User Manual

GHD1620T

600V Half-Bridge Gate Driver

Version: V1.1

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Contents

1 Product Overview

1.1 Introduction

GHD1620T is a single-phase high-voltage high-speed gate driver IC designed for the bridge circuits composed of dual N-channel VDMOS power tubes or IGBT. It can be applied to such application schemes as DC brushless and DC brush motors.

The GHD1620T controls the high-side drive circuit output (HO) and low-side drive circuit output (LO) through the input signals (HIN, LIN) respectively. The built-in 400ns dead time is the minimum dead time. When the dead time of the output signal of the single-chip microcomputer is greater than the built-in dead time, the actual dead time is the dead time set by the single-chip microcomputer. The built-in VCC and VBS undervoltage (UVLO) protection functions can prevent the system from turning on the external power transistors at low driving voltage.

1.2 Main characteristics

- Floating offset voltage: +600V
- Supply voltage operating range: 10V~20V
- Built-in VCC and VBS undervoltage protection (UVLO)
- Built-in straight-through prevention function
- Built-in 400ns dead time
- Matching of high and low-side channels
- Output and input are non-inverting
- Built-in pull-down resistor of input pin
- 3.3V/5V input logic compatibility
- Built-in pull-down resistor of output pin
- Built-in temperature sensor output
- Built-in over-temperature protection
- Built-in bootstrap diode
- High peak current output capability
- Peak output current 45mA@15V, 1nF load rise time 550ns
- Peak input current 230mA@15V, 1nF load fall time 70ns

1.3 Application scope

- High-voltage fans, high-voltage ceiling fans, water pumps, and other three-phase DC brushless motor drives

2 Pin information

2.1 Pin distribution

Figure 1 Distribution Diagram of GHD1620T Pins

2.2 Pin functional description

Table 1Legends/Abbreviations Used in Output Pin Table

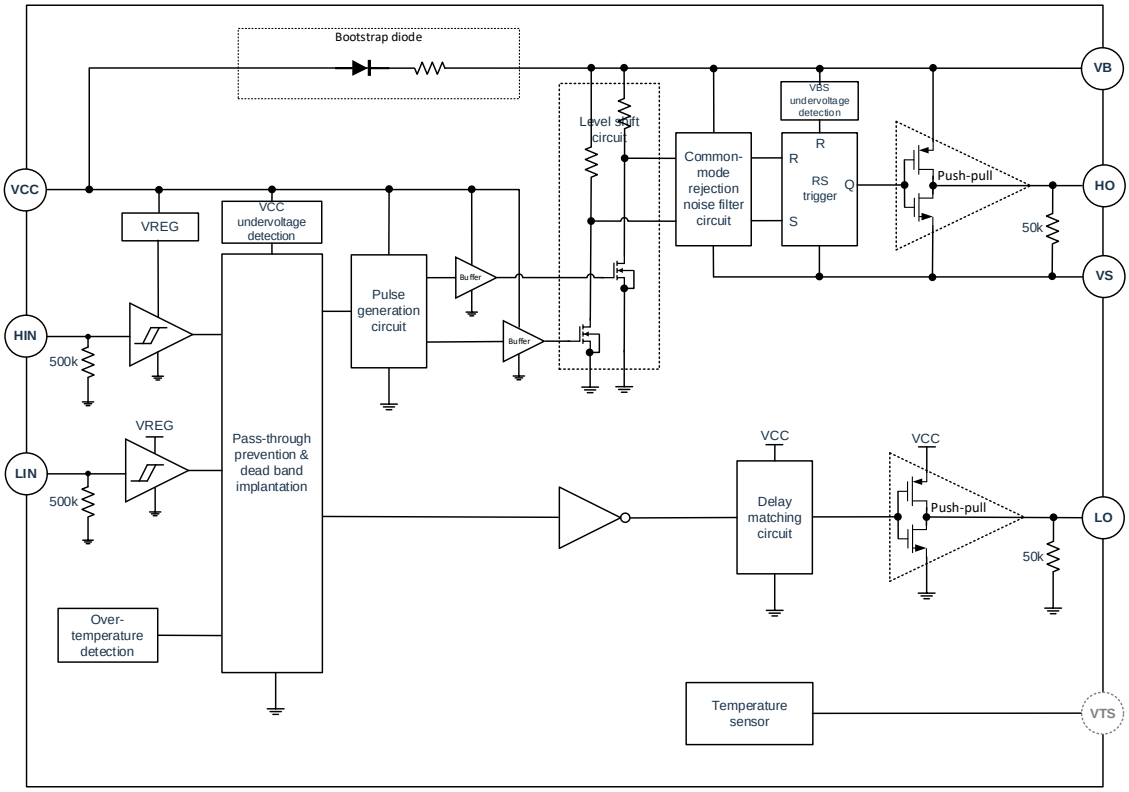
Name	Abbreviations	Definitions
Pin type	P	Power pin or ground
	I	Only input pin
	O	Only output pin
	I/O	I/O pin

