MODEL 19036

KEY FEATURES

- 5-in-1 composite analyzer (ACV / DCV / IR / DCR / Impulse)
- Hi-pot test
  - AC max. 5kV / DC max. 6kV
  - High Frequency Contact Check (HFCC)
- Insulation Resistance (IR)
  - Max. 5kV
- DC Resistance (DCR)
  - DCR Balance
- Impulse Winding Test (IWT)
  - Waveform sampling rate 200MHz
  - 2 judgments in IWT BreakDown Voltage mode
    - Area
    - Laplacian
  - 7 judgments in test mode
    - Area
    - Differential Area
    - Flutter
    - Laplacian
    - ΔPeak%
    - ΔResonant Area
    - Δ*fr*%
- Δ /Y DC Resistance (Δ/Y DCR)
- Impulse Winding Test Compare (IWT CMP)
- High Speed Contact Check (HSCC)
- Open/Short Check (OSC)
- Supports 3302/3252 inductance, Q-value measurement (optional)
  - Inductance (Lx)
  - Inductance Balance (Lx Balance)
- Ground Fault Interrupt (GFI)
- Supports max. 40-channel scanning test
- Standard LAN, USB, RS232 interfaces
- USB data storage and screen capture functions
- User interfaces: English, Traditional Chinese, and Simplified Chinese

WOUND COMPONENT EST ANALYZER MODEL 19036

Chroma 19036 is the Wound Component Electrical Safety Test (EST) Analyzer, which integrates Hi-pot (AC/DC), insulation resistance (IR), DC resistance (DCR), and impulse winding test (IWT) in one tester. It can output up to AC 5kV/DC 6kV for the Hi-pot test, output up to DC 5kV for the IR measurement, measure the resistance from 2mΩ to 2MΩ for four-wire DCR measurement, and output up DC 6kV for the IWT. And, it has 10-channels for testing multiple DUTs at once by the scanning test. The scanning test, that can save the test time and labor costs for greatly improving the production efficiency, can extent up to 40 channels by connecting with two 16 channels external scanning boxes.

The 19036 can provide the safety test for wound components; transformers, motors, inductors, and etc., and let the manufacturer and operator check the product quality more effectively and efficiently for the product inspection.

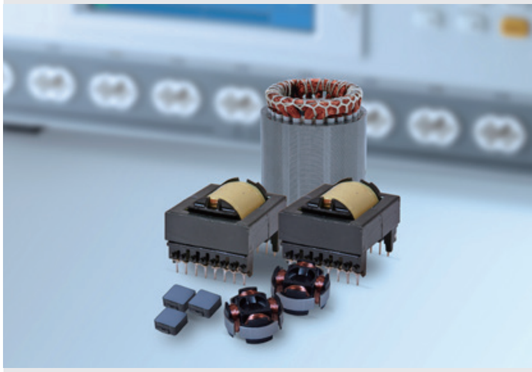
The poor insulation of a coil is usually caused by the poor initial design, the poor manufacturing, the deterioration of insulating material, etc., which leads the coil to have a poor insulation (layer short) between windings or turns, a poor insulation (short) between the coil and core, or a poor manufacturing (short) between the coil and pins or leads. Adding the impulse test into the test items of product manufacturing can analyze the measurements of various defects from the product, hence improves the product quality of wound component products.

The impulse test has seven judgements; which are Area, Differential Area, Flutter, Laplacian, ΔPeak%, ΔResonant Area, and Δ*fr*%, that can effectively detect and analyze the poor insulation between layers/turns, the poor quality of core, and the inductance difference of a coil.

19036 has 4-wire DCR measurement technique. Therefore, each channel has Drive and Sense terminals. One single unit can provide 10 channels for 4-wire DCR measurement. The DCR measurement also has the temperature compensation function, which can measure the temperature of the DUT or the environment with a temperature probe, and calculate the new resistance value with temperature compensation.

19036 has High Speed Contact Check (HSCC) and Open/Short Check (OSC) functions, which can quickly check whether the contact/connection to the DUT is good for every channel, and whether the DUT has an open-circuit or a short-circuit issue before executing the test. This can solve the test failure or invalid test issue that is caused by the poor contact/connection to the DUT.

The Hi-pot test of 19036 is designed to have a 500VA output power that can meet the output power requirement of IEC/UL standards (e.g. the safety test standards for motor:UL1004-1, GB14711). It can output and measure the current; max. 120mA (<4kV) for AC/max. 20mA for DC, to satisfy the test requirement of electrical safety test for larger leakage current or large size equipment.



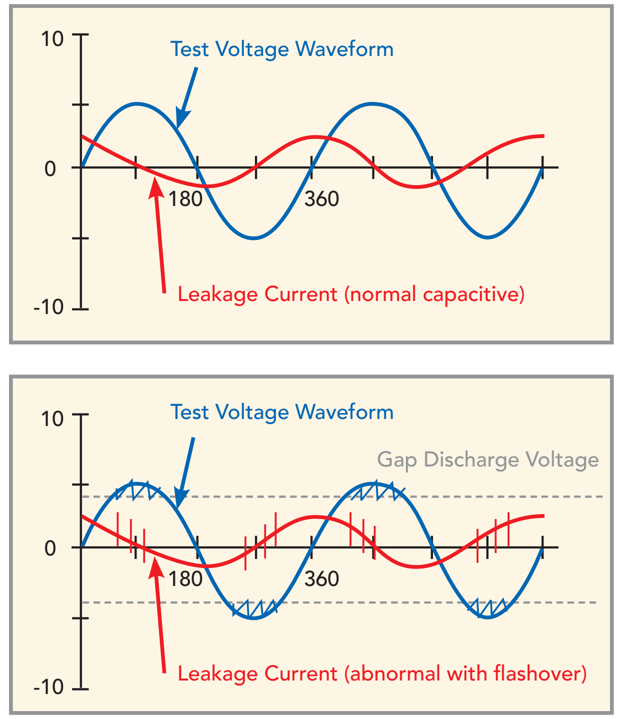
HANDLER LAN USB RS-232 CE

Chroma

Hi-pot Test

■ Flashover Detection (ARC)

