QUCS simulation for FG Series 1

Vc Above Threshold and

Vds Above Saturation

Vc = 0.8V   Vds=2V

T1=0s   T2=0.5ms   Tr=0.01ms Tf=0.01ms

Vtun (variable amplitude)   Total pulse duration=50us Tr=5us   Tf=5us

Sampling time=1us

Tunnel Voltage	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	start of pulse Itun during pulse	end of pulse Itun during pulse
(volts)	(volts)	(volts)	(volts)	(volts)	(volts)	A x e-5	A x e-5	A x e-5	A x e-5	A x e-13	A x e-9	A x e-9
10	0.799	0.815	0.826	0.809	0.0105	1.68	1.96	2.14	1.85	1.96E+00	3.68	3.53
10.1	0.799	0.816	0.831	0.815	0.016	1.68	1.96	2.25	1.95	2.26E+00	5.65	5.31
10.2	0.799	0.816	0.84	0.823	0.024	1.68	1.96	2.4	2.09	2.79E+00	8.59	7.85
10.3	0.799	0.816	0.851	0.834	0.0355	1.68	1.97	2.63	2.3	3.77E+00	12.9	11.3
10.4	0.799	0.816	0.867	0.85	0.0515	1.68	1.97	2.97	2.61	5.75E+00	19.3	16
10.5	0.799	0.816	0.889	0.872	0.0733	1.68	1.98	3.47	3.07	1.02E+01	28.4	21.9
10.6	0.799	0.817	0.918	0.901	0.102	1.68	1.98	4.19	3.75	2.19E+01	41.4	29
10.7	0.799	0.817	0.955	0.938	0.139	1.68	1.99	5.22	4.72	5.86E+01	59.6	37.2
10.8	0.799	0.818	1	0.983	0.185	1.68	2	6.65	6.08	1.99E+02	84.6	45.9
10.9	0.799	0.818	1.06	1.04	0.239	1.68	2.01	8.6	7.94	8.63E+02	117	54.6
11	0.799	0.819	1.12	1.1	0.302	1.68	2.02	11.2	10.4	4.75E+03	163	62.9
11.1	0.799	0.82	1.19	1.17	0.372	1.68	2.04	14.4	13.6	3.22E+04	220	70.4
11.2	0.799	0.821	1.27	1.25	0.449	1.68	2.06	18.5	17.5	2.53E+05	291	76.8

QUCS simulation for FG **Vc Above Threshold and** **Vds Above Saturation**

Vc = 0.8V   Vds=2V

T1=0s   T2=0.5ms   Tr=0.01ms Tf=0.01ms

Vtun (variable amplitude)

Total pulse duration=50usTr=5us   Tf=5us

Sampling time=1us

Tunnel Voltage (volts)	Vfg at start of pulse (volts)	Vfg after pulse rise (volts)	Vfg before pulse fall (volts)	Vfg after pulse fall (volts)	Vfg after Vc removed (volts)	Is before pulse A x e-5	Is after pulse initial rise A x e-5	Is at end of pulse before fall A x e-5	Is after pusle removed A x e-5	Is after Vc removed A x e-13	Itun during pulse A x e-9	Itun during pulse A x e-9
11.5	0.799	0.828	1.52	1.51	0.707	1.68	2.18	36	34.6	5.97E+07	577	89.6
11.6	0.799	0.832	1.62	1.6	0.8	1.68	2.26	43.6	42	1.75E+08	686	92.2
11.7	0.799	0.836	1.71	1.69	0.894	1.68	2.33	52.2	50.5	3.58E+08	797	94.1
11.8	0.799	0.843	1.81	1.79	0.989	1.68	2.46	61.7	59.8	6.28E+08	903	95.6
11.9	0.799	0.851	1.9	1.88	1.09	1.68	2.63	72.2	70	9.82E+08	1000	96.8
12	0.799	0.862	2	1.98	1.18	1.68	2.86	83.5	81.2	1.42E+09	1090	97.6
12.1	0.799	0.876	2.1	2.08	1.28	1.68	3.17	95.7	93.3	1.94E+09	1160	98.3
12.2	0.799	0.894	2.2	2.18	1.38	1.68	3.58	109	106	2.55E+09	1230	98.8
12.3	0.799	0.916	2.3	2.28	1.48	1.68	4.14	123	123	3.25E+09	1280	99.1
12.4	0.799	0.943	2.4	2.38	1.58	1.68	4.88	138	135	4.03E+09	1320	99.4
12.5	0.799	0.976	2.5	2.48	1.68	1.68	5.86	154	150	4.91E+09	1350	99.6

start of pulse / end of pulse

	Vc Below Threshold and	Vds Below Saturation

Vc= 0.05V   Vds=0.1V

T1=0s   T2=0.5ms Tr=0.01ms Tf=0.01ms

Vtun (variable amplitude)   Total pulse duration=50us Tr=5us   Tf=5us

Sampling time=1us

											start of pulse	end of pulse	
Tunnel Voltage (volts)	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	Itun during pulse	Itun during pulse	Itun after pulse removed
	mV	mV	mV	mV	mV	xe-13(A)	xe-13(A)	xe-13(A)	xe-13(A)	xe-13(A)	xe-8(A)	xe-8(A)	xe-8
8.8	49.9	64.6	65.9	51.3	1.37	5.4	7.94	8.234	5.59	1.51	0.047	0.0467	-8.09
8.85	49.9	64.6	66.4	51.7	1.74	5.4	7.96	8.33	5.65	1.53	0.0597	0.0593	-8.14
8.9	49.9	64.7	66.9	52.1	2.2	5.4	7.97	8.45	5.72	1.54	0.0757	0.075	-8.19
8.95	49.9	64.8	67.6	52.7	2.27	5.4	7.99	8.6	5.8	1.57	0.0956	0.0945	-8.23
9	49.9	64.9	68.4	53.4	3.49	5.4	8.01	8.78	5.91	1.6	0.12	0.119	-8.28
9.05	49.9	65	69.3	54.3	4.38	5.4	8.03	9.01	6.06	1.63	0.151	0.149	-8.32
9.1	49.9	65.1	70.5	55.4	5.48	5.4	8.05	9.29	6.23	1.68	0.19	0.186	-8.37
9.15	49.9	65.2	72	56.8	6.84	5.4	8.07	9.65	6.46	1.74	0.237	0.231	-8.42
9.2	49.9	65.3	73.7	58.4	8.5	5.4	8.09	101	6.75	1.82	0.296	0.286	-8.46
9.25	49.9	65.3	75.8	60.5	10.5	5.4	8.1	107	7.12	1.92	0.368	0.353	-8.51
9.3	49.9	65.4	78.4	62.9	13	5.4	8.13	114	7.6	2.05	0.457	0.434	-8.55
9.35	49.9	65.5	81.5	65.9	16	5.4	8.15	125	8.23	2.22	0.565	0.531	-8.6
9.4	49.9	65.6	85.2	69.6	19.2	5.4	8.17	137	9.06	2.44	0.698	0.647	-8.65

	Vc Below Threshold and	Vds Below Saturation
QUCS simulation for FG		

Vc= 0.05V   Vds=0.1V

T1=0s   T2=0.5ms Tr=0.01ms Tf=0.01ms

| Vtun (variable amplitude) | Total pulse duration =50us | Tr=5us | Tf=5us |

Sampling time=1us

Tunnel Voltage (volts)	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	Itun during pulse (start of pulse)	Itun during pulse (end of pulse)	Itun after pulse removed
	mV	mV	mV	mV	mV	xe-13(A)	xe-13(A)	xe-13(A)	xe-13(A)	xe-13(A)	xe-8(A)	xe-8(A)	xe-8
9.45	49.9	65.7	89.6	74	24	5.4	8.19	154	10.2	2.73	0.859	0.785	-8.69
9.5	49.9	65.8	94.9	79.2	29.3	5.4	8.21	177	11.7	3.14	1.06	0.946	-8.74
9.55	49.9	66	101	85.4	35.5	5.4	8.24	210	13.8	3.69	1.29	1.13	-8.78
9.6	49.9	66.1	109	92.89	42.9	5.4	8.26	255	16.8	4.48	1.58	1.35	-8.83
9.65	49.9	66.2	117	101	51.5	5.4	8.29	322	21.1	5.63	1.93	1.6	-8.87
9.7	49.9	66.3	128	112	61.6	5.4	8.32	422	27.6	7.35	2.34	1.88	-8.92
9.75	49.9	66.5	139	123	73.4	5.4	8.35	578	37.7	10	2.84	2.19	-0.0115
9.8	49.9	66.6	153	137	86.8	5.4	8.39	831	54	14.3	3.43	2.53	-0.0115
9.85	49.9	66.8	168	152	102	5.4	8.42	1260	81.5	21.5	4.14	2.9	-0.0115
9.9	49.9	67	186	170	120	5.4	8.47	1010	130	34.2	4.97	3.3	-0.0115
9.95	49.9	67.2	205	189	139	5.4	8.51	3400	220	57.5	5.96	3.72	-0.0115
10	49.9	67.4	227	211	161	5.4	8.56	6110	394	103	7.11	4.15	-9.2

QUCS simulation for FG   **Vc Below Threshold and**   **Vds Above Saturation**

Vc set at 0.05V   Vds=2V

Series 3   T1=0s   T2=0.5ms Tr=0.01ms Tf=0.01ms

Vtun (variable amplitude)   Total pulse duration=50us Tr=5us   Tf=5us

Sampling time=1us

Tunnel Voltage (volts)	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	Itun during pulse (start of pulse)	Itun during pulse (end of pulse)	Itun after pulse removed
	mV	mV	mV	mV	mV	A x e-13	A x e-13	A x e-13	A x e-13	A x e-13	A x e-8	A x e-8	A x e-8
8.8	49.9	64.6	65.9	51.3	1.37	5.51	8.11	8.4	5.71	1.54	0.047	0.0467	-8.09
8.85	49.9	64.6	66.4	51.7	1.74	5.51	8.13	8.51	5.77	1.56	0.0597	0.0593	-8.14
8.9	49.9	64.7	66.9	52.1	2.2	5.51	8.14	8.63	5.84	1.58	0.0757	0.075	-8.19
8.95	49.9	64.8	67.6	52.7	2.77	5.51	8.16	8.78	5.93	1.6	0.0956	0.0945	-8.23
9	49.9	64.9	68.4	53.4	3.49	5.51	8.18	8.97	6.04	1.63	0.12	0.119	-8.28
9.05	49.9	65	69.3	54.3	4.38	5.51	8.2	9.2	6.18	1.67	0.151	0.149	-8.32
9.1	49.9	65.1	70.5	55.4	5.48	5.51	8.22	9.49	6.37	1.72	0.19	0.186	-8.37
9.15	49.9	65.2	72	56.8	6.84	5.51	8.24	9.86	6.6	1.78	0.237	0.231	-8.42
9.2	49.9	65.3	73.7	58.4	8.5	5.51	8.26	10.3	6.89	1.86	0.296	0.286	-8.46
9.25	49.9	65.3	75.8	60.5	10.5	5.51	8.28	10.9	7.27	1.96	0.368	0.353	-8.51
9.3	49.9	65.4	78.4	62.9	13	5.51	8.3	11.7	7.77	2.09	0.457	0.434	-8.55
9.35	49.9	65.5	81.5	65.9	16	5.51	8.32	12.7	8.41	2.26	0.565	0.531	-8.6
9.4	49.9	65.6	85.2	69.6	19.7	5.51	8.34	14	9.26	2.49	0.698	0.647	-8.65
9.45	49.9	65.7	89.6	74	24	5.51	8.36	15.7	10.4	2.79	0.859	0.785	-8.69

QUCS simulation for FG **Vc Below Threshold and** **Vds Above Saturation**

Vc set at 0.05V   Vds=2V

T1=0s   T2=0.5ms Tr=0.01ms Tf=0.01ms

Vtun (variable amplitude)   Total pulse duration=50us Tr=5us   Tf=5us

Sampling time=1us

Tunnel Voltage (volts)	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	Itun during pulse (start of pulse)	Itun during pulse (end of pulse)	Itun after pulse removed
	mV	mV	mV	mV	mV	A x e-13	A x e-13	A x e-13	A x e-13	A x e-13	A x e-8	A x e-8	A x e-8
9.5	49.9	65.8	94.9	79.2	29.3	5.51	8.39	18.1	11.9	3.2	1.06	0.946	-8.74
9.55	49.9	66	101	85.4	35.5	5.51	8.41	21.4	14.1	3.77	1.29	1.13	-8.78
9.6	49.9	66.1	109	92.8	42.9	5.51	8.44	26.1	17.1	4.58	1.58	1.35	-8.83
9.65	49.9	66.2	117	101	51.5	5.51	8.47	32.9	21.5	5.75	1.93	1.6	-8.87
9.7	49.9	66.3	128	112	61.6	5.51	8.5	43.1	28.2	7.51	2.34	1.88	-8.92
9.75	49.9	66.5	139	123	73.4	5.51	8.53	59.1	38.5	102	2.84	2.19	-11.5
9.8	49.9	66.6	153	137	86.8	5.51	8.57	84.9	55.2	146	3.43	2.53	-11.5
9.85	49.9	66.8	168	152	102	5.51	8.6	128	83.3	220	4.14	2.9	-11.5
9.9	49.9	67	186	170	120	5.51	8.65	205	133	349	4.97	3.3	-11.5
9.95	49.9	67.2	205	189	139	5.51	8.69	347	224	587	5.96	3.72	9150
10	49.9	67.4	227	211	161	5.51	8.75	624	402	1050	7.11	4.15	9200

