Save $$$$ over comparable analysers!

AN EVEN BETTER USB SPECTRUM ANALYSER

By JIM ROWE

USB-powered mini spectrum analysers based on SDR technology are evolving fast. The Signal Hound USB-SA44B shows how rapidly this technology is developing – demonstrating a performance that compares very well indeed with that of high-end self contained analysers, for a fraction of their price.

When I reviewed the Triarchy TSG5G35 USB 'dongle' spectrum analyser for the January 2014 issue of SILICON CHIP, I was impressed by the level of performance it provided – especially considering its tiny price.

It did have a few shortcomings, particularly if you compared it with self-contained analysers like the Gratten GA4063 (SILICON CHIP November 2013). But it still seemed likely to have plenty of practical applications.

So I wasn't really expecting much when the opportunity came a few weeks ago to review another SDR-based USB spectrum analyser, the Signal Hound USB-SA44B.

Boy, was I wrong!

Not long after the review sample arrived I installed its accompanying software on a PC running Windows 7 Pro (64bit) and started to explore the capabilities of both the hardware and its software.

And the more I explored, the more impressed I became. . .

In fact I found that it's much more than 'yet another USB mini spectrum analyser based on SDR (software-defined radio) technology' – more an example of where this technology is

Front (above) and rear (right) panels of the Signal Hound USB-SA44B, just a bit larger than life size. There are no controls as such – they're all taken care of via the supplied software.

really headed. But let's start at the beginning.

The USB-SA44B comes from a company in the USA. Originally it was called Test Equipment Plus or 'TEP', which began operation in 1996 refurbishing and reselling used test equipment.

In 2006 they began designing and manufacturing colour LCD kits for use in refurbishing older CRT-based HP spectrum analysers for which the CRTs were no longer available.

This was so successful that they expanded their capabilities to become a comprehensive repair service for HP/Agilent spectrum analysers, oscilloscopes and signal generators.

In 2009 they decided to design a compact, lightweight and inexpensive spectrum analyser of their own. This appeared in February 2010 as the Signal Hound USB-SA44, which apparently sold like 'hot cakes'.

Before long they not only came up with an improved model (the USB-SA44B, which we're reviewing here) but also renamed the company itself as Signal Hound in April this year.

The TEP side of the business is still going strongly though, repairing HP/Agilent (and I presume the newest incarnation, Keysight Technologies) test equipment.

Encouraged by the success of the USB-SA44/B they've also produced a higher performance USB 3.0 based spectrum analyser, the BB60.

Despite its higher price, the BB60A sold out very quickly and Signal Hound will soon be releasing a production run of a significantly improved BB60C model.

So that's an idea of where the USB-SA44B comes from. By the way in Australia and New Zealand, Signal Hound products like the USB-SA44B are distributed by Silvertone Electron-

