CONTACT

No. 18 MEASUREMENT • NEWS 2003

Test & Measurement

Electrical engineering: choosing a handheld multimeter

Temperature control

Gentle power control

CHAUVIN ARNOUX

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Testing distorted voltage

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EDITORIAL

LOYALTY AND MODERNITY,

In these times of international unrest and economic slowdown, it is always reassuring and motivating to realise that, in the measurement profession, innovation and service loyalty live on and are constantly being consolidated. However, as far as we are concerned, it is the loyalty of our customers, your loyalty, a constant, additional source of information and adaptation, that is an assurance of sustainability and modernity!

Modernity, with all the new instruments you are going to discover in your magazine, some of them unique worldwide, such as the members of the MTX Compact family. Loyalty, with our willingness to offer you increasingly better, sustainable service. Thus, our sales networks, engineers and laboratory technicians, maintenance and metrology staff, our presence on the international front, the quality, ergonomics, design and safety of our instruments, our training manuals or our capacity to advise you and provide technical support are all part of the product "package" each time we are privileged to receive an order from you! This is a fairly rare added value nowadays!

Our Web site www.chauvin-arnoux.com has now been completely revamped: you will now be able to access full information about our company and all our products at any time in five languages. We have made the decision to devote greater effort on an ongoing basis to this permanent "e-show room", a tool to keep you better informed.
We are therefore devoting a full page to the presentation of our site, the virtuality of which, moreover, will further consolidate our presence as time goes by.

Finally, in view of the tightly-packed history of the 20th century, we will be preparing for our 110th anniversary in 2003 with you at our sides! 110 years of modern tradition: serving and creating!
Welcome to the 21st century of measurement.

Axel Arnoux
Vice-président
Groupe Chauvin Arnoux

National Defense: Air force base equipment

The French Ministry of Defence has relied on Chauvin Arnoux as a supplier for the Army, Navy and Air Force for many years now. All CA Group product divisions are concerned; the latest products to be listed are in the Test and Measurement Division.

The four main criteria chosen by this prestigious customer are metrological performance, reliability, durability of the equipment and service quality. All the various types of equipment, display systems, measurement PLCs, testing and regulation instruments, etc. represent over a thousand references to be managed under NATO nomenclature (NNO), in addition to the latest 2002 successes, i.e. several thousand Metrix pocket multimeters in the MX Concept series.

The MX Concept range of multimeters in their blue uniform appealed to the Armed Forces due to their performance

Opening of Chauvin Arnoux's 9th subsidiary

The Group has chosen the capital of the Lebanon, Beirut, as the location for its new subsidiary: Chauvin Arnoux Middle East.

Situated in the heart of the region since the second part of this year, the subsidiary covers Libya, Egypt, Jordan, Syria, the Lebanon, Iraq, Saudi Arabia, Kuwait, Bahrain, the United Arab Emirates, the Yemen, Oman and Iran.

The Group's three product Divisions (Test and Measurement, Power M&C, Temperature M&C) are concerned by this development.

Chauvin Arnoux was already present in the Middle East via its Export Department; this setup by the Group of facilities in the very heart of the market is part of a growth logic. Up to now the Group had facilities in Europe, China and the United States.

CHAUVIN ARNOUX MIDDLE EAST

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Chauvin Arnoux - supplier to the German Armed Forces

Chauvin Arnoux has been awarded the international tender for the supply of equipment to the German Army, Air Force and Navy.
The C.A 5003 analogue multimeter convinced the German Army thanks to its price and performance.
Chauvin Arnoux's capacity to adapt its products to meet special applications has also enabled a solution to be found for Air Force helicopter maintenance departments for earth continuity testing.
These departments now have a customised version of the C.A 10 micro-ohmmeter.

Company - University: a common vision of excellente

The name of the very first promotion of students taking the **DESS*** **Instrumentation physique, chimique et biomédicale** (Postgraduate Diploma in Physical, Chemical and Biomedical Instrumentation) at the University of **Paris XII** was chosen in honour of the world's oldest measurement instrument company which, up to the present, has patented over 400 inventions. Students of the **"Daniel Arnoux promotion"** were personally presented with the diploma that opens the door to professional life by their sponsor, Chauvin Arnoux's Chairman.

The 10 diplomas were presented at a formal ceremony last July attended by the Vice President of the University of Paris XII in charge of DESS, the Dean of the Faculty of Science and Technology, the teaching staff, Professor Christian Vauge, the Director and, above all, promoter of this course, and, obviously, Daniel Arnoux.
You can find full information on this DESS course on: www.univ-paris12.fr

*DESS: Specialised Postgraduate University Diploma (students will have completed 5 years of studies since entering the University)

The postgraduate students were warmly applauded by Daniel Arnoux and Professor C. Vauge, Director of this DESS course.

Audit by the French Railwways (SNCF): Renewal of CA Commercial and Technical Qualification

The procedure, based on the technical capability of the production machine population and the quality system and financial reliability of the supplier, was ratified in April by an audit on the production site concerned - Reux-Pont l'Evêque.

This SNCF qualification, an assurance of the reliability of Chauvin Arnoux and the quality of its production, concerns products manufactured in the three principal divisions on the above French site.

The Group Internet site

Metrix, Enerdis, Chauvin Arnoux, Pyro-Contrôle, Radio Contrôle, Manumesure? Test & Measurement, Power M&C, Temperature M&C and Service Divisions? Don't panic, access the Group's products and services offering, make your selection and ask for a price proposal on www.chauvin-arnoux.com

From the Group's Home Page you will not only be able to access the offerings of the various Divisions but also do a product search on the entire site if you are not familiar with our organisation.

A well-endowed catalogue, with a quotation request function

The product catalogue on our new Internet site presents the up-to-date offering proposed by each of our 4 Divisions.

With just **two clicks of the mouse, you can access** the product data sheets with information in as much detail as possible. Sales documentation in pdf format can generally be obtained by download.

Once on the data sheet of the product you are interested in, you will find detailed, up-to-date information. The prices are not indicated because you can request a personalised quotation thanks to the "virtual shopping cart" mechanism. Just select the article, specify the quantity and validate.

Our Customer Service Representative will send you a price proposal as soon as possible. At the same time, you will have his details if you wish to contact him: sometimes a telephone call is worth its weight in gold!

If you want to know where to buy our products or if there is a retailer – once identified on our site, you will obtain the details of the right person to contact in our sales departments, together with a list of the retailers in your area.

Another popular feature of the site is the possibility of asking questions about our products, receiving a personalised answer and reading all the other questions already asked.

To find a product there are two additional solutions.

■ The search bar: type in one or several key words relative to the product sought and start the search. The results will be displayed in the form of a list from which you can make your choice.

You can also directly input a product name if you already know it.

For example **"digital multimeter"** will directly display a list of the various models proposed by our Test & Measurement Division.

■ The catalogue menu proposed by each division: the various functions of the instruments proposed are classified into sections and sub-sections.

For example, if you follow this path for the Test & Measurement Division: **tester & handheld multimeter > digital multimeter > over 10000 counts**, you will obtain a list of all the families of digital multimeters with five or more digits.

Direct access:

■ **www.chauvin-arnoux.com: international site for the entire Group**

■ **www.chauvin-arnoux.fr and**
■ **www.metrix.fr: Test & Measurement Division pages (portable test and measurement instruments)**

■ **www.enerdis.fr: Power M&C Division pages**

■ **www.pyro-controle.fr: Temperature M&C Division pages**

■ **www.manumesure.fr: Service Division pages**

These pages can be viewed in English, French, German, Spanish or Italian.

Sign up to take full advantage of the site

While the product catalogues can be freely accessed, some site functions require the Internaut to be identified. For example, asking for a quotation, asking a question or downloading software or a user manual are operations restricted to Internauts registered on the site.

Registration involves filling in a form online, which some people find rather long, but which enables us to get to know you better and therefore fully satisfy your requirements.

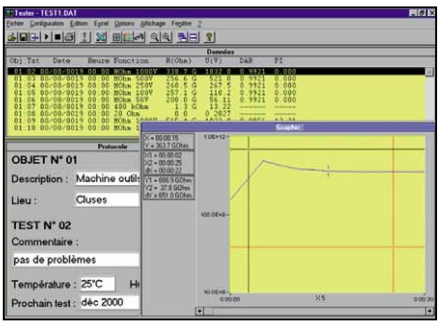
Once the questionnaire has been filled in, choose a personal identifier and password. Your contact details are recorded once and for all: when you return to the site, input your identification to take advantage of the functions enabled. ■

Two new 5 kV insulation expert instruments

Chauvin Arnoux, the specialist in electrical testing and safety instruments has extended its range of high-performance megohmmeters to include two new insulation testers, the C.A 6545 and C.A 6547, both of which come in a site-proof case. At the leading edge of technology and functions, they will be the new reference instruments for testing insulation below 5 kV.

