Precise fully automatic core loss measurement at high frequency

De facto standard equipment for research & development of soft magnetic materials.
Precise automatic core loss measurement in higher frequency

Precise and accurate core loss measurement
Iwatsu’s B-H analyzers which hiring CROSS-POWER method (IEC62044-3) enable precise and highly accurate measurement embedded minimized phase error integration on frequency spectrum with current detecting resisters and compensation on detecting circuit with full compensation on amplitude and phase characteristics. Third generation models from year 1984 are available now to contribute leading-edge development on future power management.

Feature

- Wide band frequency range from 10Hz to 10MHz (SY-8218)
- Voltage : ±140V, max. / Current : ±5.2A, max. DC to 3MHz High power amplifier (IE-1125B)
- 41pcs., max. specimen for temperature range of -30°C to 150°C automatic scanner system (SY-321A)
- 36mm(L),min. 35mm(W),max. single sheet test (SY-956)
- DC30A, max. DC-bias superposing test (SY-960/961/962)
Various types of soft magnetic material property test

<table>
<thead>
<tr>
<th>Soft magnetic materials</th>
<th>Types of shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrite</td>
<td>Toroidal</td>
</tr>
<tr>
<td>Permalloy</td>
<td>EE core</td>
</tr>
<tr>
<td>Amorphous</td>
<td>EI core</td>
</tr>
<tr>
<td>Silicon steel sheet</td>
<td>Sheet</td>
</tr>
<tr>
<td>Dust core</td>
<td>Powder</td>
</tr>
</tbody>
</table>

Full automatic test

Sample parameters (Effective magnetic length, Effective cross section, number of turns of windings, etc.) and test conditions (Frequency, Maximum field strength: \( H_m \), Maximum flux density: \( B_m \), Maximum induced voltage: \( V_{2m} \), Maximum exciting current: \( I_{1m} \)) inputs enable obtaining BH hysteresis curve and magnetic properties in value automatically.

Full automatic test with options

Temperature scanner system, Single sheet test system and DC biasing system are able to control with the SY-810 Remote control software.
B-H analyzer : SY-8218/8219 (Mainframes)

Precise test in higher frequency

B-H analyzer
SY-8218 10Hz-10MHz
SY-8219 10Hz-1MHz

- Test freq. : 10Hz to 10MHz (SY-8218) / 10Hz to 1MHz (SY-8219)
- Applying signal waveform : Sinusoidal or Pulse (10Hz to 1MHz)
- Input current : ±6A, maximum
- Input voltage : ±200V, maximum
- Excitation method : Automatic excitation (at fixed Hm, Bm 11m or V2m)

Residual flux can be eliminated by degaussing with applying AC magnetic field

<table>
<thead>
<tr>
<th>Measurement method</th>
<th>CROSS-POWER method (conformance to IEC62044-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement item (Symbol)</td>
<td>Max. Magnetic flux density (Bm), Residual magnetic flux density (Br), Max. Magnetic field strength (Hm), Coercive force (Hz), Rectangular ratio (Br/Br), Relative amplitude permeability (μr), Core loss (μr+μi=Pv), Primary excitation current (Im), Secondary induced voltage (V2m), Phase (θ), Total magnetic flux linkage (2φm), Apparent power (VA), Impedance permeability (μz), Complex permeability (μ', μ''), Loss coefficient (tanθ), Inductance (L), Resistance (R), Impedance (Z), Quality factor (Q), Total harmonic distortion (THD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Waveform display</th>
<th>B-H curve, Excitation current, Induced voltage, Magnetic field, Magnetic flux density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test frequency</td>
<td>Sinusoidal 10Hz<del>10MHz (SY-8218) / 10Hz</del>1MHz (SY-8219)</td>
</tr>
<tr>
<td>Magnetic field signal detection</td>
<td>Voltage drop at Non-inductive resistor, Maximum current at ±6A</td>
</tr>
<tr>
<td>Magnetic flux density signal detection</td>
<td>Voltage drop at induced voltage detection coil, Maximum signal detection voltage at ±200V</td>
</tr>
<tr>
<td>Digitizer</td>
<td>16bits (8192points/cycle)</td>
</tr>
<tr>
<td>Sample connection method</td>
<td>2 or 1 coil (winding) method selectable</td>
</tr>
<tr>
<td>Display</td>
<td>8.4” TFT-LCD SVGA 800×600 pixels</td>
</tr>
<tr>
<td>Power</td>
<td>AC100V to AC240V, 50/60Hz, Approx. 130VA</td>
</tr>
<tr>
<td>Weight &amp; Dimensions</td>
<td>Approx. 12.5kg 420W×266H×480D (mm)</td>
</tr>
<tr>
<td>External memory</td>
<td>USB port for data storage</td>
</tr>
<tr>
<td>Accessories</td>
<td>Reference sample, POD cover, AC coupler module, Power amplifier cable (BNC-BNC), OSC cable (SMA-BNC), Power cable, Operation manual (CD-ROM), Users guide</td>
</tr>
</tbody>
</table>

