



## Description

### Technical Field

This invention relates generally to demodulator circuits and, more particularly, to a demodulator circuit which is synchronized with a modulated signal by the energy of the modulated signal.

### Background Art

Generally, a demodulator must be synchronized with a modulated data stream input signal to provide a valid output. Previous methods for acquiring synchronization with a modulated signal include the continuous transmission of a carrier signal having embedded sync bits in a fixed pattern which can be used to synchronize the demodulator. A severe limitation of using a carrier signal with a sync pattern is the fact that the pattern occupies a long time period and delays demodulation of the data stream. Another method for acquiring synchronization is to add a start bit at the beginning of the data stream signal. However, not only does a start bit require an extra bit for each data signal, most applications typically use several stop bits which require additional bits.

### Summary of the Invention

Accordingly, an object of the present invention is to provide an improved demodulator circuit which is synchronized by the presence of energy of a modulated signal.

Another object of the present invention is to provide an improved synchronized demodulator circuit which detects sync with a modulated signal and which is faster than demodulator circuits of the prior art.

In carrying out the above and other objects and advantages of the present invention, there is provided, in one form, differential amplifier means for providing a single ended output from a modulated two line input of a 2, 4, or 6 wire telephone system. A sync detect circuit is coupled to the output of the differential amplifier means and provides a detection signal by detecting synchronization with the occurrence of the initial burst of signal energy from the line. The detection signal is integrated by a counter to provide an integration signal which is coupled to a threshold detector and decoded from the counter. The threshold detector provides a sync detect signal when the integration signal exceeds a predetermined level. The sync detect signal is coupled to a filter to provide a valid data signal which indicates the acquisition of synchronization of the demodulator with the modulated signal. A correlator is coupled to the sync detect circuit which uses the detection signal to provide valid data bits. The valid data bits are stored until the occurrence of the valid data signal.

The above and other objects, features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings.

### Brief Description of the Drawings

FIG. 1 illustrates in block diagram form an energy synchronized demodulator circuit constructed in accordance with the preferred embodiment of the present invention; and

FIG. 2 is a graphic timing diagram for the energy synchronized demodulator circuit of FIG. 1.

### Description of the Preferred Embodiment

Shown in FIG. 1 is an energy synchronized demodulator circuit 10 constructed in accordance with the preferred embodiment of the present invention. Synchronized demodulator circuit 10 is comprised generally of a differential to single ended conversion portion 12, a window detection portion 14, an integration and threshold detect portion 16, a pulse shaping portion 18, a correlation portion 20 and a storage portion 22. Conversion portion 12 is comprised of an operational amplifier 24 which has an output, a first input coupled to a first line input signal, LI1, and a second input coupled to a second line input signal, LI2. Line input signals LI1 and LI2 represent a modulated signal shown in FIG. 2 from a modulator (not shown) and, in a preferred embodiment, represent two lines of a 2, 4 or 6 wire telephone system. The modulated signal shown in FIG. 2 illustrates the conventional Differential Phase Shift Keying (DPSK) modulation which utilizes phase relationship between bit intervals. In other words, in a binary system, a phase reversal at the completion of one cycle indicates a binary "1" and no phase reversal indicates a binary "0".

In a window detection portion 14, a comparator 26 has a first input coupled to the output of operational amplifier 24, and a second input coupled to a positive threshold voltage level,  $V_{TH1}$ . A comparator 28 has a first input coupled to both the first input of comparator 26 and the output of operational amplifier 24, and a second input coupled to a negative threshold voltage level  $V_{TH2}$ . An output of comparator 26 which provides a signal A is coupled to a first input of an OR gate 30. An output of comparator 28 which provides a signal B is coupled to a second input of OR gate 30. The output of OR gate 30 provides a first detection signal C. A comparator 32 has a first input coupled to the first inputs of comparators 26 and 28 and to the output of operational amplifier 24. Comparator 32 has a second input coupled to a reference voltage, say analog ground,  $V_{AG}$ , and an output coupled to a correlator circuit 34. The output of comparator 32 provides a second detection signal D.