Table 2 Description of Sorting by Pin Number of GHD1620T

Name	Type	Functional description	Pin sequence
VCC	P	Power end of the chip	1
HIN	I	High-side input	2
LIN	I	Low-side input	3
GND	P	Grounding end of the chip	4
LO	O	Low-side output	5
VS	P	High-side floating end	6
HO	O	High-side output	7
VB	P	High-side bootstrap power end	8

3 System Block Diagram

Figure 2 GHD1620T Internal Block Diagram



4 Electrical Characteristics

4.1 Recommended safe operating range

T_A=25℃, all pins take GND as the reference points, unless otherwise specified.

Table 3General Operating Conditions

Symbol	Parameter	Minimum value	Typical value	Maximum value	Unit
T_A	Ambient temperature	-40	-	105	℃
V_{HO}	High-side output voltage	VS	VS+15	VB	V
V_{LO}	Low-side output voltage	0	15	VCC	V
VB	High-side floating offset absolute voltage	VS+10	VS+15	VS+20	V
VS	High-side floating offset relative voltage	GND-5	-	480	V
VCC	Supply voltage	10	15	20	V
V_{IN}	Input voltage (HIN1, 2, 3/LIN1, 2, 3)	0	-	5	V

Note:

(1) T_A represents the ambient temperature at which the circuit operates.

(2) Operation beyond the recommended conditions for a long time may affect its reliability.

4.2 Absolute maximum rated value

T_A=25℃, all pins take GND as the reference points, unless otherwise specified.

Table 4 Power Consumption

Symbol	Description	Minimum value	Maximum value	Unit
P_D	Maximum power consumption	-	0.625	W

Note: At any time, the power consumption cannot exceed $_{PD}$. The calculation formula for the maximum power consumption at different ambient temperatures is: $_{PD}$=(150℃-T_A)/θ_{JA},
150℃ is the maximum operating junction temperature of the circuit, $_{TA}$ is the operating ambient temperature of the circuit, and $_{\theta JA}$ is the thermal resistance of the package.

Table 5 Temperature Characteristics

Symbol	Description	Minimum value	Maximum value	Unit
T_s	Storage temperature	-55	150	℃
θ_{JA}	Junction-to-ambient thermal resistance	-	200	℃/W
T_J	Junction temperature	-	150	℃
TL	Pin welding temperature (duration 10s)	-	260	℃

Table 6Maximum Rated Voltage Characteristics

Symbol	Description	Minimum value	Maximum value	Unit
V_{HO}	High-side output voltage	VS-0.3	VB+0.3	V
V_{LO}	Low-side output voltage	-0.3	VCC+0.3	V
VB	High-side floating offset absolute voltage	-0.3	625	V
VS	High-side floating offset relative voltage	VB-25	VB+0.3	V
VCC	Maximum supply voltage	-0.3	25	V
V_{IN}	Maximum input voltage （HIN1,2,3/LIN1,2,3）	-0.3	10	V
dVS/dt	Maximum slew rate of offset voltage	-	50	V/ns

Table7　ESD Characteristics

Symbol	Description	Minimum value	Maximum value	Unit
V_{ESD}	Electrostatic discharge voltage (human body model)	-	1500	V

Note: The 100pF capacitor is discharged through a 1.5kΩ resistor.

4.3 Electrical characteristic parameters

T_A=25℃, VCC=VBS=15V, VS=GND; all pins take GND as the reference points, unless otherwise specified.

