Established 1981

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CT-7000 S2

digital circuit breaker analyzer

Vanguard Instruments Company, Inc.
www.vanguard-instruments.com

CT-7000 S2

digital circuit breaker analyzer

The CT-7000 S2 is Vanguard's third generation, stand-alone, microprocessor-driven EHV circuit-breaker analyzer. This inexpensive and easy to use analyzer is available in models with either 3 (CT-7000-3 S2), 6 (CT-7000-6 S2), or 12 (CT-7000-12 S2) dry-contact inputs. The CT-7000 S2 can fully analyze a circuit-breaker's performance by testing the contact time, stroke, velocity, over-travel, and contact wipe. Contact motion analysis can be performed for all circuit breaker operations (Open, Close, Open – Close, Close – Open, and Open – Close – Open). The CT-7000 S2's timing window is selectable between 1-second, 10-second, or 20-second periods. The 10-second and 20-second timing windows are ideal for timing long duration events such as circuit-switcher contact testing.

1

Contact Timing Inputs

The CT-7000 S2 is available in models with either 3 (CT-7000-3 S2), 6 (CT-7000-6 S2), or 12 (CT-7000-12 S2) dry-contact inputs. Each contact input channel can detect main contact and insertion-resistor contact times in milli-seconds and cycles.

2

Breaker Stroke and Velocity

Three digital travel transducer channels are available on the CT-7000 S2 for measuring circuit-breaker velocity, stroke, over-travel, and bounce-back. Unlike other transducer types, the digital transducer requires neither calibration nor setup. A breaker's contact-velocity is calculated based on the contact's travel distance over a period of time. A special feature is also available to "slow-close" test a breaker and obtain a test result report.

3

Resistor Type Transducer Input

One optional resistor type input channel is also available on the CT-7000 S2. This input channel allows the unit to measure circuit-breaker motion by directly interfacing with resistive type transducers. The transducer resistance ranges from 200 ohms to 10K Ohms.

4

Voltage Monitoring Inputs

One analog voltage input channel, designated as V1, is dedicated to monitoring a circuit-breaker's DC power supply or coil voltage (0 – 255 volts, DC or peak AC). A second voltage input channel, designated as V2, is dedicated to detecting the voltage on/off status (presence or absence) of an A/B switch.

5

Breaker Initiate Features

A built-in solid-state initiate device is used to operate a breaker from the CT-7000 S2. The operational modes include Open, Close, Open–Close, Close–Open, and Open–Close–Open. Multiple operations, such as Open–Close and Open–Close–Open, can be initiated by using programmable delay time or by sensing a breaker's contact condition.

A built-in Hall-effect current sensor records the Trip/Close current level and duration. The breaker's operate-coil current waveform duration (effectively, a performance "fingerprint" or "current profile") can be used as a diagnostic tool for analyzing a breaker's performance.

6

Built-in Thermal Printer

The CT-7000 S2's built-in 4.5-inch wide thermal printer can print the breaker contact analysis results in both tabular and graphic formats.

ordering information

Part number **CT-7000-3 S2**	CT-7000 S2 with 3 contact channels, cables, and PC software
Part number **CT-7000-6 S2**	CT-7000 S2 with 6 contact channels, cables, and PC software
Part number **CT-7000-12 S2**	CT-7000 S2 with 12 contact channels, cables, and PC software
Part number **CT-7000-CASE**	CT-7000 S2 shipping case
Part number **Paper-TP4**	Thermal printer paper

CT-7000 S2 Controls & Indicators

7

Computer Interface

The CT-7000 S2 can be computer-controlled via its RS232C or USB interface. Windows® based BreakerAnalysis software is provided with each unit. Using this software, circuit-breakers can be timed from the PC. Test records can be retrieved from the CT-7000 S2 and then stored on the PC for future analysis and report generation. Circuit-breaker test plans can also be created on the PC and transferred to the CT-7000 S2. Additionally, test records can be exported in Excel, PDF, and XML formats for further analysis.

8

User Interface

The CT-7000 S2 features a back-lit LCD screen (20 characters by 4 lines) that is viewable in both bright sunlight and low-light levels. A rugged, 16-key, membrane keypad is used to control the unit.

