

Description**Background of the Invention**

This invention relates to electrical circuits responsive to signals having a predetermined frequency and, more particularly to apparatus for detecting the presence of a signal exhibiting a predetermined frequency.

Description of the Prior Art

One conventional technique for detecting the presence of a signal exhibiting a predetermined frequency is an analog inductor-capacitor type filter tuned to the predetermined frequency and coupled to a threshold detector. When a signal waveform containing the signal exhibiting the predetermined frequency is applied to the analog filter, such signal flows in a substantially unattenuated manner to the output of the filter. Since all other signals are substantially attenuated, only signals having substantial signal energy at or near the predetermined frequency of the tuned filter will reach the threshold detector and be detected thereby. The approach just described constitutes a selective frequency signal detector employing a passive filter. It is known that circuits for detecting signals of predetermined frequency are also implemented by employing active filters.

Digital filters such as the finite impulse response (FIR) filters described in Digital Signal Processing by Oppenheim and Schaffer, published by Prentice Hall Inc., 1975, pages 239—250, the text of which is incorporated herein by reference, may be employed to select a signal exhibiting substantial energy at or near a predetermined frequency and to reject signals exhibiting other frequencies. In this approach an input signal is sampled at a predetermined rate to generate signal samples. The conventional digital bandpass filter operates on such samples in a manner such that, in effect, a passband is formed for signals exhibiting energy at or near the desired predetermined frequency and, stop bands are formed for signals exhibiting other frequencies. It is known that increasing the number of samples taken per unit time increases the performance capabilities of the digital filter in terms of maximum allowable input frequency. However, this approach has substantial limitations in that as the number of samples taken increases, the amount of computational time consumed likewise substantially increases.

One digital filtering technique is to observe the samples of the unknown signal during a finite duration window or observation window. One window which may be employed is the rectangular window shown in FIG. 2 and discussed by Oppenheim and Schaffer in the aforementioned text. All samples which occur during such a rectangular window are by definition multiplied by a constant weight of 1 throughout the duration of the window. Samples occurring before or after the window are by definition given a weight of 0. Thus, such samples are in effect multiplied by the window. Although this approach is rather simple, it unfortunately results in substantial undesired side lobe response in the Fourier transform of the rectangular window as shown in FIG. 1. This undesired side lobe response corresponds to undesired filter responses in the filter stop-band. If such a filter were to be employed in a frequency detection scheme, it is likely that signals exhibiting frequencies other than the desired filter pass-band would pass through the digital filter at high enough levels to be falsely detected by threshold detection circuitry.

As discussed on pages 241—250 of the Oppenheim-Schaffer text, other windows besides the aforementioned rectangular window may be employed to multiply or weight the signal samples thereby in the course of digital filtering to reduce the amplitude of the undesired side lobes. For example, the Bartlett, Hanning, Hamming, Blackman and Kaiser windows may be employed to weight sample values during such respective windows. Although each of these windows substantially reduces the amplitudes of undesired side lobe responses as compared to the main lobe response, implementation of such other nonrectangular windowing techniques consumes extremely large amounts of computational time when employed in a microprocessor, for example, as compared with the rectangular windowing technique. This is true because in the rectangular windowing technique, all samples which occur during the window are multiplied by 1 which is a simple computational task in binary processing. However, in the aforementioned non-rectangular windows, each of the signal samples is weighted by a different value having fractional values between 0 and 1 as is seen for example in the triangular Kaiser type window of Figure 3. Weighting by such fractional values consumes large amounts of computational processing time.

A digital pseudo continuous correlation tone detector which samples the input signals of different frequencies over sequential time intervals after they have first been digitalised is known from US Patent No. 4,302,817. The detector provides a detect signal when the input frequency exhibits a predetermined value. However, since sampling occurs during many short time windows, a large amount of computational time is consumed and in addition undesired noise will always be present due to the detection of input signals with frequencies near the predetermined frequency.

It is one object of the present invention to improve the attenuation of the undesired stop-band response which corresponds to the side lobe response in the Fourier transform of the rectangular observation window.

It is another object of the present invention to more readily detect the presence of signal energy at or near a predetermined frequency.

Another object of the present invention is to detect the presence of a signal exhibiting a frequency within a selected pass-band without consuming large quantities of computational processing time.

Brief Summary of the Invention

In accordance with one aspect of the present invention there is provided a decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a first sample during a substantially rectangular observation interval, said decoder circuit characterized by:

ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval after said first sample, said bite interval having its center located between approximately $0.02 T_1$ and $0.28 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

In accordance with a second aspect of the present invention there is provided a decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a last sample during a substantially rectangular observation interval, said decoder circuit characterized by:

ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval prior to said last sample, said bite interval having its center located between approximately $0.72 T_1$ and $0.98 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

The invention is described by way of example only, with reference to the accompanying drawings.

Description of the Drawings

FIG. 1 is a representation of the Fourier transform of a rectangular observation window.

FIG. 2 is a representation of a rectangular window.

FIG. 3 is a representation of a non-rectangular, triangular type Kaiser window.

FIG. 4 is a block diagram of the decoding apparatus of the present invention.

FIG. 5 is a amplitude vs. time graph of the observation window employed in the apparatus of the present invention.

FIG. 6A is a representation of the main lobe response and side lobe response obtained when employing the aforementioned conventional rectangular windowing technique.

FIG. 6B is a representation of the main lobe response and improved side lobe response achieved by the present invention.

FIG. 7 is a graphical representation illustrating the amount of improvement in side lobe suppression measured in dB achieved by the present invention as the width of the bite (bite duration) in the observation window of FIG. 5 is varied and as the position of the bite (bite duration) is varied within such observation window.

FIG. 8 is an amplitude vs. time graph of an alternative observation window which may be employed in the present invention.

FIG. 9 is a graphical representation of the amount of improvement in side lobe suppression measured in dB achieved by employing the window of FIG. 8 as a function of the width and the position of the bite in the observation window.

FIG. 10 is a block diagram of one timing circuit which may be employed as the timing circuit shown in the apparatus of FIG. 4.

FIGS 11A—11G are the timing diagrams illustrating the signal waveforms of various test points in the timing circuit of FIG. 8.

FIG. 12 is a block diagram of one correlator circuit which may be employed as the correlator shown in FIG. 4.

FIG. 13 is a flow chart which summarizes the steps in the operation of the present invention.

FIG. 14 is a block diagram of an embodiment of the invention which employs a micro-computer.

FIG. 15 is a more detailed block diagram of the apparatus of FIG. 14.

Detailed Description of the Preferred Embodiment

FIG. 4 illustrates one embodiment of the present invention wherein the decoder of the present invention is advantageously employed to detect the presence of at least one tone signal superimposed or modulated on a radio frequency carrier wave, hereinafter referred to as the incoming signal. The incoming signal is captured by an antenna 10 and applied to the input of a receiver 20. Receiver 20 demodulates the incoming signal such that the radio frequency portion of the incoming signal is separated from the tone portion of the incoming signal which is provided to the output of receiver 20 and is hereinafter designated the received tone signal. The remaining circuitry of FIG. 4 subsequently described operates to detect the

presence of received tone signals exhibiting a predetermined frequency, for example, 1,000 Hz.

The output of receiver 20 is coupled to the input of a sampling circuit 30 such that the received tone signal is applied to the input of sampling circuit 30. Sampling circuit 30 samples the received tone signal at a predetermined rate, for example, 10,989 Hz in this embodiment of the invention. A timing circuit 40 is coupled to sampling circuit 30 to cause sampling circuit 30 to conduct its sampling operation during the specially modified, substantially rectangular observation window (observation interval) depicted in FIG. 5. More specifically, the observation window of FIG. 5 determines which samples of the received tone signal occurring during the observation window will be provided to the output of sampling circuit 30. For purposes of discussion and graphic convenience, the observation window of FIG. 5 is "normalized" to have an overall duration T1 of 1 unit of time. However, in one embodiment of the invention, T1 equals 10 msec, for example.

Since sampling circuit 30 provides output to received tone signal samples during the observation interval defined in FIG. 5, sampling circuit 30 passes samples to its output during the T1 observation interval, except for a portion thereof defined as the "bite interval" 70 which in one embodiment of the invention exhibits a time duration of T2 (.12 unit time) defined between .06 and .18 units of time of the T1 observation interval as shown in FIG. 5. Stated alternatively, during the substantially rectangular observation interval or window shown in FIG. 5, each sample taken by sampling circuit 30 during the observation interval occurring between the beginning of the observation interval and the beginning of bite interval 70 are, in effect, multiplied by or weighted 1. Thus, the samples just described are provided to the output of sampling circuit 30. However, those samples occurring during bite interval 70 are, in effect, multiplied by or weighted 0. It is seen that the plurality of signal samples occurring in succession during bite 70 are effectively dropped. Thus, in one embodiment, such samples do not reach the output of sampling circuit 30. As seen in FIG. 5, those samples occurring in the remaining portion of the observation interval after bite interval 70 are, in effect, multiplied by or weighted 1. Thus, such samples are provided output at the output of sampling circuit 30. The samples which thus reach the output of sampling circuit 30 are hereinafter referred to as "windowed samples".

The output of sampling circuit 30 is coupled to the input of an A/D converter 50. In one embodiment of the invention, the output of timing circuit 40 is operatively coupled to A/D converter 50. Converter 50 operates on the windowed samples to convert such samples from an analog to a digital format of 1,0 or -1. A converter output signal of 1 corresponds to a converter input signal greater than zero. A converter output signal of -1 corresponds to a converter input signal of less than or equal to zero. A converter output of zero corresponds to a sample weighted zero.

The output of converter 50 is coupled to the input of a correlator 60. Correlator 60 operates on the windowed samples to determine if such samples result from a received tone signal exhibiting the predetermined frequency of 1,000 Hz, for example. One correlator which may be employed as correlator 60 is described and claimed in United States Patent Number 4,301,817, issued to Gerald LaBedz, entitled "Psuedo-Continuous Tone Detector", and assigned to instant Assignee. United States Patent 4,301,817 is incorporated herein by reference. Another correlator which may be employed as correlator 60 is shown in FIG. 12 and is described later.

FIG. 6A is an amplitude versus frequency graph of the main lobe and side lobe response of conventional circuitry for detecting the presence of a tone signal which employs the rectangular observation window or interval of FIG. 2 to appropriately sample received tone signals. The main lobe response at frequency F_0 is normalized at 0 dB. It is observed that by employing the rectangular observation window of FIG. 2, a side lobe response is generated which follows a $(\sin x)/x$ function. For several frequency detection purposes, this relatively high side lobe response is unacceptable. More specifically, the response exhibited by the first side lobe at a frequency of F_{-1} is -13.26 dB with respect to the main lobe response at a frequency F_0 . Thus, due to the relatively high response exhibited at the first side lobe (F_{-1}) a decoder employing the rectangular window of FIG. 2 may tend to yield false indications that a desired signal exhibiting a frequency of F_0 is present when, in reality, a signal exhibiting a frequency of F_{-1} is present. The side lobe response formed by the side lobes at frequencies of F_{-2} and F_{-3} is also shown in FIG. 6A.

FIG. 6B illustrates the improved side lobe response achieved by the decoder apparatus of the present invention which employs the modified substantially rectangular observation interval of FIG. 5 to window the samples taken of the received tone signal by sampling circuit 30. The main lobe response is centered about a frequency of 1,000 Hz F_0' and exhibits a relative peak amplitude of 0 dB. First and second side lobes are shown at frequencies of F_{-1}' and F_{-2}' , respectively. It is observed that in the response characteristics shown in FIG. 6B, the peak amplitude of the first side lobe at frequency F_{-1}' is -17.05 dB. In comparison, the peak amplitude of the first side lobe (F_{-1}) for the response of FIG. 6A is -13.26 dB for the rectangular observation window. Thus, it is seen that the decoder apparatus of the present invention achieves an improvement of 3.79 dB in first side lobe response suppression as compared to techniques employing the rectangular observation window of FIG. 2.

