ZXHQ-Y Transformer Field Calibrator





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Warning

This manual would help user to operate CTPT analyzer in right condition. The main content of this manual include functions, technical index, operation, test connection and potential risks of analyzer. Please read this manual carefully before you start work with CTPT analyzer. It would save your lots of time and cut down the risks in test procedure.

The operation of CT test with CTPT analyzer should follow associated national standards constraints. This manual can not replace national standards to electrical tests. The operator should have the certificate of high voltage electrical test when CTPT analyzer works in high voltage station.

Safety regulations for CTPT analyzer application

- 1) All technical index should keep in work condition before test with analyzer
- 2) Please follow associated national standards in a special application
- 3) Forbid high voltage or high current connected to CTPT analyzer direct
- 4) All tests should follow procedure in user manual
- It is forbid to open the box of CTPT analyzer. Otherwise the quality assurance would be invalid.
- 6) It is forbid to update or extend the tester without manufacturer authorization.
- 7) Please use the original accessories for analyzer
- 8) It is forbid to cut off test connection before power out LED out.
- 9) Please connect analyzer to ground with grounding cable in no laboratory application
- 10) Please confirm that one terminal of sample CT primary connected to ground
- 11) Do not run analyzer in extreme moist condition
- 12) Please confirm that all terminals connected to analyzer have no voltage. All voltage output from CTPT analyzer.
- Please confirm that voltage had been injected to CT secondary coil in CT test.
 Otherwise the analyzer may be damaged.
- 14) Please confirm that voltage had been injected to PT primary coil in PT ratio test.Otherwise the analyzer may be damaged.



1 Application and technical index of CTPT analyzer

1.1 Application

Tests for current transformer:

- 1) Excitation curve and parameters test
- 2) Turns ratio test
- 3) Ratio and phase error test
- 4) Polarity mark check
- 5) Coil resistance measurement
- 6) Secondary loop burden measurement
- 7) Error line curve test for protection CT
- 8) Transient CT parameters test
- 9) CT nameplate guess
- 10) Saturation hysteresis loop curve measurement

Tests for voltage transformer:

- 1) Turns ratio test
- 2) Polarity test
- 3) Secondary burden test
- 4) Coil resistance test

Applications for CTPT analyzer:

- 1) CT nameplate check
- 2) CT parameters check in work burden
- 3) CT transient parameters analysis
- 4) CT ratio and phase error calibration
- 5) PT routine test

1.2 CTPT analyzer technical index

- 1. Test standards: IEC60044-1, IEC60044-6, GB1208, GB16847, C57.13
- 2. Power supply: AC220V±10%, 50Hz/60Hz±10%
- 3. Power output: 0.1~125V (AC)
- 4. Current output: 0.001~5A(RMS)



- 5. Power output: 300VA
- 6. Maximum knee voltage measurement; 45kv
- 7. Current measurement:

Range: 0~10A (automatically change range in 0.1/0.4/2/10A)

Error <±0.1%+0.01%FS

8. Voltage measurement:

Range: 0~200 V (automatically change range in 1V/10V/70V/200V)

Error < ±0.1%+0.01%FS

- 9. Turns ratio measurement:
 - Range : 1~30000,
 - 1~2000 error<0.05%
 - 2000~5000 error>0.1%

5000~30000 error<0.2%

- 10. Phase measurement: error: ±2min, resolution: 0.01min
- 11. Coil resistance measurement:

Range: 0~8kΩ (automatically change range in 2ohm/20ohm/80ohm/800ohm/8kohm) Error< 0.2%RDG+0.02%FS

Maximum resolution: $0.1m\Omega$

- 12. Temperature measurement: -50~100 Celsius degree, error<3 Celsius degree
- 13. CT Secondary burden:

Range $0\sim$ 160ohm (automatically change range in 20hm/20ohm/80ohm/160ohm)

Error <0.2%RDG+0.02%FS

Maximum resolution 0.001ohm

14. PT Secondary burden:

Range 0~80kohm (automatically change range in 800ohm/8kohm/80kohm)

Error <0.2%RDG+0.02%FS

Maximum resolution: 0.10hm

15. PT ratio measurement:

Range : 1~30000,

1~5000 error<0.2%

5000~30000 error<0.5%

- 16. Saved data groups: >1000groups
- 17. Work condition: Temperature: $-10^{\circ}C \sim 50^{\circ}C$, moist: $\leq 90\%$
- 18. Size: 485mm×356mm×183mm
- 19. Weight: <15Kg



2 Hardware

2.1 Introduction



The appearance of CTPT analyzer is as figure 2.1.

Figure2.1 CTPT analyzer

2.2 Power supply

Power supply connection of CTPT analyzer is located at right side. It is showed as figure 2.2. Power supply range is $AC220\pm10\%$, $50/60Hz\pm10\%$. There is an AC250V/3A fuse installed in the internal of power supply connector.

2.3 Test connection terminals

There are 3 groups of test connection terminals on the surface panel of CTPT analyzer. They are power output, CT secondary input and CT primary input.

Power output terminals: voltage output range AC0~125V, current output range AC0~5A.

CT secondary/PT primary input terminals: CT secondary or PT primary voltage measurement input range AC0~125V

CT primary/PT secondary input terminals: CT primary or PT secondary voltage measurement



input range AC0~5V



Figure 2.2 Power supply panel

2.4 Hardware schematic diagram

The schematic diagram of CTPT analyzer is as figure 2.3. Constant voltage and current source is isolated with AC220V power supply. DSP system controls the constant voltage and current source output and amplitude. This source could generate AC0-125v voltage or DC 0~0.5A current to sample CT.





Figure 2.3 CTPT analyzer schematic diagram

The main functions of DSP system are as follow:

- 1) Constant voltage and current source control
- 2) Data sample
- 3) Communication with computer.

There is a computer integrated in the tester. Large memory capacity make the tester could save over 1000 groups of test data.

2.5 Keyboard

There is 16keys small keyboard installed in analyzer. Keyboard appearance showed as figure 2.4



Figure 2.4 Keyboard

The definitions of keys are as follow

- 1) 0~9 digital input
- 2) \wedge up direction input
- 3) \lor down direction input
- 4) < Delete
- 5). Dot input
- 6) ESC: cancel selection
- 7) OK: Enter or select



3 Test connection

3.1 CT Secondary burden measurement

Please connect analyzer and sample CT as figure 3.1 in CT secondary burden test



Figure 3.1 Secondary burden test connection

Detail test connection procedures are as follow::

1) Connect analyzer grounding terminal to protection earth(PE).

2) Disconnect sample CT secondary coil with secondary loop as figure 3.1.

3) Connect power output red terminal of analyzer to one side of CT secondary circuit.

4) Connect power output black terminal of analyzer to another side of CT secondary circuit.

5) Please keep the voltage measurement connection behind the power output connection so that contact resistance has no effect in test results. Reference connection is showed



as figure 3.2

Warning: Please disconnect CT secondary coil to secondary loop. Otherwise test results would be wrong. It is the combination of secondary loop burden and secondary coil. There is no degauss procedure when burden test. So if the connection to secondary coil was not disconnected the CT secondary coil would work in saturation state.



Figure 3.2 Reference connections to clear contact resistance effect

3.2 CT analysis, ratio and polarity test

Please connect analyzer and sample CT as figure 3.3 in CT analysis, ratio and polarity test. It is the same in test connection for all the three tests.



Figure 3.3 Connection for CT analysis, ratio and polarity test



Detail test connection procedures are as follow.

1) Connect analyzer grounding terminal to protection earth (PE).

2) Disconnect power line connection in primary of CT as figure 3.4. Power line which is not connected to earth would bring lots of noise signal when testing

3) Connect power output red terminal of analyzer to one side of CT secondary coil.

- 4) Connect power output black terminal of analyzer to another side of CT secondary coil.
- 5) Connect one side of CT primary coil to CT primary black terminal of analyzer
- 6) Connect another side of CT primary coil to CT primary red terminal of analyzer
- 7) Connect one side of CT secondary coil to CT secondary black terminal of analyzer
- 8) Connect another side of CT secondary coil to CT secondary red terminal of analyzer

9) Please keep the voltage measurement connection behind the power output connection so that contact resistance has no effect in test results. Reference connection is showed as figure 3.4



Figure 3.4 Reference connections for CT analysis, ratio and polarity test

CAUTION: Please short connect other non-test secondary windings for CT that have multiple secondary windings while the rated primary and secondary current are the same in CT analysis or ratio test. For example one sample CT which have three secondary windings as figure 3.4.1. When the winding 0.5 class is being tested please short connect the 10p and TPY windings as figure 3.4.1





Figure 3.4.1 Short connection for CT analysis and ratio/phase test

3.3 CT Coil resistance test

Please connect analyzer and sample CT as figure 3.5 in CT coil resistance test

- 1) Connect analyzer grounding terminal to protection earth (PE).
- 2) Disconnect sample CT secondary coil with secondary loop as figure 3.5.
- 3) Connect power output red terminal of analyzer to one side of CT secondary coil.
- 4) Connect power output black terminal of analyzer to another side of CT secondary coil.

5) Please keep the voltage measurement connection behind the power output connection so that contact resistance has no effect in test results. Reference connection is showed as figure 3.4



Figure 3.5 Reference connections for CT coil resistance test



3.4 PT Secondary burden test



Please connect analyzer and sample PT as figure 3.6 in PT secondary burden test

Figure 3.6 PT secondary burden test connection

Detail test connection procedures are as follow::

- 1) Connect analyzer grounding terminal to protection earth(PE).
- 2) Disconnect sample PT secondary coil with secondary loop as figure 3.6.
- 3) Connect power output red terminal of analyzer to one side of PT secondary circuit.

4) Connect power output black terminal of analyzer to another side of PT secondary circuit.

Warning: Please disconnect PT secondary coil to secondary loop. Otherwise test results would be wrong. It is the combination of secondary loop burden and secondary coil.

