

HICUM - Productization and Support Update

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OUTLINE

- HICUM/L0 Support Update
- HICUM/L2 v2.23 Overview on changes
- HICUM/L2 Next Version
- Test Results

HICUM/L0 Support Update

- HICUM/L0 v1.12
 - released on March 9, 2007
 - five-terminal model: thermal node set as external
 - introduction of flag FLSH (0,1,2): control of SH calculation
 - all series resistors and RTH will be limited to a minimum value
 - increase of code clarity
 - substrate transistor current added
 - working on detailed documentation (to be available on website)
- support work: responses to requests re. implementation, parameters, testing, and applications (e.g. HICUM/L0 to III-V HBTs)

HICUM/L2 Support Update

V 2.23 will be released according to decision made at the March 07 CMC meeting

- will be released after intensive testing
- documentation update in progress
- implementation of vertical NQS effects still according to Weil's approach
 - => corresponding code already existing in previous versions
 - => VA does not allow to use Weil's approach directly
 - => expected to be taken over

HICUM/L2 Version 2.23 - overview on changes

Code related minor changes only

- Lateral NQS effect in small-signal model formulation

HICUM/L2v2.23: (Cdei and Cdc_i are included only according to theory/Crbi)

$$C_{rBi} = f_{crBi}(ddx(Q_{jEi}, V(bi)) + ddx(Q_{jCi}, V(bi)) + (-1)ddx(Q_{dEi}, V(ei)) + (-1)ddx(Q_{dCi}, V(ci)))$$

$$Q_{rBi} = C_{rBi}V(bp, bi)$$

HICUM/L2v2.22: (Last two derivatives signify Cdei+Ccdei and Cdc_i+Cbdci)

$$C_{rBi} = f_{crBi}(ddx(Q_{jEi}, V(bi)) + ddx(Q_{jCi}, V(bi)) + ddx(Q_{dEi}, V(bi)) + ddx(Q_{dCi}, V(bi)))$$

$$Q_{rBi} = C_{rBi}V(bp, bi)$$

Note: theory for Crbi is valid only for small-signal case!

=> recommended to be used only for small-signal applications

- Parameter range extensions

- FGEO : v2.22 from [0,1]  v2.23 from [0,inf]
- FDQR0 : v2.22 from [0,1]  v2.23 from [0,inf]

HICUM/L2 Version 2.23 - overview on changes

Code related minor changes only

- Collector current spreading

HICUM/L2v2.22:

For $LATB > 0.01$ $FClnl = \ln(1 + latl \times FCw)$
 For $LATB \leq 0.01$ $FClnl = latl \times FCw$ } $FClnl$ is passed to HICFCI and HICFCT routines
 => can cause inconsistency

similar case for $FClnb = \ln(1 + latb \times FCw)$

HICUM/L2v2.23:

Correct expression $FClnx = \ln(1 + latx \cdot FCw)$
 coded ONLY inside HICFCI and HICFCT } No conditional change,
 hence no inconsistency

- In `@(initial_model)`:
 external if-block for HICTUN_T has been removed tried to access voltages $V(bp,ei)$, $V(bi,ei)$ in initial model section which may cause extra undesired and unnecessary iterations

HICUM/L2 Next Version

- NQS Effect

- => investigating efficient way for implementing NQS Effect
- => presently working on resolving the bias dependent issue in the NQS adjunct network approach
- => intensive correspondence and discussions (via email)

(Ref: Prof.M.Schroter, "hicum_update_0307.pdf", CMC Meeting Q1/07, Tokyo)

