2SC4416

Silicon NPN Epitaxial

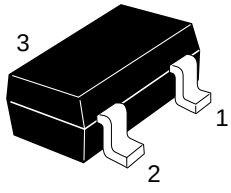
HITACHI

Application

UHF Frequency conversion, Wide band amplifier

Outline

MPAK



1. Base
2. Emitter
3. Collector

Hitachi semiconductor

Absolute Maximum Ratings (Ta = 25°C)

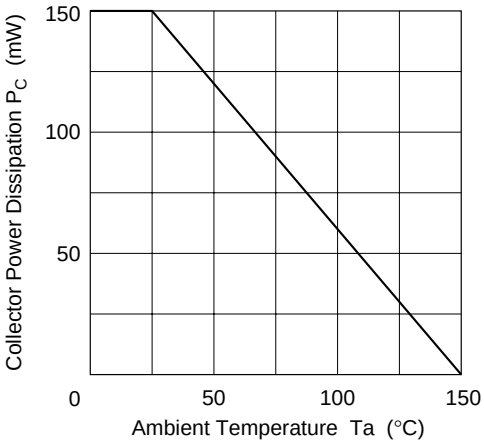
Item	Symbol	Ratings	Unit
Collector to base voltage	V_{CBO}	25	V
Collector to emitter voltage	V_{CEO}	13	V
Emitter to base voltage	V_{EBO}	3	V
Collector current	I_C	50	mA
Collector power dissipation	P_C	150	mW
Junction temperature	Tj	150	°C
Storage temperature	Tstg	–55 to +150	°C

Electrical Characteristics (Ta = 25°C)

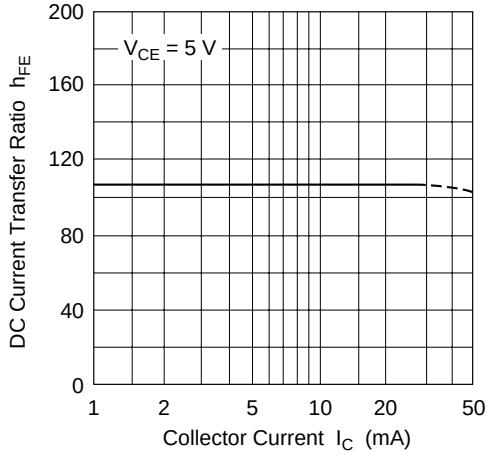
Item	Symbol	Min	Typ	Max	Unit	Test conditions
Collector to base breakdown voltage	$V_{(BR)CBO}$	25	—	—	V	I_C = 10 µA, I_E = 0
Collector cutoff current	I_{CBO}	—	—	0.1	µA	V_{CB} = 15 V, I_E = 0
	I_{CEO}	—	—	10	µA	V_{CB} = 13 V, R_{BE} = ∞
Emitter cutoff current	I_{EBO}	—	—	0.3	µA	V_{EB} = 3 V, I_C = 0
Collector to emitter saturation voltage	$V_{CE(sat)}$	—	—	0.3	V	I_C = 20 mA, I_B = 4 mA
DC current transfer ratio	h_{FE}	50	—	180		V_{CE} = 5 V, I_C = 5 mA
Collector output capacitance	Cob	—	0.85	1.3	pF	V_{CB} = 10 V, I_E = 0, f = 1 MHz
Gain bandwidth product	f_T	3.0	3.8	—	GHz	V_{CE} = 5 V, I_C = 20 mA
Conversion gain	CG	15	19	—	dB	V_{CC} = 5 V, I_C = 0.8 mA, f_{in} = 900 MHz, f_{OSC} = 930 MHz (–5dBm), f_{out} = 30 MHz
Noise figure	NF	—	8	1.2	dB	

Note: Marking is “XB–”.

