

- Perform Fixed-Rate or Variable-Rate Frequency Division
- For Applications in Arithmetic, Radar, Digital-to-Analog (D/A), Analog-to-Digital (A/D), and other Conversion Operations
- Typical Maximum Clock Frequency . . . 32 MHz

### description

These monolithic, fully synchronous, programmable counters utilize Series 54/74 TTL circuitry to achieve 32-megahertz typical maximum operating frequencies. These decade counters feature buffered clock, clear, enable and set-to-nine inputs to control the operation of the counter, and a strobe input to enable or inhibit the rate input/decoding AND-OR-INVERT gates. The outputs have additional gating for cascading and transferring unity-count rates.

The counter is enabled when the clear, strobe set-to-nine, and enable inputs are low. With the counter enabled, the output frequency is equal to the input frequency multiplied by the rate input  $M$  and divided by 10, i.e.:

$$f_{out} = \frac{M \cdot f_{in}}{10}$$

where:  $M = B_3 \cdot 2^3 + B_2 \cdot 2^2 + B_1 \cdot 2^1 + B_0 \cdot 2^0$   
for decimal zero through nine.

When the rate input is binary 0 (all rate inputs low),  $Z$  remains high. In order to cascade devices to perform two-decade rate multiplication (0-99), the enable output is connected to the enable and strobe inputs of the next stage, the  $Z$  output of each stage is connected to the unity/cascade input of the other stage, and the sub-multiple frequency is taken from the  $Y$  output. For longer words, see typical application data, Figure 1.

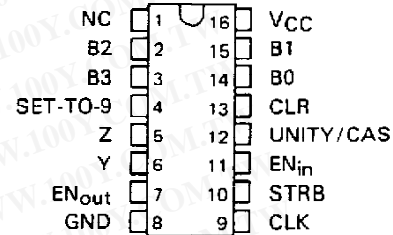
The unity/cascade input, when connected to the clock input, may be utilized to pass the clock frequency (inverted) to the  $Y$  output when the rate input/decoding gates are inhibited by the strobe. The unity/cascade input may also be used as a control for the  $Y$  output.

All of the inputs of these counters are diode-clamped, and each input, except the clock input, represents one normalized Series 54/74 load. The buffered clock input, used with the strobe gate, is only two Series 54/74 loads. Full fan-out to 10 Series 54/74 loads is available from each of the output. These devices are completely compatible with most TTL and DTL families. Typical dissipation is 270 milliwatts. The SN54167 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ , and the SN74167 is characterized for operation from  $0^\circ\text{C}$  to  $70^\circ\text{C}$ .

SN54167 . . . J OR W PACKAGE

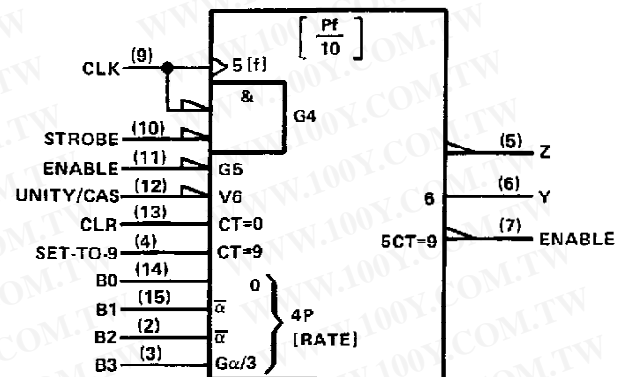
SN74167 . . . N PACKAGE

(TOP VIEW)



NC—No internal connection

### logic symbol†



† This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS  
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

勝特力材料 886-3-5753170  
 勝特力电子(上海) 86-21-54151736  
 勝特力电子(深圳) 86-755-83298787

Http://www.100y.com.tw

# SN54167, SN74167 SYNCHRONOUS DECADE RATE MULTIPLIERS

STATE AND/OR RATE FUNCTION TABLE (See Note A)

