APPLICATION MANUAL

Auto Discharge Function, Ultra Small Package,
High RR, Fast Response, Low Noise, 300mA
CMOS LDO Regulator IC TK648xxAMF

CONTENTS

Auto Discharge Function, Ultra Small Package, High RR, Fast Response, Low Noise, 300mA CMOS LDO Regulator IC TK648xxAMF

1. DESCRIPTION

The TK648xxAMF is a CMOS LDO regulator with auto discharge function. The package is the very small and thin HSON1214-4.
The IC is designed for portable applications with space requirements.
The IC can supply 300mA output current.
The IC does not require a noise-bypass capacitor.
The output voltage is internally fixed from 1.2V to 4.2V.

2. FEATURES

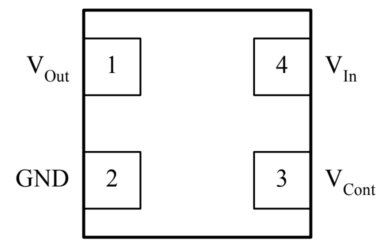
- Auto discharge function
- Package: HSON1214-4
- No noise bypass capacitor required
- High ripple rejection
- Fast transient response
- Low noise
- Thermal and over current protection
- High maximum load current
- On/Off control
- High accuracy

3. APPLICATIONS

- Mobile communication
- Battery powered system
- Any electronic equipment

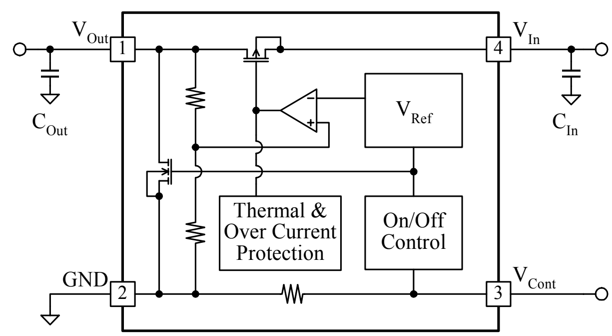
4. PIN CONFIGURATION

- HSON1214-4

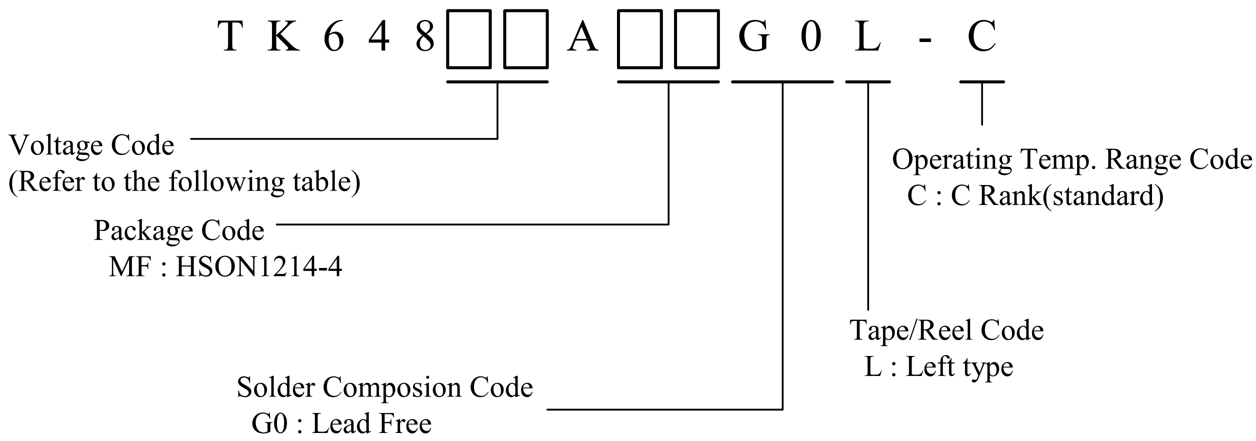


(Top View)

5. BLOCK DIAGRAM



6. ORDERING INFORMATION



Output Voltage	Voltage Code	Output Voltage	Voltage Code	Output Voltage	Voltage Code
1.2V	12	2.8V	28	3.3V	33
1.5V	15	2.85V	01	3.5V	35
1.8V	18	2.9V	29	4.0V	40
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 ~ 6.0	V	
Output pin Voltage	$V_{Out,MAX}$	-0.3 ~ V_{In}+0.3	V	
Control pin Voltage	$V_{Cont,MAX}$	-0.3 ~ 6.0	V	
Storage Temperature Range	T_{stg}	-55 ~ 150	°C	
Power Dissipation	P_D	400	mW	When mounted on a PCB (7mm×8mm×0.8mm), Internal Limited T_j=150°C ***1**
		900	mW	When mounted on a PCB (30mm×30mm×1mm), Internal Limited T_j=150°C ***2**
Operating Condition				
Operational Temperature Range	T_{OP}	-40 ~ 85	°C	
Operational Voltage Range	V_{OP}	1.8 ~ 6.0	V	

*1: P_D must be decreased at the rate of 3.2mW/°C for operation above 25°C.
*2: P_D must be decreased at the rate of 7.2mW/°C for operation above 25°C.
The maximum ratings are the absolute limitation values with the possibility of the IC being damaged.
If the operation exceeds any of these standards, quality cannot 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 by 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	ΔV_{In}=1V
Load Regulation	LoaReg	**Refer to TABLE 2**			mV	I_{Out}=5mA ~ 100mA
		Refer to TABLE 2			mV	I_{Out}=5mA ~ 200mA
		Refer to TABLE 2			mV	I_{Out}=5mA ~ 300mA
Dropout Voltage ***1**	V_{Drop}	**Refer to TABLE 2**			mV	I_{Out}=100mA
		Refer to TABLE 2			mV	I_{Out}=200mA
		Refer to TABLE 2			mV	I_{Out}=300mA
Maximum Load Current ***2**	$I_{Out,MAX}$	310	500	-	mA	V_{Out}=$V_{Out,TYP}$×0.9
Quiescent Current	I_Q	-	35	70	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}	-	45	90	µA	I_{Out}=50mA, V_{Cont}=V_{In}
Discharge Resistance	R_{Dis}	-	25	-	Ω	V_{In}=5V, V_{Out}=0.1V, V_{Cont}=0V
Control Terminal						
Control Current	I_{Cont}	-	0.7	1.4	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 (TK64828A)	V_{Noise}	-	35	-	µVrms	C_{Out}=2.2µF, I_{Out}=30mA, BPF=400Hz~80kHz
Ripple Rejection (TK64828A)	RR	-	72	-	dB	C_{Out}=2.2µF, I_{Out}=10mA, f=1kHz
Rise Time (TK64828A)	t_r	-	90	-	µs	C_{Out}=2.2µF, I_{Out}=30mA V_{Cont}: Pulse Wave (100Hz), V_{Cont} On → V_{Out}×95% point

***1**: For V_{Out} ≤ 1.8V , no regulations.
***2**: The maximum output current is limited by power dissipation.
The maximum load current is the current where the output voltage decreases to 90% by increasing the output current at T_j=25°C, compared to the output voltage specified at V_{In}=$V_{Out,TYP}$+1V. The maximum load current indicates the current at which over current protection turns on.
For all output voltage products, the maximum output current for normal operation without operating any protection is 300mA. Accordingly, LoaReg and V_{Drop} are specified on the condition that I_{Out} is less than 300mA.

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

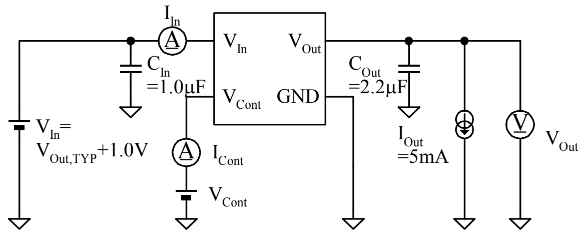
Part Number	Output Voltage		
	MIN	TYP	MAX
	V	V	V
TK64812AMF	1.175	1.200	1.225
TK64815AMF	1.475	1.500	1.525
TK64818AMF	1.775	1.800	1.825
TK64825AMF	2.475	2.500	2.525
TK64826AMF	2.574	2.600	2.626
TK64827AMF	2.673	2.700	2.727
TK64828AMF	2.772	2.800	2.828
TK64801AMF	2.821	2.850	2.879
TK64829AMF	2.871	2.900	2.929
TK64830AMF	2.970	3.000	3.030
TK64831AMF	3.069	3.100	3.131
TK64832AMF	3.168	3.200	3.232
TK64833AMF	3.267	3.300	3.333
TK64835AMF	3.465	3.500	3.535
TK64840AMF	3.960	4.000	4.040

TABLE 2. Preferred Product

Part Number	Load Regulation						Dropout Voltage					
	I_{Out}=5 ~ 100mA		I_{Out}=5 ~ 200mA		I_{Out}=5 ~ 300mA		I_{Out}=100mA		I_{Out}=200mA		I_{Out}=300mA	
	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX
	mV	mV	mV	mV	mV	mV	mV	mV	mV	mV	mV	mV
TK64812AMF	10	40	19	76	29	116	-	-	-	-	-	-
TK64815AMF	10	40	19	76	29	116	-	-	-	-	-	-
TK64818AMF	10	40	20	80	29	116	-	-	-	-	-	-
TK64825AMF	10	40	20	80	30	120	95	145	185	310	275	465
TK64826AMF	10	40	20	80	30	120	90	145	180	300	265	450
TK64827AMF	10	40	20	80	30	120	90	140	175	295	260	440
TK64828AMF	10	40	20	80	30	120	85	135	170	290	255	430
TK64801AMF	10	40	20	80	30	120	85	135	170	285	250	425
TK64829AMF	10	40	20	80	30	120	85	135	165	285	250	425
TK64830AMF	10	40	20	80	30	120	85	130	165	280	245	415
TK64831AMF	11	44	21	84	31	124	80	130	160	275	240	410
TK64832AMF	11	44	21	84	31	124	80	125	160	270	235	400
TK64833AMF	11	44	21	84	31	124	80	125	155	265	235	395
TK64835AMF	11	44	21	84	31	124	75	120	150	255	225	380
TK64840AMF	11	44	21	84	31	124	70	115	140	240	210	360

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

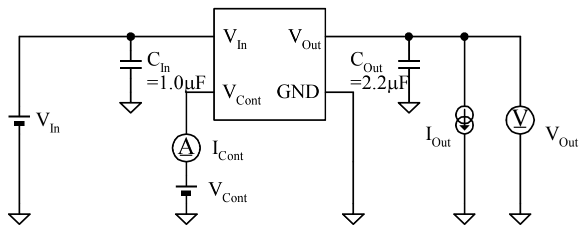
9. TEST CIRCUIT



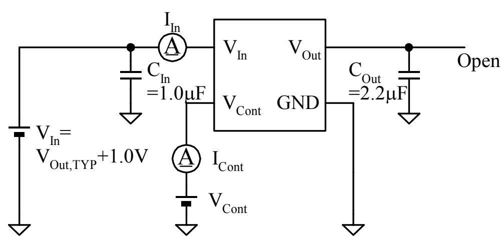
■ Test circuit for electrical characteristic

Notice.

