Ordering number : EN*A1723

Preliminary

SANYO Semiconductors
DATA SHEET

STK625-728-E — Thick-Film Hybrid IC 3-phase Inverter Motor Drive Inverter Hybrid IC

Overview

The STK625-728-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.

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 emitter line of each lower side transistor is connected to an external terminal (3 lines in total), so the terminals can be used for the detection of the 3-phase current by connecting external shunt resistors.
- The temperature monitor is enabled through the use of an internal thermistor.

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Specifications

Absolute Maximum Ratings at Tc = 25°C

Parameter	Symbol	Conditions	Ratings	unit
Supply voltage	V_{CC}	+ - U - (V -, W -) terminal, surge < 500V *1	450	V
Collector-emitter voltage	V_{CE}	+ - U (V, W) terminal or U (V, W) - U - (V -, W -) terminal	600	V
Output current	I_O	+, U -, V -, W -, U, V, W terminal current	±10	A
Output peak current	Iop	+, U -, V -, W -, 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	VFLTEN	FLTEN 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 V_{SS} terminal voltage.

*1 Surge voltage generated by the switching operation due to the effect of the wiring inductance between the + and U- (V-, W-) 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		1.9	2.7	V
Diode forward voltage	V_F	I_O = -10A		2.1	2.9	V
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
FLTEN terminal input electric current	IOSD	During fault operations (low) VFLTEN = 0.1V		2		mA
FAULT clearness delay time	FLTCLR	After each protection operation ending	1	2	3	ms
Pre-drive low voltage protection	UVLO		10		12	V
ITRIP terminal threshold voltage	VITRIP	Between the ITRIP (16) and V_{SS} (29) terminals	0.44	0.49	0.54	V
Board Temperature Mounting resistance	Rt	Resistance between the TH (27) and V_{SS} (29) terminals	90	100	110	kΩ
Switching time	tON	I_O = 10A, Inductive load	0.3	0.6	1.3	µs
	tOFF			0.8	1.5	
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) - U - (V -, W -) terminal	-50		50	V/ns

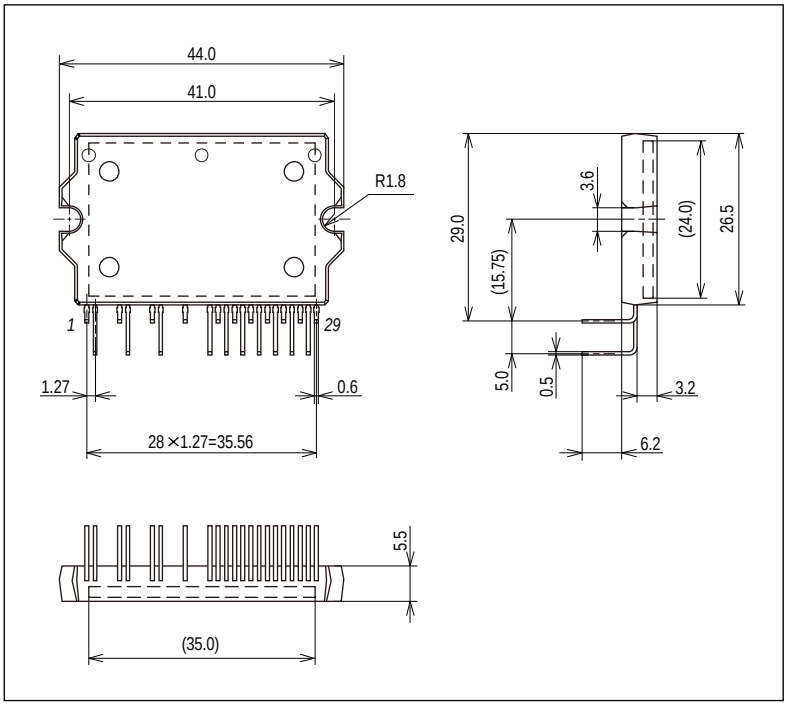
In the case without the instruction, the voltage standard is V_{SS} terminal voltage.