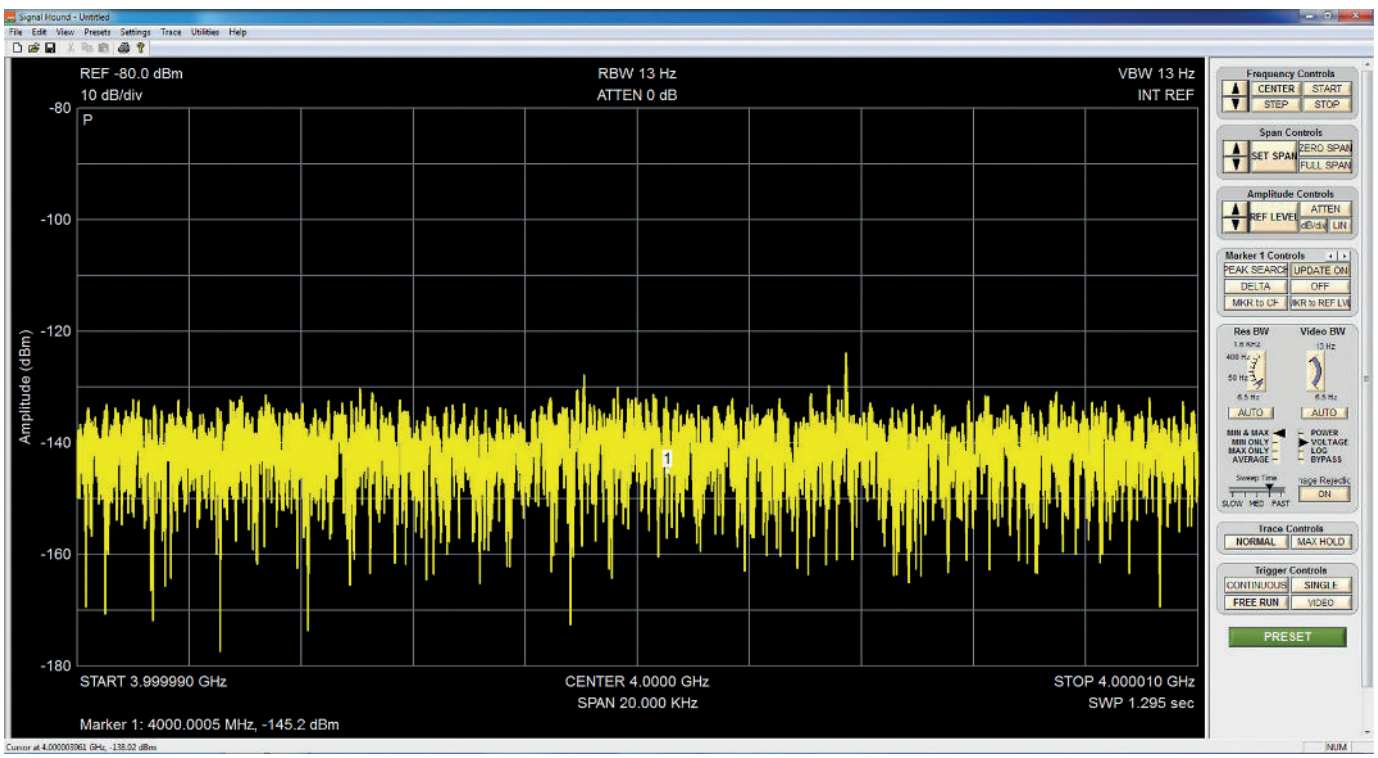

Fig.1: A screen grab showing the SA44B's DANL (displayed average noise level) at 4.0GHz with its input terminated in 50Ω. It shows a DANL of -140dBm, with very occasional spikes reaching about -124dBm. Note the control panel at right.

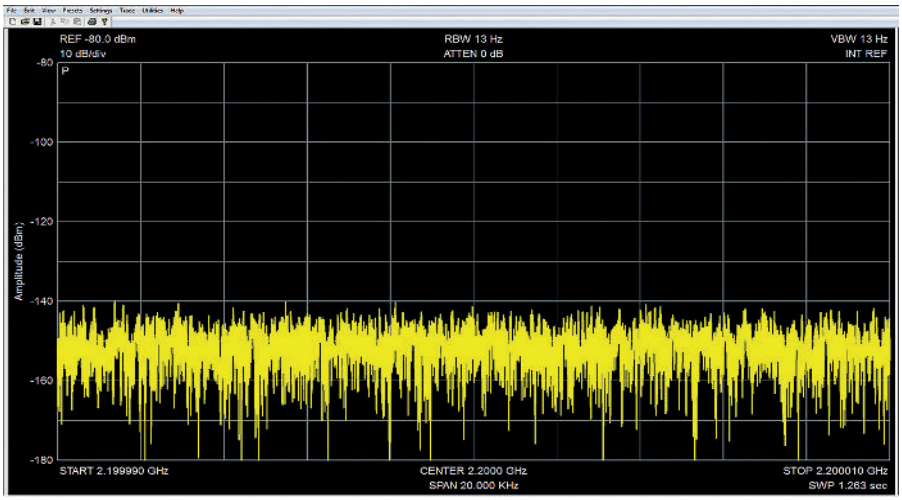

Fig.2: Another screen grab showing the SA44B's DANL at 2.2GHz. It's even better, displaying -150dBm with very few peaks reaching -140dBm.

ics, now based in Wagga Wagga, NSW. You'll find their website at **www.silvertone.com.au**

So let's look more closely at the USB-SA44B analyser itself. As you can see from the photo it's not as tiny as a dongle but nevertheless quite compact. The case is based on an aluminium extrusion, measuring 77 x 27mm and with a length of 167mm (not counting the input and output connectors at each end). It weighs just on 290g.