3.5 PT coil resistance test

Please connect analyzer and sample PT as figure 3.7 in PT coil resistance test

- 1) Connect analyzer grounding terminal to protection earth (PE).
- 2) Disconnect sample PT coil with loop as figure 3.7.
- 3) Connect power output red terminal of analyzer to one side of PT coil.
- 4) Connect power output black terminal of analyzer to another side of PT coil.
- 5) Please keep the voltage measurement connection behind the power output connection



so that contact resistance has no effect in test results. Reference connection is showed as figure 3.4



Figure 3.7 Coil resistance test connection

3.6 PT turns ratio and polarity test

Please connect analyzer and sample PT as figure 3.9 in PT turns ratio test and polarity test. It is the same in test connection for both tests.



Figure 3.9 PT turns ratio and polarity test connection



Detail test connection procedures are as follow.

1) Connect analyzer grounding terminal to protection earth (PE).

2) Disconnect power line connection in primary of PT. Power line which is not connected

to earth would bring lots of noise signal when testing

3) Connect power output red terminal of analyzer to one side of PT primary coil.

4) Connect power output black terminal of analyzer to another side of PT primary coil.

5) Connect one side of PT secondary coil to PT secondary black terminal of analyzer

7) Connect another side of PT secondary coil to PT secondary red terminal of analyzer

8) Connect one side of PT primary coil to PT primary black terminal of analyzer

9) Connect another side of PT primary coil to PT primary red terminal of analyzer

10) Please keep the voltage measurement connection behind the power output connection so that contact resistance has no effect in test results. Reference connection is showed as figure 3.4



4 User interface

4.1 Software panel

Six work states had been defined in CTPT analyzer. They are "Wait for new test", "wait for view saved data", "wait for test", "Run", "View results" and "View saved results". The software panel is different when analyzer works in different state. The whole software panel is divided into 5 areas generally. All the five areas are showed as figure 4.1. The names of the 5 areas are toolbar panel, work panel, state information panel, test parameters panel and test control panel. Analyzer changes the software show in work panel when it works in different state.

4.2 Toolbar panel

The toolbar panel of analyzer includes lots of tester command button. They are "new test", "save", "read", "system setting", "language selection", "transformer setting", "data export" and "help" buttons.



Figure 4.1 Software panel in "Wait for new test" state



4.2.1 New test command

The functions of new test command are that end current test selection and make analyzer work in "wait for new test" state. Panel as figure 4.1 would be load to LCD if analyzer works in "Wait for new test" state. You can select a new test in this panel. The tests in analyzer include "CT analysis", "CT ratio and phase error ", "CT secondary burden", "CT Polarity" and "CT coil resistance". System close and software restart commands are also located at this panel.

4.2.2 Save

The function for save command is that save test results showed in current panel. Save command is also valid when both saved results are reloaded to panel and the display mode is changed (such as standard selection or accuracy selection changed).

The file name of test results saved is constructed as follow mode:

Year-month-date Hour: minute: second Transformer ID Test name .cta

For example: 2011-04-08 11:12:30 HYDL CT analysis.cta

The date time in first part of file name is that the value when test was started. So the original file would be overwritten when we save the test results in "view saved data" state. There is no another copy created.

4.2.3 Read

The function of read command is that reload the saved results to software panel. Panel as figure 4.2 would be showed when we click read command.

💝 Data read			
Test time	Test model File counte	File size	1/2
2011-03-27 10h44m53sec 2011-03-27 11h26m39sec	e whhyCT analysis.Cta 945KB e whhyCT analysis.Cta 945KB		Previous page
			Next page
			Delete all
			Delete file
			Cancel
			Read file
File list		Commands	

Figure 4.2 Saved files read window form



The list box in left side of panel shows all files saved in analyzer. All commands to saved files are located at right side of panel. There is a counter to show current selection index and total files in top of the panel.

All commands to saved files are as follow:

- 1) "Previous page" shows saved files of previous page in list box.
- 2) "Next page" shows saved files of next page in list box
- 3) "Delete all files" deletes all files saved in analyzer
- 4) "Delete file" deletes current selection file in analyzer.
- 5) "Cancel" close the read file window form
- 6) "Read" load test results in current selection file to software panel

4.2.4 System setting

The function of system setting command is that set the system run parameters such as system time, operator, and test address and so on. Panel as figure 4.3 would be showed on LCD when system setting button is clicked.

System parameters setting					
System run parameters Tester ID Unknown Software ID	Operator Unknown				
Test company Unknown	Test address Unknown				
Report top tag CT Test report					
Report bottom tag CT Analyzer					
□ Add hysteresis loop curve in word report					
Evaluation parameters setting	Excit test control				
• Close evaluation procedure	Saturation voltage 5.0 🗘 V				
• Evalution in work burden only	✓ Auto setting Auto is recommended				
• Evalution in both rated and work burden Display excitation curve data in breif mode					
Nameplate deduce parameters setting					
Coil Resistance1.00Image: Constant of the stands for 5A, otherwise1A knee point20.00Image: V Stands for MCT, otherwise	wise stands for 1A Software Upgrade				
5A knee point< 40.00 🗘 V Stands for MCT, otherwise	se stands for PCT Virtual Time keys Setting				
Excitation data search mode setting					
• Search current from voltage • Search volt	age from current Cancel Ok				

Figure 4.3 System setting window form

System run parameters in system setting panel have no effect in test control. All system run parameters only affect word test report. The name and definition of system run parameters are showed in table 4.1.

Table 4.1 System run parameters

Parameters name	Description



Tester ID	The identification number offered by manufacturer			
Soft ID	Software version			
Operator	Operator name in word test report			
Test company	Test company in word test report			
Test address	Test address in word test report			
Report header	Document header in word test report			
Report footer	Document footer in word test report			
Add hysteresis loop	If this item is checked the hysteresis loop curve and data will be			
curve in word report	inserted into the word test report			

Other parameters in system setting panel are response for test control. Detail information of those parameters is as table 4.2

Table 4.2 System setting parameters

Parameters name	Description
Automatic	1) If "Close evaluation" is selected analyzer would offer parameter
evaluation	results of CT only when CT analysis test is end. Analyzer would not
	evaluate the test results according to selected standard
	2) If "Evaluation for work burden" is selected analyzer would offer
	both parameter results of CT and evaluation results according to
	selected standard when CT analysis test is end. But the evaluation
	results only include the parameters calculated in work burden.
	3) If "Evaluation for both work and rated burden" is selected analyzer
	would offer both parameter results of CT and evaluation results
	according to selected standard when CT analysis test is end. The
	evaluation results include the parameters calculated in both work and
	rated burden.
Excitation test	Measure saturation voltage automatically is factory setting. This
control	parameter affect CT analysis and ratio test. If measure saturation
	voltage automatically is selected analyzer would select a special test
	frequency according to saturation value in excitation curve
	measurement. Otherwise analyzer would not measure saturation
	voltage before excitation curve test start.
	Warning: Please select automatic mode in most of time. Just set the
	saturation value when you can not get the correct excitation curve in
	automatic mode.
Show excitation	If Show excitation curve data in brief mode has been selected the
curve data in brief	excitation data table items would not more than 30 points. 15 points
mode	before knee point and 15 points after knee point. All those points are
	sampled from excitation curve measured in the same step.



	If this item are not selected all the excitation curve data would been			
	showed in excitation curve data table.			
Transformer	This parameter is valid in nameplate information guess. Analyzer			
secondary current	guesses the rated secondary current of CT according to this parameter.			
guess threshold	If the coil resistance measured in CT secondary is lower than this value			
value	analyzer set the rated secondary current of CT to 5A. Otherwise the			
	rated secondary current of CT is 1A.			
1A CT core type	This parameter is valid in nameplate information guess. Analyzer			
guess threshold	guesses the core type of 1A CT according to this parameter.			
value	If the knee point voltage of 1A transformer is lower than this value			
	analyzer set the core type of CT to measurement. Otherwise the core			
	type of CT is protection.			
5A CT core type	This parameter is valid in nameplate information guess. Analyzer			
guess threshold	guesses the core type of 5A CT according to this parameter.			
value	If the knee point voltage of 5A transformer is lower than this value			
	analyzer set the core type of CT to measurement. Otherwise the core			
	type of CT is protection.			
Excitation data	If search current from voltage is selected the tester would find the right			
search mode	current value in excitation curve by the voltage value inputted			
	If search voltage from current is selected the tester would find the right			
	voltage value in excitation curve by the current value inputted			

4.2.5 Language selection

CTPT analyzer support both English and Chinese language. The function of this command is that change current language show in software. If English is selected the work text in software is showed in English. Otherwise Chinese would be the work language.

4.2.6 Transformer setting

The function of transformer setting command is that set the parameters of sample CT for

Language selection(语言)	选择)
Language select	ion(语言选择)
• Simplified Ch	inese(简体中文)
Fnglish	
• Eligiton	
Cancel(取消)	ok(确定)
Cancer(-KiH)	UR(HYTAC)

Figure 4.4 Language selection



analysis and ratio test. Panel as figure 4.5 would be load when transformer setting button is clicked. The detail information of parameters in this panel is the same as analysis test parameters setting. Please refer to chapter 5.2



Figure 4.5 Transformer parameters setting

4.2.7 Data export

The function of data export command is that export the data file or word report saved in analyzer to removable disk. Panel as figure 4.6 would be loaded when data export button is clicked.

The list box in left side of panel shows all files saved in analyzer. All export form commands to saved files are located at right side of panel. There is a counter to show current selection index and total files in top of the panel. The combo list top of export window form is response for file type show. ".cta" data files would be showed in list box if "*.cta" had been selected in this combo list. Otherwise ".doc" word files would be showed in list box.

All commands to saved files in export file window form are as follow:

- 1) "Previous page" shows saved files of previous page in list box.
- 2) "Next page" shows saved files of next page in list box
- 3) "Delete all files" deletes all files saved in analyzer
- 4) "Delete file" deletes current selection file in analyzer.

