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KA2822D

3-Phase BLDC Motor Driver

Features

- 3-phase, full-wave, linear BLDC motor driver with 2 hall sensors
- Built-in soft switching drive circuit
- 300 or 360 RPM speed control
- Snubberless
- Built-in chip enable function
- Built-in digital speed control circuit
- Built-in current limit circuit
- Index sensorless
- Built-in TSD (Thermal shutdown)
- Low saturation voltage
- Digital input: TTL, 5V CMOS compatible
- Built-in current-mode control circuit (I_{PEAK}: 1A)

Description

The KA2822D is a monolithic integrated circuit, and suitable for the three-phase spindle motor driver of FDD system.

28-SSOPH-375

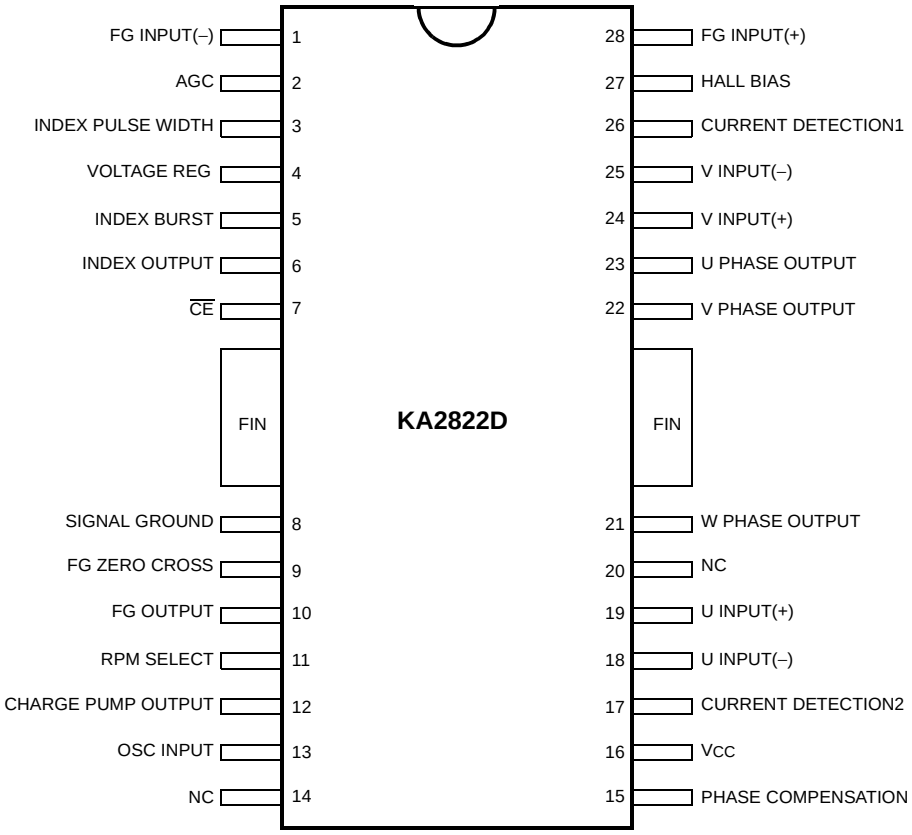
Typical Application

- 3.5-inch floppy disk drive (FDD) spildle motor
- Other 3-phase BLDC motor

Ordering Information

Device	Package	Operating Temp.
KA2822D	28-SSOPH-375	0 ~ 75°C
KA2822DTF	28-SSOPH-375	0 ~ 75°C
KA2822BD	28-SSOPH-375	0 ~ 75°C
KA2822BDTF	28-SSOPH-375	0 ~ 75°C

