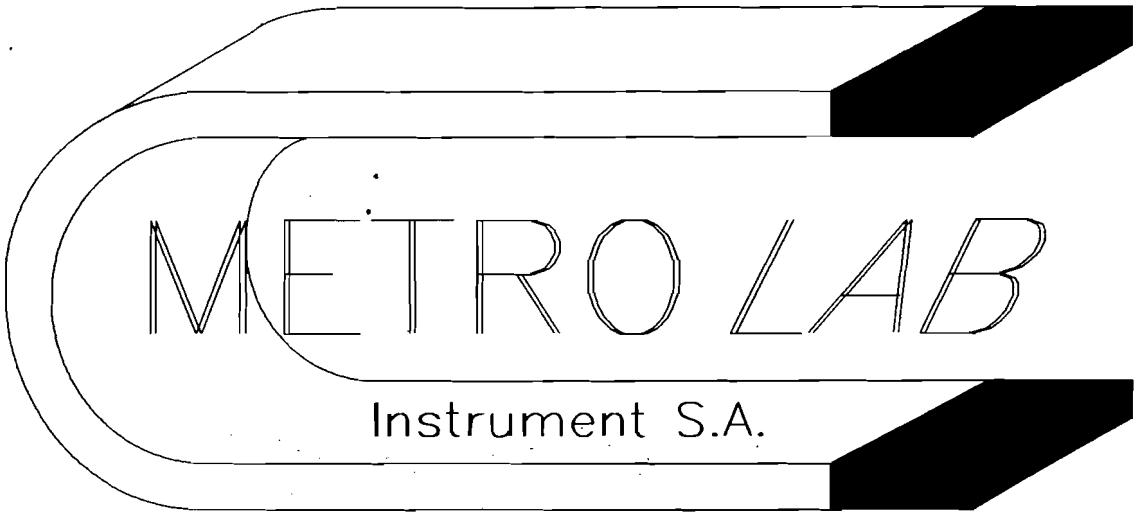

PDI 5025

SYNCHROTRON MAGNETIC FIELD CYCLE MEASUREMENT SYSTEM

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SYNCHROTRON MAGNETIC FIELD CYCLE MEASUREMENT SYSTEM

GENERAL PURPOSE

The hardware and software system we describe in this document has been developed specifically for CERN (see report SPS/PCO/89-9 for more details) to measure the very short magnetic SPS field cycle platforms and ramps when the accelerator is used as injector for LEP.

The system includes the standard METROLAB PT 2025 Teslameter and PDI 5025 Precision Digital Integrator as well as a menu driven software package which, althought written for CERN, is general purpose. We also refer to the PT 2025 and PDI 5025 data sheets.

Provided the user supplies:

a) a field ramped magnet (see Fig. 1) and fixed pick-up coil system; as at CERN, the magnet can be a reference magnet of the synchrotron accelerator powered in series with the other magnets;

b) two field flat-tops (HF-High Field and LF-Low Field) which last enough time (~1-2 sec) to permit significative NMR measurements; the PT 2025 is operated at ~10 measurements/sec;

c) a sysnchronization pulse (T_0) at beginning of each cycle and the precise knowledge of the accelerator field cycle timing structure;

d) IEEE 488 bus, computer hardware and drivers;

our system permits to measure precisely the magnetic field cycle with great accuracy (~10 ppm over a field cycle at CERN of ~14 sec).

The principle of operation is the continuous measurement of the voltage across an induction coil in the time varying field, integrated between software selected trigger pulses generated by a precise internal timer. The sum of these values yields the instantaneous flux. The NMR measurements of the two flat-tops permits to obtain the absolute value of the induction (B) as well as to correct for the linear drift due to the integrator input offset. The digital integrator design is such that there is no dead time between the flux change measurements (on-fly measurements) thus ensuring no loss of accuracy on the overall measurement of the cycle.

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HARDWARE CONFIGURATION

The hardware system is shown in Fig. 2. The PT 2025, PDI 5025 and the host are connected to the IEEE 488 bus. The user provides the synchronization signal T_0 which typically is a pulse coming from the accelerator timing unit. This pulse represents the time origin to which all the data acquisition is synchronized.

SOFTWARE CONFIGURATION

The basic steps of the software program (menu driven) are given in Fig. 3.

A) Initialization

Here the PT 2025 and PDI 5025 initialization is performed including the Integrator Gain setting, the Trigger Source definition (Timer with external Synchronization), the Integrator mode of operation (MOD,I), the PT 2025 fast reading rate setting (10 readings/sec).

