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(54) **Title:** SYSTEM AND METHOD FOR COORDINATING MULTIPLE JAMMING DEVICES

(57) **Abstract:** A jammer for jamming undesired transmissions includes a jamming signal generator and a data modulator. The jamming signal generator generates a jamming signal, and the data modulator modulates the jamming signal with a data stream.
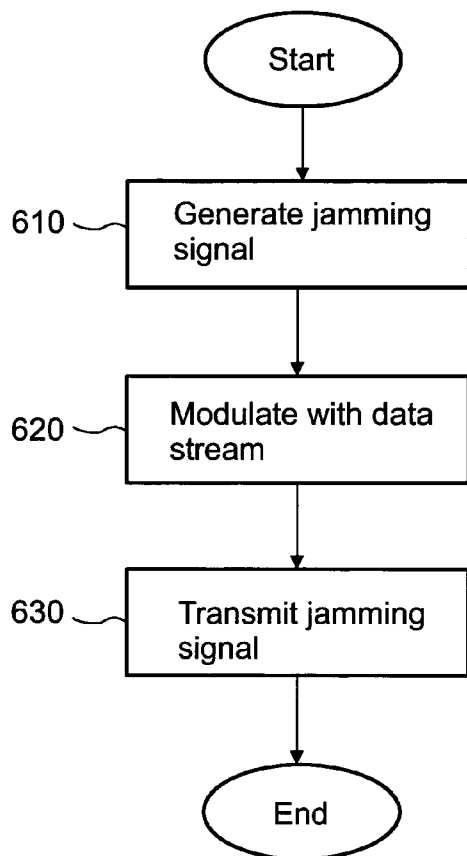
FIG. 6A

HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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SYSTEM AND METHOD FOR COORDINATING MULTIPLE JAMMING DEVICES

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to jamming of undesired transmissions while optionally enabling data communication.

SUMMARY OF THE INVENTION

The present embodiments are directed to providing a jamming and communications system capable of generating and transmitting a data-modulated jamming signal, by data-modulating the transmitted jamming signal.

Some aspects of the present embodiments are directed to providing a system architecture in which the operation of multiple jamming units is coordinated by a central jamming signal coordinator, enabling the jamming units to continuously transmit and receive data-modulated jamming signal with reduced mutual interference.

According to a first aspect of the present invention there is provided a jammer for jamming undesired transmissions which includes a jamming signal generator and a data modulator. The jamming signal generator generates a jamming signal and the data modulator modulates the jamming signal generated by the jamming signal generator with a data stream.

Optionally, the jammer further comprises a data demodulator, configured for demodulating received external transmissions to extract a data stream.

Optionally, the jammer further comprises an RF receiver configured for receiving external transmissions.

Optionally, the jammer further comprises a transmitter configured for transmitting the data modulated jamming signal.

Optionally, a system is formed of multiple jammers and a jammer coordinator. The jammer coordinator is configured for coordinating the jammers to reduce the interference of a transmitted jamming signal or signals upon the demodulating.

Optionally, the transmissions are received during the transmission of the jamming signal.

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Optionally, the jammer further comprises a jamming signal cancellation unit, configured for canceling an interference of the jamming signal on the demodulating.

Optionally, the method further comprises modulating the jamming signal with a data stream.

Optionally, the method further comprises demodulating received transmissions to extract a data stream.

Optionally, the method further comprises canceling an interference of the jamming signal on the demodulating.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, suitable methods and materials are described below. In case of conflict, the patent specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be necessarily limiting.

