

Setting Phase and Ground Overcurrent Levels

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Qualified Persons

WARNING

Only qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A Qualified Person is someone who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the Qualified Person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended ONLY for such Qualified Persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet

NOTICE

Thoroughly and carefully read this instruction sheet and all materials included in the product's S&C Instruction Handbook before installing or operating your S&C 5800 Series Automatic Switch Control. Familiarize yourself with the Safety Information and Safety Precautions on pages 4 through 5. The latest version of this publication is available online in PDF format at sandc.com/en/support/product-literature/.

Retain this Instruction Sheet

This instruction sheet is a permanent part of your S&C 5800 Series Automatic Switch Control. Designate a location where you can easily retrieve and refer to this publication.

Proper Application

WARNING

The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the selected equipment.

Special Warranty Provisions

The standard warranty contained in S&C's standard conditions of sale, as set forth in Price Sheets 150 and 181, applies to the S&C 5800 Series Automatic Switch Control, except that the first paragraph of the said warranty is replaced by the following:

- (1) **General:** The seller warrants to the immediate purchaser or end user for a period of 10 years from the date of shipment that the equipment delivered will be of the kind and quality specified in the contract description and will be free of defects of workmanship and material. Should any failure to conform to this warranty appear under proper and normal use within 10 years after the date of shipment, the seller agrees, upon prompt notification thereof and confirmation that the equipment has been stored, installed, operated, inspected, and maintained in accordance with the recommendations of the seller and standard industry practice, to correct the nonconformity either by repairing any damaged or defective parts of the equipment or (at the seller's option) by shipment of necessary replacement parts. The seller's warranty does not apply to any equipment that has been disassembled, repaired, or altered by anyone other than the seller. This limited warranty is granted only to the immediate purchaser or, if the equipment is purchased by a third party for installation in third-party equipment, the end user of the equipment. The seller's duty to perform under any warranty may be delayed, at the seller's sole option, until the seller has been paid in full for all goods purchased by the immediate purchaser. No such delay shall extend the warranty period.

Replacement parts provided by the seller or repairs performed by the seller under the warranty for the original equipment will be covered by the above special warranty provision for its duration. Replacement parts purchased separately will be covered by the above special warranty provision.

For equipment/services packages, the seller warrants for a period of one year after commissioning that the 5800 Series Automatic Switch Control will provide automatic fault isolation and system reconfiguration per agreed-upon service levels. The remedy shall be additional system analysis and reconfiguration of the IntelliTeam® SG Automatic Restoration System until the desired result is achieved.

Warranty of the S&C 5800 Series Automatic Switch Control is contingent upon the installation, configuration, and use of the control or software in accordance with S&C's applicable instruction sheets.

This warranty does not apply to major components not of S&C manufacture, such as batteries and communication devices. However, S&C will assign to the immediate purchaser or end user all manufacturer's warranties that apply to such major components.

Warranty of equipment/services packages is contingent upon receipt of adequate information on the user's distribution system, sufficiently detailed to prepare a technical analysis. The seller is not liable if an act of nature or parties beyond S&C's control negatively impact performance of equipment/services packages; for example, new construction that impedes radio communication, or changes to the distribution system that impact protection systems, available fault currents, or system-loading characteristics.

Safety Information

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to your S&C 5800 Series Automatic Switch Control. Familiarize yourself with these types of messages and the importance of these various signal words:

⚠ DANGER

“DANGER” identifies the most serious and immediate hazards that will likely result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ WARNING

“WARNING” identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION

“CAUTION” identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE

“NOTICE” identifies important procedures or requirements that can result in product or property damage if instructions are not followed.”

Following Safety Instructions

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website sandc.com, or call the S&C Global Monitoring and Support Center at 1-888-762-1100.

NOTICE

Read this instruction sheet thoroughly and carefully before installing your S&C 5800 Series Automatic Switch Control.



Replacement Instructions and Labels

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

⚠ DANGER



The S&C 5800 Series Automatic Switch Control line voltage input range is 93 to 276 Vac. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. QUALIFIED PERSONS. Access to the 5800 Series Automatic Switch Control must be restricted only to qualified persons. See "Qualified Persons" on page 2. 2. SAFETY PROCEDURES. Always follow safe operating procedures and rules. 3. PERSONAL PROTECTIVE EQUIPMENT. Always use suitable protective equipment such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules. | <ol style="list-style-type: none"> 4. SAFETY LABELS. Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels. 5. MAINTAINING PROPER CLEARANCE. Always maintain proper clearance from energized components. |
|---|---|

Fault current for each phase is measured by a high-speed detecting circuit with a full scale of approximately 4000 amps RMS and is sampled every 6.25 ms. The control phase fault-detection characteristics are controlled by the **Phase Fault-Detection Current Level** and the **Phase Fault-Duration Time Threshold** setpoints. All three phase currents are monitored and compared with these two setpoints. When an overcurrent condition is registered, the switch control starts the **Phase Fault Duration Time Threshold** timer. If the overcurrent condition is present for the duration of the timer, the switch control records a **Phase Overcurrent Fault** state.

