EE 435

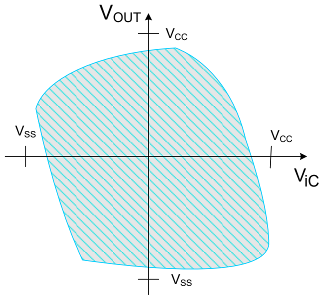
Lecture 7:

- High Gain Single-Stage Op Amps

Signal Swing of Single-Stage Op Amp

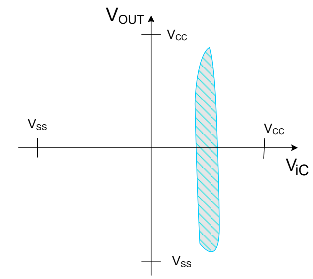
What type of signal swing is needed ?

Review from last lecture:



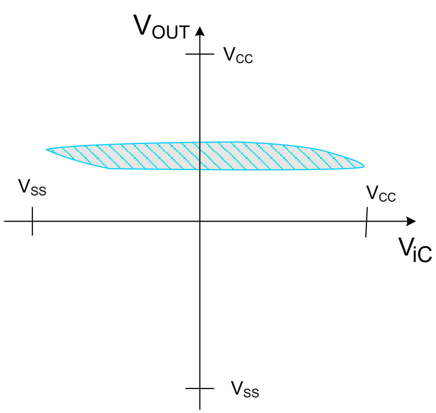
Wide V_{iC} and V_{OUT} range

Expected for catalog parts and overall I/O in many applications



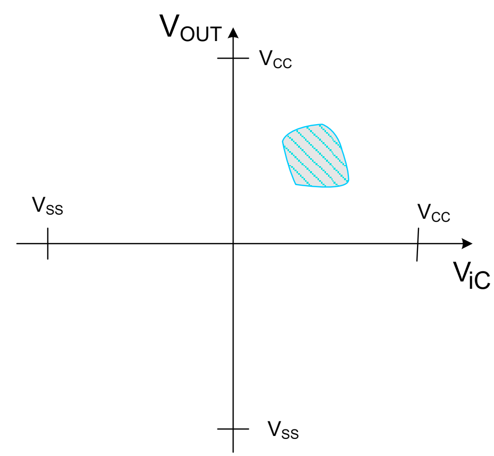
Narrow V_{iC} and wide V_{OUT} range

Acceptable when ViC is fixed



Narrow V_{OUT} and wide V_{iC} range

Acceptable when followed by high-gain stage

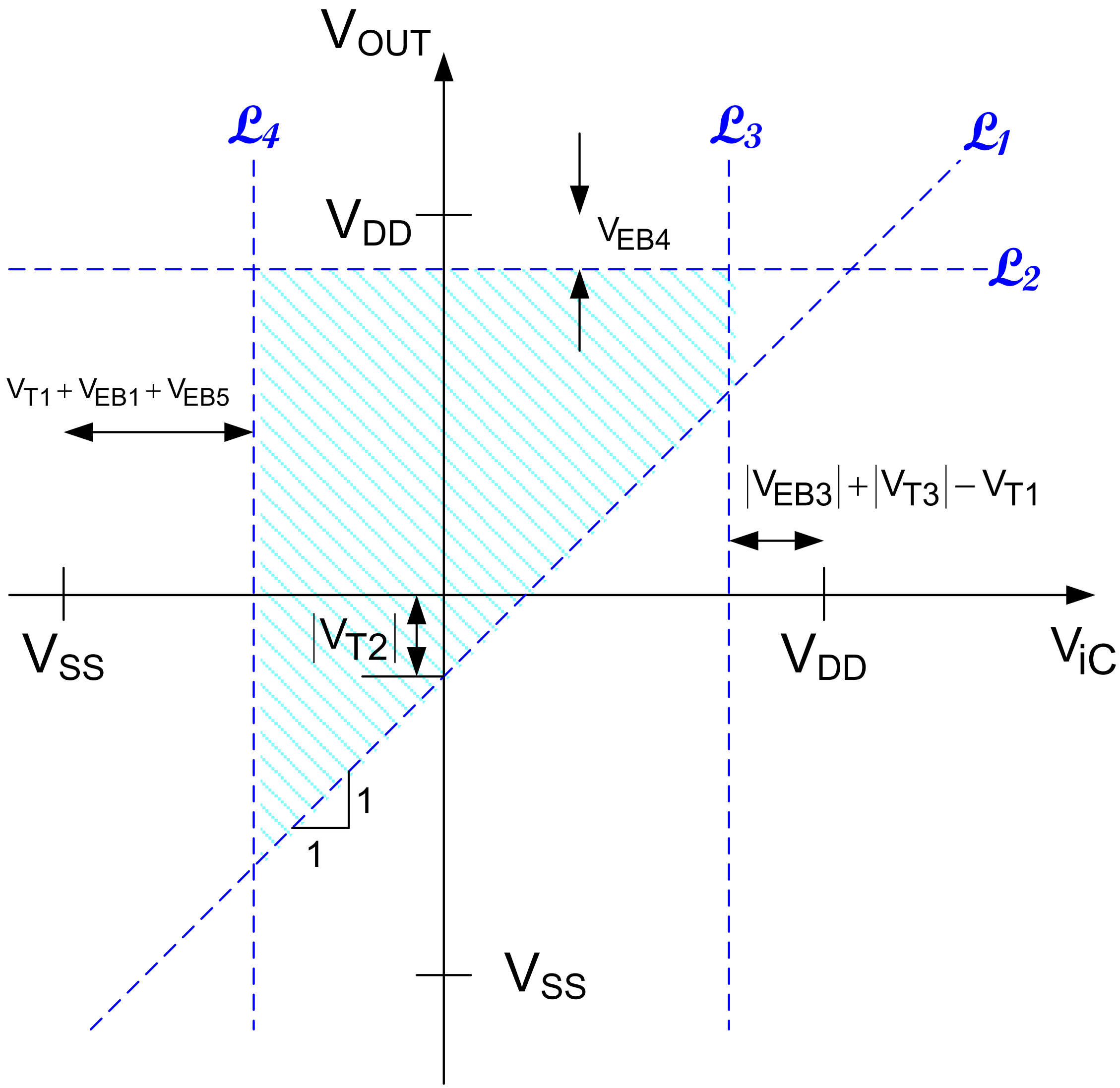


Narrow V_{iC} and V_{OUT} range

Acceptable when V_{iC} fixed and followed by high-gain stage

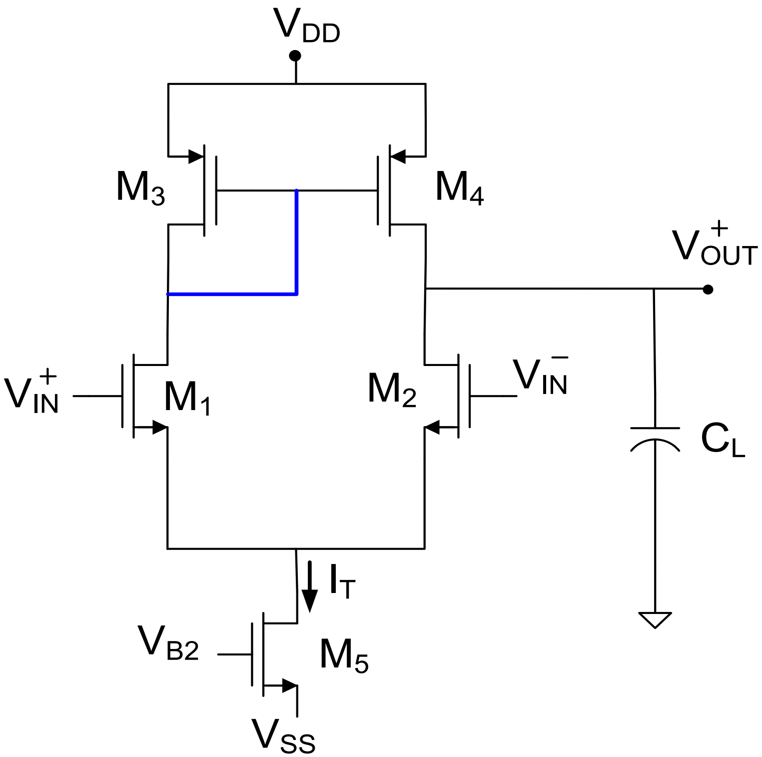
Review from last lecture:

Signal Swing of Single-Stage Op Amp



Review from last lecture:

Design space for single-stage op amp



Performance Parameters in Practical Parameter Domain $\{ V_{EB1}\ V_{EB2}\ V_{EB5}\ P \}$:

$$A_0 = \left[\frac{1}{\lambda_1+\lambda_3}\right]\left(\frac{2}{V_{EB1}}\right)$$

$$GB = \left(\frac{P}{V_{DD}C_L}\right)\left[\frac{1}{V_{EB1}}\right]$$

$$SR = \frac{P}{(V_{DD}-V_{SS})C_L}$$

$$V_{OUT} < V_{DD} - |V_{EB3}|$$

$$V_{OUT} > V_{ic} - V_{T2}$$

$$V_{iC} < V_{DD} + V_{T1} - |V_{T3}| - |V_{EB3}|$$

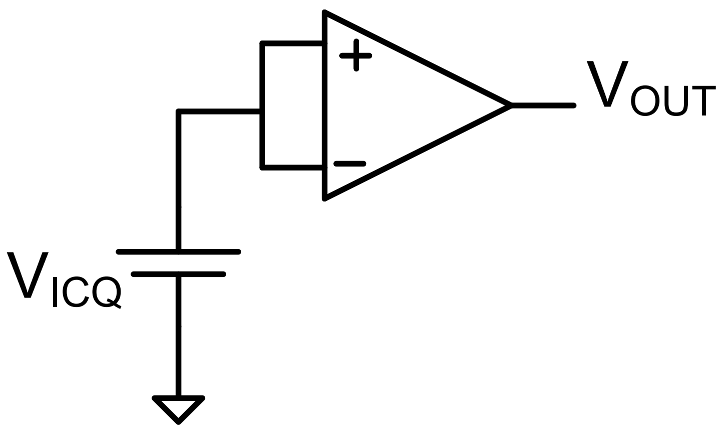
$$V_{ic} > V_{T1} + V_{EB1} + V_{EB5} + V_{SS}$$

Simple Expressions (7) in Practical Parameter Domain

Laboratory Support

Offset Voltage

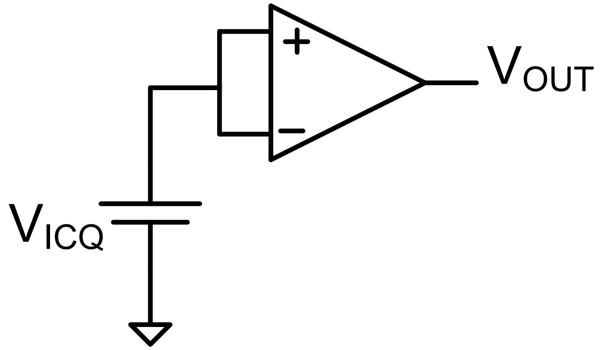
- Systematic Offset Voltage
- Random Offset Voltage



Laboratory Support

Offset Voltage

- Systematic Offset Voltage
- Random Offset Voltage

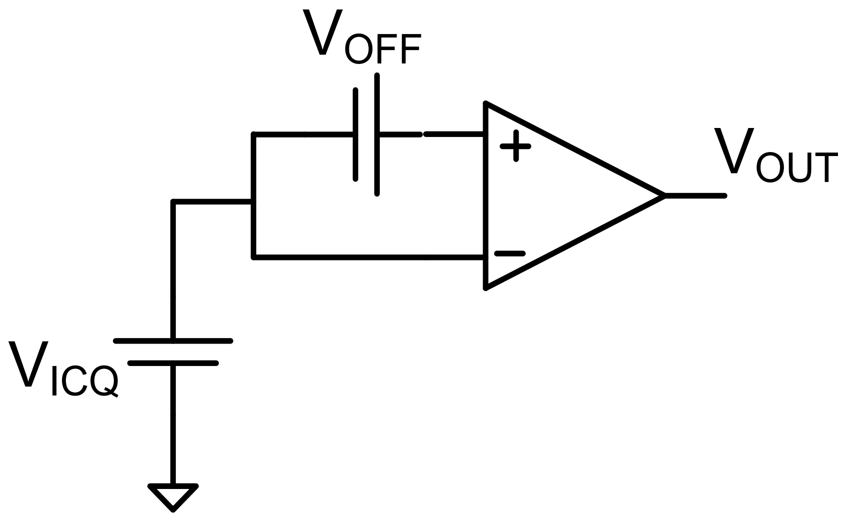


Definition: The output offset voltage is the difference between the desired output and the actual output when V_{id}=0 and V_{ic} is the quiescent common-mode input voltage.

$$V_{OUTOFF} = V_{OUT} - V_{OUTDES}$$

Note: V_{OUTOFF} is dependent upon V_{ICQ} although this dependence is usually quite weak and often not specified

Laboratory Support



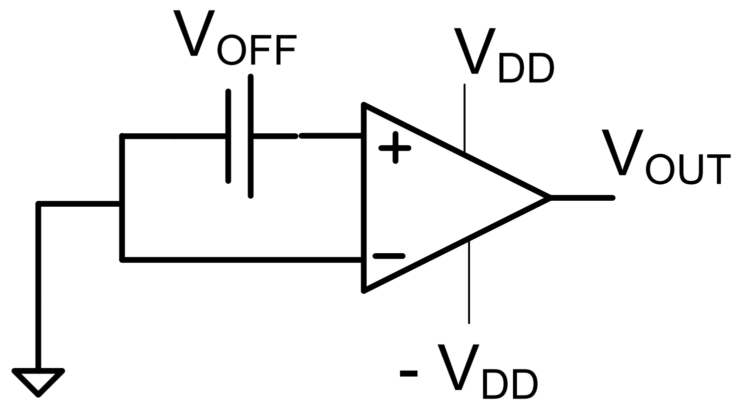
Definition: The input-referred offset voltage is the differential dc input voltage that must be applied to obtain the desired output when V_{ic} is the quiescent common-mode input voltage.

Note: V_{OFF} is usually related to the output offset voltage by the expression

$$V_{OFF} = \frac{V_{OUTOFF}}{A_D}$$

Note: V_{OFF} is dependent upon V_{ICQ} although this dependence is usually quite weak and often not specified

Laboratory Support

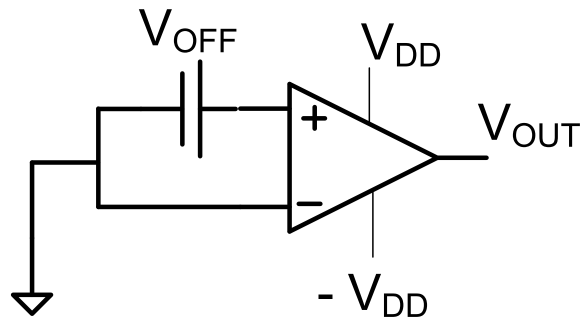


When differential input op amps are biased with symmetric supply voltages, it is generally assumed that the desired quiescent input voltage Is 0V and the desired quiescent output voltage is 0V so V_{OFF} is the differential Input voltage needed to make V_{OUT}=0V.

The input offset voltage is comprised of two parts, a systematic component and a random component

$$V_{OFF} = V_{OFFSYS} + V_{OSR}$$

Laboratory Support



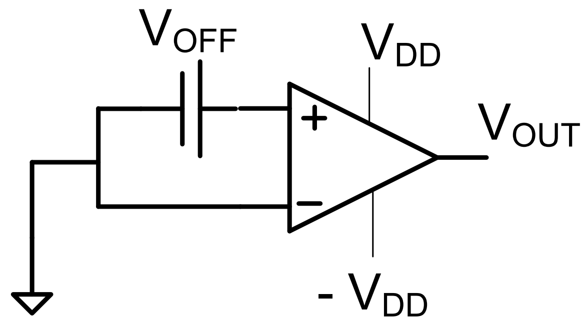
$$V_{OFF} = V_{OFFSYS} + V_{OSR}$$

After fabrication there is no distinction made between V_{OFFSYS} and V_{OSR} and simply V_{OFF} is of concern

V_{OSR} is determined entirely by random variations in component values from their ideal value and will only be seen in a simulation if deviations are intentionally introduced (Monte Carlo Analysis if often used for predicting V_{OSR})

It is expected that V_{OFFSYS} should be small (much smaller than V_{OSR}) and it is the designer's responsibility to make this small

Laboratory Support

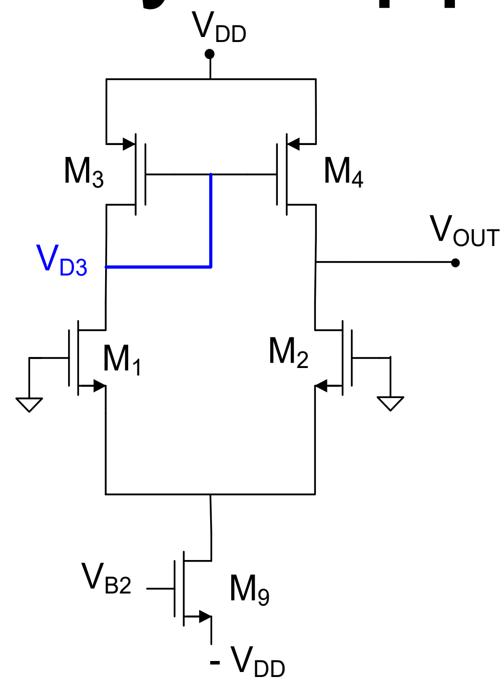


$$V_{OFF} = V_{OFFSYS} + V_{OSR}$$

It is not necessary to make V_{OFFSYS} =0 although this can and is often done by making a minor tweak of matching critical parameters after the design of the op amp is almost complete

V_{OFFSYS} can also be set to 0 by using a degree of freedom of the amplifier design variables but this is generally an unwise use of degrees of freedom (although some textbooks including Martin and Johns in Sec 5.1 do this!)

Laboratory Support

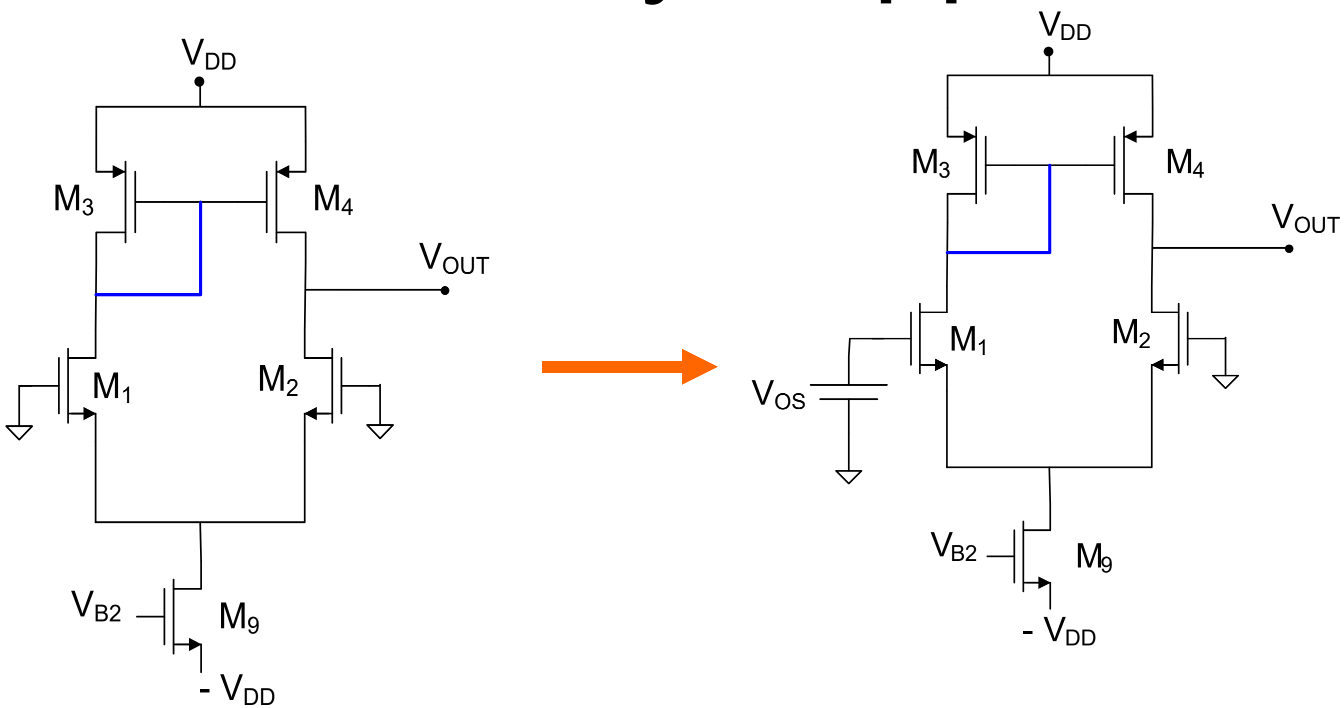


(If no missmatch is introduced, will be seeing only effects of systematic offset)

By symmetry, to force $V_{OUT} = 0$, it is necessary to have $V_{D3}=0$

- Making $V_{D3}=0$ sets $|V_{EB3}| = V_{DD} + V_{Tp}$ and results in the use of one degree of freedom!
- Making V_{EB3} so large will severely limit the voltage swing at V_{OUT}
- This shows why it is not wise to use a degree of freedom to make desired output voltage 0

Laboratory Support

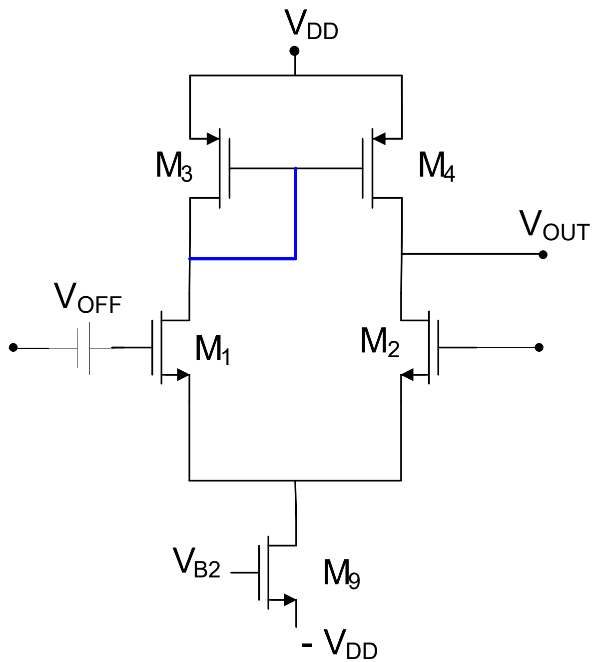


Can sweep a voltage in simulator at gate of M_1 to make $V_{OUT}=V_{OUT\_DESIRED}$

The value of V_{OS} that makes $V_{OUT}=V_{OUT\_DES}$ is the systematic offset voltage

Can simply add the systematic offset voltage to input throughout rest of the design phase and then remove after design is complete or tweak at end of design to eliminate systematic offset.

Laboratory Support



Usually V_{OFF} will change if changes in any design variables are made so re-simulation will be needed to get the correct value of V_{OFF}

If V_{OFF} is not included, ac simulation of open-loop amplifier will usually not give desired results because small-signal models will be developed in simulator at incorrect operating point (often even in incorrect region of operation)

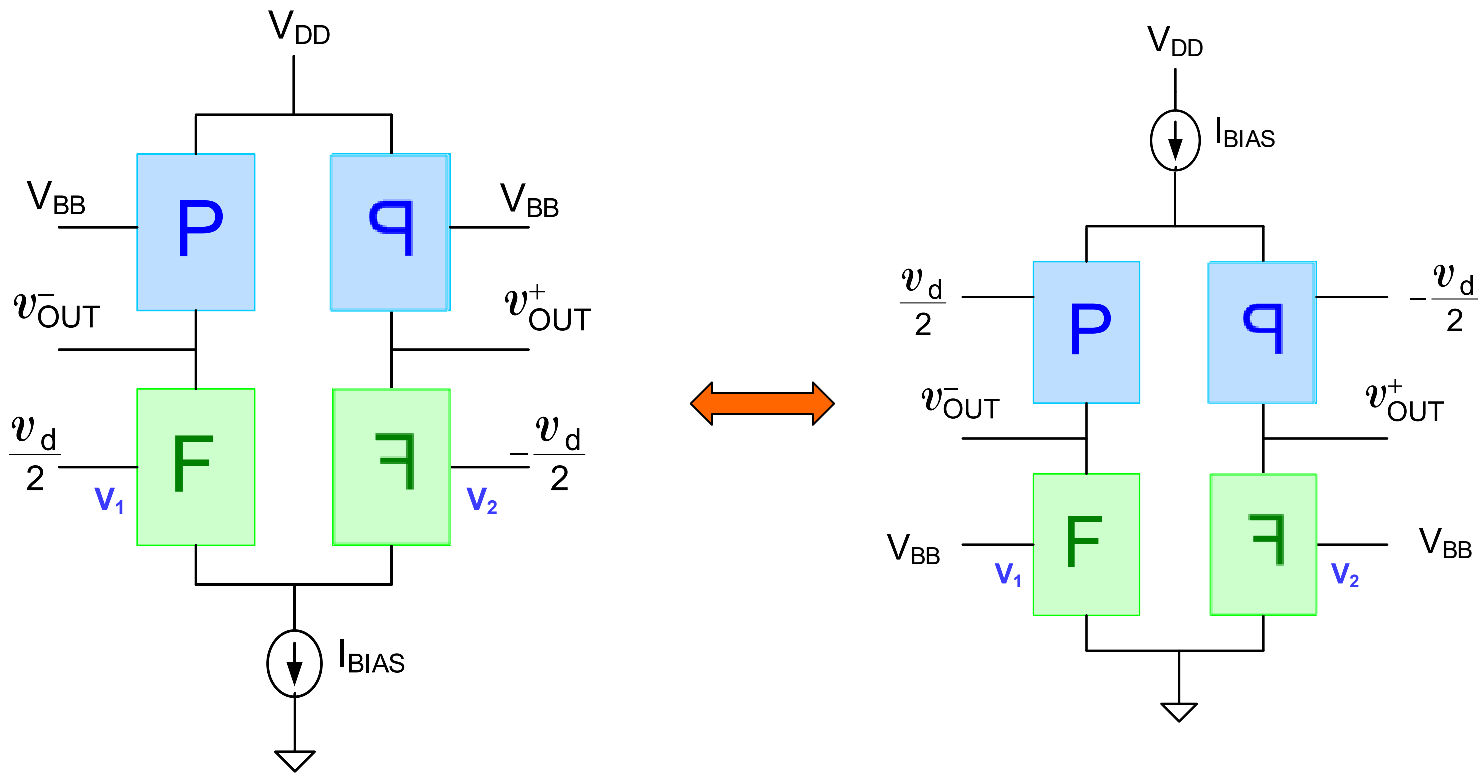
Alternative is to do ac simulations by embedding op amp into a FB configuration that will inherently compensate for offset voltage but issue of compensation must be addressed for amplifiers with two or more poles

Where we are at:

Basic Op Amp Design

- Fundamental Amplifier Design Issues
- Single-Stage Low Gain Op Amps
- Single-Stage High Gain Op Amps
- Other Basic Gain Enhancement Approaches
- Two-Stage Op Amp

Inputs into Counterpart Circuit or Quarter Circuit



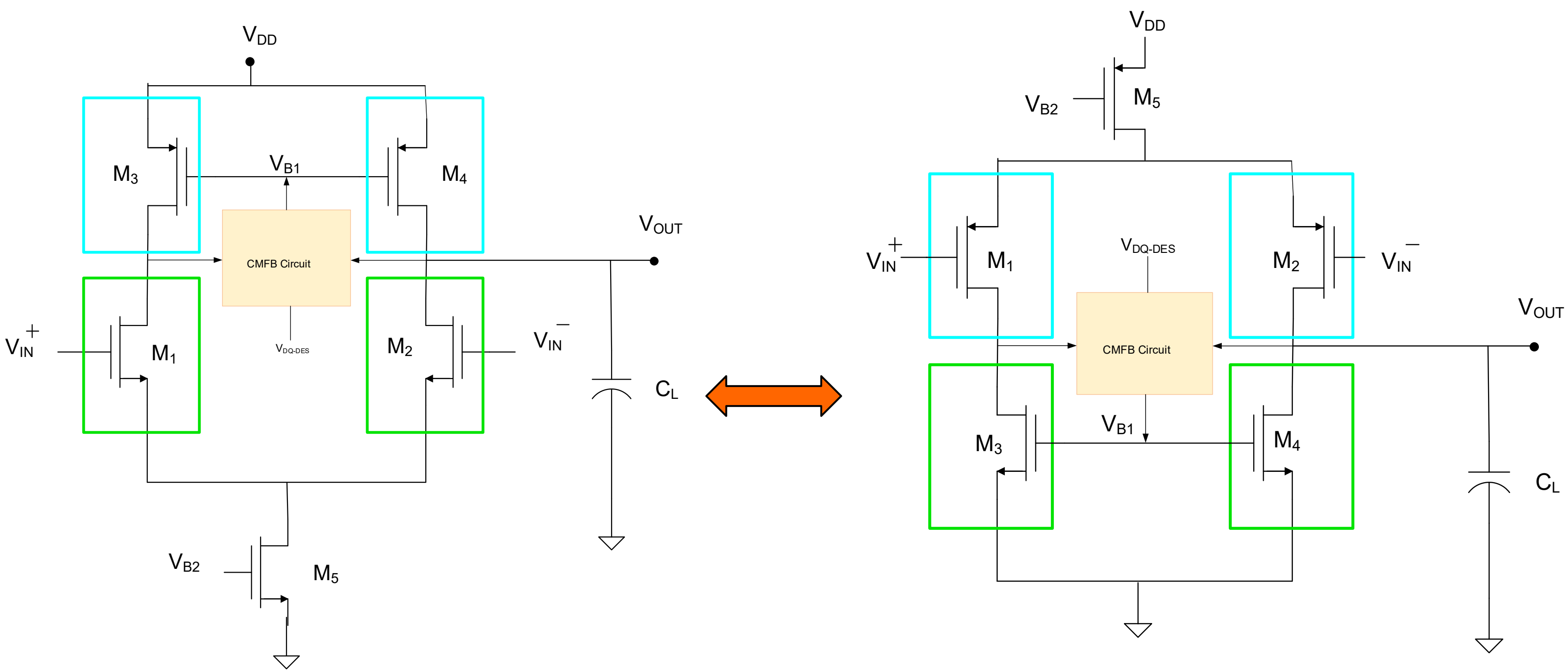
Gain, BW, and GB expressions identical

- This is a general concept not related to what type of quarter circuit is used
- Performance may be different because n-channel and p-channel performance different

Inputs into Counterpart Circuit or Quarter Circuit for single-transistor quarter circuit

5T Op Amp with n-ch inputs

5T Op Amp with p-ch inputs



Gain, BW, and GB expressions identical

- Performance may be different because n-channel and p-channel performance different
- Both are widely used

Single-stage op amps

Question – is the gain achievable with the single-stage low-gain op amps using a single MOS transistor as a quarter circuit adequate?

$$\mathbf{A_{V0}} = \left[\frac{\mathbf{1}}{\boldsymbol{\lambda_1} + \boldsymbol{\lambda_3}}\right]\left(\frac{\mathbf{1}}{\mathbf{V_{EB1}}}\right)$$

If $\lambda_1=\lambda_3=.01V^{-1}$ and $V_{EB1}=.15V$, then

$$A_{V0} \approx \frac{1}{(.01+.01)}\frac{1}{0.15} = 333$$

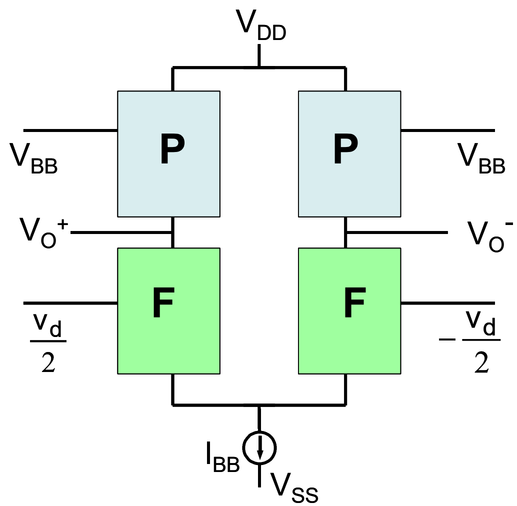
or, in db, $A_{V0db}=20\log_{10}333=50db$

This is inadequate for many applications !

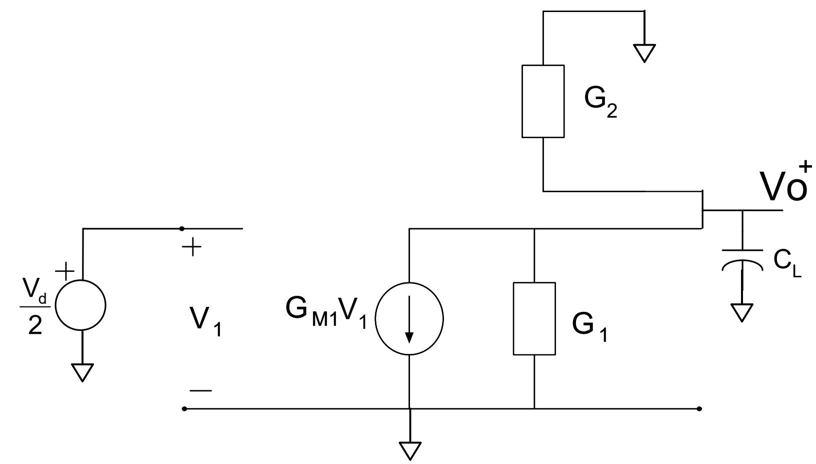
What can be done about it ?

Recall from a previous lecture:

Determination of op amp characteristics from quarter circuit characteristics



Small signal differential half-circuit



$$A_V = \frac{V_O^+}{V_d} = \frac{-\frac{G_{M1}}{2}}{sC_L + G_1 + G_2}$$

$$\boxed{A_{VO} = \frac{-G_{M1}}{2(G_1 + G_2)}}$$

$$BW = \frac{G_1 + G_2}{C_L}$$

$$GB = \frac{G_{M1}}{2C_L}$$

Recall from a previous lecture:

Single-Stage High Gain Op Amps

How can the gain of the op amp be increased?

Recall from Quarter-Circuit Concept

$$A_{VO} = \frac{1}{2}\;\frac{-G_{M1}}{G_1 + G_2}$$

A possible strategy :

Increase G_{M1} or Decrease G_1 (and G_2) in Quarter Circuit or Both

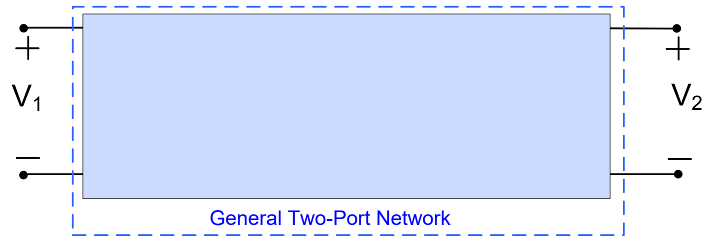
Recall from a previous lecture:

Single-Stage High-Gain Op Amps

- If the output conductance can be decreased without changing the transconductance, the gain can be enhanced

- Will concentrate on quarter-circuits and extend to op amps

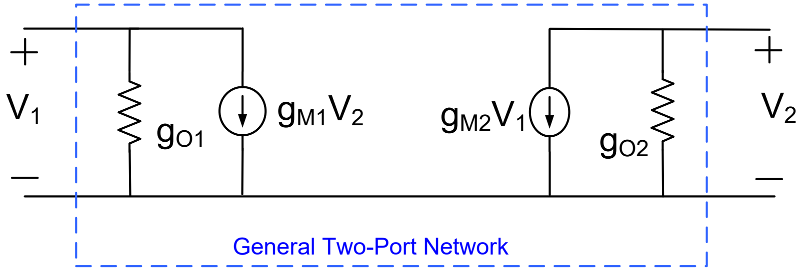
Determination of 2-port parameters



Determination of $\{g_{o1}, g_{o2}, g_{M1}, g_{M2}\}$

Method 1 Open-Short Termination Approach

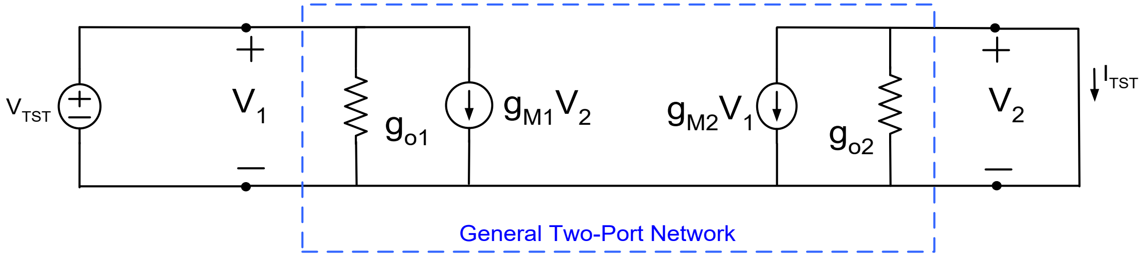
Method 2 Load Termination Approach



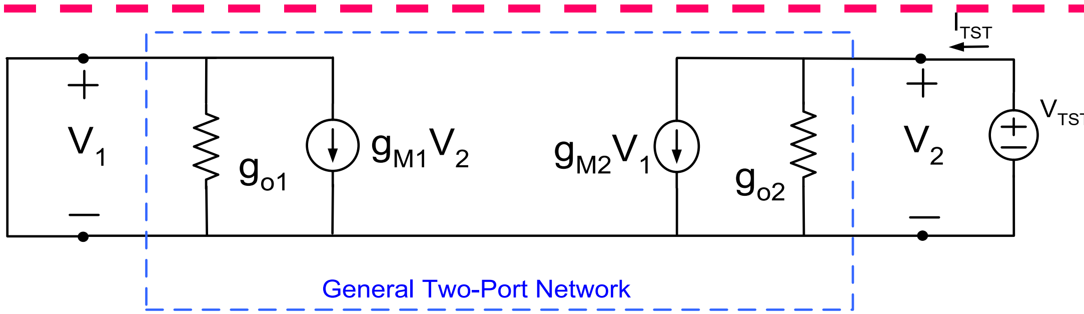
Determination of 2-port parameters

Determination of $\{g_{o1}, g_{o2}, g_{M1}, g_{M2}\}$

Method 1 Open-Short Termination Approach



$$g_{M2} = -\frac{I_{TST}}{V_{TST}}$$



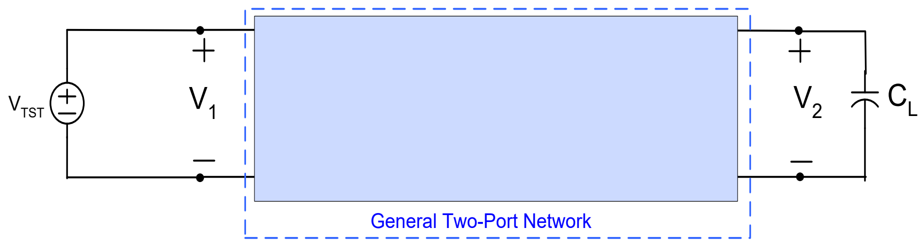
$$g_{o2} = \frac{I_{TST}}{V_{TST}}$$

By structural symmetry, repeat to obtain g_{m1} and g_{o1}

Determination of 2-port parameters

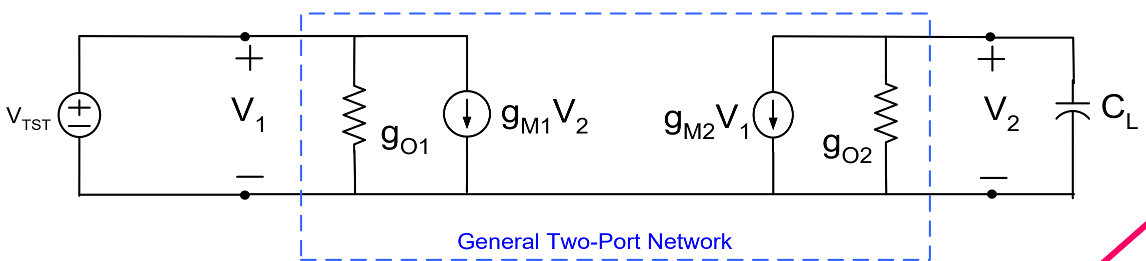
Determination of $\{g_{o1}, g_{o2}, g_{M1}, g_{M2}\}$

