

Generation of harmonics previously measured in the mains by the TS33 automatic test system

Application Note No40

The mains can have high distortion due to variable and non-linear loads. These distortions affect the correct operation of many power equipment. The TS33 automatic test system makes it possible to measure and record these distortions in the mains and then reproduce them in the generated voltage and current signal, simulating the behaviour of the power network. In this way, the behaviour of the measuring instruments can be checked in the laboratory under the same conditions as they were at the site where they were installed.

In the example below, the method of the TS33 automatic test system is presented using the C300B three-phase calibrator as a power system simulator with pre-programmed distortions. The distortions programmed into the C300B calibrator are shown in the figures below (Fig.1). There are three harmonics: 3rd - 20% of fundamental, 5th - 10% of fundamental and 7th - 5% of fundamental. The fundamental voltage and current are set to 230V, 5A and 50Hz.

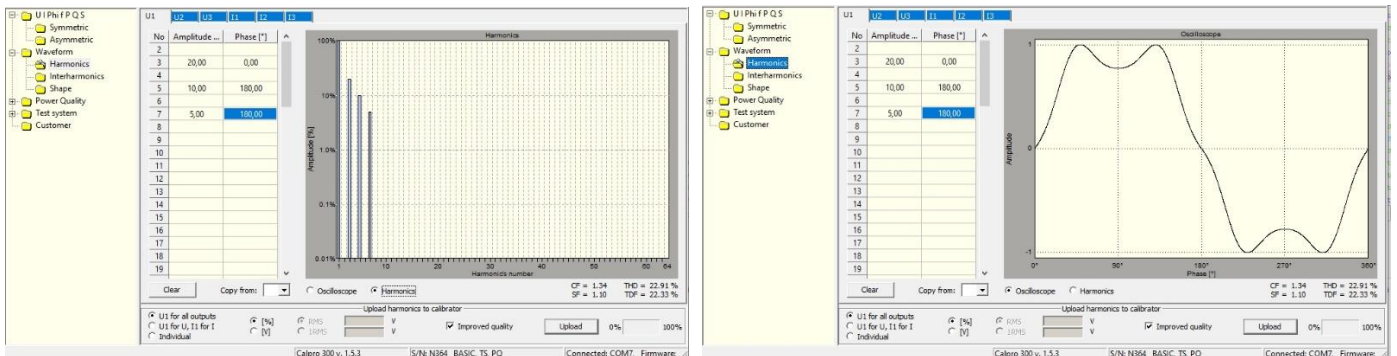


Fig.1. Harmonic programmed in the C300B power calibrator

Then the U & I harmonics are measured by TS33 automatic test system. The measured RMS values and values of harmonics are presented in the picture (Fig.2). Bar diagram and wavsshape are presented in picture (Fig.3).