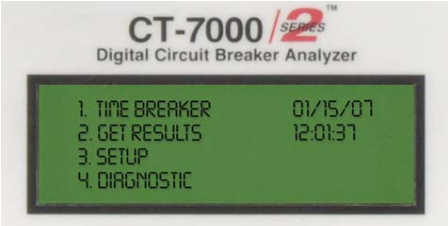
Internal Test Record and Test Plan Storage

Up to 150 test records can be stored in Flash EEPROM. Test records can be retrieved and printed on the built-in thermal printer, or they can be transferred to a PC via the unit's RS232C or USB interface.

Up to 99 circuit breaker test plans can be stored in Flash EEPROM. Test plans are comprised of all circuit-breaker performance specifications (stroke, velocity, and contact time). A test plan can be used to immediately test a circuit-breaker. A pass/fail report is then generated by comparing actual performance with the specifications in the stored test plan. Test plans can also be generated on a PC and transferred to the CT-7000 S2 via the unit's RS232C or USB interface.

Diagnostic Capabilities

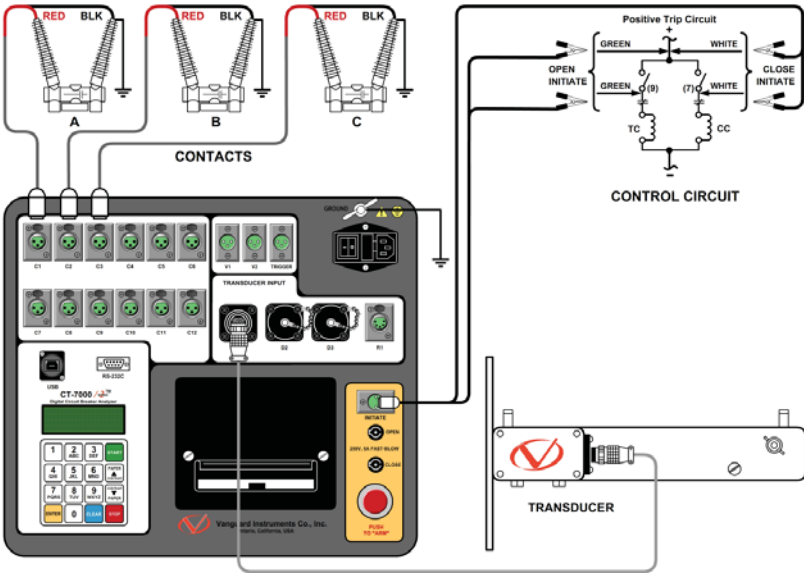
The CT-7000 S2 can perform diagnostics on its internal electronics. Diagnostics can also be performed to verify contact cable connections and to test the travel transducer's electronics.



outstanding features

- Prints breaker analysis results in both tabular and graphic formats
- Built-in 4.5" wide thermal printer
- Initiate breaker operation
- Digital travel transducer requires no setup or calibration
- Detects main contact and insertion contact on the same input channel
- Stores up to 150 test records and 99 test plans
- RS-232C and USB computer interfaces
- Supports resistor type transducer

CT-7000 S2 *connections*



CT-7000 S2 *desktop printer output*

Desktop printout of tabulated test results

Vanguard Instruments Company, Inc.

Filename:	GCB 42 OC 1.dat	Date/Time:	09/15/11 11:57:53
Company:	BGE	Manufacturer:	ALSTOM
Station:	HIGH RIDGE GIS	S/N:	4-5-6
Circuit:	GCB 42	Operator:	WJH
Model:	B105/4	Test:	OPEN-CLOSE

CONTACT (OPEN)				CONTACT (CLOSE)			
CHA	P/F Time(ms)	Cycle	Bounce(ms)	CHA	P/F Time(ms)	Cycle	Bounce(ms)
1	22.650	1.36	0.05	1	128.000	7.68	1.35
2	23.000	1.38	0.05	2	128.300	7.70	1.05
3	22.900	1.37	0.10	3	126.850	7.61	1.75
4	0.000	0.00	0.00	4	0.000	0.00	0.00
5	0.000	0.00	0.00	5	0.000	0.00	0.00
6	0.000	0.00	0.00	6	0.000	0.00	0.00

