iPIMMS in Penang

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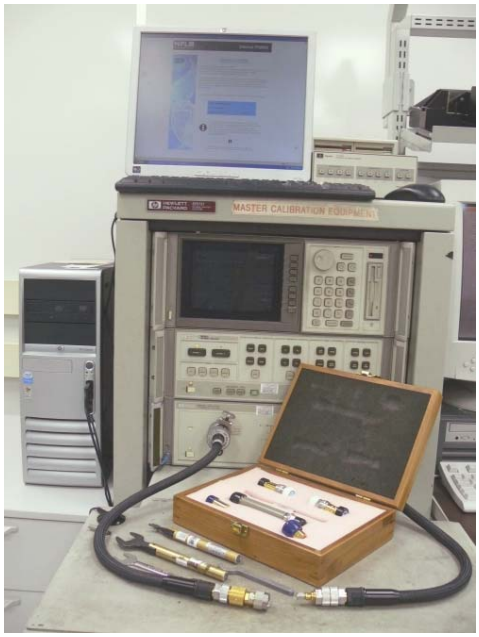
Measurements made using Vector Network Analysers are as complex as they are fascinating. The internet-enabled Primary Impedance Measurement System (iPIMMS), which was launched in 2001 by the National Physical Laboratory (NPL) in the United Kingdom, allows microwave network analyser users to achieve uncertainties which are equivalent to those of measurements performed at NPL.[1]

The iPIMMS development took into account many key preferences for any calibration laboratory; namely traceability to National Standards, a very short traceability chain, low uncertainties and reduced cost of calibration.[2] These aspects easily justified the need for an iPIMMS at Agilent's largest manufacturing site; in Penang, Malaysia.

How does it work?

iPIMMS is NPL's first measurement service to make extensive use of the internet to realise a measurement capability. The internet forms an extended link between the user's measuring equipment – in this case an Agilent 8510C Vector Network Analyser – and NPL's dedicated software that is located on the NPL server. The software provides several functions including controlling the measuring instrument, interfacing with the equipment operator and collecting readings from the instrument. It performs corrections during calibration and calculates the measurement results, including evaluation of the measurement uncertainty. Traceability to SI units is obtained by NPL calibration of a reference standard which, in this case, is a short length of precision air-spaced transmission line. This standard's characterisation data is stored on the NPL server and, using it, real time corrections are applied during the measurement process. Through the use of such devices and measurement repetition required by iPIMMS, which uses statistical algorithms defined in the ISO *Guide to the Expression of Uncertainty in Measurement*, very low measurement uncertainties are achieved. In fact, the result is a calibration capability for complex transmission and reflection coefficients (S-parameters) that is comparable in accuracy to the UK's primary standards facility.



The iPIMMS workstation together with the NPL-traceable artefacts used to error correct and check the system.

Why use it?

Agilent's Penang Calibration Laboratory supplies many different calibrations to the manufacturing production lines including some performed under their Skim Akreditasi Makmal Malaysia (ISO/IEC 17025) accreditation. Network analysers are particularly important because a wide range of items including power splitters, power sensors, attenuators, couplers, terminations and co-axial adapters are calibrated with them. As technology advances, manufacturing sophistication and accuracy requirements must improve to match customer demand. High quality measurements with low uncertainty is a crucial means of achieving it.

The initial justification for iPIMMS in Agilent Penang stemmed from the need of some special equipment used on the production lines which requires small measurement uncertainties. This special test set-up is used to measure the source match of the reference calibrator of microwave power meters. In the past, this characteristic impedance was attributed only with a "typical" value due to the problems associated with performing the measurement. As the market has developed and customers have become more knowledgable about assessing their own measurement accuracy, it was evident that the calibrator source match was a significant contributor in their uncertainty budget. This led to a desire to improve this Output VSWR specification for Agilent's latest power meters, the N1911A / N1912A.[3] The solution was to adopt a measurement technique developed by NPL which uses a power splitter, 50 ohm load and a power sensor. A similar technique was described in the EPM-P series power meter Service Guide.[4]

The equipment that requires the special calibration provided by iPIMMS.

Accurate measurements are required for the power splitter, both with and without the load connected. The uncertainties relating to these measurements are the most significant in the source match uncertainty budget and so, to minimise the contribution, national metrology institutes (NMIs) such as NPL or the US NIST would traditionally be used to obtain this data. But now, with iPIMMS, they can be adequately performed in the factory so avoiding the downtime, costs and administration effort associated with external calibrations.

Expansion of iPIMMS in Agilent

Agilent South Queensferry obtained the first ever calibration accreditation based on internet-enabled metrology using iPIMMS.[5] The transfer of manufacturing from South Queensferry to Penang was accompanied by completion of the first iPIMMS installation in Malaysia. The Penang calibration laboratory staff were recently trained on the use of the system, enabling them to produce calibrations of similar quality to those obtained from an NMI, at a fraction of the cost normally associated with this level of measurement confidence.

Looking to the future, Agilent Penang would like to use iPIMMS to provide more of the special calibrations required by its production lines. This could include the ability to calibrate network analyser calibration and verification kits and to provide some local verification service for e-cal modules. The ultimate aim would be to achieve ISO/IEC 17025 accreditation for all of these measurements in Malaysia. Although the idea of subscribing to NPL's iPIMMS service may have been initiated to support a special test set-up, it has opened doors for future development that will be of benefit to the company both technologically and financially.

References

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