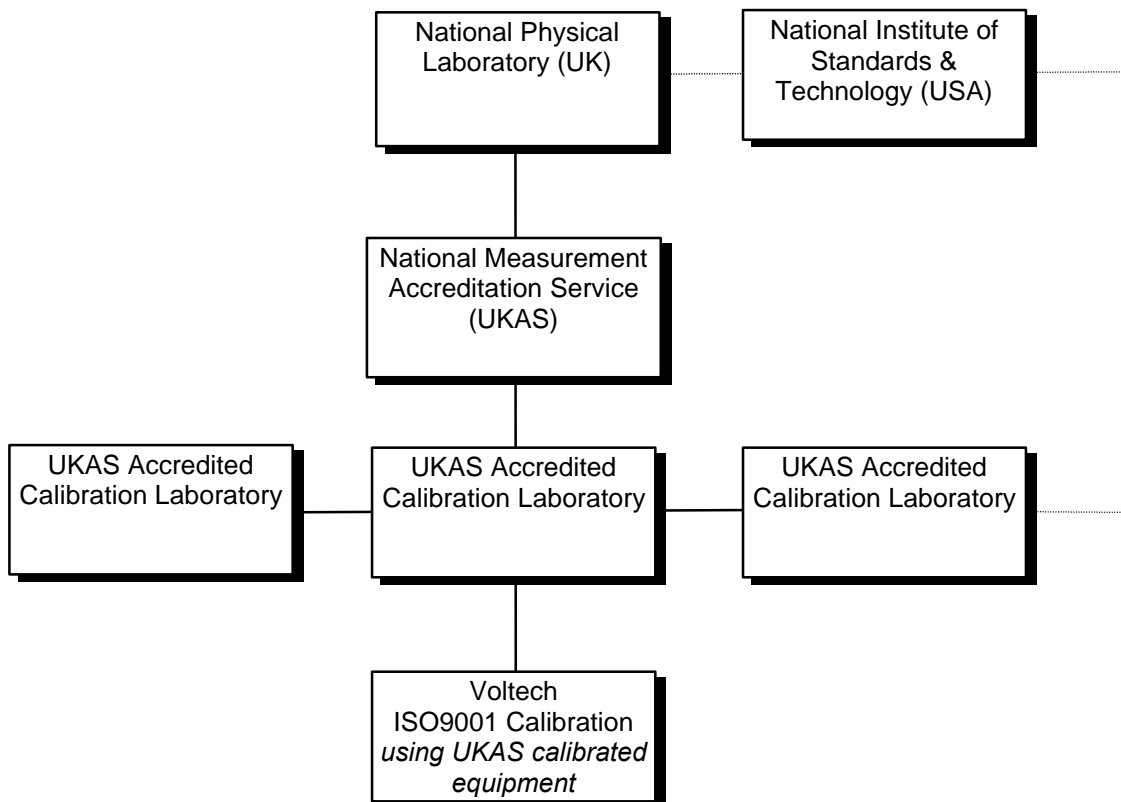# Voltech™

PM6000
Reference Sheet 003

PM6000 and Measurement Traceability to IEC61000-4-7 (Interharmonics), IEC61000-3-2 & IEC61000-3-3 (Harmonics & Flicker)

Each PM6000 is supplied with a certificate of conformance and calibration. The certificate identifies the exact equipment used and states the overall calibration uncertainty. Traceability to international standards of voltage, current and frequency is provided in the following manner:

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┌─────────────────────┐        ┌─────────────────────┐
│ National Physical   │ ······ │ National Institute of│ ······
│ Laboratory (UK)     │        │ Standards &         │
│                     │        │ Technology (USA)    │
└──────────┬──────────┘        └─────────────────────┘
           │
┌──────────┴──────────┐
│ National Measurement│
│ Accreditation Service│
│ (UKAS)              │
└──────────┬──────────┘
           │
┌──────────────────┐  ┌──────────┴──────────┐  ┌──────────────────┐
│ UKAS Accredited  │──│ UKAS Accredited     │──│ UKAS Accredited  │ ······
│ Calibration      │  │ Calibration         │  │ Calibration      │
│ Laboratory       │  │ Laboratory          │  │ Laboratory       │
└──────────────────┘  └──────────┬──────────┘  └──────────────────┘
                                 │
                      ┌──────────┴──────────┐
                      │ Voltech             │
                      │ ISO9001 Calibration │
                      │ using UKAS calibrated│
                      │ equipment           │
                      └─────────────────────┘
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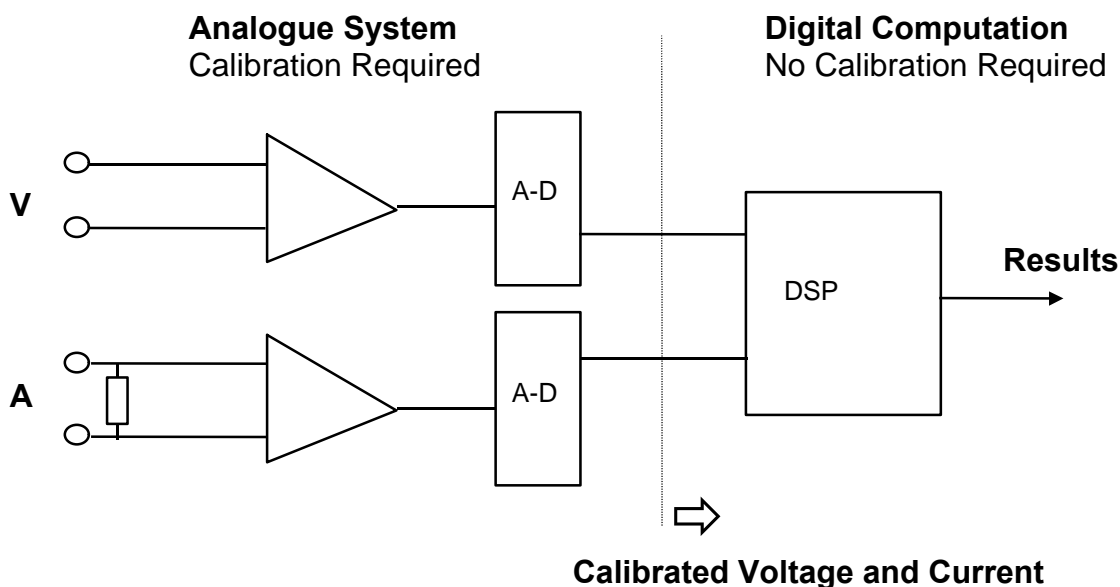
The validity of this chart is ensured by Voltech's ISO9001 accreditation which demonstrates that our calibration equipment is subject to periodic inspection, test and calibration by UKAS accredited laboratories. UKAS similarly ensures that the UKAS laboratory's own equipment is referenced to NPL and thus to other international standards.

Calibration of voltage, current and frequency is sufficient to ensure that a PM6000 achieves it's full specification. All other measurements, including IEC61000-4-7 (interharmonics), IEC61000-3-2/3, are the result of mathematics performed on digital information, where performance does not change with time.

How calibration of voltage, current and frequency guarantees traceable accuracy for all measurements on a PM6000.

The basic components of a PM6000 are shown below.
Precisely timed samples are taken of the voltage and current signals that are present at the PM6000s input terminals. These samples are then converted to digital form by analogue to digital (A-D) converters. These <u>digital</u> voltage and current samples are then processed using proprietary firmware to provide the desired results - RMS Voltage & Current, Watts, Frequency, Harmonics, and Voltage Flicker.

Analogue System
Calibration Required

Digital Computation
No Calibration Required

V

A-D

A

A-D

DSP

Results

Calibrated Voltage and Current

Simplified Block Diagram of a PM6000 measurement Channel

Periodic calibration is necessary to compensate for the effects of any variables in this system. Those variables exist only in the analogue parts of the voltage and current channels, the result of variation in the absolute values of amplifier gain, shunt value, reference voltages and so on.

The DSP (Digital Signal Processor) firmware performs fixed mathematical calculations on the calibrated voltage and current signals to provide the required results. There is no method or requirement to 'calibrate' the mathematics of the DSP.

**How Voltech ensures that the PM6000 firmware mathematics are correct.**

All of the filters and processing required by IEC61000-4-7 (interharmonics) and IEC61000-3-2/3 are implemented digitally by the firmware. The correct operation of all parts of the firmware mathematics is confirmed by detailed type-testing using UKAS traceable equipment.

Type-testing is the normal method of verifying the performance of any instrument over its complete range of operation and on all Voltech products it is performed at every revision of firmware or hardware, and periodically on sample instruments from a normal production batch.

For example, IEC61000-4-15 Ed.1.1. (2003) *Flickermeter Functional and Design Specifications*, *Type test specifications*

For the points used on the theoretical curve, this result should give a value of one. The allowed tolerance for Flickermeters as defined in IEC 61000-4-15 is ± 5 % of reading

A type-test for a PM6000 takes a qualified engineer 4 weeks to perform and the results consist of over 1000 pages of detailed results and test methods. The results are scrutinised by further engineering and quality assurance staff under Voltech's ISO9001 system before that revision of firmware or hardware is approved for use.
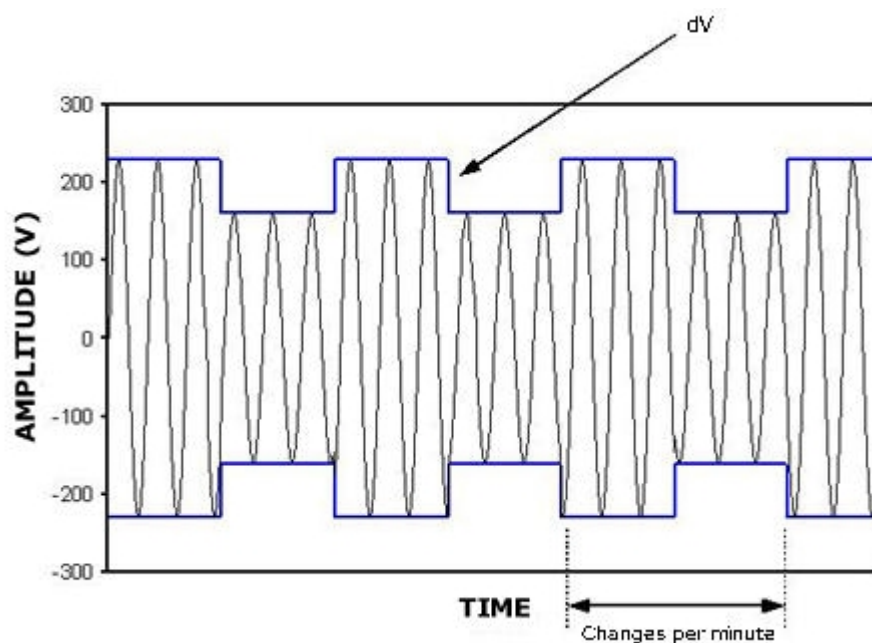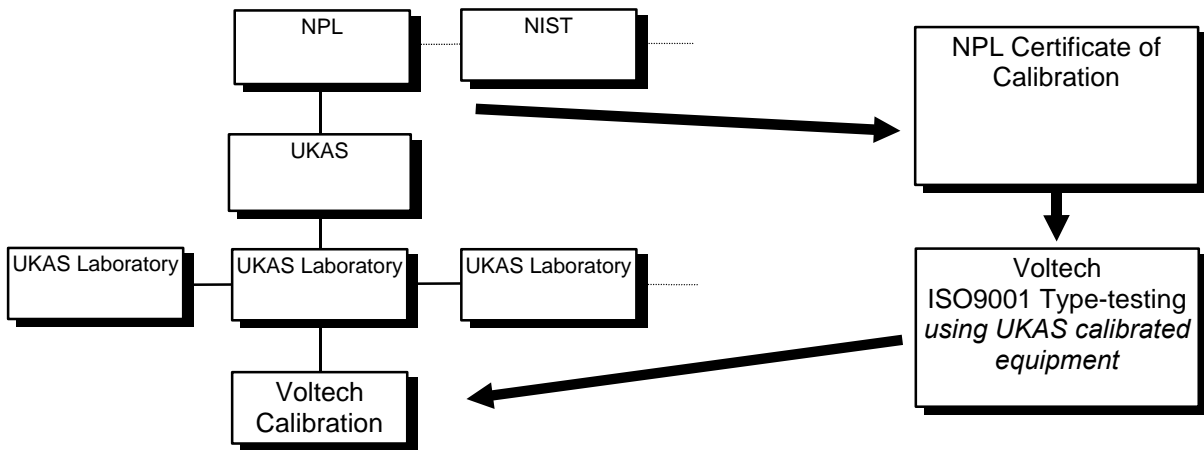

A squarewave modulation of the mains voltage is used to type test Flickermeter

How Voltech makes absolutely sure of its type-test methods and equipment.

In the case of IEC61000-4-7 (interharmonics) and IEC61000-3-2/3 the standards describe very specific and complex methods that must be used to achieve compliance testing. To guarantee with absolute confidence that Voltech achieves the accuracy required by these standards when using our firmware, we chose to supplement our own type-testing by having a PM6000 type-tested by an independent authority - NPL.
NPL supplied Voltech with a Certificate of Calibration which shows that a sample PM6000 taken from Voltech's normal production easily achieves the accuracy requirements of the standard. Where possible, the type-test conditions described by the standards were used. In the case of Voltage flicker for example, the NPL certificate <u>independently</u> verifies Voltech's correct implementation of all of the complex filters and processing that is required.

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┌─────────┐    ┌─────────┐                    ┌──────────────────┐
│   NPL   │    │  NIST   │                    │ NPL Certificate of│
└─────────┘    └─────────┘                    │   Calibration     │
     │                                        └──────────────────┘
┌─────────┐                                            │
│  UKAS   │                                            ▼
└─────────┘                                 ┌──────────────────┐
     │                                      │     Voltech       │
┌──────────┐ ┌──────────────┐ ┌──────────┐  │ ISO9001 Type-testing│
│UKAS      │ │UKAS Laboratory│ │UKAS      │  │ using UKAS calibrated│
│Laboratory│ │              │ │Laboratory│  │    equipment      │
└──────────┘ └──────────────┘ └──────────┘  └──────────────────┘
                   │
            ┌─────────────┐
            │   Voltech    │
            │ Calibration  │
            └─────────────┘
```

1. The traceable accuracy of each PM6000 for volts, amps and frequency is shown by its calibration certificate.

2. The correct operation of the digital processing is confirmed by type-testing, which is performed on at least each revision of firmware or hardware.
3. The validity of Voltech type-testing is demonstrated by the NPL certificate of calibration.

Thus by a process of calibration, periodic type-testing, and independent type test, Voltech ensures that <u>every</u> PM6000 fully complies with all of the requirements of IEC61000-4-7 (interharmonics) and IEC61000-3-2/3.