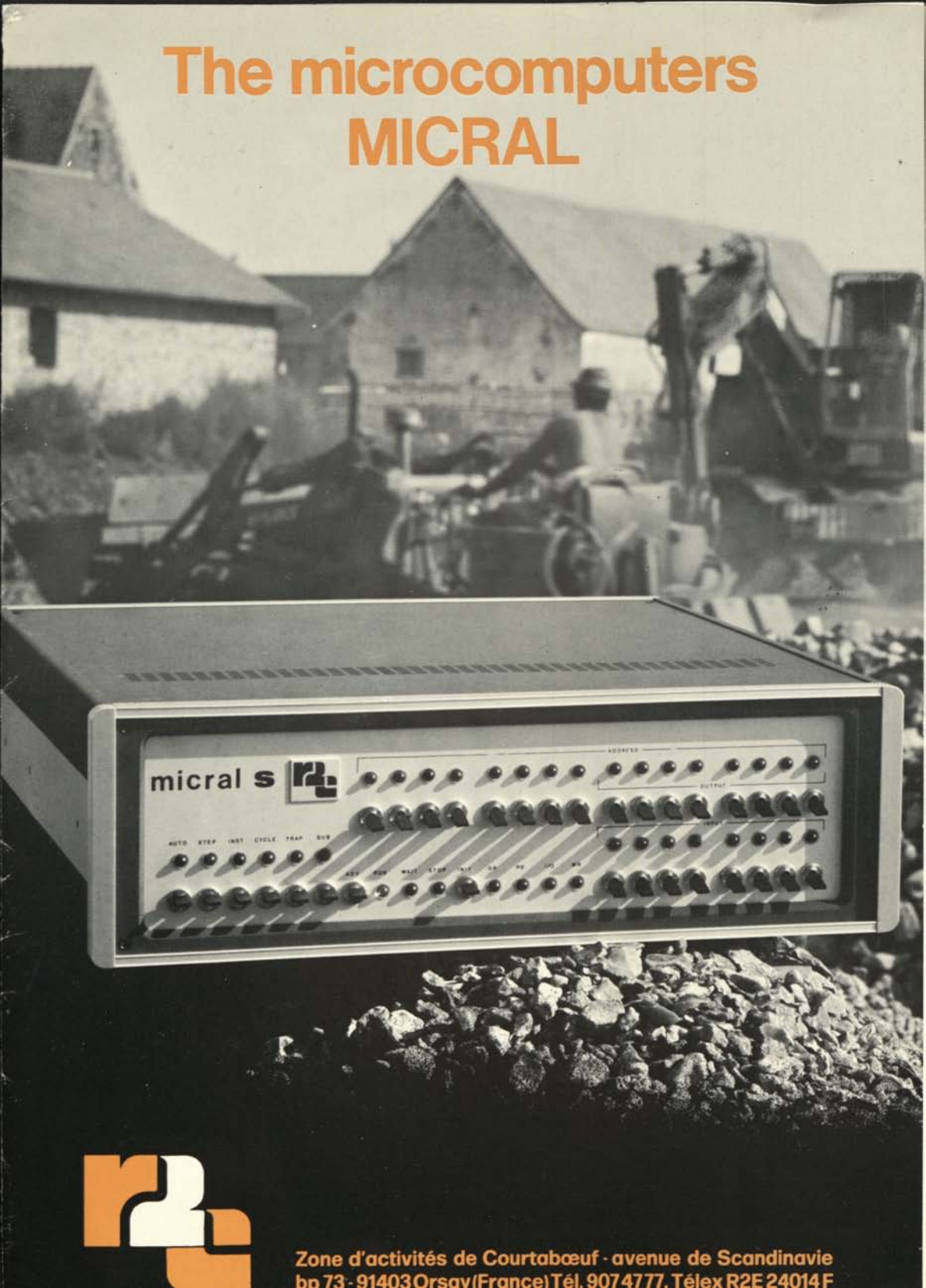
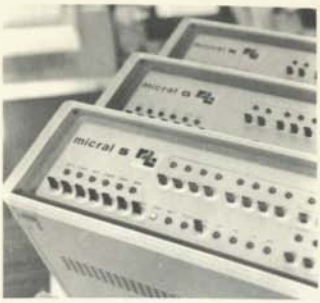
The microcomputers MICRAL



