IC DATA SHEET

TOKO

LDO REGULATOR WITH ON/OFF SWITCH
TK717xx

MEETING YOUR NEEDS
TOKO, INC.

TK717xx

Features

   Built-in shunt circuit of output to GND. Charged energy of output capacitor is discharged quickly.

  Built-in PNP power transistor. Very small Dropout Voltage
    Vdrop=163mV at Iout=　00m

Very good stability (CL=0.22μF is stable for any type capacitor with 2.0V　Vout

High accuracy out put voltage　±50mV or± 1.5

Good ripple rejection ratio　80dB　at　1KHz　Iout=10mA

Wide operating voltage range　　1.8V　14V

Built-in short circuit protection

Built-in over temperature protection

Suitable for low noise applications

Available with on　off control　　High　on　. Off time input current becomes pA level

Very small package

Description

The TK717xx is an integrated circuit with a silicon monolithic bipolar structure. The regulator is of the low saturation voltage output type with very little quiescent current (72μA).

The PNP power transistor is built-in. The I/O voltage difference is 163 mV (typical) when a current of 200mA is supplied to the system. Because of the low voltage drop, the voltage source can be effectively used; this makes it very suitable for battery powered equipment.

The on/off function is built into the IC. The current during standby mode becomes very small (pA level). In addition, the output short-circuit function works at off times.　It is a unique characteristic by which the residual charge of the output side capacitor is rapidly discharged.
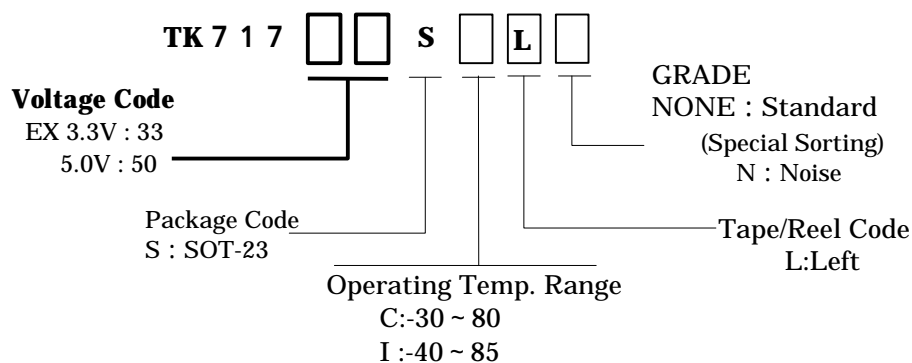
The output voltage is available from 1.5 to 10.0V in 0.1V steps. The output voltage is trimmed with high accuracy. This allows the optimum voltage to be selected for the equipment.

The over current sensor circuit and the reverse-bias protection circuit are built-in.

It is a very rugged design because the ESD protection is high. Therefore, the TK717xx can be used with confidence. When mounted on the PCB, the power dissipation rating becomes about 500mW, even though the package is very small.

The TK717xx features very high stability in both DC and AC. The capacitor on the output side provides stable operation with 0.22μF with 2.0V　Vout. A capacitor of any type can be used; however, the larger this capacitor is, the better the overall characteristics are.

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                    ┌─────────────────────────┐
                    │  ORDERING   INFORMATION │
                    └─────────────────────────┘

            TK    □□   S   □ L □
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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

GRADE
NONE   Standard
(Special Sorting)
N   Noise

Boldface type applies **Standard Voltage.**

OUT	V CODE	OUT	V CODE	OUT	V CODE	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

Absolute maximum ratings

Parameters	Symbol	Limiting Values		Unit
Supply voltage	cc Max	0.4	6	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	
Operating temperature range	Top	-30	80	
Short circuit current	Ishort	410		mA
Power dissipation	Internally limited	150mW free air		500mW mounted (reference)

Electronic characteristics

Vtest=Vout$_{Typ}$+1V   Vcont=1.8V   Ta 25

Parameters	Symbol	Min	yp	Max	Unit	Condition	
Output voltage	Vout	See table 1					
Line regulation	LinReg		0	5	V	Vtest=Vout$_{Typ}$+1V---- Vout$_{Typ}$+6V	V=5V
Load regulation	LoaReg		(8)	(23)	V	5mA Iout 100mA Note1	
			(21)	(58)	mV	5mA Iout 200mA Note1	
Dropout voltage	Vdrop		65	130	mV	out=50mA	
			103	200	mV	out=100mA	
			163	300	mV	out=200mA **(2.4V Vout)**	
			163	300	mV	out=180mA **(2.1V Vout 2.4V)**	
	1.5V Vout 2.0V		**No regulation**			Because of Vop$_{Min}$=1.8V	
Maximum output current	IoutMax	280	370		A	When Vout$_{Typ}$.× 0.9	
			250			**1.8V Vcc 2.1V** Reference Value	
Quiescent current	Iq		72	110	μ A	out=0mA Excluding Icont	
Ground pin current	Ignd		0.8	1.5	A	Iout=50 A	
Standby current	Istandby		0.0	0.1	μ A	Vcc= V, Vcont 0.15V Off state	
Discharge current	Idis	19	29		A	rev=2V off state (71720)	
		25	38		A	rev=3V off state (71730)	
		27	41		A	rev=4V off state (71740)	
		29	44		A	rev=5V off state (71750)	
Control terminal Specification (Pull down resistor =None Note 2							
Control current	Icont		0.86	2.5	μ A	Vcont 1.8 on state	
Control voltage	Vcont	1.6			V	on state	
				0.6	V	off state	
Np treminal Voltage	VNp		1.26		V		
Vo	Vo/Ta	Typ=25 ppm/				Reference Value	
Out put noise	Vno	0.14 0.25 μ V/ Hz at 1KHz				Reference Value	

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

Note 2: The input current decreases to the pA level by connecting the control terminal to GND.   Off
       state

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 μ V/ Hz at 1KHz : 25   65μ Vrms at BW400-80kHz

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

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

Table 1

C Rank   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 are same as C Rank
    Operating Temperature Range   Top=-40   85
    Operating Voltage Range   Vop   2.1V   14V   Other items are same as C rank.

Boldface type applies over the full operating temperature range. (-40   85)

Vtest=Vout$_{Typ}$+1V Vcont=1.8V

Parameters	Symbol	Min	yap	Max	Unit	Condition
Output voltage	Vout		See table			
Line regulation	LinReg		0	5 8	V	V=5V
Load regulation	LoaReg		(8)	(23) 31	mV	5mA IL 100mA Note1
			(21)	(58) 72	mV	5mA IL 200mA Note1
Dropout voltage	Vdrop		65	130 180	mV	out=50mA
			103	200 270	mV	out=100mA
			163	300 350	mV	out=200mA**(2.4V Vout)**
			163	300 350	mV	out=180mA **(2.2V Vout 2.4V)**
	1.5V Vout 2.1V		**No regulation**			Because of Vop$_{Min}$=2.1V
Maximum output current	IoutMax	280 250	370		A	When Vout$_{Typ.}$× 0.9
Quiescent current	Iq		72	110 120	μ A	out=0mA Excluding Icont
Ground pin current	Ignd		0.8	1.5 1.8	A	Iout=50 A
Standby current	Istandby		0.0	0.1 0.5	μ A	Vcont 0.15V 0ff
Discharge current	Idis	13	29		A	rev=2V off state (71720)
		17	38		A	rev=3V off state (71730)
		19	41		A	rev=4V off state (71740)
		20	44		A	rev=5V off state (71750)
Control terminal Specification (Pull down resistor =none Note2						
Control current	Icont		0.86	2.5 3.0	μ A	Vcont 1.8 on
Control Voltage	Vcont	1.6 1.8			V	on state
				0.6 0.35	V	off state
Np Terminal Voltage	VNp		1.26		V	
Vo	Vo/Ta		Typ=25 ppm/			Reference value
Output noise	Vno	0.14	0.25 μ V/	Hz at1KHz		Reference value

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

Note 2: The input current decreases to the pA level by connecting the control terminal to GND.   Off state

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

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 μ V/ Hz at 1KHz : 25   65μ Vrms at BW400-80kHz

