Adjustable Micropower Voltage Reference

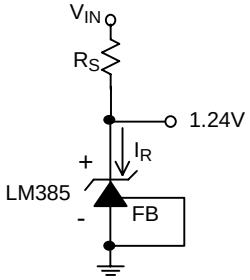
FEATURES

- Adjustable from 1.24V to 5.3V.
- Operating Current from 10μA to 20mA.
- Low Temperature Coefficient.
- 1% and 2% Initial Tolerance.
- Low Dynamic Impedance.

APPLICATIONS

- Portable, Battery-Powered Equipment.
- Instrumentation.
- Process Control.
- Energy Management.
- Product Testing.
- Automotive.
- Precision Audio Components.

TYPICAL APPLICATION CIRCUIT



Precision 1.24V Voltage Reference

DESCRIPTION

The LM385 is micropower 3-terminal adjustable band-gap voltage reference. Operating from 1.24V to 5.3V and over 10μA to 20mA current range. They feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to achieve tight voltage tolerance. Since the LM385 band-gap reference uses only transistors and resistors, low noise and good longterm stability result.

Careful design of the LM385 has made the device tolerant of capacitive loading, making it easy to use in almost any reference application. The wide dynamic operating range allows its use with widely varying supplies with excellent regulation.

The extremely low power drain of the LM385 makes it useful for micropower circuitry. This voltage reference can be used to make portable meters, regulators or general-purpose analog circuitry with battery life approaching shelf life. Further, the wide operating current allows it to replace older references with a tighter tolerance part.

ORDERING INFORMATION

LM385X-XXXX

- PACKING TYPE
  - BG: BAG
  - TR: TAPE & REEL
  - TB: TUBE (for SOP-8)
- PACKAGE TYPE
  - X: SOT-89
  - Z: TO-92
  - S: SOP-8
- C: COMMERCIAL
  - P: LEAD FREE COMMERCIAL
  - G:GREEN PACKAGE
- TOLERANCE
  - Default: 2%

Example: LM385-CXTR

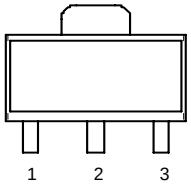
→ 2% version, in SOT-89 Package & Taping & Reel Packing Type
(CS is not available in BAG packing type.)

LM385B-PXTR

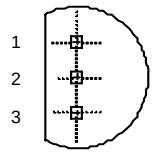
→ 1% version, in Lead Free SOT-89 Package & Taping & Reel Packing Type

PIN CONFIGURATION

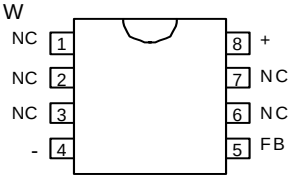
SOT-89
TOP VIEW
1: FB
2: -
3: +



TO-92
TOP VIEW
1: FB
2: +
3: -



SOP-8
TOP VIEW



- **SOT-89 Marking**

Part No.	Marking	Part No.	Marking	Part No.	Marking
LM385CX	AI01	LM385PX	AI01P	LM385GX	AI01G
LM385BCX	AIB01	LM385BPX	AI0BP	LM385BGX	AI0BG

ABSOLUTE MAXIMUM RATINGS

Reverse Current 30mA
Forward Current 10mA
Operating Temperature Range ..... -40°C to 85°C
Junction Temperature ..... 125°C
Storage Temperature Range ..... -65°C to 150°C
Lead Temperature (soldering, 10s) ..... 260°C

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

TEST CIRCUIT

Refer to TYPICAL APPLICATION CIRCUIT.