5) "Cancel" closes the read file window form

6) "Export all files" export all files in selected type (word or *.cta data files) to removable disk. The saved directory in removable disk is "work data\analyzer test data\".



7) "Export file" export current selected file to removable disk. The saved directory in removable disk is "work data\analyzer test data\".

8) "Clear memory" delete all files saved in directory "work data\analyzer test data" in removable disk.

♦ File export Fil					X
File list	Please select export fil	es type	*.Cta type test file	~	12 File counter
2011-03-27 10时 2011-03-27 11h26	44分53秒 whlyCT 分析.Cta 5m39sec whlyCT analysis.Cta	9451 945	KB KB		Previous page
					Next page
					Clear memory
					Delete all
	Saved file list				Delete file
					Export all files
					Export file
					Cancel
				- C.	Commands

Figure 4.6 file export window form

4.2.8 Help

The help document would be loaded when this help command button is clicked. The help document would be showed in "*.pdf" document format.

4.3 Work panel

Work panel is located at center of the software panel. The content of work panel is changed according to analyzer work state. Fox example panel as figure 4.1 would be loaded if analyzer works in "wait for new test" state. Panel as figure 4.7 would be loaded if analyzer works in "View results" state and excitation curve show had been selected.

4.4 State information panel

The content of state information panel is as follow:

1) Analyzer work state. For example "wait for new test", "wait for test", "View results",



"View saved results" and "wait for view results"

2) Communication state. If communication between DSP system and computer system is success online would be showed. Otherwise off line would be showed. All test is valid only when analyzer work in online condition

3) Current test name. For example: "CT analysis", "Ratio and phase error" and so on.

- 4) System time and date
- 5) Current room temperature

			C	T Analyze	r−V2(1.21.	. 107)			
New test	Save	0	pen	System Setting	Languag (语言选择	e Trai (F) S	nsformer etting	Data Output	Help
X Excitation IR Y Secondary EMF,	/v 42.33								
Curve title	37.62								
IEC60044-1/GB120	32.92								
< <left< td=""><td>28.22</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></left<>	28.22								
>>Right	23.51								
Knee voltage 32.4V	18.81								
Knee current	14, 11								
0.030A ✓ Knee show	<mark>9. 41</mark>								
Read saved curve	4.70								
Clear saved curve	0.00	0.0000	0.0497 0.09	94 0.149	L 0.1988	0.2485	0.2982	0.3479 0.3	3976 0. 4473
Hysteresis loop	Excitation curve data	Excitation curve	Error cur data	ve Er cu	ror Ra rve pha	tio and se error	Coil Resistanc	e Secondary burden	Test evaluation
Test time: 2	Test time: 2011-04-10 16h37m34sec Report model 1 WORD test report								
Test address	: Unknown				Operator: Unl	known			Malze Deport
Test company	y: Unknown				Test code: 00	0000			Make Report
Run State:	Offline Vie	w saved test re	sults Test	item					
電車し・*								Test setting	Run test
Шгад — , Л									

Figure 4.7 Excitation curve show

4.5 Test control panel

Test control panel include test parameters setting button and test start button. Test parameters setting button is valid when analyzer work in "wait for test" state. Special parameters setting window form which is associated to a special test would be loaded when test parameters setting button is clicked.

Test would be started when test start button is clicked and the text of test start button would be changed to be stop. Click this button again tests would be forced to stop. The work state of analyzer would be changed to be "run" when test is started. And the work state would be changed to be "view results" when test is end or forced to stop.



Warning: if you want to start a new test in "view saved data results" state you would have to click "new test" button first and then analyzer enter "wait for new test" state. The procedure of a new test start is as follow: "Wait for new test"-> "Wait for test"-> "Run"-> "View results"

4.6 Analyzer start and close

Analyzer application in computer would be loaded automatically when analyzer is power on. The Analyzer would stay in "Wait for new test" first.

Please close the analyzer by software command "close system" first and then cut off power supply when "It is safe to shutdown now" is showed on LCD Please cut off power supply direct in emergency.



5 Test operation

5.1 Common procedure of test run

There are 6 work states which had been listed in chapter 4 in analyzer. The common work state changing procedures for test in analyzer are as follow.

1) Run a new test from "wait for new test" after analyzer power on

"Wait for new test"-> "wait for test"-> "Run"-> "View results"

1>Analyzer would be stay at "wait for new test" state after power on.

2> It would turn to "wait for test" state when one of the test buttons is clicked.

3>Test is started by "start" button.

4>Analyzer would turn to "Run" state when start button is clicked.

5>Analyzer would be stay at "View results" state when test is end.

2) Run a new test from "view results" work state

"View results"-> "Wait for new test"-> "Wait for test"-> "Run"-> "View results"

1> Analyzer would be stay at view results when test is end. All results would be showed in work area.

2> Click "new test" button and then analyzer would be turn to "wait for new test" state.

3> the other steps are the same as procedure 1.

3) Repeat current test

"View results"-> "Run"-> "View results"

This procedure is simple. Just click restart button in "View results" state.

5.2 CT analysis

5.2.1 Parameters setting for CT analysis

Parameters setting window of CT analysis is showed as figure 5.1. The window of CT analysis and ratio test is the same. All the parameters need to be set in ratio and phase error test should be set in CT analysis test also.

All the parameters set in CT analysis are divided to be two parts. First part of that is associated to CT accuracy and the other is not associated to CT accuracy. The parameters which are not associated to CT accuracy are described in table 5.1. Other parameters which are related to CT accuracy are described in table 5.2 to table 5.6.



5.2.2 Test procedure for CT analysis

The test procedures for CT analysis are as follow:

- 1) Connect the analyzer with sample CT according to instruction manual
- 2) Click CT analysis button in "wait for new test" state
- 3) Set parameters for CT analysis test
- 4) Run test by start button
- 5) Wait for the end of CT analysis test
- 6) Analyses test results

Warning: The test cycle would be last for 30 minutes when the saturation of CT is high. The lowest frequency of voltage output is 0.25Hz. Please do not disconnect the connection before test is end.

The whole test procedure of CT analysis is as follow:

Coil resistance test->Degaussing first->Degaussing second-> Accuracy voltage regulation for ratio and phase error measure-> Rough voltage regulation for ratio and phase error measure -> CT Excitation test

- 1) If the parameters of saturation is set to be non-automatically the procedure of degaussing first would be ignore.
- 2) If the saturation of CT is low the procedure of rough voltage regulation would be ignore

The state of power output would be showed in state information area of software panel.



Sample transformer parameters Input nameplate Deduce nameplate auto	Short connect other non-test windings for CT that had multiple secondary windings while the rated primary and
Manufacturer CT model CT ID whhy Rated Primary current Rated frequency 2500.0 A Unknown Stated Sec current 50Hz 60Hz IA 5A Unknown Max test current 1.0 A	secondary current are the same. That would reduce the measurement error of ratio and phase Primary CT CT CT Analyzer
Test standards • IEC60044-1/GB1208 • IEC60044-6/GB16847 • C57.13 ANSI45 • C57.13 ANSI30	Tpx/y CT parameters setting t-all 100 ms Symmetry short current factor Kssc 10.0 Image: Content factor Kssc
Auto search CT class	tl 100 🗊 ms Dimensioning factor Ktd 1.0 🗊
EC60044-1/GB1208 EC60044-6/GB16847 C57.13	t-al2 100 🗘 ms Primary loop time constant 100 🗘 ms
• TPS • TPX • TPY • TPZ	t2 100 🗘 ms Secondary loop time constant Ts 100 🗘 ms
Secondary burden	tfr 100 🗘 ms O C-O energization O C-O-C-O energization
Rated 3.00 0 ohm 3.00 0 VA Cosq 1.00 0	Test mode and coil resistance setting Cancel 75°C Coil resistance 0.000 \$ ohm
Work 0.20 omn 0.20 VA Cosq 1.00	• standard test • Ok

Figure 5.1 Parameters setting for CT analysis

The record points would be little and the rise step voltage would be high if we select fast test mode. So the excitation curve would not be smooth for saturation and the excitation parameters would be un-exact if the sample CT's knee point is low(less than 250V) and remanence flux factor is high. Please select standard mode test for this CT. Standard test would get exact and high resolution excitation curve. But the test period is 2 times of fast test.

Parameters name	Description
Guess nameplate	This parameter is only response for CT analysis, ratio and phase
	error test. If the option "Set nameplate" is checked analyzer would
	not guess the nameplate information. Otherwise analyzer would
	guess nameplate information according to missing item. The items
	which could be guessed in nameplate include rated primary current,
	rated secondary current and CT accuracy.
Manufacturer	Manufacturer in word test report
CT type	CT type in word test report
CT ID	CT ID in word test report and saved file name
Rated primary current	Rated primary current. If it is set to be missing analyzer would guess
	the value according to turns ratio measured and rated secondary
	current.
Rated secondary	Rated secondary current. If it is set to be missing analyzer would
current	guess the value according to coil resistance measured

Table 5.1 Parameters setting for CT analysis



Rated frequency	Rated frequency for CT. Analyzer would set the voltage frequency in								
	this value in ratio and phase error measurement test								
Error curve calculation	This parameter is valid in IEC60044-1 protection CT. Analyzer would								
	calculate 5% or 10% error line curve according to the selection of								
	this item.								
Test Standards	The standard of sample CT is designed according to. Different								
	standard selected in test would get different test results								
CT Accuracy	The accuracy series defined in a special standard								
Secondary Burden	The results calculated in CT analysis and ratio test are associated to								
	secondary burden. Different burden connected in CT secondary loop								
	circuit would get different error results. The calculation in analyzer is								
	divided to be two burden conditions.								
	Rated burden: the rated burden value get from CT nameplate								
	Work burden: The actual burden value measured from secondary								
	loop circuit of sample CT.								
	Burden set range: 0~100.00 power factor: 0~1.00								
Coil resistance in 75	Coil resistance in 75 Celsius degree marked in nameplate of CT								
Celsius degree									

