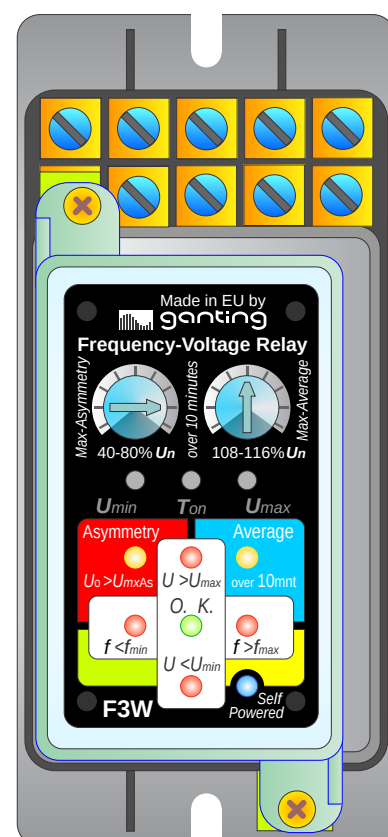


NOVELTIES, ORDERING CODE

Novelties

- F3w contains 2 frequency relays with **programmable hysteresis**.
- **Frequency hysteresis** means a reliable operation and improved noise immunity;
- **Asymmetry of three-phase system** is analyzed by measuring the zero sequence voltage component. Its average is observed in a constant time window, to determine a tendency of declination of the three-phase voltage system.
- **Average of Maximum Voltage** is observed over a ten minute time window, to determine trend inclination of the Three-phase Voltage system, enabling the intime intervention, in a case of danger.

Ordering code **F3W-50Hz-3x230V**



APPLICATION, FUNCTION, FEATURES**Application**

- Solar power plant,
- Wind power plant or
- Private thermal or water facilities, to operate with public electro distribution grid.
- Private power plant to operate independently of Distribution Public Network in the Island mode.

Function

- over-voltage
- under-voltage
- average voltage maximum supervision
- phase asymmetry supervision
- over frequency
- under frequency

Features

- New design in Combiflex mechanical system;
- Surface or rail mounting; Transparent cover, ready for safety plumb-sealing;
- Fast response to pre-set limit exceeding;
- Self powering for autonomy supply is taken from 2 phases;
- Self power indicator lit, if at least one phase provides sufficient supply.
- Settings in accordance to present EU prescription;
- Indication of present status by LED lamps, settled in the cross-window matrix;

SETTINGS AND INDICATIONS

Maximum Average Asymmetry setting, estimated during 5 minutes period.
Single turn knob (0 - 270)°, range 40 to 80% U_n .

T_{on} set to → 30s
Turn on time trimmed to 30s

U_{min} set to → 80% U_n
Minimum Voltage limit reach down to 70% U_n .

Yellow lamp indicating, that Average Asymmetry, inside estimated time period, exceeds the set Limit.

Red Lamp indicating, that the frequency drop below the limit ($f < f_{min}$).

Green O.K. Lamp indicates, that it passed more than T_{on} , since all measurements are inside set limits.

Red Lamp indicating, that the Voltage dropped below the limit ($U < U_{min}$), at least in one phase.



Maximum Average Voltage setting, averaging during 10 minutes period.
Single turn knob(0 - 270)°, offers a setting range 108 to 116% U_n .

U_{max} set to → 115% U_n
Maximum Voltage limit reach up to...120% U_n .

Red Lamp displays that, phase Voltage exceeded the limit ($U > U_{max}$), at least in one phase.

Yellow lamp is showing, that Average Maximum Voltage, inside 10minute interval, exceeds the set Limit.

Red Lamp shows, that the frequency exceeded the upper limit ($f > f_{max}$).

Blue Lamp lit ON means, that the power supply is ready and sufficient for all functions.