The phenomenon of electrical flashover is a transient or discontinuous discharge caused by a sufficient potential/voltage difference or electric field intensity, which causes the interior or surface of an insulating material to lose its original insulating properties. When the released energy of electric discharge is great enough to damage the insulating material of the product, the insulating material will be carbonized and form a conductive (creepage) path, which makes the product to be short-circuited. If the judgment condition only uses the leakage current, it will not able to detect the defective products that have abnormal discharge (flashover) during the test. Therefore, the judgement condition needs to use the rate of change of test voltage or leakage current in order to effectively detect the defective products that have abnormal discharge during the test. This is why the flashover detection is a necessary check item for Hi-pot test. 19036 has the flashover detection in both AC & DC Hi-pot test modes by detecting the rate of change of leakage current.



Comparison of AC Hi-pot Test Without and With Flashover

DCR

■ 4-wire Measurement / 2-wire Measurement

All 10 channels of 19036 have the capability of 4-wire DC resistance measurement (2mΩ~2MΩ). Therefore, 19036 can provide a high accuracy DCR measurement for the wound components (motors, transformers, etc.) that have multi-coils/multi-windings. The channels can be extended to support up to 40 channels with two external scanning boxes.

External Scanning Box:

- 4-wire Measurement: A190362 (collocate with four-wire test cables)
- 2-wire Measurement: A190359 (collocate with two-wire test cables)

■ DCR Balance

When the DC resistances of a motor are unbalanced, it easily causes a lot of energy loss and vibration due to the unbalanced rotation. The quality will gradually deteriorate due to the long-term usage. The judgment method of the DCR Balance mode is to compare the difference between the maximum and minimum DCR values of all windings. If the difference exceeds the allowable setting range, the product will be judged as fail/NG. This is an effective auxiliary tool for the reliability test of motor products.

■ Temperature Compensation

When measuring the small DCR values, the measurement discrepancy that is caused by the temperature difference is often encountered. Therefore, when the temperature is different, the measurement result of DCR varies with the temperature. The Temperature Compensation function of 19036 collocates with a temperature probe and uses the temperature coefficient to convert the measured DCR to the resistance at the target temperature for reducing the effect that is caused by the temperature difference.

Contact Check Functions

■ High Speed Contact Check (HSCC)

When there is an open-circuit in the test loop, the defective (NG) products may be misjudged as the good products, which causes the invalid test results. When there is a short-circuit in the test loop, it needs to be found/known before the Hi-pot test for reducing the damage on/to the test fixture. The High Speed Contact Check can rapidly scan all the test loops for checking whether all the contacts to the DUTs are normal/good, which can allow the contact check before the Hi-pot test to be done faster than ever.

■ Open Short Contact (OSC)

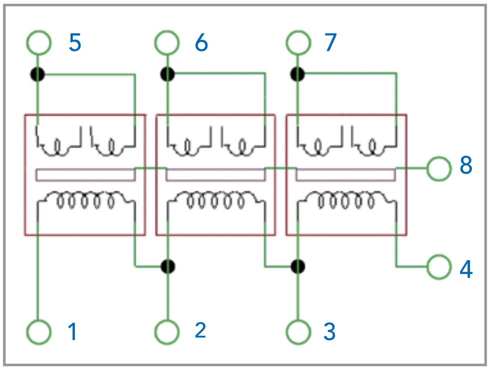
The Open/Short Check (Patent no. 254135) function can detect whether there is an open-circuit (poor contact) between the test fixture and the DUT and whether there is a short-circuit between the winding and the iron core. The judgment criterion of the Open/Short Check is the capacitance value of the test loop. When the test fixture and the DUT are certainly connected, the capacitance value of the test loop will be within the allowable range. But, when the test fixture and the DUT are not certainly connected, the capacitance value of the test loop will be lower than the allowable range, and it will be judged as open; when the test fixture or the DUT has a short-circuit, the capacitance value of the test loop will be higher than the allowable range, and it will be judged as short.

■ High Frequency Contact Check (HFCC)

The AC & DC Hi-pot test modes of 19036 both have the High Frequency Contact Check. The High Frequency Contact Check is similar to the Open/Short Check, but it uses higher test frequency to improve the Open/Short Check for smaller capacitance (1pF~100pF).

SUB-Step Function

The production line often executes the Hi-pot test by testing multiple DUTs (test points) in parallel at once for improving the production test speed. But, when the test result of the parallel test is failed, it is difficult to differentiate the good product and the defective (NG) product for each of them, so these products need to do the post-test in other test station for differentiating the good product and the defective (NG) product, which increases the amount of test stations and the production cost. The SUB-Step function uses the FAIL result from the main step as a condition for triggering the execution of the SUB-step. This is why when the test result from the main step (parallel test) is failed, the test procedure will enter the SUB-Steps (single tests) and execute the individual tests, which can quickly determine the defective (NG) product(s), and optimize the productivity and inspection quality.