Controlled by a microprocessor, the **C.A 6545 and C.A 6547** megohmmeters have extremely advanced functions for the measurement of insulation (**up to 10TΩ**), AC/DC (5100 V) voltage, capacity (50 µF) and leak current (3 mA).

The **C.A 6547** model also comes with a 128 Ko **memory** and RS 232 link which enables the **instrument to be controlled** from a PC, processing of data via the dedicated MEGOHMVIEW **software** and **printing** of the results.



In addition to the functions that have made the first two testers in the range, the C.A 6541 and C.A 6543* so successful, these new testers have the following new features:

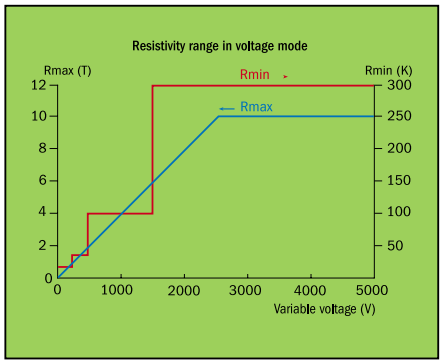
Var 50-5000 V Position

To adapt measurement to all applications, both models have four fixed testing voltages: 500, 1000, 2500 and 5000 V and a test voltage programmable between 40 and 5100 V in increments of 10 or 100 V.

Dielectric discharge test DD

(see insert)

For a more thorough analysis of the quality of insulation, this test will, for example, highlight non-homogeneous insulation or the presence of a faulty layer amid other highly resistive layers – problems that cannot be detected with classic insulation measurement devices or by calculation of the PI or DAR.



The programmable test voltage (Var 50/5000 V) enables the greatest possible accuracy to be achieved. It can be set by increments of:
• 10 V between 40 and 1000 V
• 100 V between 1000 and 5100 V

And, as always:

Automatic calculation of PI and DAR ratios. *(see insert)*

Parasitic current may interfere with the result and this may also occur due to climatic conditions (temperature/hygrometry). When a rotating machine is tested, for example, long-duration measurements must be taken. The insulation value recorded at the end of measurement and the PI and DAR coefficient values enable a reliable assessment to be made of the quality of insulation.

DAR	PI	DD	Insulation quality
< 1,25	< 1	> 7	Dangerous
		from 4 to 7	Poor
	from 1 to 2	from 2 to 4	Doubtful
from 1,25 to 1,6	from 2 to 4	< 2	Good
> 1,6	4	< 1	Excellent

Overview of the Dielectric Absorption Ratio (DAR), The polarisation index (PI) and dielectric load test (DD)

Curve trace R(t)

The user chooses himself the duration of the test and the speed at which the insulation measurement samples will be saved to memory. These values will then be used to determine the insulation evolution curve according to the test voltage application time, by hand or, for the C.A 6547, directly on a PC screen via the MEGOHMVIEW software.

Lock-in of insulation test voltage

In order to avoid the risk of manipulation should the instrument be loaned to a "less experienced" person.

Programmable alarms for visual, audible warnings.

Smoothing of measurements displayed via the "Smooth" function

... and other features that will facilitate and increase the safety of off-site manipulation.

**you will find these two products in C.A.M. n°53 or you can request our documentation*

Reader service No. 1

Mapping an electric field

We have conducted a study of the radioelectric coverage of a DCS (BTS) retransmission station not far from Annecy, using the C.A 47 Selective Receiver (see the Article in No. 16). Representation by mapping the results obtained is an ideal means to assess the efficiency of communications from a mobile telephone in this area and, on a more global basis, to know the distribution of the field transmitted by the station over the zone covered.

From an electric field to a telephone call

The establishment of a connection between two callers using DCS or other standard mobile telephones is based on the propagation of electromagnetic waves in a free space.

The electric field radiated by the transmission station is captured by the mobile telephone of each of the callers. When it is propagated, this electric field is attenuated due to the distance between the receiving and transmission aerials. The call connection can be established if the signal captured is greater than the sensitivity of the mobile receiver; this condition must be complied with throughout the coverage zone of each transmission station.

What measurements?

The measurement objective resides in the verification of the distribution of the level of the electric field in the coverage zone and therefore determination of the zones where reception is enabled.

To do this, an ultrasensitive electric field measurement instrument is used, such as the CA 47 Selective RF Receiver, equipped with a measurement antenna suitable for the operating frequency; a GPS (Global Positioning System) is associated with the instrument which permanently provides the geographic co-ordinates of the measurement point. Finally, an odometer is coupled to a wheel of the transportation vehicle to ensure correct calibration of the distance travelled.

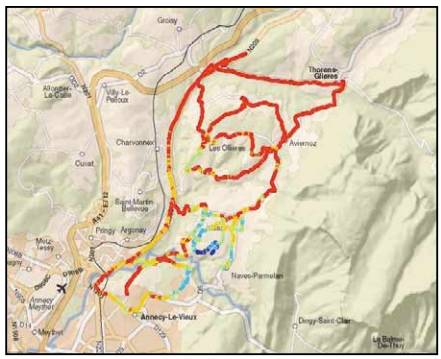
Interpreting the results

The information recorded is collected by a PC equipped with the LOG 47 software which configures and controls the C.A 47 Receiver and then memorises the measurements taken as the vehicle moves around, tracing the corresponding variance curve in real time.

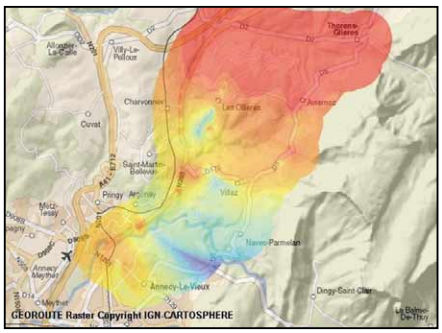
The truest and most accurate solution to illustrate the overall results consists of **mapping the electric field**: it corresponds to the representation of the levels of field available at all points in the coverage zone. This representation is reflected by the positioning of areas of colour on a geographic map of the zone which correspond to the ranges of levels captured.

The larger the number of measurements taken along the communication channels in the zone to be assessed, the more representative and realistic the mapping.

Chauvin Arnoux has selected 3 specialist software modules in partnership with ESRI™ France in order to obtain an automatic mapping representation in successive stages:

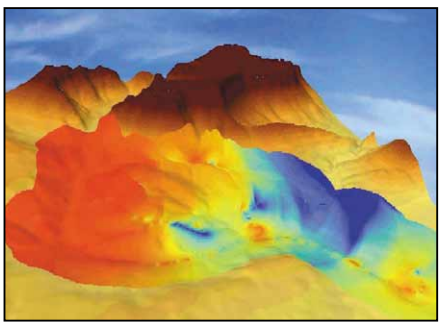


■ The first software module uses a cartographic background on which the **values measured are indicated** at each point of the route travelled, based on geographic co-ordinates provided by the GPS. The ranges of values are defined by a colour associated with them (for example, any value between 0.2 mV/m and 2 mV/m will be represented in blue).



■ A second module uses the above information to develop a map in the form of **areas of different colours according to electric field levels** by interpolation between all the measurement points.

This software can also trace the "profile" of the electric field between any 2 points chosen on the map of the zone assessed, even if they do not correspond to points measured.



■ A third module provides a **relief representation (in 3D)** of the map to facilitate interpretation of the distribution of the electric field, taking the region's relief into account from a visual standpoint.

The mapping obtained reflects the actual area of geographic coverage around the transmitter and its various ranges by integrating the values of the levels of fields recorded on site.

Reader service No. 2

Complete expert assessment of Earth with one instrument

For any electrical installation, an earth connection is vital in order to ensure life and property safety (NFC 15-100 standard).
Before installation and in order to save time and money, it may be advisable to choose the ideal location according to the quality of the ground and its resistivity. Once installed, it is essential to check the characteristics of this earth on a regular basis.

The new **C.A 6460** and **C.A 6462** Earth and Resistivity testers, which come in a heavy-duty site case with a cover for use in the field, are three-in-one **Resistivity, earth and coupling** testers: these new-generation testers are suitable for every need and are popular with installers and expert users alike!

For greater usability, the C.A 6462 also has an internal battery, rechargeable on the mains supply.

The reliability of the measurements taken by these two instruments is ensured by the use of **traditional stake methods**: 4 stakes are placed in a line to measure resistivity and 3 stakes to search for earth resistance.
The **self-diagnosis** function, consisting of three LEDs to indicate the presence of any faults liable to invalidate the result, is another assurance of validation.

