



# LB1978V

## Three-Phase Half-Wave Sensorless Motor Driver for Headphone Stereos

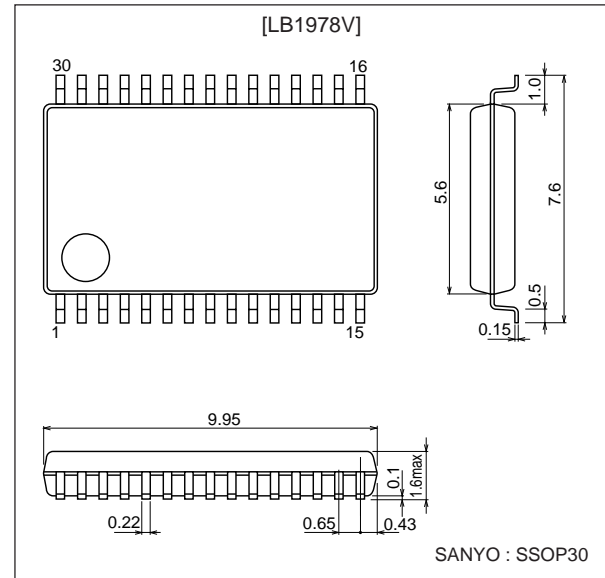
### Functions and Features

- Three-phase sensorless motor driver
- Built-in speed control
- Built-in reference voltage and forward/reverse switching pin
- Soft switching
- Built-in short brake drive pin

### Package Dimensions

unit: mm

#### 3191-SSOP30



### Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{cc\ max}$		2.0	V
Output transistor withstand voltage	$V_{sus}$		4	V
Maximum output current	$I_o\ max$		0.6	A
Allowable power dissipation	$P_d\ max$	$T_j = 125^\circ\text{C}$	0.4	W
Operating temperature	$T_{opr}$		0 to 60	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 to +125	$^\circ\text{C}$

#### Allowable Operating Ranges at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	$V_{cc}$		1.0 to 1.7	V

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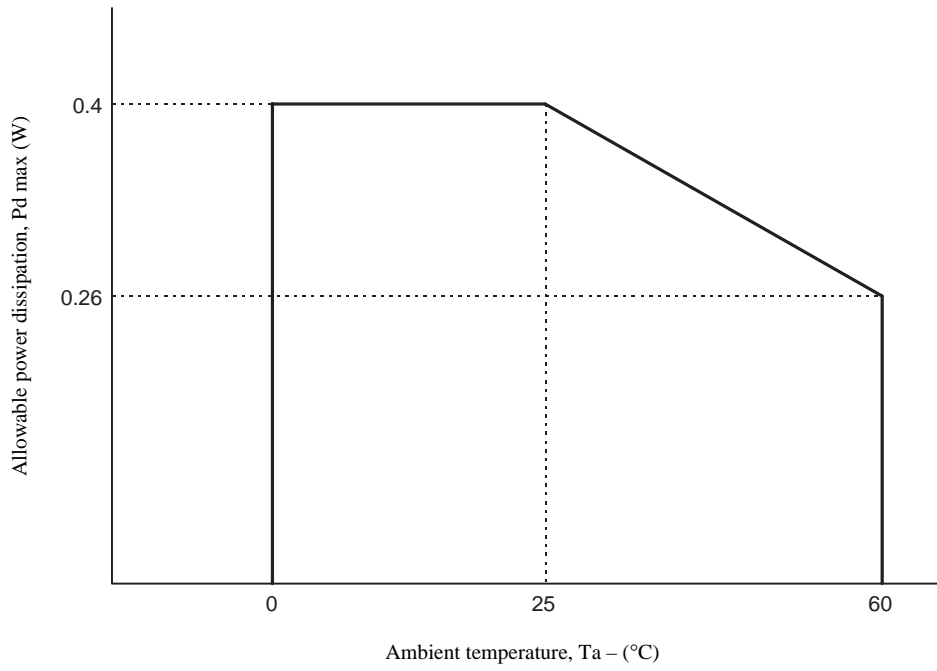
### Electrical Characteristics at Ta = 25°C, Vcc = 1.2V, in the specified test circuit

