HACETTEPE UNIVERSITY

ELECTRICAL AND ELECTRONICS ENGINEERING

ELE338 MICROPROCESSOR ARCHITECTURE AND PROGRAMMING LAB.

TERM PROJECT
ASSIGNMENT GROUP 4
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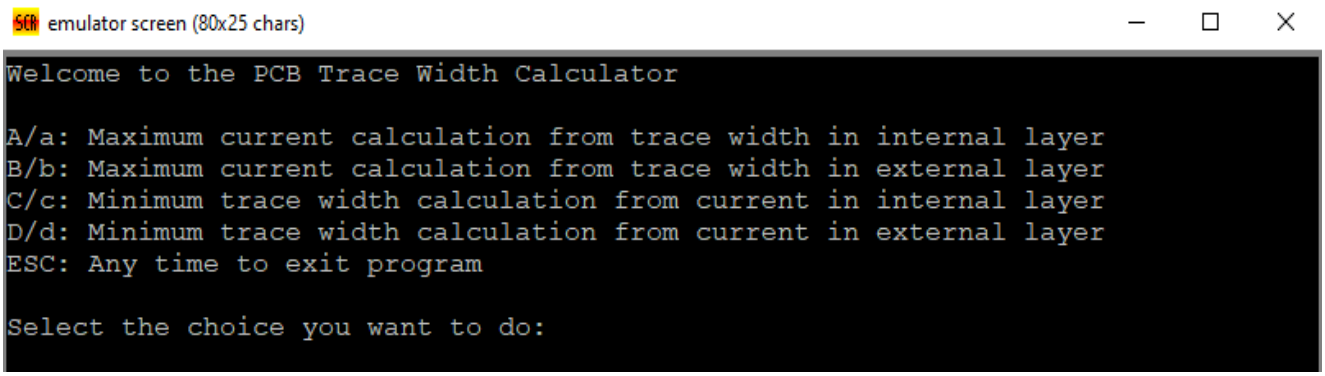
CODE ANALYSIS

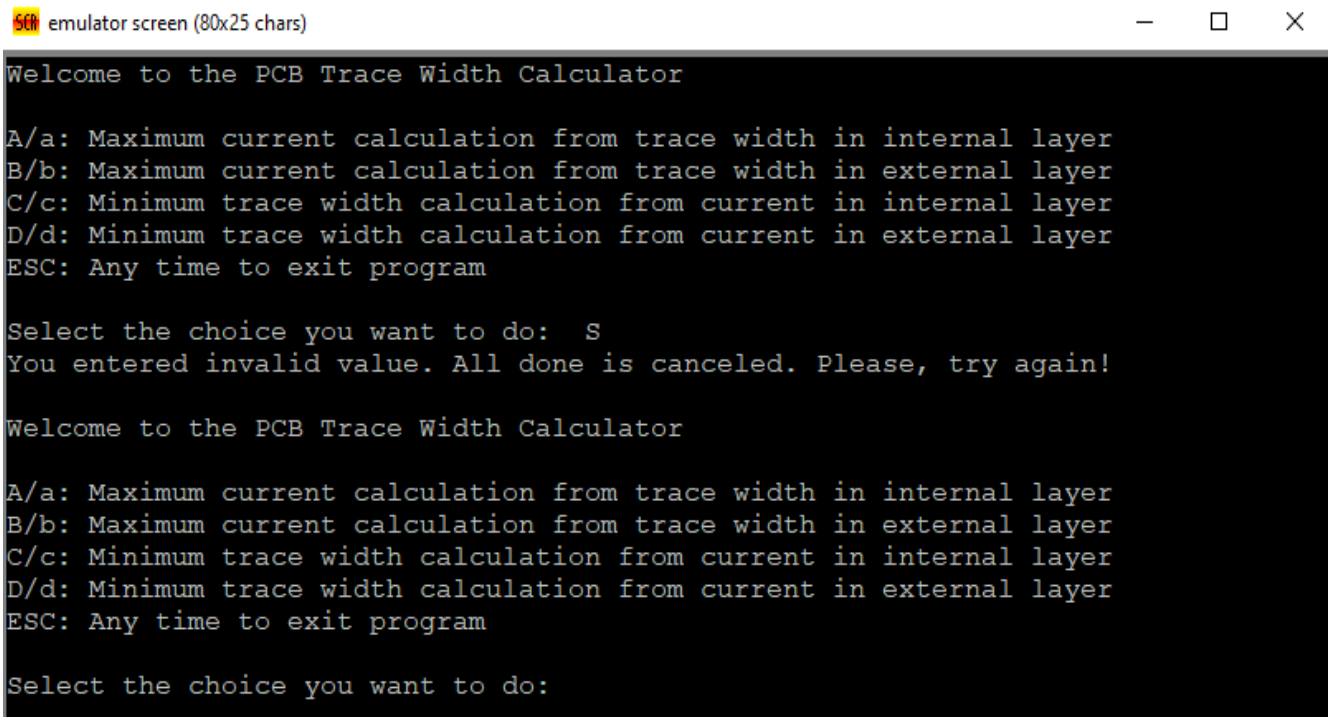
I will explain the important parts of my code one by one.

LOGIN SCREEN



When we ran the code, I printed these as the login screen. There are 5 different situations for the code to move on to the next step. Pressing A/a, B/b, C/c, D/d or ESC moves to the next step. Pressing A/a, B/b, C/c or D/d moves to the next step to get the input value from you. Pressing Esc ends the code.

PRESS DIFFERENT KEY



If we press any key other than A / a, B / b, C / c, D / d or ESC. It writes 'invalid input' on the screen and puts the code first. It asks for input from us again to make a selection.

TO DRAW INTERNAL AND EXTERNAL LAYER

To draw the external layer, I first examined the INT 10h commands one by one.

