Editors: Clause 100.2.7.1, Page 86, Line 19. Change “54 MHz” to “258 MHz”, Same change 100.2.12.1, Page 105, Line 20 and Line 25, Same 100.3.1, Page 108, Line 13.

Editor: Replace old section 100.2.8 in the draft with this updated section 100.2.8.

100.2.8 CLT transmitter requirements

100.2.8.1 OFDM channel power definitions

This subclause defines the terms and concepts used when specifying the CLT RF output requirements. For an OFDM channel there is a) the number of equivalent 6 MHz channels (*Neq)*, b) the encompassed spectrum, c) the encompassed spectrum, d) the modulated spectrum, and e) the number of active equivalent 6 MHz channels (*Neq*').

The number of equivalent 6 MHz channels, N*eq*, is constant and is derived from a single OFDM channel size of 192 MHz as shown in Equation (100-1):

$$Neq = 192\text{ MHz} / 6\text{ MHz} = 32 \quad (100\text{-}1)$$

Neqport at the MDI ("RF port") is the sum of the individual *Neq* of each OFDM channel.

The total number of OFDM channels, *NOFDM* is 5. Thus *Neqport* is 5 * 32 = 160.

The encompassed spectrum is the difference between the center frequency of the highest frequency active subcarrier of the highest frequency OFDM channel and the lowest frequency active subcarrier of the lowest frequency OFDM channel, plus the subcarrier spacing (all expressed in MHz). The encompassed spectrum of a single OFDM channel is the difference between the center frequency of the highest frequency active subcarrier and the lowest frequency active subcarrier in the OFDM channel, plus the subcarrier spacing.

Occupied spectrum (*Occupiedspectrum*) as shown in Equation (100-2) is the sum of the bandwidth (RF spectrum) in all channel frequency allocations (e.g., 6 MHz *channelsize*) that are occupied by the OFDM channel (*OFDMchannelbandwidth*). Even if one active subcarrier of an OFDM channel is placed in a given standard channel frequency allocation, that standard channel frequency allocation in its entirety is said to be occupied by the OFDM channel.

$$Occupiedspectrum = channelsize \times \lceil OFDMchannelbandwidth / channelsize \rceil \quad (100\text{-}2)$$

The occupied spectrum is a multiple of 6 MHz, with a minimum of 24 MHz, and consists of all 6 MHz channels that are included in the encompassed spectrum, plus the taper region shaped by the OFDM channels' transmit windowing; the out-of-band spurious emissions requirements in 100.2.8.5 (except for interior exclusion band spurious emissions requirements) apply outside the occupied spectrum. With a 1 MHz taper region on each band edge of the OFDM channel, shaped by the transmit windowing function, an encompassed spectrum of 190 MHz of active subcarriers has 192 MHz of occupied spectrum.

The modulated spectrum of a single OFDM channel is the encompassed spectrum minus the total spectrum in the internal excluded subbands of the OFDM channel, where the total spectrum in the internal excluded subbands is equal to the number of subcarriers in all of the internal excluded subbands of the OFDM channel multiplied by the subcarrier spacing of the OFDM channel. For example, with 190 MHz encompassed spectrum, if there are 188 subcarriers total in three internal exclusion subbands, then the total spectrum in the internal excluded subbands (in MHz) is 188*0.05 = 9.40 MHz, and the modulated spectrum is 190.00 MHz - 9.40 MHz = 180.60 MHz.

The modulated spectrum at the MDI ("RF port") is the sum of the modulated spectrum of each OFDM channel.

The number of active equivalent 6 MHz channels, *Neq'*, for an OFDM channel is a function of the modulated spectrum (MHz) of a channel as calculated in Equation (100-3):

$$Neq' = \lceil modulated\ spectrum\ of\ a\ single\ channel / channelsize \rceil \qquad (100\text{-}3)$$

Neqport' at the MDI ("RF port") is the sum of the *Neq*' of each OFDM channel.