QUCS simulation for FG Series 4   **Vc Above Threshold and**   **Vds Below Saturation**

Vc set at 0.8V   Vds=0.1V

T1=0s   T2=0.5ms   Tr=0.01ms   Tf=0.01ms

Vtun (variable amplitude)   Total pulse duration=50us   Tr=5us   Tf=5us

Sampling time=1us

Tunnel Voltage	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	Itun during pulse (start of pulse)	Itun during pulse (end of pulse)
(volts)	(volts)	(volts)	(volts)	(volts)	(volts)	A x e-5	A x e-5	A x e-5	A x e-5	A x e-13	A x e-9	A x e-9
10	0.799	0.815	0.826	0.809	0.0105	1.37	1.55	1.67	1.48	1.92	3.68	3.53
10.1	0.799	0.816	0.831	0.815	0.016	1.37	1.55	1.73	1.54	2.22	5.65	5.31
10.2	0.799	0.816	0.84	0.823	0.024	1.37	1.55	1.82	1.63	2.73	8.59	7.85
10.3	0.799	0.816	0.851	0.834	0.0355	1.37	1.56	1.95	1.76	3.69	12.9	11.3
10.4	0.799	0.816	0.867	0.85	0.0515	1.37	1.57	2.14	1.94	5.62	19.3	16
10.5	0.799	0.816	0.889	0.872	0.733	1.37	1.56	2.39	2.19	10	28.4	21.9
10.6	0.799	0.817	0.918	0.901	0.102	1.37	1.57	2.72	2.52	21.5	41.4	29
10.7	0.799	0.817	0.955	0.938	0.139	1.37	1.57	3.15	2.95	57.4	59.6	37.2
10.8	0.799	0.818	1	0.983	0.185	1.37	1.57	3.67	3.47	195	84.6	45.9
10.9	0.799	0.818	1.06	1.04	0.239	1.37	1.58	4.28	4.09	854	118	54.6
11	0.799	0.819	1.12	1.1	0.302	1.37	1.59	4.99	4.79	4710	163	62.9
11.1	0.799	0.82	1.19	1.17	0.372	1.37	1.6	5.77	5.58	31900	227	70.4

QUCS simulation for FG | **Vc Above Threshold and** | **Vds Below Saturation**

Vc set at 0.8V | Vds=0.1V

T1=0s   T2=0.5ms Tr=0.01ms Tf=0.01ms

Vtun (variable amplitude) | Total pulse duration=50us Tr=5us | Tf=5us

Sampling time=1us | | | | | | | | | | | start of pulse | end of pulse

Tunnel Voltage	Vfg at start of pulse	Vfg after pulse rise	Vfg before pulse fall	Vfg after pulse fall	Vfg after Vc removed	Is before pulse	Is after pulse initial rise	Is at end of pulse before fall	Is after pusle removed	Is after Vc removed	Itun during pulse	Itun during pulse
(volts)	(volts)	(volts)	(volts)	(volts)	(volts)	A x e-5	A x e-5	A x e-5	A x e-5	A x e-13	A x e-9	A x e-9
11.2	0.799	0.821	1.27	1.25	0.449	1.37	1.61	6.63	6.43	251000	290	76.8
11.3	0.799	0.823	1.35	1.33	0.531	1.37	1.63	7.54	7.34	2.02E+06	375	82.1
11.4	0.799	0.825	1.43	1.42	0.618	1.37	1.66	8.5	8.29	13200000	472	86.3
11.5	0.799	0.827	1.52	1.51	0.707	1.37	1.68	9.49	9.28	54800000	578	89.6
11.6	0.799	0.831	1.62	1.6	0.8	1.37	1.72	10.5	10.03	139000000	689	92.2
11.7	0.799	0.836	1.71	1.69	0.894	1.37	1.78	11.5	11.3	244000000	799	94.2
11.8	0.799	0.842	1.81	1.79	0.989	1.37	1.85	12.6	12.4	354000000	905	95.7
11.9	0.799	0.851	1.9	1.88	1.09	1.37	1.95	13.6	13.4	464000000	1000	96.8
12	0.799	0.862	2	1.98	1.18	1.37	2.05	14.7	14.5	572000000	1090	97.7