Amateur Radio Service (ARS), “Approximate” & “Regulated” Bandwidth of a Single Side Band Suppressed Carrier – Amplitude Modulation (SSBSC - AM), Radiotelephony Signal (RTPY), Full Emission Designator - 2K70J3E

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1. **"3.0 kHz" is the *"Approximate"* Bandwidth, of a Single Side Band Suppressed Carrier - Amplitude Modulation (SSBSC-AM) Radiotelephony signal (J3E), using either the Lower Side Band (LSB) or Upper Side Band (USB) Mode in the Amateur Radio Service.**

    a. **The *"3.0 KHz Approximate"* Bandwidth, is tested for in all "3" Amateur Radio Service License Class Examinations.**

2. **"2.7 kHz" is the "*Regulated*" Bandwidth (2K70), of a Single Side Band Suppressed Carrier - Amplitude Modulation (SSBSC-AM) Radiotelephony signal (J3E), using either the Lower Side Band (LSB) or Upper Side Band (USB) Mode in the Amateur Radio Service and is Specifically Full Emission Designator "2K70J3E".**

    a. **The *" 2.7 kHz Regulated"* Bandwidth *is referenced in the:***

        i. **CFR - Code of Federal Regulations**
        ii. **Title 47 - Telecommunications**
        iii. **Chapter I - Federal Communications Commission (FCC)**
        iv. **Part 97 - Amateur Radio Service**
        v. **Subpart A - General Provisions**
        vi. **Paragraph 97.3 - Definitions**
        vii. **Subparagraph 97.3(c) - The following terms are used in this Part to indicate emission types. Refer to §2.201 of the FCC Rules, Emission, modulation and transmission characteristics, for information on Emission Type Designators.**
        viii. **Subpart D – Technical Standards**
        ix. **Paragraph 97.307 - Emission Standards**
        x. **Subparagraph 97.307(b) - Emissions resulting from *'modulation'* must be confined to the band or segment available to the control operator. Emissions outside the *'Necessary Bandwidth'* must not cause 'splatter' or 'keyclick' interference to operations on adjacent frequencies.**

    b. **The *" 2.7 kHz Regulated"* Bandwidth *is published in the:***

        i. **CFR - Code of Federal Regulations**
        ii. **Title 47 - Telecommunications**
        iii. **Chapter I - Federal Communications Commission (FCC)**

iv. **Part 2 - Frequency Allocations and Radio Treaty Matters; General Rules and Regulations**
v. **Subpart C - Emissions**
vi. **Paragraph 2.201 - Emission, Modulation, and Transmission Characteristics**
vii. **Subparagraph 2.201(a) - Emissions are designated according to their *Classification* and their *Necessary Bandwidth.***
viii. **Subparagraph 2.201(g) - Whenever the full designation of an emission is necessary, the symbol for that emission, as given above, shall be preceded by the *Necessary Bandwidth* of the emission as indicated in §2.202(b)(1).**
ix. **Paragraph 2.202 - Bandwidths**
x. **Subparagraph 2.202(b) - *Necessary Bandwidth***
xi. **Subparagraph 2.202(b)(1) - The *Necessary Bandwidth* shall be expressed by three numerals and one letter. The letter occupies the position of the decimal point and represents the unit of bandwidth. The first character shall be neither zero nor K, M or G.**

3. **Questions from the current Amateur Radio Service *"Technician", "General" and "Amateur Extra Class"* License Examination Question Pools listed for reference: *(Number in parenthesis after the question number is the correct answer number).***

a. ***"Technician Class License"*** **- Examination Question Pool (Effective July 1, 2010):**

i. **T4B09 (3): Which of the following is an appropriate receive filter to select in order to minimize noise and interference for SSB reception?**
   1. **500 Hz**
   2. **1000 Hz**
   3. **2400 Hz (Note: This is the correct answer).**
   4. **5000 Hz**
      a. **Note: 2400 Hz (2.4 kHz) and 2200 Hz (2.2 kHz) were a standard Transceiver Transmitter Module, Band Pass Filter (BPF) Band Width (BW) for many years, and Transceiver Manufacturers did not make them adjustable in the transmit mode for a wider Band Width (BW) operation. However the Transceivers Receiver Module, Band Pass Filter (BPF) Band Width (BW) could be narrowed.**
      b. **Note: The newer Transceivers have the capability to widen the Transmitter Band Pass Filter (BPF) Band Width (BW), but you should not transmit wider than 2.7 kHz on AM - SSBSC (LSB or USB) to allow for "Spurious Signals called spurs".**

ii. **T8A08 (2): What is the "approximate bandwidth" of a SSB voice signal?**
   1. **1 kHz**
   2. **3 kHz (Note: This is the correct answer)**
   3. **6 kHz**
   4. **15 kHz**

b. ***"General Class License"*** **- Examination Question Pool (Effective July 1, 2011):**

