RF212

Image-Reject Front End for Dual or Tri-Band GSM Applications

The RF212 device is available as a dual-band (EGSM900/DCS1800) front end or as a tri-band (EGSM900/DCS1800/PCS1900) front end for Global System for Mobile Communications (GSM) mobile telephony applications. Each device integrates all the required front-end components after the frequency pre-select filters. These components include the Low Noise Amplifiers (LNAs), the internal image-reject filters, mixers, and a Local Oscillator (LO) amplifier.

The main advantage of the RF212 is its ability to provide a minimum of 35 dB of image rejection for each band. The block diagrams of the devices are shown in Figures 1 and 2. The device packages and pin configurations are shown in Figures 3 and 4.

Features

- Supports EGSM
- LNA and mixer for RF to IF conversion
- 12 dB or 20 dB switchable gain step
- Minimum 35 dB of image rejection
- No external post-LNA filters required
- Common Intermediate Frequency (IF) port for all bands
- IF range from 350 MHz to 450 MHz
- High isolation LO input buffer
- Differential IF output
- High dynamic range with low current consumption
- Three-cell battery operation (2.7 to 3.6 V)
- 20-pin Exposed paddle, Thin Shrink Small Outline Package (ETSSOP)

Applications

- Dual/tri-band digital cellular mobile telephony (EGSM900/DCS1800, or EGSM900/DCS1800/PCS1900)

