



Westinghouse Electric Corporation
Relay-Instrument Division
Coral Springs, FL 33060

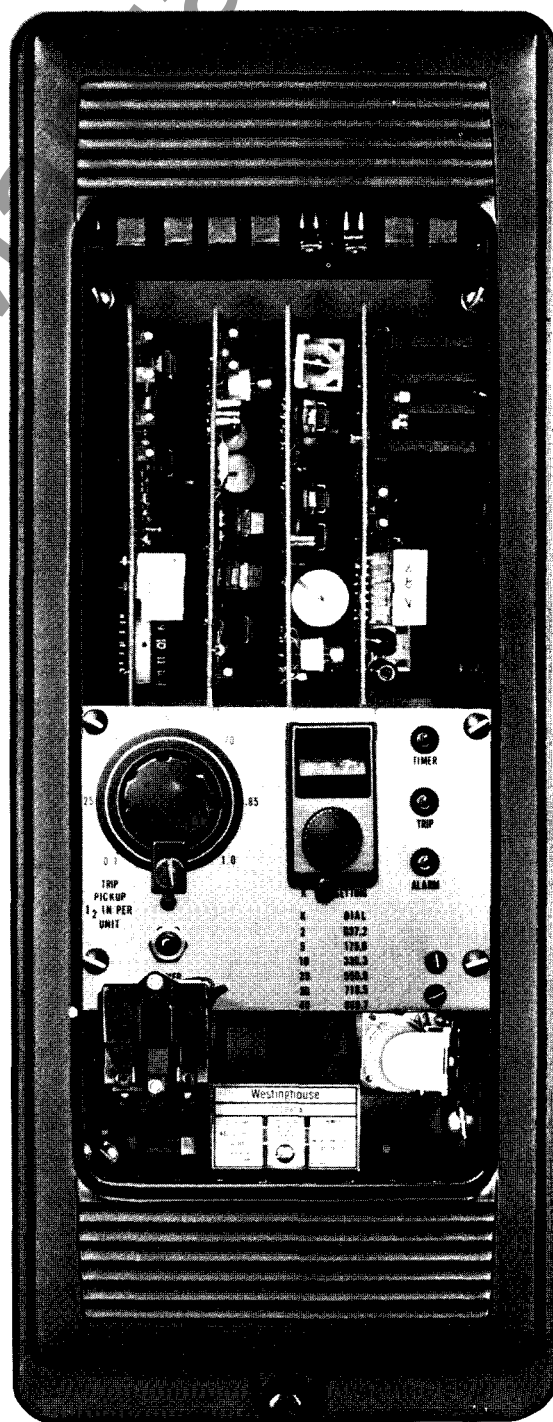
Descriptive Bulletin
41-161

Page 1

July, 1979
New Information
Mailed to: E, D, C/2017/DB

For Protection of Rotating Machinery

Type SOQ Negative Sequence Time Overcurrent Relay



Application

The SOQ negative sequence time overcurrent relay is used to protect rotating machinery against excessive heating damage because of prolonged current unbalance.

The relay is suitable for use with directly or indirectly-cooled turbine generators, synchronous condensers, or any rotating machinery having a known I_2^2t limit.

An alarm feature in the SOQ relay alerts an operator to an abnormal I_2^2 level in the ma-

chine being monitored. This feature can be set from 0.03 to 0.20 per unit.

The relay is also equipped with the provision for remote indication of per unit I_2^2 level flowing in the machine. Using this option an operator can estimate the severity of the unbalanced loading and take appropriate action.

Settings of the SOQ relay are compatible with the ANSI standard requirements for I_2^2t limits for generators, covering the range from 2 to 40. The relay has a per unit adjustment allow-

ing it to be related to the full load current of the machine. The I_2^2 trip pickup can be independently adjusted from 0.1 to 1.0 per unit, thus allowing time delayed tripping to occur at any I_2^2 level above this point.

The exponential resetting action of the SOQ relay's timer has been made compatible with that of air-cooled and hydrogen-cooled turbine generators.

