ADE-207-130C (Z)

HA166171RFP2/HA166172RFP4
Read/Write Amplifier for Hard Disk Drive

HITACHI

Preliminary
Rev. 3
Mar. 1995

The HA166171RFP2 and HA166172RFP4 are read/write amplifier designed for use with thin film recording heads. They have the following functions and features.

Functions

- Read amplifier circuit
- Write driver circuit
- Constant write current setup circuit
- 4 channel servo write

Features

- Single power supply +5 V
- Low power
  Read: 175 mW (Typ)
  Idle: 25 mW (Typ)
- Low Noise: 0.54 nV/√Hz (Typ)
- Read amplifier has high differential voltage gain
  : 380 V/V (Typ)
- Built-in current and voltage monitors
- ECL compatible interface
- Emitter-follower read amplifier outputs
- Input capacitance: 9 pF (Typ)
- Write current range: 5 to 20 mA
- Self switching damping resistance

Ordering Information

Type	Channel	Package
HA166171RFP2	2	FP-20DA
HA166172RFP4	4	FP-24D

Pin Arrangement

HA166171RFP2

GND	1	20	$\overline{CS}$
H0X	2	19	R/$\overline{W}$
H0Y	3	18	WC
H1X	4	17	SGND
H1Y	5	16	RDX
GND	6	15	RDY
$\overline{WCR}$	7	14	SGND
WDIB	8	13	HS0
WDI	9	12	NC
$\overline{WSER}$	10	11	V5

(Top view)

HA166172RFP4

GND	1	24	$\overline{CS}$
H0X	2	23	R/$\overline{W}$
H0Y	3	22	WC
H1X	4	21	SGND
H1Y	5	20	RDX
H2X	6	19	RDY
H2Y	7	18	SGND
H3X	8	17	HS0
H3Y	9	16	HS1
GND	10	15	V5
$\overline{WCR}$	11	14	$\overline{WSER}$
WDIB	12	13	WDI

(Top view)

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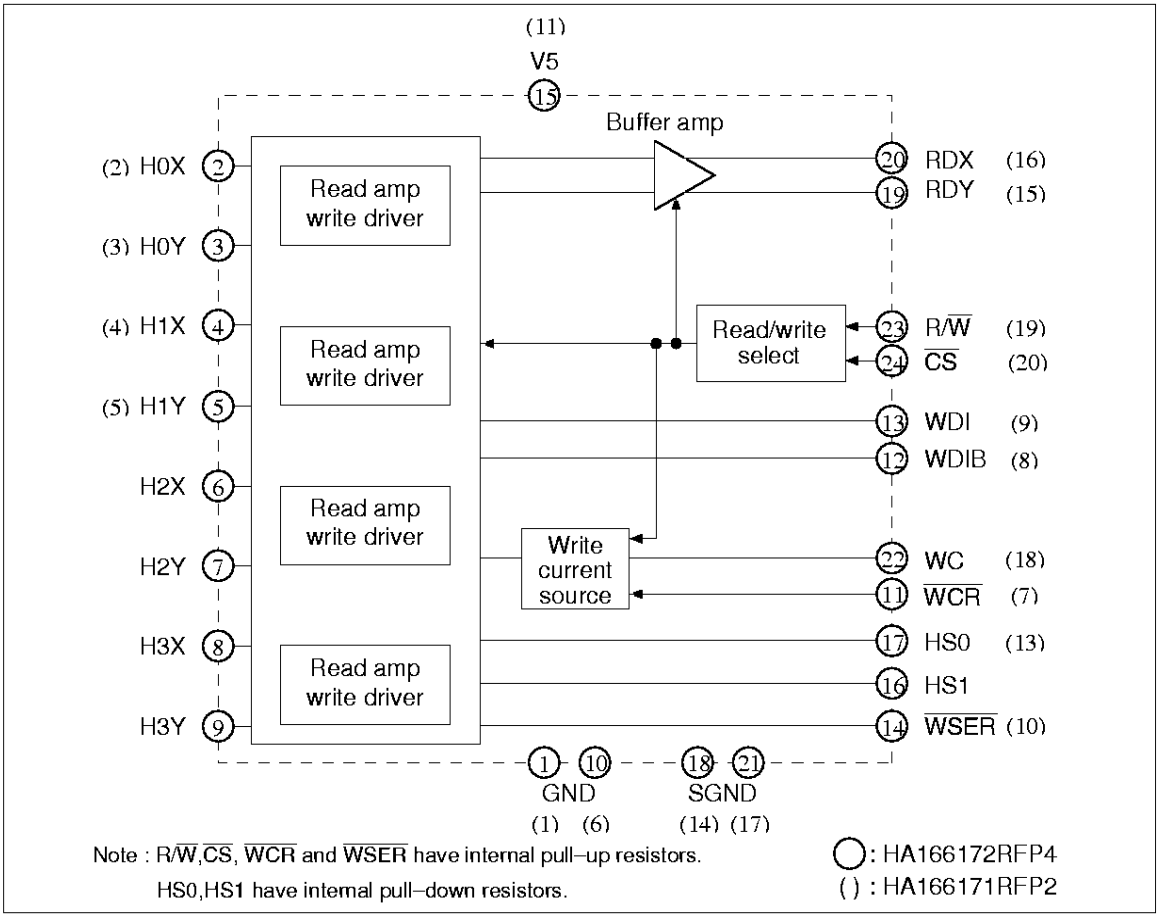
Pin Description