- Correlated Noise

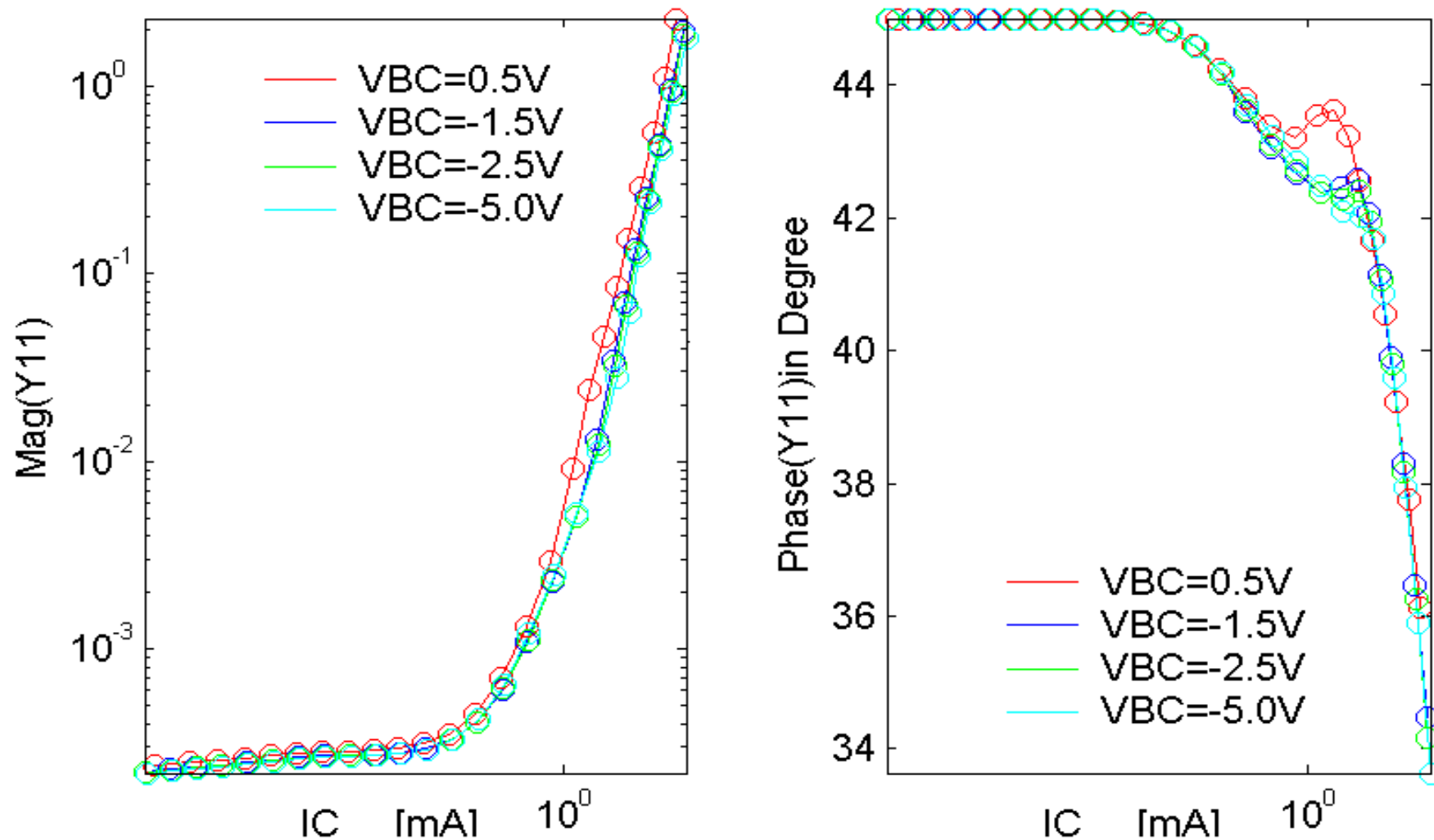
- => investigating efficient option for implementation of proposed solution

- Field-based model investigation

- => B-C depletion charge and capacitance as function of current and voltage
- => Improved physics for base and collector related minority charge transit time

