LT432

ADJUSTABLE PRECISION SHUNT REGULATION

General Description

The LT432 is a low voltage three terminal adjustable shunt regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage can be set to any value between 1.24V (VREF) to 20V with two external resistors (see application circuit). The high precise Reference voltage tolerance is available in two grades: ±0.5% and ±1.0%. This device has a typical output impedance of 0.2Ω. Active output circuitry provides a very sharp turn on characteristic, making this device excel lent replacement for Zener diodes in many applications.

The LT432 is characterized for operation from -40℃ to 125℃. The LT432 is available in a low profile SOT23-3L & TO92-3L package.

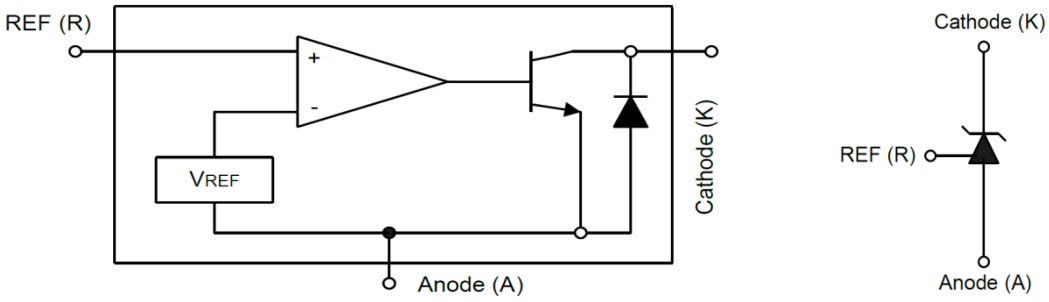
Features

- Precision reference voltage :
  - LT432OCA/OCR : 1.24V±0.5%
  - LT432N : 1.24V±1.0%
- Adjustable output voltage is VREF to 20V
- Sink current capability is 150mA
- Low dynamic output impedance is 0.2Ω (typ.)
- Minimum Cathode current for regulation is 0.2mA (typ.)
- Plastic material has UL flammability classification 94V-0

Applications

- Switching Mode Power Supply
- Voltage Reference Application

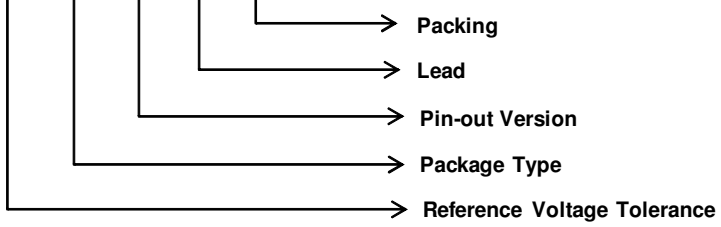
Block Diagram & Symbol



Please be aware that an **Important Notice** concerning availability, disclaimers, and use in critical applications of LSC products is at the end of this document.

Ordering Information

LT 432 X X X X X



Reference Voltage Tolerance	Package Type	Pin-out Version	Lead	Packing
O : ±0.5% N : ±1.0%	H : TO92-3L C : SOT23-3L	Blank (TO92-3L): 1. REF 2. ANODE 3. CATHODE A (SOT23-3L): 1. CATHODE 2. REF 3. ANODE R (SOT23-3L): 1. REF 2. CATHODE 3. ANODE	P : RoHS & Halogen Free (ref. IEC 61249-2-21)	A : Tape & Reel

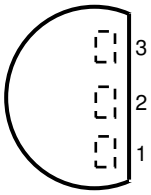
Product Number	Output Voltage Tolerance	Package	Lead	Packing
LT432NHPA	1.0 %	TO92-3L	RoHS & Halogen Free	Taping
LT432OCAPA	0.5 %	SOT23-3L	RoHS & Halogen Free	Taping & Reel
LT432NCAPA	1.0 %	SOT23-3L	RoHS & Halogen Free	Taping & Reel
LT432OCRPA	0.5 %	SOT23-3L	RoHS & Halogen Free	Taping & Reel
LT432NCRPA	1.0 %	SOT23-3L	RoHS & Halogen Free	Taping & Reel

Note: TO92-3L package only to provide ±1.0% Output Voltage Tolerance.