Pin No.				
171RFP2	172RFP4	Symbol	Pin Name	Description
1, 6	1, 10	GND	Ground	Ground pins
2, 3	2, 3	H0X, H0Y	Head 0X, 0Y	These pins are connected to the R/$\overline{W}$ head coil of channel 0.
4, 5	4, 5	H1X, H1Y	Head 1X, 1Y	These pins are connected to the R/$\overline{W}$ head coil of channel 1.
	6, 7	H2X, H2Y	Head 2X, 2Y	These pins are connected to the R/$\overline{W}$ head coil of channel 2.
	8, 9	H3X, H3Y	Head 3X, 3Y	These pins are connected to the R/$\overline{W}$ head coil of channel 3.
7	11	$\overline{WCR}$	Write current reduce	A low level selects the write current reduce mode. A pin shall be used to reduce write current by 20% from the resistor programmed value.
8, 9	12, 13	WDIB, WDI	Write data input	Write data input pin. The signal is devided in the IC, anddrives the write driver.
10	14	$\overline{WSER}$	Servo write switch	When R/$\overline{W}$ and $\overline{WSER}$ are set low, all write drivers are selected. Refer to the Mode Select Table.
11	15	V5	5 V	5 V power supply
	16	HS1	Head select 1	Input pins for head select signals. The combination of these signals selects one head from head 0 to head 3. Refer to the head select table.
13	17	HS0	Head select 0	
14, 17	18, 21	SGND	Shield ground	Ground for shield of RDX, RDY.
15, 16	19, 20	RDY, RDX	Read amplifier output	Differential output pins for the read amp. The signal read out from the head coil is amplified and provided on these pins.
18	22	WC	Write current setting	Write current setting pin. The write current is defined by the equation below by connecting the external resistance R_{WC} between this pin and GND. Write current [mA] = K/R_{WC} [kΩ]
19	23	R/$\overline{W}$	R/$\overline{W}$ switch	Mode select switch for changing over the bias condition of the head coil. A low level selects the write mode, while a high level selects the read mode.
20	24	$\overline{CS}$	Chip select	When this line is set high, the circuit goes into the idle state, a low power state. When this line is low, the chip is active.

