# IPS CORPORATION

4593 Hosohora Ono Tatsuno-machi,
Kamiina-gun, Nagano-ken,
399-06 Japan
Phone: +81-266-46-3856
Fax  : +81-266-46-3857

May 12, 1998

PCTEST Engineering Laboratory, Inc.
6660-B Dobbin Road,
Columbia, MD 21045   U.S.A

Attention: Mr. Randy Ortanez / President

Reference: FCC Reply for Toko FCC ID: NUSCFO-SS10.

Dear Mr. Ortanez,

Thank you very much for your cooperation. Following is our first reply for the request technical information [Correspondence ID: 123], 731 Confirmation Number: EA88675. Please make a first reply letter to FCC and please confirm that reply is enough or not except the items No.2 and 7.

1. Please refer the attached theory of operation.

2. We will remeasure with peak power meter at end of the May. We will send the data as soon as possible. Please wait a moment.

3. Both output power and PSD were measured with conducted. Measurement made at "External Connector" part (Antenna connection part). Refer to the block diagram in the test report.

4. The theoretical processing gain (Gp):
   = $10 \log W/B = 10 \log 22/2 = 10.413926 dB$
       B: Bit rate   – 2Mbps/Ch
       W: Chip rate – 22Mbps/Ch
   CFO-SS10 provide multiple carries. However, the processing gain is unchangeable due to the above processing gains were synthesizing.

5. Actual Frequency : 2442MHz (No.5 Center Frequency)

6. EUT was verified with FCC Class A digital device. The statement Sec.15.247(b)(4) should be indicated on the each mass production unit.

7. After measure the out put power, we examine the statement should be necessary or not. However, we would like to know the example statement in accordance with the Sec.15.247(b)(4). Please inform us.

Please confirm this reply and your kind consideration to this would be greatly appreciated.

Very truly yours,

IPS Corporation.

Takashi Maruyama
President and Chief Engineer

January, 1998

# What is CFO-SS?

- CFO-SS is an abbreviation of "Carrier Frequency Offset-Spread Spectrum", which is a kind of synchronous multi-carrier DS CDMA technique and utilizing a single PN (Barker) code commonly assigned to all the multiple carriers. Orthogonality among multiple carriers are achieved by specially selected carrier frequencies.
- CFO-SS employs a receiver with surface acoustic wave (SAW) matched filters (or baseband digital matched filters) to achieve rapid signal acquisition.
- Good performance is achieved by CFO-SS even under multipath fading environment.
- Hardware is simple. 10 Mbit/s CFO-SS transceiver basically consists of five units of the 2 Mbit/s 2.4 GHz wireless LAN terminal. One clock tracking circuit is only required which is shared by five units.
- CFO-SS requires no special equalizing technique.

Submission　　　　　　　　　　　　　Page 5　　H. Ishikawa & H. Shinonaga. KDD R&D Labs.

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January, 1998

# Theoretical explanation of the CFO-SS
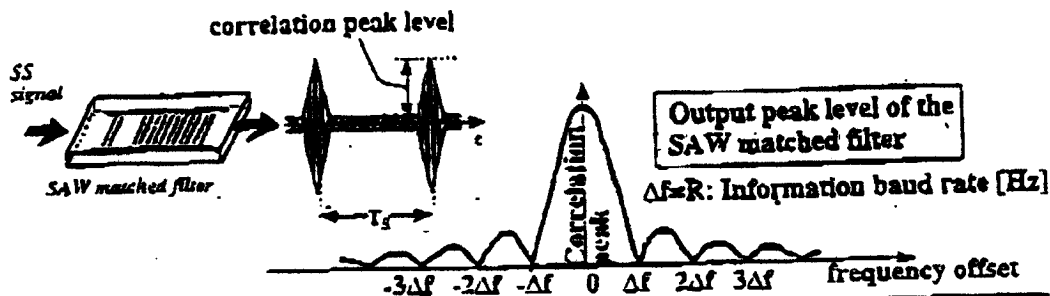


The correlation peak value is obtained by the following equation when a frequency offset exists between the carrier frequency of the SS signal and the nominal operating frequency of the SAW matched filter.

