

STRUCTURE
PRODUCT SERIES

Silicon Monolithic Integrated Circuit
7-Channel Switching Regulator Controller for Digital Camera

TYPE

BD9738KN

FEATURES

- Wide input Voltage range (1.5 to 10V)
- Controls up to 7 switching regulators: Step-up converter (2 channels), Step-down converter (1 channel), Configurable for step-up or step-down conversion (3 channels), Step-up converter for LED (1 channels)
- Synchronous rectifying action mode (4 channels) Built-in FET Transistor (3 channels)
- Positive-negative regulator with soft start for CCD supply

○ Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Units
Power Supply Voltage	VBAT1,2, VCC, PVCC	-0.3~12	V
	PVCCH, PVCC	-0.3~15	V
Power Input Voltage	DRAIN1,2,3	-0.3~12	V
	OUT1B	-0.3~20	V
	OUT7B	-0.3~20	V
	VIN+	-0.3~20	V
	VIN-	-12~0.3	V
	SWOUT1,4, PGIN1	-0.3~12	V
	SWIN6,7	-0.3~20	V
Power Dissipation	Pd	610(*1)	mW
		1200(*2)	mW
Operating Temperature	Topr	-25~+85	°C
Storage Temperature	Tstg	-55~+125	°C

(*1) Without external heat sink, the power dissipation reduces by 6.1mW/°C over 25°C.

(*2) Reduced by 12.0mW/°C over 25°C, when mounted on a PCB (70.0mm×70.0mm×1.6mm).

○ Operating conditions (Ta = -25~+85°C)

Parameter	Symbol	Spec.			Units
		Min.	Typ.	Max.	
Power Supply Voltage	VBAT	1.5	—	10	V
	VCC, PVCC	2.5	—	10	V
	PVCC, PVCC	4.0	—	14	V
VREF Pin Connect Capacitor	CVREF	1.0	—	4.7	μF
VREGA Pin Connect Capacitor	CVREGA	1.0	—	10	μF
SCP Pin Connect Capacitor	CSS1	0.001	—	2.2	μF
SS1 Pin Connect Capacitor	CSS23	0.005	—	10	μF
[Driver]					
DRAIN Pin Input Voltage	VDRAIN	—	—	8	V
Nch FET Output Current (CH2 Step down, CH3)	IoFET1	—	—	700	mA
Nch FET Output Current (CH1, CH2 Step up)	IoFET2	—	—	300	mA
Driver Output Current (CH4,5,6)	Iout	—	—	30	mA
Driver Peak Current	Ipeak	—	—	200	mA
Built-in NPN TR Sink Current(CH1)	INPNsink	—	—	500	mA

◎ It is strongly recommended that a capacitor connect to VREF, VREGA pin to prevent oscillation.

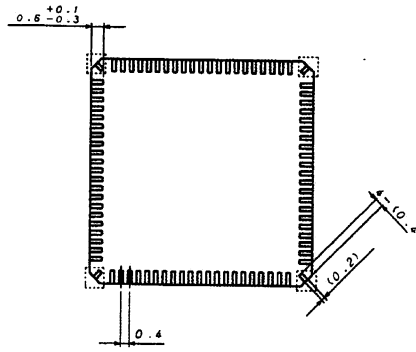
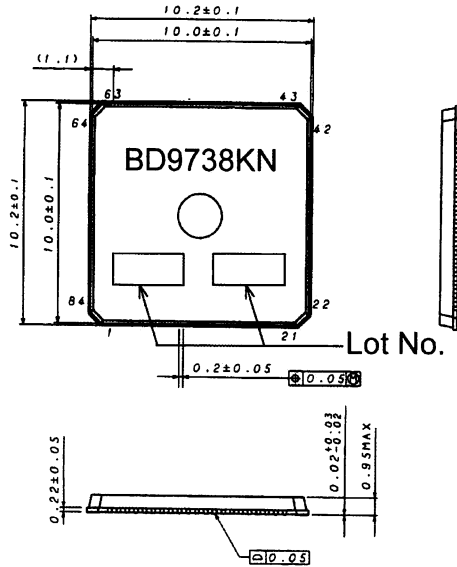
Parameter	Symbol	Spec.			Units
		Min.	Typ.	Max.	
[oscillator]					
Oscillator Frequency	fosc	0.1	—	1.2	MHz
OSC Timing Resistor	RT	4.7	—	30	kΩ
OSC Timing Capacitor	CT	100	—	10000	pF
[Positive-Negative Regulator]					
VIN+Pin Input Voltage	VVIN1	—	—	18	V
VIN-Pin Input Voltage	VVIN2	-10	—	—	V
Positive Regulator Output Current	IOREG1	—	—	50	mA
Negative Regulator Output Current	IOREG2	—	—	50	mA
Output Pin Capacitor	COREG	1.0	—	22	μF
SS2 Pin Connect Capacitor	CSS2	0.001	—	2.2	μF
[SW Circuit]					
DELAY Time Set-up Resistor	RDELAY	100	—	400	kΩ
SWOUT1 Sink Current	ISWOUT1	—	—	10	mA
PGOUT1 Source Current	IPGOUT1	—	—	100	mA
PG23 Sink Current	IPG23	—	—	1	mA
SWOUT4 Sink Current	ISWOUT4	—	—	1	mA
SWOUT6 Sink Current	ISWOUT6	—	—	50	mA
SWOUT7 Sink Current	ISWOUT7	—	—	50	mA

