

User's and Programming Guide
Agilent Technologies
ESG Family Signal Generators
Option 300 Base Station BERT Extension
for Option UN7



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1 Getting Started

This chapter provides a product overview and information for the recommended test equipment and setup instructions for the Agilent Technologies ESG-D Option 300, Base Station BERT Extension for Option UN7.

Product Overview

The ESG-D Option 300, GSM Base Station BERT Extension for Option UN7 adds RF loopback bit error rate testing (BERT) to the ESG/VSA combination. It provides device-independent loopback bit error rate (BER) measurements for the GSM standard, including residual bit error rate (RBER) for both Class Ib and Class II bits and frame erasure ratio (FER). It provides high speed sensitivity search routines for high throughput in production, and tests both transceiver modules and base transceiver stations.

With the exception of encryption and data type, the test signal from the ESG-D Option 300 emulates a fully coded PN9 or PN15 full-rate traffic channel signal from a mobile station. The timeslot under test is selectable from 0–7 on any absolute radio frequency channel number (ARFCN). Adjacent time slots can be loaded with fully-coded GSM signals at up to ± 130 dB from the timeslot under test, and within the output power range of the ESG. In addition, Option 300 synchronizes the ESG receiver to the broadcast channel (BCH) or to a traffic channel (TCH) from the base transceiver station (BTS). A 13 MHz reference clock input on the vector spectrum analyzer (VSA) allows the VSA and ESG time bases to be locked to the BTS. The ESG-D Option 300 can report the following results:

- Class Ib RBER and total class Ib bits tested
- Class II RBER and total class II bits tested
- FER and total frames tested
- Sensitivity search results

Required Equipment

The following equipment is required to make loopback BER measurements.

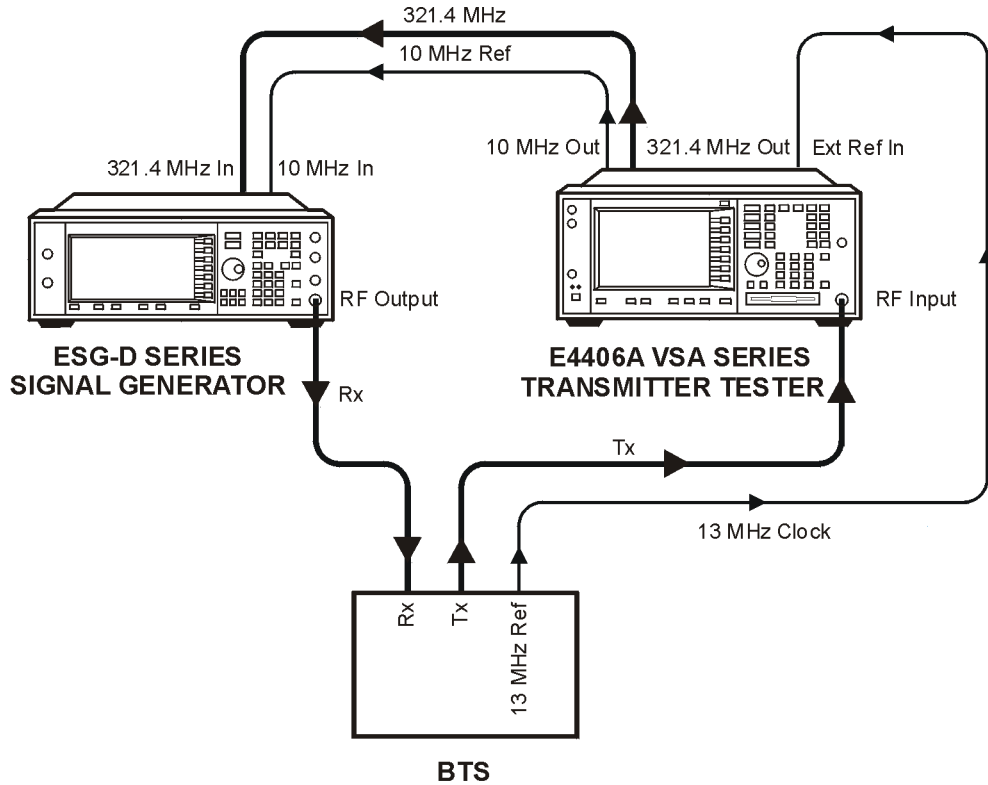
- VSA Series Transmitter Tester, model E4406A, with the following required options:
 - Option BAH - GSM Measurement Personality
 - Option 300 - 321.4 MHz IF Output
- ESG-D Series Signal Generator, models E4430B, E4431B, E4432B, or E4433B, with the following required options:
 - Option UN8 - Real-time I/Q Baseband Generator
 - Option UN7 - Bit Error Rate Test
 - Option 300 - Base Station BERT Extension for Option UN7

NOTE Option UNA, Alternate Timeslot Power Level Control, is not required but is recommended.

