National Semiconductor

August 1995

54F/74F189 64-Bit Random Access Memory with TRI-STATE® Outputs

General Description

The 'F189 is a high-speed 64-bit RAM organized as a 16-word by 4-bit array. Address inputs are buffered to minimize loading and are fully decoded on-chip. The outputs are TRI-STATE and are in the high impedance state whenever the Chip Select ($\overline{CS}$) input is HIGH. The outputs are active only in the Read mode and the output data is the complement of the stored data.

Features

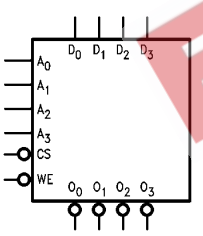
- TRI-STATE outputs for data bus applications
- Buffered inputs minimize loading
- Address decoding on-chip
- Diode clamped inputs minimize ringing
- Available in SOIC, (300 mil only)

Commercial	Military	Package Number	Package Description
74F189PC		N16E	16-Lead (0.300″ Wide) Molded Dual-In-Line
	54F189DL (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F189SC (Note 1)		M16A	16-Lead (0.150″ Wide) Molded Small Outline, JEDEC
74F189SJ (Note 1)		M16D	16-Lead (0.300″ Wide) Molded Small Outline, EIAJ
	54F189FL (Note 2)	W16A	16-Lead Cerpack
	54F189LL (Note 2)	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

Note 1: Devices also available in 13″ reel. Use suffix = SCX and SJX.

Note 2: Military grade device with environmental and burn-in processing. Use suffix = DLQB, FLQB and LLQB.

Logic Symbols



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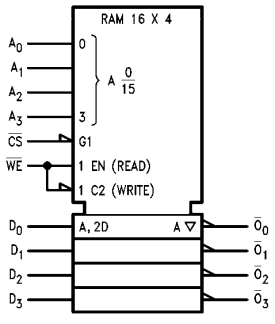
IEEE/IEC



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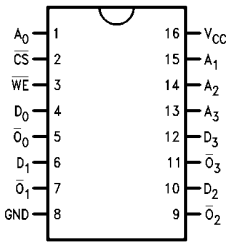
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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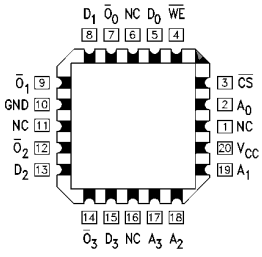
Pin Assignment for LCC



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Unit Loading/Fan Out

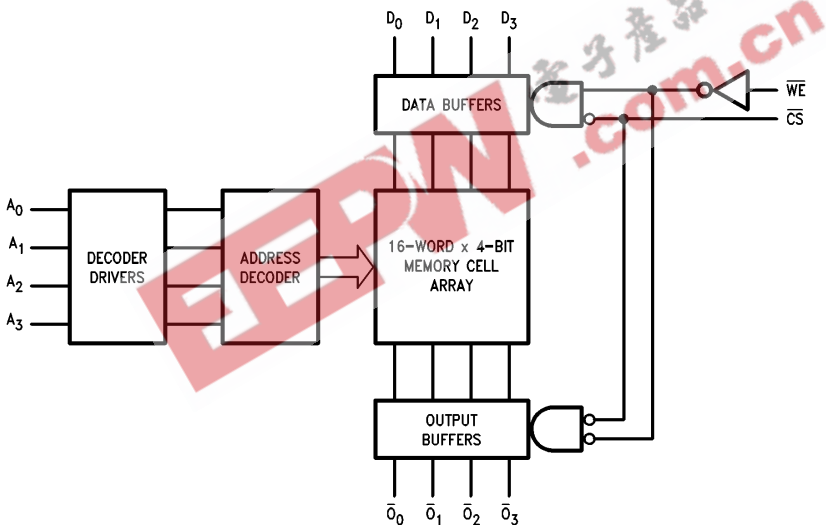
Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
A_0–A_3	Address Inputs	1.0/1.0	20 μA/−0.6 mA
$\overline{CS}$	Chip Select Input (Active LOW)	1.0/1.0	20 μA/−1.2 mA
$\overline{WE}$	Write Enable Input (Active LOW)	1.0/1.0	20 μA/−0.6 mA
D_0–D_3	Data Inputs	1.0/1.0	20 μA/−0.6 mA
$\overline{O}_0$–$\overline{O}_3$	Inverted Data Outputs	150/40 (33.3)	−3.0 mA/24 mA (20 mA)