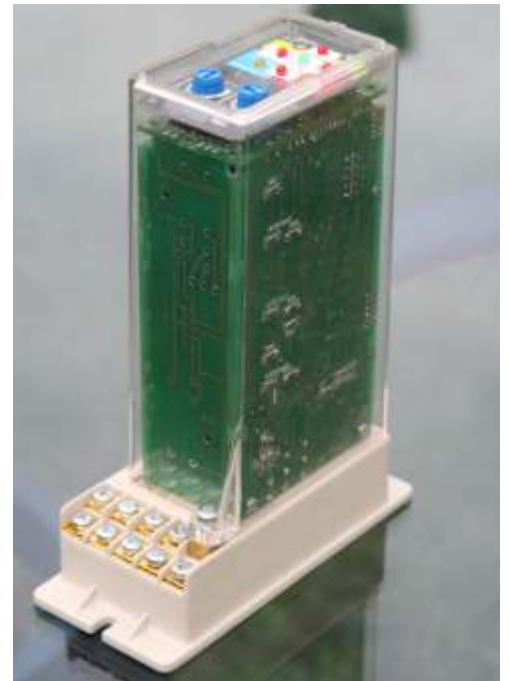
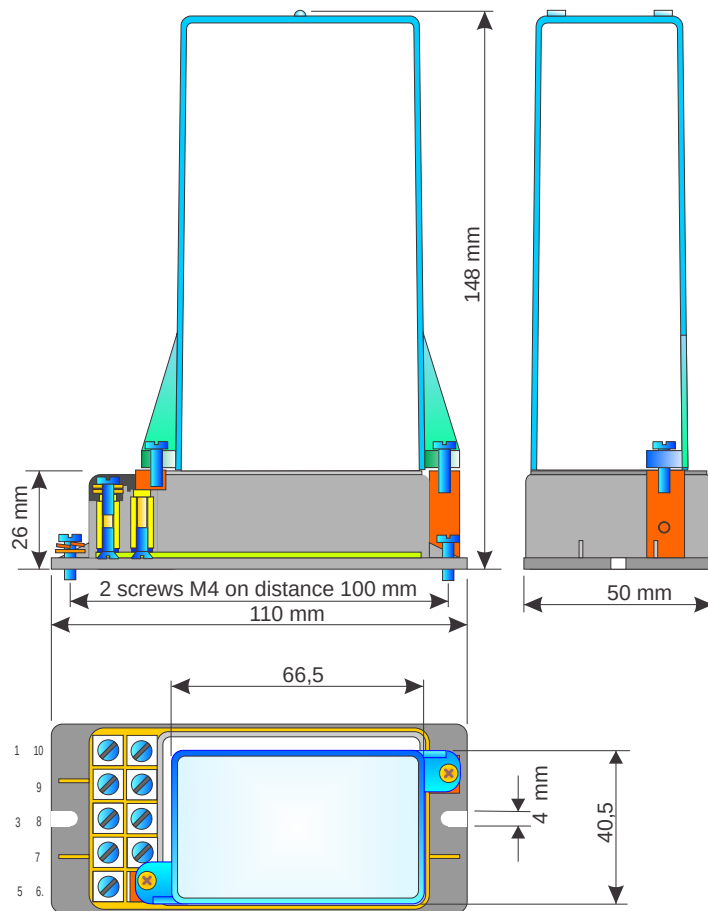
TECHNICAL DATA

The producer reserves the right to modify data and design in the light of future progress.

