150V Three Phase BLDC Gate Driver

1 Feature

- High-side floating bootstrap power supply design, withstand voltage of 150V
- Compatible with 5V, 3.3V input voltage V_{HINx}/V_{LINx}
- Maximum frequency support up to 500KHz
- Built-in dead time control circuit
- Under-voltage protection for upper and lower bridge power supplies, startup and protection points at 4.4V and 4.1V
- Internally integrated low-on-resistance bootstrap charging diode
- Output source/sink current Io+/Io- is +1.0A/-1.3A
- HIN input high-level active, controls upper bridge HO output
- LIN input high-level active, controls lower bridge LO output
- TSSOP20, QFN24 package
- RoHS compliant

2 Applications

- Three-phase brushless DC motor driver
- Electric vehicle controller

3 Description

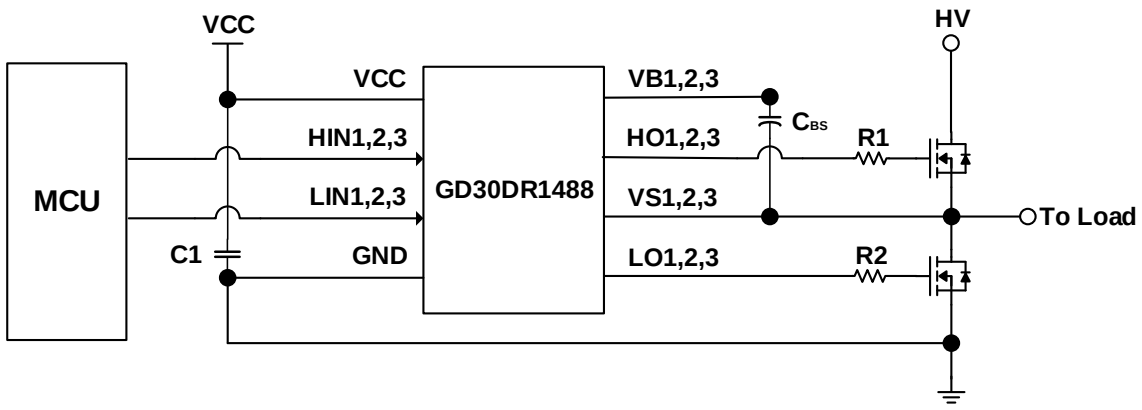
The GD30DR1488 is a cost-effective dedicated three-phase BLDC gate driver circuit used for driving high-power MOSFET and IGBT gates. The IC integrates logic signal processing circuits, dead time control circuits, under-voltage protection circuits, level shifting circuits, pulse filtering circuits, and output driver circuits, specifically designed for use in the drive circuits of brushless motor controllers.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
GD30DR1488	TSSOP20	6.50mm x 4.40mm
	QFN24	4.00mm x 4.00mm

1. For packaging details, see *Package Information* section.

Simplified Application Schematic



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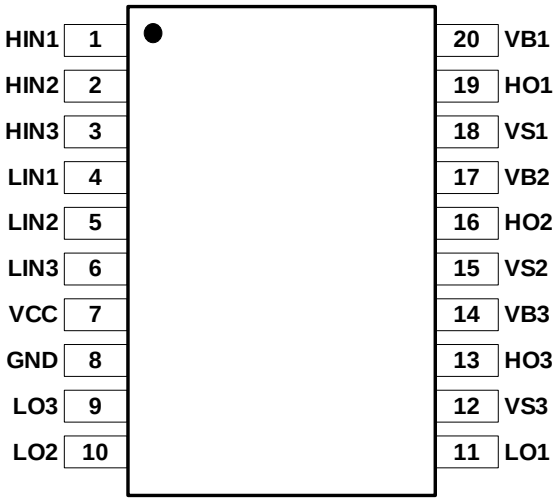
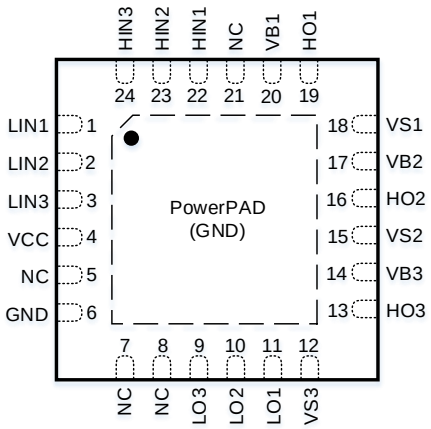
4 Device Overview

