

Substation Automation and Protection Division

Phase Comparison Testing Of REL350 Relays Using One Test Device Or Two Test Devices Not Synchronized

Introduction

Satellite synchronized testing is not required nor recommended for commissioning of the REL350 phase comparison relays. IB 40-201.82 provides on-load functional test instructions (page 6 – 25). However, load might not be present and the ct wire reversal method described in this section may be undesirable. As an alternative, complete functional system testing can be performed with unsynchronized test sets as described in this Application Note.

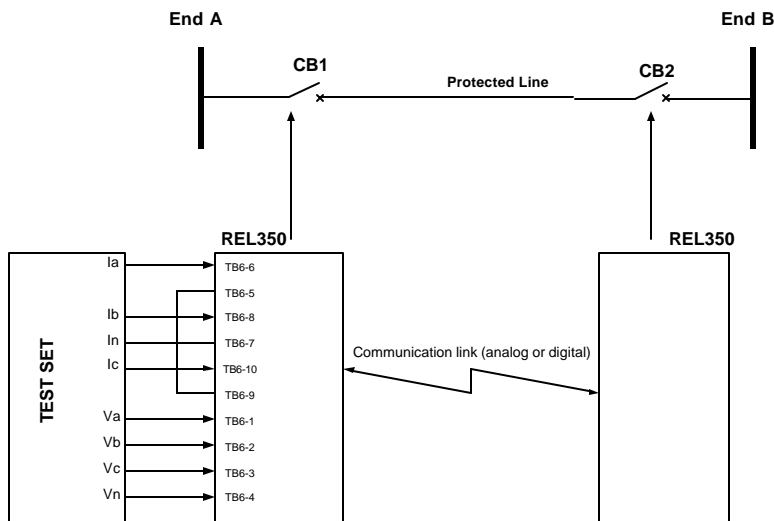
Below, the test procedure describes, step by step, how to trip test REL350 with unsynchronized test sets. With one test set, trip of the local relay can be achieved (section 1.1). With two test sets, both relays can be tripped (section 1.2).

Unsynchronized testing fully verifies correct operation of the REL350 system, including the communication link.

Application

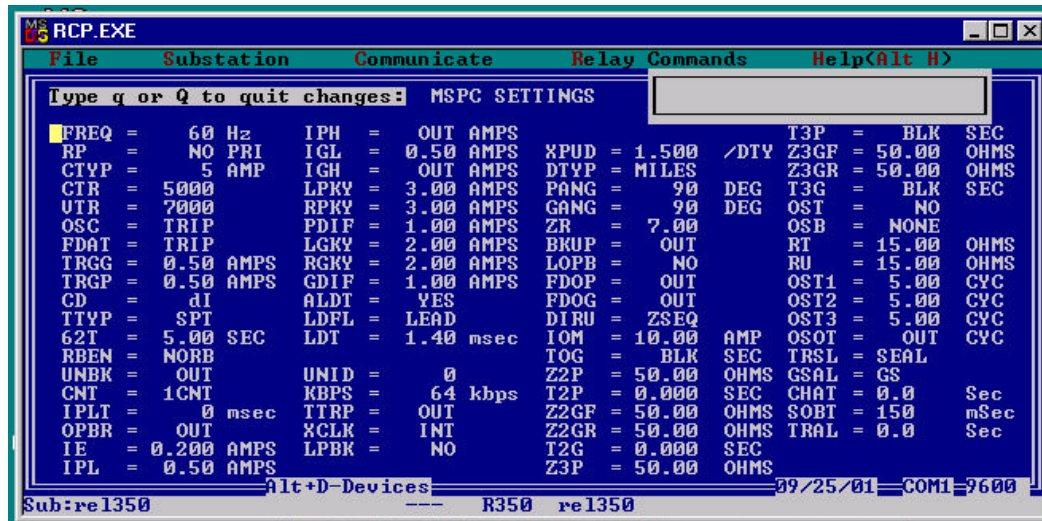
1.1. Testing one line end tripping with one test device

Consider the line that is protected with REL350 relays at both ends like in Fig. 1