$$|Y| = sin(\pi N T_c X)/sin(\pi T_c X)$$

Y: Amplitude of the correlation peak　　　　$T_c$: Chip duration [sec]

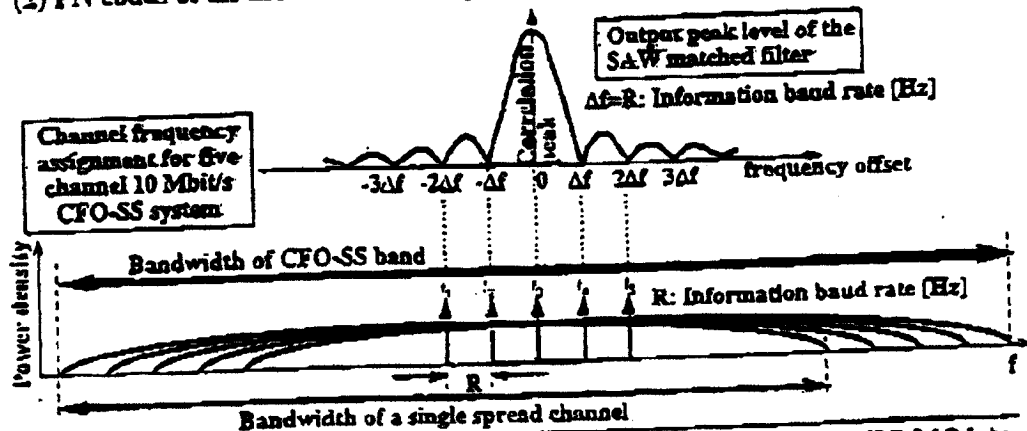X: Frequency offset [Hz]　　　　　　　　N: Length of the PN code [chip]

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# Principle of CFO-SS scheme

- Correlation peak vanishes at the frequencies specified by the information rate.
- For 10 Mbit/s five channel system, minimum channel separation is 1 MHz. However, 2 MHz separation makes the system strong against multipath fading.
- Multiple signals spread by a single PN code can be multiplexed without interfering one another(orthogonality among multiple carriers) if the following conditions (CFO conditions) are simultaneously satisfied.

(1) The symbol timing in each channel are synchronized with the PN code.
(2) PN codes of all the channels are synchronized.



Output peak level of the SAW matched filter
$\Delta f=R$: Information baud rate [Hz]

Channel frequency assignment for five channel 10 Mbit/s CFO-SS system

R: Information baud rate [Hz]

Bandwidth of CFO-SS band

Bandwidth of a single spread channel

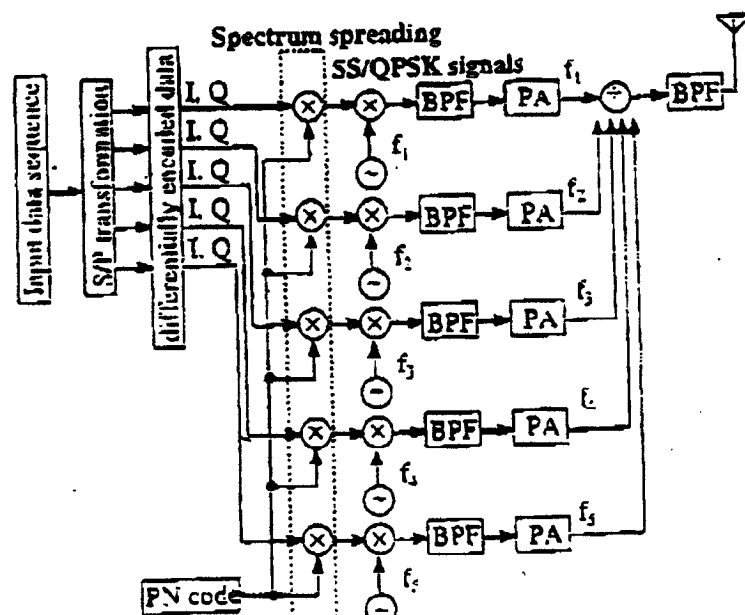Submission                                                   Page 7        H. Ishikawa & H. Shinonaga, KDD R&D Labs.

