	V_{DROP3}'	$I_{O3} = 100mA$		0.15	0.23	V
Ripple rejection	R_{REJ3}	$f = 120Hz, I_{O3} = 200mA$	40	50		dB
ILM (8-12V) Output ; CTRL1 = [M1]						
ILM_F pin voltage	V_{I4}		1.222	1.260	1.298	V
ILM output voltage 1	V_{O4}	$I_{O4} = 200mA, R2 = 30k\Omega, R3 = 5.6k\Omega *3$	7.65	8.0	8.35	V
ILM output voltage 2	V_{O4}'	$I_{O4}' = 200mA, R2 = 27k\Omega, R3 = 3.9k\Omega *3$	9.55	10.0	10.45	V
ILM output voltage 3	V_{O4}''	$I_{O4}'' = 200mA, R2 = 33k\Omega, R3 = 3.9k\Omega *3$	11.36	11.9	12.44	V
ILM output current	I_{O4}		300			mA
Line regulation	ΔV_{OLN4}	$12V < V_{CC} < 16V, I_{O4} = 200mA$		30	90	mV
Load regulation	ΔV_{OLD4}	$1mA < I_{O4} < 200mA$		70	150	mV
Dropout voltage 1	V_{DROP4}	$I_{O4} = 200mA$		0.7	1.05	V
Dropout voltage 2	V_{DROP4}'	$I_{O4} = 100mA$		0.35	0.53	V
Ripple rejection	R_{REJ4}	$f = 120Hz, I_{O4} = 200mA$	40	50		dB
Remoto (EXT) ; CTRL1 = [M2]						
Output voltage	V_{O5}	$I_{O5} = 350mA$	$V_{CC}-1.0$	$V_{CC}-0.5$		V
Output current	I_{O5}	$V_{O5} \geq V_{CC}-1.0$	350			mA
ANT remoto ; CTRL1 = [H]						
Output voltage	V_{O6}	$I_{O6} = 300mA$	$V_{CC}-1.0$	$V_{CC}-0.5$		V
Output current	I_{O6}	$V_{O6} \geq V_{CC}-1.0$	300			mA
SW 5V Output ; CTRL2 = [M]						
Output voltage 1	V_{O7}	$I_{O7} = 1mA, I_{O1}, I_{O8} = 0A *4$	$V_{O1}-0.25$	V_{O1}		V
Output voltage 2	V_{O7}'	$I_{O7} = 200mA, I_{O1}, I_{O8} = 0A *4$	$V_{O1}-0.45$	$V_{O1}-0.2$		V
Output current	I_{O7}	$V_{O7} \geq 4.55$	200			mA
ACC Detection ; ACC Integration 5V output						
ACC detection voltage	V_{TH8}		2.75	3.0	3.25	V
Hysteresis width	V_{HIS8}		0.2	0.3	0.4	V
Input impedance	Z_{I8}	(Pull-down resistance internal)	42	60	78	$k\Omega$
ACC output voltage 1	V_{O8}	$I_{O8} = 0.5mA, I_{O1}, I_{O7} = 0A *4$	$V_{O1}-0.25$	V_{O1}		V
ACC output voltage 2	V_{O8}'	$I_{O8} = 100mA, I_{O1}, I_{O7} = 0A *4$	$V_{O1}-0.45$	$V_{O1}-0.2$		V
ACC output voltage	I_{O8}	$V_{O8} \geq 4.55$	100			mA

