Rev F. Jul 2017(S)

150mA Low-Noise Low-Dropout Regulator with Chip Enable used with very low ESR output Capacitors

Features

- Low dropout voltage — 60mV @ 30mA; 200mV @ 100mA
- Guaranteed output current — 150mA
- High output voltage accuracy — 1.5V ~ 1.95V ± 3%; 2.0V ~ 6.0V ± 2%
- Custom output voltage — 1.5V ~ 6.0V
- Wide supply voltage range — 10V max
- Low shut down quiescent current — 0.1 µ A (Typ.)
- Low Power Consumption — 70 µ A (Typ.)
- High Ripple Rejection — 70dB (10kHz)
- Low Output Noise — 30 µ Vrms
- Operating temperature — -40 ° C ~ +85 ° C
- Stable with low-ESR output capacitor

Applications

- Cordless Phone
- Palmtop/Laptop Computer
- Personal Digital Assistant
- Digital Camera
- Portable Multimedia Player
- Battery powered equipment
- Reference voltage

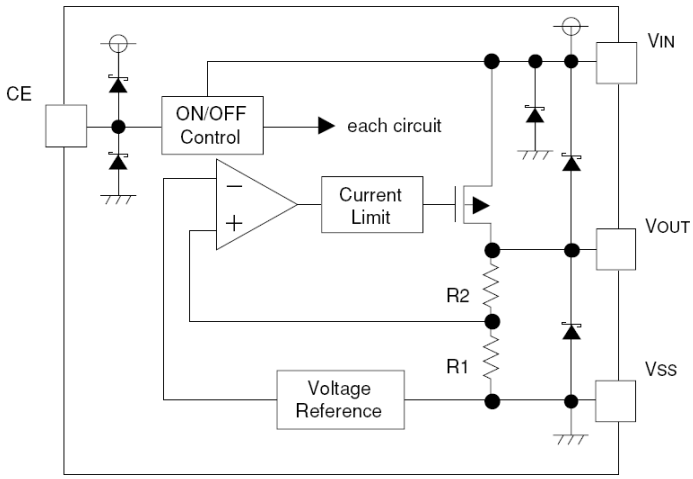
Available Packages

- SOT-23-5
- SOT-89-5

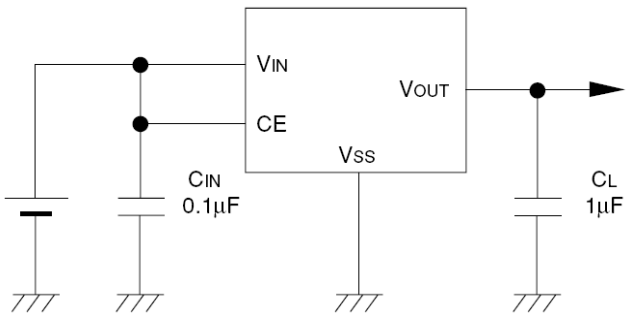
General Description

The CS7R6204 series are highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The device achieves high ripple rejection and low dropout. The output voltage is selectable in 50mV increments within a range of 1.5V to 6.0V. The device is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the device. The device has an integrated current limiter, which also operates as a short protection for the output pin. The active high CE function enables the output to be turned off, resulting in greatly reduced power consumption.

Block Diagram



Typical Application



Selection Guide

The output voltage, version, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below

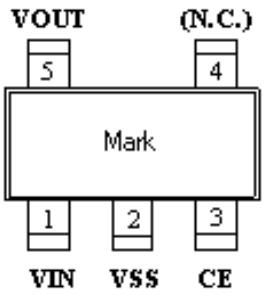
Part number CS7R6204 - 30 B - TS - G

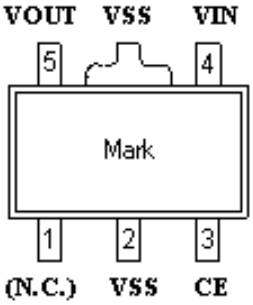
1 2 3 4 5

→ 3.0V ± 2% LDO with active high chip enable packaged with lead free SOT23-5 package and put inside an embossed tape in standard feed form

Designator	Description	Symbol	Values
1	Output voltage	15 ~ 60	Ex : 30 ⇒ Vout = 3.0V 18 ⇒ Vout = 1.8V
2	Voltage step size	A	50mV increments : ± 2% accuracy Ex : 3.0V @ 2% ⇒ Vout = 3.05V ± 2%
		B	100mV increments : ± 2% accuracy Ex : 3.0V @ 2% ⇒ Vout = 3.0V ± 2%
3	Package type	T	SOT 23 - 5
		P	SOT 89 - 5
4	Reel type	S	Embossed Tape : Standard feed
		N	Embossed Tape : Reverse feed
5	Lead free package	G	Missing label ⇒ non-lead free package

Pin Configuration



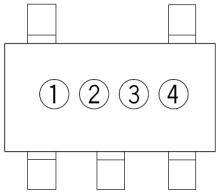


Pin Descriptions

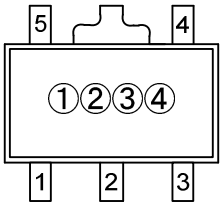
Pin No.		Pin Name	Description
SOT-23-5	SOT-89-5		
1	4	VIN	Input
2	2	VSS	Ground
3	3	CE	ON/OFF Control
4	1	N.C.	No Connection
5	5	VOUT	Output

Marking Information

- SOT-23-5



- SOT-89-5



① represents the product name

Designator	Product Name
P	CS7R6204

② represents the integer part of the output voltage

Designator	Output voltage (V)
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0
6	6.0

③ represents the decimal part of the output voltage

Designator	Output Voltage (V)	Designator	Output voltage (V)
0	0.0	A	0.05
1	0.1	B	0.15
2	0.2	C	0.25
3	0.3	D	0.35
4	0.4	E	0.45
5	0.5	F	0.55
6	0.6	G	0.65
7	0.7	H	0.75
8	0.8	I	0.85
9	0.9	J	0.95

e.g. ②③=12 □ 1.20V and ②③= 1C □ 1.25V.

④ represents the CE pull up resistor type

Designator	Resistor Version
B	Active “High” (no pull-down resistor built in)

- Electrical Characteristics

Parameter	Symbol	Conditions	Ta=25°C			-40°C ≤ Ta ≤ 85°C			Units	Circuit
			Min	Typ	Max	Min	Typ	Max		
Output Voltage	$V_{OUT(E)}$	I_{OUT} = 30mA, 1.5V ≤ $V_{OUT(T)}$ ≤ 1.95V	X0.97	$V_{OUT(T)}$	X1.03	X0.96	$V_{OUT(T)}$	X1.04	V	1
		I_{OUT} = 30mA, 2.0V ≤ $V_{OUT(T)}$ ≤ 6.0V	X0.98	$V_{OUT(T)}$	X1.02	X0.97	$V_{OUT(T)}$	X1.03		
Maximum Output Current	I_{OUT} MAX		150			150			mA	1
Load Regulation	Δ V_{OUT}	1mA ≤ I_{OUT} ≤ 100mA		15	50		30	80	mV	1
Dropout Voltage	Vdif1	I_{OUT} = 30mA	E-1						mV	1
	Vdif2	I_{OUT} = 100mA	E-2						mV	
Supply Current	I_{DD}	V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V	20	70	100	20	80	120	μA	2
Standby Current	Istby	V_{IN}=OUT(T)+1.0V, VCE=VSS		0.01	0.10		0.05	1.00	μA	2
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN}-V_{OUT}}$	$V_{OUT(T)}$+1.0V ≤ V_{IN} ≤ 10V, I_{OUT}=30mA		0.01	0.20		0.05	0.30	%/V	1
Input Voltage	V_{IN}		2		10	2		10	V	--
Output Voltage vs Temp. Characteristics	$\frac{\Delta V_{OUT}}{\Delta Topr-V_{OUT}}$	I_{OUT}=30mA, -40°C ≤ Topr ≤ 85°C		100					Ppm/°C	1
Output Noise	$\overline{en}$	I_{OUT}=10mA, 300Hz ~ 50kHz		30					μVrms	3
Ripple Rejection Rate	PSRR	V_{IN}=[$V_{OUT(T)}$+1.0]V+1.0Vp-pAC, I_{OUT}=50mA, f=10kHz		70					dB	4
Current Limited	ILim	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{IN}		300			280		mA	1
Short-circuit Current	Ishort	V_{IN}=$V_{OUT(T)}$+1.0V, V_{CE}=V_{IN}		50			60		mA	1
CE "High" Voltage	V_{CEH}		1.6		V_{IN}	1.7		V_{IN}	V	1
CE "Low" Voltage	V_{CEL}				0.25			0.20	V	1
CE "High" Current	I_{CEH}	V_{IN}=V_{CE}=$V_{OUT(T)}$+1.0V	-0.10		0.10	-0.15		0.15	μA	2
CE "Low" Current	I_{CEL}	V_{IN} =$V_{OUT(T)}$+1.0V, V_{CE}=V_{SS}	-0.10		0.10	-0.15		0.15	μA	2

Note

(NOTE 1) Unless otherwise stated, V_{IN} =$V_{OUT(T)}$ +1.0V

(NOTE 2) $V_{OUT(T)}$=Specified Output Voltage

(NOTE 3) $V_{OUT(E)}$=Effective Output Voltage (I.e. the output voltage when "$V_{OUT(T)}$+1.0V" is provided at the V_{IN} pin while maintaining a certain I_{OUT} value)

(NOTE 4) Vdif= (V_{IN1} (NOTE6) – V_{OUT1} (NOTE5))

(NOTE 5) V_{OUT1}=A voltage equal to 97.5% of the Output Voltage whenever an amply stabilized I_{OUT} ($V_{OUT(T)}$+1.0V) is input.

(NOTE 6) V_{IN1}=The Input Voltage when V_{OUT1} appears as Input Voltage is gradually decreased.

(NOTE 7) The values for -40°C ≤ Topr ≤ 85°C are designed values.

- Dropout voltage

SYMBOL	E-0		E-1				E-2			
PARAMETER / OUTPUT VOLTAGE	Output Voltage (V)		Dropout Voltage 1 (mV) (I_{OUT}=30mA)				Dropout Voltage 2 (mV) (I_{OUT}=100mA)			
			Ta=25°C		-40°C ≤ Topr ≤ 85°C		Ta=25°C		-40°C ≤ Topr ≤ 85°C	
VOUT(T)	VOUT		Vdif1	Vdif1	Vdif1	Vdif1	Vdif2	Vdif2	Vdif2	Vdif2
	MIN	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX
1.50	1.455	1.545	400	500	410	520	600	800	620	820
1.55	1.504	1.597	400	500	410	520	600	800	620	820
1.60	1.552	1.648	300	380	310	400	500	680	520	700
1.65	1.601	1.700	300	380	310	400	500	680	520	700
1.70	1.649	1.751	250	320	260	330	400	620	420	640
1.75	1.698	1.803	250	320	260	330	400	620	420	640
1.80	1.746	1.854	200	250	210	260	350	480	360	500
1.85	1.795	1.906	200	250	210	260	350	480	360	500
1.90	1.843	1.957	140	180	150	190	320	460	340	480
1.95	1.892	2.009	140	180	150	190	320	460	340	480
2.00	1.960	2.040	100	150	110	160	270	420	290	440
2.05	2.009	2.091	100	150	110	160	270	420	290	440
2.10	2.058	2.142	100	150	110	160	250	400	280	410
2.15	2.107	2.193	100	150	110	160	250	400	280	410
2.20	2.156	2.244	100	150	110	160	250	400	280	410
2.25	2.205	2.295	100	150	110	160	250	400	280	410
2.30	2.254	2.346	100	150	110	160	240	380	280	400
2.35	2.303	2.397	100	150	110	160	240	380	280	400
2.40	2.352	2.448	100	150	110	160	240	380	280	400
2.45	2.401	2.499	100	150	110	160	240	380	280	400
2.50	2.450	2.550	90	120	100	130	230	350	260	380
2.55	2.499	2.601	90	120	100	130	230	350	260	380
2.60	2.548	2.652	90	120	100	130	230	350	260	380
2.65	2.597	2.703	90	120	100	130	230	350	260	380
2.70	2.646	2.754	90	120	100	130	230	350	260	380
2.75	2.695	2.805	90	120	100	130	230	350	260	380
2.80	2.744	2.856	90	120	100	130	220	330	260	370
2.85	2.793	2.907	90	120	100	130	220	330	260	370
2.90	2.842	2.958	90	120	100	130	220	330	260	370
2.95	2.891	3.009	90	120	100	130	220	330	260	370
3.00	2.940	3.060	80	100	90	110	220	300	260	350
3.05	2.989	3.111	80	100	90	110	220	300	260	350
3.10	3.038	3.162	80	100	90	110	200	280	240	330
3.15	3.087	3.213	80	100	90	110	200	280	240	330
3.20	3.136	3.264	80	100	90	110	200	280	240	330

- Dropout voltage (con't)

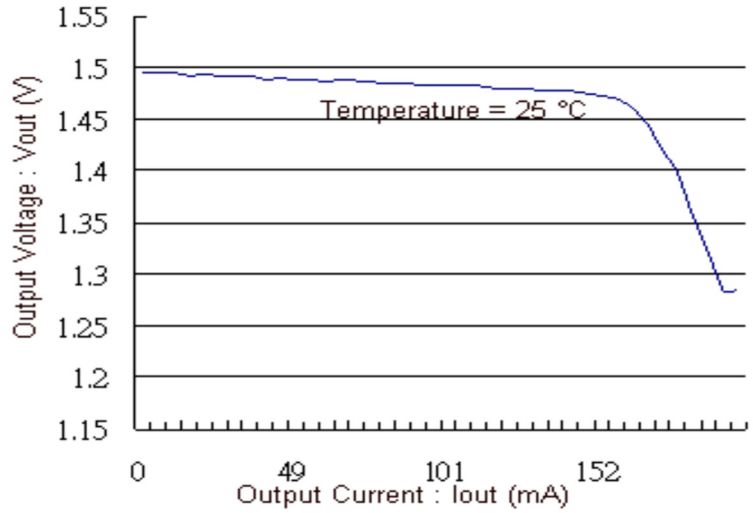
SYMBOL	E-0		E-1				E-2			
PARAMETER / OUTPUT VOLTAGE	Output Voltage (V)		Dropout Voltage 1 (mV) (I_{OUT}=30mA)				Dropout Voltage 2 (mV) (I_{OUT}=100mA)			
			Ta=25°C		-40°C ≤ Topr ≤ 85°C		Ta=25°C		-40°C ≤ Topr ≤ 85°C	
V_{OUT}(T)	V_{OUT}		Vdif1	Vdif1	Vdif1	Vdif1	Vdif2	Vdif2	Vdif2	Vdif2
	MIN	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX
3.25	3.185	3.315	80	100	90	110	200	280	240	330
3.30	3.234	3.366	80	100	90	110	200	280	240	330
3.35	3.283	3.417	80	100	90	110	200	280	240	330
3.40	3.332	3.468	80	100	90	110	200	280	240	330
3.45	3.381	3.519	80	100	90	110	200	280	240	330
3.50	3.430	3.570	80	100	90	110	200	280	240	330
3.55	3.479	3.621	80	100	90	110	200	280	240	330
3.60	3.528	3.672	80	100	90	110	200	280	240	330
3.65	3.577	3.723	80	100	90	110	200	280	240	330
3.70	3.626	3.774	80	100	90	110	200	280	240	330
3.75	3.675	3.825	80	100	90	110	200	280	240	330
3.80	3.724	3.876	80	100	90	110	200	280	240	330
3.85	3.773	3.927	80	100	90	110	200	280	240	330
3.90	3.822	3.978	80	100	90	110	200	280	240	330
3.95	3.871	4.029	80	100	90	110	200	280	240	330
4.00	3.920	4.080	70	90	80	100	180	260	220	310
4.05	3.969	4.131	70	90	80	100	180	260	220	310
4.10	4.018	4.182	70	90	80	100	180	260	220	310
4.15	4.067	4.233	70	90	80	100	180	260	220	310
4.20	4.116	4.284	70	90	80	100	180	260	220	310
4.25	4.165	4.335	70	90	80	100	180	260	220	310
4.30	4.214	4.386	70	90	80	100	180	260	220	310
4.35	4.263	4.437	70	90	80	100	180	260	220	310
4.40	4.312	4.488	70	90	80	100	180	260	220	310
4.45	4.361	4.539	70	90	80	100	180	260	220	310
4.50	4.410	4.590	70	90	80	100	180	260	220	310
4.55	4.459	4.641	70	90	80	100	180	260	220	310
4.60	4.508	4.692	70	90	80	100	180	260	220	310
4.65	4.557	4.743	70	90	80	100	180	260	220	310

- Dropout voltage (con't)

SYMBOL	E-0		E-1				E-2			
PARAMETER / OUTPUT VOLTAGE	Output Voltage (V)		Dropout Voltage 1 (mV) (I_{OUT}=30mA)				Dropout Voltage 2 (mV) (I_{OUT}=100mA)			
			Ta=25°C		-40°C ≤ Topr ≤ 85°C		Ta=25°C		-40°C ≤ Topr ≤ 85°C	
V_{OUT}(T)	V_{OUT}		Vdif1	Vdif1	Vdif1	Vdif1	Vdif2	Vdif2	Vdif2	Vdif2
	MIN	MAX	TYP	MAX	TYP	MAX	TYP	MAX	TYP	MAX
4.70	4.606	4.794	70	90	80	100	180	260	220	310
4.75	4.655	4.845	70	90	80	100	180	260	220	310
4.80	4.704	4.896	70	90	80	100	180	260	220	310
4.85	4.753	4.947	70	90	80	100	180	260	220	310
4.90	4.802	4.998	70	90	80	100	180	260	220	310
4.95	4.851	5.049	70	90	80	100	180	260	220	310
5.00	4.900	5.100	50	80	60	90	160	240	200	290
5.05	4.949	5.151	50	80	60	90	160	240	200	290
5.10	4.998	5.202	50	80	60	90	160	240	200	290
5.15	5.047	5.253	50	80	60	90	160	240	200	290
5.20	5.096	5.304	50	80	60	90	160	240	200	290
5.25	5.145	5.355	50	80	60	90	160	240	200	290
5.30	5.194	5.406	50	80	60	90	160	240	200	290
5.35	5.243	5.457	50	80	60	90	160	240	200	290
5.40	5.292	5.508	50	80	60	90	160	240	200	290
5.45	5.341	5.559	50	80	60	90	160	240	200	290
5.50	5.390	5.610	50	80	60	90	160	240	200	290
5.55	5.439	5.661	50	80	60	90	160	240	200	290
5.60	5.488	5.712	50	80	60	90	160	240	200	290
5.65	5.537	5.763	50	80	60	90	160	240	200	290
5.70	5.586	5.814	50	80	60	90	160	240	200	290
5.75	5.635	5.865	50	80	60	90	160	240	200	290
5.80	5.684	5.916	50	80	60	90	160	240	200	290
5.85	5.733	5.967	50	80	60	90	160	240	200	290
5.90	5.782	6.018	50	80	60	90	160	240	200	290
5.95	5.831	6.069	50	80	60	90	160	240	200	290
6.00	5.880	6.120	50	80	60	90	160	240	200	290

- Typical Performance Characteristics
- Output voltage VS Output current

CS7R6204-15B-TS-G



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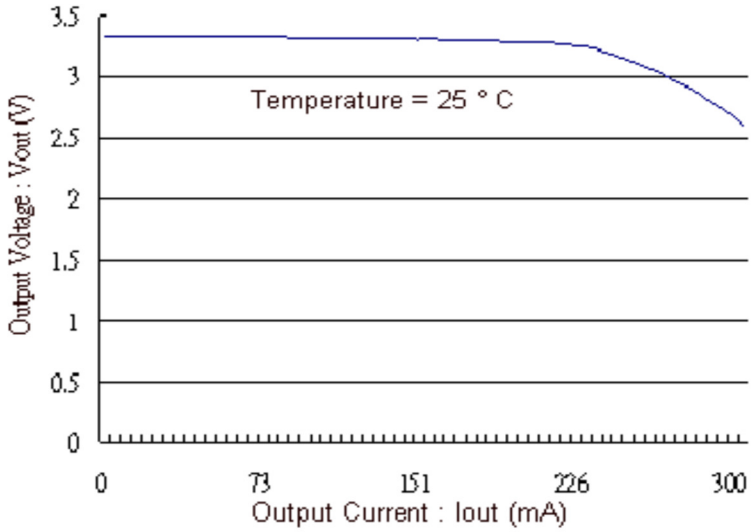

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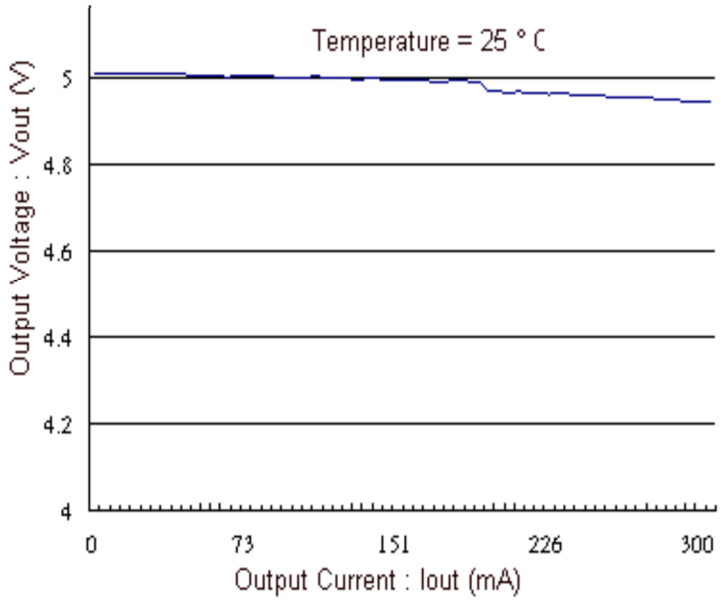
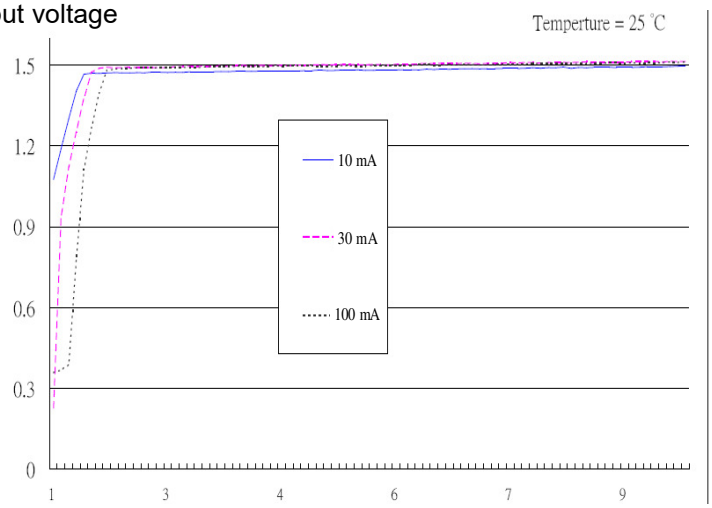


- Typical Performance Characteristics
- Output voltage VS Input voltage

CS7R6204-15B-TS-G



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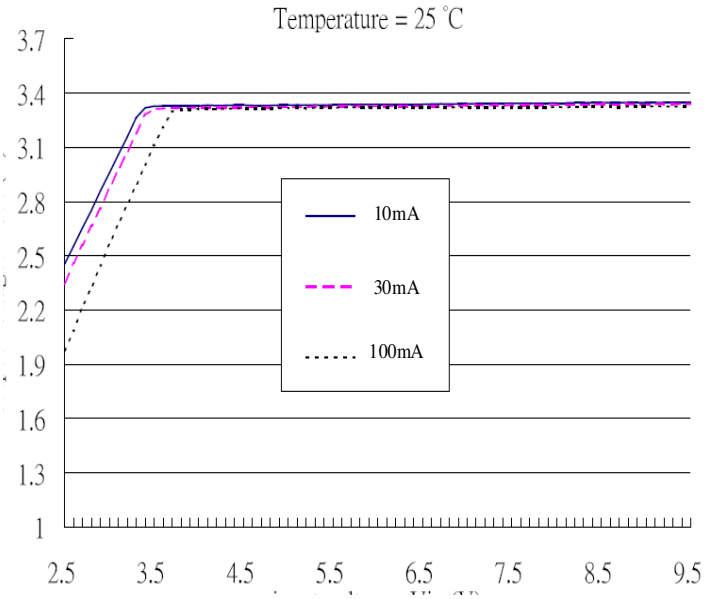

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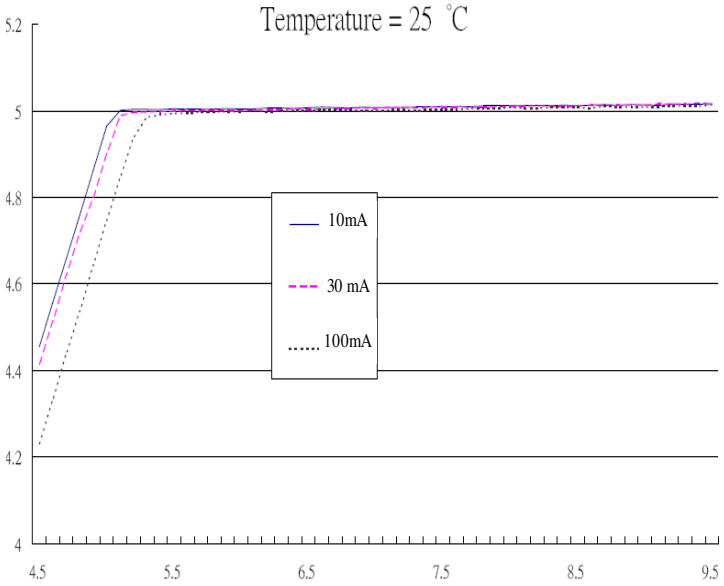
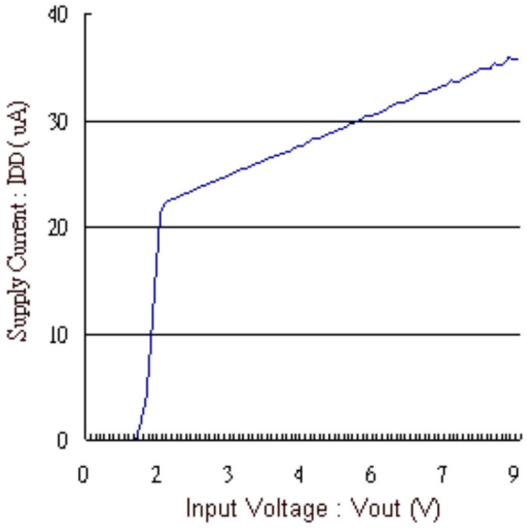
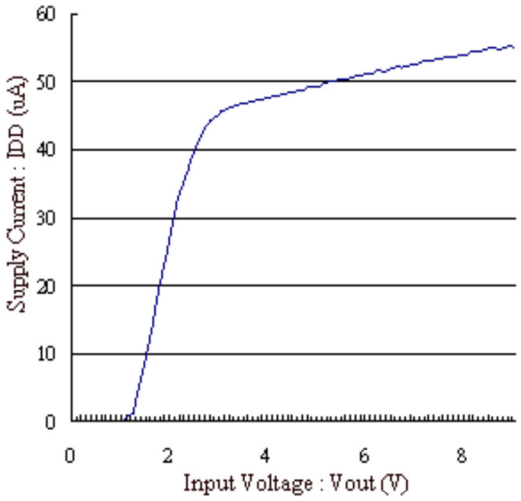


- Typical Performance Characteristics
- Supply current VS Input voltage

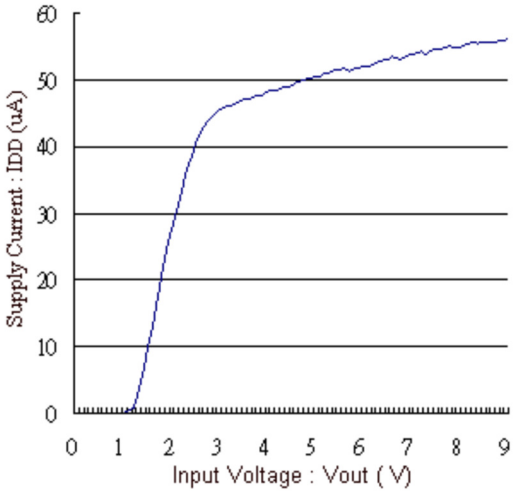
CS7R6204-15B-TS-G



CS7R6204-33B-TS-G

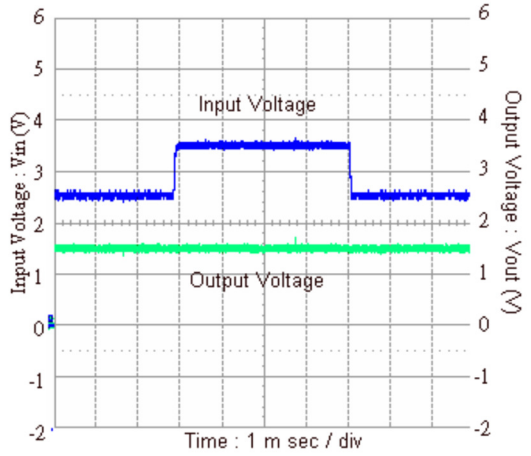


CS7R6204-50B-TS-G

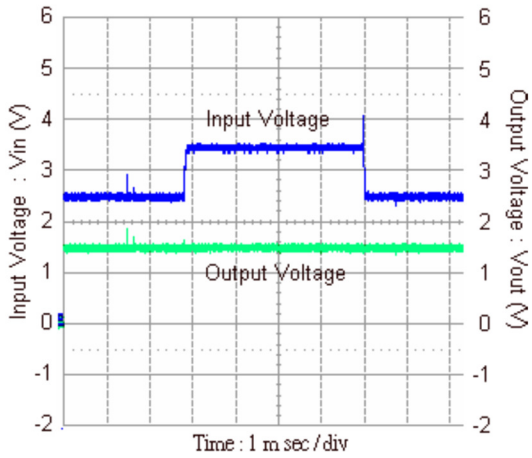


- Input Transient Response

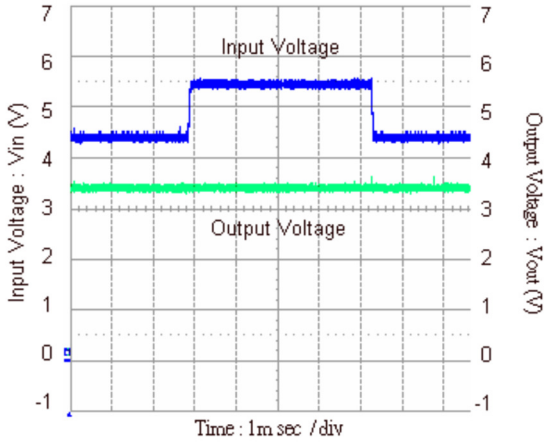
CS7R6204-15B-TS-G
Vin = 2.5V to 3.5V, tr = tf = 20 μ s
Cin = CL = 1 μ F (Ceramic)



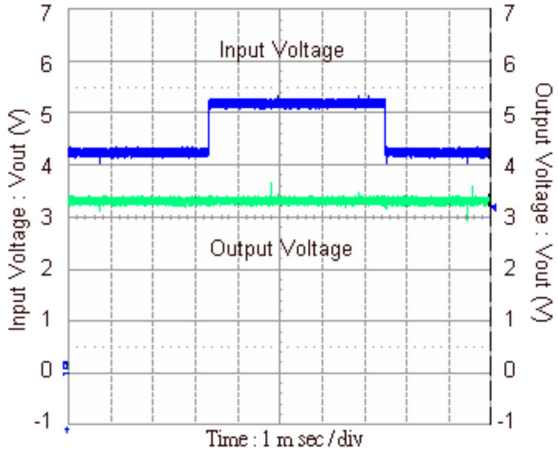
CS7R6204-15B-TS-G
Vin = 2.5V to 3.5V, tr = tf = 20 μ s
Cin = CL = 1 μ F (Ceramic)



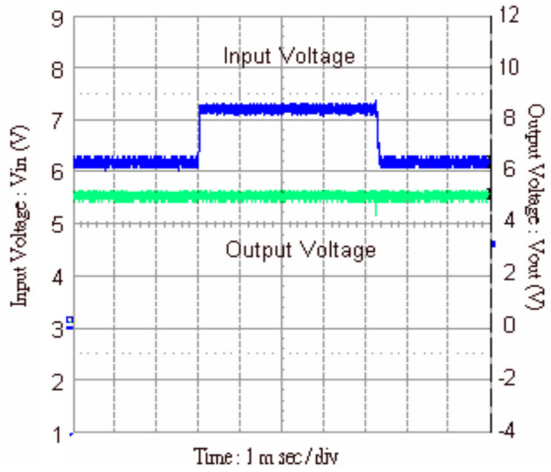
CS7R6204-33B-TS-G
Vin = 4.3V to 5.3V, tr = tf = 20 μ s
Cin = CL = 1 μ F (Ceramic)



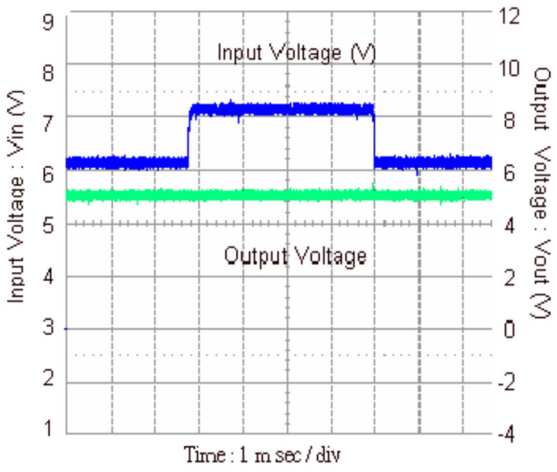
CS7R6204-33B-TS-G
Vin = 4.3V to 5.3V, tr = tf = 20 μ s
Cin = CL = 1 μ F (Ceramic)



CS7R6204-50B-TS-G
Vin = 6V to 7V, tr = tf = 20 μ s
Cin = CL = 1 μ F (Ceramic)

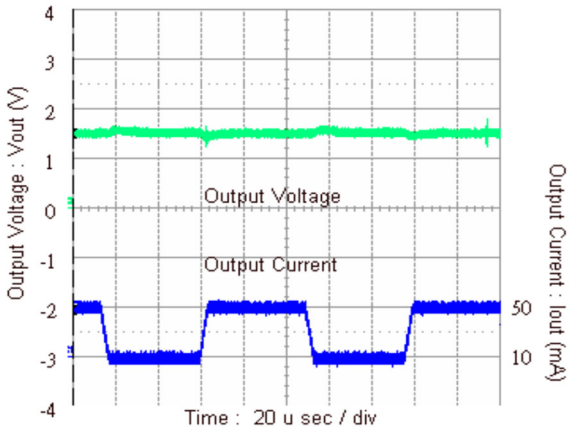


CS7R6204-50B-TS-G
Vin = 6V to 7V, tr = tf = 20 μ s
Cin = CL = 1 μ F (Ceramic)

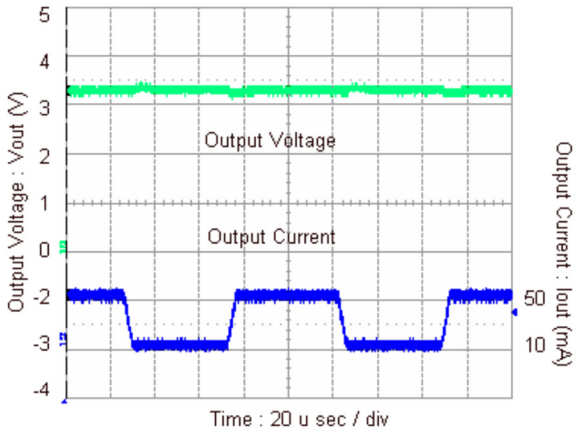


- Load Transient Response

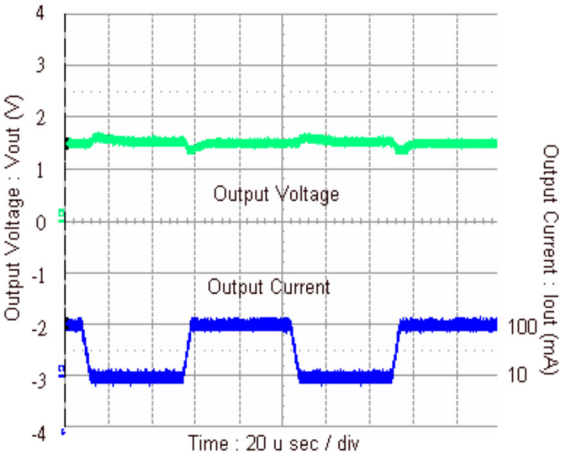
CS7R6204-15B-TS-G
Vin = 2.5V, tr = tf = 5 μ s
Cin = CL = 1 μ F (Ceramic)



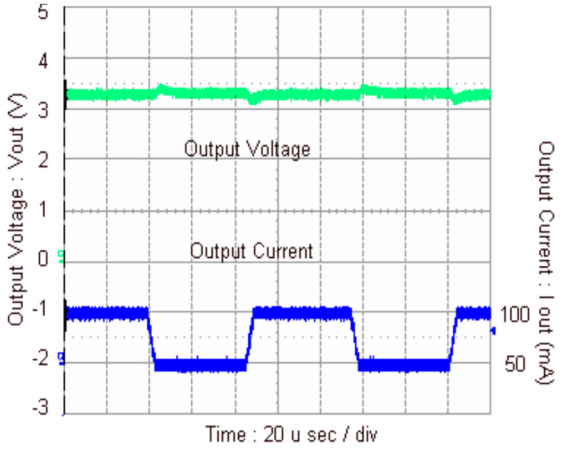
CS7R6204-33B-TS-G
Vin = 4.3V, tr = tf = 5 μ s
Cin = CL = 1 μ F (Ceramic)



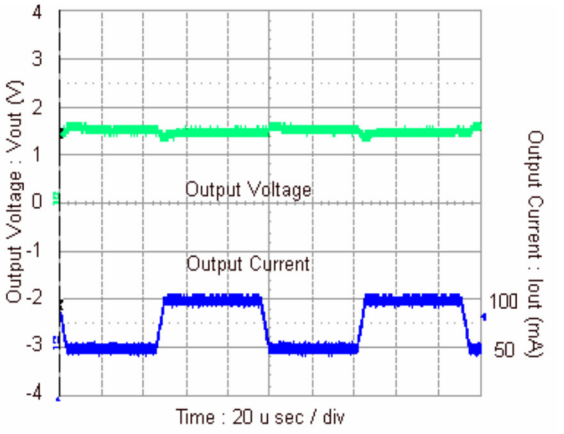
CS7R6204-15B-TS-G
Vin = 2.5V , tr = tf = 5 μ s
Cin = CL = 1 μ F (Ceramic)



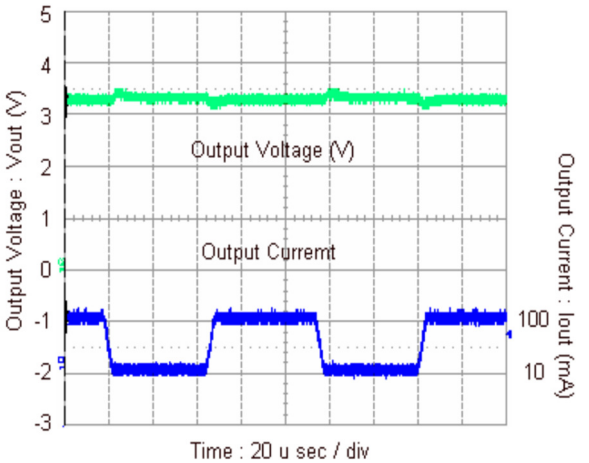
CS7R6204-33B-TS-G
Vin = 4.3V, tr = tf = 5 μ s
Cin = CL = 1 μ F (Ceramic)



CS7R6204-15B-TS-G
Vin = 2.5V, tr = tf = 5 μ s
Cin = CL = 1 μ F (Ceramic)

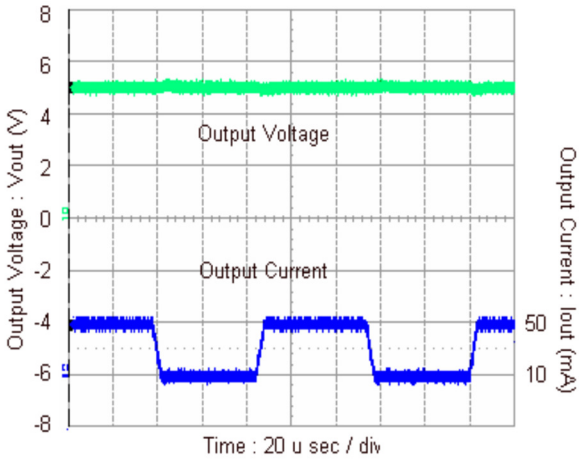


CS7R6204-33B-TS-G
Vin = 4.3V, tr = tf = 5 μ s
Cin = CL = 1 μ F (Ceramic)

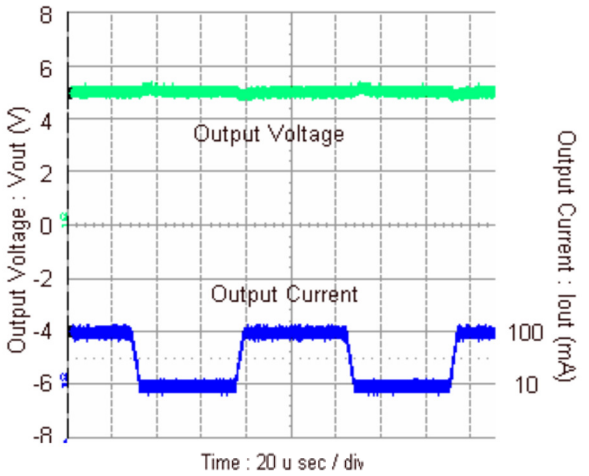


- Load Transient Response

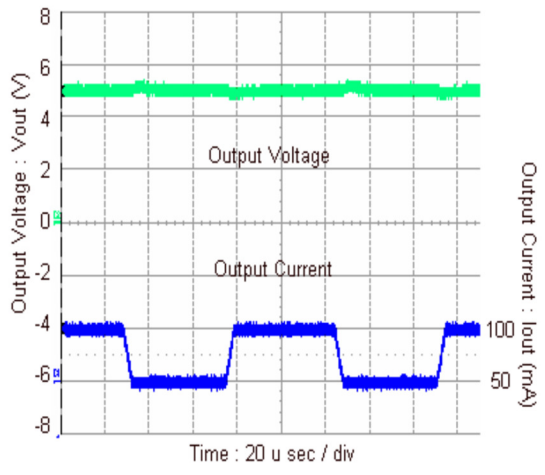
CS7R6204-50B-TS-G
Vin = 6V, tr = tf = 5μs
Cin = CL = 1μF (Ceramic)



CS7R6204-50B-TS-G
Vin = 6V, tr = tf = 5μs
Cin = CL = 1μF (Ceramic)

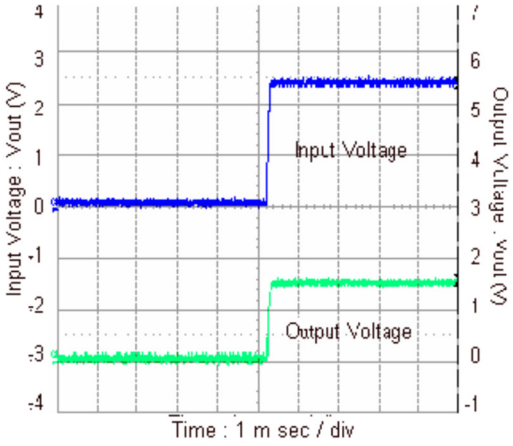


CS7R6204-50B-TS-G
Vin = 6V, tr = tf = 5μs
Cin = CL = 1μF (Ceramic)

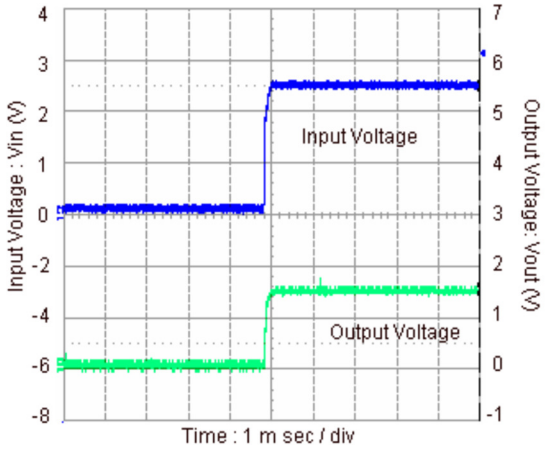


- Turn on Transient Response

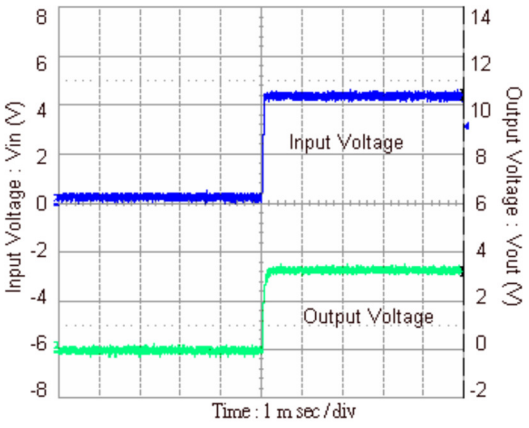
CS7R6204-15B-TS-G
Vin = 0V to 2.5V, Iout = 30mA, tr = tf = 50 μ s
Cin = CL = 1 μ F (Ceramic)



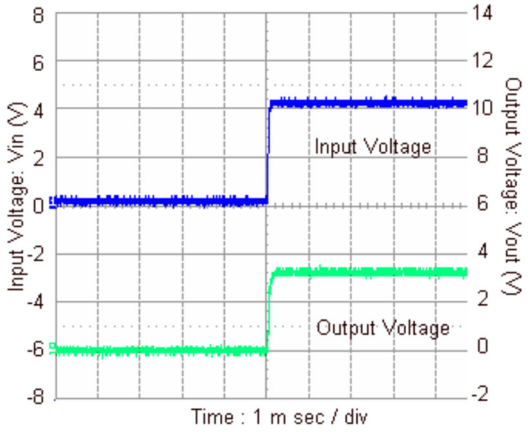
CS7R6204-15B-TS-G
Vin = 0V to 2.5V, Iout = 100mA, tr = tf = 50 μ s
Cin = CL = 1 μ F (Ceramic)



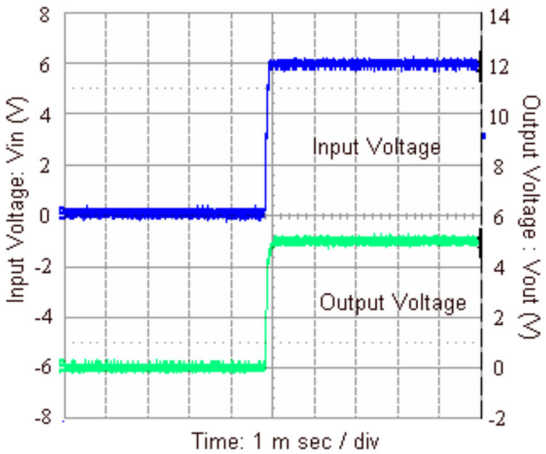
CS7R6204-33B-TS-G
Vin = 0V to 4.3V, Iout = 30mA, tr = tf = 50 μ s
Cin = CL = 1 μ F (Ceramic)



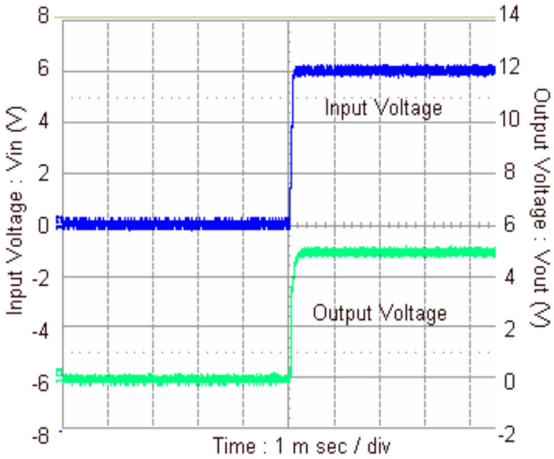
CS7R6204-33B-TS-G
Vin = 0V to 4.3V, Iout = 100mA, tr = tf = 50 μ s
Cin = CL = 1 μ F (Ceramic)



CS7R6204-50B-TS-G
Vin = 0V to 6V, Iout = 30mA, tr = tf = 50 μ s
Cin = CL = 1 μ F (Ceramic)

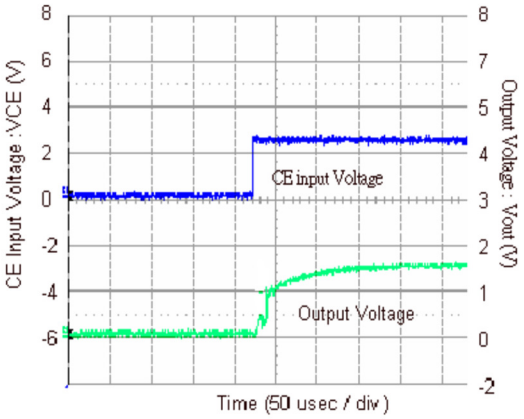


CS7R6204B-100B-TS-G-F
Vin = 0V to 6V, Iout = 30mA, tr = tf = 50 μ s
Cin = CL = 1 μ F (Ceramic)

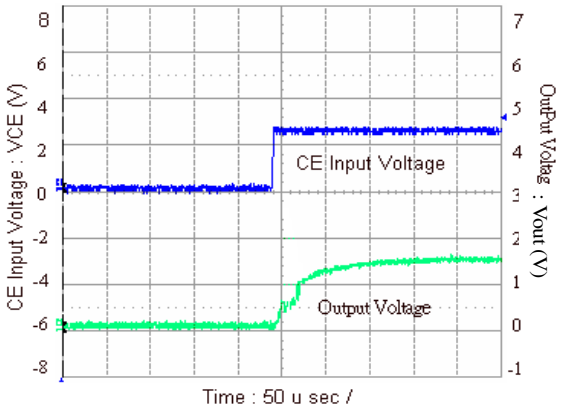


- Enable Transient Response

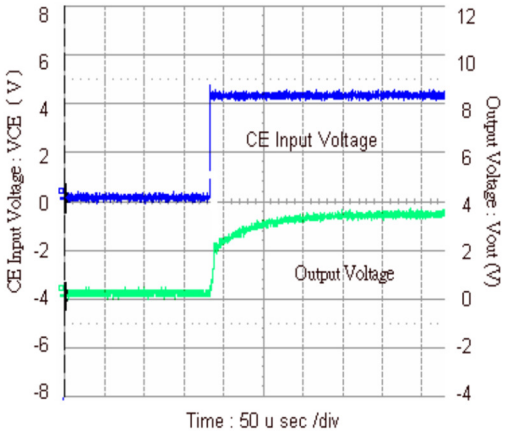
CS7R6204-15B-TS-G
Vin = 2.5V, Iout = 30mA, tr = tf = 5 μ s
VCE = 0V to 2.5V, Cin = CL = 1 μ F (Ceramic)



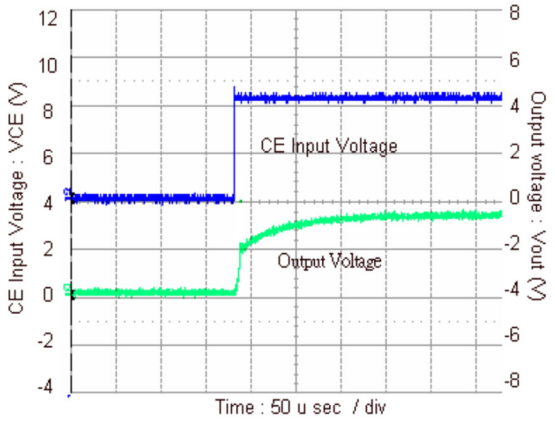
CS7R6204-15B-TS-G
Vin = 2.5V, Iout = 100mA, tr = tf = 5 μ s
VCD = 0V to 2.5V, Cin = CL = 1 μ F (Ceramic)



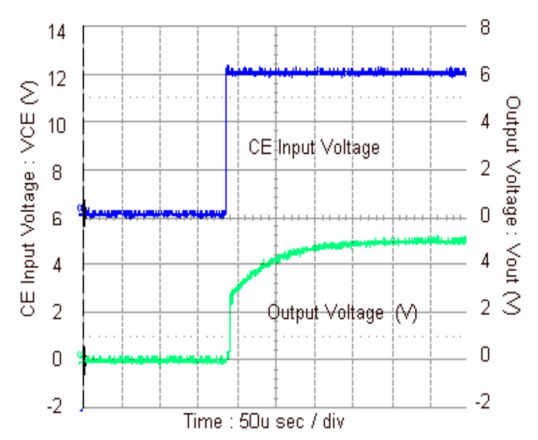
CS7R6204-33B-TS-G
Vin = 4.3V, Iout = 30mA, tr = tf = 5 μ s
VCD = 0V to 4.3V, Cin = CL = 1 μ F (Ceramic)



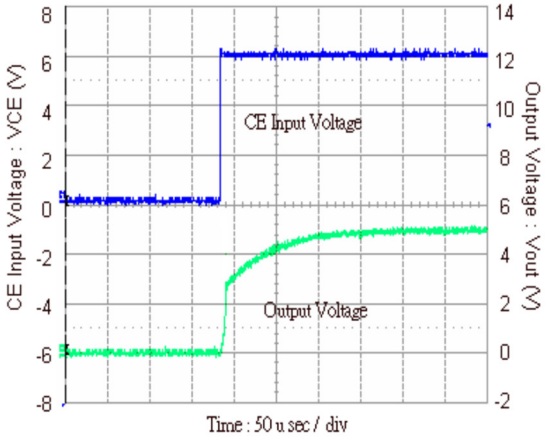
CS7R6204-33B-TS-G
Vin = 4.3V, Iout = 100mA, tr = tf = 5 μ s
VCD = 0V to 4.3V, Cin = CL = 1 μ F (Ceramic)



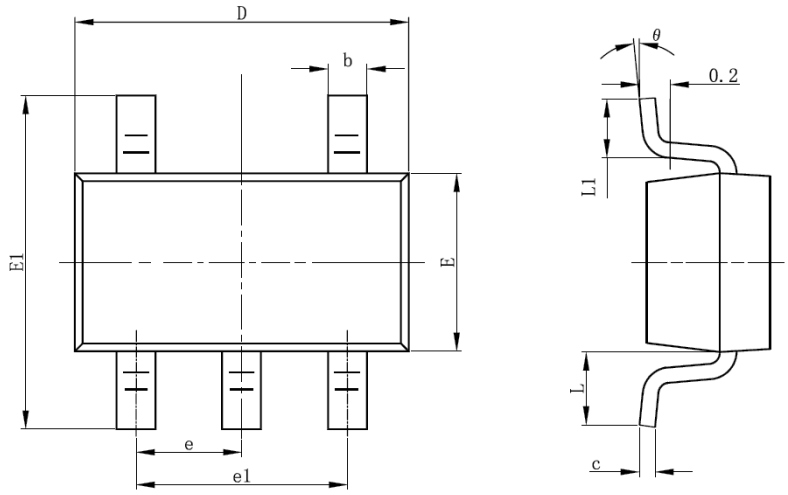
CS7R6204-50B-TS-G
Vin = 6V, Iout = 30mA, tr = tf = 5 μ s
VCD = 0V to 6V, Cin = CL = 1 μ F (Ceramic)



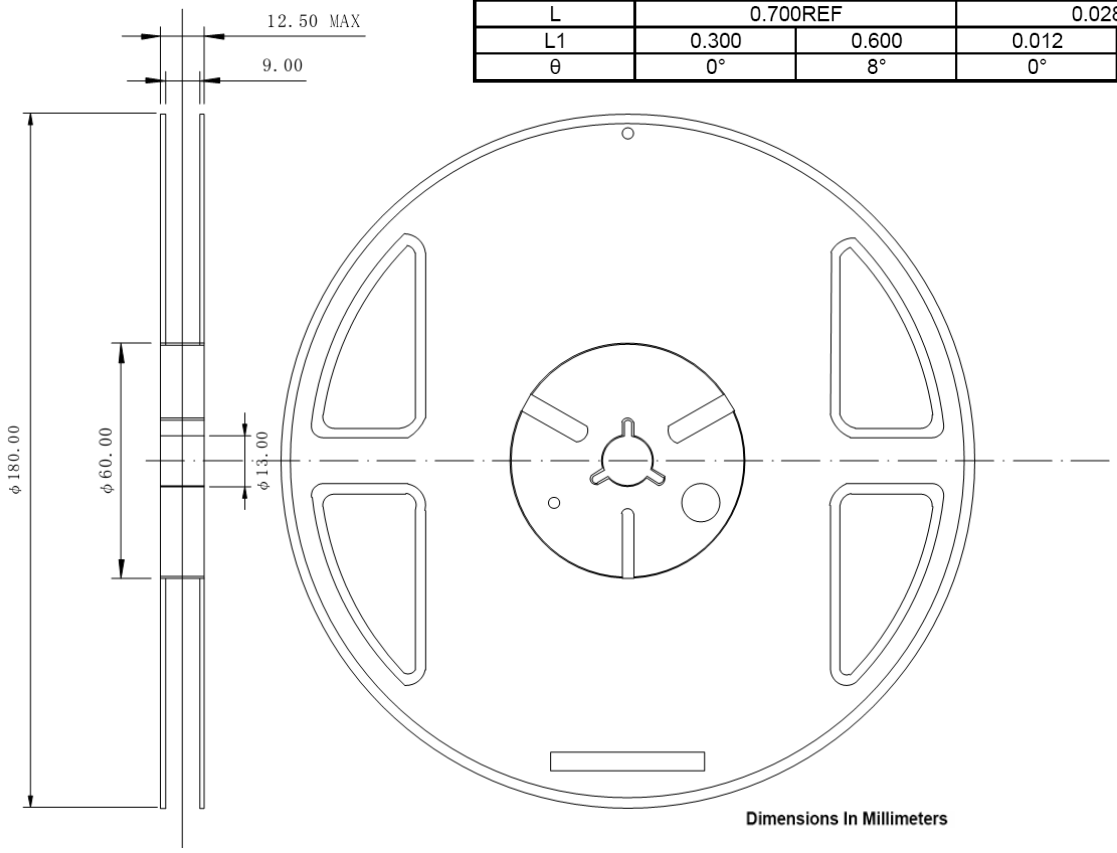
CS7R6204-50B-TS-G
Vin = 6V, Iout = 100mA, tr = tf = 5 μ s
VCD = 0V to 6V, Cin = CL = 1 μ F (Ceramic)



- SOT-23-5 package and reel dimensions

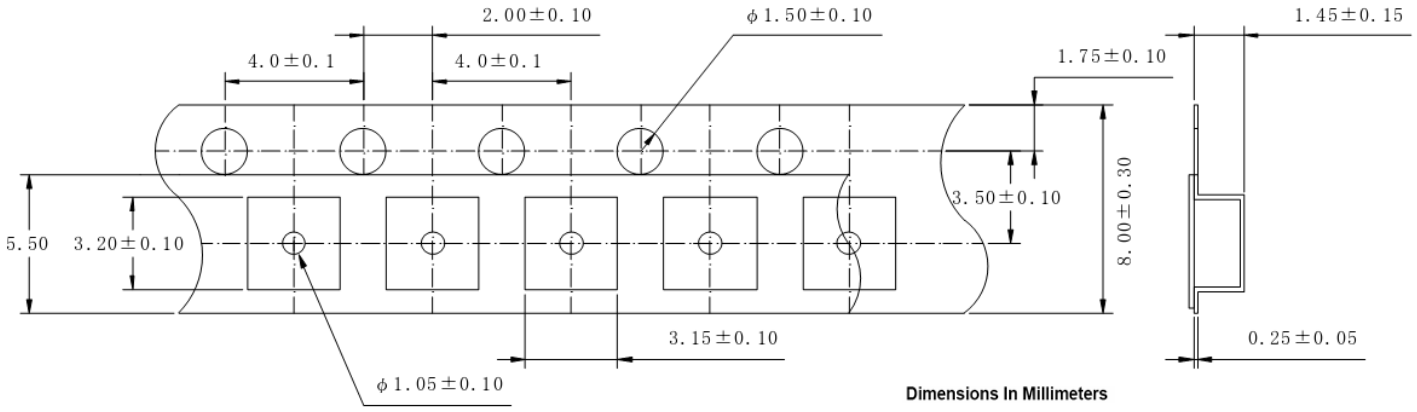


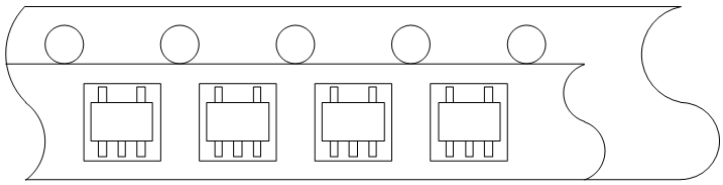
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°



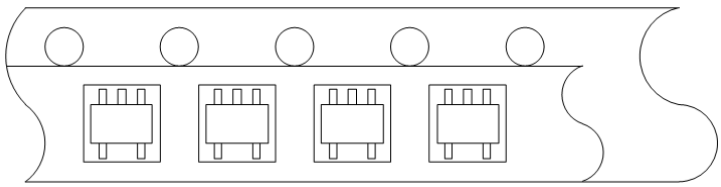
Dimensions In Millimeters

- SOT-23-5 Taping



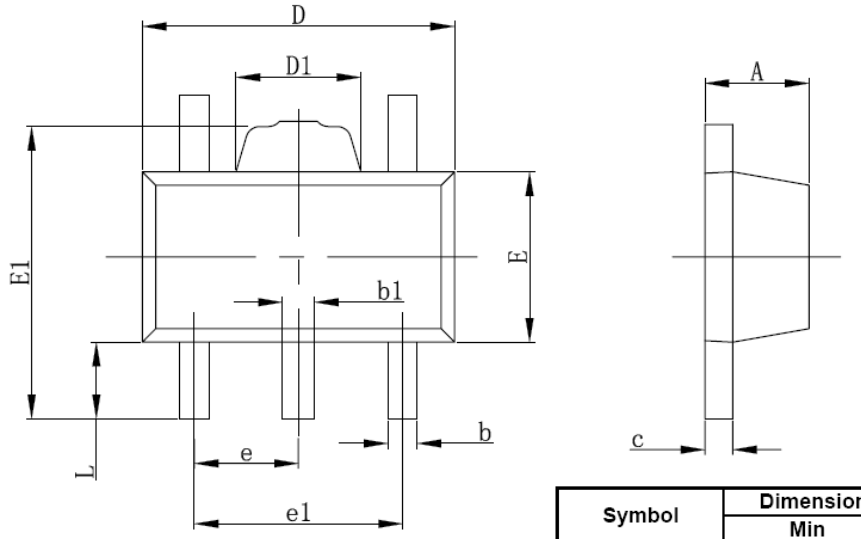


- S Type : standard

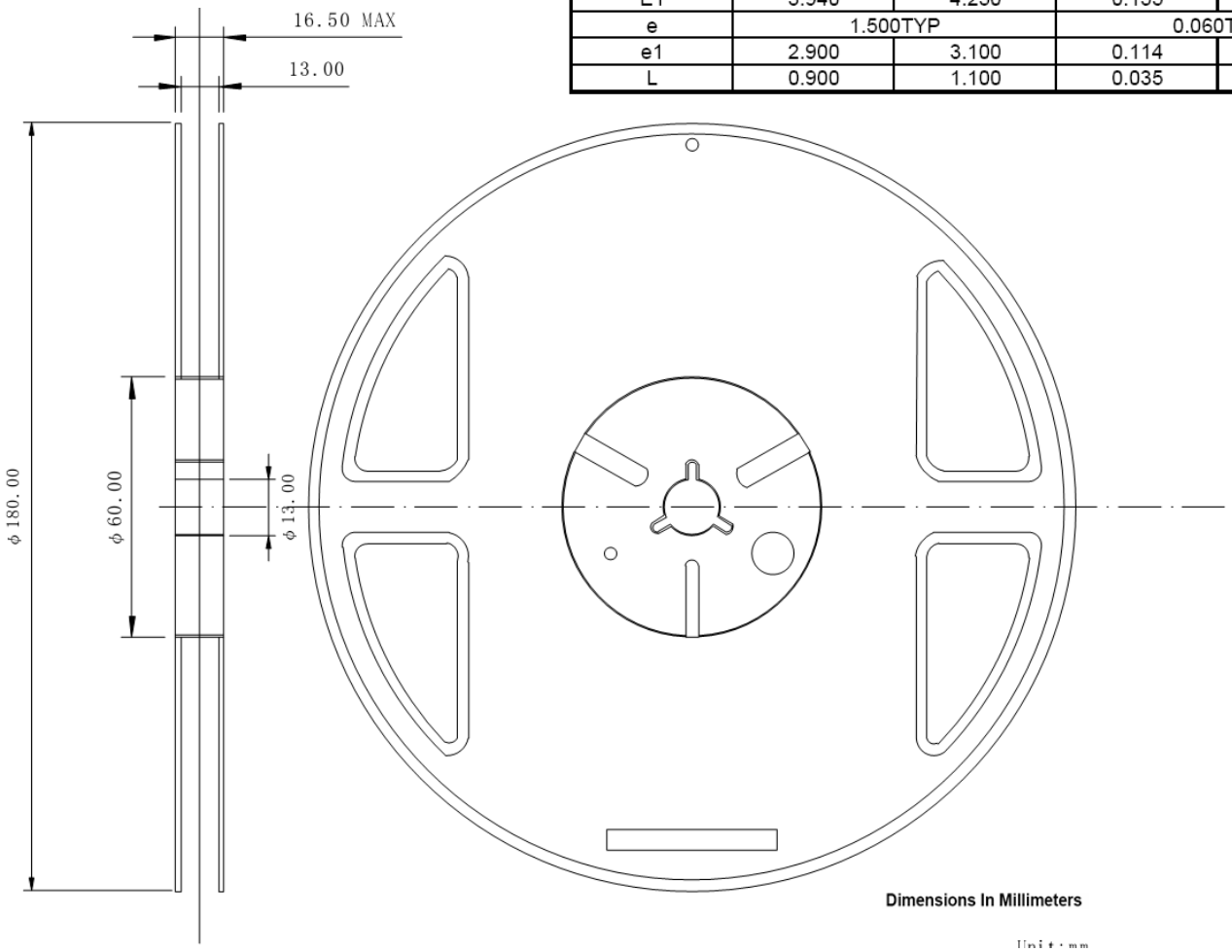


- N Type : Reverse

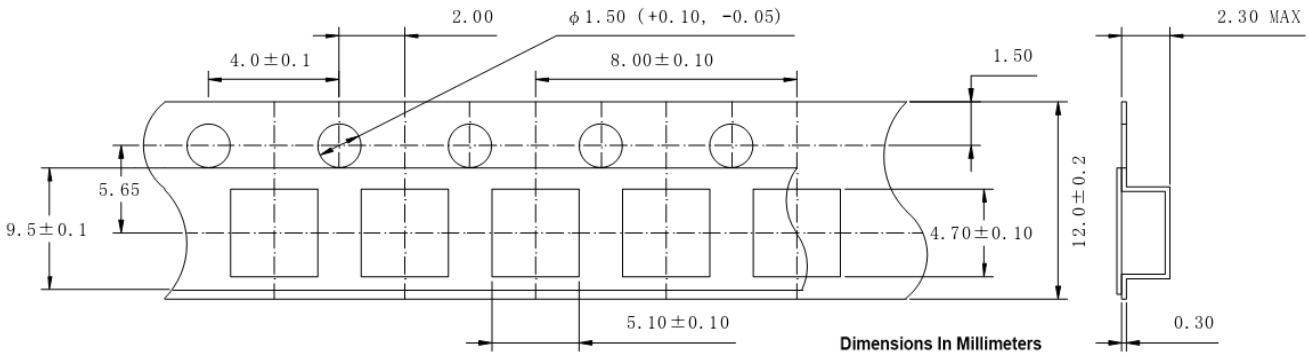
- SOT-89-5 package and reel dimensions

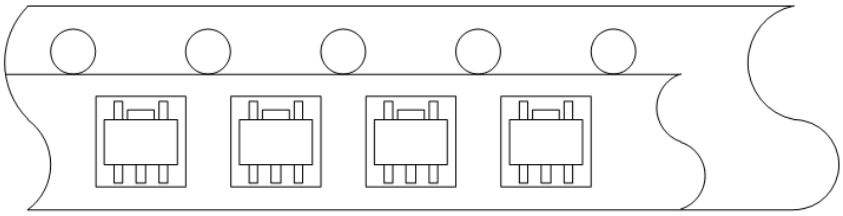


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.360	0.560	0.014	0.022
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500TYP		0.060TYP	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043

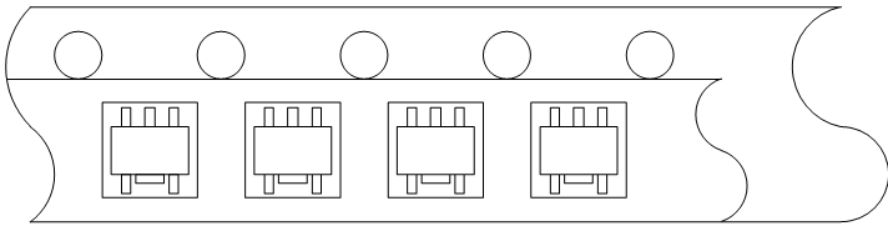


- SOT-89-5 Taping





- S Type : standard



- N Type : Reverse

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