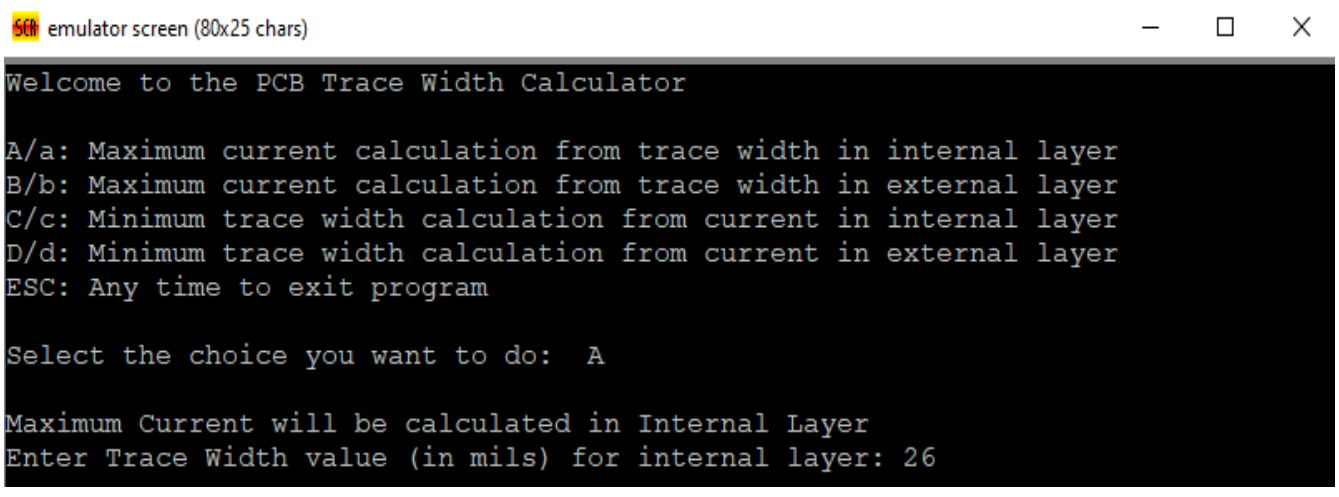
Mov AX,03h
Int 10h
The command system allows us to use an 80x25 emulator screen. In this command system, we use DH and DL Registers as rows and columns. We enter the start command of the shape we will draw at the beginning of the procedure.

```
Mov AH,02h
Int 10h
Mov AL,32d      ; AL = Charachter
Mov BH,0        ; BH = Page Number
Mov BL,0E0h     ; BL = Color   (0E0h= Yellow , 0A0h= Green)
Mov CX,1        ; CX = Number of times to print character
```

I used this command system to print the shape we want on the screen.

I designed the shape in my head and drew it with these commands. At the end of the figure, I printed the input and output values to the screen together with its units.

IF OUR CHOICE IS A/a



If we choose A/a. Maximum current will be calculated in internal layer. To calculate the maximum current in the internal layer, we need to enter the width(mils) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished.

TAYLOR SERIES ACCORDING TO THE INPUT VALUE

```
0128 Call Scan_Num
0129 Mov Inp2,CX
0130 Cmp CX,20d
0131 Jng First_Taylor_CI
0132 Cmp CX,70d
0133 Jng Second_Taylor1_CI
0134 Jmp Third_Taylor1_CI
```

If the input value (width) entered is 20 or less than 20, ıt does the operations in First_Taylor_CI.
If the input value (width) is between 70 and 21, ıt does the operations in Second_Taylor1_CI.
If the input value (width) is greater than 70, ıt does the operations in Third_Taylor1_CI.

Input Value : 1 ≤ Width ≤ 20 (First_Taylor_CI)

Area = (Current/(k*Temp_Rise^b))^(1/c)
Width = Area/(Thickness*1.378)

IN INTERNAL LAYERS:
Temp_Rise = 10 C , Thickness = 1 oz
b = 0.44 , c = 0.725 , k = 0.024

Current = Area^c (k*10^b)
Current = (Width^0.725)/12
Current = (1+0.725(Width-1))/12
Current = (10+7(Width-1))/120
Finally
Current = (3+7*Width)/120

If the input value is between 1 and 20, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **(3 + 7*Width)/120**.

My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 7 times. Then I added 3 to my AX value. To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 120 to my BX Register. My output value has been found.

Input Value : 21 ≤ Width ≤ 70 (Second_Taylor1_CI)

Current = (Width^0.725)/12
(Width^0.725) = Center^0.725 + (Center^-0.275)(0.725)(Width-Center)
(Width^0.725) = 9 + 3(Width-21)/10

If the input value is between 21 and 70, I took the center of the taylor series as 21. After putting the constants in place, the resulting equation is **(9 + 3(Width-21)/10)/12**

My input value is registered in the CX Register, I subtracted 21 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 3 times. I divided my AX Register by BL = 10. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+10, otherwise I add it as AL+9. I multiply the CX by 10 for the last time. And I put the value in AX Register.

To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 120 to my BX Register. My output value has been found.

Input Value : Width ≥ 71 (Third_Taylor1_CI)

Current = (Width^0.725)/12
(Width^0.725) = Center^0.725 + (Center^-0.275)(0.725)(Width-Center)
(Width^0.725) = 22 + 1(Width-71)/4

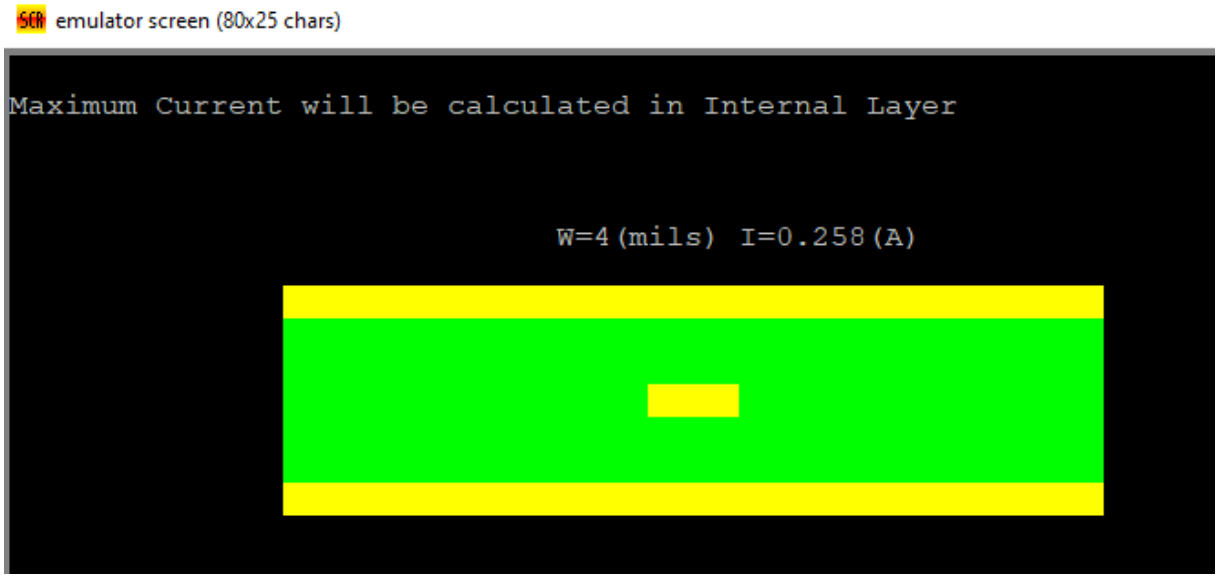
If the input value is greater than 70, I took the center of the taylor series as 71. After putting the constants in place, the resulting equation is **(22 + 1(Width-71)/4)/12**