Multiple Transformers Testing Wiring Diagram

Example : Multiple test points in parallel test

When the test result of Step1 is PASS, it executes the Step2(skip SUB-Step).

When the test result of Step1 is FAIL, it executes the SUB-Step for finding the FAIL channel.

Step 1 : AC Hipot [pin 1 to pin 5, 6, 7]

FAIL

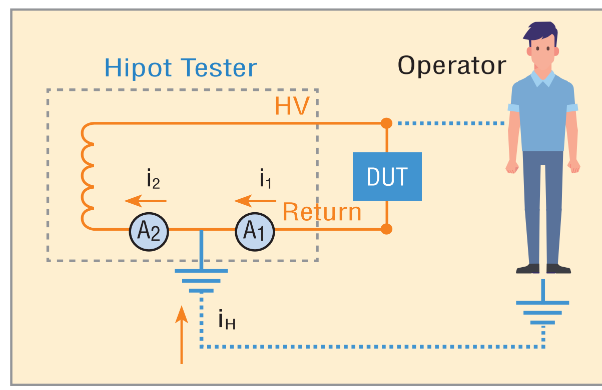
- SUB Step 1.1 : AC Hipot [pin 1 to pin 5] → PASS
- SUB Step 1.2 : AC Hipot [pin 1 to pin 6] → FAIL
- SUB Step 1.3 : AC Hipot [pin 1 to pin 7] → PASS

PASS

Step 2 : AC Hipot [pin 8 to pin 5, 6, 7]

Ground Fault Interrupt (GFI) Function

The Ground Fault Interrupt (GFI) function is used to protect the test operator. When the operator suddenly gets an electric shock, the GFI function can immediately cuts off the output to protect the operator from the electrical injury. The GFI function compares the difference between the total amount of return current (i_2) and the return current (i_1) from the return terminal for detecting the return current (i_H) from the earth/ground. When return current (i_H) from the earth/ground is greater than 0.5mA (Typical), the output will be cut off immediately.

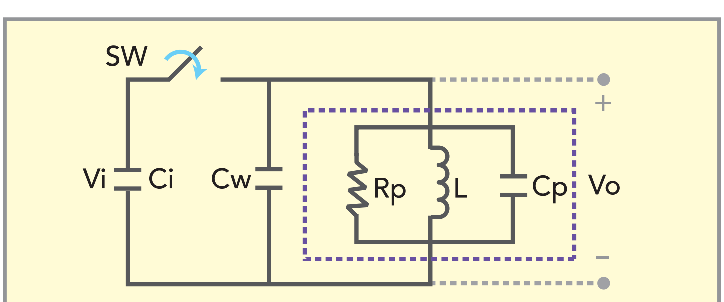


Ground Fault Interrupt Function Schematic Diagram

IMPULSE TESTING

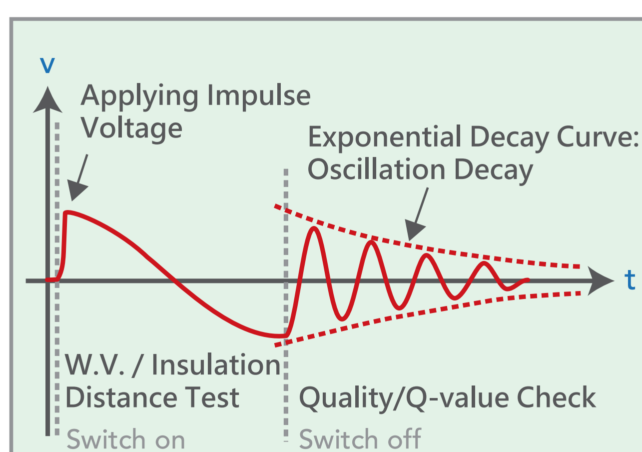
The theory of Impulse Winding Test

"Impulse Winding Test" applies a "non-destructive", high-speed, and low-energy impulse voltage to the wound component with an appropriate test voltage, and determines the DUT is a good product or defective (NG) product by analyzing/comparing the difference of resonant waveforms between the DUT and the golden sample. Applying the Impulse Winding Test to the wound component is for finding the latent defect. For example, layer-to-layer short-circuit, turn-to-turn short-circuit, flashover discharge, corona discharge, etc. The oscillation decay of the resonant waveform, which is generated by the resonance between the inductance and stray capacitance of the DUT, can be used for determining whether the quality of the product is good. The oscillation decay state represents the energy loss of the DUT during the operation. When the switch is turned on, an impulse voltage is applied to the DUT. The test voltage applied on the DUT is used for checking whether the insulation distance between turns is sufficient. When the switch is turned off, the inductance of the DUT resonates with the stray capacitance. The oscillation decay state of the resonant waveform is used for checking the quality of the DUT.