Connecting the Test Equipment

Refer to the following setup diagram for connections to the ESG, VSA, and base station.

Figure 1-1 BTS Loopback Test Equipment Setup



pk744b

2 Making Measurements

Look in this chapter for examples of GSM base station receiver sensitivity measurements using the loopback technique.

Measuring RF Loopback BER

The following procedure uses the data looped back from the base transceiver station (BTS) to measure the bit error ratio introduced by the BTS receiver when it is receiving coded data from the test equipment. Timing synchronization must first be achieved between the BTS and the test equipment so that data can be transmitted and received at the expected times. Synchronization is achievable either to a received broadcast channel (BCH) or to a received full rate speech traffic channel (TCH).

NOTE This example uses an ARFCN of 520 for the BCH and synchronizes to the TCH midamble in timeslot 2 on ARFCN 570. You can substitute as appropriate for your BTS.

Configuring GSM Mode on the Agilent Technologies E4406A VSA Series Transmitter Tester

The following steps will show you how to set up the vector signal analyzer (VSA) for synchronization.

1. To preset the VSA:
Press the **Preset** key.
2. To select GSM mode:
Press **MODE > GSM**.
3. To set up GSM mode for BTS test:
Press **Mode Setup > Radio > Band > DCS 1800**.
Toggle **Device BTS MS** until **BTS** is underlined.
Toggle **Freq Hopping On Off** until **Off** is underlined.
4. To set the frequency:
Press **FREQUENCY Channel > Center Freq**.
Enter **1.8068**, then press **GHz**.
Select **Burst Type > Normal**.
Toggle **TSC Auto Manual** until **Auto** is underlined.
5. To lock the VSA and ESG to the BTS 13 MHz reference:
Press **System > Reference**.
Press **Freq Ref**, enter **13**, and then press **MHz**.
Toggle **Freq Ref Int Ext** until **Ext** is underlined.
Toggle **10 MHz Out Off On** until **On** is underlined.

Configuring GSM Mode on the ESG-D Series Signal Generator

The following steps will show you how to configure a timeslot with multiframe data, set up traffic channel 570, and set the frequency and amplitude in GSM mode on the signal generator. When configuring a timeslot in this procedure, keep the following points in mind:

- Prior to synchronization, the transmitter must be configured to generate multiframe data in the timeslot to be tested.
- TCH synchronization requires that the training sequences match between the ESG timeslot configuration and the timeslot sent by the base station. The default for the ESG, which is TS0, can be modified.

1. To preset the ESG:

Press the **Preset** key.

2. To select GSM mode:

Press **Mode** > **Real Time I/Q BaseBand** > **TDMA** > **GSM**.

Alternately, to configure measurements from the Option 300 menu:

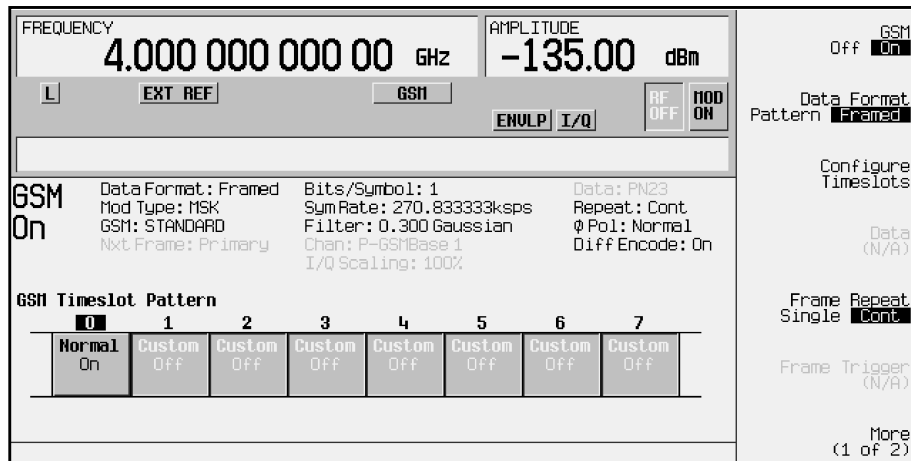
Press **MODE** > **BERT** > **BTS BERT** > **Configure Measurement** > **Transmit Settings**.