Pin Assignment

TO92-3L

(Top View)

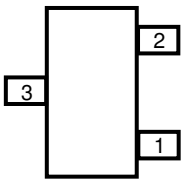


LT432NHPA

1. R
2. A
3. C

SOT23-3L

(Top View)

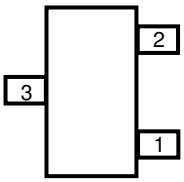


LT432OCAPA
LT432NCAPA

1. C
2. R
3. A

SOT23-3L

(Top View)



LT432OCRPA
LT432NCRPA

1. R
2. C
3. A

Pin Descriptions

Pin Name	Pin Description
R	Ref
A	Anode
C	Cathode

Absolute Maximum Ratings (at T_A=25℃)

Note: Operate over the "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to such conditions for extended time may still affect the reliability of the device.

Characteristics		Symbol	Rating	Unit
Cathode Voltage		V_{KA}	20	V
Continuous Cathode Current		I_{KA}	150	mA
Reference Input Current		I_{REF}	10	mA
Junction Temperature		T_J	150	℃
Storage Temperature		T_{STG}	-40~150	℃
Thermal Resistance (Junction to Case)	SOT23-3L	θjc	110	℃/W
	TO92-3L		80	W
Thermal Resistance (Junction to Ambient)	SOT23-3L	θja	350	℃/W
	TO92-3L		150	℃/W
Power dissipation	SOT23-3L	P_D	285	mW
	TO92-3L		625	℃/W
Moisture Sensitivity		MSL	Please refer the MSL label on the IC package bag/carton for detail	

Note1 : Ratings apply to ambient temperature at 25℃

Recommended Operating Conditions

Characteristics	Symbol	Min	Max	Unit
Cathode Voltage	V_{KA}	V_{REF}	18	V
Cathode Current	I_{KA}	0.3	100	mA
Operating Temperature (Operating free-air temperature)	T_A	-40	125	℃

Electrical Characteristics

(T_A=25℃, unless otherwise specified)

Characteristics	Symbol	Conditions		Min	Typ	Max	Unit
Reference Voltage	V_{REF}	V_{KA} = V_{REF}, I_{KA} = 1mA (Fig.1)	0.5 %	1.233	1.24	1.246	V
			1.0 %	1.227		1.252	
Deviation of Reference Input Voltage over full temperature Range (*Note 2)	$V_{REF(DEV)}$	V_{KA} = V_{REF}, I_{KA} = 10mA, T_A = -20~85°C (Fig.1)			6	20	mV
		V_{KA} = V_{REF}, I_{KA} = 10mA, T_A = -40~125°C (Fig.1)			6	70	
Reference Input Current	I_{REF}	R1 = 10KΩ,R2 = ∞, I_{KA}= 10mA (Fig.2)			1.5	3.5	uA
Deviation of Reference Input Current over Temperature (*Note 2)	$I_{REF(DEV)}$	R1 = 10KΩ,R2 = ∞, I_{KA} = 10mA T_A = -40~125°C(Fig.2)			0.4	1.2	uA
Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	I_{KA} = 10mA (Fig.2)	V_{KA} = 20V ~V_{REF}		-1.4	-2.0	mV/V
Minimum Cathode Current for Regulation	$I_{KA(min)}$	V_{KA} = V_{REF} (Fig.1)			0.15	0.3	mA
Off-state Cathode Current	$I_{KA(OFF)}$	V_{KA} = 20V, V_{REF} = 0V (Fig.3)			0.1	1	uA
Dynamic Output Impedance	Z_{KA}	V_{KA} = V_{REF} Frequency ≤ 1KHz (Fig.1)			0.5	1	Ω

Note 2 : Thes speicifications are guaranteed by designed and are not tested when in mass-production.