○Electrical characteristics (Ta=25°C, VBAT=3V, VCC=5V, RT=11kohm, CT=180pF, STB1~7=3V, unless otherwise specified)

Parameter	Symbol	Spec.			Units	Conditions
		Min.	Typ.	Max.		
[Reference Voltage]						
Reference Voltage	Vref2	0.99	1.0	1.01	V	
Line Regulation	DVLJ	-	4.0	12.5	mV	Vcc=3.0V~9.5V
Load Regulation	DVLo	-	1.0	7.5	mV	Iref=10μA ~100μA
Short-Circuit Output Current	Ios	0.2	1	-	mA	Vref=0V
[Internal Regulator]						
REGA Output Voltage	VREGA	2.4	2.5	2.6	V	Ireg=1mA
[Low Voltage Input Prevented Operation Faults Circuit]						
Threshold Voltage 1	Vstd1	3.45	3.6	3.75	V	PVCCL monitor
Hysteresis width 1	ΔVst1	-	300	-	mV	
Threshold Voltage 2	Vstd2	2.3	2.4	2.5	V	VCC monitor
Hysteresis width 2	ΔVst2	-	200	-	mV	
Threshold Voltage 3	Vstd3	-	2.0	-	V	VREGA monitor
Hysteresis width 3	ΔVst3	-	50	-	mV	
[Start up Circuit]						
Oscillator Frequency	Fstart	50	120	220	kHz	
Minimum VBAT Voltage	Vst1	2.5	-	-	V	VBAT monitor
Slow Start Charge Current	Iss1	1.1	2.2	3.3	μA	Vss1=0V
[Protection Circuit]						
Timer Start Threshold Voltage	Vtc	2.1	2.2	2.3	V	FB monitor
SCP Output Current	Iscp	0.5	1.0	1.5	μA	VSCP=0.1V
SCP Threshold Voltage	Visc	0.45	0.50	0.55	V	
SCP Standby Voltage	Vssc	-	22	170	mV	
[Triangular wave oscillator]						
Oscillator Frequency	fosc1	450	500	550	kHz	RT=11kohm CT=180pF
Frequency Stability	Df	-	0.3	2	%	VCC=3.0V~9.5V
RT Output Voltage	VRT	0.78	1.00	1.22	V	
[Error Amp 1 ~ 6]						
Low-level Output Voltage	VOL	-	1.3	-	V	INV=2V
High-level Output Voltage	VOH	VREGA-0.3	-	-	V	INV=0V
Maximum Sink Current	IOI	36	72	-	μA	FB=1.7V, VINV=1.1V
Maximum Source Current	IOO	36	72	-	μA	FB=1.7V, VINV=0.9V
[Error Amp 7]						
Low-level Output Voltage	VOL	-	1.3	-	V	INV=2V
High-level Output Voltage	VOH	VREGA-0.3	-	-	V	INV=0V
Maximum Sink Current	IOI	36	72	-	μA	FB=1.7V, VINV=1.1V
Maximum Source Current	IOO	36	72	-	μA	FB=1.7V, VINV=0.9V
Non-inverting voltage reference	VNON7	-	0.2	-	V	
[Soft Start 23]						
SS23 charge Current	Iss23	5	10	15	μA	Vss23=0V
[PWM Comparator]						
Input Threshold Voltage1, 2,3	Vl0	-	1.49	-	V	V1:DUTY0%
	Vl100	-	1.95	-	V	V1:DUTY100%
Input Threshold Voltage 4,5,6,7	Vl0	-	1.49	-	V	V1:DUTY0%
	Vl100	-	1.95	-	V	V1:DUTY100%
MAX DUTY1,6,7	Dmax1	77	85	93	%	VINV=0.9V, VSCP=0V
MAX DUTY2,4,5(step-up)	Dmax2	77	85	93	%	VINV=0.9V, VSCP=0V, UDSEL=0V
[Output circuit]						
High-level Output Voltage on Driving	VSATH	VCC-1.6	VCC-0.8	-	V	Ic=30mA
Low-level Output Voltage on Driving	VSATL	-	0.8	1.6	V	Ic=30mA
H-side Nch FET ON Resistor	Ron	-	270	500	mΩ	PVCC=5V (Ic=200mA)
Lo-side Nch FET ON Resistor	Ron	-	270	500	mΩ	PVCC=5V (Ic=200mA)
[Step up/down Selector]						
UDSEL2/4/5 Control Voltage	Step down	VUDDO	VCC x 0.7	-	V	V
	Step up	VUDUP	0	-	V	VCC x 0.3

