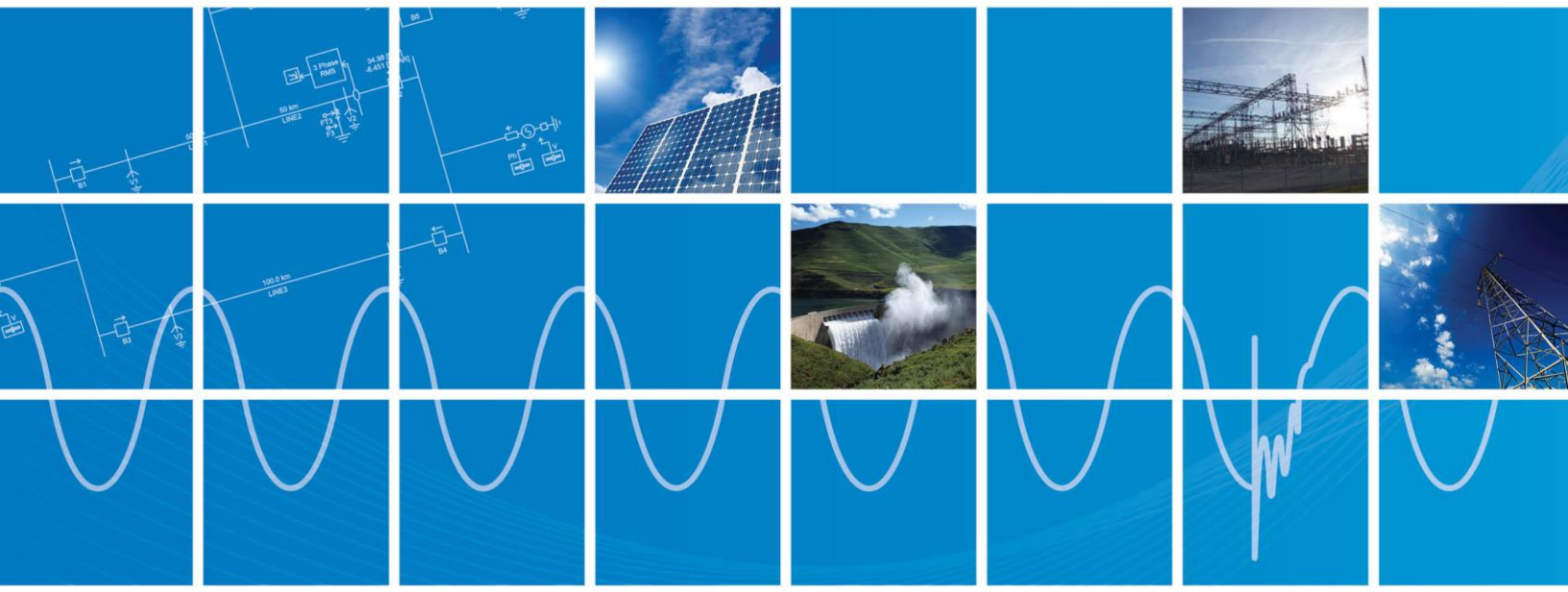
PSCAD™

IEEE 118 Bus System

May 23, 2018
Revision 1



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Contents

1.0 Objective

IEEE bus systems are used by researchers to implement new ideas and concepts. This technical note describes the details of the IEEE 118-bus system [1]. The system consists of loads, capacitor banks, transmission lines, and generators. Figure 1 depicts a part of the PSCAD model of the IEEE 118-bus system.

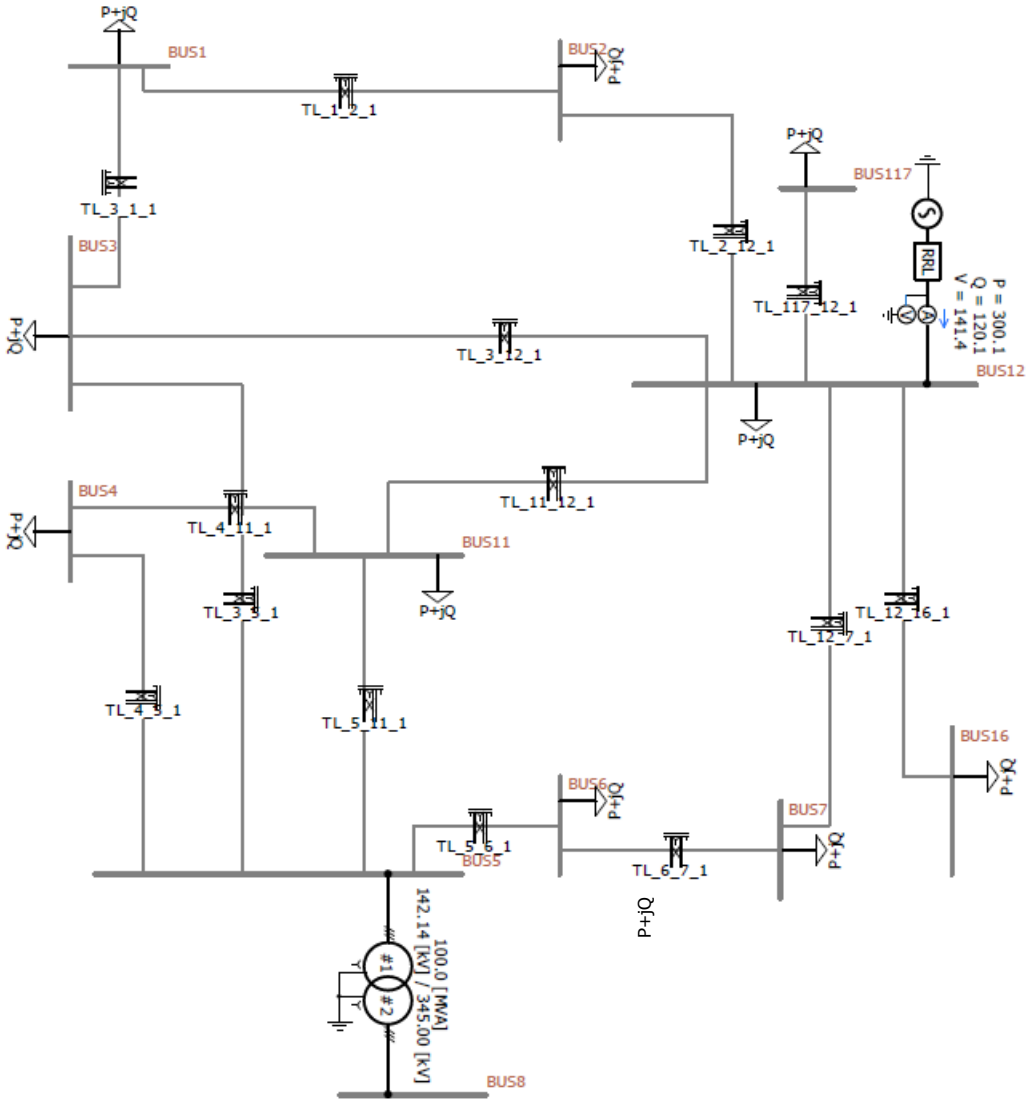

Figure 1 – PSCAD Model of IEEE 118-bus system

Each machine (generator) is represented as a voltage source where its source impedance is set arbitarily as 1 Ohm. Table 1 summarizes the setting for each source, with a base of 100 [MVA] for per unitizing.

Table 1 - Terminal conditions of IEEE 118-bus system

Bus	V [pu]	δ [deg]	P [pu]	Q [pu]
31	0.9989	-24.69	0.30	0.1200
113	1.0206	-21.32	1.00	-0.3000
32	1.0121	-23.46	1.00	0.3000
12	1.0249	-25.37	3.00	1.2000
72	1.0200	-8.060	0.30	-0.0776
65	1.0400	0.000	5.47	0.3994
34	1.0188	-16.52	0.30	0.1500
73	1.0321	-2.630	0.30	0.1200
70	1.0177	-2.880	0.80	0.3200
36	1.0226	-16.10	1.00	0.3000
46	1.0200	-1.770	1.00	-0.0639
76	0.9962	1.200	1.00	0.3000
77	1.0084	3.550	1.00	0.3000
40	0.9980	-14.83	0.30	0.1500
80	1.0200	4.620	3.00	0.2613
92	1.0300	21.55	3.00	-0.3155
110	1.0270	24.08	0.50	0.2300
100	1.0300	18.78	3.00	0.6672
54	1.0300	-4.150	2.50	0.7249
112	1.0400	26.74	1.00	0.0360
105	1.0172	20.41	1.00	0.2300
107	1.0196	19.25	0.20	0.1500

Transmission lines are modelled using the Bergeron model. Table 2 summarizes part of the transmission line parameters of the IEEE 118-bus system.

Table 2 - Transmission line characteristics of IEEE 118-bus system (for complete list, see [1])

Line		R [pu/m]	X [pu/m]	B [pu/m]
From Bus	To Bus			
1	2	0.03030	0.09990	0.02540
1	3	0.01290	0.04240	0.01082
2	12	0.01870	0.06160	0.01572
3	12	0.04840	0.16000	0.04060
3	5	0.02410	0.10800	0.02840
4	11	0.02090	0.06880	0.01748
4	5	0.00176	0.00798	0.00210
5	6	0.01190	0.05400	0.01426
5	11	0.02030	0.06820	0.01738
6	7	0.00459	0.02080	0.00550
7	12	0.00862	0.03400	0.00874
8	30	0.00431	0.05040	0.51400
31	17	0.04740	0.15630	0.03990
31	32	0.02980	0.09850	0.02510
31	29	0.01080	0.03310	0.00830
29	28	0.02370	0.09430	0.02380
28	27	0.01913	0.08550	0.02160
27	32	0.02290	0.07550	0.01926
27	115	0.01640	0.07410	0.01972
27	25	0.03180	0.16300	0.17640
115	114	0.00230	0.01040	0.00276
114	32	0.01350	0.06120	0.01628
32	113	0.06150	0.20300	0.05180
23	24	0.01350	0.04920	0.04980
23	22	0.03420	0.15900	0.04040
23	25	0.01560	0.08000	0.08640
12	14	0.02150	0.07070	0.01816
14	15	0.05950	0.19500	0.05020
12	16	0.02120	0.08340	0.02140
12	117	0.03290	0.14000	0.03580
15	17	0.01320	0.04370	0.04440
17	18	0.01230	0.05050	0.01298

Loads are modelled as a constant PQ load and part of the load parameters are shown in Table 3.

Table 3 - Load characteristics of IEEE 118-bus system (for complete list, see [1])

Bus	P [pu]	Q [pu]
1	0.5414	0.0866
3	0.4140	0.1062
2	0.2123	0.0955
117	0.2123	0.0849
12	0.4989	0.1062
11	0.7431	0.2442
16	0.2654	0.1062
18	0.6369	0.3609
20	0.1911	0.0318
21	0.1486	0.0849
22	0.1062	0.0531
23	0.0743	0.0318
70	0.6600	0.2000
74	0.6800	0.2700
75	0.4700	0.1100
118	0.3300	0.1500
76	0.6800	0.3600
78	0.7100	0.2600
79	0.3900	0.3200

2.0 Validation

The PSCAD model was validated against the PSS/E power flow values from [1]. Table 4 depicts part of the line and source power flow comparison.