Vi: Internal charging voltage
Vo: Test voltage
Ci: Internal charge capacitor
Cw: The parallel equivalent capacitance of test cables
L: The equivalent inductance of wound component/coil
Rp: The parallel equivalent resistance of coil
Cp: The parallel equivalent/ stray capacitance of coil

The Equivalent Circuit Diagram of Impulse Winding Test

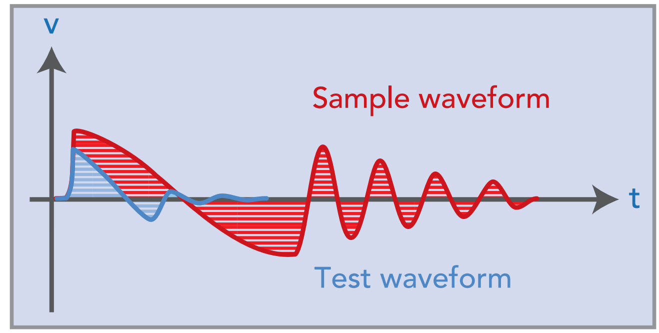


The Impulse Winding Test Waveform

Area

When the switch is turned on, the impulse voltage is applied to the DUT, and the DUT resonates with the capacitance of the test loop. The peak voltage is used for checking the insulation distance between turns of the DUT. When the insulation distance between turns is not sufficient to withstand the test voltage of the impulse winding test, the discharge occurs between turns, which causes the total area of the resonant waveform to become smaller.

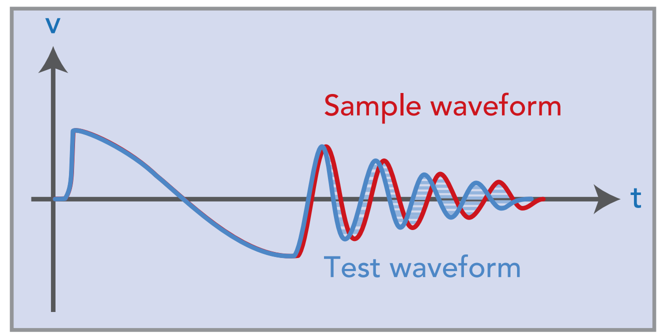
When the switch is turned off, the DUT resonates with the stray capacitance. The oscillation decay state of the resonant waveform is used for checking the quality of the DUT. The oscillation decay state of the resonant waveform will be affected by the quality of the DUT. When the quality of the DUT is poorer, the resonance waveform will decay faster, which causes the total area of the resonant waveform from the DUT to become smaller than that from the golden sample.
Therefore, the Area judgement can be used for checking the product which has the insufficient insulation distance or the poor quality.



Area Diagram

Differential Area

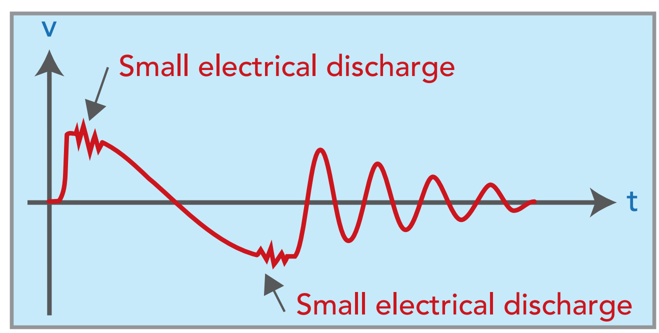
When the impulse voltage is applied to the DUT, the DUT resonates with the capacitance of the test loop. If the inductance of the DUT is different from that of the golden sample, the resonant frequency of the DUT is different from that of the golden sample as well. Therefore, there will have the non-overlapping areas between the resonant waveforms from the DUT and the golden sample. The Differential Area judgement calculates the total amount of the non-overlapping areas between the resonant waveforms of the DUT and the golden sample and then compares it with the total area of the resonant waveform from the golden sample by displaying the percentage. It is recommended to be used together with the Area judgement for sorting out the product that has certain inductance difference to the golden sample.



Differential Area Diagram

Flutter

When the impulse voltage is applied to the DUT, which the insulation distance between turns is insufficient, but not insufficient to have the insulation breakdown, a small electrical discharge (ex. Corona discharge) will occur. Because the energy release of this small electrical discharge is smaller than the insulation breakdown, the total area of the resonant waveform is not affected much. Therefore, using the Area judgement for detecting the small electrical discharge is hard. The Flutter judgement calculates the total vertical variation (up and down) of the resonant waveform, and compares the difference between the DUT and the golden sample. When the small electrical discharge occurs, the total vertical variation of the resonant waveform will increase because there are some vibrations on the resonant waveform. Therefore, the increase in total vertical variation of the resonant waveform can be used for detecting the small electrical discharge.



Small Electrical Discharge Diagram

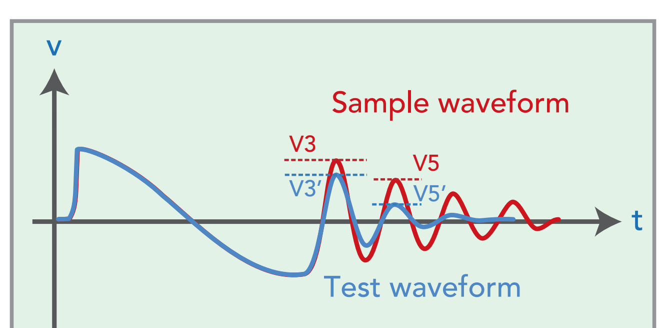
Laplacian

When the small electrical discharge (ex. Corona discharge) occurs, the resonant waveform, which was supposed to be smooth, becomes not smooth because some vibrations occur on the resonant waveform. Therefore, the resonant waveform has the drastic changes of the slope. The Laplacian judgement uses the calculation of second derivative to calculate the maximum rate of the slope change of the resonant waveform. Therefore, the Laplacian judgement can be used to detect the drastic slope change, which is caused by the small electrical discharge, on the resonant waveform. And, it can effectively sort out the defective product that has occurred the small electrical discharge during the IWT.