To determine the proper setting, look at the source-side device phase time-current characteristic (TCC) curves for the range of fault duty, up to the maximum available phase fault current at the sectionalizing switch. In general, set the **Phase Fault Detection Current Level** setpoint slightly lower than the source-side device's minimum pickup/trip and the **Phase Fault Duration Time Threshold** setpoint slightly faster than the fastest time the source-side device will trip. For an example, see Figure 1 on page 7. Follow these steps to configure the parameter:

STEP 1. Set the **Phase Fault Detection Current Level** setpoint to a value about 90% of the minimum pickup/trip of the source-side device.

STEP 2. Set the **Phase Fault Duration Time Threshold** setpoint to a value equal to or less than the breaker total clearing time minus 19 ms. The 19-ms value is the approximate time required for the control to confirm a fault.

Note: When the **Phase Current Inrush Restraint Multiplier** setpoint is set to **Time Block** mode, the **Phase Fault Duration Time Threshold** and **Phase Current Inrush Restraint Time** setpoints must be coordinated to ensure the switch control has enough time after the time block to detect a phase fault.

COORDINATION SHEET #1

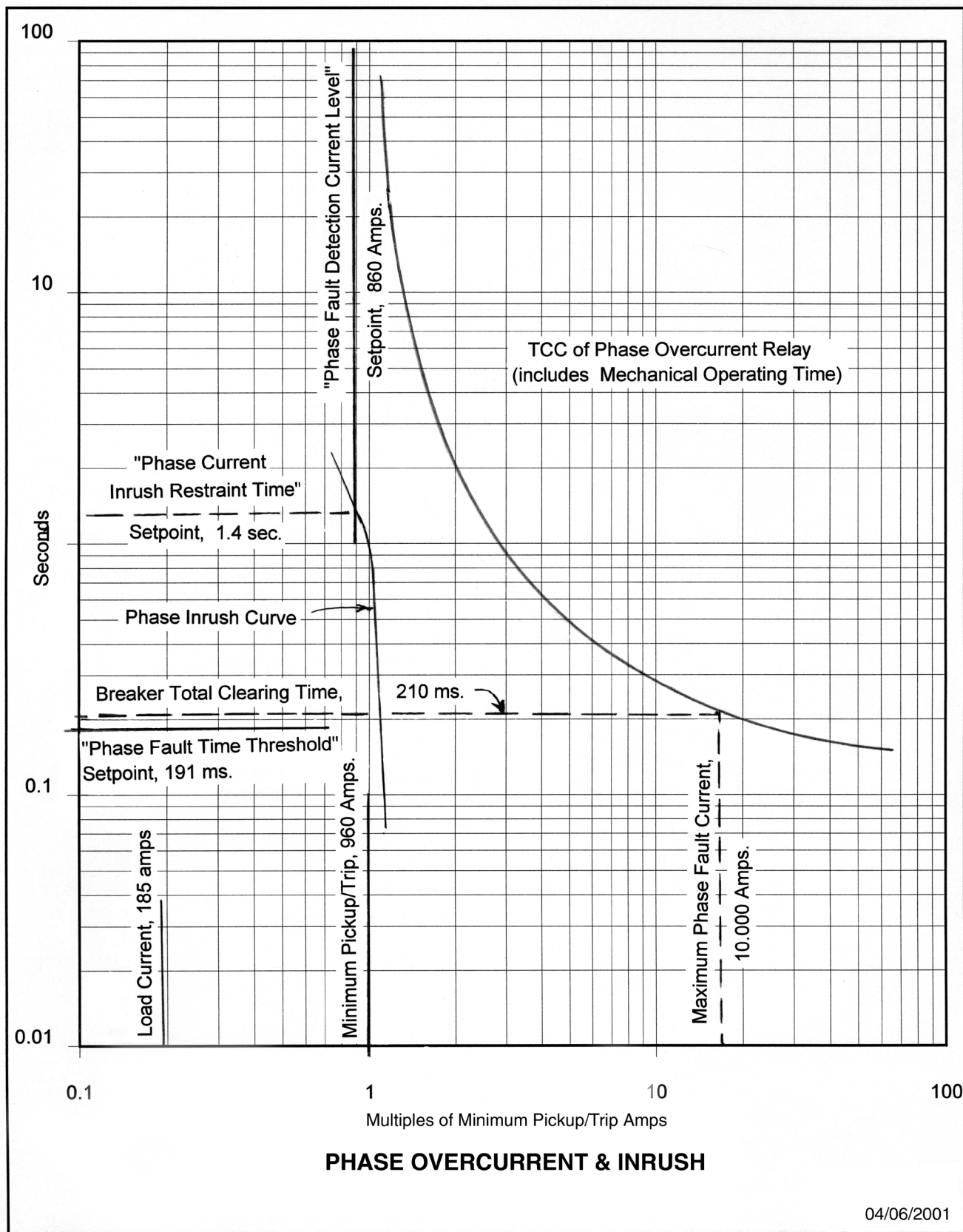


Figure 1. The phase-overcurrent and inrush curves.

Ground fault current is measured separately by a true RMS-detecting circuit as the analog residual of the three individually sensed phase currents. The detecting circuit (which has a full scale of approximately 800 amps) is slower than the phase-detecting circuit. The circuit continuously integrates the analog signal over several cycles and samples every 50 ms. Because the circuit is continuously integrating the current signal, the switch control can detect faults of a shorter duration than the sampling rate. The net response of the circuit is similar to the time-current characteristic (TCC) curves of a protective relay. (See the ground fault current curves in 1042-530: “S&C 5800 Series Automatic Switch Controls With IntelliTeam Automatic Restoration System: *Setup*.”) For example, the curves show that with a **Ground Fault Detection Current Level** setting of 150 amps, the switch control would detect a 500-amp fault in 42 ms. It would detect a 600-amp fault in about 30 ms.

The switch control ground-fault detection characteristics are controlled by the **Ground Fault Detection Current Level** and the **Ground Fault Duration Time Threshold** setpoints. To determine the proper setting, look at the source-side device's ground TCC curves for a range of fault duty, up to the maximum available ground fault current at the sectionalizing switch. The switch control must be able to detect the fault prior to the source-side device tripping. See Figure 2 on page 9 for an example.

