

## HP Forum Archive 13

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### 15c or 32s, which is better?

Message #1 Posted by [Jim B](#) on 4 Nov 2003, 5:39 p.m.

I have a choice between picking up either a 32s (Singapore 1991) or a 15c (US 1987). Both are in like new condition. The problem is that I can only pick up one of them and I'm having a hard time choosing. I thought I'd get the opinion of those of you who are knowledgeable about both calculators. So, which one should I choose????

*Edited: 5 Nov 2003, 10:46 a.m. after one or more responses were posted*

### Re: 15c or 32s?

Message #2 Posted by [Victor Koechli](#) on 4 Nov 2003, 6:37 p.m.,  
in response to message #1 by [Jim B](#)

Pick up both. I know you can't, but do it anyway. Borrow money from a friend, or go to the bank. Just get them. However, if you *\*really\** have to choose, there are good arguments for either of these two. I'd take the 15C for the following reasons:

- It's the smallest of all HPs ever (except the HP-01, of course)
- It does matrix math
- It has a true complex stack
- It has more memory
- It's of superb quality
- It runs for decades on a single set of tiny batteries
- Nothing, really nothing beats a Voyager. I mean, the looks!

Cheers, Victor

### The 15C hands down

Message #3 Posted by [Valentin Albillo](#) on 5 Nov 2003, 6:08 a.m.,

*in response to message #1 by Jim B*

It's really a no-brainer. The 15C is the one to choose for far too many reasons to mention.

Best regards from V.

### **Confirming Valentin and Victor's opinion**

*Message #4 Posted by [Thibaut.be](#) on 5 Nov 2003, 6:58 a.m.,*

*in response to message #1 by Jim B*

If it's a OR choice, then the 15C is the choice. But if you can manage to pick up both of them then do it !

### **Consider the 32s for programming ...**

*Message #5 Posted by [Paul Brogger](#) on 5 Nov 2003, 11:08 a.m.,*

*in response to message #1 by Jim B*

The main argument in favor of the 32s is:

If you're going to do ad-hoc programming -- especially if you're going to do it infrequently, then

The 32s and sII programming environment is surpassed only by that of the 42s (and, presumably, the 41C's), from the standpoint of simple, mnemonic, ease-of-use.

With all programmables employing 7-segment displays (and that includes the 15c), program lines are encoded and presented as row/column values describing the keyboard matrix. The user is constantly deciphering sequences of two-digit numerics, scanning the keyboard and translating into keystroke sequences, and thus the intended commands.

With the 32s, command codes are presented alphanumerically, and are MUCH more straightforward in interpretation.

Certainly, with experience, a given non-alpha calculator's keycodes can become second nature, but the casual or infrequent user will find alphanumeric command presentation to be much easier to pick up again & again. (Yes, an assumption of infrequent use is a counter-argument: it ain't that important 'cause you don't use it that often!)

ALSO (IIRC), the 32s will handle hexadecimal display and conversions much more nicely than the 15c. If you're to use it for programming & debugging rather than for matrix calculations, the 32s may be much better suited to the task.

ALL THAT SAID, the 15c is simply a less-readily-available beast than is the 32s/32sII. From the "calculator-ownership strategy" standpoint, you'll choose the rare one when it's available . . .

### (I used "programming" in two ways)

Message #6 Posted by **Paul Brogger** on 5 Nov 2003, 2:16 p.m.,  
in response to message #5 by Paul Brogger

To clarify a bit (not that anyone has expressed confusion yet),

The alphanumeric display of the 32s simplifies **programming** *the calculator itself*, while

The hexadecimal conversion feature (and BASE conversions in general, for any octal or binary unfortunates out there) help in any role involving **programming** and debugging *other systems*.

### Re: 15c or 32s, which is better?

Message #7 Posted by **Ron Ross** on 5 Nov 2003, 11:55 a.m.,  
in response to message #1 by Jim B

Most of us would chose the 15c, but that being said, both machines are top shelf.

If you want matrix functions, you need the 15c, if not you still have a choice and as Paul mentioned, the 32s is somewhat better to program (more clearly).

Layout of the keyboard will probably determine your choice. The 15c horizontal layout is very addictive once you use it, hence you should avoid it! I am serious with this statement. A 32s user could make do with a 48G ten years from now without to many complaints except that it is a big clunker on your desk or takes up room in a travel bag. A 15c user would also complain about the vertical layout and maybe would switch to a 12c rather than use a 48G (which is a mistake in my opinion).

