19-0824; Rev 2; 3/96

MAXIM

True RMS-to-DC Converters

General Description

The MX536A and MX636 are true RMS-to-DC converters. They feature low power and are designed to accept low-level input signals from 0 to $7V_{RMS}$ for the MX536A and 0 to $200mV_{RMS}$ for the MX636. Both devices accept complex input waveforms containing AC and DC components. They can be operated from either a single supply or dual supplies. Both devices draw less than 1mA of quiescent supply current, making them ideal for battery-powered applications.

Input and output offset, positive and negative waveform symmetry (DC reversal), and full-scale accuracy are laser trimmed, so that no external trims are required to achieve full rated accuracy.

Applications

Digital Multimeters

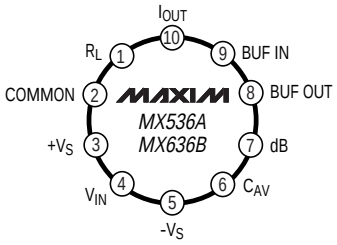
Battery-Powered Instruments

Panel Meters

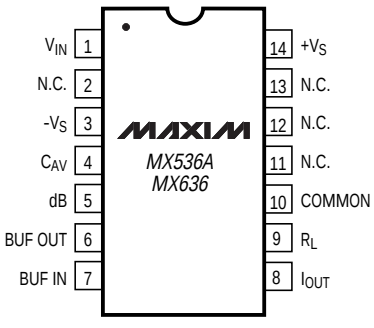
Process Control

Pin Configurations

TOP VIEW



TO-100



DIP

Pin Configurations continued at end of data sheet.

Features

- ♦ **True RMS-to-DC Conversion**
- ♦ **Computes RMS of AC and DC Signals**
- ♦ **Wide Response:**
  2MHz Bandwidth for V_{RMS} > 1V (MX536A)
  1MHz Bandwidth for V_{RMS} > 100mV (MX636)
- ♦ **Auxiliary dB Output: 60dB Range (MX536A)**
  50dB Range (MX636)
- ♦ **Single- or Dual-Supply Operation**
- ♦ **Low Power: 1.2mA typ (MX536A)**
  800µA typ (MX636)

Ordering Information

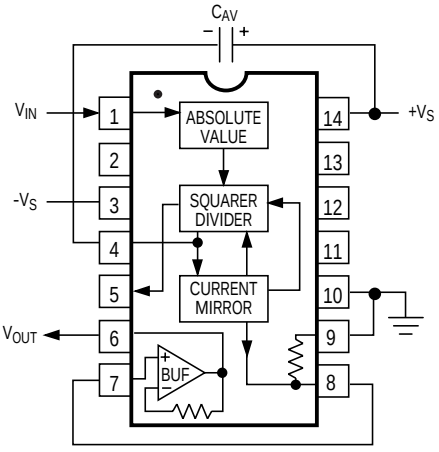
PART	TEMP. RANGE	PIN-PACKAGE
MX536AJC/D	0°C to +70°C	Dice**
MX536AJCWE	0°C to +70°C	16 Wide SO
MX536AJD	0°C to +70°C	14 Ceramic
MX536AJH	0°C to +70°C	10 TO-100
MX536AJN	0°C to +70°C	14 Plastic DIP
MX536AJQ*	0°C to +70°C	14 CERDIP
MX536AKCWE	0°C to +70°C	16 Wide SO
MX536AKD	0°C to +70°C	14 Ceramic
MX536AKH	0°C to +70°C	10 TO-100
MX536AKN	0°C to +70°C	14 Plastic DIP
MX536AKQ*	0°C to +70°C	14 CERDIP
MX536ASD	-55°C to +125°C	14 Ceramic

Ordering Information continued at end of data sheet.

** Maxim reserves the right to ship ceramic packages in lieu of CERDIP packages.*

*** Dice are specified at T_A = +25°C.*

Typical Operating Circuits



Typical Operating Circuits continued at end of data sheet.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage: Dual Supplies (MX536A) ..... ±18V
(MX636) ..... ±12V
Single Supply (MX536A) ..... +36V
(MX636) ..... +24V
Input Voltage (MX536A) ..... ±25V
(MX636) ..... ±12V
Power Dissipation (Package)
Plastic DIP (derate 12mW/°C above +75°C) 450mW
Small Outline (derate 10mW/°C above +75°C) 400mW
Ceramic (derate 10mW/°C above +75°C) 500mW
TO-100 metal can (derate 7mW/°C above +75°C) 450mW

Output Short-Circuit Duration ..... Indefinite
Operating Temperature Ranges
Commercial (J, K) ..... 0°C to +70°C
Military (S) ..... -55°C to +125°C
Storage Temperature Range ..... -55°C to +150°C
Lead Temperature (soldering, 10sec) ..... 300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS—MX536A