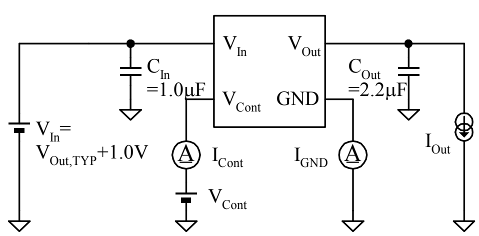
The limit value of electrical characteristics is applied when C_{In}=1.0µF(Ceramic), C_{Out}=2.2µF(Ceramic).
But C_{In}, and C_{Out} can be used with both ceramic and tantalum capacitors.



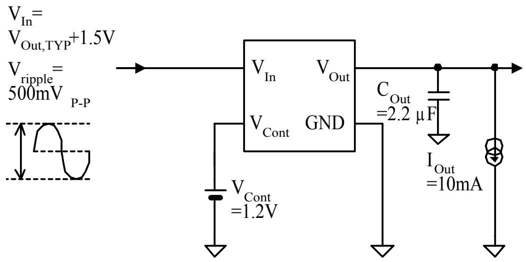
- ■ ΔV_{Out} vs V_{In}
- ■ V_{Drop} vs I_{Out}
- ■ V_{Out} vs I_{Out}
- ■ ΔV_{Out} vs I_{Out}
- ■ ΔV_{Out} vs T_a
- ■ V_{Drop} vs T_a
- ■ $I_{Out,MAX}$ vs T_a
- ■ I_{Cont} vs V_{Cont} , V_{Out} vs V_{Cont}
- ■ I_{Cont} vs T_a
- ■ V_{Cont} vs T_a
- ■ V_{Noise} vs V_{In}
- ■ V_{Noise} vs I_{Out}
- ■ V_{Noise}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



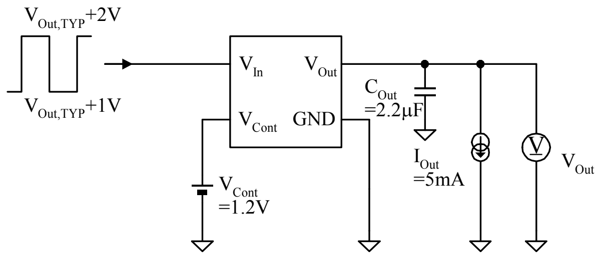
- ■ I_Q vs V_{In}
- ■ $I_{Standby}$ vs V_{In}
- ■ I_Q vs T_a



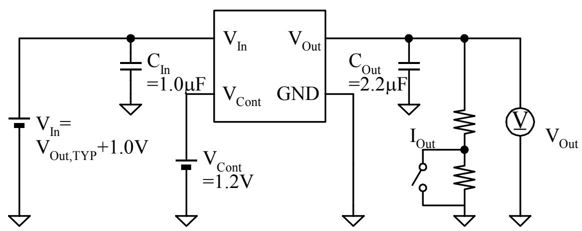
- ■ I_{GND} vs I_{Out}
- ■ I_{GND} vs T_a



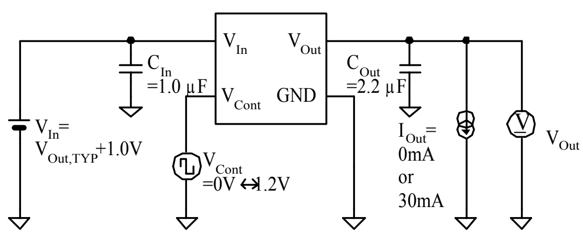
■ RR vs V_{In}
■ RR vs Frequency
■ RR vs Frequency



■ Line Transient



■ Load Transient

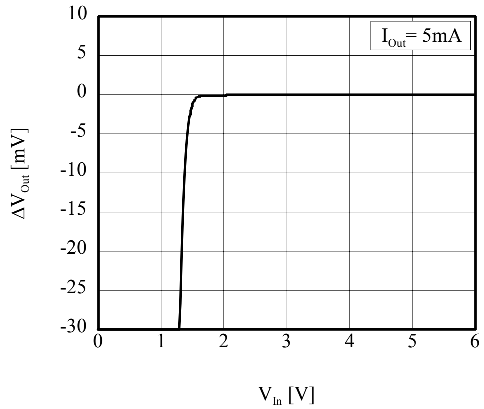


■ On/Off Transient

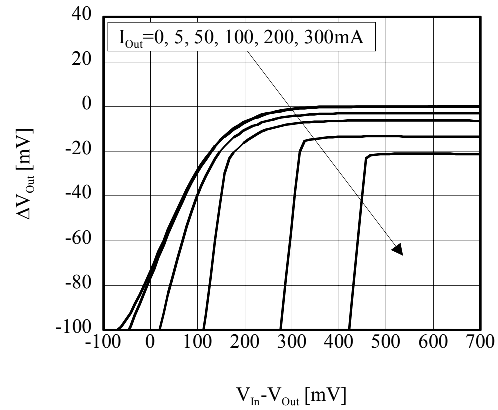
10. TYPICAL CHARACTERISTICS

10-1. DC CHARACTERISTICS

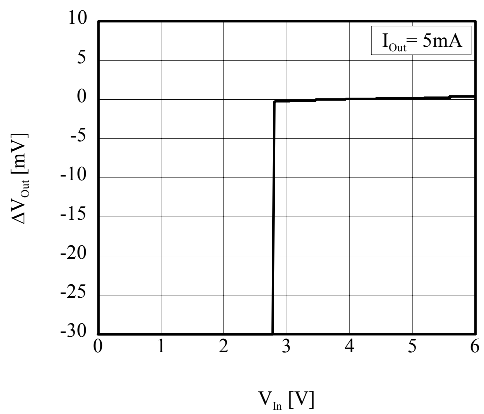
■ ΔV_{Out} vs V_{In} (TK64812AMF)



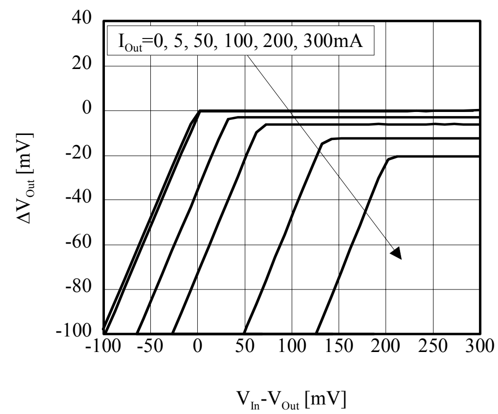
■ ΔV_{Out} vs V_{In} (TK64812AMF)



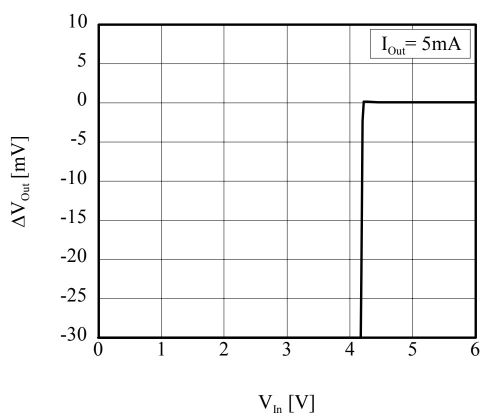
■ ΔV_{Out} vs V_{In} (TK64828AMF)



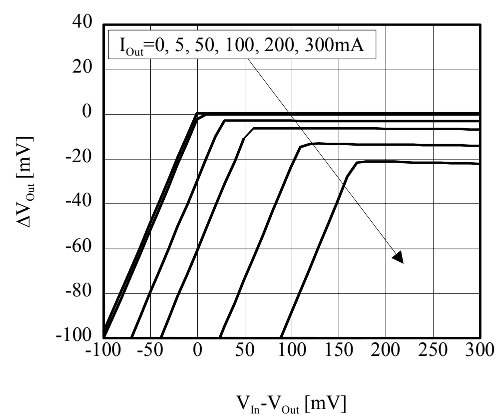
■ ΔV_{Out} vs V_{In} (TK64828AMF)



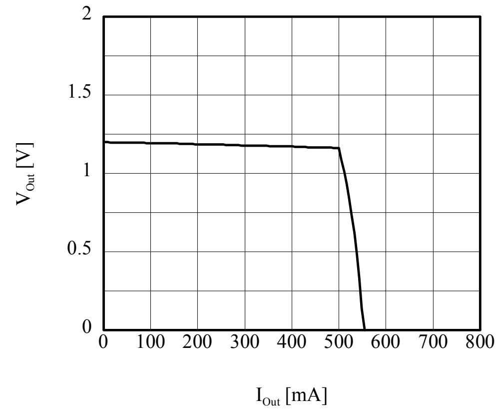
■ ΔV_{Out} vs V_{In} (TK64842AMF)



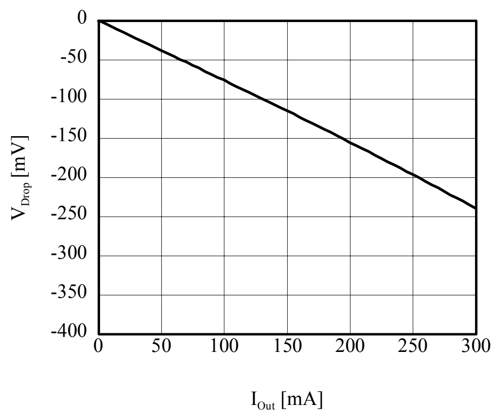
■ ΔV_{Out} vs V_{In} (TK64842AMF)



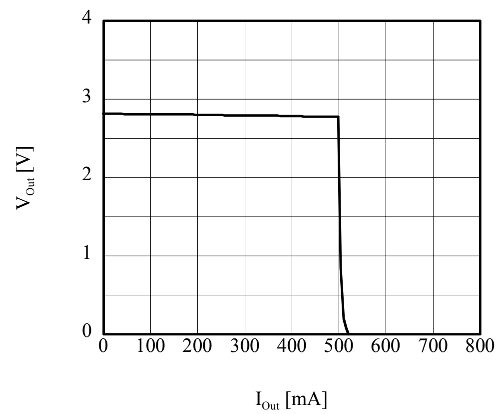
■ V_{Out} vs I_{Out} (TK64812AMF)



■ V_{Drop} vs I_{Out} (TK64828AMF)



■ V_{Out} vs I_{Out} (TK64828AMF)