My input value is registered in the CX Register, I subtracted 71 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 1 times. I divided my AX Register by BL = 4. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+23, otherwise I add it as AL+22. I multiply the CX by 10 for the last time. And I put the value in AX Register.

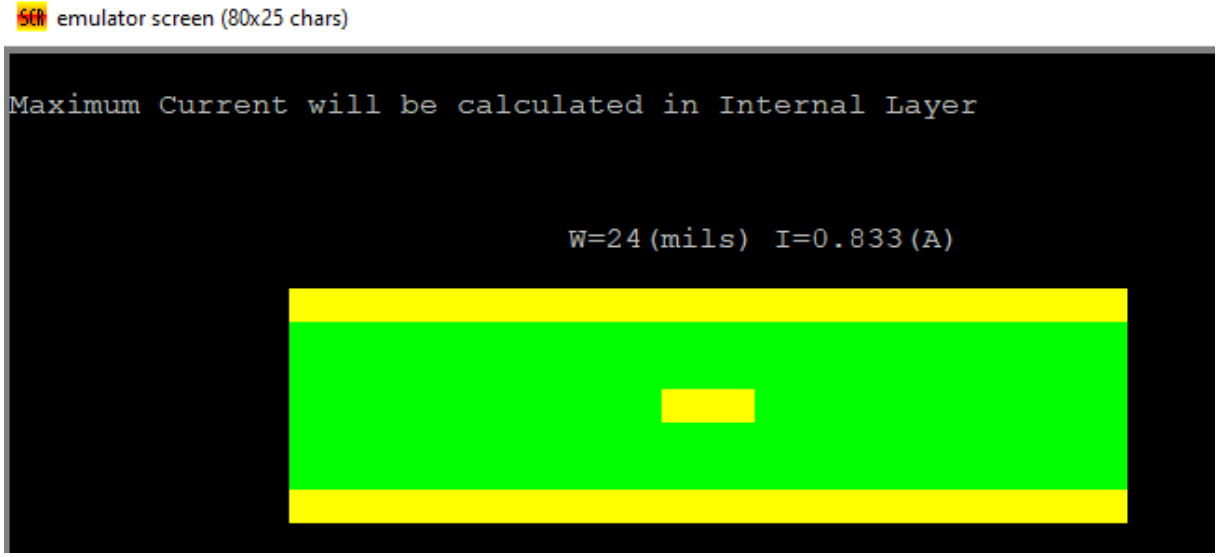
To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 120 to my BX Register. My output value has been found.

RESULTS

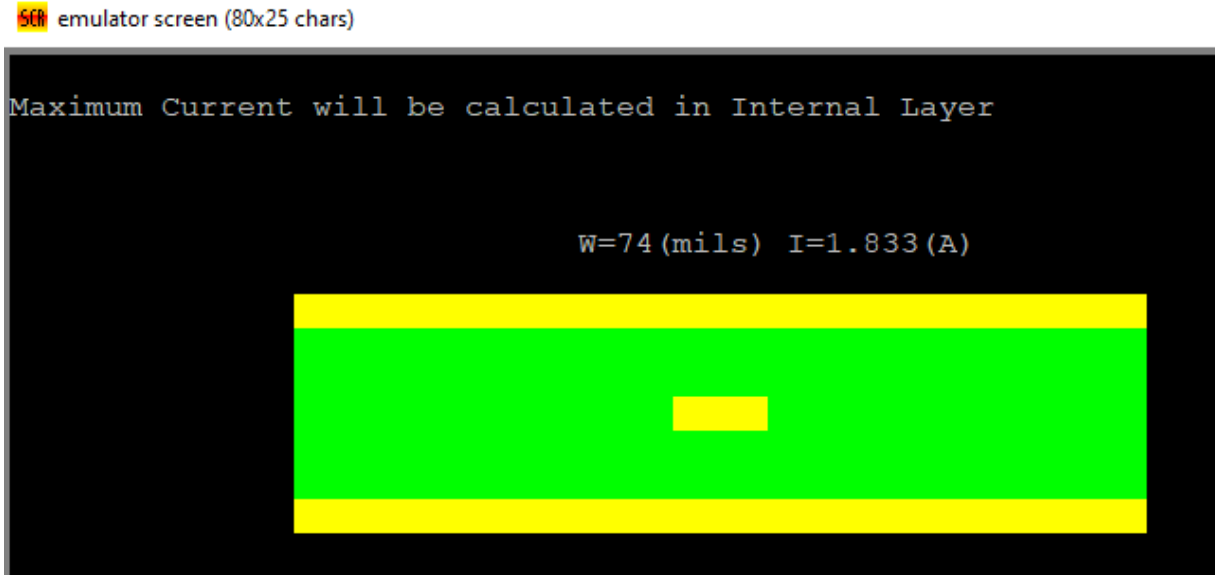
Input: Width = 4(mils)



