



## Time Delay Voltage

### Description

The IAV relays are single phase induction disk relays designed to respond, with time delay, to either an increasing or a decreasing voltage, or both. Some models are frequency compensated, and some include an instantaneous unit (hinged armature type). Most models listed in the Selection Guide include a target seal-in unit on all contacts.

The basic mechanism of all models is an induction-disk unit with either a tapped coil or a tapped resistor for setting pickup. (In the overvoltage models, the relay is calibrated on increasing voltage to close the normally open contact at tap setting. The time dial adjusts the angle through which the disk rotates and, hence, the time delay.)

In the undervoltage models, the relay is calibrated on decreasing voltage to close the normally closed contact at tap setting. The time dial adjusts the angle through which the disk rotates at voltages above tap setting.

In the combined overvoltage and undervoltage models, the relay is calibrated on increasing voltages to close the normally open contacts at tap setting and on decreasing voltages to close the normally closed contacts at various percentages of tap setting.

For the undervoltage and combined undervoltage and overvoltage relays, the two connecting plug S2 case is used to prevent false tripping when the relay is removed or replaced. Either plug completes the coil circuit and thus opens the normally closed contact used with under voltage operation. Both plugs are needed to complete the contact circuits.

### Features and Benefits

- Frequency compensation (optional)
- Target seal-in unit (most units)
- Instantaneous units (optional)

### Applications

- AC Generators (including Hydro)
- Distribution feeder
- Time delay pickup or dropout

### Protection and Control

- Generator overvoltage
- Feeder under and overvoltage
- Ground detection



## Application

### Overvoltage Relays

IAV overvoltage relays are used for protection against simple overvoltage, but other applications are also common. They are applied to ground detection, both on feeders and on ac generators, and they are also used in timed switching arrangements, where their dependability and accuracy make them preferable to purely mechanical timing relays.

For protection against overvoltage in a three-phase system, use the IAV51A relay (Fig. 1). For instantaneous protection as well as time delay, use the IAV71B.

For the detection of grounds on ungrounded three-phase systems, two methods are in general use. One measures the zero sequence potential (Fig. 3), and the other measures the actual voltage between the system neutral and ground (Fig. 5).

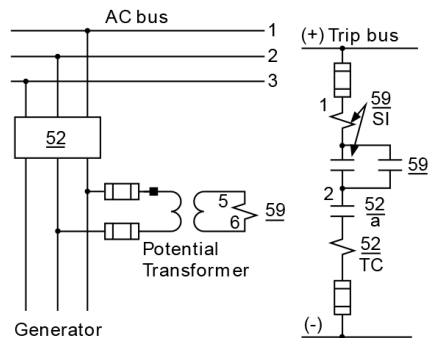


Fig. 1. Typical external for IAV51A used for overvoltage protection

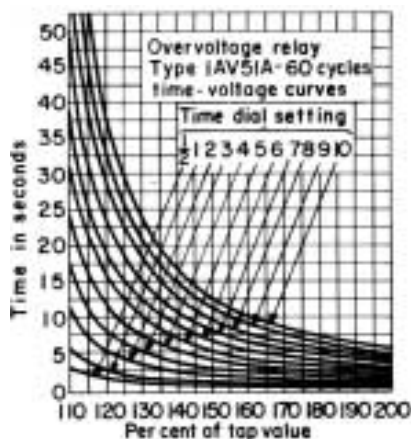


Fig. 2 Typical time voltage curve for IAV51A, 71 and 72

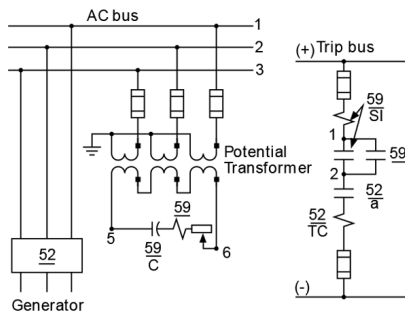


Fig. 3 Typical external for ground fault protection 3-phase; ungrounded system IAV512D

For the circuit of Figure 3, use IAV51D, a low pickup relay which has its operating circuit tuned to the rated frequency. The potential transformers used in this circuit are connected grounded-Y primary, broken-delta secondary. The primaries should have ratings equal to the line-to-line voltage of the system, and the secondaries can have ratings of either 67 or 115 V.

