

描述/Description

- XNS04H54D6是一款4A/600V半桥IPM，适用于先进的电机驱动应用，如节能风扇和泵。
XNS04H54D6 is a 4A, 600V half-bridge IPM designed for advanced appliance motor drive applications such as energy efficient fans and pumps.
- Xiner技术在隔离封装中提供了一种非常紧凑、高性能的半桥拓扑。
Xiner's technology offers an extremely compact, high performance half-bridge topology in an isolated package.
- 这种先进的IPM将Trench FS-IGBT、FRD、自举二极管和工业标准高压半桥驱动集成在小型PQFN封装内。
This advanced IPM offers a combination of Trench FS-IGBT、FRD、BSD and the industry benchmark half-bridge high voltage, rugged driver in a small PQFN package.
- 只有8x9mm面积，这种表面安装封装的紧凑的占位面积使其适合空间有限的应用。
At only 8x9mm and featuring integrated bootstrap functionality, the compact footprint of this surface mount package makes it suitable for applications that are space-constrained.
- XNS04H54D6应用时不需要散热片。
XNS04H54D6 functions without a heat sink.

主要特点

- 内置半桥驱动芯片
- 适用于正弦波或梯形波调制应用
- 沟槽栅场终止IGBT
- 封装内置自举二极管
- 双通道欠压保护
- 所有通道延迟时间匹配
- 优化的dV/dt和EMI特性
- 3.3V逻辑电平输入
- 输入正逻辑
- 绝缘电压1500VRMS min

Features

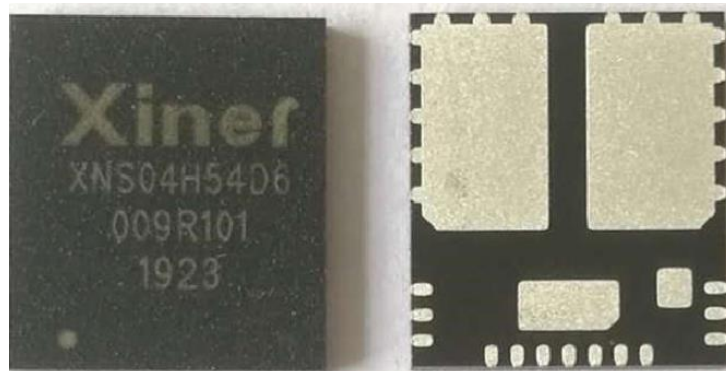
- Integrated gate drivers
- Suitable for sinusoidal or trapezoidal modulation
- Trench FS-IGBT
- Embedded Bootstrap Diode in the Package
- Under-voltage lockout for both channels
- Matched propagation delay for all channels
- Optimized dV/dt for loss and EMI trade offs
- 3.3V input logic compatible
- Active high HIN and LIN
- Isolation 1500VRMS min

应用

- 小功率电机

Applications

- Small Power AC Motor



绝对最大额定值 / Absolute Maximum Ratings

逆变器部分(单个IGBT, 除非另有说明) / Inverter Part (Each IGBT @ Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
V_{PN}	加在V+-V-之间的电源电压 DC Link Input Voltage		600	V
* I_{D25}	单个IGBT漏极持续电流 Each IGBT Drain Current, Continuous	$T_C = 25^\circ C$	4	A
* I_{D80}	单个IGBT漏极持续电流 Each IGBT Drain Current, Continuous	$T_C = 80^\circ C$	2.5	A
* I_{DP}	单个IGBT漏极峰值电流 Each IGBT Drain Current, Peak	$T_C = 25^\circ C, PW < 100 \mu s$	12	A
* P_D	最大功耗 Maximum Power Dissipation	$T_C = 25^\circ C, \text{ For Each IGBT}$	50	W

控制部分 / Control Part

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
V_{CC}	控制电源电压 Control Supply Voltage	施加在 V_{CC} 和COM之间 Applied Between V_{CC} and COM	25	V
V_{BS}	高端偏置电压 High-side Bias Voltage	施加在 V_B 和 V_S 之间 Applied Between V_B and V_S	25	V
V_{IN}	输入信号电压 Input Signal Voltage	施加在IN和COM之间 Applied Between IN and COM	$-0.3 \sim V_{CC} + 0.3$	V