100.2.8.2 CLT output electrical requirements

For OFDM, all modulated subcarriers in an OFDM channel are set to the same average power (except pilots which are boosted by 6 dB). For the purposes of meeting spurious emissions requirements, for each OFDM channel:

- Configure the OFDM channel power.
- CLT calculates power for data subcarrier and pilots (using total number of active subcarriers).
- The configured average power of an equivalent 6 MHz channel for each OFDM channel is defined as follows:
  - For the first OFDM channel the power calculated for the 6 MHz band centered on the PHY Link is the configured average power of an equivalent 6 MHz channel for that OFDM channel.
  - For the second OFDM channel, let *X* dB = data subcarrier power for the second channel - data subcarrier power for the first channel (offset dB). The configured average power of an equivalent 6 MHz channel for the second channel is equal to the configured average power of an equivalent 6 MHz channel for the first channel plus *X* dB. Different offsets are computed separately for the third, fourth, and fifth channels.

Editor: need to make sure these Table xref's are correct in the larger document when incorporated as Table 100-1 below will be Table 100-2 in the full clause 100 document. Make sure these xref's rename as shown here. Also need to validate footnotes after moving back into larger document.

A CLT shall output an OFDM RF modulated signal with the characteristics defined in Table 100–2, Table 100–4, and Table 100–5. These requirements are to be met under the conditions where the configured average power of an equivalent 6 MHz channel is the same for each OFDM channel, with the exception of the following: Single Channel Active Phase Noise, Diagnostic Carrier Suppression, OFDM Phase Noise, OFDM Diagnostic Suppression, and power difference requirements, and as described for Out-of-Band Noise and Spurious Requirements.

Table 100–1—CLT RF output requirements

Parameter	Value	Units
Frequency Band	258 to 1218	MHz
OFDM Channel Bandwidth	24 to 192	MHz
Encompassed spectrum	22 to 190	MHz
Subcarrier Spacing	50	kHz
OFDM Symbol Rate FFT Duration	20	µsec
FFT Size	4096	FFT bins
Maximum Number of active subcarriers per FFT	3800	subcarriers
Level	See Table 100–3.	

Table 100–1—CLT RF output requirements *(continued)*

Parameter	Value	Units
Modulation Format	See Table 100–2.	
Inband Spurious, Distortion, and Noise. [d]		
For measurements below 600 MHz [a]	≤ –50	dBr
For measurements from 600 MHz to 1002 MHz [a]	≤ –47	dBr
For measurements 1002 MHz to 1218 MHz [a]	≤ –45	dBr
MER in 192 MHz OFDM channel occupied spectrum 528 MHz total occupied spectrum, 88 equivalent 6 MHz channels [b, c, d, e, f]		
For measurements below 600 MHz:		
Any single subcarrier	≥ 48	dB
Average over the complete OFDM channel	≥ 50	dB
For measurements from 600 MHz to 1002 MHz:		
Any single subcarrier	≥ 45	dB
Average over the complete OFDM channel	≥ 47	dB
For measurements 1002 MHz to 1218 MHz:		
Any single subcarrier	≥ 43	dB
Average over the complete OFDM channel	≥ 45	dB
MER in 24 MHz OFDM channel occupied spectrum, single OFDM channel only, 24 MHz total occupied spectrum [b, c, d, g]. Average over the complete OFDM channel:		
For measurements below 600 MHz	≥ 48	dB
For measurements from 600 MHz to 1002 MHz	≥ 45	dB
For measurements 1002 MHz to 1218 MHz	≥ 43	dB
Output Impedance	75	ohms
Output Return Loss. Specified for within an active output OFDM channel or in every inactive OFDM channel as noted.		
88 MHz to 750 MHz; active	> 14	dB
750 MHz to 870 MHz; active	> 13	dB
870 MHz to 1218 MHz; active	> 12	dB
54 MHz to 870 MHz ; inactive	> 12	dB
870 MHz to 1218 MHz; inactive	> 10	dB

[a] Average over center 400 kHz subcarriers within gap.
[b] Receiver OFDM channel estimation is applied in the test receiver; test receiver does best estimation possible. Transmit windowing is applied to potentially interfering channel and selected to be sufficient to suppress cross channel interference.

[c] MER (modulation error ratio) is determined by the cluster variance caused by the transmit waveform at the output of the ideal receive matched filter. MER includes all discrete spurious, noise, subcarrier leakage, clock lines, synthesizer products, distortion, and other undesired transmitter products. Phase noise up to ± of the subcarrier is excluded from inband specification, to separate the phase noise and inband spurious requirements as much as possible. In measuring MER, record length or carrier tracking loop bandwidth may be adjusted to exclude low-frequency phase noise from the measurement. MER requirements assume measuring with a calibrated test instrument with its residual MER contribution removed.

