cmos028fdsoi Technology

SG DK 1.2 RF_mmW models

LVT

Comparison with RVT model(s)

Focus on analog performance

Please use the bookmark to navigate

General information on SG DK 1.2 RF_mmW models

- Maximum supply voltage is - V.
- Validity domain is defined as follows:
  - ✔ Drawn gate length varies from 30nm to 10um.
  - ✔ Drawn transistor width varies from 80nm to 10um.
  - ✔ Device temperature varies from -40 °C to 125 °C.

Output parameters definitions

- Model(s): lvtnfet_acc, lvtpfet_acc
  - ✔ Gm_ana : Drain transconductance at Ids = iana*M*W/L, Vds = Vdd/4V, f = 100kHz.
  - ✔ Sv@1hz : Gate noise voltage spectral density at 1Hz, Vgs = Vgs_ana, Vds = Vdd/4V
  - ✔ Aid : delta_Id/Id * sqrt(W.L)
  - ✔ Gds_ana : Drain conductance at Ids = iana*M*W/L, Vds = Vdd/4, f = 100k
  - ✔ Vgs_ana : Vgs value for which drain current is iana*M*shrink_iana*W/(shrink_iana*L+dlshrink_iana+plashrink_iana*p_la) at Vds=Vdd/4V.
  - ✔ Avt : delta_Vt * sqrt(W.L)
  - ✔ Id_sv : Drain current at Vgs = Vgs_ana and Vds = Vdd/4V for which noise voltage and current spectral densities Sv, Si are extracted.
  - ✔ Cbd_off : Bulk-to-Drain capacitance at Vgs = 0V, Vds = 0V, f = 100kHz.
  - ✔ Cdg_ana : Drain-to-Gate transcapacitance at Ids = iana*M*W/L, Vds = Vdd/4V, f = 100kHz.
  - ✔ Ft_ana : Transition frequency at Ids = iana*M*W/L, Vds = Vdd/4V
  - ✔ Sv@th : Gate thermal noise voltage spectral density, Vgs = Vgs_ana, Vds = Vdd/4V
  - ✔ Abeta : delta_GmMax/GmMax * sqrt(w/L)
  - ✔ Cdd_ana : Total drain capacitance at Ids = iana*M*W/L, Vds = Vdd/4V, f = 100kHz.
  - ✔ Gdc_ana : Voltage gain at Ids = iana*M*W/L, Vds = Vdd/4V, f = 100kHz
  - ✔ Cgg_ana : Total gate capacitance at Ids = iana*M*W/L, Vds = Vdd/4V, f = 100kHz
  - ✔ Cgd_0v : Gate-to-Drain capacitance at Vgs = 0V, Vds = vds_cggV, f = 100kHz.
  - ✔ Vtgmmax : Threshold voltage at Vds = 0.05 derived from Gm max method.

lvtnfet_acc
Electrical characteristics per geometry

lvtnfet_acc wrt nfet_acc @ w=0.30e-6, l=0.030e-6, pre_layout_local=1, nf=1, sa=8.500e-08, sb=8.500e-08, sd=1.140e-07, pcpastrx_top=5.700e-08, pcpastrx_bot=8.000e-08, devtype=PCELLwoWPE, as=2.55e-14, ad=2.55e-14, ps=7.7e-07, pd=7.7e-07, vbs=0, vdd=1, temp=25

LVT wrt RVT

	SSF	TT	FFF
VtGmmax [mV]	352.1 -63.0mV	332.3 -52.2mV	309.4 -51.3mV
Vgs_ana [mV]	613.5 -49.4mV	561.8 -46.5mV	514.4 -43.3mV
GDC_ana []	4.98 11.1%	5.55 12.4%	5.44 10.1%
GBW_QS [GHz]	233.5 -3.0%	271.2 -0.6%	280.1 -1.5%
Ft_ana [GHz]	202.9 -3.2%	227.9 0.1%	239.8 0.0%
Gm_ana [µS]	293.5 -3.6%	331.4 -0.8%	359.3 -1.5%
Gds_ana [µS]	58.88 -13.2%	59.67 -11.7%	66.04 -10.5%
Cgg_ana [aF]	230.2 -0.4%	231.4 -0.9%	238.3 -1.3%
Cdg_ana [aF]	191.4 -1.6%	176 -0.6%	185 -1.2%
Cdd_ana [aF]	189.6 0.6%	188.1 0.5%	196.9 0.8%
Avt [mV.µm]	1.16 -1.5%	1.21 -4.3%	1.21 -6.3%
Abeta [%.µm]	0.34 -0.4%	0.37 6.4%	0.39 16.7%
AId [%.µm]	0.3 27.4%	0.33 35.6%	0.35 52.6%
Sv@1Hz [V/√Hz]	3.58e-05 7.5%	1.23e-04 7.7%	4.70e-04 10.7%
Sv@th [V/√Hz]	1.05e-08 4.7%	1e-08 3.7%	9.82e-09 5.0%

lvtnfet_acc wrt nfet_acc @ w=20e-6, l=2.0e-6, pre_layout_local=1, nf=4, sa=8.500e-08, sb=8.500e-08, sd=1.140e-07, pcpastrx_top=1.050e-07, pcpastrx_bot=1.050e-07, devtype=PCELLwoWPE, as=4.25e-13, ad=4.25e-13, ps=1.017e-05, pd=1.017e-05, vbs=0, vdd=1, temp=25

LVT wrt RVT

	SSF	TT	FFF
VtGmmax [mV]	491.7 -67.9mV	459.6 -59.3mV	430.5 -56.8mV
Vgs_ana [mV]	607.7 -65.6mV	570.3 -56.4mV	535.5 -55.4mV
GDC_ana []	234.2 25.5%	254.3 21.3%	248.7 14.7%
GBW_QS [GHz]	13.41 19.9%	14.09 16.2%	14.11 13.0%
Ft_ana [GHz]	0.26 6.1%	0.26 5.6%	0.26 7.6%
Gm_ana [µS]	575 -1.6%	594.3 -1.2%	608.6 -1.7%
Gds_ana [µS]	2.46 -21.6%	2.34 -18.6%	2.45 -14.3%
Cgg_ana [fF]	346.1 -7.3%	365 -6.4%	368.8 -7.4%
Cdg_ana [fF]	136 -9.6%	143.8 -8.4%	145 -9.3%
Cdd_ana [fF]	6.82 -17.9%	6.71 -15.0%	6.86 -12.9%
Avt [mV.µm]	7.05 40.5%	7.46 42.7%	6.85 38.7%
Abeta [%.µm]	1.29 37.5%	1.27 37.6%	1.26 37.8%
AId [%.µm]	1.75 14.0%	1.7 18.2%	1.52 24.6%
Sv@1Hz [V/√Hz]	1.58e-06 8.1%	1.8e-06 6.5%	2.14e-06 8.1%
Sv@th [V/√Hz]	4.22e-09 1.3%	4.12e-09 0.7%	4.05e-09 1.1%

lvtpfet_acc
Electrical characteristics per geometry

lvtpfet_acc wrt pfet_acc @ w=0.30e-6, l=0.030e-6, pre_layout_local=1, nf=1, sa=8.500e-08, sb=8.500e-08, sd=1.140e-07, pcpastrx_top=5.700e-08, pcpastrx_bot=8.000e-08, devtype=PCELLwoWPE, as=2.55e-14, ad=2.55e-14, ps=7.7e-07, pd=7.7e-07, vdd=1, temp=25
vbs=1 wrt vbs=0

LVT wrt RVT

	SSF	TT	FFF
VtGmmax [mV]	392.7 -126.1mV	374.3 -123.8mV	360.4 -114.9mV
Vgs_ana [mV]	630.5 -148.8mV	593 -133.3mV	554.9 -122.3mV
GDC_ana []	4.25 23.1%	3.78 7.9%	3.22 0.7%
GBW_QS [GHz]	108.8 3.2%	111.3 -2.9%	108.9 -5.5%
Ft_ana [GHz]	90.18 10.4%	93.47 6.4%	94.45 5.3%
Gm_ana [µS]	126.2 8.6%	128.7 2.0%	128.6 -2.3%
Gds_ana [µS]	29.69 -11.8%	34.08 -5.5%	39.91 -3.0%
Cgg_ana [aF]	222.7 -1.7%	219.2 -4.1%	216.6 -6.9%
Cdg_ana [aF]	152.2 2.7%	143.2 -1.9%	141.3 -6.3%
Cdd_ana [aF]	179.5 6.2%	180 5.8%	183.2 4.6%
Avt [mV.µm]	1.92 -0.6%	1.93 -4.0%	1.91 -9.5%
Abeta [%.µm]	0.38 -11.0%	0.49 3.3%	0.63 8.5%
AId [%.µm]	0.31 -32.2%	0.41 -19.0%	0.55 -7.3%
Sv@1Hz [V/√Hz]	3.41e-05 -26.6%	1.15e-04 -19.0%	4.11e-04 -10.1%
Sv@th [V/√Hz]	1.6e-08 -2.2%	1.6e-08 1.5%	1.64e-08 4.4%

lvtpfet_acc wrt pfet_acc @ w=20e-6, l=2.0e-6, pre_layout_local=1, nf=4, sa=8.500e-08, sb=8.500e-08, sd=1.140e-07, pcpastrx_top=1.050e-07, pcpastrx_bot=1.050e-07, devtype=PCELLwoWPE, as=4.25e-13, ad=4.25e-13, ps=1.017e-05, pd=1.017e-05, vdd=1, temp=25
vbs=1 wrt vbs=0

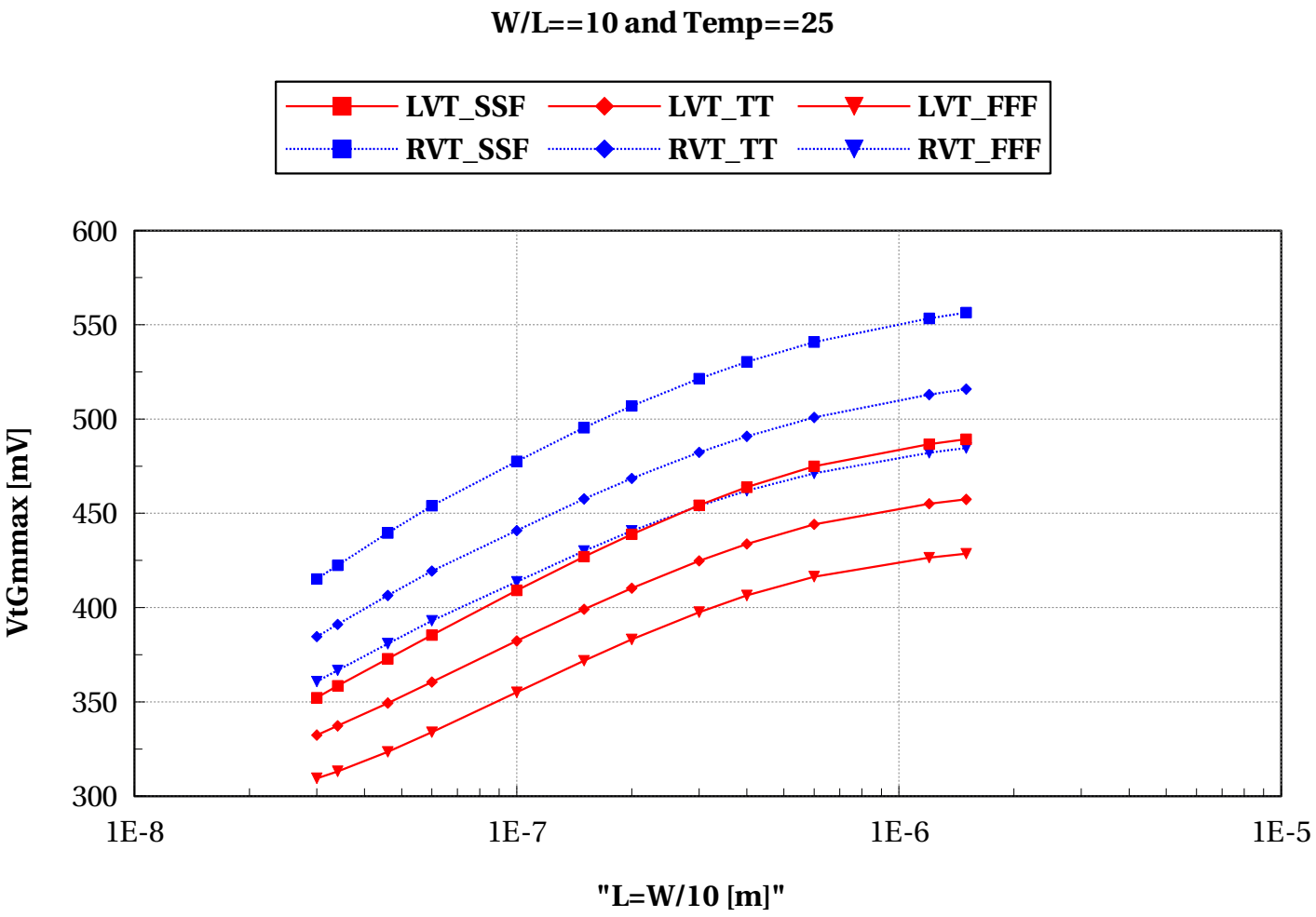
LVT wrt RVT

	SSF	TT	FFF
VtGmmax [mV]	503.5 -123.9mV	477.8 -123.1mV	455 -122.1mV
Vgs_ana [mV]	644.6 -139.8mV	608.8 -145.7mV	575.2 -152.6mV
GDC_ana []	61.12 -36.8%	69.69 -38.6%	75.25 -40.4%
GBW_QS [GHz]	1.58 12.3%	1.81 14.6%	2.01 16.3%
Ft_ana [GHz]	8.91e-02 14.3%	9.63e-02 20.1%	0.1 28.8%
Gm_ana [µS]	203.3 0.2%	211.2 0.9%	217.6 1.2%
Gds_ana [µS]	3.33 58.5%	3.03 64.4%	2.89 70.3%
Cgg_ana [fF]	363.2 -12.3%	348.9 -15.9%	333.7 -19.7%
Cdg_ana [fF]	149.4 -12.3%	142.4 -16.0%	135.3 -19.8%
Cdd_ana [fF]	20.46 -10.8%	18.54 -12.0%	17.21 -12.9%
Avt [mV.µm]	15.41 41.9%	14.79 45.0%	14.54 46.9%
Abeta [%.µm]	1.82 27.0%	1.81 18.9%	1.89 15.7%
AId [%.µm]	3.24 -8.4%	2.47 -9.3%	2.01 -9.6%
Sv@1Hz [V/√Hz]	1.13e-06 -30.4%	1.5e-06 -28.4%	2.02e-06 -26.1%
Sv@th [V/√Hz]	7.13e-09 0.8%	6.92e-09 0.2%	6.76e-09 -0.2%

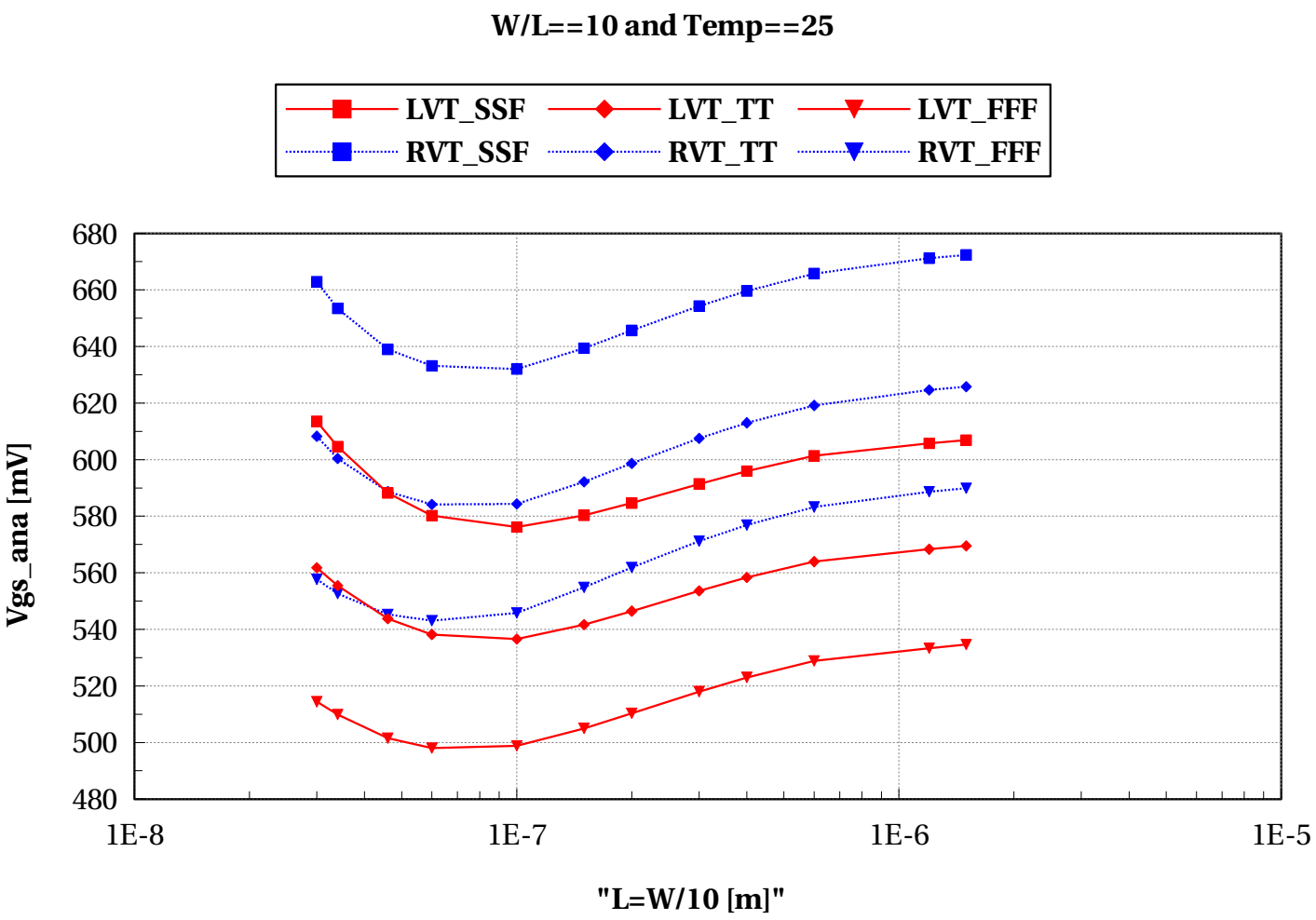
lvtnfet_acc
Electrical characteristics scaling