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current	I <sub>cc</sub>	START pin H, R <sub>IRF</sub> = 180 kΩ		6.8	10	mA
		START pin L, V <sub>BR</sub> = 0V		0	10	μA
Reference voltage	V <sub>ref</sub>		0.725	0.755	0.785	V
Reference voltage characteristics	$\frac{\Delta V_{ref}}{\Delta I_{ref}} / \Delta V_{cc}$	V <sub>cc</sub> = 1.0 to 1.7V		1.0	2.0	%/V
Reference voltage load characteristics	$\frac{\Delta V_{ref}}{\Delta I_{ref}}$	I <sub>ref</sub> = 0 to -50 μA	-0.2	-0.06		mV/μA
Oscillator cycle	T <sub>S</sub>	C <sub>S</sub> = 1500 pF	0.52	0.6	0.68	ms
Rotation switching load characteristics	T <sub>F/S</sub>	C <sub>S</sub> = 1500 pF, R <sub>IRF</sub> = 180 kΩ *Target	7.70		10.9	ms
Rotation detection accuracy	NF/S	T <sub>S</sub> = 0.60 ms *Target	-16		+16	%
COM voltage	V <sub>COM-</sub>	R <sub>COM</sub> = 1 kΩ	12	25	38	mV
F side output saturation voltage	V <sub>sat1</sub>	V <sub>cc</sub> = 1.0V, I <sub>m</sub> = 0.3A		0.17	0.30	V
S side output saturation voltage	V <sub>sat2</sub>	V <sub>cc</sub> = 1.0V, I <sub>m</sub> = 0.2A		0.12	0.25	V
S/S pin input High level voltage	V <sub>SSH</sub>		0.9			V
S/S pin input Low level voltage	V <sub>SSL</sub>				0.3	V
F/S DR pin ON voltage	V <sub>Lon</sub>				0.2	V
F/S DR pin OFF voltage	V <sub>Loff</sub>		V <sub>cc</sub> -0.3			V
TC pin pull-in voltage	V <sub>TC1</sub>	F/S = H	80	110	150	mV
	V <sub>TC2</sub>	F/S = L	160	220	300	mV
BR1 ON voltage	V <sub>BRon</sub>		0.9			V
BR1 OFF voltage	V <sub>BRoff</sub>				0.3	V
BRsat voltage	V <sub>BRsat</sub>	I <sub>o</sub> = 6 mA, V <sub>BR1</sub> = 1.2V		0.15	0.3	V
CI rise voltage	V <sub>CI</sub>		0.620	0.650	0.680	V
CI hysteresis width	ΔV <sub>CI</sub>		60	80	100	mV
IRF voltage	V <sub>IRF</sub>	R <sub>IRF</sub> = 180 kΩ	0.725	0.755	0.785	V
VI output current	I <sub>VI</sub>	V <sub>VI</sub> = 0.3V, V <sub>IV</sub> = GND	26	30	34	μA
PV pin voltage	V <sub>PV</sub>		0.720	0.755	0.785	V
ΔI <sub>FC</sub> /ΔV <sub>VI</sub> ratio	ΔI <sub>FC</sub> /ΔV <sub>VI</sub>		150	210	250	μA/V
Output transistor OFF voltage	V <sub>OUT OFF</sub>		V <sub>cc</sub> -0.3			V
Output transistor ON voltage	V <sub>OUT ON</sub>				0.3	V

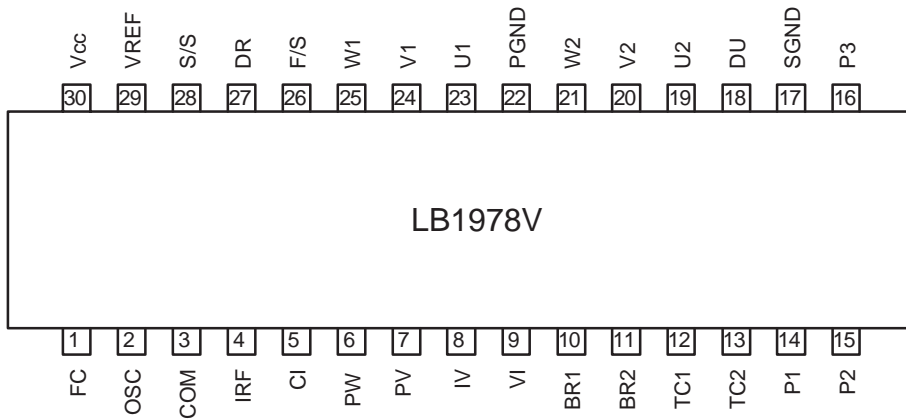
Note: Items shown to be "Target" are not measured.