[d] Phase noise up to 10 MHz offset is mitigated in test receiver processing or by test equipment (latter using hardline carrier from modulator, which requires special modulator test port and functionality).

[e] Up to 5 subcarriers in one OFDM channel can be excluded from this requirement.

[f] When the estimated channel impulse response used by the test receiver is limited to half of length of smallest transmit cyclic prefix then there is a 2 dB relief for above requirements (e.g., MER > 48 dB becomes MER > 46 dB).

[g] A single subcarrier in the OFDM channel can be excluded from this requirement, no windowing is applied and minimum CP is selected.

100.2.8.3 Phase Noise Requirements

The CLT transmitted signal for each OFDM channel shall be meet the phase noise requirements as per Table 100–2:

Table 100–2—Downstream Phase Noise Requirements

Parameter	Value	Units
Phase noise, integrated double sided maximum, 1002 MHz or lower:		
1 kHz to 10 kHz:	–48	dBc
10 kHz to 100 kHz:	–56	dBc
100 kHz to 1 MHz:	–60	dBc
1 MHz to 10 MHz:	–54	dBc
10 MHz to 100 MHz:	–60	dBc

100.2.8.4 Power per OFDM channel for CLT

The CLT shall adjust the RF transmit power per Table 100–3. In Table 100–3 the value for N^*, the adjusted number of active channels combined per RF port, is calculated using Equation (100-4).

$$\text{for } N^* \equiv \begin{cases} \text{minimum}\left[4Neqport', \left\lceil \frac{Neqport'}{4} \right\rceil\right], Neqport' < \frac{Neqport}{4} \\ Neqport', Neqport' \geq \frac{Neqport}{4} \end{cases} \qquad (100\text{-}4)$$

For an N_{eqport}-channel per RF port CLT, the applicable maximum power per OFDM channel and spurious emissions requirements are defined using the value of N^* per Equation (100-4).

Table 100–3—CLT RF output requirements

Parameter	Value[a,b]	Units
Maximum value of OFDM channel power in the OFDM channel occupied bandwidth normalized to 6 MHz ((OFDM signal power / occupied bandwidth) * 6 MHz:		
Neqport' OFDM channels combined onto a single RF port for $Neqport' \geq Neqport / 4$ [c] NOTE: With N* = bottom term in Equation (100-4)	$60 - \lceil 3.6 \times \log_2(N^*) \rceil$	dBmV / 6 MHz
Neqport' OFDM channels combined onto a single RF port for $4 \leq Neqport' < Neqport / 4$ [c] NOTE: With N* = top term in Equation (100-4)	$60 - \lceil 3.6 \times \log_2(N^*) \rceil$	dBmV / 6 MHz
Range of commanded transmit power for each OFDM channel, at least 8 dB below the required power level specified in the two rows above, maintaining full fidelity over the range	≥ 8	dB
Commanded power per OFDM channel step size. Strictly monotonic.	≤ 0.2	dB
Power difference between any two adjacent OFDM channels in the 108 MHz to 1218 MHz downstream spectrum (with commanded power difference removed if channel power is independently adjustable)	≤ 0.5	dB
Power difference between any two non-adjacent channels in a 48 MHz contiguous bandwidth block (with commanded power difference removed if channel power is independently adjustable)	≤ 1	dB
Power difference (normalized for bandwidth) between any two channels OFDM channel blocks in the 108 MHz to 1218 MHz downstream spectrum (with commanded power difference removed if channel power is independently adjustable)	≤ 2	dB
Power per channel absolute accuracy	± 2	dB

[a] Add 3 dB relaxation to the values specified above for noise and spurious emissions requirements in all channels with 603 MHz ≤ center frequency ≤ 999 MHz. For example –73 dBc becomes –70 dBc.
Add 5 dB relaxation to the values specified above for noise and spurious emissions requirements in all channels with 999 MHz < center frequency ≤ 1209 MHz . For example –73 dBc becomes –68 dBc.
[b] Add 1 dB relaxation to the values specified above for noise and spurious emissions requirements in gap channels with center frequency below 600 MHz. For example –73 dBc becomes –72 dBc.
[c] All equations are *Ceiling(Power, 0.5)* dBc. Use "*Ceiling(2*Power) / 2*" to get 0.5 steps from ceiling functions that return only integer values. For example Ceiling(–63.9, 0.5) = –63.5 dBc.

