



R&E International

A Subsidiary of Microchip Technology Inc.

RE46C109

Voltage Regulator, Voltage Converter and Piezoelectric Horn Driver
Product Specification

General Description

The RE46C109 is intended for use in applications where low voltage regulation and a high voltage horn driver are required. The circuit features a voltage boost converter/regulator and driver circuit suitable for driving a piezoelectric horn. The horn enable pin activates the boost converter and horn driver circuit. Supply current is 6.5uA maximum when the boost regulator and horn driver are not in use. A 3V regulator is also provided for microprocessor voltage regulation. Low battery detection and signaling are also available. Interconnect pins are provided to allow communication in multiple unit environments. A power good pin monitors the status of the regulator output.

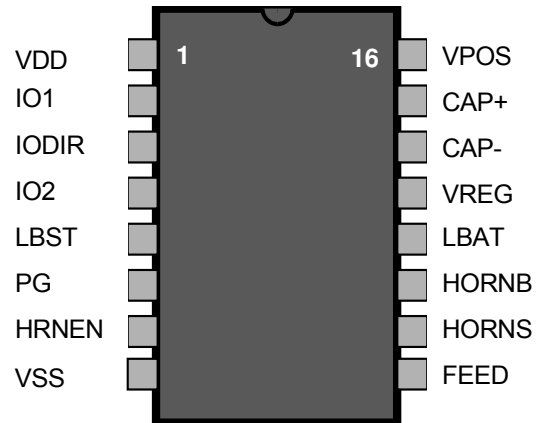
Applications

Smoke detectors
CO Detectors
Personal Security Products
Electronic Games
Hand Held Instruments

Features

- Low Quiescent Current
- 12V Boost Regulator
- Low Horn Driver Ron
- 3V Regulator, Other Options Available
- Low Battery Detection Interface
- Power Good and Brownout Circuits
- Device interconnection
- Available in DIP and SOIC packages
- Available in Standard Packaging or RoHS Compliant Pb Free Packaging

Pin Configuration



ABSOLUTE MAXIMUM RATINGS

PARAMETER

Supply Voltage
 Input Voltage Range Except FEED, IO1, IO2
 FEED Input Voltage Range
 IO2 Input Voltage Range
 IO1 (as input) Voltage Range
 Input Current except FEED
 Operating Temperature
 Continuous Operating Current (Horn or VPOS)
 Storage Temperature
 Maximum Junction Temperature

SYMBOL

VALUE

UNITS

V _{DD}	12	V
V _{in}	-.3 to V _{dd} +.3	V
V _{infd}	-10 to +22	V
V _{io2}	-.3 to VREG+.3	V
V _{io1}	-.3 to V _{dd} + 6	V
I _{in}	10	mA
T _A	-40 to 85	°C
I _{con}	50	mA
T _{STG}	-55 to 125	°C
T _J	125	°C

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and operation at these conditions for extended periods may affect device reliability.

This product utilizes CMOS technology with static protection; however proper ESD prevention procedures should be used when handling this product. Damage can occur when exposed to extremely high static electrical charges.

RE46C109

Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Electrical Characteristics at $T_A=27^{\circ}\text{C}$, $V_{dd}=9\text{V}$, $V_{ss}=0\text{V}$ (unless otherwise noted).

