

FOCUS ON: SCOPE MULTIMETERS

A new type of test instrument, the portable digital storage oscilloscope (DSO) has appeared on the electronics scene, and looks here to stay. This instrument is often combined with a digital multimeter (DMM), and is marked by a large LCD screen and a control panel which make it particularly suitable for field use. Prices of these units are beginning to come down to a level where even the hobbyist may become interested.



By our editorial staff

IN the field of measurement technology, microprocessors and automated measurements play an increasingly important role, and have a great effect on the working tools available to the electronics engineer and the service technician. Work that used to consist of just a few voltmeter checks now involves complex voltage waveforms and sequences, all of which have to be recorded and processed. Today's service engineer should be conversant with programmable controls, while he or she struggles with noise in switch-mode power supplies and faults in digital circuits based on extremely complex digital circuits. No wonder a test instrument for all these different functions is a must for cost-effective design, repair and adjustment work.

Manufacturers of electronic test instruments keep a close watch on such trends because of the market potential, which is another way of saying that they want to increase their turnover. Test instruments get smaller and smaller, more powerful, more intelligent, and ... cheaper! Currently prices have dropped

to a level where even the advanced hobbyist may consider purchasing a portable DSO/DMM for use inside and outside the workshop.

The handheld oscilloscope has a large liquid crystal display (LCD) instead of a cathode ray tube (CRT). This change has made the instrument much lighter and smaller, which has obvious advantages for servicing and other field work. The portable DSO also doubles as a versatile digital multimeter, while even more functions are available that replace a pretty hefty stack of measurement equipment: frequency and event counter, logic analyser and function generator.

This article aims at presenting a couple of the more affordable portable DSOs/DMMs on the market today. The range of instruments is fairly small, and mainly supplied by Tektronix/Sony, Fluke/Philips, Escort and Hung Chang. The latter two are Korean manufacturers whose products are sold under the brand names Keithley and Gould respectively. Unfortunately Hitachi's product overview of portable oscilloscopes arrived too late for inclusion in this article.

Just like the modern oscilloscope seems to move into the direction of the digital multimeter, the multimeter is becoming an increasingly graphics-oriented instrument. You probably know the bargraph readout, which is far better than a sequence of just digital values when it comes to indicating slowly changing quantities ('trends'). New, however, are DMMs which are capable of showing a (simple) graph on an LCD screen. Unfortunately we found only two instruments, a Fluke and a Tektronix, which offered this relatively new feature. These instruments are available at a price below approximately £600.

Some impressions

Tektronix THS-710

This oscilloscope offers a DSO and a DMM function, but lacks a number of features available on competitive products. Fortunately, this has a positive effect on the quality of the measurements as well as on the ease of operation. Achieving a bandwidth of 60 MHz and a maximum sample rate of 250 MS/s the

THS-710 is the fastest of the DSOs/DMMs discussed in this article. All function keys and function areas are neatly arranged, and easily mastered by the new owner in a couple of minutes without the need of consulting the handbook. Multiple key functions are avoided wherever possible. Unfortunately, the THS-710 responds fairly slowly to key actions, a problem which is shared by all handheld DSOs. The 150-page manual supplied with the THS-710 is well laid out. Moreover, a quick reference is available.

The THS-710 has a brighter display than any of its competitors. In fact, the brightness is almost equal to that of a CRT. Of great interest are the instrument's extensive trigger options including TV, pulse width, and missing pulse.

The multimeter mode allows direct and alternating voltage, as well as resistance, to be measured. The multimeter values may be displayed as maximum, minimum or delta-max-min. Moreover, they may be averaged and held. An acoustic continuity tester, a diode check and a data logger function are also available. For reliable and safe measurements, the inputs of the instrument are electrically isolated from one another. The RS232 serial interface enables measured values, screendumps and other data to be conveyed to a PC. Supported file formats include TIF, BMP, EPS and HPGL. Optionally, the RS232 interface enables software to be uploaded and downloaded.

Other instruments:

THS-720, functionally similar, bandwidth 100 MHz.

