

**LB1896**

## 3-phase Brushless Motor Driver for CD-ROM Spindle Drive Use

### Overview

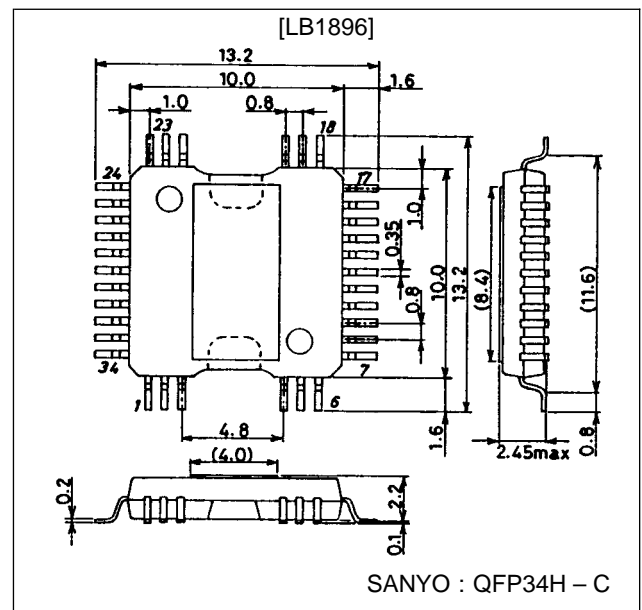
The LB1896 is a 3-phase brushless motor driver IC that is ideal for driving CD-ROM spindle motors.

### Functions and Features

- 120° voltage linear technique
- V-type control voltage
- Switchable control gain
- Control, noncontrol, acceleration/deceleration mode select pins built in.
- Start/Stop pin built in, Hall bias built in.

### Package Dimensions

unit : mm

**3219-QFP34H-C**

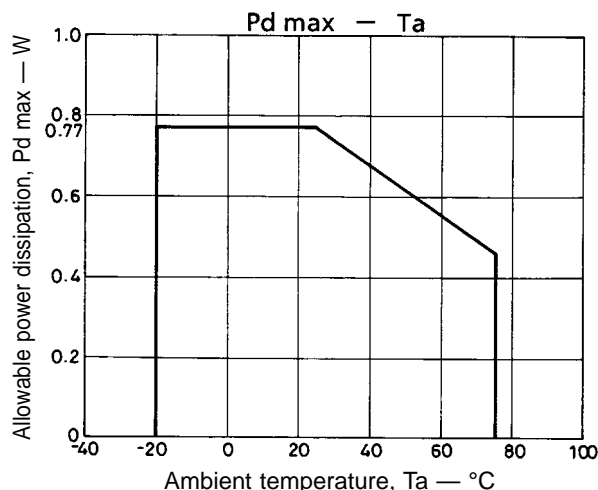
### Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC1</sub> max		20	V
	V <sub>CC2</sub> max		7.0	V
Applied output voltage	V <sub>OU, v, w</sub>		20	V
Output current	I <sub>OUT</sub>		1.2	A
Allowable power dissipation	P <sub>d</sub> max	Independent IC	0.77	W
Operating temperature	T <sub>opr</sub>		-20 to +75	°C
Storage temperature	T <sub>stg</sub>		-55 to +150	°C

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

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V <sub>CC1</sub>		5 to 18	V
	V <sub>CC2</sub>	V <sub>CC1</sub> ≥ V <sub>CC2</sub>	4.3 to 6.5	V
V <sub>Cref</sub> input voltage	V <sub>Cref</sub>		V <sub>CC2</sub> /2 ±1.0	V
V <sub>NS</sub> input voltage	V <sub>NS</sub>		0 to V <sub>CC2</sub> -1.0	V



