

**LA5633****Satellite Broadcast (BS/CS) Tuner Regulator IC****Overview**

The LA5633 is a low-saturation regulator IC designed for use in satellite broadcast tuners (such as tuners for the Japanese BS and CS systems) and provides four controllable outputs.

Applications

- Power supply systems in BS/CS tuners
- Audio Video (AV) equipment that includes any type of satellite broadcast tuner
- Miniature electronic equipment

Functions

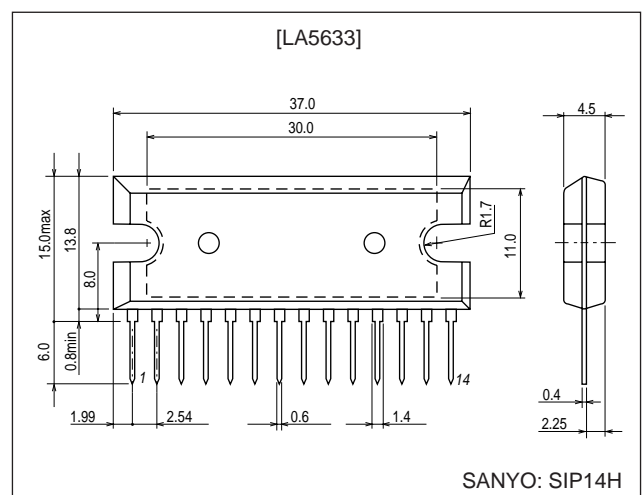
- Built-in four regulators of low-saturation output (15.7 V/350 mA, 9 V/250 mA, 12 V/100 mA, 5 V/650 mA)
- Output on/off control (active low)
- On-chip thermal protection and overcurrent protection circuits

Features

- Provides all four voltages required by BS/CS tuners, and thus can contribute to end product miniaturization.
- V_{O1} can be controlled independently, and V_{O2} , V_{O3} , and V_{O4} are controlled together, thus providing a high degree of flexibility in system design.
- The adoption of a low-saturation regulator circuit reduces internal power dissipation.
- Provides 3 inputs to make both low-power design and thermal design easy.

Package Dimensions

unit: mm

3023A-SIP14H

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Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	$V_{IN\text{ max}}$	$V_{IN1} \geq V_{IN2} \geq V_{IN3}$	35	V
Enable pin voltage	$V_{EN\text{ max}}$	EN1, EN2	$V_{IN\text{ max}}$	V
Allowable power dissipation	$P_{d\text{ max}}$	With an arbitrarily large heat sink	15	W
		With no heat sink	4.3	W
Junction to case thermal resistance	θ_{j-c}		3	$^\circ\text{C/W}$
Junction to atmosphere thermal resistance	θ_{j-a}		29.07	$^\circ\text{C/W}$
Operating temperature	T_{opr}		-20 to +80	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$
Junction temperature	$T_{j\text{ max}}$		150	$^\circ\text{C}$

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

Parameter	Symbol	Conditions	Ratings	Unit
Output current	I_{O1}	Regulator 1	5 to 350	mA
	I_{O2}	Regulator 2	1 to 250	mA
	I_{O3}	Regulator 3	1 to 100	mA
	I_{O4}	Regulator 4	5 to 650	mA

Operating Characteristics at $T_a = 25^\circ\text{C}$ in the stipulated test circuit