B) NMR Frequency adjustment

A DAC in the PT 2025 controls the NMR Coarse Frequency (or Field) setting. The High Field (HF) and Low Field (LF) flat-tops approximative (+- 600 ppm of true field) values are entered and the corresponding DAC values memorized. During data acquisition this allows the PT 2025 to lock quickly on the NMR signals for the precise (+- 5 ppm) measurement of the two fields and the successive calculation (see F).

C) Measurement Configuration

A measurement configuration is created. Here the precise time occurence of the HF and LF flat-tops following the T_0 synchronization signal is given as well as the trigger timing sequence for the integrator. The sequence typically consists of several subsequences having different triggering rates. The min. time between triggers is 1 ms and the number of different subsequences is practically unlimited. The Timer is driven by a +- 1 ppm quartz oscillator and the triggering accuracy is better than +- 1 us. The system automatically defines the PDI vs NMR calibration points which will be used to obtain the final B(t) curve. The total time extent of the field cycle is also entered.

D) Measurement configuration

A previously stored measurement configuration can be loaded and, if required, modified.

E) Measurement start

The measurement is started when the T_0 synchronization pulse generated by the accelerator timing unit is received. The T_0 pulse is fed directly into the PDI 5025 unit.

F) Field calculation

Here the calculation of the Tesla vs Time curve is performed. The flux changes measurements are converted in Tesla using the absolute NMR calibration points.

The PDI 5025 data are corrected for the integrator drift due to the input offset. The correction (linear) is performed using the NMR calibration points of two successive field cycles.