4.1 Pinout and Pin Assignment

TSSOP20
(Top View)



QFN24
(Top View)



4.2 Pin Description

Pin sequence			PIN TYPE	FUNCTION
PIN	ESOP8	QFN24		
HIN1	1	22	I	Upper bridge gate drive control logic signal input 1
HIN2	2	23	I	Upper bridge gate drive control logic signal input 2
HIN3	3	24	I	Upper bridge gate drive control logic signal input 3
LIN1	4	1	I	Lower bridge gate drive control logic signal input 1
LIN2	5	2	I	Lower bridge gate drive control logic signal input 2
LIN3	6	3	I	Lower bridge gate drive control logic signal input 3
VCC	7	4	P	Gate driver power supply input pin, connect a 10μF or larger X5R or X7R ceramic capacitor between VCC and GND
GND	8	6	G	Ground
LO3	9	9	O	Lower bridge gate drive control logic signal output 3
LO2	10	10	O	Lower bridge gate drive control logic signal output 2
LO1	11	11	O	Lower bridge gate drive control logic signal output 1
VS3	12	12	I	Upper bridge floating ground 3
HO3	13	13	O	Upper bridge gate drive control logic signal output 3
VB3	14	14	O	Upper bridge bootstrap power supply 3, bootstrap capacitor connected between VB3 and VS3
VS2	15	15	I	Upper bridge floating ground 2
HO2	16	16	O	Upper bridge gate drive control logic signal output 2

Pin sequence			PIN TYPE	FUNCTION
PIN	ESOP8	QFN24		
VB2	17	17	O	Upper bridge bootstrap power supply 2, bootstrap capacitor connected between VB2 and VS2
VS1	18	18	I	Upper bridge floating ground 1
HO1	19	19	O	Upper bridge gate drive control logic signal output 1
VB1	20	20	O	Upper bridge bootstrap power supply 1, bootstrap capacitor connected between VB1 and VS1
NC		5, 7, 8, 21		No connection

1. I = Input, O = Output, P = Power, G = Ground.

5 Parameter Information

5.1 Absolute Maximum Ratings

Exceeding the operating temperature range (unless otherwise noted)[1]

SYMBOL	PARAMETER	MIN	MAX	UNIT
VB1,2,3	Upper bridge bootstrap power supply	−0.3	150	V
VS1,2,3	Upper bridge floating terminal	VB–20	VB+0.3	V
VHO1,2,3	Upper bridge output voltage	VS–0.3	VB+0.3	V
VCC	Power supply	−0.3	20	V
VLO1,2,3	Lower bridge output voltage	−0.3	VCC+0.3	V
PD	Maximum power consumption		500	mW
T_J	Operating junction temperature		150	°C
T_{stg}	Storage temperature		150	°C

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

5.2 Recommended Operation Conditions

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
VCC	Power supply	4	15	18	V
VS1,2,3	Upper bridge floating terminal	−6[1]		150	V
		−36[2]		150	
VB1,2,3	Upper bridge bootstrap power supply		VS+15	VS+18	V
CL	Upper and lower bridge load capacitance			22	nF
VIN	Upper and lower bridge input level	0	3.3	5.0	V
T_A	Operating ambient temperature	−40		125	°C

1. Direct current negative voltage, at this time the minimum value of VB-VS is 12V.
2. Instantaneous negative voltage with a width of 100ns.

5.3 Electrical Sensitivity

SYMBOL	CONDITIONS	VALUE	UNIT
$V_{ESD(HBM)}$	Human-body model (HBM), ANSI/ESDA/JEDEC JS-001-2017[1]	±2000	V
$V_{ESD(CDM)}$	Charge-device model (CDM), ANSI/ESDA/JEDEC JS-002-2022[2]	±200	V

1. JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
2. JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

5.4 Thermal Resistance

SYMBOL [1]	CONDITIONS	TSSOP20	QFN24	UNIT
Θ_{JA}	Natural convection, 2S2P PCB	100	49	°C/W