*3 : When a component with a resistance accuracy of $\pm 1\%$ is used

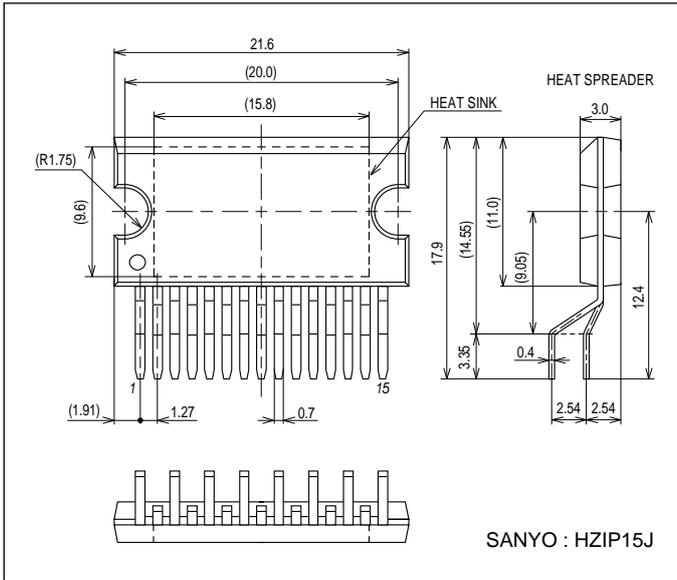
<Reference> When a component with a resistance accuracy of $\pm 0.5\%$ is used, V_{O3}'' is $8.67V \leq 9.0V \leq 9.33V$.

*4 : Since the SW 5.7V and ACC 5.7V are output from V_{DD} 5.7V through the SW, the voltage drops by an amount equivalent to the ON resistance of the SW.

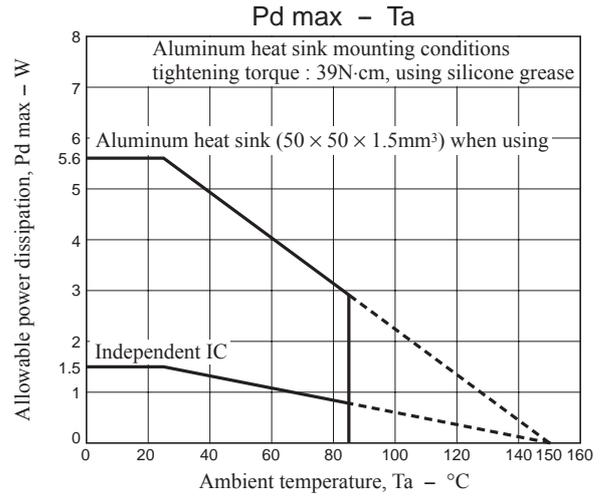
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Package Dimensions