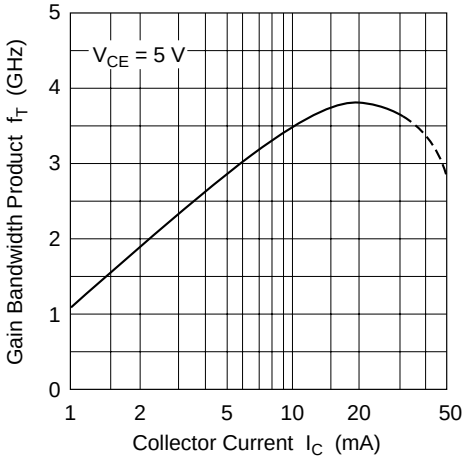
Maximum Collector Dissipation Curve



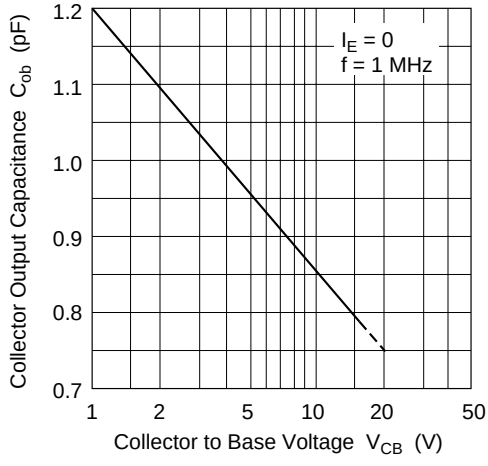
DC Current Transfer Ratio vs. Collector Current



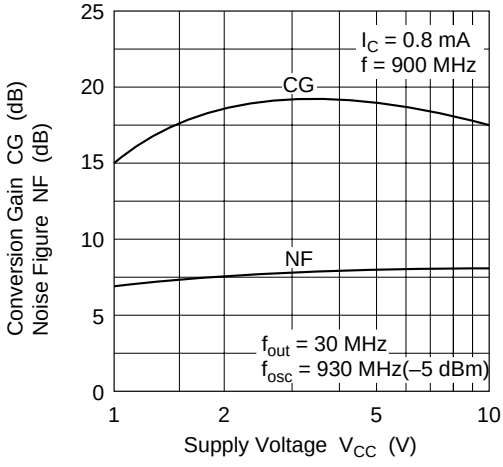
Gain Bandwidth Product vs. Collector Current



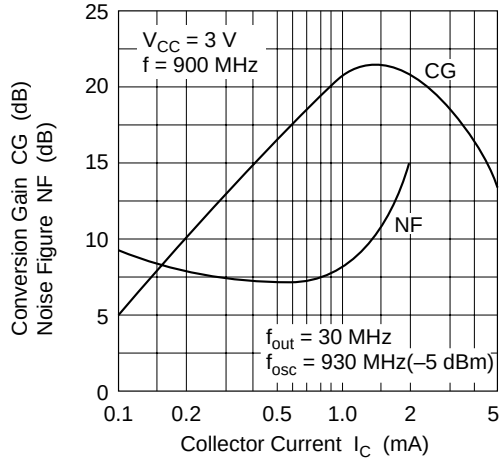
Collector Output Capacitance vs. Collector to Base Voltage



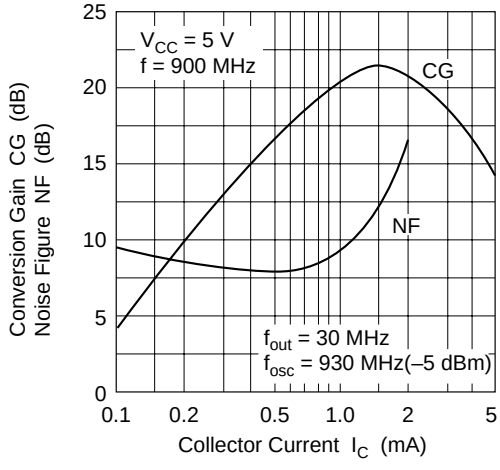
Conversion Gain and Noise Figure vs. Supply Voltage