**Electrical Characteristics at Ta = 25 °C, V<sub>CC1</sub> = 12 V, V<sub>CC2</sub> = 5 V**

Parameter	Symbol	Conditions	min	typ	max	Unit
Supply current 1	I <sub>CC1</sub>	V <sub>C</sub> = open, V <sub>Cref</sub> = open, R <sub>L</sub> = ∞, V <sub>S/S</sub> = 5 V		17	30	mA
Supply current 2	I <sub>CC2</sub>	V <sub>C</sub> = open, V <sub>Cref</sub> = open		7.5	10.5	mA
Supply current 3	I <sub>CC3</sub>	V <sub>C</sub> = open, V <sub>Cref</sub> = open, R <sub>L</sub> = ∞, V <sub>S/S</sub> = 0 V, (I <sub>CC</sub> of V <sub>CC1</sub> )		0.9	3	mA
[Drive block]						
Output saturation voltage	V <sub>O(sat)1</sub>	I <sub>OUT</sub> = 0.4 A, sink + source		1.6	2.2	V
	V <sub>O(sat)2</sub>	I <sub>OUT</sub> = 0.8 A, sink + source		2.0	3.0	V
Output TRS sustaining voltage	V <sub>O(sus)</sub>	I <sub>OUT</sub> = 20 mA	20			V
Output static voltage	V <sub>OQ</sub>	V <sub>C</sub> = 2.5 V, V <sub>Cref</sub> = 2.5 V	5.7	6.0	6.3	V
Hall amplifier input offset voltage	V <sub>H offset</sub>		-5		+5	mV
Hall amplifier input bias current	I <sub>H bias</sub>			1	5	μA
Hall amplifier common-mode input voltage range	V <sub>Hch</sub>		1.3		2.2	V
Hall input/output voltage gain	G <sub>VHO</sub>		40	43	46	dB
Control/output drive gain 1	G <sub>VCO1</sub>	RZ1 = RZ2, GC1 = L, GC2 = L	26	29		dB
Control/output channel difference 1	ΔG <sub>VCO1</sub>	RZ1 = RZ2, GC1 = L, GC2 = L	-1.5		+1.5	dB
Control/output drive gain 2	G <sub>VCO2</sub>	RZ1 = RZ2, GC1 = L, GC2 = H	32	35		dB
Control/output channel difference 2	ΔG <sub>VCO2</sub>	RZ1 = RZ2, GC1 = L, GC2 = H	-1.9		+1.9	dB
Input dead zone voltage	V <sub>DZ</sub>	RZ1 = RZ2, GC1 = L, GC2 = L V <sub>O</sub> (voltage between out and out) = 0.1 V	±13	±38	±55	mV
Input bias current 1	I <sub>B SERVO</sub>	V <sub>C</sub> = 1.0 V			500	nA
Input bias current 2	I <sub>B n.s</sub>	V <sub>NS</sub> = 1.0 V			500	nA
S/S pin high voltage	V <sub>S/S H</sub>	Input is CMOS level	4			V
S/S pin low voltage	V <sub>S/S L</sub>	Note) S/S pin V <sub>th</sub> = V <sub>CC2</sub> /2			1	V
Gain control 1 high voltage	V <sub>GC1 H</sub>	Input is at CMOS level.	4			V
Gain control 1 low voltage	V <sub>GC1 L</sub>	Note) GC1 pin V <sub>th</sub> = 2.0 V			1	V
Gain control 2 high voltage	V <sub>GC2 H</sub>	Input is at CMOS level.	4			V
Gain control 2 low voltage	V <sub>GC2 L</sub>	Note) GC2 pin V <sub>th</sub> = 2.0 V			1	V
S/S pin input current	I <sub>S/S</sub>	Input voltage = 5 V		50	100	μA
Gain control 1, 2 current	I <sub>GC</sub>	Input voltage = 5 V		53	110	μA
Rotation output saturation voltage	V <sub>(sat) H.FG</sub>	I <sub>O</sub> = -5 mA		0.24	0.5	V
Rotation output saturation sustaining voltage	V <sub>(sus) H.FG</sub>				7	V
Hall bias voltage	V <sub>H±</sub>	I <sub>O</sub> = 5 mA, R <sub>H</sub> = 200 Ω	0.7	0.97	1.2	V
CTRL pin high voltage	V <sub>CTRL H</sub>	Common for CTRL1 and CTRL2 input CMOS level	4			V
CTRL pin low voltage	V <sub>CTRL L</sub>	Note) CTRL pin V <sub>th</sub> = 2.5 V			1.0	V
CTRL input current	I <sub>CTRL</sub>	Input voltage = 5 V		53	110	μA
TSD operation voltage	TSD	Design target	150	180	210	°C
TSD hysteresis	ΔTSD	Design target		15		°C

Note) V<sub>th</sub> is a design target and not measured.