Follow these steps to configure the parameter:

STEP 1. Set the **Ground Fault Detection Current Level** setpoint to a value equal to or slightly less than the source-side device ground minimum pickup/trip value. Then, compare the source-side device TCC curve (including the breaker mechanical operating time) with the switch control's Ground Fault Current curve for the selected value. The control should detect fault currents at all current levels up to the maximum available ground fault current at the sectionalizing switch prior to the source-side device tripping. If the control's curve does not coordinate over the full range of fault current, lower the **Ground Fault Detection Current Level** setpoint and try again.

Note: For locations where the load current exceeds the **Ground Fault Detection Current Level** setpoint and the circuitry is four-wire grounded wye, source-side line-to-ground faults on a four-wire grounded wye distribution system can reduce load current on faulted phase(s) and result in an imbalance up to the magnitude of the phase load current. If the unbalanced current exceeds the **Ground Fault Detection Current Level** setting for a period equal to the **Ground Fault Duration Time Threshold** setting, the switch control records a ground fault. If the event is followed by a loss of voltage, the control will count one step.

During stand-alone sectionalizing, the control may go to a full count and trip. For IntelliTeam systems, registering a false fault may prematurely shut down the reconfiguration and service-restoration process. In both cases, customers will experience an unnecessary outage. This can be prevented by setting the **Ground Fault Detection Current Level** setpoint to a value greater than the load current. A disadvantage is the switch control will ignore any low-level ground faults below the setpoint. However, in most cases the fault-current levels are high enough to be detected by the high-speed phase fault-detection system. This is especially true for underground construction because the faults are usually low impedance, high current, and persistent.

STEP 2. Set the **Ground Fault Duration Time Threshold** setpoint to a value equal to or less than the breaker total clearing time minus the time required to detect a ground fault. See the ground fault current curves in 1042-530: “S&C 5800 Series Automatic Switch Controls with IntelliTeam® Automatic Restoration System: *Setup*” for the time required to detect a ground fault.

Note: When the **Ground Current Inrush Restraint Multiplier** setpoint is set to the **Time Block** mode, the **Ground Fault Duration Time Threshold** and **Ground Current Inrush Restraint Time** setpoints must be coordinated to ensure the switch control has enough time after the time block to detect a real ground fault.

