

M56733AFP

3-Phase Brushless Motor Driver

REJ03F0081-0100Z

Rev.1.0

Sep.22.2003

Description

The M56733AFP is a semiconductor integrated circuit designed as a single-chip controller for FDD spindle motors. It incorporates a power amplifier, Hall amplifier, FG amplifier, oscillator, and speed discriminator, along with various protective circuits. Control of switching between three speeds by the single MOD pin gives this IC the edge for use in compact systems.

Features

- Digital servo provides high precision, good stability, and freedom from the need for adjustment.
- A single pin controls switching between three speed. ●● MOD
- Two enable signals. ●● EN, $\overline{\text{EN}}$
- $I_{O(\text{peak})} = 1.0 \text{ A}$
- Low-capacitance damping capacitor

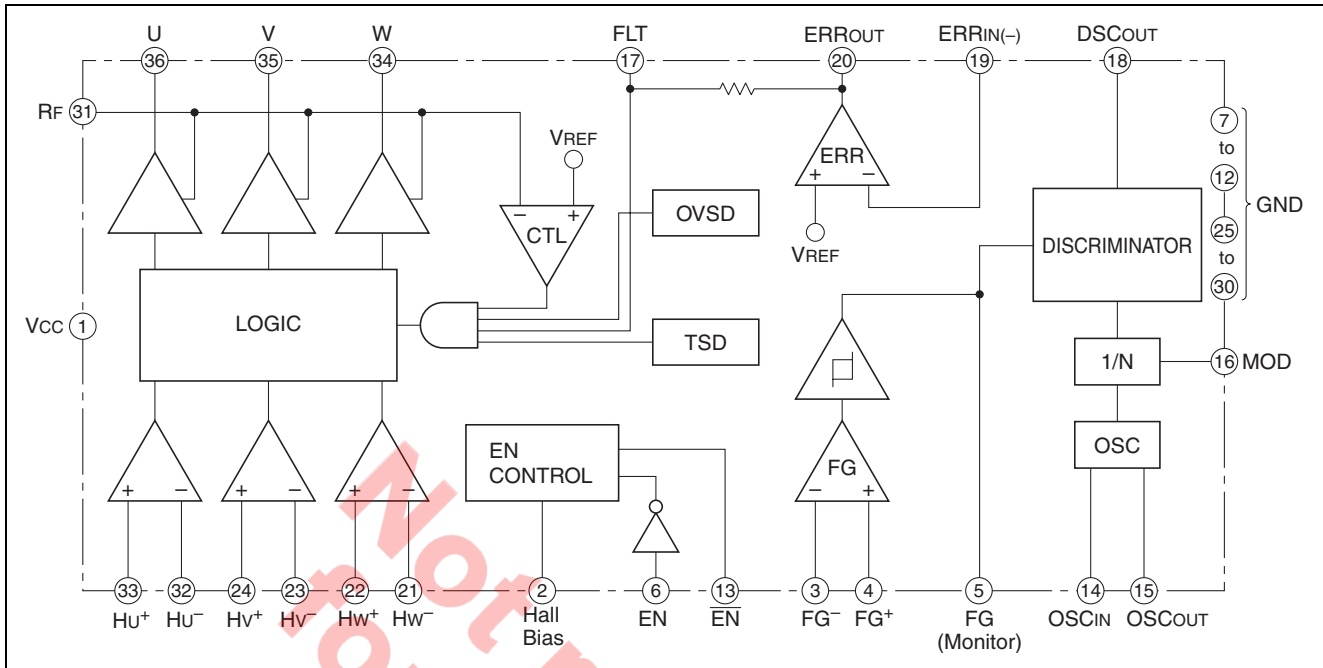
Applications

- FDD spindle motors (5 inches)

