



SANYO Semiconductors

DATA SHEET

LA5647H — Monolithic Linear IC For Car AV Equipment Multifunction Multi-Voltage Power Supply

Overview

The LA5647H power supply IC provides a set of functions optimal for car audio applications. These functions include regulators, emitter-follower outputs, open-collector outputs, and a reset function.

Features

- 5V/50mA regulator (always on, with reverse current flow prevention function).
- 10V/2000mA regulator (when used with an external 2SB921 PNP transistor) with standby function (on/off control).
- Regulators (four for 8V systems and one 5V system) with on/off functions controlled by a shift resistor/latch function. This IC also provides four open-collector output systems and two emitter-follower type output systems.
- Full complement of built-in protection circuits.
 - 1) Overcurrent protection for each V_O except the open collector outputs.
 - 2) Thermal protection for each V_O except the V_{DD5V} output.

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	$V_{CC\ max}$		24	V
Allowable power dissipation	$P_d\ max$	$T_a \leq 25^\circ\text{C}$, Independent IC	0.82	W
		$T_a \leq 25^\circ\text{C}$, Mounted substrate *	2.01	W
Thermal junction to ambient air thermal resistance	θ_{j-a}		152.4	$^\circ\text{C/W}$
Operating temperature	T_{opr}		-30 to +85	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

* Mounted substrate : 114.3mm×76.1mm×1.6mm, glass epoxy board.

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Recommended Operating Condition at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}	$V_{DD}5V$ output, normal operating mode	6 to 18	V
		COM10V output, normal operating mode	10.3 to 18	V
Standby input voltage	$V_{ST\ OFF}$	Output off, control voltage	0 to 1.5	V
	$V_{ST\ ON}$	Output on, control voltage	3.5 to 5	V
$V_{DD}5V$ output current	I_{O1}		0 to 50	mA
COM10V output current	I_{O2}	Within the external transistor ASO		mA
COM8V output current	I_{O3}		0 to 100	mA
TAPE8V output current	I_{O4}		0 to 30	mA
RD8V output current	I_{O5}		0 to 150	mA
FM8V output current	I_{O6}		0 to 100	mA
$A_{CC}5V$ output current	I_{O7}		0 to 100	mA
AMP+B output current	I_{O9}		0 to 100	mA
ANT+B output current	I_{O10}		0 to 100	mA
P1 (ILL) output current	I_{O11}		0 to 10	mA
P2 (LCD) output current	I_{O12}		0 to 10	mA
P3 (CAP MR) output current	I_{O13}		0 to 10	mA
P4 (RSV) output current	I_{O14}		0 to 10	mA

Electrical Characteristics at $T_a = 25^\circ\text{C}$, in the specified test circuit

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
No load state [$V_{CC} = 13.2V$, each output $I_O = 0A$]						
Current drain 1	I_{Q1}	$V_{STBY} = 0V$		200	250	μA
Current drain 2	I_{Q2}	$V_{STBY} = 5V$		12	40	mA
$V_{DD}5V$ output [$V_{CC} = 13.2V$, $V_{STBY} = 0V$, $I_{O1} = 50mA$]						
Output voltage	V_{O1}		4.75	5	5.25	V
Dropout voltage	V_{DROP1}	$V_{CC} = 4.75V$		1.0	1.4	V
Line regulation	ΔV_{OLN1}	$6.7V \leq V_{CC} \leq 18V$		10	30	mV
Load regulation	ΔV_{OLD}	$0 \leq I_{O1} \leq 50mA$		50	100	mV
Peak output current	I_{OP1}		50			mA
Output shorted current (for reference purposes)	I_{OSC1}			100		mA
Ripple rejection	R_{REJ1}	$f = 120Hz$, $7V \leq V_{CC} \leq 18V$	50	56		dB
Output pin leakage current	I_{OLEAK}	$V_{CC} = 0V$, $V_O = 6V$		0.001	2	μA
Output voltage difference 1	ΔV_{ODEF1}	Between $V_{DD}5V$ and $A_{CC}5V$, ($V_{O1} - V_{O7}$) $I_{O7} = 100mA$	0	0.1	0.285	V
Reset block [$V_{CC} = 13.2V$]						
Reset threshold voltage	V_{RT}	$V_{RST\ OUT} : Lo \rightarrow Hi$	1.21	1.25	1.30	V
Reset threshold hysteresis voltage	V_{RTH}		25	50	80	mV
COM10V output [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O2} = 2A$]						
Output voltage	V_{O2}	With an external 2SB921 Transistor	9.5	10	10.5	V
Dropout voltage	V_{DROP2}	$V_{CC} = 9.5V$		0.3	0.6	V
Line regulation	ΔV_{OLN2}	$11.2V \leq V_{CC} \leq 18V$		30	300	mV
Load regulation	ΔV_{OLD2}	$0 \leq I_{O2} \leq 2A$		200	800	mV
Control input current	I_{CONT}				20	mA
Output off voltage	$V_{O2\ OFF}$				0.2	V
Ripple rejection (for reference purposes)	R_{REJ2}	$C_{CN} = 1\mu F$, $f = 120Hz$, $11.2V \leq V_{CC} \leq 18V$		70		dB

