US 20040071195A1

(19) United States
(12) Patent Application Publication
Huang et al.

(10) Pub. No.: US 2004/0071195 A1
(43) Pub. Date: Apr. 15, 2004

(54) METHOD AND ELECTRONIC DEVICE FOR A SPREAD SPECTRUM SIGNAL

(76) Inventors: **Xiaojing Huang**, Waverton (AU); **Yunxin Li**, Ryde (AU)

Correspondence Address:
MOTOROLA, INC.
1303 EAST ALGONQUIN ROAD
IL01/3RD
SCHAUMBURG, IL 60196

(21) Appl. No.: 10/269,633

(22) Filed: Oct. 11, 2002

Publication Classification

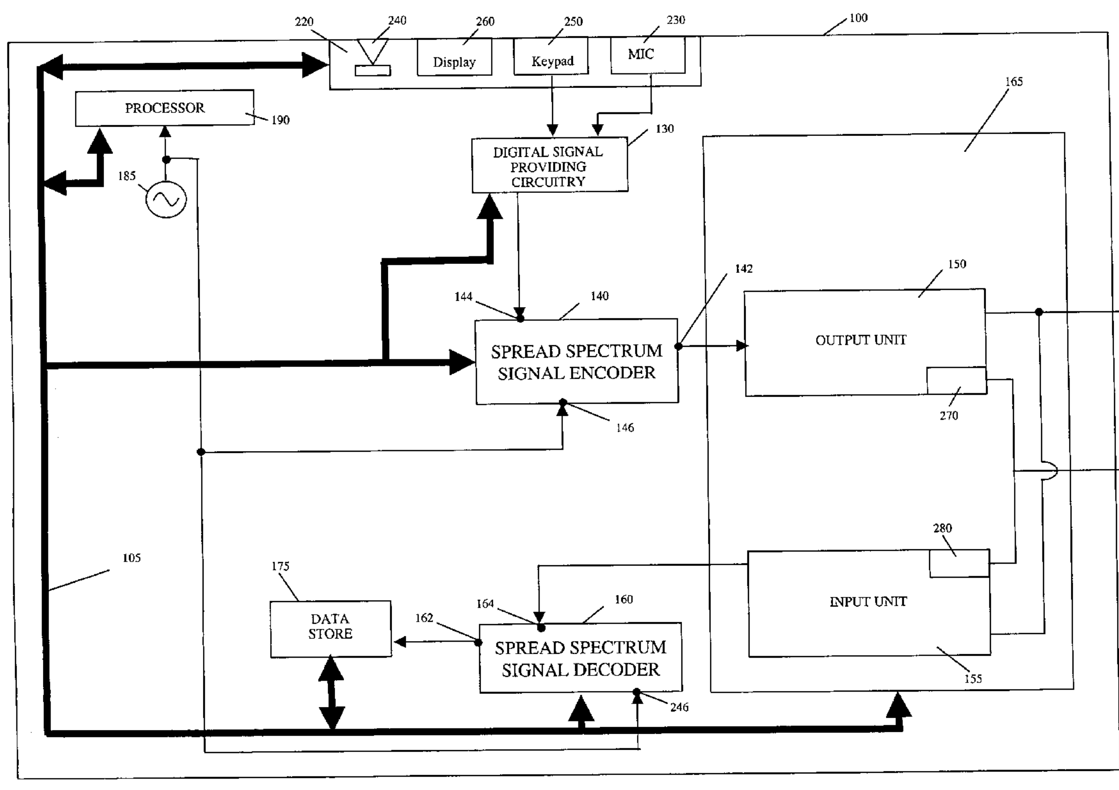
(51) Int. Cl.[7] H04B 1/69

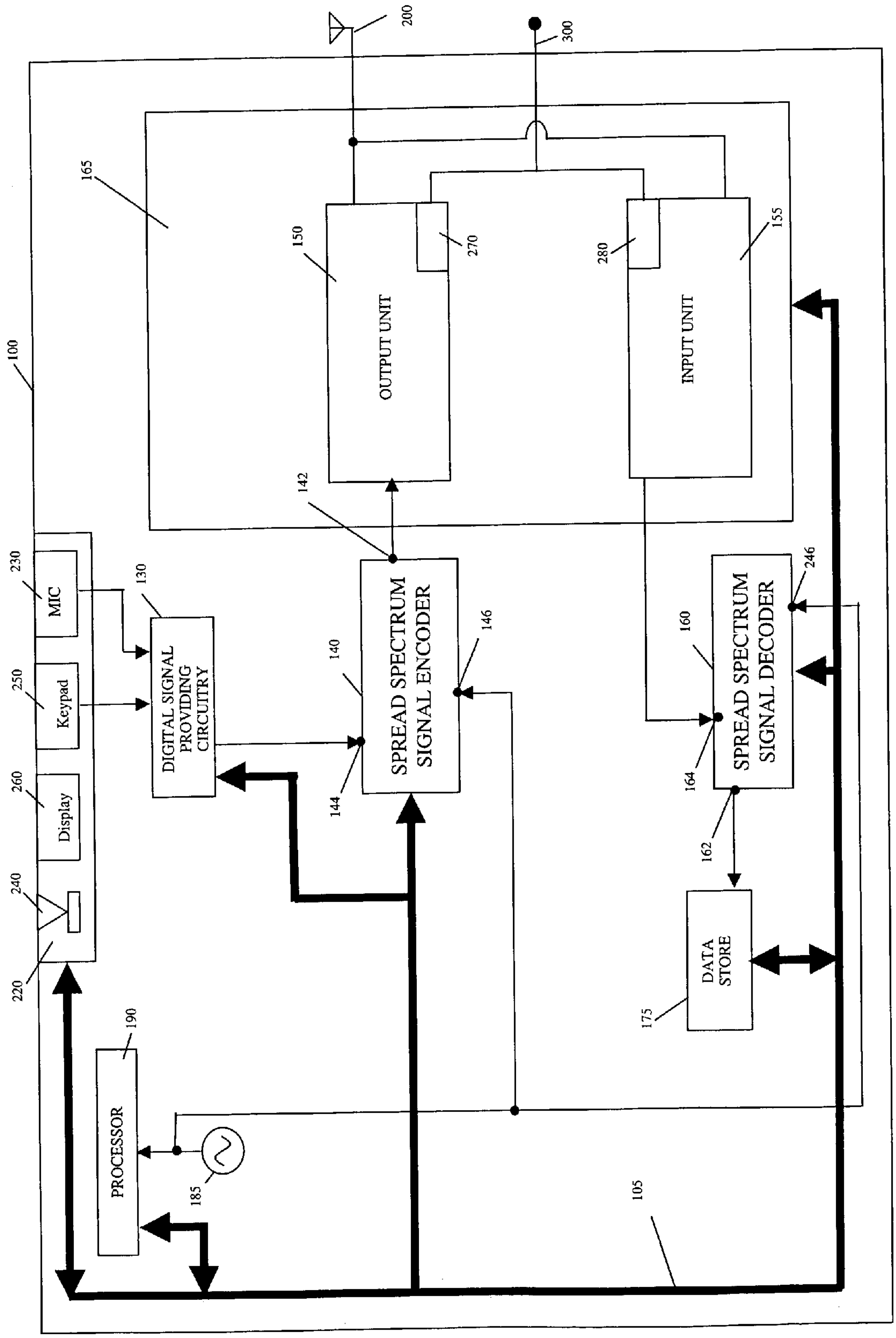
(52) U.S. Cl. 375/146; 375/147

(57) ABSTRACT

A device (**100**) and method (**700**) for creating a spread spectrum signal by providing a complementary code spreading signal (**740**) having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval. The method includes modulating (**750**) a data stream with the complementary code spreading signal to provide the spread spectrum signal.