Application Circuit

Fig1: $V_{KA}=V_{REF}$

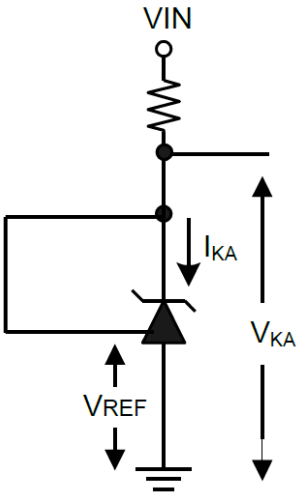
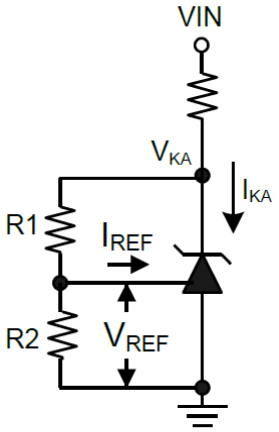
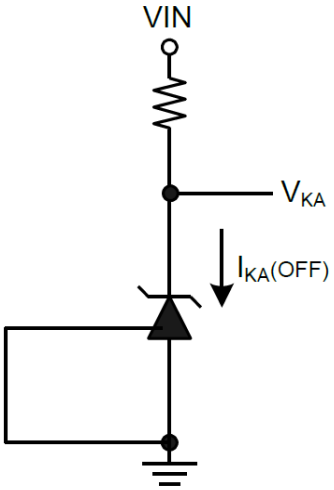


Fig2: $V_{KA}>V_{REF}$



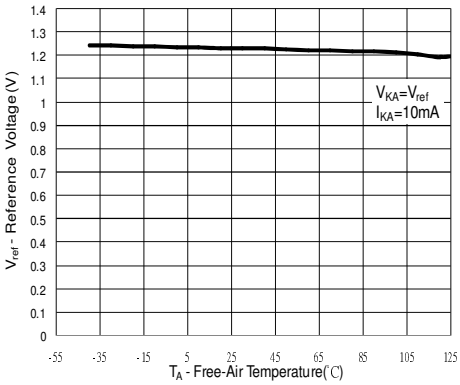
$VKA=V_{REF}(1+R1/R2)+I_{REF}*R1$

Fig3: Off state current

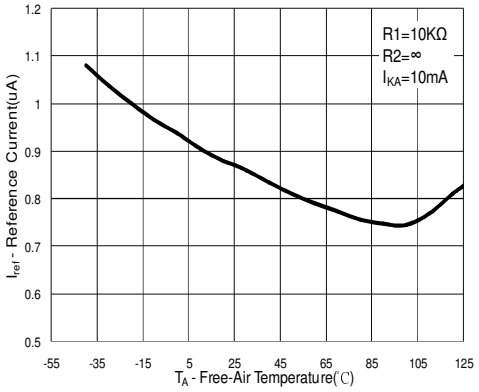


Typical Characteristics

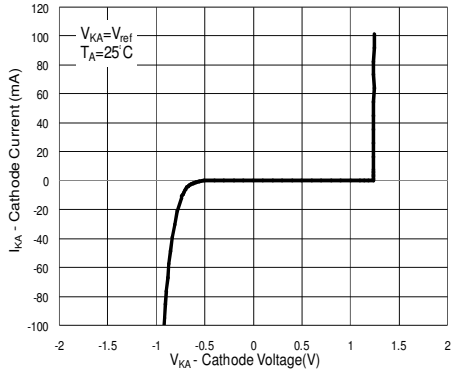
REFERENCE VOLTAGE VS. FREE-AIR TEMPERTURE



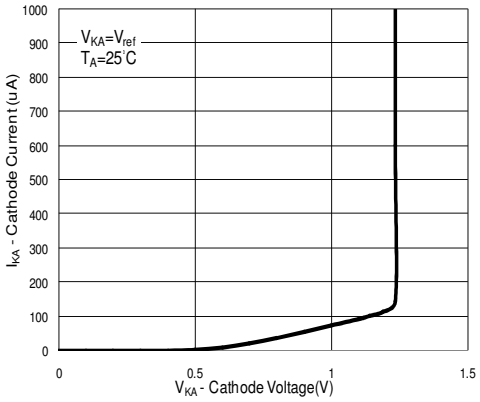
REFERENCE CURRENT VS. FREE-AIR TEMPERATURE



