



ETC4370, ETC4371

PWM Controlled, Step-Up DC/DC Converters

Description

The ETC4370/71 series is a group of PWM controlled step-up DC/DC converters. The ETC4370/71 series employs CMOS process and laser trimming technologies so as to attain low power and high accuracy. On-chip proprietary phase compensation and soft start-up circuits ensure excellent transient response and improved performance.

Standard output voltages of 3.3V and 5.0V (accuracy: $\pm 2.5\%$) are available and custom output voltages from 2.0V to 7.0V in 0.1V increments can be considered. Oscillator frequency is 180kHz (accuracy: $\pm 15\%$). Custom frequencies of 50kHz and 100kHz can also be considered.

Every built-in switching transistor type (4370) enables a step-up circuit to be configured using only three external components: a coil, a diode, and a capacitor. External transistor versions (4371) are available to accommodate high output current applications.

Typical Applications

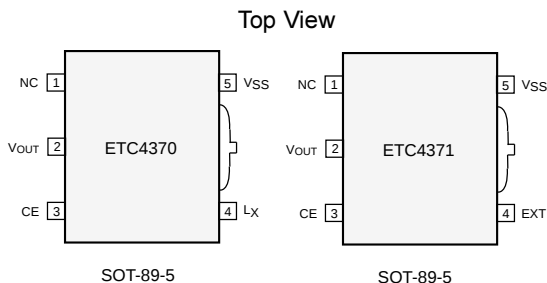
- Cellular phones, pagers
- Palmtops
- Cameras, video recorders
- Portable equipment

Ordering Information

<u>Part</u>	<u>Package</u>	<u>Temp. Range</u>
ETC4370A-XXP	SOT-89-5	-30°C to +80°C
ETC4371A-XXP	SOT-89-5	-30°C to +80°C

XX: Output voltage (33 = 3.3V, 50 = 5.0V)

Pin Configurations



Features

- Operating (start-up) voltage range: 0.9V minimum
- Standard output voltages: 3.3V or 5.0V
- Customizable output voltage range: 2.0V to 7.0V in 0.1V increments
- Highly accurate: Output voltage $\pm 2.5\%$
- Oscillator frequency: 180kHz ($\pm 15\%$) standard, 50kHz and 100kHz custom
- Maximum output currents (built-in transistor): 100mA typ. $V_{IN}=3.0V$, $V_{OUT}=5.0V$, Note(1)
- Highly efficient (built-in transistor): 85% typ. at $V_{IN}=3.0V$, $V_{OUT}=5.0V$, Note(1)
- Both built-in and external switching transistor types are available
- Built-in phase compensation and soft start-up circuits
- Package: SOT-89-5

Note(1): Performance depends on external components and PCB layout.

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Selection Guide

Part Type	Mode	Package	Switching Related	Additional Function	Features
ETC4370	PWM	SOT-89-5	Built-in Transistor "LX" lead	Chip Enable (CE)	▪ Stand-by current: 0.5μA max.
ETC4371	PWM	SOT-89-5	External Transistor "EXT" lead	Chip Enable (CE)	▪ Stand-by current: 0.5μA max.

Absolute Maximum Ratings

Terminal Voltage	
V _{DD} , V _{OUT} , L _X , CE	12V
EXT	(V _{SS} -0.3V) to (V _{OUT} +0.3V)
Terminal Current	
L _X	400mA
EXT	+/-50mA

Operating Temperature Range	
T _{opr}	-30°C to 80°C
Storage Temperature Range	
T _{stg}	-40°C to 125°C
Power Dissipation	
P _d	500mW

Stresses above those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability. Operating ranges define those limits between which the functionality of the device is guaranteed.