The CLT shall comply with all requirements operating with all *Neqport* channels on the RF port and with all requirements for the device operating with *Neqport*' active channels on the RF port for all values of *Neqport*' less than *Neqport*.

100.2.8.5 Out-of-band noise and spurious requirements for the CLT

Table 100–4 lists the out-of-band spurious requirements. In cases where the configured average power of an equivalent 6 MHz channel is not the same for each OFDM channel, 0 dBc for the spurious emissions requirements corresponds to the largest configured average power of an equivalent 6 MHz channel among all the active OFDM channels. When the configured average power of an equivalent 6 MHz channel is the same for each OFDM channel, 0 dBc should be interpreted as the measured power of the 6 MHz band centered on the PHY Link (of the OFDM channel containing the PHY Link).

The CLT modulator shall satisfy the out-of-band spurious emissions requirements of Table 100–4 in measurements below 600 MHz and outside the encompassed spectrum when the active OFDM channels are contiguous or when the ratio of modulated spectrum to gap spectrum within the encompassed spectrum is 4:1 or greater. Gap spectrum is spectrum between active OFDM channel's occupied spectrum and excluded bands within OFDM channel's occupied spectrum.

The CLT modulator shall satisfy the out-of-band spurious emissions requirements of Table 100–4 in gap spectrum between OFDM channels of at least 6 MHz and within exclusion bands within OFDM channels of at least 8 MHz, except for the 1 MHz of inactive subcarriers on each edge of any exclusion band, with relaxations as described in the following paragraphs when applicable.

The CLT modulator shall satisfy the out-of-band spurious emissions requirements of Table 100–4, with 1 dB relaxation, in measurements within gap spectrum in modulated spectrum below 600 MHz and within the encompassed spectrum when the ratio of modulated spectrum to gap spectrum within the encompassed spectrum is 4:1 or greater.

The CLT modulator shall satisfy the out-of-band spurious emissions requirements of Table 100–4, with 3 dB relaxation, when the ratio of modulated spectrum to gap spectrum within the encompassed spectrum is 4:1 or greater, in measurements with 603 MHz ≤ center frequency ≤ 999 MHz, outside the encompassed spectrum or in gap spectrum within the encompassed spectrum.

The CLT modulator shall satisfy the out-of-band spurious emissions requirements of Table 100–4, with 5 dB relaxation, when the ratio of modulated spectrum to gap spectrum within the encompassed spectrum is 4:1 or greater, in measurements with 999 MHz < center frequency ≤ 1209 MHz, outside the encompassed spectrum or in gap spectrum within the encompassed spectrum.

The CLT modulator shall satisfy the out-of -band spurious emissions requirements of Table 100–4, in addition to contributions from theoretical transmit windowing, with permissible configurations of lower edge and upper edge subband exclusions of at least 1 MHz each, FFT Size, cyclic prefix length (*DSNcp*) and windowing roll-off period (*DSNrp*) values. The test limit for determining compliance to the spurious emissions requirements is the power sum of the spurious emissions requirements, taken in accordance with Table 100–4 and the contributions from the theoretical transmit windowing for the configured transmissions.

The full set of *Neqport*' active equivalent 6 MHz channels is referred to throughout this specification as the modulated OFDM channels or the active OFDM channels. However, for purposes of determining the spurious emissions requirements for non-contiguous transmitted OFDM channels, each separate contiguous sub-block of channels within the active OFDM channels is identified, and the number of OFDM channels in each contiguous sub-block is denoted as:

Neqi, for $i = 1$ to K,

where K is the number of contiguous blocks. Therefore,

$$Neqport' \leq \sum_{i=1}^{K} Neqi \qquad (100\text{-}5)$$

Because exclusion subbands may be as small as 1 MHz with two or more contiguous sub-blocks within an OFDM channel, the number of active equivalent 6 MHz channels in each contiguous sub-block may add to more than the number of active equivalent 6 MHz channels in the full OFDM channel. Any double-counting of active subcarriers near small exclusion bands is acceptable in calculating the spurious emissions requirements; the equipment has to meet spurious emissions requirements in cases where Equation (100-5) is met with equality and the small relaxation in requirements which results from inequality is thus not compelling.

