Ordering number :EN5452A

Monolithic Digital IC

LB1955

Three-Phase Brushless Motor Driver

Functions

- The LB1955 is a 3-phase brushless motor driver IC that is optimal for applications such as driving the drum motor in VCRs.

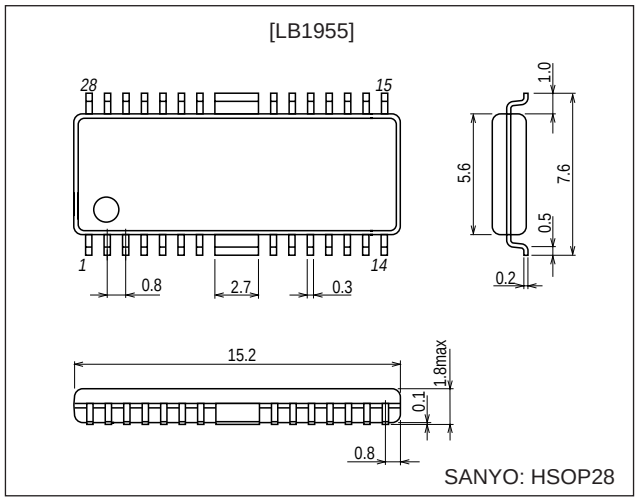
Features

- Current linear drive
- FG and PG free
- Single-voltage power supply
- Built-in AGC circuit
- Built-in thermal shutdown circuit

Package Dimensions

unit: mm

3222-HSOP28



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC}max		14.5	V
Maximum output current	I_{OUT}		1.0	A
Allowable power dissipation	Pdmax	Independent device	0.60	W
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–55 to +150	°C

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		10.2 to 13.8	V
Hall input amplitude	Vhall	At the input	70 to 500	mVp-p
VC input voltage	V_C		0 to 5	V

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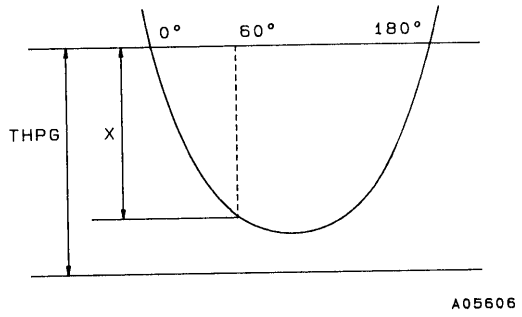
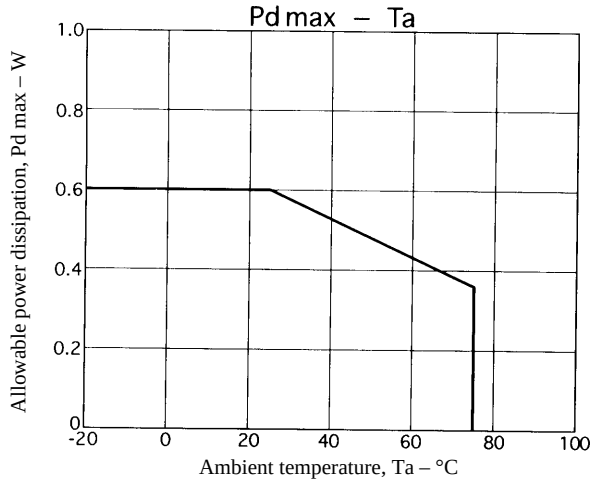
Electrical Characteristics at Ta = 25°C, V_{CC} = 12 V