There is also described a method (**800**) for decoding a spread spectrum signal to provide a data stream by providing a complementary code despreading signal (**840**) having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval. The method (**800**) includes demodulating (**850**) the spread spectrum signal with the complementary code despreading signal to provide the data stream.





200
300
165
100
150
270
280
155
OUTPUT UNIT
INPUT UNIT
142
230
MIC
130
250
Keypad
DIGITAL SIGNAL PROVIDING CIRCUITRY
140
SPREAD SPECTRUM SIGNAL ENCODER
146
144
260
Display
240
220
160
SPREAD SPECTRUM SIGNAL DECODER
246
164
162
DATA STORE
175
190
PROCESSOR
185
105

FIG. 1

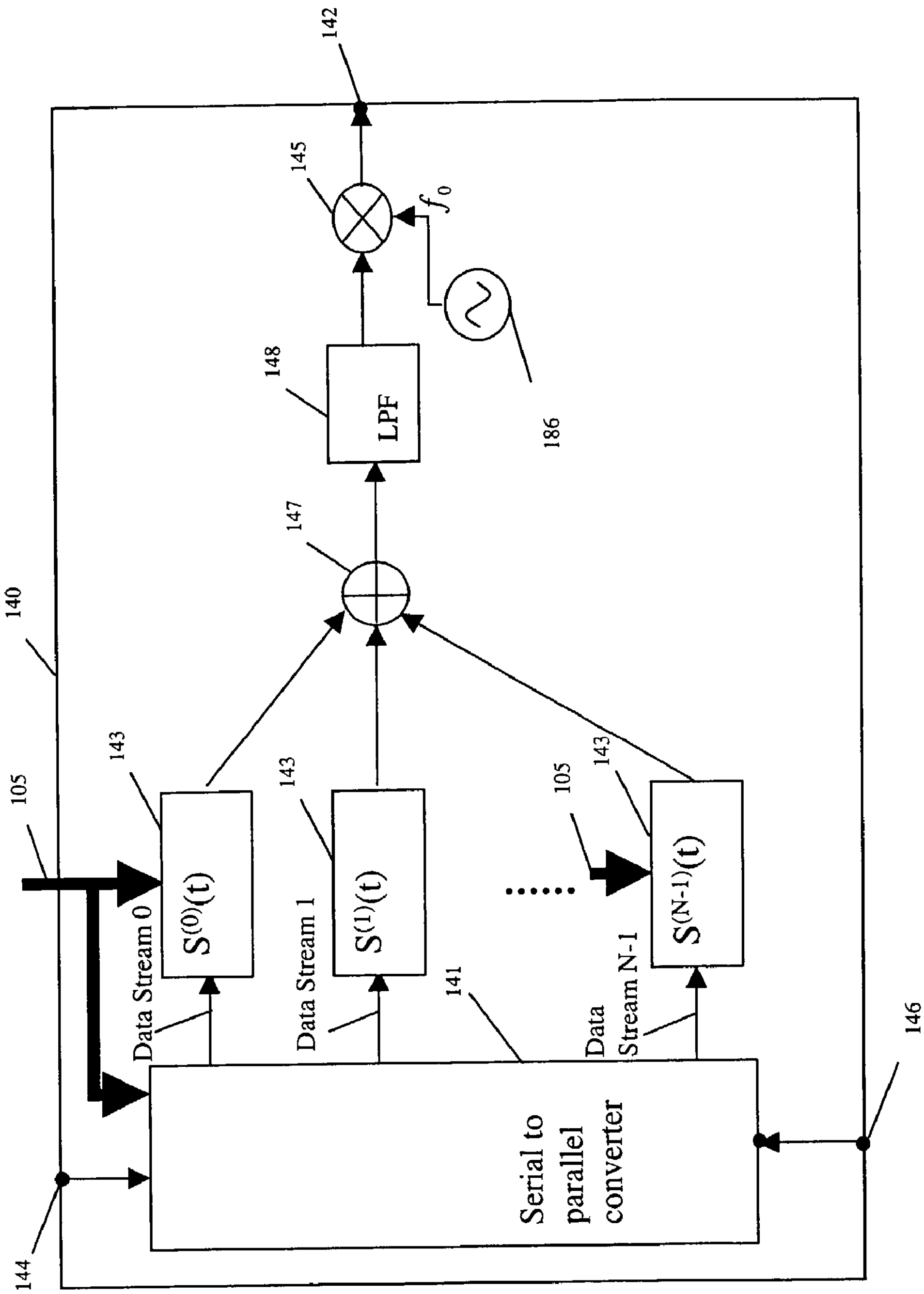

142
145
f_0
148
LPF
186
147
140
143
105
$S^{(0)}(t)$
$S^{(1)}(t)$
$S^{(N-1)}(t)$
Data Stream 0
Data Stream 1
Data Stream N-1
141
146
144
Serial to parallel converter

