IC DATA SHEET

LDO REGULATOR WITH ON/OFF SWITCH

TK111xxC

MEETING YOUR NEEDS

TOKO, INC.

Regulator with on/off
TK111xxC

Features

- Very good stability CL=0.1μF is steady enough. Any type can be used.（1.8V≦Vout）
- Very low Dropout Voltage. Vd=120mV at 100mA
- High Precision output Voltage（±1.5% or ±50mV）
- Good ripple rejection ratio（80dB at 1KHz）
- Wide operating voltage range(1.8V～14V)
- Built in Short circuit protection
- Peak output current is 320mA.(0.3V down point)
- Built-in Thermal Shutdown
- Very low quiescent current (Iq=63uA at Io=0mA)
- Available Very Low Noise Application
- Built-in on/off Control (0.1μA Max Standby current） High On
- Very Small Surface Mount Packages
- Built in reverse bias over current protection

Description

TK111xxC is an integrated circuit of the silicon monolithic bipolar structure, and the regulator of the low saturation output type with very little quiescent current(63μA).
The PNP power transistor is built into. The I/O voltage difference when the current of Typ.200mA is supplied to the system is 0.2V. The voltage source can be effectively used
Therefore, It is the best for the battery use set.
The on/off function is built into IC. The current at standing-by mode becomes slight (pA level).
1.5-10.0V is arranged to the output voltage in 0.1V step. The output voltage is trimmed in high accuracy. The best voltage for the set used will be able to be selected.
The over current sensor circuit and the reverse-bias over current obstruction circuit are built into.
It is a design not broken because an ESD is also high. It is possible to use (*O) at ease.
When mounting on PCB, the loss becomes about 500mW though the package is very small.
TK111xxC uses the circuit with very high stability in DC and AC.
The capacitor on the output side is steady in 0.1μF (1.8V≦Vout). The kind of this capacitor is not asked. It is possible to use every type capacitor.
However, a good characteristic is shown the more overall larger this capacitor is.
The ripple rejection is 84dB at 400Hz and 80dB at 1kHz.

ORDERING INFORMATION

TK111 □□ CS □ L □

Voltage Code
EX 3.3V : 33
5.0V : 50

Package Code
S:SOT-23

Operating Temp. Range
C:-30～80℃
I :-40～85℃

Tape/Reel Code
L:Left

(Special Sorting)
N：Noise

Boldface type applies **Standard Voltage.**

V OUT	V CODE	V OUT	V CODE	V OUT	V CODE	V OUT	V CODE
1.5 v	15	2.5 v	25	3.5 v	35	4.5 v	45
1.6	16	2.6	26	3.6	36	4.6	46
1.7	17	2.7	27	3.7	37	**4.7**	**47**
1.8	18	**2.8**	**28**	**3.8**	**38**	4.8	48
1.9	19	**2.9**	**29**	3.9	39	4.9	49
2.0	**20**	**3.0**	**30**	**4.0**	**40**	**5.0**	**50**
2.1	21	3.1	31	4.1	41		
2.2	22	**3.2**	**32**	4.2	42		
2.3	23	**3.3**	**33**	4.3	43		
2.4	24	3.4	34	4.4	44		

Please contact your authorized Toko representative for voltage availability

C rank device

Absolute maximum ratings

Parameters	Symbol	Limiting Values	Unit
Supply voltage	Vcc Max	－0.4～16	V
Reverse bias	VrMax	－0.4～6	V
Np pin voltage	VnpMax	－0.4～5	V
Control pin voltage	VcontMax	－0.4～16	V
Storage temperature Range	Tstg	－55～150	℃
Operating voltage range	Vop	1.8～14	V
Operating temperature range	Top	-30～80	℃
Short circuit current	Ishort	360	mA
Power dissipation	Internal limited（150mW unit）	500mW mounted (reference)	

5 pin mini flat package

Electrical characteristics

Test Condition Vtest=$Vout_{Typ}$+1V Vcont=1.8V（Ta＝25℃）

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Output voltage	Vout	See table 1				
Line regulation	LinReg		0.0	5	mV	Vtest=$Vout_{Typ}$+1V---- $Vout_{Typ}$ +6V ΔV=5V
Load regulation	LoaReg		(11)	(28)	mV	5mA＜Iout＜100mA note 1
			(27)	(64)	mV	5mA＜Iout＜200mA note 1
Drop-out voltage	Vdrop		80	140	mV	I out=50mA
			120	210	mV	I out=100mA
			200	350	mV	I out=200mA **(2.4V≦Vout)**
			230	350	mV	I out=180mA **(2.1V≦Vout＜2.4V)**
	1.5V≦Vout≦2.0V：No regulation					Because of VopMin=1.8V
Maximum output current	IoutMax	240	320		mA	When （$Vout_{Typ}$.×0.9）
			250		mA	**1.8V≦Vcc≦2.1V** Reference Value
Consumption current	Icc		63	100	μA	I out=0mA Except Icont
Standing by current	Istanby		0.0	0.1	μA	Vcc=8V , Vcont≦0.15V Off state
Quiescent current	Iq		1.0	1.8	mA	Iout=50mA
Control terminal Specification (Pull down resistor =500k （Note 2）						
Control current	Icont		5	15	μA	Vcont＝1.8v on state
Control voltage	Vcont	1.6			V	on state
				0.6	V	off state
Np treminal Voltage	VNp		1.28		V	
Vo	Vo/Ta	Typ=35 ppm/℃				Reference Value
Out put noise	Vno	0.14～0.25 μV/√Hz at 1KHz				Reference Value

Note 1: This value depends on the output voltage. (It is a value of Vout=3V device.)
This item improves in a low voltage device.

Note 2: The input current decreases to the pA level by connecting control terminal to GND.（Off state）
Pull-down resistor is 500KΩ.

General Note: Limits are guaranteed by production testing or correction techniques using Statistical Quality Control (SQC) methods. Unless otherwise noted. Vtest=$Vout_{Typ}$+1v；IL=1mA（Tj=25 ℃）The operation of -30℃-80℃ is guaranteed in the design by a usual inspection.

General Note: Exceeding the “Absolute Maximum Rating “ may damage the device

General Note: Connecting a capacitor to the noise bypass pin can decrease the output noise voltage

General Note: Output noise is 0.14-0.25 μV/√Hz at 1KHz : 25～65μVrms at BW400-80kHz

General Note: The ripple rejection is 84dB at 400Hz and 80dB at 1kHz.
［CL=1.0μF,Cnp=0.01μF,Vnois=200mV_{RMS},Vin=$Vout_{Typ}$+1.5v,Iout=10mA］

Table 1

C lank output voltage

Ta=25℃ Iout=5mA

Output Voltage	Voltage Code	Vout Min	Vout Max	Test Voltage	Output Voltage	Voltage Code	Vout Min	Vout Max	Test Voltage
1.5v	15	1.450v	1.550v	2.5v	3.4 v	34	3.349v	3.451v	4.4v
1.6	16	1.550	1.650	2.6	3.5	35	3.447	3.553	4.5
1.7	17	1.650	1.750	2.7	3.6	36	3.546	3.654	4.6
1.8	18	1.750	1.850	2.8	3.7	37	3.644	3.756	4.7
1.9	19	1.850	1.950	2.9	3.8	38	3.743	3.857	4.8
2.0	20	1.950	2.050	3.0	3.9	39	3.841	3.959	4.9
2.1	21	2.050	2.150	3.1	4.0	40	3.940	4.060	5.0
2.2	22	2.150	2.250	3.2	4.1	41	4.038	4.162	5.1
2.3	23	2.250	2.350	3.3	4.2	42	4.137	4.263	5.2
2.4	24	2.350	2.450	3.4	4.3	43	4.235	4.365	5.3
2.5	25	2.450	2.550	3.5	4.4	44	4.334	4.466	5.4
2.6	26	2.550	2.650	3.6	4.5	45	4.432	4.568	5.5
2.7	27	2.650	2.750	3.7	4.6	46	4.531	4.669	5.6
2.8	28	2.750	2.850	3.8	4.7	47	4.629	4.771	5.7
2.9	29	2.850	2.950	3.9	4.8	48	4.728	4.872	5.8
3.0	30	2.950	3.050	4.0	4.9	49	4.826	4.974	5.9
3.1	31	3.050	3.150	4.1	5.0	50	4.925	5.075	6.0
3.2	32	3.150	3.250	4.2					
3.3	33	3.250	3.350	4.3					

The output voltage table indicates the standard value when manufactured.

I Rank

Absolute Maximum Ratings is same C Lank
Operating Temperature Range Top=-40～85℃
Operating Voltage Range Vop＝2.1V～14V

Another items are same C rank.

Boldface types apply over the full operating temperature range. (-40℃～85℃)

Vtest=Vout$_{Typ}$+1V Iout=5mA

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Output voltage	Vout	See table 2				
Line regulation	LinReg		0.0	5 **8**	mV	Vtest=Vout$_{Typ}$+1V---- Vout$_{Typ}$ +6V ΔV=5V
Load regulation	LoaReg		(11)	(28) **(34)**	mV	5mA＜Iout＜100mA Note 1
			(27)	(64) **(90)**	mV	5mA＜Iout＜200mA Note 1
Drop-out voltage	Vdrop		80	140 **180**	mV	Iout=50mA
			120	210 **270**	mV	Iout=100mA
			200	350 **390**	mV	Iout=200mA**(2.4V≦Vout)**
			230	350 **390**	mV	Iout=180mA**(2.1V≦Vout＜2.4V)**
	1.5V≦Vout≦2.0V：No regulation					Because of Vop$_{Min}$=2.1V
Maximum output current	IoutMax	240 **220**	320		mA	When (Vout$_{Typ.}$×0.9)
Consumption current	Icc		63	100 **120**	μA	Iout=0mA Except Icont
Standing by current	Istandby		0.0	0.1 **0.5**	μA	Vcc=8V, Vcont≦0.15V Off state
Quiescent current	Iq		1.0	**1.8**	mA	Iout=50mA
Control terminal Specification (Pull down resistor =500k (Note 2)						
Control current	Icont		5.0	15 **15**	μA	Vcont＝1.8v on state
Control voltage	Vcont	1.6 **1.8**			V	on state
				0. 6 **0.35**	V	off state
Np terminal Voltage	VNp		1.28		V	
Vo	Vo/Ta	Typ=25 ppm/℃				Reference Value
Out put noise	Vno	0.14～0.25 μV/√Hz at1KHz				Reference Value

Note 1: This value depends on the output voltage. (It is a value of Vout=3V device.)

Note 2: The input current decreases to the pA level by connecting control terminal to GND. (Off state) Pull-down resistor is 500KΩ.

General Note: Limits are guaranteed by production testing or correction techniques using Statistical Quality Control (SQC) methods. Unless otherwise noted. Vtest=Vout$_{Typ}$+1v；IL=1mA (Tj=25 ℃) The operation of -30℃-80℃ is guaranteed in the design by a usual inspection.

