

**Errata for the 6th & 7th Printings of
"Understanding Digital Signal Processing, 2/E",
by Richard Lyons**

I beg your pardon for the typographical errors in the book.
It will not take long to make these corrections. I promise.
- Rick Lyons

Page 7: In the third line below Eq. (1-7), the text:

"... indicate that $X_{\text{sum}}(n)$ has a frequency ..."

The uppercase "X" should be lowercase "x" as:

"... indicate that $x_{\text{sum}}(n)$ has a frequency ..."

[Found by Angela Livingstone, 3/30/08; [Production Error]

Page 23: On the right side of Eq. (2-3), the text is printed as:

$$\dots = \sin(2\pi(f_0 + \frac{1}{32})nt_s) \quad (2-3)$$

The fraction $\frac{1}{32}$ should be $\frac{m}{nt_s}$, making the text print as:

$$\dots = \sin(2\pi(f_0 + \frac{m}{nt_s})nt_s) \quad (2-3)$$

[Found by Jim Murphy [9/14/05].][Author Error]

Page 34: In the 5th line down, the text:

"... where spectral replications do not butt up against each other except at zero Hz."

is confusing. Please edit it as follows:

"... where spectral replications ~~do not~~ butt up against each other ~~except~~ at zero Hz."

Page 37: The " f_s " labels, within the arrows, at the very bottom of Figure 2-13 should be " $f_s/2$ ".

[Found by Author [6/20/06].][Author Error]

Page 38: In the fifth line up from the bottom of the page, the text:

"... where m_{odd} is an odd integer[14]."

should be changed to:

"... where m_{odd} is an odd integer greater than one[14]."

[Found by Jim Murphy [9/14/05] & Justin Reeves [6/20/06].][Author Error]

Page 40: In the 2nd line below Eq. (2-14), the text:

"m = 2 provide an optimum ..."

should be changed to:

" $m_{\text{even}} = 2$ provide an optimum ..."

[Found by Justin Reeves, 6/20/06.][Author Error]

Page 42: In the middle of Table 2-2, on the right side, the text:

" m_{odd} is any positive odd integer ..."

should be changed to:

" m_{odd} is an odd integer greater than one ..."

[Found by Justin Reeves, 6/20/06.][Author Error]

Page 48: The incorrect letter "v" in the third line of Eq. (3-4d) should be replaced with a "." multiplication symbol.

[Found by Uday Padmanabhan, 11/19/08.][Author Error]

Page 49: In Equation (3-8), the ϕ subscript for the X at the left-hand side is missing, and superscript after the "tan" characters should be "-1". Equation (3-8) should look like:

$$X_{\phi}(m) = \tan^{-1}\left(\frac{X_{\text{imag}}(m)}{X_{\text{real}}(m)}\right) \quad (3-8)$$

[Found by Justin Reeves [6/19/06.][Production Error]

Page 62: The second part of equation (3-18') printed as:

$$x(n) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X^n(m) e^{j2\pi nm/N} \quad (3-18')$$

should have the lower limit of the summation changed to "m" instead of "n", as :

$$x(n) = \frac{1}{\sqrt{N}} \sum_{m=0}^{N-1} X^n(m) e^{j2\pi nm/N} \quad (3-18')$$

[Found by Larry Ong, 2/19/08.][Author Error]

Page 63: On line 9, the text:

"..., that $X(N/2+1)$, when $m = N/2+1$ "

should be

"..., that $X(N/2)$, when $m = N/2$ "

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 77: For both Eq. (3-29) and Eq. (3-30), the "-1" characters should be deleted from the denominator of the cosine arguments. The cosine argument, in both equations, should be:

$$\dots \cos(2\pi n/N),$$

[Found by Author, 10/26/07.][Author Error]

Page 93: The last term in Equ. 3-37 has a missing minus sign in its exponent. The last term should be:

$$\dots + e^{-jq(K-1)}] .$$

[Found by Stan Moore, 3/19/12.][Production Error]

Page 105: In Table 3-1, on the second row the 1st column text:

"Frequency in radians"

should be replaced with:

"Frequency in radians/second"

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 110: In both lines of Equation (3-58) there is a missing minus sign in front of the "j" in the exponent of "e". For both lines of Eq. (3-58) the printed expression should be:

$$= e^{-j(2\pi n/N)} \dots$$

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 114: The label text above the arrow in Figure 3-41 states:

" ... transform of $x(n)$..."