Table 5.2 Parameters setting for IEC60044-1/GB1208 measurement CT

Parameters name	Description
FS	Instrument security factor in nameplate. Range 1~300
Ext	Extended ratio error calculation point. Range 0%~400%
Table 5.3 Parameters se	tting for IEC60044-1/GB1208 5P/10P/5PR/10PR CT

Parameters name	Description				
ALF	Accuracy limit factor in nameplate. Range 1~300				
Max primary current	Max current in the primary circuit of CT in grid fault state				
Table 5.4 Parameters setting for IEC60044-1/GB1208 PX CT					

Parameters name	Description				
ALF	Accuracy limit factor in nameplate. Range 1~300				
Ktd	Transient dimension factor in nameplate. Range1~300				
Accuracy limit voltage	Accuracy limits voltage in nameplate. Range 0~10000.00				
Accuracy limit current	Accuracy limits current in nameplate. Range 0~9.9999A				
Table 5.5 Parameters setting for IEC60044-6 TPS CT					

Parameters name	Description
Kssc	Symmetric short circuit current factor. Range 1~300
Ktd	Transient dimension factor in nameplate. Range1~300
Тр	Primary loop time constant. Range 0~10000ms
Val	Accuracy limits voltage in nameplate. Range 0~10000V



lal	Accuracy limits current in nameplate. Range 0~9.9999A							
Table 5.6 Parameters setting for IEC60044-6 TPX/TPY CT								
Parameters name	Description							
Kssc	Symmetric short circuit current factor. Range 1~300							
Ktd	Transient dimension factor in nameplate. Range1~300							
Тр	Primary loop time constant. Range 0~10000ms							
Ts	Secondary loop time constant. Range 0~100000ms							
Duty cycle	C-O or C-O-C-O duty cycle selection. This parameter is response for							
	calculation and evaluation.							
t1	The duration of first current flow. Range 0 \sim 10000ms.This parameter							
	is response for calculation and evaluation.							
t2	The duration of second current flow. Range 0 \sim 10000ms.This							
	parameter is response for calculation and evaluation.							
t-al1	The time specified accuracy being maintained during in first current							
	flow. Range 0 \sim 10000ms. This parameter is response for calculation							
	and evaluation.							
t-al2	The time specified accuracy being maintained during in second							
	current flow. Range 0 \sim 10000ms. This parameter is response for							
	calculation and evaluation.							
tfr	Time interval between interruption and re-application of primary							
	short-circuit current during a circuit breaker auto-reclosing duty							
	cycle. Range: 0~5000ms							

Table 5.7 Parameters setting for IEC60044-6 TPZ CT

Parameters name	Description
Kssc	Symmetric short circuit current factor. Range 1~300
Ktd	Transient dimension factor in nameplate. Range1~300
Тр	Primary loop time constant. Range 0~10000ms
Ts	Secondary loop time constant. Range 0~100000ms

Table 5.8 Parameters setting for C57.13 CT

Parameters name	Description				
RF	Continuous thermal current rating factor in nameplate. Range				
	0~10.00.				
	If the parameter is not 0 analyzer would calculate the ratio and phase				
	error at RF*Rated current. This parameter is response for calculation				
	and evaluation.				
VB	Rated secondary voltage in nameplate. This parameter is response				
	for calculation and evaluation. Range 0~10000.0V				



5.2.3 Test results for CT analysis

Panel as figure 4.7 would be showed on LCD first when CT analysis test is end. Click the button on the bottom of the panel you can get different results item for CT analysis. The functions of those buttons are as follow:

1 Hysteresis loop curve and data

Click on "hysteresis loop" button. The hysteresis loop curve will be showed on the screen as figure 5.2.1. This curve is the saturation hysteresis loop curve which is measured in a constant frequency sine voltage. The test frequency is listed on the left of the panel. The X coordinates of the curve is the instantaneous current value and the Y coordinates of the curve is the core flux value. The whole hysteresis loop curve is consisted by rise curve and fall curve. Click on the "data analyze" check box you can read the current, rise curve flux value and fall curve flux value from the curve. Click on the hysteresis loop data. All the rise curve data and fall curve data will be listed on the window.

				CT Ana	alyzer-V	2 (1. 21. 1	.07)				
New test	Save	0	pen	Syste Setti	em l ng (i	Language 吾言选择)	Trai S	nsformer etting	Data Outpu	ıt	Help
X Current/A Y Flux/Wb	0.2010										
Curve title Hysteresis loop	0.1508	والمراجع والمراجع والمراجع									
Data analyze	0.1005										
< <left< td=""><td>0. 0503</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></left<>	0. 0503										
>>Right	0.0000						/				
Test Frequency 0.0Hz	-0. 0503										
	-0.1005	والمراجع وبالمراجع والمراجع									
	-0. 1508										
	-0.2010										
Hysteresis loop data	-0.2513	-5.0050	-4.0040	-3.0030	-2.0020	-1.0010	0.0000	1.0010	2.0020	3.0030	4.0040
Hysteresis loop	Excitation curve data	Excitation curve	Error da	curve Ita	Error curve	Rati phase	o and error	Coil Resistance	e Seconda burden	ry e	Test evaluation
Test time: 20	11-04-10 16h3	7m34sec			Rep	ort model	1 W	ORD test repo	ort		*
Test address: Unknown					Operator: Unknown Make Rep(ake Report
Test company:	Unknown				Test	code: 0000	00				1
Run State:	Offline Vie	w saved test re	sults	Test item						_	
 態英 ッ・ 大国	≡ 8 1 .								Test setting		Run test

Figure 5.2.1 Hysteresis loop curve

2 Excitation curve data

Panel as figure 5.2 would be showed on LCD when this button is clicked. All the data which construct the excitation curve would be showed in the list box. Drag the slide on the right of the panel you can view all data in the list box.

The knee voltage and current of excitation curve are showed on the bottom of the panel. There is a search function excitation data show panel. You can find the excitation current fast by



			CT Analy	zer-V2(1.21.	107)		
New to	est	Save	pen System Setting	Language (语言选择	Transformer Setting	Data Output	Help
Exc	itation curv	ve data					
	Group	Excitation	I Excitation	V Group	Excitation I	Excitatio	on V 🔷
•	1	0. 0000A	0.000V	187	0. 0133A	19.00V	
	2	0. 0004A	0.105V	188	0. 0133A	19.11V	
	3	0.0005A	0. 206V	189	0.0134A	19.21V	
	4	0.0007A	0.307V	190	0.0134A	19.31V	
	5	0. 0008A	0.410V	191	0.0135A	19.41V	
	6	0.0010A	0.512V	192	0. 0136A	19.52V	
	7	0.0011A	0.615V	193	0. 0136A	19.62V	
	8	0.0013A	0.715V	194	0.0137A	19.72V	
	9	0.0014A	0.816V	195	0.0137A	19.82V	
	10	0.0015A	0.918V	196	0. 0138A	19.92V	
	11	0.0017A	1.022V	197	0. 0139A	20. 02V	
	12	0.0018A	1.123V	198	0. 0139A	20.13V	
steres loop	iee point nee voltage sis Excitat curve d	32.4V V K tion Excitation curve	inee current 0.030A Error curve data	A Find exci Error Ra curve phas	itation data 0.0000 tio and Coil se error Resistan	00 🗘 V 0.000 Secondary burden	0 🗘 A Test evaluatio
lest time	2011-04-10	16h37m34sec		Report model	1 WORD test re	port	
est add	ress: Unknow	vn.		Operator: Unl	nown		
est com	pany: Unkno	wn		Test code: 000	0000		Make Rep
n State:	Offlin	e View saved test res	sults Test item				
転送って	,大國皆副					Test setting	Run test

search the excitation point according to excitation voltage.

Figure 5.2 Excitation curve data

3 Excitation curve



Figure 5.3 Excitation curve compare



The panel of excitation curve is as figure 5.3. The content of excitation curve panel includes follow items.

- 1) Excitation curve
- 2) Knee point voltage and current
- 3) Knee point show check box. If the box is checked the knee point would be marked on the curve. Otherwise there is no mark on the curve.
- 4) Excitation curve analysis buttons and data show panel. If excitation curve analysis check box is checked there is vertical line on the excitation curve. The voltage and current value which is the same position as the vertical line would be showed on the top panel.
- 5) Excitation curve compare with saved curve. The saved curve could be load to current results panel when "read saved curve" button is clicked. Both the two curves are drawn on the same scope as figure 5.3. We can find the exact change in transformer excitation curve by this function. The saved curve would be cleared when "clear saved curve" is clicked.

				CT Anal	zer-V2	(1.21.10	07)					
New test	Save	C	pen	System Setting	em Language ing (语言选择)		Transformer Setting		Data Output		Help	
X Secondary com… Y Times of pri…	. 69. 70											
Curve title	61.95											
Data analyze	54.21											
< <left< td=""><td>46. 46</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></left<>	46. 46											
>>Right	38.72											
	30.98											
	23. 23	1										
	15. 49	1										
	7.74											
	0.00								80.100			
		0.000	4.348	8.695 1	3.043	17.390	21.738	26.085	30. 433	34.780	39.128	
loop	Excitation curve data	Excitation curve	Error	ta	Error curve	phase	error	Coll Resistance	burder	ıry ı	evaluation	
Test time: 20	11-04-10 16h37	m34sec			Repor	t model	1 WO	RD test repo	ort		~	
Test address:	Unknown	Operator: Unknown										
Test company:	: Unknown			Test code: 000000								
Run State:	Offline View	v saved test re	sults 7	Fest item								
									Test setting		Run test	
態英し、大岡	₩8 ₽								c			

Figure 5.4 Error curve

4 Error curve data and error curve

There are error curve data and error curve results when the accuracy of CT is set to be IEC60044-1 protection type. The panel of error curve data and error curve are showed as figure 5.4 and figure 5.2. There is no knee point in error curve.