自举二极管部分(单个二极管, 除非另有说明) / Bootstrap Diode Part (Each Bootstrap Diode Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
V_{RRMB}	最大重复反向电压 Maximum Repetitive Reverse Voltage		600	V
* I_{FB}	正向电流 Forward Current	$T_C = 25^\circ C$	0.5	A
* I_{FPB}	正向电流 (峰值) Forward Current (Peak)	$T_C = 25^\circ C, \text{ Under 1ms Pulse Width}$	1.5	A

热阻 / Thermal Resistance

符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
$R_{\theta JCT}$	节点-壳体顶部全部热阻 Junction to Case Top Total Thermal Resistance	逆变器工作条件下 Inverter Operating Condition	25	$^\circ C/W$
$R_{\theta JCB}$	节点-壳体底部热阻 Junction to Case Bottom Thermal Resistance	逆变器工作条件下的单个IGBT Each IGBT under Inverter Operating Condition	2.0	$^\circ C/W$

整个系统 / Total System

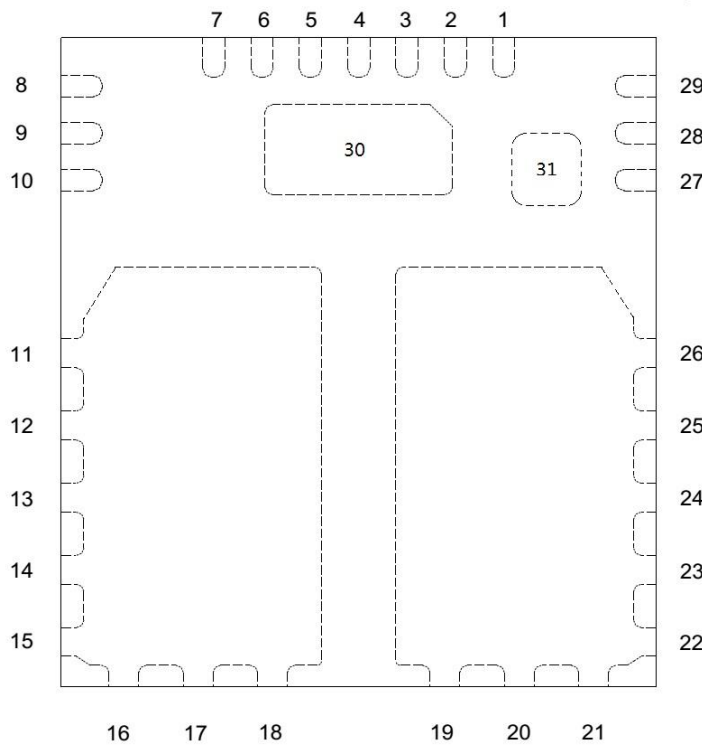
符号/Symbol	参数/Parameter	工作条件/ Conditions	额定值/Rating	单位/Unit
T_J	工作结温 Operating Junction Temperature		$-50 \sim 150$	$^\circ C$
T_S	焊接温度 (焊接30S) Lead Temperature (Soldering, 30 seconds)		~ 260	$^\circ C$
T_{STG}	存储温度 Storage Temperature		$-40 \sim 150$	$^\circ C$
V_{ISO}	绝缘电压 Isolation Voltage	60Hz, 正弦波, 1分钟, 连接基板到引脚 60 Hz, Sinusoidal, 1 minute, Connection Pins to Heatsink	1500	V_{rms}

注 / Note:

1. 标记“*”的为计算值或设计因素。 / Marking “*” Is Calculation Value or Design Factor

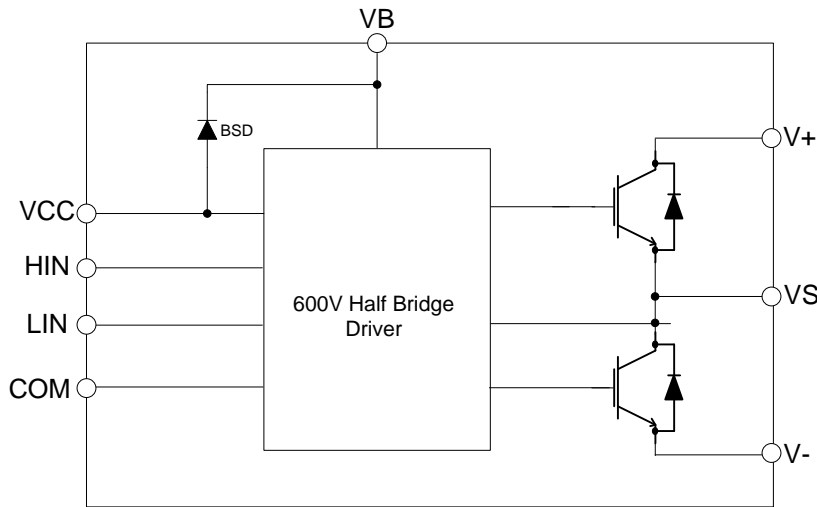
引脚描述 / Pin descriptions

引脚号/Pin Number	引脚名/Pin Name	引脚描述/ Pin Description
1, 4, 7, 30	COM	IC公共电源接地 IC Common Supply Ground
2	V _{CC}	低端IGBT驱动的偏压 Bias Voltage for IC and Low Side IGBT Driving
3	HIN	高端的信号输入 Signal Input for High-Side
5	LIN	低端的信号输入 Signal Input for Low-Side
6	N.C	无连接 N.C
8、9、10	V-	直流输入负端 Negative DC-Link Input
11-18	V _S	相输出 Phase Output
19-26	V+	直流输入正端 Positive DC-Link Input
27-28	V _S	相输出和高端IGBT驱动的偏压接地输出 Phase Output & Bias Voltage Ground for High Side IGBT Driving
29	V _B	高端IGBT驱动的偏压 Bias Voltage for High Side IGBT Driving
30	-	连接到COM To be connected to COM
31	-	连接到VB To be connected to VB



Top view

内部框图 / Internal Block Diagram



注 / Note:

低端IGBT的源极端子与IPM中的电源接地或偏压接地不连接。

Source Terminal of Each Low-Side IGBT is Not Connected to Supply Ground or Bias Voltage Ground Inside IPM.

电气特性($T_J=25^\circ\text{C}$, $V_{CC}=V_{BS}=15\text{V}$, 除非另有说明) / **Electrical Characteristics** ($T_J=25^\circ\text{C}$, $V_{CC}=V_{BS}=15\text{V}$ Unless Otherwise Specified)

逆变器部分(单个IGBT, 除非另有说明) / **Inverter Part** (Each IGBT @ Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
BV_{DSS}	漏极-源极击穿电压 Drain-Source Breakdown Voltage	$V_{IN}=0\text{V}$, $I_D=250\mu\text{A}$ (Note 1)	600	-	-	V
I_{DSS}	零栅极电压漏极电流 Zero Gate Voltage Drain Current	$V_{IN}=0\text{V}$, $V_{DS}=600\text{V}$	-	10	-	μA
$V_{CE(SAT)}$	集电极-发射极饱和电压 Collector-Emitter Saturation Voltage	$V_{CC}=V_{BS}=15\text{V}$, $V_{IN}=5\text{V}$	-	2.1	2.3	V
		$I_C=4\text{A}$, $T_J=125^\circ\text{C}$,	-	2.3	2.5	
V_{SD}	漏极-源极二极管正向导通电压 Drain-Source Diode Forward Voltage	$V_{CC}=V_{BS}=15\text{V}$, $V_{IN}=0\text{V}$, $I_D=-4\text{A}$	-	1.3	1.5	V
t_{ON}	开关时间 Switching Times	$V_{PN}=400\text{V}$, $V_{CC}=V_{BS}=15\text{V}$, $I_D=4\text{A}$ $V_{IN}=0\text{V} \leftrightarrow 5\text{V}$, 高端和低端IGBT开关(注2) / High- and Low-Side IGBT Switching(Note 2)	-	0.75	-	μs
t_{OFF}			-	0.95	-	μs
t_{rr}			-	100	-	ns
E_{ON}			-	500	-	μJ
E_{OFF}			-	150	-	μJ
DT			内置死区时间 Built-in Dead Time	$V_{CC}=V_{BS}=13.5 \sim 16.5\text{V}$, $T_J \leq 150^\circ\text{C}$	-	300
$T_{FIL,IN}$	输入滤波时间 Input Filter Time(HIN,LIN)	$V_{CC}=V_{BS}=13.5 \sim 16.5\text{V}$, $T_J \leq 150^\circ\text{C}$	-	300	-	ns
$RBSOA$	反向偏压安全工作区 Reverse-Bias Safe Operating Area	$V_{PN}=400\text{V}$, $V_{CC}=V_{BS}=15\text{V}$, $I_D=I_{DP}$, $V_{DS}=BV_{DSS}$, $T_J=150^\circ\text{C}$, 高端和低端IGBT开关(注3) / High- and Low-Side IGBT Switching (Note 3)	整个区域 Full Square			