There is a missing "c" subscript, the arrow's label text should state:

" ... transform of $x_c(n)$..."

[Found by Jimmy Ceilidh [12/26/04.][Author Error]

On page 134, in Figure 4-2, the lower right four twiddle factors:

$$W_8^4, W_8^5, W_8^6, W_8^7$$

should be

$$-W_8^0, -W_8^1, -W_8^2, -W_8^3$$

[Found by Saul Iverson, 10/3/17.][Author Error]

Page 135: On the 3rd line from the bottom, the "1" in:

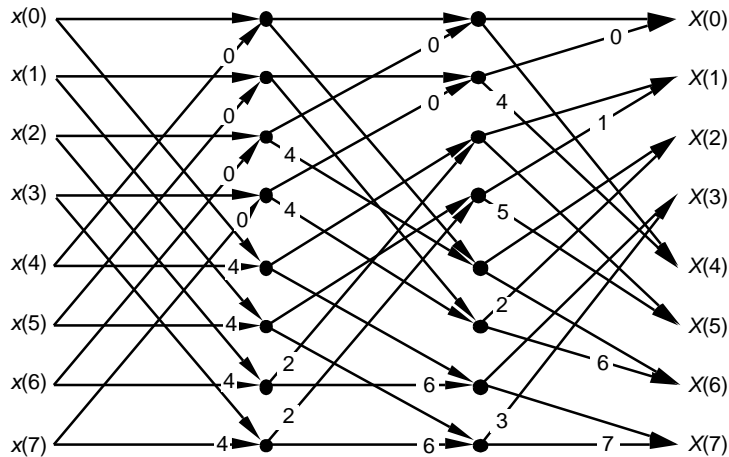
$$"e^{-j\pi} = 1"$$

should be a minus 1 as

$$"e^{-j\pi} = -1"$$

[Found by Antoine Trux, 1/2/07.][Author Error]

Page 143: In Figure 4-10, in the middle stage there is the number 4 on the 1st and 2nd (counting down from the top) southeast-pointing arrows. Those 4s should not be there. The 4s should be on the 3rd and 4th southeast-pointing arrows of the middle stage as shown below.



[Found by Antoine Trux, 1/2/07.][Author Error]

Page 163: The text on the bottom line, printed as:

"Figures 5-8(a) and 5-8(b)."

should be changed to

"Figures 5-8(b) and 5-8(c)."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 178: In the 3rd & 4th lines of the 1st paragraph the text printed as:

"... defined by 32 discrete samples, to which 480 zeros were ..."

should be

"... defined by 16 discrete samples, to which 496 zeros were ..."

[Found by Fitzgerald Sungkyung Park, 4/25/06.][Author Error]

Page 179: In the 5th line of the next to the last paragraph the text printed as:

"... by 32 discrete samples, with 480 zeros appended, ..."

should be

"... by 16 discrete samples, with 496 zeros appended, ..."

[Found by Fitzgerald Sungkyung Park, 4/25/06.][Author Error]

Page 198: On line 8, the text:

"... in Figure-34(b), ..."

Should be:

"... in Figure 5-40(b), ..."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 222: In Figure 6-7(a), the label above the arrow should be

$\sigma = -a_0/a_1$

just as it is in Figure 6-8(a)

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 244: The normalized-frequency labeling (radians/sample) on the frequency axis of Figures 6-24(b) and 6-24(c) should be changed as:

-2π changed to -4π
 $-\pi$ changed to -2π
 π changed to 2π
 2π changed to 4π

[Found by Author, 10/17/08.][Author Error]

Page 245: On the second line the text:

"... if Figure 6-4(a) ..."

should be changed to

"... if Figure 6-24(a) ..."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 247: On the last line of the footnote, the text:

"... in Step 5."

should be changed to:

"... in Step 6."

[Found by Antoine Trux, 12/15/04.][Author Error]

Page 257: In the eleventh line below Eq. (6-87)

"... Figure 6-21(b). Knowing that ..."

should be changed to:

"... Figure 6-**22**(b). Knowing that ..."