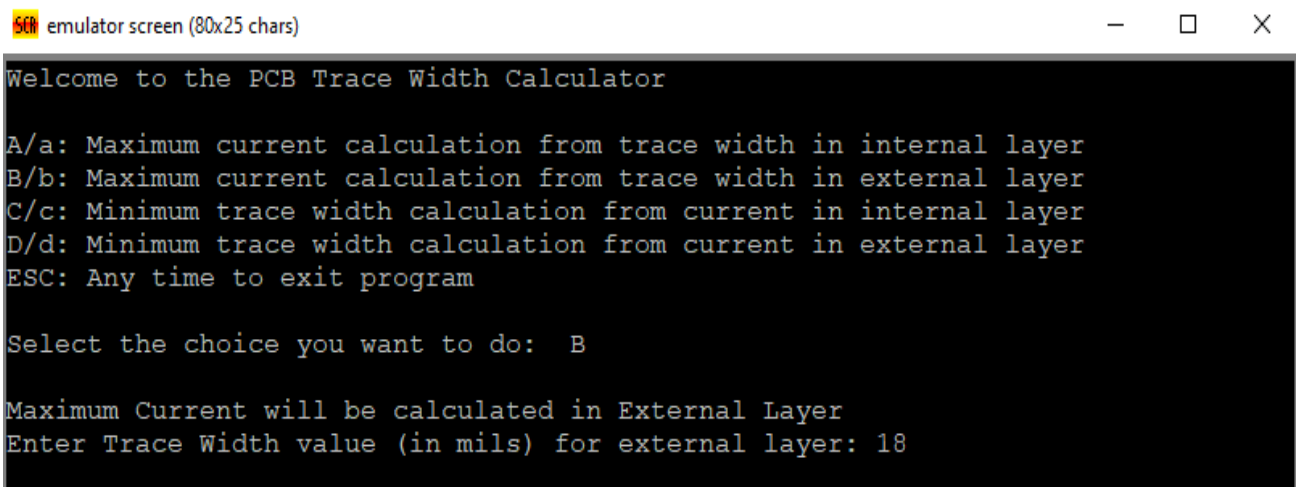
Input: Width = 24(mils)



Input: Width = 74(mils)



IF OUR CHOICE IS B/b



If we choose B/b. Maximum current will be calculated in external layer. To calculate the maximum current in the external layer, we need to enter the width(mils) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished.

TAYLOR SERIES ACCORDING TO THE INPUT VALUE

```
0296 Call Scan_Num
0297 Mov Inp2,CX
0298 Cmp CX,19d
0299 Jng First_Taylor_CE
0300 Cmp CX,71d
0301 Jng Second_Taylor1_CE
0302 Jmp Third_Taylor1_CE
```

If the input value (width) entered is 19 or less than 19, ıt does the operations in First_Taylor_CE.
If the input value (width) is between 71 and 20, ıt does the operations in Second_Taylor1_CE.
If the input value (width) is greater than 71, ıt does the operations in Third_Taylor1_CE.

Input Value : 1 ≤ Width ≤ 19 (First_Taylor_CE)

Area = (Current/(k*Temp_Rise^b))^(1/c)
Width = Area/(Thickness*1.378)

IN EXTERNAL LAYERS:
Temp_Rise = 10 C , Thickness = 1 oz
b = 0.44 , c = 0.7 , k = 0.048

Current = Area^c (k*10^b)
Current = (Width^0.7)/6
Current = (1+0.7(Width-1))/6
Current = (10+7(Width-1))/60

Finally
Current = (3+7*Width)/60

If the input value is between 1 and 19, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **(3 + 7 * Width) / 60**.

My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 7 times. Then I added 3 to my AX value. To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 60 to my BX Register. My output value has been found.

Input Value : 20 ≤ Width ≤ 71 (Second_Taylor1_CE)

Current = (Width^0.7)/6
(Width^0.7) = Center^0.7 + (Center^-0.3)(0.7)(Width-Center)
(Width^0.7) = 8 + 3(Width-20)/10

If the input value is between 20 and 71, I took the center of the taylor series as 20. After putting the constants in place, the resulting equation is **(8 + 3(Width-20)/10)/6**

My input value is registered in the CX Register, I subtracted 20 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 3 times. I divided my AX Register by BL = 10. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+9, otherwise I add it as AL+8. I multiply the CX by 10 for the last time. And I put the value in AX Register.

To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 60 to my BX Register. My output value has been found.

Input Value : Width ≥ 72 (Third_Taylor1_CI)

Current = (Width^0.7)/6
(Width^0.7) = Center^0.7 + (Center^-0.3)(0.7)(Width-Center)
(Width^0.7) = 20 + 1(Width-72)/5

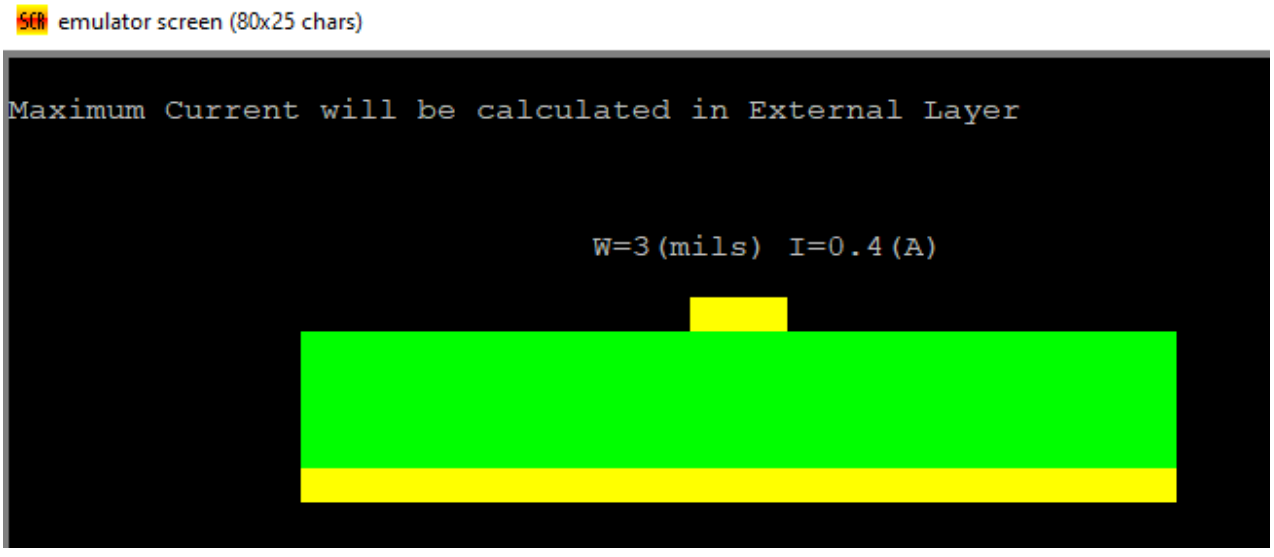
If the input value is greater than 71, I took the center of the taylor series as 72. After putting the constants in place, the resulting equation is **(20 + 1(Width-72)/5)/6**

My input value is registered in the CX Register, I subtracted 72 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 1 times. I divided my AX Register by BL = 5. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+21, otherwise I add it as AL+20. I multiply the CX by 10 for the last time. And I put the value in AX Register.