Conversion Gain and Noise Figure vs. Collector Current

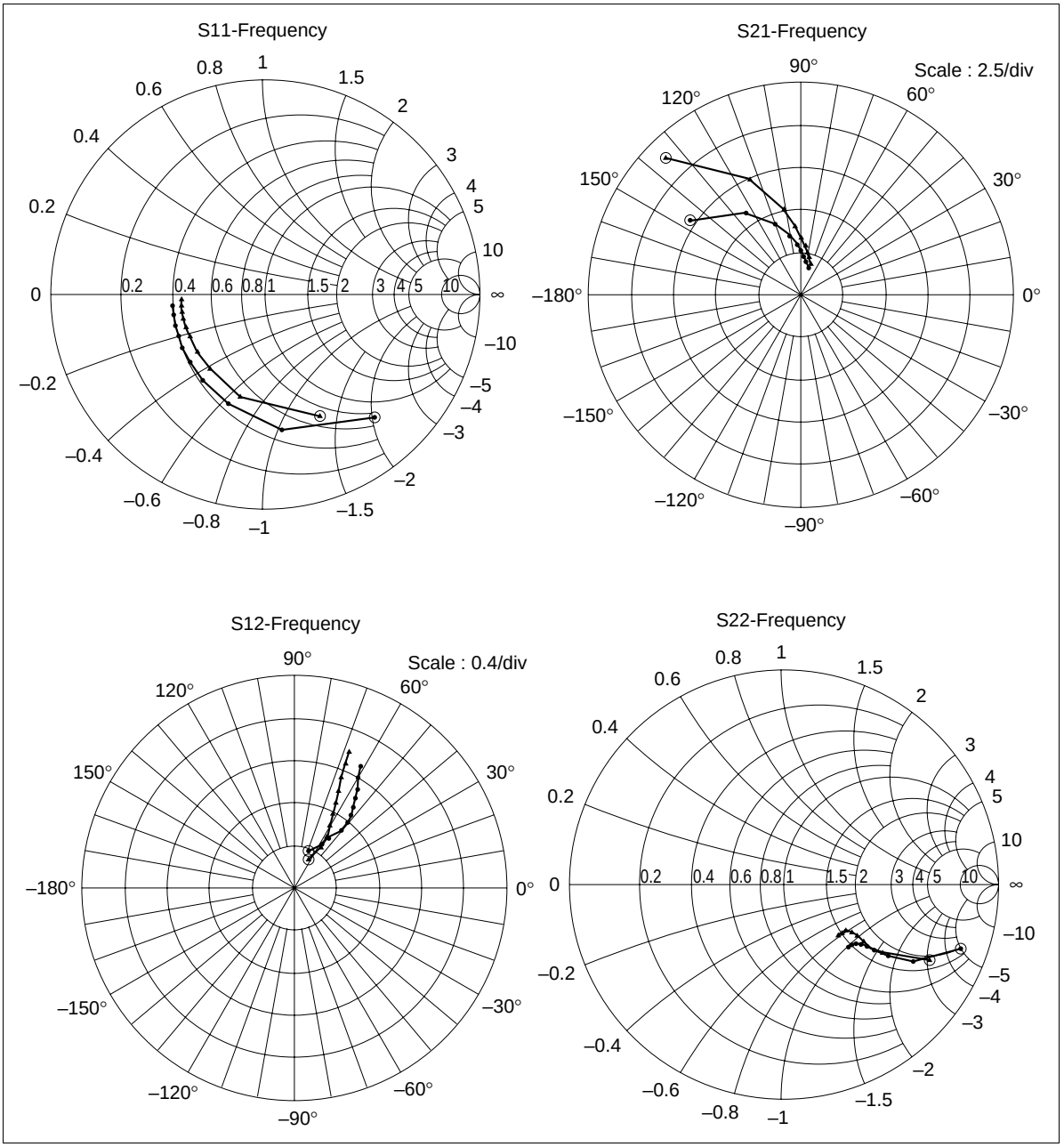


Conversion Gain and Noise Figure vs. Collector Current



S Parameters (Emitter Common)

Test Condition V_{CE} = 5 V, 100 MHz to 1000 MHz (100 MHz STEP) , Z_O = 50 Ω
I_C = 5 mA
I_C = 10 mA



S Parameters (Emitter Common)

Test Condition V_{CE} = 5 V, I_C = 5 mA, Z_O = 50 Ω

Freq.	S11		S21		S12		S22	
(MHz)	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
100	0.777	–47.6	12.318	146.4	0.037	66.8	0.878	–20.1
200	0.636	–82.6	9.212	124.5	0.058	55.3	0.702	–30.7
300	0.540	–107.9	6.901	110.6	0.071	51.0	0.586	–34.8
400	0.494	–125.0	5.480	101.6	0.079	50.7	0.520	–36.4
500	0.468	–138.0	4.547	94.5	0.087	52.0	0.480	–37.2
600	0.452	–147.7	3.859	89.0	0.095	53.7	0.452	–38.4
700	0.439	–155.4	3.374	84.2	0.103	55.7	0.436	–39.9
800	0.437	–162.0	2.982	80.0	0.112	57.5	0.427	–41.3
900	0.428	–167.9	2.691	76.1	0.122	59.6	0.419	–43.4
1000	0.429	–173.8	2.457	72.5	0.131	61.2	0.415	–45.0