10-15 years from now, you may have to replace it and then you will cry about not finding a suitable replacement. A 32s user can easily find 48G's. A 15c user will be crying about having to program a 12C.

I have both, and if I were buying, I would buy the 15c again. I started with a 15c, then got a 42s. The 42s gave me so much more that I could not stay with with my 15c any longer. But I never would have went from a 15c to a 48G without the 42s. And I wouldn't have started using the 48G except, I could not bear to part with it being stolen (such irony, my favorite tool, stays home).

I still like my 15c layout best. I miss it (I know, tears rolling down cheeks, etc...). But a 32s user can switch right over to a 48G, a 15c user may hesitate to touch such a beast, and instead opt for the lowly 12c. That is how well liked the horizontal format is, once it is used (some people never like this layout though either).

That is your delimia.

**Re: 15c or 32s, which is better?**

Message #8 Posted by **Joel B** on 5 Nov 2003, 10:42 p.m.,  
in response to message #7 by Ron Ross

How are the keys on the 32s compared to the keys on a 15c or 11c? I've used a 32sii (Indonesian made in 2001) and I wasn't impressed with the keys. I also own a 28s and like those keys very much. Just wondering how the keys on the 32s and 15c compare.

**Re: 15c or 32s, which is better?**

Message #9 Posted by **RR** on 7 Nov 2003, 10:22 a.m.,  
in response to message #8 by Joel B

My suggestion is that you would be better served with an Hp32 (and anything made after 1999 does not reflect the true quality of these machines). For general use the 32sII actually has some useful conversions and a very good solver. My 32sII happens to be made in the Good Old USA (and my plain 32s is made overseas) I don't have an answer to that one.

My reasoning is the keyboard layout, plain and simple. Most people prefer the vertical arrangement. If by chance you use and begin to appreciate the horizontal layout, you will forever miss it, should you need to replace. Why go there? Both are RPN and very well made. Both will have to be purchased used. One will live 25 years, the other 20, but since the other is 5 years newer, well, you get the point (Most think they will last forever, and a few just might). But general use and ABUSE will kill each and everyone off, eventually.

**Re: 15c or 32s, which is better?**

Message #10 Posted by **bill platt** on 5 Nov 2003, 2:03 p.m.,  
in response to message #1 by Jim B

Well, I use the 32sii most. But now that I own 8 calculators (and rising), what I am about to say is not so directly applicabhle to me, but is worth mentioning.

The 15c has Considerably more memory than either the 32s or 32sii. It has both mopre registers (over 60, vs about 27) and more potential lines of programming (over 400, instead of about 256).

So,

IF `you like either:

LONG programs,

LOTS of DATA,

MATRIX STUFF,

LOTS of DIFFERENT LITTLE PROGRAMS,

THEN 15c,

ELSE 32s

<END>

Regards,

BILL

### **My 32SII [long]**

*Message #11 Posted by [Tizedes Csaba](#) on 6 Nov 2003, 4:01 a.m.,  
in response to message #1 by Jim B*

I've got an 32SII and an 15C. My first programmable HP was the 32SII, that is that calc, what I use in every day.

(The following lists are not fulls...)

Things, what I like in my 32SII:

- it had vertical shape
- LN and  $e^x$  functions are not shifted (!important in engineering practice!)
- program listings are uses mnemonics
- simple program editing
- simple program deleting (with thats labels)
- equation editor
- 12 digit precision
- solver result structure: x:root1, y:root2, z:f(root1) t:f(root2)
- fast machine
- keyboard 'feeling'

Things what I don't like in my 32SII:

- too small memory (max. 256 steps)
- GTO label line is non programmable (but it's not really problem)
- no GTO I (!missing, when I try to programming nested loops!)
- equations not editable (!just BS, then re-write!)
- INTEGRATE and SOLVE not useable at some time
- no AND, OR, NOT and XOR instructions
- no complex stack
- not all the mathematical functions and their inverses works with complex numbers
- not really slim
- plastic case, not metallic (???why the CASIO CAN to make very good metallic cases, like on my CASIO FX-850P: thats a beautiful slim machine with strong metal body, with REALLY screws! I dont understand this 'Barbie-plastic-world'???)