In integration and threshold detect portion 16, an up-down counter 36 has an input coupled to the output of OR gate 30 and an output coupled to pulse shaping portion 18. A clock signal generated by conventional clock means 38 is coupled to up-down counter 36. In a preferred embodiment, up-down counter 36 is a conventional counter circuit capable of counting at varying rates. Counter 36 functionally provides an integration signal whose level is an integration over time of a



input signal and provides an output sync detect signal E when the integration signal exceeds a predetermined threshold level.

In pulse shaping portion 18, an input of a digital filter 40 is coupled to the output of up-down counter 36. Filter 40 represents a conventional digital filter which is functionally capable of providing a constant level output signal as long as a time varying input signal applied thereto remains above a predetermined threshold level for a predetermined amount of time. Included in filter 40 is conventional circuitry for performing an algorithm which calculates the timing and duration of the sync detect signal E and for validating the synchronization. The output of filter 40 is a signal which represents the presence of synchronized valid data.

In correlation portion 20, correlator 34 has the clock signal of clock means 38 coupled thereto. An output of correlator 34 which provides a signal D' is coupled to an input of storage portion 22 which comprises a storage register 42. In a preferred embodiment, correlator 34 is a conventional circuit (not shown) capable of detecting either a phase or a frequency relationship between predetermined bit intervals of a modulated input signal and providing a digital signal indicative of the phase or frequency relationship for each of the bit intervals. When DPSK modulation is used, the modulated input signal is sampled during consecutive cycles and the samples are then compared to correlate a change in phase. Therefore correlator 34 may be implemented by selectively coupling the samples to an exclusive OR logic gate. The output signal D' of correlator 34 represents valid demodulated data which is stored by storage register 42.

In operation, the line input signal shown in FIG. 2 is coupled to the inputs of operational amplifier 24. The threshold levels  $V_{TH1}$  and  $V_{TH2}$  are predetermined at some positive and negative level, respectively. For each portion of the line input signal which is more positive than  $V_{TH1}$ , comparator 26 provides a pulse shown as signal A. Similarly, for each portion of the line input signal which is more negative than  $V_{TH2}$ , comparator 28 provides a pulse shown as signal B. Thus, comparators 26 and 28 and OR gate 30 function as a window detector to receive the modulated input line signal and provide a detection signal. The window includes all voltage levels more positive than  $V_{TH1}$  and all voltage levels more negative than  $V_{TH2}$ . The output of OR gate 30 shown as detection signal C is the combination of pulses from signals A and B. Up-down counter 36 functions as both an integrator and a threshold detector. After detection signal C is received, up-down counter 36 begins counting up the length of the presence of detection signal C at a first predetermined rate. If detection signal C remains present until up-down counter 36 counts up to a mid-range value or a synchronization threshold level, then threshold detection means in up-down counter 36 provide a constant level sync detect signal E. When detection signal C is not present

between pulses, up-down counter 36 still provides a sync detect signal E which is above the predetermined mid-range level. Between the pulses of detection signal C, up-down counter 36 begins counting down at a second predetermined rate. The second predetermined rate is slower than the first count rate so that the synchronization threshold level is not reached during the intervals between pulses of data of detection signal C. Since the level of sync detect signal E is constantly changing, signal E is coupled to filter 40 which provides a valid data signal of constant predetermined level whenever sync detect signal E is greater than the synchronization threshold level.

In pulse shaping portion 18, before filter 40 provides the valid data signal, an algorithm is performed by conventional logic circuitry (not shown) to validate the presence, timing and duration of sync detect signal E. The algorithm is implemented by a circuit which times the presence of sync detect signal E and determines whether or not the duration sync detect signal E is within a predetermined percentage of the duration of the modulated line input signal. Thus the purpose of the algorithm is to validate sync detect signal E and determine whether or not signal E resulted only from a continuous flow of noise on the line input. The algorithm also insures that the valid data signal is not interrupted in case signal E drops below the mid range level for one cycle because of noise interference during the presence of the modulated input signal.