Table 8 Supply Voltage Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
VBS_{HY+}	VBS undervoltage high-level potential		8.1	8.6	9.3	V
VBS_{HY-}	VBS undervoltage low-level potential		7.5	8.0	8.5	V
VBS_{HY}	VBS undervoltage hysteresis level		0.3	0.6	0.8	V
VCC_{HY+}	VCC undervoltage high-level potential		8.3	8.8	9.5	V
VCC_{HY-}	VCC undervoltage low-level potential		7.7	8.2	8.7	V
VCC_{HY}	VCC undervoltage hysteresis level		0.3	0.6	0.8	V
VS_{QN}	VS static negative pressure	VBS=15V	-	-15	-	V

Table 9 Supply Current Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
I_{CCD}	VCC dynamic current	f_{LIN}=20kHz	700	1000	1500	uA
I_{BSD}	VBS dynamic current	f_{HIN}=20kHz	100	300	500	uA
I_{CCQ}	VCC quiescent current	V_{IN}=0V	500	700	1000	uA
I_{BSQ}	VBS quiescent current	VHIN=0V	50	80	150	uA
I_{LK}	VB floating power supply leakage current	VB=VS=600V	0	1	5	uA

Table10 Time Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
t_{ON}	Output rising edge transmission time	No Load	200	300	450	ns
t_{OFF}	Output falling edge transmission time	No Load	200	300	450	ns
t_r	Output rise time	CL=1nF	350	550	800	ns
t_f	Output fall time	CL=1nF	50	70	100	ns
DT	Dead time	No Load	300	400	550	ns
MT	High and low-side matching time	ΔTON & $_{\Delta TOFF}$	-	30	50	ns

Table 11 Input-end Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
V_{IN+}	Input high-level potential		1.7	2.1	2.5	V
V_{IN-}	Input low-level potential		0.6	1.4	1.9	V
I_{IN+}	Input high-level current	V_{IN}=5V	8	11	14	uA
I_{IN-}	Input low-level current	V_{IN}=0V	-	0	1	uA
V_{INHY}	Input hysteresis level		0.4	0.7	1.2	V

Table 12 Output-end Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
V_{OUT+}	High-level output voltage	I_{OUT}=5mA	630	900	1120	mV

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
V_{OUT-}	Low-level output voltage	I_{OUT}=5mA	70	100	130	mV
I_{OUT+}	High-level short-circuit pulse current	VIN=5V V_O=0V PWD≤10μs	30	45	65	mA
I_{OUT-}	Low-level short-circuit pulse current	VIN=0V V_O=15V PWD≤10μs	200	230	270	mA

Table 13 Bootstrap Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
I_{BSD15L}	Bootstrap charging current	VCC=15V, VB=13V	2.5	7	12.5	mA
I_{BSD15H}	Bootstrap charging current	VCC=15V, VB=0V	23	45	62	mA

Table 14Temperature Parameters

Symbol	Parameter	Condition	Minimum value	Typical value	Maximum value	Unit
OTP_{HY+}	High value of over-temperature protection		160	170	180	℃
OTP_{HY-}	Low value of over-temperature protection		140	150	160	℃
OTP_{HY}	Over-temperature protection hysteresis		12	19	25	℃
VTS_{20}	Temperature sensor output	Temp=20℃	0.37	0.52	0.67	V
VTS100	Temperature sensor output	Temp=100℃	1.73	1.88	2.03	V