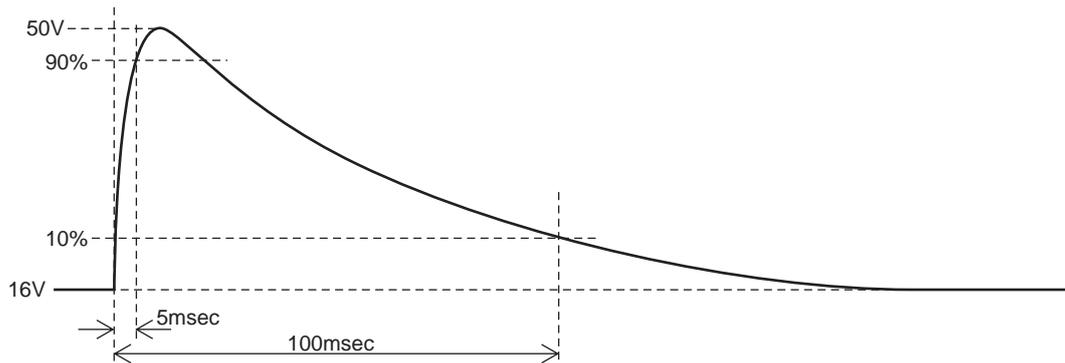
unit : mm (typ)
3395



• Allowable power dissipation derating curve

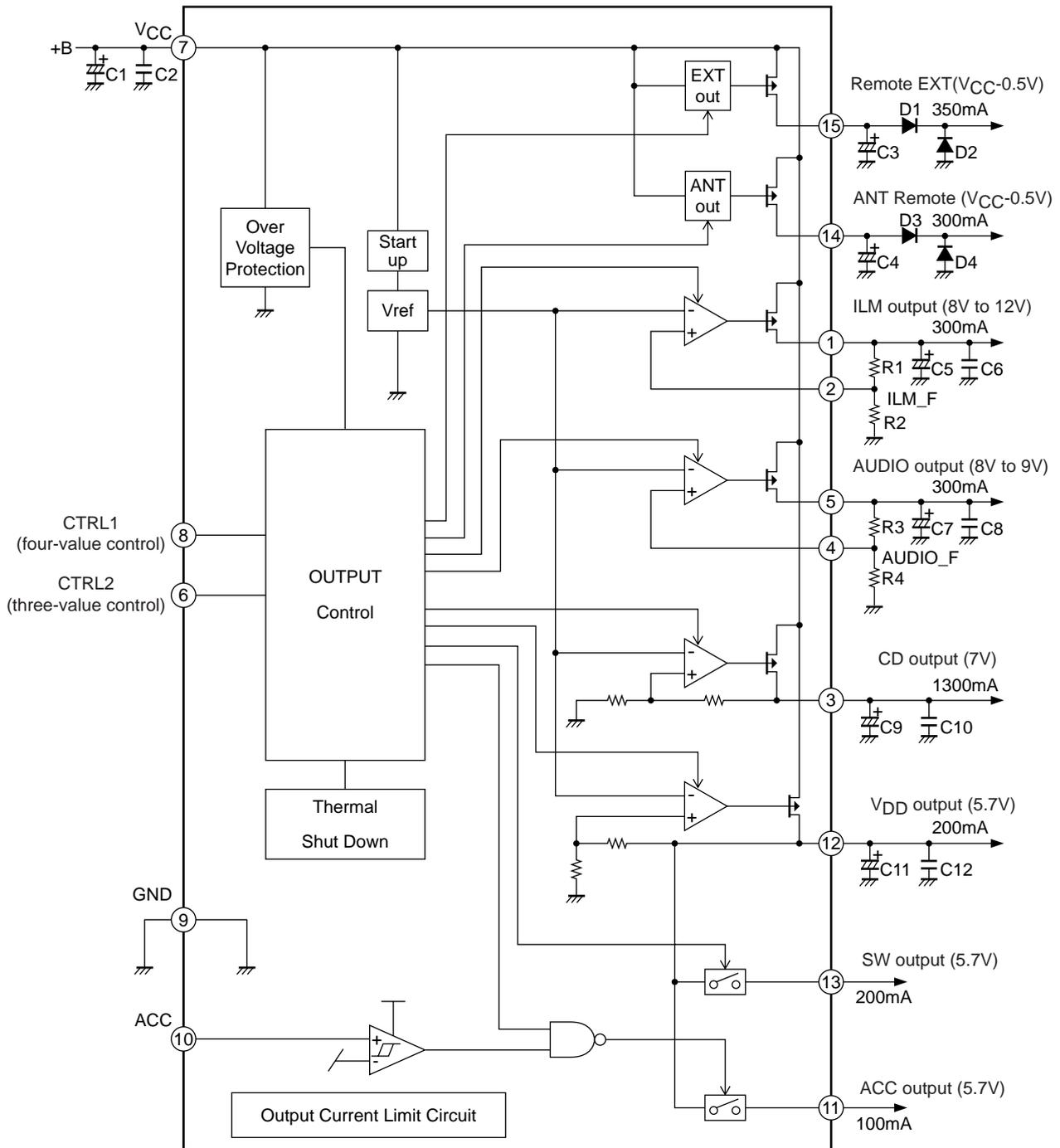


• Waveform applied during surge test



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Block Diagram



Pin Function

Pin No.	Pin name	Description	Equivalent Circuit
1	ILM	ILM output pin ON when CTRL1 = M1, M2, H 8.0 to 12.0V/300mA	
2	ILM_F	ILM output voltage adjustment pin	

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Pin No.	Pin name	Description	Equivalent Circuit
3	CD	CD output pin ON when CTRL2 = M, H 7.0V/1.3A	
4	AUDIO_F	AUDIO output voltage adjustment pin	
5	AUDIO	AUDIO output pin ON when CTRL2 = M, H 8.0 to 9.0V/300mA	
6	CTRL2	CTRL2 input pin three-value input	
7	VCC	Supply terminal	
8	CTRL1	CTRL1 input pin four-value input	
9	GND	GND pin	