Typically, every modulator/demodulator system must prevent noise from interrupting synchronization and proper data transmission. In an example shown in FIG. 2, a noise pulse 44 is present on the line input. In a telephone system, transformer action will produce both a positive and a negative pulse at the line input. Therefore, first detection signal C has two pulses generated at the output of OR gate 30 by a single noise spike. However, up-down counter 36 never counts up to the synchronization threshold level, and as a result, filter 40 never provides a valid data signal. Therefore, demodulator circuit 10 is insensitive to short duration noise interference.

Synchronization of the line input signal with the demodulator has been accomplished beginning with the initial burst of energy from the line input signal. Simultaneous with the action of up-down counter 36, second detection signal D is coupled to correlator 34. Correlator 34 detects a phase relationship between consecutive cycles. When the phase reverses, signal D provides two consecutive pulses of the same polarity. When no phase reversal occurs, signal D provides alternating pulses. Therefore, correlator 34 provides the binary demodulated output signal D' which is coupled to storage register 42. When the valid data signal is present, synchronized demodulated data can be transferred out of storage register 42. Similarly, correlator 34 can be adapted to demodulate a line input signal by detecting a frequency relationship between predetermined bit



intervals of first detection signal D. Frequency demodulation may be accomplished by correlator 34 if the modulated line input signal utilizes conventional FSK modulation instead of DPSK modulation.

While the invention has been described in the context of a preferred embodiment, it will be apparent to those skilled in the art that the present invention may be modified in numerous ways and may assume many embodiments other than that specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications which fall within their scope.

#### Claims

1. An energy synchronized demodulator circuit (10) for detecting, synchronizing and demodulating a modulated signal characterized by:

differential amplifier means (12) for receiving said modulated signal, and for providing a modulation signal related to the AC component of said modulated signal;

window detection means (14) coupled to said differential amplifier means, for receiving the modulation signal, and providing a first detection signal (C) when the amplitude of said modulation signal exceeds predetermined positive and negative half cycle threshold levels and a second detection signal (D) of predetermined positive and negative levels in response to said modulation signal varying above and below, respectively, a reference voltage;

integration means (16) coupled to said window detection means, for receiving said first detection signal, and providing an integration signal the level of which is an integration over time of said first detection signal;

threshold detection means (16) coupled to said integration means, for receiving said integration signal and providing a sync detect signal indicative of the detection of said modulated signal in response to said integration signal exceeding a predetermined synchronization threshold level;

correlation means (20) coupled to said window detection means, for receiving said second detection signal, detecting either a phase or a frequency relationship between predetermined bit intervals of said second detection signal, and providing a data bit indicative of said phase or frequency relationship for each of said bit intervals;

storage means (22) coupled to said correlation means, for receiving said data bits, and storing a predetermined number of the most recently received of said data bits; and

pulse shaping means (18) coupled to said threshold detection means, for receiving said sync detect signal, and providing a valid data signal indicative of both the acquisition of synchronization and the validity of the data bits stored in said storage means in response to the presence of said sync detect signal for at least said predetermined number of bit intervals.

2. The energy synchronized demodulator circuit

of claim 1 wherein said window detection means are further characterized by:

a first comparator (26) having a first input coupled to an output of said differential amplifier means, a second input coupled to said positive threshold voltage, and an output for providing a first signal (A) when the amplitude of said modulation signal exceeds the predetermined positive threshold level;

a second comparator (28) having a first input coupled to the output of said differential amplifier means, a second input coupled to said negative threshold voltage, and an output, for providing a second signal (B) when the amplitude of said modulation signal exceeds the predetermined negative threshold level;

logic means (30) having a first input coupled to said first signal, a second input coupled to said second signal and an output, for providing said first detection signal; and

a third comparator (32) having a first input coupled to the output of said differential amplifier means, a second input coupled to said reference voltage, and an output for providing said second detection signal.

