

**LB1813M****FDD Spindle Motor Driver****Overview**

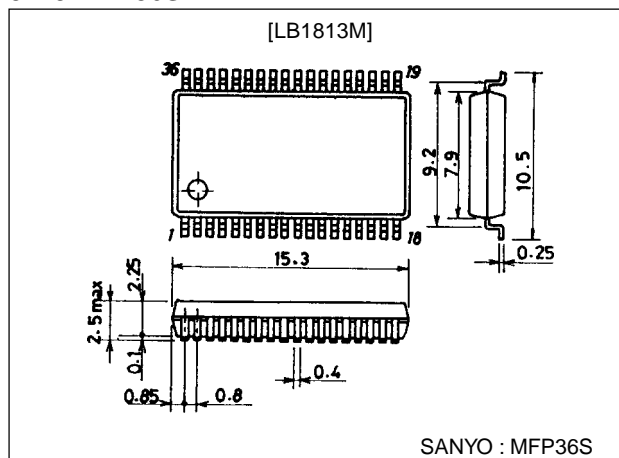
The LB1813M is 3-phase DD motor driver IC and is an ideal FDD spindle motor driver for 3.5 inch applications.

Features

- Three phase total wave linear driver.
- Eliminates need for output electrolytic capacitor (however, depending on the motor, this may not apply)
- On-chip digital speed control : $f_{osc} = (1024 \times f_{FG}) / D$
When SL1=high D=5/8
SL1=low D=6/8
- Start/Stop circuit.
- Rotation speed switching.
- Current limiter circuit.
- On-chip index comparator (single hysteresis)
- On-chip index delay circuit.
- AGC circuit.
- Thermal protection circuit.

Package Dimensions

unit:mm

3129-MFP36S**Specifications****Absolute Maximum Ratings at Ta = 25°C**

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC \max}$		7.0	V
Maximum output current	$I_O \max 1$	$t \leq 0.5s$	1.0	A
Steady maximum output current	$I_O \max 2$		0.7	A
Allowable power dissipation	$P_d \max$	Independent IC	1	W
Operating temperature	T_{opr}		-20 to +80	°C
Storage temperature	T_{stg}		-40 to +150	°C