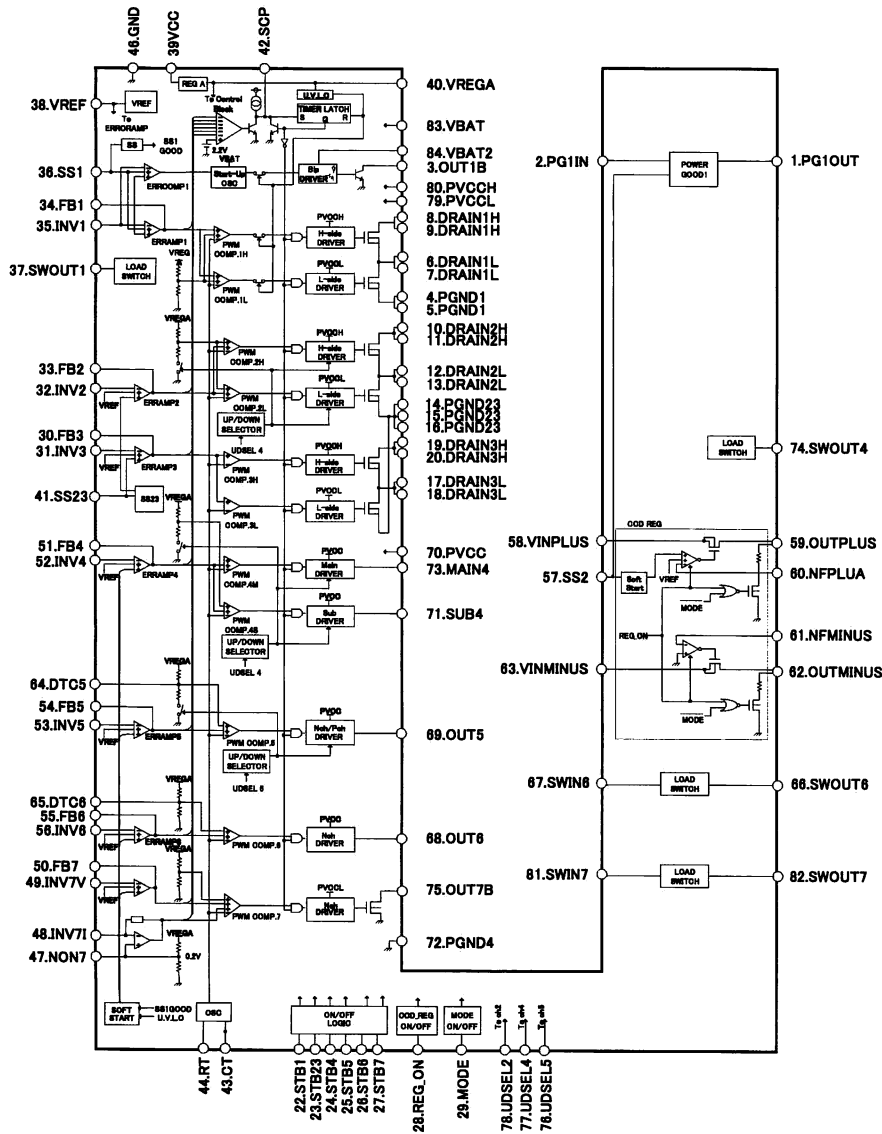
○this product is not designed for normal operation within a radioactive environment.