And my 15C? I think it came from an another world. It had mistakes, but the 15C is one of the best calculators of HP.

Csaba

### **My HP-15C vs. your 32S/SII**

*Message #12 Posted by [Valentin Albillo](#) on 6 Nov 2003, 5:49 a.m.,  
in response to message #11 by Tizedes Csaba*

Here are a few reasons why the HP-15C is better than the HP32S/SII:

- smaller, the most pocketable of all bar none.
- much more rugged and solidly built, will stand a lot of abuse without flinching, wears very little with age even in the worst environments. So far, 20 years up and counting ...
- clearer, very contrasty, segmented display, ideal for optimum visibility and legibility of numbers and numeric computations, like it should for a pure \*calculator\*.
- batteries last for \*decades\*, even under daily use.
- the 32S/SII usually gathers a lot of dust under the display, which is very annoying and extremely difficult to remove, if at all. The 15C doesn't, even if using it in extremely dusty places (e.g.: a year at the Sahara desert)

- *\*much\** better keyboard, with classic molded keys, Helvetica font lettering, [f] and [g] keys, large ENTER key, ..., never failing to register a key or provide tactile feedback.
- *\*much\** larger RAM, besides most instructions take 1 byte. The 32S is absolutely *\*starved\** for RAM, and instructions take 1.5 or more bytes, so it uses it fast. For instance, the number 123 in a program takes just 3 bytes on the 15C, 9.5 bytes on the 32S !! This means that any given amount of RAM (say 200 bytes) will store much more instructions in the HP-15C than it does on the 32S/SII, so further compounding the problem.
- complete matrix functionality, including multiple matrices in memory, perfectly integrated with RPN: you can have matrices on the stack, on registers, do all kind of arithmetic functions with them, solve systems of linear equations with a single instruction, special functions to deal with complex matrices, etc, etc.
- complete complex number functionality, perfectly integrated with RPN: *\*all\** standard functions work with complex numbers, including hyperbolics and inverse hyperbolics, 5-level parallel RPN stack, including LAST X, etc.
- the 15C can have up to 67 registers available for data. The 32S can have only 26 at most.
- the 15C has all 12 comparison test, the 32S doesn't. Many other instructions have test capabilities in programs as well, such as SOLVE, INTEGRATE, and a number of matrix operations.
- the 15C does have GTO (i) and GSB (i), for indirect branching, plus if the I register contains a negative number, it will perform rapid branching to *\*any\** program *\*step\**, no label needed. The 32S/SII has no such capabilities at all, which further cripples programming.
- The Hp-15C oozes quality. Every feature, from the extremely well-thought keyboard layout, to the microcode implementation of all its many functions, has been designed with utmost care, no compromises. For instance, the HP-15C overloads operators to maximize every key's functionality. Take the [+] key, for example; would you believe it has *\*seven\** different functionalities ? Namely:
  1. to add up two real values
  2. to add up two complex values
  3. to add up two matrices
  4. to add up some scalar to all elements of a matrix
  5. to directly add up a value in the display to a register (STO+)
  6. to directly add the value of a register to a number in the display (RCL+)
  7. to specify a certain diagnostic test ([ON]-[+])

That's just the tip of the quality iceberg. The numerical algorithms are the best, most accurate in the world. The USER modes for entering/displaying matrix elements, with autoincrement, do-if-true capability, will even preview the name of the matrix and indexes of the affected element as long as the relevant key is kept pressed, performing the operation upon release or nulling it out upon timeout, etc, etc.

On the other hand, the HP32S/32SII is a machine full of compromises, with some good features intermixed with other half-baked ones or even frankly crippled. It's not an all-round product, at all. Just look at the overloaded [+] key example above: to add two complex numbers on the 32S, you must use an ad-hoc function for the task, CMPLX +, as the obvious choice, the [+] key on its own, won't do it.

- The bottom line: the HP-15C is probably the best pure calculator ever built, period, and owning one is both classy and expensive. The 32S, though desirable, can't come up even close to that privileged status. It's just a fine but ultimately seriously flawed calculator. Comparing it to the 15C is kind of preposterous, the 42S is more like it.

In short, I'm not saying that the 32S/32SS aren't worthwhile machines, I've got several of both, they do a lot of work very well, and they are great, even excellent. But comparing them to the HP-15C ... !!! Come on !!! :-)

Best regards from V.