[Found by Yancen Li (7/14/14)]; [Author Error]

Page 264: In the 6th line of the first full paragraph, the text:

"...squeezed in toward zero Hz."

should be:

"...squeezed in toward $f_s/2$ Hz."

[Found by VV (vanamali), 3/12/09.] [Author Error]

Page 264: In the next to the last line of the first full paragraph there's a missing "|" vertical bar character indicating "magnitude". The text:

"...in $|H_d(f_d)-...$ "

should be:

"...in $|H_d(f_d)|-...$ "

[Found by Author, 7/14/05.] [Author Error]

Page 265: In the first and third lines of the caption to Figure 6-32, the subscripted "c" in " f_C " should be an "a", as " f_a ".

In the third line of the caption, the subscripted "c" in " H_C " should be an "a", as " H_a ".

[Found by Author, 7/14/05.] [Author Error]

Page 267: There is a missing " $x(n)$ " factor in Equation (6-114), the first part of that equation should be:

$$y(n) = 0.20482712 \cdot \mathbf{x(n)} + 0.40965424 \cdot x(n-1) + \dots$$

[Found by Kendall Castor-Perry, 5/3/09.] [Author Error]

Page 286: The feedback coefficient of the resonator in Figure 7-3, printed as:

$$e^{j\omega r}$$

it should be changed to:

$$e^{j\omega r}$$

[Found by Author, 7/14/09.] [Production Error]

Page 300: In Figure 7-18(b), the feedback coefficient label on the right side of the figure printed as:

$$2r \cos(2\neq k/N),$$

the " \neq " should be replaced with " π " (pi), as:

$$"2r \cos(2\pi k/N)"$$

[Found by Antoine Trux, 12/15/04.] [Author Error]

Page 345: On the right side of Figure 8-8 the term $e^{j2\pi f_0 t}$ should

be divided by two, making it

$$e^{j2\pi f_0 t}/2.$$

[Found by John Littig, 9/24/07.] [Author Error]

Page 353: In the sentence just before Eq. (8-17), the described notion of orthogonality of $i(n)$ and $q(n)$ is only conditionally true. Because this orthogonality topic was not described in sufficient detail, I suggest you strike out both the sentence just before Eq. (8-17) as well as Eq. (8-17).

[Found by Ken Walsh, 5/9/06.] [Author Error]

Page 354: In the third line from the bottom, the text:

"... about zero Hz, not f_c Hz as in Figure 8-17(b)."

should have a comma inserted after " f_c Hz", as:

"... about zero Hz, not f_c Hz, as in Figure 8-17(b)."

(Note: The missing comma is essential because it changes the meaning of the sentence.)

[Found by Antoine Trux, 12/15/04.] [Author Error]

Page 373: In Figure 9-11, in the middle and bottom figures, the two labels within the figures printed as:

"... of $H_1(\square)$ " should be changed to "... of $H_1(\mathbf{0})$ "

[Found by Antoine Trux, 12/15/04.] [Author Error]

Page 379: In Item# 6, in the 2nd sentence the "cos" and "sin" subscripts printed as:

"In this case half the $h_{\sin}(k)$ coefficients are zeros, and all but one of the $h_{\cos}(k)$ coefficients are zeros!"

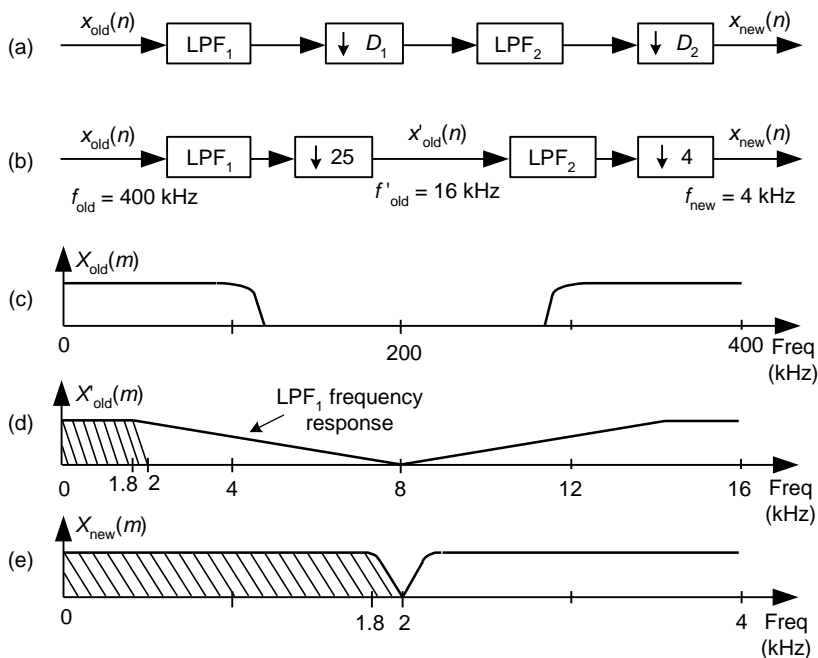
should be swapped making that sentence be:

