## 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 ($\theta_{JA}$)
Multilayer Board .....113.10°C/W
Single-Layer Board.....180°C/W
Junction-to-Case Thermal Resistance ($\theta_{JC}$).....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 |

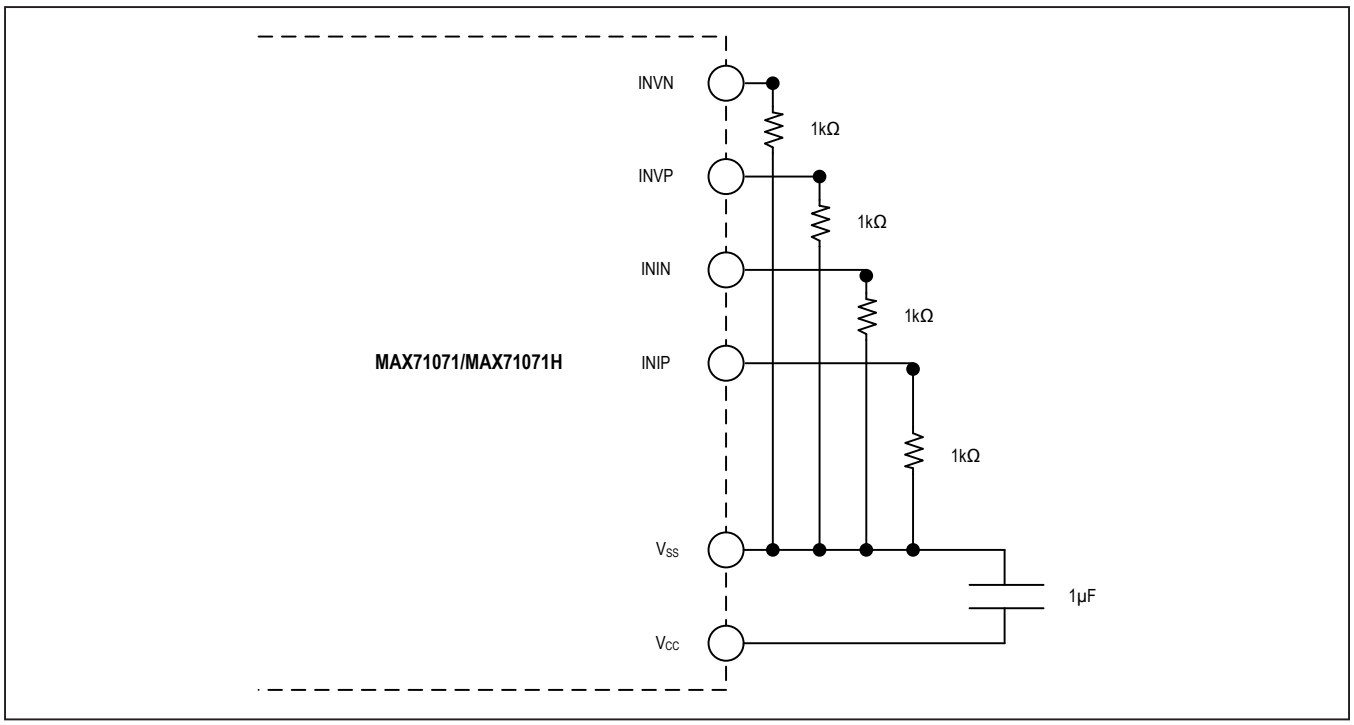



*Figure 1. Recommended External Components Circuit*

## 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 $V_{NOM}(T)$<br>$[(V_{REF}(T) - V_{NOM}(T))/V_{NOM}(T)] \times [10^6/62]$ | (Note 3) | | 0 | | ppm/°C |
| **IF TRIMBGB NOT AVAILABLE (TRIMBGB = 00)** | | | | | |
| $V_{REF}(T)$ Deviation from $V_{NOM}(T)$<br>$[(V_{REF}(T) - V_{NOM}(T))/V_{NOM}(T)] \times [10^6/62]$ | (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 |
| 250$mV_{PK}$/Preamp Gain, Preamp Gain = 4x, 9x, 14x | $V_{IN}$ = 65Hz, 64kpts FFT, Blackman-Harris window | | 85 | | dB |

