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Preliminary

SANYO Semiconductors
DATA SHEET

STK621-728-E — Thick-Film Hybrid IC 3-phase Inverter Motor Drive Inverter Hybrid IC

Overview

The STK621-728-E is an inverter power hybrid IC for use in 3-phase fan-motor applications and contains power stage, pre-driver, and protection circuits.

Applications

- 3-phase inverter motor drive for air conditioners, washing machines, etc.

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.(Hi Active).
- Single power supply drive is possible through the use of a built-in upper-side power-supply bootstrap circuit (Needs external capacitors).
- 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.)
- The current level for overcurrent protection can be adjusted by connecting an external resistor R_{SD} between the I_{SD} and V_{SS} terminals.
- The built-in thermistor allows substrate temperature to be monitored.

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Specifications

Absolute Maximum Ratings at Tc = 25°C

Parameter	Symbol	Conditions	Ratings	unit
Supply voltage	V_{CC}	+ - - terminal, surge < 500V *1	450	V
Collector-emitter voltage	V_{CE}	+ - U (V, W) terminal or U (V, W) - - terminal	600	V
Output current	I_O	+, -, U, V, W terminal current	±10	A
Output peak current	Iop	+, -, U, V, W terminal current P.W. = 100µs	±20	A
Pre-driver supply voltage	VD1, 2, 3, 4	VB1 - U, VB2 - V, VB3 - W, V_{DD} - V_{SS} terminal *2	20	V
Input signal voltage	V_{IN}	HIN1, 2, 3, LIN1, 2, 3 terminal	0 to 15	V
FAULT terminal voltage	VFAULT	FAULT terminal	20	V
Maximum loss	Pd	IGBT, Per 1 channel	31.2	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 *3	1.0	N•m
Withstand voltage	Vis	50Hz sine wave AC 1 minute *4	2000	VRMS

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.

*3 Flatness of the heat-sink should be lower than 0.15mm.

*4 The test condition is AC 2500V, 1 second.

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

Parameter	Symbol	Conditions		min	typ	max	unit
Power output part							
Collector-to-emitter cut-off current	I_{CE}	V_{CE} = 600V				0.1	mA
Boot-strap diode reverse current	IR (BD)	VR (BD) = 600V				0.1	mA
Collector-to-emitter saturation voltage	V_{CE} (sat)	I_O = 10A	Upper side		1.9	2.6	V
		I_O = 10A	Lower side		2.2	2.9	
Diode forward voltage	V_F	I_O = -10A	Upper side		1.4	2.1	V
		I_O = -10A	Lower side		1.7	2.4	
Junction-to-substrate thermal resistance	θj-c (T)	IGBT				4	°C/W
	θj-c (D)	FWD				6	°C/W
Control (Pre-driver) part							
Pre-drive power supply consumption electric current	I_D	VD1, 2, 3 = 15V			0.07	0.4	mA
		VD4 = 15V			1.6	4	
Input ON threshold voltage	Vinth (on)	HIN1, HIN2, HIN3, LIN1, LIN2, LIN3-V_{SS} terminal		1.5	2.1	2.5	V
Input OFF threshold voltage	Vinth (off)			0.8	1.3	1.5	V
Input threshold voltage hysteresis *1	Vinth (hys)			(0.5)	(0.8)		V
FAULT terminal input electric current	IOSD	During fault operations (low) VFAULT = 0.1V			2		mA
FAULT clearness delay time	FLTCLR	After each protection operation ending/RCIN open		18		80	ms
Board Temperature Mounting resistance	Rt	Resistance between the TH (29) and V_{SS} (26) terminals		90	100	110	kΩ
Protection part							
Over-current protection electric current	ISD	P.W. = 100µs, RDS = 0Ω		18.1		22.9	A
Pre-drive low voltage protection	UVLO			10		12	V
Switching time	tON	I_O = 10A, Inductive load		0.3	0.6	1.3	µs
	tOFF				0.8	1.5	
Electric current output signal level	ISO	I_O = 10A		0.31	0.33	0.35	V
Reverse bias safe operating area	RBSOA	I_O = 20A, V_{CE} = 450V		Full Square			
Short circuit safe operating area	SCSOA	V_{CE} = 200V		4			µs
Allowable offset voltage slew rate	dv/dt	U (V, W) - - terminal		-50		50	V/ns