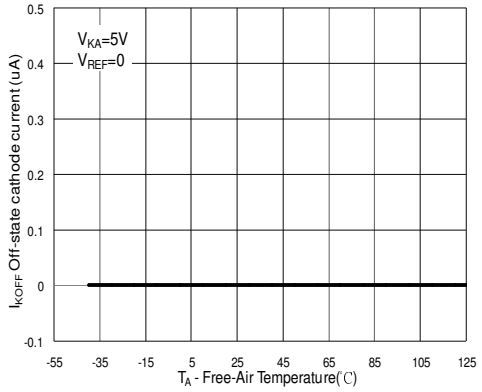
CATHODE CURRENT VS. CATHODE VOLTAGE



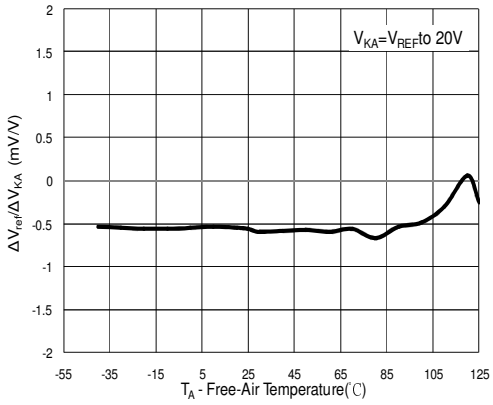
CATHODE CURRENT VS. CATHODE VOLTAGE



OFF-STATE CATHODE CURRENT VS. FREE-AIR TRMPERATURE

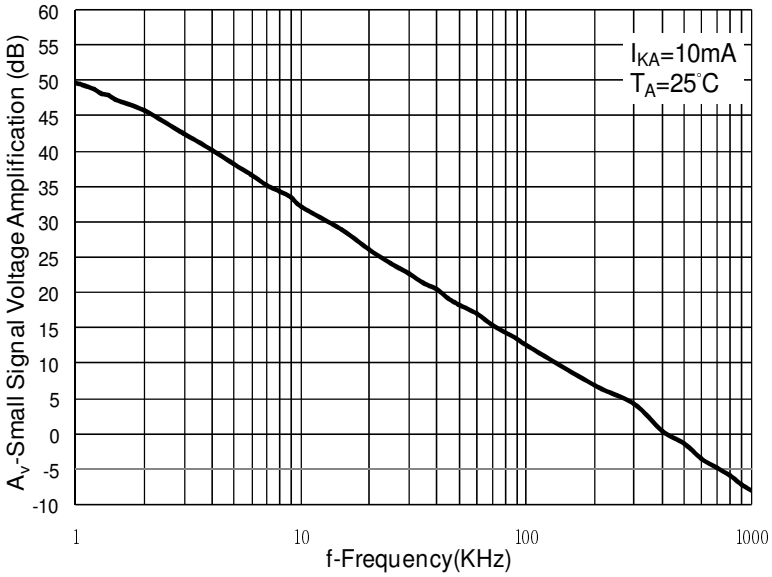


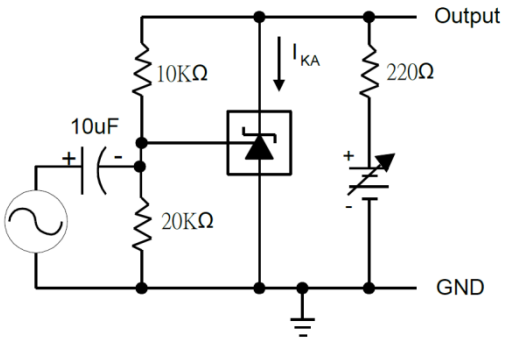
RATIO OF DELTA REFERENCE VOLTAGE TO DELTA CATHODE VOLTAGE VS. FREE-AIR TEMPERATURE



Typical Characteristics (Continued)

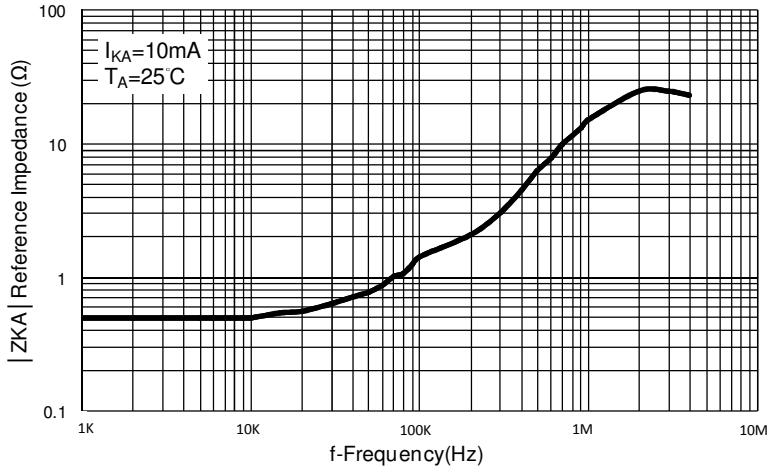
(1) Small Signal Voltage Amplification Vs Frequency

