MFJ 854   External Current Probe

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VE2AZX
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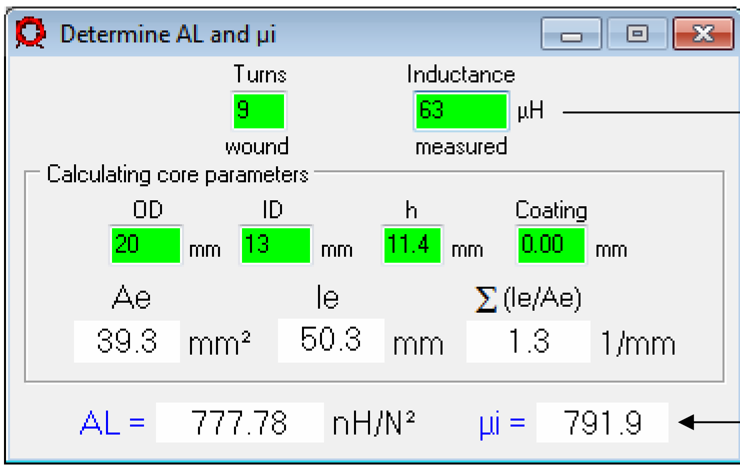
This probe is very easy to use and replaces the clamp-on ferrite which is mounted on the MFJ housing.
The ferrite is larger and allows checking the current on coaxes up to 0.55 in. of diameter.
Once the probe has been recalibrated, (1 Amp @ 7 MHz) all current scales are functional as before.

Existing clamp-on ferrite

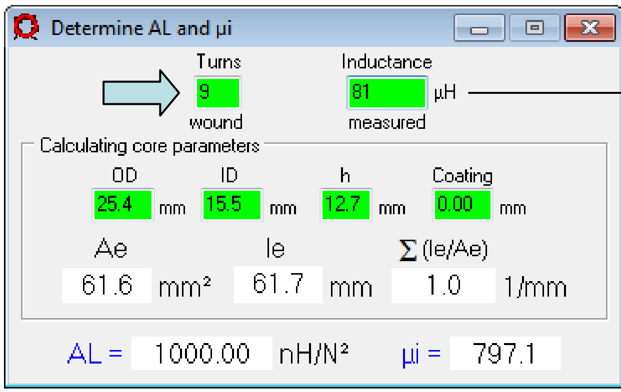


Mesured: 50 uH   Yields: Fc ~ 190 KHz

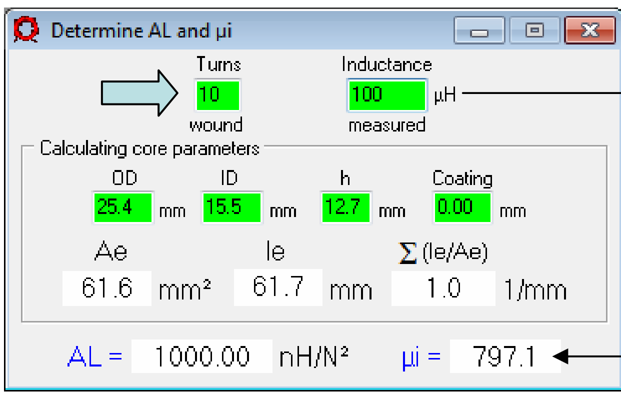
Material #43

The permeability (µ) was determined using Mini Ring Core Calculator s/w
plus core dimensions and measured inductance.
µ ~ 800 which is material # 43