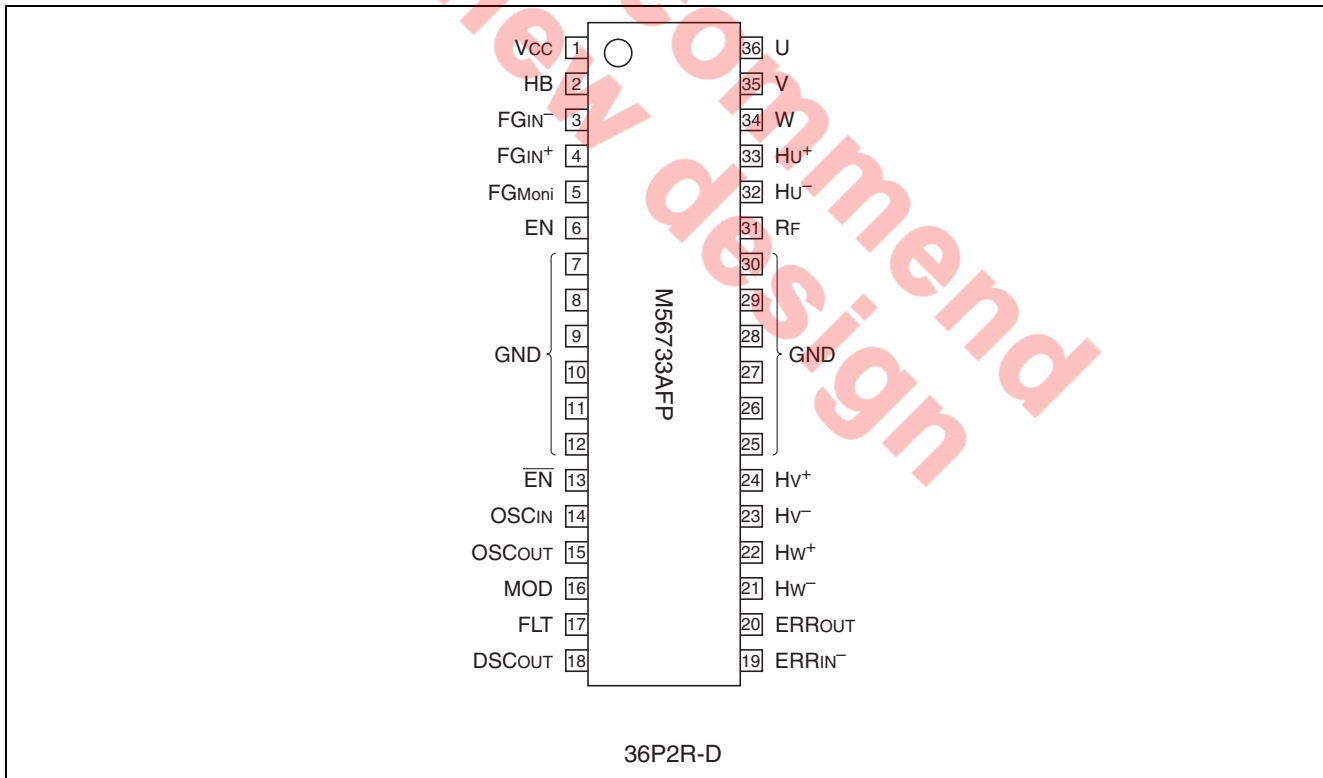
Recommended Operating Conditions

- Power-supply voltage: 10.8 (min.) to 13.2 (max.), 12.0 (typ.)
- Oscillation frequency: 492 kHz
- Maximum output current: 800 mA
- FG amplifier input signal level: 5 mVp-p or more