Rotating Machine

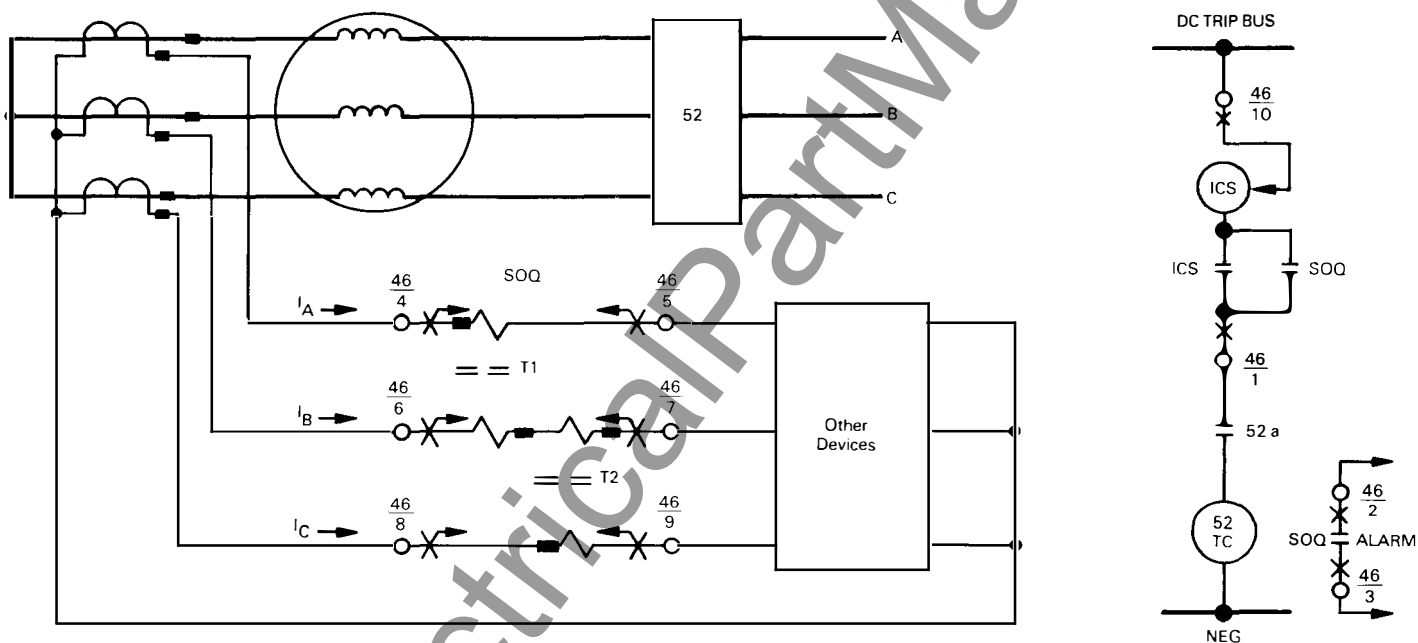


Figure 1. System Application Diagram of The SOQ Relay

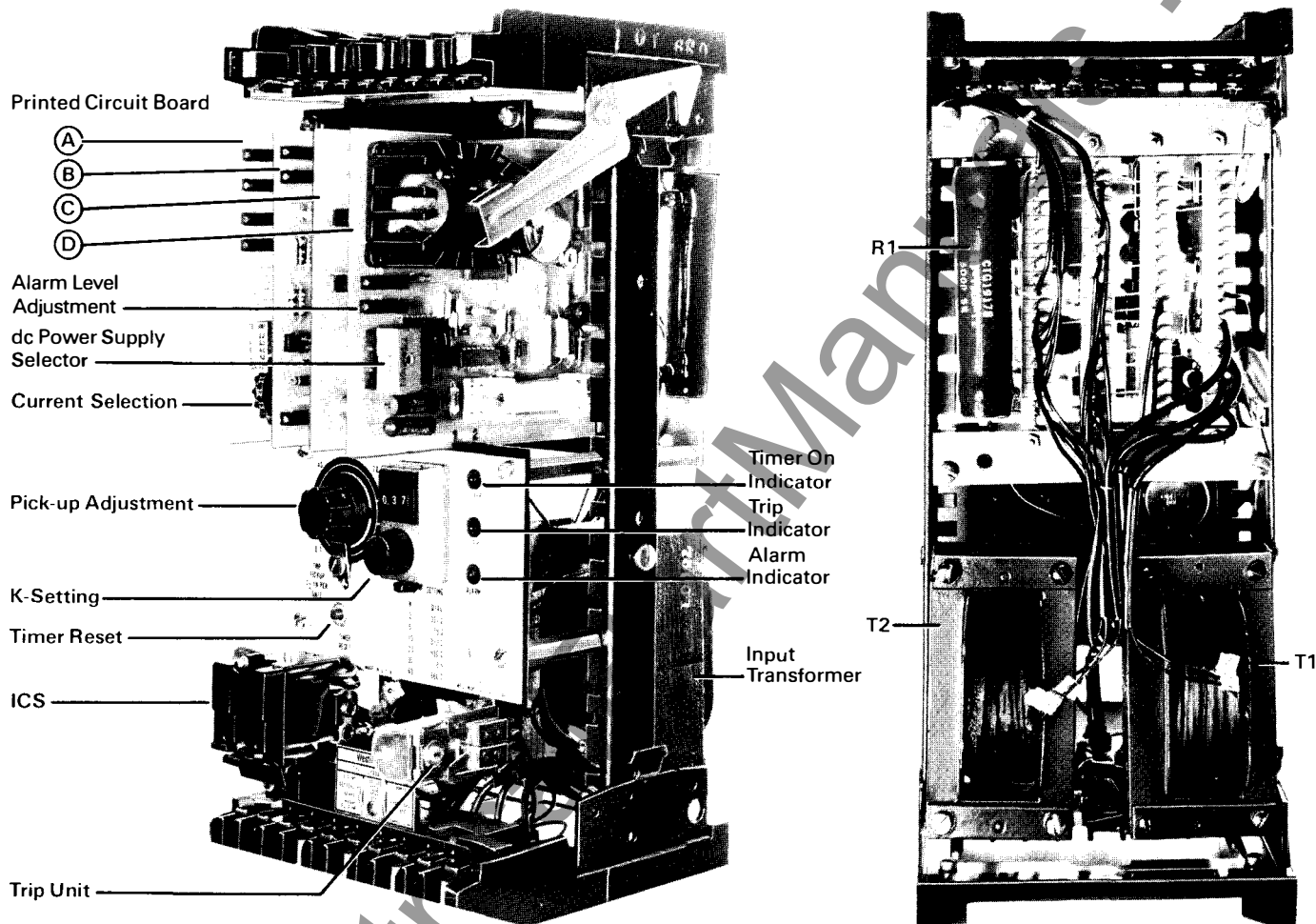
Device Number Chart

46 - Negative sequence
Generator relay type SOQ
ICS - Indicating contactor
Switch in SOQ relay

52 - Power circuit breaker
a - Breaker auxiliary contact
TC - Breaker trip coil



Construction



Printed Circuit Boards – slide into position and engage into a terminal block at the rear of the relay. The boards and terminal blocks are notched preventing insertion into the wrong position. Each board may be removed and used in conjunction with an extender board (Style No. 644B315G02) permitting access to test points and terminals while the relay is energized.

- (A) Input Board
- (B) Timer Board
- (C) Control Board
- (D) Power Supply Board

Panel & Dial Plate – contains the ten-turn potentiometer used for the K-setting and the single-turn potentiometer to set the trip pickup level. The panel also contains three (3) light-emitting diodes for timer-on, trip, and alarm condition indication. A pushbutton is utilized to reset the timer and its associated LED. This function is used primarily for routine relay testing.