Note that $K = 1$ when and only when the entire set of active OFDM channels is contiguous. Also note that an isolated transmit OFDM channel, i.e., a transmit channel with empty adjacent OFDM channels, is described by $Neqi = 1$ and constitutes a block of one contiguous OFDM channel. Any number of the contiguous blocks may have such an isolated transmit OFDM channel; if each active OFDM channel was an isolated channel, then $K = Neq'$.

When the *Neqport'* combined active OFDM channels are not contiguous and the ratio of modulated spectrum to gap spectrum within the encompassed spectrum is 4:1 or greater, the spurious emissions requirements are determined by summing the spurious emissions power allowed in a given measurement bandwidth by each of the contiguous blocks among the occupied spectrum. In the gap spectrum within the encompassed spectrum and below 600 MHz there is a 1 dB relaxation in the spurious emissions requirements, so that within the encompassed spectrum the spurious emissions requirements (in absolute power) are 26% higher power in the measurement band determined by the summing of the contiguous blocks spurious emissions requirements. In all OFDM channels above 600 MHz there is a 3 dB relaxation in the spurious emissions requirements, so that the spurious emissions requirements (in absolute power) are double the power in the measurement band determined by the summing of the contiguous blocks spurious emissions requirements. The following three paragraphs provide the details of the spurious emissions requirements for non-contiguous OFDM channel operation outside the encompassed spectrum; within the encompassed spectrum the same details apply, except there is an additional 1 dB allowance below 600 MHz and a 3 dB allowance is applied above 600 MHz for all OFDM channels.

When $Neqport' \geq Neqport / 4$, Table 100–4 is used for determining the noise and spurious power requirements for each contiguous block, even if the block contains fewer than $Neqport / 4$ active OFDM channels. When $Neqport' < Neqport / 4$, Table 100–4 is used for determining the noise and spurious power requirements for each contiguous block. Thus, the noise and spurious power requirements for all contiguous blocks of transmitted channels are determined from Table 100–4, where the applicable table is determined by whether $Neqport' \geq Neqport / 4$ or not. The noise and spurious power requirements for the *i*th contiguous block of transmitted channels is determined from Table 100–4 using the value *Neqi* for the number of active OFDM channels combined per RF port, and using dBc relative to the highest commanded power level of a 6 MHz equivalent channel among all the active OFDM channels, and not just the highest commanded power level in the *i*th contiguous block, in cases where the *Neqport'* combined OFDM channels are not commanded to the same power. The noise and spurious emissions power in each measurement band, including harmonics, from all *K* contiguous blocks, is summed (absolute power, NOT in dB) to determine the composite noise floor for the non-contiguous channel transmission condition.

For the measurement OFDM channels adjacent to a contiguous block of channels, the spurious emissions requirements from the non-adjacent blocks are divided on an equal per Hz basis for the narrow and wide adjacent measurement bands. For a measurement channel wedged between two contiguous blocks, adjacent to each, the measurement channel is divided into three measurement bands: one wider in the middle and two narrower bands each abutting one of the adjacent transmit channels. The wideband spurious and noise requirement is split into two parts, on an equal per Hz basis, to generate the allowed contribution of power to the middle band and to the farthest narrowband.

In Table 100–4 the value for N^* is calculated using Equation (100-4). Items 1 through 4 list the requirements in channels adjacent to the commanded channels. Item 5 lists the requirements in all other channels further from the commanded channels. Some of these "other" channels are allowed to be excluded from meeting the Item 5 specification. All the exclusions, such as 2nd and 3rd harmonics of the commanded channel, are fully identified in the table. Item 6 lists the requirements on the 2*Neqport*' 2nd harmonic channels and the 3*Neqport*' 3rd harmonic channels.

