

**Errata for the 1st Printing of the American  
(blue and green front cover) version of  
"Understanding Digital Signal Processing, 3/E",  
by Richard Lyons**

I beg your pardon for the typographical errors in this 1st edition. (Almost 40% of those errors were caused by faulty software at the Printer, and those errors could not be detected until after the 1st edition is actually printed.) It will not take long to make these corrections. I promise.

-Rick Lyons-

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**Page 47:** The text in the first line of page 47 should be changed from

"... in Figures 2-9(c) and 2-9(d)."  
to:  
"... in Figures 2-9(a), 2-9(b), and 2-9(e)."

[Found by Walter Schulte (6/6/11)]; [Author Error]

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**Page 47:** In Figure 2-10 the strange 'ñ' characters should be minus signs.

[Found by Author (9/14/11)]; [Production Error]

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**Page 56:** On the left side of Figure P2-19 the label:

"±1000"  
should be changed to:  
"-1000".

[Found by Author (9/14/11)]; [Production Error]

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**Page 63:** On the right side of Eq. (3-6), the text:

"X<sub>(m)</sub>"  
should be:  
"X<sub>φ(m)</sub>"

as it is on the left side of Eq. (3-8).

[Found by Turki Almadhi (12/5/10)]; [Production Error]

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**Page 64:** On the right side of Eq. (3-10) there is a missing right parenthesis between the "4" and the period. The equation should end with:

"...+3π/4)."

[Found by Lionel Keene (12/18/10)]; [Production Error]

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**Page 83:** In the third line of the text, the words:

"... Sections 3.14 and 3.15 discuss ..."  
should be changed to:

"... Section 3.13 discusses ..."

[Found by Lionel Keene (12/29/10)]; [Author Error]

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**Page 96:** In the second line of Section 3.10, the text:

"... in Section 3.16, for ..."

should be changed to:

"... in Section 3.1**3**, for ...".

[Found by Anonymous (11/27/11)]; [Author Error]

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**Page 97:** In the sixth line from the bottom of the page, the value:

"... or -1.45 dB, ..."

should be changed to:

"... or **-1.72** dB, ...".

[Found by Rajeev Krishnamurthi (4/10/12)]; [Author Error]

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**Page 107:** 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]

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**Page 112:** In the second line down from the top of the page, the text:

"... width of the main lobe ... "

should be changed to:

"... first zero-crossing ... "

[Found by Richard Lavery (8/20/14)]; [Author Error]

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**Page 120:** Here's a truly strange error by the typesetting people. Equation (3-51), printed as:

$$\sum_{n=-\infty}^{\infty} x(n)e^{-jon}$$

should be changed to:

$$X(\omega) = \frac{\sin(N\omega/2)}{\sin(\omega/2)} .$$

[Found by Stan Shear (4/3/13)]; [Production Error]

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On page 144, 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]

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**Page 187:** In the line just above Eq. (5-10), the text:

"... as Eq. (3-59), is ... "

should be changed to:

"... as Eq. (3-**47**), is ... "

[Found by Stan Shear (4/4/13)]; [Author Error]

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**Page 211:** In the third line of the last paragraph the text:

"slope of the  $H_\phi(m)$  response ..."

should be:

"negative of the slope of the  $H_\phi(m)$  response ..."

[Found by Edward Beadle (7/19/16)]; [Production Error]

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**Page 220:** In the first line of text, in the text:

"... impulse response  $x(k)$  of ..."

the "x" should be changed to "h" making the text read as:

"... impulse response **h**(k) of ..."

[Found by Martin Forrester (3/28/11)]; [Author Error]

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**Page 227:** The third term on the right side of Eq. (5-35)

"...  $h(2)e^{-j0\omega}$  ..."

should be changed to:

"...  $h(2)e^{-j**2**\omega}$  ...".