B-H analyzer SY-8218 BH analyzer mainframe

Measurement POD image without POD cover

Wide band and High power

Best fit with B-H analyzer
HSA4101-IW 10MHz, 1A, 71V
HSA4014-IW 1MHz, 5.6A, 75V
IE-1125B 3MHz, 5.2A, 140V

<table>
<thead>
<tr>
<th>Frequency</th>
<th>DC~10MHz</th>
<th>DC~1MHz</th>
<th>DC~3MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output current (peak)</td>
<td>±1A, max.</td>
<td>±5.6A, max.</td>
<td>±5.2A, max.</td>
</tr>
<tr>
<td>Output voltage (peak)</td>
<td>±71V, max.</td>
<td>±75V, max.</td>
<td>±140V, max.</td>
</tr>
<tr>
<td>Output power</td>
<td>50VA</td>
<td>200VA</td>
<td>350VA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input power</th>
<th>50/60Hz</th>
<th>50/60Hz</th>
<th>50/60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Range</td>
<td>AC100V to 115V</td>
<td>AC200V to 230V</td>
<td>AC 90V to 250V</td>
</tr>
<tr>
<td>Power consumption</td>
<td>700VA, max. (400W)</td>
<td>900VA, max. (700W)</td>
<td>2kVA, max.</td>
</tr>
<tr>
<td>Weight &amp; Dimensions</td>
<td>Approx. 7.8kg 220W×177H×450D (mm)</td>
<td>Approx. 18kg 290W×177H×450D (mm)</td>
<td>Approx. 29kg 440W×238H×600D (mm)</td>
</tr>
</tbody>
</table>

Max. output current values:
- 5.6A at 500kHz
- 5.0A at 500kHz
- 4.4A at 500kHz
- 2.7A at 3MHz
- 1.8A at 1MHz
- 1.4A at 1MHz
- 1.3A at 1MHz
- 1.0A at 1MHz

Max. output voltage values:
- 140V at 500kHz
- 130V at 500kHz
- 110V at 3MHz
- 67.5V at 1MHz
- 65.1V at 1MHz
- 55V at 1MHz
- 49.5V at 1MHz

※SY-911 connection cable option has to be required for IE-1125B.
Temperature scanner system SY-320A / SY-321A

Temperature range: -30°C to 150°C, Sample 41pcs, max.

Temperature scanner system
SY-320A sample 20pcs., max.
SY-321A sample 41pcs., max.