3. The energy synchronized demodulator circuit of claim 2 wherein said integration means are characterized by a counter (36) having an input coupled to the output of said logic means, for counting the duration of said first detection signal and providing said integration signal.

4. The energy synchronized demodulator circuit of claim 3 wherein said threshold detection means are characterized by said counter for detecting said integration signal exceeding the predetermined threshold level.

5. The energy synchronized demodulator circuit of claim 2 wherein said correlation means are characterized by second logic means having first and second inputs selectively coupled to predetermined bit intervals of said second detection signal, and an output, for providing said data bit indicative of said phase or frequency relationship for each of the bit intervals.

6. The energy synchronized demodulator circuit of claim 2 wherein said pulse shaping means are characterized as being a filter (40).

7. The energy synchronized demodulator circuit of claim 6 wherein said pulse shaping means are further characterized by third logic means for performing an algorithm to validate the presence, timing and duration of said sync detect signal.

8. Method of synchronously detecting a modulated signal and demodulating the modulated signal, characterized by the steps of:

receiving said modulated signal and providing a modulation signal related to the AC component of said modulated signal;

providing a first detection signal (C) when the amplitude of said modulation signal exceeds predetermined positive and negative half cycle threshold levels, and also providing a second detection signal (D) in response to said modulation signal varying above and below a reference voltage;

intervals of first detection signal D. Frequency demodulation may be accomplished by correlator 34 if the modulated line input signal utilizes conventional FSK modulation instead of DPSK modulation.

While the invention has been described in the context of a preferred embodiment, it will be apparent to those skilled in the art that the present invention may be modified in numerous ways and may assume many embodiments other than that specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications which fall within their scope.

#### Claims

1. An energy synchronized demodulator circuit (10) for detecting, synchronizing and demodulating a modulated signal characterized by:

differential amplifier means (12) for receiving said modulated signal, and for providing a modulation signal related to the AC component of said modulated signal;

window detection means (14) coupled to said differential amplifier means, for receiving the modulation signal, and providing a first detection signal (C) when the amplitude of said modulation signal exceeds predetermined positive and negative half cycle threshold levels and a second detection signal (D) of predetermined positive and negative levels in response to said modulation signal varying above and below, respectively, a reference voltage;

integration means (16) coupled to said window detection means, for receiving said first detection signal, and providing an integration signal the level of which is an integration over time of said first detection signal;

threshold detection means (16) coupled to said integration means, for receiving said integration signal and providing a sync detect signal indicative of the detection of said modulated signal in response to said integration signal exceeding a predetermined synchronization threshold level;

correlation means (20) coupled to said window detection means, for receiving said second detection signal, detecting either a phase or a frequency relationship between predetermined bit intervals of said second detection signal, and providing a data bit indicative of said phase or frequency relationship for each of said bit intervals;

storage means (22) coupled to said correlation means, for receiving said data bits, and storing a predetermined number of the most recently received of said data bits; and

pulse shaping means (18) coupled to said threshold detection means, for receiving said sync detect signal, and providing a valid data signal indicative of both the acquisition of synchronization and the validity of the data bits stored in said storage means in response to the presence of said sync detect signal for at least said predetermined number of bit intervals.

2. The energy synchronized demodulator circuit

of claim 1 wherein said window detection means are further characterized by:

a first comparator (26) having a first input coupled to an output of said differential amplifier means, a second input coupled to said positive threshold voltage, and an output for providing a first signal (A) when the amplitude of said modulation signal exceeds the predetermined positive threshold level;

a second comparator (28) having a first input coupled to the output of said differential amplifier means, a second input coupled to said negative threshold voltage, and an output, for providing a second signal (B) when the amplitude of said modulation signal exceeds the predetermined negative threshold level;

logic means (30) having a first input coupled to said first signal, a second input coupled to said second signal and an output, for providing said first detection signal; and

a third comparator (32) having a first input coupled to the output of said differential amplifier means, a second input coupled to said reference voltage, and an output for providing said second detection signal.