[Found by Mark Tachiki (11/28/13)]; [Author Error]

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**Page 277:** The second minus sign in the denominator of Eq. (6-27) should be a plus sign. That equation should be:

$$H(\omega) = \frac{\sum_{k=0}^N b(k) \cdot \cos(k\omega) - j \sum_{k=0}^N b(k) \cdot \sin(k\omega)}{1 - \sum_{k=1}^M a(k) \cdot \cos(k\omega) + j \sum_{k=1}^M a(k) \cdot \sin(k\omega)}$$

[Found by Bert RAM Aerts (8/20/14)]; [Production Error]

**Page 278:** In the 3rd line from the top, the expression:

$$"- \pi \leq \omega \leq + \omega"$$

should be changed to:

$$"- \pi \leq \omega \leq + \pi"$$

[Found by Mark Tachiki (12/5/13)]; [Author Error]

**Page 278:** The last term in Eq. (6-28)

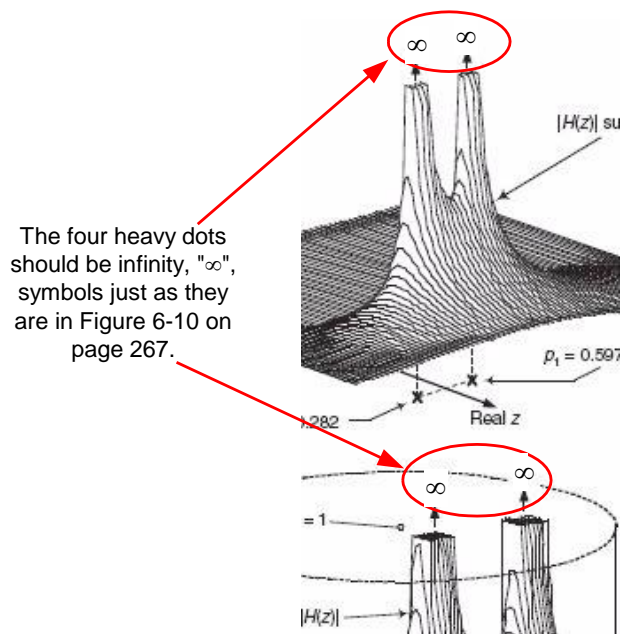
$$"... -0.436 \cdot (n-2) \dots"$$

should be changed to:

$$"... -0.436 \cdot \mathbf{Y}(n-2) \dots"$$

[Found by Yancen Li (7/13/14)]; [Production Error]

**Page 283:** In Figure 6-20, the four heavy dots above the vertical arrows should be infinity, " $\infty$ ", symbols, as shown below.



**Figure 6-20**

[Found by Author, (11/9/10)]; [Production Error]

**Page 297:** In the 7th line up from the bottom of the page, the text printed as:

$$(3!)^2 = 24$$

should be changed to:

$$(3!)^2 = 36$$

[Found by Bert RAM Aerts (8/30/14)]; [Production Error]

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**Page 298:** In the center Section 2 portion of Figure 6-27, the printed

$b'(0)$

should be changed to:

$b''(0)$

[Found by Yancen Li (8/11/14)]; [Author Error]

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**Page 304:** In Figures 6-32(b) and 6-32(c), the 'p' letters in the frequency axes should be the Greek symbol ' $\pi$ '.

[Found by Author (7/11/16)]; [Production Error]

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**Page 317:** In the eleventh line below Eq. (6-104)

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

should be changed to:

"... 6-22(c). Knowing that ..."

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

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**Page 324:** In the third line from the bottom of the page, the text

"...in the form of Eq. (6-43)."

should be changed to:

"...in the form of Eq. (6-60)."

[Found by Yancen Li (8/11/14)]; [Author Error]

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**Page 329:** In the fourth line from the top of the page, the text

"...design filter in Figure 6-28(a)... "

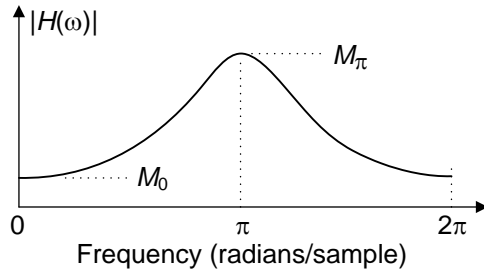
should be changed to:

"...design filter in Figure 6-36(a)... "

[Found by Yancen Li (8/11/14)]; [Author Error]

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**Page 345:** The right side of Figure P6-26 should look like the following:



[Found by Kip Haggerty (11/22/14)]; [Production Error]

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**Page 366:** The denominators in Eq. (7-10) printed as:

$$h_{SL1}(k) = \frac{-1}{6}, \frac{8}{6}, 0, \frac{-8}{6}, \frac{1}{6} \quad (7-10)$$

should be changed to:

$$h_{SL1}(k) = \frac{-1}{12}, \frac{8}{12}, 0, \frac{-8}{12}, \frac{1}{12} \quad (7-10)$$

[Found by Author (4/20/14)]; [Author Error]

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**Page 366:** The denominators in Eq. (7-11) printed as:

$$h_{SL2}(k) = \frac{-22}{126}, \frac{67}{126}, \frac{58}{126}, 0, \frac{-58}{126}, \frac{-67}{126}, \frac{22}{126} \quad (7-11)$$

should be changed to:

$$h_{SL2}(k) = \frac{-22}{252}, \frac{67}{252}, \frac{58}{252}, 0, \frac{-58}{252}, \frac{-67}{252}, \frac{22}{252} \quad (7-11)$$

[Found by Joseph Galante (4/15/14)]; [Author Error]

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**Page 368:** The upper right side of Eq. (7-13) contains four typos as shown by the red ovals in the following expression.

$$= \frac{j}{2\pi} \left[ \frac{e^{j\omega_c k}}{k} - \frac{j\omega_c e^{j\omega_c k}}{k} - \frac{e^{-j\omega_c k}}{k^2} + \frac{j\omega_c e^{-j\omega_c k}}{k} \right]$$

That part of Eq. (7-13) should be changed to:

$$= \frac{j}{2\pi} \left[ \frac{e^{j\omega_c k}}{k^2} - \frac{j\omega_c e^{j\omega_c k}}{k} - \frac{e^{-j\omega_c k}}{k^2} - \frac{j\omega_c e^{-j\omega_c k}}{k} \right]$$

[Found by Author, (1/22/11)]; [Author & Production Error]

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**Page 384:** In the sixth line of the paragraph following Eq. (7-31'), the figure callout:

"... in Figure 7-34(b). "

should be changed to:

"... in Figure 7-16(b). "

[Found by Jérôme Leclère (10/9/13)]; [Author Error]

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**Page 463:** In the 3rd line up from the bottom of the page, the text:

"... and use Eq. (2-13) with  $m_{\text{odd}} = 5$  to set ..."

should be changed to:

"... and use Eq. (2-11) with  $k = 3$  to set ..."

[Found by Jiwoo Kim, (2/5/12)]; [Author Error]

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**Page 467:** In Problem 8.9, the minus sign in the denominator should be a plus sign. The following is correct.

$$\tan(\alpha) = \frac{e^{j\alpha} - e^{-j\alpha}}{j(e^{j\alpha} + e^{-j\alpha})}.$$

[Found by Lee Fugal, (1/5/13)]; [Author Error]

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**Page 510:** In the 12th line, the text:

"... band  $B_v$ , the ..."

should be changed to:

"... band  $B'$ , the ...".

[Found by Jiwoo Kim, (1/12/12)]; [Author Error]

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**Page 512:** Eq. (10-3) contains two inappropriate small 'a' characters. The printed Eq. (5-3) should be changed to:

$$N \approx \frac{\textit{Atten}}{22(f_{\text{stop}} - f_{\text{pass}})} = \frac{60}{22(2.2/400 - 1.8/400)} \approx 2727$$

[Found by Author, (6/16/11)]; [Production Error]

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**Page 515:** In Figure 10-5(c) the frequency axis labels marked