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Pin No.	Pin name	Description	Equivalent Circuit
10	ACC	Accessory input	
11	ACC5V	Accessory detection output ON when ACC > 3V	
12	V _{DD} 5V	V _{DD} 5.7V output pin 5.7V/500mA	
13	SW5V	SW5.7V output pin ON when CTRL2 = M, H	
14	ANT	ANT output pin ON when CTRL1 = H V _{CC} -0.5V/300mA	
15	EXT	EXT output pin ON when CTRL1 = M2, H V _{CC} -0.5V/350mA	

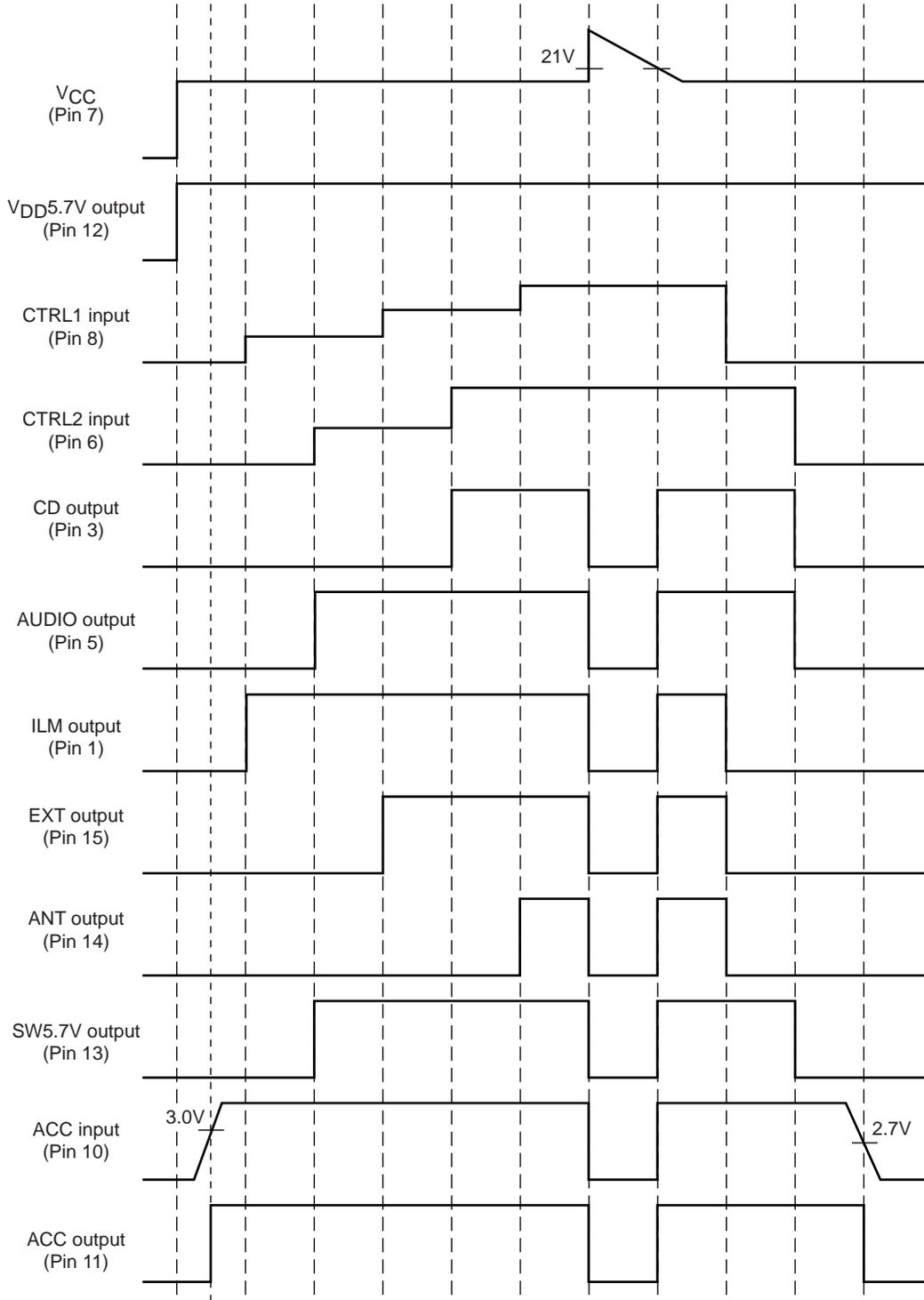
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CTRL Pin Output Truth Table