Block Diagram



Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Applicable Terminal
Supply voltage	V5	–0.3 to +6.0	V	V5
Write current	I_h	25	mA	
Interface input voltage	V_{IN}	–0.3 to V5 +0.3	V	HS0, HS1, WDI, WDIB WSER, R/W, CS
Read data output current	I_{RO}	–10	mA	RDX, RDY
Operating temperature	Topr	0 to +70	°C	
Storage temperature	Tstg	–55 to +150	°C	
Head voltage swing	V_{HSW}	4.0	Vpp	
Power dissipation	P_T *	900	mW	

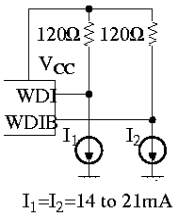
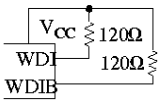
Note : * Grass epoxy board (40 mm × 40 mm), writing density of 20 %, Ta = 70 °C

Power Supply (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Supply voltage range	V5	4.5	—	5.5	V	
+5.5 V supply current	I5	—	36	—	mA	Read mode
		—	35 + 1.55 I_h	—		Write mode
		—	5	—		Idle mode
+5.0 V supply current	I5	—	84 + 4.55 I_h	—	mA	Servo write mode

Electrical Characteristics (V_{CC} = 5 V, Ta = 25°C unless otherwise specified)

Digital Input

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Low level input voltage1	V_{IL1}	–0.3	—	0.8	V	
Low level input current1	I_{IL1}	–100	—	—	µA	V_{IL} = 0.4 V
High level input voltage1	V_{IH1}	2.0	—	V_{CC} + 0.3	V	
High level input current1	I_{IH1}	—	—	40	µA	V_{IH} = 2.0 V
Low level input voltage2	V_{IL2}	V_{CC} – 1.82	—	V_{CC} – 1.0 V		(WDI, WDIB)  I_1=I_2=14 to 21mA
High level input voltage2	V_{IH2}	V_{CC} – 0.3	—	V_{CC}	V	(WDI, WDIB) 
Differential voltage	V_{DI}	0.65	—	1.82	V	$\lvert V_{WDI} - V_{WDIB} \rvert$
High level input current2	I_{IH2}	—	2	2.6	mA	$V_{IH} = V_{CC}$ (WDI, WDIB)
Read/write transition time	t_{RW}	—	110	150	ns	
Write/read transition time	t_{WR}	—	200	300	ns	
Head select switching delay time	t_{HS}	—	—	1000	ns	Read mode
Chip disable transition time	t_{IR}	—	—	1000	ns	Idle to read
Read/servo write transition time	t_{RS}	—	—	350	ns	R/$\overline{W}$ to 90 % of write current $\overline{WSER}$: L
Servo write/read transition time	t_{SR}	—	—	350	ns	R/$\overline{W}$ to 90 % of 100 mV read signal envelope, $\overline{WSER}$: L

Head Select Table

HS1	HS0	Head Selected
L	L	0
	H	1
H	L	2
	H	3

Mode Select Table

R/$\overline{W}$	$\overline{WSER}$	Mode
L	L	Servo Write
	H	Write
H	L	Read
	H	

Read Amplifier

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Differential voltage gain	Avd	320	380	440	V/V	f = 300 kHz
Bandwidth	B_W	(90)*1	(150)*1	—	MHz	–3 dB
Input noise voltage	Vn	—	(0.54)*1	—	nV/√Hz	f ≤ 15 MHz, Inputs shorted
Common mode rejection ratio	CMRR	60	80	—	dB	
Power supply stability	PSRR	45	60	—		V_{CC} ±100 mVp-p, f = 5 MHz
Channel separation	Sep	60	80	—		Vin = 100 mVp-p on unselected channels and Vin = 0 mVp-p on selected channels, f = 5 MHz
Output offset voltage	Vo	–300	—	300	mV	Inputs shorted
Differential input impedance	Rin	—	0.72	—	kΩ	f = 300 kHz
			0.70			f = 5 MHz
Common mode output voltage	Vcom	—	2.8	—	V	
Output source current	I_{OSO}	—	–10	—	mA	
Output sink current	I_{OSI}	—	1.2	—		
Input capasitance	C_{IN}	—	(9)*1	(10.8)*1	pF	
Dynamic Range	D_R	1.5	—	—	mVpp	