Select a relay model with a continuous rating of three times the potential transformer secondary voltage. This is necessary because, when a ground occurs, the zero sequence voltage may be up to three times the normal transformer secondary voltage. Thus, with a potential transformer secondary rated 67 V, use a 199-V relay coil. For ground fault protection of ac rotating machines, use a circuit similar to that shown in Figure 5 applying IAV51D or IAV51K relays. These are low-pickup relays whose coil circuits are tuned by capacitors to their rated frequencies. The circuits are thus rendered only one-eighth as sensitive to the third harmonic as they are to the rated frequency.

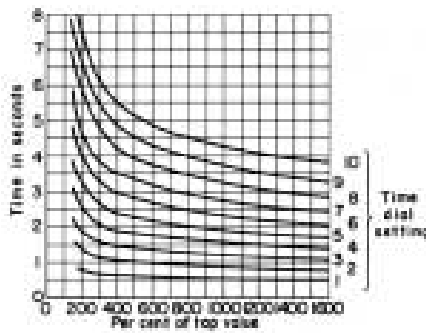


Fig. 4 Typical time voltage curve for IAV51D and 51K

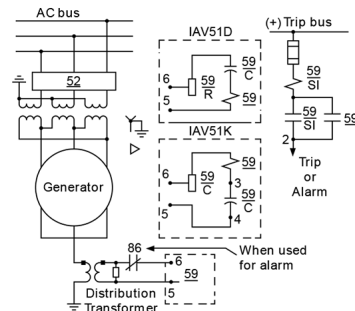


Fig. 5. Typical external for ground fault protection of an AC rotating machine IAV51D or 51K

In Figure 5, a distribution transformer is connected between the machine neutral of the generator and ground. Normally there is no voltage on the transformer but during a fault, there is a voltage with a worst-case magnitude equal to the phase-to-ground value.

Greater sensitivity can be obtained by choosing a distribution transformer with higher secondary voltage. In such a case, the relay will not carry the fault voltage continuously, and provision must be made to deenergize the operating coil using an auxiliary relay. The short-time rating for both IAV51D and IAV51K is 360 V for 10 sec.

The IAV51M relay may be used for a definite time delay and the time is adjustable from 3 to 30 sec by means of a time dial. Operating time is defined as the time to close the contacts with voltage suddenly raised from zero to the rated value.

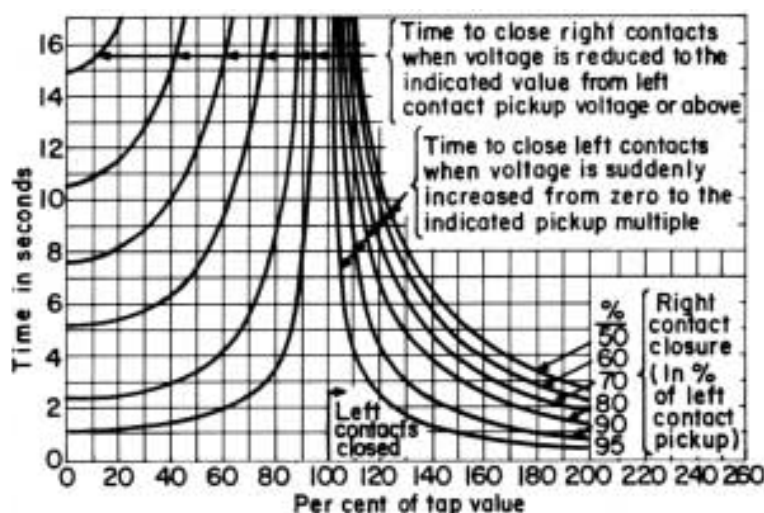


Fig. 6. Typical time voltage curve for IAV53K, 53L, 73A and 73B

### Undervoltage Relays

For simple undervoltage protection, select the IAV relay according to the time voltage characteristic required.

