Smart meter is one of the basic equipment for data collection of smart grid (especially smart distribution grid), which undertakes the tasks of original electric energy data collection, metering and transmission, and is the basis for realizing information integration, analysis and optimization, and information presentation. In addition to the basic power consumption measurement function of the traditional power meter, smart meter can also monitor the power quality and power supply condition in real time, so as to respond to users' complaints timely and accurately and take measures in advance to prevent the occurrence of power quality problems, of which the interharmonic detection is a very important part.

Figure 1 Smart meter

What are interharmonics?

AC non-sinusoidal signals can be decomposed into linear combinations of sinusoidal components of different frequencies. When the frequency of the sinusoidal component is the same as the frequency of the original AC signal, it is called the fundamental; when the frequency of the sinusoidal component is an integer multiple of the frequency of the original AC signal, it is called a harmonic; when the frequency of the sinusoidal component is a non-integer multiple of the frequency of the original AC signal, it is called a fractional harmonic, or fractional harmonics, or interharmonics.

Features

Interharmonic sources are characterized by amplified voltage flicker and disturbances, affecting the picture of television sets and causing vibrations and abnormalities in induction motors. For passive filter circuits consisting of capacitors, inductors and resistors, interharmonics may be amplified, and in severe cases, the filter may not operate properly due to harmonic overload or may even be damaged. Therefore, there is a limitation on the permissible interharmonic content in the utility grid, and the smart meter is required to be able to accurately detect interharmonics. The national standard GB/T 24337-2009 "power quality public power grid harmonics" stipulates the permissible limit of interharmonic voltage in the public power grid and the measurement method. To be able to complete the testing required by the national standard, smart meters need to be able to simulate the corresponding interharmonic power supply environment in R&D and production.

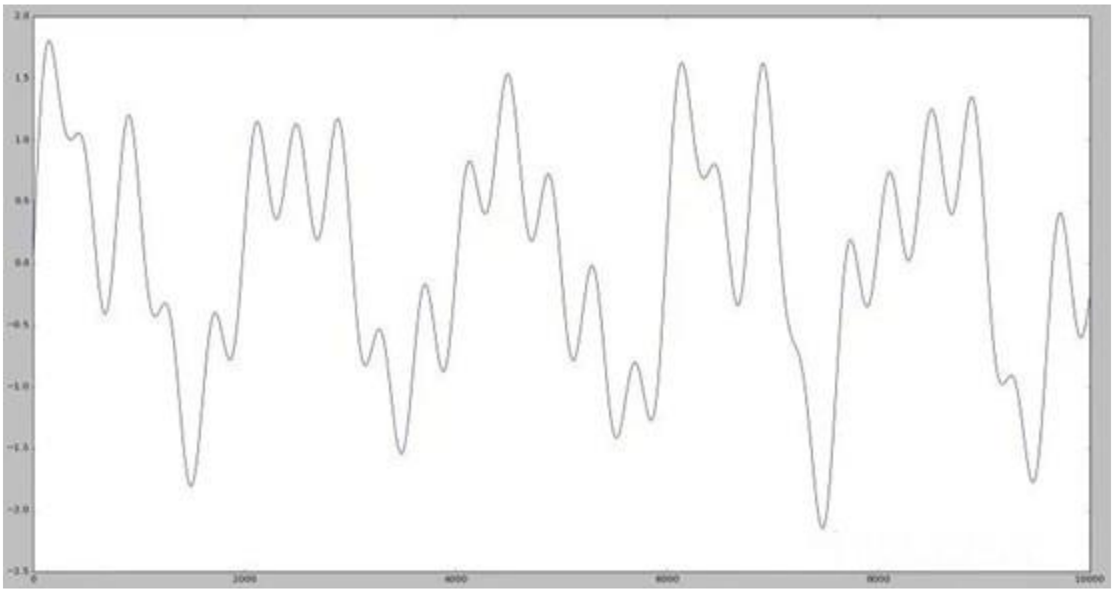

Figure 2 Example of interharmonics

Cases

Example: IT7900 Intergrid Harmonics Simulation Utility Intergrid Harmonics Standard

DUT: Electricity meter

Test Requirements: National Standard GB/T 24337-2009 "Power Quality Intergrid Harmonics of Public Grids

Test Methods: Use the inter-grid harmonics simulation function of the IT7900 grid simulator. Edit the grid 220V, 50Hz fundamental, fill in the various interharmonics and interharmonic content according to the regulations. After output, the actual interharmonic content is calculated by the meter sampling chip.