i. **G4D08 (3): What frequency range is occupied by a 3 kHz LSB signal when the displayed carrier frequency is set to 7.178 MHz?**
   1. **7.178 to 7.181 MHz**
   2. **7.178 to 7.184 MHz**
   3. **7.175 to 7.178 MHz (Note: This is the correct answer)**
   4. **7.1765 to 7.1795 MHz**

ii. **G4D09 (2): What frequency range is occupied by a 3 kHz USB signal with the displayed carrier frequency set to 14.347 MHz?**
   1. **14.347 to 14.647 MHz**
   2. **14.347 to 14.350 MHz (Note: This is the correct answer)**
   3. **14.344 to 14.347 MHz**
   4. **14.3455 to 14.3485 MHz**

iii. **G4D10 (1): How close to the lower edge of the 40 meter General Class phone segment should your displayed carrier frequency be when using 3 kHz wide LSB?**
   1. **3 kHz above the edge of the segment (Note: This is the correct answer)**
   2. **3 kHz below the edge of the segment**
   3. **Your displayed carrier frequency may be set at the edge of the segment**
   4. **Center your signal on the edge of the segment**

iv. **G4D11 (2): How close to the upper edge of the 20 meter General Class band should your displayed carrier frequency be when using 3 kHz wide USB?**
   1. **3 kHz above the edge of the band**
   2. **3 kHz below the edge of the band (Note: This is the correct answer)**
   3. **Your displayed carrier frequency may be set at the edge of the band**
   4. **Center your signal on the edge of the band**

c. ***"Amateur Extra Class License"*** **- Examination Question Pool (Effective July 1, 2012):**

i. **E1A01 (4) [97.301, 97.305]: When using a transceiver that displays the carrier frequency of phone signals, which of the following displayed frequencies will result in a normal USB emission being within the band?**
   1. **The exact upper band edge**
   2. **300 Hz below the upper band edge**
   3. **1 kHz below the upper band edge**
   4. **3 kHz below the upper band edge (Note: This is the correct answer)**

ii. **E1A02 (4) [97.301, 97.305]: When using a transceiver that displays the carrier frequency of phone signals, which of the following displayed frequencies will result in a normal LSB emission being within the band?**
   1. **The exact lower band edge**
   2. **300 Hz above the lower band edge**
   3. **1 kHz above the lower band edge**
   4. **3 kHz above the lower band edge (Note: This is the correct answer)**

iii. **E1A03 (3) [97.301, 97.305]: With your transceiver displaying the carrier frequency of phone signals, you hear a DX station's CQ on 14.349 MHz USB. Is it legal to return the call using upper sideband on the same frequency?**
   1. **Yes, because the DX station initiated the contact**
   2. **Yes, because the displayed frequency is within the 20-meter band**
   3. **No, my sidebands will extend beyond the band edge (Note: This is the correct answer)**
   4. **No, USA stations are not permitted to use phone emissions above 14.340 MHz**

iv. **E1A04 (3) [97.301, 97.305]: With your transceiver displaying the carrier frequency of phone signals, you hear a DX station's CQ on 3.601 MHz LSB. Is it legal to return the call using lower sideband on the same frequency?**
   1. **Yes, because the DX station initiated the contact**
   2. **Yes, because the displayed frequency is within the 75-meter phone band segment**
   3. **No, my sidebands will extend beyond the edge of the phone band segment (Note: This is the correct answer)**
   4. **No, USA stations are not permitted to use phone emissions below 3.610 MHz**

4. **Most transmitters are not completely free of *"spurious emissions"*, commonly called *"spurs"*. Also most have less than an optimum suppression of 3rd Order Intermodulation Distortion (IM3) products. A "3.0 kHz Approximate" Band Width (BW), should be maintained which gives a *"300 Hz"* Guard Band Width (BW), so that your transmitted emissions will not:**

   a. **Be *"Out-of-Band-Edge-Frequency"* (Outside Amateur Radio Service Band frequency limits).**

   b. **Be *"Out-of-Operator-Band-Segment-Edge-Frequency"* (Outside frequency limits for specific Operator License Class within the Band).**

   c. **Be *"Out-of-Mode-Band-Segment-Edge-Frequency"* (Outside frequency limits for the specific "Mode" of Emission).**

   d. **Cause *"Unnecessary-Interference"* to other Amateur Radio Service Stations on nearby frequencies.**

   e. **Reference: CFR, Title 47, Chapter-1, Part 97, Sub-Part B, Section 97.101(d) and Sub-Part D, Section 97.301(a), (b), (c) and (d).**