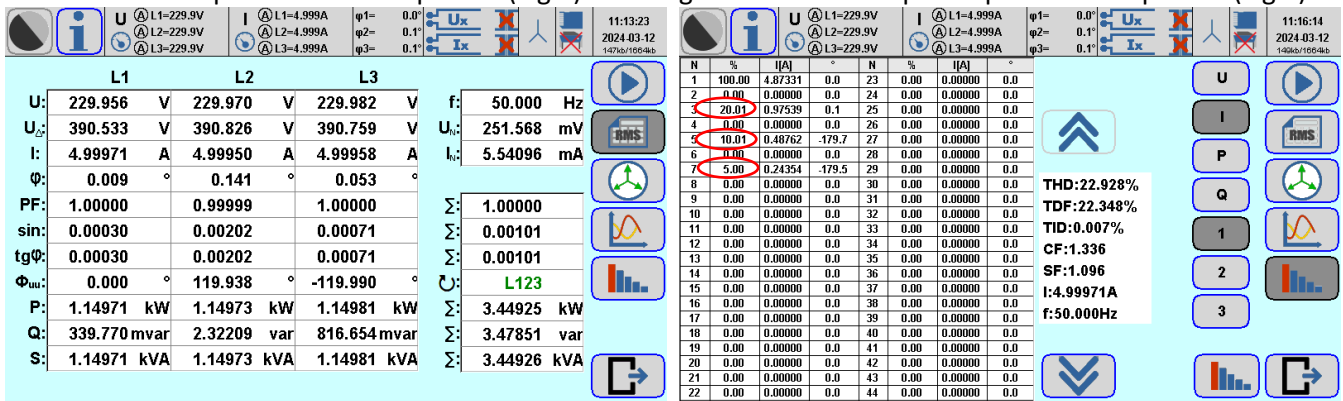


Fig.2. Measured by TS33 RMS values and harmonic content

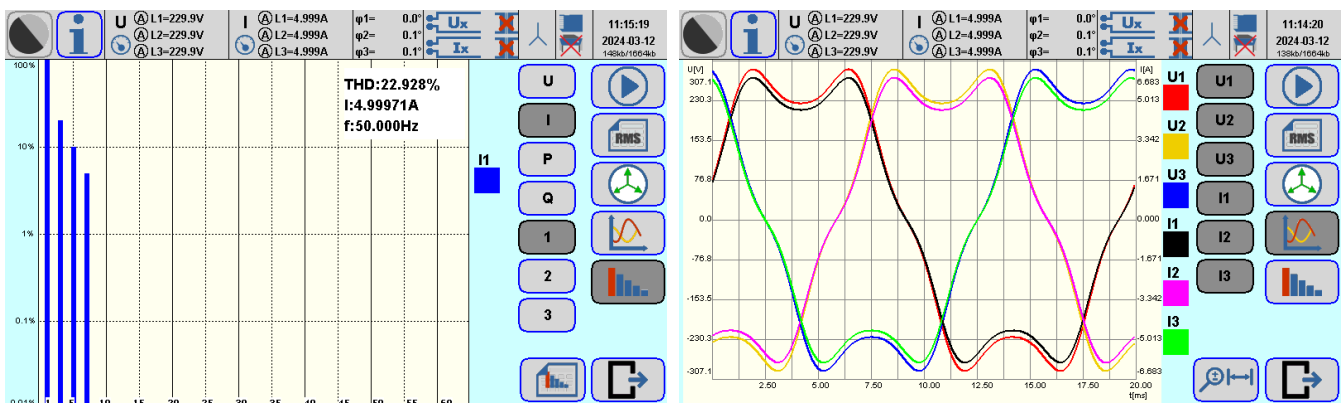


Fig.3. Measured by TS33 harmonics in bar and wavsshape diagram

The voltage and current distortions measured by the TS33 are exactly the same as those pre-programmed into the C300B calibrator. The measurement results should now be stored in the TS33 memory. To do this press the key **i** and then the key **📄** (Fig.4) to open the file name editor box. Enter the name of the file in which you wish to store the measurement result (in this example HARM357) and confirm by pressing ENTER. Finally, press the button **📄** again to save.