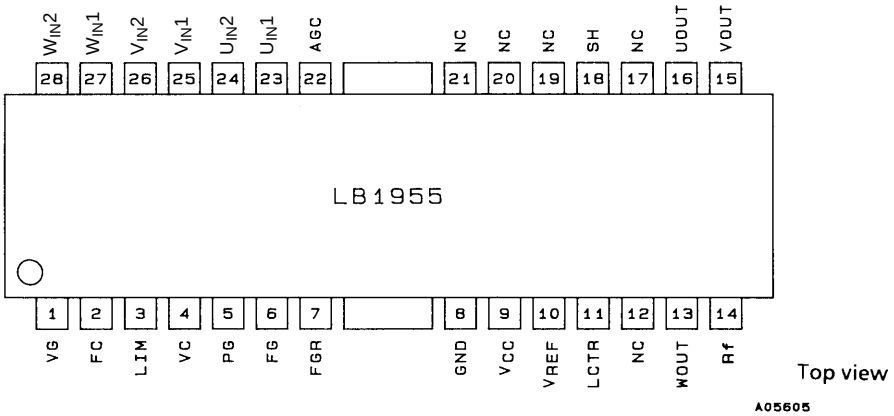
Parameter	Symbol	Conditions		Ratings min	Ratings typ	Ratings max	Unit
[Power Supply]							
Current drain	I_{CC}	V_C = 0 V, LCTR = 6 V		7.0	10.0	13.0	mA
IC internal power supply	V_{REF}			4.75	5.0	5.25	V
[Output]							
Output saturation voltage	$V_{O(sat)}1$	I_O = 400 mA	Sink side			0.4	V
		V_C = 5 V, R_f = 0 Ω	Source side			1.5	V
Output saturation voltage 2	$V_{O(sat)}2$	I_O = 800 mA	Sink side			0.7	V
		V_C = 5 V, R_f = 0 Ω	Source side			2.0	V
3-phase output current ripple	Ior	I_O = 100 mA, R_f = 0.47 Ω		–5		+5	%
[Hall Amplifier]							
Input offset voltage	VHoff			–20		+20	mV
Input bias current	IHb	V_{AGC} = 1.4 V	U_{IN}			10	μA
			V_{IN}, W_{IN}			5	μA
Common-mode input voltage range	V_{HCM}			2.2		5.0	V
[Control]							
VC pin input bias current	I_{VCb}	V_C = 0 V		–10	–1.3		μA
Control start voltage	V_{THVC}	R_f = 0.47 Ω, I_O ≥ 10 mA With the Hall input logic fixed		2.25	2.5	2.75	V
Open-loop control gain	G_{MVC}	R_f = 0.47 Ω, ΔI_O = 200 mA With the Hall input logic fixed and VG shorted to RF		0.72	0.9	1.08	A/V
[PG]							
PG Hall amplifier input offset voltage	V_{PGoff}	Design target		–10		+10	mV
Peak hold charge current	I_{SHCHG}	(U, V, W) = (L, L, H)			30		μA
PG comparator threshold	THPG	SH = 1000pF, Design target*		113	117	121	%
PG output high-level voltage	V_{PGH}			4.5		5.2	V
PG leakage current	I_{LEAKPG}			–10	0	+10	μA
[FG]							
Back emf Schmitt input hysteresis width	V_{SCHG}	In the back emf Schmitt input increasing direction, Design target			100		mV
		In the back emf Schmitt input decreasing direction, Design target			0		mV
Ringing canceller Schmitt input hysteresis width	V_{SCHR}	In the Schmitt input increasing direction, Design target			180		mV
		In the Schmitt input decreasing direction, Design target		–20	0	+20	mV
FG output high-level voltage	V_{FGH}	FGR = 0 V		4.5		5.2	V
FG leakage current	I_{LEAKFG}			–10	0	+10	μA
[TSD]							
Thermal shutdown operating temperature	TTSD	Design target			180		°C
Thermal shutdown temperature hysteresis width	ΔTSD	Design target			15		°C

Note: * is provided for when X is the peak value at the 60° position of the lower side of the $U_{IN}1$ Hall amplifier input: THPG = 1.17X.
However, note that the THPG level may be reduced if the value of the capacitor (SH) used for the sample-and-hold circuit is too small since a discharge current of a few nA will result.