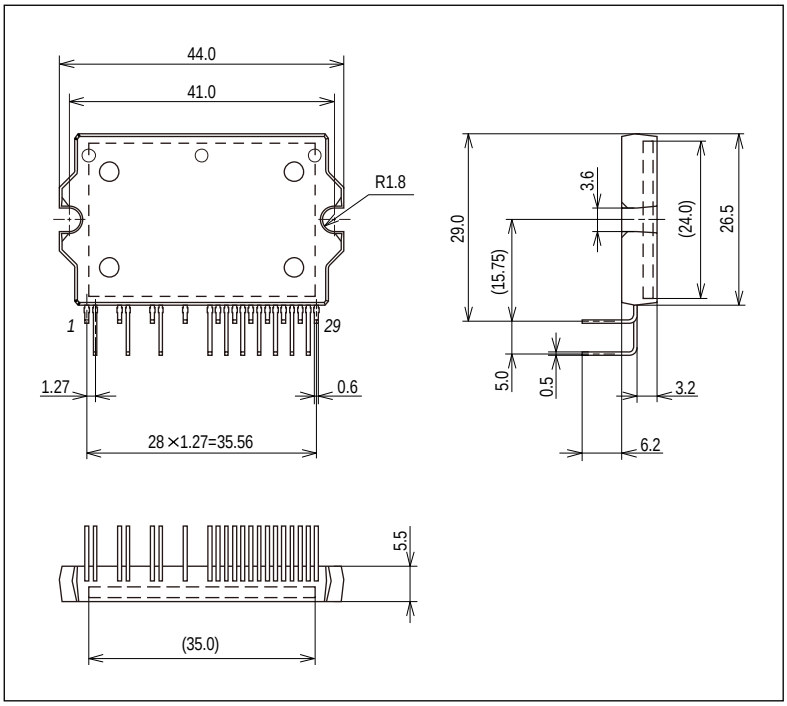
In the case without the instruction, the voltage standard is - terminal = V_{SS} terminal voltage.