5 Description of application

5.1 Recommended application circuit diagram

Figure 3 Application Circuit

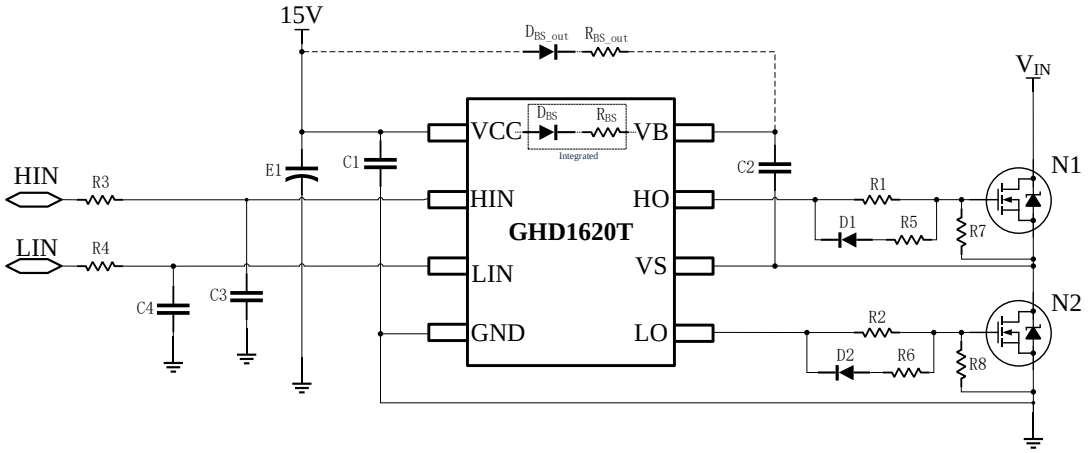


Table 15 Recommended Parameters

Device list	Name	Typical application value	Device form package
E1	Power storage capacitor	100F/50Vμ	Electrolytic capacitor
C1	Power filter capacitor	4.7F/50Vμ	Chip capacitor 1206
C2	Bootstrap energy storage capacitor	2.2μF/50V (depending on the application)	Chip capacitor 1206
C3，C4	Input filter capacitor	1nF/16V	Chip capacitor 1206
R1，R2	Output driving resistor	30Ω/5% (depending on the application)	Chip resistor 0603
R3，R4	Input filter resistor	100Ω/5%	Chip resistor 0603
R5, R6	Fast-closing resistor	3.3Ω/5% (depending on the application)	Chip resistor 0603
D1, D2	Fast-closing diode	1N4148	SOD323
R7, R8	gate pull-down resistor	100kΩ	Chip capacitor 0805
DBS_OUT	bootloader diode (external)	selects reverse breakdown voltage (> 600V)	SMB
RBS_OUT	bootstrap current-limiting resistor (external)	10Ω	Chip capacitor 0805

Note:

(1) E1 is driving power storage capacitor, and it requires a large capacitance value to ensure power stability;

(2) C1 is driving power filter capacitor, with a capacitance value smaller than E1, and it can filter power noise;

(3) The R1/R2 output drive resistor is determined based on the parameters of the driven device, dead time, MOSFET power consumption, and electromagnetic compatibility. It is recommended to use a reverse diode fast turn-off or PNP transistor fast turn-off circuit;

(4) R3/C3 and R4/C4 are input RC filtering circuits, which can filter signal noise;

(5) C2 bootstrap capacitor, with a withstand voltage of 2*VCC or above, and a capacitance value recommended between 1u and 100uF. It is best to select based on the actual observed ripple, and it is best to pair it with a clamping diode;

(6) R5/D1 and R6/D2 constitute a fast-closing circuit, which can improve the shutdown speed and optimize the parasitic conduction noise;

(7) D_{BS_OUT} bootstrap diode, it is recommended to choose a fast recovery diode with a withstand voltage of 1.5*VIN or above and an instantaneous current value greater than 1A. It should be paired with a current-limiting resistor, and the actual power-on and charging time should be taken into consideration.

5.2 PCB Layout suggestions

(1) The chip power supply filter capacitor C1 is placed close to the VCC pin and GND pin of GHD1620T. The bootstrap current-limiting resistor RBS_OUT, bootstrap diode DBS_OUT, and bootstrap capacitor C2 are placed close to the corresponding pins of GHD1620T, minimizing the loop area as much as possible.

(2) Minimize the traces between the MCU PWM output and the GHD1620T PWM input. Place the R3, C3, R4, and C4 filter resistors and capacitors close to the GHD1620T pins.

(3) The drive gate resistors R1 and R2 and the gate fast switch resistors R5 and R6 are placed close to the N1 and N2 gates to reduce the oscillation of the drive signal caused by the trace inductance.

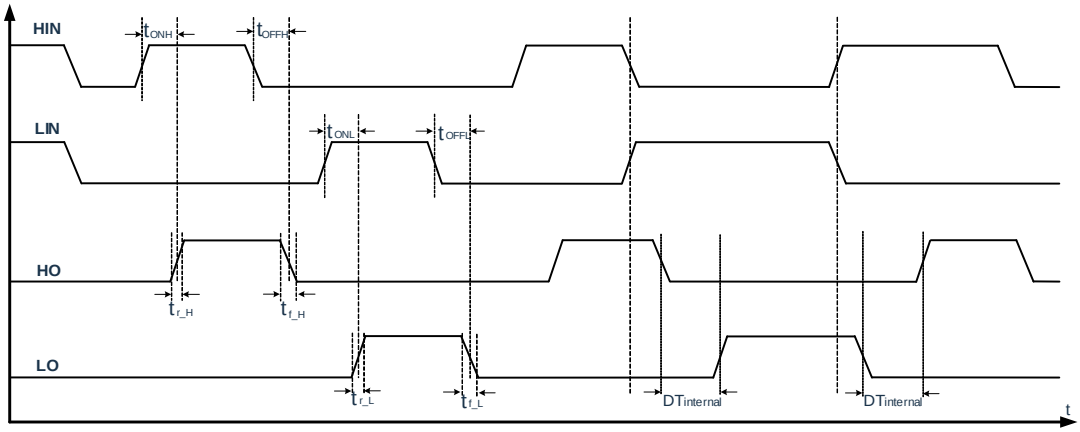
(4) The area of the power circuit should be as small as possible, and the power ground, power supply ground and signal ground should be routed separately.