Electrical Characteristics

ETC4370A-50 V_{OUT}=5.0V, F_{OSC}=180kHz, T_a=25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Output Voltage	V _{OUT}		4.875	5.000	5.125	V
Maximum Input Voltage	V _{IN}		10			V
Operation Start-up Voltage	V _{ST1}	External components connected, I _{OUT} =1mA			0.90	V
Oscillation Start-up Voltage	V _{ST2}	No external components, Apply voltage to V _{OUT} , L _X : 10kΩ pull-up to 5V			0.80	V
Supply Current 1	I _{DD1}	Same as V _{ST2} , Apply output voltage x 0.95 to V _{OUT}		80.2	133.8	μA
Supply Current 2	I _{DD2}	Same as V _{ST2} , Apply output voltage x 1.1 to V _{OUT}		8.2	16.5	μA
L _X Switch-On Resistance	RSWON	Same as I _{DD1} , V _{LX} =0.4V		1.4	2.4	Ω
L _X Leakage Current	IL _{XL}	No external components, V _{OUT} =V _{LX} =10V			1.0	μA
Oscillator Frequency	F _{OSC}	Same as I _{DD1} , Measuring of L _X waveform	153	180	207	kHz
Maximum Duty Ratio	MAXDTY	Same as I _{DD1} , Measuring of L _X waveform	80	87	92	%
Stand-by Current	I _{STB}	Same as I _{DD1}			0.5	μA
CE "High" Voltage	V _{CEH}	Same as I _{DD1} , Existence of L _X oscillation	0.75			V
CE "Low" Voltage	V _{CEL}	Same as I _{DD1} , Disappearance of L _X oscillation			0.20	V
CE "High" Current	I _{CEH}	Same as I _{DD1} , V _{CE} =V _{OUT} x 0.95			0.25	μA
CE "Low" Current	I _{CEL}	Same as I _{DD1} , V _{CE} =0V			-0.25	μA
L _X Limit Voltage	V _{LXLMT}	Same as I _{DD1} , Apply output voltage to L _X , Voltage required to produce F _{OSC} x 2	0.7		1.3	V
Efficiency	EFFI			85		%
Soft-Start Time	T _{SS}		4.0	10.0	20.0	msec

Measuring conditions: Unless otherwise specified, connect CE to V_{OUT}, V_{IN}=V_{OUT} x 0.6, I_{OUT}=50mA. See Typical Application Circuits, Fig. 1.

Electrical Characteristics**ETC4371A-50** $V_{OUT}=5.0V$, $F_{OSC}=180kHz$, $T_a=25^{\circ}C$

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Output Voltage	V_{OUT}		4.875	5.000	5.125	V
Maximum Input Voltage	V_{IN}		10			V
Operation Start-up Voltage	V_{ST1}	External components connected, $I_{OUT}=1mA$			0.90	V
Oscillation Start-up Voltage	V_{ST2}	No external components, Apply voltage to V_{OUT}			0.80	V
Supply Current 1	I_{DD1}	Same as V_{ST2} , Apply output voltage x 0.95 to V_{OUT}		40.0	66.8	μA
Supply Current 2	I_{DD2}	Same as V_{ST2} , Apply output voltage x 1.1 to V_{OUT}		8.2	16.5	μA
EXT "High" On Resistance	R_{EXTH}	Same as I_{DD1} , $V_{EXT}=V_{OUT}-0.4V$		37.5	62.5	Ω
EXT "Low" On Resistance	R_{EXTL}	Same as I_{DD1} , $V_{EXT}=0.4V$		30	50	Ω
Oscillator Frequency	F_{OSC}	Same as I_{DD1} , Measuring of EXT waveform	153	180	207	kHz
Maximum Duty Ratio	$MAXDTY$	Same as I_{DD1} , Measuring of EXT waveform	80	87	92	%
Stand-by Current	I_{STB}	Same as I_{DD1}			0.5	μA
CE "High" Voltage	V_{CEH}	Same as I_{DD1} , Existence of EXT oscillation	0.75			V
CE "Low" Voltage	V_{CEL}	Same as I_{DD1} , Disappearance of EXT oscillation			0.20	V
CE "High" Current	I_{CEH}	Same as I_{DD1} , $V_{CE}=V_{OUT} \times 0.95$			0.25	μA
CE "Low" Current	I_{CEL}	Same as I_{DD1} , $V_{CE}=0V$			-0.25	μA
Efficiency	$EFFI$			85		%
Soft-Start Time	T_{SS}		4.0	10.0	20.0	msec

Measuring conditions: Unless otherwise specified, connect CE to V_{OUT} , $V_{IN}=V_{OUT} \times 0.6$, $I_{OUT}=50mA$. See Typical Application Circuits, Fig. 2.

