HP-15C USER PROGRAM

PROGRAM TITLE	**AIR-CORED SINGLE LAYER INDUCTOR CALCULATIONS**
AUTHOR(S)	**John Dale**
DATE	**9 June 2019**

Program description, equations, variables:

The program will calculate the self-inductance of a single-layered air-cored coil given the total number of turns in the coil, the radius of the coil and the length of the coil. The length and radius units are in imperial inches and the self-inductance is given in microHenries.

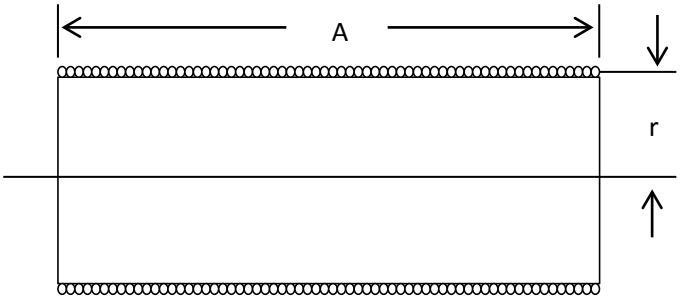

Figure (i)

For the coil shown in Figure (i) the self-inductance, L, is given by $= \frac{r^2N^2}{(9r+10A)}$, where N is the number of turns of wire in the coil.

The program will also calculate any one of the four variables if the other three are known.

Registers R.0 to R.3 inclusive are used to hold the values used by the equation above;

R.0	A
R.1	L
R.2	r
R.3	N

To use the program store the three known variables in the appropriate registers.

The label keys A - D inclusive are used to calculate the missing value;

A	L
B	N
C	A
D	r

Operating limits and warnings:

If measurements are made in cm for A and r, divide by 2.54 before storing the values in the registers.

References:

USER INSTRUCTIONS

TITLE AIR-CORED INDUCTOR CALCULATIONS **PAGE** 2 **OF** 4

PROGRAMMER John Dale **DATE** 9 June 2019

STEP	PROCEDURE	ENTER	PRESS				DISPLAY
	To calculate the self-inductance of a 1" coil of 101 turns of 31AWG enamelled wire						
	wound onto a 4" diameter former						
1	Enter the value for A (1") and store in Register .0	A	1	STO	.0		1.0000
2	Enter the value for N (101) and store in Register .3	N	101	STO	.3		101.0000
3	Enter the value for r (2") and store in Register .2	r	2	STO	.2		2.0000
4	Calculate the self-inductance, L, by using label key A		f	A			1,457.2857
	To calculate the number of turns needed for a self-inductance of 200 microHenries						
	store the value 200 in Register .1 and then use label key B.						
	The result should be **37.4166**						
	To calculate the length of coil needed for a self-inductance of 50 microHenries						
	store the value 50 in Register .1, do step 2 and then use label key C.						
	The result should be **79.8080**						
	To calculate the coil diameter needed for a self-inductance of 1000 microHenries						
	store the value 1000 in Register .1, do steps 1 and 2 and then use label key D.						
	Multiply the result by two to get the diameter of the coil. The result should be **3.0501**						

CODING FORM

TITLE AIR-CORED INDUCTOR CALCULATIONS **PAGE** 3 **OF** 4

PROGRAMMER John Dale **DATE** 9 June 2019

LOC	Key Codes	Instruction	Comments
00	42 21 11	LBL A	Press key A to calculate L
01	45 .2	RCL .2	r
02	43 11	X^2	r^2
03	45 .3	RCL .3	N
04	43 11	X^2	N^2
05	20	x	r^2N^2
06	32 .0	GSB .0	Get (9r+10A)
07	10	÷	Evaluate L
08	44 .1	STO .1	Save L in Register .1
09	43 32	RTN	Finish with L in display
10	42 21 .0	LBL .0	Subroutine to calculate (9r+10A)
11	45 .2	RCL .2	r
12	9	9	
13	20	x	9r
14	45 .0	RCL .0	A
15	1	1	
16	0	0	
17	20	x	10A
18	40	+	9r + 10A
19	43 32	RTN	Return the result
20	42 21 12	LBL B	Press key B to calculate N
21	32 .0	GSB .0	Get (9r+10A)
22	45 .1	RCL .1	L
23	20	x	L(9r+10A)
24	45 .2	RCL .2	r

LOC	Key Codes	Instruction	Comments
25	43 11	X^2	r^2
26	10	÷	$L(9r+10A)/ r^2$
27	11	$\sqrt{X}$	Evaluate N
28	44 .3	STO .3	Save N in Register 3
29	43 32	RTN	Finish with N in the display.
30	42 21 13	LBL C	Press key C to calculate A
31	45 .2	RCL .2	r
32	43 11	X^2	r^2
33	45 .3	RCL .3	N
34	43 11	X^2	N^2
35	20	x	r^2N^2
36	45 .1	RCL .1	L
37	10	÷	r^2N^2/L
38	45 .2	RCL .2	r
39	9	9	
40	20	x	9r
41	30	-	$r^2N^2/L-9r$
42	1	1	
43	0	0	
44	10	÷	$A=(r^2N^2/L-9r)/10$
45	44 .0	STO .0	Save A in Register 0
46	43 32	RTN	Finish with A in the display
47	42 21 14	LBL D	Press key D to calculate r
48	45 .1	RCL .1	L
49	9	9	

Registers	
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

.0	A
.1	L
.2	r
.3	N
.4	
.5	
.6	
.7	
.8	
.9	

I	

CODING FORM

TITLE AIR-CORED INDUCTOR CALCULATIONS **PAGE** 4 **OF** 4

PROGRAMMER John Dale **DATE** 9 June 2019

LOC	Key Codes	Instruction	Comments
50	20	x	9L
51		X^2	$(9L)^2$
52		RCL .3	N
53		X^2	N^2
54		RCL .1	L
55		x	N^2L
56		RCL .0	A
57		x	N^2LA
58		4	
59		0	
60		x	$40N^2LA$
61		+	$(9L)^2 + 40N^2LA$
62		$\sqrt{X}$	$\sqrt{((9L)^2 + 40N^2LA)}$
63		RCL .1	L
64		9	
65		x	9L
66		+	$9L + \sqrt{((9L)^2 + 40N^2LA)}$
67		RCL .3	N
68		X^2	N^2
69		2	
70		x	$2N^2$
71		÷	$r=(9L + \sqrt{((9L)^2 + 40N^2LA))}/ 2N^2$
72		STO .2	Save r in Register 2
73		RTN	Finish with r in the display
74			

LOC	Key Codes	Instruction	Comments
75			
76			
77			
78			
79			
80			
81			
82			
83			
84			
85			
86			
87			
88			
89			
90			
91			
92			
93			
94			
95			
96			
97			
98			
99			

Registers	
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
.0	
.1	
.2	
.3	
.4	
.5	
.6	
.7	
.8	
.9	
I	