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### HISTORY

Issue I - August 1989

## **1 GENERAL**

### **1.1**

The signalling requirements for the Signalling System Multifrequency No 4 (SSMF4) when used in conjunction with an inter PBX private network signalling system (eg SSAC15) are detailed in this BTNR.

### **1.2**

SSMF4 is also the subject of two international recommendations - CCITT Recommendation Q23 and CEPT T/CSS5. The signalling requirements detailed in this BTNR accord closely with these two recommendations.

### **1.3**

This BTNR describes the use of SSMF4 to convey the inter register signals (eg Digit Signals) between PBXs via a Private Circuit. The line signalling (Seize, Answer, Clear, and Recall) is performed by an associated Line Signalling System eg SSAC15.

SSAC15 is specified in BTNR 181.

## **2 OUTLINE**

### **2.1 GENERAL**

SSMF4 is an inband multifrequency signalling system. The system is designed to have a low signalling error rate resulting from a high order of immunity to noise and interference.

## **2.2 SIGNAL FREQUENCIES AND CODING**

### **2.2.1 Signal Frequencies**

The signal frequencies occupy two separate groups within the speech band (300-3400 Hz), a 'low' group, each group providing four signalling frequencies. These frequencies shall be normally:

- low group frequencies: 697, 770, 852 and 941 Hz
- high group frequencies: 1209, 1336, 1477 and 1633 Hz.

### **2.2.2 Signal Coding**

Each signal shall be represented by a combination of two signalling frequencies, one frequency from each of the low and high groups. Both frequencies shall be applied simultaneously to the line. The signal designation and coding shall be as shown in Table 1.

This coding is referred to as a 'one out of four plus one out of four' system and allows for a maximum of 16 discrete signals.

	HIGH GROUP FREQUENCY (Hz)			
	1209	1336	1477	1633
LOW 697	1	2	3	A
GROUP 770	4	5	6	B
FREQUENCY 852	7	0	9	C
(Hz) 941	*	8	#	D

**NOTE:** Table 1 gives the full allocation of signal codes. The system may be implemented with only 10 signals, in which case the signals designate, A, B, C, D, # and \* will not be used.

### 3 SENDER REQUIREMENTS

The requirements for the SSMF4 sender for signalling over an inter PBX private circuit are specified below.

#### 3.1 SIGNAL OUTPUT REQUIREMENTS

The Signal Output Requirements are specified in terms of the signals and other frequencies appearing on the line at the output of the subscriber's terminal. Only 2 functional states of the sender exist at the output, the Signal state and the Pause state. The requirements for these two stages and the transitions between them are given below - see Figure 4.

##### 3.1.1 Signal Requirements

For the duration of the signal is output, but after the completion of the risetime, the following requirements shall be met on the line:

###### 3.1.1.1 Frequency Tolerance

The output frequencies shall be maintained within +1.5% of their nominal values. This tolerance shall include the effect of different line impedances offered to the sender.

###### 3.1.1.2 Sending Level

The sending levels shall be for

- the high frequency group: -10 dBm + 2 dB
- the low frequency group: -13 dBm + 2 dB

with a restriction that the level of the higher frequency component of the compound signal shall be 2 dB + 1 dB above the level of the lower frequency components.

### **3.1.1.3 Unwanted Frequency Components**

When the signal is output

a the total power level of all unwanted frequency components shall be at least 20 dB below the level of the low group frequency component of the signal;

b the level of any individual unwanted frequency component shall not exceed the following limits:

-in the frequency band 300-3400 Hz: -33 dBm

-in the frequency band 3400-50000 Hz: -33 dBm at 3400 Hz falling at 12 dB per octave to 50000 Hz

-in the frequency band above 50000 Hz: -80 dBm.

### **3.1.2 Pause Requirements**

For the duration of the pause, but after the completion of the fall time, the following requirement shall be met on the line.

#### **3.1.2.1 Unwanted Frequency Components**

The power level of any single frequency emitted from the sender to line shall not exceed -80 dBm.

#### **3.1.3 Risetime**

The Signal Requirements shall be met within 5 ms from the commencement of the signal output.

#### **3.1.4 Falltime**

The pause requirements shall be met within 5 ms from the cessation of the signal output.

### 3.1.5 Signal Timing

#### 3.1.5.1 Signal Duration

- a) The minimum Signal Duration (T1) shall be 70+ 2 ms (excluding risetime)

#### 3.1.5.2 Pause Duration

- a) If, after the elapse of this duration, no further signal is required to be sent the pause duration shall be extended indefinitely until the start of the next signal output.

### 3.2 ELECTRICAL CHARACTERISTICS

The sender shall function correctly in the presence or absence of any dial tone or other audible signal specified in POR 1080, for indicating to the caller that keying may commence.

### 4 RECEIVER REQUIREMENTS

The requirements for the SSMF4 receiver for signalling over an inter PBX private circuit are specified below.

#### 4.1 GENERAL

**4.1.1** These requirements shall be met when the receiver is in use in PABXs receiving signals from a sender conforming to the requirements of 3.

**4.1.2** The receiver shall be equipped to recognise the 10 signals designated 1 to 0. The system may be utilised with 16 discrete signals, (in which case the signals A, B, C, D and \*, # will be used) or 12 discrete signals (in which case the signals \* and # will be used)

### 4.2 OPERATE AND NON OPERATE REQUIREMENTS

The operate and non-operate requirements are specified in terms of the Signal Condition and Character

Recognition as follows;

## 4.2.1 Signal Condition

The Signal Condition is defined as the state of the line at the input of the receiver when the electrical signals on it correspond to a genuine signal as specified in 2 accompanied by a tolerable amount of other unwanted frequencies. Exact definitions of the above parameters are given in 4.2.3.