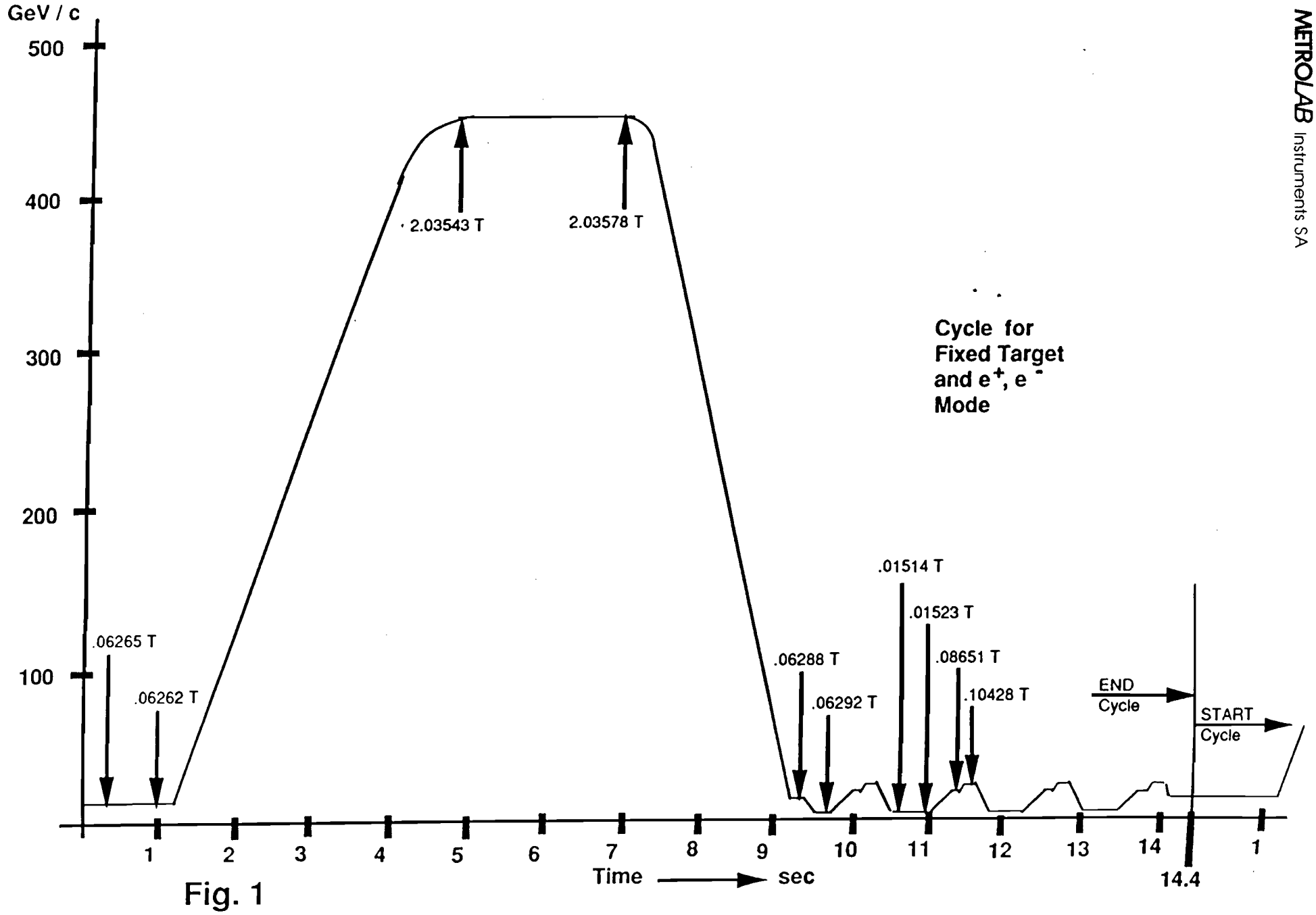

Fig. 1

METROLAB Instruments SA

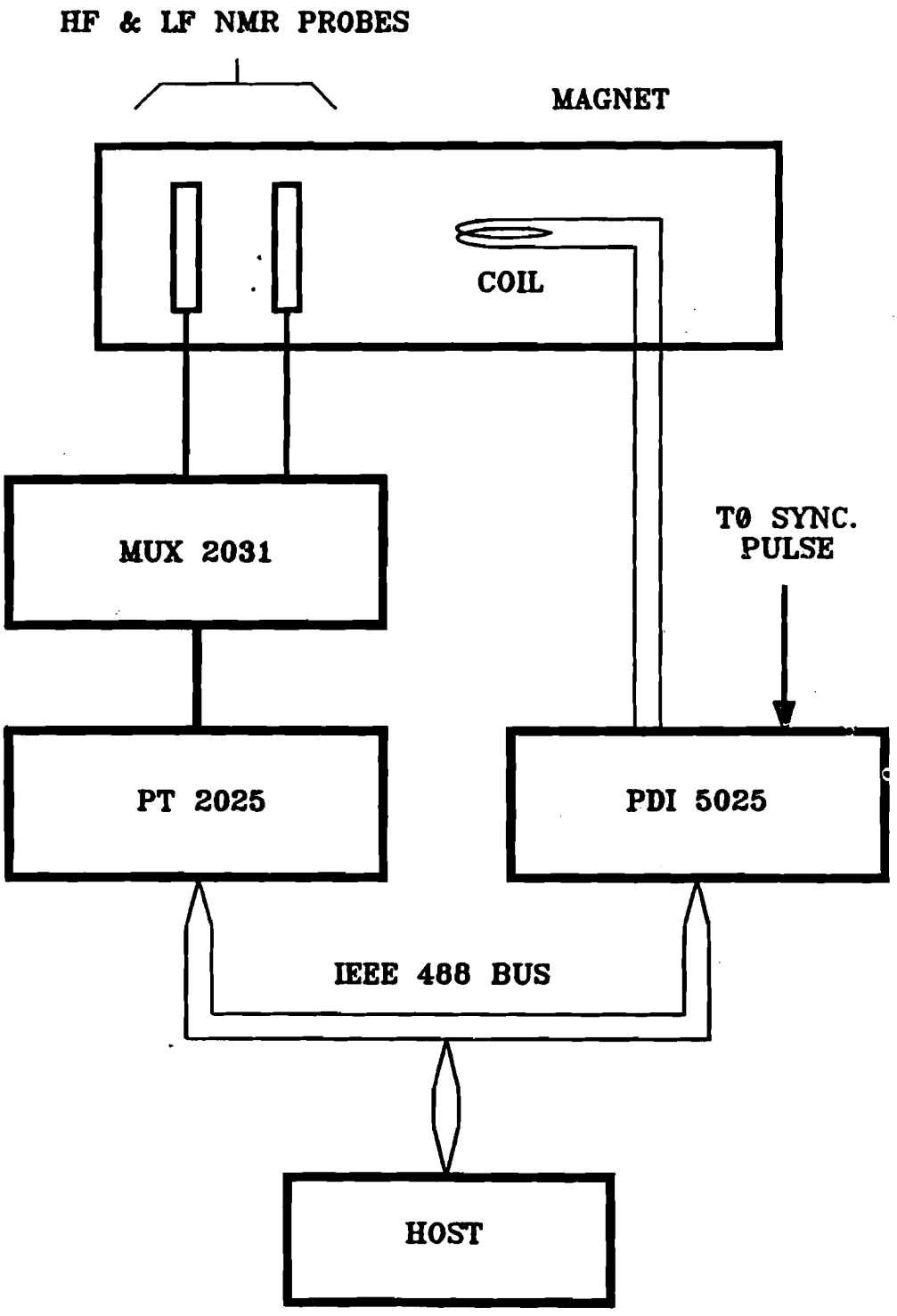
HF & LF NMR PROBES
MAGNET
COIL
MUX 2031
T0 SYNC.
PULSE
PT 2025
PDI 5025
IEEE 488 BUS
HOST

FIG. 2

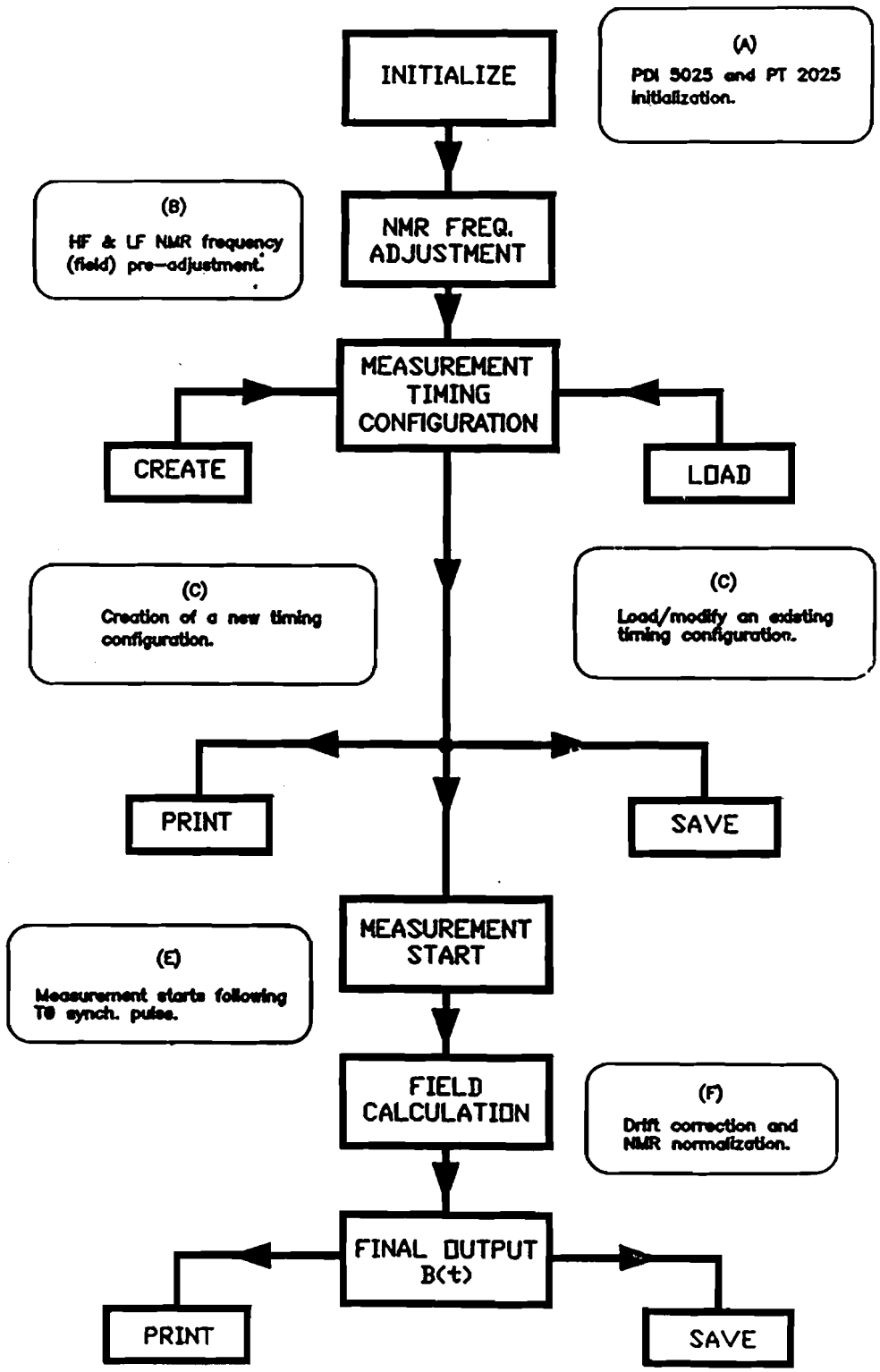
INITIALIZE
(A)
PDI 5025 and PT 2025 initialization.
(B)
HF & LF NMR frequency (field) pre-adjustment.
NMR FREQ. ADJUSTMENT
MEASUREMENT TIMING CONFIGURATION
CREATE
LOAD
(C)
Creation of a new timing configuration.
(C)
Load/modify an existing timing configuration.
PRINT
SAVE
MEASUREMENT START
(E)
Measurement starts following T0 synch. pulse.
FIELD CALCULATION
(F)
Drift correction and NMR normalization.
FINAL OUTPUT B(t)
PRINT
SAVE

FIG. 3