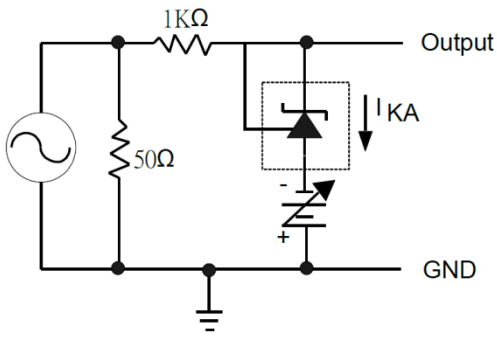




Test Circuit for Voltage Amplification

(2) Reference Impedance VS Frequency

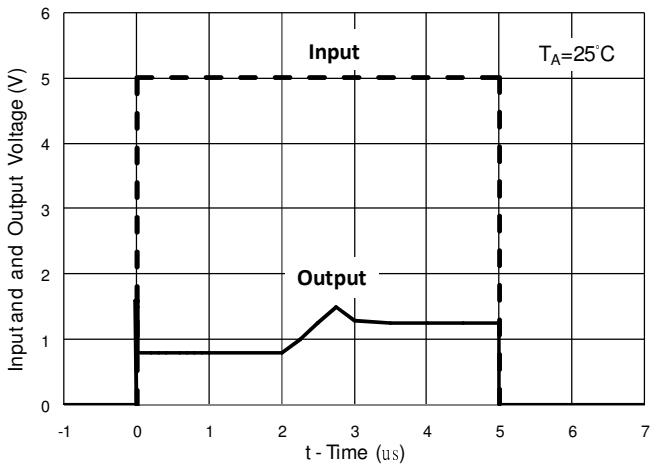


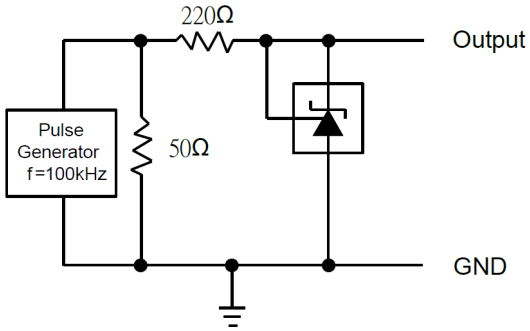


Test Circuit for Reference Impedance

Typical Characteristics (Continued)

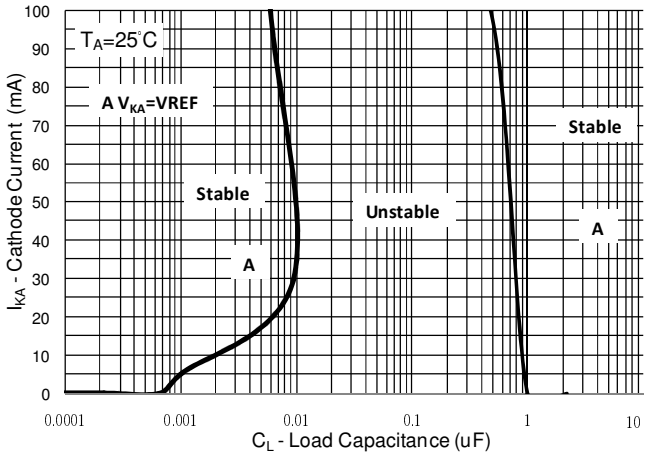
(3) Pulse Response



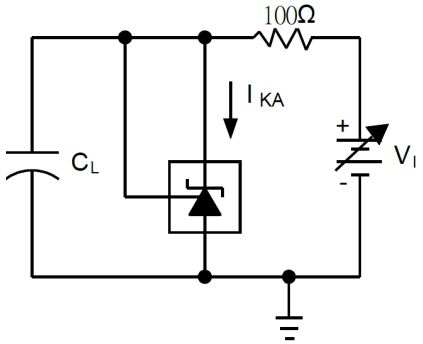


Test Circuit for Pulse Response

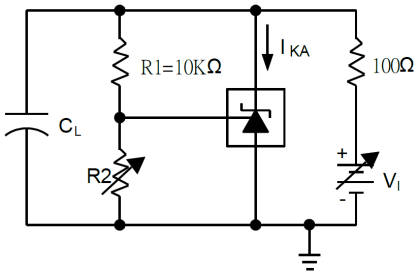
(4) Stability boundary conditions



Above curves represented the I_{KA} and C_L that caused 432 to oscillate when $V_{KA}=V_{REF}$. For V_{KA}=5V/10V/15V, 432 was stable in all I_{KA} and C_L conditions.