The following Table 1 is a listing of the increases in dB's in the suppression of the first side lobe as a function of the time position of bite 70 (bite time position) within the T1 observation interval and as a function of the time duration of the bite (bite duration). Bite duration and bite time position are expressed as fractional portions of the T1 observation interval which is normalized to exhibit an overall duration of unit time 1. Various bite time positions are listed at the top of each column of dB suppression improvement

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values. Various values of bite duration are expressed as fractional portions of the T1 observation window at the beginning of each row of dB improvement of first side lobe suppression.

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W-T-W ADEAT-OZ→

	1880	1920	1940	1960	1980	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
0.0000	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0010	13.26	13.12	13.10	13.45	13.50	13.54	13.57	13.58	13.58	13.57	13.53	13.53	13.45	13.10	13.31	13.26	13.26
0.0020	13.26	13.34	13.40	13.62	13.74	13.83	13.90	13.92	13.92	13.89	13.83	13.75	13.64	13.51	13.30	13.26	13.26
0.0030	13.26	13.37	13.55	13.76	13.95	14.12	14.22	14.26	14.26	14.21	14.13	13.99	13.81	13.61	13.40	13.26	13.26
0.0040	13.26	13.26	13.50	13.60	14.16	14.40	14.57	14.65	14.65	14.50	14.43	14.21	13.96	13.60	13.30	13.14	13.14
0.0050	13.26	13.26	13.50	13.90	14.35	14.60	14.92	15.05	15.05	14.86	14.68	14.42	14.14	13.74	13.31	13.00	13.00
0.0060	13.26	13.26	13.51	14.02	14.50	14.95	15.20	15.47	15.47	15.12	15.02	14.65	14.22	13.72	13.32	12.99	12.99
0.0070	13.26	13.26	13.41	14.00	14.67	15.19	15.65	15.91	15.92	15.70	15.37	14.95	14.27	13.70	13.25	12.75	12.75
0.0080	13.26	13.26	13.26	13.95	14.60	15.41	16.10	16.30	16.27	15.54	15.12	14.41	13.81	13.17	12.50	12.50	12.50
0.0090	13.26	13.26	13.26	13.94	14.60	15.57	16.17	16.74	16.74	15.84	15.12	14.15	13.42	12.70	12.15	12.41	12.41
0.0100	13.26	13.26	13.26	13.60	14.62	15.66	16.60	16.40	16.41	15.47	14.76	13.70	13.02	12.50	12.35	12.21	12.21
0.0110	13.26	13.26	13.26	13.50	14.50	15.66	16.57	16.25	16.15	14.44	13.90	13.20	12.65	12.11	1.95	1.92	1.92
0.0120	13.26	13.26	13.26	13.36	14.37	15.57	16.36	15.67	14.65	13.97	13.22	12.61	11.99	11.57	11.31	11.27	11.27
0.0130	13.26	13.26	13.26	13.26	14.09	15.30	16.06	15.47	14.47	13.81	13.11	12.31	11.70	11.20	11.04	10.99	10.99
0.0140	13.26	13.26	13.26	13.03	14.13	15.13	16.62	15.49	14.47	13.81	13.11	12.31	11.70	11.20	11.04	10.99	10.99
0.0150	13.26	13.26	13.26	13.55	14.02	16.17	15.34	14.35	13.69	12.97	12.31	11.43	11.02	10.74	10.44	10.14	10.14
0.0160	13.26	13.26	13.26	13.26	13.26	14.50	15.72	14.25	14.27	13.54	12.97	11.70	11.19	10.78	10.45	10.50	10.50
0.0170	13.26	13.26	13.26	13.26	14.10	15.30	16.22	14.25	13.20	12.34	11.56	10.97	10.56	10.31	10.10	10.10	10.10
0.0180	13.26	13.26	13.26	13.26	13.86	14.91	16.06	14.96	14.07	13.04	12.12	11.34	10.70	10.17	10.15	10.11	10.11
0.0190	13.26	13.26	13.26	13.26	13.55	14.56	16.65	13.84	12.04	11.92	11.18	10.60	10.20	9.99	9.95	9.95	9.95
0.0200	13.26	13.26	13.26	13.26	13.26	14.24	14.37	13.62	12.66	11.76	11.02	10.45	10.06	9.85	9.81	9.81	9.81
0.0210	13.26	13.26	13.26	13.26	13.26	13.95	14.13	13.43	12.49	11.61	10.80	10.32	9.94	9.73	9.57	9.57	9.57
0.0220	13.26	13.26	13.26	13.26	13.70	13.92	13.27	12.36	11.49	10.77	10.22	9.84	9.64	9.42	9.27	9.27	9.27
0.0230	13.26	13.26	13.26	13.26	13.47	13.73	13.14	12.25	11.40	10.68	10.14	9.77	9.56	9.36	9.20	9.20	9.20
0.0240	13.26	13.26	13.26	13.26	13.26	13.50	13.62	12.66	11.76	11.02	10.45	10.06	9.71	9.52	9.36	9.36	9.36
0.0250	13.26	13.26	13.26	13.26	13.26	13.46	12.94	12.16	11.27	10.50	10.05	9.61	9.35	9.16	9.01	9.01	9.01
0.0260	13.26	13.26	13.26	13.26	13.26	13.26	13.46	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94
0.0270	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0280	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0290	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0300	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0310	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0320	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0330	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26

From Table 1, it is seen that the improvement in first side lobe suppression achieved by the decoder of the present invention varies with the position of the bite (bite time position) within the T1 observation interval and also with the duration of the bite. Depending on the bite time position and the bite duration of a particular bite in the T1 observation interval, increased side lobe suppression, decreased side lobe suppression or the same amount of side lobe response is achieved, as compared with decoders employing the completely rectangular observation window shown in FIG. 2. More specifically, referring directly to Table 1, it is seen, for example, that for a bite duration of .12 and a bite time position centered about .12 of the unit time 1 of the T1 time window, the peak amplitude of the first side lobe is 17.05 dB below the peak amplitude of the main response. It is recalled that prior decoder techniques employing a completely rectangular window typically result in a first side lobe exhibiting a peak amplitude of approximately -13.26 dB with respect to the main lobe response.

The aforementioned values for bite duration and bite time position are believed to be optimal for the decoder of the present invention. However, as seen from Table 1, a large range of bite durations and bite time positions near the beginning of the T1 observation interval result in an improvement in first side lobe suppression over the 13.26 dB suppression achieved by prior decoders employing rectangular observation windows. Improved values of first side lobe suppression are noted within the solid line forming an irregularly shaped box within Table 1. The corresponding bite durations and bite time positions which cause a particular improved side lobe suppression value within the box are readily determined by selecting a particular value of side lobe suppression and reading horizontally over to the corresponding bite duration and vertically upward to the corresponding bite time position.

It is noted that first side lobe suppression values outside of the box either represent no improvement in side lobe suppression or a decrease in first side lobe suppression. For example, a bite duration of .33 T1 together with a bite time position of .1 T1 yield a first side lobe with a peak amplitude of 13.26 dB. This represents no improvement over the rectangular observation window of conventional decoders. Also by way of example, a bite duration of .33 T1 and a bite time position centered about .32 of the T1 normalized observation interval yield a first side lobe having a peak amplitude of 6.2 dB which is larger and thus less desirable than the first side lobe response achieved by conventional decoders employing a completely rectangular observation window. It is thus seen that it is important to select bite duration and bite time position values corresponding to side lobe suppression values within the box of Table 1 in order to achieve significant amounts of side lobe suppression consistent with the present invention.

FIG. 7 is a three-dimensional representation of increase of first side lobe suppression achieved by the decoder of the present invention as a function of bite duration and bite time position within the normalized T1 observation interval. In this representation, the bite time position is shown between 0.0 T1 and .33 T1. For convenience, when plotting the graph of FIG. 7 from the values shown in Table 1, the representation of FIG. 7 concentrates on the values of bite duration and bite time position which result in increases in first side lobe suppression. This is accomplished by portraying all values of side lobe suppression which are not increases of side lobe suppression as a flat plane having a value of 13.26 dB. From FIG. 7, it will be appreciated that certain values of bite duration and a bite time position are more optimal than others in terms of maximizing first side lobe suppression.

FIG. 8 is a representation of an alternative modified rectangular observation window employed in the decoder apparatus of the present invention. FIG. 8 is substantially similar to the observation window of FIG. 5 except that the bite during which sampling circuit 30 is inhibited is now, by symmetry, situated near the end of the T1 time interval instead of near the beginning of the T1 time interval. The bite shown in FIG. 8 is designated bite 80. In an alternative embodiment of decoder apparatus of the present invention, the bite is situated in the manner shown in FIG. 8 for bite 80 as opposed to the manner shown in FIG. 5 for bite 70.

Bite 80 is optimally centered approximately at .88 T1 in the T1 observation interval which exhibits a total unit time of 1. The optimal time duration or bite duration T2 for bite 80 is .12 T1 as shown in FIG. 8. Thus, when the observation interval or observation window shown in FIG. 8 is employed in the decoding apparatus of the present invention, samples taken by sampling circuit 30 from the beginning of the T1 time interval until the beginning of bite 80 are, in effect, multiplied by or weighted by the quantity 1. Samples occurring during bite 80 are weighted or multiplied by 0. Thus, the plurality of samples occurring in succession during bite 80 are effectively dropped. Samples occurring after the end of bite 80 and before the end of the T1 observation interval are weighted or multiplied by 1. Such weighting of samples is implemented for each observation window which is imposed upon the incoming samples of the received tone signal.

The following Table 2 is a table substantially similar to Table 1, except bite time positions between .66 and 1 of the T1 observation interval are used. Thus, Table 2 shows the various amounts of first side lobe suppression improvements (in dB) which occur for bite durations between 0.0 T1 and .33 T1 and for bite positions between .66 T1 and 1.0 T1 of the T1 time interval. In a manner similar to Table 1, a solid line is drawn around all values which represents an improvement in first side lobe suppression to form an irregularly shaped box within Table 2. Each first side lobe suppression value within the box corresponds to a particular bite duration and bite time position.