Zone d'activités de Courtabœuf - avenue de Scandinavie
bp 73 - 91403 Orsay (France) Tél. 907 47 77. Télex R2E 24014 F

MICRAL : an homogeneous range of general purpose microcomputers



Introduced at the beginning of 1973 by R2E, the general purpose microcomputers concept has nowadays become habitual in data processing : real computer including a powerful input-output system, implementing a microprocessor on-a-chip and essentially proposed at very low cost. The notion of general purpose which is often misused is, on the contrary, well adapted to the MICRAL range of computers.

Indeed the applications made by R2E are related to the industrial sector, with the most various process control, as well as to data transmission and also to the most standard business applications with the GESSIX offices computers. The common point of all these applications is to design, thanks to the very modular structure of the MICRAL, a data processing system as near as possible from the optimum system, thus at lowest cost.

The MICRAL range includes three versions, the MICRAL N, the MICRAL G and MICRAL S respectively, in increasing order of performances and capabilities. They have two original characteristics, as far as their architecture is concerned, which makes them the most competitive if considering their price-performance ratio.

First originality : the Pluribus

The heart of the MICRAL mainfrance is the PLURIBUS, the system internal communication unit. It has the shape of a printed circuit card equipped with 11 sockets which can receive 11 cards. This circuit makes it possible to route 60 bits in parallel. Each socket is entirely unspecialized, that is to say, it can receive a coupler card or a memory card or a channel card. This insures an

optimum filling capacity as well as a great modularity.
In the basic configuration, a 11-socket PLURIBUS only occupies half of the available room. It is possible to equipe the whole system of socket-system per mini wrapping technology.

Second originality : the channels

The MICRAL computers are provided with programmed channels having their own buffer memories which are thus to be compared to peripheral processors. These channels are connected to the PLURIBUS but are totally asynchronous. Further, they are asynchronous between one another. These channels thus offer the advantage of not abstracting a cycle from the processor like the DMA (Direct Memory Access). The MICRAL S can be provide with a DMA channel.

The transfers of data between a channel and the system is made by a 256 or 1,024 bytes blocks up to 1 million bytes per second. The transfers being asynchronous, the channels transfers rates are thus cumulative : 7 million bytes per second for the seven channels.

The transfers per block can be made in parallel (1 block of n 16, 24, 32, 36 bits words) or in series, by connecting the channels between one another by means of a "link" bit. It is also possible to use a mixed method making it possible to link blocks of 16 or 24 bits.

Each channel can receive up to 10 high speed peripherals devices (disks, tapes,...) Further, these channels can be connected across several MICRAL computers, which then builds up a multi-processing system.

At last, the connection of a MICRAL to a high power computer is made through these channels as well.

The memories

The MICRAL have been design to meet the users requirements, whose applications do not include much processing in relation to input-output facilities.

In fact, except the scientific programs with important computation algorithms, most applications include a great part of input-output management in relation to the processing properly said.

Thus, the capacity of the main storage of the MICRAL, in the various systems which use it, may greatly vary. Configurations with a memory of some pages (one page = 256 bytes) are not rare. The cost of such a configuration is not so far penalized as it is the case for more performing units. The basic version is indeed provided with all the necessary devices for a good starting up of the system : 8 external interrupt levels, a real time clock, a power supply, automatic start-up, a channel with a 256 bytes buffer memory, a 32 inputs/32 outputs coupler, and the frame (the MICRAL S is provided with a series TTY connection).

There is only to add a memory the size and the type of which are directly conditionned by the application.

Three types of memories are proposed :

- semi-conductor RAM (Random Access Memory). A card may receive up to 16 K bytes ;
- ROM or REPROM (Read-Only-Memory). The card may receive up to 8 pages of 256 bytes that is 2 K bytes) ;
- mixed memory. The same card may receive up to 7 pages bytes of read-only-memory and one page of RAM. Another combination : O or 1K RAM and up to 3 K REPROM.