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

     CL=1.0μ F,Cnp=0.01μ F,Vnois=200mV$_{RMS}$,Vin=Vout$_{Typ}$+1.5v,Iout=10mA
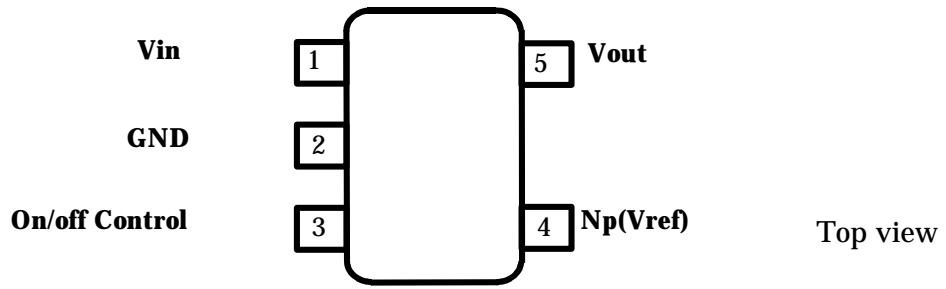
Table 2

I Rank   Output Voltage

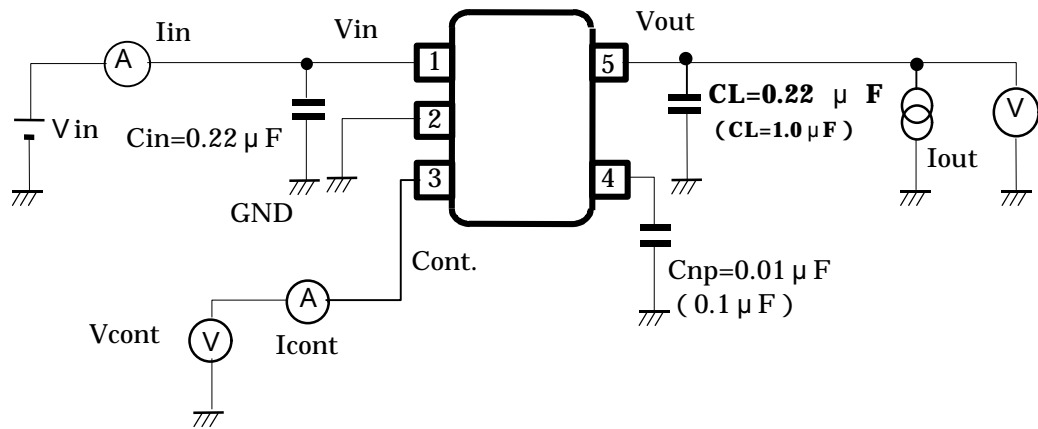**Boldface type** applies over the full operating temperature range.   Ta=-40 85   Iout=5mA

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 **2.020**	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 **2.920**	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

Vin	1		5	Vout
GND	2			
On/off Control	3		4	Np(Vref)

Top view

Application

Iin   Vin   Vout

in   Cin=0.22μF   CL=0.22 μ F
                       CL=1.0μF
                       Iout

GND   Cont.

Vcont   Icont   Cnp=0.01μ F
                    0.1μ F

Block diagram

Vin

Cont.

Control Circuit

700k

Constant Current Source

Bandgap Reference

Thermal & Over Current Protect

Auto Discharge Circuit

Vout

GND   Np
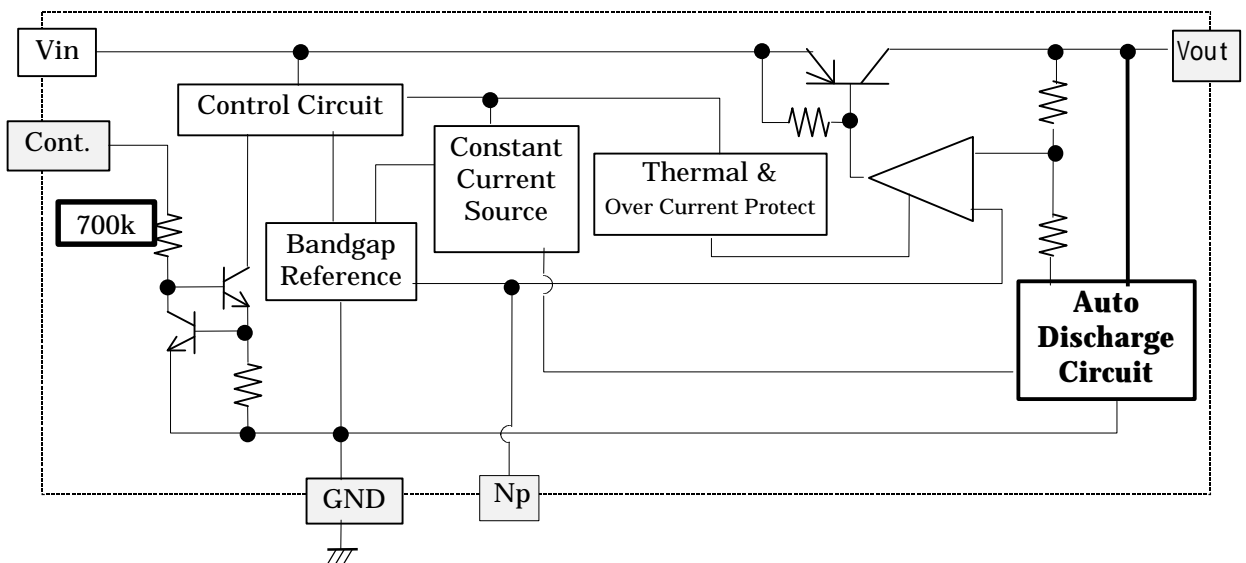
Input /Output Capacitors

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.

The recommended values:	Vout	2.0V	CL	0.22μ F. Iout	0.5mA
	Vout	1.5V	CL	0.47μ F. Iout	0.5mA
The exception to this is at low output current.					

Vout

Cin=0.22μ F
0.1μ F

Cn=0.01μ F

CL=0.22μ F
0.1μ F
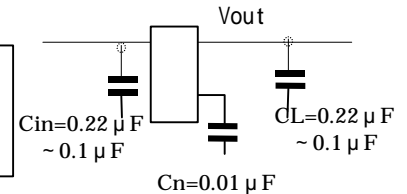
The input capacitor is necessary when the battery is discharged, the power supply impedance increases, or the line distance to the power supply is long. This capacitor might be necessary on each individual IC even if two or more regulator ICs are used. It is not possible to determine this indiscriminately. Please confirm the stability while mounted. The IC provides stable operation with an output side capacitor of 0.22μ F (Vout 2.0V). If it is 0.1μ F 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   at 100kHz
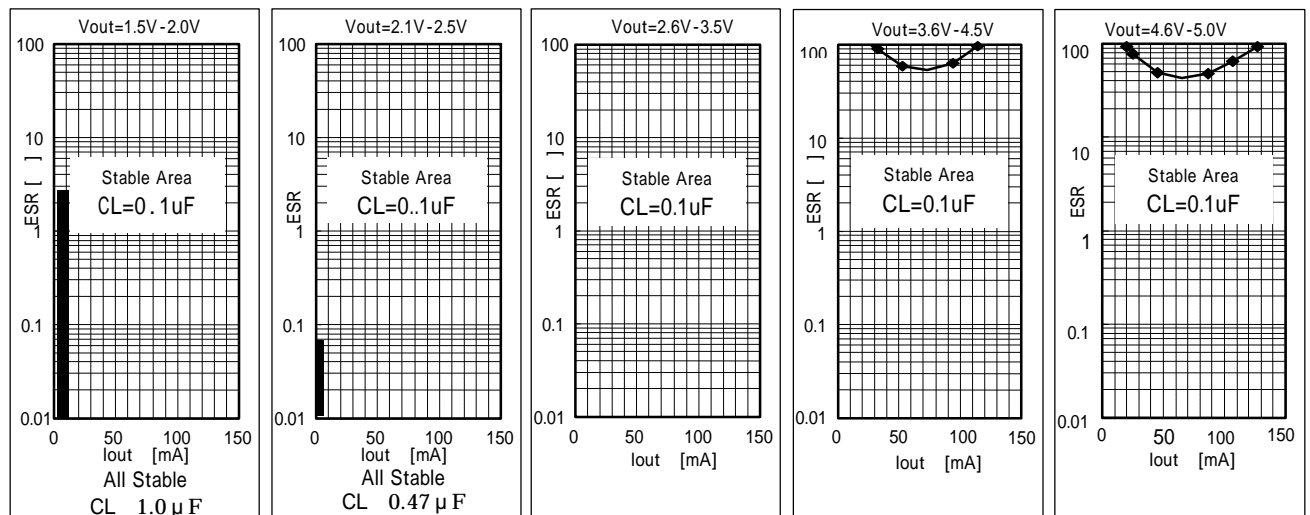
Please increase the output capacitor value when the load current is 0.5 mA or less. The stability of the regulator improves if a big output side capacitor is used (the stable operation area extends.)