Test Results

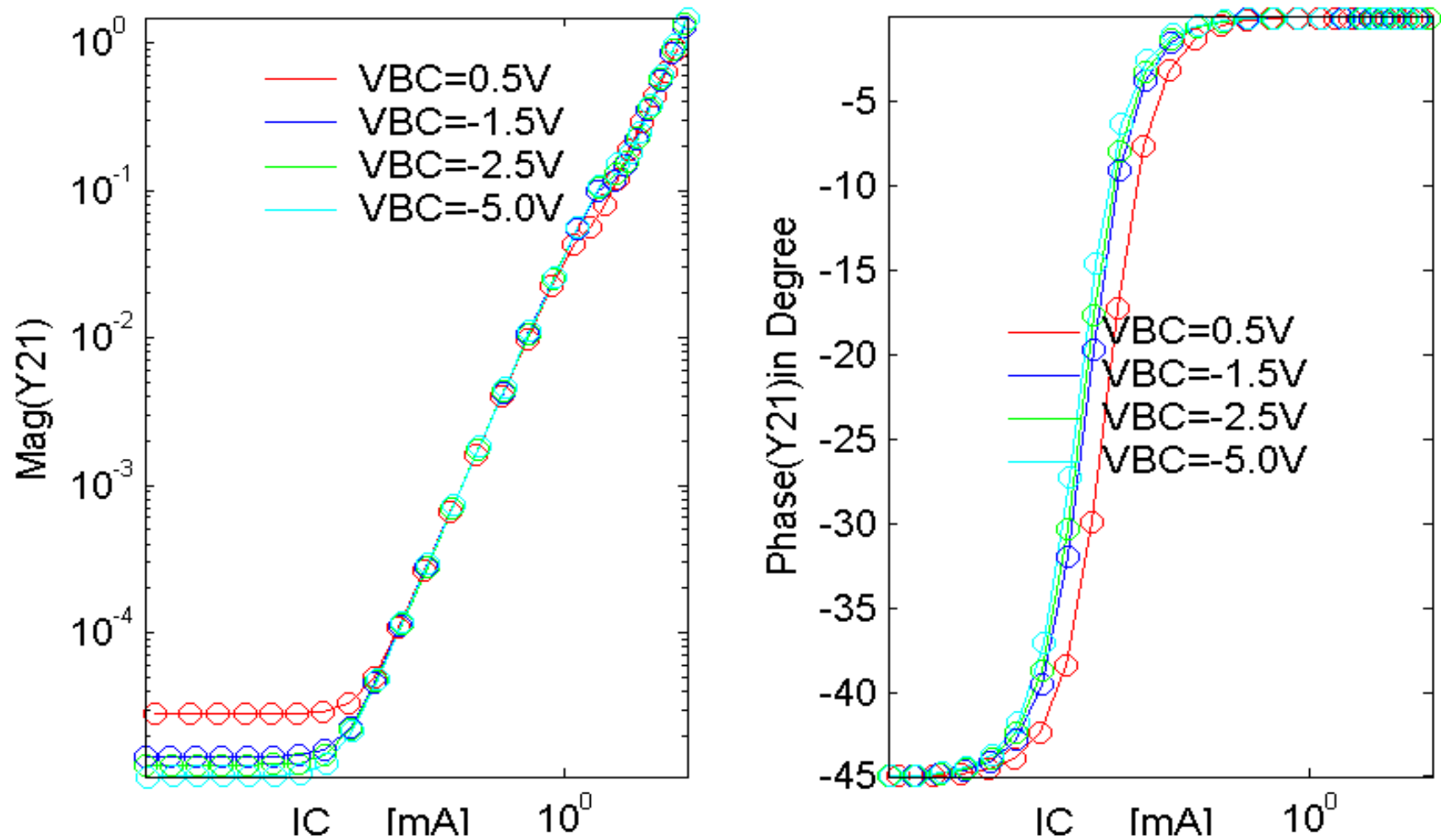
Intrinsic Transistor Model: Y11 plot at T=300K
V2.23 Continuous line and V2.22 Symbol



Test Results (Contd.)

