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How Legitimate is Legal Metrology Today? The Case of Electronic Meters: Vacatio Legis

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Abstract

Today, legal metrology deals with methods and tools related to the technical and legal needs of the State and was born mainly to guarantee the public faith of citizens. It can be considered as a science of measures dealing with practical cases concerning the use of measuring instruments employed for legal purposes, in any field of science or its technical application. Computer technologies, which are massively used in electronic measurement instruments, are a key and relevant aspect for legal metrology, since the result of a measure is highly dependent on both the hardware and mainly, the software used to manage the physical quantities to be measured: from the determination of the physical quantity to be measured by the use of a transducer, to the display of the measurement result. The use of active or passive sensors/transducers used for measuring the size to be measured, inevitably involves different construction technologies for both

the hardware and the related management software. The metrological verification of the hardware appears simple since they are physical components, and therefore easily controllable; instead, the software component of the measuring instruments appears critical in the legal metrological control of the same: in particular for those measuring instruments on which the "remoting function" of the measurement data is implemented, and for the problems related to the transmission of the measurement data to remote systems. The remote management of measuring instruments is extremely critical: it suffices to vary remotely a metrologically relevant size to invalidate the whole result of the measure. The total control of the relevant software by the State in order to guarantee the public faith, therefore, must be absolutely rigid and transparent also in order to give legal instruments to the bodies of verification and control of the measuring instrument. A fundamental aid to this problem is provided by the OIML and the supreme judges of the European High Court of Justice.

Keywords: Electricity, Electricity Network, Data Sending, Enel, Regulatory Vacuum, Energy Meter, Critical Software

INTRODUCTION

The hardware is known to be the physical part of the measuring instrument used to determine the metrological size to be measured. It may also contain devices capable of receiving data from the outside.

The software, in addition to managing the operation of the hardware, processes both the input data from the sensor and the data received from the external. All this information is presented at the output and represents the measure of the unknown physical size, the object of the measurement activity.

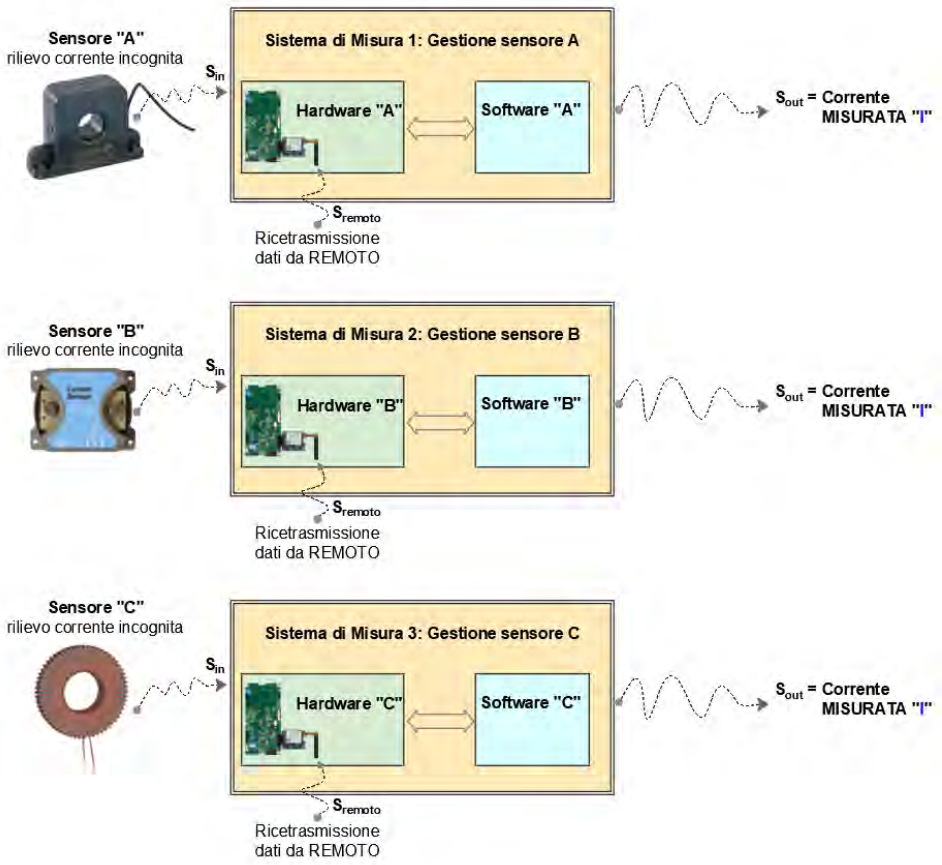
In extreme synthesis, therefore, the measurement data presented on the output depends on both the information provided by the input sensor and the data received remotely.