To float my output, I set my AX Register as the numerator and my BX Register as the denominator. By assigning a value of 60 to my BX Register. My output value has been found.

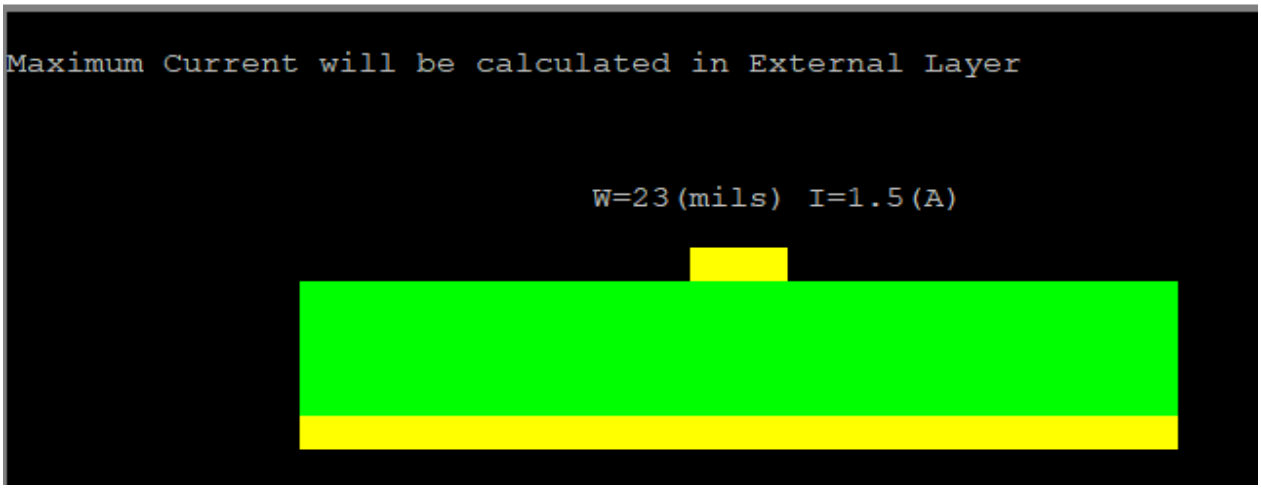
RESULTS

Input: Width = 3(mils)



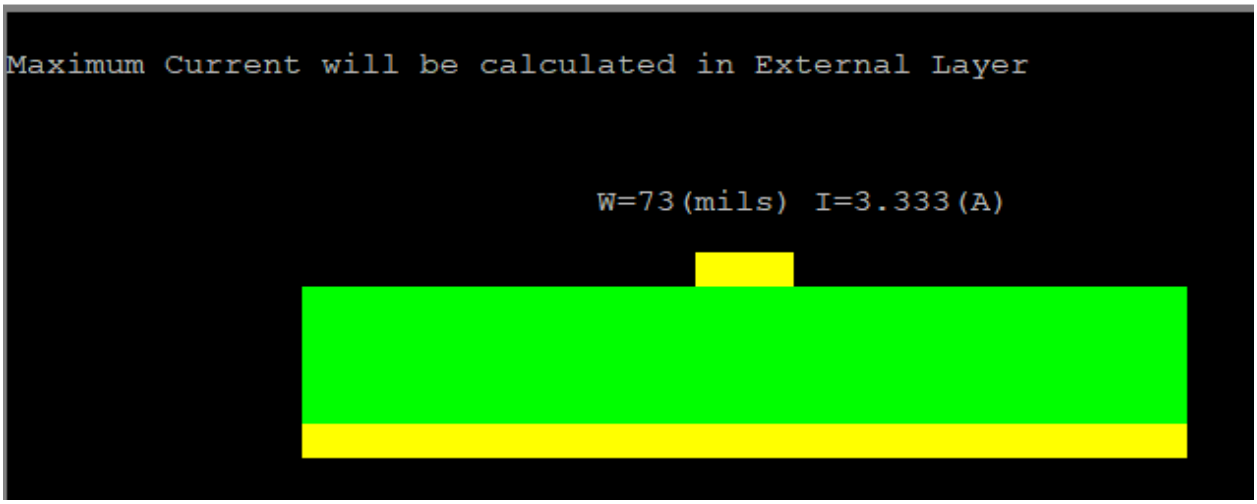
Input: Width = 23(mils)

emulator screen (80x25 chars)



Input: Width = 73(mils)

emulator screen (80x25 chars)



IF OUR CHOICE IS C/c

emulator screen (80x25 chars)

```
Welcome to the PCB Trace Width Calculator

A/a: Maximum current calculation from trace width in internal layer
B/b: Maximum current calculation from trace width in external layer
C/c: Minimum trace width calculation from current in internal layer
D/d: Minimum trace width calculation from current in external layer
ESC: Any time to exit program

Select the choice you want to do:  C

Minimum Trace Width will be calculated in Internal Layer
Enter Current value (in A) for internal layer: 5
```

If we choose B/b. Minimum trace width will be calculated in internal layer. To calculate the Minimum trace width in the internal layer, we need to enter the current(A) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished.

TAYLOR SERIES ACCORDING TO THE INPUT VALUE

```
0463 Call Scan_Num
0464 Mov Inp2,CX
0465 Cmp CX,20d
0466 Jng First_Taylor_WI
0467 Cmp CX,70d
0468 Jng Second_Taylor1_WI
0469 Jmp Third_Taylor1_WI
```

If the input value (current) entered is 20 or less than 20, ıt does the operations in First_Taylor_WI.
If the input value (current) is between 70 and 21, ıt does the operations in Second_Taylor1_WI.
If the input value (current) is greater than 70, ıt does the operations in Third_Taylor1_WI.