The X coordinates of error curve is maximum burden value allowed. The Y coordinates of error



curve is the times of rated primary current. If the value of secondary burden over than the maximum value in error curve the ratio error of sample CT would over than 10%(or 5%).

5 Ratio and phase error

The ratio error, phase error, turns ratio, turns ratio error and polarity would be showed on the panel as figure 5.5 when ratio and phase error or CT analysis test is end. The definitions of parameters in figure 5.5 are described as table 5.9.

		5		CT Analy	yzer-	V2 (1	. 21. 107)			
Nev	w test	Save	Ор	en System Setting	(Lang 语言	uage Transfor 选择) Settin	mer g Data O	utput Help	
CT	Test con	dition and	standards			Tu	n ratio and polarit	v		
Pa	ted Dri en	ment 20	0.0 A Bota	d Sac current 1			Turn votio 100	04. 1	CT Polority	
Ка		20	A Kat		A			.04: 1	CIFUAINy	
Sta	ndard I	EC60044-	1/GB1208	Frequency 50	Hz	Tw	n ratio error 0.4	8%	Same polarity (-)	
Ra	tio and ph	ase error	at rated burde	n		Rat	io and phase error	at work burde	en	
Ra	ted burde	n <u>5.00</u>	ohm Pov	ver factor 1.00		Wo	rk burden 5.00	ohm Pow	ver factor 1.00	
	I% rat	ed t	Ratio error(%)	Phase error(min)	*		I% rated current	Ratio error(%)	Phase error(min)	
•	1%		-1.02%	-82.72'		•	1%	-1.02%	-82.72'	
	5%		-0.15%	-36.93'			5%	-0.15%	-36.93'	
	20%		-0.03%	-25.79'			20%	-0.03%	-25.79'	
	50%		0.04%	-19.27' -14.61'		50% 100%		0.04%	-19.27'	
	100%		0.07%					0.07%	-14.61'	
	120%		0.07%	-13.40'		120% 0		0.07%	-13.40'	
_	Ext100	.0%	0.07%	-14.61'	~	Ext100.0% 0.07% -14.61				
Hyste	eresis E: op cu	xcitation uve data	Excitation curve	Error curve data	Ентон сшую		Ratio and phase error Re	Coil Seco sistance bu	ndary Test rden evaluation	
Test	time: 2011-	04-10 16h37	m34sec		Rej	port m	odel 1 WORD	test report	~	
Test address: Unknown Operator: Unknown										
Test	Test company: Unknown Te:						. 000000		Make Report	
Run St	ate:	Offline Vie	w saved test resu	lts Test item						
振英	し・, 大闘	8 B.						Test set	tting Run test	

Figure 5.5 the results of ratio and phase error

Table 5.9 Ratio and phase error results panel

Parameters name	Description				
Rated primary current	Response for turns ratio error calculation				
Rated secondary current	Response for turns ratio error calculation and test procedure				
	control				
Standard	Response for ratio and phase error calculation				
Test frequency	Response for ratio and phase error test procedure control				
Turns ratio	Turns ratio measured				
Turns ratio error	Turns ratio error. Calculated by (Turns ratio measured-Rated				
	current ratio) /Rated current ratio. Rated current ratio= (rated				
	primary current/rated secondary current)				
Polarity	The polarity measured of current connection. The polarity is				
	either same polarity(-) or reverse polarity(+)				



Rated burden	Rated burden marked in nameplate. It is response for ratio and phase error calculation
Power factor of Rated burden	Power factor of rated burden. It is response for ratio and phase calculation
Ratio and phase error in rated burden	Ratio and phase error which are calculated by rated burden
Work burden	The actual burden connected to the sample CT secondary circuit
Power factor of work burden	Power factor of work burden. It is response for ratio and phase calculation
Ratio and phase error in work burden	Ratio and phase error which are calculated by work burden

6 Coil resistance

Panel as figure 5.6 would be showed on LCD if the button of coil resistance is clicked when CT analysis is end.

		1000	CT A	nalyze	r-V2 (1. 21. 107	7)		
New test	Save	Open	Sys Set	tem ting	Language (语言选择)	Transformer Setting	Data Output	Help
- Test res	sults at cur	rent temperat	ure					2
Tes	t current	0.510	Α	Te	st temperature	32.6	Celsius	degrees
Tes	t voltage	0.3265	V	(Coil Resistance	0.6395	ohm	
Referen	nce value a	nt 75 Celsius d erature 75.0	egrees Celsius de	grees (Coil Resistance	0.7410	ohm	
Hysteresis E loop cu	xcitation urve data	Excitation 1 curve	Error curve data	En	ror Ratio a rve phase e	nd Coil rror Resistan	Secondary burden	Test evaluation
Test time: 2011	-04-10 16h371	n34sec			Report model	1 WORD test re	eport	~
Test address: U	Test address: Unknown Operator: Unknown Make Report							
Test company:	Unknown	1	T		Test code: 000000			
Kun State: 」「鰡英つ・大岡	SE	-saved test results	I est iten				Test setting	Run test

Figure 5.6 the results of coil resistance

The parameters definitions in coil resistance panel are as table 5.10 Table 5.10 results of coil resistance

Parameters name	Description
Test current	The current applied to CT secondary coil
Test temperature	The actual atmospheric temperature of test start
Test voltage	The DC voltage measured from CT coil



Coil resistance	Coil resistance in test temperature
Reference temperature	The reference temperature marked in CT nameplate
Coil resistance in reference	The formula for coil resistance in reference temperature is
temperature	$R_{ref} = R \times (1 + TK_{copper} (T_{ref} - T_{meas}))$
	Kcopper is the temperature factor for copper material

7 Excitation parameters and evaluation item,

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The panel of excitation and evaluation item is showed as figure 5.7. The excitation result items are different for different accuracy CT. Please refer to Chapter 6 for detail information.

The evaluation result items are showed in bottom list box of figure 5.7. The evaluation items of CT analysis are constructed by different single item evaluation result. If one of the evaluation items is fail the item would be marked in red color. The final evaluation passes only when all single item evaluation pass. Please refer to chapter 6 for detail definition of evaluation for different accuracy CT.

	CT Analyzer-V2 (1. 21. 107)														
	New	test	Save		Ор	en	Sy: Se	stem tting	ן (ז	Language 吾言选择)	Tr	ansformer Setting	Data Output	Helj	p
		Calculat	ion parameter	umeters Value Calculation pa						ramete	15		Value		
	Accuracy factor ALF at rated burden 6.6 Secondary lo							Secondary loop	o time o	onstant at worl	k burden	0.682s			
	Error at ALF in rated burden						99.9%		Saturation con	ductor	Ls		3mH		
		Accuracy	factor ALF a	t work bu	urden			6.6		Un-saturation	conduc	tor Lm		3.92H	
		Error at .	ALF in work t	urden				99.9%		Remanence flu	ıx Kr			93.0%	
		Secondar	y loop time co	nstant T	's at rated	burden		0.682s							
	*				-										
	1	Evaluatio	on item								Evalua	tion standards		Results	^
	+	Accuracy	factor ALF a	t rated b	urden 6.6						>Accu	acy factor ALF	in nameplate 10.0	Fail	
		Ratio err	or at 100% ra	ted curr	ent at rate	ed burden <i>(</i> 0.0	07%)				Maxim	um error 3.00%	6	Pass	
		Accuracy	factor ALF a	t work bu	urden 6.6		,				>Accu	acy factor ALF	in nameplate 10.0	Fail	
		Ratio err	or at 100% ra	ted curr	ent at wor	k burden(0.0	07%)				Maximum error 3.00%			Pass	
															~
	Eva	luati	ion star	ıdar	dsIE0	C6004	4-1	/GB1	208	8 10PC	lass	• •	CT evaluati	on fail	
H	ystere	esis E	xcitation	Excit	ation	Error c	urve	E	ror	Ratio	and	Coil	Secondary	Tes	t
	loop	CI	urve data	cur	ve	data	ı	cu	urve	phase	error	Resistan	ce burden	evalua	tion
т	ost tir	. 2011	-04-10 1653	m34sec					Ren	ut model	1.1	WORD test re	nort		
T	ont od	duces I	Internet	1104500					One	oton Unline		HOLD MALL	pore		
								Make R	eport						
Т	Test company: Unknown Test code: 000000														
Ru	n Stat	91	Offline Vie	w saved	test resu	lts Te	est iter	m							
														_	
													Test setting	Runt	est

Figure 5.7 Excitation and evaluation results panel



5.3 CT ratio and phase error measurement

5.3.1 Parameters setting for ratio and phase error test

The panel of ratio and phase error test is the same as CT analysis test. Please reference to chapter 5.2.

5.3.2 Test procedure for ratio and phase error test

The connection and test procedure is the same as CT analysis test except excitation curve measurement. There is no excitation test in ratio and phase error test. The typical procedure for ratio and phase error test is as follow:

Coil resistance test->Degaussing first->Degaussing second-> Accuracy voltage regulation for ratio and phase error measure-> Rough voltage regulation for ratio and phase error measure

1) If the parameters of saturation is set to be non-automatically the procedure of degaussing first would be ignore.

2) If the saturation of CT is low the procedure of rough voltage regulation would be ignore

5.3.3 Ratio and phase error results

The panel of ratio and phase error results is the same as CT analysis test. Please reference to chapter 5.2.

5.4 CT coil resistance measurement

There is no parameters need to be set except CT ID in coil resistance test. Analyzer injects a 0.5A DC current to CT secondary coil when coil resistance test is started. The coil resistance value would be stable when coil was charged to saturation. The test records the coil resistance, current temperature, test current and coil voltage when the test is end.