ELECTRICAL CHARACTERISTICS (T_A=25°C, unless otherwise specified.) (Note1)

PARAMETER	TEST CONDITIONS		SYMBOL	MIN.	TYP.	MAX.	UNIT
Reverse Voltage	I_R=100μA	LM385B LM385	V_R	1.228 1.215	1.240 1.240	1.252 1.265	V
Reverse Voltage Change with Current	$I_{RMIN} \le I_R \le$1mA 1mA$\le I_R \le$20mA		ΔV_R		0.2 5	1 15	mV
Minimum Operating Current	V_{OUT}=1.24V V_{OUT}=5.3V		I_{RMIN}		7 35	11 55	μA
Dynamic Output Impedance	I_R=100μA, f=100Hz I_{AC}=0.1I_R, V_{OUT}=1.24V, V_{OUT}=5.3V		Z_R		0.4 1		Ω
Reference Voltage Change with Output Voltage	I_R=100μA				2	5	mV
Feedback Current			I_{FB}		8	20	nA
Output Wideband Noise	I_R=100μA, 10Hz<f<10KHz V_{OUT}=1.24V, V_{OUT}=5.3V		e_N		50 170		μV_{RMS}
Average Temperature Coefficient (Note 2)	I_R=100μA		αV_R		100		ppm/°C
Long Term Stability	I_R=100μA, T=1000Hrs, T_A=25°C±0.1°C		$\Delta V_R/\Delta t$		20		ppm

Note 1: Specifications are production tested at TA=25°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

Note 2: The average temperature coefficient is defined as the maximum deviation of reverse voltage at all measured temperatures from T_{MIN} to T_{MAX}, divided by T_{MAX} - T_{MIN}. The measured temperatures are 0°C, 25°C, 50°C and 70°C.

