Ordering number : EN*A1719

Preliminary

SANYO Semiconductors
DATA SHEET

STK611-730-E — Thick-Film Hybrid IC Fan 3-phase Inverter Motor Drive Inverter Hybrid IC

Overview

The STK611-730-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 fans, refrigerators, 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.)
- Overcurrent protection can be provided by adding an external shunt resistor.
- The built-in thermistor allows substrate temperature to be monitored.

Specifications

Absolute Maximum Ratings at Tc = 25°C

Parameter	Symbol	Conditions	Ratings	unit
Supply voltage	V_{CC}	+ - - terminal, surge < 500V *1	400	V
Collector-emitter voltage	V_{CE}	+ - U (V, W) terminal or U (V, W) - - terminal	500	V
Output current	I_O	+, -, U, V, W terminal current	±3	A
Output peak current	Iop	+, -, U, V, W terminal current P.W. = 100μs	±6	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/EN terminal voltage	VFAULT	FAULT/EN terminal	20	V
Maximum loss	Pd	MOSFET, Per 1 channel	12	W
Junction temperature	Tj	MOSFET 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	0.6	N•m

–/V_{SS} terminal voltage is the reference voltage unless otherwise specified.

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

*2 VD1 means voltage between VB1 and U terminals, VD2 between VB2 and V, VD3 between VB3 and W, and VD4 between V_{DD} and V_{SS}.

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

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

Parameter	Symbol	Conditions	min	typ	max	unit
Power output part						
Drain-to-source leak current	I_{DSS}	V_{DS} = 500V			0.1	mA
Boot-strap diode reverse current	IR (BD)	VR (BD) = 500V			0.1	mA
Drain-to-source on resistance	R_{DS} (on)	I_D = 3A		(1.5)		Ω
Diode forward voltage	V_{SD}	I_D = 3A			1.2	V
Boot-strap diode on resistance	RB			200		Ω
Junction-to-substrate thermal resistance	θj-c				10	°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
FAULT/EN clearness delay time	FLTCLR	After each protection operation ending		9		ms
Protection part						
Pre-drive low voltage protection	UVLO		10		12	V
Board Temperature Mounting resistance	Rt	Resistance between the TH and V_{SS} terminals	90	100	110	kΩ
FAULT/EN terminal input electric current	IOSD	During fault operations (low) VFAUT = 0.1V		0.5		mA
ITRIP terminal threshold voltage	VITRIP		0.37	0.46	0.55	V
Switching time	tON	I_O = 3A, Inductive load		(0.8)		μs
	tOFF			(0.9)		

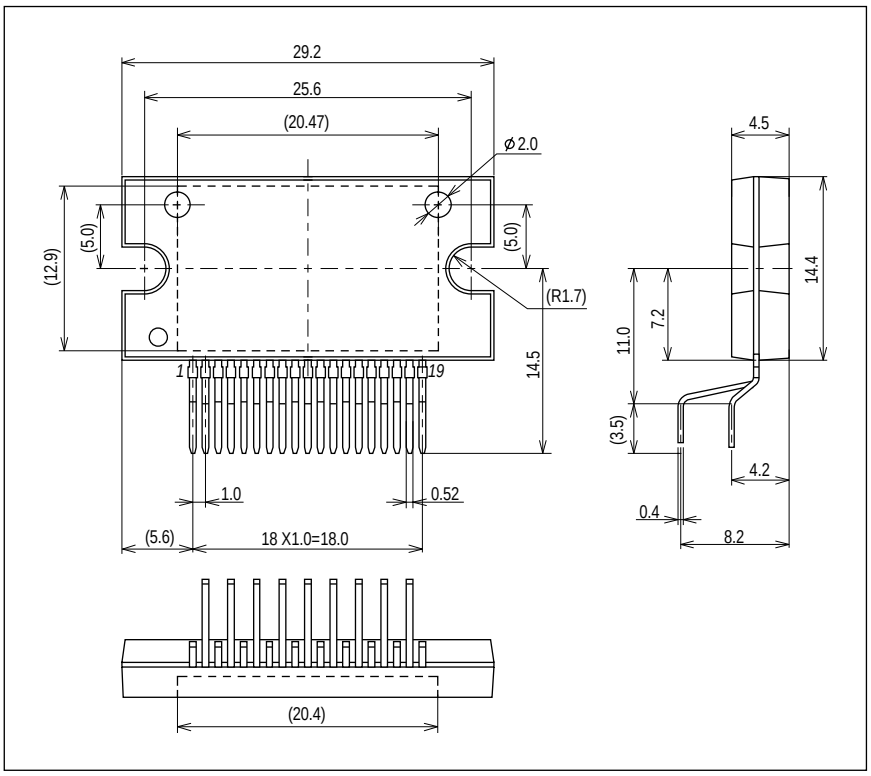
V_{SS} terminal voltage is the reference voltage unless otherwise specified.