Table 100–4—CLT output out-of-band noise and spurious emissions requirements

Item	Band	Requirement (in dBc)[a,b,c,d]
1	Adjacent channel up to 750 kHz from channel block edge	For $N^* = 1$: ≤ -58 For $N^* = 2$: ≤ -58 For $N^* = 3$: ≤ -58 For $N^* = 4$: ≤ -58 For $N^* \geq 5$: $\leq 10*\log_{10} [10^{-58/10} + (0.75/6)*(10^{-65/10} + (N^*-2)*10^{-73/10})]$
2	Adjacent channel (750 kHz from channel block edge to 6 MHz from channel block edge)	For $N^* = 1$: ≤ -62 For $N^* \geq 2$: $\leq 10*\log_{10} [10^{-62/10} + (5.25/6)*(10^{-65/10} + (N^*-2)*10^{-73/10})]$
3	Next-adjacent channel (6 MHz from channel block edge to 12 MHz from channel block edge)	$\leq 10*\log_{10} [10^{-65/10} + (N^*-1)*10^{-73/10}]$
4	Third-adjacent channel (12 MHz from channel block edge to 18 MHz from channel block edge)	For $N^* = 1$: ≤ -73 For $N^* = 2$: ≤ -70 For $N^* = 3$: ≤ -67 For $N^* = 4$: ≤ -65 For $N^* = 5$: ≤ -64.5 For $N^* = 6$: ≤ -64 For $N^* = 7$: ≤ -64 For $N^* \geq 8$: $\leq -73 + 10*\log_{10} (N^*)$
5	Noise in other channels (47 MHz to 1218 MHz) Measured in each 6 MHz channel excluding the following: a) Desired channel(s) b) 1st, 2nd, and 3rd adjacent channels (see Items 1, 2, 3, 4 in this table) c) Channels coinciding with 2nd and 3rd harmonics (see Item 6 in this table)	For $N^* = 1$: ≤ -73; For $N^* = 2$: ≤ -70; For $N^* = 3$: ≤ -68; For $N^* = 4$: ≤ -67; For $N^* \geq 5$: $\leq -73 + 10*\log_{10} (N^*)$
6	In each of 2*Neqport*' contiguous 6 MHz channels or in each of 3*Neqport*' contiguous 6 MHz channels coinciding with 2nd harmonic and with 3rd harmonic components respectively (up to 1218 MHz)	$\leq -73 + 10*\log_{10} (N^*)$ or -63, whichever is greater
7	Lower out of band noise in the band of 5 MHz to 47 MHz, measured in 6 MHz channel bandwidth	$\leq -50 + 10*\log_{10}(N^*)$
8	Higher out of band noise in the band of 1218 MHz to 3000 MHz, measured in 6 MHz channel bandwidth	For $N^* \leq 8$: $\leq -55 + 10*\log_{10}(N^*)$ For $N^* > 8$: $\leq -60 + 10*\log_{10}(N^*)$

[a] All equations are Ceiling(Power, 0.5) dBc. Use "Ceiling(2*Power) / 2" to get 0.5 steps from ceiling functions that return only integer values. For example Ceiling(–63.9, 0.5) = –63.5 dBc.

[b] Add 3 dB relaxation to the values specified above for noise and spurious emissions requirements in all channels with 603 MHz ≤ center frequency ≤ 999 MHz. For example –73 dBc becomes –70 dBc.
[c] Add 5 dB relaxation to the values specified above for noise and spurious emissions requirements in all channels with 999 MHz < center frequency ≤ 1209 MHz . For example –73 dBc becomes –68 dBc.
[d] Add 1 dB relaxation to the values specified above for noise and spurious emissions requirements in gap channels with center frequency below 600 MHz. For example –73 dBc becomes –72 dBc.

100.2.8.6 CLT Transmitter Output Requirements

The CLT MUST provide for independent selection of center frequency with the ratio of number of active channels to gap spectrum in the encompassed spectrum being at least 2:1.