控制部分 / Control Part

符号/Symbol	参数/Parameter	工作条件/ Conditions		最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
I _{QCC}	V _{CC} 静态电流 Quiescent V _{CC} Current	V _{CC} =15 V, V _{IN} =0V	施加在V _{CC} 和COM之间 Applied Between V _{CC} and COM	-	0.76	1	mA
I _{QBS}	V _{BS} 静态电流 Quiescent V _{BS} Current	V _{BS} =15 V, V _{IN} =0V	施加在V _{B(U)} -U, V _{B(V)} -V, V _{B(W)} -W Applied Between V _{B(U)} -U, V _{B(V)} -V, V _{B(W)} -W	-	70	85	uA
UV _{CCD}	低端欠压保护 (图8) Low-Side Undervoltage Protection (Figure 8)	V _{CC} 欠压保护检测电平 V _{CC} Undervoltage Protection Detection Level		7.3	8.1	9	V
UV _{CCR}		V _{CC} 欠压保护复位电平 V _{CC} Undervoltage Protection Reset Level		7.8	8.6	9.4	V
UV _{BSD}	高端欠压保护 (图9) High-Side Undervoltage Protection (Figure 9)	V _{BS} 欠压保护检测电平 V _{BS} Undervoltage Protection Detection Level		6.3	7.2	8	V
UV _{BSR}		V _{BS} 欠压保护复位电平 V _{BS} Undervoltage Protection Reset Level		7	7.8	8.6	V
V _{IH}	导通阈值电压 ON Threshold Voltage	逻辑高电平 Logic High Level	施加在V _{IN} 和COM之间 Applied between IN and COM	-	-	2.8	V
V _{IL}	关断阈值电压 OFF Threshold Voltage	逻辑低电平 Logic Low Level		0.6	-	-	V
I _{IN+}	输入偏置电流V _{IN} =5V Input Bias Current V _{IN} =5V	施加在V _{IN} 和COM之间 Applied between IN and COM			10	20	uA
I _{IN-}	输入偏置电流V _{IN} =0V Input Bias Current V _{IN} =0V				0	1	uA

注/Note:

- BV_{DSS}是IPM产品中单个IGBT/FRD的集电极和发射极端子之间的绝对最大额定电压。考虑到寄生电感, V_{PN}应远低于该值, 因此V_{PN}在任何情况下不得超过BV_{DSS}。
BV_{DSS} is the Absolute Maximum Voltage Rating Between Collector and Emitter Terminal of Each IGBT/FRD Inside IPM. V_{PN} Should be Sufficiently Less Than This Value Considering the Effect of the Stray Inductance so that V_{DS} Should Not Exceed BV_{DSS} in Any Case.
- t_{ON}和t_{OFF}包括内部驱动IC的传输延迟。所列出的数值是在实验室条件下测得, 在实际应用中因为印刷电路板和布线的差异, 数值也会有所不同。
t_{ON} and t_{OFF} Include the Propagation Delay Time of the Internal Drive IC. Listed Values are Measured at the Laboratory Test Condition, and They Can be Different According to the Field Applications Due to the Effect of Different Printed Circuit Boards and Wirings.
- 每个IGBT在开关工作时的峰值电流和电压也应在安全工作区 (SOA) 的范围内。
The peak current and voltage of each IGBT during the switching operation should be included in the safe operating area (SOA).

自举二极管部分(单个二极管, 除非另有说明) / Bootstrap Diode Part(Each Bootstrap Diode Unless Otherwise Specified)

符号/Symbol	参数/Parameter	工作条件/ Conditions	最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
V _{FB}	正向电压 Forward Voltage	I _F = 0.1 A, T _C = 25°C (注 5) I _F = 0.1 A, T _C = 25°C (Note 5)	-	4.5	-	V
t _{rrB}	反向恢复时间 Reverse Recovery Time	I _F = 0.1 A, T _C = 25°C	-	80	-	ns

