

Load Shedding (7RW80)

1.0 INTRODUCTION

Under normal conditions the generation and demand of power is balanced. If the demand exceeds the power generation, the frequency drops down. This can lead to a collapse of the whole network.

Load shedding is a possible solution to avoid that the whole system collapses. The consumers are divided into two or more groups, depending on the importance of the power supply. Hospitals or factories have e.g. a higher priority than normal houses and apartments.

When the power demand exceeds the generation, the frequency drops down. The 7RW80 detects the decreasing frequency and issues a trip signal to shed the consumers with the lowest priority. This should lead to a stabilization of the frequency. If the frequency keeps on decreasing, the consumers with the next lowest priority will be shed.

2.0 CONNECTION

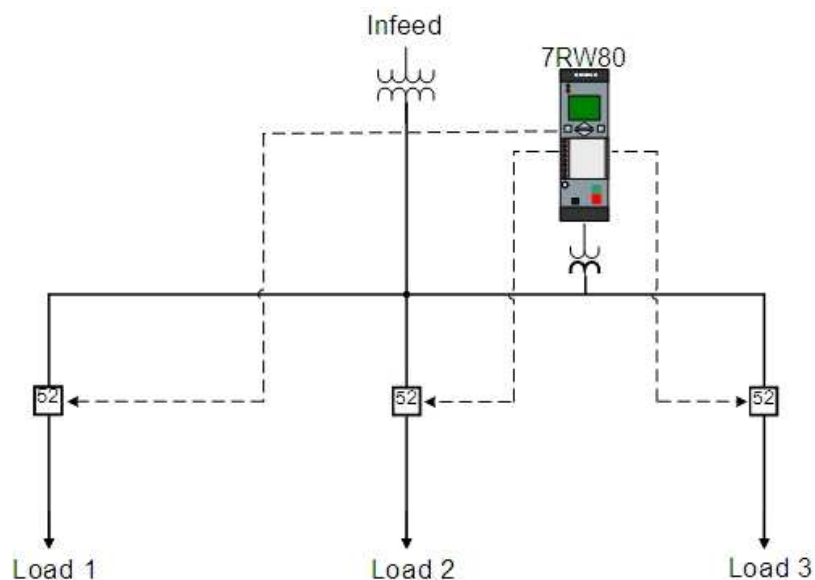


Fig. 1: Load Shedding Application

The preferred relay for this application is the 7RW802, due to the higher amount of binary inputs and outputs compared to the 7RW801.

3.0 SETTINGS IN DIGSI

3.1 PARAMETERS

An underfrequency indicates that the power demand is higher than the generation. To keep the network balanced, the relay must shed certain consumers, if the frequency drops below a certain threshold.

For this application the frequency protection function has to be enabled. To enable this function, open the device in DIGSI, go to “Device configuration” (Fig. 2) and enable the function “Over / Underfrequency Protection” (Fig. 3).

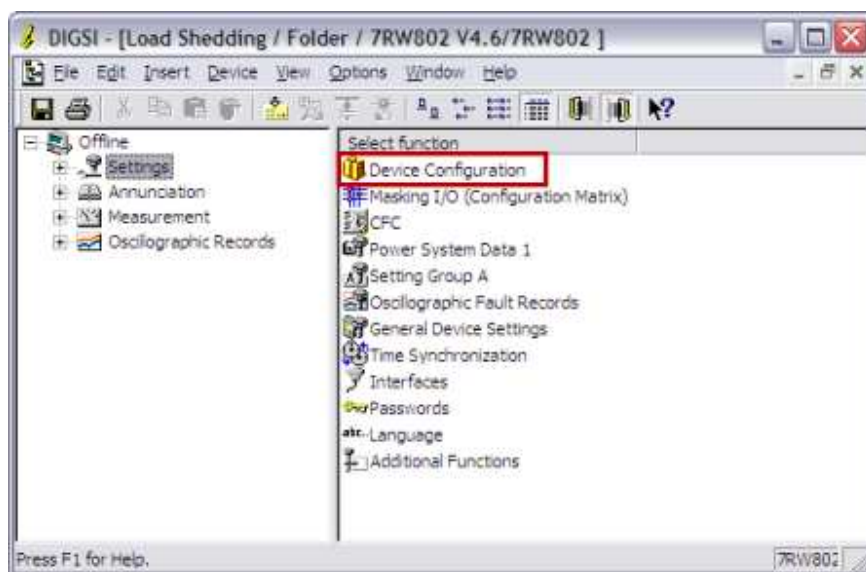


Fig. 2: Open the “Device configuration”