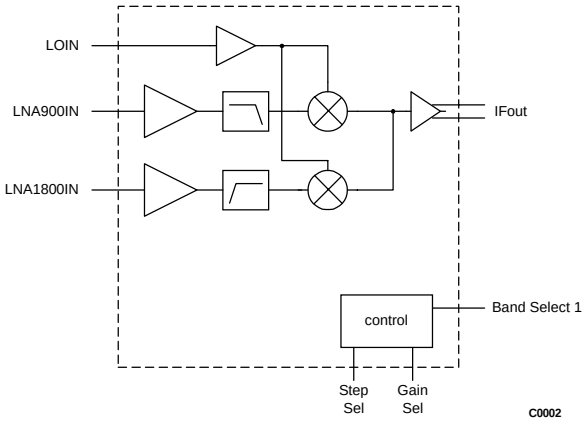

Figure 1. RF212 Dual-Band Device Block Diagram

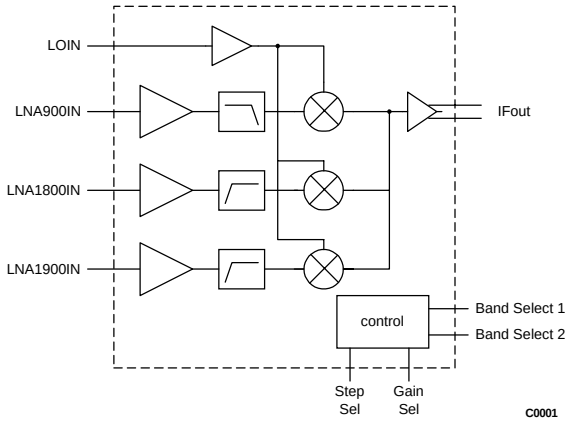

Figure 2. RF212 Tri-Band Device Block Diagram

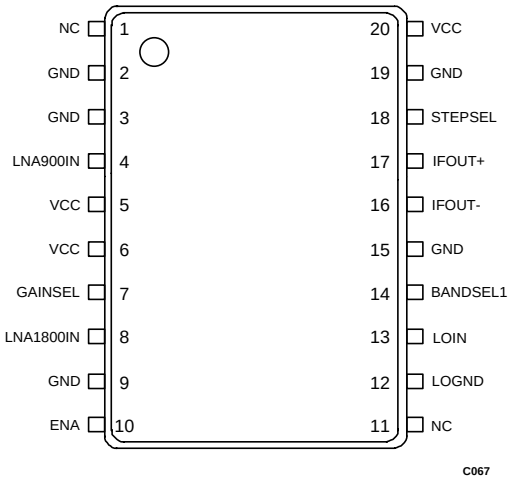

Figure 3. RF212 Dual-Band Device Pin Configuration – 20-Pin ETSSOP

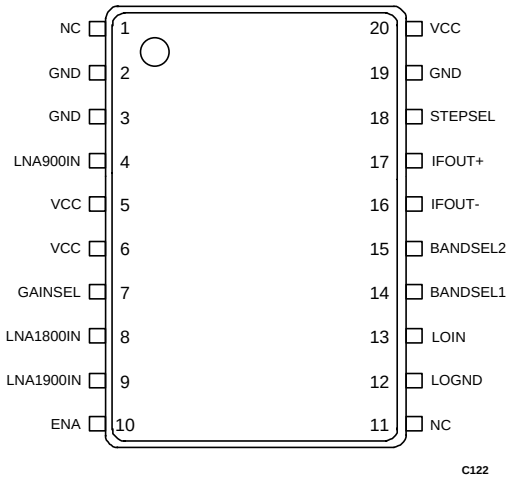

Figure 4. RF212 Tri-Band Device Pin Configuration – 20-Pin ETSSOP

Technical Description

Both RF212 devices form front ends of a dual-band or a tri-band super-heterodyne receiver. The RF212 dual-band device is optimized for an EGSM900/DCS1800 design, while the RF212 tri-band device is suitable for EGSM900, DCS1800, and PCS 1900. Each frequency band has its own separate front-end receiver path. Each receiver path contains an LNA, an image-reject filter, and a mixer. The IF and LO ports are common to all frequency bands. The image rejection achievable by this front-end design without any additional external components is 35 dB minimum for an IF of 400 MHz. Both devices operate over a supply voltage range of 2.7 V to 3.6 V.

The RF212 dual-band device has one band selection pin (BANDSEL1 on pin 14). When BANDSEL1 is set to logic "0," the EGSM900 receiver path is active. The LO frequency needs to be higher than the RF input frequency (i.e., a high side injection is used). When BANDSEL1 is set to logic "1," the DCS1800 receiver path is active. The LO frequency needs to be less than the RF input frequency (i.e., a low-side injection is used). With a 400 MHz IF, this arrangement allows a single, wide-range Voltage Controlled Oscillator (VCO) to be used for each band of operation.

Similarly, the RF212 tri-band device has two band selection pins (BANDSEL1 and BANDSEL2, pins 14 and 15, respectively). The EGSM900 path uses the high side injection for the LO, while DCS1800 and PCS1900 paths use the low side injection. Tables 1 and 2 provide the frequency band selection settings for the dual and tri-band devices, respectively.

All the LNAs have switchable gain. The gain mode is selectable using the GAINSEL signal (pin 7). Low gain mode is selected by driving the GAINSEL signal to a logic "1"; high gain mode is selected by driving the signal to a logic "0." Depending on the need of the handset design on the gain distribution, the gain step between the high gain and low gain modes can be set to either a 12 dB step or a 20 dB step. This gain step is selectable with the STEPSEL signal (pin 18).

Electrical and Mechanical Specifications

The RF212 signal pin assignments and functional pin descriptions are found in Table 3 (dual-band) and Table 4 (tri-band). The absolute maximum ratings of the RF212 are provided in Table 5, the operating conditions are specified in Table 6, and electrical specifications are provided in Table 7. Figure 3 shows the diagram for a typical application circuit using the RF212 front end. Figure 4 provides the package dimensions for both of the 20-pin ETSSOP devices.

ESD Sensitivity

The RF212 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

Table 1. RF212 Dual-Band Selection

BANDSEL1, pin 14	Mode
0	EGSM900
1	DCS1800

Table 2. RF212 Tri-Band Selection

BANDSEL1, pin 14	BANDSEL2, pin 15	Mode
0	0	EGSM900
0	1	
1	0	DCS1800
1	1	PCS1900

Table 3. RF212 Dual-Band Device Signal Description

Pin #	Name	Description	Pin #	Name	Description
1	NC	No connect (recommend connecting to ground)	11	NC	No connect (recommend connecting to ground)
2	GND	Ground	12	LOGND	LO input ground
3	GND	Ground	13	LOIN	LO input
4	LNA900IN	900 MHz LNA input	14	BANDSEL1	Band select control
5	VCC	Supply	15	GND	Ground
6	VCC	Supply	16	IFOUT–	Mixer negative output
7	GAINSEL	LNA gain select	17	IFOUT+	Mixer positive output
8	LNA1800IN	1800 MHz LNA input	18	STEPSEL	Gain step select. STEPSEL= 0 selects a 12 dB gain step; STEPSEL = 1 selects a 20 dB gain step
9	GND	Ground	19	GND	Ground
10	ENA	Device enable, active high	20	VCC	Supply