5. **Do not transmit any closer to any *"Band Edge Frequency", "Band Segment Edge Frequency", "Mode-Band-Segment-Edge-Frequency"* or *"Another Conversations Frequency"* for the following emission types:**

   a. **"100 Hz" using *Emission Designator* "100HA1A", which is *"ON" and "OFF" keying Continous Wave (CW) Radiotelegraphy using the International Morse Code.***

b. **"2.7 kHz" using *Emission Designator* "2K70J3E", which is *Single Side Band Suppressed Carrier - Amplitude Modulation (SSBSC-AM) Radiotelephony.***

c. **"6 kHz" using *Emission Designator* "6K00A3E", which is *Double Side Band Full Carrier - Amplitude Modulation (DSBFC-AM) Radiotelephony.***

d. **"16 kHz" using *Emission Designator* "16K0F3E", which is *Frequency Modulation (FM) Radiotelephony.***

e. **"16 kHz" using *Emission Designator* "16K0G3E", *which is Phase Modulation (PM) Radiotelephony***

f. **Reference: CFR, Title 47, Chapter-1, Part 2, Sub-Part C, Section 2.201 and 2.202.**

6. The Most Common Producers of a Transmitter Stages Excessive Band Width (EBW) are:

a. **Improper adjustment of the 'Bias Voltage Variable Resistors' in a Transmitter RF Power Amplifier (RFPA) stage.**

i. Variable Resistors are connected in circuits inside a Transceiver configured using either all 'Three' legs, referred to as 'Potentiometers' or using only 'Two' of the 'Three' legs, referred to as 'Rheostats'. The most common Printed Circuit Board (PCB) configuration is the Potentiometer.

ii. *The 'Bias Voltage Potentiometers'*, in the Transmitter Modules RFPA Stage, set the Bias Voltage for the 'Driver' Transistor(s) and 'Final' Transistor(s) so they are in the appropriate Class of Operation.

iii. *Proper setting of the 'Bias Voltage Potentiometers'* ensures that the Transmitter Modules RFPA Stage is in a *Linear Mode* of operation when using a SSBSC-AM Radiotelephony Emission, which must be Class 'A', Class 'AB1', Class 'AB2', or Class 'B'.

iv. *Improper setting of the 'Bias Voltage Potentiometers'* can cause the Transmitter Modules RFPA Stage to be in a *Non-Linear Mode* of operation when using SSBSC-AM Radiotelephony Emission, which would be Class 'C'. *This will distort the SSBSC-AM Audio Frequencies (AF) modulating the Radio Frequency (RF) Carrier Signal.*

b. **Use of an Electron Tube *or* Solid State Semiconductor, RFPA, that does not have an Input 'Pi' or 'L' Configured Low Pass Filter (LPF) Coupling Network.**

i. **An Input 'Pi' or 'L' configured LPF Coupling Network, *must* be applied to the 'Input Electrode', of any RFPA.** The Input Electrodes are the *'Cathode'* in a Power Triode, the *'Control-Grid'* in a Power Tetrode, the *'Control-Grid'* in a Power Pentode, the *'Base'* of a Bipolar Junction Transistor (BJT) and the *'Gate'* of a Field Effect Transistor (FET).

ii. An Input 'Pi' or 'L' configured LPF Coupling Network, **prevents input signal waveform distortion.**

iii. An Input 'Pi' or 'L' configured LPF Coupling Network, **provides Intermodulation Distortion (IMD) Harmonic Reduction.**

iv. An Input 'Pi' or 'L' configured LPF Coupling Network, **provides Impedance matching between the 'Characteristic Impedance' of the connected Input RF Feed Line and the 'Input Electrode Impedance' of the RFPA.**

c. Under-Coupling (also called Under-Loading) a Linear Mode Class 'A', Class 'AB1', Class 'AB2' or Class 'B', Electron Tube or Solid State Semiconductor RF Power Amplifier (RFPA) when using SSBSC-AM mode.

d. Using a Non-Linear Mode Class 'C', Electron Tube or Solid State Semiconductor RF Power Amplifier (RFPA) in SSBSC-AM mode.

e. Setting a Transceiver's Microphone gain to high (set outside the ALC range) and using excessive speech compression and/or processing.

f. Enhancing the Microphone's 'Bass' and 'Treble' Audio Frequencies (AF) outside a 300 Hz ~ 3000 Hz range, which increases the Radio Frequency (RF) signal Band Width (BW).

g. Rules of Thumb for Intermodulation Distortion (IMD) Band Width (BW) are;

i. The maximum frequency spacing of IMD products is the difference between the lowest and highest pitched Audio Frequency (AF) modulating the transmitter.

ii. The total Band Width (BW) occupied by a SSBSC-AM signal, when we include 3rd Order Intermodulation Distortion (IM3) products, is approximately three times the Audio Frequency (AF) Band Width (BW) of the system.

iii. Any increase in frequency difference between the highest and lowest modulation frequency increases Band Width (BW) greatly. Any increase in level increases the strength of the IMD product in even greater proportion than we might expect.

iv. The Band Width (BW) of the Transmit Band Pass Filter (BPF) does not set the Band Width (BW) of the signal.