Capella Microsystems Inc.

3777 Stevens Creek Blvd., Suite 320 Santa Clara, CA 95051-7364 U.S.A Tel: (408) 260-3400 FAX: (408) 248-3416

CMI8800 Single/Three Phase

Spindle Motor Controller/Driver IC

For DVD/CD-ROM

PRELIMINARY DATA SHEET

Revision 3.0

07/09/99

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CMI8800 Motor Controller

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GENERAL DESCRIPTION

The CMI8800 is a spindle motor controller/ driver IC designed for DVD/CD-ROM and Video CD (VCD) applications. This chip can be used to control/drive single phase spindle motors (see Page 20, Figure 17 for the CMI8800 Application example) as well as conventional three phase spindle motors. It contains all of the necessary functional blocks such as the hall bias generator, hall amplifier, current limit amplifier, thermal shutdown, anti-reverse protection, short brake, H-bridge power driver and other functional blocks required for motor controller/driver ICs (see Page 4, Figure 2 for the CMI8800 Simplified Block Diagram).

FEATURES

- Brushless DC motor controller/driver IC dedicated for DVD/CD-ROM and Video-CD (VCD) spindle motor applications
- Can drive both single phase spindle motors as well as conventional three phase spindle motors
- Built-in hall bias generator and hall amplifiers for easy interface with hall sensor devices
- Built-in sleep or start/stop mode to put the chip and motor into sleep mode for power saving
- Built-in current limit amplifier to limit the maximum allowed current into the motor coil
- Built-in thermal shutdown for overheat protection
- Built-in torque control to setup the motor's torque according to the control voltage applied to the EC and ECR pins
- Built-in anti-reverse protection circuitry to prevent the motor from going into the opposite (reverse) rotation direction in the constant linear velocity (CLV) operating mode (used when the rotation speed is decreased from the inner track to the outer track)
- Built-in frequency generator (FG) output as well as rotation detect (FR) output circuitry
- Built-in short brake circuitry to short all of the motor coils and stop the motor quickly
- Compatible with 3.3V digital signal processor (DSP) interface

APPLICATIONS

- DVD-DRIVES
- CD-DRIVES

Absolute Maximum Ratings

(Ta = 25°C)

Description	Symbol	Value	Unit
Power Supply for Internal Core	VCCI	7	V
Power Supply for Motor Driver	VCCM1/VCCM2	16	V
Maximum Power Dissipation	Pd	1700*	mW
Storage Temperature	Tstg	-55 ~ 150	°C
Operating Temperature	Topr	-20 ~ 75	°C
Maximum Output Current	Iout	1300	mA
Hall Bias Current	IHB	50	mA

* 13.6mW/°C Derating for Operating Temperature > 25°C
(see Page 19, Figure 16 for the Derating Curve)

Recommended Power Supply Range

Description	Symbol	Value	Unit
Power Supply for Internal Core	VCCI	4.25 ~ 5.5	V
Power Supply for Motor Driver	VCCM1/VCCM2	3.0 ~ 15	V

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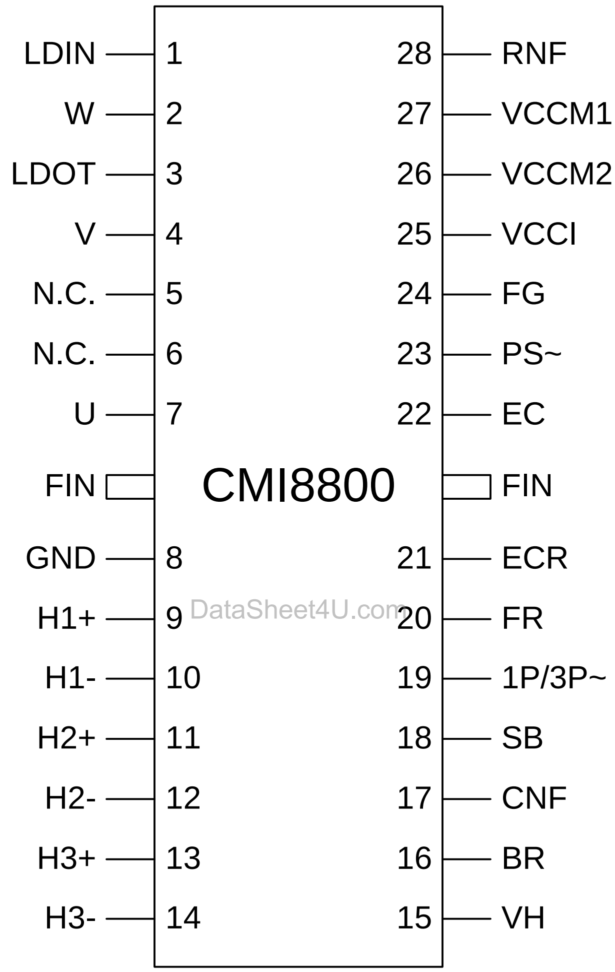

Figure 1: CMI8800 Pin Assignment

CMI8800 Motor Controller

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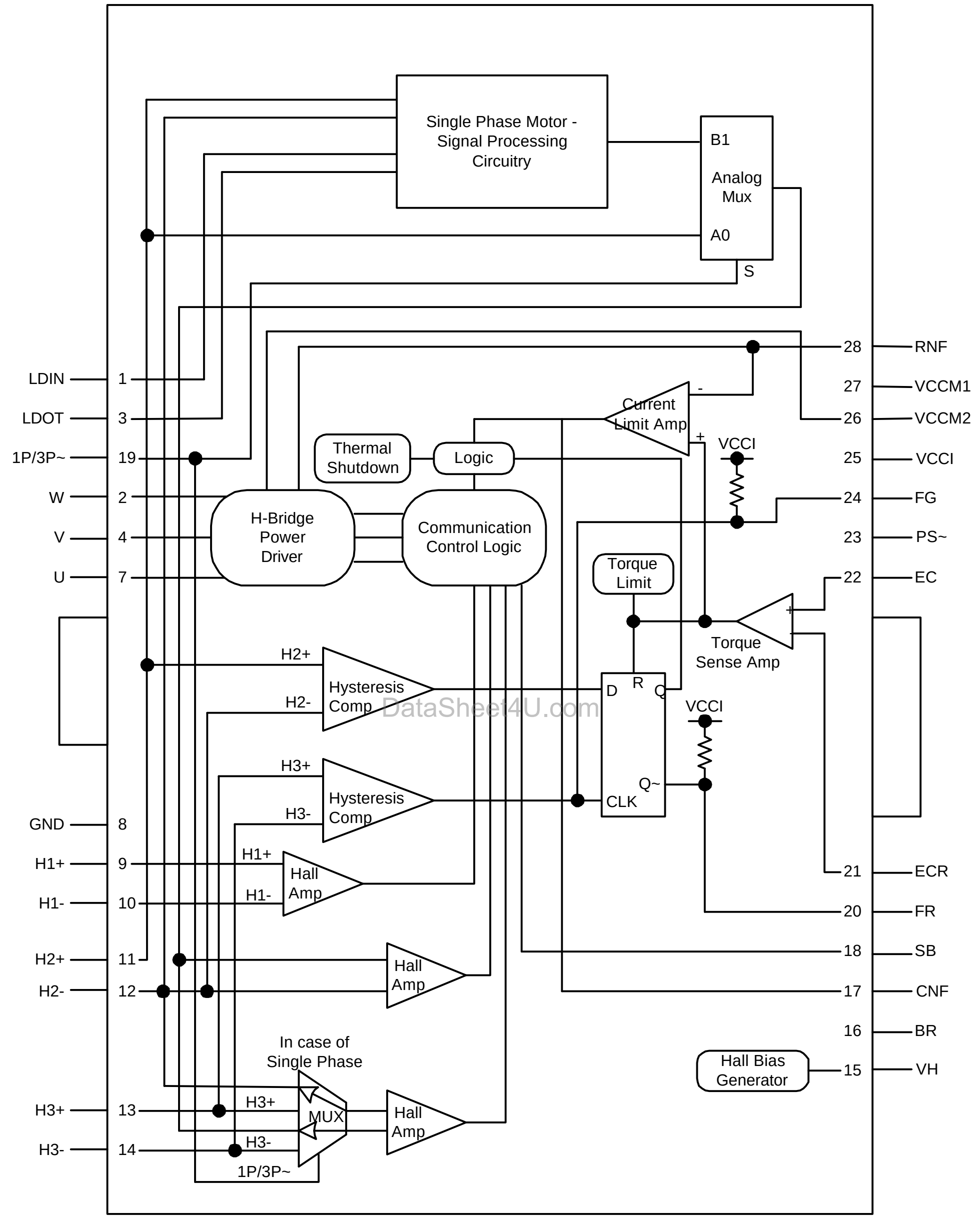