INPUTS									OUTPUTS			NOTES
CLEAR	ENABLE	STROBE	BCD RATE				NUMBER OF CLOCK PULSES	UNITY/ CASCADE	LOGIC LEVEL OR NUMBER OF PULSES			
			B3	B2	B1	B0			Y	Z	ENABLE	
H	X	H	X	X	X	X	X	H	L	H	H	B
L	L	L	L	L	L	L	10	H	L	H	1	C
L	L	L	L	L	L	H	10	H	1	1	1	C
L	L	L	L	L	H	L	10	H	2	2	1	C
L	L	L	L	L	H	H	10	H	3	3	1	C
L	L	L	L	H	L	L	10	H	4	4	1	C
L	L	L	L	H	L	H	10	H	5	5	1	C
L	L	L	L	H	H	L	10	H	6	6	1	C
L	L	L	L	H	H	H	10	H	7	7	1	C
L	L	L	H	L	L	L	10	H	8	8	1	C
L	L	L	H	L	L	H	10	H	9	9	1	C
L	L	L	H	L	H	L	10	H	8	8	1	C, D
L	L	L	H	L	H	H	10	H	9	9	1	C, D
L	L	L	H	H	L	L	10	H	8	8	1	C, D
L	L	L	H	H	L	H	10	H	9	9	1	C, D
L	L	L	H	H	H	L	10	H	8	8	1	C, D
L	L	L	H	H	H	H	10	H	9	9	1	C, D
L	L	L	H	L	L	H	10	L	H	9	1	E

NOTES: A. H = high level, L = low level, X = irrelevant. All remaining entries are numeric counts.

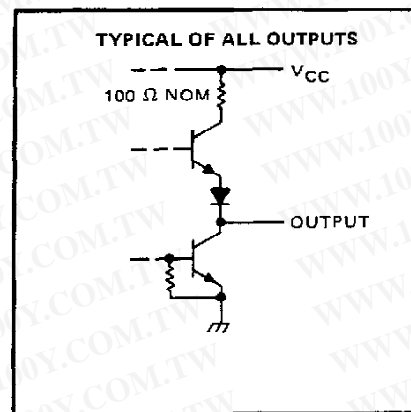
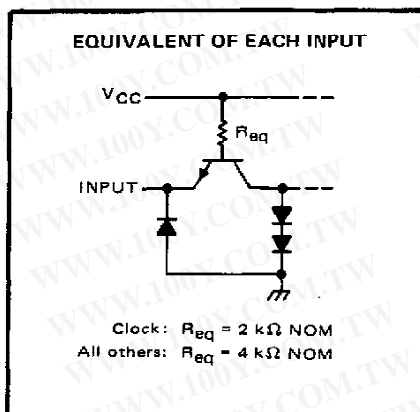
B. This is a simplified illustration of the clear function. The states of clock and strobe can affect the logic level of Y and Z. A low unity/cascade will cause output Y to remain high.

C. Each rate illustrated assumes a constant value at rate inputs; however, these illustrations in no way prohibit variable-rate inputs.

D. These input conditions exceeded the range of the decimal rate inputs.

E. Unity/cascade can be used to inhibit output Y.

## schematics of inputs and outputs



勝特力材料 886-3-5753170  
 勝特力电子(上海) 86-21-54151736  
 勝特力电子(深圳) 86-755-83298787  
[Http://www.100y.com.tw](http://www.100y.com.tw)