Notes

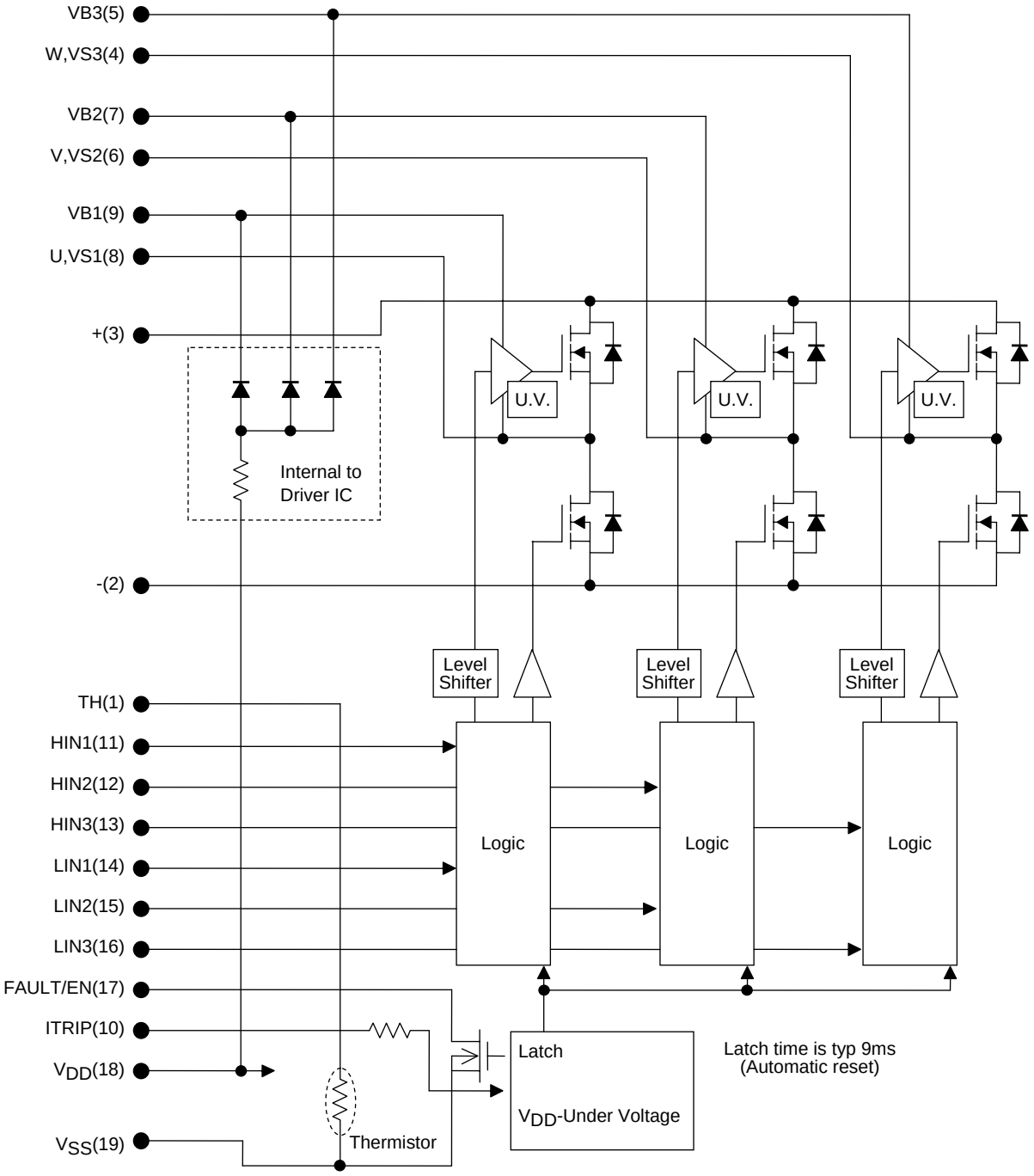
1. Input ON voltage turns on output stage and input OFF voltage turns off output stage.
   Apply voltage 3.0V to 5.0V to the V_{IN} (ON) pin to turn output stage on, and apply voltage 0V to 0.3V to the V_{IN} (OFF) pin to turn output stage off.
2. When the internal protection circuit operates, there is a FAULT/EN signal ON (When the FAULT/EN terminal is low level, FAULT/EN signal is ON state: output form is open DRAIN) but the FAULT/EN signal doesn't latch.
   After protection operation ends, it returns automatically within about 9ms and resumes operation beginning condition.
   So, after FAULT/EN 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 0.7V) is as follows.
   Upper side → There is no FAULT/EN 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 during input signal ON (High).
   Lower side → It outputs FAULT/EN signal with gate signal OFF.
   However, it is different from the protection operation of upper side, it 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 0.4N•m to 0.6N•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