In a typical automatic-preferred emergency throwover scheme, the undervoltage contacts of the IAV54E relay are used to trip the circuit breaker in the normal source circuit, and the auxiliary switch (52b) of this normal source breaker permits the voltage closing contacts of an IAV51A relay in the emergency source to close its circuit breaker.

### Combined Undervoltage and Overvoltage Relays

IAV53, IAV69, IAV70, and IAV73 relays are time-delay, over-and undervoltage relays having two contacts, one of which closes on overvoltage and the other on undervoltage.

### Frequency Compensation

The following IAV relays are frequency compensated:

- Overvoltage relays-IAV71, IAV72
- Undervoltage relays-IAV74A
- Undervoltage and Overvoltage relays IAV73A, IAV73B

These relays have uniform characteristics over a frequency range of 30-90 Hz. A typical application is on systems supplied by hydrogenerators, where the frequency tends to increase when faults occur. Frequency compensation is provided by an R-C circuit across the wound shading coils of the induction disk operating coil and core unit.

### Characteristics

IAV relays will continuously withstand rated voltage on all taps, and tap voltage on all taps above rated voltage. For the minimum and maximum taps shown in the list below, the following intermediate taps are available:

| TAP RANGE | TAPS AVAILABLE                         |
|-----------|----------------------------------------|
| 5.4-20    | 5.4, 7.5, 12.5, 20                     |
| 10-40     | 10, 15, 25, 40                         |
| 16-64     | 16, 24, 40, 64                         |
| 28-112    | 28, 42, 70, 112                        |
| 55-140    | 55, 64, 70, 82, 93, 105, 120, 140      |
| 110-280   | 110, 128, 140, 164, 186, 210, 240, 280 |

| TAP RANGE | TAPS AVAILABLE                         |
|-----------|----------------------------------------|
| 220-560   | 220, 256, 280, 328, 372, 420, 480, 560 |

The overvoltage relays and the undervoltage relays are provided with time dials for adjustment of time delay.

The combined under-and over-voltage relays are made both with and without time delay adjustment. Models IAV53, -69, and -73 have time delays which are functions of the setting of the undervoltage contacts. Model IAV70 has a time dial which permits adjustment of timedelay independently of the voltage settings.

### Tripping Circuits and Contact Ratings

The current carrying rating of the contact circuit is determined by whether the relay has a seal-in unit and by the tap used on the seal-in coil. Without a seal-in unit the relay contacts will close and carry 30 A for tripping duty and 2 A continuously at control voltages of 250 vdc or less. Refer to the GE Vernova Multilin CD or Home Page for data on target seal-in units.

