Ordering number : ENA2159

# LV5696P

### **Bi-CMOS LSI**

# Multi-Power Supply IC for Car Audio Systems



http://onsemi.com

#### Overview

LV5696P is a multiple voltage regulator for car audio system. This IC has 6 system of voltage regulators, 3.3/5.0Voutput for a microcontroller, 8.0V output for CD driver, 3V-8V (Adjustable) output for illuminations, 8.5V output for audio control, 5V output for SYS control, 3.3V output for DSP control and 1 high side switch output for ANT output.

About protection circuits, it has Over-current-protection, Over-voltage-protection and Thermal-shut-down.

#### **Features**

• Low current consumption : typ 50µA

• 6 system of regulators

V<sub>DD</sub> (Micon): V<sub>OUT</sub> 3.3/5.0V, I<sub>OUT</sub> MAX 200mA CD: V<sub>OUT</sub> 8.0V, I<sub>OUT</sub> MAX 1000mA

Illumination : VOUT 3.0V to 8.0V (Adjustable external resistors), IOUT MAX 200mA

Audio : V<sub>OUT</sub> 8.5V, I<sub>OUT</sub> MAX 300mA SYS : V<sub>OUT</sub> 5.0V, I<sub>OUT</sub> MAX 500mA DSP : V<sub>OUT</sub> 3.3V, I<sub>OUT</sub> MAX 800mA

• 1 high-side switch coupled V<sub>CC</sub>

ANT :  $I_{OUT}$  MAX 200mA,  $V_{CC}$ - $V_{OUT}$  = 0.5V

- Over current protection
- Over voltage protection typ 21V (All outputs except for V<sub>DD</sub> are turned off)
- Thermal shut down circuit typ 175°C
- Applied P-LDMOS to output stage

(Warning) The protector functions only improve the IC's tolerance and they do not guarantee the safety of the IC if used under the conditions out of safety range or ratings. Use of the IC such as use under overcurrent protection range, thermal shutdown state may degrade the IC's reliability and eventually damage the IC.

# **Specifications** Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		36	V
Power dissipation	Pd max	IC Unit	1.5	W
		At using AI heat sink of (50×50×1.5mm³)	5.6	W
		Infinite large heat sink	32.5	W
Peak voltage	V <sub>CC</sub> peak	See below about Pulse wave	50	V
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-55 to +150	°C
Junction maximum temperature	Tj max		150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

# **Recommended Operating Conditions** at Ta = 25°C

Parameter	Conditions Ratings		Unit
Power supply voltage rating 1	V <sub>DD</sub> output, ANT output	7.5 to 16	V
Power supply voltage rating 2	AUDIO output	10.5 to 16	V
Power supply voltage rating 3	CD output, ILM output, SYS output, DSP output	10 to 16	V

<sup>\*</sup>Make sure that  $V_{CC}1$  is as follows:  $V_{CC}1 > V_{CC} - 0.7V$ 

# **Electrical Characteristics** at Ta = 25 °C, $V_{CC} = V_{CC}1 = 14.4$ V

Parameter	Symbol	Conditions		Ratings		Unit		
Farameter	Symbol	Conditions	min	typ	max	Offic		
Quiescent current	Icc	V <sub>DD</sub> No Load, CTRL1/2/3 = L/L/L J		50	100	μΑ		
CTRL1 (ANT)								
Low input voltage	V <sub>IL</sub> 1	ANT: OFF	0		0.3	V		
High input voltage	V <sub>IH</sub> 1	ANT: ON	2.7	3.3	5.5	V		
Input impedance	R <sub>IN</sub> 1	input voltage ≤ 3.3V	280	400	520	kΩ		
CTRL2 (ILM)				<u>.</u>				
Low input voltage	V <sub>IL</sub> 2	ILM: OFF	0		0.3	V		
High input voltage	V <sub>IH</sub> 2	ILM: ON	2.7	3.3	5.5	V		
Input impedance	R <sub>IN</sub> 2	input voltage ≤ 3.3V	280	400	520	kΩ		
CTRL3								
Low input voltage	V <sub>IL</sub> 3	CD, AUDIO, SYS5V, DSP: OFF	0		0.3	V		
Middle input voltage	V <sub>IM</sub> 3	CD, DSP:OFF	1.3	1.65	2.0	٧		
		SYS5V, AUDIO: ON						
High input voltage	V <sub>IH</sub> 3	CD, AUDIO, SYS5V, DSP: ON	2.7	3.3	5.5	V		
Input impedance	R <sub>IN</sub> 3	input voltage ≤ 3.3V	280	400	520	kΩ		
V <sub>DD</sub> output 5.0V/3.3V -ON ;	IKV <sub>DD</sub> = V <sub>CC</sub> 1 : V	$DD = 5V/IKV_{DD} = GND : V_{DD} = 3.3V$						
V <sub>DD</sub> output voltage 1	V <sub>O</sub> 1	$I_{O}1 = 200 \text{mA}, IKV_{DD} = V_{CC}1$	4.75	5.0	5.25	٧		
V <sub>DD</sub> output voltage 2	V <sub>O</sub> 1'	$I_O1 = 200 \text{mA}, IKV_{DD} = GND$	3.13	3.3	3.47	>		
V <sub>DD</sub> output current	I <sub>O</sub> 1		200			mA		
Line regulation	ΔV <sub>OLN</sub> 1	7.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 1 = 200mA		30	100	mV		
Load regulation	ΔV <sub>OLD</sub> 1	1mA < I <sub>O</sub> 1 < 200mA		70	150	mV		
Dropout voltage 1	V <sub>DROP</sub> 1	I <sub>O</sub> 1 = 200mA		1.0	1.5	V		
Dropout voltage 2	V <sub>DROP</sub> 1'	I <sub>O</sub> 1 = 100mA		0.5	0.75	V		
Ripple rejection	R <sub>REJ</sub> 1	f = 120Hz, I <sub>O</sub> 1 = 200mA	40	50		dB		
CD output 8.0V-ON ; CTRL3	=[H]			<u>.</u>				
CD output voltage	V <sub>O</sub> 2	I <sub>O</sub> 2 = 1000mA	7.6	8.0	8.4	V		
CD output current	I <sub>O</sub> 2		1000			mA		
Line regulation	ΔV <sub>OLN</sub> 2	10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 3 = 1000mA		50	100	mV		
Load regulation	ΔV <sub>OLD</sub> 2	10mA < I <sub>O</sub> 2 < 1000mA		100	200	mV		
Dropout voltage 1	V <sub>DROP</sub> 2	I <sub>O</sub> 2 = 1000mA		1.0	1.5	V		
Dropout voltage 2	V <sub>DROP</sub> 2'	I <sub>O</sub> 2 = 500mA		0.5	0.75	V		
Ripple rejection	R <sub>REJ</sub> 2	f = 120Hz, I <sub>O</sub> 2 = 1000mA	40	50		dB		

