DSATools™
Dynamic Security Assessment Software

TSAT

Transient Security Assessment Tool

Support for Data in PSS/E Format

A product of
Powertech
Powertech Labs Inc.
Surrey, British Columbia
Canada
www.powertechlabs.com
www.DSATools.com

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

DSATools™ TSAT SOFTWARE AND ITS DOCUMENTATION WERE PREPARED BY **POWERTECH LABS INC. (PLI).** NEITHER PLI, ANY COSPONSOR, NOR ANY PERSON ACTING ON BEHALF OF ANY OF THEM:

(A) MAKES ANY WARRANTY OR REPRESENTATION WHATSOEVER, EXPRESS OR IMPLIED, (I) WITH RESPECT TO THE USE OF ANY INFORMATION, APPARATUS, METHOD, PROCESS, OR SIMILAR ITEM DISCLOSED IN THIS DOCUMENT, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, OR (II) THAT SUCH USE DOES NOT INFRINGE ON OR INTERFERE WITH PRIVATELY OWNED RIGHTS, INCLUDING ANY PARTY'S INTELLECTUAL PROPERTY, OR (III) THAT THIS DOCUMENT IS SUITABLE TO ANY PARTICULAR USER'S CIRCUMSTANCE; OR

(B) ASSUMES RESPONSIBILITY FOR ANY DAMAGES OR OTHER LIABILITY WHATSOEVER (INCLUDING ANY CONSEQUENTIAL DAMAGES, EVEN IF PLI OR ANY PLI REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES) RESULTING FROM YOUR SELECTION OR USE OF THIS DOCUMENT OR ANY INFORMATION, APPARATUS, METHOD, PROCESS, OR SIMILAR ITEM DISCLOSED IN THIS DOCUMENT.

Last modified – March 2022

CONTENTS

1 Introduction 4
2 Importing PTI PSS/E Data 5
2.1 Powerflow Data 5
2.2 Dynamic Data 5
2.3 Sequence network data 15
2.4 Other Remarks 15
2.5 Remarks 15

1 Introduction

TSAT accepts data in various non-TSAT formats. The following non-TSAT formats are supported:

- PTI PSS/E
- GE PSLF
- BPA

This document describes the methods to import data of PTI PSS/E format and convert them to TSAT format.

When models are provided in non-TSAT formats, it is converted to matching TSAT models. Conversion is available for most of the dynamic models in the above formats.

It is allowed to include non-TSAT data with TSAT data in one case, as long as the non-TSAT data is in the format specified by the format code in the Dynamic Data section.

Note that conversion of any non-TSAT models is made using the best engineering judgement for cases in which no model details are provided. Powertech cannot guarantee that the performance of such converted models be 100% compatible with the models in their original format.

This document describes the PSS/E format models that are available in the Transient Security Assessment Tool (TSAT).

For PSS/E formats only the necessary information is provided for conversion and interface of various models to TSAT. The user should consult the appropriate manuals of the concerned programs for their modelling details.

Note: PSS/E is a trademark and brand of Siemens Power Transmission & Distribution, Inc.

Note that this document is accurate to **TSAT version 21.0.43**

2 Importing PTI PSS/E Data

2.1 Powerflow Data

TSAT can read PSS/E powerflow data in two formats:

(1) PSS/E RAWD format
(2) PSS/E saved format (binary)

TSAT supports both of these formats up to PSS/E Rev. 31. Importing PSS/E saved binary powerflow data is available only to licensed PSS/E users. Since some DLLs from the PSS/E package are required to read the saved binary powerflow data, PSS/E must be installed in your computer in order to read this format.

If you upgraded PSS/E from previous versions, you may need to remove the previous versions of PSS/E completely in order to be able to read the saved cases of the latest version. Otherwise, saved case importing may fail due to possible conflict in DLL usage. If, however, you use only powerflow in PSS/E RAWD format, this has no impact.

Note that although the three-winding transformer models in PSS/E format are fully supported in TSAT, you have very little access in simulations to these transformers. For instance, they cannot be monitored, cannot be accessed in switching commands (except for tripping the entire transformer), cannot have dynamic ULTC models, and cannot be used to obtain remote signals (such as line power) in user defined models. If any of the above is needed for a three-winding transformer, it must be represented by equivalent two-winding transformer models.