Test Condition V_{CE} = 5 V, I_C = 10 mA, Z_O = 50 Ω

Freq.	S11		S21		S12		S22	
(MHz)	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
100	0.627	–64.8	17.938	135.2	0.032	63.2	0.766	–27.4
200	0.492	–102.5	11.621	113.8	0.047	56.4	0.560	–35.3
300	0.432	–125.3	8.190	102.4	0.058	57.2	0.460	–36.1
400	0.411	–139.4	6.332	95.1	0.069	59.6	0.412	–36.2
500	0.395	–150.3	5.168	89.5	0.079	61.7	0.385	–36.2
600	0.394	–157.4	4.350	84.8	0.090	63.7	0.366	–36.8
700	0.392	–163.5	3.784	80.9	0.102	65.2	0.356	–38.3
800	0.390	–168.7	3.333	77.1	0.113	66.5	0.351	–39.7
900	0.388	–173.1	2.995	73.8	0.127	67.3	0.347	–41.6
1000	0.387	–177.0	2.731	70.5	0.138	67.9	0.345	–43.5

Y Parameters (Emitter Common)

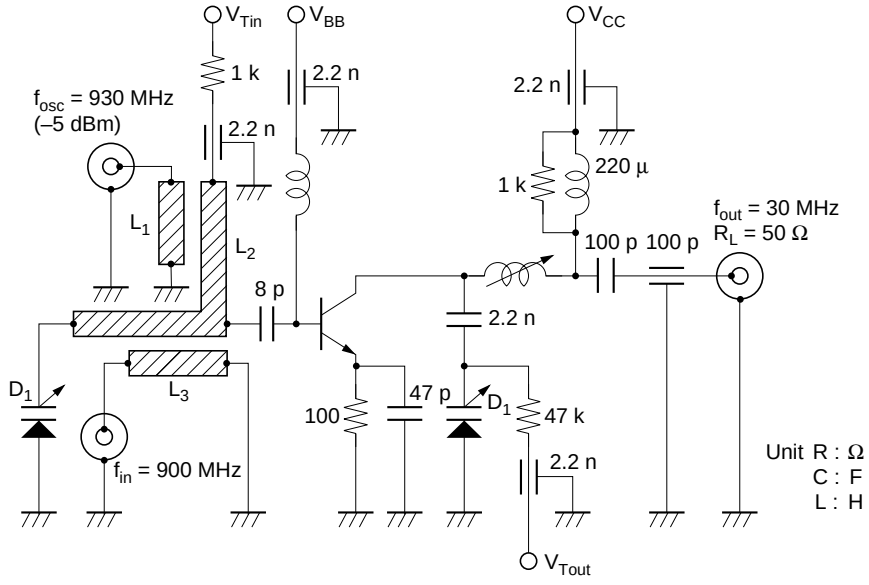
Test Condition V_{CE} = 5 V, I_C = 5 mA

Freq.	Yie (mS)		Yfe (mS)		Yre (mS)		Yoe (mS)	
(MHz)	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.
100	2.182	5.286	149.226	–28.448	–0.004	–0.459	0.069	0.745
200	4.596	9.838	138.489	–53.561	–0.005	–0.941	0.137	1.465
300	8.314	13.395	121.525	–74.164	–0.025	–1.460	0.086	2.251
400	12.329	15.566	103.171	–87.811	–0.044	–1.955	0.111	3.025
500	16.310	16.548	83.990	–97.188	–0.068	–2.451	0.080	3.813
600	19.817	16.562	66.015	–100.594	–0.104	–2.958	0.154	4.618
700	22.727	15.707	49.791	–101.015	–0.136	–3.433	0.226	5.461
800	25.355	14.778	36.105	–98.928	–0.165	–3.943	0.246	6.241
900	27.058	13.073	23.869	–95.428	–0.192	–4.438	0.307	7.067
1000	28.966	11.370	13.481	–92.170	–0.260	–4.944	0.328	7.902