General Note: Exceeding the “Absolute Maximum Rating “ may damage the device

General Note: Connecting a capacitor to the noise bypass pin can decrease the output noise voltage

General Note: Output noise is 0.14-0.25 μV/√Hz at 1KHz : 25～65μVrms at BW400-80kHz

General Note: The ripple rejection is 84dB at 400Hz and 80dB at 1kHz.

[CL=1.0μF,Cnp=0.01μF,Vnois=200mV$_{RMS}$,Vin=Vout$_{Typ}$+1.5v,Iout=10mA]

Table 2

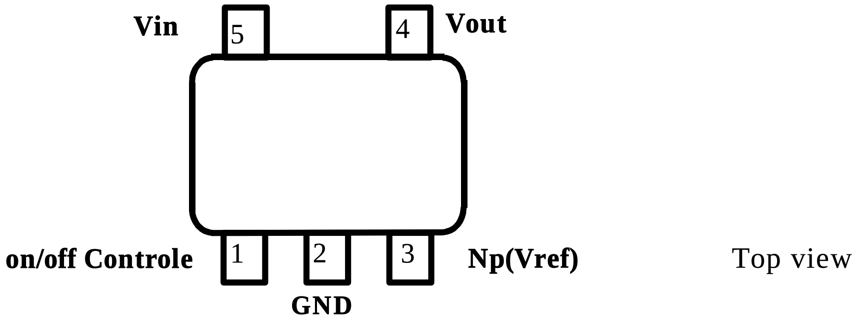
I lank output voltage

Boldface types apply over the full operating temperature range. (Ta=-40～85℃) Iout=5mA

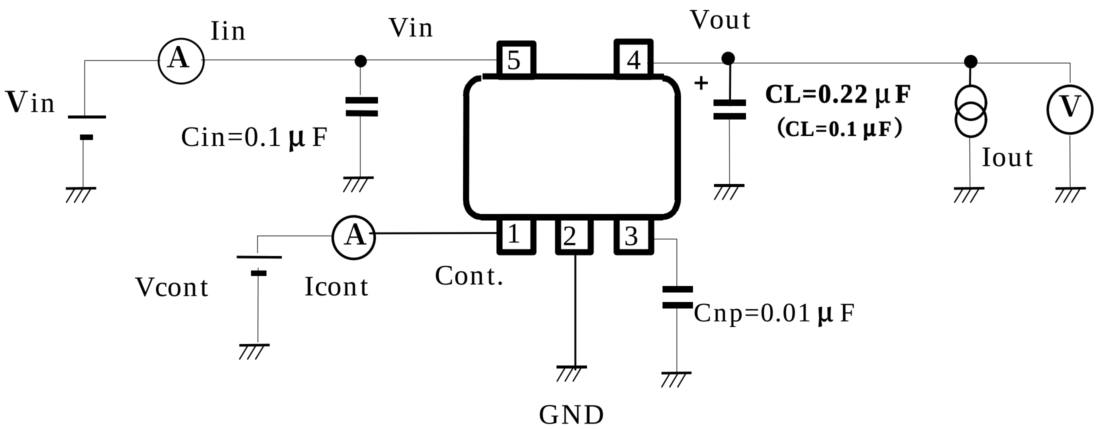
Output Voltage	Voltage Code	Vout Min	Vout Max	Test Voltage	Output Voltage	Voltage Code	Vout Min	Vout Max	Test Voltage
1.5V	15	1.450V **1.420**	1.550V **1.580**	2.5V	3.4 V	34	3.349 V **3.315**	3.451 V **3.485**	4.4 V
1.6	16	1.550 **1.520**	1.650 **1.680**	2.6	3.5	35	3.447 **3.412**	3.553 **3.588**	4.5
1.7	17	1.650 **1.620**	1.750 **1.780**	2.7	3.6	36	3.546 3.510	3.654 3.690	4.6
1.8	18	1.750 **1.720**	1.850 **1.880**	2.8	3.7	37	3.644 **3.607**	3.756 **3.793**	4.7
1.9	19	1.850 **1.820**	1.950 **1.980**	2.9	3.8	38	3.743 **3.705**	3.857 **3.895**	4.8
2.0	20	1.950 **1.920**	2.050 **2.080**	3.0	3.9	39	3.841 **3.802**	3.959 **3.998**	4.9
2.1	21	2.050 **2.220**	2.150 **2.180**	3.1	4.0	40	3.940 **3.900**	4.060 **4.100**	5.0
2.2	22	2.150 **2.120**	2.250 **2.280**	3.2	4.1	41	4.038 **3.997**	4.162 **4.203**	5.1
2.3	23	2.250 **2.220**	2.350 **2.380**	3.3	4.2	42	4.137 **4.095**	4.263 **4.305**	5.2
2.4	24	2.350 **2.320**	2.450 **2.480**	3.4	4.3	43	4.235 **4.192**	4.365 **4.408**	5.3
2.5	25	2.450 **2.420**	2.550 **2.580**	3.5	4.4	44	4.334 **4.290**	4.466 **4.510**	5.4
2.6	26	2.550 **2.520**	2.650 **2.680**	3.6	4.5	45	4.432 **4.387**	4.568 **4.613**	5.5
2.7	27	2.650 **2.620**	2.750 **2.780**	3.7	4.6	46	4.531 **4.485**	4.669 **4.715**	5.6
2.8	28	2.750 **2.720**	2.850 **2.880**	3.8	4.7	47	4.629 **4.582**	4.771 **4.818**	5.7
2.9	29	2.850 **2.820**	2.950 **2.980**	3.9	4.8	48	4.728 **4.680**	4.872 **4.920**	5.8
3.0	30	2.950 **3.920**	3.050 **3.080**	4.0	4.9	49	4.826 **4.777**	4.974 **5.023**	5.9
3.1	31	3.050 **3.020**	3.150 **3.180**	4.1	5.0	50	4.925 **4.875**	5.075 **5.125**	6.0
3.2	32	3.150 **3.120**	3.250 **3.280**	4.2					
3.3	33	3.250 **3.217**	3.350 **3.383**	4.3					

The output voltage table indicates the standard value when manufactured.

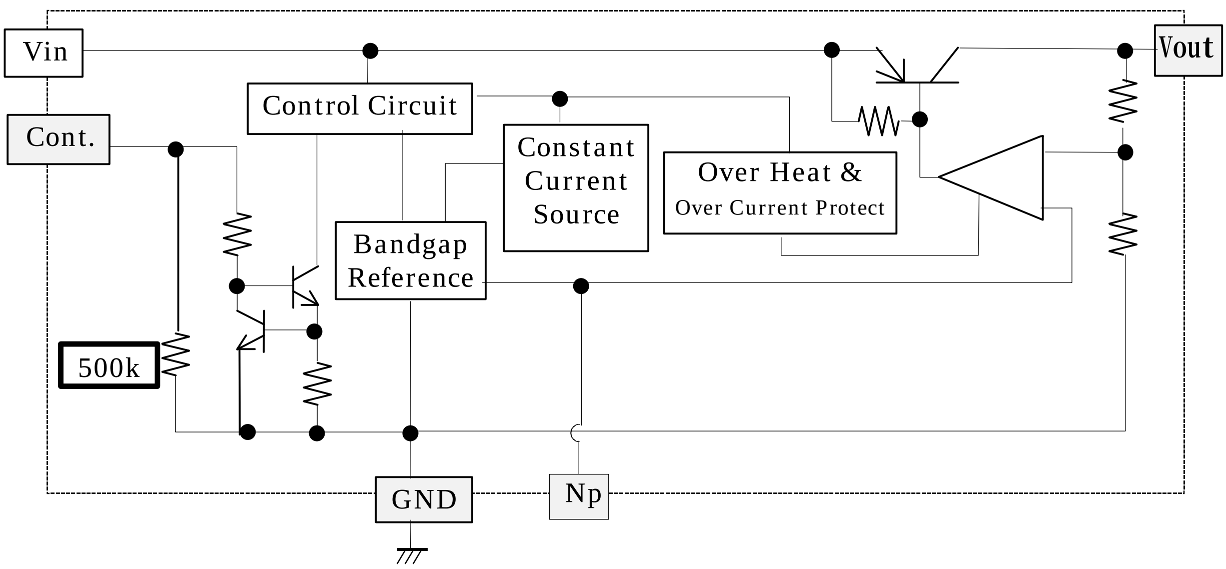
Pin Layout



Application



Block Diaguram

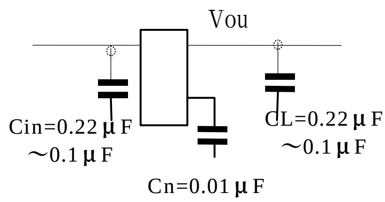


Input /Output Capacitors

Linear regulators require input and output capacitors in order to maintain the regulator's loop stability. The equivalent series resistance (ESR) of the output capacitor must be in the stable operation area. However, it is recommended to use as large a value of capacitance as is practical. The output noise and the ripple noise decrease as the capacitance value increases.

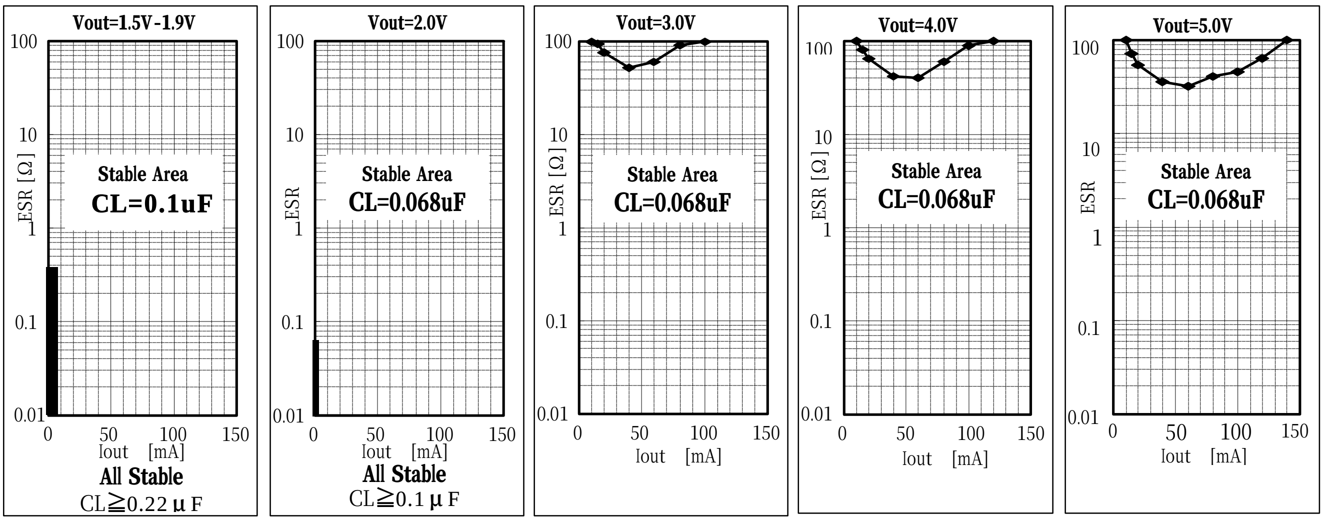
ESR values vary widely between ceramic and tantalum capacitors. However, tantalum capacitors are assumed to provide more ESR damping resistance, which provides greater circuit stability. This implies that a higher level of circuit stability can be obtained by using tantalum capacitors when compared to ceramic capacitors with similar values.