Intrinsic Transistor Model: Y21 plot at T=300K

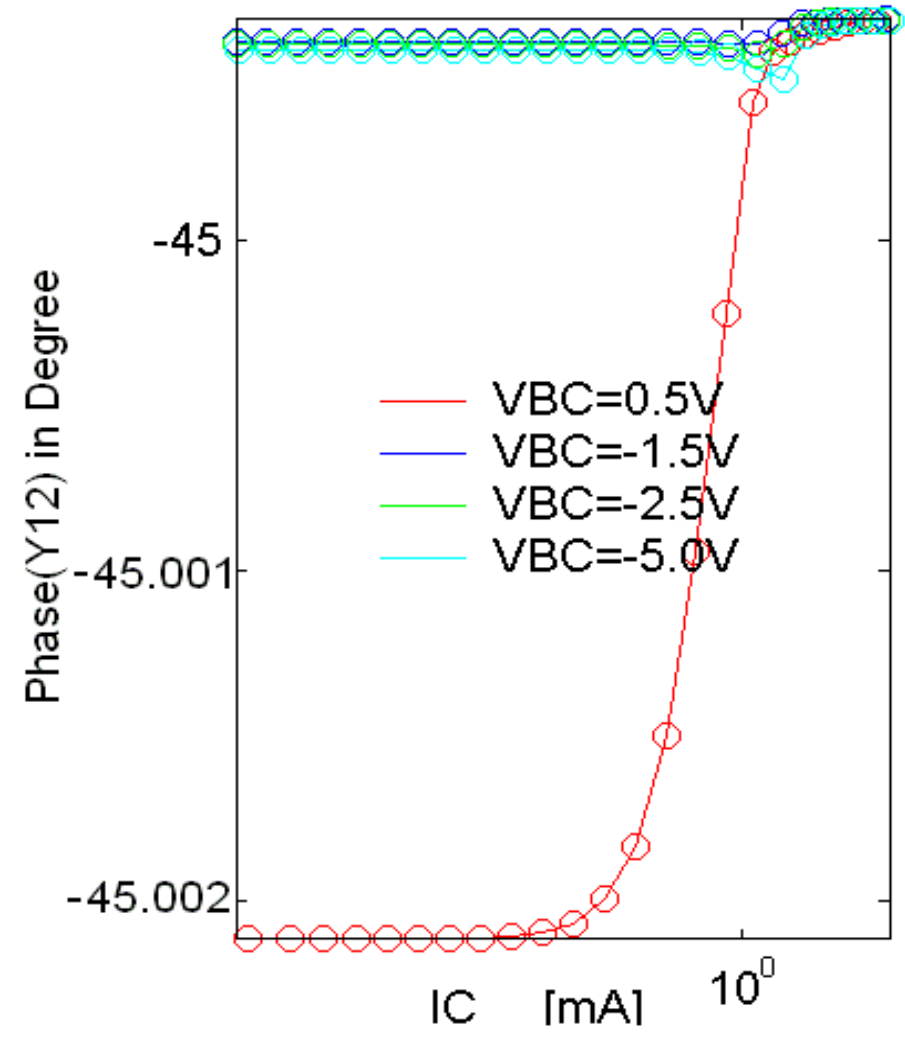
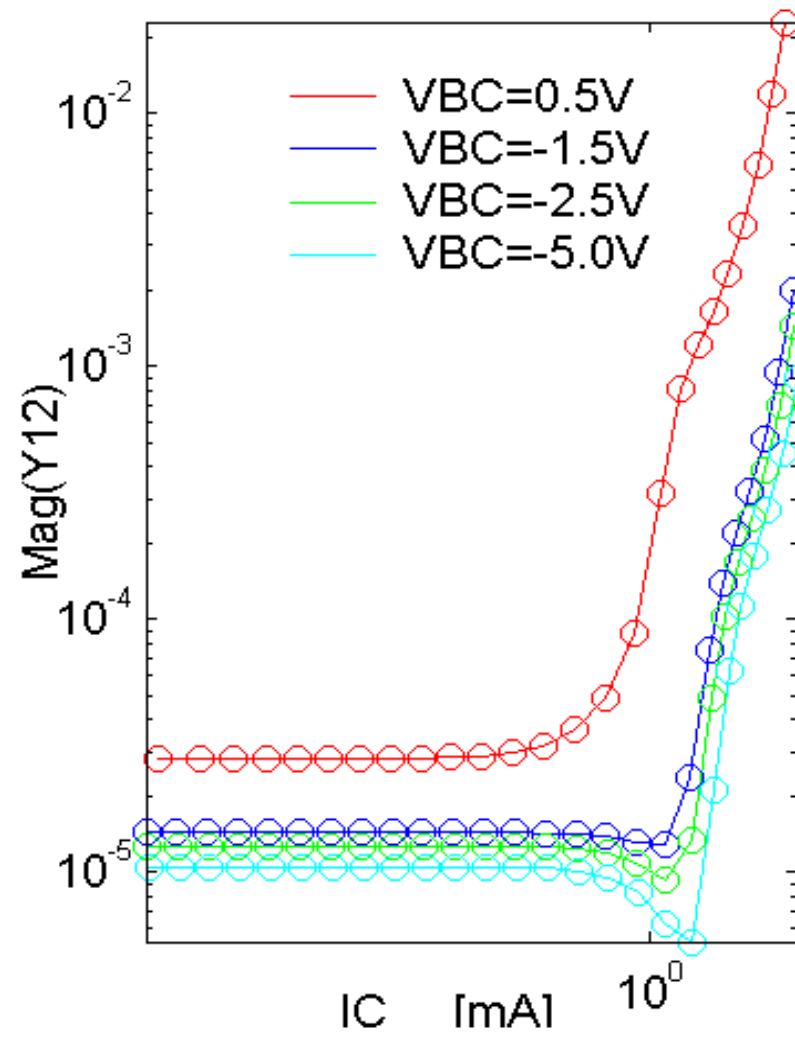
V2.23 Continuous line and V2.22 Symbol



Test Results (Contd.)