Allowable Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		4.2 to 6.5	V

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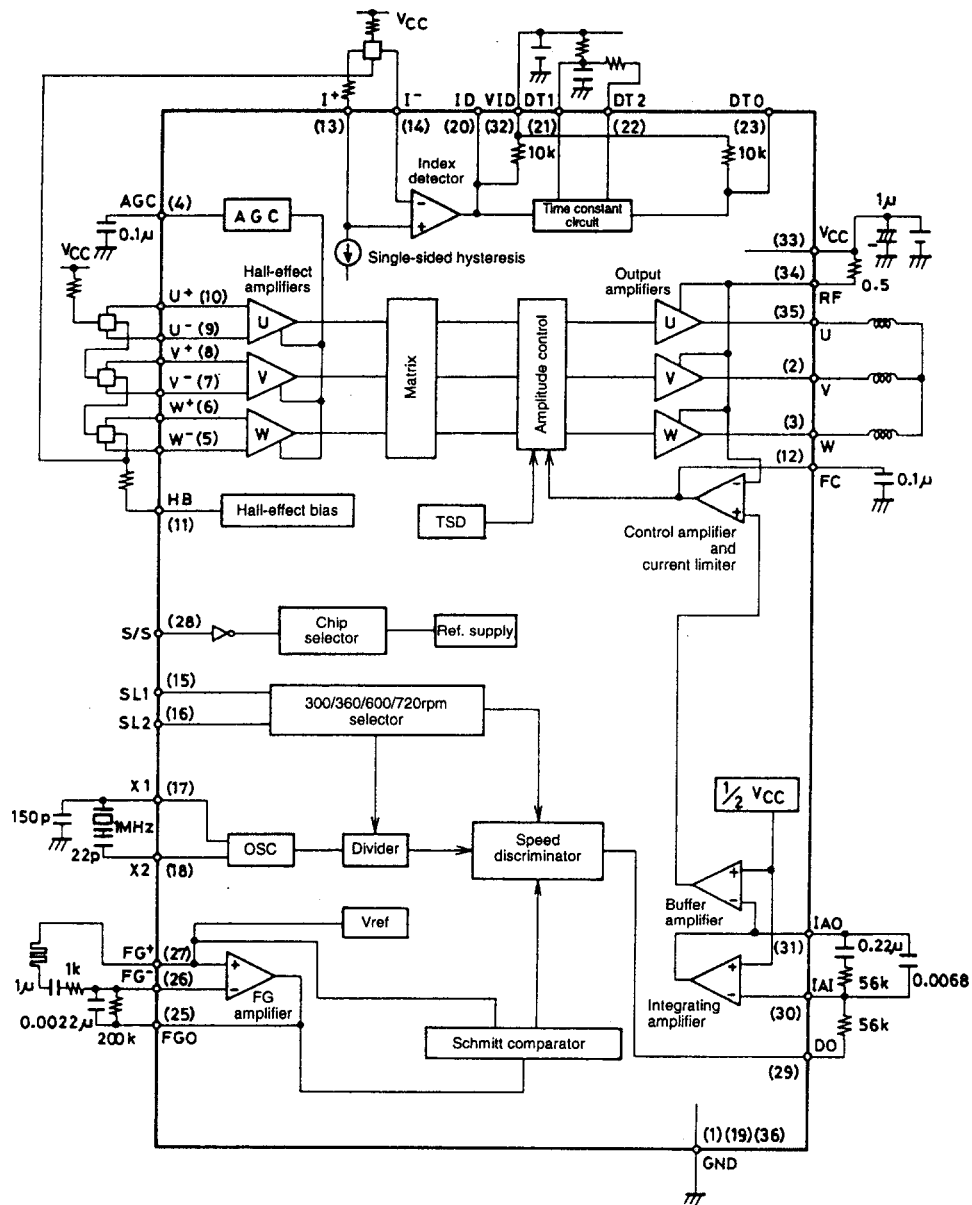
Electrical Characteristics at Ta = 25°C, VCC=5V