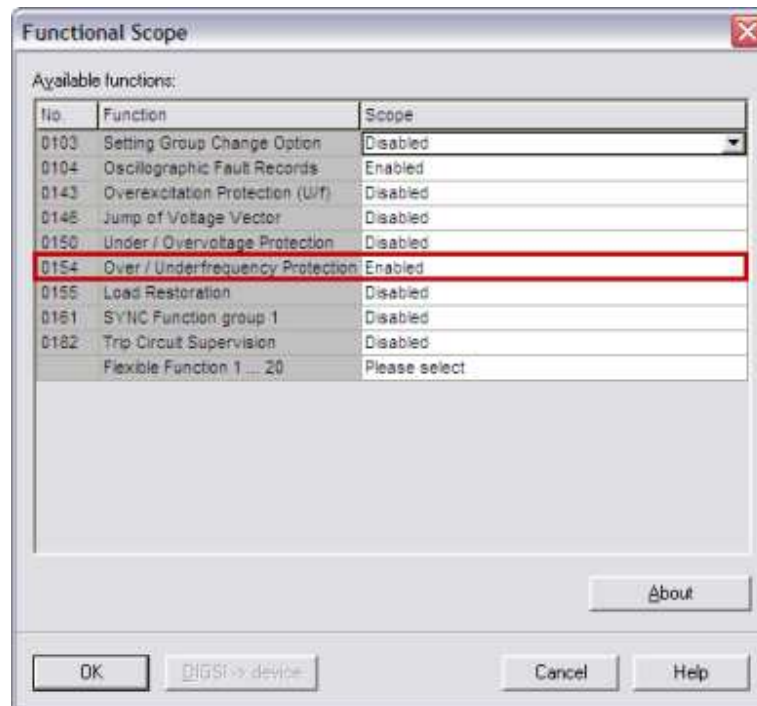


Fig. 3: Enable the Over / Underfrequency Protection

The settings of the frequency protection are available in “Setting Group A”. The first parameter 5401 must be set to “ON” to activate the frequency protection in general (Fig. 4). The following parameters 5421 – 5424 activate up to four independent frequency stages. If more stages are needed, the flexible functions can be used to add up to 20 more stages.

In our example we have divided our consumers into three priority groups. This means we need three stages F1 – F3 which have to be set to “ON – underfrequency stage”. The parameter 5402 defines the minimum voltage required for the frequency protection. If the voltage is below this threshold, the frequency function is blocked. In case of a three-phase connection, this parameter is a phase-to-phase quantity. If only a single phase-to-ground voltage is connected, this threshold must be set as phase voltage. In general the setting should be roundabout 2/3 of the nominal voltage.