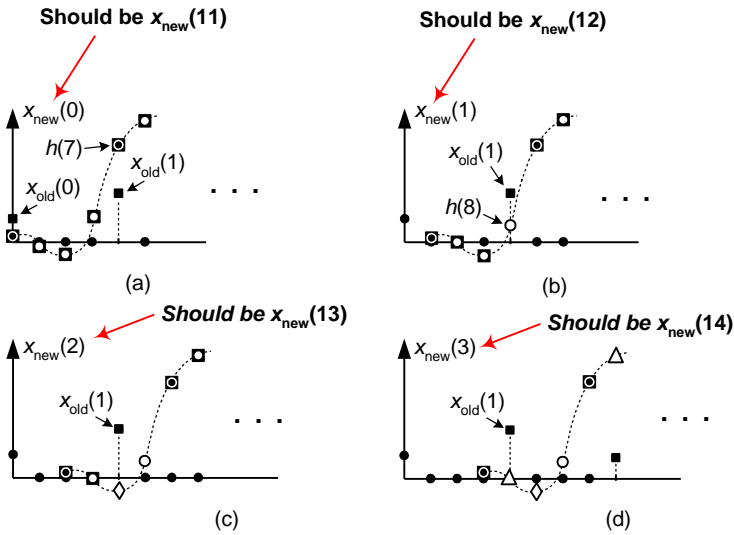
**$(-3f_{s,\text{old}})$  and  $(3f_{s,\text{old}})$**

should be:

**$(-3f_{s,\text{new}})$  and  $(3f_{s,\text{new}})$ .**

[Found by Author, (2/25/17)]; [Author Error]

**Page 523:** The labels of the vertical axes in Figure 10-11 should be changed as shown below.



[Found by Martin Forrester (3/24/11)]; [Author Error]

**Page 556:** On the left side of Figure 10-35 all instances of

"±"

should be changed to:

"-", minus signs.

[Found by Author, (9/14/11)]; [Production Error]

**Page 557:** On the left side of Figure 10-36 all instances of

"±"

should be changed to:

"-", minus signs.

[Found by Author, (9/14/11)]; [Production Error]

**Page 561:** At the upper-left side of Table 10-2, the " $v(n)$ " (circled in red below):

	Three-bit integrator accumulator			Four-bit integrator accumulator		
$n$	$v(n)$	$w(n-5)$	$v(n)$	$w(n)$	$w(n-5)$	$v(n)$
0	0	0	0	0	0	0
1	1	0	1	1	0	1

should be changed to



" $w(n)$ "

making the upper-left side of the Table 10-2 look as shown below:

$n$	Three-bit integrator accumulator			Four-bit integrator accumulator		
	$w(n)$	$w(n-5)$	$v(n)$	$w(n)$	$w(n-5)$	$v(n)$
0	0	0	0	0	0	0
1	1	0	1	1	0	1

[Found by Author (2/1/11)]; [Author Error]

**Page 574:** In the next to the last line before Figure P10-11, the complex-valued expression:

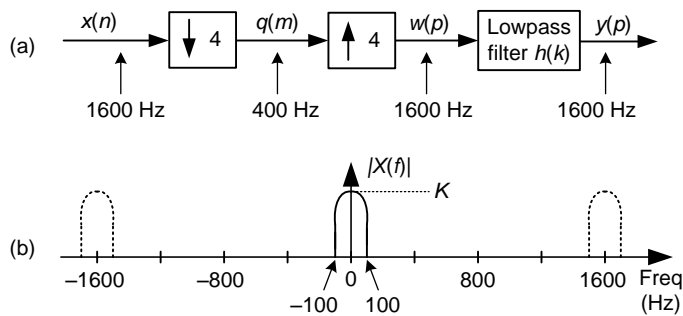
$$e^{-j2n/4}$$

should be changed to:

$$e^{-j2\pi n/4}$$

[Found by Renato Lopes, (10/29/13)]; [Author Error]

**Page 578:** For some reason the wrong figure was printed for Figure P10-17. The correct Figure P10-17 is:



[Found by Prof. Renato da Rocha Lopes (9/17/13)]; [Production Error]

**Page 604:** In the second line of Eq. (11-20'), the 2nd term in parenthesis:

$$(-0.9239 + j0.3827)$$

should be changed to:

$$(-0.9239 - j0.3827)$$

[Found by Jérôme Leclère (10/9/13)]; [Author Error]

**Page 648:** On the 2nd and 3rd lines down from the top, the references to Eqs. (D-11) and (D-12) should be changed to Eqs. (D-28) and (D-29).