Method 2 Load Termination Approach



Since first-order express the gain A(s) in form

$$A(s)=\frac{a_0}{sC_L+b_0}$$



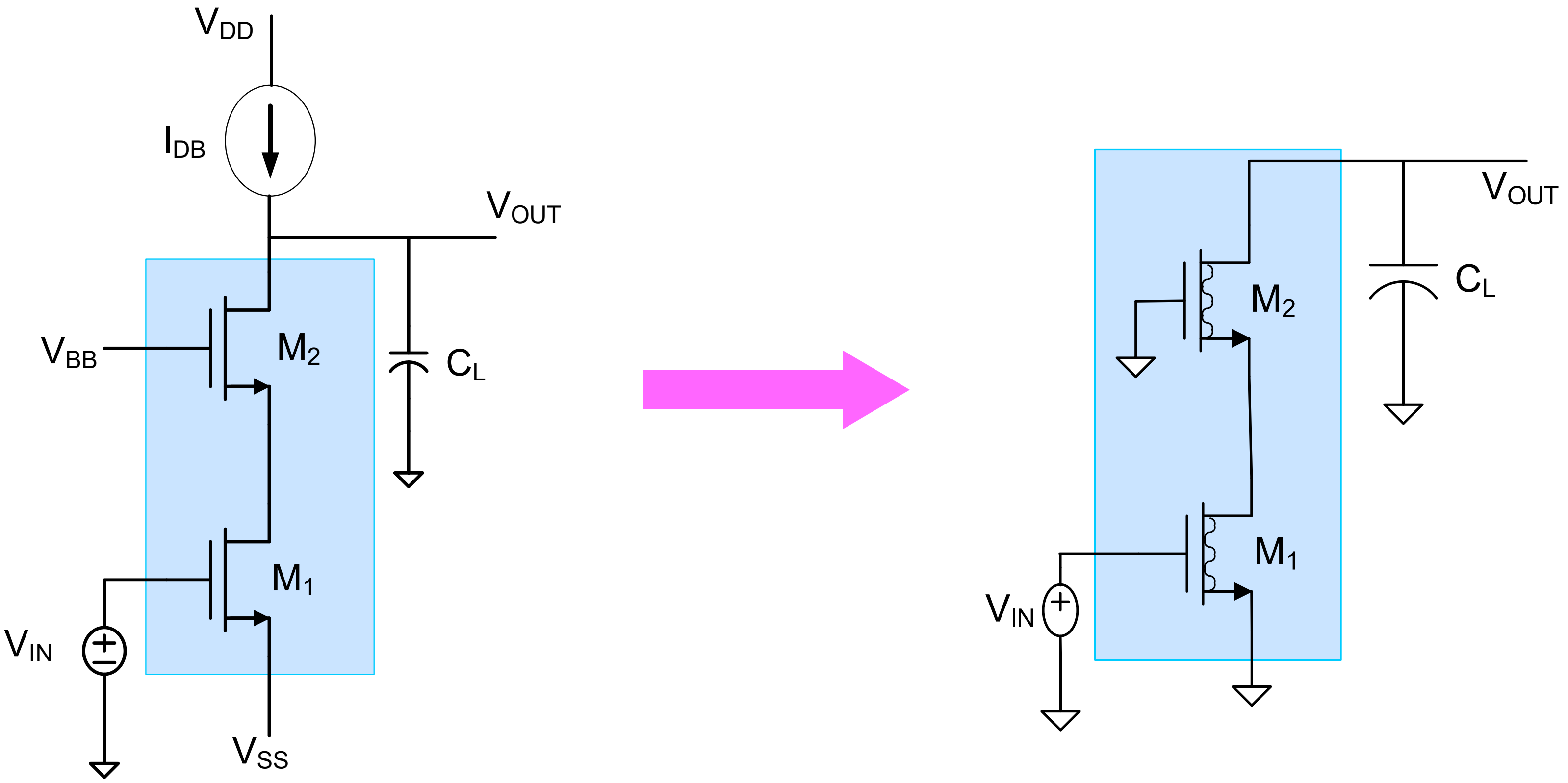
observe

$$V_2(g_{O2}+sC_L)+g_{M2}V_{TST}=0$$

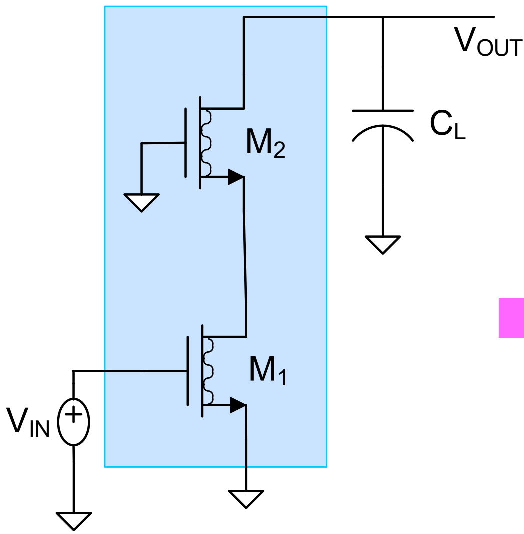
$$A(s)=\frac{V_2(s)}{V_{TST}(s)}=-\frac{g_{M2}}{sC_L+g_{O2}}$$

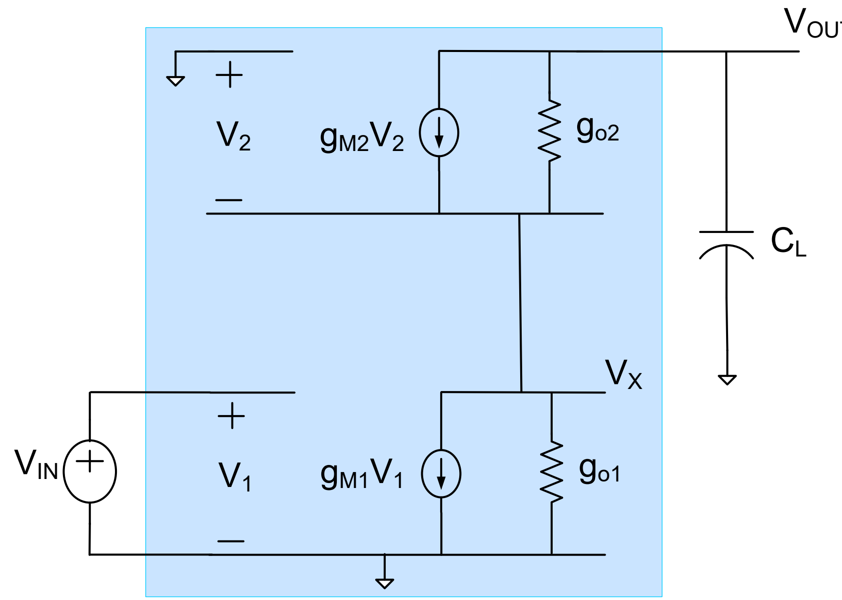
(must express with coefficient of s in den equal to C_L)

Recall Cascode Amplifier (dc current source bias)



Analysis of Cascode Amplifier (dc current source bias)

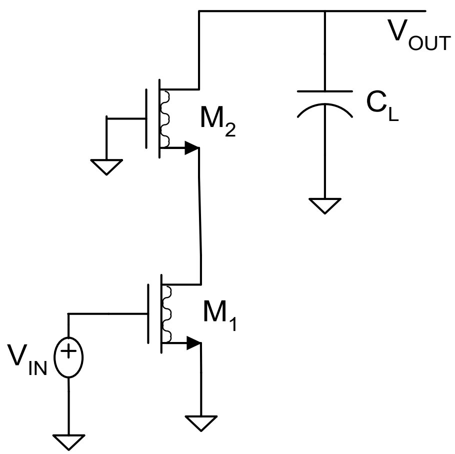




$$\left.\begin{aligned}
&\mathbf{V_{OUT}\left(g_{o2}+sC_L\right)+g_{m2}V_2=V_Xg_{o2}}\\
&\mathbf{V_X\left(g_{o1}+g_{o2}\right)+g_{m1}V_1-g_{m2}V_2=V_{OUT}g_{o2}}\\
&\mathbf{V_2=-V_X}\\
&\mathbf{V_1=V_{IN}}
\end{aligned}\right\}$$

V_X,V_1 and V_2 can be eliminated from these 4 equations

Analysis of Cascode Amplifier



$$\left.\begin{aligned} &V_{OUT}\left(g_{o2}+sC_L\right)+g_{m2}V_2=V_Xg_{o2}\\ &V_X\left(g_{o1}+g_{o2}\right)+g_{m1}V_1-g_{m2}V_2=V_{OUT}g_{o2}\\ &V_2=-V_X\\ &V_1=V_{IN}\end{aligned}\right\}$$

$$\left.\begin{aligned} &V_{OUT}\left(g_{o2}+sC_L\right)-g_{m2}V_X=V_Xg_{o2}\\ &V_X\left(g_{o1}+g_{o2}\right)+g_{m1}V_{IN}+g_{m2}V_X=V_{OUT}g_{o2}\end{aligned}\right\}$$

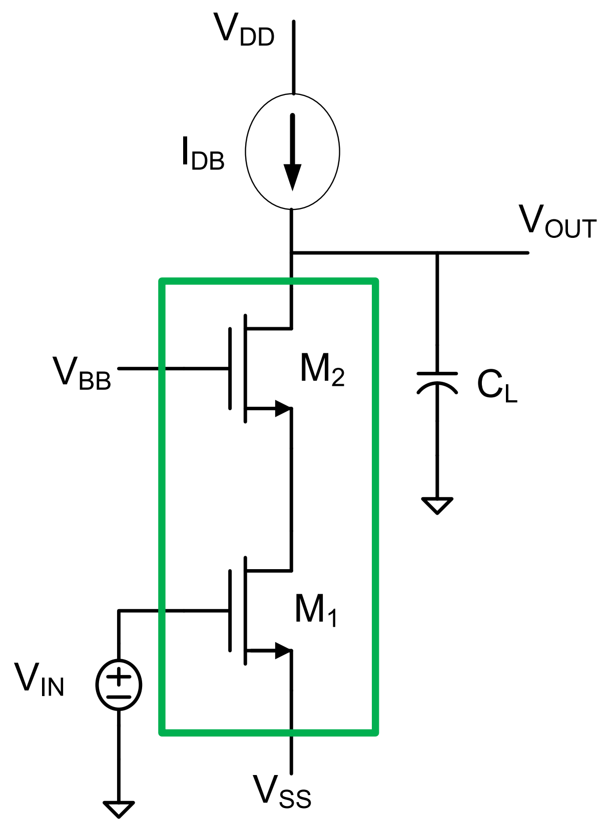
$$\frac{V_{OUT}}{V_{IN}}=\frac{-g_{m1}\left(g_{o2}+g_{m2}\right)}{sC_L\left(g_{o1}+g_{o2}+g_{m2}\right)+g_{o1}g_{o2}}\approx\frac{-g_{m1}g_{m2}}{sC_Lg_{m2}+g_{o1}g_{o2}}$$

$$\frac{V_{OUT}}{V_{IN}}\approx\frac{-g_{m1}}{sC_L+g_{o1}\left(\frac{g_{o2}}{g_{m2}}\right)}$$

g_{MEQ}

g_{OEQ}

High output impedance quarter-circuits



Cascode Amplifier

$$G = g_{OEQ} \cong g_{O1}\left[\frac{g_{O2}}{g_{m2}}\right]$$

$$G_M = g_{mEQ} \cong g_{m1}$$

- **Transconductance appears to be unchanged** **(from basic single-device structure)**
- **Output conductance appears to have been decreased !**

$$A_v(s) \cong \frac{-g_{m1}}{sC_L + g_{o1}\left[\frac{g_{o2}}{g_{m2}}\right]}$$

$$A_{V0} \cong \left(\frac{g_{m1}}{g_{o1}}\right)\left[\frac{g_{m2}}{g_{o2}}\right]$$

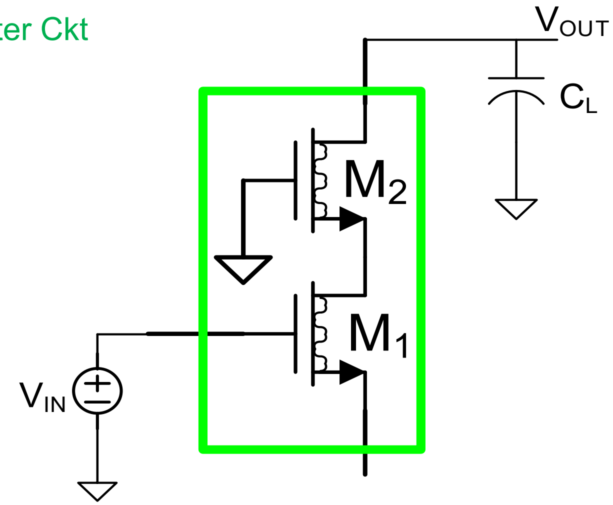
$$GB \cong \frac{g_{m1}}{C_L}$$

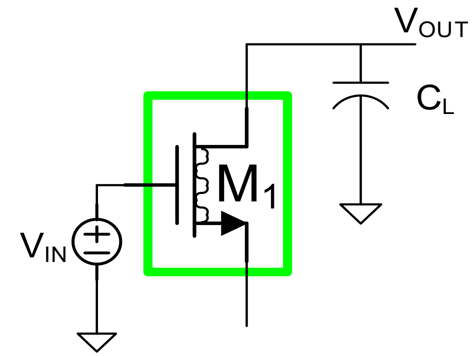
But must verify in the practical parameter domain to be sure!

Comparison of Basic Amplifier and Cascode Amplifier

$$\frac{V_{OUT}}{V_{IN}} = \frac{-G_m}{sC_L + G}$$

General form for any Quarter Ckt





$$\frac{\mathbf{V_{OUT}}}{\mathbf{V_{IN}}} \approx \frac{-\mathbf{g_{m1}}}{\mathbf{sC_L} + \mathbf{g_{o1}}\left(\frac{\mathbf{g_{o2}}}{\mathbf{g_{m2}}}\right)}$$

$$\frac{V_{OUT}}{V_{IN}} = \frac{-g_{m1}}{sC_L + g_{O1}}$$

$$G = g_{OEQ} \cong g_{O1}\left[\frac{g_{O2}}{g_{m2}}\right]$$

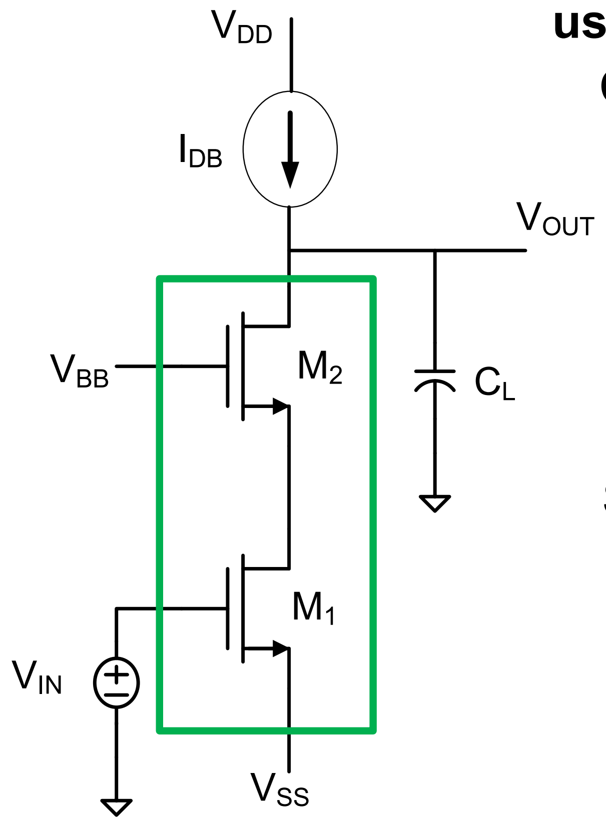
$$G_M = g_{mEQ} \cong g_{m1}$$

$$G = g_{O1}$$

$$G_M = g_{m1}$$

High output impedance quarter-circuits

How does this compare with previous amplifier using single transistor as quarter circuit?



Cascode amplifier quarter circuit:

$$A_{V0} \cong \left[\frac{2}{\lambda_1 V_{EB1}}\right] \bullet \left[\frac{2}{\lambda_2 V_{EB2}}\right]$$

$$GB = \left[\frac{2P}{V_{DD} C_L}\right] \bullet \left[\frac{1}{V_{EB1}}\right]$$

Single transistor quarter circuit:

$$A_{V0} = \left[\frac{2}{\lambda V_{EB}}\right]$$

$$GB = \left(\frac{2P}{V_{DD} C_L}\right) \bullet \left(\frac{1}{V_{EB}}\right)$$

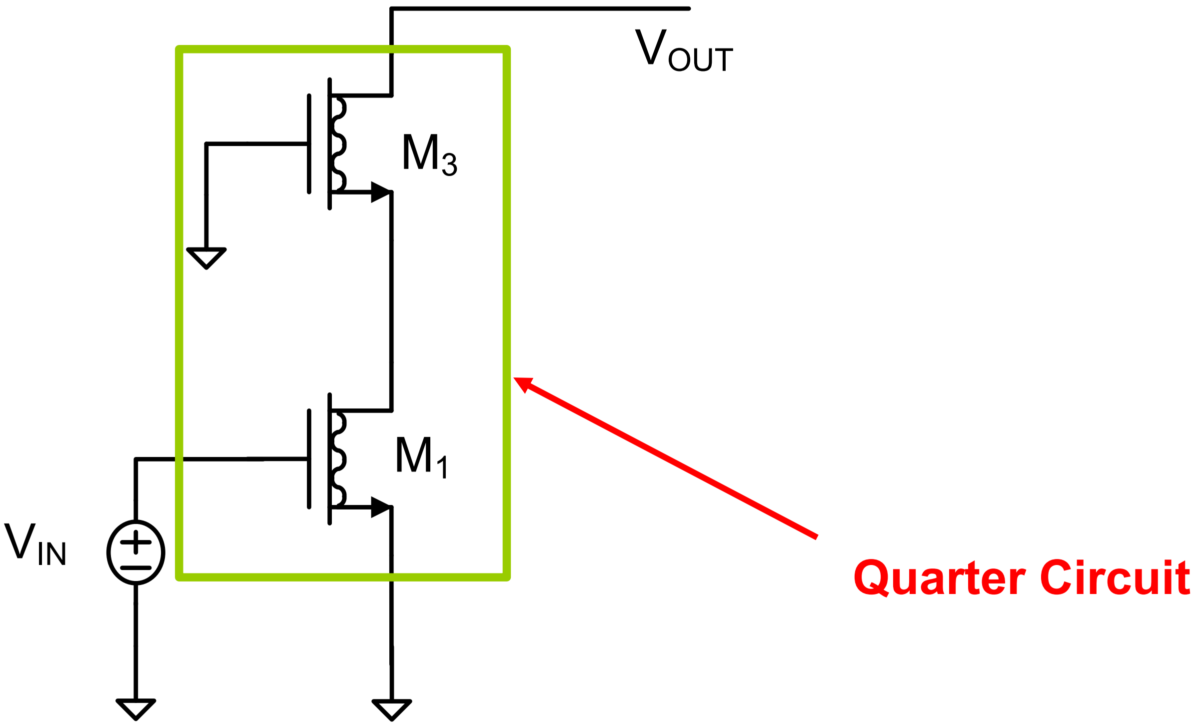
Cascode Amplifier

$$A_{V0} \cong \left(\frac{g_{m1}}{g_{o1}}\right)\left[\frac{g_{m2}}{g_{o2}}\right] \qquad GB \cong \frac{g_{m1}}{C_L}$$

Substantial increase in dc gain

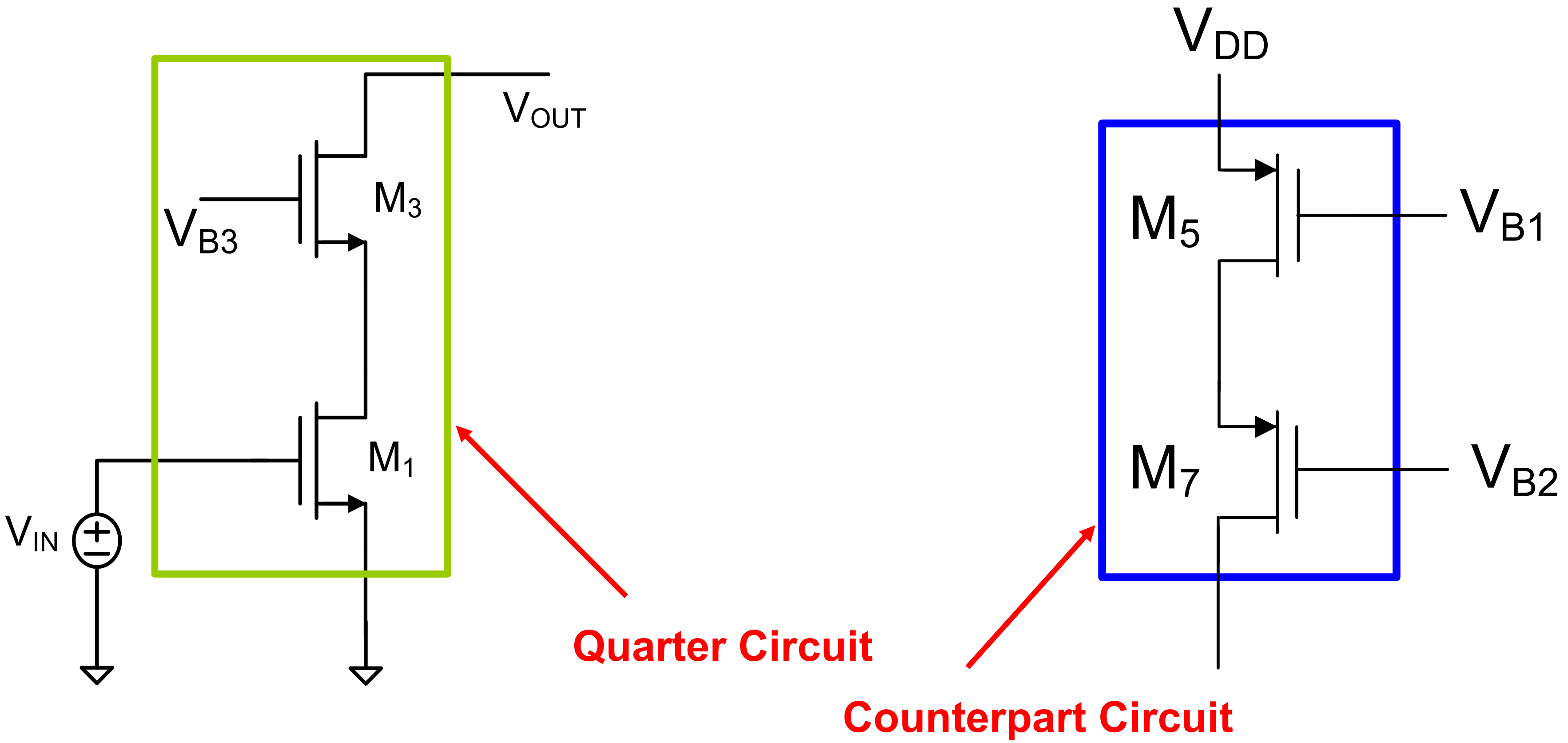
No improvement in GB but also no deterioration in GB !

High output impedance quarter-circuits



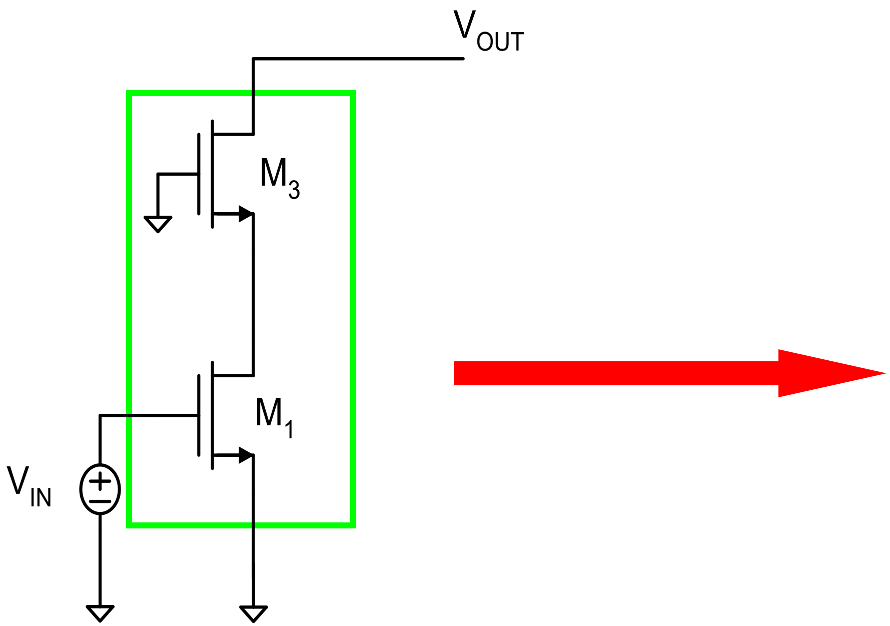
Cascode Amplifier (small-signal equiv)

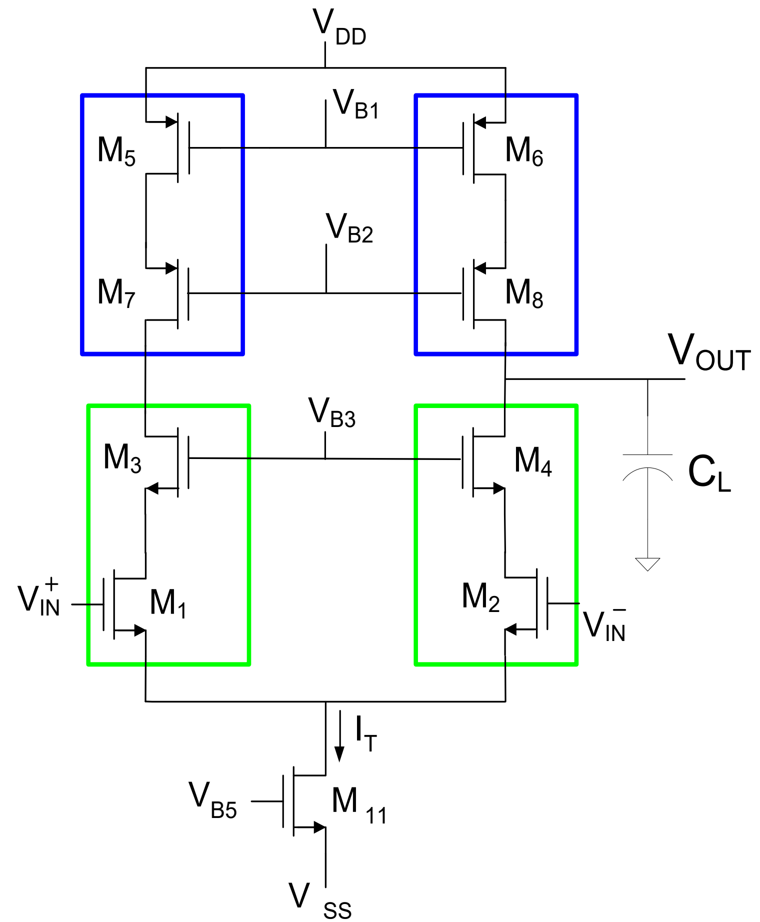
High output impedance quarter-circuits



Cascode Amplifier

Telescopic Cascode Op Amp



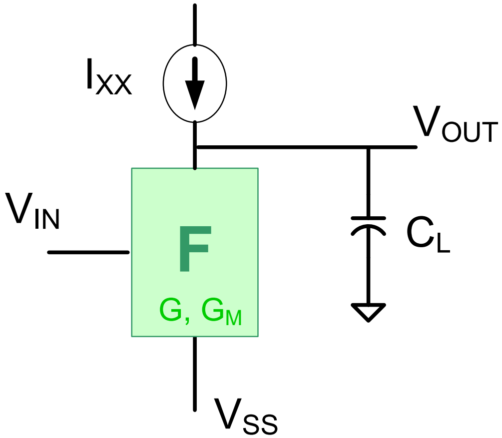


Needs CMFB Circuit for V_{B1} or V_{B5}
Either single-ended or differential outputs
Can connect counterpart as current mirror to eliminate CMFB

Recall:

Determination of op amp characteristics from quarter circuit characteristics (for single-ended gain)

Small signal Quarter Circuit



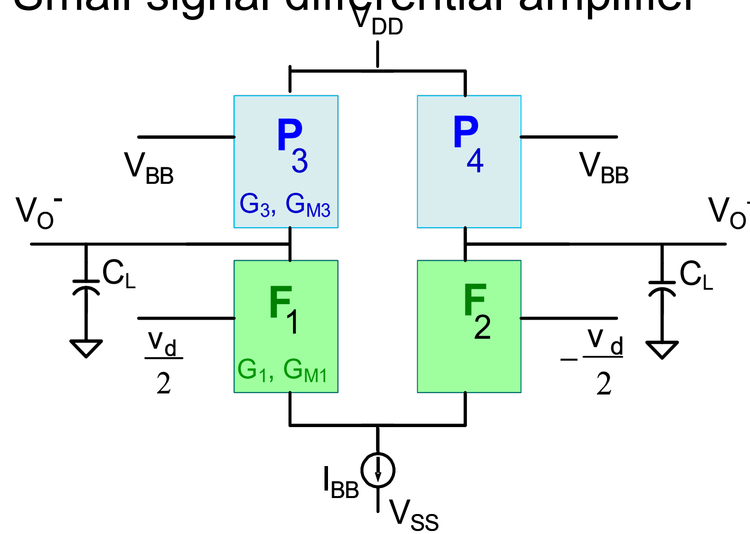
$$A_{V0QC} = -\frac{G_M}{G}$$

$$BW = \frac{G}{C_L}$$

$$GB = \frac{G_M}{C_L}$$

$$A(s) = \frac{-G_M}{sC_L + G}$$

Small signal differential amplifier



$$A_{V0} = \frac{-\frac{G_{M1}}{2}}{(G_1 + G_3)}$$

$$BW = \frac{G_1 + G_3}{C_L}$$

$$GB = \frac{G_{M1}}{2C_L}$$

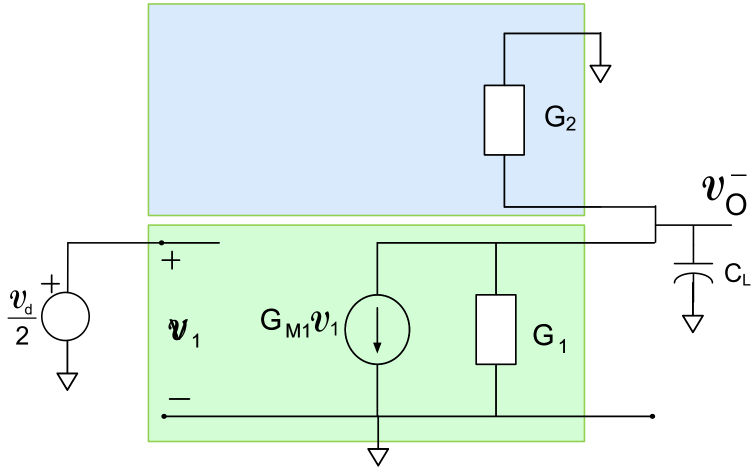
$$A(s) = \frac{-\frac{G_{M1}}{2}}{sC_L + G_1 + G_3}$$

Note: Factor of 4 reduction of single-ended gain (for G_1=G_2)

Recall equivaletly:

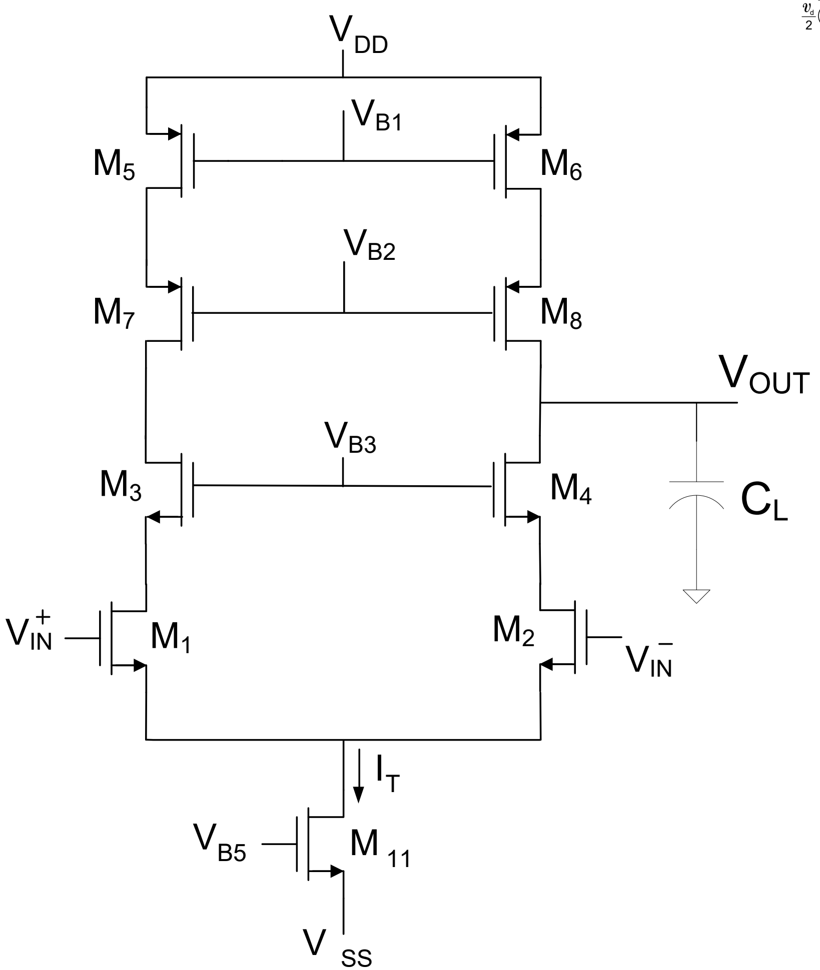
Recall from earlier lecture:

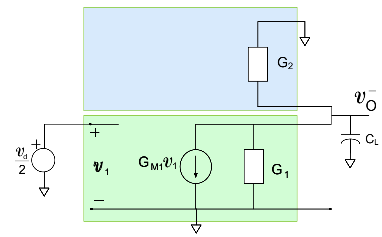
-- The “differential” gain --



$$A_{Vd} = \frac{v_o^-}{v_d} = \frac{-\frac{G_{M1}}{2}}{sC_L + G_1 + G_2}$$

Telescopic Cascode Op Amp





$$A_{Vd}=\frac{v_o^-}{v_d}=\frac{-\frac{G_{M1}}{2}}{sC_L+G_1+G_2}$$

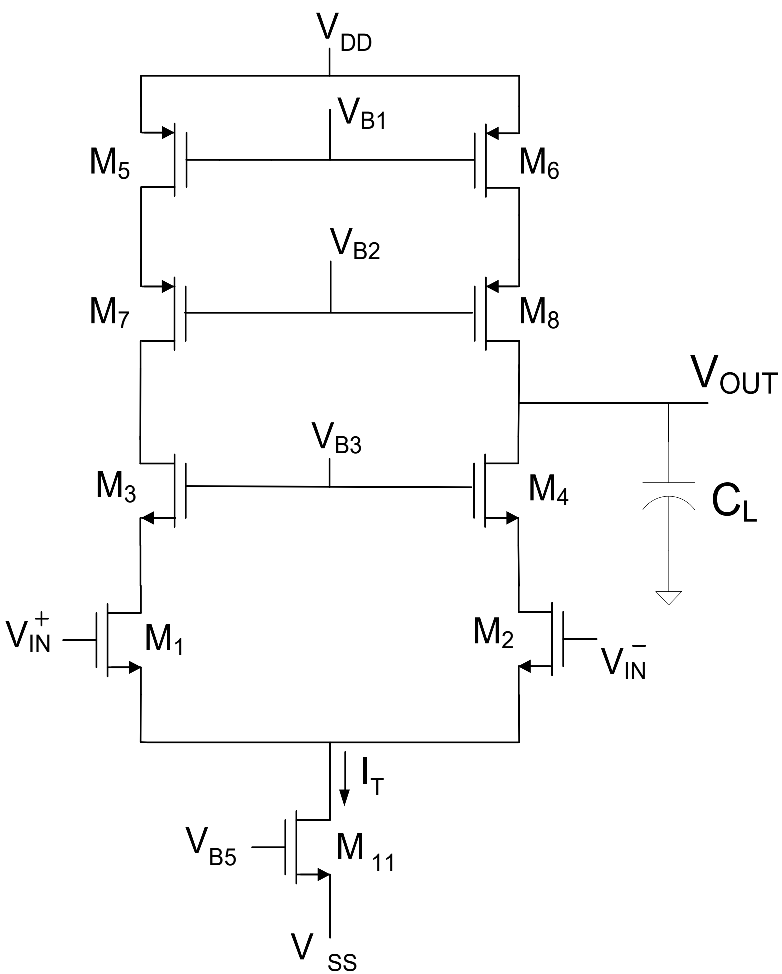
Single-ended operation

$G_1=g_{OQC}=$ ____________________

$G_2=g_{OCC}=$ ____________________

$G_{M1}=g_{mQC}=$ ____________________

Telescopic Cascode Op Amp



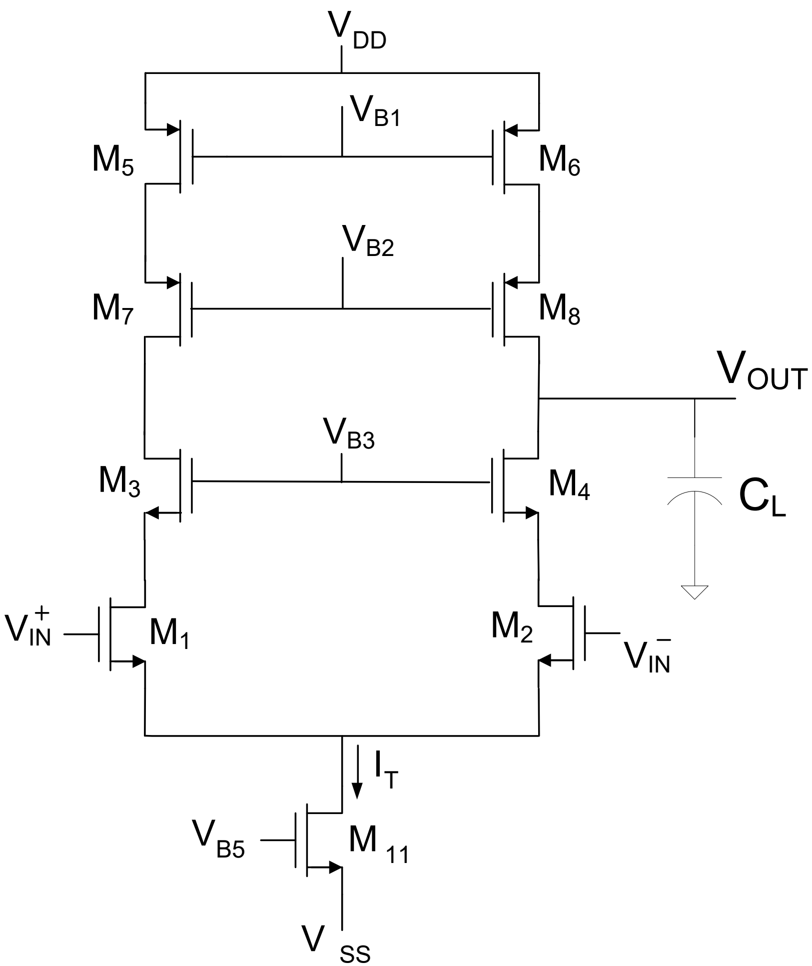
Single-ended operation

$$A_d(s) = \frac{-\frac{g_{m1}}{2}}{sC_L + g_{o1}\frac{g_{o3}}{g_{m3}} + g_{o5}\frac{g_{o7}}{g_{m7}}}$$

$$A_o = \frac{-\frac{g_{m1}}{2}}{g_{o1}\frac{g_{o3}}{g_{m3}} + g_{o5}\frac{g_{o7}}{g_{m7}}}$$

$$GB = \frac{g_{m1}}{2C_L}$$

Telescopic Cascode Op Amp



(CMFB circuit not shown)

Single-ended operation

$$A_d(s)=\frac{-\frac{g_{m1}}{2}}{sC_L+g_{o1}\frac{g_{o3}}{g_{m3}}+g_{o5}\frac{g_{o7}}{g_{m7}}}$$

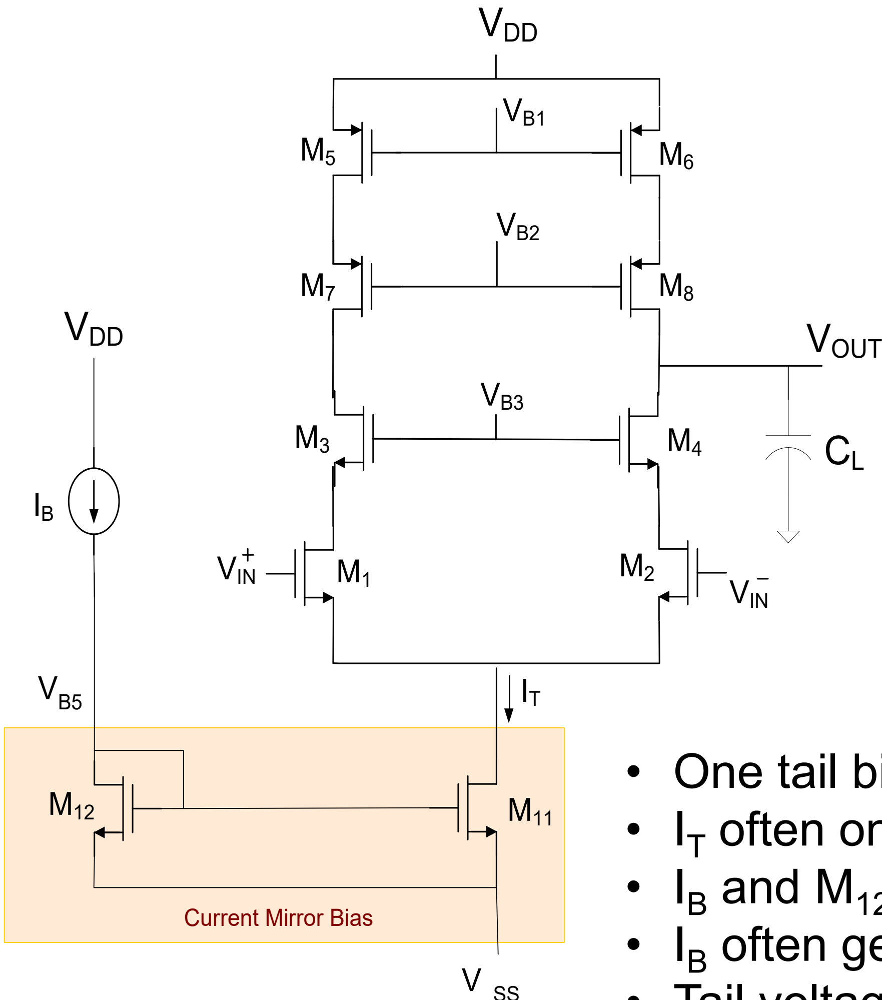
$$A_o=\frac{-\frac{g_{m1}}{2}}{g_{o1}\frac{g_{o3}}{g_{m3}}+g_{o5}\frac{g_{o7}}{g_{m7}}}$$

$$GB=\frac{g_{m1}}{2C_L}$$

- Large improvement in A_0
- No change in GB

This circuit is widely used !!

