Appendix A:

At y=0 $$A_n(\xi)=B_n(\xi)+C_n(\xi)$$

and $$A_n(\xi)=\frac{\mu_0}{\mu_1}\frac{\chi}{\eta}\left[B_n(\xi)+C_n(\xi)\right]$$

$$B_n(\xi)=\frac{A_n(\xi)}{2}\left[1+\frac{\mu_1}{\mu_0}\frac{\eta}{\chi}\right]$$

$$C_n(\xi)=\frac{A_n(\xi)}{2}\left[1-\frac{\mu_1}{\mu_0}\frac{\eta}{\chi}\right]$$

At y=c $$D_n(\xi)e^{\gamma c}+E_n(\xi)e^{-\gamma c}=B_n(\xi)e^{\chi c}+C_n(\xi)e^{-\chi c}$$

$$D_n(\xi)e^{\gamma c}-E_n(\xi)e^{-\gamma c}=\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\left[B_n(\xi)e^{\chi c}+C_n(\xi)e^{-\chi c}\right]$$

$$D_n(\xi)=\frac{A_n(\xi)}{2}e^{\gamma c}\left[\cosh\chi c+\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\sinh\chi c+\frac{\mu_1}{\mu_0}\frac{\eta}{\chi}\sinh\chi c+\frac{\mu_2}{\mu_0}\frac{\eta}{\gamma}\cosh\chi c\right]$$

$$E_n(\xi)=\frac{A_n(\xi)}{2}e^{-\gamma c}\left[\cosh\chi c-\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\sinh\chi c+\frac{\mu_1}{\mu_0}\frac{\eta}{\chi}\sinh\chi c-\frac{\mu_2}{\mu_0}\frac{\eta}{\gamma}\cosh\chi c\right]$$

At y=b,

$$F_n(\xi)e^{\eta b}+I_n(\xi)e^{-\eta b}=D_n(\xi)e^{\gamma b}+E_n(\xi)e^{-\gamma b}$$

$$F_n(\xi)e^{\eta b}-I_n(\xi)e^{-\eta b}=\frac{\mu_0}{\eta}J_2(\xi)+\frac{\mu_0}{\mu_2}\frac{\gamma}{\eta}\left[D_n(\xi)e^{\gamma b}-E_n(\xi)e^{-\gamma b}\right]$$

$$F_n(\xi)=\frac{\mu_0}{2\eta}J_2(\xi)e^{\eta b}+\frac{A_n(\xi)}{2}e^{\eta b}\left[\begin{array}{l}\cosh\chi c\cosh\gamma(b-c)+\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\sinh\chi c\sinh\gamma(b-c)+\\ \frac{\mu_1}{\mu_0}\frac{\eta}{\chi}\sinh\chi c\cosh\gamma(b-c)+\frac{\mu_2}{\mu_0}\frac{\eta}{\gamma}\cosh\chi c\sinh\gamma(b-c)\\ +\frac{\mu_0}{\mu_2}\frac{\gamma}{\eta}\cosh\chi c\sinh\gamma(b-c)+\frac{\mu_0}{\mu_1}\frac{\chi}{\eta}\sinh\chi c\cosh\gamma(b-c)\\ +\frac{\mu_1}{\mu_2}\frac{\gamma}{\chi}\sinh\chi c\sinh\gamma(b-c)+\cosh\chi c\cosh\gamma(b-c)\end{array}\right]$$

$$I_n(\xi)=-\frac{\mu_0}{2\eta}J_2(\xi)e^{\eta b}+\frac{A_n(\xi)}{2}e^{\eta b}\left[\begin{array}{l}\cosh\chi c\cosh\gamma(b-c)+\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\sinh\chi c\sinh\gamma(b-c)+\\ \frac{\mu_1}{\mu_0}\frac{\eta}{\chi}\sinh\chi c\cosh\gamma(b-c)+\frac{\mu_2}{\mu_0}\frac{\eta}{\gamma}\cosh\chi c\sinh\gamma(b-c)\\ -\frac{\mu_0}{\mu_2}\frac{\gamma}{\eta}\cosh\chi c\sinh\gamma(b-c)-\frac{\mu_0}{\mu_1}\frac{\chi}{\eta}\sinh\chi c\cosh\gamma(b-c)\\ -\frac{\mu_1}{\mu_2}\frac{\gamma}{\chi}\sinh\chi c\sinh\gamma(b-c)-\cosh\chi c\cosh\gamma(b-c)\end{array}\right]$$

At y=a $$-\frac{\eta}{\mu_0}\left[F_n(\xi)e^{\eta a}-I_n(\xi)e^{-\eta a}\right]=-J_1(\xi)$$

$$\begin{aligned}K(\xi)=\Big[&\frac{\mu_1}{\mu_0}\frac{\xi}{\chi}\sinh\chi c.\cosh\gamma(b-c).\sinh\xi(a-b)+\frac{\mu_3}{\mu_1}\frac{\chi}{\xi}\sinh\chi c.\cosh\gamma(b-c).\cosh\xi(a-b)\\ &+\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\sinh\chi c.\sinh\gamma(b-c).\sinh\xi(a-b)+\frac{\mu_3\mu_1}{\mu_0\mu_2}\frac{\gamma}{\chi}\sinh\chi c.\sinh\gamma(b-c).\cosh\xi(a-b)\\ &+\frac{\mu_3}{\mu_0}\cosh\chi c.\cosh\gamma(b-c).\cosh\xi(a-b)+\frac{\mu_2}{\mu_0}\frac{\xi}{\gamma}\cosh\chi c.\sinh\gamma(b-c).\sinh\xi(a-b)\\ &+\cosh\chi c.\cosh\gamma(b-c).\sinh\xi(a-b)+\frac{\mu_3}{\mu_2}\frac{\gamma}{\xi}\cosh\chi c.\sinh\gamma(b-c).\cosh\xi(a-b)\Big]\end{aligned}$$

$$W(\xi,a)=\left[me^{\pm j0.5k\tau}\sinh\xi(a-b)K(\xi)\right]-\left[1+me^{\pm j0.5k\tau}\cosh\xi(a-b)\right]$$

$$\left[\frac{\mu_2}{\mu_1}\frac{\chi}{\gamma}\sinh\chi c.\sinh\gamma(b-c).\cosh\xi(a-b)+\frac{\mu_3\mu_1}{\mu_0\mu_2}\frac{\gamma}{\chi}\sinh\chi c.\sinh\gamma(b-c).\sinh\xi(a-b)\right.$$

$$+\frac{\mu_1}{\mu_0}\frac{\xi}{\chi}\sinh\chi c.\cosh\gamma(b\text{-}c).\cosh\xi(a\text{-}b)+\frac{\mu_3}{\mu_1}\frac{\chi}{\xi}\sinh\chi c.\cosh\gamma(b\text{-}c).\sinh\xi(a\text{-}b)$$

$$+\cosh\chi c.\cosh\gamma(b\text{-}c).\cosh\xi(a\text{-}b)+\frac{\mu_3}{\mu_0}\cosh\chi c.\cosh\gamma(b\text{-}c).\sinh\xi(a\text{-}b)$$

$$+\frac{\mu_2}{\mu_0}\frac{\xi}{\gamma}\cosh\chi c.\sinh\gamma(b\text{-}c).\cosh\xi(a\text{-}b)+\frac{\mu_3}{\mu_2}\frac{\gamma}{\xi}\cosh\chi c.\sinh\gamma(b\text{-}c).\sinh\xi(a\text{-}b)]$$

$$H(\xi)=[\cosh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)+\frac{\gamma}{\xi}\sinh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\xi}{\gamma}\sinh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)+\cosh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\mu_4}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)+\frac{\mu_4}{\mu_0}\frac{\gamma}{\chi}\sinh\gamma d\cosh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\xi^2}{\gamma\chi}\frac{\mu_4}{\mu_0}\sinh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)+\frac{\mu_4}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\cosh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\mu_5}{\mu_4}\cosh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)+\frac{\gamma}{\xi}\frac{\mu_5}{\mu_4}\sinh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\mu_5}{\mu_4}\frac{\xi}{\gamma}\sinh\gamma d\cosh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)+\frac{\mu_5}{\mu_4}\cosh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\mu_5}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)+\frac{\mu_5}{\mu_0}\frac{\gamma}{\chi}\sinh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\xi^2}{\gamma\chi}\frac{\mu_5}{\mu_0}\sinh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)+\frac{\mu_5}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)]$$

$$G(\xi,a)=[\cosh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)+\frac{\gamma}{\xi}\sinh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\xi}{\gamma}\sinh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)+\cosh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\mu_4}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)+\frac{\mu_4}{\mu_0}\frac{\gamma}{\chi}\sinh\gamma d\cosh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\xi^2}{\gamma\chi}\frac{\mu_4}{\mu_0}\sinh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)+\frac{\mu_4}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\cosh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\mu_5}{\mu_4}\cosh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)+\frac{\gamma}{\xi}\frac{\mu_5}{\mu_4}\sinh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\cosh\chi(a-b)$$

$$+\frac{\mu_5}{\mu_4}\frac{\xi}{\gamma}\sinh\gamma d\cosh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)+\frac{\mu_5}{\mu_4}\cosh\gamma d\sinh\xi(c-d)\sinh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\mu_5}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)+\frac{\mu_5}{\mu_0}\frac{\gamma}{\chi}\sinh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)$$

$$+\frac{\xi^2}{\gamma\chi}\frac{\mu_5}{\mu_0}\sinh\gamma d\sinh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)+\frac{\mu_5}{\mu_0}\frac{\xi}{\chi}\cosh\gamma d\cosh\xi(c-d)\cosh\chi(b-c)\sinh\chi(a-b)]$$

Appendix B:

Table B.1 Details of POPAMPs LM675 and LM3886

Parameters	**LM3886** [Datasheet, LM3886]	**LM675** [Datasheet, LM675]
Supply Voltage (V^++V^-)	84V	30 V
Differential Input Voltage	60V	16V to 60V
Output Current	7A to 11A	3A max
Temperature Range	-20°C to +85°C	0°C to +70°C
Input Bias Current	1µA	2 µA
Open Loop Voltage Gain	90dB	90dB

Appendix C: Flow Chart of the Performance and Electromagnetic Field Calculation