1. Thermal characteristics are based on simulation, and meet JEDEC document JESD51-7.

5.5 Electrical Characteristics

V_{CC} = 15V, VB1,2,3 = 15V, VS1,2,3 = 0V, T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
STATIC PARAMETER						
VIH1,2,3	High level at the input		2.5			V
VIL1,2,3	Low level at the input				0.8	V
VHOH1,2,3	Upper bridge arm output high level	Difference with VB, Io+ = 10mA			100	mV
VHOL1,2,3	Upper bridge arm output low level	Difference with VB, Io- = 10mA			50	mV
VLOH1,2,3	Lower bridge arm output high level	Difference with VCC, Io+ = 10mA			100	mV
VLOL1,2,3	Lower bridge arm output low level	Difference with GND, Io- = 10mA			50	mV
IHINH	Input current	HIN1,2,3 = 5V		50		μA
IHINL		HIN1,2,3 = 0V		0		μA
ILINH		LIN1,2,3 = 0V		0		μA
ILINL		LIN1,2,3 = 5V		50		μA
IO+	Output pull current	Vo = 0V, V_{IN} = V_{IH}, PW≤ 10μs		1.0		A
IO-	Output sink current	Vo = 15V, V_{IN} = V_{IL}, PW≤ 10μs		1.3		A
RBSD	Bootstrap diode charging resistor	VCC = 15V, VB = 0V		40		Ω
IQCC	Quiescent current	LIN1,2,3 = 0V		90		μA
		LIN1,2,3 = 5V		250		μA
IQBS1, 2,3	Upper bridge arm quiescent current	HIN1,2,3 = 0V		30		μA
		HIN1,2,3 = 5V		120		μA
VCCUV+	VCC undervoltage lockout voltage			4.4		V
VCCUV-				4.1		V
VBSUV+	VB undervoltage lockout voltage			4.4		V
VBSUV-				4.1		V
DYNAMIC PARAMETER [1]						
Switching time characteristics of upper bridge arm output HO						
t_{on}	Rise delay			200		ns

Electrical Characteristics

V_{CC} = 15V, VB1,2,3 = 15V, VS1,2,3 = 0V, T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
t_{off}	Fall delay			100		ns
t_r	Rise time			35		ns
t_f	Fall time			15		ns
Switching time characteristics of lower bridge arm output LO						
t_{on}	Rise delay			200		ns
t_{off}	Fall delay			100		ns
t_r	Rise time			35		ns
t_f	Fall time			15		ns
Dead time characteristic						
DT	Dead time			100		ns
MT	Difference between rise and fall dead time			10		ns