Scaling versus Length @ W/L=10 and W/NF<5e-6

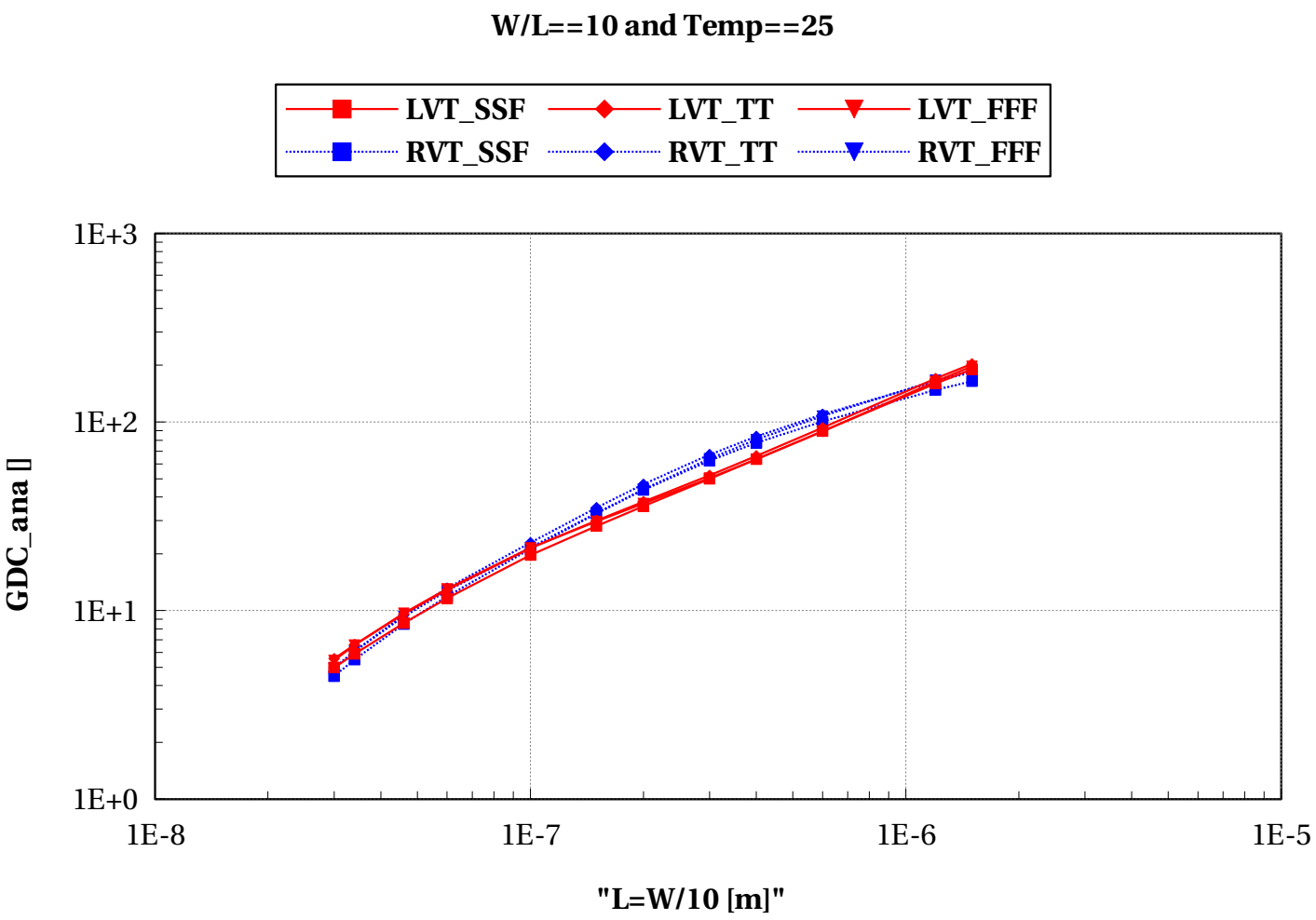
lvtnfet_acc, VtGmmax [mV] vs "L=W/10 [m]"



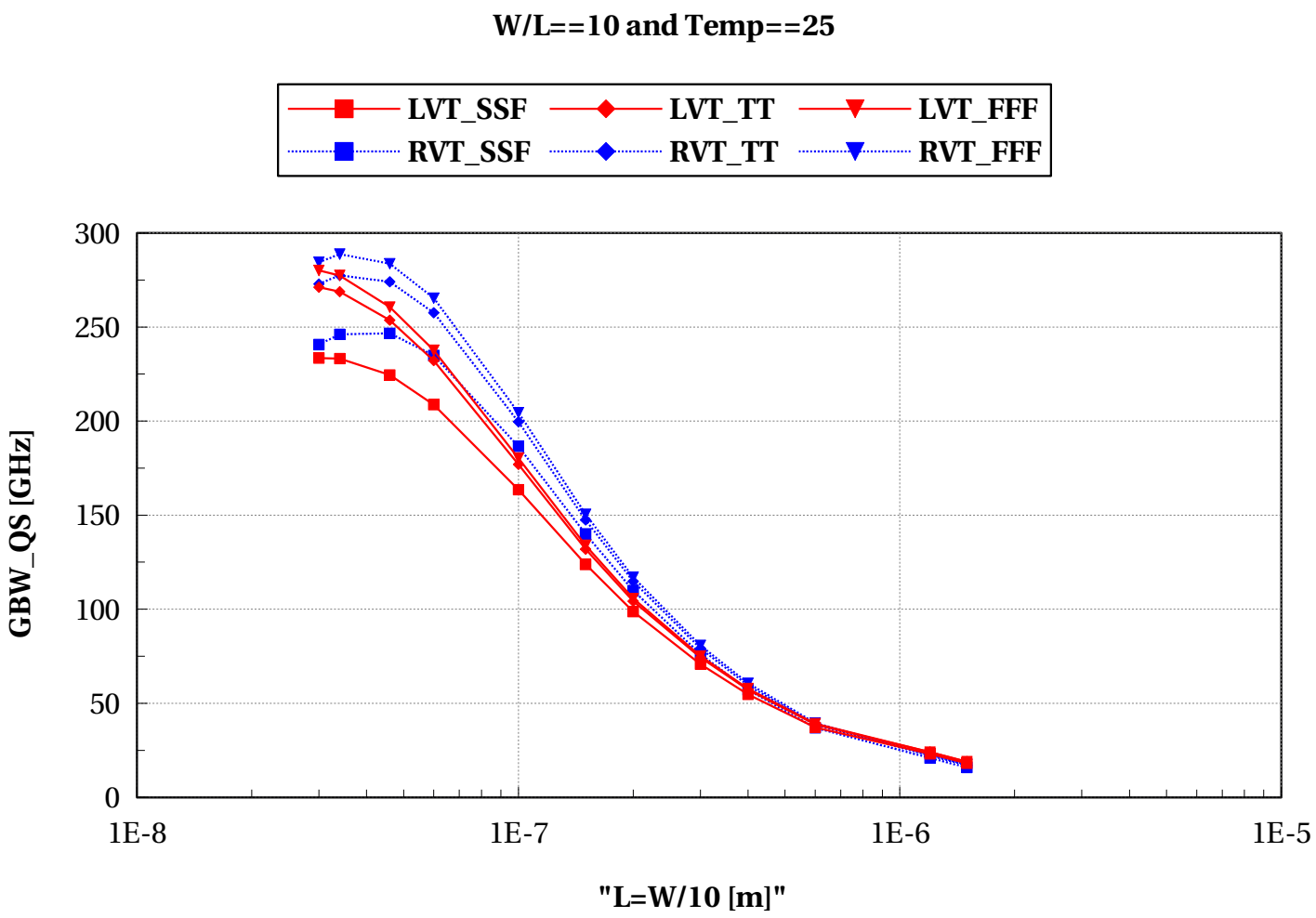
lvtnfet_acc, Vgs_ana [mV] vs "L=W/10 [m]"



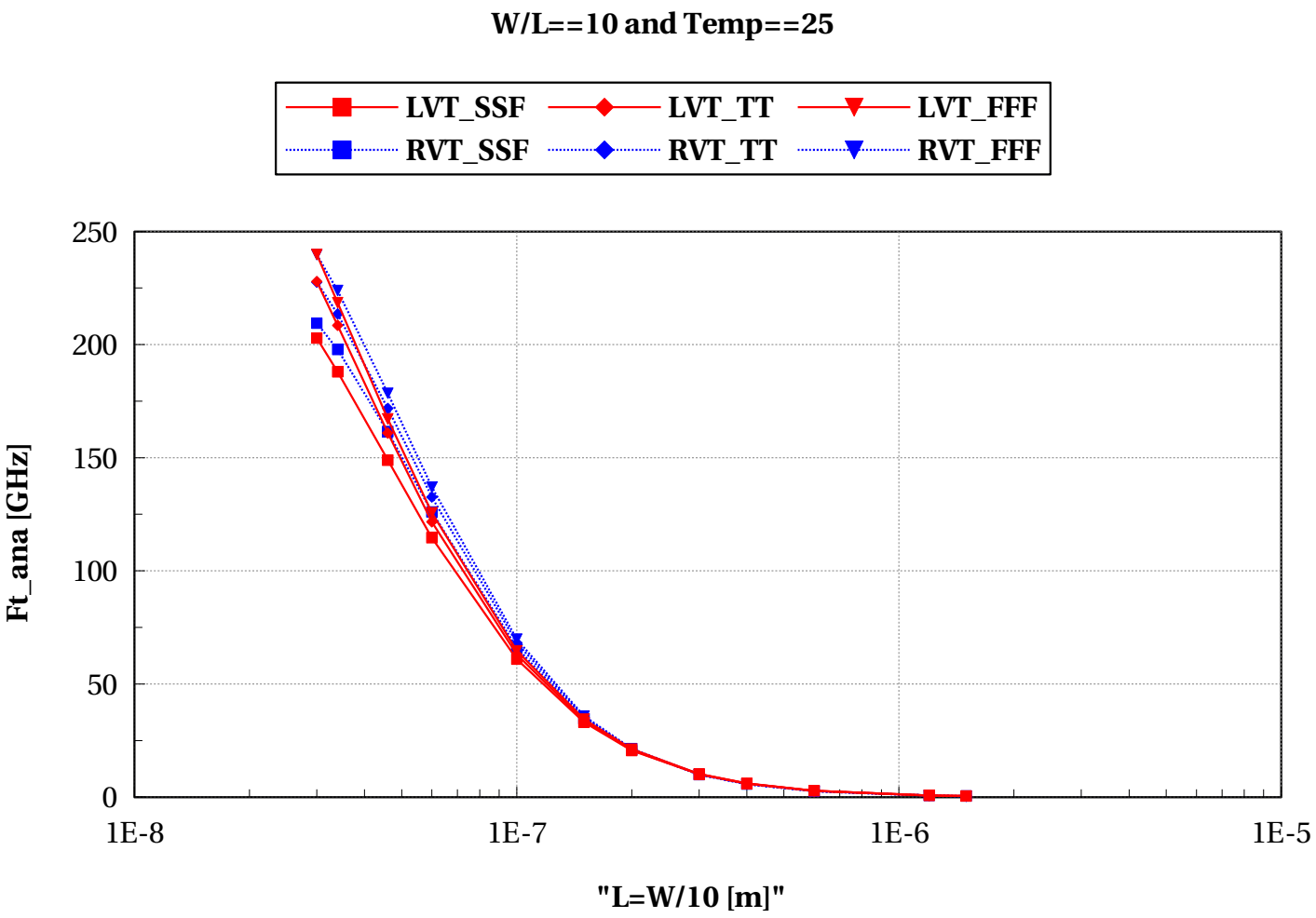
lvtnfet_acc, GDC_ana [] vs "L=W/10 [m]"



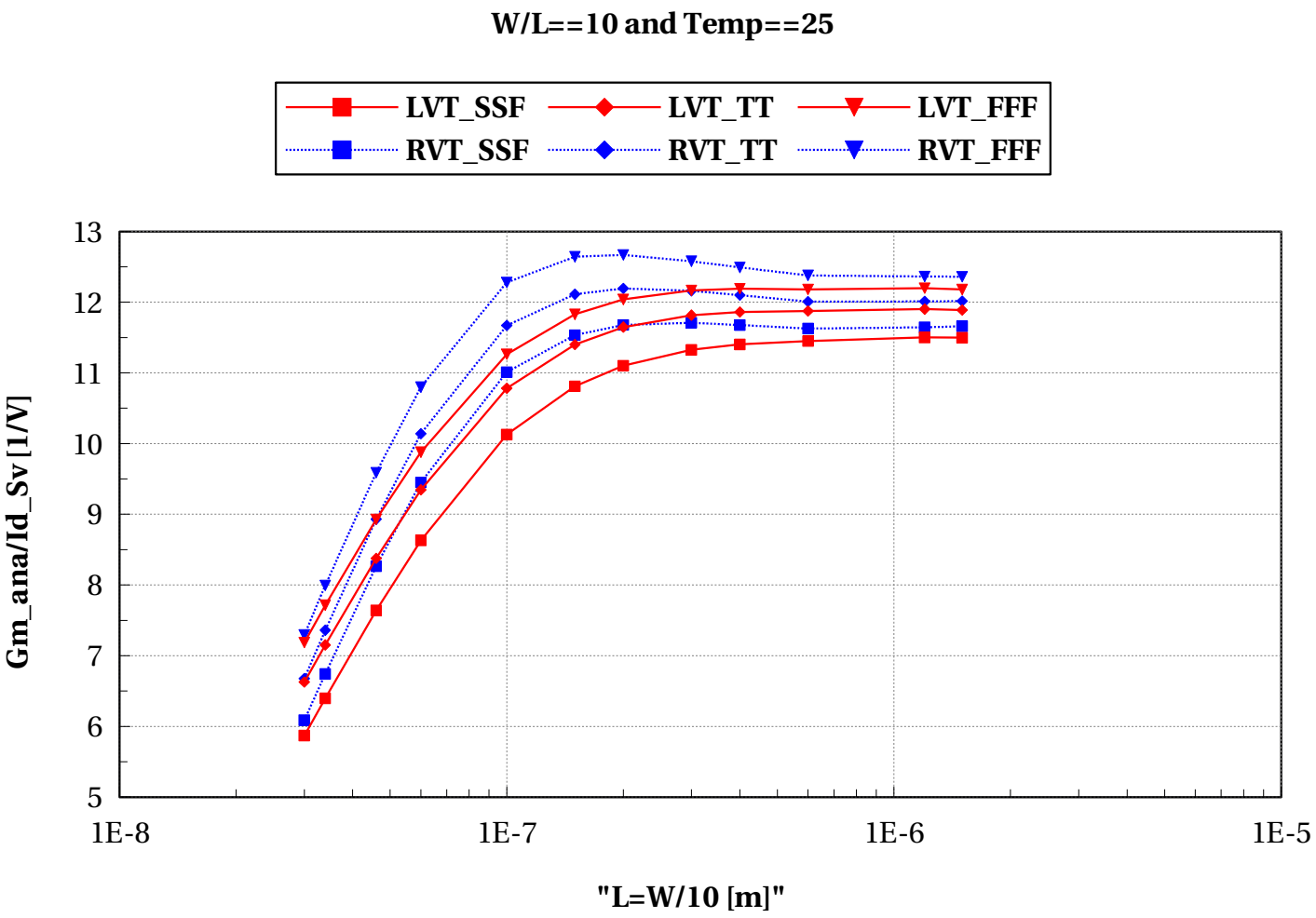
lvtnfet_acc, GBW_QS [GHz] vs "L=W/10 [m]"



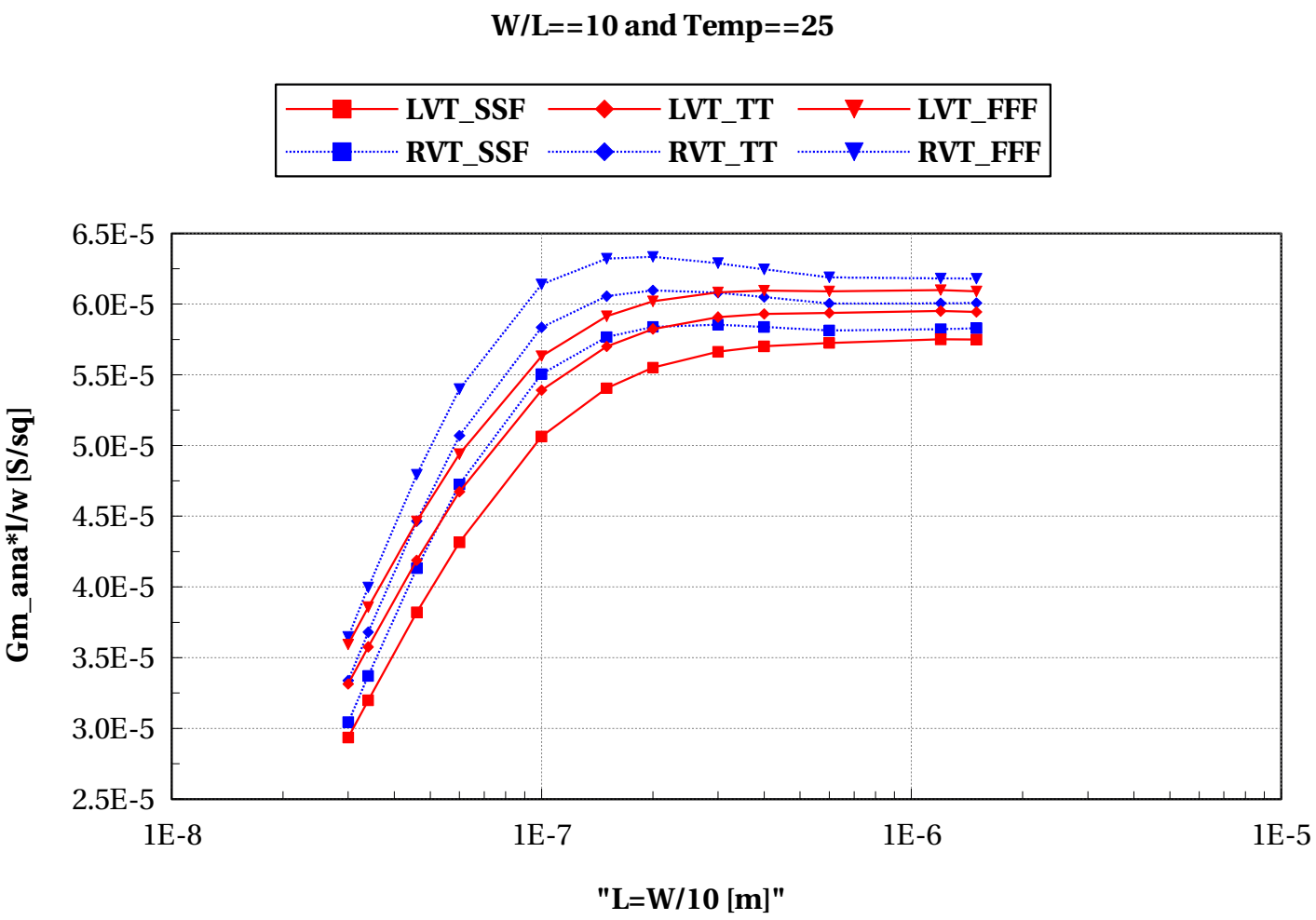
lvtnfet_acc, Ft_ana [GHz] vs "L=W/10 [m]"



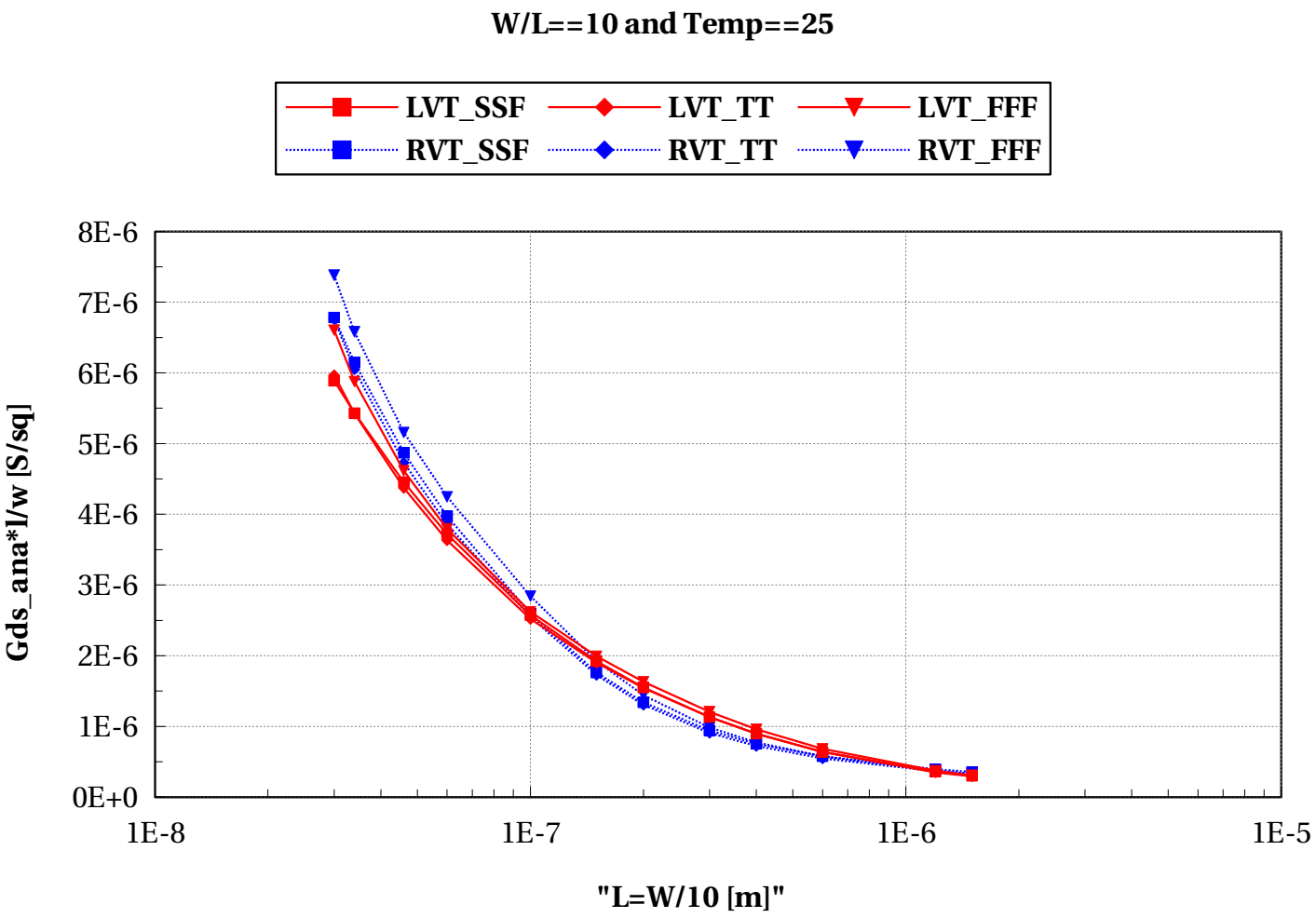
lvtnfet_acc, Gm_ana/Id_Sv [1/V] vs "L=W/10 [m]"