Delta Time(ms): 0.350 Delta Time(ms): 1.450

Travel Analysis	T1	T2	T3
Peak To Peak (mm)	206.502	205.994	205.994

Initiator Current: 7.708 A V1 Nominal: 1V V1 Min: 0V

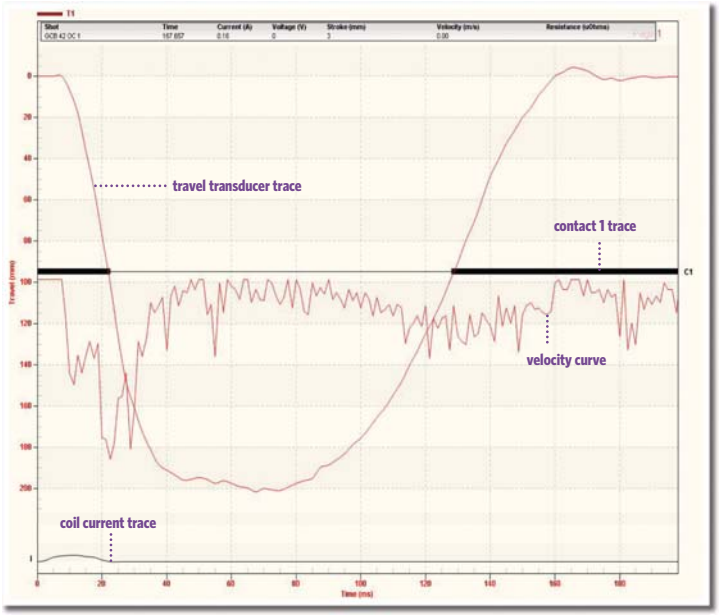
Shot Length: 1 SEC

Insertion Resistor: None

Delay: 10 (ms)

Trigger: Internal

Desktop printout of graphic test results



CT-7000 S2 *thermal printer output*

Thermal printout of tabulated test results

BREAKER TIMING RESULTS - 60 Hz

SHOT NUMBER: 3
DATE: 04/03/12 TIME: 09:27:02

COMPANY: VANGUARD INSTRUMENTS
STATION: MIRA
CIRCUIT: 220KV
MFR: MITSUBISHI
MODEL: 200 SFMT 63F
S/N:
OPERATOR: SPK

TEST: OPEN - CLOSE

CONTACT OPEN TIME

CH	TIME (mS)	CYCLES	BOUNCE (mS)
1	18.05	1.08	0.05
2	18.50	1.11	0.05
3	18.50	1.11	0.05

CONTACT RECLOSE TIME

CH	TIME (mS)	CYCLES	BOUNCE (mS)
1	135.90	8.15	1.55
2	136.05	8.16	1.60
3	136.00	8.16	1.50

CONTACT DEAD TIME

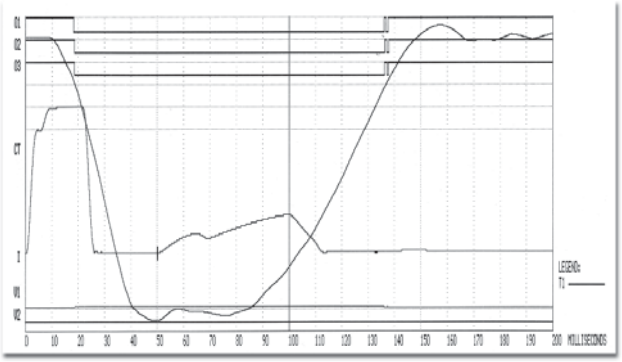
CH	TIME (mS)	CYCLES
1	117.85	7.07
2	117.55	7.05
3	117.50	7.05