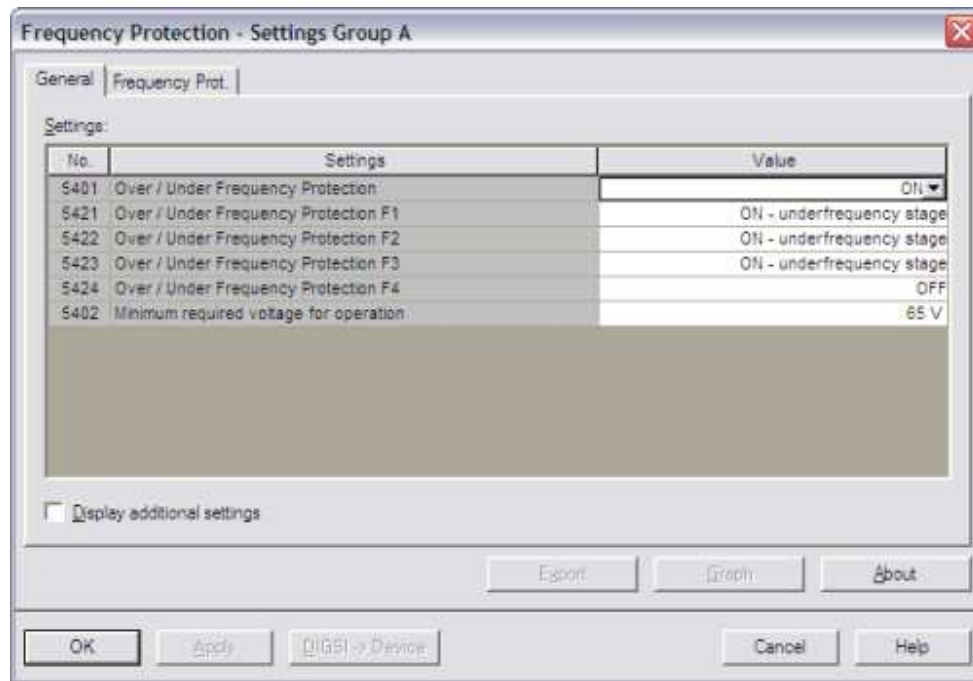


Fig. 4: Frequency Protection Settings I

The three frequency stages can be set in the tab “Frequency Prot.” (Fig. 5).

The first stage F1 shall shed the consumers with the lowest priority. Therefore this stage must pick up first. We select 49.50 Hz as pickup threshold.

If the frequency decreases further below 49.00 Hz, the load with medium priority must also be disconnected. If the frequency would still decrease (below 47.50 Hz), the complete load has to be shed.

The time delay of these three stages shall be set to 500ms.

The settings of the fourth stage are irrelevant, as this stage is deactivated.

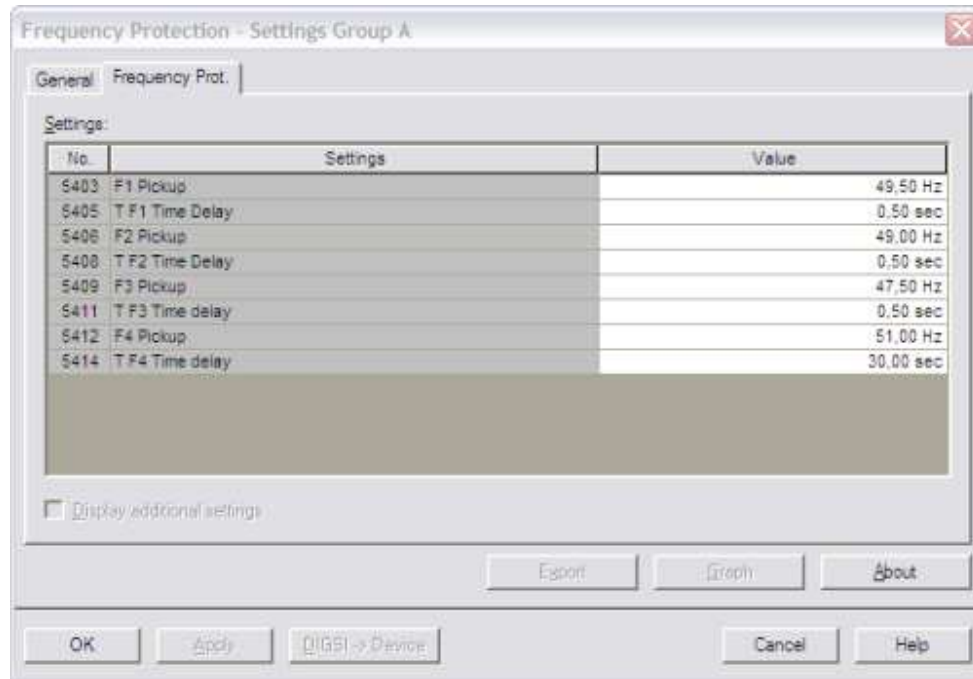


Fig. 5: Frequency Protection Settings II

3.2 ROUTING

Now the routing has to be configured. Open the “Configuration Matrix” and maximize the group “Control Device”. The predefined switching devices in this group have to be replaced by new information. They can be deleted by right-clicking on the signal and selecting “Delete Information” (Fig. 6).