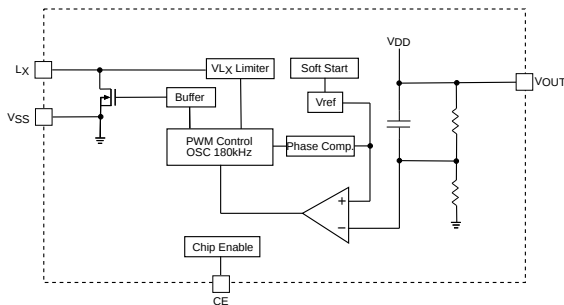
Pin Functions

Pin Name	Pin No.		Function
	ETC4370	ETC4371	
V_{SS}	5	5	Ground
V_{OUT}	2	2	Output voltage monitor, IC internal power supply
L_X	4	-	Switch
EXT	-	4	External switch transistor drive
CE	3	3	Chip enable
NC	1	1	No connection

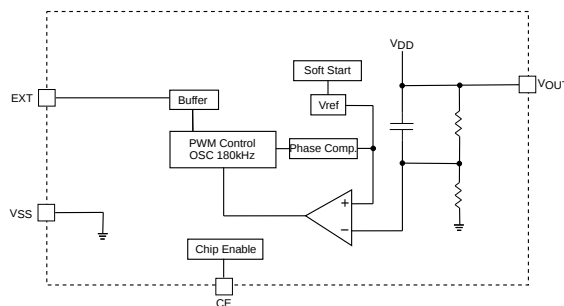
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Block Diagrams

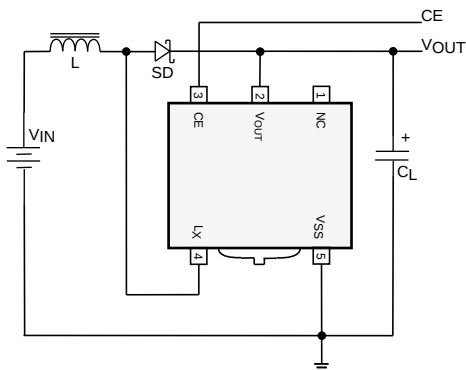
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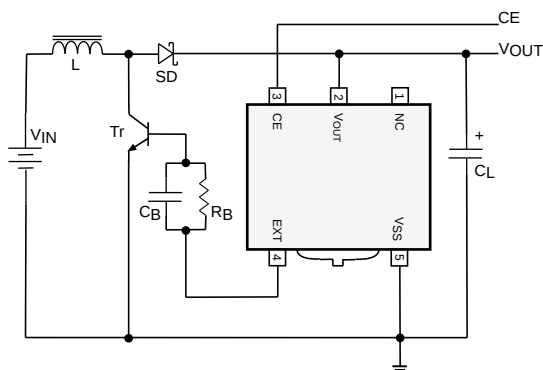


Typical Application Circuits



L: 100 μ H (SUMIDA, CD-54)
SD: MA735 (Schottky diode; MATSUSHITA)
CL: 16V 47 μ F (Tantalum capacitor, NICHICON, F93)

Fig. 1 ETC4370 Application

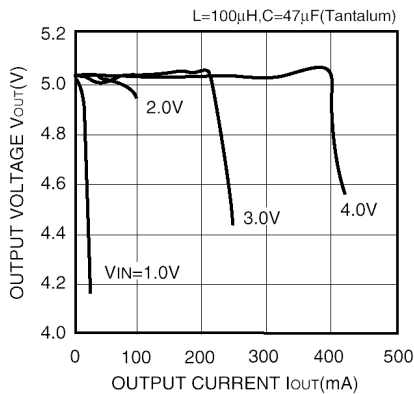


L: 47 μ H (SUMIDA, CD-54)
SD: MA735 (Schottky diode; MATSUSHITA)
CL: 16V 47 μ F (Tantalum capacitor, NICHICON, F93)
RB: 1k Ω , CB: 3300pF
Tr: 2SC3279, 2SD1628G