∆Peak%

The Peak Ratio is correlated with the energy loss of the DUT's performance, and the energy loss of the DUT' s performance is also correlated with the quality/Q-value of the DUT. The Peak Ratio can automatically find the 3rd peak voltage(V3) and 5th peak voltage(V5) of the resonant waveform, and calculate the percentage of the 5th peak voltage(V5) divided by the 3rd peak voltage(V3). It reduces the complexity of setting and makes it easier for users to use. Therefore, when the quality/Q-value of the DUT is worse, the decay rate of the DUT' s resonant waveform is faster, and the Peak Ratio is smaller.

$$\text{Peak Ratio} = \frac{V_5}{V_3} \times 100\%$$



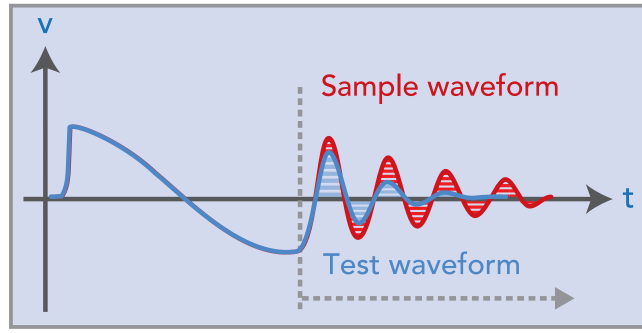
Peak Ratio and ∆ Peak Ratio Diagram

When the quality of the DUT is worse/poorer than the golden sample's or the decay rate of the DUT's resonant waveform is faster than the golden sample's, the peak ratio of the DUT's resonant waveform is less/lower than the golden sample's. The △Peak% judgement subtracts the peak ratio of the golden sample's resonant waveform from the peak ratio of the DUT's resonant waveform for comparing the difference of peak ratios between the DUT and the golden sample, so the △Peak% judgement gets a negative result. Therefore, the △Peak% judgement can efficiently sort out the DUT that has worse energy loss than the golden sample.

$$\Delta \text{ Peak } \% = [\text{Peak Ratio}]_{\text{test}} - [\text{Peak Ratio}]_{\text{sample}}$$

ΔResonant Area

When the switch is turned off, the DUT resonates with the stray capacitance. The oscillation decay state of the resonant waveform is used for checking the quality of the DUT. The oscillation decay state of the resonant waveform will be affected by the quality of the DUT. When the quality of the DUT is poorer, the resonance waveform will decay faster, which causes the total area of the resonant waveform from the DUT to become smaller than that from the golden sample. The △Resonant Area judgement is very similar to the Area judgement. The only difference is that the △Resonant Area judgement only compares the total area difference between the DUT's resonant waveform and the golden sample' resonant waveform after the switch is turned off. Therefore, the △Resonant Area judgement can be more sensitive than the Area judgement to sort out the product that has the poor quality.

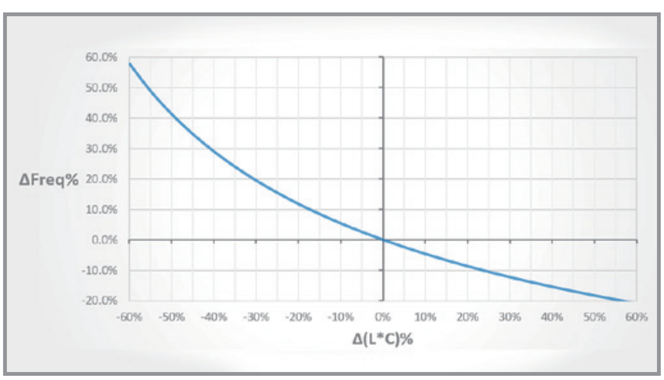


Resonant Area Diagram

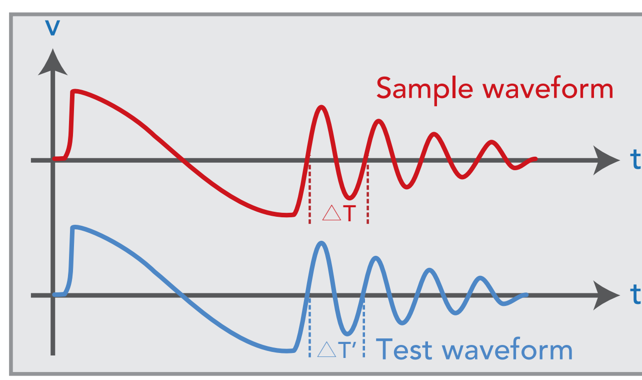
Δ*fr*%

When the switch is turned off, the DUT resonates with the stray capacitance. The difference of the resonant frequency between the DUT and the golden sample can be used for checking the difference in the inductance or the stray capacitance of the DUT. The DUT's resonant frequency is inversely proportional to its inductance or stray capacitance, so the higher the resonant frequency, the smaller the inductance or the stray capacitance. On the other hand, the lower the resonant frequency, the larger the inductance or the stray capacitance. The △ *fr* % uses the correlation between the resonant frequency of the DUT and its inductance or stray capacitance to compare the difference of the inductance or the stray capacitance between DUT and golden sample. The △ *fr* % calculates the difference of resonant frequency between the DUT and the golden sample in percentage. This is why the △ *fr* % can be used to check the difference of the inductance or the stray capacitance between the DUT and the golden sample.

