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Preliminary

SANYO Semiconductors
DATA SHEET

STK621-150A-E, STK621-150B-E

Thick-Film Hybrid IC
3-phase Inverter Motor Drive
Inverter Hybrid IC

Overview

The STK621-150A-E and STK621-150B-E are 3-phase inverter power hybrid IC containing power elements, pre-driver, and excessive temperature protection circuit.

Applications

- 3-phase inverter motor drive.

Features

- Protective circuits including overcurrent (bus line), and pre-drive low voltage protection are built in.
- Direct input of CMOS level control signals without an insulating circuit is possible.
- The temperature monitor is enabled through the use of an internal thermistor.
- Single power supply drive is possible through the use of a built-in upper-side power-supply bootstrap circuit (capacitor is externally connected).
- Built-in simultaneous upper/lower ON prevention circuit to prevent arm shorting through simultaneous ON input for the upper and lower side transistors. (Dead time is required for preventing shorting due to switching delay.)
- SIP (The single in-line package) of the transfer full mold structure.

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SANYO Semiconductor Co., Ltd.
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Specifications

Absolute maximum ratings at Tc = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}	+ - -, Surge < 500V *1	450	V
Collector-emitter voltage	V_{CE}	+ - U (V, W) or U (V, W) - -	600	V
Output current	I_O	+, -, U, V, W terminal current	±15	A
Output peak current	Iop	+, -, U, V, W terminal current PW=100μs	±30	A
Pre-driver supply voltage	VD1, 2, 3, 4	VB1 - U, VB2 - V, VB3 - W, V_{DD} - V_{SS} *2	20	V
Input signal voltage	V_{IN}	HIN1, 2, 3, LIN1, 2, 3 terminal	0 to 7	V
FAULT terminal voltage	VFAULT	FAULT terminal	20	V
Maximum loss	Pd	IGBT, Per 1 channel	31	W
Junction temperature	Tj	IGBT, FRD junction temperature	150	°C
Storage temperature	Tstg		-40 to +125	°C
Operating temperature	Tc	H-IC case temperature	-20 to +100	°C
Tightening torque	MT	A screw part	1.0	N•m

In the case without the instruction, the voltage standard is - terminal = V_{SS} terminal voltage.

*1 Surge voltage developed by the switching operation due to the wiring inductance between the + and – terminals.

*2 VD1= between VB1-U, VD2=VB2-V, VD3=VB3-W, VD4=V_{DD}-V_{SS}, terminal voltage.

Electrical Characteristics at Tc=25°C, VD=15V

Parameters	Symbols	Conditions		min	typ	max	unit	Test circuit
Power output part								
Collector-to-emitter cut-off current	I_{CE}	V_{CE}=600V				0.1	mA	Fig.1
Boot-strap diode reverse current	IR (BD)	VR (BD)				0.1	mA	Fig.1
Collector-to-emitter saturation voltage	V_{CE} (SAT)	I_O=8A	Upper side		1.6	2.1	V	Fig.2
			Lower side		1.8	2.3		
Diode forward voltage	VF	I_O=-8A	Upper side		2.0	3.0	V	Fig.3
			Lower side		2.2	3.2		
Junction-to-substrate thermal resistance	θj-c(T)	IGBT			3.5	4	°C/W	
	θj-c(D)	FWD			5	5.5		
Control (Pre-driver) part								
Pre-drive power supply consumption electric current	I_D	VD1, 2, 3=15V			0.05	1	mA	Fig.4
		VD4=15V			2	10		
Input ON voltage	V_{IH}	Output ON				0.8	V	
Input OFF voltage	V_{IL}	Output OFF		3.0			V	
Protection part								
Overcurrent protection electric current	ISD	PW=100μs		25		32	A	Fig.5
Pre-drive low voltage protection	UVLO			10		12	V	
FAULT terminal input electric current	IOSD	VFAULT =0.1V			2		mA	
FAULT clearness delay time	FLTCLR	After each protection operation ending		6	9	12	ms	
Board temperature mounting resistance	Rt	Resistance between the VTH and V_{SS} terminals		90		110	kΩ	
Switching time	tON	I_O=8A, Inductive load			0.6		μs	Fig.6
	tOFF				0.8			
Electric current output signal level	ISO	I_O=8A		0.129	0.136	0.143	V	