When using PSS/E powerflow data, dynamic data can be in any supported format except for the BPA format (however, third party dynamic data formats cannot be mixed; for instance, PSS/E and PSLF models cannot be mixed in one case).

2.2 Dynamic Data

TSAT accepts dynamic data produced by the DYDA activity in PSS/E. The data file(s) can be read directly by TSAT without any changes, as long as the dynamic data flag in the TSAT case file is set to PSS/E or left at the default (refer to TSAT User Manual for details).

Table 2-1 to **Table 2-13** list all PSS/E dynamic models that are converted in TSAT.

Table 2-1: PSS/E generator model conversion

Generator		
PSS/E	TSAT	Comments
CGEN1	DG0S2	
GENCLS	CGEN	
GENROE	DG0S2	
GENROU,GENROA	DG0S5	
GENSAE	DG0S2	
GENSAL,GENSAA	DG0S4	
GENTRA	DG0S5	

GENTPJU1	GENTPJ	
GENTPJ1	GENTPJ	
GENQEC		

Table 2-2: PSS/E wind generator model conversion

Wind Generator		
PSS/E	TSAT	Comments
W1G1U,WT1G1, W12T1U,WT12T1, W12A1U,WT12A1	WGNA, WGNAT, WGNAE	
W2G1U,WT2G1, W2E1U,WT2E1, W12T1U,WT12T1, W12A1U,WT12A1	WGNB, WGNBT, WGNBE	
WT3G1,WT3G2, W3G2U,WT3E1, WT3T1,WT3P1	WGNC, WGNBT, WGNBE	
W4G1U,WT4G1, W4E1U,WT4E1	WGND, WGNDT, WGNBE	
EXF2	ENRCN	
CIMTSS, TSHAFT	User defined model	
GEWTG1, GEWTE1, GEWTT, GEWTA, GEWTP	User defined model	
REGCAU1, REGCA1, REGCBU1 REPCAU1,REPCTAU1, REPCA1,REPCTA1, REECA1, REECAU1, REECB1,REECBU1, REECCU1, REECDU1 WTARAU1,WTARA1, WTDTAU1,WTDTA1 WTPTAU1,WTPTA1 WTTQAU1,WTTQA1, PLNTBU1 FCTAXBU1 REAX3BU1 REAX4BU1	REGC_A, REGC_B REPC_A, REEC_A, REEC_D WTGA_A, WTGT_A WTGP_A, WTGQ_A,	2nd generation generic wind turbine generator models
DERA1,DERAU1	DER_A	Distributed Energy Resources
GEWTG2,GEWTE2, GEWTA2,GEWTP2, GEWTT1,GEWGD1	Internally converted	

Table 2-3: PSS/E induction machine model conversion

Induction Machine		
PSS/E	TSAT	Comments
CIMTRx	MOT1G	Interfaced with generators in powerflow

Induction Machine		
PSS/E	TSAT	Comments
CIM5BL	MOT1LI	CIM5BL model takes 100% active and reactive load for the specified load ID (or the entire load if the load ID is specified as '*') at the load bus. This means that if additional static load models are specified for the load ID (or the entire load), these models are ignored.
CIMWBL	MOT1LI	Type 8 torque characteristic*
CMOTOR	MOT1LI	

* Contact Powertech Labs for model details.

Table 2-4: PSS/E exciter model conversion

Exciter		
PSS/E	TSAT	Comments
AC1C	AC1C	
AC2C	AC2C	
AC3C	AC3C	
AC4C	AC4C	
AC5C	AC5C	
AC6A	AC6C	
AC6C	AC6C	
AC7B	User defined model	
AC8B	User defined model	
AC8C	AC8C	
AC9C	AC9C	SCL Flag is not used in TSAT
AC11C	AC11C	SCL Flag is not used in TSAT
BBSEX1	User defined model	
CELIN	User defined model	External PSS model is allowed for CELIN excitation system model if its internal PSS is disabled.
DC1C	DC1C	
DC2C	DC2C	
DC3A	EXC9	
DC4B	User defined model	
EMAC1	User defined model	
ESAC1A	EXC5	
ESAC2A	EXC6	
ESAC3A	EXC4	
ESAC4A	EXC30	
ESAC5A	EXC10	
ESAC6A	User defined model	
ESAC8B	User defined model	
ESDC1A	EXC1	
ESDC2A	EXC1	
ESST1A	EXC34	
ESST2A	EXC7	
ESST3A	EXC8	
ESST4B	User defined model	
ESURRY	User defined model	
EX2000	User defined model	
EXAC1	EXC5	
EXAC1A	EXC3	