TYPICAL PERFORMANCE CHARACTERISTICS

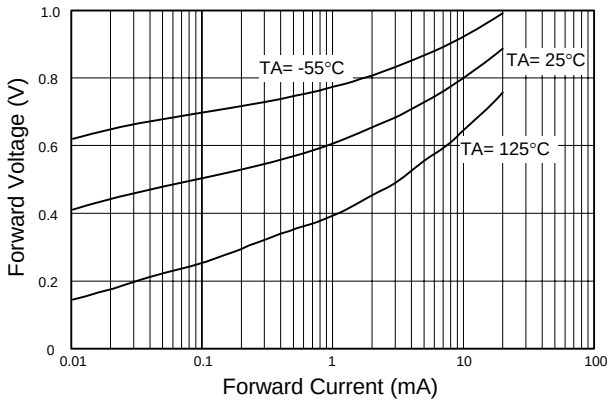


Fig. 1 Forward characteristics

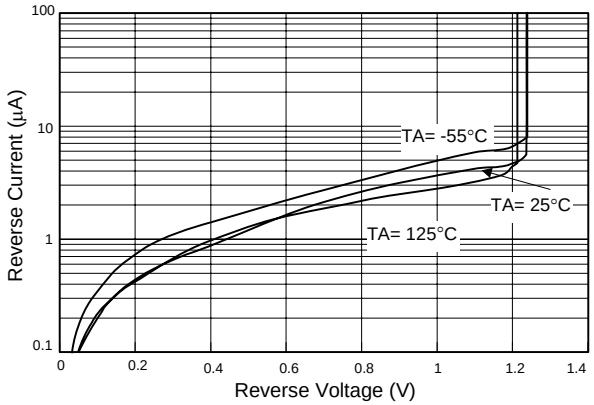


Fig. 2 Reverse Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

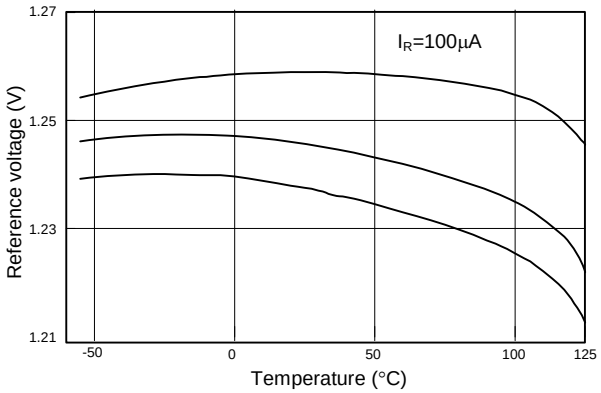


Fig. 3 Temperature Drift of 3 Representative Units

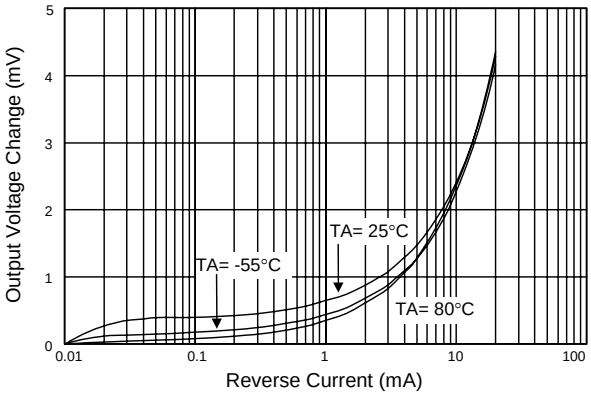


Fig. 4 Reverse Characteristics

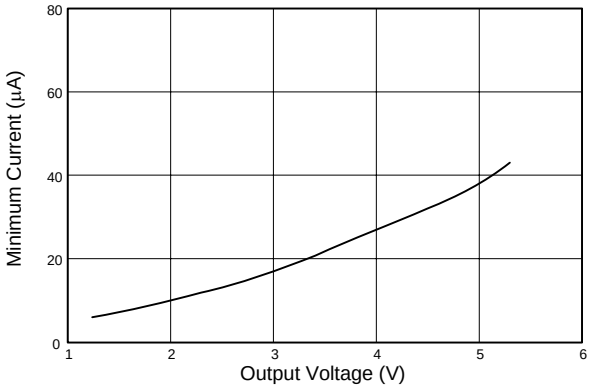


Fig. 5 Minimum Operating Current

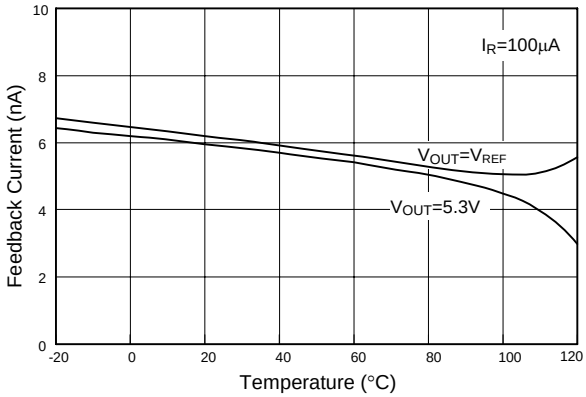


Fig. 6 Feedback Current

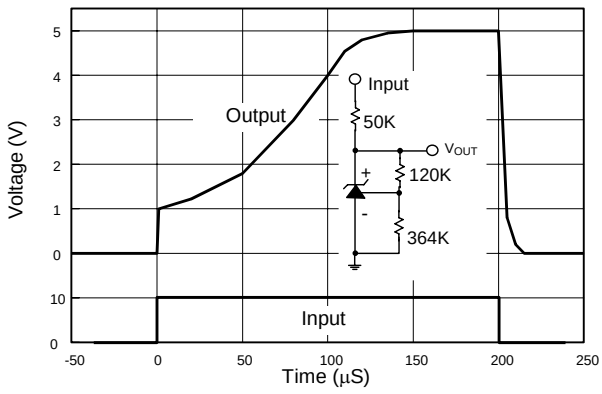


Fig. 7 Response Time

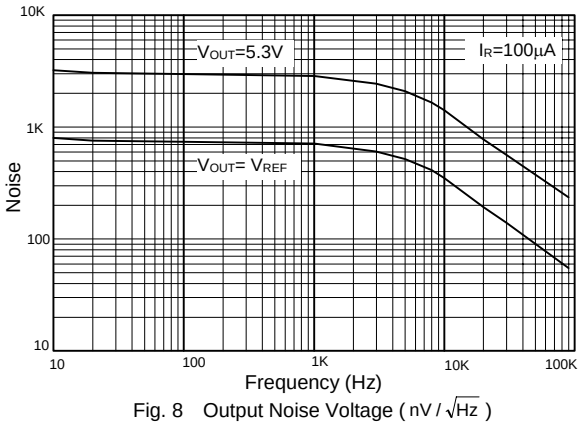
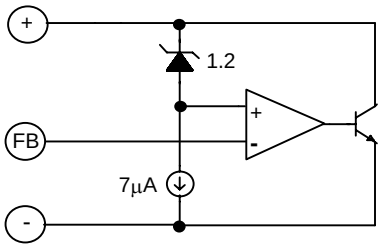
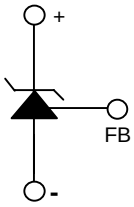


