1250 Northland Drive
Mendota Heights, MN 55120 Suite 110
FRN: 0017129677
Grantee Code: VUR

Modular Sensor Radio
Design in Specification Manual - Preliminary

The purpose of this document is to provide all the information that a hardware engineer might need to design a PCB that incorporates the Modular Sensor Radio (MSR) product. The document includes both mechanical and electrical specifications.

FCC Statements:

Caution Statement:
The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Compliance Statement:

Healthsense, Inc.
1250 Northland Drive
Mendota Heights, MN 55120
Phone:800-576-1779 / FAX: 800-952-1329
EUT: Modular Sensor Radio
FCC ID: VUR100030

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference, and, 2) This device must accept any interference received including interference that may cause undesired operation.

Class B Product Compliance Statement:
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Castellation Connection Descriptions

Power Group

Ground

Pins 1, 11, 22, 46
Signal Name: GND

Battery Input

Pin 2
Signal Name: VBAT

This pin provides the power source for the MSR. The pin is usually connected directly to a 3.0 volt lithium cell, but many other power sources are possible. The battery should have a supercap or Apogee power controller across the terminals to mitigate the effects of current spikes on the supply.

V max 3.6V
V nom 3.0V
V min URB dependent
I max 500mA

The maximum current is URB dependent. The number given will accommodate all future designs.

Switched Vcc Out

Pin 56
Signal Name: SWVCC

This pin provides power back to the motherboard. The purpose of the pin is to allow the designer to make sure that the logic on the motherboard is compatible with the MSR. This will eliminate voltage mismatches and the possibility of excessive current flows through input protection diodes. In some of the MSRs, this voltage is

boosted to 3.3V from the battery voltage, while on other designs it is simply the battery voltage.
This voltage is not available when the MSR processor goes to sleep. A motherboard design that requires a constant power source must provide that source externally to the MSR. The design must also verify that the logic levels between the host and the MSR are compatible under all circumstances.

Vout Vbat or 3.3V, whichever is greater
I max 100mA

Wake

Pin: 3
Signal Name: WAKE

The wake pin is active high and is used to control a low true shut down pin on any host logic or power. The wake pin is used to control the Vout power source in several of the MSR designs. The host design will most likely use either Wake or Switched Vcc, but not both. It will always go inactive prior to the removal of Vout however Wake will go active before Vout has stabilized. The timing for this is MSR specific, and the designer must allow for the possibility that the wake to Vout timing may be several milliseconds..

The pin will drive high, but not drive low. The host must provide a pull down that is sufficient to keep the host logic inactive during a power down.

Vout High Vbat or 3.3V, whichever is higher
Vout Low 0V
Iout High 100uA
Iout Low 0uA

Battery Test

Pin: 16
Signal name: BT

This pin is connected to the A/D converter on the MSR. It is able to measure voltages in the range of 0 to 1.5V. The micro on the MSR will periodically measure the voltage and report the results back to a host. The purpose of an external measurement is to allow for cases where the Vbat voltage is not the actual battery voltage.

Vin High 1.5V
Vin Low 0V
Rin > 100K

Battery Test Enable

Pin: 15
Signal Name: BTE

This pin is used to enable any external battery test logic. The purpose of the pin is to reduce current drain that might occur in the resistor divider networks that may be required to bring the battery voltage into the range acceptable to the A/D converter. This pin is active high and will go active 100uS prior to taking a battery reading on the BT signal input.

Vout High SWVCC
Vout Low 0V
Iout High 100uA
Iout Low 0uA

Indicator Group

LED

Pin: 13
Signal Name: LED

This pin is a high drive for an LED. The drive voltage will vary with the fall of Vbat, but the software will compensate with longer on times.

Vout High Vbat
Vout Low 0V
Iout High 5mA
Iout Low 10uA

Buzzer

Pin: 14
Signal Name: BUZZ

This pin is a high drive for a buzzer or mini speaker. The drive voltage will vary with the fall of Vbat, but the software will compensate with longer on times. The buzzer voltage is modulated at 1500Hz to produce a tone. Later version may be configurable as to the tone frequency.

