MachTach

User's Guide

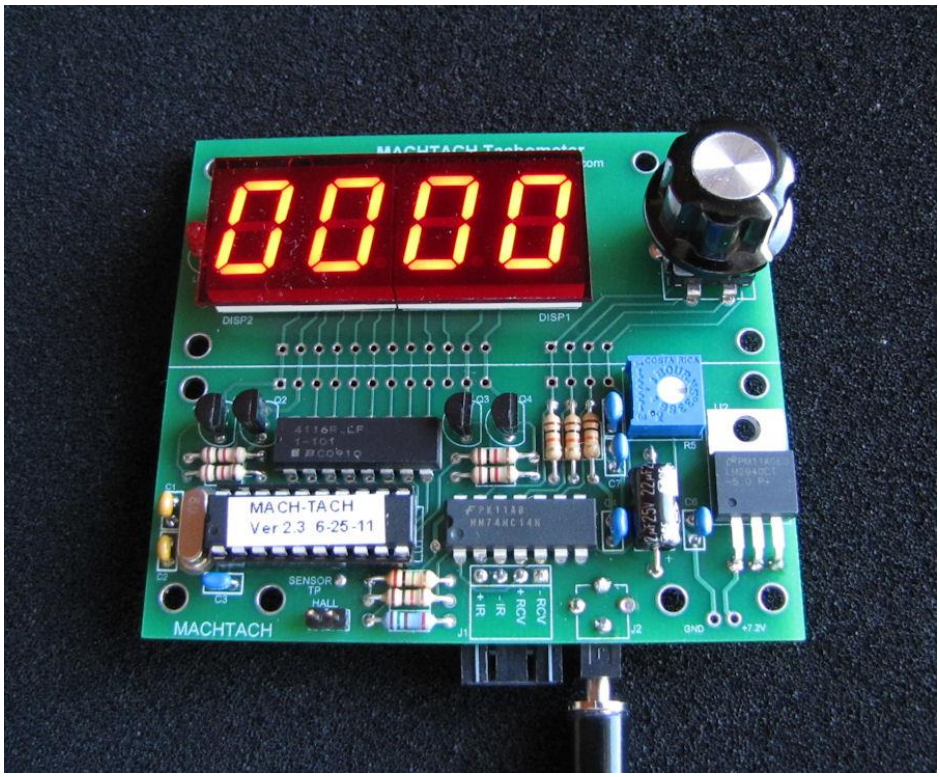
Machine Tachometer

for Rev 2.3/2.4/2.5 PCBs
Version 2.3 6-14-2014
http://www.machtach.com

Contents

What's a MachTach?

The MachTach is a machine tachometer which is used to display the speed of any machine tool. Machine speed is important because it determines how quickly you may remove material, the surface finish, and tool life. Speed or surface feet per minute should be chosen based on the material, cutting tools to be used, and surface finish desired. The MachTach is capable of displaying either revolutions per minute (RPM), surface feet per minute (SFM), or Surface Meters per Minute (SMM) on the metric version. It requires only a simple sensor to make its measurements.



Features:

Four Modes of Operation
- Revolutions per Minute mode - 0-9999 RPM
- Surface Feet per Minute mode - 0-9999 SFM
- Surface Meters per Minute (Metric Version) - 0-9999 SMM
- Diameter Entry Mode for SFM -
  - 0.01ò ï 99.99ò (0.01ò increments)
  - 1 - 999 (1 mm increments) metric version
- Slot Entry Mode - You can program any number of encoder slots/targets/magnets 1-60

1 second display update (2 second at slow RPMs)
Rotary encoder knob w/ push action switch for mode change and slot/diameter entry
The MachTach includes a socketed PIC microcontroller so it can be easily updated by replacing IC.
Four Module Configurations
- 3.3" x 2.9" x 0.5ò Full Size Module that can be mounted in your enclosure or Serpac SR031
- 3.3" x 1.45" x 1.0ò Half Size Module that can be mounted in your enclosure
- 3.3ò x 1.45ò x 0.78ò Extra Compact Half Size Module using shorter spacers
- 4.375ò x 3.25ò x 0.9ò Plastic Enclosure with laminated front panel

Slot and Diameter values are saved between sessions so they do not need to be re-entered
Power: 7-12V at ~ 200 ma

Example Installations

The MachTach is designed for the home shop. Its printed circuit board can be installed in a variety of machines using your own panel or enclosure. The MachTach also fits inside a Serpac SR031 plastic enclosure. The MachTach can be attached to any machine. Because of its small size, it is easy to mount it inside of your machine. Example internal installations are shown below. For restricted spaces the module can be cut in half and folded. For very tight installations, the display board and controller may be located in different spots within your machine and connected with wires or a ribbon cable.

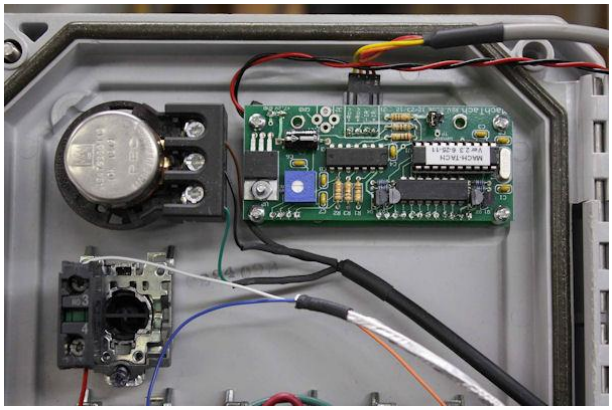
Custom Installation on a Metal Lathe

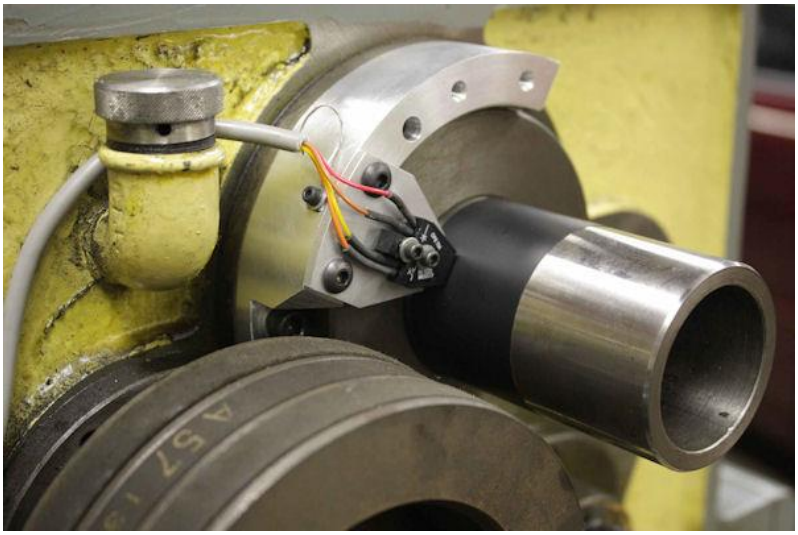
Installation on a Wood Lathe

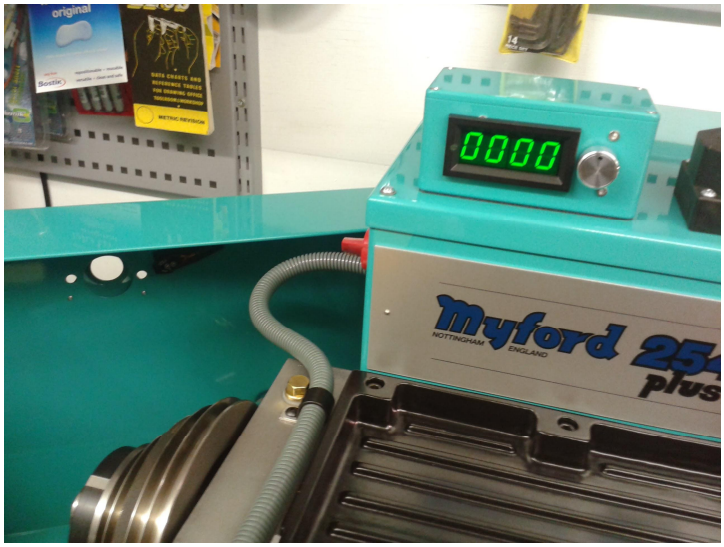
Milling Machine

Drill Press Installation


RPM / SFM
MODE / DIA
START
EMERGENCY STOP
OFF ON
STOP



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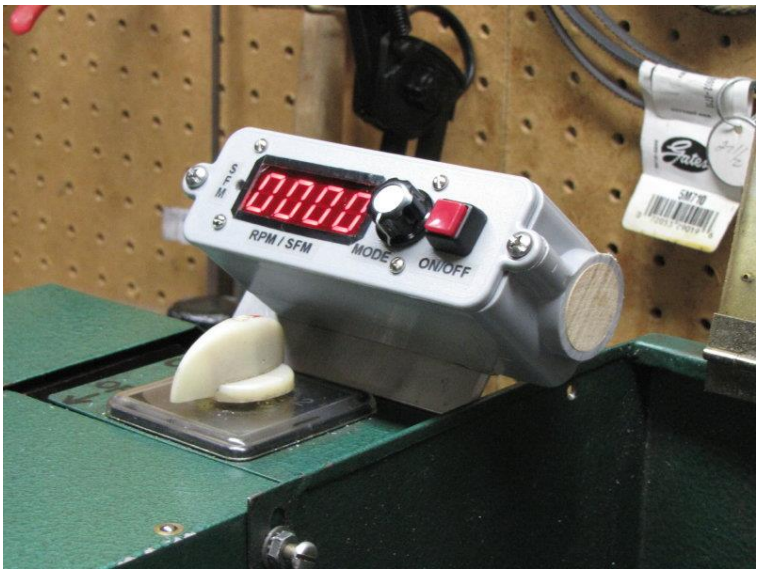

0000
RPM / SFM
MODE
ON/OFF

How to Use a MachTach

The MachTach powers up in RPM mode - turning the knob does nothing in this mode. Pushing the encoder knob switches back and forth between RPM and SFM modes. An LED at the left of the display indicates SFM mode In SFM mode, turning the knob automatically switches to diameter entry mode allowing the diameter 0.01" - 99.99" to be entered. Diameter entry mode exits automatically as soon as you stop turning the knob and after a 1 second delay. Diameter mode exits back to SFM mode. In any mode, holding the knob in for greater than 5 seconds, puts the MachTach into slot entry mode. In slot entry mode, you can enter the number of slots 1-60 by turning the knob. The slot number is used to calculate RPM. You exit the slot mode by pushing the knob once. The slot entry mode is designed to not be entered easily since it should be needed only once when the MachTach is initially set up. Slot entry and diameter entry modes enter and exit differently. With slot entry mode, the user has to push the knob and hold it to enter the mode and again to confirm the number of slots which is permanently saved to EEPROM. With diameter entry mode, the user is able to turn the knob while the MachTach is displaying SFM without having to click to enter. This allows the user to continuously change the diameter on the fly by just turning the knob. When you stop turning the knob, it automatically switches to displaying SFM again. The diameter is saved each time you stop turning the knob and persists between power ups of the MachTach.

Setting the Slot Number

To set the initial number of slots, magnets, or reflective patches for your encoder, push in on the knob and hold it for greater than 5 seconds which will put it in slot entry mode. The center two digits will light up with a number like ñ01ò displayed and with no decimal place. Turn the knob to set the number of slots/magnets/targets to 1-60. Push the knob again to return. This will only need to be done once. The value you entered is stored permanently until you enter a new number. This number is not lost when the MachTach is powered down. The slot number is used to for all calculations.

Using the RPM Mode

The MachTach defaults to RPM mode when powered up. The SFM LED to the left of the display is off when in the RPM mode. In RPM mode, turning the knob will do nothing because the diameter does not matter for RPM calculations. Pressing the knob once will switch to SFM mode. Pressing the knob again will switch back to RPM mode.

Using the SFM Mode

To enter SFM mode, press the knob once and the SFM LED to the left of the display will be lit. In SFM display mode, turning the knob will set the diameter you want. Once you start turning the knob, the display will automatically switch to 4 digits with a decimal point (XX.XX) which will allow you to set 0.01" through 99.99" as the diameter. Stop turning the knob and the display will automatically revert to SFM mode. Pushing the knob again will return to the RPM display mode which will be indicated by the SFM LED going out. In diameter entry mode turning the knob quickly will increase or decrease the diameter quickly while turning it slowly will change the diameter by hundredths of inches.

You may enter the diameter of your work for lathes and the diameter of your milling tool for milling machines. Surface feet per minute calculations work the same whether the work is turning or the tool is turning.

Slot Entry Mode

Pressing and holding the knob in for 5 seconds will enter the Slot Entry mode. This mode should only be needed once when you first set up your MachTach. Slot entry mode allows you to enter a number 01-60

which is the number of slots on your IR encoder wheel, or the number of magnets used with your Hall Effect sensor, or the number of black and white patches on your black target when using IR reflective sensors. The MachTach has not been tested with inductive type sensors but it should work. You would use slot mode to enter the number of gear teeth.

Using an Encoder Strip or Reflective Material

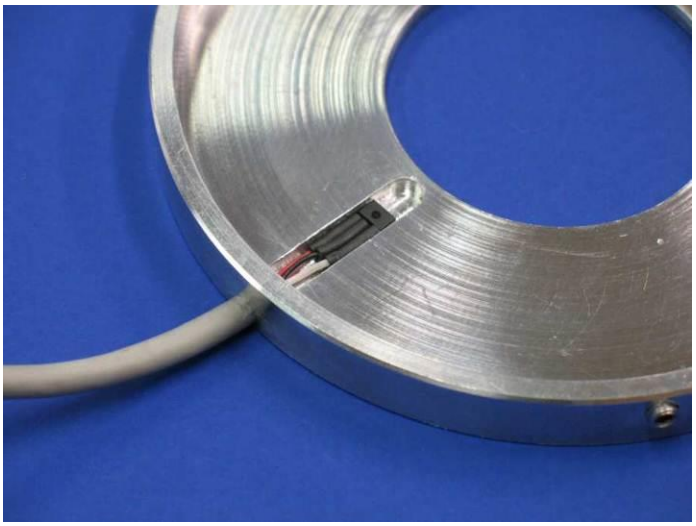
The MachTach is supplied with reflective material. The reflective material can be cut into patches and attached to almost any rotating object to be used as a target for the reflective IR sensor. The reflective material should be attached to something with a dark background. Once you install the reflective patches, count the number of reflective patches and enter that number into the slot entry mode of the MachTach. Mount the sensor close (about .15ò-.20ò) and you will be able to measure RPM and SFM. The patches must be mounted with uniform spacing otherwise the stability of the RPM display will be affected.

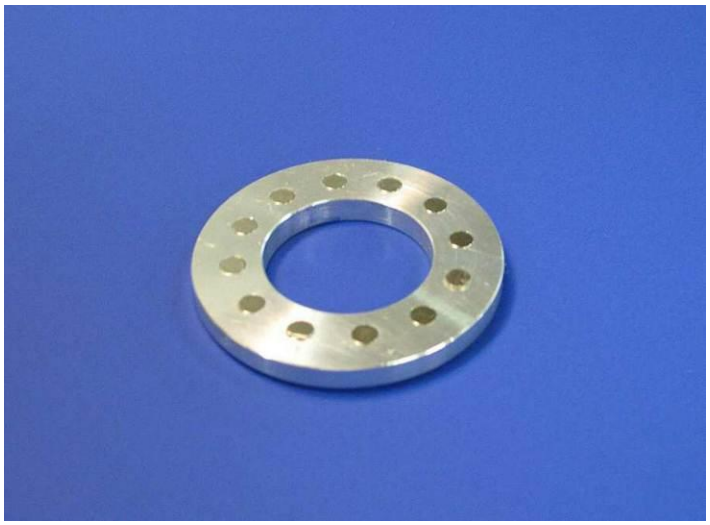
Using IR Interrupter Modules

The MachTach also works with IR Interrupter modules with slotted or holed encoder wheels. The setup is similar to the reflective modules. Enter the number of holes or slots into the MachTach.

Using Hall Effect Sensors

The MachTach also works with Hall Effect sensors. If you make a cable and plan to use this sensor, install a jumper at the header labeled HALL. This will supply +5V to the sensor instead of the current limited voltage used for the IR LED. DO NOT use the MachTach with an IR type sensor with the HALL jumper in place. It will damage the IR LED with over current.





Hall Effect Sensor in its Housing and the Matching Magnet Ring

Hall Effect sensors are good for dirty environments where a reflective or slotted IR sensor might get fouled with oil or debris. The magnets must be mounted with uniform spacing otherwise the stability of the RPM display will be affected.

How the MachTach Calculates RPM and SFM

The MachTach works by measuring the time between sensor pulses. The time is measured in microseconds during a period of 1 second at moderate and fast speeds and over a period of 2 seconds for slow speeds. The MachTach averages the readings which gives a smoother display reading.

RPM is calculated using the following formula:

Revolutions per Minute:

RPM = ((1,000,000 / number of slots) / time between pulses in microseconds) x 60 seconds

Surface feet per minute is calculated using the formulas:

SFM = (RPM x (diameter in tenths of inches) x 314) / 12000 (Rev 2.3)
SFM = (RPM x (diameter in hundredths of inches) x 314) / 120000 (Rev 2.4)
SMM = (RPM x (diameter in millimeters) x 314) / 100000 (Rev 2.4 metric)

Users often wonder what the advantage is of using more than one slot or patch. It would seem like one slot should be enough. One slot or patch is enough but using more slots or patches allows the MachTach to see more pulses at low speeds and to average those pulse times to give a smoother display

The MachTach code is written in C and programmed into a PIC16F690 microprocessor. The MachTach uses two timers, one that measures an accurate 1 or 2 second interval which is used to update the display and to restart the capture process and another timer that measures the time from one rising pulse of the input pulse stream to the next rising pulse. During each 1 second display update interval, the MachTach measures as many pulse durations as it can and keeps track of how many it captured. When the 1 second interval is complete, the MachTach divides the total time of all pulse captures by the total number of pulses captured. This gives it the average pulse period which it uses to calculate the RPM and SFM. One of the tricks the MachTach uses is to scale constants such as 1 second = 1,000,000 microseconds and 314 = PI so that all calculations can be performed with integers instead of floating point numbers. This is important with a lowly 8 bit processor but unnecessary if you are using a more powerful 16 or 32 bit processor.

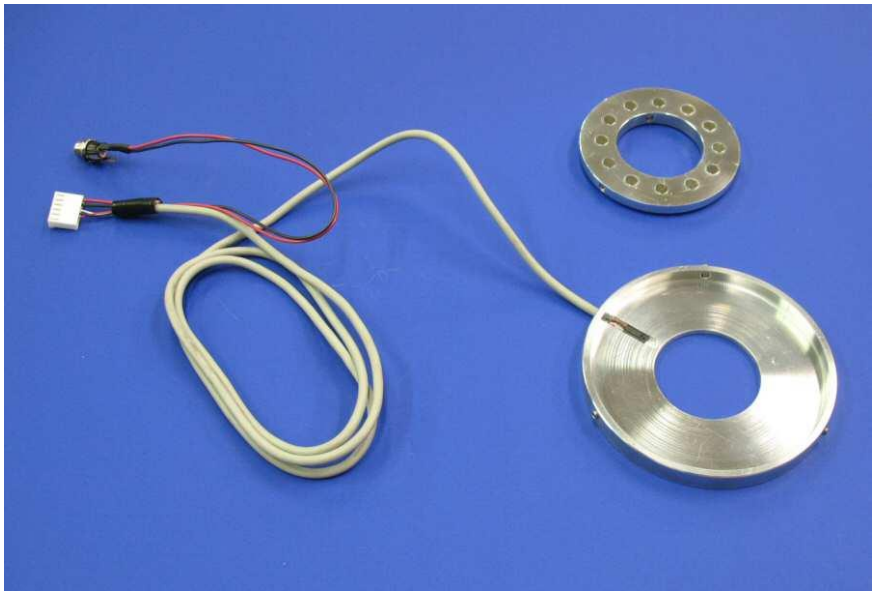
During the endless loop of capturing pulse durations and displaying the result, the MachTach checks if the average pulse duration gets longer than a certain threshold. If it does, it switches from the normal 1 second update to a 2 second capture and update. The threshold is around 100 RPMs. This allows the MachTach to better display low RPMs down to single digits. This was necessary because below 60 RPM and low numbers of slots, there may not be a pulse to measure.

