

The table below provides the description of files in the data set for TSAT simulation by using Case 1 as an example.

File	Description
Case1_Disturbance.swi	SWI type of TSAT file defining calculation time, integration and output time steps, sequence of actions in time and other parameters configuring the simulation.
Case1_DynamicData.dyr	Dynamic data of power system dynamic components
Case1_FO_FrequencyProfile.csv	Frequency profile of forced oscillation as a function of time. This profile defines the frequency of a sin shape forced signal injected into the TGOV1FOCSV or SEXSFOCSV User Defined Model (UDM) templates referenced in the Case1_FO_LocationType.dat file.
Case1_FO_LocationType.dat	File containing the reference to a specific UDM template, location of a generator or load, and parameters for template models.
Case1_FO_MagnitudeProfile.csv	Magnitude profile of forced oscillation as a function of time. This profile defines the amplitude of a sin shape forced signal injected into TGOV1FOCSV or SEXSFOCSV UDM referenced in the Case1_FO_LocationType.dat file.
Case1_Monitoring.mon	MON type of TSAT file defining monitoring quantities.
Case1_NoiseModel.dat	This file contains a list of references to UDM INJECTCSV, a dynamic load model, to realize load fluctuations during a dynamic simulation. The UDM load model INJECTCSV modifies MW and Mvar consumptions of a load to follow the time series defined in Profile_N.csv, where N=1, 2, ... or 15. This file specifies which load (MW/Mvar) follows which Profile_N.csv. Each Profile_N.csv file provides a random fluctuation signal to mimic actual load fluctuation, but without trend meaning that the load stays approximately constant over time.
Case1_PowerFlow.pfb	Power flow case in PFB format.
Case1_PowerFlow.raw	Power flow case in RAW format.
Case1_TSAT.tsa	TSA file of TSAT software defining the TSAT case
TSAT_Template_UDMs.tudm	Base template UDM models used in the simulation, to be instantiated in Case 1 dynamic data specified in the Case1_FO_LocationType.dat file (for noise and FO injection as specified above). See appendix for a description of the models developed in the template library.
Profile_1.csv ... Profile_15.csv	15 profile files defining 15 random fluctuation signals between t = 0 to 120 seconds. Every fluctuation signal is defined around 1 p.u. value to mimic actual load fluctuation without trend.

Notes:

- For Case 10, there are two “FO_FrequencyProfile.csv” files and two “FO_MagnitudeProfile.csv” files, because there are two FOs respectively injected at two different generators’ controls.
- For Case 13, a generic user-defined line-commutated converter model was used to represent the dynamics of the HVDC-link introducing FO into the system (Pacific DC Intertie – PDCI). PDCI oscillation was introduced by modulating the converter alpha angle on the Californian side of the link (bus 2619 SYLMARLA 230kV). The FO parameters were input to the model in time-series CSV format.

Appendix: Template UDM models

Template user-defined model library was created for use in this contest. Instructions and examples on use are provided in this appendix.

1 Load or Source with FO injection

Forced Oscillation Injection represented with a dummy machine (using simple active/reactive current injection end block), in parallel with existing load at bus.