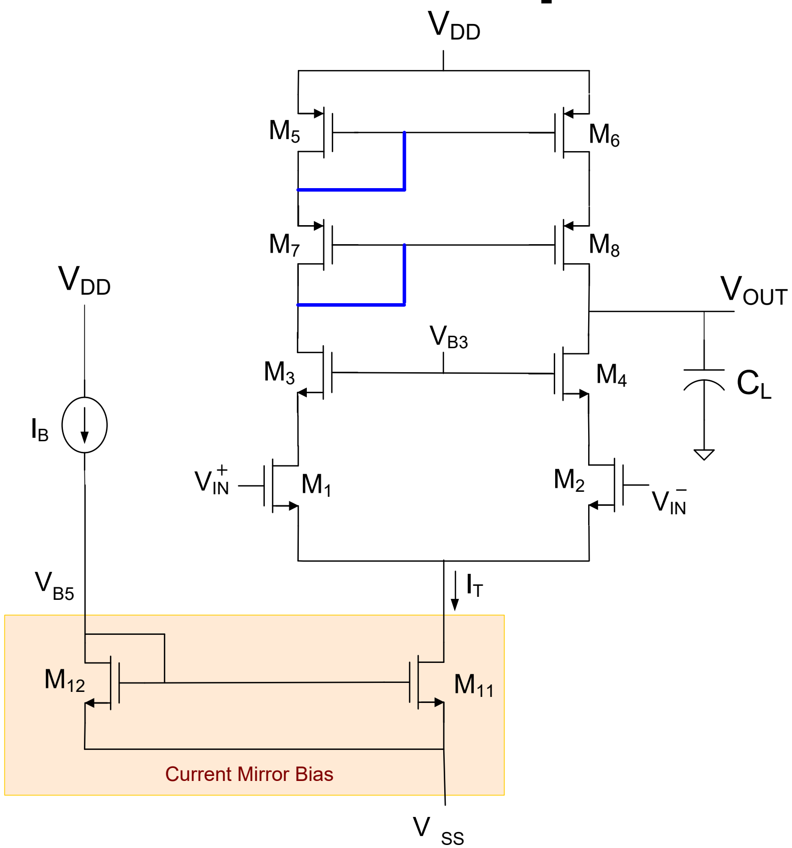
Telescopic Cascode Op Amp



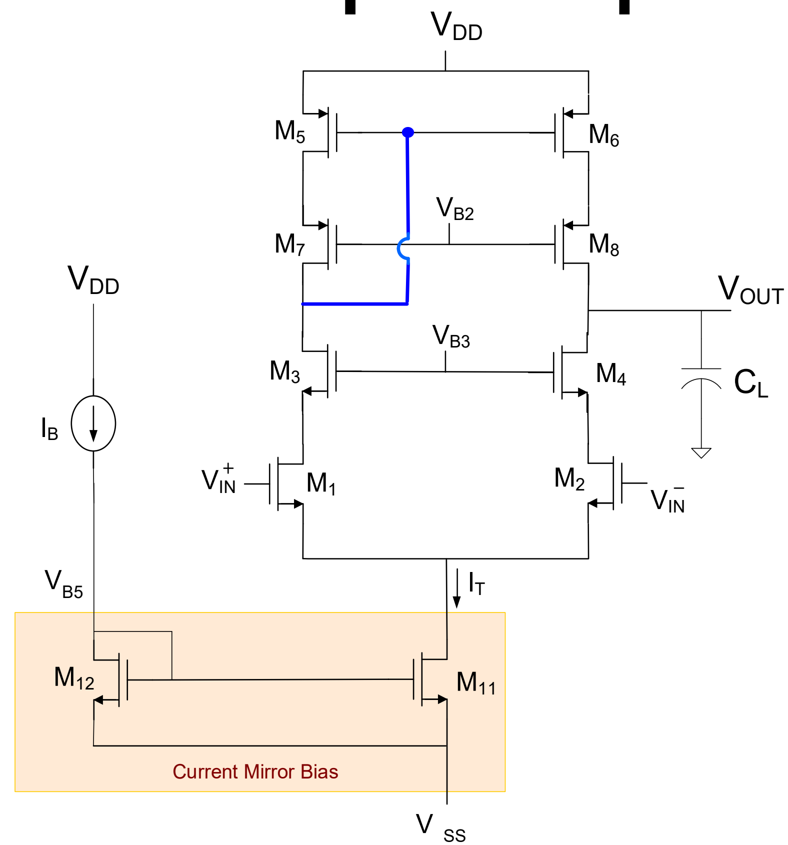
- One tail bias current generator shown
- I_T often one of many outputs of a current mirror
- I_B and M_{12} often common to many blocks
- I_B often generated from a reference generator circuit
- Tail voltage bias can also be used

(CMFB circuit not shown)

Telescopic Cascode Op Amp



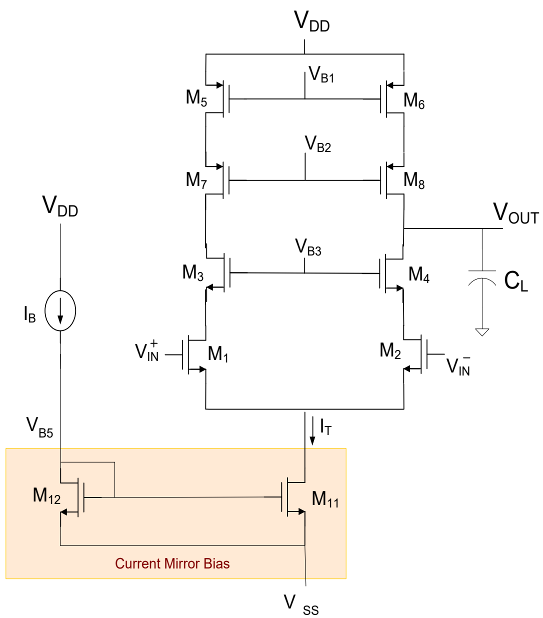
Standard p-channel Cascode Mirror



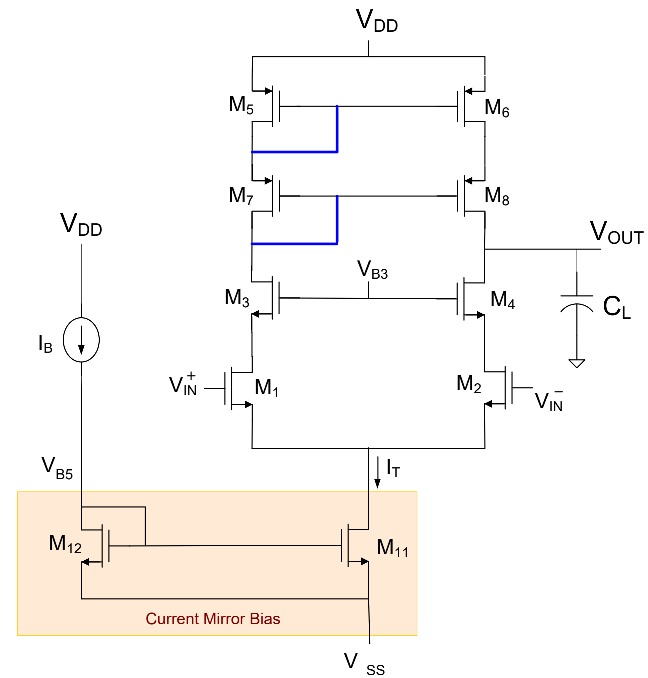
Wide-Swing p-channel Cascode Mirror

- Current-Mirror p-channel Bias to Eliminate CMFB
- Only single-ended output available
- Doubles dc gain

Telescopic Cascode Op Amp



(CMFB circuit needed)



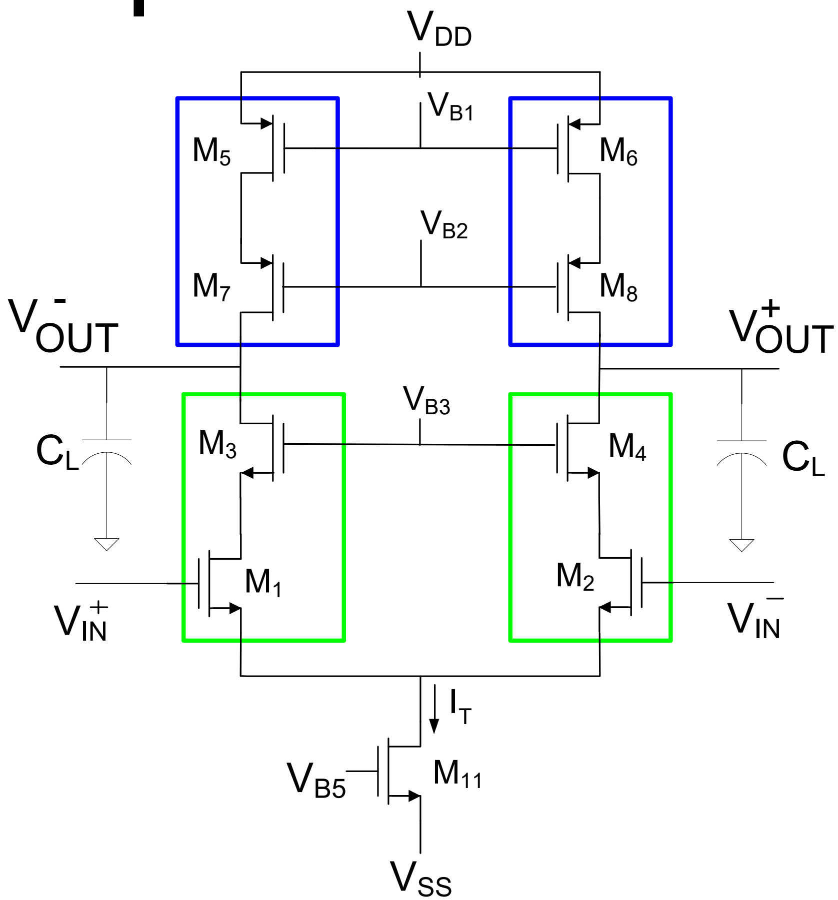
(No CMFB circuit needed)

$$A_d(s)=\frac{-\frac{g_{m1}}{2}}{sC_L+g_{o1}\frac{g_{o3}}{g_{m3}}+g_{o5}\frac{g_{o7}}{g_{m7}}}$$

?

$$A_d(s)=\frac{-g_{m1}}{sC_L+g_{o1}\frac{g_{o3}}{g_{m3}}+g_{o5}\frac{g_{o7}}{g_{m7}}}$$

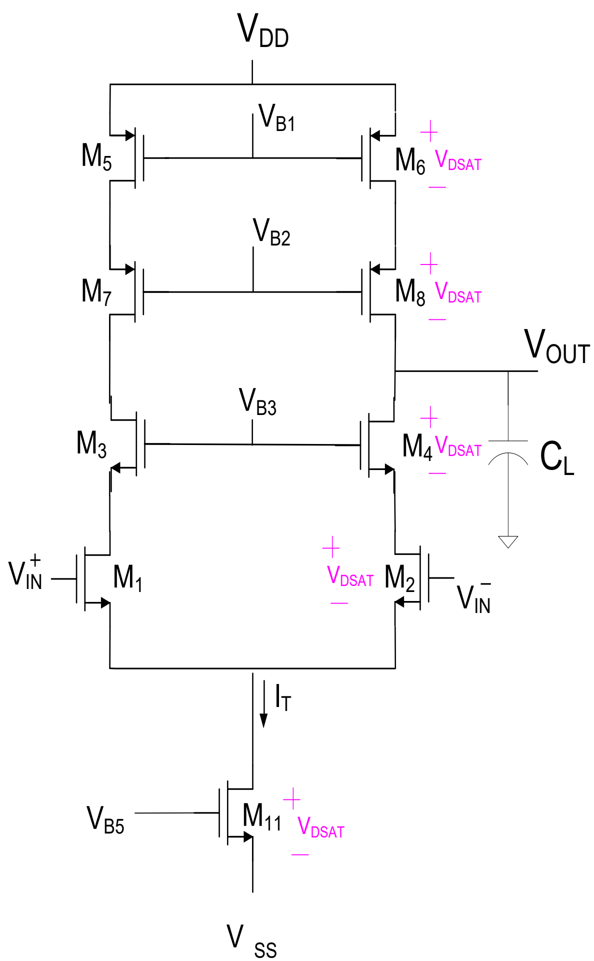
Telescopic Cascode Op Amp



- Differential Output
- CMFB to establish V_{B1} or V_{B5} needed
- Tail current generally generated with current mirror

Telescopic Cascode Op Amp

Signal Swing and Power Supply Limitations

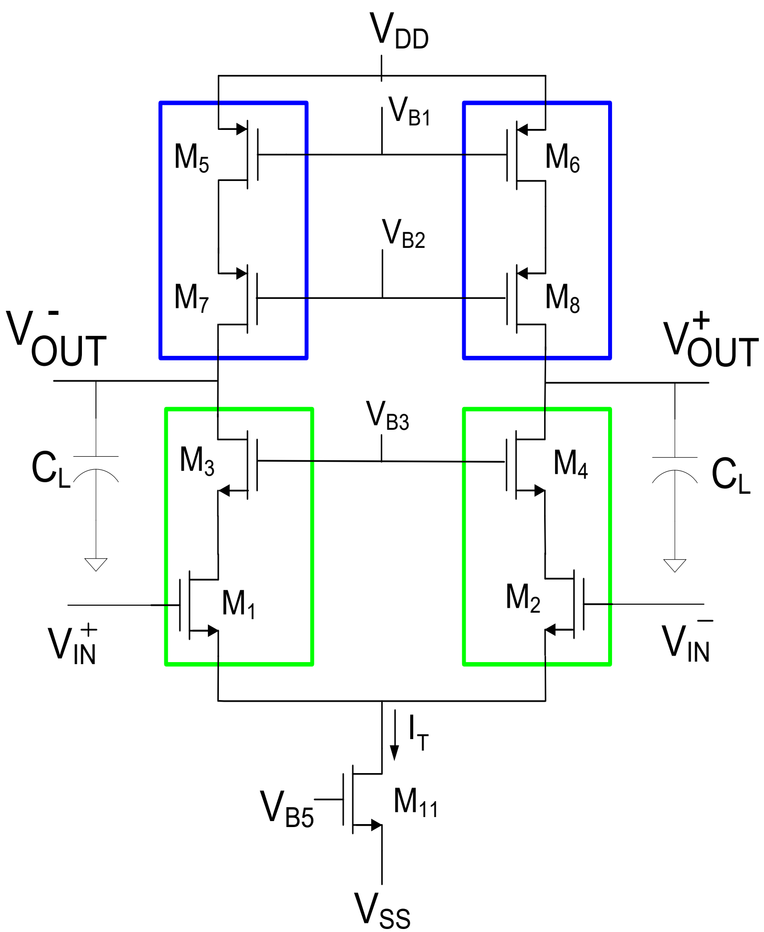


There are a minimum of 2 V_{DSAT} drops between V_{OUT} and V_{DD} and a minimum of 3 V_{DSAT} drops between V_{OUT} and V_{SS}

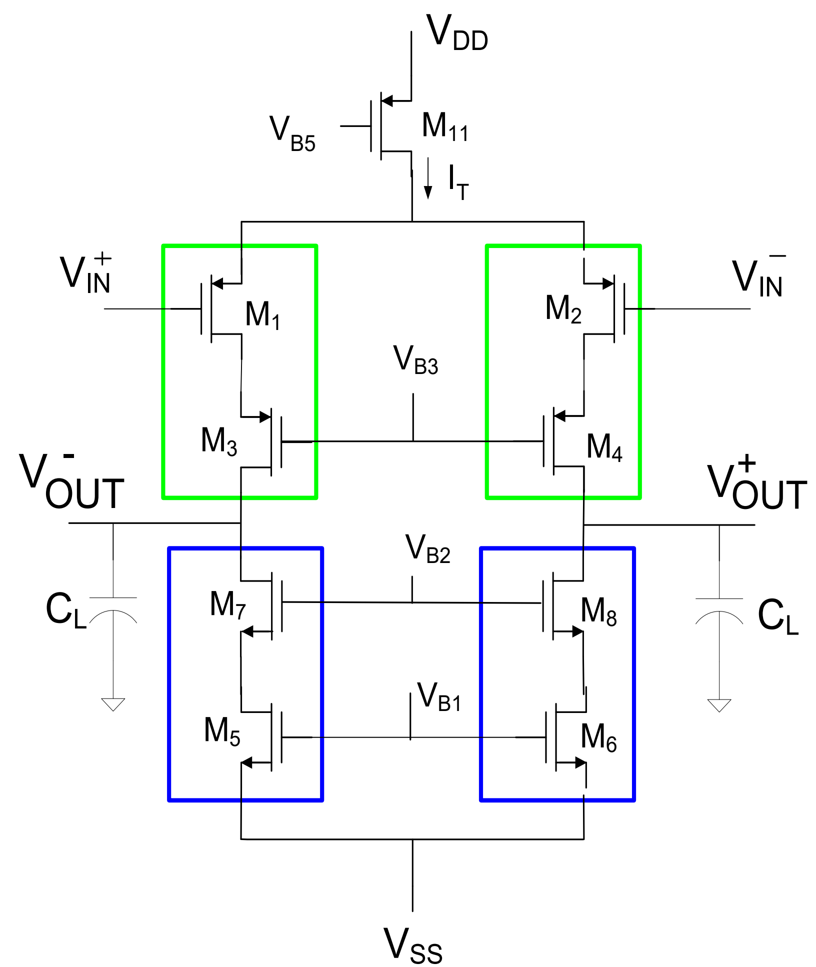
Thus, there are a minimum of 5 V_{DSAT} drops between V_{DD} and V_{SS}

This establishes a lower bound on V_{DD}-V_{SS} and it will be further reduced by the p-p signal swing required on the output

Telescopic Cascode Op Amp



n-channel inputs

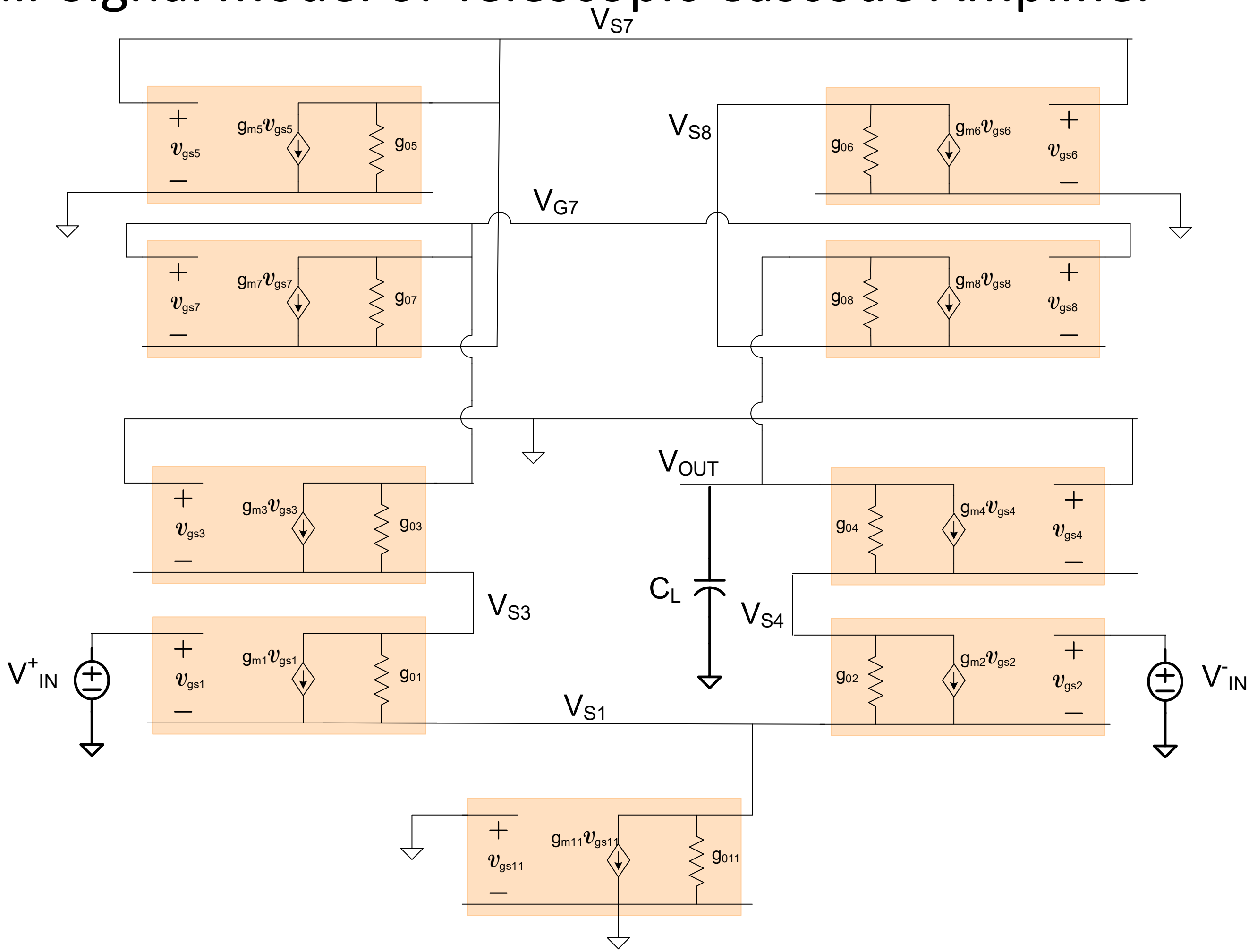


p-channel inputs

How important is it to develop good approximate analysis methods for an op amp with the complexity of the telescopic cascode structure?

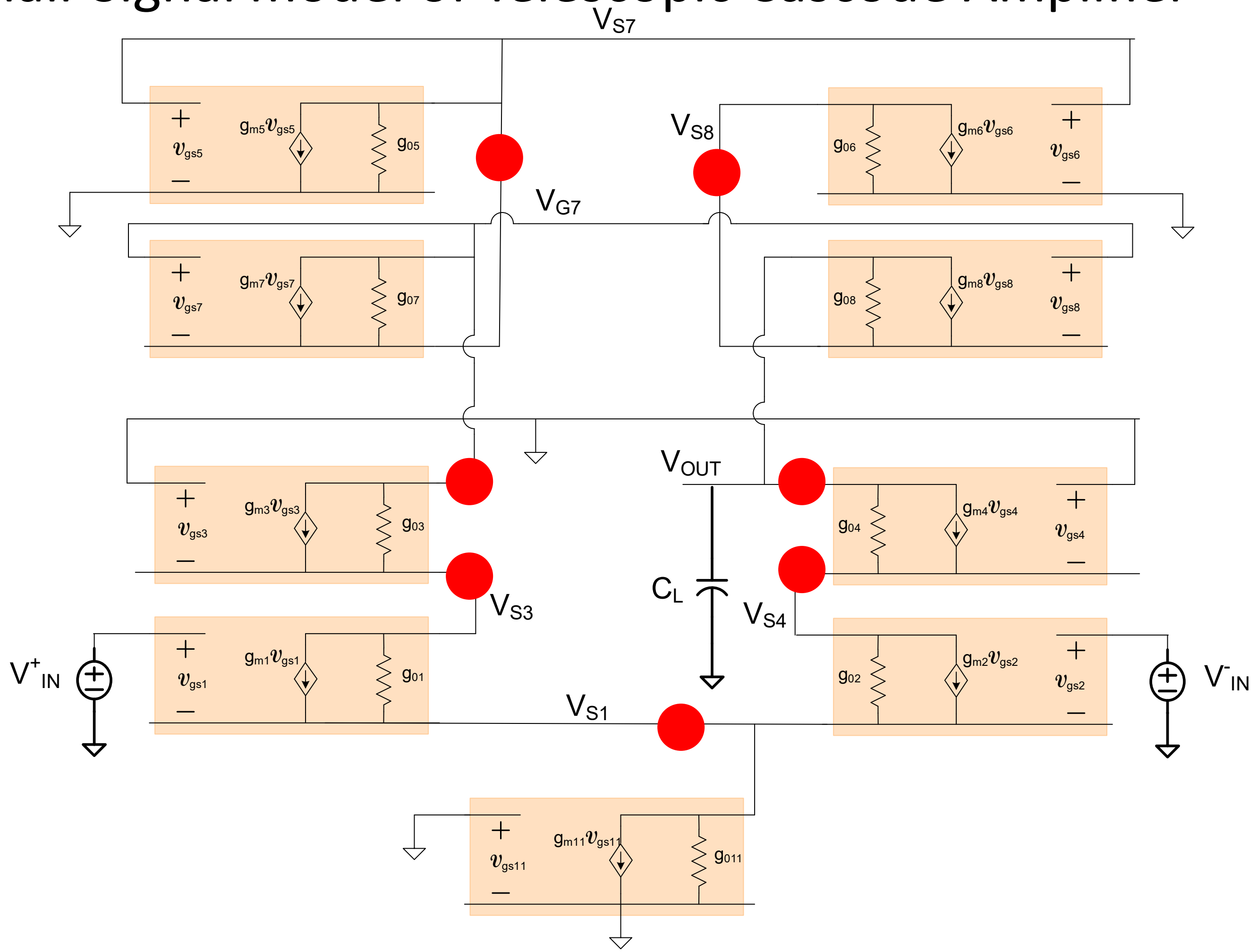
And many useful op amp circuits will have more complexity !!

Small-Signal model of Telescopic Cascode Amplifier

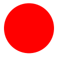


A bit tedious to obtain but really straight forward

Small-Signal model of Telescopic Cascode Amplifier



A bit tedious to obtain but really straight forward

 Non-ground nodes for small-signal nodal analysis

Analysis of Telescopic Cascode Amplifier

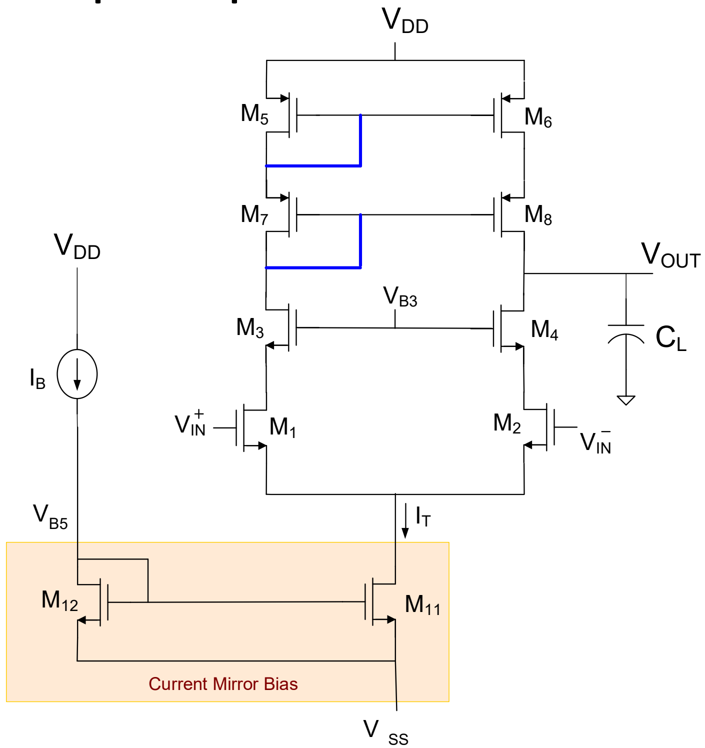
Apply KCL at 7 nodes to obtain a set of 7 independent linear equations

$$\left.\begin{aligned}
&V_{S1}\left(g_{01}+g_{02}+g_{011}\right)=V_{S3}g_{01}+V_{S4}g_{02}+g_{m1}\left(V_{IN}^{+}-V_{S1}\right)+g_{m2}\left(V_{IN}^{-}-V_{S1}\right)\\
&V_{S3}\left(g_{01}+g_{03}\right)+g_{m1}\left(V_{IN}^{+}-V_{S1}\right)=g_{01}V_{S1}+g_{03}V_{G7}-g_{m3}V_{S3}\\
&V_{S4}\left(g_{02}+g_{04}\right)+g_{m2}\left(V_{IN}^{-}-V_{S1}\right)=g_{02}V_{S1}+g_{04}V_{OUT}-g_{m4}V_{S4}\\
&V_{OUT}\left(sC_{L}+g_{04}+g_{08}\right)-g_{m4}V_{S4}+g_{m8}\left(V_{G7}-V_{S8}\right)=g_{04}V_{S4}+g_{08}V_{S8}\\
&V_{G7}\left(g_{07}+g_{03}\right)+g_{m7}\left(V_{G7}-V_{S7}\right)-g_{m3}V_{S3}=g_{03}V_{S3}+g_{07}V_{S7}\\
&V_{S8}\left(g_{06}+g_{08}\right)+g_{m8}V_{S7}=g_{m8}\left(V_{G7}-V_{S8}\right)+V_{OUT}g_{08}\\
&V_{S7}\left(g_{05}+g_{07}\right)+g_{m5}V_{S7}=g_{m7}\left(V_{G7}-V_{S7}\right)+g_{07}V_{G7}
\end{aligned}\right\}$$

A bit tedious to obtain but really straight forward

Time required to obtain set of equations is quite small

Telescopic Cascode Op Amp with Mirror-connected Counterpart Circuit



- Previous analysis obtained almost by inspection
- Gain expressions were real simple
- Gain expressions provide major insight into operation
- Some assumptions were made to simplify analysis
  - Vac=0 at "approximate axis of symmetry"
  - Matched left and right side transistors
  - Current mirror used to mirror left-side current to right side

How much more involved would an exact analysis be ?

Would an exact analysis provide additional insight ?

Analysis of Telescopic Cascode Amplifier

Apply KCL at 7 nodes to obtain a set of 7 independent linear equations

$$\left.\begin{aligned}
&V_{S1}\left(g_{01}+g_{02}+g_{011}\right)=V_{S3}g_{01}+V_{S4}g_{02}+g_{m1}\left(V_{IN}^{+}-V_{S1}\right)+g_{m2}\left(V_{IN}^{-}-V_{S1}\right)\\
&V_{S3}\left(g_{01}+g_{03}\right)+g_{m1}\left(V_{IN}^{+}-V_{S1}\right)=g_{01}V_{S1}+g_{03}V_{G7}-g_{m3}V_{S3}\\
&V_{S4}\left(g_{02}+g_{04}\right)+g_{m2}\left(V_{IN}^{-}-V_{S1}\right)=g_{02}V_{S1}+g_{04}V_{OUT}-g_{m4}V_{S4}\\
&V_{OUT}\left(sC_{L}+g_{04}+g_{08}\right)-g_{m4}V_{S4}+g_{m8}\left(V_{G7}-V_{S8}\right)=g_{04}V_{S4}+g_{08}V_{S8}\\
&V_{G7}\left(g_{07}+g_{03}\right)+g_{m7}\left(V_{G7}-V_{S7}\right)-g_{m3}V_{S3}=g_{03}V_{S3}+g_{07}V_{S7}\\
&V_{S8}\left(g_{06}+g_{08}\right)+g_{m8}V_{S7}=g_{m8}\left(V_{G7}-V_{S8}\right)+V_{OUT}g_{08}\\
&V_{S7}\left(g_{05}+g_{07}\right)+g_{m5}V_{S7}=g_{m7}\left(V_{G7}-V_{S7}\right)+g_{07}V_{G7}
\end{aligned}\right\}$$

In matrix form, this looks like (0 in blank locations)

$$\begin{bmatrix}
a_{11} & a_{12} & a_{13} & & & & \\
a_{21} & a_{22} & & & & a_{26} & \\
a_{31} & & a_{33} & & & & a_{37}\\
 & & a_{43} & & a_{45} & a_{46} & a_{47}\\
 & a_{52} & & a_{54} & & a_{56} & \\
 & & & a_{64} & a_{65} & a_{66} & a_{67}\\
 & & & a_{74} & & a_{76} &
\end{bmatrix}
\begin{bmatrix} V_{S1}\\ V_{S3}\\ V_{S4}\\ V_{S7}\\ V_{S8}\\ V_{G7}\\ V_{OUT}\end{bmatrix}
=
\begin{bmatrix} g_{m1} & g_{m2}\\ g_{m1} & 0\\ 0 & g_{m2}\\ 0 & 0\\ 0 & 0\\ 0 & 0\\ 0 & 0\end{bmatrix}
\begin{bmatrix} V_{IN}^{+}\\ V_{IN}^{-}\end{bmatrix}$$

$$[A]\bullet[V]=[G]\bullet[V_{IN}]$$

$$[V]=[A]^{-1}\bullet[G]\bullet[V_{IN}]$$

- The A matrix has many 0's which dramatically reduces complexity of solution
- But there are still a large number of off-diagonal terms

Analytical solution of these equations is not practical

MATLAB

```
%Complete Analysis of Telescopic Cascode Op Amp
diary('matlabdiary')
clear
clc
fprintf('Complete Analysis of Telescopic Cascode Op Amp')
syms Av s CL VOUT VS1 VS3 VS4 VS7 VS8 VG7 Vinn Vinp  g01 g02 g03 g04 g05
g06 g07 g08 g011 gm1 gm2 gm3 gm4 gm5 gm6 gm7 gm8
eqn1 =VS1*(gm1+gm2+g01+g02+g011)==VS3*g01+VS4*g02+Vinp*gm1+gm2*Vinn;
eqn2 = VS3*(gm3+g01+g03)+gm1*Vinp==VS1*(g01+gm1)+VG7*g03;
eqn3 = VS4*(gm4+g02+g04)+Vinn*gm2==VS1*(gm2+g02)+VOUT*g04;
eqn4 = VOUT*(s*CL+g04+g08)+VG7*gm8==VS4*(gm4+g04)+VS8*(gm8+g08);
eqn5 = VG7*(gm7+g07+g03)==VS3*(gm3+g03)+VS7*(gm7+g07);
eqn6 = VS8*(gm8+g06+g08)+VS7*gm8==VG7*gm8+VOUT*g08;
eqn7 = VS7*(gm7+gm5+g05+g07)==VG7*(gm7+g07);
eqn8 = Av==VOUT/Vinp;
sol=solve([eqn1,eqn2,eqn3,eqn4,eqn5,eqn6,eqn7,eqn8],[VOUT,VS1,VS3,VS4,VS7,
VS8,VG7,Av]);
VOUTX=sol.VOUT
collect(VOUTX,Vinn)
```

Simple program and effort to write program is small

MATLAB

```
fprintf('Differential Analysis of Telescopic Cascode Op Amp')
syms Av s CL VOUT VS1 VS3 VS4 VS7 VS8 VG7 Vdiff g01 g02 g03 g04 g05 g06 g07 g08 g011 gm1 gm2 gm3
gm4 gm5 gm6 gm7 gm8
eqn1 =VS1*(gm1+gm2+g01+g02+g011)==VS3*g01+VS4*g02+Vdiff*gm1/2-gm2*Vdiff/2;
eqn2 = VS3*(gm3+g01+g03)+gm1*Vdiff/2==VS1*(g01+gm1)+VG7*g03;
eqn3 = VS4*(gm4+g02+g04)-Vdiff*gm2/2==VS1*(gm2+g02)+VOUT*g04;
eqn4 = VOUT*(s*CL+g04+g08)+VG7*gm8==VS4*(gm4+g04)+VS8*(gm8+g08);
eqn5 = VG7*(gm7+g07+g03)==VS3*(gm3+g03)+VS7*(gm7+g07);
eqn6 = VS8*(gm8+g06+g08)+VS7*gm8==VG7*gm8+VOUT*g08;
eqn7 = VS7*(gm7+gm5+g05+g07)==VG7*(gm7+g07);
eqn8 = Av==VOUT/Vdiff;
sol=solve([eqn1,eqn2,eqn3,eqn4,eqn5,eqn6,eqn7,eqn8],[VOUT,VS1,VS3,VS4,VS7,VS8,VG7,Av]);
VOUTX=sol.VOUT;
GainAv=sol.Av
collect(GainAv,s)
```

Simple program and effort to write program is small

MATLAB simulation results using Symbolic Math Toolbox

Analysis with Vin+ and Vin-

MATLAB Solution:

```
VOUTX =

(-(g01*g03*g04*g07*gm2*gm8^2 + g01*g03*g04*gm2*gm7*gm8^2 + g01*g03*g07*gm2*gm4*gm8^2 +
g01*g04*g07*gm2*gm3*gm8^2 + g03*g04*g07*gm1*gm2*gm8^2 + g01*g03*gm2*gm4*gm7*gm8^2 +
g01*g04*gm2*gm3*gm7*gm8^2 + g01*g07*gm2*gm3*gm4*gm8^2 + g03*g04*gm1*gm2*gm7*gm8^2 +
g03*g07*gm1*gm2*gm4*gm8^2 + g04*g07*gm1*gm2*gm3*gm8^2 + g01*gm2*gm3*gm4*gm7*gm8^2 +
g03*gm1*gm2*gm4*gm7*gm8^2 + g04*gm1*gm2*gm3*gm7*gm8^2 + g07*gm1*gm2*gm3*gm4*gm8^2 +
gm1*gm2*gm3*gm4*gm7*gm8^2 + g01*g03*g04*g05*g06*g07*gm2 + g01*g03*g04*g05*g07*g08*gm2 +
g01*g03*g04*g05*g06*g011*gm2 + g01*g03*g04*g05*g08*g011*gm2 + g01*g03*g04*g06*g07*g011*gm2 +
g01*g03*g04*g07*g08*g011*gm2 + g01*g04*g05*g06*g07*g011*gm2 + g01*g04*g05*g07*g08*g011*gm2 +
g03*g04*g05*g06*g07*g011*gm2 + g03*g04*g05*g07*g08*g011*gm2 + g01*g03*g04*g05*g06*gm2*gm7 +
g01*g03*g04*g06*g07*gm2*gm5 + g01*g03*g05*g06*g07*gm2*gm4 + g01*g04*g05*g06*g07*gm2*gm3 +
g03*g04*g05*g06*g07*gm1*gm2 + g01*g03*g04*g05*g06*gm2*gm8 + g01*g03*g04*g05*g07*gm2*gm8 +
g01*g03*g04*g05*g08*gm2*gm7 + g01*g03*g04*g07*g08*gm2*gm5 + g01*g03*g05*g07*g08*gm2*gm4 +
g01*g04*g05*g07*g08*gm2*gm3 + g03*g04*g05*g07*g08*gm1*gm2 + g01*g03*g04*g06*g07*gm2*gm8 +
g01*g03*g04*g06*g011*gm2*gm5 + g01*g03*g05*g06*g011*gm2*gm4 + g01*g03*g04*g07*g08*gm2*gm8 +
g01*g03*g04*g05*g011*gm2*gm8 + g01*g03*g04*g06*g011*gm2*gm7 + g01*g03*g04*g08*g011*gm2*gm5 +
g01*g03*g05*g08*g011*gm2*gm4 + g01*g03*g06*g07*g011*gm2*gm4 + g01*g03*g04*g07*g011*gm2*gm8 +
g01*g03*g04*g08*g011*gm2*gm7 + g01*g03*g07*g08*g011*gm2*gm4 + g01*g04*g05*g06*g011*gm2*gm7 +
g01*g04*g06*g07*g011*gm2*gm5 + g01*g05*g06*g07*g011*gm2*gm4 + g01*g04*g05*g07*g011*gm2*gm8 +
g01*g04*g05*g08*g011*gm2*gm7 + g01*g04*g07*g08*g011*gm2*gm5 + g01*g05*g07*g08*g011*gm2*gm4 +
g03*g04*g05*g06*g011*gm2*gm7 + g03*g04*g06*g07*g011*gm2*gm5 + g03*g05*g06*g07*g011*gm2*gm4 +
g04*g05*g06*g07*g011*gm2*gm3 + g03*g04*g05*g07*g011*gm2*gm8 + g03*g04*g05*g08*g011*gm2*gm7 +
g03*g04*g07*g08*g011*gm2*gm5 + g03*g05*g07*g08*g011*gm2*gm4 + g04*g05*g07*g08*g011*gm2*gm3 +
g01*g03*g04*g06*gm2*gm5*gm7 + g01*g03*g05*g06*gm2*gm4*gm7 + g01*g03*g06*g07*gm2*gm4*gm5 +
g01*g04*g05*g06*gm2*gm3*gm7 + g01*g04*g06*g07*gm2*gm3*gm5 + g01*g05*g06*g07*gm2*gm3*gm4 +
g03*g04*g05*g06*gm1*gm2*gm7 + g03*g04*g06*g07*gm1*gm2*gm5 + g03*g05*g06*g07*gm1*gm2*gm4 +
g04*g05*g06*g07*gm1*gm2*gm3 + g01*g03*g04*g06*gm2*gm5*gm8 + g01*g03*g05*g06*gm2*gm4*gm8 +
g01*g04*g05*g06*gm2*gm3*gm8 + g03*g04*g05*g06*gm1*gm2*gm8 + g01*g03*g04*g05*gm2*gm7*gm8 +
g01*g03*g04*g07*gm2*gm5*gm8 + g01*g03*g04*g08*gm2*gm5*gm7 + g01*g03*g05*g07*gm2*gm4*gm8 +
g01*g03*g05*g08*gm2*gm4*gm7 + g01*g03*g07*g08*gm2*gm4*gm5 + g01*g04*g05*g07*gm2*gm3*gm8 +
g01*g04*g05*g08*gm2*gm3*gm7 + g01*g04*g07*g08*gm2*gm3*gm5 + g01*g05*g07*g08*gm2*gm3*gm4 +
g03*g04*g05*g07*gm1*gm2*gm8 + g03*g04*g05*g08*gm1*gm2*gm7 + g03*g04*g07*g08*gm1*gm2*gm5 +
g03*g05*g07*g08*gm1*gm2*gm4 + g04*g05*g07*g08*gm1*gm2*gm3 + g01*g03*g04*g06*gm2*gm7*gm8 +
g01*g03*g06*g07*gm2*gm4*gm8 + g01*g04*g06*g07*gm2*gm3*gm8 + g03*g04*g06*g07*gm1*gm2*gm8 +
g01*g03*g06*g011*gm2*g\\\r\nm4*gm5 + g01*g03*g04*g08*gm2*gm7*gm8 + g01*g03*g07*g08*gm2*gm4*gm8 +
g01*g04*g07*g08*gm2*gm3*gm8 + g03*g04*g07*g08*gm1*gm2*gm8 + g01*g03*g04*g011*gm2*gm5*gm8 +
g01*g03*g05*g011*gm2*gm4*gm8 + g01*g03*g06*g011*gm2*gm4*gm7 + g01*g03*g08*g011*gm2*gm4*gm5 +
g01*g03*g04*g011*gm2*gm7*gm8 + g01*g03*g07*g011*gm2*gm4*gm8 + g01*g03*g08*g011*gm2*gm4*gm7 +
g01*g04*g06*g011*gm2*gm5*gm7 + g01*g05*g06*g011*gm2*gm4*gm7 + g01*g06*g07*g011*gm2*gm4*gm5 +
g01*g04*g05*g011*gm2*gm7*gm8 + g01*g04*g07*g011*gm2*gm5*gm8 + g01*g04*g08*g011*gm2*gm5*gm7 +
g01*g05*g07*g011*gm2*gm4*gm8 + g01*g05*g08*g011*gm2*gm4*gm7 + g01*g07*g08*g011*gm2*gm4*gm5 +
g03*g04*g06*g011*gm2*gm5*gm7 + g03*g05*g06*g011*gm2*gm4*gm7 + g03*g06*g07*g011*gm2*gm4*gm5 +
g04*g05*g06*g011*gm2*gm3*gm7 + g04*g06*g07*g011*gm2*gm3*gm5 + g05*g06*g07*g011*gm2*gm3*gm4 +
g03*g04*g05*g011*gm2*gm7*gm8 + g03*g04*g07*g011*gm2*gm5*gm8 + g03*g04*g08*g011*gm2*gm5*gm7 +
g03*g05*g07*g011*gm2*gm4*gm8 + g03*g05*g08*g011*gm2*gm4*gm7 + g03*g07*g08*g011*gm2*gm4*gm5 +
g04*g05*g07*g011*gm2*gm3*gm8 + g04*g05*g08*g011*gm2*gm3*gm7 + g04*g07*g08*g011*gm2*gm3*gm5 +
g05*g07*g08*g011*gm2*gm3*gm4 + g01*g03*g06*gm2*gm4*gm5*gm7 + g01*g04*g06*gm2*gm3*gm5*gm7 +
g01*g05*g06*gm2*gm3*gm4*gm7 + g01*g06*g07*gm2*gm3*gm4*gm5 + g03*g04*g06*gm1*gm2*gm5*gm7 +
g03*g05*g06*gm1*gm2*gm4*gm7 + g03*g06*g07*gm1*gm2*gm4*gm5 + g04*g05*g06*gm1*gm2*gm3*gm7 +
g04*g06*g07*gm1*gm2*gm3*gm5 + g05*g06*g07*gm1*gm2*gm3*gm4 + g01*g03*g06*gm2*gm4*gm5*gm8 +
g01*g04*g06*gm2*gm3*gm5*gm8 + g01*g05*g06*gm2*gm3*gm4*gm8 + g03*g04*g06*gm1*gm2*gm5*gm8 +
g03*g05*g06*gm1*gm2*gm4*gm8 + g04*g05*g06*gm1*gm2*gm3*gm8 + g01*g03*g04*gm2*gm5*gm7*gm8 +
g01*g03*g05*gm2*gm4*gm7*gm8 + g01*g03*g07*gm2*gm4*gm5*gm8 + g01*g03*g08*gm2*gm4*gm5*gm7 +
g01*g04*g05*gm2*gm3*gm7*gm8 + g01*g04*g07*gm2*gm3*gm5*gm8 + g01*g04*g08*gm2*gm3*gm5*gm7 +
g01*g05*g07*gm2*gm3*gm4*gm8 + g01*g05*g08*gm2*gm3*gm4*gm7 + g01*g07*g08*gm2*gm3*gm4*gm5 +
g03*g04*g05*gm1*gm2*gm7*gm8 + g03*g04*g07*gm1*gm2*gm5*gm8 + g03*g04*g08*gm1*gm2*gm5*gm7 +
g03*g05*g07*gm1*gm2*gm4*gm8 + g03*g05*g08*gm1*gm2*gm4*gm7 + g03*g07*g08*gm1*gm2*gm4*gm5 +
g04*g05*g07*gm1*gm2*gm3*gm8 + g04*g05*g08*gm1*gm2*gm3*gm7 + g04*g07*g08*gm1*gm2*gm3*gm5 +
g05*g07*g08*gm1*gm2*gm3*gm4 + g01*g03*g06*gm2*gm4*gm7*gm8 + g01*g04*g06*gm2*gm3*gm7*gm8 +
g01*g06*g07*gm2*gm3*gm4*gm8 + g03*g04*g06*gm1*gm2*gm7*gm8 + g03*g06*g07*gm1*gm2*gm4*gm8 +
g04*g06*g07*gm1*gm2*gm3*gm8 + g01*g03*g08*gm2*gm4*gm7*gm8 + g01*g04*g08*gm2*gm3*gm7*gm8 +
g01*g07*g08*gm2*gm3*gm4*gm8 + g03*g04*g08*gm1*gm2*gm7*gm8 + g03*g07*g08*gm1*gm2*gm4*gm8 +
g04*g07*g08*gm1*gm2*gm3*gm8 + g01*g03*g011*gm2*gm4*gm5*gm8 + g01*g03*g011*gm2*gm4*gm7*gm8 +
g01*g06*g011*gm2*gm4*gm5*gm7 + g01*g04*g011*gm2*gm5*gm7*gm8 + g01*g05*g011*gm2*gm4*gm7*gm8 +
g01*g07*g011*gm2*gm4*gm5*gm8 + g01*g08*g011*gm2*gm4*gm5*gm7 + g03*g06*g011*gm2*gm4*gm5*gm7 +
```