Fluke: 96 ScopeMeter

As regards its price and technical data, the Fluke 96 ScopeMeter falls into the same class as the THS-710. The instrument is marked by extensive options for calculation and display, both in oscilloscope and multimeter mode. The maximum sensitivity is not achieved over the entire timebase range. The instrument has a very useful switchable function called Auto Set, which performs fully automatic settings for the timebase, trigger and attenuator.

The operation of the 96 ScopeMeter is a little more complex than that of the Tektronix instrument. Understandable, however, because of the more extensive measurement and display options. When the instrument is only used occasionally, you will find that the extensive, 180-odd pages thick manual has to be consulted to be able to perform measurements which call for the less usual functions. For 'emergency cases' a Quick Operating Card may be found in the carrying bag.

In addition to the oscilloscope function, the 96 Scopemeter has a 32/3 digit multimeter which not only measures direct voltages, alternating voltages and



resistance, but also frequency, events, mark/space ratios and pulse widths. The measurement values may be displayed in different decibel notations. Also available are a diode tester, a continuity tester and a general-purpose component tester.

The 96 ScopeMeter has an internal signal generator which supplies a rectangular test signal for adjusting probes. Instrument settings and signals may be memorized and sent to a PC or a printer via an optical RS232 interface. Software is available as an option.

A weak point of the instrument is its difficult to read LC display. In a practical

test, our design engineers found that the display was only readable from a short distance, and vertically, when fluorescent lighting was used. The LCD's backlight failed to improve the readability. Somewhat better results were obtained under daylight conditions. The LCD has rather too much information on it, and the texts and symbols shown are poorly laid out. Also, in DMM mode the displayed figures are relatively small. On the positive side, a short help text may be called up for each item on the display. The 96 ScopeMeter is marked by low current consumption and a small number of sockets and plugs, which remain limited to an optical interface, a socket for the mains adaptor, two wander ('banana') sockets and two BNC sockets.

Other instruments:

Scopemeter 91, single-channel without cursor measurement function and memory;

Scopemeter 92, dual-channel without cursor measurement function and memory;

ScopeMeter 99, with signal shape mathematics, signal generator, component tester, full PC interface;

Scopemeter 105, as Scopemeter 99, however 100 MHz bandwidth.

Keithley: Model 125 ScopeBook (Gould EasyScope 340)

As far as could be ascertained, these are identical instruments manufactured by Korea-based Escort Instruments, who are known for their instruments with a good price/performance ratio. Not surprisingly, the Model 125 ScopeBook is much cheaper than the Tektronix or Fluke instruments. The ScopeBook not only offers DSO and DMM functions, it also doubles as an 8-channel logic



analyser and a frequency meter.

Unfortunately, the wealth of functions offered by the ScopeBook seems to be obtained at the cost of operating speed of the oscilloscope: a bandwidth of just 20 MHz may not be enough for modern measurement applications. None the less, the features of the oscilloscope meet the usual standards as regards horizontal and vertical deflection, as well as the triggering facilities.

The multimeter has a 3 $\frac{3}{4}$ -digit display and a 40-segment bargraph readout. A diode and an acoustic continuity tester are integrated. Moreover, current measurement are possible without the need of connecting an extra probe, as with the Fluke and Tektronix instruments.

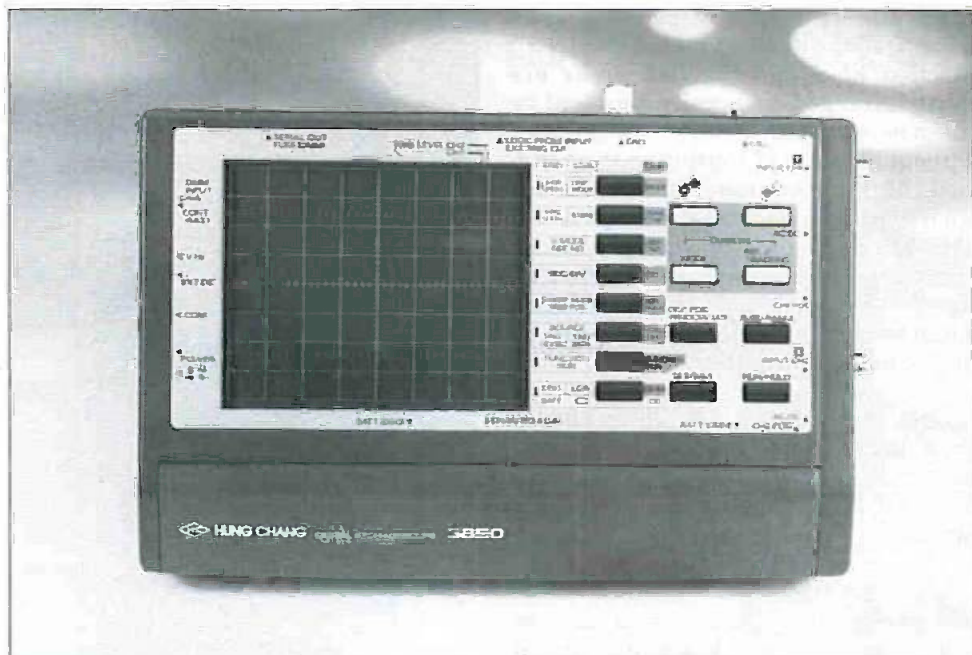
The 8-channel logic analyser turns the 125 ScopeBook into a multi-purpose test instrument. However, the timing resolution is on the low side, so that this interesting function is really only suitable for use with relatively slow signals.

The instrument has an 'encoder' rotary control on the front panel. This control replaces up/down buttons, and offers a simple and easy-going 'quasi-analogue' way of controlling the instrument. Without occasional recourse to the users manual, however, it is not always clear which functions are controlled by the rotary control, and which functions, by the rubber presskeys (having a agreeable tactile 'click'). The display is sufficiently large and its readability is good even at bad lighting conditions and unfavourable viewing angles. As on the Fluke DSO, plastic BNC sockets are used. However, the ones on the ScopeBook appear to be made from a much harder plastic, and give a more solid impression. The documentation that came with the ScopeBook did not state the current consumption. The instrument put to our disposal for this article worked about 1.5 hours on a freshly loaded set of batteries.

Hung Chang: HC 3850 (DataBlue 6000)