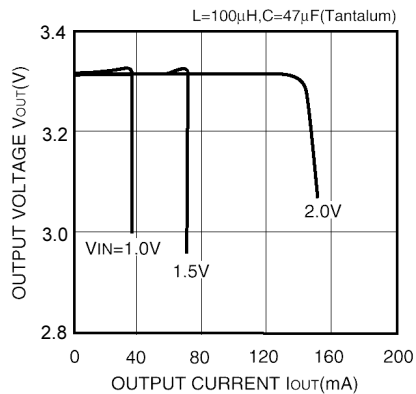
Fig. 2 ETC4371 Application

Characteristics

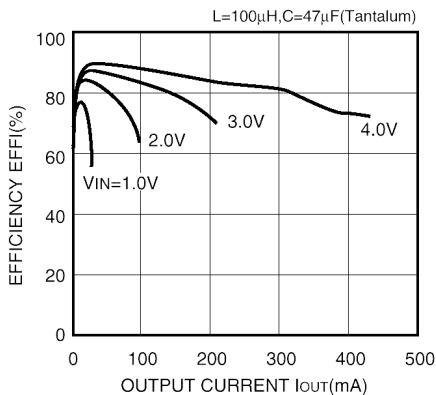
(1) OUTPUT VOLTAGE vs. OUTPUT CURRENT ETC4370A-50



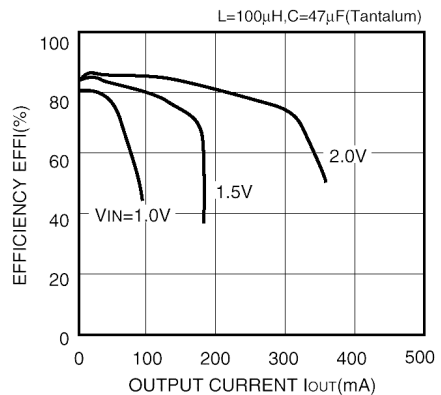
ETC4370A-33



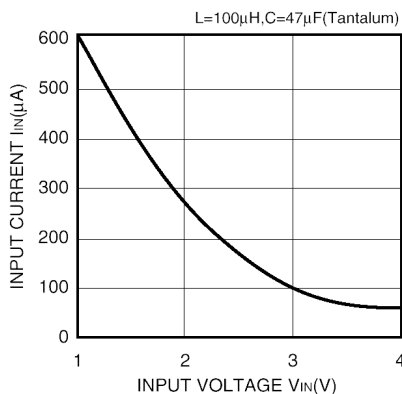
(2) EFFICIENCY vs. OUTPUT CURRENT ETC4370A-50



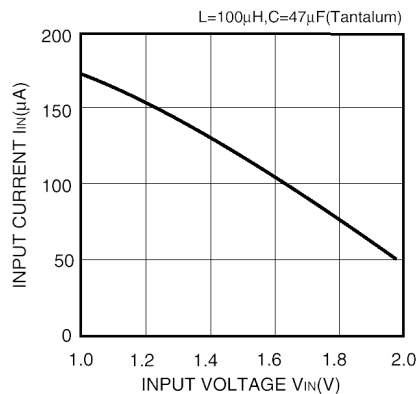
ETC4370A-33



(3) NO LOAD, INPUT CURRENT vs. INPUT VOLTAGE ETC4370A-50



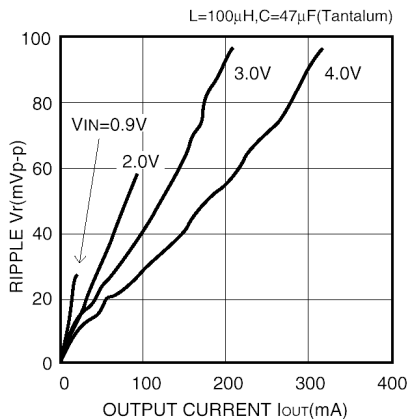
ETC4370A-33



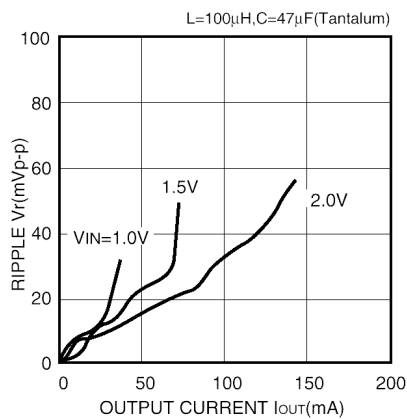
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Characteristics