## Selection Guide

| GENERAL DESCRIPTION                                                                                                                                                                                                       | RATED VAC                                                | TAP RANGE VOLTS        |                          | TARGET SEAL-IN | CONTACTS | MODEL NUMBERS                 |                                | CASE SIZE       | APPROX. Wt. IN lbs (kg) |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------|--------------------------|----------------|----------|-------------------------------|--------------------------------|-----------------|-------------------------|-------------|
|                                                                                                                                                                                                                           |                                                          | MIN                    | MAX                      |                |          | 60 Hz                         | 50 Hz                          |                 | NET                     | SHIP        |
| OVERVOLTAGE (DEVICE No. 59)                                                                                                                                                                                               |                                                          |                        |                          |                |          |                               |                                |                 |                         |             |
| General duty, overvoltage and control switching.<br>Time delay 1 to 10 sec at 1.6 times tap setting                                                                                                                       | 115<br>208<br>230<br>460                                 | 55<br>70<br>110<br>220 | 140<br>140<br>280<br>560 | 0.2/2          | 1-N.O.   | IAV51A1A<br>A7A<br>A2A<br>A3A | IAV51A4A<br>A9A<br>A5A<br>A11A | S1              | 12<br>(5.4)             | 15<br>(6.8) |
| Same as IAV51A except 2-N.O. Contacts<br>1-Target Seal-in                                                                                                                                                                 | 115<br>199<br>230                                        | 55<br>70<br>110        | 140<br>140<br>280        | 0.2/2          | 2-N.O.   | IAV52A1A<br>A7A<br>A2A        | IAV52A4A<br>A9A<br>A5A         |                 |                         |             |
| LOW PICK-UP                                                                                                                                                                                                               |                                                          |                        |                          |                |          |                               |                                |                 |                         |             |
| Ground detection on 3-phase systems and on generator stator windings. Time delay 0.75 to 7.5 sec at 200% of tap setting, or 4 sec on N.O. 10 TDs.                                                                         | 115 <sup>①</sup><br>119 <sup>①</sup><br>345 <sup>①</sup> | 10<br>16<br>28         | 40<br>64<br>112          | 0.2/2          | 1-N.O.   | IAV51D2A<br>D1A<br>D9A        | IAV51D5A<br>D4A<br>D10A        | S1              | 12<br>(5.4)             | 15<br>(6.8) |
|                                                                                                                                                                                                                           | 67 <sup>①</sup>                                          | 5.4                    | 20                       |                |          | IAV51K1A                      | IAV51K2A                       | S1 <sup>②</sup> | 13<br>(5.9)             | 16<br>(7.3) |
| Same as IAV51D or IAV51K except 2 N.O. Contacts                                                                                                                                                                           | 199 <sup>①</sup><br>67 <sup>①</sup>                      | 16<br>5.4              | 64<br>20                 | 0.2/2          | 2-N.O.   | IAV52D1A                      | - - - -                        | S1              | 12<br>(5.4)             | 15<br>(6.8) |
|                                                                                                                                                                                                                           |                                                          |                        |                          |                |          | IAV52K1A                      | IAV52K2A                       | S1 <sup>②</sup> | 13<br>(5.9)             | 16<br>(7.3) |
| TIMING APPLICATIONS                                                                                                                                                                                                       |                                                          |                        |                          |                |          |                               |                                |                 |                         |             |
| Single circuit closes with time delay. Fixed pickup voltage. Time delay: 3 to 30 sec at rated volts.                                                                                                                      | 115<br>208<br>230                                        |                        | 55<br>100<br>110         | 0.2/2          | 1-N.O.   | IAV51M1A<br>M4A<br>M3A        | IAV51M2A                       | S1              | 12<br>(5.4)             | 15<br>(6.8) |
| FREQUENCY COMPENSATED                                                                                                                                                                                                     |                                                          |                        |                          |                |          |                               |                                |                 |                         |             |
| Frequency sensitive applications. Otherwise same as IAV51A compensated 30-90 Hz.                                                                                                                                          | 115                                                      | 55                     | 140                      | 0.2/2          | 1-N.O.   | IAV71A1A                      | IAV71A3A                       | S1              | 13<br>(5.9)             | 16<br>(7.3) |
| Frequency compensated; instantaneous unit added, also frequency compensated; for hydro-generator applications; general duty for AC generator overvoltage protection and voltage regulator backup. 1 to 10 sec time delay. | 115                                                      | 55                     | 140                      |                |          | IAV71B2A <sup>③</sup>         | IAV71B3A <sup>③</sup>          |                 |                         |             |
|                                                                                                                                                                                                                           | 230                                                      | 110                    | 280                      |                |          | B5A <sup>③</sup>              | - - - -                        |                 |                         |             |
|                                                                                                                                                                                                                           | 230                                                      | 110                    | 280                      |                |          | B6A <sup>④</sup>              | - - - -                        |                 |                         |             |
| Similar to IAV71A except 2 N.O. contacts.                                                                                                                                                                                 | 115                                                      | 55                     | 140                      |                | 2-N.O.   | IAV72A1A                      | - - - -                        |                 |                         |             |
| Similar to IAV72A except includes ints. unit with 1 N.O. contact                                                                                                                                                          | 115                                                      | 55                     | 140                      |                |          | IAV72B1A <sup>③</sup>         | IAV72B4A <sup>③</sup>          |                 |                         |             |
|                                                                                                                                                                                                                           | 230                                                      | 110                    | 280                      |                |          | - - - -                       | B3A <sup>③</sup>               |                 |                         |             |
| Similar to IAV72B except includes int Unit with 2 N.O. contacts                                                                                                                                                           | 115                                                      | 55                     | 140                      |                |          |                               | - - - -                        |                 |                         |             |

<sup>①</sup> IAV51D, 51K, 52D, and 52K-10 sec rating at 360 V.