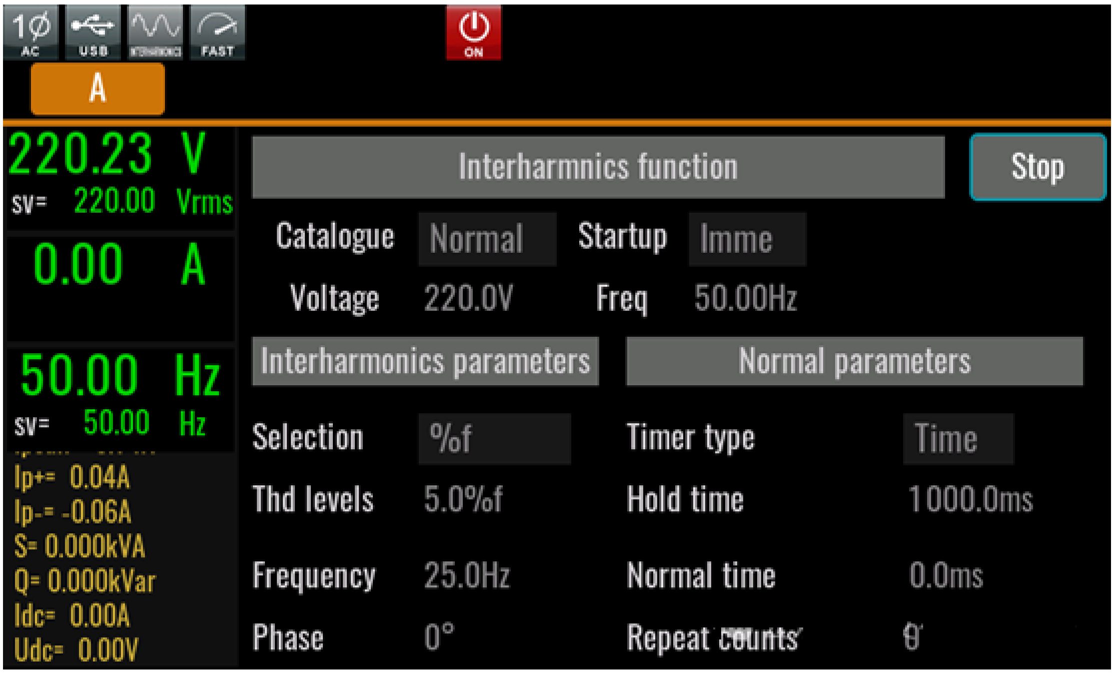

Figure 3 Interharmonic simulation function

间谐波次数 ih	系统频率 50 Hz，标称电压 230 V	
	间谐波频率 f_a/Hz	间谐波电压含有率/%
$0.76<ih<0.84$	$38<f_a\leqslant 42$	0.18
$0.84<ih<0.88$	$42<f_a\leqslant 44$	0.18
$0.88<ih<0.92$	$44<f_a\leqslant 46$	0.24
$0.92<ih<0.96$	$46<f_a\leqslant 48$	0.36
$0.96<ih<1.04$	$48<f_a\leqslant 52$	0.64
$1.04<ih<1.08$	$52<f_a\leqslant 54$	0.36
$1.08<ih<1.12$	$54<f_a\leqslant 56$	0.24
$1.12<ih<1.16$	$56<f_a\leqslant 58$	0.18
$1.16<ih<1.24$	$58<f_a\leqslant 62$	0.18
$1.24<ih<1.28$	$62<f_a\leqslant 64$	0.23
$1.28<ih<1.32$	$64<f_a\leqslant 66$	0.28
$1.32<ih<1.36$	$66<f_a\leqslant 68$	0.35
$1.36<ih<1.40$	$68<f_a\leqslant 70$	0.43
$1.4<ih<1.8$	$70<f_a\leqslant 90$	0.51

注：此表中含有率对应的是间谐波频率 f_a，而图 A.1 的横坐标是拍频 f_B，两者关系为 $f_a=50\pm f_B$(Hz)。

Figure 4 Intergrid Harmonics Standard for Utility Grids

In addition to non-integer harmonics, the IT7900 series of grid simulators can edit odd-even and other integer harmonics up to 50th, which can satisfy the grid simulation test standards for all kinds of power devices.

