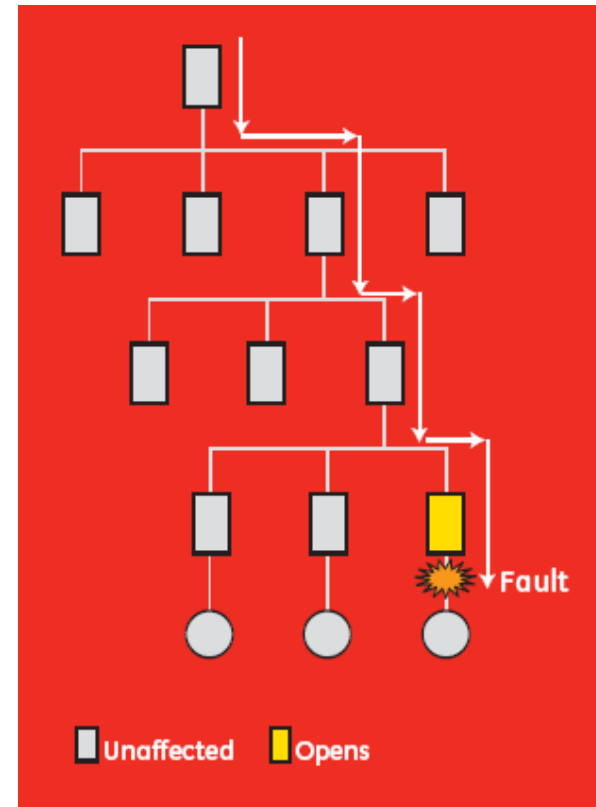


InstaPlan™ 2.0

A tool for planning power system instantaneous selective coordination



InstaPlan™ 2.0

InstaPlan allows the accurate and quick selection of circuit breakers based on their potential for being selective up to the full theoretical bolted fault value on a protected circuit.

You provide information regarding utility bus interrupting current levels, conductors, and distribution transformers. InstaPlan then estimates fault values at multiple buses, including asymmetry, and provides a selection of circuit breakers that are able to deliver the required fault and instantaneous selectivity performance.

InstaPlan™ 2.0

Provide your system information and InstaPlan will estimate fault values at multiple buses, including asymmetry, and then provide a selection of circuit breakers that are able to deliver the required fault and instantaneous selectivity performance.

INSTAPLAN, The Short Circuit Current Estimator and Instantaneous Selectivity Circuit Breaker Selection Tool

Tool calculates 1st cycle fault A, provides selection of CBs that meet selectivity requirements up to the fault current available at the load side device. Fault current values displayed are RMS values not reflecting fault current asymmetry. A full short circuit and coordination study is recommended. Version 2.0, July 3rd, 2007

Source Information Go To Directions & Assumptions If Checked estimator uses generators, otherwise transformer

Generators	Transformer	Output from Transformer
Generator kW: 3000	Type: Liquid filled, 150-2000kVA, 55/65 deg rise, with fans	Motor contribution at main panel: 0 A
Generator V: 480	Utility X/mfr kVA: 1000	Nominal Secondary Amperes: 1,203 A
Generator PF: 0.90	Utility X/mfr or Service V: 480	Extended current rating in %: 129 %
Generators in Parallel: 1	Utility X/mfr Z%: 5.30% Tolerance: 0	Extended Rating Amperes: 1,549 A
Total Generator kVA: 3,323	Mtr load % of Base kVA: 0	Max. SC Current A: 22,695 X/R: 5.2
Generator Subtransient Z%: 18%	Tolerance: 0 Volts: 0.0%	Source SCA: 100,000 A
Mtr load % of Base kVA: 100	System Tolerances Conductor Z: 0.0%	Service: 4,000 Amperes Mtr Contribution SCA: A

Conductors

Close Coupled Conductor Type: CU, PVC Conduit Cable Size: 500MCM

Calculate Cable, Seg 1 # of Cables/Phase: 7 Cable Run Length in Feet: 60

Busway Conductor Material: Busway copper Busway Amp Rating: 4000 Busway Run length: 30