> For output voltage device ≧2.0V applications, the recommended value of CL≧0.10μF.
> For output voltage device ≧1.5V applications, the recommended value of CL≧0.22μF.



The input capacitor is necessary when the battery is discharged, the power supply impedance increases, or the line distance to the power supply is long. This capacitor might be necessary on each individual IC even if two or more regulator ICs are used. It is not possible to determine this indiscriminately. Please confirm the stability while mounted.
The IC provides stable operation with an output side capacitor of 0.1μF (Vout≧2.0V). If it is 0.1μF or more over the full range of temperature, either a ceramic capacitor or tantalum capacitor can be used without considering ESR.

Stable operation area vs. voltage, current, and ESR

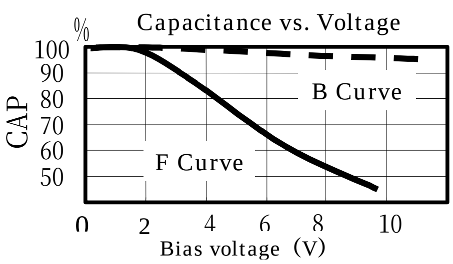


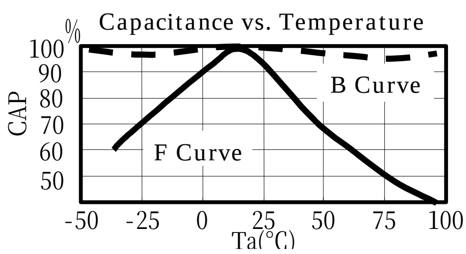
Please increase the output capacitor value when the load current is 0.5 mA or less. The stability of the regulator improves if a big output side capacitor is used (the stable operation area extends.)

For evaluation KYOCERA CM05B104K10AB、CM05B224K10AB、CM105B104K16A、CM105B224K16A、CM21B225K10A
MURATA GRM36B104K10、GRM42B104K10 GRM39B104K25、GRM39B224K10、GRM39B105K6.3

Bias Voltage and Temperature Characteristics of Ceramic Capacitor

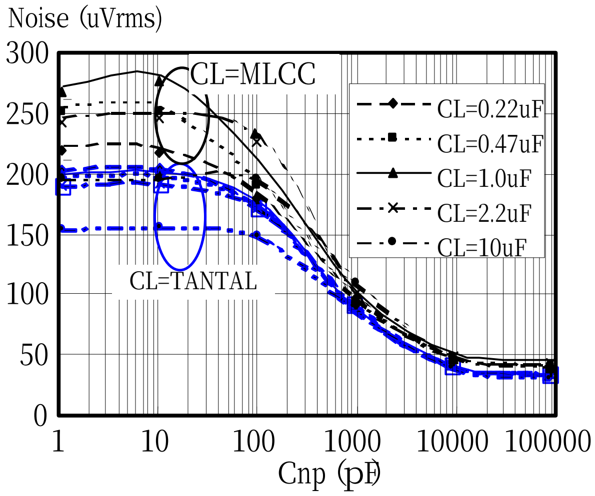
Generally, a ceramic capacitor has both a temperature characteristic and a voltage characteristic. Please consider both characteristics when selecting the part. The B curves are the recommend characteristics.



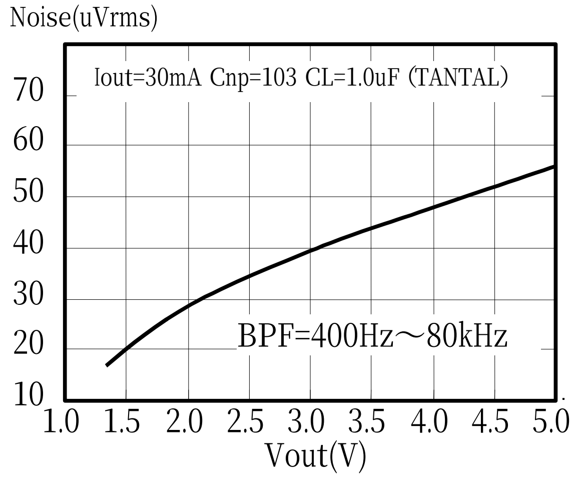


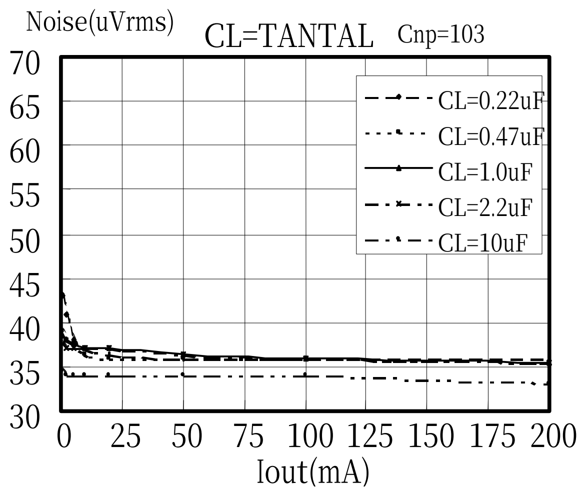
Output noise

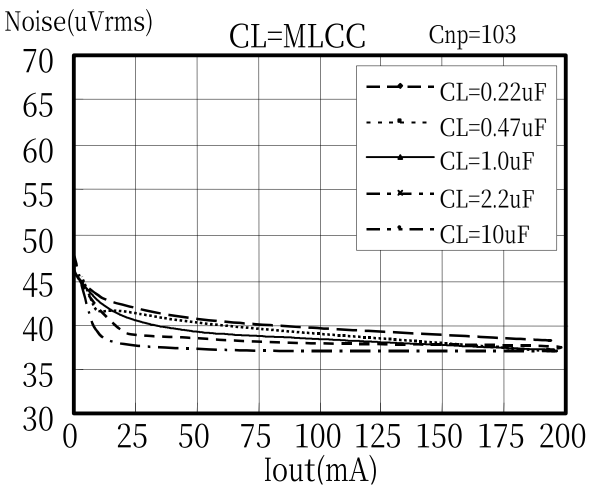
TK11130CS Cnp vs Noise Iout=30mA BPF=400Hz～80kHz



TK111xxCS Vout vs Noise

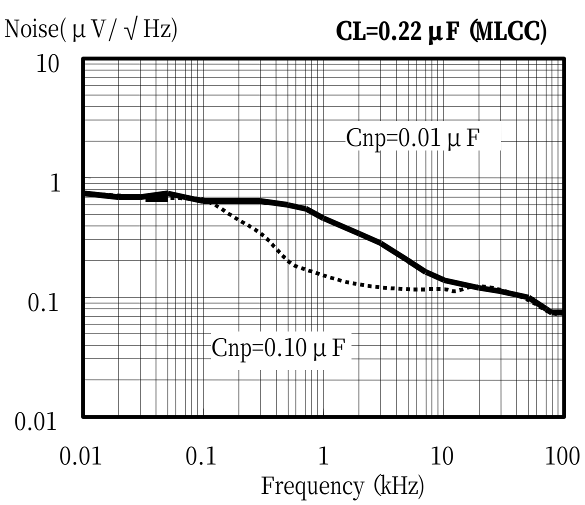






CL is not increased and it is more effective in the noise decrease to enlarge Cnp. The Cnp capacity recommends 6800pF(682) or 0.01μF(103). The amount of the noise increases in a higher output voltage. Please increase this capacity when low noise or more is demanded. IC does not operate abnormally about 0.1 and 0.22μF.

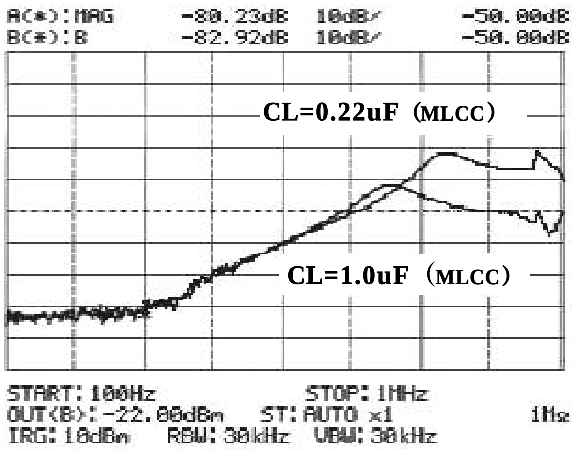
TK11130CS Cin=10μF Iout=10mA

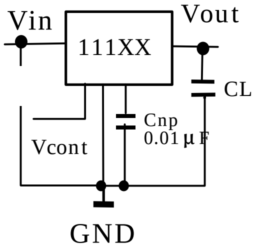


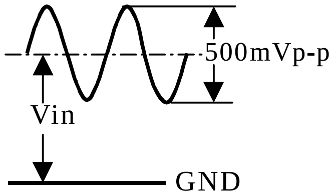
MLCC stance for Multi Layer Ceramic Capacitor.

TANTAL Stance for Tantalum Capacitor.

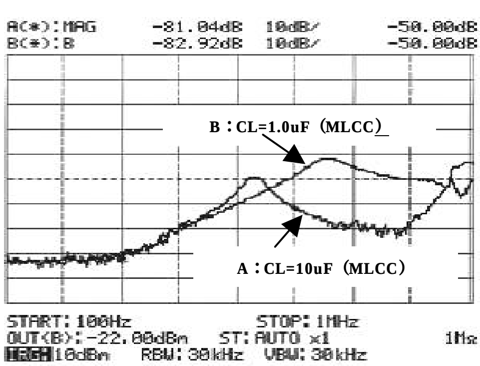
Ripple rejection

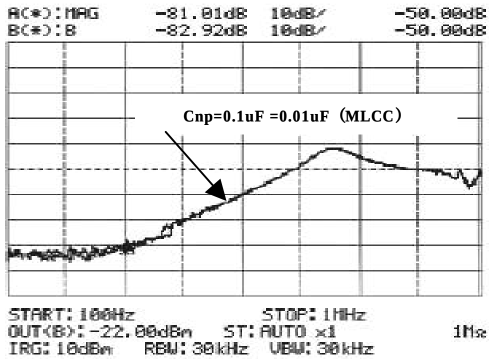




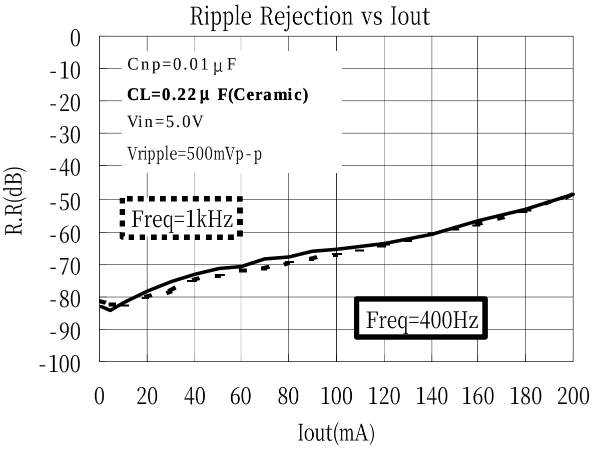


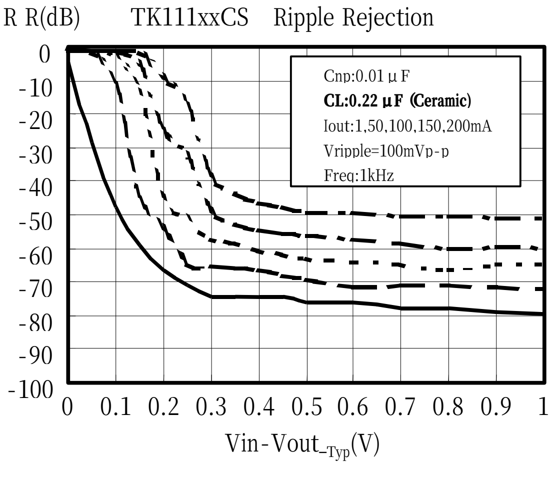
Vin=5.0V0V (Vtest=Vout$_{Typ}$+2V) Vout=3.0V Iout=10mA
VR=500mVp-p f=100～1MHz Cnp=0.01uF





The ripple rejection characteristic depends on the characteristic and the capacity value of the capacitor connected with the output side. The RR characteristic of 50KHz or more changes greatly in the capacitor on the output side and PCB pattern. Please confirm stability if necessary while operated.