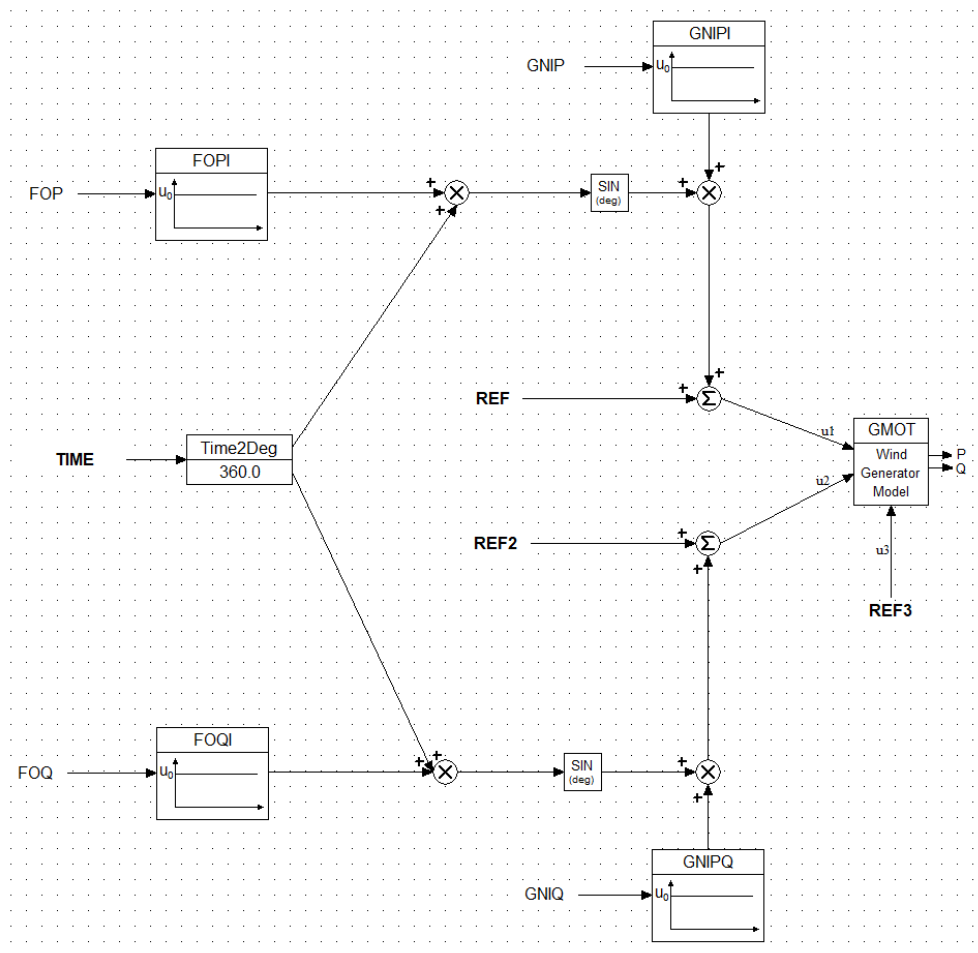
1.1 FO Parameters specified as constants

Instantiation format:

'\$TMPLT','FOINJECT',BUS,ID,SBASE,FOP,GNIP,FOQ,GNIQ/

Example: dummy machine at bus 1002, 0.614 Hz forced oscillation injection of Ip, 0.614 Hz, approx 25 MW amplitude (Sbase=1 MVA)