3. The energy synchronized demodulator circuit of claim 2 wherein said integration means are characterized by a counter (36) having an input coupled to the output of said logic means, for counting the duration of said first detection signal and providing said integration signal.

4. The energy synchronized demodulator circuit of claim 3 wherein said threshold detection means are characterized by said counter for detecting said integration signal exceeding the predetermined threshold level.

5. The energy synchronized demodulator circuit of claim 2 wherein said correlation means are characterized by second logic means having first and second inputs selectively coupled to predetermined bit intervals of said second detection signal, and an output, for providing said data bit indicative of said phase or frequency relationship for each of the bit intervals.

6. The energy synchronized demodulator circuit of claim 2 wherein said pulse shaping means are characterized as being a filter (40).

7. The energy synchronized demodulator circuit of claim 6 wherein said pulse shaping means are further characterized by third logic means for performing an algorithm to validate the presence, timing and duration of said sync detect signal.

8. Method of synchronously detecting a modulated signal and demodulating the modulated signal, characterized by the steps of:

receiving said modulated signal and providing a modulation signal related to the AC component of said modulated signal;

providing a first detection signal (C) when the amplitude of said modulation signal exceeds predetermined positive and negative half cycle threshold levels, and also providing a second detection signal (D) in response to said modulation signal varying above and below a reference voltage;



Integrating said first detection signal and providing an integration signal the level of which is an integration over time of said detection signal; providing a sync detect signal (E) indicative of the detection of said modulated signal in response to said integration signal exceeding a predetermined synchronization threshold level;

detecting either a phase or a frequency relationship between predetermined bit intervals of said second detection signal, and providing a data bit indicative of said detected phase or frequency relationship for each of said bit intervals;

storing a predetermined number of the most recently received of said data bits; and

providing a valid data signal indicative of both the acquisition of synchronization and the validity of the data bits stored, in response to the presence of said sync detect signal for at least said predetermined number of bit intervals.

### Patentansprüche

1. Energiesynchronisierter Demodulatorkreis (10) zum Ermitteln, Synchronisieren und Demodulieren eines modulierten Signals, gekennzeichnet durch

eine Differentialverstärkereinrichtung (12) zum Empfangen des modulierten Signals und zum Abgeben eines Modulationssignals, das auf die Wechselstromkomponente des modulierten Signals bezogen ist;

eine Fensterdetektoreinrichtung (14), die mit der Differentialverstärkereinrichtung verbunden ist, um das Modulationssignal zu empfangen und um ein erstes Detektorsignal (C) abzugeben, wenn die Amplitude des Modulationssignals vorbestimmte positive und negative Halbzyklusschwellenwerte übersteigt, und ein zweites Detektorsignal (D) vorbestimmter positiver und negativer Pegel in Abhängigkeit von dem Modulationssignal abzugeben, die oberhalb bzw. unterhalb einer Bezugsspannung schwanken;

eine Integrationseinrichtung (16), die mit der Fensterdetektoreinrichtung verbunden ist, um das erste Detektorsignal aufzunehmen und ein Integrationssignal abzugeben, dessen Pegel eine Integration über der Zeit des ersten Detektorsignals ist;

eine Schwellenwertdetektoreinrichtung (16), die mit der Integrationseinrichtung verbunden ist, um das Integrationssignal aufzunehmen und ein Synchrondetektorsignal abzugeben, das die Ermittlung des modulierten Signals in Abhängigkeit davon anzeigt, daß das Integrationssignal einen vorbestimmten Synchronisationsschwellenwertpegel übersteigt;

eine Korrelationseinrichtung (20), die mit der Fensterdetektoreinrichtung verbunden ist, um das zweite Detektorsignal aufzunehmen, die entweder ein Phasen- oder ein Frequenzverhältnis zwischen vorbestimmten Bitintervallen des zweiten Detektorsignals ermittelt und ein Datenbit abgibt, das für jedes der genannten Bitintervalle des Phasen- oder Frequenzverhältnis anzeigt;