# LV5696P

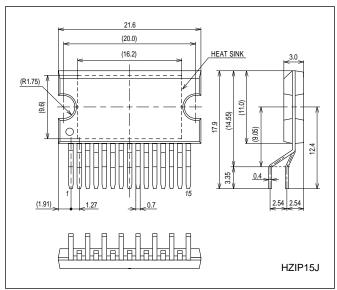
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Parameter   Symbol   Conditions     Conditions     Conditions   Con	1.222 -1 7.65 2.86 200 40 8.07 300	1.260  8.0  3.0  30  70  0.7  0.35  50  8.5  30  70  0.7  0.35	90 1.05 0.53 8.93 90 150	Unit  V  μA  V  V  mA  mV  V  dB  V  mA  mV  V  V  V  V  V  V  V  V  V  V  V  V
LM_ADJ current         I <sub>IN</sub> 3           LM_ADJ current         I <sub>IN</sub> 3           LM output voltage1         V <sub>O</sub> 3         I <sub>O</sub> 3 = 200mA, R1 = 300kΩ, R2 = 56kΩ           LM output voltage2         V <sub>O</sub> 3'         I <sub>O</sub> 3 = 200mA, R1 = 51kΩ, R2 = 36kΩ           LM output current         I <sub>O</sub> 3         R1 = 300kΩ, R2 = 56kΩ           Line regulation         ΔV <sub>O</sub> LN3         10.5V < V <sub>C</sub> C < 16V, I <sub>O</sub> 4 = 200mA           Line regulation         ΔV <sub>O</sub> LD3         1mA < I <sub>O</sub> 3 < 200mA           Dropout voltage 1         V <sub>DROP3</sub> I <sub>O</sub> 3 = 200mA           Dropout voltage 1         V <sub>DROP3</sub> I <sub>O</sub> 3 = 100mA           Dropout voltage 2         V <sub>DROP3</sub> I <sub>O</sub> 3 = 100mA           RREJ3         f = 120Hz, I <sub>O</sub> 4 = 200mA           AUDIO output 8.5V-ON ; CTRL3 = [M or H]         I <sub>O</sub> 4 = 300mA           AUDIO output voltage         V <sub>O</sub> 4         I <sub>O</sub> 4 = 300mA           AUDIO output current         I <sub>O</sub> 4           Line regulation         ΔV <sub>O</sub> LN4         10.5V < V <sub>C</sub> C < 16V, I <sub>O</sub> 4 = 300mA           Dropout voltage 1         V <sub>DROP4</sub> I <sub>O</sub> 4 = 200mA           Dropout voltage 2         V <sub>DROP4</sub> I <sub>O</sub> 4 = 100mA           Propout voltage 2         V <sub>DROP4</sub> I <sub>O</sub> 4 = 100mA           Propout voltage 3         I <sub>O</sub> 5 = 500mA      <	-1 7.65 2.86 200 40 8.07 300	8.0 3.0 30 70 0.7 0.35 50 8.5 30 70 0.7	1 8.35 3.14 90 150 1.05 0.53 8.93 90 150 1.05	μΑ V V MA MV V V dB V mA MV V V V MA
LM_ADJ current  LM_ADJ current  LM_Output voltage1  VO3 $I_{O3} = 200mA, R1 = 300kΩ, R2 = 56kΩ$ LM output voltage2  VO3' $I_{O3} = 200mA, R1 = 51kΩ, R2 = 36kΩ$ LM output current $I_{O3}$ R1 = 300kΩ, R2 = 56kΩ  LM output current $I_{O3}$ R1 = 300kΩ, R2 = 56kΩ  Line regulation $\Delta V_{OLN3}$ 10.5V < V <sub>CC</sub> < 16V, $I_{O4} = 200mA$ Dropout voltage 1  VDROP3 $I_{O3} = 200mA$ Propout voltage 2  VDROP3' $I_{O3} = 100mA$ RREJ3 $I_{O3} = 100mA$ ROPOUT voltage 2  VDROP3' $I_{O3} = 100mA$ ROPOUT voltage 3  AUDIO output 8.5V-ON; CTRL3 = \begin{array}{cccccccccccccccccccccccccccccccccccc	-1 7.65 2.86 200 40 8.07 300	8.0 3.0 30 70 0.7 0.35 50 8.5 30 70 0.7	1 8.35 3.14 90 150 1.05 0.53 8.93 90 150 1.05	μΑ V V MA MV V V dB V mA MV V V V MA
LM output voltage1 $V_{O3}$ $I_{O3} = 200 \text{mA}, R1 = 300 \text{k}\Omega, R2 = 56 \text{k}\Omega$ LM output voltage2 $V_{O3}$ ' $I_{O3} = 200 \text{mA}, R1 = 51 \text{k}\Omega, R2 = 36 \text{k}\Omega$ LM output current $I_{O3}$ $R1 = 300 \text{k}\Omega, R2 = 56 \text{k}\Omega$ Line regulation $\Delta V_{OLN3}$ $10.5 \text{V} < \text{V}_{CC} < 16 \text{V}, I_{O4} = 200 \text{mA}$ Line regulation $\Delta V_{OLD3}$ $1 \text{mA} < I_{O3} < 200 \text{mA}$ $1 \text{mA} < I_{O4} < 300 \text{mA}$ $1 \text{mA}$	7.65 2.86 200 40 8.07 300	3.0 30 70 0.7 0.35 50 8.5 30 70 0.7	8.35 3.14 90 150 1.05 0.53 8.93 90 150 1.05	V V MA MV V V V dB MV MV MV MV