Vout High Vbat
Vout Low 0V
Iout High 5mA
Iout Low 10uA

Push Button

Pin: 12
Signal name: PB

This pin is connected to an input pin that has a small current source. The push button will be normally open with a connection to ground. The state of the push button is sampled, not continuously monitored with an interrupt.

I sense 3uA

Serial Port Group

The serial port is provided so that a design that needs more complex messaging or control can be easily coupled into the MSR design. It is configured for 8 bit data, a single stop bit and no parity. The default baud rate is 50Kbps. An RS232 port can be created by adding level converters to these signals.

The serial port also uses LIN2 and LOUT2 for the wake up protocol between the MSR and the host. This function is enabled when the serial port is part of the product design. The pins cannot be shared for another use while the serial port is inactive. The wake up can be initiated from either side by taking the signal line high. Serial traffic can begin to flow once both signal are high. The MSR and host will negotiate across the serial lines when a power down is required.

Serial Transmit

Pin: 9
Signal Name: TX

This pin is connected to the serial port output. The serial port will not normally transmit a character till a start bit has been seen on the receive input. The serial port is inactive when WAKE is false, and the signal levels must be taken low.

Vout High Vbat
Vout Low 0V

Iout High 10uA
Iout Low 10uA

Serial Receive
Pin: 10
Signal name: RX

This pin is connected to the serial port input. It is configured for 8 bit data, a single stop bit and no parity. The default baud rate is 50Kbps..

Vin HIGH MAX Vbat
Vin HIGH MIN 2.0V

Sample and Control Group

Analog to Digital Sample
Pin 4
Signal Name: AD1

The pin is connected to a low speed A/D converter.

Vin High 1.5V
Vin Low 0V
Rin > 100K

Logic Input
Pin 5 and 6
Signal Name: LIN1, LIN2

The two pins operate independently. They will cause an interrupt to the MSR processor when the state changes. This interrupt will cause a wake up if the processor is asleep. The change of state on the pin is reported to the host.

Vin High Max Vbat
Vin Low 0V

Logic Output
Pin: 7 and 8
Signal Name: LOUT1, LOUT2

The two pins operate independently. The host is able to set the state of the pin. The pin state is maintained through a power down cycle.

Vout High Vbat
Vout Low 0V
Iout High 10uA
Iout Low 10uA

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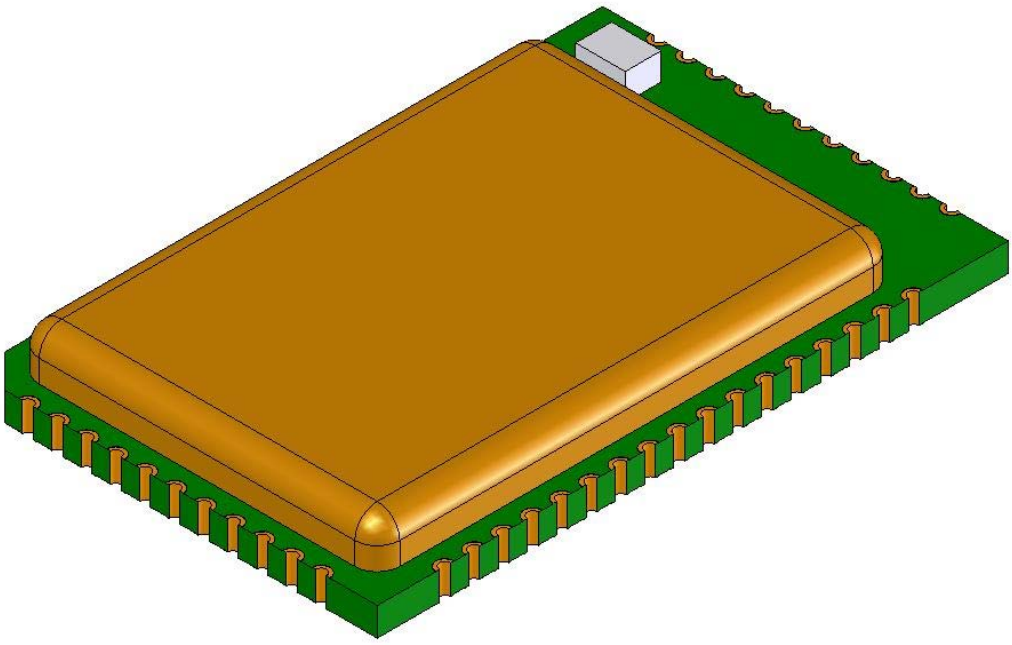
MSR Mechanical Details

This section provides the mechanical details for the MSR design. There are two physical sizes specified. The larger one accommodates the radio designs that have multiple IC's, especially a power amplified on the RF output. The smaller one is used for the newer single chip radio designs where a 10mW power at the antenna is sufficient for network connectivity.

Currently only the larger module size is used and it is available in both an 802.15.4, and an 802.11 configuration.

The following is a picture of the module.



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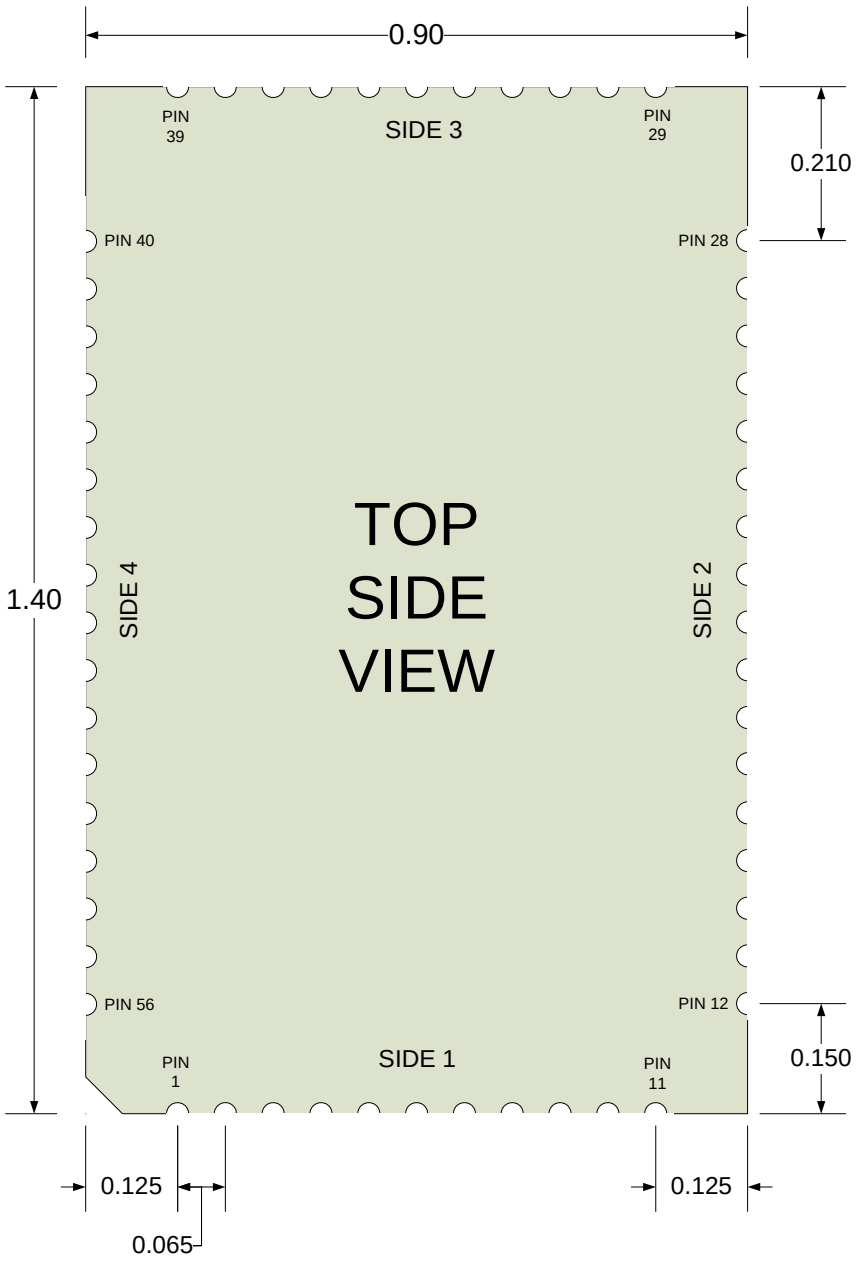
Full Size Radio Module

This diagram shows the placement of the pins on the module as well as the overall dimensions. This module size is implemented in both a 802.15.4, and an 802.11 configuration.