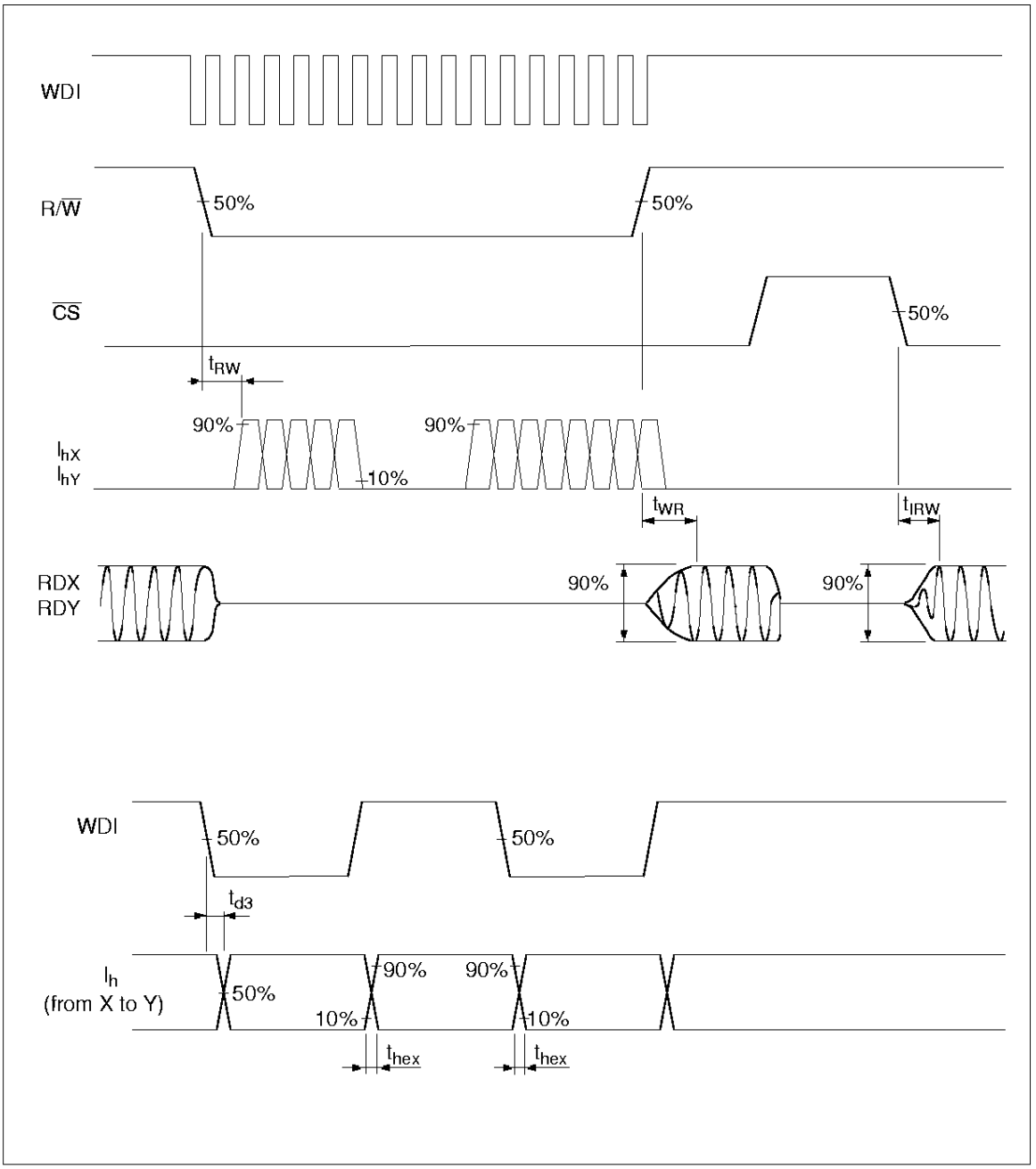
Note: 1. These values are only for design purpose.