The MachTach uses an optical encoder for user inputs. The MachTach reads both clockwise, counterclockwise, and push button actions of an optical encoder input device. The MachTach debounces the encoder outputs and determines direction. It also determines how fast the knob is turning and how long the knob is pressed. A fast turn of the knob while entering the diameters increases or decreases the numbers quickly and slowly turning the knob moves it slowly. This allows entering a large number like 12.95ò (1295) to go quickly and moving from 0.55 to 0.6 (55 to 60) to move one at a time. Depressing the knob for greater than 5 seconds enters the MachTach into the slot entry mode with one additional click exiting that mode. A quick depress takes you from RPM mode to SFM mode. In SFM mode, turning the knob takes you into diameter entry mode which exits 1 second after you stop turning the knob. It all seems intuitive when you use it but requires a state machine to keep track of modes and how long different entries of the knob switches take.

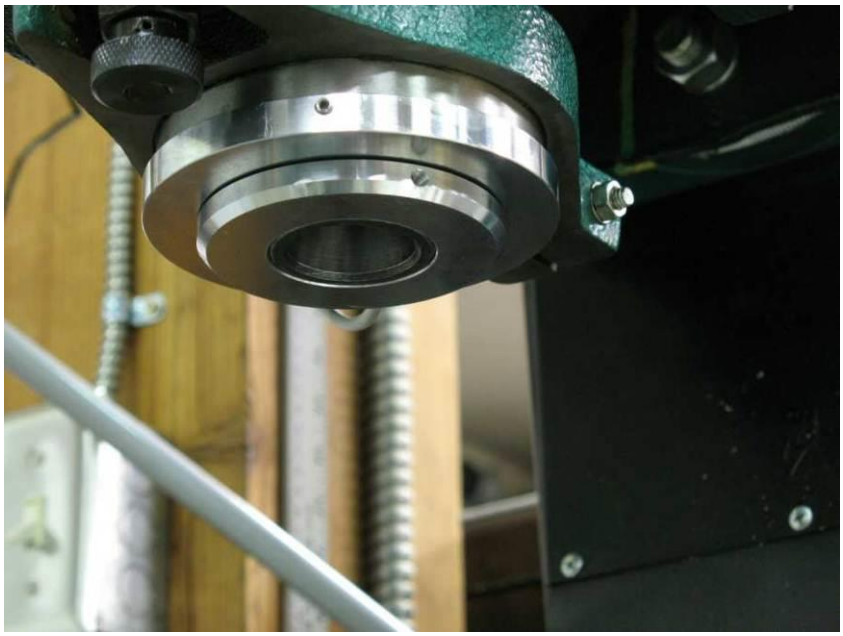
Selecting the Sensor You Will Use

The MachTach will work with many types of sensors including IR reflective, IR slotted Hall Effect, and probably others such as gear tooth proximity sensors. The question is which one is best for your machine. Here are a few suggestions on selecting a sensor:

Hall Effect Sensors are good in a harsh environment where there is dust oil or other liquids. I used a Hall Effect sensor on my milling machine because I wanted to sense the spindle speed which is near where cutting oil or debris might hit it. I still enclosed the sensor in an enclosure which protects it but it would have been more difficult to mount an IR sensor in the same location



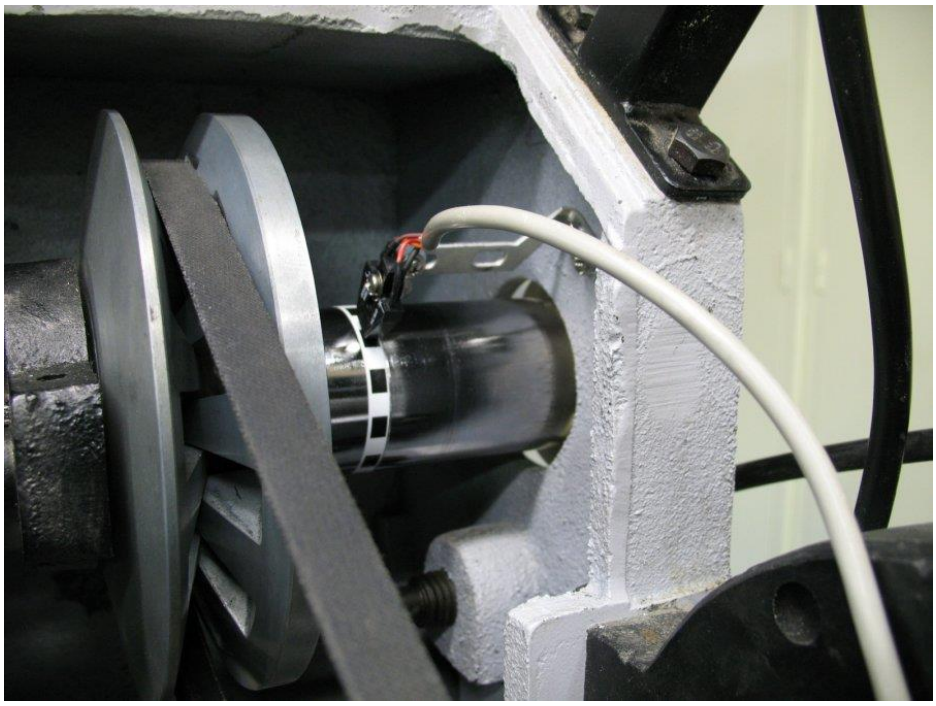
Hall Effect Sensor for Bench Top Milling Machine



Hall Effect Sensor Installed on Bench Top Milling Machine

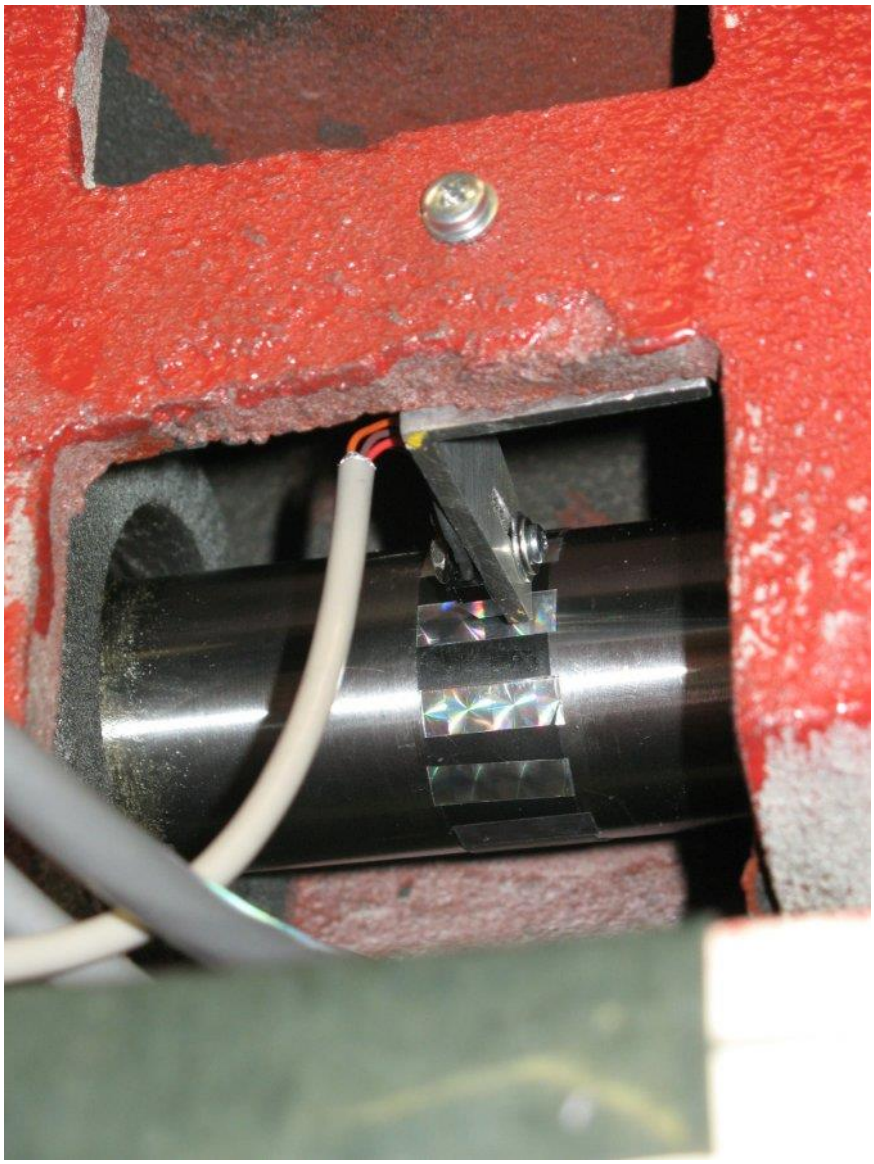
IR Reflective Sensors work well in relatively clean environment where dust will not affect their operation. They are easy to install using a simple bracket and reflective tape on a dark background. I have used IR reflective sensors inside of machine boxes which do not have oil spray or dust entering the enclosure.

The IR sensor works in total darkness because it shines its own IR light on the patch and then picks up the reflection. IR is invisible to the human eye so you can't see if it is working. Sometimes a camera can see the IR light. Try it out.



IR Reflective Sensor Installation inside the Head of a Wood Lathe – Uses L Bracket

Example IR Reflective Bracket Mounting and Tape Patches



IR Reflective Sensor inside of Head of Metal Lathe

Slotted IR Sensors are good where you can drill some small holes in an existing flange or pulley. For example, Iôve seen people drill small holes in the edge of a pulley. Slotted sensors can also be used with a small slotted wheel mounted on the end of a shaft or spindle. Some people add these to a lathe spindle inside the pulley/gear box of the lathe.

Other Sensors ï The MachTach is designed to use any sensor with a transistor output. It is able to supply 5V to the sensor and it can also accept a 0-5V input signal. Almost all sensors fit these requirements. The MachTach is able to deal with noisy signals because it has a noise conditioning front end with hysteresis. There are sensors which can detect gear teeth. As long as the selected sensor has a transistor output that can swing at least 1-4V, it will probably work with the MachTach.

Example of a Gear Sensor Installation

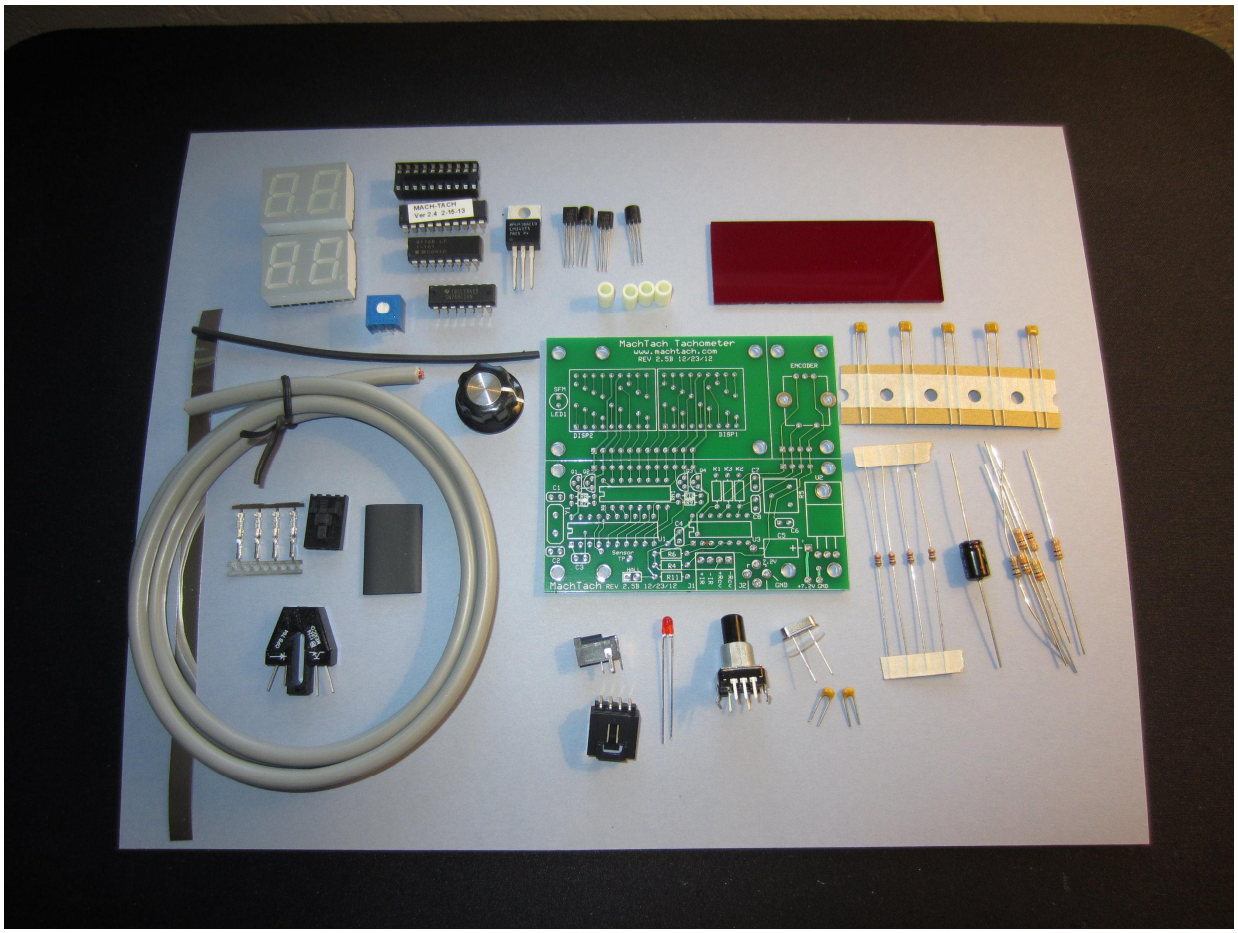
MachTach Lowest Displayable RPM

The number of magnets, slots, or patches determines the lowest speed displayable on the MachTach. The MachTach does not use pulse counting, it measures time between pulses and it waits as long as 2 seconds for a pulse. Because the MachTach measures time between pulses, it must see at least 1 set of encoder targets within 2 seconds or it will display zero. 6 magnets, slots, or patches will give you a lowest speed of 5 RPM. 12 magnets will give you a lowest speed of 2-3 RPM. The Following table summarizes the lowest speed possible:

Magnets/Slots/Patches	Lowest RPM Displayable
1	30
2	15
4	7
6	5
12	2
30	1

The number of slots/patches/magnets does not increase accuracy. It merely determines the slowest speed that can be measured. MachTach always displays to the nearest 1 RPM. Sometimes people will notice jitter in the measurement of a few RPMs. This can be caused by uneven spacing of the strips.

This photo shows all the parts in the MachTach Kit including LED Plastic, cable and sensor.



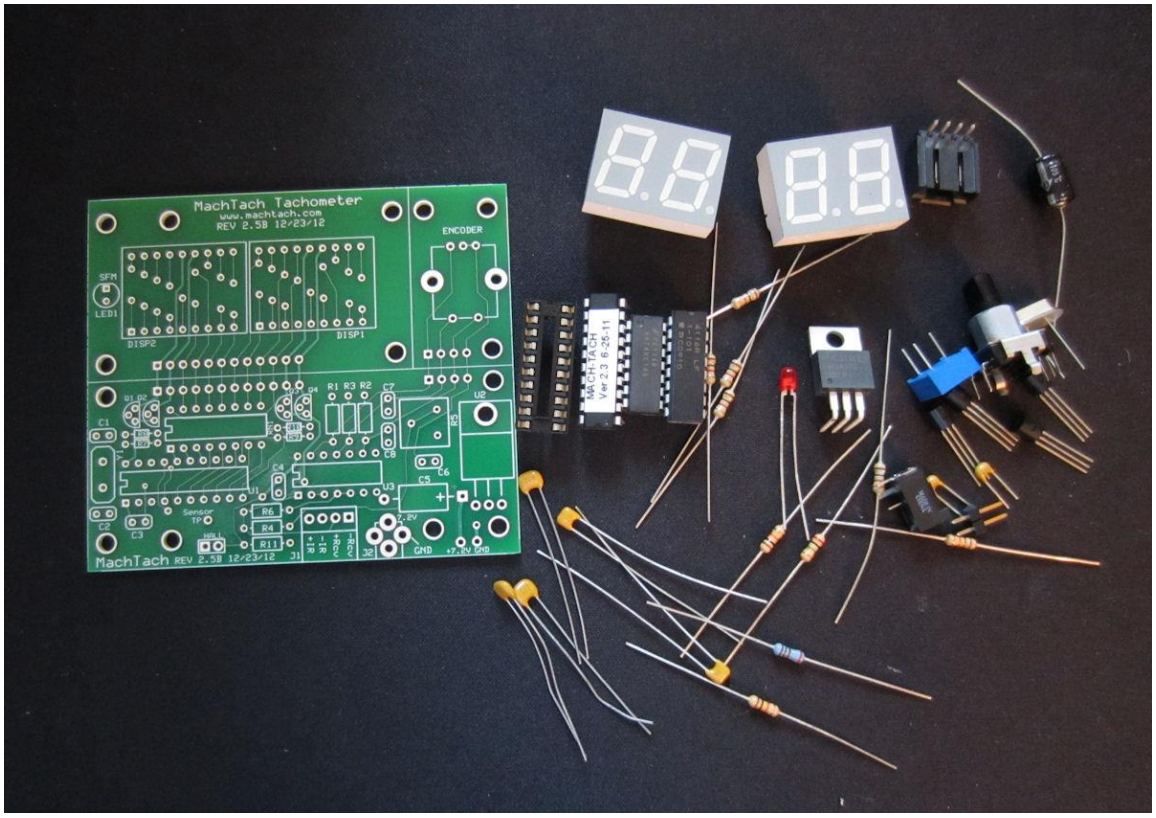
Assembling the MachTach

MachTach versions 2.3, 2.4, and 2.5 are very similar. Versions 2.3 and 2.4 corrected minor PC Board layout issues and version 2.5 was the first version with silkscreened and solder mask PC Board. All three versions use the same V2.5 MachTach IC. The complete kits include all parts needed to build a MachTach including the cable, connectors and sensor. The only things not included are an enclosure and a wall transformer which are available as options. We made these items optional for people that want to install their MachTach inside their machine tool or want to use their own power source.

