APPLICATION MANUAL

Capacitor-less CMOS LDO Regulator IC
TK637xxB/H/S

CONTENTS

TOKO

Capacitor-less CMOS LDO Regulator
TK637xxB/H/S

1. DESCRIPTION

The TK637xxB/H/S is a CMOS LDO regulator. The packages are the very small 4-bump flip chip, the small and thin SON2017-6, and the extremely versatile SOT23-5.
The IC is designed for portable applications with space requirements.
The IC does not require input capacitor, output capacitor, and noise-bypass capacitor.
The IC offers low quiescent current, and good transient performance.
The output voltage is internally fixed from 1.35V to 4.2V.

2. FEATURES

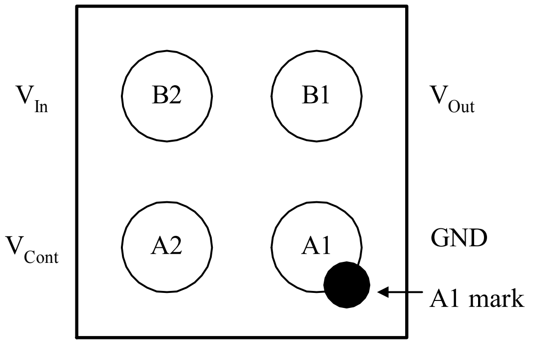
- Capacitor-less
(Without input capacitor, output capacitor, and noise-bypass capacitor)
- Package: FC-4 / SON2017-6 / SOT23-5
- Low quiescent current
- Good transient performance
- Thermal and over current protection
- On/Off control
- High accuracy

3. APPLICATIONS

- Mobile Communication
- Battery Powered System
- Any Electronic Equipment

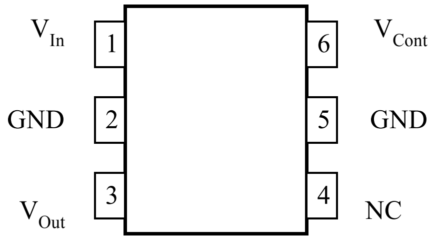
4. PIN CONFIGURATION

- FC-4 (TK637xxB)



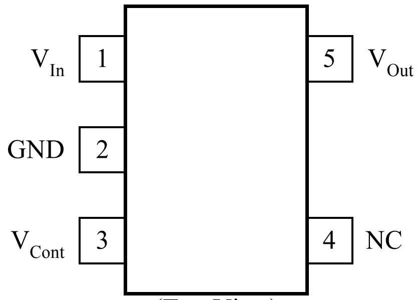
(Top View)

- SON2017-6 (TK637xxH)



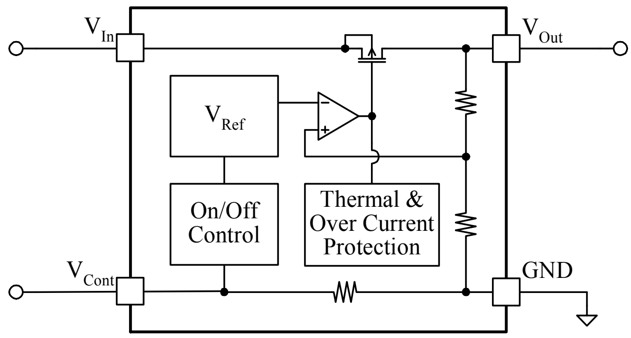
(Top View)

- SOT23-5 (TK637xxS)



(Top View)

5. BLOCK DIAGRAM



6. ORDERING INFORMATION

T K 6 3 7 □□□ C □□

Voltage Code
(Refer to the following table)

Package Code
B : FC-4
H : SON2017-6 Package
S : SOT23-5 Package

Operating Temp. Range Code
C : C Rank(standard) only

Solder Composion Code
- G : Lead Free
brank : Lead Containing

Tape/Reel Code
B : Normal type for FC
L : Normal type for plastic packages

Output Voltage	Voltage Code	Output Voltage	Voltage Code	Output Voltage	Voltage Code
1.35V	02	2.8V	28	3.3V	33
1.5V	15	2.85V	01	3.5V	35
1.8V	18	2.9V	29		
2.5V	25	3.0V	30		
2.6V	26	3.1V	31		
2.7V	27	3.2V	32		

*If you need a voltage other than the value listed in the above table, please contact TOKO.

7. ABSOLUTE MAXIMUM RATINGS

T_a=25°C

Parameter	Symbol	Rating	Units	Conditions
Absolute Maximum Ratings				
Input Voltage	$V_{In,MAX}$	-0.3 ~ 7.0	V	
Output pin Voltage	$V_{Out,MAX}$	-0.3 ~ V_{In}+0.3	V	
Control pin Voltage	$V_{Cont,MAX}$	-0.3 ~ 7.0	V	
Storage Temperature Range	T_{stg}	-55 ~ 150	°C	
Power Dissipation	P_D	360 500	mW	Internal Limited T_j=150°C *, When mounted on PCB FC-4 SON2017-6 , SOT23-5
Operating Condition				
Operational Temperature Range	T_{OP}	-40 ~ 85	°C	
Operational Voltage Range	V_{OP}	1.8 ~ 6.0	V	

* P_D must be decreased at the rate of 2.9mW/°C (FC-4) or 4mW/°C (SON2017-6 , SOT23-5) for operation above 25°C.
The maximum ratings are the absolute limitation values with the possibility of the IC breakage.
When the operation exceeds this standard quality can not be guaranteed.

8. ELECTRICAL CHARACTERISTICS

The parameters with min. or max. values will be guaranteed at $T_a=T_j=25°C$ with test when manufacturing or SQC(Statistical Quality Control) methods. The operation between -40 ~ 85°C is guaranteed when design.

$V_{In}=V_{Out,TYP}+1V$, $V_{Cont}=1.2V$, $T_a=T_j=25°C$

Parameter	Symbol	Value			Units	Conditions
		MIN	TYP	MAX		
Output Voltage	V_{Out}	Refer to TABLE 1			V	$I_{Out}=5mA$
Line Regulation	LinReg	-	0.0	4.0	mV	$\Delta V_{In}=1V$
Load Regulation	LoaReg	Refer to TABLE 1			mV	$I_{Out}=1mA \sim 50mA$
		Refer to TABLE 1			mV	$I_{Out}=1mA \sim 100mA$
Dropout Voltage *1	V_{Drop}	Refer to TABLE 1			mV	$I_{Out}=50mA$
		Refer to TABLE 1			mV	$I_{Out}=100mA$
Maximum Load Current *2	$I_{Out,MAX}$	200	300	-	mA	$V_{Out}=V_{Out,TYP}\times0.9$
Quiescent Current	I_Q	-	10	20	µA	$I_{Out}=0mA$, $V_{Cont}=V_{In}$
Standby Current	$I_{Standby}$	-	0.01	0.1	µA	$V_{Cont}=0V$
GND Pin Current	I_{GND}	-	25	50	µA	$I_{Out}=50mA$, $V_{Cont}=V_{In}$
Control Terminal						
Control Current	I_{Cont}	-	0.3	0.6	µA	$V_{Cont}=1.2V$
Control Voltage	V_{Cont}	1.2	-	-	V	V_{Out} On state
		-	-	0.2	V	V_{Out} Off state

Reference Value						
Output Voltage / Temp.	$\Delta V_{Out}/\Delta T_a$	-	100	-	ppm/°C	$I_{Out}=5mA$
Output Noise Voltage (TK63728)	V_{Noise}	-	45	-	µVrms	$C_{Out}=1.0\mu F$, $I_{Out}=30mA$, BPF=400Hz~80kHz
Ripple Rejection (TK63728)	RR	-	65	-	dB	$C_{Out}=1.0\mu F$, $I_{Out}=10mA$, f=1kHz
Rise Time (TK63728)	t_r	-	300	-	µs	$C_{Out}=1.0\mu F$, V_{Cont} : Pulse Wave (100Hz) , V_{Cont} On → $V_{Out}\times95\%$ point

***1**: For $V_{Out} \le 1.8V$, no regulations.
***2**: The maximum output current is limited by power dissipation.

General Note

Parameters with only typical values are just reference. (Not guaranteed)
The noise level is dependent on the output voltage, the capacitance and capacitor characteristics.

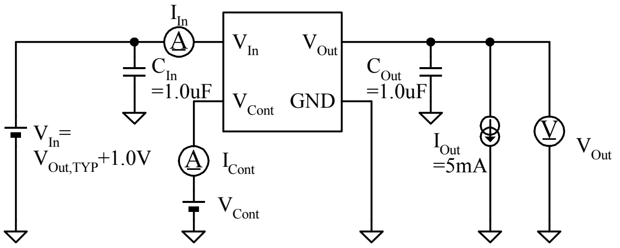
TABLE 1. Preferred Product

Part Number	Output Voltage			Load Regulation				Dropout Voltage			
				I_{Out}=1 ~ 50mA		I_{Out}=1 ~ 100mA		I_{Out}=50mA		I_{Out}=100mA	
	MIN	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX
	V	V	V	mV	mV	mV	mV	mV	mV	mV	mV
TK63702B	1.290	1.350	1.410	4	16	7	28	240	-	480	-
TK63715B	1.440	1.500	1.560	4	16	7	28	180	-	350	-
TK63718B	1.740	1.800	1.860	4	16	8	32	130	-	255	-
TK63725B	2.440	2.500	2.560	6	24	10	40	95	145	185	285
TK63726B	2.540	2.600	2.660	6	24	11	44	90	140	180	275
TK63727B	2.640	2.700	2.760	6	24	11	44	90	135	175	265
TK63728B	2.740	2.800	2.860	6	24	11	44	85	130	165	255
TK63701B	2.790	2.850	2.910	6	24	11	44	85	125	165	250
TK63729B	2.840	2.900	2.960	6	24	11	44	80	125	160	245
TK63730B	2.940	3.000	3.060	6	24	12	48	80	125	160	245
TK63731B	3.038	3.100	3.162	7	28	12	48	80	125	160	245
TK63732B	3.136	3.200	3.264	7	28	12	48	80	125	160	245
TK63733B	3.234	3.300	3.366	7	28	13	52	80	125	160	245
TK63735B	3.430	3.500	3.570	7	28	13	52	80	125	160	245

Part Number	Output Voltage			Load Regulation				Dropout Voltage			
				I_{Out}=1 ~ 50mA		I_{Out}=1 ~ 100mA		I_{Out}=50mA		I_{Out}=100mA	
	MIN	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX
	V	V	V	mV	mV	mV	mV	mV	mV	mV	mV
TK63715H/S	1.440	1.500	1.560	7	28	13	52	190	-	380	-
TK63718H/S	1.740	1.800	1.860	7	28	14	56	145	-	290	-
TK63725H/S	2.440	2.500	2.560	8	32	15	60	105	155	210	320
TK63726H/S	2.540	2.600	2.660	8	32	15	60	100	150	200	310
TK63727H/S	2.640	2.700	2.760	8	32	15	60	100	145	195	295
TK63728H/S	2.740	2.800	2.860	8	32	15	60	95	140	185	285
TK63701H/S	2.790	2.850	2.910	8	32	15	60	95	140	185	285
TK63729H/S	2.840	2.900	2.960	8	32	15	60	90	135	180	275
TK63730H/S	2.940	3.000	3.060	8	32	16	64	90	135	180	275
TK63731H/S	3.038	3.100	3.162	8	32	16	64	90	135	180	275
TK63732H/S	3.136	3.200	3.264	8	32	16	64	90	135	180	275
TK63733H/S	3.234	3.300	3.366	8	32	16	64	90	135	180	275
TK63735H/S	3.430	3.500	3.570	8	32	16	64	90	135	180	275

Notice.
Please contact your authorized TOKO representative for voltage availability.

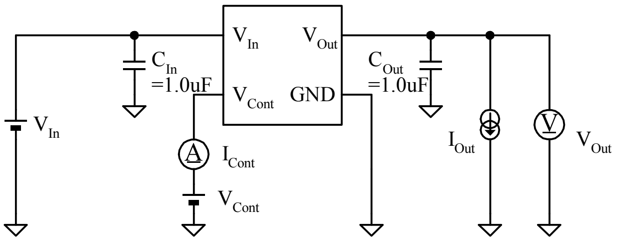
9. TEST CIRCUIT



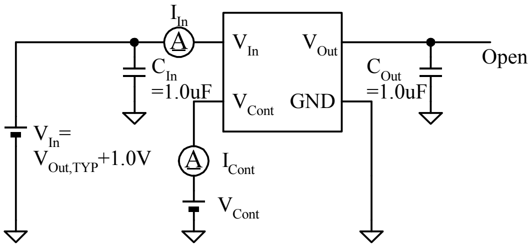
■ Test circuit for electrical characteristic

Notice.

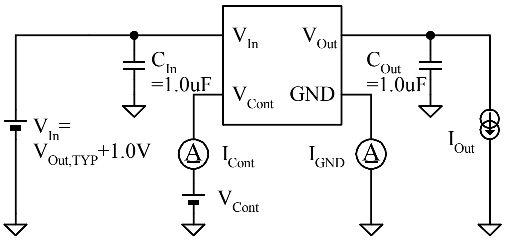
The limit value of electrical characteristics is applied when C_{In}=1.0µF(Tantalum), C_{Out}=1.0µF(Tantalum).
But C_{In}, and C_{Out} can be used with both ceramic and tantalum capacitors. Also, the IC provides stable operation even if without using capacitor.



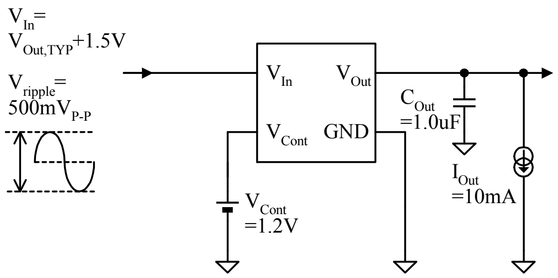
- ■ ΔV_{Out} vs V_{In}
- ■ V_{Drop} vs I_{Out}
- ■ V_{Out} vs I_{Out}
- ■ ΔV_{Out} vs I_{Out}
- ■ ΔV_{Out} vs T_a
- ■ V_{Drop} vs T_a
- ■ $I_{Out,MAX}$ vs T_a
- ■ I_{Cont} vs V_{Cont} , V_{Out} vs V_{Cont}
- ■ I_{Cont} vs T_a
- ■ V_{Cont} vs T_a
- ■ V_{Noise} vs V_{In}
- ■ V_{Noise} vs I_{Out}
- ■ V_{Noise} vs V_{Out}
- ■ V_{Noise} vs Frequency



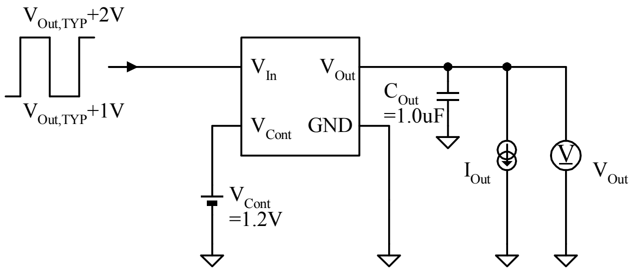
- ■ I_Q vs V_{In}
- ■ $I_{Standby}$ vs V_{In}
- ■ I_Q vs T_a



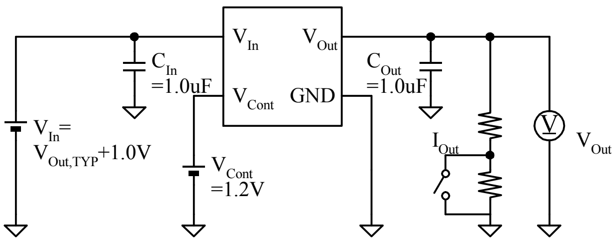
- ■ I_{GND} vs I_{Out}
- ■ I_{GND} vs T_a



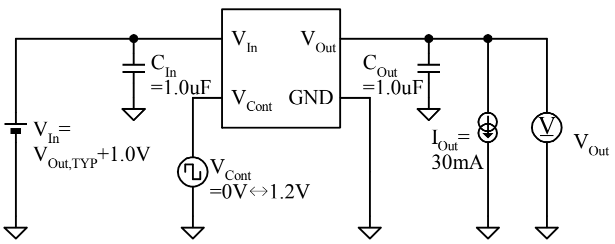
- RR vs V_{In}
- RR vs Frequency
- RR vs Frequency



- Line Transient



- Load Transient

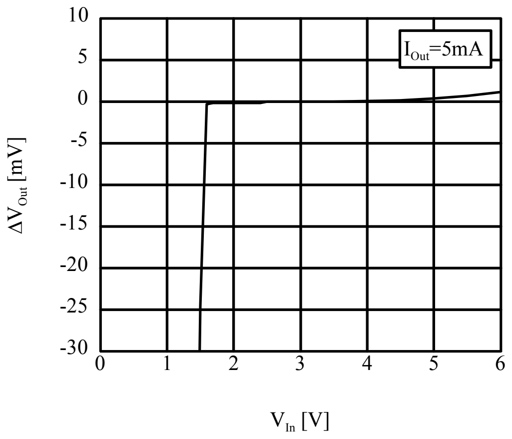


- On/Off Transient

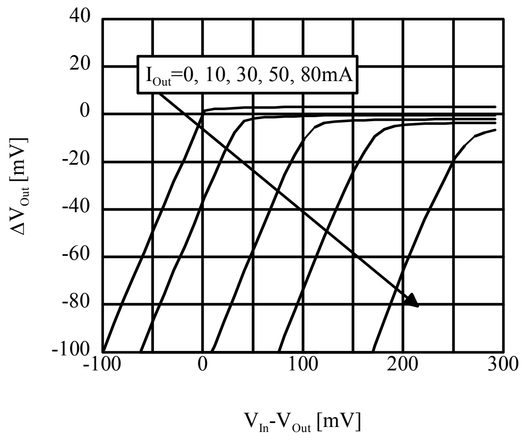
10. TYPICAL CHARACTERISTICS

10-1. DC CHARACTERISTICS

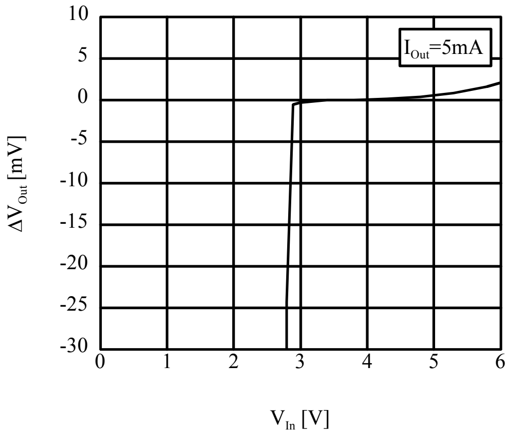
■ ΔV_{Out} vs V_{In} (TK63715B/H/S)



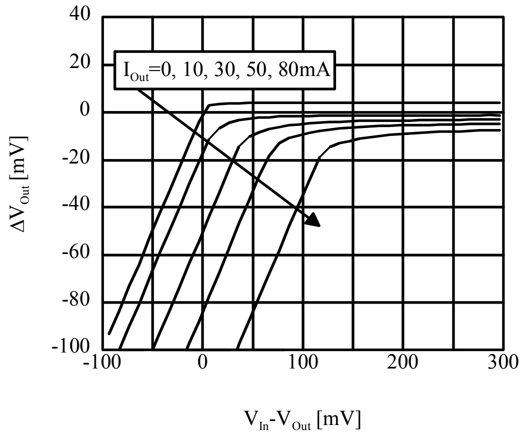
■ ΔV_{Out} vs V_{In} (TK63715B)



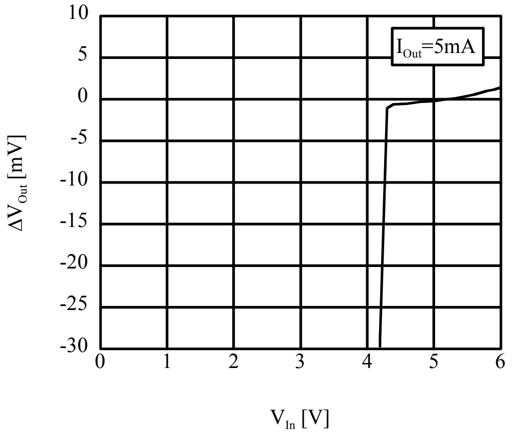
■ ΔV_{Out} vs V_{In} (TK63728B/H/S)



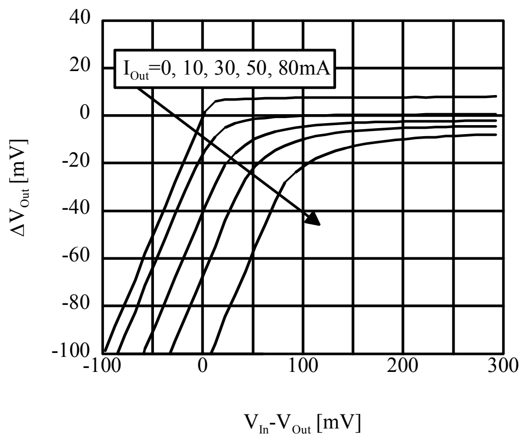
■ ΔV_{Out} vs V_{In} (TK63728B)



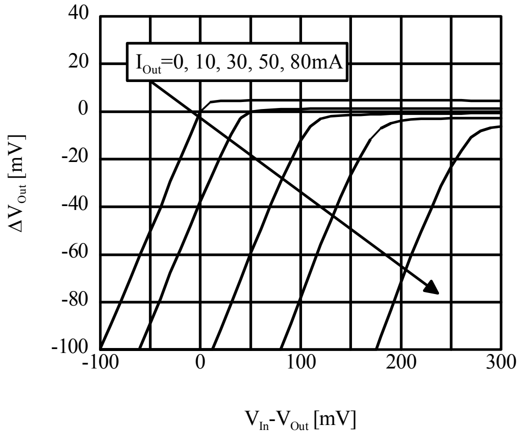
■ ΔV_{Out} vs V_{In} (TK63742B/H/S)



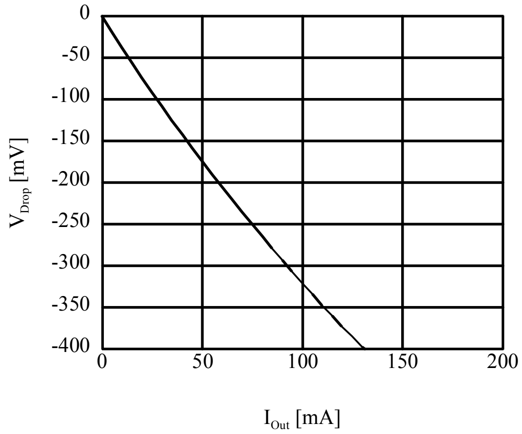
■ ΔV_{Out} vs V_{In} (TK63742B)



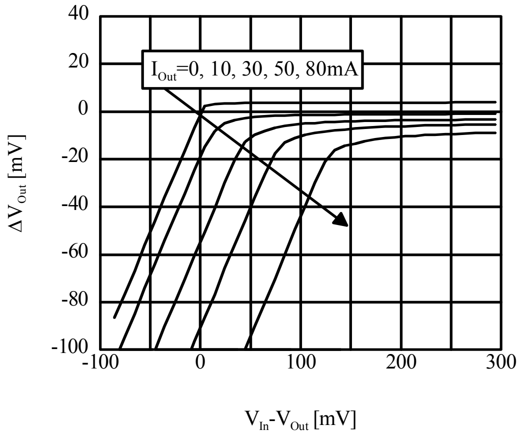
■ ΔV_{Out} vs V_{In} (TK63715H/S)



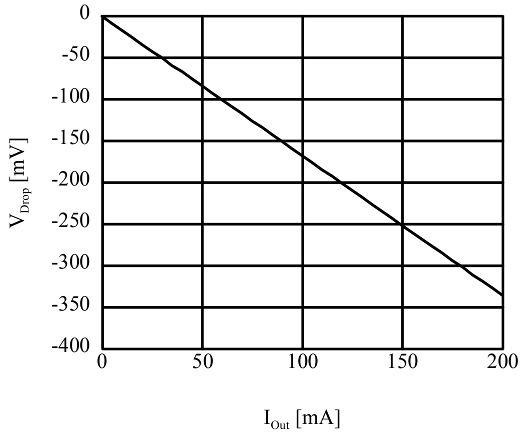
■ V_{Drop} vs I_{Out} (TK63715B)



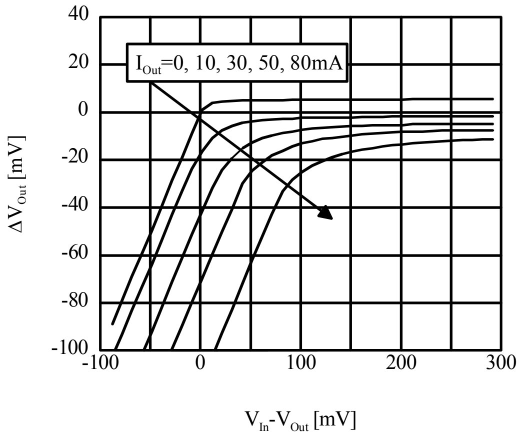
■ ΔV_{Out} vs V_{In} (TK63728H/S)



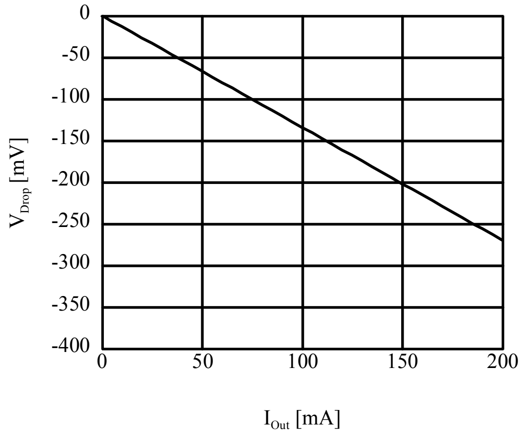
■ V_{Drop} vs I_{Out} (TK63728B)



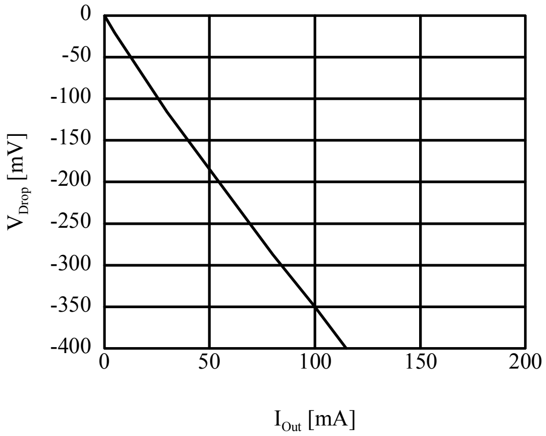
■ ΔV_{Out} vs V_{In} (TK63742H/S)



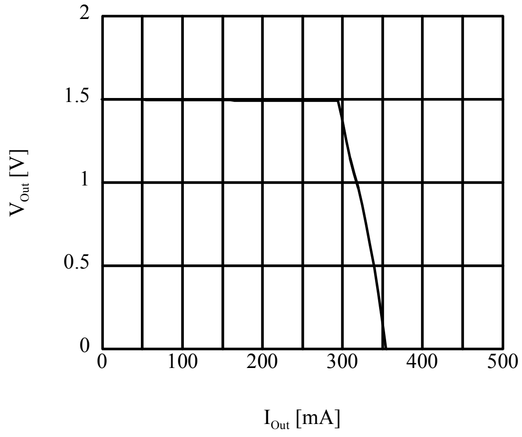
■ V_{Drop} vs I_{Out} (TK63742B)



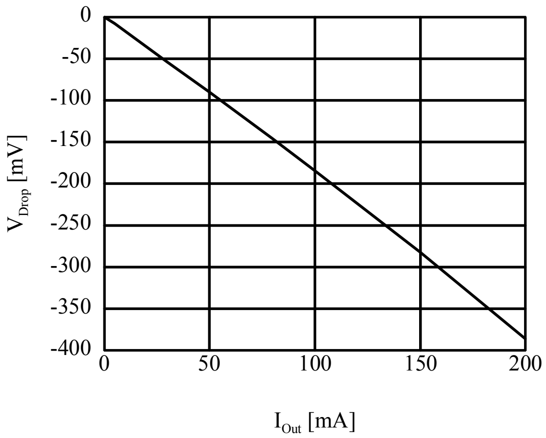
■ V_{Drop} vs I_{Out} (TK63715H/S)



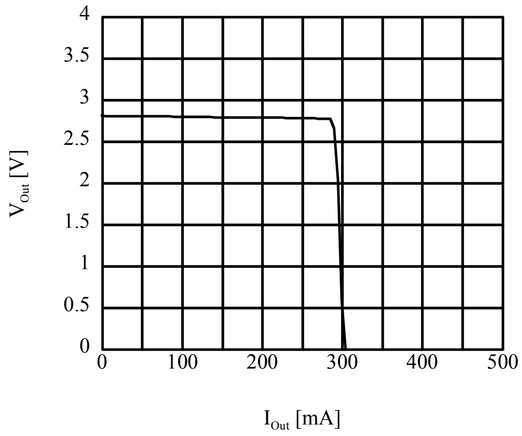
■ V_{Out} vs I_{Out} (TK63715B/H/S)



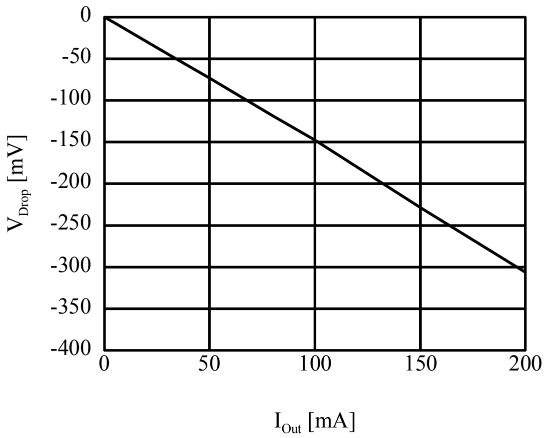
■ V_{Drop} vs I_{Out} (TK63728H/S)



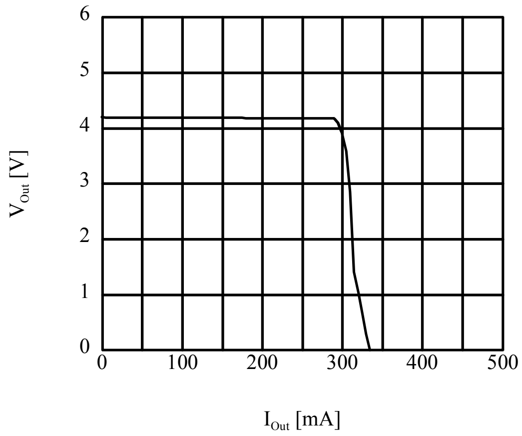
■ V_{Out} vs I_{Out} (TK63728B/H/S)



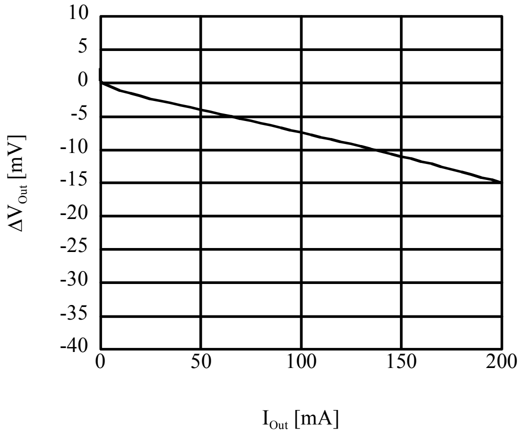
■ V_{Drop} vs I_{Out} (TK63742H/S)



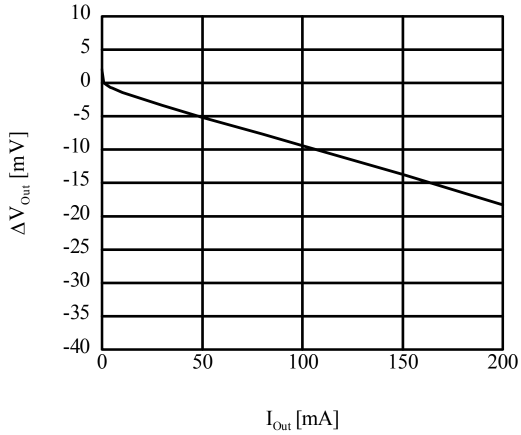
■ V_{Out} vs I_{Out} (TK63742B/H/S)



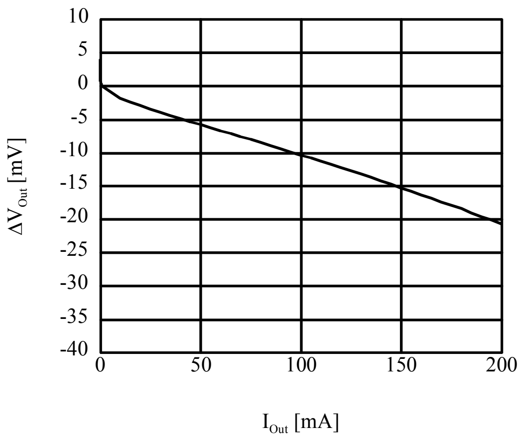
■ ΔV_{Out} vs I_{Out} (TK63715B)



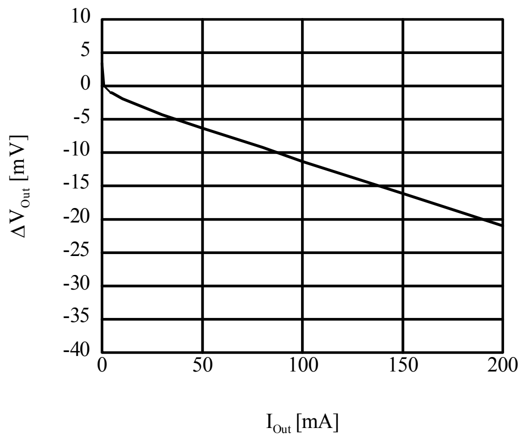
■ ΔV_{Out} vs I_{Out} (TK63715H/S)



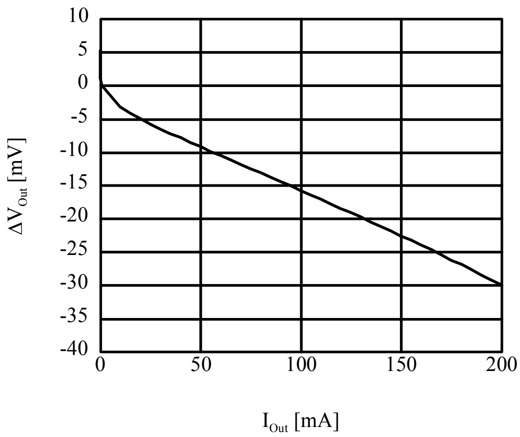
■ ΔV_{Out} vs I_{Out} (TK63728B)



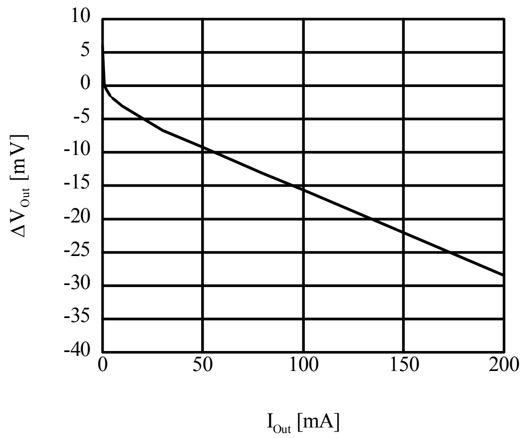
■ ΔV_{Out} vs I_{Out} (TK63728H/S)



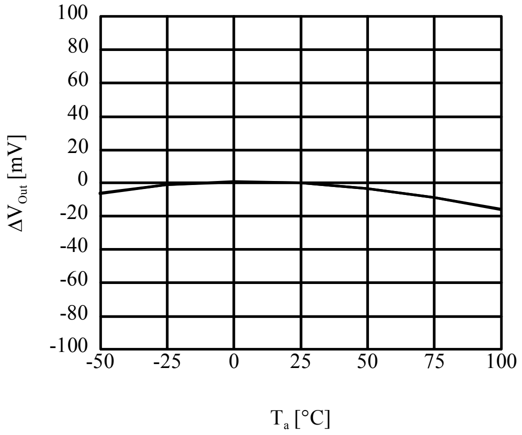
■ ΔV_{Out} vs I_{Out} (TK63742B)



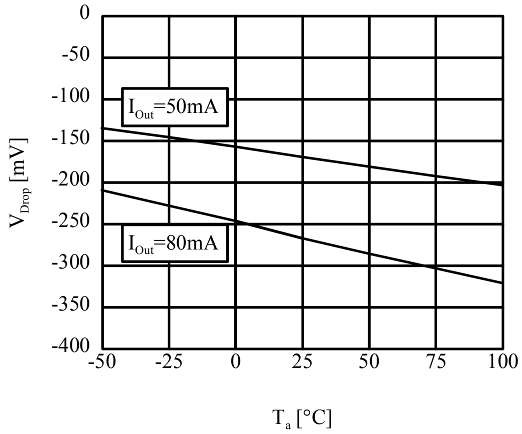
■ ΔV_{Out} vs I_{Out} (TK63742H/S)



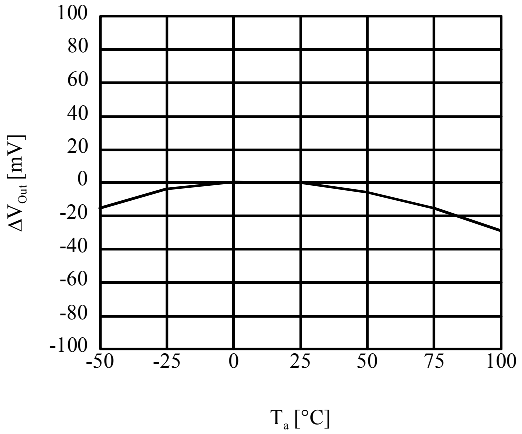
■ ΔV_{Out} vs T_a (TK63715B/H/S)



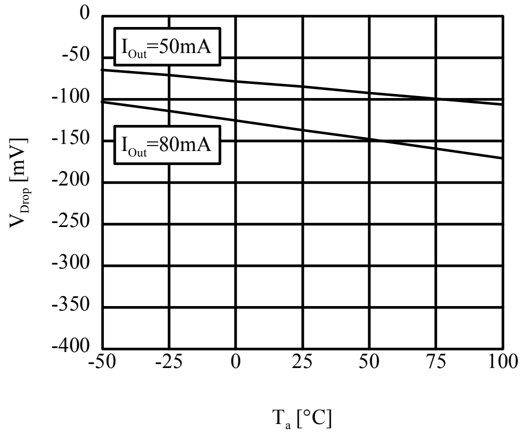
■ V_{Drop} vs T_a (TK63715B)



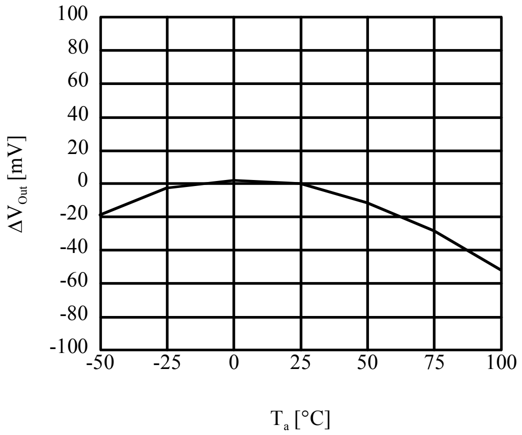
■ ΔV_{Out} vs T_a (TK63728B/H/S)



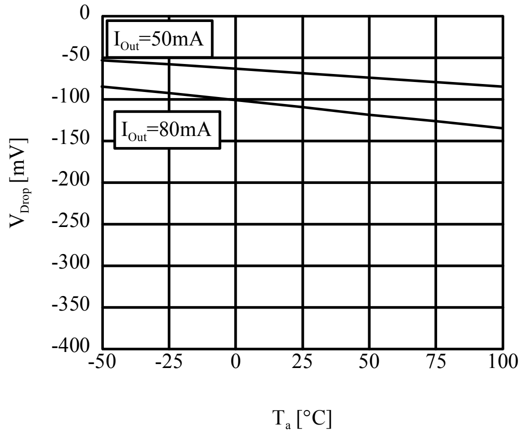
■ V_{Drop} vs T_a (TK63728B)



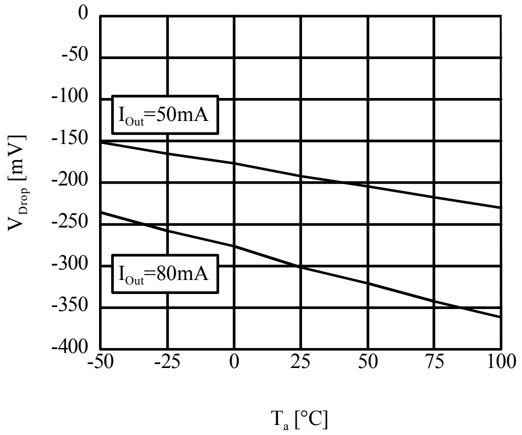
■ ΔV_{Out} vs T_a (TK63742B/H/S)



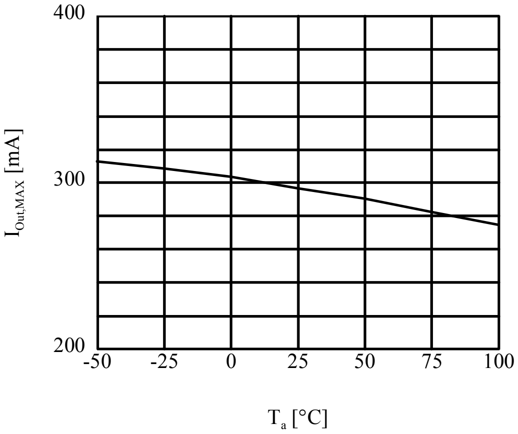
■ V_{Drop} vs T_a (TK63742B)



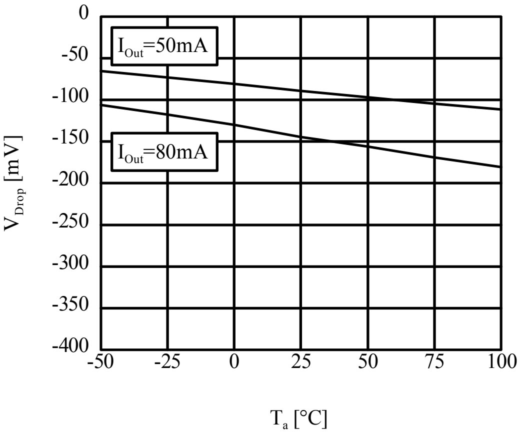
■ V_{Drop} vs T_a (TK63715H/S)



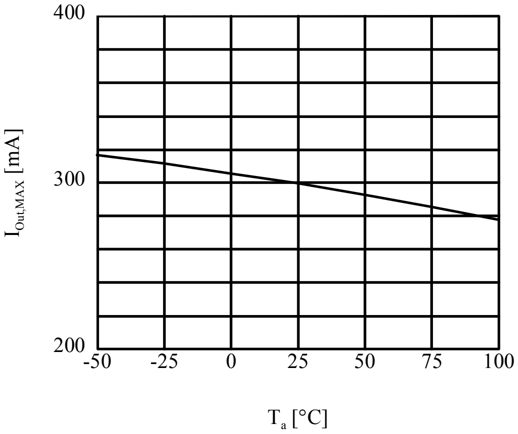
■ $I_{Out,MAX}$ vs T_a (TK63715B/H/S)



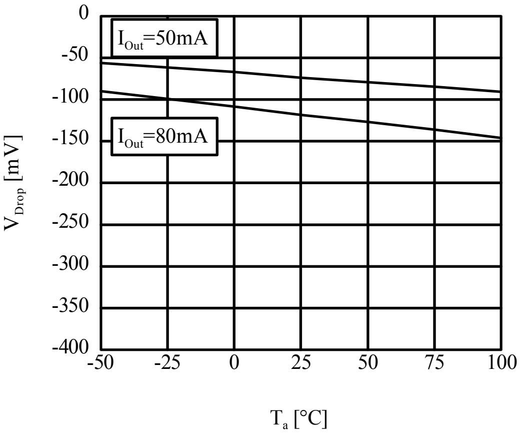
■ V_{Drop} vs T_a (TK63728H/S)



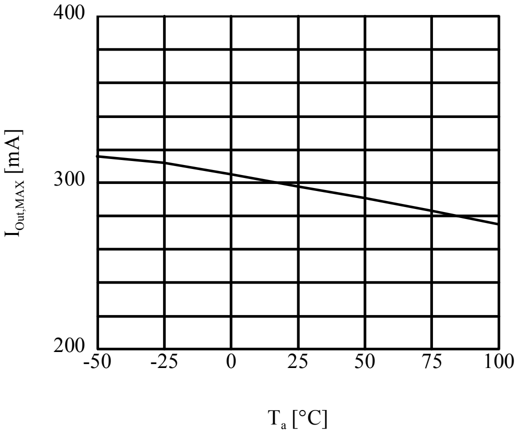
■ $I_{Out,MAX}$ vs T_a (TK63728B/H/S)



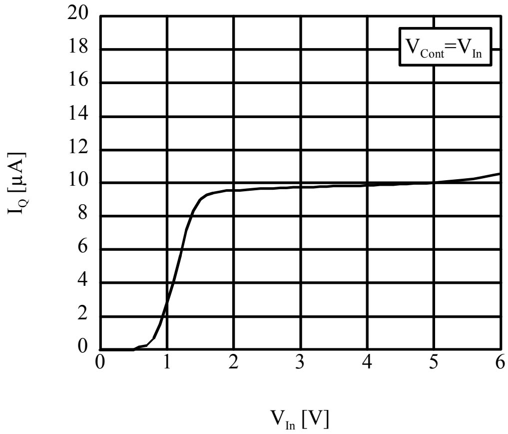
■ V_{Drop} vs T_a (TK63742H/S)



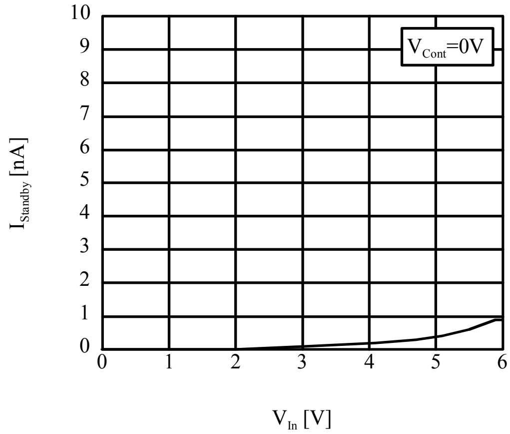
■ $I_{Out,MAX}$ vs T_a (TK63742B/H/S)



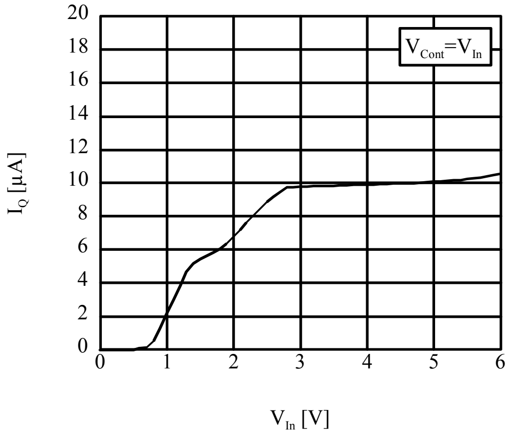
■ I_Q vs V_{In} (TK63715B/H/S)



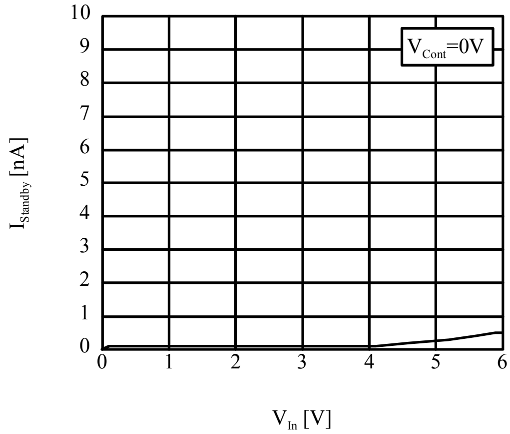
■ $I_{Standby}$ vs V_{In} (TK63715B/H/S)



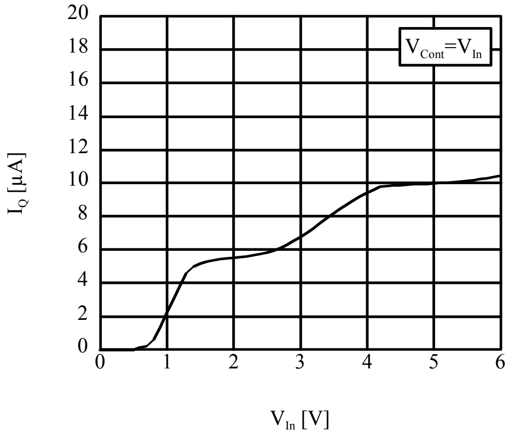
■ I_Q vs V_{In} (TK63728B/H/S)



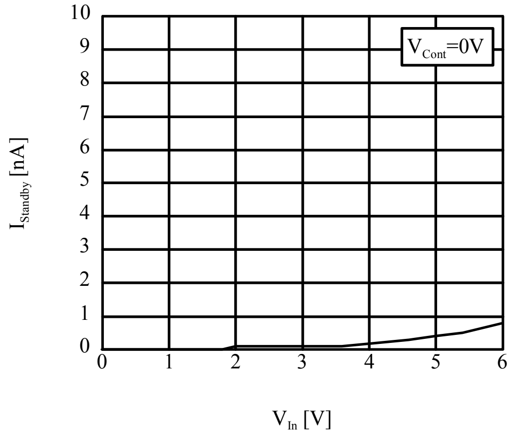
■ $I_{Standby}$ vs V_{In} (TK63728B/H/S)



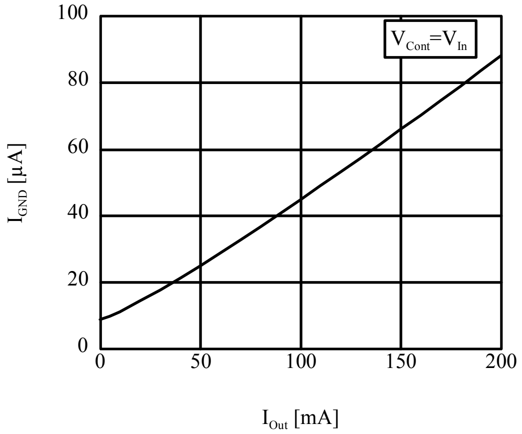
■ I_Q vs V_{In} (TK63742B/H/S)



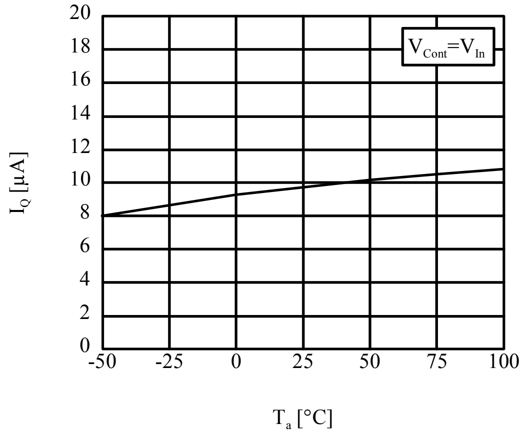
■ $I_{Standby}$ vs V_{In} (TK63742B/H/S)



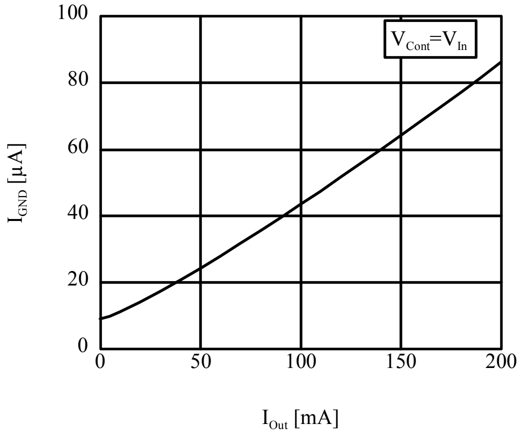
■ I_{GND} vs I_{Out} (TK63715B/H/S)



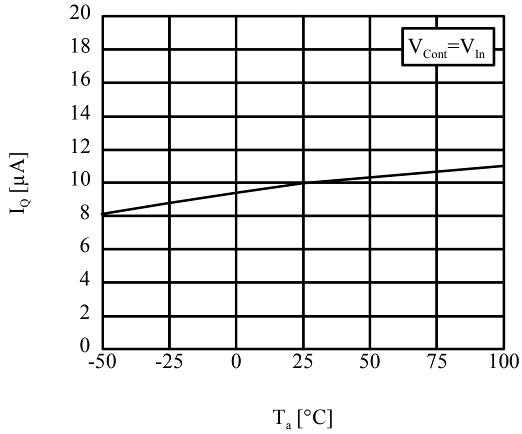
■ I_Q vs T_a (TK63715B/H/S)



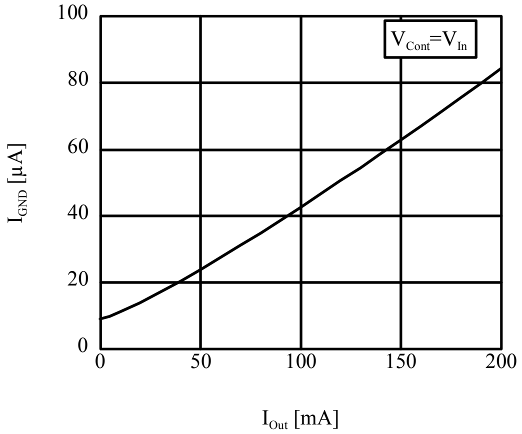
■ I_{GND} vs I_{Out} (TK63728B/H/S)



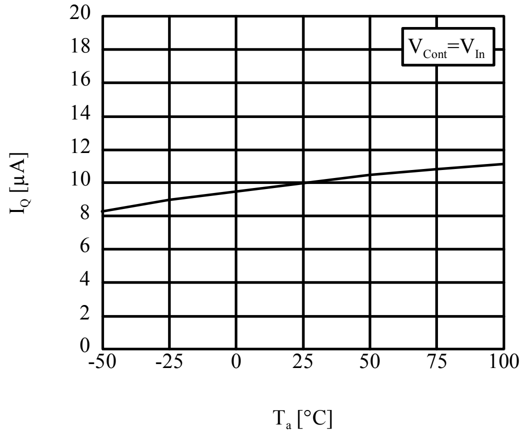
■ I_Q vs T_a (TK63728B/H/S)



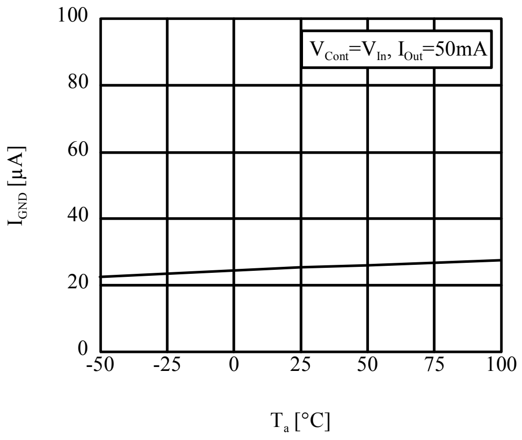
■ I_{GND} vs I_{Out} (TK63742B/H/S)



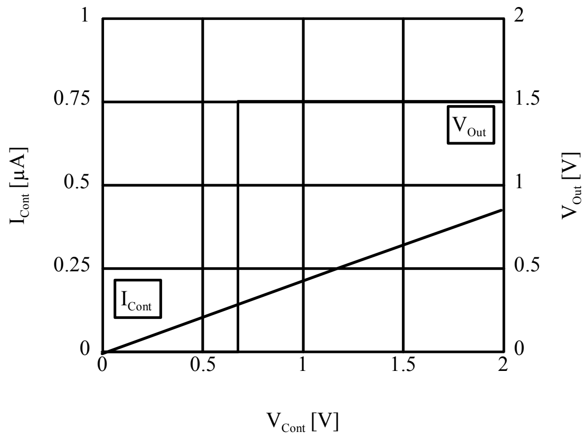
■ I_Q vs T_a (TK63742B/H/S)



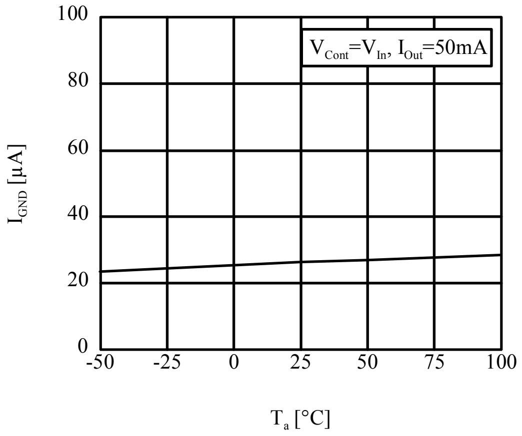
■ I_{GND} vs T_a (TK63715B/H/S)



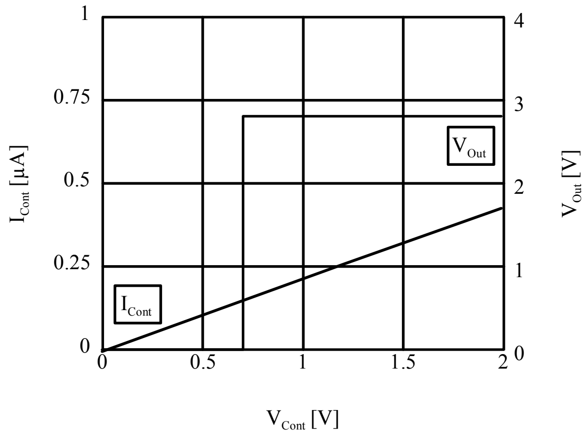
■ I_{Cont} vs V_{Cont}, V_{Out} vs V_{Cont} (TK63715B/H/S)



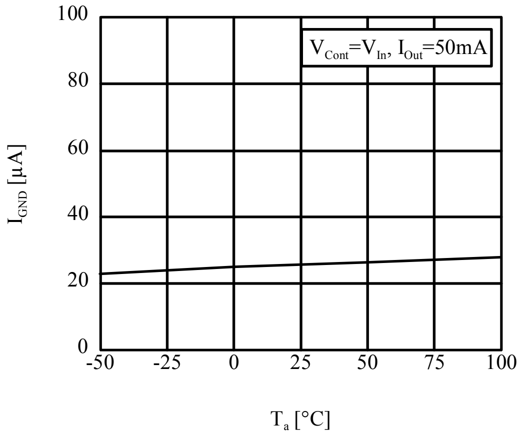
■ I_{GND} vs T_a (TK63728B/H/S)



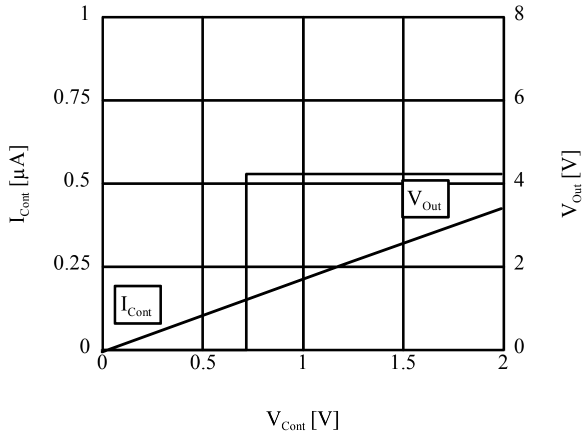
■ I_{Cont} vs V_{Cont}, V_{Out} vs V_{Cont} (TK63728B/H/S)



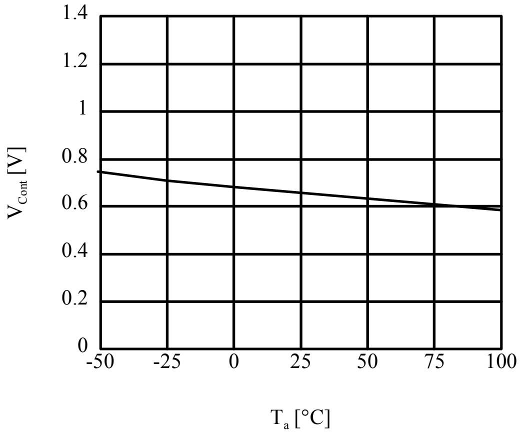
■ I_{GND} vs T_a (TK63742B/H/S)



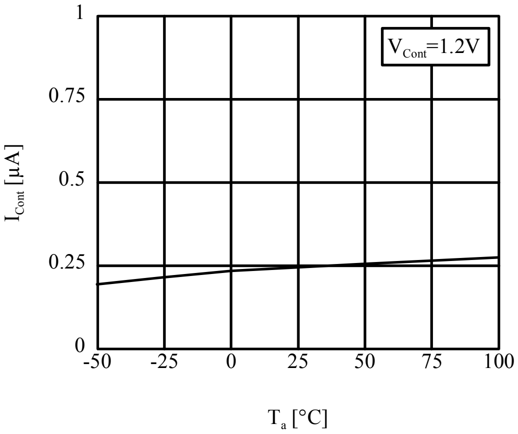
■ I_{Cont} vs V_{Cont}, V_{Out} vs V_{Cont} (TK63742B/H/S)



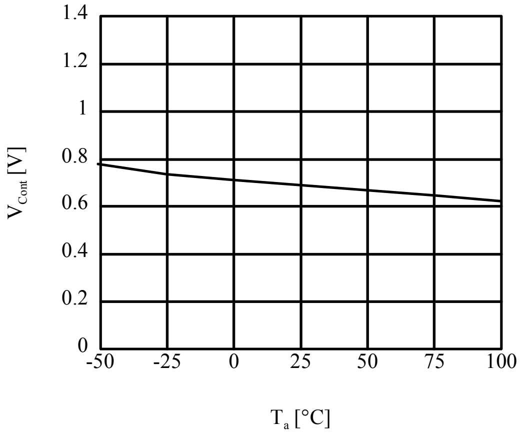
■ V_{Cont} vs T_a (TK63715B/H/S)



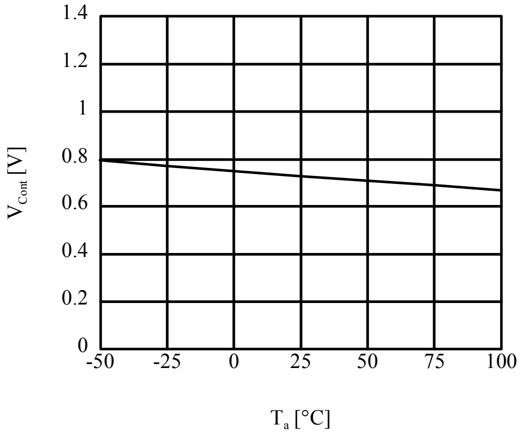
■ I_{Cont} vs T_a (TK637xxB/H/S)



■ V_{Cont} vs T_a (TK63728B/H/S)

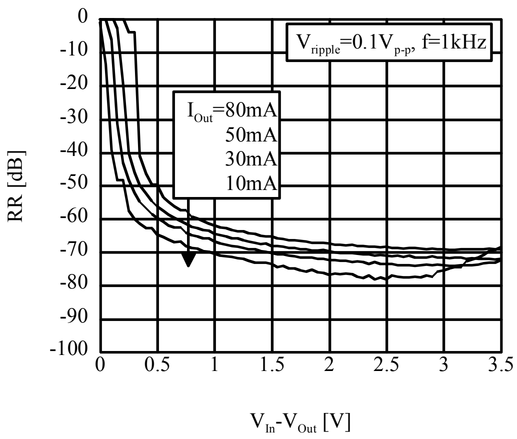


■ V_{Cont} vs T_a (TK63742B/H/S)

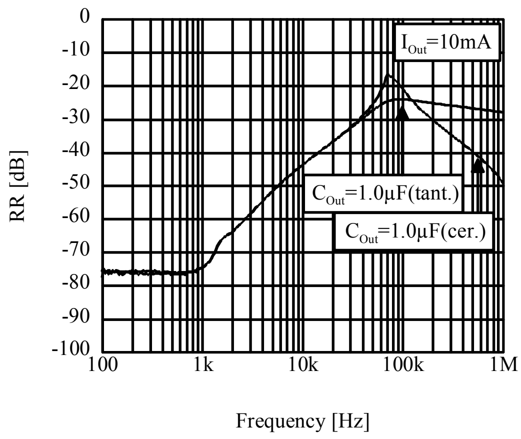


10-2. AC CHARACTERISTICS

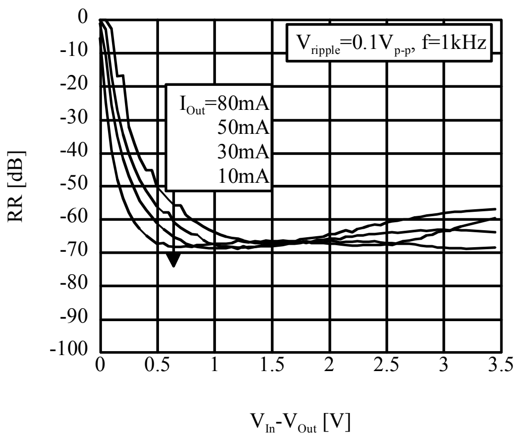
■ RR vs V_{In} (TK63715B/H/S)



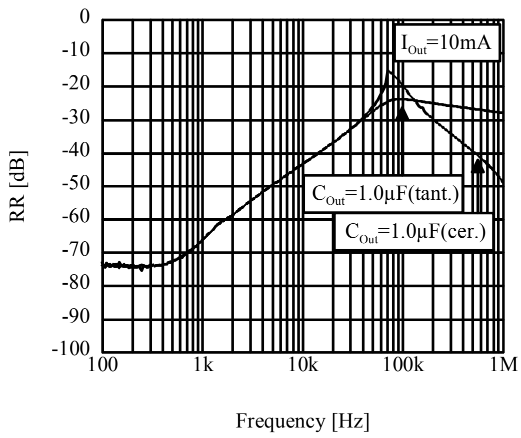
■ RR vs Frequency (TK63715B/H/S)



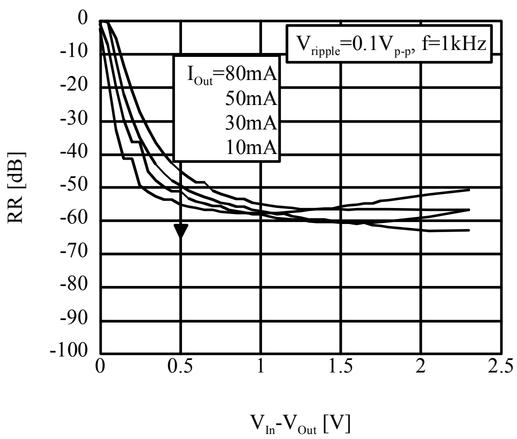
■ RR vs V_{In} (TK63728B/H/S)



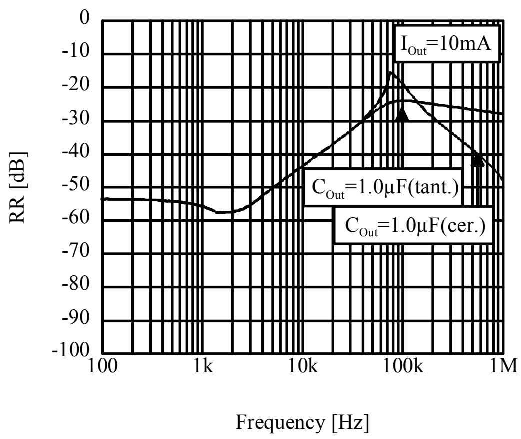
■ RR vs Frequency (TK63728B/H/S)



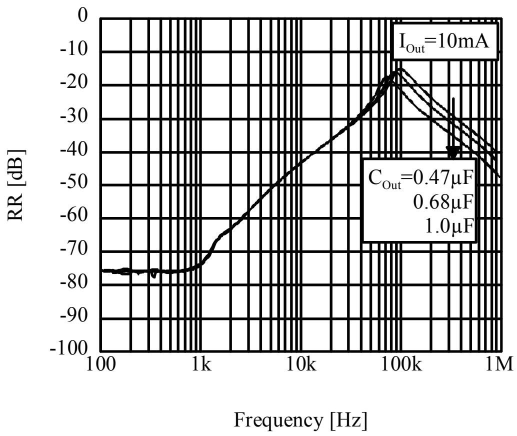
■ RR vs V_{In} (TK63742B/H/S)



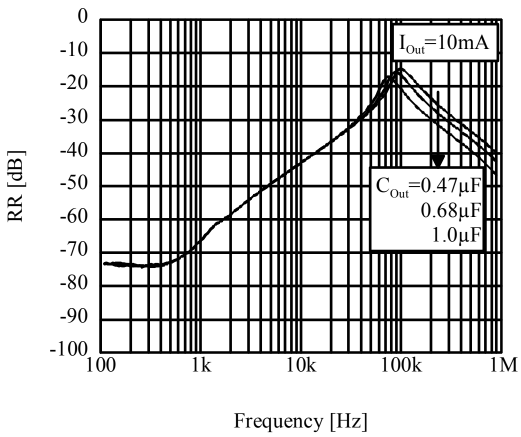
■ RR vs Frequency (TK63742B/H/S)



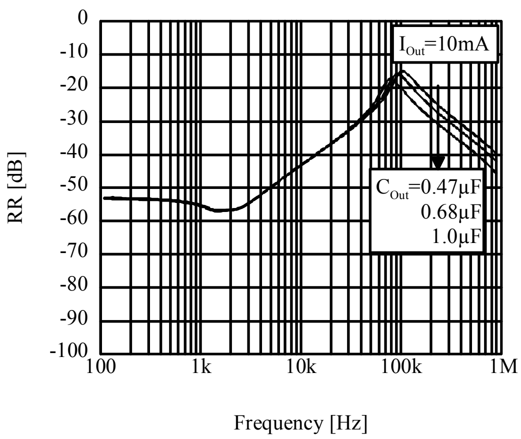
■ RR vs Frequency (TK63715B/H/S)



■ RR vs Frequency (TK63728B/H/S)

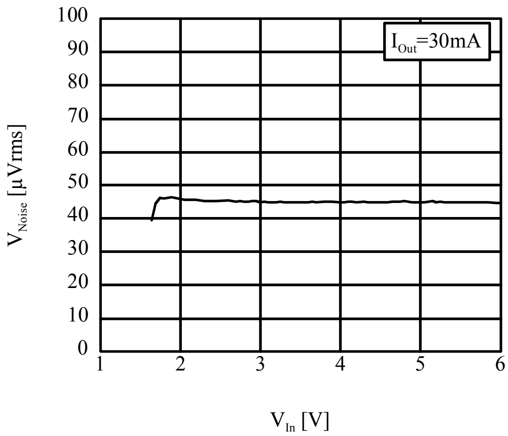


■ RR vs Frequency (TK63742B/H/S)

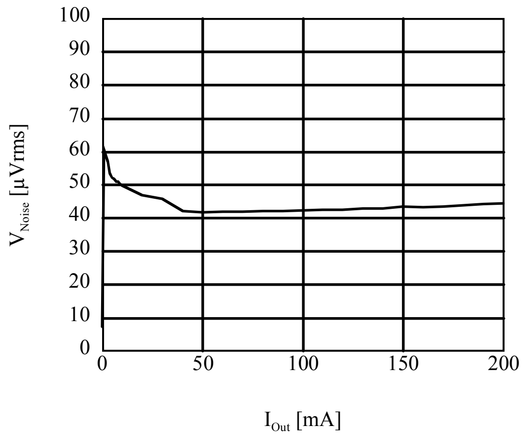


The ripple rejection (RR) characteristic depends on the characteristic and the capacitance value of the capacitor connected to the output side. The RR characteristic of 50kHz or more varies greatly with the capacitor on the output side and PCB pattern. If necessary, please confirm stability of your design.

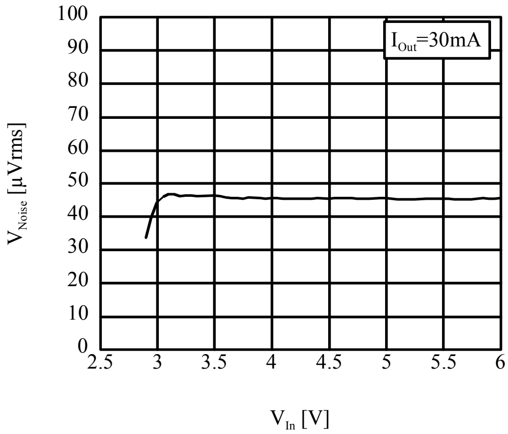
■ V_{Noise} vs V_{In} (TK63715B/H/S)



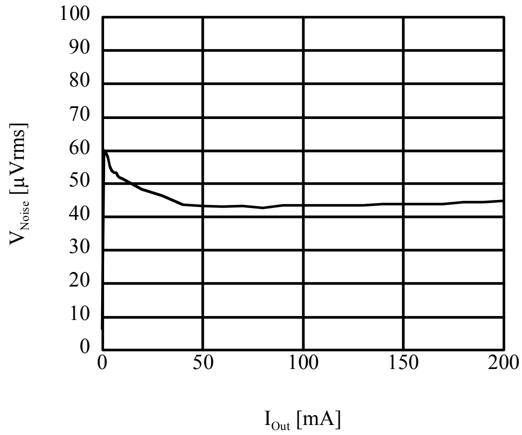
■ V_{Noise} vs I_{Out} (TK63715B/H/S)



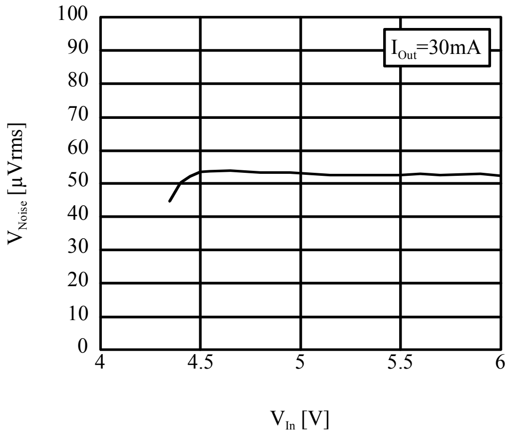
■ V_{Noise} vs V_{In} (TK63728B/H/S)



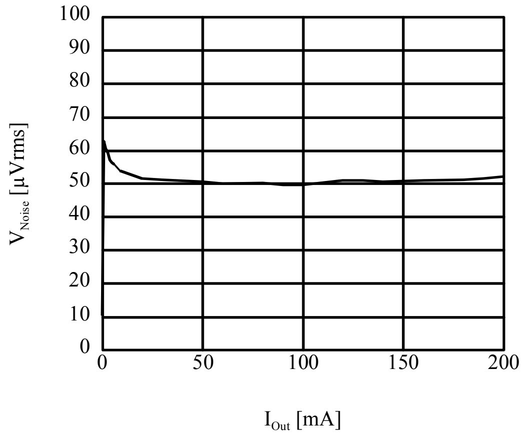
■ V_{Noise} vs I_{Out} (TK63728B/H/S)



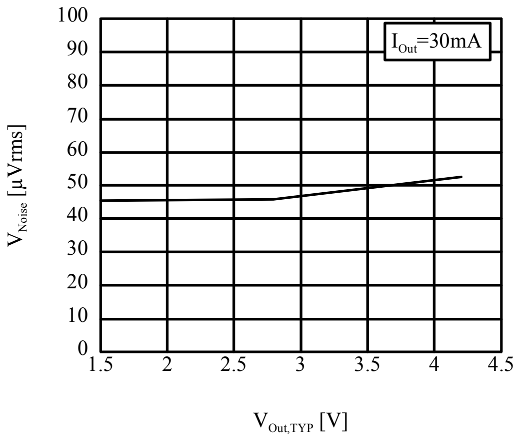
■ V_{Noise} vs V_{In} (TK63742B/H/S)



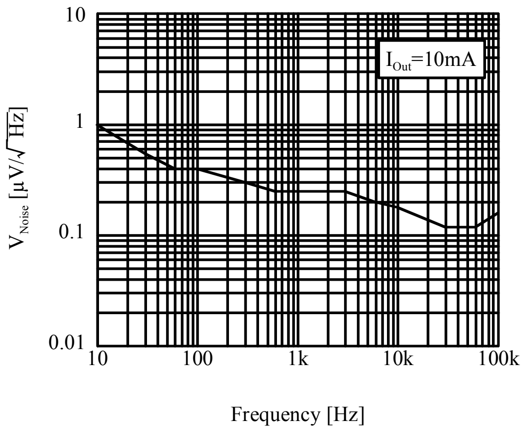
■ V_{Noise} vs I_{Out} (TK63742B/H/S)



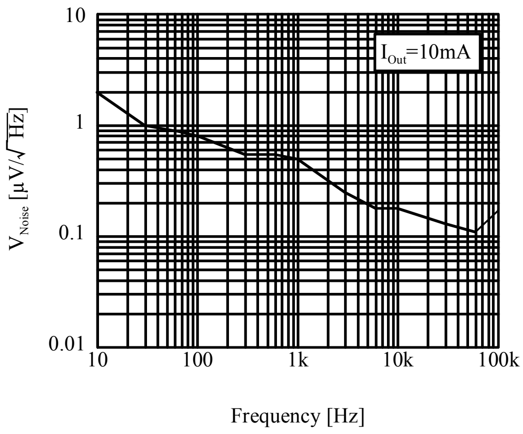
■ V_{Noise} vs $V_{Out,TYP}$ (TK637xxB/H/S)



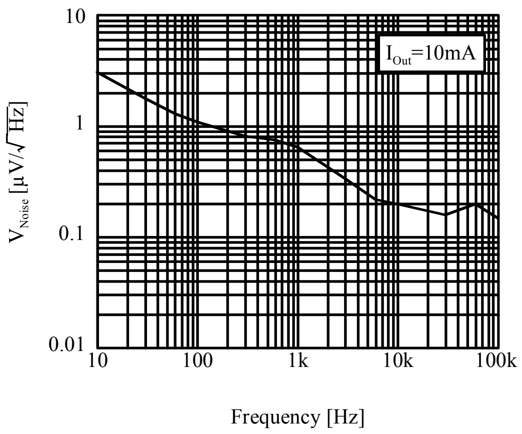
■ V_{Noise} vs Frequency (TK63715B/H/S)



■ V_{Noise} vs Frequency (TK63728B/H/S)

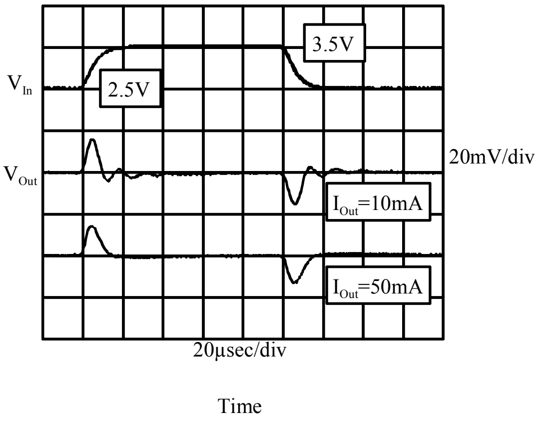


■ V_{Noise} vs Frequency (TK63742B/H/S)

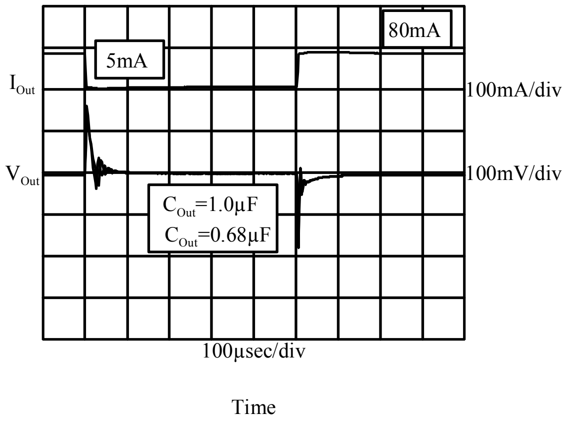


10-3. TRANSIENT CHARACTERISTICS

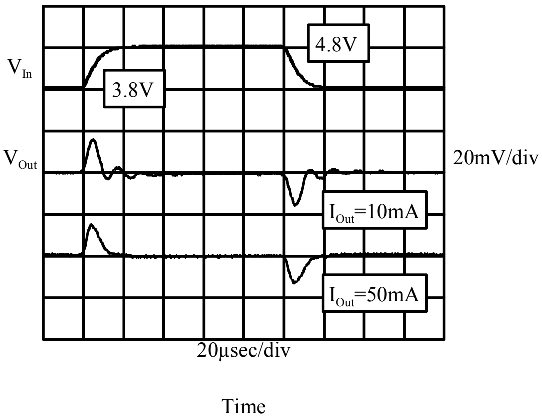
■ Line Transient (TK63715B/H/S)



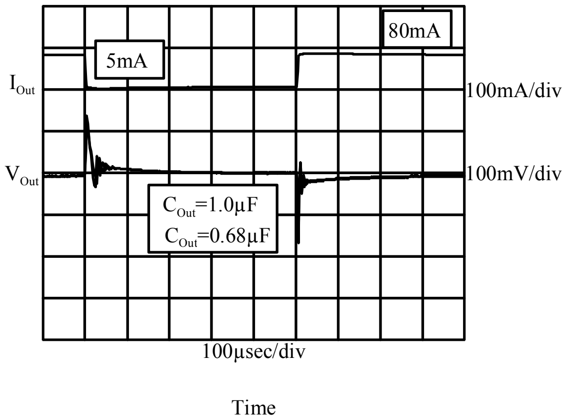
■ Load Transient (I_{Out}=5↔80mA) (TK63715B/H/S)



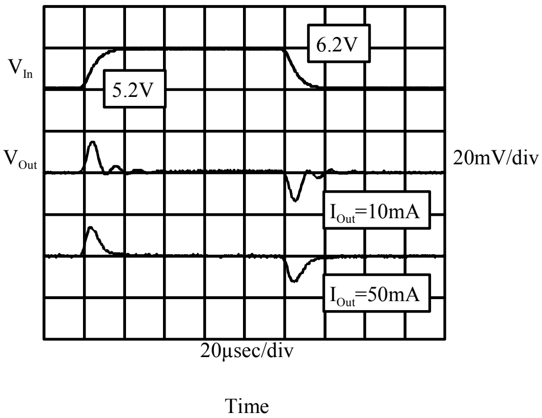
■ Line Transient (TK63728B/H/S)



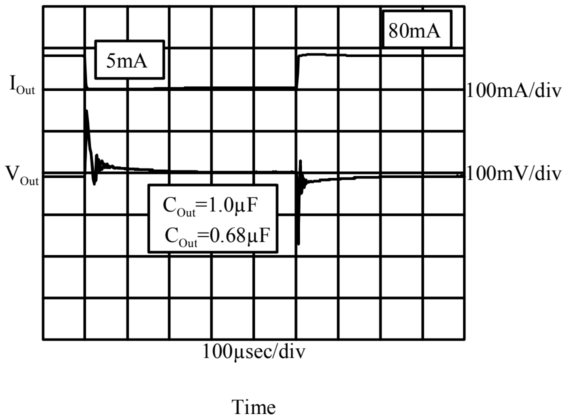
■ Load Transient (I_{Out}=5↔80mA) (TK63728B/H/S)



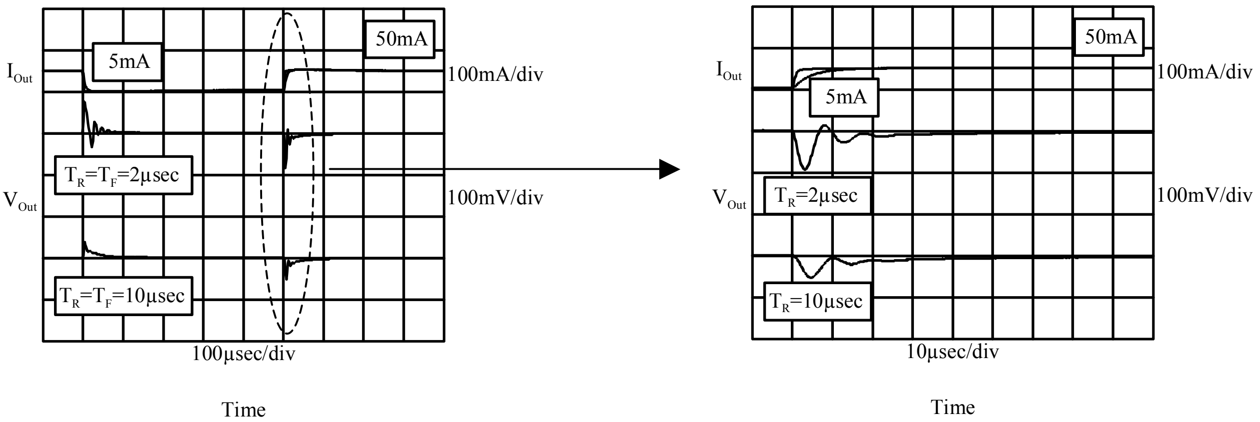
■ Line Transient (TK63742B/H/S)



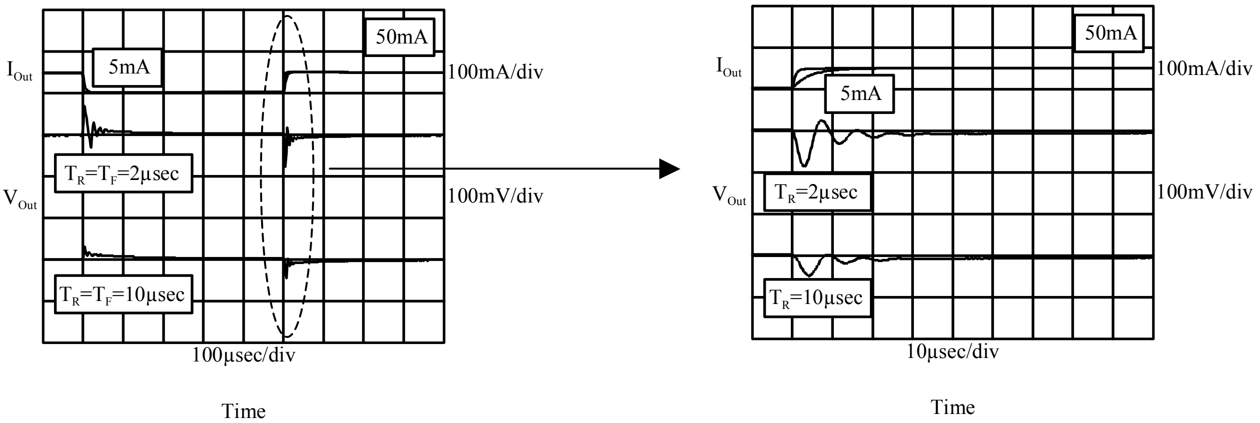
■ Load Transient (I_{Out}=5↔80mA) (TK63742B/H/S)



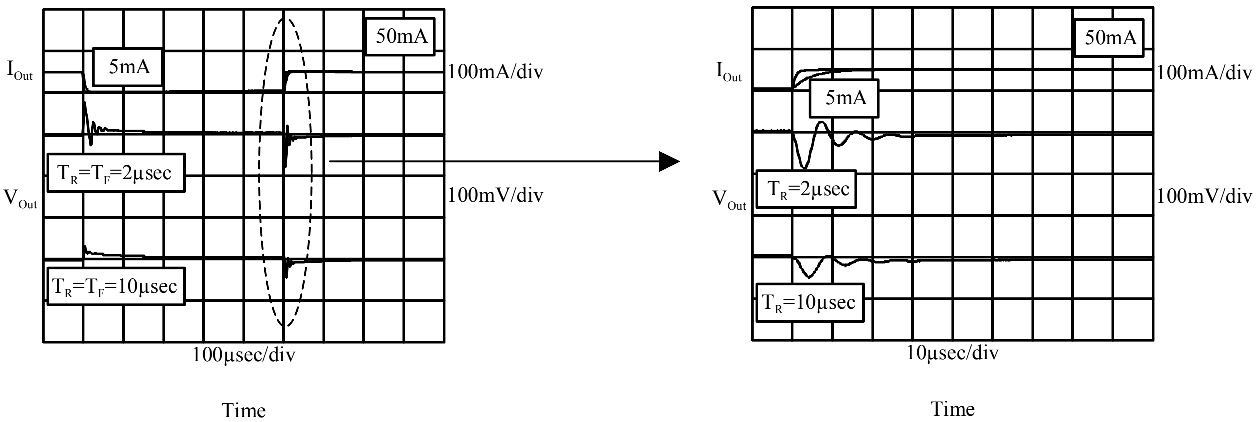
■ Load Transient (I_{Out}=5↔50mA) (TK63715B/H/S)



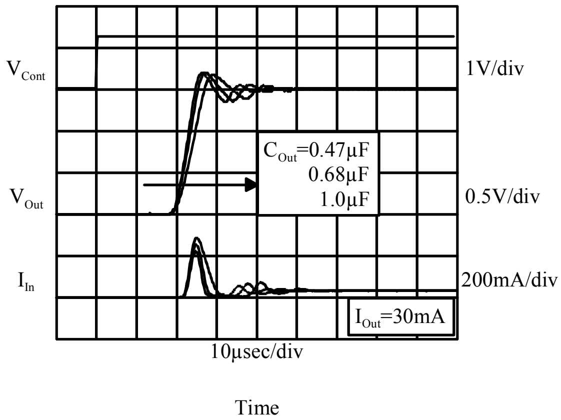
■ Load Transient (I_{Out}=5↔50mA) (TK63728B/H/S)



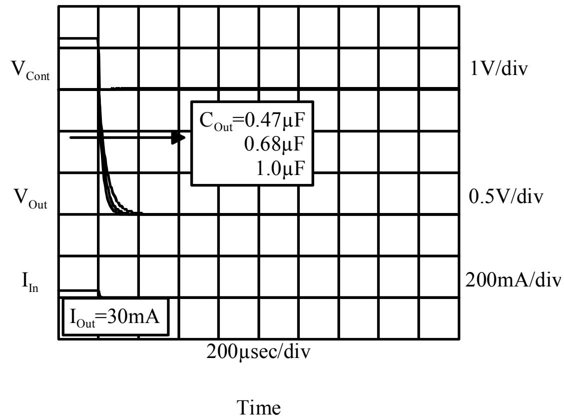
■ Load Transient (I_{Out}=5↔50mA) (TK63742B/H/S)



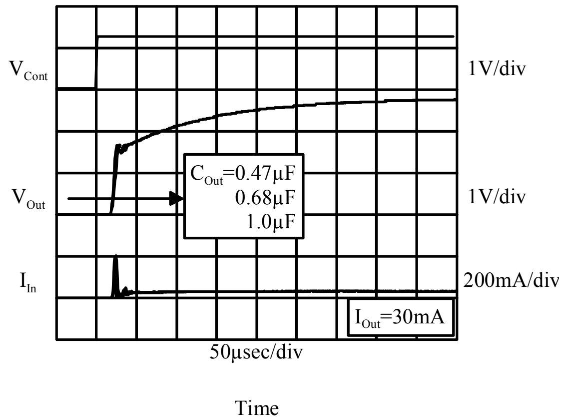
■ On/Off Transient (V_{Cont}=0→1.2V) (TK63715B/H/S)



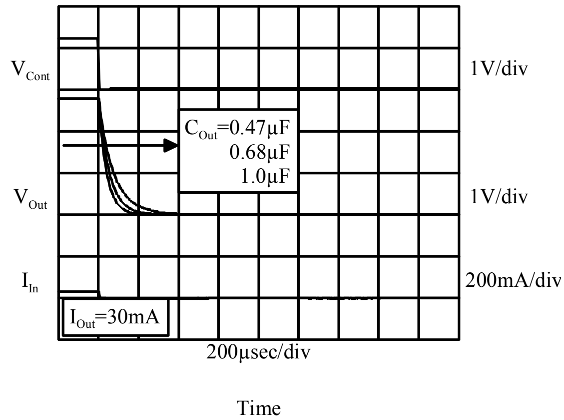
■ On/Off Transient (V_{Cont}=1.2→0V) (TK63715B/H/S)



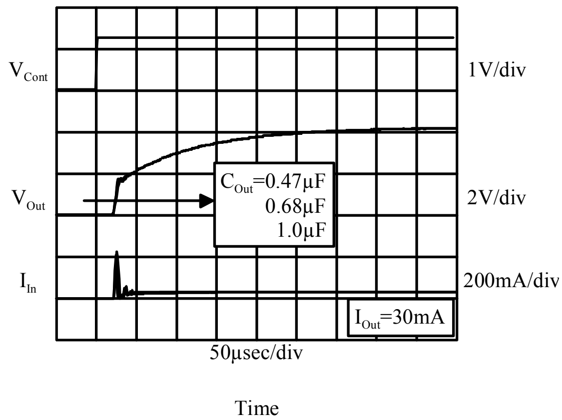
■ On/Off Transient (V_{Cont}=0→1.2V) (TK63728B/H/S)



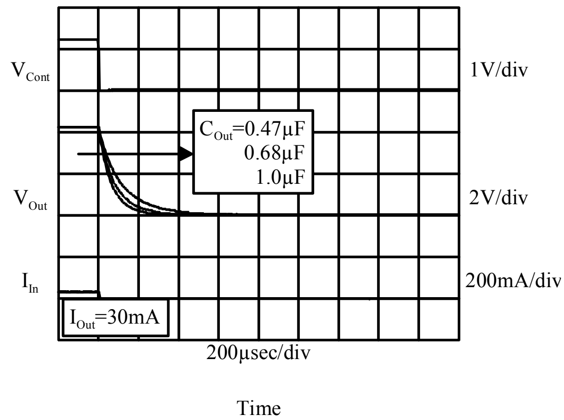
■ On/Off Transient (V_{Cont}=1.2→0V) (TK63728B/H/S)



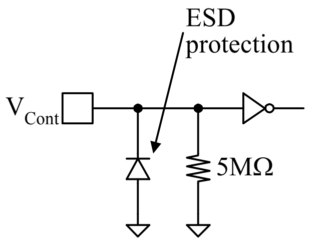
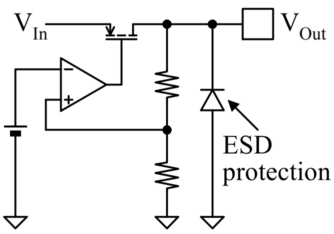
■ On/Off Transient (V_{Cont}=0→1.2V) (TK63742B/H/S)



■ On/Off Transient (V_{Cont}=1.2→0V) (TK63742B/H/S)



11. PIN DESCRIPTION

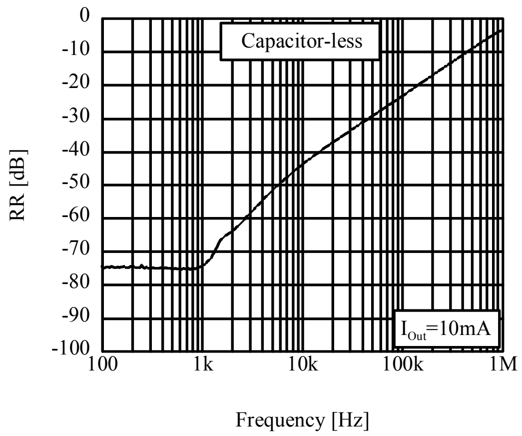
Pin No.			Pin Description	Internal Equivalent Circuit	Description
TK637xxB	TK637xxH	TK637xxS			
A1	2, 5	2	GND		GND Terminal
A2	6	3	V_{Cont}		Control Terminal V_{Cont} > 1.2V : On V_{Cont} < 0.2V : Off The pull-down resistor (about 5MΩ) is built-in.
B1	3	5	V_{Out}		Output Terminal
B2	1	1	V_{In}		Input Terminal
	4	4	NC		No Connected

12. APPLICATIONS INFORMATION

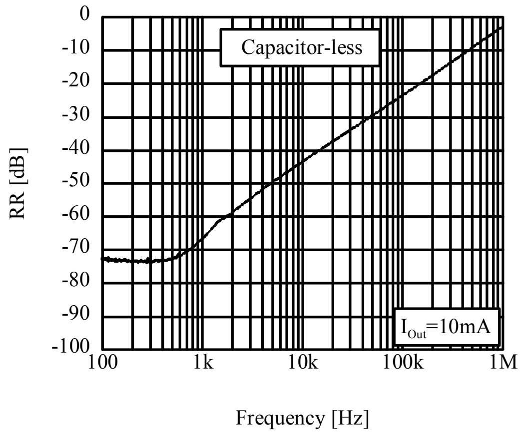
12-1. External Capacitor

General linear regulators require input capacitor and output capacitor in order to maintain the regulator's loop stability.
The TK637xxB/H/S provides stable operation without input capacitor and output capacitor.
Refer to the following data that measured without external capacitor.
The other electrical characteristics are equal to using external capacitor.
Transient characteristics (influence of load deviation) improve by using output capacitor (see the "Load Transient" on page 28).
Because a situation changes with each application, please confirm to operation in your design.

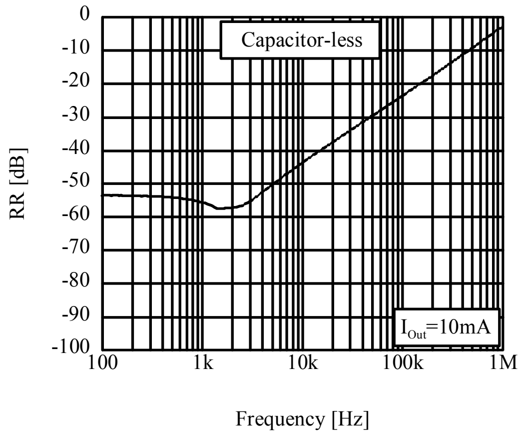
■ RR vs Frequency (TK63715B/H/S)



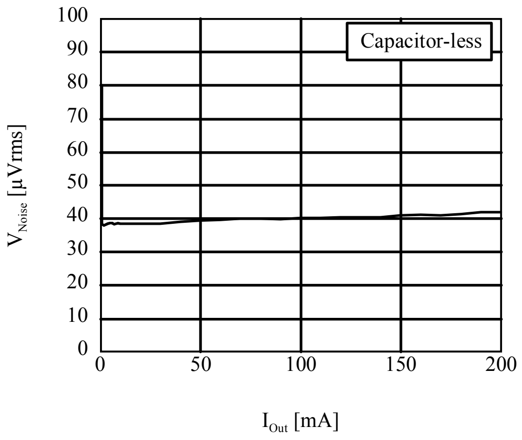
■ RR vs Frequency (TK63728B/H/S)



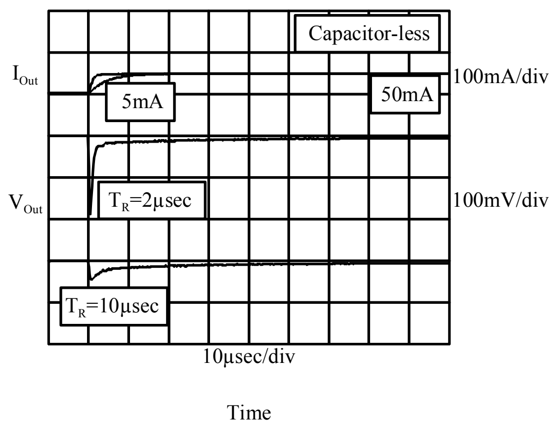
■ RR vs Frequency (TK63742B/H/S)



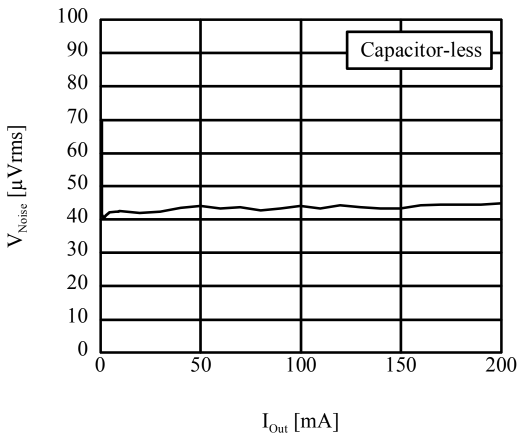
■ V_{Noise} vs I_{Out} (TK63715B/H/S)



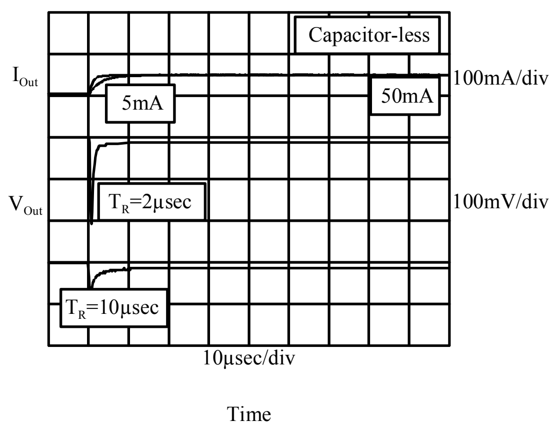
Load Transient (I_{Out}=5→50mA) (TK63715B/H/S)



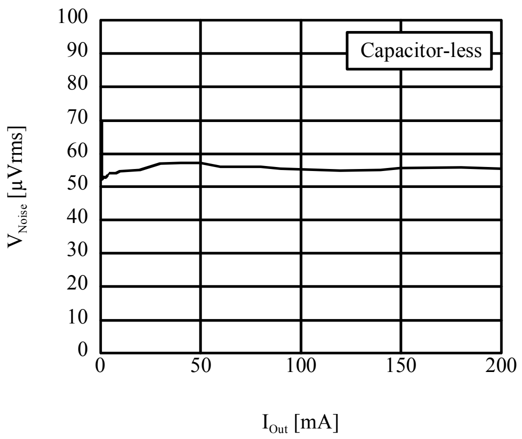
■ V_{Noise} vs I_{Out} (TK63728B/H/S)



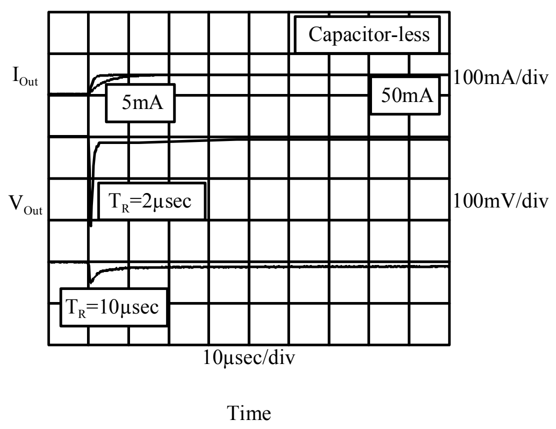
Load Transient (I_{Out}=5→50mA) (TK63728B/H/S)



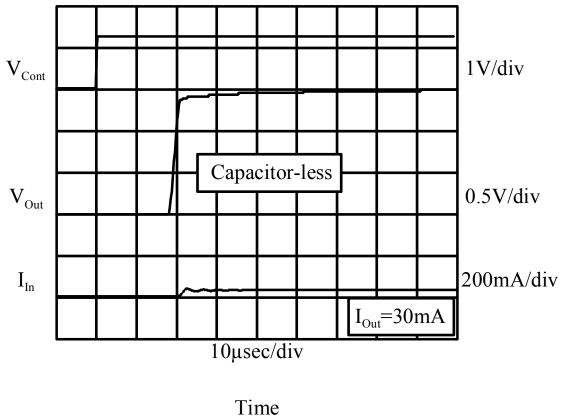
■ V_{Noise} vs I_{Out} (TK63742B/H/S)



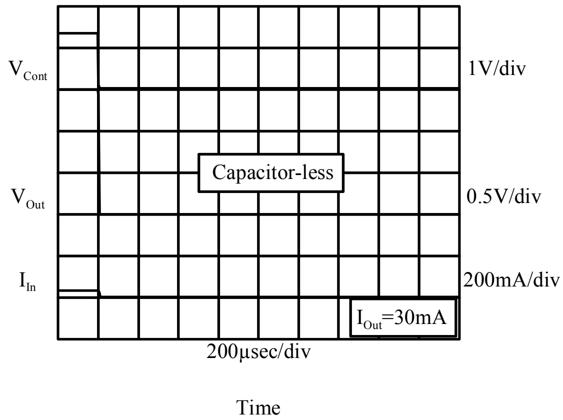
Load Transient (I_{Out}=5→50mA) (TK63742B/H/S)



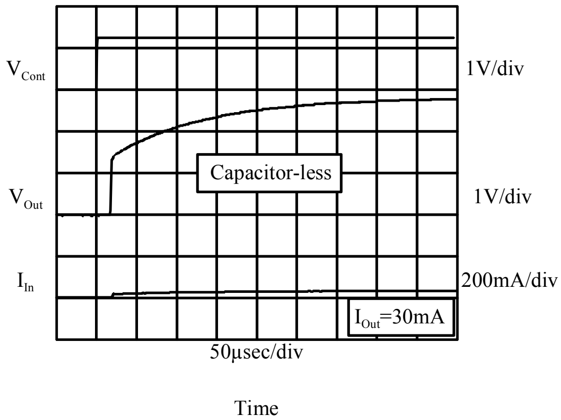
■ On/Off Transient (V_{Cont}=0→1.2V) (TK63715B/H/S)



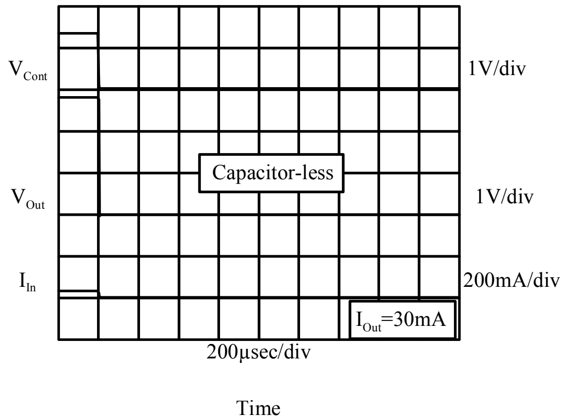
■ On/Off Transient (V_{Cont}=1.2→0V) (TK63715B/H/S)



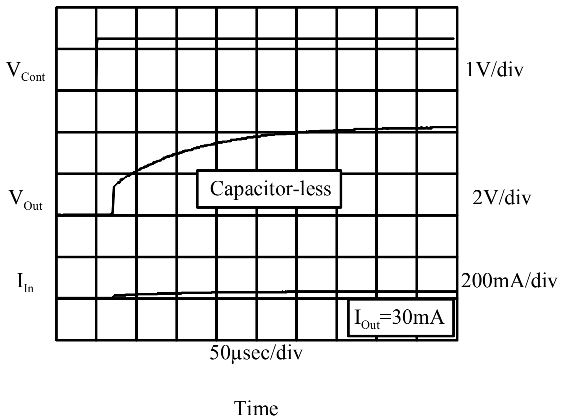
■ On/Off Transient (V_{Cont}=0→1.2V) (TK63728B/H/S)



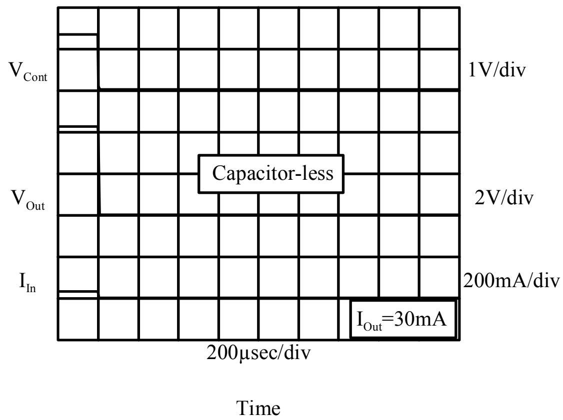
■ On/Off Transient (V_{Cont}=1.2→0V) (TK63728B/H/S)



■ On/Off Transient (V_{Cont}=0→1.2V) (TK63742B/H/S)

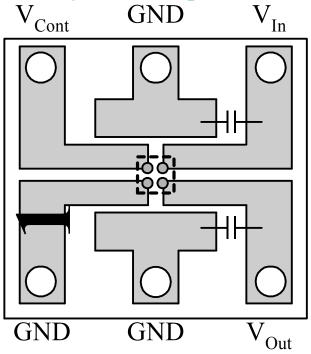


■ On/Off Transient (V_{Cont}=1.2→0V) (TK63742B/H/S)



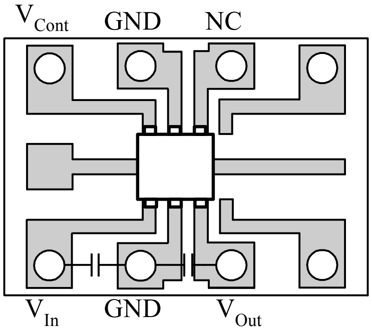
12-2. Layout

Fig12-1: Layout example (TK637xxB)



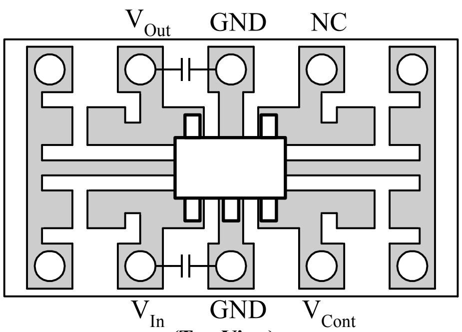
PCB Material : Glass epoxy
Size : 7mm×8mm×0.8mm

Fig12-2: Layout example (TK637xxH)



PCB Material : Glass epoxy
Size : 10mm×7mm×0.8mm

Fig12-3: Layout example (TK637xxS)



PCB Material : Glass epoxy
Size : 12mm×7mm×0.8mm

Please do derating with 2.9mW/°C at Pd=360mW (TK637xxB), or with 4mW/°C at Pd=500mW (TK637xxH/S), and 25°C or more. Thermal resistance (θ_{ja}) is=250°C/W.

Fig12-4: Derating Curve (TK637xxB)

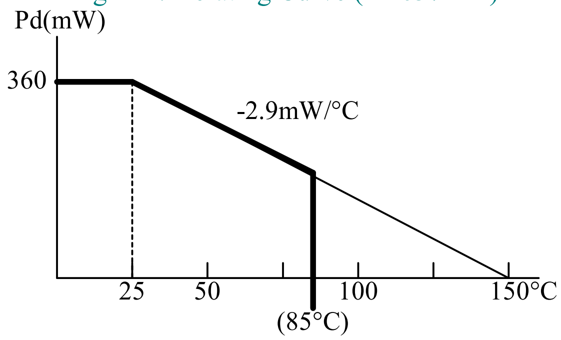
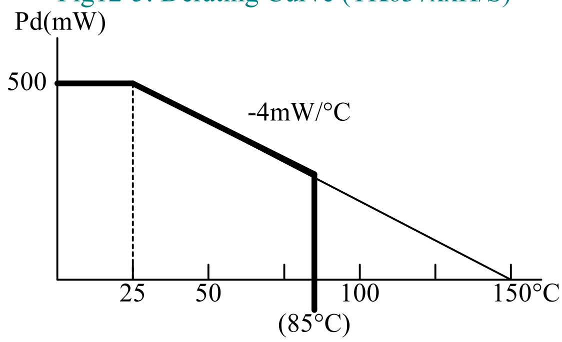


Fig12-5: Derating Curve (TK637xxH/S)



The package loss is limited at the temperature that the internal temperature sensor works (about 150°C). Therefore, the package loss is assumed to be an internal limitation. There is no heat radiation characteristic of the package unit assumed because of its small size. Heat is carried away from the device by being mounted on the PCB. This value is directly effected by the material and the copper pattern etc. of the PCB. The losses are approximately 360mW (TK637xxB), or 500mW (TK637xxH/S). Enduring these losses becomes possible in a lot of applications operating at 25°C.

The overheating protection circuit operates when the junction temperature reaches 150°C (this happens when the regulator is dissipating excessive power, outside temperature is high, or heat radiation is bad). The output current and the output voltage will drop when the protection circuit operates. However, operation begins again as soon as the output voltage drops and the temperature of the chip decreases.

How to determine the thermal resistance when mounted on PCB

The thermal resistance when mounted is expressed as follows:

$$T_j=\theta_{ja}\times Pd+T_a$$

T_j of IC is set around 150°C. Pd is the value when the thermal sensor is activated.

If the ambient temperature is 25°C, then:

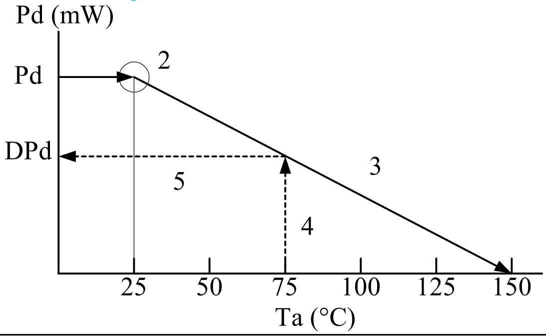
$$150=\theta_{ja}\times Pd+25$$

$$\theta_{ja}=125/Pd\ (°C\ /mW)$$

Pd is easily calculated.

A simple way to determine Pd is to calculate $V_{In} \times I_{In}$ when the output side is shorted. Input current gradually falls as output voltage rises after working thermal shutdown. You should use the value when thermal equilibrium is reached.

Fig12-6: How to determine DPd



Procedure (When mounted on PCB.)

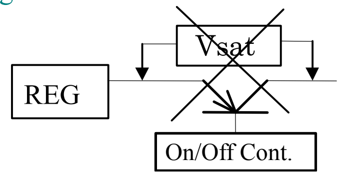
1. Find Pd ($V_{In} \times I_{In}$ when the output side is short-circuited).
2. Plot Pd against 25°C.
3. Connect Pd to the point corresponding to the 150°C with a straight line.
4. In design, take a vertical line from the maximum operating temperature (e.g., 75°C) to the derating curve.
5. Read off the value of Pd against the point at which the vertical line intersects the derating curve. This is taken as the maximum power dissipation DPd.
6. DPd ÷ ($V_{In,MAX} - V_{Out}$)=I_{Out} (at 75°C)

The maximum output current at the highest operating temperature will be $I_{Out} \cong$ DPd ÷ ($V_{In,MAX} - V_{Out}$).
Please use the device at low temperature with better radiation. The lower temperature provides better quality.

12-3. On/Off Control

It is recommended to turn the regulator Off when the circuit following the regulator is not operating. A design with little electric power loss can be implemented. We recommend the use of the On/Off control of the regulator without using a high side switch to provide an output from the regulator. A highly accurate output voltage with low voltage drop is obtained.
Because the control current is small, it is possible to control it directly by CMOS logic.

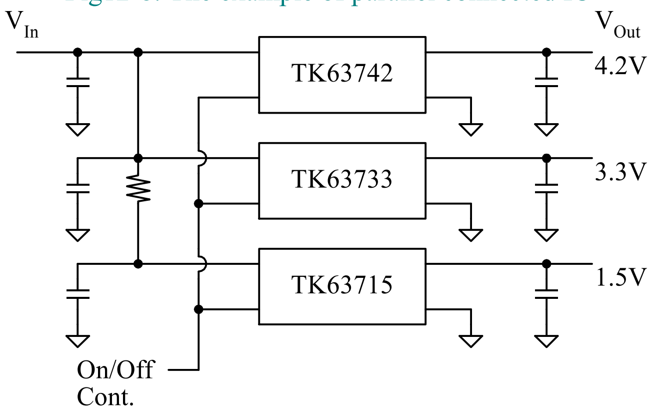
Fig12-7: The use of On/Off control



Control Terminal Voltage ((V_{Cont})	On/Off State
$V_{Cont} > 1.2V$	On
$V_{Cont} < 0.2V$	Off

Parallel Connected On/Off Control

Fig12-8: The example of parallel connected IC



The above figure is multiple regulators being controlled by a single On/Off control signal. There is concern of overheating, because the power loss of the low voltage side IC (TK63715B/H/S) is large. The series resistor (R) is put in the input line of the low output voltage regulator in order to prevent over-dissipation. The voltage dropped across the resistor reduces the large input-to-output voltage across the regulator, reducing the power dissipation in the device. When the thermal sensor works, a decrease of the output voltage, oscillation, etc. may be observed.

12-4. Influence by Light(TK637xxB)

When TK637xxB (FC-4) is exposed to strong light, the electrical characteristics change. Please confirm the influence by light in your design.

12-5. Definition of term

Characteristics

♦ Output Voltage (V_{Out})
The output voltage is specified with V_{In}=(V_{OutTYP}+1V) and I_{Out}=5mA.

♦ Maximum Output Current ($I_{Out, MAX}$)
The rated output current is specified under the condition where the output voltage drops 0.9V times the value specified with I_{Out}=5mA. The input voltage is set to V_{OutTYP}+1V and the current is pulsed to minimize temperature effect.

♦ Dropout Voltage (V_{Drop})
The dropout voltage is the difference between the input voltage and the output voltage at which point the regulator starts to fall out of regulation. Below this value, the output voltage will fall as the input voltage is reduced. It is dependent upon the output voltage, the load current, and the junction temperature.

♦ Line Regulation (LinReg)
Line regulation is the ability of the regulator to maintain a constant output voltage as the input voltage changes. The line regulation is specified as the input voltage is changed from V_{In}=$V_{Out,TYP}$+1V to V_{In}=6V. It is a pulse measurement to minimize temperature effect.

♦ Load Regulation (LoaReg)
Load regulation is the ability of the regulator to maintain a constant output voltage as the load current changes. It is a pulsed measurement to minimize temperature effects with the input voltage set to V_{In}=$V_{Out,TYP}$+1V. The load regulation is specified under an output current step condition of 1mA to 50mA.

♦ Ripple Rejection (RR)
Ripple rejection is the ability of the regulator to attenuate the ripple content of the input voltage at the output. It is specified with 500mV_{P-P}, 1kHz super-imposed on the input voltage, where V_{In}=$V_{Out,TYP}$+1.5V. Ripple rejection is the ratio of the ripple content of the output vs. input and is expressed in dB.

♦Standby Current ($I_{Standby}$)
Standby current is the current which flows into the regulator when the output is turned off by the control function (V_{Cont}=0V).

Protections

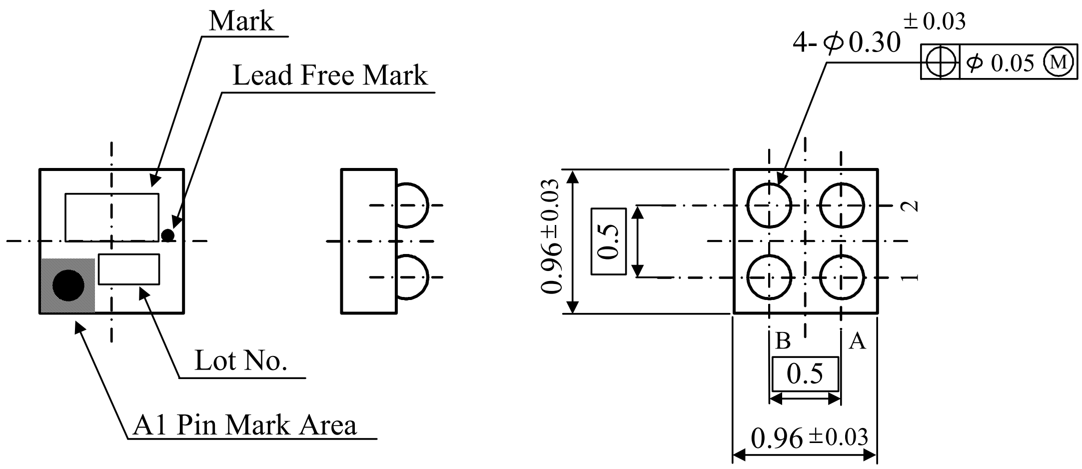
♦ Over Current Sensor
The over current sensor protects the device when there is excessive output current. It also protects the device if the output is accidentally connected to ground.

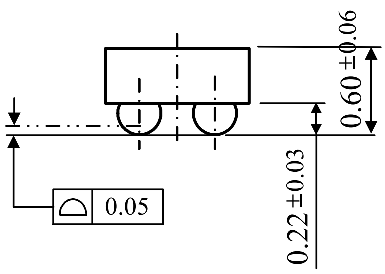
♦ Thermal Sensor
The thermal sensor protects the device in case the junction temperature exceeds the safe value (T_j=150°C). This temperature rise can be caused by external heat, excessive power dissipation caused by large input to output voltage drops, or excessive output current. The regulator will shut off when the temperature exceeds the safe value. As the junction temperatures decrease, the regulator will begin to operate again. Under sustained fault conditions, the regulator output will oscillate as the device turns off then resets. Damage may occur to the device under extreme fault.
Please prevent the loss of the regulator when this protection operates, by reducing the input voltage or providing better heat efficiency.

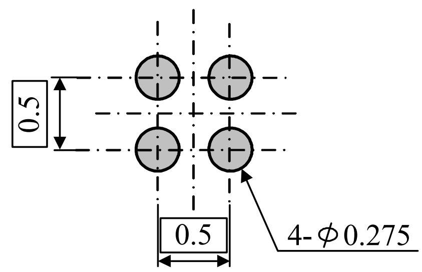
♦ ESD
MM : 200pF 0Ω 150V or more
HBM : 100pF 1.5kΩ 2000V or more

13. PACKAGE OUTLINE

■ 4-bump flip chip : FC-4







Reference Mount Pad

Unit : mm

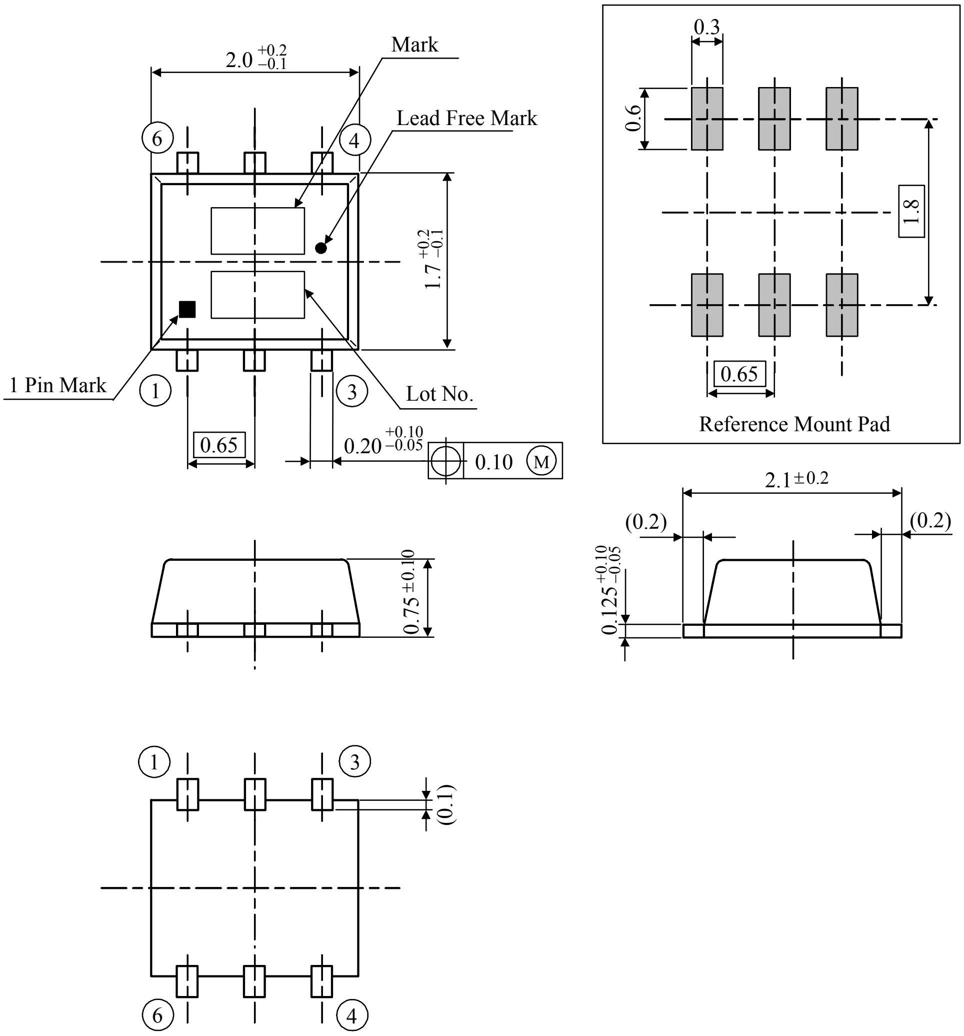
Package Structure and Others

Base Material	: Si	Mark Method	: Laser
Terminal Material	: Lead Free Solder Bump	Country of Origin	: Japan
Solder Composition	: Sn-2.5Ag	Mass	: 0.0012g

Marking

Part Number	Marking Code	Part Number	Marking Code	Part Number	Marking Code
TK63702B	D02	TK63728B	D28	TK63733B	D33
TK63715B	D15	TK63701B	D01	TK63735B	D35
TK63718B	D18	TK63729B	D29		
TK63725B	D25	TK63730B	D30		
TK63726B	D26	TK63731B	D31		
TK63727B	D27	TK63732B	D32		

■ 6-Lead-Small Outline Non-Leaded Package : SON2017-6



Unit : mm

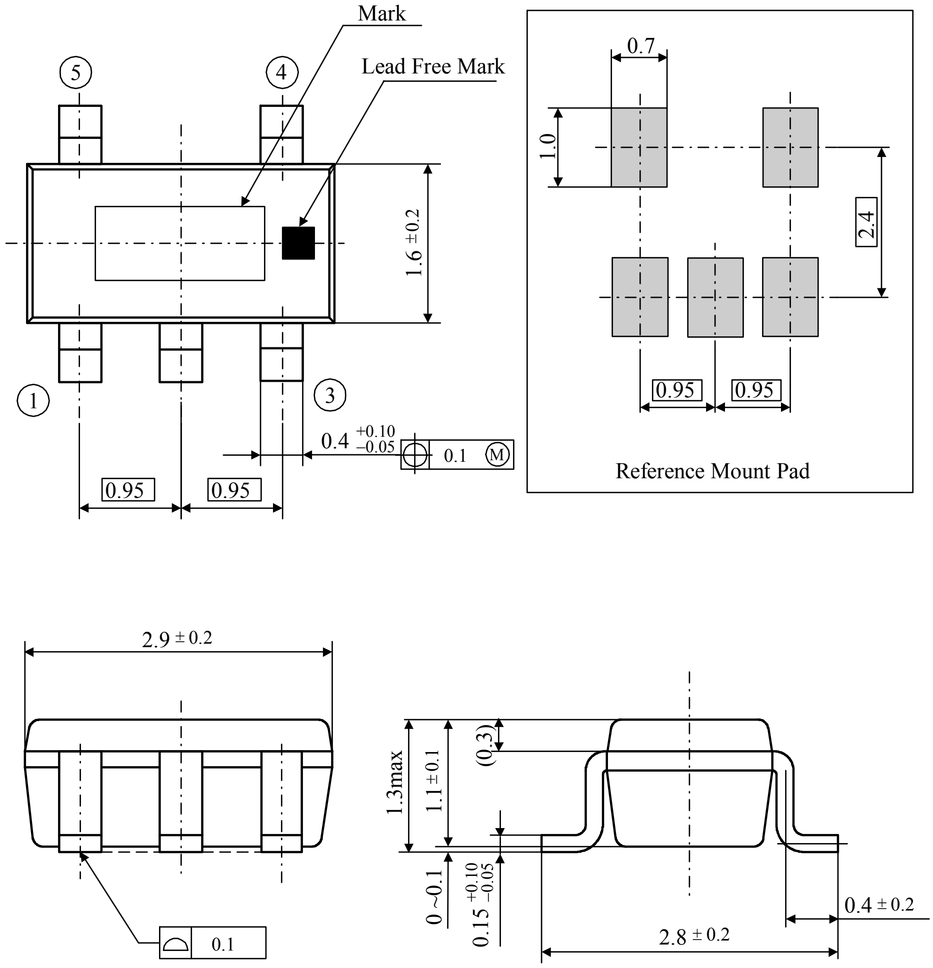
Package Structure and Others

Package Material	:	Epoxy Resin	Mark Method	:	Laser
Terminal Material	:	Copper Alloy	County of Origin	:	Japan
Terminal Finish	:	Lead Free Solder Plating(5~15µm)	Mass	:	0.0066g
Solder Composition	:	Sn-2.5Ag			

Marking

Part Number	Marking Code	Part Number	Marking Code	Part Number	Marking Code
TK63715H	D15	TK63701H	D01	TK63735H	D35
TK63718H	D18	TK63729H	D29		
TK63725H	D25	TK63730H	D30		
TK63726H	D26	TK63731H	D31		
TK63727H	D27	TK63732H	D32		
TK63728H	D28	TK63733H	D33		

■ 5-Lead-Surface Mount Discrete Package: SOT23-5



Unit : mm

Package Structure and Others

Package Material : Epoxy Resin
Terminal Material : Copper Alloy
Terminal Finish : Lead Free Solder Plating(5~15µm)
Solder Composition : Sn-2.5Ag

Mark Method : Laser
Country of Origin : Japan
Mass : 0.016g

Marking

Part Number	Marking Code	Part Number	Marking Code	Part Number	Marking Code
TK63715S	D15	TK63701S	D01	TK63735S	D35
TK63718S	D18	TK63729S	D29		
TK63725S	D25	TK63730S	D30		
TK63726S	D26	TK63731S	D31		
TK63727S	D27	TK63732S	D32		
TK63728S	D28	TK63733S	D33		

14. NOTES

■ Please be sure that you carefully discuss your planned purchase with our office if you intend to use the products in this application manual under conditions where particularly extreme standards of reliability are required, or if you intend to use products for applications other than those listed in this application manual.

- Power drive products for automobile, ship or aircraft transport systems; steering and navigation systems, emergency signal communications systems, and any system other than those mentioned above which include electronic sensors, measuring, or display devices, and which could cause major damage to life, limb or property if misused or failure to function.
- Medical devices for measuring blood pressure, pulse, etc., treatment units such as coronary pacemakers and heat treatment units, and devices such as artificial organs and artificial limb systems which augment physiological functions.
- Electrical instruments, equipment or systems used in disaster or crime prevention.

■ Semiconductors, by nature, may fail or malfunction in spite of our devotion to improve product quality and reliability. We urge you to take every possible precaution against physical injuries, fire or other damages which may cause failure of our semiconductor products by taking appropriate measures, including a reasonable safety margin, malfunction preventive practices and fire-proofing when designing your products.

■ This application manual is effective from Sep.2005. Note that the contents are subject to change or discontinuation without notice. When placing orders, please confirm specifications and delivery condition in writing.

■ TOKO is not responsible for any problems nor for any infringement of third party patents or any other intellectual property rights that may arise from the use or method of use of the products listed in this application manual. Moreover, this application manual does not signify that TOKO agrees implicitly or explicitly to license any patent rights or other intellectual property rights which it holds.

■ None of the ozone depleting substances(ODS) under the Montreal Protocol are used in our manufacturing process.

15. OFFICES

If you need more information on this product and other TOKO products, please contact us.

■ TOKO Inc. Headquarters
1-17, Higashi-yukigaya 2-chome, Ohta-ku, Tokyo, 145-8585, Japan
TEL: +81.3.3727.1161
FAX: +81.3.3727.1176 or +81.3.3727.1169
Web site: http://www.toko.co.jp/

■ TOKO America
Web site: http://www.toko.com/

■ TOKO Europe
Web site: http://www.tokoeurope.com/

■ TOKO Hong Kong
Web site: http://www.toko.com.hk/

■ TOKO Taiwan
Web site: http://www.tokohc.com.tw/

■ TOKO Singapore
Web site: http://www.toko.com.sg/

■ TOKO Seoul
Web site: http://www.toko.co.kr/

■ TOKO Manila
Web site: http://www.toko.com.ph/

■ TOKO Brazil
Web site: http://www.toko.com.br/

TOKO

Semiconductor Division

YOUR DISTRIBUTOR