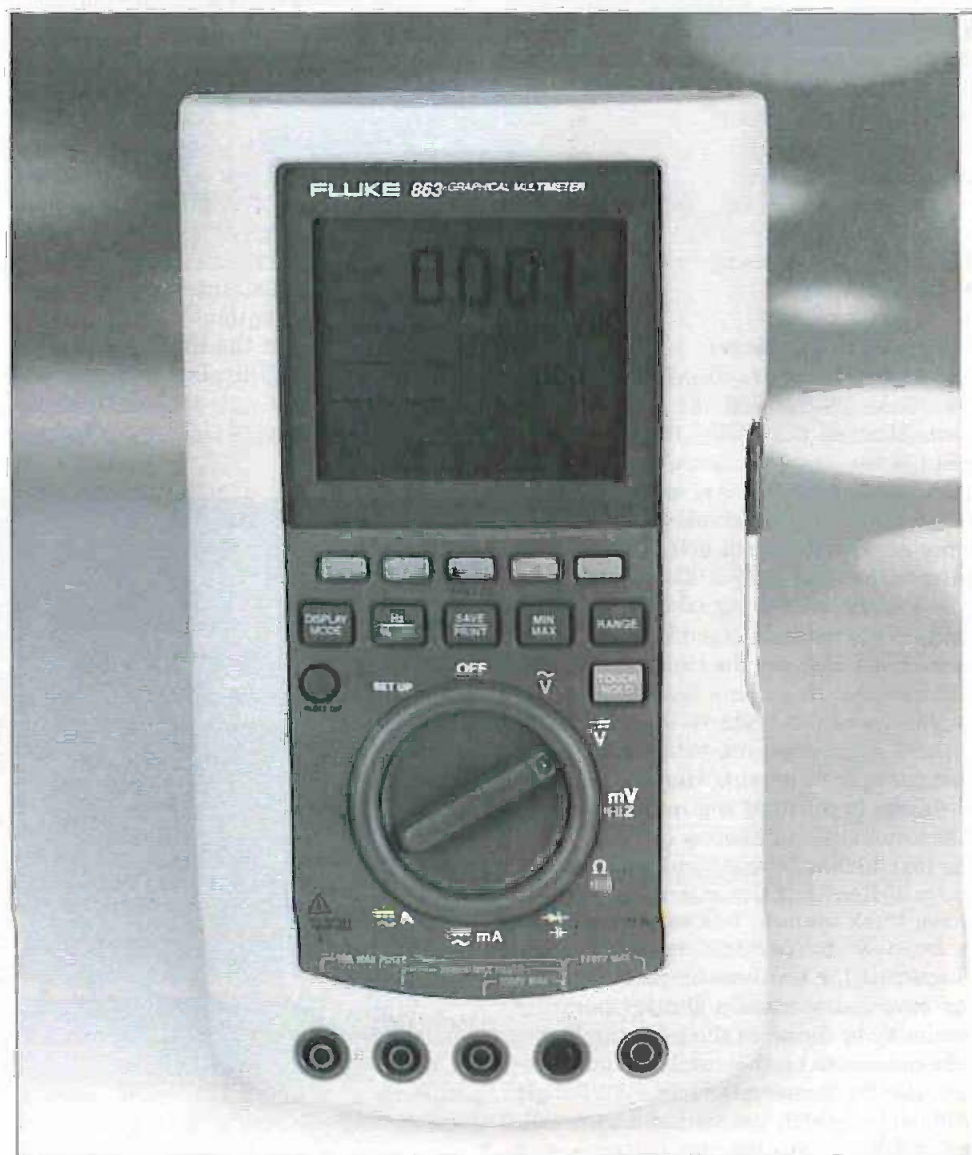
These two instruments are identical and marketed under different brand names by Korea-based manufactures Hung Chang. Their price is much lower than that of the other three DSOs mentioned above, making it dangerous to do a direct comparison as regards technical data. None the less, the HC 3850 has the largest number of functions of all DSOs. Apart from an optically isolated DSO and DMM with voltage, current and resistance measurement, the instrument offers a frequency meter and a capacitance meter. A logic analyser with 16 channels is also integrated.

In most measurement modes, fewer ranges are available than on the other models. However, the measurement errors remain in the acceptable range. The bandwidth is stated as 50 MHz, while the maximum sample rate is an astounding 50 MS/s (on one channel).



The push buttons are a bit unstable, while the abbreviations used as function legends are not always clear until you have consulted the manual. The main

shortcoming of the Hung Chang is, however, its display. Offering only low resolution, it gives a fairly 'coarse' impression. The low resolution not only



affects the graphs, it also makes the texts on the display difficult to read. Because of the limited space for them, texts are often abbreviated or turned into acronyms. Another obvious shortcoming, particularly with the graphics functions (DSO and logic analyser), is the lack of a clear distinction between measurement readout and text.

The graticule does not appear on the display as with the other instruments. Instead, it is printed at the inside of the cover plate. The printed graticule not only aggravates the parallax effect, it also interferes with the numerical display of the measured values.

The supply for the DSO and DMM sections are separated. While the six NiCd batteries for the DSO are exhausted after about 2.5 hours, the two cells for the DMM last about 200 hours. The Hung Chang has all-metal BNC sockets.

In spite of its shortcomings, the HC 3850 (DataBlue 6000) is an interesting choice for tight budgets, because it meets most requirements of the advanced electronics hobbyist.

Other instruments:

DataBlue 4000/HC3820 with 20 MHz bandwidth.

DMMs with graphics display

Apart from the above mentioned portable DSOs, we also had a chance to examine two graphic multimeters, the Fluke 863 and the Tektronix THM 420.