Parameter	Symbol	Conditions	Limits			
			MIN	TYP	MAX	UNITS
Supply Voltage	Vdd	Operating	6		12	V
Quiescent Supply Current	Idd1	HRNEN, LBST, IODIR, FEED, REGSEL=VSS, No Loads		4.7	6.5	μA
Supply Current	Idd2	LBST, IODIR, FEED =VSS HRNEN=VDD, No Loads		350		μA
Input Leakage	Iin	All Inputs except FEED, Vin=VDD or VSS	-100		100	nA
	Iihf	FEED=+22V		20	50	μA
	Iilf	FEED=-10V	-50	-15		μA
Output Leakage	Iout	PG = 5.0v			1.0	μA
Input Voltage Low	Vil	All Inputs except FEED			1	V
Input Voltage High	Vih	All Inputs Except FEED	2.3			V
Output Low Voltage	Vol1	HORNB or HORNS; Iout=16mA;		.3	.5	V
	Vol2	IO2, Iout=100 μA ; IODIR=Vil, IO1=Vil		.3	.5	V
	Vol3	PG, Iout=5.0mA;		.5		V
Output High Voltage	Voh1	HORNB or HORNS; Iout=-16mA	Vpos-.5	Vpos-.3		V
	Voh2	IO2, Iout=-100 μA ; IODIR=Vil, IO1=Vih	Vreg -.5	Vreg -.3		V
VPOS RMS Output Voltage	V _{vpos}	VPOS; Iout=-16mA; HRNEN=VDD	10.7	11.8	12.7	V
Charge pump Oscillator Frequency	CPf			150		kHz
Charge pump Power Efficiency	CPpe	VPOS; Iout=-16mA, C1=1 μF C2=10 μF ; Vdd=6.5v		85		%
Charge pump Voltage Efficiency	CPve	VPOS; No Loads, C1=1 μF C2=10 μF ; Vdd=6.0v	95	99		%
Low Battery Interface	Lbv	LBAT; LBST=Vdd	.17 *Vdd	.2*Vdd	.23*Vdd	V
VREG Voltage	Vreg	VREG; Iout<50mA; HRNEN=VSS	2.85	3	3.15	V
VREG Line Regulation	Vregln	VREG; Vdd=6V to 12V; VREG Iout=10mA; HRNEN = VSS; Note 3			50	mV
VREG Load Regulation	Vregld	VREG; Iout=0 to -50mA; HRNEN=VSS; Note 3			90	mV
Brownout Threshold	Vbvt	Falling Edge of VDD; Note 1	4.5	5.0	5.5	V
Brownout Pull Down Current	Ibt	Vdd=4.5V, Vreg=2v	15	25		mA

RE46C109

Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Electrical Characteristics at $T_A=27^\circ\text{C}$, $V_{dd}=9\text{V}$, $V_{ss}=0\text{V}$ (unless otherwise noted).

Parameter	Symbol	Conditions	Limits			
			MIN	TYP	MAX	UNITS
VREG Over Voltage Clamp	Vcl	$I_{out}>1\text{mA}$; Note 2	3.7	4.0	4.3	V
VREG Over Voltage Clamp Current	Icl	$V_{REG}\geq V_{cl}$	0.5			mA
PG Trip Threshold	PGvtr	Vreg output rising	77	84	94	%Vreg
	PGvtf	Vreg output falling	72	80	88	%Vreg
PG Delay	PGtdly	Delay time with respect to PGvtr		500		usec
IO1 Output Current	IO1ih1	IODIR=Vil, IO1=Vdd-2V, Vdd=12V	25		60	UA
	IO1ih2	IODIR=Vil, IO1=17V, Vdd=12V			150	UA
	IO1ioh1	IODIR, IO2=Vih, Vdd=6.5V, IO1=4.5V	-4			mA
	IO1ioh2	IODIR, IO2=Vih, Vdd=12V, IO1=Vss			-16	mA
	IO1iol1	IO dump current IODIR= Vih, IO2=Vil, IO1=1V	10	15		mA
IO1 Alarm Voltage	IO1vih	IODIR=Vil	3			V
	IO1vil	IODIR=Vil			1.5	V

Unless noted the limits at room temperature are guaranteed and 100% production tested. Limits over temperature are guaranteed but not 100% tested.

Note 1: The brown-out threshold voltage is the Vdd voltage at which the regulator will be disabled and VREG (output) will be pulled to Vss.

Note 2: In normal operation, the regulator will provide high-side current of up to 50mA, but current sinking capability is typically under 1uA. The overvoltage clamp, Vcl is intended to limit the voltage at VREG (output) when it is pulled up by an external source.

Note 3: Not 100% production tested but limits are guaranteed by design.

Interconnect Logic Truth Table

IODIR (pin 3)	IO2 (pin 4)		IO1 (pin 2)	
	Input	Output	Input	Output
1	0			0
1	1			1
0		0	0	
0		1	1	

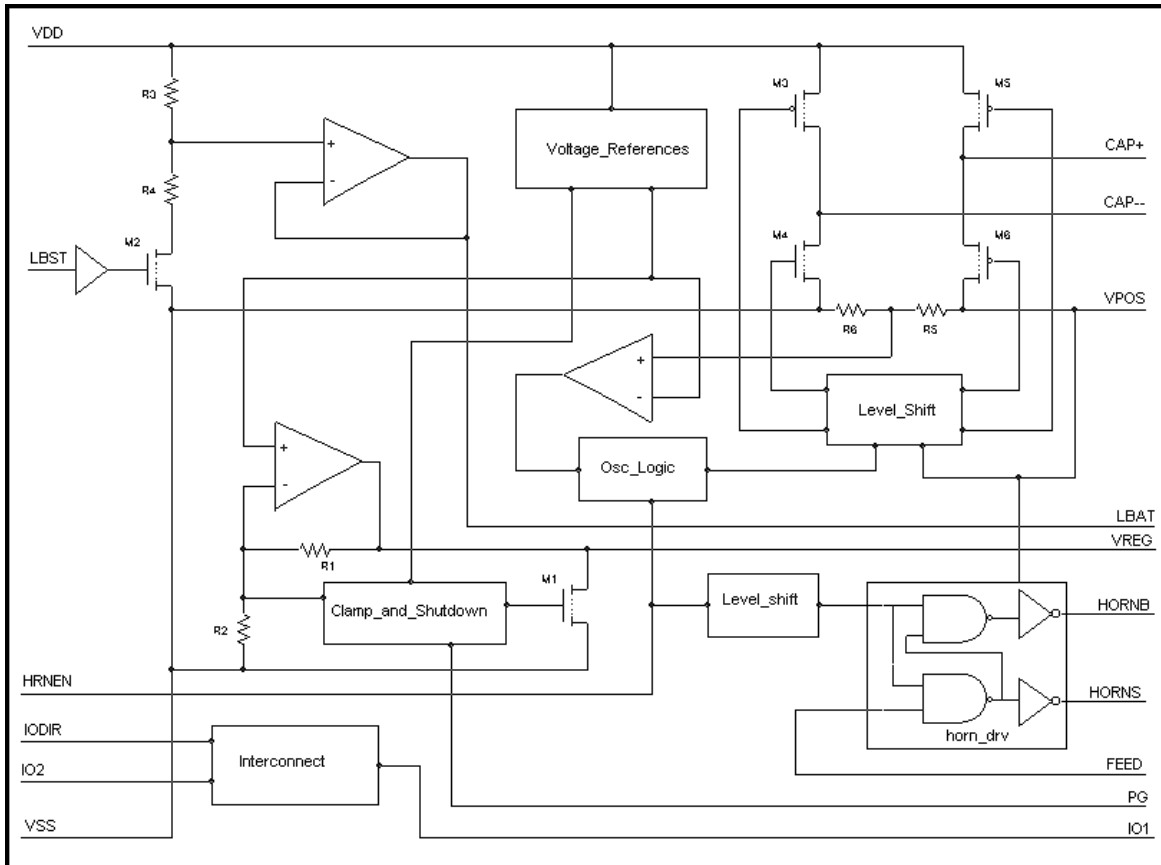
RE46C109

Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Functional Block Diagram



RE46C109

*Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver
Product Specification*



R&E International
A Subsidiary of Microchip Technology Inc.

PIN DESCRIPTIONS

VDD (Pin 1, Input) - Connect to the positive terminal of the supply voltage for the voltage regulator, charge pump voltage converter and bi-directional Interconnect block.

IO1 (Pin 2, Input/Output) - This bi-directional pin provides an interface to additional RE46C109 IO1 pins. This serves as a communication link between separate modules.

IODIR (Pin 3, Input) - This input provides control for the bi-directional pins IO1 and IO2.

IO2 (Pin 4, Input/Output) - This bi-directional pin provides an interface to a TTL/CMOS I/O of a μ P or ASIC. Refer to the interconnect logic truth table.

LBST (Pin 5, Input) - This input provides an enable or strobe control for the analog low battery detection function.

PG (Pin 6, Output) - This open drain NMOS output provides a status indication of when the VREG output is above or below a specified voltage level.

HRNEN (Pin 7, Input) - This input provides activation control for the charge pump boost regulator and horn driver outputs.

VSS (Pin 8, Input) - This power pin is connected to the negative terminal of the supply voltage.

FEEDBACK (Pin9, Input) - Horn driver input.

HORNS (Pin10, Output) - Horn output driver which provides VPOS to VSS output voltage swing for the piezoelectric horn.

HORN B (Pin11, Output) - Horn output driver which provides VPOS to VSS output voltage swing for the piezoelectric horn.

LBAT (Pin12, Output) - Analog output voltage that is proportional to the VDD supply and functions as a low battery detection output.

VREG (Pin13, Output) - Voltage regulator output, requires an external capacitor.

VCAP- (Pin14, I/O) - Negative terminal for the external charge pump boost (fly) capacitor.

VCAP+ (Pin 15, I/O) - Positive terminal for the external charge pump boost (fly) capacitor.

VPOS (Pin 16, Output) - This output pin requires an external filter capacitor which supplies voltage for the horn driver outputs.

RE46C109

***Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver***
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Device Operation

(Please refer to the functional block diagram)

The RE46C109 consists of the following main functional blocks: band gap voltage reference, low drop-out voltage regulator (with over voltage clamp and power supply brownout protection), low battery detection, switched capacitor 12 volt boost regulator, horn driver and Interconnect logic.

When power is applied the band gap voltage reference and the voltage regulator output are initially enabled. The low battery detection, horn driver outputs and switched capacitor 12v boost regulator are enabled by TTL compatible positive logic control inputs.

When the HRNEN (Horn Enable) input is brought to a logic high level, the horn driver outputs as well as the 12v boost regulator become active. The 12v boost regulator supplies the horn driver outputs. The 12v boost regulator utilizes a charge pump to boost the V_{dd} supply input to a regulated 12-volt output. The charge pump consists of an internal oscillator that is controlled in a voltage comparator feedback configuration.

The low battery detection is enabled and strobed when the LBST input is brought to a logic high level. The LBAT output is a voltage follower amplifier whose input is determined by a resistor divider across the device supply rails.