*Edited: 6 Nov 2003, 12:05 p.m. after one or more responses were posted*

### **Re: My HP-15C vs. your 32S/SII**

*Message #13 Posted by [Tizedes Csaba](#) on 6 Nov 2003, 6:29 a.m.,  
in response to message #12 by Valentin Albillo*

Dear Valentin,

I don't want to compare two calculators, I just wrote what I like and don't like in my 32SII.

I own some of HP calc's, but I'm not a really collector. My 15C was my 2nd calc from HP. The 1st is my 32SII.

When I preparing to my controlling-exam, I use 15C for wrote programs to calculate cutting-frequency, to examine Nyquist- and Bode-plots, to examine stability of controlling systems with feedback and disturbance.

I never think to use 32SII. I use 15C. It was very powerful.

So, my heart is throbbled, when I begin to use it. ;)

The really problem about the valuation of calculators is that, who when started to use this machines, and which machines used.

I wasn't meeted with this calcs in the '80s, I'm not really feel what mean this era. But my feeling is 'nearest to the truth'.

Csaba



**Re: My HP-15C vs. your 32S/SII**

Message #14 Posted by [bill platt](#) on 7 Nov 2003, 9:30 a.m.,  
in response to message #12 by Valentin Albillo

Hi Valentin,

I have to put a couple cents in...

- 1) My 15c has dust under the display---my 32sii does not have that--and cannot--as the LCD is not covered with a protection, like the 32s was.
- 2) The 32sii DOES have GTO (i) and XEQ (i) ....so yes, you can indirectly address a subroutine or a spaghetti noodle in the 32sii. (Is this also true for the orig 32s?) BUT you are correct that you cannot program a line number Goto---but then again that is bad spaghetti noodle practice anyway, yes?
- 3) You actually have 33 available storage registers in the 32sii---the statistics registers are accessible via indirection (i). This is no less cumbersome than the 15c--where *\*most\** of the registers must be accessed via indirection. Doesn't the 32s allow this?
- 4) The 32sii has all twelve conditional tests. Is it true that the 32s does not?!

I have never owned or used the original 32s---so I am not familiar with its intricacies.

You know, if the 32sii had a lot more memory, then it would be far more powerful than the 15c--because you could write programs to handle the Matrix and Complex stuff. The only real cramp in the 32sii is the small memory. However, I am assuming the good old days of HP, where HP would provide the matrix and complex math programs in the manual.....

It will be interesting to see what the 33s brings...

Oh, one more question for you: A while back, you suggested that I really *\*must\** get the 15c advanced functions book---(regarding numerical methods)--do you know is that the same as what I saw included on the Museum's CDROM?

Best regards,

Bill

**Re: My HP-15C vs. your 32S/SII**

Message #15 Posted by [Valentin Albillo](#) on 7 Nov 2003, 10:11 a.m.,  
in response to message #14 by bill platt

Bill Platt posted:

*"If the 32sii had a lot more memory, then it would be far more powerful than the 15c"*

In Spain we have kinda proverb which roughly translates like this:

"Were my father to be round and red, he'd be a tomato ...  
But since he's not, he ain't."

Get the point ? If your statement above would be worth anything, then by the same token "if the 15c had a faster CPU and/or alphanumerics and/or a card reader it would be far more powerful than [insert any given calc here]" ... Alternate futures are interesting sci-fi devices, but I suggest we limit our arguments to actual *\*facts\**, ok ? The 32sii does *\*not\** have a lot more memory, and so it's *\*not\** far more powerful than the 15c, period.

*"... because you could write programs to handle the Matrix and Complex stuff."*

Since when writing programs to do something is comparable to having the complete set of functionality implemented in microcode right in the internal ROMs ? As long as it is a programmable calculator, you can in theory write programs to do anything, but facts are that you frequently neither have the space to write all necessary programming (the HP-15C has a very comprehensive matrix functions set) nor do the resulting programs run as fast or as conveniently as the microcoded built-in set. So the fact that you could (in theory) write a program to do something is a given for a programmable calculator and adds nothing to the discussion.