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Regulator 1 [V _{EN1} = low, V _{O1} : on, V _{IN1} = 20 V, I _{O1} = 350 mA]						
Output voltage 1	V _{O1}		14.9	15.7	16.5	V
Dropout voltage	V _{DROP1-1}			0.3	0.5	V
	V _{DROP1-2}	I _{O1} = 175 mA		0.15	0.3	V
Line regulation	ΔV _{OLN1}	17.5 V ≤ V _{IN1} ≤ 23 V		20	100	mV
Load regulation	ΔV _{OLD1}	5 mA ≤ I _{O1} ≤ 350 mA		40	200	mV
Peak output current	I _{OP1}		350	540		mA
Output short-circuit current	I _{OSC1}			150		mA
Output on control voltage	V _{ENL1}	V _{O1} : ON			1.0	V
Output off control voltage	V _{ENH1}	V _{O1} : OFF	4.0		V _{IN1}	V
Output low-level voltage	V _{O1} OFF				0.2	V
Output noise voltage	V _{NOISE1}	10 Hz ≤ f ≤ 100 kHz		110		μVrms
Ripple rejection	R _{rej1}	f = 120 Hz, 18 V ≤ V _{IN1} ≤ 23 V		50		dB
Regulator 2 [V _{EN2} = low, V _{O2} : on, V _{IN2} = 11 V, I _{O2} = 250 mA]						
Output voltage 2	V _{O2}		8.55	9.0	9.45	V
Dropout voltage	V _{DROP2}			0.3	0.5	V
Line regulation	ΔV _{OLN2}	10.45 V ≤ V _{IN2} ≤ 23 V		20	100	mV
Load regulation	ΔV _{OLD2}	1 mA ≤ I _{O2} ≤ 250 mA		30	100	mV
Peak output current	I _{OP2}		250	270		mA
Output short-circuit current	I _{OSC2}			70		mA
Output on control voltage	V _{ENL2}	V _{O2} : ON			1.0	V
Output off control voltage	V _{ENH2}	V _{O2} : OFF	4.0		V _{IN2}	V
Output low-level voltage	V _{O2} OFF				0.2	V
Output noise voltage	V _{NOISE2}	10 Hz ≤ f ≤ 100 kHz		110		μVrms
Ripple rejection	R _{rej2}	f = 120 Hz, 11 V ≤ V _{IN2} ≤ 23 V		50		dB
Regulator 3 [V _{EN2} = low, V _{O3} on, V _{IN1} = 20 V, I _{O3} = 100 mA]						
Output voltage 3	V _{O3}		11.4	12.0	12.6	V
Dropout voltage	V _{DROP3}			0.3	0.5	V
Line regulation	ΔV _{OLN3}	13.6 V ≤ V _{IN1} ≤ 23 V		20	100	mV
Load regulation	ΔV _{OLD3}	1 mA ≤ I _{O3} ≤ 100 mA		20	50	mV
Peak output current	I _{OP3}		100	150		mA
Output short-circuit current	I _{OSC3}			40		mA
Output on control voltage	V _{ENL2}	V _{O3} : ON			1.0	V