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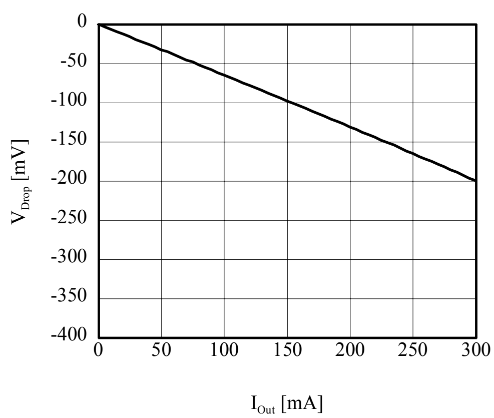
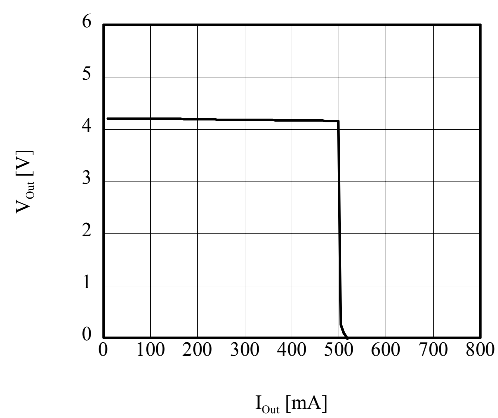
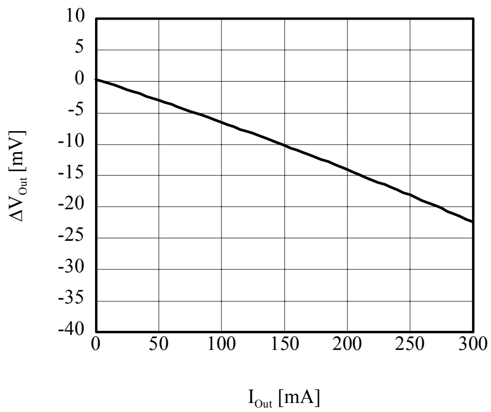


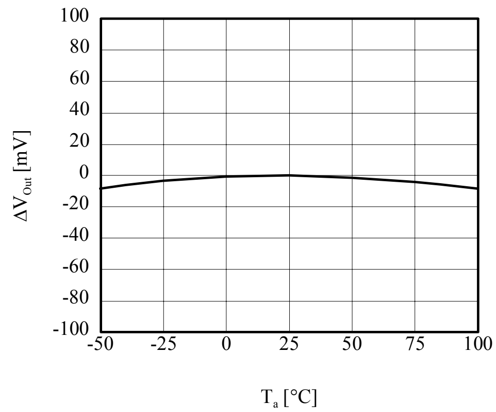
■ V_{Out} vs I_{Out} (TK64842AMF)



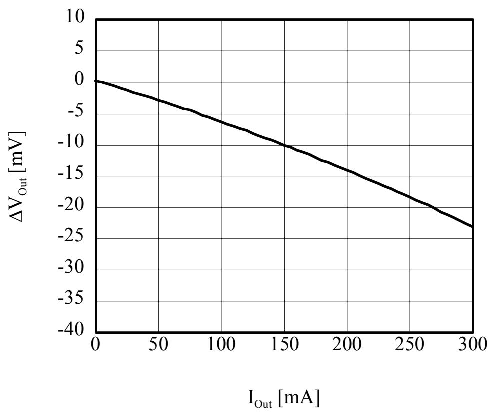
■ ΔV_{Out} vs I_{Out} (TK64812AMF)



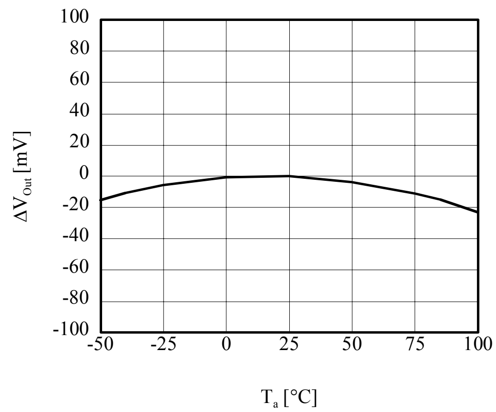
■ ΔV_{Out} vs T_a (TK64812AMF)



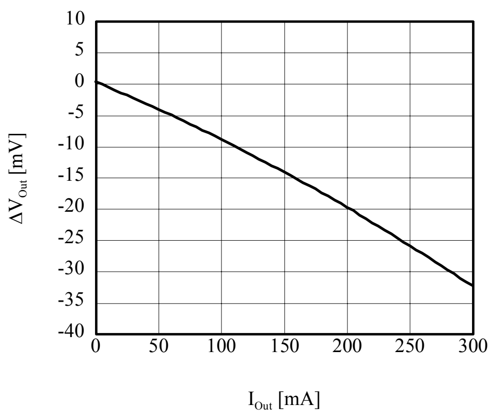
■ ΔV_{Out} vs I_{Out} (TK64828AMF)



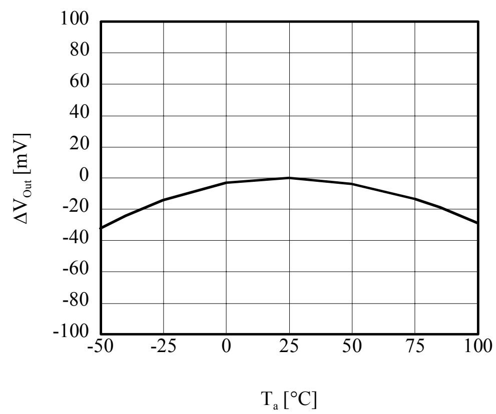
■ ΔV_{Out} vs T_a (TK64828AMF)



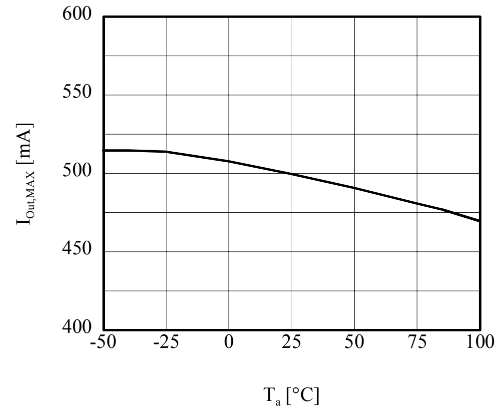
■ ΔV_{Out} vs I_{Out} (TK64842AMF)



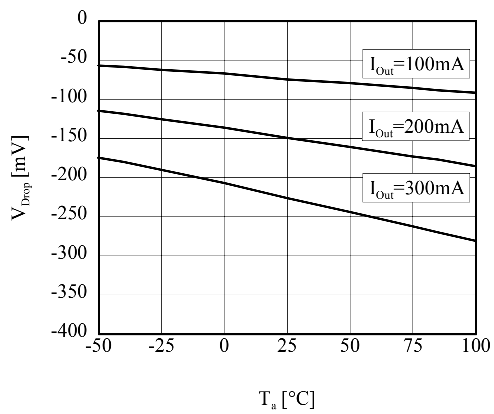
■ ΔV_{Out} vs T_a (TK64842AMF)



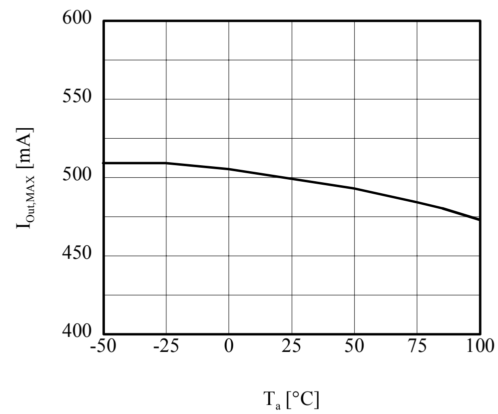
■ $I_{Out,MAX}$ vs T_a (TK64812AMF)



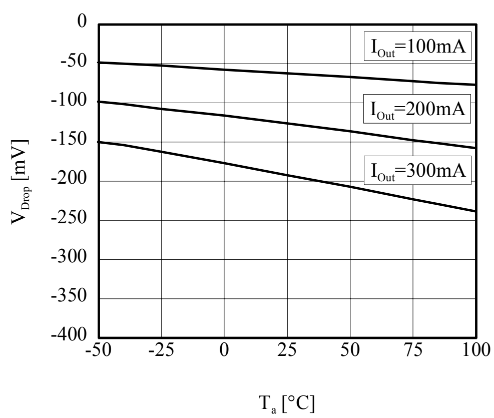
■ V_{Drop} vs T_a (TK64828AMF)



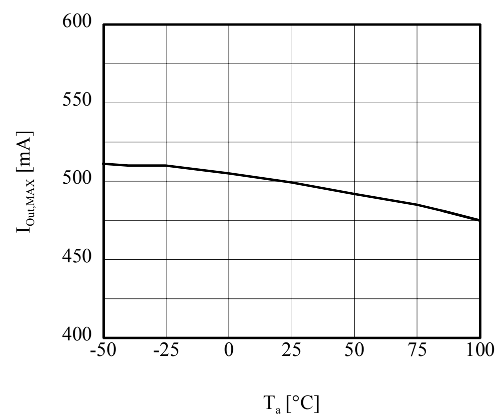
■ $I_{Out,MAX}$ vs T_a (TK64828AMF)



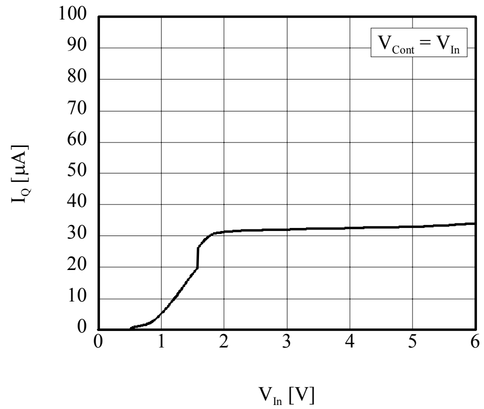
■ V_{Drop} vs T_a (TK64842AMF)



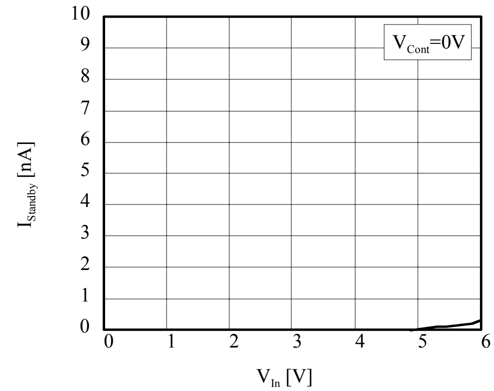
■ $I_{Out,MAX}$ vs T_a (TK64842AMF)



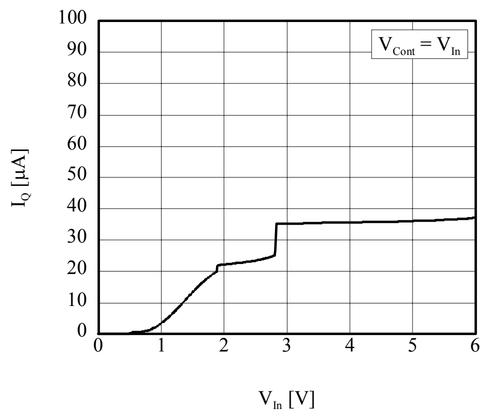
■ I_Q vs V_{In} (TK64812AMF)