COORDINATION SHEET #2

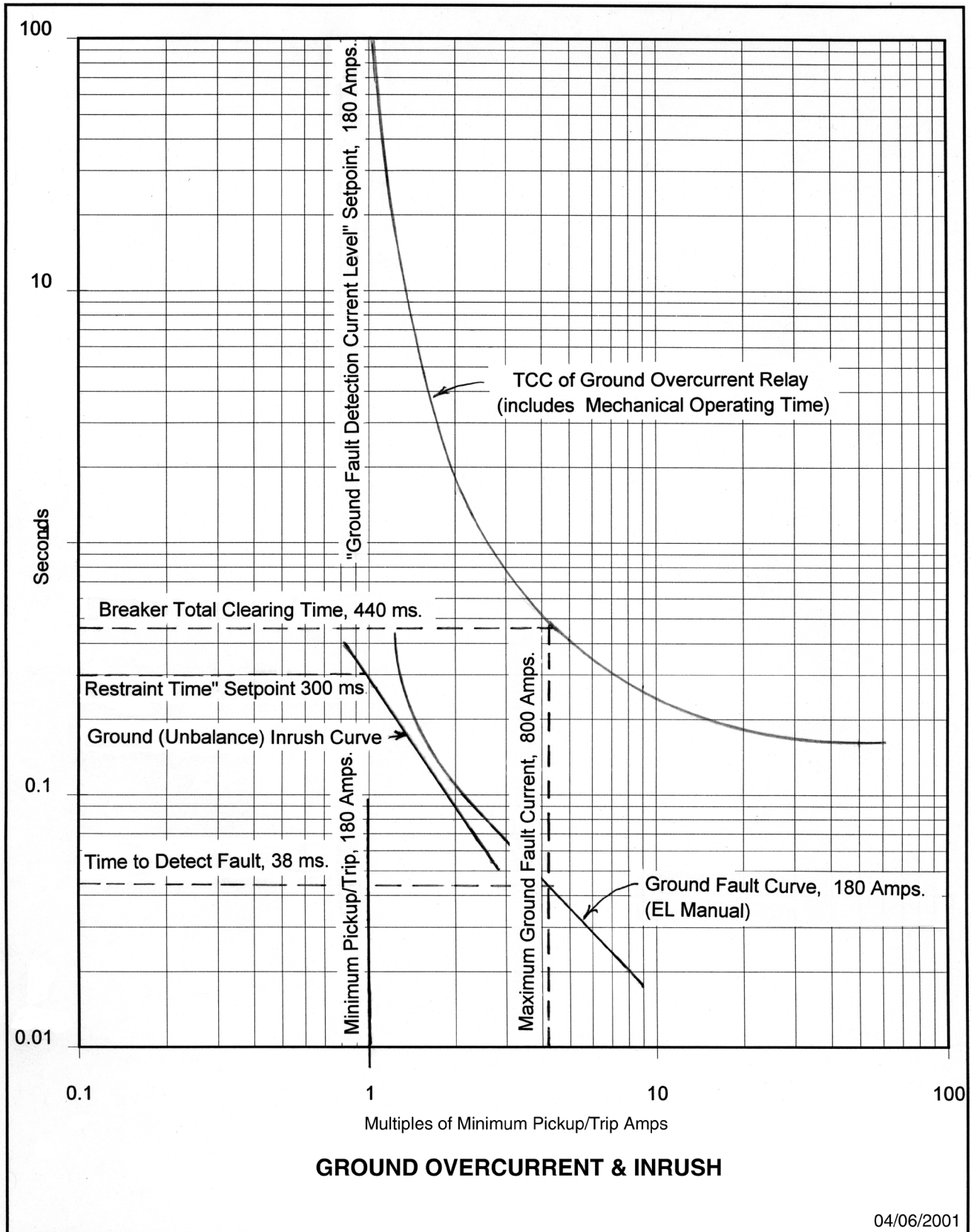


Figure 2. The ground-overcurrent and inrush curves.

Inrush and Load Pickup Restraint

Current Definitions

Inrush and load pickup currents occur when voltage is restored to a distribution circuit with connected load:

- **Magnetizing Inrush**—The magnetizing inrush current has a short duration, and its magnitude depends primarily on connected transformer capacity, residual magnetism in the transformers, and system impedance.
- **Hot Load Pickup**—The hot load pickup current occurs when the source breaker trips and recloses. Its magnitude depends on the type of connected load. For example, motor controllers may disconnect motors due to a momentary power interruption.
- **Cold Load Pickup**—The cold load pickup current occurs from connected load after an extended outage. The magnitude depends on the type and amount of connected load and the duration of the outage. For example, thermostatically controlled loads (such as refrigeration, air conditioning, and heating) will increase because of a loss in diversity.