CTRL1	ANT	EXT	ILM
L	OFF	OFF	OFF
M1	OFF	OFF	ON
M2	OFF	ON	ON
H	ON	ON	ON

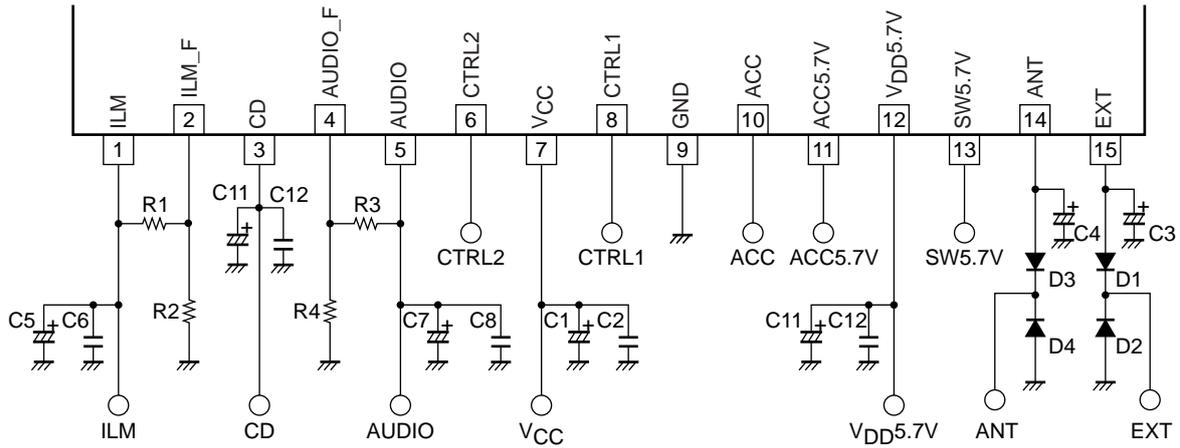
CTRL2	CD	AUDIO	SW5
L	OFF	OFF	OFF
M	OFF	ON	ON
H	ON	ON	ON

Timing Chart



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Recommended Operation Circuit



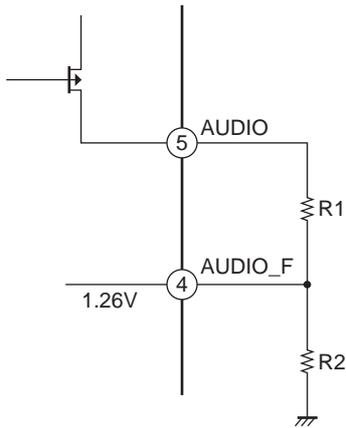
Peripheral parts list

Name of part	Description	Recommended value	Remarks
C1	Power supply bypass capacitor	100 μ F or more	These capacitors must be placed near the V _{CC} and GND pins.
C2	Oscillation prevention capacitor	0.22 μ F or more	
C3	EXT output stabilization capacitor	2.2 μ F or more	
C4	ANT output stabilization capacitor	2.2 μ F or more	
C5, C57 C9, C11	Output stabilization capacitor	4.7 μ F or more	Electrolytic capacitor *
C6, C8, C10, C12	Output stabilization capacitor	0.22 μ F or more	Ceramic capacitor *
R1,R2	Resistor for ILM voltage adjustment	R1/R2 :30k Ω /5.6k Ω = 8.0V :27k Ω /3.9k Ω = 10.0V :33k Ω /3.9k Ω = 11.9V	A resistor with resistance accuracy as low as less than $\pm 1\%$ must be used.
R3, R4	Resistor for AUDIO voltage setting	R3/R4 :30k Ω /5.6k Ω = 8.0V :27k Ω /4.7k Ω = 8.5V :24k Ω /3.9k Ω = 9.0V	A resistor with resistance accuracy as low as less than $\pm 1\%$ must be used.
D1, D2, D3, D4	Diode for internal device breakdown protection		

* : In order to stabilize the regulator outputs, it is recommended that the electrolytic capacitor and ceramic capacitor be connected in parallel.