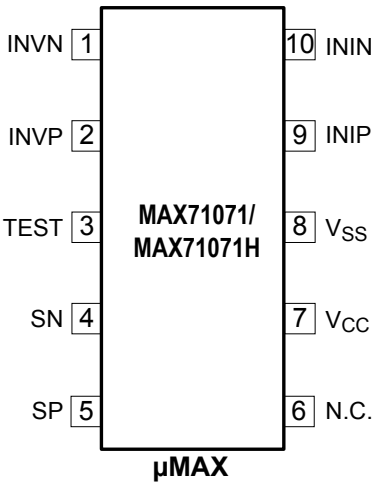
## Performance Specifications (continued)

(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




## 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.

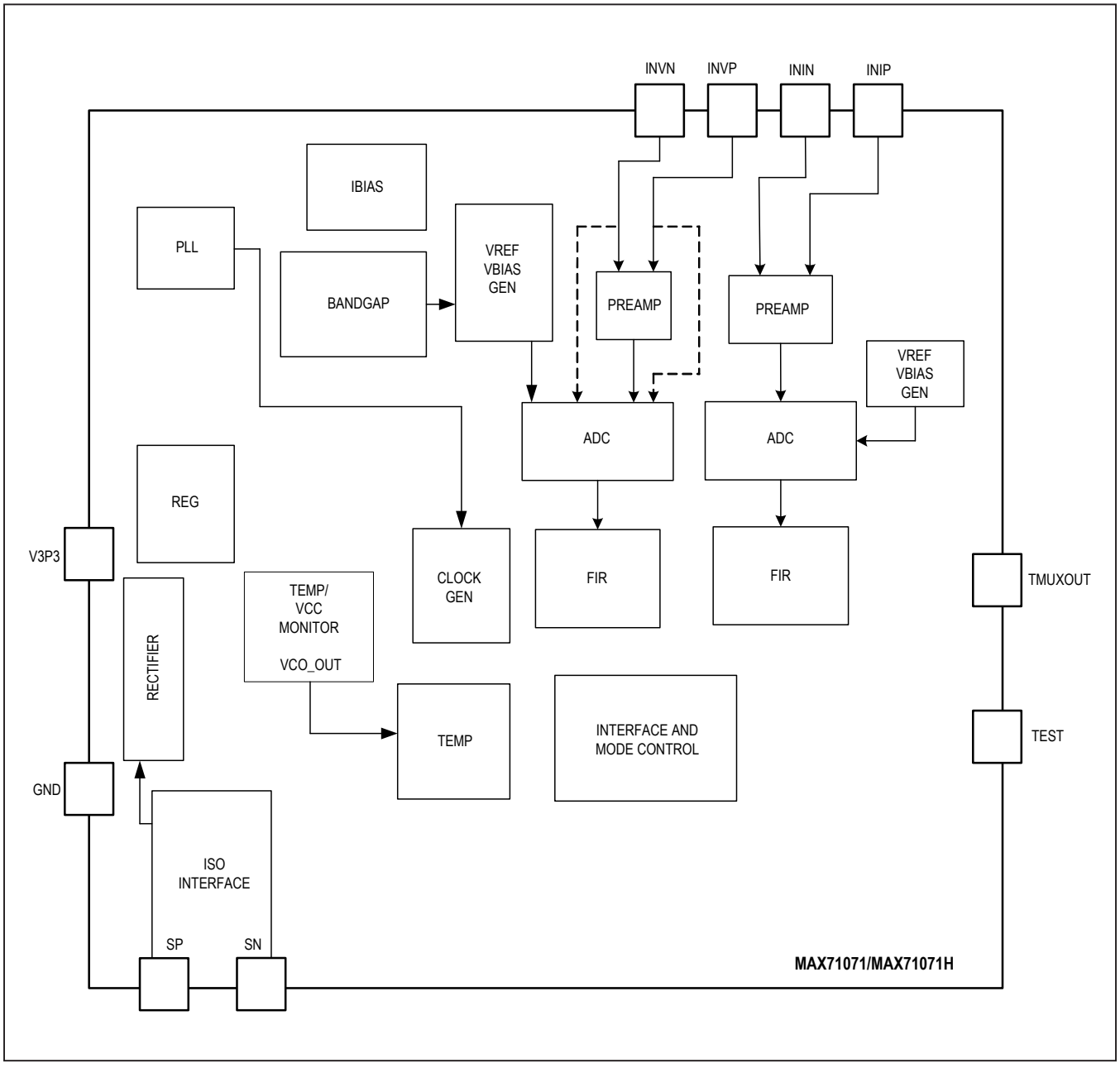
### Pulse IO

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 |

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