## 4.2.2 Character Recognition Condition

The Character Recognition is defined as the functional state which the receiver is in when the signal condition and time requirements as specified in 4.3.4 are satisfied. This functional state causes the correct one of the possible signal codes as specified in 2 to be output in appropriate form.

## 4.2.3 Signal Condition Requirements

4.2.3.1 The Signal Condition as defined in 4.3.1 (and in accordance with the system utilisation as described in 4.3.2) exists if, on the line at the input of the receiver,

- a) two of the signalling frequencies are present, one of each of the low and high frequency groups as specified in 2, and input of the receiver
- b) each of these signalling frequencies is within  $\pm (1.5\% + \text{Hz})$  of the nominal value, and
- c) the level of each of these 2 signalling frequencies is within the range -25 to 0 dBm, and
- d) the difference in level of these 2 signalling frequencies is less than 6 dB, and
- e) these 2 frequencies are accompanied by other frequencies not exceeding:
  - I. in the range 15-480 Hz, a total level of 0 dBm. This includes interference from dial tone.
  - II. in the range 480-3400 Hz, a total level of 20 dBm, whichever is the higher.
  - III. in the range over 3400 Hz, an individual level of -34 dBm at 3400 Hz, rising at 6dB per octave to a level of +10 dBm.

4.2.3.2 The Signal Condition as defined in 4.2.1, does not exist, if, on the line at the input of the receiver,

- a) the level of that signalling frequency in the low signalling frequency group as defined in 2 which has the highest level of the 4 signalling frequencies of the group is less than -34 dBm,  
or
- b) the level of that signalling frequency in the high signalling frequency group as defined in 2 which has the highest level of the 4 signalling frequencies of the group is less than -34 dBm.

This non-existence of the Signal Condition is also known as the Pause Condition.

#### 4.2.4 Character Recognition Requirements

4.2.4.1 The Character Recognition Condition as defined in 4.2.2 shall exist if

a the corresponding Signal Condition is preceded by the continuous non-existence of a signal condition for more than 40 ms, and

b the Signal Condition then exists continuously for more than 40 ms. However, when this Signal Condition exists for less than 20 ms, the Character Recognition shall not exist.

4.2.4.2 Once the Character Recognition Condition exists, it shall be unaffected by an interval of less than 20 ms between 2 Signal Conditions corresponding to the same signal code as specified in 2, where the interval consists either: a of any in the Signal Condition, or

b of a signal condition corresponding to a different signal code as defined in 2.

#### NOTE 1 - SIGNAL CONDITION REQUIREMENTS

These requirements are illustrated in Table 2. For the Signal Condition to exist, all 4 inequalities in the 'Does exist' row must be satisfied simultaneously. For it not to exist, the inequality on the 'Does Not exist' row must be satisfied. Between these two states, there is a 'grey area' represented by the 'May' row, in which the Signal Condition may or may not exist dependent upon the design and production tolerances of the particular receiver in question.

SIGNAL CONDITION	FREQUENCY DEVIATION	SIGNAL LEVEL (X)	DIFFERENCE IN SIGNAL LEVEL	UNWANTED FREQUENCY S
Does exist	<+(1.5%+2 hz)	-25<x<0 dBm	<6 dB	<(u) dBm *
May exist	>+(1.5%+2Hz)	-25>x>-34 dBm or x>0dBm	<6 dB	>(U)dBm
Does not exist		x<-34dBm		

TABLE 2

\*(U) = 4. 2. 3. 1e.

**NOTE 2 - CHARACTER RECOGNITION CONDITION REQUIREMENTS**

These time requirements are illustrated diagrammatically in Table 3 The 'grey area' between the requirements specified in 4.2.4 is illustrated by the 'May' rows. This 'grey area' allows for the design and production tolerances of receivers.

CHARACTER RECOGNITION	WHEN CRC AND THEN.
SHALL EXIST	SC>40 ms
MAY EXIST	20<SC<40 ms
SHALL NOT EXIST	SC<20 ms

CHARACTER RECOGNITION	WHEN CRC AND THEN.
SHALL CEASE	SC>40 ms
MAY CEASE	20<SC<40 ms
SHALL NOT CEASE	SC<20 ms

TABLE 3

Legend - SC = The continuous existence of Signal Condition (SIGNAL)

SC = The continuous non-existence of Signal Condition (PAUSE)

CRC = The existence of Character Recognition Condition

CRC = The non-existence of Character Recognition Condition

#### **4.3 SPEECH IMMUNITY PERFORMANCE (TEST CONDITION)**

**4.3.1** The receiver should not perform more than 46 false operations per 100 speech hours at a long term (mean) level of speech whilst active of -10 dBm as measured by a Speech Voltmeter No 5B. This corresponds to an overall performance of one false digit per 10,000 sent from an untimed sender with no holdover.

**4.3.2** A speech hour is defined as a total duration of one hour when speech in both directions may be present, that is when the circuit is seized and the call established (conversation condition).

#### **5. REFERENCES**

CCITT Rec Q23  
CEPT T/CSS  
BTNR 181  
POR 1080