



LA5635H

Multifunction Multi-Voltage Power Supply for Car AV Equipment

Overview

The LA5635H 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.

Functions

- 5 V/50 mA regulator (always on, with reverse current flow prevention function)
- 10 V, 2000 mA regulator (when used with an external 2SB921 pnp transistor) with standby function (on/off control)
- Regulators (four 8 V systems and two 5 V systems) with on/off functions controlled by a shift register/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
 - Overcurrent protection for each V_O except the open-collector outputs
 - Thermal protection for each V_O except the V_{DD} 5 V output
- Two reset circuit systems

Specifications

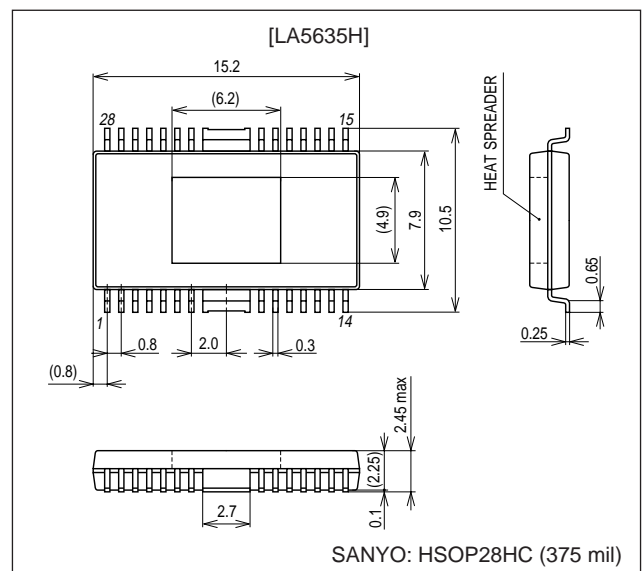
Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC} max		24	V
Allowable power dissipation	Pd max	$T_a \leq 25^\circ\text{C}$, independent IC	0.82	W
		Mounted on a $76.1 \times 114.3 \times 1.6$ mm ³ glass epoxy circuit board	2.01	W
Transistor junction to ambient air thermal resistance	θ_{j-a}		152.4	$^\circ\text{C}/\text{W}$
Operating temperature	T_{opr}		-30 to +85	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

Package Dimensions

unit: mm

3234B-HSOP28HC



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LA5635H

Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V _{CC}		6 to 18	V
STBY pin 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 200	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
ACC5V output current	I _{O7}		0 to 100	mA
CD5V output current	I _{O8}		0 to 300	mA
AMP+B output current	I _{O9}		0 to 100	mA
ANT+B output current	I _{O10}		0 to 500	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 Ta = 25°C, in the specified test circuit

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
No Load State [V _{CC} = 13.2 V, each output I _O = 0]						
Current drain 1	I _{Q1}	V _{STBY} = 0 V, V _{RST IN1} , 2 < 4.46 V		600	780	μA
Current drain 2	I _{Q2}	V _{STBY} = 5 V		12	40	mA
V _{DD} 5V Output [V _{CC} = 13.2 V, V _{STBY} = 0 V, I _{O1} = 50 mA]						
Output voltage	V _{O1}		4.75	5	5.25	V
Dropout voltage	V _{DROP1}	V _{CC} = 4.75 V		1.0	1.4	V
Line regulation	ΔV _{OLN1}	6.7 V ≤ V _{CC} ≤ 18 V		10	30	mV
Load regulation	ΔV _{OLD1}	0 ≤ I _{O1} ≤ 50 mA		50	100	mV
Peak output current	I _{OP1}		50			mA
Output shorted current (for reference purposes)	I _{O SC1}			100		mA
Ripple rejection	R _{REJ1}	f = 120 Hz, 7 V ≤ V _{CC} ≤ 18 V	50	56		dB
Output pin leakage current	I _{O LEAK}	V _{CC} = 0 V, V _O = 6 V		0.001	2	μA
Output voltage difference 1	ΔV _{O DEF1}	Between V _{DD} 5V and ACC5V, I _{O7} = 100 mA			0.4	V
Output voltage difference 2	ΔV _{O DEF2}	Between V _{DD} 5V and CD5V, I _{O8} = 300 mA			0.4	V
Reset Block 1 [V _{CC} = 13.2 V]						
Reset threshold voltage	V _{RT1}	V _{RST OUT} : low → high	4.46	4.60	4.74	V
Reset threshold hysteresis voltage	V _{RTH1}		0.234	0.26	0.286	V
Low-level reset output voltage	V _{ORL1}	V _{RST IN1} < 4.46 V, I _{RST OUT1} = 1 mA		50	200	mA
Reset Block 2 [V _{CC} = 13.2 V]						
Reset threshold voltage	V _{RT2}	V _{RST OUT2} : low → high	4.46	4.60	4.74	V
Reset threshold hysteresis voltage	V _{RTH2}		0.234	0.26	0.286	V
Low-level reset output voltage	V _{ORL2}	V _{RST IN2} < 4.46 V, I _{RST OUT1} = 1 mA		50	200	mA
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} = 9.5 V		0.3	0.6	V
Line regulation	ΔV _{OLN2}	11.2 V ≤ V _{CC} ≤ 18 V		30	300	mV
Load regulation	ΔV _{OLD2}	0 ≤ I _{O2} ≤ 2 A		200	800	mV
Control input current	I _{CONT}				20	mA
Output off voltage	V _{O2 OFF}				0.2	V
Ripple rejection (for reference purposes)	P _{REJ2}	C _{CN} = 1μF, f = 120 Hz, 11.2V ≤ V _{CC} ≤ 18 V		70		dB