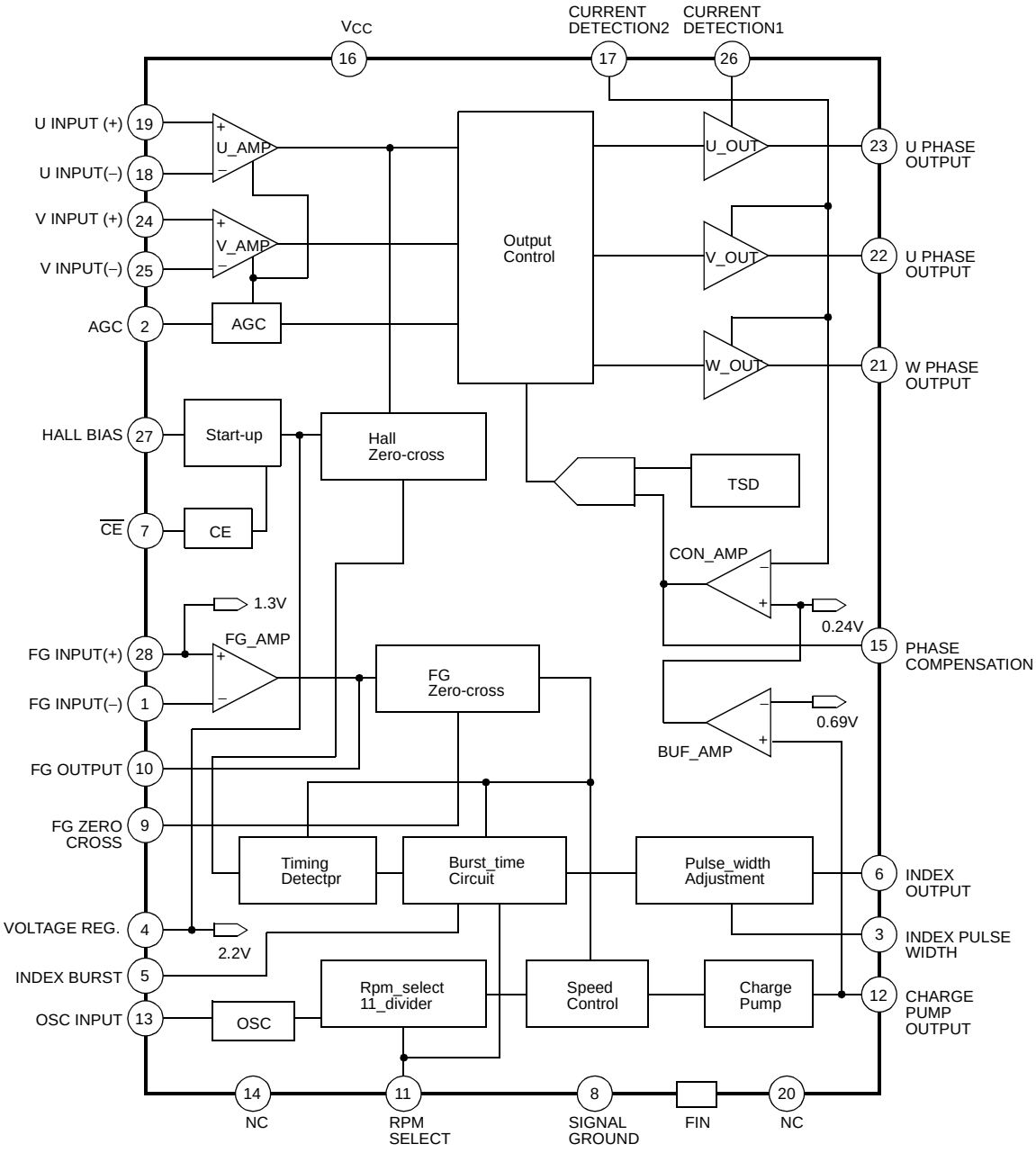
Pin Assignments



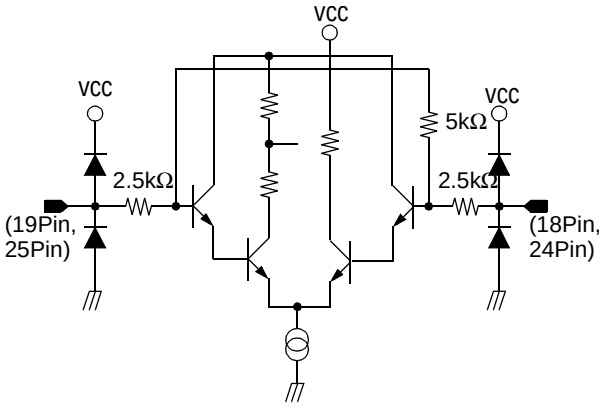
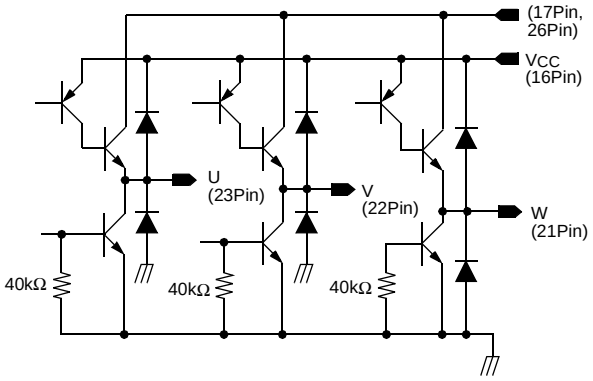
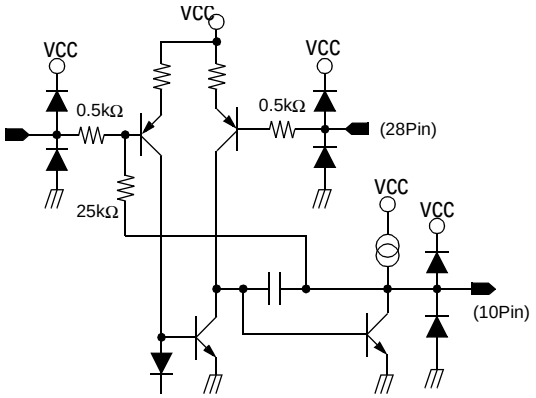
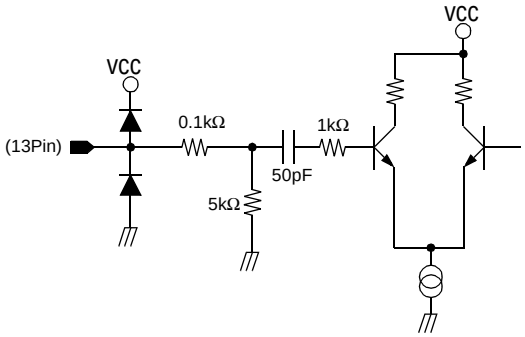
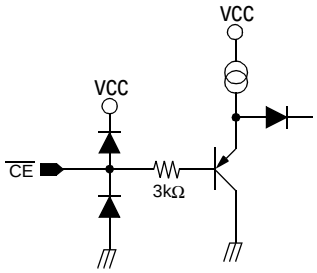
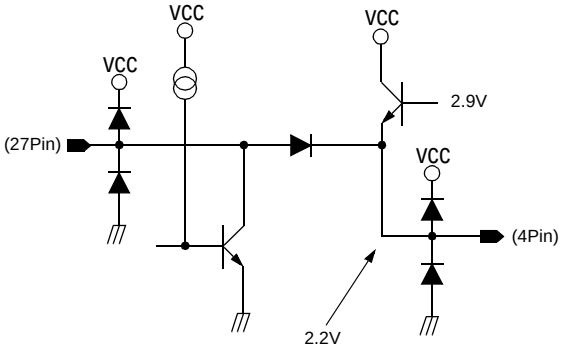
Pin Definitions