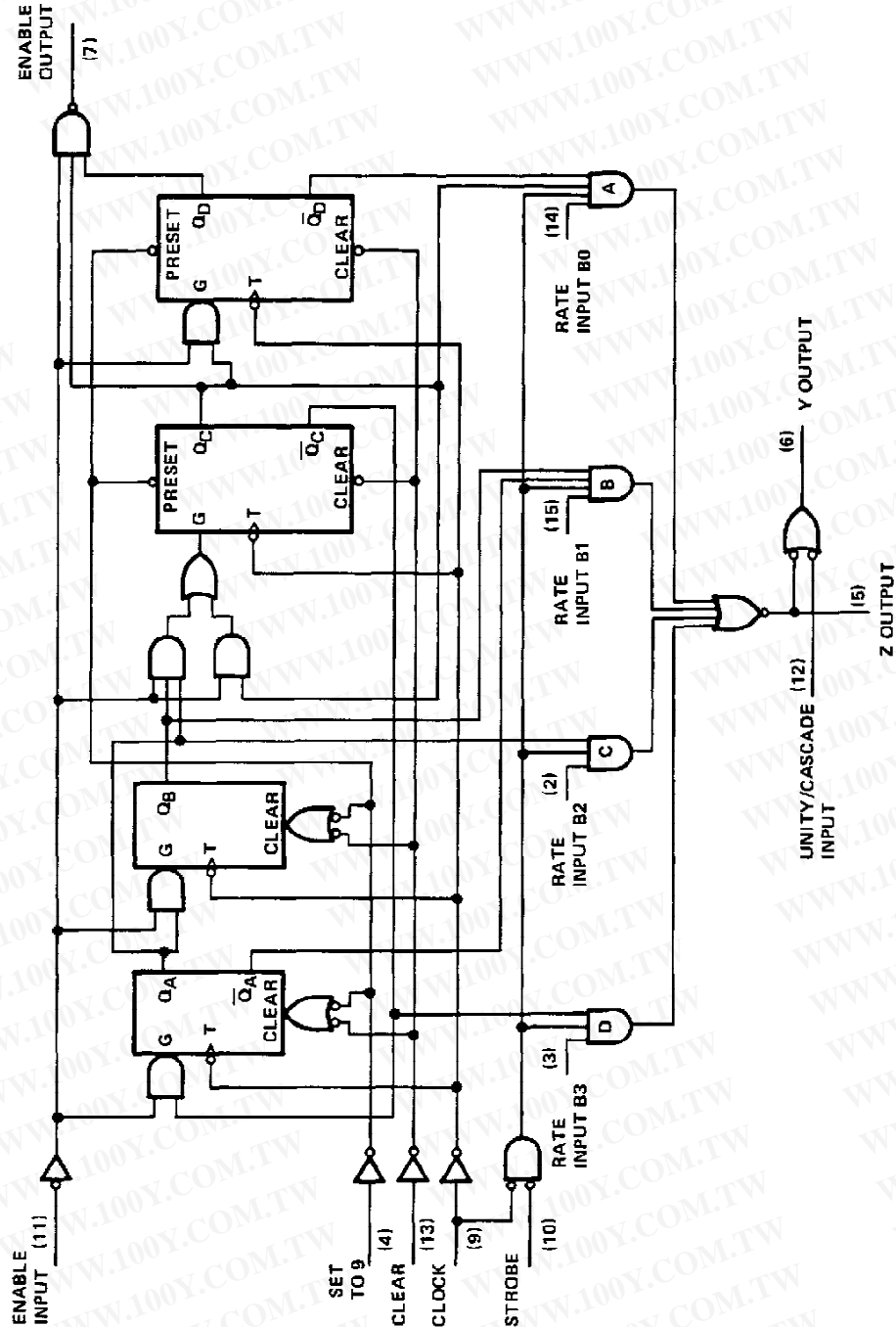
TEXAS  
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

勝特力材料 886-3-5753170  
 勝特力电子(上海) 86-21-54151736  
 勝特力电子(深圳) 86-755-83298787  
 Http://www.100y.com.tw

**SN54167, SN74167**  
**SYNCHRONOUS DECADE RATE MULTIPLIERS**

logic diagram (positive logic)



**TEXAS**  
**INSTRUMENTS**

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54167, SN74167**  
**SYNCHRONOUS DECADE RATE MULTIPLIERS**

勝特力材料 886-3-5753170  
 勝特力电子(上海) 86-21-54151736  
 勝特力电子(深圳) 86-755-83298787  
 Http://www.100y.com.tw

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage	5.5 V
Operating free-air temperature range: SN54167	-55°C to 125°C
SN74167	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54167		SN74167		UNIT		
	MIN	NOM MAX	MIN	NOM MAX			
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
High-level output current, $I_{OH}$			-400			-400	$\mu$ A
Low-level output current, $I_{OL}$			16			16	mA
Clock frequency, $f_{clock}$	0		25	0		25	MHz
Width of clock pulse, $t_{w(clock)}$	20			20			ns
Width of clear pulse, $t_{w(clear)}$	15			15			ns
Width of set-to-nine pulse $t_{w(set-to-9)}$	15			15			ns
Enable setup time, $t_{SU}$ : From positive-going transition of clock pulse From negative-going transition of previous clock pulse	25			25			ns
	0	$t_{w(clock)}-10$		0	$t_{w(clock)}-10$		ns
Enable hold time, $t_H$ : From positive-going transition of clock pulse From negative-going transition of previous clock pulse	0	$t_{w(clock)}-10$		0	$t_{w(clock)}-10$		ns
	20	$t_{cp}-10$		20	$t_{cp}-10$		ns
Operating free-air temperature, $T_A$	-55		125	0		70	°C