Notes

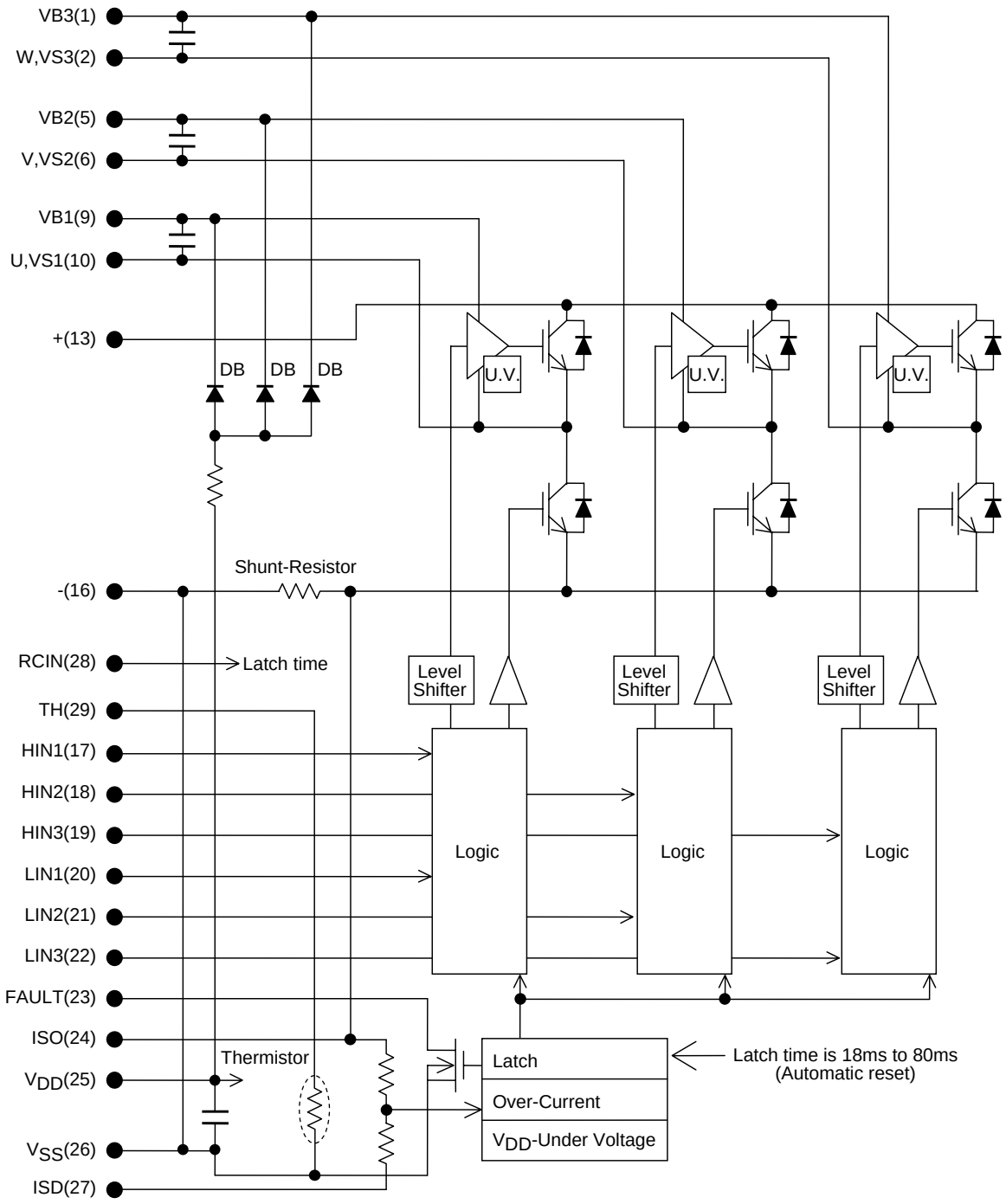
1. Input ON voltage turns on output stage and input OFF voltage turns off output stage.
   Apply voltage Vinth (max) to 15V to the V_{IN} (ON) pin to turn output stage on, and apply voltage 0V to Vinth (min) to the V_{IN} (OFF) pin to turn output stage off.
   *1 : "Input threshold voltage hysteresis" indicates a reference value based on the design value of built-in pre-driver IC.
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 18ms and resumes operation beginning condition. So, after Fault signal detection, set OFF (Low) to all input signals at once.
   However, the operation of pre-drive power supply low voltage protection (UVLO: it has a hysteresis about 0.2V) 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 (High).
   Lower side → It outputs FAULT signal with gate signal OFF.
   However, it is different from the protection operation of upper side, it automatically resets about 18ms 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