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
COM8V output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O3} = 100mA]						
Output voltage	V _{O3}		7.6	8	8.4	V
Dropout voltage	V _{DROP3}	V _{O2} = 7.6V		1.0	1.4	V
Line regulation	ΔV _{OLN3}	9.9V ≤ V _{CC} ≤ 18V		50	75	mV
Load regulation	ΔV _{OLD3}	0 ≤ I _{O3} ≤ 100mA		100	150	mV
Peak output current	I _{OP3}		100			mA
Output shorted current (for reference purposes)	I _{O3SC3}			230		mA
Output off voltage	V _{O3 OFF}				0.2	V
TAPE8V output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O4} = 30mA]						
Output voltage	V _{O4}		7.6	8	8.4	V
Dropout voltage	V _{DROP4}	V _{O2} = 7.6V		1.0	1.4	V
Line regulation	ΔV _{OLN4}	9.9V ≤ V _{CC} ≤ 18V		50	75	mV
Load regulation	ΔV _{OLD4}	0 ≤ I _{O4} ≤ 30mA		100	150	mV
Peak output current	I _{OP3}		30			mA
Output shorted current (for reference purposes)	I _{O3SC4}			60		mA
Output off voltage	V _{O4 OFF}				0.2	V
RD8V output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O5} = 150mA]						
Output voltage	V _{O5}		7.6	8	8.4	V
Dropout voltage	V _{DROP5}	V _{O2} = 7.6V		1.0	1.4	V
Line regulation	ΔV _{OLN5}	9.9V ≤ V _{CC} ≤ 18V		50	75	mV
Load regulation	ΔV _{OLD5}	0 ≤ I _{O5} ≤ 150mA		100	150	mV
Peak output current	I _{OP5}		150			mA
Output shorted current (for reference purposes)	I _{O3SC5}			320		mA
Output off voltage	V _{O5 OFF}				0.2	V
FM8V output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O6} = 100mA]						
Output voltage	V _{O6}		7.6	8	8.4	V
Dropout voltage	V _{DROP6}	V _{O2} = 7.6V		1.0	1.4	V
Line regulation	ΔV _{OLN6}	9.9V ≤ V _{CC} ≤ 18V		50	75	mV
Load regulation	ΔV _{OLD6}	0 ≤ I _{O6} ≤ 100mA		100	150	mV
Peak output current	I _{OP6}		100			mA
Output shorted current (for reference purposes)	I _{O3SC6}			230		mA
Output off voltage	V _{O6 OFF}				0.2	V
Output voltage difference 2	ΔV _{ODEF2}	Between RD8V and FM8V, I _{O5} = 150mA			0.3	V
ACC5V output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O7} = 100mA]						
Output voltage	V _{O7}		4.65	4.9	5.15	V
Dropout voltage	V _{DROP7}	V _{O2} = 4.65V		1.0	1.4	V
Line regulation	ΔV _{OLN7}	6.6V ≤ V _{CC} ≤ 18V		50	75	mV
Load regulation	ΔV _{OLD7}	0 ≤ I _{O7} ≤ 100mA		100	150	mV
Peak output current	I _{OP7}		100			mA
Output shorted current (for reference purposes)	I _{O3SC7}			220		mA
Output off voltage	V _{O7 OFF}				0.2	V
AMP+B output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O9} = 100mA]						
Output voltage	V _{O9}		11.7	12.2		V
Dropout voltage	V _{DROP9}			1	1.5	V
Peak output current	I _{OP9}		100			mA
Output shorted current (for reference purposes)	I _{O3SC9}			170		mA
Output off voltage	V _{O9 OFF}				0.2	V

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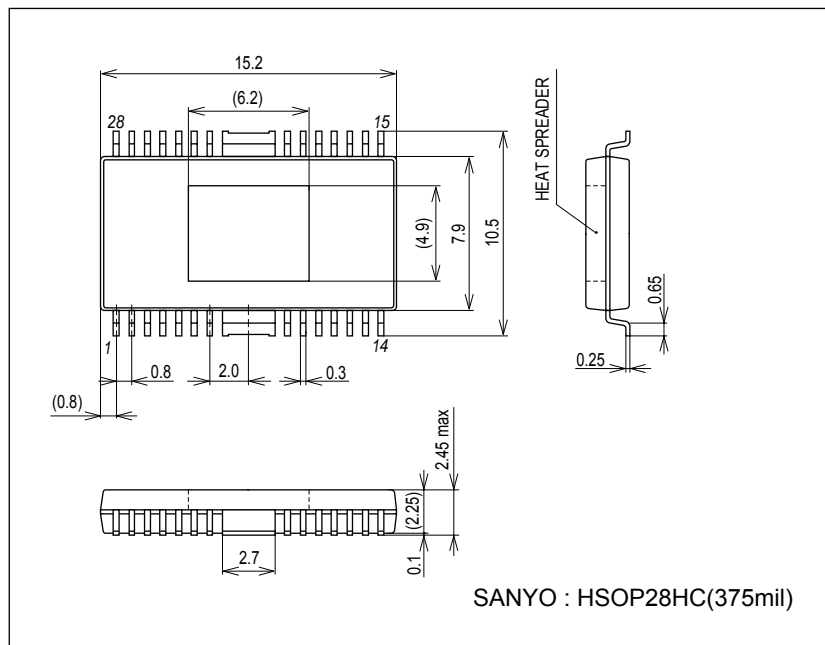
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
ANT+B output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O10} = 100mA]						
Output voltage	V _{O10}		11.7	12.2		V
Dropout voltage	V _{DRDP10}			1	1.5	V
Peak output current	I _{OP10}		100			mA
Output shorted current (for reference purposes)	I _{OSC10}			170		mA
Output off voltage	V _{O10 OFF}				0.2	V
P1 (ILL) output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O11} = 10mA]						
Dropout voltage	V _{DRDP11}			0.4	0.8	V
Sink output current	I _{O11}		10			mA
P2 (LCD) output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O12} = 10mA]						
Dropout voltage	V _{DRDP12}			0.4	0.8	V
Sink output current	I _{O11}		10			mA
P3 (CAP MR) output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O13} = 10mA]						
Dropout voltage	V _{DRDP13}			0.4	0.8	V
Sink output current	I _{O13}		10			mA
P4 (RSV) output [V_{CC} = 13.2V, V_{STBY} = 5V, I_{O14} = 10mA]						
Dropout voltage	V _{DRDP14}			0.4	0.8	V
Sink output current	I _{O14}		10			mA
Overheat protection						
Operating temperature*	TSD	V _{O2} (COM10V) operation V _{O3} to V _{O14} interlocked to V _{O2}	150	175		°C

Note) * for overheat protection indicates the design target value and not the measured value.

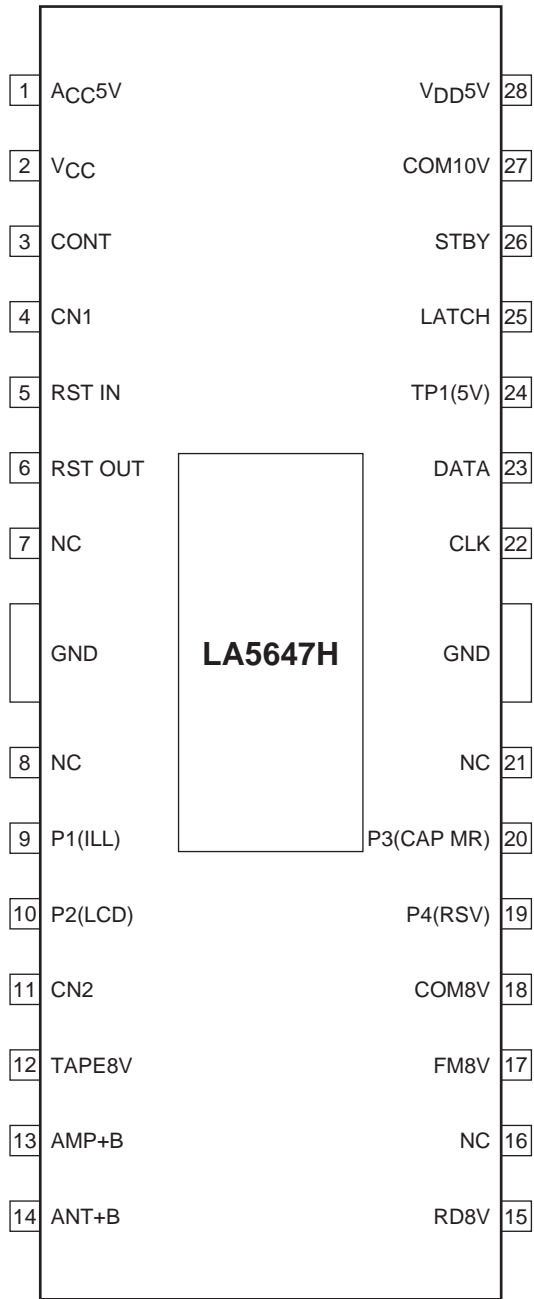
Package Dimensions

unit : mm (typ)

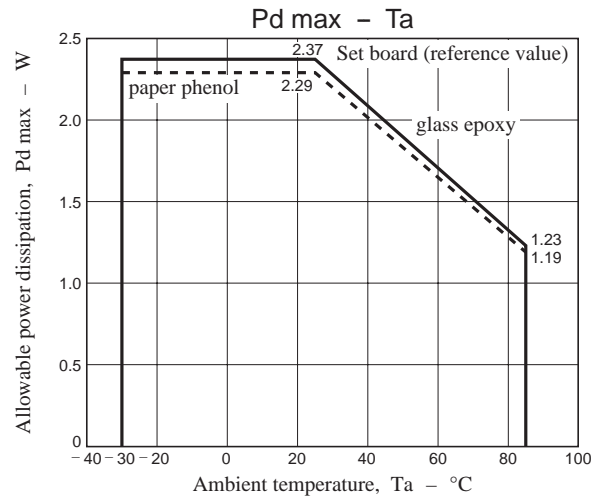
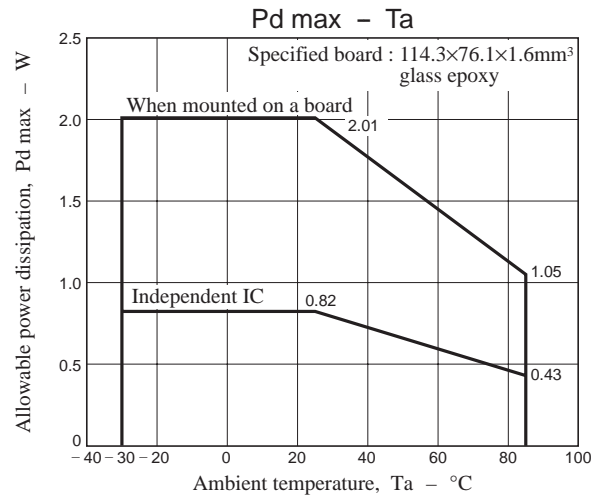
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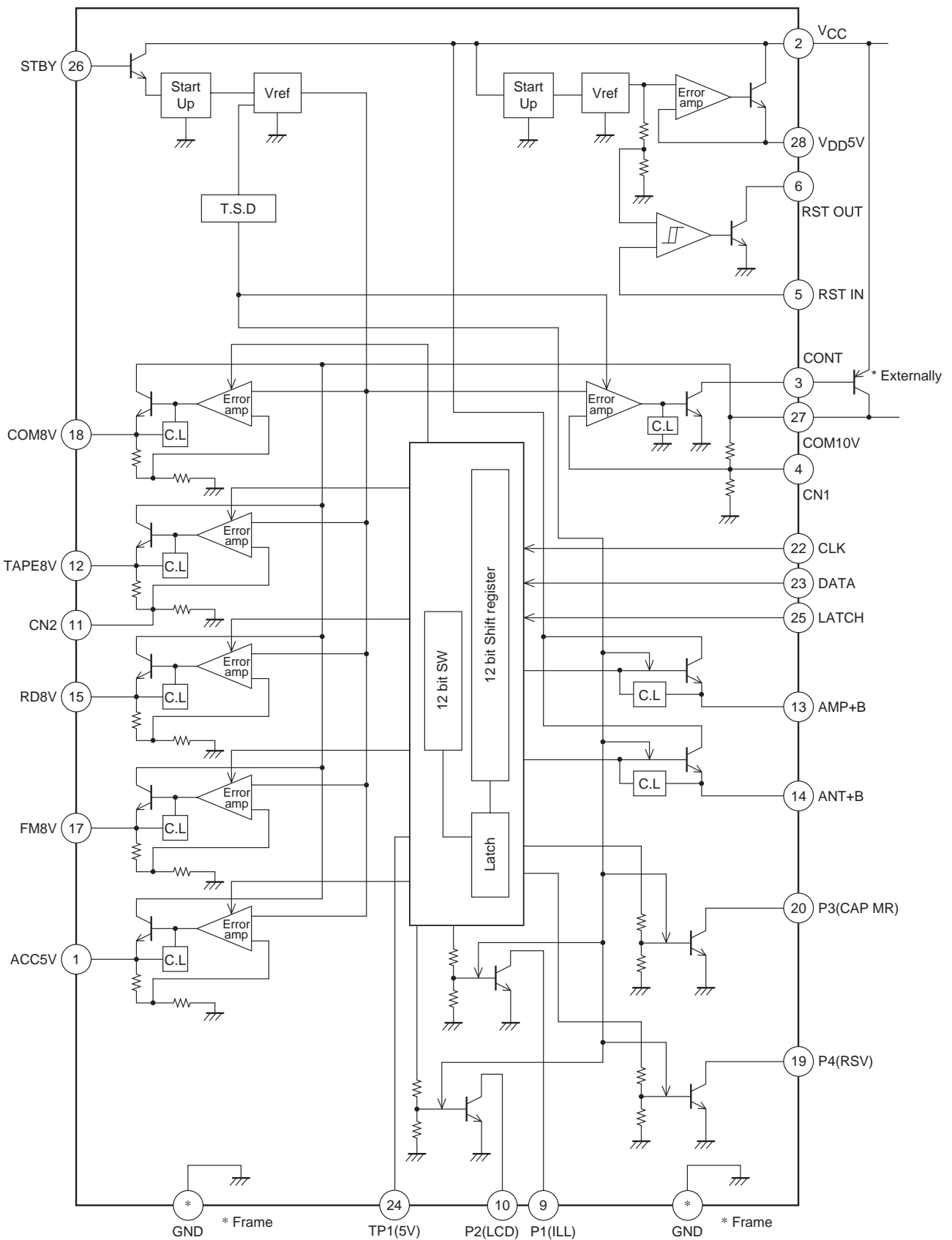
Pin Assignment



Top view



Block Diagram



* External PNPT_r is 2SB921 or equivalent under application.

Pin Functions

Pin No.	Functions	Description	Equivalent Circuit
1 11 12 15 17 18	4.9V 100mA (ACC 5V) CN2 8V 30mA (TAPE 8V) 8V 150mA (RD 8V) 8V 100mA (FM 8V) 8V 100mA (COM 8V)	<ul style="list-style-type: none"> Stabilized 5V system and 8V system power supply outputs The on/off state of CD5V is controlled by STBY and other systems by the serial data, respectively. <p>Application examples</p> <p>Pin 1 : ACC5V, digital 5V</p> <p>Pin 11 : Insert a capacitor of about 10μF between this pin and pin 12 to improve the TAPE8V ripple rejection. This pin controls the pin 12 output voltage. Set this pin to about 7V by inserting a resistor between this pin and ground if impulse noise from the Dolby IC occurs in cranking mode.</p> <p>Pin 12 : TAPE8V</p> <p>Pin 15 : 9 pro V_{CC} as 9 RD 8V</p> <p>Pin 17 : FM8V power supply for use with a band switch</p> <p>Pin 18 : COM8V power supply for an electronic volume/tone control circuit.</p> <p>* : Note that total of Pd must not exceed the rating of the IC.</p>	<p>Only applies to the pin 12 output block</p>
2 3 4 27	V _{CC} CONT CN1 COM10V	<p>Pin 2 : Power supply</p> <p>* : This pin must be at the same voltage level as the emitter of the external transistor.</p> <p>Pin 3 : Bias for the external Transistor. The maximum sink current is 20mA.</p> <p>Pin 4 : Ripple rejection for each of the power supply systems. To increase the rejection capacity, insert a 1μF capacitor between this pin and pin 27. This pin controls the COM10V output voltage. The voltage is set to 10V internally.</p> <p>Pin 27 : The 10V power supply used for CD power, tuner VT, cassette loading, LCD, and ILL illumination.</p> <ul style="list-style-type: none"> Used as the power supply for internal 8V and 5V (except V_{DD}5V) systems. The output voltage can be controlled with the CN1 pin. The ripple rejection can be improved at the CN1 pin. 	<p>Only applies to the pin 12 output block</p>
5	RST IN	<ul style="list-style-type: none"> Voltage detection input: pin 6 is the corresponding output. Internal reference voltage : 1.25V, typical. Used for +B detection, Acc detection, and other purposes by resistor voltage division of the +B level. 	

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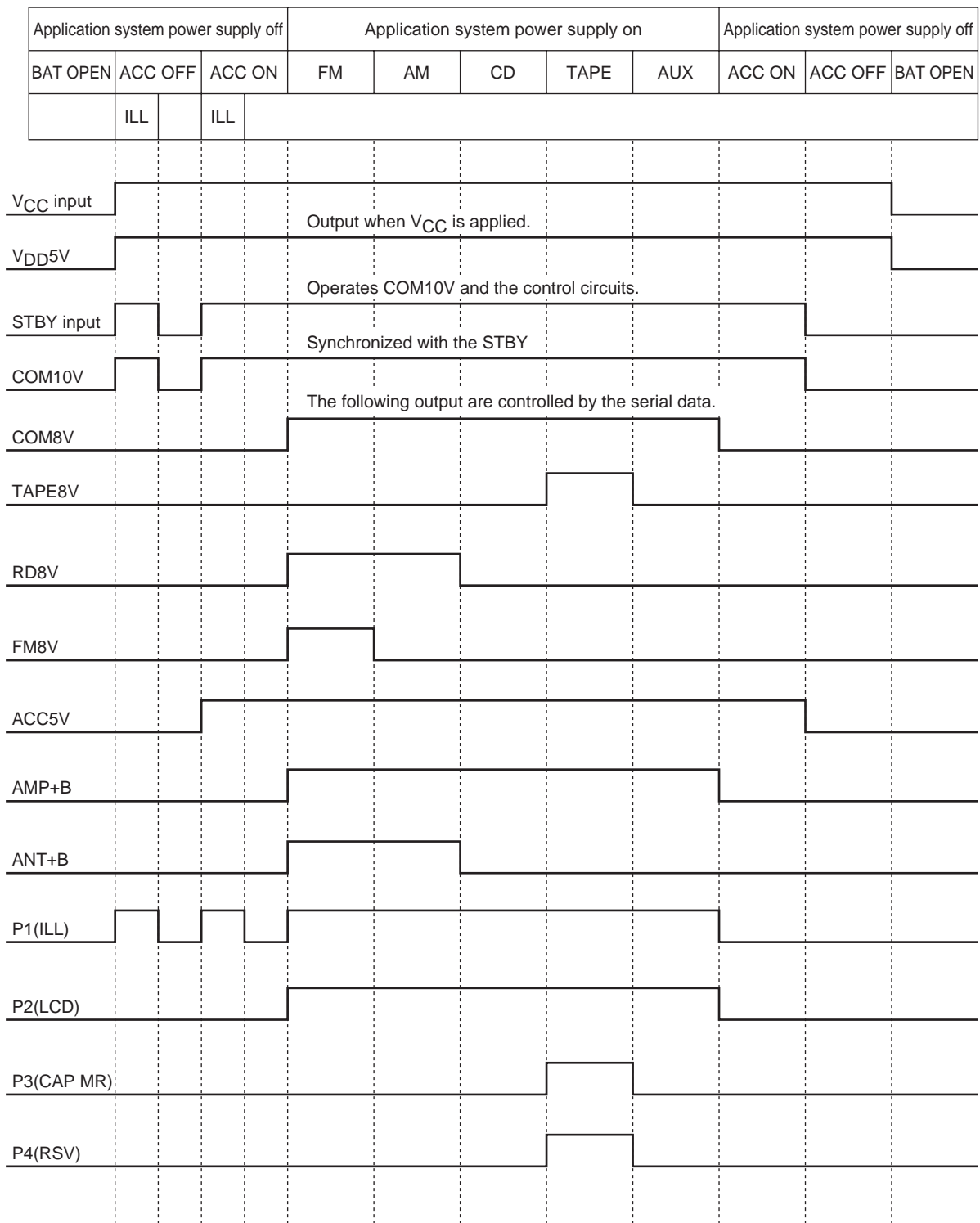
Pin No.	Functions	Description	Equivalent Circuit
6	RST OUT	<ul style="list-style-type: none"> Reset signal output to microcontroller and other circuits. 	
7	NC		
8	NC		
16	NC		
21	NC		
9	P1 (ILL)	<ul style="list-style-type: none"> The on/off state of these systems is controlled by the serial data. Pin 9 : ILL illumination on/off control Pin 10 : LCD illumination on/off control Pins 19 and 20 : Used for other applications. 	
10	P2 (LCD)		
19	P4 (CAP MR)		
20	P3 (RSV)		
13	V _{CC} 100mA (AMP+B)	<ul style="list-style-type: none"> V_{CC}-1V unstabilized outputs that can provide 100mA. The on/off state of these outputs can be controlled with serial data. Used with the ANT+B and AMP+B systems. 	
14	V _{CC} 100mA (ANT+B)		
22	CLK	<ul style="list-style-type: none"> The serial data received over this serial interface controls the outputs other than COM10V, CD5V, and V_{DD}5V. It also controls the on/off state of P1 to P4. 	
23	DATA		
25	LATCH		
24	TP1 (5V)	<ul style="list-style-type: none"> Monitors the power supply used for the internal logic circuits (the CLK, DATA, and LATCH inputs and on/off control). 	

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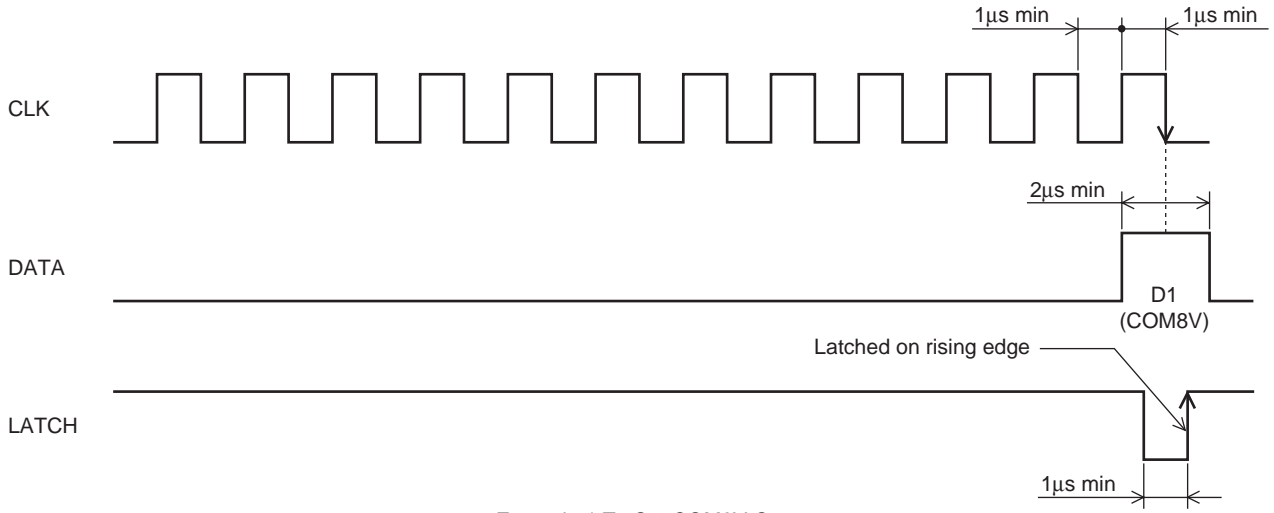
Pin No.	Functions	Description	Equivalent Circuit
26	STBY	<ul style="list-style-type: none"> Controls the running/stopped state of this IC. When low, only $V_{DD}5V$ operates. All other circuits are stopped. When high, only COM10V and $V_{DD}5V$ operate unconditionally. All other outputs are controlled by the serial data. 	
28	$V_{DD} 5V$	<ul style="list-style-type: none"> When +B is applied to the $V_{CC}2$ pin, 5V is output. Used as the power supply system for systems, such as the microcontroller, that require memory backup. $I_Q = 150$ to $180\mu A$ The current flowing into pin 28 when V_{CC} is off, is minimal. 	
Frame	GND	Connected to the IC substrate (lowest potential)	

Output Timing Chart

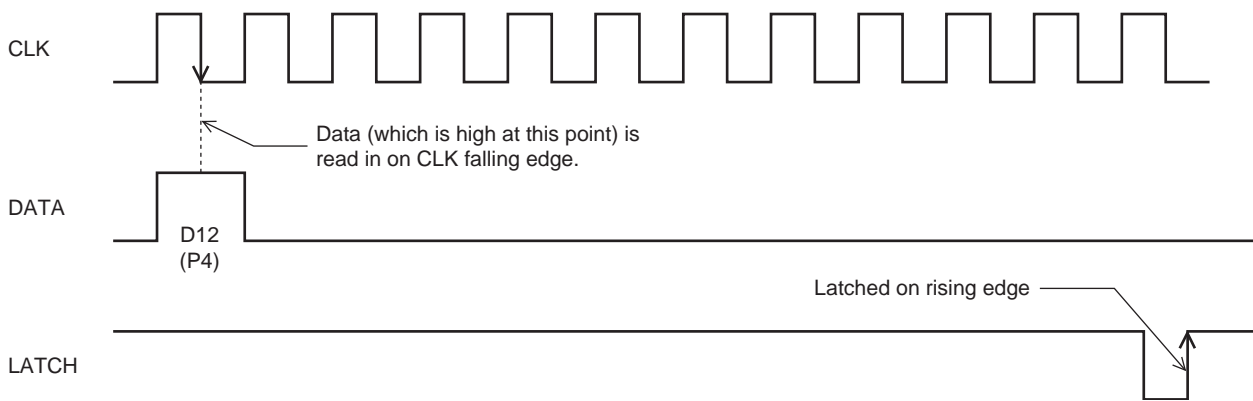


Control Timing and Data Formats

Input the stipulated data to the CLK, DATA, and LATCH pins to control the outputs other than the V_{DD}5V and COM10V.



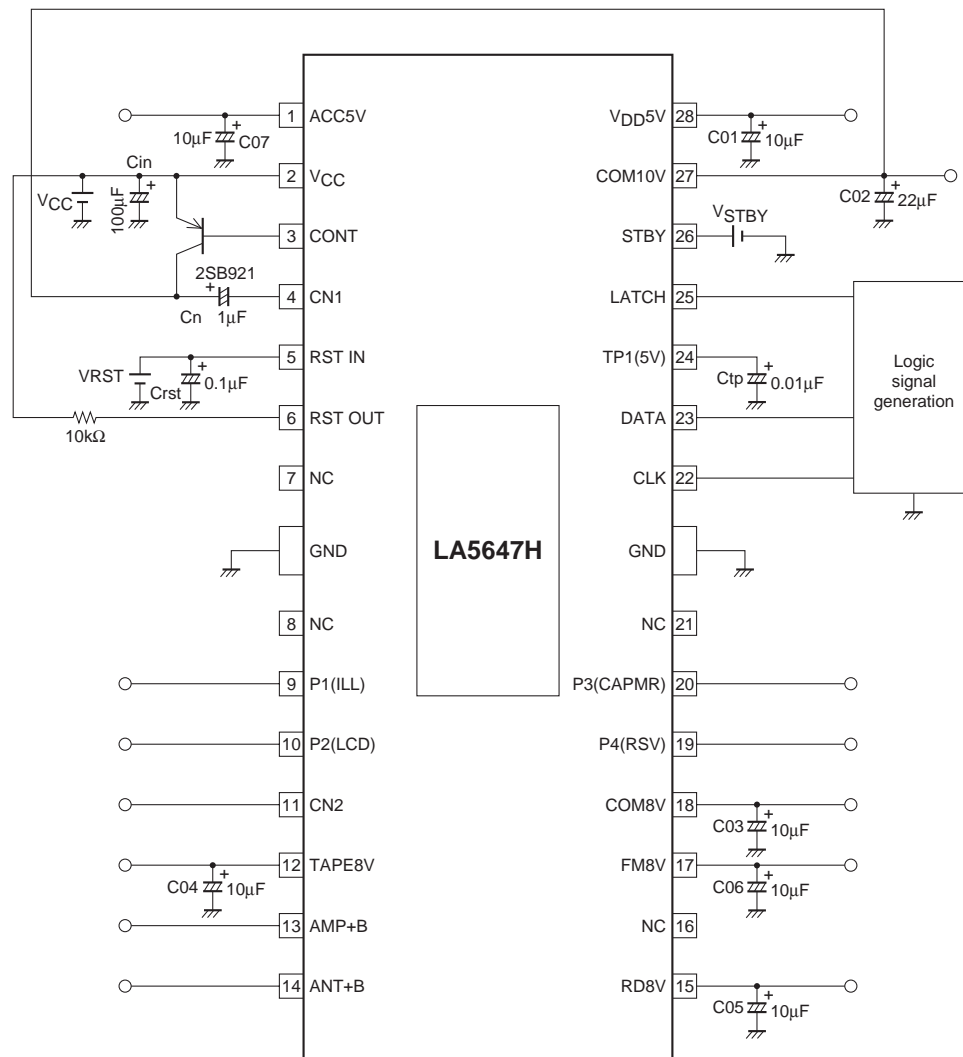
Example 1 To Set COM8V On



Example 2 To Set P4 On

DATA	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12
Output	COM8V	TAPE8V	RD8V	FM8V	ACC5V	-	AMP+B	ANT+B	P1 (ILL)	P2 (LCD)	P3 (CAPMR)	P4 (RSV)

Specified Test Circuit



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