Furthermore, the values listed above do not guarantee stabilization during the overcurrent protection operations of the regulator, so oscillation may occur during an overcurrent protection operation.

• AUDIO/ILM output voltage setting method



The AUDIO_F voltage is determined by the internal band gap voltage of the IC (typ = 1.26V).

Formula for AUDIO voltage calculation

$$AUDIO = \frac{1.26[V]}{R_2} \times R_1 + 1.26[V]$$

$$\frac{R_1}{R_2} = \frac{(AUDIO - 1.26)}{1.26}$$

The circuit must be designed in such a way that the R1:R2 ratio satisfies the formula given above for the AUDIO voltage that has been set.

Example : AUDIO = 8.5V setting method

$$\frac{R_1}{R_2} = \frac{(8.5 - 1.26)}{1.26} \cong 5.75$$

$$\frac{R_1}{R_2} = \frac{27k\Omega}{4.7k\Omega} \cong 5.74$$

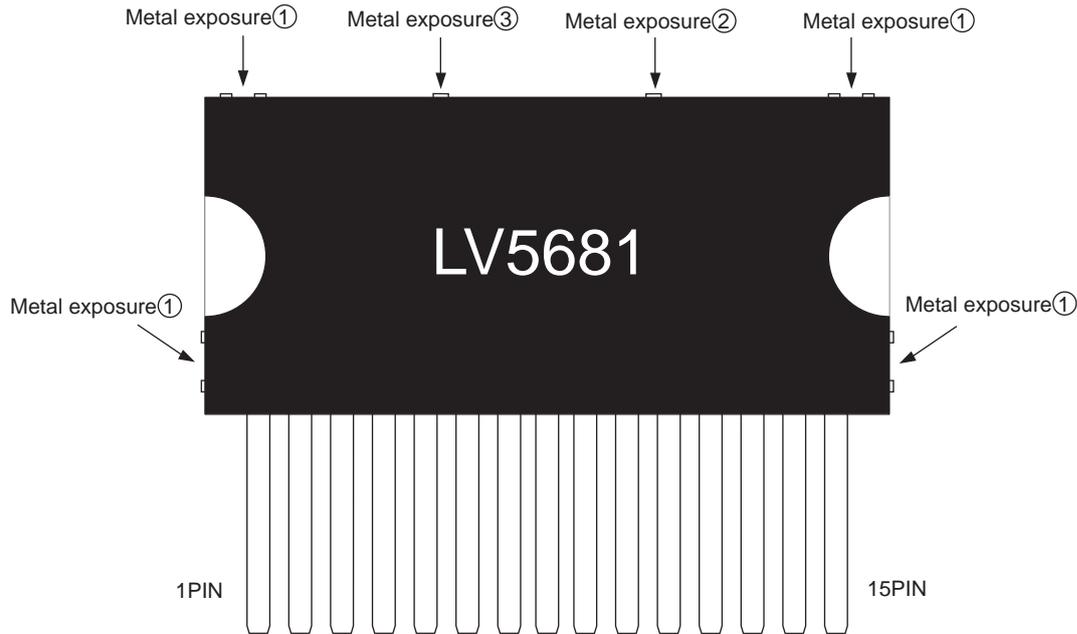
$$AUDIO = 1.26V \times 5.74 + 1.26V \cong 8.49V$$

The ILM output voltage can be set by the above-mentioned method.

Note : In the above, the typical values are given in all instances for the values used and, as such, they will vary due to the effects of production-related variations of the IC and external resistors.

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- Frame diagram (LV5681P) *In the system power supply other than LV5681P, pin assignment may differ.



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