*"The only real cramp in the 32sii is the small memory."*

Yes, if you so chose to ignore the lack of matrices and matrix operations, true handling of complex numbers, etc, etc, etc. I don't quite get it why you feel it correct to make such a statement, as if these and all other points were nonexistent or nonrelevant.

Anyway, Bill, do as you please. You want to think and believe that the 32S/Sii is better ? Do it, man, I don't get paid to promote the 15C, be my guest, that's entirely your issue, I couldn't care less ... :-)

*"one more question for you: A while back, you suggested that I really *\*must\** get the 15c advanced functions book---(regarding numerical methods)---do you know is that the same as what I saw included on the Museum's CDROM?"*

I don't have the Museum's CD-ROMs so I don't know.

Best regards from V.

## **Re: My HP-15C vs. your 32S/SII**

Message #16 Posted by *bill platt* on 7 Nov 2003, 11:02 a.m.,

*in response to message #15 by Valentin Albillo*

Hi Valentin,

Thanks for your reply-----

Actually I do not think the 32sii is "better" than the 15c---clearly without the matrix stuff and the complex stuff, AND less memory, it is inferior...

The point of the bit about more memory and making the Matrix and complex stuff programmed rather than built-in is that not everyone uses matrix and complex numbers---I for instance rarely need either, yet I often run out of programming space.....

So, if you free the ROM (by making matrix and complex optional) you also make the calculator more versatile for some users.....

And, I am not a crack programmer, but would it not be reasonable and possible to duplicate the 15c Matrix and complex functionality in an RPN program set? Am I missing some fundamentals? (I ask these questions because your explanations are generally very well written and enjoyable to read!). Obviously the 32sii does not have enough memory available for that....but how about the 33s IF it has 32 kB?

Or in other words, just how much more programming lines could the 15c have had, had that ROM space been made available for the user (rather than used for matrix stuff). We also must not forget that a significant portion of the RAM in the 15c gets used in *\*manipulating\** matrices and complex numbers----

And of course I am sure that the Matrix and complex stuff is *\*packed\** in the ROM more efficiently than an RPN program of equal power would be----perhaps that is one of the careful trade-offs made way back in 1983.

The fact is, the 15c is really cool----no doubt! I just thought it is interesting that the 32sii has all the programming features, except line number gotos.....so it is quite good for many tasks--just too small!

And regarding differences between the 32s and the sii that I raised---anyone have answers there?

Regarding numerical analysis, HP15c "Advanced Functions"----is that the one?

And I like the spanish proverb----that's a good one! How do you write it in Spanish (my son likes Spanish).

One more thing--your name appears in the Chess world a lot--is it you, or your doppelganger?

Best regards,

Bill

**Re: My HP-15C vs. your 32S/SII**

Message #17 Posted by [Valentin Albillo](#) on 7 Nov 2003, 11:43 a.m.,  
in response to message #16 by bill platt

Bill posted:

*"Actually I do not think the 32sii is "better" than the 15c---clearly without the matrix stuff and the complx stuff, AND less memory, it is inferior..."*

Now we are making progress ... :-)

*"not everyone uses matrix and complex numbers"*

Fine. At the time of the 41C release, not everyone had a use for many of its advanced capabilities. But that didn't invalidate the fact that it was the superior machine. If you only need the basic four arithmetic functions, that won't mean that an HP-32S isn't superior to a \$1 four-function banger, right ? In our present case, the fact that not everyone uses matrices and/or complex numbers does nothing to detract from the fact that the 15C is nonetheless the superior model.

*"So, if you free the ROM (by making matrix anc complex optional) you also make the calculator more versatile for some users....."*

I don't follow your argument here. ROM and RAM are very different beasts. "Freeing" ROM won't do a thing to increase your RAM availability, both were very differently priced at the time, and it was usually much more sound from an economical point of view to implement as much functionality in ROM as possible, just to save a few precious RAM bytes. That's why HP did include so many functions and features in the ROM, such as hyperbolics or recall arithmetic, because that would save the user a lot of bytes here and there. But if you chose not to use the ROM for said purposes, it would simply remain unused. The HP-45, for instance, had some pages of ROM available after implementing all projected functions. Havig nothing better to do with it ('trading' it for extra RAM being out of the question), they did include there the microcode for the HP-55 timer.