The results of coil resistance test include coil resistance in current temperature, actual test current, actual coil voltage and coil resistance in reference temperature. The results panel of coil resistance test is the same as that in CT analysis test.

5.5 CT polarity test

There is no parameters need to be set except CT ID in polarity test. Analyzer injects a AC



voltage to CT secondary coil when polarity test is started. Both the primary and secondary coil voltage would be sampled at the same time. The test would be end when primary voltage reached a threshold value or secondary voltage reached to the maximum value.

CT /	Analyzer-V2(1.21.107)	
New test Save Open Sy	rstem Language Tran (语言选择) Se	sformer etting Data Output Help
Hysteresis Loop Excitation curve data Excitation curve	bolarity	Coil Secondary Test evaluation
Test time: 2011-04-10 16h35m26sec	Report model 1 WC	ORD test report
Test address: Unknown Test company, Unknown	Operator: Unknown Tost code: 000000	Make Repor
Run State: Offline View saved test results Test ite	m	
「「「」」の「「」」の「「」」の「「」」の「「」」の「「」」の「「」」の「「		Test setting Run test

Figure 5.8 Test results of polarity test

If there is a normal end in polarity test the result would be either same polarity (-) or reverse polarity (+). The abnormal end conditions are as follow:

- 1) The test is stopped manual
- 2) There is wrong connection in primary and secondary

The test result would be same polarity if the phase difference in primary voltage and secondary voltage is less than 90 degree. Otherwise the test result is reverse polarity. The results panel of polarity test is showed as figure 5.8.

5.6 CT secondary burden test

5.6.1 Parameters setting for secondary burden test

The parameters which are applied to CT burden test include test current, test frequency and CT ID. The panel of secondary burden setting is showed as figure 5.9.





Figure 5.9 Parameters setting for secondary burden test

The definitions of those parameters are as follow:

1) Test current

Test current is that the RMS value of current which would be injected to CT secondary circuit.

2) Test frequency

Test frequency is that the frequency of test current which would be injected to CT secondary circuit. There are 50Hz and 60Hz for selection in test.

3) CT ID

It is construction of saved file name.

5.6.2 The test procedure for secondary burden test

The test current is divided to be two range in secondary burden test. The current value and measurement range are as follow::

1) Test current 0.5A (RMS), measurement range 0~80ohm

2) Test current 0.25A (RMS), Measurement range 0~160ohm

Analyzer would inject a AC0.5A (or 0.25A) constant sine current to CT secondary circuit



when secondary burden test is started.

5.6.3 The test results of secondary burden test

	CT Analyzer-V2(1	. 21. 107)			
New test Save Open	System Lan. Setting (语言	guage Transformer 〔选择) Setting	Data Output	Help	
Rated secondary burden					
Rated secondary burden 5.00	VA 5.00	ohm Rated power f	actor 1.00		
Secondary burden measuremen	t				
Test current (RMS)	0.500	Α			
Test voltage (RMS)	0.953	V Test Frequency	50	Hz	
Secondary burden	1.906	VA Power factor	1.00		
Secondary complex resistance	1.906	ohm			
Hysteresis Excitation Excitation loop curve data curve	tror curve Error data curve	Ratio and Coil phase error Resistant	se Secondary burden	Test evaluation	
Test time: 2011-04-11 15h26m52sec	Report n	1 WORD test rep	ort	×	
Test address: Unknown Test company: Unknown	Operator Test cod	Operator: Unknown Test code: 000000			
Run State: Offline View saved test results	Test item				
「陽英し・大國왕乱」			Test setting	Run test	

The results panel of CT secondary burden is showed as figure 5.10.

Figure 5.10 Test results of CT secondary burden test

The results parameters of CT secondary burden test are as table 5.11. Table 5.11 Test results of CT secondary burden test

Parameters name	Description				
Rate secondary	Rated secondary burden showed in VA mode				
burden					
Rated power factor	Power factor of rated secondary burden				
Test current	The RMS value of test current				
Test voltage	The RMS value measured from CT secondary loop.				
Test frequency	The frequency of test current				
Work burden	The burden value measured from CT secondary loop.				
	It is showed in VA.				
Work power factor	Power factor of work burden				
Work resistance	The resistance of work burden.				
	It is showed in ohm				



5.7 PT Coil resistance measurement

The parameters setting panel of PT coil resistance test is showed as figure 5.11. There are two parameters need to be set in this test. PT ID in PT coil resistance test has no effect in test control. There are three selection items for test current. Please select right current according to sample resistance range.



Figure 5.11 Parameters setting for PT coil resistance test

The results of PT coil resistance test include coil resistance in current temperature, actual test current, actual coil voltage. The results panel of coil resistance test is the same as that in CT coil resistance except resistance in reference temperature.

5.8 PT polarity test

There is no parameters need to be set except PT ID in PT polarity test. Analyzer injects an AC voltage to PT primary coil when polarity test is started. Both the primary and secondary coil voltage would be sampled at the same time. The test would be end when secondary voltage reached a threshold value or primary voltage reached to the maximum value. The results panel of PT polarity is the same as CT polarity test.

If there is a normal end in PT polarity test the result would be either same polarity (-) or reverse polarity (+). The abnormal end conditions are as follow:



- 1) The test is stopped manual
- 2) There is wrong connection in primary and secondary

The test result would be same polarity if the phase difference in primary voltage and secondary voltage is less than 90 degree. Otherwise the test result is reverse polarity.

5.9 PT secondary burden test

5.9.1 Parameters setting for PT secondary burden test





The parameters which are applied to PT burden test are rated secondary voltage, test frequency and PT ID. The panel of PT secondary burden setting is showed as figure 5.12.

The definitions of those parameters are as follow:

1) Rated secondary voltage

The value measured by analyzer in PT secondary loop is complex resistance. And then analyzer calculates the burden by rated secondary voltage and the resistance measured. The unit format of PT burden in analyzer is VA. The formula of burden calculation is that Vrated*Vrated/R.

Vrated is the rated secondary voltage R is the mod of complex resistance measured.



2) Test frequency

Test frequency is that the frequency of test voltage which would be injected to PT secondary loop. There are 50Hz and 60Hz for selection in test.

3) PT ID

It is a part of saved file name.

5.9.2 The test procedure for PT secondary burden test

Analyzer injects voltage to PT secondary loop when test is started. The test would be end in one of the follow two conditions:

- 1) The current of circuit reach at 0.2A
- 2) The voltage of analyzer output reach at rated secondary voltage of PT

The results panel of PT secondary burden test is the same as CT secondary burden test. But there is no rated burden value showed in PT burden test.

5.10 PT ratio test

PT ratio test is different with CT ratio test. There is no ratio error and phase error measured in PT ratio test in analyzer. Only turns ratio, coil resistance in PT primary and polarity would be measured in PT ratio. The parameters setting panel of PT ratio test is as figure 5.13.



Figure 5.13 Parameters setting for PT ratio test

1) PT ID is a part of saved file name

2) Rated primary voltage and rated secondary voltage are applied to calculate the standard turns ratio and turns ratio error of PT.

3) Test standard. Different test standard in PT ratio test would get different test procedure.

If IEC60044-2/GB1207 has been selected analyzer would measure the primary coil resistance



first in ratio test. It is mean that the sample PT is an inductive voltage transformer.

If IEC60044-5/GBT4703 has been selected analyzer would not measure the primary coil resistance in ratio test. There is no coil resistance in primary of capacitor voltage transformer. Please set right test standard for sample PT before test is started.

The test results panel of PT ratio is as figure 5.14. Only turns ratio, turns ratio error and polarity would be showed on this panel.

	CT Analyzer-V2(1.21.107)								
New test	Save	Open	System Setting	Language (语言选择)	ransformer Setting	Data Output	Help		
ſ	CT Test condition	and standards -		Turn ratio and p	polarity				
	Rated Pri voltage	10000.0	V	Turn ratio	9999.514	100.000			
1	Rated Sec voltage	100.000	v	Turn ratio error	r 0.00%				

PT Polarity Reverse polarity (+)

Standard IEC60044-2/GB1207

Hysteresis loopExcitation curve dataExcitation curveError curve data	Error Ratio and phase error Res	Coil Secondary Test evaluation
Test time: 2011-04-11 15h26m52sec	Report model 1 WORD t	est report 😽
Test address: Unknown	Operator: Unknown	Make Report
Test company: Unknown Run State: Offline View saved test results Test item	Test code: 000000	
「「「「」」の「「」」の「」」の「「」」の「」」の「「」」の「」」の「」」の「		
		Test setting Run test

Figure 5.14 Test results of PT ratio



5.11 Make word test report

You can make word test report in analyzer when it is in "view results" or "View saved results" work state. Also this word report could be made in computer application offered by us.

The format of this word report is MS word 2003. The header and footer of word report could be set in system setting panel. The appearance of CT analysis test word report is showed as figure 5.17.

	CI analyser report	
C	T analyse test repor	t
	• •	
Test setting		
Test time - 2011-03-27 11626	inkarer	
Test address - WUHAN	-	
Test company: HYDL		
Operator: Unknow Test	code: 001994	
? Test results CT parameters		
Marafacturer:		
CT model:		
CT ID: whity		
Rated Pricurent: 200.0A	Rated Sec current: 1.0	A(
Test Frequency: 60.0Hz		
Test standards : IEC60044-1/	'GB 1208	
Actracy class: 10P Class		
Ratio and phase error at rat	ed burden(Raied burden	0.2VA/Power factor 1.00
%Rated Pri current	Ratio error(%)	Phase error(inin)

%Rated Pri current	Ratio error(%)	Phase error(inin)	
1%	-0.95%	-72.23'	

1%	-0.95%	-72.23'
5%	0.21%	-14.61
20%	0.39%	-5.73'
50%	0.42%	-4.49'
100%	0.42%	-3.82'
120%	0.43%	-3.68'
Ext100.0%	0.42%	-3.82'

Tatio and phase error at work burden(Work burden 0.2VA/Power factor 1.00)

%Rated Pri current	Ratio error(%)	Phase error(min)
1%	-0.95%	-72.23'
5%	0.21%	-14.61'

CI IESI REPORT Figure 5.17 CT analysis test word report



6 Evaluation and nameplate guess

6.1 Evaluation

6.1.1 Definition of evaluation

The definition of evaluation is that compare the test results with the limit of selected test standard. The evaluation is passing if all the test results meet the requirements of selected standard. Otherwise the evaluation would be failure.