Write Driver

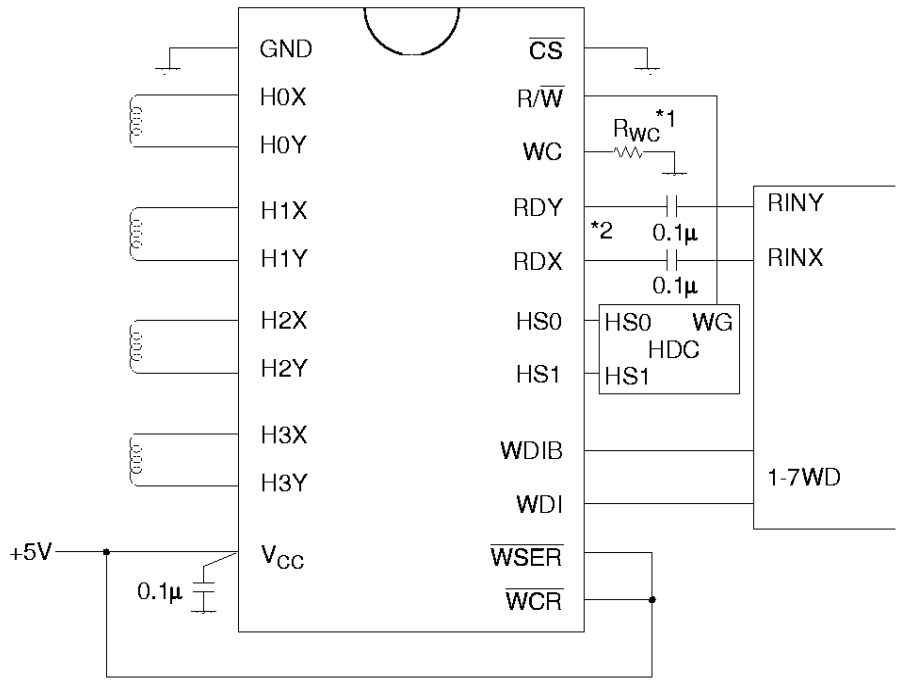
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Write current setting range	I_h	5	—	20	mA	Rh = 10 Ω
Head current rise time	t_{hex}	—	3.5	4.4	ns	Lh = 0 µH, Rh = 0 Ω, 10% to 90% point
Head current switching delay time	t_{d3}	—	—	30		Rh = 0 Ω, Lh = 0 µH, from 50% point
Head current switching symmetry	t_{d4}	—	—	(1)*1		WDI duty cycle = 50%, rise/fall time = 1 ns
Head current gain	I_h/I_{WC}	—	20	—	A/A	Head current/I_{WC}
WC output voltage	V_{WC}	—	2.7	—	V	
Write current accuracy1	I_{h1}	9.1	10	10.9	mA	R_{WC} = 5.3 kΩ, Rh = 10 Ω, $\overline{WCR}$: H
Write current accuracy2	I_{h2}	—	8	—	mA	R_{WC} = 5.3 kΩ, Rh = 10 Ω, $\overline{WCR}$: L
V_{CC} monitor operative range (Max)	I_{hoff1}	3.6	4.0	4.3	V	R_{WC} = 5.3 kΩ, $\overline{WCR}$: H Head current $I_h \leq$ 0.5 mA
V_{CC} monitor operative range (Min)	I_{hoff2}	—	—	0		

Note: 1. These values are only for design purpose.
2. Write current constant : K = 53 typ.

Timing Waveforms



Application Circuit Example



Unit R: Ω
C: F

Notes: 1. External resistance value R_{WC} is determined by following equation.