$$\Delta fr\% = \frac{fr_{\text{test}} - fr_{\text{sample}}}{fr_{\text{sample}}} \times 100\%$$



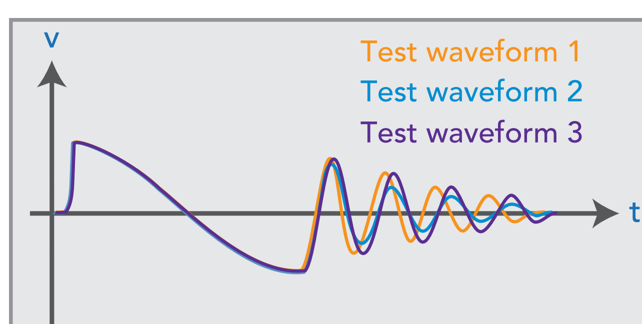
△*fr*% and △(L*C)% Conversion Chart



△*fr* Diagram

IWT Compare

When the difference between the three windings of a three-phase motor stator is too large, it may cause the motor rotor to have an unbalanced rotation. The IWT Compare mode can perform a cross-comparison of the IWT between the different windings/phases, and sort out the product that has a large difference between the windings/phases.



IWT Compare Diagram

IWT BDV Mode

The IWT BDV Mode (IWT Breakdown Voltage Mode) can determine the highest withstand voltage of the wound component. The R&D (research and development) engineer can use the IWT BDV Mode to analyze and research the product, and improve the weakness of the product. The IWT BDV Mode gradually increases the test voltage from the start voltage (Vstart) to the end voltage (Vend) by the percentage of 100 steps (Vstep). During the test voltage rising, it compares the resonant waveform of every test voltage with the resonant waveform of the previous test voltage. When the value of the Area or the Laplacian exceeds the High or Low limit, it indicates that the insulation between turns of the DUT has begun to occurr/ appear an abnormal phenomenon, and the previous test voltage is judged as the highest withstand voltage of the DUT, which is its breakdown voltage.

PRODUCT APPLICATIONS

Components: Motor Stator, Transformer, Inductor, etc.

In the manufacturing process of the wound components, it is recommended to use the Hi-pot (AC/DC) test, the insulation resistance (IR) measurement, the DC resistance (DCR) measurement, the impulse winding test (IWT), and etc. for ensuring the product quality. (refer to Mechanical & Machinery Industry Standard - JB/T 7080)

The 19036 has ten independent test channels, so it is able to test multiple motor stators (ex. 3 three-phase motor stators) at once by the scanning test, which can increase the production capacity.

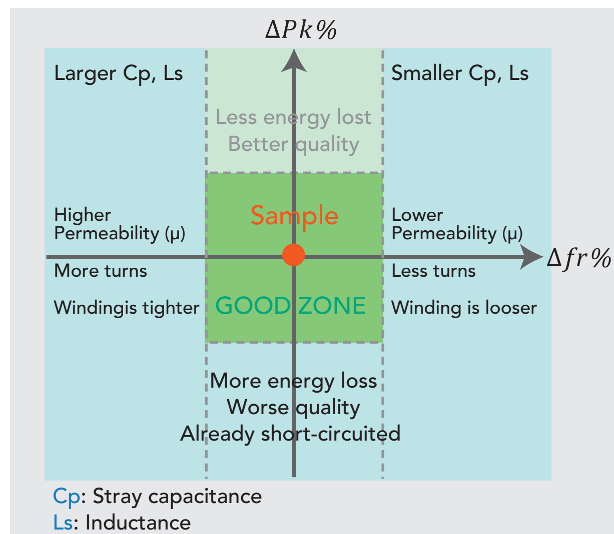
Recommended test items in sequence:

1. HSCC / OSC
2. Hi-pot Test
3. IWT Test
4. IWT Compare
5. IR
6. △/Y DCR / DCR Test

The test application of △Peak% and △fr% for wound component

The DUT, which has worse quality/Q value, loses more energy and generates more heat easily. During the long-term usage, the quality deteriorates faster than the normal product due to the temperature rising, so the service life is shorter. The low limit of the △Peak% can be established by using the product that has the quality/Q value close to the low limit within the allowable range.

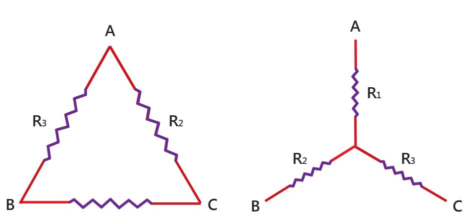
The resonant frequency of the resonant waveform from the DUT can be affected by its inductance and stray capacitance(Cp). The stray capacity(Cp) can be affected by the tightness of the coil's winding. When the winding is tighter, the Cp is larger. When the winding is looser, the Cp is smaller. The inductance is affected by the number of turns and the permeability (μ) of the iron core. When the turns are more or the μ is higher, the inductance is larger. When the turns are less or the μ is lower, the inductance is smaller. The upper and lower limits of the △fr% can be established by using the product that has the inductance and stray capacitance(Cp) within the allowable range (between the upper and lower limits).