Low Voltage device: Please increase the output capacitor like 1.0μ F when the load current is used by 0.5mA or less.

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

Please increase the output capacitor to 1.0μ F when the load current is 0.5mA or less.

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 recommended characteristics.
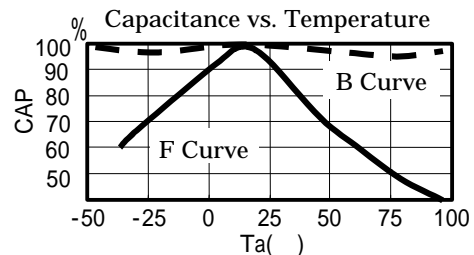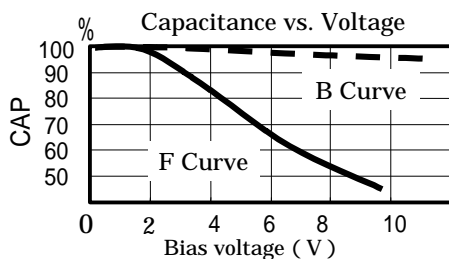
Output noise

TK71730S   Cnp vs Noise Iout=30mA BPF=400Hz 80kHz   (MLCC   stands for Multi Layer Ceramic Capacitor)

Cnp vs Noise

Noise uVrms)

CL=MLCC

	CL=0.22uF
	CL=0.47uF
	CL=1.0uF
	CL=2.2uF
	CL=10uF

CL=Tantalum

Cnp   F

Vout vs Noise

Noise(uVrms)

Iout=30mA Cnp=103 CL=1.0uF

MLCC

Tantalum cap

BPF=400Hz   80kHz
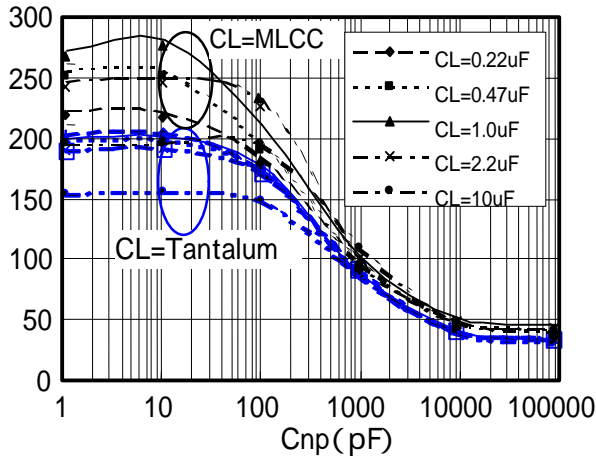
Vout(V)
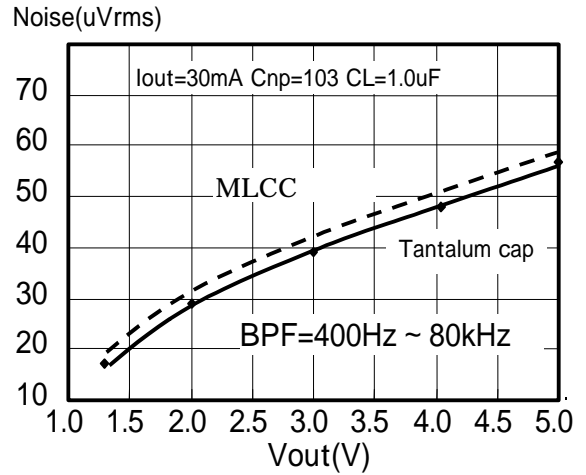
Noise(uVrms)   **CL=Tantalum**   Cnp=103

	CL=0.22uF
	CL=0.47uF
	CL=1.0uF
	CL=2.2uF
	CL=10uF

Iout(mA)

Noise(uVrms)   **CL=MLCC**   Cnp=103

	CL=0.22uF
	CL=0.47uF
	CL=1.0uF
	CL=2.2uF
	CL=10uF

Iout(mA)
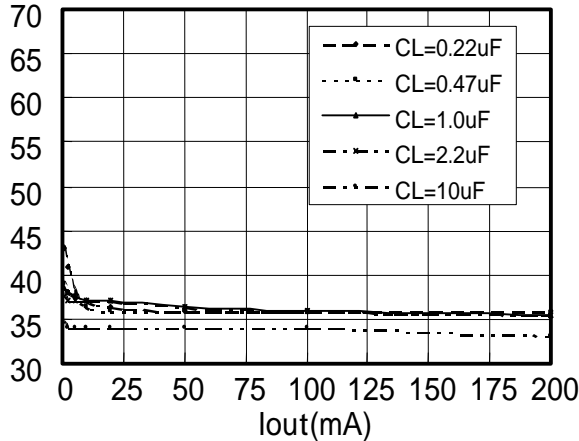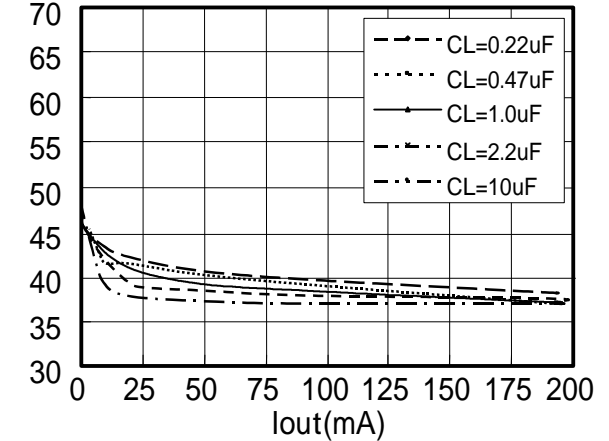
For better noise reduction, it is more effective to increase Cnp without increasing CL. The recommended Cnp capacitance is 6800pF (682) or 0.01μF (103). As the output voltage increases, the noise will also increase.

Please increase this capacitance when low noise is demanded. The IC does not operate abnormally about 0.1 and 0.22μF.

TK71730S   Cin=10μF Iout=10mA

Noise(μV/ Hz)   **CL=0.22μF Ceramic)**

Cnp=0.01μF

Cnp=0.10μF

Frequency kHz)
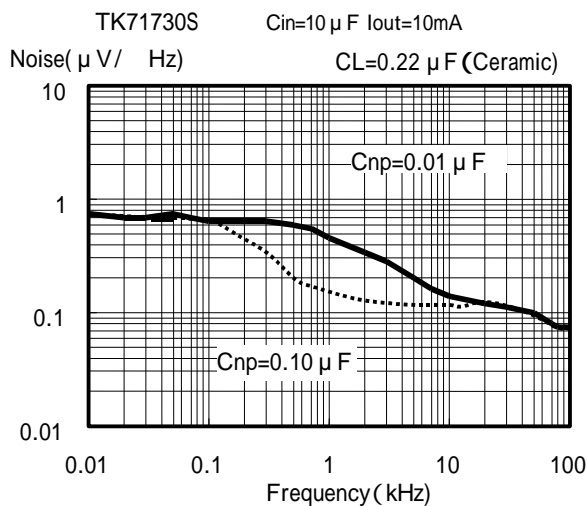
MLCC stands for Multi Layer Ceramic Capacitor.

TANTAL stands for Tantalum Capacitor.
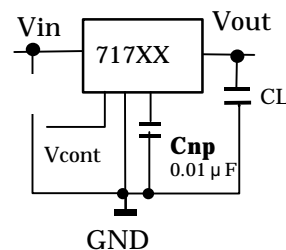
Ripple rejection

Vin=5.0V   Vout=3.0V   Iout=10mA   VR=500mVp-p   f=100   1MHz   Cin=0 pF   Cnp=0.01uF

M.L.Ceramic Capacitor
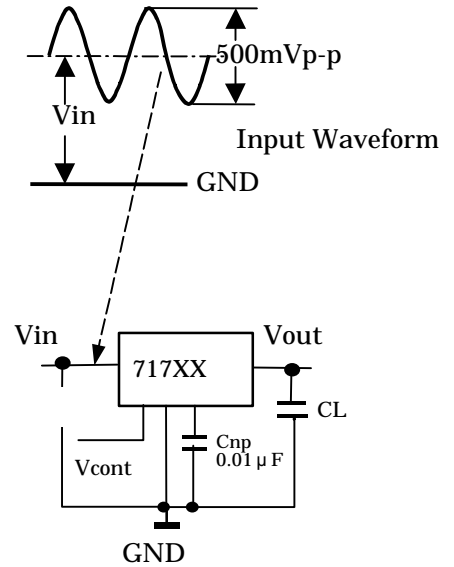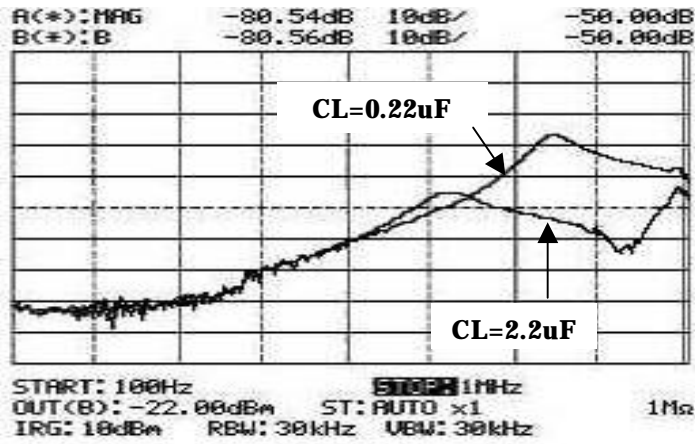
Tantalum Capacitor
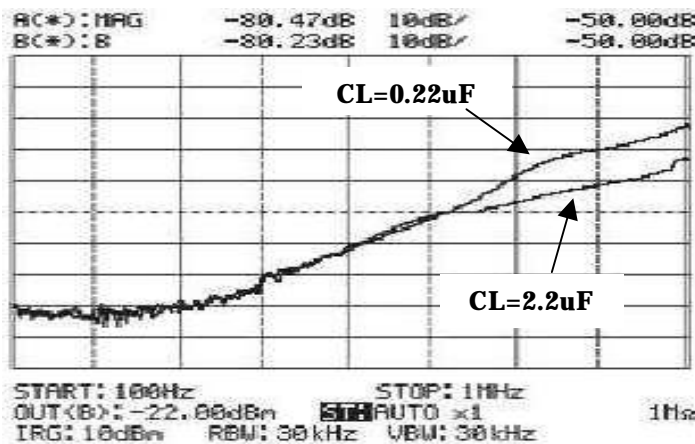
The ripple rejection characteristic depends on the characteristic and the capacitance value of the capacitor connected to the output side. The RR characteristic of 50KHz or more varies greatly with the capacitor on the output side and PCB pattern. If necessary, please confirm stability while operating.
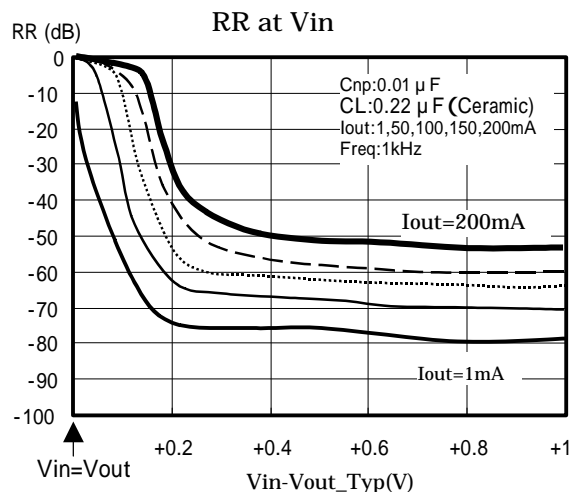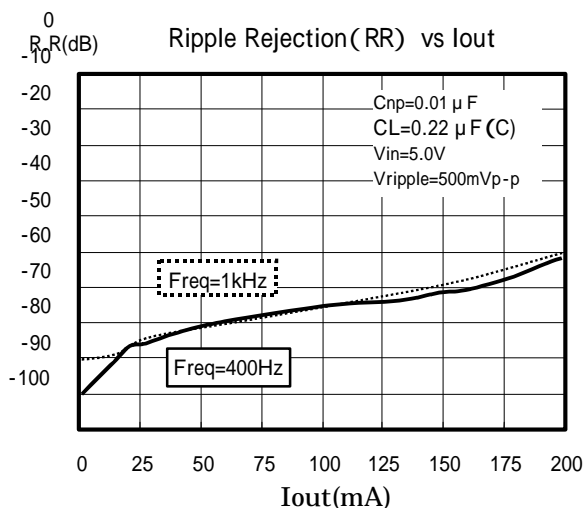
The stability level to a rapid power-supply voltage change and a load current change greatly depends on the value of the output side capacitor and the noise bypass capacitor.
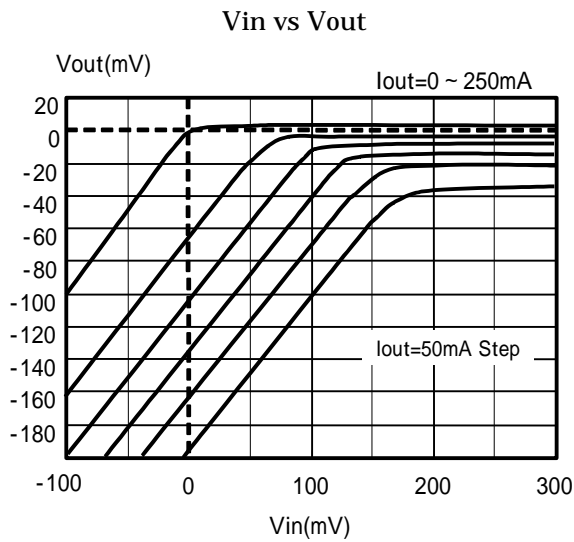
Please refer to the figure below.

Iout vs step response 1   Iout vs step response 2   Vcc vs step response
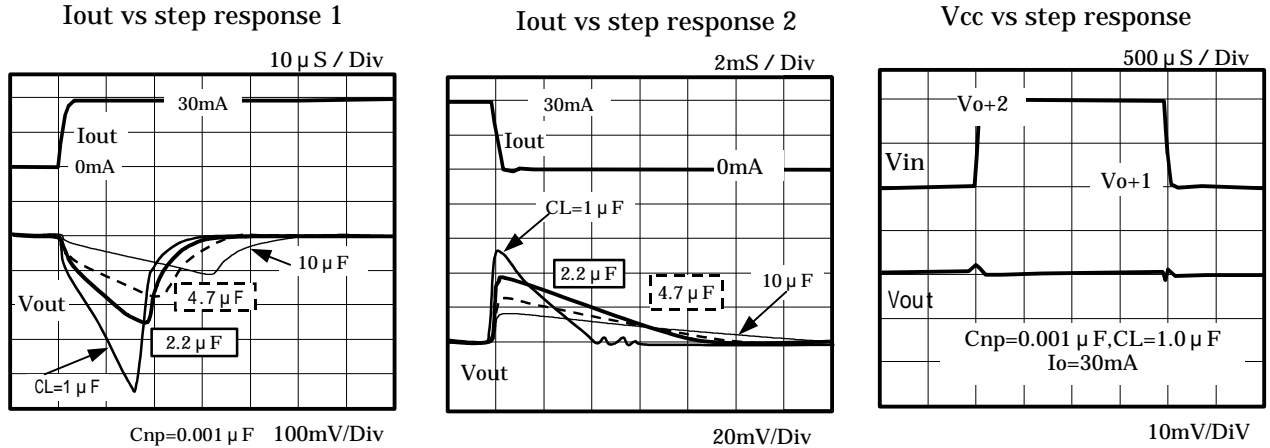
If the current is thrown into the load, the step response is settled fast.