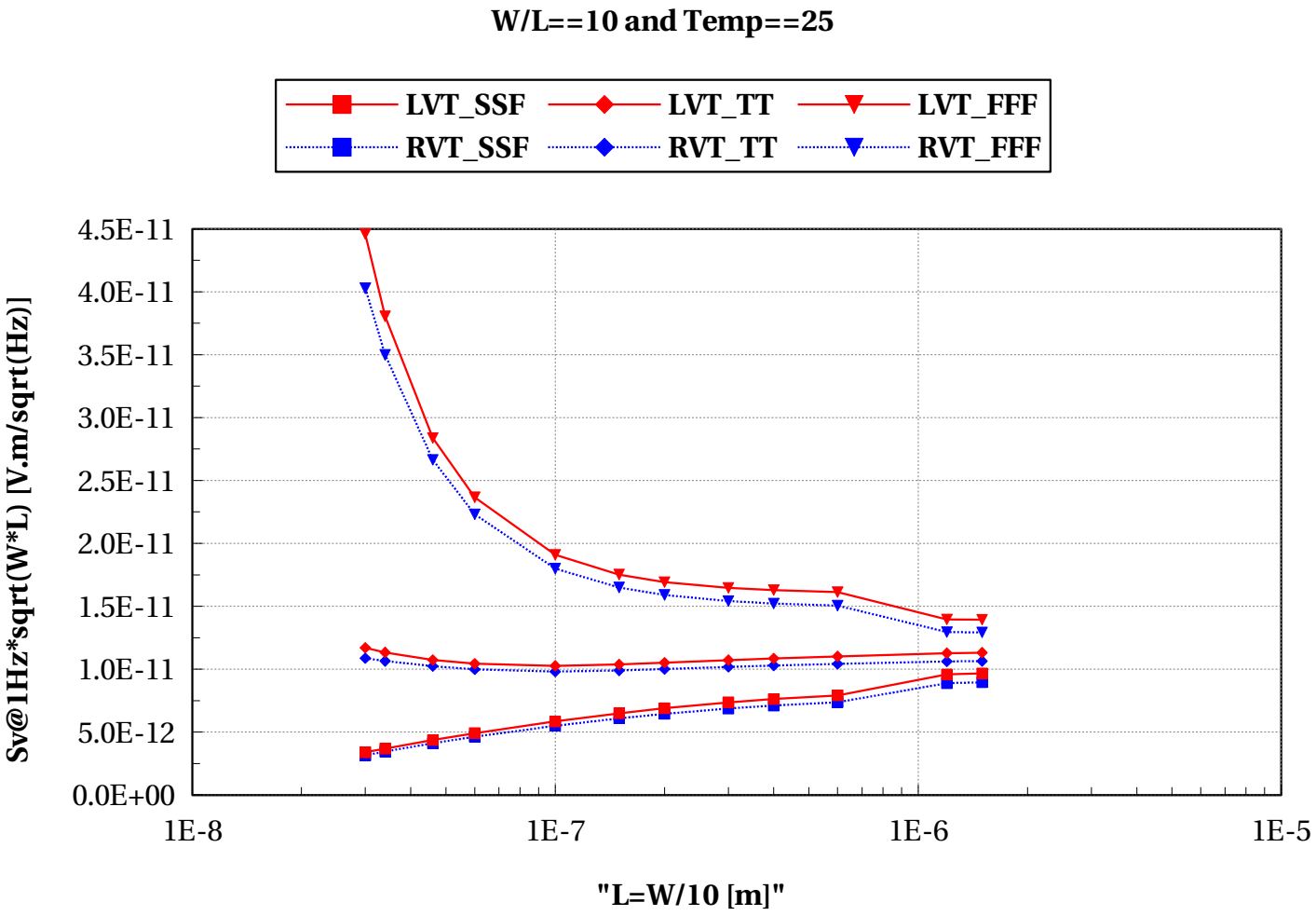
lvtnfet_acc, Gm_ana*l/w [S/sq] vs "L=W/10 [m]"



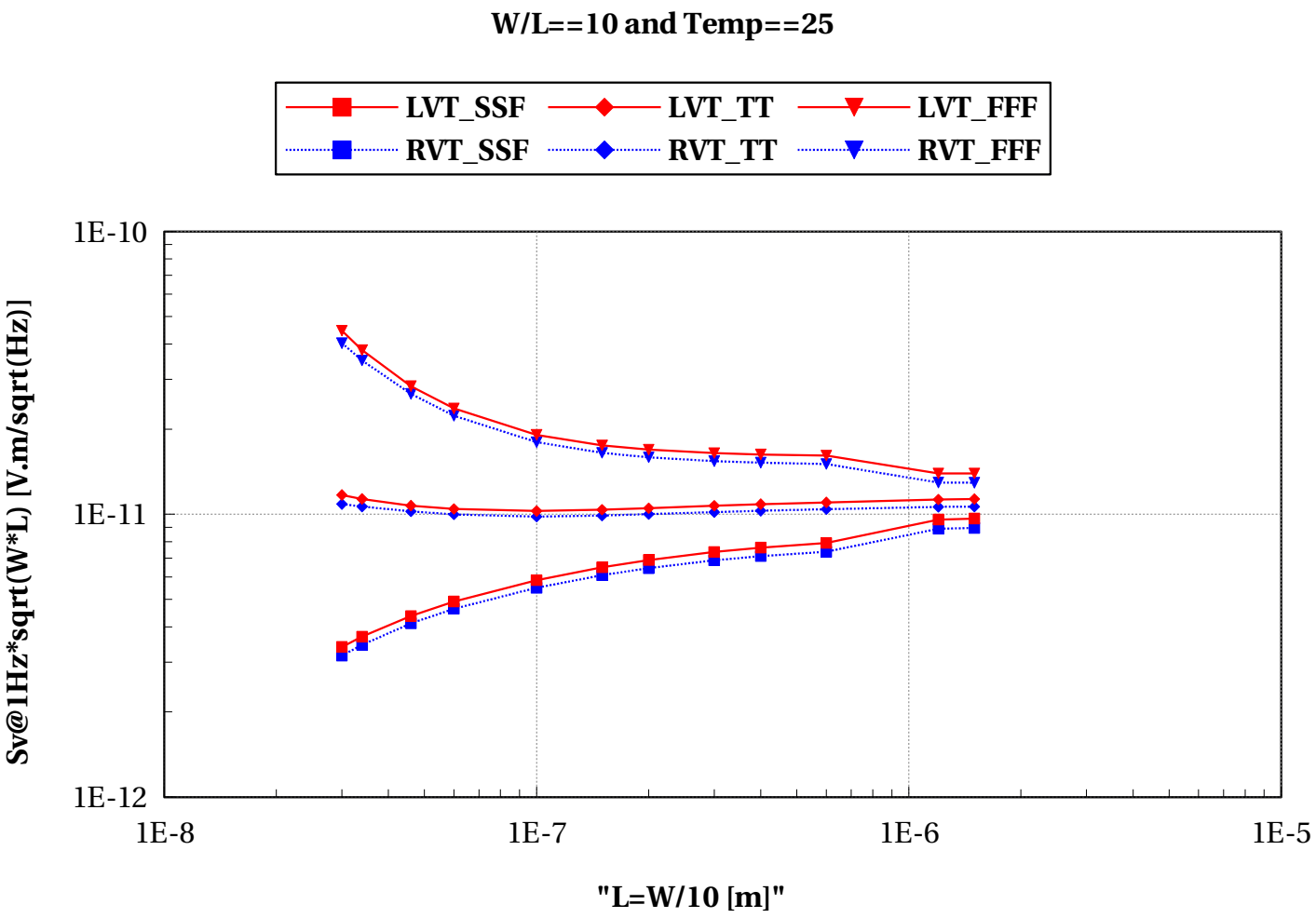
lvtnfet_acc, Gds_ana*l/w [S/sq] vs "L=W/10 [m]"



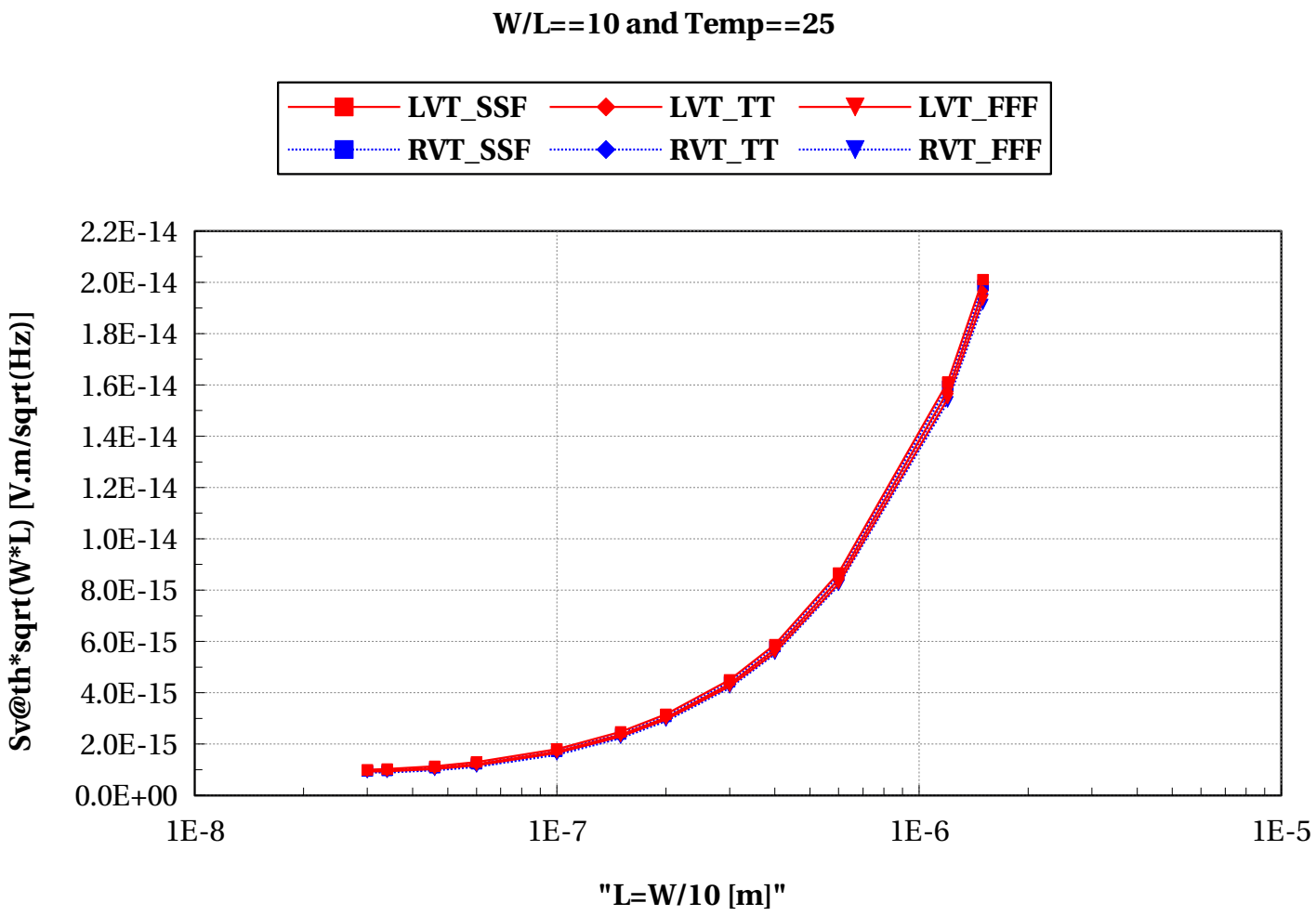
lvtnfet_acc, Sv@1Hz*sqrt(W*L) [V.m/sqrt(Hz)] vs "L=W/10 [m]"



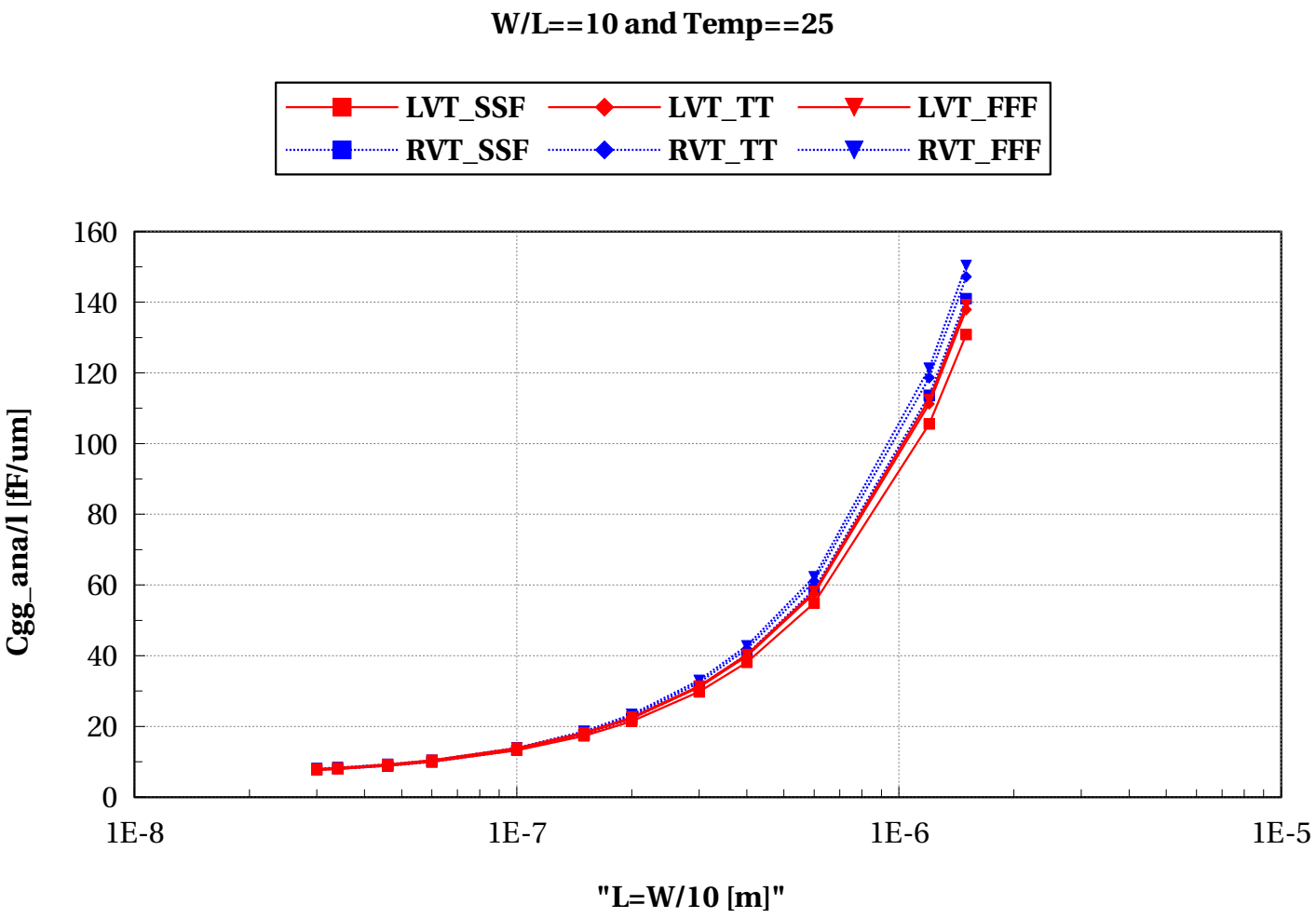
lvtnfet_acc, Sv@1Hz*sqrt(W*L) [V.m/sqrt(Hz)] vs "L=W/10 [m]"



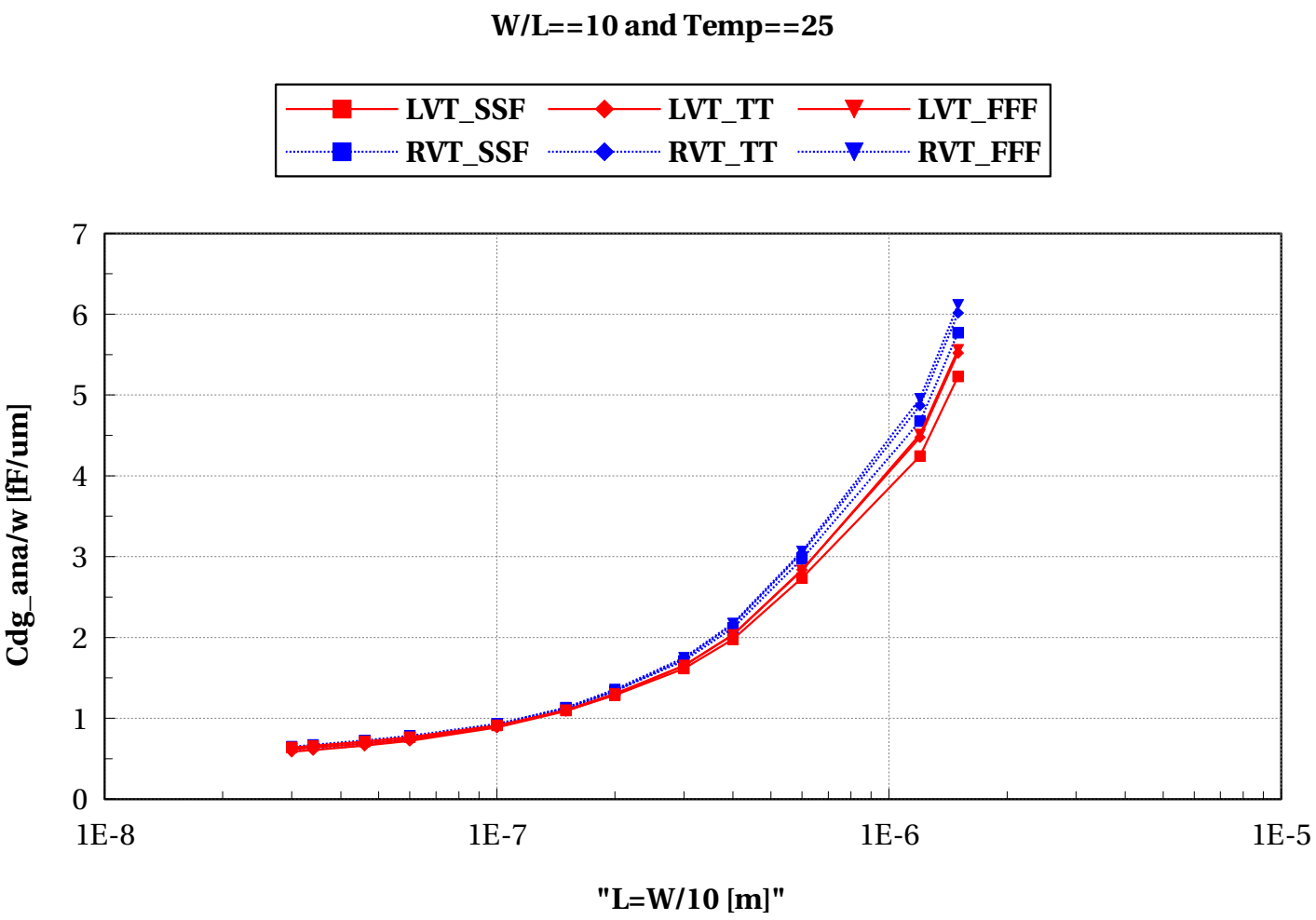
lvtnfet_acc, Sv@th*sqrt(W*L) [V.m/sqrt(Hz)] vs "L=W/10 [m]"