(4) RIPPLE VOLTAGE vs. OUTPUT CURRENT
ETC4370A-50

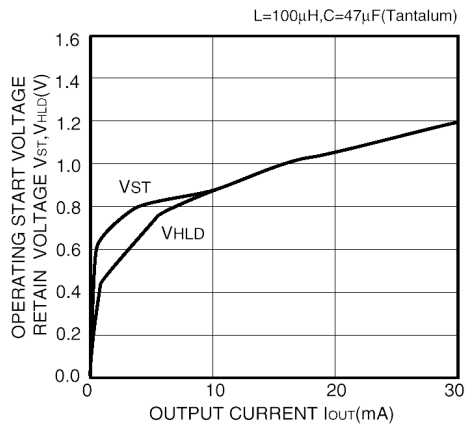


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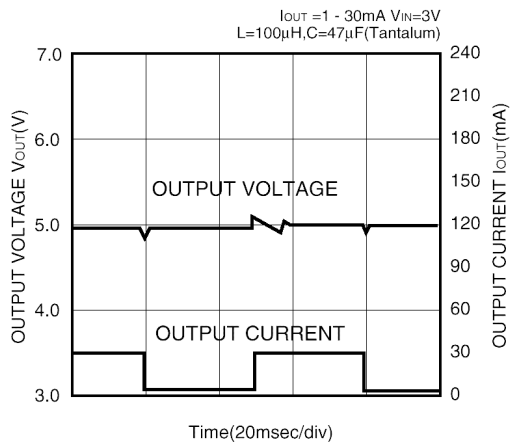
(5) OPERATING START VOLTAGE/RETAIN VOLTAGE
vs. OUTPUT CURRENT

ETC4370A-50



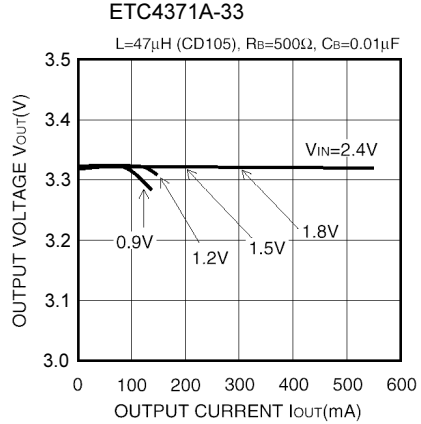
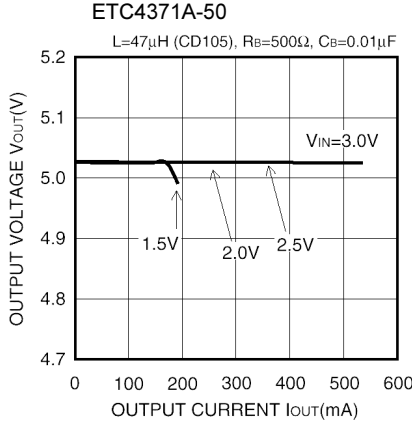
(6) LOAD TRANSIENT RESPONSE

ETC4370A-50

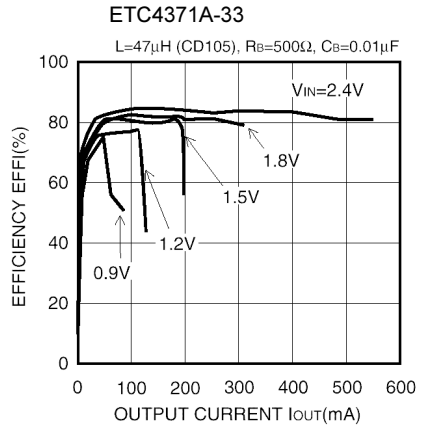
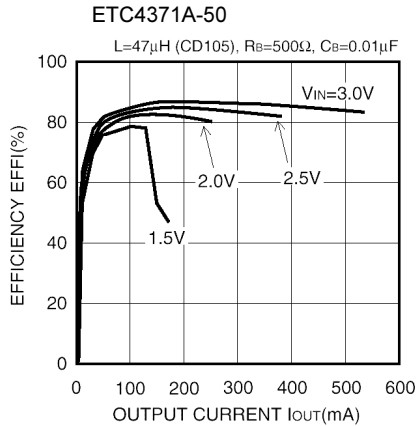


Characteristics (External Transistor)

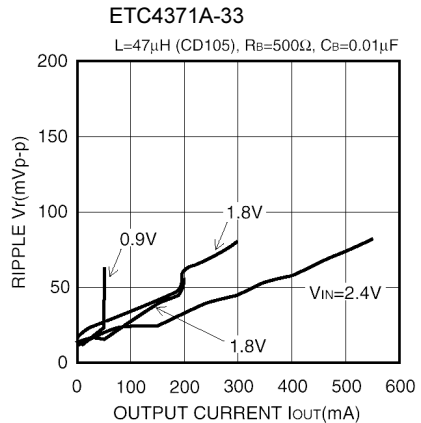
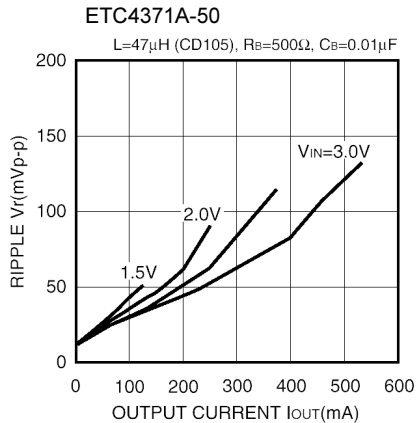
(1) OUTPUT VOLTAGE vs. OUTPUT CURRENT



(2) EFFICIENCY vs. OUTPUT CURRENT



(3) RIPPLE VOLTAGE vs. OUTPUT CURRENT



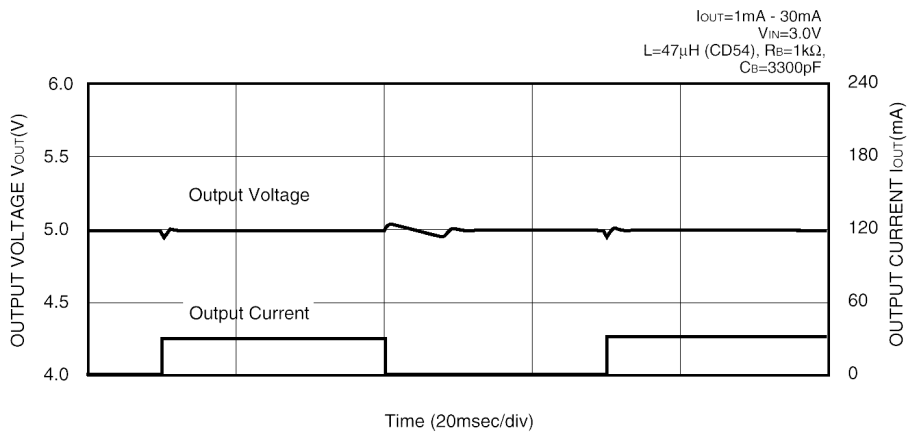
Conditions: $C_{\text{IN}}=100\mu\text{F}$ (Electrolytic), $C_L=47\mu\text{F}$ (Tantalum) x 2, SD: MA735, Tr: 2SD1628G

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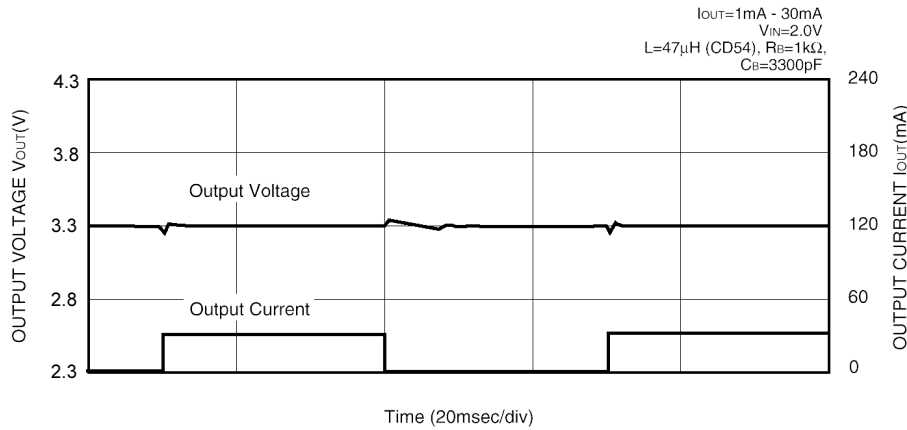
Characteristics (External Transistor)