New ferrite used is larger to provide clearance for larger cables



Fc ~ 118 KHz



Fc ~ 95 KHz

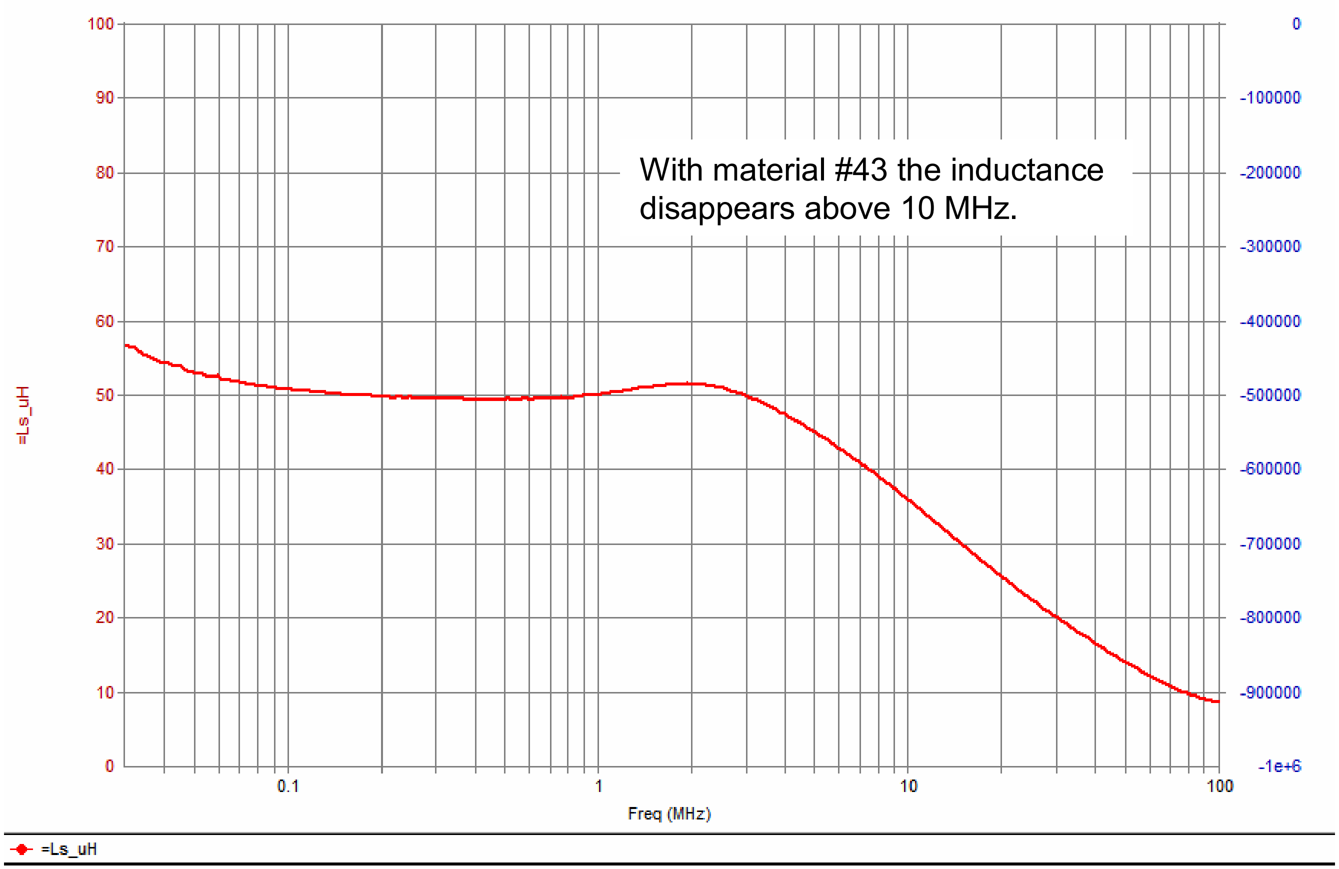
MATÉRIEL #43

Hinged (Snap On) Free Hanging Ferrite Core 90Ohm @ 100MHz ID 0.610" Dia (15.49mm) OD 1.360" W x 0.591" H (34.54mm x 15.01mm)

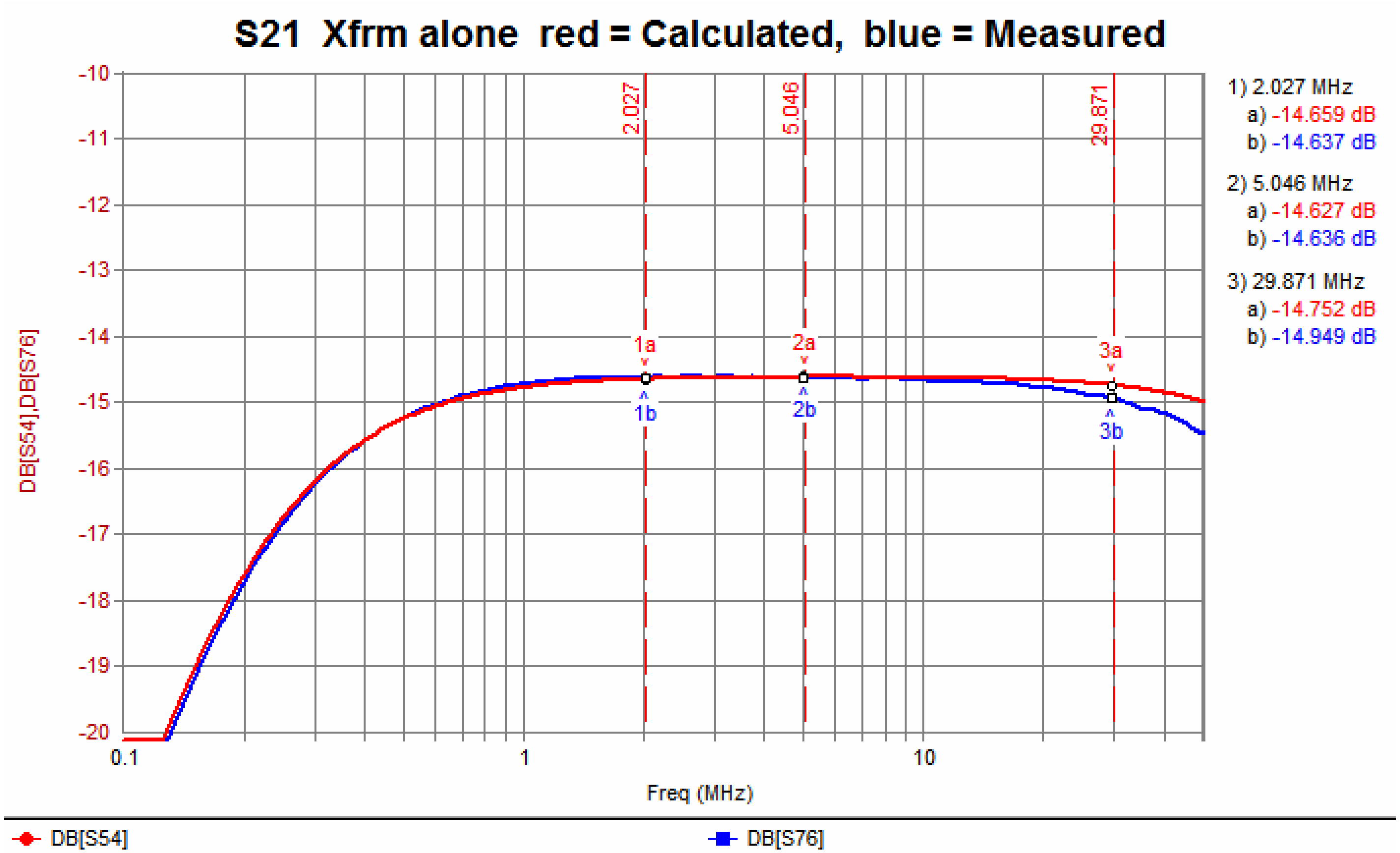
Length 0.835" (21.21mm) #43 material 0443806406 1934-1209-ND $2.84

The Final Probe

Measured inductance
11 turn coil on snap-on ferrite **(10 turn was used to get Ztr > 5)**