Test Circuit for $V_{KA}=V_{REF}$



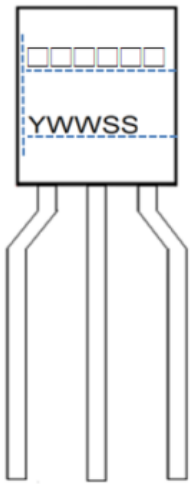
Test Circuit for V_{KA}=5V/10V/15V

* R2 and V_I were adjusted to establish the initial V_{KA} and I_{KA} conditions with C_L=0 . V_{BATT} and C_L were then adjusted to determine the ranges of stability.

Marking Information (NEW)

Effective Date: 2016/1/1

(1) TO92-3L



1) YWWSS = Date Code,

Y: Year

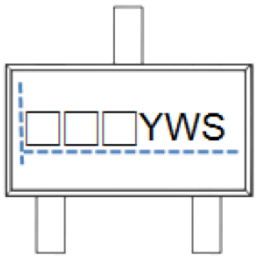
WW: Week

SS: Internal control code

2) □□□□□□ = Marking Number

LT432NHPA: T432NH

(2) SOT23-3L



1) YWS = Date Code,

Y: Year

W: Week

S: Internal control code

2) □□□ = Marking Number

LT432OCAPA: OEA

LT432NCAPA: NEA

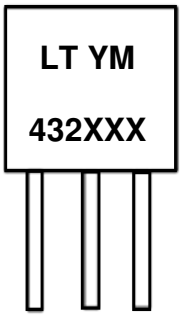
LT432OCRPA: OER

LT432NCRPA: NER

Marking Information (OLD)

Before 2015/12/31 (included) production, the marking code of parts were used as below.

