



*Static relay for high speed detection of underfrequency or overfrequency conditions.*

#### Features and Benefits

- Easy setpoint setup
- Ac or Dc control power
- Drawout case
- Up to 4 frequency setpoints

#### Applications

- Load shedding frequency schemes
- Extremely accurate frequency detection

#### Protection and Control

- Under and overfrequency with undervoltage cutoff
- Load shedding and restoration

#### User Interfaces

- Indicator LEDs
- Front panel settings adjustment
- Optional card extender for testing



## Description

SFF relays are digital frequency relays designed to operate when the system frequency changes to a predetermined level. They may be set for over-, under-, or restore-frequency operation. Versions are available with one, two, or four frequency points independently settable for function, frequency value, and output delay.

The setting range is 40 to 79.9 Hz in 0.01 Hz steps. Detection of overfrequency or underfrequency levels for 3 cycles will result in an output in 0 to 1.55 sec delay (0.05 sec steps). Detection of system frequency above restore frequency setting for 3 cycles will result in an output prolonged by 0 to 1.55 sec.

A rate of change feature on the multifrequency models, when enabled, will produce an output at the higher of two adjacent underfrequency setpoints if the next lower frequency setpoint is reached before the higher setpoint times out.

An AC undervoltage function will cutoff all outputs whenever the input voltage is less than its setting. The function is adjustable from 35 to 100% of 120 V (in 5% steps). It will drop out in 1/2 cycle and pickup in 1 cycle. The SFF relays may be powered from either a DC or AC control source (37-280 VDC or 45-132 Vrms 50/60 Hz). However, when the restore frequency mode is used, a restore enable contact input requires DC control power.

All adjustments are front panel accessible without removing the nameplate. These include: frequency, mode of operation, time delay, undervoltage cutoff, and rate of change "in" or "out" (multi-frequency models only). All above adjustments are per measurement point except undervoltage cutoff.

Indications are provided on the front panel for:

- IN SERVICE (green LED) = Control power and Startup OK (normally on) [1 per relay]
- TRIP F (#) (red LED) = Freq (#) output (trip current operated and latched until reset) [1 per setpoint]
- TRIP RoC (red LED) = Rate of change caused freq (#) trip current operated and latched until reset [for FI in SFF202; for FI, F2, F3 in SFF204]
- TEST F (#) (amber LED) = Freq (#) detector output (self reset) [1 per setpoint]
- TESTTB (amber LED) = Freq (#) output to trip bus (self reset) [1 per setpoint]

## Application

The SFF series of frequency relays can be applied wherever an extremely stable device is required for the accurate detection of underfrequency or overfrequency conditions.

### Underfrequency

The underfrequency trip feature of the SFF relays may be used in load conservation schemes where accuracy and repeatability of frequency measurement is important. If a system disturbance results in loss of generating capacity such that load exceeds generation, system frequency will start to decay and the system may be in danger of collapsing. Underfrequency relays distributed around the system can be used to detect this condition and to disconnect selected system load to compensate for the loss of generation. Such action must be taken promptly and must be of sufficient magnitude to conserve essential load and enable the rest of the system to recover from the underfrequency condition.

Since the SFF compares the period of three successive voltage waves with a crystal reference, distortions of this input voltage wave affecting its period may cause incorrect measurement. Longer time delay settings will

make this less likely to occur.

It is generally not good practice to supply a relay from a potential source that is connected to one bus section while using that relay to disconnect load on another bus section. For example, a frequency relay connected to a motor bus may see the frequency decaying faster than the voltage and produce a trip output. If the undervoltage cutoff does not coordinate with the underfrequency delay in such a relay, it could inadvertently disconnect load on a separate bus section. When an unattended substation with a large amount of motor load is isolated from the system, a load shedding scheme may see the frequency decaying faster than the voltage due to the motor load and initiate a trip and lock-out. The undervoltage cutoff feature coordinated with the underfrequency delay in the SFF can be used to prevent such inadvertent operation.