1. Dynamic electrical parameter CL=1000pF.

6 Functional Description

6.1 Block Diagram

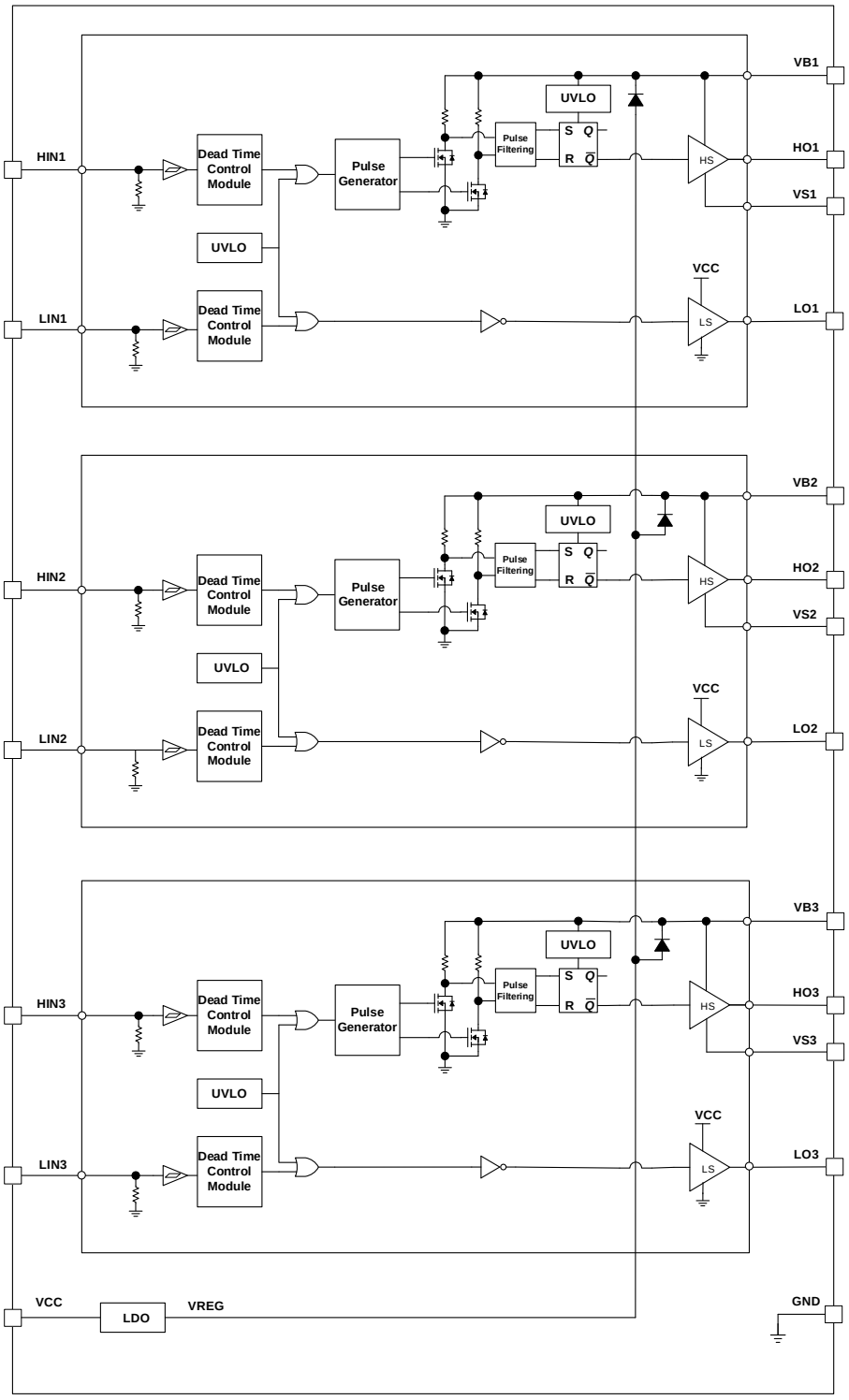
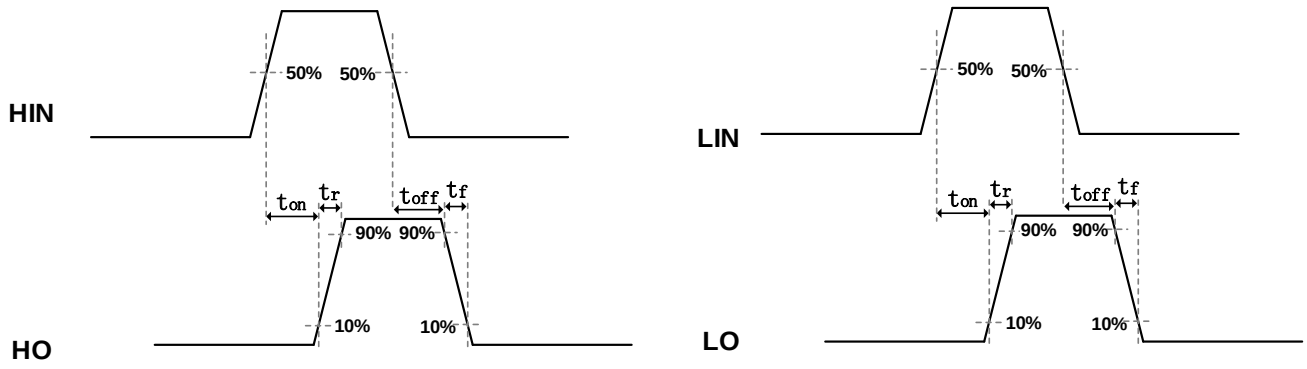
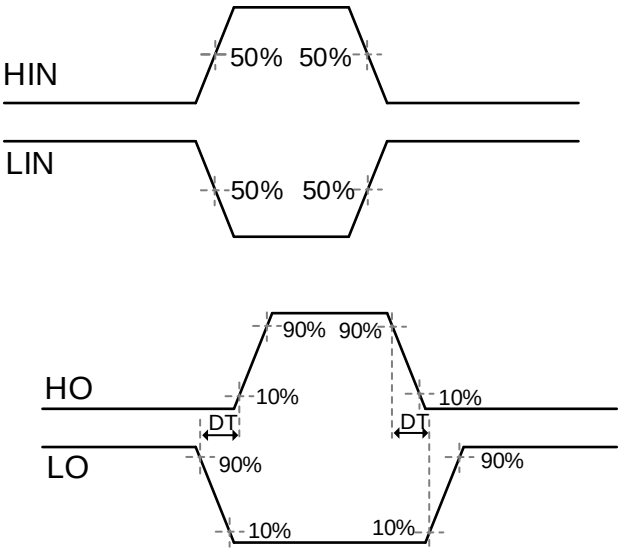