Calculate Busway, Seg 2

Transformer 1

Capacity in kVA: 75 kVA Secondary Voltage: 208 Volts

Transformer Impedance %: 5.00 X/R: 1.85

Primary FLA: 30 Amperes Secondary FLA: 208 Amperes

LV Panel SCA at Primary V: 1,706 Amperes SCA at Transformer Secondary: 3,853 Amperes

Motor load: 0% of X/mfr Current SCA with Motor Contribution at panel: 3,825 Amperes

Util Panel SCA with motor contribution (4): 22,052 Amperes
 Util Panel SCA without motor contribution: 22,052 Amperes X/R: 4.9
 Util Panel Main Rating: 2500
 Util Panel Main Type: PB225025250
 Note, MCB selection based on CB AIC rating derated for X/R compared to panel's fault current inclusive of motor contribution.

Transformer 1 Primary 125%FLA: 113 Amperes
 Transformer 1 Primary 250%FLA: 226 Amperes
 Transformer 1 Primary CB Rating: 20 To Transformer
 Avail Transformer 1 Primary CB Type: (3 pole)

Branch Rating Poles: 3 poles Branch Rating: 500 Branch Type: TK08500
 Distribution Panel Main Rating: 400 To panel below
 Distribution Panel Main Type: FG40400 (3 pole)

Transformer 1 LV Panel

Transformer 1 LV Panel SCA: 3,825
 X/R: 1.7
 Suggested Transformer 1LV Main Min Rating A: 260
 Suggested Transformer 1LV Main CB Max Rating A: 520


Transformer 1LV Panel Main CB (3P) Rating: 300
 Avail Transformer 1LV Panel Main CB Type: FG403000
 Transformer 1LV Panel Branch Rating Poles: 1 pole
 Transformer 1LV Panel Branch Rating: 15
 Transformer 1LV Panel Branch Type: #REF!

Transformer 2

Cover Instructions SC Summary Txmfr Main Txmfr Windings CB Designations

InstaPlan™ 2.0

Full Instructions and Assumptions are provided



Version 2.0,
July 3rd, 2007

INSTAPLAN, The Short Circuit Current Estimator & Instantaneous Selectivity Circuit Breaker Selection Tool

Instructions and Assumptions

[Go To Short Circuit Estimator & Circuit Breaker Selector](#)
[Go To Introduction](#)

- 1) Tool will estimate short circuit currents based on defined available source fault values and various system impedances. Actual values should be confirmed using full systems analysis software. In addition the spread sheet will provide indication of GE circuit breaker types that fulfill the instantaneous selectivity and short circuit requirements imposed by the system. The values displayed are RMS fault current values that do not reflect fault current asymmetry. Selectivity logic is based on the RMS value of current or the 1st half cycle peak, inclusive of asymmetry.
- 2) Tool identifies circuit breaker families that may meet the requirements. Circuit breakers are defined by frame type and size, trip size or sensor and plug size where applicable. Circuit breakers may be provided in various short circuit ratings, selectivity level used herein reflect the selectivity capability of the highest rated CB within the family. A lower rated CB from the same family may be used if suitable for the application. For more exact definition of circuit breaker part numbers see the GE catalogs or contact your GE salesman. A guide to circuit breaker nomenclature used can be found at:

[Go To CB Nomenclature Guide](#)
- 3) The main breaker selections include ANSI circuit breakers without an instantaneous trip. If the system being estimated has multiple levels of ANSI CBs without IOC trips you may start the analysis at the lowest such CB.
- 4) Tool allows three types of power sources. Transformers (1), Generators (1-4 in parallel) or a defines bus.
- 5) Transformer fault current is calculated by the following formula:

$$I_{Txfmr\ Fault} = (I_{Txfmr\ FLA} / (Z_{Txfmr} \times (1 + Z_{Tolerance}))) \times (1 + V_{tolerance})$$

this allows the user to include a transformer Impedance tolerance of 0 or 7.5%, and a voltage tolerance of 1, 5, 7.5 or 10%.
- 6) Transformer X and R are calculated by the following formula:

$$X_{Txfmr} = \sqrt{(Z^2 / (1 + (R/X)^2))}$$

$$R_{Txfmr} = \sqrt{(Z^2 / (1 + (X/R)^2))}$$

this allows use of the X and R for the transformer to be added to X and R of conductors to calculate the fault current in lower busses.
- 7) Generator fault current and X & R are calculated the same way. Only the subtransient impedance of the generator is used as this software calculates instantaneous selectivity only.
- 8) Fault currents are calculating the cumulative X and R from the source to the bus for which fault current is being calculated. Tolerance from 1-10% can be added to the voltage and from 1-7.5% for conductor impedance
- 9) Smaller distribution transformers have fault current, X and R calculated in the same way except impedance tolerance is not taken into account
- 10) X/R ratios for transformers are calculated as follows:

Substation Transformers		
Size Range		X/R
From	To	
15	225	3.0
225	500	3.5
501	1000	5.2
1001	1500	6.5
1501	2000	7.0
2001	2500	7.4
2501	3500	10.5
3501	5000	11.7

Generators		
Size Range		X/R
From	To	
250	250	14.0
251	500	20.0
501	750	23.0
751	3000	25.0

Distribution Transformers		
Size Range		X/R
From	To	
15	112.5	1.85
113	300	3.5
301	500	4.4

Dry type distribution transformer impedance and other characteristics for several types of GE transformers can be found in the following worksheets:

[Go To Transformer Information](#)
- 11) Motor contribution is calculated at the main incoming panel. The motor contribution is not considered for selectivity analysis purposes at the panel where it enters the system, since the contribution

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Txfmr Main
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InstaPlan™ 2.0

Project reports
can be easily
printed

InstaPlan 2.0
Short Circuit Estimator and Circuit Breaker Selector

The screenshot displays the InstaPlan 2.0 software interface, which is used for short circuit estimation and circuit breaker selection. The interface is divided into several sections:

- Source Information:** Contains fields for General Info (Generator, Transformer, Output from Transformer), Breaker Info (Type, Breaker, Breaker Rating), and Cable Info (Cable Type, Cable Size, Cable Length).
- Transformer 1:** Provides detailed parameters for the first transformer, including Capacity in kVA, Primary Voltage, Secondary Voltage, and various fault current and impedance values.
- Transformer 2:** Provides similar parameters for the second transformer.
- Circuit Diagram:** A central schematic showing the electrical network, including a busbar, a transformer, and a circuit breaker. The diagram is annotated with numerical values for fault currents and impedances at various points.
- Notes and Comments:** Sections for user input, including a list of notes and a comments area.

At the bottom of the interface, there is a warning message: "#REF! Error are caused by not having selected a circuit breaker upstream of the selected where the #REF! Error show up".

7/6/2007, 10:45:18 AM, GE InstaPlan 2.0, SC Summary

InstaPlan™ 2.0

Useful reference tables are included for transformers and circuit breakers

INSTAPLAN, The Short Circuit Current Estimator & Instantaneous Selectivity Circuit Breaker Selection Tool
3 Phase Distribution Transformer Information

Version 2.0, July 3rd, 2007

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TYPICAL TRANSFORMER PERFORMANCE DATA
Copper 480V DELTA TO 208/120V WYE
TP1 TRANSFORMERS

K Factor	kVA	DEG C RISE	CAT HO	%R	%X	%Z	X/R
1	15	150	9T83C3871	4.2	2.3	4.8	0.5
		115	9T83C3871G15	4.2	2.3	4.8	0.5
		80	9T83C3871G80	1.3	2.1	2.5	1.6