Pin Number	Pin Name	I/O	Pin Function Description
1	FG_INPUT	I	Negative input pin FG signal amp.
2	AGC	I	Automatic gain control input pin
3	INDEX PULSE WIDTH	O	Index pulse width detection (1.1V) pin
4	VOLTAGE REGULATOR	O	Voltage (2.2V) generator output pin
5	INDEX BURST	O	Index pulse width detection (1.4V) pin
6	INDEX OUTPUT	O	Index pulse output pin
7	CE	I	Chip enable (Active low)
8	SIGNAL GROUND	-	Signal ground
9	FG ZERO CROSS	O	FG signal zero cross detection pin
10	FG OUTPUT	O	FG signal output pin
11	RPM SELECT	I	RPM selection pin (L: 300, H: 360rpm)
12	CHARGE PUMP OUTPUT	O	Charge pump output pin
13	OSC INPUT	I	1MHz oscillation input pin
14	NC	-	No connection
15	PHASE COMPENSATION	I	Phase compensation cap. connection pin
16	V_{CC}	-	5V power supply pin
17	CURRENT DETECTION2	I	Over current detection pin
18	U INPUT (–)	I	Negative input pin of U phase amp
19	U INPUT (+)	I	Positive input pin of U phase amp
20	NC	-	No connection
21	W PHASE OUTPUT	O	W phase output pin
22	V PHASE OUTPUT	O	V phase output pin
23	U PHASE OUTPUT	O	U phase output pin
24	U INPUT (+)	I	Positive input pin of V phase amp
25	V INPUT (–)	I	Negative input pin of V phase amp
26	CURRENT DETECTION1	I	Over current detection pin
27	HALL BIAS	I	Hall sensor bias input pin
28	FG INPUT (+)	I	Positive input pin of FG signal amp
FIN	POWER GROUND	-	Power ground

