SR830 vs. EG&G 7265 Discussion

Customer

I am considering getting an SR830 lock-in. An alternative is an EG&G model 7265. The price is enough the same this not a factor. But I am interested in what appears to be (from my reading the EG&G brochure) an interesting difference in the user interface. I hope you have time to respond to this lengthy note. I have read the 830 info in your catalog.

The EG&G brochure mentions the following modes:

1. Dual harmonic
2. Dual reference
3. Virtual reference
4. Spectral display
5. Frequency response
6. Transient recorder

I am not an expert lock-in user but, as a physicist, I believe I would understand your comments if you care to make any. I certainly would appreciate hearing from you directly instead of going through either of your representatives. In addition to the user interface question please feel free to explain to me any other particularly significant advantage of the SR 830 over the EG&G lock-in.

SRS response

Thanks for your interest in SRS and specifically the SR830. Let me start by addressing your questions about the EG&G 7265. I think the most interesting (and annoying) thing is that they advertise the 7265 as a 250 kHz bandwidth lock-in. It's not until you get the unit, open up the box and start reading the manual that you find out it is actually a 60 kHz lock-in! They sample the front-end A/D converter at 166 kHz, which should give you a bandwidth of 83 kHz (and still satisfy Nyquist - which says you must sample at twice the max. frequency of interest), but they don't use a very steep rolloff anti-aliasing filter so the actual bandwidth is 60 kHz. Then they go on to say that you actually can measure signals above 60 kHz, in fact all the way up to 250 kHz, but the lock-in will be undersampling which will create aliasing (distortion), and lots of it. If you're operating at a frequency where aliasing is occurring, your measurement will be completely erroneous and there's no way you'll know it. Then they say, so go ahead and use the lock-in above 60 kHz - at your own risk.

If you can get your hands on their manual and read this discussion for yourself it will make even more of an impact. How they can ignore Nyquist and have the guts to advertise this design flaw is beyond me.

This is probably the reason that the 7265 has never penetrated the market. The SR830 has a majority of the worldwide lock-in market while the 7265 has very little. You can go into any lab and ask anyone's opinion about lock-ins and they will be familiar with the SR830. It will be hard to find anyone who knows about the performance of the 7265.

Now about the dual harmonic / dual reference mode. This feature gives the user the ability to slave the lock-in to an external signal (like one from a chopper), and then dial up another frequency from their internal source, and detect at both frequencies. I think they added this feature to make normalizing to laser source intensity fluctuations easy. But actually it is rare that you would ever use this feature for normalization. If you did it would require another chopper that could be slaved to an external reference signal (not an easy thing to find) and another detector. On the SR830 normalization is easy. There's a separate input for the normalizing signal and you just choose 'ratio' for the measurement.

The 'virtual reference' on the 7265 is another useless feature. In fact, any lock-in can be operated in a 'virtual reference' mode by simply using the internal source.

The frequency response feature sounds great but is really sort of silly. Let me give an example. We make FFT spectrum analyzers (excellent frequency response tools) and I have access to them always. They are on the same bench as my lock-ins. How often do I use the spectrum analyzer to help me choose a good operating frequency for my lock-in experiments? The answer is never. I use good common sense in choosing an operating frequency, like avoiding 50/60 Hz, but looking at the frequency response of my input is something I would never do.

The transient recording feature may be useful. We have this feature on our model SR850 and there are times when it is useful, but most of the time I just want to see my current measurement results.

I encourage you to get the EG&G manual and read through it. If you do, pay close attention to pages 3-7 through 3-9. Their discussion about the 60 kHz bandwidth, aliasing, etc. is amazing - they really make themselves look foolish.

If you have further questions about the 7265 and SR830's performance and features please contact me. If you decide to buy the SR830 and are not fully satisfied, we will take the unit back.

Customer

Thank you. I will look in the physics department at an SR830 and at an EG&G which I know exists. I am not sure which EG&G it is. I should be able to read the manuals, as you suggest, and talk to the users. Your explanations are clear and instructive. I did notice that the EG&G brochure advertises 250 kHz bandwidth and I am glad you pointed out what they have done. That misdirection in advertising alone (indicating other possible difficulties) may be enough for me to prefer the SR830.

Customer

As you suggested I investigated the EG&G 250 kHz specification. I asked them for their sampling rate and their anti-aliasing filter technique. In response I received a report #98/051 dated April 27,1998. They admit to the undersampling at 166.7 kHz and agree that this is in disagreement with the sampling theorem. They do not call it the Nyquist theorem but it is obviously that. Later they explain how they do filtering at the higher frequencies and the explanation includes: (I quote) "Does Undersampling Matter? The only situation where undersampling in the EG&G 7220 and 7260 instruments may cause a problem is when they are used at high reference frequencies (above 60 kHz) with short time constants (less than 5 ms).

At reference frequencies greater than 60 kHz, the instruments anti-aliasing filter changes to a bandpass response."(End quote)

They go on to describe the beat frequencies above the 60 kHz region. And then discuss this in more detail especially with respect to the bandpass filter and the effect of time constant variation on improving the condition.

Then the following:

(Again I quote)
"AND REMEMBER....
The vast majority of applications (probably 80%) are performed at frequencies well below 60 kHz so that undersampling should never be a problem for the user" (End quote)
So Dave, your statement about their sampling rate is substantiated.

Earlier in their report they state:

(I quote) "Why Do We Use a Lower Sampling Rate?
We use the same 18-bit ADC as is used by SRS, but we run it within its specified operating frequency range. The device manufacture's absolute maximum rating for the sampling frequency is 200 kHz and so SRS are using it at a frequency which is 28% higher that that for which it is designed. At this frequency, its equivalent number of bits of output accuracy is very much less than 18 bits, and may possibly be as low as 12 bits. The effect of this is to produce an instrument with a noisier output than ours when measuring the same signal and operating at the same control settings." (End quote)

They then describe a comparison test at 57 kHz using a EG&G 7260 and a SR 830. EG&G dynamic reserve set at 50 dB and SRS at "Normal". A 10 uv signal. Set at 20 uv full scale sensitivity, with 6 db/octave output filter slope. 7260 set to 320 us and SR 830 to 300 us time constants. 180 samples of the voltage recorded for 20 seconds.

They state from that test: (I quote)"...the EG&G 7260 is more than four times less noisy than the SR 830. At higher dynamic reserve setting the difference is even greater". (End quote)

Please note that they use their 7260. Now they have the 7265. I don't know if that matters.

QUESTIONS OKAY? First I still favor Stanford. 1.Although I don't know if applies in my application, but I still am interested in this noise comparison. I can always increase the time constant I use to change the filter response. Would you please comment.
2. I will be measuring the output of a photoelectric cell. I want a record of the current delivered by the cell as a function of the wavelength of the incident light. From this we will calculate quantum efficiency. I think these are relatively slow cells in the millisecond region perhaps. I do not know their internal impedance yet. I see there is a "low" impedance input mode in the SR 830. How to I get a figure for the photoelectric current out of the cell?

I greatly appreciate you help up to now and hope you can take the time to answer these two questions.

SRS response

Thanks for the information. I'm happy to see you have explored the under sampling thing yourself and come to the same conclusion.

I find the little experiment EG&G has designed rather humorous. What they have done is compared apples to oranges, not apples to apples. If you look closely you'll find that they place the SR830 in 'normal' dynamic reserve, which is 75 dB for 20 us sensitivity setting, and place the 7260 at 50 dB dynamic reserve for the same sensitivity setting. If you place the SR830 in 'low noise' dynamic reserve, which is 44 dB (a lot closer to 50 dB than 75 dB is) for this sensitivity setting, the SR830 cleans up by about a factor of 30 and should be much quieter than the 7260. You have to compare apples to apples but that's EG&G for you!

But this whole thing is a joke anyway. Our lock-in is not optimized at 6 dB/oct rolloff. To optimize a measurement you should use a steeper rolloff, like 24 dB/oct. And you'll find you can use a much shorter time constant and still get effective filtering.

I'm not sure what you are asking in the second question. The SR830 does have a current input (low impedance) which you should use. Are you looking for detailed specs on this input? If so, there are some specs in the SR830 brochure and it is very similar to the SR570 Current amplifier at the 10e6 or 10e8 gain settings. You can find specs on these products in our catalog or on our web site (www.thinkSRS.com).

I hope this is helpful.