(T_A = +25°C, $+V_S$ = +15V, $-V_S$ = -15V, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Transfer Equation				V_{OUT} = [avg. $(V_{IN})^2$] $^1/_2$		
Averaging Time Constant	Figure 3			25		ms/µF C_{AV}
CONVERSION ACCURACY						
Total Error, Internal Trim (Note 1)	MX536AJ, AS				±5 ±0.5	mV ±% of Reading
	MX536AK				±2 ±0.2	
Total Error vs. Temperature	T_{MIN} to +70°C	MX536AJ			±0.1 ±0.01	mV ±% of Reading/°C
		MX536AK			±0.05 ±0.005	
		MX536AS			±0.1 ±0.005	
	+70°C to +125°C	MX536AS			±0.03 ±0.005	
Total Error vs. Supply				±0.1 ±0.01		mV ±% of Reading/V
Total Error vs. DC Reversal	MX536AJ, AS			±0.2		% of Reading
	MX536AK			±0.1		
Total Error, External Trim (Note 1)	MX536AJ, AS			±3 ±0.3		mV ±% of Reading
	MX536AK			±2 ±0.1		
ERROR vs. CREST FACTOR (Note 2)						
Additional Error	Crest Factor 1 to 2			Specified Accuracy		% of Reading
	Crest Factor = 3			-0.1		
	Crest Factor = 7			-1.0		
FREQUENCY RESPONSE (Note 3)						
Bandwidth for 1% Additional Error (0.09dB)	V_{IN} = 10mV			5		kHz
	V_{IN} = 100mV			45		
	V_{IN} = 1V			120		
±3dB Bandwidth	V_{IN} = 10mV			90		kHz
	V_{IN} = 100mV			450		
	V_{IN} = 1V			2.3		MHz

ELECTRICAL CHARACTERISTICS—MX536A (continued)

(T_A = +25°C, $+V_S$ = +15V, $-V_S$ = -15V, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS						
Input Signal Range	±15V Supplies Continuous RMS			0 to 7		V_{RMS}
	Peak Transient				±20	V_{PK}
	±5V Supplies Continuous RMS			0 to 2		V_{RMS}
	Peak Transient				±7	V_{PK}
Safe Input	All Supplies				±25	V_{PK}
Input Resistance			13.33	16.7	20.00	kΩ
Input Offset Voltage	MX536AJ, AS			0.8	±2	mV
	MX536AK			0.5	±1	
OUTPUT CHARACTERISTICS						
Offset Voltage	T_A = +25°C	MX536AJ		±1	±2	mV
		MX536AK		±0.5	±1	
		MX536AS			±2	
	$T_A = T_{MIN}$ to T_{MAX}	MX536AJ, AK		±0.1		mV/°C
		MX536AS			±0.2	
	Supply Voltage	MX536AJ, AK		±0.1		mV/V
		MX536AS		±0.2		
Output Voltage Swing	±15V Supplies		0 to 11	12.5		V
	±5V Supplies		0 to 2			
Output Current	Source		5			mA
	Sink		-130			µA
Short Circuit Current				20		mA
Output Resistance					0.5	Ω
dB OUTPUT						
Error	V_{IN} = 7mV to $7V_{RMS}$, 0dB = $1V_{RMS}$	MX536AJ		±0.4	±0.6	dB
		MX536AK		±0.2	±0.3	
		MX536AS		±0.5	±0.6	
Scale Factor				-3		mV/dB
Scale Factor TC (Uncompensated)				0.33		% of Reading/°C
I_{REF}	0dB = $1V_{RMS}$		5	20	80	µA
I_{REF} Range			1		100	µA
I_{OUT} TERMINAL						
I_{OUT} Scale Factor				40		$µA/V_{RMS}$
I_{OUT} Scale Factor Tolerance				±10	±20	%
Output Resistance			20	25	30	kΩ
Voltage Compliance				$-V_S$ to $(+V_S - 2.5)$		V

ELECTRICAL CHARACTERISTICS—MX536A (continued)

(T_A = +25°C, $+V_S$ = +15V, $-V_S$ = -15V, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
BUFFER AMPLIFIER					
Input and Output Voltage Range		$-V_S$ to ($+V_S$ - 2.5)			V
Input Offset Voltage	R_S = 25kΩ		±0.5	±4	mV
Input Bias Current			20	300	nA
Input Resistance			10^8		Ω
Output Current	Source	+5			mA
	Sink	-130			µA
Short-Circuit Current			20		mA
Small-Signal Bandwidth			1		MHz
Slew Rate (Note 4)			5		V/µs

ELECTRICAL CHARACTERISTICS—MX636

(T_A = +25°C, $+V_S$ = +3V, $-V_S$ = -5V, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Transfer Equation				V_{OUT} = [avg. $(V_{IN})2]^{1/2}$		
Averaging Time Constant	Figure 3			25		ms/µF C_{AV}
CONVERSION ACCURACY						
Total Error, Internal Trim (Notes 5, 6)	MX636J				±0.5 ±1.0	mV ±% of Reading
	MX636K				±0.2 ±0.5	
Total Error vs. Temperature (0°C to +70°C)	MX636J				±0.1 ±0.01	mV ±% of Reading/°C
	MX636K				±0.1 ±0.005	
Total Error vs. Supply				±0.1 ±0.01		mV ±% of Reading/V
Total Error vs. DC Reversal	V_{IN} = 200mV	MX636J		±0.2		±% of Reading
		MX636K		±0.1		
Total Error, External Trim (Note 5)	MX636J			±0.3 ±0.1		mV ±% of Reading
	MX636K			±0.1 ±0.1		
ERROR vs. CREST FACTOR (Note 3)						
Additional Error	Crest Factor 1 to 2			Specified Accuracy		±% of Reading
	Crest Factor = 3			-0.2		
	Crest Factor = 6			-0.5		
FREQUENCY RESPONSE (Notes 6, 8)						
Bandwidth for 1% Additional Error (0.09dB)	V_{IN} = 10mV			14		kHz
	V_{IN} = 100mV			90		
	V_{IN} = 200mV			130		
±3dB Bandwidth	V_{IN} = 10mV			100		kHz
	V_{IN} = 100mV			900		
	V_{IN} = 200mV			1.5		MHz