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Pd max – Ta



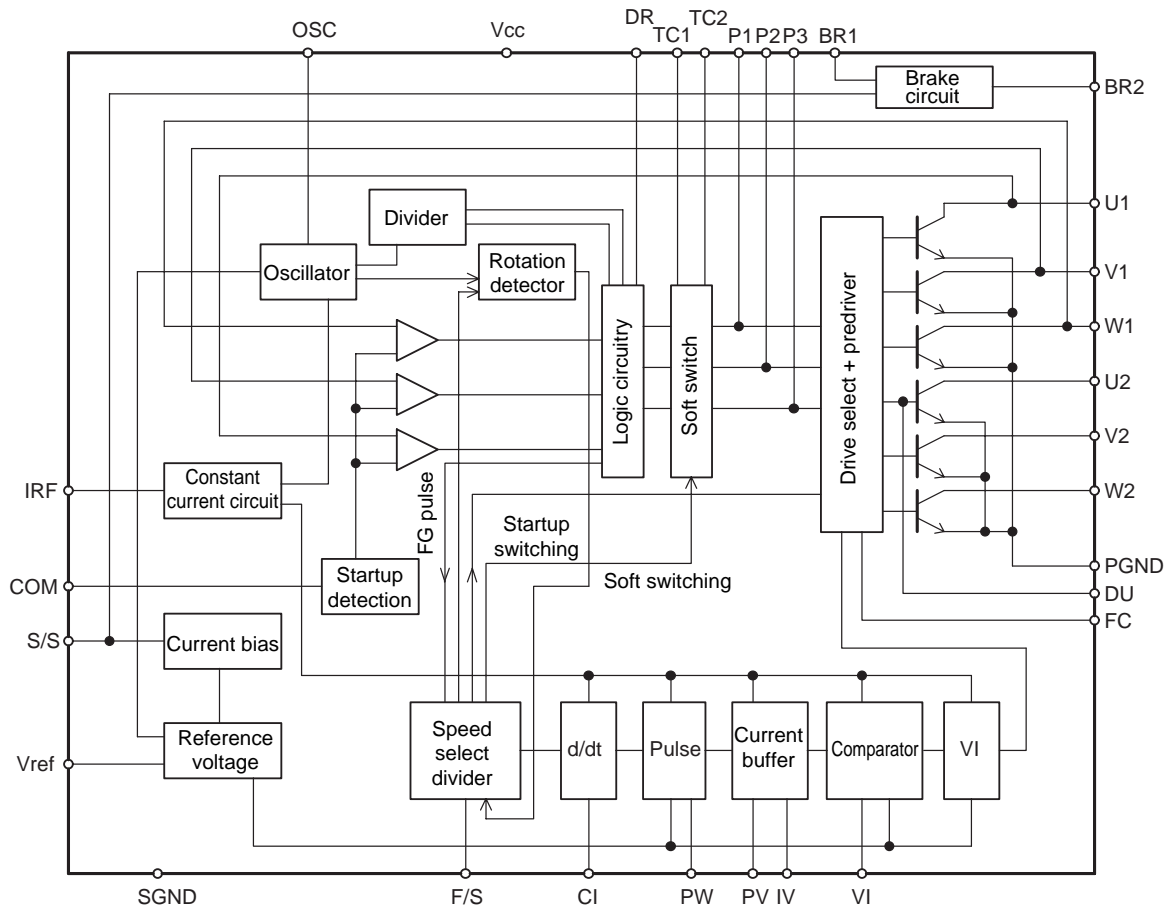
## Pin Assignment



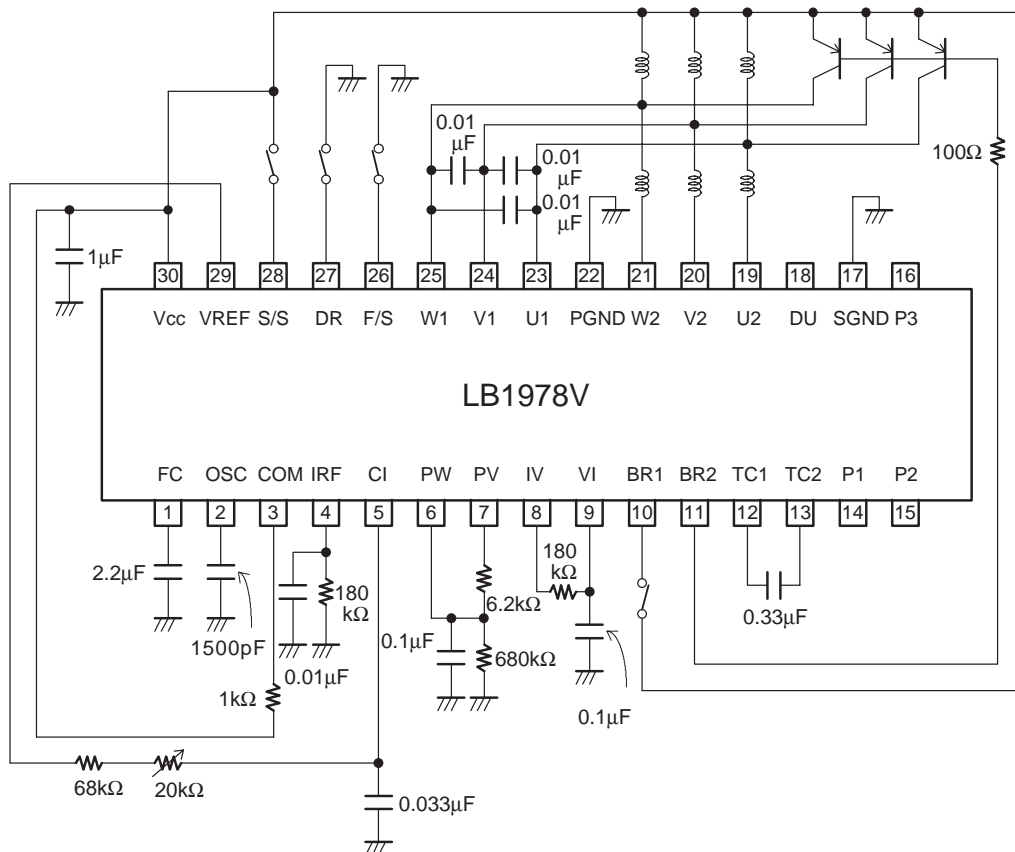
Top view

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## Equivalent Circuit Block Diagram



## Sample Application Circuit



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## Pin Description

Pin number	Pin name	Equivalent circuit	Pin function
1	FC		<p>Oscillator and ripple suppression pin.</p> <p>The higher the capacitance connected to FG, the more effectively will ripple components be suppressed.</p>
2	OSC		<p>Startup pulse cycle and drive switching cycle setting pin.</p> <p>Increased capacitance will result in higher startup pulse cycle and drive switching cycle.</p>
3	COM		<p>Startup waveform detector offset setting pin.</p> <p><math>R_{COM} = 1\text{ k}\Omega</math> results in approx. 25 mV offset at startup</p>
4	IRF		<p>Oscillator circuit and F-V servo circuit internal current setting pin.</p>
5	CI		<p>Speed adjustment pin using CR oscillation based on FG pulse edge detection.</p>

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Pin number	Pin name	Equivalent circuit	Pin function
6	PW		CI pin waveform and reference voltage comparator output pin.
7	PV		Current buffer input/output pin.
8	IV		Current-to-voltage converter comparator input pin.
9	VI		Voltage-to-current converter input pin. Speed increases when VI pin voltage is higher than reference voltage and decreases when VI pin voltage is lower than reference voltage.