On   off   Speed

The on/off switching speed quickens when the Cnp and CL capacitance is reduced.

However, the Load transient and Line transient response deteriorate when the capacitance is small.   In addition, the noise increases. We will recommend CL=0.22μ F and Cnp=1000pF to the demand of high-speed operation. Please increase each capacitance when low noise is desired.

The on/off switch speed greatly depends on the value of the output side capacitor and the noise bypass capacitor. Please refer to the figures below.

on/off Speed 1: Cnp=1000pF   on/off Speed 2: CL=2.2μ
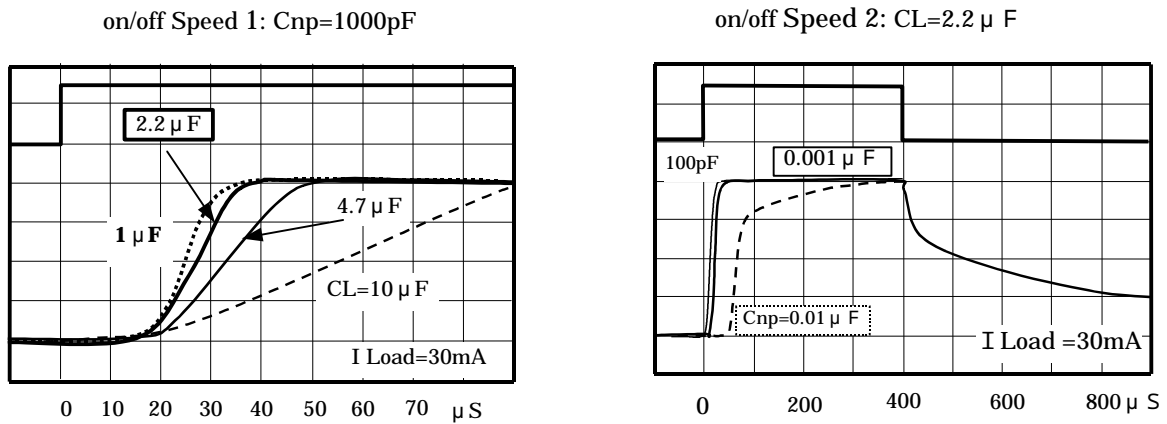
on → off Speed: CL=2.2μ F

TK717xx   has a short circuit during off .

TK716xxS and AS have a Disconnect circuit during off.

TK111xxC is a normal regulator.
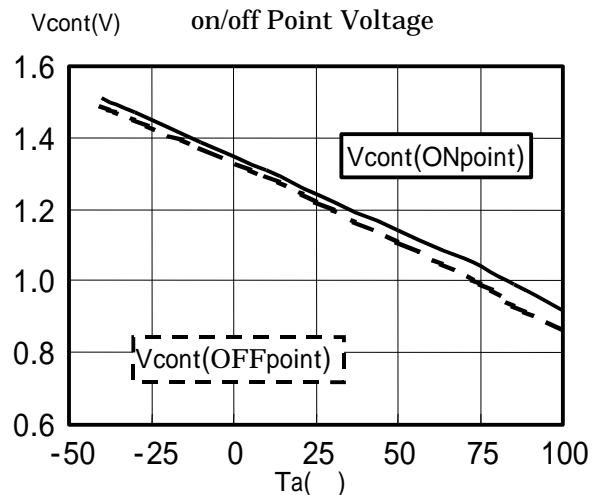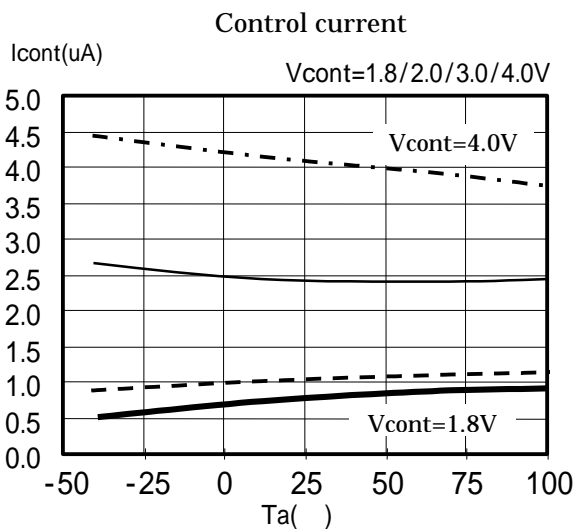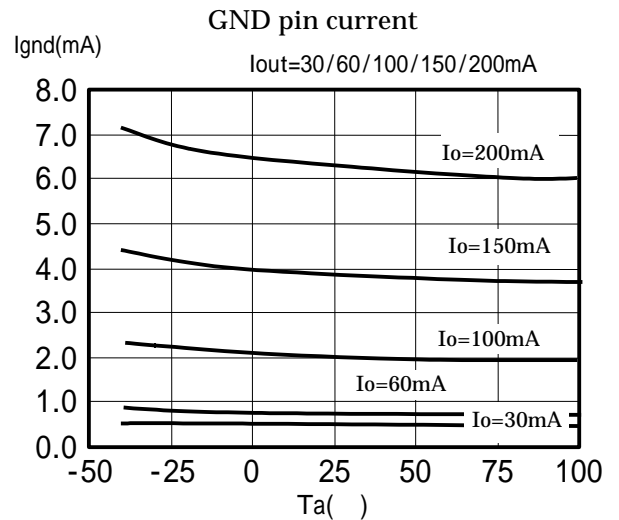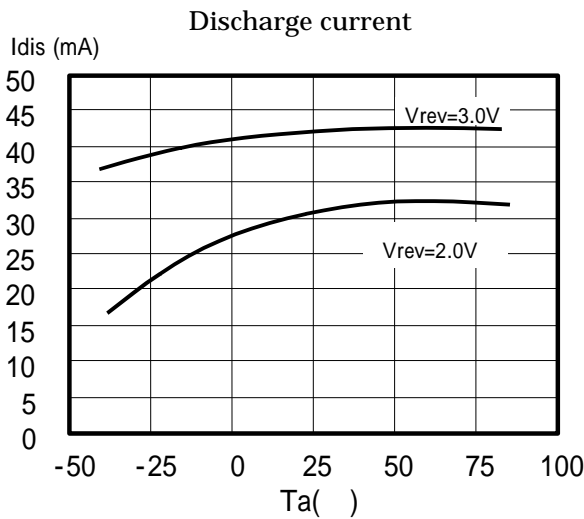
Please refer to the figure.