All the measurements with one instruments

Over and above high measurement performance, the C.A 6460 and C.A 6462 testers are extremely easy to use. The stakes are connected to the instrument on three identified terminals, marked with different colours to facilitate connection. A captive terminal strip, fitted onto the terminals, can be used to adapt the instrument for “4-wire” or “3-wire” measurement.

No tiresome settings: the instrument **automatically selects the correct measurement calibre** and measurement current.
Measurement is triggered by one pushbutton and the backlit LCD display facilitates reading. The stakes and leads (in colours to match the 4 terminals) are proposed as accessories in shoulder bags especially designed for stowing the instrument.

Designed to meet NF EN 61010 - IEC 61557, EN 61 000-3 and EN 61 000-4 standards, the C.A 6460 and 6462 offer extremely high utilisation safety and are suitable for measurement in difficult conditions (presence of spurious external voltage, high telluric current and very resistive auxiliary connections,...).

Reader service No. 3

MTX Compact Family: attractive shapes and convincing performance

For the design of its new family of laboratory instruments, the MTX Compact range, Metrix focussed on useful innovation, giving its instruments a smart appearance and numerous plus points that the world of industry and technical education could not resist. The family now consists of a generator-measurer, a multimeter-analyser and digital oscilloscope-analysers.

Oscilloscopes with LCD screen controls. A generator and multimeter with a large-screen display.

Metrix confronted its development teams with an ambitious project with innovation as the byword: the creation of a family of laboratory instruments breaking away from the run-of-the-mill market offering. The challenge consisted of devising and producing different instruments with hitherto unknown performance. Even better, every design detail not only had to be justified from an aesthetic standpoint but also as regards ease of use, the technical aspect and sturdiness.

This gave rise to the MTX COMPACT range. Centred on ergonomy, their architecture offers unequalled utilisation pleasure and efficiency.

For example, the size and readability of the generator/multimeter display is new to the market: 140 x 50 mm. Despite their compactness, which facilitates their integration into any work situation, the functional zones are consistent and at least twice the surface area of those on traditional instruments.

As for the oscilloscopes, when used with the keyboard, a record level of efficiency is achieved since only twenty-one keys and an encoder have been retained for direct access and setting adjustment. Thanks to the "Windows" style ergonomy and its universal utilisation mode, unique on this category of instrument, operation of the oscilloscopes is particularly accessible. There is a mouse for opening menus and easy browsing; it also enables direct, efficient action on graph elements (cursors, trigger, trace position, etc.). All these tools are light and can be moved without any hesitation from one workstation to another, thanks to the integrated handle.

Triple backlit display, measurement connections on the front, keys with laser, deterioration-proof marking and keyboard with micro-switch contacts for ease of use and long, reliable service life.

Placed directly on the worktop, the space they save is considerable. They can also be placed on or under a half-shelf or directly on another instrument.

Such prodigious technology that investment needs not be measured!

The technological innovations integrated into the MTXs combine the essential functions required by the user, a hitherto unknown feat for one instrument.

The **MTX 3252** and **MTX 3352 digital oscilloscopes**, 60 and 100 MHz, respectively, with a maximum sampling speed of 20 G samples

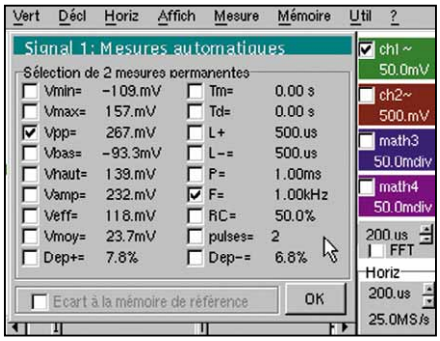
Online help is available in five languages at all times by pressing the "?" key. The files generated are in standard "Windows" environment format: .gif, .pcl, .txt, .bmp, .eps, .prn etc. It is possible to save them to the instrument's file system, print them or export them directly to a PC for use in "Windows" applications (reports, spreadsheets, printable files and images…).

per sec., allow rescaling on the channels with the reading and physical unit of the signal, associated with exceptional vertical dynamics, from 2.5 mV to 100 per division.

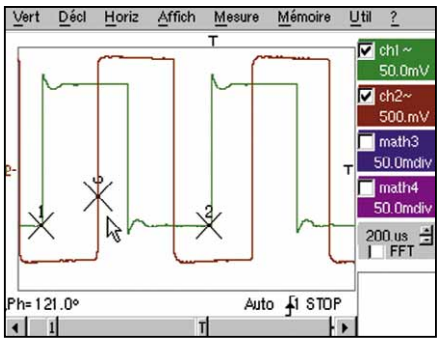
The mathematical editor displays the result of the 4 functions on the screen in real time as required, either from acquired signals or as a complete simulation. Thanks to the 50,000-count memory, the reference in this category, and the unique "winzoom" horizontal and vertical trace with a 200-times enlargement factor, we continue to see only true acquisition points.

Fully in tune with its era, the Ethernet network interface with HTML server (option) allows the user to go one step further and, without any extra software, to manipulate the oscilloscope(s) set up in a network.

Originally a signal viewing instrument, the oscilloscope has become a veritable analysis tool.



A window enables the user to simultaneously view the 18 automatic measures available on the instrument.



The cursors can be positioned on the signals at any time to take a variety of highly-accurate measurements, such as, for example, the dephasing between two signals. Attached to the curve like a magnet, the encoder or mouse move them by means of a single horizontal movement.

As a result, the MTX 3352 and 3252 have FFT real-time analysis and multichannel signal capability, a standard function on Metrix for several years now.

MTX 3352 and 3252 oscilloscopes, here with their screens folded down, come with a 230 kbauds RS232 link and Centronics interface as standard equipment.

The MTX 3240 generator offers frequency adjustment stability with one-digit accuracy, automatic range change for "LEVEL and OFFSET" amplitude, an adjustable duty cycle without variation of frequency and the "LOGIC" function for a simple, fast response to the generation of logic signals with adjustable thresholds.
The sturdiness of the generator is enhanced by protection of its 60 VDC and 40 VAC outputs.
Finally, because some instruments are only used occasionally which does not justify purchase, the MTX generator is also a 100 MHz frequency-meter.

The MTX 3250 50,000-count multimeter has 3 terminal connections and full current "AUTO-RANGING". Combinations of measurements can be viewed on the triple display; SPEC mode calculates and displays the instrument's uncertainties: MATH mode reads the quantity measured directly; SURV mode traps and dates faults and RELATIF mode, expressed as an absolute value, percentage or dB, offers access to direct utilisation, such as, for example, verification of the bandwidth.

The AUTOPEAK® mode facilitates constant verification of the voltage or current peak factor of the signal measured and, thanks to this elementary analysis, can work on a suitable range, thus eliminating any uncontrolled error.
The MTX 3250 is also a frequency-meter, thermometer and even a recorder, in its data acquisition version.

Innovative and really complete, these two instruments are available in a fully-programmable version via an SCPI-compatible RS232 optical link.

For users in the electrical engineering field, 31-rank multichannel harmonics analysis is proposed as an option.

Finally, for anyone who has to monitor the variation of physical or mechanical phenomena over a period of time, a veritable fast digital recorder can be integrated into the instrument in the form of a software module.

On the other hand, thanks to functions enabling accurate analysis of the signal, MTXs are suitable for fully autonomous implementation and avoid systematic utilisation and therefore the purchase of another instrument to validate the settings.

Reader service No. 4

Electricity and electrical engineering applications: which multimeter to choose?

In the factory, out on site, for maintenance or teaching purposes, the multimeter has long been the essential tool for electricians, mechanics and electrical engineers. Although multimeter choice criteria - performance, robustness, handiness, ease of use and utilisation safety and readability – have not really changed for decades, they are becoming instruments of considerable, and sometimes astonishing, talent. The basic functions are still the measurement of voltage, intensity and resistance but there are now a multitude of additional functions and new levels of performance. How do you make the right choice and differentiate between useful and superfluous features?

Chauvin Arnoux's Research and Development teams focus on the development of "100%-useful, leading-edge technology" to ensure the correct balance between instruments and applications linked to the various professional sectors, while ensuring user safety.

Safety – first!

With EC and IEC 61010, 600 V Category III certification, our multimeters offer protection that will satisfy the requirements of the majority of users. They have been designed in full compliance with European standards, with stringent selection criteria for components and materials. All the efforts made with regard to safety also apply to the accessories

■ In a professional environment, a Category III overvoltage instrument is essential for measurement on electricity cubicles and cabinets. Downline of the installation, in all other cases (2P+E sockets), this category is not obligatory but efficiently ensures the safety of users in the event of transient overvoltage.

High-quality metrology

For professional use, whether digital and/or analogue displays, for processing analogue and/or digital signals, for measuring average values (AVG), RMS (AC) or TRMS (AC+DC), instruments must ensure high-quality measurement and be extremely simple to use (intuitive).