Generally Accepted Values

These values are usually configured:

Inrush (for a single distribution transformer):

25x full-load kVA for 0.01 second

2x full-load kVA for 0.1 second

Hot load pickup:

12x to 15x full load for 0.1 second

Cold load pickup:

6x full load for 1 second

3x full load for 10 seconds

2x full load for 100 to 300 seconds

The 5800 Series Automatic Switch Control invokes inrush restraint after an outage whenever three-phase voltage is restored. The software has two types of inrush/load pickup restraint. When the **Inrush Restraint Multiplier** setpoint is set to **Time Block** mode, the switch control ignores all overcurrent conditions during the restraint time. When it is set to a value (**2x**, **4x**, **8x**, or **16x**), the corresponding **Phase or Ground Fault Detection Current** level is temporarily raised by the multiplier value.

Setup Procedure

Evaluate the magnitude and type of load beyond the switch control, and estimate the magnitude and duration of the inrush/load pickup current. Follow these steps to set the phase current parameters:

- STEP 1.** Set the **Phase Current Inrush Restraint Time** setpoint to a value long enough to allow the inrush/load pickup current to drop below the **Phase Fault Detection Current Level** setpoint before the timer expires.
- STEP 2.** Set the **Phase Current Inrush Restraint Multiplier** setpoint to the **Time Block** mode or to a **Multiplier** value.
- STEP 3.** Set to **Time Block** mode. All phase currents are ignored until the restraint timer expires. If an overcurrent condition is present at the end of the **Time Block** period, the switch control starts the **Phase Fault Duration Time Threshold** timer.

Note: When the **Phase Current Inrush Restraint Multiplier** setpoint is set to **Time Block** mode, the **Phase Fault Duration Time Threshold** and **Phase Current Inrush Restraint Time** setpoints must be coordinated to ensure the switch control has enough time after the **Time Block** period to detect a phase fault.

Note: The phase fault detection current level is temporarily raised by the selected **Multiplier** value (**2x**, **4x**, **8x**, or **16x**). If the switch control detects currents where magnitudes are greater than the elevated level, it starts the **Phase Fault Duration Time Threshold** timer immediately. If the currents remain above fault levels and the timer expires, the switch control records a fault.

- STEP 4.** Where possible, set the multiplier to raise the **Phase Fault Current Detection Level** setting above the inrush/load pickup levels but below end-of-line (EOL) minimum phase fault currents.

Follow these steps to set the ground current parameters:

- STEP 1.** Estimate the maximum imbalance inrush/load pickup current and its duration at the switch control. Set the **Ground Current Inrush Restraint Time** setpoint to a value long enough to allow the inrush/load pickup current to drop below the **Ground Fault Detection Current Level** setpoint before the timer expires.

- STEP 2.** Set the **Ground Current Inrush Restraint Multiplier** setpoint to the **Time Block** mode or to a **Multiplier** value:

Time Block mode—All ground (unbalanced) currents are ignored until the **Time Block** timer expires. If an overcurrent condition is present at the expiration of the **Time Block** timer, the switch control starts the **Ground Fault Duration Time Threshold** timer.

Note: When the **Ground Current Inrush Restraint Multiplier** setpoint is **Time Block** mode, the **Ground Fault Duration Time Threshold** and **Ground Current Inrush Restraint Time** setpoints must be coordinated to ensure the switch control has enough time after the time block to detect a ground fault.

Multiplier value—The **Ground Fault Detection Current Level** setting is temporarily raised by the selected **Multiplier** value (**2x**, **4x**, **8x**, or **16x**). If the switch control detects currents where magnitudes are greater than the elevated level, it starts the **Ground Fault Duration Time Threshold** timer immediately. If the currents remain above fault levels and the timer expires, the switch control records a fault.

- STEP 3.** Where possible, set the **Multiplier** value to raise the **Ground Fault Current Detection Level** setting above the inrush/load pickup levels but below end-of-line (EOL) minimum ground fault currents.

Site Information for Each Switch Location

For more information about fault detection, see Instruction Sheet 1042-530: “S&C 5800 Series Automatic Switch Controls With IntelliTeam® Automatic Restoration System: *Setup*.” The following information should be obtained for each switch-control location:

- Phase and ground time-current characteristic (TCC) curves for the source-side protective device
- Phase and ground source-side breaker minimum pickup/trip (amps)
- Source-side breaker total interrupting time
- Maximum available phase and ground fault current at each sectionalizing switch
- Minimum end-of-line fault current at each sectionalizing switch location
- Normal load current