The association of RAM and ROM or REPROM whithin a system makes it possible to include the programs or a part of the programs as well as information which are thus protected against any incident.

The basic software

A computer, as "micro" as it may be, would be nothing without the software necessary to the programmation. Though the MICRAL are easely programmable, numerous tools have been designed to help programmers. It is to be noticed that, due to their design, safeguarding the general registers and safeguarding the ordinal counter at each program interrupt through automatic stacking the MICRAL

are capable of managing up to 8 programs simultaneously without any operating system.

There are nowadays four languages used by the MICRAL :
- the Local assembler language with symbolic instruction codes ;
- the Assix language (macro-assembler designed to be used in business applications);
- a BASIC business oriented ;
- a MICRALSPA language especially designed for specialists in automatic and electronics who deal with industrial automatic devices.

Standard basic software provide also :
- a cross-assembler written in Fortran ;
- a TTY monitor ;
- a floppy-disk operating system ;
- a text editor.

The MICRAL users also have at their disposal a mathematical library comprising floating-point arithmetic (mantissa : 3 bytes, exponent : 1 byte that is: $\pm (2^{23}) \pm 128$ extended library on 3 bytes + sign), as well as the fixed-point library, the binary/decimal and decimal/binary conversion programs.

The MICRAL's software is compatible from the model N to the model S.

TECHNICAL FEATURES

	MICRAL N	MICRAL G	MICRAL S
Memory format	8 bits	8 bits	8 bits
Instructions format	8-16-24 bits	8-16-24 bits	8-16-24 bits
Memory capacity	from 256 bytes to 16 K bytes	from 256 bytes to 16 K bytes (extension up to 64 K)	from 256 bytes to 64 K bytes
Memory types	ROM, RAM or mixed	ROM, RAM or mixed	ROM, RAM or mixed
Addressing	Direct and immediate on 16 K	Direct and immediate on 16 K ; indirect on 64 K	Direct, immediat, indirect on 64 K
General registers	7 of 8 bits + 14 bits instruction counter	7 of 8 bits + 14 bits instruction counter	7 of 8 bits + 16 bits instruction counter
Indicators	4 : carry, null, sign, bit parity	4 : carry, null sign, bit parity	5 : + decimal carry indicator
Stack on instruction counter	Stack of 7 registers LIFO automatic processing	Stack of 7 registers LIFO automatic processing	Stack in RAM, number and capacity within the limit of 64 K
Instructions set	51	56	74
Decimal arithmetic	No	No	Yes
Data handling	8 bits	8 bits	8 or 16 bits
Clock frequency	0,5 MHz	1 MHz	2 MHz
Real time clock	adjustable	adjustable	programmable
Execution time of a register instruction	20 μ s	10 μ s	2 μ s
Input directly addressable	1792 bytes	1792 bytes	256 bytes
Output directly addressable	23 bytes	95 bytes	95 bytes
Standard interruption levels	7	7	8
Maximum number of interruption levels	56	56	64
Buffered channels (256 or 1024 bytes blocks)	7	7	8
Transfers rate per channel (million bytes per second)	1	1	1
Maximum transfer rate	7	7	8
DMA	No	No	Yes

R2E, a team whose aim is efficiency at the best price / performance ratio

(R2E may have to change at any time the specifications printed).

SAGHA

Micral

The M 1500 industrial modules serie

One of Micral's vocations is to meet the requirements of the industrial applications. For this purpose it has been provided with various modules ensuring coupling to these environmental conditions.

32 - optoelectronic input module M1500

Use:

This module features 32 inputs which can be addressed with four bytes.

Insulation is ensured by optoelectronic coupling.

Description:

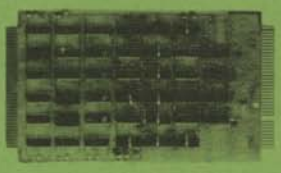
A low-pass filter determining a 2.2µs time constant also ensures interference suppression.

The current required to control the input is 30mA and the voltage is 5V.

Specification:

The module does not store the inputs. Information are read bit by bit among the 32 available inputs. The read bit is selected by Micral's software.

