

Ultrasonic Investigation of Thin Ceramic Plates by Means of Delay Line Contact Mode

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GOAL OF THE STUDY

In this work, a delay line transducer with optimal operating frequency is used to investigate the ceramic plates of Peltier modules. The applied method is suitable for measuring objects up to several millimeters thick.

METHODOLOGY OF THE INVESTIGATION

Ultrasonic measurements were carried out by means of GE Krautkramer gauge USMgo. Transducers with delay lines, emitting at 5 MHz, 10 MHz, 15 MHz and 20 MHz, were used to determine the operating frequency range. An analysis of a number of echoes, amplitude and shape of signals, pulse duration and pulse rise time was performed. Ceramic plates of six Peltier modules, models TEC1-12708 (1, 2 and 3) and TEC1-12710 (4, 5 and 6), were measured with a selected transducer of 15 MHz.

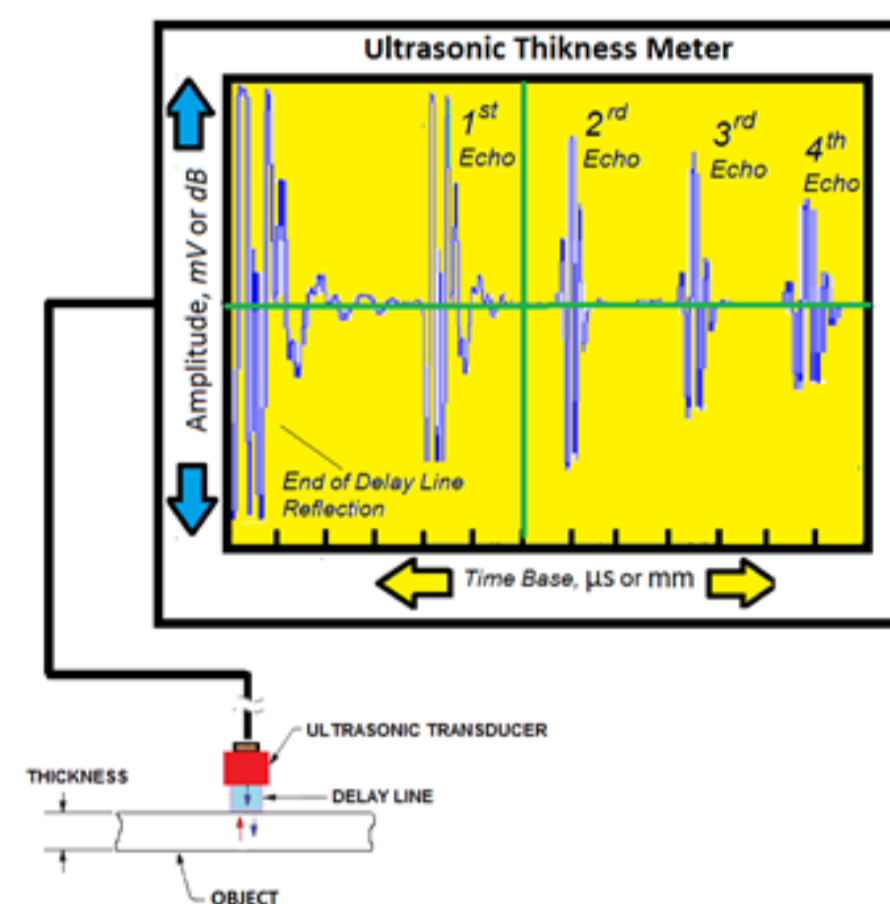


Fig. 1. Experimental set-up

MAIN RESULTS FROM THE STUDY

Frequency range determination

It was found that frequency range from 10 to 15 MHz is applicable for the measurement of thin samples with good resolution and reproducibility.

Measurements of a ceramic plate (Al_2O_3) by the 10 and 15 MHz transducers

A-scan images showed that both pulse rise time and pulse duration decrease when the 15 MHz probe was applied. Additionally, a set of 7 echoes with good resolution is observed (Fig. 2).