"In this case half the $h_{\cos}(k)$ coefficients are zeros, and all but one of the $h_{\sin}(k)$ coefficients are zeros!"

[Found by Author [10/09/05].] [Author Error]

Page 384: The "shading" in two places at the bottom in Figure 10-3 doesn't show up in the figure.

The shading in Figure 10-3 should look like the following:



[Found by Author 11/3/05.] [Production Error]

Page 389: In the seventh line of the second paragraph, the text is printed as:

"The lower the attenuation, the ...".

Please change the word "lower" to "greater" so that the text reads:

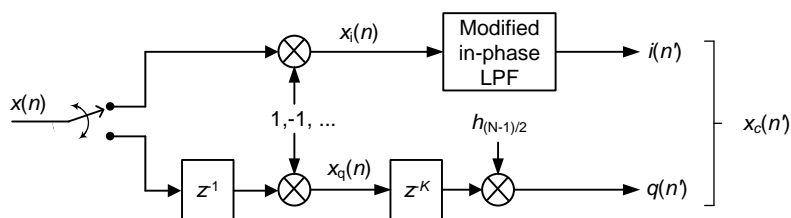
"The **greater** the attenuation, the ...".

[Found by Mark Kolber, 1/29/08.] [Author Error]

Page 478: in the fifth line down, delete the text:

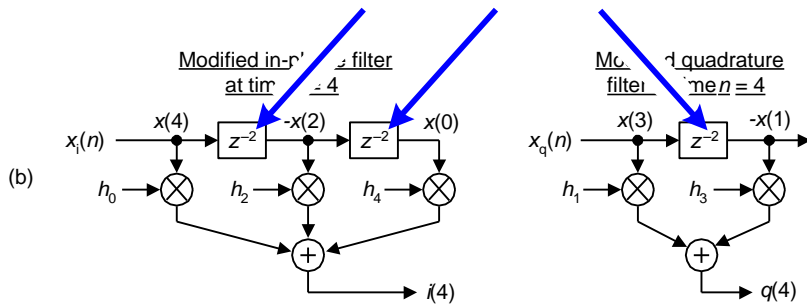
"...followed by another K delay..."

In Figure 13-6(c) the final z^{-K} delay block should be deleted making that figure look as follows:

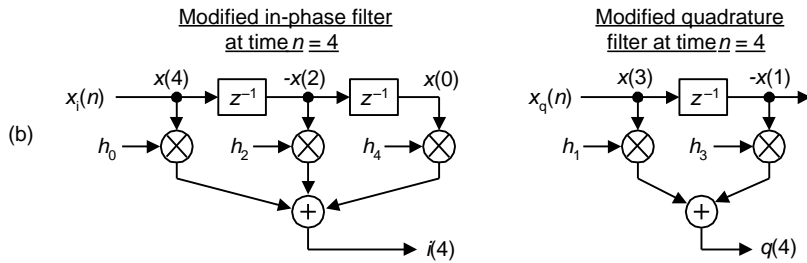


[Found by Brian Frantz, 8/8/17.] [Author Error]

Page 479: In Figure 13-6(b) the superscripted "-2" characters shown by the large arrows below:



Should be changed from "-2" to "-1" making Figure 13-6(b) become:



[Found by Damon Bradley, 10/1/09.] [Author Error]