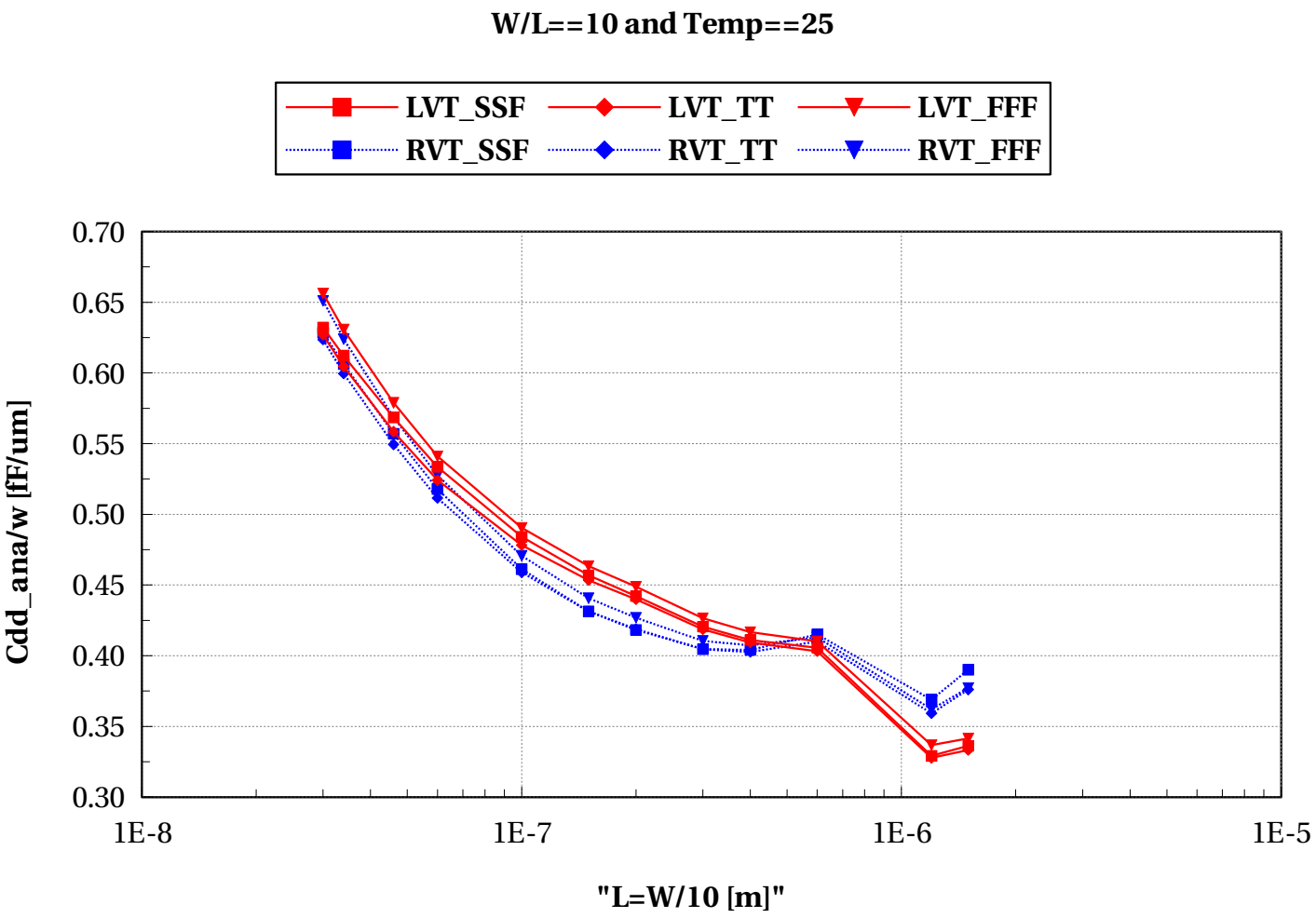
lvtnfet_acc, Cgg_ana/l [fF/um] vs "L=W/10 [m]"



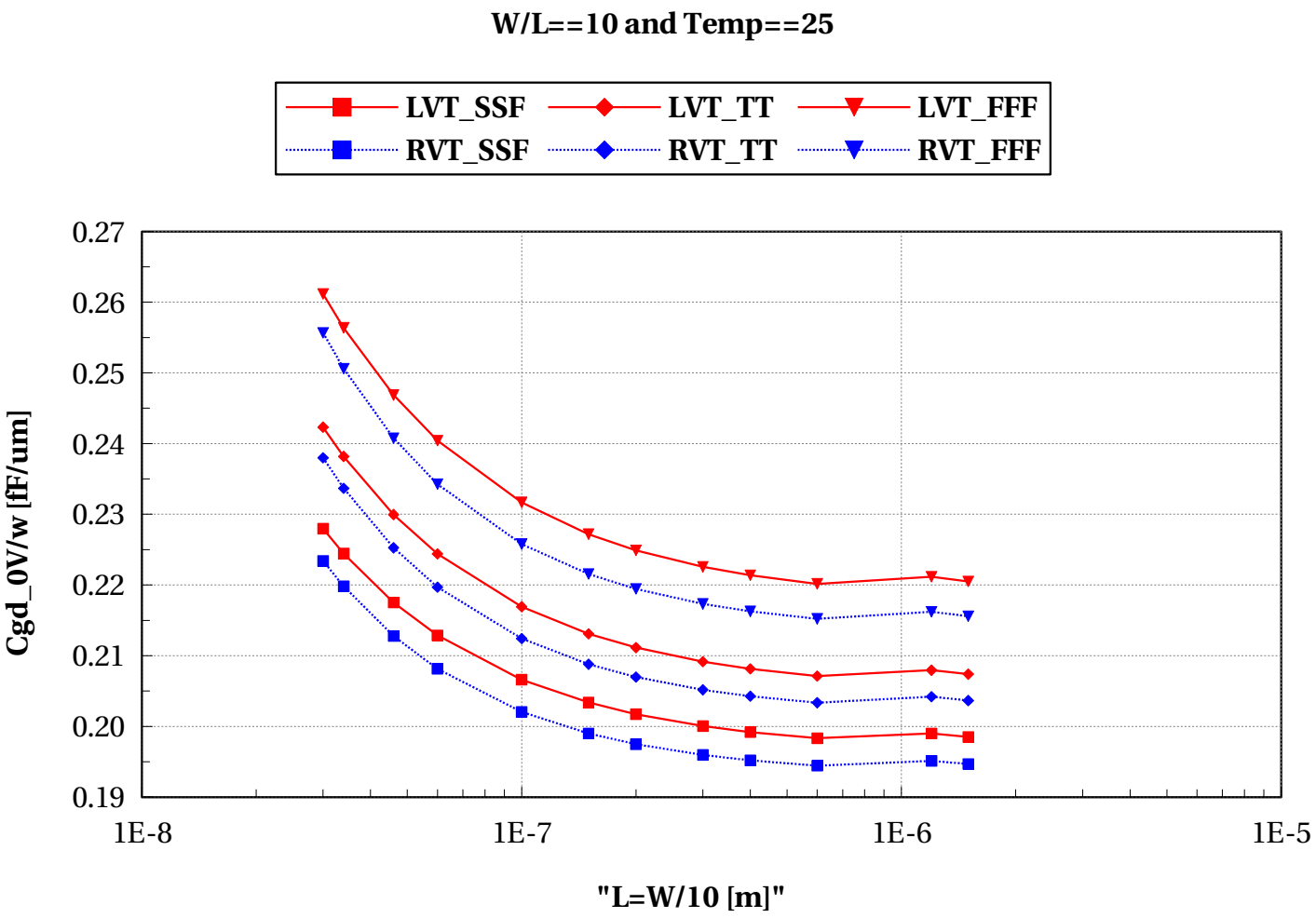
lvtnfet_acc, Cdg_ana/w [fF/um] vs "L=W/10 [m]"



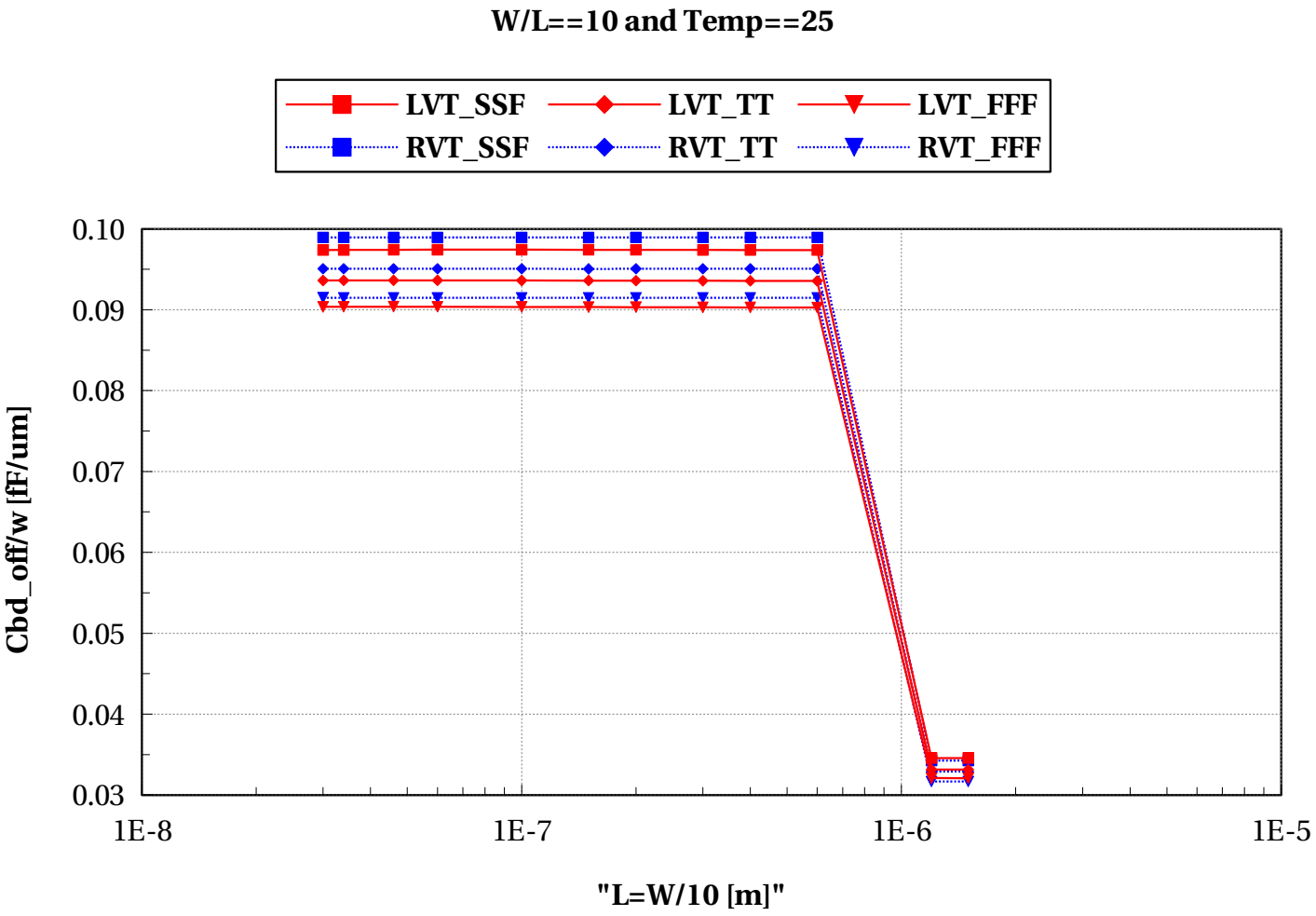
lvtnfet_acc, Cdd_ana/w [fF/um] vs "L=W/10 [m]"



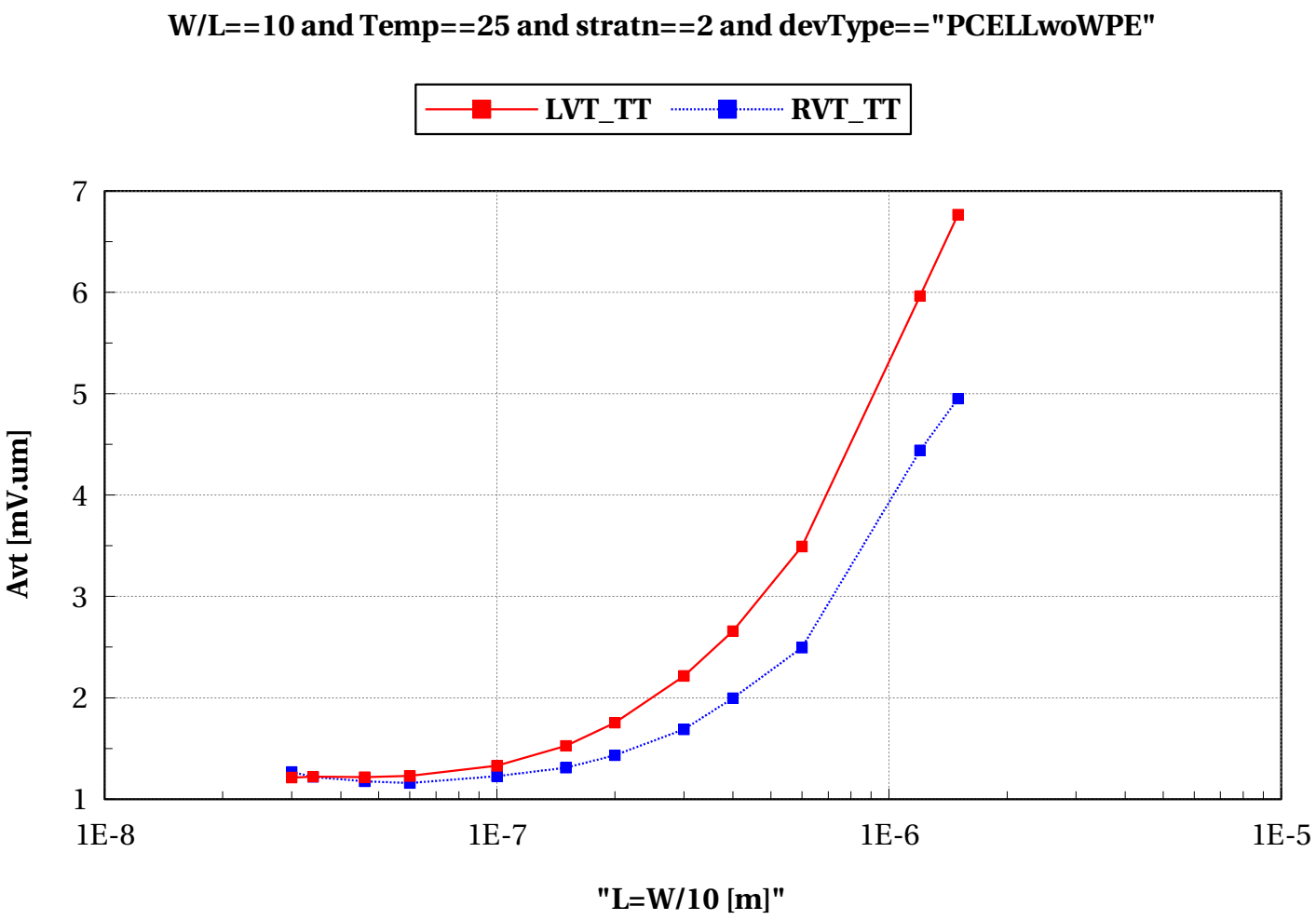
lvtnfet_acc, Cgd_0V/w [fF/um] vs "L=W/10 [m]"



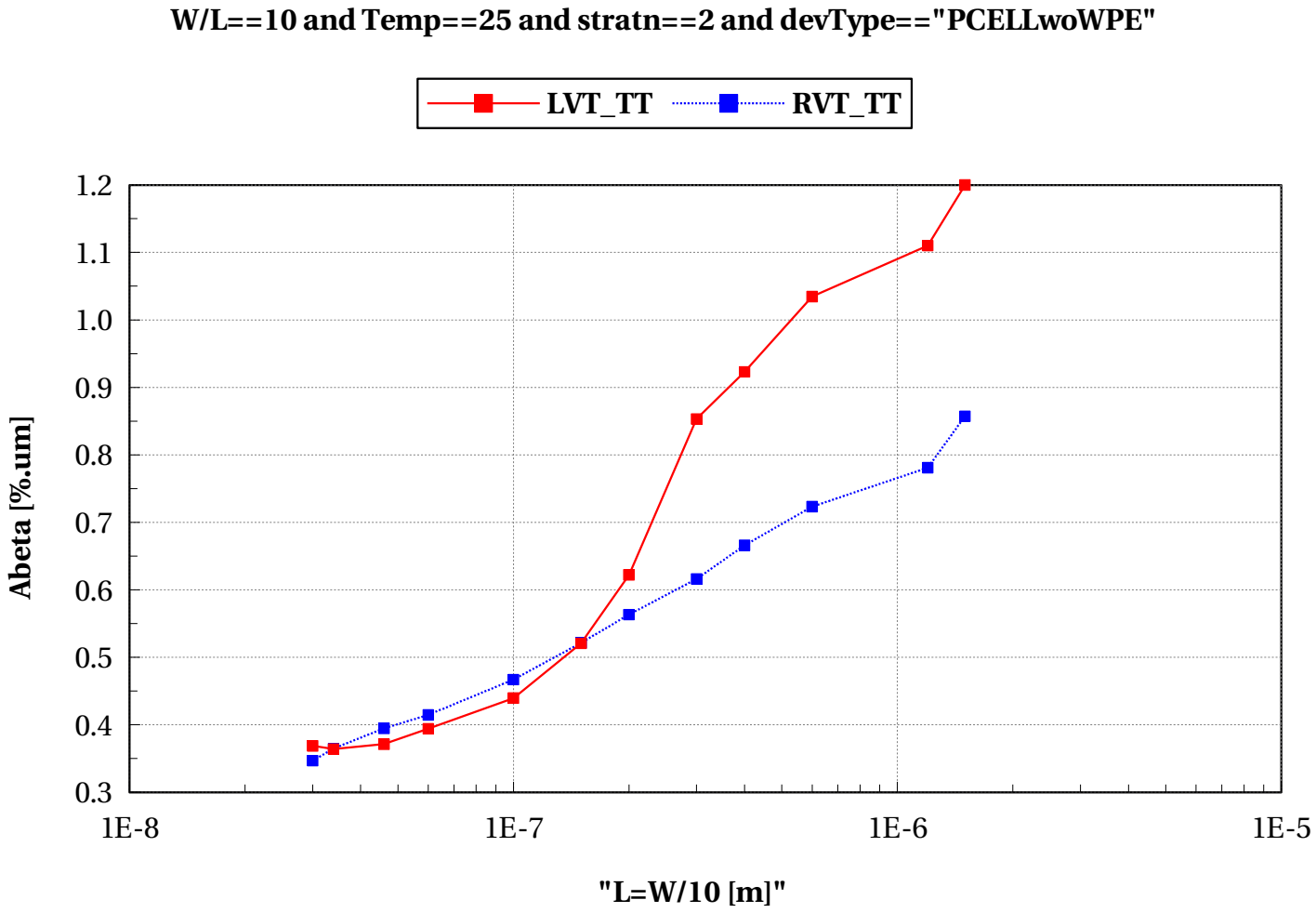
lvtnfet_acc, Cbd_off/w [fF/um] vs "L=W/10 [m]"