# LB1896

## Mode Switching Truth Table

CTRL0	CTRL1	Mode
L	L	Control
L	H	Noncontrol
H	L	Acceleration
H	H	Deceleration

L = 0 to 1.0 V

H = 4.0 V or more

## Hall Logic Truth Table

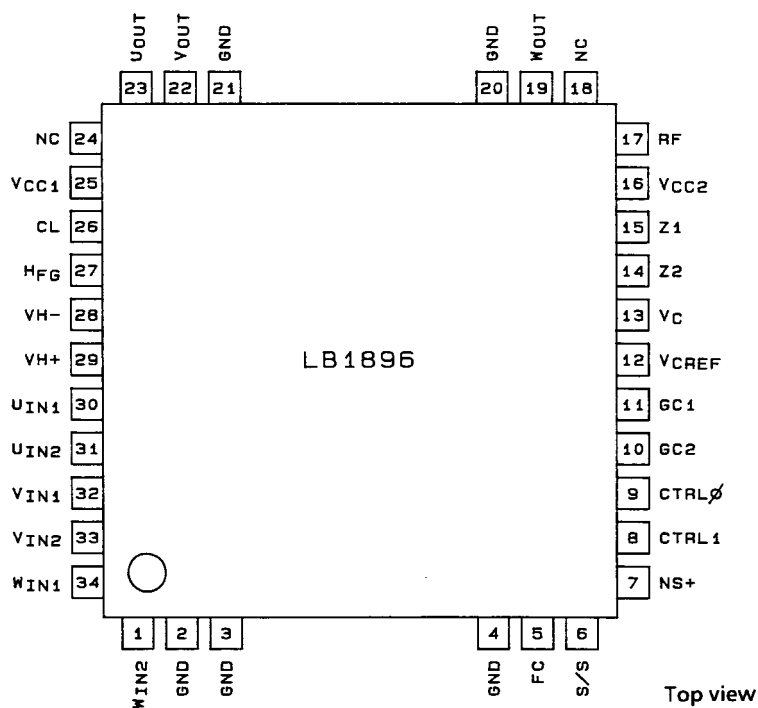
	Source → Sink	Hall input			F/R Control
		U <sub>IN</sub>	V <sub>IN</sub>	W <sub>IN</sub>	
1	W → V	H	H	L	Forward
	V → W				Reverse
2	W → U	H	L	L	Forward
	U → W				Reverse
3	V → W	L	L	H	Forward
	W → V				Reverse
4	U → V	L	H	L	Forward
	V → U				Reverse
5	V → U	H	L	H	Forward
	U → V				Reverse
6	U → W	L	H	H	Forward
	W → U				Reverse

An input is considered to be HIGH when  $U_{IN1} > U_{IN2}$ ,  $V_{IN1} > V_{IN2}$ , and  $W_{IN1} > W_{IN2}$  by 0.2 V or more.

Forward when  $V_C > V_{Cref}$

Reverse when  $V_C < V_{Cref}$

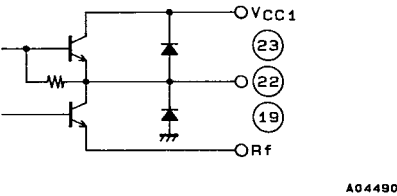
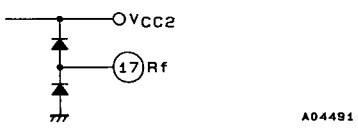
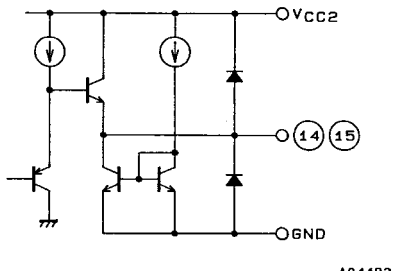
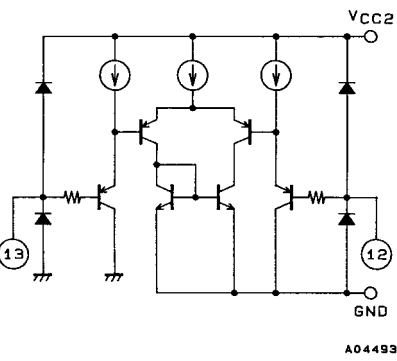
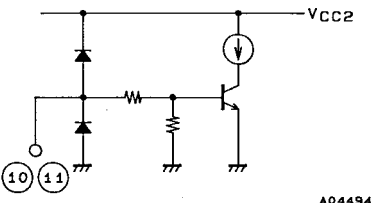
## Pin Assignment