LM output voltage2 $V_O3^\circ$ $I_O3 = 200 \text{mA}, R1 = 51 \text{k}\Omega, R2 = 36 \text{k}\Omega$ LM output current $I_O3$ $R1 = 300 \text{k}\Omega, R2 = 56 \text{k}\Omega$ Line regulation $\Delta V_{OLN}3$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 200 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < V_{CC} < 16 \text{V}, I_O4 = 300 \text{mA}$ $10.5 \text{V} < 10.5 \text{V} < $	2.86 200 40 8.07 300	3.0 30 70 0.7 0.35 50 8.5 30 70 0.7	90 150 1.05 0.53 8.93 90 150 1.05	V mA mV V dB V mA mV
LM output current $I_{O3}$ $R1 = 300k\Omega$ , $R2 = 56k\Omega$ Line regulation $\Delta V_{OLN3}$ $10.5V < V_{CC} < 16V$ , $I_{O4} = 200mA$ Load regulation $\Delta V_{OLD3}$ $1mA < I_{O3} < 200mA$ Dropout voltage 1 $V_{DROP3}$ $I_{O3} = 200mA$ Dropout voltage 2 $V_{DROP3}$ , $I_{O3} = 100mA$ Ripple rejection $R_{REJ3}$ $f = 120Hz$ , $I_{O4} = 200mA$ AUDIO output 8.5V-ON; CTRL3 = $[M \text{ or } H]$ AUDIO output voltage $V_{O4}$ $I_{O4} = 300mA$ AUDIO output current $I_{O4}$ Line regulation $\Delta V_{OLN4}$ $10.5V < V_{CC} < 16V$ , $I_{O4} = 300mA$ Dropout voltage 1 $V_{DROP4}$ $I_{O4} = 200mA$ Dropout voltage 1 $V_{DROP4}$ $I_{O4} = 200mA$ Dropout voltage 2 $V_{DROP4}$ $I_{O4} = 200mA$ Dropout voltage 2 $V_{DROP4}$ $I_{O4} = 100mA$ Ripple rejection $R_{REJ4}$ $f = 120Hz$ , $I_{O4} = 300mA$ $R_{SYS}$ output 5.0V-ON; CTRL3 = $[M \text{ or } H]$ SYS output voltage $V_{O5}$ $I_{O5} = 500mA$ Line regulation $\Delta V_{OLN5}$ $I_{O5} = 500mA$	40 8.07 300	30 70 0.7 0.35 50 8.5 30 70	90 150 1.05 0.53 8.93 90 150	mA mV mV V dB V mA mV
Line regulation   ΔV <sub>OLN</sub> 3   10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 200mA	8.07 300	70 0.7 0.35 50 8.5 30 70 0.7	150 1.05 0.53 8.93 90 150 1.05	mV v v dB v mA mV
Load regulation         ΔV <sub>OLD</sub> 3         1mA < I <sub>O</sub> 3 < 200mA           Dropout voltage 1         V <sub>DROP</sub> 3         I <sub>O</sub> 3 = 200mA           Dropout voltage 2         V <sub>DROP</sub> 3'         I <sub>O</sub> 3 = 100mA           Ripple rejection         R <sub>REJ</sub> 3         f = 120Hz, I <sub>O</sub> 4 = 200mA           AUDIO output 8.5V-ON; CTRL3 = [M or H]         I <sub>O</sub> 4           AUDIO output voltage         V <sub>O</sub> 4         I <sub>O</sub> 4 = 300mA           AUDIO output current         I <sub>O</sub> 4           Line regulation         ΔV <sub>OLN</sub> 4         10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA           Load regulation         ΔV <sub>OLD</sub> 4         1mA < I <sub>O</sub> 4 < 300mA	8.07	70 0.7 0.35 50 8.5 30 70 0.7	150 1.05 0.53 8.93 90 150 1.05	mV V V dB V mA mV
Oropout voltage 1         VDROP3         IO3 = 200mA           Oropout voltage 2         VDROP3'         IO3 = 100mA           Ripple rejection         RREJ3         f = 120Hz, IO4 = 200mA           AUDIO output 8.5V-ON; CTRL3 = [M or H]         AUDIO output voltage         VO4           AUDIO output current         IO4         IO4 = 300mA           Line regulation         ΔVOLN4         10.5V < VCC < 16V, IO4 = 300mA	8.07	0.7 0.35 50 8.5 30 70 0.7	1.05 0.53 8.93 90 150 1.05	V V dB V mA mV