The address is assigned on 9 bits.



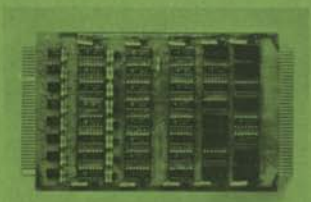
8-stored optoelectronic input module M1510

Use:

The 8-stored optoelectronic input module is a direct coupler which permits storing random signals through an optoelectronic coupler ensuring perfect insulation.

Description:

The input circuit is energized by a 30-mA current. On the module, an interruption level



can be associate with an event appearing at the input. So Micral is able to react to any external actuation.

The interruption level is bound to the position of the jumper on the support. Reading of the stored byte leads to the acknowledgement of the associated interruption.

32-optoelectronic input module M1501

This module features 32 inputs which can be addressed individually.

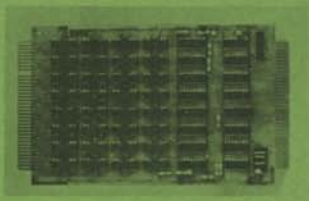
Its characteristics are the same as those of module M1500.

32-relay type output module M1503

Use:

This module permits connecting the processor to an external element through the Clare relay.

The application fulfilled by this



type of module is the process control from Micral.

Description:

Each of the 32 relays ensures a 10-VA max. control with a 100-VDC insulation and can maintain a 1-Amp current when contact is made. The INIT control clears all the outputs.

R2E. Z.I. de Courtabœuf BP 73 - 91403 Orsay (France) - Tél 907 47 77 - Télex R2E 24014 F (R2E may have to change at any time the specifications printed).

Micral

Analog modules M 1600

The M1600 standard and modular analog measurement series include multiplexers (64-input analog and 8-channel low-level relay type), amplifiers with or without programmable gain and analog to numerical or numerical to analog converters.

Relay type low-level analog multiplexer module M1600

Use:

The low-level multiplexer module has been designed to be integrated in a low level signal multiplexing system with a rather high common mode voltage.

Multiplexing is ensured by mercury relays, switching being performed on three wires; this permits operating in differential mode.

Electrical characteristics

Life time: 2.5×10^{10} low level operations

operating times: (10-Hz frequency) closing: 1.8 µs
release: 1.5 µs

Logic 1: 0.8V

Logic 0: 2.5V

64-input multiplexer module M1601

The user can place upstream the analog to numerical converter module two types of multiplexers, one is of the low-level type and is fitted with mercury relays and permits multiplexing 8 differential channels, the other is of the static switching type ensured by C-MOS circuits and permits multiplexing 64-single channels of 32 dual channels. The amplitude of the high level signals is ± 10V with respect to the electrical ground.

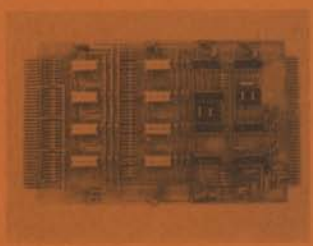
Electrical characteristics

- scanning frequency: 500kHz
- scanning time per channel: 0.5 µs
- Rise time of a channel: 1.5 µs max.

Logic 1: 0.8V

Logic 0: 2.5V

Up to 4 modules M1601 are permitted.



Analog to numerical converter module M1620 and M1621

The Analog to Numerical converter modules are the heart of the M1600 series. They can receive many optional features which provide them with great flexibility.

The user can select a 10-bit converter or a 12-bit converter and has the possibility to place a blocking sampler upstream the converter having an acquisition time included between 100ns and 5µs and a programmed or programmable gain amplifier upstream the whole assembly.

Use:

Due to the flexibility of its components (converter only, converter + amplifier, converter + sampler + amplifier) this module can enter a wide range of applications.

