

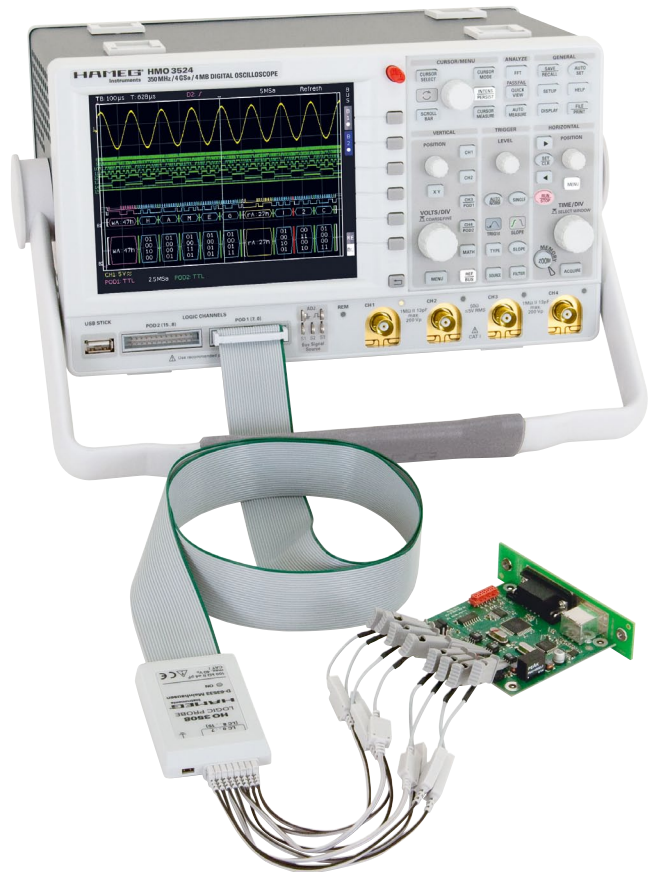
HAMEG Oscilloscopes

Mixed-Signal-Oscilloscopes with serial bus analysis at a fair price

In the past years, electronics performed a great leap forward. Yesterday, individual functions – e.g. the control of the motor of a washing machine – were realized employing discrete power electronics, today, an embedded system takes over the control, far beyond just motor control. The system derives information from a full array of sensors, determines the actual state of the machine and initiates and controls the necessary actions. If the system recognizes, e.g., a heavy load and an imbalance at the same time, it will immediately change the start-up procedure of the spinning phase accordingly. In many branches of industry this development towards integrated systems with distributed processors and sensors has become standard. Apart from household appliances, such systems can be found in the automotive, the communications, and the consumer industries.

Common to all applications is the information exchange between a microprocessor and peripherals such as sensors, actors, control or display units. The design engineers of these products use parallel buses (8 or 16 bits wide), serial buses, also, quite frequently, they have to include power electronics. During the last years, the Mixed-Signal-Oscilloscope has established itself as the most important tool for designing such systems. This kind of oscilloscopes features the usual 2 to 4 analog input channels and (mostly 16) digital logic channels. This combination provides the classical oscilloscope functions and the necessary logic analyzer functions for parallel data and address buses while preserving the familiar operation. In these embedded systems, the peripheral elements mentioned above typically use serial bus protocols like I²C, SPI or UART, RS-232. Also here, there is need to check the signal quality and the contents of the protocols for quality assurance and debug purposes. The Mixed-Signal-Oscilloscopes of the leading manufacturers hence provide the options to trigger and decode such serial buses.

As embedded systems are encountered more and more also in low-cost products, there is mounting pressure on the cost of the instruments used for analysis. Few years ago, the prices of Mixed-Signal-Oscilloscopes with such options were in the five-digit Euro region; now HAMEG offers such a system, its HMO series, with 350 MHz, 4 GS/s, 4 MPoints of acquisition memory for considerably less than 4,000 €. This package already includes the option for triggering and decoding of I²C, SPI, and UART/RS-232 buses at a fraction of the otherwise customary 1,200 to 2,200 €.



Up to two serial or parallel buses may be displayed in mixed operation. In the following example, a parallel and an I²C bus are analyzed. The presentation of the bus usually is in the so-called state form (table). Especially for individual bit tests the four-line binary presentation is of advantage to the user. Even at lower time base ranges and with a densely packed table the user will remain in control. The coloured presentation of parts of the messages is very helpful. With I²C packets, e.g., the read addresses are shown in yellow, acknowledge in green, not acknowledge in red, and data in blue. Even in a deep memory, important informations from the messages can be read immediately. Just by pressing a button the individual bit lines of each bus will be shown above the state information which also allows checking the exact timing – with colours identical to those of the state information. Fig. 1 shows the highly informative and clear presentation of the informations:

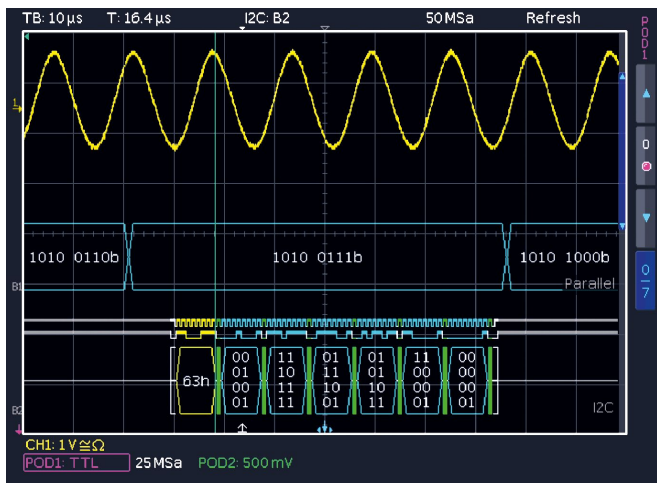


Fig. 1: Decoding of parallel and serial I²C buses with colour indication

New with Mixed-Signal-Oscilloscopes is also the built-in bus signal source in the HMO2524. The usual Probe Adjust output was extended by 3 outputs. Depending on the actual requirements, at these outputs, an internal circuit provides stochastic serial data of the diverse protocols (I²C, SPI, UART) or a random 4 bit pattern respectively a 4 bit counter signal. This solves one of the most frequent problems – the correct set-up – during bus analysis: The user can fall back on known signals and check the settings for the analysis of his circuit.

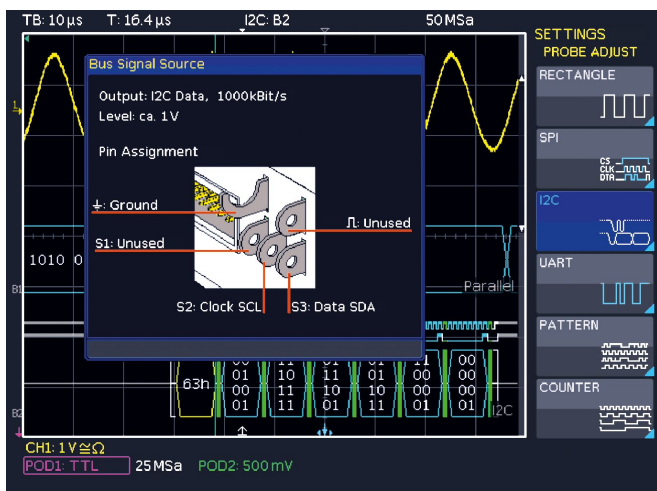


Fig. 2: Setting of the internal bus signal source of the HMO2524

The decoding of a parallel or a serial data stream in quasi real-time requires a top hardware and software design, especially with fast bus clocks. The hardware logic contained in the basic instrument allows high bus frequencies without a noticeable reduction of the acquisition rate (waveforms per second). This feature is by no means common, it eases the daily work immensely, and it is superior to any solution purely by software which is especially true with deep acquisition memories. As an example: a revolution sensor may be connected via an I²C bus, and its write address is known; it is possible to trigger on this write

address, and this trigger condition can also be combined with a given data value. This allows to isolate individual sensors during the transmission of certain values as events and to check those most precisely.

Frequently, products with embedded systems also contain power electronic circuits which are also analyzed with the Mixed-Signal-Oscilloscope. The oscilloscopes must provide for performing calculations with the data gathered, e.g. in order to calculate the instantaneous energy during the switching interval of the power electronics. It must thus be possible to enter scale factors and physical units into the mathematical channels. This allows to generate the necessary scaling when using current probes and difference amplifier probes. In order to calculate the energy, the oscilloscope must be at least able to multiply the acquisition inputs for current and voltage and to display the instantaneous power curve. This curve must be integrated in order to show the energy over time.

These functions are standard in the HMO series. It features sets of formulas with up to 5 formulas which may be simply selected in an editor. 5 such sets of formulas are provided. Thus the user can define the most important mathematical operations once, any time he needs one he can recall the desired set of formulas very quickly.

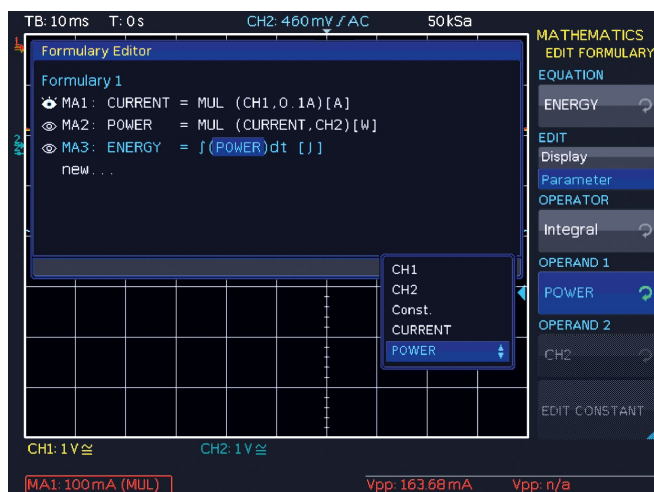


Fig. 3: Definition of the energy equation

Fig. 3 shows the setting described. The formulas may be given names in order to ease the documentation, the names will be shown in the formula editor and also in a later screen print-out.

As shown in this article, the HMO series Mixed-Signal-Oscilloscopes provide powerful analysis functions for analog as well as embedded applications which leave hardly anything to be desired in the design lab, the test and service areas. With its specifications: 350 MHz, up to 4 GS/s sampling rate, 4 MPoints acquisition memory together with the optional serial bus analysis and its attractive price this instrument family addresses entirely new customers.