Figure 2: CMI8800 Simplified Block Diagram

CMI8800 Motor Controller

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Pin Description

Pin #	Pin Name	Pin Description
1	LDIN	Input for the External Lead Network (for Single Phase Motor) **This Pin is left open for three phase motor applications**
2	W	H-Bridge Power Driver Output (W)
3	LDOT	Output of External Lead Network (for Single Phase Motor) **This pin must be left open for three phase motor applications**
4	V	H-Bridge Power Driver Output (V), NC for Single Phase Mode
5	NC	No Connection [**This pin must be left open**]
6	NC	No Connection [**This pin must be left open**]
7	U	H-Bridge Power Driver Output (U)
8	GND	Common Ground
9	H1+	Hall Amplifier #1 Positive Input
10	H1-	Hall Amplifier #1 Negative Input
11	H2+	Hall Amplifier #2 Positive Input
12	H2-	Hall Amplifier #2 Negative Input
13	H3+	Hall Amplifier #3 Positive Input
14	H3-	Hall Amplifier #3 Negative Input
15	VH	Hall Bias Generator Output (Open Collector Output)
16	BR	Brake Mode Control, High = Break Mode
17	CNF	Charge Pump Capacitor Between this Pin and Ground
18	SB	Short Brake Control Pin, High = Short Brake Mode
19	1P/3P~	Single Phase (1P)/Three Phase (3P) Control Pin High = Single Phase. Default = Three Phase = Low
20	FR	Rotation Detection Pin
21	ECR	Reference Voltage to Torque Sense Amplifier
22	EC	Torque Control Input Terminal
23	PS~	Power Save or Sleep Mode Control (**Logic Low: Power Save or Sleeping Mode**)
24	FG	FG Signal Output Pin
25	VCCI	5V Power Supply for Internal Core Circuitry
26	VCCM2	12V Power Supply for H-Bridge Motor (Power) Driver
27	VCCM1	12V Power Supply for Internal Core Circuitry
28	RNF	Motor Current Sense Resistor

Note: FIN → GND

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Electrical Characteristics

(Ta = 25°C, VCCI = 5V, VCCM1 = 12V, VCCM2 = 12V)

Description	Signal	Condition	min	typ	max	Unit
Internal Core Circuitry Supply Current at Normal Mode	IVCCIN	PS Pin = High	-	4.1	6.5	mA
Internal Core Circuitry Supply Current at Power Save	IVCCIS	PS Pin = Low	-	0	0.2	mA
Power Save Mode On Voltage	PS~on		-	-	1.5	V
Power Save Mode Off Voltage	PS~off		3.5	-	-	V
Single Phase Mode On Voltage	1Pon		3.5	-	-	V
Single Phase Mode Off Voltage	1Poff		-	-	1.5	V
Three Phase Mode On Voltage	3Pon		-	-	1.5	V
Three Phase Mode Off Voltage	3Poff		3.5	-	-	V
Short Brake Mode On Voltage	SBon	BR Pin = 0V	3.5	-	-	V
Short Brake Mode Off Voltage	SBoff	BR Pin = 0V	-	-	1.5	V
Brake Mode On Voltage	BRon	EC>ECR, SB Pin Open	3.5	-	-	V
Brake Mode Off Voltage	BRoff	EC>ECR, SB Pin Open	-	-	1.5	V
FG Pin (Active Low) O/P High Voltage	VOH(FG)	IFG = -20µA	4.5	4.8	-	V
FG Pin (Active Low) O/P Low Voltage	VOL(FG)	IFG = 3.0mA	0	0.25	0.4	V
FR O/P High Voltage (Reverse Rotation)	VOH(FR)	IFR = -20µA	4.1	4.4	-	V
FR O/P Low Voltage (Forward Rotation)	VOL(FR)	IFR = 3.0mA	0	0.25	0.4	V
Hall Bias Voltage	VHB	IHB = 10.0mA	0.5	0.9	1.5	V
Hall Amp I/P Bias Current	IBHA		0	0.7	3.0	µA
In-Phase I/P Voltage Range for Hall Amp.	VIPHA		1.5	-	4.0	V
Minimum Hall I/P AC Signal	Vinh(AC)		50	-	-	mVp-p
H3 Hysteresis (Hysteresis Comp)	Vhys(H3)		10	20	40	mV
Ec/ECR Pin I/P Voltage Range	VEC		1.0	-	4.0	V
Torque Sense Amp Offset Voltage +	Ec (o/s+)	ECR = 2.5V	20	50	80	mV
Torque Sense Amp Offset Voltage -	Ec (o/s-)	ECR = 2.5V	-80	-50	-20	mV
Torque Sense Amp I/P Bias Current	IB(TSA)	EC = ECR	-	0.5	2.0	µA
Torque Sense Amp Transfer Gain	GEC(TSA)	EC = 1.5V, 2.0V Measured	0.41	0.51	0.61	A/V
H-Bridge O/P High Voltage	VOH(HB)	Iout = 600mA With Respect to VCCM	-	1.0	1.5	V
H-Bridge O/P Low Voltage	VOL(HB)	Iout = 600mA	-	0.4	0.8	V
Pre-Drive Current	IPDR	EC = 0V, O/P Open	-	35	70	mA
Torque Limit Current	ITL		560	700	840	mA

Input-Output State Machine Table

Input Condition							Output						Test Point (Forward)
							Forward			Reverse			
Pin No.	9	10	11	12	13	14	7	4	2	7	4	2	
Pin Name	H1+	H1-	H2+	H2-	H3+	H3-	U	V	W	U	V	W	
1	L	M	H	M	M	M	H	L	L	L	H	H	**Pin 7 High**
2	H	M	L	M	M	M	L	H	H	H	L	L	**Pin 7 Low**
3	M	M	L	M	H	M	L	H	L	H	L	H	**Pin 4 High**
4	M	M	H	M	L	M	H	L	H	L	H	L	**Pin 4 Low**
5	H	M	M	M	L	M	L	L	H	H	H	L	**Pin 2 High**
6	L	M	M	M	H	M	H	H	L	L	L	H	**Pin 2 Low**

Note 1: Forward EC<ECR, Reverse EC>ECR
Note 2: Input Condition H=2.6V, M=2.5V, L=2.4V

Input-Output State Machine Table

Brake Mode (BR) Pin #16	EC<ECR	EC>ECR
L	Forward	Reverse Brake
H	Forward	Short Brake