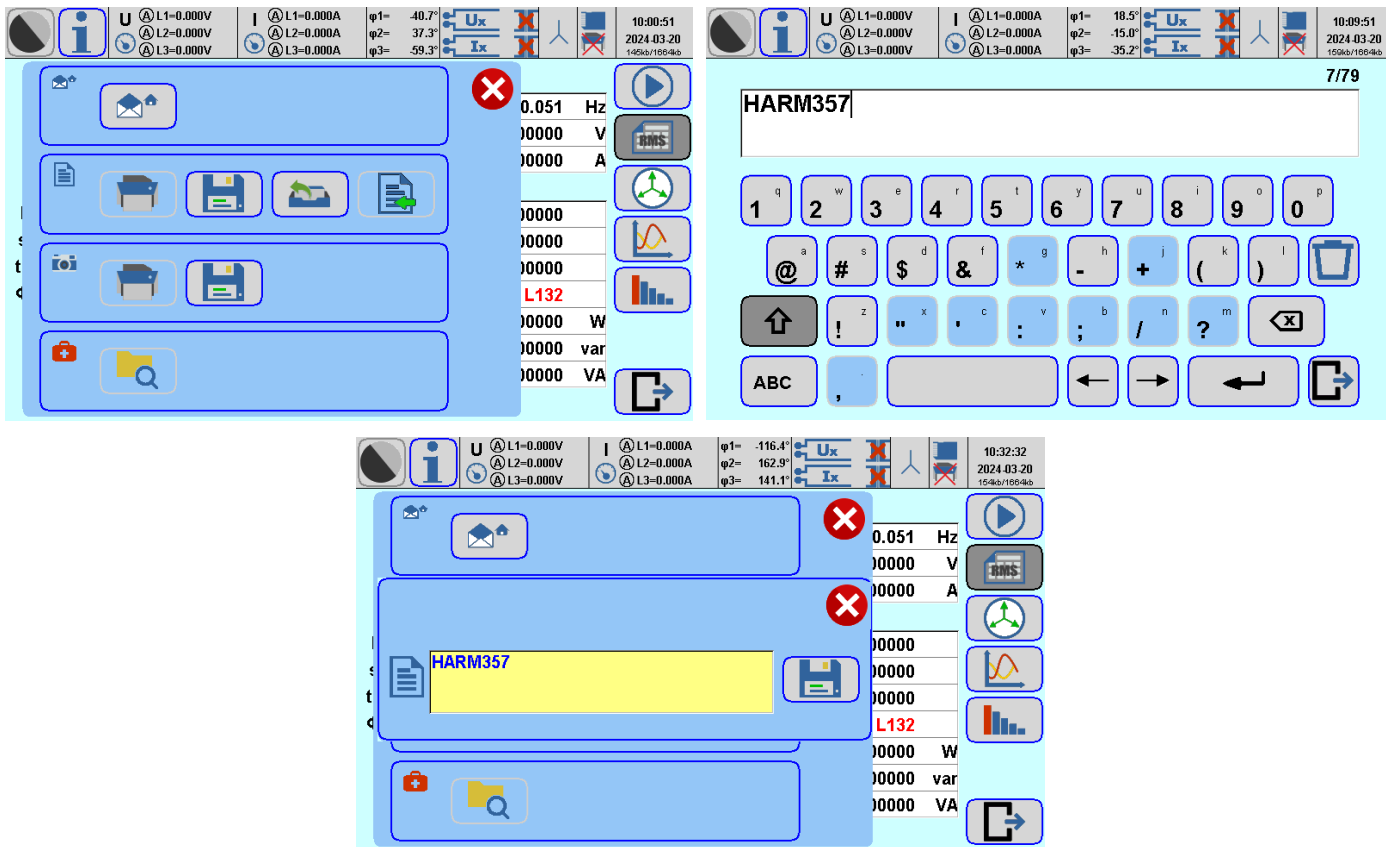


Fig.4. Saving the measurement result in TS33 memory

Now switch the TS33 from Meter Mode (⚙️) to Source Mode (🔌) by pressing source tab – see Fig.5.

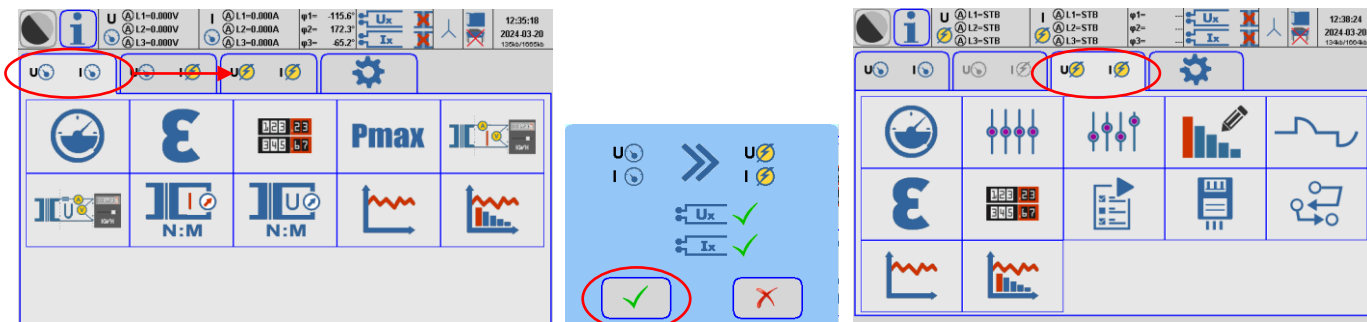


Fig.5. Switching from Meter to Source Mode

Open the harmonic setting window **📊**, press the **i** button to open file load menu (Fig.6).