■ In industry, if inverters, variable speed drives, neon/fluorescent lighting and other non-linear loads are part of the environment, it is advisable to user an RMS/TRMS instrument for diagnosis.

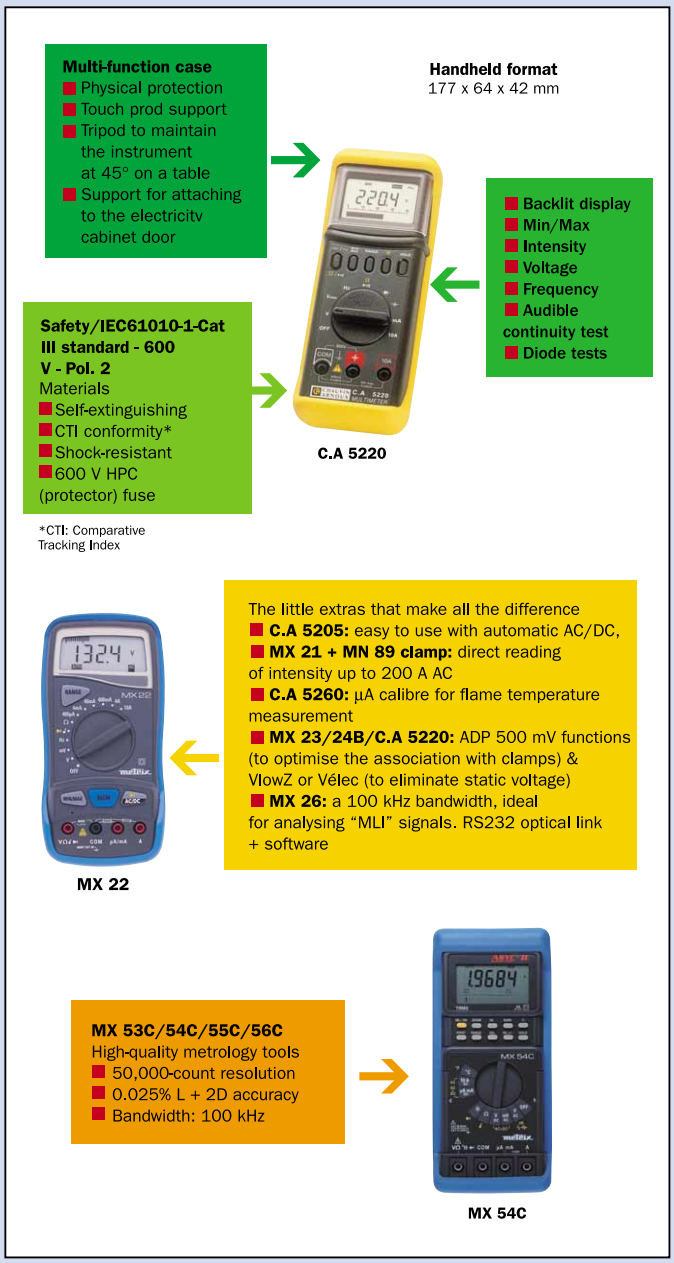
■ Office block maintenance, PC screens and partitioned power supplies, fluorescent lighting, etc. also require RMS/TRMS measurement. An average value (AVG) measured on a non-sinusoidal signal may result in an error in the region of 30%.

■ For new or maintenance work, exclusively in houses, the loads are principally linear (incandescent lighting, electric heating, etc...) and average-value measurement is sufficient.

Instruments for all measurements

Apart from direct measurement of current, voltage, frequency, resistances, capacity and continuity and component testing, some multimeters, combined with specific accessories, will enable you to carry out physical measurements (temperature, lighting levels, etc.) at a high voltage (with a probe).

Connected to an ammeter clamp, a multimeter can measure very low or very high intensity (from mA to kA) without having to disturb operation of the installation.



To choose the multimeter most suited to your requirements, you should first of all determine:

1 – The applications it is intended for

A - The environment: industrial, large commercial, domestic. This will determine the category. All our multimeters comply with the IEC 61010, 600 V, Cat. III standard, offering maximum safety for the majority of applications.

B - The type of load: non-linear or resistive,

C - The type of task: verification or diagnosis. The measurement accuracy and display resolution required...

2 – What type of intensity measurement? AC & DC or only AC?

3 – The measurement scope and method (via a clamp or direct)?

4 – The type of display required (analogue or digital, bargraph)

5 – Other measurements: frequency, capacity...

6 - Other tests: continuity & diode tests

7 - Ergonomic functions:

- Hold/Min-Max/Peak...
- Backlit display

8 - Utilisation ergonomics:

- Physical protection (against dropping, impact etc.)
- Stowing of accessories in the protective case de protection
- User-friendly working position (19 mm centre distance + touch prod "on" case)
- Possibility of hooking onto the electricity cabinet or held on a table

Put back in their sheath, multimeters will put up any treatment, even of the most severe type!

This choice process is illustrated in diagram form in the table below, together with our product solutions.

Reader service No. 5

LINEAR - RESISTIVE LOADS
(Incandescent Lighting, Heating, Direct-start motors, Ovens)

DIAGNOSIS

TESTING

1) **AVG** (Average)
2) Bandwidth

Bandwidth < 2kHz

General electricians
An ideal tool for daily use on sites and for maintenance

Heating engineers
Measurement in µA (flame temperatures...)
C.A 5260G

AC Intensity

AC & DC Intensity

Digital Display
C.A 5205G, MX 21, MX 23 + AC clamp

(direct reading of Intensity up to 200 A:
MX 21 + MN 89 clamp)

Analogue Display
C.A 5001, C.A 5003, C.A 5005 + clamp, MX 1, MX 2B + clamp

C.A 5003 + MN 89 clamp

Digital Display
C.A 5220G, MX 22

Reader service No. 6

NON-LINEAR LOADS
(Fluorescent & Neon Lighting, PC Screens, inverters, variable speed drives)

DIAGNOSIS

1) **RMS/TRMS**
2) Bandwidth

General Applications

Speed drive Applications

Bandwidth < 2 kHz

Bandwidth 30 kHz

Bandwidth 100 kHz

AC & DC Intensity

AC & DC Intensity 50,000 ct

AC & DC Intensity

C.A 5011
C.A 5230
C.A 5240
MX 24B

MX 53C

MX 26
MX 54C
MX 55C
MX 56C

The F05 powered up

In our previous issue (C.M.N No. 17), we presented the new range of multimeter clamps – the F01-F03-F05-F07. Let's take a closer look at the mainspring of the range: the F05, which offers the measurement of power, the power factor, frequency and phase rotation. A close-up on some of its most invaluable functions.

The F05 multimeter clamp offers a certain number of features not commonly found in such a small instrument (19 cm) which allow it to compete with a number of top-of-the-range instruments on the market today.

Testing of active power

On an electricity network, dephasing between voltage and current makes the **measurement of power** extremely useful in order to know the electrical consumption of the receiver with greater accuracy. (cf. diagrams 1 & 2)

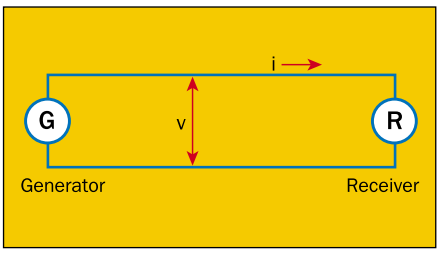


Diagram 1

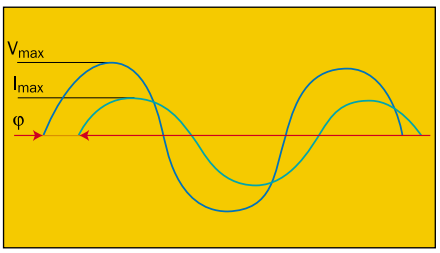


Diagram 2

In the case in point, on a single-phase installation, the F05 measures active power up to 240 kW and the power factor.
On unbalanced, 3-wire triple-phase networks (3 phases with no neutral), power is measured by means of the two-wattmeter method - P=P1+P2. (cf. diagram 3)

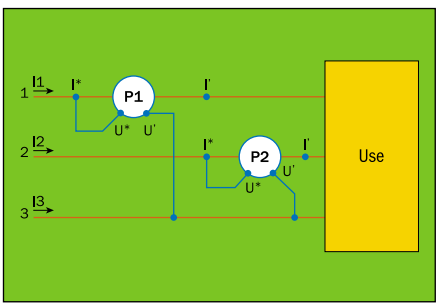


Diagram 3

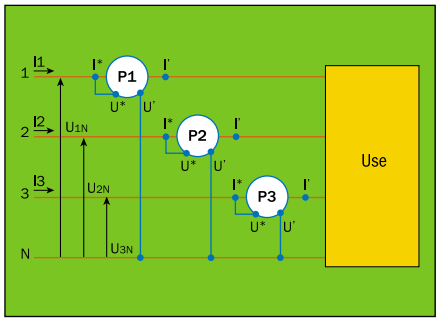


Diagram 4

However, the F05 clamp can be used by itself if measurement is stable. For unbalanced, 4-wire triple-phase networks (3 phases + neutral), the 3-wattmeter method is required - P=P1+P2+P3 (cf. diagram 4).
Here again, one F05 is all that is required if measurement is stable.