Intrinsic Transistor Model: Y12 plot at T=300K

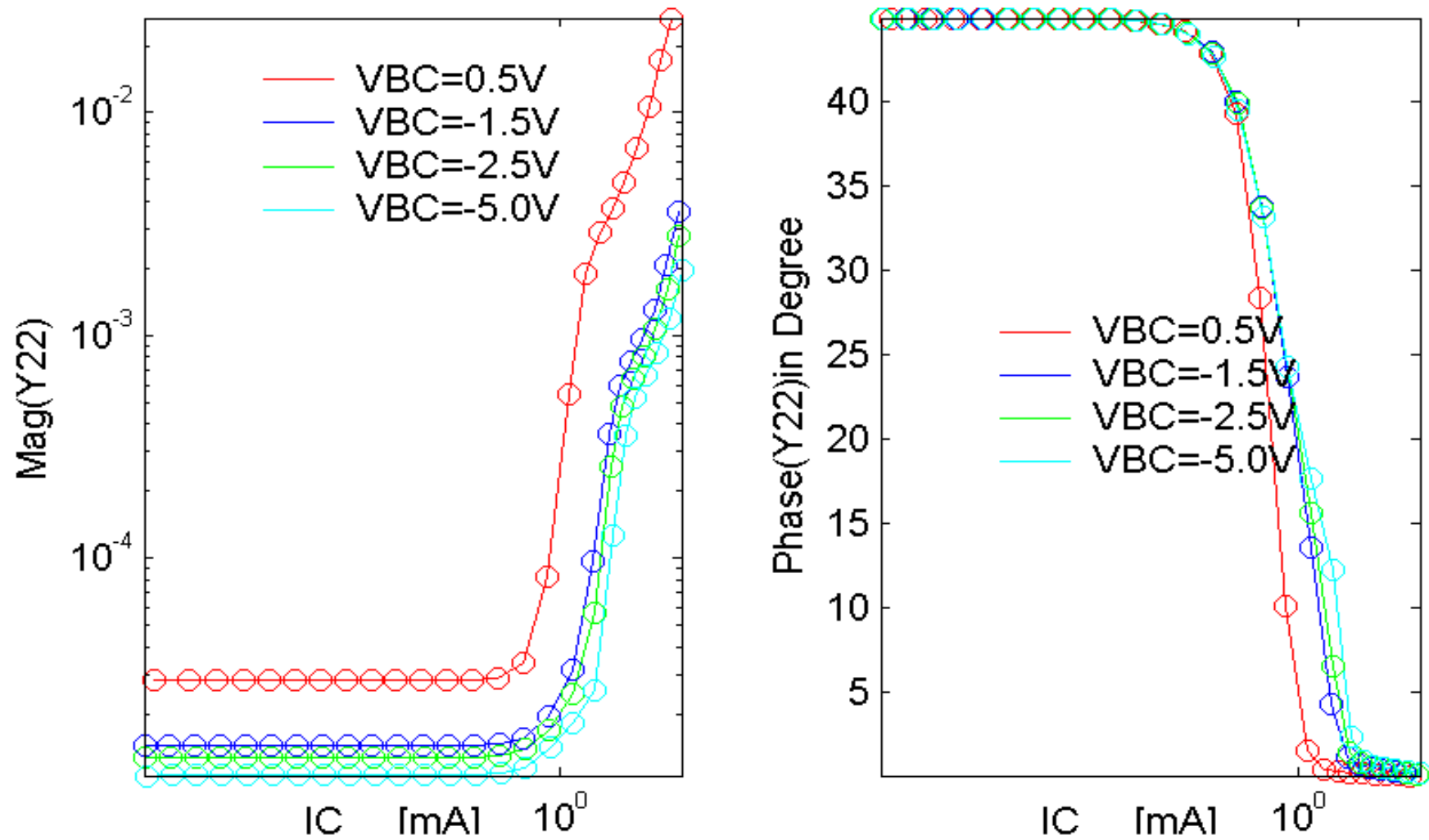
V2.23 Continuous line and V2.22 Symbol



Test Results (Contd.)

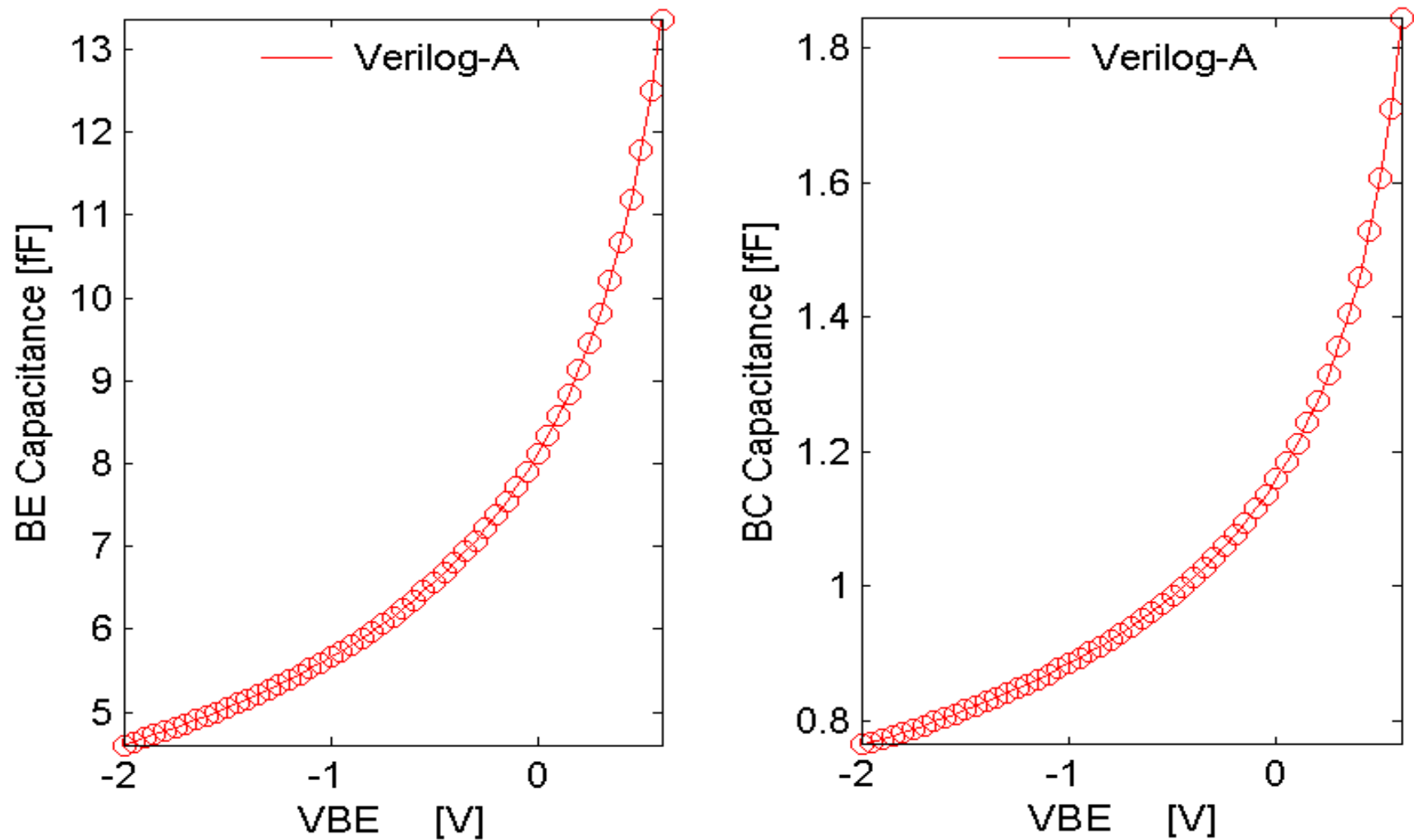
Intrinsic Transistor Model: Y22 plot at T=300K