MATLAB Solution Continued 1:

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g04*g06*g011*gm2*gm3*gm5*gm7 + g05*g06*g011*gm2*gm3*gm4*gm7 + g06*g07*g011*gm2*gm3*gm4*gm5 +
g03*g04*g011*gm2*gm5*gm7*gm8 + g03*g05*g011*gm2*gm4*gm7*gm8 + g03*g07*g011*gm2*gm4*gm5*gm8 +
g03*g08*g011*gm2*gm4*gm5*gm7 + g04*g05*g011*gm2*gm3*gm7*gm8 + g04*g07*g011*gm2*gm3*gm5*gm8 +
g04*g08*g011*gm2*gm3*gm5*gm7 + g05*g07*g011*gm2*gm3*gm4*gm8 + g05*g08*g011*gm2*gm3*gm4*gm7 +
g07*g08*g011*gm2*gm3*gm4*gm5 + g01*g06*gm2*gm3*gm4*gm5*gm7 + g03*g06*gm1*gm2*gm4*gm5*gm7 +
g04*g06*gm1*gm2*gm3*gm5*gm7 + g05*g06*gm1*gm2*gm3*gm4*gm7 + g06*g07*gm1*gm2*gm3*gm4*gm5 +
g01*g06*gm2*gm3*gm4*gm5*gm8 + g03*g06*gm1*gm2*gm4*gm5*gm8 + g04*g06*gm1*gm2*gm3*gm5*gm8 +
g05*g06*gm1*gm2*gm3*gm4*gm8 + g01*g03*gm2*gm4*gm5*gm7*gm8 + g01*g04*gm2*gm3*gm5*gm7*gm8 +
g01*g05*gm2*gm3*gm4*gm7*gm8 + g01*g07*gm2*gm3*gm4*gm5*gm8 + g01*g08*gm2*gm3*gm4*gm5*gm7 +
g03*g04*gm1*gm2*gm5*gm7*gm8 + g03*g05*gm1*gm2*gm4*gm7*gm8 + g03*g07*gm1*gm2*gm4*gm5*gm8 +
g03*g08*gm1*gm2*gm4*gm5*gm7 + g04*g05*gm1*gm2*gm3*gm7*gm8 + g04*g07*gm1*gm2*gm3*gm5*gm8 +
g04*g08*gm1*gm2*gm3*gm5*gm7 + g05*g07*gm1*gm2*gm3*gm4*gm8 + g05*g08*gm1*gm2*gm3*gm4*gm7 +
g07*g08*gm1*gm2*gm3*gm4*gm5 + g01*g06*gm2*gm3*gm4*gm7*gm8 + g03*g06*gm1*gm2*gm4*gm7*gm8 +
g04*g06*gm1*gm2*gm3*gm7*gm8 + g06*g07*gm1*gm2*gm3*gm4*gm8 + g01*g08*gm2*gm3*gm4*gm7*gm8 +
g03*g08*gm1*gm2*gm4*gm7*gm8 + g04*g08*gm1*gm2*gm3*gm7*gm8 + g07*g08*gm1*gm2*gm3*gm4*gm8 +
g01*g011*gm2*gm4*gm5*gm7*gm8 + g06*g011*gm2*gm3*gm4*gm5*gm7 + g03*g011*gm2*gm4*gm5*gm7*gm8 +
g04*g011*gm2*gm3*gm5*gm7*gm8 + g05*g011*gm2*gm3*gm4*gm7*gm8 + g07*g011*gm2*gm3*gm4*gm5*gm8 +
g08*g011*gm2*gm3*gm4*gm5*gm7 + g06*gm1*gm2*gm3*gm4*gm5*gm7 + g06*gm1*gm2*gm3*gm4*gm5*gm8 +
g01*gm2*gm3*gm4*gm5*gm7*gm8 + g03*gm1*gm2*gm4*gm5*gm7*gm8 + g04*gm1*gm2*gm3*gm5*gm7*gm8 +
g05*gm1*gm2*gm3*gm4*gm7*gm8 + g07*gm1*gm2*gm3*gm4*gm5*gm8 + g08*gm1*gm2*gm3*gm4*gm5*gm7 +
g06*gm1*gm2*gm3*gm4*gm7*gm8 + g08*gm1*gm2*gm3*gm4*gm7*gm8 + g011*gm2*gm3*gm4*gm5*gm7*gm8 +
gm1*gm2*gm3*gm4*gm5*gm7*gm8)/(g01*g02*g03*g04*g07*gm8^2 + g01*g02*g03*g04*gm7*gm8^2 +
g01*g02*g04*g07*gm3*gm8^2 + g02*g03*g04*g07*gm1*gm8^2 + g01*g02*g04*gm3*gm7*gm8^2 +
g02*g03*g04*gm1*gm7*gm8^2 + g02*g04*g07*gm1*gm3*gm8^2 + g02*g04*gm1*gm3*gm7*gm8^2 +
g01*g02*g03*g04*g05*g06*g07 + g01*g02*g03*g04*g05*g06*g08 + g01*g02*g03*g04*g05*g07*g08 +
g01*g02*g03*g04*g06*g07*g08 + g01*g02*g03*g04*g05*g06*g011 + g01*g02*g03*g05*g06*g07*g08 +
g01*g02*g04*g05*g06*g07*g08 + g01*g02*g03*g04*g05*g08*g011 + g01*g02*g03*g04*g06*g07*g011 +
g01*g03*g04*g05*g06*g07*g08 + g02*g03*g04*g05*g06*g07*g08 + g01*g02*g03*g04*g07*g08*g011 +
g01*g02*g03*g05*g06*g08*g011 + g01*g02*g04*g05*g06*g07*g011 + g01*g02*g03*g06*g07*g08*g011 +
g01*g02*g04*g05*g07*g08*g011 + g01*g03*g04*g05*g06*g08*g011 + g02*g03*g04*g05*g06*g07*g011 +
g01*g02*g05*g06*g07*g08*g011 + g01*g03*g04*g06*g07*g08*g011 + g02*g03*g04*g05*g07*g08*g011 +
g01*g04*g05*g06*g07*g08*g011 + g02*g03*g05*g06*g07*g08*g011 + g03*g04*g05*g06*g07*g08*g011 +
g01*g02*g03*g04*g05*g06*gm7 + g01*g02*g03*g04*g06*g07*gm5 + g01*g02*g04*g05*g06*g07*gm3 +
g02*g03*g04*g05*g06*g07*gm1 + g01*g02*g03*g04*g05*g06*gm8 + g01*g02*g03*g04*g06*g08*gm5 +
g01*g02*g03*g05*g06*g08*gm4 + g01*g03*g04*g05*g06*g08*gm2 + g01*g02*g03*g04*g05*g07*gm8 +
g01*g02*g03*g04*g05*g08*gm7 + g01*g02*g03*g04*g07*g08*gm5 + g01*g02*g04*g05*g07*g08*gm3 +
g02*g03*g04*g05*g07*g08*gm1 + g01*g02*g03*g04*g06*g07*gm8 + g01*g02*g03*g04*g06*g08*gm7 +
g01*g02*g03*g06*g07*g08*gm4 + g01*g03*g04*g06*g07*g08*gm2 + g01*g02*g03*g04*g06*g011*gm5 +
g01*g02*g03*g05*g06*g08*gm7 + g01*g02*g03*g06*g07*g08*gm5 + g01*g02*g05*g06*g07*g08*gm3 +
g02*g03*g05*g06*g07*g08*gm1 + g01*g02*g03*g04*g07*g08*gm8 + g01*g02*g04*g05*g06*g08*gm7 +
g01*g02*g04*g06*g07*g08*gm5 + g01*g02*g05*g06*g07*g08*gm4 + g01*g04*g05*g06*g07*g08*gm2 +
g01*g02*g03*g04*g05*g011*gm8 + g01*g02*g03*g04*g06*g011*gm7 + g01*g02*g03*g04*g08*g011*gm5 +
g01*g03*g04*g05*g06*g08*gm7 + g01*g03*g04*g06*g07*g08*gm5 + g01*g03*g05*g06*g07*g08*gm4 +
g01*g04*g05*g06*g07*g08*gm3 + g03*g04*g05*g06*g07*g08*gm1 + g02*g03*g04*g05*g06*g08*gm7 +
g02*g03*g04*g06*g07*g08*gm5 + g02*g03*g05*g06*g07*g08*gm4 + g02*g04*g05*g06*g07*g08*gm3 +
g03*g04*g05*g06*g07*g08*gm2 + g01*g02*g03*g04*g07*g011*gm8 + g01*g02*g03*g04*g08*g011*gm7 +
g01*g02*g03*g06*g08*g011*gm5 + g01*g02*g04*g05*g06*g011*gm7 + g01*g02*g04*g06*g07*g011*gm5 +
g01*g02*g03*g06*g08*g011*gm7 + g01*g02*g04*g05*g07*g011*gm8 + g01*g02*g04*g05*g08*g011*gm7 +
g01*g02*g04*g07*g08*g011*gm5 + g01*g03*g04*g06*g08*g011*gm5 + g01*g03*g05*g06*g08*g011*gm4 +
g02*g03*g04*g05*g06*g011*gm7 + g02*g03*g04*g06*g07*g011*gm5 + g02*g04*g05*g06*g07*g011*gm3 +
g01*g02*g05*g06*g08*g011*gm7 + g01*g02*g06*g07*g08*g011*gm5 + g01*g03*g04*g06*g08*g011*gm7 +
g01*g03*g06*g07*g08*g011*gm4 + g02*g03*g04*g05*g07*g011*gm8 + g02*g03*g04*g05*g08*g011*gm7 +
g02*g03*g04*g07*g08*g011*gm5 + g02*g04*g05*g07*g08*g011*gm3 + g01*g04*g05*g06*g08*g011*gm7 +
g01*g04*g06*g07*g08*g011*gm5 + g01*g05*g06*g07*g08*g011*gm4 + g02*g03*g05*g06*g08*g011*gm7 +
g02*g03*g06*g07*g08*g011*gm5 + g02*g05*g06*g07*g08*g011*gm3 + g03*g04*g05*g06*g08*g011*gm7 +
g03*g04*g06*g07*g08*g011*gm5 + g03*g05*g06*g07*g08*g011*gm4 + g04*g05*g06*g07*g08*g011*gm3 +
g01*g02*g03*g04*g06*gm5*gm7 + g01*g02*g04*g05*g06*gm3*gm7 + g01*g02*g04*g06*g07*gm3*gm5 +
g02*g03*g04*g05*g06*gm1*gm7 + g02*g03*g04*g06*g07*gm1*gm5 + g02*g04*g05*g06*g07*gm1*gm3 +
g01*g02*g03*g04*g06*gm5*gm8 + g01*g02*g03*g06*g08*gm4*gm5 + g01*g02*g04*g05*g06*gm3*gm8 +
g01*g03*g04*g06*g08*gm2*gm5 + g01*g03*g05*g06*g08*gm2*gm4 + g02*g03*g04*g05*g06*gm1*gm8 +
g01*g02*g03*g04*g05*gm7*gm8 + g01*g02*g03*g04*g07*gm5*gm8 + g01*g02*g03*g04*g08*gm5*gm7 +
g01*g02*g04*g05*g07*gm3*gm8 + g01*g02*g04*g05*g08*gm3*gm7 + g01*g02*g04*g07*g08*gm3*gm5 +
g02*g03*g04*g05*g07*gm1*gm8 + g02*g03*g04*g05*g08*gm1*gm7 + g02*g03*g04*g07*g08*gm1*gm5 +
g02*g04*g05*g07*g08*gm1*gm3 + g01*g02*g03*g04*g06*gm7*gm8 + g01*g02*g03*g06*g08*gm4*gm7 +
g01*g02*g04*g06*g07*gm3*gm8 + g01*g03*g04*g06*g08*gm2*gm7 + g01*g03*g06*g07*g08*gm2*gm4 +
g02*g03*g04*g06*g07*gm1*gm8 + g01*g02*g03*g06*g08*gm5*gm7 + g01*g02*g05*g06*g08*gm3*gm7 +
g01*g02*g06*g07*g08*gm3*gm5 + g02*g03*g05*g06*g08*gm1*gm7 + g02*g03*g06*g07*g08*gm1*gm5 +
g02*g05*g06*g07*g08*gm1*gm3 + g01*g02*g03*g04*g08*gm7*gm8 + g01*g02*g04*g06*g08*gm5*gm7 +
g01*g02*g04*g07*g08*gm3*gm8 + g01*g02*g05*g06*g08*gm4*gm7 + g01*g02*g06*g07*g08*gm4*gm5 +
g01*g04*g05*g06*g08*gm2*gm7 + g01*g04*g06*g07*g08*gm2*gm5 + g01*g05*g06*g07*g08*gm2*gm4 +
g02*g03*g04*g07*g08*gm1*gm8 + g01*g02*g03*g04*g011*gm5*gm8 + g01*g03*g04*g06*g08*gm5*gm7 +
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MATLAB Solution Continued 2:

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g01*g03*g05*g06*g08*gm4*gm7 + g01*g03*g06*g07*g08*gm4*gm5 + g01*g04*g05*g06*g08*gm3*gm7 +
g01*g04*g06*g07*g08*gm3*gm5 + g01*g05*g06*g07*g08*gm3*gm4 + g03*g04*g05*g06*g08*gm1*gm7 +
g03*g04*g06*g07*g08*gm1*gm5 + g03*g05*g06*g07*g08*gm1*gm4 + g04*g05*g06*g07*g08*gm1*gm3 +
g02*g03*g04*g06*g08*gm5*gm7 + g02*g03*g05*g06*g08*gm4*gm7 + g02*g03*g06*g07*g08*gm4*gm5 +
g02*g04*g05*g06*g08*gm3*gm7 + g02*g04*g06*g07*g08*gm3*gm5 + g02*g05*g06*g07*g08*gm3*gm4 +
g03*g04*g05*g06*g08*gm2*gm7 + g03*g04*g06*g07*g08*gm2*gm5 + g03*g05*g06*g07*g08*gm2*gm4 +
g04*g05*g06*g07*g08*gm2*gm3 + g01*g02*g03*g04*g011*gm7*gm8 + g01*g02*g04*g06*g011*gm5*gm7 +
g01*g02*g04*g05*g011*gm7*gm8 + g01*g02*g04*g07*g011*gm5*gm8 + g01*g02*g04*g08*g011*gm5*gm7 +
g01*g03*g06*g08*g011*gm4*gm5 + g02*g03*g04*g06*g011*gm5*gm7 + g02*g04*g05*g06*g011*gm3*gm7 +
g02*g04*g06*g07*g011*gm3*gm5 + g01*g02*g06*g08*g011*gm5*gm7 + g01*g03*g06*g08*g011*gm4*gm7 +
g02*g03*g04*g05*g011*gm7*gm8 + g02*g03*g04*g07*g011*gm5*gm8 + g02*g03*g04*g08*g011*gm5*gm7 +
g02*g04*g05*g07*g011*gm3*gm8 + g02*g04*g05*g08*g011*gm3*gm7 + g02*g04*g07*g08*g011*gm3*gm5 +
g01*g04*g06*g08*g011*gm5*gm7 + g01*g05*g06*g08*g011*gm4*gm7 + g01*g06*g07*g08*g011*gm4*gm5 +
g02*g03*g06*g08*g011*gm5*gm7 + g02*g05*g06*g08*g011*gm3*gm7 + g02*g06*g07*g08*g011*gm3*gm5 +
g03*g04*g06*g08*g011*gm5*gm7 + g03*g05*g06*g08*g011*gm4*gm7 + g03*g06*g07*g08*g011*gm4*gm5 +
g04*g05*g06*g08*g011*gm3*gm7 + g04*g06*g07*g08*g011*gm3*gm5 + g05*g06*g07*g08*g011*gm3*gm4 +
g01*g02*g04*g06*gm3*gm5*gm7 + g02*g03*g04*g06*gm1*gm5*gm7 + g02*g04*g05*g06*gm1*gm3*gm7 +
g02*g04*g06*g07*gm1*gm3*gm5 + g01*g02*g04*g06*gm3*gm5*gm8 + g01*g03*g06*g08*gm2*gm4*gm5 +
g02*g03*g04*g06*gm1*gm5*gm8 + g02*g04*g05*g06*gm1*gm3*gm8 + g01*g02*g03*g04*gm5*gm7*gm8 +
g01*g02*g04*g05*gm3*gm7*gm8 + g01*g02*g04*g07*gm3*gm5*gm8 + g01*g02*g04*g08*gm3*gm5*gm7 +
g02*g03*g04*g05*gm1*gm7*gm8 + g02*g03*g04*g07*gm1*gm5*gm8 + g02*g03*g04*g08*gm1*gm5*gm7 +
g02*g04*g05*g07*gm1*gm3*gm8 + g02*g04*g05*g08*gm1*gm3*gm7 + g02*g04*g07*g08*gm1*gm3*gm5 +
g01*g02*g04*g06*gm3*gm7*gm8 + g01*g03*g06*g08*gm2*gm4*gm7 + g02*g03*g04*g06*gm1*gm7*gm8 +
g02*g04*g06*g07*gm1*gm3*gm8 + g01*g02*g06*g08*gm3*gm5*gm7 + g02*g03*g06*g08*gm1*gm5*gm7 +
g02*g05*g06*g08*gm1*gm3*gm7 + g02*g06*g07*g08*gm1*gm3*gm5 + g01*g02*g04*g08*gm3*gm7*gm8 +
g01*g02*g06*g08*gm4*gm5*gm7 + g01*g04*g06*g08*gm2*gm5*gm7 + g01*g05*g06*g08*gm2*gm4*gm7 +
g01*g06*g07*g08*gm2*gm4*gm5 + g02*g03*g04*g08*gm1*gm7*gm8 + g02*g04*g07*g08*gm1*gm3*gm8 +
g01*g03*g06*g08*gm4*gm5*gm7 + g01*g04*g06*g08*gm3*gm5*gm7 + g01*g05*g06*g08*gm3*gm4*gm7 +
g01*g06*g07*g08*gm3*gm4*gm5 + g03*g04*g06*g08*gm1*gm5*gm7 + g03*g05*g06*g08*gm1*gm4*gm7 +
g03*g06*g07*g08*gm1*gm4*gm5 + g04*g05*g06*g08*gm1*gm3*gm7 + g04*g06*g07*g08*gm1*gm3*gm5 +
g05*g06*g07*g08*gm1*gm3*gm4 + g02*g03*g06*g08*gm4*gm5*gm7 + g02*g04*g06*g08*gm3*gm5*gm7 +
g02*g05*g06*g08*gm3*gm4*gm7 + g02*g06*g07*g08*gm3*gm4*gm5 + g03*g04*g06*g08*gm2*gm5*gm7 +
g03*g05*g06*g08*gm2*gm4*gm7 + g03*g06*g07*g08*gm2*gm4*gm5 + g04*g05*g06*g08*gm2*gm3*gm7 +
g04*g06*g07*g08*gm2*gm3*gm5 + g05*g06*g07*g08*gm2*gm3*gm4 + g01*g02*g04*g011*gm5*gm7*gm8 +
g02*g04*g06*g011*gm3*gm5*gm7 + g02*g03*g04*g011*gm5*gm7*gm8 + g02*g04*g05*g011*gm3*gm7*gm8 +
g02*g04*g07*g011*gm3*gm5*gm8 + g02*g04*g08*g011*gm3*gm5*gm7 + g01*g06*g08*g011*gm4*gm5*gm7 +
g02*g06*g08*g011*gm3*gm5*gm7 + g03*g06*g08*g011*gm4*gm5*gm7 + g04*g06*g08*g011*gm3*gm5*gm7 +
g05*g06*g08*g011*gm3*gm4*gm7 + g06*g07*g08*g011*gm3*gm4*gm5 + g02*g04*g06*gm1*gm3*gm5*gm7 +
g02*g04*g06*gm1*gm3*gm5*gm8 + g01*g02*g04*gm3*gm5*gm7*gm8 + g02*g03*g04*gm1*gm5*gm7*gm8 +
g02*g04*g05*gm1*gm3*gm7*gm8 + g02*g04*g07*gm1*gm3*gm5*gm8 + g02*g04*g08*gm1*gm3*gm5*gm7 +
g02*g04*g06*gm1*gm3*gm7*gm8 + g02*g06*g08*gm1*gm3*gm5*gm7 + g01*g06*g08*gm2*gm4*gm5*gm7 +
g02*g04*g08*gm1*gm3*gm7*gm8 + g01*g06*g08*gm3*gm4*gm5*gm7 + g03*g06*g08*gm1*gm4*gm5*gm7 +
g04*g06*g08*gm1*gm3*gm5*gm7 + g05*g06*g08*gm1*gm3*gm4*gm7 + g06*g07*g08*gm1*gm3*gm4*gm5 +
g02*g06*g08*gm3*gm4*gm5*gm7 + g03*g06*g08*gm2*gm4*gm5*gm7 + g04*g06*g08*gm2*gm3*gm5*gm7 +
g05*g06*g08*gm2*gm3*gm4*gm7 + g06*g07*g08*gm2*gm3*gm4*gm5 + g02*g04*g011*gm3*gm5*gm7*gm8 +
g06*g08*g011*gm3*gm4*gm5*gm7 + g02*g04*gm1*gm3*gm5*gm7*gm8 + g06*g08*gm1*gm3*gm4*gm5*gm7 +
g06*g08*gm2*gm3*gm4*gm5*gm7 + CL*g01*g02*g03*g04*g05*g06*s + CL*g01*g02*g03*g04*g05*g08*s +
CL*g01*g02*g03*g04*g06*g07*s + CL*g01*g02*g03*g05*g06*g07*s + CL*g01*g02*g03*g04*g07*g08*s +
CL*g01*g02*g04*g05*g06*g07*s + CL*g01*g02*g03*g05*g07*g08*s + CL*g01*g03*g04*g05*g06*g07*s +
CL*g01*g02*g04*g05*g07*g08*s + CL*g02*g03*g04*g05*g06*g07*s + CL*g01*g02*g03*g05*g06*g011*s +
CL*g01*g03*g04*g05*g07*g08*s + CL*g02*g03*g04*g05*g07*g08*s + CL*g01*g02*g03*g05*g08*g011*s +
CL*g01*g02*g03*g06*g07*g011*s + CL*g01*g03*g04*g05*g06*g011*s + CL*g01*g02*g03*g07*g08*g011*s +
CL*g01*g02*g05*g06*g07*g011*s + CL*g01*g03*g04*g05*g08*g011*s + CL*g01*g03*g04*g06*g07*g011*s +
CL*g01*g02*g05*g07*g08*g011*s + CL*g01*g03*g04*g07*g08*g011*s + CL*g01*g04*g05*g06*g07*g011*s +
CL*g02*g03*g05*g06*g07*g011*s + CL*g01*g04*g05*g07*g08*g011*s + CL*g02*g03*g05*g07*g08*g011*s +
CL*g03*g04*g05*g06*g07*g011*s + CL*g03*g04*g05*g07*g08*g011*s + CL*g01*g02*g03*g04*g06*gm5*s +
CL*g01*g02*g03*g05*g06*gm4*s + CL*g01*g03*g04*g05*g06*gm2*s + CL*g01*g02*g03*g04*g05*gm8*s +
CL*g01*g02*g03*g04*g06*gm7*s + CL*g01*g02*g03*g04*g08*gm5*s + CL*g01*g02*g03*g05*g08*gm4*s +
CL*g01*g02*g03*g06*g07*gm4*s + CL*g01*g03*g04*g05*g08*gm2*s + CL*g01*g03*g04*g06*g07*gm2*s +
CL*g01*g02*g03*g05*g06*gm7*s + CL*g01*g02*g03*g06*g07*gm5*s + CL*g01*g02*g05*g06*g07*gm3*s +
CL*g02*g03*g05*g06*g07*gm1*s + CL*g01*g02*g03*g04*g07*gm8*s + CL*g01*g02*g03*g04*g08*gm7*s +
CL*g01*g02*g03*g07*g08*gm4*s + CL*g01*g02*g04*g05*g06*gm7*s + CL*g01*g02*g04*g06*g07*gm5*s +
CL*g01*g02*g05*g06*g07*gm4*s + CL*g01*g03*ng04*g07*g08*gm2*s + CL*g01*g04*g05*g06*g07*gm2*s +
CL*g01*g02*g03*g05*g07*gm8*s + CL*g01*g02*g03*g05*g08*gm7*s + CL*g01*g02*g03*g07*g08*gm5*s +
CL*g01*g02*g05*g07*g08*gm3*s + CL*g01*g03*g04*g05*g06*gm7*s + CL*g01*g03*g04*g06*g07*gm5*s +
CL*g01*g03*g05*g06*g07*gm4*s + CL*g01*g04*g05*g06*g07*gm3*s + CL*g02*g03*g05*g07*g08*gm1*s +
CL*g03*g04*g05*g06*g07*gm1*s + CL*g01*g02*g04*g05*g07*gm8*s + CL*g01*g02*g04*g05*g08*gm7*s +
CL*g01*g02*g04*g07*g08*gm5*s + CL*g01*g02*g05*g07*g08*gm4*s + CL*g01*g04*g05*g07*g08*gm2*s +
CL*g02*g03*g04*g05*g06*gm7*s + CL*g02*g03*g04*g06*g07*gm5*s + CL*g02*g03*g05*g06*g07*gm4*s +
CL*g02*g04*g05*g06*g07*gm3*s + CL*g03*g04*g05*g06*g07*gm2*s + CL*g01*g02*g03*g06*g011*gm5*s +
CL*g01*g03*g04*g05*g07*gm8*s + CL*g01*g03*g04*g05*g08*gm7*s + CL*g01*g03*g04*g07*g08*gm5*s +
```

MATLAB Solution Continued 3:

```
CL*g01*g03*g05*g07*g08*gm4*s + CL*g01*g04*g05*g07*g08*gm3*s + CL*g03*g04*g05*g07*g08*gm1*s +
CL*g02*g03*g04*g05*g07*gm8*s + CL*g02*g03*g04*g05*g08*gm7*s + CL*g02*g03*g04*g07*g08*gm5*s +
CL*g02*g03*g05*g07*g08*gm4*s + CL*g02*g04*g05*g07*g08*gm3*s + CL*g03*g04*g05*g07*g08*gm2*s +
CL*g01*g02*g03*g05*g011*gm8*s + CL*g01*g02*g03*g06*g011*gm7*s + CL*g01*g02*g03*g08*g011*gm5*s +
CL*g01*g03*g04*g06*g011*gm5*s + CL*g01*g03*g05*g06*g011*gm4*s + CL*g01*g02*g03*g07*g011*gm8*s +
CL*g01*g02*g03*g08*g011*gm7*s + CL*g01*g02*g05*g06*g011*gm7*s + CL*g01*g02*g06*g07*g011*gm5*s +
CL*g01*g03*g04*g05*g011*gm8*s + CL*g01*g03*g04*g06*g011*gm7*s + CL*g01*g03*g04*g08*g011*gm5*s +
CL*g01*g03*g05*g08*g011*gm4*s + CL*g01*g03*g06*g07*g011*gm4*s + CL*g01*g02*g05*g07*g011*gm8*s +
CL*g01*g02*g05*g08*g011*gm7*s + CL*g01*g02*g07*g08*g011*gm5*s + CL*g01*g03*g04*g07*g011*gm8*s +
CL*g01*g03*g04*g08*g011*gm7*s + CL*g01*g03*g07*g08*g011*gm4*s + CL*g01*g04*g05*g06*g011*gm7*s +
CL*g01*g04*g06*g07*g011*gm5*s + CL*g01*g05*g06*g07*g011*gm4*s + CL*g02*g03*g05*g06*g011*gm7*s +
CL*g02*g03*g06*g07*g011*gm5*s + CL*g02*g05*g06*g07*g011*gm3*s + CL*g01*g04*g05*g07*g011*gm8*s +
CL*g01*g04*g05*g08*g011*gm7*s + CL*g01*g04*g07*g08*g011*gm5*s + CL*g01*g05*g07*g08*g011*gm4*s +
CL*g02*g03*g05*g07*g011*gm8*s + CL*g02*g03*g05*g08*g011*gm7*s + CL*g02*g03*g07*g08*g011*gm5*s +
CL*g02*g05*g07*g08*g011*gm3*s + CL*g03*g04*g05*g06*g011*gm7*s + CL*g03*g04*g06*g07*g011*gm5*s +
CL*g03*g05*g06*g07*g011*gm4*s + CL*g04*g05*g06*g07*g011*gm3*s + CL*g03*g04*g05*g07*g011*gm8*s +
CL*g03*g04*g05*g08*g011*gm7*s + CL*g03*g04*g07*g08*g011*gm5*s + CL*g03*g05*g07*g08*g011*gm4*s +
CL*g04*g05*g07*g08*g011*gm3*s + CL*g01*g02*g03*g06*gm4*gm5*s + CL*g01*g03*g04*g06*gm2*gm5*s +
CL*g01*g03*g05*g06*gm2*gm4*s + CL*g01*g02*g03*g04*gm5*gm8*s + CL*g01*g02*g03*g05*gm4*gm8*s +
CL*g01*g02*g03*g06*gm4*gm7*s + CL*g01*g02*g03*g08*gm4*gm5*s + CL*g01*g03*g04*g05*gm2*gm8*s +
CL*g01*g03*g04*g06*gm2*gm7*s + CL*g01*g03*g04*g08*gm2*gm5*s + CL*g01*g03*g05*g08*gm2*gm4*s +
CL*g01*g03*g06*g07*gm2*gm4*s + CL*g01*g02*g03*g06*gm5*gm7*s + CL*g01*g02*g05*g06*gm3*gm7*s +
CL*g01*g02*g06*g07*gm3*gm5*s + CL*g02*g03*g05*g06*gm1*gm7*s + CL*g02*g03*g06*g07*gm1*gm5*s +
CL*g02*g05*g06*g07*gm1*gm3*s + CL*g01*g02*g03*g04*gm7*gm8*s + CL*g01*g02*g03*g07*gm4*gm8*s +
CL*g01*g02*g03*g08*gm4*gm7*s + CL*g01*g02*g04*g06*gm5*gm7*s + CL*g01*g02*g05*g06*gm4*gm7*s +
CL*g01*g02*g06*g07*gm4*gm5*s + CL*g01*g03*g04*g07*gm2*gm8*s + CL*g01*g03*g04*g08*gm2*gm7*s +
CL*g01*g03*g07*g08*gm2*gm4*s + CL*g01*g04*g05*g06*gm2*gm7*s + CL*g01*g04*g06*g07*gm2*gm5*s +
CL*g01*g05*g06*g07*gm2*gm4*s + CL*g01*g02*g03*g05*gm7*gm8*s + CL*g01*g02*g03*g07*gm5*gm8*s +
CL*g01*g02*g03*g08*gm5*gm7*s + CL*g01*g02*g05*g07*gm3*gm8*s + CL*g01*g02*g05*g08*gm3*gm7*s +
CL*g01*g02*g07*g08*gm3*gm5*s + CL*g01*g03*g04*g06*gm5*gm7*s + CL*g01*g03*g05*g06*gm4*gm7*s +
CL*g01*g03*g06*g07*gm4*gm5*s + CL*g01*g04*g05*g06*gm3*gm7*s + CL*g01*g04*g06*g07*gm3*gm5*s +
CL*g01*g05*g06*g07*gm3*gm4*s + CL*g02*g03*g05*g07*gm1*gm8*s + CL*g02*g03*g05*g08*gm1*gm7*s +
CL*g02*g03*g07*g08*gm1*gm5*s + CL*g02*g05*g07*g08*gm1*gm3*s + CL*g03*g04*g05*g06*gm1*gm7*s +
CL*g03*g04*g06*g07*gm1*gm5*s + CL*g03*g05*g06*g07*gm1*gm4*s + CL*g04*g05*g06*g07*gm1*gm3*s +
CL*g01*g02*g04*g05*gm7*gm8*s + CL*g01*g02*g04*g07*gm5*gm8*s + CL*g01*g02*g04*g08*gm5*gm7*s +
CL*g01*g02*g05*g07*gm4*gm8*s + CL*g01*g02*g05*g08*gm4*gm7*s + CL*g01*g02*g07*g08*gm4*gm5*s +
CL*g01*g04*g05*g07*gm2*gm8*s + CL*g01*g04*g05*g08*gm2*gm7*s + CL*g01*g04*g07*g08*gm2*gm5*s +
CL*g01*g05*g07*g08*gm2*gm4*s + CL*g02*g03*g04*g06*gm5*gm7*s + CL*g02*g03*g05*g06*gm4*gm7*s +
CL*g02*g03*g06*g07*gm4*gm5*s + CL*g02*g04*g05*g06*gm3*gm7*s + CL*g02*g04*g06*g07*gm3*gm5*s +
CL*g02*g05*g06*g07*gm3*gm4*s + CL*g03*g04*g05*g06*gm2*gm7*s + CL*g03*g04*g06*g07*gm2*gm5*s +
CL*g03*g05*g06*g07*gm2*gm4*s + CL*g04*g05*g06*g07*gm2*gm3*s + CL*g01*g03*g04*g05*gm7*gm8*s +
CL*g01*g03*g04*g07*gm5*gm8*s + CL*g01*g03*g04*g08*gm5*gm7*s + CL*g01*g03*g05*g07*gm4*gm8*s +
CL*g01*g03*g05*g08*gm4*gm7*s + CL*g01*g03*g07*g08*gm4*gm5*s + CL*g01*g04*g05*g07*gm3*gm8*s +
CL*g01*g04*g05*g08*gm3*gm7*s + CL*g01*g04*g07*g08*gm3*gm5*s + CL*g01*g05*g07*g08*gm3*gm4*s +
CL*g03*g04*g05*g07*gm1*gm8*s + CL*g03*g04*g05*g08*gm1*gm7*s + CL*g03*g04*g07*g08*gm1*gm5*s +
CL*g03*g05*g07*g08*gm1*gm4*s + CL*g04*g05*g07*g08*gm1*gm3*s + CL*g02*g03*g04*g05*gm7*gm8*s +
CL*g02*g03*g04*g07*gm5*gm8*s + CL*g02*g03*g04*g08*gm5*gm7*s + CL*g02*g03*g05*g07*gm4*gm8*s +
CL*g02*g03*g05*g08*gm4*gm7*s + CL*g02*g03*g07*g08*gm4*gm5*s + CL*g02*g04*g05*g07*gm3*gm8*s +
CL*g02*g04*g05*g08*gm3*gm7*s + CL*g02*g04*g07*g08*gm3*gm5*s + CL*g02*g05*g07*g08*gm3*gm4*s +
CL*g03*g04*g05*g07*gm2*gm8*s + CL*g03*g04*g05*g08*gm2*gm7*s + CL*g03*g04*g07*g08*gm2*gm5*s +
CL*g03*g05*g07*g08*gm2*gm4*s + CL*g04*g05*g07*g08*gm2*gm3*s + CL*g01*g02*g03*g011*gm5*gm8*s +
CL*g01*g03*g06*g011*gm4*gm5*s + CL*g01*g02*g03*g011*gm7*gm8*s + CL*g01*g02*g06*g011*gm5*gm7*s +
CL*g01*g03*g04*g011*gm5*gm8*s + CL*g01*g03*g05*g011*gm4*gm8*s + CL*g01*g03*g06*g011*gm4*gm7*s +
CL*g01*g03*g08*g011*gm4*gm5*s + CL*g01*g02*g05*g011*gm7*gm8*s + CL*g01*g02*g07*g011*gm5*gm8*s +
CL*g01*g02*g08*g011*gm5*gm7*s + CL*g01*g03*g04*g011*gm7*gm8*s + CL*g01*g03*g07*g011*gm4*gm8*s +
CL*g01*g03*g08*g011*gm4*gm7*s + CL*g01*g04*g06*g011*gm5*gm7*s + CL*g01*g05*g06*g011*gm4*gm7*s +
CL*g01*g06*g07*g011*gm4*gm5*s + CL*g02*g03*g06*g011*gm5*gm7*s + CL*g02*g05*g06*g011*gm3*gm7*s +
CL*g02*g06*g07*g011*gm3*gm5*s + CL*g01*g04*g05*g011*gm7*gm8*s + CL*g01*g04*g07*g011*gm5*gm8*s +
CL*g01*g04*g08*g011*gm5*gm7*s + CL*g01*g05*g07*g011*gm4*gm8*s + CL*g01*g05*g08*g011*gm4*gm7*s +
CL*g01*g07*g08*g011*gm4*gm5*s + CL*g02*g03*g05*g011*gm7*gm8*s + CL*g02*g03*g07*g011*gm5*gm8*s +
CL*g02*g03*g08*g011*gm5*gm7*s + CL*g02*g05*g07*g011*gm3*gm8*s + CL*g02*g05*g08*g011*gm3*gm7*s +
CL*g02*g07*g08*g011*gm3*gm5*s + CL*g03*g04*g06*g011*gm5*gm7*s + CL*g03*g05*g06*g011*gm4*gm7*s +
CL*g03*g06*g07*g011*gm4*gm5*s + CL*g04*g05*g06*g011*gm3*gm7*s + CL*g04*g06*g07*g011*gm3*gm5*s +
CL*g05*g06*g07*g011*gm3*gm4*s + CL*g03*g04*g05*g011*gm7*gm8*s + CL*g03*g04*g07*g011*gm5*gm8*s +
CL*g03*g04*g08*g011*gm5*gm7*s + CL*g03*g05*g07*g011*gm4*gm8*s + CL*g03*g05*g08*g011*gm4*gm7*s +
CL*g03*g07*g08*g011*gm4*gm5*s + CL*g04*g05*g07*g011*gm3*gm8*s + CL*g04*g05*g08*g011*gm3*gm7*s +
CL*g04*g07*g08*g011*gm3*gm5*s + CL*g05*g07*g08*g011*gm3*gm4*s + CL*g01*g03*g06*gm2*gm4*gm5*s +
CL*g01*g02*g03*gm4*gm5*gm8*s + CL*g01*g03*g04*gm2*gm5*gm8*s + CL*g01*g03*g05*gm2*gm4*gm8*s +
CL*g01*g03*g06*gm2*gm4*gm7*s + CL*g01*g03*g08*gm2*gm4*gm5*s + CL*g01*g02*g06*gm3*gm5*gm7*s +
CL*g02*g03*g06*gm1*gm5*gm7*s + CL*g02*g05*g06*gm1*gm3*gm7*s + CL*g02*g06*g07*gm1*gm3*gm5*s +
CL*g01*g02*g03*gm4*gm7*gm8*s + CL*g01*g02*g06*gm4*gm5*gm7*s + CL*g01*g03*g04*gm2*gm7*gm8*s +
```

MATLAB Solution Continued 4:

```
CL*g01*g03*g07*gm2*gm4*gm8*s + CL*g01*g03*g08*gm2*gm4*gm7*s + CL*g01*g04*g06*gm2*gm5*gm7*s +
CL*g01*g05*g06*gm2*gm4*gm7*s + CL*g01*g06*g07*gm2*gm4*gm5*s + CL*g01*g02*g03*gm5*gm7*gm8*s +
CL*g01*g02*g05*gm3*gm7*gm8*s + CL*g01*g02*g07*gm3*gm5*gm8*s + CL*g01*g02*g08*gm3*gm5*gm7*s +
CL*g01*g03*g06*gm4*gm5*gm7*s + CL*g01*g04*g06*gm3*gm5*gm7*s + CL*g01*g05*g06*gm3*gm4*gm7*s +
CL*g01*g06*g07*gm3*gm4*gm5*s + CL*g02*g03*g05*gm1*gm7*gm8*s + CL*g02*g03*g07*gm1*gm5*gm8*s +
CL*g02*g03*g08*gm1*gm5*gm7*s + CL*g02*g05*g07*gm1*gm3*gm8*s + CL*g02*g05*g08*gm1*gm3*gm7*s +
CL*g02*g07*g08*gm1*gm3*gm5*s + CL*g03*g04*g06*gm1*gm5*gm7*s + CL*g03*g05*g06*gm1*gm4*gm7*s +
CL*g03*g06*g07*gm1*gm4*gm5*s + CL*g04*g05*g06*gm1*gm3*gm7*s + CL*g04*g06*g07*gm1*gm3*gm5*s +
CL*g05*g06*g07*gm1*gm3*gm4*s + CL*g01*g02*g04*gm5*gm7*gm8*s + CL*g01*g02*g05*gm4*gm7*gm8*s +
CL*g01*g02*g07*gm4*gm5*gm8*s + CL*g01*g02*g08*gm4*gm5*gm7*s + CL*g01*g04*g05*gm2*gm7*gm8*s +
CL*g01*g04*g07*gm2*gm5*gm8*s + CL*g01*g04*g08*gm2*gm5*gm7*s + CL*g01*g05*g07*gm2*gm4*gm8*s +
CL*g01*g05*g08*gm2*gm4*gm7*s + CL*g01*g07*g08*gm2*gm4*gm5*s + CL*g02*g03*g06*gm4*gm5*gm7*s +
CL*g02*g04*g06*gm3*gm5*gm7*s + CL*g02*g05*g06*gm3*gm4*gm7*s + CL*g02*g06*g07*gm3*gm4*gm5*s +
CL*g03*g04*g06*gm2*gm5*gm7*s + CL*g03*g05*g06*gm2*gm4*gm7*s + CL*g03*g06*g07*gm2*gm4*gm5*s +
CL*g04*g05*g06*gm2*gm3*gm7*s + CL*g04*g06*g07*gm2*gm3*gm5*s + CL*g05*g06*g07*gm2*gm3*gm4*s +
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CL*g01*g03*g08*gm4*gm5*gm7*s + CL*g01*g04*g05*gm3*gm7*gm8*s + CL*g01*g04*g07*gm3*gm5*gm8*s +
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CL*g01*g07*g08*gm3*gm4*gm5*s + CL*g03*g04*g05*gm1*gm7*gm8*s + CL*g03*g04*g07*gm1*gm5*gm8*s +
CL*g03*g04*g08*gm1*gm5*gm7*s + CL*g03*g05*g07*gm1*gm4*gm8*s + CL*g03*g05*g08*gm1*gm4*gm7*s +
CL*g03*g07*g08*gm1*gm4*gm5*s + CL*g04*g05*g07*gm1*gm3*gm8*s + CL*g04*g05*g08*gm1*gm3*gm7*s +
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CL*g02*g03*g05*gm4*gm7*gm8*s + CL*g02*g03*g07*gm4*gm5*gm8*s + CL*g02*g03*g08*gm4*gm5*gm7*s +
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CL*g02*g05*g07*gm3*gm4*gm8*s + CL*g02*g05*g08*gm3*gm4*gm7*s + CL*g02*g07*g08*gm3*gm4*gm5*s +
CL*g03*g04*g05*gm2*gm7*gm8*s + CL*g03*g04*g07*gm2*gm5*gm8*s + CL*g03*g04*g08*gm2*gm5*gm7*s +
CL*g03*g05*g07*gm2*gm4*gm8*s + CL*g03*g05*g08*gm2*gm4*gm7*s + CL*g03*g07*g08*gm2*gm4*gm5*s +
CL*g04*g05*g07*gm2*gm3*gm8*s + CL*g04*g05*g08*gm2*gm3*gm7*s + CL*g04*g07*g08*gm2*gm3*gm5*s +
CL*g05*g07*g08*gm2*gm3*gm4*s + CL*g01*g03*g011*gm4*gm5*gm8*s + CL*g01*g02*g011*gm5*gm7*gm8*s +
CL*g01*g03*g011*gm4*gm7*gm8*s + CL*g01*g06*g011*gm4*gm5*gm7*s + CL*g02*g06*g011*gm3*gm5*gm7*s +
CL*g01*g04*g011*gm5*gm7*gm8*s + CL*g01*g05*g011*gm4*gm7*gm8*s + CL*g01*g07*g011*gm4*gm5*gm8*s +
CL*g01*g08*g011*gm4*gm5*gm7*s + CL*g02*g03*g011*gm5*gm7*gm8*s + CL*g02*g05*g011*gm3*gm7*gm8*s +
CL*g02*g07*g011*gm3*gm5*gm8*s + CL*g02*g08*g011*gm3*gm5*gm7*s + CL*g03*g06*g011*gm4*gm5*gm7*s +
CL*g04*g06*g011*gm3*gm5*gm7*s + CL*g05*g06*g011*gm3*gm4*gm7*s + CL*g06*g07*g011*gm3*gm4*gm5*s +
CL*g03*g04*g011*gm5*gm7*gm8*s + CL*g03*g05*g011*gm4*gm7*gm8*s + CL*g03*g07*g011*gm4*gm5*gm8*s +
CL*g03*g08*g011*gm4*gm5*gm7*s + CL*g04*g05*g011*gm3*gm7*gm8*s + CL*g04*g07*g011*gm3*gm5*gm8*s +
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CL*g01*g07*gm2*gm4*gm5*gm8*s + CL*g01*g08*gm2*gm4*gm5*gm7*s + CL*g02*g06*gm3*gm4*gm5*gm7*s +
CL*g03*g06*gm2*gm4*gm5*gm7*s + CL*g04*g06*gm2*gm3*gm5*gm7*s + CL*g05*g06*gm2*gm3*gm4*gm7*s +
CL*g06*g07*gm2*gm3*gm4*gm5*s + CL*g01*g03*gm4*gm5*gm7*gm8*s + CL*g01*g04*gm3*gm5*gm7*gm8*s +
CL*g01*g05*gm3*gm4*gm7*gm8*s + CL*g01*g07*gm3*gm4*gm5*gm8*s + CL*g01*g08*gm3*gm4*gm5*gm7*s +
CL*g03*g04*gm1*gm5*gm7*gm8*s + CL*g03*g05*gm1*gm4*gm7*gm8*s + CL*g03*g07*gm1*gm4*gm5*gm8*s +
CL*g03*g08*gm1*gm4*gm5*gm7*s + CL*g04*g05*gm1*gm3*gm7*gm8*s + CL*g04*g07*gm1*gm3*gm5*gm8*s +
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CL*g07*g08*gm1*gm3*gm4*gm5*s + CL*g02*g03*gm4*gm5*gm7*gm8*s + CL*g02*g04*gm3*gm5*gm7*gm8*s +
CL*g02*g05*gm3*gm4*gm7*gm8*s + CL*g02*g07*gm3*gm4*gm5*gm8*s + CL*g02*g08*gm3*gm4*gm5*gm7*s +
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CL*g07*g08*gm2*gm3*gm4*gm5*s + CL*g01*g011*gm4*gm5*gm7*gm8*s + CL*g02*g011*gm3*gm5*gm7*gm8*s +
CL*g06*g011*gm3*gm4*gm5*gm7*s + CL*g03*g011*gm4*gm5*gm7*gm8*s + CL*g04*g011*gm3*gm5*gm7*gm8*s +
CL*g05*g011*gm3*gm4*gm7*gm8*s + CL*g07*g011*gm3*gm4*gm5*gm8*s + CL*g08*g011*gm3*gm4*gm5*gm7*s +
CL*g02*gm1*gm3*gm5*gm7*gm8*s + CL*g06*gm1*gm3*gm4*gm5*gm7*s + CL*g01*gm2*gm4*gm5*gm7*gm8*s +
CL*g06*gm2*gm3*gm4*gm5*gm7*s + CL*g01*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm1*gm4*gm5*gm7*gm8*s +
CL*g04*gm1*gm3*gm5*gm7*gm8*s + CL*g05*gm1*gm3*gm4*gm7*gm8*s + CL*g07*gm1*gm3*gm4*gm5*gm8*s +
CL*g08*gm1*gm3*gm4*gm5*gm7*s + CL*g02*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm2*gm4*gm5*gm7*gm8*s +
CL*g04*gm2*gm3*gm5*gm7*gm8*s + CL*g05*gm2*gm3*gm4*gm7*gm8*s + CL*g07*gm2*gm3*gm4*gm5*gm8*s +
CL*g08*gm2*gm3*gm4*gm5*gm7*s + CL*g011*gm3*gm4*gm5*gm7*gm8*s + CL*gm1*gm3*gm4*gm5*gm7*gm8*s +
CL*gm2*gm3*gm4*gm5*gm7*gm8*s))*Vinn + (Vinp*g02*g03*g04*g07*gm1*gm8^2 +
Vinp*g02*g03*g07*g011*gm1*gm8^2 + Vinp*g03*g04*g07*g011*gm1*gm8^2 +
Vinp*g02*g03*g04*gm1*gm7*gm8^2 + Vinp*g02*g03*g07*gm1*gm4*gm8^2 + Vinp*g02*g04*g07*gm1*gm3*gm8^2
+ Vinp*g03*g04*g07*gm1*gm2*gm8^2 + Vinp*g02*g03*g011*gm1*gm7*gm8^2 +
Vinp*g02*g07*g011*gm1*gm3*gm8^2 + Vinp*g03*g04*g011*gm1*gm7*gm8^2 +
Vinp*g03*g07*g011*gm1*gm4*gm8^2 + Vinp*g04*g07*g011*gm1*gm3*gm8^2 +
Vinp*g02*g03*gm1*gm4*gm7*gm8^2 + Vinp*g02*g04*gm1*gm3*gm7*gm8^2 + Vinp*g02*g07*gm1*gm3*gm4*gm8^2
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MATLAB Solution Continued 5:

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+ Vinp*g03*g04*gm1*gm2*gm7*gm8^2 + Vinp*g03*g07*gm1*gm2*gm4*gm8^2 +
Vinp*g04*g07*gm1*gm2*gm3*gm8^2 + Vinp*g02*g011*gm1*gm3*gm7*gm8^2 +
Vinp*g03*g011*gm1*gm4*gm7*gm8^2 + Vinp*g04*g011*gm1*gm3*gm7*gm8^2 +
Vinp*g07*g011*gm1*gm3*gm4*gm8^2 + Vinp*g02*gm1*gm3*gm4*gm7*gm8^2 +
Vinp*g03*gm1*gm2*gm4*gm7*gm8^2 + Vinp*g04*gm1*gm2*gm3*gm7*gm8^2 + Vinp*g07*gm1*gm2*gm3*gm4*gm8^2
+ Vinp*g011*gm1*gm3*gm4*gm7*gm8^2 + Vinp*gm1*gm2*gm3*gm4*gm7*gm8^2 +
Vinp*g02*g03*g04*g05*g06*g07*gm1 + Vinp*g02*g03*g04*g05*g07*g08*gm1 +
Vinp*g02*g03*g04*g05*g06*gm1*gm7 + Vinp*g02*g03*g04*g06*g07*gm1*gm5 +
Vinp*g02*g03*g05*g06*g07*gm1*gm4 + Vinp*g02*g04*g05*g06*g07*gm1*gm3 +
Vinp*g03*g04*g05*g06*g07*gm1*gm2 + Vinp*g02*g03*g04*g05*g06*gm1*gm8 +
Vinp*g02*g03*g04*g05*g07*gm1*gm8 + Vinp*g02*g03*g04*g05*g08*gm1*gm7 +
Vinp*g02*g03*g04*g07*g08*gm1*gm5 + Vinp*g02*g03*g05*g07*g08*gm1*gm4 +
Vinp*g02*g04*g05*g07*g08*gm1*gm3 + Vinp*g03*g04*g05*g07*g08*gm1*gm2 +
Vinp*g02*g03*g04*g06*g07*gm1*gm8 + Vinp*g02*g03*g04*g07*g08*gm1*gm8 +
Vinp*g02*g03*g05*g06*g011*gm1*gm8 + Vinp*g02*g03*g06*g07*g011*gm1*gm8 +
Vinp*g03*g04*g05*g06*g011*gm1*gm8 + Vinp*g02*g03*g07*g08*g011*gm1*gm8 +
Vinp*g03*g04*g06*g07*g011*gm1*gm8 + Vinp*g03*g04*g07*g08*g011*gm1*gm8 +
Vinp*g02*g03*g04*g06*gm1*gm5*gm7 + Vinp*g02*g03*g05*g06*gm1*gm4*gm7 +
Vinp*g02*g03*g06*g07*gm1*gm4*gm5 + Vinp*g02*g04*g05*g06*gm1*gm3*gm7 +
Vinp*g02*g04*g06*g07*gm1*gm3*gm5 + Vinp*g02*g05*g06*g07*gm1*gm3*gm4 +
Vinp*g03*g04*g05*g06*gm1*gm2*gm7 + Vinp*g03*g04*g06*g07*gm1*gm2*gm5 +
Vinp*g03*g05*g06*g07*gm1*gm2*gm4 + Vinp*g04*g05*g06*g07*gm1*gm2*gm3 +
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Vinp*g03*g04*g07*g08*gm1*gm2*gm5 + Vinp*g03*g05*g07*g08*gm1*gm2*gm4 +
Vinp*g04*g05*g07*g08*gm1*gm2*gm3 + Vinp*g02*g03*g04*g06*gm1*gm7*gm8 +
Vinp*g02*g03*g06*g07*gm1*gm4*gm8 + Vinp*g02*g04*g06*g07*gm1*gm3*gm8 +
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Vinp*g02*g03*g07*g08*gm1*gm4*gm8 + Vinp*g02*g04*g07*g08*gm1*gm3*gm8 +
Vinp*g03*g04*g07*g08*gm1*gm2*gm8 + Vinp*g02*g03*g06*g011*gm1*gm5*gm8 +
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Vinp*g03*g05*g06*g011*gm1*gm4*gm8 + Vinp*g04*g05*g06*g011*gm1*gm3*gm8 +
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Vinp*g04*g06*g07*g011*gm1*gm3*gm8 + Vinp*g03*g04*g08*g011*gm1*gm7*gm8 +
Vinp*g03*g07*g08*g011*gm1*gm4*gm8 + Vinp*g04*g07*g08*g011*gm1*gm3*gm8 +
Vinp*g02*g03*g06*gm1*gm4*gm5*gm7 + Vinp*g02*g04*g06*gm1*gm3*gm5*gm7 +
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Vinp*g03*g04*g08*gm1*gm2*gm5*gm7 + Vinp*g03*g05*g07*gm1*gm2*gm4*gm8 +
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Vinp*g02*g06*g011*gm1*gm3*gm5*gm8 + Vinp*g02*g06*g011*gm1*gm3*gm7*gm8 +
Vinp*g03*g06*g011*gm1*gm4*gm5*gm8 + Vinp*g04*g06*g011*gm1*gm3*gm5*gm8 +
Vinp*g05*g06*g011*gm1*gm3*gm4*gm8 + Vinp*g02*g08*g011*gm1*gm3*gm7*gm8 +
Vinp*g03*g06*g011*gm1*gm4*gm7*gm8 + Vinp*g04*g06*g011*gm1*gm3*gm7*gm8 +
```

MATLAB Solution Continued 6:

```
Vinp*g06*g07*g011*gm1*gm3*gm4*gm8 + Vinp*g03*g08*g011*gm1*gm4*gm7*gm8 +
Vinp*g04*g08*g011*gm1*gm3*gm7*gm8 + Vinp*g07*g08*g011*gm1*gm3*gm4*gm8 +
Vinp*g02*g06*gm1*gm3*gm4*gm5*gm7 + Vinp*g03*g06*gm1*gm2*gm4*gm5*gm7 +
Vinp*g04*g06*gm1*gm2*gm3*gm5*gm7 + Vinp*g05*g06*gm1*gm2*gm3*gm4*gm7 +
Vinp*g06*g07*gm1*gm2*gm3*gm4*gm5 + Vinp*g02*g06*gm1*gm3*gm4*gm5*gm8 +
Vinp*g03*g06*gm1*gm2*gm4*gm5*gm8 + Vinp*g04*g06*gm1*gm2*gm3*gm5*gm8 +
Vinp*g05*g06*gm1*gm2*gm3*gm4*gm8 + Vinp*g02*g03*gm1*gm4*gm5*gm7*gm8 +
Vinp*g02*g04*gm1*gm3*gm5*gm7*gm8 + Vinp*g02*g05*gm1*gm3*gm4*gm7*gm8 +
Vinp*g02*g07*gm1*gm3*gm4*gm5*gm8 + Vinp*g02*g08*gm1*gm3*gm4*gm5*gm7 +
Vinp*g03*g04*gm1*gm2*gm5*gm7*gm8 + Vinp*g03*g05*gm1*gm2*gm4*gm7*gm8 +
Vinp*g03*g07*gm1*gm2*gm4*gm5*gm8 + Vinp*g03*g08*gm1*gm2*gm4*gm5*gm7 +
Vinp*g04*g05*gm1*gm2*gm3*gm7*gm8 + Vinp*g04*g07*gm1*gm2*gm3*gm5*gm8 +
Vinp*g04*g08*gm1*gm2*gm3*gm5*gm7 + Vinp*g05*g07*gm1*gm2*gm3*gm4*gm8 +
Vinp*g05*g08*gm1*gm2*gm3*gm4*gm7 + Vinp*g07*g08*gm1*gm2*gm3*gm4*gm5 +
Vinp*g02*g06*gm1*gm3*gm4*gm7*gm8 + Vinp*g03*g06*gm1*gm2*gm4*gm7*gm8 +
Vinp*g04*g06*gm1*gm2*gm3*gm7*gm8 + Vinp*g06*g07*gm1*gm2*gm3*gm4*gm8 +
Vinp*g02*g08*gm1*gm3*gm4*gm7*gm8 + Vinp*g03*g08*gm1*gm2*gm4*gm7*gm8 +
Vinp*g04*g08*gm1*gm2*gm3*gm7*gm8 + Vinp*g07*g08*gm1*gm2*gm3*gm4*gm8 +
Vinp*g06*g011*gm1*gm3*gm4*gm5*gm8 + Vinp*g06*g011*gm1*gm3*gm4*gm7*gm8 +
Vinp*g08*g011*gm1*gm3*gm4*gm7*gm8 + Vinp*g06*gm1*gm2*gm3*gm4*gm5*gm7 +
Vinp*g06*gm1*gm2*gm3*gm4*gm5*gm8 + Vinp*g02*gm1*gm3*gm4*gm5*gm7*gm8 +
Vinp*g03*gm1*gm2*gm4*gm5*gm7*gm8 + Vinp*g04*gm1*gm2*gm3*gm5*gm7*gm8 +
Vinp*g05*gm1*gm2*gm3*gm4*gm7*gm8 + Vinp*g07*gm1*gm2*gm3*gm4*gm5*gm8 +
Vinp*g08*gm1*gm2*gm3*gm4*gm5*gm7 + Vinp*g06*gm1*gm2*gm3*gm4*gm7*gm8 +
Vinp*g08*gm1*gm2*gm3*gm4*gm7*gm8 + Vinp*gm1*gm2*gm3*gm4*gm5*gm7*gm8)

/

(g01*g02*g03*g04*g07*gm8^2 + g01*g02*g03*g04*gm7*gm8^2 + g01*g02*g04*g07*gm3*gm8^2 +
g02*g03*g04*g07*gm1*gm8^2 + g01*g02*g04*gm3*gm7*gm8^2 + g02*g03*g04*gm1*gm7*gm8^2 +
g02*g04*g07*gm1*gm3*gm8^2 + g02*g04*gm1*gm3*gm7*gm8^2 + g01*g02*g03*g04*g05*g06*g07 +
g01*g02*g03*g04*g05*g06*g08 + g01*g02*g03*g04*g05*g07*g08 + g01*g02*g03*g04*g06*g07*g08 +
g01*g02*g03*g04*g05*g06*g011 + g01*g02*g03*g05*g06*g07*g08 + g01*g02*g04*g05*g06*g07*g08 +
g01*g02*g03*g04*g05*g08*g011 + g01*g02*g03*g04*g06*g07*g011 + g01*g03*g04*g05*g06*g07*g08 +
g02*g03*g04*g05*g06*g07*g08 + g01*g02*g03*g04*g07*g08*g011 + g01*g02*g03*g05*g06*g08*g011 +
g01*g02*g04*g05*g06*g07*g011 + g01*g02*g03*g06*g07*g08*g011 + g01*g02*g04*g05*g07*g08*g011 +
g01*g03*g04*g05*g06*g08*g011 + g02*g03*g04*g05*g06*g07*g011 + g01*g02*g05*g06*g07*g08*g011 +
g01*g03*g04*g06*g07*g08*g011 + g02*g03*g04*g05*g07*g08*g011 + g01*g04*g05*g06*g07*g08*g011 +
g02*g03*g05*g06*g07*g08*g011 + g03*g04*g05*g06*g07*g08*g011 + g01*g02*g03*g04*g05*g06*gm7 +
g01*g02*g03*g04*g06*g07*gm5 + g01*g02*g04*g05*g06*g07*gm3 + g02*g03*g04*g05*g06*g07*gm1 +
g01*g02*g03*g04*g05*g06*gm8 + g01*g02*g03*g04*g06*g08*gm5 + g01*g02*g03*g05*g06*g08*gm4 +
g01*g03*g04*g05*g06*g08*gm2 + g01*g02*g03*g04*g05*g07*gm8 + g01*g02*g03*g04*g05*g08*gm7 +
g01*g02*g03*g04*g07*g08*gm5 + g01*g02*g04*g05*g07*g08*gm3 + g02*g03*g04*g05*g07*g08*gm1 +
g01*g02*g03*g04*g06*g07*gm8 + g01*g02*g03*g04*g06*g08*gm7 + g01*g02*g03*g06*g07*g08*gm4 +
g01*g03*g04*g06*g07*g08*gm2 + g01*g02*g03*g04*g06*g011*gm5 + g01*g02*g03*g05*g06*g08*gm7 +
g01*g02*g03*g06*g07*g08*gm5 + g01*g02*g05*g06*g07*g08*gm3 + g02*g03*g05*g06*g07*g08*gm1 +
g01*g02*g03*g04*g07*g08*gm8 + g01*g02*g04*g05*g06*g08*gm7 + g01*g02*g04*g06*g07*g08*gm5 +
g01*g02*g05*g06*g07*g08*gm4 + g01*g04*g05*g06*g07*g08*gm2 + g01*g02*g03*g04*g05*g011*gm8 +
g01*g02*g03*g04*g06*g011*gm7 + g01*g02*g03*g04*g08*g011*gm5 + g01*g03*g04*g05*g06*g08*gm7 +
g01*g03*g04*g06*g07*g08*gm5 + g01*g03*g05*g06*g07*g08*gm4 + g01*g04*g05*g06*g07*g08*gm3 +
g03*g04*g05*g06*g07*g08*gm1 + g02*g03*g04*g05*g06*g08*gm7 + g02*g03*g04*g06*g07*g08*gm5 +
g02*g03*g05*g06*g07*g08*gm4 + g02*g04*g05*g06*g07*g08*gm3 + g03*g04*g05*g06*g07*g08*gm2 +
g01*g02*g03*g04*g07*g011*gm8 + g01*g02*g03*g04*g08*g011*gm7 + g01*g02*g03*g06*g08*g011*gm5 +
g01*g02*g04*g05*g06*g011*gm7 + g01*g02*g04*g06*g07*g011*gm5 + g01*g02*g03*g06*g08*g011*gm7 +
g01*g02*g04*g05*g07*g011*gm8 + g01*g02*g04*g05*g08*g011*gm7 + g01*g02*g04*g07*g08*g011*gm5 +
g01*g03*g04*g06*g08*g011*gm5 + g01*g03*g05*g06*g08*g011*gm4 + g02*g03*g04*g05*g06*g011*gm7 +
g02*g03*g04*g06*g07*g011*gm5 + g02*g04*g05*g06*g07*g011*gm3 + g01*g02*g05*g06*g08*g011*gm7 +
g01*g02*g06*g07*g08*g011*gm5 + g01*g03*g04*g06*g08*g011*gm7 + g01*g03*g06*g07*g08*g011*gm4 +
g02*g03*g04*g05*g07*g011*gm8 + g02*g03*g04*g05*g08*g011*gm7 + g02*g03*g04*g07*g08*g011*gm5 +
g02*g04*g05*g07*g08*g011*gm3 + g01*g04*g05*g06*g08*g011*gm7 + g01*g04*g06*g07*g08*g011*gm5 +
g01*g05*g06*g07*g08*g011*gm4 + g02*g03*g05*g06*g08*g011*gm7 + g02*g03*g06*g07*g08*g011*gm5 +
g02*g05*g06*g07*g08*g011*gm3 + g03*g04*g05*g06*g08*g011*gm7 + g03*g04*g06*g07*g08*g011*gm5 +
g03*g05*g06*g07*g08*g011*gm4 + g04*g05*g06*g07*g08*g011*gm3 + g01*g02*g03*g04*g06*gm5*gm7 +
g01*g02*g04*g05*g06*gm3*gm7 + g01*g02*g04*g06*g07*gm3*gm5 + g02*g03*g04*g05*g06*gm1*gm7 +
g02*g03*g04*g06*g07*gm1*gm5 + g02*g04*g05*g06*g07*gm1*gm3 + g01*g02*g03*g04*g06*gm5*gm8 +
g01*g02*g03*g06*g08*gm4*gm5 + g01*g02*g04*g05*g06*gm3*gm8 + g01*g03*g04*g06*g08*gm2*gm5 +
g01*g03*g05*g06*g08*gm2*gm4 + g02*g03*g04*g05*g06*gm1*gm8 + g01*g02*g03*g04*g05*gm7*gm8 +
g01*g02*g03*g04*g07*gm5*gm8 + g01*g02*g03*g04*g08*gm5*gm7 + g01*g02*g04*g05*g07*gm3*gm8 +
g01*g02*g04*g05*g08*gm3*gm7 + g01*g02*g04*g07*g08*gm3*gm5 + g02*g03*g04*g05*g07*gm1*gm8 +
g02*g03*g04*g05*g08*gm1*gm7 + g02*g03*g04*g07*g08*gm1*gm5 + g02*g04*g05*g07*g08*gm1*gm3 +
g01*g02*g03*g04*g06*gm7*gm8 + g01*g02*g03*g06*g08*gm4*gm7 + g01*g02*g04*g06*g07*gm3*gm8 +
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MATLAB Solution Continued 7:

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g01*g03*g04*g06*g08*gm2*gm7 + g01*g03*g06*g07*g08*gm2*gm4 + g02*g03*g04*g06*g07*gm1*gm8 +
g01*g02*g03*g06*g08*gm5*gm7 + g01*g02*g05*g06*g08*gm3*gm7 + g01*g02*g06*g07*g08*gm3*gm5 +
g02*g03*g05*g06*g08*gm1*gm7 + g02*g03*g06*g07*g08*gm1*gm5 + g02*g05*g06*g07*g08*gm1*gm3 +
g01*g02*g03*g04*g08*gm7*gm8 + g01*g02*g04*g06*g08*gm5*gm7 + g01*g02*g04*g07*g08*gm3*gm8 +
g01*g02*g05*g06*g08*gm4*gm7 + g01*g02*g06*g07*g08*gm4*gm5 + g01*g04*g05*g06*g08*gm2*gm7 +
g01*g04*g06*g07*g08*gm2*gm5 + g01*g05*g06*g07*g08*gm2*gm4 + g02*g03*g04*g07*g08*gm1*gm8 +
g01*g02*g03*g04*g011*gm5*gm8 + g01*g03*g04*g06*g08*gm5*gm7 + g01*g03*g05*g06*g08*gm4*gm7 +
g01*g03*g06*g07*g08*gm4*gm5 + g01*g04*g05*g06*g08*gm3*gm7 + g01*g04*g06*g07*g08*gm3*gm5 +
g01*g05*g06*g07*g08*gm3*gm4 + g03*g04*g05*g06*g08*gm1*gm7 + g03*g04*g06*g07*g08*gm1*gm5 +
g03*g05*g06*g07*g08*gm1*gm4 + g04*g05*g06*g07*g08*gm1*gm3 + g02*g03*g04*g06*g08*gm5*gm7 +
g02*g03*g05*g06*g08*gm4*gm7 + g02*g03*g06*g07*g08*gm4*gm5 + g02*g04*g05*g06*g08*gm3*gm7 +
g02*g04*g06*g07*g08*gm3*gm5 + g02*g05*g06*g07*g08*gm3*gm4 + g03*g04*g05*g06*g08*gm2*gm7 +
g03*g04*g06*g07*g08*gm2*gm5 + g03*g05*g06*g07*g08*gm2*gm4 + g04*g05*g06*g07*g08*gm2*gm3 +
g01*g02*g03*g04*g011*gm7*gm8 + g01*g02*g04*g06*g011*gm5*gm7 + g01*g02*g04*g05*g011*gm7*gm8 +
g01*g02*g04*g07*g011*gm5*gm8 + g01*g02*g04*g08*g011*gm5*gm7 + g01*g03*g06*g08*g011*gm4*gm5 +
g02*g03*g04*g06*g011*gm5*gm7 + g02*g04*g05*g06*g011*gm3*gm7 + g02*g04*g06*g07*g011*gm3*gm5 +
g01*g02*g06*g08*g011*gm5*gm7 + g01*g03*g06*g08*g011*gm4*gm7 + g02*g03*g04*g05*g011*gm7*gm8 +
g02*g03*g04*g07*g011*gm5*gm8 + g02*g03*g04*g08*g011*gm5*gm7 + g02*g04*g05*g07*g011*gm3*gm8 +
g02*g04*g05*g08*g011*gm3*gm7 + g02*g04*g07*g08*g011*gm3*gm5 + g01*g04*g06*g08*g011*gm5*gm7 +
g01*g05*g06*g08*g011*gm4*gm7 + g01*g06*g07*g08*g011*gm4*gm5 + g02*g03*g06*g08*g011*gm5*gm7 +
g02*g05*g06*g08*g011*gm3*gm7 + g02*g06*g07*g08*g011*gm3*gm5 + g03*g04*g06*g08*g011*gm5*gm7 +
g03*g05*g06*g08*g011*gm4*gm7 + g03*g06*g07*g08*g011*gm4*gm5 + g04*g05*g06*g08*g011*gm3*gm7 +
g04*g06*g07*g08*g011*gm3*gm5 + g05*g06*g07*g08*g011*gm3*gm4 + g01*g02*g04*g06*gm3*gm5*gm7 +
g02*g03*g04*g06*gm1*gm5*gm7 + g02*g04*g05*g06*gm1*gm3*gm7 + g02*g04*g06*g07*gm1*gm3*gm5 +
g01*g02*g04*g06*gm3*gm5*gm8 + g01*g03*g06*g08*gm2*gm4*gm5 + g02*g03*g04*g06*gm1*gm5*gm8 +
g02*g04*g05*g06*gm1*gm3*gm8 + g01*g02*g03*g04*gm5*gm7*gm8 + g01*g02*g04*g05*gm3*gm7*gm8 +
g01*g02*g04*g07*gm3*gm5*gm8 + g01*g02*g04*g08*gm3*gm5*gm7 + g02*g03*g04*g05*gm1*gm7*gm8 +
g02*g03*g04*g07*gm1*gm5*gm8 + g02*g03*g04*g08*gm1*gm5*gm7 + g02*g04*g05*g07*gm1*gm3*gm8 +
g02*g04*g05*g08*gm1*gm3*gm7 + g02*g04*g07*g08*gm1*gm3*gm5 + g01*g02*g04*g06*gm3*gm7*gm8 +
g01*g03*g06*g08*gm2*gm4*gm7 + g02*g03*g04*g06*gm1*gm7*gm8 + g02*g04*g06*g07*gm1*gm3*gm8 +
g01*g02*g06*g08*gm3*gm5*gm7 + g02*g03*g06*g08*gm1*gm5*gm7 + g02*g05*g06*g08*gm1*gm3*gm7 +
g02*g06*g07*g08*gm1*gm3*gm5 + g01*g02*g04*g08*gm3*gm7*gm8 + g01*g02*g06*g08*gm4*gm5*gm7 +
g01*g04*g06*g08*gm2*gm5*gm7 + g01*g05*g06*g08*gm2*gm4*gm7 + g01*g06*g07*g08*gm2*gm4*gm5 +
g02*g03*g04*g08*gm1*gm7*gm8 + g02*g04*g07*g08*gm1*gm3*gm8 + g01*g03*g06*g08*gm4*gm5*gm7 +
g01*g04*g06*g08*gm3*gm5*gm7 + g01*g05*g06*g08*gm3*gm4*gm7 + g01*g06*g07*g08*gm3*gm4*gm5 +
g03*g04*g06*g08*gm1*gm5*gm7 + g03*g05*g06*g08*gm1*gm4*gm7 + g03*g06*g07*g08*gm1*gm4*gm5 +
g04*g05*g06*g08*gm1*gm3*gm7 + g04*g06*g07*g08*gm1*gm3*gm5 + g05*g06*g07*g08*gm1*gm3*gm4 +
g02*g03*g06*g08*gm4*gm5*gm7 + g02*g04*g06*g08*gm3*gm5*gm7 + g02*g05*g06*g08*gm3*gm4*gm7 +
g02*g06*g07*g08*gm3*gm4*gm5 + g03*g04*g06*g08*gm2*gm5*gm7 + g03*g05*g06*g08*gm2*gm4*gm7 +
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g05*g06*g07*g08*gm2*gm3*gm4 + g01*g02*g04*g011*gm5*gm7*gm8 + g02*g04*g06*g011*gm3*gm5*gm7 +
g02*g03*g04*g011*gm5*gm7*gm8 + g02*g04*g05*g011*gm3*gm7*gm8 + g02*g04*g07*g011*gm3*gm5*gm8 +
g02*g04*g08*g011*gm3*gm5*gm7 + g01*g06*g08*g011*gm4*gm5*gm7 + g02*g06*g08*g011*gm3*gm5*gm7 +
g03*g06*g08*g011*gm4*gm5*gm7 + g04*g06*g08*g011*gm3*gm5*gm7 + g05*g06*g08*g011*gm3*gm4*gm7 +
g06*g07*g08*g011*gm3*gm4*gm5 + g02*g04*g06*gm1*gm3*gm5*gm7 + g02*g04*g06*gm1*gm3*gm5*gm8 +
g01*g02*g04*gm3*gm5*gm7*gm8 + g02*g03*g04*gm1*gm5*gm7*gm8 + g02*g04*g05*gm1*gm3*gm7*gm8 +
g02*g04*g07*gm1*gm3*gm5*gm8 + g02*g04*g08*gm1*gm3*gm5*gm7 + g02*g04*g06*gm1*gm3*gm7*gm8 +
g02*g06*g08*gm1*gm3*gm5*gm7 + g01*g06*g08*gm2*gm4*gm5*gm7 + g02*g04*g08*gm1*gm3*gm7*gm8 +
g01*g06*g08*gm3*gm4*gm5*gm7 + g03*g06*g08*gm1*gm4*gm5*gm7 + g04*g06*g08*gm1*gm3*gm5*gm7 +
g05*g06*g08*gm1*gm3*gm4*gm7 + g06*g07*g08*gm1*gm3*gm4*gm5 + g02*g06*g08*gm3*gm4*gm5*gm7 +
g03*g06*g08*gm2*gm4*gm5*gm7 + g04*g06*g08*gm2*gm3*gm5*gm7 + g05*g06*g08*gm2*gm3*gm4*gm7 +
g06*g07*g08*gm2*gm3*gm4*gm5 + g02*g04*g011*gm3*gm5*gm7*gm8 + g06*g08*g011*gm3*gm4*gm5*gm7 +
g02*g04*gm1*gm3*gm5*gm7*gm8 + g06*g08*gm1*gm3*gm4*gm5*gm7 + g06*g08*gm2*gm3*gm4*gm5*gm7 +
CL*g01*g02*g03*g04*g05*g06*s + CL*g01*g02*g03*g04*g05*g08*s + CL*g01*g02*g03*g04*g06*g07*s +
CL*g01*g02*g03*g05*g06*g07*s + CL*g01*g02*g03*g04*g07*g08*s + CL*g01*g02*g04*g05*g06*g07*s +
CL*g01*g02*g03*g05*g07*g08*s + CL*g01*g03*g04*g05*g06*g07*s + CL*g01*g02*g04*g05*g07*g08*s +
CL*g02*g03*g04*g05*g06*g07*s + CL*g01*g02*g03*g05*g06*g011*s + CL*g01*g03*g04*g05*g07*g08*s +
CL*g02*g03*g04*g05*g07*g08*s + CL*g01*g02*g03*g05*g08*g011*s + CL*g01*g02*g03*g06*g07*g011*s +
CL*g01*g03*g04*g05*g06*g011*s + CL*g01*g02*g03*g07*g08*g011*s + CL*g01*g02*g05*g06*g07*g011*s +
CL*g01*g03*g04*g05*g08*g011*s + CL*g01*g03*g04*g06*g07*g011*s + CL*g01*g02*g05*g07*g08*g011*s +
CL*g01*g03*g04*g07*g08*g011*s + CL*g01*g04*g05*g06*g07*g011*s + CL*g02*g03*g05*g06*g07*g011*s +
CL*g01*g04*g05*g07*g08*g011*s + CL*g02*g03*g05*g07*g08*g011*s + CL*g03*g04*g05*g06*g07*g011*s +
CL*g03*g04*g05*g07*g08*g011*s + CL*g01*g02*g03*g04*g06*gm5*s + CL*g01*g02*g03*g05*g06*gm4*s +
CL*g01*g03*g04*g05*g06*gm2*s + CL*g01*g02*g03*g04*g05*gm8*s + CL*g01*g02*g03*g04*g06*gm7*s +
CL*g01*g02*g03*g04*g08*gm5*s + CL*g01*g02*g03*g05*g08*gm4*s + CL*g01*g02*g03*g06*g07*gm4*s +
CL*g01*g03*g04*g05*g08*gm2*s + CL*g01*g03*g04*g06*g07*gm2*s + CL*g01*g02*g03*g05*g06*gm7*s +
CL*g01*g02*g03*g06*g07*gm5*s + CL*g01*g02*g05*g06*g07*gm3*s + CL*g02*g03*g05*g06*g07*gm1*s +
CL*g01*g02*g03*g04*g07*gm8*s + CL*g01*g02*g03*g04*g08*gm7*s + CL*g01*g02*g03*g07*g08*gm4*s +
CL*g01*g02*g04*g05*g06*gm7*s + CL*g01*g02*g04*g06*g07*gm5*s + CL*g01*g02*g05*g06*g07*gm4*s +
CL*g01*g03*g04*g07*g08*gm2*s + CL*g01*g04*g05*g06*g07*gm2*s + CL*g01*g02*g03*g05*g07*gm8*s +
CL*g01*g02*g03*g05*g08*gm7*s + CL*g01*g02*g03*g07*g08*gm5*s + CL*g01*g02*g05*g07*g08*gm3*s +
```

MATLAB Solution Continued 8:

```
CL*g01*g03*g04*g05*g06*gm7*s + CL*g01*g03*g04*g06*g07*gm5*s + CL*g01*g03*g05*g06*g07*gm4*s +
CL*g01*g04*g05*g06*g07*gm3*s + CL*g02*g03*g05*g07*g08*gm1*s + CL*g03*g04*g05*g06*g07*gm1*s +
CL*g01*g02*g04*g05*g07*gm8*s + CL*g01*g02*g04*g05*g08*gm7*s + CL*g01*g02*g04*g07*g08*gm5*s +
CL*g01*g02*g05*g07*g08*gm4*s + CL*g01*g04*g05*g07*g08*gm2*s + CL*g02*g03*g04*g05*g06*gm7*s +
CL*g02*g03*g04*g06*g07*gm5*s + CL*g02*g03*g05*g06*g07*gm4*s + CL*g02*g04*g05*g06*g07*gm3*s +
CL*g03*g04*g05*g06*g07*gm2*s + CL*g01*g02*g03*g06*g011*gm5*s + CL*g01*g03*g04*g05*g07*gm8*s +
CL*g01*g03*g04*g05*g08*gm7*s + CL*g01*g03*g04*g07*g08*gm5*s + CL*g01*g03*g05*g07*g08*gm4*s +
CL*g01*g04*g05*g07*g08*gm3*s + CL*g03*g04*g05*g07*g08*gm1*s + CL*g02*g03*g04*g05*g07*gm8*s +
CL*g02*g03*g04*g05*g08*gm7*s + CL*g02*g03*g04*g07*g08*gm5*s + CL*g02*g03*g05*g07*g08*gm4*s +
CL*g02*g04*g05*g07*g08*gm3*s + CL*g03*g04*g05*g07*g08*gm2*s + CL*g01*g02*g03*g05*g011*gm8*s +
CL*g01*g02*g03*g06*g011*gm7*s + CL*g01*g02*g03*g08*g011*gm5*s + CL*g01*g03*g04*g06*g011*gm5*s +
CL*g01*g03*g05*g06*g011*gm4*s + CL*g01*g02*g03*g07*g011*gm8*s + CL*g01*g02*g03*g08*g011*gm7*s +
CL*g01*g02*g05*g06*g011*gm7*s + CL*g01*g02*g06*g07*g011*gm5*s + CL*g01*g03*g04*g05*g011*gm8*s +
CL*g01*g03*g04*g06*g011*gm7*s + CL*g01*g03*g04*g08*g011*gm5*s + CL*g01*g03*g05*g08*g011*gm4*s +
CL*g01*g03*g06*g07*g011*gm4*s + CL*g01*g02*g05*g07*g011*gm8*s + CL*g01*g02*g05*g08*g011*gm7*s +
CL*g01*g02*g07*g08*g011*gm5*s + CL*g01*g03*g04*g07*g011*gm8*s + CL*g01*g03*g04*g08*g011*gm7*s +
CL*g01*g03*g07*g08*g011*gm4*s + CL*g01*g04*g05*g06*g011*gm7*s + CL*g01*g04*g06*g07*g011*gm5*s +
CL*g01*g05*g06*g07*g011*gm4*s + CL*g02*g03*g05*g06*g011*gm7*s + CL*g02*g03*g06*g07*g011*gm5*s +
CL*g02*g05*g06*g07*g011*gm3*s + CL*g01*g04*g05*g07*g011*gm8*s + CL*g01*g04*g05*g08*g011*gm7*s +
CL*g01*g04*g07*g08*g011*gm5*s + CL*g01*g05*g07*g08*g011*gm4*s + CL*g02*g03*g05*g07*g011*gm8*s +
CL*g02*g03*g05*g08*g011*gm7*s + CL*g02*g03*g07*g08*g011*gm5*s + CL*g02*g05*g07*g08*g011*gm3*s +
CL*g03*g04*g05*g06*g011*gm7*s + CL*g03*g04*g06*g07*g011*gm5*s + CL*g03*g05*g06*g07*g011*gm4*s +
CL*g04*g05*g06*g07*g011*gm3*s + CL*g03*g04*g05*g07*g011*gm8*s + CL*g03*g04*g05*g08*g011*gm7*s +
CL*g03*g04*g07*g08*g011*gm5*s + CL*g03*g05*g07*g08*g011*gm4*s + CL*g04*g05*g07*g08*g011*gm3*s +
CL*g01*g02*g03*g06*gm4*gm5*s + CL*g01*g03*g04*g06*gm2*gm5*s + CL*g01*g03*g05*g06*gm2*gm4*s +
CL*g01*g02*g03*g04*gm5*gm8*s + CL*g01*g02*g03*g05*gm4*gm8*s + CL*g01*g02*g03*g06*gm4*gm7*s +
CL*g01*g02*g03*g08*gm4*gm5*s + CL*g01*g03*g04*g05*gm2*gm8*s + CL*g01*g03*g04*g06*gm2*gm7*s +
CL*g01*g03*g04*g08*gm2*gm5*s + CL*g01*g03*g05*g08*gm2*gm4*s + CL*g01*g03*g06*g07*gm2*gm4*s +
CL*g01*g02*g03*g06*gm5*gm7*s + CL*g01*g02*g05*g06*gm3*gm7*s + CL*g01*g02*g06*g07*gm3*gm5*s +
CL*g02*g03*g05*g06*gm1*gm7*s + CL*g02*g03*g06*g07*gm1*gm5*s + CL*g02*g05*g06*g07*gm1*gm3*s +
CL*g01*g02*g03*g04*gm7*gm8*s + CL*g01*g02*g03*g07*gm4*gm8*s + CL*g01*g02*g03*g08*gm4*gm7*s +
CL*g01*g02*g04*g06*gm5*gm7*s + CL*g01*g02*g05*g06*gm4*gm7*s + CL*g01*g02*g06*g07*gm4*gm5*s +
CL*g01*g03*g04*g07*gm2*gm8*s + CL*g01*g03*g04*g08*gm2*gm7*s + CL*g01*g03*g07*g08*gm2*gm4*s +
CL*g01*g04*g05*g06*gm2*gm7*s + CL*g01*g04*g06*g07*gm2*gm5*s + CL*g01*g05*g06*g07*gm2*gm4*s +
CL*g01*g02*g03*g05*gm7*gm8*s + CL*g01*g02*g03*g07*gm5*gm8*s + CL*g01*g02*g03*g08*gm5*gm7*s +
CL*g01*g02*g05*g07*gm3*gm8*s + CL*g01*g02*g05*g08*gm3*gm7*s + CL*g01*g02*g07*g08*gm3*gm5*s +
CL*g01*g03*g04*g06*gm5*gm7*s + CL*g01*g03*g05*g06*gm4*gm7*s + CL*g01*g03*g06*g07*gm4*gm5*s +
CL*g01*g04*g05*g06*gm3*gm7*s + CL*g01*g04*g06*g07*gm3*gm5*s + CL*g01*g05*g06*g07*gm3*gm4*s +
CL*g02*g03*g05*g07*gm1*gm8*s + CL*g02*g03*g05*g08*gm1*gm7*s + CL*g02*g03*g07*g08*gm1*gm5*s +
CL*g02*g05*g07*g08*gm1*gm3*s + CL*g03*g04*g05*g06*gm1*gm7*s + CL*g03*g04*g06*g07*gm1*gm5*s +
CL*g03*g05*g06*g07*gm1*gm4*s + CL*g04*g05*g06*g07*gm1*gm3*s + CL*g01*g02*g04*g05*gm7*gm8*s +
CL*g01*g02*g04*g07*gm5*gm8*s + CL*g01*g02*g04*g08*gm5*gm7*s + CL*g01*g02*g05*g07*gm4*gm8*s +
CL*g01*g02*g05*g08*gm4*gm7*s + CL*g01*g02*g07*g08*gm4*gm5*s + CL*g01*g04*g05*g07*gm2*gm8*s +
CL*g01*g04*g05*g08*gm2*gm7*s + CL*g01*g04*g07*g08*gm2*gm5*s + CL*g01*g05*g07*g08*gm2*gm4*s +
CL*g02*g03*g04*g06*gm5*gm7*s + CL*g02*g03*g05*g06*gm4*gm7*s + CL*g02*g03*g06*g07*gm4*gm5*s +
CL*g02*g04*g05*g06*gm3*gm7*s + CL*g02*g04*g06*g07*gm3*gm5*s + CL*g02*g05*g06*g07*gm3*gm4*s +
CL*g03*g04*g05*g06*gm2*gm7*s + CL*g03*g04*g06*g07*gm2*gm5*s + CL*g03*g05*g06*g07*gm2*gm4*s +
CL*g04*g05*g06*g07*gm2*gm3*s + CL*g01*g03*g04*g05*gm7*gm8*s + CL*g01*g03*g04*g07*gm5*gm8*s +
CL*g01*g03*g04*g08*gm5*gm7*s + CL*g01*g03*g05*g07*gm4*gm8*s + CL*g01*g03*g05*g08*gm4*gm7*s +
CL*g01*g03*g07*g08*gm4*gm5*s + CL*g01*g04*g05*g07*gm3*gm8*s + CL*g01*g04*g05*g08*gm3*gm7*s +
CL*g01*g04*g07*g08*gm3*gm5*s + CL*g01*g05*g07*g08*gm3*gm4*s + CL*g03*g04*g05*g07*gm1*gm8*s +
CL*g03*g04*g05*g08*gm1*gm7*s + CL*g03*g04*g07*g08*gm1*gm5*s + CL*g03*g05*g07*g08*gm1*gm4*s +
CL*g04*g05*g07*g08*gm1*gm3*s + CL*g02*g03*g04*g05*gm7*gm8*s + CL*g02*g03*g04*g07*gm5*gm8*s +
CL*g02*g03*g04*g08*gm5*gm7*s + CL*g02*g03*g05*g07*gm4*gm8*s + CL*g02*g03*g05*g08*gm4*gm7*s +
CL*g02*g03*g07*g08*gm4*gm5*s + CL*g02*g04*g05*g07*gm3*gm8*s + CL*g02*g04*g05*g08*gm3*gm7*s +
CL*g02*g04*g07*g08*gm3*gm5*s + CL*g02*g05*g07*g08*gm3*gm4*s + CL*g03*g04*g05*g07*gm2*gm8*s +
CL*g03*g04*g05*g08*gm2*gm7*s + CL*g03*g04*g07*g08*gm2*gm5*s + CL*g03*g05*g07*g08*gm2*gm4*s +
CL*g04*g05*g07*g08*gm2*gm3*s + CL*g01*g02*g03*g011*gm5*gm8*s + CL*g01*g03*g06*g011*gm4*gm5*s +
CL*g01*g02*g03*g011*gm7*gm8*s + CL*g01*g02*g06*g011*gm5*gm7*s + CL*g01*g03*g04*g011*gm5*gm8*s +
CL*g01*g03*g05*g011*gm4*gm8*s + CL*g01*g03*g06*g011*gm4*gm7*s + CL*g01*g03*g08*g011*gm4*gm5*s +
CL*g01*g02*g05*g011*gm7*gm8*s + CL*g01*g02*g07*g011*gm5*gm8*s + CL*g01*g02*g08*g011*gm5*gm7*s +
CL*g01*g03*g04*g011*gm7*gm8*s + CL*g01*g03*g07*g011*gm4*gm8*s + CL*g01*g03*g08*g011*gm4*gm7*s +
CL*g01*g04*g06*g011*gm5*gm7*s + CL*g01*g05*g06*g011*gm4*gm7*s + CL*g01*g06*g07*g011*gm4*gm5*s +
CL*g02*g03*g06*g011*gm5*gm7*s + CL*g02*g05*g06*g011*gm3*gm7*s + CL*g02*g06*g07*g011*gm3*gm5*s +
CL*g01*g04*g05*g011*gm7*gm8*s + CL*g01*g04*g07*g011*gm5*gm8*s + CL*g01*g04*g08*g011*gm5*gm7*s +
CL*g01*g05*g07*g011*gm4*gm8*s + CL*g01*g05*g08*g011*gm4*gm7*s + CL*g01*g07*g08*g011*gm4*gm5*s +
CL*g02*g03*g05*g011*gm7*gm8*s + CL*g02*g03*g07*g011*gm5*gm8*s + CL*g02*g03*g08*g011*gm5*gm7*s +
CL*g02*g05*g07*g011*gm3*gm8*s + CL*g02*g05*g08*g011*gm3*gm7*s + CL*g02*g07*g08*g011*gm3*gm5*s +
CL*g03*g04*g06*g011*gm5*gm7*s + CL*g03*g05*g06*g011*gm4*gm7*s + CL*g03*g06*g07*g011*gm4*gm5*s +
CL*g04*g05*g06*g011*gm3*gm7*s + CL*g04*g06*g07*g011*gm3*gm5*s + CL*g05*g06*g07*g011*gm3*gm4*s +
CL*g03*g04*g05*g011*gm7*gm8*s + CL*g03*g04*g07*g011*gm5*gm8*s + CL*g03*g04*g08*g011*gm5*gm7*s +
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MATLAB Solution Continued 9:

```
CL*g03*g05*g07*g011*gm4*gm8*s + CL*g03*g05*g08*g011*gm4*gm7*s + CL*g03*g07*g08*g011*gm4*gm5*s +
CL*g04*g05*g07*g011*gm3*gm8*s + CL*g04*g05*g08*g011*gm3*gm7*s + CL*g04*g07*g08*g011*gm3*gm5*s +
CL*g05*g07*g08*g011*gm3*gm4*s + CL*g01*g03*g06*gm2*gm4*gm5*s + CL*g01*g02*g03*gm4*gm5*gm8*s +
CL*g01*g03*g04*gm2*gm5*gm8*s + CL*g01*g03*g05*gm2*gm4*gm8*s + CL*g01*g03*g06*gm2*gm4*gm7*s +
CL*g01*g03*g08*gm2*gm4*gm5*s + CL*g01*g02*g06*gm3*gm5*gm7*s + CL*g02*g03*g06*gm1*gm5*gm7*s +
CL*g02*g05*g06*gm1*gm3*gm7*s + CL*g02*g06*g07*gm1*gm3*gm5*s + CL*g01*g02*g03*gm4*gm7*gm8*s +
CL*g01*g02*g06*gm4*gm5*gm7*s + CL*g01*g03*g04*gm2*gm7*gm8*s + CL*g01*g03*g07*gm2*gm4*gm8*s +
CL*g01*g03*g08*gm2*gm4*gm7*s + CL*g01*g04*g06*gm2*gm5*gm7*s + CL*g01*g05*g06*gm2*gm4*gm7*s +
CL*g01*g06*g07*gm2*gm4*gm5*s + CL*g01*g02*g03*gm5*gm7*gm8*s + CL*g01*g02*g05*gm3*gm7*gm8*s +
CL*g01*g02*g07*gm3*gm5*gm8*s + CL*g01*g02*g08*gm3*gm5*gm7*s + CL*g01*g03*g06*gm4*gm5*gm7*s +
CL*g01*g04*g06*gm3*gm5*gm7*s + CL*g01*g05*g06*gm3*gm4*gm7*s + CL*g01*g06*g07*gm3*gm4*gm5*s +
CL*g02*g03*g05*gm1*gm7*gm8*s + CL*g02*g03*g07*gm1*gm5*gm8*s + CL*g02*g03*g08*gm1*gm5*gm7*s +
CL*g02*g05*g07*gm1*gm3*gm8*s + CL*g02*g05*g08*gm1*gm3*gm7*s + CL*g02*g07*g08*gm1*gm3*gm5*s +
CL*g03*g04*g06*gm1*gm5*gm7*s + CL*g03*g05*g06*gm1*gm4*gm7*s + CL*g03*g06*g07*gm1*gm4*gm5*s +
CL*g04*g05*g06*gm1*gm3*gm7*s + CL*g04*g06*g07*gm1*gm3*gm5*s + CL*g05*g06*g07*gm1*gm3*gm4*s +
CL*g01*g02*g04*gm5*gm7*gm8*s + CL*g01*g02*g05*gm4*gm7*gm8*s + CL*g01*g02*g07*gm4*gm5*gm8*s +
CL*g01*g02*g08*gm4*gm5*gm7*s + CL*g01*g04*g05*gm2*gm7*gm8*s + CL*g01*g04*g07*gm2*gm5*gm8*s +
CL*g01*g04*g08*gm2*gm5*gm7*s + CL*g01*g05*g07*gm2*gm4*gm8*s + CL*g01*g05*g08*gm2*gm4*gm7*s +
CL*g01*g07*g08*gm2*gm4*gm5*s + CL*g02*g03*g06*gm4*gm5*gm7*s + CL*g02*g04*g06*gm3*gm5*gm7*s +
CL*g02*g05*g06*gm3*gm4*gm7*s + CL*g02*g06*g07*gm3*gm4*gm5*s + CL*g03*g04*g06*gm2*gm5*gm7*s +
CL*g03*g05*g06*gm2*gm4*gm7*s + CL*g03*g06*g07*gm2*gm4*gm5*s + CL*g04*g05*g06*gm2*gm3*gm7*s +
CL*g04*g06*g07*gm2*gm3*gm5*s + CL*g05*g06*g07*gm2*gm3*gm4*s + CL*g01*g03*g04*gm5*gm7*gm8*s +
CL*g01*g03*g05*gm4*gm7*gm8*s + CL*g01*g03*g07*gm4*gm5*gm8*s + CL*g01*g03*g08*gm4*gm5*gm7*s +
CL*g01*g04*g05*gm3*gm7*gm8*s + CL*g01*g04*g07*gm3*gm5*gm8*s + CL*g01*g04*g08*gm3*gm5*gm7*s +
CL*g01*g05*g07*gm3*gm4*gm8*s + CL*g01*g05*g08*gm3*gm4*gm7*s + CL*g01*g07*g08*gm3*gm4*gm5*s +
CL*g03*g04*g05*gm1*gm7*gm8*s + CL*g03*g04*g07*gm1*gm5*gm8*s + CL*g03*g04*g08*gm1*gm5*gm7*s +
CL*g03*g05*g07*gm1*gm4*gm8*s + CL*g03*g05*g08*gm1*gm4*gm7*s + CL*g03*g07*g08*gm1*gm4*gm5*s +
CL*g04*g05*g07*gm1*gm3*gm8*s + CL*g04*g05*g08*gm1*gm3*gm7*s + CL*g04*g07*g08*gm1*gm3*gm5*s +
CL*g05*g07*g08*gm1*gm3*gm4*s + CL*g02*g03*g04*gm5*gm7*gm8*s + CL*g02*g03*g05*gm4*gm7*gm8*s +
CL*g02*g03*g07*gm4*gm5*gm8*s + CL*g02*g03*g08*gm4*gm5*gm7*s + CL*g02*g04*g05*gm3*gm7*gm8*s +
CL*g02*g04*g07*gm3*gm5*gm8*s + CL*g02*g04*g08*gm3*gm5*gm7*s + CL*g02*g05*g07*gm3*gm4*gm8*s +
CL*g02*g05*g08*gm3*gm4*gm7*s + CL*g02*g07*g08*gm3*gm4*gm5*s + CL*g03*g04*g05*gm2*gm7*gm8*s +
CL*g03*g04*g07*gm2*gm5*gm8*s + CL*g03*g04*g08*gm2*gm5*gm7*s + CL*g03*g05*g07*gm2*gm4*gm8*s +
CL*g03*g05*g08*gm2*gm4*gm7*s + CL*g03*g07*g08*gm2*gm4*gm5*s + CL*g04*g05*g07*gm2*gm3*gm8*s +
CL*g04*g05*g08*gm2*gm3*gm7*s + CL*g04*g07*g08*gm2*gm3*gm5*s + CL*g05*g07*g08*gm2*gm3*gm4*s +
CL*g01*g03*g011*gm4*gm5*gm8*s + CL*g01*g02*g011*gm5*gm7*gm8*s + CL*g01*g03*g011*gm4*gm7*gm8*s +
CL*g01*g06*g011*gm4*gm5*gm7*s + CL*g02*g06*g011*gm3*gm5*gm7*s + CL*g01*g04*g011*gm5*gm7*gm8*s +
CL*g01*g05*g011*gm4*gm7*gm8*s + CL*g01*g07*g011*gm4*gm5*gm8*s + CL*g01*g08*g011*gm4*gm5*gm7*s +
CL*g02*g03*g011*gm5*gm7*gm8*s + CL*g02*g05*g011*gm3*gm7*gm8*s + CL*g02*g07*g011*gm3*gm5*gm8*s +
CL*g02*g08*g011*gm3*gm5*gm7*s + CL*g03*g06*g011*gm4*gm5*gm7*s + CL*g04*g06*g011*gm3*gm5*gm7*s +
CL*g05*g06*g011*gm3*gm4*gm7*s + CL*g06*g07*g011*gm3*gm4*gm5*s + CL*g03*g04*g011*gm5*gm7*gm8*s +
CL*g03*g05*g011*gm4*gm7*gm8*s + CL*g03*g07*g011*gm4*gm5*gm8*s + CL*g03*g08*g011*gm4*gm5*gm7*s +
CL*g04*g05*g011*gm3*gm7*gm8*s + CL*g04*g07*g011*gm3*gm5*gm8*s + CL*g04*g08*g011*gm3*gm5*gm7*s +
CL*g05*g07*g011*gm3*gm4*gm8*s + CL*g05*g08*g011*gm3*gm4*gm7*s + CL*g07*g08*g011*gm3*gm4*gm5*s +
CL*g01*g03*gm2*gm4*gm5*gm8*s + CL*g02*g06*gm1*gm3*gm5*gm7*s + CL*g01*g03*gm2*gm4*gm7*gm8*s +
CL*g01*g06*gm2*gm4*gm5*gm7*s + CL*g01*g02*gm3*gm5*gm7*gm8*s + CL*g01*g06*gm3*gm4*gm5*gm7*s +
CL*g02*g03*gm1*gm5*gm7*gm8*s + CL*g02*g05*gm1*gm3*gm7*gm8*s + CL*g02*g07*gm1*gm3*gm5*gm8*s +
CL*g02*g08*gm1*gm3*gm5*gm7*s + CL*g03*g06*gm1*gm4*gm5*gm7*s + CL*g04*g06*gm1*gm3*gm5*gm7*s +
CL*g05*g06*gm1*gm3*gm4*gm7*s + CL*g06*g07*gm1*gm3*gm4*gm5*s + CL*g01*g02*gm4*gm5*gm7*gm8*s +
CL*g01*g04*gm2*gm5*gm7*gm8*s + CL*g01*g05*gm2*gm4*gm7*gm8*s + CL*g01*g07*gm2*gm4*gm5*gm8*s +
CL*g01*g08*gm2*gm4*gm5*gm7*s + CL*g02*g06*gm3*gm4*gm5*gm7*s + CL*g03*g06*gm2*gm4*gm5*gm7*s +
CL*g04*g06*gm2*gm3*gm5*gm7*s + CL*g05*g06*gm2*gm3*gm4*gm7*s + CL*g06*g07*gm2*gm3*gm4*gm5*s +
CL*g01*g03*gm4*gm5*gm7*gm8*s + CL*g01*g04*gm3*gm5*gm7*gm8*s + CL*g01*g05*gm3*gm4*gm7*gm8*s +
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CL*g03*g05*gm1*gm4*gm7*gm8*s + CL*g03*g07*gm1*gm4*gm5*gm8*s + CL*g03*g08*gm1*gm4*gm5*gm7*s +
CL*g04*g05*gm1*gm3*gm7*gm8*s + CL*g04*g07*gm1*gm3*gm5*gm8*s + CL*g04*g08*gm1*gm3*gm5*gm7*s +
CL*g05*g07*gm1*gm3*gm4*gm8*s + CL*g05*g08*gm1*gm3*gm4*gm7*s + CL*g07*g08*gm1*gm3*gm4*gm5*s +
CL*g02*g03*gm4*gm5*gm7*gm8*s + CL*g02*g04*gm3*gm5*gm7*gm8*s + CL*g02*g05*gm3*gm4*gm7*gm8*s +
CL*g02*g07*gm3*gm4*gm5*gm8*s + CL*g02*g08*gm3*gm4*gm5*gm7*s + CL*g03*g04*gm2*gm5*gm7*gm8*s +
CL*g03*g05*gm2*gm4*gm7*gm8*s + CL*g03*g07*gm2*gm4*gm5*gm8*s + CL*g03*g08*gm2*gm4*gm5*gm7*s +
CL*g04*g05*gm2*gm3*gm7*gm8*s + CL*g04*g07*gm2*gm3*gm5*gm8*s + CL*g04*g08*gm2*gm3*gm5*gm7*s +
CL*g05*g07*gm2*gm3*gm4*gm8*s + CL*g05*g08*gm2*gm3*gm4*gm7*s + CL*g07*g08*gm2*gm3*gm4*gm5*s +
CL*g01*g011*gm4*gm5*gm7*gm8*s + CL*g02*g011*gm3*gm5*gm7*gm8*s + CL*g06*g011*gm3*gm4*gm5*gm7*s +
CL*g03*g011*gm4*gm5*gm7*gm8*s + CL*g04*g011*gm3*gm5*gm7*gm8*s + CL*g05*g011*gm3*gm4*gm7*gm8*s +
CL*g07*g011*gm3*gm4*gm5*gm8*s + CL*g08*g011*gm3*gm4*gm5*gm7*s + CL*g02*gm1*gm3*gm5*gm7*gm8*s +
CL*g06*gm1*gm3*gm4*gm5*gm7*s + CL*g01*gm2*gm4*gm5*gm7*gm8*s + CL*g06*gm2*gm3*gm4*gm5*gm7*s +
CL*g01*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm1*gm4*gm5*gm7*gm8*s + CL*g04*gm1*gm3*gm5*gm7*gm8*s +
CL*g05*gm1*gm3*gm4*gm7*gm8*s + CL*g07*gm1*gm3*gm4*gm5*gm8*s + CL*g08*gm1*gm3*gm4*gm5*gm7*s +
CL*g02*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm2*gm4*gm5*gm7*gm8*s + CL*g04*gm2*gm3*gm5*gm7*gm8*s +
CL*g05*gm2*gm3*gm4*gm7*gm8*s + CL*g07*gm2*gm3*gm4*gm5*gm8*s + CL*g08*gm2*gm3*gm4*gm5*gm7*s +
CL*g011*gm3*gm4*gm5*gm7*gm8*s + CL*gm1*gm3*gm4*gm5*gm7*gm8*s + CL*gm2*gm3*gm4*gm5*gm7*gm8*s)
```
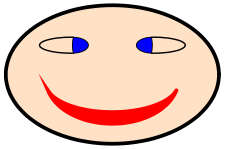

We now (finally) have a complete analytic expression !



Zoom in to look at a few terms

```
Vinp*g06*g07*g011*gm1*gm3*gm4*gm8 + Vinp*g03*g08*g011*gm1*gm4*gm7*gm8 +
Vinp*g04*g08*g011*gm1*gm3*gm7*gm8 + Vinp*g07*g08*g011*gm1*gm3*gm4*gm8 +
Vinp*g02*g06*gm1*gm3*gm4*gm5*gm7 + Vinp*g03*g06*gm1*gm2*gm4*gm5*gm7 +
Vinp*g04*g06*gm1*gm2*gm3*gm5*gm7 + Vinp*g05*g06*gm1*gm2*gm3*gm4*gm7 +
Vinp*g06*g07*gm1*gm2*gm3*gm4*gm5 + Vinp*g02*g06*gm1*gm3*gm4*gm5*gm8 +
Vinp*g03*g06*gm1*gm2*gm4*gm5*gm8 + Vinp*g04*g06*gm1*gm2*gm3*gm5*gm8 +
Vinp*g05*g06*gm1*gm2*gm3*gm4*gm8 + Vinp*g02*g03*gm1*gm4*gm5*gm7*gm8 +
Vinp*g02*g04*gm1*gm3*gm5*gm7*gm8 + Vinp*g02*g05*gm1*gm3*gm4*gm7*gm8 +
Vinp*g02*g07*gm1*gm3*gm4*gm5*gm8 + Vinp*g02*g08*gm1*gm3*gm4*gm5*gm7 +
Vinp*g03*g04*gm1*gm2*gm5*gm7*gm8 + Vinp*g03*g05*gm1*gm2*gm4*gm7*gm8 +
Vinp*g03*g07*gm1*gm2*gm4*gm5*gm8 + Vinp*g03*g08*gm1*gm2*gm4*gm5*gm7 +
Vinp*g04*g05*gm1*gm2*gm3*gm7*gm8 + Vinp*g04*g07*gm1*gm2*gm3*gm5*gm8 +
Vinp*g04*g08*gm1*gm2*gm3*gm5*gm7 + Vinp*g05*g07*gm1*gm2*gm3*gm4*gm8 +
Vinp*g05*g08*gm1*gm2*gm3*gm4*gm7 + Vinp*g07*g08*gm1*gm2*gm3*gm4*gm5 +
Vinp*g02*g06*gm1*gm3*gm4*gm7*gm8 + Vinp*g03*g06*gm1*gm2*gm4*gm7*gm8 +
Vinp*g04*g06*gm1*gm2*gm3*gm7*gm8 + Vinp*g06*g07*gm1*gm2*gm3*gm4*gm8 +
Vinp*g02*g08*gm1*gm3*gm4*gm7*gm8 + Vinp*g03*g08*gm1*gm2*gm4*gm7*gm8 +
Vinp*g04*g08*gm1*gm2*gm3*gm7*gm8 + Vinp*g07*g08*gm1*gm2*gm3*gm4*gm8 +
Vinp*g06*g011*gm1*gm3*gm4*gm5*gm8 + Vinp*g06*g011*gm1*gm3*gm4*gm7*gm8 +
Vinp*g08*g011*gm1*gm3*gm4*gm7*gm8 + Vinp*g06*gm1*gm2*gm3*gm4*gm5*gm7 +
Vinp*g06*gm1*gm2*gm3*gm4*gm5*gm8 + Vinp*g02*gm1*gm3*gm4*gm5*gm7*gm8 +
Vinp*g03*gm1*gm2*gm4*gm5*gm7*gm8 + Vinp*g04*gm1*gm2*gm3*gm5*gm7*gm8 +
Vinp*g05*gm1*gm2*gm3*gm4*gm7*gm8 + Vinp*g07*gm1*gm2*gm3*gm4*gm5*gm8 +
Vinp*g08*gm1*gm2*gm3*gm4*gm5*gm7 + Vinp*g06*gm1*gm2*gm3*gm4*gm7*gm8 +
Vinp*g08*gm1*gm2*gm3*gm4*gm7*gm8 + Vinp*gm1*gm2*gm3*gm4*gm5*gm7*gm8)

/

(g01*g02*g03*g04*g07*gm8^2 + g01*g02*g03*g04*gm7*gm8^2 + g01*g02*g04*g07*gm3*gm8^2 +
g02*g03*g04*g07*gm1*gm8^2 + g01*g02*g04*gm3*gm7*gm8^2 + g02*g03*g04*gm1*gm7*gm8^2 +
g02*g04*g07*gm1*gm3*gm8^2 + g02*g04*gm1*gm3*gm7*gm8^2 + g01*g02*g03*g04*g05*g06*g07 +
g01*g02*g03*g04*g05*g06*g08 + g01*g02*g03*g04*g05*g07*g08 + g01*g02*g03*g04*g06*g07*g08 +
[illegible]
g01*g02*g03*g04*g05*g08*g011 + g01*g02*g03*g04*g06*g07*g011 + g01*g03*g04*g05*g06*g07*g08 +
g02*g03*g04*g05*g06*g07*g08 + g01*g02*g03*g04*g07*g08*g011 + g01*g02*g03*g05*g06*g08*g011 +
g01*g02*g04*g05*g06*g07*g011 + g01*g02*g03*g06*g07*g08*g011 + g01*g02*g04*g05*g07*g08*g011 +
g01*g03*g04*g05*g06*g08*g011 + g02*g03*g04*g05*g06*g07*g011 + g01*g02*g05*g06*g07*g08*g011 +
g01*g03*g04*g06*g07*g08*g011 + g02*g03*g04*g05*g07*g08*g011 + g01*g04*g05*g06*g07*g08*g011 +
g02*g03*g05*g06*g07*g08*g011 + g03*g04*g05*g06*g07*g08*g011 + g01*g02*g03*g04*g05*g06*gm7 +
g01*g02*g03*g04*g06*g07*gm5 + g01*g02*g04*g05*g06*g07*gm3 + g02*g03*g04*g05*g06*g07*gm1 +
g01*g02*g03*g04*g05*g06*gm8 + g01*g02*g03*g04*g06*g08*gm5 + g01*g02*g03*g05*g06*g08*gm4 +
g01*g03*g04*g05*g06*g08*gm2 + g01*g02*g03*g04*g05*g07*gm8 + g01*g02*g03*g04*g05*g08*gm7 +
g01*g02*g03*g04*g07*g08*gm5 + g01*g02*g04*g05*g07*g08*gm3 + g02*g03*g04*g05*g07*g08*gm1 +
g01*g02*g03*g04*g06*g07*gm8 + g01*g02*g03*g04*g06*g08*gm7 + g01*g02*g03*g06*g07*g08*gm4 +
g01*g03*g04*g06*g07*g08*gm2 + g01*g02*g03*g04*g06*g011*gm5 + g01*g02*g03*g05*g06*g08*gm7 +
g01*g02*g03*g06*g07*g08*gm5 + g01*g02*g05*g06*g07*g08*gm3 + g02*g03*g05*g06*g07*g08*gm1 +
g01*g02*g03*g04*g07*g08*gm8 + g01*g02*g04*g05*g06*g08*gm7 + g01*g02*g04*g06*g07*g08*gm5 +
g01*g02*g05*g06*g07*g08*gm4 + g01*g04*g05*g06*g07*g08*gm2 + g01*g02*g03*g04*g05*g011*gm8 +
g01*g02*g03*g04*g06*g011*gm7 + g01*g02*g03*g04*g08*g011*gm5 + g01*g03*g04*g05*g06*g08*gm7 +
g01*g03*g04*g06*g07*g08*gm5 + g01*g03*g05*g06*g07*g08*gm4 + g01*g04*g05*g06*g07*g08*gm3 +
g03*g04*g05*g06*g07*g08*gm1 + g02*g03*g04*g05*g06*g08*gm7 + g02*g03*g04*g06*g07*g08*gm5 +
g02*g03*g05*g06*g07*g08*gm4 + g02*g04*g05*g06*g07*g08*gm3 + g03*g04*g05*g06*g07*g08*gm2 +
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g01*g02*g04*g05*g06*g011*gm7 + g01*g02*g04*g06*g07*g011*gm5 + g01*g02*g03*g06*g08*g011*gm7 +
g01*g02*g04*g05*g07*g011*gm8 + g01*g02*g04*g05*g08*g011*gm7 + g01*g02*g04*g07*g08*g011*gm5 +
g01*g03*g04*g06*g08*g011*gm5 + g01*g03*g05*g06*g08*g011*gm4 + g02*g03*g04*g05*g06*g011*gm7 +
g02*g03*g04*g06*g07*g011*gm5 + g02*g04*g05*g06*g07*g011*gm3 + g01*g02*g05*g06*g08*g011*gm7 +
g01*g02*g06*g07*g08*g011*gm5 + g01*g03*g04*g06*g08*g011*gm7 + g01*g03*g06*g07*g08*g011*gm4 +
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g02*g05*g06*g07*g08*g011*gm3 + g03*g04*g05*g06*g08*g011*gm7 + g03*g04*g06*g07*g08*g011*gm5 +
g03*g05*g06*g07*g08*g011*gm4 + g04*g05*g06*g07*g08*g011*gm3 + g01*g02*g03*g04*g06*gm5*gm7 +
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g01*g02*g03*g04*g07*gm5*gm8 + g01*g02*g03*g04*g08*gm5*gm7 + g01*g02*g04*g05*g07*gm3*gm8 +
g01*g02*g04*g05*g08*gm3*gm7 + g01*g02*g04*g07*g08*gm3*gm5 + g02*g03*g04*g05*g07*gm1*gm8 +
g02*g03*g04*g05*g08*gm1*gm7 + g02*g03*g04*g07*g08*gm1*gm5 + g02*g04*g05*g07*g08*gm1*gm3 +
g01*g02*g03*g04*g06*gm7*gm8 + g01*g02*g03*g06*g08*gm4*gm7 + g01*g02*g04*g06*g07*gm3*gm8 +
```

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CL*g03*g05*g07*g011*gm4*gm8*s + CL*g03*g05*g08*g011*gm4*gm7*s + CL*g03*g07*g08*g011*gm4*gm5*s +
CL*g04*g05*g07*g011*gm3*gm8*s + CL*g04*g05*g08*g011*gm3*gm7*s + CL*g04*g07*g08*g011*gm3*gm5*s +
CL*g05*g07*g08*g011*gm3*gm4*s + CL*g01*g03*g06*gm2*gm4*gm5*s + CL*g01*g02*g03*gm4*gm5*gm8*s +
CL*g01*g03*g04*gm2*gm5*gm8*s + CL*g01*g03*g05*gm2*gm4*gm8*s + CL*g01*g03*g06*gm2*gm4*gm7*s +
CL*g01*g03*g08*gm2*gm4*gm5*s + CL*g01*g02*g06*gm3*gm5*gm7*s + CL*g02*g03*g06*gm1*gm5*gm7*s +
CL*g02*g05*g06*gm1*gm3*gm7*s + CL*g02*g06*g07*gm1*gm3*gm5*s + CL*g01*g02*g03*gm4*gm7*gm8*s +
CL*g01*g02*g06*gm4*gm5*gm7*s + CL*g01*g03*g04*gm2*gm7*gm8*s + CL*g01*g03*g07*gm2*gm4*gm8*s +
CL*g01*g03*g08*gm2*gm4*gm7*s + CL*g01*g04*g06*gm2*gm5*gm7*s + CL*g01*g05*g06*gm2*gm4*gm7*s +
CL*g01*g06*g07*gm2*gm4*gm5*s + CL*g01*g02*g03*gm5*gm7*gm8*s + CL*g01*g02*g05*gm3*gm7*gm8*s +
CL*g01*g02*g07*gm3*gm5*gm8*s + CL*g01*g02*g08*gm3*gm5*gm7*s + CL*g01*g03*g06*gm4*gm5*gm7*s +
CL*g01*g04*g06*gm3*gm5*gm7*s + CL*g01*g05*g06*gm3*gm4*gm7*s + CL*g01*g06*g07*gm3*gm4*gm5*s +
CL*g02*g03*g05*gm1*gm7*gm8*s + CL*g02*g03*g07*gm1*gm5*gm8*s + CL*g02*g03*g08*gm1*gm5*gm7*s +
CL*g02*g05*g07*gm1*gm3*gm8*s + CL*g02*g05*g08*gm1*gm3*gm7*s + CL*g02*g07*g08*gm1*gm3*gm5*s +
CL*g03*g04*g06*gm1*gm5*gm7*s + CL*g03*g05*g06*gm1*gm4*gm7*s + CL*g03*g06*g07*gm1*gm4*gm5*s +
CL*g04*g05*g06*gm1*gm3*gm7*s + CL*g04*g06*g07*gm1*gm3*gm5*s + CL*g05*g06*g07*gm1*gm3*gm4*s +
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CL*g01*g07*g08*gm2*gm4*gm5*s + CL*g02*g03*g06*gm4*gm5*gm7*s + CL*g02*g04*g06*gm3*gm5*gm7*s +
CL*g02*g05*g06*gm3*gm4*gm7*s + CL*g02*g06*g07*gm3*gm4*gm5*s + CL*g03*g04*g06*gm2*gm5*gm7*s +
CL*g03*g05*g06*gm2*gm4*gm7*s + CL*g03*g06*g07*gm2*gm4*gm5*s + CL*g04*g05*g06*gm2*gm3*gm7*s +
CL*g04*g06*g07*gm2*gm3*gm5*s + CL*g05*g06*g07*gm2*gm3*gm4*s + CL*g01*g03*g04*gm5*gm7*gm8*s +
CL*g01*g03*g05*gm4*gm7*gm8*s + CL*g01*g03*g07*gm4*gm5*gm8*s + CL*g01*g03*g08*gm4*gm5*gm7*s +
CL*g01*g04*g05*gm3*gm7*gm8*s + CL*g01*g04*g07*gm3*gm5*gm8*s + CL*g01*g04*g08*gm3*gm5*gm7*s +
CL*g01*g05*g07*gm3*gm4*gm8*s + CL*g01*g05*g08*gm3*gm4*gm7*s + CL*g01*g07*g08*gm3*gm4*gm5*s +
CL*g03*g04*g05*gm1*gm7*gm8*s + CL*g03*g04*g07*gm1*gm5*gm8*s + CL*g03*g04*g08*gm1*gm5*gm7*s +
CL*g03*g05*g07*gm1*gm4*gm8*s + CL*g03*g05*g08*gm1*gm4*gm7*s + CL*g03*g07*g08*gm1*gm4*gm5*s +
CL*g04*g05*g07*gm1*gm3*gm8*s + CL*g04*g05*g08*gm1*gm3*gm7*s + CL*g04*g07*g08*gm1*gm3*gm5*s +
CL*g05*g07*g08*gm1*gm3*gm4*s + CL*g02*g03*g04*gm5*gm7*gm8*s + CL*g02*g03*g05*gm4*gm7*gm8*s +
CL*g02*g03*g07*gm4*gm5*gm8*s + CL*g02*g03*g08*gm4*gm5*gm7*s + CL*g02*g04*g05*gm3*gm7*gm8*s +
CL*g02*g04*g07*gm3*gm5*gm8*s + CL*g02*g04*g08*gm3*gm5*gm7*s + CL*g02*g05*g07*gm3*gm4*gm8*s +
CL*g02*g05*g08*gm3*gm4*gm7*s + CL*g02*g07*g08*gm3*gm4*gm5*s + CL*g03*g04*g05*gm2*gm7*gm8*s +
CL*g03*g04*g07*gm2*gm5*gm8*s + CL*g03*g04*g08*gm2*gm5*gm7*s + CL*g03*g05*g07*gm2*gm4*gm8*s +
CL*g03*g05*g08*gm2*gm4*gm7*s + CL*g03*g07*g08*gm2*gm4*gm5*s + CL*g04*g05*g07*gm2*gm3*gm8*s +
CL*g04*g05*g08*gm2*gm3*gm7*s + CL*g04*g07*g08*gm2*gm3*gm5*s + CL*g05*g07*g08*gm2*gm3*gm4*s +
CL*g01*g03*g011*gm4*gm5*gm8*s + CL*g01*g02*g011*gm5*gm7*gm8*s + CL*g01*g03*g011*gm4*gm7*gm8*s +
CL*g01*g06*g011*gm4*gm5*gm7*s + CL*g02*g06*g011*gm3*gm5*gm7*s + CL*g01*g04*g011*gm5*gm7*gm8*s +
CL*g01*g05*g011*gm4*gm7*gm8*s + CL*g01*g07*g011*gm4*gm5*gm8*s + CL*g01*g08*g011*gm4*gm5*gm7*s +
CL*g02*g03*g011*gm5*gm7*gm8*s + CL*g02*g05*g011*gm3*gm7*gm8*s + CL*g02*g07*g011*gm3*gm5*gm8*s +
CL*g02*g08*g011*gm3*gm5*gm7*s + CL*g03*g06*g011*gm4*gm5*gm7*s + CL*g04*g06*g011*gm3*gm5*gm7*s +
CL*g05*g06*g011*gm3*gm4*gm7*s + CL*g06*g07*g011*gm3*gm4*gm5*s + CL*g03*g04*g011*gm5*gm7*gm8*s +
CL*g03*g05*g011*gm4*gm7*gm8*s + CL*g03*g07*g011*gm4*gm5*gm8*s + CL*g03*g08*g011*gm4*gm5*gm7*s +
CL*g04*g05*g011*gm3*gm7*gm8*s + CL*g04*g07*g011*gm3*gm5*gm8*s + CL*g04*g08*g011*gm3*gm5*gm7*s +
CL*g05*g07*g011*gm3*gm4*gm8*s + CL*g05*g08*g011*gm3*gm4*gm7*s + CL*g07*g08*g011*gm3*gm4*gm5*s +
CL*g01*g03*gm2*gm4*gm5*gm8*s + CL*g02*g06*gm1*gm3*gm5*gm7*s + CL*g01*g03*gm2*gm4*gm7*gm8*s +
CL*g01*g06*gm2*gm4*gm5*gm7*s + CL*g01*g02*gm3*gm5*gm7*gm8*s + CL*g01*g06*gm3*gm4*gm5*gm7*s +
CL*g02*g03*gm1*gm5*gm7*gm8*s + CL*g02*g05*gm1*gm3*gm7*gm8*s + CL*g02*g07*gm1*gm3*gm5*gm8*s +
CL*g02*g08*gm1*gm3*gm5*gm7*s + CL*g03*g06*gm1*gm4*gm5*gm7*s + CL*g04*g06*gm1*gm3*gm5*gm7*s +
CL*g05*g06*gm1*gm3*gm4*gm7*s + CL*g06*g07*gm1*gm3*gm4*gm5*s + CL*g01*g02*gm4*gm5*gm7*gm8*s +
CL*g01*g04*gm2*gm5*gm7*gm8*s + CL*g01*g05*gm2*gm4*gm7*gm8*s + CL*g01*g07*gm2*gm4*gm5*gm8*s +
CL*g01*g08*gm2*gm4*gm5*gm7*s + CL*g02*g06*gm3*gm4*gm5*gm7*s + CL*g03*g06*gm2*gm4*gm5*gm7*s +
CL*g04*g06*gm2*gm3*gm5*gm7*s + CL*g05*g06*gm2*gm3*gm4*gm7*s + CL*g06*g07*gm2*gm3*gm4*gm5*s +
CL*g01*g03*gm4*gm5*gm7*gm8*s + CL*g01*g04*gm3*gm5*gm7*gm8*s + CL*g01*g05*gm3*gm4*gm7*gm8*s +
CL*g01*g07*gm3*gm4*gm5*gm8*s + CL*g01*g08*gm3*gm4*gm5*gm7*s + CL*g03*g04*gm1*gm5*gm7*gm8*s +
CL*g03*g05*gm1*gm4*gm7*gm8*s + CL*g03*g07*gm1*gm4*gm5*gm8*s + CL*g03*g08*gm1*gm4*gm5*gm7*s +
CL*g04*g05*gm1*gm3*gm7*gm8*s + CL*g04*g07*gm1*gm3*gm5*gm8*s + CL*g04*g08*gm1*gm3*gm5*gm7*s +
CL*g05*g07*gm1*gm3*gm4*gm8*s + CL*g05*g08*gm1*gm3*gm4*gm7*s + CL*g07*g08*gm1*gm3*gm4*gm5*s +
CL*g02*g03*gm4*gm5*gm7*gm8*s + CL*g02*g04*gm3*gm5*gm7*gm8*s + CL*g02*g05*gm3*gm4*gm7*gm8*s +
CL*g02*g07*gm3*gm4*gm5*gm8*s + CL*g02*g08*gm3*gm4*gm5*gm7*s + CL*g03*g04*gm2*gm5*gm7*gm8*s +
CL*g03*g05*gm2*gm4*gm7*gm8*s + CL*g03*g07*gm2*gm4*gm5*gm8*s + CL*g03*g08*gm2*gm4*gm5*gm7*s +
CL*g04*g05*gm2*gm3*gm7*gm8*s + CL*g04*g07*gm2*gm3*gm5*gm8*s + CL*g04*g08*gm2*gm3*gm5*gm7*s +
CL*g05*g07*gm2*gm3*gm4*gm8*s + CL*g05*g08*gm2*gm3*gm4*gm7*s + CL*g07*g08*gm2*gm3*gm4*gm5*s +
CL*g01*g011*gm4*gm5*gm7*gm8*s + CL*g02*g011*gm3*gm5*gm7*gm8*s + CL*g06*g011*gm3*gm4*gm5*gm7*s +
CL*g03*g011*gm4*gm5*gm7*gm8*s + CL*g04*g011*gm3*gm5*gm7*gm8*s + CL*g05*g011*gm3*gm4*gm7*gm8*s +
CL*g07*g011*gm3*gm4*gm5*gm8*s + CL*g08*g011*gm3*gm4*gm5*gm7*s + CL*g02*gm1*gm3*gm5*gm7*gm8*s +
CL*g06*gm1*gm3*gm4*gm5*gm7*s + CL*g01*gm2*gm4*gm5*gm7*gm8*s + CL*g06*gm2*gm3*gm4*gm5*gm7*s +
CL*g01*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm1*gm4*gm5*gm7*gm8*s + CL*g04*gm1*gm3*gm5*gm7*gm8*s +
CL*g05*gm1*gm3*gm4*gm7*gm8*s + CL*g07*gm1*gm3*gm4*gm5*gm8*s + CL*g08*gm1*gm3*gm4*gm5*gm7*s +
CL*g02*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm2*gm4*gm5*gm7*gm8*s + CL*g04*gm2*gm3*gm5*gm7*gm8*s +
CL*g05*gm2*gm3*gm4*gm7*gm8*s + CL*g07*gm2*gm3*gm4*gm5*gm8*s + CL*g08*gm2*gm3*gm4*gm5*gm7*s +
CL*g011*gm3*gm4*gm5*gm7*gm8*s + CL*gm1*gm3*gm4*gm5*gm7*gm8*s + CL*gm2*gm3*gm4*gm5*gm7*gm8*s)
```

Individual product terms have product of 7 small-signal parameters

- Approximately 2000 factors in output characteristics
- Approximately 14,000 small-signal parameter appearances
- GB expression much longer