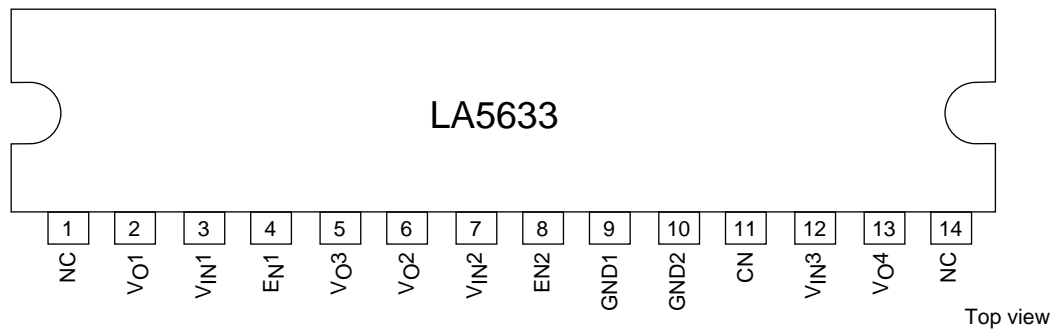
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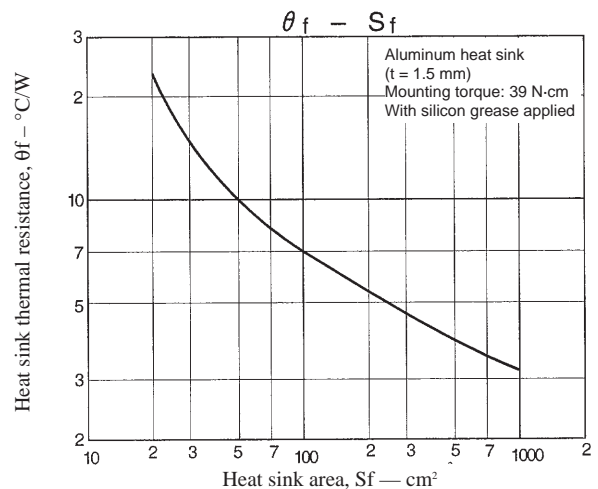
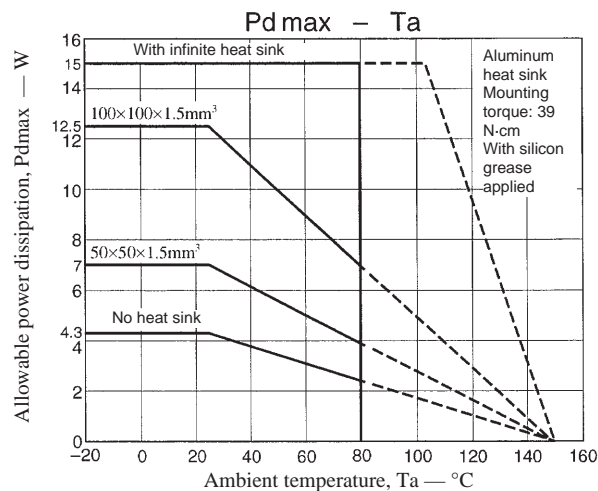
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output off control voltage	V_{ENH2}	$V_{O3} : \text{OFF}$	4.0		V_{IN1}	V
Output low-level voltage	$V_{O3 \text{ OFF}}$				0.2	V
Output noise voltage	V_{NOISE3}	$10 \text{ Hz} \leq f \leq 100 \text{ kHz}$		70		μVrms
Ripple rejection	R_{rej3}	$f = 120 \text{ Hz}, 14 \text{ V} \leq V_{IN1} \leq 23 \text{ V}$		55		dB
Regulator 4 [$V_{EN2} = \text{low}$, $V_{O4} : \text{on}$, $V_{IN3} = 7.0 \text{ V}$, $I_{O4} = 650 \text{ mA}$]						
Output voltage 4	V_{O4}		4.75	5.0	5.25	V
Dropout voltage	$V_{DROP4-1}$			0.3	0.5	V
	$V_{DROP4-2}$	$I_{O1} = 325 \text{ mA}$		0.2	0.4	V
Line regulation	ΔV_{OLN4}	$6.25 \text{ V} \leq V_{IN3} \leq 23 \text{ V}$		20	100	mV
Load regulation	ΔV_{OLD4}	$5 \text{ mA} \leq I_{O4} \leq 650 \text{ mA}$		40	200	mV
Peak output current	I_{OP4}		650	900		mA
Output short-circuit current	I_{OSC4}			250		mA
Output on control voltage	V_{ENL2}	$V_{O4} : \text{ON}$			1.0	V
Output off control voltage	V_{ENH2}	$V_{O4} : \text{OFF}$	4.0		V_{IN3}	V
Output low-level voltage	$V_{O4 \text{ OFF}}$				0.2	V