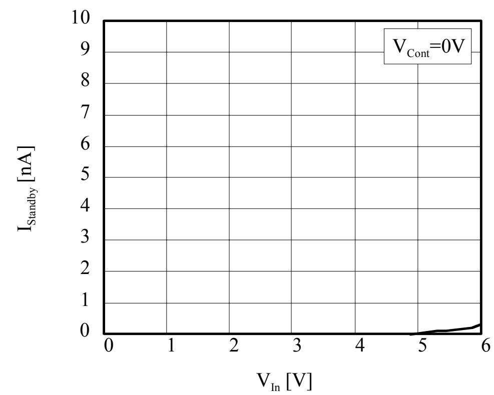
■ $I_{Standby}$ vs V_{In} (TK64812AMF)



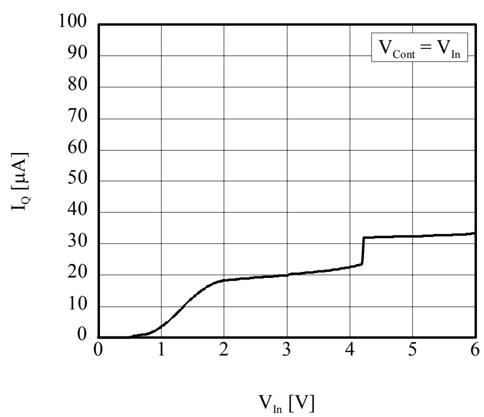
■ I_Q vs V_{In} (TK64828AMF)



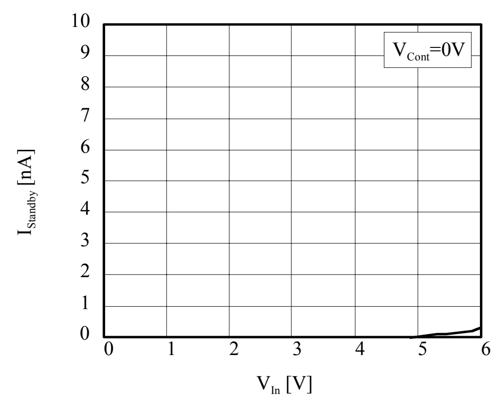
■ $I_{Standby}$ vs V_{In} (TK64828AMF)



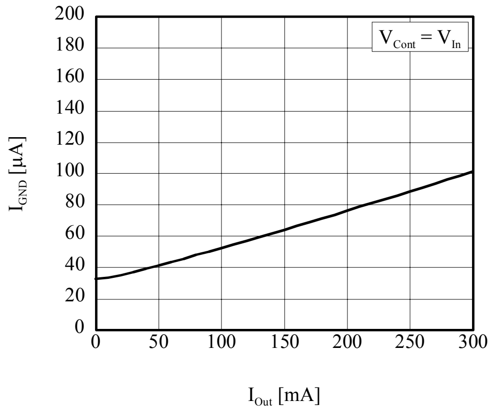
■ I_Q vs V_{In} (TK64842AMF)



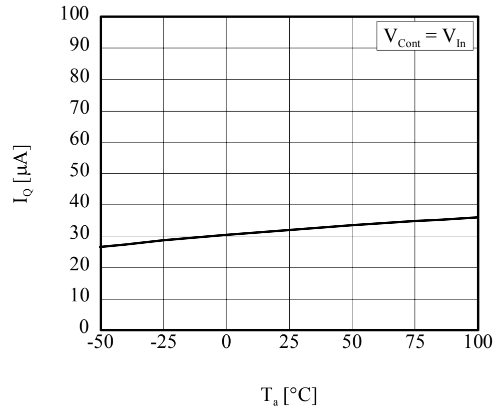
■ $I_{Standby}$ vs V_{In} (TK64842AMF)



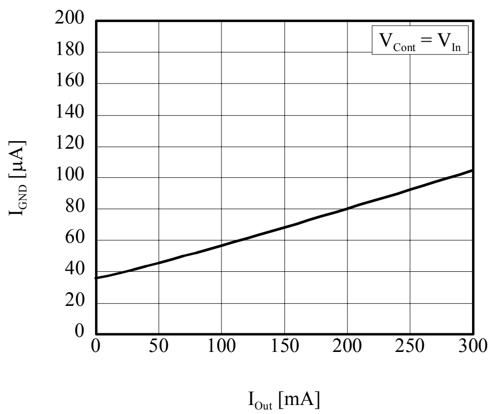
■ I_{GND} vs I_{Out} (TK64812AMF)



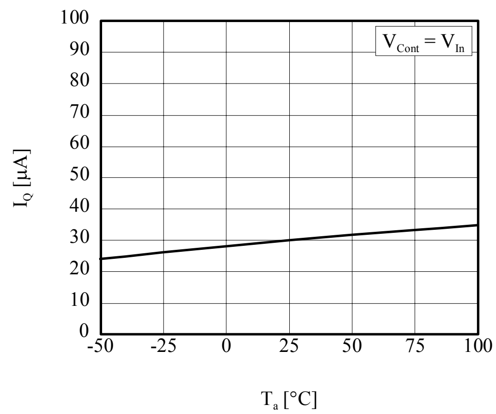
■ I_Q vs T_a (TK64812AMF)



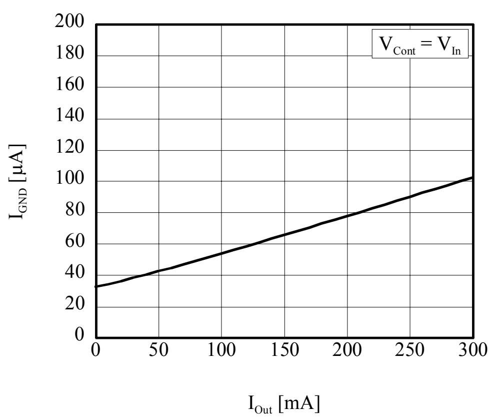
■ I_{GND} vs I_{Out} (TK64828AMF)



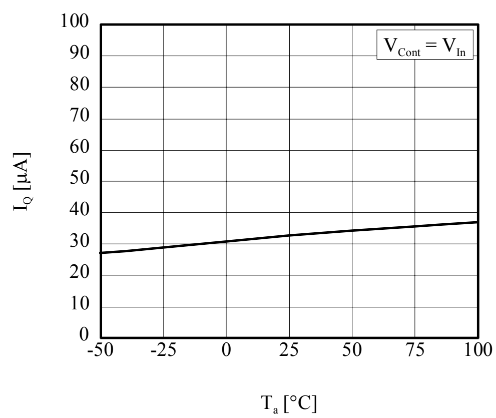
■ I_Q vs T_a (TK64828AMF)



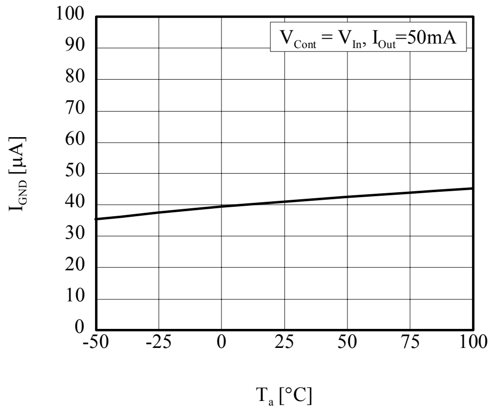
■ I_{GND} vs I_{Out} (TK64842AMF)



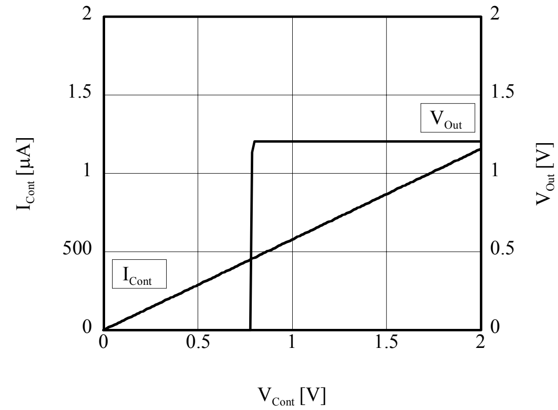
■ I_Q vs T_a (TK64842AMF)



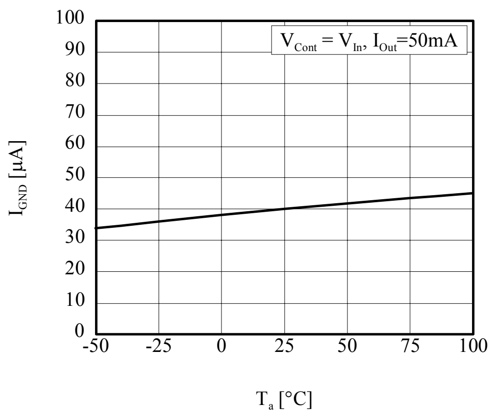
■ I_{GND} vs T_a (TK64812AMF)



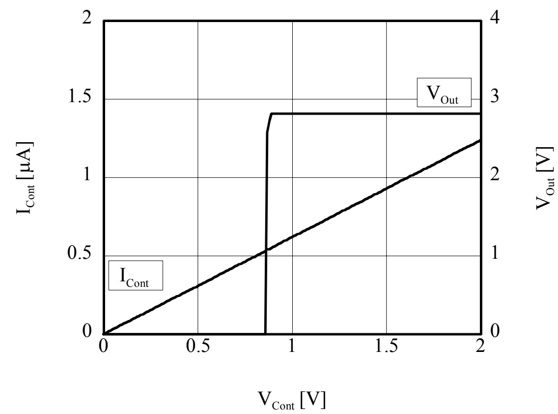
■ I_{Cont} vs V_{Cont}, V_{Out} vs V_{Cont} (TK64812AMF)



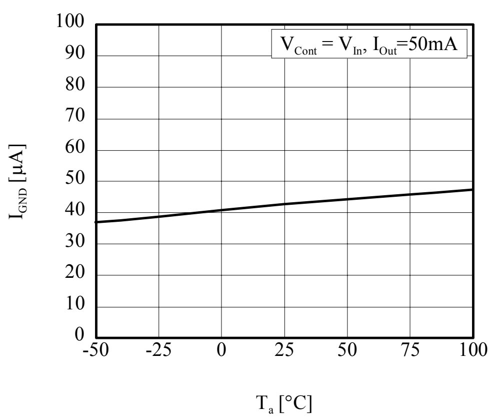
■ I_{GND} vs T_a (TK64828AMF)