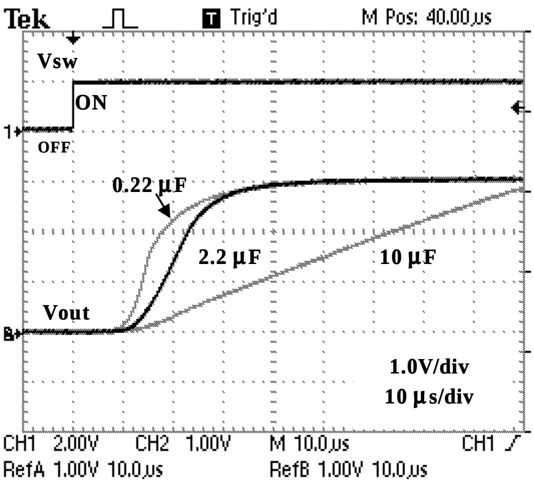
Transient characteristics Common condition Iout=30mA Cin=1.0μF,

・**ON／OFF_**

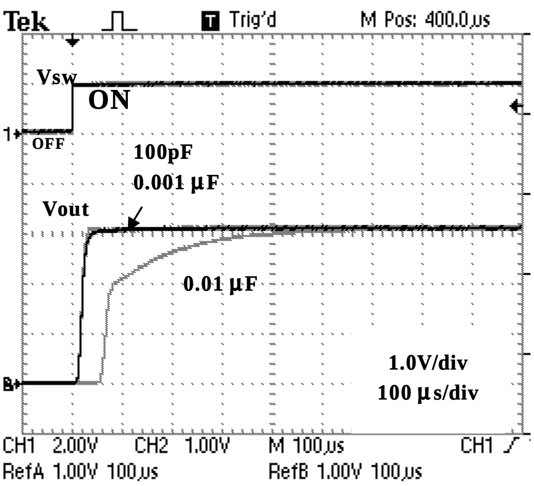
Condition **Vsw=0V⇔2V（f=100Hz）**

Iout=30mA, Cin=1.0μF, CL=2.2μF, Cnp=0.001μF

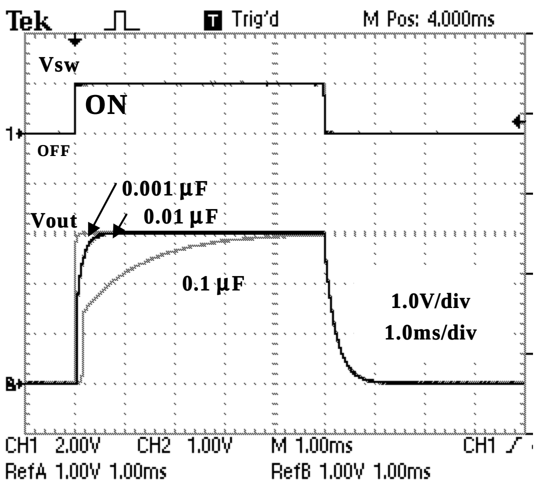
CL=0.22μF, 2.2μF, 10μF Cnp=0.001μF



Cnp=100pF, 0.001μF, 0.01μF CL=2.2μF

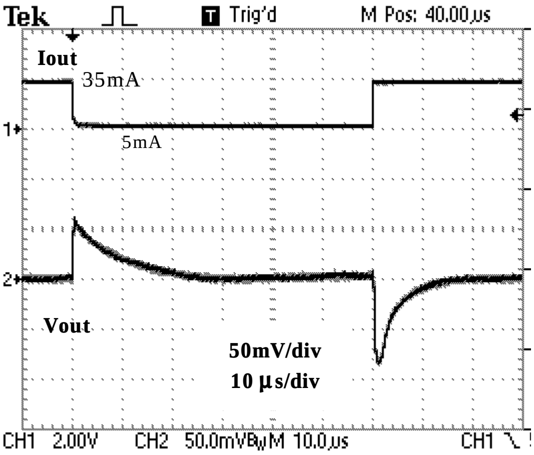


Cnp=0.001μF, 0.01μF, 0.1μF CL=2.2μF

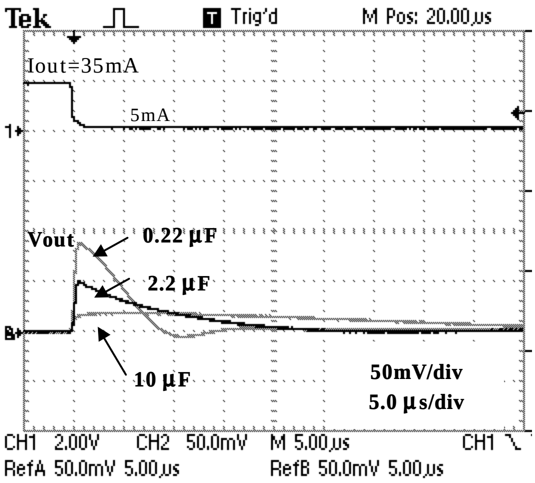


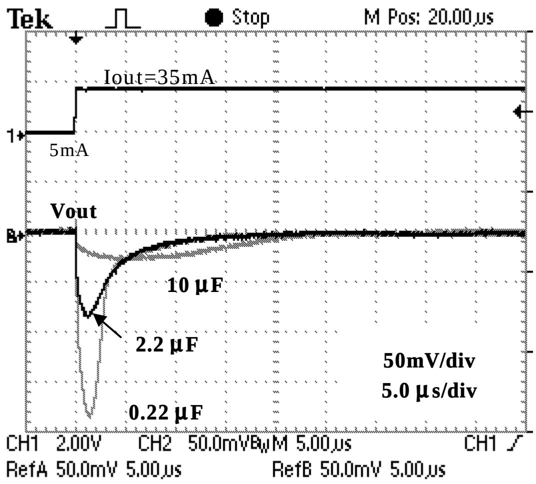
Load transient

Condition <u>Iout=5mA⇔35mA</u> , Vsw=2.0V, Cin=1.0μF, CL=2.2μF, Cnp=0.001μF

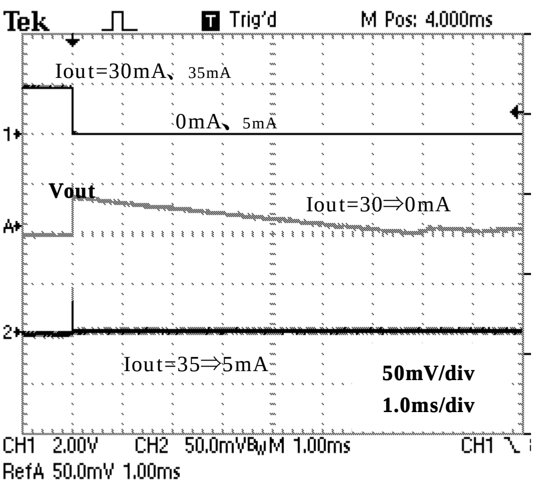


CL=0.22μF, 2.2μF, 10μF Cnp=0.001μF

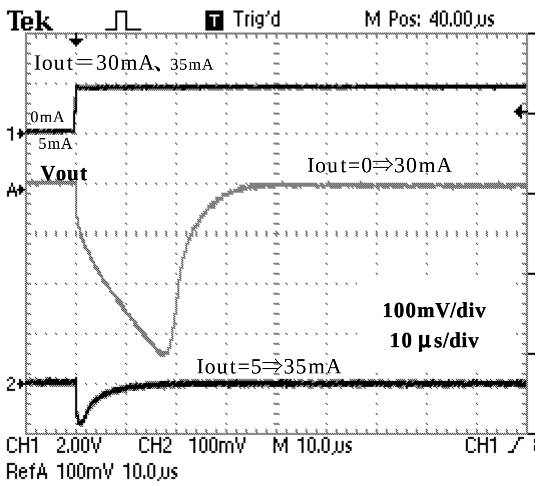




Iout=30⇒0mA, 35⇒5mA

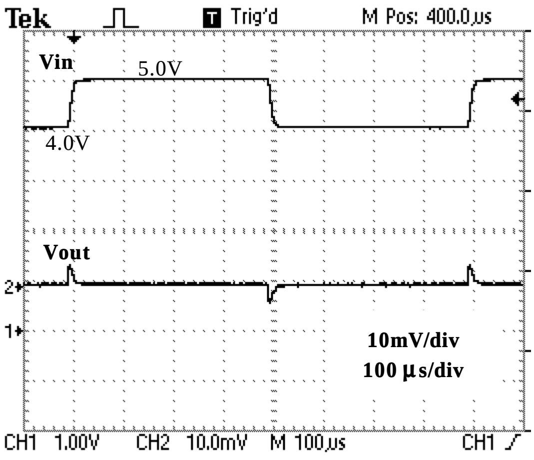


Iout=0⇒30mA, 5⇒35mA

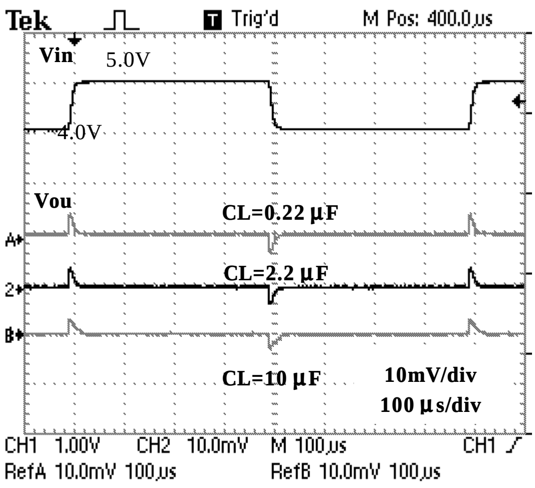


Line transient

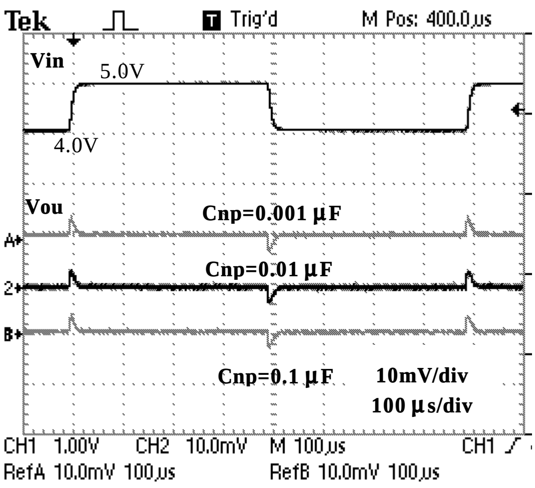
Vin=4.0V⇔5.0V Iout=30mA, Vsw=2.0V, Cin=1.0μF, CL=2.2μF, Cnp=0.001μF