Analysis of current inrush when a motor is started

Particularly useful to capture transients on specific strong current inrush applications, the **INRUSH** function proposed on the F05 clamp measures the greatest rms values over 10, 20, 50, 100, and 200 ms.

For example, when a transformer is switched on it produces an inrush current which may be as much as 25 times the nominal current. Knowing these rms values for inrush current is a decisive element when choosing the optimum setting for magnetic protection upline of a transformer or on metal vapour lamp power circuits.

INRUSH measurement is also helpful when troubleshooting failures on control circuits or on uninterrupted circuits: in fact, as a result of the high impedance of independent power supplies, drops in current are replicated and amplified into drops in voltage (computers on the same uninterrupted network, for example).

Calculation of minimum and maximum values

The **MIN./MAX.** function of the F05 clamp automatically calculates the highest rms value over 100 ms (5 periods). In the case of numerous magneto-thermic circuit-breakers, for example, this feature enables the user to determine whether the startup current is greater than the magnetic setting. (cf. diagram 5)

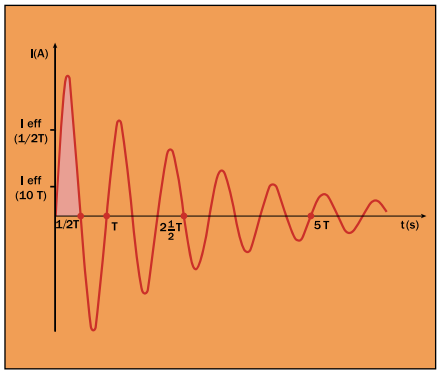


Diagram 5

Indication of peak values

Particularly appreciated when testing a wave form (I_{peak}/I), necessary for detecting possible network pollution, the **PEAK** function on the F05 clamp indicates the maximum instant values of a period over 0.5 ms. For a sine wave signal, the I_{peak}/I relationship typically has a value of 1.414; any value measured above 2 indicates harmonic pollution.

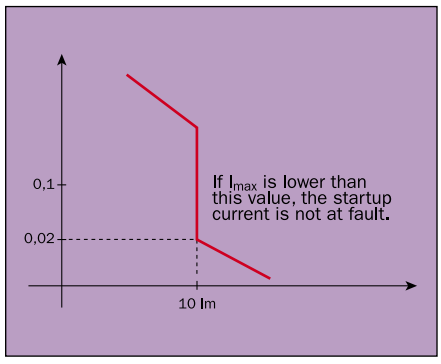
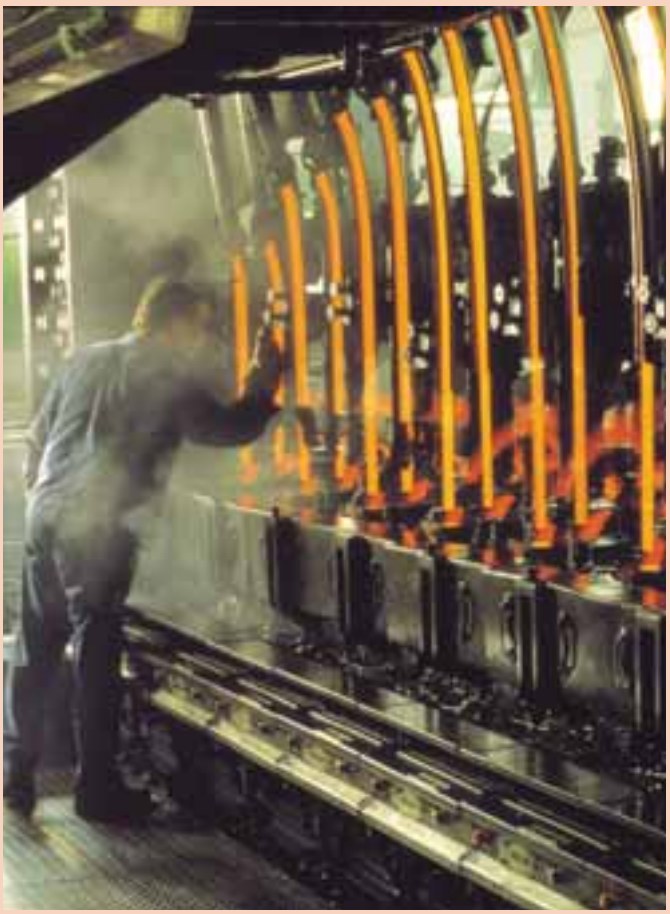


Diagram 6

Reader service No. 7

Power regulators for smooth heating

In many heating process applications where an electric resistance is used to control heating, there is often a parameter that requires refinement: the heating function. Important issues are at stake since current can be as high as several hundred or even several thousand amps. Thyristor power regulators used to have numerous current generation modes in order to match the type of resistance used as closely as possible. The latest models on the market have gone one step further, notably with the possibility of co-ordinating the operation of groups of regulators in order to eliminate influential parameters (mains variation, non-linearity and temporal load variations).



Control of the heating function is essential for efficient operation, high quality, monitoring improvement of the productivity of a transformation installation – in the glass, plastics, steel industry, etc..

This function is enabled by specialised modules with various names; they used to be called “power blocks” or “step-by-step resistors” but today they are more commonly called “thyristor static relays” and “power regulators”, the latter term referring to the integration of power control functions.
These functions enable a constant voltage, current or power assigned to a heating resistance to be maintained. Control can now be maintained over any variation, notably due to variation of the mains supply or impedance of this load.
By choosing a power regulator with these features, the destabilising factors of influence on the temperature loop can be offset.
The quality of the heat regulation loop is thus considerably improved.

Conduction modes for every situation

The temperature and atmosphere inside an oven determine the type of heating element to be used. They are generally resistance or selfic types of element (or a combination of both). Some resistances require a low-voltage power supply, isolated from the mains which then means that a transformer has to be used.

Power regulators must be able to adapt to all cases. For this purpose, two major conduction techniques have been devised: phase angle and wave train; combinations of these two modes also exist.

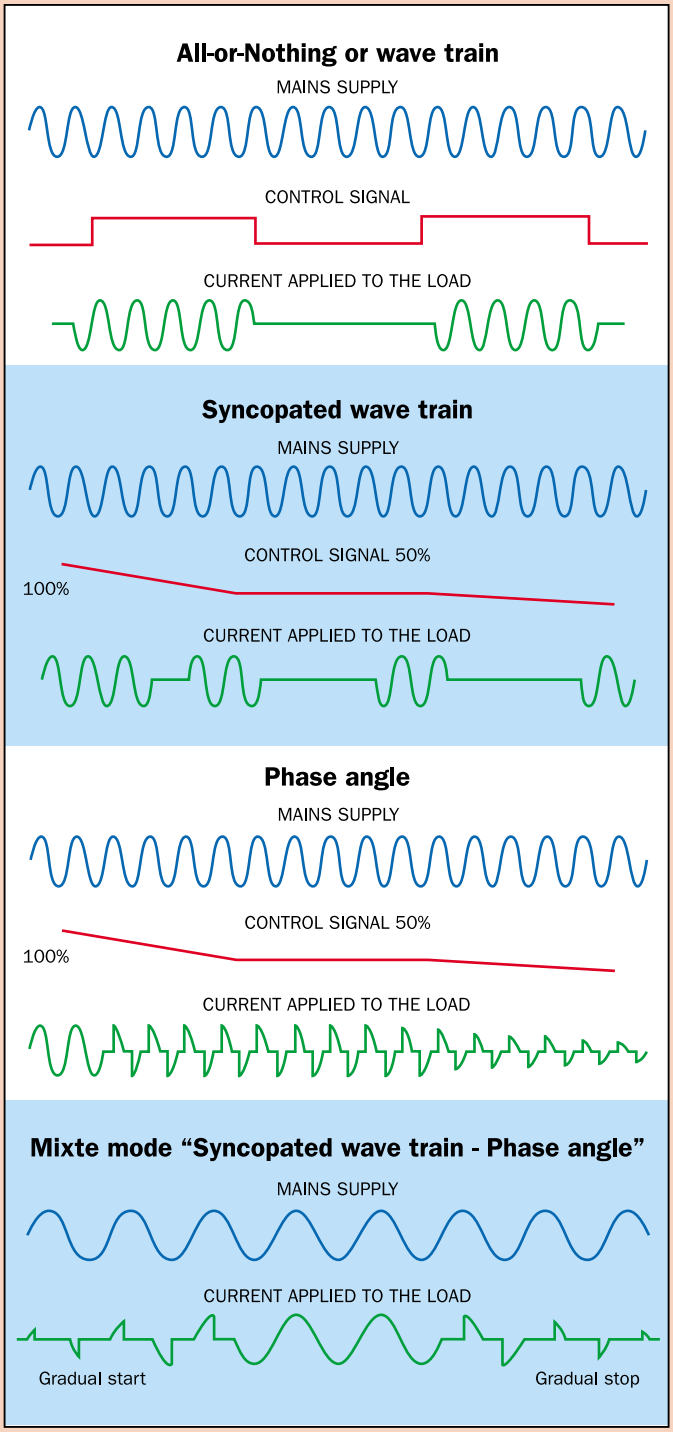
■ All-or-Nothing or wave train
Power is only supplied when voltage is applied as the actuator is enabled. It is switched on and off at zero voltage. This mode is suitable for the simplest, fairly inert installations and when slight oscillation is acceptable on either side of the set point.
The thyristors function until this value is reached and conduction is resumed when variance is sufficient.