TABLE 2

dB IMPROVEMENT

	BITE POSITION →															
	6400	7000	7200	7400	7600	7800	8000	8200	8400	8600	8800	9000	9200	9400	9600	9800
0.0000	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26	13.26
0.0010	13.11	13.10	13.26	13.11	13.39	13.45	13.50	13.54	13.57	13.58	13.58	13.58	13.58	13.58	13.58	13.58
0.0020	12.95	13.09	13.23	13.30	13.51	13.64	13.75	13.83	13.92	13.92	13.92	13.92	13.92	13.92	13.92	13.92
0.0030	12.77	12.97	13.10	13.40	13.61	13.81	13.90	14.11	14.23	14.20	14.20	14.22	14.22	14.22	14.22	14.22
0.0040	12.56	12.82	13.10	13.19	13.60	13.96	14.21	14.41	14.50	14.60	14.60	14.65	14.65	14.65	14.65	14.65
0.0050	12.34	12.66	13.00	13.17	13.74	14.10	14.41	14.72	14.94	15.06	15.06	15.05	15.05	15.05	15.05	15.05
0.0060	12.10	12.40	12.80	13.12	13.77	14.22	14.65	15.02	15.32	15.40	15.40	15.47	15.47	15.47	15.47	15.47
0.0070	11.86	12.24	12.75	13.25	13.70	14.27	14.85	15.12	15.76	15.92	15.92	15.91	15.91	15.91	15.91	15.91
0.0080	11.61	12.00	12.50	13.15	13.41	13.83	14.43	15.17	15.54	16.27	16.30	16.02	16.02	16.02	16.02	16.02
0.0090	11.36	11.86	12.41	12.75	12.90	13.41	14.02	14.75	15.12	15.84	16.74	16.37	16.37	16.37	16.37	16.37
0.0100	11.10	11.62	12.21	12.45	12.50	13.02	13.64	14.30	14.76	15.47	16.40	16.00	16.00	16.00	16.00	16.00
0.0110	10.83	11.38	11.92	12.18	12.22	12.65	13.20	14.00	14.44	15.15	16.20	16.92	16.92	16.92	16.92	16.92
0.0120	10.56	11.13	11.58	11.85	11.88	12.31	12.87	13.75	14.10	14.80	15.91	17.05	17.05	17.05	17.05	17.05
0.0130	10.29	10.88	11.27	11.53	11.57	11.99	12.61	13.42	13.97	14.65	15.87	16.96	16.96	16.96	16.96	16.96
0.0140	10.02	10.63	10.90	11.04	11.20	11.70	12.31	13.11	13.61	14.35	15.67	16.82	16.82	16.82	16.82	16.82
0.0150	9.75	10.37	10.73	10.70	11.02	11.43	12.03	12.83	13.69	14.35	15.74	16.97	16.97	16.97	16.97	16.97
0.0160	9.49	10.12	10.50	10.55	10.70	11.19	11.79	12.57	13.54	14.27	15.75	16.97	16.97	16.97	16.97	16.97
0.0170	9.23	9.86	10.30	10.37	10.56	10.97	11.56	12.34	13.20	14.25	15.72	16.97	16.97	16.97	16.97	16.97
0.0180	8.97	9.60	10.11	10.15	10.37	10.78	11.36	12.12	13.04	14.07	15.55	16.97	16.97	16.97	16.97	16.97
0.0190	8.72	9.35	9.95	9.99	10.20	10.60	11.10	11.92	12.84	13.84	15.30	16.97	16.97	16.97	16.97	16.97
0.0200	8.47	9.10	9.61	9.65	10.06	10.45	11.02	11.76	12.66	13.62	15.05	16.97	16.97	16.97	16.97	16.97
0.0210	8.22	8.85	9.37	9.43	9.94	10.32	10.80	11.61	12.49	13.47	14.90	16.97	16.97	16.97	16.97	16.97
0.0220	7.98	8.61	9.12	9.18	9.64	10.22	10.77	11.49	12.34	13.27	14.70	16.97	16.97	16.97	16.97	16.97
0.0230	7.74	8.37	8.88	8.94	9.41	10.14	10.60	11.40	12.25	13.14	14.57	16.97	16.97	16.97	16.97	16.97
0.0240	7.51	8.13	8.64	8.70	9.17	10.00	10.42	11.21	12.16	13.04	14.45	16.97	16.97	16.97	16.97	16.97
0.0250	7.29	7.90	8.40	8.46	8.93	10.05	10.50	11.27	12.10	12.96	14.30	16.97	16.97	16.97	16.97	16.97
0.0260	7.07	7.68	8.18	8.24	8.71	9.84	10.36	11.25	12.07	12.91	14.15	16.97	16.97	16.97	16.97	16.97
0.0270	6.85	7.46	7.96	8.02	8.49	9.56	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97
0.0280	6.63	7.24	7.74	7.80	8.27	9.34	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97
0.0290	6.41	7.02	7.52	7.58	8.05	9.12	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97
0.0300	6.25	6.86	7.36	7.42	7.89	8.96	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97
0.0310	6.03	6.64	7.14	7.20	7.67	8.74	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97
0.0320	5.81	6.42	6.92	6.98	7.45	8.52	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97
0.0330	5.74	6.35	6.85	6.91	7.38	8.45	10.36	11.21	12.00	12.84	13.97	16.97	16.97	16.97	16.97	16.97

BITE DURATION →

FIG. 9 is a three-dimensional representation of the improvement in first side lobe suppression as a function of bite duration and bite time position. More specifically, the representation of FIG. 9 is a plot of the side lobe suppression values of Table 2 as a function of bite duration and bite time position during the .66 T₁ to 1.0 T₁ portion of the T₁ observation interval. It is seen that a relatively large number of bite durations and bite time positions will result in the improvements in the suppression of the first side lobe response.

FIG. 10 is a schematic diagram of one timing circuit which may be employed as timing circuit 40 of FIG. 4. Timing circuit 40 generates the substantially rectangular observation interval or observation window shown in FIG. 8 including bite 80 therein centered about .88 T₁ of the T₁ time interval. Assuming that bite 80 exhibits a bite duration of .12 of the unit time 1, bite 80 commences at .82 T₁ and ceases at .94 T₁ of the T₁ interval as shown in FIG. 8. As shown in FIG. 10, timing circuit 40 includes a one shot monostable multivibrator 42 having an input forming the overall input of timing circuit 40 so as to receive the timing initialization pulse shown in the timing diagram FIG. 11A which commences an observation window. Multivibrator 42 is configured to exhibit an on time equal to that of the observation interval T₁. Thus, when the initialization pulse shown in the timing diagram of FIG. 11A is applied to the input of multivibrator 42, multivibrator 42 turns on and stays on for the entirety of the T₁ time interval, that is for one unit of time as shown in the timing diagram of FIG. 11B.

The input of multivibrator 42 is coupled to the input of a one shot monostable multivibrator 44 which transitions from the zero logic state to the one logic state whenever the initialization pulse of FIG. 11A is applied thereto. Multivibrator 44 then returns to the zero logic state after .82 of the T₁ unit time interval has elapsed as seen in FIG. 11C which shows the Q output wave form of multivibrator 44. The $\bar{Q}$ output of multivibrator 44 is coupled to the input of a one shot monostable multivibrator 46 such that the waveform shown in FIG. 11D is provided thereto. It is noted that the waveform of 11D is the inverse of the waveform of 11C. Multivibrator 46 is configured to transition from a logical zero output state to a logical one output state at the Q output thereof whenever a positive going transition is provided to the input thereof. Thus, when the positive going transition of the FIG. 11D waveform at .82 of the T₁ time interval is provided to the input of multivibrator 46, multivibrator 46 transitions from a logical zero to a logical one for a duration of .12 of the T₁ time interval as shown in FIG. 11E. After .12 of the T₁ time interval has elapsed, the Q output of multivibrator 46 transitions from a logical one to a logical zero as shown in the waveform of FIG. 11E. FIG. 11F shows the waveform at the $\bar{Q}$ output of multivibrator 46. It is noted that the waveform of FIG. 11F is the inverse of the waveform of 11E.

The Q output of multivibrator 42 and the $\bar{Q}$ output of multivibrator 46 are coupled to the respective inputs of a two input AND gate 48. Thus, the waveform of FIG. 11B and the waveform of FIG. 11F are AND'ed together by AND gate 48 such that the waveform shown in FIG. 11G is generated at the output of AND gate 48. The waveform of FIG. 11G corresponds to one modified substantially rectangular observation interval or window which is employed to control sampling circuit 30 of FIG. 4. The specific connections of timing circuit 40 as shown in FIG. 10 to the remaining portions of the circuitry of the present invention in order to achieve windowing of the samples of the received signals in accordance with the present invention will be discussed in more detail subsequently.

One correlator which may be employed as correlator 60 of FIG. 4 is the correlator shown in FIG. 12. The correlator of FIG. 12 is shown in FIG. 3 of United States Patent 4,216,463 entitled Programmable Digital Tone Detector issued to Backof, Jr. et al. and assigned to the instant Assignee. United States Patent, 4,216,463 is incorporated herein by reference. Such correlator is now described briefly in the discussion of FIG. 12.

A sine wave reference signal $\sin(\omega_{\text{REF}} t)$ is applied via a limiter circuit 61 to one input 62A of a two input multiplier circuit 62, the remaining input of which is designated 62B. Mixer input 62A is coupled via a minus 90° phase shift network 64 to one input 66A of a two input multiplier circuit 66, the remaining input of which is designated 66B. Thus, while a sine wave reference signal is applied to multiplier input 62A, a cosine wave reference signal is applied to multiplier input 66A due to the phase shift action of circuit 64. The samples of the received signal generated by sampling circuit 30 of FIG. 4 are provided to multiplier inputs 62B and 66B via a limiting circuit 50 coupled between sampling circuit output 30 and multiplier inputs 62B and 66B. It is noted that although in the representation of FIG. 4 timing circuit 40 is shown coupled to sampling circuit 30, timing circuit 40 is shown operatively coupled to converter circuit 50 as well, in a manner so as to appropriately permit samples weighted by a factor of 1 to be supplied to correlator 60 during all portions of the T₁ observation interval except for the T₂ bite portion thereof during which samples weighted zero are supplied to correlator 60.

Each of the samples reaching multiplier input 62B are multiplied by the sine wave reference signal at multiplier input 62A. The resultant of such multiplication appears at the output of multiplier 62 which is coupled to the input of an integrator 70. Integrator circuit 70 integrates the multiplied samples supplied thereto so as to generate the integral of the multiplied samples at the output thereof. The output of integrator 70 is coupled to an absolute value circuit 80 which generates the absolute value of the integrated multiplied samples and provides the same to one input of a two-input adder circuit 90.

The samples applied to multiplier circuit input 66B are multiplied by the cosine wave reference signal supplied to multiplier input 66A such that the resultant of these two signals is provided to the output of multiplier 66 which is coupled to the input of an integrator circuit 100. Integrator circuit 100 integrates the multiplied samples provided thereto to generate the integral of such multiplied samples at the output

thereof. The output of integrator circuit 100 is coupled to the input of an absolute value circuit 110 which generates the absolute value of the integral of the multiplied samples at the output thereof. The output of absolute value circuit 110 is coupled to the remaining input of adder circuit 90. Thus, a signal representing the summation of the absolute value of the integral of received signal samples multiplied by the sine wave reference waveform at multiplier input 62A and the absolute value of the integral of the samples of the received signal multiplied by the cosine reference waveform at multiplier input 66A is generated at the output of adder circuit 90.

The output of adder circuit 90 is coupled to a threshold detector 120. Whenever the input of threshold detector 120 exceeds a predetermined value, detector 120 generates an output signal which indicates that a predetermined degree of correlation has occurred. More specifically, when this occurs, correlator 60 has determined that the tone signal received by receiver 20 and sampled by sampler circuit 30 exhibits a frequency approximately equal to the frequency of the sine wave reference waveform supplied to multiplier input 62A of correlator 60. In the foregoing example, correlator 60 was configured to detect the presence of a 1000Hz received signal. Thus, the sine wave reference waveform supplied to multiplier input 62A equals 1000Hz in this example. However, it is understood that the presence of other received tone signals may be detected as well, for example, received tone signals exhibiting frequencies of 1500Hz and 2000Hz providing that sine wave reference waveforms exhibiting such alternative frequencies are supplied to the input of limiter 61. The circuit of the present invention will operate to reduce the amplitude of the first side lobe for these received tone signals as well, thus permitting the threshold of threshold detector 120 to be set at relatively lower levels resulting in an increase in the probability of tone signal detection. Alternatively, the threshold of threshold detector 120 is not changed to the aforementioned relatively lower level. In such case, the result is a corresponding decrease in the probability of detector 120 responding to tone signals occurring at frequencies corresponding to the first side lobe response.

FIG. 13 is a flow chart describing the operation of the apparatus of the present invention when the T1 observation interval shown in FIG. 8 is employed therein. It is recalled that in accordance with the invention, during such T1 observation interval or observation window, samples of the received tone signal are taken, weighted by a factor of one, and correlated until the time .82 T1 is reached. At such time bite 80 commences during which samples of the received signals are weighted zero or otherwise suppressed or inhibited for the duration of the bite which exists from a time equal to .82 T1 and .94 T1. At the end of bite 80, namely at .94 T1, sampling of the received tone signal continues and weighting of such samples of the received signal by a factor of 1 continues along with correlation thereof until the end of T1 time interval. The flow chart of FIG. 13 illustrates this operation of the invention.

More specifically, the flow chart of FIG. 13 commences with a START statement 200 followed by statement 210 which sets SMPNM equal to zero. SMPNM is a counter representing the number accorded to a particular sample of the received tone signal. After executing block 210, data is sampled and correlated in accordance with block 220. After executing block 220, the counter SMPNM is incremented by 1 such that the apparatus of the invention proceeds to the next (in this case the first) sample in accordance with block 230. After incrementing in accordance with block 230, a decision block 240 is provided which determines whether a particular sample occurs during the bite 80 of the T1 time interval, that is between a time equal to .82 T1 and .94 T1. If SMPNM is between .82 T1 and .94 T1 (which corresponds to being between 82 and 94 in the flow chart of FIG. 13), then the decision block 240 causes operation to return to block 230 where SMPNM is incremented by one. The loop formed between decision block 240 and block 230 continues until SMPNM is no longer between .82 T1 and .94 T1, that is when the sample no longer occurs during bite 80. When this occurs, the flow chart proceeds to a decision block 250 which tests to see if SMPNM is greater than 100. If the answer is no, another sample is taken and correlated in accordance with block 220. When SMPNM finally exceeds 100, that is when the T1 observation interval is complete, then the decision reached by decision block 250 is affirmative and the flow chart proceeds to stop at block 260.