Figure 1. GD30DR1488 Functional Block Diagram

6.2 Switch Operation Waveform



6.3 Dead Time



6.4 Input-Output Logic Truth Table

Input		Output	
HIN	LIN	HO	LO
Low Level	Low Level	Low Level	Low Level
Low Level	High Level	Low Level	High Level
High Level	Low Level	High Level	Low Level
High Level	High Level	Low Level	Low Level

7 Application Information

The GD30DR1488 is widely used in three-phase brushless motor drive control. Section 7.1 briefly describes how to configure the application circuit for the GD30DR1488.

7.1 Typical Application Circuit

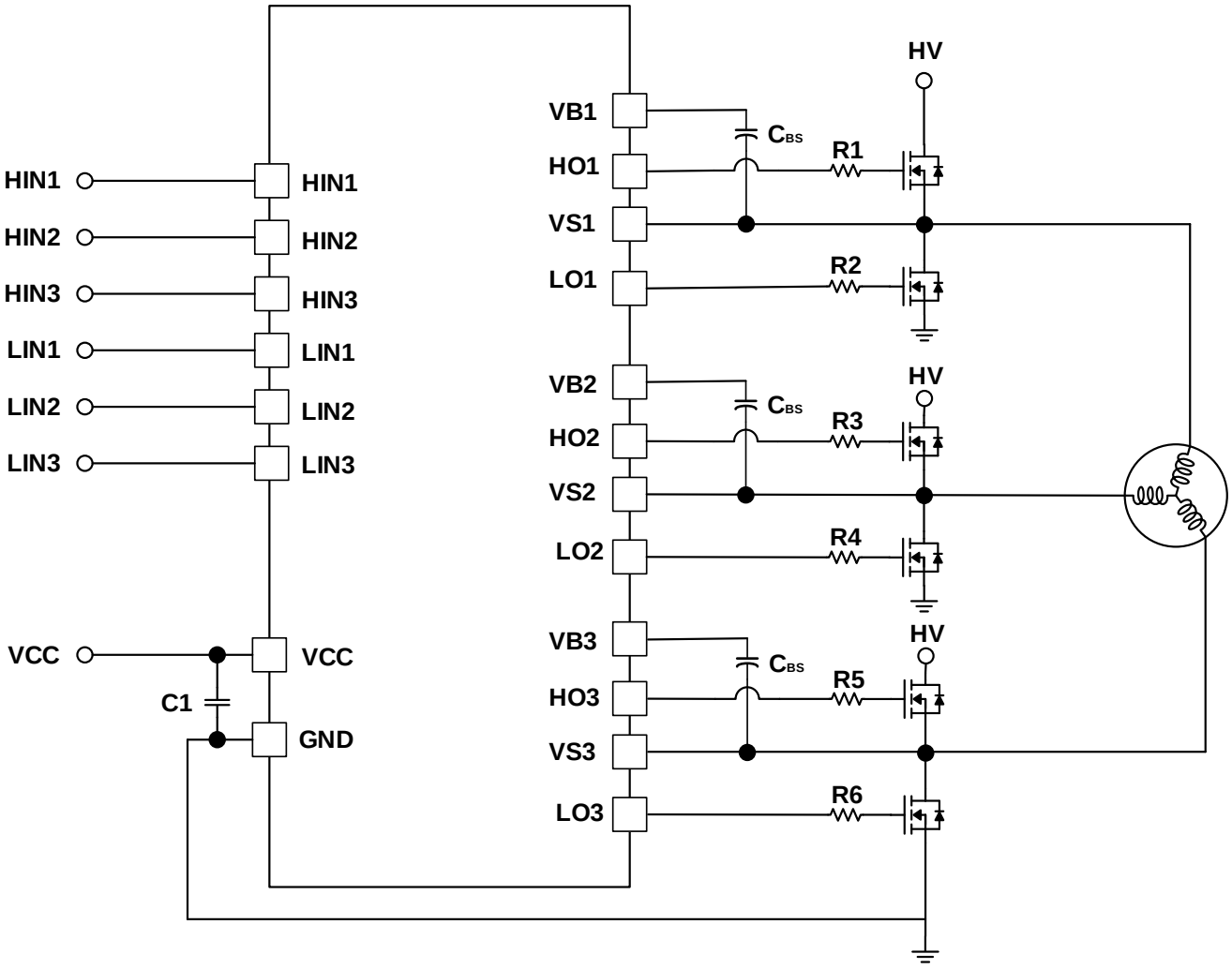
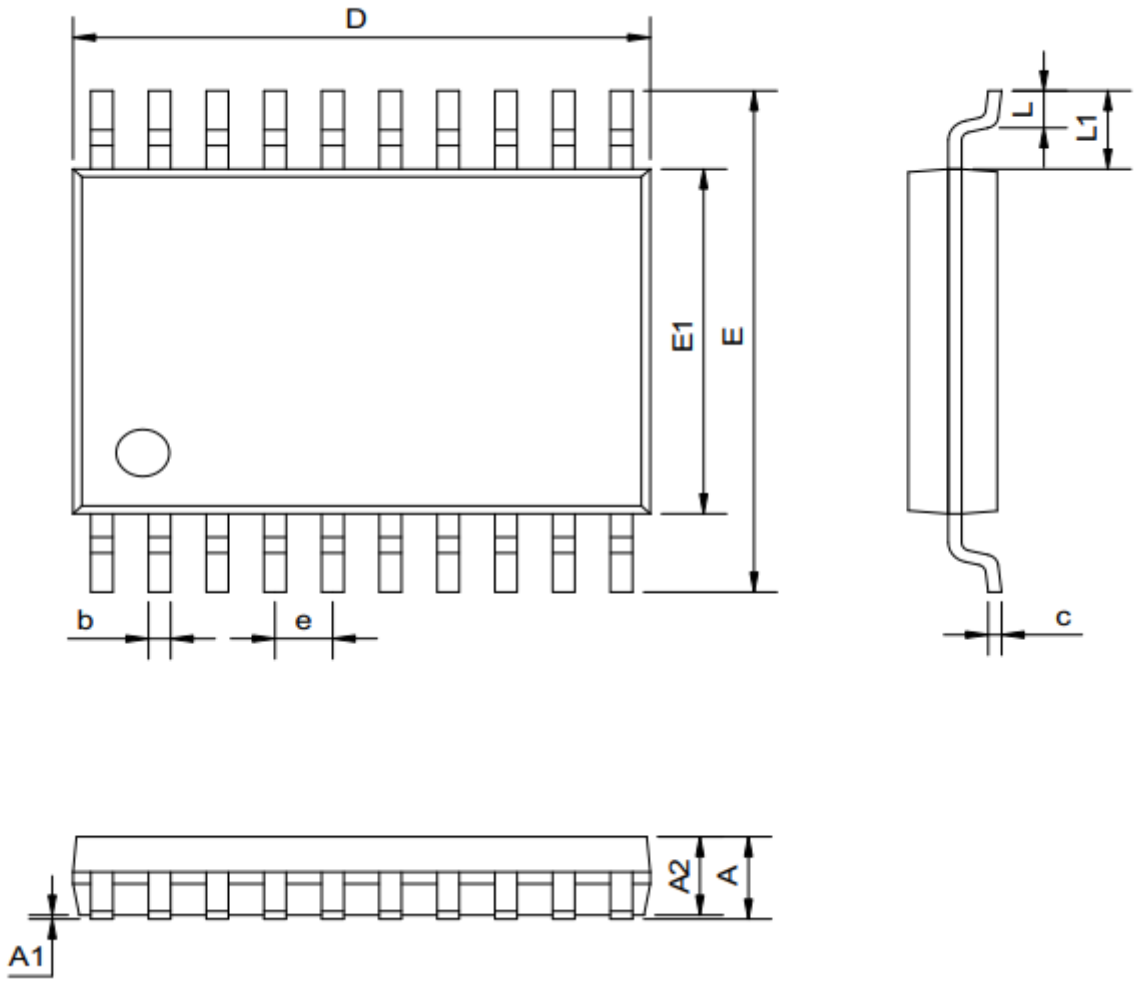