Table 4 - Source and line power comparison of IEEE 118-bus system

Bus		PSS/E		PSCAD	
		P [pu]	Q [pu]	P [pu]	Q [pu]
31		0.30	0.1200	0.3004	0.1201
113		1.00	-0.3000	1.0000	-0.2990
32		1.00	0.3000	1.0010	0.3000
12		3.00	1.2000	3.0010	1.2010
72		0.30	-0.0776	0.3001	-0.0773
65		5.47	0.3994	5.4680	0.3973
34		0.30	0.1500	0.3000	0.1500
73		0.30	0.1200	0.3000	0.1200
70		0.80	0.3200	0.8003	0.3198
36		1.00	0.3000	1.0000	0.2999
From Bus	**To Bus**				
2	1	0.291	0.052	0.2910	0.0520
3	1	0.250	0.034	0.2500	0.0340
12	2	0.506	0.131	0.5060	0.1310
12	3	0.310	0.083	0.3102	0.0826
5	3	0.355	0.050	0.3547	0.0498
4	11	0.029	-0.032	0.0292	-0.0320
5	4	0.348	0.096	0.3478	0.0955
5	6	0.237	0.022	0.2372	0.0218
11	5	0.071	0.024	0.0705	0.0239
7	6	0.315	0.200	0.3156	0.2003
12	7	0.518	0.219	0.5179	0.2187
30	8	1.014	0.127	1.0140	0.1271
17	30	0.237	0.088	0.2367	0.0876
32	31	0.239	0.072	0.2386	0.0719
31	29	0.319	-0.007	0.3191	-0.0070
29	28	0.063	-0.045	0.0631	-0.0447
27	28	0.118	0.096	0.1176	0.0958
27	32	-0.395	0.046	-0.3952	0.0459
27	115	-0.059	0.043	-0.0595	0.0430
25	27	0.322	0.151	0.3217	0.1506
114	115	0.293	0.012	0.2932	0.0121
32	114	0.378	0.042	0.3783	0.0420
113	32	0.185	0.009	0.1850	0.0092

23	24	-1.301	0.289	-1.3010	0.2885
23	22	0.328	0.062	0.3284	0.0623
23	25	0.431	-0.255	0.4312	-0.2547
12	14	0.073	0.091	0.0729	0.0907
14	15	-0.076	0.098	-0.0761	0.0978
12	16	0.019	0.097	0.0194	0.0971
12	117	0.214	0.055	0.2140	0.0547
17	15	0.704	0.347	0.7037	0.3471
17	18	0.569	0.403	0.5695	0.4031

3.0 PSCAD Case Set-up Instructions

Dependencies

This example is compatible with PSCAD v4.5.3 and beyond. The files required to run the tutorial are as follows:

- New_IEEE_118_CT.pscx

4.0 Future updates to the system model

- Replace the voltage sources with detailed machine models for dynamic analysis.
- Update short circuit levels of each source to represent specific system strengths.

5.0 Technical References

[1] [Online]. Available FTP: http://psdyn.ece.wisc.edu/IEEE_benchmarks

[2] http://sas.ieee.ca/pesias/seminar_slides/IEEE_PES-IAS_Chapter_24_01_13.pdf

Appendix A

The line resistances and reactances are provided in [1] for each line segment of the test system. The following table lists the approximate line lengths of part of the segments, based on typical line data (as listed in Table A-2).

Table A-1- Approximate line lengths based on typical line reactance values as shown in Table A-2

From Bus	To Bus	Total Reactance (Ω)	Approximate length of the line based on typical line reactance values (km)
1	2	19.0249	38.0499
1	3	8.07465	16.1493
2	12	11.7311	23.4622
3	12	30.4704	60.9408
3	5	20.5675	41.1350
4	11	13.1023	26.2045
4	5	1.51971	3.03942
5	6	10.2838	20.5675
5	11	12.9880	25.9760
6	7	3.96115	7.92230
7	12	6.47496	12.9499
8	30	59.9886	199.962
31	17	29.7658	59.5315
31	32	18.7583	37.5166
31	29	6.30356	12.6071
29	28	17.9585	35.9169
28	27	16.2826	32.5652
27	32	14.3782	28.7564
27	115	14.1116	28.2232
27	25	31.0417	62.0834
115	114	1.98058	3.96115
114	32	11.6549	23.3099
32	113	38.6593	77.3186
23	24	9.3696	18.7393
23	22	30.2799	60.5599
23	25	15.2352	30.4704
12	14	13.4641	26.9282
14	15	37.1358	74.2716
12	16	15.8827	31.7654
12	117	26.6616	53.3232
15	17	8.32223	16.6444
17	18	9.61722	19.2344

Table A-2- Typical line reactance values

Voltage (kV)	R(Ω/km)	X(Ω/km)
72	0.41	0.5
138	0.14	0.5
230 (single)	0.09	0.5
230 (bundled)	0.04	0.4
345 (bundled)	0.03	0.3
500 (bundled)	0.02	0.3

DOCUMENT TRACKING

Rev.	Description	Date
0	Initial	30/Dec/2014
1	Update to new brand guidelines	23/May/2018