Exciter		
PSS/E	TSAT	Comments
EXAC2	EXC6	
EXAC2B	User defined model	
EXAC3	EXC4	
EXAC3A	User defined model	
EXAC4	EXC30	
EXBAS	User defined model	
EXDC2	EXC1	
EXELI	User defined model	
EXPIC1	User defined model	
EXSCAS	User defined model	The same as EXSCAZ
EXSCAZ	User defined model	
EXSCEE	User defined model	The same as EXSCEZ
EXSCEZ	User defined model	
EXSCMZ	User defined model	
EXST1	EXC34	
EXST2	EXC7	
EXST2A	EXC7	
EXST3	EXC8	
IEEET1,I3ET1A	EXC1	
IEEET2	EXC10	
IEEET3	EXC7	
IEEET4	EXC9	
IEEET5	EXC9	
IEEEX1	EXC1	
IEEEX2	EXC10	
IEEEX3	EXC7	
IEEEX4	EXC9	
IEET1A	User defined model	
IEET1B	User defined model	
IEET1S	EXC30	
IEET5A	EXC9	
	User defined model	User defined model is used if $T_{RH} \neq 0.0$
IEEX2A	EXC5	
IVOEX	User defined model	
OEX12,OEX12T	EXC32	
OEX3, OEX3T	EXC3	
REXSY1	User defined model	
REXSYS	User defined model	
SCRX	EXC30	
SEXS	EXC30	
ST1C	ST1C	
ST5B	User defined model	
ST5C	ST5C	
ST6B,UST6B	User defined model	
ST7B	User defined model	
ST7C	ST7C	
ST10C, ST10CU1	ST10C	
UAC8B	User defined model	
UDC4B	User defined model	
UREXAC	User defined model	
URST4B	User defined model	

Exciter		
PSS/E	TSAT	Comments
URST5B,URST5T	User defined model	

Table 2-5: PSS/E power system stabilizer model conversion

PSS		
PSS/E	TSAT	Comments
IEE2ST	PSS12	
IEEEST	PSS1	
OSTAB2,OSTB2T	PSS2*	
OSTAB5,OSTB5T	PSS5*	
PSS2A,PSS2B	PSS9, PSS9B	
PSS3B	User defined model	
PTIST1	User defined model	
PTIST3	User defined model	
ST2CUT	PSS12	
STAB1	PSS1	
STAB2A	User defined model	
STAB3	PSS1	
STAB4	PSS12	
UPSS2B	PSS9	
PSS2C	PSS9B*	

* DSATools format not yet available. Contact Powertech Labs for model details.

Table 2-6: PSS/E governor model conversion

Governor		
PSS/E	TSAT	Comments
AEPG	User defined model	
CRCMGV	GOV4	
	User defined model	User defined model is used if: T_1(HP) ≠ T_1(LP) or T_3(HP) ≠ T_3(LP) or T_4(HP) ≠ T_4(LP) or T_5(HP) ≠ T_5(LP) or ABS(P_{MAX}(HP)*R(HP) – P_{MAX}(LP)*R(LP))> 0.02
DEGOV,DEGOV1	User defined model	
DEGOV1DU	User defined model	
ETSIG1	User defined model	
ETSIG2	User defined model	
GAST	GOV7	
GASTDU	GOV7	
GAST2A	User defined model	
GAST2ADU	User defined model	
GASTWD	User defined	

Governor		
PSS/E	TSAT	Comments
	model	
GASTWDDU	User defined model	
GFT8WD	User defined model	
GFT8WN	User defined model	
GGOV1,GGOV1B	User defined model	
GGOV1DU	User defined model	
H6EU1	H6E	
HYGOV	GOV20	
HYGOVDU	GOV20	
HYGOV2	User defined model	
HYGOV2DU	User defined model	
HYGOV4	User defined model	
IEEEG1	GOV4	
IEEEG1SDU	GOV4	
IEEEG1CDU	GOV4	
IEEEG2	GOV22	
IEEEG3	GOV21	User-defined model if a11/(a11-a13*a21/a23) ≠ -0.5
IEEEG3DU	User defined model	
IEESGO	GOV4	
IEESGODU	GOV4	
PIDGOV	User defined model	
PIDGOVDU	User defined model	
TGOV1	GOV6	
TGOV1DU	GOV6	
TGOV2	GOV4	
TGOV3	GOV4	
TGOV3DU	GOV4	
THGOV1	User defined mode	
UCBGT	User defined model	
UCCPSS	User defined model	
UGGOV1	User defined model	
UHRSG	User defined model	
URGAS3,URGS3T	GOV7	
USIEG2	User defined model	
UST8HM,UST8HS, SGT8HMU1,SGT8HM1	User defined model	