$$S\_out=f(S\_in, S\_remoto)$$

With: S_out= Outgoing signal of the measuring instrument representing the measurement results;
S_in = Signal provided by the sensor to detect the measurement size;
S_remoto = Signal exchanged remotely from measurement device manager.

From the above, it can be affirmed that the role of the software in the measures is of fundamental importance and influences on the result of the same measure. It seems obvious that different detector probes require different hardware and different software, however, presenting an identical output of the measuring instrument.

For simplicity only, the block diagram is illustrated:



However, the electronic design introduces in commerce electronic circuits to microcontrollers able to receive more sensors in input and in this case the hardware will present 3 Sin1, sin2, Sin3 inputs. Through a remote signal intercepted from a transmission device present in the hardware, it is possible to process each input, with its own code present in the software, and to supply in output the same identical result based on the selected inputs. It is obvious that a full and complete knowledge of the software, since its central role in the measurement process, **must be guaranteed by the State**. Therefore, the role of the software integrated in a measuring system will be thorough in order to protect the public faith and allow a correct metrological verification of the measuring instrument.

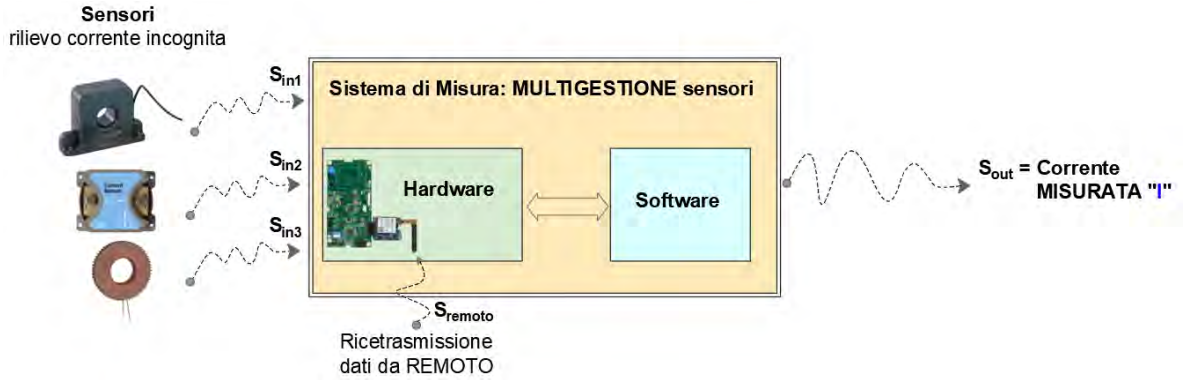


Figure 2: Different sensors applied to a single system, produces an identical result

All this means that the results of the output of the measured size can be altered remotely, and this constitutes a significant and damaging vulnus of the good of the public faith, as it allows fraudulent use.

THE SOFTWARE

The International Organisation of Legal Metrology (OIML) has addressed the issue of legal metrology in cases of measuring instruments entirely managed by microcontrollers or miniPCs with measurement functions. For this purpose, the OIML R 46-1 / 2nd edition 2012[1] document illustrates the metrological and technical requirements, as well as procedures, tests, and performance of active electricity meters. In that document, the OIML introduces the term "legally relevant" (2.2.40), meaning the attribute of a part of a measuring instrument, device, or software, subjected to legal control. The organization aims primarily to protect the public faith by the unique identification of the software responsible for the measurement function, which must be clearly identified with the software version or another token in an indissoluble way (3.6.2). This identification shall be indicated on the type-approval certificate.

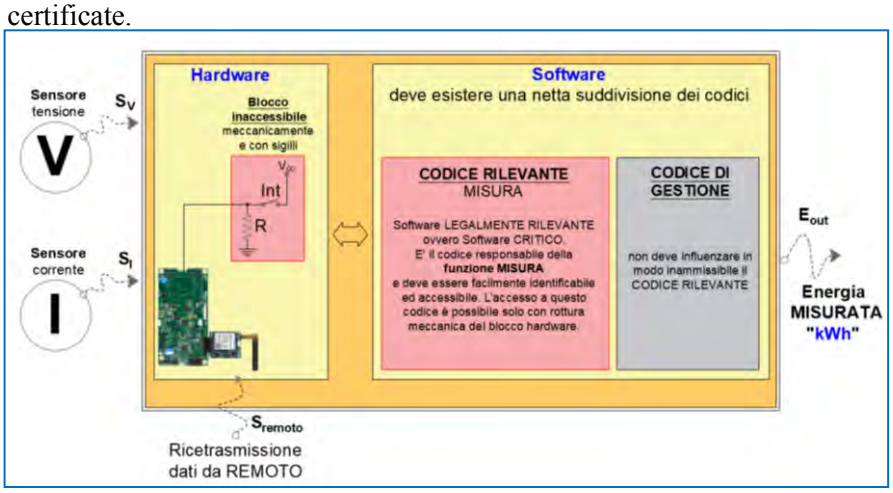


Figure 3: SCHEMATIZATION of hardware and software according to O.I.M.L.

The OIML has provided adequate mechanical, electronic, and/or cryptographic sealing to avoid unauthorised intervention in the relevant code (3.6.3.2.3). This protection can be achieved, for example, by making mechanically inaccessible a signal sent to the hardware with a sealed switch. In case of a broken seal, the parameters, and configurations legally relevant to the relevant metrological code may be changed.

As shown in Figure 3, in the hardware part the device marked with the name "inaccessible block" will allow the access to the "relevant code". In this case any change in the relevant code, responsible for the measurement function, will result in a new verification of the whole instrument. It seems obvious and obvious that in presence of metric instruments with display, this code must not be absolutely visible to anyone and there must be no access from the menu visible in the display. In the case of code updates for any reason, the whole instrument shall be re-subjected to metrological verification and the update track shall be kept.

It is important to emphasize that any reception of data from remote can be manipulated and managed only and exclusively by the "management code" and can absolutely not influence the measured output quantity: the latter is reserved only and exclusively by the relevant code.

$$CR=f(Int,S\_V,S\_I) \text{ and } CG=g(CR,S\_remoto,)$$

[1]OIML R 46-1 / -2 fonte https://www.oiml.org/en/files/pdf_r/r046-p-e12.pdf

with CR = relevant code; CG = management code

Public faith is absolutely guaranteed by these planning criteria of a measuring instrument.

SENDING DATA REMOTELY

Nothing prevents the management code, however, from sending the measured energy result to the data transmission device in the hardware.

Nevertheless, if the result is sent remotely using the transmission device present in the hardware and used by the owner of the measuring instrument as the basis of calculation for a commercial transaction, then there are legal problems not fully covered by the MID[2].

In this case, both the management code and the transmission device in the hardware play legally relevant roles.

Here is the intervention of the Judges of the European High Court which is in perfect accord with the recommendation of the OIML in the part which highlights that electronic measuring devices, if connected to devices for the transmission of the measurement data, which is legally relevant, then the whole system– element resulting from the link of measuring instrument to a data transmission one - shall consider legally relevant (3.6.5.1). Such a system is not covered by the aforementioned MID legislation: hence the legal vacuum mentioned above.

The same legal consideration is applied to the management code (3.6.6.1).

Therefore, in the case of remote sending of metrologically relevant data, part of the management code relating to the remote sending of data should be considered legally relevant and as such falls and will be classified as relevant code, and consequently subject to all metrological checks.

JUDGMENT "VILNIAUSENERGIJA" C 423/13 OF 10 SEPTEMBER 2014[3]

A concrete indication to the intricate question on the legality of the data sending by the remote device present in the hardware of the measuring instrument, is provided by the Judgment of the European High Court[4] which deals with the case of the transmission of the consumption to the remote device remote of a hot water meter. From a technical and legal point of view, the problem is absolutely identical to the case of the electricity meter. The supreme judges of the European High Court declare*: "Article 34 TFEU and Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments are to be interpreted as preventing national legislation and practice according to which a hot water meter, complying with all the requirements of that Directive, in connection with a remote (telemetric) data transmission device, is to be considered as a measuring*

[2]DIRETTIVA MID http://www.labcert.it/pdf/DIRETTIVA%202014-32-EU%20%28MID%29%20-%20ITALIANO.pdf

[3]http://curia.europa.eu/juris/document/document.jsf;jsessionid=9ea7d0f130de972d44f6473547c3915ad446d42c8400.e34KaxiLc3eQc40LaxqMbN4ObxaSe0?text=&docid=157488&pageIndex=0&doclang=it&mode=lst&dir=&occ=first&part=1&cid=105408

[4]http://curia.europa.eu/juris/document/document.jsf;jsessionid=9ea7d0f130de972d44f6473547c3915ad446d42c8400.e34KaxiLc3eQc40LaxqMbN4ObxaSe0?text=&docid=157488&pageIndex=0&doclang=it&mode=lst&dir=&occ=first&part=1&cid=105408

system and for this reason cannot be used in accordance with its intended purpose until it, together with that device, has not been subjected to metrological verification as a measurement system".

The consequences of the sentence pronounced by the supreme judges of the European High Court can therefore be summarized as follows:

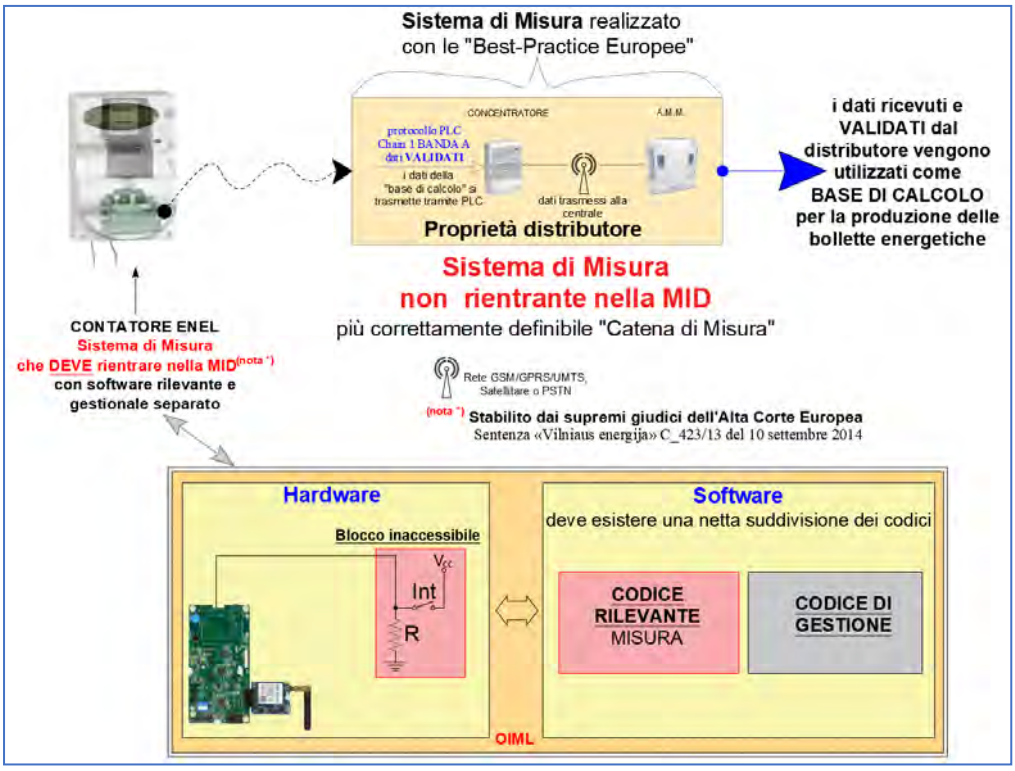
1. The energy meter installed can play the role of energy meter if and only if the basis of calculation for the formation of energy bills is that indicated in the display because the meter is a measuring instrument already subjected to MID verification; in this case, the metrologically relevant code merely carries out the display management task and only reports the results of the measurement function performed, and the tele transmitted data are not authentic vis-à-vis third parties.
2. If the verified energy meter MID is used as a source for remote data transmission then the whole measurement system used in the transmission process cannot be used for the generation of energy bills: the system is not covered by the MID; this means that the management code sends the measurement data to the data transmission device and must be considered metrologically relevant both the relevant management code and the data transmission device, which, according to that judgment, constitute a measuring system and as such, it must be subjected to a specific metrological regulation.

The legal considerations of the European High Court and the recommendations of the OIML are **perfectly consistent and mutually agreed.**

THE STATE OF THE ART OF METROLOGY IN DIGITAL MEASURING INSTRUMENTS

There is no legislation that establishes precise criteria for subdividing the relevant code (measuring function subject to metrological checks) from the management code. Everything is left to the "common sense" of the producer who, remotely, may affect the measurement. The presence of a legislative measure would also provide instruments for the supervisory bodies guaranteeing the public faith. It is obvious that, in the absence of appropriate measures, the measurement data transmitted by the data transmission device present in the hardware and controlled by the management software *"cannot be relied on in the relationship with third parties".*

Incidentally, the indication of the consumption data in the energy bills is proof that the remote data used for the formation of electricity bills cannot be considered valid metrologically and legally for the above reasons, as a result of a system of measurement that is not standardised metrologically, that is, outside legal metrology and, consequently, is not subjected to checks.



DISCUSSION AND CONCLUSIONS

Discussions are discussed "daily" in the courtrooms: today the courts are clogged in civil disputes between distributor-seller or between seller-user for ERRATA MEASUREMENT, CONSUMER RECONSTRUCTION, METER FUNCTION, TECHNICAL DEFECTS, and so on and it is not easy for the judges to decide because of intricate rules difficult to interpret. The solution, from the legal point of view and according to current legislation, is that already indicated by the MID, that is: "the basis of calculation of the energy consumption is established only from the display of the meter" because is managed by the code of management and used only for the visualization of the metrological results elaborated by the relevant metrological code.

Certainly as long as there is no legislation and rules are created to identify the clear distinction between the metrological part and the purely managerial part in the software of the measuring instrument (which should not influence the metrological code)and, likewise, no rules and methodologies for checking compliance between the software, deposited by the producer at the time of approval, and the software operating on the instrument being checked shall be established, the metrology of digital measuring instruments can be considered as an orphan of an essential part of the compliance check of the instrument. To date, the presence of microcontrollers in digital and electronic display instruments is such that the software element carries out a primary task on the metrological and performance characteristics of the measuring instrument using these technologies; therefore, reliability and metrological safety are considered as other factors that contribute to substantiate the requirement of conformity and, ultimately, effective concreteness to the protection of the public faith, which is the primary task of legal metrology. Allow us to conclude with an aphorism that is the natural conclusion of the above, I hope with clarity, according to which: "*In every State of Law, the civilization of measurement, becomes itself the measure of civilization*".

Certainly as long as there is no legislation and rules are created to identify the clear distinction in the hardware and codes implemented in the meters, to be subdivided clearly into relevant code (metrologically controlled) and management code (which should not affect the relevant code), the metrology of digital measuring instruments can be considered as a NON-EXACT and juridically a

NON-LEGAL science in the case where there is no clear separation of both the legally relevant electronic devices and the relevant codes, equally responsible for the measuring function, because the results of the measure may be altered remotely.

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