Where an industrial installation is tapped off a power company transmission circuit that utilizes high speed automatic reclosing, an SFF relay could be used at the industrial location to prevent motor/ generator damage which might result from reclosing to the system out of phase. The relay would detect the drop in frequency while the transmission breaker is open and trip the industrial incoming breaker before reclosing could occur.

### Rate of Change

This feature will allow load to be shed faster if the frequency decays at a rate faster than was anticipated when the delay timer settings were determined.

### Overfrequency

The overfrequency function may be used anywhere that it is desired to detect an overfrequency condition, e.g., to protect a generator against sustained overfrequency beyond rating due to inadvertent load rejection.

Another application is the removal of supplemental protection enabled only during off-line operation of a generator such as applied for protection against accidental energization on turning gear.

**Load Restoration**

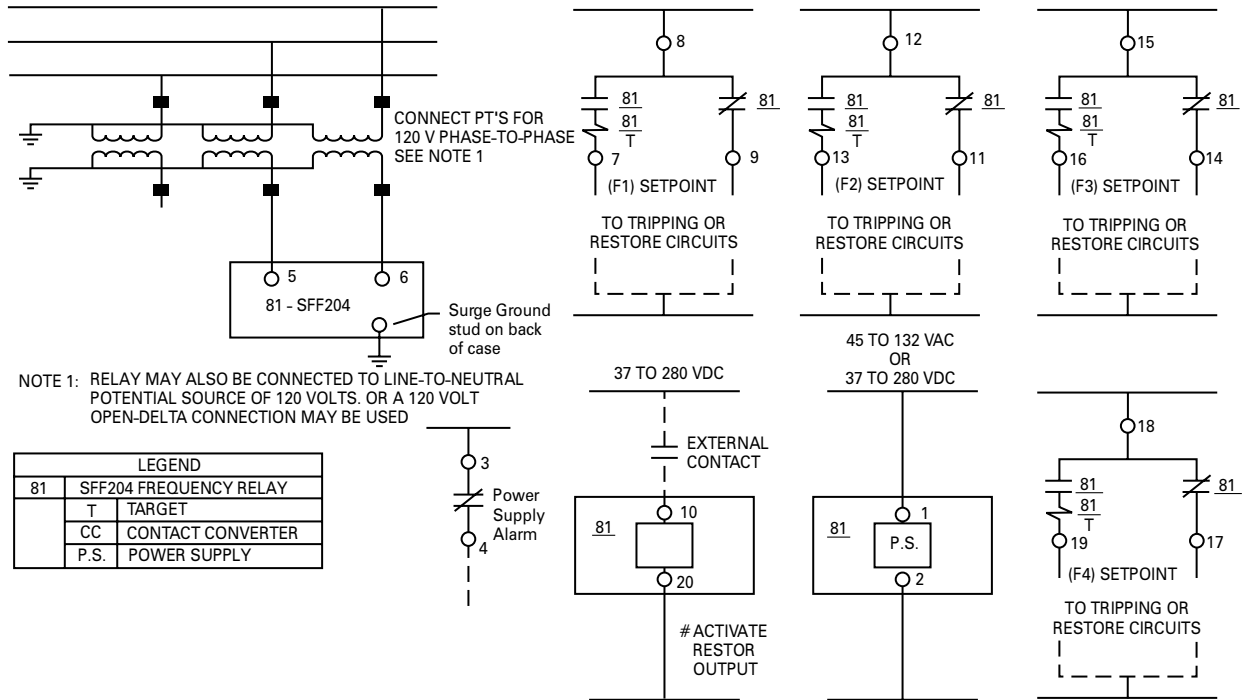
Once the system frequency has recovered after a successful load

shedding operation, the restore function in the SFF relay (if selected) can be used to initiate the load restoration process. A load restoration program usually incorporates substantial time delay, which must be provided by a timer external to the SFF relay. The time delay is related to the time required to add generation and the desire to stagger the

reconnection of load allowing the system to stabilize after each step.