A04487

# LB1896

## Pin Functions

Pin No.	Pin Name	Pin Voltage	Equivalent Circuit Diagram	Pin Function
3, 4 20, 21	Frame GND			Frame GND. GND must be shared.
2	GND			GND
23 22 19	$U_{OUT}$ $V_{OUT}$ $W_{OUT}$		 <p style="text-align: right;">A04490</p>	Output pins. Motor connection
17	Rf		 <p style="text-align: right;">A04491</p>	Output Tr GND. A resistor can be connected between this pin and GND to sense the output current as a voltage drop to provide for overcurrent protection.
18, 24	NC			Idle pins.
16	$V_{CC2}$	4.3 to 6.5 V		<ul style="list-style-type: none"> <li>Power supply for blocks other than the output block.</li> <li>This supply should be kept stable to prevent ripple and noise from entering this pin.</li> </ul>
15 14	Z1 Z2		 <p style="text-align: right;">A04492</p>	<ul style="list-style-type: none"> <li>First-stage amplifier gain setting resistors.</li> <li>Z1 and Z2 normally range from several tens of <math>k\Omega</math> to several hundreds of <math>k\Omega</math>.</li> <li>The gain is about 6 dB.</li> </ul>
13 12	$V_C$ $V_{Cref}$	$V_{CC2}/2$ $\pm 1.0$	 <p style="text-align: right;">A04493</p>	<ul style="list-style-type: none"> <li><math>V_C</math> is the speed control pin. Forward when <math>V_C &gt; V_{Cref}</math>. Reverse when <math>V_C &lt; V_{Cref}</math>. <math>V_C</math> is used to control the output voltage.</li> <li><math>V_{Cref}</math> determines the motor control stop voltage. <math>V_{CC2}/2</math> in normal use.</li> </ul>
11 10	GC1 GC2	0 to $V_{CC2}$	 <p style="text-align: right;">A04494</p>	<ul style="list-style-type: none"> <li>Input/output gain switching pins.</li> <li>GC1 is for first-stage amplifier Z1/Z2 switching. When GC1 is LOW, Z1 is selected; when HIGH, Z2 is selected. GC2 is for next-stage amplifier switching.</li> </ul>

Continued on next page.

# LB1896

Continued from preceding page.

Pin No.	Pin Name	Pin Voltage	Equivalent Circuit Diagram	Pin Function
9 8	CTRL $\phi$ CTRL1	0 to V <sub>CC2</sub>	<p style="text-align: right;">A04495</p>	<ul style="list-style-type: none"> <li>• Operation mode switching pins.</li> <li>• Refer to the Mode Switching Truth Table for selection of control, acceleration, or deceleration.</li> </ul>
7	NS+	0 to V <sub>CC2</sub> - 1 V	<p style="text-align: right;">A04496</p>	<ul style="list-style-type: none"> <li>• Input pin at noncontrol mode.</li> <li>• The input-output gain is 14 dB. (GC2: LOW)</li> <li>• Motor stops when V<sub>NS</sub> = 0 V.</li> </ul>
6	S/S	0 to V <sub>CC2</sub>	<p style="text-align: right;">A04497</p>	<ul style="list-style-type: none"> <li>• When the S/S pin is HIGH, START; when LOW, STOP.</li> <li>• The threshold is V<sub>CC2</sub>/2.</li> </ul>
5	FC		<p style="text-align: right;">A04498</p>	<ul style="list-style-type: none"> <li>• Connect a capacitor between this pin and GND to reduce the input/output gain frequency response and to stop the oscillator.</li> </ul>
1 34 33 32 31 30	W <sub>IN2</sub> W <sub>IN1</sub> V <sub>IN2</sub> V <sub>IN1</sub> U <sub>IN2</sub> U <sub>IN1</sub>	1.3 to 2.2 V	<p style="text-align: right;">A04499</p>	<p>W-phase Hall device input pins. Logic "H" represent W<sub>IN1</sub> &gt; W<sub>IN2</sub></p> <p>V-phase Hall device input pins. Logic "H" represent V<sub>IN1</sub> &gt; V<sub>IN2</sub></p> <p>U-phase Hall device input pins. Logic "H" represent U<sub>IN1</sub> &gt; U<sub>IN2</sub></p>