PEAK TO PEAK TRAVEL (mm)
T1
211.8

V1 NOMINAL VOLTAGE = 1 VOLTS
V1 MINIMUM VOLTAGE = 0 VOLTS
INITIATOR CURRENT = 14.9 AMPS

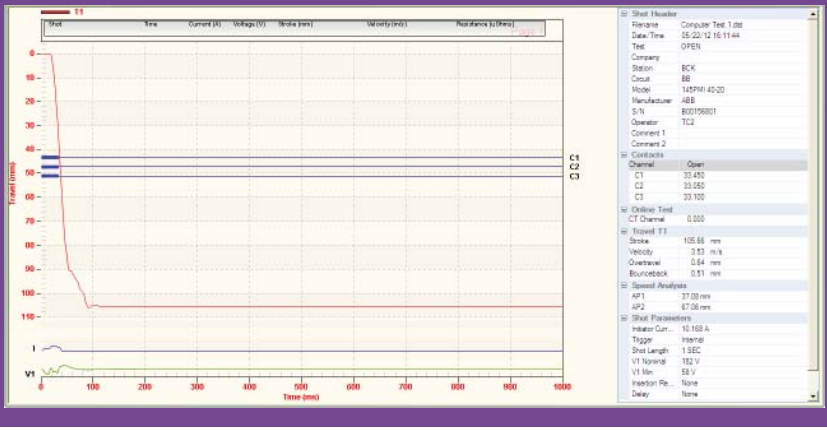
SHOT LENGTH: 1 SECOND
INSERTION RESISTOR: NO
TRIGGER: INTERNAL
DELAY: 50 mS

Thermal printout of graphic test results



Computer control and analysis with included VCBA S2 Software

The CT-7000 S2 comes with the Vanguard Circuit Breaker Analysis Series 2 (VCBA S2) PC software. The VCBA S2 software can be used to retrieve timing records from the CT-7000 S2, analyze retrieved records, view test results in graphic format, generate timing reports, create breaker test plans, transfer breaker test plans to the CT-7000 S2, and control the CT-7000 S2 from the PC to perform timing tests. The software can also be used to print test results to a desktop printer.



CT-7000 S2 specifications

type	portable digital circuit-breaker analyzer
physical specifications	16"W X 11"H x 14"D (40.6 cm x 29.9 cm x 35.6 cm); Weight: less than 25 lbs (11.3 kg)
input power	100 – 240 Vac, 50/60 Hz
dry-contact inputs	3, 6, or 12 dry-input channels (depending on model). Each channel detects main and insertion resistor contacts
timing windows	1 second, 10 seconds, or 20 seconds
timing resolutions	±50 micro-seconds @ 1 sec. duration, ±500 micro-seconds @ 10 sec. duration, ±1.0 milli-seconds @ 20 sec. duration
timing accuracy	0.05% of reading ±0.05 ms @ 1 second duration
dry-contact channel protection	all contact inputs are grounded until test; input channels are protected against static discharge
dry-contact detection range	closed: less than 20 ohms; open: greater than 5,000 ohms
resistor detection range	50 – 5,000 ohms
ct current sensor	one, non-contact, 0 – 100 amperes
trigger input voltage	open/close: 30 – 300 V, DC or peak AC
voltage sensing input range	V1: analog input; 0 – 255 V DC or peak AC; sensitivity ±1 V V2: voltage presence/absence detector input; 30 – 300 V DC or peak AC
breaker operations	Initiate Open, Close, Open-Close, Close-Open, Open-Close-Open
breaker initiate capacity	30A, 250 Vac/dc max
initiate current reading range	one, non-contact, Hall-effect sensor, 0 – 20 amp range, dc to 5 Khz
digital travel transducer inputs	3 digital travel transducer channels; linear range: 0.0 – 60.0 in (±0.01 in) rotary range: 0 – 360 degrees (±0.36 degrees)
optional resistor type transducer input	one channel, resistance range: 200 ohms – 10 K ohms
contact travel point difference	measures "slow-close" contact-point distances; results can be printed
display	back-lit LCD screen (20 characters by 4 lines); viewable in bright sunlight and low light
printer	built-in 4½" wide thermal printer that can print both graphic contact travel waveforms and tabulated test results
internal test record storage	stores up to 150 test records and 99 test plans
computer interfaces	one RS-232C port, one USB port
pc software	Windows® based Breaker Analysis software included with purchase price
safety	designed to meet UL 6101A-1 and CAN/CSA C22.2 No 1010.1-92 standards
environment	Operating: -10°C to +50°C (+15°F to +122°F); Storage: -30°C to +70°C (-22°F to +158°F)
humidity	90% RH @ 40°C (104°F) non-condensing
altitude	2,000 m (6,562 ft) to full safety specifications
cables	furnished with full set of test leads (including 20-foot contact leads and 30-foot contact lead extensions)
options	transportation case (available for the CT-7500 S2 and travel transducers)
warranty	one year on parts and labor