(1) TO92-3L



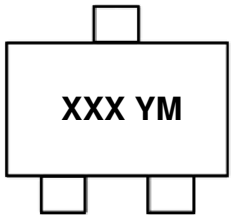
1) YM = Date Code,

Y: Year, M: Month

2) 432xxx = Marking Code

LT432NHPA: 432NHP

(2) SOT23-3L



1) YM = Date Code,

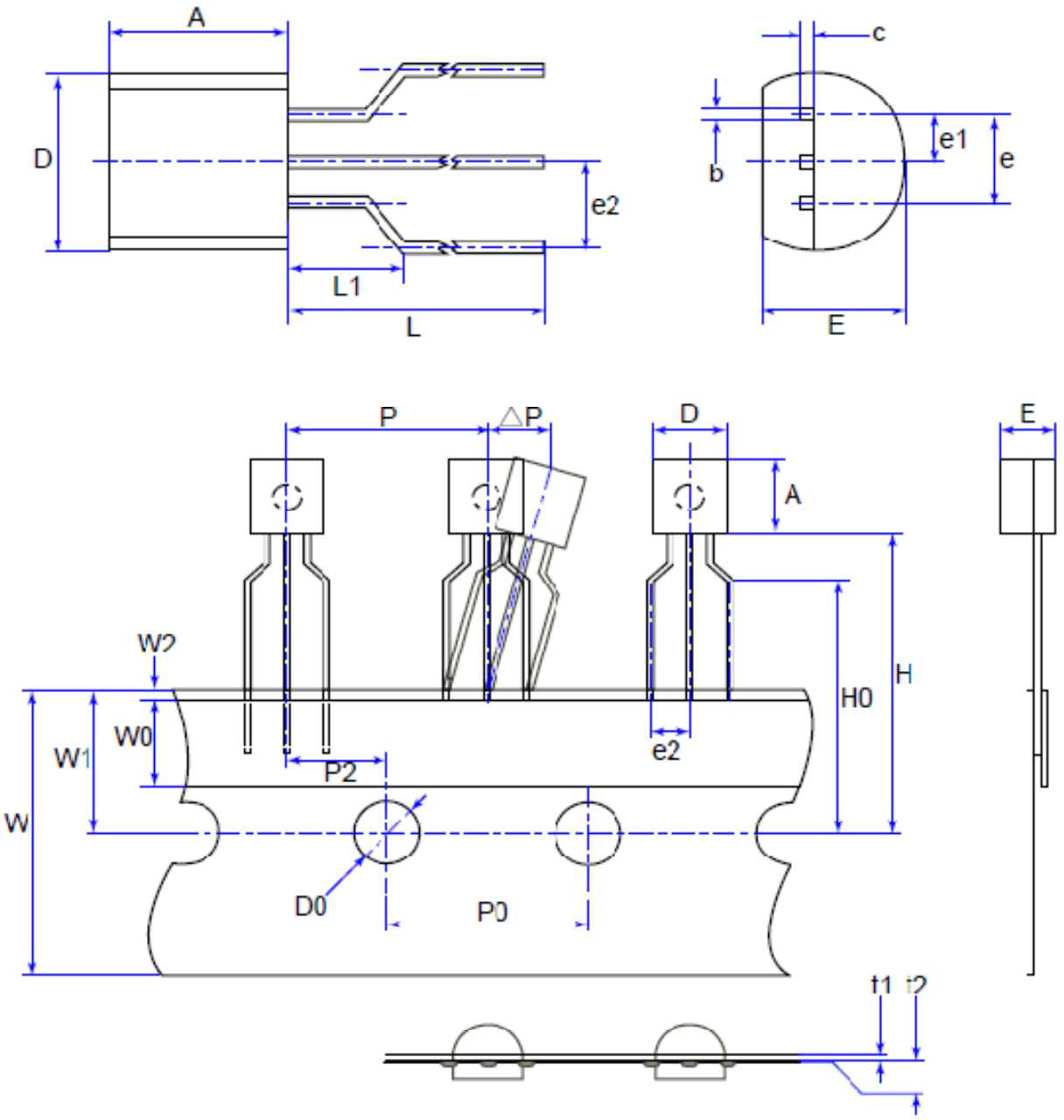
Y: Year, M: Month

2) xxx = Marking Code

LT432OCAPA: OEA
LT432NCAPA: NEA
LT432OCRPA: OER
LT432NCRPA: NER

Mechanical Information

(1) Package type: TO92-3L



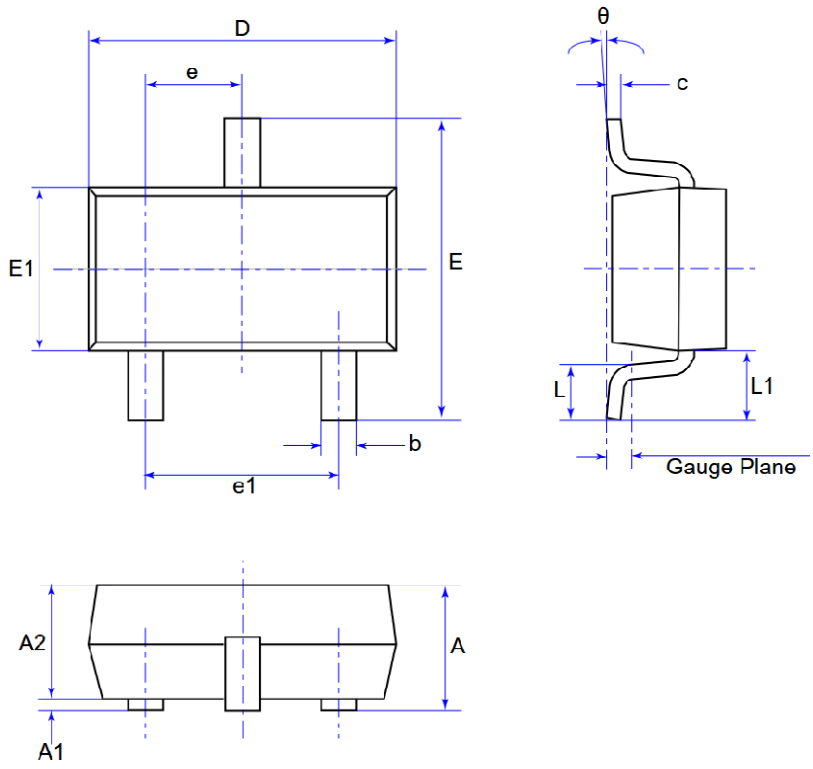
Mechanical Information (Continued)