Lots parameters of CT are associated with the secondary burden. So the test results would be different if the secondary burden connected to CT is different.

The evaluation module has 3 modes for selection. They are evaluation noting, evaluation for work burden only and evaluation for both rated and work burden.

1) The evaluation procedure would be closed if evaluation nothing is checked.

2) If the evaluation for work burden only is checked. Analyzer compare test results calculated in work burden only with selected standards. The results calculated from rated burden would be ignored. If all those parameters meet the requirements of selected standards the final evaluation would be passing. Otherwise the final evaluation is failure.
3) If the evaluation for both rated and work burden selected analyzer would compare both test results calculated in rated and work burden with selected standards. If all those parameters meet the requirements of selected standards the final evaluation would be passing. Otherwise the final evaluation would be passing. Otherwise the requirements of selected standards the final evaluation would be passing. Otherwise the final evaluation is failure.

6.1.2 The item and pass condition for evaluation

The items of evaluation are different for different accuracy transformer. The detail information of evaluation items is as table 6.1 to table 6.5.

Accuracy	Items	Pass condition
0.1 class	1) FS	1) FS measured<=FS rated
	2) Ratio and phase error in	2) Ratio error in 5% Is <=0.4%
	5%,20%,50%,100% rated	Ratio error in 20% Is<=0.2%
	secondary current in 25% and 100%	Ratio error in 100, 120% Is <=0.1%
	rated burden or work burden	Phase error in 5% Is<=15min
		Phase error in 20% Is<=8 min
		Phase error in 100, 120% Is<=5min

Table 6.1 Evaluation for IEC60044-1 measurement CT



		T
		Is: Rated secondary current
0.2 class	1) FS	1) FS measured<=FS rated
	2) Ratio and phase error in	2) Ratio error in 5% Is <=0.75%
	5%,20%,50%,100% rated	Ratio error in 20% Is<=0.35%
	secondary current in 25% and 100%	Ratio error in 100, 120% Is <=0.2%
	rated burden or work burden	Phase error in 5% Is<=30min
		Phase error in 20% Is<=15 min
		Phase error in 100, 120% Is<=10min
0.2S class	1) FS	1) FS measured<=FS rated
	2) Ratio and phase error in	2) Ratio error in 1% Is <=0.75%
	1%,5%,20%,50%,100% rated	Ratio error in 5% Is<=0.35%
	secondary current in 25% and 100%	Ratio error in 20,100,120% Is
	rated burden or work burden	<=0.2%
		Phase error in 1% Is<=30min
		Phase error in 5% Is<=15 min
		Phase error in 20, 100, 120%
		Is<=10min
0.5 class	1) FS	1) FS measured<=FS rated
	2) Ratio and phase error in	2) Ratio error in 5% Is <=1.5%
	5%,20%,50%,100% rated	Ratio error in 20% Is<=0.75%
	secondary current in 25% and 100%	Ratio error in 100,120% Is <=0.5%
	rated burden or work burden	Phase error in 5% Is<=90min
		Phase error in 20% Is<=45 min
		Phase error in 100, 120% Is<=30min
0.5S class	1) FS	1) FS measured<=FS rated
	2) Ratio and phase error in	2) Ratio error in 1% Is <=1.5%
	1%,5%,20%,50%,100% rated	Ratio error in 5% Is<=0.75%
	secondary current in 25% and 100%	Ratio error in 20,100, 120% Is
	rated burden or work burden	<=0.5%
		Phase error in 1% Is<=90min
		Phase error in 5% Is<=45 min
		Phase error in 20, 100, 120%
		ls<=30min
1.0 class	1) FS	1) FS measured<=FS rated
	2) Ratio and phase error in	2) Ratio error in 5% Is <=3%
	5%,20%,50%,100% rated	Ratio error in 20% Is<=1.5%



	secondary current in 25% and 100%	Ratio error in 100,120% Is <=1.0%
	rated burden or work burden	Phase error in 5% Is<=180min
		Phase error in 20% Is<=90 min
		Phase error in 100, 120% Is<=60min
3.0 class	1) FS	1) FS measured<=FS rated
	2) Ratio error in 50%,120% rated	2) Ratio error in 50% Is <=3%
	secondary current in 50% and 100%	Ratio error in 120% Is<=3%
	rated burden or work burden	
5.0 class	1) FS	1) FS measured<=FS rated
	2) Ratio error in 50%,120% rated	2) Ratio error in 50% Is <=5%
	secondary current in 50% and 100%	Ratio error in 120% Is<=5%
	rated burden or work burden	

Table6.3 Evaluation for IEC60044-1 protection CT

Accuracy	Items	Pass condition
5P class	1)ALF	1) ALF measured>=ALF rated
	2)Ratio and phase error in 100%	2) Ratio error in 100% Is<=1%
	rated secondary current	3) Phase error in 100% Is<=60min
10P class	1)ALF	1) ALF measured>=ALF rated
	2)Rated error in 100% rated	2) Ratio error in 100% Is<=3%
	secondary current	
5PR class	1)ALF	1) ALF measured>=ALF rated
	2)Ratio and phase error in 100%	2) Ratio error in 100% Is<=1%
	rated secondary current	3) Phase error in 100% Is<=60min
	3) Remanence factor kr	4) Kr<=10%
10PR class	1)ALF	1) ALF measured>=ALF rated
	2)Rated error in 100% rated	2) Ratio error in 100% ls<=3%
	secondary current	3) Kr<=10%
	3) Remanence factor kr	
PX class	1) Turns ratio error	1) Turns ratio error<=0.25%
	2) Accuracy limit voltage Ek	2) Ek measured>=Ek rated
	3) Accuracy limit current le	3) le measured>=le rated
	4) Dimension factor Kx	4) Kx measured>=Kx rated
	Coil resistance in 75 Celsius degree	5) Coil resistance in 75 degree
		<=Rated value in nameplate



Table 6.3 Evaluation for IEC60044-6 CT

Accuracy	Items	Pass condition
TPS class	1) Turns ratio	1) Turns ratio error <=0.25%
	2) Accuracy limit voltage Val	2) Val measured>=Val rated
	3) Accuracy limit current lal	3) lal measured <= lal rated
	4) Symmetric short current factor	4) K*Kssc measured>=K*Kssc rated
	Kssc	5) Coil resistance in 75 degree
	5) Coil resistance in 75 Celsius	measured <= rated value in
	degree	nameplate
TPX class	1) Ratio error in rated current	1) Ratio error in Is<= 0.5%
	2) Phase error in rated current	2) Phase error in Is<=30min
	3) Peak instantaneous error	3) Peak instantaneous <= 10%
	4) Kssc*Ktd measured	4) Kssc*Ktd measured >= Kssc*Ktd
	5) Coil resistance in 75 Celsius	rated
	degree	5) Coil resistance in 75 degree
		measured <= rated value in
		nameplate
TPY class	1)Ratio error in rated current	1) Ratio error in Is<= 1.0%
	2)Phase error in rated current	2) Phase error in Is<=60min
	3)Peak instantaneous error	3) Peak instantaneous <= 10%
	4) Kssc*Ktd measured	4) Kssc*Ktd measured >= Kssc*Ktd
	5) Coil resistance in 75 Celsius	rated
	degree	5) Ts measured <= 30% rated in
	6) Remanence factor kr	nameplate
	7) Secondary loop time constant Ts	6) Kr<=10%
		7) Coil resistance in 75 degree
		measured <= rated value in
		nameplate
TPZ class	1)Ratio error in rated current	1) Ratio error in Is <=1.0%
	2)Phase error in rated current	2) Phase error in Is <=180min
	3) Kssc*Ktd measured	3) Kssc*Ktd measured >=Kssc*Ktd
	4) Coil resistance in 75 Celsius	rated
	degree	4) Ts measured <= 30% Ts rated in
	5) Secondary loop time constant Ts	nameplate
		5) Coil resistance in 75 degree
		measured <= rated value in
		nameplate



Accuracy	Items	Pass condition
0.3 class	Ratio error in 10%,100% and	Ratio error in 10% Is<=0.6%
	RF*100% Is in rated or work burden	Ratio error in 100,100*RF% Is<=0.3%
0.6 class	Ratio error in 10%,100% and	Ratio error in 10% Is<=1.2%
	RF*100% Is in rated or work burden	Ratio error in 100,100*RF% Is<=0.6%
1.2 class	Ratio error in 10%,100% and	Ratio error in 10% Is<=2.4%
	RF*100% Is in rated or work burden	Ratio error in 100,100*RF% Is<=1.2%

Table 6.4	Evaluation	for	C57 13	measurement CT
Table 0.4	Evaluation	101	607.13	measurement CT

Table 6.5 Evaluation for C57.13 CT

Accuracy	Items	Pass condition
C class	1) Vbmax measured	1) Vbmax measured >=Vbmax rated
	2) Secondary current Isec in Vbmax	(If the value of Vbmax rated is
	3) Ratio error in 20*Isn	missing analyzer would set the value
	4) Ratio error in Vbmax rated	to 20*Is*Rated burden)
		2) Isec measured >=20*Is rated
		3) Ratio error 20*lsn<=10%
		4) Ratio error Vbmax rated<=10%
		Isn rated secondary current
K class	1) Vbmax measured	1) Vbmax measured >=Vbmax rated
	2) Secondary current in Vbmax	2) Isec measured >=20*Is rated
	3) Ratio error in 20*Isn	3) Ratio error 20*lsn<=10%
	4) Ratio error in Vbmax rated	4) Ratio error Vbmax rated<=10%
		5) Knee point voltage>= 70% Vbmax
		rated
T class	1) Vbmax measured	1) Vbmax measured >=Vbmax rated
	2) Secondary current in Vbmax	2) Isec measured >=20*Is rated
	3) Ratio error in 20*Isn	3) Ratio error 20*lsn<=10%
	4) Ratio error in Vbmax rated	4) Ratio error Vbmax rated<=10%
		Isn rated secondary current

6.2 Calculation of excitation parameters

One of CT analysis results panels is excitation and evaluation panel. The evaluation results and excitation calculation parameters are listed in this panel. The excitation parameters for different CT accuracy are listed in table 6.6, table 6.7 and table 6.8.