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# Example transmitter configuration of CFO-SS system with a five channel model
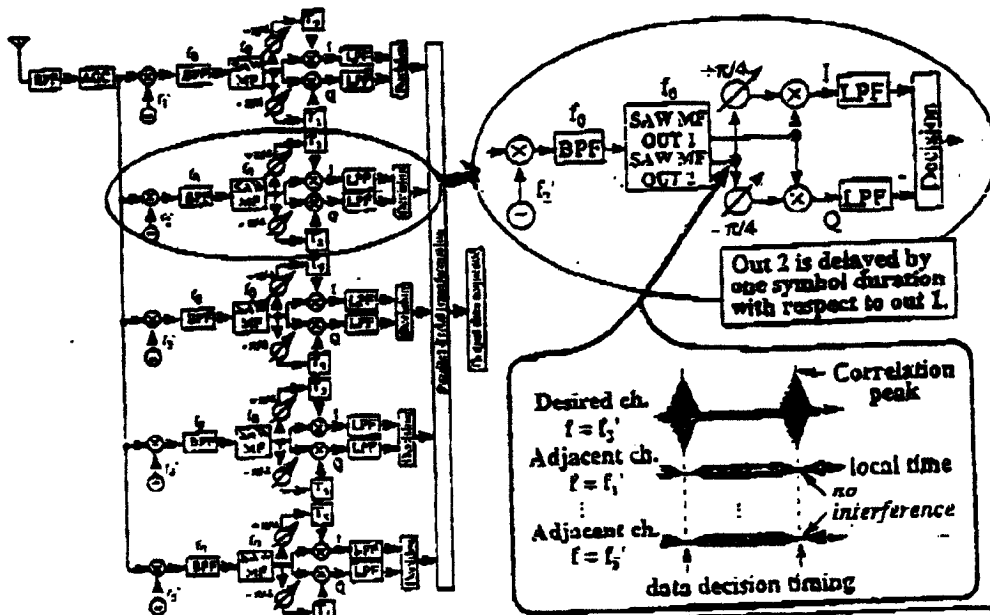


Submission                                                   Page 8        H. Ishikawa & H. Shinonaga, KDD R&D Labs.

# Example receiver configuration of CFO-SS system with a five channel model
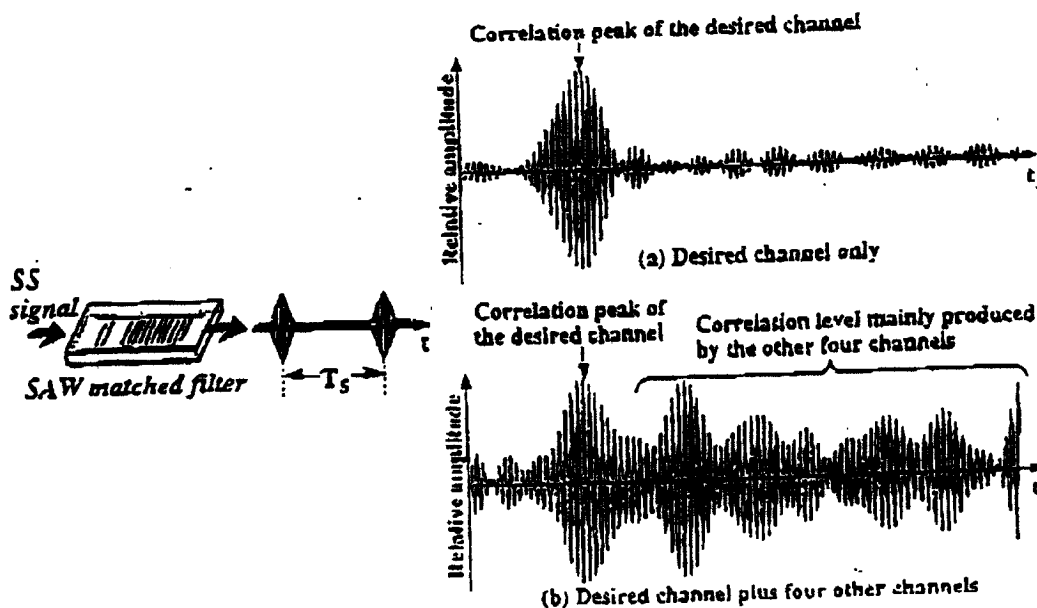


Out 2 is delayed by one symbol duration with respect to out 1.