Fig. 8 Output Noise Voltage (nV / $\sqrt{Hz}$)

BLOCK DIAGRAM



- **SYMBOL**



PIN DESCRIPTIONS

PIN + - sinks current with a range from 20μA to 20mA for normal applications. And a stable positive voltage, relative to Pin-, occurs on Pin+.

PIN - - Pin- sources current for normal application. The current value is the same as Pin+.

PIN NC - Not connected.

APPLICATION EXAMPLES

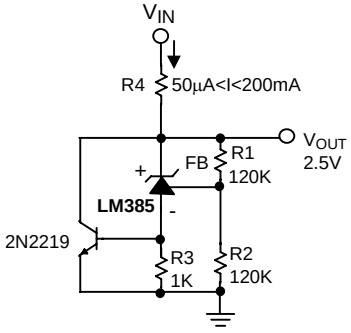


Fig. 9 200mA Shut Regulator

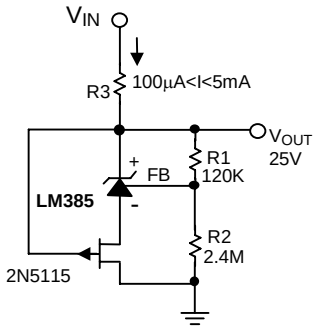


Fig. 10 25V Low Current Shunt Regulator

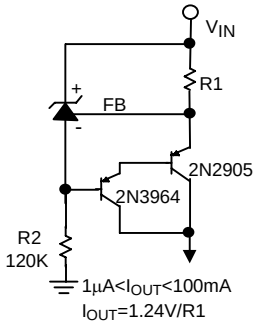


Fig. 11 Current Source

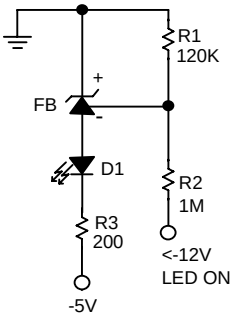


Fig. 12 Voltage Level Detector

APPLICATION EXAMPLES (Continued)

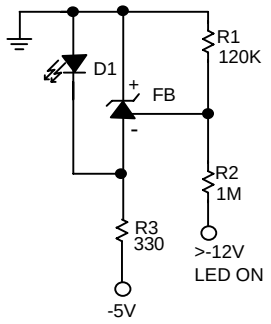
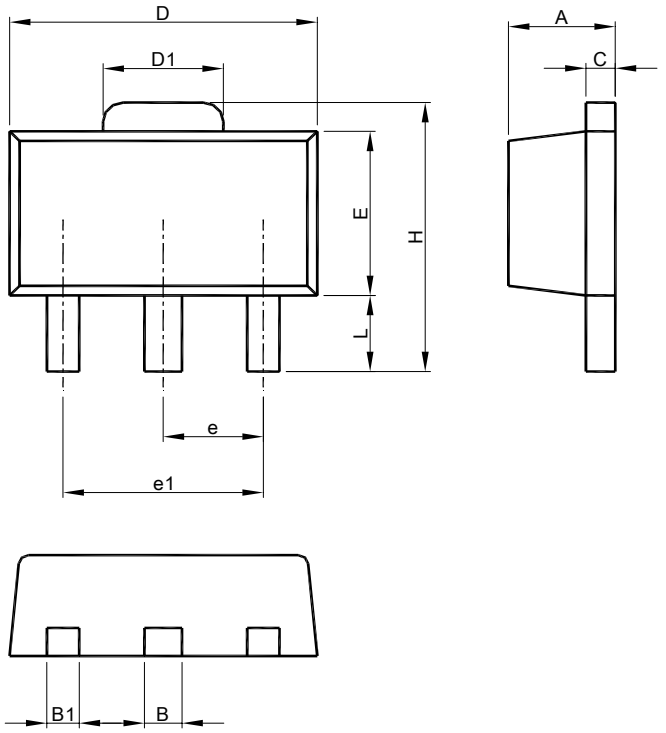