NOTE : the above specifications are valid at nominal voltage and ambient temperature of +25°C (+77°F). Specifications are subject to change without notice.

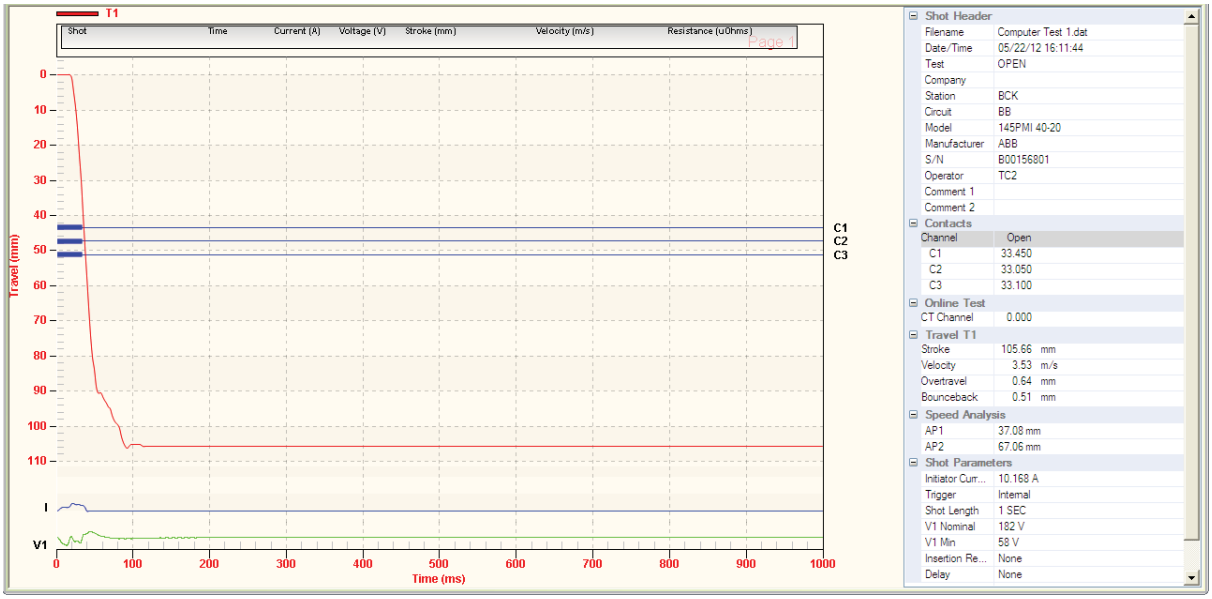
VCBA S2

Vanguard circuit breaker analyzer software

The Vanguard Circuit Breaker Analyzer Series 2 (VCBA S2) Windows®-based software is included with all compatible Vanguard Circuit Breaker Analyzers (CT-6500 S2, CT-7000 S2, CT-7500 S2, CT-8000, DigiTMR S2, DigiTMR S2 PC) at no additional cost. This robust application can be used to control the circuit breaker analyzer from a PC to perform CB timing tests. It can also be used to retrieve test records from the circuit breaker analyzer, analyze timing records, and view test results in tabulated and graphical format. Circuit breaker test plans can also be created and transferred to the circuit breaker analyzer.