| | Information | | | | Source | | | | | | | D | | |
|------------------|-------------|--------------|---|--------|--------|---|---|---|---|---|---|---|---|---|
| | Number | Display text | L | Type | BI | | | | | | | | F | C |
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | |
| Device | | | | | | | | | | | | * | | |
| P.System Data 1 | | | | | | | | | | | | | * | |
| Disc. Fault Rec. | | | | | | | | | | | | | | |
| P.System Data 2 | | | | | * | * | | | | | | | | |
| Frequency Prot. | | | | | | | | | | | | | | |
| Load Restore | | | | | | | | | | | | | | |
| Measuram.Superv | | | | | | | | | | | | | | |
| Cntrl Authority | | | | | | | | | | | | | | |
| Control Device | | Breaker | | CF_D12 | | | | | | | | | | |
| | | Breaker | | | | | | | | | | | | |
| | | Disc.Swit. | | | | | | | | | | | | |
| | | Disc.Swit. | | | | | | | | | | | | |
| | | EarthSwit | | | | | | | | | | | | |
| | | EarthSwit | | | DP | | | | | | | | | |
| Process Data | | | | | | | | | | | | | | |
| Measurement | | | | | | | | | | | | | | |
| Min/Max meter | | | | | | | | | | | | | | |
| Set Points(MV) | | | | | | | | | | | | | | |
| Energy | | | | | | | | | | | | | | |
| Statistics | | | | | | | | | | | | | | |
| SetPoint(Stat) | | | | | | | | | | | | | | |
| Thresh.-Switch | | | | | | | | | | | | | | |

Fig. 6: Delete information

Open the information catalog by clicking the button on the upper-right side of the matrix. Select a “Control with feedback”, e.g. a “Double Control” with one trip coil and one close coil. The feedback signal shall be a double point signal. We select the signal “Double Point; 0=not valid (CF_D2)”.

As we need three circuit breakers for this load shedding application, we have to drag this signal three times into the group “Control Device” (Fig. 7).

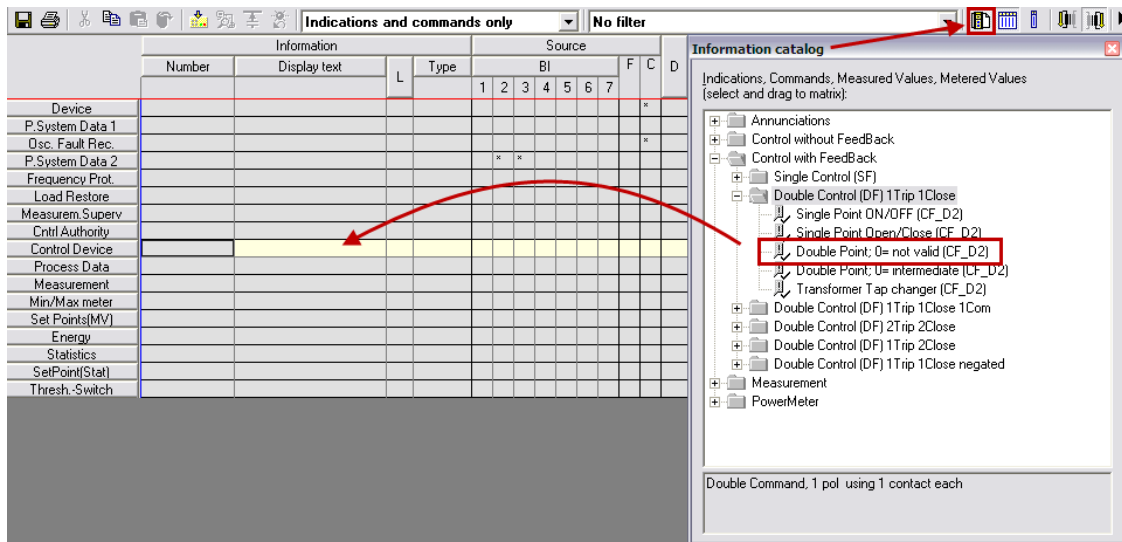


Fig. 7: Add new information

Each control signal consists of two lines. The first line is the control (CF_D2) and the second line the circuit breaker feedback (DP). When you rename the new signals (e.g. CB Load 1/2/3), don't forget to give the signals a "long text" name as well. The "long text" is the name that will appear later on in the log files.

Now the signals have to be assigned to the binary contacts. As we want to start from the scratch, the default routings should be deleted. Just right-click on "BI", "BO" and "LEDs" and select "Delete configurations at Binary Inputs/Binary Outputs/LEDs".

Assign the control signal of the first circuit breaker (CB Load 1) to the binary outputs that are connected to this circuit breaker (e.g. BO 1 and BO 2) and the feedback signal to the correct binary inputs (e.g. BI 1 and BI 2).

Proceed now in the same way with the other two switching devices (CB Load 2: BO 3/4 and BI 3/4; CB Load 3: BO 5/6 and BI 5/6).

To be able to control the circuit breakers, the control signals have to be assigned to "Destination -> Control Menu (CM)" as well.

Now the trip signals of the frequency protection function have to be routed in the group "Frequency Prot.". They have to be assigned "unlatched" to the same binary outputs as the circuit breaker control trip signals. This means that the signal "F1 Trip" has to be assigned to binary output 1 (like the trip command of the control "CB Load 1"). The same applies to the signals "F2 Trip" (BO 3) and "F3 Trip" (BO 5).

Of course the LEDs shall display, if load has been shed. Therefore the signals "Fx Trip" have to be assigned to the LEDs (e.g. LED 1 – 3) as "latched".

The complete configuration of the matrix can be seen in Fig. 8.

| | Information | | | | Source | | | | | | | Destination | | | | | | | | | | | | | | | | | | | | |
|-----------------|-------------|-----------------|-----|------|--------|---|---|---|---|---|---|-------------|---|----|----|----|----|----|---|---|---|------|---|---|---|---|---|---|---|---|---|----|
| | Number | Display text | L | Type | BI | | | | | | | F | C | BO | | | | | | | | LEDs | | | | | | | | B | C | CM |
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | |
| Device | | | | | | | | | | | | * | | | | | | | | | | | | | | | | | | * | * | |
| P.System Data 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | |
| Osc. Fault Rec. | | | | | | | | | | | | * | | | | | | | | | | | | | | | | | | * | * | |
| P.System Data 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | |
| Frequency Prot. | 05203 | >BLOCK Freq. | | SP | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05206 | >BLOCK F1 | | SP | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05207 | >BLOCK F2 | | SP | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05208 | >BLOCK F3 | | SP | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05209 | >BLOCK F4 | | SP | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05211 | Freq. OFF | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05212 | Freq. BLOCKED | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05213 | Freq. ACTIVE | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05214 | Freq UnderV Blk | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05232 | F1 picked up | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05233 | F2 picked up | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05234 | F3 picked up | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05235 | F4 picked up | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 05236 | F1 TRIP | | OUT | | | | | | | | | | U | | | | | | | | | | | | | L | | | | | |
| | 05237 | F2 TRIP | | OUT | | | | | | | | | | | U | | | | | | | | | | | | L | | | | | |
| 05238 | F3 TRIP | | OUT | | | | | | | | | | | | U | | | | | | | | | | | L | | | | | | |
| 05239 | F4 TRIP | | OUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Load Restore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measur. Superv | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | |
| Crit. Authority | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Control Device | CB Load 1 | CF_D2 | | | | | | | | | | | | Tr | Cl | | | | | | | | | | | | | | | | X | |
| | CB Load 1 | DP | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | CB Load 2 | CF_D2 | | | | | | | | | | | | | | Tr | Cl | | | | | | | | | | | | | | X | |
| | CB Load 2 | DP | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | CB Load 3 | CF_D2 | | | | | | | | | | | | | | | Tr | Cl | | | | | | | | | | | | | X | |
| CB Load 3 | DP | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |

Fig. 8: Complete Routing

Important for the load shedding is the routing of the frequency protection trip signals. The signals in the group "Control Device" are optional. They give you the possibility to control the breakers, but can be left out, if the amount of binary inputs and outputs is not enough, e.g. in case of a 7RW801.