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LA5635H

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
COM8V Output [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O3} = 200mA$]						
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}	$9.9V \leq V_{CC} \leq 18V$		50	75	mV
Load regulation	ΔV_{OLD3}	$0 \leq I_{O3} \leq 200mA$		100	150	mV
Peak output current	I_{OP3}		200			mA
Output shorted current (for reference purposes)	I_{OSC3}			350		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}	$9.9V \leq V_{CC} \leq 18V$		50	75	mV
Load regulation	ΔV_{OLD4}	$0 \leq I_{O4} \leq 30mA$		100	150	mV
Peak output current	I_{OP4}		30			mA
Output shorted current (for reference purposes)	I_{OSC4}			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}	$9.9V \leq V_{CC} \leq 18V$		50	75	mV
Load regulation	ΔV_{OLD5}	$0 \leq I_{O5} \leq 150mA$		100	150	mV
Peak output current	I_{OP5}		150			mA
Output shorted current (for reference purposes)	I_{OSC5}			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}	$9.9V \leq V_{CC} \leq 18V$		50	75	mV
Load regulation	ΔV_{OLD6}	$0 \leq I_{O6} \leq 100mA$		100	150	mV
Peak output current	I_{OP6}		100			mA
Output shorted current (for reference purposes)	I_{OSC6}			230		mA
Output off voltage	$V_{O6 OFF}$				0.2	V
Output voltage difference 3	ΔV_{ODEF3}	Between RD8V and FM8V, $I_{O5} = 150mA$			0.4	V
ACC5V [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O7} = 100mA$]						
Output voltage	V_{O7}		4.75	5	5.25	V
Dropout voltage	V_{DROP7}	$V_{O2} = 4.75V$		1.0	1.4	V
Line regulation	ΔV_{OLN7}	$6.7V \leq V_{CC} \leq 18V$		50	75	mV
Load regulation	ΔV_{OLD7}	$0 \leq I_{O7} \leq 100mA$		100	150	mV
Peak output current	I_{OP7}		100			mA
Output shorted current (for reference purposes)	I_{OSC7}			220		mA
Output off voltage	$V_{O7 OFF}$				0.2	V
CD5V Output [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O8} = 300mA$]						
Output voltage	V_{O8}		4.75	5	5.25	V
Dropout voltage	V_{DROP8}	$V_{O2} = 4.75V$		1.0	1.4	V
Line regulation	ΔV_{OLN8}	$6.7V \leq V_{CC} \leq 18V$		50	75	mV
Load regulation	ΔV_{OLD8}	$0 \leq I_{O8} \leq 300mA$		100	150	mV
Peak output current	I_{OP8}		300			mA
Output shorted current (for reference purposes)	I_{OSC8}			600		mA
Output off voltage	$V_{O8 OFF}$				0.2	V

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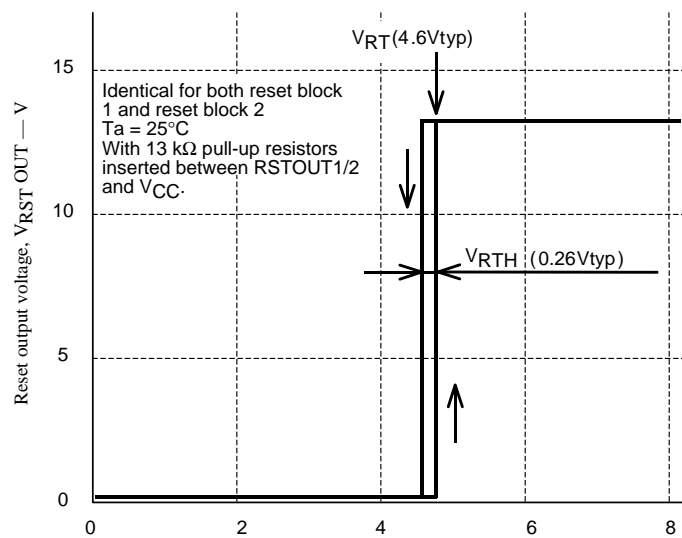
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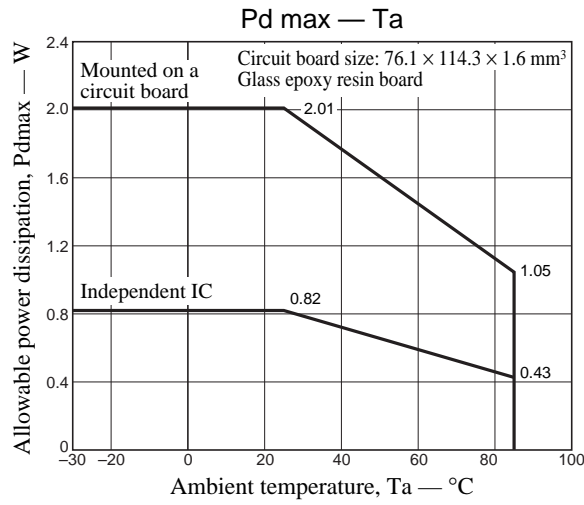
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
AMP + B Output [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O9} = 100mA$]						
Output voltage	V_{O9}		11.7	12.2		V
Dropout voltage	V_{DROP9}			1	1.5	V
Peak output current	I_{OP9}		100			mA
Output shorted current (for reference purposes)	I_{OSC9}			170		mA
Output off voltage	$V_{O9 OFF}$				0.2	V
ANT + B Output [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O10} = 500mA$]						
Output voltage	V_{O10}		11.7	12.2		V
Dropout voltage	V_{DROP10}			1	1.5	V
Peak output current	I_{OP10}		500			mA
Output shorted current (for reference purposes)	I_{OSC10}			250		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_{DROP11}			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_{DROP12}			0.4	0.8	V
Sink output current	I_{O12}		10			mA
P3 (CAP MR) Output [$V_{CC} = 13.2V$, $V_{STBY} = 5V$, $I_{O13} = 10mA$]						
Dropout voltage	V_{DROP13}			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_{DROP14}			0.4	0.8	V
Sink output current	I_{O14}		10			mA

Reset Operation Characteristics

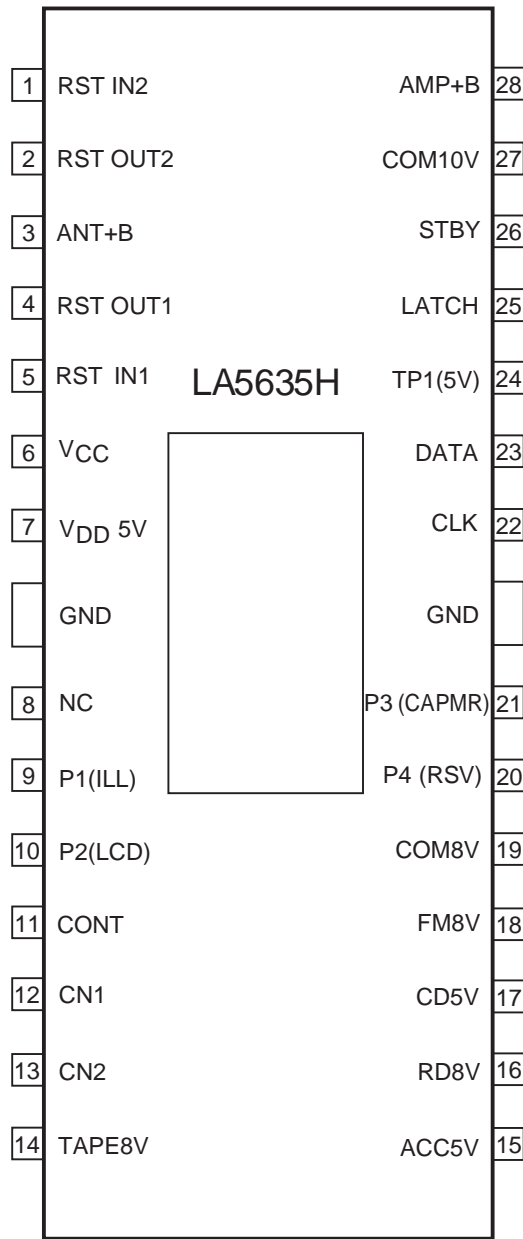
$V_{RST OUT} - V_{RST IN}$



LA5635H



Pin Assignments



Top view

Pin Functions

Pin No.	Name	Description	Equivalent circuit
1 5	RST IN2 RST IN1	<ul style="list-style-type: none"> • Voltage detection inputs: pins 6 and 8 are the corresponding outputs. • Internal reference voltage: 4.70 V, typical • Used for +B detection, ACC detection, and other purposes by resistor voltage division of the +B level. 	
2 4	RST OUT2 RST OUT1	Reset signal outputs to the microcontroller and other circuits	
3 28	V _{CC} 500mA (ANT+B) V _{CC} 100mA (ANT+B)	<ul style="list-style-type: none"> • V_{CC} -1V unstabilized outputs that can provide 100 or 500mA • The on/off state of these outputs can be controlled with serial data. • Used with the ANT+B and AMP+B systems. 	
6 11 12 27	V _{CC} CONT CN1 COM10V	<p>Pin 6: Power supply *: This pin must be at the same potential as the emitter of the external transistor.</p> <p>Pin 11: Bias for the external transistor. The maximum sink current is 20 mA.</p> <p>Pin 12: Ripple rejection for each of the power supply systems. To increase the rejection capacity, insert a 1 μF capacitor between this pin and pin 27.</p> <ul style="list-style-type: none"> • This pin controls the COM10V output voltage. The voltage is set to 10 V internally. <p>Pin 27: The 10 V 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. 	

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LA5635H

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Pin No.	Name	Description	Equivalent circuit
7	V _{DD} 5V	<ul style="list-style-type: none"> When +B is applied to the V_{DD}6 pin, 5 V is output. Used as the power supply for systems, such as the microcontroller, that require memory backup. I_Q = 600 to 780 μA The current flowing into pin 7 when V_{CC} is off, is minimal. 	
8	NC		
9 10 20 21	P1 (ILL) P2 (LCD) P4 (CAP MR) P3 (RSV)	<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 20 and 21: Used for other applications. 	
13 14 15 16 17 18 19	CN2 8V 30mA (TAPE 8V) 5V 100mA (ACC 5V) 8V 150mA (RD 8V) 5V 300mA (CD 5V) 8V 100mA (FM 8V) 8V 200mA (COM 8V)	<ul style="list-style-type: none"> Stabilized 5 V system and 8 V system power supply outputs The on/off state of these systems is controlled by the serial data. <p>Application examples</p> <p>Pin 13: Insert a capacitor of about 1 μF between this pin and pin 14 to improve the TAPE8V ripple rejection. This pin controls the pin 14 output voltage. Set this pin to about 7 V by inserting a resistor between this pin and ground if impulse noise from the Dolby IC occurs in cranking mode.</p> <p>Pin 14: TAPE8V Pin 15: ACC5V, digital system 5 V power supply Pin 16: RD8V Pin 17: CD5V Pin 18: FM8V power supply for use with a band switch Pin 19: COM8V power supply for an electronic volume/tone control circuit .</p> <p>*: Note that the total Pd must not exceed the IC rating.</p>	<p>Only applies to the pin 14 output block</p>
22 23 25	CLK DATA LATCH	<ul style="list-style-type: none"> The serial data received over this serial interface controls the outputs other than COM10V and V_{DD}5. It also controls the on/off state of P1 to P4. 	