*"would it not be reasonable and possible to duplicate the 15c Matrix and complex functionality in an RPN program set?"*

That's a *\*VERY\** tall order, for any programmer. The microcoded matrix algorithms were state-of-the-art, developed ad-hoc for the HP-15C, and going through every loop to achieve maximum speed and accuracy, even above and beyond the 13-digit internal precision. And as the HP-15C's matrix set is quite comprehensive, accurately emulating it in user-code software would be prohibitive for most any individual.

*I ask these questions because your explanations are generally very well written and enjoyable to read!*

Thank you very much, but trying to lure me with sweet words won't do you any good, I'll trash you all the same ... :-)

*"Obviously the 32sii does not have enough memory available for that....but how about the 33s IF it has 32 kB?"*

That amount of RAM would be enough to implement a number of programs and routines simultaneously, even at the preposterous rate the 32S gobbles up RAM (remember the 1.5 bytes minimum per instruction, 9.5 bytes for all numbers not 0-99, etc). But in the case of the matrix operations, the difficulty lies not only in the RAM required, but in the complexity of the algorithms themselves. Of course you can implement a matrix inversion or solve a system with fairly compact programs, but not with the quality and accuracy of the built-in 15C matrix functions (also present in the HP-71B, 42S, etc).

*"just how much more programming lines could the 15c have had, had that ROM space been made available for the user (rather than used for matrix stuff)."*

None. See my explanation above. You just didn't trade RAM for ROM at the time. Either you used all the ROM available for useful or miscellaneous functionality, or else it was left unused. If I recall correctly, the HP-75's I/O ROM was another such case, with a certain amount of poetry being burned into spare ROM space, just for fun as it would be left utterly unused otherwise.

*"I like the spanish proverb----that's a good one! How do you write it in Spanish (my son likes Spanish)."*

My pleasure. The proverb goes like this:

"Si mi padre fuese redondo y colorado, seria un tomate."  
"Pero como no es, no es."

My compliments to your son. This is for him:

Hola, me alegro mucho de que te guste mi idioma nativo. A mi tambien me gusta mucho el idioma Ingles, es precioso, potente, y permite comunicarse a gente de todos los paises. Espero que sigas progresando con el idioma Español y que algun dia te animes a venir de vacaciones a España. Saludos de Valentin.

*"One more thing--your name appears in the Chess world a lot--is it you, or your doppelganger?"*

It's me. As far as I know, I am the only Valentin Albillo in the world ! :-)

Thanks for your kind words and interest, and best regards from V.

*Edited: 7 Nov 2003, 11:45 a.m.*

**Does 15c feel as cheap as a 12c?**

Message #18 Posted by **John** on 10 Nov 2003, 5:52 a.m.,  
in response to message #1 by Jim B

I was in an Office Supply Store yesterday looking over their calculators, which were all TI's except for a 12c. Having never used a 15c (I have only used a 32sii) I was wondering if the 15c keyboard feels as cheap as the 12c does??

**Re: Does 15c feel as cheap as a 12c?**

Message #19 Posted by **Wayne Brown** on 10 Nov 2003, 7:42 a.m.,  
in response to message #18 by John

When the 15C was being manufactured, neither it nor the 12C felt cheap. The current-production 12C, like everything HP makes these days, is inferior to what it once was. Try to find a 12C that was made about 10 years ago and you'll see a real difference in quality.

**Re: Does 15c feel as cheap as a 12c?**

Message #20 Posted by **Valentin Albillo** on 10 Nov 2003, 7:52 a.m.,  
in response to message #18 by John

OK, I'll bite ...

The HP-15C (the US-made models, at least), along with all other models from the Voyager series (10C, 11C, vintage 12C, 16C) has one of the very best keyboards ever made for any handheld calculator, if not the best. Only the HP-71B's keyboard can compare.

None of the HP-15C's physical aspects feels 'cheap' in the least, quite on the contrary. It's solid as a brick, has a wonderfully clear, contrasty display, and as I've said before, it oozes quality.

By the way, should you try to test this humble opinion of mine, try and get an HP-15C, from eBay for example. You'll discover a new meaning for the word 'cheap' ... ;-) )

Best regards from V.

**"Don't You DARE ever post here AGAIN!!!!" 8o)**

Message #21 Posted by **Ron Ross** on 10 Nov 2003, 8:42 a.m.,  
in response to message #18 by John

That is really a bold and misguided statement to compare quality of a 15c to any of today's calculators.