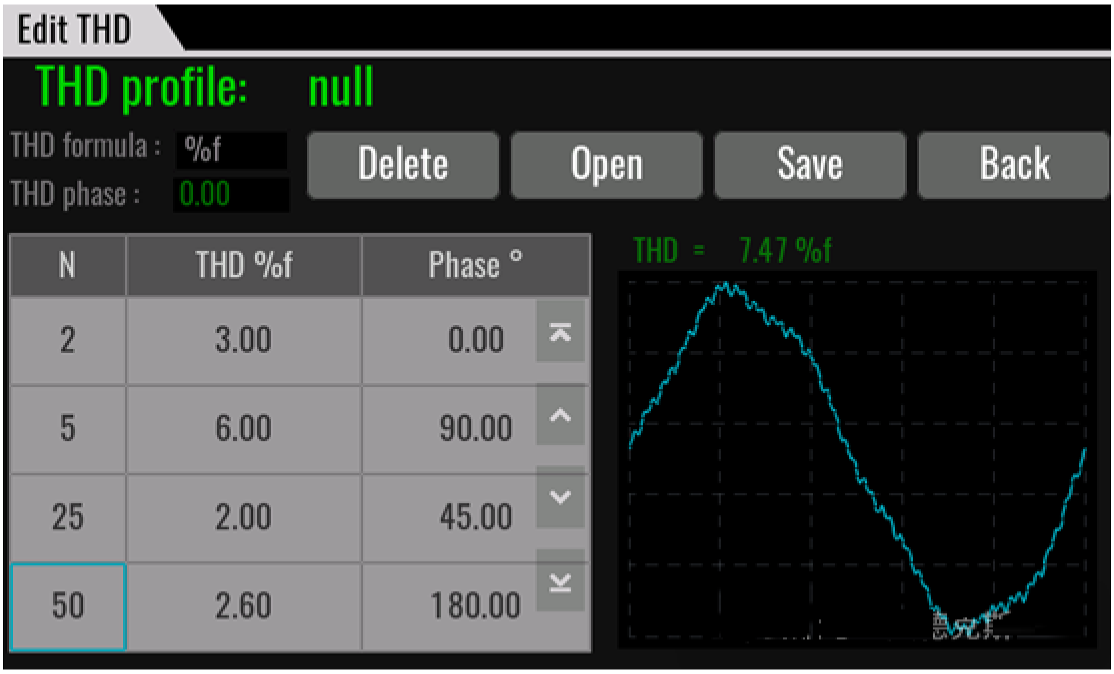

Figure 5 IT7900 Harmonic Simulation Function

The IT7900 series is a programmable, four-quadrant grid simulator. It is also a four-quadrant power amplifier, which can be used to test various grid-connected equipment. For example, PCS, energy storage system, microgrid, BOBC (V2X), PHiL, etc. With advanced SiC technolgoy, a single unit of IT7900 can realize the anti-islanding protection test through islanding mode(RLC settable). The IT7900 series grid simulators are equipped with an energy recovery function that provides 100% current absorption and is fed back into the grid through the device, Saving on electricity and cooling costs.

Besides, the power density of IT7900 series is very high, 6kVA in 1U, 15kVA in 3U. After parallel connection, the power can be extended to 960kVA at most. Rich operating modes meet various test requirement of single-phase, three-phase, reverse-phase and multi-channel. In reverse mode, the voltage can be extended to 200% of the rated voltage. The strong arbitrary waveform editing function can simulate various power grid disturbance waveforms, making it an ideal choice for testing and R&D laboratories.