NOTE 2:  $t_{w(clock)}$  is the interval in which the clock is high.  $t_{cp}$  is the total clock cycle starting with a negative transition. See Figure 1 on SN5497, SN7497 data sheet.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
$V_{IH}$	High-level input voltage		2			V
$V_{IL}$	Low-level input voltage				0.8	V
$V_I$	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$			-1.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -400 \mu\text{A}$	2.4	3.4		V
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$		0.2	0.4	V
$I_I$	Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1	mA
$I_{IH}$	High-level input current	clock input			80	$\mu$ A
		other inputs	$V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$		40	$\mu$ A
$I_{IL}$	Low-level input current	clock inputs			-3.2	mA
		other inputs	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$		-1.6	mA
$I_{OS}$	Short circuit output current§	$V_{CC} = \text{MAX}$	-18		-55	mA
$I_{CCH}$	Supply current, output high	$V_{CC} = \text{MAX},$ See Note 3		43		mA
$I_{CCL}$	Supply current, output low	$V_{CC} = \text{MAX},$ See Note 4		65	99	mA

NOTES: 3.  $I_{CCH}$  is measured with outputs open and all inputs low.

4.  $I_{CCL}$  is measured with outputs open and all inputs high except the set-to-nine input which is low.

† For test conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable device type.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time.

TEXAS  
 INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54167, SN74167**  
**SYNCHRONOUS DECADE RATE MULTIPLIERS**

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETERS†	FROM INPUT	TO OUTPUT	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$f_{\max}$			$C_L = 15\text{ pF}$ , $R_L = 400\ \Omega$ , See Note 5	25	32		MHz	
$t_{PLH}$	Enable	Enable			13	20		ns
$t_{PHL}$					14	21		
$t_{PLH}$	Strobe	Z			12	18		ns
$t_{PHL}$					15	23		
$t_{PLH}$	Clock	Y			26	39		ns
$t_{PHL}$					20	30		
$t_{PLH}$	Clock	Z			12	18		ns
$t_{PHL}$					17	26		
$t_{PLH}$	Rate	Z			9	14		ns
$t_{PHL}$					6	10		
$t_{PLH}$	Unity/Cascade	Y			9	14		ns
$t_{PHL}$					6	10		
$t_{PLH}$	Strobe	Y			19	30		ns
$t_{PHL}$					22	33		
$t_{PLH}$	Clock	Enable			19	30		ns
$t_{PHL}$					22	33		
$t_{PLH}$	Clear	Y			24	36		ns
$t_{PHL}$		Z			15	23		
$t_{PHL}$	Set-to-9	Enable			18	27		ns
$t_{PLH}$	Any Rate Input	Y		15	23		ns	
$t_{PHL}$					15	23		

†  $f_{\max}$  is maximum clock frequency.

$t_{PLH}$  is propagation delay time, low-to-high-level output.

$t_{PHL}$  is propagation delay time, high-to-low-level output.

NOTE 5: Load circuit, voltage waveforms, and input conditions for measuring switching characteristics are the same as those for the SN5497 and SN7497.

勝特力材料 86-3-5753170  
 勝特力电子(上海) 86-21-54151736  
 勝特力电子(深圳) 86-755-83298787  
[Http://www.100y.com.tw](http://www.100y.com.tw)