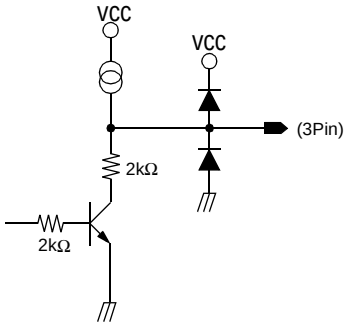
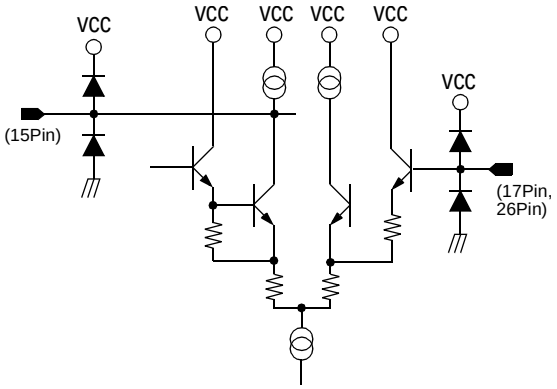
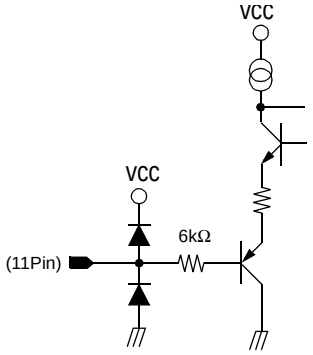
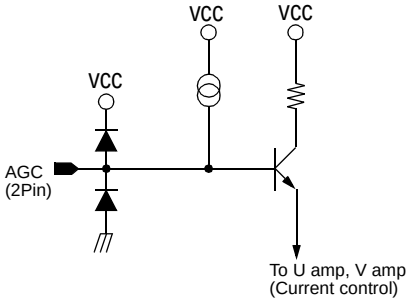
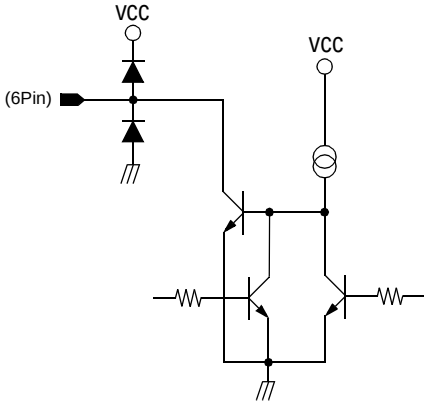
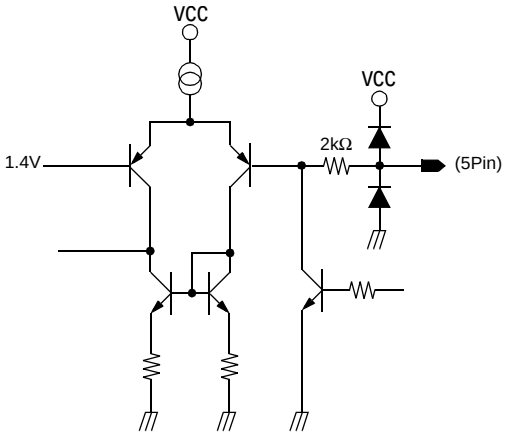
Internal Block Diagram



Equivalent Circuits

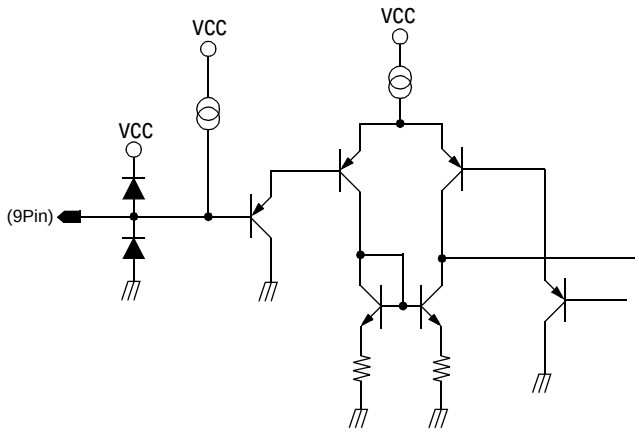
U_amp, V_ amp input	U, V, W drive output and current detection 1, 2
	
FG input and FG output	**OSC input**
	
CE input	**Hall bias input and voltage regulator output**
	

Equivalent Circuits (Continued)

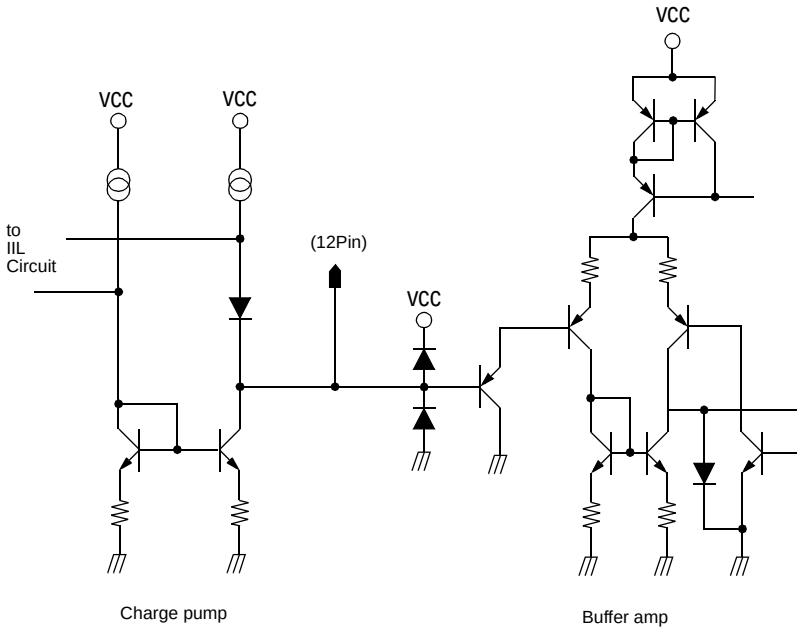
Index pulse width detection output	Phase compensation and current detection 1, 2
	