Block Diagram



Pin Configuration

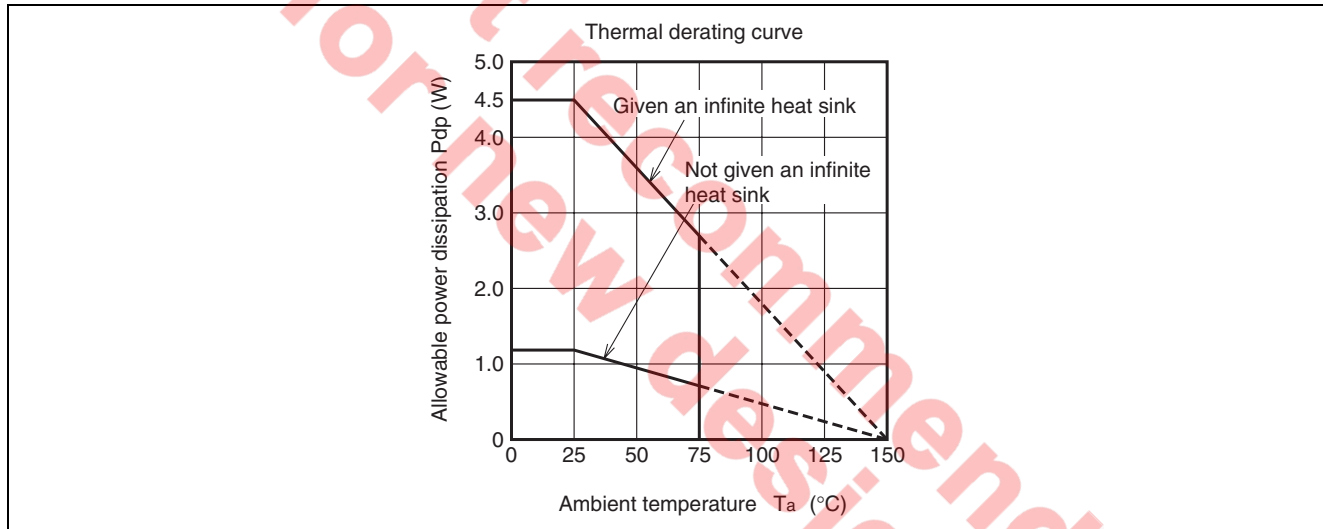


Absolute Maximum Ratings

(Ta = 25°C)

Symbol	Parameter	Test conditions	Ratings	Unit
V _{CC}	Power-supply voltage		15	V
I _o	Output current		1.0	A
V _{HD}	Hall amplifier differential input voltages	Between pins 21 and 22, 23 and 24, and 32 and 3	5	V
V _{IN}	Voltage applied to pins	6, 13, 21 to 24, 32, 33 (pin numbers)	0 to V _{CC}	V
f _{IN}	Clock frequency		1000	kHz
P _t	Allowable dissipation	Infinite heat sink	4.5	A
K _θ	Thermal derating range	Infinite heat sink	27.8	°C/W
T _j	Junction temperature		150	°C
T _{opr}	Ambient operating temperature		-20 to 75	°C
T _{stg}	Storage temperature		-40 to 125	°C

