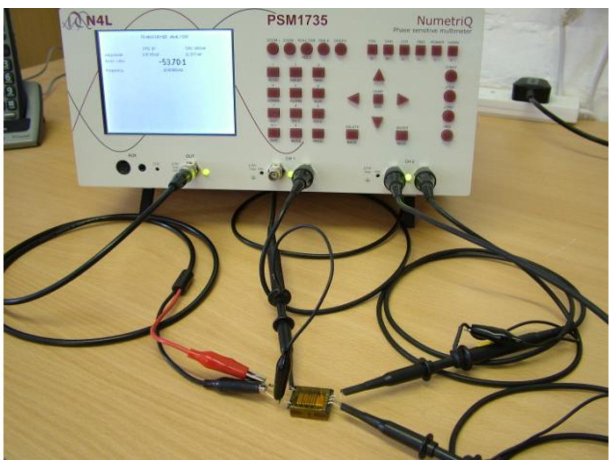
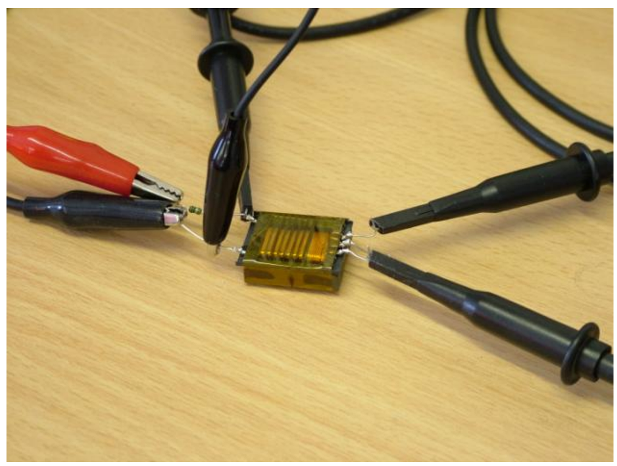
This report has been compiled after receiving a sample transformer from John Pannifex and was subjected to the following tests:

turns ratio
primary inductance and resistance
leakage inductance
interwinding capacitance
insertion loss
return loss
harmonics
thd
longitudinal balance

Using the Newtons4th PSM1735 Phase Sensitive Multimeter in “Transformer Analyser” mode, which is the most straight forward option to use, this report is compiled to show the test circuits used and the measurements obtained. As no test data was received, the test voltages were set to what was considered appropriate (usually 1v pk) at a frequency of 10KHz with the inputs set to differential. As the tests conducted were found to be fairly straight forward it was deemed that the TAF01 box was not required. In this situation it was considered that the customer could fairly easily construct a small transformer holder/fixture to accommodate the minimal components used for testing, as most of these tests require some simple circuitry such as resistors to be fitted on the test.





Above shows the transformer being subjected to testing and for all the tests the same probes and connections were used to complete the measurements. Therefore, as minimal alterations were necessary, only the addition of Loss load and longitudinal resistors added, all the tests were completed without the need for sophisticated fixtures.

Turns Ratio

The Turns Ratio test was conducted by injecting into the Secondary and measuring from the Primary to achieve the ratio measurements. This orientation was due to what visibly looked like a large step up ratio, and to eliminate any possible electrical damage to the PSM inputs the test was conducted this way. The circuit used is shown in Fig (1) with a frequency of 10KHz and generator voltage of 1v pk.

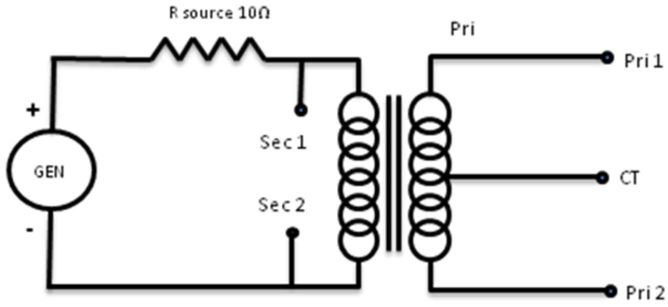


Fig 1

Turns ratio measurement connections and results:

- CH1+ (Sec1) and CH1– (Sec2), CH2+ (Pri1) and CH2- (Pri2) Total turns ratio = **53.70 : 1**
- CH1+ (Sec1) and CH1– (Sec2), CH2+ (Pri1) and CH2- (CT) Total turns ratio = **107.6 : 1**
- CH1+ (Sec1) and CH1– (Sec2), CH2+ (Pri2) and CH2- (CT) Total turns ratio = **107.4 : 1**

Inductance

The Primary and Secondary inductance was carried out using the circuits in Fig (2 & 3).