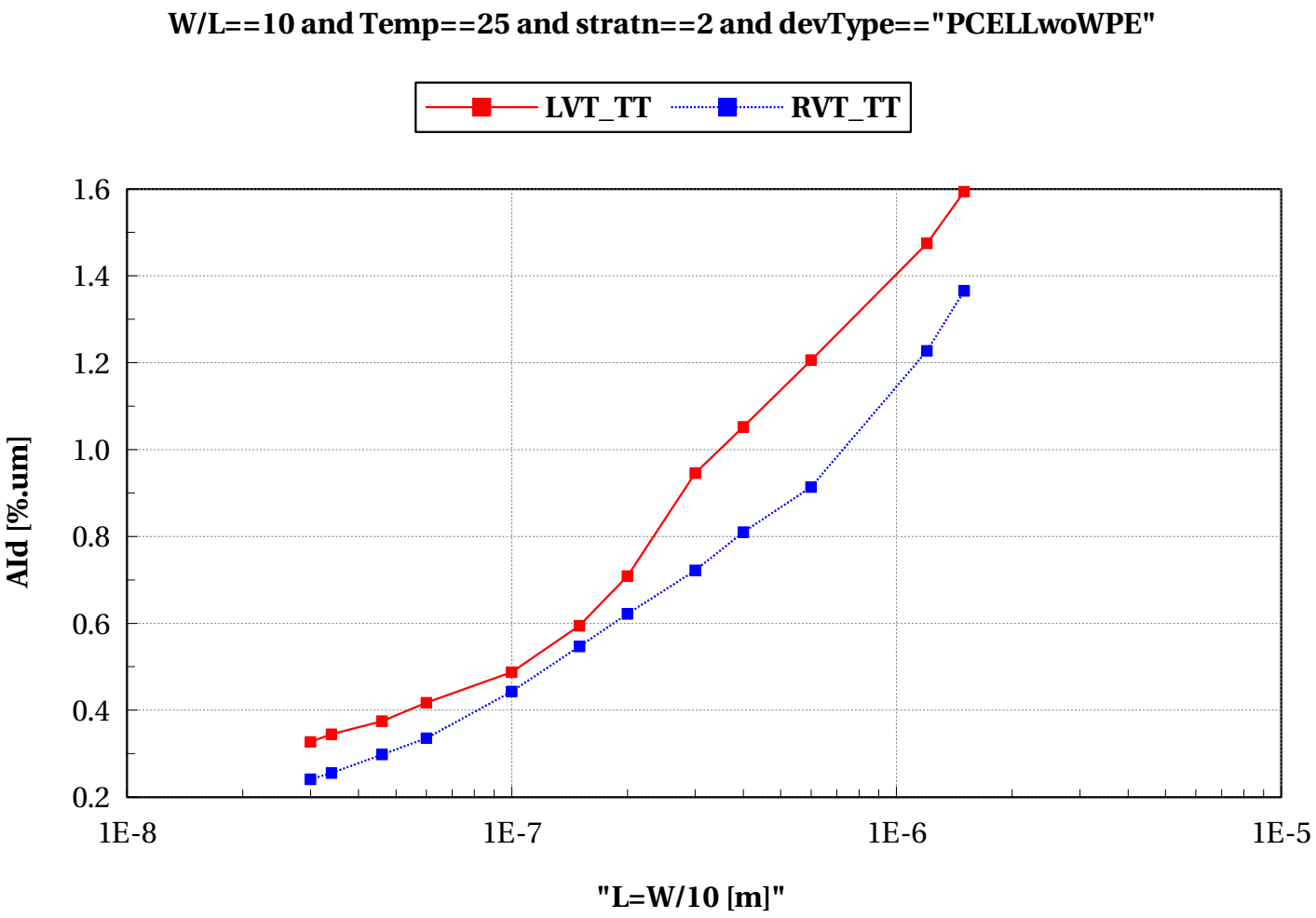
lvtnfet_acc, Avt [mV.um] vs "L=W/10 [m]"



lvtnfet_acc, Abeta [%.um] vs "L=W/10 [m]"



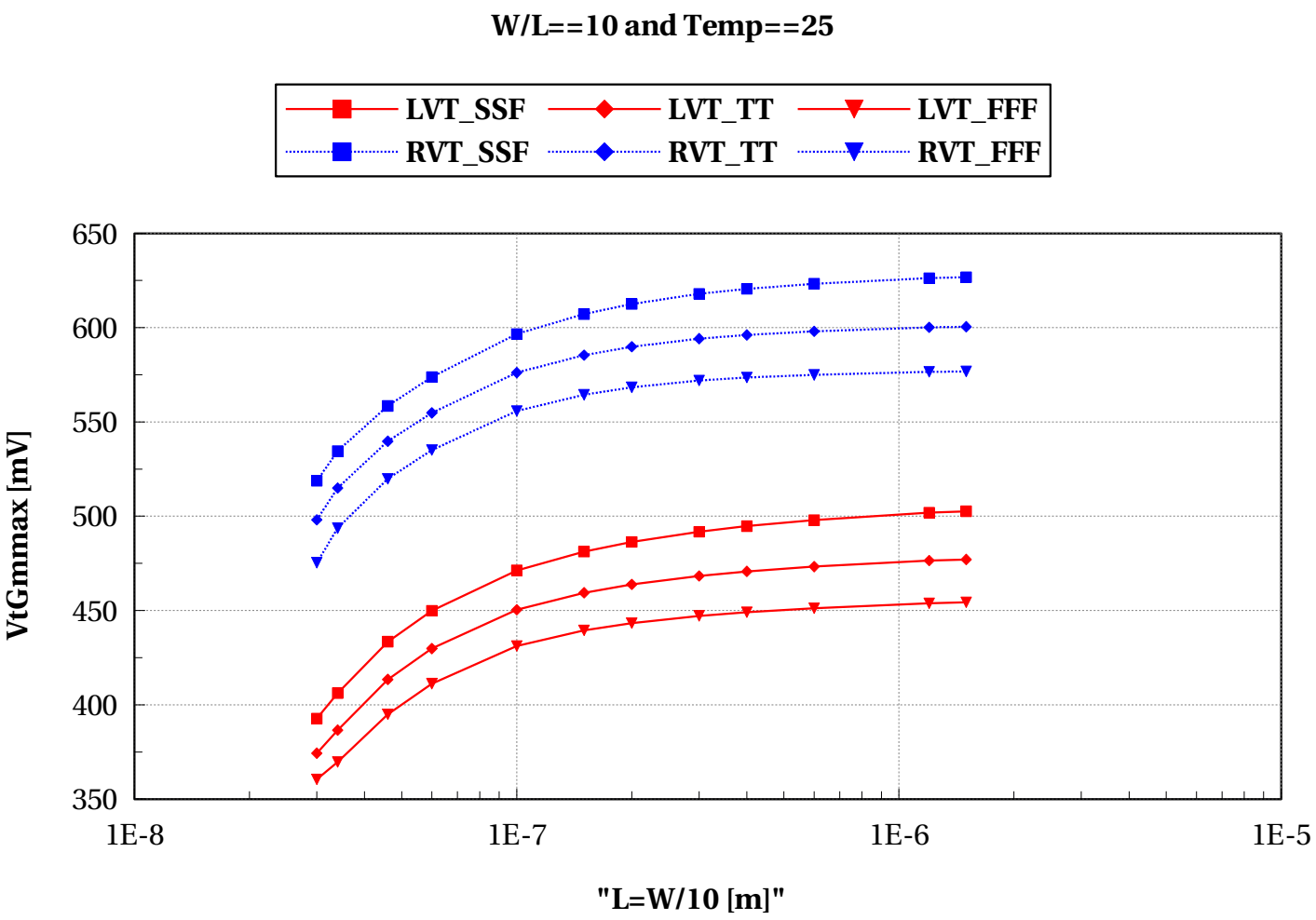
lvtnfet_acc, AId [%.um] vs "L=W/10 [m]"



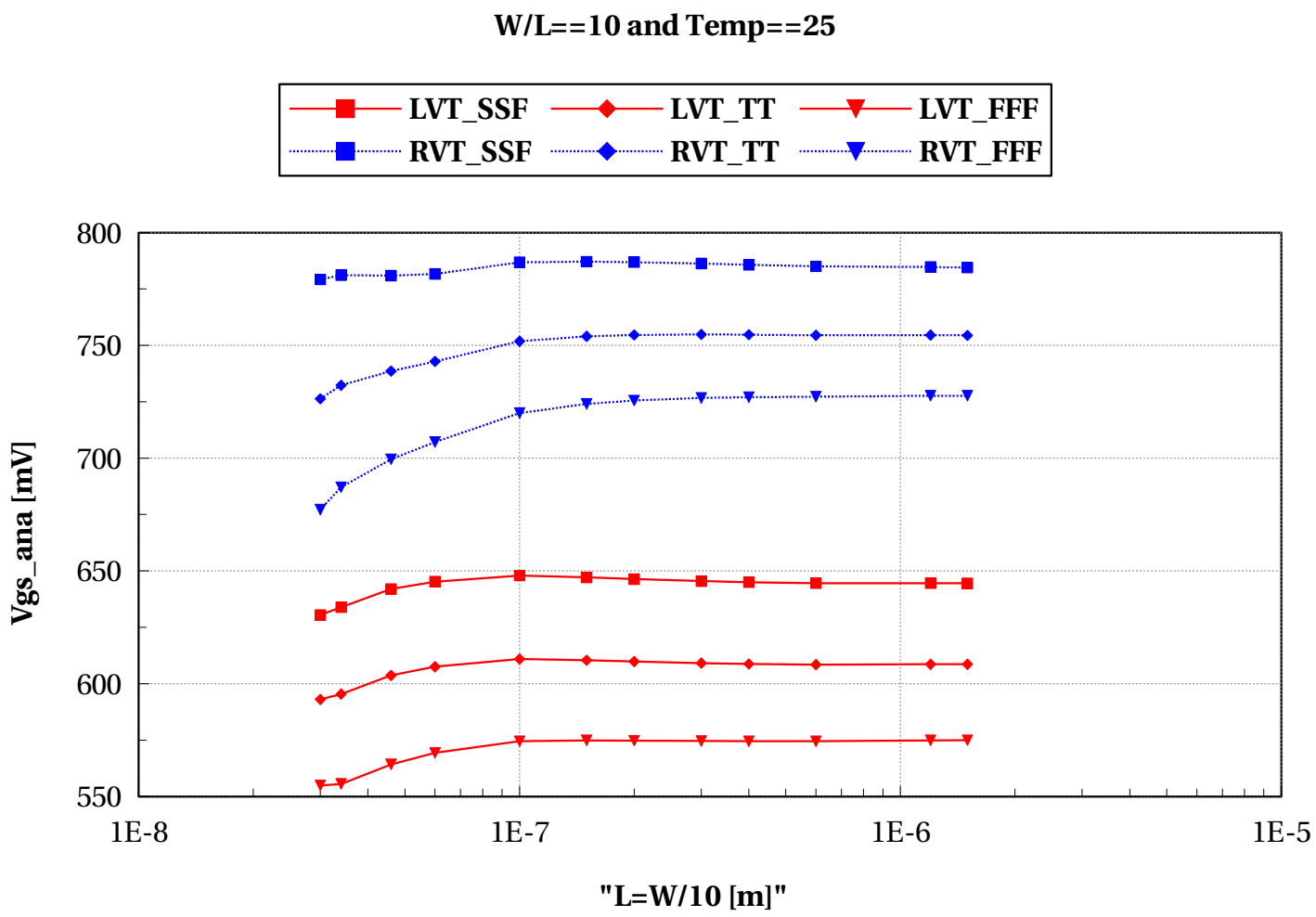
lvtpfet_acc
Electrical characteristics scaling

Scaling versus Length @ W/L=10 and W/NF<5e-6

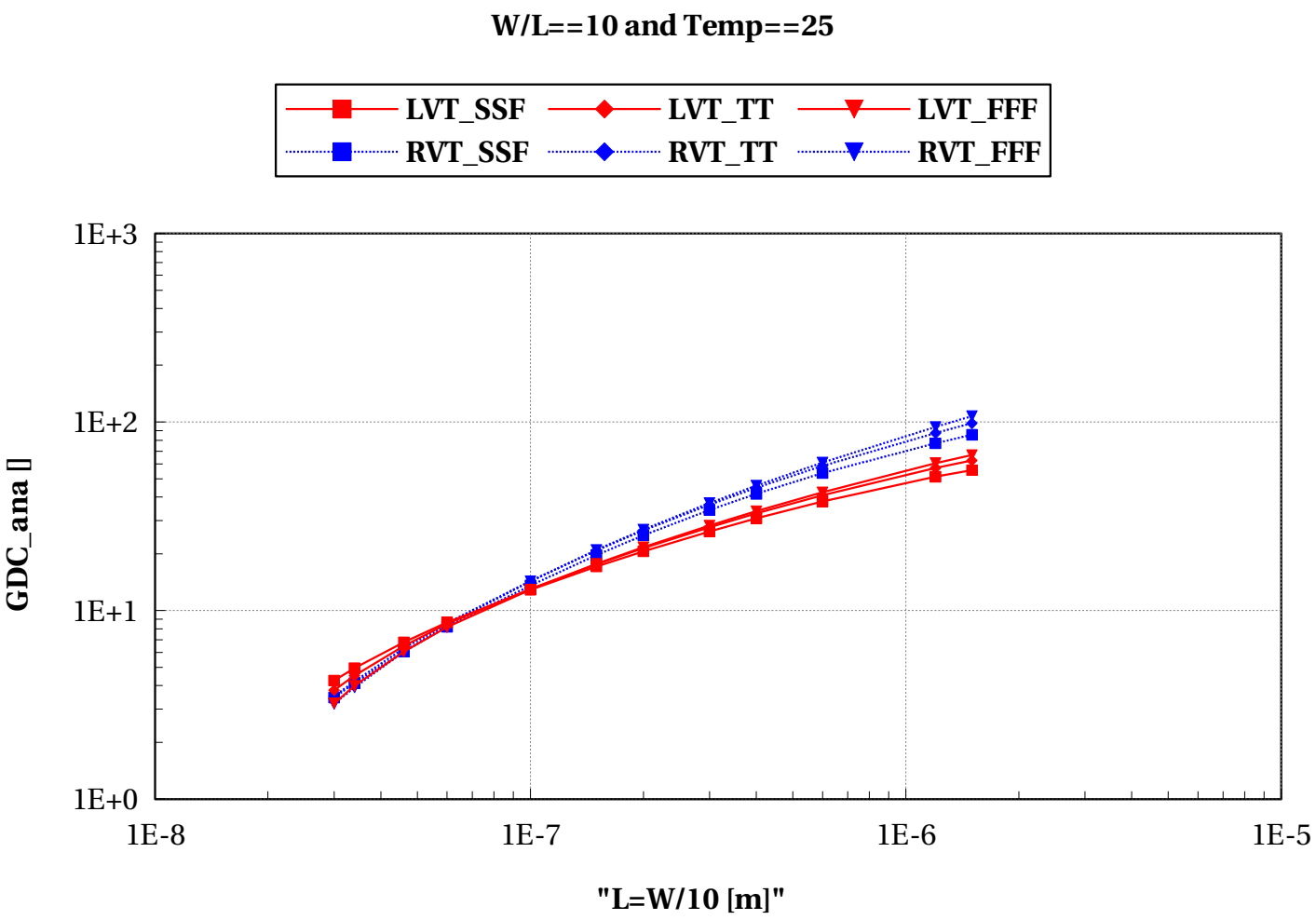
lvtpfet_acc, VtGmmax [mV] vs "L=W/10 [m]"



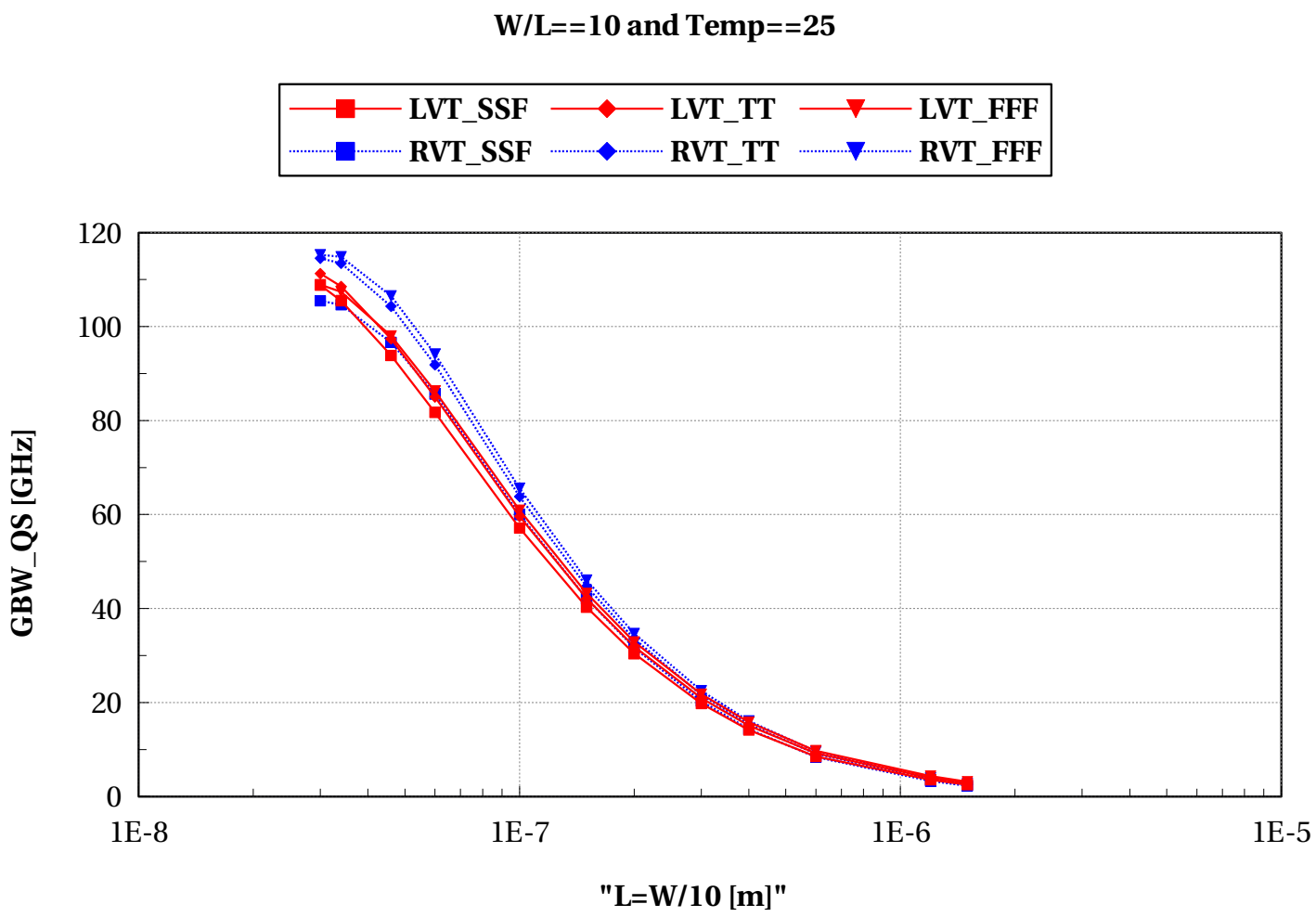
lvtpfet_acc, Vgs_ana [mV] vs "L=W/10 [m]"



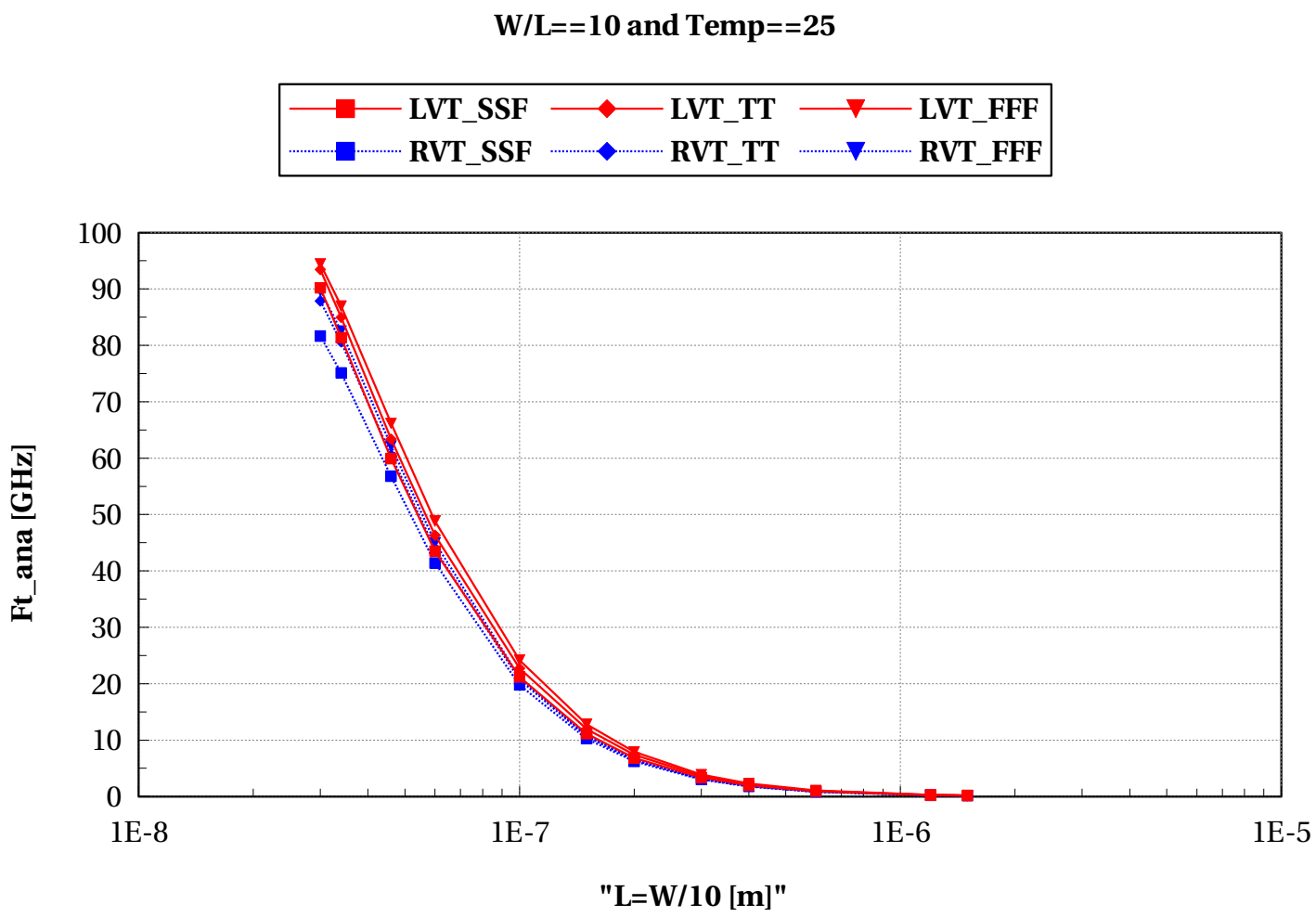
lvtpfet_acc, GDC_ana [] vs "L=W/10 [m]"