Correlation peak

Desired ch. $f = f_3'$

Adjacent ch. $f = f_1'$ — local time
no interference

Adjacent ch. $f = f_5'$

data decision timing

# Output waveforms of SAW matched filter



Correlation peak of the desired channel

Relative amplitude

(a) Desired channel only

SS signal

SAW matched filter — $T_s$

Correlation peak of the desired channel

Correlation level mainly produced by the other four channels

Relative amplitude

(b) Desired channel plus four other channels

January. 1998

# Eye diagram of CFO-SS system when five channels are multiplexed

Output peak of desired signal

*Relative output level of differential detector*

←————— One information symbol duration —————→
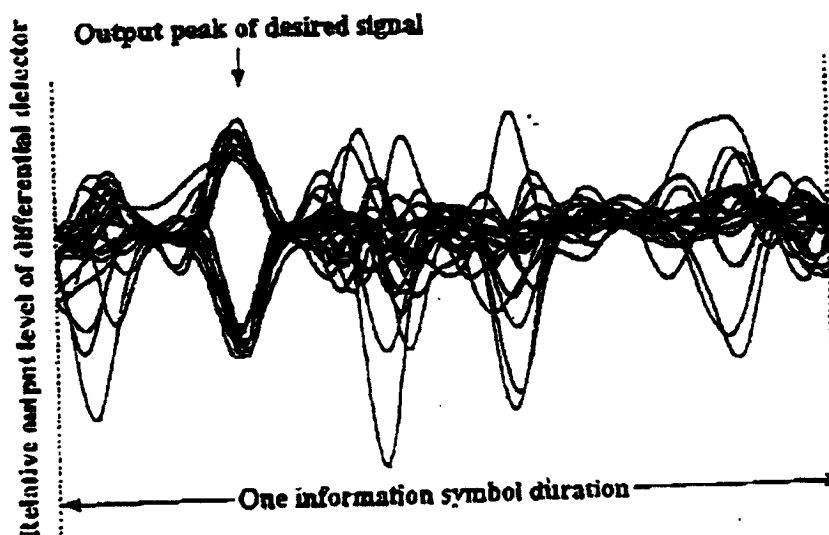
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# Implementation

- **RF/IF complexity**

  1) RF unit consists of antenna, divider, combiner, power amplifiers and LNA's.

  2) IF unit basically consists of five units of the 2 Mbit/s PHYs.

  3) One clock tracking circuit is shared by five units.

- **Baseband processing complexity**

  1) Serial-Parallel translator.

- **Equalizer complexity**

  CFO-SS does not require a special equalizer.

- **Diversity implementation**

  Conventional selection diversity technique is also adequate to CFO-SS.

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# *IPS CORPORATION*

Page 1 of 1

4593 Hosohora Ono Tatsuno-machi,
Kamiina-gun, Nagano-ken,
399-06 Japan
Phone: +81-266-46-3856
Fax : +81-266-46-3857

June 09, 1998

PCTEST Engineering Laboratory, Inc.
6660-B Dobbin Road,
Columbia, MD 21045   U.S.A

Attention: Mr. Randy Ortanez / President
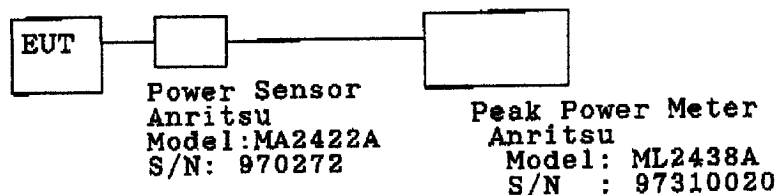
Reference: FCC Reply for Toko FCC ID: NUSCFO-SS10.

Dear Mr. Ortanez,

Thank you very much for your cooperation. Following is our first
reply for the request technical information [Correspondence ID:
123], 731 Confirmation Number: EA88675. Please make a reply
letter to FCC.

Item 2. Re-measurement results of the output power with a peak
power meter.