**Connection Diagram**

Fig. 1 External connections for the SFF204 relay



## Technical Specifications

<b>DC CONTROL VOLTAGE</b> 37 to 280 V	<b>SETTINGS</b> <b>Frequency:</b> Setpoint 40.00 to 79.99 Hz on 0.01 Hz steps Repeatability ±0.002 Hz <b>Timing:</b> Setpoint 0 to 255 ms in 1 ms steps* 0 to 25.5 sec in 0.1 sec steps Repeatability ±3% of setting <b>Undervoltage:</b> Setpoint 35 to 95% in 5% steps (based on 120 Vrms) Repeatability ±3% of setting <b>Rate of Change (multi-setpoint models only):</b> Freq 1 to freq 2: IN or OUT Freq 2 to freq 3: IN or OUT Freq 3 to freq 4: IN or OUT * Total time delay is the time-delay setting plus 3 cycles plus the output relay operating time of 6-8 ms.	<b>ACCESSORIES</b> A card extender (catalog number 215B8031G1) is available for testing the printed circuit cards. It should be listed as a separate item on an order.
<b>AC CONTROL VOLTAGE</b> 45 to 132 Vrms 50/60 Hz		<b>ENVIRONMENTAL</b>
<b>AC MEASUREMENT INPUT</b> 42 to 132 Vrms 50/60 Hz		<b>Operating:</b> -20 to +55°C, 95% relative humidity (noncondensing) Note: The unit will not malfunction, nor be damaged, in ambient up to +65°C.
<b>CONTACT RATINGS</b> Make and carry = 30 A for 1 sec		<b>Storage:</b> -40 to +75°C, 95% relative humidity (noncondensing)
<b>TARGET SUPERVISION UNIT</b> 0.1 A operate level with less than 0.6 VDC drop at 30 A		<b>Surge:</b> ANSI C37.90 (SWC and Fast Transient) IEC 255 GE RFI
<b>BURDEN</b> See Selection Guide below.		Specifications subject to change without notice.

## Selection Guide

Burdens					Setpoints	Model Number	Case Size	Approx. Wt. in lbs (kg)	
Power Supply			Measurements					Net	Ship
DC Watts		AC VA	AC VA						
48 VDC	125 VDC	250 VDC	120 VAC	120 VAC					
3.2	3.5	6.3	8.1	1	1	SFF201B1A	S2	13(5.91)	16(7.25)
4.9	5.2	8.0	10.6	1	2	SFF202B1A	M2	19(8.64)	23(10.43)
8.4	8.7	11.5	15.7	1	4	SFF204B1A	M2	20(9.09)	24(10.89)

Single phase measurement at 120 V nominal, 48/125/250 VDC or 69/120 Vrms nominal control power (see above specifications for setting ranges and ratings that apply to all models)

## Substitution List

Original Relay Number	Closest* Superseding Relay Number	Original Relay Number	Closest* Superseding Relay Number	Original Relay Number	Closest* Superseding Relay Number
SFF21A1A	SFF201B1A	SFF21A11A	SFF201B1A	SFF23C – All Forms	SFF201B1A
SFF21A2A	SFF201B1A	SFF21A12A	SFF201B1A	SFF31A – All Forms	SFF201B1A
SFF21A3A	SFF201B1A	SFF21A13A	SFF201B1A	SFF31C1A	SFF201B1A
SFF21A4A	SFF201B1A	SFF21A14A	SFF201B1A	SFF31D1A	SFF201B1A
SFF21A5A	SFF201B1A	SFF21B – All Forms	None	SFF32A – All Forms	SFF202B1A
SFF21A6A	SFF201B1A	SFF21H – All Forms	SFF201B1A	SFF32C1A	SFF202B1A
SFF21A7A	SFF201B1A	SFF22A – All Forms	SFF202B1A	SFF33A1A	SFF201B1A
SFF21A8A	SFF201B1A	SFF22C1A	SFF202B1A	SFF33C1A	SFF201B1A
SFF21A9A	None	SFF22E1A	SFF202B1A	SFF201A1A	SFF201B1A
SFF21A10A	None	SFF22F1A	SFF202B1A	SFF202A1A	SFF202B1A
				SFF204A1A	SFF204B1A

**\*Note:** The new SFF-series relays are a new design digital relay, by its very design being different than the earlier SFF20-series and the SFF30-series. This difference is not only in the connection points, but in some instances also in the case size.