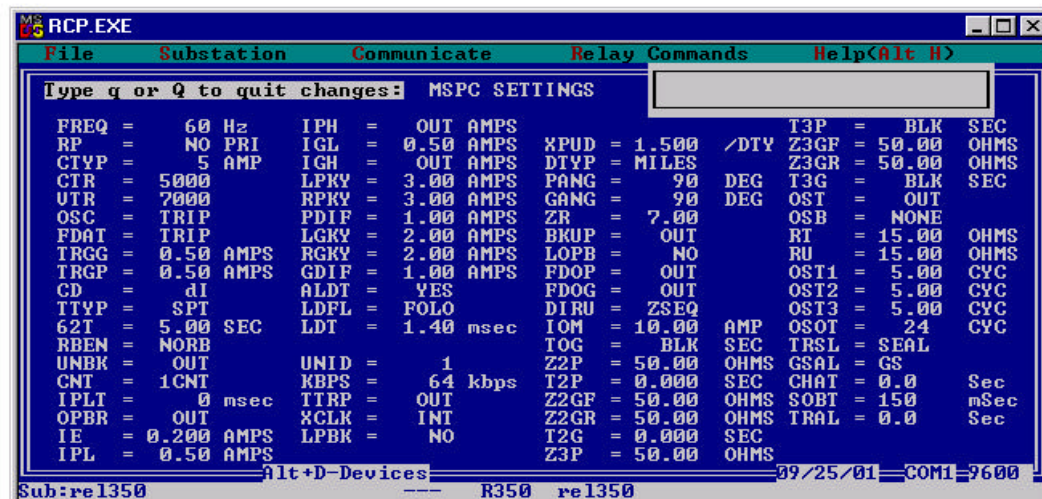


Step 1: Connect the test set as shown in the Figure 1. If the relay was already connected to the CT, PT, ensure that primary circuit is isolated from the relay either using the test switch or making necessary connections at the terminal blocks in the panel (CT circuit short circuited and VT circuit opened);

Step 2: Set the relay in the End A using either RCP software tool or directly from the relay front interface. Please note that these are default settings for test purpose only:



Step 3: Set the relay in the End B using either RCP software tool or directly from the relay front interface. Please note that these are default settings for test purpose only:



Step 4: Check that communication interface (either analog or digital depending on the catalog number) between relays is hooked up;

Step 5: Enter VOLTS/AMPS/ANGLE submenu of relays at end A and B pressing RAISE or LOWER function buttons. Ensure that CHR X is GUARD, CHTX is GUARD, BERR is 0. If not check the settings as per steps 3,4; or communication link between relays. Note that XCLK in the steps 3 and 4 is INT. This setting should be changed to EXT depending on the communication topology (use of the MUX etc);

Step 6: At the End B press the DISPLAY SELECT button to enter the TEST submenu. Pressing the RAISE and LOWER function buttons enter TEST. At the VALUE screen read GUARD;

Step 7: At he End A press the DISPLAY SELECT button to enter the VOLTS/AMPS/ANGLE submenu. Pressing the RAISE and LOWER function buttons select CHR.X. At the VALUE screen read ARM;

Step 8: Inject the current as per table*.

| Fault Type | I Amps | Angle | Indication/ Last Fault |
|------------|----------------------------|-------------------|---|
| AG | Ia=4.0 Ib=0.0 Ic=0.0 | 0 -120 -240 | PLT = AG PLTG = YES PTOG = YES |
| BG | Ia=0.0 Ib=4.0 Ic=0.0 | 0 -120 -240 | PLT = BG PLTG = YES PTOG = YES |
| CG | Ia=0.0 Ib=0.0 Ic=4.0 | 0 -120 -240 | PLT = CG PLTG = YES PTOG = YES |
| AB | Ia=4.5 Ib=4.5 Ic=0.0 | 0 -180 -240 | PLT = AB PLTA = YES PLTB = YES |
| BC | Ia=0.0 Ib=4.5 Ic=4.5 | 0 -120 -300 | PLT = BC PLTB = YES PLTC = YES |
| CA | Ia=4.5 Ib=0.0 Ic=4.5 | 0 -120 -180 | PLT = CA PLTA = YES PLTC = YES |
| ABC | Ia=4.5 Ib=4.5 Ic=4.5 | 0 -120 -240 | PLT = ABC PLTA = YES PLTB = YES PLTC = YES |

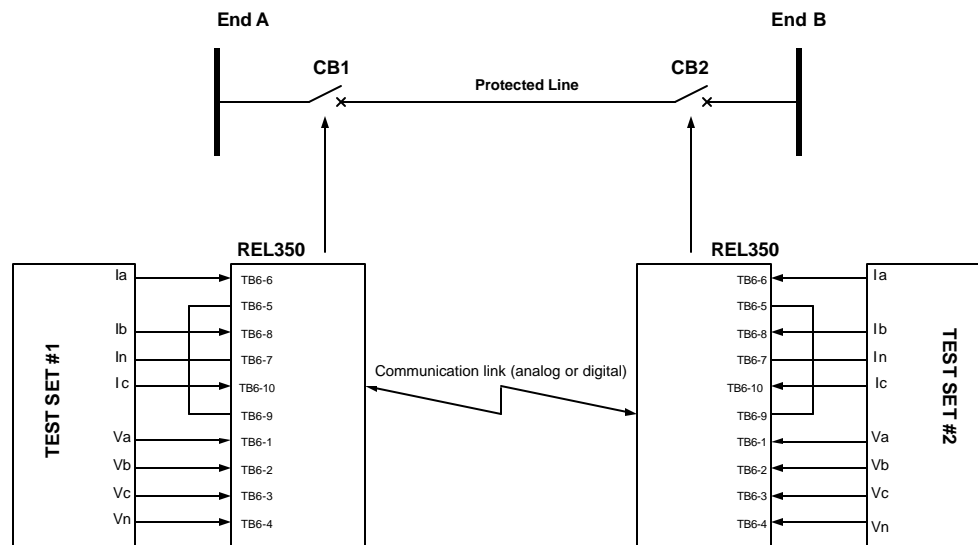
Step 9: Check proper operation of the Circuit Breaker for different type of the faults (single pole or three pole tripping depending on the setting of TTYP) .

Step 10: The same procedure could be repeated for the relay at the end B. Just follow the steps 5,6,7 and swap the words End A and End B (In this case Step 6 should be: At the **End A** press the DISPLAY SELECT button to enter the TEST submenu. Pressing the RAISE and LOWER function buttons enter TEST. At the VALUE screen read GUARD)

The trip values will not reflect relay operating threshold! Injected trip current value may vary +/- 10%.

1.2. Testing both line ends tripping with one test set at each end, test sets are not synchronised

Consider the line that is protected with REL350 relays at both ends like in Fig. 2



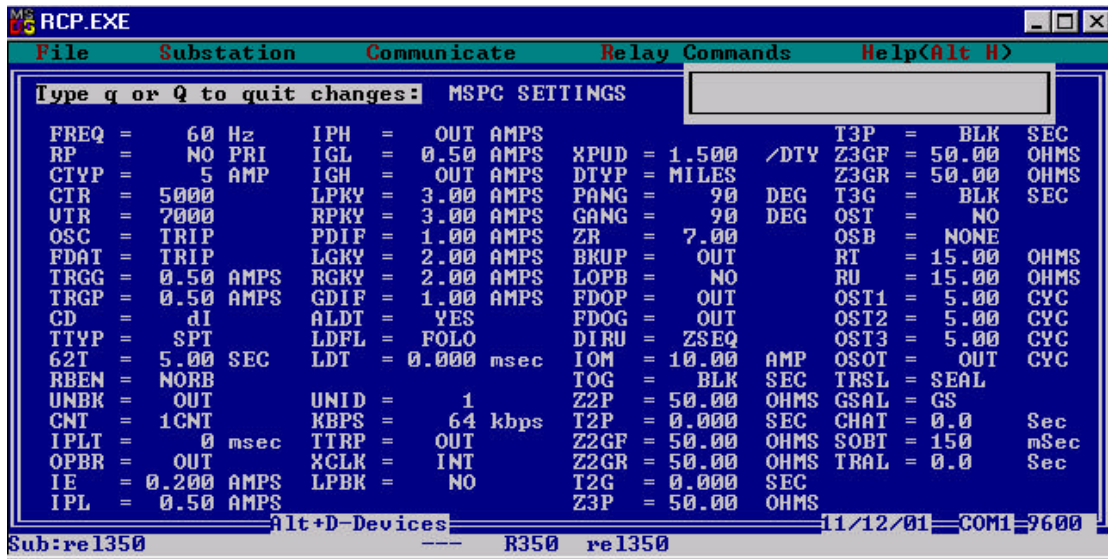
Step 1: Connect the test sets as shown in the Figure 2. If the relays were already connected to the CT, PT, ensure that primary circuit is isolated from the relay either using the test switch or making necessary connections at the terminal blocks in the panel (CT circuit short circuited and VT circuit opened);

Step 2: Set the relay in the End A using either RCP software tool or directly from the relay front interface. Please note that these are default settings for test purpose only:

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RCP.EXE
File Substation Communicate Relay Commands Help(Alt H)
Type q or Q to quit changes: MSPC SETTINGS
FREQ = 60 Hz IPH = OUT AMPS T3P = BLK SEC
RP = NO PRI IGL = 0.50 AMPS XPUD = 1.500 /DTY Z3GF = 50.00 OHMS
CTYP = 5 AMP IGH = OUT AMPS DTYP = MILES Z3GR = 50.00 OHMS
CTR = 5000 LPKY = 3.00 AMPS PANG = 90 DEG T3G = BLK SEC
UTR = 7000 RPKY = 3.00 AMPS GANG = 90 DEG OST = NO
OSC = TRIP PDIF = 1.00 AMPS ZR = 7.00 OSB = NONE
FDAT = TRIP LGKY = 2.00 AMPS BKUP = OUT RT = 15.00 OHMS
TRGG = 0.50 AMPS RGKY = 2.00 AMPS LOPB = NO RU = 15.00 OHMS
TRGP = 0.50 AMPS GDIF = 1.00 AMPS FDOP = OUT OST1 = 5.00 CYC
CD = dl ALDT = YES FDOG = OUT OST2 = 5.00 CYC
TTYP = SPT LDPL = LEAD DIRU = ZSEQ OST3 = 5.00 CYC
62T = 5.00 SEC LDT = 0.000 msec IOM = 10.00 AMP OSOT = OUT CYC
RBEN = NORB UNID = 0 Z2P = 50.00 OHMS GSAL = GS
UNBK = OUT KBPS = 64 kbps T2P = 0.000 SEC CHAT = 0.0 Sec
CNT = 1CNT TTRP = OUT Z2GF = 50.00 OHMS SOBT = 150 nSec
IPLT = 0 msec XCLK = INT Z2GR = 50.00 OHMS TRAL = 0.0 Sec
OPBR = OUT LPBK = NO T2G = 0.000 SEC
IE = 0.200 AMPS Z3P = 50.00 OHMS
IPL = 0.50 AMPS
Alt +D-Devices 11/12/01 COM1 9600
Sub:re1350 --- R350 re1350
    
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Step 3: Set the relay in the End B using either RCP software tool or directly from the relay front interface. Please note that these are default settings for test purpose only:



Step 4: Check that communication interface (either analog or digital depending on the catalog number) between relays is hooked up;

Step 5: Enter VOLTS/AMPS/ANGLE submenu of relays at end A and B pressing RAISE or LOWER function buttons. Ensure that CHRX is GUARD, CHTX is GUARD, BERR is 0. If not check the settings as per steps 3,4; or communication link between relays. Note that XCLK in the steps 3 and 4 is INT. This setting should be changed to EXT depending on the communication topology (use of the MUX etc);

Step 6: At the End B press the DISPLAY SELECT button to enter the TEST submenu. Pressing the RAISE and LOWER function buttons enter TEST. At the VALUE screen read GUARD;

Step 7: At the End A press the DISPLAY SELECT button to enter the VOLTS/AMPS/ANGLE submenu. Pressing the RAISE and LOWER function buttons select CHRX. At the VALUE screen read ARM;

Step 8: Inject the current at the end A as:

| I Amps Angle | |
|--------------|------|
| Ia=1.5 | 0 |
| Ib=0.0 | -120 |
| Ic=0.0 | -240 |

Step 9: Inject the current at the end B permanently as:

| I Amps | Angle |
|---------------|--------------|
| la=1.0 | 0 |
| lb=0.0 | -120 |
| lc=0.0 | -240 |

Step10: Verify no tripping at both line ends;

Step11: Increase the current at the end A as per table. Suddenly increase the current for the Change Detector Operation

| I Amps | Angle |
|---------------|--------------|
| la=4.0 | 0 |
| lb=0.0 | -120 |
| lc=0.0 | -240 |

Step 12: Verify the relay operation at the end A and B. Check the Target Indication at both line ends. They should be as (read under LAST FAULT Submenu):

PLT = AG
PLTG = YES
PTOG = YES

Step 13: Verify the proper operation of the Circuit Breaker. Only phase A should open (in the case of the TTYP = 3PT all three poles of the Circuit Breaker should open).

Step 14: Repeat the same test for the phase B and C following the steps 8 to 13.

Step 15: The same procedure could be repeated for the relay at the end B. Just follow the steps 5,6,7 and swap the words End A and End B (In this case Step 6 should be: At the **End A** press the DISPLAY SELECT button to enter the TEST submenu. Pressing the RAISE and LOWER function buttons enter TEST. At the VALUE screen read GUARD)

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