(5) If a DC-DC switching power supply is used in the circuit, the operating frequency of some parts of the DC-DC circuit is relatively high, and the loop area should also be as small as possible. It is best to Layout this part according to the layout recommendations of the DC-DC chip used.

6 Test instructions

6.1 Time parameter test

Figure 4 Time Parameters



6.2 Logic Timing Diagram

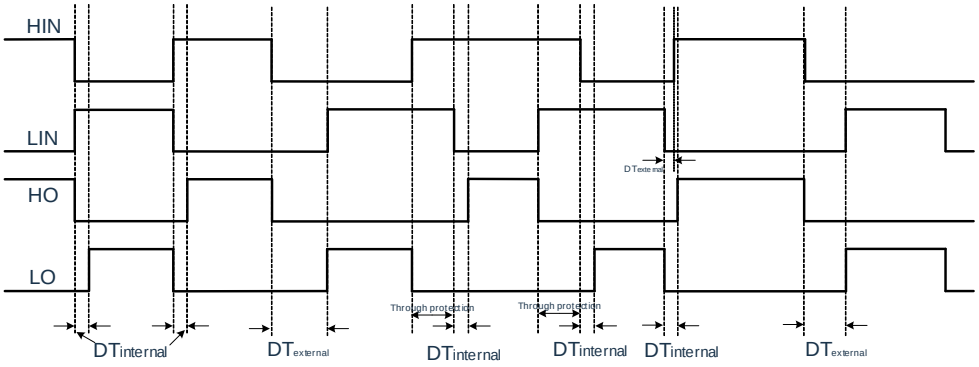
The chip is internally equipped with a fixed dead time protection circuit, and during the dead time, both the high and low-side outputs are set to a low level. The set dead time must ensure that after one power tube is effectively shut down, another power tube will be turned on, which can prevent direct connection between the upper and lower tubes.

If the external dead time $DT_{external}$ is less than the internal minimum dead time $DT_{internal}$, $DT_{internal}$ is the drive output dead time;

If the external dead time $DT_{external}$ is greater than the internal minimum dead time $DT_{internal}$, $DT_{external}$ is the drive output dead time.

The chip is also designed with a protection circuit specially to prevent direct connection of the power tubes, which can effectively prevent the power tubes from being directly connected and damaged when the high and low-side input signals are interfered with.

Figure 5 Timing Relationship between Dead Time, Input Signal, Driver Output Signal, and Direct Protection Circuit



6.3 VCC and VBS undervoltage test

VCC and VBS are respectively the power supply ends of the low-side and high-side circuits.

To prevent abnormal operation caused by low drive voltage and ensure that the chip operates within an appropriate power supply voltage range, an under-voltage locking circuit is embedded. The high and low values of VCC undervoltage belong to the level-triggered type, while the high value of VBS undervoltage belongs to the edge-triggered type, which requires the HIN edge to be re-triggered, and the low value of VBS undervoltage belongs to the level-triggered type.

Figure 6 VCC Undervoltage Timing Diagram (Ignore transmission delay)

