Extra Class License Manual – Supplemental Information and Errata

The following text is intended to support or correct the 12th edition of the *Extra Class License Manual* and the 5th edition of the *Extra Class Q&A*. Recent changes in this version of the document are in red.

Determine the version of the manual you are using by referring to the first page of the preface inside your copy. Look for the text box with the copyright information where you'll also find the edition and printing information. (If the edition number is not followed by printing information, the book is the first printing.) If the material does not refer to a specific printing, it applies to all versions of the manual.

The question pool for the current Extra Class license took effect on July 1, 2020.

Question Pool Changes

None.

Supplemental Information

Extra Class License Manual

Significant Digits in Answers: Students may be confused when making calculations because the answer in the question pool or example does not reflect the exact number produced by a calculator. For example, when calculating reactance in Example 4.4 on page 4-22, using the formula for X_L a calculator will display a value of 396.2052. Following the rules of significant digits, the answer should be rounded to 400. A tutorial on significant digits is available online at **chemcollective.org/activities/tutorials/stoich/significant_figures** as well as through the online Khan Academy (**www.khanacademy.org**). Although the question pool is not completely consistent regarding significant digits in calculations, the student should expect answers to be rounded or refer to "best representations" to accommodate different methods of calculation. The associated question to this calculation (E5C15) asks only which of the graphed points "best represents" the resulting impedance, for example. High precision is not required in any exam question.

Chapter 4

Page 4-27

Figure 4.24 shows the intersection of two lines representing reactance vs frequency: the curved line, decreasing to the right, shows capacitive reactance $X_C = 1/2\pi fC$, and the straight line rising to the right shows inductive reactance $X_L = 2\pi fL$. At the frequency where the lines cross, $X_C = X_L$ and the circuit is resonant. The scales of both axes are linear, resulting in the curved and straight lines. In most engineering manuals and texts, however, reactances are plotted on a log-log chart where both types of reactance are plotted as straight lines. This makes it a lot easier to see where the resonant frequency is for a wide range of capacitance, inductance, and frequencies. You can see this kind of chart in the Electrical Fundamentals chapter of the *ARRL Handbook* or online at **www.rfcafe.com/references/electrical/frequency-reactance-nomograph.htm**.

Chapter 5

Page 5-21

In Figure 5.38 - the first line of the state table (B) for S = 0 and R = 0 is saying "If S and Rare both zero, the states of the Q and not-Q outputs are unchanged."

In the bottom line of the truth table, the output states are uncertain for S = 1 and R = 1 because both Q and not-Q attempt to go to the *same* state, which is not allowed for complementary outputs. Either 0 or 1 would possible - see https://en.wikipedia.org/wiki/Flip-flop_(electronics). Whether it is 0 or 1 depends on exact timing of signal changes and similar concerns. This is one reason why the S-R flip-flop isn't often used in favor of a clocked D-type or J-K flip-flop.

Chapter 6

The symbol // (two parallel slashes) is used to mean "in parallel with" instead of showing the full equation for the paralleled components. Using // is often clearer than the full equation when attempting to explain a design or relationship.

Page 6-13

In Figure 6-12, the symbol β (beta) is used to represent the feedback ratio through the feedback network. While this is standard terminology (en.wikipedia.org/wiki/Barkhausen_stability_criterion), beta is also used to represent the ratio of collector to base current in a bipolar transistor. The context of the discussion should be used to alert the reader which meaning of the symbol is used. There are many symbols with multiple uses in electronics – caution is advised, along with a good glossary.

Page 6-37

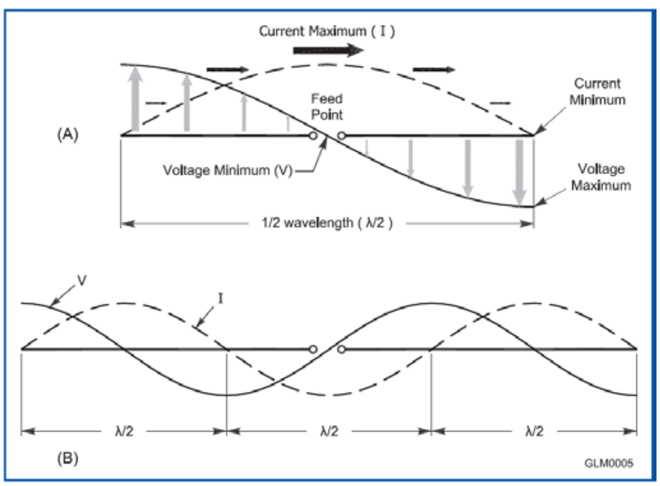
The phrase *"As a pulse becomes narrower and narrower, its frequency spectrum spreads out more and more"* can be hard to understand. Without getting into the full mathematics of the spectrum of pulses, we can simplify the reasoning a bit as follows: As the pulse becomes narrower in time, higher and higher frequency components are required to make the sharp edges with the short duration between them. At the extreme, the spectrum of a zero-width impulse has components at *all* frequencies. This is why impulse noise, such as from arcs and spark discharges, has such a wide spectrum and creates interference across a wide frequency range. Similarly for key clicks - the sharper the keying, the worse the clicks become.

Page 6-41

The function of the linear regulator circuit on the exam (Figure E7-3) is easier to understand if both Figure 6.46 and Figure E7-3 are available while reading the explanation of the circuit's function on page 6-45. The schematic in Figure 6.46 is more typical of an actual linear regulator than the exam figure which is somewhat oversimplified.

Chapter 9

A resonant antenna has a feed point impedance that is all resistance. i.e. $Z = R + j0$. Yet the current and voltage appear to be 90 degrees out of phase at resonance – why?



The drawing above shows the current and voltage distributions. The distributions along the wire are just the magnitude of the waveforms (like the envelope of a modulated signal) and doesn't say anything about the phase of the actual waveform. It is the distributions that are 90 degrees out of phase, not the waveforms. At the center, the voltage waveform reaches a minimum while the current waveform is at a maximum - yet both waveforms are in-phase (at resonance), resulting in a purely resistive impedance.

Page 9-23

In Equation 9.4B, because System Gain is given in dB, the anti- or inverse log function must be used to calculate ERP in watts. $\log^{-1}(x)$ is also the same thing as 10^x.

Page 9-31

In the explanation of the function of the hairpin inductor, it is correct that the hairpin is a shunt inductor. [E9E05] This shunt inductor then combines with the capacitive reactance of the antenna's driven element to form an L network, matching the antenna's feed point impedance to 50 ohms.

Extra Class Q&A

None

Errata

Extra Class License Manual

Page 5.24, Equation 5.7 – the denominator should be $C_1[R_1 + (2 \times R_2]$

Extra Class Q&A

No errata.