Continued on next page.

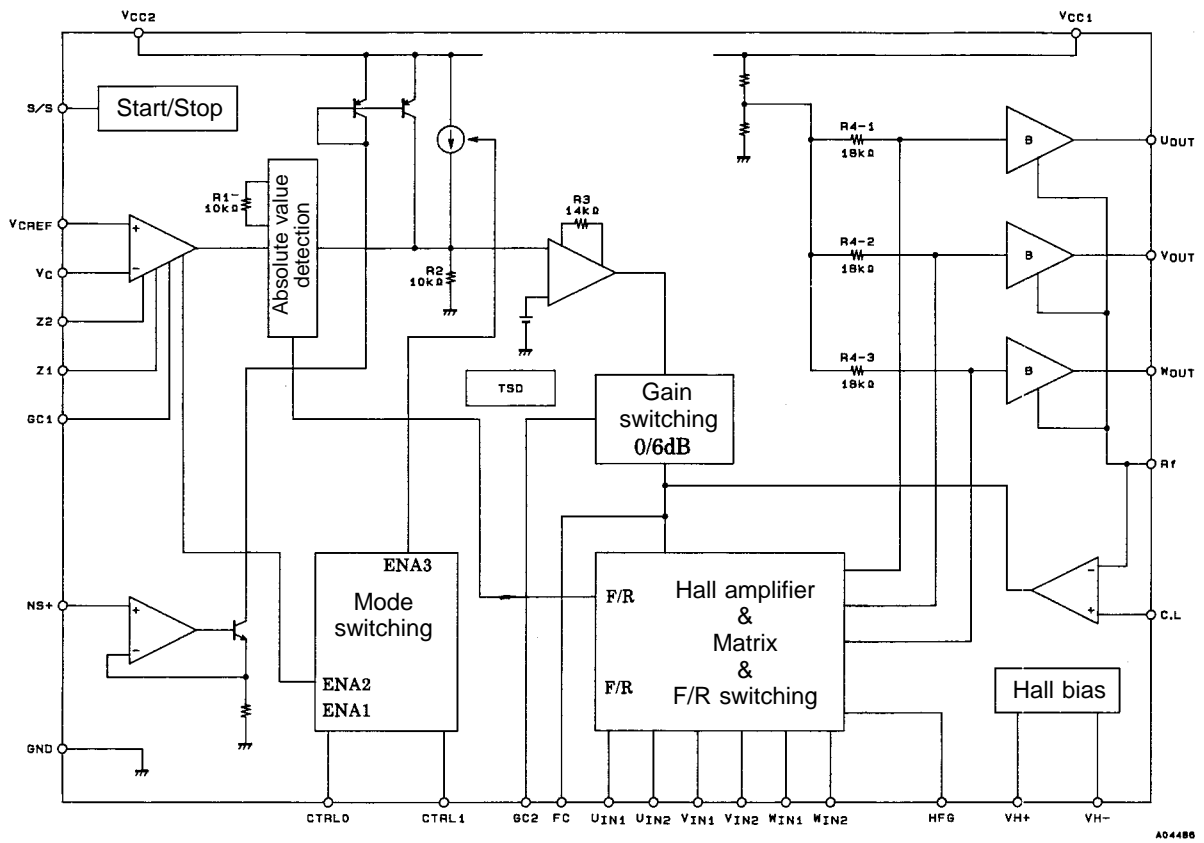
# LB1896

Continued from preceding page.

