

DIY Steam Gauge Options for Home Flight Simulators

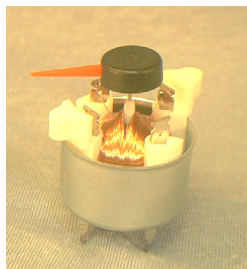
Mike Powell

A home flight simulator can greatly enhance the already outstanding experiences provided by today's simulation applications. A home simulator can block out sights and sounds that detract from the simulation experience and add visual and functional elements that support it. As the realism grows to occupy our full attention our disbelief in the illusion fades and we are flying!

Home simulators are customized based on personal preference and situation. A general approach is to prioritize your work based on the amount of interaction with each part of the simulator. Focus first on systems you will physically interact with most, like the primary flight and engine controls. Systems that you will visually respond to most, probably the exterior view and main instrument cluster, come next. Systems indicators and controls come last. Note that removing (or blocking out) distractions can offer as great an improvement as the addition of more bells and whistles.

Adding an instrument panel improves your simulator several ways. With the instruments off the main display the exterior scenery view is better. Having the instruments closer than the scenery display causes your eyes to focus differently when moving from one to the other. This creates a subtle but important feeling of inside versus outside. And of course, the instruments themselves add a substantial degree of functional and visual realism.

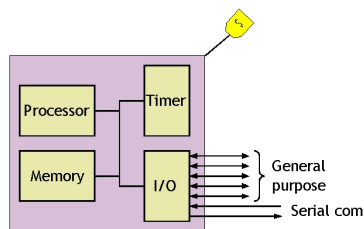
You can build extremely realistic simulated instruments using these building blocks.



Air-core movements excel in low-torque, single-needle applications such as IAS, VSI and tachometer simulations. The movement has two windings that control the pointer direction. Winding current and voltage requirements are modest, and the associated electronics is simple. A low cost micro controller accompanied by a pair of support chips can both control an air-core movement, and interface it to a PC's serial port. Movements can be salvaged, built from scratch, or (possibly, maybe, perhaps) purchased new.

Air-Core Movement Manufacturers

- Beede Electrical Instrument Co., Inc. www.beede.com
- Thomas G. Faria Corp. www.faria-instruments.com
- Prime Instruments, Inc. www.primeinstruments.com
- Simco, Ltd. www.simcoltd.com
- Teleflex Electrical Inc. www.tflx.com



Micro Controllers are the “universal glue” of DIY instruments and home cockpit building. Even inexpensive models offer several I/O options and enough memory to model surprisingly complex behavior in simulated instruments. A little time invested learning how to use these devices will pay large dividends. An introduction to working with micro controllers from MicroChip® is the book [Programming and Customizing PICmicro Microcontrollers](#), 2nd ed. by

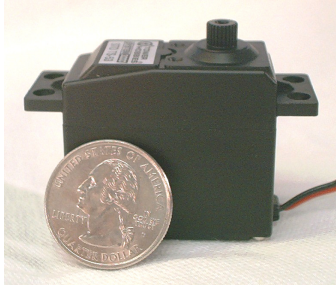
Myke Predko. Manufacturers' websites (MicroChip® www.microchip.com, Atmel® www.atmel.com, etc.) offer detailed device information, sample firmware, application notes and free development tools. Several web sites offer free information about programming micro controllers and building simple programming hardware.

Device Programming Applications

- IC-Prog (freeware) www.ic-prog.com
- PICALLW (freeware) www.picallw.com

Designs for DIY Programmers

- P16PRO programmer www.picallw.com
- JDM programmer www.jdm.homepage.dk/newpics.htm



Servos are useful for applications requiring greater torque. A servo uses a geared-down motor to provide that torque, a position sensor to measure the output shaft's rotational position, and control electronics to make the whole thing go. You can build a servo system from individual components, or you can use an RC servo that conveniently packages everything in a single, small box. Rotation is limited to 90 or 180 degrees (varies by model) because of the potentiometer used for internal position sensing. RC servos are easily controlled and interfaced by micro controllers.

RC Servo Sources/Manufacturers

- Airtronics www.airtronics.net
- Cermark www.cermark.com
- FMA Direct www.fmadirect.com
- Futaba www.futaba-rc.com

Electronic Components Sources

- DigiKey www.digikey.com
- Jameco www.jameco.com
- Mouser www.mouser.com

Plastic Sources (to make acetal bearings)

- Tap Plastics www.tapplastics.com
- US Plastics www.usplastics.com

- GWS www.gws.com.tw
- Hitec RCD USA www.hitechrcd.com
- Hobbico www.hobbico.com
- Tower Hobbies www.towerhobbies.com

Small Gear Sources

- Serv-O-Link www.servolink.com
- Small Parts www.smallparts.com
- Stock Drive Products www.sdp-si.com

Small Ball Bearing Sources

- VXB Ball Bearings (buy through Ebay)
- Tower Hobbies www.towerhobbies.com (look for slot car replacement bearings)



Stepping motors provide substantial torque, unlimited rotation and accurate relative positioning (you must establish an initial position when the device is first powered up). Stepping motors are stepped by switching current to the motors' windings, a task easily accomplished by a micro controller and a few support chips. An excellent online reference is "Control of Stepping

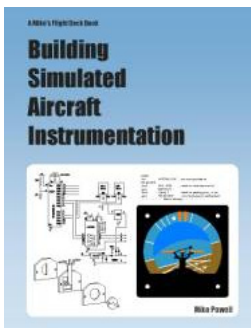
Motors" by Douglas W. Jones available at www.cs.uiowa.edu/~jones/step/. Application notes by Allegro MicroSystems, www.allegromicro.com, (makes motor driver chips) are additional sources of information, as are the web sites of motor manufacturers.

Stepping Motor Manufacturers

- Astrosyn www.astrosyn.com
- Danaher Motion www.danahermcg.com
- Lin Engineering www.linengineering.com
- Nippon Pulse Motors www.nipponpulse.com
- Minebea Electronics www.minebea-ele.com/en
- Mitsumi www.mitsumi.co.jp
- Shinano Kenshi www.shinano.com

Surplus Stepping Motor Sources

- All Electronics www.allelectronics.com
- Electronics Goldmine www.goldmine-elec.com
- Alltronics www.alltronics.com
- Jameco www.jameco.com



Building Simulated Aircraft Instrumentation is the ultimate book (actually, it's the only book) on building instruments for home simulators. It covers air-core movements, servo systems and stepping motors in detail, and demonstrates through projects how to apply each to instrument simulations. All projects are fully documented with dimensioned mechanical drawings, electronic schematics and commented firmware listings. Visit Mike's Flight Deck Books, www.mikesflightdeckbooks.com, for a sample chapter and ordering information. 400 pages 7" x 9 1/4" trade paperback.