At the input end there's an SMA socket in the centre, with a busy/ready LED visible through a small window on the left.

Then at the output end there's a USB type B socket in the centre for connection back to your PC/laptop/tablet, plus a BNC socket on either side.

One of these is for feeding in an external 10MHz reference if you need higher frequency accuracy than is provided by the internal TCXO (temperature compensated crystal oscillator), while the other is for a number of utility purposes – some associated with the matching Signal Hound USB-TG44A tracking generator (available separately).

Inside the box . . .

You'll find an advanced narrowband SDR receiving system tuning over the range from 1Hz to 4.4GHz, (yes, you read that correctly!) made up from the following elements:

1. A programmable input attenuator with four ranges (0dB, -5dB, -10dB and -15dB).

2. A wideband RF preamplifier which can be switched in to achieve higher sensitivity and a lower noise floor. (The preamp can only be used for frequencies above 500kHz.)

3. A pair of mixers, where the incoming signals are mixed with higher and lower frequency local oscillator signals to allow image cancellation.

4. The two IF signals then pass through dual IF amplifier/filters, before passing to the 'IF to bits' digital receiver section, where they are processed by quadrature I/Q digital samplers to produce a 2MB/s output data stream. This is then conveyed to the PC via the USB 2.0 cable.

The output data stream from the hardware box is processed and analysed by the Signal Hound software, to produce the analyser's output display and measurements.

The software also controls the operation of the hardware, becoming the analyser's 'front panel'.

Software & manual on CD

The USB-SA44B comes with a CD-ROM containing both its matching driver and control software and the User Manual as a PDF file, plus a 1.8m-long USB cable.

An optional accessory kit, comprising a 20dB SMA/SMA fixed attenuator,

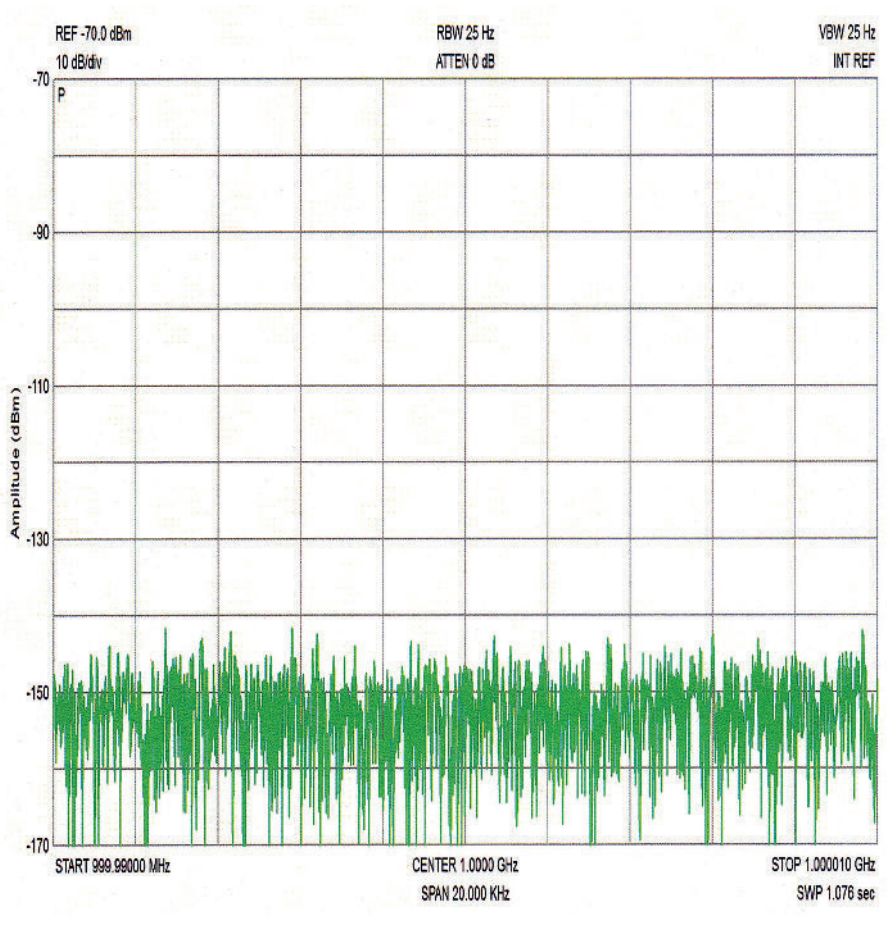

Fig.3: A printout from the SA44B's control software this time, showing its DANL or 'noise floor' at 1GHz to be a bit below -150dBm. Just about all of the analyser settings are printed out as well.

an SMA/BNC adaptor and an SMA/SMA DC blocking adaptor, is available separately.