Parameter	Symbol	Conditions	Ratings			Unit	Note
			min	typ	max		
Current drain	I _{CCO1}	V _{CC} =5.0V (Stop)			0.4	mA	
	I _{CC1}	V _{CC} =5.0V (Steady)		20	30	mA	
Time changeover bias current	I _{SL}				0.4	mA	
Time changeover input voltage1	V _{SLL}		0		0.8	V	
Time changeover input voltage2	V _{SLH}		2.0		V _{CC}	V	
S/S bias current	I _{S/S}				0.1	mA	
S/S start voltage	V _{S/S}		0		0.8	V	
S/S stop voltage	V _{S/S}		2.0		V _{CC}	V	
Hall-effect bias amplifier input current	I _{HB}				20	μA	
In-phase input voltage range	V _h		2.2		V _{CC} -0.7	V	
Differential input voltage range	V _{dif}		70		200	mVp-p	
Input offset voltage	V _{ho}				±10	mV	*
Hall-effect output voltage	V _H	I _H =5mA		1.5	1.8	V	
Leak current	I _{HL}	Stop			±10	μA	
Output saturation voltage (sink plus source)	V _{sat1}	I _O =0.35A, V _{CC} =4.2V		1.2	1.4	V	
	V _{sat2}	I _O =0.70A, V _{CC} =4.2V		1.5	2.0	V	
Output leak current	I _{OL}				±1.0	mA	
Current limiter	V _{ref1}		0.27	0.30	0.33	V	
Control amplifier voltage gain	G _C			-6		dB	
Voltage gain phase differential	ΔG _C				±1	dB	
Integrated amplifier internal reference voltage	V _{ref2}			V _{CC} /2		V	
Integrated amplifier bias current	I _{ib}				±1	μA	
Integrated output voltage amplitude	V _{i+}	I _i =-0.5mA with reference of V _{ref2}		0.75		V	
	V _{i-}	I _i =0.5mA with reference of V _{ref2}		-1.4		V	
Gain band width				1000		kHz	*
FG amplifier input voltage range	V _{FG}		5		100	mVp-p	
FG amplifier voltage gain	G _{FG}	Open loop		60		dB	
FG amplifier input offset	V _{FG0}				±10	mV	
FG amplifier internal reference voltage	V _{FGB}		2.20	2.50	2.80	V	
Schmitt hysteresis width	ΔV _{sh1}	High→Low		25		mV	*
	ΔV _{sh2}	Low→High		25		mV	*
Schmitt input operation level	V _{sh}		1		V _{CC} -1	V	
Speed disk recount number	N			1042			
Disk recount out low level voltage	V _{DL}	I _D =-0.5mA			0.3	V	
Disk recount out high level voltage	V _{DH}	I _D =0.5mA	V _{CC} -0.4			V	
Disk recount out leak current	I _{D1}				±1.0	μA	
Disk recount operation frequency	F _D				1.0	MHz	*
Oscillation range	F _{OSC}				1.0	MHz	*
Index bias current	I _{IDB}				±10	μA	
In-phase input voltage range	V _{ID}		1.5		V _{CC} -0.5	V	
Hysteresis setting current range	I _{IDO}		5	10	15	μA	
Index output low level voltage	V _{IDL}	V _{ID} =5V			0.4	V	
Index output high level voltage	V _{IDH}	V _{ID} =5V	4.5			V	
Brak-down voltage	V _{DLDC}	V _{ID} =5V		2.50		V	
Delay output low level voltage	V _{DLL}	V _{ID} =5V			0.4	V	
Delay output high level voltage	V _{DLH}	V _{ID} =5V	4.5			V	
Thermal shutdown operating temperature	TSD		150	180		°C	*
Hysteresis width	ΔTSD			40		°C	*

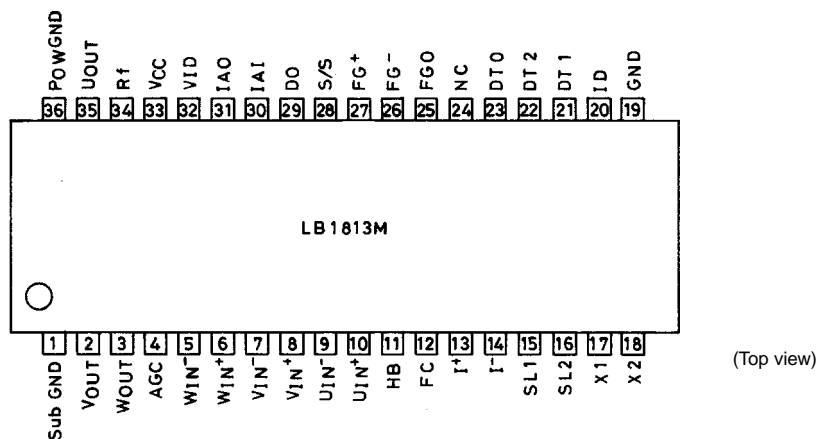
Note : *) Marked values are guaranteed by the design itself and therefore do not require measurement.

LB1813M

Block Diagram



Pin Assignment



Truth Table

	Source→Sink	Hall-Effect Input		
		U	V	W
1	V-phase →W-phase	H	H	L
2	V-phase →U-phase	L	H	L
3	W-phase →U-phase	L	H	H
4	W-phase →V-phase	L	L	H
5	U-phase →V-phase	H	L	H
6	U-phase →W-phase	H	L	L

When an high level exists for Hall-effect input.