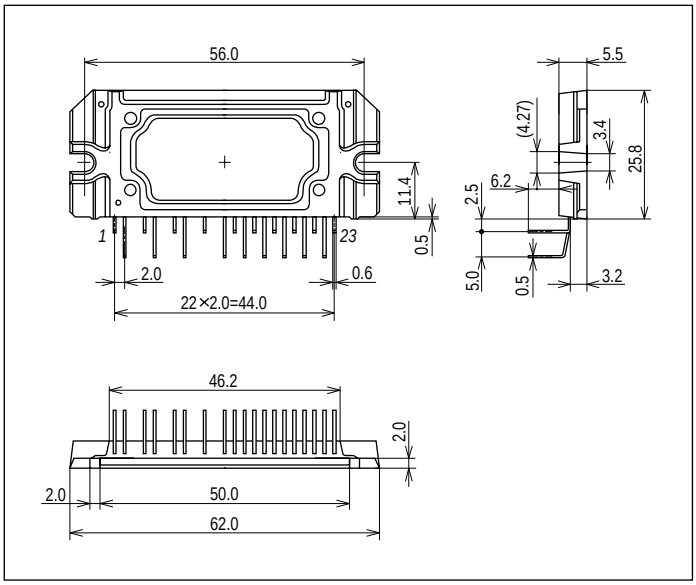
In the case without the instruction, the voltage standard is - terminal = V_{SS} terminal voltage.

Notes

1. Input ON voltage indicates a value to turn on output stage IGBT.
   Input OFF voltage indicates a value to turn off output stage IGBT.
   At the time of output ON, set the input signal voltage 0V to V_{IH} (max).
   At the time of output OFF, set the input signal voltage V_{IL} (min) to 5V.
2. When the internal protection circuit operates, there is a FAULT signal ON (When the FAULT terminal is low level, FAULT signal is ON state: output form is open DRAIN) but the FAULT signal doesn't latch.
   After protection operation ends, it returns automatically within about 9ms and resumes operation beginning condition.
   So, after FAULT signal detection, set OFF (HIGH) to all input signals at once.
   However, the operation of pre-drive power supply low voltage protection (UVLO: it has a hysteresis about 0.3V) is as follows.
   Upper side → There is no FAULT signal output, but it does a corresponding gate signal OFF.
   Incidentally, it returns to the regular operation when recovering to the normal voltage, but the latch continues among input signal ON (low).
   Lower side → It outputs FAULT signal with gate signal OFF.
   However, it is different from the protection operation of upper side, it is automatically resets about 9ms later and resumes operation beginning condition when recovering to normal voltage.
   (The protection operation doesn't latch by the input signal.)
3. When assembling the hybrid IC on the heat sink, tightening torque range is 0.8N•m to 1.0N•m.
4. The pre-drive low voltage protection is the feature to protect a device when the pre-driver supply voltage declines with the operating malfunction. As for the pre-driver supply voltage decline in case of operation beginning, and so on, we request confirmation in the set.