Input Value : 1 ≤ Current ≤ 20 (First_Taylor_WI)

Area = (Current/(k*Temp_Rise^b))^(1/c)
Width = Area/(Thickness*1.378)

IN INTERNAL LAYERS:
Temp_Rise = 10 C , Thickness = 1 oz
b = 0.44 , c = 0.725 , k = 0.024

Width = (Current^(1/c))/(k^(1/c)*10^(0.44/c)*1.378)
Width = 31*(Current^(1.38))
Width = 31*(1+1.38(Current-1))
Width = 31+43(Current-1)

Finally
Width = 43*Current-12

If the input value is between 1 and 19, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **43*Current – 12**.

My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 43 times. Then I subtract 12 to my AX value. My output value has been found.

Input Value : 21 ≤ Current ≤ 70 (Second_Taylor1_WI)

Width = 31*(Current^(1.38))
(Current^1.38) = Center^1.38 + (Center^0.38)(1.38)(Width-Center)
(Current ^1.38) = 67 + 9(Width-21)/2

If the input value is between 20 and 70, I took the center of the taylor series as 21. After putting the constants in place, the resulting equation is **31*(67 + 9(Width-21)/2)**

My input value is registered in the CX Register, I subtracted 21 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 9 times. I divided my AX Register by BL = 2. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+68, otherwise I add it as AL+67. I multiply the CX by 31 for the last time. And I put the value in AX Register. My output value has been found.

Input Value : Current ≥ 71 (Third_Taylor1_WI)

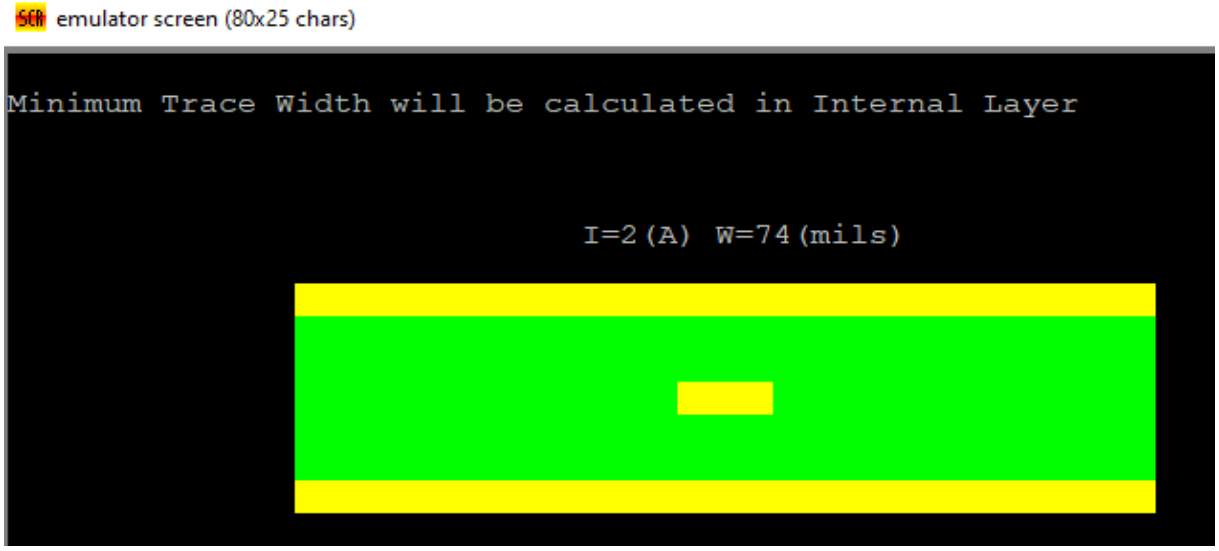
Width = 31*(Current^(1.38))
(Current^1.38) = Center^1.38 + (Center^0.38)(1.38)(Width-Center)
(Current^1.38) = 359 + 7(Width-71)

If the input value is greater than 70, I took the center of the taylor series as 71. After putting the constants in place, the resulting equation is **31*(359 + 7(Width-71))**

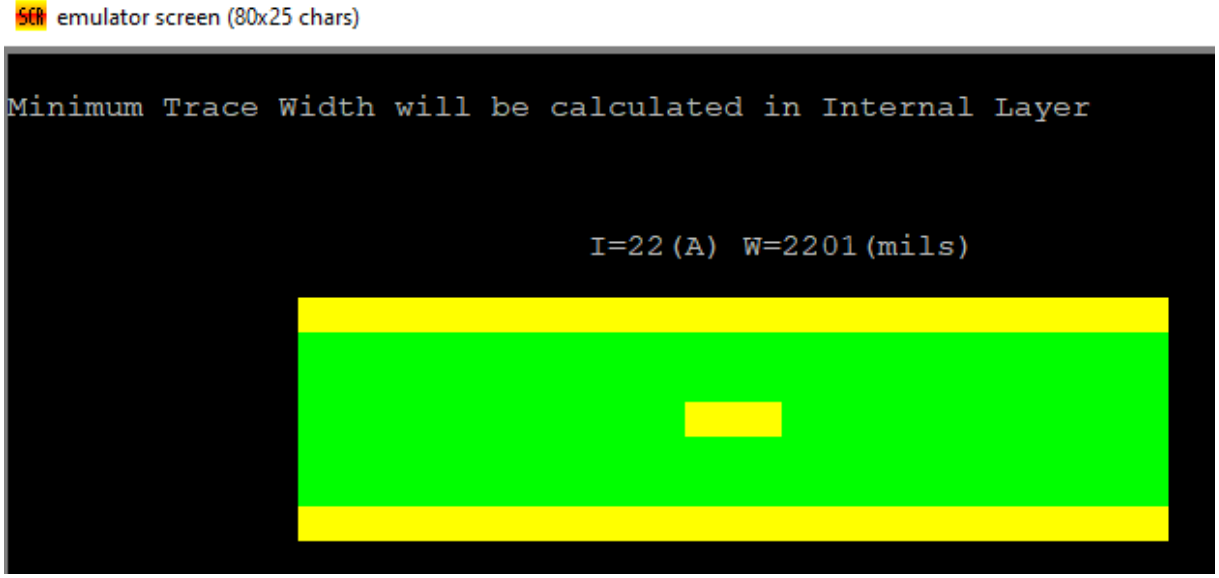
My input value is registered in the CX Register, I subtracted 71 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 7 times. I added 359 to AX. Then, I multiply the AX by 10 for the last time. My output value has been found.