10	BRI		Brake bias pin. When S/S pin is Low and BR1 pin is 0.9V or higher, brake drive pin BR2 goes ON.

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Pin number	Pin name	Equivalent circuit	Pin function
11	BR2		<p>Brake drive pin.</p> <p>When S/S pin is Low and BR1 pin is 0.9V or higher, brake drive is activated. This is an open-collector output.</p>
12 13	TC1 TC2		<p>Motor current rise/fall slope setting pins.</p> <p>Setting value changes depending on the High or Low status of the F/S pin.</p>
14 15 16	P1 P2 P3		<p>Internal operation measurement pins which shape the current waveform. Must be left open for use.</p>
17	SGND		<p>Signal ground pin. Separate from power supply ground.</p>
18 19 20 21	DU U2 V2 W2		<p>DU is base pin for U low-speed output transistor.</p> <p>U2, V2, and W2 are pins for connection to low-speed motor coils.</p>
22	PGND		<p>Power supply ground.</p>

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Pin number	Pin name	Equivalent circuit	Pin function
23 24 25	U1 V1 W1		U1, V1, and W1 are pins for connection to high-speed motor coils.
26	F/S		High-speed/low-speed mode select pin.  Vcc -1.0V or lower: high-speed (fast) Vcc -0.3V or higher: low-speed (slow)
27	DR		Rotation direction select pin.  Vcc -0.3V or higher: phase sequence U -> V -> W Vcc -1.0V or lower: phase sequence U -> W -> V
28	S/S		Start/stop pin. 0.9V or higher: Start High active.
29	Vref		Reference voltage pin. Reference voltage is 0.75V.
30	Vcc		Power supply pin.



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