'\$TMPLT','FOINJECT',1002,'IM',1,0.614,25,0.614,0/



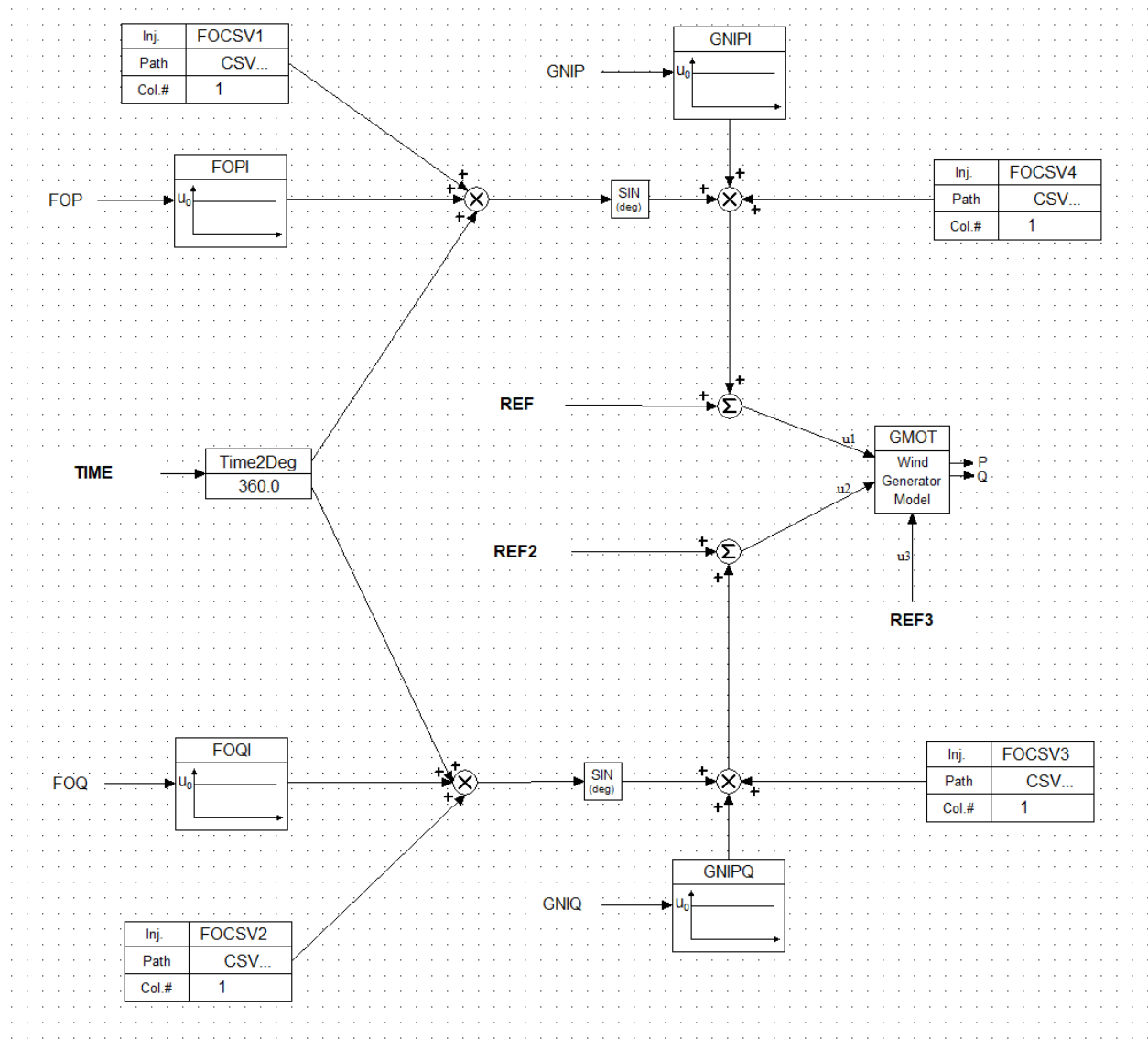
1.2 FO Injection with frequency and amplitude specified with external CSV file

Instantiation format:

'\$TMPLT','FOINJECTCSV',BUS,ID,SBASE,FOP,GNIP,FOQ,GNIQ,CSVFILEFO,CSVFILEFOGN/'

Example: dummy machine at bus 1002, 0.614 Hz forced oscillation injection of Ip, 0.614 Hz, approx 25 MW amplitude (Sbase=1 MVA) the frequency and magnitude of a sin forced signal are set in .txt files 'Frequency.csv', 'Magnitude.csv'

'\$TMPLT','FOINJECTCSV',1002,'IM',1,0.614,25,0.614,0,'Frequency.csv','Magnitude.csv'/



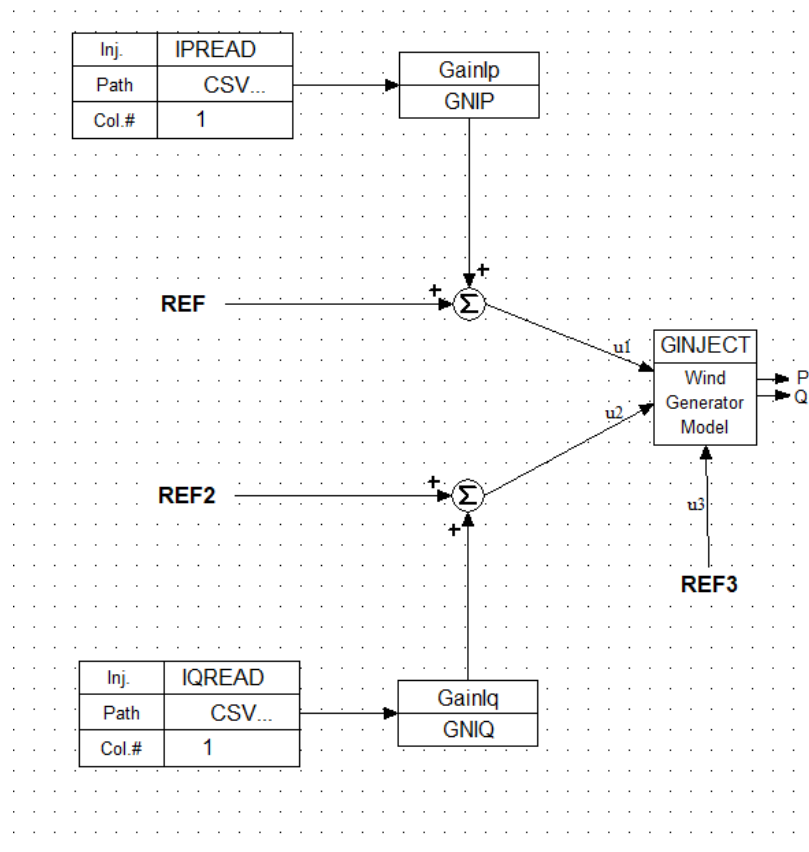
1.3 Load or Source with Arbitrary Injection (used for random noise injection)