Table 4. RF212 Tri-Band Device Signal Description

Pin #	Name	Description	Pin #	Name	Description
1	NC	No connect (recommend connecting to ground)	11	NC	No connect (recommend connecting to ground)
2	GND	Ground	12	LOGND	LO input ground
3	GND	Ground	13	LOIN	LO input
4	LNA900IN	900 MHz LNA input	14	BANDSEL1	Band select control 1
5	VCC	Supply	15	BANDSEL2	Band select control 2
6	VCC	Supply	16	IFOUT–	Mixer negative output
7	GAINSEL	LNA gain select	17	IFOUT+	Mixer positive output
8	LNA1800IN	1800 MHz LNA input	18	STEPSEL	Gain step select. STEPSEL= 0 selects a 12 dB gain step; STEPSEL = 1 selects a 20 dB gain step
9	LNA1900IN	1900 MHz LNA input	19	GND	Ground
10	ENA	Device enable, active high	20	VCC	Supply

Table 5. Absolute Maximum Ratings

Parameter	Minimum	Maximum	Units
Storage Temperature	–40	+125	°C
Supply Voltage (VCC)	–0.3	+3.6	V
Input Voltage Range	–0.3	Vcc	V

Table 6. RF212 Recommended Operating Conditions

Parameter	Min	Typical	Max	Units
Supply Voltage	2.7	3.0	3.6	V
Operating Temperature	–30	+25	+85	°C

Table 7. RF212 Electrical Specifications (1 of 3)
(T_A = 25 °C, Vcc = 2.7 V, f_{IF} = 400 MHz, *Plo* = –10 dBm)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
EGSM900 Mode						
Supply current:: Enable mode Sleep mode		 ENA = 1 ENA = 0		 15	 30	 mA µA
RF Input frequency			925		960	MHz
IF frequency	f_{IF}		350	400	450	MHz
LO to RF input isolation			30			dB
Input impedance				50		Ω
Power gain (for 2 kΩ differential output impedance): High gain mode Low gain mode 1 Low gain mode 2 Gain step 1 Gain step 2 Temperature coefficient Gain variation versus frequency	 G_{MAX1} G_{MIN1} G_{MIN2} G_{STEP1} G_{STEP2} F_{TC1}	 GAINSEL = 0 GAINSEL = 1, STEPSEL = 1 GAINSEL = 1, STEPSEL = 0	 20 –24 –14	 22 0 10 –22 –12 –0.02	 25 –20 –10 0.8	 dB dB dB dB dB dB/°C dB
Noise figure: High gain Low gain mode 1 Low gain mode 2		 GAINSEL = 0 GAINSEL = 1, STEPSEL = 1 GAINSEL = 1, STEPSEL = 0		 2.3 18 10	 3.5	 dB dB dB
Noise figure degradation with blocker: High gain		–22 dBm blocker, GAINSEL = 0 (Note 1)		 1.6		 dB
Input 1 dB compression point	$IP1_{DB}$	high gain mode low gain mode	–22 –18	–20 –13		dBm dBm
Input third order intercept point	IP3			–12		dBm
Differential IF shunt output resistance				2		kΩ
Image rejection: f_{IF} = 400 MHz f_{IF} = 350 or 450 MHz			 35 25	 50		 dB dB

Table 7. RF212 Electrical Specifications (2 of 3)
(T_A = 25 °C, Vcc = 2.7 V, f_{IF} = 400 MHz, *Plo* = –10 dBm)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
DCS1800 Mode						
Supply current: Enable mode Sleep mode		 ENA = 1 ENA = 0		 19	 30	 mA µA
RF input frequency			1805		1880	MHz
IF frequency			350	400	450	MHz
LO to RF input isolation			30			dB
Input impedance				50		Ω
Power gain (for 2 kΩ differential output impedance): High gain mode Low gain mode 1 Low gain mode 2 Gain step 1 Gain step 2 Temperature coefficient Gain variation versus frequency	 G_{MAX1} G_{MIN1} G_{MIN2} G_{STEP1} G_{STEP2} F_{TC1}	 GAINSEL = 0 GAINSEL = 1, STEPSEL = 1 GAINSEL = 1, STEPSEL = 0	 20 –22 –14	 22 2 10 –20 –12 –0.02	 25 –18 –10 1.2	 dB dB dB dB dB dB/°C dB
Noise figure: High gain Low gain mode 1 Low gain mode 2		 GAINSEL = 0 GAINSEL = 1, STEPSEL = 1 GAINSEL = 1, STEPSEL = 0		 3.5 16.5 11	 4.5	 dB dB dB
Noise figure degradation with blocker: High gain		–22 dBm blocker, GAINSEL = 0 (Note 2)		 1.6		 dB
Input 1 dB compression point	$IP1_{DB}$	high gain mode low gain mode	–23 –20	–20 –16		dBm dBm
Input third order intercept point	IP3			–12		dBm
Differential IF shunt output resistance				2		kΩ
Image rejection: f_{IF} = 400 MHz f_{IF} = 350 or 450 MHz			 35 25	 40		 dB dB
PCS1900 Mode (for tri-band device only)						
Supply current: Enable mode Sleep mode		 ENA = 1 ENA = 0		 19	 30	 mA µA
RF input frequency			1930		1990	MHz
IF frequency			350	400	450	MHz
LO to RF input isolation			30			dB
Input impedance				50		Ω
Power gain (for 2 kΩ differential output impedance): High gain mode Low gain mode 1 Low gain mode 2 Gain step 1 Gain step 2 Temperature coefficient Gain variation versus frequency	 G_{MAX1} G_{MIN1} G_{MIN2} G_{STEP1} G_{STEP2} F_{TC1}	 GAINSEL = 0 GAINSEL = 1, STEPSEL = 1 GAINSEL = 1, STEPSEL = 0	 20 –22 –14	 22 2 10 –20 –12 –0.02	 25 –18 –10 1.2	 dB dB dB dB dB dB/°C dB
Noise figure: High gain Low gain mode 1 Low gain mode 2		 GAINSEL = 0 GAINSEL = 1, STEPSEL = 1 GAINSEL = 1, STEPSEL = 0		 3.5 16.5 11	 4.5	 dB dB dB
Noise figure degradation with blocker: High gain		–22 dBm blocker, GAINSEL = 0 (Note 3)		 1.6		 dB

Table 7. RF212 Electrical Specifications (3 of 3)
(T_A = 25 °C, Vcc = 2.7 V, f_{IF} = 400 MHz, *Plo* = –10 dBm)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
PCS1900 Mode (for tri-band device only) (continued)						
Input 1 dB compression point		high gain mode low gain mode	–23 –20	–20 –16		dBm dBm
Input third order intercept point				–12		dBm
Differential IF shunt output resistance				2		kΩ
Image rejection: f_{IF} = 400 MHz f_{IF} = 350 or 450 MHz			 35 25	 40		 dB dB
Local Oscillator (LO)						
LO frequency			1275		1640	MHz
LO input return loss (with external matching circuit)		f_{IF} = 400 MHz			–10	dB
LO input power	P_{LO}		–15	–10	–5	dBm
Control Signals (All Modes)						
Digital input voltages (ENA, GAINSEL, BANDSEL1, BANDSEL2, and STEPSEL)	V_{IH} V_{IL}		Vcc – 0.4		 0.4	V V
Enable time	t_{ON}				10	µs
Bandselect switching time				15		µs

Note 1: Assumes –5 dBm @ 915 MHz blocker at the antenna input attenuated by 17 dB.
Note 2: Assumes –12 dBm @ 1785 MHz blocker at the antenna input attenuated by 10 dB.
Note 3: Assumes –12 dBm @ 1910 MHz blocker at the antenna input attenuated by 10 dB.