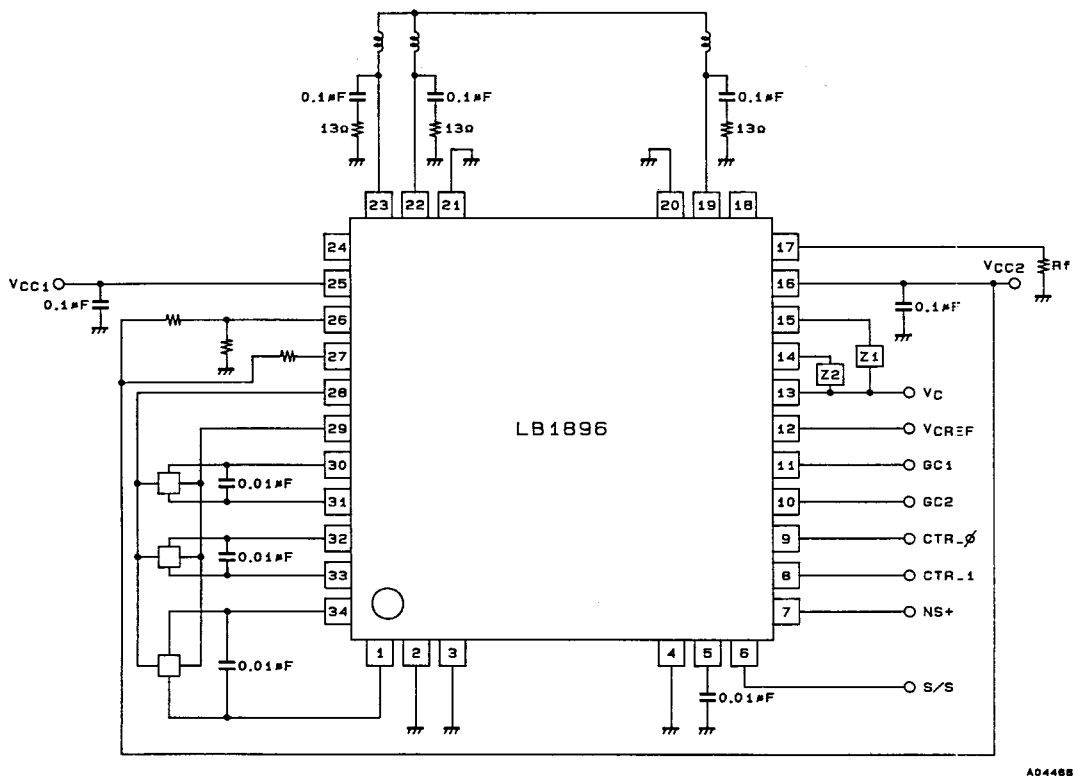
Pin No.	Pin Name	Pin Voltage	Equivalent Circuit Diagram	Pin Function
29 28	VH+ VH-	2.4 V 1.4 V	<p style="text-align: right;">A04500</p>	<ul style="list-style-type: none"> <li>Hall device power supply pins.</li> <li>A voltage difference of 1.0 V is developed between VH+ and VH-.</li> </ul>
27	H.FG	0 to V <sub>CC2</sub>	<p style="text-align: right;">A04501</p>	<ul style="list-style-type: none"> <li>Hall FG pin.</li> <li>The Hall waveform is converted into a pulse signal and then used as the FG pulse signal.</li> </ul>
26	CL	0 to V <sub>CC2</sub>	<p style="text-align: right;">A04502</p>	<ul style="list-style-type: none"> <li>When the R<sub>f</sub> pin voltage becomes equal to the C<sub>L</sub> pin voltage, the current limiter operate. The C<sub>L</sub> voltage is determined externally.</li> </ul>
25	V <sub>CC1</sub>	5 to 18 V		<ul style="list-style-type: none"> <li>Power supply for output block.</li> <li>This supply should be kept stable to prevent ripple and noise from entering this pin.</li> </ul>

# LB1896

## Block Diagram



## Sample Application Circuit



- No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.
- Anyone purchasing any products described or contained herein for an above-mentioned use shall:
  - ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
  - ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of January, 1996. Specifications and information herein are subject to change without notice.