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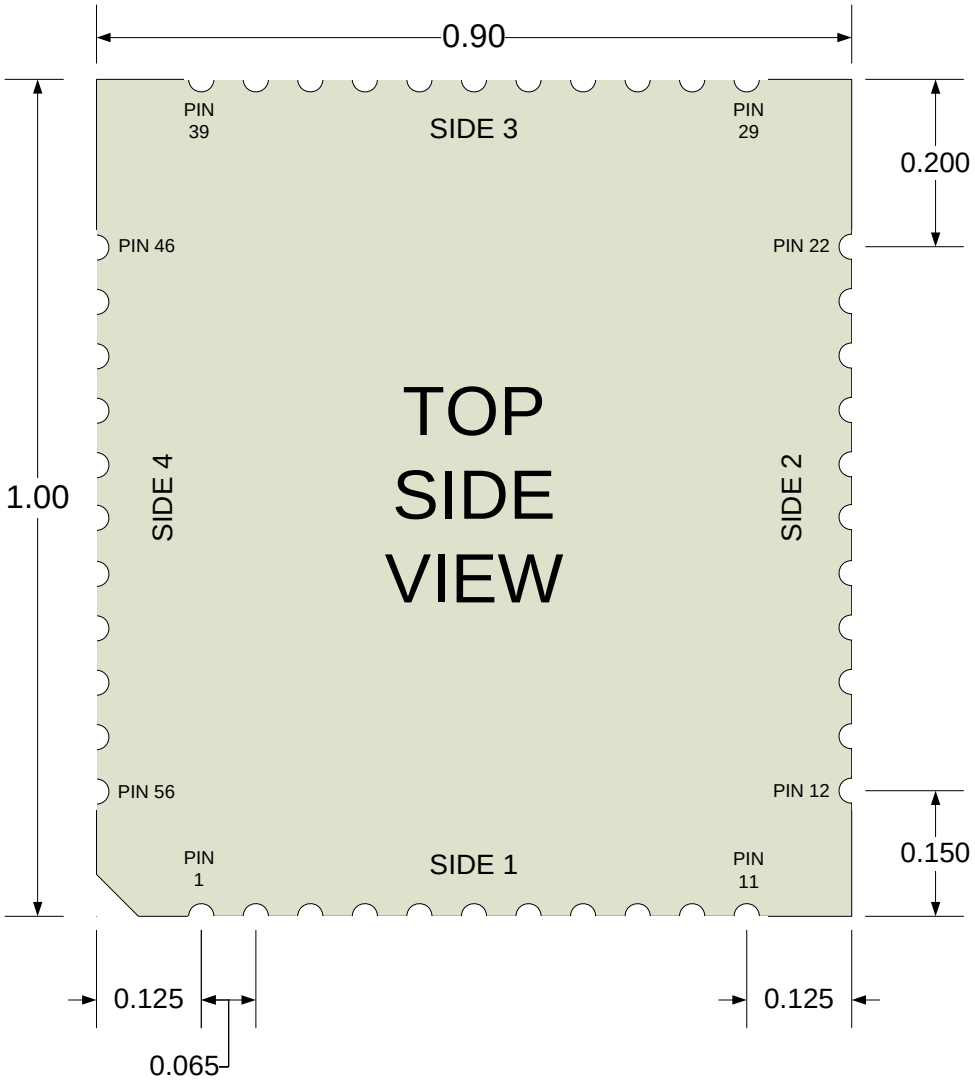
Smaller Radio Module

This diagram shows the placement of the pins on the module as well as the overall dimensions. This module is not currently being used. It is defined as a path forward when a smaller module is feasible.