Function Table

Inputs		Operation	Condition of Outputs
$\overline{CS}$	$\overline{WE}$		
L	L	Write	High Impedance
L	H	Read	Complement of Stored Data
H	X	Inhibit	High Impedance

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Block Diagram



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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +175°C
Plastic	−55°C to +150°C
V_{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V_{CC} = 0V)	
Standard Output	−0.5V to V_{CC}
TRI-STATE Output	−0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated I_{OL} (mA)

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature	
Military	−55°C to +125°C
Commercial	0°C to +70°C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

DC Electrical Characteristics

Symbol	Parameter		54F/74F Min	54F/74F Typ	54F/74F Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0			V		Recognized as a HIGH Signal
V_{IL}	Input LOW Voltage				0.8	V		Recognized as a LOW Signal
V_{CD}	Input Clamp Diode Voltage				−1.2	V	Min	I_{IN} = −18 mA
V_{OH}	Output HIGH Voltage	54F 10% V_{CC}	2.5			V	Min	I_{OH} = −1 mA
		54F 10% V_{CC}	2.4					I_{OH} = −3 mA
		74F 10% V_{CC}	2.5					I_{OH} = −1 mA
		74F 10% V_{CC}	2.4					I_{OH} = −3 mA
		74F 5% V_{CC}	2.7					I_{OH} = −1 mA
		74F 5% V_{CC}	2.7					I_{OH} = −3 mA
V_{OL}	Output LOW Voltage	54F 10% V_{CC}			0.5	V	Min	I_{OL} = 20 mA
		74F 10% V_{CC}			0.5			I_{OL} = 24 mA
I_{IH}	Input HIGH Current	54F			20.0	μA	Max	V_{IN} = 2.7V
		74F			5.0			
I_{BVI}	Input HIGH Current Breakdown Test	54F			100	μA	Max	V_{IN} = 7.0V
		74F			7.0			
I_{CEX}	Output HIGH Leakage Current	54F			250	μA	Max	V_{OUT} = V_{CC}
		74F			50			
V_{ID}	Input Leakage Test	74F	4.75			V	0.0	I_{ID} = 1.9 μA All Other Pins Grounded
I_{OD}	Output Leakage Circuit Current	74F			3.75	μA	0.0	V_{IOD} = 150 mV All Other Pins Grounded
I_{IL}	Input LOW Current				−0.6	mA	Max	V_{IN} = 0.5V (except $\overline{CS}$)
					−1.2			V_{IN} = 0.5V ($\overline{CS}$)
I_{OZH}	Output Leakage Current				50	μA	Max	V_{OUT} = 2.7V
I_{OZL}	Output Leakage Current				−50	μA	Max	V_{OUT} = 0.5V
I_{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V_{OUT} = 0V
I_{ZZ}	Bus Drainage Test				500	μA	0.0V	V_{OUT} = 5.25V
I_{CCZ}	Power Supply Current			37	55	mA	Max	V_O = HIGH Z

AC Electrical Characteristics

Symbol	Parameter	74F $T_A = +25°C$, $V_{CC} = +5.0V$, $C_L = 50$ pF			54F *T_A, V_{CC} = Mil, $C_L = 50$ pF		74F T_A, V_{CC} = Com, $C_L = 50$ pF		Units
		Min	Typ	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL}	Access Time, HIGH or LOW A_n to $\overline{O}_n$	10.0 8.0	18.5 13.5	26.0 19.0	9.0 8.0	32.0 23.0	10.0 8.0	27.0 20.0	ns
t_{PZH} t_{PZL}	Access Time, HIGH or LOW $\overline{CS}$ to $\overline{O}_n$	3.5 5.0	6.0 9.0	8.5 13.0	3.5 5.0	10.5 15.0	3.5 5.0	9.5 14.0	ns
t_{PHZ} t_{PLZ}	Disable Time, HIGH or LOW $\overline{CS}$ to $\overline{O}_n$	2.0 3.0	4.0 5.5	6.0 8.0	2.0 2.5	8.0 10.0	2.0 3.0	7.0 9.0	ns
t_{PZH} t_{PZL}	Write Recovery Time, HIGH or LOW $\overline{WE}$ to $\overline{O}_n$	6.5 6.5	15.0 11.0	28.0 15.5	6.5 6.5	37.5 17.5	6.5 6.5	29.0 16.5	ns
t_{PHZ} t_{PLZ}	Disable Time, HIGH or LOW $\overline{WE}$ to $\overline{O}_n$	4.0 5.0	7.0 9.0	10.0 13.0	3.5 5.0	12.0 15.0	4.0 5.0	11.0 14.0	ns