■ Syncopated wave train (TAKT)
Action is taken on the average power applied to the load by eliminating a whole number of full waves (20 ms, for a 50 Hz mains supply) from the power voltage sine curve.
This control mode will be proposed for the majority of applications. Voltage is only applied to the load when the sine wave passes zero.

■ Fast syncopated wave train
This mode, called QTM (quick TAKT mode), is identical to the previous one, the difference being that the product’s software authorises conduction on a 10 ms timebase.
This type of operation allows very low inertia resistances such as short infrareds to be controlled enabling flickering of the lamp to be considerably reduced.

■ Phase angle (VAR)
Here, the average power applied is controlled by truncating each half-wave of the sine wave according to a specific angle, which is variable as required. This operating mode will be proposed for selfic loads (bobbins, transformers, etc.).
Phase angle is also suitable for very refined control since voltage is always applied to the load. The principal disadvantage of this mode is that it generates interference on the electricity network (harmonics).

■ Mixed mode
This mode, called SSSD (Soft Start Soft Down), is a combination of the



The various conduction modes

previous two modes, i.e. startup in phase angle, continuation in wave train. The startup time parameters can be set from 10 ms (i.e. a half-wave) to several hundred milliseconds.

This mode constitutes a good alternative to the previous one; it only generates interference in the startup phase.
This mixed mode is often used to magnetise transformers by eliminating overcurrent when powered up.

A specialised algorithm "MOSI" improves the performance of this mode even further for loads with a strong R_{hot}/R_{cold} coefficient such as resistances made of molybdenum bisilicide. When cold, the resistance is controlled in phase angle mode and then in wave train mode when resistivity has diminished. This mixed mode of management is fully transparent as far as the user is concerned.

Synchronisation to avoid a "flicker effect"

Installations generally have several heating resistances and therefore several power regulators . This may result in a "flicker effect".

When several power regulators are connected to the same power supply, current inrushes are very likely to occur at the same time. This is very bad for the electrical installation since it overtaxes upline equipment: transformers, voltage distribution boards, cables, etc. as well as generating an additional charge on the electricity bill due to peak current overruns.
To solve this problem, manufacturers have integrated synchronisation systems into their products. Two solutions were devised: first of all, static synchronisation and, more recently, dynamic synchronisation.

■ Static synchronisation

This determines the exact moment when each power regulator is switched on. It will always be the same moment, even if the heating set points for each product are modified. To carry out this function, an independent module is required, outside the power regulator, which is equipped with several outputs, each managing a regulator.
The synchronisation module staggers the electricity authorisation sent to each power regulator in the network. Synchronisation authorisations cannot be changed and do not take the load variations of the various regulators into account.

■ Dynamic synchronisation

The patented technique is called "ASM" (Automatic Synchronisation Mode). For installations with several power regulators, it consists of automatically adjusting the moment when each regulator is switched on in order to "smooth" the power supply. Each power regulator constantly calculates the moment it should switch on according to its set value and occupancy of the power line by other products. These "anti-flicker" systems considerably reduce current peaks caused by power regulators configured in syncopated wave train mode switching on simultaneously. As a result, there are less "peak current" overloads on the electricity bill and the components along the power line will be not be overtaxed.

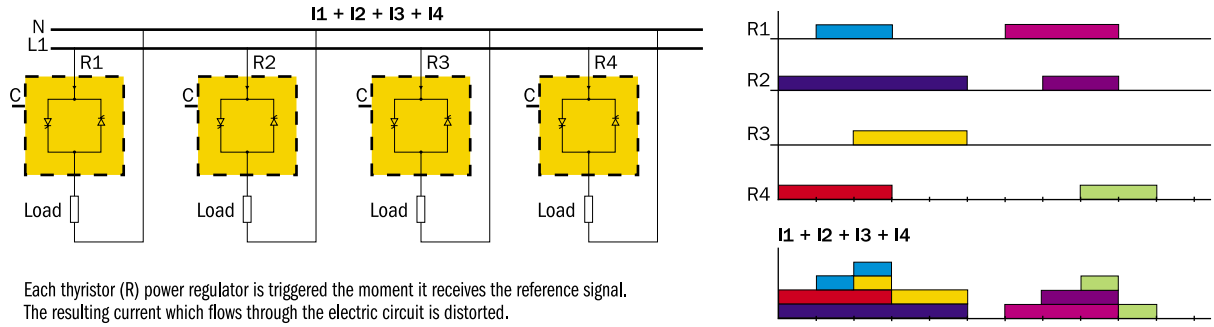
Increasingly communicative

Manufacturers have studied the possibility of connecting power regulators via field buses available on the market. A few products are already available and the offering will continue to grow. This type of regulator considerably simplifies cabling by integrating "measurement centre" type functions, adapted to heating resistance. In fact, numerous cables are needed for an analogue model to "pass down" set point and "pass up" U, I and P information, alarm relays etc. With field buses, only two wires are required to pass all the power regulator information up and down (measurement centre type) at very high communication speeds.

Numerous control ...

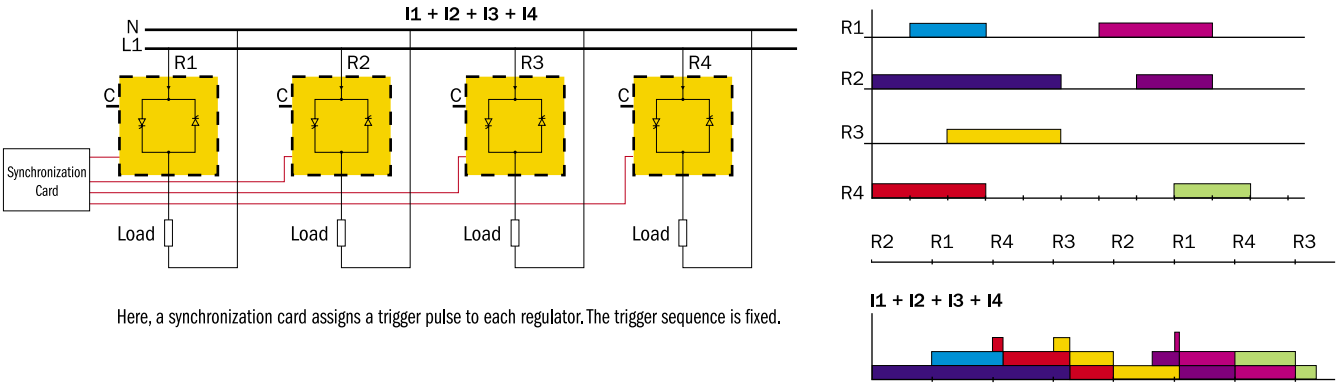
Another development, power regulators now have numerous control functions; they define their technology level.
- Current, voltage or power limitation.
- Alarms, via dry contacts or the field network, to inform users of partial or total load break – an abnormal value on the power supply network
- Abnormal overcurrent in the load – an internal fault, the thyristor or a faulty fuse ...
- "Datalogger" function for marking the time/date and saving the various anomalies to memory.