Parameter	Symbol	Spec.			Units	Conditions	
		Min.	Typ.	Max.			
[Power Good] (POWERGOOD1)							
POWERGOOD 1 Input Threshold Voltage	VTH PG1	0.63	0.7	0.77	V	VTH Low→High	
Hysteresis width	ΔVTH PG1	100	200	300	mV		
PG1	Output Voltage on driving	VSAT	VPG 1IN-0.3	VPG 1IN-0.1	V	Ic=80mA, VPG1IN=5V	
	Leak Current during Off Time	IILEAK	-	0	5	μA	STB1=0V
Discharge Resistor	RDIS	82	165	330	Ω		
[Positive-Negative Regulator]							
Slow Start Charge Current	Iss2	1.0	2.0	3.0	μA	Vss2=0V	
REG_ON	Vinon	2.0	-	11	V		
Control Voltage	Vthoff	-0.3	-	0.3	V		
Control pin Pull-down Resistance	RCONT	250	400	700	kΩ		
●REG1 (VIN=16V, R1A=700kΩ, R1B=50kΩ)							
Setup value of Feedback Voltage1	VNF1	VREF-0.05	VREF	VREF+0.05	V		
Output Voltage 1	Vo1	-	15	-	V	Ic=10mA	
Maximum Output Current1	Imax1	-	50	-	mA		
Short-circuit Output Current1	Iscp1	-	50	-	mA	Vo=0V	
Differential Voltage of input output1	ΔV1	-	80	160	mV	VIN=14V, Ic=10mA	
Load stability1	Δvo1	-	10	50	mV	Ic=0.1 ~ 10mA	
Ripple Rejection1	RR1	-	40	-	dB	f=120Hz, VRF=20dBV, Ic=1mA	
Discharge Resistor1	RDIS1	103	207	414	Ω		
●REG2 (VIN=8.5V, R2A=100kΩ, R2B=50kΩ)							
Setup value of Feedback Voltage2	VNF2	-0.05	0	0.05	V		
Output Voltage 2	Vo2	-	-7.5	-	V	Ic=10mA	
Maximum Output Current2	Imax2	-	80	-	mA		
Differential Voltage of input output2	ΔV2	-	50	100	mV	VIN=6.5V, Ic=10mA	
Load stability2	Δvo2	-	10	50	mV	Ic=0.1 ~ 10mA	
Ripple Rejection2	RR2	-	50	-	dB	f=120Hz, VRF=20dBV, Ic=1mA	
Discharge Resistor2	RDIS2	55	110	220	Ω		
[Power on Switch]							
SWOUT1	Output Voltage on driving	VSAT	-	0.1	0.3	V	Ic=1mA
	Off Time Leak Current	IILEAK	-	0	5	μA	STB1=0V
SWOUT4	Output Voltage on driving	VSAT	-	0.1	0.3	V	Ic=100μA
	Off Time Leak Current	IILEAK	-	0	5	μA	STB4=0V
SWOUT6	Output Voltage on driving	VSAT	VSW IN6-0.3	VSW IN6-0.1	V	Ic=20mA VSWIN6=5V	
	Off Time Leak Current	IILEAK	-	0	5	μA	STB6=0V
SWOUT7	Output Voltage on driving	VSAT	VSWI N7-0.3	VSWI N7-0.1	V	Ic=10mA VSWIN7=10V	
	Off Time Leak Current	IILEAK	-	0	5	μA	STB7=0V
[STB1~7]							
STB Control Voltage1	ON	VSTBH1	2.0	-	11	V	STB1
	OFF	VSTBL1	-0.3	-	0.3	V	
STB Pull-down Resistor 1	RSTB1	250	400	700	kΩ	STB1	
STB Control Voltage 2	ON	VSTBH2	2.0	-	11	V	STB2,4,5,6,7
	OFF	VSTBL2	-0.3	-	0.3	V	
STB Pull-down Resistor 2	RSTB2	250	400	700	kΩ	STB2,4,5,6,7	
[Circuit Current]							
Standby Current1 (VBAT sink current)	ISTB1	-	-	5	μA	STB1~7=0V	
Standby Current2 (VCC, PVCC sink current)	ISTB2	-	-	5	μA	STB1~7=0V	
Start up Current (VBAT sink current)	IST	-	30	100	mA	CT=1.7V VCC=0V	
Circuit Current on Driving1 (VBAT sink current)	Icc1	-	100	300	μA	CT=1.7V	
Circuit Current on Driving2 (VCC, PVCC sink current)	Icc2	-	5	15	mA	CT=1.7V INV=2.5V	