To assemble the MachTach PC board you will need the following tools:

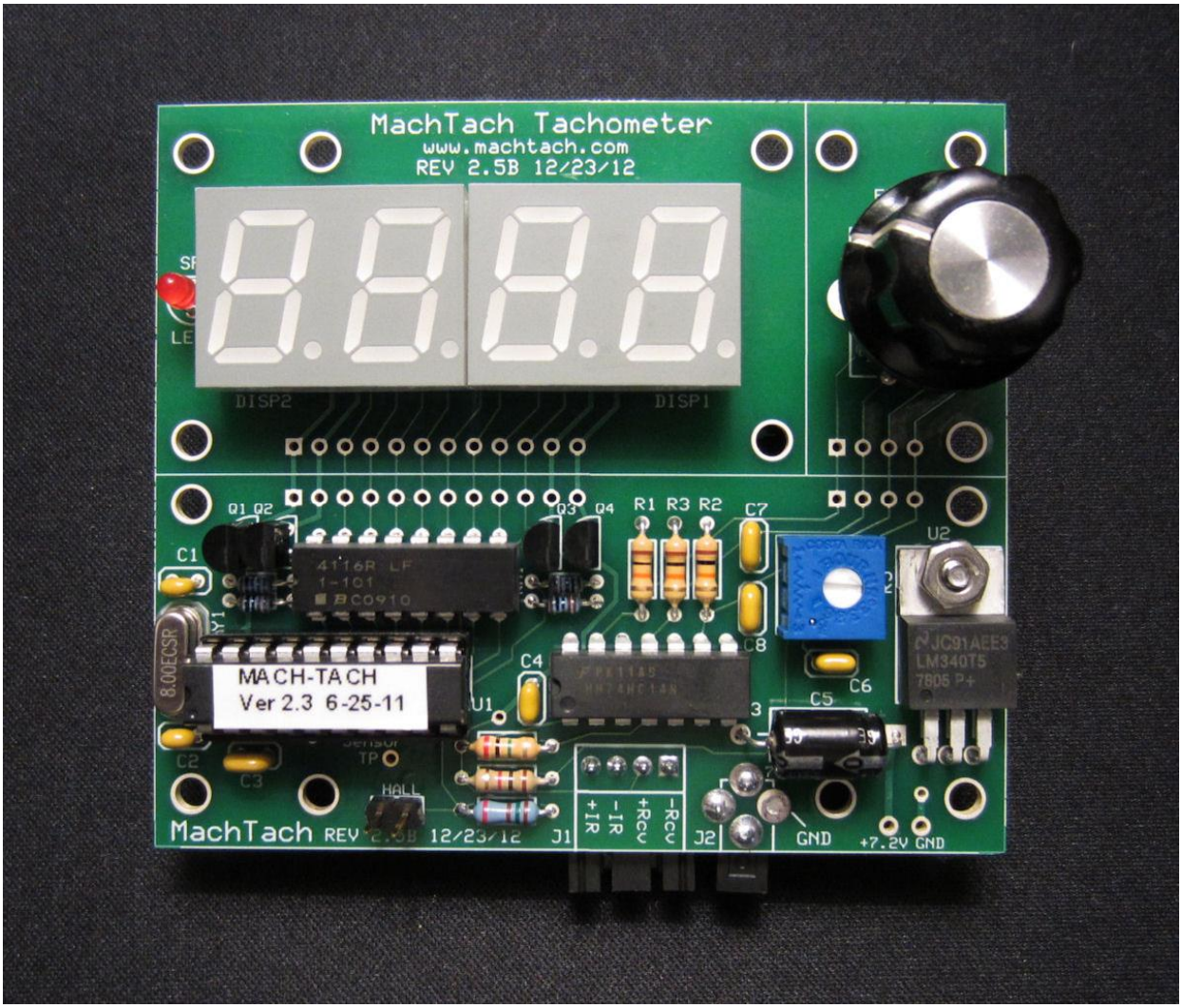
Good Quality soldering iron with small tip
Needle nose pliers
Small diagonal cutters
Solder
Flux remover or appropriate cleaner
Old tooth brush

The following pages include a parts layout diagram, the schematic and the parts list to help you with placing parts. The parts layout diagram shows the top layer with the part designations and outlines. Be careful when installing parts to get them in the correct holes. Itôs a good idea to tack things in place until all parts are mounted and then solder all of the pins at once.

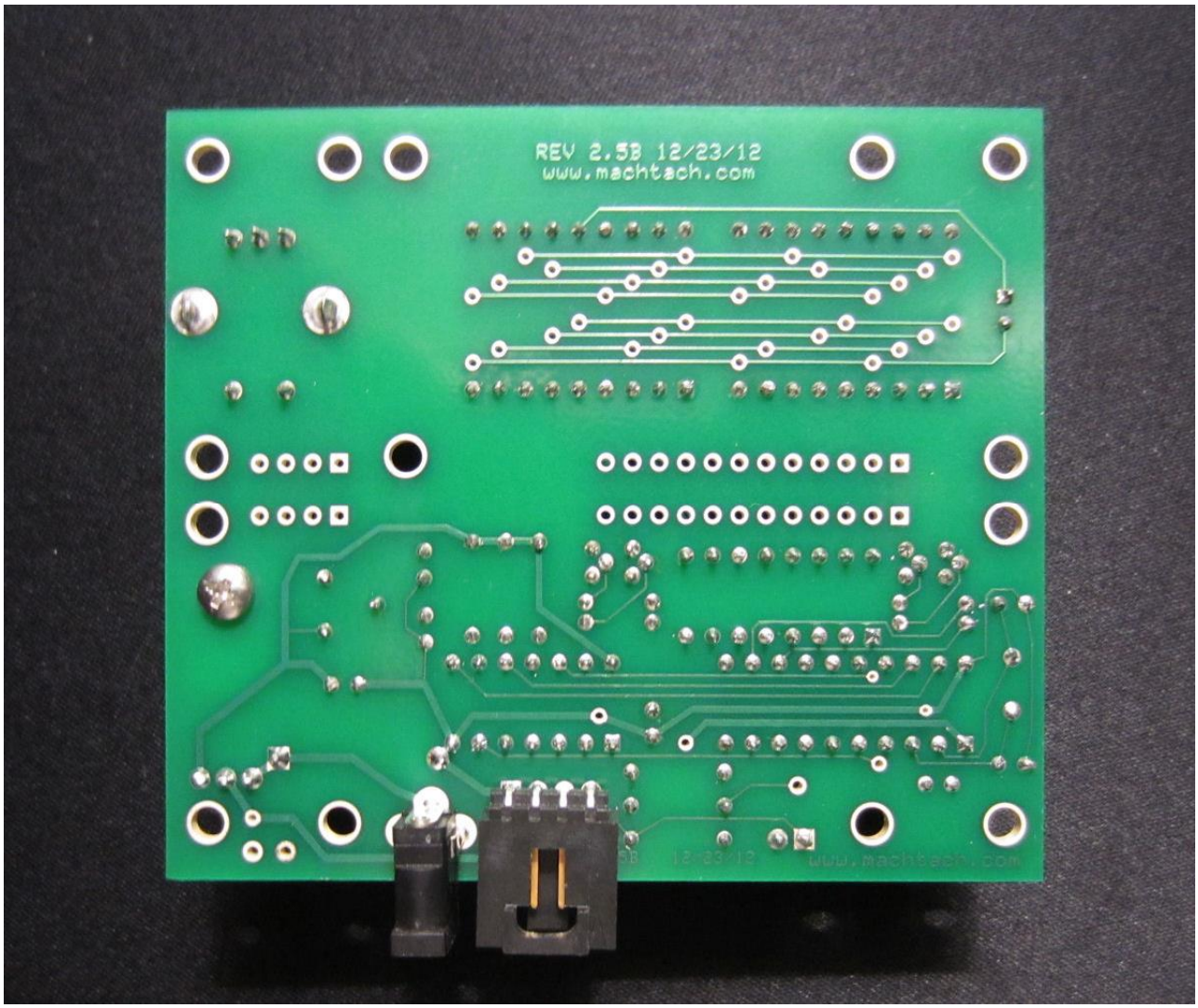


Note: PCB Version 2.3, 2.4, and 2.5 are all virtually identical and use the same V2.5 software. The assembly pictures are also the same for all versions.

If your board has been cut in half, pay special attention to which side you mount the components. The ñMachTachò name is on the component side which faces out on each board. The solder sides face to the center of the stack. The cut and folded configuration requires 16 jumpers to make the connections that were PCB traces but were cut when the board was cut in half. Headers can be used for this connection but be warned that they are not flexible so it will be hard to access the back side of the boards. It may be better to use plain wire. The cut-offs from the resistors and capacitors work great for these jumpers.



The Completed MachTach PCB (V2.5 shown)



MachTach PCB Backside (V2.5 shown) – Note Backside Mounted Connectors

IMPORTANT NOTE:
If you are using the connectors for your sensor and the wall transformer jack, you may mount them on either side of the PCB but they should be mounted on the backside of the PCB if you plan to install the board in the Serpac SR31 enclosure. After mounting the connectors on one side or the other, make sure you use the correct diagram for your encoder cable wiring because the pin-out will be reversed if you mount the connectors on the top side of the board.

To assemble the PC board:

1. Install all the smaller parts like resistors and ceramic capacitors which are low to the board. Check the labeling guide below if you are unsure which resistor or capacitor is which.
2. Install the socket for U1, install U3 (74HC14), and the resistor network RN1.
3. Install the crystal, Y1. The crystal must be installed with the supplied insulator to avoid it shorting between the two pads. The insulator should be already on Y1.
4. Install R5 and C5.
5. Install the two displays paying extra attention to make sure they go in with the decimal points towards the middle of the board and that they are aligned straight. Tack two pins first, check the alignment and that the displays are flush to the board before soldering the rest of the pins.

6. For LED1, make sure the flat portion of the skirt is pointing in the direction shown on the layout which is towards the top edge of the board. The top of the LED should be level with the two displays and centered. If your LED does not have a flat portion of the skirt, the long lead (anode) goes in the round pad hole not the square pad hole. You may elect to mount the LED higher than the displays so it pokes through the panel or the Serpac 31 enclosure. Make sure it is perpendicular to the board.
7. Install the four transistors Q1 ï Q4 as shown in the parts layout. Make sure that the tops of the transistors are level or lower than the displays. All parts should be the same height or lower than the two displays. Make sure the curve side of the transistors face the correct direction as shown in the silkscreen of the board.
8. Install the regulator U2. The hole in the T220 Tab should line up with the hole in the PCB. You may add a 4-40 screw and small nut to hold the tab to the PCB which is optional.
9. Install all remaining parts. Itôs best to install taller parts like the displays and the encoder last.
10. If your board was delivered in a single un-split piece, do not fill the holes along the center with solder. Doing so will make it more difficult later if you decide to switch to the cut and folded half size configuration.
11. You will need to solder either wires or a connector at location J1 and J2 to connect the sensor and the power leads. The sensor and power connectors may be mounted on either side of the board but must be mounted on the back side for use with the standard Serpac SR31 plastic enclosure. If you decide to mount them on the top side, be sure to use the cable diagrams for the top side mounting where the pin outs are reversed from the back side mounting. You must wire your cable using the correct diagram for your connector mounting. The power jack operates the same on either the front side or backside of the board.
12. After the board is complete, you may optionally use flux remover and a toothbrush to clean it. Do this in a well-ventilated area. Clean and rinse the board three times. If you do not have flux remover, rubbing alcohol will also work with a little extra effort.
13. Use compressed air to dry the board if available.
14. Install the microcontroller U1.
15. If you will be using the Hall Effect sensor, solder a jumper at the location labeled HALL jumper header. **Do not install this jumper if you are using IR sensors. It will damage an IR sensor because it will apply 5V directly to the IR LED.**

Here are the resistor color codes for people that are not familiar with the resistor color code chart.

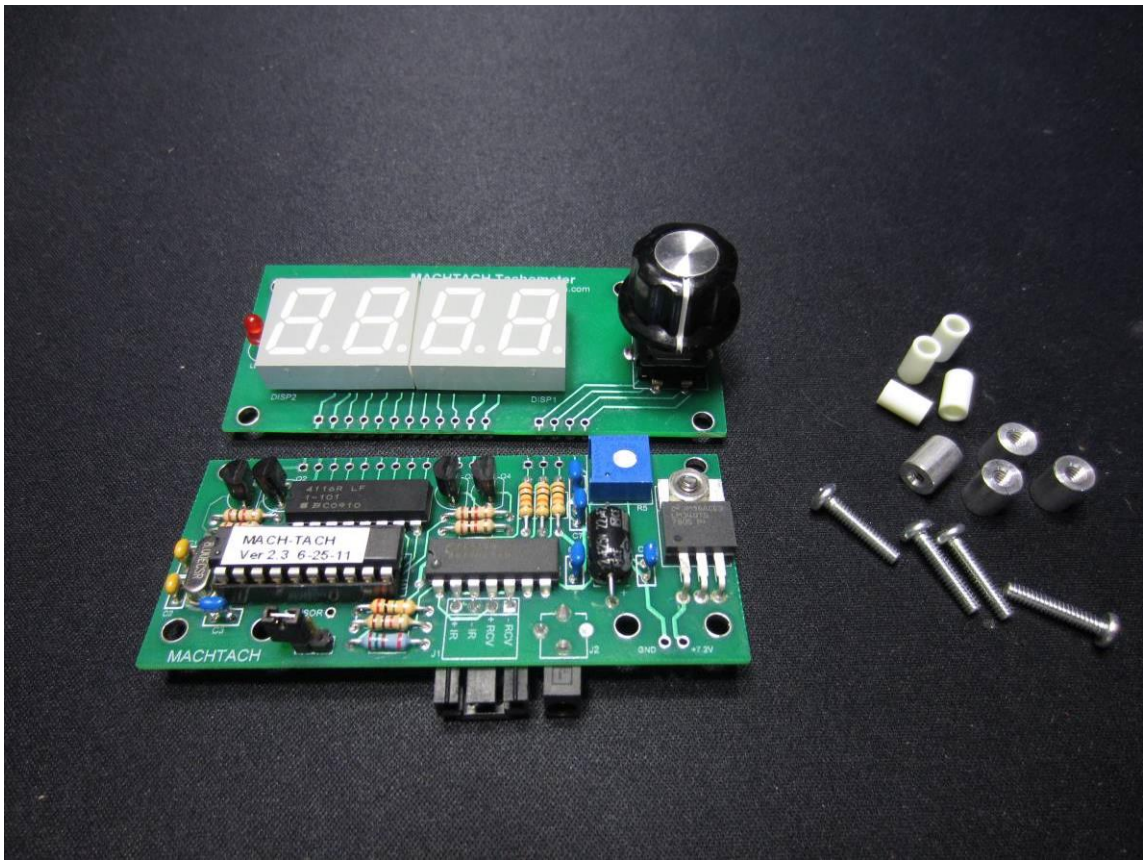
1K	BROWN-BLACK-RED
10K	BROWN-BLACK-ORANGE
2M	RED-BLACK-GREEN
150	BROWN-GREEN-BROWN

Here are the designations for the capacitors

22pf	220	C1, C2
0.1uf	104	C3, C4, C6, C7, C8
22 uf	22 uf	C5

Assembling a Half Size Module

The Full Size MachTach PCB can be cut in half and assembled as a half size module. Cutting the board in half disconnects 16 traces which are reconnected with jumpers as shown in the following pictures. The module will also need the supplied 0.3125ò or 0.375ò plastic spacers to hold the boards apart.



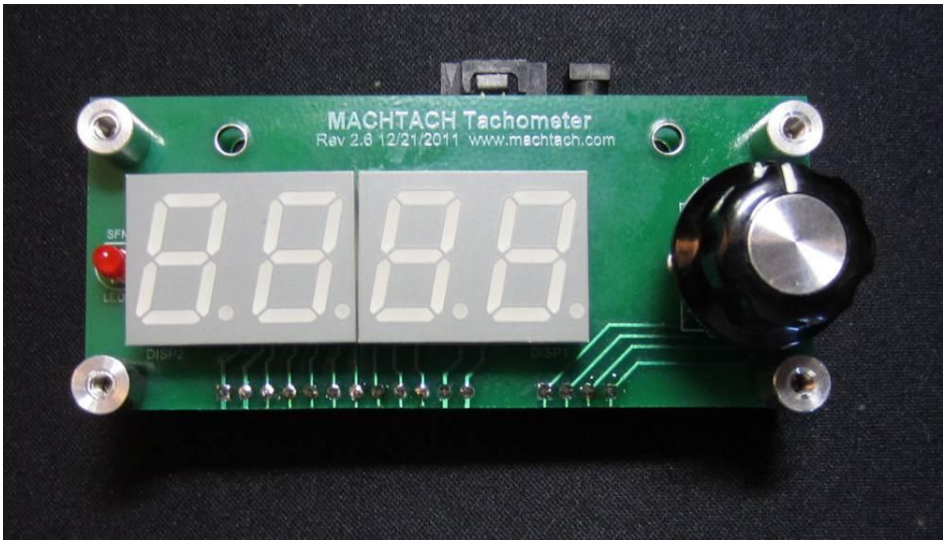
Half Size Module before assembly with Spacers

Each side of the board is assembled the same as a full size module. The two boards are then mounted back to back using plastic standoffs and then 16 connections jumper the two boards together. Make sure all of your leads are trimmed short enough to not touch when the boards are mounted back to back. You will need to make a total of 32 solder connections on your 16 jumpers.

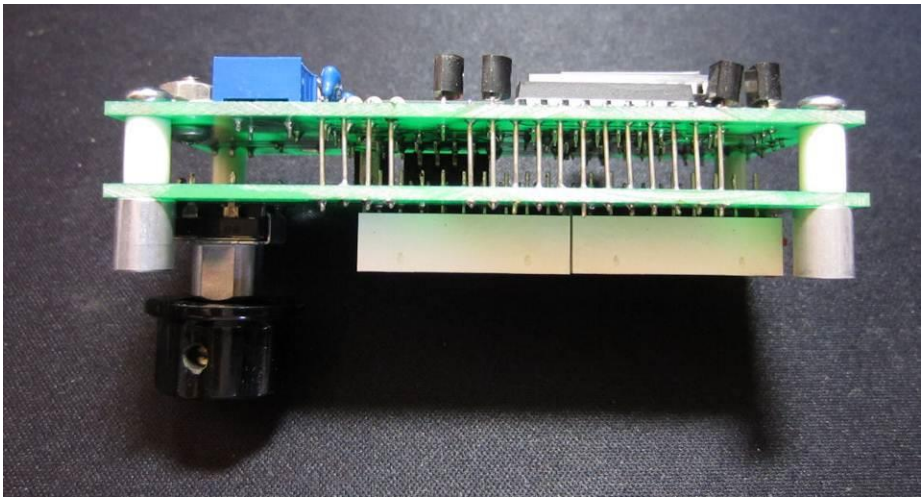
To jumper the module, just feed wire through all 16 pairs of holes and solder pads on both boards.

Note: The kit is supplied with 5/16ò or 3/8òspacers. If you would like an even more compact module, mount the sensor and power connectors on the front side of the board and using the supplied 1/8ò spacers. Make sure all your leads are trimmed very short so they donôt touch across the front and back boards. This will reduce the thickness by 3/16ò.

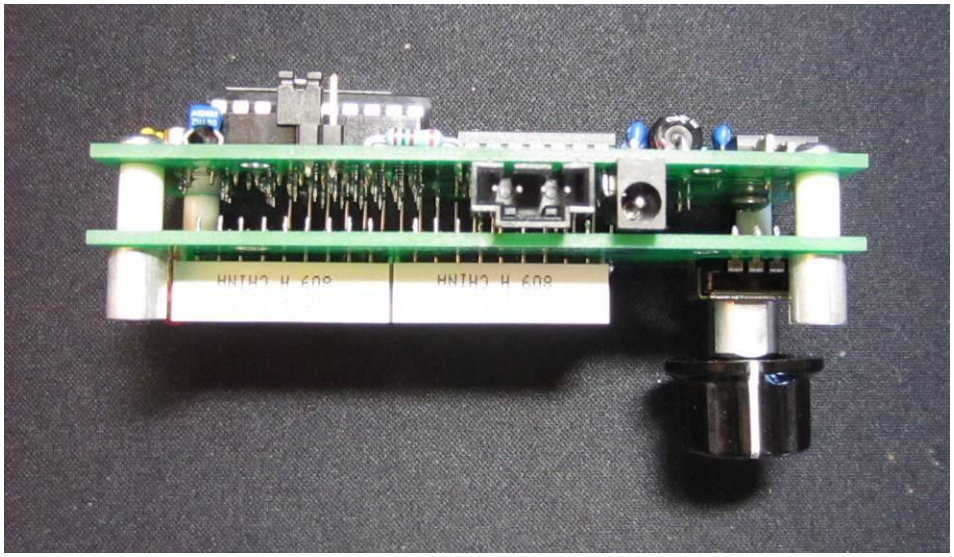
Note: the photos in this section show 5/16ò spacers. 1/8ò spacers can also be used to make a thinner module. The sensor connector and power connector are mounted on the component side of the board for the thin module shown later in a photo. See the next section of this manual.



Completed Half Size Module



Side View of a Completed Half Size Module Showing Jumpers and Spacers



Side View of a Completed Half Size Module Showing Power and Sensor Connectors

Building an Extra Compact Half Size Module

If you need a very compact module, you can assemble your half size MachTach with the 1/8ò spacers, no MachTach IC socket, and leave off the connectors. This will create a module that is only 0.80ò thick. The sensor and power cables can be soldered directly to the board.