The latter would be especially useful because the SA-44B's input circuit cannot cope with DC voltages greater than ±0.2V.

I should also mention that the software supplied on the CD-ROM is able to control the optional TG44A tracking generator as well as the SA44B.

The basic specification for the SA44B shown in the panel at right gives a good idea of the performance delivered by this very nicely integrated hardware and software combination. It compares very favourably with analysers costing many times its price (which is $AU1198.70 plus GST in Australia and NZ).

What I found

The first thing I did when the SA44B arrived was to print out the User Manual (old-fashioned, I know but I do prefer to read a 'hard copy'), and then read it carefully before proceeding. This seems to be very well written and informative.

I then realised that although I'd planned to install the SA44B's control software on my old 'workhorse' Windows XP machine near my workbench, this wouldn't be a good idea because the SA44B control software needs to link up to Signal Hound's website when it initially starts up, to download a special temperature correction file.

I had to disconnect the XP machine from the network and internet when Microsoft stopped supporting XP earlier in the year, so this wouldn't be feasible. As a result, I had to install the software on my main machine running Windows 7 Pro (64-bit) – which is connected to the internet, of course.

Installing the USB drivers and control software for the SA44B turned out to be very quick and painless. I was soon familiar with the SA44B's GUI and it gave every evidence of being well written and quite intuitive to use.

It did take a little while to get the hang of adjusting one or two of the controls on the 'front panel' running down the right-hand side of the screen but there were no major hassles.

Then I spent an interesting couple of hours running a variety of tests on the SA44B.

But before I discuss the results of this testing, I should note that although the SA44B control and display software does not allow you to directly print out any of your analyser displays: it only prints out the contents of the display window – not the control panel alongside.

It even allows you to reverse these printouts so they're dark on a white background, to save printer ink or toner.

And the display printout does contain pretty well all the information you'd normally need – like the start,

Basic Specification – Signal Hound USB-SA44B

Frequency Range:			1Hz to 4.4GHz
Span Modes:	*Either*		Centre Frequency + Span
	or		Start + Stop Frequencies
Maximum Span:			4.4GHz
Minimum Span:			10Hz, or Zero Span
Internal Frequency Reference Accuracy:			±1ppm
Frequency Readout and Marker Accuracy:			reference error ±1 sample
Resolution Bandwidth (RBW):			0.1Hz to 250kHz
Amplitude Range*: Input level for 1dB gain compression with preamp off, attenuator set for -15dB:*			+16dBm typical, 1Hz-150MHz
			+19dBm typical, 150MHz-4.4GHz
Displayed Average Noise Level (DANL):		*(preamp off)*	*(preamp on)*
(with 0dB input attenuation, 1Hz RBW [ie, noise floor])	10Hz:	-124dBm	
	100Hz - 10kHz:	-130dBm	
	10kHz - 500kHz:	-142dBm	
	500kHz - 10MHz:	-142dBm	-153dBm
	10MHz - 100MHz:	-148dBm	-161dBm
	100MHz - 1GHz:	-144dBm	-158dBm
	1GHz - 2.6GHz:	-139dBm	-151dBm
	2.6GHz - 3.3GHz:	-135dBm	-151dBm
	3.3GHz - 4.4GHz	-128dBm	-134dBm
Absolute Accuracy (*Reference level <=0dBm*):			±1.5dB
Absolute Accuracy (*0dBm < Ref Level <+10dBm*):			±2.0dB
Relative Accuracy (*Ref Level <= 0dBm*):			±0.25dB
Maximum Safe Input Level (*15dB attenuation, preamp off*):			+20dBm
Maximum DC voltage input:			< ±0.2V, absolute
Residual Responses (*input terminated, span <= 10kHz, 0dB attenuation, preamp on*):			< -80dBm