Pin Assignment



Pin Functions

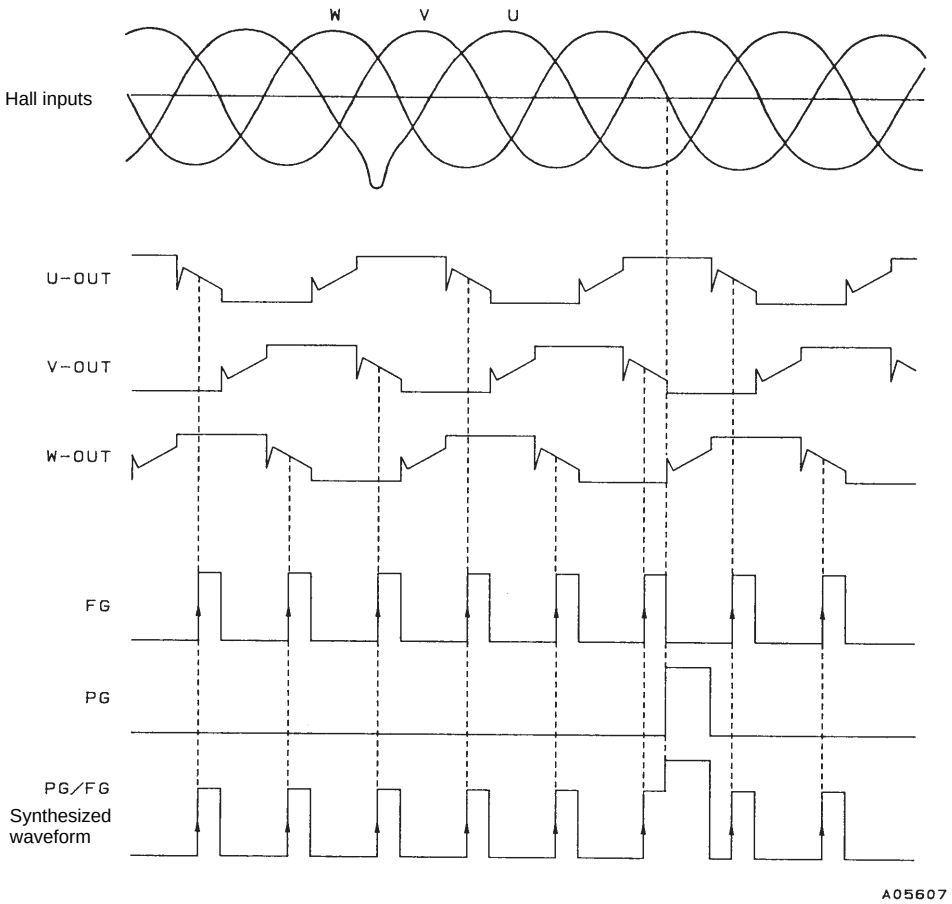
Pin No.	Pin	Function
23, 24	$U_{IN}1$, $U_{IN}2$	U phase Hall element input
25, 26	$V_{IN}1$, $V_{IN}2$	V phase Hall element input
27, 28	$W_{IN}1$, $W_{IN}2$	W phase Hall element input
16	UOUT	U phase output
15	VOUT	V phase output
13	WOUT	W phase output
11	LCTR	Pin connected to the center points of the coils that are Y-connected to the U, V, and W outputs.
9	V_{CC}	Power supply
10	V_{REF}	Reference voltage output
8	GND	GND
14	Rf	Output current detection
1	VG	Closed loop control gain switching
2	FC	Speed control loop frequency characteristics correction
3	LIM	Output current limit setting
4	VC	Speed control
5	PG	PG waveform output
6	FG	FG waveform output (FGR shorted to GND)
7	FGR	PG/FG synthesized output (FGR shorted to PG)
18	SH	PG waveform sample-and-hold circuit capacitor connection
22	AGC	Connection for the capacitor used by the AGC circuit, which holds the input gain at a fixed level.
12, 17, 19 20, 21	NC	No connection