Fig. 13 Voltage Level Detector

PHYSICAL DIMENSIONS (unit: mm)

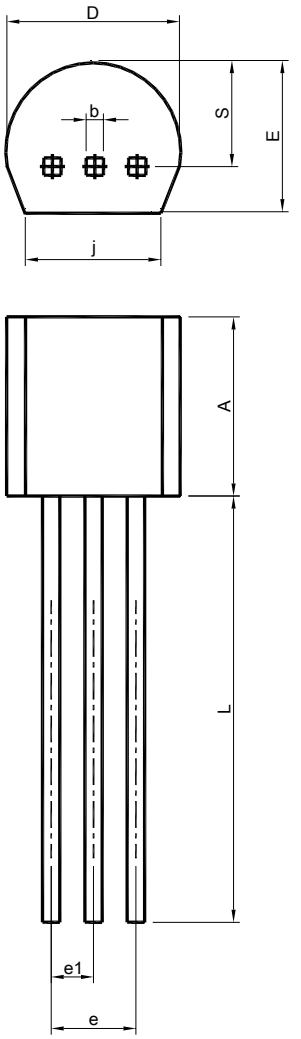
- **SOT-89**



SYMBOL	SOT-89	
	MILLIMETERS	
	MIN.	MAX.
A	1.40	1.60
B	0.44	0.56
B1	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.50	1.83
E	2.29	2.60
e	1.50 BSC	
e1	3.00 BSC	
H	3.94	4.25
L	0.89	1.20

Note: 1. Refer to JEDEC TO-243AA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