Table 6.6 Excitation calculation parameters for IEC60044-1

Parameters	Description	IEC60044-1measur	IEC60044-1
------------	-------------	------------------	------------



		ement CT	Protection CT
V-kn	Knee point voltage	\checkmark	\checkmark
l-kn	Knee point current	\checkmark	\checkmark
Ek	Accuracy limit voltage for PX		\checkmark
le	Accuracy limit current for PX		\checkmark
FS	Instrument security factor	\checkmark	
ALF	Accuracy limit factor		\checkmark
Кх	Dimension factor for PX CT		\checkmark
Ls	Saturation inductor	\checkmark	\checkmark
Lu	Non-saturation inductor	\checkmark	\checkmark
Ts	Secondary loop time constant	\checkmark	\checkmark
Kr	Remanence factor	√	\checkmark
Ktd	Dimension factor		\checkmark

Table 6.6 Excitation calculation parameters for IEC60044-6

Parameter	Description	TPS	TPX/Y	TPZ
s				
V-Kn	Knee point voltage	\checkmark	\checkmark	\checkmark
l-Kn	Knee point current	\checkmark	V	\checkmark
V-al	Accuracy limit voltage for TPS	\checkmark		
I-al	Accuracy limit current for TPS 🛛 🗸			
Kssc	Symmtric short current factor			
Eerror	Peak instantaneous error in Emax		\checkmark	
Emax	Maximum EMF		\checkmark	
Ls	Saturation inductor	\checkmark	\checkmark	\checkmark
Lu	Non-saturation inductor		\checkmark	\checkmark
Ts	Secondary loop time constant		\checkmark	\checkmark
Kr	Remanence factor			
Ktd	Dimension factor		\checkmark	\checkmark

Table 6.8 excitation parameters calculation for C57.13 CT

Parameters	Description	C57.13	C57.13 protection
		measurement CT	СТ
V-kn	Knee point voltage	\checkmark	\checkmark
l-kn	Knee point current	\checkmark	\checkmark
FS	Instrument security factor	\checkmark	
ALF	Instrument security factor		\checkmark
Ls	Saturation inductor	\checkmark	\checkmark



Lu	Non-saturation inductor	\checkmark	\checkmark
Ts	Secondary loop time constant	\checkmark	\checkmark
Kr	Remanence factor	\checkmark	\checkmark

6.3 Definition of knee point and excitation curve

The definition of knee point and excitation curve is different for different test standard. The detail information for knee point and excitation curve are as table 6.9 and table 6.10. Table 6.9 Definition of excitation curve for different standard

Standard name	Y coordinates	X coordinates
IEC60044-1	Secondary terminal voltage in	Excitation current in RMS
	RMS	
IEC60044-6	Secondary EMF in RMS	Excitation current in peak
		value
C57.13	Secondary EMF in RMS	Excitation current in RMS

Table 6.10 Definition of knee point for different standard

Standard name	Definition of knee point
IEC60044-1	The point that excitation current(RMS) rise rate over 50%
	when the voltage rise rate is 10% in excitation curve
IEC60044-6	The point that excitation current(Peak value) rise rate over
	50% when the voltage rise rate is 10% in excitation curve
C57.13	The point that the positive cutting angle is 45 degree in
	excitation curve for C57.13 ANSI45 standard.
	The point that the positive cutting angle is 30 degree in
	excitation curve for C57.13 ANSI30 standard.

6.4 Nameplate information guess

The function of nameplate information guess is that get part of nameplate information from test results when nameplate is unknown. The information could be guessed include rated primary current, rated secondary current and accuracy class.

The guess logic for analyzer is as follow:

 If the value of rated secondary current is unknown analyzer get the value from the coil resistance measured. If the coil resistance in 75 Celsius degree is less than the threshold value the rated secondary current would be 5A. Otherwise the rated secondary current is 1A.



- 2) If the value of rated primary current is unknown analyzer get the value from the turns ratio measured and rated secondary current. The primary current of CT is the 1, 10,100 or 1000 times of 5,10,12,15,20 ,25,30,40,50,60and 75A.
- 3) Guess the accuracy of CT

First analyzer guesses the transformer core type from the saturation voltage value. If the saturation voltage of CT is less than the threshold value the core of CT is measurement. Otherwise the core of CT is protection.

If it is protection core analyzer guess the accuracy class as follow procedure.

1) If the test standard is IEC60044-1 analyzer set the accuracy according to follow step and evaluation for all the steps. The first class which passes the evaluation would be set to be the accuracy of the sample CT.

5PR->10PR->PX->5P->10P

2) If the test standard is IEC60044-6 analyzer set the accuracy according to follow step and evaluation for all the steps. The first class which passes the evaluation would be set to be the accuracy of the sample CT.

TPY->TPX->TPZ->TPS

2) If the test standard is C57.13 analyzer set the accuracy according to follow step and evaluation for all the steps. The first class which passes the evaluation would be set to be the accuracy of the sample CT.

K->C->T

If it is measurement core analyzer guess the accuracy class as follow procedure.

- If the test standard is IEC60044-1 analyzer set the accuracy according to follow step and evaluation for all the steps. The first class which passes the evaluation would be set to be the accuracy of the sample CT.
 0.1->0.2S->0.2->0.5S->0.5->1.0->3.0->5.0
- If the test standard is C57.13 analyzer set the accuracy according to follow step and evaluation for all the steps. The first class which passes the evaluation would be set to be the accuracy of the sample CT.
 0.3->0.6->1.2



7 Accessories list

7.1 CTPT analyzer standard configuration

Table 7.1 Standard configuration for CTPT analyzer

Name	qty	Description
Host	1	
3M mask cable	2	Test cable for power out and CT secondary connection
10M mask cable	1	Test cable for CT primary connection
Grounding cable	1	
Big test pliers	2	One red and one black
Test gasket	4	Two red and two black
Test pin	4	Two red and two black
Test pliers	12	Three red and nine black
Short connection cable	1	Including six connection terminals
3A fuse	3	
Power cable	1	
Accessories bag	1	
Production disk	1	Include Analysis application and instruction manual
Instruction manual	1	
Inspection report/Warranty card	1	



Appendix A the principle of low frequency excitation test

The voltage frequency of excitation test could be low than power frequency as it described in IEC60044-6 standard. So that the capacity of test source is achievable and also the insulation of secondary terminal of CT is safety. The formula of flux offered by IEC60044-6 is as follow:

$$\Psi(t) = \int_{0}^{t} [U_{CT}(t) - R_{CT}I_{CT}(t)]dt + \Psi_{0}$$
(A.1)

- R CT : Stand for secondary coil resistance
- U CT : Stand for secondary terminal voltage
- I CT : Stand for secondary current
- $\Psi 0 \quad : \ \text{Stand for initial flux}$
- $\Psi(t)$: Stand for flux in time t

The definition of EMF is as follow:

$$U_C(t) = U_{CT}(t) - R_{CT}I_{CT}(t)$$

(A.2)

If U C (t) is a sine signal:

$$U_{c}(t) = U_{Cm}\sin(\omega t + \frac{\pi}{2}) = \frac{d\Psi(t)}{dt} = \frac{d}{dt}(\Psi_{m}\sin\omega t) = \omega\Psi_{m}\sin(\omega t + \frac{\pi}{2})$$
(A.3)

$$U_{Crms} = \frac{\omega \Psi_m}{\sqrt{2}} = \frac{2\pi f \Psi_m}{\sqrt{2}} = 4.44 f \Psi_m \tag{A.4}$$

The f in formula is the frequency of sine signal. We can get the conclusion that the core voltage is proportional to the frequency. So just cut down the test frequency we can get the excitation curve of high saturation voltage CT in low voltage.



Appendix B 10% error curve calculation

The main contribution of ratio error in CT is excitation current lext. The current convert from primary to secondary is constructed by vector sum of lext and secondary current lst. So the value of primary is not equal to N*Iset(N is the turns ratio). We define the error curve line error value as follow.

$$\varepsilon = \frac{I_1^{'} - I_2}{I_1^{'}} \times 100 = \frac{I_0}{I_1^{'}} \times 100$$
 (B. 1)

Relay protection system require that the error is less than 10%. So we can get formula B.2 and B.3 if the power factor of burden is 1.0.

$$I'_1 = 10I_0$$
 (B. 2)
 $I_2 = 9I_0$ (B. 3)

M is defined as the times of rated primary current. K is the turn ratio of CT

$$M = \frac{I_{1M}}{I_{1N}} = \frac{K \times I_1'}{K \times I_{2N}} = \frac{10I_0}{I_{2N}}$$
(B.4)

$$Z_{B} = \frac{E_{0}}{I_{2}} - Z_{2} = \frac{E_{0}}{9I_{0}} - Z_{2}$$
(B.5)

I1M Maximum short circuit current in primary

I1N Rated primary current

I2N Rated secondary current

Z2 Secondary coil resistance

E0 EMF in secondary coil of CT

ZB Secondary burden

We can calculate the error curve according to formula B.4 and B.5. The X coordinates of the curve is secondary burden. The Y coordinates is the times of rated primary current.