V2.23 Continuous line and V2.22 Symbol



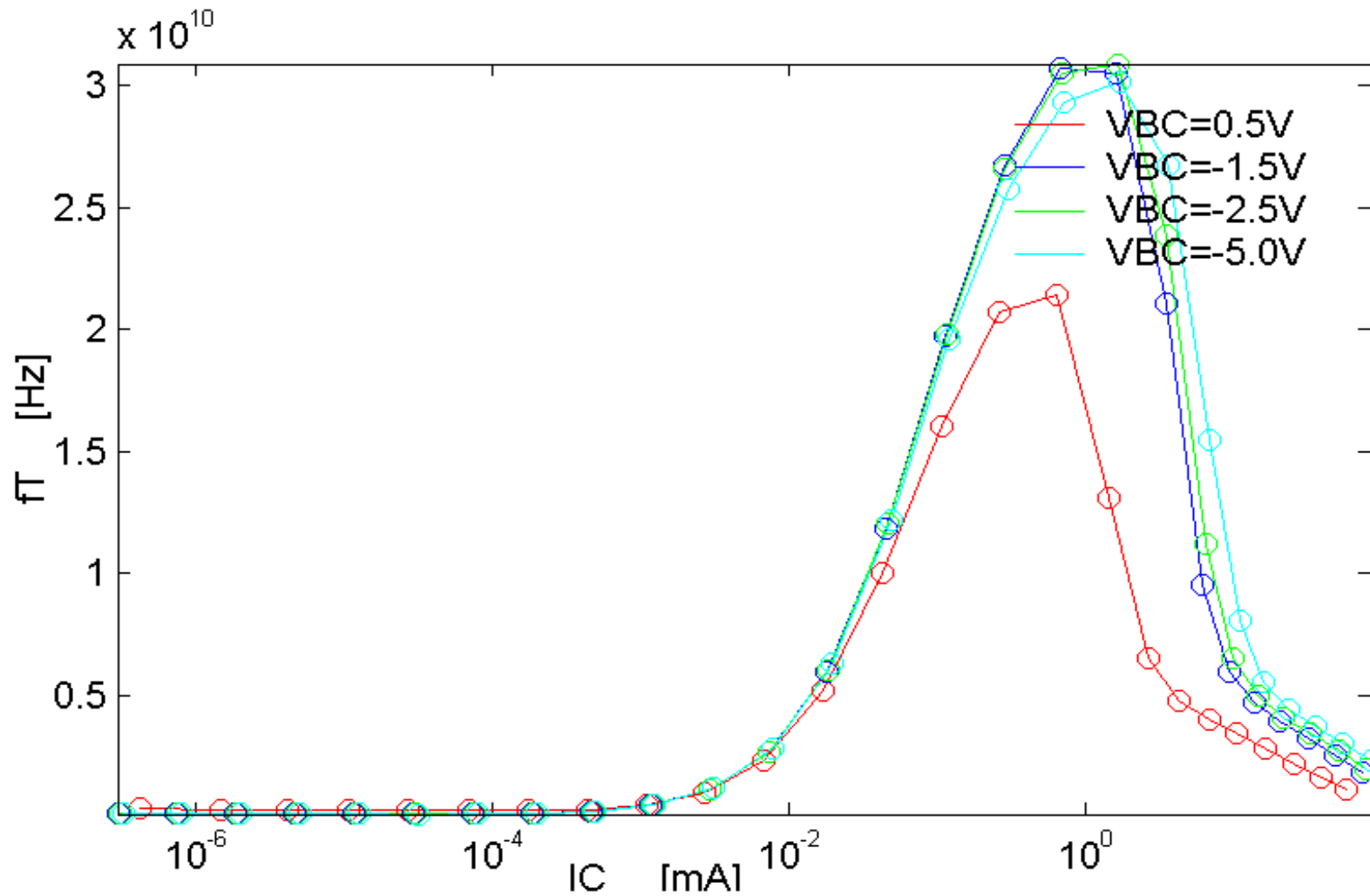
Test Results (Contd.)