<table>
<thead>
<tr>
<th></th>
<th>SY-320A</th>
<th>SY-321A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanner chamber unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>AC100V 50/60Hz</td>
<td></td>
</tr>
<tr>
<td>Input current</td>
<td>12.5A, max.</td>
<td>21.0A, max.</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-30°C to 150°C</td>
<td></td>
</tr>
<tr>
<td>Scanner mechanism unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input power</td>
<td>AC100V to 120V, 50/60Hz</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>28VA</td>
<td></td>
</tr>
<tr>
<td>Test frequency range</td>
<td>10Hz to 5MHz with SY-8218</td>
<td>10Hz to 1MHz with SY-8219</td>
</tr>
<tr>
<td>Samples</td>
<td>20pcs., max.</td>
<td>41pcs., max.</td>
</tr>
<tr>
<td>Input current</td>
<td>±6A, max.</td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>±200V, max.</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>85kg</td>
<td>135kg</td>
</tr>
<tr>
<td>Outer Dimensions</td>
<td>543W×695L×620H (mm)</td>
<td>640W×920L×660H (mm)</td>
</tr>
<tr>
<td>Accessories</td>
<td>Reference sample, Chamber cable(SY901), Turn table*, GPIB cable(1meter), Power cable, Operation manual</td>
<td>SY-510(SY-320A) or SY-511(SY-321A)</td>
</tr>
</tbody>
</table>

Remote control system configurations

REMOTE CONTROL SOFTWARE: SY-810

Temp. Freq. Target magnetic field strength

Example of test result

Spare parts for temperature scanner system
- Turntable (for setting samples on scanner mechanism)
  - SY-510 (for SY-320A)
  - SY-511 (for SY-321A)
- Spare connection pin set
  - SY-512 (for SY-320A/321A)
Single Sheet Test system : SY-956

Full automatic accurate test for single sheet shape samples such as Silicon-steel sheets, etc.

**Measurement method**
- Vertical single yoke current excitation type single sheet magnetic property characteristics test method
- IEC 60404-3 compatible
- Yoke compensation function: available

**Applicable magnetic field strength**
- Approx. 10,000A/m (Max.) with excitation level at 5A

**Test frequency**
- Sinusoidal 10Hz to 20kHz

**Sample dimensions**
- 35mm(W), max., 36mm(L), min. / 35mm(W), max., 36mm(L), min. 3mm(thickness), max.

**Detection current**
- ±6A, max.

**Detection voltage**
- ±200V, max.

**Power**
- AC100V to AC240V, 50Hz/60Hz, Approx. 27VA(Max.)

**Performance guarantee temperature**
- 18℃ to 28℃

**Dimension**
- 330W×200H×320D(mm)
- Approx. 8.5kg

**Accessories**
- Single sheet test system connection cable SY-957, B coil (2kinds), Connection terminal screw, Pincer, Blowing blush, Accessory case, Power cable, Operation manual

**Hint:**
Steel sheet will show different magnetic properties between the different shapes even exactly the same material. It is important to test magnetic property as a single sheet prior to machining.

### LF AC coupler SY-514

AC coupler at fLc=300Hz(-3dB) to use in lower frequency than AC coupler SY-503 which provided as a standard accessory with BH analyzer mainframe.

- fLc(cut-off freq.) : Approx. 300Hz
- Input voltage : ±200V, max.
- Input current : ±6A, max.
- Connection cable : BNC cable(0.6m)

### Blank toroidal core SY-513

Blank toroidal shape casing for powder material or layered thin material donuts shape, etc.

### DC biasing source SY-931

DC current : 10A, max.
Operation freq. : 1MHz, max.

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**Example of Permalloy**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hc</td>
<td>Round=Oval</td>
</tr>
<tr>
<td>Br</td>
<td>Round=Oval</td>
</tr>
<tr>
<td>Bm</td>
<td>Round=Oval</td>
</tr>
<tr>
<td>Core loss</td>
<td>Round=Oval</td>
</tr>
</tbody>
</table>
Automatic test on power inductor properties with DC biasing

DC-bias test system (SY-960, SY-961, SY-962)

**DC-bias test system**
SY-960/961/962

- DC bias current: 30A, max
- AC Ripple current: ±6A, max
- Test frequency (Sinusoidal): 10kHz to 3MHz
- Test frequency (Pulse): 10kHz to 1MHz (Duty 10%-90%)

*Test example on chip inductor (Chopper excitation)*

- DC biasing non-sinusoidal signal
- Pulse (Triangular signal waveform in current at specimen, called QUASI-CHOPPER), or Sinusoidal test with DC biasing

**Hint:**
In actual operation, both AC magnetic field and DC magnetic field may be applied at the same time usually. Magnetic property test with changing DC biasing level is considered important.