RESULTS

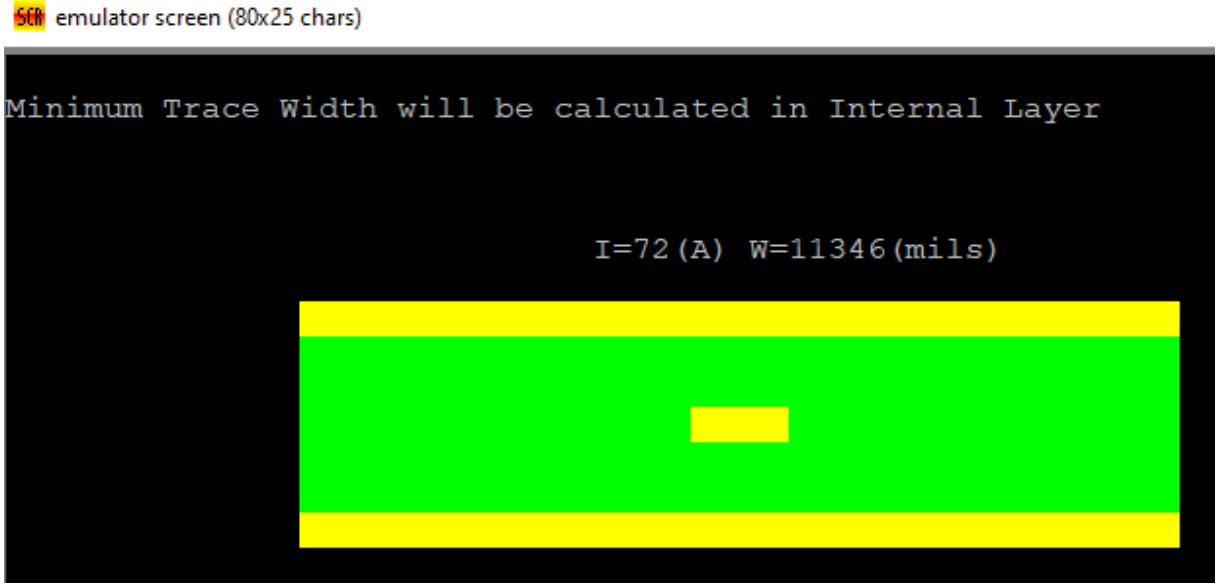
Input: Current = 2(A)



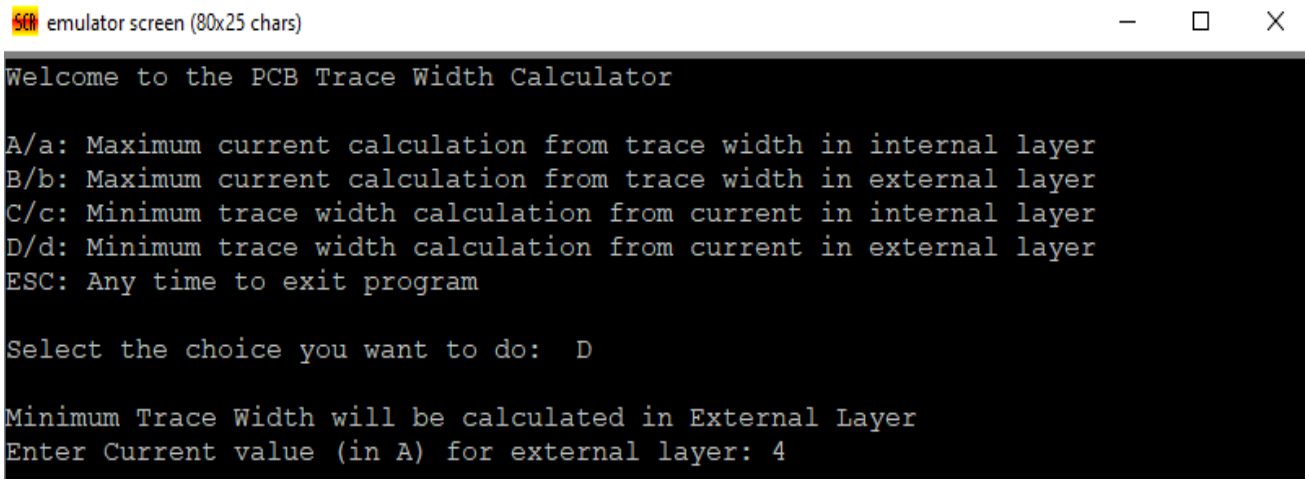
Input: Current = 22(A)



Input: Current = 72(A)



IF OUR CHOICE IS D/d



If we choose B/b. Minimum trace width will be calculated in internal layer. To calculate the Minimum trace width in the internal layer, we need to enter the current(A) as the input value. I write the output value to the screen as decimal. When I press the enter, my output value is finished.

TAYLOR SERIES ACCORDING TO THE INPUT VALUE

```
0617 Call Scan_Num
0618 Mov Inp2,CX
0619 Cmp CX,21d
0620 Jng First_Taylor_WE
0621 Cmp CX,70d
0622 Jng Second_Taylor1_WE
0623 Jmp Third_Taylor1_WE
```

If the input value (current) entered is 20 or less than 20, ıt does the operations in First_Taylor_WE.
If the input value (current) is between 70 and 21, ıt does the operations in Second_Taylor1_WE.
If the input value (current) is greater than 70, ıt does the operations in Third_Taylor1_WE.

Input Value : 1 ≤ Current ≤ 21 (First_Taylor_WE)

Area = (Current/(k*Temp_Rise^b))^(1/c)
Width = Area/(Thickness*1.378)

IN EXTERNAL LAYERS:
Temp_Rise = 10 C , Thickness = 1 oz
b = 0.44 , c = 0.7 , k = 0.048

Width = (Current^(1/c))/(k^(1/c)*10^(0.44/c)*1.378)
Width = 13*(Current^(1.43))
Width = 13*(1+1.43(Current-1)) (From Taylor Series)
Width = 13+19(Current-1)

Finally
Width = 19*Current-6

If the input value is between 1 and 19, I took the center of the taylor series as 1. After putting the constants in place, the resulting equation is **19*Current – 6**.