10 turn probe S21

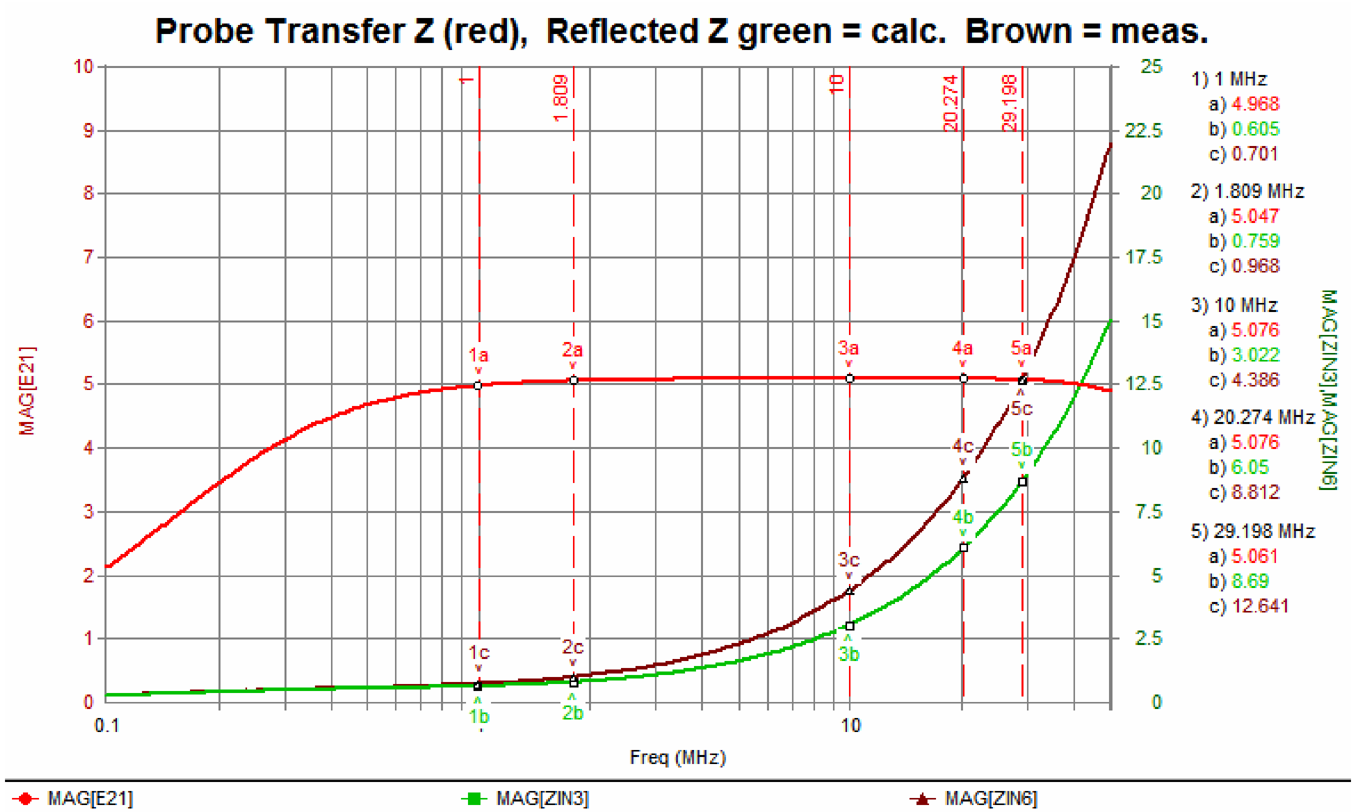


During simulation: the coupling coefficient K is adjusted to get equal S21 at 5 MHz for both measured and calculated conditions. K = 0.938

The secondary inductance L2 was adjusted to obtain equal low freq. rolloff. Flow = 200 KHz