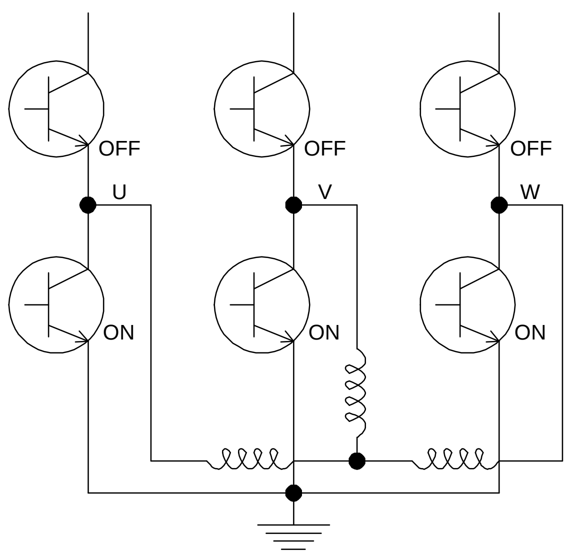

Figure 3: CMI8800 Short Brake Operation

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Test Circuit and Conditions

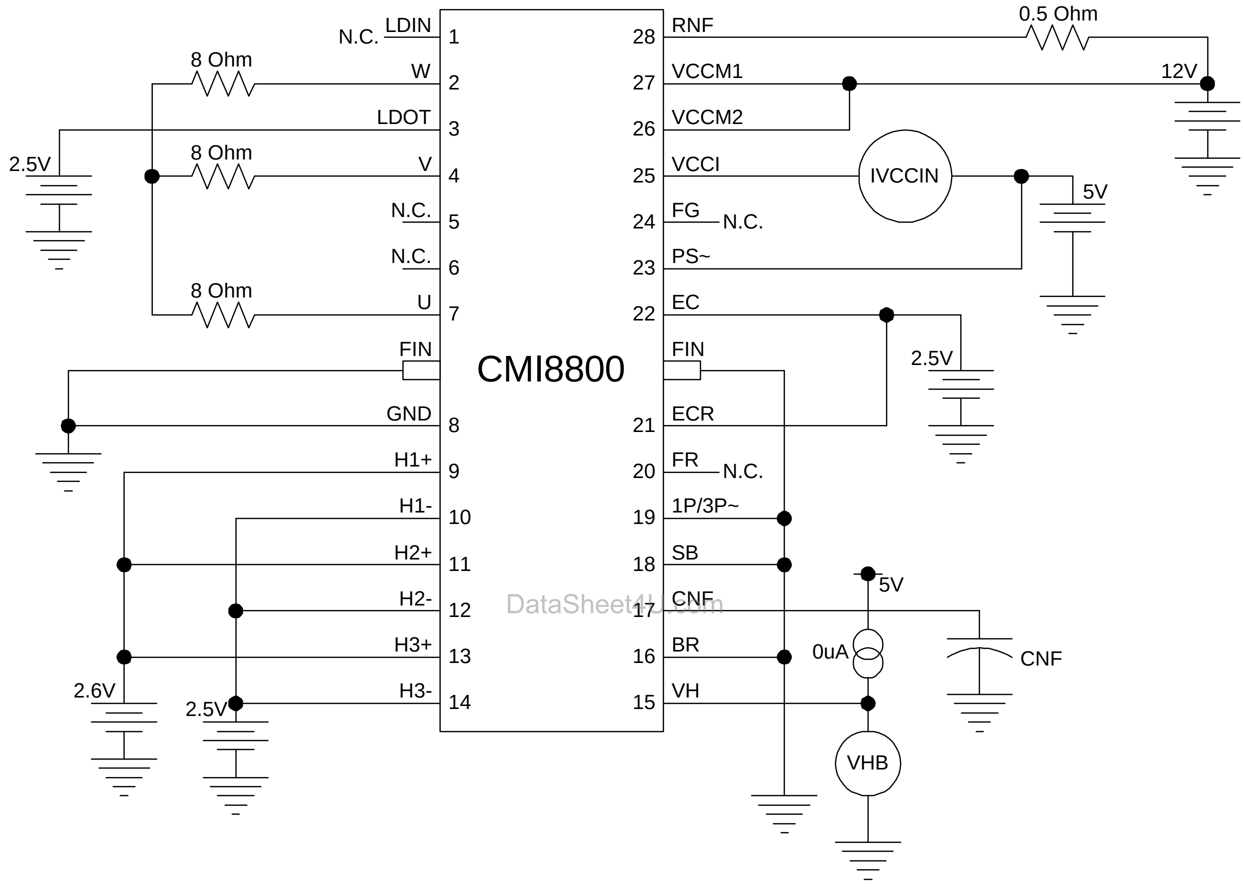

Figure 4: CMI8800 Internal Core Circuitry Supply Current at Normal (IVCCIN)

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Test Circuit and Conditions (Continued)

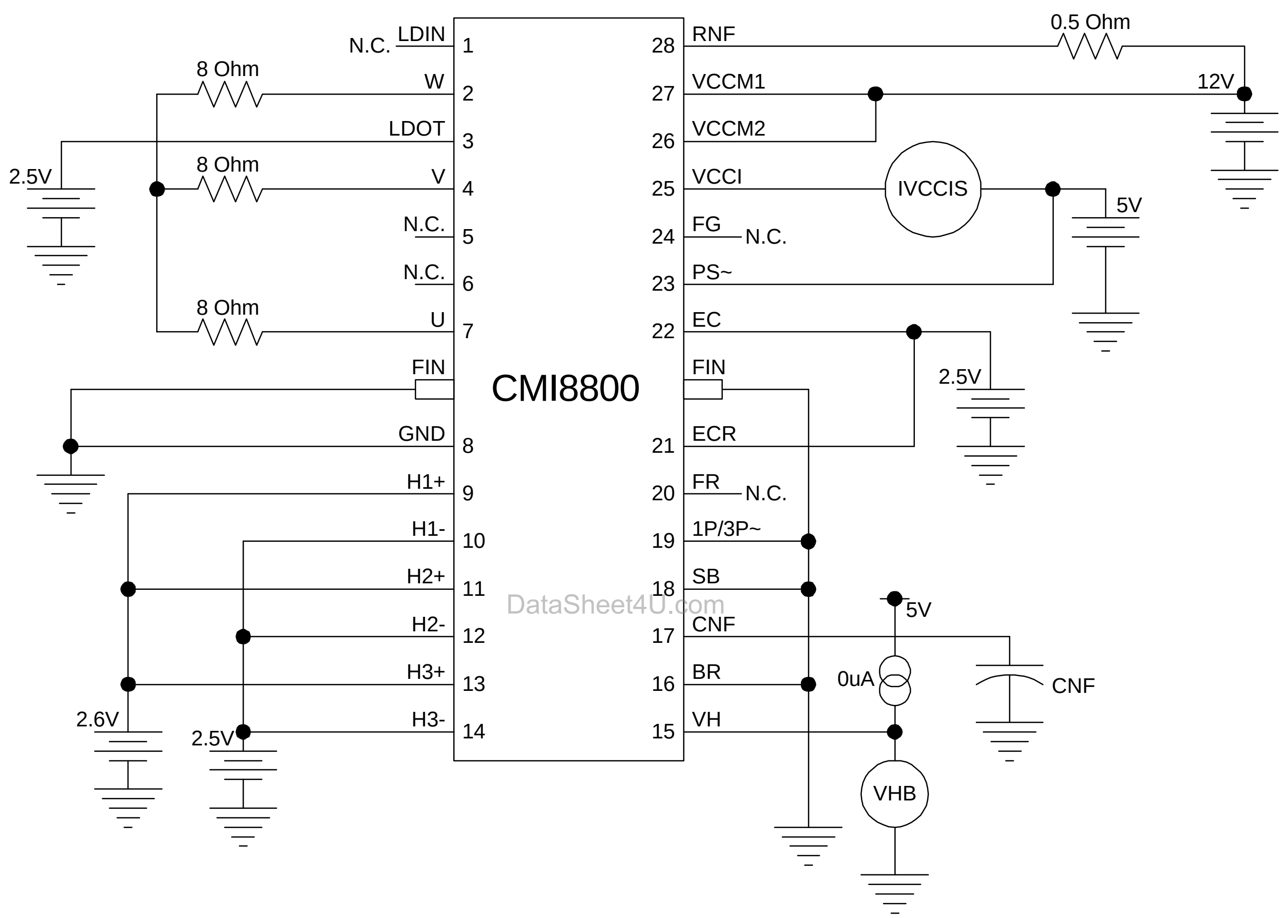

Figure 5: CMI8800 Internal Core Circuitry Supply Current at Sleep (IVCCIS)

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Test Circuit and Conditions (Continued)