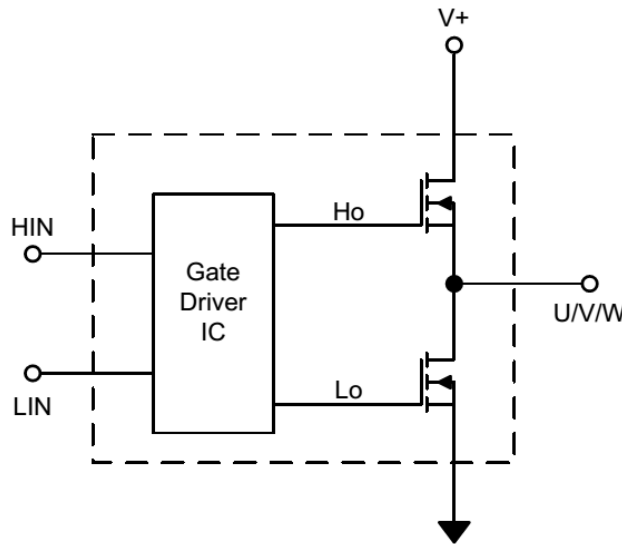
推荐工作条件 / Recommended Operating Condition

符号/Symbol	参数/Parameter	工作条件/ Conditions	最小值 /Min	典型值 /Typ	最大值 /Max	单位 /Unit
V _{PN}	电源电压 Supply Voltage	施加在V+和V-之间 Applied Between P and N	-	300	400	V
V _{CC}	控制电源电压 Control Supply Voltage	施加在V _{CC} 和COM之间 Applied Between V _{CC} and COM	13.5	15	16.5	V
V _{BS}	高端偏压 High-Side Bias Voltage	施加在V _B 和V _S 之间 Applied Between V _B and V _S	13.5	15	16.5	V
V _{IN(ON)}	输入导通阈值电压 Input ON Threshold Voltage	施加在V _{IN} 和COM之间 Applied Between IN and COM	3.0	-	V _{CC}	V
V _{IN(OFF)}	输入关断阈值电压 Input OFF Threshold Voltage		0	-	0.6	V
t _{dead}	防止桥臂直通的死区时间 Blanking Time for Preventing Arm-Short	V _{CC} =V _{BS} = 13.5 ~ 16.5 V, T _J ≤ 150°C	1	-	-	us
f _{PWM}	PWM开关频率 PWM Switching Frequency	T _J ≤ 150°C	-	15	20	kHz

质量信息 / Qualification Information

质量等级 Qualification Level	工业 Industrial	
湿度敏感等级 Moisture Sensitivity Level	MSL3	
静电 ESD	机器模型 Machine Model	Class B
	人体模型 Human Body Model	Class 1C
ROHS指令 RoHS Compliant	是 Yes	

输入输出逻辑表 / Input-Output Logic Level Table



HIN	LIN	U,V,W
HI	LO	V+
LO	HI	0
HI	HI	**
LO	LO	*

* V+ if motor current is flowing into VS, 0 if current is flowing out of VS into the motor winding

** Anti Shoot-through protection active (LO, HO are switched off)

参考波形 / Referenced Figures

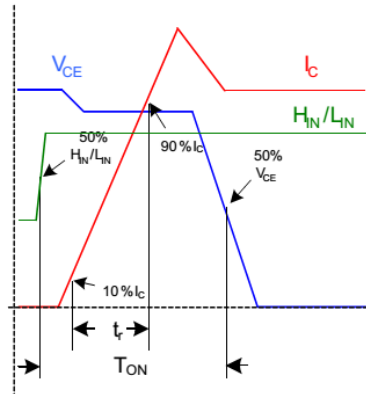


Figure 1a. Input to Output propagation turn-on delay time.

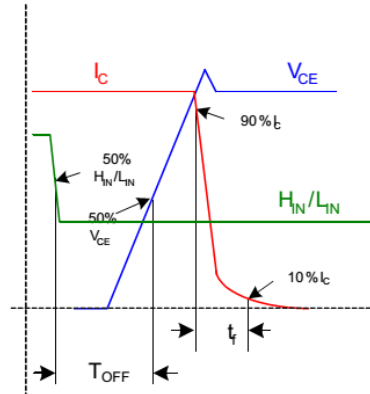


Figure 1b. Input to Output propagation turn-off delay time.