TYPICAL TRANSFORMER PERFORMANCE DATA
Aluminum 480V DELTA TO 208/120V WYE
TP1 TRANSFORMERS

K Factor	kVA	DEG C RISE	CAT HO	%R	%X	%Z	X/R
1	15	150	9T83B3871	5.1	3.3	6.1	0.8
		115	9T83B3871G15	5.1	3.3	6.1	0.8
		80	9T83B3871G80	1.3	2.1	2.5	1.6

TYPICAL TRANSFORMER PERFORMANCE DATA
Copper 480V DELTA TO 208/120V WYE
K FACTOR = 4 TRANSFORMERS

K Factor	kVA	DEG C RISE	CAT HO	%R	%X	%Z	X/R
4	15	150	9T83C9461G03	4.3	2.2	4.8	0.5
		115	9T83C9461G13	1.3	2.1	2.5	1.6
		80	9T83C9461G83	1.3	2.1	2.5	1.6

TYPICAL TRANSFORMER PERFORMANCE DATA
480V DELTA TO 208/120V WYE AL WY
K FACTOR = 4 TRANSFORMERS

K Factor	kVA	DEG C RISE	CAT HO	%R	%X	%Z	X/R
4	15	150	9T83B3461G03	5.1	3.3	6.1	0.8
		115	9T83B3461G13	1.7	2.2	2.5	1.6
		80	9T83B3461G83	1.7	2.2	2.5	1.6

INSTAPLAN, The Short Circuit Current Estimator & Instantaneous Selectivity Circuit Breaker Selection Tool
CB Nomenclature Guide

Go To Short Circuit Estimator & Circuit Breaker Selector — Go To Directions & Assumptions

Stored Energy Circuit Breakers

CB Frame Designation	Sensor	Designation	Plug Designation	CB Designation
WP	800	08	150	015
WP	800	08	400	040
WP	800	08	800	080
WP	1600	16	1600	160
WP	2000	20	2000	200
WP	3200	32	3200	320
WP	4000	40	4000	400
WP	4000	40	4000	400
WP	4000	40	4000	400
WP	5000	50	5000	500

Electronic Trip Molded Case, Record Plus Family

CB Frame Designation	Sensor	Designation	Plug Designation	CB Designation
FE	25	02	20	000
FE	25	02	25	025
FE	60	06	30	030
FE	60	06	35	035
FE	60	06	40	040

Delta Wye & Transformer Ratio Factors

Transformers transmit power through their windings by converting the primary current and voltage to secondary current and voltage based on their transformer turns ratio. In a 480 to 208 volt transformer the secondary current is increased by the same factor by which the secondary voltage is decreased. The factor is 2.31 (480/208). The factor may be adjusted by taps in either direction as much as 5%. This software does not take taps into account. When a 3 phase fault occurs on the secondary side the same transformation occurs on the fault current. Hence a fault current of magnitude "X" on the secondary side is limited on the primary side by the transformer turns ratio. The primary current for a secondary fault of "X" magnitude will be "X/2.31". Use of taps will affect the transformer ratio.

Expressed in per unit @ the applicable Volts

- The per unit on one side of the transformer is related to the other side by the transformer ratio $V_p/V_s = R_T$ (Primary voltage/Secondary voltage, also equal to secondary current/Primary current).
- 480-208 Volt transformer $R_T = 480/208 = 2.31$.
- Hence, a system with 10,000A available as 3 phase fault current on the secondary side, when experiencing a ϕ to G fault will reflect a fault current as follows on the 480V side:

$$10,000A \cdot \frac{\sqrt{3}}{3} \cdot \frac{208}{480} = 0.58 \cdot \frac{10,000}{2.31} = 2500A$$

Net effect is when the main in on the primary side and the feeder is on the secondary side, three and single phase faults on the primary CB are smaller than on the secondary CB by the transformer ratio and ground faults are smaller by the transformer ratio and 0.58.

Go To Short Circuit Estimator & Circuit Breaker Selector

Go To Directions & Assumptions

Version 2.0, July 3rd, 2007

imagination at work



InstaPlan™ 2.0

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