<sup>②</sup> Includes external capacitor.

<sup>③</sup> Inst. unit adjustable 120-200 V.

<sup>④</sup> Inst. unit adjustable 180-300 V

## Selection Guide

| GENERAL DESCRIPTION                                                                       | RATED VAC | TAP RANGE VOLTS |     | TARGET SEAL-IN | CONTACTS | MODEL NUMBERS |          | CASE SIZE | APPROX. Wt. IN lbs (kg) |          |
|-------------------------------------------------------------------------------------------|-----------|-----------------|-----|----------------|----------|---------------|----------|-----------|-------------------------|----------|
|                                                                                           |           | MIN             | MAX |                |          | 60 Hz         | 50 Hz    |           | NET                     | SHIP     |
| UNDERVOLTAGE (DEVICE NO. 27)                                                              |           |                 |     |                |          |               |          |           |                         |          |
| 5 sec time delay at zero volts if set on No. 10 TD, time range 1 to 13 sec at 80% of tap. | 67        | 32              | 80  | 0.2/2          | 1 N.C.   | IAV54E14A     | ----     | S2        | 12 (5.4)                | 16 (7.3) |
|                                                                                           | 115       | 55              | 140 |                |          | E1A           | IAV54E4A |           |                         |          |
|                                                                                           | 208       | 110             | 280 |                |          | E13A          | ----     |           |                         |          |
|                                                                                           | 230       | 110             | 280 |                |          | E2A           | E5A      |           |                         |          |
| 30 sec time delay at zero volts if set on No. 10 TD                                       | 460       | 220             | 560 |                |          | E3A           | E6A      |           |                         |          |
|                                                                                           | 115       | 55              | 140 | None           |          | IAV54F1A      | ----     |           |                         |          |
|                                                                                           | 230       | 110             | 280 |                |          | F2A           | IAV54F4A |           |                         |          |
|                                                                                           | 460       | 220             | 460 |                |          | F3A           | ----     |           |                         |          |
| 75 sec time delay at zero volts on No. 10 TD                                              | 115       | 55              | 140 |                |          | IAV54H1A      | ----     |           |                         |          |
| Same as IAV54E except no seal-in                                                          | 460       | 220             | 560 |                |          | H2A           | ----     |           |                         |          |
|                                                                                           | 115       | 55              | 140 | 0.2/2          | 2 N.C.   | IAV54J1A      | ----     |           |                         |          |
|                                                                                           | 230       | 110             | 280 |                |          | J2A           | ----     |           |                         |          |
|                                                                                           | 460       | 220             | 560 |                |          | J3A           | IAV54J4A |           |                         |          |
| 5 sec time delay same as IAV54E except 2 N.C.                                             | 115       | 55              | 140 |                |          | IAV55C1A      | IAV55CA4 |           |                         |          |
| 30 sec time delay                                                                         | 230       | 110             | 280 |                |          | C2A           | C5A      |           |                         |          |
|                                                                                           | 460       | 220             | 560 |                |          | C3A           | C9A      |           |                         |          |
|                                                                                           | 115       | 55              | 140 |                |          | IAV55F1A      | ----     |           |                         |          |
|                                                                                           | 230       | 110             | 280 |                |          | F2A           | ----     |           |                         |          |
| 75 sec time delay                                                                         | 115       | 55              | 140 |                |          | IAV55H1A      | ----     |           |                         |          |
| FREQUENCY COMPENSATED                                                                     |           |                 |     |                |          |               |          |           |                         |          |
| 5 sec time delay at zero volts on No. 10 TDS. Compensated 30-90 Hz                        | 115       | 55              | 140 | 0.2/2          | 1 N.C.   | IAV74A1A      |          | S2        | 13 (5.9)                | 17 (7.7) |