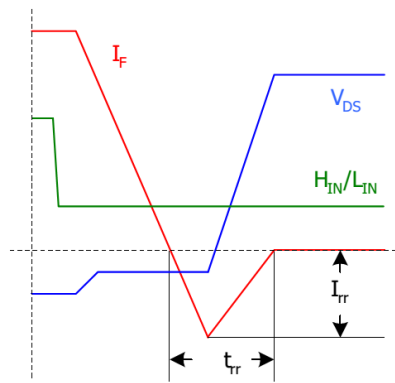
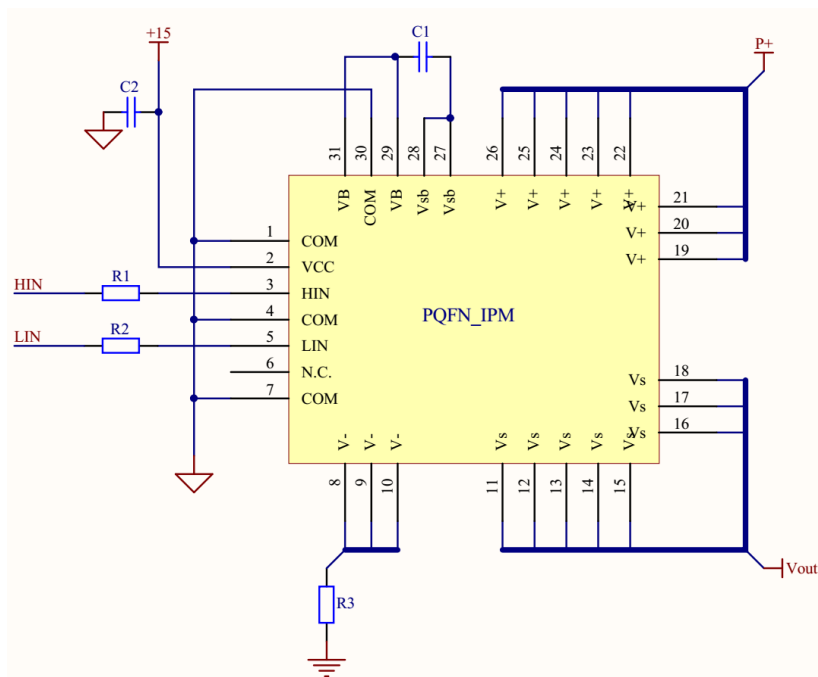
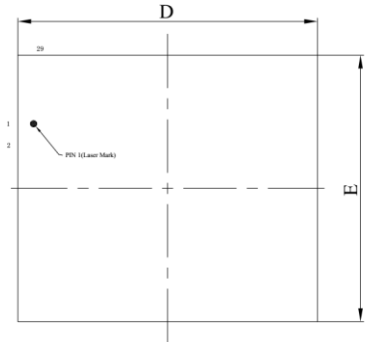


Figure 1c. Diode Reverse Recovery.

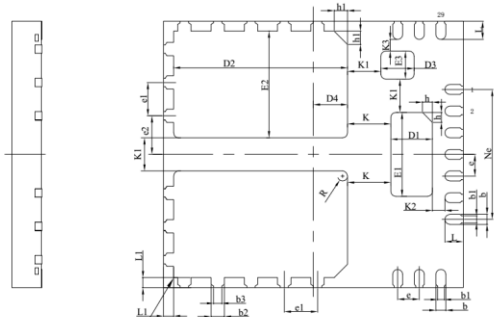
参考电路 / Referenced Circuit



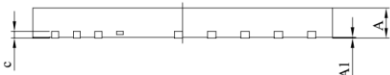
轮廓封装 / Package Outline



TOP VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.85	0.90	0.95
A1	0.00	0.02	0.05
b	0.25	0.30	0.35
b1	0.21REF		
b2	0.35	0.40	0.45
b3	0.25REF		
c	0.203REF		
D	8.90	9.00	9.10
D1	1.15	1.25	1.35
D2	5.125	5.225	5.325
D3	0.90	1.00	1.10
D4	0.925	1.025	1.125
e	0.65BSC		
e1	1.00BSC		
e2	1.16BSC		
E	7.90	8.00	8.10
E1	2.42	2.52	2.62
E2	3.10	3.20	3.30
E3	0.74	0.84	0.94
Ne	3.90BSC		
L	0.50	0.55	0.60
L1	0.25	0.30	0.35
K	1.30REF		
K1	1.00REF		
K2	0.375REF		
K3	0.35REF		
h	0.25	0.30	0.35
h1	0.35	0.40	0.45
R	0.15REF		

** 特殊设计: 无;

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封装打标和订货信息/Package Marking & Ordering Information

Device Marking	Device	Package	Packing Type	Quantity
XNS04H54D6	XNS04H54D6	PQFN 8×9	Tray	264

版本历史 /Revision history

Revision	Changes
1.0	初版发布
1.1	修正参数

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