Electrical characteristics		
CONVERTERS	M1620	M1621
Input voltage	± 5V or 0 to 10V	0 to 10V
Resolution	10 bits	12 bits
Precision	± 0.05 % of the whole scale within ± 1/2 of the LSD	± 0.02 % of the whole scale within ± 1/2 of the LSD
Conversion time	4µs	20µs
BLOCKING SAMPLERS	SHM1	SHM 2
Pass-band	200 kHz at 3 dB	500 kHz at 3 dB
Maximum acquisition time	5µs ± 0.025 of the whole scale	10ns ± 0.1% of the whole scale
opening time	50 ns	10 ns

Production of gain amplifier : 45 MHz.

The various configurations permit ensuring :

- the analog to numerical conversion
- the converter output impedance and level matching
- fast variation signal conversion.

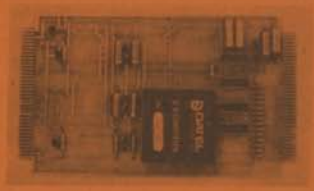
For the signal inputs or outputs, the user can, according to its needs, gain access either to the upper or lower section of the module.

Numerical to analog converter module M1622

This module can operate as a converter only or associated with a programmable gain amplifier or with an amplifier and booster.

Electrical characteristics :

- Converter only : resolution : 10 bits (two-pole or single pole) precision ± 0.1 % of the whole scale, output rise time : 5µs.
- with programmable gain amplifier : 4 voltage ranges available between ± 1V and ± 50V selected by means of four bits accessible from the Micral processor.



- with amplifier and booster : The output voltage swing passes from ± 20mA to ± 1Amp max. (± 50V).

A M1630 alimentation module (±15V) is needed by M1601, M1610, M1620, M1621 modules.

R2E. Z.I. de Courtabœuf BP 73 - 91403 Orsay (France) - Tél 907 47 77 - Télex R2E 24014 F (R2E may have to change at any time the specifications printed).

Micral

Magnetic support peripherals

Micral features most of the magnetic disc and tape peripherals.

Floppy disc unit M2310

Use:

This unit permits reading and writing on floppy discs.

This external store offers small dimensions and easy operation.

In addition, it offers to the user a low-price support for small size files.

It has a wide application range: business data acquisition, message switching, etc.

Each unit includes one or two disc readers. Micral can accommodate up to two units.

Technical characteristics

The storage capacity is 262, 144 bytes per disc, i.e. 524, 288 bytes for two discs.

Each disc is broken-down into 64 tracks of 32 areas, each area (addressing unit) including 128 bytes.

Track to track access time: 10 ms; mean access time: 400ms; 128-byte block transfer time: 5 ms approx.

Another model: The 2320 floppy disc unit is IBM compatible.

Mass storage disc unit M2302

Use:

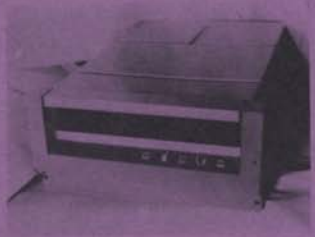
This unit permits reading and writing on a fixed disc enclosed in a sealed cartridge protecting it against all risks of damage.

This unit permits compiling large files from low-cost configurations.

Application range:

- file examination
- recordings of measurements etc.

Technical characteristics
Storage capacity: 3,000,000 bytes on 204 tracks of 24 areas (256 bytes), for one fixed disc, and 6,000,000



bytes for one fixed and one removable disc.
Track to track access time: 24 ms
mean access time: 75 ms
maximum access time: 125 ms
Reading-writing head positioning ensured by a linear motor
Built-in ventilation system with air filtering.

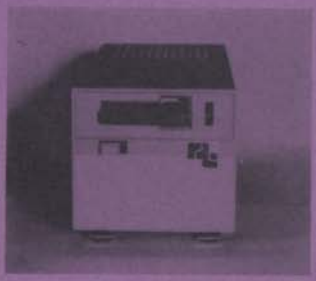
Magnetic tape unit M2500

Use:
Magnetic tape unit M2500 includes an unwinder which

permits reading and recording large files. It can also be used as a program library. It is to be connected to Micral through a coupler.
Technical characteristics
- 800 bpi
- recording format: 9 NRZI tracks
- speed: 25 ips
- out put: 30k bytes/s
- 730-m reels
- IBM compatible

Cassette drive M2300

Use:
The cassette coupler permits connecting the PHILIPS and TEAC units.



