Motor Driver IC Series for Tape Record System

3 in 1 Motor Driver for Digital Video Camera

BD6637KV/KS, BD6300KU

●Description

The low power consumption, 3 in 1 motor driver, utilizes a DMOS linear output driver. It integrates the capstan, cylinder, loading motor driver, and amplifier of each sensor signal that is required for digital video camera systems.

●Features

・3-phase motor driver for capstan
1) 3-phase full wave drive system (pseudo-linear)
2) Output stage DMOS drive system
3) Built-in torque ripple canceling circuit
4) Built-in output Tr saturation preventing circuit (lower)
5) Equipped with a VM power supply control terminal
6) Built-in normal, reverse, and short brake function
7) Built-in FG sensor amplifier

・3-phase sensor-less motor driver for cylinder
1) Soft switching drive system
2) Output stage DMOS drive system
3) Built-in output Tr saturation preventing circuit (lower)
4) Equipped with a VM power supply control terminal
5) Built-in startup circuit
6) Built-in FG/PG sensor amplifier

・Reversible motor driver for loading
1) Output stage DMOS drive system
2) Normal/Reverse rotation and braking 3 mode output
3) Any setting of output voltage with L_REF terminal available

・Built-in TSD
・Built-in voltage rise circuit
・Power saving function

●Applications

Portable video equipment, such as digital video cameras, VTR, and 8-mm video cameras.

Ver.B Oct. 2005

●Product lineup

Item	BD6637KV/KS	BD6300KU
Capstan	3-phase pseudo-linear drive (DMOS linear drive)	3-phase pseudo-linear drive (DMOS linear drive)
Cylinder	3-phase sensor-less soft switching drive (DMOS linear drive)	3-phase sensor-less soft switching drive (DMOS linear drive)
Loading	DMOS H bridge drive	DMOS H bridge drive
Sensor Amplifier	Capstan FG signal, Cylinder PG signal (coil sense), Cylinder FG signal waveform coordinate	Capstan FG signal, Cylinder PG signal (hall sense), Cylinder FG signal, Reel sensor signal waveform coordinate
Package	VQFP64/SQFP56	UQFP64

●Absolute maximum ratings (Ta=25℃)

Parameter		Symbol	Limit	Unit
Supply voltage		VCC	7	V
		UNREG	15	V
		C_VM	10	V
		D_VM	10	V
		L_VM	7	V
Power dissipation	BD6637KV/KS	Pd	1250＊	mW
	BD6300KU		1750＊	mW
Operate temperature		T_{opr}	−25～+75	℃
Storage temperature		T_{stg}	−40～+150	℃
Junction temperature		T_{jmax}	150	℃
Output max current	BD6637KV/KS	I_{omax}	1000＊＊	mA
	BD6300KU		800＊	mA

＊70mm×70mm×1.6mm glass epoxy board. Reduced by 14mW/℃ when Ta=25℃

＊＊However, do not exceed Pd, ASO and Tj=150℃(Common to 3 drivers)

●Operating conditions

Supply voltage	VCC	2.7 ～ 4.5	V
	UNREG	5 ～ 12＊	V
	C_VM	0 ～ 8＊	V
	D_VM	0 ～ 8＊	V
	L_VM	4.5 ～ 5.5	V

＊UNREG≧C_VM
UNREG≧D_VM
L_VM≧VCC

●Electrical characteristics

BD6637KV/KS (Unless otherwise specified Ta=25℃,VCC=3V, C_VM＝D_VM＝L_VM=5V, UNREG=7.2V)

Parameter	Symbol	Limit			Unit	Conditions	Fig No.
		Min.	Typ.	Max.			
<TOTAL>							
VCC Circuit current 1	Icc1	6	13	20	mA	Power save OFF	Fig.1
VCC Circuit current 2	Icc2	—	—	5	μA	Power save ON	Fig.2
UNREG stand by current	IUNREG	—	—	5	μA	Power save ON	Fig.3
PS input switching level	PS	0.6	1.4	2	V		—
VG voltage	VG	9.5	11	12.5	V		Fig.4,5
<CAPSTAN OUTPUT>							
Output H voltage	C_VOH	—	0.35	0.55	V	IOUT=-400mA	Fig.6
Output L voltage	C_VOL	—	0.4	0.65	V	IOUT=400mA,C_RNF=0.33Ω	Fig.7
<CAPSTAN HALL AMP>							
In-phase input voltage range	C_VCM	1.2	—	VCC-1.1	V		—
Hall input offset range	C_VHOF	-15	—	15	mV		—
<CAPSTAN F/B/R>							
Forward rotation control	C_VFWD	—	—	0.7	V		—
Brake voltage range	C_VBRK	1.3	1.5	1.7	V		—
Reverse rotation control	C_VREV	2.3	—	—	V		—
<CAPSTAN TORQUE CONTROL>							
EC input bias current	C_IEC	—	3	7.5	μA	C_EC=VCC	—
Torque control input/output gain	C_GIO	0.35	0.5	0.65	A/V	C_RNF=0.33Ω,C_RCC=3.3kΩ	Fig.8
Torque control start voltage	C_VECOFS	1.05	1.2	1.35	V		Fig.8
Current limit voltage	C_Climit	0.2	0.24	0.28	V	C_RNF=0.33Ω,C_RCC=3.3kΩ	Fig.8
Ripple cancel ratio	C_VRCC	8	20	32	%	IOUT=400mA,C_RCC=3.3kΩ	—
<CAPSTAN VS>							
Voltage gain	C_GVS	7	8	9	TIMES		—
Output H voltage	C_VVSOH	—	0.5	0.8	V	IOVS=1mA,	—
Output L voltage	C_VVSOL	—	0.13	0.2	V	IOVS=50μA	—
VS offset voltage	C_VVSOFS	0.12	0.25	0.38	V	DC/DC×3 in use	—
<CAPSTAN FGAMP>							
Input offset voltage	C_VFGOFS	-12	—	12	mV		—
DC bias voltage	C_VFG	1.3	1.5	1.7	V		—
Voltage gain 1	C_AV1	50	59	—	dB	f=3kHz	Fig.20
Voltage gain 2	C_AV2	30	36	—	dB	f=50kHz	Fig.20
In-phase input voltage range	C_VFGCM	0.35	—	VCC-1.1	V		—
Output H voltage	C_VFGAOH	—	0.3	0.5	V	IOH=0.2mA,	—
Output L voltage	C_VFGAOL	—	0.1	0.3	V	IOL=1mA	—
<CAPSTAN FGHYS>							
C_FG hysteresis width	C_VFGHYS	±30	±46	±62	mV		Fig.22
DC bias voltage	C_VFG+	1.3	1.5	1.7	V		—
Output L voltage	C_VFGSOL	—	0.1	0.3	V	IOL=1mA	Fig.21
<CYLINDER OUTPUT>							
Output H voltage	D_VOH	—	0.3	0.5	V	IOUT=-400mA	Fig.9
Output L voltage	D_VOL	—	0.4	0.65	V	IOUT=400mA,C_RNF=0.33Ω	Fig.10
<CYLINDER TORQUE CONTROL>							
EC input bias current	D_IEC	—	2	5	μA	D_EC=VCC	—
Torque control input/output gain	D_GIO	0.45	0.66	0.87	A/V	D_RNF=0.33Ω	Fig.11
Torque control start voltage	D_VECOFS	1.05	1.2	1.35	V		Fig.11
Current limit voltage	D_Climit	0.217	0.274	0.332	V	D_RNF=0.33Ω	Fig.11

BD6637KV/KS (Unless otherwise specified Ta=25℃,VCC=3V, C_VM＝D_VM＝L_VM=5V, UNREG=7.2V)

Parameter	Symbol	Limit			Unit	Conditions	Fig No.
		Min.	Typ.	Max.			
<CYLINDER STARTING/DETECTION/SLOPE>							
DETECT terminal charge current	D_I_{DETO}	2	5	10	μA		Fig.12
DETECT terminal discharge current	D_I_{DETI}	2	5	10	μA		Fig.12
DETECT terminal H voltage	D_V_{DETH}	1.1	1.3	1.5	V		Fig.13
DETECT terminal L voltage	D_V_{DETL}	0.5	0.65	0.8	V		Fig.13
ISET voltage	D_V_{ISET}	0.32	0.4	0.48	V	R_{D_ISET}=18kΩ	Fig.14
SL1,2 charge current	D_I_{SLO}	16	22	28	μA	R_{D_ISET}=18kΩ	Fig.15
SL1,2 discharge current	D_I_{SLI}	17	24	31	μA	R_{D_ISET}=18kΩ	Fig.15
SL1,2 H voltage	D_V_{SLH}	2.5	2.8	—	V		Fig.16
SL1,2 L voltage	D_V_{SLL}	0.85	1	1.15	V		Fig.16
SL1,2 charge and discharge current ratio	D_R_{SL}	0.82	0.89	0.96			—
SL switching EC level	D_V_{ECSL}	1.6	2	2.4	V		—
< CYLINDER VS>							
Voltage gain	D_G_{VS}	7	8	9	TIMES		—
Output H voltage	D_V_{VSOH}	—	0.5	0.8	V	I_{OVS}=1mA, between VCC and output	—
Output L voltage	D_V_{VSOL}	—	0.13	0.2	V	I_{OVS}=50μA	—
VS offset voltage	D_V_{VSOFS}	0.12	0.25	0.38	V	DC/DC×3 in use	—
<CYLINDER FGAMP>							
Input offset voltage	D_V_{FGOFS}	-12	—	12	mV		—
DC bias voltage	D_V_{FG+}	1.3	1.5	1.7	V		—
Voltage gain 1	D_FAV1	50	59	—	dB	f=3kHz	Fig.20
Voltage gain 2	D_FAV2	30	36	—	dB	f=50kHz	Fig.20
In-phase input voltage range	D_V_{FGCM}	0.35	—	VCC-1.1	V		—
Output H voltage	D_V_{FGAOH}	—	0.3	0.5	V	I_{OH}=-0.2mA, between VCC and output	—
Output L voltage	D_V_{FGAOL}	—	0.15	0.35	V	I_{OL}=1mA	—
<CYLINDER FGHYS>							
D_FG hysteresis width	D_V_{FGHYS}	±84	±110	±136	mV	Measure D_FGAMP at 1K feed back resistance	Fig.24
DC bias voltage	D_V_{FG+}	1.3	1.5	1.7	V	Measure D_FGAMP at 1K feed back resistance	—
Output L voltage	D_V_{FGSOL}	—	0.1	0.3	V	I_{OL}=1mA	Fig.21
<CYLINDER PGAMP>							
Input offset voltage	D_V_{PGOFS}	-12	—	17	mV		—
DC bias voltage	D_V_{PG+}	1.3	1.5	1.7	V		—
Voltage gain 1	D_PAV1	50	59	—	dB	f=3kHz	Fig.20
Voltage gain 2	D_PAV2	30	36	—	dB	f=50kHz	Fig.20
In-phase input voltage range	D_V_{PGCM}	0.35	—	VCC-1.1	V		—
Output H voltage	D_V_{PGAOH}	—	0.3	0.5	V	I_{OH}=-0.2mA, between VCC and output	—
Output L voltage	D_V_{PGAOL}	—	0.15	0.35	V	I_{OL}=1mA	—
<CYLINDER PGHYS>							
D_PG hysteresis width	D_V_{PGHYS}	±118	±144	±170	mV		Fig.23
DC bias voltage	D_V_{PG+}	1.3	1.5	1.7	V		—
Output L voltage	D_V_{PGSOL}	—	0.1	0.3	V	I_{OL}=1mA	Fig.21
<LOADING>							
Output saturation voltage	L_VSAT	—	0.3	0.5	V	IOUT=200mA,L_REF=L_VM Total saturation voltage of low and high side output transistor	Fig. 17,18
L_REF pin input current	L_I_{IREF}	—	0.3	2	μA		—
Vout-L_REF offset	L_V_{OFS}	0	100	200	mV		Fig.19
Forward rotation control voltage range	L_V_{FWD}	—	—	0.7	V		—
Brake voltage range	L_V_{BRK}	1.3	1.5	1.7	V		—
Reverse rotation control voltage range	L_V_{REV}	2.3	—	—	V		—
L_REF output open voltage	L_V_{REF}	—	—	1.3	V		—

●Electrical characteristics

BD6300KU (Unless otherwise specified Ta=25℃,VCC=3V, C_VM＝D_VM＝L_VM=5V, UNREG=7.2V)

Parameter	Symbol	Limit			Unit	Conditions	Fig No.
		Min.	Typ.	Max.			
<TOTAL>							
VCC Circuit current 1	Icc1	5	11	17	mA	Power save OFF	Fig.25
VCC Circuit current 2	Icc2	1	4	7	mA	Power save ON	Fig.26
VG voltage	VG	9.5	11	12.5	V		Fig. 28,29
<CAPSTAN OUTPUT>							
Output H voltage 1	C_V_{OH1}	−	0.1	0.16	V	I_{OUT}=-200mA	Fig.31
Output H voltage 2	C_V_{OH2}	−	0.2	0.32	V	I_{OUT}=-400mA	Fig.31
Output L voltage	C_V_{OL}	−	0.2	0.32	V	I_{OUT}=200mA,C_R_{NF}=0.33Ω	Fig.32
<CAPSTAN HALL AMP>							
In-phase input voltage range	C_VCM	1.2	−	VCC-1.1	V		−
Hall input offset range	C_VHOF	-15	−	15	mV		−
<CAPSTAN PS, F/B/R>							
C_PS input threshold level	C_PS	0.7	1.4	2	V		−
Forward rotation control voltage range	C_V_{FWD}	−	−	0.7	V		−
Brake voltage range	C_V_{BRK}	1.3	1.5	1.7	V		−
Reverse rotation control voltage range	C_V_{REV}	2.3	−	−	V		−
<CAPSTAN TORQUE CONTROL>							
EC input bias current	C_I_{EC}	−	3	7.5	μA	C.EC=VCC	−
Torque control input/output gain	C_G_{IO}	0.42	0.6	0.78	A/V	C_R_{NF}=0.33Ω,C_R_{CC}=3.3kΩ	Fig.30
Torque control start voltage	C_V_{ECOFS}	1.05	1.2	1.35	V		Fig.30
Current limit voltage	C_C_{limit}	0.25	0.33	0.41	V	C_R_{NF}=0.33Ω,C_R_{CC}=3.3kΩ	Fig.30
Ripple cancel ratio	C_V_{RCC}	22	45	68	%	I_{OUT}=100mA,C_R_{CC}=3.3kΩ C_R_{NF}=0.33Ω	−
<CAPSTAN VS>							
Voltage gain	C_G_{VS}	7	8	9	TIMES		−
Output H voltage	C_V_{VSOH}	−	0.5	0.8	V	I_{OVS}=1mA, between VCC and output	−
Output L voltage	C_V_{VSOL}	−	0.13	0.2	V	I_{OVS}=50μA	−
<CAPSTAN FGAMP>							
In-phase input voltage range	C_V_{FGCM}	0.35	−	VCC-1.1	V		−
Input bias current	C_I_{FG}	−	−	1	μA		−
Output H voltage	C_V_{FGSOH}	2.8	−	−	V		−
Output L voltage	C_V_{FGSOL}	−	0.1	0.3	V	I_{OL}=1mA	Fig.44
<CYLINDER OUTPUT>							
Output H voltage	D_V_{OH}	−	0.3	0.48	V	I_{OUT}=-400mA	Fig.34
Output L voltage	D_V_{OL}	−	0.28	0.4	V	I_{OUT}=100mA,C_R_{NF}=0.33Ω	Fig.35
<CYLINDER OUTPUT>							
D_PS input threshold level	D_PS	0.7	1.4	2	V		−
<CYLINDER TORQUE CONTROL>							
EC input bias current	D_I_{EC}	−	2	5	μA	D_EC=VCC	−
Torque control input/output gain	D_G_{IO}	0.45	0.66	0.87	A/V	D_R_{NF}=0.33Ω	Fig.33
Torque control start voltage	D_V_{ECOFS}	1.05	1.2	1.35	V		Fig.33
Current limit voltage	D_C_{limit}	0.217	0.274	0.332	V	D_R_{NF}=0.33Ω	Fig.33
<CYLINDER STARTING/DETECTION>							
DETECT terminal charge current	D_I_{DETO}	2	5	10	μA		Fig.36
DETECT terminal discharge current	D_I_{DETI}	2	5	10	μA		Fig.36
DETECT terminal H voltage	D_V_{DETH}	1.1	1.3	1.5	V		Fig.37
DETECT terminal L voltage	D_V_{DETL}	0.5	0.65	0.8	V		Fig.37

BD6300KU　ELECTRICAL CHARACTERISTICS (Unless otherwise specified Ta=25℃,VCC=3V, C_VM＝D_VM＝L_VM=5V,　UNREG=7.2V)

Parameter	Symbol	Limit			Unit	Conditions	Fig No.
		Min.	Typ.	Max.			
<CYLINDER SLOPE>							
ISET voltage	D_V$_{ISET}$	0.32	0.4	0.48	V	R$_{D_ISET}$=18kΩ	Fig.38
SL1,2 charge current	D_I$_{SLO}$	16	22	28	μA	R$_{D_ISET}$=18kΩ	Fig.39
SL1,2 discharge current	D_I$_{SLI}$	17	24	31	μA	R$_{D_ISET}$=18kΩ	Fig.39
SL1,2 H voltage	D_V$_{SLH}$	2.5	2.8	—	V		Fig.40
SL1,2 L voltage	D_V$_{SLL}$	0.85	1	1.15	V		Fig.40
SL1,2 charge and discharge current ratio	D_R$_{SL}$	0.82	0.89	0.96			—
< CYLINDER VS>							
Voltage gain	D_G$_{VS}$	7	8	9	TIME		—
Output H voltage	D_V$_{VSOH}$	—	0.5	0.8	V	I$_{OVS}$=-1mA, between VCC and output	—
Output L voltage	D_V$_{VSOL}$	—	0.13	0.2	V	I$_{OVS}$=50A	—
<CYLINDER FGAMP/SMT>							
DC bias voltage	D_V$_{FG+}$	1.3	1.5	1.7	V		—
In-phase input voltage range	D_V$_{FGCM}$	0.35	—	VCC-1.1	V		—
DC bias current	D_I$_{FG}$	—	—	1	μA		—
Output H voltage	D_V$_{FGSO}$	2.8	—	—	V		—
Output L voltage	D_V$_{FGSO}$	—	0.1	0.3	V	I$_{OL}$=1mA	Fig.45
<CYLINDER PGAMP>							
DC bias voltage	D_V$_{PG+}$	1.3	1.5	1.7	V		—
In-phase input voltage range	D_V$_{PGC}$	0.35	—	VCC-1.1	V		—
Output H voltage	D_V$_{PGSO}$	2.8	—	—	V		—
Output L voltage	D_V$_{PGSO}$	—	0.14	0.3	V		Fig.46
<LOADING>							
Output saturation voltage	L_V$_{SAT}$	—	0.3	0.5	V	IOUT=200mA,L_REF=L_VM Total saturation voltage of low and high side output transistor	Fig. 41,42
L_REF pin input current	L_I$_{IREF}$	—	0.3	2	μA	L_REF=L_VM	—
Vout-L_REF offset	L_V$_{OFS}$	—	100	200	mV		Fig.43
Forward rotation control voltage range	L_V$_{FWD}$	—	—	0.7	V		—
Brake voltage range	L_V$_{BRK}$	1.3	1.5	1.7	V		—
Reverse rotation control voltage range	L_V$_{REV}$	2.3	—	—	V		—
L_REF output open voltage	L_V$_{REF}$	—	—	1.3	V		—
<REEL AMP>							
Input bias current	R_I$_{IN}$	—	—	1	μA		—
Input offset voltage	R_V$_{OFS}$	-8	—	8	mV		—
In-phase input voltage range	R_V$_{INCM}$	0.35	—	VCC-1.1	V		—
Output L voltage	R_V$_{SOL}$	—	0.1		V	I$_{OL}$=1mA	Fig.47

●Reference data

BD6637KV/KS Characteristic data

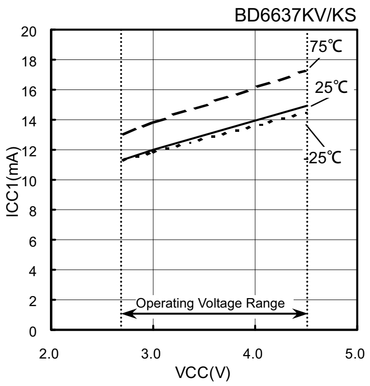


Fig.1 VCC Circuit current 1

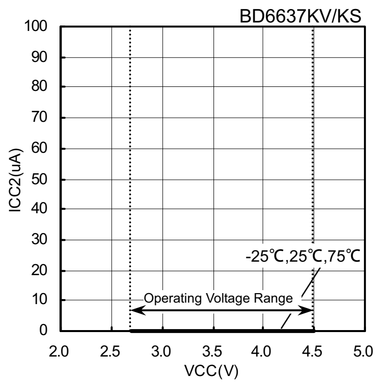


Fig.2 VCC Circuit current 2

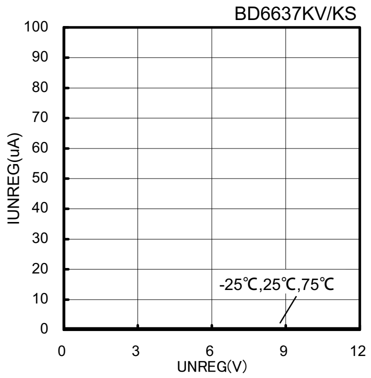


Fig.3 UNREG stand by current

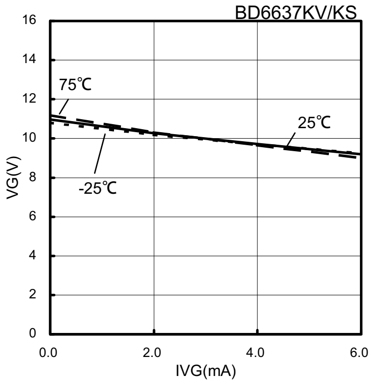


Fig.4 VG voltage
(Temperature characteristics)

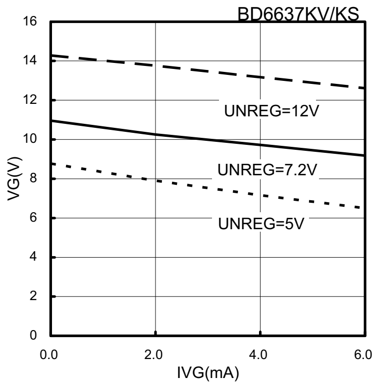


Fig.5 VG voltage
(Voltage characteristics)

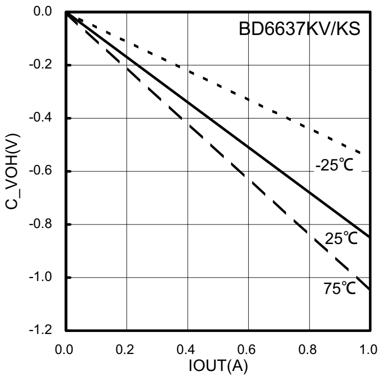


Fig.6 CAPSTAN Output High-voltage

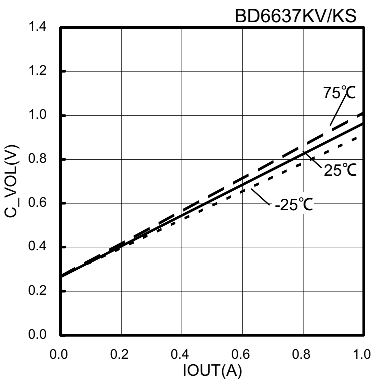


Fig.7 CAPSTAN Output High-voltage

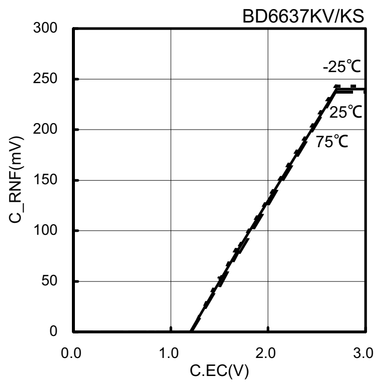


Fig.8 CAPSTAN Torque control
input/output gain

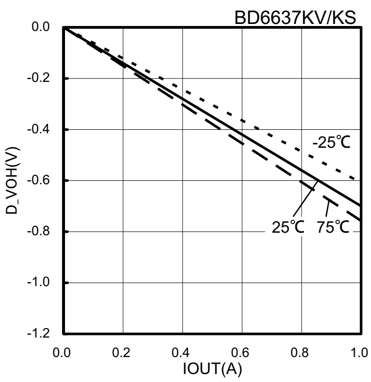


Fig.9 CYLINDER Output
High-voltage

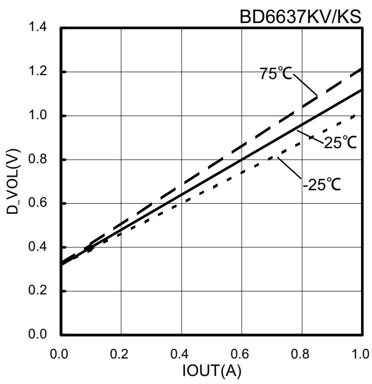


Fig.10 CYLINDER
Output Low-voltage

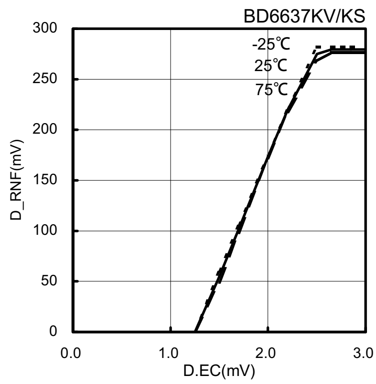


Fig.11 CYLINDER Torque control
input/output gain

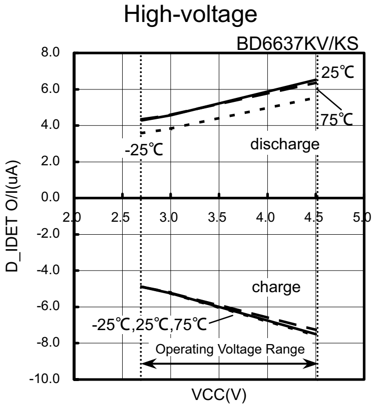


Fig.12 DETECT terminal
charge/discharge current

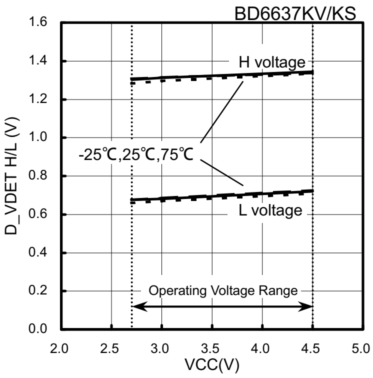


Fig.13 DETECT terminal H/L voltage

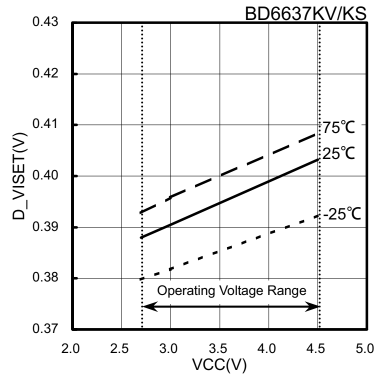


Fig.14 ISET voltage

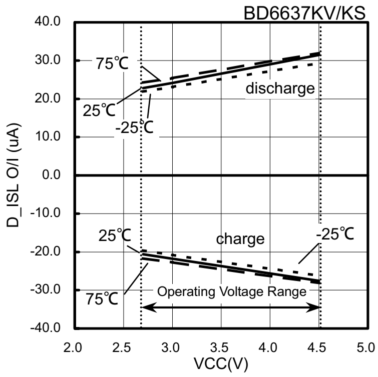


Fig.15 SL1,2 charge/discharge current

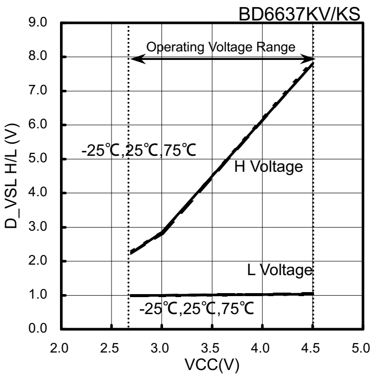


Fig.16 SL1,2 H/L voltage

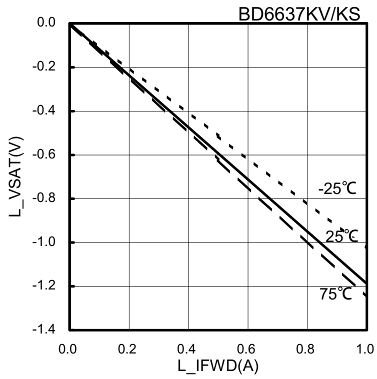


Fig.17 LOADING Output High-voltage

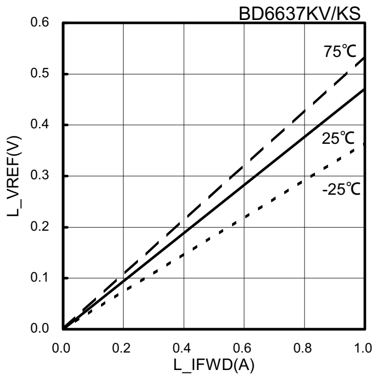


Fig.18 LOADING Output Low-voltage

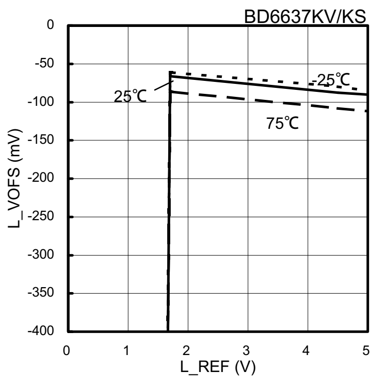


Fig.19 Vout-L_REF offset

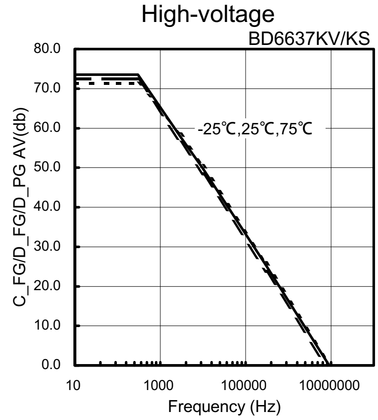


Fig.20 C_FG/D_FG/D_PG Voltage gain

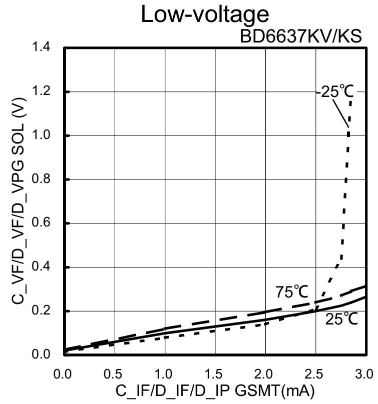


Fig.21 C_FG/D_FG/D_PG Output Low-voltage

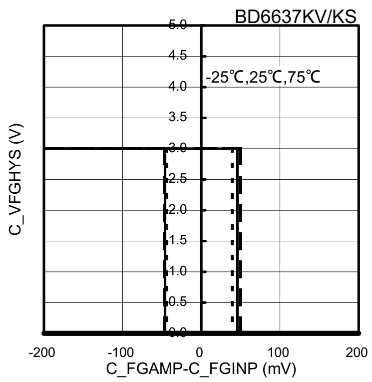


Fig.22 C_FG hysteresis width

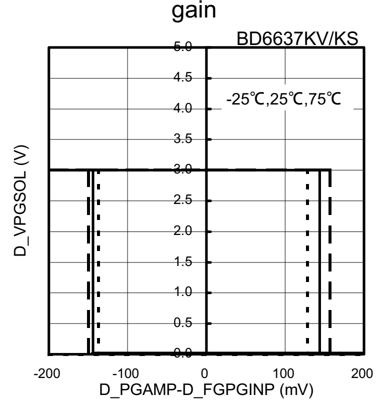


Fig.23 D_PG hysteresis width

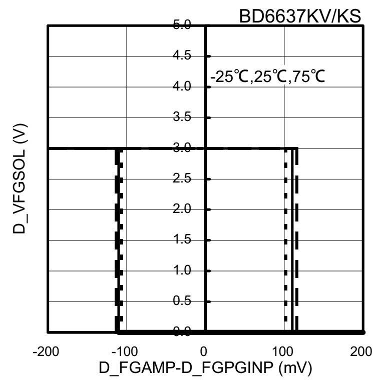


Fig.24 D_FG hysteresis width

●**Reference data**

BD6300KU Characteristic data

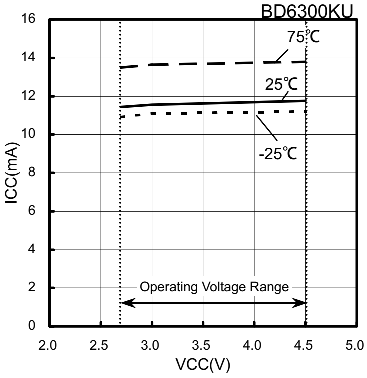


Fig.25 VCC Circuit current 1

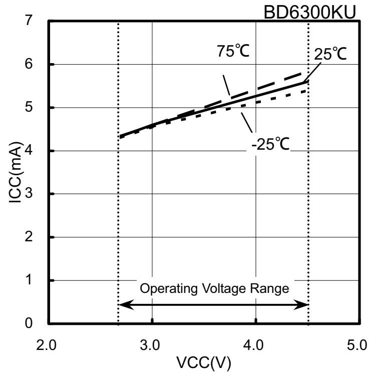


Fig.26 VCC Circuit current 2

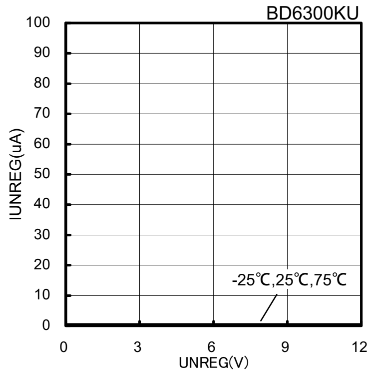


Fig.27 UNREG stand by current

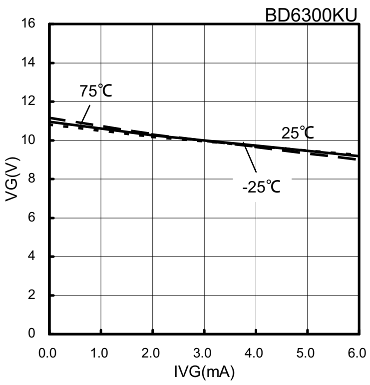


Fig.28 VG voltage
(Temperature characteristics)

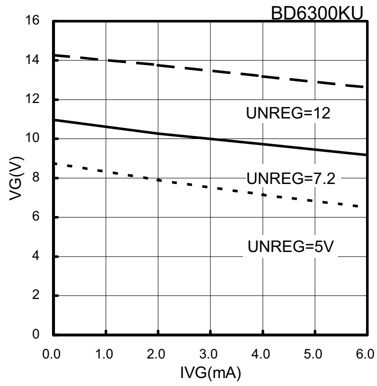


Fig.29 VG voltage
(Voltage characteristics)

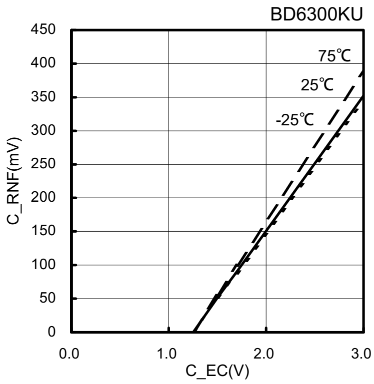


Fig.30 CAPSTAN
Torque control input/output gain

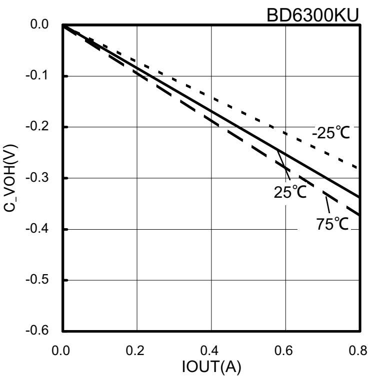


Fig.31 CAPSTAN Output
High-voltage

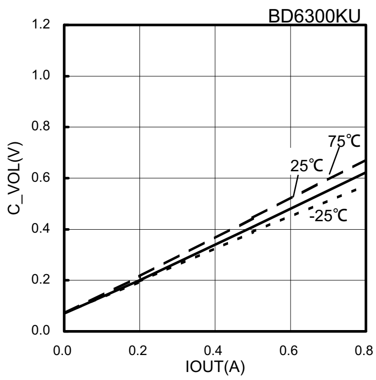


Fig.32 CAPSTAN Output
Low-voltage

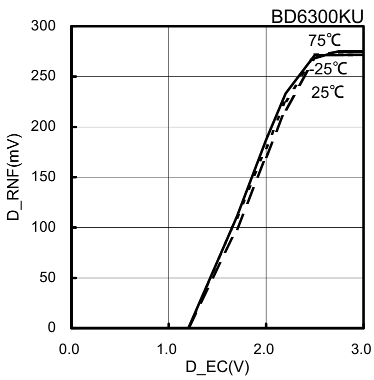


Fig.33 CYLINDER Torque control
input/output gain

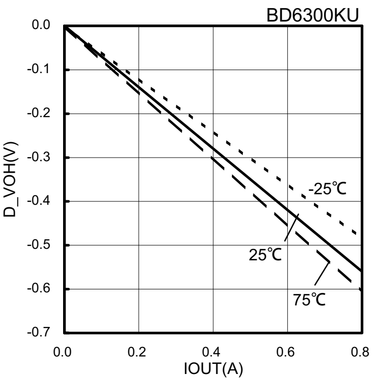


Fig.34 CYLINDER Output
High-voltage

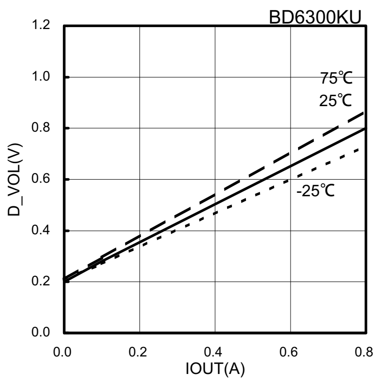


Fig.35 CYLINDER Output
Low-voltage

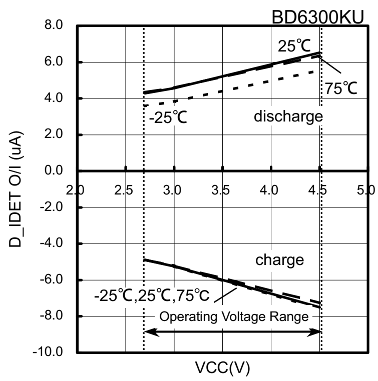


Fig.36 DETECT terminal
charge/discharge current

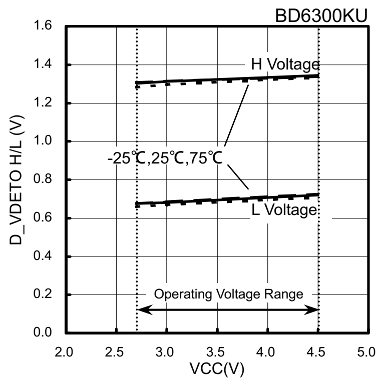


Fig.37 DETECT terminal H/L voltage

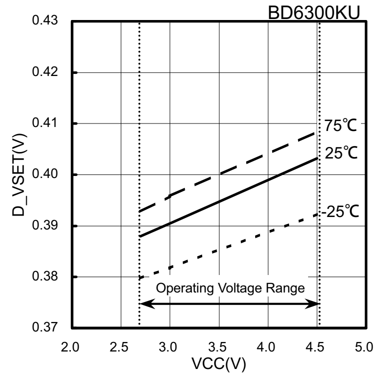


Fig.38 ISET voltage

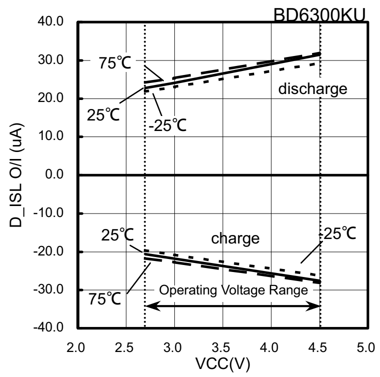


Fig.39 SL1,2 charge/discharge current

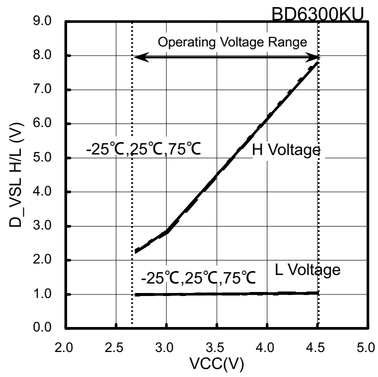


Fig.40 SL1,2 H/L voltage

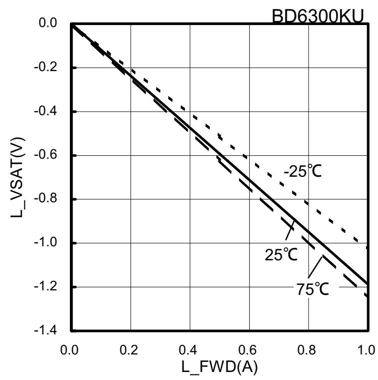


Fig.41 LOADING Output High-voltage

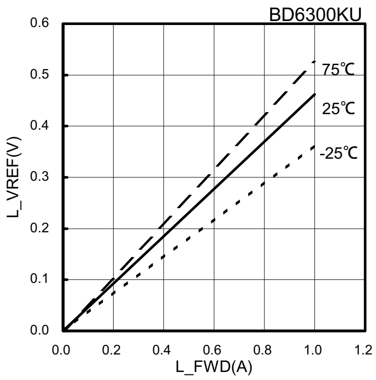


Fig.42 LOADING Output Low-voltage

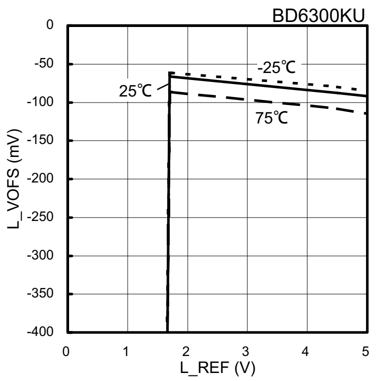


Fig.43 Vout-L_REF offset

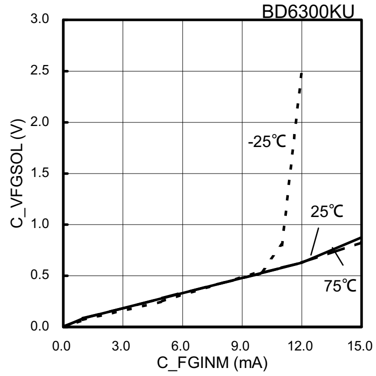


Fig.44 C_FGSMT Output Low-voltage

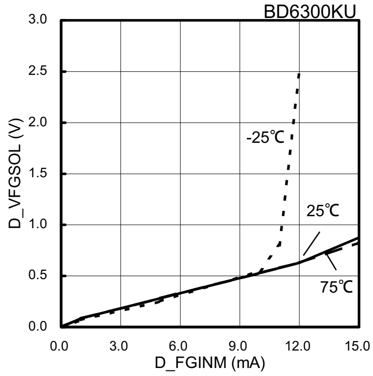


Fig.45 D_FGSMT Output Low-voltage

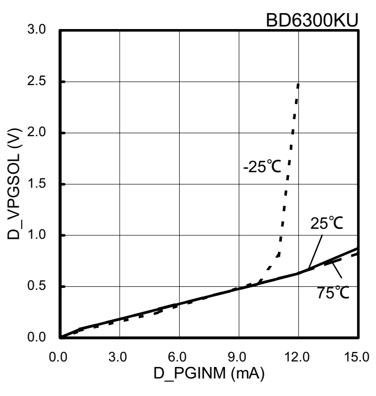


Fig.46 D_PGSMT Output L voltage

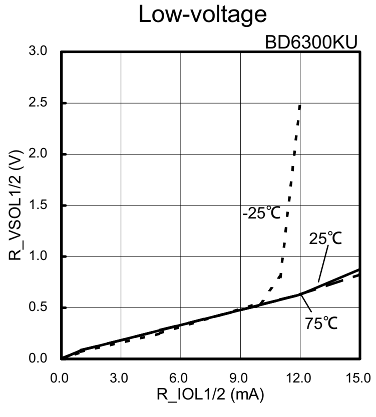
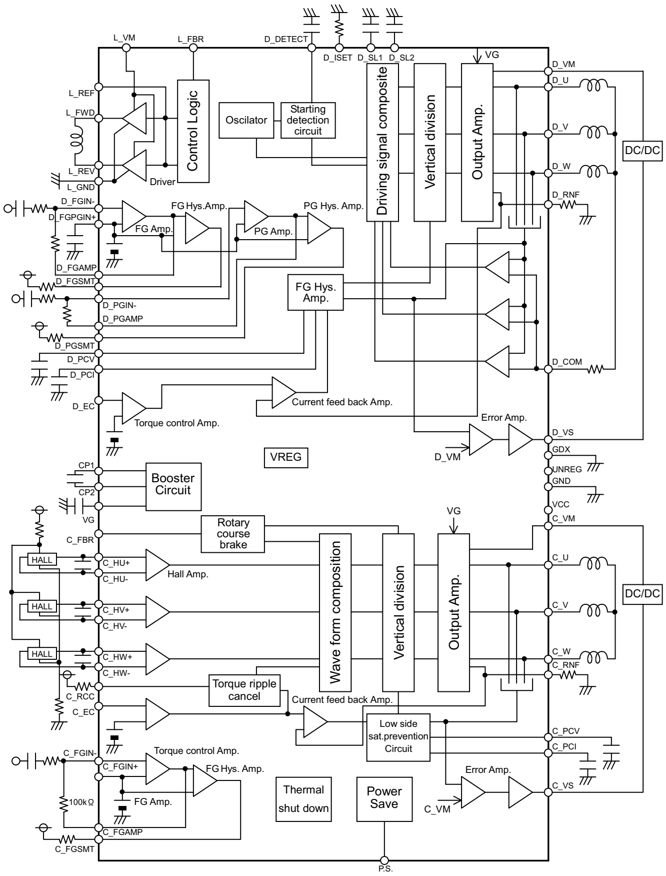


Fig.47 R_OUT1/2 Output L voltage

●Block diagram

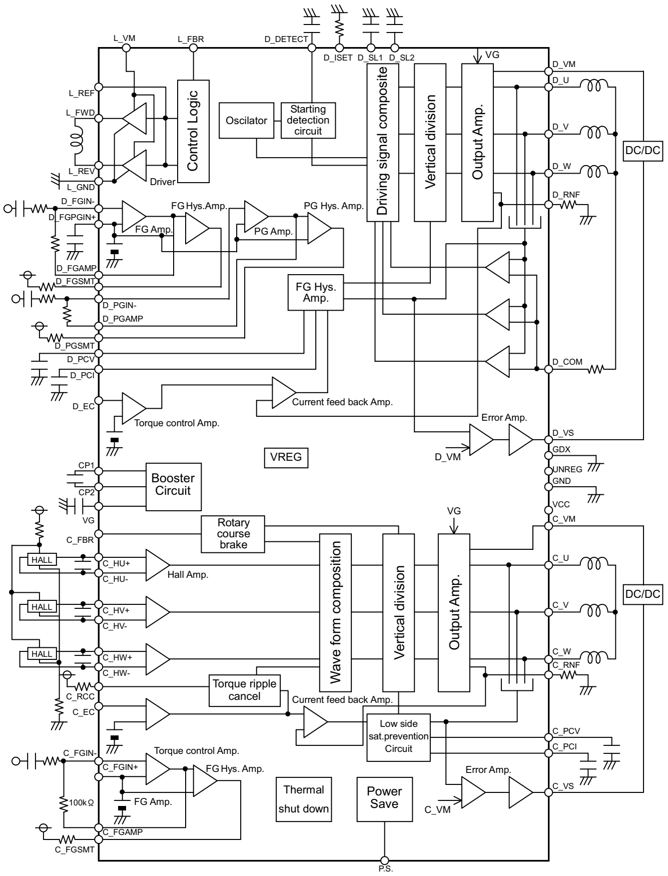
BD6637KV/KS



Terminal function table

PIN NO.	PIN Name (KV)	PIN Name (KS)	PIN NO.	PIN Name (KV)	PIN Name (KS)
1	N.C.	C_U	33	D_COM	D_W
2	C_U	C_V	34	D_U	L_FBR
3	C_V	C_RNF	35	D_V	L_REF
4	C_RNF	C_W	36	D_RNF	L_FWD
5	C_W	C_HU+	37	D_W	L_GND
6	N.C.	C_HU-	38	N.C.	L_REV
7	N.C.	C_HV+	39	L_FBR	L_VM
8	C_HU+	C_HV-	40	L_REF	C_FGIN+
9	C_HU-	C_HW+	41	L_FWD	C_FGIN-
10	C_HV+	C_HW-	42	N_C	C_FGAMP
11	C_HV-	D_PGSMT	43	L_GND	C_FGSMT
12	C_HW+	D_PGAMP	44	L_REV	VG
13	C_HW-	D_PGIN-	45	L_VM	CP1
14	D_PGSMT	D_FGPGIN+	46	C_FGIN+	CP2
15	D_PGAMP	D_FGIN-	47	C_FGIN-	GND
16	D_PGIN-	D_FGAMP	48	C_FGAMP	GDX
17	D_FGPGIN+	D_FGSMT	49	C_FGSMT	PS
18	D_FGIN-	VCC	50	N.C.	C_RCC
19	D_FGAMP	D_DETECT	51	VG	C_FBR
20	D_FGSMT	D_ISET	52	CP1	C_VM
21	VCC	D_SL1	53	CP2	C_VS
22	D_DETECT	D_SL2	54	N.C.	C_EC
23	D_ISET	UNREG	55	GND	C_PCI
24	D_SL1	D_VM	56	GDX	C_PCV
25	D_SL2	D_VS	57	PS	
26	UNREG	D_EC	58	C_RCC	
27	N.C.	D_PCI	59	C_FBR	
28	D_VM	D_PCV	60	C_VM	
29	D_VS	D_COM	61	C_VS	
30	D_EC	D_U	62	C_EC	
31	D_PCI	D_V	63	C_PCI	
32	D_PCV	D_RNF	64	C_PCV	

BD6300KU



Terminal function table

PIN NO.	PIN Name	PIN NO.	PIN Name
1	D_PH	33	R_IN+2
2	D_FGIN-	34	R_IN-2
3	D_FGPGIN+	35	R_OUT2
4	D_PGIN-	36	VG
5	D_FGSMT	37	CP2
6	VCC	38	CP1
7	D_DETECT	39	GND
8	D_ISET	40	GDX
9	D_SL1	41	D_PS
10	D_SL2	42	C_PS
11	UNREG	43	C_FBR
12	D_VM	44	C_VM
13	D_VS	45	C_VS
14	D_EC	46	C_EC
15	D_PCI	47	C_PCI
16	D_PCV	48	C_PCV
17	D_COM	49	FGND1
18	D_U	50	C_U
19	D_V	51	C_V
20	D_RNF	52	C_RNF
21	D_W	53	C_W
22	N.C.	54	C_RCC
23	FGND2	55	C_HV-
24	L_FBR	56	C_HV+
25	L_REF	57	C_HU-
26	L_FWD	58	C_HU+
27	L_GND	59	C_HW+
28	L_REV	60	C_HW-
29	L_VM	61	C_FGIN+
30	R_IN+1	62	C_FGIN-
31	R_IN-1	63	C_FGSMT
32	R_OUT1	64	D_PGSMT

●**Description of operations**

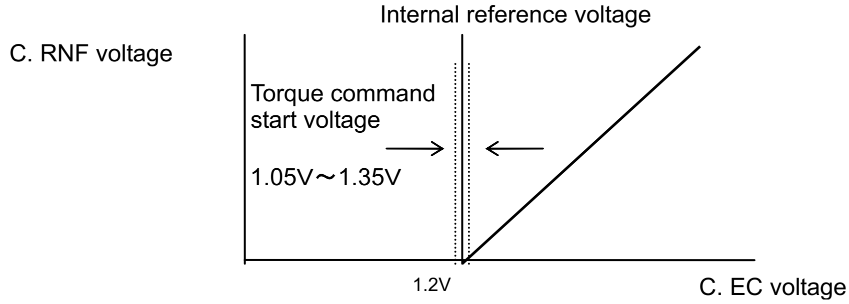
- Description of capstan operation

1. Hall input - output

   The Hall sensor input signal of the three-phase, is amplified by the Hall amplifier to produce a drive signal waveform. This drive signal is amplified, once again, by the output amplifier to supply a drive current for the motor coil. Output current is a trapezoidal waveform. Due to the trapezoidal waveform, gaps are generated in the magnetic field by the three-phase coil, which causes a slight irregularity of rotation. In operation, the triangle wave is superimposed upon the trapezoidal output waveform. (Torque ripple cancellation)

2. Torque control

   Output current can be controlled by the voltage applied to C.EC (torque control terminal).



3. Brake

   When the C.FBR terminal is set to M, each output voltage becomes low and the brake is applied.
   Brake command voltage: C.FBR 1.3V to 1.7V

4. Motor power supply control function

   In order to use power effectively (as well as to prevent exceeding permissible dissipation of IC), it is required to change supply voltage according to output current, i.e. to reduce supply voltage when current output is low, and increase when current output is high, thereby preventing extra voltage from being applied between Drain and Source of output stage MOS. Power supply control function (VS terminal) is installed for this purpose. In this function, the voltage between Drain and Source of upper MOS of output stage is detected, and output to VS terminal as a power supply control signal. This gain signal is multiplied several times by DC/DC, for controlling motor power supply.

5. Output TR saturation preventing circuit

   This circuit is used to operate output MOS in linear region. It has good dynamic range from a low to high current, and provides a good rotating performance under overload, etc.

- Description of cylinder operation

1. Back electromotive force detecting comparator (BEMF)

   Compares the output voltage of the motor with the midpoint potential BEMF and detects the position of the rotor and stator (magnet and coil). Further, the BEMF is provided with hysteresis, which can be set by resistor RD.com, connected to D.COM terminal.

2. Phase switching logic

   Synthesizes the output from three-phase BEMF force detecting comparator. The noise pulse of BEMF by the motor is eliminated by MASK signal, generated by D.SL terminal 1 and 2 with reference to each position-detected signal. Only the rising edge of masked synthetic output is used as a signal for the secondary counter. While output from secondary and drive signal is synthesized, FG signal is generated every 60 degrees (electric angle).

3. Slope

   D.SL terminal 1 and 2 are charged and discharged in synchronization with the timing of the internal FG signal. For driving soft switching, slope is applied to output current waveform by the slope rate of D.SL terminal 1 and 2.
   MASK signal is generated by charging and discharging waveform of D.SL terminal 1 and 2. MASK signal L is output only when the charging and discharging waveform of D.SL terminal 1 and 2 is clamped at L level, when MASK is canceled. Otherwise, H is output and MASK is applied, and noise pulse by back electromotive force of motor is removed.

4. Detection circuit - start signal synthesizing

   When a capacitor is connected to D.DETECT terminal, charging and discharging are performed. When the motor is stopped, D.DETECT terminal repeats charging and discharging between Low-level and High-level. Only the rising edge of square wave (SEL) that is synchronized with D.DETECT terminal, is compared with rising edge of synthesized output of BEMF detecting comparator. When the motor is stopped, BEMF detecting comparator is not output. Therefore, the edge of SEL signal is input to secondary counter and attempts to force the motor to rotate (synchronized mode). Before the motor rotates and D.DETECT terminal reaches High-level, BEMF detecting comparator detects BEMF motor. When synthetic output of BEMF detection comparator is output, D.DETECT terminal starts discharging on the corresponding edge. When Low-level is reached, charging is started again, and discharging is started on the edge of BEMF detecting comparator output. Here the edge of synthetic output of BEMF comparator is input to secondary counter, and the motor rotates. (BEMF mode)

5. Torque control

Output current can be controlled by the voltage applied to D.EC (torque control terminal), as with capstan assembly.

6. Motor power supply control function

In order to use power effectively (as well as to prevent exceeding permissible dissipation of IC), it is required to control supply voltage according to output current. For example, reduce supply voltage when current output is low, and increase when current output is high, thereby preventing extra voltage from being applied between Drain and Source of output stage MOS. Power supply control function (VS terminal) is used for this purpose. In this function, the voltage between Drain and Source of upper MOS of output stage is detected, and sent to VS terminal as a power supply control signal. This gain signal is multiplied several times by DC/DC, for controlling motor power supply.

7. Output TR saturation preventing circuit

This circuit is used to operate output MOS in linear region. It has good dynamic range from a low to high current, and provides a good rotating performance under overload, etc.

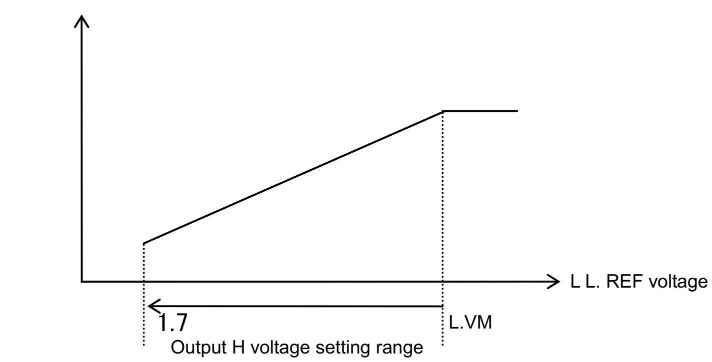
- Description of loading assembly operation

1. L.FBR input - output

Output (L.REV and L.FWD) is three-mode output for forward/reverse rotation and braking, depending on the voltage input to L.FBR.

2. Loading assembly output H voltage control

Output High-voltage of loading assembly can be set by the voltage input to L.RFF terminal.
Output High-voltage VOH can be represented by the formula below:
L.REF voltage where the formula above holds true is 1.7 V - L. VM voltage.

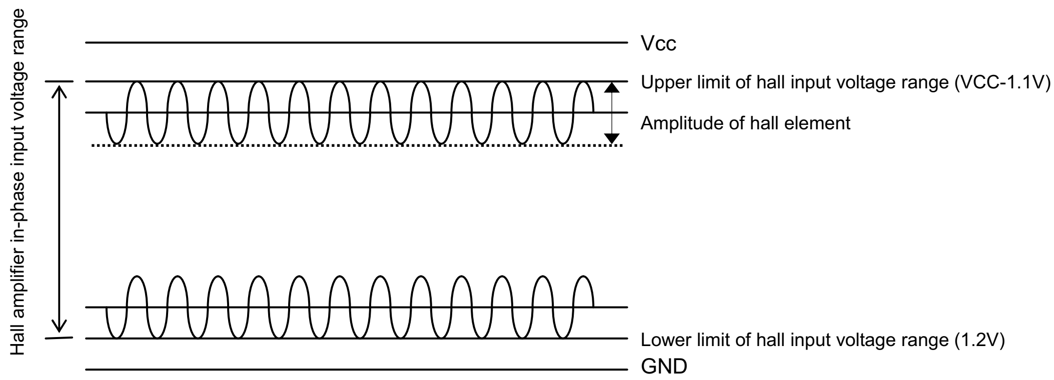


●Application part selecting procedure

Selection of constant in the example of recommended circuit is shown below:

1) Capstan hall bias resistor (R_{H1} and R_{H2})

The amplitude and bias point of hall element can be set by hall bias resistor. Hall amplitude varies with hall element in use even when the same bias resistor is used, therefore adjust the bias resistor so that the amplitude of hall element is 50 - 100mvp-p as well as within the range of hall amplifier in-phase input voltage range of capstan assembly (1.2 - VCC-1.1V).



2) Capstan C.RCC resistor

Canceling rate of torque ripple canceling circuit of capstan assembly can be adjusted by the resistor equipped externally on C.RCC terminal. Select the optimum value, considering the vibrations, when the IC is mounted to the motor. The optimum value depends on the motor, while 2k Ω to 4k Ω is recommended.

3) Cylinder D.COM terminal connection terminal

By inserting a resistor in the middle point of D.COM terminal and motor, the BEMF detecting comparator can also generate hysteresis, thereby preventing any noise from causing malfunction. Hysteresis width can be calculated as follows:

Hysteresis width = ± $R_{.D.COM}$ x 20 μA (Typ. value)

The optimum value depends on the motor, while 200 Ω to 300Ω is recommended.

4) Cylinder and output current slope setting capacitor (C_{SL1}, C_{SL2})

Triangle wave is output from D.SL terminal 1 and 2 for normal rotation of the cylinder. Level 1 is output for Low-level of the triangle wave. The level determined by cylinder rotating speed is output for High-level. Adjust the capacitor of terminal D.SL1 and D.SL2 and the resistance of ISET terminal so that this High-level is approximately 1.8V. It can be set as follows:

Example: When normal rotation speed of cylinder is 9000 rpm, capacitor of terminal D.SL1 and D.SL2 0.047μF and resistance 18 k Ω are recommended.

$$C_{SL1}, C_{SL2} = \frac{185\mu s \times I_{SL}}{0.8V} (\mu F) \qquad \left(\text{where } I_{SL} = \frac{\text{ISET terminal voltage (Typ.:0.4V)}}{R_{ISET}}\right)$$

5) Setting of drive signal frequency in cylinder startup

Drive signal frequency in cylinder startup can be controlled by changing the capacitor of D.DETECT terminal. Adjust the optimum value, so that starting time is shortest on your motor. Drive signal frequency during startup can be calculated as follows: Optimum value depends on motor, while 0.1 - 0.2 μ F is recommended.

$$\frac{\text{DETECT terminal charging and discharging current}}{(\text{DETECT terminal H voltage} - \text{DETECT terminal L voltage}) \times C_{DETECT} \times 6} \text{ (Hz)}$$

DETECT terminal H voltage	: 1.3V (Typ. value)
DETECT terminal L	: 0.65V (Typ. value)
DETECT terminal charging and discharging current	: 5μA (Typ. value)

6) PCI/PCV terminal connecting capacitor (capstan/cylinder)

Capacitor connected to PCI and PCV terminal is used to compensate the phase of upper and lower saturation prevention circuit and current feedback loop. When it is too large, the entire loop (including servo system), becomes unstable. When it is too small, the output waveform oscillates. Recommended are 100pF for PCI terminal, 0.1 μ F for PCV terminal of cylinder, 0.1 μ F for PCI terminal and 0.1 μ F for PCV terminal of capstan.

7) DC/DC (capstan/cylinder)

When the output of VS terminal of capstan/cylinder is connected to the DC/DC converter, the motor voltage can be controlled according to the output voltage waveform of the motor. When the DC/DC converter gain is low, the maximum VM voltage cannot be output. The output current waveform is distorted, therefore adjust to an optimum value.

8) RNF terminal

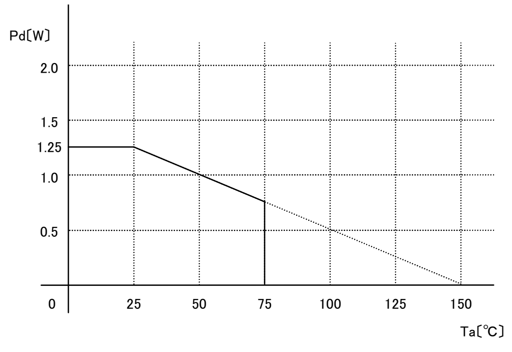
Connect a small resistor (0.33 Ω to 0.5 Ω) between RNF terminal and GND for detecting output current. Because High current flows in this resistor, take precautious against high resistor wattage. The value of the torque command gain versus this resistor (0.33 Ω), is described in the electrical characteristics. Note that this value also changes when resistance changes.

9) Voltage rising circuit

This IC applies Nch DMOS on output stage, and incorporates a voltage boost current for the corresponding gate voltage. When the capacitance value between CP1 terminal and CP2 terminal is low, the current capability of VG terminal voltage is low. When the capacitance value between VG terminal and GND terminal is low, the ripple of VG voltage becomes high. Recommended capacitance value between terminal CP1 and CP2 is 0.1 to 0.22 μ F and that between terminal VG and GND is 1 to 10 μ F.

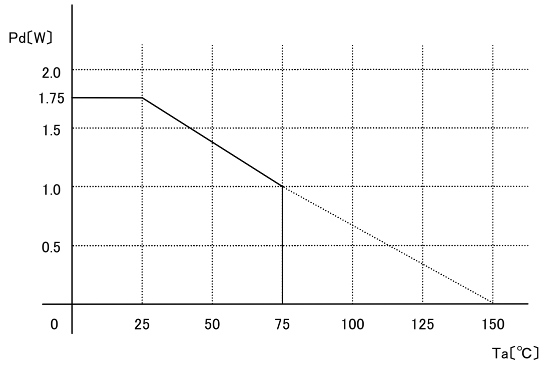
●Thermal derating characteristics

BD6637KV/KS



* 70 mm x 70 mm x 1.6 mm glass epoxy board mounted
Reduce by 10m W/°C when Ta = 25 °C

BD6300KU



* 70 mm x 70 mm x 1.6 mm glass epoxy board mounted
Reduce by 14m W/°C when Ta = 25 °C

●Operation Notes

1) Absolute maximum ratings

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2) Power supply lines

Design PCB layout pattern to provide low impedance GND and supply lines. To obtain a low noise ground and supply line, separate the ground section and supply lines of the digital and analog blocks. Furthermore, for all power supply terminals to ICs, connect a capacitor between the power supply and the GND terminal. When applying electrolytic capacitors in the circuit, note that capacitance characteristic values are reduced at low temperatures.

3) GND potential

Ensure a minimum GND pin potential in all operating conditions. In addition, ensure that no pins other than the GND pin carry a voltage less than or equal to the GND pin, including during actual transient phenomena. The voltage of the motor output pin may, however, drop below the GND potential due to the BEMF voltage of the motor. Malfunctions or other failures may result, depending on the operating conditions, environment, and individual characteristics of the motor. Check that the IC has no operational problems.

4) Thermal Design

Use a proper thermal design that allows for a sufficient margin of the power dissipation (Pd) at actual operating conditions.

5) Pin short and mistake fitting

Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if positive and ground power supply terminals are reversed. The IC may also be damaged if pins are shorted together or are shorted to other circuit’s power lines.

6) Operation in a strong electromagnetic field

Use caution when using the IC in the presence of a strong magnetic field, as doing so may cause the IC to malfunction.

7) ASO

When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

8) Thermal shutdown circuit

If the junction temperature (Tj) reaches 175°C (Typ.), the TSD circuit will operate, and the coil output circuit of the motor will open. There is a temperature hysteresis of approximately 25°C (Typ.). The TSD circuit is designed only to shut off the IC in order to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. The performance of the IC’s characteristics is not guaranteed and it is recommended that the device is replaced after the TSD is activated.

9) Testing on application boards

When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to, or removing it from a jig or fixture, during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting and storing the IC.

10) Ground wiring patterns

If small-signal GND and large-current GND are provided, It will be recommended to separate the large-current GND pattern from the small-signal GND pattern and establish a single ground at the reference point of the set PCB so that resistance to the wiring pattern and voltage fluctuations due to a large current will cause no fluctuations in voltages of the small-signal GND. Pay attention not to cause fluctuations in the GND wiring pattern of external parts as well.

11) Capacitors connected between output and ground pins

If a large capacitance value is connected between the output and ground pins, and if the VCC falls to 0 V or becomes shorted with the ground pin, the current stored in the capacitor may flow to the output pin. This can cause damage to the IC. The capacitance value between the output and GND must be 100μF or lower.

12) Regarding input pin of the IC

If no Vcc voltage is applied to the IC do not apply any voltage to the input pins. If a voltage higher, or as high as the Vcc, or a voltage lower than, or as low as, the GND is applied, parasitic elements may result due to the structure of the IC. The operation of parasitic elements can cause interference with circuit operation as well as IC malfunction and damage. Use caution so that the IC is not used in a manner that will trigger the operation of parasitic elements.

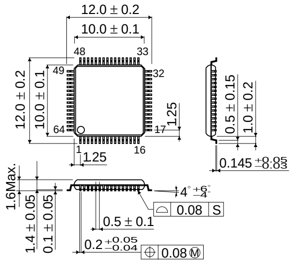
13) Operating Precautions

Although ROHM is confident that the example application circuit reflects the best possible recommendations, be sure to verify circuit characteristics for your particular application. Modification of constants for other externally connected circuits may cause variations in both static and transient characteristics for external components as well as this Rohm IC. Allow for sufficient margins when determining circuit constants.

●Physical Dimension

VQFP64

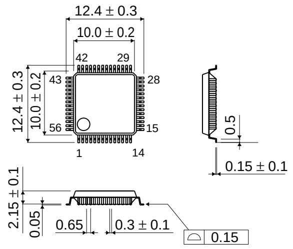
〈Dimension〉



(Unit:mm)

SQFP56

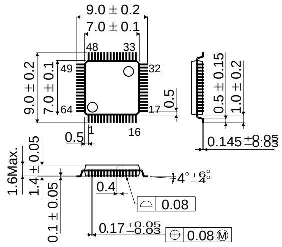
〈Dimension〉



(Unit:mm)

UQFP64

〈Dimension〉



(Unit:mm)

●Ordering part number

・Please order by ordering part number. ・Please confirm the combination of each items. ・Please write the letter close to left when column is blank

B	D	6	6	3	7	K	V	−	E	2

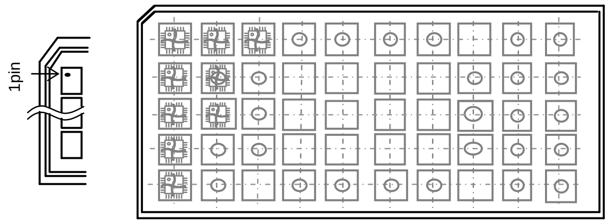
Part Number
- BD6637KV
- BD6637KS
- BD6300KU

Package Type
- KV : VQFP64
- KS : SQFP56
- KU : UQFP64

E1 Emboss tape reel Pin 1 on draw-out side
E2 Emboss tape reel Pin 1 opposite draw-out side

<Packing information>

Container	Tray(with dry pack)
Quantity	1000pcs
Direction of feed	Direction of product is fixed in a tray.



※When you order , please order in times the amount of package quantity.

The products listed in this catalog 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.

Excellence in Electronics

ROHM

ROHM CO., LTD.
21, Saiin Mizosaki-cho, Ukyo-ku, Kyoto
615-8585, Japan
TEL: (075)311-2121 FAX: (075)315-0172
URL http: // www. rohm. com

Published by
Application Engineering Group

Contact us for further information about the products.

Atlanta U.S.A. / ROHM ELECTRONICS ATLANTA SALES OFFICE (DIVISION OF ROHM ELE. U.S.A.,LLC)
TEL: +1(770)754-5972 FAX: +1(770)754-0691
Dallas U.S.A. / ROHM ELECTRONICS DALLAS SALES OFFICE (DIVISION OF ROHM ELE. U.S.A.,LLC)
TEL: +1(972)312-8818 FAX: +1(972)312-0330
San Diego U.S.A. / ROHM ELECTRONICS SAN DIEGO SALES OFFICE (DIVISION OF ROHM ELE. U.S.A.,LLC)
TEL: +1(858)625-3630 FAX: +1(858)625-3670
Germany / ROHM ELECTRONICS GMBH (GERMANY)
TEL: +49(2154)9210 FAX: +49(2154)921400
United Kingdom / ROHM ELECTRONICS GMBH (UK)
TEL: +44(0)1908-306700 FAX: +44(0)1908-235788
France / ROHM ELECTRONICS GMBH (FRANCE)
TEL: +33(0)1 56 97 30 60 FAX: +33(0)1 56 97 30 80
Hong Kong China / ROHM ELECTRONICS (H.K.) CO., LTD.
TEL: +852(2)7406262 FAX: +852(2)375-8971
Shanghai China / ROHM ELECTRONICS (SHANGHAI) CO., LTD.
TEL: +86(21)6279-2727 FAX: +86(21)6247-2066
Dalian China / ROHM ELECTRONICS TRADING (DALIAN) CO., LTD.
TEL:+86(411)8230-8549 FAX:+86(411)8230-8537
Beijing China / BEIJING REPRESENTATIVE OFFICE
TEL: +86(10)8525-2483 FAX: +86(10)8525-2489
Taiwan / ROHM ELECTRONICS TAIWAN CO., LTD.
TEL: +886(2)2500-6956 FAX: +886(2)2503-2869
Korea / ROHM ELECTRONICS KOREA CORPORATION
TEL: +82(2)8182-700 FAX: +82(2)8182-715
Singapore / ROHM ELECTRONICS ASIA PTE. LTD. (RES / REI)
TEL: +65-6332-2322 FAX: +65-6332-5662
Malaysia / ROHM ELECTRONICS (MALAYSIA) SDN. BHD.
TEL: +60(3)7958-8355 FAX: +60(3)7958-8377
Philippines / ROHM ELECTRONICS (PHILIPPINES) SALES CORPORATION
TEL: +63(2)807-6872 FAX: +63(2)809-1422
Thailand / ROHM ELECTRONICS (THAILAND) CO., LTD.
TEL: +66(2)254-4890 FAX: +66(2)256-6334

Catalog No.05T350Be '05.10 ROHM© 2000 TSU

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.
It is our top priority to supply products with the utmost quality and reliability. However, there is always a chance of failure due to unexpected factors. Therefore, please take into account the derating characteristics and allow for sufficient safety features, such as extra margin, anti-flammability, and fail-safe measures when designing in order to prevent possible accidents that may result in bodily harm or fire caused by component failure. ROHM cannot be held responsible for any damages arising from the use of the products under conditions out of the range of the specifications or due to non-compliance with the NOTES specified in this catalog.

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

ROHM Customer Support System

THE AMERICAS / EUROPE / ASIA / JAPAN

www.rohm.com

Contact us : webmaster@rohm.co.jp

ROHM CO., LTD. 21 Saiin Mizosaki-cho, Ukyo-ku, Kyoto 615-8585, Japan
TEL : +81-75-311-2121
FAX : +81-75-315-0172