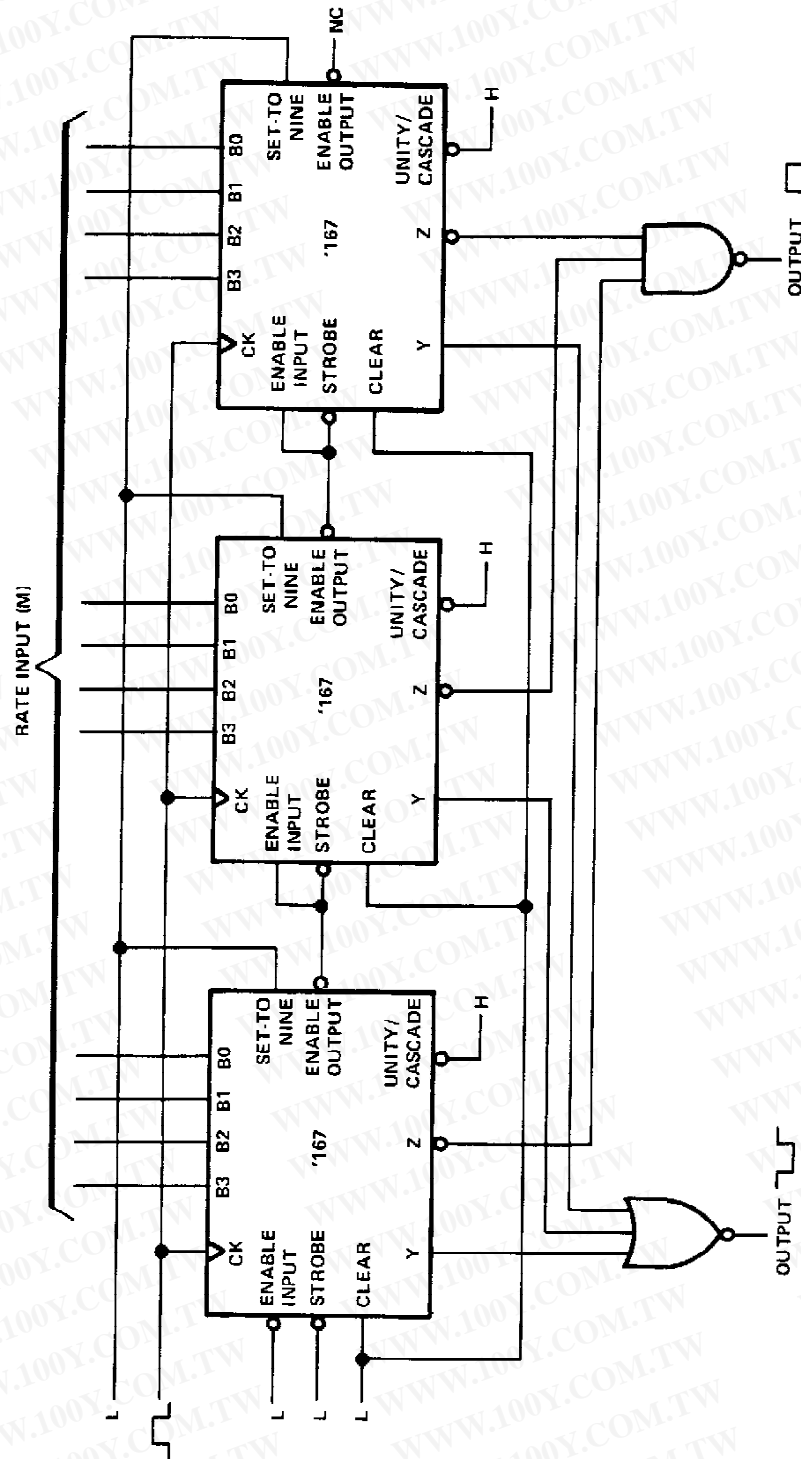
POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

**SN54167, SN74167  
SYNCHRONOUS DECADE RATE MULTIPLIERS**

勝特力材料 886-3-5753170  
 勝特力电子(上海) 86-21-54151736  
 勝特力电子(深圳) 86-755-83298787  
[Http://www.100y.com.tw](http://www.100y.com.tw)

**TYPICAL APPLICATION DATA**

This application demonstrates how the decimal-rate multipliers may be cascaded for longer words. Three decades are illustrated (0.999 to 999) although longer words can be implemented by using the pattern shown. The output is decoded either from output Y with a NOR gate or from output Z with a NAND gate. Either method of decoding produces the complement of the output used.



## IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.

Copyright © 1996, Texas Instruments Incorporated

勝特力材料 886-3-5753170  
勝特力电子(上海) 86-21-54151736  
勝特力电子(深圳) 86-755-83298787  
[Http://www.100y.com.tw](http://www.100y.com.tw)

## IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.

Copyright © 1998, Texas Instruments Incorporated

勝特力材料 886-3-5753170  
勝特力电子(上海) 86-21-54151736  
勝特力电子(深圳) 86-755-83298787  
[Http://www.100y.com.tw](http://www.100y.com.tw)