Characteristic curves

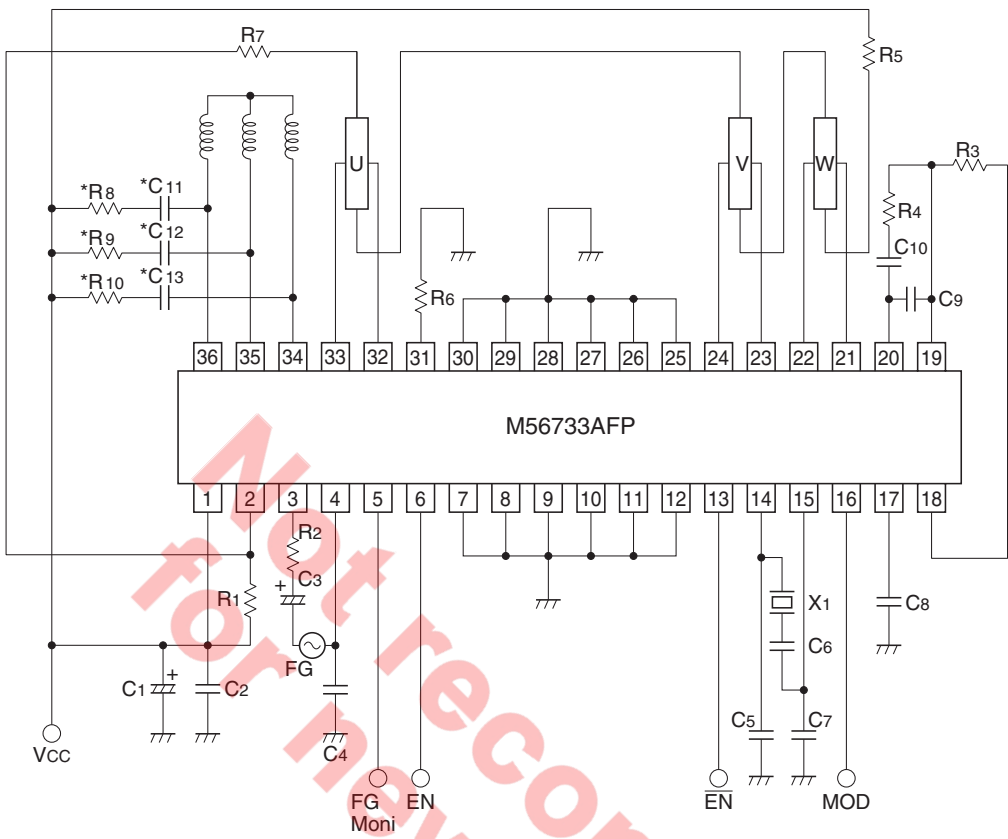


Electrical Characteristics

(unless otherwise noted, $T_a = 25^\circ\text{C}$, $V_{CC} = 5.0\text{ V}$.)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CCH}	Circuit Current	When the circuit is switched on. Excludes the injector current.	9	18	28	mA
I_{CCL}	Circuit Current	When only the minimal circuit is switched on.	—	—	300	μA
I_{INHA}	Current input to the Hall amplifier		—	0.4	4.0	μA
V_N	Voltage when the output is at the mid-phase point		5.1	6.3	7.1	V
ΔV_N	Difference of voltage when the output is at the mid-phase point		—	—	0.2	V
V_{sat}	Saturation output voltage	$I_o = 0.7\text{ A}$, sum of upper and lower transistors	—	2.8	3.2	V
V_{TH}	Control-input reference voltage	FLT-pin voltage for which motor rotates	1.05	1.20	1.35	V
G_V	Voltage gain between control input and output	Source side	16.65	18.05	25.10	dB
		Sink side	20.82	23.80	26.81	dB
		Source and sink sides	26.00	28.00	30.00	dB
ΔG_V	Difference of voltage-gain between phases		—	—	2	dB
V_{ref}	Error amplifier reference voltage	Intermediate level of discriminator output is measured	2.0	2.2	2.4	V
$I_{IN}\bullet E$	Error amplifier input current		-0.2	-0.02		μA
$V_{O}\bullet E$	Error amplifier output level	High	2.2	2.5	3.1	V
		Low	0.6	0.8	1.05	V
V_{CL}	Current-limiting reference voltage	The RF pin voltage when voltage on the FLT pin falls below 1.5 V. No load.	0.36	0.40	0.44	V
V_{IN}	Function- input threshold voltage	High Pins 6 and 13	2.5	—	—	V
		Low	—	—	0.1	V
I_{IN}	Current input to the function-input pins	$V_{IN} = 12\text{ V}$, pin 6	500	700	1000	V
		$V_{IN} 0\text{ V}$, pin 13	-150	-100	-70	V
V_{inj}	Injector pin voltage		0.6	0.9	1.5	V
V_{oDSC}	Discriminator output level	High	4.1	4.8	5.3	V
		Low	0.5	0.8	1.2	V
ΔT	Discriminator count error	+ : Deceleration side - : Acceleration side $f_{osc} = 492\text{ kHz}$	-6	1	6	μA
f_{osc}	Oscillation frequency	$f_{osc} = 492\text{ kHz}$	-0.2	—	0.2	%
I_{injMAX}	Injector max. operating current	$f_{osc} = 492\text{ kHz}$	25	—	—	mA
I_{injMIN}	Injector min. operating current	$f_{osc} = 492\text{ kHz}$	—	—	4	mA
V_{OLFG}	FG amplifier output low level (monitor)	$I_L = 200\text{ }\mu\text{A}$	—	0.1	0.2	V
I_{IFG}	FG amplifier output pin leakage current (monitor)	When 12 V is applied	—	—	1.0	μA
I_{INMOD}	Current input to the MOD pin	When 12 V is applied	435	565	800	μA
		When 0 V is applied	-75	-98	-140	μA

Application Example



(Individual values)

- C₁=33 F
- C₂=0.47 F
- C₃=10 F
- C₄=0.01 F
- C₅=165pF
- C₆=56pF
- C₇=165pF
- C₈=1 F
- C₉=0.01 F
- C₁₀=0.1 F
- C₁₁=0.1 F
- C₁₂=0.1 F
- C₁₃=0.1 F
- R₁=5.1k
- R₂=510
- R₃=47k
- R₄=180k
- R₅=1.2k
- R₆=0.5
- R₇=1.2k
- R₈=4.7
- R₉=4.7
- R₁₀=4.7
- X₁=492kHz (Oscillator)

Notes:

1. Values for elements marked * (asterisk) must be selected to prevent oscillation.
2. R₁ is used to boost the injection current. Select a suitable value.
3. Select an element of suitable value as required to adjust the gain.

4. Enable function

	EN	Lo	Hi
EN			
Lo		DISABLE	ENABLE
Hi		DISABLE	DISABLE

5. Mode function

Mode pin	FG synchronization frequency
Lo (MOD ≤ 0.8V)	fosc/1640Hz
M (Open)	fosc/820Hz
Hi (MOD V 2.6V)	fosc/ (4100/3) Hz