Implementation of the method and system of the present invention involves performing or completing selected tasks or steps manually, automatically, or a combination thereof. Moreover, according to actual instrumentation and equipment of preferred embodiments of the method and system of the present invention, several selected steps could be implemented by hardware or by software on any operating system of any firmware or a combination thereof. For example, as hardware, selected steps of the invention could be implemented as a chip or a circuit. As software, selected steps of the invention could be implemented as a plurality of software instructions being executed by a computer using any suitable operating system. In any case, selected steps of the method and system of the invention could be described as being performed by a data processor, such as a computing platform for executing a plurality of instructions.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

In the drawings:

FIG. 1A is a simplified block diagram of a jammer, according to preferred embodiment of the present invention respectively;

FIG. 6A is a simplified block diagram of a method for jamming undesired transmissions with a data-modulated jamming signal, in accordance preferred embodiment of the present invention;

FIG. 9 show two examples of a typical power spectrum of a jamming system output signal.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention, in some embodiments thereof, relates to a jammer for jamming undesired transmissions while optionally enabling data communication. The jammer may be configured into a jamming system with improved interoperability with between jammers and with other friendly devices.

Utilizing the jamming signal for digital communication with other jamming and communication devices reduces the need for dedicated data communication equipment, leading to a simpler system configuration.

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The principles and operation of a jamming method system which enables optional data communication may be better understood with reference to the drawings and accompanying descriptions. Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

In the following, parts that are the same as those in previous figures are given the same reference numerals and are not described again except as necessary for an understanding of the present embodiment.

Reference is now made to Fig. 1a, which is a simplified block diagram of a jammer for jamming undesired transmissions, according to an embodiment of the present invention. Jammer 5 serves as a combined jammer and digital communication device by modulating the jamming signal with the digital data.

In the preferred embodiment, jammer 5 includes jamming signal generator 13.1 and data modulator 16. Jamming signal generator 13.1 generates a jamming signal, preferably in accordance with a jamming scheme designed to disrupt the undesired transmissions. The jamming scheme may be provided externally, preprogrammed, or defined and/or modified internally.

Data modulator 16 modulates the jamming signal with a data stream. Any suitable data modulation technique may be utilized, including amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM).

Data modulator 16 may perform data modulation of the jamming signal by any method known in the art, including, but not limited to: frequency shift keying (FSK), phase shift keying (PSK), amplitude shift keying (ASK) and quadrature amplitude modulation (QAM). Spread spectrum modulation techniques such as direct-sequence spread-spectrum (DSSS) may be used as well, in order to provide a wideband noise-like jamming signal on the one hand, while carrying the data stream on the other hand. Modulation may be performed at baseband, at the transmitted RF frequency or at intermediate frequency (IF), as required by system considerations.

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Jammer 5 may also include data reception functionality. In the preferred embodiment, jammer 5 includes data demodulator 17 which demodulates received transmissions to extract a data stream. The data modulator 17 may receive transmissions while the jamming signal is being transmitted.

The data carried by the demodulated data stream may be used for general data communication, for example between jammers, or for controlling jammer 5.

Jammer 5 may further include jamming signal cancellation unit 18, which cancels (or reduces) the interference of the jamming signal on the demodulation. Reduction of the interference of the jamming signal may result in lower levels of noise generated by self transmission, and in improved reception of signals transmitted by other communication and/or jamming systems.

Preferably, a sample of the jamming signal is input to jamming signal cancellation unit 18, which uses the sampled jamming signal to reduce the effect of the jamming signal on RF receiver 14 and/or data demodulator 17. Fig. 1a shows the sampled jamming signal being provided directly to jamming signal cancellation unit 18 by jamming signal generator 13.1. However sampling of the jamming signal may be performed at any point between generation of the jamming signal and its transmission.

Jamming signal cancellation unit 18 may use any jamming signal cancellation method known in the art. Examples of such methods are described in US Patent No. 5,363,104 by Richmond, US Patent No. 6,100,838 by Richmond et al, and in US patent No. 7,058,368 by Nicholls et al.

In the preferred embodiment, jammer 5 further includes receiver 14 for receiving the external transmissions and/or RF transmitter 15 for transmitting the jamming signal.

Receiver 14 serves as an RF front-end which receives external transmissions, and may perform further RF processing of the received transmissions such as downconverting the received signals to baseband or any intermediate frequency (IF) suitable for processing by other jammer components.

Transmitter 15 upconverts the jamming signal generated by jamming signal generator 13.1, if necessary, and amplifies the jamming signal for transmission. Transmitter 15 is preferably suitable for transmission of all types of jamming signals

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which may be generated by jamming signal generator 13.1, so that jammer 5 may include a single transmitter.