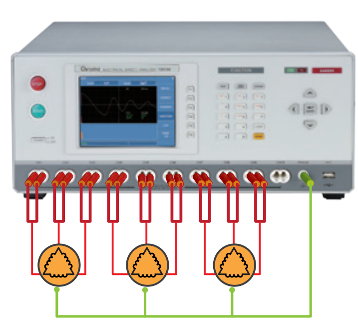


The relation between defective reasons and Pk% & △fr%

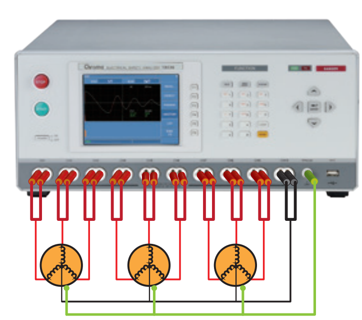
Δ/Y DCR

The three phases of a △/Y-type motor stator have already been connected together (with/without the neutral), so it is impossible to measure the DCR of each single phase directly. But, the △/Y DCR mode of 19036 is able to calculate the individual DCR value of the winding on each phase for three different phases by using the special calculation.





△-type motor stator



Y-type motor stator

40-Channel Scanning Test

Both external scanning boxes, which are A190362 (support 4-wire DCR measurement) and A190359 (support 2-wire DCR measurement), have 16 test channels each. Each channel can be set to HIGH (positive), LOW (negative), or NONE (open circuit). The 19036 with external scanning box(es) can perform multi-point measurements, and complete all the tests to multiple DUTs within one test station.