Page 484: Equation (13-10) has suffered a series of "foul-ups" in different Printings of the book. Eq. (13-10) should be:

$$\begin{aligned}
 W(m) &= \sum_{n=0}^{N-1} \alpha e^{-j2\pi nm/N} - \frac{\beta}{2} \cdot \sum_{n=0}^{N-1} e^{j2\pi n/N} e^{-j2\pi nm/N} - \frac{\beta}{2} \cdot \sum_{n=0}^{N-1} e^{-j2\pi n/N} e^{-j2\pi nm/N} \\
 &= \alpha \sum_{n=0}^{N-1} e^{-j2\pi nm/N} - \frac{\beta}{2} \cdot \sum_{n=0}^{N-1} e^{j2\pi n(m-1)/N} - \frac{\beta}{2} \cdot \sum_{n=0}^{N-1} e^{-j2\pi n(m+1)/N}. \quad (13-10)
 \end{aligned}$$

[Found by Author, 3/22/04.] [Author Error]

Page 488: Equation (13-18) has minus signs where equal signs should be. Equation (13-18) should be:

$$\begin{aligned}
 x(0) &= a(0) + jb(0) \\
 x(1) &= a(1) + jb(1) \\
 x(2) &= a(2) + jb(2) \\
 &\vdots \\
 &\vdots \\
 x(N-1) &= a(N-1) + jb(N-1) \quad (13-18)
 \end{aligned}$$

[Found by Author [1/11/07].] [Production Error. Wierd. This error was NOT in the 1st Edition!]

Page 489: In the 3rd line below Eq. (13-22) change the text from:

"... in Eq. (13-40) , ...

to:

"... in Eq. (13-20) , ...

[Found by Antoine Trux, 1/11/07.] [Author Error]

Page 496: In the 6th and 7th lines below Eq. (13-40)
change the text from:

"... real, $X_a(N)$ through $X_a(2N-1)$ are merely the
complex conjugates of their $X_a(0)$ through $X_a(N-1)$
counterparts ..."

to:

"... real, $X_a(N+1)$ through $X_a(2N-1)$ are merely the
complex conjugates of their $X_a(N-1)$ through $X_a(1)$
counterparts ..."

[Found by Antoine Trux, 1/11/07.][Author Error]

I (the author) suggest you write the following in
the book's margin:

$$\begin{aligned} X_{a,\text{real}}(N) &= X_r(0) - X_i(0) \\ X_{a,\text{imag}}(N) &= 0 \end{aligned}$$

Page 518: For more accurate results, the " $12/M$ " factor at the
beginning of Eq. (13-70) should be changed to $\sqrt{12/M}$.
Thus Eq. (13-70) should be:

$$y_{\text{desired}}(n) = \sqrt{\frac{12}{M}} \cdot \sigma' \cdot \left[\left(\sum_{k=1}^M x_k(n) \right) - \frac{M}{2} \right] + \mu' . \quad (13-70)$$

[Found by Bharat Pathak, 7/13/07.][Author Error]

Page 544: In the exponent of Eq. (13-104), originally printed as:

$$X(k) = \sum_{n=0}^{M-1} x(n) e^{-j2\pi nk/N} . \quad (13-104)$$

The " N " should be changed, in two places, to an " M ", making the
equation print as:

$$X(k) = \sum_{n=0}^{M-1} x(n) e^{-j2\pi nk/M} . \quad (13-104)$$

[Found by Author 3/13/06.][Author Error]

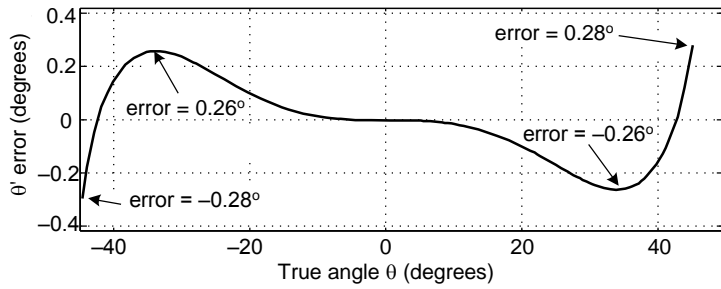
Page 548: 4th line below Eq. (13-107), change the text:

"... 0.26° using ..."

to

"... 0.28° using ...".

For preciseness, you might note on Figure 13-59 that the error
is -0.28° at True $\theta = -45^\circ$, and the error is $+0.28^\circ$ at True $\theta = +45^\circ$,
as shown in the following figure.