Truth Table

	Source → sink	Hall input logic		
		U	V	W
1	W phase → V phase	H	H	L
2	W phase → U phase	H	L	L
3	V phase → U phase	H	L	H
4	V phase → W phase	L	L	H
5	U phase → W phase	L	H	H
6	U phase → V phase	L	H	L

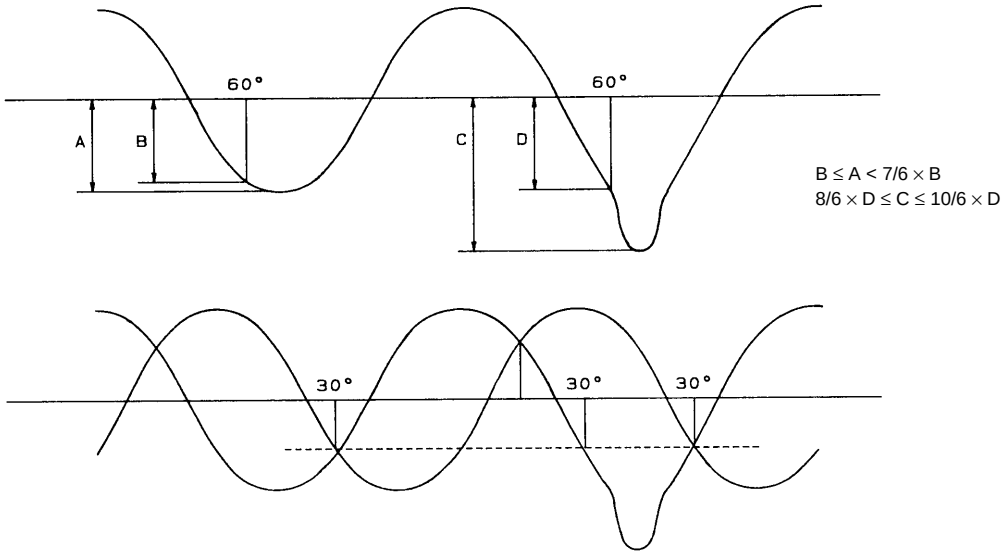
Note: The Hall input "H" and "L" values are defined as follows: "H" means that for that phase the (+) input is higher than the (-) input, and "L" means that for that phase the (+) input is lower than the (-) input. However, note that an input potential difference corresponding to the Hall to output gain is required.

Timing Charts



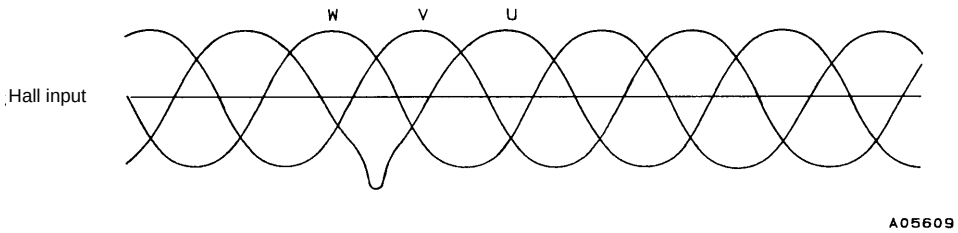
Note: The Hall inputs are defined as follows: U = $U_{IN}1 - U_{IN}2$, V = $V_{IN}1 - V_{IN}2$, and W = $W_{IN}1 - W_{IN}2$.
Inputs to the Hall input pins must be applied in the phase order shown in the timing chart.