$$R_{WC}\ [k\Omega] = \frac{K}{\text{Write current [mA]}}$$

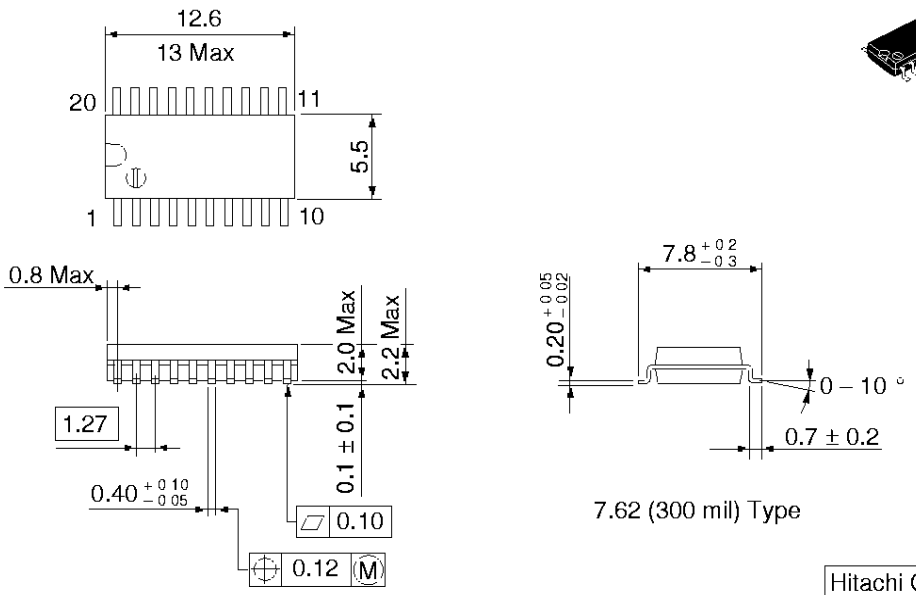
Also, write current ringing on changeover between read and write can be suppressed by locating the resistor R_{WC} as close as possible to the WC pin.

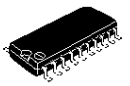
2. When the length of the wiring pattern increases, the RDX and RDY outputs might have some oscillation. This oscillation can be eliminated by inserting series resistors on these outputs as close to the pins as possible.

Package Dimensions

Unit: mm

• HA166171RFP2

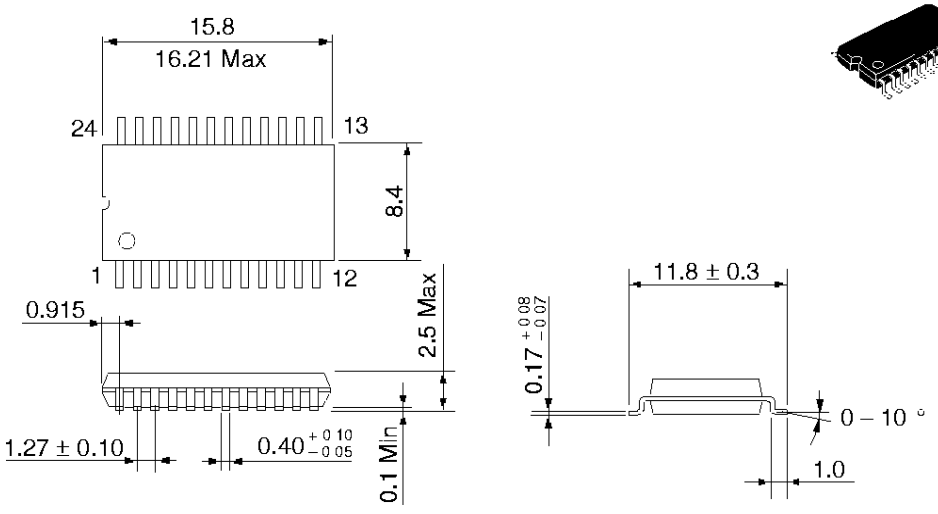


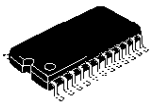


7.62 (300 mil) Type

Hitachi Code	FP-20DA
EIAJ	——
JEDEC	——

• HA166172RFP4





11.43 (450 mil) Type

Hitachi Code	FP-24D
EIAJ	——
JEDEC	——

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HITACHI

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

For further information write to:

Hitachi America, Ltd.
Semiconductor & IC Div.
2000 Sierra Point Parkway
Brisbane, CA. 94005-1835
U S A
Tel: 415-589-8300
Fax: 415-583-4207

Hitachi Europe GmbH
Electronic Components Group
Continental Europe
Dornacher Straße 3
D-85622 Feldkirchen
München
Tel: 089-9 91 80-0
Fax: 089-9 29 30 00

Hitachi Europe Ltd.
Electronic Components Div.
Northern Europe Headquarters
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA
United Kingdom
Tel: 0628-585000
Fax: 0628-778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 0104
Tel: 535-2100
Fax: 535-1533

Hitachi Asia (Hong Kong) Ltd.
Unit 706, North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon
Hong Kong
Tel: 27359218
Fax: 27306071

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