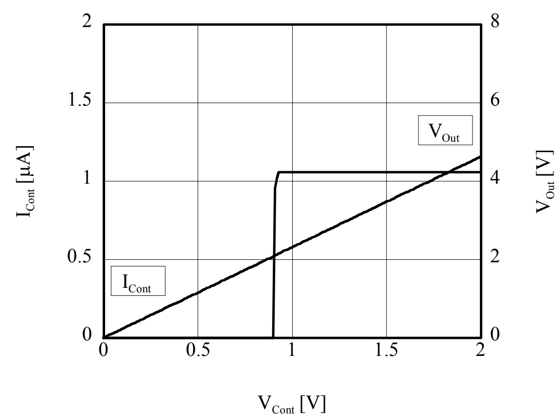
■ I_{Cont} vs V_{Cont}, V_{Out} vs V_{Cont} (TK64828AMF)



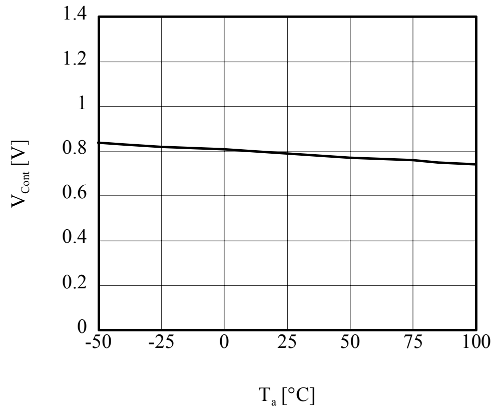
■ I_{GND} vs T_a (TK64842AMF)



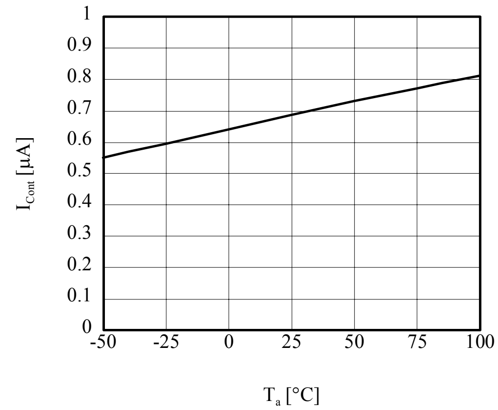
■ I_{Cont} vs V_{Cont}, V_{Out} vs V_{Cont} (TK64842AMF)



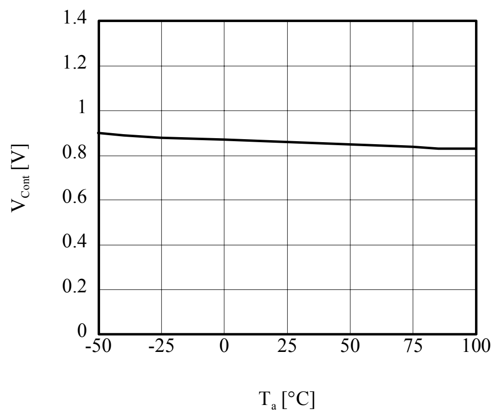
■ V_{Cont} vs T_a (TK64812AMF)



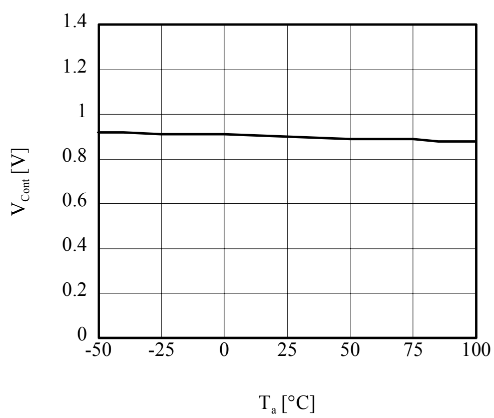
■ I_{Cont} vs T_a (TK648xxAMF)



■ V_{Cont} vs T_a (TK64828AMF)

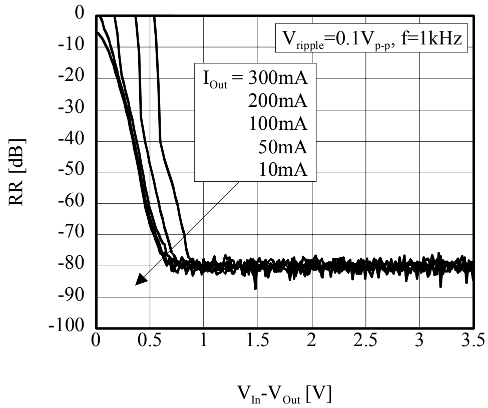


■ V_{Cont} vs T_a (TK64842AMF)

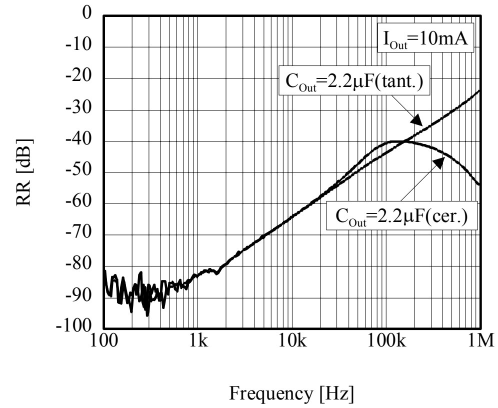


10-2. AC CHARACTERISTICS

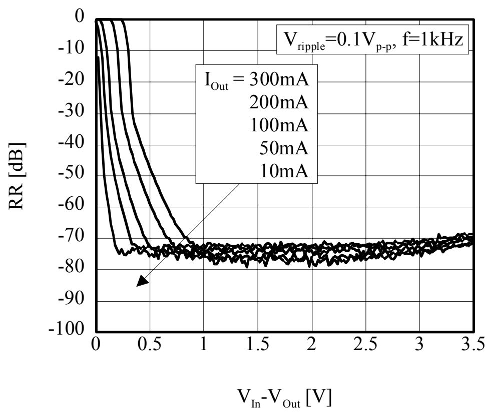
■ RR vs V_{In} (TK64812AMF)



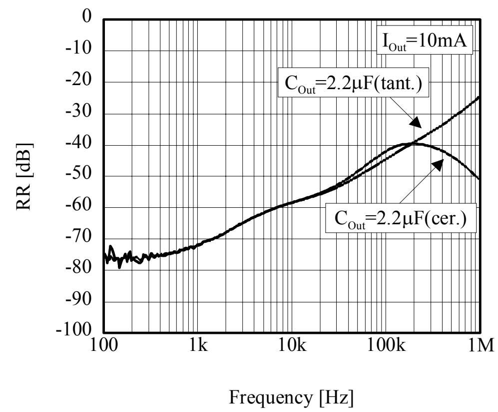
■ RR vs Frequency (TK64812AMF)



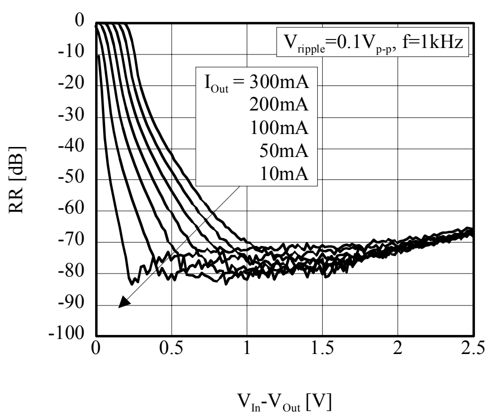
■ RR vs V_{In} (TK64828AMF)



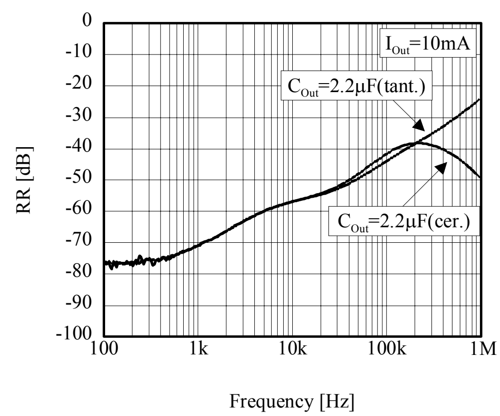
■ RR vs Frequency (TK64828AMF)



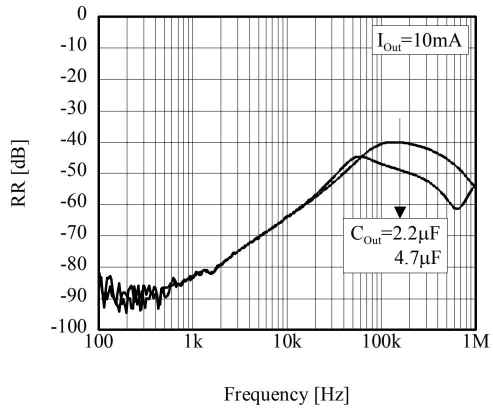
■ RR vs V_{In} (TK64842AMF)



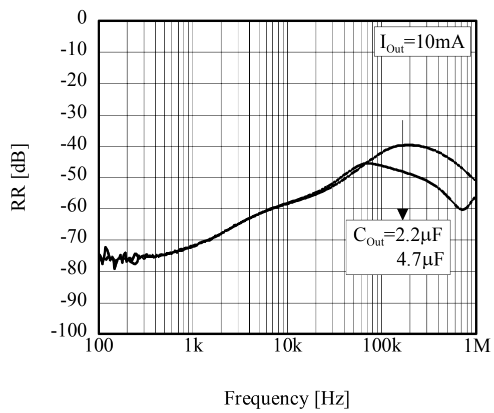
■ RR vs Frequency (TK64842AMF)



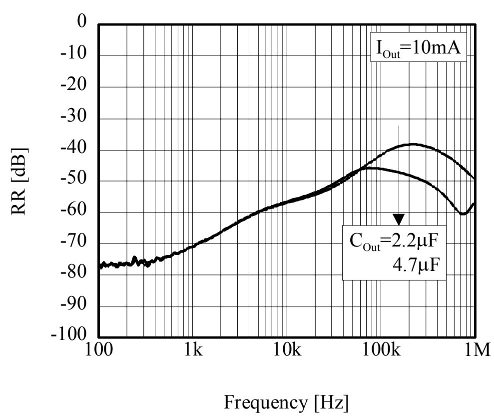
■ RR vs Frequency (TK64812AMF)



■ RR vs Frequency (TK64828AMF)

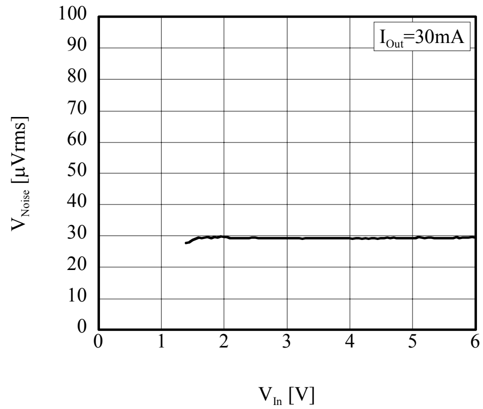


■ RR vs Frequency (TK64842AMF)

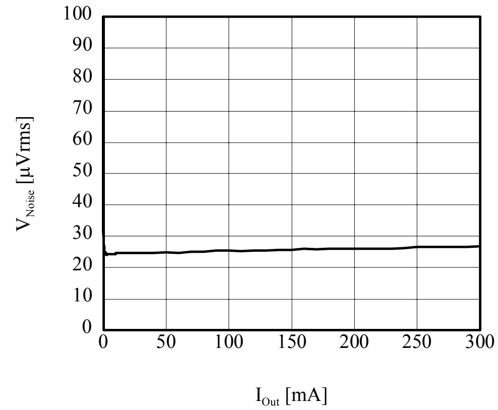


The ripple rejection (RR) characteristic depends on the characteristic and the capacitance value of the capacitor connected to the output side. The RR characteristic of 50kHz or more varies greatly with the capacitor on the output side and PCB pattern. If necessary, please confirm stability of your design.