## 9.23mW

<Measurement Block Diagram>

| EUT |——| |———| |

Power Sensor
Anritsu
Model:MA2422A
S/N: 970272

Peak Power Meter
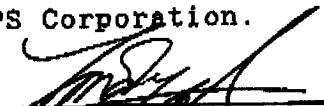Anritsu
Model: ML2438A
S/N : 97310020

Item 7. Please examine the statement should be necessary or not.
And if it is necessary, please inform us of the example
statement in accordance with the Sec.15.247(b)(4).

Please confirm this reply and your kind consideration to this
would be greatly appreciated.

Very truly yours,

IPS Corporation.

Takashi Maruyama
President and Chief Engineer

**SECTION IV -** *Enter FCC ID from Page 1, Section I* ▶

1.(a) Instead of Applicant, FCC is authorized to mail original Grant to:   *(See instructions)*

Firm name,
number, street,
City, State/Country,
ZIP/Postal Code
4

**PCTEST Engineering Laboratory, Inc.**
**6660-B Dobbin Road**
**Columbia, MD 21045**

(b) Name, Title and Mail Stop, if any, of person at above address to receive Grant:   (If 1.(a) is completed, this item must be completed)

**Randy Ortanez, President**

| | | |
|---|---|---|
| 2.(a) Technical contact: Firm name, contact person, number, street, City, State/Country, ZIP/Postal Code | **PCTEST Engineering Laboratory, Inc.** **Randy Ortanez** **6660-B Dobbin Road** **Columbia, MD 21045** | (b)Telephone No. (Area/Country/City code, No. and Ext.) **(410) 290-6652** |
| | | (c) FAX No. (Area/Country/City code and No.) **(410) 290-6654** |

(d) Internet e-mail address: randy@pctestlab.com

| | | |
|---|---|---|
| (e) Non-Technical contact: Firm name, contact person, number, street, City, State/Country, ZIP/Postal Code | **PCTEST Engineering Laboratory, Inc.** **Randy Ortanez** **6660-B Dobbin Road** **Columbia, MD 21045** | (f) Telephone No. (Area/Country/City code, No. and Ext.) **(410) 290-6652** |
| | | (g) FAX No. (Area/Country/City code and No.) **(410) 290-6654** |

(h) Internet e-mail address: **randy@pctestlab.com**

| | | | |
|---|---|---|---|
| 3. | Does this application include a request for confidentiality for any portion(s) of the data contained in this application pursuant to 47 CFR §0.459 of the Commission's Rules?  *If "Yes" see instructions.* | ☐ Yes | ☒ No |
| 4. | Does the applicant request that the Commission defer grant of this application pursuant to 47 CFR §0.457(d)(1)(ii)?  *(See instructions)* | ☐ Yes | ☒ No |

5. Type of equipment authorization requested: (check *one* box only)    ☒ Certification    ☐ Type Acceptance    ☐ Notification

| | |
|---|---|
| 6.(a) Equipment Code and description:  *(See instructions, page 4)* ⎡D⎤⎡S⎤⎡S⎤  Carrier Freq. Offset-Spread Spectrum, Wireless Modem | (b) Equipment will be operated under FCC Rule Part(s): **15.247; Subpart C** |

7. Application is for: (Check one box only)

☒ 1. Original equipment  *(See instructions)*

☐ 2. Change in identification of presently authorized equipment

ORIGINAL FCC ID            Grant date

☐ 3. Class II permissive change or modification of presently authorized equipment  *(See instructions)*

8. **EQUIPMENT SPECIFICATIONS:**  *(See instructions)*

| (a) Frequency range in MHz | (b) Rated RF power output in watts | (c) Frequency tolerance %, Hz, ppm | (d) Emission designator (See 47 CFR §2.201 and §2.202) | (e) Microprocessor model number |
|---|---|---|---|---|
| 2442 MHz | | | | |

| | | | |
|---|---|---|---|
| 9. Is the equipment in this application: (a) a composite device subject to more than one type of equipment authorization? | | ☐ Yes | ☒ No |
| (b) part of a system that operates with, or is marketed with, another device that requires an equipment authorization? | | ☐ Yes | ☒ No |

*If either of the above questions is answered "Yes" complete items 10.(a) and (b).*   *(See instructions)*

COMPLETE, SIGN and DATE Page 3