Instantiation format:

'\$TMPLT','INJECTCSV',BUS,ID,SBASE,GNIP,GNIQ,CSVFILEIP,CSVFILEIQ/'

Example: dummy machine at bus 2612, PQ injection from iptimeseries.txt, iqtimeseries.txt (Ip ramp)

'\$TMPLT','INJECTCSV',2612,'IM',1.0,1.0,1.0,'iptimeseries.txt','iqtimeseries.txt'/'



2. TGOV1 Governor Model with FO

Modification to TGOV1 model to inject FO at controller output (input to end block/plant model for hydraulic turbine).

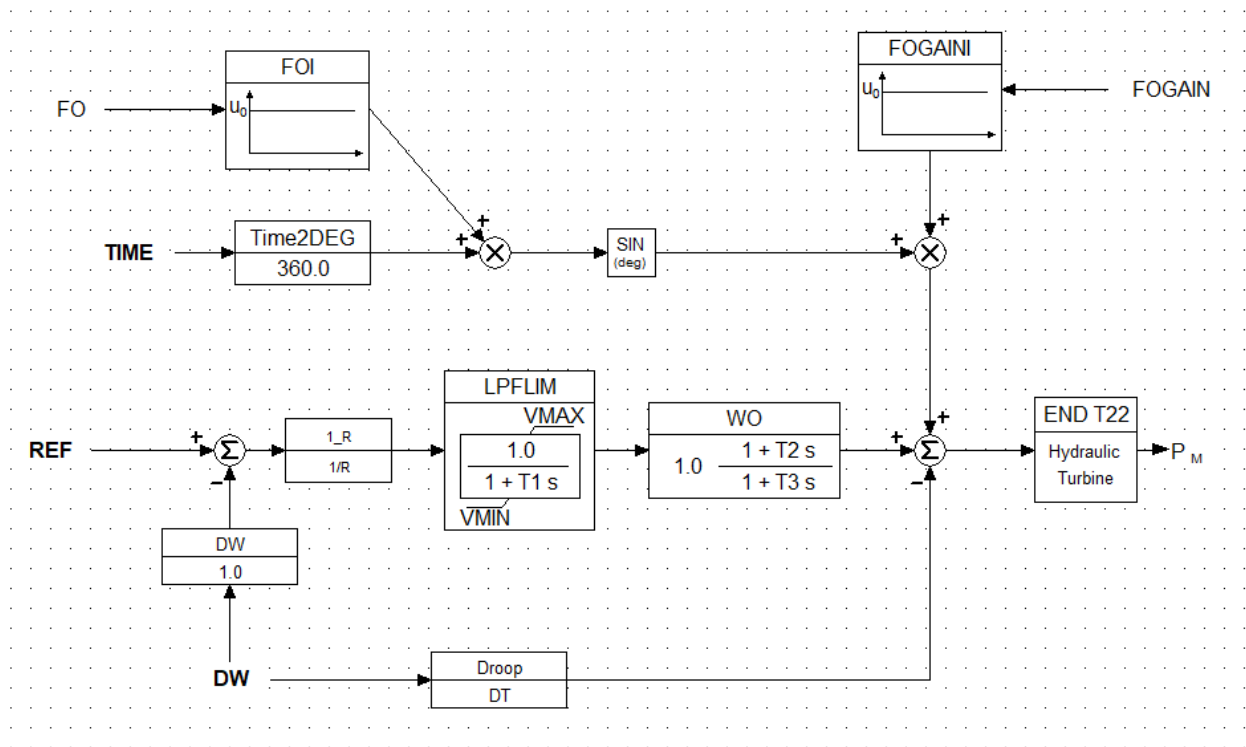
2.1 Governor with FO specified as constant parameters