Figure 2. Brushless Motor Drive Reference Circuit

8 Package Information

8.1 Outline Dimensions

TSSOP20 Package Outline



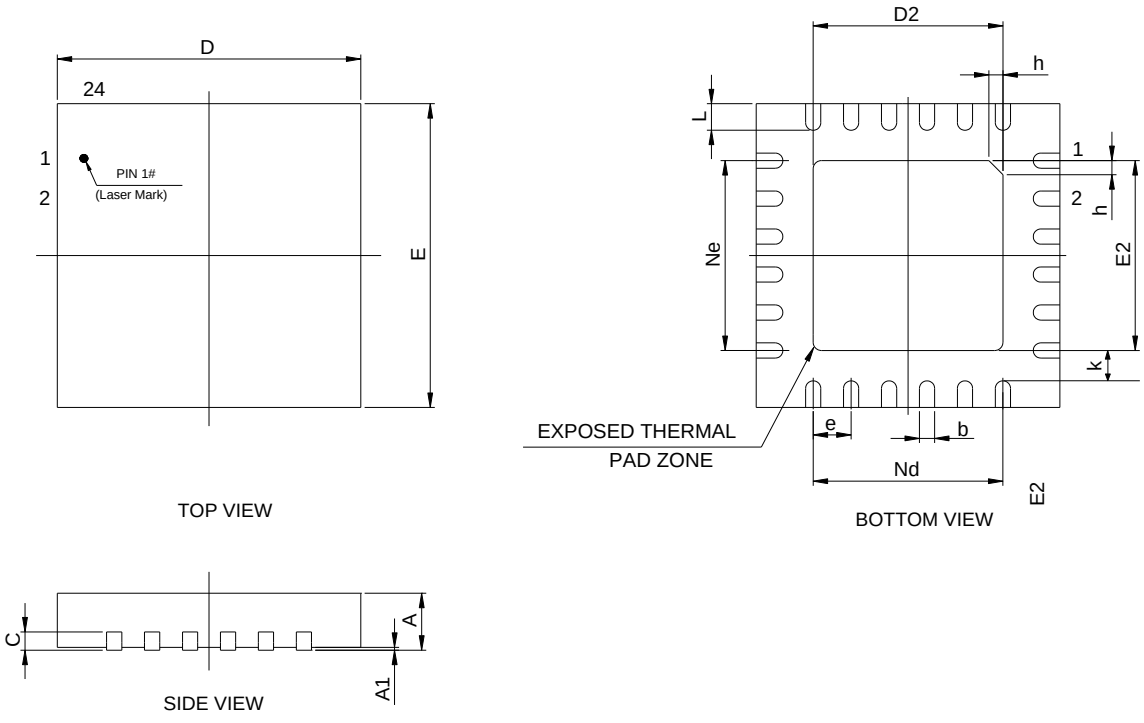
NOTES:

1. All dimensions are in millimeters.
2. Refer to the *Table 1.TSSOP20 Dimensions (mm)*.

Table 1.TSSOP20 Dimensions (mm)

SYMBOL	MIN	MAX
A		1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	6.40	6.60
E	6.20	6.60
E1	4.30	4.50
e	0.65 BSC	
L	0.40	0.80
L1	1.00 BSC	

QFN24 Package Outline



NOTES:

1. Refer to the *Table 2. QFN24 Dimensions (mm)*.

Table 2. QFN24 Dimensions (mm)

SYMBOL	MIN	MAX
A	0.70/0.80	0.80/0.90
A1		0.05
b	0.20	0.30
c	0.203 REF	
D	3.90	4.10
D2	2.60	2.80
e	0.50 BSC	
Nd	2.50 BSC	
Ne	2.50 BSC	
E	3.90	4.10
E2	2.60	2.80
L	0.35	0.45
h	0.25	0.35
K	0.25 REF	

9 Ordering Information

Ordering Code	Package Type	ECO Plan	Packing Type	MOQ	OP Temp(°C)
GD30DR1488FPTR-K	TSSOP20	Green	Tape & Reel	4000	–40°C to +125°C
GD30DR1488EUTR-K	QFN24	Green	Tape & Reel	5000	–40°C to +125°C

10 Revision History

REVISION NUMBER	DESCRIPTION	DATE
1.0	Initial release and device details	2023
1.1	Add QFN24 thermal resistance parameters	2025

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