Notes

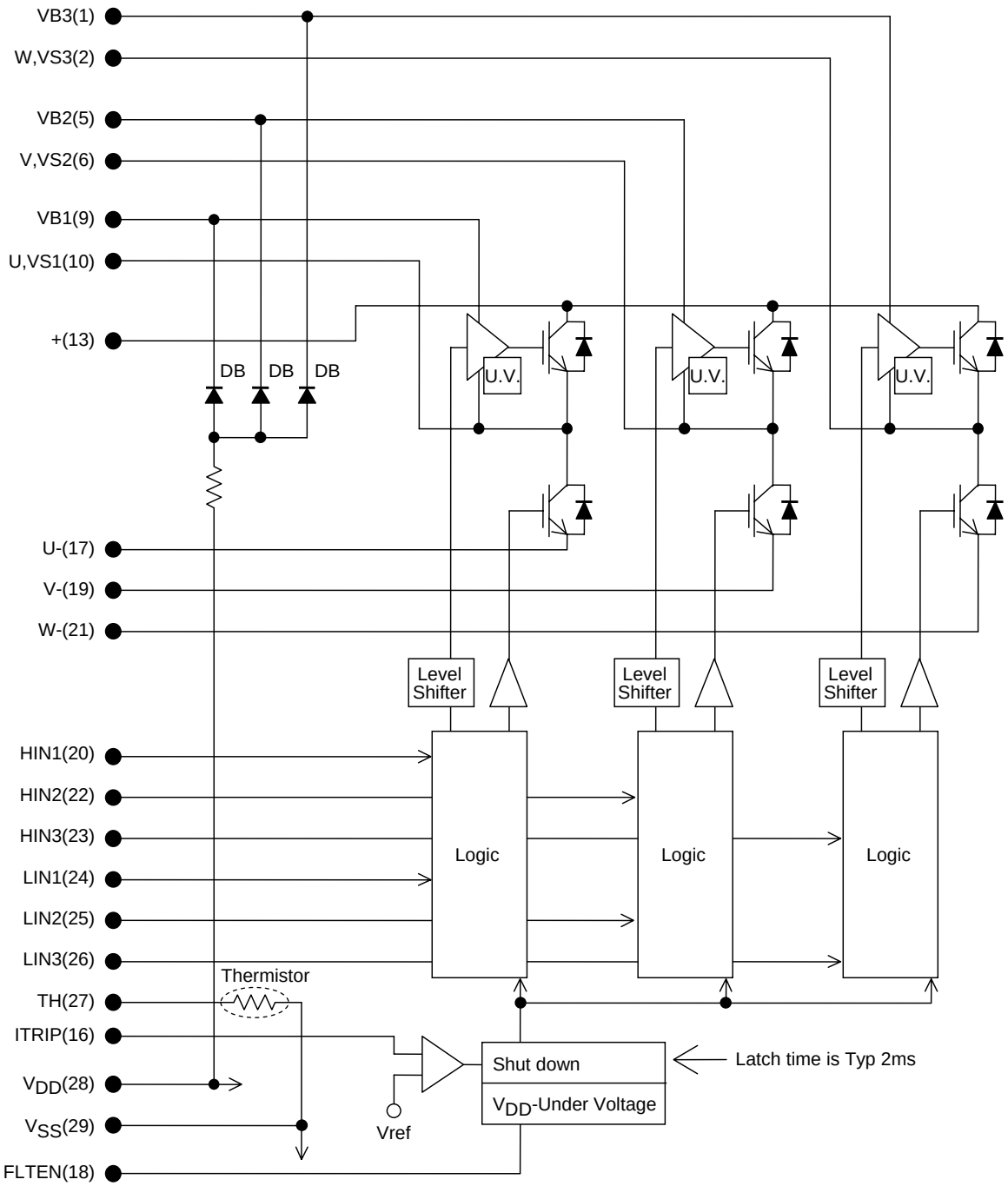
1. Input ON voltage turns on output stage and input OFF voltage turns off output stage.
   Apply voltage Vinth (max) to 15V to the V_{IN} (ON) pin to turn output stage on, and apply voltage 0V to Vinth (min) to the V_{IN} (OFF) pin to turn output stage off.
   *1 : "Input threshold voltage hysteresis" 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 FLTEN signal ON (When the FLTEN terminal is low level, FLTEN signal is ON state: output form is open DRAIN) but the FLTEN signal doesn't latch.
   After protection operation ends, it returns automatically within about 2ms and resumes operation beginning condition.
   So, after FLTEN 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 FLTEN 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 FLTEN signal with gate signal OFF.
   However, it is different from the protection operation of upper side, it automatically resets about 2ms 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.
5. When providing overcurrent protection using external resistors, it is necessary to select the resistance level so that the protection current level will be less than two times the rated output current level (I_O).