Retrieving and Analyzing Test Records

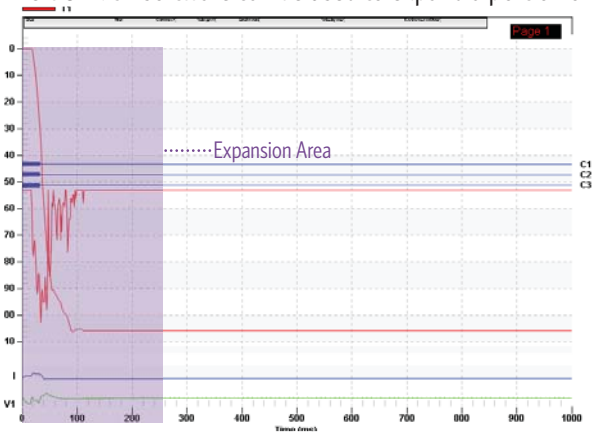
The VCBA S2 software can be used to quickly retrieve test records from a compatible Vanguard circuit breaker analyzer. Test results can be viewed in tabular and graphical format and can be saved on the PC hard drive. Test record header information, such as the company name, station, circuit, operator name, manufacturer, model, and serial number can also be edited.



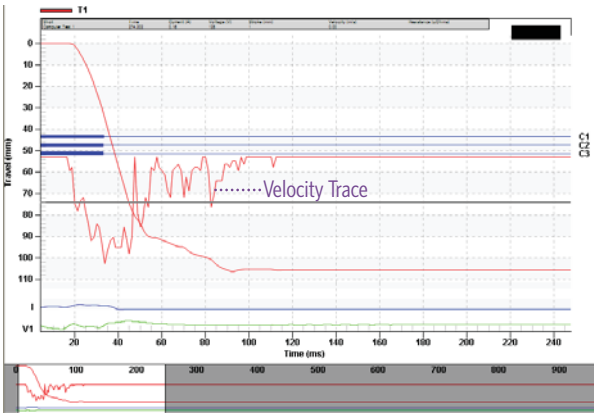
Sample Test Results (OPEN Test)

Getting a Closer View with Graph Expansions

The VCBA S2 software can be used to expand a portion of the graphical test results for more accurate analysis.



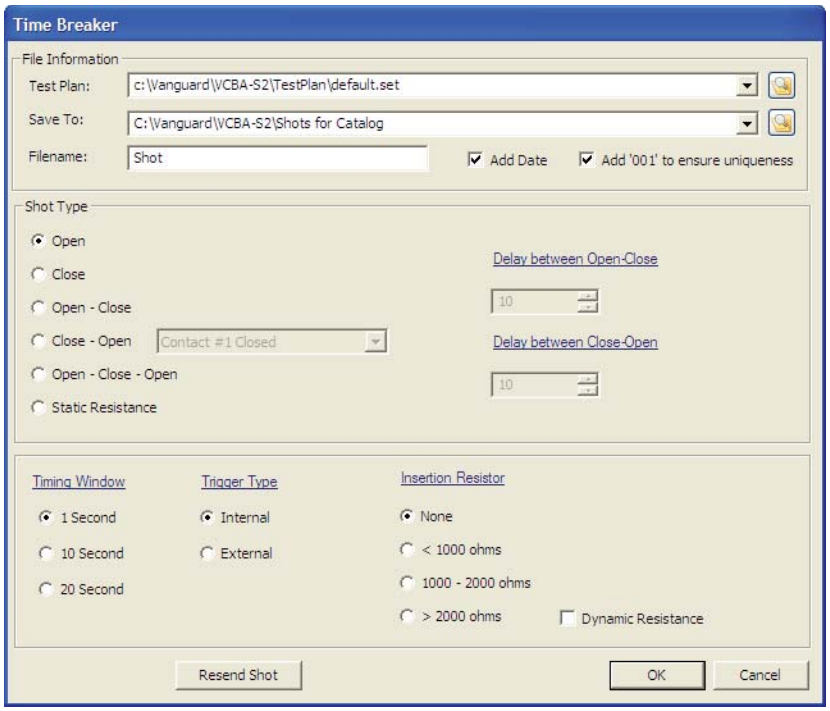
Graphical Test Results



Graphical Test Results Expansion (from 0 to 200ms)