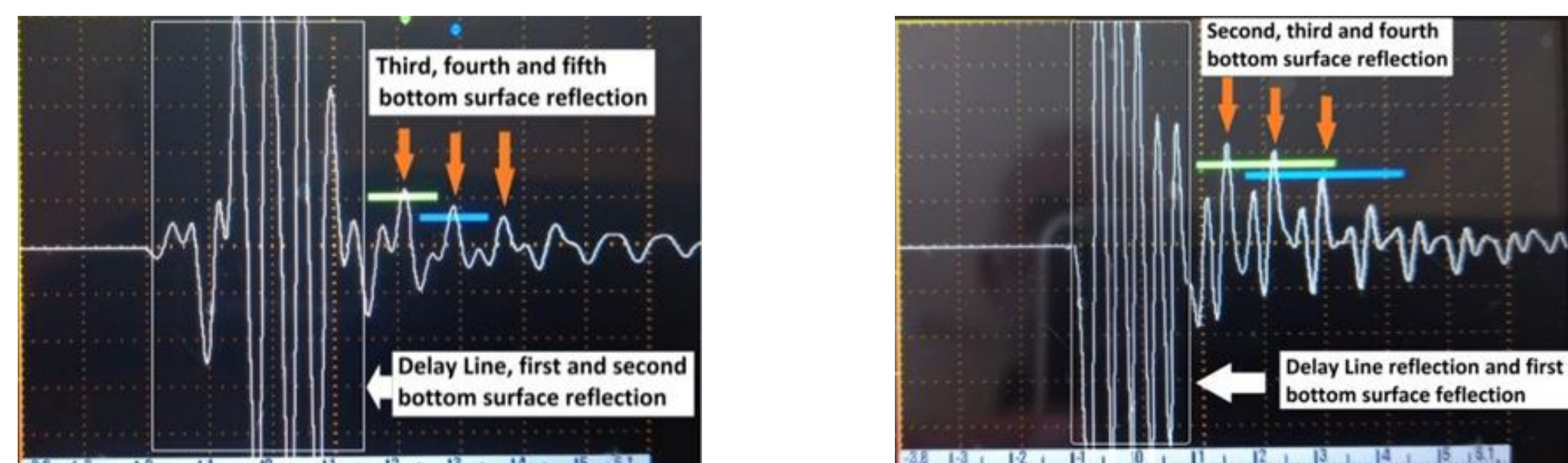


Fig. 2. A-scan measurement on ceramic sample plate at 10MHz and 15MHz

Measurements of the plates of Peltier modules

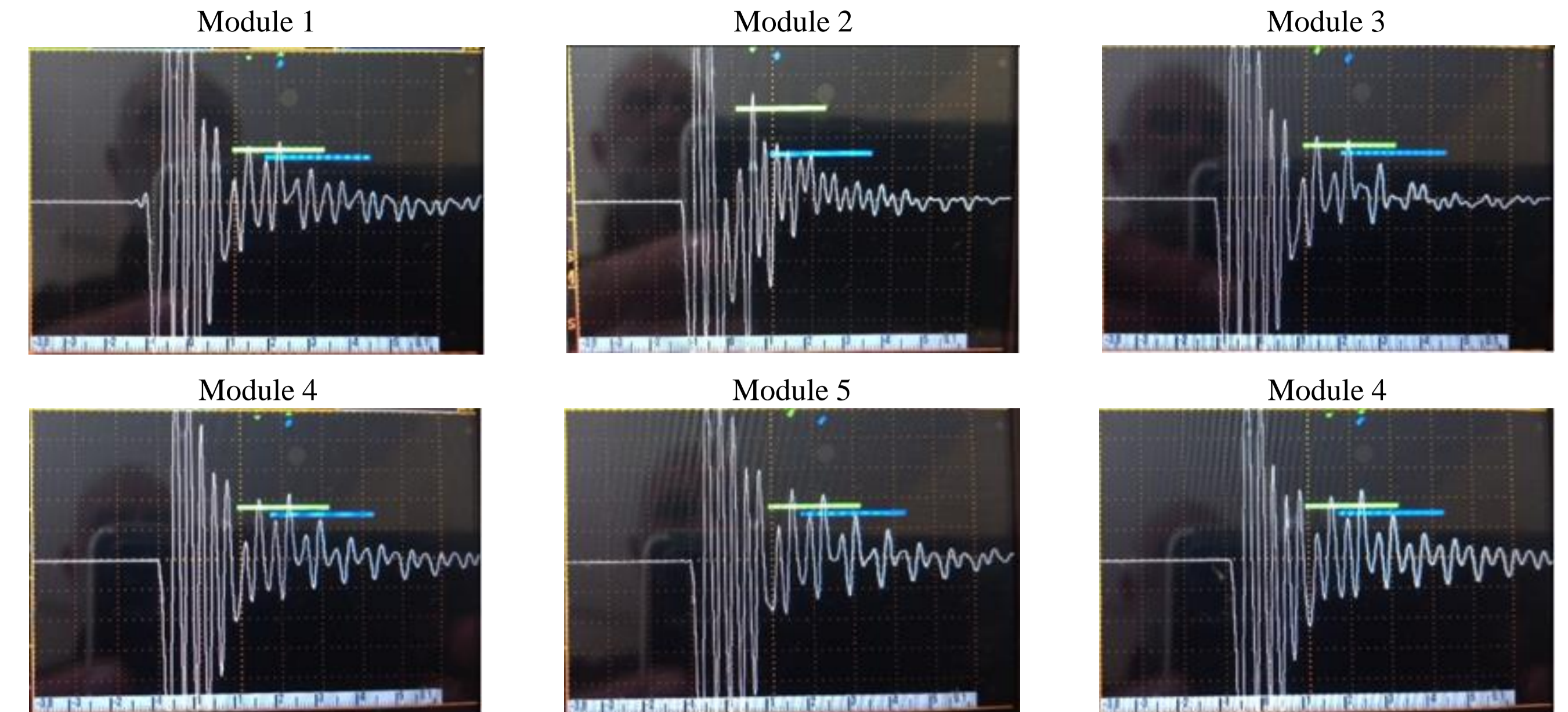


Fig. 3. A-scan images of plates of Peltier modules

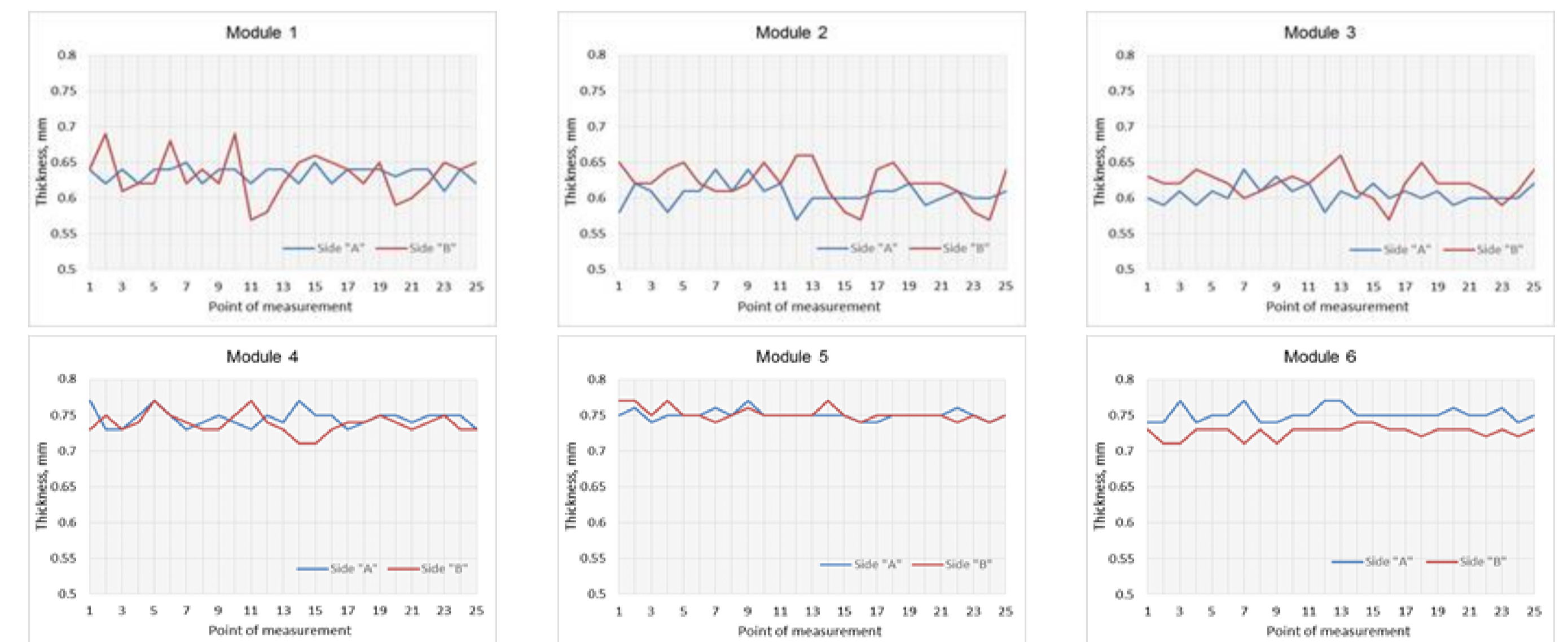


Fig. 4. Ultrasonically measured thickness at 25 points of plates

Table 1. Mean values of thickness of two plates (A and B)

Side	Thickness (mm)					
	1	2	3	4	5	6
A	0.63	0.60	0.60	0.74	0.75	0.75
B	0.63	0.62	0.62	0.73	0.73	0.72

CONCLUSIONS

- The results for distortion of the sinusoidal shape, pulse rise time, pulse duration and amplitude show that waves absorption and scattering by the plates are different depending on the structure of the material.
- Different waveforms could be used as a basis for characterizing thin ceramic plates by the ultrasonic method.
- The study of thin ceramic plates by ultrasonic contact method with 15 MHz transducer and delay line can provide additional information about the quality of Peltier modules.