Without Synchronization



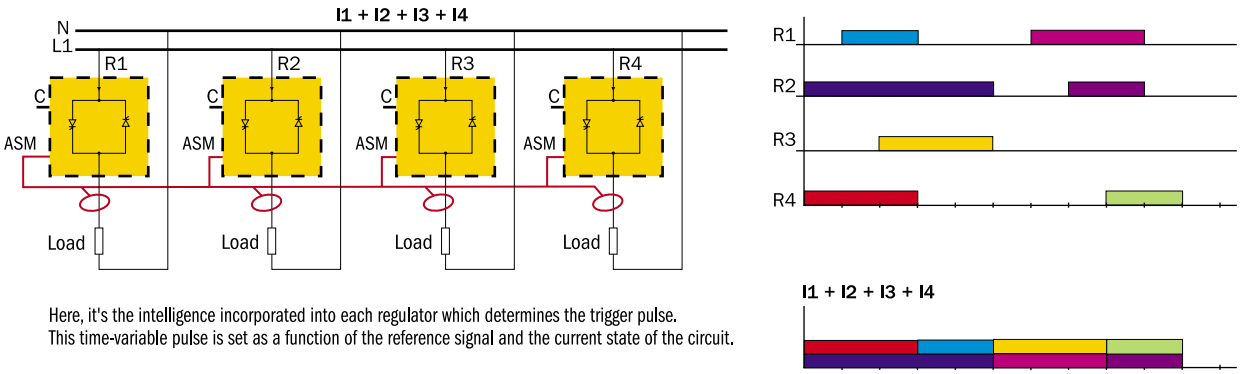
Each thyristor (R) power regulator is triggered the moment it receives the reference signal.
The resulting current which flows through the electric circuit is distorted.

With Static Synchronization



Here, a synchronization card assigns a trigger pulse to each regulator. The trigger sequence is fixed.

With Dynamic Synchronization



Here, it's the intelligence incorporated into each regulator which determines the trigger pulse.
This time-variable pulse is set as a function of the reference signal and the current state of the circuit.

The Different Control Systems

... and recording functions

Some very high-technology power regulators integrate data recording functions and are able to display curves such as current, voltage and the power or ohmic value of the load on an LCD type screen in real time.

Demanding applications

Thanks to their multiple operating modes and integrated functions, new-generation power regulators can tackle "difficult" applications.

■ "Furnace boosting" in the glass industry

Glass has the physical particularity of being a conductor of electricity in its liquid form.

Its conductance varies according to the temperature. Many glass furnace applications make the most of this to heat the glass directly at the core. The glass therefore offers a resistance and molybdenum electrodes plunged into the core enable the electric current to circulate.

Depending on the type of furnace, certain applications require current of up to 3000 A.

In addition to the intensity required, the type of power regulator used must meet a certain number of technical criteria. In particular, it must have a very high correct average operating time because a glassmaking furnace never stops. It must not generate a continuous component leading to the deterioration of the electrodes. Finally, it must take into account the extremely high variations in the impedance of the glass.

■ Transformer primary

Certain types of resistance such as molybdenum bisilicide, graphite and silicon carbide need low voltage in order to function. To reduce the voltage, a step-down transformer must be installed between the power regulator and this resistance.

In this type of application, the power regulator must be capable of working in two different conduction modes. Initially, during the time the transformer is magnetised, it must work in “phase angle” mode. Next, it must switch to full wave train – “zero voltage” mode.

Phase angle control on the first sine wave must not occur when the voltage passes to zero but at the moment that corresponds to the current zero (the two moments are staggered since there is often dephasing between voltage and current).
If this phase angle control did not occur at exactly the right place on the sine wave (angle and time), the current running through the transformer could increase exponentially, take on very high values and cause deterioration of the thyristors and associated protector fuses.

Then, transition to “wave train” conduction mode allows the generation of harmonics to be avoided.

Pyro-Contrôle Chauvin Arnoux masters this type of technology.
Transformer control can be undertaken by means of a triple phase assembly with two-phase switching. This type of assembly is very economical.
The power regulator is actually only equipped with two sets of thyristors instead of three. The current running through the transformer via the L2 phase is controlled by the L1 and L3 phase thyristors with a magnetisation time of 10 ms.
The total level of the harmonics generated by this mode is identical to a wave train mode, i.e. very low.

Power regulators: our measurement solution for smooth heating.

Pyro-Contrôle Chauvin Arnoux provides an industrial solution for all types of temperature and measurement control. For smooth heating, it proposes the Thyritop 40, thecommunicating power regulator.

The THYRITOP 40, the newcomer to the power regulator range, covers all the load control requirements for high-temperature processes.

This thyristor power regulator has an integrated 32 byte “RISC” processor, comes in 3 versions (1,2 or 3 phases) with over 100 models.

It is fully electronic and ensures a fast response to the switching of loads from 37 A to 900 A with measurement accuracy of 0.25% of the full scale. It is used for all types of resistive and inductive loads on single or triple-phase networks from 230 V to 690 V, with 2 or 3-phase switching. It has a plug-in, remotable crystal display/programmer which displays U, I and P values (curves or values) and the control set points. The programming function of the module records the parameters selected on a THYRITOP 40 which enables other THYRITOP 40s to be programmed in an identical fashion.

This top-of-the-range regulator has numerous functions: I^2, U^2 and P^2 control, I, U and P limited, three “copy measurement” outputs, dynamic synchronisation, load break detection, diagnostics and alarms, etc.

For programming and remote supervision with a computer, it uses the Modbus or Profibus network communication solution.

The THYRITOP 40 can be configured using THYROTOOL software (Win 95/98/NT4.0), supplied as an option with an RS 232 optical fibre converter.

Finally, an installation assistance service and specific onsite training can be provided on request.

Reader service No. 8

Temperature sensors for incineration plants

These are "metal-ceramic" sheathed sensors, particularly suitable for testing the temperature of household and industrial waste incineration furnaces.

Sensor with "metal-ceramic" sheathing measuring the temperature of the firebox, positioned next to an inspection hole. Incineration plant in Le Mans.

Insertion pyrometers with a "metal-ceramic" protective sheathing are successfully used in household and industrial waste incinerators. These pyrometers measure the operating temperature of furnaces to ensure that waste is burned correctly; temperatures are generally between 1200°C and 1300°C. The measurement accuracy required is ± 5°C at 1200°C.
Particularly appropriate for high temperatures of up to 1550°C, the "metal-ceramic" protective sheathing is composed of 77% chrome (metal) and 23% alumina (ceramic).

This type of sheathing is a good replacement for pure alumina, which can withstand temperatures of up to 1800°C but is very sensitive to thermal shock, and platinum-based sheathing which resists corrosion but is very expensive*.

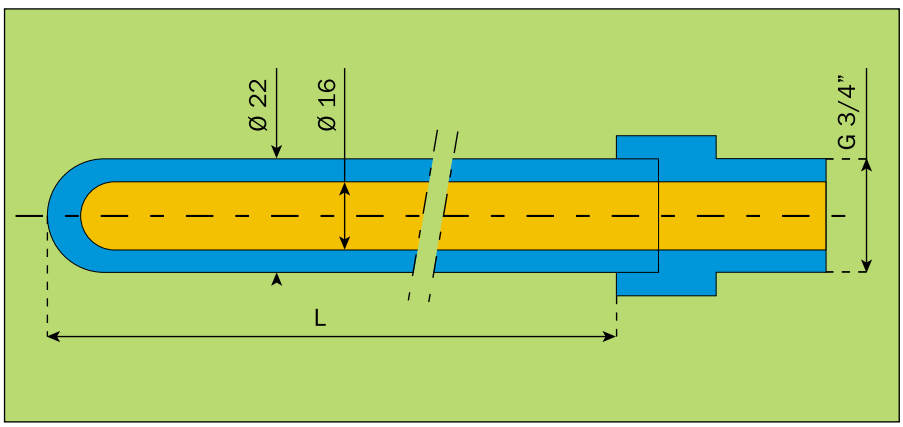
The sensors used in incinerators are generally type K or S, depending on the instrumentation of the furnace. 500 to 1200 mm long, they are installed either horizontally or vertically, depending on the type of furnace.

The protective sheathing must withstand the mechanical stress caused by tipping in the waste and, of course, the temperature of the furnace, as well as any aggressive chemical residue stemming from incineration of the waste material: sulphur, chlorine, etc..

Superior characteristics at high temperatures

"Metal-ceramic" sheathing possesses a series of rather remarkable thermal, mechanical and chemical characteristics at high temperatures, where classic metals and refractory ceramics have one or more weak points.
Without going into too much detail of the resistance of materials, below are their principal strong points:

- Heat conductibility almost as high as cast iron
- Stability in an oxidative atmosphere of over 1200°C



Pyro-Contrôle Chauvin Arnoux "metal-ceramic" sheathing: 7 models in the catalogue, corresponding to 7 different lengths, from 229 to 1219 mm.

Lyon urban district incineration plant. (With the kind permission of Greater Lyon)

- Good hardness, offering resistance to erosion and abrasion above 1200°C
- Good resistance to molten metal
- Good resistance to buckling
- Good resistance to repeated thermal shock
- Good resistance to chemical agents; for example, sheathing lasted for 3 years in a firebox burning sulphur at 1200°C

A sensor protected by "metal-ceramic" sheathing will have a service life 4, 5, 6 times longer or more.
Without this type of protection, the life of a sensor in an incineration furnace varies from seven days to one month.
mois.