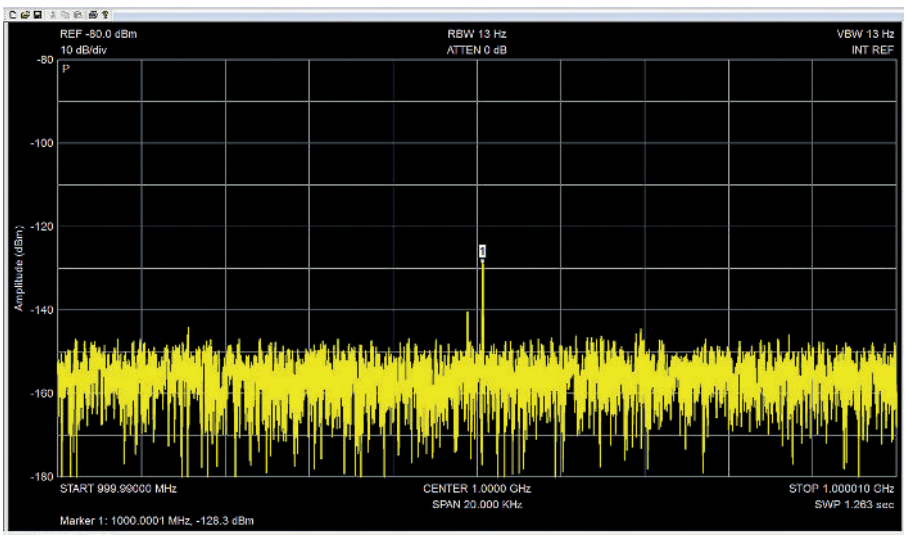

Fig.4: this shows the SA44B capturing the output of a Gratten GA-1484B signal generator at 1.0GHz and with a level of -127dBm (100nV at 50Ω). The carrier spike measures -128.3dBm, showing the cable loss as 1.3dBm.

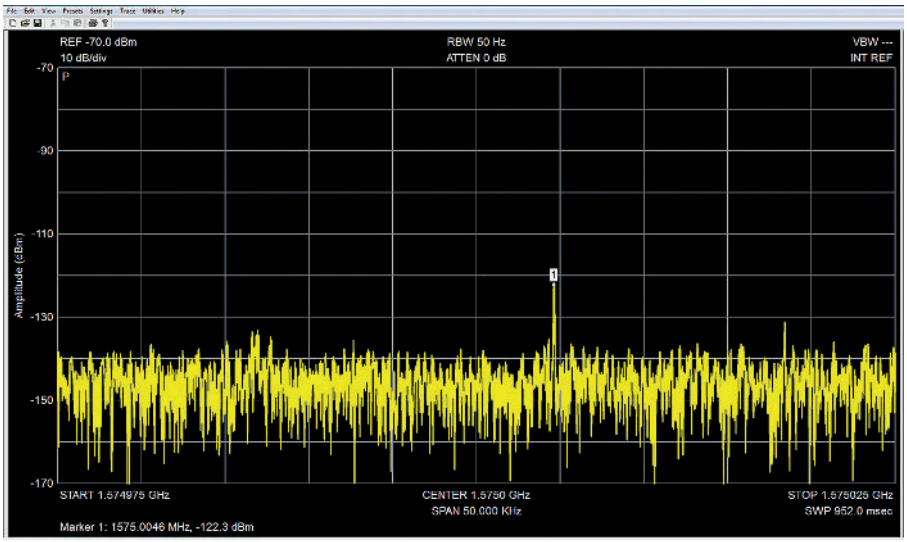

Fig.5: this one's taken with a tiny whip antenna connected to the SA44B input, scanning in the vicinity of 1575GHz. There's a small spike of -122.3dBm at 1575MHz, presumably from a GPS satellite passing nearby.