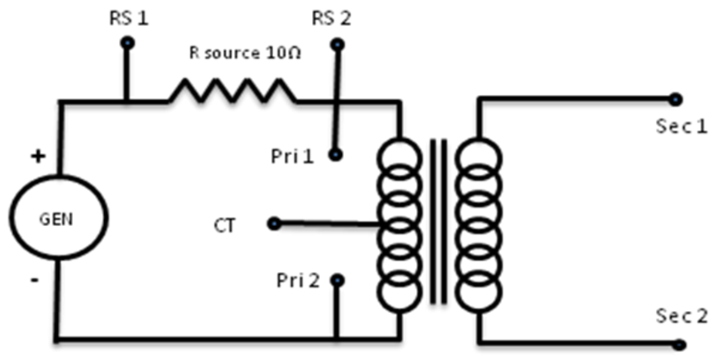


Fig 2

Inductance measurement connections and results:

- Total Primary Inductance measurements between CH1+ (Pri1) and CH1– (Pri2), CH2+ (RS2) and CH2- (RS1) Total Primary inductance = **89.16μH**

- Primary Centre Tap Inductance measurements between CH1+ (Pri1) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary CT inductance = **22.18μH**
- Primary Centre Tap Inductance measurements between CH1+ (Pri2) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary - CT inductance = **22.21μH**

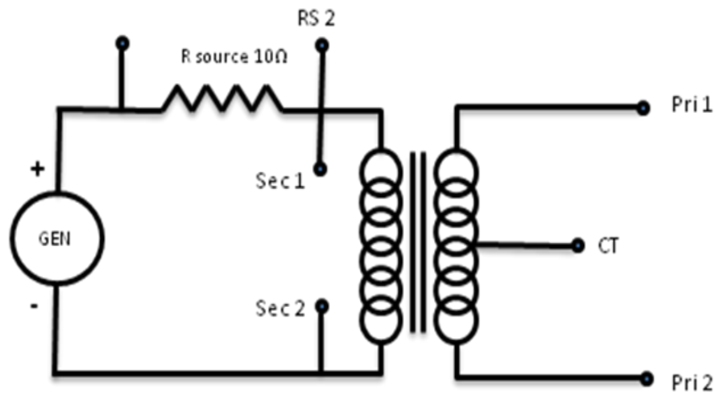


Fig 3

- Total Secondary Inductance measurements between CH1+ (Sec1) and CH1– (Sec2), CH2+ (RS2) and CH2- (RS1) Total Secondary inductance = **15.63mH**

Leakage Inductance

The Primary and Secondary leakage inductance was carried out using the circuits in Fig (4 & 5). Leakage inductance is measured in the same way as primary inductance but with the secondary shorted.

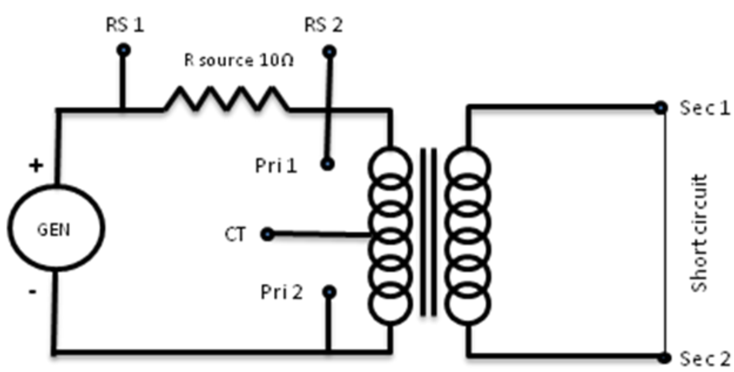


Fig 4

Leakage inductance measurement connections and results:

- Total Primary leakage Inductance measurements between CH1+ (Pri1) and CH1– (Pri2), CH2+ (RS2) and CH2- (RS1) Total Primary leakage inductance = **22.36μH**

- Primary Centre Tap leakage Inductance measurements between CH1+ (Pri1) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary – CT leakage inductance = **5.56µH**
- Primary Centre Tap leakage Inductance measurements between CH1+ (Pri2) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary - CT leakage inductance = **5.55µH**

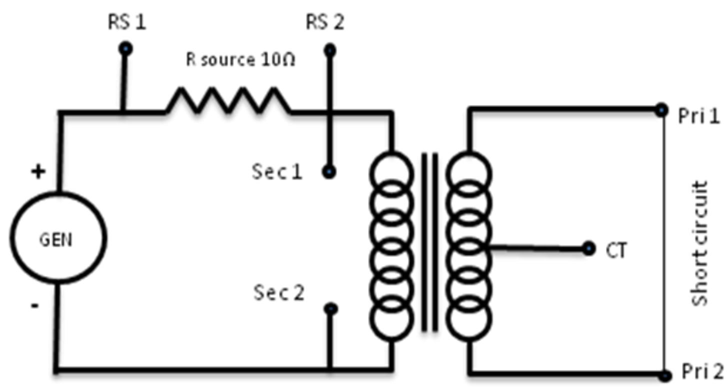


Fig 5

- Total Secondary leakage Inductance measurements between CH1+ (Sec1) and CH1– (Sec2), CH2+ (RS2) and CH2- (RS1) Total Secondary leakage inductance = **27.57mH**