Recommended Special Magnetization Waveforms



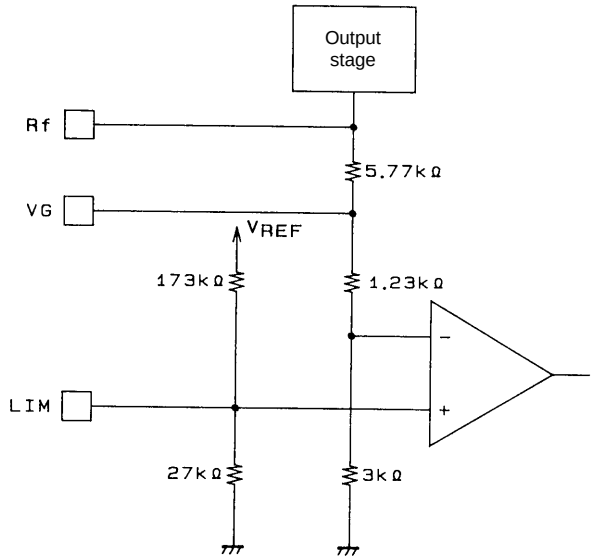
Note: Note that the intersections between the special magnetization and general waveforms and the intersections between pairs of general waveforms must be set up to be 30° apart.

Hall Input Order



Note: The Hall input order must be set up to be W → V → U.

VG and LIM Pin Usage



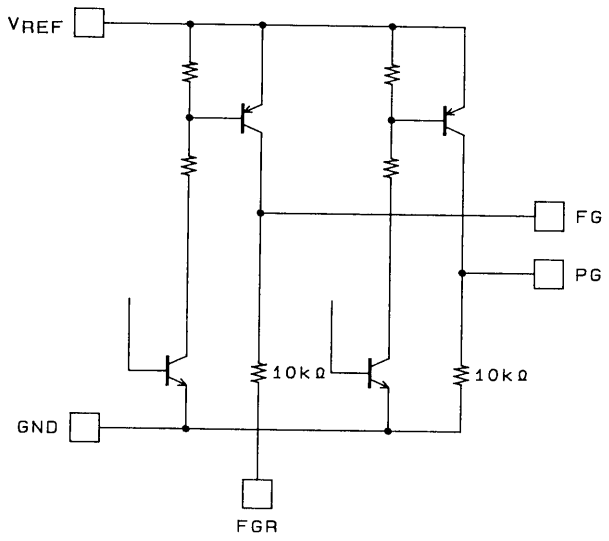
LIM pin: Open
VG – Rf: Shorted
Gm = 0.423/Rf (A/V)
(Closed loop control gain)
Ilim = (V_{REF} × 27/200 – 0.2) × 4.23/3/Rf
(Current limit)

VG pin: Open
Gm = 1/Rf (A/V)
(Closed loop control gain)
Ilim = (V_{REF} ×27/200 – 0.2) ×10/3/Rf
(Current limit)

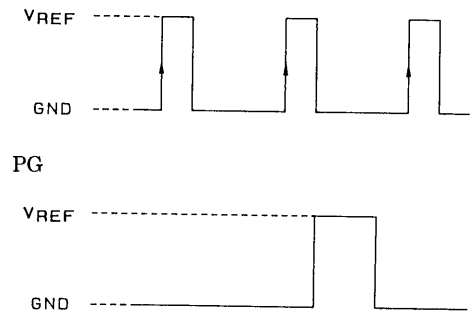
LIM – V_{REF}: Shorted
No current limit.

Note: This current limiting function is for protection against unusual and abnormal currents. If a current limit level below the rated current is set, this will, inversely, result in heat generation within the IC.
When the LIM pin is open, VG is shorted to Rf, and Rf = 0.47 Ω, this will result in a current limit level of about 1.3 to 1.4 A. If this limit falls under the rated value due to mode changes or changes in the value of the Rf resistor, set the current limit to an appropriate value by applying to the LIM pin a voltage that is divided from the V_{REF} to ground potential by resistors of a few kΩ. Alternatively, short the LIM pin to V_{REF} to defeat the current limit function.