L2 secondary = 39.5 µH

10 turn probe S21



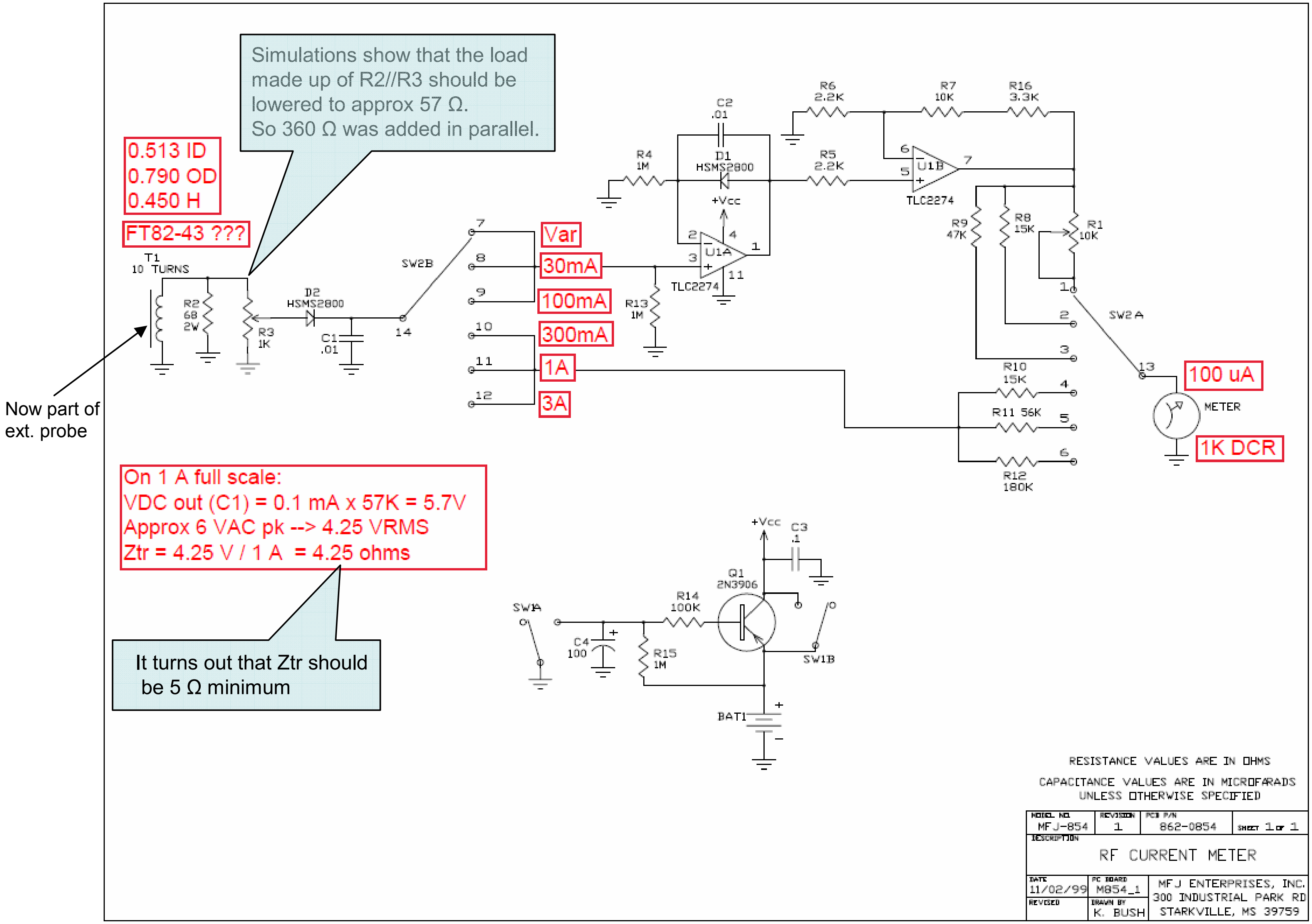
Probe transfer impedance (Ztr) is 5.07 Volts / Amps at 10 MHz (red curve) with the internal load ZL = 54.2 Ω, inside the MFJ-824.