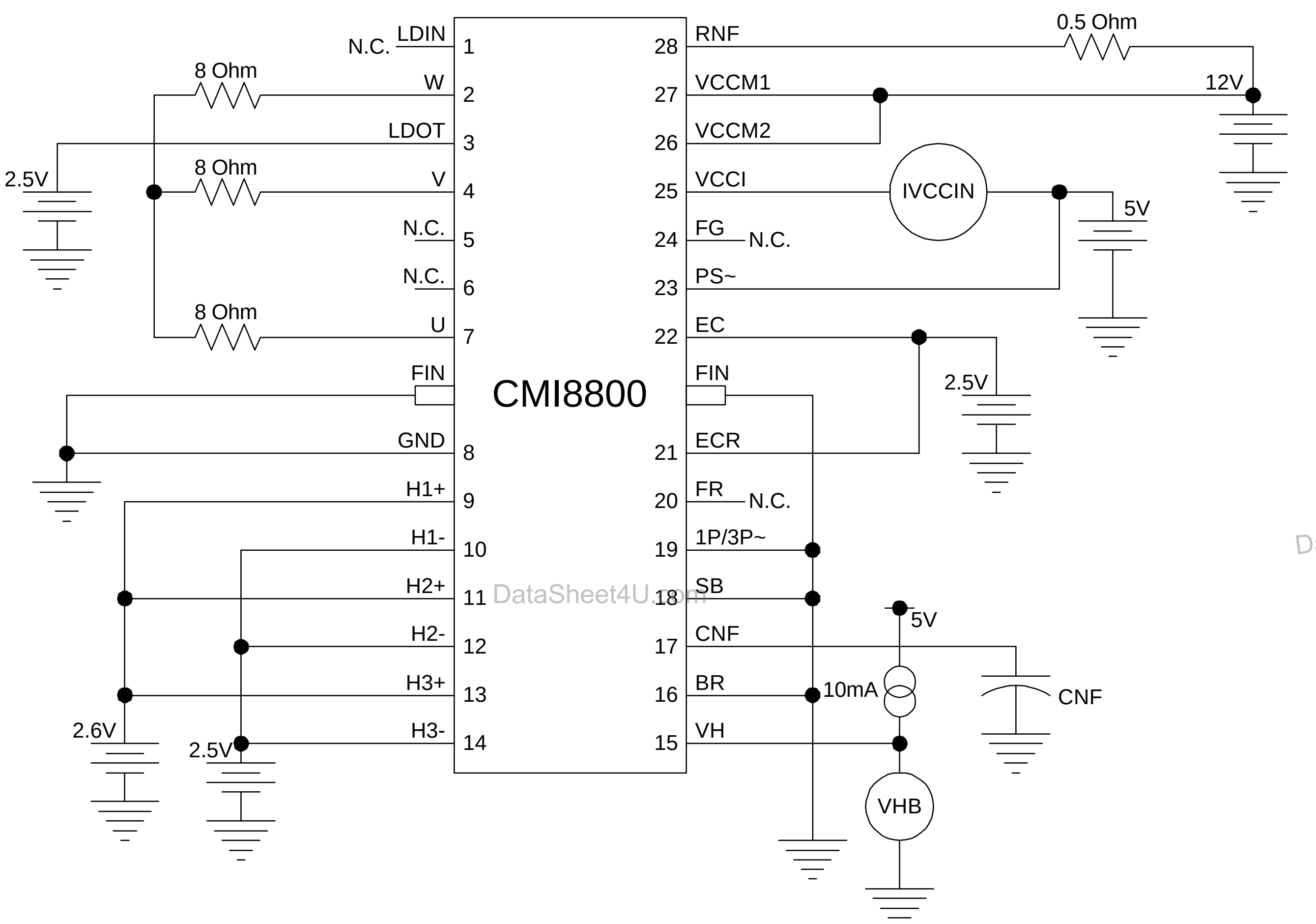

Figure 6: CMI8800 Hall Bias Voltage (VHB) Measurement

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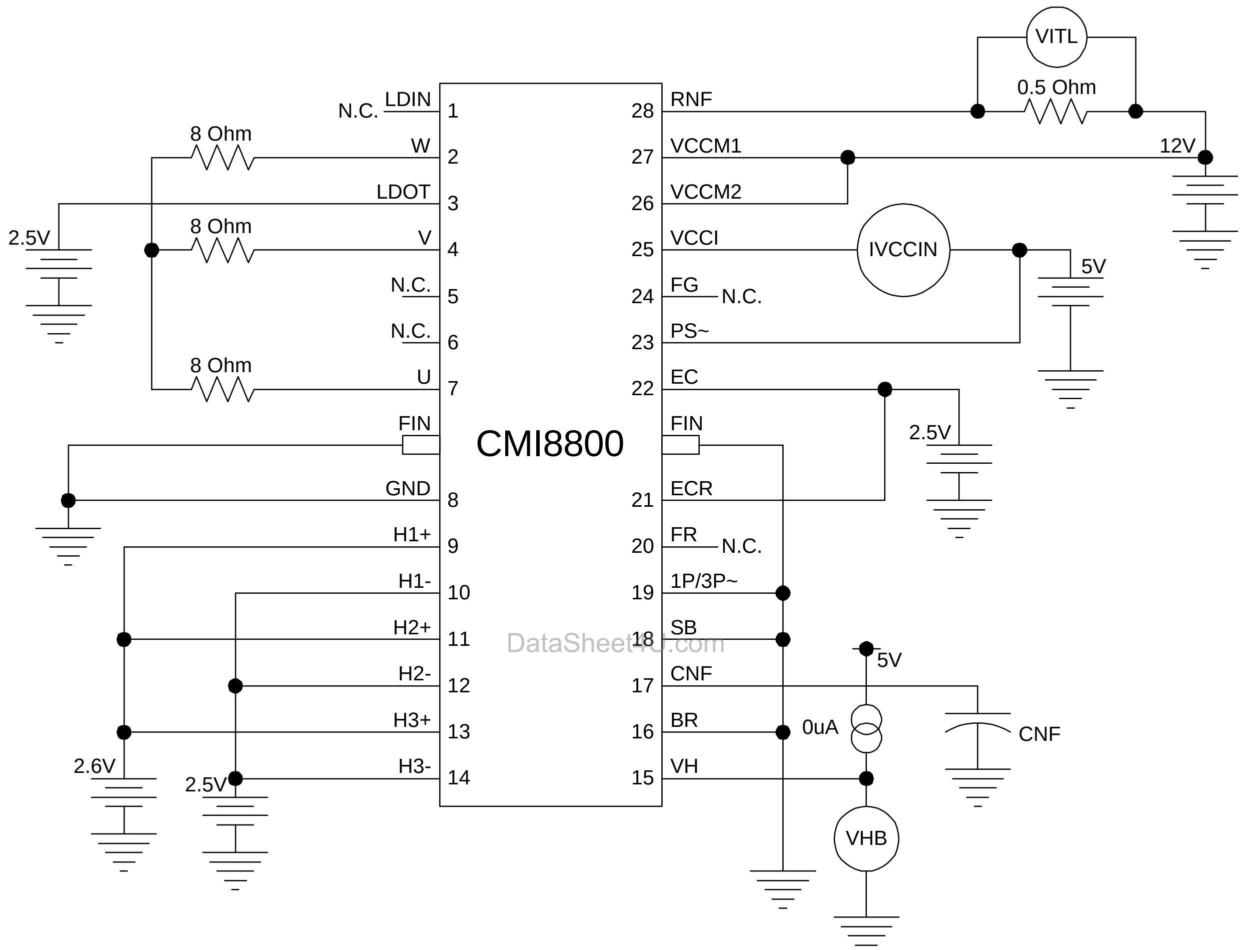
Test Circuit and Conditions (Continued)



Note: ITL=VITL/0.5

Figure 7: CMI8800 Torque Limit Current (ITL) Measurement

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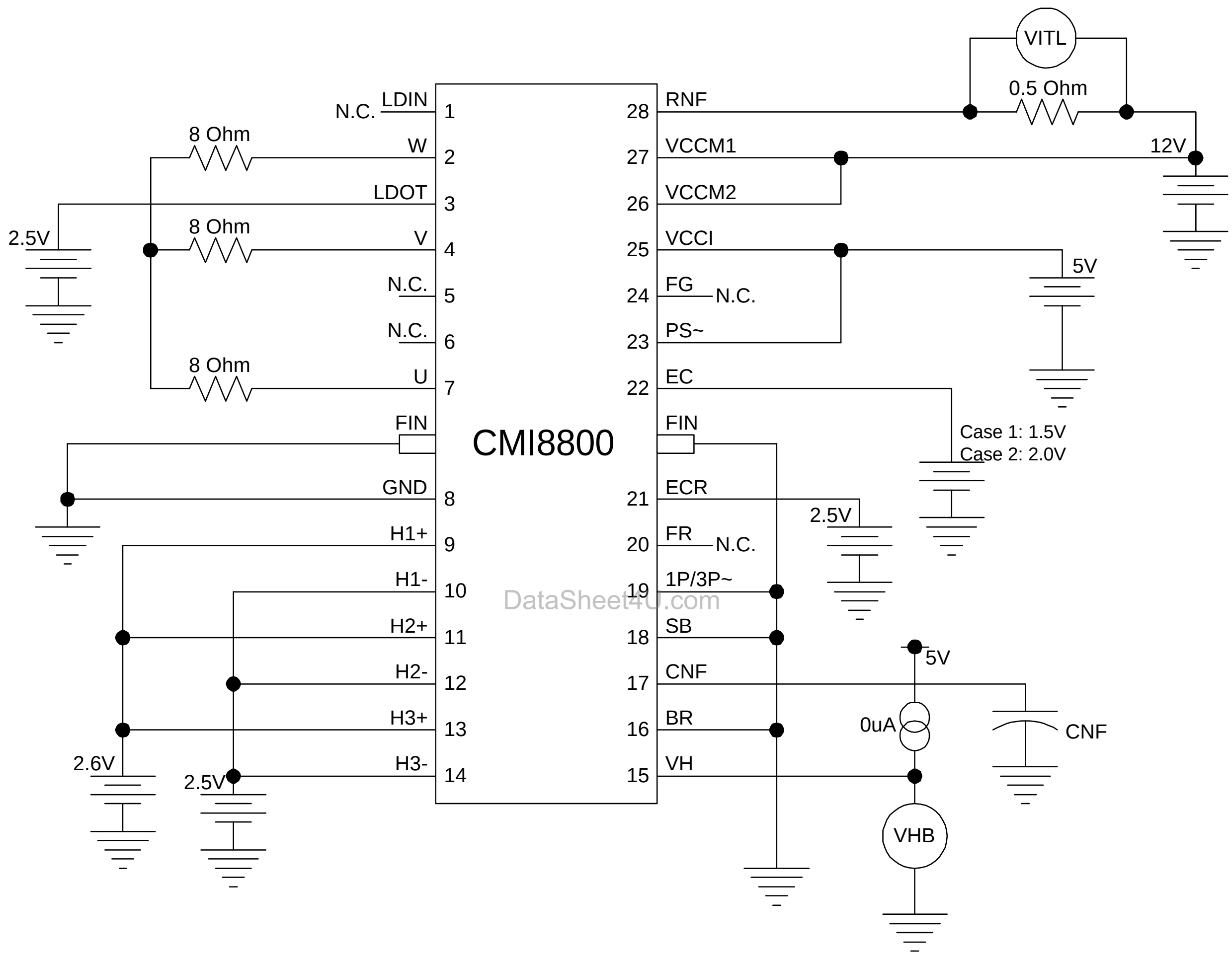
Test Circuit and Conditions (Continued)