Output noise voltage	V_{NOISE1}	$10 \text{ Hz} \leq f \leq 100 \text{ kHz}$		70		μVrms
Ripple rejection	R_{rej4}	$f = 120 \text{ Hz}, 7 \text{ V} \leq V_{IN3} \leq 23 \text{ V}$		60		dB
Current drain	I_{Q1}	$I_{O1}, I_{O2}, I_{O3}, I_{O4} = 0$		11		mA
	I_{Q2}	$I_{O1} = 350 \text{ mA}, I_{O2} = 250 \text{ mA}, I_{O3} = 100 \text{ mA}, I_{O4} = 650 \text{ mA}$		65		mA
Output rise times [$V_{IN1} = 20 \text{ V}$, $V_{IN2} = 11 \text{ V}$, $V_{IN3} = 7 \text{ V}$, $C_{O1} = 220 \mu\text{F}$, $C_{O2} = 220 \mu\text{F}$, $C_{O3} = 220 \mu\text{F}$, $C_{O4} = 3300 \mu\text{F}$]						
Regulator 1 rise time	t_{O1}	$V_{EN1} = 5 \text{ V} \rightarrow 0 \text{ V}$, $V_{EN2} = 0 \text{ V}$, $I_{O1} = 350 \text{ mA}$, $I_{O2} \text{ to } I_{O4} = 0 \text{ A}$			22.0	ms
Regulator 2 rise time	t_{O2}	$V_{EN1} = 0 \text{ V}$, $V_{EN2} = 5 \text{ V} \rightarrow 0 \text{ V}$, $I_{O2} = 250 \text{ mA}$, $I_{O1}, I_{O3}, I_{O4} = 0 \text{ A}$			27.5	ms
Regulator 3 rise time	t_{O3}	$V_{EN1} = 0 \text{ V}$, $V_{EN2} = 5 \text{ V} \rightarrow 0 \text{ V}$, $I_{O3} = 100 \text{ mA}$, $I_{O1}, I_{O2}, I_{O4} = 0 \text{ A}$			44.5	ms
Regulator 4 rise time	t_{O4}	$V_{EN1} = 0 \text{ V}$, $V_{EN2} = 5 \text{ V} \rightarrow 0 \text{ V}$, $I_{O4} = 630 \text{ mA}$, $I_{O1} \text{ to } I_{O3} = 0 \text{ A}$			81.0	ms