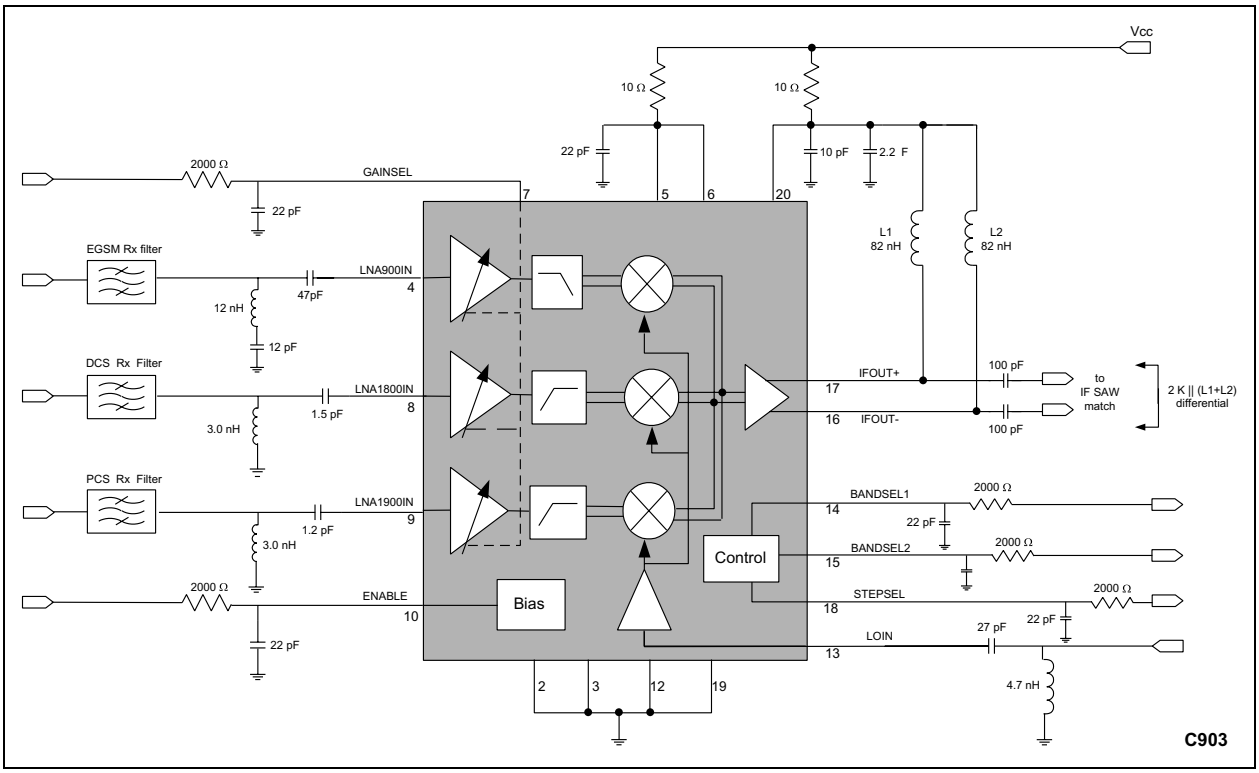

Figure 3. Typical RF212 Application Circuit
(for dual-band device, ground pins 9 and 15)