AC Operating Requirements

Symbol	Parameter	74F $T_A = +25°C$, $V_{CC} = +5.0V$		54F *T_A, V_{CC} = Mil		74F T_A, V_{CC} = Com		Units
		Min	Max	Min	Max	Min	Max	
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW A_n to $\overline{WE}$	0 0		0 0		0 0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW A_n to $\overline{WE}$	2.0 2.0		2.0 2.0		2.0 2.0		ns
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW D_n to $\overline{WE}$	10.0 10.0		11.0 11.0		10.0 10.0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW D_n to $\overline{WE}$	0 0		2.0 2.0		0 0		ns
$t_s(L)$	Setup Time, LOW $\overline{CS}$ to $\overline{WE}$	0		0		0		ns
$t_h(L)$	Hold Time, LOW $\overline{CS}$ to $\overline{WE}$	6.0		7.5		6.0		ns
$t_w(L)$	$\overline{WE}$ Pulse Width, LOW	6.0		15.0		6.0		ns

*T_A = −55°C to +125°C

Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:

74F 189 S C X

Temperature Range Family
74F = Commercial
54F = Military

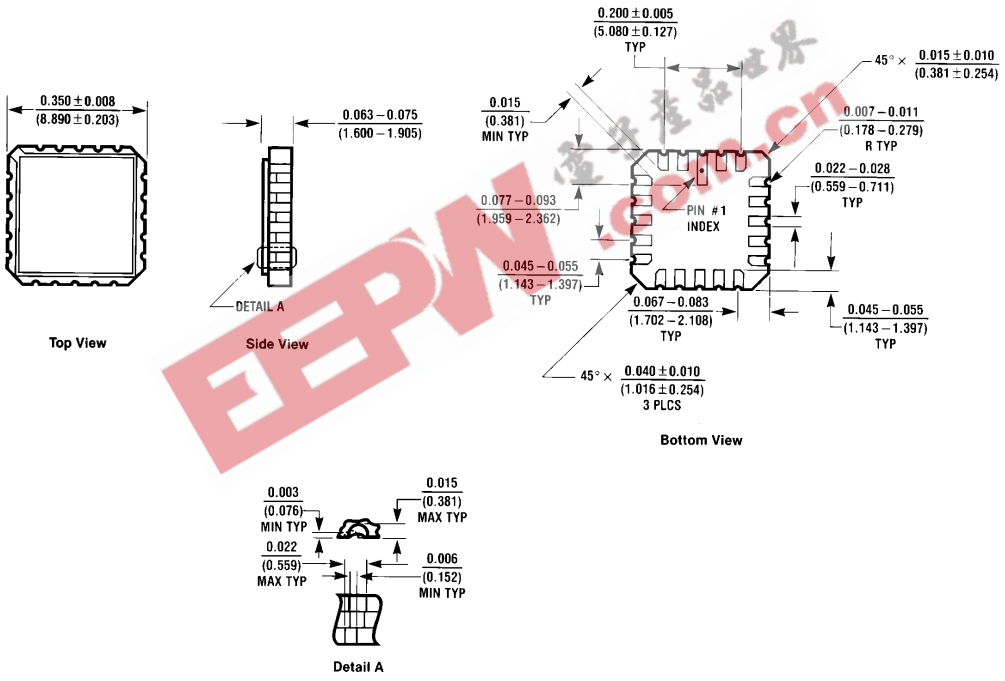
Device Type

Package Code
P = Plastic DIP
D = Ceramic DIP
F = Flatpak
L = Leadless Ceramic Chip Carrier (LCC)
S = Small Outline SOIC JEDEC
SJ = Small Outline SOIC EIAJ

Temperature Range
C = Commercial (0°C to +70°C)
L = Military (−40°C to +125°C)