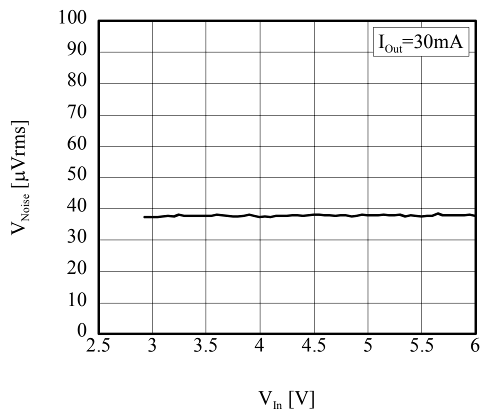
■ V_{Noise} vs V_{In} (TK64812AMF)



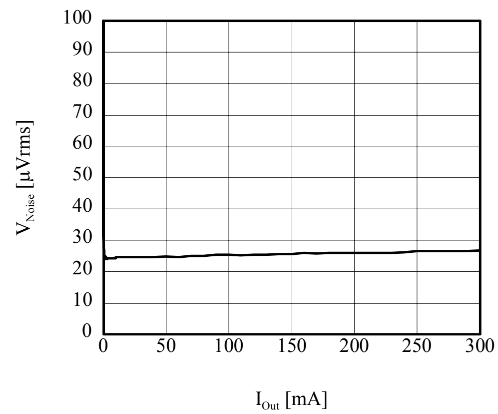
■ V_{Noise} vs I_{Out} (TK64812AMF)



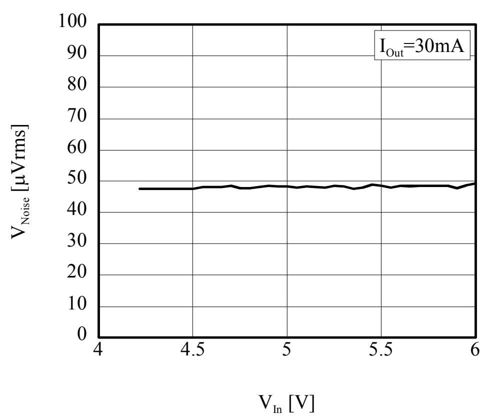
■ V_{Noise} vs V_{In} (TK64828AMF)



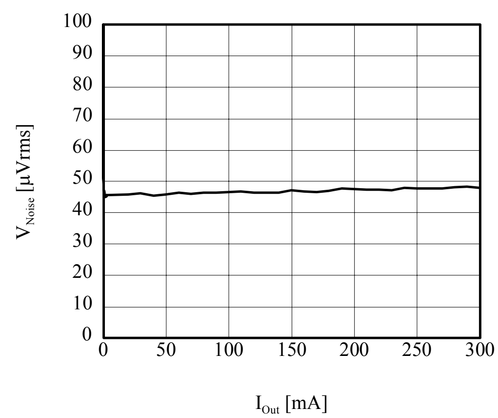
■ V_{Noise} vs I_{Out} (TK64828AMF)



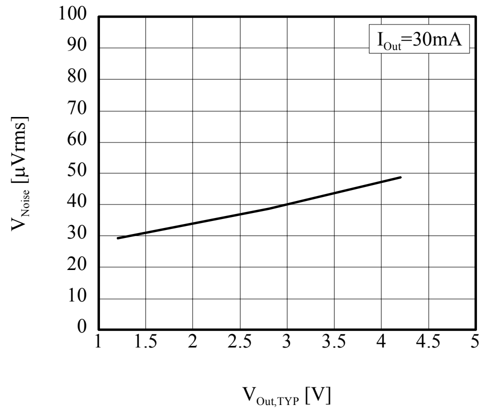
■ V_{Noise} vs V_{In} (TK64842AMF)



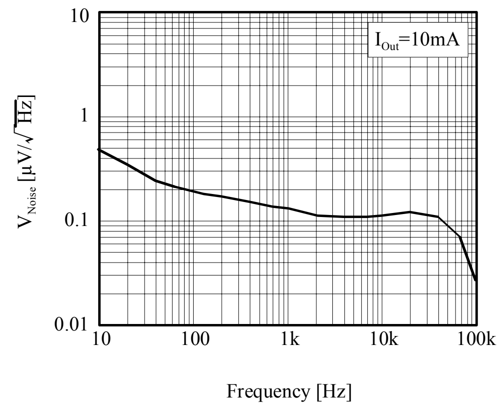
■ V_{Noise} vs I_{Out} (TK64842AMF)



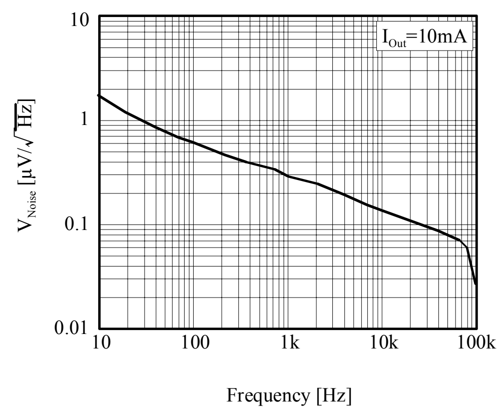
■ V_{Noise} vs V_{Out} (TK648xxAMF)



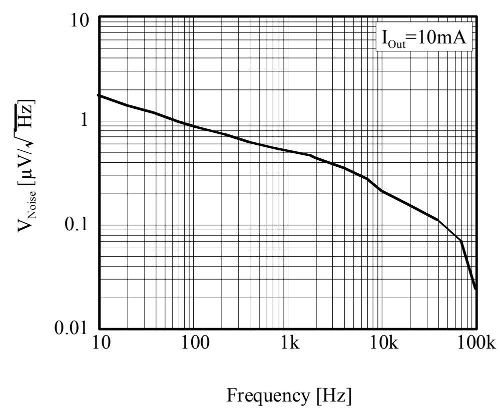
■ V_{Noise} vs Frequency (TK64812AMF)



■ V_{Noise} vs Frequency (TK64828AMF)

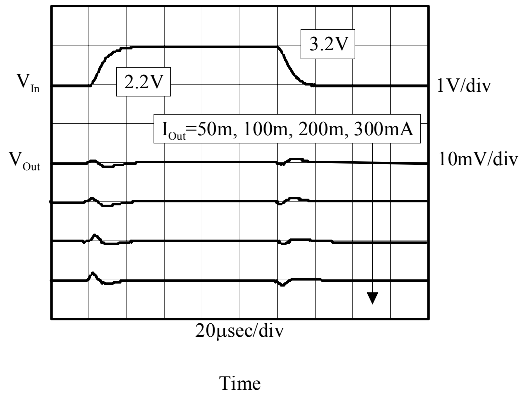


■ V_{Noise} vs Frequency (TK64842AMF)

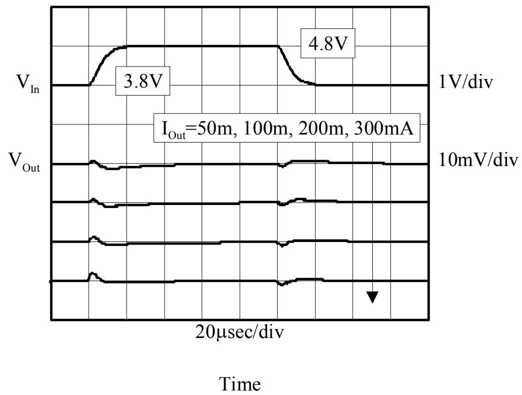


10-3. TRANSIENT CHARACTERISTICS

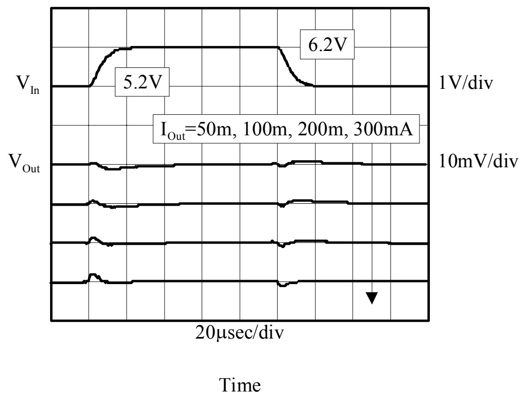
■ Line Transient (TK64812AMF)



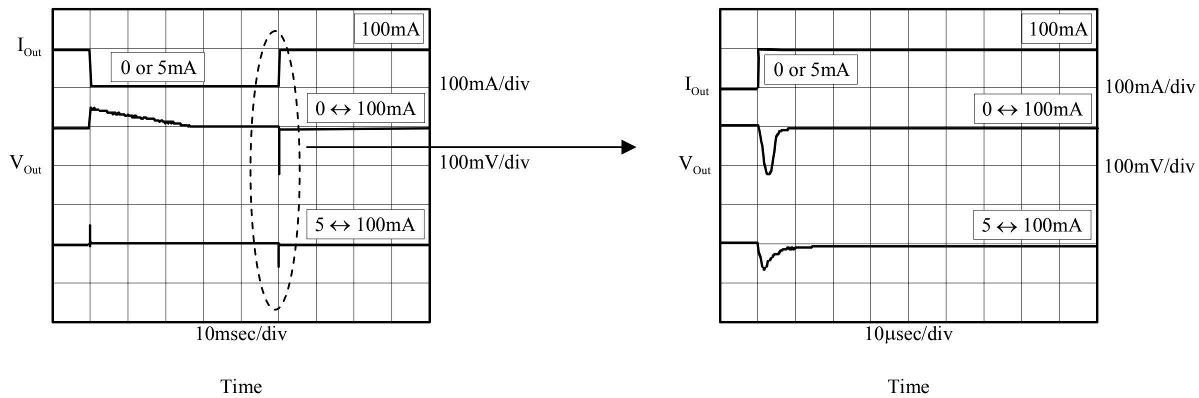
■ Line Transient (TK64828AMF)