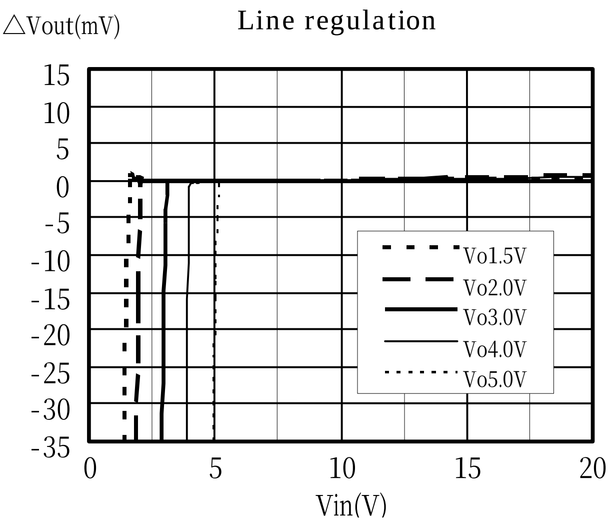


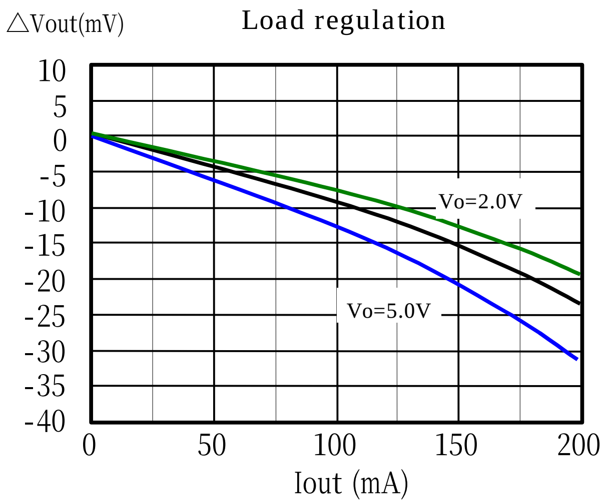
Cnp=0.001μF **CL=0.22μF, 2.2μF, 10μF**

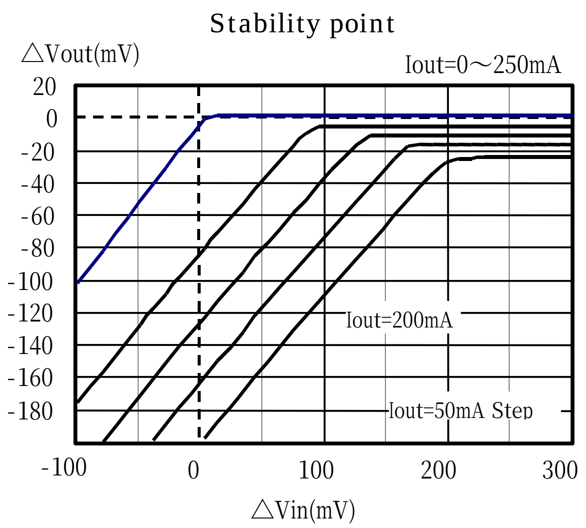


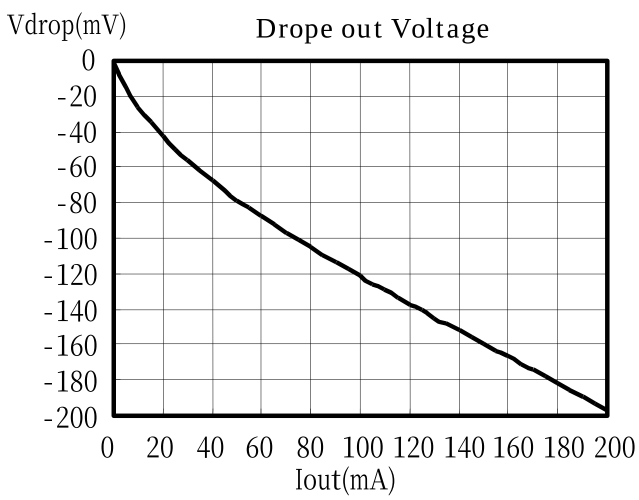
CL=2.2μF **Cnp=0.001μF, 0.01μF, 0.1μF**

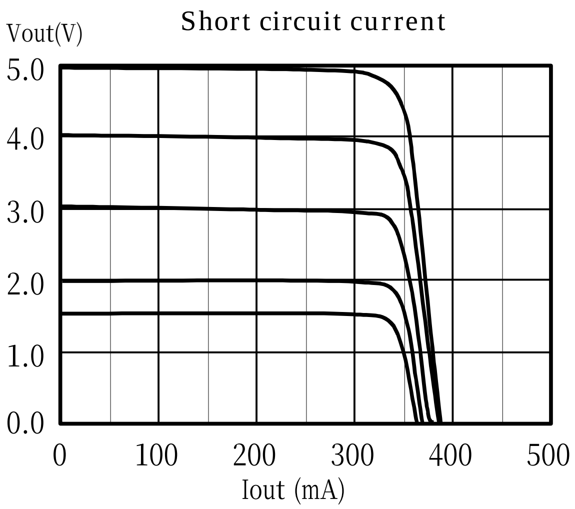


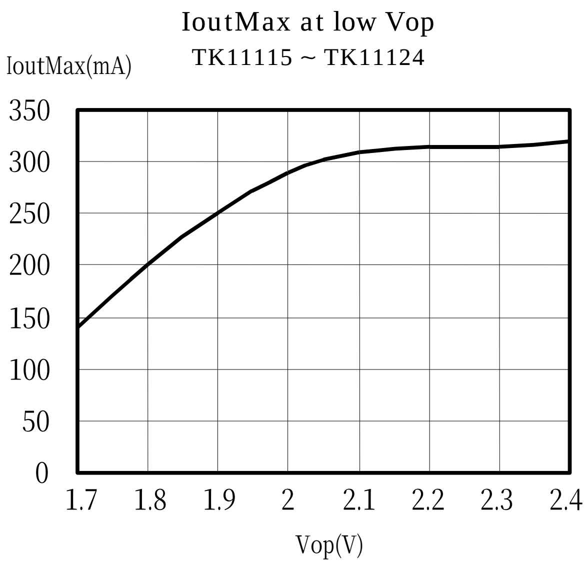

△Vout(mV)
Line regulation
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
0
5
10
15
20
Vin(V)
Vo1.5V
Vo2.0V
Vo3.0V
Vo4.0V
Vo5.0V

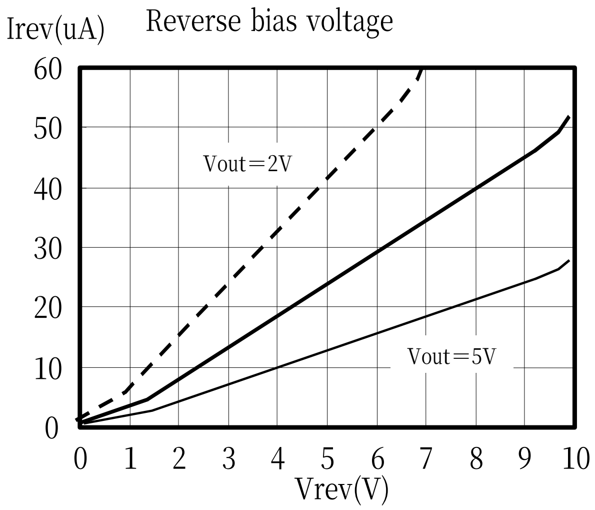

△Vout(mV)
Load regulation
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
0
50
100
150
200
Iout (mA)
Vo=2.0V
Vo=5.0V

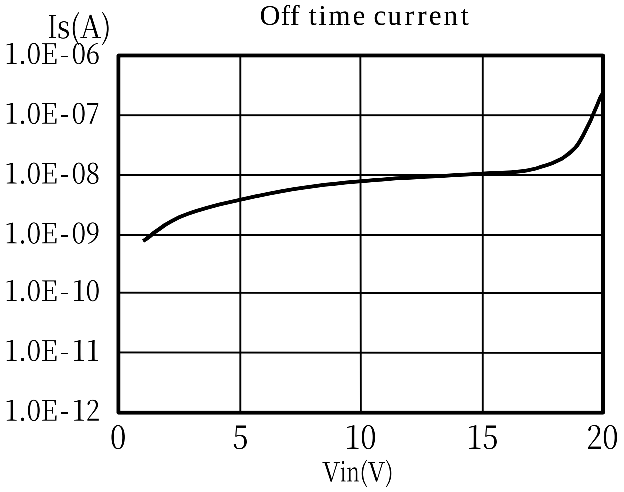

Stability point
△Vout(mV)
Iout=0～250mA
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
Iout=200mA
Iout=50mA Step
-100
0
100
200
300
△Vin(mV)

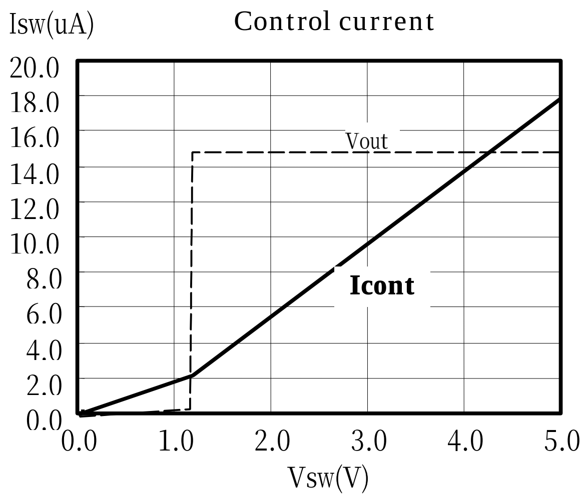

Vdrop(mV)
Drope out Voltage
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
0
20
40
60
80
100
120
140
160
180
200
Iout(mA)