Note: GEC(TSA)=[(VITL at 1.5V-VITL at 2.0V) 0.5]/(2.0V-1.5V)

Figure 8: CMI8800 Torque Sense Amplifier Transfer Gain [GEC(TSA)] Measurement

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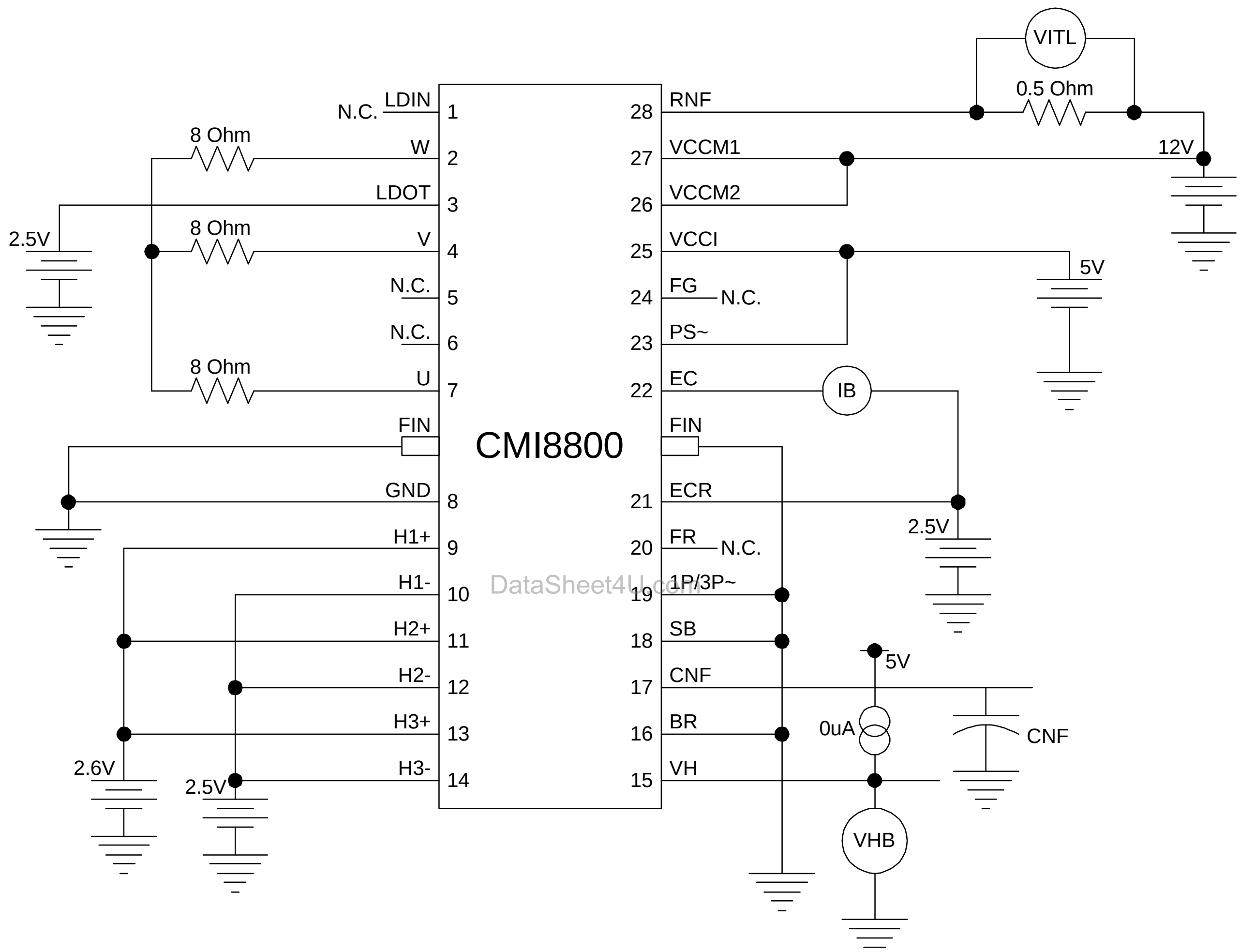
Test Circuit and Conditions (Continued)



Note: Current meter IB reading

Figure 9: CMI8800 Torque Sense Amplifier I/P Bias Current Measurement

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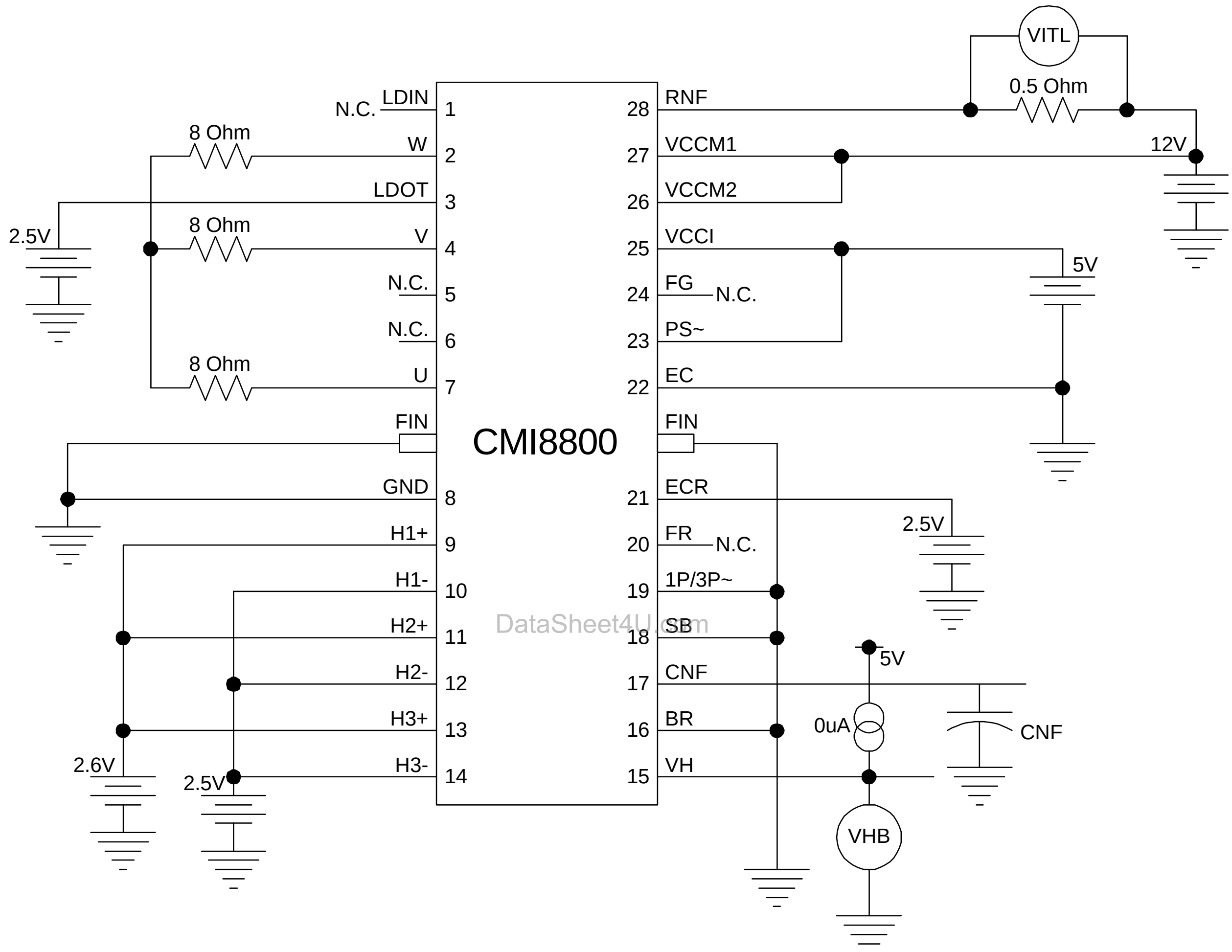
Test Circuit and Conditions (Continued)