RPM select input	**AGC input**
	
Index output	**Index burst output**
	

Equivalent Circuits (Continued)

FG zero cross output



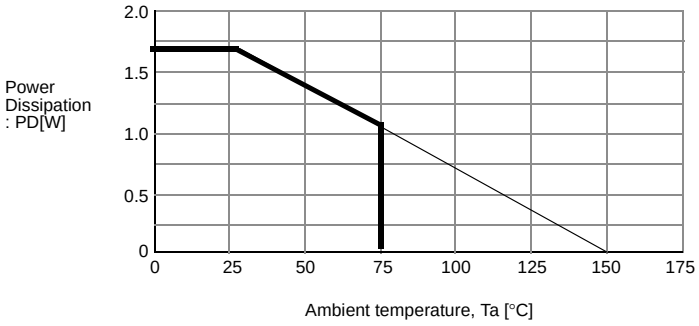
Charge pump output



Absolute Maximum Rating (Ta=25°C)

Parameter	Symbol	Value	Unit
Maximum power supply voltage	V_{CCMAX}	7.0	V
Maximum input voltage	V_{INMAX}	0 ~ V_{CC}	V
Maximum output current	I_{OMAX}	1	A
Normal output current	I_O	0.7	A
Power dissipation	P_D	1.5	W
Operating temperature	T_A	0 ~ 75	°C
Junction temperture	T_J	150	°C
Storage temperature	T_{STG}	–55 ~ +125	°C

Power Dissipation Curve



Power dissipation decreases in the rate of 13.5mV / °C when mounted on 50mm × 50mm × 1mm PCB (Phenolic resin material) and used above Ta=25°C.

Recommended Operating Conditions (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max	Unit
Supply voltage	V_{CC1}, V_{CC2}	10.8	12.0	13.2	V
Supply voltage in logic part	V_{CC3}	4.5	5.0	5.5	V
Ambient operating temperature range	Ta	0	-	+70	°C

Temperature Characteristic

Parameter	Symbol	Min.	Typ.	Max	Unit
Thermal shutdown temperature note	TSD	125	150	-	°C

NOTE:
Reference value

Electrical Characteristics

(Ta=25°C, V_{CC}=5V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
SUPPLY CURRENT						
Supply current 1	I_{CCO}	V_{CC}=6.5V $\overline{CE}$=H, RPM=L	-	1.0	2.0	mA
Supply current 2	I_{CC}	V_{CC}=6.5V, $\overline{CE}$=L	-	15	23	mA
CHIP ENABLE						
Input current	I_{CE}	$\overline{CE}$=0~5V	-	5	10	µA
Input low voltage	I_{CE1}	-	-	-	1.0	V
Input high voltage	I_{CEH1}	-	3.5	-	-	V
RPM SELECT						
Input current	I_{RPM}	$\overline{CE}$=0~5V	-	5	10	µA
Input low voltage	V_{RPM1}	-	-	-	1.0	V
Input high voltage	V_{RPMH}	-	3.5	-	-	V
HALL AMP						
Input resistance note	RI_N	-	1	10	-	kΩ
Common mode input voltage range note	V_{COM}	-	2.0	-	V_{CC}	V
Differential input voltage range note	V_{DIF}	-	100	-	420	mV_{PP}
START-UP						
Hall bias voltage 1	V_{HB1}	I_H=4mA, $\overline{CE}$=L	2.3	2.5	2.7	V
Hall bias voltage 2	V_{HB2}	I_H=10mA, $\overline{CE}$=L	2.7	2.9	3.1	V
Reference voltage	Vref	I_O=1mA, $\overline{CE}$=L	1.7	2.2	2.7	V
Bias off current	I_{HOFF}	V_H=7V, $\overline{CE}$=H	-	5	10	µA
OUTPUT AMP						
Leakage current	I_{CER}	-	-	0.5	1	mA
Saturation voltage 1	Vsat1	I_O=0.35A	-	1.0	1.2	V
Saturation voltage 2	Vsat2	I_O=0.7A	-	1.3	1.8	V
BUFFER & CONTROL AMP						
Voltage gain 1 note	G_{CT1}	-	-	–11	-	dB
Reference voltage 1 note	Vref1	Current limiter voltage	0.205	0.208	0.210	V
Reference voltage 2 note	Vref2	Control begin voltage	-	0.69	-	V

Notes:
Reference value

Electrical Characteristics (Continued)