Thus, it is seen that by following the above flow chart in accordance with the present invention, an incoming received tone signal is sampled and the samples are correlated during a modified substantially rectangular observation window with a carefully positioned bite therein to detect the presence of a received tone signal exhibiting a predetermined frequency. The sequence of such flow chart is repeated as many times as is necessary while the presence of a received tone signal exhibiting a predetermined frequency is being determined.

FIG. 14 is a simplified blocked diagram of a microcomputer embodiment of a radio frequency receiver incorporating the present invention to detect the presence of a received tone signal exhibiting a predetermined frequency. The many different tone signalling schemes known in the art today require apparatus and methods for distinguishing received toned signals exhibiting a selected frequency from received signals exhibiting other frequencies in order to perform selected functions at the receiver, for example opening a squelch circuit as well as other functions.

The apparatus of FIG. 14 includes an antenna 300 for gathering radio frequency signals incident thereon and providing such signals to a receiver 310 coupled thereto. Receiver 310 demodulates the radio frequency signals coupled thereto and provides the demodulated signals, that is received tone signals to outputs 310A and 310B thereof. A receiver output 310C couples a signal which indicates the presence of a radio frequency carrier signal at receiver 310 to the input of a squelch circuit 320. One output of squelch circuit 320 is coupled to an input of a microcomputer 330. Microcomputer 330 supervises and controls the

operation, for example, noise squelch and decoding functions, of the remaining functions of the receiver of FIG. 14. Microcomputer 330 includes a random access memory (not shown) therein for storing digital signal information and includes a plurality of registers (not shown) for facilitating processing of such information.

Another output of squelch circuit 320 is electrically coupled to one input of a receiver audio circuit 340. Receiver output 310A is coupled to an input of receiver audio circuit 340. One output of microcomputer 330 is also coupled to an input of receiver audio circuit 340 to control the operation thereof. Receiver output 310B is coupled to an input of microprocessor 330.

A read only memory 350, also referred to as a code plug, is conveniently encoded with a wide variety of information regarding the operation of the microcomputer controlled receiver of FIG. 14. More specifically, certain functions to be performed by the receiver of FIG. 14 are encoded into read only memory 350. In this embodiment, read only memory 350 contains information which tells the microcomputer 330 which sequence of received audio tones of predetermined frequency must be received and processed by microcomputer 330 before microcomputer 330 will permit squelch circuit 320 to turn on the receiver audio of circuit 340 to provide voice messages subsequent to an encoded tone sequence to reach loudspeaker 345 where such messages are audible to the receiver user. It is apparent that the sampling and correlation of samples of the received signal in accordance with the modified substantially rectangular observation window employed in the present invention is conveniently implemented by microprocessor 330. In this manner, the first side lobe response of each tone signal which the receiver of FIG. 14 is to receive, in sequence or otherwise, is significantly reduced such that the likelihood of signal falsing substantially diminished. From the above discussion, it is clear that the present invention not only applies to reducing the side lobe response of a single tone exhibiting a predetermined frequency, but may also be employed to reduce the first side lobe response to each of a sequence of received tone signals exhibiting respective predetermined frequencies.

Advantageously, during the bite of the observation interval employed in the present invention, microcomputer 330 is now free to perform tasks other than sampling and correlating. This is so because during the bite interval, it is assured that all samples will be weighted zero, a task which can be accomplished all together at the beginning of the bite interval, leaving the remainder of each bite interval of each observation interval free for the performance of other tasks by the microcomputer 330. Such other tasks include monitoring and control of the radio receiver circuits and operating conditions and functions of the same, for example. In lieu of performing such tasks during the remainder of the bite interval, microcomputer 330 assumes an idle mode to decrease power consumption.

FIG. 15 is a more detailed representation of a microcomputer-firmware embodiment of the apparatus of the present invention. The representation of FIG. 15 is substantially identical to the block diagram of FIG. 14 except for the following modifications and additions to detail. A filter 360 and a limiter 370 are coupled together in series between receiver output 310B and an input of microcomputer 330. The Motorola MC147805G2P microcomputer is employed as microprocessor 330 in the firmware embodiment of the invention shown in FIG. 15. The actual pin terminal numbers of microcomputer 330 are shown circled adjacent the periphery of the rectangular block representing microcomputer 330. Further, an associated alphanumeric designation is situated next to each of such circled pin numbers for ease of identification. Those skilled in the art will readily understand how to employ the aforementioned microcomputer to utilize the frequency decoder of the present invention. For detailed information on the operation of the aforementioned microcomputer, reference may be made to the "M6805/M146805 Family Microcomputer/Microprocessor User's Manual" published by Motorola, Inc. 3501 Ed Bluestein Blvd., Austin, Texas 78721, the contents of which are incorporated herein by reference. Even more detailed information regarding this microcomputer is conveniently found in the "Motorola Microprocessor Data Manual" in the section entitled "MC146805G2", the contents of which are also incorporated herein by reference.

Microcomputer pins 19 and 2, respectively designated PB7 and INT are electrically coupled to a power supply. Pin 5, designated PA6 is coupled to an input of receiver audio circuit 340. Pin 18 designated PB6 is coupled to limiter circuit 370 as shown in FIG. 15. Pin 8, designated PA3 is coupled to the output of squelch circuit 330.

Terminals 40 (VDD), 22 (PC6), 23 (PC5) and 24 (PC4) are coupled together and to pins 12 (RESET) and 14 (VCC) of read only memory 350 and to a source of appropriate operating voltage designated B+. One read only memory which may be employed as read only memory 350 is the Motorola EEPROM MCM2802P. Pins 4 (VPP), 3 (T1), 5 (S4), 7 (VSS), 8 (S3), 9 (S2), 10 (S1) and 13 (T2) of read only memory 350 are coupled together and to ground and to microcomputer pins 20 (VSS), 37 (TIMER) and 3 (NUM). Microcomputer pins 7 (PA4), 14 (PB2) and 21 (PC7) are coupled to each other and to ground. In this embodiment of the invention, microprocessor 330 is appropriately clocked at a 1 MHz bus frequency.

Table 3 is a hexadecimal core dump of the contents of microprocessor 330. Table 4 is a hexadecimal dump of the contents of read only memory of code plug 350. When microcomputer 330 and read only memory 350 are appropriately programmed by reading the contents of Tables 3 and 4 therein, respectively, microcomputer 330 together with read only memory 350 and theremaining portions of the circuit shown in FIG. 15 cooperate to implement one embodiment of the present invention. Tables 3 and 4 follow.

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TABLE 3

0000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0020	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0030	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0080	24	04	16	01	20	02	17	01	18	01	19	01	81	A6	60 E7
0090	09	A6	21	E7	04	AE	10	A6	14	E7	3E	A6	0A	E7	3D CD
00A0	00	ED	3A	3D	26	F9	E6	10	26	04	9C	CC	06	42	81 E7
00E0	3E	A6	4E	E7	3A	20	06	E7	3E	A6	46	E7	3A	A6	08 E7
00C0	3C	EE	3A	F6	3C	3A	DE	3E	F7	3C	3E	3A	3C	26	F2 81
00D0	4F	05	01	00	49	0F	02	00	49	81	14	72	18	72	05 3F
00E0	05	05	6C	02	1A	68	3F	69	3F	6A	3F	6B	81	1F	03 16
00F0	05	1A	01	17	01	E0	88	8D	8B	E6	77	46	E0	80	46 E0
0100	80	E6	3E	E7	3C	3B	3C	3B	3C	3B	3C	A6	08	3B	3C E0
0110	80	4A	26	F9	17	05	A6	20	1E	01	20	02	8D	88	06 01
0120	00	79	69	01	69	02	69	03	4A	26	F1	9F	AB	04	97 3C
0130	3E	1E	03	81	E0	8D	AE	2E	20	04	E0	8D	AE	30	12 72
0140	E6	2D	E7	65	E6	2B	E7	3C	20	1E	E0	8D	E6	29	E7 3C
0150	AE	56	E6	2E	20	0E	1A	00	20	2A	E0	8D	E6	2A	E7 3C
0160	AE	5E	E6	2C	27	F0	E7	65	1A	00	A6	02	E7	3D	A6 8C
0170	E7	08	A6	07	E7	09	8F	A6	08	4A	26	FD	3A	3D	26 EE
0180	3A	65	26	E6	A6	60	E7	09	02	72	2A	A6	FF	E7	75 A6
0190	05	E7	44	EF	39	21	FE	EE	39	F6	A4	0F	A1	0F	26 03
01A0	CC	02	62	E1	75	26	08	A6	0F	E7	75	A6	24	20	05 E7
01E0	75	48	AE	10	97	F6	E7	37	E7	45	E6	01	E7	3B	0E 72
01C0	3A	A6	FC	E7	07	A6	94	E7	03	E6	3B	E7	08	3F	09 8F
01D0	A6	02	9D	4A	26	FD	A6	9C	E7	03	E6	3B	E7	08	3F 09
01E0	8F	E6	3B	E7	08	3F	09	8F	A6	02	9D	9D	4A	26	FD 01
01F0	72	12	0F	01	0A	A6	60	E7	09	20	65	A6	EC	20	C4 1E
0200	37	9D	20	08	9D	9D	9D	9D	9D	21	FE	A6	84	E7	03
0210	E6	3B	E7	08	3F	09	8F	A6	02	9D	4A	26	FD	A6	80 E7
0220	03	E6	3B	E7	08	3F	09	8F	E6	3B	E7	08	3F	09	8F 21
0230	FE	9D	9D	9D	9D	3A	37	26	0E	3A	3C	27	12	E6	45 E7
0240	37	CC	01	C5	9D	21	FE	9D	9D	9D	9D	CC	01	C5	9D
0250	9D	9D	9D	21	FE	A6	84	E7	03	A6	01	E7	3C	03	72 07
0260	13	72	A6	94	E7	03	81	3A	44	27	F7	3C	39	A6	07 4A
0270	9D	26	FC	CC	01	95	A6	60	E7	09	80	04	68	7E	06 6B
0280	03	CC	03	8D	E0	D0	E8	77	27	05	1C	09	CC	06	17 0B
0290	68	08	0B	3F	05	07	00	02	E0	DE	17	68	AE	01	A6 FE
02A0	E7	3D	E7	02	09	02	3B	5C	0E	02	34	5C	0D	02	30 5C
02E0	39	3D	E6	3D	E7	02	08	3D	EE	03	68	15	3A	66	26 11
02C0	11	68	13	68	A6	21	E7	04	10	00	0E	68	04	15	6C 3F
02D0	70	81	E7	67	12	6B	A6	01	E7	66	81	A6	03	20	F9 BF
02E0	73	9F	03	68	ED	B1	67	26	D3	00	68	EF	3C	66	A6 03
02F0	E1	66	26	DD	10	68	14	68	B1	15	68	1D	03	E6	73 A1
0300	0A	27	6E	A1	0C	26	1D	A6	E0	E7	04	E6	76	E7	00 1D
0310	68	AE	55	5C	A3	60	24	4D	F6	2A	F8	EF	74	E6	42 E7
0320	71	18	68	81	A1	0E	26	02	3F	73	09	43	10	E1	63 26
0330	0C	E6	62	E1	74	27	4E	AE	05	E1	74	27	45	0B	43 06
0340	E6	73	B1	61	27	3C	A6	E0	E7	04	E6	76	E7	00	1D 6B
0350	09	68	19	E6	73	EE	74	AA	80	F7	5C	A3	60	24	06 F6
0360	2A	F8	EF	74	81	19	68	A6	C0	E7	71	81	E6	42	E7 71
0370	81	0D	04	03	0C	00	15	0D	71	08	1B	72	8D	DA	9C CC
0380	05	62	A6	E6	E7	04	E6	76	E7	00	1D	68	81	16	6B E6
0390	6A	A4	1E	27	04	1D	07	20	02	1C	07	E6	6C	E7	6D 01
03A0	01	0F	01	6D	0B	3A	6E	27	13	10	6C	20	11	3F	6E 20
03E0	0B	00	6D	F5	3C	6E	A6	03	E1	6E	27	ED	11	6C	0F 01
03C0	0F	03	6D	0B	3A	6F	27	13	12	6C	20	11	3F	6F	20 0B
03D0	02	6D	F5	3C	6F	A6	03	E1	6F	27	ED	13	6C	0F	43 12
03E0	08	00	12	05	6D	0B	3A	70	27	16	14	6C	20	14	3F 70
03F0	20	0E	0B	00	EE	04	6D	F2	3C	70	A6	03	E1	70	27 EA
0400	15	6C	E6	6D	E8	6C	27	62	1B	72	10	04	1D	03	46 24
0410	2D	01	6C	2C	1E	68	8D	DE	05	6C	14	07	3F	0B	05 72
0420	19	0B	3F	05	0B	72	0E	1B	72	16	72	E6	43	20	61 14