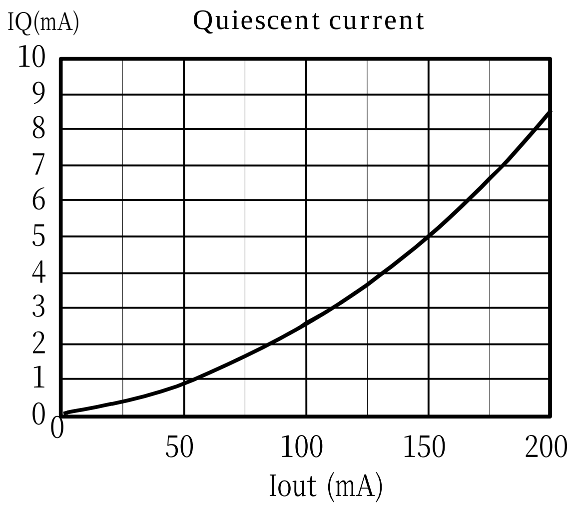

Vout(V)
Short circuit current
5.0
4.0
3.0
2.0
1.0
0.0
0
100
200
300
400
500
Iout (mA)


IoutMax at low Vop
TK11115 ~ TK11124
IoutMax(mA)
350
300
250
200
150
100
50
0
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
Vop(V)


Irev(uA)
Reverse bias voltage
60
50
40
30
20
10
0
Vout=2V
Vout=5V
0 1 2 3 4 5 6 7 8 9 10
Vrev(V)

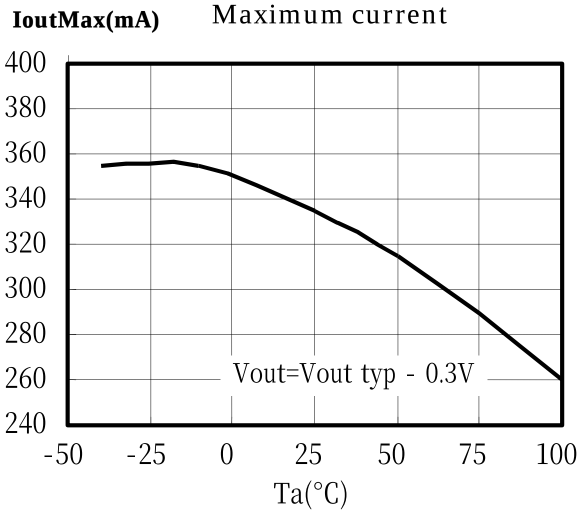

Is(A)
Off time current
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
1.0E-12
0 5 10 15 20
Vin(V)

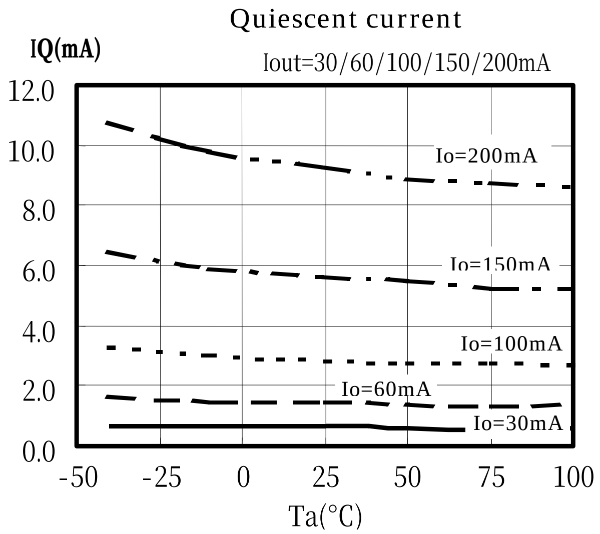

Isw(uA)
Control current
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Vout
Icont
0.0 1.0 2.0 3.0 4.0 5.0
Vsw(V)

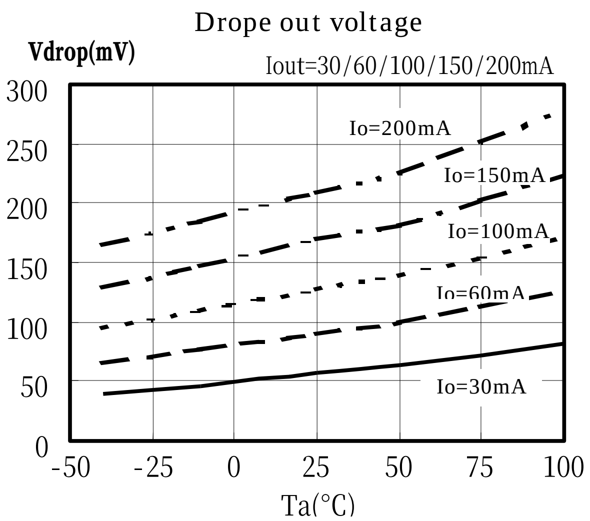

IQ(mA)
Quiescent current
10
9
8
7
6
5
4
3
2
1
0
0 50 100 150 200
Iout (mA)

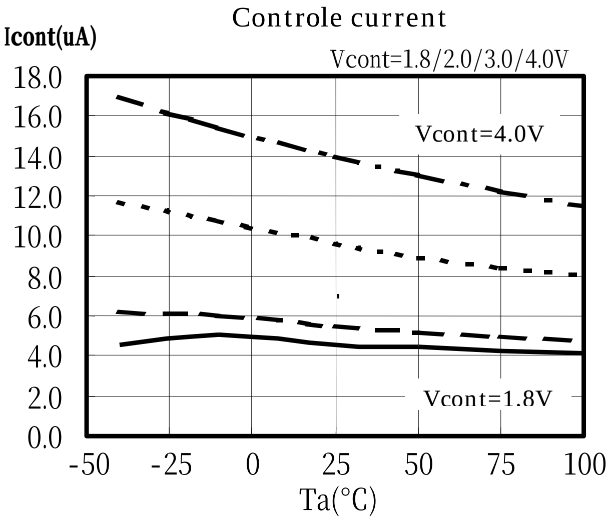
Temperature characteristics

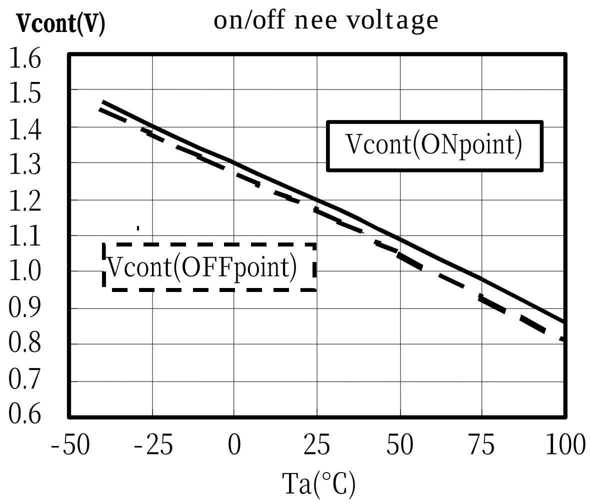
(Ta: ambient temperature)