Line regulation

Vout(mV)

Vo1.5V
Vo2.0V
Vo3.0V
Vo4.0V
Vo5.0V

Vin(V)

Load regulation

Vout(mV)

Vo=2.0V
Vo=3.0V
Vo=5.0V

Iout (mA)

Vin vs Vout

Vout(mV)

Iout=0   250mA

Iout=50mA Step

Vin(mV)

Dropout voltage

Vdrop(mV)

Iout (mA)

Short Circuit current

Vout(V)

Iout (mA)

IoutMax at low Vop
TK71715 ~ TK71724

IoutMax(mA)

Vop(V)

Discharge Current

Idis(mA)

Standby Current

Is(A)

Control Current   Io=0mA

Icont(uA)

Vout

Icont

Vcont(V)

GND pin Current

Ignd(mA)

Iout (mA)

Icc at Low voltage   Io=0mA

Iin(mA)

Vo2.0V
Vo3.0V
Vo4.0V
Vo5.0V

Vin(V)

Temperature characteristics-1   (Ta: Ambient temperature)
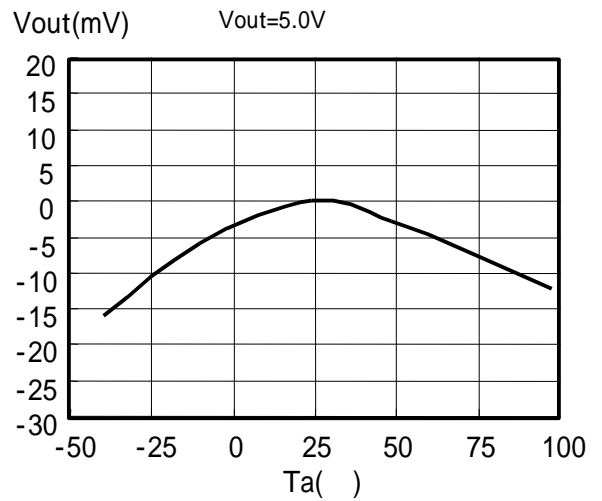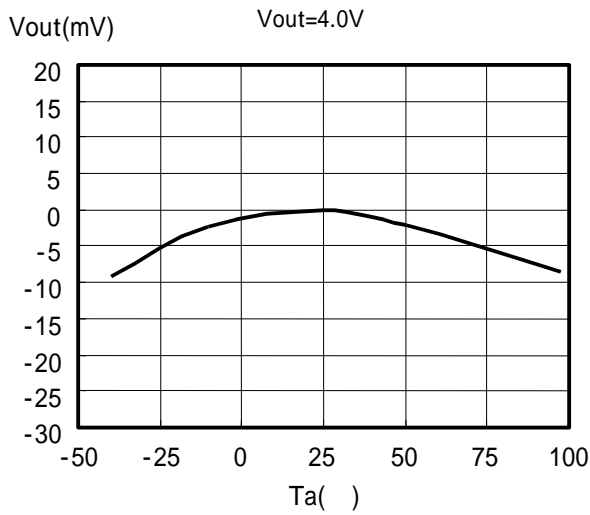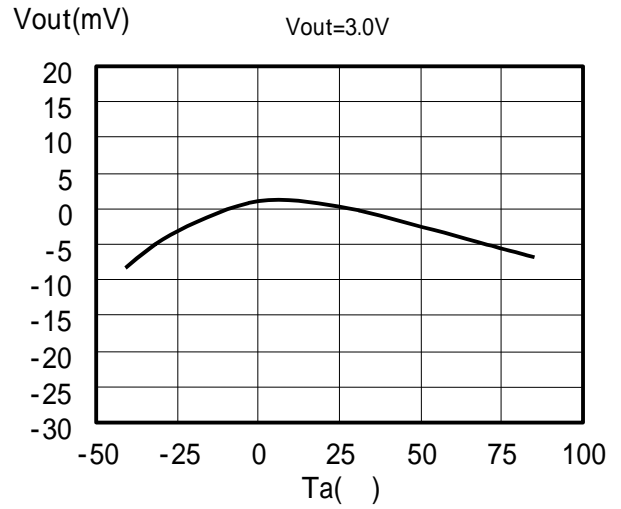
Dropout voltage

Vdrop(mV)

Iout=30／50／100／150／200／250／280mA

Io=280mA
Io=250mA
Io=200mA
Io=150mA
Io=100mA
Io=50mA
Io=30mA

Ta( )

Iout MAX

Iout Max(mA)

$Vout = Vout_{Typ.} \times 0.9$

Ta( )

Discharge current

Idis (mA)

Vrev=3.0V

Vrev=2.0V

Ta( )

GND pin current

Ignd(mA)

Iout=30／60／100／150／200mA

Io=200mA
Io=150mA
Io=100mA
Io=60mA
Io=30mA

Ta( )

Control current

Icont(uA)

Vcont=1.8／2.0／3.0／4.0V

Vcont=4.0V

Vcont=1.8V

Ta( )

on/off Point Voltage

Vcont(V)

Vcont(ONpoint)

Vcont(OFFpoint)

Ta( )

Temperature characteristics-2   Output voltage   (Ta: Ambient temperature)

Vout(mV)   Vout=2.0V

Vout(mV)   Vout=3.0V

Vout(mV)   Vout=4.0V

Vout(mV)   Vout=5.0V
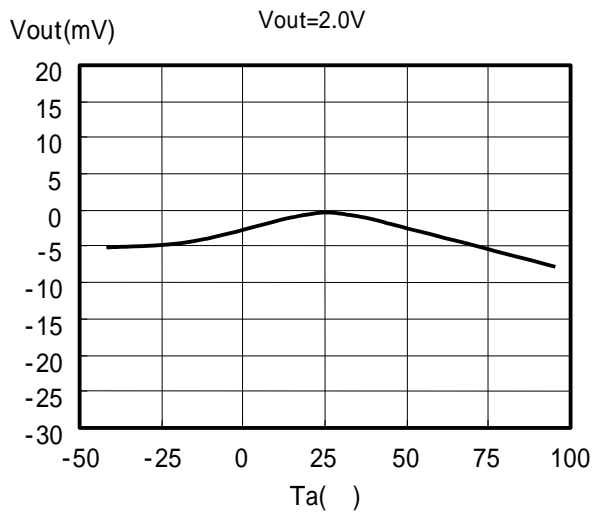
Low voltage device

The operating initial voltage at normal temperature is about 1.6V. The voltage dependency of the output current at the low input voltage is large. The operating initial voltage rises at low temperature.