Other applications

The various properties of "metal-ceramic" sheathing have also enabled it to be used successfully in the following applications:

- reducing atmospheres of up to 1200°C
- in the glass industry for furnace vault pyrometers
- for oil-heated sulphurous ambience furnaces
- in foundries for metals containing copper, brass and bronze (1200 to 1400°C)
- roasting of pyrites (1300°C) hypersulphurous milieu SO2 and SO3

** For details of the characteristics and technology of protective sheathing, we recommend you read the feature entitled "Protective sheathing for pyrometers" in CMN No. 17.*

Reader service No. 9

Accurate measurement of the temperature of flames

"Aspiration" pyrometers eliminate spurious effects and determine the exact temperature of a gaseous mixture: flame or combustion gases.

It is not easy to measure the exact temperature of a gaseous mixture!
The temperature indicated by a thermocouple plunged into a gas is, generally speaking, different from the actual temperature of the gas. Several factors can affect the accuracy of the temperature taken: poor exchange of heat between the gas and hot weld of the thermocouple; loss of heat by radiation between the hot weld and the surrounding milieu and also losses by conduction of heat along the thermocouple wires.

The aspiration pyrometer was designed to eliminate these effects and give the actual temperature of a gaseous mixture. The principle is the forced aspiration of part of the hot gases around the thermocouple; this aspiration increases the speed of gases on the hot weld of the thermocouple thus fostering the exchange of heat by convection.
In addition, loss of heat by radiation of the hot weld is reduced by means of one or several sheaths placed inside the pyrometer end piece.

The gases required to take the measurement are sucked in via an orifice situated at the tip of the end piece.

A prerequisite to the use of aspiration pyrometers is the experimental determination of an efficiency coefficient specific to the instrument, depending on the gas aspiration speed.

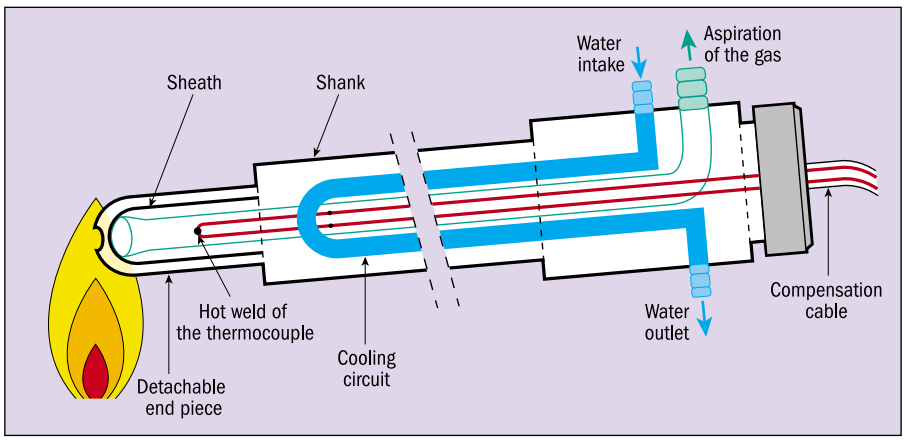
Pyrolysis[1] of dangerous waste

Companies handling the incineration of dangerous waste may produce dioxine for example, and must be able to prove to the DRIRE[2] that their waste has been pyrolised. For this, the temperature of the gases must be tested at the foot of stacks, at the firebox exit – with a high degree of accuracy. Aspiration pyrometers satisfy this requirement.

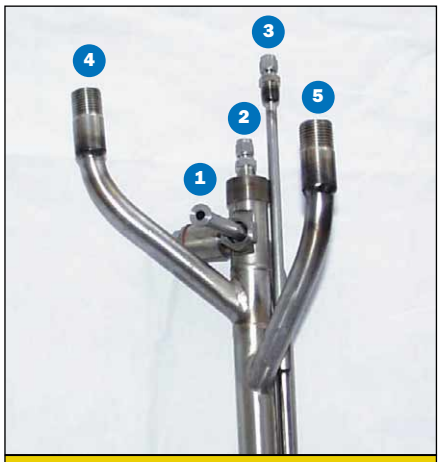
Three models of pyrometer

Pyro-Contrôle Chauvin Arnoux proposes three models of aspiration pyrometers to meet this accuracy requirement, depending on the dimensions of the stack at its base and the pyrolysis temperature to be measured.
A "miniature" pyrometer for laboratory use; its small size is ideal for extraction stacks of less than 50 cm in diameter.
The "semi-industrial" pyrometer.
The "industrial" model for intensive use, suitable for stacks 1 to 2 m in diameter.
Depending on the temperature to be measured, several types of thermocouples are proposed: type K up to 1100°C, types S or R up to 1500°C and type B up to 1600°C.

The removable end piece is composed of two alumina or rhodium-plated sheaths, depending on the model. Note that a rhodium-plated end piece can withstand temperatures of up to 1900 °C for 15 minutes.
A second output which measures "ambient temperature" is available as an option.



Principe of an aspiration pyrometer



Details of an aspiration pyrometer connections – industrial model with ambient temperature option – total length around 2 m

1. ***Aspiration of the gas to measure the temperature of the flame***
2. ***K or S type thermocouple for flame temperature measurement***
3. ***Option: K or S type thermocouple to measure the ambient temperature***
4. ***Cooling circuit water intake***
5. ***Cooling circuit water outlet***

For laboratory applications, miniature pyrometers come with a calibration table specific to the wiring supplied in order to establish the temperature/e.m.f. for the particular thermocouple used.
Note that these aspiration pyrometers are manufactured under a BNM-INM (French Metrology Agency-National Metrology Institute) licence.

Principle of an aspiration pyrometer

The objective of an aspiration pyrometer is to foster heat exchange by convection between the gas and the thermocouple and to reduce losses due to radiation of the hot weld.

The flame or gases are sucked into the pyrometer by means of a pump; the aspiration orifice is situated at the tip of the end piece. The latter can be easily taken apart. It is composed of two concentric sheaths wrapped around the thermocouple.
The efficiency coefficient is determined "in situ". It enables the actual value of the temperature of the gas sample to be obtained by correcting the influence of the nominal aspiration chosen.

The body of the sensor or "shank" is made of stainless steel and contains the water cooling circuit and gas aspiration circuit.
Measurement output by compensation cable.

(1) Note: the pyrolysis of a material consists of heating it to a certain specific temperature at which it breaks down into its various chemical elements
(2) Direction Régionale de l'Industrie, de la Recherche et de l'Environnement (French Environment Agency)

Reader service No. 10

F01 - F03 - F05 - F07 multimeter clamps

With their practical "go anywhere" size (only 19 mm for a clamping diameter of 26 mm) and exceptional ergonomics, the fully automatic, RMS **F01, F03, F05 and F07** clamps have exceptional measurement capabilities.

They are principally designed for independent electricians and maintenance departments. Take a look at their numerous functions (voltage, current, temperature, resistance, continuity – as well as frequency, power, power factor, phase rotation and adaptor function).

Reader service No. 7

Triple-phase network analysers with versatile display features

Designed for control and maintenance departments in industrial or administrative buildings, the **CA 8332 and CA 8334 Qualistars** enable regular tests to be made on the quality of the electricity network and fast processing of results. Very easy to use, these instruments reflect the results of a full network analysis in graphic form, displayed in various ways. These instruments are ergonomic and comfortable to use for a thorough inspection in compliance with current standards.

Reader service No.11

Class 0.2S for the new range of JVS current transformers

The new range of **JVS current transformers** for LV networks, with a class 0.2S accuracy rating, is designed in particular for electronic measurement instruments compliant with the IEC 687 standard. Its 9 models, for primary current from 100 to 5000 A, with a 5 A secondary, have a multiple-cavity feedthrough for cable (ø 22 to 65 mm) and busbar (30x10 to 80x30 mm) or a busbar feedthrough (100x20 to 125x60 mm).

Reader service No.12

The TCR range – a complete range of current transformers

The **TCR range of current transformers** is distinctive for the choice of calibres offered and connection diversity. It is composed of 12 models to measure currents ranging between 5 and 5000 A on LV networks, with 1 or 5 A secondaries: 3 primary bobbins, one of which has a modular presentation for a DIN rail, 6 combined cable (ø 17 to 66 mm) and busbar (20x5 to 80x30 mm) feedthroughs and 3 busbar feedthroughs (30x10 to 80x30 mm).

Reader service No.13

MTX COMPACT:

Efficiency displayed with elegance

- Oscilloscopes - Analyzers MTX 3352 and MTX 3252
- Multimeter - Analyzer MTX 3250
- Generator - Measurer MTX 3240

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