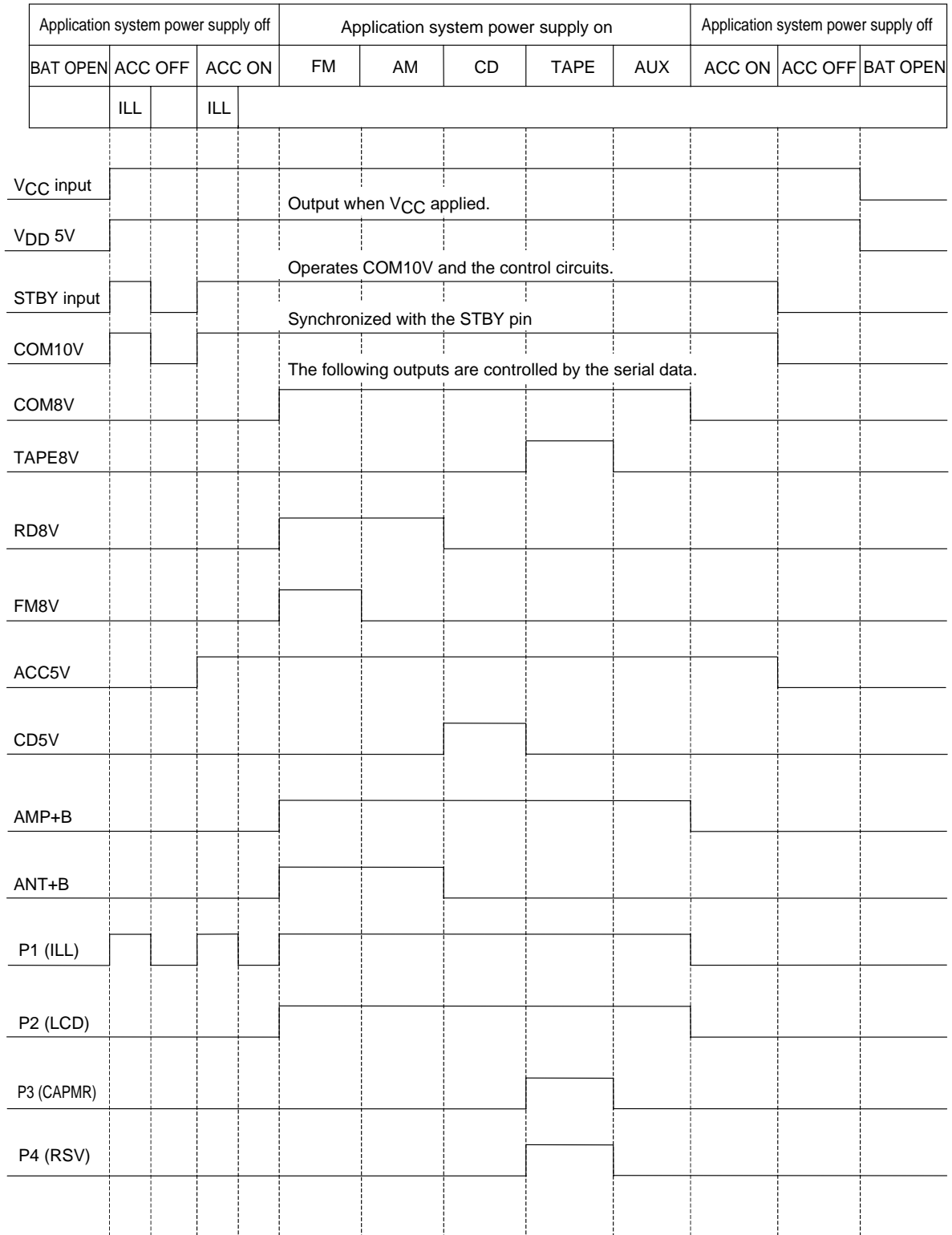
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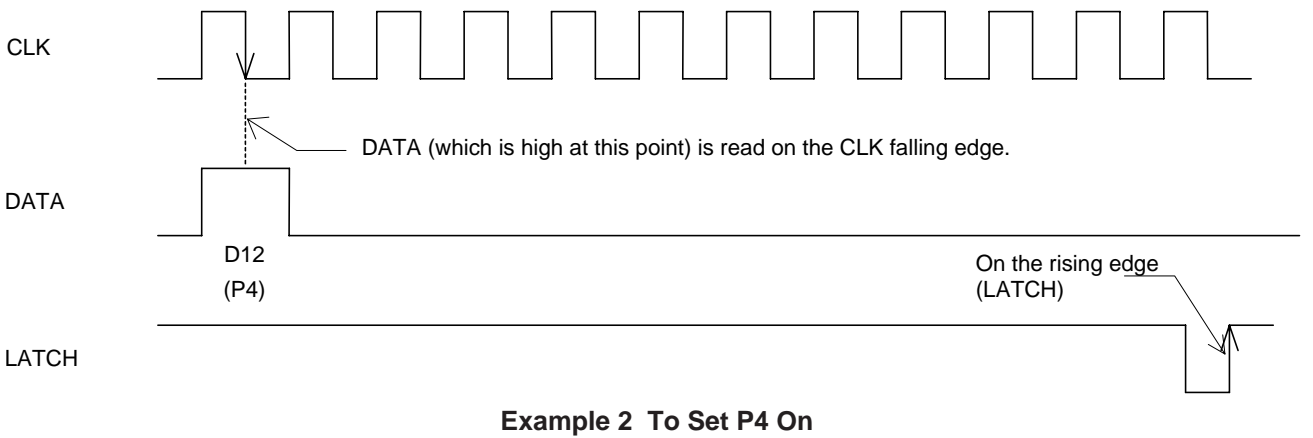
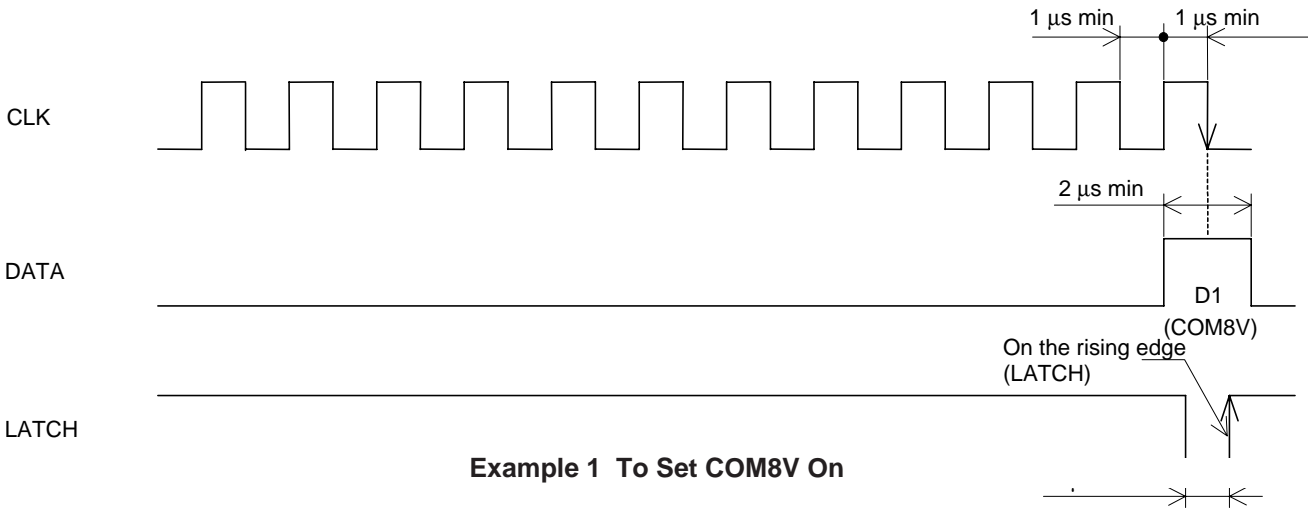
Pin No.	Name	Description	Equivalent circuit
24	TP1 (5V)	<ul style="list-style-type: none"> Monitors the power supply used for the internal logic circuits (the CLK, DATA, and LATCH inputs and on/off control). 	
26	STBY	<ul style="list-style-type: none"> Controls the running/stopped state of this IC. When low, only DCC5V 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. 	
Frame	GND	Connected to the IC substrate (lowest potential)	

Output Timing Chart



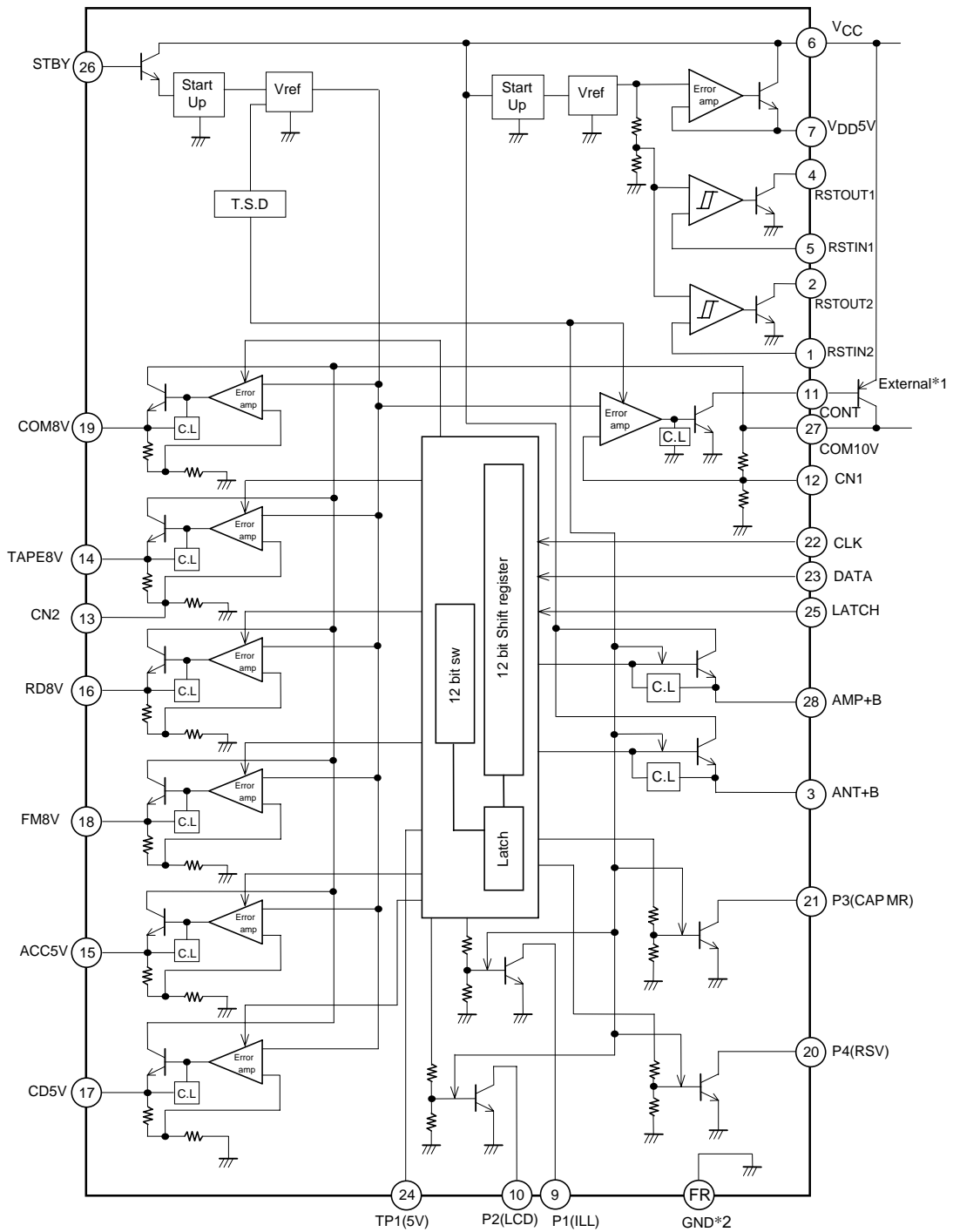
Control Timing and Data Formats

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



DATA	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12
Output	COM8V	TAPE8V	RD8V	FM8V	ACC5V	CD5V	AMP+B	ANT+B	P1 (ILL)	P2 (LCD)	P3 (CAP MR)	P4 (RSV)