Oropout voltage 2         VDROP3'         IQ3 = 100mA           Ripple rejection         RREJ3         f = 120Hz, IQ4 = 200mA           AUDIO output 8.5V-ON; CTRL3 = [M or H]         VQ4         IQ4 = 300mA           AUDIO output voltage         VQ4         IQ4 = 300mA           AUDIO output current         IQ4           Line regulation         ΔVQLN4         10.5V < VCC < 16V, IQ4 = 300mA	8.07	0.35 50 8.5 30 70 0.7	0.53 8.93 90 150 1.05	V dB V mA mV
Ripple rejection   RREJ3   f = 120Hz, I <sub>O</sub> 4 = 200mA     AUDIO output 8.5V-ON ; CTRL3 = [M or H.]     AUDIO output voltage   V <sub>O</sub> 4   I <sub>O</sub> 4 = 300mA     AUDIO output current   I <sub>O</sub> 4     Line regulation   ΔV <sub>OLN</sub> 4   10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA     Load regulation   ΔV <sub>OLN</sub> 4   10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA     Dropout voltage 1   V <sub>DROP</sub> 4   I <sub>O</sub> 4 = 200mA     Dropout voltage 2   V <sub>DROP</sub> 4'   I <sub>O</sub> 4 = 100mA     Ripple rejection   R <sub>REJ</sub> 4   f = 120Hz, I <sub>O</sub> 4 = 300mA     SYS output 5.0V-ON ; CTRL3 = [M or H.]     SYS output voltage   V <sub>O</sub> 5   I <sub>O</sub> 5 = 500mA     SYS output current   I <sub>O</sub> 5     Line regulation   ΔV <sub>OLN</sub> 5   10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA     Load regulation   ΔV <sub>OLN</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mA < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   ΔV <sub>OLD</sub> 5   1mB < I <sub>O</sub> 5 < 500mA     Load regulation   1mB < I <sub>O</sub> 5	8.07	8.5 30 70 0.7	8.93 90 150 1.05	V mA mV
AUDIO output 8.5V-ON; CTRL3 = M or H  AUDIO output voltage  V <sub>O</sub> 4  I <sub>O</sub> 4 = 300mA  AUDIO output current  I <sub>O</sub> 4  Line regulation  ΔV <sub>OLN</sub> 4  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA  Dropout voltage 1  V <sub>DROP</sub> 4  V <sub>DROP</sub> 4  I <sub>O</sub> 4 = 200mA  Dropout voltage 2  V <sub>DROP</sub> 4  I <sub>O</sub> 4 = 100mA  R <sub>REJ</sub> 4  F = 120Hz, I <sub>O</sub> 4 = 300mA  BYS output 5.0V-ON; CTRL3 = M or H  SYS output voltage  V <sub>O</sub> 5  I <sub>O</sub> 5  Line regulation  ΔV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA  Dropout voltage  AV <sub>OLN</sub> 5  10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA	8.07	8.5 30 70 0.7	90 150 1.05	V mA mV
AUDIO output voltage       V <sub>O</sub> 4       I <sub>O</sub> 4 = 300mA         AUDIO output current       I <sub>O</sub> 4         Line regulation       ΔV <sub>OLN</sub> 4       10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA         Load regulation       ΔV <sub>OLD</sub> 4       1mA < I <sub>O</sub> 4 < 300mA	300	30 70 0.7	90 150 1.05	mA mV mV
AUDIO output current $I_{O4}$ Line regulation $\Delta V_{OLN4}$ $\Delta V_{OLD4}$ $\Delta V_{OLD5}$	300	30 70 0.7	90 150 1.05	mA mV mV
Line regulation $\Delta V_{OLN4}$ 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 4 = 300mA 10.5V < 0.5V <		70 0.7	150 1.05	mV mV