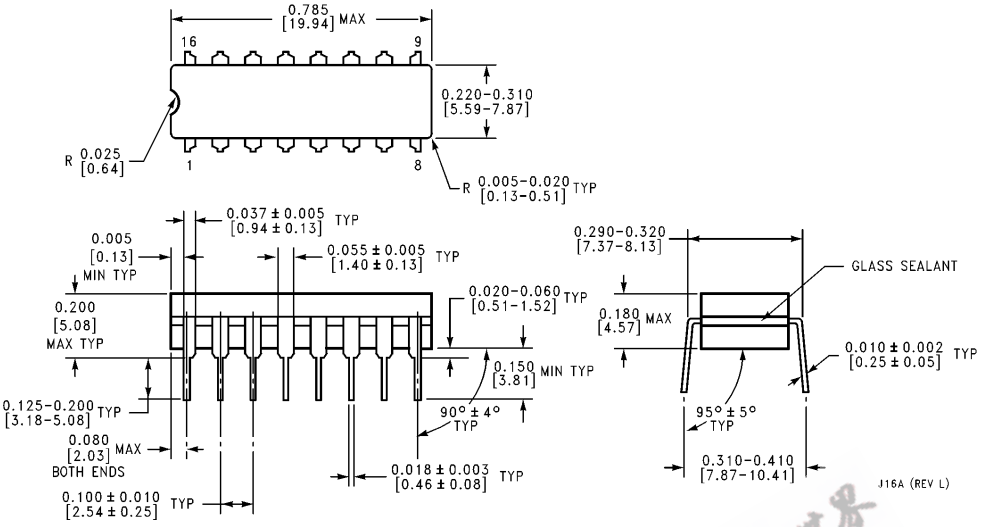
Special Variations
X = Devices shipped in 13″ reels
QB = Military grade with environmental and burn-in processing shipped in tubes

Physical Dimensions inches (millimeters)

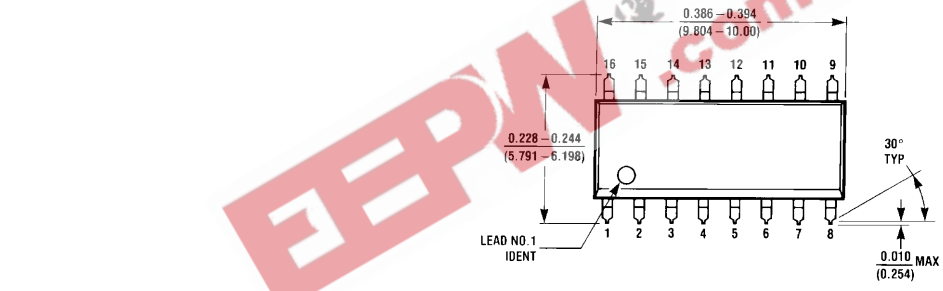


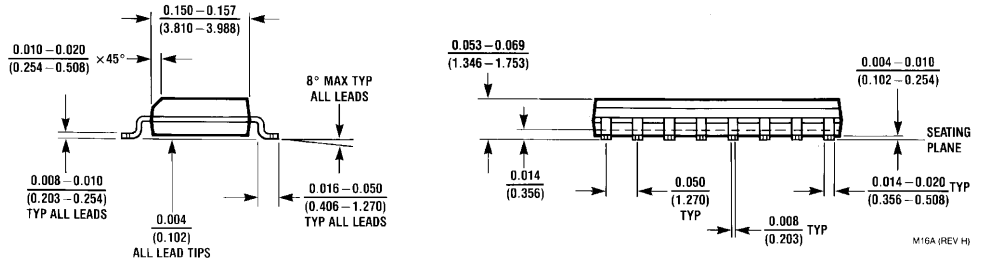
20-Lead Ceramic Leadless Chip Carrier (L)
NS Package Number E20A

Physical Dimensions inches (millimeters) (Continued)



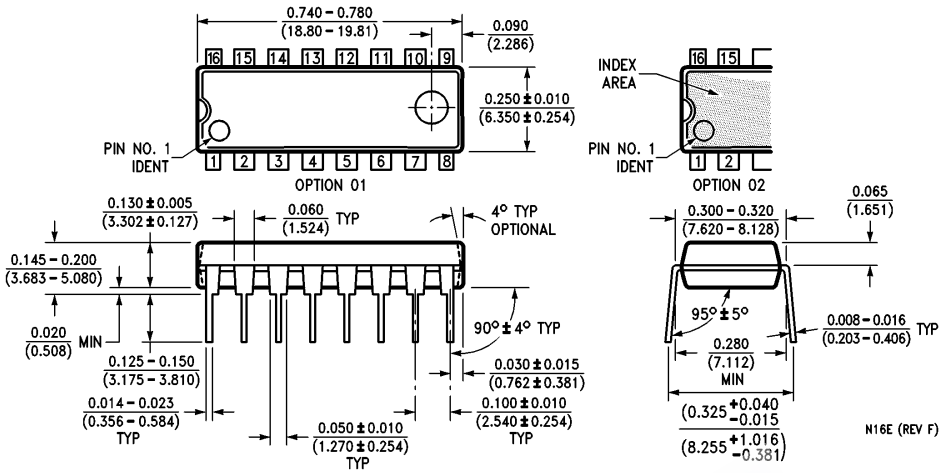
16-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J16A