Parameter		Min.	Nom.	Max.	Unit	Conditions @ T _{Amb} = 25°C
Nominal phase voltage* Nominal frequency**			230 50		V Hz	Note: * U_n ...on request: 100V, 110V; ** f_n ... on request: 60Hz
Frequency relays	Frequency relays					
	Under-frequency High Limit	$f_u = f_{uH}$	48,0		Hz	Both limits set by producer;
	Under-frequency Low Limit	$f_u = f_{uL}$	47,5		Hz	
	Over-frequency High Limit	$f_o = f_{oH}$	50,20		Hz	Both limits set by producer;
	Over-frequency Low Limit	$f_o = f_{oL}$	50,15		Hz	
	Programmable increment	$DP=1/Df$	10		ms	@ f_{set} = 50Hz; T_{Amb} =(5°/45°C); Df_u =(f_{u1} - f_{u0}); Df_o =(f_{o1} - f_{o0});
	Min. nominal increment	Df_n	25		mHz	
	frequency accuracy		2 0,004	5 0,01	mHz %	
	Hysteresis:	Df_u ; Df_o	25		mHz	
	Time delay for Over- and for Under-frequency relay	T_d	160	200	240	ms
	reset time	T_{rst}		17		ms
3-phase Voltage relays	Over-voltage relay limit					115% U_n , set by producer;
	Setting range	U_{max}	108	120	V % U_n	
	Under-voltage relay limit					80% U_n , set by producer;
	Setting range	U_{min}	70	90	V % U_n	
	Repetition accuracy		1	2	% U_n	Knob setting angle (0-270)°
	Reset Ratio (pick-up/drop-out)		99	97	% U_n	
	Max-Voltage Average Setting range Averaging Time Constante	Mx-Avrg RC(Avrg)	106 600	116	% U_n s	Setting by the single turn scale potentiometer on a front plate;
	Max-Asymmetry Setting range Integrating Time Constane	Mx-Asy RC(Asy)	40 300	80	% U_n s	
	Repetition accuracy		2	5	% U_n	
	Resistance „Line to Null“	R_{LN}	1		MΩ	Each phase Line to Null
	Delay of Output Relay	T_{ON}	20	50	s	(from O.K. condition till output contacts switch over);
	Trimmer Scale range		30		s	set by producer; of set value;
	Prescribed setting		1	2	%	
	Repetition accuracy			25	ms	
Self-powering	Self-powering Self-powering indicator		160 69	400 480 60	V % U_n % U_n	supplied from inter-phase (U_{RS}) Blue LED is ON Blue LED is OFF
	Power dissipation nominal released state	P_{no}		2,2	W	U_{RS} = 400V, @ relay is off;
	nominal, ON-state	P_{n1}		3,8	W	U_{RS} = 400V, @ relay is ON;
Ambient Temperature		T_{Amb}	-10 +5 -25	+55 +45 +85 85	°C °C °C %	operating range standard accuracy range
Contact rating: Making capability Breaking capacity - A.c.				8 2	A A	250V, 50/60 Hz
D.c. Breaking capacity, without arc suppressor				50	mA	L/R < 20 ms; 220V d.c.
via arc suppressor				3	A	L/R < 40 ms; 264V d.c.
Insulation Test Voltage (50Hz; 1min.)				2,5	kV _{rms}	between all d.c. separated circuits