Test Condition V_{CE} = 5 V, I_C = 10 mA

Freq.	Yie (mS)		Yfe (mS)		Yre (mS)		Yoe (mS)	
(MHz)	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.	REAL	IMAG.
100	4.137	6.218	246.938	–82.680	–0.004	–0.462	0.139	0.754
200	7.995	10.306	193.805	–128.092	–0.015	–0.937	0.220	1.578
300	12.296	12.125	140.844	–144.955	–0.027	–1.432	0.322	2.338
400	15.691	12.521	100.830	–145.272	–0.024	–1.913	0.404	3.028
500	18.471	12.026	70.237	–139.959	–0.049	–2.396	0.410	3.817
600	20.418	11.618	48.828	–130.672	–0.032	–2.894	0.492	4.460
700	21.855	10.887	33.158	–121.649	–0.024	–3.394	0.474	5.196
800	23.059	10.127	20.494	–112.454	–0.017	–3.889	0.502	5.950
900	23.687	9.375	11.528	–103.839	–0.013	–4.418	0.446	6.699
1000	24.366	8.807	4.277	–96.921	–0.013	–4.905	0.471	7.486

Conversion Gain and Noise Figure Test Circuit

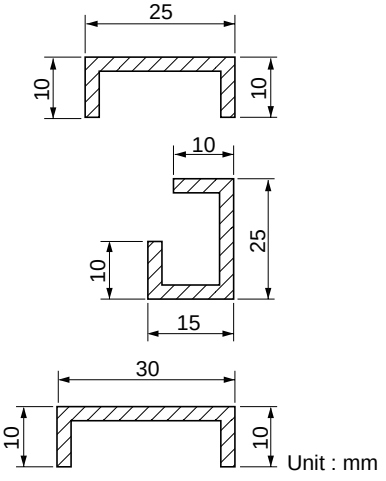


D_1 : 1SV188

L_1 : ϕ1 mm Enameled Copper Wire.

L_2 : ϕ1 mm Enameled Copper Wire.

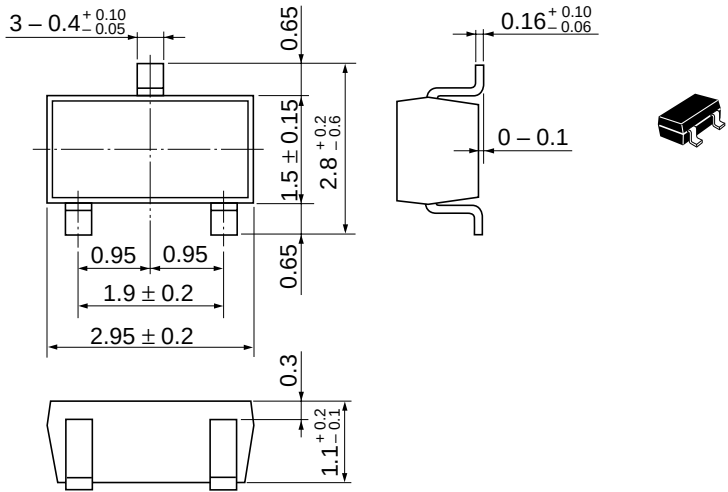
L_3 : ϕ1 mm Enameled Copper Wire.



L_4 : Inside Dia 3 mm, ϕ0.5 mm Enameled Copper Wire 1 Turn.

L_5 : Inside Dia 5 mm Bobin, ϕ0.2 mm Enameled Copper Wire 20 Turns Using Ferrite Core.

Unit: mm



Hitachi Code	MPAK
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.011 g

Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

HITACHI

Hitachi, Ltd.
Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL
NorthAmerica : http:semiconductor.hitachi.com/
Europe : http://www.hitachi-eu.com/hel/ecg
Asia (Singapore) : http://www.has.hitachi.com.sg/grp3/sicd/index.htm
Asia (Taiwan) : http://www.hitachi.com.tw/E/Product/SICD_Frame.htm
Asia (HongKong) : http://www.hitachi.com.hk/eng/bo/grp3/index.htm
Japan : http://www.hitachi.co.jp/Sicd/indx.htm

For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose,CA 95134
Tel: <1> (408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building. No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX