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**COMBINATION SWITCHING CONTROLLER
AND LOW DROPOUT REGULATOR**
SC113X

April 8, 1998

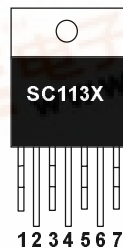
TEL:805-498-2111 FAX:805-498-3804 WEB:http://www.semtech.com

DESCRIPTION

The SC1131/2/3/4 incorporates a high current low dropout linear regulator section together with a switching buck mode controller. This unique combination is well suited for high current low voltage power supply applications such as the Intel Pentium™ P55, AMD K6 and the Cyrix M2 processors. The SC113X was designed to reduce the number of components required to design a dual power supply for multivoltage processor applications.

Switching Controller Section: The switching control section is a voltage mode controller designed for high current, low voltage power supply applications. Key features include a temperature compensated voltage reference, triangular oscillator and an internally compensated transconductance error amplifier. The switching controller operates at a fixed frequency of 200kHz, providing an optimum compromise between size, efficiency and cost in the intended application areas.

Linear Section: The linear portion is a high performance positive voltage regulator designed for use in applications requiring "very low dropout performance" at 1.5, 3, 5 and 7.5 amps. Additionally, the linear section provides excellent regulation over variations due to changes in line, load or temperature.

PIN CONFIGURATION


Pin #	Pin Name	Pin Function
1	DH	MOSFET Driver Output
2	P _{GND}	Switching Power Ground
3	V _{O SENSE}	Error Amplifier Input (Switcher)
4	GND	Signal Ground
5	V _{CC}	+12V Input Voltage
6	V _{OUT}	V _{OUT} (Linear Section)
7	V _{IN}	+5V Input Voltage

FEATURES

- 85% typical efficiency for switching section
- Grounded tab
- 1.5, 2.5 or 3.3V @ 1% for linear
- Thermal shutdown
- Internal short circuit protection
- 7 pin TO-220 package

APPLICATIONS

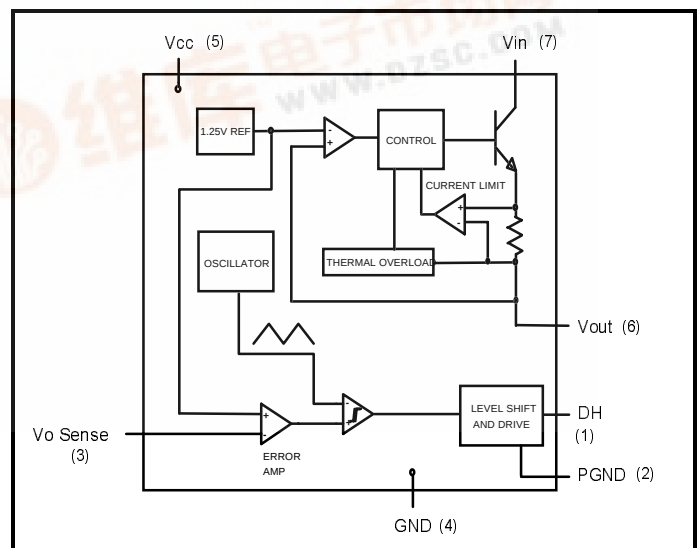
- Microprocessor supplies
- Modules supplies
- 1.3V to 3.5V power supplies
- Dual power supplies from 5V source

ORDERING INFORMATION

PART NUMBER ⁽¹⁾	PACKAGE	OUTPUT CURRENT
SC1131CT-XY	TO-220	1.5A
SC1132CT-XY	TO-220	3.0A
SC1133CT-XY	TO-220	5.0A
SC1134CT-XY	TO-220	7.5A

Note:

(1) Where XY denotes voltage options and lead configurations. Available voltages (X) are: 1.5V, 2.5V and 3.3V. Available lead configurations (Y) are dual bend (DB), single bend (SB) and straight leads (leave blank). Sample part number: SC1133CT-2.5DB.

BLOCK DIAGRAM


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ABSOLUTE MAXIMUM RATINGS

V_{IN} to GND		-0.3V, 7V
V_{CC} to GND		-0.3V, 15V
T_J	Junction Operating Temperature	0°C to +125°C
T_S	Storage Temperature	-65°C to +125°C
T_L	Lead Soldering Temperature	260°C, 10 sec.
θ_{JC}	Thermal Resistance, Junction to Case	2°C/W
θ_{JA}	Thermal Resistance, Junction to Ambient	50°C/W

ELECTRICAL CHARACTERISTICS

SWITCHING CONTROL SECTION

$V_{CC} = 12V$; $V_{IN} = 5.0V$; $GND = P_{GND} = 0V$; $V_{OUT} = 2.8V$. Per application circuit unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
I_{CC}	Total Quiescent Current	Linear out = No Load	25° C		15	25	mA
V_{REF}	Reference Voltage		25° C	1.238	1.250	1.263	V
			0-125° C	1.225	1.250	1.275	
Reg_{LOAD}	Load Regulation		25° C			1	%
Reg_{LINE}	Line Regulation		25° C		0.5		%
DH_{HI}	MOSFET Driver Source Voltage	$V_{CC} - DH$; $I_{DH} = 0.5A$	25° C		1.6		V
DH_{LOW}	MOSFET Driver Sink Voltage	$DH - P_{GND}$; $I_{DH} = 0.5A$	25° C		1.1		V
f_{OSC}	Oscillator Frequency		25° C	180	200	220	kHz
dc	Duty Cycle (maximum)		25° C	90	95		%

LINEAR SECTION

$V_{CC} = 12V$; $V_{IN} = 5.0V$; $GND = P_{GND} = 0V$; $V_{OUT} = 3.3V$. Per application circuit unless otherwise specified.

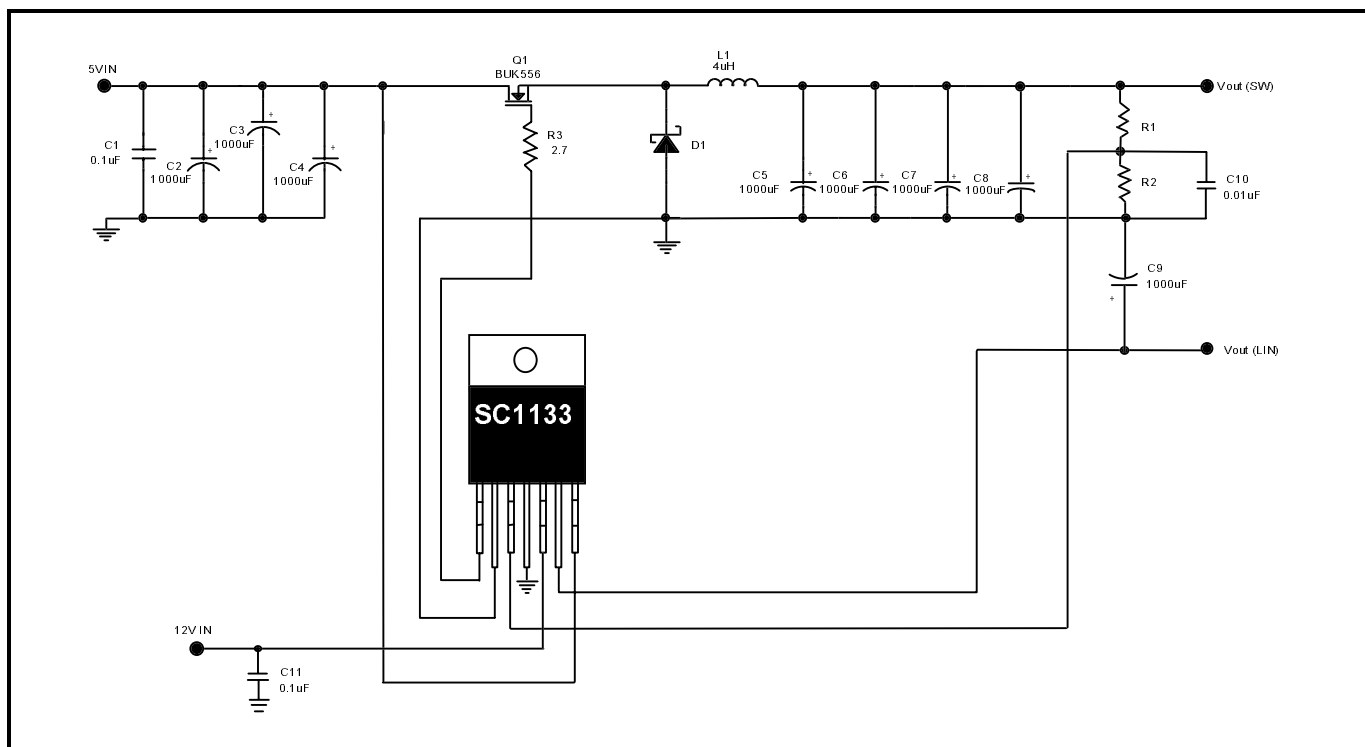
SYMBOL	PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
V_{OUT}	Output Voltage	$V_{IN} = 5.0V$, $I_{OUT} = I_R$	25° C	3.267	3.300	3.333	V
		$V_{IN} = 4.75-5.55V$, $I_{OUT} = 10mA$ to I_R	0-125° C	3.234	3.300	3.366	
Reg_{LOAD}	Load Regulation	$V_{IN} = 5.0V$ $I_{OUT} = 10mA$ to I_R	25° C			1	%
			0-125 C			1.5	
Reg_{LINE}	Line Regulation	$V_{IN} = 4.75-5.55V$, $I_{OUT} = I_R$	25° C		0.5		%
			0-125 C		1		
I_{LIMIT}	Current Limit		25° C	$I_R + 0.1$			A
R_A	Ripple Rejection ⁽¹⁾	$V_{IN} = 5.0V$, $I_{OUT} = I_R/2$	25° C	60	80		dB
T_{REG}	Thermal Regulation ⁽²⁾		25° C		0.002	0.02	%/°C
V_{DO}	Dropout Voltage ⁽³⁾	$I_{OUT} = I_R$	SC1131, 2, 3	25° C	0.8	0.9	V
		SC1134	25° C		1.3	1.4	
V_{IN}	Minimum V_{IN}	$I_{OUT} = I_R$	SC1131, 2, 3	25° C	0.8	0.9	V
		SC1134	25° C		1.3	1.4	

NOTES:

- $V_{CC} = V_{IN} = 5.0V$ Avg; $V_{RIPPLE} = 1V$ PK-PK, 120 Hz.
- 30ms pulse
- Minimum input/output voltage required to maintain 1% regulation
- I_R = Rated load current per ordering information

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APPLICATION CIRCUIT



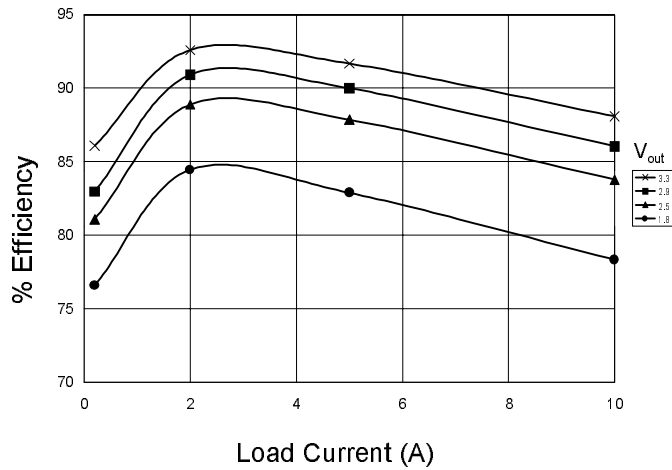
MATERIALS LIST

Quantity	Reference	Part/Description	Vendor	Notes
1	C1,C11	0.1μF Ceramic	Various	
1	C10	0.01μF Ceramic	Various	
8	C2-C9	1000μF/6.3V	SANYO	MV-GX or equiv. Low ESR
1	D1	32CTQ030	Various	16A, 30V Schottky, TO-220
1	L1	4μH		8 Turns 16AWG on MICROMETALS T50-52D core
1	Q1	BUK556	PHILIPS	Logic level FET, ≤ 22mΩ, 30V
1	U1	SC1133T-XY	SEMTECH	5A Linear Regulator with Switching Controller
1	R1	SMT 1%	Various	Value depends on V _{OUT}
1	R2	SMT 1%	Various	Value depends on V _{OUT}
1	R3	2.7Ω 1/8W	Various	

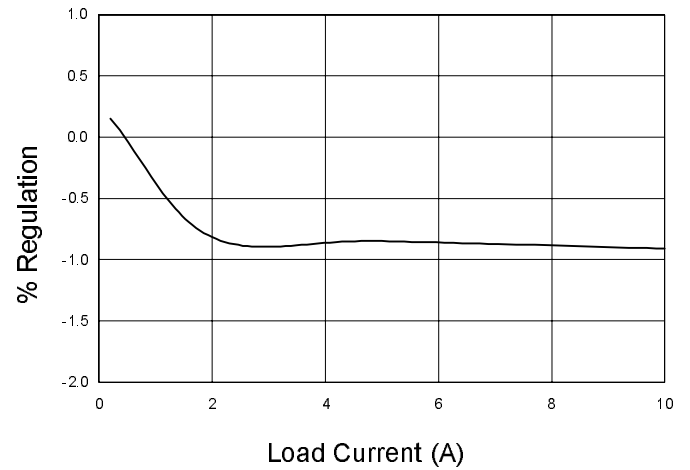


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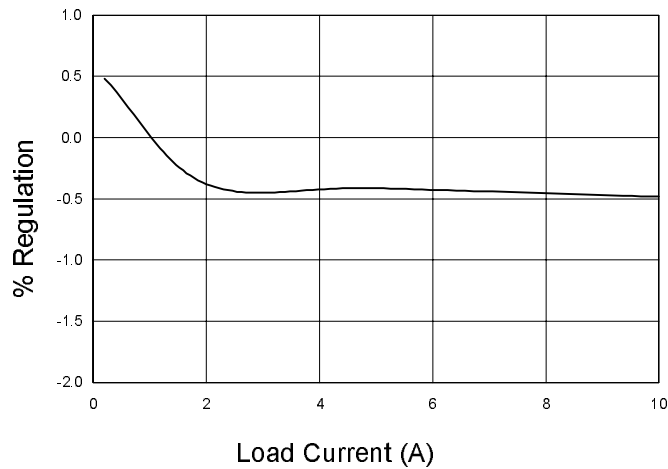
SC113x Efficiency



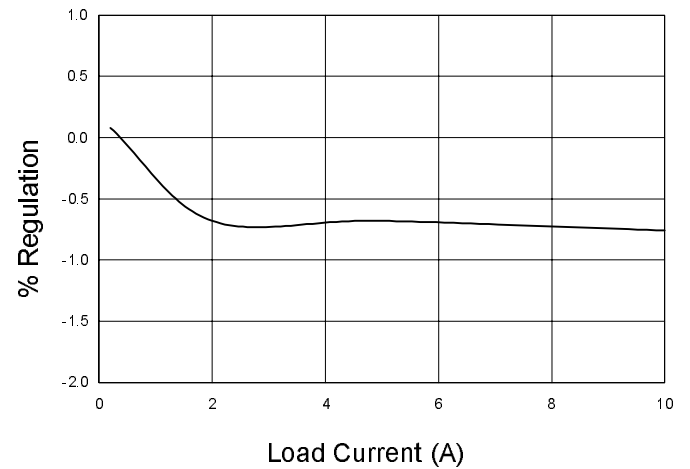
% Load Regulation 3.3V, 0.3 to 10 Amps



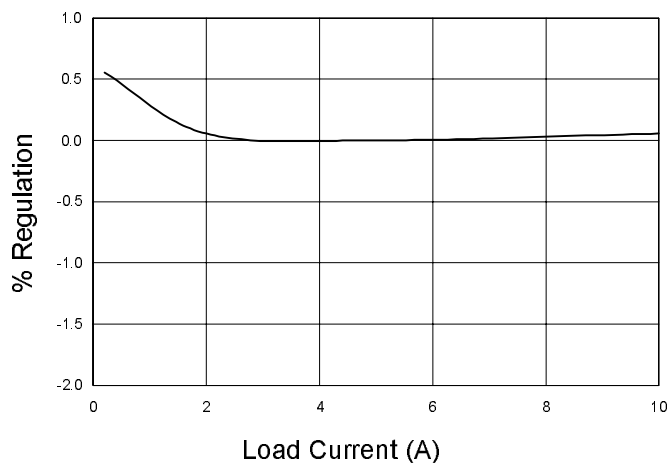
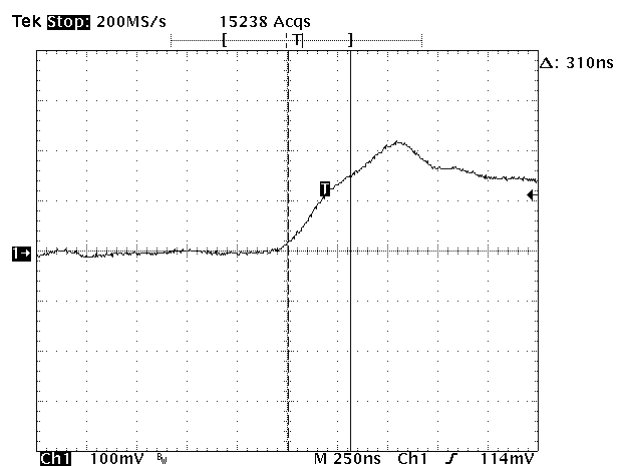
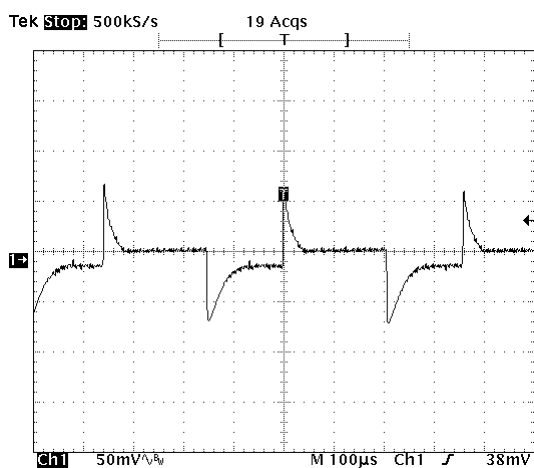
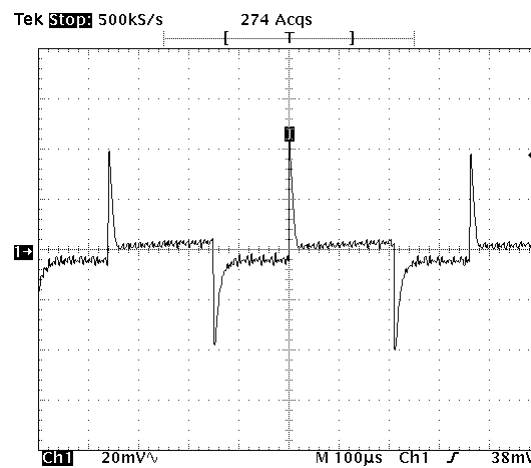
% Load Regulation 2.9V, 0.3 to 10 Amps



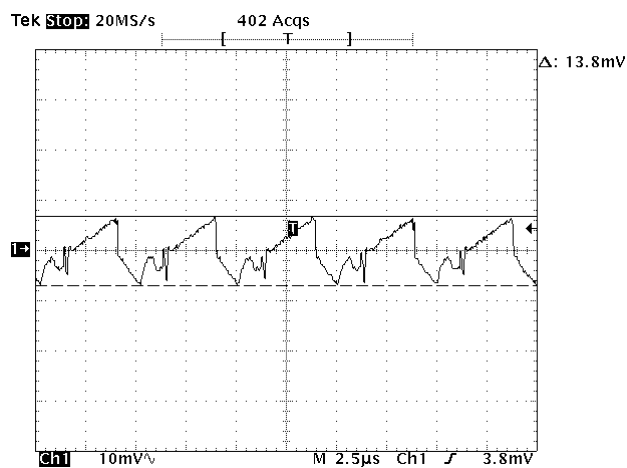
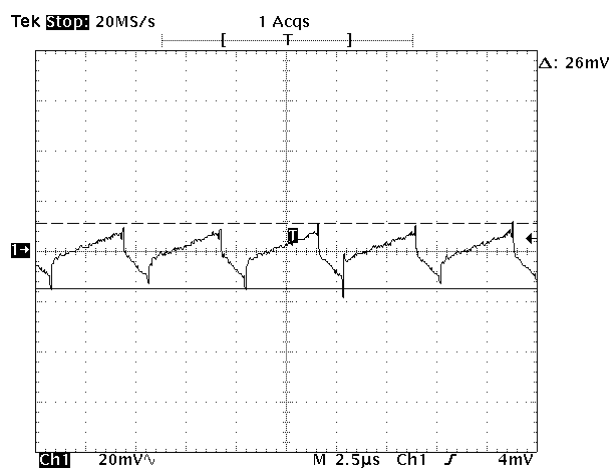
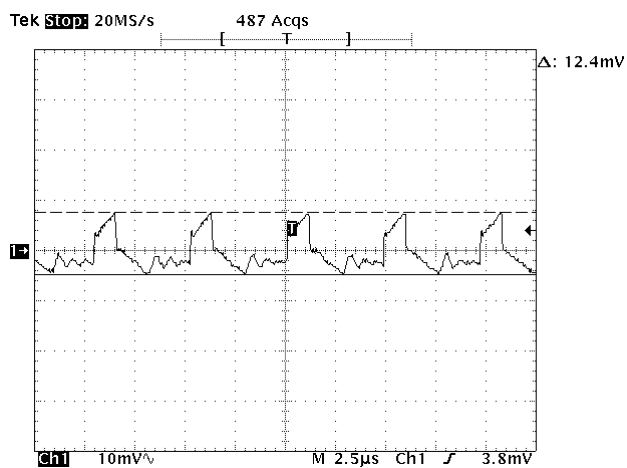
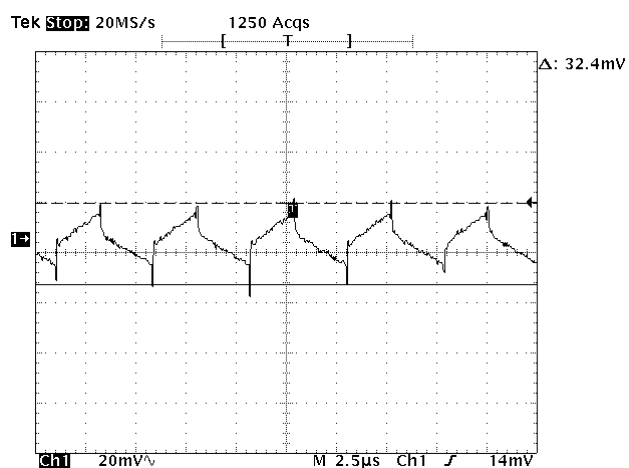
% Load Regulation 2.3V, 0.2 to 10 Amps



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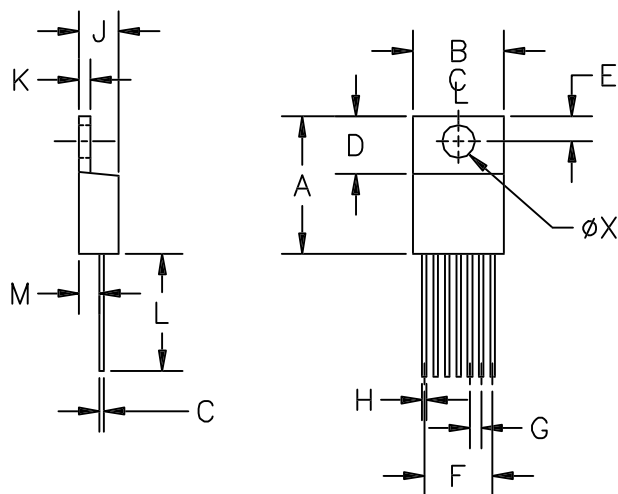
% Load Regulation 1.8V, 0.2 to 10 Amps

Transient Load Current Rise 3.3V @ 10A

Transient Voltage Response 3.3V From 0.3 to 10A

Transient Voltage Response 1.8V From 0.2 to 10A


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Output Ripple 3.3V @ 0.3A

Output Ripple 1.8V @ 0.2A

Output Ripple 3.3V @ 10A

Output Ripple 1.8V @ 10A


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OUTLINE TO-220 (STRAIGHT LEAD)

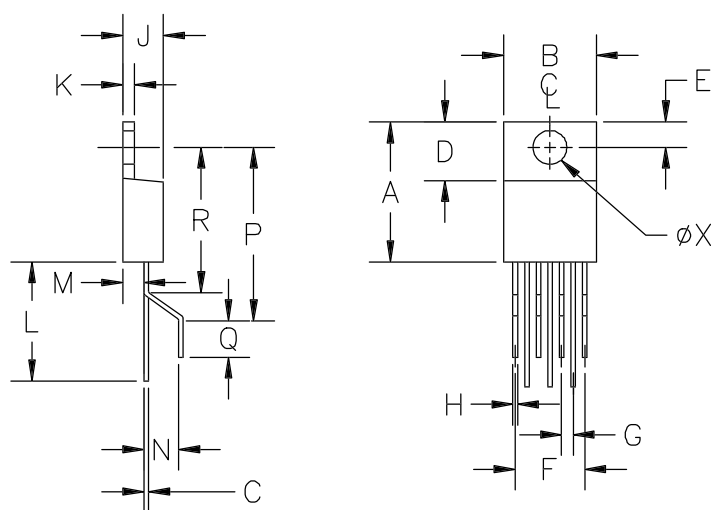


① CONTROLLING DIMENSION : INCHES.

DIMENSIONS					
DIM ^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.590	.660	14.22	14.99	—
B	.385	.415	9.78	10.54	—
C	.015	.022	0.38	0.56	—
D	.234	.258	5.94	6.55	—
E	.103	.113	2.62	2.87	—
F	.295	.305	7.49	7.75	—
G	.045	.055	1.14	1.40	—
H	.023	.037	.058	0.94	—
J	.160	.190	4.06	4.83	—
K	.045	.055	1.14	1.40	—
L	.580	.640	13.72	14.22	—
M	.090	.115	2.29	2.92	—
ØX	.146	.156	3.71	3.96	—

JEDEC TO-220

OUTLINE: TO-220-SB (SINGLE BEND LEAD)

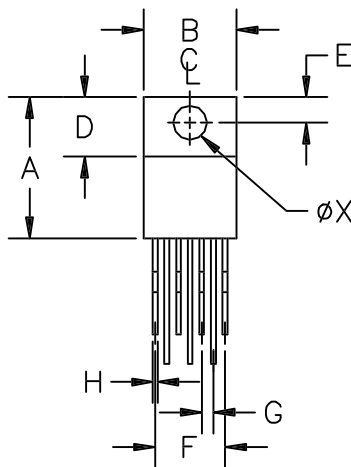
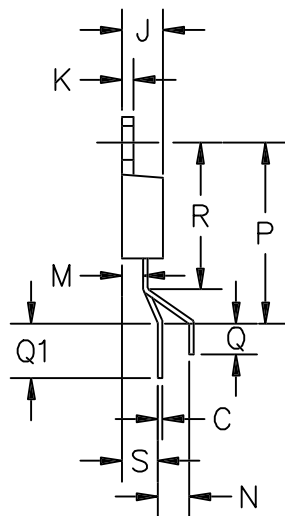


① CONTROLLING DIMENSION : INCHES.

DIMENSIONS					
DIM ^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.560	.590	14.22	14.99	—
B	.385	.415	9.78	10.54	—
C	.015	.022	0.38	0.56	—
D	.234	.258	5.94	6.55	—
E	.103	.113	2.62	2.87	—
F	.295	.305	7.49	7.75	—
G	.045	.055	1.14	1.40	—
H	.023	.035	.058	0.89	—
J	.160	.190	4.06	4.83	—
K	.045	.055	1.14	1.40	—
L	.540	.560	13.72	14.22	—
M	.090	.115	2.29	2.92	—
N	.205	.225	5.21	5.72	—
P	.745	.765	18.92	19.43	—
Q	.155	.175	3.94	4.45	—
R	.605	.625	15.37	15.88	—
ØX	.146	.156	3.71	3.96	—

JEDEC TO-220 (BODY ONLY)

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OUTLINE: TO-220-DB (DUAL BEND LEAD)


DIM ^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.560	.590	14.22	14.99	—
B	.385	.415	9.78	10.54	—
C	.015	.022	0.38	0.56	—
D	.234	.258	5.94	6.55	—
E	.103	.113	2.62	2.87	—
F	.295	.305	7.49	7.75	—
G	.045	.055	1.14	1.40	—
H	.023	.035	.058	0.89	—
J	.160	.190	4.06	4.83	—
K	.045	.055	1.14	1.40	—
M	.095	.115	2.413	2.921	—
N	.135	.165	3.429	4.191	—
P	.700	.728	17.78	18.49	—
Q	.152	.202	3.861	5.130	—
Q1	.260	.320	6.604	8.128	—
R	.620	—	15.75	—	TYP
S	.155	.190	3.937	4.826	—
ØX	.146	.156	3.71	3.96	—

JEDEC TO-220 (BODY ONLY)

① CONTROLLING DIMENSION : INCHES.