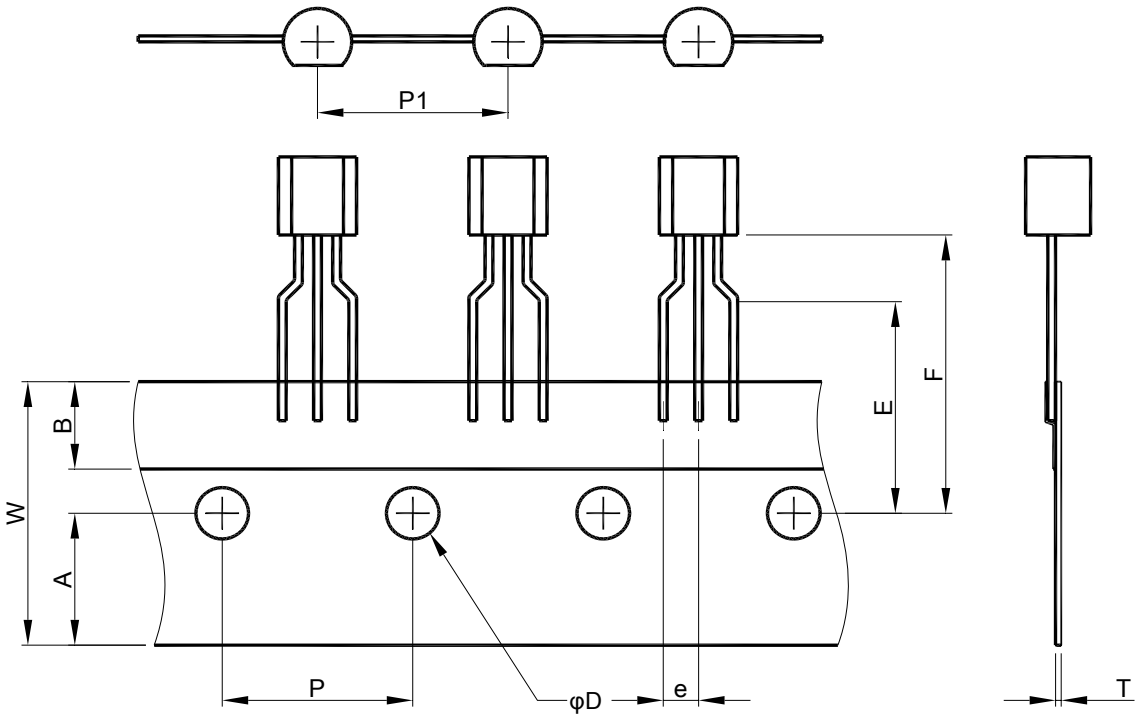
- **TO-92 (BAG)**



SYMBOL	TO-92	
	MILLIMETERS	
	MIN.	MAX.
A	4.32	5.33
b	0.36	0.47
D	4.45	5.20
E	3.18	4.19
e	2.42	2.66
e1	1.15	1.39
j	3.43	
L	12.70	
S	2.03	2.66

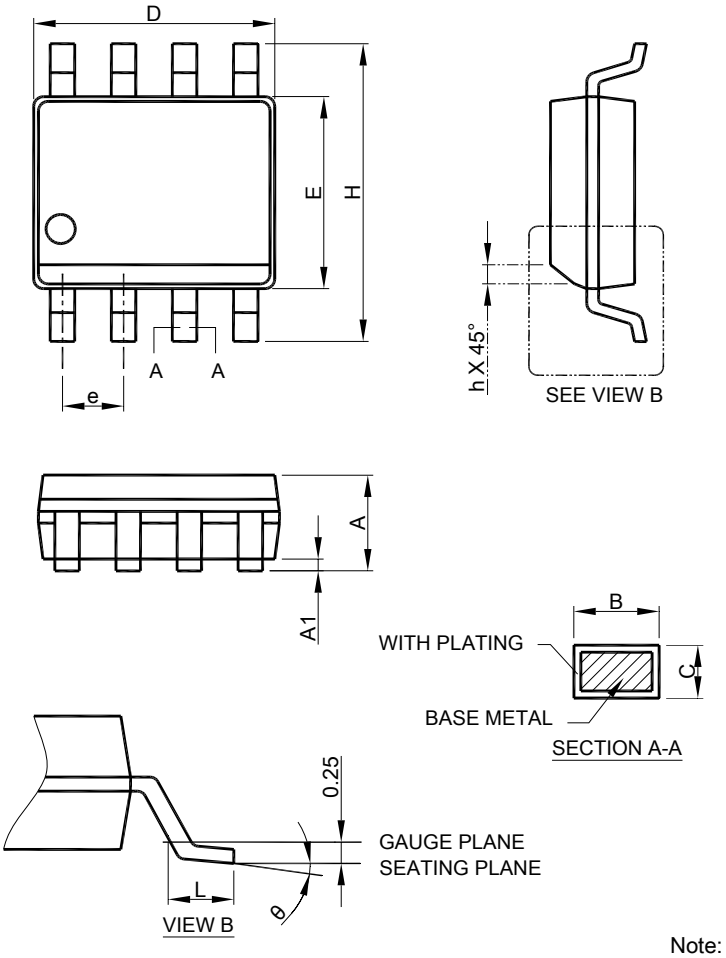
Note: 1. Refer to JEDEC TO-226.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "A" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

- **TO-92 (Tape & Reel)**



SYMBOL	W	A	B	E	F
SPEC.	18.0±0.2	9.0±0.2	6.0±0.20	16.0±0.5	19.0±0.5
SYMBOL	P	P1	D	e	T
SPEC.	12.7 BSC	12.7 BSC	4.0±0.2	2.5 BSC	0.6±0.1

- **SOP-8**



SYMBOL	SOP-8	
	MILLIMETERS	
	MIN.	MAX.
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
θ	0°	8°

Note: 1. Refer to JEDEC MS-012AA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

Note: