General Description

The MAX71071/MAX71071H are dual-channel isolated analog-to-digital converters (ADCs) for use with a compatible MAX71xxx host. The device provides current and voltage measurements to the host while the host provides control, command, and power to the MAX71071/MAX71071H. A pulse transformer provides the isolated data, clock, and power path between the device and host, eliminating the need for additional isolation components in the measurement subsystem. These metrology ADCs operate over the industrial temperature range and come in a 10-pin µMAX® package.

µMAX is a registered trademark of Maxim Integrated Products, Inc.

Ordering Information appears at end of data sheet.

Benefits and Features

- Accurately Measure Voltage and Current
  - Dual 24-Bit ADC
  - 0.1% Accuracy Over 2000:1 Dynamic Range
  - Exceeds IEC 62053/ANSI C12.20 Standards
  - On-Chip Temperature Sensor Enables Localized Digital Temperature Compensation
- Galvanic Isolation Through Pulse Transformer Provides Power, Bidirectional Data, and Timing Reference
  - 1.4mA Typical Consumption
  - On-Chip PLL and Power Monitoring

Block Diagram
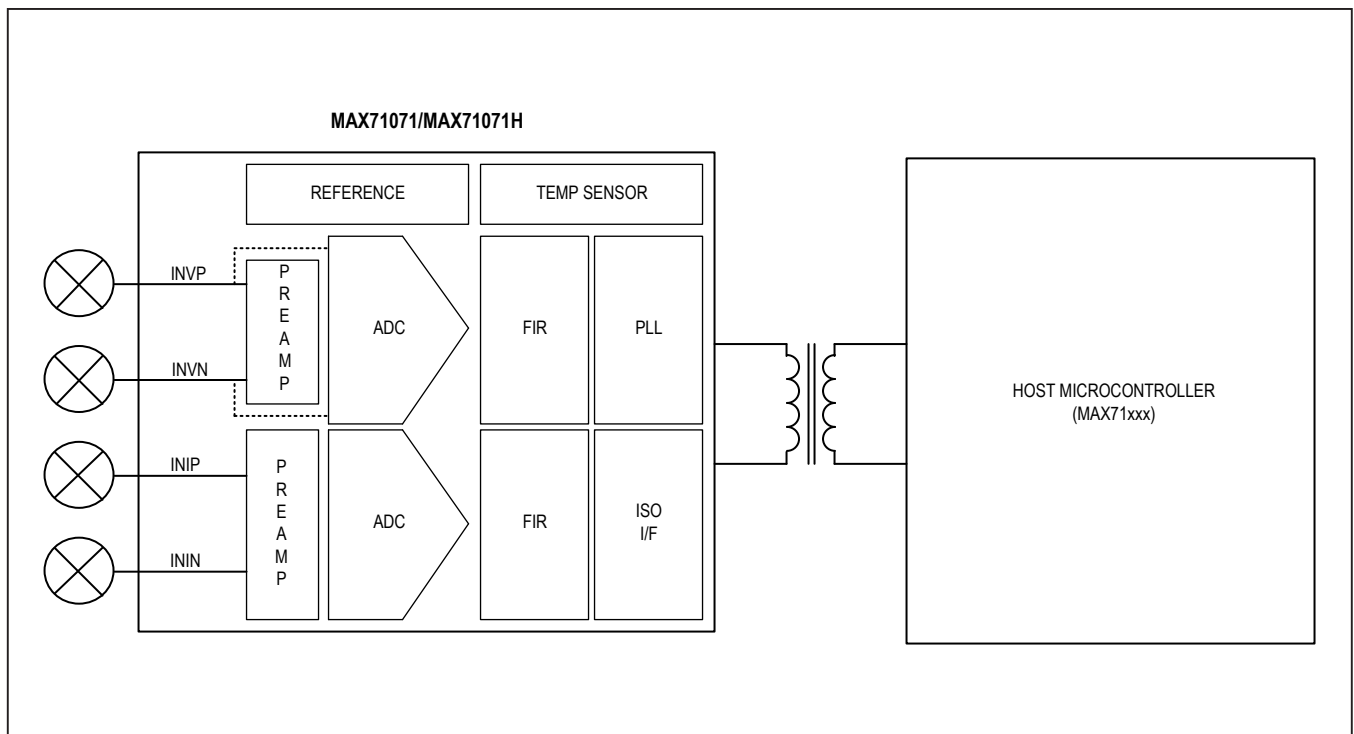
Absolute Maximum Ratings

(All voltages with respect to V_{SSA}.)

Supplies and Ground Pins

V_{CC}..-0.5V to +3.6V
V_{SS} ....-0.1V to +0.1V

Analog Input Pins

INP, INN, SP, SN .....-10mA to +10mA, -0.5V to (V_{CC} + 0.5V)

Digital Pins

TEST.....................................-10mA to +10mA, -0.5V to +3.6V
Operating Junction Temperature (peak, 100ms)............+140°C
Operating Junction Temperature (continuous)...............+125°C
Storage Temperature.. -45°C to +165°C
Solder Temperature (10s duration) ....+250°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.

Package Thermal Characteristics (Note 1)

µMAX

Junction-to-Ambient Thermal Resistance (θ_{JA})
  Multilayer Board ....113.10°C/W
  Single-Layer Board..180°C/W

Junction-to-Case Thermal Resistance (θ_{JC})................42°C/W

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maximintegrated.com/thermal-tutorial**.

Recommended External Components

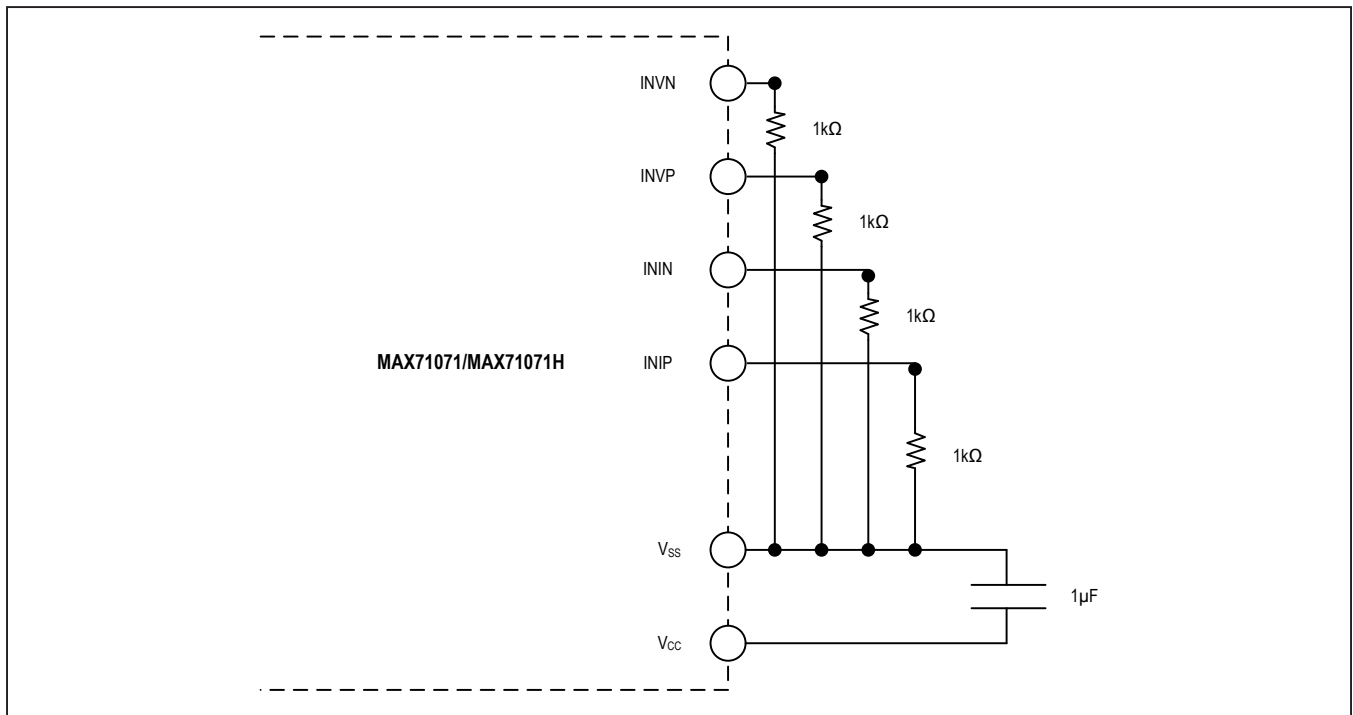| NAME	FROM	TO	FUNCTION	VALUE	UNITS
C1	V_{CC}	V_{SS}	Bypass capacitor for supply	1.0	µF
R1, R2, R3, R4	Sensor	GND	To establish proper bias for INVN/INVP and ININ/INIP pins	1.0	kΩ

Figure 1. Recommended External Components Circuit

Recommended Operating Conditions

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{CC} Supply Voltage		2.5		3.6	V
Operating Temperature Range		-40		+85	°C

Performance Specifications

(Limits are production tested at T_A = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY CURRENT					
V_{CC} Current, Normal Operation	V_{CC} = 3.3V, voltage ADC preamp bypassed		1.2	1.6	mA
V_{REF}					
$V_{REF}(22)$, V_{REF} Output Voltage	T_A = +22°C	1.1925	1.195	1.1975	V
V_{REF} Power Supply Sensitivity $\Delta V_{REF}/\Delta V_{CC}$		-2.4		+2.4	mV/V
V_{NOM} Definition	$V_{NOM}(T) = V_{REF}(22) + (T - 22) \times TC1 + (T - 22)^2 \times TC2$ (Note 2)				V
IF TRIMBGB AVAILABLE (NOT 00)					
$V_{REF}(T)$ Deviation from $V_{NOM}(T)$ $[(V_{REF}(T) - V_{NOM}(T))/V_{NOM}(T)] \times [10^6/62]$	(Note 3)		0		ppm/°C
IF TRIMBGB NOT AVAILABLE (TRIMBGB = 00)					
$V_{REF}(T)$ Deviation from $V_{NOM}(T)$ $[(V_{REF}(T) - V_{NOM}(T))/V_{NOM}(T)] \times [10^6/62]$	(Note 3)		0		ppm/°C
V_{CC} VOLTAGE MONITOR					
BNOM: Nominal Value, T_A = +22°C	V_{CC} = 3.0V		120		LSB
V_{CC} Voltage	V_{CC} = 3.0 + (BSENSE - 120) x 0.0244 (Note 4)				V
Measurement Error		-150		+150	mV

Performance Specifications (continued)

(Limits are production tested at T_A = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
TEMPERATURE MONITOR					
T_{NOM}: Nominal Value, T_A = +22°C			945		LSB
Temperature Error	T_A = -40°C, -10°C, +55°C, +85°C (Note 3)		0		°C
TETIME: Duration of Temperature Measurement	V_{CC} = 3.0V		14	30	ms
POWER PULSE					
Power Pulse Frequency			1.638		MHz
PULSE IO					
SP Output V_{OH} (ONE Pulse)	I_{OH} = 1mA			V_{CC} - 0.28	V
SN Output V_{OL} (ONE Pulse)	I_{OL} = 1mA			0.287	V
SN Output V_{OH} (ZERO Pulse)	I_{OH} = 1mA			V_{CC} - 0.28	V
SP Output V_{OL} (ZERO Pulse)	I_{OL} = 1mA			0.287	V
PREAMP					
Gain = 14x		-2%	14	+2%	V/V
Gain = 9x		-2%	9	+2%	V/V
Gain = 4x		-2%	4	+2%	V/V
Phase Shift			1		m°
Phase Shift Variation vs. Supply	(Note 3)	-10		+10	m°/V
Phase Shift Variation vs. Temperature	(Note 3)	-0.1		+0.1	m°/°C
Input Current	Preamp gain = 4x, 9x, 14x	7.5	13	24	µA
ADC CONVERTER					
Usable Input Range (I_{NP} - I_{NN})		-250/gain		250/gain	mV_{PK}
THD (FIRST 10 HARMONICS)					
Preamp Gain = 1x	V_{IN} = 65Hz, 64kpts FFT, Blackman-Harris window		85		dB
250mV_{PK}/Preamp Gain, Preamp Gain = 4x, 9x, 14x	V_{IN} = 65Hz, 64kpts FFT, Blackman-Harris window		85		dB

Performance Specifications (continued)

(Limits are production tested at T_A = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.)

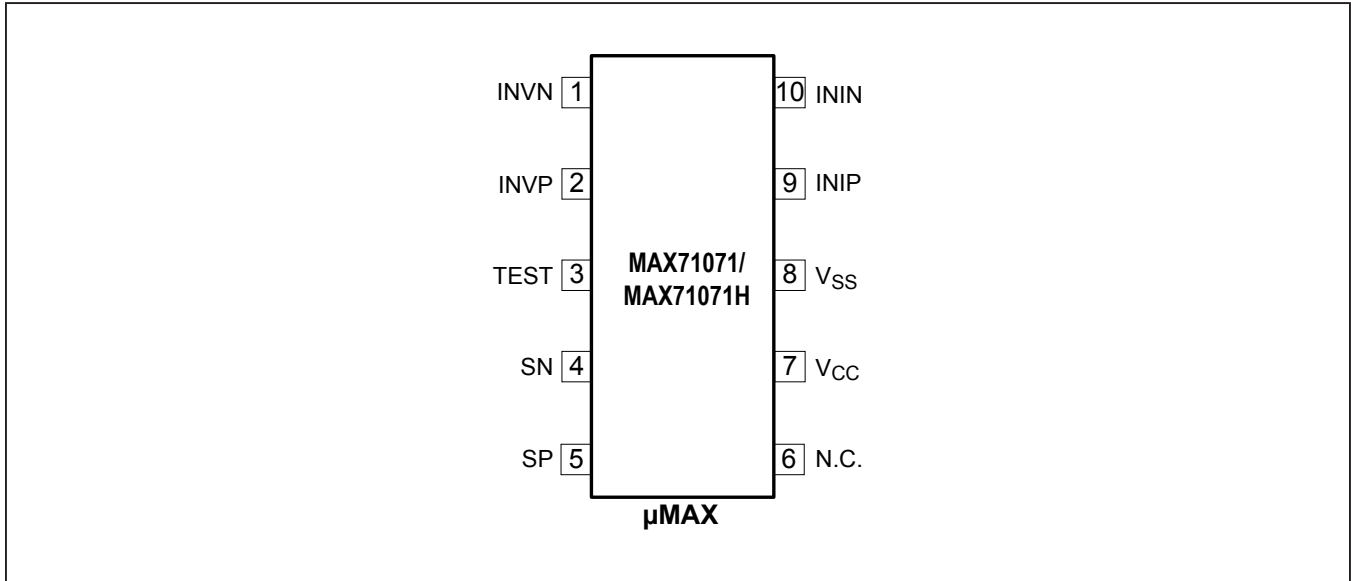| PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
20mV$_{PK}$/Preamp Gain, Preamp Gain = 4x, 9x, 14x	V_{IN} = 65Hz, 64kpts FFT, Blackman-Harris window		85		dB
Input Impedance	Preamp bypassed	20		40	kΩ
	Preamp = 4x	6.5	12	18	
	Preamp = 9x	3.5	6.3	9.1	
	Preamp = 14x	2.3	4.3	6.3	
LSB SIZE					
Preamp Gain = 14x	FIR length = 100		22.9		nV/LSB
Preamp Gain = 9x	FIR length = 100		35.5		nV/LSB
Preamp Gain = 4x	FIR length = 100		79.9		nV/LSB
Digital Full Scale L = FIR Length	FIR length = 100		±1,000,000		LSB
ADC Gain Error vs. % Power Supply Variation	V_{IN} = 250mV$_{PK}$, 55Hz			120	ppm/%
Current Channel Gain Variation	V_{IN} = 250mV$_{PK}$, 55Hz (Note 3)			90	ppm/%
Input Offset, Preamp Bypassed		-4		+4	mV

Note 2: This relationship describes the nominal behavior of V_{REF} at different temperatures.
Note 3: Guaranteed by design, not production tested.
Note 4: This is a definition, and it is not a measured quantity.

Pin Configuration

```
                  ┌──────────────┐
         INVN  1 ─┤              ├─ 10  ININ
                  │              │
         INVP  2 ─┤              ├─ 9   INIP
                  │  MAX71071/   │
         TEST  3 ─┤  MAX71071H   ├─ 8   V_SS
                  │              │
           SN  4 ─┤              ├─ 7   V_CC
                  │              │
           SP  5 ─┤              ├─ 6   N.C.
                  └──────────────┘
                       μMAX
```

Pin Description

PIN	NAME	FUNCTION
1	INVN	Voltage Channel Negative Input
2	INVP	Voltage Channel Positive Input
3	TEST	Test Mode Enable. Must be grounded in normal operation.
4	SN	Transformer Negative
5	SP	Transformer Positive
6	N.C.	Not Connected
7	V_{CC}	Power Bypass. Connect 1μF capacitor to ground.
8	V_{SS}	Ground. The 1μF capacitor from V_{CC} to V_{SS} must be connected to this pin.
9	INIP	Current Channel Positive Input
10	ININ	Current Channel Negative Input

Detailed Description

The MAX71071/MAX71071H are dual-channel isolated metrology analog-to-digital converters (ADCs) that are compatible with MAX71xxx hosts. The device digitizes a current signal from a shunt type current sensor and/or a voltage signal from a resistor-divider. The two input channels of the MAX71071/MAX71071H are identical except that the voltage channel contains an option to bypass the preamp.

The device continuously sends ADC data to the host. The host can request the device to return certain ancillary data such as temperature monitor output. The MAX71071/MAX71071H communicate with the host through a pulse transformer to provide isolation from the high-voltage power domain.

The MAX71071/MAX71071H include a rectifier, two staring preamp/ADC channels, bandgap, temperature monitor, PLL, and BIAS block.

Rectifier

The active rectifier in the device rectifies the power pulses received from the host through the isolation transformer to create the V_{CC} voltage. The block also has the drivers that drive the data bits out of the MAX71071/MAX71071H and through the transformer.

ISO Interface

The isolated interface block receives the incoming data from the host and transmits data back to the host through the isolation transformer.

Preamp

The preamp is a low-noise differential amplifier. The INP and INN pins are the differential inputs to the preamp. It has three gain settings (4x, 9x, and 14x) The gain is controlled by the two preamp gain control bits: 00 is 4x, 01 is 9x, and 10 is 14x. The inputs are V_{SS} referenced, and the output of the preamp connects directly to the ADC.

Bandgap

The device includes an on-chip precision bandgap voltage reference that incorporates autozero techniques as well as production trims to minimize errors caused by component mismatch and drift. The result is a voltage output with a predictable temperature coefficient that is compensated in firmware by the host.

Temperature Monitor

The temperature monitor block does a temperature and a supply measurement whenever the MAX71071/MAX71071H receives an instruction from a MAX71xxx host requesting for STEMP or BSENSE. This request causes the MAX71071/MAX71071H to return STEMP or BSENSE from the previous measurement and to initiate a new measurement for both.

PLL

The PLL locks to the incoming power pulses to create reference clocks for the ADC and communications interface to the host.

Pulse IO

The pulse IO block in the MAX71071/MAX71071H receives the incoming data from the MAX71xxx host and transmits the data back to the host. The integrated output is applied to the input of a comparator, and the comparator output is captured by a flip-flop at the end of the integration time.

ADC

Maxim Integrated's proven delta-sigma ADC digitizes the voltage and current-sense voltages.