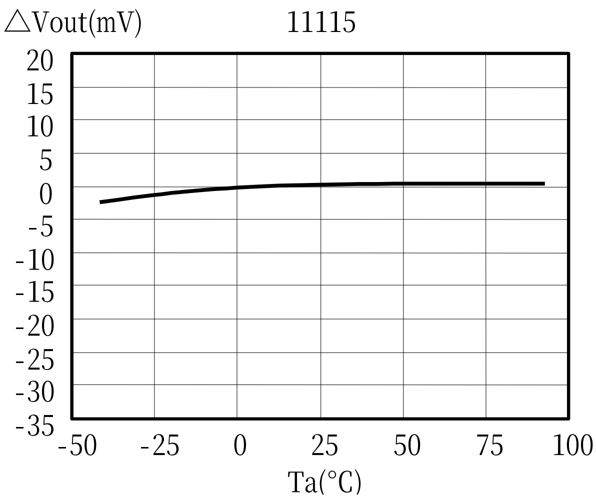


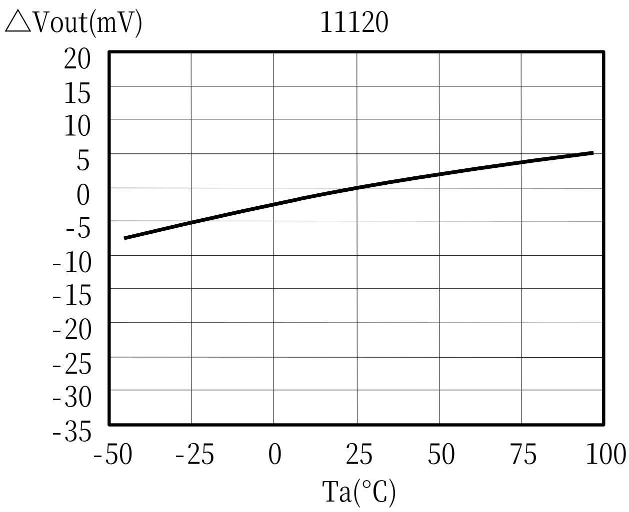


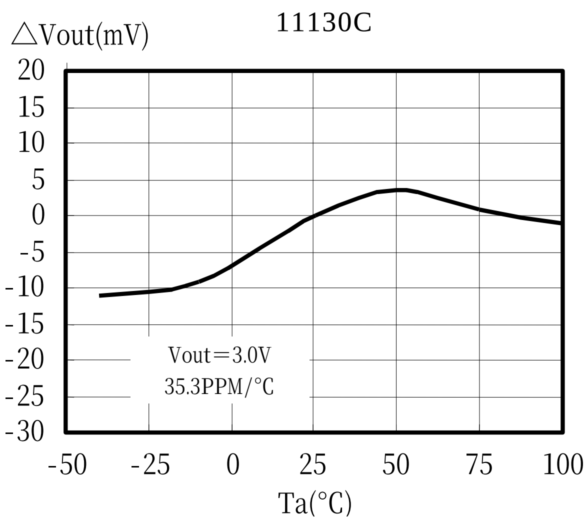


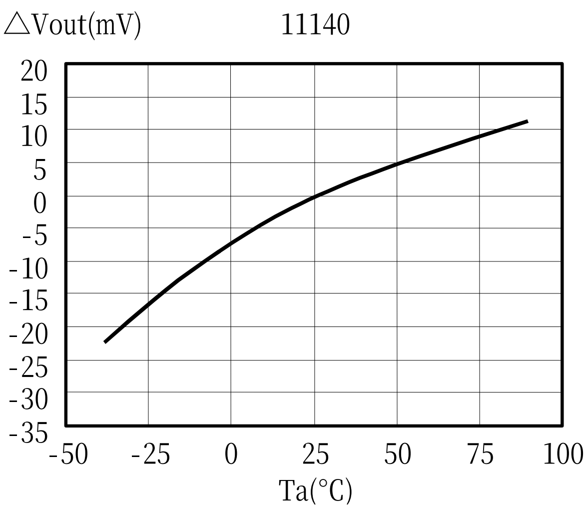
Temperature Characteristics

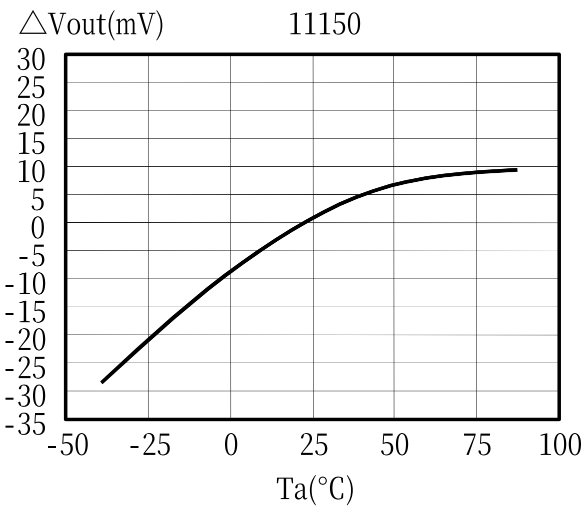
Low Output Voltage



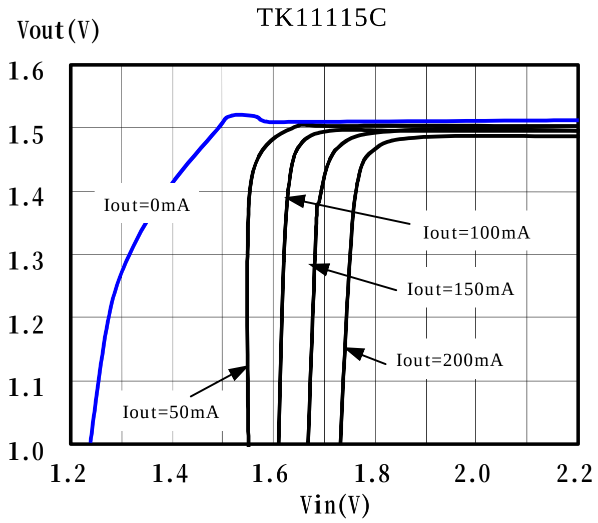


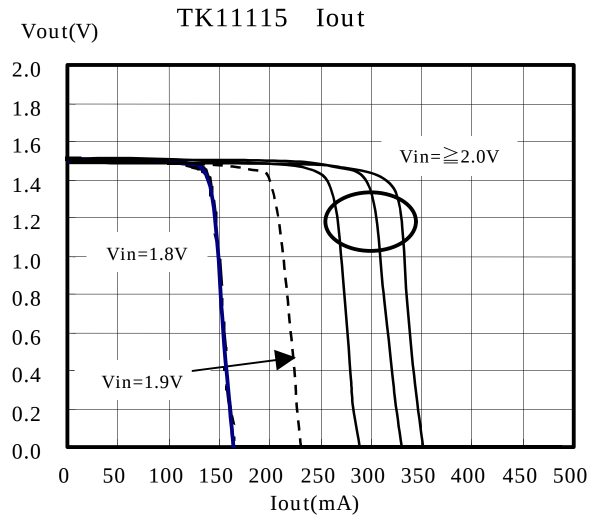


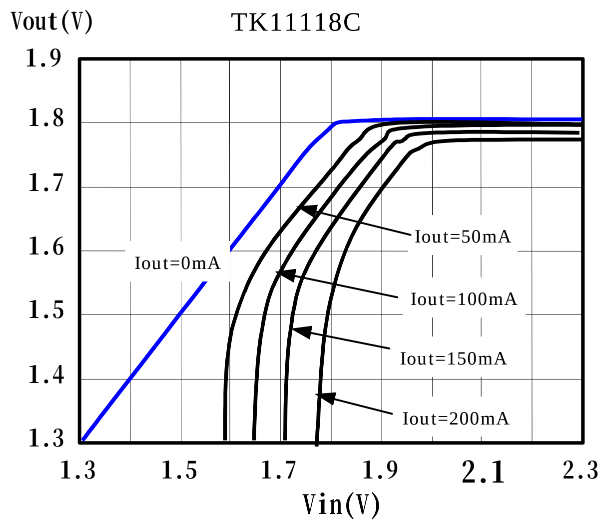


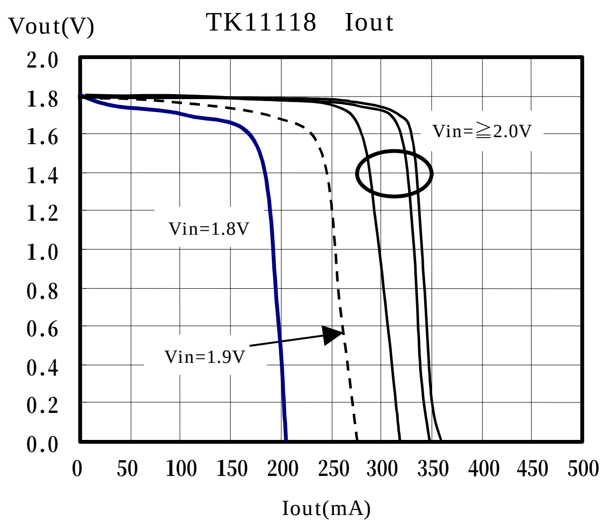


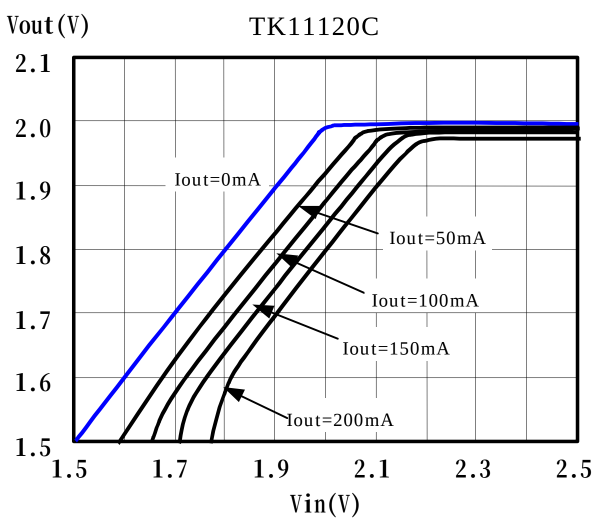
Low output voltage device **Vin-Vout characteristics**

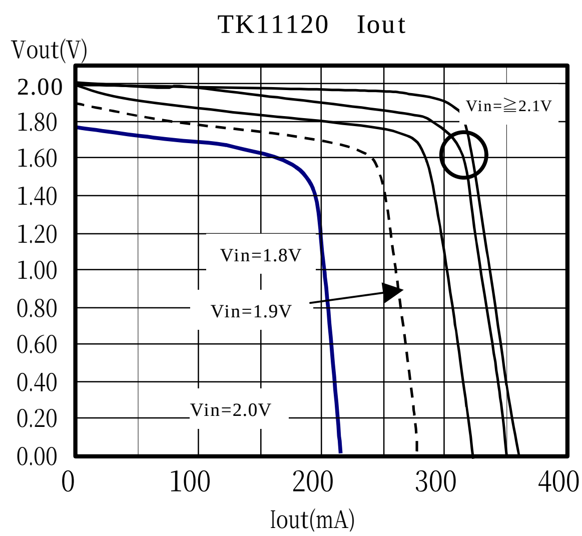




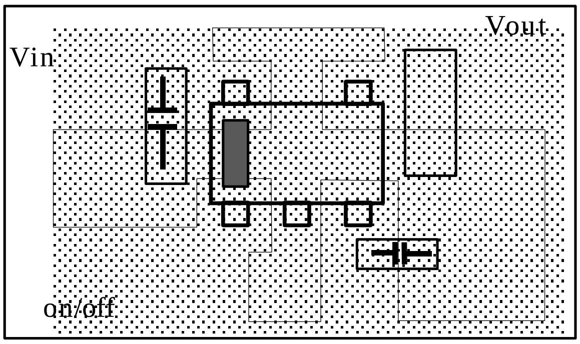


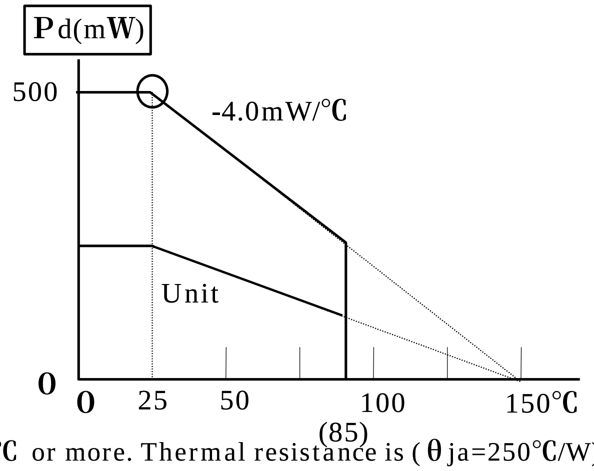






Layout Material：Grass epoxy 40＊40mm t=0.8mm





Please do derating with 4mW/℃ at Pd=500mW and 25℃ or more. Thermal resistance is (θja=250℃/W). The heat loss of A and B is done in total. The package loss is limited at the temperature that the temperature sensor of internal organs works (about 150℃). Therefore, the package loss is assumed to be an internal limitation. There is no heat radiation characteristic of the package unit well because of the small size. Heat runs away by the thing installed in PCB. This value changes by the material and the copper pattern etc. of PCB. The loss's of about 500mW enduring becomes possible in a lot of applications at 25℃ time.

The thermal resistance when mounted on PCB is requested.

The operating chip junction temperature is shown by
Tj=θja×Pd+Ta. Tj of IC is set to about 150℃.
Pd is a value when the overheating sensor is made to work.

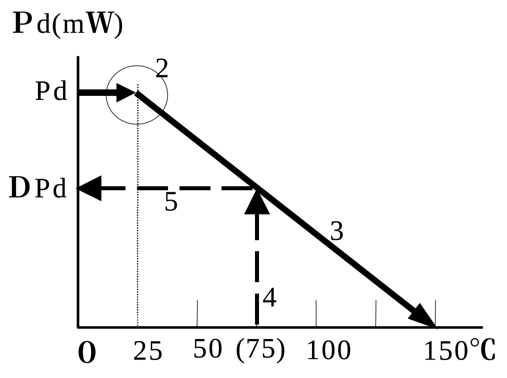
Ta（Ta=25℃）
150＝θja×pd＋25
θja×Pd＝125
θja＝（125／pd）(℃／mW)

Pd is easily obtained.

Mount the IC on the print circuit board. Short between the output pin and ground. after that, raise input voltage from 0V to evaluated voltage (see*1) gradually.
At shorted the output pin, the power dissipation P_D can be expressed as Pd=Vin × Iin.
The input current decreases gradually as the temperature of the chip becomes high. After a while, it reaches the thermal equilibrium. Use this currrent value at the thermal equilibrium. In almost all the cases, it shows 500mW(SOT23-5) or more.