Instantiation format:

'\$TMPLT','TGOV1FO',BUS,ID,R,T1,VMAX,VMIN,T2,T3,DT,FO,FOGAIN/

Example: Replace governor model for generator 1431 ID 'N', 0.82 Hz oscillation with 0.01pu amplitude, other TGOV1 parameters per base (DYR) dynamics

'\$TMPLT','TGOV1FO',1431,'N',0.08,2,1,0,3,15,0.4,0.82,0.01/



2.2 Governor with FO defined in CSV

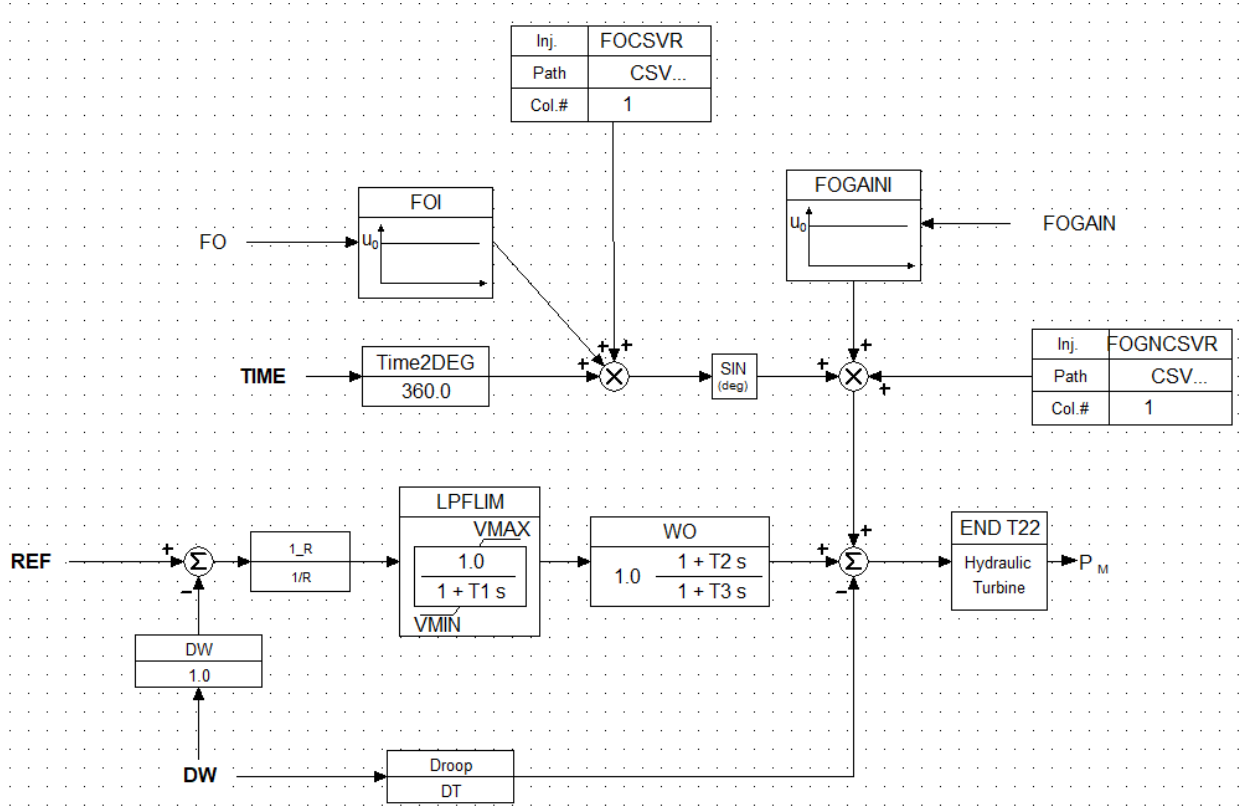
Instantiation Format:

'\$TMPLT','TGOV1FOCSV', BUS,ID,R,T1,VMAX,VMIN,T2,T3,DT,FO,FOGAIN,CSVFILEFO,CSVFILEFOGN/

Example: Replace governor model for generator 1431 ID 'N', other TGOV1 parameters per base (DYR) dynamics. The frequency and magnitude of a sin forced signal are set in .txt files