Pin Assignment

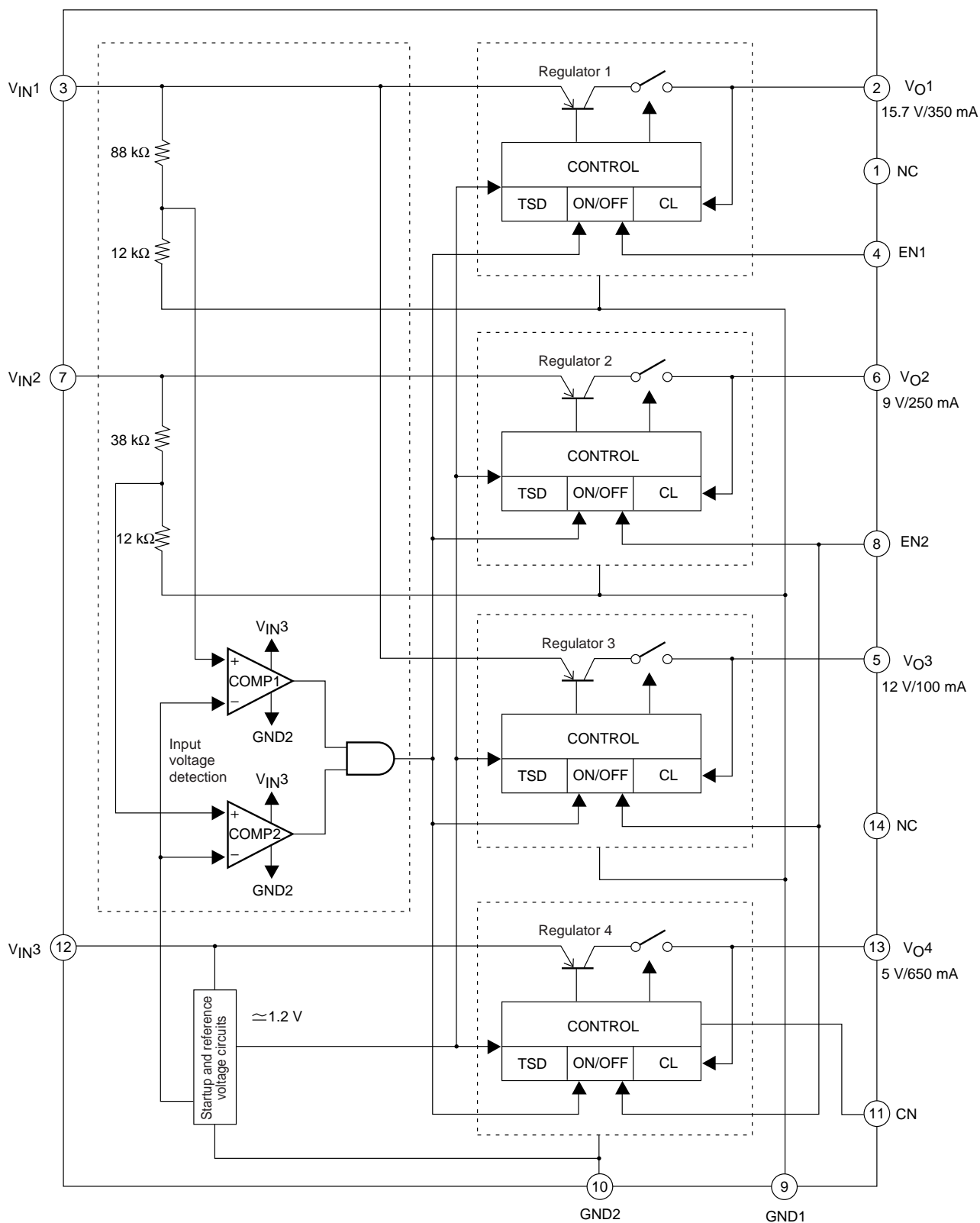


Note: NC pins must not be used (Pins 1 and 14 in the pin assignment figure.)