*1 In the case that the power, Vin ×Ishort(Short Circuit Current), becomes more than twice of the maximum rating of its power dissipation in a moment, there is a possibility that the IC is destroyed before internal thermal protection works.

Pd is obtained by the normal temperature degree. The current that can be used at the highest operating temperature is obtained from the graph of the figure below.



Procedure (When PCB is mounted, do).

1. Pd is obtained (Vin×Iin when the output side is short-circuited).
2. Pd is plotted on the line of 25℃.
3. Pd is connected with the point of 150℃ by the straight line. (bold face line)
4. Lines are extended more vertically than the points of the use height temperature in the design (For instance, it is assumed 75℃). (broken line)
5. extension of intersection of derating curve (fat solid line) (broken line) to the left and reading by Pd value
6. DPd÷(Vinmax—Vout)=Iout (at 75℃)

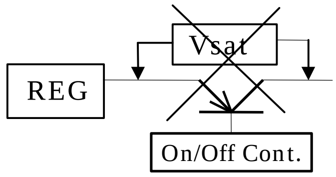
The current that can be maximum used at the highest operating temperature is

Iout DPd÷(Vinmax—Vout).

When (Vinmax—Vout) is small, a lot of Iout is calculated. However, use that exceeds IoutMax cannot be done.

Application hint

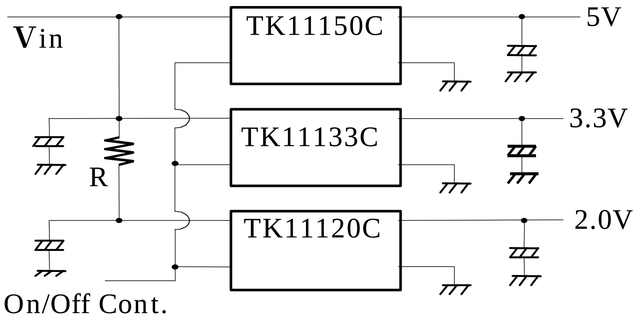
On/off Control



Please make the regulator Off when the circuit after the regulator non-operates. The design with a little electric power loss can be done. We will recommend the use of the on/off control of the regulator without using high side SW to output the regulator. A highly accurate output voltage and the low drop voltage are obtained.

Because the control current is a little, it is possible to control directly by CMOS logic.
The PULLDOWN resistance is built into the control terminal. (500KΩ)
The noise and the ripple rejection characteristic depend on the capacity of the terminal Vref and change.
The ripple rejection characteristic of the low frequency region improves by the capacity of Cnp large.
A standard value is Cnp=0.0068μF. Please enlarge Cn in the design with an important output noise and ripple rejection. IC does not break even if the capacitor is enlarged.
The switch speed of off/on changes depending on the capacity of the terminal Np. The switch speed slows when capacity is large.

Parallel connected ON/OFF Control



There is overheating worry because the power loss of low voltage side (TK11120) IC is large.
Please decrease the electric power loss by using resistance (R) as shown in a left chart if necessary.
When the overheating sensor works, the decrease of the output voltage or the oscillation, etc. are observed.

Current boost

Please use the undermentioned product. The low saturation and the large current regulator can be easily made.

TK714xx Only PNP-Tr for a current boost is external.

TK732XX (For Iout-Max10A regulator)

Built in Short circuit protect: Constant current can be set by external resistor.

Definition of term

The measurement voltage (output voltage Typ+1V) has been described in the output voltage table.

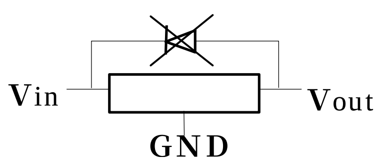
- Output voltage (Vout) is measured by the following condition.
  (Vin = output voltage Typ+1V) ：Output current (Iout=5mA).
- The maximum output current (Iout Max) It is an input voltage (output voltage Typ+1V).
- It is an output current measured when the output voltage obtained this time decrease by ($Vout_{Typ.}$×0.9) by the thing to throw load current (Iout).
- The maximum output current will be measured in a short time so that the influence done by the temperature of the chip is not done.
- The output current decreases when a low voltage operates.
  Please refer to "Low input voltage-output current" graph for 2.1V or less.
- Drop out voltage (Vdrop) is an I/O voltage difference when the circuit stops the stability operation decreasing in the input voltage. This voltage depends on load current (Iout) and junction temperature (Tj).
- The input voltage is gradually decreased than the standard. It is a voltage difference between the input and the output when the output voltage decreases by 100mV.
- Line regulation (Lin Reg) The input voltage is assumed to be a standard. It is an output voltage change when this input voltage is made to change 5V higher. This measurement does not influence by the temperature of IC and be measured in a short time.
- Load regulation (Load Reg) .. The input voltage is assumed to be a standard. It is an output voltage change to the change from 5 to 100mA and 200mA in the load current.
  ΔVlo=｜VM1`−VM2`｜ This measurement does not influence by the temperature of IC and be measured in a short time.
- Quiescent current (IQ) . Current which flows to terminal GND according to load current. It is measured by(input current-output current)
- Ripple rejection (**RR**) ..Input voltage is (Vout＋1.5V) and Iout=10mA CL=1.0μF CN=0.01μF
  The Alternating Current of (f=1KHz 200mV_{RMS})is made to be superimposed to the power-supply voltage. The ratio of the voltage and the input voltage that this shape of waves appears to the output is measured. It obtains about 80dB in 1KHz. The ripple rejection improves when the capacitor of the noise passing terminal in the circuit composition is large. However, the response of on/off worsens.
- Standing by current. Current which flows to IC when control is made 0 voltages. 8V input voltage.

Protection circuit

- Short circuit sensor............ This operates when there are quite a lot of output currents (The output was mistaken and connected to GND. The current flows to the set peak value.
- Overheating sensor. This operates when there are a lot of losses of the regulator (An outside temperature is high and heat radiation is bad). When the temperature of the chip (Tj)reaches about 150℃, IC does the operation stop. However, operation begins at once when the operation stop is done and the temperature of the chip decreases. Therefore, it seems that on/off doing IC oscillates at high speed when the output side is observed with the oscilloscope. Please improve heat radiation or lower the input electric power. When heat radiation is bad, the forecast package loss is not obtained.

* In the case that the power, Vin × Ishort(Short Circuit Current), becomes more than twice of the maximum rating of its power dissipation in a moment, there is a possibility that the IC is destroyed before internal thermal protection works.

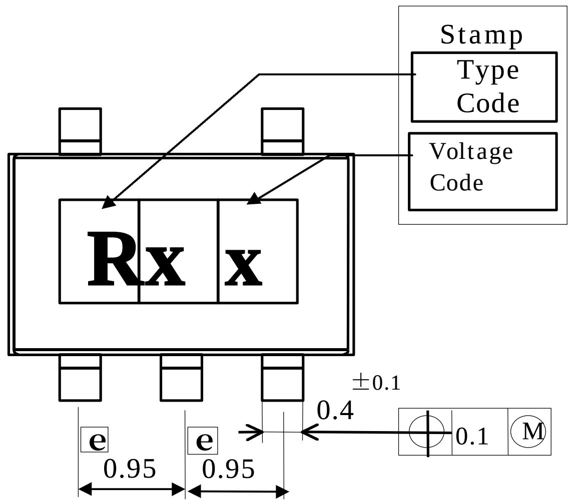
- Reverse bias current .... An excessive current does not flow to IC even if the input voltage becomes 0 with the voltage impressed to the output side. (Input-GND short-circuit) Max of the voltage of a reverse-bias is 6V.

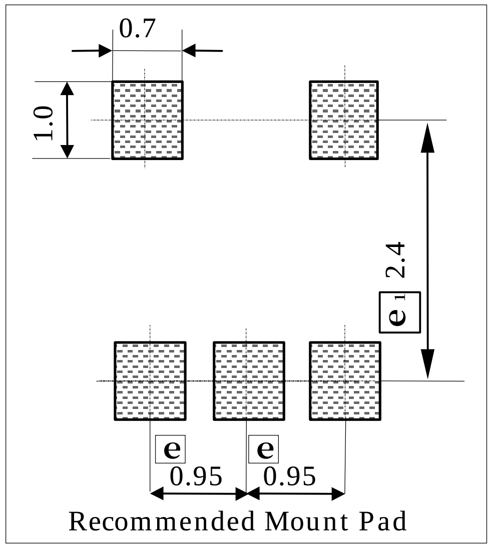


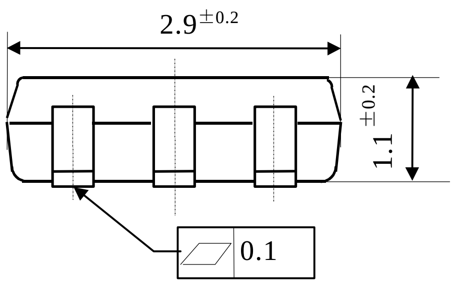
- **ESD**..........MM 200pF 0Ω 200V Min
  HBM 100pF 1.5kΩ 2000V Min

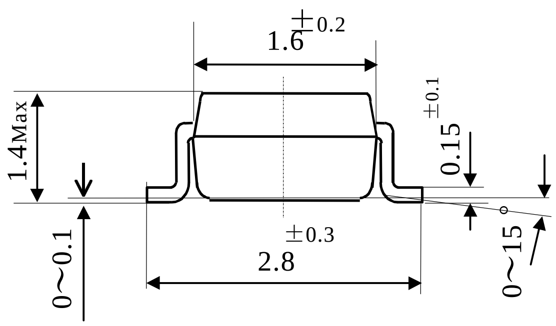
Outline ; PCB ; Stamps

SOT23-5









Unit : mm
General tolerance : ±0.2

Molded Resin with Body	: Epoxy Resin
Lead Frame	: Copper Alloy
Treatment	: Solder Plating(5～15 μm)
Marking Method	: Ink or Laser
Weight	: 0.016g
Country of origin	: Japan or Korea

V OUT	V CODE	V OUT	V CODE	V OUT	V CODE	V OUT	V CODE
1.5 v	15	2.5 v	25	3.5 v	35	4.5 v	45
1.6	16	2.6	26	3.6	36	4.6	46
1.7	17	2.7	27	3.7	37	4.7	47
1.8	18	2.8	28	3.8	38	4.8	48
1.9	19	2.9	29	3.9	39	4.9	49
2.0	20	3.0	30	4.0	40	5.0	50
2.1	21	3.1	31	4.1	41		
2.2	22	3.2	32	4.2	42		
2.3	23	3.3	33	4.3	43		
2.4	24	3.4	34	4.4	44		

The output voltage table indicates the standard value when manufactured.

NOTE

Please be sure that you carefully discuss your planned purchase with our office if you intend to use the products in this data sheet 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 data sheet.

- 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 data sheet is effective from Oct. 2002. 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 data sheet. Moreover, this data sheet does not signify that TOKO agrees implicitly or explicitly to license any patent rights or other intellectual property rights which it holds.

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

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

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