Governor		
PSS/E	TSAT	Comments
WEHGOV	User defined model	
WESGOV	User defined model	
WESGOVDU	User defined model	
WPIDHY	User defined model	
WPIDHYDU	User defined model	
WSHYDD	User defined model	
WSHYGP	User defined model	
WSIEG1	GOV4	

Table 2-7: PSS/E SVC model conversion

SVC		
PSS/E	TSAT	Comments
BLOKSV	User defined model	
CHESVC,CHSVCT	User defined model	
CSSCS1,CSSCST	User defined model	
CSTATC,CSTATT	User defined model	
CSVGN1	SVC Type 1	
CSVGN3	SVC Type 1	
CSVGN4	SVC Type 1	
CSVGN5	SVC Type 2	
CSVGN5,STBSVC	SVC Type 3	
CSVGN6	SVC Type 2	
SVSMO1U1, SVSMO1U2, SVSMO1T2, SVSMO2U2, SVSMO2T2	User defined model	
ABBSVC1	User defined model	
CDVAR5U1	DVAR5	

Table 2-8: PSS/E FACTS model conversion

FACTS		
PSS/E	TSAT	Comments
CSTCON,CSTCNT	User defined model	
SVSMO3U1, SVSMO3U2, SVSMO3T2	User defined model	

Table 2-9: PSS/E load model conversion

Load		
PSS/E	TSAT	Comments
IEELAL	LOADS	

Load		
PSS/E	TSAT	Comments
IEELAR,IEELCA	LOADA	
IEELBL,IEELCB	LOADB	
IEELZN,IEELCZ	LOADZ	
IEELOW		
LDFRBL, LDFRZN, LDFRAR, LDFRAL	Internally converted	The conversion is made only if the loads in powerflow (in either PSS/E or PFB format) have non-constant power components. In other words, if all loads are specified as constant power model in powerflow data, these models are ignored.
CLODBL	LOADB	The following assumptions are made when converting these models: • The transformer saturation component is ignored. • The large and small motors have IDs 'L' and 'S' respectively. • A step-down transformer is added if data is provided in the model. The transformer tap is set to maintain the low-tension bus voltage at 0.98 pu. • It is recommended that loads represented by the CLODBL models are not included in the load shedding list (manual or automatic load shedding). • When monitoring loads represented by CLODBL models, only the static components are included. To get motor quantities, motors must be monitored.
CLODZN	LOADZ	Same as CLODBL
CLODAR	LOADA	Same as CLODBL
CLODAL	LOADS	Same as CLODBL
CLODOW		Same as CLODBL
CMLDBLU1, CMLDZNU1, CMLDARU1, CMLDALU1, CMLDOWU1	Internally converted	Model based on WECC specification for composite load model.
CMLDBLU2, CMLDZNU2, CMLDARU2, CMLDALU2, CMLDOWU2	Internally converted	Model based on WECC specification for composite load model.
CMLDBLDGU2, CMLDZNDGU2, CMLDARDGU2, CMLDALDGU2, CMLDOWDGU2	Internally converted	Model based on WECC specification for composite load model.

Table 2-10: PSS/E relay model conversion

Relay		
PSS/E	TSAT	Comments
DISTR1	User defined model	
DLSHAL	Internally converted	