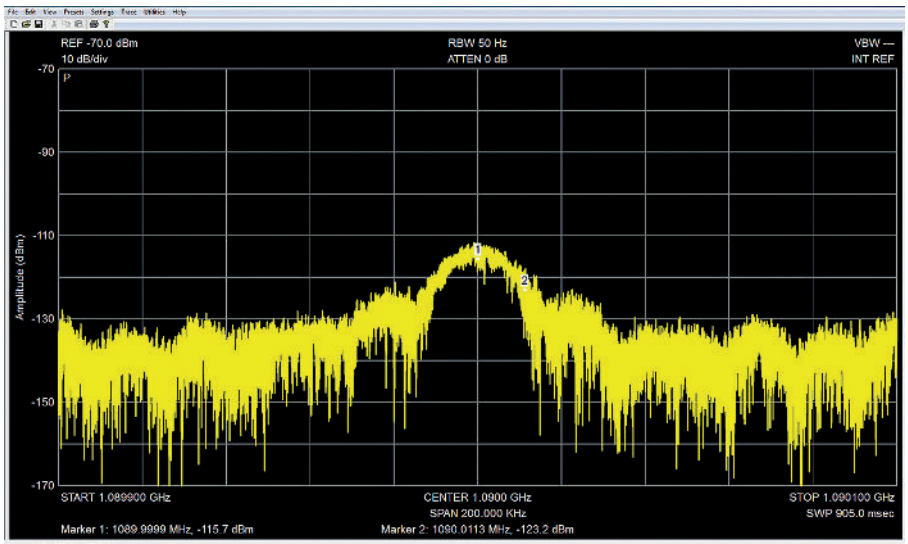

Fig.6: finally, a scan centred on 1090MHz with the SA44B connected to an external VHF-UHF discone antenna. It appears to be an ADSB squitter from a passing commercial aircraft.

centre, span and stop frequencies, the reference level, the resolution bandwidth (RBW) and video display bandwidth (VBW), the attenuator setting, whether or not the preamp is switched in, the sweep time and so on. But there seems to be no provision to print out the control panel as well.

What I had to do in order to provide the full screen grabs you see in this review was resort to the old trick of pressing the 'Print Scrn' key on the keyboard when I wanted to capture a grab and then switch to Photoshop to paste the grab in from the Windows 'clipboard', after which I could save it as a JPEG file.

Then I had to switch back to Signal Hound, in order to continue testing.

It's a bit clumsy and it would be good if Signal Hound gave you an option of saving and/or printing the entire screen.

OK then, let's look at the test results. Overall, the SA44B meets its specs with flying colours. For example, Fig.1 shows its noise floor at 4.000GHz, with the input terminated in a 50Ω wideband SMA termination, a sweep span of 20kHz, a reference level of -80dBm, an RBW of 13Hz, 0dB of input attenuation and the SA44B's preamp switched in.

As you can see its DANL (Displayed Average Noise Level) is very close to -140dBm, with only the occasional noise peak reaching about -124dBm. And the DANL figures at lower frequencies were even better. For example at 2.2GHz I measured a figure of -150dBm, with only a very few noise peaks reaching -140dBm (see Fig.2), while at 1.5GHz and below it was slightly better again (see Fig.3).

When I tried using the SA44B to look at the output of my Gratten GA-1484B signal generator at a frequency of 1.000GHz and with the output level set to -127dBm (100nV at 50Ω), I achieved the display shown in Fig.4.

As you can see it shows the signal peak as having a level of -128.3dBm, which is pretty good when you consider I had connected the two together with a 1m long SMA-SMA cable made from RG-213 coax, with a loss of about 1.3dBm.

(When I substituted a 3m long RG-213 cable, the SA44B showed a further drop of very close to 2.6dBm.)

Next I tried connecting a tiny whip antenna to the input of the SA44B, placing the antenna right in the window of my office.

Then I did a scan centred on 1.575GHz, to see if I could pick up any signals from passing GPS satellites. Fig.5 shows the result: I found a peak of -122.3dBm at 1575.0046MHz, according to the SA44B.

Finally, Fig.6 shows the result of a further scan done with the SA44B connected to an outside VHF-UHF discone antenna. It reveals the capture of an ADSB squitter at 1.090GHz from a passing commercial airliner. (See 'ADSB and Flightradar 24', SILICON CHIP August 2013).

Summarising

The USB-SA44B delivers a level of performance that is well and truly comparable with self-contained analysers costing many times its price.

Not only that, it also offers many of the features of an SDR-based measuring receiver.

In effect, the hardware of the SA44B and its matching software seem to have been so well integrated in a functional sense that they really can turn your PC into a high performance spectrum analyser.

So if you'd like to have the features and performance of a 4.4GHz spectrum analyser/measuring receiver but can't justify an outlay of $6800 plus, the Signal Hound USB-SA44B is well worth considering, especially at the price (as we mentioned earlier, a shade over $1300 including GST). SC