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0430 72 18 72 20 E6 16 72 9C 20 76 14 72 20 1A 18 68
0440 46 24 09 03 6C 06 1F 04 E6 42 20 44 46 24 1A 1F
0450 68 04 4C 07 14 72 18 72 1D 04 81 15 72 19 72 1C
0460 04 0F 43 03 1D 00 81 1C 00 81 E6 35 48 E8 49 E7
0470 69 4F E9 6A E7 6A 4F E9 6E E7 6E 0C 43 0E E1 60
0480 26 E7 0E 68 E4 1F 68 AD D2 1B 68 81 E6 6A 20 EE
0490 E7 3A 9C A6 21 E7 04 E6 3A A4 0C A1 08 26 3D 06
04A0 72 03 CC 05 39 03 3A 08 00 3A 08 CD 01 34 20 0C
04B0 A6 60 E7 09 20 06 03 01 F2 CD 01 3A 1A 00 1D 03
04C0 A6 FF E7 08 A6 05 E7 09 8F 01 01 0A 3A 6E 26 F0
04D0 17 72 11 6C 20 3F A6 03 E7 6E 20 E4 05 3A 0E 06
04E0 3A 05 CD 01 34 20 06 03 01 F8 CD 01 3A 01 3A 35
04F0 03 3A 0F 0D 71 32 CD 01 4A CD 01 5A 20 10 9D 9D
0500 20 13 0F 71 2B CD 01 5A 0D 71 03 CD 01 4A 0A 42
0510 ED E6 42 E7 71 A6 CE E7 07 A6 84 E7 03 06 72 9C
0520 18 00 CC 06 6A 02 3A 05 0F 71 05 20 CC 0C 71 DB
0530 06 72 DB 04 42 DB CC 06 DB 03 3A 10 00 3A 05 CD
0540 01 34 20 01 03 01 FB CD 01 3A 20 C9 10 72 01 3A
0550 08 03 01 05 CD 01 3A 20 03 CD 01 34 11 72 13 6C
0560 20 E3 09 42 A6 20 8F 9C ED 8D A6 01 E7 3C A6 04
0570 E7 65 A6 80 E7 72 AE 32 CD 01 68 1B 00 CC 06 17
0580 A6 60 E7 09 1D 03 1E 68 0C 72 10 01 3F 0D CD 01
0590 5A A6 CE E7 07 A6 84 E7 03 1E 00 03 3F 30 1A 72
05A0 1C 68 0D 72 47 A6 02 E7 3C A6 E2 E7 04 E6 76 E7
05B0 00 A6 5D E7 08 A6 06 E7 09 CD 02 7E 8F 21 FE 0B
05C0 72 0C 0D 68 13 3A 3C 27 05 0C 72 E3 20 38 1B 72
05D0 1D 68 A6 21 E7 04 10 00 0D 72 0C 0D 3F 04 1C 07
05E0 1C 03 ED DA CC 06 6A 0F 3F F8 20 F2 A6 7D E7 3C
05F0 A6 12 E7 3B A6 E4 E7 04 E6 76 E7 00 A6 9C E7 0B
0600 A6 06 E7 09 20 E3 3A 3E 26 F2 00 04 E3 A6 07 E7
0610 3E 10 04 10 00 20 E5 9C A6 21 E7 04 A6 01 E7 00
0620 A6 30 E7 05 A6 0F E7 06 A6 CE E7 07 A6 84 E7 03
0630 4F E7 01 E7 02 E7 6C E7 6E E7 6F E7 70 E7 72 E7
0640 68 9A ED 00 E7 77 A6 0A E7 3E AE 3E A6 0A E7 3D
0650 ED ED 3A 3D 26 FA E6 44 EE 45 A1 A5 26 E4 E6 42
0660 E7 71 4F 0F 43 02 A6 C0 E7 76 9C E6 40 E7 45 E6
0670 3E E7 39 3F 37 1D 72 A6 60 E7 09 CD 08 28 3F 3C
0680 3F 3D AE 10 CD 08 17 AE 23 CD 08 17 E6 22 E7 14
0690 E6 20 E7 12 E6 21 E7 13 E6 34 E7 26 E6 35 44 44
06A0 44 E7 27 A6 70 E7 08 3F 09 3F 36 E6 14 E0 27 2B
06B0 12 1A 36 26 04 E6 35 20 0E E7 14 EE 27 E6 35 E7
06C0 27 20 08 40 E7 27 EE 14 E6 22 E7 14 14 36 8F CD
06D0 07 3C 04 36 03 CD 02 7E E6 36 A4 09 26 05 03 36
06E0 CB 20 E7 07 36 05 01 39 02 1C 72 3C 37 34 39 E6
06F0 41 E1 37 26 82 CC 05 80 E6 32 E8 29 E7 29 E6 31
0700 B9 28 E7 28 0D 01 18 2E 0E 0C 28 04 3C 2A 20 27
0710 3C 28 20 23 0C 28 04 3C 2C 20 1C 3C 2D 20 18 2B
0720 0E 0C 28 04 3A 2A 20 0F 3A 2B 20 0E 0C 28 04 3A
0730 2C 20 04 3A 2D 20 00 5A 27 42 21 00 E6 1F E8 16
0740 E7 16 E6 1E E9 15 E7 15 0D 01 18 2E 0E 0C 15 04
0750 3C 17 20 A4 3C 18 20 A0 0C 15 04 3C 19 20 99 3C
0760 1A 20 95 2E 0E 0C 15 04 3A 17 20 8C 3A 18 20 88
0770 0C 15 04 3A 19 20 81 3A 1A CC 06 F8 A6 AD C7 00
0780 0E A6 02 E7 09 E6 1C EE 16 E7 16 E6 1B E9 15 E7
0790 15 E6 2F E8 29 E7 29 E6 2E E9 28 E7 28 05 36 05
07A0 AE 10 CD 07 AE 0E 36 05 AE 23 CD 07 AE 81 E6 0C
07B0 E7 25 E6 0E E0 0A E7 3C E6 07 E0 09 E7 3E E8 3C
07C0 00 25 01 47 E7 30 E6 3E E0 3C 00 25 01 47 E7 3C
07D0 EE 01 2A 01 40 E7 3E E6 30 FE 2A 01 40 E8 3E E1
07E0 0D 23 10 6A 03 26 14 A3 10 26 04 10 36 20 0C 16
07F0 36 20 08 E6 03 E1 11 27 02 6C 03 E6 37 27 15 0A
0800 36 12 3A 12 26 0E A1 01 26 08 E6 20 E7 12 3A 45
0810 26 02 12 36 00 25 07 E6 3D F7 E6 3C E7 01 4F E7
0820 07 E7 08 E7 09 E7 0A 81 A6 1B E7 3A 0E 3E 03 0C
0830 72 37 01 39 02 A6 4E E7 3A E6 1B 00 36 02 E6 2E
0840 E7 3D E6 37 48 E7 3E AE 1B E0 ED E0 ED A6 2E E7
0850 3E E0 E0 E6 37 27 2A E6 1B E1 3D 26 04 A6 1B ED

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0860 E7 E6 2E E1 3D 26 1A 20 0A E6 2E E1 4E 26 0A A6
 0870 1E ED E7 A6 2E ED E7 20 08 A6 1E ED AF A6 2E ED
 0880 AF 81 00 00 00 00 00 00 00 00 00 00 00 00 00
 0890 43 6F 70 79 72 69 67 68 74 20 31 39 38 32 20 20
 08A0 4D 6F 74 6F 72 6F 6C 61 20 49 6E 63 2E 20 20 20

1FF0 00 00 00 00 00 00 02 76 06 17 05 67 06 17 06 17

TABLE 4

9A 01 29 33 40 0D 04 5C 9A 01 29 33 40 0D 04 5C
 9A 01 29 33 40 0D 04 5C 9A 01 29 33 40 0D 04 5C
 9A 01 29 33 40 0D 04 5C 00 2E 01 05 C0 0A A0 05
 E4 91 2A 3C 92 0D 04 55 8F 49 26 37 E9 00 04 55
 80 80 09 09 09 0A 01 09 09 09 05 AA AA AA 00 00
 A7 0D 4A 64 51 57 59 4A 62 3E 6E 34 75 2B 80 22
 BD 1A 9A 13 E7 07 C3 03 05 01 01 04 04 04 54 52
 54 52 0A 05 09 09 09 00 00 00 00 00 00 00 00 79

From the above description, it is clear that one aspect of the invention includes a method of processing a particular signal to determine if such particular signal exhibits a predetermined frequency. This method, although described above in detail, is now briefly summarized. The method includes the step of generating an observation interval signal. The method further includes the step of sampling the particular signal during the observation window established by the observation interval signal to produce samples of the particular signal. The present method includes the step of ignoring a portion of the samples of the particular signal occurring in time near the beginning, or alternatively, near the end of said observation window, and the step of correlating the samples of the particular signal with a predetermined pattern to detect the presence of a signal exhibiting the predetermined frequency.

The foregoing describes a digitally sampling decoder circuit which detects the presence of a signal exhibiting a predetermined frequency in a manner achieving a substantial response at a selected predetermined frequency while diminishing the undesired side lobe response. The presence or absence of a signal exhibiting the predetermined frequency is determined without consuming large quantities of computational processing time.

Claims

1. A decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a first sample during a substantially rectangular observation interval, said decoder circuit characterized by:

ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval after said first sample, said bite interval having its center located between approximately 0.02 T₁ and 0.28 T₁, wherein T₁ is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

2. The circuit of claim 1 including means, responsive to said ignoring means, for performing operations other than said sampling and said correlating during times at which said ignoring means is ignoring samples.

3. The circuit of claim 2 wherein said means for performing includes means, responsive to said ignoring means, for assuming an idle mode for purposes of reducing power consumption.

4. The circuit of claim 1 wherein said means for ignoring establishes a bite interval occurring within said observation interval between approximately 0.06 T₁ and approximately 0.18 T₁, wherein T₁ is defined to be time duration of the observation interval.

5. The circuit of claim 1 wherein said means for ignoring establishes a bite interval centered at approximately 0.12 T₁, wherein T₁ is defined to be time duration of the observation interval.

6. The circuit of claim 1 wherein said ignoring means further includes weighting means, coupled to said sampling means, for weighting each of the unignored samples with a weighting factor consisting of a

0840 E7 E6 2E B1 3D 26 1A 20 0A E6 2E E1 4E 26 0A A6
 0870 1B BD E7 A6 2E BD E7 20 0B A6 1B BD AF A6 2E BD
 0880 AF B1 00 00 00 00 00 00 00 00 00 00 00 00 00
 0890 43 6F 70 79 72 69 67 68 74 20 31 39 38 32 20 20
 08A0 4D 6F 74 6F 72 6F 6C 61 20 49 6E 63 2E 20 20 20

1FF0 00 00 00 00 00 00 02 76 06 17 05 67 06 17 06 17

TABLE 4

9A 01 29 33 40 0D 04 5C 9A 01 29 33 40 0D 04 5C
 9A 01 29 33 40 0D 04 5C 9A 01 29 33 40 0D 04 5C
 9A 01 29 33 40 0D 04 5C 00 2E 01 05 C0 0A A0 05
 E4 91 2A 3C 92 0D 04 55 8F 49 26 37 E9 0D 04 55
 80 80 09 09 09 0A 01 09 09 09 05 AA AA AA 00 00
 A7 0D 4A 64 51 57 59 4A 62 3E 68 34 75 2B 80 22
 8D 1A 9A 13 E7 07 C3 03 05 01 01 04 04 04 54 52
 54 52 0A 05 09 09 09 00 00 00 00 00 00 00 00 79

From the above description, it is clear that one aspect of the invention includes a method of processing a particular signal to determine if such particular signal exhibits a predetermined frequency. This method, although described above in detail, is now briefly summarized. The method includes the step of generating an observation interval signal. The method further includes the step of sampling the particular signal during the observation window established by the observation interval signal to produce samples of the particular signal. The present method includes the step of ignoring a portion of the samples of the particular signal occurring in time near the beginning, or alternatively, near the end of said observation window, and the step of correlating the samples of the particular signal with a predetermined pattern to detect the presence of a signal exhibiting the predetermined frequency.

The foregoing describes a digitally sampling decoder circuit which detects the presence of a signal exhibiting a predetermined frequency in a manner achieving a substantial response at a selected predetermined frequency while diminishing the undesired side lobe response. The presence or absence of a signal exhibiting the predetermined frequency is determined without consuming large quantities of computational processing time.

Claims

1. A decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a first sample during a substantially rectangular observation interval, said decoder circuit characterized by:

ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval after said first sample, said bite interval having its center located between approximately 0.02 T₁ and 0.28 T₁, wherein T₁ is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

2. The circuit of claim 1 including means, responsive to said ignoring means, for performing operations other than said sampling and said correlating during times at which said ignoring means is ignoring samples.

3. The circuit of claim 2 wherein said means for performing includes means, responsive to said ignoring means, for assuming an idle mode for purposes of reducing power consumption.

4. The circuit of claim 1 wherein said means for ignoring establishes a bite interval occurring within said observation interval between approximately 0.06 T₁ and approximately 0.18 T₁, wherein T₁ is defined to be time duration of the observation interval.

5. The circuit of claim 1 wherein said means for ignoring establishes a bite interval centered at approximately 0.12 T₁, wherein T₁ is defined to be time duration of the observation interval.

6. The circuit of claim 1 wherein said ignoring means further includes weighting means, coupled to said sampling means, for weighting each of the unignored samples with a weighting factor consisting of a



numerical constant and for weighting each of the ignored samples with a weighting factor of 0.0.

7. The circuit of claim 6 wherein said numerical constant is equal to 1.0.

8. The circuit of claim 1 wherein said portion of said samples includes a plurality of samples.

9. A decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a last sample during a substantially rectangular observation interval, said decoder circuit characterized by:

ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval prior to said last sample, said bite interval having its center located between approximately $0.72 T_1$ and $0.98 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

10. The circuit of claim 9 including means, responsive to said ignoring means, for performing operations other than said sampling and said correlating during times at which said ignoring means is ignoring samples.

11. The circuit of claim 10 wherein said means for performing includes means, responsive to said ignoring means, for assuming an idle mode for purposes of reducing power consumption.

12. The circuit of claim 9 wherein said means for ignoring establishes a bite interval occurring within said observation interval between approximately $0.82 T_1$ and approximately $0.94 T_1$, wherein T_1 is defined to be time duration of the observation interval.

13. The circuit of claim 9 wherein said means for ignoring establishes a bite interval centered at approximately $0.88 T_1$, wherein T_1 is defined to be time duration of the observation interval.

14. The circuit of claim 9 wherein said ignoring means further includes weighting means, coupled to said sampling means, for weighting each of the unignored samples with a weighting factor consisting of a numerical constant and for weighting each of the ignored samples with a weighting factor of 0.0.

15. The circuit of claim 14 wherein said numerical constant is equal to 1.0.

16. The circuit of claim 9 wherein said portion of said samples includes a plurality of samples.

17. A decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a first sample during a substantially rectangular observation interval, said decoder circuit characterized by:

sample inhibiting means, coupled to said sampling means, for inhibiting said sampling means from sampling during a bite interval occurring within a portion of said observation interval, said bite interval occurring after said first sample and having its center located between approximately $0.02 T_1$ and $0.28 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

18. The circuit of claim 17 wherein said sample inhibiting means further includes weighting means, coupled to said sampling means, for weighting each of said samples with a weighting factor consisting of a numerical constant.

19. The circuit of claim 18 wherein said numerical constant is equal to 1.0.

20. The circuit of claim 17 wherein said sample inhibiting means inhibits said sampling means from taking a plurality of successive samples.

21. The circuit of claim 20 wherein said successive samples are centered about approximately $0.12 T_1$.

22. The circuit of claim 20 wherein said successive samples are inhibited for a duration of approximately $0.12 T_1$.

23. The circuit of claim 17 further including means responsive to said sample inhibiting means for performing operations other than said correlating during times when said samples are inhibited by said sample inhibiting means.

24. The circuit of claim 23 wherein said means for performing includes means, responsive to said sample inhibiting means, for assuming an idle mode for purposes of reducing power consumption.

25. A decoder circuit for detecting the presence of a signal exhibiting a predetermined frequency, said circuit including timing means for generating observation interval signals and sampling means, responsive to said timing means, for sampling a first signal to produce samples thereof including a last sample during a substantially rectangular observation interval, said decoder circuit characterized by:

sample inhibiting means, coupled to said sampling means, for inhibiting said sampling means from sampling during a bite interval occurring within a portion of said observation interval, said bite interval occurring prior to said last sample and having its center located between approximately $0.72 T_1$ and $0.98 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.



26. The circuit of claim 25 wherein said sample inhibiting means further includes weighting means, coupled to said sampling means, for weighting each of said samples with a weighting factor consisting of a numerical constant.

27. The circuit of claim 26 wherein said numerical constant is equal to 1.0.

5 28. The circuit of claim 25 wherein said sample inhibiting means inhibits said sampling means from taking a plurality of successive samples.

29. The circuit of claim 28 wherein said successive samples are centered about approximately $0.88 T_1$.

30. The circuit of claim 28 wherein said successive samples are inhibited for a duration of approximately $0.12 T_1$.

10 31. The circuit of claim 25 further including means responsive to said sample inhibiting means for performing operations other than said correlating during times when said samples are inhibited by said sample inhibiting means.

32. The circuit of claim 31 wherein said means for performing includes means, responsive to said sample inhibiting means, for assuming an idle mode for purposes of reducing power consumption.

15 33. A decoder for detecting the presence of a signal exhibiting a predetermined frequency, said decoder including microcomputer means for processing sampled signal information, said microcomputer means including a random access memory and a read only memory for storing information therein, and further including a plurality of registers for facilitating processing of such information, said microcomputer means further including sampling means for sampling a first signal to produce samples thereof including a first sample during a substantially rectangular observation window, said decoder characterized by:

20 ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval after said first sample, said bite interval having its center located between approximately $0.02 T_1$ and $0.28 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

25 correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

34. A decoder for detecting the presence of a signal exhibiting a predetermined frequency, said decoder including microcomputer means for processing sampled signal information, said microcomputer means including a random access memory and a read only memory for storing information therein, and further including a plurality of registers for facilitating processing of such information, said microcomputer means further including sampling means for sampling a first signal to produce samples thereof including a last sample during a substantially rectangular observation window, said decoder characterized by:

35 ignoring means for ignoring a plurality of successive samples within a bite interval occurring in a portion of said observation interval prior to said last sample, said bite interval having its center located between approximately $0.72 T_1$ and $0.98 T_1$, wherein T_1 is defined to be the time duration of the observation interval, and

40 correlation means, electrically coupled to said sampling means, for correlating the remaining samples with a predetermined pattern to detect the presence of a signal exhibiting said predetermined frequency within said first signal.

Patentansprüche

45 1. Decoderschaltung zum Ermitteln der Anwesenheit eines Signals, das eine vorbestimmte Frequenz hat, enthaltend eine Zeitgebereinrichtung zum Erzeugen von Beobachtungsintervallsignalen und eine Abtasteinrichtung, die auf die Zeitsignale anspricht, zum Abtasten eines ersten Signals, um Tastwerte desselben zu erzeugen, einschließlich eines ersten Tastwertes während eines im wesentlichen rechteckigen Beobachtungsintervalls, gekennzeichnet durch:

50 eine Ignoriereinrichtung zum Ignorieren einer Mehrzahl aufeinanderfolgender Tastwerte innerhalb eines Ausschnittintervalls, das in einem Abschnitt des Beobachtungsintervalls nach dem ersten Tastwert auftritt, welches Ausschnittintervall mit seiner Mitte zwischen etwa $0,02 T_1$ und $0,28 T_1$ zentriert ist, wobei T_1 als die Zeitdauer des Beobachtungsintervalls definiert ist, und

55 eine Korreliereinrichtung, die elektrisch mit der Abtasteinrichtung verbunden ist, um die übrigen Tastwerte mit einem vorbestimmten Muster zu korrelieren, um die Anwesenheit eines Signals, das die vorbestimmte Frequenz aufweist, in dem ersten Signal zu ermitteln.

2. Schaltung nach Anspruch 1, enthaltend eine Einrichtung, die auf die Ignoriereinrichtung anspricht, um andere Tätigkeiten als die Abtastung und die Korrelierung während Zeiten auszuführen, in denen die Ignoriereinrichtung Tastwerte ignoriert.

60 3. Schaltung nach Anspruch 2, bei der die Ausführungseinrichtung eine Einrichtung enthält, die auf die Ignoriereinrichtung anspricht, um einen Leerlaufbetriebszustand zum Zwecke der Verminderung des Stromverbrauchs anzunehmen.

4. Schaltung nach Anspruch 1, bei der die Einrichtung zum Ignorieren ein Ausschnittintervall einrichtet, das innerhalb des Beobachtungsintervalls zwischen etwa $0,06 T_1$ und etwa $0,18 T_1$ auftritt, wobei T_1 als die Zeitdauer des Beobachtungsintervalls definiert ist.



5. Schaltung nach Anspruch 1, bei der die Einrichtung zum Ignorieren ein Ausschnittintervall einrichtet, das bei etwa 0,12 T1 zentriert ist, wobei T1 als die Zeitdauer des Beobachtungsintervalls definiert ist.

6. Schaltung nach Anspruch 1, bei der die Ignoriereinrichtung weiterhin eine Gewichtungseinrichtung enthält, die mit der Abtasteinrichtung verbunden ist, um jeden der nicht ignorierten Tastwerte mit einem Gewichtungsfaktor zu gewichten, der aus einer numerischen Konstanten besteht, und um jeden der ignorierten Tastwerte mit einem Gewichtungsfaktor von 0,0 zu gewichten.

7. Schaltung nach Anspruch 6, bei der die numerische Konstante gleich 1,0 ist.

8. Schaltung nach Anspruch 1, bei der der Abschnitt der Tastwerte mehrere Tastwerte enthält.

9. Decoderschaltung zur Ermittlung der Anwesenheit eines Signals, das eine vorbestimmte Frequenz aufweist, enthaltend eine Zeitgebereinrichtung zum Erzeugen von Beobachtungsintervallsignalen und eine Abtasteinrichtung, die auf die Zeitsignale anspricht, um ein erstes Signal abzutasten, um Tastwerte desselben zu erzeugen, einschließlich eines letzten Tastwertes während eines im wesentlichen rechteckigen Beobachtungsintervalls, gekennzeichnet durch:

eine Ignoriereinrichtung zum Ignorieren einer Mehrzahl von aufeinanderfolgenden Tastwerten innerhalb eines Ausschnittintervalls, das in einem Abschnitt des Beobachtungsintervalls von dem letzten Tastwert erscheint, wobei das Ausschnittintervall mit seiner Mitte zwischen etwa 0,72 T1 und 0,98 T1 liegt, wobei T1 als die Zeitdauer des Beobachtungsintervalls definiert ist, und

eine Korreliereinrichtung, die elektrisch mit der Abtasteinrichtung verbunden ist, um die übrigen Tastwerte mit einem vorbestimmten Muster zu korrelieren, um die Anwesenheit eines Signals, das die vorbestimmte Frequenz aufweist, innerhalb des ersten Signals zu ermitteln.

10. Schaltung nach Anspruch 9, enthaltend eine auf die Ignoriereinrichtung ansprechende Einrichtung, um andere Tätigkeiten als die Abtastung und Korrelierung während Zeiten auszuführen, in denen die Ignoriereinrichtung Tastwerte ignoriert.

11. Schaltung nach Anspruch 10, bei der die Ausführungseinrichtung eine auf die Ignoriereinrichtung ansprechende Einrichtung enthält, um einen Leerlaufzustand zum Zwecke der Stromverbrauchsverminderung anzunehmen.

12. Schaltung nach Anspruch 9, bei der die Einrichtung zum Ignorieren ein Ausschnittintervall einrichtet, das innerhalb des Beobachtungsintervalls zwischen etwa 0,82 T1 und etwa 0,94 T1 auftritt, wobei TM als die Zeitdauer des Beobachtungsintervalls definiert ist.

13. Schaltung nach Anspruch 9, bei der die Einrichtung zum Ignorieren ein Ausschnittintervall einrichtet, das bei etwa 0,88 T1 zentriert ist, wobei T1 als die Zeitdauer des Beobachtungsintervalls definiert ist.

14. Schaltung nach Anspruch 9, bei der die Ignoriereinrichtung weiterhin eine Gewichtungseinrichtung enthält, die mit der Abtasteinrichtung verbunden ist, um jeden der nicht ignorierten Tastwerte mit einem Gewichtungsfaktor zu gewichten, der aus einer numerischen Konstanten besteht, und um jeden der ignorierten Tastwerte mit einem Gewichtungsfaktor von 0,0 zu gewichten.

15. Schaltung nach Anspruch 14, bei der die numerische Konstante gleich 1,0 ist.

16. Schaltung nach Anspruch 9, bei der der Abschnitt der Tastwerte mehrere Tastwerte enthält.

17. Decoderschaltung zum Ermitteln der Anwesenheit eines Signals, das eine vorbestimmte Frequenz aufweist, enthaltend eine Zeitgebereinrichtung zum Erzeugen von Beobachtungsintervallsignalen und eine Abtasteinrichtung, die auf die Zeitgebereinrichtung anspricht, um ein erstes Signal abzutasten, um Tastwerte desselben zu erzeugen, einschließlich eines ersten Tastwertes während eines im wesentlichen rechteckigen Beobachtungsintervalls, gekennzeichnet durch:

eine Abtastsperrereinrichtung, die mit der Abtasteinrichtung verbunden ist, um die Abtasteinrichtung am Abtasten während eines Ausschnittintervalls zu sperren, das innerhalb eines Teils des Beobachtungsintervalls auftritt, welches Ausschnittintervall nach dem ersten Tastwert auftritt und mit seiner Mitte zwischen etwa 0,02 T1 und 0,28 T1 zentriert ist, wobei T1 als die Zeitdauer des Beobachtungsintervalls definiert ist, und

eine Korreliereinrichtung, die elektrisch mit der Abtasteinrichtung verbunden ist, um die übrigen Tastwerte mit einem vorbestimmten Muster zu korrelieren, um die Anwesenheit eines Signals, das die vorbestimmte Frequenz aufweist, innerhalb des ersten Signals zu ermitteln.

18. Schaltung nach Anspruch 17, bei der die Abtastsperrereinrichtung weiterhin eine Gewichtungseinrichtung enthält, die mit der Abtasteinrichtung verbunden ist, um jeden der Tastwerte mit einem Gewichtungsfaktor zu gewichten, der aus einer numerischen Konstanten besteht.

19. Schaltung nach Anspruch 18, bei der die numerische Konstante gleich 1,0 ist.

20. Schaltung nach Anspruch 17, bei der die Abtastsperrereinrichtung die Abtasteinrichtung dagegen sperrt, mehrere aufeinanderfolgende Tastwerte zu nehmen.

21. Schaltung nach Anspruch 20, bei der die aufeinanderfolgenden Tastwerte um etwa 0,12 T1 zentriert sind.

22. Schaltung nach Anspruch 20, bei der die aufeinanderfolgenden Tastwerte für eine Dauer von etwa 0,1 T1 gesperrt sind.

23. Schaltung nach Anspruch 17, weiterhin enthaltend eine Einrichtung, die auf die Abtastsperrereinrichtung anspricht, um andere Tätigkeiten als die genannte Korrelierung während Zeiten auszuführen, wenn die Tastwerte von der Abtastsperrereinrichtung gesperrt werden.

24. Schaltung nach Anspruch 23, bei der die Ausführungseinrichtung eine auf die Abtastsperrereinrichtung



ansprechende Einrichtung enthält, um einen Leerlaufbetriebszustand zum Zwecke der Stromverbrauchsverminderung anzunehmen.

25. Decoderschaltung zur Ermittlung der Anwesenheit eines Signals, das eine vorbestimmte Frequenz aufweist, enthaltend eine Zeitgebereinrichtung zur Erzeugung von Beobachtungsintervallsignalen und eine
5 Abtasteinrichtung, die auf die Zeitgebersignale anspricht, um ein erstes Signal abzutasten, um Tastwerte desselben zu erzeugen, einschließlich eines letzten Tastwertes, während eines im wesentlichen rechteckigen Beobachtungsintervalls, gekennzeichnet durch

eine Abtastsperrereinrichtung, die mit der Abtasteinrichtung verbunden ist, um die Abtasteinrichtung am Abtasten während eines Ausschnittintervalls zu sperren, das innerhalb eines Teils des
10 Beobachtungsintervalls auftritt, welches Ausschnittintervall vor dem letzten Tastwert auftritt und mit seiner Mitte zwischen etwa $0,72 T_1$ und $0,98 T_1$ liegt, wobei T_1 als die Zeitdauer des Beobachtungsintervalls definiert ist, und

eine Korreliereinrichtung, die elektrisch mit der Abtasteinrichtung verbunden ist, um die übrigen Tastwerte mit einem vorbestimmten Muster zu korrelieren, um die Anwesenheit eines Signals, das die
15 vorbestimmte Frequenz aufweist, in dem ersten Signal zu ermitteln.

26. Schaltung nach Anspruch 25, bei der die Abtastsperrereinrichtung weiterhin eine Gewichtungseinrichtung enthält, die mit der Abtasteinrichtung verbunden ist, um jeden der Tastwerte mit einem Gewichtungsfaktor zu gewichten, der aus einer numerischen Konstanten besteht.

27. Schaltung nach Anspruch 26, bei der die numerische Konstante gleich 1,0 ist.

20 28. Schaltung nach Anspruch 25, bei der die Abtastsperrereinrichtung die Abtasteinrichtung am Nehmen mehrerer aufeinanderfolgender Tastwerte sperrt.

29. Schaltung nach Anspruch 28, bei der die aufeinanderfolgenden Tastwerte um etwa $0,88 T_1$ zentriert sind.

30. Schaltung nach Anspruch 28, bei der die aufeinanderfolgenden Tastwerte für eine Dauer von etwa
25 $0,12 T_1$ gesperrt sind.

31. Schaltung nach Anspruch 25, weiterhin enthaltend eine Einrichtung, die auf die Abtastsperrereinrichtung anspricht, um andere Aufgaben als das Korrelieren während Zeiten auszuführen, in denen die Tastwerte von der Abtastsperrereinrichtung gesperrt werden.

32. Schaltung nach Anspruch 31, bei der die Ausführungseinrichtung eine auf die
30 Abtastsperrereinrichtung ansprechende Einrichtung enthält, um einen Leerlaufbetriebszustand zum Zwecke der Stromverbrauchsverminderung anzunehmen.

33. Decoder zum Ermitteln der Anwesenheit eines Signals, das eine vorbestimmte Frequenz aufweist, enthaltend eine Mikrocomputereinrichtung zum Verarbeiten von abgetasteter Signalinformation, welche Mikrocomputereinrichtung einen Speicher mit wahlfreiem Zugriff und einen MUR-Lese-Speicher zum
35 Speichern von Information darin enthält, und weiterhin enthaltend mehrere Register zum Erleichtern der Verarbeitung solcher Information, welche Mikrocomputereinrichtung weiterhin eine Abtasteinrichtung enthält, um ein erstes Signal abzutasten, um Tastwerte desselben zu erzeugen, einschließlich eines ersten Tastwertes, während eines im wesentlichen rechteckigen Beobachtungsfensters, gekennzeichnet durch:

eine Ignoriereinrichtung zum Ignorieren einer Vielzahl aufeinanderfolgender Tastwerte innerhalb eines
40 Ausschnittsintervalls, das in einem Teil des Beobachtungsintervalls nach dem ersten Tastwert auftritt, welches Ausschnittintervall mit einer Mitte zwischen etwa $0,02 T_1$ und $0,28 T_1$ zentriert ist, wobei T_1 als die Zeitdauer des Beobachtungsintervalls definiert ist, und

eine Korreliereinrichtung, die elektrisch mit der Abtasteinrichtung verbunden ist, um die übrigen Tastwerte mit einem vorbestimmten Muster zu korrelieren, um die Anwesenheit eines Signals, das die
45 vorbestimmte Frequenz aufweist, in dem ersten Signal zu ermitteln.

34. Decoder zum Ermitteln der Anwesenheit eines Signals, das eine vorbestimmte Frequenz aufweist, enthaltend eine Mikrocomputereinrichtung zum Verarbeiten von abgetasteter Signalinformation, welche Mikrocomputereinrichtung einen Speicher mit wahlfreiem Zugriff und einen MUR-Lese-Speicher zum
50 Speichern von Information darin aufweist, und weiterhin enthaltend eine Vielzahl von Registern zum Erleichtern der Verarbeitung solcher Information, welche Mikrocomputereinrichtung weiterhin eine Abtasteinrichtung zum Abtasten eines ersten Signals aufweist, um Tastwerte desselben zu erzeugen, einschließlich eines letzten Tastwertes während eines im wesentlichen rechteckigen Beobachtungsfensters, gekennzeichnet durch:

eine Ignoriereinrichtung zum Ignorieren einer Vielzahl aufeinanderfolgender Tastwerte innerhalb eines
55 Ausschnittsintervalls, das in einem Teil des Beobachtungsintervalls vor dem letzten Tastwert auftritt, welches Ausschnittintervall mit seiner Mitte zwischen etwa $0,72 T_1$ und $0,98 T_1$ liegt, wobei T_1 als die Zeitdauer des Beobachtungsintervalls definiert ist, und

eine Korreliereinrichtung, die elektrisch mit der Abtasteinrichtung verbunden ist, um die übrigen Tastwerte mit einem vorbestimmten Muster zu korrelieren, um die Anwesenheit eines Signals, das die
60 vorbestimmte Frequenz aufweist, in dem ersten Signal zu ermitteln.

Revendications

65 1. Un circuit décodeur destiné à détecter la présence d'un signal présentant une fréquence



- prédéterminée, ce circuit comprenant des moyens de génération d'intervalles de temps destinés à produire des signaux d'intervalles d'observation, et des moyens d'échantillonnage, fonctionnant sous la dépendance des moyens de génération d'intervalles de temps, de façon à échantillonner un premier signal, pour produire des échantillons de ce signal comprenant un premier échantillon pendant un intervalle d'observation pratiquement rectangulaire, ce circuit décodeur étant caractérisé par:
- 5 d'observation pratiquement rectangulaire, ce circuit décodeur étant caractérisé par:
 - des moyens de rejet destinés à rejeter un ensemble d'échantillons successifs pendant un intervalle de rejet qui apparaît pendant une partie de l'intervalle d'observation, après le premier échantillon, le centre de cet intervalle de rejet se trouvant entre approximativement $0,02 T_1$ et $0,28 T_1$, en désignant par T_1 la durée de l'intervalle d'observation, et
 - 10 des moyens de corrélation, connectés électriquement aux moyens d'échantillonnage, ayant pour fonction de corréler les échantillons restants avec une configuration prédéterminée, pour détecter la présence dans le premier signal d'un signal présentant la fréquence prédéterminée.
 2. Le circuit de la revendication 1, comprenant des moyens qui fonctionnent sous la dépendance des moyens de rejet, pour accomplir des opérations autres que l'échantillonnage et la corrélation, pendant les périodes au cours desquelles les moyens de rejet rejettent des échantillons.
 - 15 3. Le circuit de la revendication 2, dans lequel les moyens accomplissant des opérations comprennent des moyens, qui fonctionnent sous la dépendance des moyens de rejet, de façon à prendre un mode de repos dans le but de réduire la consommation d'énergie.
 4. Le circuit de la revendication 1, dans lequel les moyens de rejet établissent un intervalle de rejet qui apparaît à l'intérieur de l'intervalle d'observation, entre approximativement $0,06 T_1$ et approximativement $0,18 T_1$, en désignant par T_1 la durée de l'intervalle d'observation.
 - 20 5. Le circuit de la revendication 1, dans lequel les moyens de rejet établissent un intervalle de rejet qui est centré sur approximativement $0,12 T_1$, en désignant par T_1 la durée de l'intervalle d'observation.
 6. Le circuit de la revendication 1, dans lequel les moyens de rejet comprennent en outre des moyens de pondération, connectés aux moyens d'échantillonnage, qui sont destinés à pondérer chacun des échantillons non rejetés avec un facteur de pondération consistant en une constante numérique, et à pondérer chacun des échantillons rejetés avec un facteur de pondération de 0,0.
 - 25 7. Le circuit de la revendication 6, dans lequel la constante numérique est égale à 1,0.
 8. Le circuit de la revendication 1, dans lequel la partie précitée des échantillons comprend un ensemble d'échantillons.
 - 30 9. Un circuit décodeur destiné à détecter la présence d'un signal présentant une fréquence prédéterminée, ce circuit comprenant des moyens de génération d'intervalles de temps destinés à produire des signaux d'intervalles d'observation, et des moyens d'échantillonnage, fonctionnant sous la dépendance des moyens de génération d'intervalles de temps, de façon à échantillonner un premier signal pour produire des échantillons de celui-ci comprenant au moins un dernier échantillon pendant un intervalle d'observation pratiquement rectangulaire, ce circuit décodeur étant caractérisé par:
 - 35 des moyens de rejet destinés à rejeter un ensemble d'échantillons successifs pendant un intervalle de rejet qui apparaît pendant une partie de l'intervalle d'observation, avant le dernier échantillon, le centre de cet intervalle de rejet se trouvant entre approximativement $0,72 T_1$ et $0,98 T_1$, en désignant par T_1 la durée de l'intervalle d'observation, et
 - 40 des moyens de corrélation, connectés électriquement aux moyens d'échantillonnage, pour corréler les échantillons restants avec une configuration prédéterminée, afin de détecter la présence dans le premier signal d'un signal présentant la fréquence prédéterminée.
 10. Le circuit de la revendication 9, comprenant des moyens qui fonctionnent sous la dépendance des moyens de rejet, pour accomplir des opérations autres que l'échantillonnage et la corrélation, pendant les périodes au cours desquelles les moyens de rejet rejettent des échantillons.
 - 45 11. Le circuit de la revendication 10, dans lequel les moyens accomplissant des opérations comprennent des moyens, qui fonctionnent sous la dépendance des moyens de rejet, de façon à prendre un mode de repos dans le but de réduire la consommation d'énergie.
 12. Le circuit de la revendication 9, dans lequel les moyens de rejet établissent un intervalle de rejet qui apparaît à l'intérieur de l'intervalle d'observation, entre approximativement $0,82 T_1$ et approximativement $0,94 T_1$, en désignant par T_1 la durée de l'intervalle d'observation.
 - 50 13. Le circuit de la revendication 9, dans lequel les moyens de rejet établissent un intervalle de rejet qui est centré sur approximativement $0,88 T_1$, en désignant par T_1 la durée de l'intervalle d'observation.
 14. Le circuit de la revendication 9, dans lequel les moyens de rejet comprennent en outre des moyens de pondération, connectés aux moyens d'échantillonnage, qui sont destinés à pondérer chacun des échantillons non rejetés avec un facteur de pondération consistant en une constante numérique, et à pondérer chacun des échantillons rejetés avec un facteur de pondération de 0,0.
 - 55 15. Le circuit de la revendication 14, dans lequel la constante numérique est égale à 1,0.
 16. Le circuit de la revendication 9, dans lequel la partie précitée des échantillons comprend un ensemble d'échantillons.
 - 60 17. Un circuit décodeur destiné à détecter la présence d'un signal présentant une fréquence prédéterminée, ce circuit comprenant des moyens de génération d'intervalles de temps destinés à produire des signaux d'intervalles d'observation, et des moyens d'échantillonnage, fonctionnant sous la dépendance des moyens de génération d'intervalles de temps, pour échantillonner un premier signal afin



de produire des échantillons de celui-ci comprenant un premier échantillon pendant un intervalle d'observation pratiquement rectangulaire, ce circuit décodeur étant caractérisé par:

des moyens d'invalidation d'échantillons, connectés aux moyens d'échantillonnage, pour empêcher les moyens d'échantillonnage d'effectuer l'opération d'échantillonnage pendant un intervalle de rejet qui apparaît à l'intérieur d'une partie de l'intervalle d'observation, cet intervalle de rejet apparaissant après le premier échantillon et ayant son centre situé entre approximativement $0,02 T_1$ et $0,28 T_1$, en désignant par T_1 la durée de l'intervalle d'observation, et

des moyens de corrélation, connectés électriquement aux moyens d'échantillonnage, pour corréler les échantillons restants avec une configuration prédéterminée, afin de détecter la présence, dans le premier signal, d'un signal présentant la fréquence prédéterminée.

18. Le circuit de la revendication 17, dans lequel les moyens d'invalidation d'échantillons comprennent en outre des moyens de pondération, connectés aux moyens d'échantillonnage, pour pondérer chacun des échantillons avec un facteur de pondération qui consiste en une constante numérique.

19. Le circuit de la revendication 18, dans lequel la constante numérique est égale à 1,0.

20. Le circuit de la revendication 17, dans lequel les moyens d'invalidation d'échantillons empêchent les moyens d'échantillonnage de prélever un ensemble d'échantillons successifs.

21. Le circuit de la revendication 20, dans lequel les échantillons successifs sont centrés sur approximativement $0,12 T_1$.

22. Le circuit de la revendication 20, dans lequel les échantillons successifs sont invalidés pendant une durée d'environ $0,12 T_1$.

23. Le circuit de la revendication 17, comprenant en outre des moyens qui fonctionnent sous la dépendance des moyens d'invalidation d'échantillons, de façon à accomplir des opérations autres que la corrélation, pendant des périodes au cours desquelles les échantillons sont invalidés par les moyens d'invalidation d'échantillons.

24. Le circuit de la revendication 23, dans lequel les moyens d'accomplissement d'opérations comprennent des moyens, fonctionnant sous la dépendance des moyens d'invalidation d'échantillons, de façon à prendre un état de repos dans le but de réduire la consommation d'énergie.

25. Un circuit décodeur destiné à détecter la présence d'un signal présentant une fréquence prédéterminée, ce circuit comprenant des moyens de génération d'intervalles de temps destinés à produire des signaux d'intervalles d'observation, et des moyens d'échantillonnage, fonctionnant sous la dépendance des moyens de génération d'intervalles de temps, pour échantillonner un premier signal afin de produire des échantillons de celui-ci comprenant un premier échantillon pendant un intervalle d'observation pratiquement rectangulaire, ce circuit décodeur étant caractérisé par:

des moyens d'invalidation d'échantillons, connectés aux moyens d'échantillonnage, pour empêcher les moyens d'échantillonnage d'effectuer l'opération d'échantillonnage pendant un intervalle de rejet qui apparaît à l'intérieur d'une partie de l'intervalle d'observation, cet intervalle de rejet apparaissant avant le dernier échantillon et ayant son centre situé entre approximativement $0,72 T_1$ et $0,98 T_1$, en désignant par T_1 la durée de l'intervalle d'observation, et

des moyens de corrélation, connectés électriquement aux moyens d'échantillonnage, pour corréler les échantillons restants avec une configuration prédéterminée, afin de détecter la présence, dans le premier signal, d'un signal présentant la fréquence prédéterminée.

26. Le circuit de la revendication 25, dans lequel les moyens d'invalidation d'échantillons comprennent en outre des moyens de pondération, connectés aux moyens d'échantillonnage, pour pondérer chacun des échantillons avec un facteur de pondération qui consiste en une constante numérique.

27. Le circuit de la revendication 26, dans lequel la constante numérique est égale à 1,0.

28. Le circuit de la revendication 25, dans lequel les moyens d'invalidation d'échantillons empêchent les moyens d'échantillonnage de prélever un ensemble d'échantillons successifs.

29. Le circuit de la revendication 28, dans lequel les échantillons successifs sont centrés sur approximativement $0,88 T_1$.

30. Le circuit de la revendication 28, dans lequel les échantillons successifs sont invalidés pendant une durée d'environ $0,12 T_1$.

31. Le circuit de la revendication 25, comprenant en outre des moyens qui fonctionnent sous la dépendance des moyens d'invalidation d'échantillons, de façon à accomplir des opérations autres que la corrélation pendant des périodes au cours desquelles les échantillons sont invalidés par les moyens d'invalidation d'échantillons.

32. Le circuit de la revendication 31, dans lequel les moyens d'accomplissement d'opérations comprennent des moyens, fonctionnant sous la dépendance des moyens d'invalidation d'échantillons, de façon à prendre un état de repos dans le but de réduire la consommation d'énergie.

33. Un décodeur destiné à détecter la présence d'un signal présentant une fréquence prédéterminée, ce décodeur comprenant des moyens à micro-ordinateur destinés à traiter une information de signal échantillonné, ces moyens à micro-ordinateur comprenant une mémoire vive et une mémoire morte qui sont destinées à enregistrer de l'information, et comprenant en outre un ensemble de registres ayant pour but de faciliter le traitement de cette information, ces moyens à micro-ordinateur comprenant en outre des moyens d'échantillonnage destinés à échantillonner un premier signal pour produire des échantillons de



celui-ci comprenant un premier échantillon, pendant une fenêtre d'observation pratiquement rectangulaire, ce décodeur étant caractérisé par:

des moyens de rejet destinés à rejeter un ensemble d'échantillons successifs pendant un intervalle de rejet qui apparaît dans une partie de l'intervalle d'observation, après le premier échantillon, le centre de cet intervalle de rejet se trouvant entre approximativement $0,02 T_1$ et $0,28 T_1$, en désignant par T_1 la durée de l'intervalle d'observation, et

des moyens de corrélation, connectés électriquement aux moyens d'échantillonnage, pour corréler les échantillons restants avec une configuration prédéterminée, afin de détecter la présence, dans le premier signal, d'un signal présentant la fréquence prédéterminée.

34. Un décodeur destiné à détecter la présence d'un signal présentant une fréquence prédéterminée, ce décodeur comprenant des moyens à micro-ordinateur destinés à traiter une information de signal échantillonné, ces moyens à micro-ordinateur comprenant une mémoire vive et une mémoire morte qui sont destinées à enregistrer de l'information, et comprenant en outre un ensemble de registres ayant pour but de faciliter le traitement de cette information, ces moyens à micro-ordinateur comprenant en outre des moyens d'échantillonnage destinés à échantillonner un premier signal pour produire des échantillons de celui-ci comprenant un dernier échantillon, pendant une fenêtre d'observation pratiquement rectangulaire, ce décodeur étant caractérisé par:

des moyens de rejet destinés à rejeter un ensemble d'échantillons successifs pendant un intervalle de rejet qui apparaît dans une partie de l'intervalle d'observation avant le dernier échantillon, le centre de cet intervalle de rejet se trouvant entre approximativement $0,72 T_1$ et $0,98 T_1$, en désignant par T_1 la durée de l'intervalle d'observation, et

des moyens de corrélation, connectés électriquement aux moyens d'échantillonnage, pour corréler les échantillons restants avec une configuration prédéterminée, afin de détecter la présence, dans le premier signal, d'un signal présentant la fréquence prédéterminée.