(Ta=25°C, V_{CC}=5V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
CHARGE PUMP						
Charge current	I_{CP-}	RPM=L	–15	–20	–25	µA
Discharge current	I_{CP+}	RPM=L	15	20	25	µA
Current ratio note	I_R	I_{CP+} / I_{CP-}	0.9	1.0	1.1	-
Off current	I_{OFF}	V_{CP}=0.63V	-	-	50	nA
Clamp voltage note	V_{CLP}	-	-	1.3	1.5	V
FG AMP						
Output DC voltage note	V_{FG}	-	1.0	1.3	1.6	V
Voltage gain 2	G_{FG}	-	24	34	44	dB
Input voltage range note	V_{IN}	-	2.0	-	20	mV_{P-P}
Noise margin 1 note	N_D	Differential noise	-	-	0.5	mV_{P-P}
Noise margin 2 note	N_C	Common mode noise	-	-	0.5	V_{P-P}
SPEED CONTROL						
Count range 1note	N1	RPM=L	-	1666.5	-	-
Count range 2 note	N2	RPM=H	-	1388.5	-	-
Operating freq.	F_D	-	-	1.0	1.1	MHz
BURST ADJUSTMENT						
Input current	I_{BI}	-	-	1	2	µA
Threshold voltage 1	V_{TH1}	RPM=L	1.2	1.45	1.7	V
Threshold voltage 2	V_{TH2}	RPM=H	1.05	1.3	1.55	V
PULSE WIDTH ADJUSMENT						
Ct2 charge current	I_{CT2}	-	–19	–25	–36	µA
Threshold voltage 3	V_{TH3}	-	0.9	1.1	1.3	V
INDEX OUTPUT						
Output leakage current note	I_{OH}	-	-	1	2	µA
Output low voltage	V_{O1}	I_O=1mA	-	0.2	0.4	V

Notes:
Reference value

Application Information

1. CHIP ENABLE

This function turns on or off all blocks by low or high signal.

2. U, V AND W PHASE OUTPUT AMP

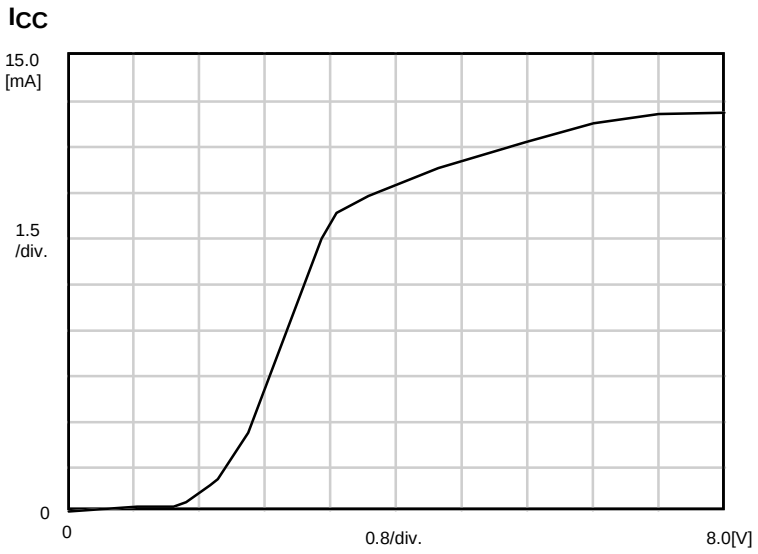
These ampilifiers drives three output phases - U, V, and W which have 120(degree) phase differences with each other. The three phase waveforms are made with the two hall sensor signals by synthesizing the third phase signal.

3. SPEED CONTROL PART

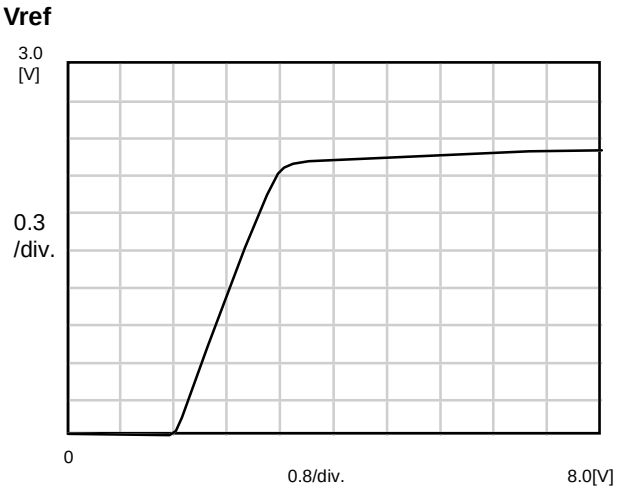
This function compares the real motor rotation frequency with the 300 or 360Hz pulse divided from 1MHz clock pulse for removing speed error when motor is on and speed error is detected by PLL.

The speed error sent to charge pump part which repeats charge and discharge controls the output current of the output amp to keep a stable rotation.

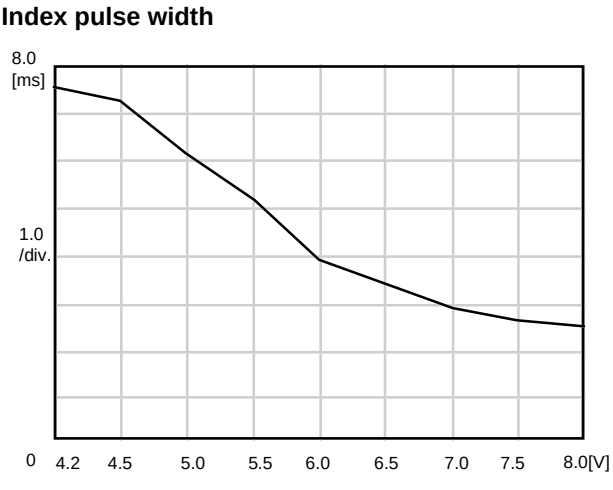
Typical Performance Characteristics



1. V_{CC} vs. I_{CC}

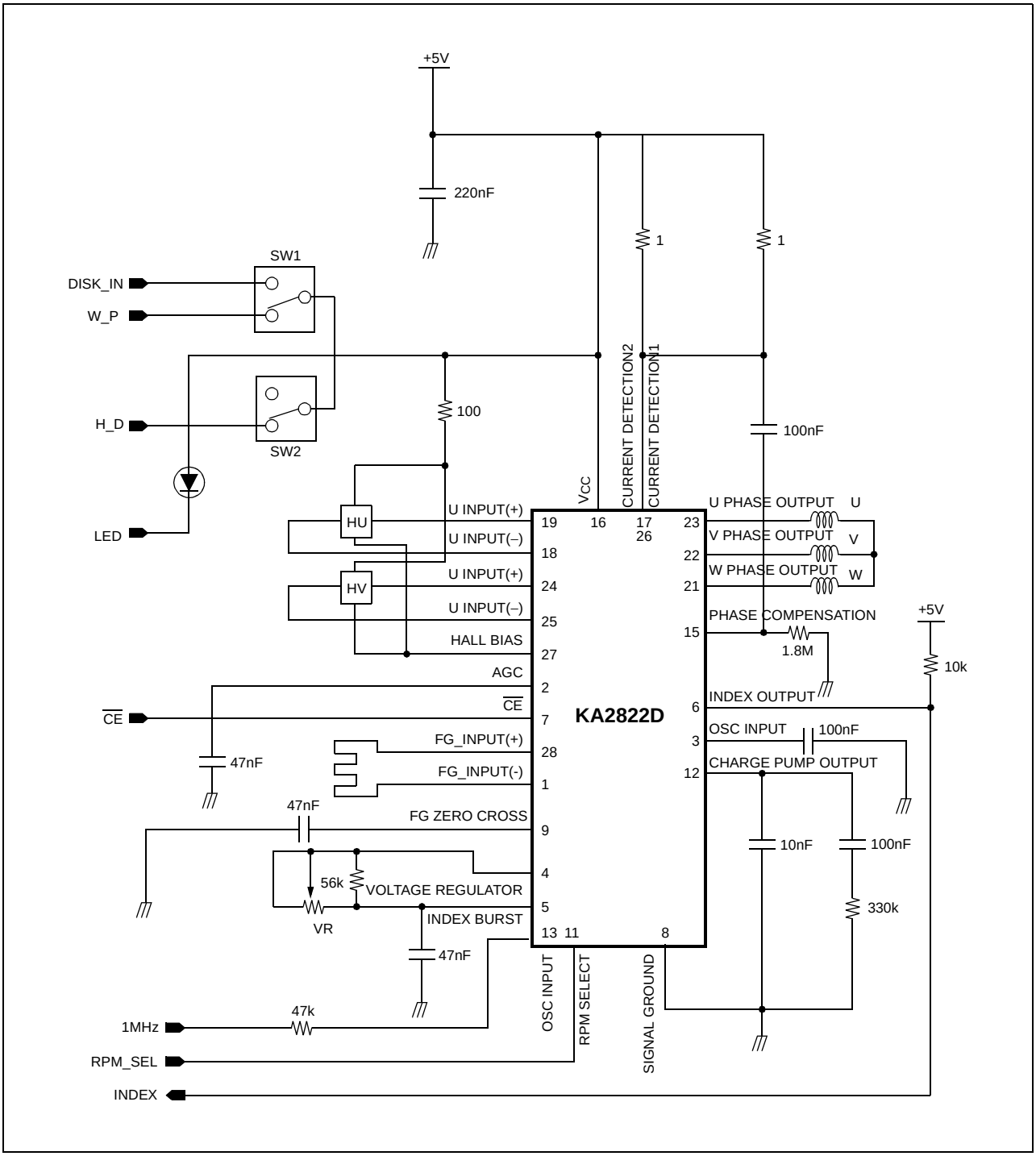


V_{CC} vs. Vref (Pin4)