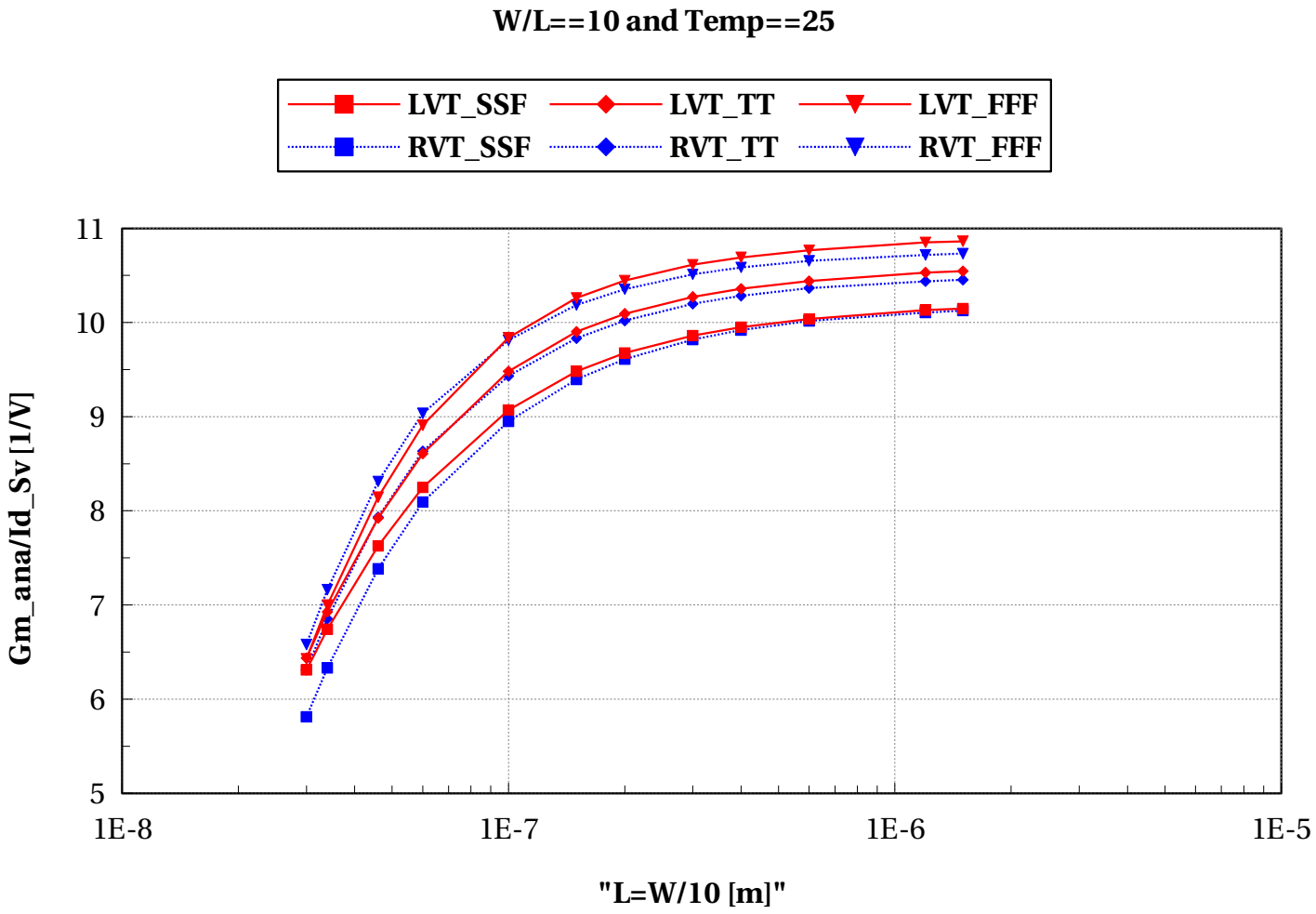
lvtpfet_acc, GBW_QS [GHz] vs "L=W/10 [m]"



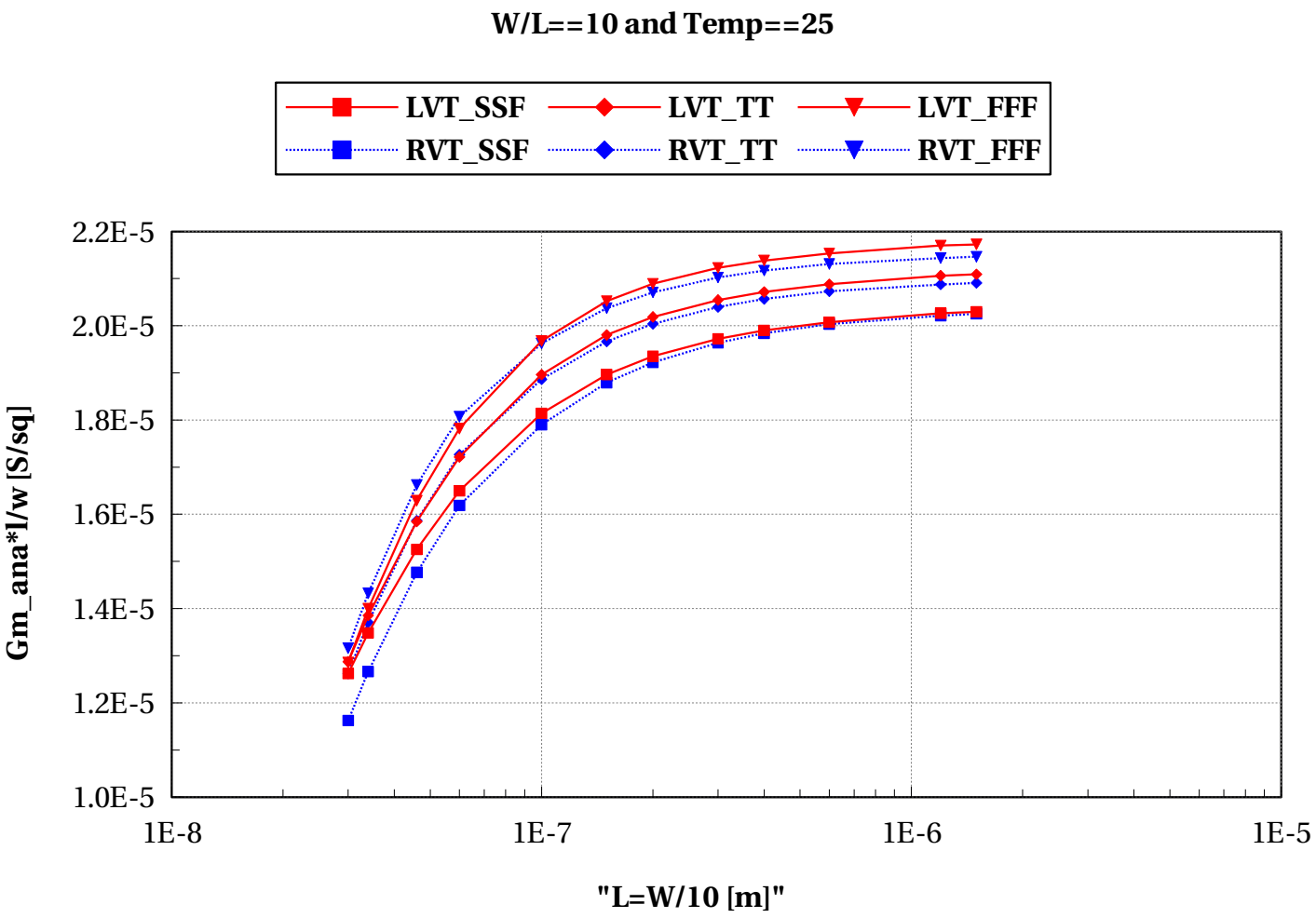
lvtpfet_acc, Ft_ana [GHz] vs "L=W/10 [m]"



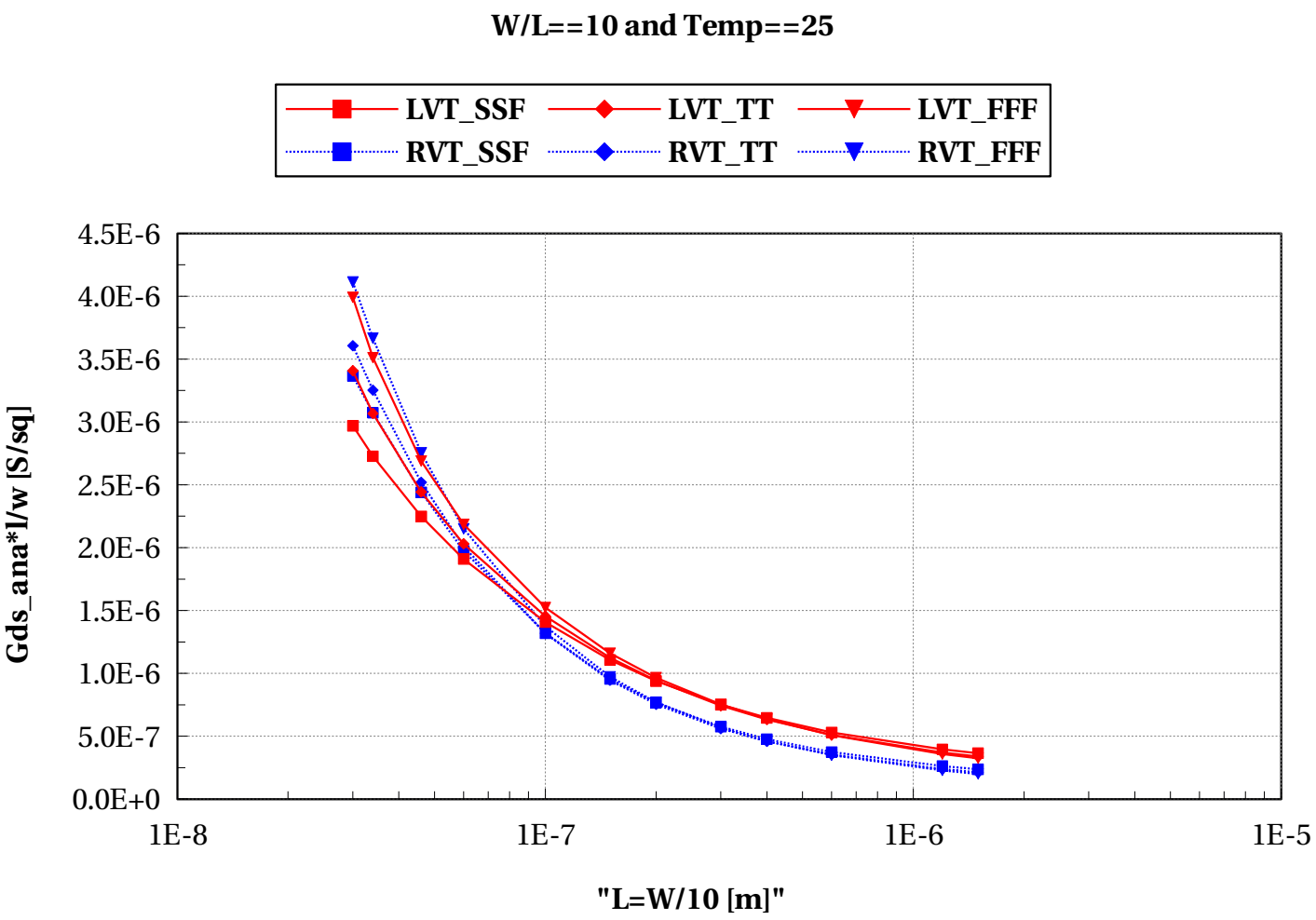
lvtpfet_acc, Gm_ana/Id_Sv [1/V] vs "L=W/10 [m]"



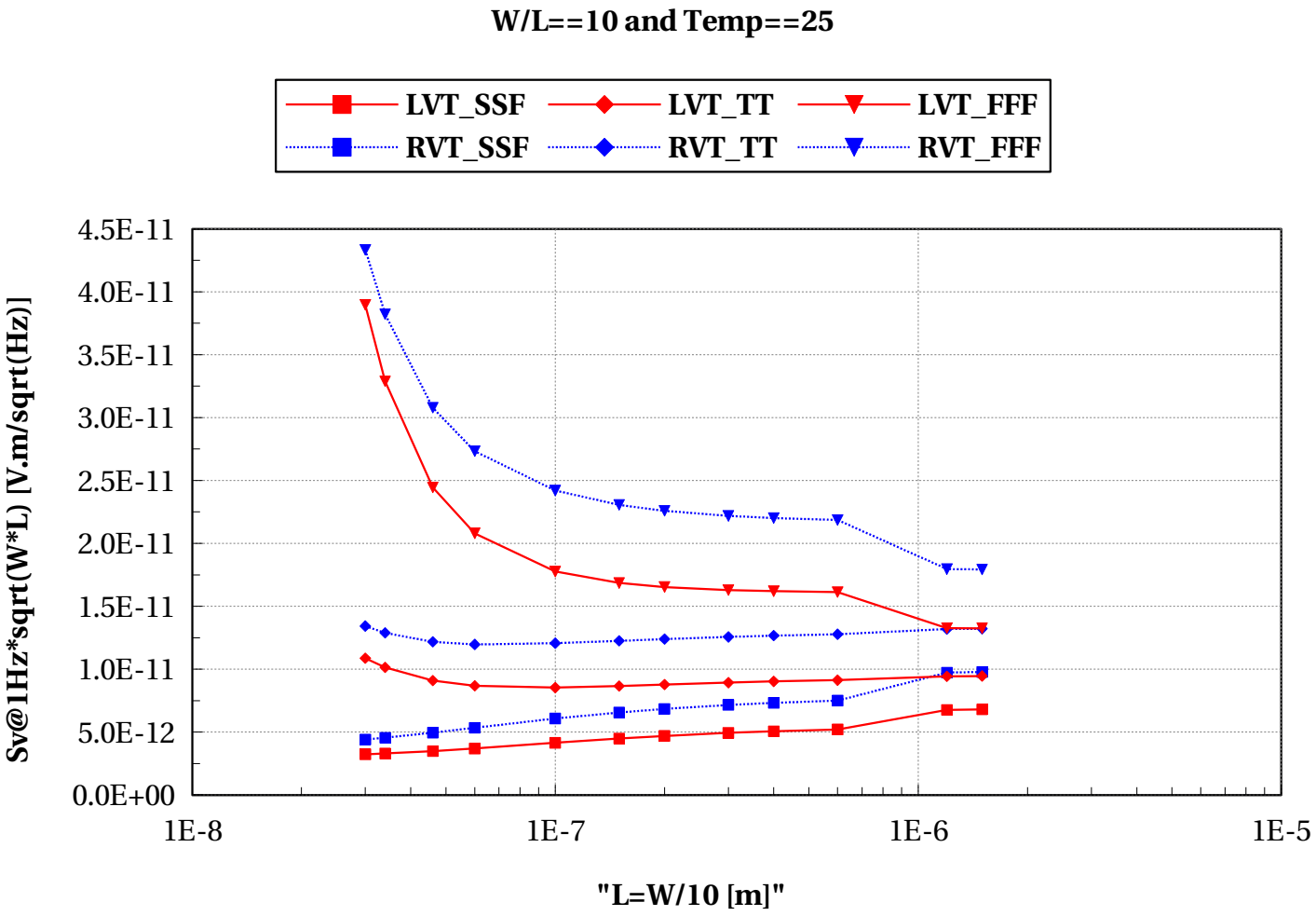
lvtpfet_acc, Gm_ana*l/w [S/sq] vs "L=W/10 [m]"



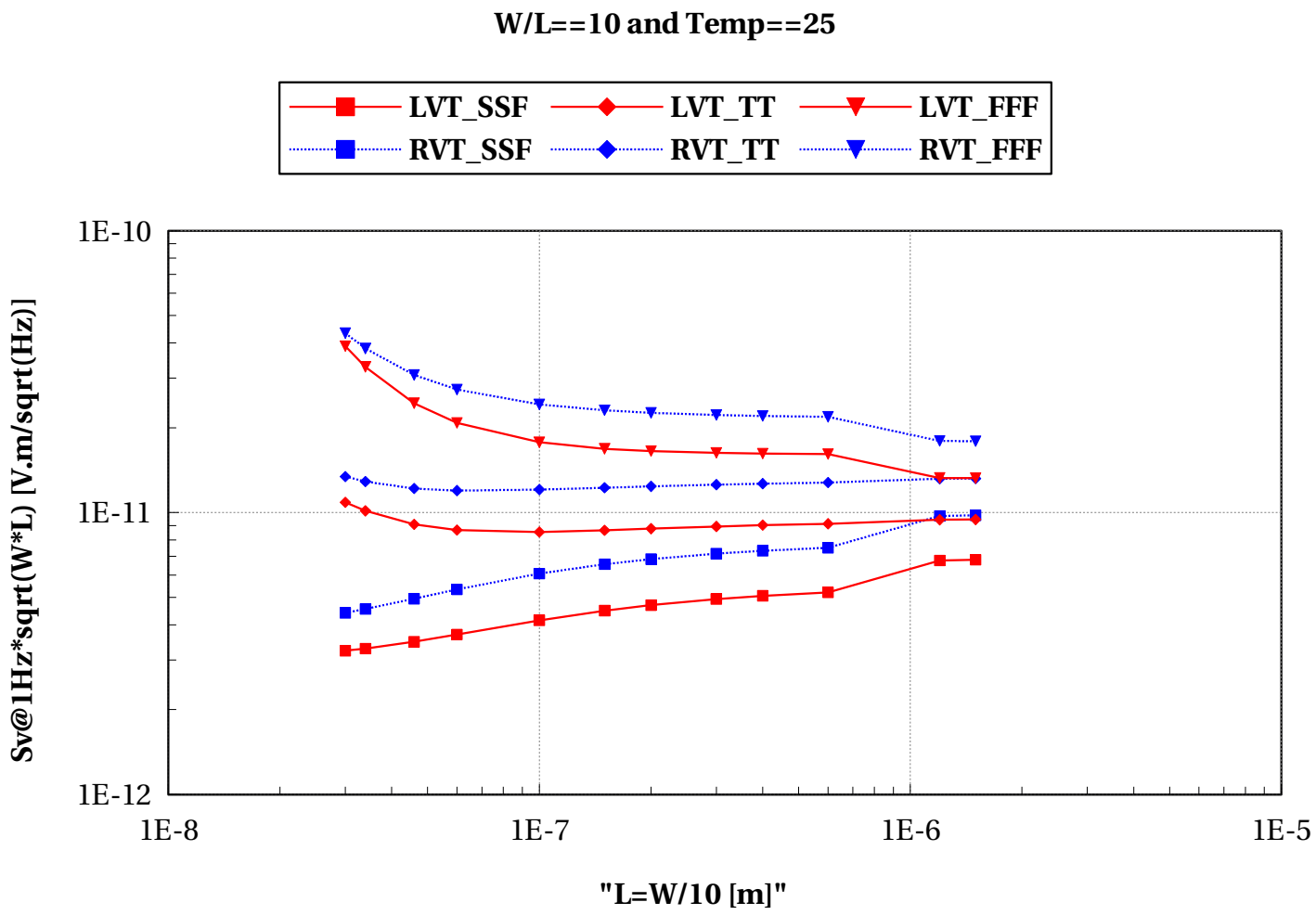
lvtpfet_acc, Gds_ana*l/w [S/sq] vs "L=W/10 [m]"