DIMENSIONS, CONNECTION TO TERMINALS

Dimensions



Connection to terminals

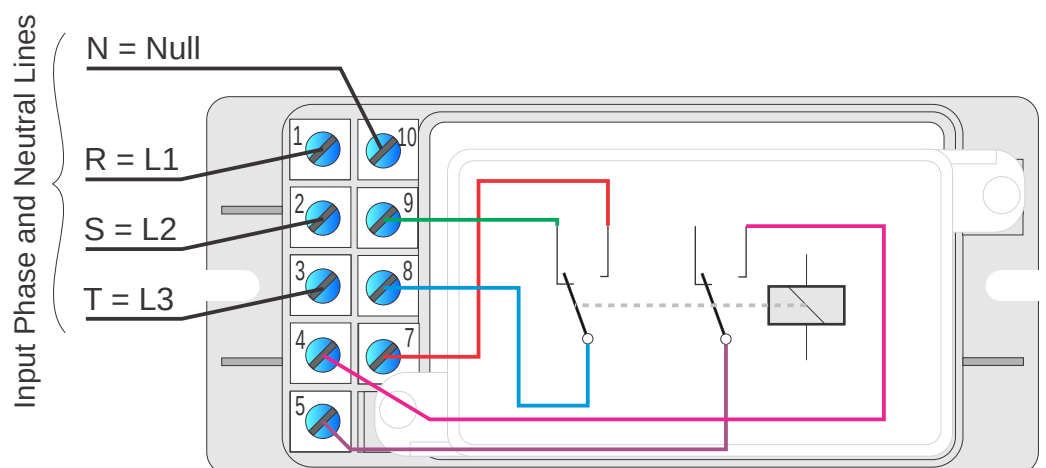
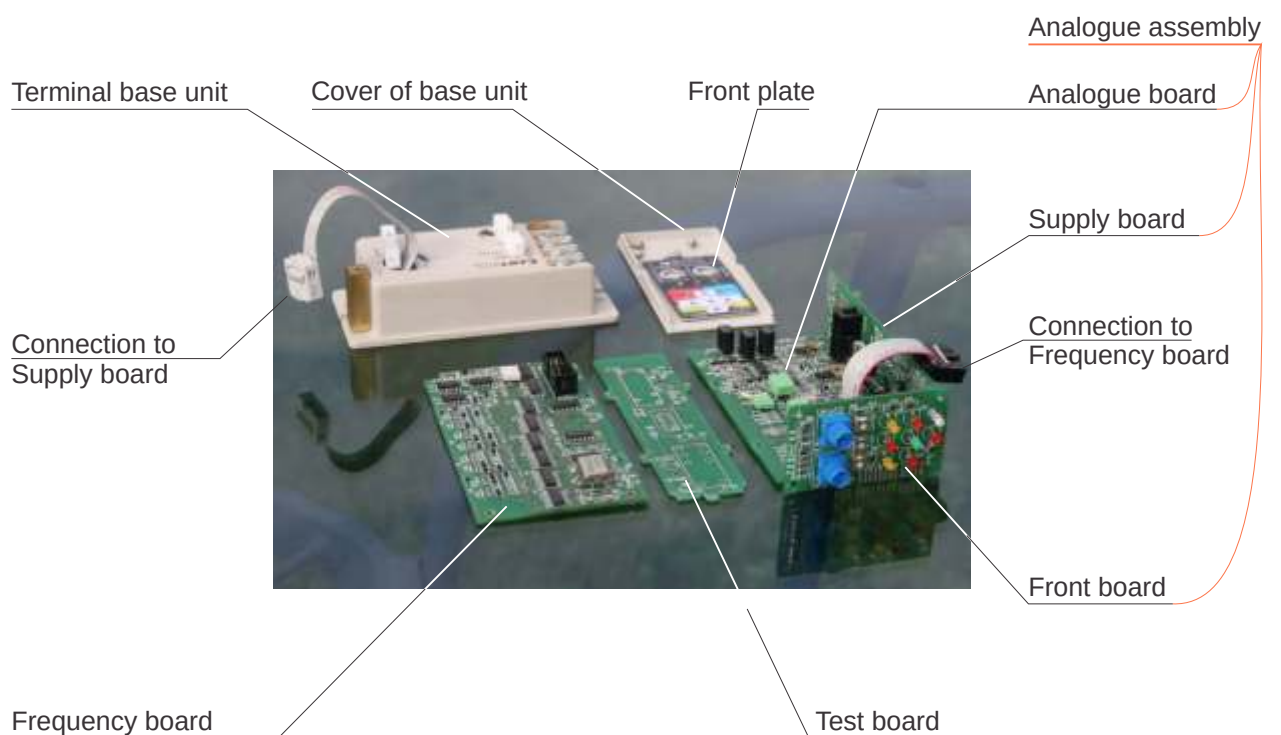


PHOTO GALLERY, DISCOVERING THE INSIDE VIEW

Opening the relay by unscrewing the plastic cover, take of the scale and unscrew 2 screws at the bottom of the Frequency board.



Terminal base unit:
containing 10kV separation transformer,
phase signal suppression and the relay with
2 change over output contacts



OPERATION

Operation

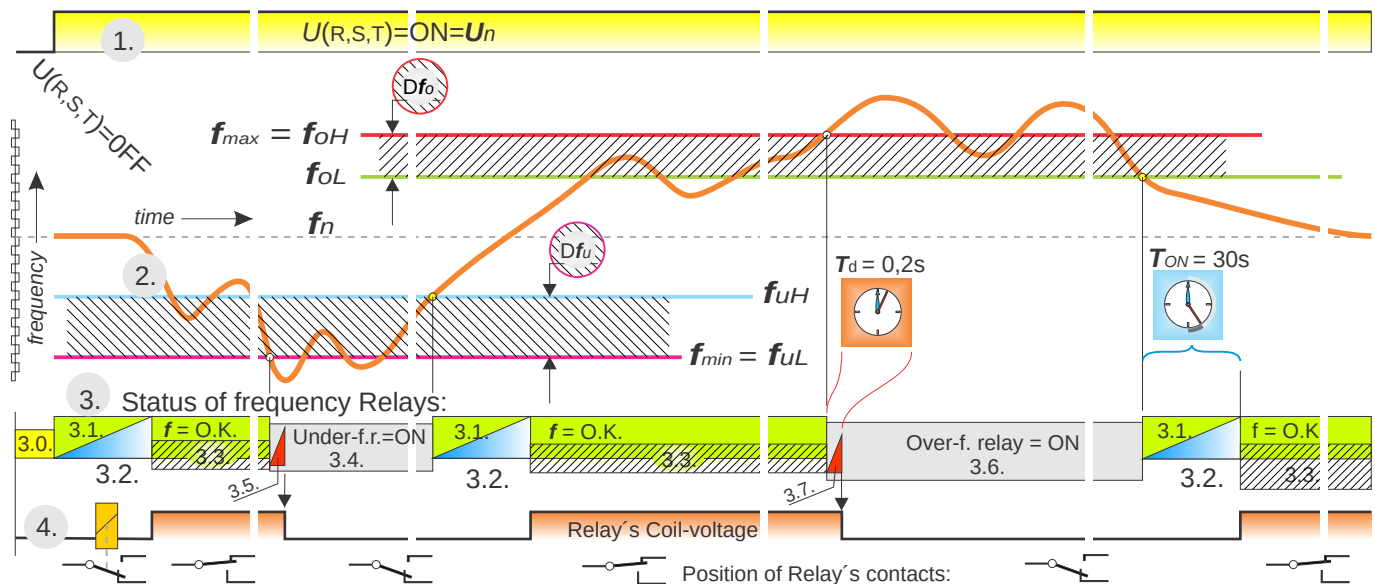
Supervision Relay F3W is monitoring frequency and 3 phase voltages. It is designed to connect and to disconnect a Private Power Plant to the Public Distribution network.

After a connection of F3W to the 3-phase Voltages, F3W compares all values and only, if they are all inside the prescribed limits for more than 30s, the F3W would permit the Private Plant to be connected to the Distribution Grid, by pick up of output relay.

During parallel operation of the solar plant with a public distribution network, the F3W has a protection function. If frequency or three phase voltage is out of set values, the output relay would drop out and disconnect the solar plant within 200ms.

Two statistic trend observations are analysing the Maximum Average Voltage and the Maximum Average Asymmetry of 3-phase voltages, over determined observation period. Either comparator of mentioned statistics would disconnect within the same 200ms drop out time.

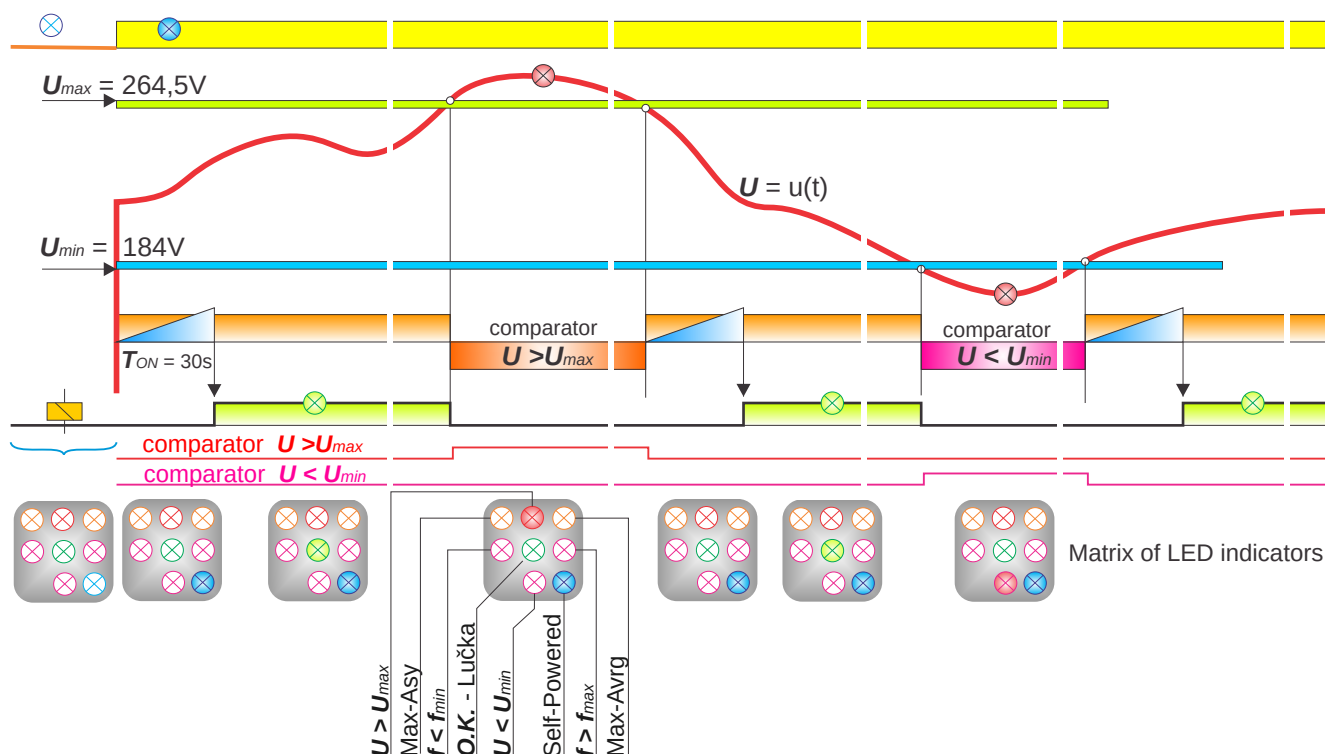
Diagram of Operation of frequency relays (at all Voltage comparators inside preset limits)



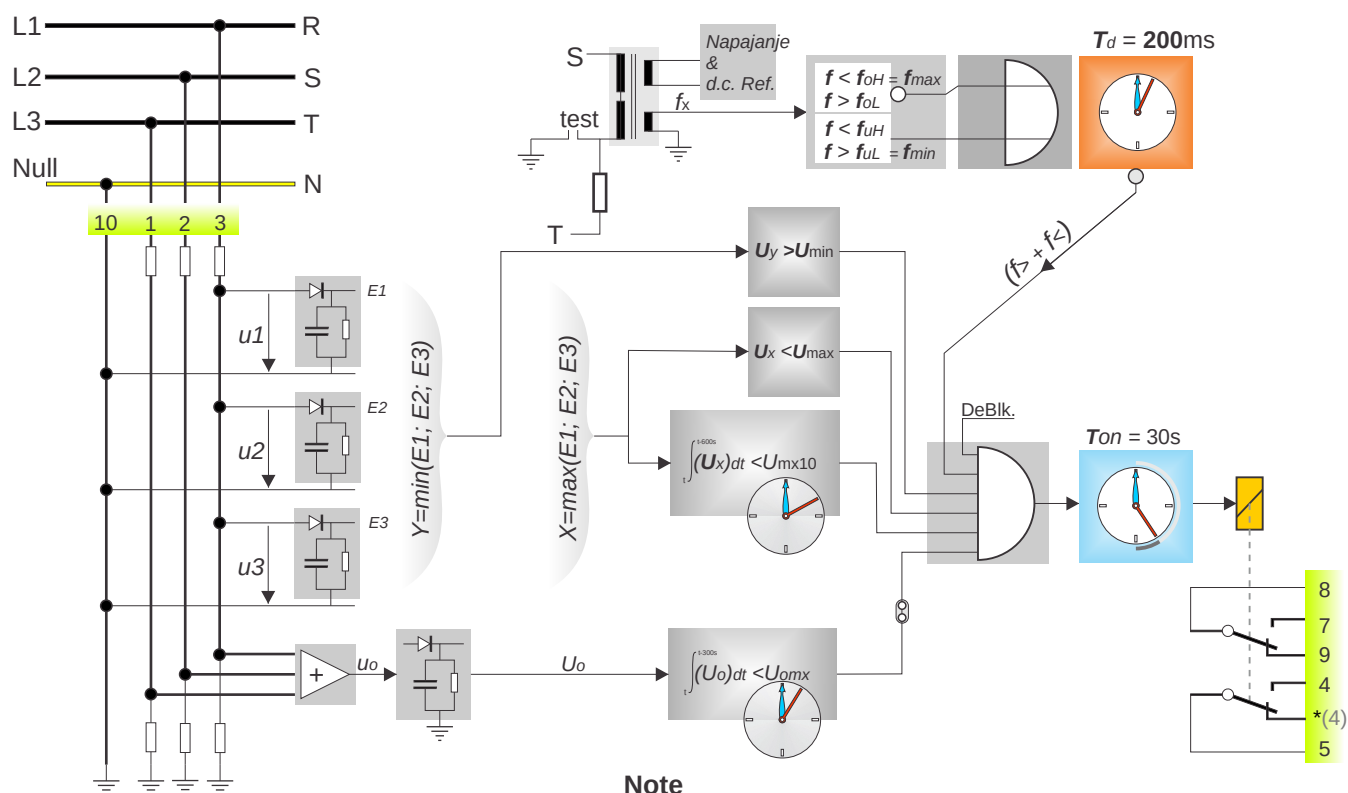
1. Voltages (U_R , U_S , U_T) applied to terminals (R, S, T, N) of F3W;
2. Frequency-time function $f = f(t)$, which flows thru both safety hysteresis regions in a remarkable way:
 - + Hysteresis of under-f-relay: $Df_u = f_{uH} - f_{uL}$. Higher and Lower limits (f_{uH} , f_{uL}), programmed by producer;
 - + Pick up frequency of U.F.R: $f_{min} = f_{uL}$; Release frequency of U.F.R: f_{oH} ;
 - + Hysteresis of over-f-relay: $Df_o = f_{oH} - f_{oL}$. Higher and Lower limits (f_{oH} , f_{oL}), programmed by producer;
 - + Pick up frequency of O.F.R: $f_{max} = f_{uH}$; Release frequency of O.F.R: f_{oL} ;
3. Status of frequency Relays:
 - 3.0. Device F3W disconnected;
 - 3.1. $f = O.K.$ state: Both U.F.R. and O.F.R. are released;
 - 3.2. $T_{ON} = 30s$ Count-down mode, triggered by O.K.-state of either under- or by over-frequency relay;
 - 3.3. Output relay pick-up state. Relay pull up after T_{ON} delay runout;
 - 3.4. or 3.6. Active state of Under-f or Over-f-relay ($f_u = ON$ or $f_o = ON$);
 - 3.5. or 3.7. T_d -Delay mode, triggered by ($f_u = ON$ or $f_o = ON$); Ten sequent comparisons are requested;
4. Output Relay and contacts.

FUNCTIONAL BLOCK DIAGRAM

Diagram of Operation of Voltage relays (@ frequency inside limits of F3W relay)



Functional Block Diagram:



Note

* Terminal (4) can be reconnected from normally open(=n.c), to normally closed contact, inside of the terminal base.

FREQUENCY - VOLTAGE SUPERVISION RELAY F3W

NOVELTIES, ORDERING CODE	1
APPLICATION, FUNCTIONS, FEATURES	2
SETTINGS AND INDICATIONS	3
TECHNICAL DATA	4
DIMENSIONS, CONNECTION TO TERMINALS	5
PHOTO GALLERY, DISCOVERING THE INSIDE VIEW	6
OPERATION	7
FUNCTIONAL BLOCK DIAGRAM	8
CONTENT	9

Place and date of issue: Medvode, 24. 01. 2019

The producer reserves the right to modify data and design in the light of future progress.