Package Dimensions

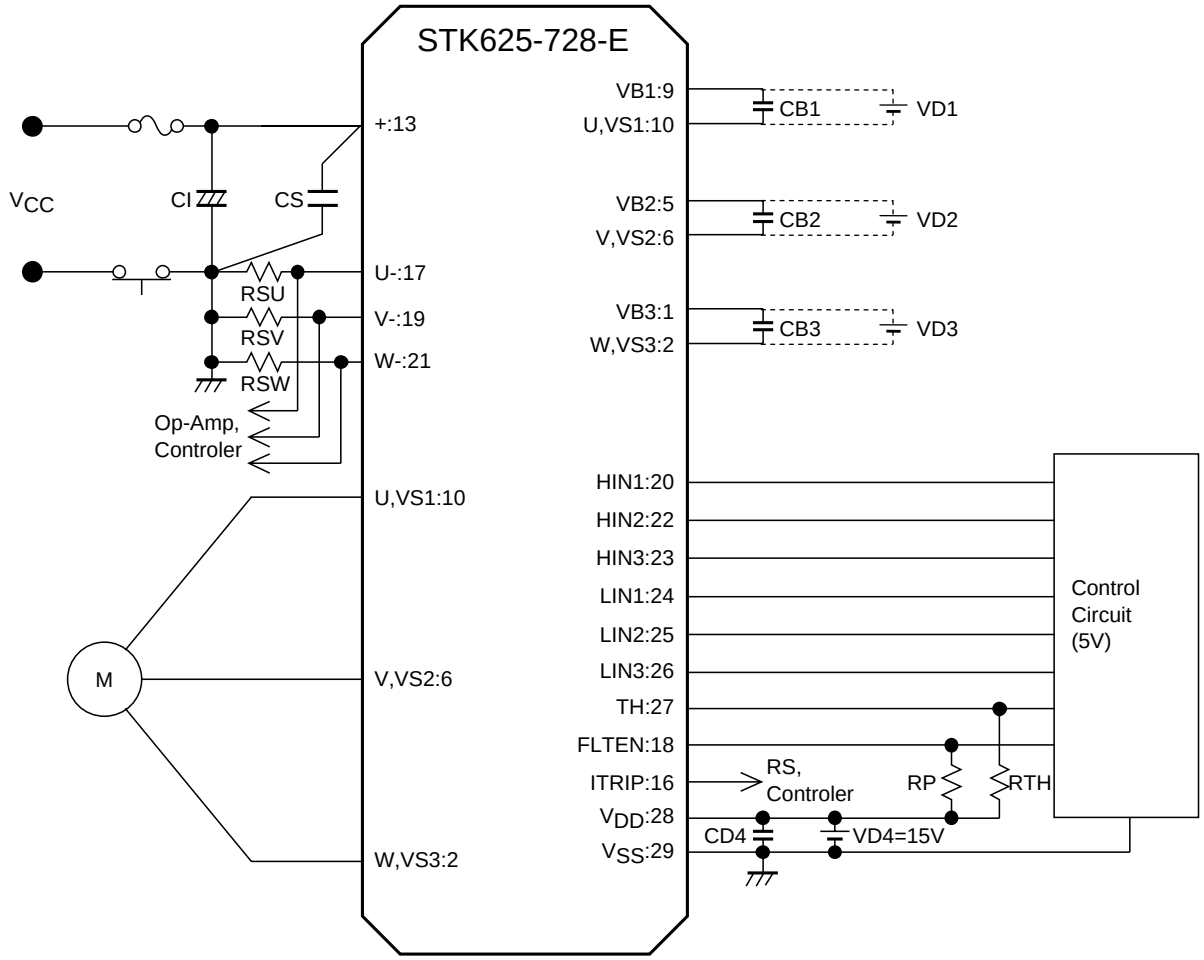
unit:mm (typ)



Internal equivalent circuit diagram



Example of the application circuit



Recommendation Operating Conditions

Parameter	Symbol	Conditions	min	typ	max	unit
Supply voltage	V_{CC}	+ - - (V -, W -) 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 turned ON (setting LIN1 to LIN3 in the lower side control signal input block to high) to charge CB.
   (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 + and U- (V-, W-) terminals, 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 Points of intersection between the + and U-, V- and W- terminals (or points of intersection in the stage after the shunt resistor if a shunt resistor is connected to each phase), and so on, with making a wiring length (among the terminals each from CI) short and making a wiring inductance small.

3. The FLTEN pin (pin 18) operates when the signal is low (open drain output). This pin is also used to shutdown the internal pre-driver, and when the input voltage is 3V or higher the pre-driver operates, when 0.8V or lower the operation is halted. To keep operation on, pull-up resistance is needed externally to have the FLTEN pin voltage to be pulled up 3V or higher. For the pull-up resistance, connect 6.8kΩ or larger capacitor when VP = 5V, 20kΩ or larger capacitor when VP = 15V.

4. A thermistor is connected between the TH terminal (pin 27) and V_{SS} terminal (pin 29) inside the IC. The substrate temperature can be monitored by connecting an external pull-up resistor (RTH).
   (the thermistor is for monitoring the temperature and the HIC itself does not have an overheat protection function.)
   Moreover, it must be noted that the thermistor is used only for monitoring the substrate temperature in the steady state of operation and it cannot handle instantaneous or local heat generation.

5. 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.

6. It is recommended that an overcurrent protection circuit using external shunt resistors be provided to protect the HIC from short-circuiting and other abnormal current conditions. For the safety, put a fuse, and so on in the V_{CC} line.

7. 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.

8. ITRIP pin (pin 16) functions as an internal comparator input pin, and apply voltage higher than the Vref voltage (0.44 to 0.55V) to halt the function. (For normal operation, apply voltage up to the Vref level). This pin is to be used to protection functions including overcurrent protection (as a feedback pin from external shunt resistor). Note that since the protection operation is not latched and typically in 2ms after the protection ends the HIC returns to normal operation, set the input signal low (OFF) as soon as the protection operation is detected.

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

The characteristics of the internal thermistor are given below.

Parameter	Symbol	Conditions	Ratings	unit
thermistor resistance	R25	Tc = 25°C	100±3%	kΩ
	R125	Tc = 125°C	2.52+11.1%/-9.9%	kΩ
B-constant (25-50°C)	B		4250±2%	k
Temperature range			-40 to +125	°C

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