$U^+ > U^-$
 $V^+ > V^-$
 $W^+ > W^-$

Pin Description

Unit (resistance : Ω)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function									
5 6 7 8 9 10	W- W+ V- V+ U- U+	2.2V min V _{CC} -0.7V max		<ul style="list-style-type: none">W-phase Hall-effect input pin. W⁺>W⁻ is established when logic is at an high level.V-phase Hall-effect input pin. V⁺>V⁻ is established when logic is at an high level.U-phase Hall-effect input pin. U⁺>U⁻ is established when logic is at an high level.									
11	HB	1.5V typ I _H =5mA		<ul style="list-style-type: none">Minus pin for Hall-effect bias, When stopped, switches open and Hall-effect bias severs.									
12	FC			<ul style="list-style-type: none">Frequency characteristics revision pin. By installing a capacitor between this pin and GND, close-loop oscillation for the current control system halts.									
13 14	I ⁺ I ⁻	1.5V typ V _{CC} -0.5V max		<ul style="list-style-type: none">Index input pin. <p>When the I⁺ pin is at an low level, I1 operates with the fixed current of I1=10μA and when at an high level, I1 does not flow.</p> <p>Hysteresis width is determined by the resistor attached externally to the I⁺ pin.</p>									
15	SL1	High : 2.0V min Low : 0.8V max		<ul style="list-style-type: none">Time changeover pin. <p>fosc=1MHz</p> <table border="1"><tr><th>SL2 \ SL1</th><th>H</th><th>L</th></tr><tr><th>H</th><td>600rpm</td><td>300rpm</td></tr><tr><th>L</th><td>720rpm</td><td>360rpm</td></tr></table> <p>FG : 60pulse/round</p>	SL2 \ SL1	H	L	H	600rpm	300rpm	L	720rpm	360rpm
SL2 \ SL1	H	L											
H	600rpm	300rpm											
L	720rpm	360rpm											
16	SL2	High : 2.0V min Low : 0.8V max											

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LB1813M

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Unit (resistance : Ω)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
17	X1			• Reference clock generating pin.
18	X2			
19	GND			• Ground pin. Grounded as with pins 1 and 36.
20	ID	High : 4.5V min Low : 0.4V max (When $V_{ID}=5V$)		• Index pulse output pin.
21	DT1			• Pin Connecting the external CR for the delay time constant circuit.
22	DT2			• Break-down current setting pin for the delay time constant circuit.
23	DTO	High : 4.5V min Low : 0.4V max (When $V_{ID}=5V$)		• Index delay pulse output pin.
25	FG0			• FG amplifier output pin.
26	FG ⁻			• FG amplifier negative input pin.
27	FG ⁺	2.48V (When $V_{ID}=5V$)		• FG amplifier positive input pin. Generates reference voltage within IC.

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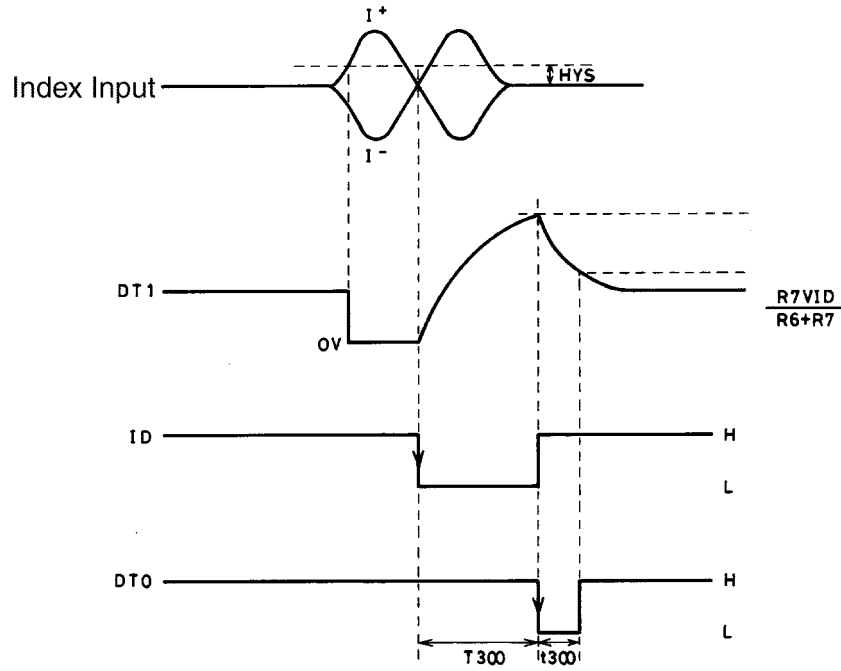
LB1813M

