IC DATA SHEET

3 TERMINAL LDO REGULATOR

TK715xxA

MEETING YOUR NEEDS

TOKO, INC.

Features

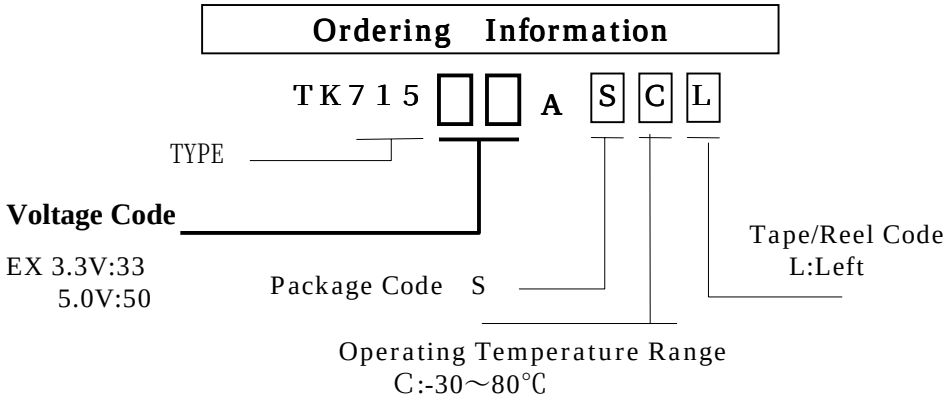
- Very low quiescent current
- Very Low Dropout voltage
- Very small package
- Reverse bias voltage protection
- High output voltage accuracy
（ 1.5V≦±60mV≦3.5V Iout＝5mA ）
- Built in short circuit protection
- High ripple rejection
- Wide operating voltage range(1.8V-18V)
- Multi layer ceramic capacitor can use

Applications

- Low Voltage Systems
- Battery Powered Systems
- Portable Consumer Equipment
- Portable Instrumentation
- Cellular Telephones
- Personal Communications Equipment
- Radio Control Systems

Description

TK715xxA is a Low Drop Out regulator with very few quiescent currents (25μA).
An internal PNP pass transistor is applied to achieve a low dropout voltage of 105mV (Typ) at 50mA load current. Because the output current (Typ.100mA) can be supplied to the system at the I/O voltage difference 0.2V time, the voltage source can be effectively just used. Therefore, it is the best for the battery use set.
1.5-12.0V is arranged to the output voltage in 0.1V step. The output voltage is trimmed in high accuracy. IC provides with the over-current sensor circuit and the reverse-bias over-current obstruction circuit.
The package is very small. However, when IC is mounted on PCB, Power dissipation becomes about 400mW.



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

Vout (below 5V) Absolute Maximum Ratings

Absolute Maximum Ratings	Symbol	Rating	Unit
Supply voltage	Vcc	-0.4～19	V
Storage Temperature Range	Tstg	-55～150	℃ Tj
Reverse Bias	VR Max	-0.4～8	V
Operating condition			
Temperature Range	Top	－30～80	℃ Ta
Voltage Range	Vop	1.8～18	V
Short circuit current	Ishort	170	mA
Power Dissipation	Pd Max=400mW As mounted on PCB		θJa=312℃/W

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.

Electrical characteristics Vin= $Vout_{typ}$+1V （Ta =25℃）

Parameter	symbol	Min	Typ	Max	unit	Condition
Output voltage	Vout	±60mV or ±70mV				SEE table 1 Iout=5mA
Line regulation	LinReg		3	12	mV	Vin=($Vout_{typ}$+1V)～($Vout_{typ}$+6V)Max18v
Load regulation	LoaReg		18	36	mV	Iout=5～100mA
Drop out voltage 1	Vdrop		0.105	0.18	V	Io=50mA
			0.160	0.28	V	Io=100mA (2.4V≦Vout≦5.0V)
			0.160	0.30	V	Io=100mA (2.1V≦Vout＜2.4V)
Drop out voltage		1.5V≦Vout≦2.0V：No regulation				Because of VopMin=1.8V
Output current	Iout Max	115	155		mA	
		70	90		mA	1.8V≦Vcc≦2.1V （Reference Val.）Note 1
supply current	Icc		25	45	μA	Iout=0mA
Quiescent current	Iq		300	500	μA	Iout=15mA
Vout temp. coefficient	ΔVo/Ta	Typ=30 PPM/℃				Iout=5mA Reference value

Note 1 See DEFINITION AND EXPLANATION OF TECHNICAL TERMS

The absolute maximum ratings are the absolute limitation values with the possibility of the IC breakage. When the operation exceeds this standard quality can not be guaranteed. The description of the item is referring the value only in Typ.

Ripple rejection ratio、60dB［CL=2.2μF,Vnois=200mV_{RMS},Vin=$Vout_{Typ}$+2v,Io=10mA］ 100Hz

The item of I/O voltage drop (Vdrop) is excluded in the product of 2.0V or less.

Table 1 Ta=25℃ IOUT=5mA

Vout	Symbol	Min	Max	Test Vol	Vout	Symbol	Min	Max	Test Vol
1.5 V	15	1.440V	1.560V	2.5V	3.3 V	33	3.240 V	3.360 V	4.3 V
1.6	16	1.540	1.660	2.6	3.4	34	3.340	3.460	4.4
1.7	17	1.640	1.760	2.7	3.5	35	3.440	3.560	4.5
1.8	18	1.740	1.860	2.8	3.6	36	3.530	3.670	4.6
1.9	19	1.840	1.960	2.9	3.7	37	3.630	3.770	4.7
2.0	20	1.940	2.060	3.0	3.8	38	3.730	3.870	4.8
2.1	21	2.040	2.160	3.1	3.9	39	3.830	3.970	4.9
2.2	22	2.140	2.260	3.2	4.0	40	3.930	4.070	5.0
2.3	23	2.240	2.360	3.3	4.1	41	4.030	4.170	5.1
2.4	24	2.340	2.460	3.4	4.2	42	4.130	4.270	5.2
2.5	25	2.440	2.560	3.5	4.3	43	4.230	4.370	5.3
2.6	26	2.540	2.660	3.6	4.4	44	4.330	4.470	5.4
2.7	27	2.640	2.760	3.7	4.5	45	4.430	4.570	5.5
2.8	28	2.740	2.860	3.8	4.6	46	4.530	4.670	5.6
2.9	29	2.840	2.960	3.9	4.7	47	4.630	4.770	5.7
3.0	30	2.940	3.060	4.0	4.8	48	4.730	4.870	5.8
3.1	31	3.040	3.160	4.1	4.9	49	4.830	4.970	5.9
3.2	32	3.140	3.260	4.2	5.0	50	4.930	5.070	6.0

All the described voltages do not immediately supply and are not able to produce samples in this table. It is a characteristic to have shown when manufacturing.

Vout (Over 5.1V)

Absolute Maximum Ratings

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	Vcc	-0.4～19	V
Storage Temperature Range	Tstg	-55～150	℃ Tj
Reverse Bias	VR Max	-0.4～8	V
Operating condition			
Temperature Range	Top	－30～80	℃ Ta
Voltage Range	Vop	1.8～18	V
Short circuit current: Side A	Ishort	170	mA
Power Dissipation	Pd Max=400mW	As mounted on PCB	

Electrical characteristics

Limits are guaranteed by production testing or correction techniques using Statistical Quality Control (SQC) methods. Unless otherwise noted. Vtest=$Vout_{Typ}$+1v ; IL=5mA（Tj=25 ℃）

The operation of -30℃-80℃ is guaranteed in the design by a usual inspection.

Electrical characteristics Vin= $Vout_{typ}$+1V （Ta =25℃）

Parameter	symbol	Min	Typ	Max	unit	Condition
Output voltage	Vout	±2%	SEE table 2		Iout=5mA	
Line regulation	LinReg		3	12	mV	Vin=($Vout_{typ}$+1V)～($Vout_{typ}$+6V)Max18v
Load regulation	LoaReg		35	80	mV	Iout=5～100mA
Drop out voltage 1	Vdrop		0.105	0.18	V	Io=50mA
			0.160	0.28	V	Io=100mA
Output current	Iout Max	115	155		mA	
supply current	Icc		32	60	μA	Iout=0mA
Quiescent current	Iq		300	500	μA	Iout=15mA
Vout temp. coefficient	ΔVo/Ta	Typ=30 PPM/℃			Iout=5mA	Reference value

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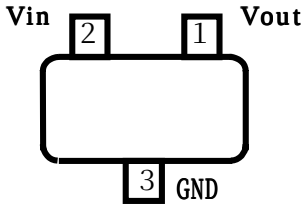
Ripple rejection ratio、60dB［CL=2.2μF,Vnois=200mV_{RMS},Vin=$Vout_{Typ}$+2v,Io=10mA］ 100Hz

Table 2 **Ta=25℃** IOUT=10mA

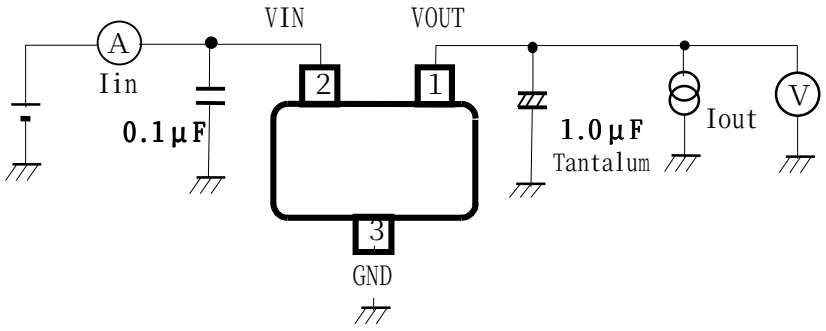
Vout	Symbol	Min	Max	Vtest	Vout	Symbol	Min	Max	Vtest
6.0V	60	5.88V	6.12V	7.0V					
7.0	70	6.86	7.14	8.0					
8.0	80	7.84	8.16	9.0					
9.0	90	8.82	9.18	10.0					

All the described voltages do not immediately supply and are not able to produce samples in this table. It is a characteristic to have shown when manufacturing

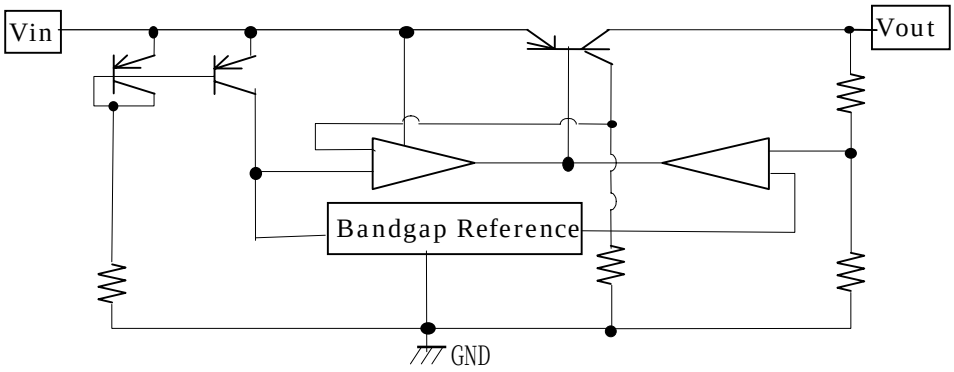
Pin lay out



Test circuit



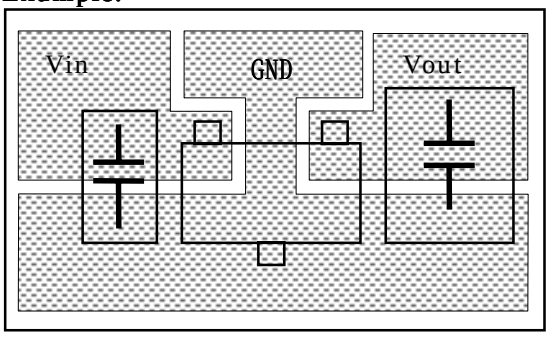
Block diagram



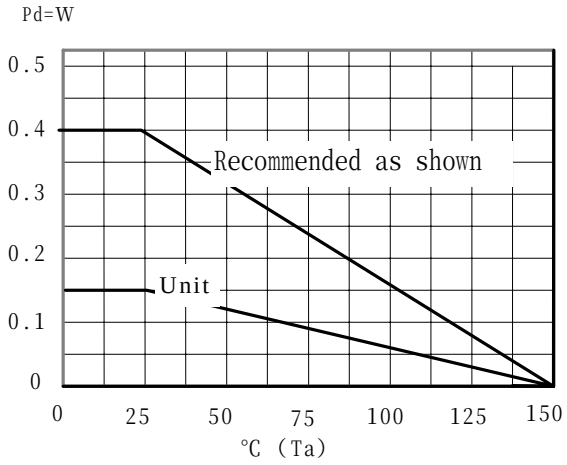
Package power dissipation

The SOT-23 package does not have enough heat radiation characteristics because of the small size. Heat can spread when the IC is mounted on PCB and the power dissipation is improved 400mW. This value largely depends on the material and the copper pattern of PCB. Heat resistance θja=312℃／W

Layout Example.



PCB：Glass epoxy 30＊30mm t=0.8mm



Approximate power dissipation is 400mW at 25℃ Derating value is 3.2mW／℃ over 25℃ (θja=312℃／W)

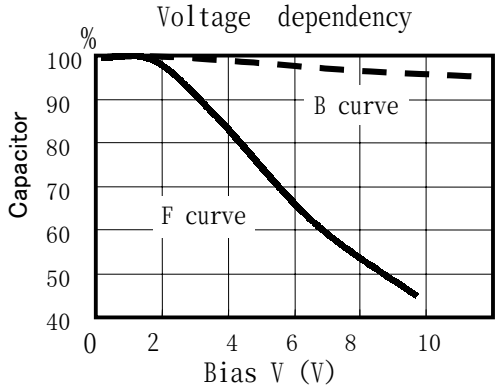
Input Output(CL) Capacitor

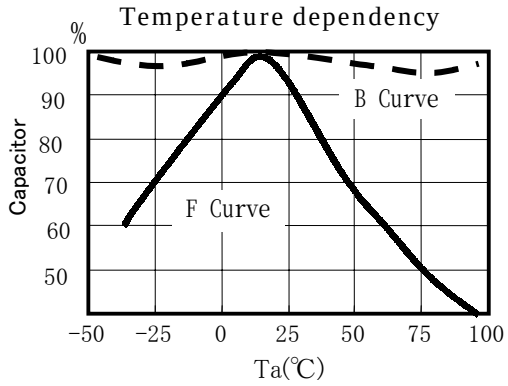
- It is necessary to connect the big capacitor on out put side of Voltage regulator. The regulator oscillates if this capacitor does not exist. The phase compensation is done in the IC because of the stability operation. Impedance on the output side influences an internal phase compensation characteristic. Therefore, the IC needs "Low value resistor with the capacitor" for the output side.
- When the Tantalum capacitor is used. The low series resistance is unnecessary because there is equivalent series resistance (ESR) in 1-8Ω. When the capacitor that the ESR is as small as the ceramic capacitor is used, series resistance is necessary with capacity. (Series resistance is by the working current value and there is an unnecessary case) Please select the value of the capacitor and resistance referring to "Stability operation area graph" in each application.
- Series resistance becomes important small the capacity of CL. The stability operation area increases if capacity is large. The output noise, ripple rejection, and the load change characteristic indicate a value good like a big capacitor. (The larger capacity is, the more the range of the stability operation extends.) The IC does not break down for the regulator with a big capacitor. Please use as big capacity as possible.
- The stability operation area" comes to narrow by lowering of the output voltage and to oscillate easily.

Voltage and temperature characteristic of ceramic capacitor

Generally, there is a dependency of the temperature and the voltage in the ceramic capacitor. Please select parts in consideration of the voltage and the temperature used.

I will recommend B characteristic.

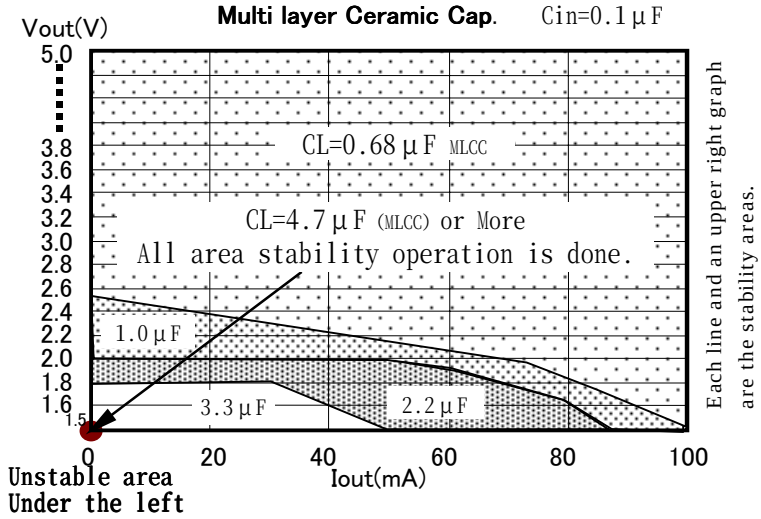


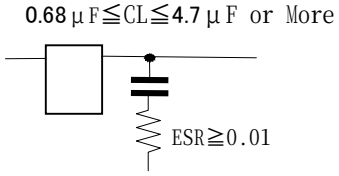


- When the battery is consumed and the source impedance increases, the input capacitor is necessary. Moreover, also when the line on the power supply side lengthens, it is necessary. Please connect the capacitor with the input side for the stability operation. It is when sufficing with one capacitor with several regulators. It is when the capacitor is individually necessary. It is not possible to say sweepingly. I will ask for the confirmation while mounted.
- Please refer to the data of the description after the next page. The kind, the characteristic, and the capacitance value of the capacitor change by the application. I will ask for the part selection suitable for the aimed specification.

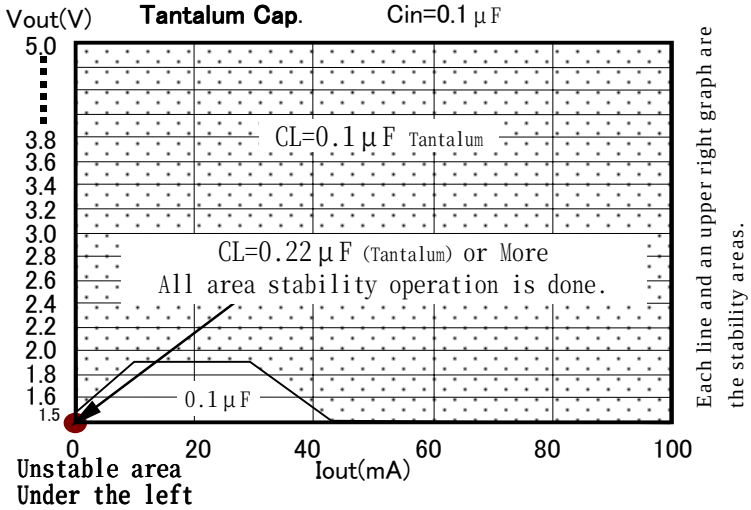
Stability area VS Output voltage, current and CL

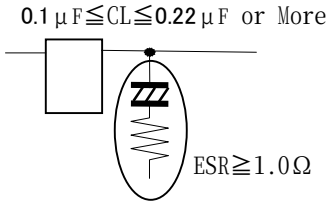
It is a graph where the stability operation area was shown to the voltage, the current, and CL. The output capacitor can be reduced by the output voltage high and there is a lot of working currents. However, the noise increases when a small output capacitor is used. IC does the stability operation by the use of large CL. Please enlarge and use CL as much as possible.
Capacity and the ESR value change at the temperature. Within the forecast range of the temperature, the capacitance value must use the thing within the range in the stability operation area.





Range which can be used :Vo≧2.8V Io=1mA～Max, Multi layer Ceramic Cap.≧0.68μF
:Vo≧2.0V Io=1mA～Max, Multi layer Ceramic Cap.≧1.0 μF
:Vo≧1.5V Io=1mA～Max, Multi layer Ceramic Cap.≧4.7 μF





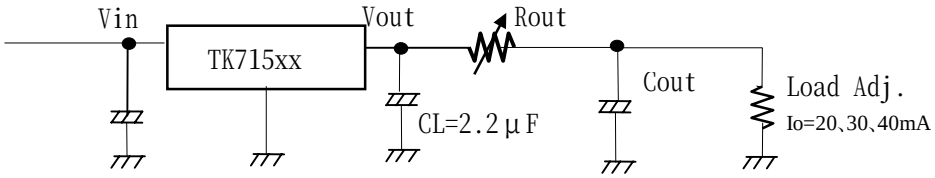
Range which can be used: Vo≧1.9V Io=1mA～Max, Tantalum Cap.≧0.1 μF or (Ceramic Cap. 0.22μF +2.2Ω)
:Vo≧1.5V Io=1mA～Max, Tantalum Cap.≧0.22μF or (Ceramic Cap. 0.22μF +2.2Ω)

Used capacitor for evaluation
MURATA : GRM39B474K10 GRM42-B684K10 GRM42-6104k10 GRM42-6224k10
KYOUSERA : CM105B474K16A、CM105B684K16A、CM21B225K10A

Only stability is assumed to be a theme in this page. The characteristic of IC improves by enlarging the capacity used. The tantalum capacitor shows a good characteristic more overalls than the ceramic capacitor. Please select parts, which suit designed set.

Output noise improvement

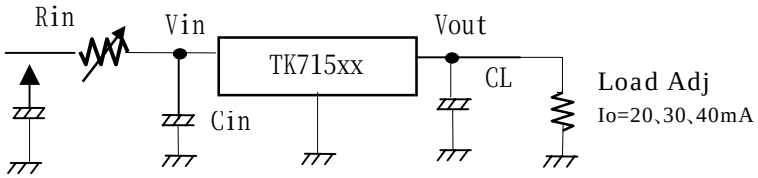
The RC filter is added to the output part of the regulator. (It is an application when the input voltage is high) The regulator with a little high output voltage is selected. A high voltage is made to descend with the CR filter. The use condition is that the change of the output current is few. The output voltage changes when the current change is large. Output noise when constant of CR filter is changed by using 3.5V device so that output voltage may become about 3.3V
Vin=4.0V Cin=10uF (aluminum electrolysis) Cout=Vari (aluminum electrolysis)

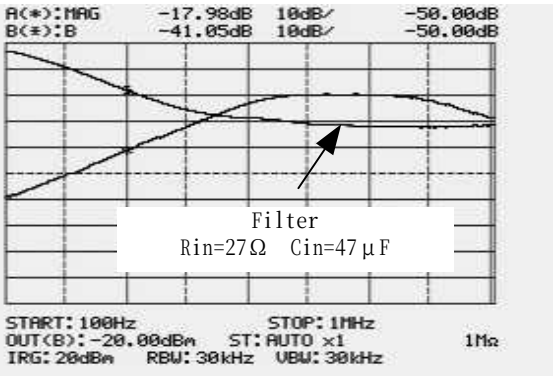


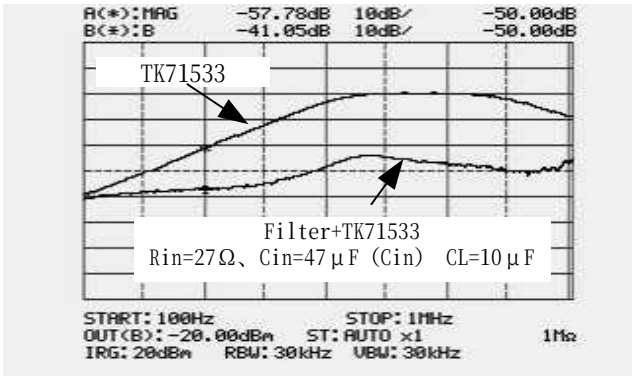
Measurement condition			Out-put side capacitor (Cout)			Unit	
Iout	Rout	V out	10μF	47μF	100μF	μF	Cout
Io=20-40mA	0	3.500V	210μV	150μV	130μV	rms	noise
20mA	10Ω	3.296V	76μV	50μV	40μV	rms	
30mA	6.8Ω	3.287V	88μV	55μV	48μV	rms	
40mA	5.1Ω	3.266V	100μV	60μV	48μV	rms	

Ripple rejection ratio

The RC filter is added to the front part of the regulator. (It is an application when the input voltage is high) Even if the I/O voltage is low, TK71533AS outputs the stable voltage.
Even if the CR filter is inserted and the input voltage decreases, the regulator becomes a stable output voltage. The voltage decreased with the CR filter depends on the value of the input ripple noise.
Please choose the value of R so that the lowest value of ripple noise (P-P) may become Output voltage + 0.2V.







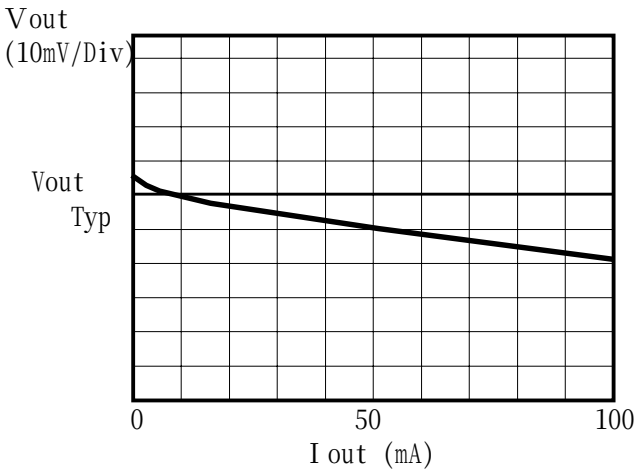
R=27Ω C=47μF (electrolysis) There are no characteristic changes in (Iout=20, 30, and 40mA)
When a low noise and the high ripple rejection characteristic are necessary, I will recommend

Current Boost

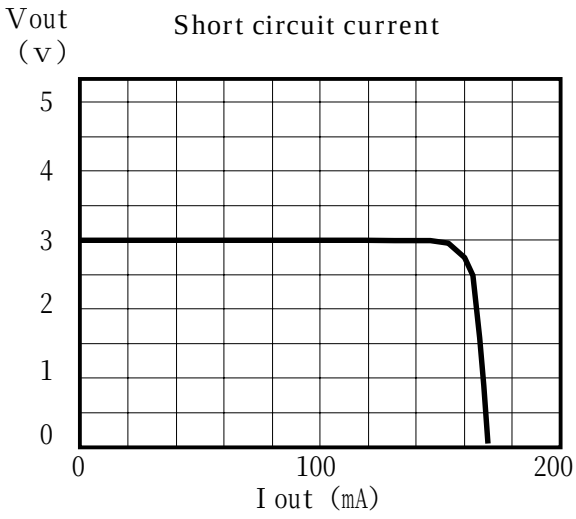
Please use TK732xx instead of this application that is control IC for big current and low drop out voltage

Typical Performance Characteristics

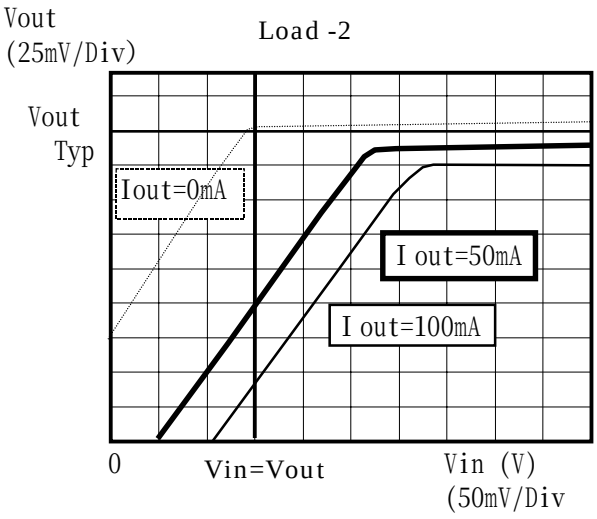
Vin VS Vout-1 Load regulation



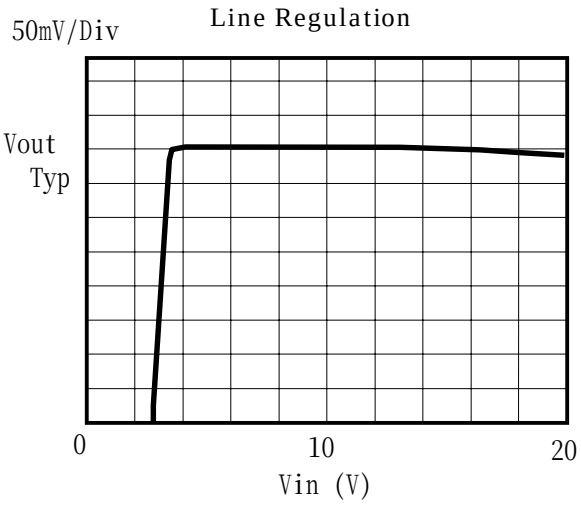
Short circuit current



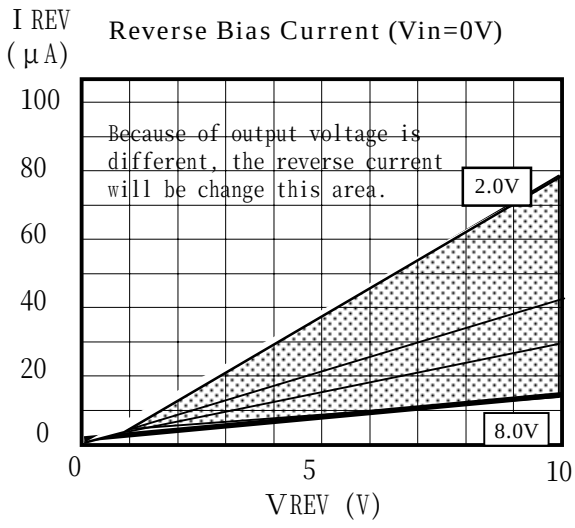
Load -2



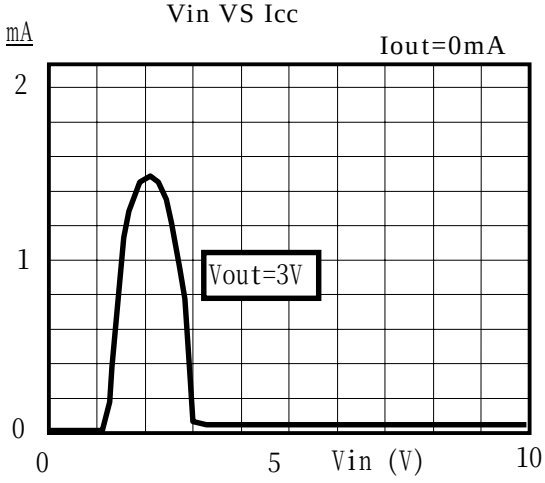
Line Regulation



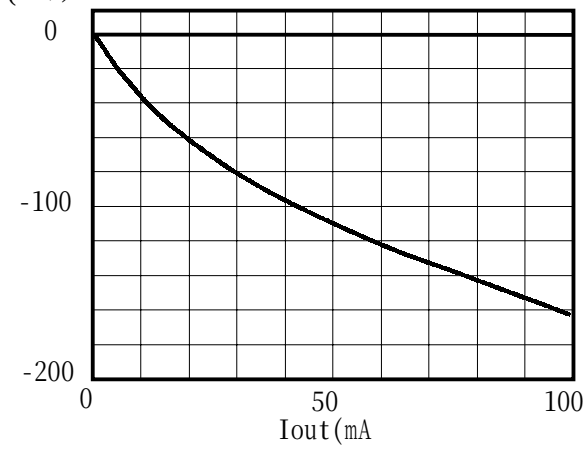
Reverse Bias Current (Vin=0V)



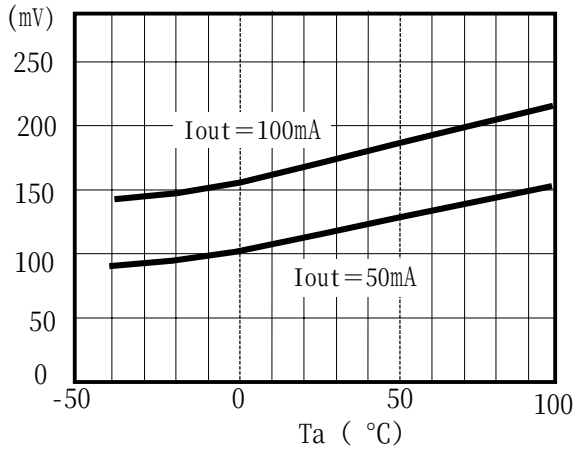
Vin VS Icc



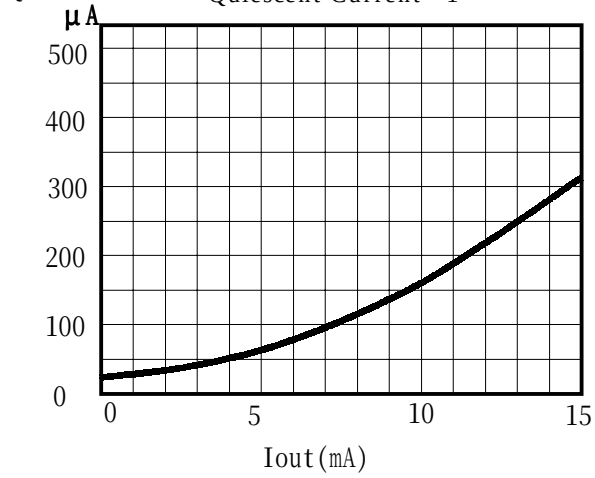
Output-Current VS Dropout-Voltage



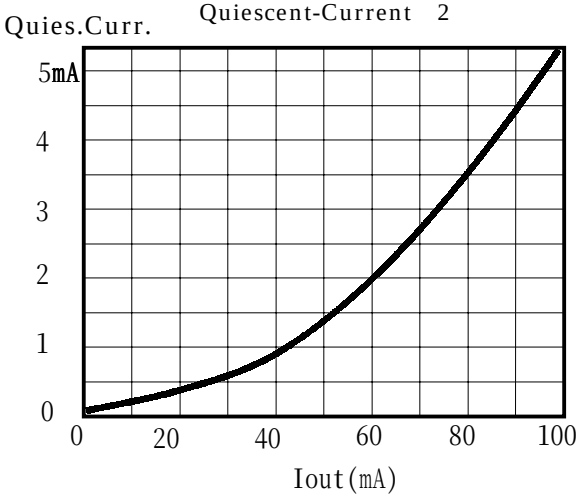
Drop out voltage VS Temperature



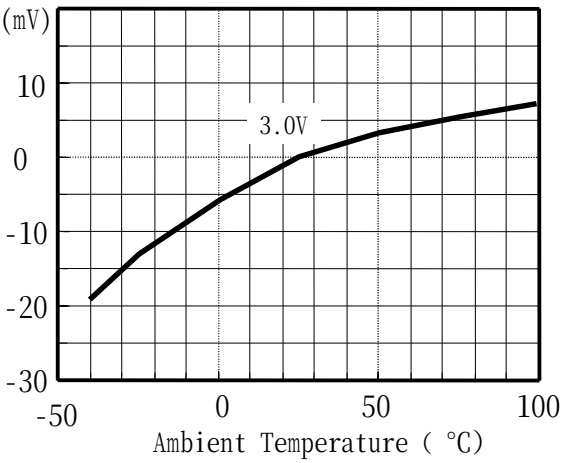
Output Current VS Quiescent-Current 1



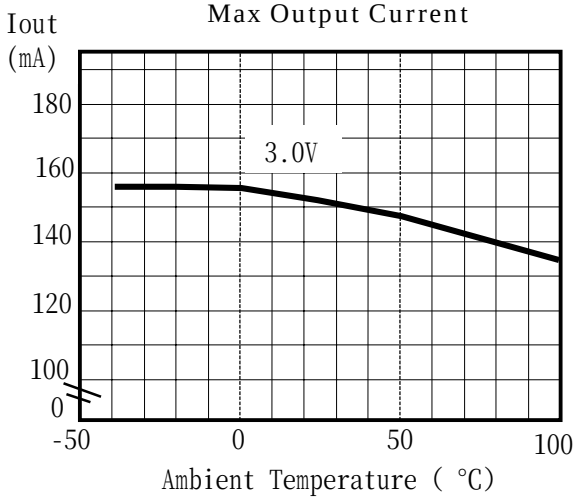
Output Current VS Quiescent-Current 2



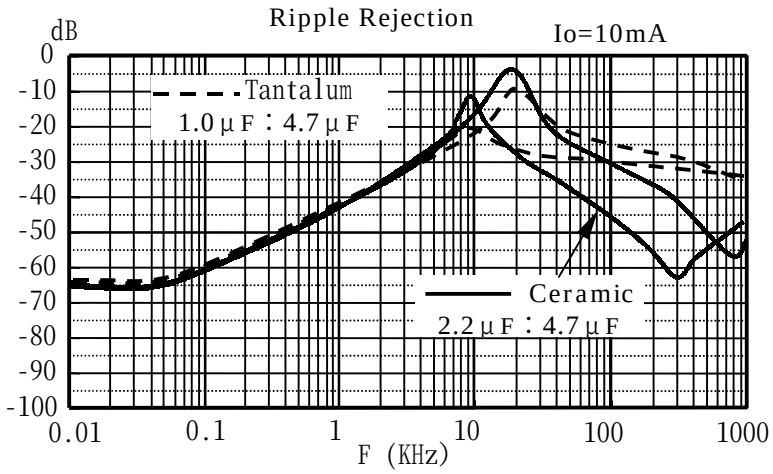
△Vout Output Voltage VS Temp.

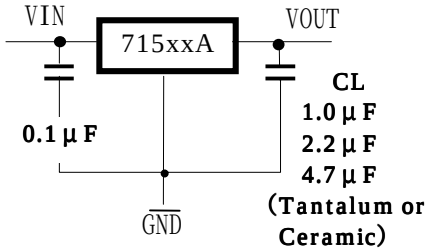


Max Output Current

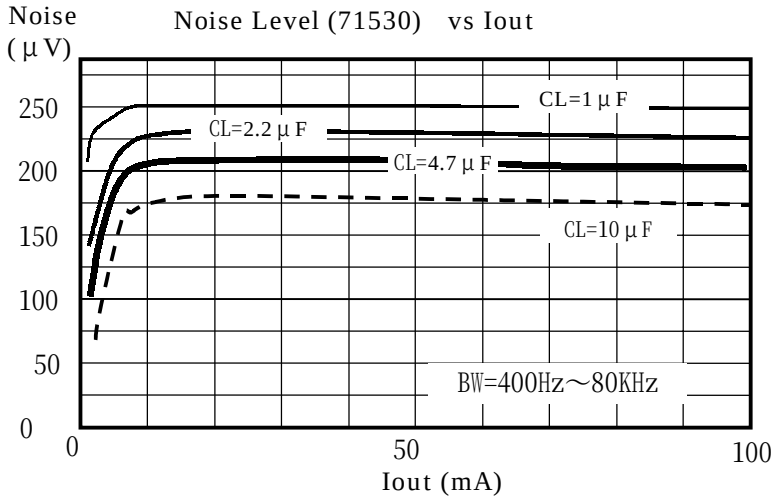


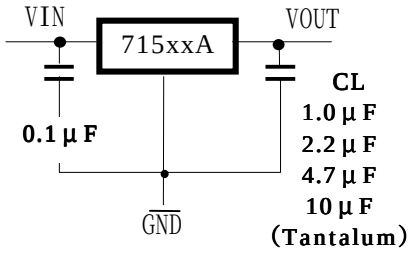
Ripple Rejection





Output Noise

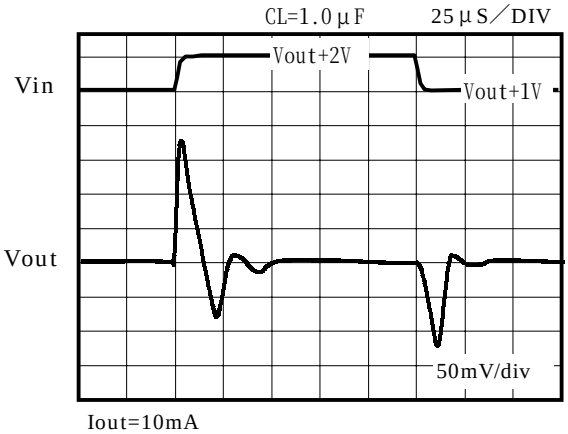




Load & Line response

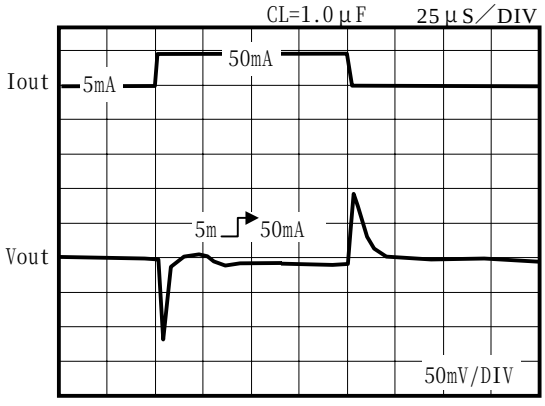
To improve the load and line transient response, please use a capacitor with grater value at output side.

Line Voltage Step Response



Iout=10mA

Load Current Step Response 1



Application

DEFINITION AND EXPLANATION OF TECHNICAL TERMS

• OUTPUT VOLTAGE (Vout)

The output voltage is specified with $V_{IN}=V_{O\,(TYP)}+1V$ and Io=5mA

• 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 depends on the load current and the temperature.