Output Contacts – A telephone type relay is provided with two Type A contacts. One of the normally open contacts is used with the target seal in unit when tripping. There are also two normally open contact (N.O.C.) reed relays, one mounted on the Power Supply Board and the other on the Control Board, used for the alarm and oscillograph start function respectively.

Indicating Contactor Switch – The dc indicating contactor switch is a small clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

Remote Readout Instrument (Optional) – may be provided to allow monitoring the negative sequence current (I^2) level at a remote location. The instrument provided is a Westinghouse switchboard type KX-241 (4½", 250° scale, 1% accuracy). It is a 1 mA dc instrument marked to represent 0.2 per unit at full scale.

Operation

The SOQ relay internally simulates a generator's characteristics, $I_2^2t = K$ where

- I_2 = negative sequence current per unit
- t = duration of unbalanced condition
- K = machine constant

Within the SOQ relay, t = the time delay for tripping.

For a detailed description of the relay's operation see Instruction Leaflet 41-161.1.

Settings

The relay requires the following settings to assure correct operating results:

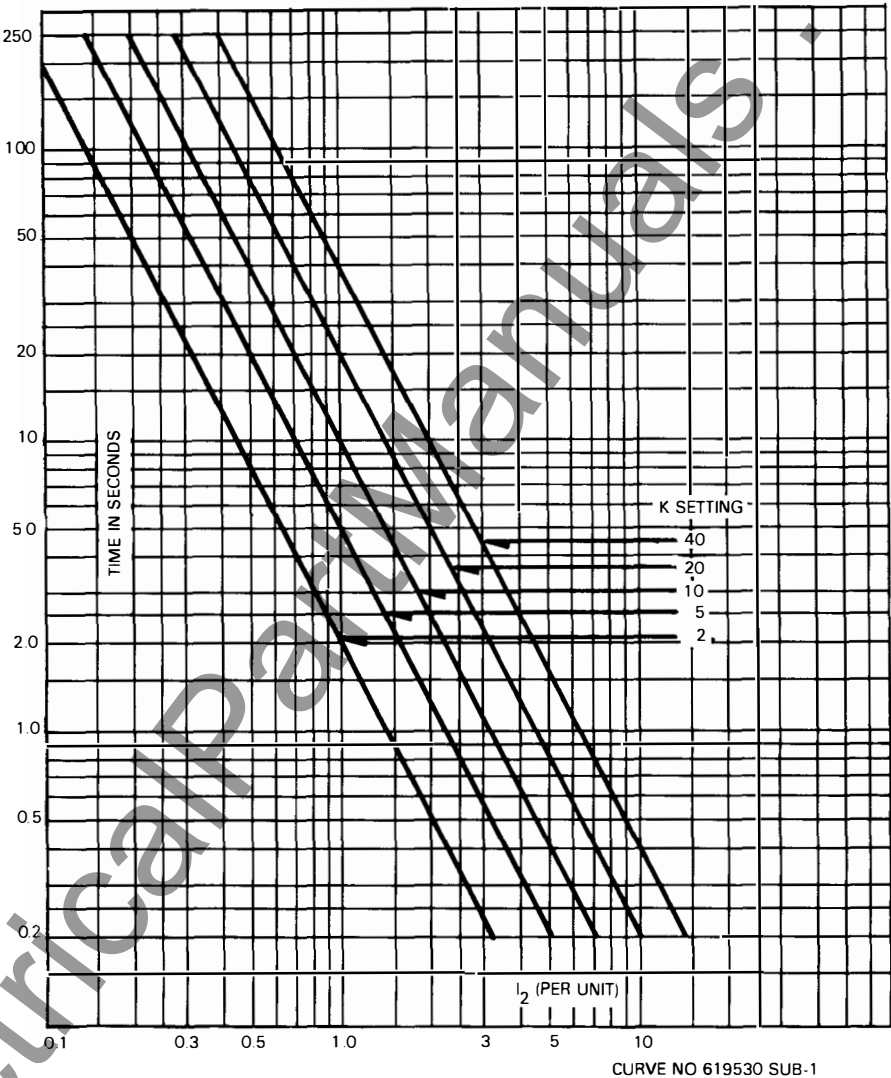
- A) Per Unit – choose the setting nearest to, but less than the full load current of the machine converted to relay amperes. For hydrogen cooled machines, this setting should be related to the capability of the machine for the particular hydrogen pressure involved.
- B) K-Setting – chosen to correspond to the I_2^2t limit for the particular machine being protected. These are typically:

Type of Machine	$I_2^2t = K$	Dial Setting
Salient Pole	40	860.7
Synchronous Condenser	30	718.5
Cylindrical Rotor		
Indirectly Cooled	30	718.5
Directly Cooled	10	330.3
	(or less)	(or less)

- C) Trip-pickup level – should be the lowest I_2 level at which tripping will be permitted. A reasonable level to consider would be that level of sustained I_2 to produce tripping at 250 seconds. This would be $\sqrt{\frac{K}{250}}$. For example, if K were 10 for the protected machine, the level would be adjusted for $I_2 = \sqrt{\frac{10}{250}} = 0.2$ per unit.

- D) Alarm Level – should be set at the lowest level consistent with normal load unbalance but in no case greater than the maximum continuous I_2 level for the machine. Typical values for generators are:

Fig. 2 Typical Time Current Curves





Type of Machine	Permissible I_2 (%)
Salient Pole	
with connected amortisseur windings	10
with non-connected amortisseur windings	5
Cylindrical Rotor	
Indirectly cooled	10
Directly cooled	
0 to 960 MVA	8
961 to 1200 MVA	6
1201 to 1500 MVA	5

For a machine with a continuous I_2 capability of 10%, a reasonable alarm level setting is 0.05 (that is, 5%).

E) Timer – within the SOQ has an inverse resetting characteristic similar to that of typical generators to allow for any cumulative effects which may, for example, take place during reclosing. Two conservative values are available and may be chosen by a “link” on the Timer Board.

The cooling time constant for hydrogen-cooled turbine generators is typically less than 40 seconds, for air-cooled machines it is typically less than 80 seconds.

By leaving the link “in” a time constant of 38 seconds is applied. With the link “out”, a constant of 80 seconds is chosen.

In the absence of specific information, the link should be removed, using the 80 second time constant. Where the actual cooling time constant is known, the lowest value that is higher than the machine time constant should be selected.

Remove the link where reclosing is not applied.

Characteristics

Ambient Temperature:

–20° to +55°C

Current Transformer:

Continuous rating – 10 amperes
One second rating – 300 amperes

Constant K Setting:

2 to 40 – 2%

Current Range Setting:

2 to 5 amperes per unit with 0.25 ampere per step

Operating Time:

0.2 to 50 seconds – 5%
50 to 250 seconds – 10%

Timer Start Pickup:

0.1 to 1.0 per unit – 5%

Alarm Pickup:

0.03 to 0.2 per unit – 5%

Alarm Time Delay:

2 seconds – 25%

Initial Disable Trip Time:

0.2 second – 10%

Final Trip Time:

250 second – 10%

Reset Exponential Time Constant:

38 or 80 seconds – 10%

Frequency Response:

No response to 57 Hz. positive sequence current at 5 amperes

DC Power Supply:

48/1 25 Volts

DC Current Drain:

0.17 ampere (max.)

Burden (ac):

1.6 volt – ampere (max.) at 5 amperes and 60 Hz.

Indicating Contactor Switch (ICS):

0.2/2 amperes

Contact Rating:

1. Trip contacts with ICS – 30 amperes at 250 volts dc for 0.2 second.

2. Trip contacts (telephone relay) – 0.1 ampere at 125 Vdc.

3. Alarm contacts (reed relay) – 0.1 ampere at 125 Vdc

4. Oscillograph start (reed relay) – 0.1 ampere at 125 Vdc.



Further Information

Instructions, Maintenance and Installation –

Instruction Leaflet 41-161.2

Relay Case Dimensions –

Descriptive Bulletin 41-075

Other Westinghouse Protective Relays –

Selector Guide – 41-000 A, B, C, & D



Westinghouse Electric Corporation
Relay-Instrument Division
Coral Springs, Fl. 33065