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Unit (resistance : Ω)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
28	S/S	High : 2.0V min Low : 0.8V max		<ul style="list-style-type: none"> Start/Stop changeover pin. Low level active.
29	DO			<ul style="list-style-type: none"> Speed discriminator output pin.
30	IAI			<ul style="list-style-type: none"> Integrated amplifier input pin.
31	IAO			<ul style="list-style-type: none"> Integrated amplifier output pin.
32	VID			<ul style="list-style-type: none"> Index pulse output and index delay pulse output power supply pin. <p>For applications when V_{CC} equals 5V, $V_{CC}=V_{ID}=5V$.</p>
33	V_{CC}			<ul style="list-style-type: none"> Total power supply voltage pin except for V_{ID}. Voltage must be stable and free of ripple and noise interference.
34	R_f			<ul style="list-style-type: none"> Output current detection pin. <p>By installing an R_f resistor between this pin and V_{CC}, output current is detected as voltage. Voltage detection at this pin activates the current limiter.</p>
35	U_{OUT}			<ul style="list-style-type: none"> U-phase output pin.
36	Pow GND			<ul style="list-style-type: none"> Output transistor ground pin.
1	Sub GND			<ul style="list-style-type: none"> Ground pin. Ground as with pins 19 and 36.
2	V_{OUT}			<ul style="list-style-type: none"> V-phase output pin.
3	W_{OUT}			<ul style="list-style-type: none"> W-phase output pin.
4	AGC			<ul style="list-style-type: none"> AGC (Automatic gain control) pin. <p>Confrds Hall-effect amplifier gain in response to Hall-effect input-frequency.</p>

Index and Timing Chart



When SL1=high level

$$T_{300} \approx 0.693CR_6$$

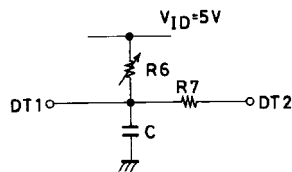
$$t_{300} \approx \frac{CR_6R_7}{R_6 + R_7} \left\{ 0.405 + \ln \left(\frac{R_6 - R_7}{R_6 - 2R_7} \right) \right\}$$

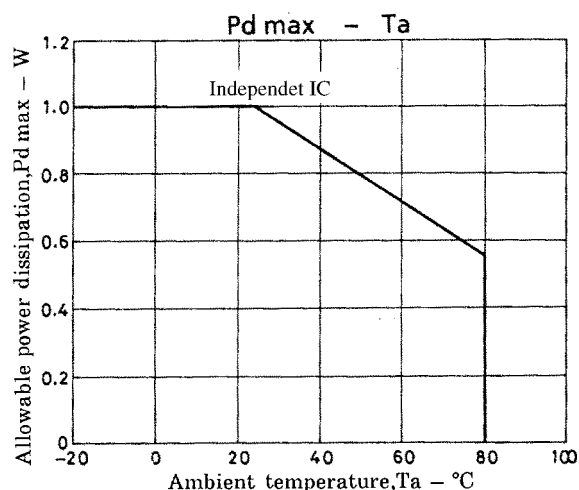
When SL1=low level.

$$T_{360} \approx 0.577CR_6$$

$$t_{360} \approx \frac{CR_6R_7}{R_6 + R_7} \left\{ 0.522 + \ln \left(\frac{0.781R_6 - R_7}{R_6 - 2R_7} \right) \right\}$$

Using only the ID pulse involves shorting DT1 and DT2.





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