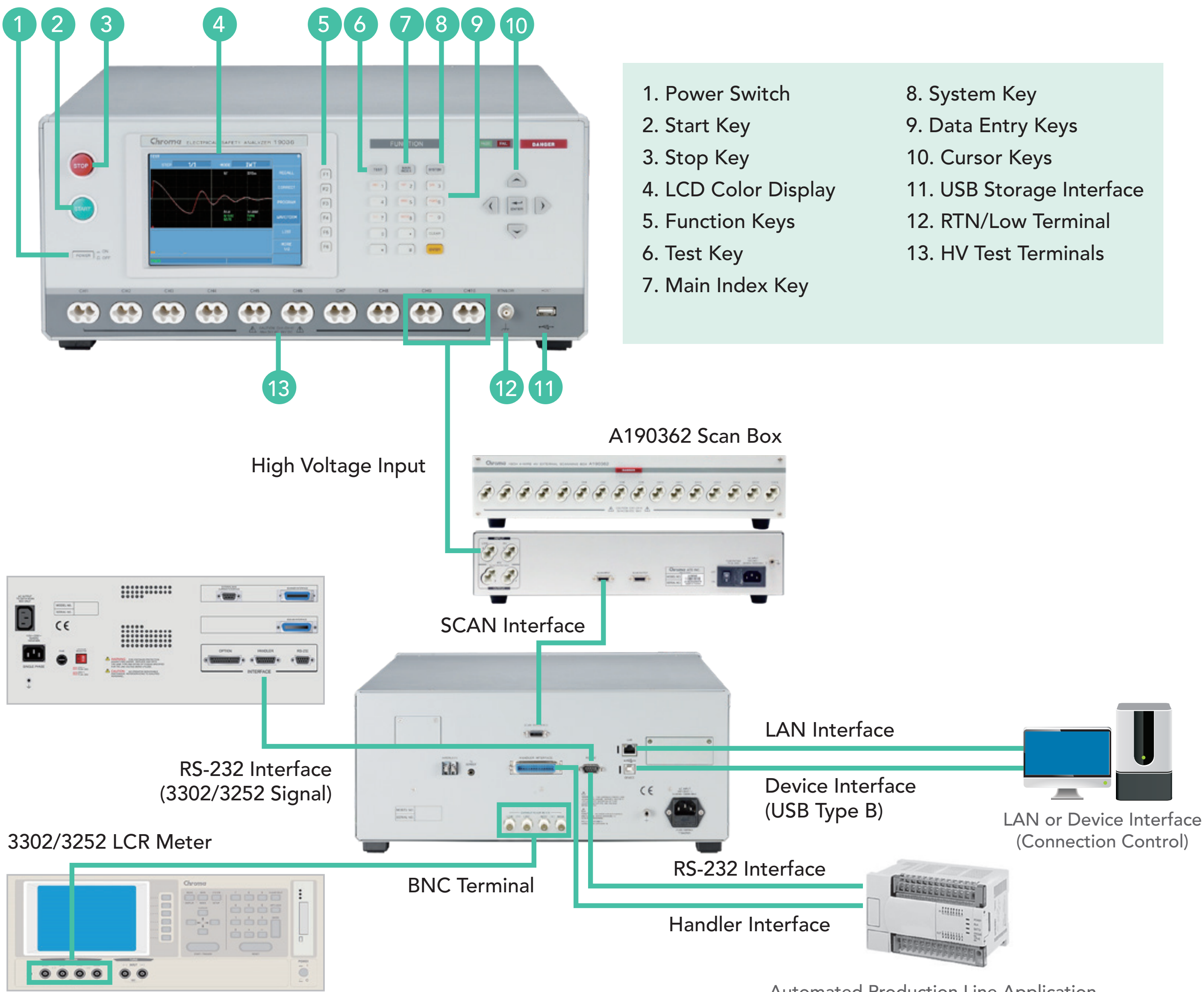
19036 with A190362 x 2

SPECIFICATIONS

Model		19036	
AC/DC Withstanding Test			
Output Voltage		AC: 0.05~5.0kV / DC : 0.05 ~ 6.0kV	
Load Regulation		≦ (1% of output + 0.1% of full scale)	
Voltage Accuracy		± (1% of setting + 0.1% of full scale)	
Voltage Resolution		2V	
Cutoff Current		AC: 0.001mA ~ 120mA (Voltage ≦4kV)	
		AC: 0.001mA ~ 100mA (Voltage >4kV)	
		DC: 0.0001mA~20mA	
Current Accuracy		± (1% of reading + 0.5% of full range)	
Test Timer		Test Time: 0.3 ~ 999 sec., and continue	
		Ramp/Fall Time: 0.1 ~ 999 sec., and OFF DWELL Time: 0.1 ~ 999 sec., and OFF (DC only)	
Output Frequency		50Hz / 60Hz	
Waveform		Sine wave	
Insulation Resistance Test			
Output Voltage		DC: 0.050 ~ 5.000kV ; Steps: 0.001kV	
Load Regulation		± (1% of reading + 0.1% of full scale)	
Voltage Accuracy		± (1% of setting + 0.1% of full scale)	
IR Range	< 0.5kV	0.1MΩ ~ 1.00GΩ	
	≧ 0.5kV	1.0MΩ ~ 50GΩ	
Resistance Accuracy	> 1kV	1MΩ ~ 1GΩ: ± (3% of reading + 0.1% of full range)	
		1GΩ ~ 10GΩ: ± (7% of reading + 2% of full range)	
		10GΩ ~ 50GΩ: ± (10% of reading + 1% of full range)	
	≧ 0.5kV and ≦1kV	0.1MΩ ~ 1GΩ: ± (3% of reading + 0.1% of full range)	
		1GΩ ~ 10GΩ: ± (7% of reading + 2% of full range)	
		10GΩ ~ 50GΩ: ± (10% of reading + 1% of full range)	
	< 0.5kV	0.1MΩ ~ 1GΩ: ± (5% of reading + (0.2*500 / Vs)% of full scale)	
Impulse Winding Test			
Applied Voltage, Step, and Energy		0.1kV ~ 6kV, 0.01kV Step, Max. 0.29 Joules	
Inductance Test Range		More than 10uH	
Sampling Speed		10bit / 5ns (200MHz)	
Sampling Range		11 Ranges	
Pulse Number		Pulse Number: 1~32, Dummy Pulse Number: 0~9	
Judgement		Area / Differential Area / Flutter / Laplacian / △ Peak% / △ Resonant Area / △ Freq%	
DC Resistance Measurement			
Test Signal		<DC 5V, 1.25A max.	
DCR Test Timer		Test Time: 0.1 ~ 999 sec., and Continue ; DWELL Time: 0.1 ~ 999 sec., and Off Switch Time: 0.01 ~ 0.2 sec.	
Measurement Accuracy & Measurement Range	Range	Test Range	Measurement Accuracy
	20mΩ	2.000mΩ ~ 20.000mΩ	± (0.20% of reading + 0.08% of range)
	200mΩ	20.00mΩ ~ 200.00mΩ	± (0.15% of reading + 0.08% of range)
	2Ω	0.2000Ω ~2 .0000Ω	± (0.15% of reading + 0.08% of range)
	20Ω	2.000Ω ~ 20.000Ω	± (0.15% of reading + 0.08% of range)
	200Ω	20.00Ω ~ 200.00Ω	± (0.15% of reading + 0.06% of range)
	2kΩ	0.2000kΩ ~ 2.0000kΩ	± (0.15% of reading + 0.03% of range)
	20kΩ	2.000kΩ ~ 20.000kΩ	± (0.20% of reading + 0.03% of range)
	200kΩ	20.00kΩ ~ 200.00kΩ	± (0.40% of reading + 0.03% of range)
	2MΩ	0.2000MΩ ~ 2.0000MΩ	± (1.00% of reading + 0.03% of range)
Flashover Detection			
Detection Current		Programmable setting AC: 1 ~ 20mA ; DC: 1 ~ 10mA	
Contact Check Function			
Contact Check		OSC (Open/Short Check)	
		HFCC (High Frequency Contact Check)	
		HSCC (High Speed Contact Check)	
Electrical Hazard Protection Function			
Ground Fault Interrupt		AC: 0.25mA~0.75mA, ON/OFF selectable	
Key Lock		Yes (password control)	
Interlock		Yes	
Indication, Alarm		GO: Short sound, Green LED ; NG: Long sound, Red LED	
Memory Storage		200 setups, each setup 60 steps max. (with IWT & IWT Compare 40 steps max.)	
Interface		Standard: RS232, Handler, USB, LAN	
General			
Operation Environment		Temperature: 0℃~45℃ ; Humidity: 15% to 95% R.H@≦ 40℃ and no condensation	
Power Consumption		No Load: <150W ; Rated Load: <1000W	
Power Requirements		100Vac~240Vac, 50/60 Hz	
Dimension (W ×H ×D)		428 x 177 x 500 mm / 16.85 x 6.97 x 19.69 inch	
Weight		26kg / 57.32 lbs	

* All specifications are subject to change without notice.

PANEL AND CONNECTIONS



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