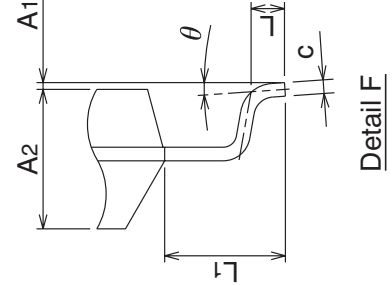
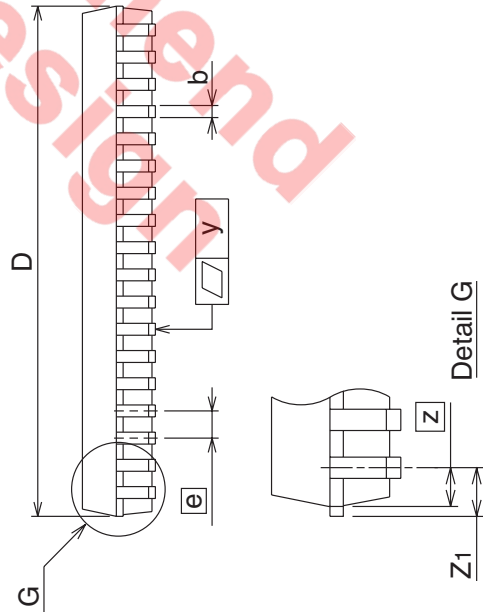
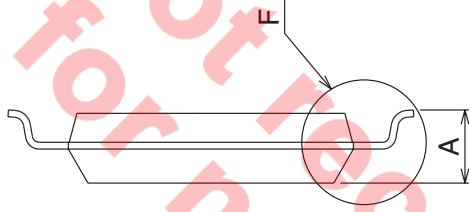
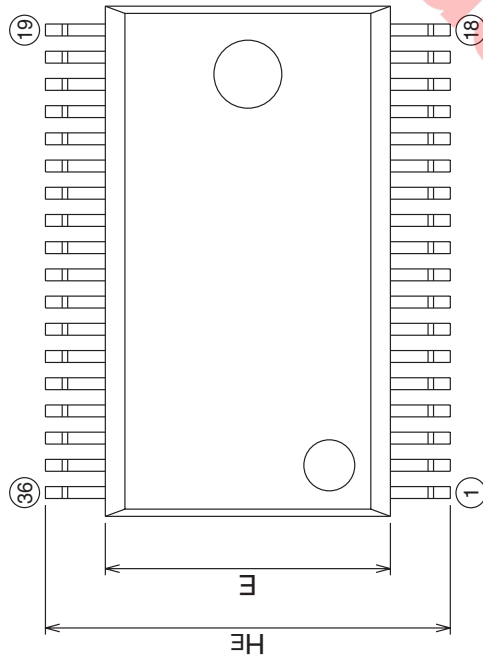
Package Dimensions

36P2R-D

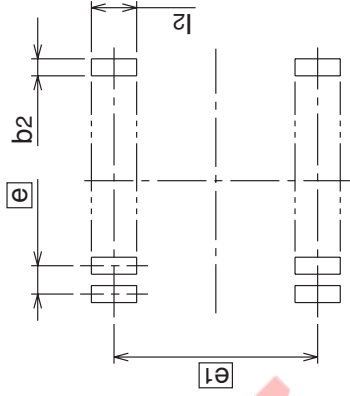
(MMP)

Plastic 36pin 450mil SSOP

EIAJ Package Code SSOP36-P-450-0.80	JEDEC Code —	Weight(g) 0.53	Lead Material Cu Alloy
--	-----------------	-------------------	---------------------------



Recommended Mount Pad



Symbol	Dimension in Millimeters		
	Min	Norm	Max
A	—	—	2.35
A1	0	0.1	0.2
A2	—	2.05	—
b	0.3	0.35	0.45
c	0.18	0.2	0.25
D	14.8	15.0	15.2
E	8.2	8.4	8.6
e	—	0.8	—
HE	11.63	11.93	12.23
L	0.3	0.5	0.7
L1	—	1.765	—
Z	—	0.7	—
Z1	—	—	0.85
y	—	—	0.15
theta	0°	—	8°
b2	—	0.5	—
e1	—	11.43	—
l2	1.27	—	—

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors.
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.



RENESAS SALES OFFICES

<http://www.renesas.com>

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500 Fax: <1> (408) 382-7501

Renesas Technology Europe Limited.
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, United Kingdom
Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

Renesas Technology Europe GmbH
Dornacher Str. 3, D-85622 Feldkirchen, Germany
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

Renesas Technology Hong Kong Ltd.
7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2375-6836

Renesas Technology Taiwan Co., Ltd.
FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology (Shanghai) Co., Ltd.
26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

Renesas Technology Singapore Pte. Ltd.
1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001