## Selection Guide

| GENERAL DESCRIPTION                                                                                                                                                                                            | RATED VAC         | TAP RANGE VOLTS  |                   | TARGET SEAL-IN | CONTACTS         | MODEL NUMBERS          |                                | CASE SIZE | APPROX. Wt. IN lbs (kg) |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------|-------------------|----------------|------------------|------------------------|--------------------------------|-----------|-------------------------|-------------|
|                                                                                                                                                                                                                |                   | MIN              | MAX               |                |                  | 60 Hz                  | 50 Hz                          |           | NET                     | SHIP        |
| Over-And Undervoltage (Device No. 27/59)                                                                                                                                                                       |                   |                  |                   |                |                  |                        |                                |           |                         |             |
| General duty; electrically separate contacts with target seal-in unit series with each contact; UV adjustable from 50 to 95% of OV tap setting. Time delay 1.1 sec at zero volts: 0.4 sec at 2 x tap. setting  | 115<br>230<br>460 | 55<br>110<br>220 | 140<br>280<br>560 | 0.2/2          | 1 N.C.<br>1 N.O. | IAV53K1A<br>K2A<br>K3A | IAV53K4A<br>K5A<br>K11A        | S2        | 13<br>(5.9)             | 17<br>(7.7) |
| Automatic control schemes; same as IAV53K except target seal-in units are omitted.                                                                                                                             | 115<br>230<br>460 | 55<br>110<br>220 | 140<br>280<br>560 | None           |                  | IAV53L1A<br>L2A<br>L3A | IAV53L4A<br>L5A<br>- - -       |           |                         |             |
| Similar to IAV53K except target seal in units are omitted. Time delay 0.5 sec at zero volts                                                                                                                    | 115<br>460        | 55<br>220        | 140<br>560        |                |                  | IAV53N1A<br>N3A        | - - - -<br>- - - -             |           |                         |             |
| General duty; common connection between contacts; OV setting is independent of UV adjustment; UV adjustable from 60 to 95% of OV tap setting; target and seal-in units in series with each contact             | 120<br>208<br>240 | 55<br>110<br>110 | 140<br>280<br>280 | 0.2/2          |                  | IAV69A1A<br>A4A<br>A2A | IVA69A3A<br>- - - -<br>- - - - |           |                         |             |
| Automatic control schemes; same as IAV69A except target seal-in units are omitted..                                                                                                                            | 120<br>240        | 55<br>110        | 140<br>280        | None           |                  | IAV69B1A<br>B2A        | IAV69B3A<br>- - - -            |           |                         |             |
| General duty; common connection between contacts; UV setting fixed at 95% or more of OV tap setting; target seal-in unit in series with each contact; adjustable time delay 30 sec max. on complete loss of V. | 120<br>240        | 55<br>110        | 140<br>280        | 0.2/2          |                  | IAV70A1A<br>A2A        | - - - -<br>- - - -             |           |                         |             |
| Automatic control schemes; same as IAV70A except target seal-in units are omitted.                                                                                                                             | 120<br>240        | 55<br>110        | 140<br>280        | None           |                  | IAV70B1A<br>B2A        | IAV70B3A<br>- - -              |           |                         |             |
| Frequency Compensated                                                                                                                                                                                          |                   |                  |                   |                |                  |                        |                                |           |                         |             |
| General duty; same as IAV53K except Frequency Compensated. 30-90 Hz                                                                                                                                            | 115               | 55               | 140               | 0.2/2          | 1 N.C.<br>1 N.C. | IAV74A1A               | - - - -                        | S2        | 13<br>(5.9)             | 17<br>(7.7) |
| Automatic control schemes; same as IAV53L except frequency compensated. 30-90 Hz.                                                                                                                              |                   |                  |                   | None           |                  | IAV73B1A               | - - - -                        |           |                         |             |

For more information, visit  
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