[Found by Prof. Kip Haggerty (1/1/16)]; [Author Error]

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**Page 673:** In Figure 13-2(b) and 13-2(d), the vertical axes should be labeled ' $\phi(m)$ ' and ' $\phi_{1,-1}(m)$ ' respectively.

[Found by Jiwoo Kim (2/18/12)]; [Production Error]

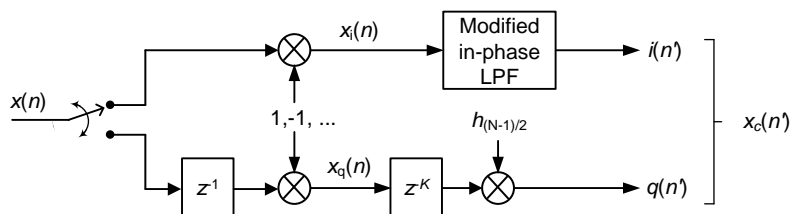
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**Page 675:** In Figures 13-4(b) and 13-4(c), the hyphens, "-", near the vertical axes'  $\phi_I(m)$  and  $\phi_Q(m)$  labels should be ignored.

[Found by Jérôme Leclère (10/9/13)]; [Author Error]

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**Page 678:** 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 become:



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

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**Page 682:** In the second part of Equation (13-7), printed as:

$$|V| = \begin{cases} \text{Max} + \text{Min}/8, & \text{if } \text{Min} < 3\text{Max}/8 \\ 27\text{Max}/32 + 19\text{Min}/16, & \text{if } \text{Min} \geq 3\text{Max}/8 \end{cases} \quad (13-7)$$

the "19" should be changed to a "9", making the equation look like:

$$|V| = \begin{cases} \text{Max} + \text{Min}/8, & \text{if } \text{Min} < 3\text{Max}/8 \\ 27\text{Max}/32 + 9\text{Min}/16, & \text{if } \text{Min} \geq 3\text{Max}/8 \end{cases} \quad (13-7)$$

[Found by Author (4/2/11)]; [Author Error]

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**Page 683:** On the left side of the third line up from the bottom of Table 13-2, in the expression:

$$27\text{Max}/32 + 19\text{Min}/16$$

the "19" should be changed to a "9", making the expression look like:

$$27\text{Max}/32 + 9\text{Min}/16$$

[Found by Author (4/2/11)]; [Author Error]

**Page 691:** This page contains seven software-induced "typos" where an angle symbol (" $\angle$ ") was inadvertently replaced by a hyphen followed by a space ("- "). Those typos are circled in red in the left panel below. The corrections are shown below in the right panel. (Correct angle symbols (" $\angle$ ") can be seen at the bottom right of page 697.)

For example, the top line below should look like:

$$= \frac{0 - j7.9999}{2} = 0 - j4 = 4\angle -90^\circ$$

$= \frac{0 - j7.9999}{2} = 0 - j4.0 = 4 - -90^\circ,$	Replace:	With:
$X_a(2) = \frac{X_r(6) + X_r(2) + j[X_i(2) - X_i(6)]}{2} = \frac{0.0 + 2.8282 + j[2.8282 - 0.0]}{2}$	= 4 - -90°	= 4∠-90°
$= \frac{2.8282 + j2.8282}{2} = 1.414 + j1.414 = 2 - 45^\circ,$	= 2 - 45°	= 2∠45°
$X_a(3) = \frac{X_r(5) + X_r(3) + j[X_i(3) - X_i(5)]}{2} = \frac{0.0 + 0.0 + j[0.0 - 0.0]}{2} = 0 - 0^\circ,$	= 0 - 0°	= 0∠0°
$X_a(4) = \frac{X_r(4) + X_r(4) + j[X_i(4) - X_i(4)]}{2} = \frac{0.0 + 0.0 + j[0.0 - 0.0]}{2} = 0 - 0^\circ,$	= 0 - 0°	= 0∠0°
$X_a(5) = \frac{X_r(3) + X_r(5) + j[X_i(5) - X_i(3)]}{2} = \frac{0.0 + 0.0 + j[0.0 - 0.0]}{2} = 0 - 0^\circ,$	= 0 - 0°	= 0∠0°
$X_a(6) = \frac{X_r(2) + X_r(6) + j[X_i(6) - X_i(2)]}{2} = \frac{2.8282 + 0.0 + j[0.0 - 2.8282]}{2}$	= 2 - -45°	= 2∠-45°
$= \frac{2.8282 - j2.8282}{2} = 1.414 - j1.414 = 2 - -45^\circ, \text{ and}$	= 4 - 90°	= 4∠90°
$X_a(7) = \frac{X_r(1) + X_r(7) + j[X_i(7) - X_i(1)]}{2} = \frac{-2.8282 + 2.8282 + j[6.8282 + 1.1717]}{2}$		
$= \frac{0.0 + j7.9999}{2} = 0 + j4.0 = 4 - 90^\circ.$		

[Found by Author, (1/29/11)]; [Production Error]

**Page 692:** Similar to the typos on page 691, this page contains four "typos" where an angle symbol (" $\angle$ ") was incorrectly replaced by a hyphen followed by a space ("- "). Those typos are circled in red in the left panel below. The corrections are shown below in the right panel.

$= \frac{5.656 + j5.656}{2} = 2.828 + j2.828 = 4 \angle 45^\circ,$ $X_b(2) = \frac{X_i(6) + X_i(2) + j[X_r(6) - X_r(2)]}{2} = \frac{0.0 + 2.8282 + j[0.0 - 2.8282]}{2}$ $= \frac{2.8282 - j2.8282}{2} = 1.414 - j1.414 = 2 \angle -45^\circ,$ $X_b(3) = \frac{X_i(5) + X_i(3) + j[X_r(5) - X_r(3)]}{2} = \frac{0.0 + 0.0 + j[0.0 - 0.0]}{2} = 0 \angle 0^\circ, \text{ and}$ $X_b(4) = \frac{X_i(4) + X_i(4) + j[X_r(4) - X_r(4)]}{2} = \frac{0.0 + 0.0 + j[0.0 - 0.0]}{2} = 0 \angle 0^\circ.$	<table> <tr> <td>Replace:</td> <td>With:</td> </tr> <tr> <td><math>= 4 \angle -45^\circ</math></td> <td><math>= 4 \angle 45^\circ</math></td> </tr> <tr> <td><math>= 2 \angle -45^\circ</math></td> <td><math>= 2 \angle -45^\circ</math></td> </tr> <tr> <td><math>= 0 \angle 0^\circ</math></td> <td><math>= 0 \angle 0^\circ</math></td> </tr> <tr> <td><math>= 0 \angle 0^\circ</math></td> <td><math>= 0 \angle 0^\circ</math></td> </tr> </table>	Replace:	With:	$= 4 \angle -45^\circ$	$= 4 \angle 45^\circ$	$= 2 \angle -45^\circ$	$= 2 \angle -45^\circ$	$= 0 \angle 0^\circ$	$= 0 \angle 0^\circ$	$= 0 \angle 0^\circ$	$= 0 \angle 0^\circ$
Replace:	With:										
$= 4 \angle -45^\circ$	$= 4 \angle 45^\circ$										
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$= 0 \angle 0^\circ$	$= 0 \angle 0^\circ$										

[Found by Author, (1/29/11)]; [Production Error]

-----  
**Page 692:** In the first line of the last paragraph, the text:

"From Section 4.4, ..."

should be changed to:

"From Section **4.6**, ..."