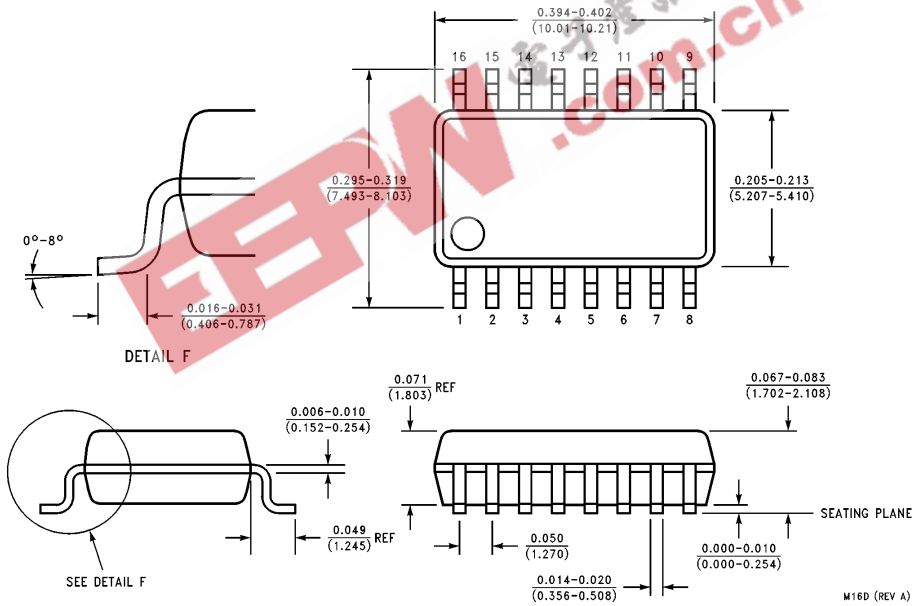


16-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A

Physical Dimensions inches (millimeters) (Continued)

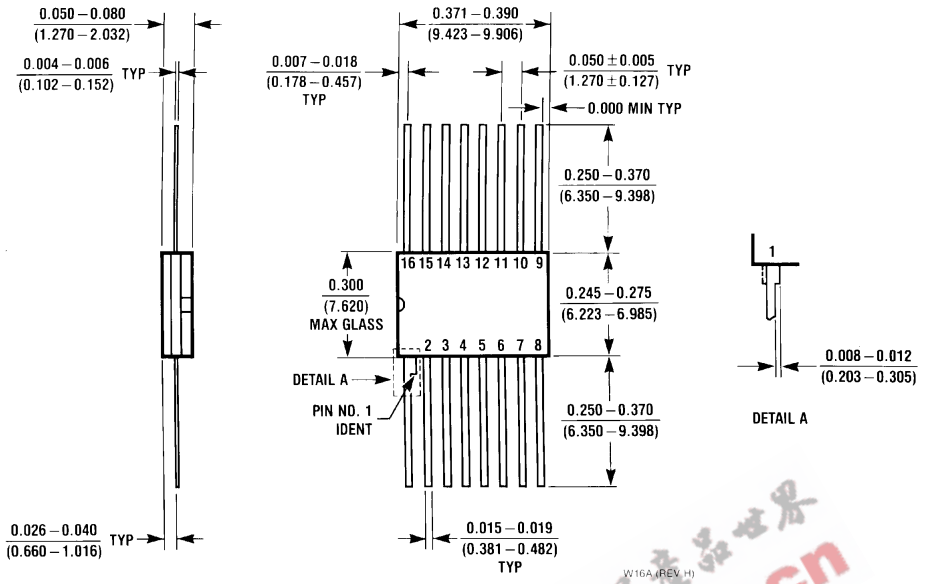


16-Lead (0.300″ Wide) Molded Dual-In-Line Package (P)
NS Package Number N16E



16-Lead (0.300″ Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D

Physical Dimensions inches (millimeters) (Continued)



16 Lead Ceramic Flatpak (F)
NS Package Number W16A

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National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408