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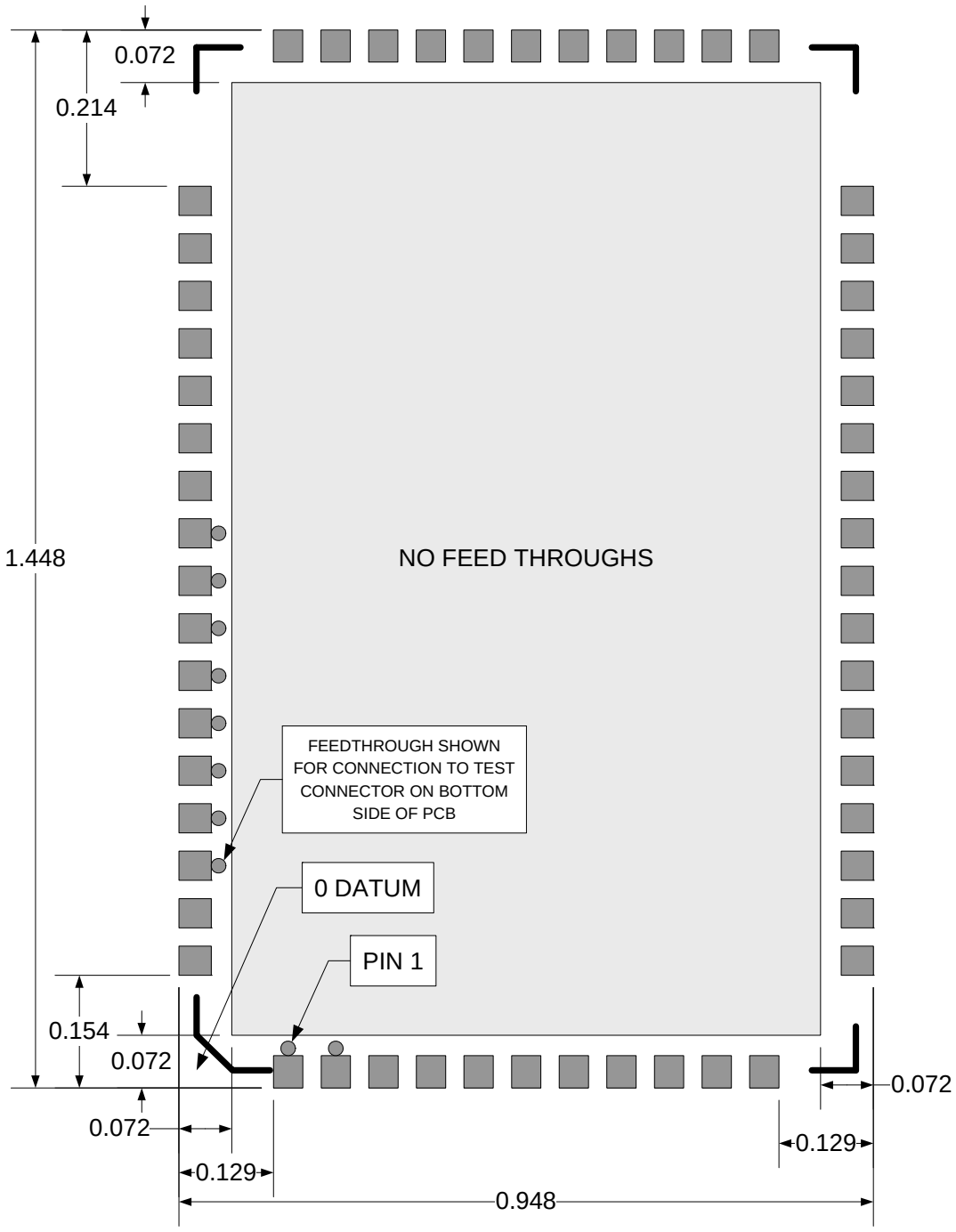
PCB Top Side Layout

This layout shows all of the pins for the larger module size. In most modules, not all pins will be used. It is recommended that unused pads not be implemented on the motherboard.