Note: VITL/0.5

Figure 10: CMI8800 Torque Sense Amplifier Torque Limit Current (ITL) Measurement

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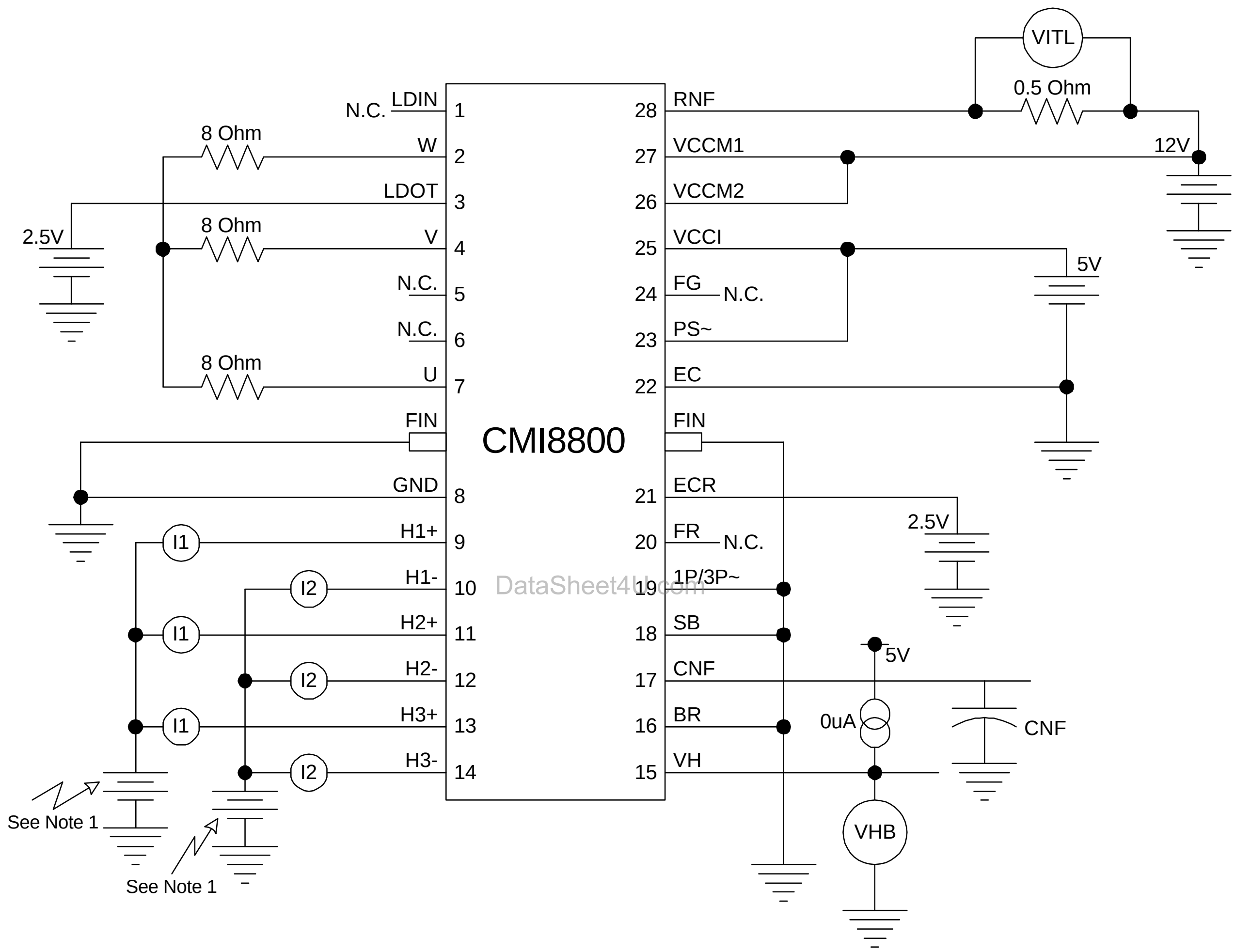
Test Circuit and Conditions (Continued)



Note 1: Value of I1 meter reading (Hn+=4.0V, Hn-=2.5V) or
Value of I2 meter reading (Hn+=2.5V, Hn-=4.0V) where n=1, 2, 3

Figure 11: CMI8800 Hall Amplifier I/P Bias Current (IHA) Measurement

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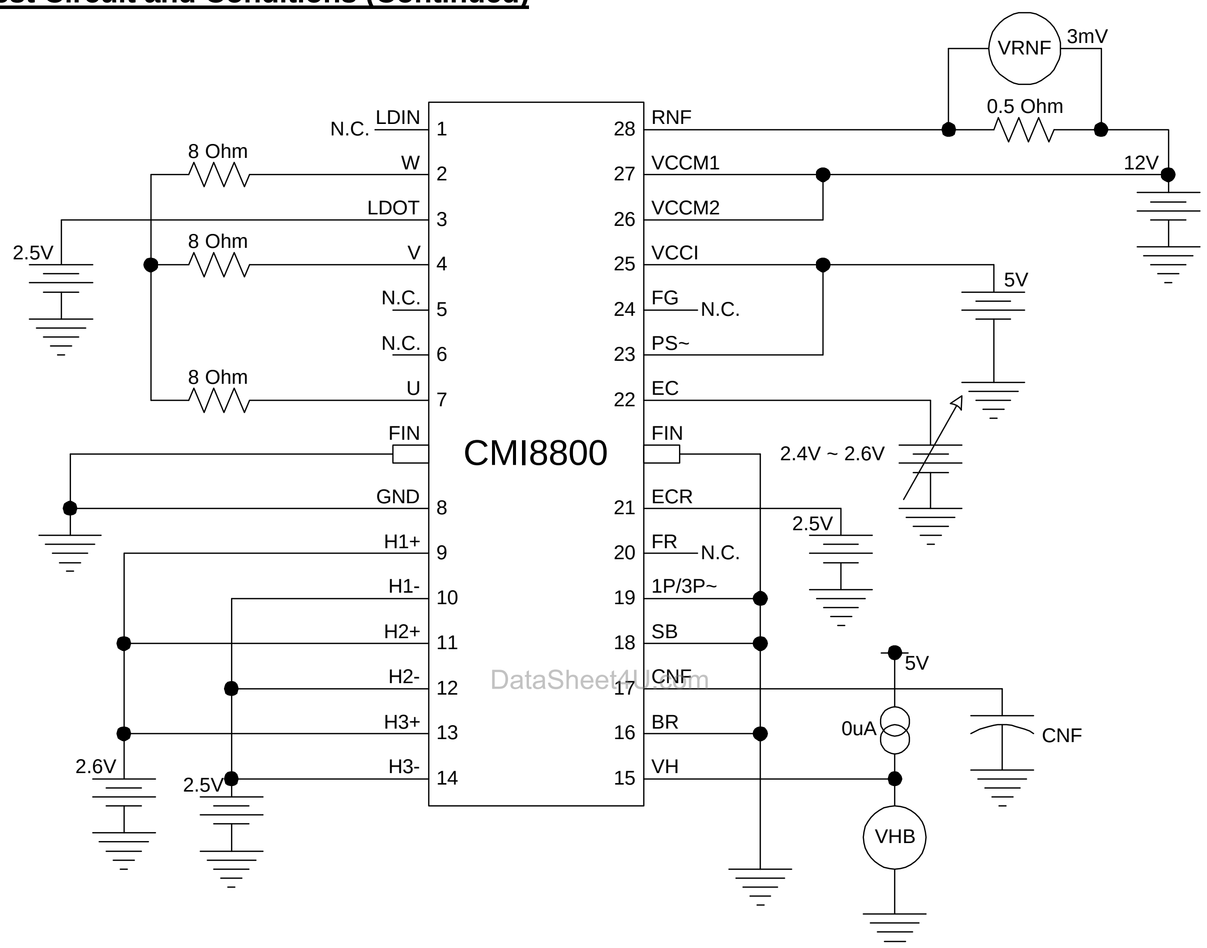
Test Circuit and Conditions (Continued)