[Found by Author (2/23/11)]; [Author Error]

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**Page 741:** In the first line of Table 13-4, the two values:

Real multiplies	Real additions
4N	2N

should be changed to:

Real multiplies	Real additions
<b>2N</b>	<b>2(N-1)</b>

[Found by Pavel Rajmic (3/5/14)]; [Author Error]

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**Page 748:** In the first line of Table 13-5, the four values:

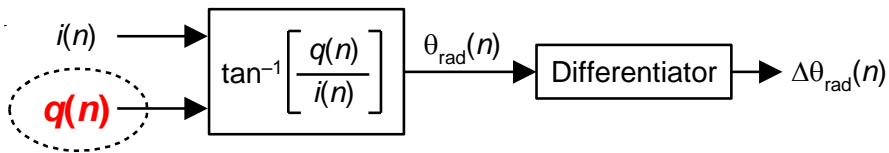
Real multiplies	Real additions	Real multiplies	Real additions
4N	2N	4N	2N

should be changed to:

Real multiplies	Real additions	Real multiplies	Real additions
<b>2N</b>	<b>2(N-1)</b>	<b>2N</b>	<b>2(N-1)</b>

[Found by Author (3/5/14)]; [Author Error]

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**Page 759:** In Figure 13-60, the two inputs to the arctangent operation should be:



[Found by Kendall Castor-Perry (8/10/12)]; [Production Error]

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**Page 805:** In the third line of the first paragraph the text:

"... in Figure 13-92(c),"

should be changed to:

"... in Figure 13-9**1**(c),"

[Found by Les Mills (5/3/11)]; [Author Error]

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**Page 813:** In the third line up from the bottom of the page, the text:

"... 13-99(c)."

should be changed to

"... 13-99(**b**)."

[Found by Author (1/23/11)]; [Author Error]

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**Page 814:** In the fourth line below Eq. (13-162), the text:

"... Figure 13-99(c) ..."

should be changed to

"... Figure 13-99(**b**) ..."

[Found by Author (1/23/11)]; [Author Error]

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**Page 828:** The  $\pi$  symbols in the exponents of both sides of Eqs. (13-170) and (13-170') are missing. The equations should be:

$$e^{-j2\pi(m+N/2)/N} = -e^{-j2\pi m/N} \quad (13-170)$$

and

$$e^{-j2\pi(m+N/4)/N} = -je^{-j2\pi m/N} \quad (13-170')$$

[Found by Jérôme Leclère (10/9/13)]; [Production Error]

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**Page 830:** In the fifth line of the first paragraph the text:

"...  $k(0 \leq k \leq N-1)$  ..."

should be:

"...  $k(0 \leq k \leq N-1)$  ..."

[Found by Edward Beadle (7/19/16)]; [Production Error]

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**Page 840:** In the first paragraph following Figure 13-121, that starts with "Ah, but there's ...", there are three instances of the expression:

$$e^{-j2\pi m/N}$$

Those expressions should have the letter "n" inserted in the exponent, making all three expressions read as:

$$e^{-j2\pi nm/N}$$

[Found by Author, 7/9/12.][Author Error]

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**Page 849:** The left side of Equ. (A-5) looks like the following:

$$-r = \frac{\pi\phi_d}{180}.$$

The minus sign should be a Greek  $\phi$  making Eq. (A-5) look like:

$$\phi_r = \frac{\pi\phi_d}{180}.$$

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

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**Page 854:** The cube root bar on the right side of Eq. (A-27) should not extend over the angle argument. The right side of Eq. (A-27) should look as follows:

$$\dots = \sqrt[3]{125} e^{j(75^\circ + n360^\circ)/3} \quad (\text{A-27})$$

[Found by Turki Almadhi (12/1/10)]; [Production Error]

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**Page 875:** Two corrections: On the left side of the second line of Eq. (D-12), the term:

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

should be changed to:

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

On the right side of the second line of Eq. (D-12), the term:

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

should be changed to:

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

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

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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.

A suggestion: This errata is complete on the day you first received it. However, I have learned over the years that because of the way books are produced, as time goes by additional typographical errors will be detected. So what this means is that 6-12 months from now you might want to send me an E-mail requesting the errata **FOR YOUR PARTICULAR PRINTING NUMBER** of the book so you can check for any recently-detected "typos."

Thanks,  
[-Rick Lyons-]