Load regulation         ΔV <sub>OLD</sub> 4         1mA < I <sub>O</sub> 4 < 300mA           Dropout voltage 1         V <sub>DROP</sub> 4         I <sub>O</sub> 4 = 200mA           Dropout voltage 2         V <sub>DROP</sub> 4'         I <sub>O</sub> 4 = 100mA           Ripple rejection         R <sub>REJ</sub> 4         f = 120Hz, I <sub>O</sub> 4 = 300mA           SYS output 5.0V-ON; CTRL3 = [M or H]         SYS output voltage         V <sub>O</sub> 5           SYS output voltage         V <sub>O</sub> 5         I <sub>O</sub> 5 = 500mA           Line regulation         ΔV <sub>OLN</sub> 5         10.5V < V <sub>CC</sub> < 16V, I <sub>O</sub> 5 = 500mA           Load regulation         ΔV <sub>OLD</sub> 5         1mA < I <sub>O</sub> 5 < 500mA	40	70 0.7	150 1.05	mV
Oropout voltage 1         VDROP4         IQ4 = 200mA           Oropout voltage 2         VDROP4'         IQ4 = 100mA           Ripple rejection         RREJ4         f = 120Hz, IQ4 = 300mA           SYS output 5.0V-ON; CTRL3 = [M or H]         SYS output voltage         VQ5           SYS output current         IQ5           Line regulation         ΔVOLN5         10.5V < VCC < 16V, IQ5 = 500mA	40	0.7	1.05	
Propout voltage 2 $V_{DROP4}$ $I_{O4}$ = 100mA Ripple rejection $R_{REJ4}$ $f$ = 120Hz, $I_{O4}$ = 300mA $I_{O5}$ SYS output 5.0V-ON; CTRL3 = $I_{O5}$ $I_{O5}$ = 500mA	40	-		V
Ripple rejection $R_{REJ4}$ $f = 120$ Hz, $I_{O}4 = 300$ mA $R_{REJ}4$ $f = 120$ Hz, $I_{O}4 = 300$ mA $R_{REJ}4$	40	0.35	0.50	ı
SYS output 5.0V-ON; CTRL3 = $\lceil M \text{ or } H \rfloor$ SYS output voltage $V_{O5}$ $I_{O5}$ = 500mA  SYS output current $I_{O5}$ Line regulation $\Delta V_{OLN5}$ $\Delta V_{OLN5}$ $\Delta V_{OLD5}$	40	0.00	0.53	V
SYS output voltage $V_{O5}$ $I_{O5} = 500 \text{mA}$ SYS output current $I_{O5}$ Line regulation $\Delta V_{OLN5}$ $10.5 V < V_{CC} < 16 V$ , $I_{O5} = 500 \text{mA}$ Load regulation $\Delta V_{OLD5}$ $1 \text{mA} < I_{O5} < 500 \text{mA}$	40	50		dB
SYS output current I <sub>O</sub> 5  Line regulation $\Delta V_{OLN}5$ 10.5V < $V_{CC}$ < 16V, I <sub>O</sub> 5 = 500mA  Load regulation $\Delta V_{OLD}5$ 1mA < I <sub>O</sub> 5 < 500mA				
ine regulation $\Delta V_{OLN}5$ $10.5V < V_{CC} < 16V, I_{O}5 = 500 mA$ Load regulation $\Delta V_{OLD}5$ $1mA < I_{O}5 < 500 mA$	4.75	5.0	5.25	V
Load regulation $\Delta V_{OLD}5$ 1mA < I <sub>O</sub> 5 < 500mA	500			mA
		30	90	mV
)ropout voltage Voncop5 Io5 = 500mA		70	150	mV
Nobor torrage   INKOPO   100 = 20011114		1.3	2.5	V
Ripple rejection $R_{REJ}$ 5 $f = 120Hz$ , $I_{O}$ 5 = 500mA	40	50		dB
DSP output 3.3V-ON; CTRL3 = [H]	•			
DSP output voltage $V_{O6}$ $I_{O6} = 800 \text{mA}$	3.13	3.3	3.47	V
DSP output current I <sub>O</sub> 6	800			mA
ine regulation $\Delta V_{OLN}6$ 10.5V < $V_{CC}$ < 16V, $I_{O}6$ = 800mA		30	90	mV
Load regulation $\Delta V_{OLD}6$ 1mA < $I_{O}6$ < 800mA		70	150	mV
Oropout voltage V <sub>DROP</sub> 6 I <sub>O</sub> 6 = 800mA		1.5	3.0	V
Ripple rejection $R_{REJ6}$ $f = 120Hz$ , $I_{O6} = 800mA$	40	50		dB
ANT Remote-ON ; CTRL1 = [H]		W.		
Output voltage $V_{O}7$ $I_{O}7 = 200 \text{mA}$	V <sub>CC</sub> -1.0	V <sub>CC</sub> -0.5		V
Dutput current $I_{07}$ $V_{07} \ge V_{CC}-1.0$	200			mA