Note 1: EC(o/s+): Voltage at EC Pin – Voltage at ECR Pin when VRNF=3mV or
EC(o/s-): Voltage at EC Pin – Voltage at ECR Pin when VRNF=3mV
(See Transfer Function Below)

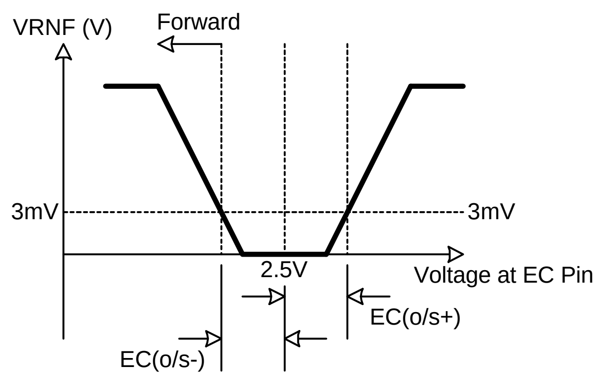


Figure 12: CMI8800 Torque Sense Amplifier Offset Voltage [EC(o/s+) and EC(o/s-)] Measurement

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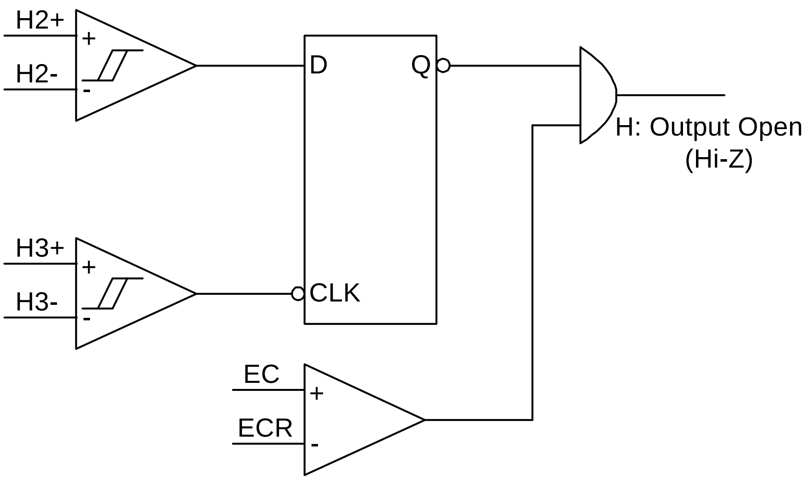

Figure 13: CMI8800 Reverse Detection Circuitry

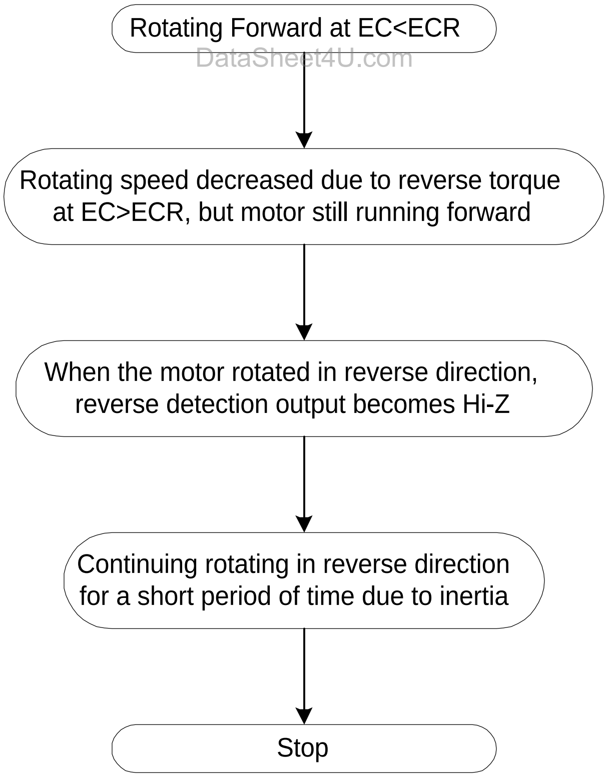

Figure 14: Anti-Reverse Protection Algorithm

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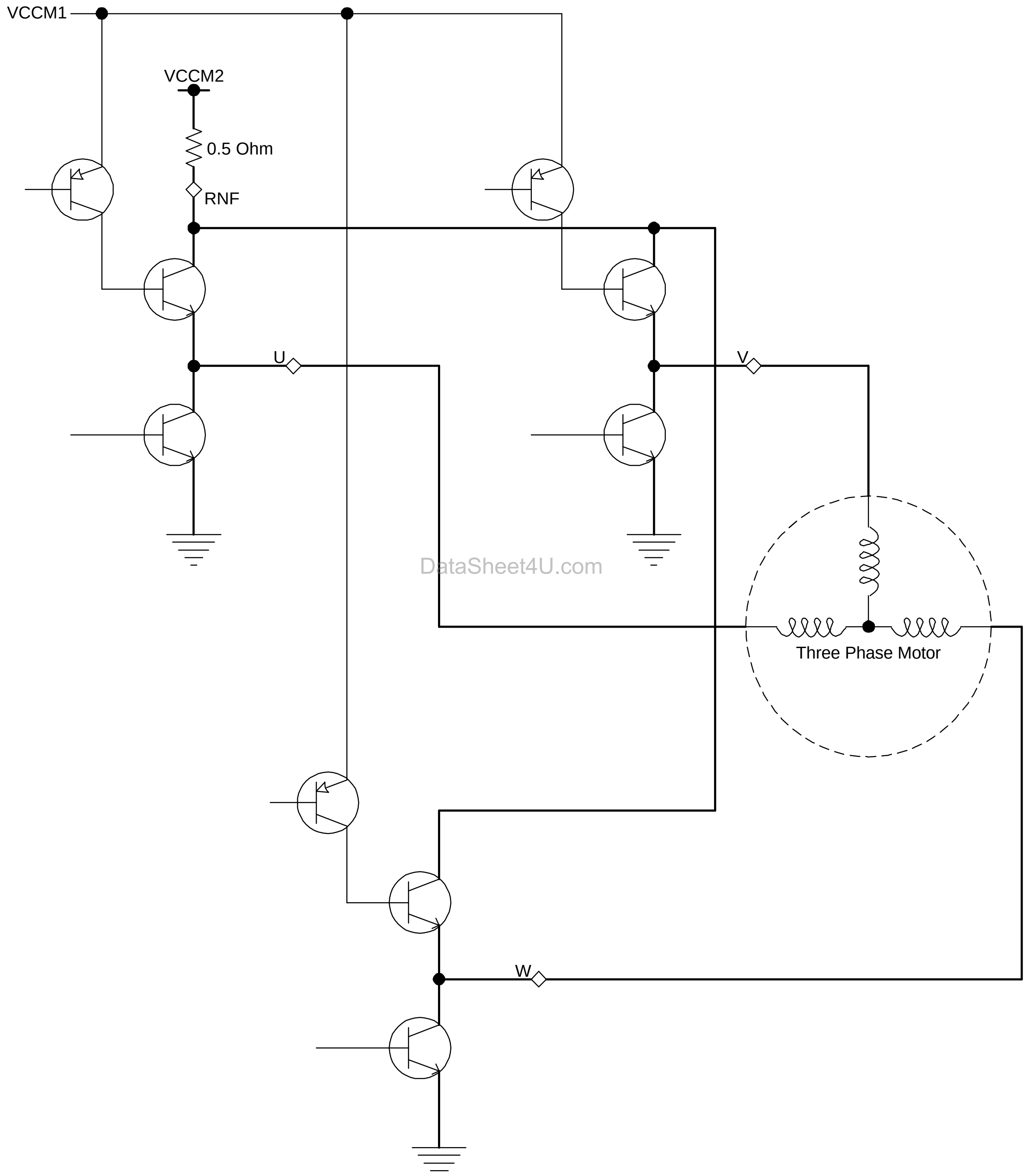