[Found by Chris Zarowski, 4/27/06.][Author Error]

Page 549: 4th line below Eq. (13-109'), change the text:

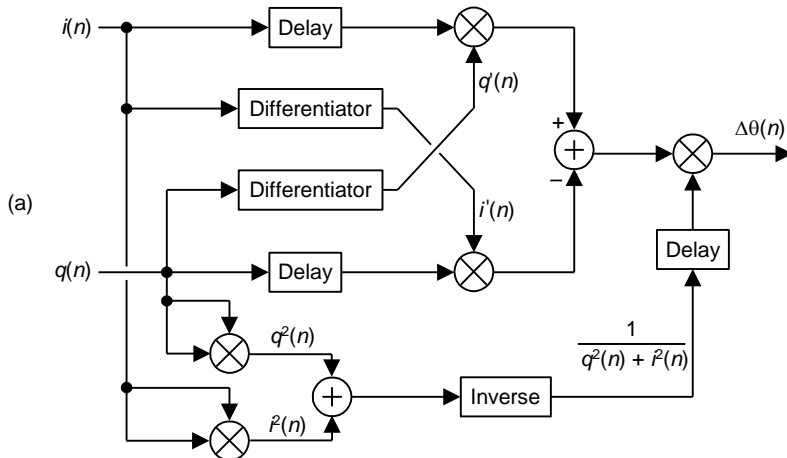
"... error is 0.26° for ..."

to

"...error is 0.28° for ...".

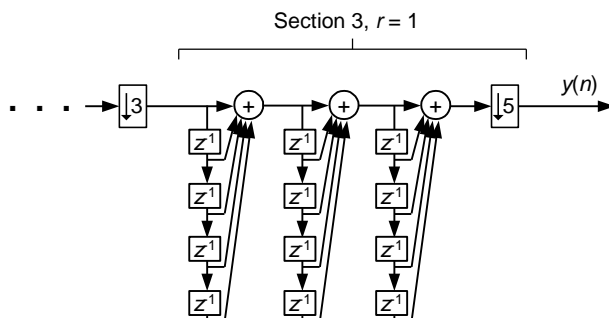
[Found by Chris Zarowski, 4/27/06.][Author Error]

Page 551: In Figure 13-61(a) there needs to be a Delay element inserted just after the "Inverse" operation as shown below. The length of that (missing) Delay element should be the same length as the Delays in the I and Q input paths.



[Found by "Jerry W." on comp.dsp, 8/25/05.][Author Error]

Page 560: In Figure 13-70(b), on the right side in the "Section 3, $r = 1$ " part of the figure, there should be three stages of delay lines instead of only two stages as shown in the figure. That "Section 3, $r = 1$ " part of the figure should look like the following:



[Found by Mike Totham, 8/31/07.][Author Error]

Page 561: Equation (13-123) has a missing 1/N scale factor in front of the summation. That equation should be:

$$M(q) = \frac{1}{N} \sum_{k=qN}^{(q+1)N-1} x(n) \quad (13-123)$$

[Found by Author, 8/24/08.][Production Error]

Page 569: In the right $X_{\text{int}}(m)$ column of Table 13-8, the *underline* character associated with row $m = 9$ should be a zero "0" value as follows:

m	$X_{\text{int}}(m)$
...	...
9	0
...	...

[Found by Author, 3/21/09.][Production Error]

Page 607: Two corrections: In the second line of Eq. (D-7), the term:

"... $-\cos(\omega t)$] ...

should be:

"... $-\cos(2\omega t)$] ...

In the third line of Eq. (D-7), the term:

"... $-\frac{1}{2}(\sin(\omega t))$..."

should be:

"... $-\frac{1}{4}(\sin(2\omega t))$..."

[Found by Julian Vrbancich, 10/23/12; [Author Error]

Page 627: The minus sign before the "0.04" value in Equation (F-5) should be deleted, making Eq. (F-5) end with:

$$"... = \frac{0.25}{2\pi} = 0.04 \text{ seconds.} \quad (F-5)"$$

[Found by Author 8/25/05.][Author Error]

Dear Reader, if you find any additional errors, no matter how trivial, please notify me at:

R.Lyons@ieee.org

I'd sure appreciate hearing from you and I promise I'll reply to your E-mail.

Thanks,

[-Rick Lyons-]