FIG. 2

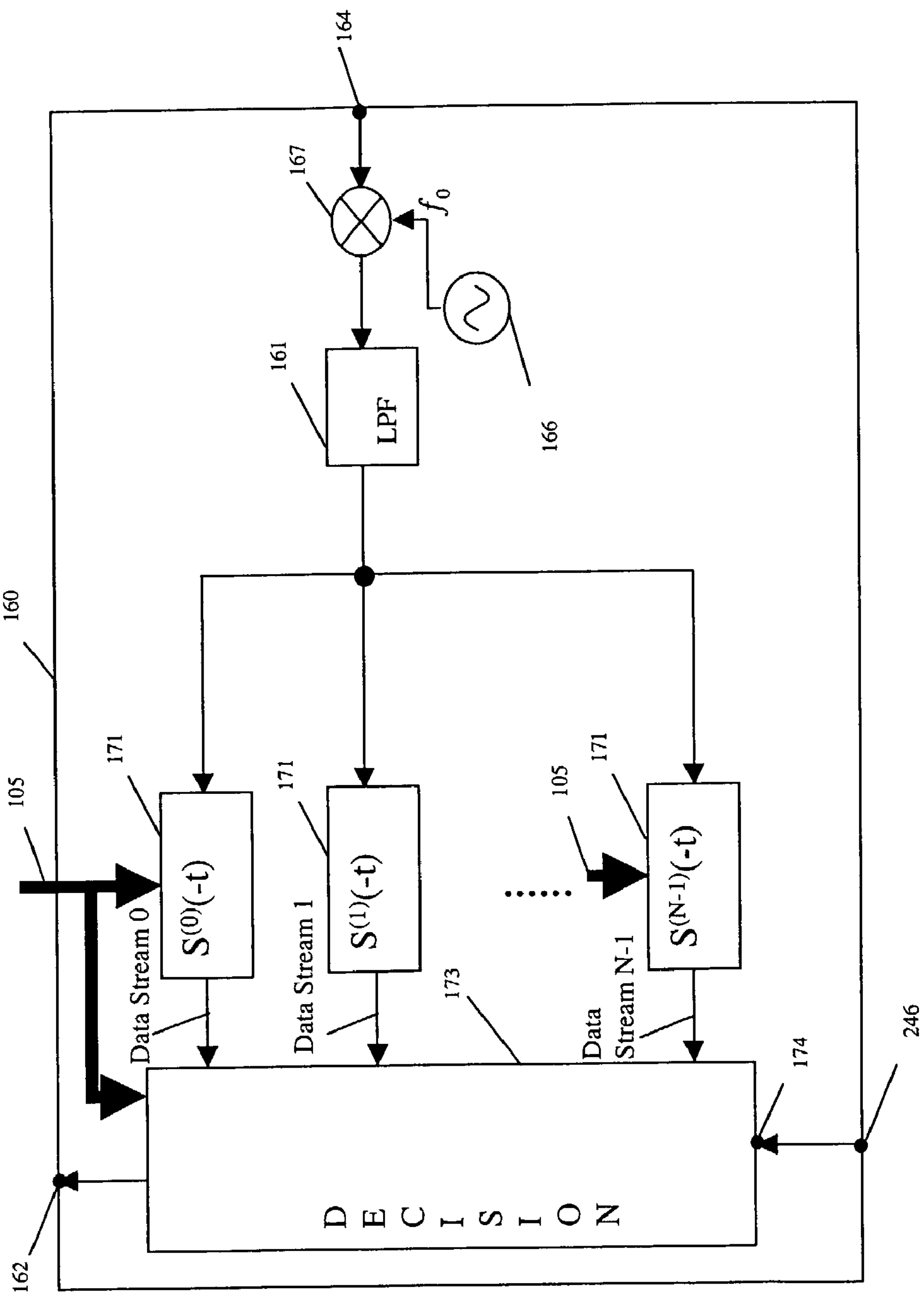

164
167
f_0
161
LPF
166
160
171
171
171
105
105
$S^{(0)}(-t)$
$S^{(1)}(-t)$
$S^{(N-1)}(-t)$
Data Stream 0
Data Stream 1
Data Stream N-1
173
174
246
162
DECISION

FIG. 3

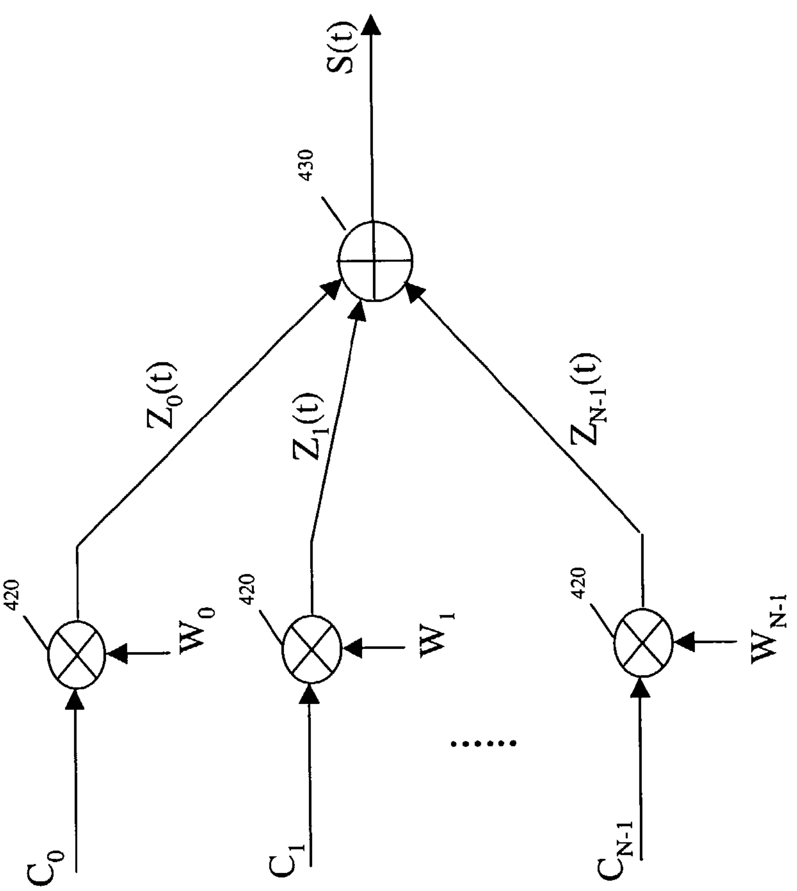


FIG. 4

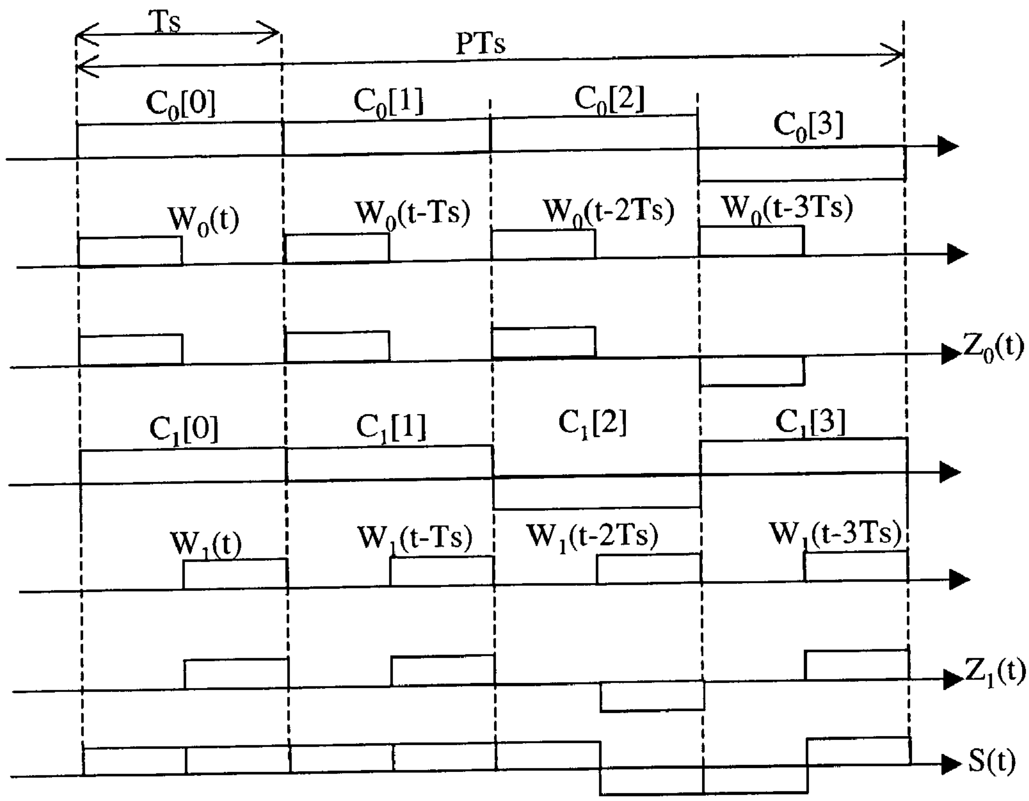

Ts
PTs
C0[0]
C0[1]
C0[2]
C0[3]
W0(t)
W0(t-Ts)
W0(t-2Ts)
W0(t-3Ts)
Z0(t)
C1[0]
C1[1]
C1[2]
C1[3]
W1(t)
W1(t-Ts)
W1(t-2Ts)
W1(t-3Ts)
Z1(t)
S(t)

Fig. 5a

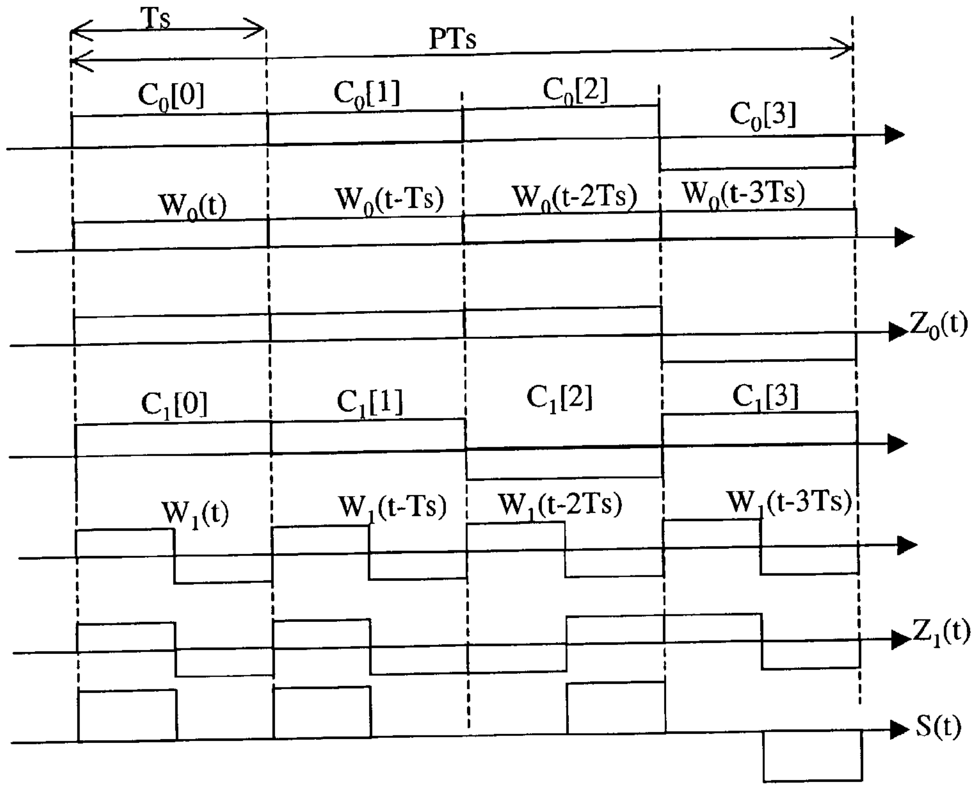

Ts
PTs
C0[0]
C0[1]
C0[2]
C0[3]
W0(t)
W0(t-Ts)
W0(t-2Ts)
W0(t-3Ts)
Z0(t)
C1[0]
C1[1]
C1[2]
C1[3]
W1(t)
W1(t-Ts)
W1(t-2Ts)
W1(t-3Ts)
Z1(t)
S(t)

Fig. 5b

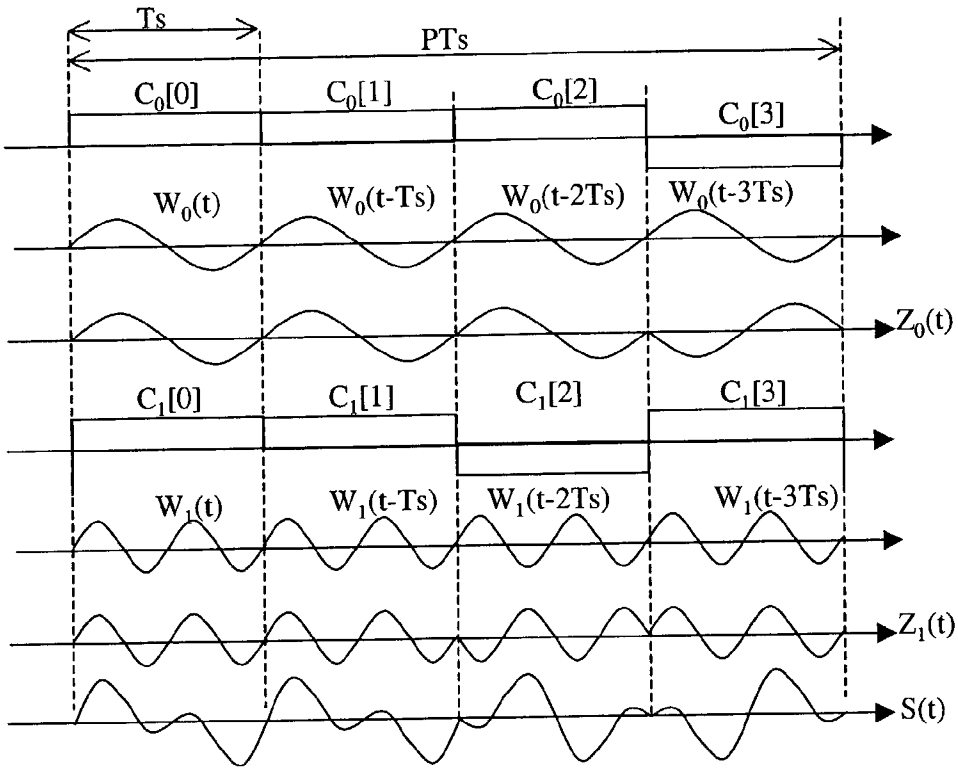

Ts
PTs
C0[0]
C0[1]
C0[2]
C0[3]
W0(t)
W0(t-Ts)
W0(t-2Ts)
W0(t-3Ts)
Z0(t)
C1[0]
C1[1]
C1[2]
C1[3]
W1(t)
W1(t-Ts)
W1(t-2Ts)
W1(t-3Ts)
Z1(t)
S(t)