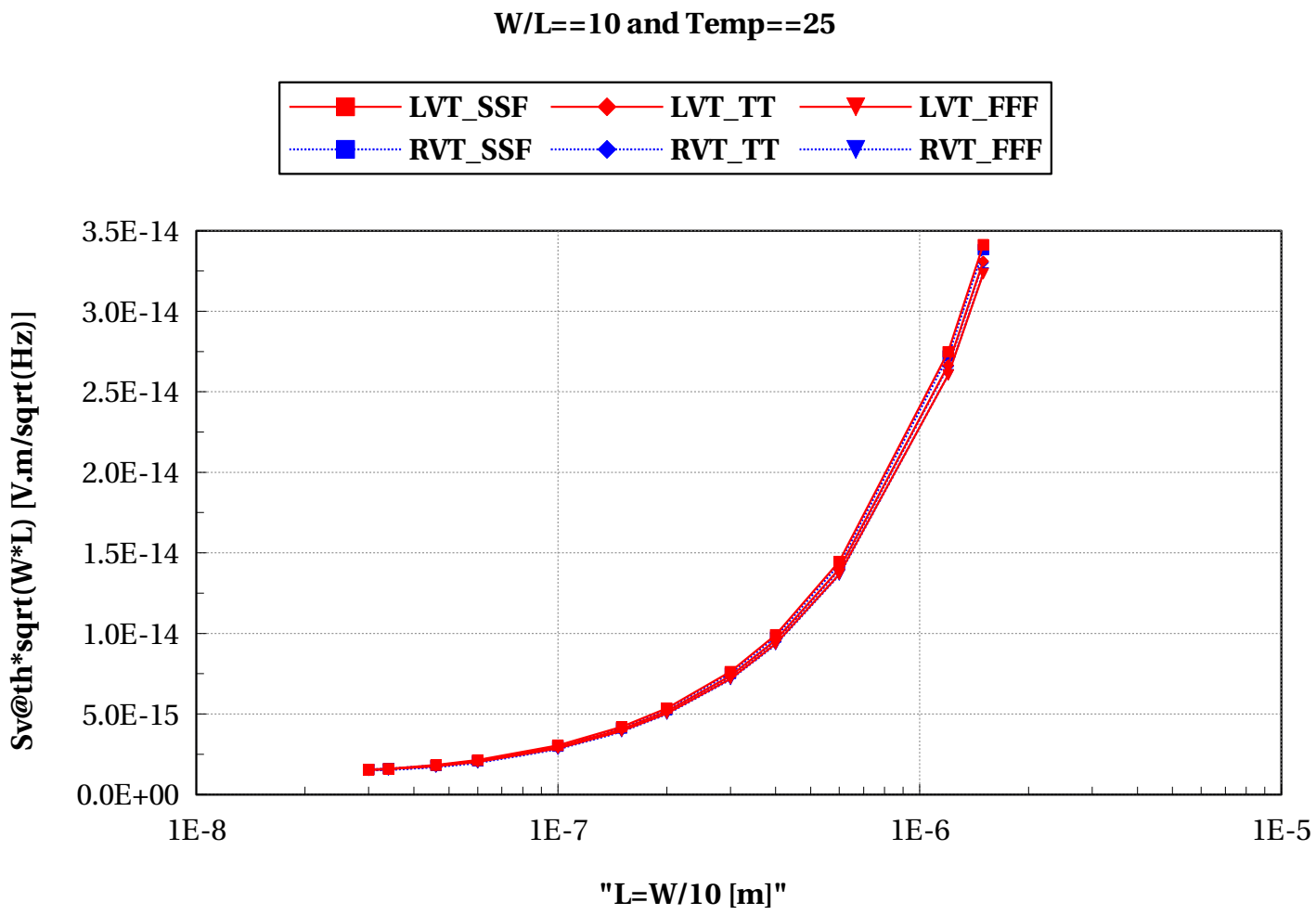
lvtpfet_acc, Sv@1Hz*sqrt(W*L) [V.m/sqrt(Hz)] vs "L=W/10 [m]"



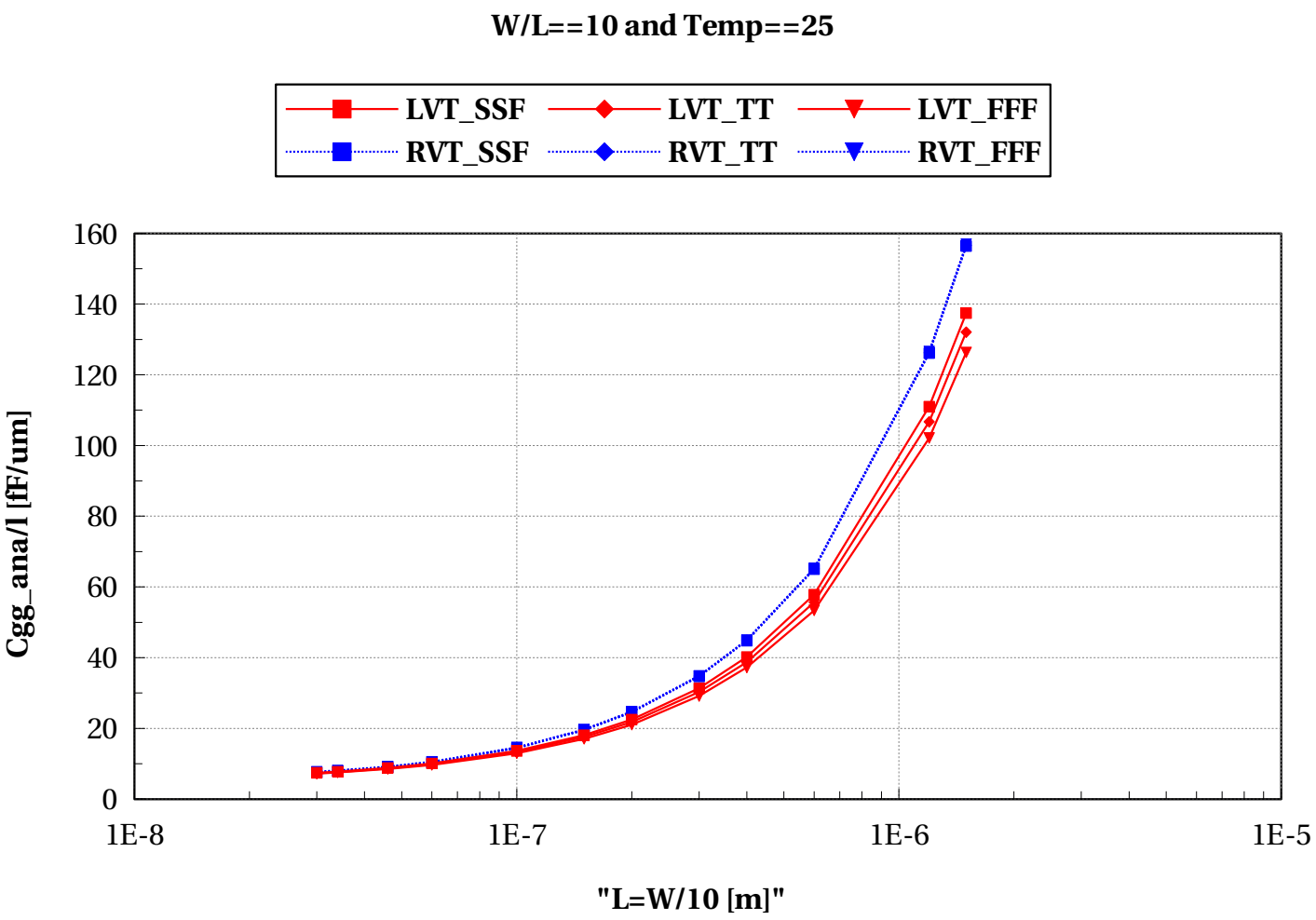
lvtpfet_acc, Sv@1Hz*sqrt(W*L) [V.m/sqrt(Hz)] vs "L=W/10 [m]"



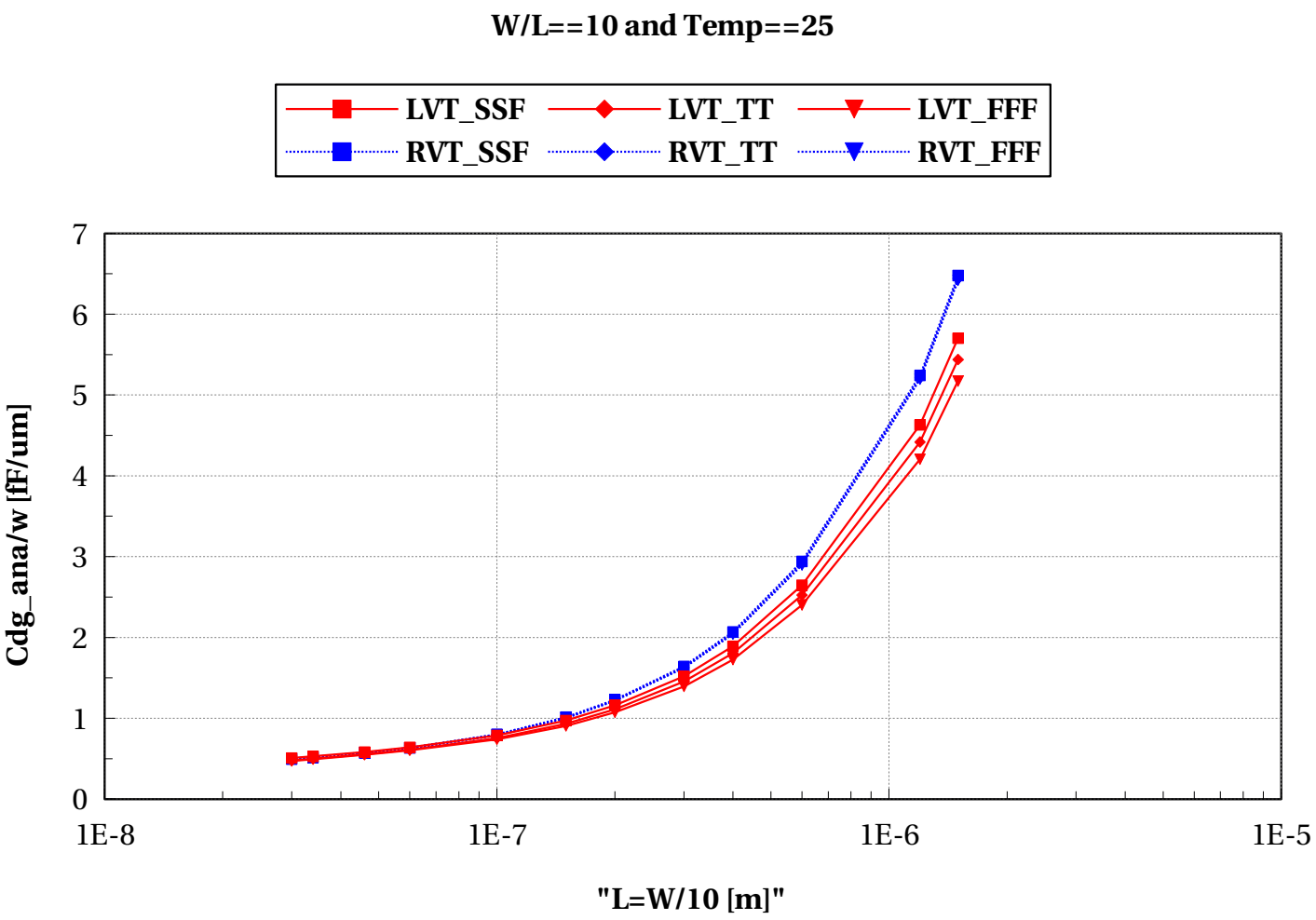
lvtpfet_acc, Sv@th*sqrt(W*L) [V.m/sqrt(Hz)] vs "L=W/10 [m]"



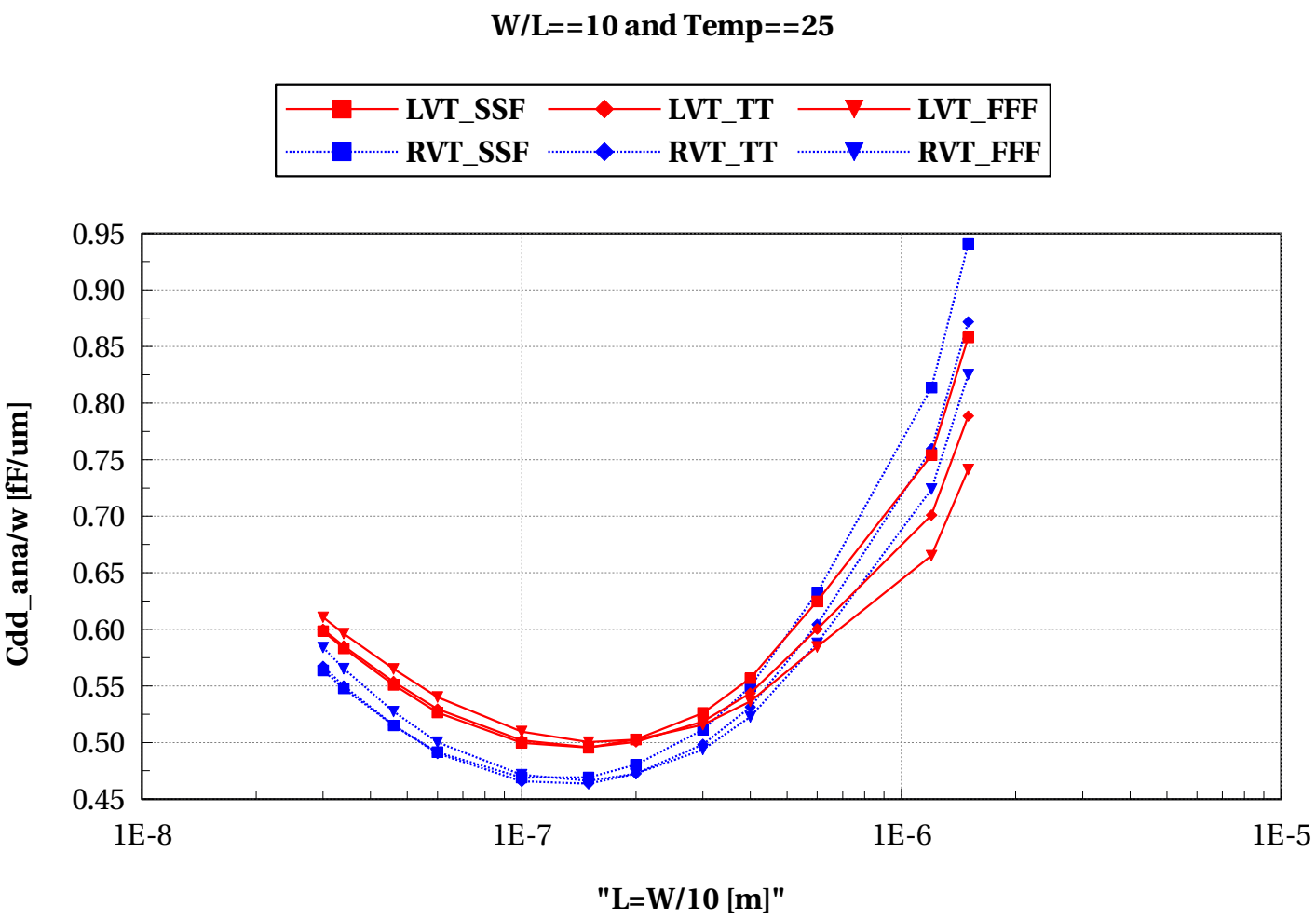
lvtpfet_acc, Cgg_ana/l [fF/um] vs "L=W/10 [m]"



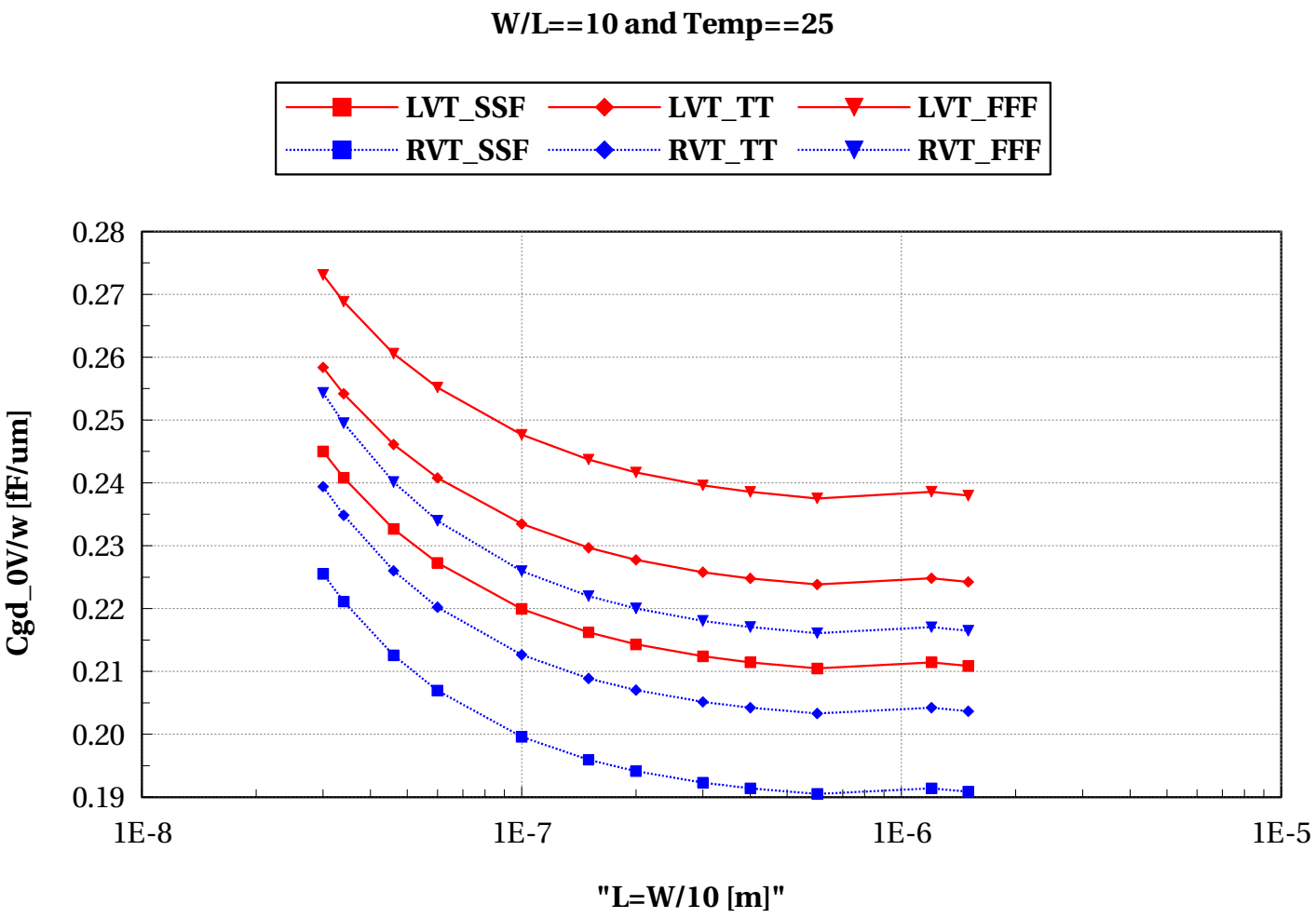
lvtpfet_acc, Cdg_ana/w [fF/um] vs "L=W/10 [m]"