Reference is now made to Figs. 6a which is a simplified block diagram of a method for jamming undesired transmissions with a data-modulated jamming signal, according to a preferred embodiment of the present invention.

In step 610 a jamming signal is generated in accordance with a jamming scheme, and in step 620 the generated jamming signal is modulated with a data stream. Preferably, the jamming signal is transmitted in step 630.

In a further preferred embodiment, external transmissions are received and demodulated to a data stream.

In Fig. 9 a power spectrum is shown of a jamming signal is modulated by data communication information. In jamming system 1 the data communication information is transmitted with frequency offset #1 740, while in jamming system 2 the same power spectrum is generated with frequency offset #2 750

It is expected that during the life of this patent many relevant jamming techniques and signals, jamming signal cancellation methods, data modulations, and RF signal processing techniques will be developed and the scope of the corresponding terms is intended to include all such new technologies *a priori*.

Additional objects, advantages, and novel features of the present invention will become apparent to one ordinarily skilled in the art upon examination of the following examples, which are not intended to be limiting. Additionally, each of the various embodiments and aspects of the present invention as delineated hereinabove and as claimed in the claims section below finds experimental support in the following examples.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations

will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims. All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention.

WHAT IS CLAIMED IS:

1.   A jammer for jamming undesired transmissions, comprising:

a jamming signal generator configured for generating a jamming signal; and

a data modulator associated with said jamming signal generator, configured for modulating said jamming signal with a data stream.

2.   A jammer according to claim 1, wherein said jamming signal generator is configured for generating said jamming signal in accordance with a jamming scheme designed to disrupt said undesired transmissions.

3.   A jammer according to claim 1 or 2, further comprising a data demodulator, configured for demodulating received external transmissions to extract a data stream.

4.   A jammer according to any one of claims 1-3, further comprising an RF receiver configured for receiving external transmissions.

5.   A jammer according to any one of claims 1-4, further comprising a transmitter configured for transmitting said data modulated jamming signal.

6.   A jammer wherein said jamming signal generator is configured to generate said jamming signal in accordance with a defined jamming scheme.

7.   A jammer further comprising a data modulator configured for modulating said jamming signal with a data stream.

8.   A jammer further comprising a data demodulator configured for demodulating received transmissions to extract a data stream.

9.   A jammer according to claim 8, wherein said transmissions are received during said transmitting a jamming signal.

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10.   A jammer according to claim 8, further comprising a jamming signal cancellation unit, configured for canceling an interference of said jamming signal on said demodulating.

11.   A method further comprising demodulating received transmissions to extract a data stream.

12.   A method according to claim 11, further comprising canceling an interference of said jamming signal on said demodulating.