Fig. 5c

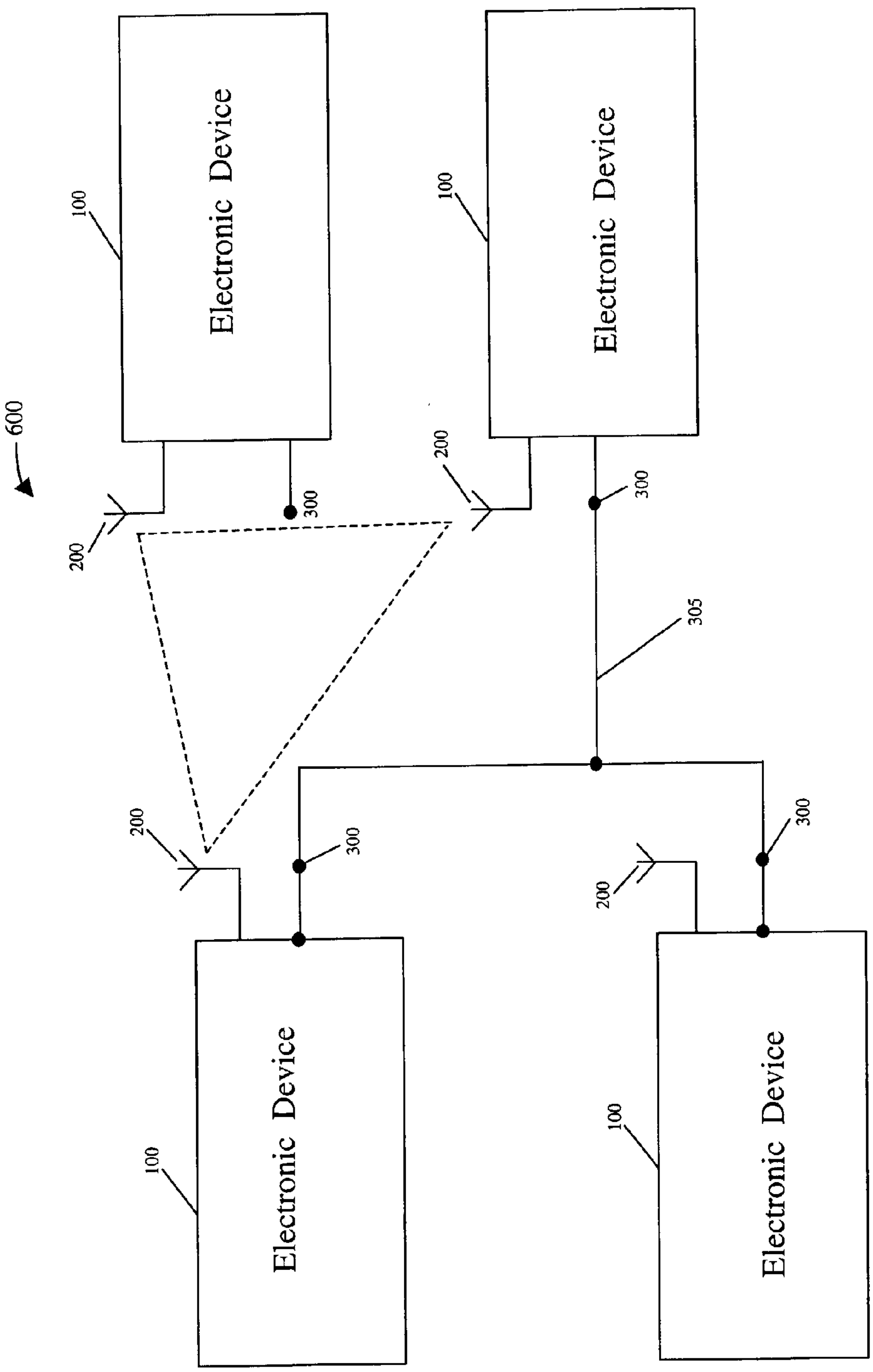

600
Electronic Device
100
200
300
Electronic Device
100
200
300
305
Electronic Device
100
200
300
Electronic Device
100
200
300

FIG. 6

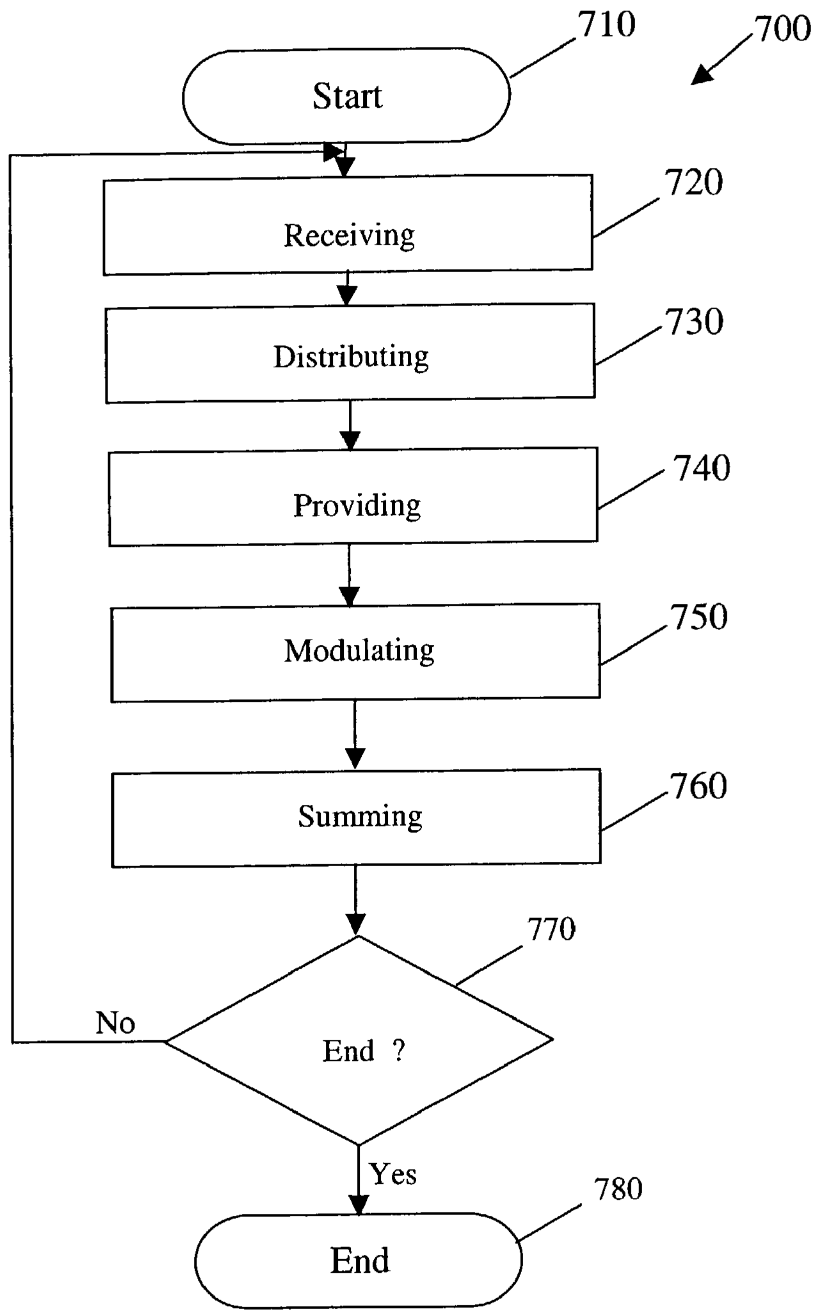

710
700
Start
720
Receiving
730
Distributing
740
Providing
750
Modulating
760
Summing
770
No
End ?
Yes
780
End

Fig. 7

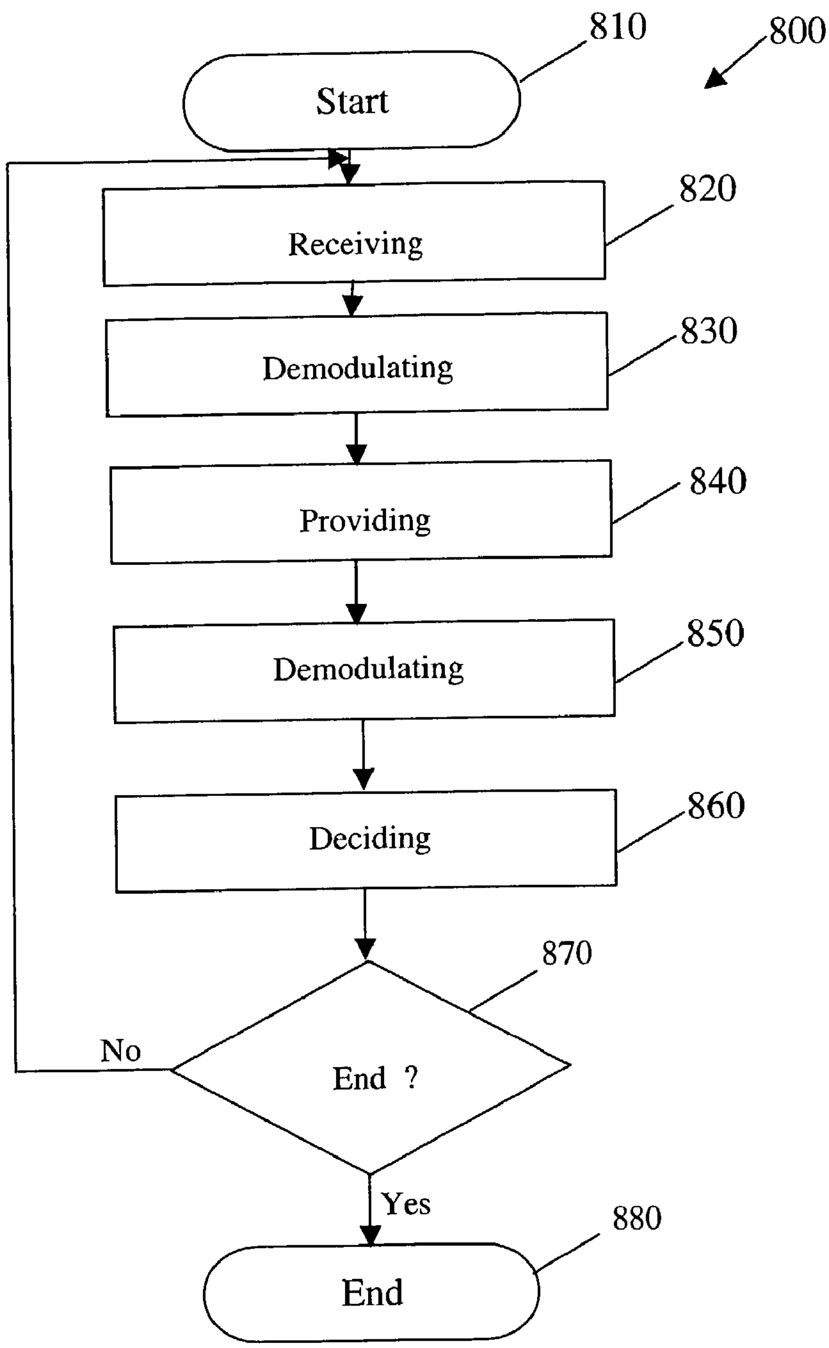

810
800
Start
Receiving
820
Demodulating
830
Providing
840
Demodulating
850
Deciding
860
870
No
End ?
Yes
880
End

Fig. 8

METHOD AND ELECTRONIC DEVICE FOR A SPREAD SPECTRUM SIGNAL

FIELD OF THE INVENTION

[0001] This invention relates to a spread spectrum system, an electronic device for providing a spread spectrum signal and an associated method for providing a spread spectrum signal. The invention is particularly useful for, but not necessarily limited to, systems and devices with radio frequency communication links.

BACKGROUND OF THE INVENTION

[0002] Spread spectrum signal technologies have been used for anti-jamming and security communications systems as well as commercial cellular and other wireless communications networks. Conventional Spread Spectrum signal systems use a pseudo-random spreading sequence such as Barker sequence that is used in the I.E.E.E.802.11 wireless LAN standard. However, the prior art single pseudo-random spreading sequences of finite length cannot have an auto-correlation function that is guaranteed to eliminate inter-symbol interference.

[0003] In this specification, including the claims, the terms 'comprises', 'comprising' or similar terms are intended to mean a non-exclusive inclusion, such that a method or apparatus that comprises a list of elements does not include those elements solely, but may well include other elements not listed.

SUMMARY OF THE INVENTION

[0004] According to one aspect of the invention there is provided a method for creating a spread spectrum signal, the spread spectrum signal being created by the steps of:

[0005] providing a complementary code spreading signal having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval; and

[0006] modulating a data stream with the complementary code spreading signal to provide the spread spectrum signal.

[0007] Suitably, the complementary code spreading signal is obtained from the steps of:

[0008] providing a set of complementary sequences with the property that the sum of their respective auto-correlation functions is zero for any non-zero offset;

[0009] providing an orthogonal waveform set of at least two orthogonal waveforms, wherein a cross correlation of any two of the orthogonal waveforms of the set is zero;

[0010] multiplying each of the complementary sequences with a respective one of the orthogonal waveforms to provide intermediate spreading signals; and

[0011] summing the intermediate spreading signals to provide said complementary code spreading signal.

[0012] Preferably, the orthogonal waveform set can be a time division orthogonal waveform set. The orthogonal waveform set may suitably be a code division orthogonal waveform set. In another suitable form the orthogonal waveform set may be a frequency division waveform set.

[0013] Preferably, the spread spectrum signal may be summed with other spread spectrum signals that are generated by other mutually orthogonal complementary code spreading signals, wherein all complementary code spreading signals have an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

[0014] According to another aspect of the invention there is provided a method for decoding a spread spectrum signal to provide a data stream, the method comprising the steps of:

[0015] providing a complementary code despreading signal having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval; and

[0016] demodulating the spread spectrum signal with the complementary code despreading signal to provide said data stream.

[0017] Suitably, the complementary code despreading signal is obtained from the steps of:

[0018] providing a set of complementary sequences with the property that the sum of their respective auto-correlation functions is zero for any non-zero offset;

[0019] providing an orthogonal waveform set of at least two orthogonal waveforms, wherein a cross correlation of any two of the orthogonal waveforms of the set is zero;

[0020] multiplying each of the complementary sequences with a respective one of the orthogonal waveforms to provide intermediate despreading signals; and

[0021] summing the intermediate despreading signals to provide said complementary code despreading signal.

[0022] Preferably, the orthogonal waveform set can be a time division orthogonal waveform set. The orthogonal waveform set may suitably be a code division orthogonal waveform set. In another suitable form the orthogonal waveform set may be a frequency division waveform set.

[0023] According to another aspect of the invention there is provided an electronic device for providing a spread spectrum signal, the device comprising:

[0024] a spread spectrum signal encoder having at least one input coupled to an output of signal providing circuitry;

[0025] an output unit coupled to spread spectrum signal encoder, wherein, in use, the encoder modulates a data stream provided from the signal providing circuitry with a complementary code spreading signal to provide the spread spectrum signal, the complementary code spreading signal having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

[0026] The electronic device may also include an input unit coupled to a spectrum signal decoder, wherein the spectrum signal decoder decodes a received spread spectrum signals received at the input unit to provide a decoded data stream.

[0027] Preferably, the spread spectrum signal encoder may comprise a plurality of data stream spreading modules coupled to an adder, wherein in use data streams are provided to the spreading modules to provide a respective spread spectrum signals that is summed together, the respective spread spectrum signals being generated by associated mutually orthogonal complementary code spreading sequences, wherein all complementary code spreading signals have an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

[0028] Suitably, the output unit may include a radio transmitter.

[0029] The output unit may include a modem.

[0030] The electronic device may be a radio communication device such as a two-way radio communication device and the digital signal providing circuitry may be coupled to a microphone. Typically, the signal providing circuitry may preferably include a digital data store.

[0031] The electronic device may form part of a spread spectrum system comprising at least one further said electronic device in communication therewith.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] In order that the invention may be readily understood and put into practical effect, reference will now be made to a preferred embodiment as illustrated with reference to the accompanying drawings in which:

[0033] **FIG. 1** is a schematic block diagram of an electronic device for providing a spread spectrum signal in accordance with the invention;

[0034] **FIG. 2** is a schematic block diagram of a spread spectrum signal encoder comprising part of the electronic device of **FIG. 1**;

[0035] **FIG. 3** is a schematic block diagram of a spread spectrum signal decoder comprising part of the electronic device of **FIG. 1**;

[0036] **FIG. 4** is a schematic diagram illustrating how a complementary code spreading signal, for use in the encoder of **FIG. 2**, can be derived;

[0037] **FIG. 5***a* to **5***c* illustrates different forms of complementary code spreading sequences;

[0038] **FIG. 6** is a schematic block diagram of a spread spectrum signal communication system;

[0039] **FIG. 7** is a flow diagram illustrating a method for creating a spread spectrum signal in accordance with the present invention; and

[0040] **FIG. 8** is a flow diagram illustrating a method for decoding a spread spectrum signal in accordance with the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

[0041] Referring to **FIG. 1** there is illustrated a schematic block diagram of an electronic device **100** for providing a spread spectrum signal. The electronic device **100** is typically a single or two way radio communication device, it may also form part of a computer or other processing unit coupled to a network by a wired communication link or radio link. The electronic device **100** includes a spread spectrum signal encoder **140** and a digital signal providing circuitry **130** coupled to a signal input **144** of spread spectrum signal encoder **140**. There is also an output unit **150** coupled to an output **142** of spread spectrum signal encoder **140**.

[0042] The electronic device **100** also includes a spread spectrum signal decoder **160** with an input **164** coupled to an input unit **155** by a buffer (not illustrated) that forms part of input unit **155**. An output **162** of the spread spectrum signal decoder **160** is coupled to a digital data store **175**. In order to provide synchronization, the electronic device **100** includes a clock **185** coupled to a processor **190** (with associated memory not shown), an input **146** of spread spectrum signal encoder **140** and an input **246** of spread spectrum signal decoder **160**. The output unit **150** includes a radio transmitter coupled to a common antenna **200**. The input unit **155** includes a radio receiver coupled to the common antenna **200**. The output unit **150** and input unit **155** form part of a communication port **165**. Further, a transmitter modem **270** forms part of output unit **150** and a receiver modem **280** forms part of input unit **155**. Alternatively, output unit **150** and input unit **155** may be compatible for direct network connection (by a wired communication link or otherwise), and provide an Ethernet port at a port node **300** of the communication port **165**.

[0043] There is also a user interface **220** having, in one embodiment, a microphone **230**, a speaker **240**, an input command or data device, typically in the form of a interactive display screen or keypad **250**, and an optional display screen **260**. The microphone **230** and keypad **250** are coupled to the digital providing circuitry **130**. A combined data and address bus **105** couples processor **190** to the user interface **220**, the spread spectrum signal encoder **140**, the spread spectrum signal decoder **160**, the digital providing circuitry **130**, the data store **175** and the communication port **165**.

[0044] As will be apparent to a person skilled in the art, the digital signal providing circuitry **130** is a memory buffer for storing digitised speech, text or data. Similarly, the data store **175** is a memory for storing received data or information received by the input unit **155** and decoded by decoder **160**. The stored received data or information is subsequently accessed by the processor **190** or it may be sent to the speaker **240** (after processing) or display screen **260**.

[0045] Referring to **FIG. 2** there is illustrated a schematic block diagram of the spread spectrum signal encoder **140** comprising a serial to parallel converter **141** with N output data streams (data stream 0 to data streams N−1) and an input provided by signal input **144**. The N data streams are coupled to a respective one of a plurality data stream spreading modules **143** and the bus **105** is coupled to both the serial to parallel converter **141** and data stream spreading modules **143**. An output of each data stream spreading module **143** is coupled to an input of an adder **147** the output of which is coupled to a modulator **145** by a spectral shaping low pass filter **148**. The input **146** of spread spectrum signal encoder **140** provides a clock signal input to the serial to parallel converter **141** and an oscillator **186** provides a modulation carrier frequency f_o to the modulator **145**. The modulator **145** is coupled to the output unit **150** through the output **142**.

[**0046**] The data stream spreading modules **143** each have a processor and memory, the memory having a complementary code spreading signal S(t) loaded, at device start up, via the bus **105**. However, in one alternative embodiment the respective complementary code spreading signal S(t) may be pre-programmed into the memory of each of the data stream spreading modules **143**. The complementary code spreading signal S(t) is derived from the following:

[**0047**] Let $C_0[j], C_1[j], \ldots C_{N-1}[j]$ denote a set of N complementary sequences of length P. According to the complementary properties of these sequences, the sum of their respective auto-correlation functions will be zero at any non-zero offset as illustrated by equation (1) as follows:

$$\sum_{i=0}^{N-1} \phi_{c_1,c_i}[j] = 0, \text{ for } j \neq 0 \tag{1}$$

[**0048**] where $\phi_{c_1,c_1}[j]$ denotes an auto-correlation function of sequence $C_i[j]$. By multiplying each sequence from the set of complementary sequences with a corresponding waveform from an orthogonal waveform set $W_0(t), W_1(t), \ldots, W_{N-1}(t)$ and adding all the products together, the complementary code spreading sequence S(t) is generated by the following equation:

$$S(t) = \sum_{i=0}^{N-1} \sum_{j=0}^{P-1} C_i[j] W_i(t - jT_s) \tag{2}$$

[**0049**] where T_s is the time duration of the orthogonal waveforms. As will be apparent to a person skilled in the art, a cross correlation of any two of the orthogonal waveforms of the set $W_0(t), W_1(t), \ldots, W_{N-1}(t)$ is zero.

[**0050**] The derivation of the complementary code spreading signal S(t) can also be illustrated with reference to **FIG. 4**. In **FIG. 4** there is illustrated N modulators **420** each having an inputs receiving one of the N complementary sequences C_0 to C_{N-1}. A modulation input of each of the modulators receives a corresponding one of the orthogonal waveform set W_0 to W_{N-1}. Each one of the modulators **420** provides a corresponding output signal Z_0 to Z_{N-1} that is received by an input of an adder module **430** the output of which provides the complementary code spreading signal S(t). For example, if there are only two complementary sequences C_0 and C_1 in the set of spreading sequences and these sequences are $C_0=\{+1, +1, +1, -1\}$ and $C_1=\{+1, +1, -1, +1\}$ (length P=4), then if a time division orthogonal waveform set W_0 and W_1 are used the complementary code spreading signal S(t) of **FIG. 5***a* will be created. If a code division orthogonal waveform set W_0 and W_1 is used then the complementary code spreading signal S(t) of **FIG. 5***b* will be created. Further, if a frequency division waveform set W_0 and W_1 is used then the complementary code spreading signal S(t) of **FIG. 5***c* will be created.

[**0051**] As will be apparent to a person skilled in the art, no matter what kind of orthogonal waveform set W_0 to W_{N-1} is used, S(t) will always demonstrate the property that its auto-correlation function is zero, for any non-zero offset which is at integer multiple of T_s as illustrated by equation (3).

$$\phi_{s,s}(t)=0, \text{ for } t=-(P-1)T_s, \ldots, -T_s, T_s, \ldots, (P+1)T_s \tag{3}$$

[**0052**] Thus at times T_s, $2T_s$, $3T_s$ and so on the auto-correlation function for S(t) is zero and as will be apparent to a person skilled in the art T_s is also a data symbol or data bit stream time interval.

[**0053**] Referring to **FIG. 3** there is illustrated a schematic block diagram of the spread spectrum signal decoder **160** comprising a demodulator **167** having an input coupled to the input **164**. An output of the demodulator **167** is coupled to a low pass filter **161** and an output of the low pass filter **161** is coupled to a plurality of dispreading modules **171**. Each despreading module **171** is coupled to bus **105**. Outputs of each despreading module **171** are coupled to a decision module **173** with an output coupled to a data store **175** via the output **162**. The combined outputs of the dispreading modules **171** provide a plurality of N data streams (data stream 0 to data stream N−1). The input **246** of spread spectrum signal decoder **160** provides a clock signal to a clock signal input **174** of decision module **173**. The spread spectrum signal decoder **160** has an oscillator **166** with an output providing a demodulation carrier frequency f_o to the demodulator **167**.

[**0054**] In **FIG. 6** there is illustrated a schematic block diagram of a spread spectrum signal communication system **600** comprising a plurality of electronic devices **100** communicating with each other either by port nodes **300** coupled by the wired communication links **305** or by the antenna **200** using radio waves.

[**0055**] Referring specifically to **FIG. 7** and generally to FIGS. **1** to **6**, there is illustrated a method **700** for creating a spread spectrum signal. The method **700** of the present invention, in use, operates such that a start step **710** is invoked by activation of the user interface **220**. The spread spectrum signal encoder **140**, at a receive step **720**, typically receives a serial data stream of bits a**0** to am from the user interface **220** via the digital signal providing circuitry **130**. The serial to parallel converter **141** of the spectrum signal encoder **140** converts and distributes, at a distributing step **730**, the serial data stream of bits a**0** to am into a plurality of parallel data bits (each bit forming part of the data streams 0 to N−1).

[**0056**] Each of the data stream spreading modules **143**, at a providing step **740**, effects the process of providing the complementary code spreading signal S(t) having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval. Then at a modulating step **750**, the data stream spreading modules **143** provide for modulating the data stream with the complementary code spreading signal S(t) to provide a spread spectrum signal. The complementary code spreading signal S(t) is obtained from:

[0057] (i) providing the set of complementary sequences $C_0[j]$, $C_1[j]$, . . . , $C_{N-1}[j]$ with the property that the sum of their respective auto-correlation functions is zero for any non-zero offset, at integer multiples of a selected time interval;

[0058] (ii) providing the orthogonal waveform set $W_0(t)$, $W_1(t)$, . . . , $W_{N-1}(t)$ of at least two orthogonal waveforms, wherein a cross correlation of any two of the orthogonal waveforms of the set is zero;

[0059] (iii) Multiplying each of the complementary sequences with a respective one of the orthogonal waveforms to provide intermediate spreading signals $Z_0(t)$ to $Z_{N-1}(t)$; and

[0060] (iv) Summing the intermediate spreading signals $Z_0(t)$ to $Z_{N-1}(t)$ to provide the complementary code spreading signal S(t).

[0061] At a summing step **760**, each spread spectrum signal at the output of a respective data stream spreading module is summed by the adder **147** with other spread spectrum signals that are generated by other complementary code spreading signals to provide a combined spread spectrum signal. It should be noted that all the complementary code spreading signals S(t) have an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

[0062] This combined spread spectrum signal is filtered by filter **148** and modulated by modulator **145** and then supplied to the output unit **150** that transmits the combined spread spectrum signal by the wired communication links **300** or by radio waves linked by the antenna **200**.

[0063] The method **700** repeats steps **720** to **760** until an end test step **770** detects and end of transmission signal from the user interface **220** that results in an end of transmission step **780**.

[0064] Referring to **FIG. 8** there is illustrated a method **800** for decoding a spread spectrum signal to provide a data stream. The method **800** of the present invention, in use, operates such that a start step **810** is invoked by either activation of the user interface **220** or automatically upon receipt of an incoming recognizable combined spread spectrum signal at the input unit **155**. The electronic device **100** receives, at a receiving step **820**, the combined spread spectrum signal via the wired communication links **300** or by radio waves linked by the antenna arrays **200**. The received combined spread spectrum signal is amplified by the input unit **155** and sent to the spread spectrum signal decoder **160**.

[0065] At a demodulating step **830**, the combined spread spectrum signal is demodulated by demodulator **167** and filtered by filter **161**. At a providing step **840**, each of the despreading modules **171** effects the process of providing the complementary code dispreading signal D(t) having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval. The dispreading modules also, at a demodulating step **850**, provide for demodulating the spread spectrum signal with the complementary code despreading signal D(t) to provide a data stream. The complementary code despreading signal D(t) is obtained in an identical manner to that of the complementary code spreading signal S(t) and therefore to avoid repetition the derivation of the despreading signal D(t) is not recited and as a person skilled in the art can refer to the derivation of S(t) described above.

[0066] At a deciding step **860**, the decision module **173** compares the output data streams 0 to N−1 from the dispreading modules **171** against a threshold to provide a decoded bits (or bit sequences) for each of the data streams 0 to N−1. The decoded bits (or sequences) are combined into a decoded bit stream and then stored in data store **175** for subsequent sending to user interface **220** or processing by processor **190**.

[0067] The method **800** repeats steps **820** to **860** until an end test step **870** detects and end of transmission signal from the user interface **220** or when no further incoming recognizable combined spread spectrum signal is received from the input unit **155**. This results in an end of transmission step **880**.

[0068] Advantageously, the present invention provides for a spreading signal that has an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval. Accordingly, the undesirable effects of inter-symbol interference is substantially reduced and relatively high speed data transmission can be achieved.

[0069] The detailed description provides a preferred exemplary embodiment only, and is not intended to limit the scope, applicability, or configuration of the invention. Rather, the detailed description of the preferred exemplary embodiment provides those skilled in the art with an enabling description for implementing a preferred exemplary embodiment of the invention. It should be understood that various changes may be made in the function and arrangement of elements without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. A method for creating a spread spectrum signal, the spread spectrum signal being created by the steps of:

providing a complementary code spreading signal having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval; and

modulating a data stream with the complementary code spreading signal to provide the spread spectrum signal.

2. A method for creating a spread spectrum signal as claimed in claim 1, wherein the complementary code spreading signal is obtained from the steps of:

providing a set of complementary sequences with the property that the sum of their respective auto-correlation functions is zero for any non-zero offset;

providing an orthogonal waveform set of at least two orthogonal waveforms, wherein a cross correlation of any two of the orthogonal waveforms of the set is zero;

multiplying each of the complementary sequences with a respective one of the orthogonal waveforms to provide intermediate spreading signals; and

summing the intermediate spreading signals to provide said complementary code spreading signal.

3. A method for creating a spread spectrum signal as claimed in claim 2, wherein the orthogonal waveform set is a time division orthogonal waveform set.

4. A method for creating a spread spectrum signal as claimed in claim 2, wherein the orthogonal waveform set is a code division orthogonal waveform set.

5. A method for creating a spread spectrum signal as claimed in claim 2, wherein the orthogonal waveform set is a frequency division waveform set.

6. A method for creating a spread spectrum signal as claimed in claim 2, wherein the spread spectrum signal may be summed with other spread spectrum signals that are generated by other mutually orthogonal complementary code spreading signals, and wherein all complementary code spreading signals have an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

7. A method for decoding a spread spectrum signal to provide a data stream, the method comprising the steps of:

providing a complementary code despreading signal having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval; and

demodulating the spread spectrum signal with the complementary code despreading signal to provide said data stream.

8. A method for decoding a spread spectrum signal as claimed in claim 7, wherein the complementary code despreading signal is obtained from the steps of:

providing a set of complementary sequences with the property that the sum of their respective auto-correlation functions is zero for any non-zero offset;

providing an orthogonal waveform set of at least two orthogonal waveforms, wherein a cross correlation of any two of the orthogonal waveforms of the set is zero;

multiplying each of the complementary sequences with a respective one of the orthogonal waveforms to provide intermediate despreading signals; and

summing the intermediate despreading signals to provide said complementary code despreading signal.

9. A method for decoding a spread spectrum signal as claimed in claim 8, wherein the orthogonal waveform set is a time division orthogonal waveform set.

10. A method for decoding a spread spectrum signal as claimed in claim 8, wherein the orthogonal waveform set is a code division orthogonal waveform set.

11. A method for decoding a spread spectrum signal as claimed in claim 8, wherein In the orthogonal waveform set is a frequency division waveform set.

12. An electronic device for providing a spread spectrum signal, the device comprising:

a spread spectrum signal encoder having at least one input coupled to an output of signal providing circuitry;

an output unit coupled to spread spectrum signal encoder, wherein, in use, the encoder modulates a data stream provided from the signal providing circuitry with a complementary code spreading signal to provide the spread spectrum signal, the complementary code spreading signal having an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

13. An electronic device for providing a spread spectrum signal as claimed in claim 12, further including an input unit coupled to a spectrum signal decoder, wherein the spectrum signal decoder decodes a received spread spectrum signals received at the input unit to provide a decoded data stream.

14. An electronic device for providing a spread spectrum signal as claimed in claim 12, wherein the spread spectrum signal encoder comprises a plurality of data stream spreading modules coupled to an adder, wherein in use data streams are provided to the spreading modules to provide a respective spread spectrum signals that is summed together, the respective spread spectrum signals being generated by associated mutually orthogonal complementary code spreading sequences, wherein all complementary code spreading signals have an auto-correlation function of zero, for any non-zero offset, at integer multiples of a selected time interval.

15. An electronic device for providing a spread spectrum signal as claimed in claim 12, wherein the electronic device forms part of a spread spectrum system comprising at least one further said electronic device in communication therewith.

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