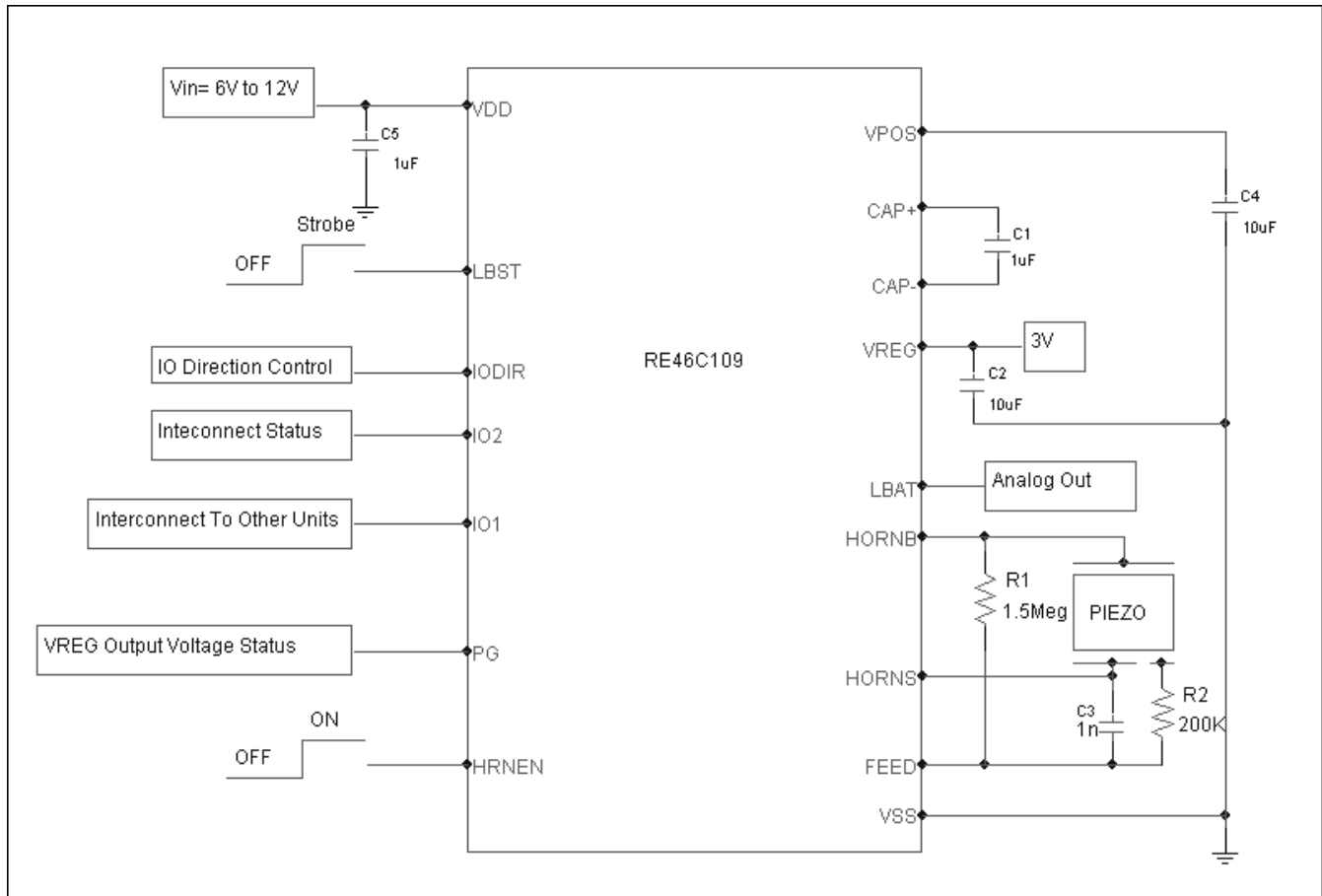
RE46C109

Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Typical Application Circuit



Application Notes:

(See application circuit)

The efficiency of the switched capacitor charge pump regulator varies with the applied input voltage and the load current. The approximate voltage efficiency is given by:

$$\text{Efficiency (\%)} = [V_{\text{POS}} / (2 \times V_{\text{DD}})] \times 100$$

RE46C109

**Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver**
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Application Notes continued:

(See application circuit)

Capacitor Selection:

To achieve minimum output voltage ripple, the output capacitor C_4 (for VPOS) should have a low ESR (Effective Series Resistance) value with leads kept as short as possible. Capacitors with long leads increase ripple voltage due to lead inductance.

Like all Low-Dropout Regulators, the RE46C109 requires an output capacitor connected between VREG (output) and VSS to stabilize the internal control loop. The recommended capacitance is $10\mu\text{F}$. Capacitor values larger than $10\mu\text{F}$ are acceptable.

PCB Layout Suggestions:

Due to large transient currents flow in the V_{DD} , V_{POS} and V_{SS} terminals, minimizing both input and output ripple is accomplished by placing capacitors as close as possible to the regulator using short direct circuit wiring or traces.

RE46C109

**Voltage Regulator, Voltage Converter and
Piezoelectric Horn Driver**
Product Specification



R&E International
A Subsidiary of Microchip Technology Inc.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, Accuron, dsPIC, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, rPIC, SmartShunt and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


FilterLab, Hampshire, Linear Active Thermistor, MXDEV, MXLAB, SEEVAL, SmartSensor and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, In-Circuit Serial Programming, ICSP, ICEPIC, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, mTouch, nanoWatt XLP, PICkit, PICDEM, PICDEM.net, PICTail, PIC³² logo, PowerCal, PowerInfo, PowerMate, PowerTool, REAL ICE, rLAB, Select Mode, Total Endurance, TSHARC, WiperLock and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2009, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
== ISO/TS 16949:2002 ==

Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC[®] MCUs and dsPIC[®] DSCs, KEELOQ[®] code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.