Intrinsic Transistor Model: Depletion Capacitance plot at T=300K
V2.23 Continuous line and V2.22 Symbol



Test Results (Contd.)

Intrinsic Transistor Model: f_T extracted at $f=2.8\text{GHz}$ at $T=300\text{K}$
V2.23 Continuous line and V2.22 Symbol



Test Results (Contd.)

Error due to approximate expression in V2.22

HICUM/L2v2.22:

For $LATB > 0.01$ $FClnl = \ln(1 + latl \times FCw)$

For $LATB \leq 0.01$ $FClnl = latl \times FCw$

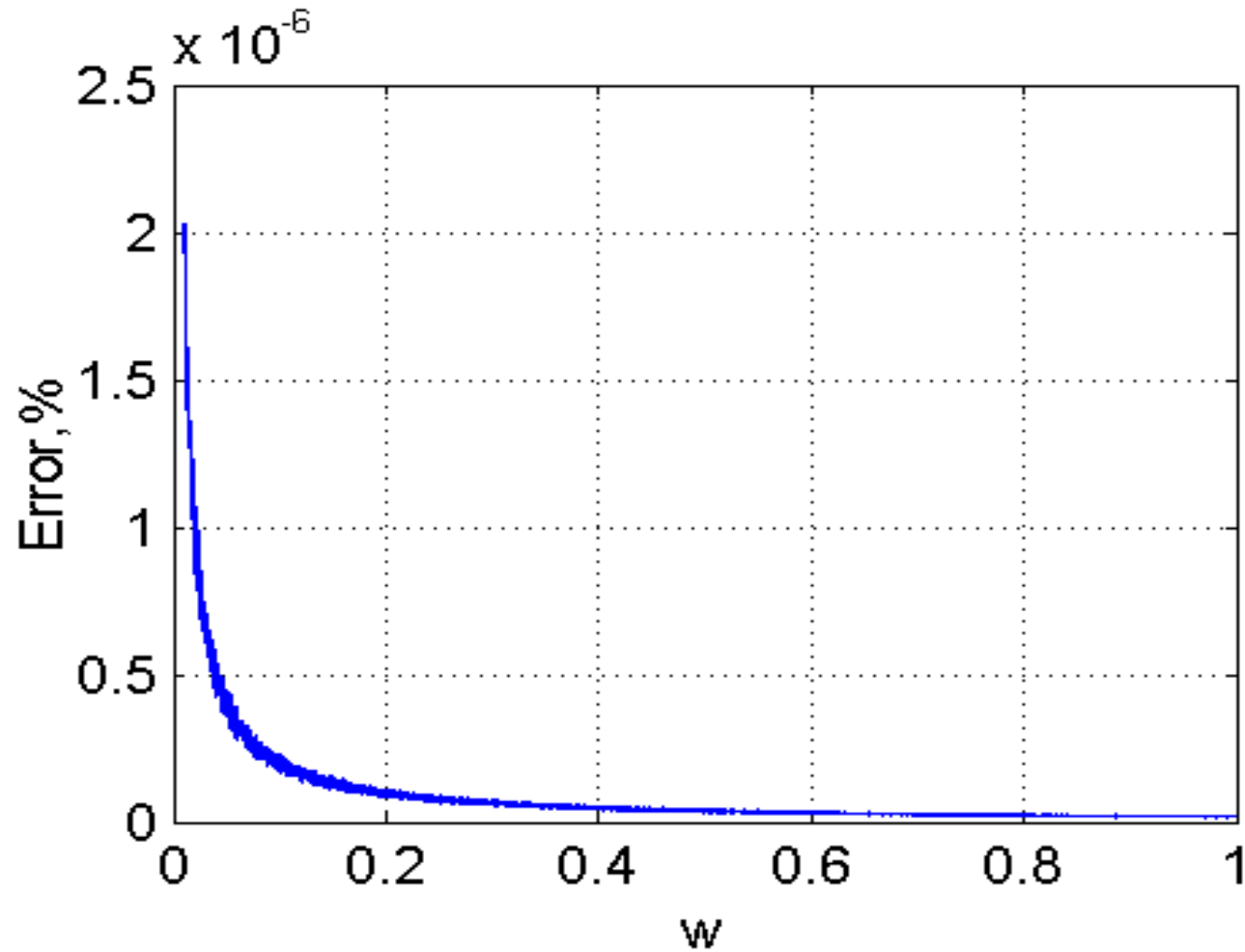
similar case for $FClnb = \ln(1 + latb \times FCw)$