Renewal Parts Data
41-161

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September, 1984
New Information
Mailed to: E, D, C/41-400B

In FT-21 Flexitest Case①

Type COQ Negative Sequence Generator Relay

Relay Complete Style Number	Range (Amps)	Frequency (Hz)	ICS or ACS Rating (Amps)	Trip	Style Number of Part
					Reactor
3499A08A09	3-5	60	.2-2.0	SPST	6670D07G03
3499A08A10	3-5	50	.2-2.0	SPST	6670D07G03
3499A08A11	3-5	60	.2-2.0	SPST	6670D07G04
3499A08A12	3-5	50	.2-2.0	SPST	6670D07G04
3499A08A13	3-5	60	1	SPST	6670D07G03
3499A08A17	3-5	60	.2-2.0	DPST	6670D07G03
3499A08A18	3-5	50	.2-2.0	DPST	6670D07G03
3499A08A19	3-5	60	.2-2.0	DPST	6670D07G04
3499A08A20	3-5	50	.2-2.0	DPST	6670D07G04

① For Flexitest Case Parts refer to RPD 41-076A1.

Ordering Information

- Give style number and name of part.
- Give the complete nameplate reading.
- State method of shipment desired.
- Send all orders or correspondence to nearest sales office of the company.

Type COQ

Reference Number	Description of Part	Style Number
1	Electromagnet with Tap Block.....	183A475G21*
2	Insulated Tap Screw.....	1545 282③
3	Disc and Shaft Assembly.....	880A772G12
4	Lower Bearing.....	184A440G01
5	Moving Contact, Spring and Adjuster Assembly SPST.....	880A721G28*
5	Moving Contact, Spring and Adjuster Assembly DPST.....	880A721G30*
6	Lower Bearing Screw.....	3499A37G09
7	Upper Bearing Screw.....	52D6291G03
8	Dial Assembly.....	1878 801
9	Insulated Block for Stationary Contact.....	33B3110H02
10	Stationary Contact - SPST.....	1732 776*
10	Stationary Contact - DPST.....	52D6280G02③*
11	Permanent Magnet.....	1732 777
Δ12	Card Holder Clip.....	182A798H01
Δ13	Reactor.....	See Table
Δ14	Resistor Assembly.....	406C956G01
15	ICS Unit - SPST - When Used.....	3491A37G17②*
15	ICS Unit - DPST - When Used.....	3491A37G18②*
16	ACS Unit - When Used.....	3491A39G17②*
17	Stationary Contact for ICS and ACS Units...	1732 868③*
17	Stationary Contact for ICS Unit - DPST Only	183A860G02*

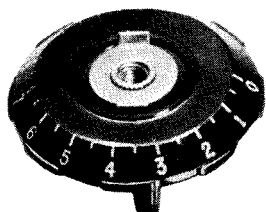
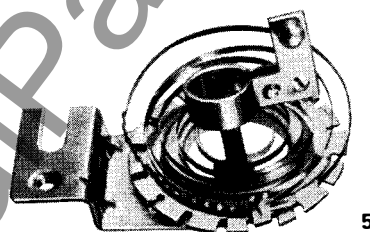
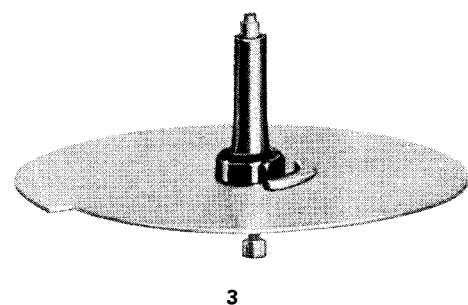
Note: Parts indented are included in the part under which they are indented.

● For ICS and ACS Unit Parts refer to RPD 41-852A1.

③ Two (2) Used.

Δ Not Illustrated.

* Recommended for Stock.



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