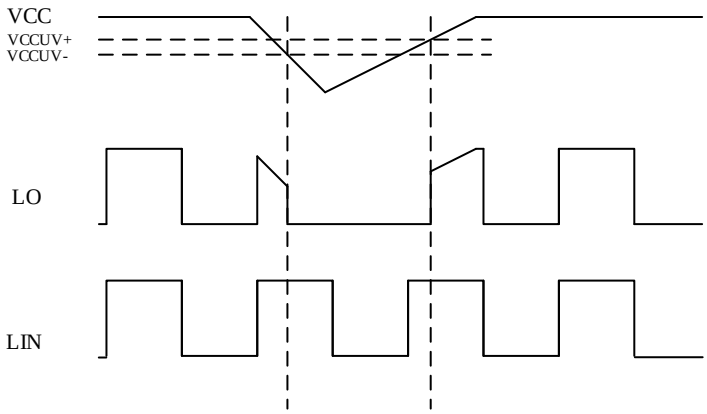
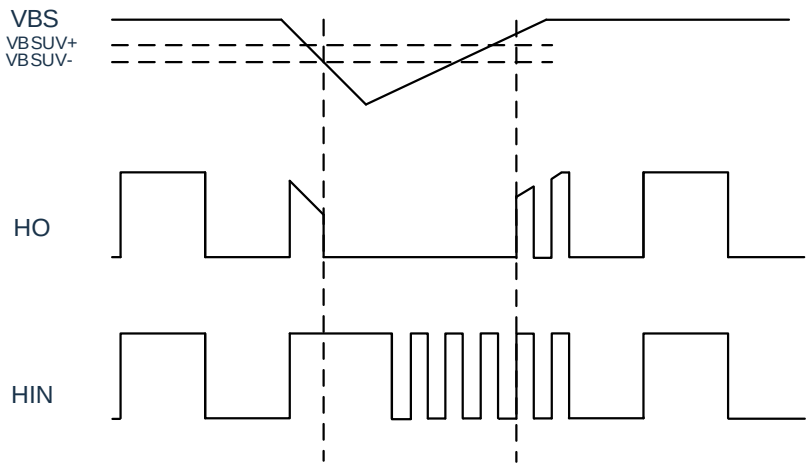


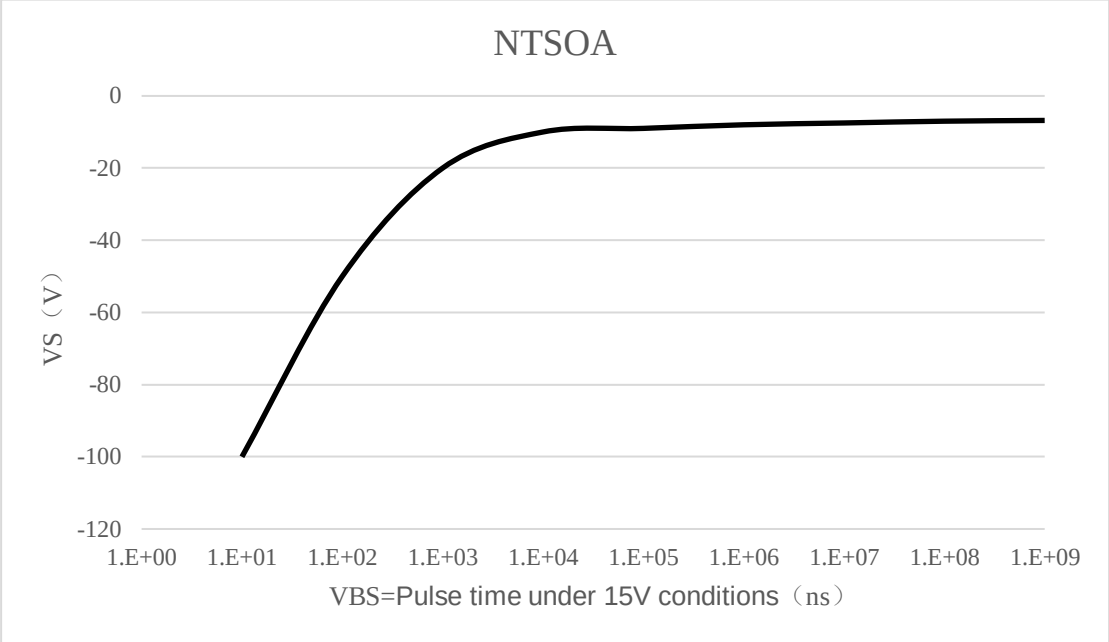
Figure 7 VBS Undervoltage Timing Diagram (Ignore transmission delay)



6.4 Transient negative-voltage safe operation area

The transient negative-voltage safe operation area (NTSOA) is used to characterize the capability of the gate driver to handle transient negative voltage. When the amplitude and the pulse width of the negative pulse are within the area above the blue line shown in the figure below, the gate driver can operate normally. Pulses with large amplitude (located in the area below the blue line) may cause abnormal operation or even permanent damage to the gate driver.

Figure 8Transient Negative-voltage Safe Operation Area



6.5 Temperature sensor VTS output curve

The temperature sensor output supports multi-chip parallel output, and the typical output curve is shown in the following figure. This range is only effective between -40℃ and 150℃.