'Case1_FO_FrequencyProfile.csv', 'Case1_FO_MagnitudeProfile.csv'

'\$TMPLT','TGOV1FOCSV',1431,'N',0.08,2,1,0,3,15,0.4,1,1,'Case1_FO_FrequencyProfile.csv','Case1_FO_MagnitudeProfile.csv'/



3. SEXS Exciter Model with FO

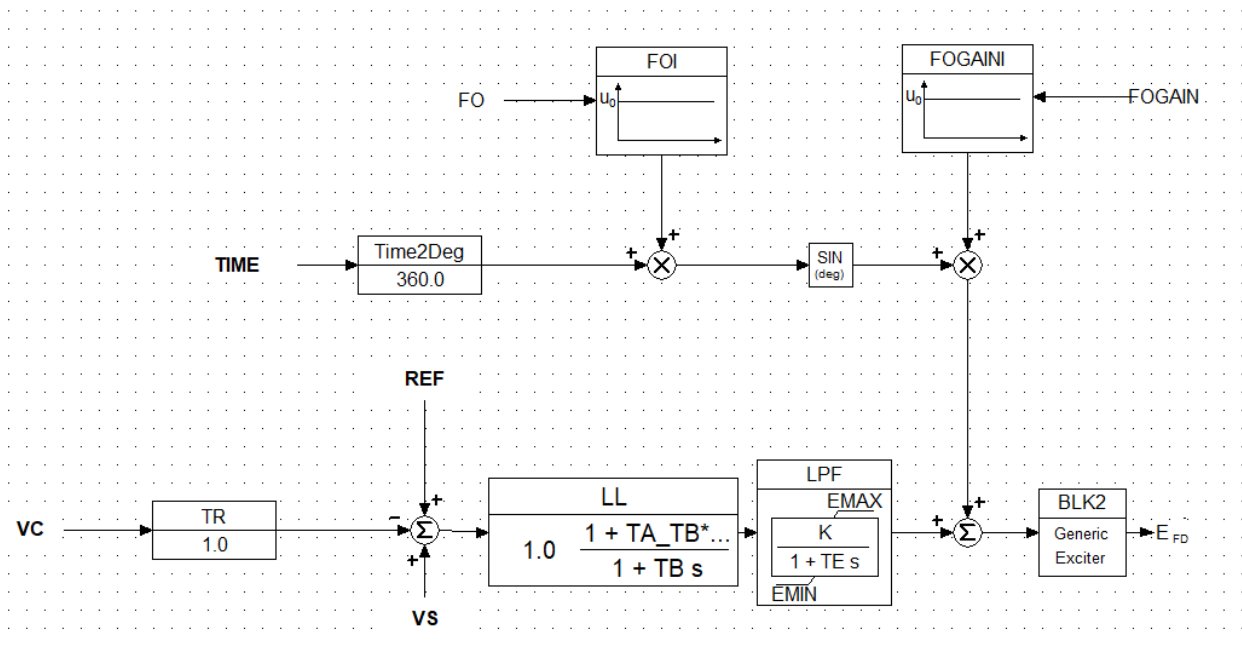
3.1 Exciter with FO specified as constant parameters

Instantiation Format:

'\$TMPLT','SEXSFO',BUS,ID,TA_TB,TB,K,TE,EMIN,EMAX,FO,FOGAIN/

Example: Replace exciter model for generator 8034 ID 'H', 1.270 Hz oscillation with 0.1 amplitude, other SEXS parameters per base (DYR) dynamics

'\$TMPLT','SEXSFO',8034,'H',0.1,10,100,0.1,0,3,1.270,0.1/



3.2 Exciter with FO parameters defined in time-series CSV

Instantiation Format:

'\$TMPLT','SEXSFOCSV',BUS,ID,TA_TB,TB,K,TE,EMIN,EMAX,FO,FOGAIN,CSVFILEFO,CSVFILEFOGN/

Example: Replace exciter model for generator 4231 ID 'H', other SEXS parameters per base (DYR) dynamics. The frequency and magnitude of a sin forced signal are set in .txt files 'Exc_frequency.csv', 'Exc_magnitude.csv'.

'\$TMPLT','SEXSFOCSV',4231,'H',0.1,10,100,0.1,0,3,1,1,'Exc_frequency.csv', 'Exc_magnitude.csv'/