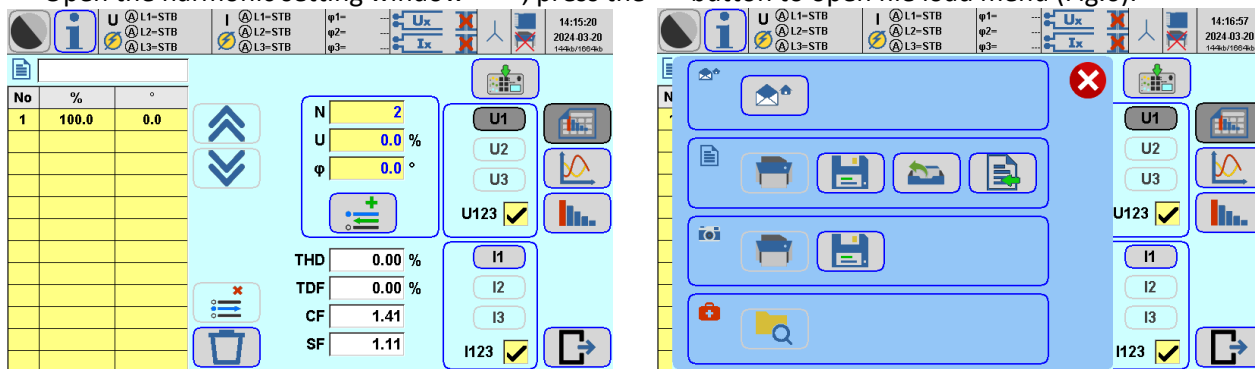


Fig.6. Opening load file menu

Then press the button and select earlier stored file which contains harmonic measurement result (HARM357 in this example). By pressing button open file and transfer the results to the harmonic setting menu (Fig.7). The harmonic setting can be sent to the TS33 by means of button.

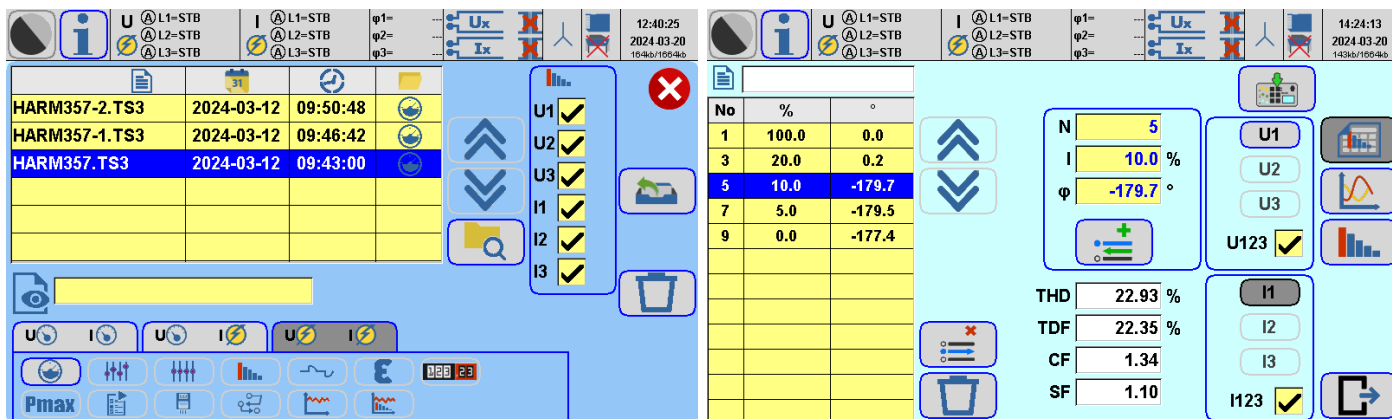


Fig.7. Downloading stored harmonic measurement results

In the next step set the values of voltage and current at the TS33 output (230V, 5A, 50Hz in this example), mark checkboxes under harmonic symbol to switch harmonic ON, and start output signal generation with harmonic by pressing , buttons (Fig.8).

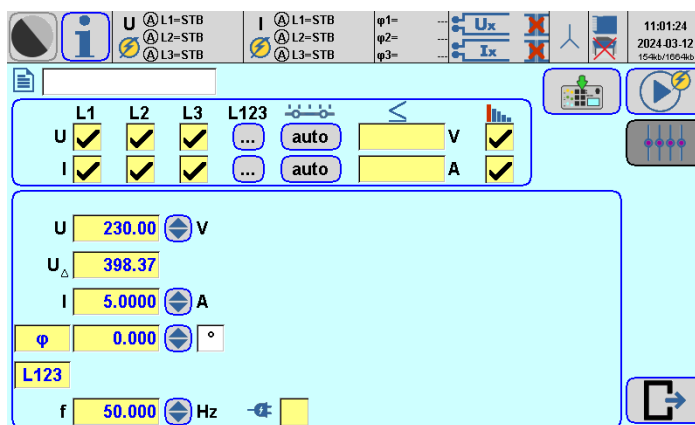


Fig.8. Set the voltage and current with harmonic at the TS33 output

You can check the results by output signal measurement and observation. You should select the measurement screen in the TS33 by pressing button . You will see the RMS values at the TS33 output (Fig.9) and oscilloscope shapes of current and voltage in each phase.