Plastic mold
(UNIT : mm)

Block Diagram



Pin No.	Pin Name
83	VBAT1
84	VBAT2
39	VCC
70	PVCC
80	PVCCH
79	PVCCL
4,5,14,15,16,72	PGND1,2,3,4
46	GND
40	VREGA
69,68	OUT5,6
75	OUT7B
3	OUT1B
8,9,10,11,19,20	DRAIN1,2,3H
6,7,12,13,17,18	DRAIN1,2,3L
73	MAIN4
71	SUB4
38	VREF
64,65	DTC 5,6
34,33,30,51,54,55,50	FB 1~7
35,32,31,52,53,56	INV 1~6
48,49	INV 1, V
47	NON7
36,57	SS1,2
44	RT
43	CT
42	SCP
45	SYNC_DTC
78,77,76	UDSEL2,4,5
29	MODE
22,23,24,25,26,27	STB 1,2,3,4,5,6,7
41	SS2,3
28	REG_ON
58	VINPLUS
63	VINMINUS
2	PG1IN
67,81	SWIN6,7
1	PG1OUT
59	OUTPLUS
60	NFPLUS
62	OUTMINUS
61	NFMINUS
37,74,66,82	SWOUT1,4,6,7
21	N.C

○NOTE FOR USE

- (1) Absolute maximum rating
The device may be destroyed when applied voltage or operating temperature exceeds its absolute maximum rating. Because the source, such as short mode or open mode, cannot be identified if the device is destroyed, it is important to take physical safety measures (such as fusing) if a special mode in excess of absolute rating limits is to be implemented.
- (2) Supply line
Since the motor's reverse electromotive force gives rise to the return of regenerative current, measures should be taken to establish a channel for the current, such as adding a capacitor between the power supply and GND. In determining the approach to take, make sure that no problems will be posed by the various characteristics involved, such as capacitance loss at low temperatures with an electrolytic capacitor.
- (3) GND potential
Make sure the potential for the GND pin is always kept lower than the potentials of all other pins, regardless of the operating mode.
- (4) Thermal design
Be sure to factor in allowable power dissipation (Pd) in actual operation, and to build sufficient margin into the thermal design to accommodate this power loss.
- (5) Operation in strong magnetic fields
Use in strong electromagnetic fields may cause malfunctions. Exercise caution with respect to electromagnetic fields.
- (6) ASO
Set the parameters so that output Tr will not exceed the absolute maximum rating or ASO value when the IC is used.
- (7) Thermal shutdown circuit
This IC is provided with a built-in thermal shutdown (TSD) circuit, which is activated when the chip temperature reaches the threshold value listed below. When TSD is on, the device goes to high impedance mode. Note that the TSD circuit is provided for the exclusive purpose shutting down the IC in the presence of extreme heat, and is not designed to protect the IC per se or guarantee performance when or after extreme heat conditions occur. Therefore, do not operate the IC with the expectation of continued use or subsequent operation once the TSD is activated.
- (8) Mutual impedance
Use short and wide wiring tracks for the main supply and ground to keep the mutual impedance as small as possible. Use inductor and capacitor network to keep the ripple voltage minimum.
- (9) Voltage of STB pin
The threshold voltages of STB pin are 0.3V and 2.0V. STB state is set below 0.3V while action state is set beyond 2.0V.
The region between 0.3V and 2.0V is not recommended and may cause improper operation.
- (10) Setting Max Duty
Max duty limit might not work normally at high frequency. Consider adequate margin when operating circuit above the maximum allowable switching frequency.
- (11) Please use the same power supply of driver block as that of main block.
This IC can't be used on the application that arbitrary voltage is applied to driver block.