(4)LOAD TRANSIENT REPSONSE

ETC4371A-50



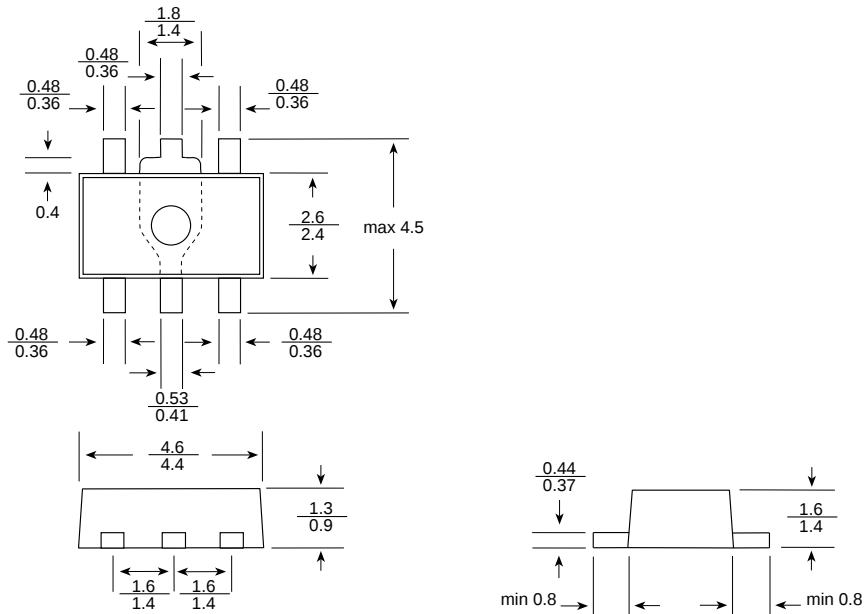
ETC4371A-33



Conditions: $C_{IN}=47\mu F$ (Tantalum), $C_L=47\mu F$ (Tantalum) x 2, SD: MA735, Tr: 2SD1628G

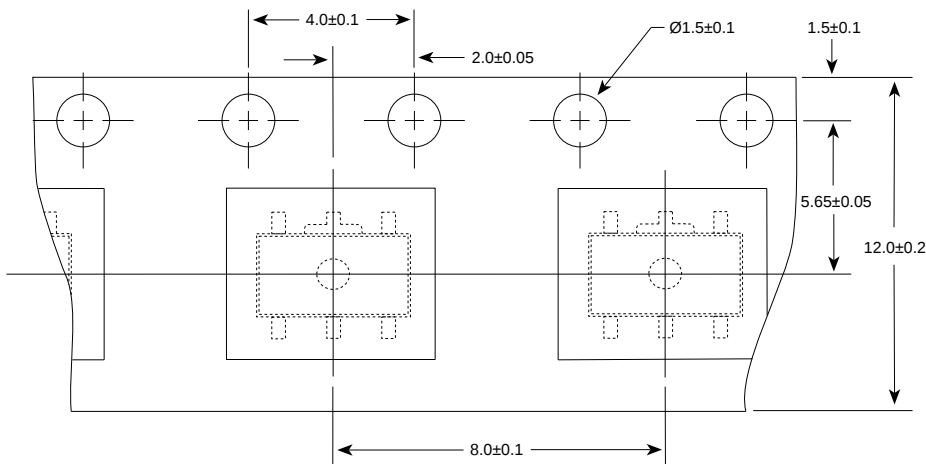
Packaging Information

P Package, 5-Pin SOT-89-5 Small Outline Transistor Package



Dimensions are in mm.

SOT-89-5 Tape and Reel Information



Dimensions are in millimeters.

Electronic Technology

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