**Different DC biasing conditions at constant \( \Delta H \)**

- \( I_{dc} = 2.6A \)
- \( I_{dc} = 2.4A \)
- \( I_{dc} = 2.2A \)
- \( I_{dc} \approx 2.2A \)

**DC bias vs \( \Delta P_C \)**

- DC Bias Coreloss \( \Delta P_C \) (100kHz, Pulse, Duty 25%, \( \Delta L = 0.5[A] \))

**Material properties**

- Ferrite (SMA)
  - L = 1.0μH
  - \( \Delta P_C = \) \( \Delta F \) vs \( L \)
  - \( \Delta F \) vs \( L \)

- Fe-Based amorphous core
  - L = 311μH
  - \( \Delta P_C = \) \( \Delta F \) vs \( L \)
  - \( \Delta F \) vs \( L \)

- Iron powder core
  - L = 8.4μH
  - \( \Delta P_C = \) \( \Delta F \) vs \( L \)
  - \( \Delta F \) vs \( L \)

DC-bias test system is uniquely used as an option for SY-8218 or SY-8219 and not be used with other equipment. Adjustment and inspection as a system with BH analyzer is required. BH analyzers (SY-8218/SY-8219) at the customer end will be returned to our factory for adjustment and inspection when DC-bias test system can be configured as a system.
Remote control software
SY-810

- Temperature conditions up to 20 kinds, Excitation conditions up to 40 kinds for each DUT (device under test) are available. This means 20x40 (=800) kinds of conditions can be programmed for each sample of DUT.
- Pulse excitation can be controlled with BH analyzer
- Hard copy of displayed results (JPEG, PNG) and signal waveform data at xxx.csv basis can be extracted to PC memory.

Option
NATIONAL INSTRUMENTS Corp.

GPIB interface
NI GPIB-USB-HS+

Standard accessories of SY-810

Bulkhead adaptor 182766-01

SY-509 GPIB-USB converter

USB

Display example of remote control software SY-810

Contents of SY-810: CD (software and operation manual at PDF), GP-IB converter SY-509, Bulkhead adaptor 182766-01 and software license agreement
PC operation environment
OS: Windows Vista SP2, Windows 7 32bit/64bit, Windows 8 32bit/64bit
.NET Framework (packed), CPU Pentium 133M or above, Memory at 64kbyte or more, Display resolution at 1024x768 or above, USB port x1
※Contact our sales for the most recommended system configurations.
※NI GPIB-USB-H5+ (NATIONAL INSTRUMENTS Corp.) is required for PC interface with SY-8218/SY-8219. PC is not included with this system and supplied by customer.

Continuous test function SY-811

Time-tendency property test can be performed at continuous excitation.
- Test timeframe at 99,999 minutes (Approx. 70 days), max. 60 second/test
- 2 kinds of properties can be monitored on display and extracted to memory.
- Measurement item can be changed during test.
- Comparison between Reference and test result on the same display.
- Test data at CSV and display hardcopy at JPG/PNG are available.

※Option for BH analyzer
※Implementation of SY-811 on BH analyzers (SY-8218/SY-8219) at the customer end will be returned to our factory for installation and inspection.

Equipment wagon

MT-600L

Table can be modified of it's height.

Major items:
- Slide pull-out table
- Pull out for accessories
- 4 wheel casters with lock function
- Equipment tighten belt
- Mountable weight: 100kg, max.
- Height: Approx. 850mm
- Table: 500W x 775D (mm) fixed
- Weight: Approx. 36kg

※Supplied as each piece and assembled by customer

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