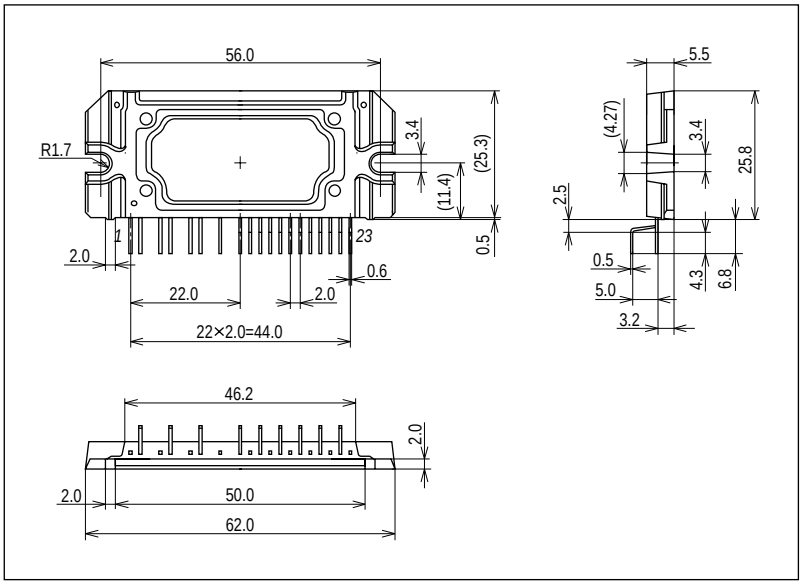
Package Dimensions

unit:mm (typ) [STK621-150A-E]

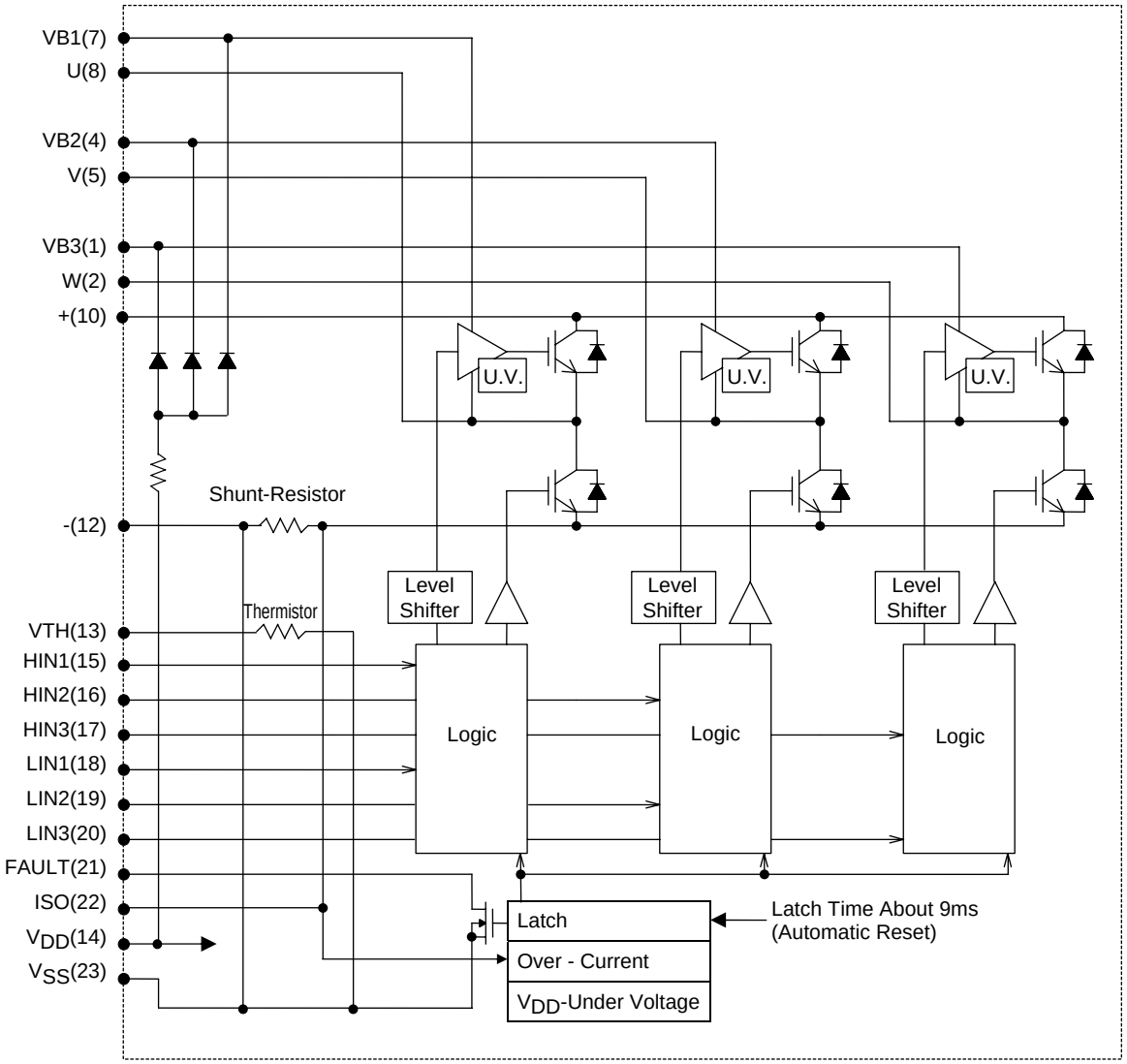


Package Dimensions

unit:mm (typ) [STK621-150B-E]



Internal Equivalent Circuit Diagram

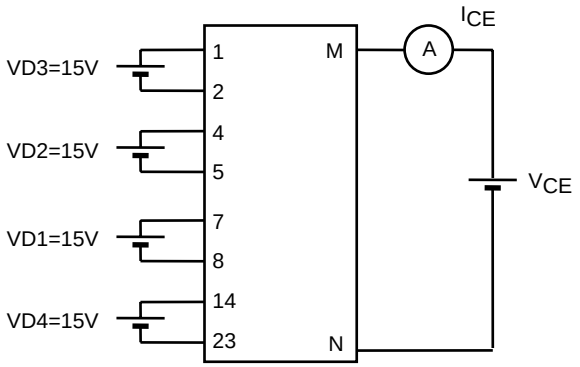


Test Circuit (Measured phase: U+ shows upper U- phase, U- shows lower U phase)

1: ICE test

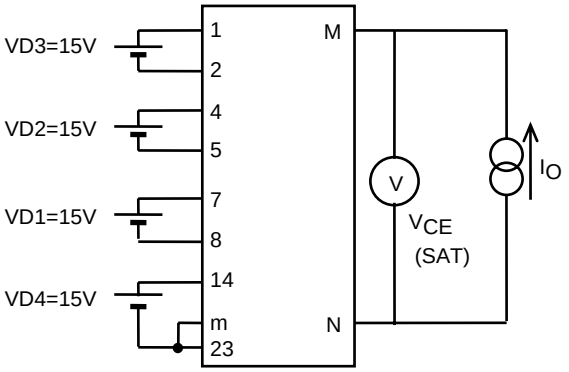
Measured Phase	U+	V+	W+	U-	V-	W-
M	10	10	10	8	5	2
N	8	5	2	12	12	12

	U(BD)	V(BD)	W(BD)
M	7	4	1
N	23	23	23



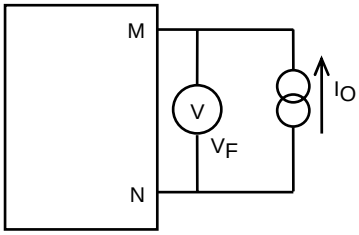
2: VCE(SAT) test (Pulse test)

Measured Phase	U+	V+	W+	U-	V-	W-
M	10	10	10	8	5	2
N	8	5	2	12	12	12
m	15	16	17	18	19	20



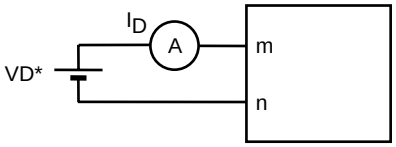
3: VF test (Pulse test)

Measured Phase	U+	V+	W+	U-	V-	W-
M	10	10	10	8	5	2
N	8	5	2	12	12	12

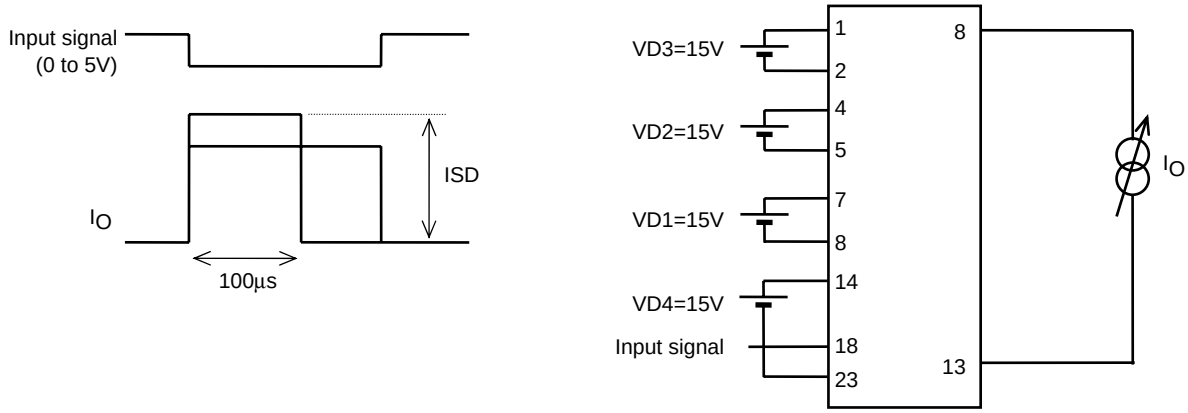


4: ID test

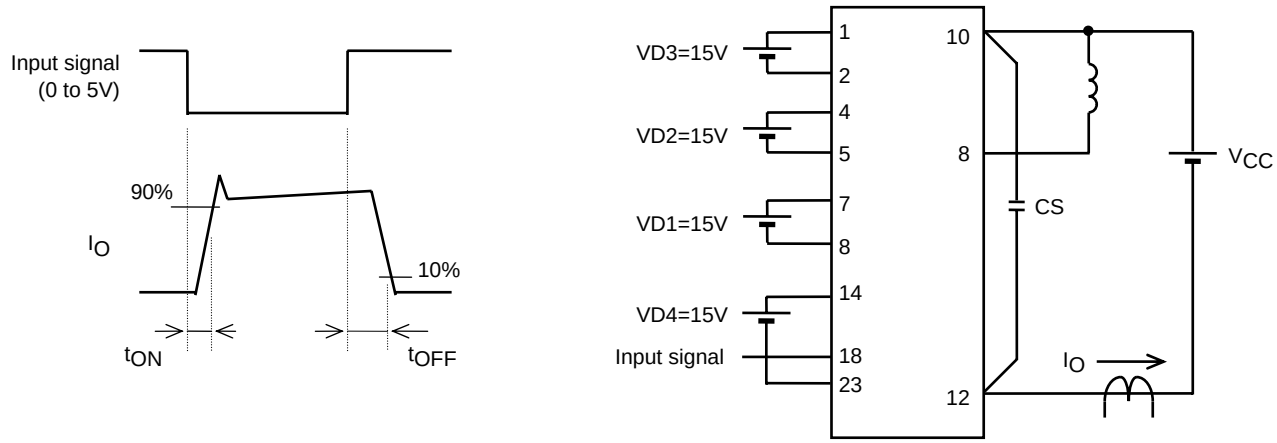
Measured Phase	VD1	VD2	VD3	VD4
m	7	4	1	14
n	8	5	2	23



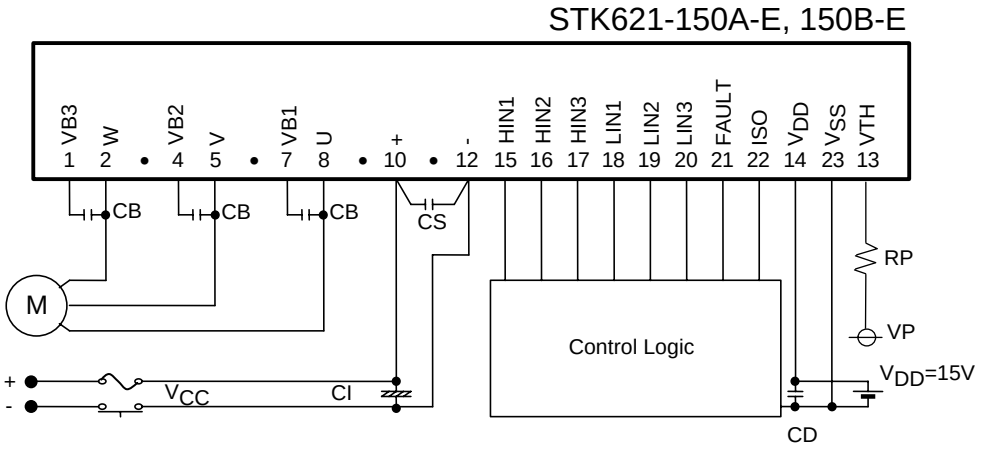
5: ISD test



6: Switching time (Right diagram shows a typical example of lower U phase)



Example of The Application Circuit



Recommended Operating Conditions

Parameters	Symbol	Conditions	min	typ	max	unit
Supply voltage	V_{CC}	+ - -	0	280	400	V
Pre-driver supply voltage	VD1, 2, 3	VB1-U, VB2-V, VB3-W	12.5	15	17.5	V
	VD4	V_{DD}-V_{SS} *1	13.5	15	16.5	
ON input signal voltage	V_{IN} (ON)	HIN1, HIN2, HIN3, LIN1, LIN2, LIN3-V_{SS} terminal	0		0.3	V
OFF input signal voltage	V_{IN} (OFF)		3.5		5	V
PWM frequency	fPWM		1		20	kHz
Dead time	DT	Upper/lower input signal downtime	2			µs
Tightening torque	MT	'M3' type screw	0.8		1.0	N•m

*1 Pre-driver power supply (VD4=15±1.5V) must have the capacity of I_O=20mA (DC), 0.5A (Peak).

Precautions

1. A control power supply can be driven with one power supply by attaching the capacitor CB (1 to 47µF) for a bootstrap. In this case, a bottom element is made to charge.
   (When not using bootstrap circuit, each upper side pre-drive power supply needs an independent power supply. Externally set.)
   Moreover, since top power supply voltage may be insufficient depending on the control method, Please carry out a check with the system.

2. Because the jump voltage which is accompanied by the vibration in case of switching operation occurs by the influence of the floating inductance of the wiring of the outer power supply which is connected with of the + terminal and the – terminal, restrains and spares serge voltage being as the connection of the snubber circuit (Capacitor / CS / about 0.1 to 10µF) for the voltage absorption with the neighborhood as possible between + and the - terminal, and so on, with making a wiring length (among the terminals each from CI) short and making a wiring inductance small.

3. ISO terminal (22pin) is for the electric current monitor.
   Note that the overcurrent protection circuit is disabled when the ISO terminal is shorted with the V_{SS} terminal.

4. Output form of the FAULT terminal is open DRAIN (it is operating as FAULT when becoming low).
   When pulling up the pin with a resistor, connect the resistor with a resistance of 5.6kΩ or more.

5. Zener diode with 5V (5.0 to 5.4V) is connected with the inside of the signal input terminal. When inputting the voltage which exceeds 5V, connect resistor to between the side of the power and the signal input terminal, for the input current of the signal input terminal become equal to or less than 0.5mA.
   This resistor is effective with the noise absorption of the signal terminal, too.

6. The over current protection feature operates only when it is possible to do a circuit control normally. For the safety, put a fuse, and so on in the V_{CC} line.

7. A thermistor is connected between the VTH terminal (pin 13) and V_{SS} terminal (pin 23) inside the IC. The substrate temperature can be monitored by connecting an external pull-up resistor (RP). Connect the resistor with a resistance of 10kΩ or more when the pull-up voltage (VP) is 5V and 39kΩ or more when the VP is 15V.

8. Because the IC sometimes destroys and bursts when motor connection terminal (2pin, 5pin, 8pin) becomes open while the motor turns, especially, be careful of the connection (the soldering condition) of this terminal.

9. Do not connect the -terminal and V_{SS} terminal externally since the overcurrent protection (ISD) value falls below the preset value in the hybrid IC if they are shorted. (-terminal and V_{SS} terminal are connected inside the hybrid IC.)

* This data shows the example of the application circuit, does not guarantee a design as the mass production set.

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