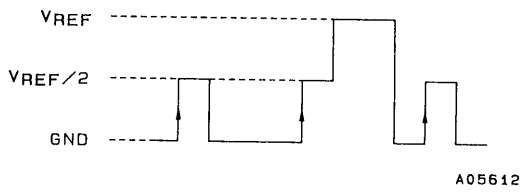
PG and FG Pin Output Circuits



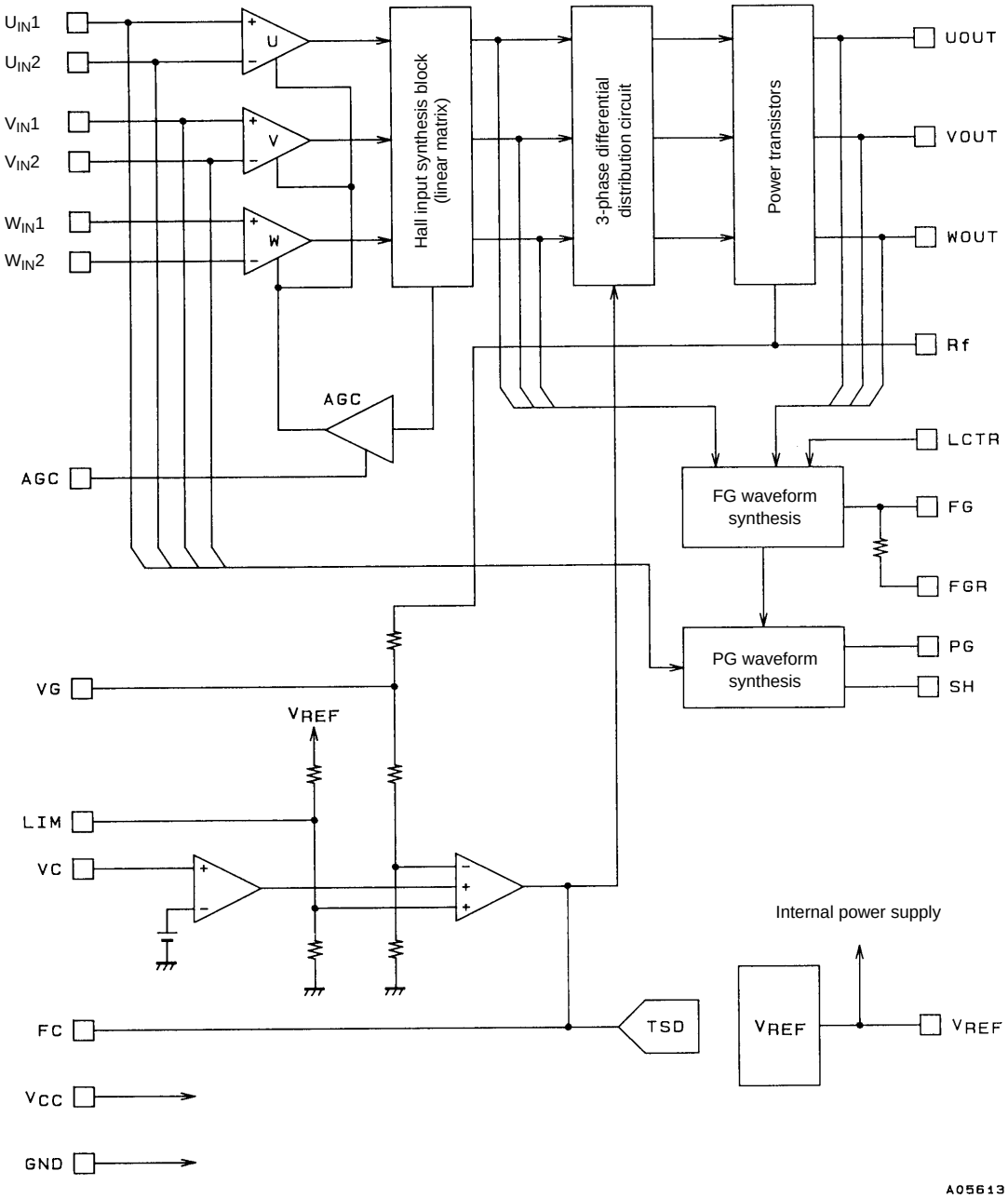
FG (FGR shorted to ground)



PG (FGR shorted to PG)



Block Diagram



Sample Application Circuit