Editor: insert this as new Clause 101.4.2.3

101.4.2.3Subcarrier Clocking

The "locking" of subcarrier "clock and carrier" are defined and characterized by the following rules:

- Each OFDM symbol is defined with an FFT duration (equal to subcarrier clock period) of 20 µs. For each OFDM symbol, the subcarrier clock period (µs) may vary from nominal with limits defined in 101.4.2.2.
- The number of cycles of each subcarrier generated by the CLT during one period of the subcarrier clock (for each OFDM symbol) MUST be an integer number. The CLT subcarrier clock shall be synchronous with the 10.24 MHz Master Clock defined by:

  subcarrier clock frequency = (40 / 8192) * Master Clock frequency

- The limitation on the variation from nominal of the subcarrier clock frequency at the output connector is defined in 101.4.2.2.
- Each OFDM symbol has a cyclic prefix which is an integer multiple of 1 / 64th, of the subcarrier clock period.
- Each OFDM symbol duration is the sum of one subcarrier clock period and the cyclic prefix duration.
- The number of cycles of each subcarrier generated by the CLT during the OFDM symbol duration (of each symbol) shall be $K + K * L / 64$, where K is an integer related to the subcarrier index and frequency up-conversion of the OFDM channel, and L is an integer related to the cyclic prefix. (K is an integer related to the subcarrier index and increases by 1 for each subcarrier).
- The phase of each subcarrier within one OFDM symbol is the same, when each is assigned the same constellation point (I + jQ), relative to the Reference Time of the OFDM symbol. There is nominally no change in phase on each subcarrier for every cycle of 64 OFDM symbols, when both are assigned the same I + jQ, and referenced to the Reference Time of their respective OFDM symbol.

Editor: Clause 101.4.2.2, Page 156, Line 38. Remove editor's note.

Editor: add new subclause 100.3.3

100.3.3 Guidelines for verifying compliance with downstream phase noise requirements

The CLT transmitted signal for each OFDM channel shall be meet the test phase noise requirements as per Table 100–5. These are transmitter requirements only.

Table 100–5—Downstream Phase Noise Test Requirements

Parameter	Value	Units
Phase noise, integrated double sided maximum, Full power CW signal 1002 MHz or lower:		
1 kHz to 10 kHz:	–48	dBc
10 kHz to 100 kHz:	–56	dBc
100 kHz to 1 MHz:	–60	dBc
1 MHz to 10 MHz:	–54	dBc
10 MHz to 100 MHz:	–60	dBc
Full power 192 MHz OFDM channel block with 6 MHz in center as Internal Exclusion subband + 0 dBc CW in center, with block not extending beyond 1002 MHz. ~~CW not processed via FFT:~~		
1 kHz to 10 kHz	–48	dBc
10 kHz to 100 kHz	–56	dBc
Full power 192 MHz OFDM channel block with 24 MHz in center as Internal Exclusion subband + 0 dBc CW in center, with block not extending beyond 1002 MHz. ~~CW not processed via FFT.~~		
100 kHz to 1 MHz:	–60	dBc
Full power 192 MHz OFDM channel block with 30 MHz in center as Internal Exclusion subband + 7 dBc CW in center, with block not extending beyond 1002 MHz. ~~CW not processed via FFT.~~		
1 MHz to 10 MHz	–53	dBc

When CW is processed via FFT, the CW is a continuous pilot selected to be on a subcarrier in proper coordination with the cyclic prefix; so there are no phase glitches on the subcarrier in transitioning from one OFDM symbol to another. In this configuration the EPoC OFDM continuous pilot is in fact phase continuous in the time domain; in general the continuous pilots are not phase continuous in the time domain. Continuous pilot means that subcarrier is continuously used as a pilot and in general does not mean that the phase is continuous. Placing a continuous pilot using a subcarrier where the continuous pilot does in fact have continuous phase in the time domain will serve as the CW signal in the phase noise tests and allow the full FFT processing associated with compliant OFDM transmissions to be engaged (compliant except for a single active subcarrier with large power in the middle of a large exclusion subband). This is the preference for verifying phase noise requirements.

If a continuous pilot is not used (as above), the OFDM channel will have real data in the non-excluded subcarriers, FFT processing is occurring for those data subcarriers. The OFDM transmitter will need to generate a time continuous phase signal on the CW signal subcarrier that is synchronous with the data subcarriers RF and symbol clock.The OFDM test receiver need to be functionally equivalent to: 1) phase/noise test equipment that will filter out data subcariers and 2) a modified compliant receiver that validates the data subcarriers are operating properly, this latter step can be done non-real time. The easiest way of validating that the transmitted waveform is as intended to should be employed.