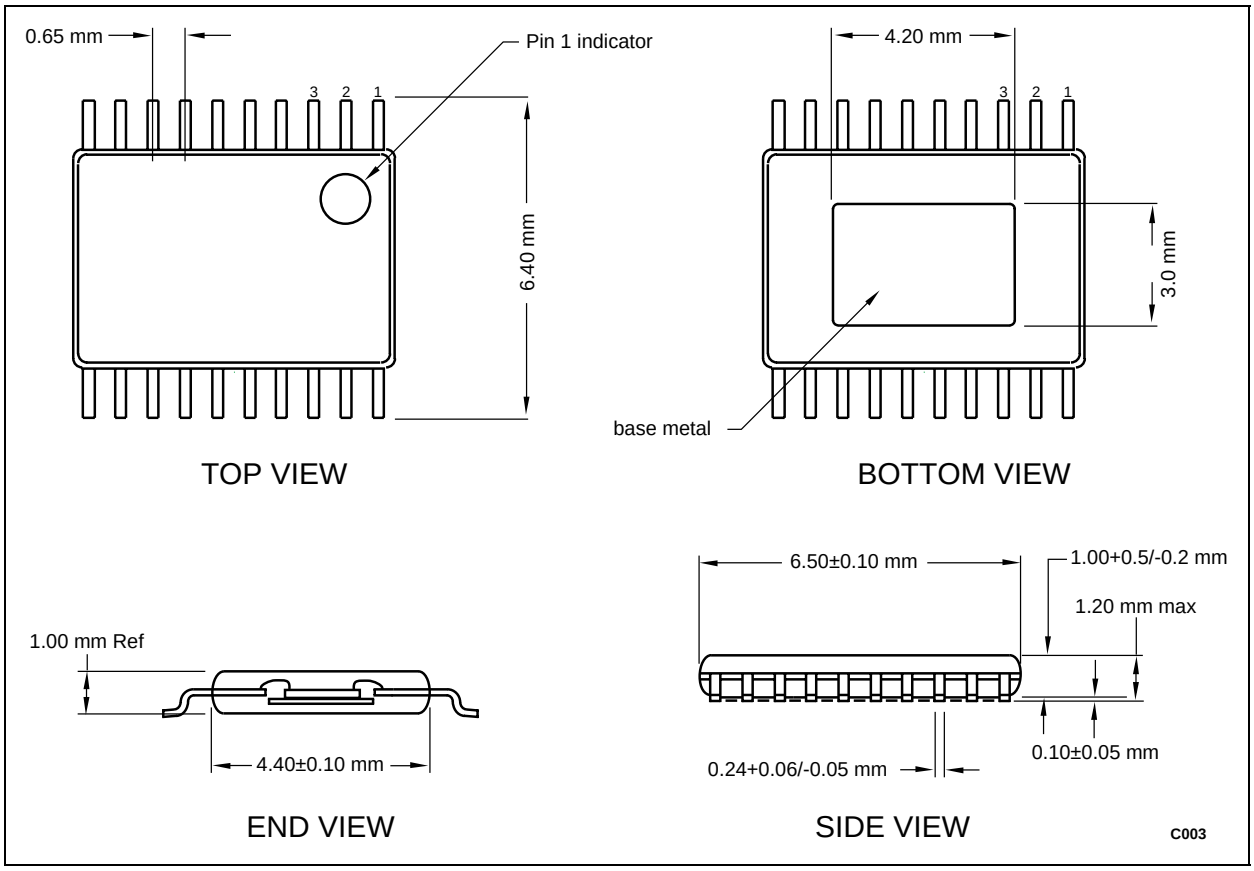

Figure 4. RF212 Package Dimensions – 20-Pin ETSSOP

Ordering Information

Model Name	Manufacturing Part Number
Dual-Band Image-Reject Front End	RF212-11
Tri-Band Image-Reject Front End	RF212-21

Further Information
literature@conexant.com
(800) 854-8099 (North America)
(949) 483-6996 (International)
Printed in USA

World Headquarters
Conexant Systems, Inc.
4311 Jamboree Road
Newport Beach, CA
92660-3007
Phone: (949) 483-4600
Fax 1: (949) 483-4078
Fax 2: (949) 483-4391

Americas

U.S. Northwest/
Pacific Northwest – Santa Clara
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Fax: (408) 249-7113

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Fax: (805) 376-8180

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Fax: (215) 244-9292

Canada – Ontario
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Fax: (613) 271-2359

Europe

Europe Central – Germany
Phone: +49 89 829-1320
Fax: +49 89 834-2734

Europe North – England
Phone: +44 1344 486444
Fax: +44 1344 486555

Europe – Israel/Greece
Phone: +972 9 9524000
Fax: +972 9 9573732

Europe South – France
Phone: +33 1 41 44 36 51
Fax: +33 1 41 44 36 90

Europe Mediterranean – Italy
Phone: +39 02 93179911
Fax: +39 02 93179913

Europe – Sweden
Phone: +46 (0) 8 5091 4319
Fax: +46 (0) 8 590 041 10

Europe – Finland
Phone: +358 (0) 9 85 666 435
Fax: +358 (0) 9 85 666 220

Asia – Pacific

Taiwan
Phone: (886-2) 2-720-0282
Fax: (886-2) 2-757-6760

Australia
Phone: (61-2) 9869 4088
Fax: (61-2) 9869 4077

China – Central
Phone: 86-21-6361-2515
Fax: 86-21-6361-2516

China – South
Phone: (852) 2 827-0181
Fax: (852) 2 827-6488

China – South (Satellite)
Phone: (86) 755-518-2495

China – North
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Fax: (86-10) 8529-9778

India
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Fax: (91-11) 692-4712

Korea
Phone: (82-2) 565-2880
Fax: (82-2) 565-1440

Korea (Satellite)
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Fax: (82-53) 745-1440

Singapore
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Japan
Phone: (81-3) 5371 1520
Fax: (81-3) 5371 1501