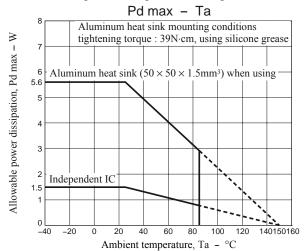
# **Package Dimensions**

unit: mm (typ)

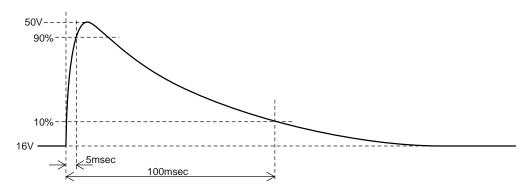
3395A



• Allowable power dissipation derating curve



• Peak Voltage testing pulse wave



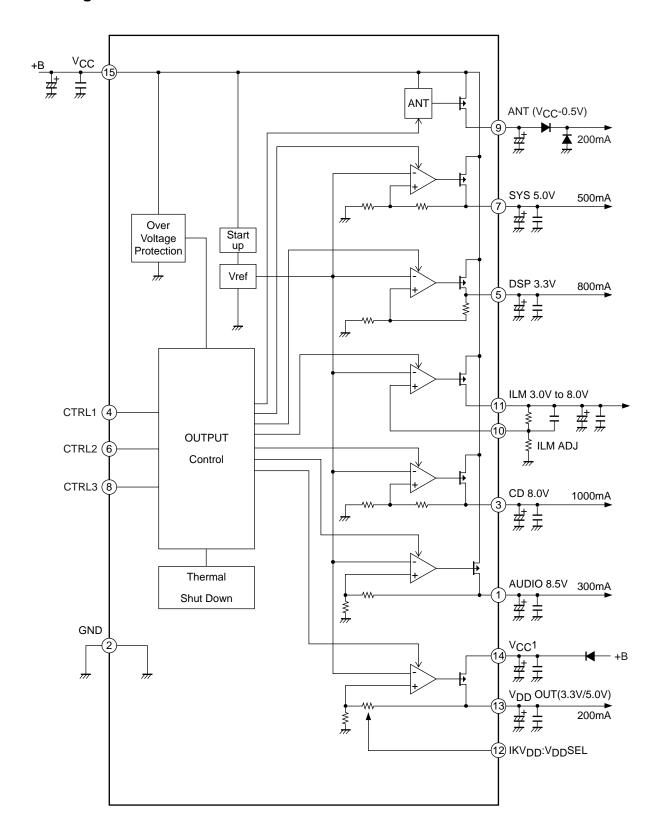
# **CTRL** logic truth table

CTRL1	ANT
L	OFF
Н	ON

CTRL2	ILM
L	OFF
Н	ON

CTRL3	AUDIO	SYS	CD	DSP
L	OFF	OFF	OFF	OFF
М	ON	ON	OFF	OFF
Н	ON	ON	ON	ON

# **Block Diagram**



# LV5696P

# **Pin Function**

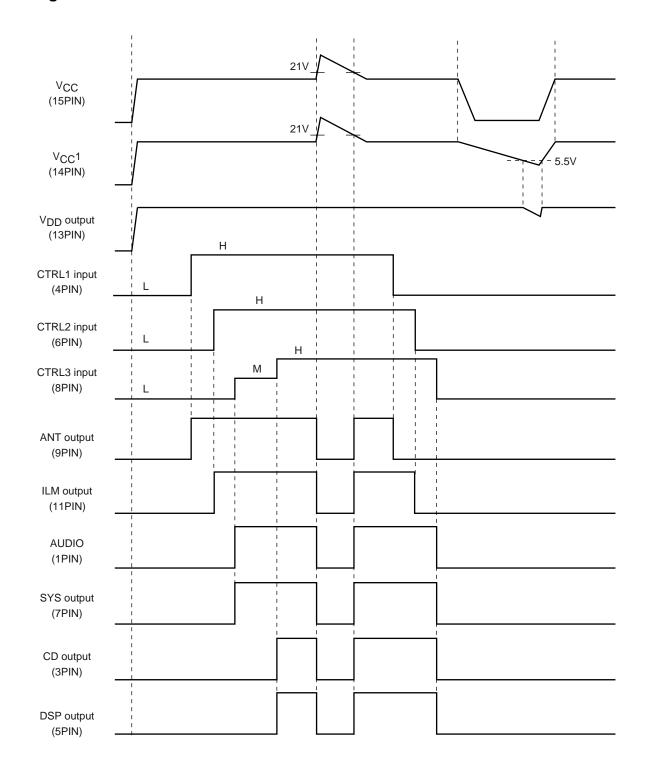
Pin No.	Pin name	Description	Equivalent Circuit
1	AUDIO	AUDIO output pin CTRL3 = M, H-ON 8.5V/0.3A	15 VCC 2 2 45kΩ 1 1 KΩ GND
2	GND	GND pin	
3	CD	CD output pin CTRL3 = H-ON 8.0V/1.0A	$\begin{array}{c} 15 \\ \hline \\ 3 \\ \hline \\ 45 \mathrm{k}\Omega \end{array}$
4	CTRL1	CTRL1 input pin Input of two values	$\begin{array}{c} 15 \\ \hline 4 \\ \hline \end{array}$
5	DSP	DSP output pin CTRL3 = H-ON 3.3V/0.8A	15 VCC

Pin No.	rom preceding pag Pin name	Description	Equivalent Circuit
6	CTRL2	CTRL2 input pin Input of two values	10kΩ VCC  6 W H H H H H H H H H H H H H H H H H H
7	SYS	SYS output pin CTRL3 = M, H-ON 5.0V/0.5A	15 VCC
8	CTRL3	CTRL3 input pin Input of three values	15 VCC 8 10kΩ 10kΩ 10kΩ GND
9	ANT	ANT output pin CTRL1 = H-ON VCC-0.5V/0.2A	15 VCC VCC VCC VCC VCC VCC VCC VCC VCC VC

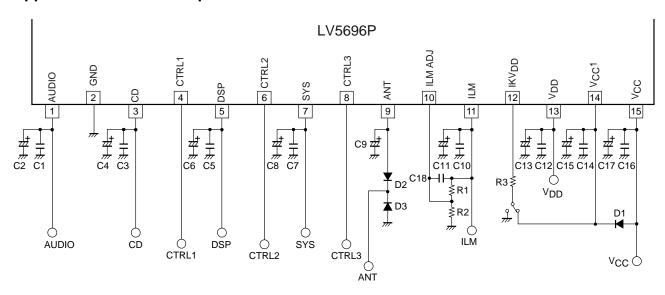
Continued from preceding page.

Pin No.	rom preceding page	Description	Equivalent Circuit
10	ILM ADJ	ILM feedback pin	15 Vcc
11	ILM	ILM output pin CTRL2 = H-ON 3.0 to 8.0V/0.2A	$\begin{array}{c c} & & & \\ \hline & \\ \hline & & \\ \hline & & \\ \hline & \\ \hline & \\ \hline & & \\ \hline &$
12	IKV <sub>DD</sub>	V <sub>DD</sub> Voltage switch control input pin V <sub>CC</sub> 1/GND	14 VCC1 5V 4.75ΜΩ 65kΩ GND
13	VDD	V <sub>DD</sub> output pin 5.0V/0.2A (IKV <sub>DD</sub> = V <sub>CC</sub> 1) 3.3V/0.2A (IKCD = GND)	13 VCC1 VCC1 VCC1 VCC1 VCC1 VCC1 VCC1 VC
14	V <sub>CC</sub> 1	V <sub>DD</sub> power supply pin	V <sub>CC</sub> (15) → ► 14) V <sub>CC</sub> 1
15	Vcc	Power supply pin	2 GND

# **Timing Chart**



# **Application circuit example**



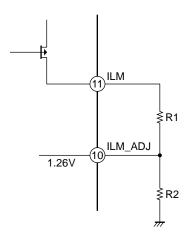
# **External Parts Lineup**

Part name	Description	Recommended value	Note
C2, C4, C6, C8,	Output stabilization capacitor	10μF or more (*1)	Electrolytic capacitor
C11, C13			
C1, C3, C5, C7,	Output stabilization capacitor	0.22μF or more (*1)	Ceramic capacitor
C10, C12			
C18	Output stabilization capacitor	20pF	Ceramic capacitor
C15, C17	Bypass capacitor	100μF or more	Connect a capacitor as close as
C14, C16	Prevent oscillation capacitor	0.22μF or more	possible to V <sub>CC</sub> pin and GND pin.
C9	Output stabilization capacitor	2.2μF or more	
		ILM output voltage	A resistor with resistance
R1, R2	Feedback resister	R1/R2: $300k\Omega/56k\Omega = 8.0V$	accuracy as low as less
		R1/R2: $51k\Omega/36k\Omega = 3.0V$	±1% must be used.
R3	Protective resister	10 to 100kΩ	
D1	Backflow prevention diode		
D2, D3	Internal element Protection diode	SB1003M3	

<sup>(\*1)</sup> Make sure that output capacitors is  $10\mu$ F or more and ESR  $10\Omega$  or less in total, in which voltage and temperature fluctuation and unit differences are taken into consideration. Moreover, high frequency characteristics of electrolytic capacitor should be sufficient.

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

## ILM output voltage setting method



ILM\_ADJ is equal to bandqap reference voltage (typ = 1.26V).

ILM calculating formula

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

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

Please design so that the ratio of R1 and R2 may fill the above-mentioned expression for the set ILM voltage.

(Ex.) Setup to 
$$ILM = 8.0V$$

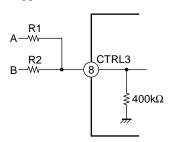
$$\frac{R_1}{R_2} = \frac{(8.0 - 1.26)}{1.26} \cong 5.349$$

$$\frac{R_1}{R_2} = \frac{300k\Omega}{56k\Omega} \cong 5.357$$

$$ILM = 1.26V \times 5.357 + 1.26V \cong \boxed{8.010V}$$

Note: The above-mentioned are all the values at the typical. The error margin of output voltage is caused by the influence of the manufacturing variations of IC and external resistance.

# CTRL3 Application Circuit



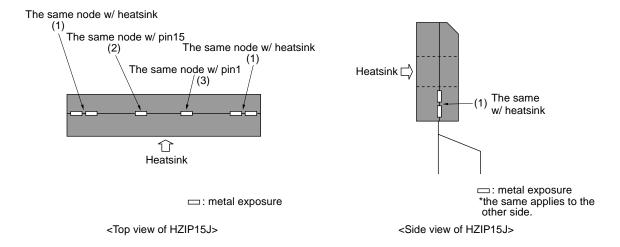
Input 3.3V :  $R1 = R2 = 47k\Omega$ 

А	В	CTRL3
0V	0V	0V
0V	3.3V	1.56V
3.3V	0V	1.56V
3.3V	3.3V	3.12V

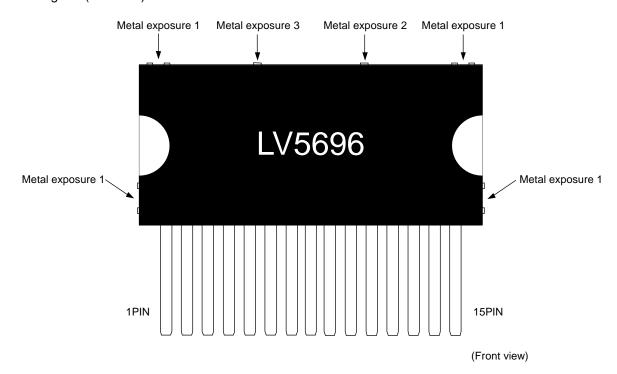
#### Warning: Implementing LV5696P to the set board

The package of LV5696P is HZIP15J which has some metal exposures other than connection pins and heatsink as shown in the diagram below. The electrical potentials of (2) and (3) are the same as those of pin15 and pin1, respectively. (2) (= pin15) is the  $V_{CC}$  pin and (3) (= pin1) is the AUDIO (regulator) output pin. When you implement the IC to the set board, make sure that the bolts and the heatsink are out of touch from (2) and (3). If the metal exposures touch the bolts which has the same electrical potential with GND, GND short occurs in AUDIO output and  $V_{CC}$ . The exposures of (1) are connected to heatsink which has the same electrical potential with substrate of the IC chip (GND). Therefore, (1) and GND electrical potential of the set board can contact each other.

#### HZIP15J outline



#### Frame diagram (HZIP15J)



#### HZIP15J Heat sink attachment

Heat sinks are used to lower the semiconductor device junction temperature by leading the head generated by the device to the outer environment and dissipating that heat.

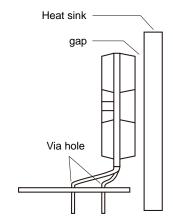
a. Unless otherwise specified, for power ICs with tabs and power ICs with attached heat sinks, solder must not be applied to the heat sink or tabs.

#### b. Heat sink attachment

- Use flat-head screws to attach heat sinks.
- Use also washer to protect the package.
- Use tightening torques in the ranges 39-59Ncm (4-6kgcm).
- If tapping screws are used, do not use screws with a diameter larger than the holes in the semiconductor device itself.
- Do not make gap, dust, or other contaminants to get between the semiconductor device and the tab or heat sink.
- Take care a position of via hole.
- Do not allow dirt, dust, or other contaminants to get between the semiconductor device and the tab or heat sink.
- Verify that there are no press burrs or screw-hole burrs on the heat sink.
- Warping in heat sinks and printed circuit boards must be no more than 0.05 mm between screw holes, for either concave or convex warping.
- Twisting must be limited to under 0.05 mm.
- Heat sink and semiconductor device are mounted in parallel.

  Take care of electric or compressed air drivers
- The speed of these torque wrenches should never exceed 700 rpm, and should typically be about 400 rpm.

# Binding head machine screw Countersunk head mashine screw



#### c. Silicone grease

- Spread the silicone grease evenly when mounting heat sinks.
- Our company recommends YG-6260 (Momentive Performance Materials Japan LLC)

#### d. Mount

- First mount the heat sink on the semiconductor device, and then mount that assembly on the printed circuit board.
- When attaching a heat sink after mounting a semiconductor device into the printed circuit board, when tightening up a heat sink with the screw, the mechanical stress which is impossible to the semiconductor device and the pin doesn't hang.
- e. When mounting the semiconductor device to the heat sink using jigs, etc.,
  - Take care not to allow the device to ride onto the jig or positioning dowel.
  - Design the jig so that no unreasonable mechanical stress is not applied to the semiconductor device.

#### f. Heat sink screw holes

- Be sure that chamfering and shear drop of heat sinks must not be larger than the diameter of screw head used.
- When using nuts, do not make the heat sink hole diameters larger than the diameter of the head of the screws used. A hole diameter about 15% larger than the diameter of the screw is desirable.
- When tap screws are used, be sure that the diameter of the holes in the heat sink are not too small. A diameter about 15% smaller than the diameter of the screw is desirable.
- g. There is a method to mount the semiconductor device to the heat sink by using a spring band. But this method is not recommended because of possible displacement due to fluctuation of the spring force with time or vibration.

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