```
Vinp*g08*gm1*gm2*gm3*gm4*gm5*gm7+ Vinp*g06*gm1*gm2*gm3*gm4*gm7*gm8 +
Vinp*g08*gm1*gm2*gm3*gm4*gm7*gm8 + Vinp*gm1*gm2*gm3*gm4*gm5*gm7*gm8)
/
(g01*g02*g03*g04*g07*gm8^2 + g01*g02*g03*g04*gm7*gm8^2 +
g01*g02*g04*g07*gm3*gm8^2 + g02*g03*g04*g07*gm1*gm8^2 +
g01*g02*g04*gm3*gm7*gm8^2 + g02*g03*g04*gm1*gm7*gm8^2 +
```

```
CL*g02*gm3*gm4*gm5*gm7*gm8*s + CL*g03*gm2*gm4*gm5*gm7*gm8*s +
CL*g04*gm2*gm3*gm5*gm7*gm8*s + CL*g05*gm2*gm3*gm4*gm7*gm8*s +
CL*g07*gm2*gm3*gm4*gm5*gm8*s + CL*g08*gm2*gm3*gm4*gm5*gm7*s +
CL*g011*gm3*gm4*gm5*gm7*gm8*s + CL*gm1*gm3*gm4*gm5*gm7*gm8*s +
CL*gm2*gm3*gm4*gm5*gm7*gm8*s)
```

MATLAB simulation results using Symbolic Math Toolbox

Differential Analysis with Vd = $Vin^{+} - Vin^{-}$

MATLAB Solution:

```
GainAv =
(g01*g03*g04*g07*gm2*gm8^2 + g02*g03*g04*g07*gm1*gm8^2 + g02*g03*g07*g011*gm1*gm8^2 +
g03*g04*g07*g011*gm1*gm8^2 + g01*g03*g04*gm2*gm7*gm8^2 + g01*g03*g07*gm2*gm4*gm8^2 +
g01*g04*g07*gm2*gm3*gm8^2 + g02*g03*g04*gm1*gm7*gm8^2 + g02*g03*g07*gm1*gm4*gm8^2 +
g02*g04*g07*gm1*gm3*gm8^2 + 2*g03*g04*g07*gm1*gm2*gm8^2 + g02*g03*g011*gm1*gm7*gm8^2 +
g02*g07*g011*gm1*gm3*gm8^2 + g03*g04*g011*gm1*gm7*gm8^2 + g03*g07*g011*gm1*gm4*gm8^2 +
g04*g07*g011*gm1*gm3*gm8^2 + g01*g03*gm2*gm4*gm7*gm8^2 + g01*g04*gm2*gm3*gm7*gm8^2 +
g01*g07*gm2*gm3*gm4*gm8^2 + g02*g03*gm1*gm4*gm7*gm8^2 + g02*g04*gm1*gm3*gm7*gm8^2 +
g02*g07*gm1*gm3*gm4*gm8^2 + 2*g03*g04*gm1*gm2*gm7*gm8^2 + 2*g03*g07*gm1*gm2*gm4*gm8^2 +
2*g04*g07*gm1*gm2*gm3*gm8^2 + g02*g011*gm1*gm3*gm7*gm8^2 + g03*g011*gm1*gm4*gm7*gm8^2 +
g04*g011*gm1*gm3*gm7*gm8^2 + g07*g011*gm1*gm3*gm4*gm8^2 + g01*gm2*gm3*gm4*gm7*gm8^2 +
g02*gm1*gm3*gm4*gm7*gm8^2 + 2*g03*gm1*gm2*gm4*gm7*gm8^2 + 2*g04*gm1*gm2*gm3*gm7*gm8^2 +
2*g07*gm1*gm2*gm3*gm4*gm8^2 + g011*gm1*gm3*gm4*gm7*m8^2 + 2*gm1*gm2*gm3*gm4*gm7*gm8^2 +
g01*g03*g04*g05*g06*g07*gm2 + g02*g03*g04*g05*g06*g07*gm1 + g01*g03*g04*g05*g07*g08*gm2 +
g02*g03*g04*g05*g07*g08*gm1 + g01*g03*g04*g05*g06*g011*gm2 + g01*g03*g04*g05*g08*g011*gm2 +
g01*g03*g04*g06*g07*g011*gm2 + g01*g03*g04*g07*g08*g011*gm2 + g01*g04*g05*g06*g07*g011*gm2 +
g01*g04*g05*g07*g08*g011*gm2 + g03*g04*g05*g06*g07*g011*gm2 + g03*g04*g05*g07*g08*g011*gm2 +
g01*g03*g04*g05*g06*gm2*gm7 + g01*g03*g04*g06*g07*gm2*gm5 + g01*g03*g05*g06*g07*gm2*gm4 +
g01*g04*g05*g06*g07*gm2*gm3 + g02*g03*g04*g05*g06*gm1*gm7 + g02*g03*g04*g06*g07*gm1*gm5 +
g02*g03*g05*g06*g07*gm1*gm4 + g02*g04*g05*g06*g07*gm1*gm3 + 2*g03*g04*g05*g06*g07*gm1*gm2 +
g01*g03*g04*g05*g06*gm2*gm8 + g02*g03*g04*g05*g06*gm1*gm8 + g01*g03*g04*g05*g07*gm2*gm8 +
g01*g03*g04*g05*g08*gm2*gm7 + g01*g03*g04*g07*g08*gm2*gm5 + g01*g03*g05*g07*g08*gm2*gm4 +
g01*g04*g05*g07*g08*gm2*gm3 + g02*g03*g04*g05*g07*gm1*gm8 + g02*g03*g04*g05*g08*gm1*gm7 +
g02*g03*g04*g07*g08*gm1*gm5 + g02*g03*g05*g07*g08*gm1*gm4 + g02*g04*g05*g07*g08*gm1*gm3 +
2*g03*g04*g05*g07*g08*gm1*gm2 + g01*g03*g04*g06*g07*gm2*gm8 + g02*g03*g04*g06*g07*gm1*gm8 +
g01*g03*g04*g06*g011*gm2*gm5 + g01*g03*g05*g06*g011*gm2*gm4 + g01*g03*g04*g07*g08*gm2*gm8 +
g02*g03*g04*g07*g08*gm1*gm8 + g01*g03*g04*g05*g011*gm2*gm8 + g01*g03*g04*g06*g011*gm2*gm7 +
g01*g03*g04*g08*g011*gm2*gm5 + g01*g03*g05*g08*g011*gm2*gm4 + g01*g03*g06*g07*g011*gm2*gm4 +
g01*g03*g04*g07*g011*gm2*gm8 + g01*g03*g04*g08*g011*gm2*gm7 + g01*g03*g07*g08*g011*gm2*gm4 +
g01*g04*g05*g06*g011*gm2*gm7 + g01*g04*g06*g07*g011*gm2*gm5 + g01*g05*g06*g07*g011*gm2*gm4 +
g02*g03*g05*g06*g011*gm1*gm8 + g01*g04*g05*g07*g011*gm2*gm8 + g01*g04*g05*g08*g011*gm2*gm7 +
g01*g04*g07*g08*g011*gm2*gm5 + g01*g05*g07*g08*g011*gm2*gm4 + g02*g03*g06*g07*g011*gm1*gm8 +
g03*g04*g05*g06*g011*gm1*gm8 + g03*g04*g05*g06*g011*gm2*gm7 + g03*g04*g06*g07*g011*gm2*gm5 +
g03*g05*g06*g07*g011*gm2*gm4 + g04*g05*g06*g07*g011*gm2*gm3 + g02*g03*g07*g08*g011*gm1*gm8 +
g03*g04*g05*g07*g011*gm2*gm8 + g03*g04*g05*g08*g011*gm2*gm7 + g03*g04*g06*g07*g011*gm1*gm8 +
g03*g04*g07*g08*g011*gm2*gm5 + g03*g05*g07*g08*g011*gm2*gm4 + g04*g05*g07*g08*g011*gm2*gm3 +
g03*g04*g07*g08*g011*gm1*gm8 + g01*g03*g04*g06*gm2*gm5*gm7 + g01*g03*g05*g06*gm2*gm4*gm7 +
g01*g03*g06*g07*gm2*gm4*gm5 + g01*g04*g05*g06*gm2*gm3*gm7 + g01*g04*g06*g07*gm2*gm3*gm5 +
g01*g05*g06*g07*gm2*gm3*gm4 + g02*g03*g04*g06*gm1*gm5*gm7 + g02*g03*g05*g06*gm1*gm4*gm7 +
g02*g03*g06*g07*gm1*gm4*gm5 + g02*g04*g05*g06*gm1*gm3*gm7 + g02*g04*g06*g07*gm1*gm3*gm5 +
g02*g05*g06*g07*gm1*gm3*gm4 + 2*g03*g04*g05*g06*gm1*gm2*gm7 + 2*g03*g04*g06*g07*gm1*gm2*gm5 +
2*g03*g05*g06*g07*gm1*gm2*gm4 + 2*g04*g05*g06*g07*gm1*gm2*gm3 + g01*g03*g04*g06*gm2*gm5*gm8 +
g01*g03*g05*g06*gm2*gm4*gm8 + g01*g04*g05*g06*gm2*gm3*gm8 + g02*g03*g04*g06*gm1*gm5*gm8 +
g02*g03*g05*g06*gm1*gm4*gm8 + g02*g04*g05*g06*gm1*gm3*gm8 + 2*g03*g04*g05*g06*gm1*gm2*gm8 +
g01*g03*g04*g05*gm2*gm7*gm8 + g01*g03*g04*g07*gm2*gm5*gm8 + g01*g03*g04*g08*gm2*gm5*gm7 +
g01*g03*g05*g07*gm2*gm4*gm8 + g01*g03*g05*g08*gm2*gm4*gm7 + g01*g03*g07*g08*gm2*gm4*gm5 +
g01*g04*g05*g07*gm2*gm3*gm8 + g01*g04*g05*g08*gm2*gm3*gm7 + g01*g04*g07*g08*gm2*gm3*gm5 +
g01*g05*g07*g08*gm2*gm3*gm4 + g02*g03*g04*g05*gm1*gm7*gm8 + g02*g03*g04*g07*gm1*gm5*gm8 +
g02*g03*g04*g08*gm1*gm5*gm7 + g02*g03*g05*g07*gm1*gm4*gm8 + g02*g03*g05*g08*gm1*gm4*gm7 +
g02*g03*g07*g08*gm1*gm4*gm5 + g02*g04*g05*g07*gm1*gm3*gm8 + g02*g04*g05*g08*gm1*gm3*gm7 +
g02*g04*g07*g08*gm1*gm3*gm5 + g02*g05*g07*g08*gm1*gm3*gm4 + 2*g03*g04*g05*g07*gm1*gm2*gm8 +
2*g03*g04*g05*g08*gm1*gm2*gm7 + 2*g03*g04*g07*g08*gm1*gm2*gm5 + 2*g03*g05*g07*g08*gm1*gm2*gm4 +
2*g04*g05*g07*g08*gm1*gm2*gm3 + g01*g03*g04*g06*gm2*gm7*gm8 + g01*g03*g06*g07*gm2*gm4*gm8 +
g01*g04*g06*g07*gm2*gm3*gm8 + g02*g03*g04*g06*gm1*gm7*gm8 + g02*g03*g06*g07*gm1*gm4*gm8 +
g02*g04*g06*g07*gm1*gm3*gm8 + 2*g03*g04*g06*g07*gm1*gm2*gm8 + g01*g03*g06*g011*gm2*gm4*gm5 +
g01*g03*g04*g08*gm2*gm7*gm8 + g01*g03*g07*g08*gm2*gm4*gm8 + g01*g04*g07*g08*gm2*gm3*gm8 +
g02*g03*g04*g08*gm1*gm7*gm8 + g02*g03*g07*g08*gm1*gm4*gm8 + g02*g04*g07*g08*gm1*gm3*gm8 +
2*g03*g04*g07*g08*gm1*gm2*gm8 + g01*g03*g04*g011*gm2*gm5*gm8 + g01*g03*g05*g011*gm2*gm4*gm8 +
g01*g03*g06*g011*gm2*gm4*gm7 + g01*g03*g08*g011*gm2*gm4*gm5 + g01*g03*g04*g011*gm2*gm7*gm8 +
g01*g03*g07*g011*gm2*gm4*gm8 + g01*g03*g08*g011*gm2*gm4*gm7 + g01*g04*g06*g011*gm2*gm5*gm7 +
g01*g05*g06*g011*gm2*gm4*gm7 + g01*g06*g07*g011*gm2*gm4*gm5 + g02*g03*g06*g011*gm1*gm5*gm8 +
g02*g05*g06*g011*gm1*gm3*gm8 + g01*g04*g05*g011*gm2*gm7*gm8 + g01*g04*g07*g011*gm2*gm5*gm8 +
g01*g04*g08*g011*gm2*gm5*gm7 + g01*g05*g07*g011*gm2*gm4*gm8 + g01*g05*g08*g011*gm2*gm4*gm7 +
g01*g07*g08*g011*gm2*gm4*gm5 + g02*g03*g06*g011*gm1*gm7*gm8 + g02*g06*g07*g011*gm1*gm3*gm8 +
g03*g04*g06*g011*gm1*gm5*gm8 + g03*g04*g06*g011*gm2*gm5*gm7 + g03*g05*g06*g011*gm1*gm4*gm8 +
g03*g05*g06*g011*gm2*gm4*gm7 + g03*g06*g07*g011*gm2*gm4*gm5 + g04*g05*g06*g011*gm1*gm3*gm8 +
g04*g05*g06*g011*gm2*gm3*gm7 + g04*g06*g07*g011*gm2*gm3*gm5 + g05*g06*g07*g011*gm2*gm3*gm4 +
g02*g03*g08*g011*gm1*gm7*gm8 + g02*g07*g08*g011*gm1*gm3*gm8 + g03*g04*g05*g011*gm2*gm7*gm8 +
```

MATLAB Solution Continued 1:

```
g03*g04*g06*g011*gm1*gm7*gm8 + g03*g04*g07*g011*gm2*gm5*gm8 + g03*g04*g08*g011*gm2*gm5*gm7 +
g03*g05*g07*g011*gm2*gm4*gm8 + g03*g05*g08*g011*gm2*gm4*gm7 + g03*g06*g07*g011*gm1*gm4*gm8 +
g03*g07*g08*g011*gm2*gm4*gm5 + g04*g05*g07*g011*gm2*gm3*gm8 + g04*g05*g08*g011*gm2*gm3*gm7 +
g04*g06*g07*g011*gm1*gm3*gm8 + g04*g07*g08*g011*gm2*gm3*gm5 + g05*g07*g08*g011*gm2*gm3*gm4 +
g03*g04*g08*g011*gm1*gm7*gm8 + g03*g07*g08*g011*gm1*gm4*gm8 + g04*g07*g08*g011*gm1*gm3*gm8 +
g01*g03*g06*gm2*gm4*gm5*gm7 + g01*g04*g06*gm2*gm3*gm5*gm7 + g01*g05*g06*gm2*gm3*gm4*gm7 +
g01*g06*g07*gm2*gm3*gm4*gm5 + g02*g03*g06*gm1*gm4*gm5*gm7 + g02*g04*g06*gm1*gm3*gm5*gm7 +
g02*g05*g06*gm1*gm3*gm4*gm7 + g02*g06*g07*gm1*gm3*gm4*gm5 + 2*g03*g04*g06*gm1*gm2*gm5*gm7 +
2*g03*g05*g06*gm1*gm2*gm4*gm7 + 2*g03*g06*g07*gm1*gm2*gm4*gm5 + 2*g04*g05*g06*gm1*gm2*gm3*gm7 +
2*g04*g06*g07*gm1*gm2*gm3*gm5 + 2*g05*g06*g07*gm1*gm2*gm3*gm4 + g01*g03*g06*gm2*gm4*gm5*gm8 +
g01*g04*g06*gm2*gm3*gm5*gm8 + g01*g05*g06*gm2*gm3*gm4*gm8 + g02*g03*g06*gm1*gm4*gm5*gm8 +
g02*g04*g06*gm1*gm3*gm5*gm8 + g02*g05*g06*gm1*gm3*gm4*gm8 + 2*g03*g04*g06*gm1*gm2*gm5*gm8 +
2*g03*g05*g06*gm1*gm2*gm4*gm8 + 2*g04*g05*g06*gm1*gm2*gm3*gm8 + g01*g03*g04*gm2*gm5*gm7*gm8 +
g01*g03*g05*gm2*gm4*gm7*gm8 + g01*g03*g07*gm2*gm4*gm5*gm8 + g01*g03*g08*gm2*gm4*gm5*gm7 +
g01*g04*g05*gm2*gm3*gm7*gm8 + g01*g04*g07*gm2*gm3*gm5*gm8 + g01*g04*g08*gm2*gm3*gm5*gm7 +
g01*g05*g07*gm2*gm3*gm4*gm8 + g01*g05*g08*gm2*gm3*gm4*gm7 + g01*g07*g08*gm2*gm3*gm4*gm5 +
g02*g03*g04*gm1*gm5*gm7*gm8 + g02*g03*g05*gm1*gm4*gm7*gm8 + g02*g03*g07*gm1*gm4*gm5*gm8 +
g02*g03*g08*gm1*gm4*gm5*gm7 + g02*g04*g05*gm1*gm3*gm7*gm8 + g02*g04*g07*gm1*gm3*gm5*gm8 +
g02*g04*g08*gm1*gm3*gm5*gm7 + g02*g05*g07*gm1*gm3*gm4*gm8 + g02*g05*g08*gm1*gm3*gm4*gm7 +
g02*g07*g08*gm1*gm3*gm4*gm5 + 2*g03*g04*g05*gm1*gm2*gm7*gm8 + 2*g03*g04*g07*gm1*gm2*gm5*gm8 +
2*g03*g04*g08*gm1*gm2*gm5*gm7 + 2*g03*g05*g07*gm1*gm2*gm4*gm8 + 2*g03*g05*g08*gm1*gm2*gm4*gm7 +
2*g03*g07*g08*gm1*gm2*gm4*gm5 + 2*g04*g05*g07*gm1*gm2*gm3*gm8 + 2*g04*g05*g08*gm1*gm2*gm3*gm7 +
2*g04*g07*g08*gm1*gm2*gm3*gm5 + 2*g05*g07*g08*gm1*gm2*gm3*gm4 + g01*g03*g06*gm2*gm4*gm7*gm8 +
g01*g04*g06*gm2*gm3*gm7*gm8 + g01*g06*g07*gm2*gm3*gm4*gm8 + g02*g03*g06*gm1*gm4*gm7*gm8 +
g02*g04*g06*gm1*gm3*gm7*gm8 + g02*g06*g07*gm1*gm3*gm4*gm8 + 2*g03*g04*g06*gm1*gm2*gm7*gm8 +
2*g03*g06*g07*gm1*gm2*gm4*gm8 + 2*g04*g06*g07*gm1*gm2*gm3*gm8 + g01*g03*g08*gm2*gm4*gm7*gm8 +
g01*g04*g08*gm2*gm3*gm7*gm8 + g01*g07*g08*gm2*gm3*gm4*gm8 + g02*g03*g08*gm1*gm4*gm7*gm8 +
g02*g04*g08*gm1*gm3*gm7*gm8 + g02*g07*g08*gm1*gm3*gm4*gm8 + 2*g03*g04*g08*gm1*gm2*gm7*gm8 +
2*g03*g07*g08*gm1*gm2*gm4*gm8 + 2*g04*g07*g08*gm1*gm2*gm3*gm8 + g01*g03*g011*gm2*gm4*gm5*gm8 +
g01*g03*g011*gm2*gm4*gm7*gm8 + g01*g06*g011*gm2*gm4*gm5*gm7 + g02*g06*g011*gm1*gm3*gm5*gm8 +
g01*g04*g011*gm2*gm5*gm7*gm8 + g01*g05*g011*gm2*gm4*gm7*gm8 + g01*g07*g011*gm2*gm4*gm5*gm8 +
g01*g08*g011*gm2*gm4*gm5*gm7 + g02*g06*g011*gm1*gm3*gm7*gm8 + g03*g06*g011*gm1*gm4*gm5*gm8 +
g03*g06*g011*gm2*gm4*gm5*gm7 + g04*g06*g011*gm1*gm3*gm5*gm8 + g04*g06*g011*gm2*gm3*gm5*gm7 +
g05*g06*g011*gm1*gm3*gm4*gm8 + g05*g06*g011*gm2*gm3*gm4*gm7 + g06*g07*g011*gm2*gm3*gm4*gm5 +
g02*g08*g011*gm1*gm3*gm7*gm8 + g03*g04*g011*gm2*gm5*gm7*gm8 + g03*g05*g011*gm2*gm4*gm7*gm8 +
g03*g06*g011*gm1*gm4*gm7*gm8 + g03*g07*g011*gm2*gm4*gm5*gm8 + g03*g08*g011*gm2*gm4*gm5*gm7 +
g04*g05*g011*gm2*gm3*gm7*gm8 + g04*g06*g011*gm1*gm3*gm7*gm8 + g04*g07*g011*gm2*gm3*gm5*gm8 +
g04*g08*g011*gm2*gm3*gm5*gm7 + g05*g07*g011*gm2*gm3*gm4*gm8 + g05*g08*g011*gm2*gm3*gm4*gm7 +
g06*g07*g011*gm1*gm3*gm4*gm8 + g07*g08*g011*gm2*gm3*gm4*gm5 + g03*g08*g011*gm1*gm4*gm7*gm8 +
g04*g08*g011*gm1*gm3*gm7*gm8 + g07*g08*g011*gm1*gm3*gm4*gm8 + g01*g06*gm2*gm3*gm4*gm5*gm7 +
g02*g06*gm1*gm3*gm4*gm5*gm7 + 2*g03*g06*gm1*gm2*gm4*gm5*gm7 + 2*g04*g06*gm1*gm2*gm3*gm5*gm7 +
2*g05*g06*gm1*gm2*gm3*gm4*gm7 + 2*g06*g07*gm1*gm2*gm3*gm4*gm5 + g01*g06*gm2*gm3*gm4*gm5*gm8 +
g02*g06*gm1*gm3*gm4*gm5*gm8 + 2*g03*g06*gm1*gm2*gm4*gm5*gm8 + 2*g04*g06*gm1*gm2*gm3*gm5*gm8 +
2*g05*g06*gm1*gm2*gm3*gm4*gm8 + g01*g03*gm2*gm4*gm5*gm7*gm8 + g01*g04*gm2*gm3*gm5*gm7*gm8 +
g01*g05*gm2*gm3*gm4*gm7*gm8 + g01*g07*gm2*gm3*gm4*gm5*gm8 + g01*g08*gm2*gm3*gm4*gm5*gm7 +
g02*g03*gm1*gm4*gm5*gm7*gm8 + g02*g04*gm1*gm3*gm5*gm7*gm8 + g02*g05*gm1*gm3*gm4*gm7*gm8 +
g02*g07*gm1*gm3*gm4*gm5*gm8 + g02*g08*gm1*gm3*gm4*gm5*gm7 + 2*g03*g04*gm1*gm2*gm5*gm7*gm8 +
2*g03*g05*gm1*gm2*gm4*gm7*gm8 + 2*g03*g07*gm1*gm2*gm4*gm5*gm8 + 2*g03*g08*gm1*gm2*gm4*gm5*gm7 +
2*g04*g05*gm1*gm2*gm3*gm7*gm8 + 2*g04*g07*gm1*gm2*gm3*gm5*gm8 + 2*g04*g08*gm1*gm2*gm3*gm5*gm7 +
2*g05*g07*gm1*gm2*gm3*gm4*gm8 + 2*g05*g08*gm1*gm2*gm3*gm4*gm7 + 2*g07*g08*gm1*gm2*gm3*gm4*gm5 +
g01*g06*gm2*gm3*gm4*gm7*gm8 + g02*g06*gm1*gm3*gm4*gm7*gm8 + 2*g03*g06*gm1*gm2*gm4*gm7*gm8 +
2*g04*g06*gm1*gm2*gm3*gm7*gm8 + 2*g06*g07*gm1*gm2*gm3*gm4*gm8 + g01*g08*gm2*gm3*gm4*gm7*gm8 +
g02*g08*gm1*gm3*gm4*gm7*gm8 + 2*g03*g08*gm1*gm2*gm4*gm7*gm8 + 2*g04*g08*gm1*gm2*gm3*gm7*gm8 +
2*g07*g08*gm1*gm2*gm3*gm4*gm8 + g01*g011*gm2*gm4*gm5*gm7*gm8 + g06*g011*gm1*gm3*gm4*gm5*gm8 +
g06*g011*gm2*gm3*gm4*gm5*gm7 + g03*g011*gm2*gm4*gm5*gm7*gm8 + g04*g011*gm2*gm3*gm5*gm7*gm8 +
g05*g011*gm2*gm3*gm4*gm7*gm8 + g06*g011*gm1*gm3*gm4*gm7*gm8 + g07*g011*gm2*gm3*gm4*gm5*gm8 +
g08*g011*gm2*gm3*gm4*gm5*gm7 + g08*g011*gm1*gm3*gm4*gm7*gm8 + 2*g06*gm1*gm2*gm3*gm4*gm5*gm7 +
2*g06*gm1*gm2*gm3*gm4*gm5*gm8 + g01*gm2*gm3*gm4*gm5*gm7*gm8 + g02*gm1*gm3*gm4*gm5*gm7*gm8 +
2*g03*gm1*gm2*gm4*gm5*gm7*gm8 + 2*g04*gm1*gm2*gm3*gm5*gm7*gm8 + 2*g05*gm1*gm2*gm3*gm4*gm7*gm8 +
2*g07*gm1*gm2*gm3*gm4*gm5*gm8 + 2*g08*gm1*gm2*gm3*gm4*gm5*gm7 + 2*g06*gm1*gm2*gm3*gm4*gm7*gm8 +
2*g08*gm1*gm2*gm3*gm4*gm7*gm8 + g011*gm2*gm3*gm4*gm5*gm7*gm8 + 2*gm1*gm2*gm3*gm4*gm5*gm7*gm8)

/

((2*CL*g01*g02*g03*g04*g05*g06 + 2*CL*g01*g02*g03*g04*g05*g08 + 2*CL*g01*g02*g03*g04*g06*g07 +
2*CL*g01*g02*g03*g05*g06*g07 + 2*CL*g01*g02*g03*g04*g07*g08 + 2*CL*g01*g02*g04*g05*g06*g07 +
2*CL*g01*g02*g03*g05*g07*g08 + 2*CL*g01*g03*g04*g05*g06*g07 + 2*CL*g01*g02*g04*g05*g07*g08 +
2*CL*g02*g03*g04*g05*g06*g07 + 2*CL*g01*g02*g03*g05*g06*g011 + 2*CL*g01*g03*g04*g05*g07*g08 +
2*CL*g02*g03*g04*g05*g07*g08 + 2*CL*g01*g02*g03*g05*g08*g011 + 2*CL*g01*g02*g03*g06*g07*g011 +
2*CL*g01*g03*g04*g05*g06*g011 + 2*CL*g01*g02*g03*g07*g08*g011 + 2*CL*g01*g02*g05*g06*g07*g011 +
2*CL*g01*g03*g04*g05*g08*g011 + 2*CL*g01*g03*g04*g06*g07*g011 + 2*CL*g01*g02*g05*g07*g08*g011 +
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MATLAB Solution Continued 2:

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2*CL*g01*g03*g04*g07*g08*g011 + 2*CL*g01*g04*g05*g06*g07*g011 + 2*CL*g02*g03*g05*g06*g07*g011 +
2*CL*g01*g04*g05*g07*g08*g011 + 2*CL*g02*g03*g05*g07*g08*g011 + 2*CL*g03*g04*g05*g06*g07*g011 +
2*CL*g03*g04*g05*g07*g08*g011 + 2*CL*g01*g02*g03*g04*g06*gm5 + 2*CL*g01*g02*g03*g05*g06*gm4 +
2*CL*g01*g03*g04*g05*g06*gm2 + 2*CL*g01*g02*g03*g04*g05*gm8 + 2*CL*g01*g02*g03*g04*g06*gm7 +
2*CL*g01*g02*g03*g04*g08*gm5 + 2*CL*g01*g02*g03*g05*g08*gm4 + 2*CL*g01*g02*g03*g06*g07*gm4 +
2*CL*g01*g03*g04*g05*g08*gm2 + 2*CL*g01*g03*g04*g06*g07*gm2 + 2*CL*g01*g02*g03*g05*g06*gm7 +
2*CL*g01*g02*g03*g06*g07*gm5 + 2*CL*g01*g02*g05*g06*g07*gm3 + 2*CL*g02*g03*g05*g06*g07*gm1 +
2*CL*g01*g02*g03*g04*g07*gm8 + 2*CL*g01*g02*g03*g04*g08*gm7 + 2*CL*g01*g02*g03*g07*g08*gm4 +
2*CL*g01*g02*g04*g05*g06*gm7 + 2*CL*g01*g02*g04*g06*g07*gm5 + 2*CL*g01*g02*g05*g06*g07*gm4 +
2*CL*g01*g03*g04*g07*g08*gm2 + 2*CL*g01*g04*g05*g06*g07*gm2 + 2*CL*g01*g02*g03*g05*g07*gm8 +
2*CL*g01*g02*g03*g05*g08*gm7 + 2*CL*g01*g02*g03*g07*g08*gm5 + 2*CL*g01*g02*g05*g07*g08*gm3 +
2*CL*g01*g03*g04*g05*g06*gm7 + 2*CL*g01*g03*g04*g06*g07*gm5 + 2*CL*g01*g03*g05*g06*g07*gm4 +
2*CL*g01*g04*g05*g06*g07*gm3 + 2*CL*g02*g03*g05*g07*g08*gm1 + 2*CL*g03*g04*g05*g06*g07*gm1 +
2*CL*g01*g02*g04*g05*g07*gm8 + 2*CL*g01*g02*g04*g05*g08*gm7 + 2*CL*g01*g02*g04*g07*g08*gm5 +
2*CL*g01*g02*g05*g07*g08*gm4 + 2*CL*g01*g04*g05*g07*g08*gm2 + 2*CL*g02*g03*g04*g05*g06*gm7 +
2*CL*g02*g03*g04*g06*g07*gm5 + 2*CL*g02*g03*g05*g06*g07*gm4 + 2*CL*g02*g04*g05*g06*g07*gm3 +
2*CL*g03*g04*g05*g06*g07*gm2 + 2*CL*g01*g02*g03*g06*g011*gm5 + 2*CL*g01*g03*g04*g05*g07*gm8 +
2*CL*g01*g03*g04*g05*g08*gm7 + 2*CL*g01*g03*g04*g07*g08*gm5 + 2*CL*g01*g03*g05*g07*g08*gm4 +
2*CL*g01*g04*g05*g07*g08*gm3 + 2*CL*g03*g04*g05*g07*g08*gm1 + 2*CL*g02*g03*g04*g05*g07*gm8 +
2*CL*g02*g03*g04*g05*g08*gm7 + 2*CL*g02*g03*g04*g07*g08*gm5 + 2*CL*g02*g03*g05*g07*g08*gm4 +
2*CL*g02*g04*g05*g07*g08*gm3 + 2*CL*g03*g04*g05*g07*g08*gm2 + 2*CL*g01*g02*g03*g05*g011*gm8 +
2*CL*g01*g02*g03*g06*g011*gm7 + 2*CL*g01*g02*g03*g08*g011*gm5 + 2*CL*g01*g03*g04*g06*g011*gm5 +
2*CL*g01*g03*g05*g06*g011*gm4 + 2*CL*g01*g02*g03*g07*g011*gm8 + 2*CL*g01*g02*g03*g08*g011*gm7 +
2*CL*g01*g02*g05*g06*g011*gm7 + 2*CL*g01*g02*g06*g07*g011*gm5 + 2*CL*g01*g03*g04*g05*g011*gm8 +
2*CL*g01*g03*g04*g06*g011*gm7 + 2*CL*g01*g03*g04*g08*g011*gm5 + 2*CL*g01*g03*g05*g08*g011*gm4 +
2*CL*g01*g03*g06*g07*g011*gm4 + 2*CL*g01*g02*g05*g07*g011*gm8 + 2*CL*g01*g02*g05*g08*g011*gm7 +
2*CL*g01*g02*g07*g08*g011*gm5 + 2*CL*g01*g03*g04*g07*g011*gm8 + 2*CL*g01*g03*g04*g08*g011*gm7 +
2*CL*g01*g03*g07*g08*g011*gm4 + 2*CL*g01*g04*g05*g06*g011*gm7 + 2*CL*g01*g04*g06*g07*g011*gm5 +
2*CL*g01*g05*g06*g07*g011*gm4 + 2*CL*g02*g03*g05*g06*g011*gm7 + 2*CL*g02*g03*g06*g07*g011*gm5 +
2*CL*g02*g05*g06*g07*g011*gm3 + 2*CL*g01*g04*g05*g07*g011*gm8 + 2*CL*g01*g04*g05*g08*g011*gm7 +
2*CL*g01*g04*g07*g08*g011*gm5 + 2*CL*g01*g05*g07*g08*g011*gm4 + 2*CL*g02*g03*g05*g07*g011*gm8 +
2*CL*g02*g03*g05*g08*g011*gm7 + 2*CL*g02*g03*g07*g08*g011*gm5 + 2*CL*g02*g05*g07*g08*g011*gm3 +
2*CL*g03*g04*g05*g06*g011*gm7 + 2*CL*g03*g04*g06*g07*g011*gm5 + 2*CL*g03*g05*g06*g07*g011*gm4 +
2*CL*g04*g05*g06*g07*g011*gm3 + 2*CL*g03*g04*g05*g07*g011*gm8 + 2*CL*g03*g04*g05*g08*g011*gm7 +
2*CL*g03*g04*g07*g08*g011*gm5 + 2*CL*g03*g05*g07*g08*g011*gm4 + 2*CL*g04*g05*g07*g08*g011*gm3 +
2*CL*g01*g02*g03*g06*gm4*gm5 + 2*CL*g01*g03*g04*g06*gm2*gm5 + 2*CL*g01*g03*g05*g06*gm2*gm4 +
2*CL*g01*g02*g03*g04*gm5*gm8 + 2*CL*g01*g02*g03*g05*gm4*gm8 + 2*CL*g01*g02*g03*g06*gm4*gm7 +
2*CL*g01*g02*g03*g08*gm4*gm5 + 2*CL*g01*g03*g04*g05*gm2*gm8 + 2*CL*g01*g03*g04*g06*gm2*gm7 +
2*CL*g01*g03*g04*g08*gm2*gm5 + 2*CL*g01*g03*g05*g08*gm2*gm4 + 2*CL*g01*g03*g06*g07*gm2*gm4 +
2*CL*g01*g02*g03*g06*gm5*gm7 + 2*CL*g01*g02*g05*g06*gm3*gm7 + 2*CL*g01*g02*g06*g07*gm3*gm5 +
2*CL*g02*g03*g05*g06*gm1*gm7 + 2*CL*g02*g03*g06*g07*gm1*gm5 + 2*CL*g02*g05*g06*g07*gm1*gm3 +
2*CL*g01*g02*g03*g04*gm7*gm8 + 2*CL*g01*g02*g03*g07*gm4*gm8 + 2*CL*g01*g02*g03*g08*gm4*gm7 +
2*CL*g01*g02*g04*g06*gm5*gm7 + 2*CL*g01*g02*g05*g06*gm4*gm7 + 2*CL*g01*g02*g06*g07*gm4*gm5 +
2*CL*g01*g03*g04*g07*gm2*gm8 + 2*CL*g01*g03*g04*g08*gm2*gm7 + 2*CL*g01*g03*g07*g08*gm2*gm4 +
2*CL*g01*g04*g05*g06*gm2*gm7 + 2*CL*g01*g04*g06*g07*gm2*gm5 + 2*CL*g01*g05*g06*g07*gm2*gm4 +
2*CL*g01*g02*g03*g05*gm7*gm8 + 2*CL*g01*g02*g03*g07*gm5*gm8 + 2*CL*g01*g02*g03*g08*gm5*gm7 +
2*CL*g01*g02*g05*g07*gm3*gm8 + 2*CL*g01*g02*g05*g08*gm3*gm7 + 2*CL*g01*g02*g07*g08*gm3*gm5 +
2*CL*g01*g03*g04*g06*gm5*gm7 + 2*CL*g01*g03*g05*g06*gm4*gm7 + 2*CL*g01*g03*g06*g07*gm4*gm5 +
2*CL*g01*g04*g05*g06*gm3*gm7 + 2*CL*g01*g04*g06*g07*gm3*gm5 + 2*CL*g01*g05*g06*g07*gm3*gm4 +
2*CL*g02*g03*g05*g07*gm1*gm8 + 2*CL*g02*g03*g05*g08*gm1*gm7 + 2*CL*g02*g03*g07*g08*gm1*gm5 +
2*CL*g02*g05*g07*g08*gm1*gm3 + 2*CL*g03*g04*g05*g06*gm1*gm7 + 2*CL*g03*g04*g06*g07*gm1*gm5 +
2*CL*g03*g05*g06*g07*gm1*gm4 + 2*CL*g04*g05*g06*g07*gm1*gm3 + 2*CL*g01*g02*g04*g05*gm7*gm8 +
2*CL*g01*g02*g04*g07*gm5*gm8 + 2*CL*g01*g02*g04*g08*gm5*gm7 + 2*CL*g01*g02*g05*g07*gm4*gm8 +
2*CL*g01*g02*g05*g08*gm4*gm7 + 2*CL*g01*g02*g07*g08*gm4*gm5 + 2*CL*g01*g04*g05*g07*gm2*gm8 +
2*CL*g01*g04*g05*g08*gm2*gm7 + 2*CL*g01*g04*g07*g08*gm2*gm5 + 2*CL*g01*g05*g07*g08*gm2*gm4 +
2*CL*g02*g03*g04*g06*gm5*gm7 + 2*CL*g02*g03*g05*g06*gm4*gm7 + 2*CL*g02*g03*g06*g07*gm4*gm5 +
2*CL*g02*g04*g05*g06*gm3*gm7 + 2*CL*g02*g04*g06*g07*gm3*gm5 + 2*CL*g02*g05*g06*g07*gm3*gm4 +
2*CL*g03*g04*g05*g06*gm2*gm7 + 2*CL*g03*g04*g06*g07*gm2*gm5 + 2*CL*g03*g05*g06*g07*gm2*gm4 +
2*CL*g04*g05*g06*g07*gm2*gm3 + 2*CL*g01*g03*g04*g05*gm7*gm8 + 2*CL*g01*g03*g04*g07*gm5*gm8 +
2*CL*g01*g03*g04*g08*gm5*gm7 + 2*CL*g01*g03*g05*g07*gm4*gm8 + 2*CL*g01*g03*g05*g08*gm4*gm7 +
2*CL*g01*g03*g07*g08*gm4*gm5 + 2*CL*g01*g04*g05*g07*gm3*gm8 + 2*CL*g01*g04*g05*g08*gm3*gm7 +
2*CL*g01*g04*g07*g08*gm3*gm5 + 2*CL*g01*g05*g07*g08*gm3*gm4 + 2*CL*g03*g04*g05*g07*gm1*gm8 +
2*CL*g03*g04*g05*g08*gm1*gm7 + 2*CL*g03*g04*g07*g08*gm1*gm5 + 2*CL*g03*g05*g07*g08*gm1*gm4 +
2*CL*g04*g05*g07*g08*gm1*gm3 + 2*CL*g02*g03*g04*g05*gm7*gm8 + 2*CL*g02*g03*g04*g07*gm5*gm8 +
2*CL*g02*g03*g04*g08*gm5*gm7 + 2*CL*g02*g03*g05*g07*gm4*gm8 + 2*CL*g02*g03*g05*g08*gm4*gm7 +
2*CL*g02*g03*g07*g08*gm4*gm5 + 2*CL*g02*g04*g05*g07*gm3*gm8 + 2*CL*g02*g04*g05*g08*gm3*gm7 +
2*CL*g02*g04*g07*g08*gm3*gm5 + 2*CL*g02*g05*g07*g08*gm3*gm4 + 2*CL*g03*g04*g05*g07*gm2*gm8 +
2*CL*g03*g04*g05*g08*gm2*gm7 + 2*CL*g03*g04*g07*g08*gm2*gm5 + 2*CL*g03*g05*g07*g08*gm2*gm4 +
2*CL*g04*g05*g07*g08*gm2*gm3 + 2*CL*g01*g02*g03*g011*gm5*gm8 + 2*CL*g01*g03*g06*g011*gm4*gm5 +
2*CL*g01*g02*g03*g011*gm7*gm8 + 2*CL*g01*g02*g06*g011*gm5*gm7 + 2*CL*g01*g03*g04*g011*gm5*gm8 +
2*CL*g01*g03*g05*g011*gm4*gm8 + 2*CL*g01*g03*g06*g011*gm4*gm7 + 2*CL*g01*g03*g08*g011*gm4*gm5 +
```

MATLAB Solution Continued 3:

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2*CL*g01*g02*g05*g011*gm7*gm8 + 2*CL*g01*g02*g07*g011*gm5*gm8 + 2*CL*g01*g02*g08*g011*gm5*gm7 +
2*CL*g01*g03*g04*g011*gm7*gm8 + 2*CL*g01*g03*g07*g011*gm4*gm8 + 2*CL*g01*g03*g08*g011*gm4*gm7 +
2*CL*g01*g04*g06*g011*gm5*gm7 + 2*CL*g01*g05*g06*g011*gm4*gm7 + 2*CL*g01*g06*g07*g011*gm4*gm5 +
2*CL*g02*g03*g06*g011*gm5*gm7 + 2*CL*g02*g05*g06*g011*gm3*gm7 + 2*CL*g02*g06*g07*g011*gm3*gm5 +
2*CL*g01*g04*g05*g011*gm7*gm8 + 2*CL*g01*g04*g07*g011*gm5*gm8 + 2*CL*g01*g04*g08*g011*gm5*gm7 +
2*CL*g01*g05*g07*g011*gm4*gm8 + 2*CL*g01*g05*g08*g011*gm4*gm7 + 2*CL*g01*g07*g08*g011*gm4*gm5 +
2*CL*g02*g03*g05*g011*gm7*gm8 + 2*CL*g02*g03*g07*g011*gm5*gm8 + 2*CL*g02*g03*g08*g011*gm5*gm7 +
2*CL*g02*g05*g07*g011*gm3*gm8 + 2*CL*g02*g05*g08*g011*gm3*gm7 + 2*CL*g02*g07*g08*g011*gm3*gm5 +
2*CL*g03*g04*g06*g011*gm5*gm7 + 2*CL*g03*g05*g06*g011*gm4*gm7 + 2*CL*g03*g06*g07*g011*gm4*gm5 +
2*CL*g04*g05*g06*g011*gm3*gm7 + 2*CL*g04*g06*g07*g011*gm3*gm5 + 2*CL*g05*g06*g07*g011*gm3*gm4 +
2*CL*g03*g04*g05*g011*gm7*gm8 + 2*CL*g03*g04*g07*g011*gm5*gm8 + 2*CL*g03*g04*g08*g011*gm5*gm7 +
2*CL*g03*g05*g07*g011*gm4*gm8 + 2*CL*g03*g05*g08*g011*gm4*gm7 + 2*CL*g03*g07*g08*g011*gm4*gm5 +
2*CL*g04*g05*g07*g011*gm3*gm8 + 2*CL*g04*g05*g08*g011*gm3*gm7 + 2*CL*g04*g07*g08*g011*gm3*gm5 +
2*CL*g05*g07*g08*g011*gm3*gm4 + 2*CL*g01*g03*g06*gm2*gm4*gm5 + 2*CL*g01*g02*g03*gm4*gm5*gm8 +
2*CL*g01*g03*g04*gm2*gm5*gm8 + 2*CL*g01*g03*g05*gm2*gm4*gm8 + 2*CL*g01*g03*g06*gm2*gm4*gm7 +
2*CL*g01*g03*g08*gm2*gm4*gm5 + 2*CL*g01*g02*g06*gm3*gm5*gm7 + 2*CL*g02*g03*g06*gm1*gm5*gm7 +
2*CL*g02*g05*g06*gm1*gm3*gm7 + 2*CL*g02*g06*g07*gm1*gm3*gm5 + 2*CL*g01*g02*g03*gm4*gm7*gm8 +
2*CL*g01*g02*g06*gm4*gm5*gm7 + 2*CL*g01*g03*g04*gm2*gm7*gm8 + 2*CL*g01*g03*g07*gm2*gm4*gm8 +
2*CL*g01*g03*g08*gm2*gm4*gm7 + 2*CL*g01*g04*g06*gm2*gm5*gm7 + 2*CL*g01*g05*g06*gm2*gm4*gm7 +
2*CL*g01*g06*g07*gm2*gm4*gm5 + 2*CL*g01*g02*g03*gm5*gm7*gm8 + 2*CL*g01*g02*g05*gm3*gm7*gm8 +
2*CL*g01*g02*g07*gm3*gm5*gm8 + 2*CL*g01*g02*g08*gm3*gm5*gm7 + 2*CL*g01*g03*g06*gm4*gm5*gm7 +
2*CL*g01*g04*g06*gm3*gm5*gm7 + 2*CL*g01*g05*g06*gm3*gm4*gm7 + 2*CL*g01*g06*g07*gm3*gm4*gm5 +
2*CL*g02*g03*g05*gm1*gm7*gm8 + 2*CL*g02*g03*g07*gm1*gm5*gm8 + 2*CL*g02*g03*g08*gm1*gm5*gm7 +
2*CL*g02*g05*g07*gm1*gm3*gm8 + 2*CL*g02*g05*g08*gm1*gm3*gm7 + 2*CL*g02*g07*g08*gm1*gm3*gm5 +
2*CL*g03*g04*g06*gm1*gm5*gm7 + 2*CL*g03*g05*g06*gm1*gm4*gm7 + 2*CL*g03*g06*g07*gm1*gm4*gm5 +
2*CL*g04*g05*g06*gm1*gm3*gm7 + 2*CL*g04*g06*g07*gm1*gm3*gm5 + 2*CL*g05*g06*g07*gm1*gm3*gm4 +
2*CL*g01*g02*g04*gm5*gm7*gm8 + 2*CL*g01*g02*g05*gm4*gm7*gm8 + 2*CL*g01*g02*g07*gm4*gm5*gm8 +
2*CL*g01*g02*g08*gm4*gm5*gm7 + 2*CL*g01*g04*g05*gm2*gm7*gm8 + 2*CL*g01*g04*g07*gm2*gm5*gm8 +
2*CL*g01*g04*g08*gm2*gm5*gm7 + 2*CL*g01*g05*g07*gm2*gm4*gm8 + 2*CL*g01*g05*g08*gm2*gm4*gm7 +
2*CL*g01*g07*g08*gm2*gm4*gm5 + 2*CL*g02*g03*g06*gm4*gm5*gm7 + 2*CL*g02*g04*g06*gm3*gm5*gm7 +
2*CL*g02*g05*g06*gm3*gm4*gm7 + 2*CL*g02*g06*g07*gm3*gm4*gm5 + 2*CL*g03*g04*g06*gm2*gm5*gm7 +
2*CL*g03*g05*g06*gm2*gm4*gm7 + 2*CL*g03*g06*g07*gm2*gm4*gm5 + 2*CL*g04*g05*g06*gm2*gm3*gm7 +
2*CL*g04*g06*g07*gm2*gm3*gm5 + 2*CL*g05*g06*g07*gm2*gm3*gm4 + 2*CL*g01*g03*g04*gm5*gm7*gm8 +
2*CL*g01*g03*g05*gm4*gm7*gm8 + 2*CL*g01*g03*g07*gm4*gm5*gm8 + 2*CL*g01*g03*g08*gm4*gm5*gm7 +
2*CL*g01*g04*g05*gm3*gm7*gm8 + 2*CL*g01*g04*g07*gm3*gm5*gm8 + 2*CL*g01*g04*g08*gm3*gm5*gm7 +
2*CL*g01*g05*g07*gm3*gm4*gm8 + 2*CL*g01*g05*g08*gm3*gm4*gm7 + 2*CL*g01*g07*g08*gm3*gm4*gm5 +
2*CL*g03*g04*g05*gm1*gm7*gm8 + 2*CL*g03*g04*g07*gm1*gm5*gm8 + 2*CL*g03*g04*g08*gm1*gm5*gm7 +
2*CL*g03*g05*g07*gm1*gm4*gm8 + 2*CL*g03*g05*g08*gm1*gm4*gm7 + 2*CL*g03*g07*g08*gm1*gm4*gm5 +
2*CL*g04*g05*g07*gm1*gm3*gm8 + 2*CL*g04*g05*g08*gm1*gm3*gm7 + 2*CL*g04*g07*g08*gm1*gm3*gm5 +
2*CL*g05*g07*g08*gm1*gm3*gm4 + 2*CL*g02*g03*g04*gm5*gm7*gm8 + 2*CL*g02*g03*g05*gm4*gm7*gm8 +
2*CL*g02*g03*g07*gm4*gm5*gm8 + 2*CL*g02*g03*g08*gm4*gm5*gm7 + 2*CL*g02*g04*g05*gm3*gm7*gm8 +
2*CL*g02*g04*g07*gm3*gm5*gm8 + 2*CL*g02*g04*g08*gm3*gm5*gm7 + 2*CL*g02*g05*g07*gm3*gm4*gm8 +
2*CL*g02*g05*g08*gm3*gm4*gm7 + 2*CL*g02*g07*g08*gm3*gm4*gm5 + 2*CL*g03*g04*g05*gm2*gm7*gm8 +
2*CL*g03*g04*g07*gm2*gm5*gm8 + 2*CL*g03*g04*g08*gm2*gm5*gm7 + 2*CL*g03*g05*g07*gm2*gm4*gm8 +
2*CL*g03*g05*g08*gm2*gm4*gm7 + 2*CL*g03*g07*g08*gm2*gm4*gm5 + 2*CL*g04*g05*g07*gm2*gm3*gm8 +
2*CL*g04*g05*g08*gm2*gm3*gm7 + 2*CL*g04*g07*g08*gm2*gm3*gm5 + 2*CL*g05*g07*g08*gm2*gm3*gm4 +
2*CL*g01*g03*g011*gm4*gm5*gm8 + 2*CL*g01*g02*g011*gm5*gm7*gm8 + 2*CL*g01*g03*g011*gm4*gm7*gm8 +
2*CL*g01*g06*g011*gm4*gm5*gm7 + 2*CL*g02*g06*g011*gm3*gm5*gm7 + 2*CL*g01*g04*g011*gm5*gm7*gm8 +
2*CL*g01*g05*g011*gm4*gm7*gm8 + 2*CL*g01*g07*g011*gm4*gm5*gm8 + 2*CL*g01*g08*g011*gm4*gm5*gm7 +
2*CL*g02*g03*g011*gm5*gm7*gm8 + 2*CL*g02*g05*g011*gm3*gm7*gm8 + 2*CL*g02*g07*g011*gm3*gm5*gm8 +
2*CL*g02*g08*g011*gm3*gm5*gm7 + 2*CL*g03*g06*g011*gm4*gm5*gm7 + 2*CL*g04*g06*g011*gm3*gm5*gm7 +
2*CL*g05*g06*g011*gm3*gm4*gm7 + 2*CL*g06*g07*g011*gm3*gm4*gm5 + 2*CL*g03*g04*g011*gm5*gm7*gm8 +
2*CL*g03*g05*g011*gm4*gm7*gm8 + 2*CL*g03*g07*g011*gm4*gm5*gm8 + 2*CL*g03*g08*g011*gm4*gm5*gm7 +
2*CL*g04*g05*g011*gm3*gm7*gm8 + 2*CL*g04*g07*g011*gm3*gm5*gm8 + 2*CL*g04*g08*g011*gm3*gm5*gm7 +
2*CL*g05*g07*g011*gm3*gm4*gm8 + 2*CL*g05*g08*g011*gm3*gm4*gm7 + 2*CL*g07*g08*g011*gm3*gm4*gm5 +
2*CL*g01*g03*gm2*gm4*gm5*gm8 + 2*CL*g02*g06*gm1*gm3*gm5*gm7 + 2*CL*g01*g03*gm2*gm4*gm7*gm8 +
2*CL*g01*g06*gm2*gm4*gm5*gm7 + 2*CL*g01*g02*gm3*gm5*gm7*gm8 + 2*CL*g01*g06*gm3*gm4*gm5*gm7 +
2*CL*g02*g03*gm1*gm5*gm7*gm8 + 2*CL*g02*g05*gm1*gm3*gm7*gm8 + 2*CL*g02*g07*gm1*gm3*gm5*gm8 +
2*CL*g02*g08*gm1*gm3*gm5*gm7 + 2*CL*g03*g06*gm1*gm4*gm5*gm7 + 2*CL*g04*g06*gm1*gm3*gm5*gm7 +
2*CL*g05*g06*gm1*gm3*gm4*gm7 + 2*CL*g06*g07*gm1*gm3*gm4*gm5 + 2*CL*g01*g02*gm4*gm5*gm7*gm8 +
2*CL*g01*g04*gm2*gm5*gm7*gm8 + 2*CL*g01*g05*gm2*gm4*gm7*gm8 + 2*CL*g01*g07*gm2*gm4*gm5*gm8 +
2*CL*g01*g08*gm2*gm4*gm5*gm7 + 2*CL*g02*g06*gm3*gm4*gm5*gm7 + 2*CL*g03*g06*gm2*gm4*gm5*gm7 +
2*CL*g04*g06*gm2*gm3*gm5*gm7 + 2*CL*g05*g06*gm2*gm3*gm4*gm7 + 2*CL*g06*g07*gm2*gm3*gm4*gm5 +
2*CL*g01*g03*gm4*gm5*gm7*gm8 + 2*CL*g01*g04*gm3*gm5*gm7*gm8 + 2*CL*g01*g05*gm3*gm4*gm7*gm8 +
2*CL*g01*g07*gm3*gm4*gm5*gm8 + 2*CL*g01*g08*gm3*gm4*gm5*gm7 + 2*CL*g03*g04*gm1*gm5*gm7*gm8 +
2*CL*g03*g05*gm1*gm4*gm7*gm8 + 2*CL*g03*g07*gm1*gm4*gm5*gm8 + 2*CL*g03*g08*gm1*gm4*gm5*gm7 +
2*CL*g04*g05*gm1*gm3*gm7*gm8 + 2*CL*g04*g07*gm1*gm3*gm5*gm8 + 2*CL*g04*g08*gm1*gm3*gm5*gm7 +
2*CL*g05*g07*gm1*gm3*gm4*gm8 + 2*CL*g05*g08*gm1*gm3*gm4*gm7 + 2*CL*g07*g08*gm1*gm3*gm4*gm5 +
2*CL*g02*g03*gm4*gm5*gm7*gm8 + 2*CL*g02*g04*gm3*gm5*gm7*gm8 + 2*CL*g02*g05*gm3*gm4*gm7*gm8 +
2*CL*g02*g07*gm3*gm4*gm5*gm8 + 2*CL*g02*g08*gm3*gm4*gm5*gm7 + 2*CL*g03*g04*gm2*gm5*gm7*gm8 +
2*CL*g03*g05*gm2*gm4*gm7*gm8 + 2*CL*g03*g07*gm2*gm4*gm5*gm8 + 2*CL*g03*g08*gm2*gm4*gm5*gm7 +
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MATLAB Solution Continued 4:

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2*CL*g04*g05*gm2*gm3*gm7*gm8 + 2*CL*g04*g07*gm2*gm3*gm5*gm8 + 2*CL*g04*g08*gm2*gm3*gm5*gm7 +
2*CL*g05*g07*gm2*gm3*gm4*gm8 + 2*CL*g05*g08*gm2*gm3*gm4*gm7 + 2*CL*g07*g08*gm2*gm3*gm4*gm5 +
2*CL*g01*g011*gm4*gm5*gm7*gm8 + 2*CL*g02*g011*gm3*gm5*gm7*gm8 + 2*CL*g06*g011*gm3*gm4*gm5*gm7 +
2*CL*g03*g011*gm4*gm5*gm7*gm8 + 2*CL*g04*g011*gm3*gm5*gm7*gm8 + 2*CL*g05*g011*gm3*gm4*gm7*gm8 +
2*CL*g07*g011*gm3*gm4*gm5*gm8 + 2*CL*g08*g011*gm3*gm4*gm5*gm7 + 2*CL*g02*gm1*gm3*gm5*gm7*gm8 +
2*CL*g06*gm1*gm3*gm4*gm5*gm7 + 2*CL*g01*gm2*gm4*gm5*gm7*gm8 + 2*CL*g06*gm2*gm3*gm4*gm5*gm7 +
2*CL*g01*gm3*gm4*gm5*gm7*gm8 + 2*CL*g03*gm1*gm4*gm5*gm7*gm8 + 2*CL*g04*gm1*gm3*gm5*gm7*gm8 +
2*CL*g05*gm1*gm3*gm4*gm7*gm8 + 2*CL*g07*gm1*gm3*gm4*gm5*gm8 + 2*CL*g08*gm1*gm3*gm4*gm5*gm7 +
2*CL*g02*gm3*gm4*gm5*gm7*gm8 + 2*CL*g03*gm2*gm4*gm5*gm7*gm8 + 2*CL*g04*gm2*gm3*gm5*gm7*gm8 +
2*CL*g05*gm2*gm3*gm4*gm7*gm8 + 2*CL*g07*gm2*gm3*gm4*gm5*gm8 + 2*CL*g08*gm2*gm3*gm4*gm5*gm7 +
2*CL*g011*gm3*gm4*gm5*gm7*gm8 + 2*CL*gm1*gm3*gm4*gm5*gm7*gm8 + 2*CL*gm2*gm3*gm4*gm5*gm7*gm8)*s +
(2*g01*g02*g03*g04*g07*gm8^2 + 2*g01*g02*g03*g04*gm7*gm8^2 + 2*g01*g02*g04*g07*gm3*gm8^2 +
2*g02*g03*g04*g07*gm1*gm8^2 + 2*g01*g02*g04*gm3*gm7*gm8^2 + 2*g02*g03*g04*gm1*gm7*gm8^2 +
2*g02*g04*g07*gm1*gm3*gm8^2 + 2*g02*g04*gm1*gm3*gm7*gm8^2 + 2*g01*g02*g03*g04*g05*g06*g07 +
2*g01*g02*g03*g04*g05*g06*g08 + 2*g01*g02*g03*g04*g05*g07*g08 + 2*g01*g02*g03*g04*g06*g07*g08 +
2*g01*g02*g03*g04*g05*g06*g011 + 2*g01*g02*g03*g05*g06*g07*g08 + 2*g01*g02*g04*g05*g06*g07*g08 +
2*g01*g02*g03*g04*g05*g08*g011 + 2*g01*g02*g03*g04*g06*g07*g011 + 2*g01*g03*g04*g05*g06*g07*g08
+ 2*g02*g03*g04*g05*g06*g07*g08 + 2*g01*g02*g03*g04*g07*g08*g011 +
2*g01*g02*g03*g05*g06*g08*g011 + 2*g01*g02*g04*g05*g06*g07*g011 + 2*g01*g02*g03*g06*g07*g08*g011
+ 2*g01*g02*g04*g05*g07*g08*g011 + 2*g01*g03*g04*g05*g06*g08*g011 +
2*g02*g03*g04*g05*g06*g07*g011 + 2*g01*g02*g05*g06*g07*g08*g011 + 2*g01*g03*g04*g06*g07*g08*g011
+ 2*g02*g03*g04*g05*g07*g08*g011 + 2*g01*g04*g05*g06*g07*g08*g011 +
2*g02*g03*g05*g06*g07*g08*g011 + 2*g03*g04*g05*g06*g07*g08*g011 + 2*g01*g02*g03*g04*g05*g06*gm7
+ 2*g01*g02*g03*g04*g06*g07*gm5 + 2*g01*g02*g04*g05*g06*g07*gm3 + 2*g02*g03*g04*g05*g06*g07*gm1
+ 2*g01*g02*g03*g04*g05*g06*gm8 + 2*g01*g02*g03*g04*g06*g08*gm5 + 2*g01*g02*g03*g05*g06*g08*gm4
+ 2*g01*g03*g04*g05*g06*g08*gm2 + 2*g01*g02*g03*g04*g05*g07*gm8 + 2*g01*g02*g03*g04*g05*g08*gm7
+ 2*g01*g02*g03*g04*g07*g08*gm5 + 2*g01*g02*g04*g05*g07*g08*gm3 + 2*g02*g03*g04*g05*g07*g08*gm1
+ 2*g01*g02*g03*g04*g06*g07*gm8 + 2*g01*g02*g03*g04*g06*g08*gm7 + 2*g01*g02*g03*g06*g07*g08*gm4
+ 2*g01*g03*g04*g06*g07*g08*gm2 + 2*g01*g02*g03*g04*g06*g011*gm5 + 2*g01*g02*g03*g05*g06*g08*gm7
+ 2*g01*g02*g03*g06*g07*g08*gm5 + 2*g01*g02*g05*g06*g07*g08*gm3 + 2*g02*g03*g05*g06*g07*g08*gm1
+ 2*g01*g02*g03*g04*g07*g08*gm8 + 2*g01*g02*g04*g05*g06*g08*gm7 + 2*g01*g02*g04*g06*g07*g08*gm5
+ 2*g01*g02*g05*g06*g07*g08*gm4 + 2*g01*g04*g05*g06*g07*g08*gm2 + 2*g01*g02*g03*g04*g05*g011*gm8
+ 2*g01*g02*g03*g04*g06*g011*gm7 + 2*g01*g02*g03*g04*g08*g011*gm5 +
2*g01*g03*g04*g05*g06*g08*gm7 + 2*g01*g03*g04*g06*g07*g08*gm5 + 2*g01*g03*g05*g06*g07*g08*gm4 +
2*g01*g04*g05*g06*g07*g08*gm3 + 2*g03*g04*g05*g06*g07*g08*gm1 + 2*g02*g03*g04*g05*g06*g08*gm7 +
2*g02*g03*g04*g06*g07*g08*gm5 + 2*g02*g03*g05*g06*g07*g08*gm4 + 2*g02*g04*g05*g06*g07*g08*gm3 +
2*g03*g04*g05*g06*g07*g08*gm2 + 2*g01*g02*g03*g04*g07*g011*gm8 + 2*g01*g02*g03*g04*g08*g011*gm7
+ 2*g01*g02*g03*g06*g08*g011*gm5 + 2*g01*g02*g04*g05*g06*g011*gm7 +
2*g01*g02*g04*g06*g07*g011*gm5 + 2*g01*g02*g03*g06*g08*g011*gm7 + 2*g01*g02*g04*g05*g07*g011*gm8
+ 2*g01*g02*g04*g05*g08*g011*gm7 + 2*g01*g02*g04*g07*g08*g011*gm5 +
2*g01*g03*g04*g06*g08*g011*gm5 + 2*g01*g03*g05*g06*g08*g011*gm4 + 2*g02*g03*g04*g05*g06*g011*gm7
+ 2*g02*g03*g04*g06*g07*g011*gm5 + 2*g02*g04*g05*g06*g07*g011*gm3 +
2*g01*g02*g05*g06*g08*g011*gm7 + 2*g01*g02*g06*g07*g08*g011*gm5 + 2*g01*g03*g04*g06*g08*g011*gm7
+ 2*g01*g03*g06*g07*g08*g011*gm4 + 2*g02*g03*g04*g05*g07*g011*gm8 +
2*g02*g03*g04*g05*g08*g011*gm7 + 2*g02*g03*g04*g07*g08*g011*gm5 + 2*g02*g04*g05*g07*g08*g011*gm3
+ 2*g01*g04*g05*g06*g08*g011*gm7 + 2*g01*g04*g06*g07*g08*g011*gm5 +
2*g01*g05*g06*g07*g08*g011*gm4 + 2*g02*g03*g05*g06*g08*g011*gm7 + 2*g02*g03*g06*g07*g08*g011*gm5
+ 2*g02*g05*g06*g07*g08*g011*gm3 + 2*g03*g04*g05*g06*g08*g011*gm7 +
2*g03*g04*g06*g07*g08*g011*gm5 + 2*g03*g05*g06*g07*g08*g011*gm4 + 2*g04*g05*g06*g07*g08*g011*gm3
+ 2*g01*g02*g03*g04*g06*gm5*gm7 + 2*g01*g02*g04*g05*g06*gm3*gm7 + 2*g01*g02*g04*g06*g07*gm3*gm5
+ 2*g02*g03*g04*g05*g06*gm1*gm7 + 2*g02*g03*g04*g06*g07*gm1*gm5 + 2*g02*g04*g05*g06*g07*gm1*gm3
+ 2*g01*g02*g03*g04*g06*gm5*gm8 + 2*g01*g02*g03*g06*g08*gm4*gm5 + 2*g01*g02*g04*g05*g06*gm3*gm8
+ 2*g01*g03*g04*g06*g08*gm2*gm5 + 2*g01*g03*g05*g06*g08*gm2*gm4 + 2*g02*g03*g04*g05*g06*gm1*gm8
+ 2*g01*g02*g03*g04*g05*gm7*gm8 + 2*g01*g02*g03*g04*g07*gm5*gm8 + 2*g01*g02*g03*g04*g08*gm5*gm7
+ 2*g01*g02*g04*g05*g07*gm3*gm8 + 2*g01*g02*g04*g05*g08*gm3*gm7 + 2*g01*g02*g04*g07*g08*gm3*gm5
+ 2*g02*g03*g04*g05*g07*gm1*gm8 + 2*g02*g03*g04*g05*g08*gm1*gm7 + 2*g02*g03*g04*g07*g08*gm1*gm5
+ 2*g02*g04*g05*g07*g08*gm1*gm3 + 2*g01*g02*g03*g04*g06*gm7*gm8 + 2*g01*g02*g03*g06*g08*gm4*gm7
+ 2*g01*g02*g04*g06*g07*gm3*gm8 + 2*g01*g03*g04*g06*g08*gm2*gm7 + 2*g01*g03*g06*g07*g08*gm2*gm4
+ 2*g02*g03*g04*g06*g07*gm1*gm8 + 2*g01*g02*g03*g06*g08*gm5*gm7 + 2*g01*g02*g05*g06*g08*gm3*gm7
+ 2*g01*g02*g06*g07*g08*gm3*gm5 + 2*g02*g03*g05*g06*g08*gm1*gm7 + 2*g02*g03*g06*g07*g08*gm1*gm5
+ 2*g02*g05*g06*g07*g08*gm1*gm3 + 2*g01*g02*g03*g04*g08*gm7*gm8 + 2*g01*g02*g04*g06*g08*gm5*gm7
+ 2*g01*g02*g04*g07*g08*gm3*gm8 + 2*g01*g02*g05*g06*g08*gm4*gm7 + 2*g01*g02*g06*g07*g08*gm4*gm5
+ 2*g01*g04*g05*g06*g08*gm2*gm7 + 2*g01*g04*g06*g07*g08*gm2*gm5 + 2*g01*g05*g06*g07*g08*gm2*gm4
+ 2*g02*g03*g04*g07*g08*gm1*gm8 + 2*g01*g02*g03*g04*g011*gm5*gm8 + 2*g01*g03*g04*g06*g08*gm5*gm7
+ 2*g01*g03*g05*g06*g08*gm4*gm7 + 2*g01*g03*g06*g07*g08*gm4*gm5 + 2*g01*g04*g05*g06*g08*gm3*gm7
+ 2*g01*g04*g06*g07*g08*gm3*gm5 + 2*g01*g05*g06*g07*g08*gm3*gm4 + 2*g03*g04*g05*g06*g08*gm1*gm7
+ 2*g03*g04*g06*g07*g08*gm1*gm5 + 2*g03*g05*g06*g07*g08*gm1*gm4 + 2*g04*g05*g06*g07*g08*gm1*gm3
+ 2*g02*g03*g04*g06*g08*gm5*gm7 + 2*g02*g03*g05*g06*g08*gm4*gm7 + 2*g02*g03*g06*g07*g08*gm4*gm5
+ 2*g02*g04*g05*g06*g08*gm3*gm7 + 2*g02*g04*g06*g07*g08*gm3*gm5 + 2*g02*g05*g06*g07*g08*gm3*gm4
+ 2*g03*g04*g05*g06*g08*gm2*gm7 + 2*g03*g04*g06*g07*g08*gm2*gm5 + 2*g03*g05*g06*g07*g08*gm2*gm4
+ 2*g04*g05*g06*g07*g08*gm2*gm3 + 2*g01*g02*g03*g04*g011*gm7*gm8 +
```

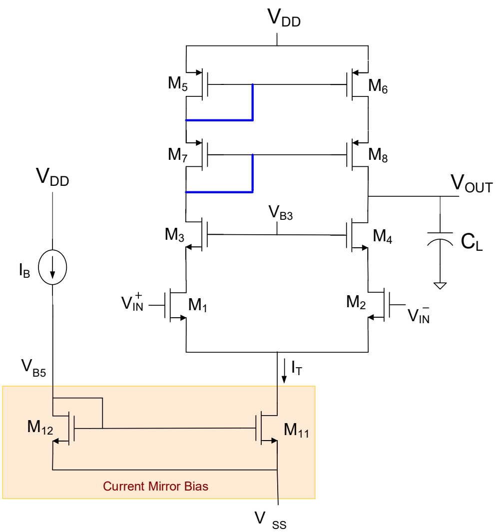
MATLAB Solution Continued 5:

```
2*g01*g02*g04*g06*g011*gm5*gm7 + 2*g01*g02*g04*g05*g011*gm7*gm8 + 2*g01*g02*g04*g07*g011*gm5*gm8
+ 2*g01*g02*g04*g08*g011*gm5*gm7 + 2*g01*g03*g06*g08*g011*gm4*gm5 +
2*g02*g03*g04*g06*g011*gm5*gm7 + 2*g02*g04*g05*g06*g011*gm3*gm7 + 2*g02*g04*g06*g07*g011*gm3*gm5
+ 2*g01*g02*g06*g08*g011*gm5*gm7 + 2*g01*g03*g06*g08*g011*gm4*gm7 +
2*g02*g03*g04*g05*g011*gm7*gm8 + 2*g02*g03*g04*g07*g011*gm5*gm8 + 2*g02*g03*g04*g08*g011*gm5*gm7
+ 2*g02*g04*g05*g07*g011*gm3*gm8 + 2*g02*g04*g05*g08*g011*gm3*gm7 +
2*g02*g04*g07*g08*g011*gm3*gm5 + 2*g01*g04*g06*g08*g011*gm5*gm7 + 2*g01*g05*g06*g08*g011*gm4*gm7
+ 2*g01*g06*g07*g08*g011*gm4*gm5 + 2*g02*g03*g06*g08*g011*gm5*gm7 +
2*g02*g05*g06*g08*g011*gm3*gm7 + 2*g02*g06*g07*g08*g011*gm3*gm5 + 2*g03*g04*g06*g08*g011*gm5*gm7
+ 2*g03*g05*g06*g08*g011*gm4*gm7 + 2*g03*g06*g07*g08*g011*gm4*gm5 +
2*g04*g05*g06*g08*g011*gm3*gm7 + 2*g04*g06*g07*g08*g011*gm3*gm5 + 2*g05*g06*g07*g08*g011*gm3*gm4
+ 2*g01*g02*g04*g06*gm3*gm5*gm7 + 2*g02*g03*g04*g06*gm1*gm5*gm7 + 2*g02*g04*g05*g06*gm1*gm3*gm7
+ 2*g02*g04*g06*g07*gm1*gm3*gm5 + 2*g01*g02*g04*g06*gm3*gm5*gm8 + 2*g01*g03*g06*g08*gm2*gm4*gm5
+ 2*g02*g03*g04*g06*gm1*gm5*gm8 + 2*g02*g04*g05*g06*gm1*gm3*gm8 + 2*g01*g02*g03*g04*gm5*gm7*gm8
+ 2*g01*g02*g04*g05*gm3*gm7*gm8 + 2*g01*g02*g04*g07*gm3*gm5*gm8 + 2*g01*g02*g04*g08*gm3*gm5*gm7
+ 2*g02*g03*g04*g05*gm1*gm7*gm8 + 2*g02*g03*g04*g07*gm1*gm5*gm8 + 2*g02*g03*g04*g08*gm1*gm5*gm7
+ 2*g02*g04*g05*g07*gm1*gm3*gm8 + 2*g02*g04*g05*g08*gm1*gm3*gm7 + 2*g02*g04*g07*g08*gm1*gm3*gm5
+ 2*g01*g02*g04*g06*gm3*gm7*gm8 + 2*g01*g03*g06*g08*gm2*gm4*gm7 + 2*g02*g03*g04*g06*gm1*gm7*gm8
+ 2*g02*g04*g06*g07*gm1*gm3*gm8 + 2*g01*g02*g06*g08*gm3*gm5*gm7 + 2*g02*g03*g06*g08*gm1*gm5*gm7
+ 2*g02*g05*g06*g08*gm1*gm3*gm7 + 2*g02*g06*g07*g08*gm1*gm3*gm5 + 2*g01*g02*g04*g08*gm3*gm7*gm8
+ 2*g01*g02*g06*g08*gm4*gm5*gm7 + 2*g01*g04*g06*g08*gm2*gm5*gm7 + 2*g01*g05*g06*g08*gm2*gm4*gm7
+ 2*g01*g06*g07*g08*gm2*gm4*gm5 + 2*g02*g03*g04*g08*gm1*gm7*gm8 + 2*g02*g04*g07*g08*gm1*gm3*gm8
+ 2*g01*g03*g06*g08*gm4*gm5*gm7 + 2*g01*g04*g06*g08*gm3*gm5*gm7 + 2*g01*g05*g06*g08*gm3*gm4*gm7
+ 2*g01*g06*g07*g08*gm3*gm4*gm5 + 2*g03*g04*g06*g08*gm1*gm5*gm7 + 2*g03*g05*g06*g08*gm1*gm4*gm7
+ 2*g03*g06*g07*g08*gm1*gm4*gm5 + 2*g04*g05*g06*g08*gm1*gm3*gm7 + 2*g04*g06*g07*g08*gm1*gm3*gm5
+ 2*g05*g06*g07*g08*gm1*gm3*gm4 + 2*g02*g03*g06*g08*gm4*gm5*gm7 + 2*g02*g04*g06*g08*gm3*gm5*gm7
+ 2*g02*g05*g06*g08*gm3*gm4*gm7 + 2*g02*g06*g07*g08*gm3*gm4*gm5 + 2*g03*g04*g06*g08*gm2*gm5*gm7
+ 2*g03*g05*g06*g08*gm2*gm4*gm7 + 2*g03*g06*g07*g08*gm2*gm4*gm5 + 2*g04*g05*g06*g08*gm2*gm3*gm7
+ 2*g04*g06*g07*g08*gm2*gm3*gm5 + 2*g05*g06*g07*g08*gm2*gm3*gm4 + 2*g01*g02*g04*g011*gm5*gm7*gm8
+ 2*g02*g04*g06*g011*gm3*gm5*gm7 + 2*g02*g03*g04*g011*gm5*gm7*gm8 +
2*g02*g04*g05*g011*gm3*gm7*gm8 + 2*g02*g04*g07*g011*gm3*gm5*gm8 + 2*g02*g04*g08*g011*gm3*gm5*gm7
+ 2*g01*g06*g08*g011*gm4*gm5*gm7 + 2*g02*g06*g08*g011*gm3*gm5*gm7 +
2*g03*g06*g08*g011*gm4*gm5*gm7 + 2*g04*g06*g08*g011*gm3*gm5*gm7 + 2*g05*g06*g08*g011*gm3*gm4*gm7
+ 2*g06*g07*g08*g011*gm3*gm4*gm5 + 2*g02*g04*g06*gm1*gm3*gm5*gm7 + 2*g02*g04*g06*gm1*gm3*gm5*gm8
+ 2*g01*g02*g04*gm3*gm5*gm7*gm8 + 2*g02*g03*g04*gm1*gm5*gm7*gm8 + 2*g02*g04*g05*gm1*gm3*gm7*gm8
+ 2*g02*g04*g07*gm1*gm3*gm5*gm8 + 2*g02*g04*g08*gm1*gm3*gm5*gm7 + 2*g02*g04*g06*gm1*gm3*gm7*gm8
+ 2*g02*g06*g08*gm1*gm3*gm5*gm7 + 2*g01*g06*g08*gm2*gm4*gm5*gm7 + 2*g02*g04*g08*gm1*gm3*gm7*gm8
+ 2*g01*g06*g08*gm3*gm4*gm5*gm7 + 2*g03*g06*g08*gm1*gm4*gm5*gm7 + 2*g04*g06*g08*gm1*gm3*gm5*gm7
+ 2*g05*g06*g08*gm1*gm3*gm4*gm7 + 2*g06*g07*g08*gm1*gm3*gm4*gm5 + 2*g02*g06*g08*gm3*gm4*gm5*gm7
+ 2*g03*g06*g08*gm2*gm4*gm5*gm7 + 2*g04*g06*g08*gm2*gm3*gm5*gm7 + 2*g05*g06*g08*gm2*gm3*gm4*gm7
+ 2*g06*g07*g08*gm2*gm3*gm4*gm5 + 2*g02*g04*g011*gm3*gm5*gm7*gm8 +
2*g06*g08*g011*gm3*gm4*gm5*gm7 + 2*g02*g04*gm1*gm3*gm5*gm7*gm8 + 2*g06*g08*gm1*gm3*gm4*gm5*gm7 +
2*g06*g08*gm2*gm3*gm4*gm5*gm7))
```

- Difference Mode Gain has only approximately 1100 product terms
- Difference Mode Gain has approximately 7700 small-signal parameters in expression
- Extremely difficult to get insight into how this relatively simple circuit performs from this solution
- This does not even include the common-mode gain expression !

Where this started

Telescopic Cascode Op Amp with Mirror-connected Counterpart Circuit



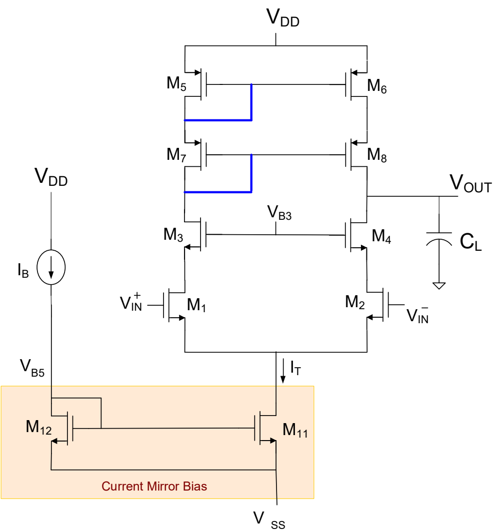
- Previous analysis obtained almost by inspection
- Gain expressions were real simple
- Gain expressions provide major insight into operation
- Some assumptions were made to simplify analysis
  - Vac=0 at "approximate axis of symmetry"
  - Matched left and right side transistors
  - Current mirror used to mirror left-side current to right side

How much more involved would an exact analysis be ?

Would an exact analysis provide additional insight ?

Where this started

Telescopic Cascode Op Amp with Mirror-connected Counterpart Circuit



$$A_d(s)=\frac{-g_{m1}}{sC_L+g_{o1}\frac{g_{o3}}{g_{m3}}+g_{o5}\frac{g_{o7}}{g_{m7}}}$$

$$A_d(s)=\frac{-g_{m7}g_{m1}g_{m3}}{sC_Lg_{m7}g_{m3}+g_{m7}g_{o3}g_{o1}+g_{m3}g_{o5}g_{o7}}$$

- Some assumptions were made to simplify analysis
  - Vac=0 at “approximate axis of symmetry”
  - Matched left and right side transistors
  - Current mirror used to mirror left-side current to right side
- Difference Mode Gain has only approximately 1100 product terms
- Difference Mode Gain has approximately 7700 small-signal parameters in expression

How many product terms are present in the simplified analysis?
How many small-signal parameters are in simplified expression?

- Simplified Difference Mode Gain has 4 product terms
- Simplified Difference Mode Gain has 12 small-signal parameters in expression

Be careful about what you ask for, you may be able to get it !

- How important is it to develop good approximate analysis methods for an op amp of this complexity?
- And many useful op amp circuits will have much more complexity !!

Will you impress your boss if you use an “exact” analysis?

Stay Safe and Stay Healthy !

End of Lecture 7