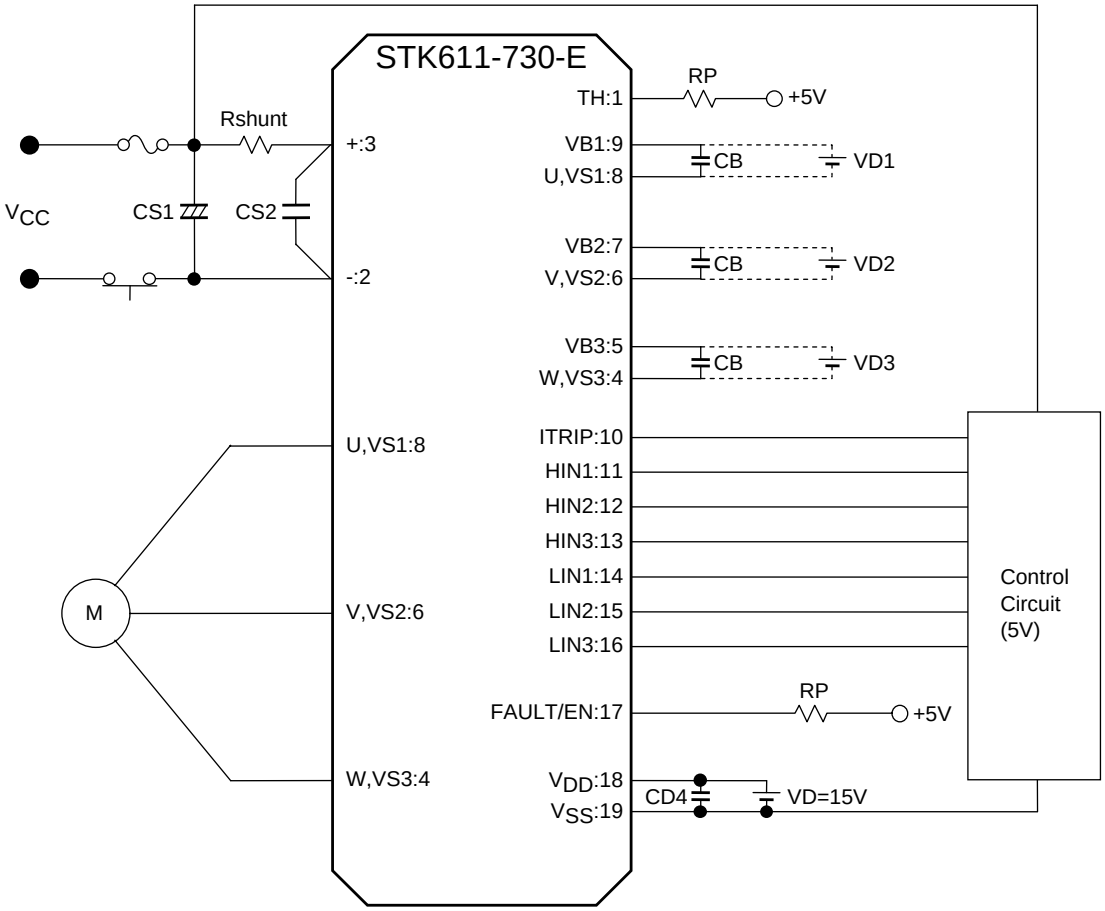
unit:mm (typ)



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		360	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	0.4		0.6	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/EN terminal is open DRAIN (it is operating as FAULT/EN when becoming low).
   This terminal is also used to serve as the shutdown function (which enables operation at a voltage of 2.5V or higher, and stops operation at a voltage of 0.8V or lower) for the internal pre-driver. Therefore, it must be pulled up externally so that the FAULT/EN terminal voltage is always 2.5V or higher.
   The resistance of the RP must be 6.8kΩ or higher at a pull-up voltage of 5V and 20kΩ or higher at a pull-up voltage of 15V.

4. A thermistor is connected between the TH terminal (pin 1) and V_{SS} terminal (pin 19) 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. 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. Because the IC sometimes destroys and bursts when motor connection terminal (4pin, 6pin, 8pin) becomes open while the motor turns, especially, be careful of the connection (the soldering condition) of this terminal.

7. The ITRIP terminal (pin 10) serves as an input terminal to the internal comparator. It is possible to stop the HIC by applying a voltage higher than or equal to Vref (0.44 to 0.54V) to this terminal. (During normal operation, the terminal must be held at a voltage equal to Vref or lower.) It must be used to provide overcurrent protection (feedback from the external shunt resistors) and other types of protection. The protection operation is not latched. After protection operation ends, the IC returns within about 2ms and resumes an operation beginning condition. So, after a protective operation is detected, turn OFF (low) all input signals at once.

8. 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.