Figure 9 Temperature Sensor VTS Output Curve

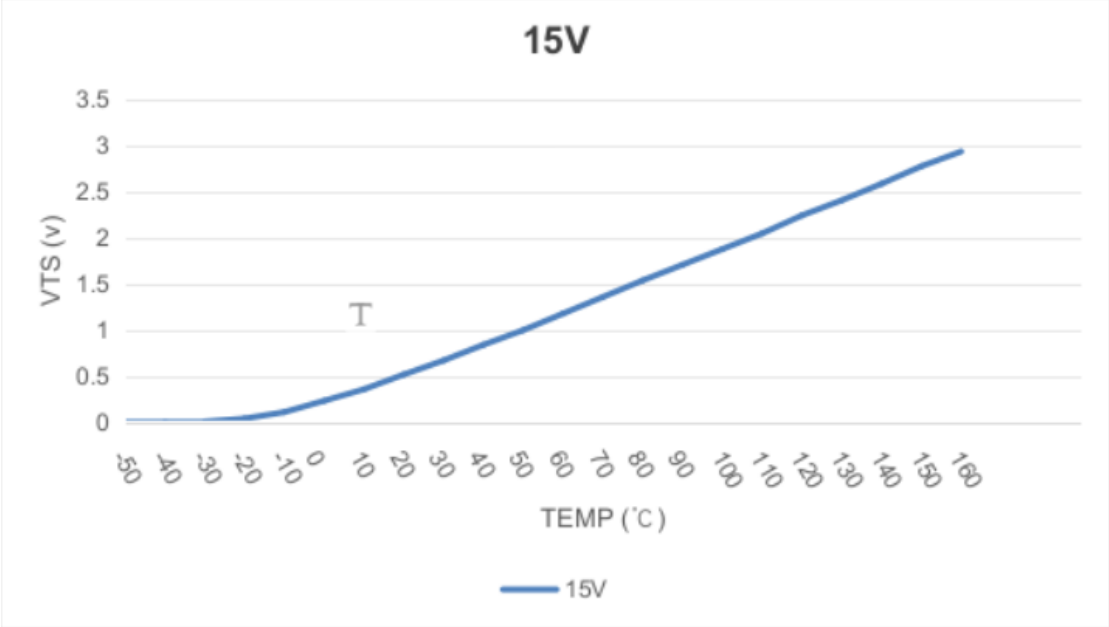


Table 16 Numerical Values under Different Temperature Conditions

TEMP (℃)	**-50**	**-40**	**-30**	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**50**	**60**
VTS(V)	0.00032	0.0011	0.0068	0.039	0.11	0.233	0.358	0.518	0.671	0.841	1.00	1.18
TEMP(℃)	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**	**160**		
VTS(V)	1.36	1.54	1.71	1.88	2.05	2.246	2.41	2.59	2.78	2.94		