13.   A method for jamming undesired transmissions with a data-modulated jamming signal, comprising:
        generating a jamming signal; and
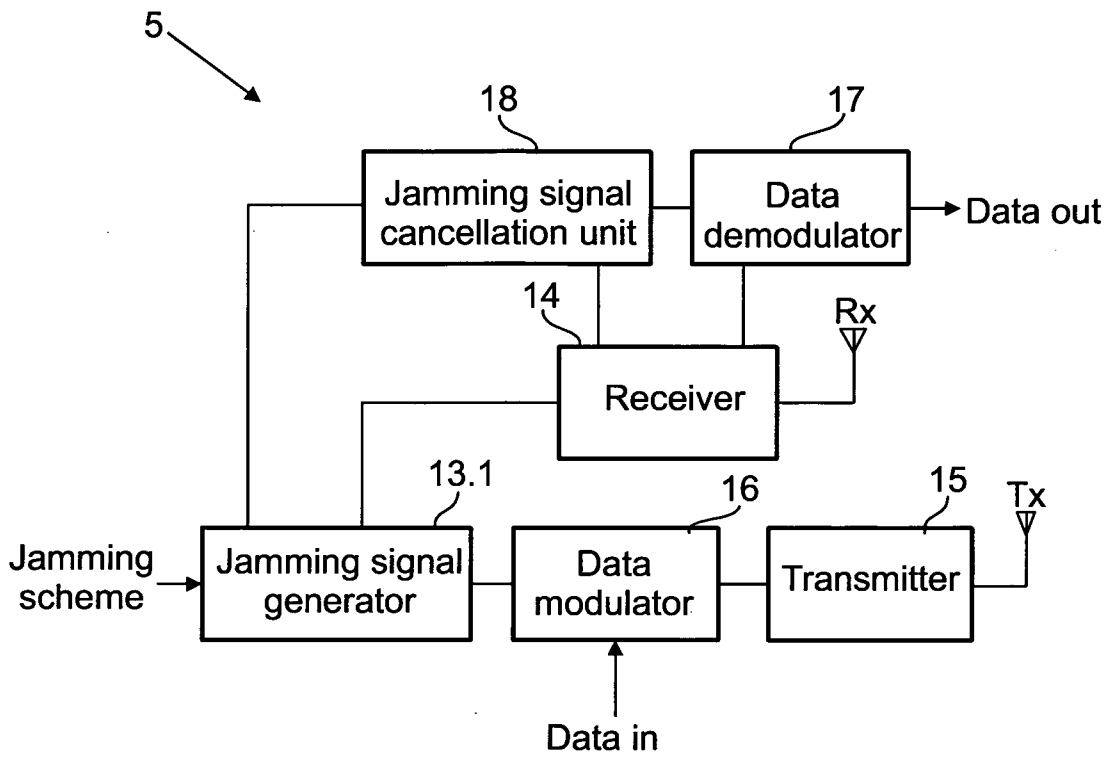   modulating said jamming signal with a data stream.
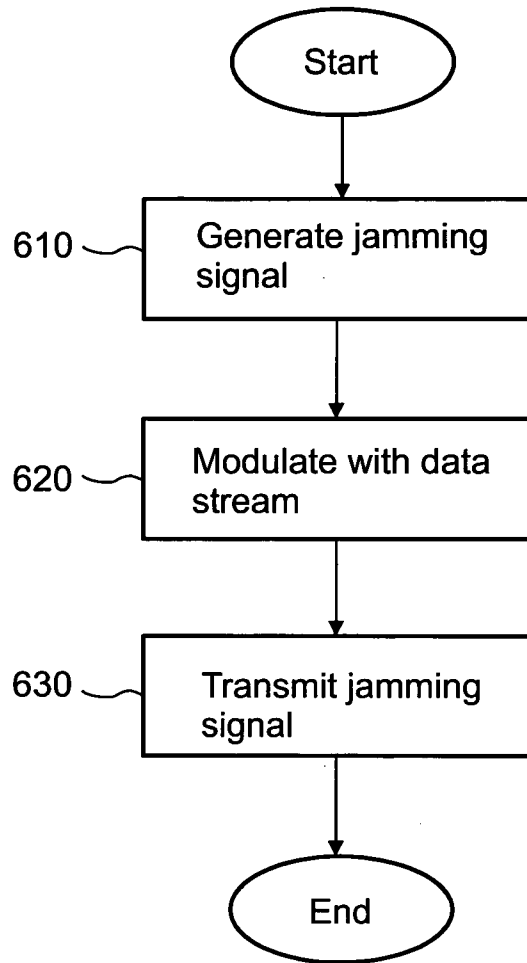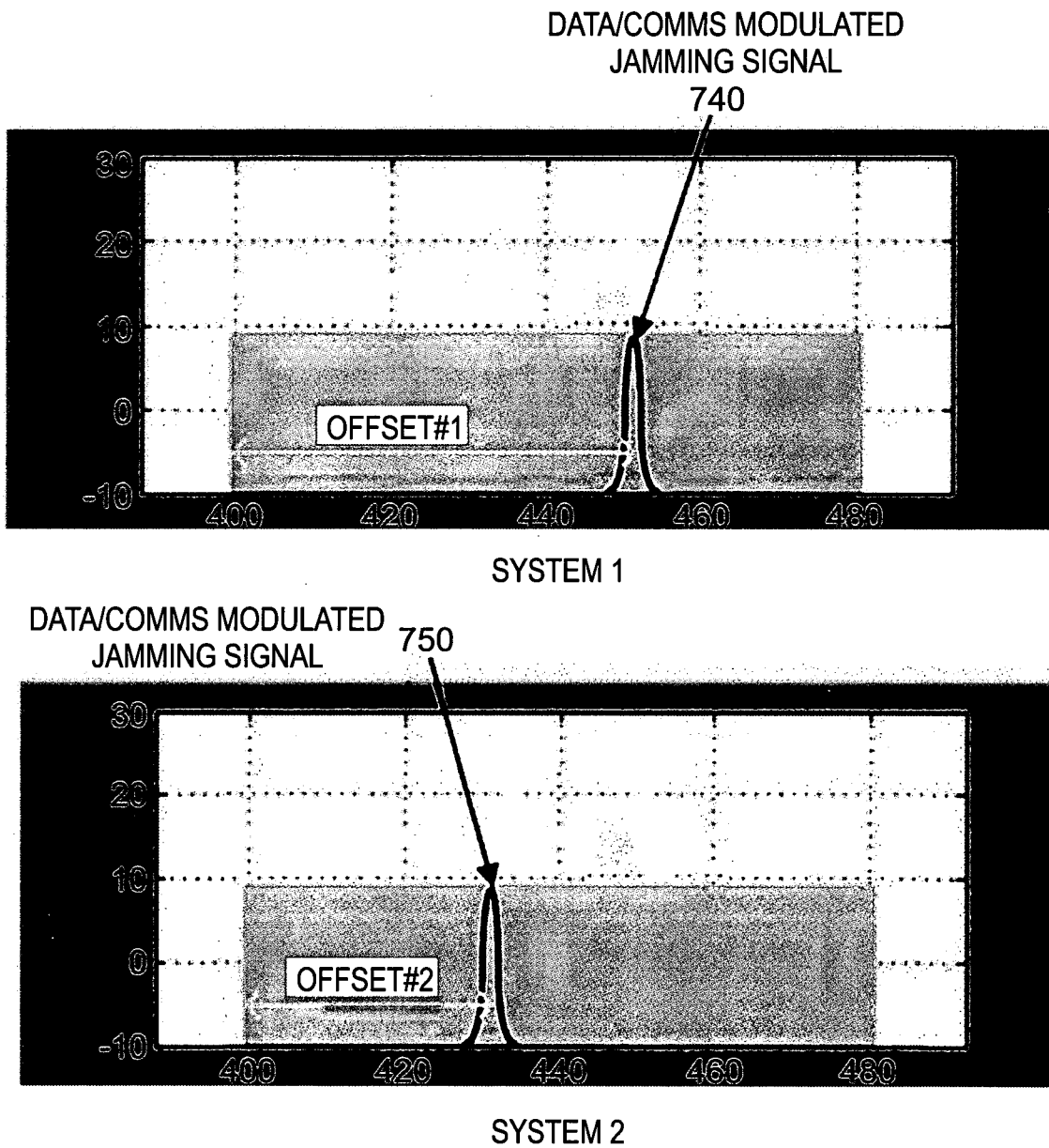
FIG. 1A

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FIG. 6A

FIG. 9

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04K3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/086790 A (BAE SYSTEMS BOFORS AB [SE]; OLSSON FREDRIK [SE]) 2 August 2007 (2007-08-02) page 6, line 7 - line 28 page 7, line 30 - line 39 page 9, line 10 - line 23 figures 1,2,3a,4a	1-13
X	EP 0 940 051 A (NETLINE COMMUNICATIONS TECHNOL [IL] NETLINE COMM TECHNOLOGIES NCT [IL]) 8 September 1999 (1999-09-08) paragraphs [0046], [0051]	1-13

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 January 2010	18/01/2010

| Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016 | Authorized officer Feng, Mei |

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