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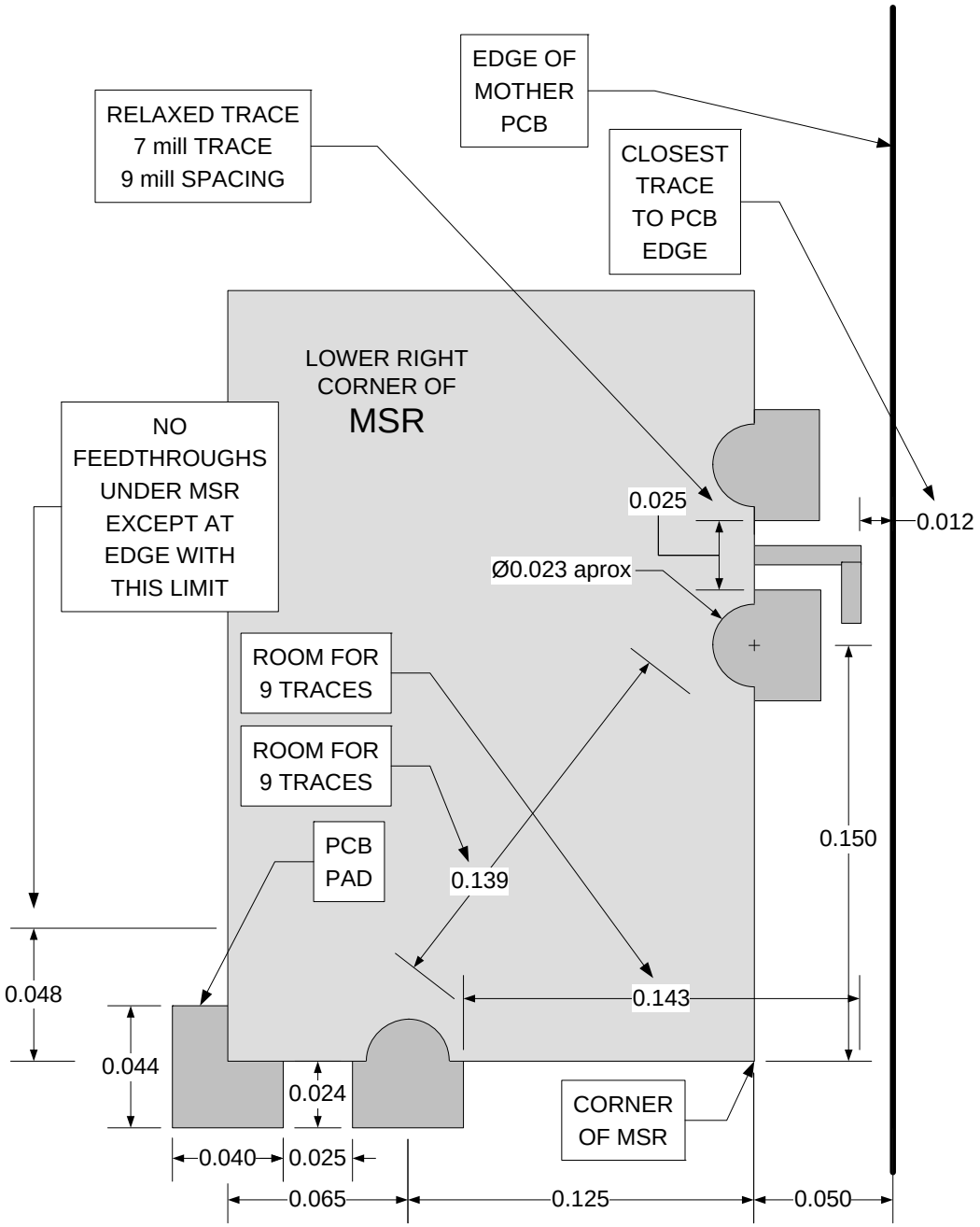
PCB Pad Detail

This drawing shows the detail for the motherboard PCB pads. This diagram also shows how traces can be routed between the pads and out through the corners.



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ATE Test Point Detail

The next diagram shows the placement of the test connectors. This will go on the back side of the PCB. The view is from the top side of the PCB. The first connector goes to a ribbon cable so that a bench test rig can be constructed. The placement of this connector is not critical. The ATE test point specification provides a consistent placement for the test pins and the radio antenna when constructing the ATE. ***The placement of these pads with respect to the 0 DATUM is critical if a common ATE configuration is desired.*** The test connector is a Hirose FH12A-10S-0.5SH and can be purchased at Digikey. The Digikey catalog number is HFK10CT-ND. The test connector is only attached for software debug.