



# Using Fax Encryption HC-4221 over BGAN

Version 1

3 September 2009

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## 1 Overview

Fax is still a robust, simple and convenient means of communication for many users. A fax machine provides a confirmation of receipt, and a fax document with a personal signature is legally binding in many business contexts. The geographical coverage is extremely large thanks to the high density of the classic telephone network (PSTN) spanning the globe.

There is, however, even greater potential for fax communications when combined with Inmarsat BGAN satellite links. BGAN terminals can be deployed on land, in vehicles (land mobile), on ships (maritime) and in aircrafts (aeronautical) – which means that flexible and portable fax communication solutions are available even in locations without infrastructure.

### 1.1 Fax encryption explained

Fax connections can be tapped, and this risk of interception increases even more when “quasi-open” satellite links are used. Over BGAN links (radio transmission from and to the satellite) encryption takes place only in the UMTS standard (Kasumi algorithm), which is not sufficient for high-security applications. In addition, this encryption may be switched off when technical problems arise on the link – which further increases the risk of interception. Furthermore, if a fax is connected to the PSTN, the terrestrial portion of the connection is not protected!

In order to protect the entire transmission (the BGAN link as well as the fixed network portion from the ground station to a recipient at headquarters, for example), a reliable end-to-end encryption is required. This is available through Fax Encryption HC-4221 from Crypto AG which has been validated for BGAN and which is widely used throughout the telecommunications industry

It is also possible to conduct fax communications over BGAN IP data connections:

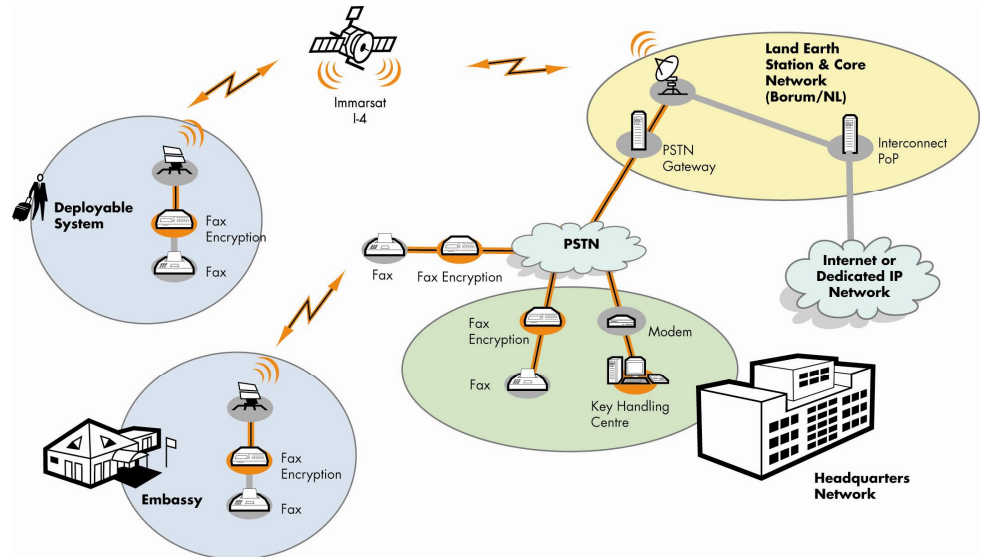
- In real-time mode with standard fax machine – the fax signals can be converted into IP packets, transmitted and converted back to fax signals at the other end (path through with G.711 or T.38) – or in the case of T.38 they can be sent to an IP fax machine directly. Alternatively, you can use an IP fax machine, and send a transmission to another IP fax machine.
- In Store & Forward mode using fax over email (T.37) – over satellite, Store & Forward mode is preferable, as no time-critical protocols are being used. The real-time mode works with reduced connectivity. There is no difference, however, in the importance of providing cryptographic protection, which can be reliably provided through IP VPN solutions from Crypto AG (see related solution sheets).

## 2 Typical users

Fax Encryption HC-4221 is a cryptographic high-security system with customer-specific algorithms which has been designed to satisfy the highest security requirements of government ministries, as well as military and security organisations. When deployed with a robust and portable satellite communication systems such as BGAN it enables secure communication from remote areas such as mountains and deserts or in areas with insufficient infrastructure. Here are a few examples of typical user profiles:

- Diplomats travelling for a Ministry of Foreign Affairs: Important documents from negotiations can be transmitted from branch offices, as can legally binding contracts (including signatures)
- Police organisations: Distribution of situation plans and operations details to mobile units
- Border guards: Transmission of pictures of wanted persons and vehicles
- Ministries of the Interior can correspond securely to all connected authorities

- Military organisations: Operational plans and management support on tactical basis in C4I systems.



The satellite terminal in the embassy might be a Thrane & Thrane EXPLORER 700, which HAS A detachable antenna that can be placed up to 100 m away from the modem and attached to a mast. The more sensitive modem is operated indoors.

There is a Deployable Secure BGAN Satellite Systems from Crypto AG which consists of an easily deployable case with integrated satellite communication, application and encryption equipment. The Deployable System uses an EXPLORER 500, which supports the Audio 3.1kHz service. This system has proven very reliable in terms of operation and availability.

### 3 Key features

- Highly secure digital end-to-end fax encryption via BGAN satellite links; sat/sat and sat/fax via classic PSTN networks (e.g. network connection from ground station to users)
- Compact, robust and emanation-free desktop unit (please note: regular fax machines are not emanation-free)
- Robust connections possible via two Sat hops (equivalent to a sat-sat connection)
- Standard: black & white, option: colour fax (expanded ITU protocol)
- Tamper-proof design
- Customer-specific high-security algorithm, profiled by the customer for absolute secrecy
- Easy operation and installation
- Automatic line speed adaptation from 14'400 bps down to 2'400 bps
- Advanced and centralised key management using chip cards and Down-Line Loading (DLL) from Key Handling Centre KHC-1500-4000
- Especially robust for satellite communication.

## 4 Benefits to BGAN users

- The cryptographic processes use a customer-specific algorithm which is not known or used by any third parties: The entire system is therefore logically impenetrable.
- The encryption processes are hardware-based in a tamper-proof security module – for every connection based on a random number a new unique session key is generated
- Unauthorised access to security data is not possible, as data never leaves the security module in plain mode
- The architecture provides enormous potential for flexible and customised use of the encryption to support the customer's security policy
- The end-user requires no security knowledge – the switch between plain and ciphered mode is via a simple push of a button
- Access can be protected by strong user authentication

## 5 Setting up

This section describes how to set up the Fax Encryptor and the BGAN terminals.

### 5.1 Setting up HC-4221 Fax Encryption (jumper setting)

Recommended settings (of the relevant jumpers only) related to the **SW release 3.21: HPV-0208 (656.102)**

| Jumper 1           | Setting   | Notes  |
|--------------------|---|--|
| Transmit Level     | Total -12dBm:<br>=><br>S2 and S3 ON,<br>S1 and S4 OFF | The level is not so critical, at the receiving side.<br>A good average level for the received signal is -15dBm/ 0.14Veff/0.39Vpp<br><br>Good range:<br>-10dBm/ 0.25Veff/0.7Vpp...-20dBm/<br>0.08Veff/0.22Vpp<br><br>Check with a true RMS digital volt meter and enlarge or decrease the transmit level in case it is out of the given range. Try out several times and check whether it is a significant improvement. |
| Operating Mode 1   | Unrestricted  | S5 OFF If there are connectivity problems one can try to set it to ON. Since it disables also the ECM mode of the connected FAX (ECM mode possibly is also disadvantageous it can be disabled by this jumper in case the required change of the ECM mode at the Fax is not known)  |
| Tax Impulse Filter | 16kHz<br>X40 & X41 to 1-2                             | Not important (there is no tax impulse from the BGAN system)   |

|                |                                     |                 |
|----------------|-------------------------------------|-----------------|
| Line Impedance | Complex:<br>X51, X52, X53 to<br>1-2 | Very important! |
|----------------|-------------------------------------|-----------------|

**Note:** There is no specific software parameters configuration for HC-4221 in SatCom mode.

Refer also the Installation and Operating Manual HC-4221.

## 5.2 About your BGAN SIM card subscription

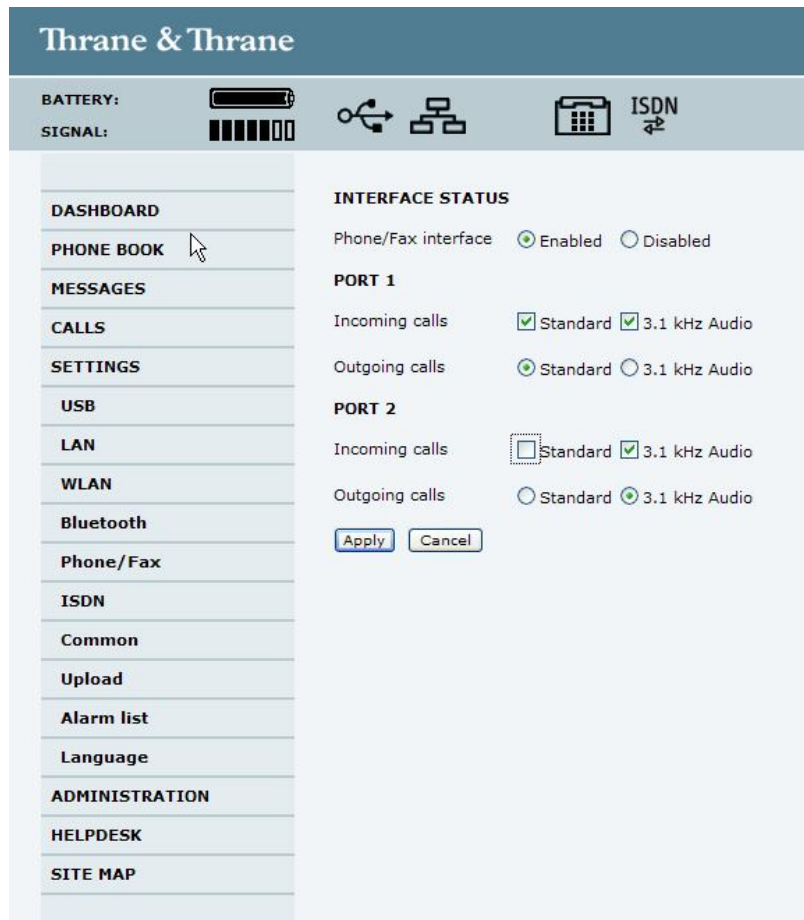
Your SIM card must be provisioned for "Audio 3.1kHz". Define the connected 2-wire interface of the BGAN terminal to use "Audio 3.1kHz" for outgoing calls.

## 5.3 Setting up the EXPLORER 500/527 and EXPLORER 700

The Thrane & Thrane EXPLORER 500, EXPLORER 527 and EXPLORER 700 BGAN terminals can be configured to use the 3.1kHz audio service by default for outgoing calls (for incoming calls, the terminals are set to accept only the audio 3.1kHz service, enabling fax and plain phone communication). This means that you do not have to press **2\*** in front of the number to select this 3.1kHz service. In 3.1kHz mode, non-encrypted voice calls are possible but at a higher cost than on the standard voice mode or require a preselection of **1\*** (prior to the subscriber number) to use the cheaper standard voice mode.

To configure the EXPLORER terminal to use the 3.1 kHz audio service by default:

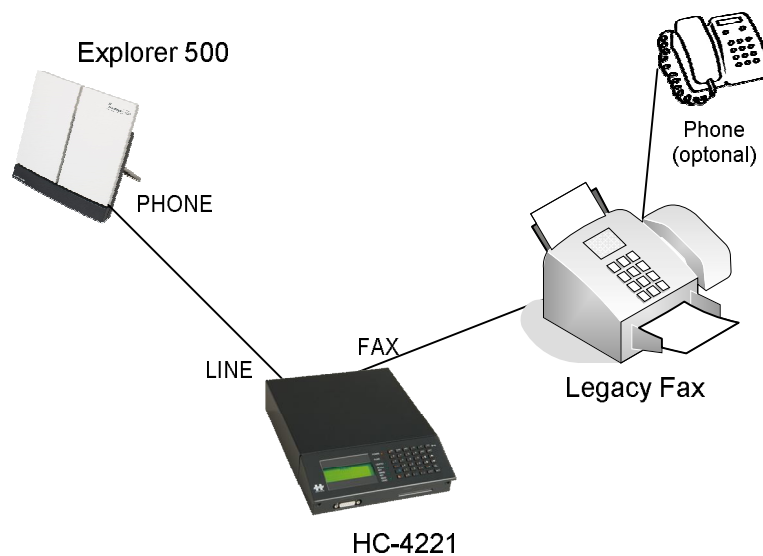
- a. With your computer connected to the EXPLORER terminal, open the Thrane & Thrane web interface by typing **191.168.0.1** into a web browser.
- b. Click on **SETTINGS**, then click on **Phone/Fax**. The following screen displays:



- c. Set Phone/Fax **3.1 kHz Audio** for incoming calls and **3.1 kHz Audio** for outgoing calls.  
 Note: The EXPLORER 500 has only one port. On the EXPLORER 700, set **Port 2** to 3.1 kHz Audio.
- d. Click on **Apply** to save the settings. You are now ready to connect the HC4221 to the terminal:
- e. Connect HC-4221 (LINE) to the EXPLORER 500 or EXPLORER 700 terminal's RJ-11 (phone/fax) port. On the EXPLORER 700, use port 1
- f. Connect HC-4221 (LINE) to the EXPLORER 500 or EXPLORER 700 terminal's RJ-11 (phone/fax) port. On the EXPLORER 700, use port 2

Notes:

- For FleetBroadband, use the same setting for terminals FB250 and FB500
- To make a secure call to Headquarters (HQ), dial out enter hash (#) after the phone number as a delimiter (for example, 0044 3456 5389#)
- Check at the HC-4221 the preset in respect of cipher or plain mode; The green Cipher LED must be on
- To select the Audio 3.1kHz BGAN service from the PSTN, you must use the assigned subscriber number for this service. It is a different number from the standard voice service number



#### 5.4 Setting up the Hughes 9201 or Hughes 9250 terminal

The Hughes 9201 uses a terminal adapter, and therefore the terminal adapter must be configured with the correct MSN numbers. By default the HNS terminal uses MSN 2 for the 3.1KHz audio service. To confirm this, click on **Terminal > ISDN interface** in BGAN LaunchPad.

You are now ready to connect the HC-4221 to the terminal:

- a. Connect the HC-4221 (LINE) to the Hughes 9201 terminal's phone/fax port.
- b. Connect the Group-3 fax-machine to the HC-4221 (FAX) plug on the unit's rear panel using the supplied RJ-11 1/RJ-11 1 cable.

## 5.5 Setting up the fax unit

Crypto AGs experience is that the majority of standard fax machines are not capable of satellite communications, even if one fax is at the PSTN and only the other at a satellite terminal. The problems are mainly caused by long delays. There are models with a so-called "overseas" mode which has to be activated. There are further parameters to adjust the timing of the fax protocol in order to improve the connectivity over satellite. Thus some work over satellite but won't if the small additional delay required by the HC-4221 is added, the fax connection setup may fail. Only a few models can cope with sat/sat communication. Brother fax models, for example the Brother Fax 2820, are quite robust in this respect. The Brother Fax 2820 works reliably over satellite and there are also detailed instructions on how to configure it (available from the Crypto AG customer service).

If fax calls from a certain fax at the PSTN to one at a satellite terminal cause problems (and a vice versa ax communication works), then a media gateway may attempt to disable fax communication or doesn't support fax communication properly. Since the caller determines the routing and the applied signal processing you may involve the fixnet provider to solve the problem, you change the provider or you use on both side satcom.

## 6 Technical specifications

- For fax transmissions, the BGAN 3.1 kHz Audio service must be used to ensure a robust connection.  
The transition to the PSTN network via the BGAN ground station is ensured by the provider.
- Continuous encryption of satellite air portion as well as the fixed network portion in end-to-end mode through Fax Encryption HC-4221
- A robust encryption is possible even over great distances with 2 Satellite hops, despite the related time-delays (provided that the fax machine in use can cope with these delays)
- Transmission according to CCITT G3 recommendations including Error Correction Mode ECM
- HC-4221 can be operated on mains voltage and for mobile operations on DC voltage (10 ... 36 V)
- Change from plain to ciphered mode by simple push of a button
- Colour mode with Colour Option HC-4221 C
- HC-4221 works with all BGAN terminals which offer the Audio 3.kHz Service via ISDN or 2-wire-interface (for example, the Thrane & Thrane EXPLORER 500/527/700, Fleet55/77, Sailor FB250/500, Hughes 9201/9250.)
- Only G3 conformant types of fax machines can be used, which are technically suitable for communication over satellite links. They may, however, have to be configured especially for satellite communication. Many fax machines are not even suited for even direct up-down-links
- Crypto AG manufactures all systems in compliance with quality assurance standard ISO 9001





## 7 General data

| Category          | Details   |
|-------------------|---|
| Operation mode    | Fully automatic at send and receive side<br>Selectable PLAIN and CRYPTO<br>Fax transmission according to CCITT G3 recommendations including Error Correction Mode (ECM)<br>Automatic ciphered/plain documentation marking |
| Communication     | 2,400...14,400 bps with automatic fallback depending on line quality<br>Suppression of non-secure G2 Fax communications   |
| Interfaces        | 2-wire balanced<br>Line:<br>Transmit level: 0...-15 dBm selectable<br>Receive level: 0...-43 dBm automatic adjustment   |
| Fax               | Output level: -9 dBm<br>Input level: 0...-20 dBm  |
| Dimensions        | 221 x 62 x 286 mm   |
| Weight            | 2.3 kg (without AC power adapter)   |
| Power supply      | 10...36 V dc direct or 90...264 VAC via external AC Power Adapter   |
| Power consumption | < 15 VA   |
| Test              | Permanent built-in self-test  |

|                   |   |
|-------------------|---|
| Approvals         | CE (European conformity)<br>Quality assurance<br>ISO 9001:2000) |
| Safety            | EN 60950-1  |
| Telecommunication | CTR-21 including all advisory notes                             |

## 8 Further details and support

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