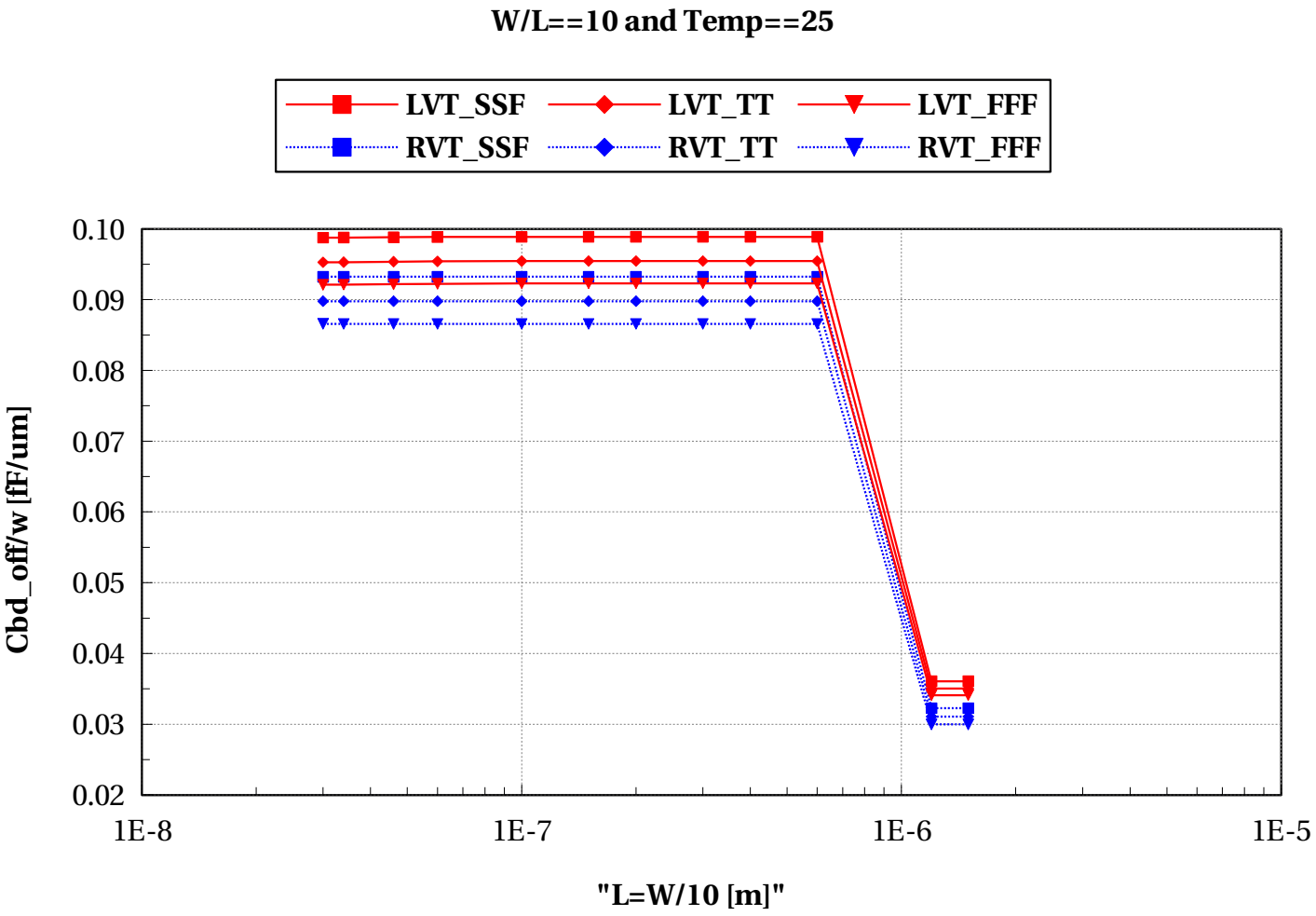
lvtpfet_acc, Cdd_ana/w [fF/um] vs "L=W/10 [m]"



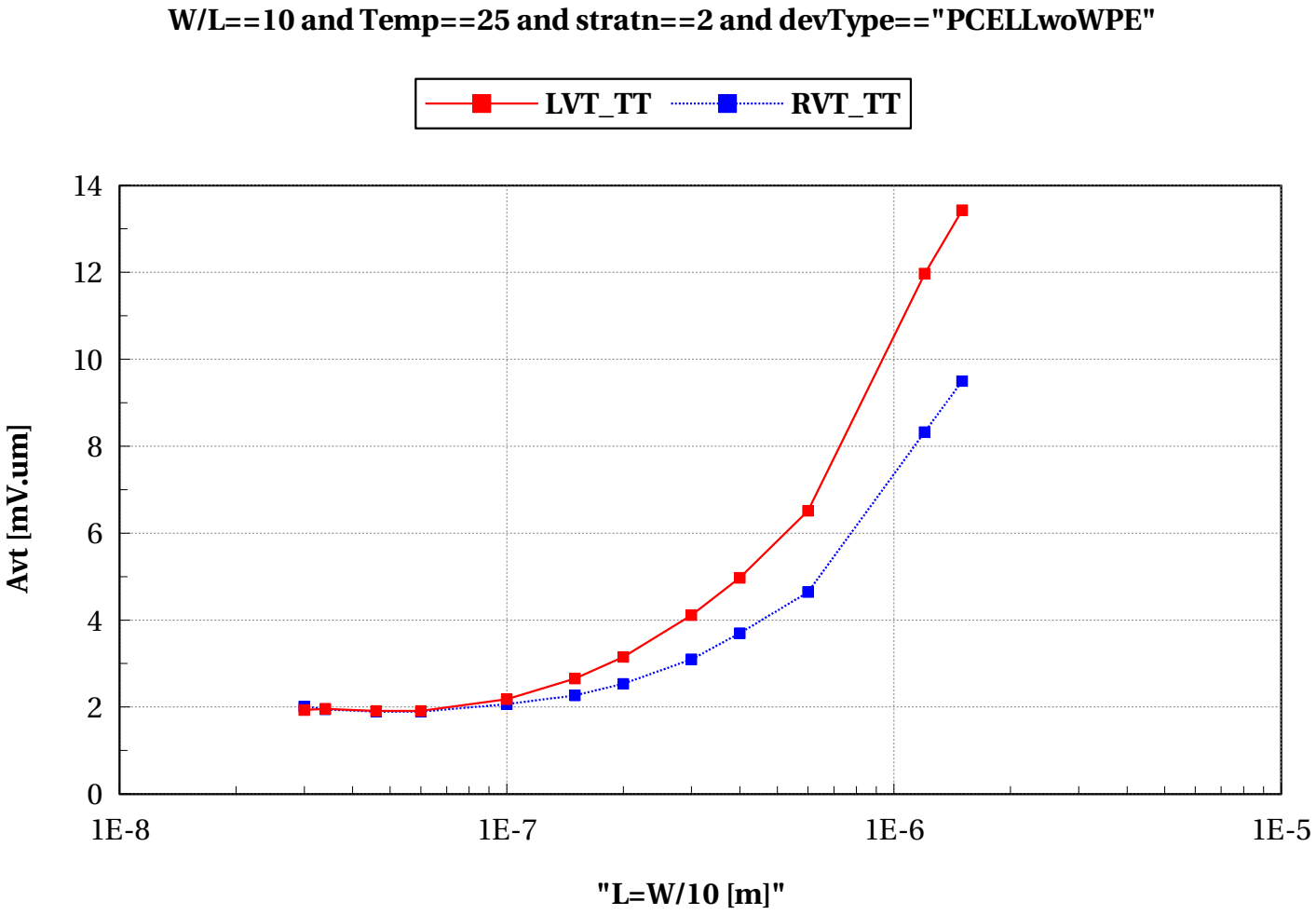
lvtpfet_acc, Cgd_0V/w [fF/um] vs "L=W/10 [m]"



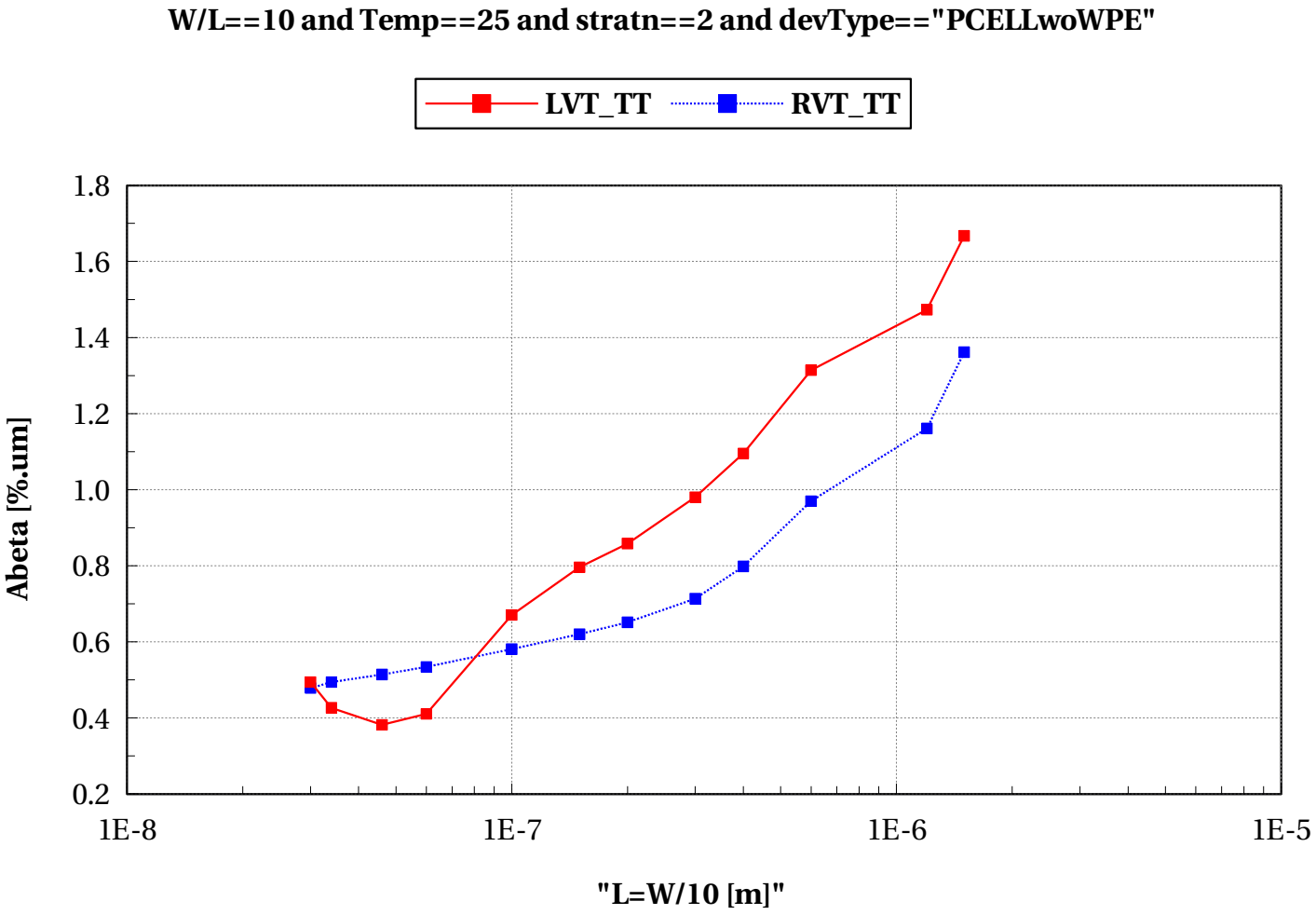
lvtpfet_acc, Cbd_off/w [fF/um] vs "L=W/10 [m]"



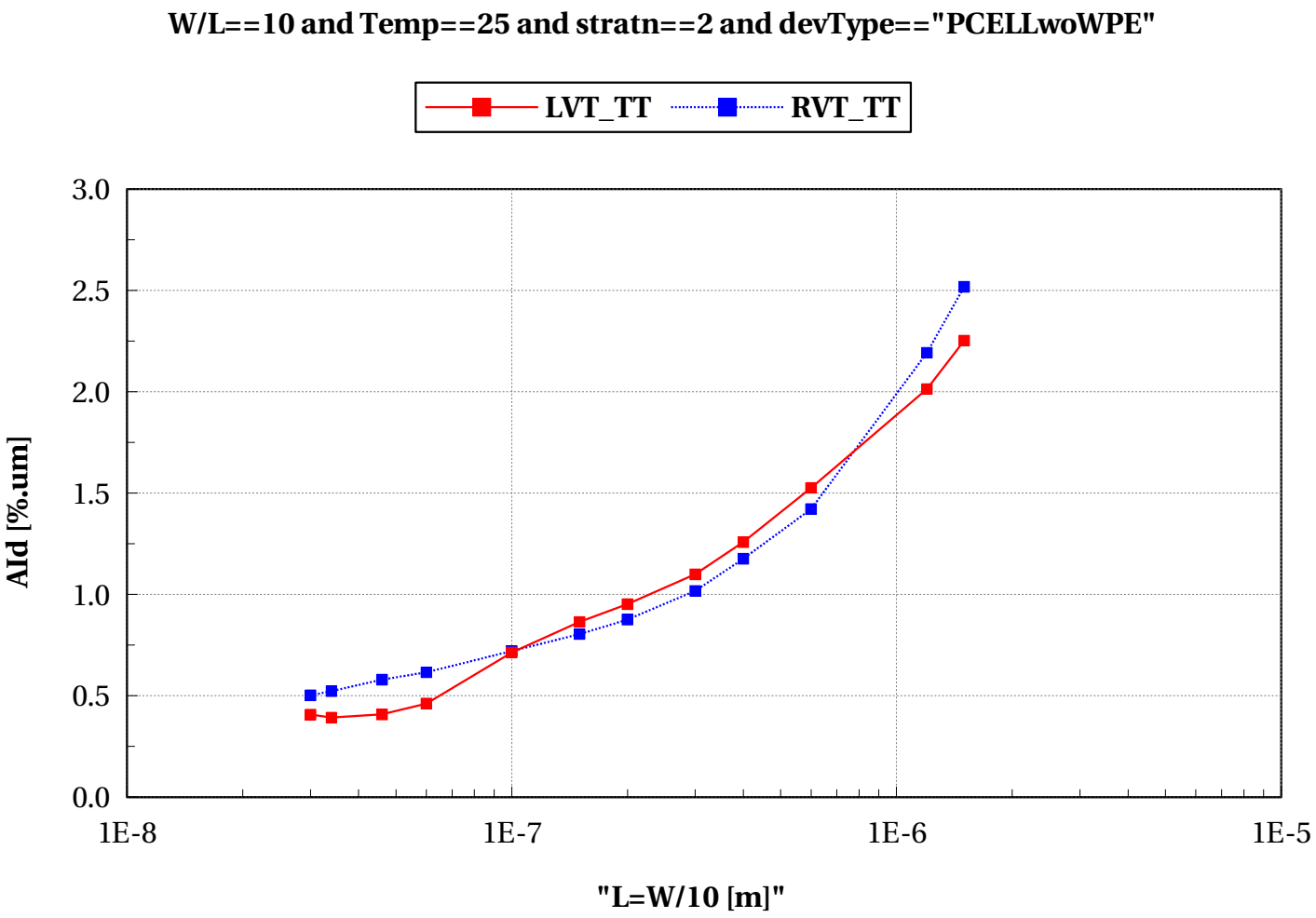
lvtpfet_acc, Avt [mV.um] vs "L=W/10 [m]"



lvtpfet_acc, Abeta [%.um] vs "L=W/10 [m]"



lvtpfet_acc, AId [%.um] vs "L=W/10 [m]"



Annex

Conditions of simulations

The simulations were done with SBenchLSF Alpha using Eldo simulator 2018.3.

- Model lvtnfet_acc (LVT)
  - ✔ Input Parameters
    - ✘ vds_off = vds_sat V
    - ✘ vds_cgd = 0 V
    - ✘ mc_sens = 0
    - ✘ vds_lin = 0.05 V
    - ✘ ivt = 300e-9 A
    - ✘ model_version = 1.3.e
    - ✘ vstep_ivt = 0.005 V
    - ✘ iana = 5e-6 A
    - ✘ vds_mm = 0.05 V
    - ✘ ams_release = 2018.3
    - ✘ vgs_stop = vdd V
    - ✘ dlshrink_ivt = 0
    - ✘ sbenchlsf_release = Alpha
    - ✘ vds_sat = Vdd V

- ✘ mc_nsigma = 3
- ✘ vgs_start = 0 V
- ✘ plashrink_ivt = 1
- ✘ ithslwi = 10e-9 A
- ✘ vds_ana = Vdd/4 V
- ✘ vds_cbd = 0 V
- ✘ vddmax = vdd
- ✘ mc_runs = 5000
- ✘ shrink_ivt = 1
- ✘ vgs_off = 0 V
- ✘ temp = 25 °C
- ✘ f_ext = 100k Hz
- ✘ vbs = 0 V
- ✘ vdd = 1 V

✔ Sweep Parameters

✔ Extra parameters

- ✘ lvt_dev = 1

● Model lvtpfet_acc (LVT)

✔ Input Parameters

- ✘ vds_off = vds_sat V
- ✘ vds_cgd = 0 V
- ✘ mc_sens = 0
- ✘ vds_lin = 0.05 V
- ✘ ivt = 70e-9 A
- ✘ model_version = 1.3.e

- ✘ vstep_ivt = 0.005 V
- ✘ iana = 2e-6 A
- ✘ vds_mm = 0.05 V
- ✘ ams_release = 2018.3
- ✘ vgs_stop = vdd V
- ✘ dlshrink_ivt = 0
- ✘ sbenchlsf_release = Alpha
- ✘ vds_sat = Vdd V
- ✘ mc_nsigma = 3
- ✘ vgs_start = 0 V
- ✘ plashrink_ivt = 1
- ✘ ithslwi = 10e-9 A
- ✘ vds_ana = Vdd/4 V
- ✘ vds_cbd = 0 V
- ✘ vddmax = vdd
- ✘ mc_runs = 5000
- ✘ shrink_ivt = 1
- ✘ vgs_off = 0 V
- ✘ temp = 25 °C
- ✘ f_ext = 100k Hz
- ✘ vbs = 1 V
- ✘ vdd = 1 V

✔ Sweep Parameters

✔ Extra parameters

- ✘ lvt_dev = 1

- Model nfet_acc (RVT)
  - ✔ Input Parameters
    - ✘ vds_off = vds_sat V
    - ✘ iana = 5e-6 A
    - ✘ shrink_iana = 1
    - ✘ mc_sens = 0
    - ✘ vds_lin = 0.05 V
    - ✘ ivt = 300e-9 A
    - ✘ model_version = 1.2.d
    - ✘ vds_cgd = 0 V
    - ✘ vds_mm = 0.05 V
    - ✘ ams_release = 2018.3
    - ✘ plashrink_iana = 0
    - ✘ vgs_stop = vdd V
    - ✘ dlshrink_ivt = 0
    - ✘ sbenchlsf_release = Alpha
    - ✘ vds_sat = Vdd V
    - ✘ mc_nsigma = 3
    - ✘ shrink_ivt = 1
    - ✘ vstep_iana = 0.01 V
    - ✘ vgs_start = 0 V
    - ✘ plashrink_ivt = 1
    - ✘ dlshrink_iana = 0
    - ✘ ithslwi = 10e-9 A
    - ✘ vds_ana = Vdd/4 V

- ✘ vds_cbd = 0 V
- ✘ vddmax = vdd
- ✘ mc_runs = 5000
- ✘ vstep_ivt = 0.005 V
- ✘ vgs_off = 0 V
- ✘ temp = 25 °C
- ✘ f_ext = 100k Hz
- ✘ vbs = 0 V
- ✘ vdd = 1 V

✔ Sweep Parameters

✔ Extra parameters

- ✘ rvt_dev = 1

● Model pfet_acc (RVT)

✔ Input Parameters

- ✘ vds_off = vds_sat V
- ✘ iana = 2e-6 A
- ✘ shrink_iana = 1
- ✘ mc_sens = 0
- ✘ vds_lin = 0.05 V
- ✘ ivt = 70e-9 A
- ✘ model_version = 1.2.d
- ✘ vds_cgd = 0 V
- ✘ vds_mm = 0.05 V
- ✘ ams_release = 2018.3
- ✘ plashrink_iana = 0

- ✘ vgs_stop = vdd V
- ✘ dlshrink_ivt = 0
- ✘ sbenchlsf_release = Alpha
- ✘ vds_sat = Vdd V
- ✘ mc_nsigma = 3
- ✘ shrink_ivt = 1
- ✘ vstep_iana = 0.01 V
- ✘ vgs_start = 0 V
- ✘ plashrink_ivt = 1
- ✘ dlshrink_iana = 0
- ✘ ithslwi = 10e-9 A
- ✘ vds_ana = Vdd/4 V
- ✘ vds_cbd = 0 V
- ✘ vddmax = vdd
- ✘ mc_runs = 5000
- ✘ vstep_ivt = 0.005 V
- ✘ vgs_off = 0 V
- ✘ temp = 25 °C
- ✘ f_ext = 100k Hz
- ✘ vbs = 0 V
- ✘ vdd = 1 V

✔ Sweep Parameters

✔ Extra parameters

- ✘ rvt_dev = 1