V_{CC} vs. Index pulse width

Typical Application Circuits



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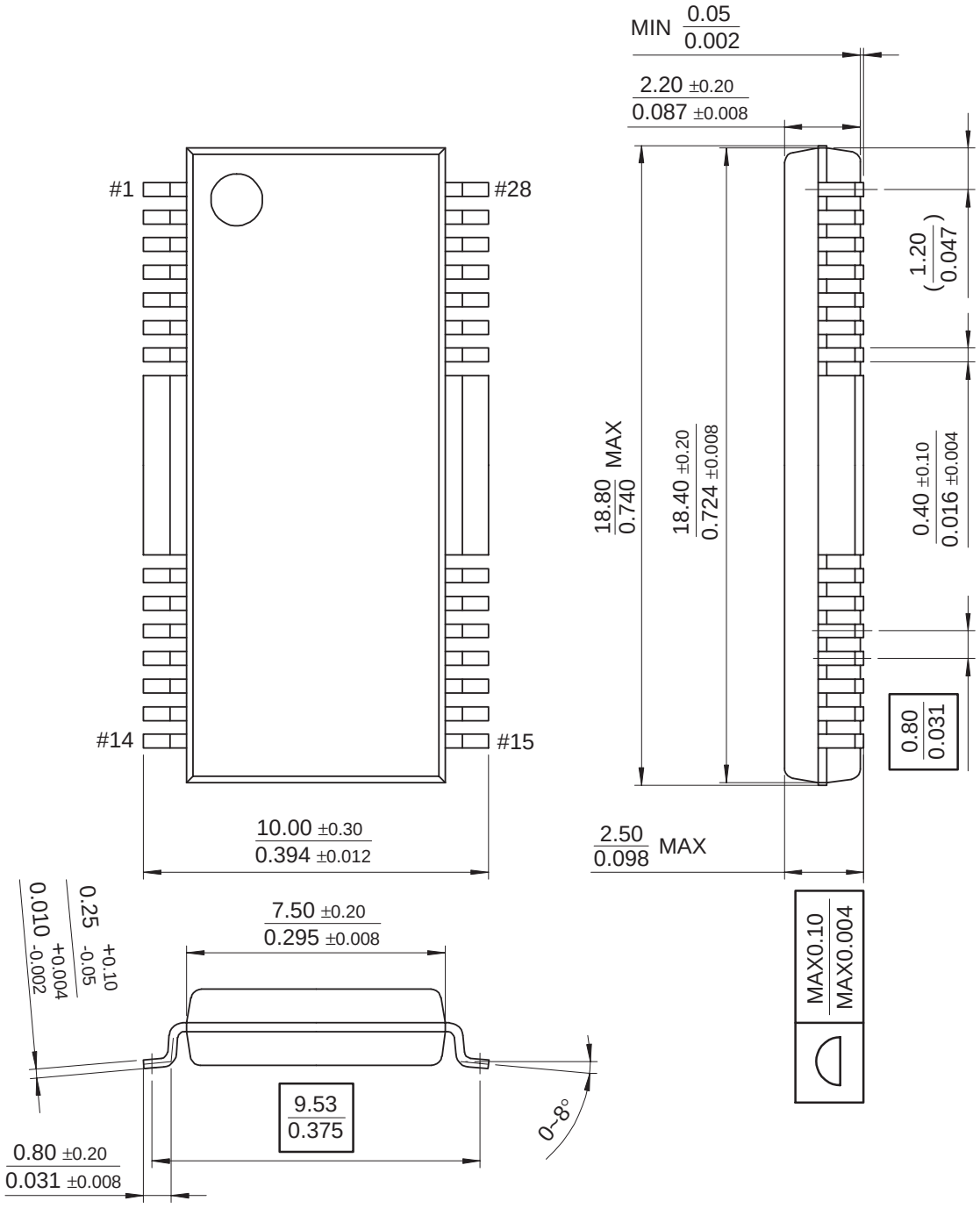
MIN 0.05 / 0.002
2.20 ±0.20 / 0.087 ±0.008
(1.20 / 0.047)
18.80 / 0.740 MAX
18.40 ±0.20 / 0.724 ±0.008
0.40 ±0.10 / 0.016 ±0.004
0.80 / 0.031
2.50 / 0.098 MAX
MAX0.10 / MAX0.004
#1
#28
#14
#15
10.00 ±0.30 / 0.394 ±0.012
0.25 +0.10 -0.05 / 0.010 +0.004 -0.002
7.50 ±0.20 / 0.295 ±0.008
9.53 / 0.375
0–8°
0.80 ±0.20 / 0.031 ±0.008

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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