eine Speichereinrichtung (22), die mit der

Korrelationseinrichtung verbunden ist, um die Datenbits aufzunehmen und eine vorbestimmte Anzahl der zuletzt empfangenen Datenbits zu speichern; und

eine Impulsformereinrichtung (18), die mit der Schwellenwertdetektoreinrichtung verbunden ist, um das Synchrondetektorsignal aufzunehmen und ein gültiges Datensignal abzugeben, das sowohl die Annahme der Synchronisation als auch die Gültigkeit der in der Speichereinrichtung gespeicherten Datenbits in Abhängigkeit vom Vorhandensein des Synchrondetektorsignals für wenigstens die vorbestimmte Anzahl von Bitintervallen anzeigt.

2. Energiesynchronisierter Demodulatorkreis nach Anspruch 1, bei dem die Fensterdetektoreinrichtung weiterhin gekennzeichnet ist durch

einen ersten Komparator (26), der einen ersten Eingang hat, der mit einem Ausgang der Differenzverstärkereinrichtung verbunden ist, einen zweiten Eingang hat, der mit der positiven Schwellenwertspannung verbunden ist, und einen Ausgang hat, um ein erstes Signal (A) abzugeben, wenn die Amplitude des Modulationssignals den vorbestimmten positiven Schwellenwertpegel übersteigt;

einen zweiten Komparator (28), der einen ersten Eingang hat, der mit dem Ausgang der Differenzverstärkereinrichtung verbunden ist, einen zweiten Eingang hat, der mit der negativen Schwellenwertspannung verbunden ist, und einen Ausgang hat, um ein zweites Signal (B) abzugeben, wenn die Amplitude des Modulationssignals den vorbestimmten negativen Schwellenwertpegel übersteigt;

eine logische Einrichtung (30) mit einem ersten Eingang, der mit dem ersten Signal verbunden ist, und einem zweiten Eingang, der mit dem zweiten Signal verbunden ist, und einem Ausgang, um das erste Detektorsignal abzugeben; und

einen dritten Komparator (32) mit einem ersten Eingang, der mit dem Ausgang der Differenzverstärkereinrichtung verbunden ist, einem zweiten Eingang, der mit der Bezugsspannung verbunden ist, und einem Ausgang zum Abgeben des zweiten Detektorsignals.

3. Energiesynchronisierter Demodulatorkreis nach Anspruch 2, bei dem die Integrationseinrichtung gekennzeichnet ist durch einen Zähler (36) mit einem Eingang, der mit dem Ausgang der logischen Einrichtung verbunden ist, um die Dauer des ersten Detektorsignals zu zählen und das Integrationssignal abzugeben.

4. Energiesynchronisierter Demodulatorkreis nach Anspruch 3, bei dem die Schwellenwertdetektoreinrichtung gekennzeichnet ist durch den Zähler zur Ermittlung des Integrationssignals, das den vorbestimmten Schwellenwertpegel übersteigt.

5. Energiesynchronisierter Demodulatorkreis nach Anspruch 2, bei dem die Korrelationseinrichtung gekennzeichnet ist durch eine zweite logische Einrichtung mit ersten und zweiten Eingängen, die selektiv mit vorbestimmten Bitinter-



valls des zweiten Detektorsignals verbunden sind, und einem Ausgang zum Abgeben des Datenbits, das für das Phasen- oder Frequenzverhältnis für jedes der Bitintervalle repräsentativ ist.

6. Energiesynchronisierter Demodulatorkreis nach Anspruch 2, bei dem die Impulsformungseinrichtung dadurch gekennzeichnet ist, daß sie ein Filter (40) ist.

7. Energiesynchronisierter Demodulatorkreis nach Anspruch 6, bei dem die Impulsformungseinrichtung weiterhin gekennzeichnet ist durch eine dritte logische Einrichtung zur Ausführung eines Algorithmus, um die Anwesenheit, die Zeitabstimmung und die Dauer des Synchron-detektorsignals zu bestätigen.

8. Verfahren zum synchronen Ermitteln eines modulierten Signals und zum Demodulieren des modulierten Signals, gekennzeichnet durch die Schritte:

Empfangen des modulierten Signals und Erzeugen eines Modulationssignals, das auf die Wechselstromkomponente des modulierten Signals bezogen ist;

Erzeugen eines ersten Detektorsignals (C), wenn die Amplitude des Modulationssignals vorbestimmte positive und negative Halbzyklusschwellenwertpegel übersteigt, und zum Erzeugen eines zweiten Detektorsignals (D) in Abhängigkeit davon, daß das Modulationssignal oberhalb und unterhalb einer Bezugsspannung variiert;

Integrieren des ersten Detektorsignals und Erzeugen eines Integrationssignals, dessen Pegel eine Integration über der Zeit des Detektorsignals ist;

Erzeugen eines Synchrondetektorsignals (E), das die Ermittlung des modulierten Signals in Abhängigkeit davon anzeigt, daß das Integrationssignal einen vorbestimmten Synchronisationsschwellenwertpegel übersteigt;

Ermitteln entweder einer Phasen- oder einer Frequenzbeziehung zwischen vorbestimmten Bitintervalls des zweiten Detektorsignals und Erzeugen eines Datenbits, das die ermittelte Phasen- oder Frequenzbeziehung für jedes der genannten Bitintervalls anzeigt;

Speichern einer vorbestimmten Zahl der zuletzt empfangenen der Datenbits; und

Erzeugen eines gültigen Datensignals, das sowohl den Erhalt der Synchronisation und die Gültigkeit der gespeicherten Datenbits anzeigt, in Abhängigkeit von der Anwesenheit des Synchrondetektorsignals für wenigstens die vorbestimmte Anzahl der Bitintervalle.

## Revendications

1. Circuit démodulateur synchronisé par l'énergie (10) pour détecter, synchroniser et démoduler un signal modulé, caractérisé par:

un moyen amplificateur différentiel (12) pour recevoir le signal modulé et pour fournir un signal de modulation lié aux composantes alternatives du signal modulé;

un moyen de détection à fenêtre (14) couplé au

moyen d'amplificateur différentiel pour recevoir le signal de modulation et fournir un premier signal de détection (C) quand l'amplitude du signal de démodulation dépasse des niveaux de seuil médians prédéterminés positif et négatif et un second signal de détection (D) de niveaux prédéterminés positif et négatif en réponse au fait que le signal de modulation varie au-dessus et en-dessous, respectivement, d'une tension de référence;

un moyen d'intégration (16) couplé au moyen de détection à fenêtre pour recevoir le premier signal de détection et fournir un signal d'intégration dont le niveau correspond à une intégration dans le temps du premier signal de détection;

un moyen de détection de seuil (16) couplé au moyen d'intégration pour recevoir le signal d'intégration et fournir un signal de détection de synchronisation indicatif de la détection du signal modulé en réponse au fait que le signal d'intégration dépasse un niveau de tension de synchronisation prédéterminé;

un moyen de corrélation (20) couplé au moyen de détection à fenêtre pour recevoir le second signal de détection, détecter une relation de phase ou de fréquence entre des intervalles de bits prédéterminés du second signal de détection, et fournir un bit de données indicatif de ladite relation de phase ou de fréquence pour chacun des intervalles de bits;

un moyen de mémorisation (22) couplé au moyen de corrélation pour recevoir les bits de données et mémoriser un nombre prédéterminé des bits de données les plus récemment reçus; et

un moyen de mise en forme d'impulsions (18) couplé au moyen de détection de seuil pour recevoir le signal de détection de synchronisation et fournir un signal de données valides indicatif à la fois de l'acquisition de la synchronisation et de la validité des bits de données mémorisés dans le moyen de mémorisation en réponse à la présence du signal de détection de synchronisation pendant au moins ledit nombre prédéterminé d'intervalles de bits.

2. Circuit démodulateur synchronisé par l'énergie selon la revendication 1, dans lequel le moyen de détection à fenêtre est en outre caractérisé par:

un premier comparateur (26) ayant une première entrée couplée à une sortie du moyen amplificateur différentiel, une seconde entrée couplée à la tension de seuil positive, et une sortie pour fournir un premier signal (A) quand l'amplitude du signal de modulation dépasse le niveau de seuil positif prédéterminé;

un second comparateur (28) ayant une première entrée couplée à la sortie du moyen amplificateur différentiel, une seconde entrée couplée à la tension de seuil négative, et une sortie pour fournir un second signal (B) quand l'amplitude du signal de modulation dépasse le niveau de tension négative prédéterminé;

un moyen logique (30) ayant une première entrée couplée au premier signal, une seconde entrée couplée au second signal et une sortie, pour fournir le premier signal de détection; et



un troisième comparateur (32) ayant une première entrée couplée à la sortie du moyen amplificateur différentiel, une seconde entrée couplée à la tension de référence et une sortie pour fournir le second signal de détection.

3. Circuit démodulateur synchronisé par l'énergie selon la revendication 2, dans lequel le moyen d'intégration est caractérisé par un compteur (36) ayant une entrée couplée à la sortie du moyen logique, pour compter la durée du premier signal de détection et fournir ledit signal d'intégration.

4. Circuit démodulateur synchronisé par l'énergie selon la revendication 3, dans lequel le moyen de détection de seuil est caractérisé en ce que ledit compteur détecte le signal d'intégration dépassant le niveau de seuil prédéterminé.

5. Circuit démodulateur synchronisé par l'énergie selon la revendication 2, dans lequel le moyen de corrélation est caractérisé par un second moyen logique ayant des première et seconde entrées sélectivement couplées à des intervalles de bits prédéterminés du second signal de détection, et une sortie, pour fournir ledit bit de données indicatif de la relation de phase de fréquence pour chacun des intervalles de bits.

6. Circuit démodulateur synchronisé par l'énergie selon la revendication 2, dans lequel le moyen de mise en forme d'impulsions est caractérisé en ce qu'il est un filtre (40).

7. Circuit démodulateur synchronisé par l'énergie selon la revendication 6, dans lequel le moyen de mise en forme d'impulsions est en outre caractérisé par un troisième moyen logique pour mettre en oeuvre un algorithme pour valider la présence, la synchronisation et la durée du signal de détection de synchronisation.

8. Procédé de détection synchrone d'un signal modulé et de démodulation du signal modulé, caractérisé en ce qu'il comprend les étapes suivantes:

5 recevoir le signal modulé et fournir un signal de modulation lié à la composante alternative du signal modulé;

10 fournir un premier signal de détection (C) quand l'amplitude du signal de modulation dépasse des niveaux de seuil médians prédéterminés positif et négatif et fournir également un second signal de détection (D) en réponse au fait que le signal de modulation varie au-dessus et en-dessous d'une tension de référence;

15 intégrer le premier signal de détection et fournir un signal d'intégration dont le niveau constitue une intégration dans le temps du signal de détection;

20 fournir un signal de détection de synchronisation (E) indicatif de la détection du signal modulé en réponse au fait que le signal d'intégration dépasse un niveau de seuil de synchronisation prédéterminé;

25 détecter une relation de phase ou de fréquence entre des intervalles de bits prédéterminés du second signal de détection et fournir un bit de données indicatif de ladite relation de phase ou de fréquence pour chacun des intervalles de bits;

30 mémoriser un nombre prédéterminé des bits de données les plus récemment reçus; et

35 fournir un signal de données valides indicatif de l'acquisition de la synchronisation et de la validité des bits de données mémorisés, en réponse à la présence du signal de détection de synchronisation pendant au moins ledit nombre prédéterminé d'intervalles de bits.

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\* C L N S \*

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