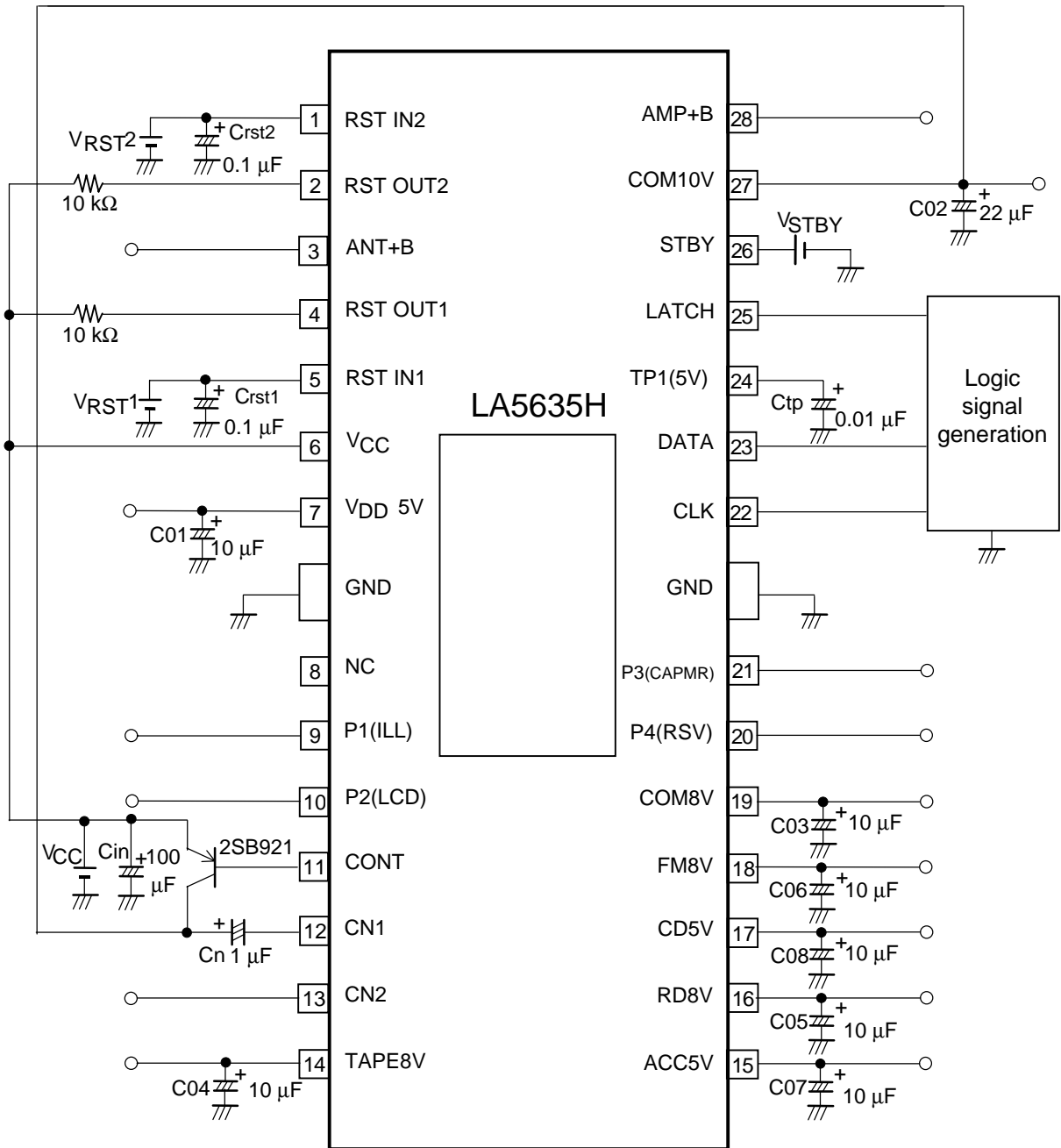
Equivalent Circuit Block Diagram



*1: The external pnp transistor must be 2SB921 or equivalent.

*2: FR = frame

Specified Test Circuit



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