Unit: mm

Symbol	Min	Max
A	4.30	4.70
b	0.38	0.55
c	0.36	0.51
D	4.30	4.70
D0	3.80	4.20
E	3.30	3.70
e	2.44	2.64
e1	1.27 TYP	
e2	2.20	2.96
H	18.00	21.00
H0	15.50	16.50
L	12.70	-
L1	2.50	4.50
P	12.40	13.00
P0	12.50	12.90
P2	6.05	6.65
t1	0.35	0.45
t2	0.15	0.25
W	17.50	19.00
W0	5.50	6.50
W1	8.50	9.50
W2	-	1.00
△P	-	1.00

Mechanical Information (Continued)

(2) Package type: SOT23-3L



Unit: mm

Symbol	Min	Max
A	0.90	1.15
A1	-	0.10
A2	0.89	1.05
b	0.30	0.50
c	0.07	0.18
D	2.80	3.04
E	2.10	2.64
E1	1.20	1.40
e	0.95 REF	
e1	1.80	2.00
L	0.30	0.50
L1	0.55 REF	
Gauge Plane	0.25 BSC	
θ	0°	8°

MSL (Moisture Sensitive Level) Information

IPC/JEDEC J-STD-020D.1 Moisture Sensitivity Levels Table

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS				
			Standard		Accelerated Equivalent [1]		
					eV 0.40-0.48	eV 0.30-0.39	CONDITION
	TIME	CONDITION	TIME (hours)	CONDITION	TIME (hours)	TIME (hours)	
1	Unlimited	≤30 ℃ /85% RH	168 +5/-0	85 ℃ /85% RH	NA	NA	NA
2	1 year	≤30 ℃ /60% RH	168 +5/-0	85 ℃ /60% RH	NA	NA	NA
2a	4 weeks	≤30 ℃ /60% RH	696[2] +5/-0	30 ℃ /60% RH	120 -1/+0	168 -1/+0	60 ℃/ 60% RH
3	168 hours	≤30 ℃ /60% RH	192[2] +5/-0	30 ℃ /60% RH	40 -1/+0	52 -1/+0	60 ℃/ 60% RH
4	72 hours	≤30 ℃ /60% RH	96[2] +2/-0	30 ℃ /60% RH	20 +0.5/-0	24 +0.5/-0	60 ℃/ 60% RH
5	48 hours	≤30 ℃ /60% RH	72[2] +2/-0	30 ℃ /60% RH	15 +0.5/-0	20 +0.5/-0	60 ℃/ 60% RH
a	24 hours	≤30 ℃ /60% RH	48[2] +2/-0	30 ℃ /60% RH	10 +0.5/-0	13 +0.5/-0	60 ℃/ 60% RH
6	Time on Label (TOL)	≤30 ℃ /60% RH	TOL	30 ℃ /60% RH	NA	NA	NA

Note 1: CAUTION - To use the ‘‘accelerated equivalent’’ soak conditions, correlation of damage response (including electrical, after soak and reflow), should be established with the ‘‘standard’’ soak conditions. Alternatively, if the known activation energy for moisture diffusion of the package materials is in the range of 0.40 - 0.48 eV or 0.30 - 0.39 eV, the ‘‘accelerated equivalent’’ may be used. Accelerated soak times may vary due to material properties (e.g .mold compound, encapsulant, etc.). JEDEC document JESD22-A120 provides a method for determining the diffusion coefficient.

Note 2: The standard soak time includes a default value of 24 hours for semiconductor manufacturer’s exposure time (MET) between bake and bag and includes the maximum time allowed out of the bag at the distributor’s facility. If the actual MET is less than 24 hours the soak time may be reduced. For soak conditions of 30 ℃/60% RH, the soak time is reduced by 1 hour for each hour the MET is less than 24 hours. For soak conditions of 60 ℃/60% RH, the soak time is reduced by 1 hour for each 5 hours the MET is less than 24 hours. If the actual MET is greater than 24 hours the soak time must be increased. If soak conditions are 30 ℃/60% RH, the soak time is increased 1 hour for each hour that the actual MET exceeds 24 hours. If soak conditions are 60 ℃/60% RH, the soak time is increased 1 hour for each 5 hours that the actual MET exceeds 24 hours.