• MAXMUM OUTPUT CURRENT (IoutMax)

Normal operating output current. At 0.3V Down from $Vout_{Typ}+1V$ This is limited by package power dissipation.

• SHORT CIRCUIT CURRENT (Ishort) . . . . . Current, which flows when output is connected with terminal GND., Be not short-circuited. This measurement is measured by the pulse so that the power loss is few and the change of the chip temperature is few.

• 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 changes from V_{IN}= Vo +1V to V_{IN}=Vo+6V

• LOAD REGULATION (Loa Reg)

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}= Vo +1V .The load regulation is specified under two output current step conditions of 5mA to 100mA.

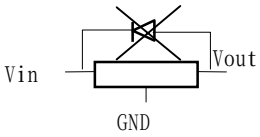
• QUIESCENT CURRENT (IQ)

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

• RIPPLE REJECTION RATIO (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 200mVrms, 100Hz superimposed on the input voltage, where V_{IN}= Vo +2V. The output side capacitor is set to 2.2 μF, and the load current is set to 10mA .It is expressed in dB.

• REVERSE VOLTAGE PROTECTION



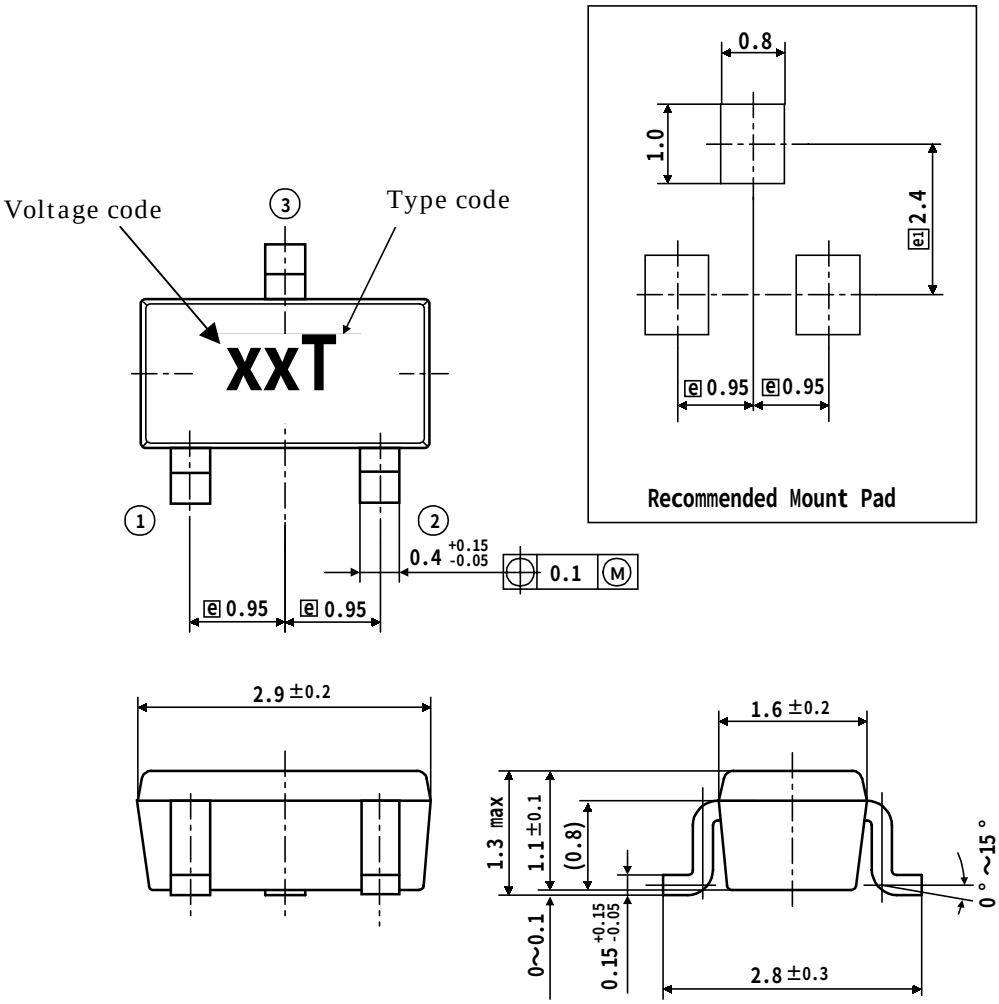
Reverse voltage protection prevents damage due to the output voltage being higher than the input voltage. This fault condition can occur when the output capacitor remains charged and the input is reduced to zero, or when an external voltage higher than input voltage is applied to the output side.

TOKO regulator don't need an inherent diode connected between the input and output (see up).

• OVER LOAD PROTECTION

This function operates when there are quite a lot of output currents. The current flows to the set peak value. (Connected with GND mistaking the output terminal)

Out line & Stamp



Unit ：mm
General tolerance ：±0.2

Molded Resin with Body	：Epoxy Resin
Lead Frame	：Copper Alloy
Treatment	：Solder Plating(5～15μm)
Marking Method	：Ink or Laser
Weight	：0.011g
Country of origin	：Japan

V OUT	V CODE	V OUT	V CODE	V OUT	V CODE	V OUT	V CODE
1.5V	15	2.6V	26	3.7V	37	4.8 V	48
1.6	16	2.7	27	3.8	38	4.9	49
1.7	17	2.8	28	3.9	39	5.0	50
1.8	18	2.9	29	4.0	40	6.0	60
1.9	19	3.0	30	4.1	41	7.0	70
2.0	20	3.1	31	4.2	42	8.0	80
2.1	21	3.2	32	4.3	43	9.0	90
2.2	22	3.3	33	4.4	44		
2.3	23	3.4	34	4.5	45		
2.4	24	3.5	35	4.6	46		
2.5	25	3.6	36	4.7	47		

All the described voltages do not immediately supply and are not able to produce samples in this table. It is a characteristic to have shown when manufacturing

NOTE

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

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