Relay		
PSS/E	TSAT	Comments
DLSHAR	Internally converted	
DLSHBL	Internally converted	
DLSHZN	Internally converted	
LDS3AL	Internally converted	
LDS3AR	Internally converted	
LDS3BL,LDSHD3	UFLSB,TTGEN, TTMOT,TTBRAN, TTMSL	
LDS3ZN	Internally converted	
LDSHAL	UFLSS	
LDSHAR	UFLSA	
LDSHBL,LODSHD	UFLSB	
LDSHZN	UFLSZ	
LVS3AL	Internally converted	
LVS3AR	Internally converted	
LVS3BL	UVLSB,TTGEN, TTMOT,TTBRAN, TTMSL	
LVS3ZN	Internally converted	
LVSHAL	UVLSS	
LVSHAR	UVLSA	
LVSHBL	UVLSB	
LVSHZN	UVLSZ	
PRICR	User defined model	
RELOUF	User defined model	
RXR1	User defined model	
SLLP1	User defined model	
TIOCR1	User defined model	
C396SP,C326SP, SGRCAP,SURCAP, MASCAP,MAXCAP,ORRCP3	User defined model	

Table 2-11: PSS/E HVDC model conversion

HVDC		
PSS/E	TSAT	Comments
CDC1,CDC1T	User defined DC model	

HVDC		
PSS/E	TSAT	Comments
CDC4,CDC4T	User defined DC model	
CDC6,CDC6T	User defined DC model	
CHVDCL	User defined DC model	
PWRHL2	User defined DC model	
VSCDCT	User defined DC model	

Table 2-12: PSS/E exciter compensation model conversion

Exciter compensation		
PSS/E	TSAT	Comments
AEPCMP		In TSAT modelled as part of exciter, EMAC1.
COMP		In TSAT modelled as part of the exciter.
IEEEVC		In TSAT modelled as part of the exciter.
REMCMP		In TSAT modelled as part of the exciter.
COMPCC		In TSAT modelled as part of the exciters.
CCOMP4U1		In TSAT modelled as part of the exciters.

Table 2-13: PSS/E miscellaneous model conversion

Other		
PSS/E	TSAT	Comments
LCFB1	User defined model	
MNLEX2	User defined model	
MNLEX3	User defined model	
SWMH	User defined model	
SWSHN1, SWSHNT	SSHV	
UNIDST	User defined model	
VFTU1, VFT1	User defined model	
LOEXR1T	User defined model	
FRQTPA, FRQDCA FRQTPAT, FRQDCAT	User defined model	
VTGTPA, VTGDCA VTGTPAT, VTGDCAT	User defined model	

Table 2-14: PSS/E under excitation limiter model conversion

Underxcitation Limiter		
PSS/E	TSAT	Comments
UEL1	UEL1	
UEL2	UEL2	KUF and KFB are set to 0

2.3 Sequence network data

TSAT accepts sequence network data in PSS/E format up to Rev. 32, in either bus number or bus name format. This data can be used to compute fault impedance in unbalanced fault simulations.

2.4 Other Remarks

If a PSS/E case comes with IDEV files for converting load models with the CONL command or netting generators with the GNET command. In addition, following IDEV commands are supported for commonly used dynamic models:

- BAT_PLMOD_STATUS
- BAT_PLMOD_REMOVE
- BAT_CHANGE_PLMOD_CON
- BAT_CHANGE_PLMOD_ICON
- BAT_WNMOD_STATUS
- BAT_CHANGE_WNMOD_CON
- BAT_CHANGE_WNMOD_ICON
- BAT_CCTMCNOMOD_STATUS
- BAT_CHANGE_CCTMCNOMOD_CON
- BAT_MACHINE_DATA_2
  - Only changing MVA Base, resistance, and reactance are supported
- BAT_SWSMOD_STATUS

If a model is not supported, a message will be displayed in the Message Report.
The IDEVs can be read by TSAT directly and processed accordingly. Please refer to TSAT user manual on how read such IDEV files.

2.5 Remarks

- Other that above commands, there is no option to read other auxiliary PSS/E files in order to change the models provided by the powerflow and dynamic data. For example, it is not possible to perform the function of the MCRE activity. Therefore, the user should make sure to include the correct machine impedances and base MVAs in the powerflow file. All IDEV files (unless otherwise mentioned above) must be applied for the powerflow to be used by TSAT.

- When using PSS/E saved binary powerflow data and if the powerflow is converted, swing buses for all islands shall be specified. This can be done in the powerflow data setup dialog in the Case Wizard.

- PSS/E user-defined models (in flex code) cannot be directly imported into TSAT. Some of the user-defined models have already been converted in TSAT (refer to **Table 2-1** to **Table 2-13**). For unconverted PSS/E user-defined models, it is usually easy to convert them to TSAT user-defined models.

- PSS/E IPLAN or Python programs are not supported in TSAT.