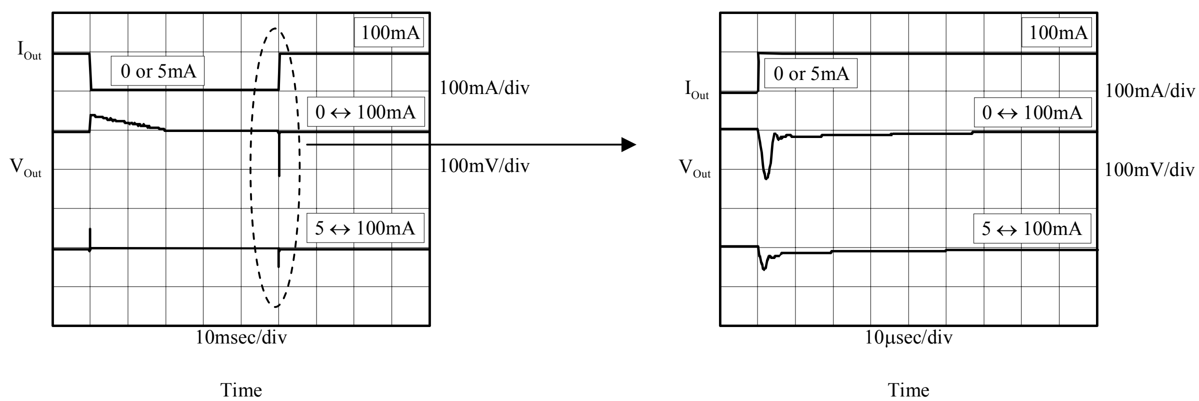
■ Line Transient (TK64842AMF)



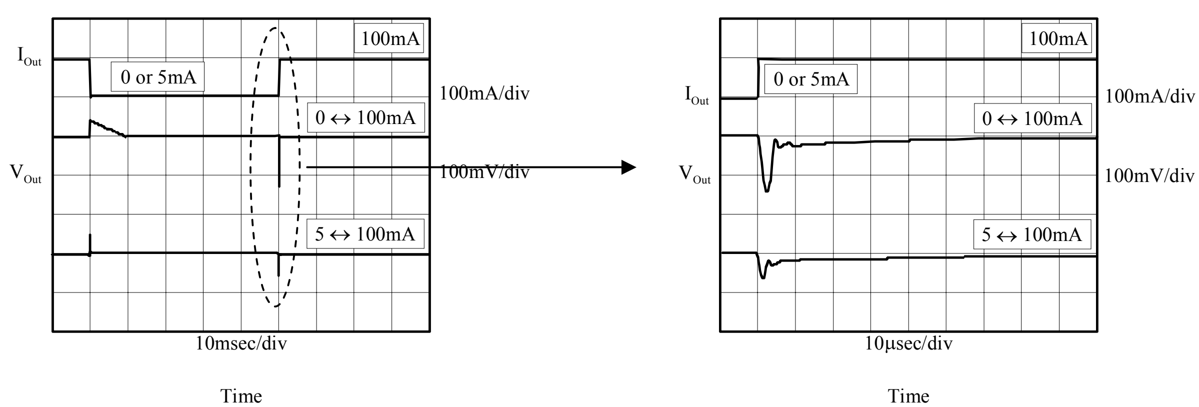
■ Load Transient (I_{Out}=0 or 5↔100mA) (TK64812AMF)



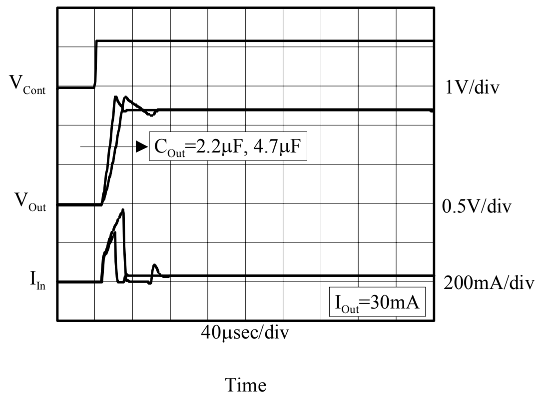
■ Load Transient (I_{Out}=0 or 5↔100mA) (TK64828AMF)



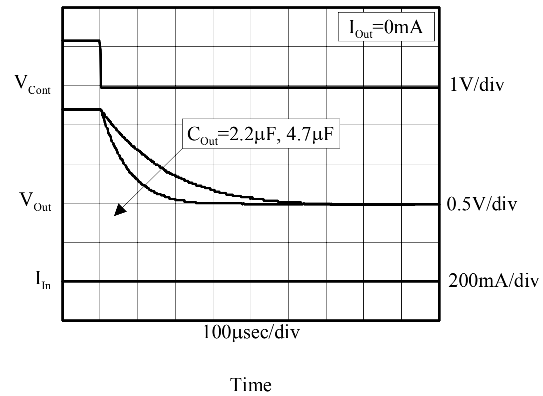
■ Load Transient (I_{Out}=0 or 5↔100mA) (TK64842AMF)



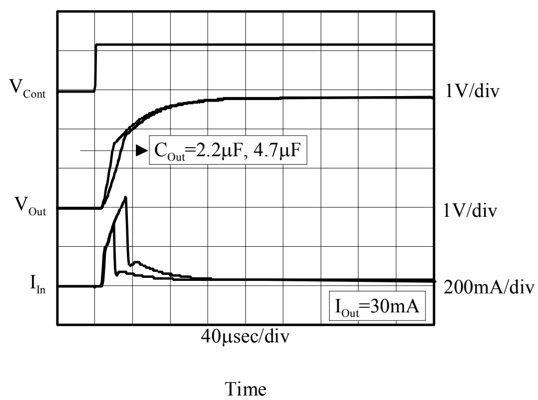
■ On/Off Transient (V_{Cont}=0→1.2V) (TK64812AMF)



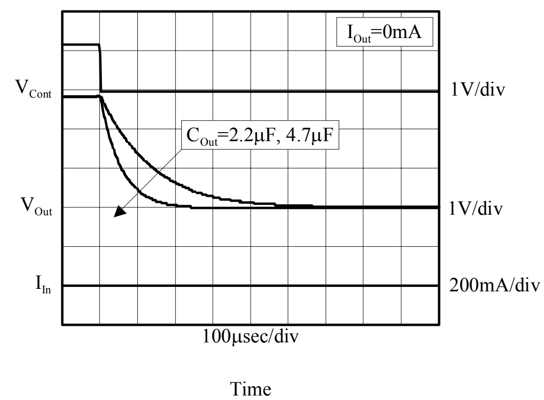
■ On/Off Transient (V_{Cont}=1.2→0V) (TK64812AMF)



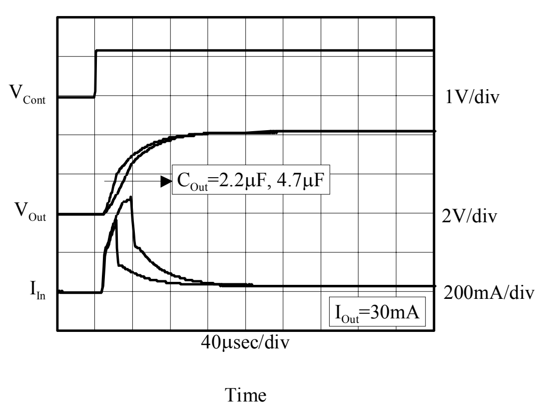
■ On/Off Transient (V_{Cont}=0→1.2V) (TK64828AMF)



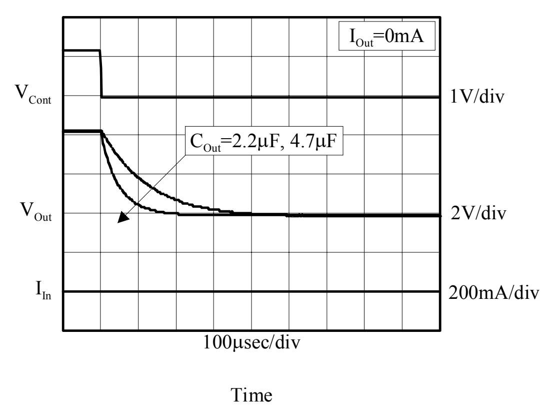
■ On/Off Transient (V_{Cont}=1.2→0V) (TK64828AMF)



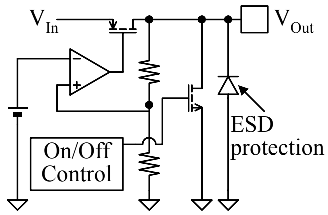
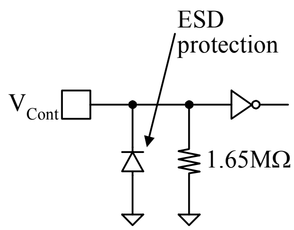
■ On/Off Transient (V_{Cont}=0→1.2V) (TK64842AMF)



■ On/Off Transient (V_{Cont}=1.2→0V) (TK64842AMF)



11. PIN DESCRIPTION

Pin No.	Pin Description	Internal Equivalent Circuit	Description
1	V_{Out}		Output Terminal
2	GND		GND Terminal
3	V_{Cont}		Control Terminal $V_{Cont} > 1.2V$: On $V_{Cont} < 0.2V$: Off The pull-down resistor (about 1.65MΩ) is built-in.
4	V_{In}		Input Terminal

12. APPLICATIONS INFORMATION

12-1. Stability

Linear regulators require input and output capacitors in order to maintain the regulator's loop stability. If 2.2µF capacitors are connected to the input side and the output side, the IC provides stable operation. However, it is recommended to use as large a value capacitor as is practical. The output noise and the ripple noise decrease as the value of the capacitor increases.

A recommended value of the application is as follows.

$C_{In} \geq 1.0\mu F$, $C_{Out} \geq 2.2\mu F$

It is not possible to determine this indiscriminately. Please confirm the stability in your design.