Notes

- No technical content pages of this document may be reproduced in any form or transmitted by any means without prior permission of ROHM CO.,LTD.
- The contents described herein are subject to change without notice. The specifications for the product described in this document are for reference only. Upon actual use, therefore, please request that specifications to be separately delivered.
- Application circuit diagrams and circuit constants contained herein are shown as examples of standard use and operation. Please pay careful attention to the peripheral conditions when designing circuits and deciding upon circuit constants in the set.
- Any data, including, but not limited to application circuit diagrams information, described herein are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO.,LTD. disclaims any warranty that any use of such devices shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes no liability of whatsoever nature in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices, other than for buyer's right to use such devices itself, resell or otherwise dispose of the same, no express or implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by
- ROHM CO., LTD. is granted to any such buyer.
- Products listed in this document are no antiradiation design.

The products listed in this document are designed to be used with ordinary electronic equipment or devices (such as audio visual equipment, office-automation equipment, communications devices, electrical appliances and electronic toys).

Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.

About Export Control Order in Japan

Products described herein are the objects of controlled goods in Annex 1 (Item 16) of Export Trade Control Order in Japan.

In case of export from Japan, please confirm if it applies to "objective" criteria or an "informed" (by MITI clause) on the basis of "catch all controls for Non-Proliferation of Weapons of Mass Destruction.

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available,
please contact your nearest sales office.

Please contact our sales offices for details ;

U.S.A / San Diego	TEL : +1(858)625-3630	FAX : +1(858)625-3670
Atlanta	TEL : +1(770)754-5972	FAX : +1(770)754-0691
Dallas	TEL : +1(972)312-8818	FAX : +1(972)312-0330
Germany / Dusseldorf	TEL : +49(2154)9210	FAX : +49(2154)921400
United Kingdom / London	TEL : +44(1)908-282-666	FAX : +44(1)908-282-528
France / Paris	TEL : +33(0)1 56 97 30 60	FAX : +33(0) 1 56 97 30 80
China / Hong Kong	TEL : +852(2)740-6262	FAX : +852(2)375-8971
Shanghai	TEL : +86(21)6279-2727	FAX : +86(21)6247-2066
Dilian	TEL : +86(411)8230-8549	FAX : +86(411)8230-8537
Beijing	TEL : +86(10)8525-2483	FAX : +86(10)8525-2489
Taiwan / Taipei	TEL : +866(2)2500-6956	FAX : +866(2)2503-2869
Korea / Seoul	TEL : +82(2)8182-700	FAX : +82(2)8182-715
Singapore	TEL : +65-6332-2322	FAX : +65-6332-5662
Malaysia / Kuala Lumpur	TEL : +60(3)7958-8355	FAX : +60(3)7958-8377
Philippines / Manila	TEL : +63(2)807-6872	FAX : +63(2)809-1422
Thailand / Bangkok	TEL : +66(2)254-4890	FAX : +66(2)256-6334

Japan /
(Internal Sales)

Tokyo	2-1-1, Yaesu, Chuo-ku, Tokyo 104-0082	TEL : +81(3)5203-0321	FAX : +81(3)5203-0300
Yokohama	2-4-8, Shin Yokohama, Kohoku-ku, Yokohama, Kanagawa 222-8575	TEL : +81(45)476-2131	FAX : +81(45)476-2128
Nagoya	Dainagayo Building 9F 3-28-12, Meieki, Nakamura-ku, Nagoya, Aichi 450-0002	TEL : +81(52)581-8521	FAX : +81(52)561-2173
Kyoto	579-32 Higashi Shiokouji-cho, Karasuma Nishi-iru, Shiokoujidori, Shimogyo-ku, Kyoto 600-8216	TEL : +81(75)311-2121	FAX : +81(75)314-6559

(Contact address for overseas customers in Japan)

Yokohama	TEL : +81(45)476-9270	FAX : +81(045)476-9271
----------	-----------------------	------------------------