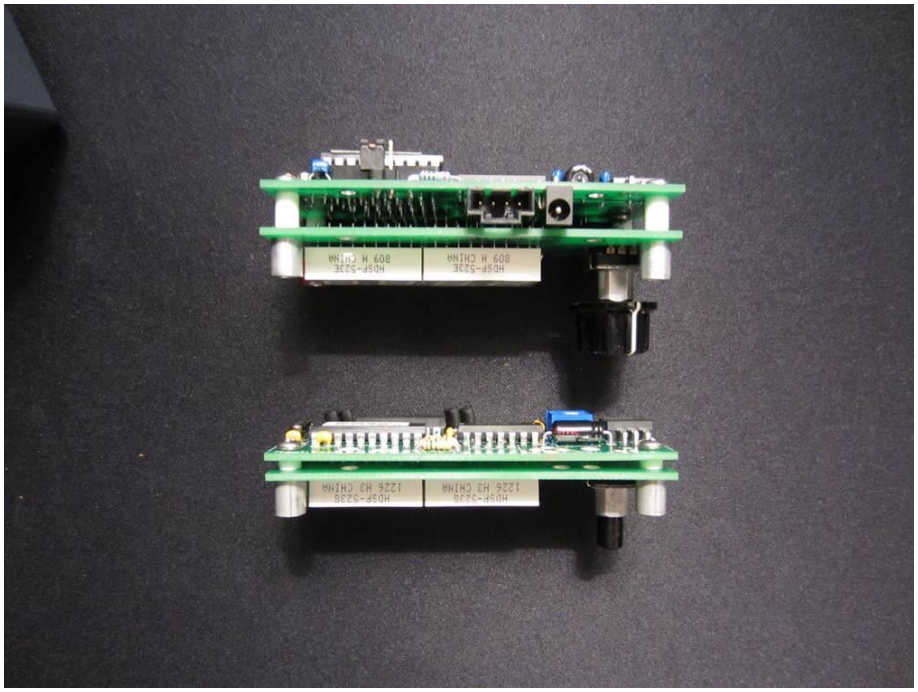
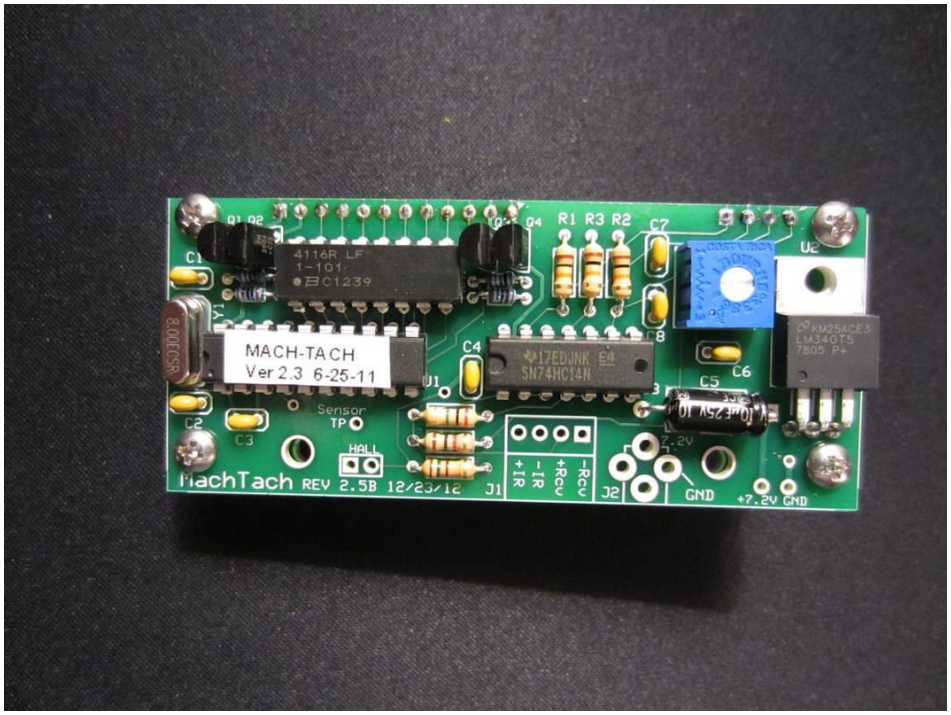
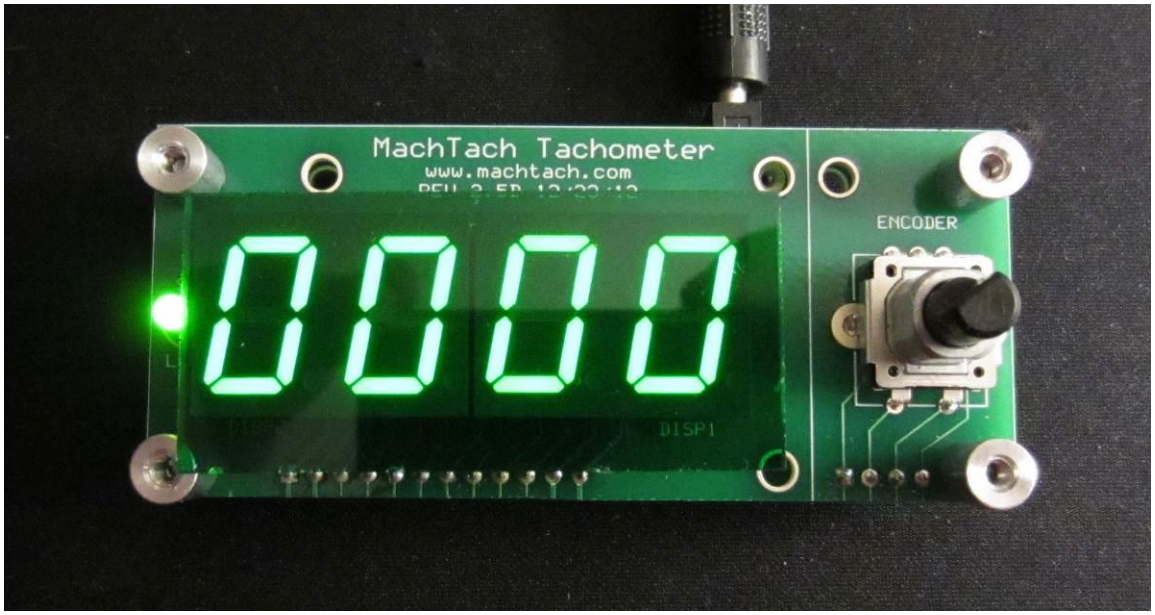


Photo showing the difference of assembling a half size module with the 5/16" spacers (upper) and 1/8" spacers (lower)



Extra Compact Module



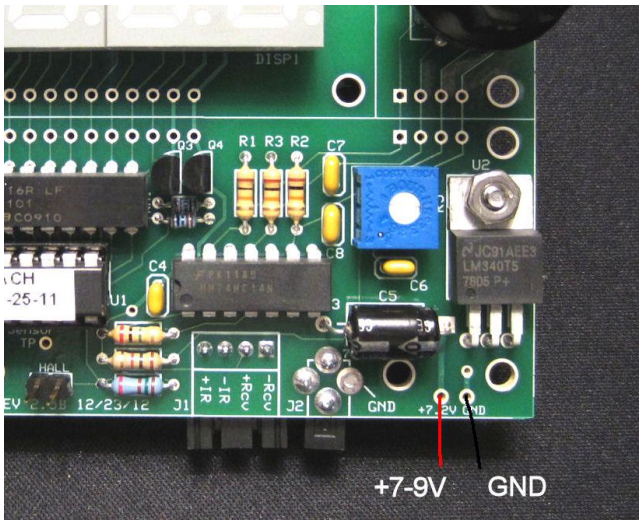
Completed Green Extra Compact MachTach

Be sure to clip all leads on the bottom side of the board short so that the halves donât short when assembled together.

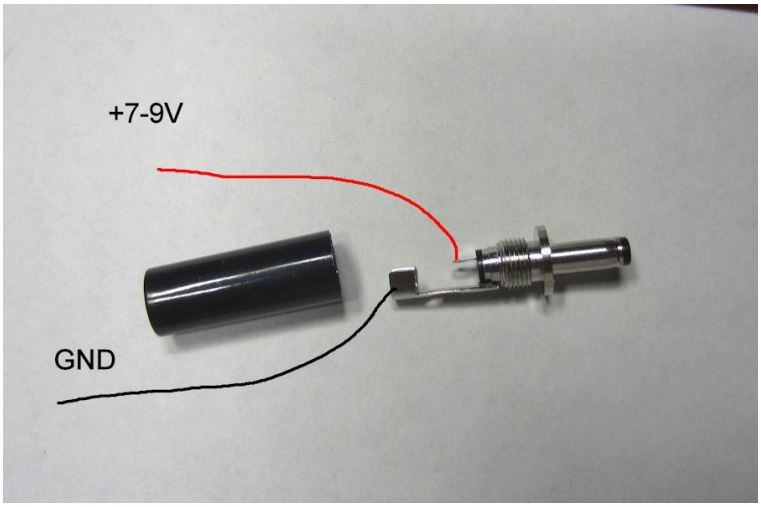
You may also optionally install the connectors and the IC socket. The module will still be less than an inch thick. Be sure to use the front side wiring diagram for your sensor cable if you add the connectors to the component side of the board.

Powering Up the MachTach

The MachTach requires 7-9 VDC for power. You may use the optional **DC** wall transformer, a 9V battery, your own wall transformer, or other suitable **DC** supply. The optional wall transformer has a 1.3mm ID/3.5mm OD connector that mates with J2. You may also purchase the matching plug for J2 from us or you may connect directly to the labeled pads on the board. Be sure to get the polarity correct because there is no reverse polarity protection circuitry. The center of the J2/P2 connection is positive. The MachTach may also be optionally powered with 12 VDC by adding a heat sink to regulator U2 using the 4-40 size screw and nut.



Direct Wired Connection



Wiring the Optional Plug

Checking Out the MachTach

Once you power up the MachTach, it should display ñ0000ò and the SFM LED should be unlit. Try pressing the knob a few times and the SFM mode LED should go on an off. In SFM mode, try turning the knob. You should be able to enter diameters from 00.01ò through 99.99ò (1 ï 999 mm for metric). Last, try holding the knob in for 5 seconds to see if can enter the Slot Entry mode. Slot Entry mode allows values of 1-60.

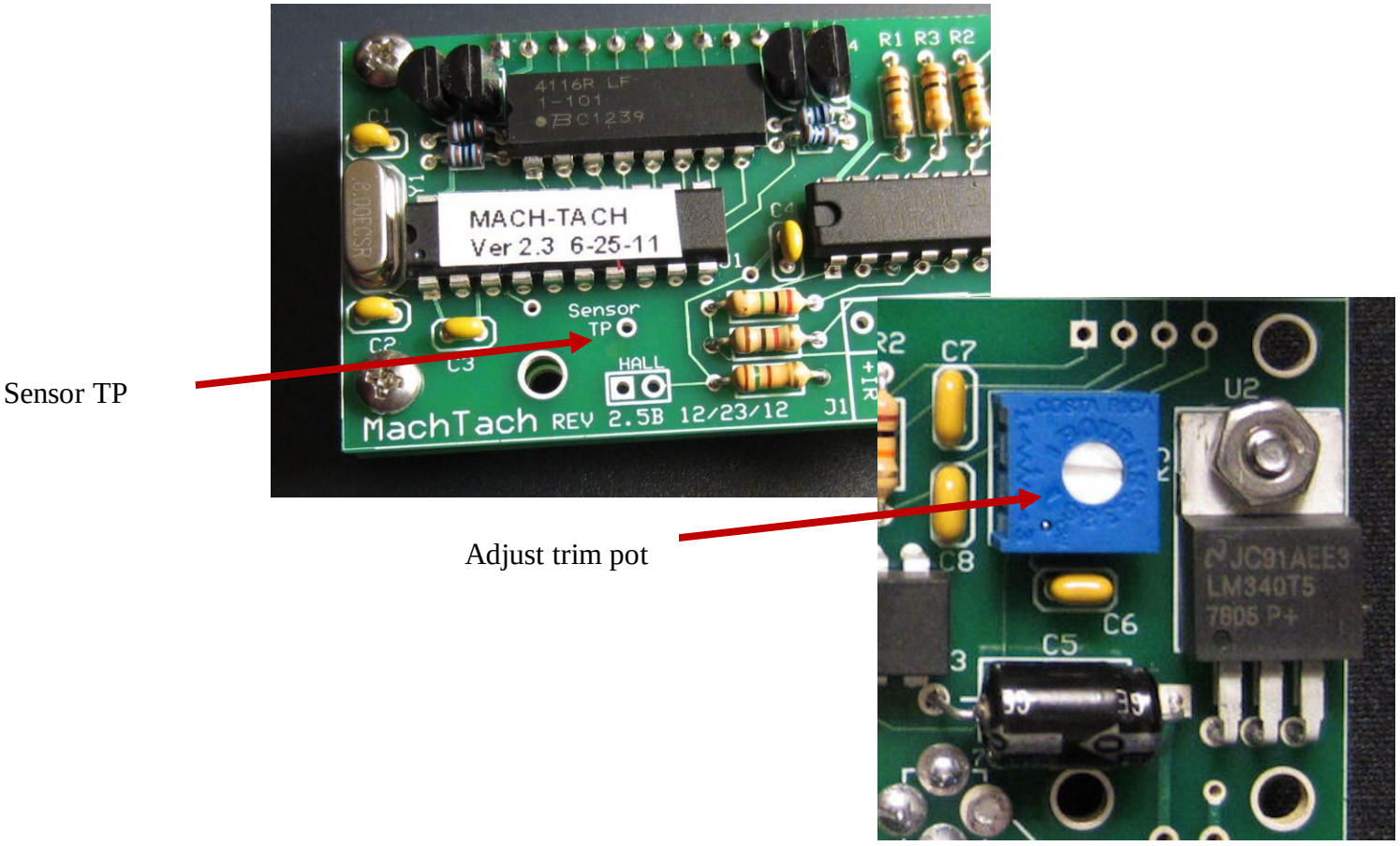
If you canôt perform any of the above checks, refer to the troubleshooting section of this manual.

Adjusting the MachTach

Once youôve checked the basic operation of the MachTach, you may connect a sensor.
The following adjustment procedure is important for the correct operation of the MachTach.

For IR sensors, refer to the schematic for sensor hook-up or the section on assembling the sensor cables. Set the R5 trim pot to mid position and wire up the sensor as shown. You will need a DVM to accomplish this task. Place the negative probe on the lower right hand pin labeled ñGNDò and the positive probe on the test point labeled ñSensor TPò which is near the controller. Set R5 fully counter clockwise. Once youôve powered it up, point the sensor at your planned dark and light patches or your slots and adjust the R5 trim pot so that the light or open slot gives you less than 1V out and with a dark spot or obstructed slot gives you greater than 4.0V. Make sure you are at the specified distance away which is 0.15 inches for the supplied IR sensor. You should be able to achieve these voltages with the supplied sensor. If you are using your own sensor and you canôt achieve these numbers by turning the pot, you will need to examine the values of R4 and R5 and select values that are appropriate for your sensorôs current range. For the supplied IR reflective sensor, R5 will usually be at about midpoint for the best setting.

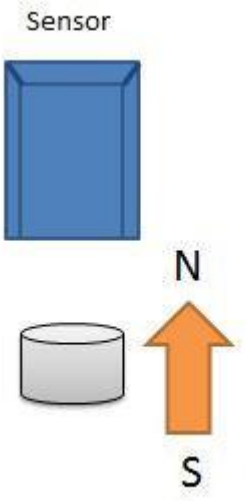
If you are attaching a Hall Effect sensor which requires 5V power, GND, and the transistor output, solder a jumper at the location labeled HALL. This will make +5V available to pin 3 of the connector or pad if you arenôt using a connector. The adjustment of R5 is the same except that you will be using your magnet to check the on and off states. For the suggested Hall Effect sensor, setting R5 fully clockwise works best. If you canôt get lower than about 1V and higher than 4.0V you will need to check the data sheet for your sensor to see what current is recommended for your sensors output stage.



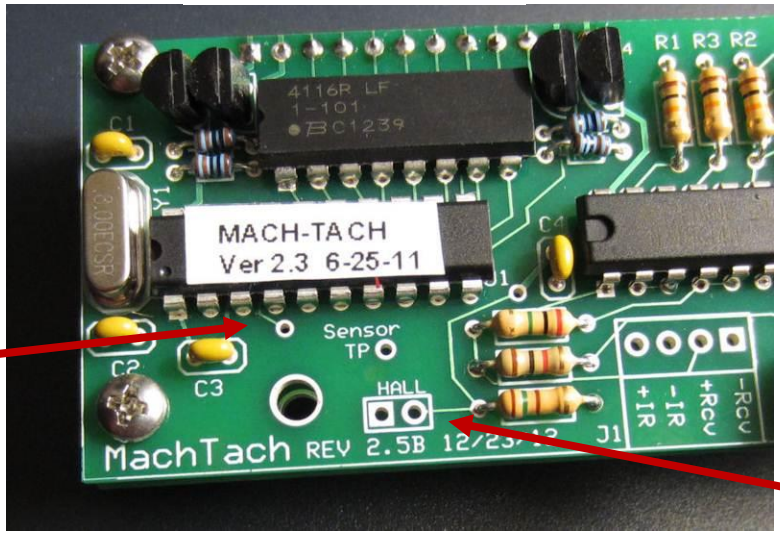
Important – Installation of Magnets for Hall Effect Sensors

If you are using the Hall Effect sensor, you must install the magnets on your ring with the North Pole facing the chamfered face of sensor. Here's a way you can get the correct direction without having to determine which end of the magnet is the North Pole.

1. Make your Hall Effect cable and connect it to the MachTach. Install a jumper in the Hall location. Solder both pads. Power up the MachTach.
2. Take the stack of magnets and point either end of the magnets at the chamfered side of the sensor which is the side that should face the magnets. Make sure the magnets are directly over the sensor and centered.
3. Measure the MachTach sensor test point. When the correct North Pole end of the magnet is facing the sensor, the voltage will go to zero or near zero. The South Pole end will give you close to 5V. If you get 5V, try the other direction. You can improve the 0V and 5V states by adjusting R5 as explained in the previous section. If you get 5V in both directions, the sensor is not working. See the troubleshooting section.
4. Install as many magnets as you will be using with all the magnets facing the same direction as determined in step 3.



Orientation of Magnets with North Pole Facing the Chamfered Face of Sensor



Hall Effect Sensor Jumper

Sensor TP

Jumper Location

Making the Sensor Cables

IMPORTANT: There are different diagrams depending on whether you installed your sensor connector on the front side or back side of the board. Be sure to select the correct diagram. If you mount your connector on the top side of the board with the other components, the numbering is reversed from a back side mounting. Use the supplied pin out tables to make sure you have the correct wiring.

Making the IR Sensor Cable

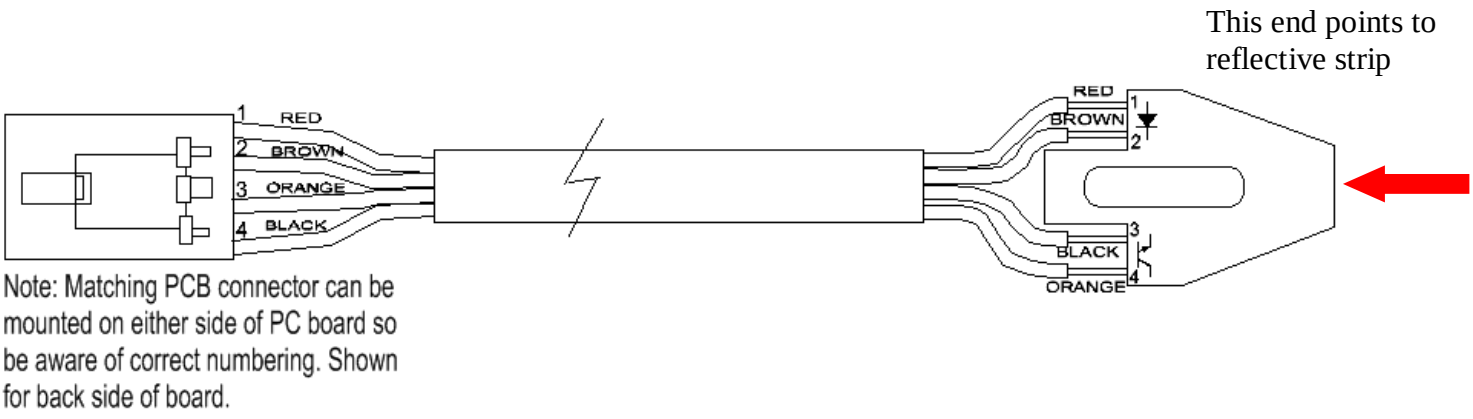
Cut your cable to the desired length and strip the outer covering to reveal the wires. A length of 36ò is usually good. Slide two pieces of 3/8ò shrink wrap over the cable which will be used to protect the connector and the sensor. Slide the 1/8ò shrink warp over each of the wires which will connect to the sensor. Using needle nose pliers, make a small loop on each lead of the sensor. Solder each wire as shown in either the pictorial or table.

Note: Some supplied cable will have yellow wire instead of black wire. Use yellow for black in the following diagrams

Diagrams for Connector Mounted on Backside of PCB

Conn Pin Number	Name	IR Sensor Pin Number	Suggested Wire Color
4	RCV Output -	3	Black
3	RCV Output +	4	Orange
2	IR LED -	2	Brown
1	IR LED +	1	Red

IR Reflective Sensor Wiring Table
CONNECTOR ON BACKSIDE OF PCB

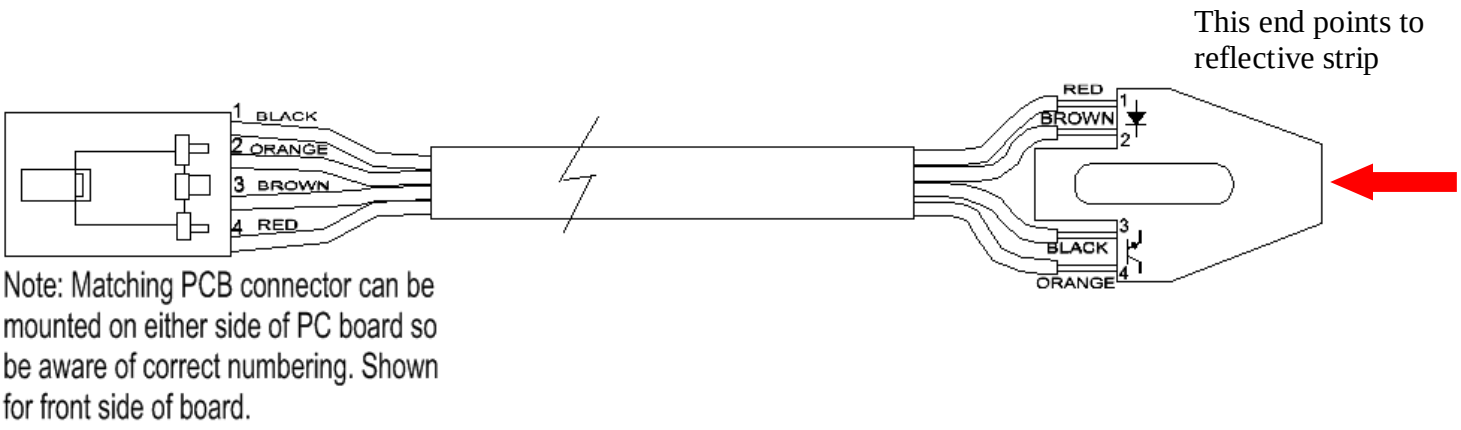


Pictorial Wiring Diagram for IR Reflective Sensor Cable –
CONNECTOR MOUNTED ON BACKSIDE OF PCB

Diagrams for Front Side Mounted PCB Connector

Conn Pin Number	Name	IR Sensor Pin Number	Suggested Wire Color
1	RCV Output -	3	Black
2	RCV Output +	4	Orange
3	IR LED -	2	Brown
4	IR LED +	1	Red

IR Reflective Sensor Wiring Table
CONNECTOR MOUNTED ON FRONTSIDE OF PCB



Pictorial Wiring Diagram for IR Reflective Sensor Cable –
CONNECTOR MOUNTED ON FRONTSIDE OF PCB

Slide the 1/8ò shrink wrap over each connection and shrink it using a heat gun. Using either a crimping tool or needle nose pliers attach the connector pins to the other end of the cable. Using the diagrams push the pins into the connector housing in the correct order. Place the large 3/8ò shrink wrap over the end of the sensor but not over the slot and over the back end of the connector. Using a heat gun shrink the wrap into place.

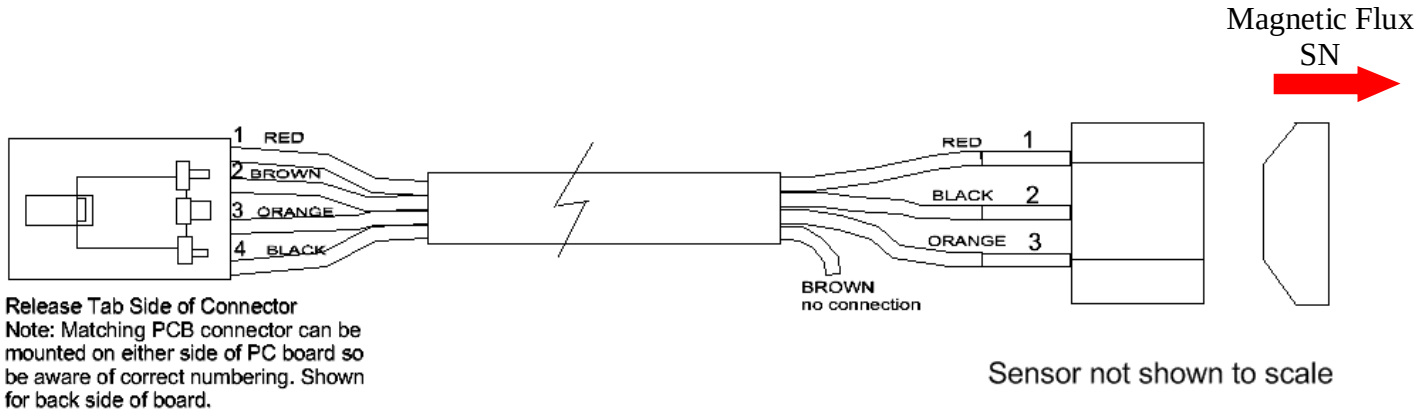
Making the Hall Effect Sensor Cable

Cut your cable to the desired length and strip the outer covering to reveal the wires. Slide one piece of 3/8ò shrink wrap over the cable which will be used to protect the connector. Slide three pieces of the 1/8ò shrink warp over each of the wires which will connect to the sensor. Using needle nose pliers, make a small loop on each lead of the sensor. Solder each wire as shown in either the pictorial or table.

Diagrams for Backside Mounted PCB Connector

Conn Pin Number	Name	Sensor Pin Number	Suggested Wire Color
4	Gnd	2	Black
3	Hall Out	3	Orange
2			Brown
1	Vcc	1	Red

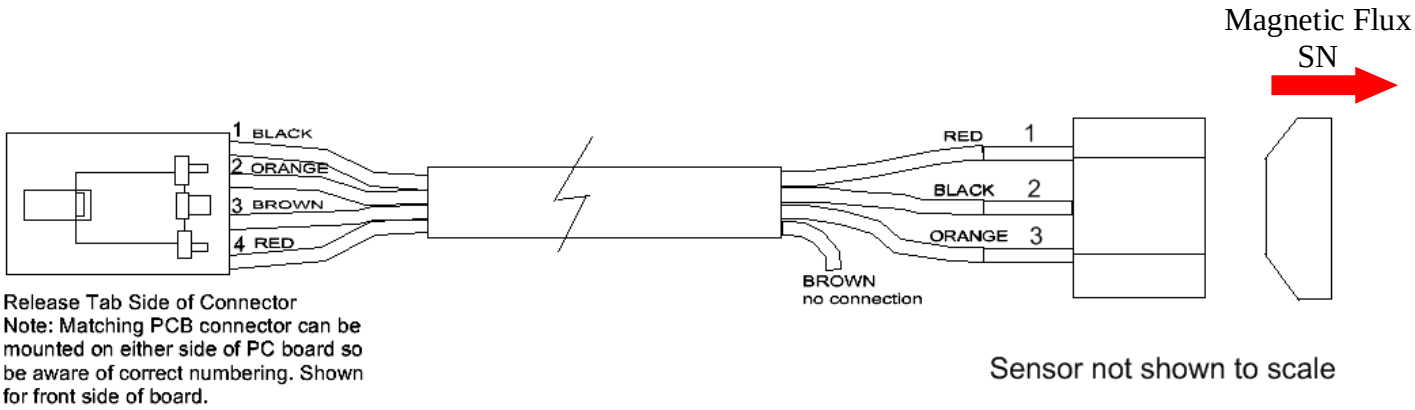
Hall Effect Sensor Wiring Table
CONNECTOR MOUNTED ON BACKSIDE OF PCB



Pictorial Wiring Diagram for Hall Effect Sensor Cable
CONNECTOR MOUNTED ON BACKSIDE OF PCB

Conn Pin Number	Name	Sensor Pin Number	Suggested Wire Color
1	Gnd	2	Black
2	Hall Out	3	Orange
3			Brown
4	Vcc	1	Red

Hall Effect Sensor Wiring Table
CONNECTOR MOUNTED ON FRONTSIDE OF PCB



Pictorial Wiring Diagram for Hall Effect Sensor Cable
CONNECTOR MOUNTED ON FRONTSIDE OF PCB

Slide the 1/8ò shrink wrap over each connection and shrink it using a heat gun. Using either a crimping tool or needle nose pliers attach the connector pins to the other end of the cable. Using the diagrams push the pins into the connector housing. Place the large 3/8ò shrink wrap over the end of the connector. Using a heat gun shrink the wrap into place.

The Hall Effect sensor should be mounted so that the magnetic lines of force run through the

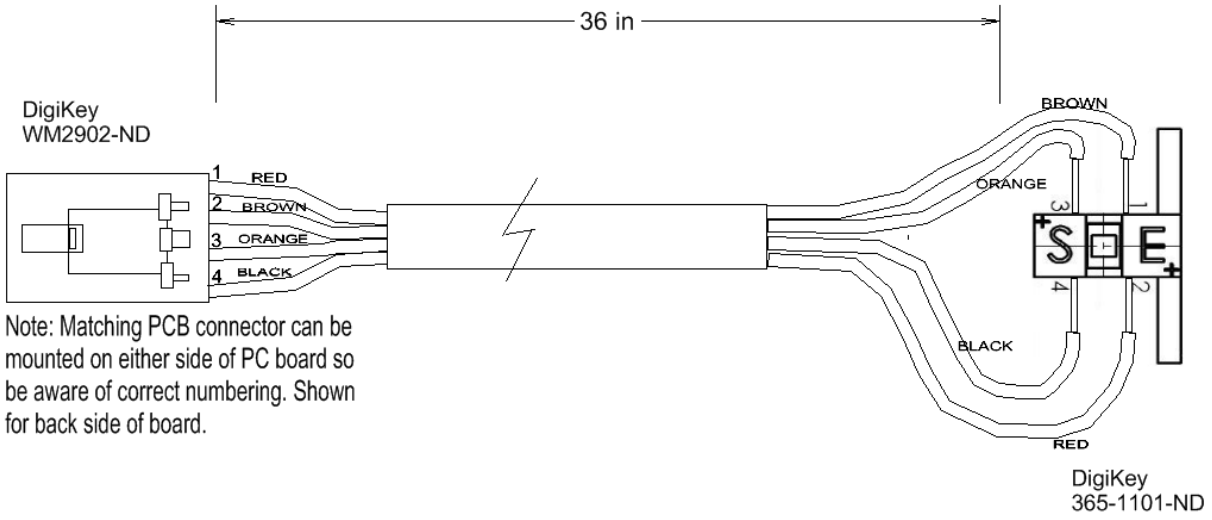
Making the IR Slotted Sensor Cable

Cut your cable to the desired length and strip the outer covering to reveal the wires. Slide one piece of 3/8ò shrink wrap over the cable which will be used to protect the connector. Slide three pieces of the 1/8ò shrink warp over each of the wires which will connect to the sensor. Using needle nose pliers, make a small loop on each lead of the sensor. Solder each wire as shown in either the pictorial or table.

Diagrams for Connector Mounted on Backside of PCB

Conn Pin Number	Name	IR Sensor Pin Number	Suggested Wire Color
4	S Output -	4	Black
3	S Output +	3	Orange
2	E -	1	Brown
1	E +	2	Red

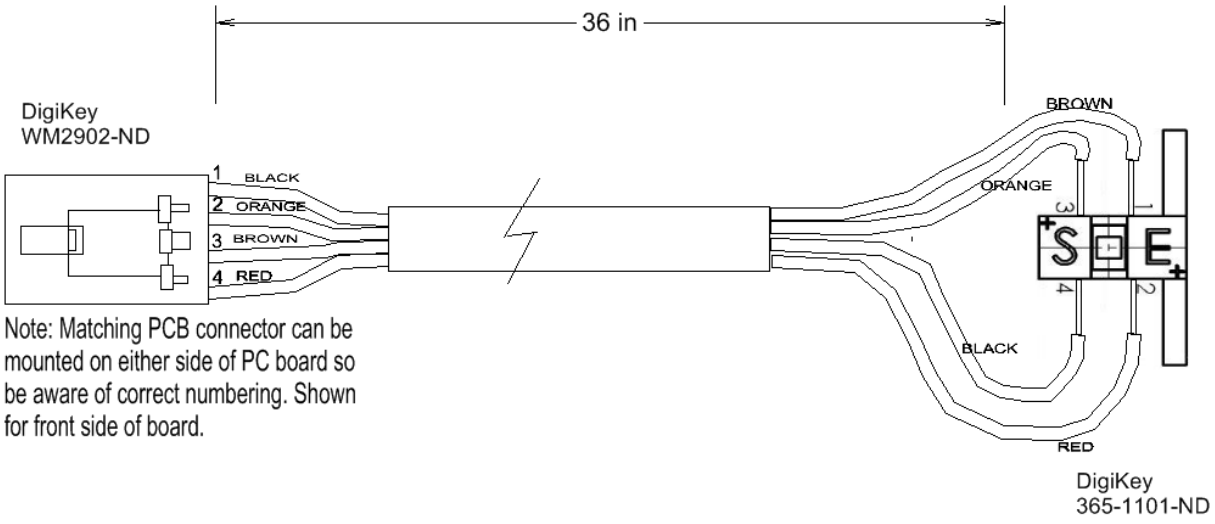
IR Reflective Sensor Wiring Table
CONNECTOR ON BACKSIDE OF PCB



Diagrams for Connector Mounted on Front side of PCB

Conn Pin Number	Name	IR Sensor Pin Number	Suggested Wire Color
1	S Output -	4	Black
2	S Output +	3	Orange
3	E -	1	Brown
4	E +	2	Red

IR Reflective Sensor Wiring Table
CONNECTOR ON FRONT SIDE OF PCB



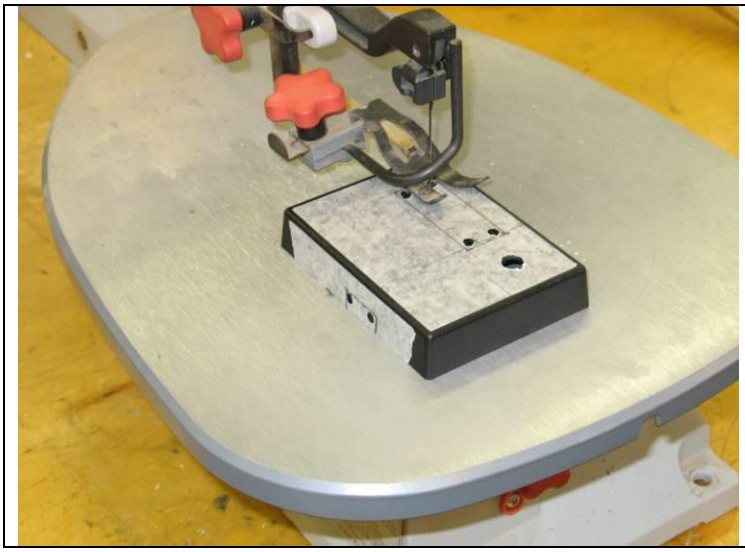
Modifying the SR031 Enclosure

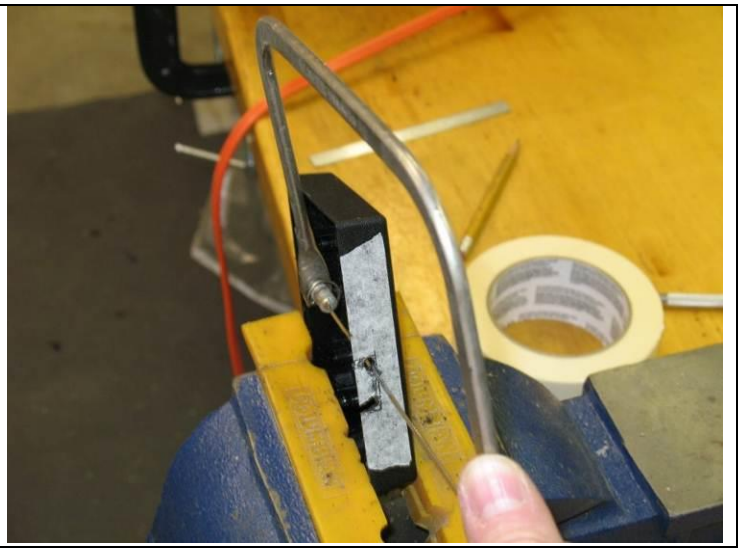
If you bought the optional SR031I plastic enclosure, it needs to be modified for the MachTach PCB to fit within it. At the end of this document is a layout of the needed panel holes. Fill the recessed panel area with masking tape and transfer the layout to the tape. As an Alternative you may print the layout to sticky back paper and stick it within the recessed area of the box.

Drill a 3/8ò hole for the encoder and a .3/16ò hole for the LED first. Drill holes in the corners of the display and connector areas and use either a jigsaw or coping saw to carefully cut out this area. It is best to not cut right to the line but to use a file to bring the opening to the line.

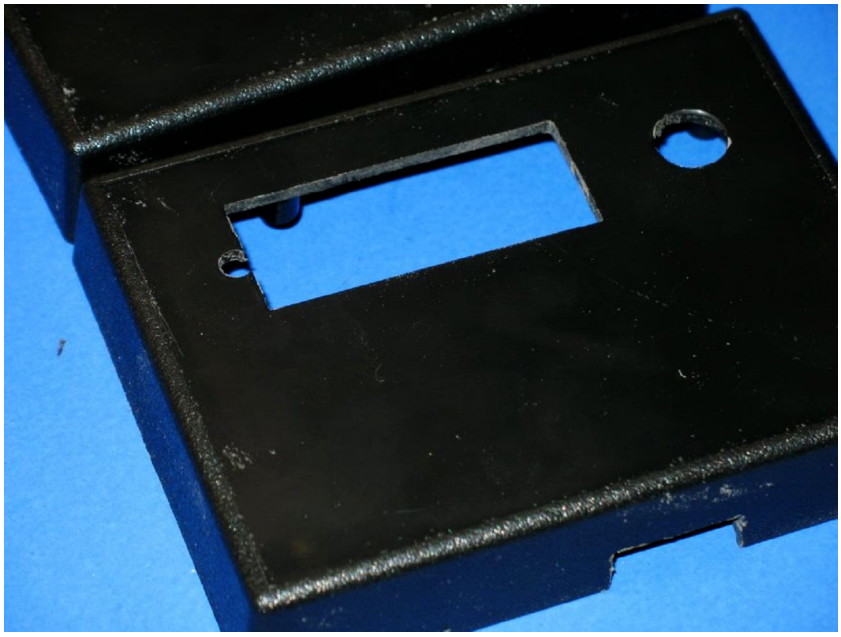
The square hole for the sensor connector and power jack can also be marked by dropping the board into the enclosure and marking where the connectors hit. Cut a recess there to clear the connectors. The bottom lid will also need to be slightly notched just on the lip that fits into the bottom of the case.

Plastic Enclosures with Masking Tape and Layout Lines

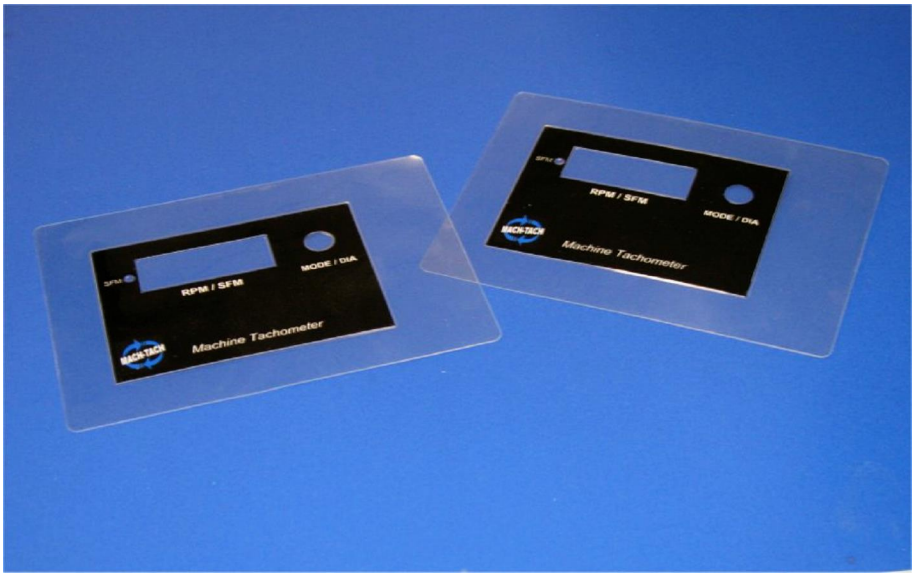




Cutting the Holes with a Jigsaw and Coping Saw



The Completed Enclosure Holes

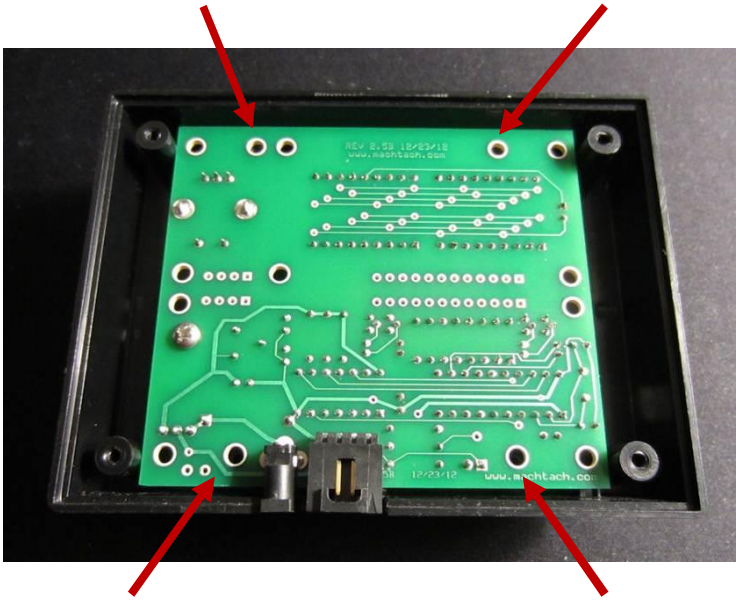


Laminated Plastic Front Panels

The plastic panel comes with excess plastic ears. These must be trimmed off to fit the recess of the enclosure. You must also provide a 3/8ò hole for the encoder shaft to stick through. Do not punch a hole for the SFM LED. The 3/8ò hole can be created either with a gasket punch or by carefully cutting the hole with an Xacto knife. The plastic panel can be mounted to the enclosure in one of two ways. You may use either permanent double sided tape which is available in any drug store or you may use contact cement. Clean the enclosure recess and back of the plastic panel with rubbing alcohol. Fill the recessed area with double sided tape but do not overlap it or cover your display, LED, or encoder holes. Filling the area assures that the panel will not be loose in the middle. Press the panel in place smoothing it firmly throughout the surface. The use of double sided tape is very effective. Iôve tried to remove a panel after installing it and it is impossible without ruining the panel.

Installing the MachTach PCB in the SR31 Enclosure

The MachTach PCB drops into the SR31 enclosure and can be screwed in place using 4 self-tapping screws to posts within the enclosure indicated with the arrows. The connectors poke out from the bottom edge of the enclosure. The screws are included when you buy the enclosure kit. The red plastic lens should be cut to fit inside the Serpac display opening. For kits with green displays, a thin sheet of green Mylar is included. This green Mylar is self-sticking and should be applied to the LED displays not the plastic overlay. The green kits come with Mylar instead of acrylic because it is not possible to buy the translucent green acrylic thin enough to fit between the display and the top of the case.

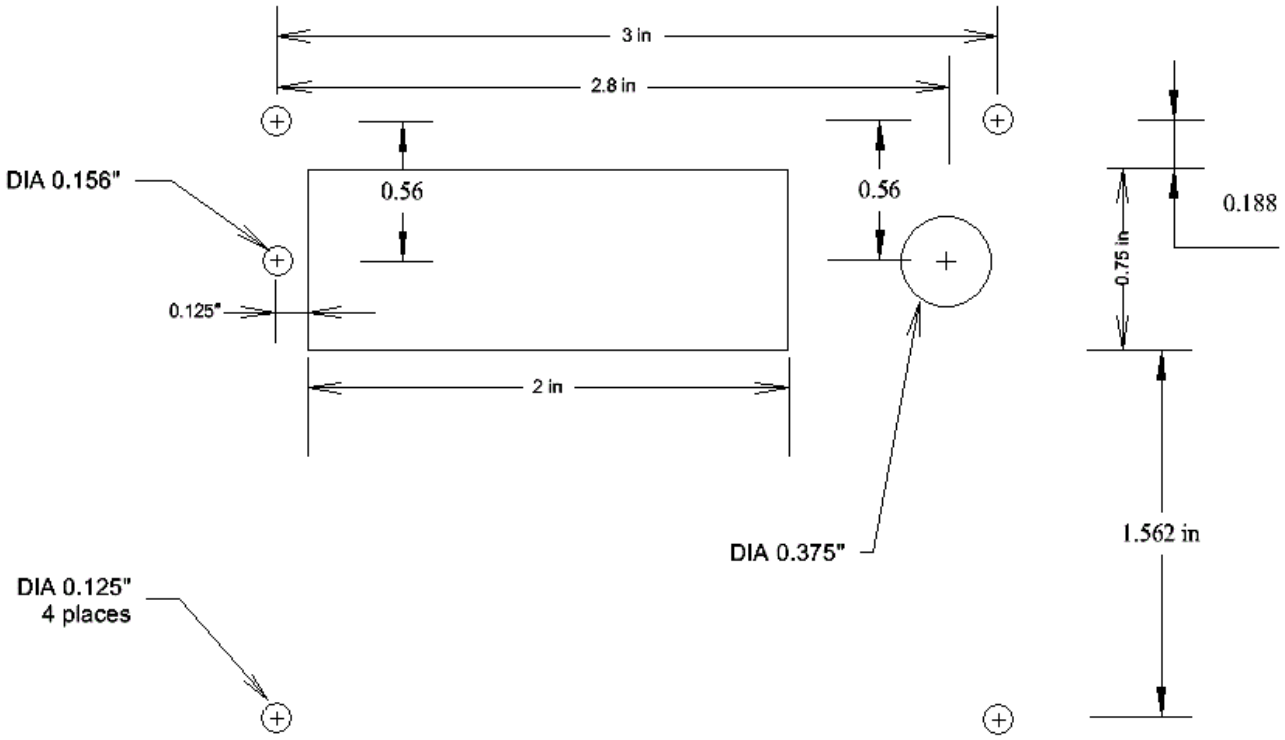


MachTach PCB Mounted inside Serpac SR31 Enclosure

Completed MachTach in the SR031I Enclosure

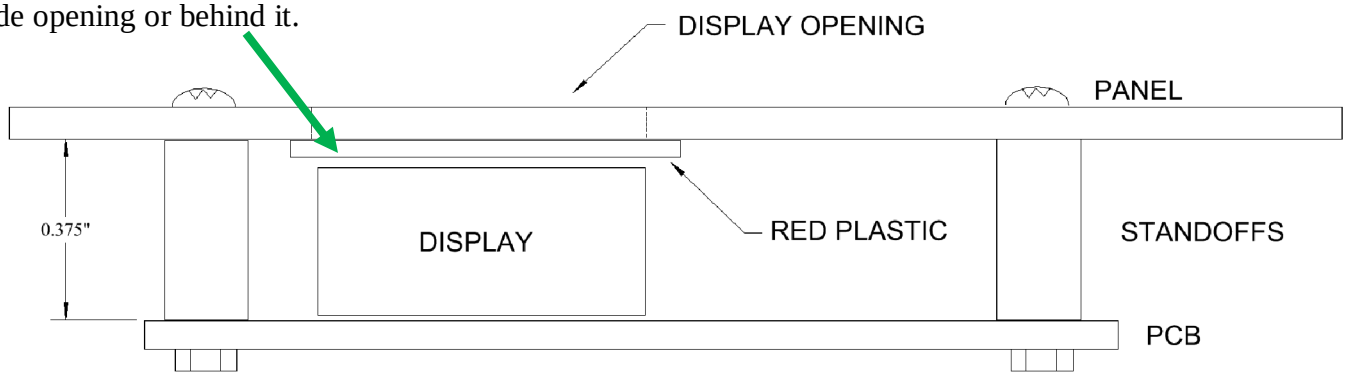
Installing the MachTach in Your Own Panel

If you decide to install the MachTach in your own enclosure or panel, use the following diagram to drill the holes and make the display window. The display opening is 2.0ò x 0.75ò. Add the 0.125ò mounting holes as shown. Add the 0.375ò hole for the control and the 0.156ò hole for the LED. Both of these holes are on the center line of the display.



Panel Layout Diagram (Full size MachTach)

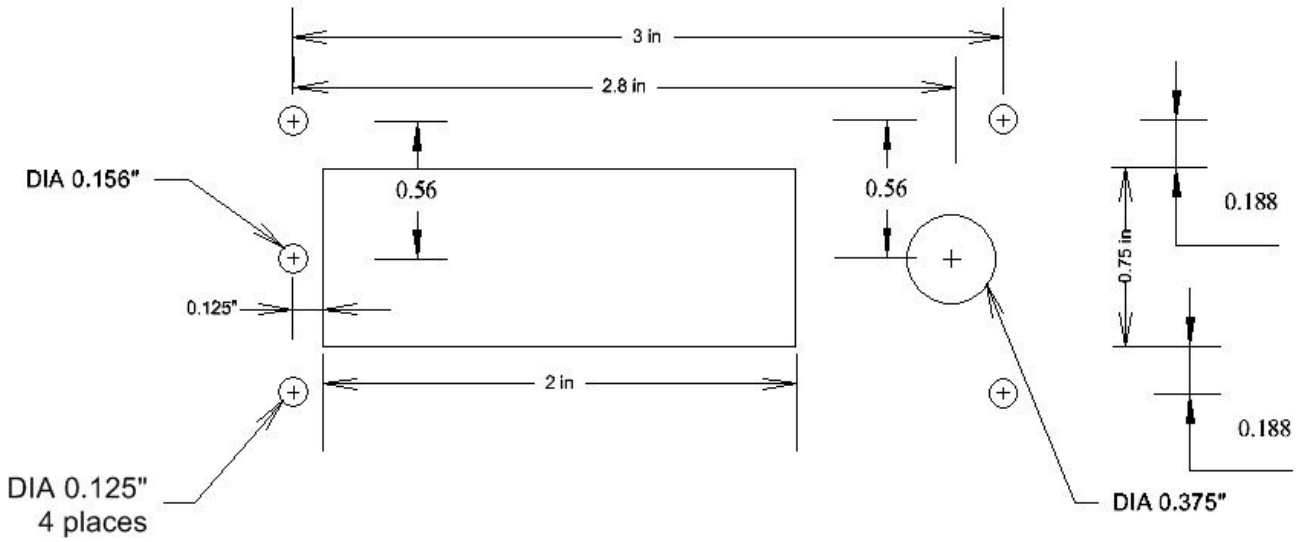
Display plastic can be installed inside opening or behind it.



The MachTach may be mounted on 0.3125ò or 0.375ò standoffs using 4-40 screws. The display will be clearer if you mount the included piece of translucent red/green plastic behind the opening. The red/green display plastic window can be attached to the back side of the panel with a little glue in the corners. You may also make the red plastic window flush by cutting it the same size as your panel opening and gluing it in place from the back. (Not shown) The standoffs can be as short as 0.3125ò for a flush installation.

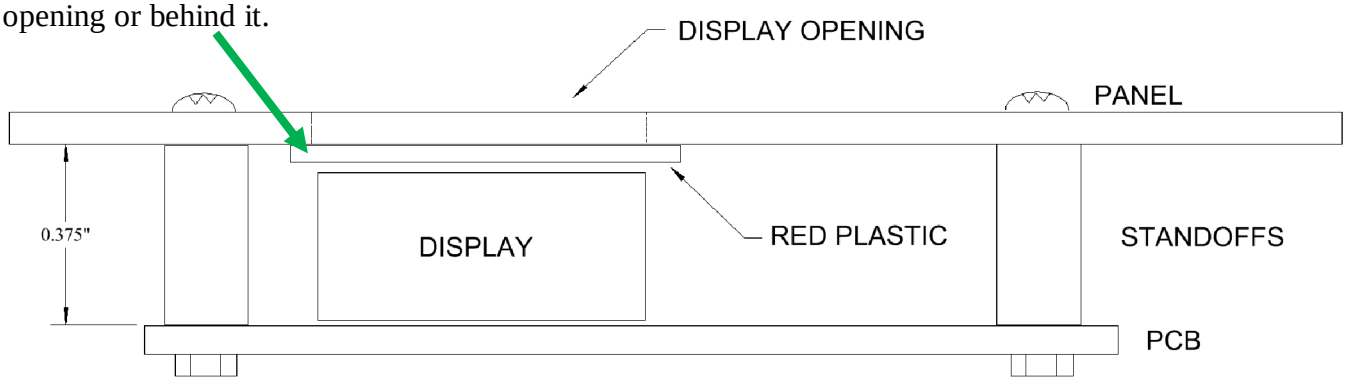
Installing a Half Size MachTach in Your Own Panel

For installation of a half size MachTach, the bottom two holes are in a different location than the full size module. Hereôs the drawing for the half size mounting hole layout.



Panel Layout Diagram (Half size MachTach)

Display plastic can be installed inside opening or behind it.



The MachTach may be mounted on 0.3125ò or 0.375ò standoffs using 4-40 screws. The display will be clearer if you mount the included piece of translucent red/green plastic behind the opening. The red/green display plastic window can be attached to the back side of the panel with a little glue in the corners. You may also make the red plastic window flush by cutting it the same size as your panel opening and gluing it in place from the back. (Not shown) The standoffs can be as short as 0.3125ò for a flush installation.

Making Your Own Plastic Front Panel

Many of the installation examples shown in this document include a plastic panel with lettering. These panels are made by creating color artwork of the panel, printing it on photo paper, and then laminating it with an office plastic laminator. The Serpac Enclosure option includes one of these Panel Overlays that fits the Serpac enclosure. Below is the laminator I use which can be purchased from Harbor Freight for $30. The part number is 92499. I do not recommend Harbor Freight lamination sheets. I suggest that you use Scotch brand plastic laminating pouches (Product TP5902-20). The plastic panels made with this process are very sturdy, impervious to oil and grease and look reasonably professional. They also create a clear plastic window that is integral to the panel. You should use the lightest and thinnest photo or presentation paper you can find. I use 24 lb. presentation paper. The thicker the paper is, the wider the borders are around the lamination which is undesirable.

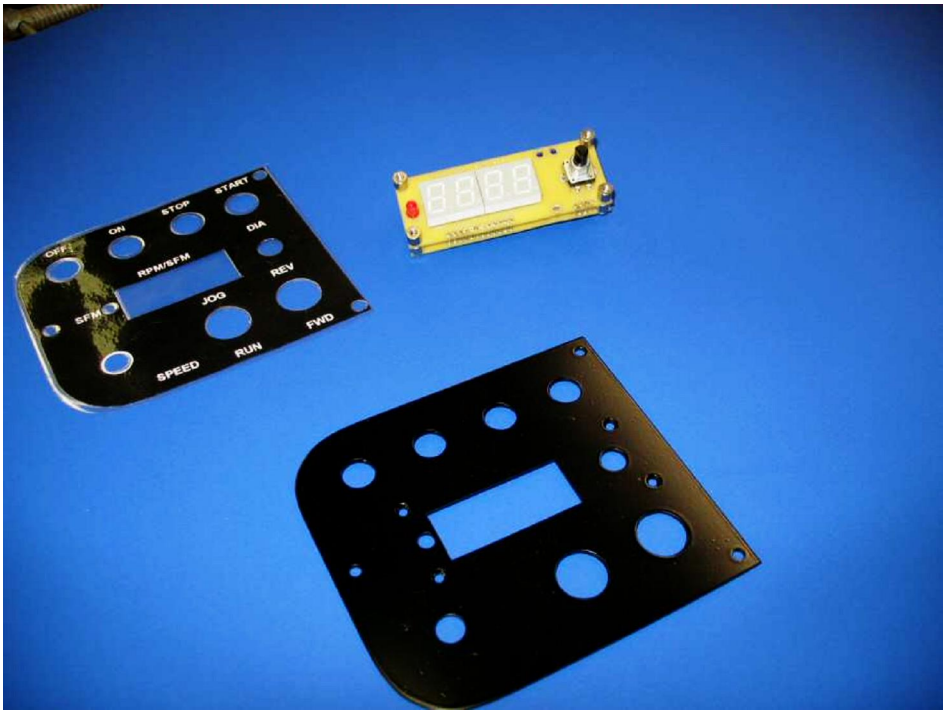
Plastic Laminator – Harbor Freight 92499

Example Plastic Laminated Panel

Here are a few tips on how to make a plastic laminated panel:

- Create your artwork and print it on thin photo paper. I use Paint Shop Pro but any photo editor will work.
- Make extra panels because not all of them will come out
- Cut out the overall panel, the display window, the LED hole, and the knob hole with an Xacto knife.
- After you cut the panel from the photo sheet, you can optionally color the edges of the paper with a black felt pin to avoid white edges. I color the display area and outside edges. This is cosmetic step but it does make the panel look nicer.
- Heat the laminator up for 20 minutes to assure that it is of a uniform temperature
- Make sure your photo paper panel is clean and place it in the lamination pocket
- Run it through the laminator and immediately place it inside a heavy book to allow it to cool flat. I have had good luck running the pouch through bare. I do not use any carrier or paper around the laminate pouch.
- The panel will have clear windows over the display area, the knob hole and the LED hole. Leave the Display window and LED hole plastic in place. Trim a round 3/8ò hole where the knob hole is but leave 1/32ò ï 1/16ò plastic border so that the panel is still sealed.
- Trim the outside edges at the plastic but not to the paper so that the paper is still sealed in plastic.

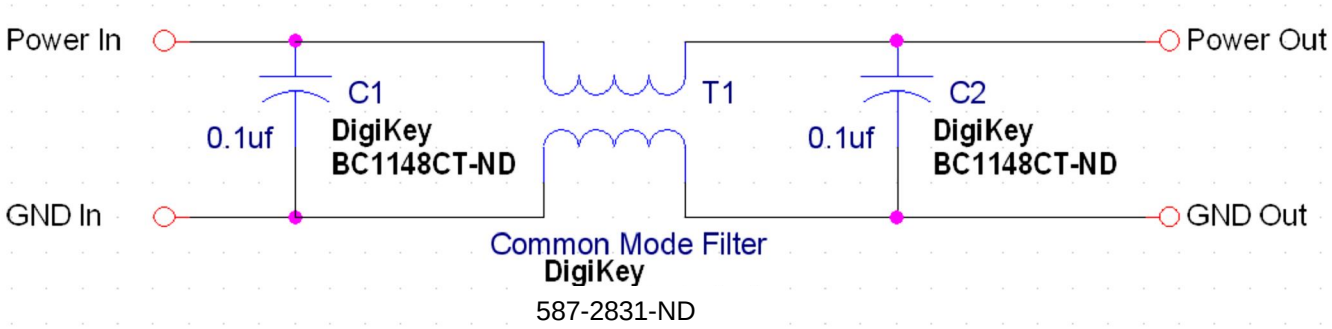
The panel can be attached using either contact cement or permanent double sided tape. Make sure the tape or glue does not obscure the window or LED.



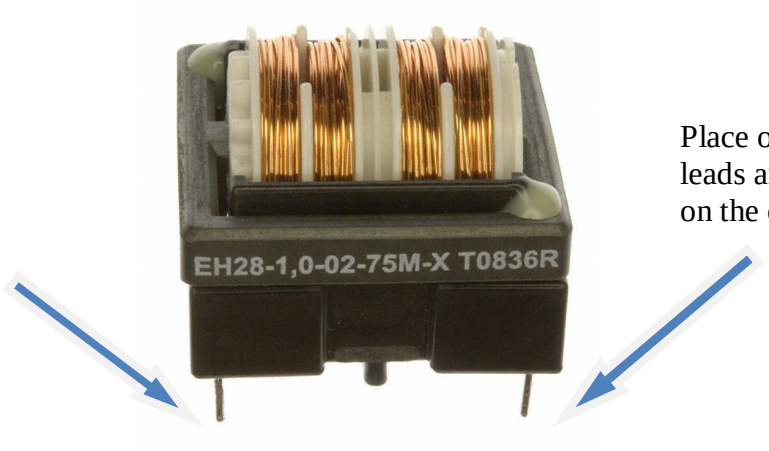
Another Example Plastic Panel

Using the MachTach with a VFD Powered Machine

If your machine tool uses a VFD motor speed control, you may need a power filter for the MachTach. This filter removes the noise on the power line caused by the VFD. The symptoms of noisy power are a MachTach display that fluctuates or has high or incorrect RPM readings. One easy way to determine if VFD noise is causing bad readings is to power the MachTach with a 9V battery. If the MachTach operates correctly with the battery but not with your wall transformer, then you will need this circuit. The following schematic including part numbers should be added to the input power of MachTach. The kit we supply comes with two capacitors and the filter. Install the cabs across the input and output of the filter and connect power in on one side and power out on the other side.



Power Filter Circuit

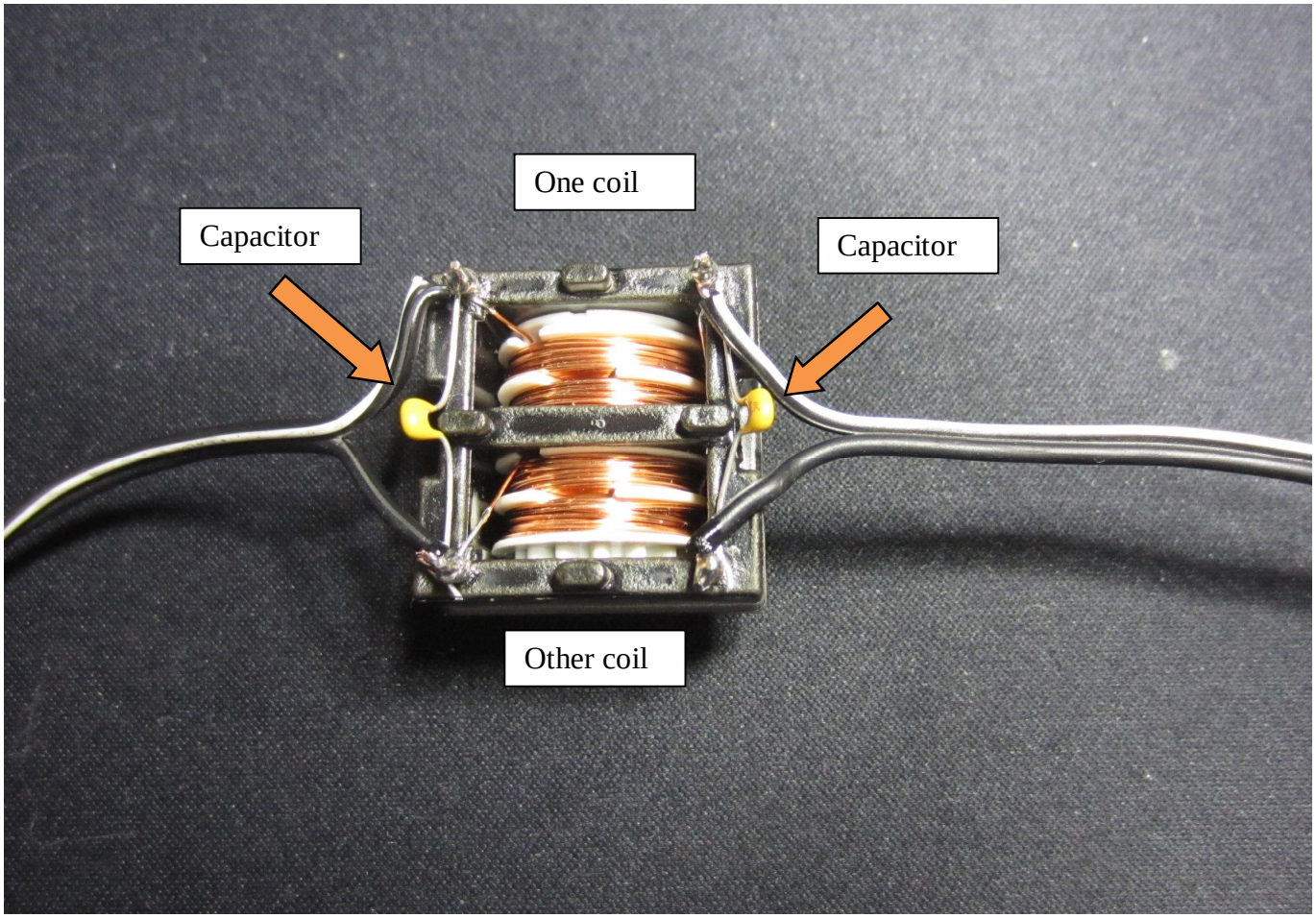


Place one capacitor across these two leads and the other across the two leads on the other side.

Common Mode Filter used with VFD Installations

Wiring the VFD Filter

The VFD filter should be installed as close as practical to the MachTach board on the 9V line. The following photo shows the wiring of the filter. Be sure the same polarity wire enter the filter on one leg exists on the same leg. You can see the black with white stripe enters on the top leg and exits on the top leg. Each capacitor is installed across the input and output of the filter. Once you wire your filter, you can epoxy it to a small mounting bracket to mount it inside your enclosure.



Troubleshooting

If you find that after assembling the MachTach, that it does not work, here are some tips to get it going. Most MachTach Problems are caused by a missed or cold solder joint or a bad or miss wired cable. Erratic operation is usually caused by a misadjusted sensor or noise from a VFD or other source.

No Display
Recheck all of your soldering. It is easy to miss soldering a joint or to have a cold joint. Check that you have 7-12V coming into the board in the lower right corner. Check that 5V appears at pin 1 of the MachTach IC as referenced to the GND pin in the lower right corner. I you assembled a half size kit, make sure you connected the 16 jumpers between the two boards.

Nothing happens when you push the knob or turn it
If you have built a half size module, make sure you connected the 4 jumpers near the encoder. Check that 5V appears at pin 14 of U3. Make sure that R1, R2, R3 have 5V on one pin. With a DVM connected to GND at the lower right corner and pins 9 and 11 of U3, make sure that as you turn the knob you see the voltage switching from approximately zero to 5V. Do the same at pins 8 and 10 of U3. With a DVM connected to GND at the lower right corner and pins 13 of U3, make sure that as you push the knob you see the voltage switching from approximately zero to 5V. Do the same at pin 12 of U3.

Display reads all zeroes but no RPM
Recheck your sensor wiring. This is easy place to make a mistake.
Check that 5V appears at pin 14 of U3. With a DVM at Sensor TP, turn your machine to activate the sensor slowly. Do this by hand if possible. Make sure that Sensor TP is switching between less than 1 V and greater than 4 V. If you find this is OK, check for the same at pins 2, 4, and 6 of U3. Check for switching between less than 1 V and greater than 4 V at pin 17 of the MachTach IC (pin 17)

Erratic results
If your RPM display is erratic, check the distance of the sensor. Check the wiring of the cable. Try operating the MachTach with a 9V battery. If it works normally, your power has noise possibly from a VFD or other noise in your shop environment. Install a common mode filter described in an earlier section. Also make sure your sensor cable does not run close to the motor wiring. This can also cause erratic results.

Wrong RPM
Recheck that you have entered the correct number of slots/patches/magnets. Try running from a 9V battery. If it works correctly, add the filter described earlier in this manual. Make sure your sensor is the correct distance from the target. If you are reading double the expected RPM with a Hall Effect sensor, enter twice the number for the magnets. Hall Effect sensors can see double the number of flux changes when the magnets are close together.

The SFM LED is Always On
It is installed backwards. Remove it and solder it in the other direction.

Some of the Display LEDs do not Light
Check your solder connections. If only one display digit is affected, the bad connection is with the transistor driving that digit. If the same segment is out on all four displays, the bad connection is between the MachTach, RN1, and the displays. If you have a half size module, recheck your jumper connections between the boards.

Half Size Module Display or Knob Does Not Work
Make sure that all 16 of the jumpers are installed and making good connections. Sometime users forget the 4 jumpers near the rotary encoder.

The RPM Reading is Erratic
An erratic display can be caused by unevenly spaced reflective patches or unevenly spaced magnets or slots. Do you have a VFD? You may need the VFD filter.

The RPM is wrong but steady
Check that you did not mix up the 22pf capacitors with the 0.1uf capacitors. Did you enter the correct number of patches/slots/magnets during the setup? If using Hall Effect sensor, are your magnets facing the correct direction? The wrong direction can cause a double reading under certain circumstances.

MachTach works but Sensor has no Effect
Check that you used the correct diagram depending on whether you mounted the connector on the front or backside of the board. Recheck your wiring. For IR sensors waving a white sheet of plastic close to the window should give you a display reading. For Hall Effect sensors, moving the North end of the magnet across the face of the sensor should give a reading on the display.

For Problems with Hall Effect Sensors
Check that you installed the Hall jumper. Make sure that R5 was adjusted. Usually all the way clockwise is correct for the Hall sensors we sell. Check the magnet orientation. It only works with the North Pole facing the sensorôs chamfered face. The wrong direction can cause a double reading under certain circumstances.

Recheck your soldering. Of the MachTachs returned to us for repair almost without fail, the problem is a missing or bad solder joint.

Suggested SFM Settings for Various Materials

The reason machinists care about RPMs and SFMs is that for certain materials, speed of material removal, and desired finish, the speed is important. You might say that you are satisfied to go slow but in some cases going too slow can cause problems like work hardening on stainless steel or poor surface finish on aluminum. Aluminum machines cleaner at the appropriate speed. Just knowing the speed is not enough because larger diameter work or tools cause higher speeds than small diameter work or tools. This is why we need to know how many surface feet per minute are being used. The following table lists the suggested SFM values for various materials. Many types of tooling whether carbide or high speed steel have suggested SFM values for best results.

MATERIAL (HSS tool)	SFM
Soft Aluminum	300
Copper	200
Yellow Brass	100
Mild Steel (leaded)	125
Steel, mild	100
Steel, Alloy 4XXX	90
Tool Steel unhardened	80
Malleable Cast Iron	80
Grey Iron Cast	60
Cast Steel	50
Titanium	25
The following multipliers can be used with the above information for other cutting tool materials:	
Cobalt steel tools 1.2	
Carbide inserted tools 2 to 3.5 depending on coating	

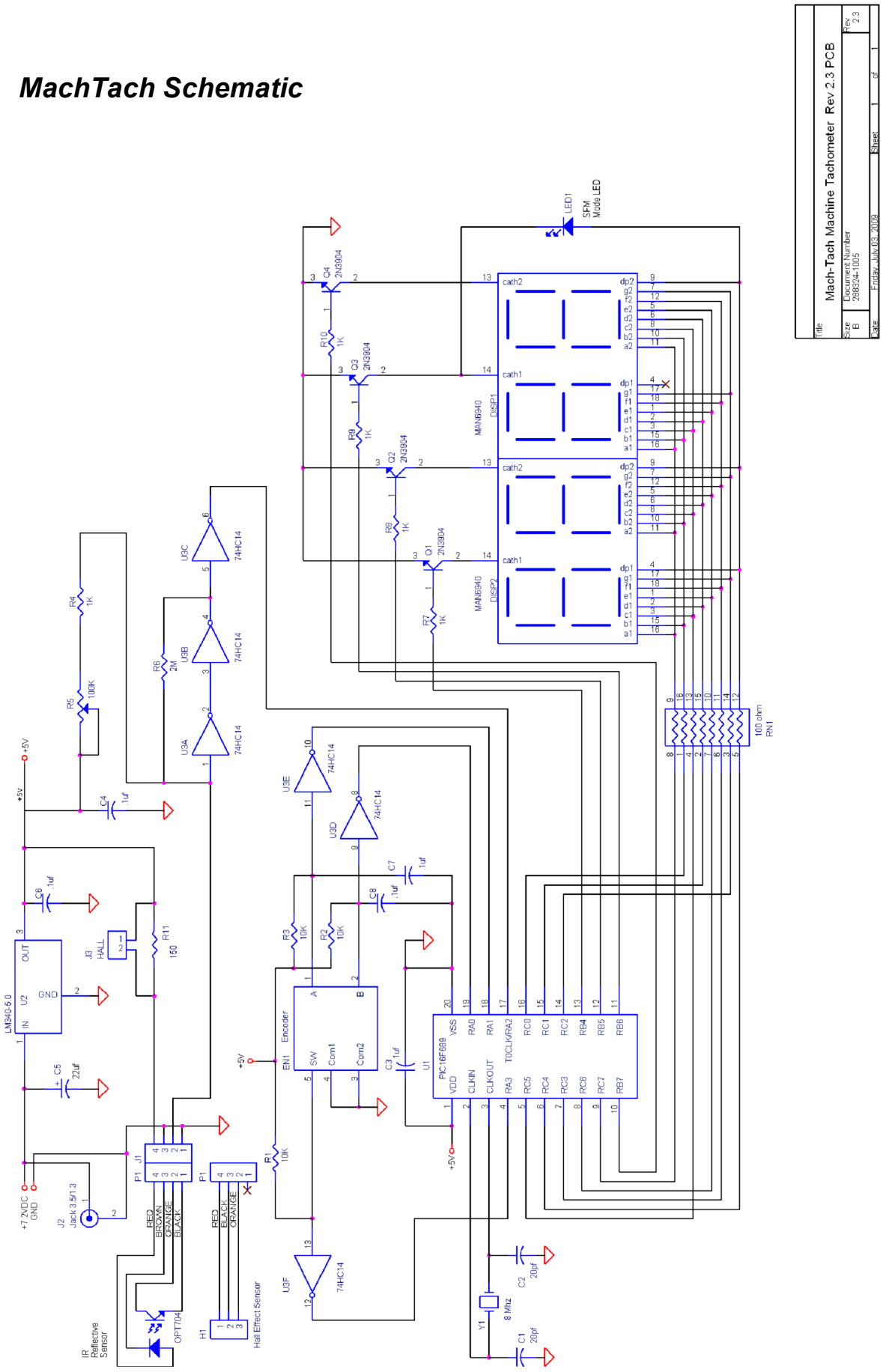
MATERIAL (HSS tool)	SMM
Soft Aluminum	100
Copper	65
Yellow Brass	35
Mild Steel (leaded)	40
Steel, mild	35
Steel, Alloy 4XXX	30
Tool Steel unhardened	25
Malleable Cast Iron	25
Grey Iron Cast	20
Cast Steel	16
Titanium	8
The following multipliers can be used with the above information for other cutting tool materials:	
Cobalt steel tools 1.2	
Carbide inserted tools 2 to 3.5 depending on coating	

Suggested SFM and SMM Settings for Various Materials

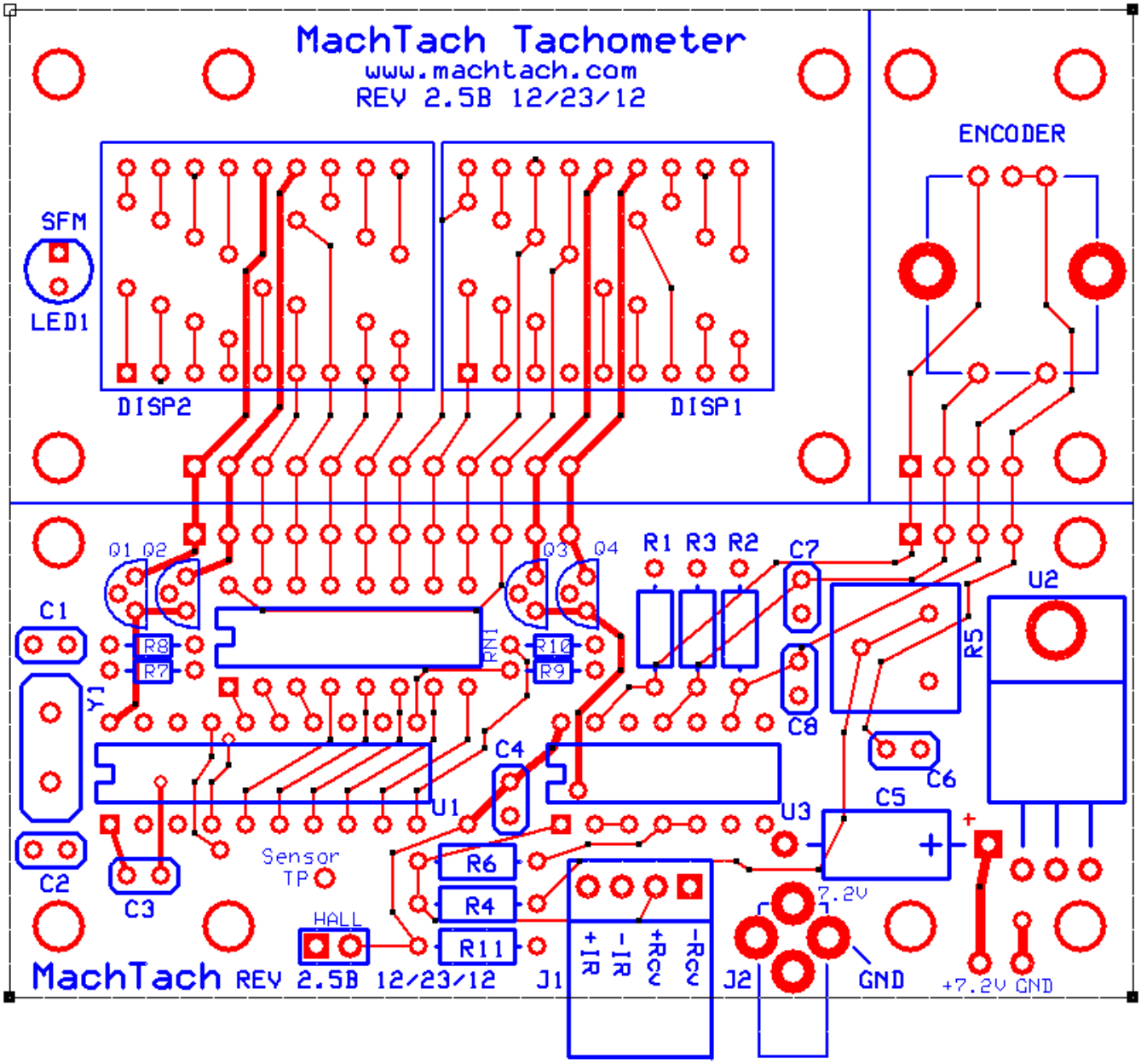
An interesting thing to note is that SFM applies to either the diameter of work spinning on a lathe or the diameter of an end mill turning on a Mill spindle. This allows us to use the MachTach with both lathes and mills by entering either the work diameter for lathes or the tool diameter for Mills. The MachTach will also work with band saws by entering the diameter of the wheel and sanders by entering the diameter of the drum. In each case we are concerned with the speed at the rim of a circle. The MachTach can take the RPM of any turning object along with the diameter of the turning object to calculate SFM.

SFM = Surface Feet per Minute
SMM = Surface Meters per Minute

MachTach Schematic



Parts Layout



Additional Information

The following pages contain a parts list, schematic and mechanical drawings for making your panel cutouts. The first mechanical drawing is for the plastic Serpac SR031 enclosure. The second drawing is for your own custom panel. The schematic is labeled for Version 2.3 but is correct for Versions 2.3, 2.4, and 2.5 of the MachTach

Mach-Tach Parts List

Mach-Tach PCB Rev 2.3, 2.4 & 2.5

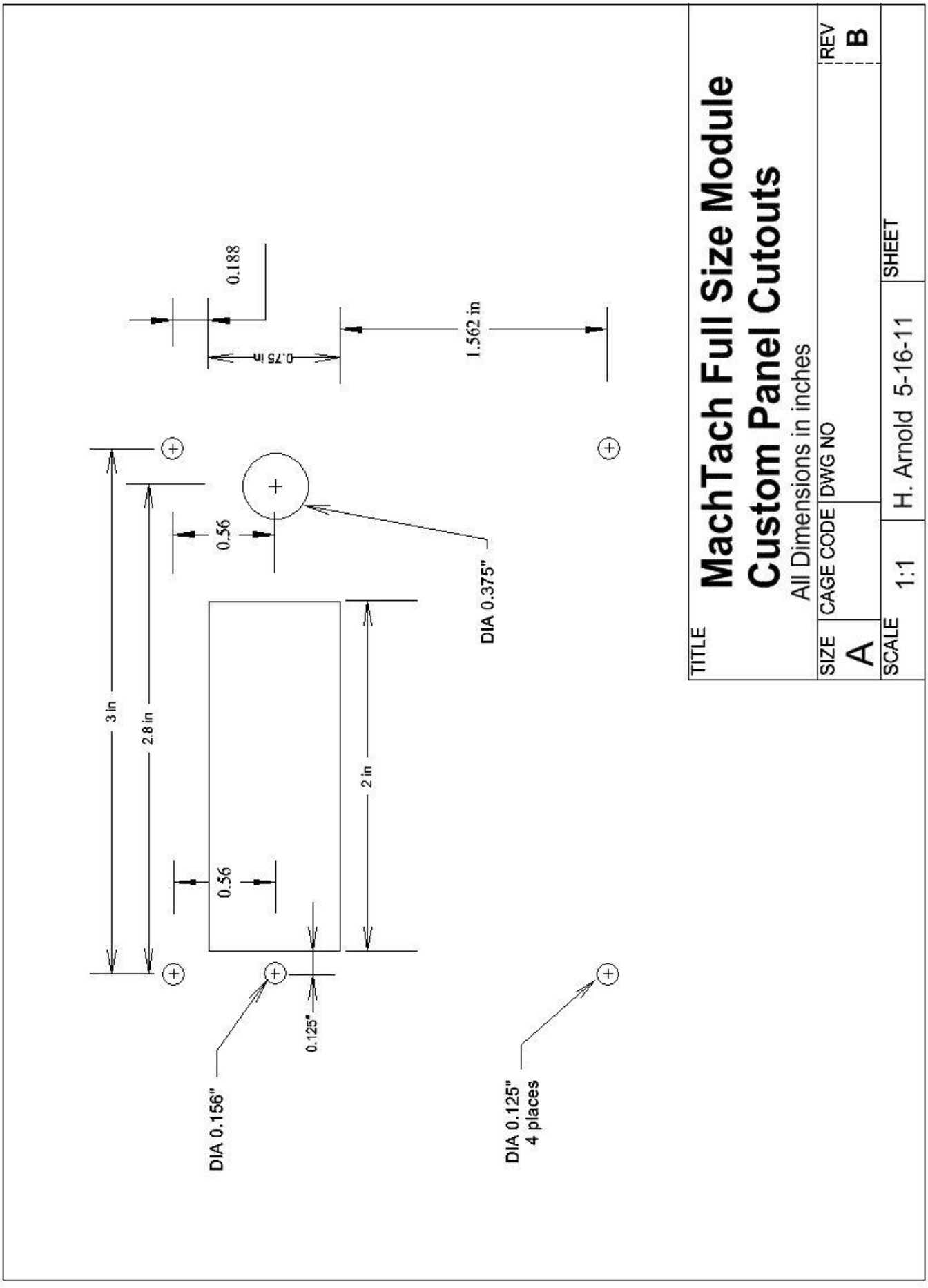
Quantity	Reference	Description	Manufacturer	Dist Part Number	Distributor
1	PCB1	Printed Circuit Board Rev 2.4	www.machtach.com	MacTach_PCB	machtach.com
1	U1	MachTach IC	www.machtach.com	MachTach_V2.3	machtach.com
1	ENCODER	ENCODER ROTARY w/ SW	Panasonic	P12336-ND	DigiKey
5	C3,C4,C6,C7,C8	Cap, Ceramic, 0.1uf		BC1148CT-ND	DigiKey
1	C5	Cap, Electrolytic,22uf Axial 16V		4046PHCT-ND	DigiKey
2	DISP1,DISP2	LED 7-SEG Dual Display - RED		516-1207-5-ND	DigiKey
4	Q1-Q4	Transistor, 2N3904		2N3904FS-ND	DigiKey
1	U2	Regulator, 5V LM340-5.0, T220		LM340T-5.0-ND	DigiKey
2	C1,C2	Cap, Ceramic,22pf		399-4162	DigiKey
1	R5	Var Resistor, 100K		3386F-104LF-ND	DigiKey
1	RN1	DIP Resistor Pack, 100 ohm		4116R-1-101LF-ND	DigiKey
1	D1	LED, Red, 3mm		160-1139-ND	DigiKey
1	R11	Resistor, 1/4 W, 150 ohm		150QBK-ND	DigiKey
1	U3	74HC14 Hex Schmidt Trigger		296-1577-5-ND	DigiKey
1	Y1	Crystal, 8 Mhz		X165-ND	DigiKey
4	R7,R8,R9,R10	Resistor, 1/8 W, 1K		CF18JT1K00CT-ND	DigiKey
1	R1,R2,R3	Resistor, 1/4 W, 10K ohm		10KQBK-ND	DigiKey
1	R4	Resistor, 1/4 W, 1K ohm		1.0KQBK-ND	DigiKey
1	R6	Resistor, 1/4 W, 2M ohm		2.0MQBK-ND	DigiKey
1	ENCODER	Knob, 1/4" shaft		450-1736-ND	DigiKey
1	U1	20 Pin Socket		AE9998-ND	DigiKey
1	J1	connector, jack	Waldom	WM4902-ND	DigiKey
4		nylon 0.3125" x 0.25" spacers		492-1075-ND	DigiKey
1		red LED plastic lens 1"x 2"		PRD250R-ND	DigiKey
1	J2	power jack 3.5mm x 1.3 mm		CP-031D-ND	DigiKey
1		crystal insulator		XC1750-ND	DigiKey

Sensor Cable Parts

Quantity	Reference	Description	Manufacturer	Dist Part Number	Distributor
1	P1	connector, plug	Waldom	WM2902-ND	DigiKey
4	P1	Pins - Connector	Waldom	WM2510CT-ND	DigiKey
1		3/8" x 1.5" Shrink Wrap			
1		1/16" x 4" Shrink Wrap			
1	Opto1	IR Reflective Sensor		365-1091-ND	DigiKey
1		6" x 1/4" reflective strip	Prostripe Pinstripe	R21205 Silver	Pep-Boys
3'		4 conductor shielded cable		644391	Jameco

Optional Parts

Quantity	Reference	Description	Manufacturer	Dist Part Number	Distributor
1	Plastic Panel	Custom Panel made from artwork using plastic laminator	from artwork at www.machtach.co		machtach.com
1	Enclosure	Plastic Enclosure - Full size	Serpac	SR031-IB-ND	DigiKey
1	Enclosure	Metal Encl. for 1/2 size MachTach	Hammond	HM841ND	DigiKey
1	L1	Choke Common Mode Filter		587-2831-ND	DigiKey
1	L1	Choke Common Mode Filter OLD		817-1015-ND	DigiKey
1	Opto1	Slotted Optical Sensor		365-1101-ND	DigiKey
1	Hall-Gear	Gear Hall Sensor		620-1326-1-ND	DigiKey
1	Hall1	Hall Effect Sensor		480-1999-ND	DigiKey
1		Wall Transformer - 9.0V		T981-P7P-ND	DigiKey
1		Wall Transformer - 9.0V 240VAC			DigiKey
4		Spacers - PCB Mount, 0.375" x 1/4"dia 4-40 threaded		3486K-ND	DigiKey
2	Disp1,Disp2	LED 7-SEG Dual Display - GREEN		516-1209-5-ND	DigiKey
1	D1	LED, Green, 3mm		751-1101-ND	DigiKey
1	RN1	DIP Resistor Pack, 82 ohm FOR GREEN		4116R-1-820LF-ND	DigiKey
6	magnets	Neodinium 0.25" x 0.0.625"			Amazon.com
1	ENCODER	Knob, 1/4" shaft	alternate source	264990	Jameco
1	C5	22uf , 16V Capacitor	alternate source	4046PHCT-ND	Jameco
1		red LED plastic lens	alternate source	2423 1/16"	Delvies Plastics Inc
1		green LED plastic lens		2092 1/8"	Delvies Plastics Inc
4		nylon 0.125" x 0.25" spacers		492-1087-ND	DigiKey
4		4-40 x 5/8" SS panhead screws		H348-ND	Digikey
1		power plug		CP3-1003-ND	Digikey
4		pcb screws #4 x 3/8"		H800-ND	Digikey
4		4-40 x 9/16" SS panhead screws			McMaster-Carr
1		power plug		CP3-1003-ND	DigiKey
4		pcb screws #4 x 3/8"			McMaster-Carr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0.75 in
1.562 in
3 in
2.8 in
0.56
DIA 0.375"
0.56
2 in
0.125"
DIA 0.156"
DIA 0.125"
4 places
TITLE
MachTach Full Size Module
Custom Panel Cutouts
All Dimensions in inches
SIZE
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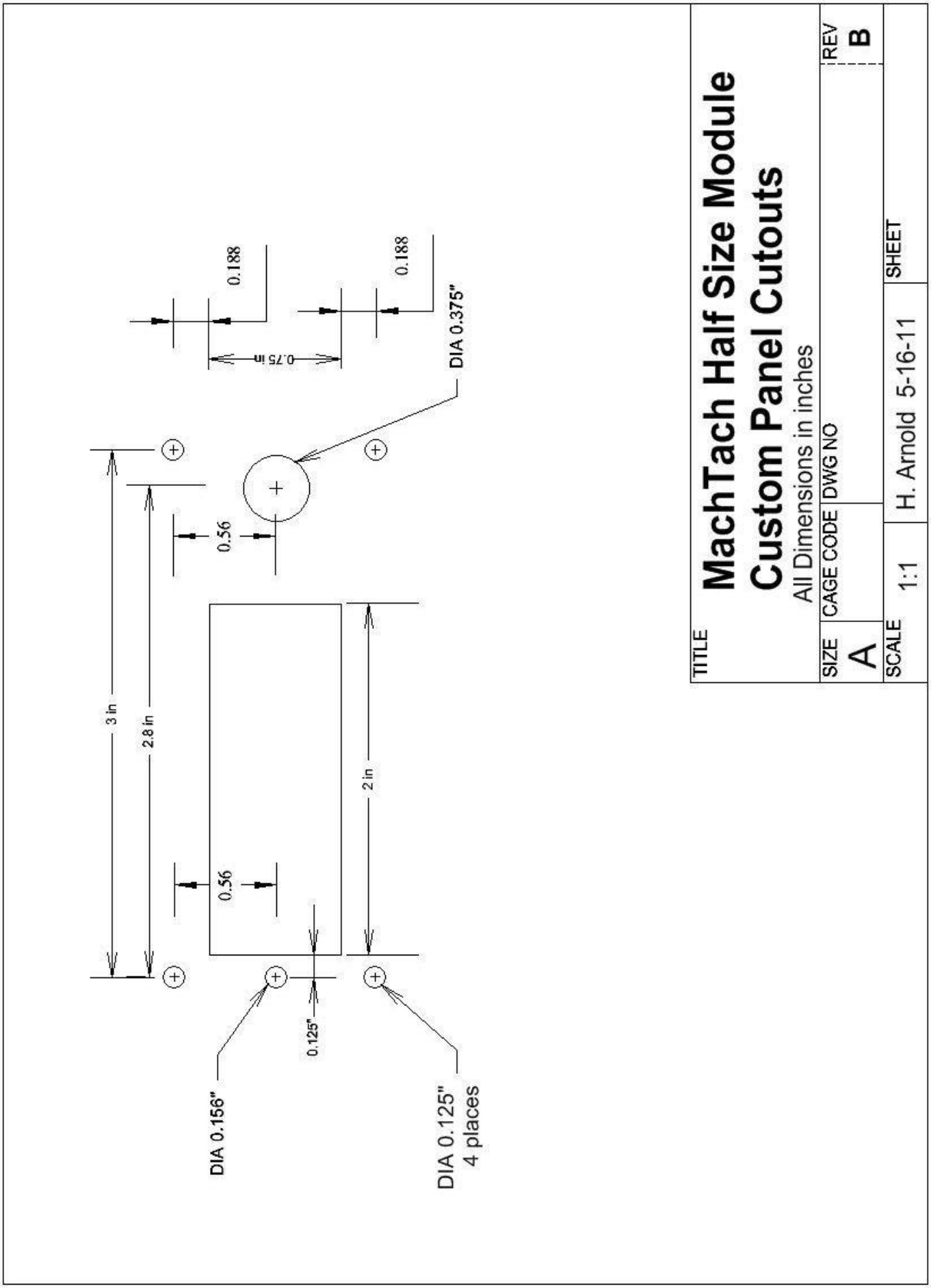
CAGE CODE
DWG NO
REV
B
SCALE
1:1
H. Arnold 5-16-11
SHEET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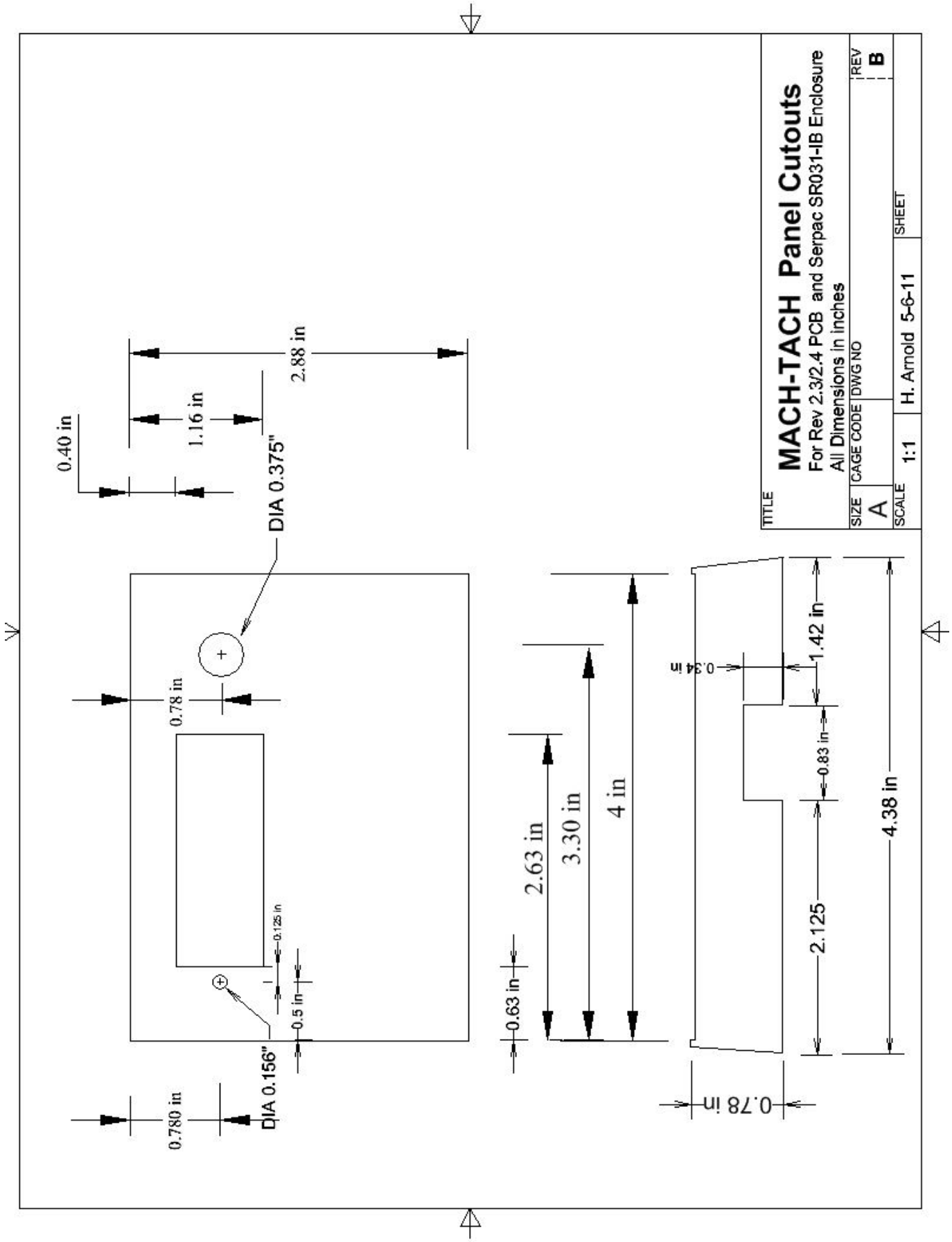
MachTach Half Size Module
Custom Panel Cutouts
All Dimensions in inches
SIZE
A
CAGE CODE
DWG NO
REV
B
SCALE
1:1
H. Arnold 5-16-11
SHEET
3 in
2.8 in
2 in
0.56
0.56
0.188
0.188
0.75 in
DIA 0.375"
0.125"
DIA 0.156"
DIA 0.125"
4 places


MACH-TACH Panel Cutouts
For Rev 2.3/2.4 PCB and Serpac SR031-IB Enclosure
All Dimensions in inches
TITLE
SIZE A
CAGE CODE
DWG NO
REV B
SCALE 1:1
H. Arnold 5-6-11
SHEET
0.40 in
1.16 in
2.88 in
DIA 0.375"
0.78 in
0.125 in
0.5 in
DIA 0.156"
0.780 in
2.63 in
3.30 in
4 in
0.63 in
0.34 in
1.42 in
0.83 in
2.125
4.38 in
0.78 in

Frequently Asked Questions

1. Why does the MachTach only go to 9999 RPMs? - The MachTach is designed for machine tools which rarely run faster than a few thousand RPMs so it did not make sense to add another display for 10,0000 RPM capability

2. Can I mount the MachTach inside my machine tool? - Yes! The MachTach is designed to be small enough to fit into many machine tool panels. The MachTach can be assembled into a half size module which will fit into tight spaces.

3. What types of sensors are supported? - The MachTach will work with IR reflective, IR interruptive, Hall Effect, and other proximity type sensors like gear sensors. Basically anything that can output at least a 1V - 4V waveform will work.

4. Why would I need the VFD Filter? Sometimes machines that have a VFD or other frequency drive motor controller create a noisy electrical environment. This is similar to static on a radio when a power tool is operated but is conducted through the power wiring. The filter removes the noise so that the MachTach can operate correctly. The noise can cause erratic MachTach operation.

5. What happens if I can't get my MachTach to work after assembling it? ï Weôll help you to get it working. Send us an email. MachTach also has a great forum with people that have built MachTachs. You can also get help there. Send us photos of the front and back side of your board and weôll look to see what may be wrong. Worst case, you can send it back to us and we'll fix it for a nominal fee.

6. Why is Surface Feet Per Minute SFM important? - RPM is only one way of telling how fast something is going and it does not take into account the diameter of the tool or the work piece that is turning. Surface Feet per Minute measures how fast the material is moving past the tool whether it is an end mill or a lathe tool. SFM is important in controlling finish for materials like aluminum and stainless steel and for protecting your tooling from excessive speeds or your work piece from too slow of a speed.

7. Why should I pay $50 plus for a tachometer kit when I can get a handheld one for $20 on EBay? ï Handheld tachometers are an inexpensive way to measure RPMs. If you are happy with a hand held unit, that is the cheapest way to go. If you want a nice looking tachometer and surface feet per minute display installed as a part of your machine tool and designed for machine use, the MachTach is one of the only options available. MachTach is also fun to assemble and you will be familiar with its operation since you built it.

More MachTach information and applications can be found at the following two websites:

www.machtach.com

http://groups.yahoo.com/group/MachTach/