2nd condition causes error as it is using approximate expression for $latb \leq 0.01$

Test Results (Contd.)

Error in V2.22

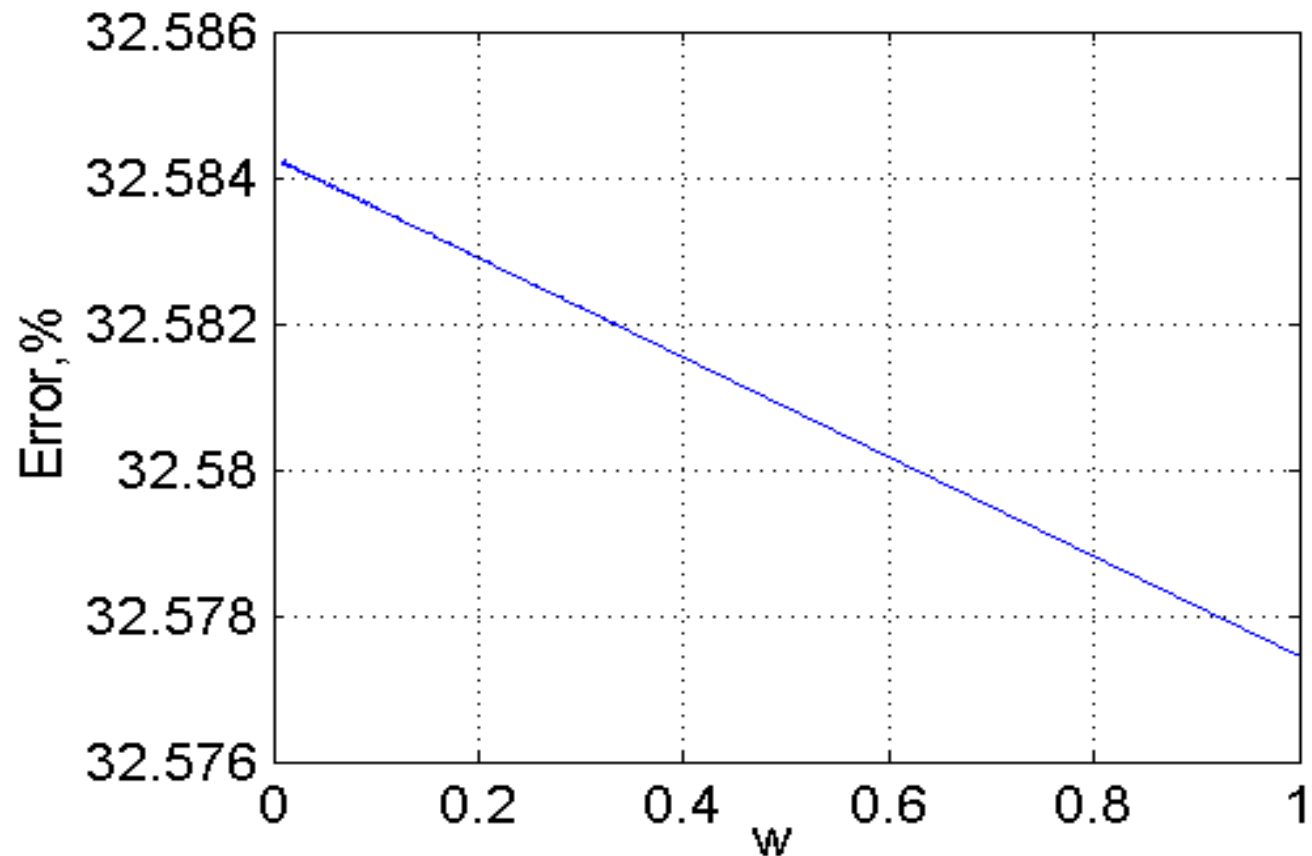
For $\text{latb}=0.1$ and $\text{latl}=0.01$



Test Results (Contd.)

Error in V2.22

- For $\text{latb}=0.01$ and $\text{latl}=0.001$



- In next version v2.23 this approximation has been removed