7 Package Information

7.1 SOP8 Package Information

Figure10 SOP8 Package Diagram

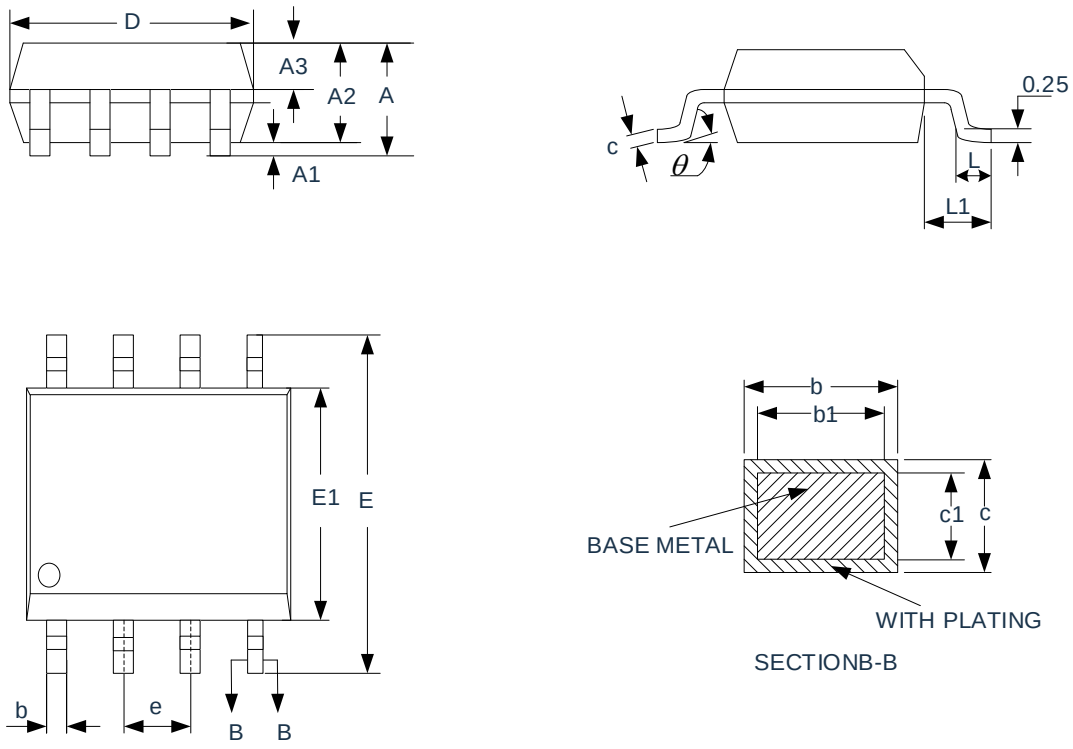


Table 17 SOP8 Package Data

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.77
A1	0.08	--	0.28
A2	1.20	1.40	1.60
A3	0.55	0.65	0.75
b	0.39	--	0.48
b1	0.38	0.41	0.44
c	0.20	--	0.26
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
L	0.50	--	0.80
L1	1.05BSC		
θ	0	--	8°

Figure 11 SOP8 Package Designator

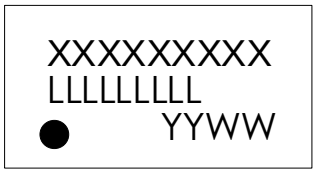


Table 18 Silk-screen printing figure description

Symbols and Icons	description
XXXXXXXXX	product model
LLLLLLLLL	batch number
YYWW	Year and week number
	PIN1 location

Note: The number of digits in each column above is not fixed.

8 Packaging Information

8.1 Tube packaging

Figure 12 Tube package drawing

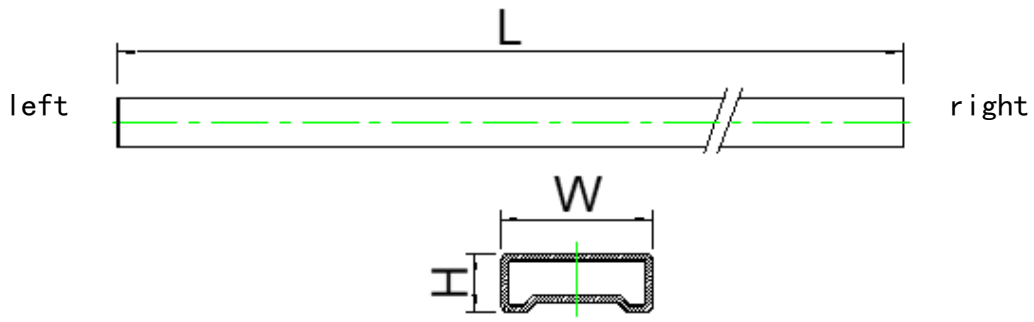


Table 19 Specification table of material tube packaging parameters

Device	Package Type	Pins	Qty Per Tube	SPQ	L (mm)	W (mm)	H (mm)
GHD1620T	SOP	8	100	10000	520	7.8	3.4

9 Ordering Information

Table 20 Product Naming Definition

Product name			
GHD1620T			
Naming example	Definitions	Naming	Information
GH	Company name	GH	Geehy
D	Product type	D	Gate driver
1	Output channel	1	2 channels (half bridge)
6	Voltage class	6	550V~650V
2	Current output capability	2	18mA~450mA
0	Logic	0	Input and output in the same direction
T	Integration function	T	Integrated BSD
N	Package	N	SOP
P	Number of pins	P	8-pin

Table 21 Ordering Information List

Product model	**Supply voltage**	**Operating temperature**	**Input logic**	**Package**	**Packaging**
GHD1620T	10V~20V	-40~105℃	HIN/LIN	SOP8	Tube

10 Revision

Table 22 Document Revision History

Date	Version	Change History
September 2025	1.0	● Initial Release
January 2026	1.1	● Modified DeadTime parameter ● Modified VCC Undervoltage Timing Diagram

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