The magnetic cassette unit represents a low-cost storage facility for small files when a magnetic tape unit is not required.
Technical characteristics
The drive unit records cassettes and read them as per the ECMA standard. With 256-byte blocks, a cassette (both sides) can contain up to 430 K bytes approximatively.

All those peripherals are supplied with the input-output software facilities to use with.

R2E. Z.I. de Courtaboeuf BP 73 - 91403 Orsay (France) - Tél 907 47 77 - Télex R2E 24014 F (R2E may have to change at any time the specifications printed).

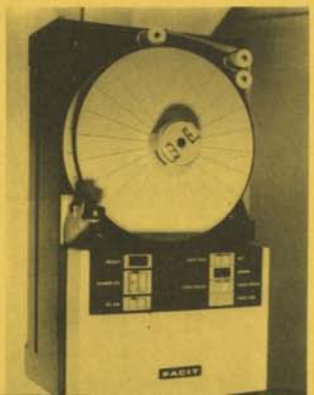
Micral

The conventional peripherals

Micral can be fitted with a large range of I/O conventional peripherals for the processing of data on paper support (punched tape and card punchers and readers) and the display of results (printers, CRTs, display units, etc.).

Tape puncher M2100

The M2100 unit operates at the speed of 75 characters per second. It is fitted with a built-in wind-unwind unit and accomodates 200-m reels. Punching is performed over 8 channels in any code. It can be provided for rack or console installation.



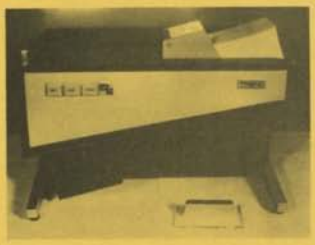
Punched tape reader M2200

This is a low cost peripheral reading data encoded over 8 channels (at the speed of 120 characters per second). Reading is of the bidirectional type. It is ensured by photo cells which offers noiseless operation.

Higher speed models are available.

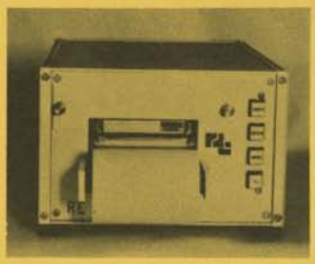
Punched card reader M2210

This reader ensures optical reading of the standard 80-column cards. Its speed is 300 cards per minute. It is provided with a magazine storing about 450 cards to be punched and with a reception magazine for 500 cards.



Printer RE 100

Printer RE100 features flying strike at a rate of 3 lines per second over 21 columns (digits and signs). It can be supplied in two versions:



- printer RE 100 S which is solely numerical
- printer RE 100 A which is alphanumerical.

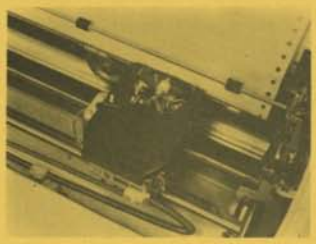
This printer has been specially designed to be used with industrial or scientific measuring units which lead to make it robust.

Printer M2304

This is a mosaic series printer featuring a printing speed of 180 characters per second, i.e. 60 lines of 132 characters per minute or 100 lines of 60 characters. It can accomodate up to 4 copies with carbon paper. It is supplied with 1 or 2 paper motions controlled by a carriage control tape. It is provided with a set of 64 characters.

Printer M2305

This series printer features a speed of 30 characters per second over 132 columns and a set of 96 characters (capital letters and small letters). An outstanding feature of this printer: it can print during printing head return and the paper displacement is bidirectional



which is of great interest for drawing graphs. Its two-color printing is of a high standard.

Display console M2700

The capacity of the CRT is 16 lines of 64 characters. The alphanumerical keyboard can

be supplied as an option. Its interface conforms to the CCITT V24 standard. The console is to be connected to Micral through asynchronous coupler M1403.

R2E. Z.I. de Courtabœuf BP 73 - 91403 Orsay (France) - Tél 907 47 77 - Télex R2E 24014 F (R2E may have to change at any time the specifications printed)