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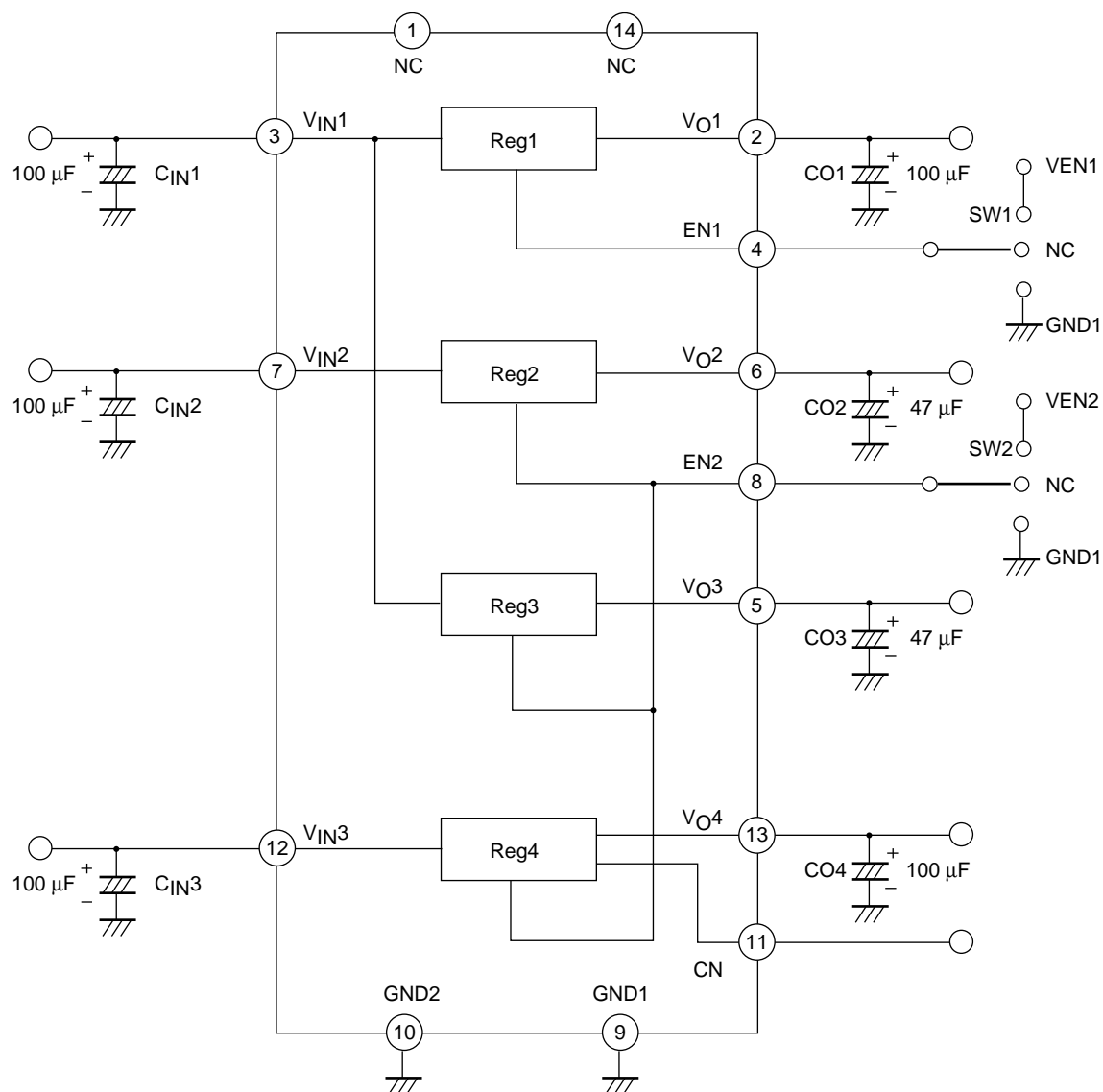
Block Diagram



TSD: Thermal shutdown (protection) circuit
 ON/OFF: Output on/off control circuit
 CL: Current limiter (overcurrent protection circuit)

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Stipulated Test Circuit



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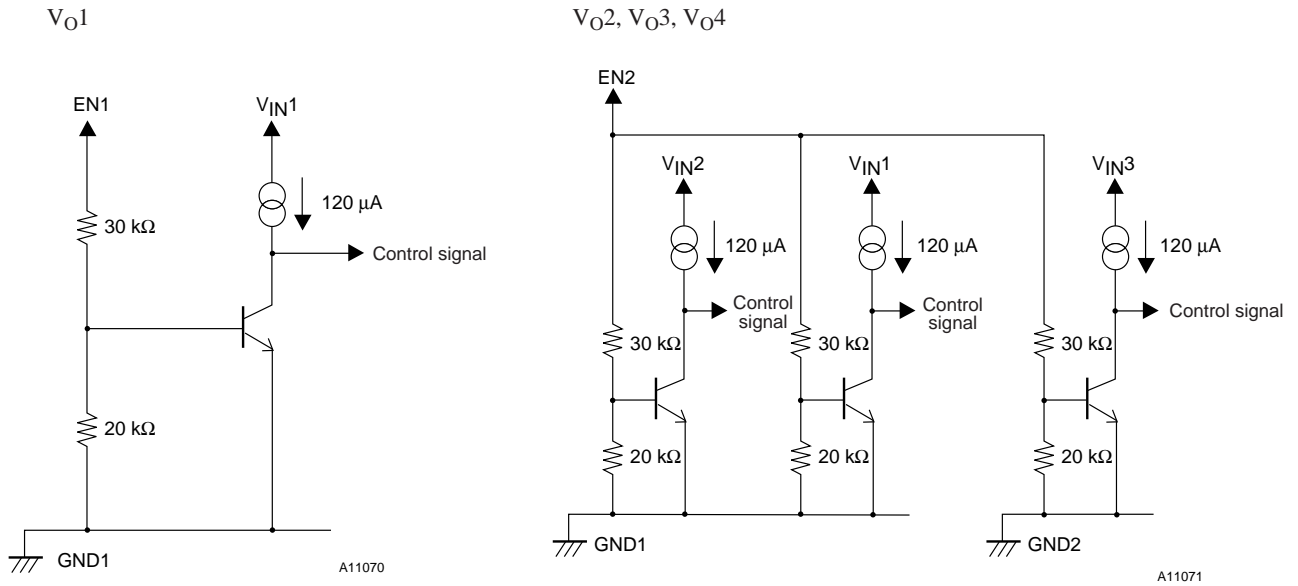
Function Table