Fig12-1: Capacitor in the application

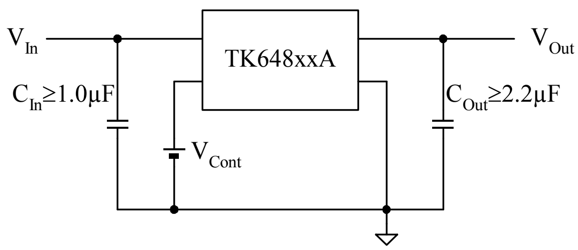
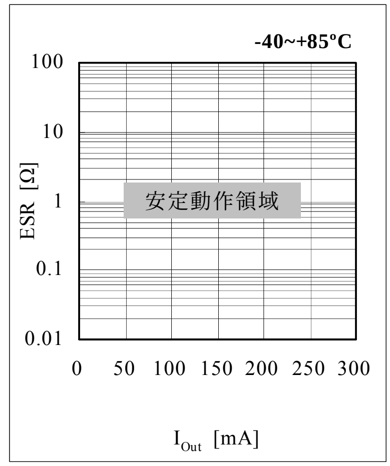
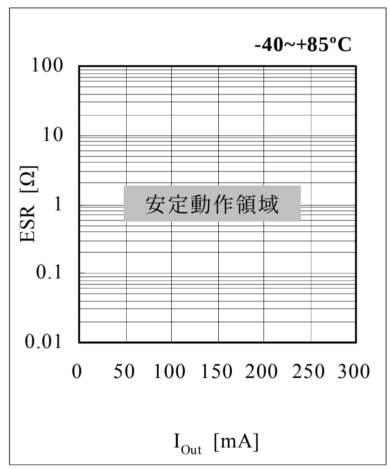


Fig12-2: Output Current vs Stable Operation Area

TK64812AMF



TK64828AMF



TK64842AMF

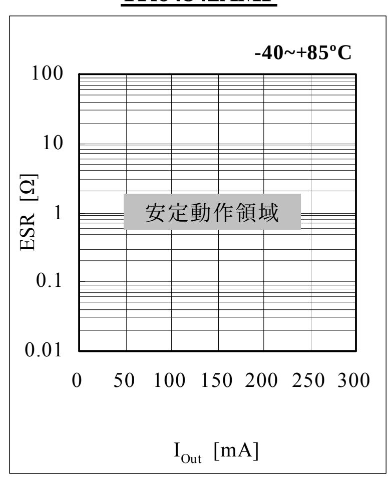
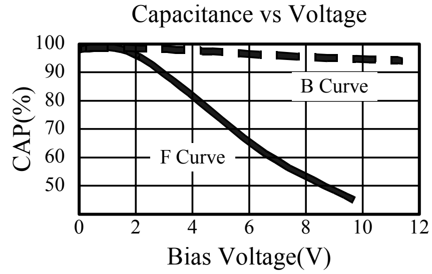


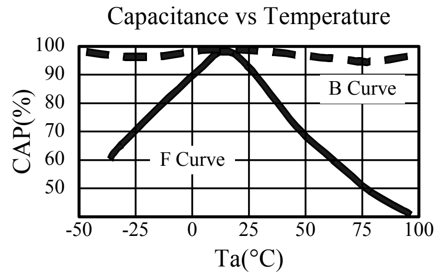
Fig.12-2 shows the stable operation area of output current and the equivalent series resistance (ESR) with a ceramic capacitor of 2.2µF. ESR of the output capacitor must be in the stable operation area. Please select the best output capacitor according to the voltage and current used. The stability of the regulator improves as the value of the output side capacitor increases (the stable operation area extends.) Please use as large a value capacitor as is practical.

For evaluation

Kyocera : CM05X5R105K10AB

Fig12-3: ex. Ceramic Capacitance vs Voltage, Temperature

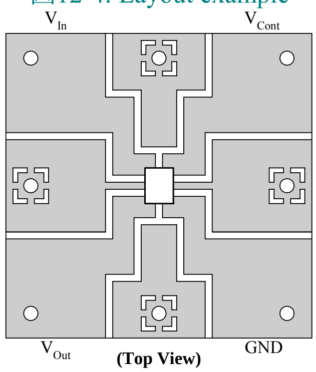




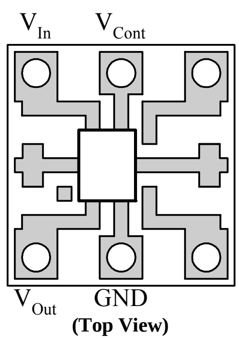
Generally, a ceramic capacitor has both a temperature characteristic and a voltage characteristic. Please consider both characteristics when selecting the part. The B curves are the recommended characteristics.

12-2. Layout

図12-4: Layout example



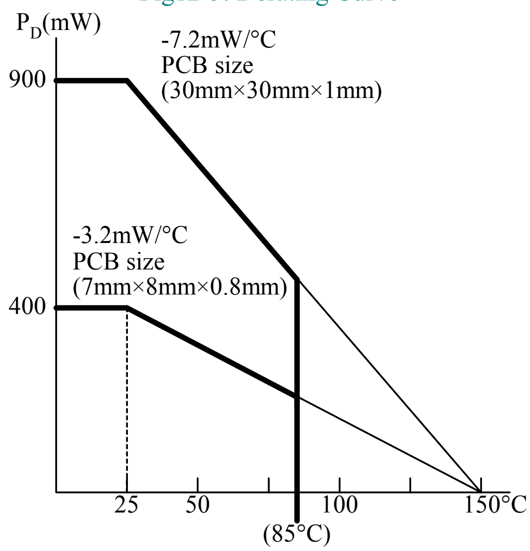
PCB Material: Glass epoxy
Size: 30mm×30mm×1mm



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

Please do derating with 3.2mW/°C(PCB size: 7mm×8mm×0.8mm), 7.2mW/°C(PCB size: 30mm×30mm×1mm), at P_D=400mW(PCB size: 7mm×8mm×0.8m), 900mW(PCB size: 30mm×30mm×1mm), and 25°C or more.

Fig12-5: Derating Curve



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 400mW. 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:

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

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

If the ambient temperature is 25°C, then:

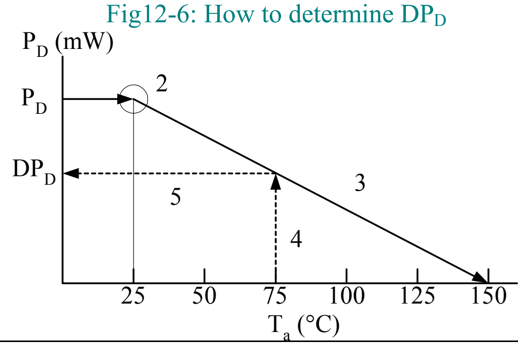
$$150=\theta_{ja}\times P_D+25$$

$$\theta_{ja}=125/P_D\ (°C\ /mW)$$

P_D is easily calculated.

A simple way to determine P_D 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 DP_D



Procedure (When mounted on PCB.)

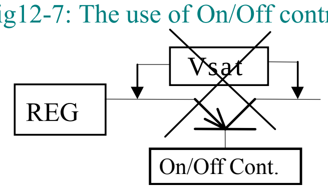
1. Find P_D ($V_{In} \times I_{In}$ when the output side is short-circuited).
2. Plot P_D against 25°C.
3. Connect P_D to the point corresponding to the 150°C with a straight line.
4. In design, take a vertical line from the maximum operating temperature (e.g., 75°C) to the derating curve.
5. Read off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

The maximum output current at the highest operating temperature will be $I_{Out} \cong DP_D \div (V_{In,MAX} - V_{Out})$.
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.

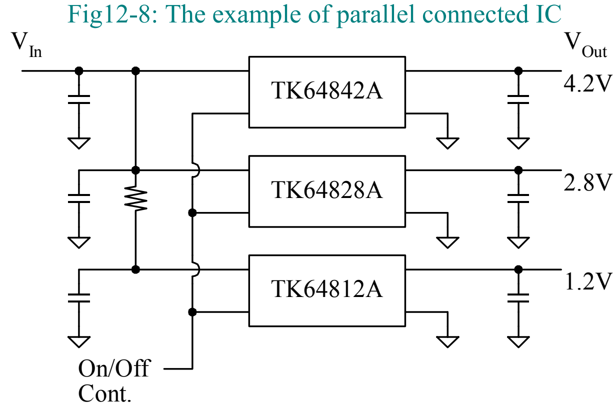
Fig12-7: The use of On/Off control



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 (TK64812A) 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. 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 to 90% of 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

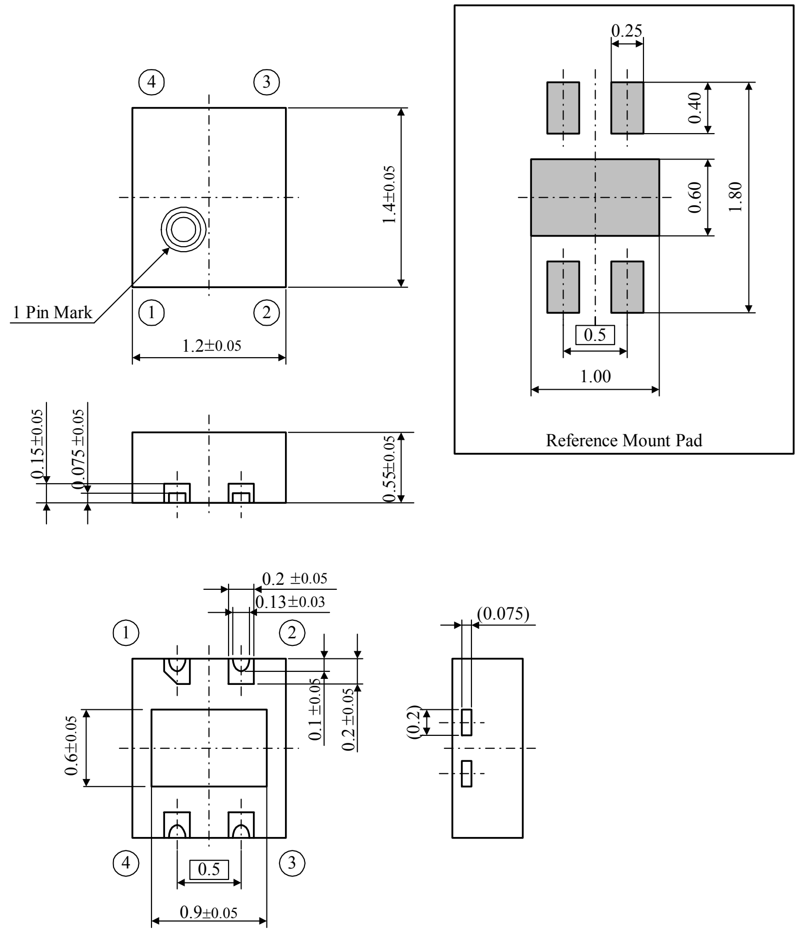
♦ **Over Current Sensor**
The over current sensor protects the device when there is excessive output current. It also protects the device if the output is accidentally connected to ground.

♦ **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-Lead-Small Outline Non-Leaded Package with Heat Sink : HSON1214-4



Unit : mm

Package Structure and Others

Package Material	:	Epoxy Resin
Terminal Material	:	Copper Alloy
Terminal Finish	:	Ni/Pd/Au

Caution in Printed Circuit Board Layout

In addition to the normal pins, this plastic package has exposed metal tabs.
This tab is electrically connected to the GND of internal chip.
Avoid electrical contact with this tab from external print traces, adjacent components other than GND, etc.
This tab is recommended to be solder-mounted so as to enhance heat release.

Marking

Part Number	Marking Code	Part Number	Marking Code	Part Number	Marking Code
TK64812AMF	E12	TK64827AMF	E27	TK64831AMF	E31
TK64815AMF	E15	TK64828AMF	E28	TK64832AMF	E32
TK64818AMF	E18	TK64801AMF	E01	TK64833AMF	E33
TK64825AMF	E25	TK64829AMF	E29	TK64835AMF	E35
TK64826AMF	E26	TK64830AMF	E30	TK64840AMF	E40

14. NOTES

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- 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.

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

15. OFFICES

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