

# Re: REQ: major electronics analysis project help needed TIA

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*Source:* <http://sci.tech-archive.net/Archive/sci.electronics.design/2005-06/msg00551.html>

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- *From:* "PeteS" <ps@xxxxxxxxxxxxxxxxxxxxxx>
  - *Date:* 4 Jun 2005 07:04:47 -0700
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>JB2 <n...@xxxxxxx> wrote:

>>I have to log 150 discrete inputs, some AC and others DC, voltages and currents. I plan on using simple inductive pickups and voltage probe points.

>How often do you need to log each input?

<<Still to be determined, but preliminary data acquisition will need to be during major changes in flight profiles, such that sample rates may only be required when user selects the need and not a continuous sampling.

>>

How many sample points will you need per effective sample? A-Ds have many subtle errors, and taking multiple samples can help around that. There are a number of algorithms available to give a more accurate result, even in the presence of noise. That brings up how fast the effective sample must be taken, which will help you decide what type of converter to use.

> Do some inputs need to be logged more often than others?

<<

No, in fact would rather have all samples at the same time for comparative analysis.

>>

How simultaneous is 'same time' ? Can some systems be treated in relative isolation, (for instance, can 20 or so [or whatever] of the inputs be dealt with as a separate / independent set) or must all the inputs be sampled at the same time?

>What kind of voltage and current ranges do you need?

<<

Gen output is 40kVA three total & One 1kVA

115v 1 phase 400Hz 650 amps

115v 3phase 400 Hz

220v 2Phase 400Hz

28 vDC 200 amps max. There are two TRs tied together in parallel, EA max 100 amps. Loss of various equipment will be executed and data

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sampled for future capabilities and emergency procedures. The main concern is the capability of the TRs to handle various loading configurations but data for all sources is required.

>>

Do you need RMS measurements only, or must you detect variations in the cycle? Again, this helps determine the speed of the acquisition, and the dynamic range it requires.

> Do you need analog measurements for everything, or is  
>digital OK for some of the inputs?

<<

Data will be used for reporting purposes, future calculations and modeling. I will probably end up building a more accurate model than currently exists (current model is solely analytical, no hard data available) All the sources are analog, but how those samples are obtained, I don't think will make a difference. I thought simple inductive pickups that feed analog to dig conv for recording.

>>

I would agree that A-D is the best solution here – much easier to record the data (imo). That said, in an aircraft there are multiple sources of noise, and the pickups should probably be buffered with instrumentation amplifiers which have superior common mode rejection. That may be within the converter, or a separate entity nearer the source.

>How accurate does each analog reading need to be?

<<

Big question! I would want at most  $\pm 2\%$ . I suspect any more deviation may make modeling too inaccurate.

>>

2% of full scale? Or 2% of whatever the sample happens to be? If you expect widely varying samples you might want to get a mu law or A-law converter (used in digital audio). These have a fairly constant quantiser error relative to the level of the signal. A linear converter will have (at best)  $\pm 0.5\text{LSB}$  error. At small samples, that can be a large error. (Most converters have larger actual errors than this)

>>Any suggestions?

>The 150 channel requirement is a biggie. If you don't need to log each input that often, it's not as big of a deal, but if you need high data rates, it may get a little expensive.

<

As noted, if you want to get all the inputs as a snapshot together, you'll either have to have 150 channels, or determine an acceptable window for the multiplexer, which will help determine the conversion time requirements.

>>I know I'll need a DAC, just not sure which would work best.

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There are premade ADC modules you can use (and probably should as it means you won't have to build them yourself unless you need ultra fast sampling). There are tradeoffs in terms of accuracy, linearity, acquisition speed and input signal requirements.

>Budget?

LOL yea right. in house resources availability of equipment., Nextweek I can check whats available, for now, I'm simply attempting to get a solid foundation for a POA.

> If you have plenty of somebody else's money, and you don't need to log each channel more than once every several seconds, go buy a data logger like a Fluke Hydra. This is essentially a good auto-ranging multimeter with a DP21T switch on the input leads. Some models can only output the data immediately over a serial port, while some can store data in an internal memory. The potential problem here is that it costs US\$2,000-\$3,000 for 20 channels, and you need to do that seven and a half times. You might be able to buy one data logger and multiplex the inputs to it with external silicon, switches, or relays. You need a 40P8T contact arrangement...

Outstanding suggestion

>>

I agree – but see my caveats about acquisition speed above.

>Instead of trying to log everything at once on a laptop, it might work better to select smaller boards with 10 or 20 inputs and let each board log to local memory, then download all the boards at the end of the flight. This may also tend to reduce the number of wires strung around the aircraft, if you can locate the boards near the measurement points.

You need some kind of sync between the boards... they all have to start their clocks at the same time, or get individually synchronized to GPS or WWV, or you need to string a wire between them. You may also have to be careful where you put the boards physically... if they make the aircraft radios go screwy the pilot will not be happy with you.

I do have GPS signals available

>>

If you can separate various measurements (i.e. a snapshot of everything is not required to be synchronised) this is a good idea. If everything has to be synchronised to an event, then you'll need some method of communicating that between measurement nodes. If not, then GPS time is a good solution.

<<

>This may be obvious, but it's probably a bad idea for there to be just one person trying to fly the plane and operate the data logging at the same time. If one-man operation is required, the interface to the data logging has to be very simple, or even something that can be started before takeoff by someone else and stopped after landing.

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I have a crew on board, flight crew, technicians, engineers (me) 707

A/C

>>

>I'm somewhat curious as to what you're doing... most of the people that want to do something like this probably work for an aircraft manufacturer and in that case I would think they'd just buy off-the-shelf stuff. But hey, maybe you're building an experimental jet in your garage. :)

I wish LOL no.... DOD trying to avoid using \$\$\$\$\$ contractors, We have the resources, but money is limited and this is my 1st project of this magnitude that I'm heading up.

>Once you can answer most of the questions above – in other words, when you can state your requirements more clearly – you may want to cross-post or post to sci.electronics.design for more good input.

>Matt Roberds

thanks Matt

The basic questions I would have before suggesting a specific solution are noted above, summarised here:

1. Do all the inputs have to have synchronised samping?
2. Can a window be established for samples to enable sample multiplexing?
3. Should you oversample to overcome errors?
4. How fast must the samples be when an 'event' occurs?
5. You may need to buffer the source transducers to minimise common mode noise.
6. What sampling error is acceptable and relative to what?

Not noted: Are any of the sampled sources outside of the cabin? If so, you'll have to be careful about temperature dependencies on the transducer / amp / connectors.

Cheers

PeteS

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• *Follow-Ups:*

◆ **Re: REQ: major electronics analysis project help needed TIA**

◇ From: JB2

• *References:*

◆ **REQ: major electronics analysis project help needed TIA**

◇ From: JB2

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