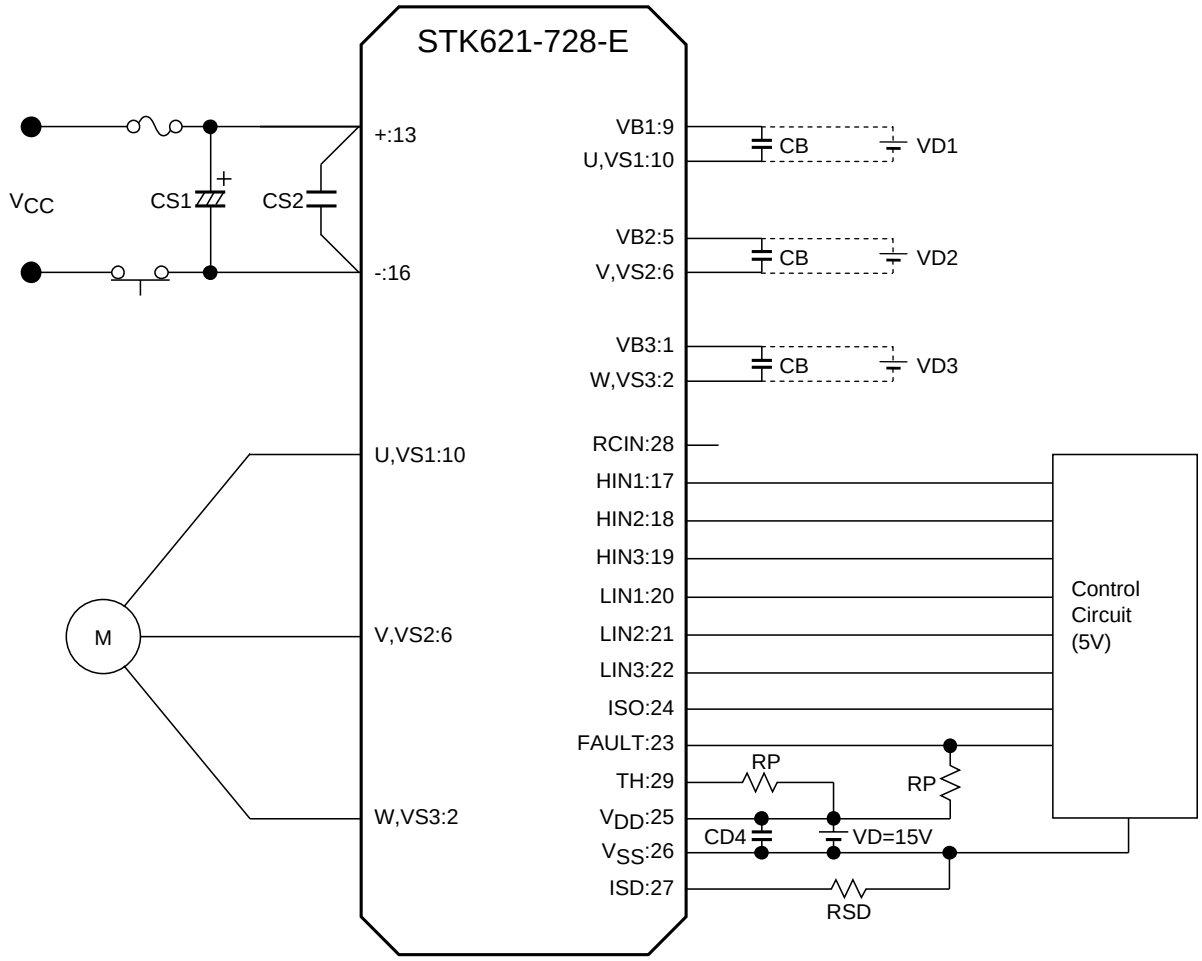
unit:mm (typ)



Internal equivalent circuit diagram



Example of the application circuit



Recommendation Operating Conditions

Parameter	Symbol	Conditions	min	typ	max	unit
Supply voltage	V_{CC}	+ - - terminal	0	280	400	V
Pre-driver supply voltage	VD1, 2, 3	VB1 - U, VB2 - V, VB3 - W, terminal	12.5	15	17.5	V
	VD4	V_{DD} - V_{SS} terminal *1	13.5	15	16.5	
ON state input voltage	V_{IN} (ON)	HIN1, HIN2, HIN3, LIN1, LIN2, LIN3 Terminal	3.0		5.0	V
OFF state input voltage	V_{IN} (OFF)		0		0.3	
PWM frequency	fPWM		1		20	kHz
Dead-time	DT	Upper/lower input signal downtime	2			µs
Allowable input pulse width	PWIN	ON and OFF	1			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.)
   In addition, please carry out capacity of the capacitor for a bootstrap (external) to 47μF (±20%). When 47μF (±20%) or more are connected, Please connect resistance (about 20Ω) also with 3-phase at series between each top power supply terminal (VB1, 2, and 3) and the capacitor for a bootstrap. 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. 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.

4. A thermistor is connected between the TH terminal (pin 29) and V_{SS} terminal (pin 26) 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.

5. ISO terminal (24 pin) is for the electric current monitor. Connect an external impedance with 5.6kΩ or more to this pin. In addition, Not short-circuit this pin to the V_{SS} pin, that leads to large current drain and is dangerous.

6. The pull-down resistor (: 33kΩ (typ)) is connected with the inside of the signal input terminal, but please connect the pull-down resistor (about 2.2 to 3.3kΩ) outside to decrease the influence of the noise by wiring etc.

7. 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.

8. Because the IC sometimes destroys and bursts when motor connection terminal (2pin, 6pin, 10pin) becomes open while the motor turns, especially, be careful of the connection (the soldering condition) of this terminal.

9. Since the overcurrent protection function operates normally when an external resistor RSD is placed between the ISD and V_{SS} terminals, it must always be connected between the terminals (or the terminals must be short-circuited). The current level for overcurrent protection can be lowered by using the external resistor RSD of an appropriate value.

10. When input pulse width is less than 1μs, an output may not react to the pulse.
    (Both ON signal and OFF signal)

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

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