This IC operates as listed in the table under the condition that $V_{IN1} \geq V_{IN2} \geq V_{IN3}$.

EN1, EN2	$V_{O1}, V_{O2}/V_{O3}/V_{O4}$
H	L
L	H
Open	H

- H and L in the EN column correspond to high and low input voltage levels, respectively.
- H and L in the V_O column correspond to the output on voltage and the output off voltage, respectively.
- The output voltages are controlled independently by the EN lines as follows: EN1 controls V_{O1} , and EN2 controls V_{O2} , V_{O3} , and V_{O4} in parallel.
- When a given EN is open, the corresponding output will be on.

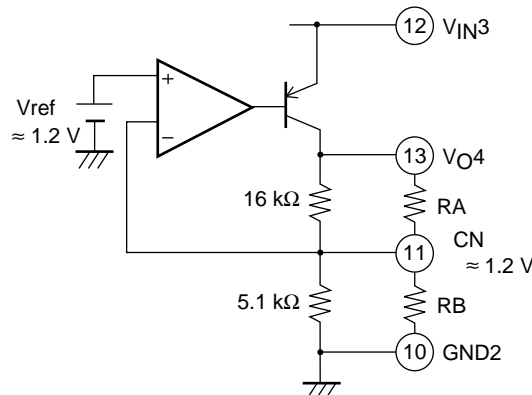
EN (on/off control) Input Block Equivalent Circuit Block Diagram



Usage Notes

- GND1 and GND2 are connected through the IC substrate, and must be connected to the lowest potential in the system and must be connected to identical potentials.
(The functions and characteristics of this IC are not guaranteed if GND1 and GND2 are connected to different potentials.)
 - The rise and fall of the V_{IN1} , V_{IN2} , and V_{IN3} voltages must be simultaneous, and none of these pins may be either left open or connected to ground.
 - If either V_{IN1} or V_{IN2} are open or at a voltage lower than the stipulated voltage, then the V_{O1} through V_{O4} outputs will be forcibly turned off to protect the IC.
 - The output capacitors C_{O1} and C_{O4} must be at least 100 μF, and C_{O2} and C_{O3} must be at least 47 μF. Capacitors with low temperature coefficients must be used to prevent oscillation at low temperatures.
 - To assure stable operation, the input capacitors C_{IN1} to C_{IN3} and the output capacitors C_{O1} to C_{O4} must be placed as close to the IC as possible.
 - The NC pins (pins 1 and 14) must not be used.
 - The output voltage V_{O4} can be adjusted by connecting resistors from the CN pin (pin 11) to either V_{O4} or to GND2.
 - To lower V_{O4} : Add resistor R_A between CN and V_{O4} .
 - To raise V_{O4} : Add resistor R_B between CN and GND2.
- Also note that external noise suppression and ripple rejection can be improved by adding an external capacitor at V_{O4} . However, care is required to assure that the system stability (phase margin) is adequate.
- Note that these power supplies can be influenced by load fluctuations in the other power supplies.

Sample CN Pin Application Circuit



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