Timing a Circuit Breaker with the VCBA S2 Software

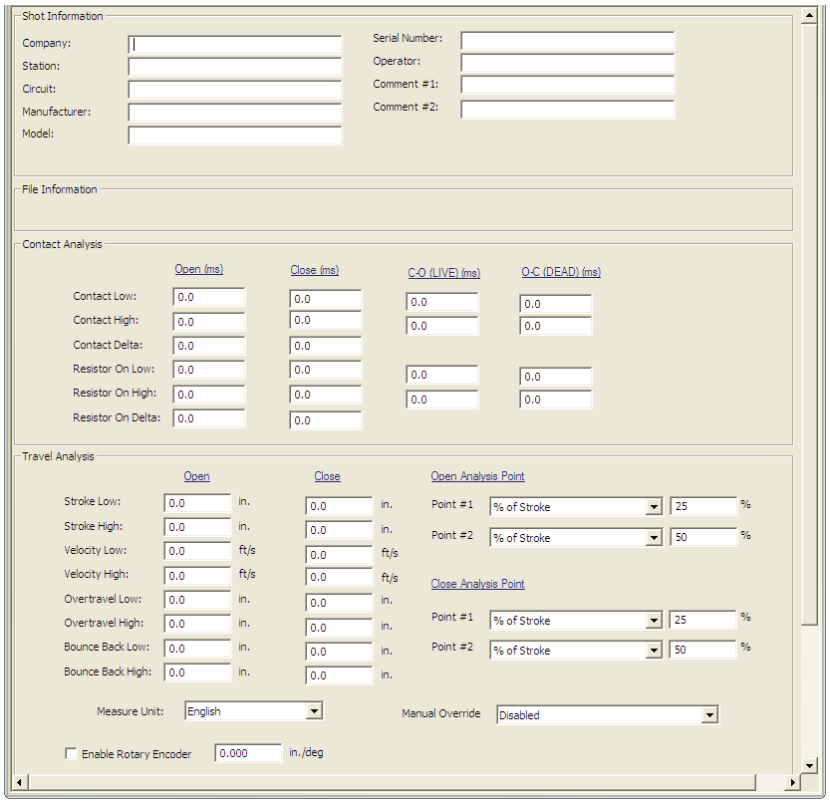
The VCBA-S2 software can be used to control a CB analyzer and run circuit breaker timing tests. The following tests are supported: OPEN, CLOSE, OPEN-CLOSE, CLOSE-OPEN, OPEN-CLOSE-OPEN, and STATIC RESISTANCE. Also, a test plan for a specific breaker can be used with the test. If a test plan is used, the Pass/Fail indicator will be displayed based on the settings in the test plan.



Breaker Testing Parameters

Creating Test Plans for Faster Testing

A circuit breaker test plan is comprised of all circuit-breaker performance specifications (stroke, velocity, and contact time). A test plan can be used to test a circuit breaker. When used with a test record, a Pass/Fail report is generated by comparing the actual performance of the breaker with the specifications in the stored test plan. Test plans can be easily created with the VCBA-S2 software and can be stored on the hard drive or transferred to a CB analyzer.



Creating a Test Plan

Instruments designed and developed by the hearts and minds of utility electricians around the world

Vanguard Instruments Company, (VIC), was founded in 1991. Currently, our 28,000 square-foot facility houses Administration, Design & Engineering, and Manufacturing operations. From its inception, VIC's vision was, and is to develop and manufacture innovative test equipment for use in testing substation EHV circuit breakers and other electrical apparatus.

The first VIC product was a computerized circuitbreaker analyzer, which was a resounding success. It became the forerunner of an entire series of circuitbreaker test equipment. Since its beginning, VIC's product line has expanded to include microcomputer-based, precision micro-ohmmeters, single and three phase transformer winding turns-ratio testers, transformer winding-resistance meters, mega-ohm resistance meters, and a variety of other electrical utility maintenance support products.

VIC's performance-oriented products are well suited for the utility industry. They are rugged, reliable, accurate, user friendly, and most are computer controlled. Computer control, with innovative programming, provides many automated testing functions. VIC's instruments eliminate tedious and time-consuming operations, while providing fast, complex, test-result calculations. Errors are reduced and the need to memorize long sequences of procedural steps is eliminated. Every VIC instrument is competitively priced and is covered by a liberal warranty.

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