Ztr at midband:
N = number of turns

$$Ztr = \frac{K * ZL}{N} = 5.08$$

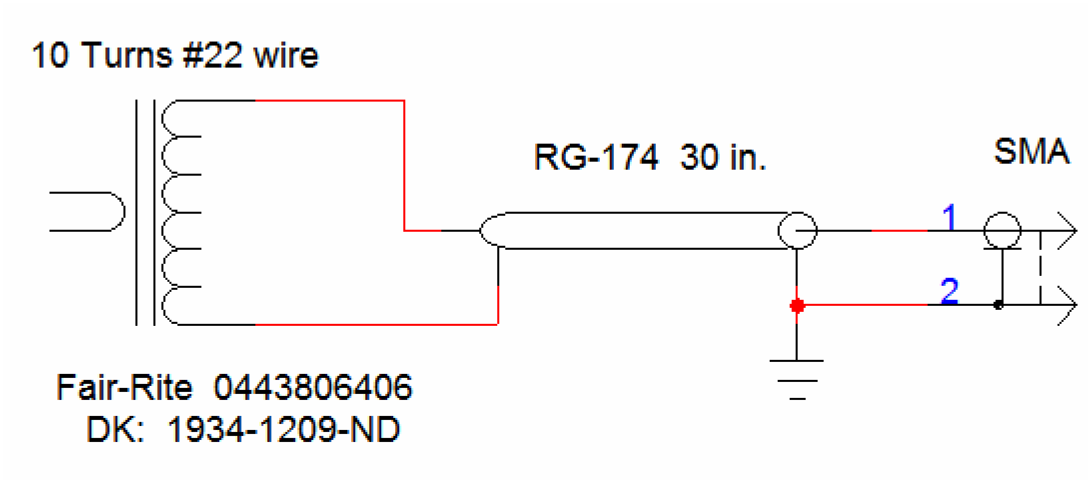
Probe sensitivity In volts / amp for the MFJ-824
With ZL = 50 Ω Ztr = 4.7

Here K = 0.938
ZL = 54.2 Ω
N = 10



Simulations show that the load made up of R2//R3 should be lowered to approx 57 Ω.
So 360 Ω was added in parallel.
0.513 ID
0.790 OD
0.450 H
FT82-43 ???
Now part of ext. probe
T1 10 TURNS
R2 68 2W
R3 1K
D2 HSMS2800
C1 .01
SW2B
Var
30mA
100mA
300mA
1A
3A
R4 1M
C2 .01
D1 HSMS2800
+Vcc
U1A
TLC2274
R13 1M
R6 2.2K
R7 10K
R16 3.3K
R5 2.2K
U1B
TLC2274
R9 47K
R8 15K
R1 10K
SW2A
R10 15K
R11 56K
R12 180K
100 uA
METER
1K DCR
On 1 A full scale:
VDC out (C1) = 0.1 mA x 57K = 5.7V
Approx 6 VAC pk --> 4.25 VRMS
Ztr = 4.25 V / 1 A = 4.25 ohms
It turns out that Ztr should be 5 Ω minimum
+Vcc
C3 .1
Q1 2N3906
R14 100K
SW1A
C4 100
R15 1M
SW1B
BAT1
RESISTANCE VALUES ARE IN OHMS
CAPACITANCE VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED
MODEL NO. MFJ-854
REVISION 1
PCB P/N 862-0854
SHEET 1 OF 1
DESCRIPTION RF CURRENT METER
DATE 11/02/99
PC BOARD M854_1
DRAWN BY K. BUSH
REVISED
MFJ ENTERPRISES, INC.
300 INDUSTRIAL PARK RD
STARKVILLE, MS 39759

Schematic of external probe for MFJ-824



Calculations

$Fc := \frac{ZL}{2 \cdot \pi \cdot L2} = 2.015 \times 10^{5}$ Low Freq. Cutoff: Fc

$Rr := \frac{K^{2} \cdot L1 \cdot ZL}{L2} = 0.44$ Reflected Resistance above Fc

$Leq := L1 \cdot \left(1 - K^{2}\right) = 4.746 \times 10^{-8}$ Reflected inductance above Fc

$Ztr(K,N) := \frac{K \cdot ZL}{N}$

Ztr is proportionnal to the K factor when f >> Fc (see below)

$Ztr(K,N) = 4.69$ In Volts / Amp

$M := K \cdot \sqrt{L1 \cdot L2}$ $M = 3.705 \times 10^{-6}$ Mutual inductance

Power dissipated in the reflected resistance at 1 Amp input when f >> Fc

$PRr := \left(\frac{Iin}{N}\right)^{2} \cdot \frac{K^{2} \cdot L1 \cdot ZL}{L2} = 4.399 \times 10^{-3}$

Power dissipated in the Load resistance ZL at 1 Amp input when f >> Fc

$PRr := \left(\frac{Iin}{N}\right)^{2} \cdot ZL = 0.5$