

# SubVI Specifications for "Communication Systems Projects with LabVIEW"

**By:**  
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**Online:**  
< <http://cnx.org/content/col10608/1.2/> >

**C O N N E X I O N S**

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Collection structure revised: January 5, 2010

PDF generated: October 26, 2012

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# Table of Contents

<b>1 General-Purpose Utilities</b>	
1.1 Bitstream sources .....	1
1.2 Bitstream conversion .....	5
1.3 Channel noise .....	11
1.4 Performance metrics .....	15
1.5 Miscellaneous .....	17
<b>2 Baseband Modulation and Pulse Amplitude Modulation (PAM)</b>	
2.1 Pulse shapes .....	25
2.2 Transmitter components .....	31
<b>3 Bandpass Modulation</b>	
3.1 bpm_EnvelopeDetector.vi .....	39
3.2 bpm_ProductModulator.vi .....	41
3.3 bpm_ReceiverFilter.vi .....	43
<b>4 Demodulation and Bitstream Regeneration</b>	
4.1 Synchronization .....	47
4.2 Preamble processing .....	53
4.3 Coherent detection .....	57
4.4 Sampling .....	59
<b>5 Hamming Block Coding</b>	
5.1 hamming_DetectorCorrector.vi .....	67
5.2 hamming_GeneratorMatrix.vi .....	69
5.3 hamming_HammingCodeParameters.vi .....	71
5.4 hamming_Mod2MatrixMultiply.vi .....	73
5.5 hamming_ParityCheckMatrix.vi .....	75
5.6 hamming_SyndromeTable.vi .....	77
<b>6 Speaker - Air - Microphone (SAM) Channel</b>	
6.1 sam_GrabAudio.vi .....	81
6.2 sam_GrabAudioDynamic.vi .....	83
6.3 sam_ListenForAudio.vi .....	85
<b>7 Caller ID Decoder</b>	
7.1 cid_Demodulator.vi .....	89
7.2 cid_DetectStartBit.vi .....	91
<b>Index</b> .....	94
<b>Attributions</b> .....	95



# Chapter 1

## General-Purpose Utilities

### 1.1 Bitstream sources

#### 1.1.1 util\_BitstreamFromRandom.vi<sup>1</sup>


	This module refers to LabVIEW, a software development environment that features a graphical programming language. Please see the LabVIEW QuickStart Guide <sup>2</sup> module for tutorials and documentation that will help you:
	<ul style="list-style-type: none"><li>• Apply LabVIEW to Audio Signal Processing</li></ul>
	Get started with LabVIEW
	<ul style="list-style-type: none"><li>• Obtain a fully-functional evaluation edition of LabVIEW</li></ul>

Table 1.1

NOTE: Visit LabVIEW Setup<sup>3</sup> to learn how to adjust your own LabVIEW environment to match the settings used by the LabVIEW screencast video(s) in this module. Click the "Fullscreen" button at the lower right corner of the video player if the video does not fit properly within your browser window.

<sup>1</sup>This content is available online at <http://cnx.org/content/m18528/1.1/>.

<sup>2</sup>"NI LabVIEW Getting Started FAQ" <http://cnx.org/content/m15428/latest/>

<sup>3</sup>"LabVIEW Setup for "Communication Systems Projects with LabVIEW"" <http://cnx.org/content/m17319/latest/>

### 1.1.1.1 LabVIEW SubVI: `util_BitstreamFromRandom.vi`

- **Description:** Generate a bitstream from a random number generator. The probability of generating a 1 can be controlled, as can the value of the random number seed.
- **Category:** General-purpose utility ("util" prefix)

### 1.1.1.2 Inputs (Controls)

1. `length (128)` – I32
2. `ones probability (0.5)` – DBL
3. `seed (-1)` – I32

Parentheses ( ) indicate default value; square brackets [ ] designate units.

### 1.1.1.3 Outputs (Indicators)

1. `bitstream out` – 1-D Boolean array

### 1.1.1.4 Required Behavior

- The bitstream length defaults to 128 bits.
- A "seed" value of -1 indicates that a new set of random bits should be generated each time the subVI is called. Positive seed values will cause the same pattern to be generated each time, with the particular seed value selecting a different pattern.



### 1.1.1.5 LabVIEW Coding Tips

View the screencast video in Create a SubVI in LabVIEW<sup>4</sup> to learn the mechanics of subVIs.

Refer to the Figure 1.1 screencast video for LabVIEW coding tips and techniques specific to this subVI.


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**Figure 1.1:** [video] LabVIEW coding tips and techniques for util\_BitstreamFromRandom.vi

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### 1.1.2 util\_BitstreamFromText.vi<sup>5</sup>

	<p>This module refers to LabVIEW, a software development environment that features a graphical programming language. Please see the LabVIEW QuickStart Guide<sup>6</sup> module for tutorials and documentation that will help you:</p>
	<ul style="list-style-type: none"> <li>• Apply LabVIEW to Audio Signal Processing</li> </ul>
	<p>Get started with LabVIEW</p>
	<ul style="list-style-type: none"> <li>• Obtain a fully-functional evaluation edition of LabVIEW</li> </ul>

**Table 1.2**

NOTE: Visit LabVIEW Setup<sup>7</sup> to learn how to adjust your own LabVIEW environment to match the settings used by the LabVIEW screencast video(s) in this module. Click the "Fullscreen" button at the lower right corner of the video player if the video does not fit properly within your browser window.

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<sup>4</sup>"Create a SubVI in LabVIEW" <<http://cnx.org/content/m14767/latest/>>

<sup>5</sup>This content is available online at <<http://cnx.org/content/m18631/1.1/>>.

<sup>6</sup>"NI LabVIEW Getting Started FAQ" <<http://cnx.org/content/m15428/latest/>>

<sup>7</sup>"LabVIEW Setup for "Communication Systems Projects with LabVIEW"" <<http://cnx.org/content/m17319/latest/>>

### 1.1.2.1 LabVIEW SubVI: `util_BitstreamFromText.vi`

- **Description:** Generate a bitstream from a sequence of text characters. Framing bits (start bit and stop bit) may optionally be added to the bitstream. The bitstream is also available in the form of a wordstream.
- **Category:** General-purpose utility ("util" prefix)

### 1.1.2.2 Inputs (Controls)

1. `text` – string
2. `insert framing bits (F)` – Boolean
3. `start bit value (T)` – Boolean

Parentheses ( ) indicate default value; square brackets [ ] designate units.

### 1.1.2.3 Outputs (Indicators)

1. `bitstream out` – 1-D Boolean array
2. `wordstream out` – 2-D Boolean array

### 1.1.2.4 Required Behavior

- Converted text follows the indexing schemes imposed by the LabVIEW built-in nodes "String to Byte Array" and "Number to Boolean Array."
- When requested, the "start bit value" will be prepended to the 8-bit Boolean value, and the complement of the "start bit value" will be appended to the 8-bit Boolean value.
- The wordstream is an Nx8 2-D version of the 1-D bitstream (Nx10 if framing bits have been inserted), where "N" is the number of characters in the text control.

### 1.1.2.5 LabVIEW Coding Tips

View the screencast video in Create a SubVI in LabVIEW<sup>8</sup> to learn the mechanics of subVIs.

Refer to the Figure 1.2 screencast video for LabVIEW coding tips and techniques specific to this subVI.

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**Figure 1.2:** [video] LabVIEW coding tips and techniques for util\_BitstreamFromText.vi

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## 1.2 Bitstream conversion

### 1.2.1 util\_BitsToWords.vi<sup>9</sup>

	<p>This module refers to LabVIEW, a software development environment that features a graphical programming language. Please see the LabVIEW QuickStart Guide<sup>10</sup> module for tutorials and documentation that will help you:</p>
	<ul style="list-style-type: none"> <li>• Apply LabVIEW to Audio Signal Processing</li> </ul>
	<p>Get started with LabVIEW</p> <ul style="list-style-type: none"> <li>• Obtain a fully-functional evaluation edition of LabVIEW</li> </ul>

**Table 1.3**

NOTE: Visit LabVIEW Setup<sup>11</sup> to learn how to adjust your own LabVIEW environment to match the settings used by the LabVIEW screencast video(s) in this module. Click the "Fullscreen" button at the lower right corner of the video player if the video does not fit properly within your browser window.

<sup>8</sup>"Create a SubVI in LabVIEW" <<http://cnx.org/content/m14767/latest/>>

<sup>9</sup>This content is available online at <<http://cnx.org/content/m18596/1.1/>>.

<sup>10</sup>"NI LabVIEW Getting Started FAQ" <<http://cnx.org/content/m15428/latest/>>

<sup>11</sup>"LabVIEW Setup for "Communication Systems Projects with LabVIEW"" <<http://cnx.org/content/m17319/latest/>>

### 1.2.1.1 LabVIEW SubVI: util\_BitsToWords.vi

- **Description:** Convert a bitstream into a wordstream (sequence of k-bit words) by reshaping a 1-D Boolean array into a 2-D Boolean array.
- **Category:** General-purpose utility ("util" prefix)

### 1.2.1.2 Inputs (Controls)

1. `bitstream in` – 1-D Boolean array
2. `k, word size` – I32

Parentheses ( ) indicate default value; square brackets [ ] designate units.

### 1.2.1.3 Outputs (Indicators)

1. `wordstream out` – 2-D Boolean array

### 1.2.1.4 Required Behavior

- The inbound bitstream of length  $N$  produces an outbound wordstream (2-D array) of dimension  $(N/k)$  by  $k$ , where  $k$  is the wordsize.
- When  $N$  is not an integer multiple of  $k$ , the wordstream will be padded with Boolean "False" value.

### 1.2.1.5 LabVIEW Coding Tips

View the screencast video in Create a SubVI in LabVIEW<sup>12</sup> to learn the mechanics of subVIs.

Refer to the Figure 1.3 screencast video for LabVIEW coding tips and techniques specific to this subVI.

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**Figure 1.3:** [video] LabVIEW coding tips and techniques for util\_BitsToWords.vi

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### 1.2.2 util\_WordsToBits.vi<sup>13</sup>

	<p>This module refers to LabVIEW, a software development environment that features a graphical programming language. Please see the LabVIEW QuickStart Guide<sup>14</sup> module for tutorials and documentation that will help you:</p>
	<ul style="list-style-type: none"> <li>• Apply LabVIEW to Audio Signal Processing</li> </ul>
	<p>Get started with LabVIEW</p>
	<ul style="list-style-type: none"> <li>• Obtain a fully-functional evaluation edition of LabVIEW</li> </ul>

**Table 1.4**

NOTE: Visit LabVIEW Setup<sup>15</sup> to learn how to adjust your own LabVIEW environment to match the settings used by the LabVIEW screencast video(s) in this module. Click the "Fullscreen" button at the lower right corner of the video player if the video does not fit properly within your browser window.

<sup>12</sup>"Create a SubVI in LabVIEW" <<http://cnx.org/content/m14767/latest/>>

<sup>13</sup>This content is available online at <<http://cnx.org/content/m18551/1.1/>>.

<sup>14</sup>"NI LabVIEW Getting Started FAQ" <<http://cnx.org/content/m15428/latest/>>

<sup>15</sup>"LabVIEW Setup for "Communication Systems Projects with LabVIEW"" <<http://cnx.org/content/m17319/latest/>>

### 1.2.2.1 LabVIEW SubVI: `util_WordsToBits.vi`

- **Description:** Convert a wordstream (sequence of k-bit words) into a bitstream by reshaping a 2-D Boolean array into a 1-D Boolean array.
- **Category:** General-purpose utility ("util" prefix)

### 1.2.2.2 Inputs (Controls)

1. `wordstream in` – 2-D Boolean array

Parentheses ( ) indicate default value; square brackets [ ] designate units.

### 1.2.2.3 Outputs (Indicators)

1. `bitstream out` – 1-D Boolean array

### 1.2.2.4 Required Behavior

- The inbound wordstream (2-D array) of dimension  $(N/k)$  by  $k$ , where  $k$  is the wordsize, produces an outbound bitstream of length  $N$ .

### 1.2.2.5 LabVIEW Coding Tips

View the screencast video in Create a SubVI in LabVIEW<sup>16</sup> to learn the mechanics of subVIs.

Refer to the Figure 1.4 screencast video for LabVIEW coding tips and techniques specific to this subVI.

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**Figure 1.4:** [video] LabVIEW coding tips and techniques for util\_WordsToBits.vi

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### 1.2.3 util\_BitstreamToText.vi<sup>17</sup>

	<p>This module refers to LabVIEW, a software development environment that features a graphical programming language. Please see the LabVIEW QuickStart Guide<sup>18</sup> module for tutorials and documentation that will help you:</p>
	<ul style="list-style-type: none"> <li>• Apply LabVIEW to Audio Signal Processing</li> </ul>
	<p>Get started with LabVIEW</p>
	<ul style="list-style-type: none"> <li>• Obtain a fully-functional evaluation edition of LabVIEW</li> </ul>

**Table 1.5**

NOTE: Visit LabVIEW Setup<sup>19</sup> to learn how to adjust your own LabVIEW environment to match the settings used by the LabVIEW screencast video(s) in this module. Click the "Fullscreen" button at the lower right corner of the video player if the video does not fit properly within your browser window.

<sup>16</sup>"Create a SubVI in LabVIEW" <<http://cnx.org/content/m14767/latest/>>

<sup>17</sup>This content is available online at <<http://cnx.org/content/m18629/1.1/>>.

<sup>18</sup>"NI LabVIEW Getting Started FAQ" <<http://cnx.org/content/m15428/latest/>>

<sup>19</sup>"LabVIEW Setup for "Communication Systems Projects with LabVIEW"" <<http://cnx.org/content/m17319/latest/>>

### 1.2.3.1 LabVIEW SubVI: `util_BitstreamToText.vi`

- **Description:** Interpret a bitstream as a sequence of text characters. Framing bits (start bit and stop bit) may optionally have been added to the bitstream, and are removed. Framing errors (mismatch between expected and actual values of framing bits) are indicated.
- **Category:** General-purpose utility ("util" prefix)

### 1.2.3.2 Inputs (Controls)

1. `bitstream in` – Boolean 1-D array
2. `includes framing bits (F)` – Boolean
3. `start bit value (T)` – Boolean

Parentheses ( ) indicate default value; square brackets [ ] designate units.

### 1.2.3.3 Outputs (Indicators)

1. `text out` – string
2. `framing error?` – 1-D Boolean array

### 1.2.3.4 Required Behavior

- The bitstream must follow the indexing schemes imposed by the LabVIEW built-in nodes "Boolean Array to Number" and "Byte Array to String."
- When `includes framing bits` is true, the start bit leading the 8-element Boolean subarray (a single text character) and the trailing stop bit will be removed from the bitstream before converting to text. In addition, the start bit will be compared to the expected value `start bit value`; the same holds true for the stop bit, which is assumed to be the complement of `start bit value`. Any mismatch is to be flagged as a framing error by setting `framing error?` true.



### 1.2.3.5 LabVIEW Coding Tips

View the screencast video in Create a SubVI in LabVIEW<sup>20</sup> to learn the mechanics of subVIs.

Refer to the Figure 1.5 screencast video for LabVIEW coding tips and techniques specific to this subVI.

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**Figure 1.5:** [video] LabVIEW coding tips and techniques for util\_BitstreamToText.vi

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## 1.3 Channel noise

### 1.3.1 util\_BinarySymmetricChannel.vi<sup>21</sup>

	<p>This module refers to LabVIEW, a software development environment that features a graphical programming language. Please see the LabVIEW QuickStart Guide<sup>22</sup> module for tutorials and documentation that will help you:</p>
	<ul style="list-style-type: none"> <li>• Apply LabVIEW to Audio Signal Processing</li> </ul>
	<p>Get started with LabVIEW</p> <ul style="list-style-type: none"> <li>• Obtain a fully-functional evaluation edition of LabVIEW</li> </ul>

**Table 1.6**

NOTE: Visit LabVIEW Setup<sup>23</sup> to learn how to adjust your own LabVIEW environment to match the settings used by the LabVIEW screencast video(s) in this module. Click the "Fullscreen" button at the lower right corner of the video player if the video does not fit properly within your browser window.

<sup>20</sup>"Create a SubVI in LabVIEW" <<http://cnx.org/content/m14767/latest/>>

<sup>21</sup>This content is available online at <<http://cnx.org/content/m18537/1.1/>>.

<sup>22</sup>"NI LabVIEW Getting Started FAQ" <<http://cnx.org/content/m15428/latest/>>

<sup>23</sup>"LabVIEW Setup for "Communication Systems Projects with LabVIEW"" <<http://cnx.org/content/m17319/latest/>>

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