A CLT shall provide a test mode of operation, for out-of-service testing, configured for *N* channels but generating one-CW-per-channel, one channel at a time at the center frequency of the selected channel; all other combined channels are suppressed. One purpose for this test mode is to support one method for testing the phase noise requirements of Table 100–2 and Table 100–5. As such, the CLT generation of the CW test tone should exercise the signal generation chain to the fullest extent practicable, in such manner as to exhibit phase noise characteristics typical of actual operational performance; for example, repeated selection of a constellation symbol with power close to the constellation RMS level would seemingly exercise much of the modulation and up-conversion chain in a realistic manner. The CLT test mode shall be capable of generating the CW tone over the full range of Center Frequency in Table 100–5.

— In addition, the CLT shall be configurable in either one or both of the following conditions: Two CW carriers on a single out-of-service DS OFDM channel, at selectable valid subcarrier center frequencies 20 MHz to 100 MHz apart within the selected channel. All other subcarriers within the selected out-of-service DS OFDM channel are suppressed.
— One CW carrier on each of two separate but synchronized DS OFDM channels at selectable valid subcarrier center frequencies 20 MHz to 100 MHz apart within the selected channels. All other subcarriers within the selected out-of-service DS OFDM channel are suppressed.

The purpose of this test mode is to support the ability to measure the downstream Symbol Clock Jitter requirements of Table 101.4.2.2, whereby the two CW carriers are mixed to create a difference product CW carrier at frequency (F2-F1), for which the jitter is measure directly and compared to the requirements stated in that section.

A CLT shall provide a test mode of operation, for out-of-service testing, generating one-CW-per-channel, at the center frequency of the selected channel, with all other N - 1 of the combined channels active and containing valid data modulation at operational power levels. One purpose for this test mode is to support one method for testing the phase noise requirements of Table 100–5. As such, the generation of the CW test tone should exercise the signal generation chain to the fullest extent practicable, in such manner as to exhibit phase noise characteristics typical of actual operational performance. For example, a repeated selection of a constellation symbol, with power close to the constellation RMS level, would seemingly exercise much of the modulation and up-conversion chain in a realistic manner. For this test mode, it is acceptable that all channels operate at the same average power, including each of the N - 1 channels in valid operation, and the single channel with a CW tone at its center frequency. When operating in one-CW-per-channel test mode the CLT shall be capable of generating the CW tone over the full range of Center Frequency in Table 100–5.

Editors: insert the following three paragraphs of text into Clause 101.4.2.2, Page 156 Line 4 between the two sentences of the first paragraph. Make the first and second sentence their own paragraph in the resulting text.

The purpose of this section is to ensure that the CLT transmitter can provide proper timing and frequency references for EPoC downstream OFDM operation and that the CNU receiver can acquire the system timing and subcarrier from the downstream for proper EPoC operation.

The CLT downstream OFDM symbol and subcarrier frequency and timing relationship is defined in 101.4.2.3.

Tolerances for the downstream subcarrier clock frequency are given in this subclause Table 100-3). Functional requirements involving the downstream subcarrier clock frequency and downstream signal generation are contained in 101.4.2.3, which couple the subcarrier clock frequency tolerance performance to the phase noise requirements of Table 100-3 and the downstream OFDM symbol clock requirements of this subclause. Each cycle of the downstream subcarrier clock is 4096 cycles (50 kHz subcarrier spacing) of the downstream OFDM symbol clock (which is nominally 204.8 MHz), since the subcarrier clock period is defined as the FFT duration for each OFDM symbol. Functional requirements on locking the downstream waveform to the 10.24 MHz Master Clock are then equivalently functional requirements locking the downstream subcarrier clock to the Master Clock. Downstream OFDM symbol clock jitter requirements (which are in the time domain) of Table 101-7 are equivalently requirements on the downstream subcarrier clock (and its harmonics). The requirements on the OFDM symbol clock are effectively measured on observables in the downstream waveform, which include the downstream subcarrier clock frequency (manifested in the subcarrier spacing) and downstream subcarrier frequencies.

Editors: add table footnote to Table 101-7 to the end of the sentence that begins with "where":

The CLT shall use a value of f_{DS} that is an integral multiple or divisor of the downstream symbol clock. For example, an f_{DS} = 409.6 MHz clock may be measured if there is no explicit 204.8 MHz clock available.

Editors: Clause 101.4.2.2, Page 156 Line 38 remove Editor's note.