My input value is registered in the CX Register, I set the AX Register to 0 first and add CX to my AX value in a loop that returns 19 times. Then I subtract 6 to my AX value. My output value has been found.

Input Value : 22 ≤ Current ≤ 70 (Second_Taylor1_WE)

Width = 13*(Current^(1.43))
(Current^1.43) = Center^1.43 + (Center^0.43)(1.43)(Width-Center)
(Current^1.43) = 83 + 11(Width-22)/2

If the input value is between 21 and 70, I took the center of the taylor series as 22. After putting the constants in place, the resulting equation is **13*(83 + 11(Width-22)/2)**

My input value is registered in the CX Register, I subtracted 22 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 11 times. I divided my AX Register by BL = 2. The remainder of the division in AH Register. If AH is greater than 5, I sum it as AL+83, otherwise I add it as AL+84. I multiply the CX by 13 for the last time. And I put the value in AX Register. My output value has been found.

Input Value : Current ≥ 71 (Third_Taylor1_WE)

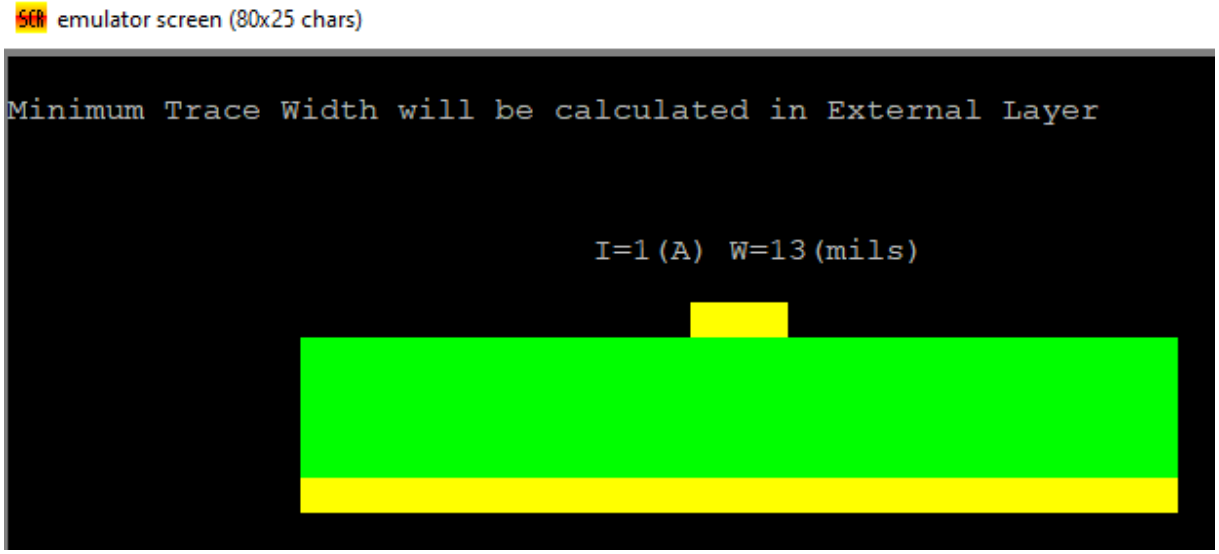
Width = 13*(Current^(1.38))
(Current^1.38) = Center^1.38 + (Center^-0.38)(1.38)(Width-Center)
(Current^0.7) = 444 + 9(Width-71)

If the input value is greater than 70, I took the center of the taylor series as 71. After putting the constants in place, the resulting equation is **13*(444 + 9(Width-71))**

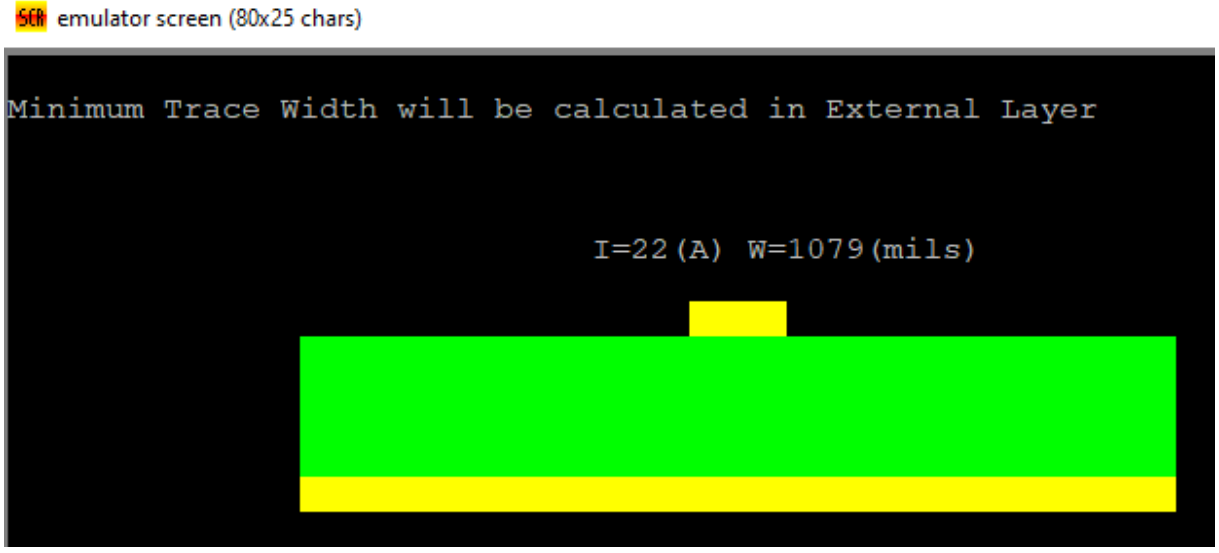
My input value is registered in the CX Register, I subtracted 71 from my CX register. I set the AX Register to 0 first and add CX to my AX value in a loop that returns 9 times. I added 444 to AX. Then, I multiply the AX by 13 for the last time. My output value has been found.

RESULTS

Input: Current = 1(A)



Input: Current = 22(A)



Input: Current = 71(A)

SCR emulator screen (80x25 chars)