TK71715

TK71718

TK71720
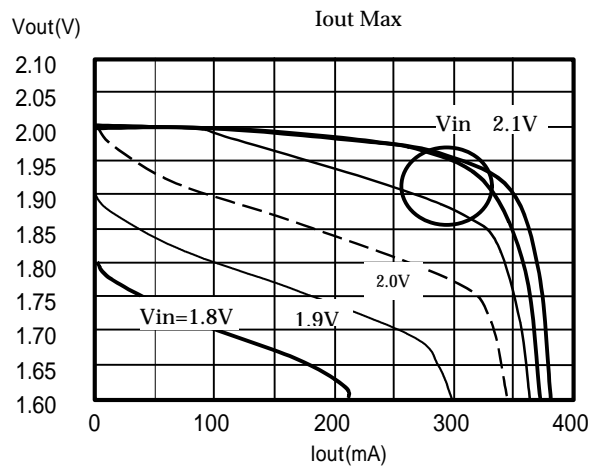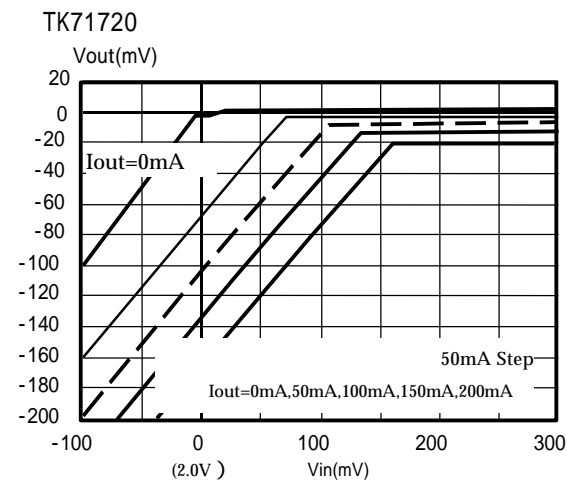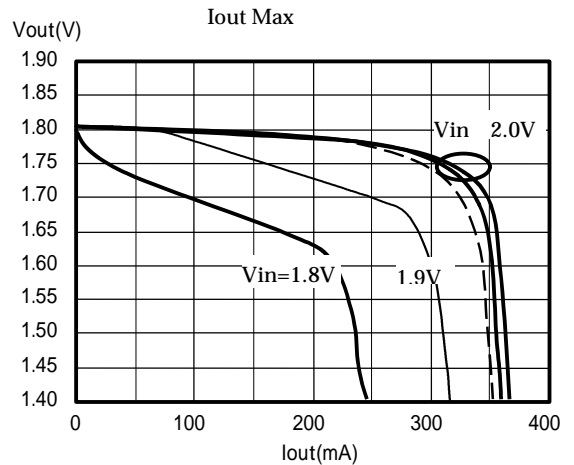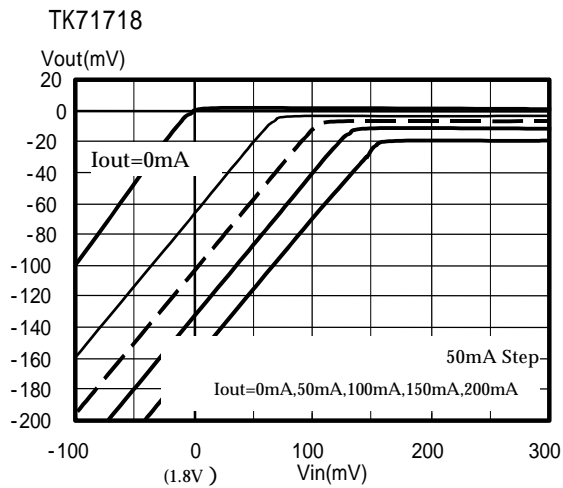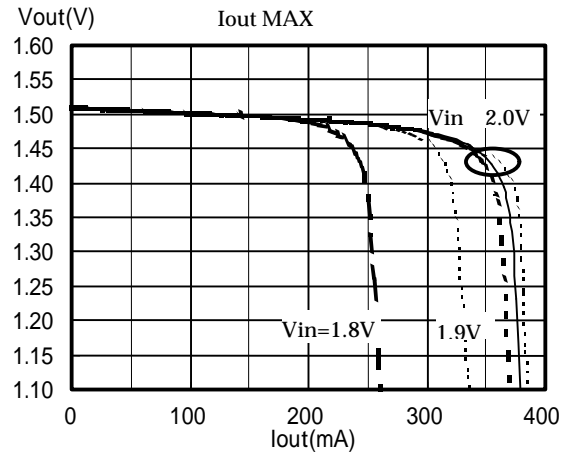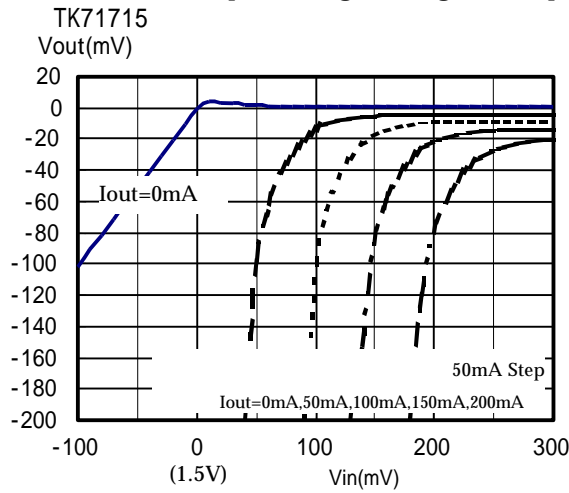
Layout   Material   Grass epoxy 20× 20mm   t=0.8mm

Pd=500 mW when mounted as recommended. Derate at 4.0 mW/°C for operation above 25°C. The thermal resistance is (ja=250 /W). The heat loss of A and B are done in total. The package loss is limited at the temperature that the internal temperature sensor works (about 150). Therefore, the package loss is assumed to be an internal limitation. There is no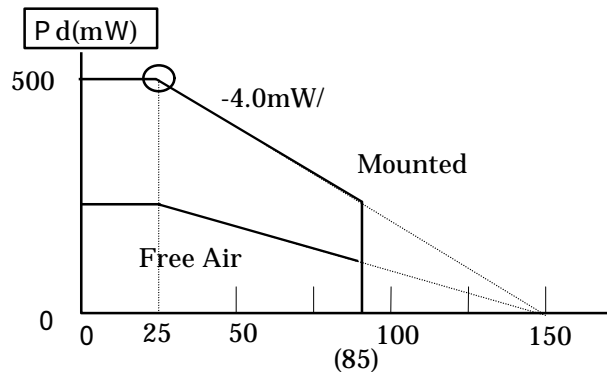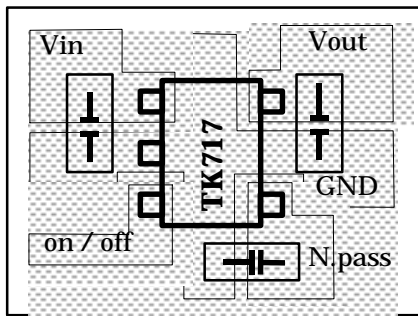 heat radiation characteristic of the package unit assumed because of the small size. Heat is carried away by the device being installed on the PCB. This value changes by the material and the copper pattern etc. of the PCB. Enduring losses of about 500mW becomes possible in a lot of applications operating at 25 .

Determining the thermal resistance when mounted on a PCB.

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

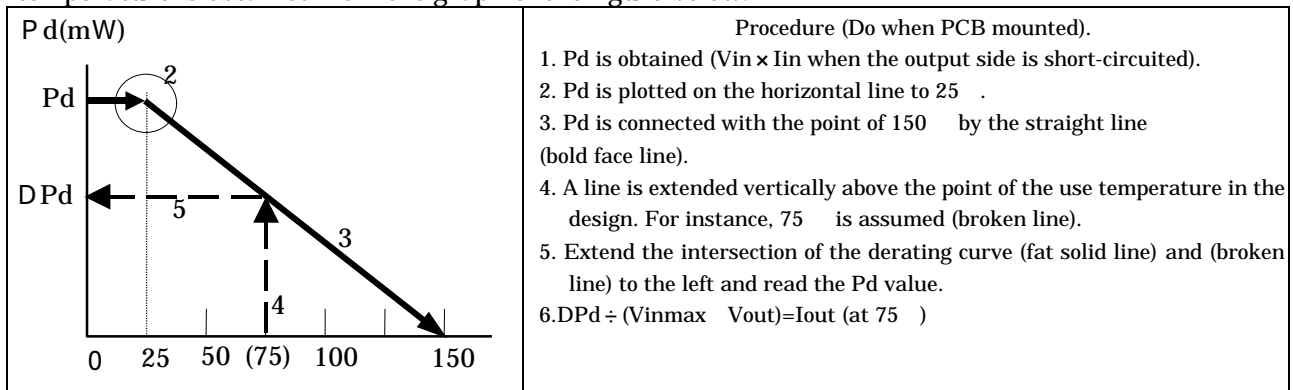| Ta   a=25 |
| 150   ja× pd 25 |
| ja×   d 125 |
| ja   125 pd (m) |

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 degrees. The current that can be used at the highest operating temperature is obtained from the graph of the figure below.

Procedure (Do when PCB mounted).
1. Pd is obtained (Vin× Iin when the output side is short-circuited).
2. Pd is plotted on the horizontal line to 25 .
3. Pd is connected with the point of 150 by the straight line (bold face line).
4. A line is extended vertically above the point of the use temperature in the design. For instance, 75 is assumed (broken line).
5. Extend the intersection of the derating curve (fat solid line) and (broken line) to the left and read the Pd value.
6.DPd÷ (Vinmax Vout)=Iout (at 75)

The maximum current that can be 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

It is recommended to turn the regulator Off when the circuit following the regulator is non-operating. A design with a 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.
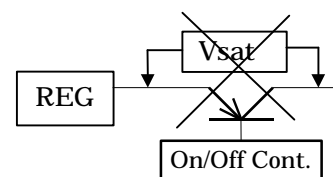
Auto discharge circuit

This circuit operates during off. Please do not connect the battery, the power supply, or other regulators to the output side. The charge of the output side capacitor chiefly passes through the automatic output side discharge circuit of the regulator during off.
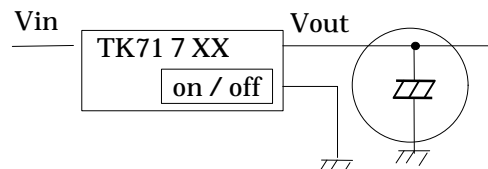
For this function

It is not possible to operate by connecting two or more regulators with different voltages to the output side of the IC.