Figure 15: CMI8800 H-Bridge Output Driver and VCCM1/VCCM2 Power Supply

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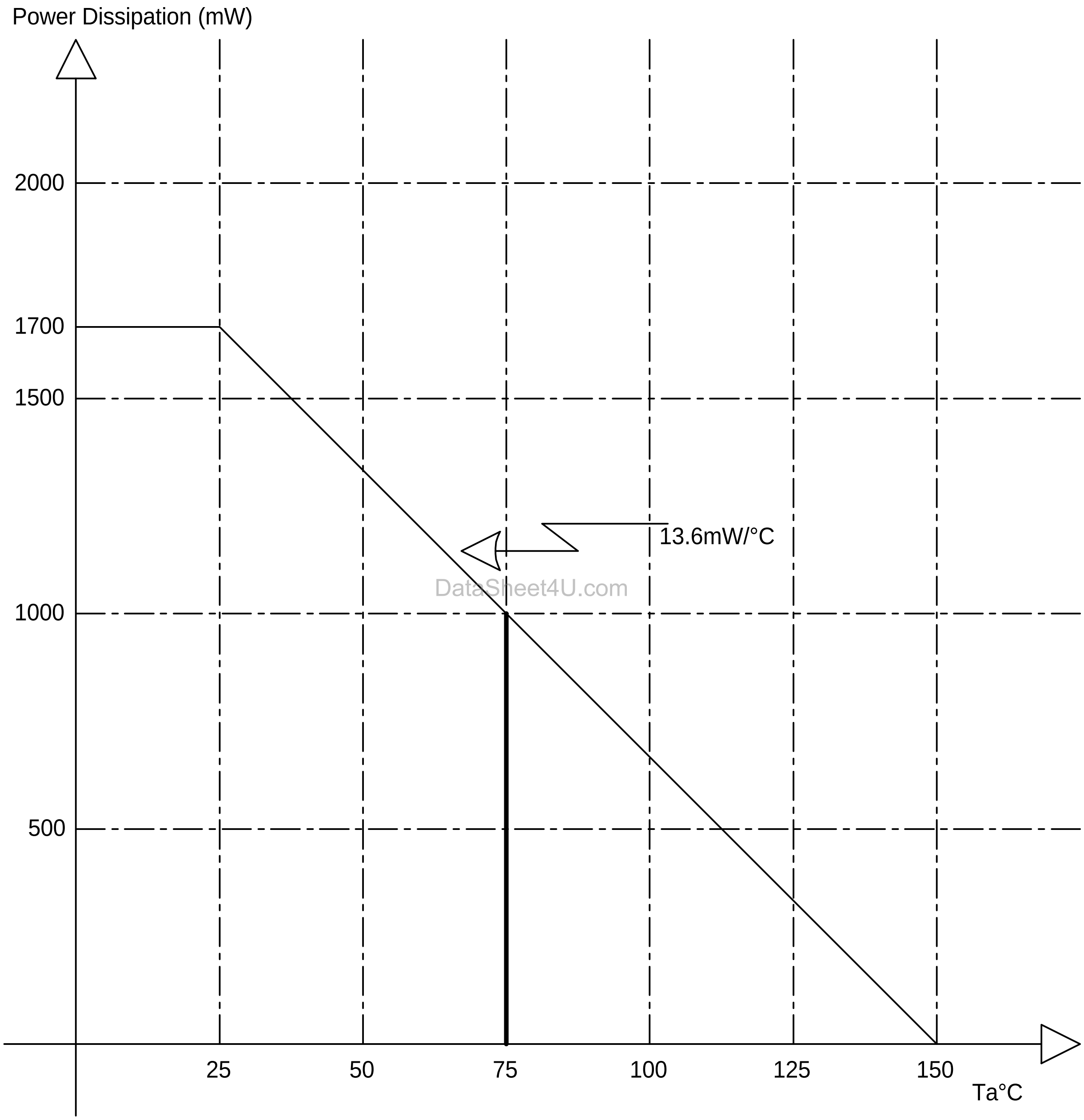

Figure 16: CMI8800 Derating Curve (for Power Dissipation)

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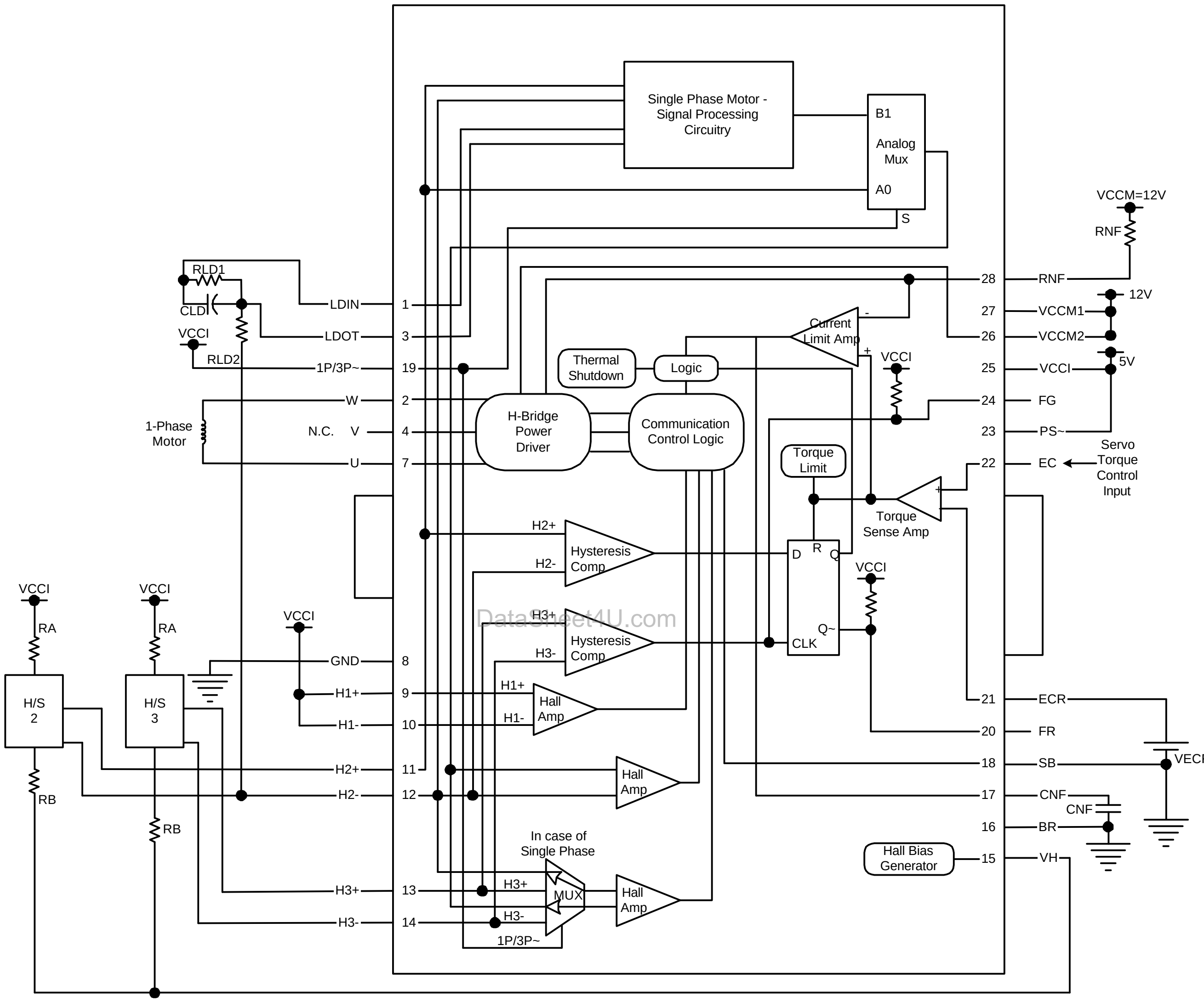

Figure 17: CMI8800 Application Example – Single Phase Motor