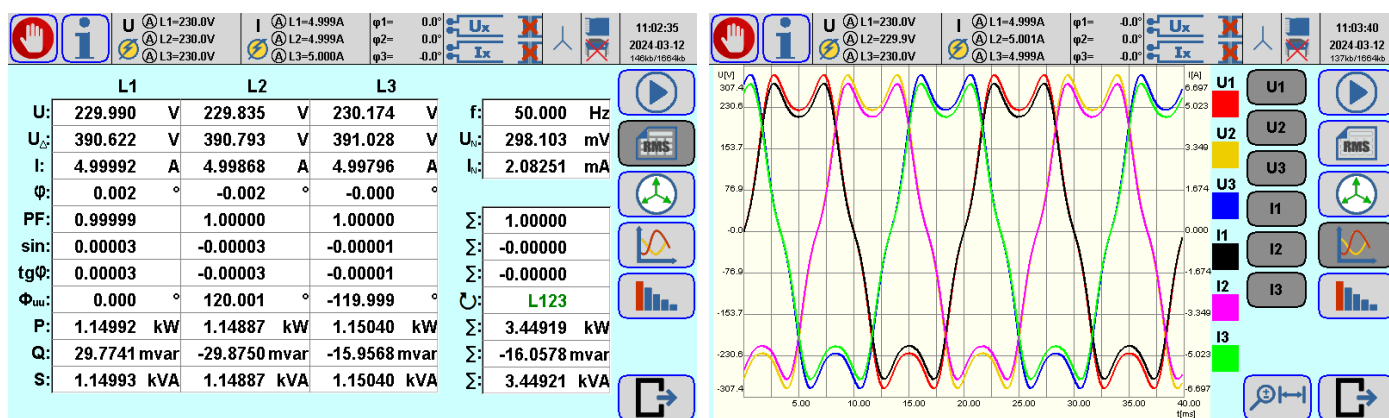


Fig.9. Reconstructed mains signals with harmonics

In the picture below (Fig.10) you can see the harmonic bar diagram (by pressing button) or exact results in table form (by pressing button).

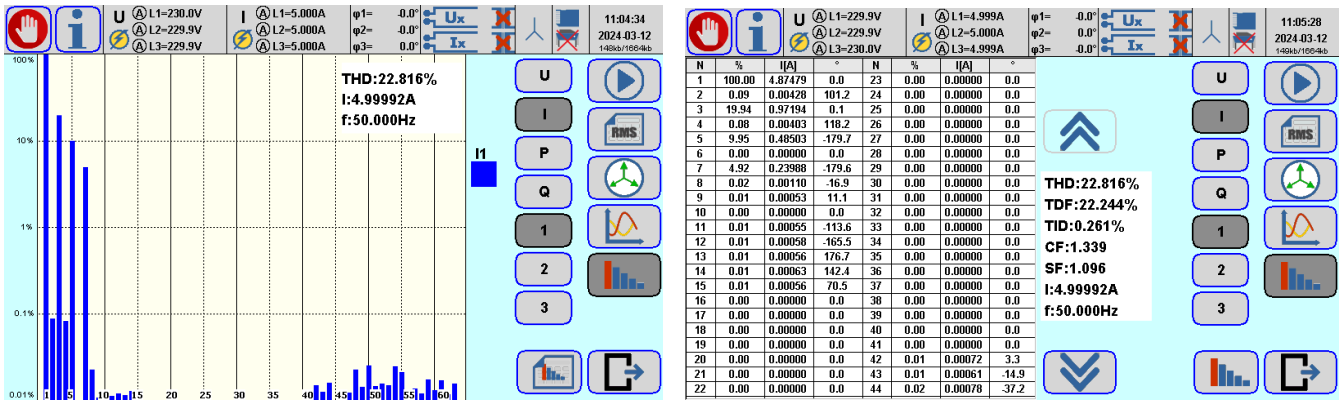


Fig.10. Reconstructed output TS33 signals harmonics in form of bars and table.

Conclusions: the TS33 automatic test system has the unique ability to measure the harmonic parameters of the mains supply, memorise them and then reproduce them faithfully to simulate the conditions that existed on the mains. This makes it possible to test power and measurement equipment in the laboratory under simulated conditions reflecting those of the mains.