Because the control current is small, it is possible to control it directly by CMOS logic.

The PULLDOWN resistance is not built into the control terminal.

The noise and the ripple rejection characteristics depend on the capacitance on the Vref terminal.

The ripple rejection characteristic of the low frequency region improves by increasing the capacitance of Cnp.

A standard value is Cnp=0.01μ F. Increase Cnp in a design with important output noise and ripple rejection requirements. The IC will not be damaged if the capacitor value is increased.

Current boost

For current boost applications, use the products below. A low voltage drop, high current regulator can be easily made.

TK714xx   Only the PNP transistor for the current boost is external.

TK732XX   For Iout=10A Max regulator)

Built-in Short circuit protection: a constant current can be set by an external resistor.

Definition of Terms

The output voltage tables are specified with a test voltage of Vin = output voltage Typ+1V.

Output Voltage (Vout)

The output voltage is specified with Vin = output voltage Typ+1V and output current (Iout=5mA).

Maximum Output Current (Iout Max)

The output current is measured when the output voltage decreases to $Vout_{Typ.} \times 0.9$. The input
 voltage is (output voltage Typ+1V). The maximum output current is measured in a short time
 so that it is not influenced by the temperature of the chip.

The output current decreases during low voltage operation.
 Please refer to the "Low input voltage-output current" graph for 2.1V or less.

Dropout Voltage (Vdrop)

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 load current (Iout) and the junction
 temperature (Tj).

The input voltage is gradually decreased below the test voltage. It is the voltage difference between
 the input and the output when the output voltage decreases by 100mV.

Line Regulation   Lin Reg

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 (output
 voltage Typ+1V) to (output voltage Typ+6V). This measurement is not influenced by the
 temperature of the IC and is measured in a short time.

Load Regulation   Load Reg)

Load regulation is the ability of the regulator to maintain a constant output voltage as the load current
 changes. The input voltage is set to (output voltage Typ+1V). The output voltage change is
 measured as the load current changes from 5 to 100mA and from 5 to 200mA. This measurement
 is not influenced by the temperature of the IC and is measured in a short time.

Quiescent Current (Iq)

The quiescent current is the current which flows through the ground terminal under no load
 conditions (Io=0 mA).

Ground Pin Current   Ignd

Ground pin current is the current which flows through the GND terminal according to load current.
 It is measured by (input current-output current).

Ripple Rejection   )

Ripple rejection is the ability of the regulator to attenuate the ripple content of the input voltage at
 the output. It is specified with the input voltage =   Vout   1.5V), Io=10mA, CL=1.0µ F and
 CN=0.01µ F. An Alternating Current source of (f=1Khz and 200 V_{RMS}) is superimposed to the
 power-supply voltage. Ripple rejection is the ratio of the ripple content of the output vs. the
 input and is expressed in dB. It is typically about 80dB at 1kHz. The ripple rejection improves
 when the value of the capacitor at the noise bypass terminal in the circuit is large. However,
 the on/off response worsens.

Standby Current

Standby current is the current which flows into the regulator when the control voltage is made 0 volts. It is measured with an input voltage of 8V.

PROTECTION CIRCUITS

Short circuit Sensor

This sensor operates when there is excessive output current. The short circuit sensor protects the device if the output is accidentally shorted to GND. The current flows at the set peak value.
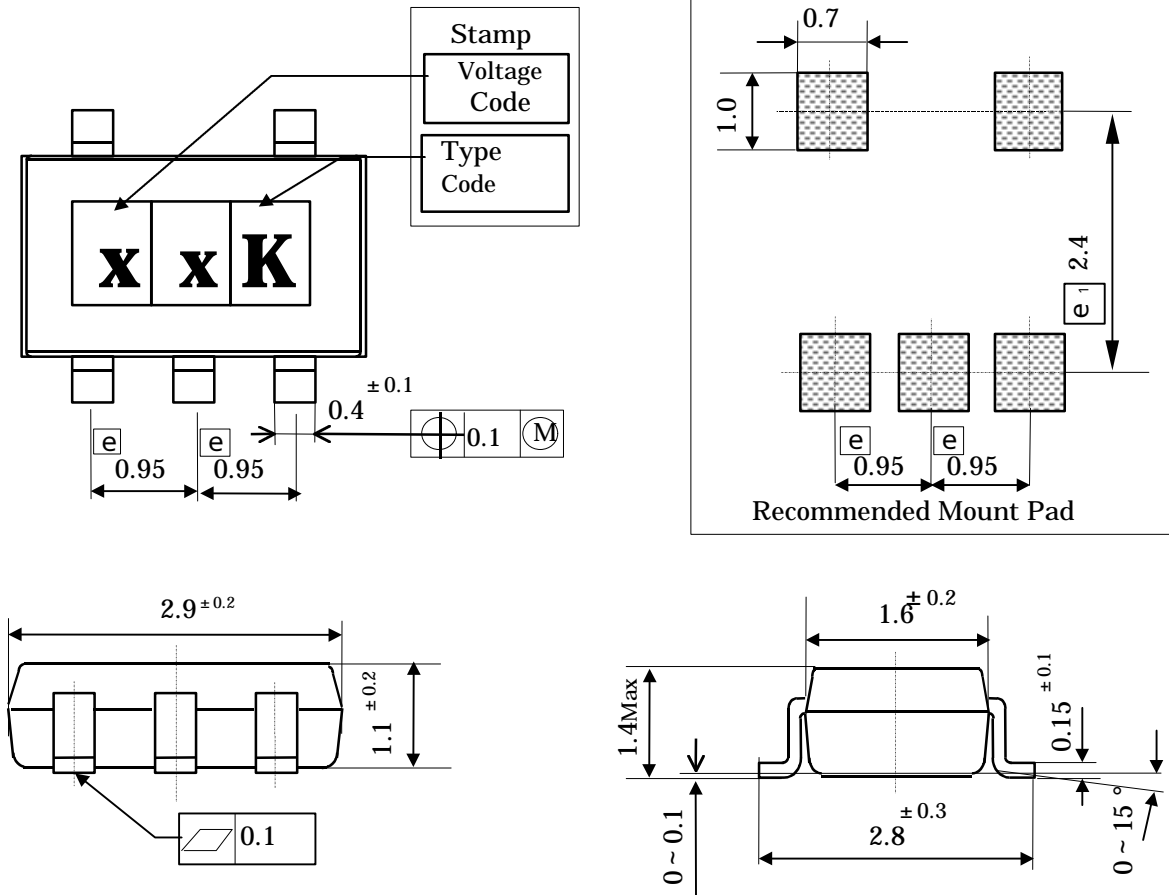
Thermal Sensor

 The thermal sensor protects the device if the junction temperature exceeds the safe value (Tj = 150 °C). This temperature rise can be caused by extreme heat, excessive power dissipation caused by large output voltage drops, or excessive output current. The regulator will shut off when the temperature exceeds the safe value. As the junction temperature decreases, the regulator will begin to operate again. Under sustained fault conditions, the regulator output will oscillate as the device turns off then resets. Please improve heat radiation or lower the input electric power. When heat radiation is poor, 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.

D   MM 200pF   0   200V Min
               HBM 100pF   1. 5k   2000V Min

Outline   PCB   Stamps

SOT23-5

Stamp

Voltage Code

Type Code

x x **K**

± 0.1

0.4

⊕ | 0.1 | Ⓜ

0.95   0.95

0.7

1.0

2.4

0.95   0.95

Recommended Mount Pad

2.9 ± 0.2

1.1 ± 0.2

◇ | 0.1

1.6 ± 0.2

1.4Max

0.15 ± 0.1

15°

± 0.3

2.8

0 0.1

0

Unit   mm
General tolerance   ± 0.2

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

OUT	V CODE	OUT	V CODE	OUT	V CODE	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.

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