AC Resistance & Q Factor

The AC resistance is measured the same way as inductance with CH1 monitoring the voltage across the winding, and CH2 monitoring the current through it via the shunt (source resistance). The Q factor measurement is an effective way of detecting a shorted turn and the Q factor will change dramatically when a shorted turn is present, however it is assumed that there is no shorted turns on the sample provided.

AC and Q factor measurement connections and results:

- Total Primary ac resistance measurements between CH1+ (Pri1) and CH1– (Pri2), CH2+ (RS2) and CH2- (RS1) Total Primary ac resistance = **155.5mΩ**
- Primary Q Factor = **35.98**

- Primary Centre Tap ac resistance measurements between CH1+ (Pri1) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary – CT ac resistance = **73.37mΩ**
- Primary – CT Q Factor = **18.97**

- Primary Centre Tap ac resistance measurements between CH1+ (Pri2) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary – CT ac resistance = **73.67mΩ**
- Primary – CT Q Factor = **18.82**

- Total Secondary ac resistance and Q factor measurements between CH1+ (Sec1) and CH1– (Sec2), CH2+ (RS2) and CH2- (RS1).
- Total Secondary ac resistance = **550.1Ω**
- Total Secondary Q factor = **1.81**

DC Resistance

DC resistance is measured with the same circuit arrangement as ac resistance. The PSM was set up to inject a 1v dc offset allowing the DC resistance measurements to be made.

DC resistance measurement connections and results:

- Total Primary dc resistance measurements between CH1+ (Pri1) and CH1– (Pri2), CH2+ (RS2) and CH2- (RS1) Total Primary dc resistance = **135.2mΩ**
- Primary Centre Tap dc resistance measurements between CH1+ (Pri1) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary – CT dc resistance = **82.05mΩ**
- Primary Centre Tap dc resistance measurements between CH1+ (Pri2) and CH1– (CT), CH2+ (RS2) and CH2- (RS1) Primary – CT dc resistance = **79.81mΩ**
- Primary – CT Q Factor = **18.82**
- Total Secondary dc resistance between CH1+ (Sec1) and CH1– (Sec2), CH2+ (RS2) and CH2- (RS1) Total Secondary dc resistance = **273.5Ω**

Inter-winding Capacitance

For inter-winding capacitance measurement a source resistance is connected in series with one winding whilst the PSM output is across the transformer from the series resistance to another winding, per Fig (6). Connect the CH1 input across the transformer (CH1+ Pri1 & CH1- Sec2) and CH2 across the series resistance (CH2- RS1 & CH2+ RS2).

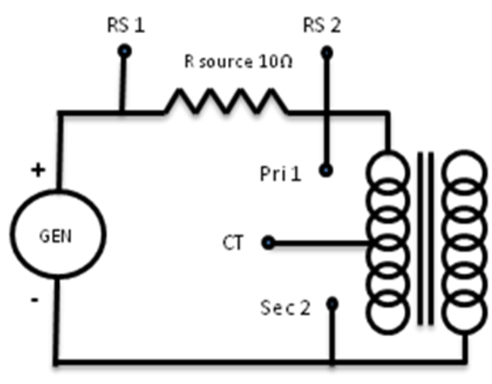


Fig 6

Inter-winding capacitance measurement result:

- Total inter-winding capacitance between primary and secondary = **350.1pf**

Magnetizing Current

The magnetising current is the current drawn by the primary, energised under normal operating conditions but without any secondary load. It is typically measured on power transformers rather than signal transformers to check iron core problems with laminations. Therefore as the original supply voltages etc are unknown and the sample transformer uses a ferrite core, it felt appropriate not to conduct this test.

Return Loss

The Return loss is the measurement of the reflected impedance when the secondary is loaded with the appropriate resistance. In this case a balanced circuit using resistances of 50Ω was used and the circuit is shown in Fig (7). The PSM connections for this test are CH1 input across the transformer primary (CH1+ Pri1 & CH1- Pri2) and CH2 across the series source resistance, now 50Ω (CH2- RS1 & CH2+ RS2).

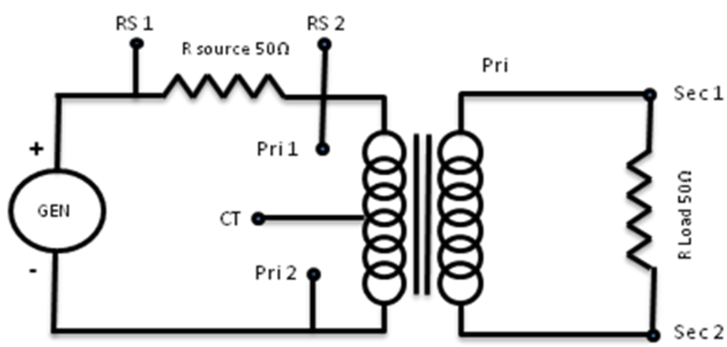


Fig 7

- With the circuit balanced and loaded with 50Ω the return loss measurement = **0.075dB**

Insertion Loss

The Insertion loss is a measure of power loss due to impedance mismatch in signal transformers that are terminated with the design load resistance. Normally the secondary is terminated with the appropriate load resistance and the primary is energised via a source resistance that is equal to the resistance that should be reflected back from the secondary. As these "actual" values are not known, the test reverted back to using the original source resistance and maintained the 50Ω load resistance. Both values need to be entered into the PSM for this test and the circuit used can be seen in Fig (8), the PSM connections for this test, (CH1+ Pri1 & CH1- Pri2) and CH2 (CH2+ Sec1 & CH2- Sec2).

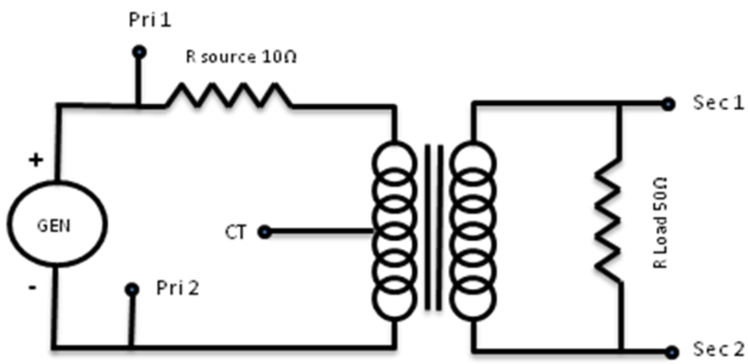


Fig 8

- With the circuit loaded with 50Ω the insertion loss measurement = **21.47dB**

Single and Total Harmonic Distortion

The Harmonic distortion introduced by a signal transformer may be measured either at a single spot harmonic or as the thd computed from a series of harmonics. The primary of the transformer is energised by the PSM output, (CH1+ Pri1 & CH1- Pri2) and CH2 (CH2+ Sec1 & CH2- Sec2), and is usual to measure harmonic distortion with the secondary loaded. The circuit used is the same as used for insertion loss is shown in Fig (8).

Single and thd measurement results:

- With the harmonic “H3” selected the single harmonic measurement = **0.017%**
- With a series of 20 harmonics selected the thd measurement = **0.051%**

Longitudinal Balance

The Longitudinal balance is a measure of the common mode rejection ratio, CMRR, of the transformer. To test longitudinal balance it requires external circuitry to reduce the loading and provide the required accuracy. Therefore, and as the sample is more representative of a signal transformer, it was decided to use 600Ω (at least 1%) resistors to balance the circuit, which can be seen in Fig (9).

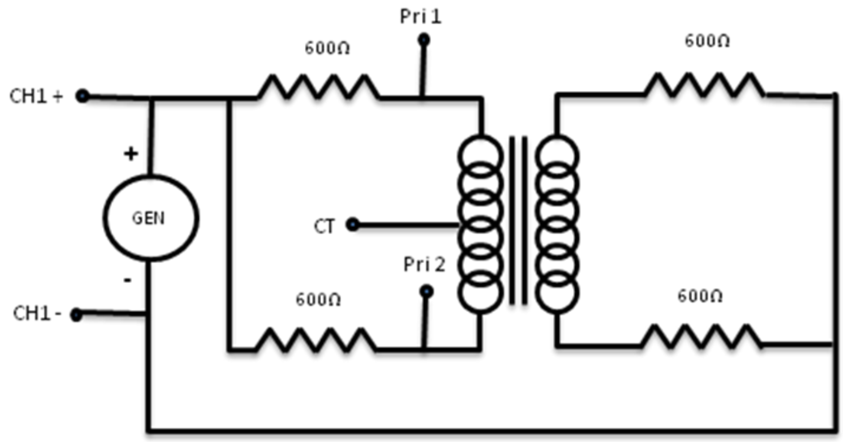


Fig 9

Longitudinal balance measurement result:

- The Longitudinal Balance measurement = **52.48dB**