Functional Diagram
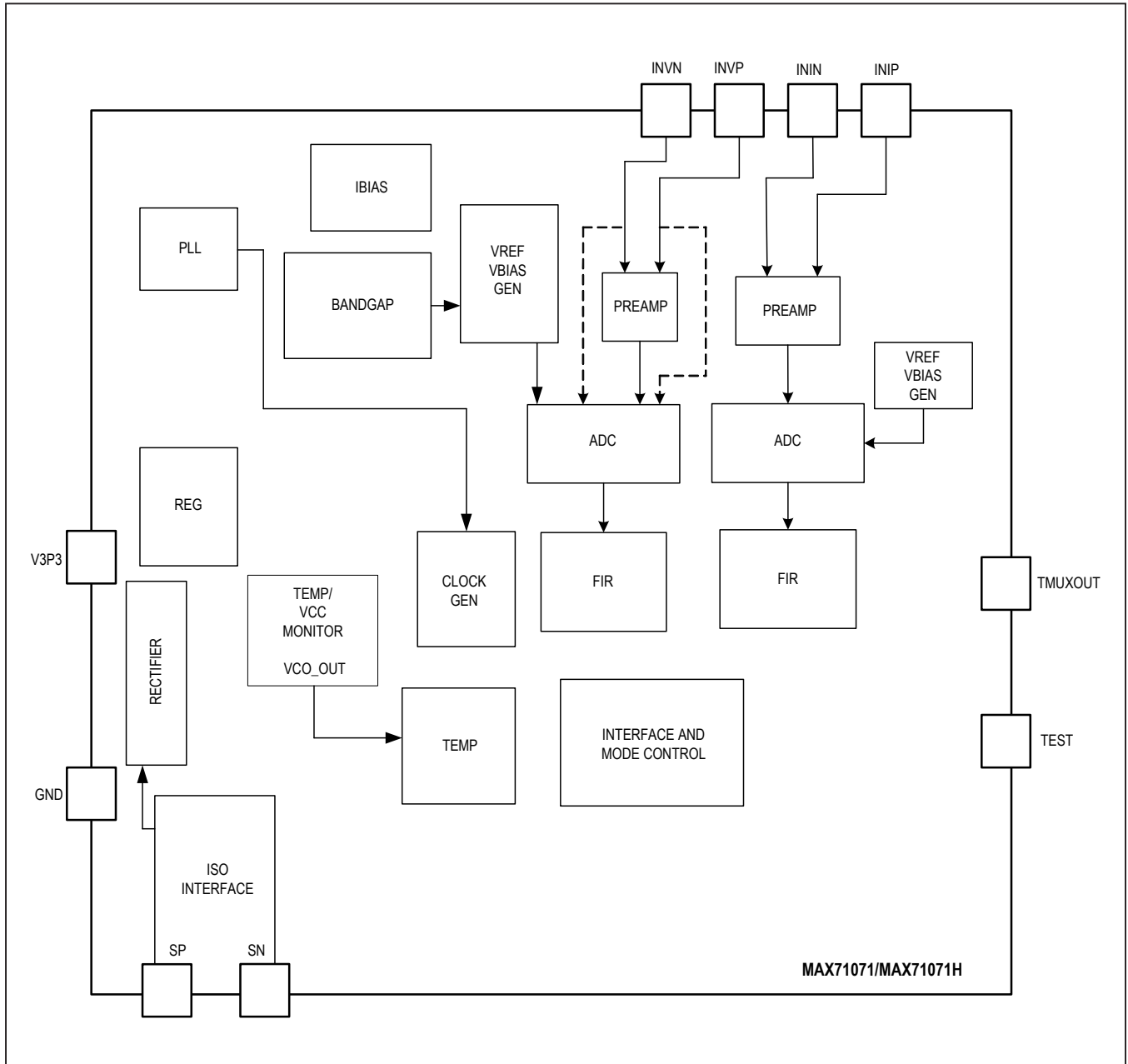
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX71071+	-40°C to +85°C	10 µMAX
MAX71071+T	-40°C to +85°C	10 µMAX
MAX71071H+*	-40°C to +85°C	10 µMAX
MAX71071H+T*	-40°C to +85°C	10 µMAX

+Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

*Future product—contact factory for availability.

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
µMAX	U10+5	**21-0061**	**90-0330**

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/14	Initial release	—
1	1/15	Updated the *Benefits and Features* section	1