These two instruments look like normal, high-end DMMs. They are operated by a centrally located rotary switch, and feature autoranging. Autoranging, obviously, helps to keep the lettering around the rotary switch to a minimum. In addition to the rotary control, these graphic multimeters (GMMs) have a couple of extra buttons. On the THM 420, these buttons serve to select between two functions, creating a great resemblance with an ordinary DMM. The scope function only serves as a coarse indication of the graph shape — it is not really suitable for quantitative measurements because of the small height of the display, the low resolution and the poor scaling. The multimeter functions are limited to the bare essentials. An interface is not available on the Tek. On the positive side, the 863 is the only instrument which actually deserves the description *handheld*.

At the cost of being difficult to handle with just average size hands, the Fluke GMM offers a multitude of functions which may be selected and configured with the aid of six toggle keys and five so-called soft keys, each of which having different functions depending on the menu. Operation is relatively complex, so that you are really helpless without the manual. The measurement values have a very small basic error, while the graphics



in 'view' mode are sufficiently large for an accurate indication of the graph shape. Here, too, the graticule could be clearer.

The Fluke 863 takes an intermediate position between a DMM and an oscilloscope. As shown in the photograph, the instrument allows a special mode to be selected which combines a numerical and a graphical display. The Fluke 863 does not have an interface, however this is available on more expensive GMMs in the series (which also offer additional features such as a memory for measured values). The protective, non-removable, case of the Fluke is of excellent quality.

Other instruments:

Fluke 865, with logic/component tester and signal memory;

Fluke 867, with logic/components tester, signal memory and PC interface.

The choice: handheld DSO, GMM or bench instrument?

If you are involved in any kind of field testing, calibration or repair work, the question whether or not to include the relatively new handheld DSOs and GMMs in one's choice is definitely answered in the positive. There can be no doubt that these new instruments are

lighter and more compact than an equivalent stack of bulky, mains-powered bench instruments. Not so in the electronics laboratory, however, where benchtop instruments still have a better price/performance ratio, and better accuracy, than any of the new handheld DSOs and GMMs. Another totally different situation is that of the hobbyist, who may not be after the highest specs as regards accuracy. He or she may be perfectly satisfied with the performance of, for example, the Hung Chang instrument, which eliminates the usual cable mess when using separate instruments, and allows quick and efficient construction of prototypes. Provided the DSO supports the function, all measured data may be sent to a PC via a single interface for further processing. However, the cost of such an instrument will continue to be the decisive factor for the hobbyist. As already mentioned, handheld scopes are nice, but expensive. (950083)

Some useful addresses:

Write or telephone the manufacturers or their local sales offices for extensive technical data on their products.

Tektronix U.K. Limited, Fourth Avenue, Globe Park, Marlow, Bucks SL7 1YD. Tel. (01628) 403300. Fax: (01628) 403301.

Head office: Tektronix Inc., Corporate Offices, 26600 SW Parkway, P.O. Box 1000, Wilsonville, Oregon 97070-1000. Tel. (503) 682-3411, (800) 426-2200.

Fluke UK Ltd., Colonial Way, Watford, Herts WD2 4TT. Tel. (01923) 240511. Fax: (01923) 225067.

Head office: John Fluke Mfg. Co. Inc., P.O. Box 9090, Everett, WA 98206, U.S.A. Tel. (206) 347-6100. Fax: (206) 356-5116.

Keithley Instruments, Ltd., The Minster, 58 Portman Road, Reading, Berks RG3 1EA. Tel. (01734) 575666. Fax (01734) 59649.

European Headquarters: Keithley Instruments GmbH, Landsberger Str. 65, D-822110, Germany. Tel. (+49) 89 849307-0. Fax (+49) 89 84930759.

Hung Chang Products Co., Ltd., 2nd/3rd Floor, Hongje-dong, Seodaemun-ku, Seoul, Korea. Tel. (02) 395-8610/19. Fax (02) 395-5381/84.