3. Toggle the **GSM On Off** softkey until **On** is highlighted.

4. To select a framed data transmission:

Toggle the **Data Format Pattern Framed** softkey until **Framed** is highlighted.

Notice that the GSM timeslot pattern is displayed on the screen.



5. To turn off timeslot 0:

Press **Configure Timeslots**.

Toggle **Timeslot Off On** until **Off** is highlighted.

6. To configure timeslot 2:

Press **Timeslot #**, enter **2**, and then press **Enter**

Press **Timeslot Type > Normal**.

Press **Configure Normal > E > Multiframe PN Sequence > MPN15**.

If the default training sequence (TSC0) does not match the training sequence sent by the BTS, press **TS** and select the proper training sequence.

Press **Return** and toggle the **Timeslot Off On** softkey until **On** is highlighted.

7. Configure the adjacent timeslots:

Press **Timeslot #**, enter **1**, and then press **Enter**.

Press **Timeslot Type > Normal**.

Press **Configure Normal > E > Multiframe PN Sequence > MPN9**.

Press **Return** and toggle the **Timeslot Ampl Main Delta** softkey until **Delta** is highlighted.

Toggle the **Timeslot Off On** softkey until **On** is highlighted.

Repeat these steps for timeslot 3.

8. To set the adjacent timeslot power to delta +50 dB:

Press **Ampl > Alternate Amplitude > Alt Ampl Delta > 50 > dB**.

9. To set up traffic channel 570 in GSM mode:

Press **Mode > Real Time I/Q BaseBand > TDMA > GSM**.

Press **More (1 of 2) > Freq Channels > Channel Band > More (1 of 2) > DCS Mobile**.

Toggle **Freq Channels Off On** until **On** is highlighted.

Press **Channel Number**. Enter **570**, and then press **Enter**.

Notice that the active entry area displays the following:

Channel: 570 (1.7218000000GHz)

The screenshot shows the following information:

- FREQUENCY:** 1.721 800 000 00 GHz
- Amplitude:** $\Delta = 50.00\text{dB}$, -135.00 dBm
- Channel:** 570 (1.7218000000GHz)
- GSM On:** Data Format: Framed, Mod Type: MSK, GSM: STANDARD, Nxt Frame: Primary, Bits/Symbol: 1, Sym Rate: 270.833333ksps, Filter: 0.300 Gaussian, Chan: DCSMobile 570, I/Q Scaling: 100%, Data: PN23, Repeat: Cont, ϕ Pol: Normal, Diff Encode: On
- GSM Timeslot Pattern:**

0	1	2	3	4	5	6	7
Normal Off	Normal On 50dB	Normal On	Normal On 50dB	Custom Off	Custom Off	Custom Off	Custom Off
- RF On/Off:** RF OFF, MOD ON
- Channel Band:** (DCS Mobile)

10. To set the amplitude to -104 dBm:

Press **Amplitude**, enter -104, and then press **dBm**.

11. Press the **RF On/Off** key to turn the RF output on.

Notice that the RF annunciator is turned on and the new power level is shown in the amplitude area of the display:

The screenshot shows the following information:

- FREQUENCY:** 1.721 800 000 00 GHz
- Amplitude:** $\Delta = 50.00\text{dB}$, -104.00 dBm
- Channel:** 570 (1.7218000000GHz)
- GSM On:** Data Format: Framed, Mod Type: MSK, GSM: STANDARD, Nxt Frame: Primary, Bits/Symbol: 1, Sym Rate: 270.833333ksps, Filter: 0.300 Gaussian, Chan: DCSMobile 570, I/Q Scaling: 100%, Data: PN23, Repeat: Cont, ϕ Pol: Normal, Diff Encode: On
- GSM Timeslot Pattern:**

0	1	2	3	4	5	6	7
Normal Off	Normal On 50dB	Normal On	Normal On 50dB	Custom Off	Custom Off	Custom Off	Custom Off
- RF On/Off:** RF ON, MOD ON
- Channel Band:** (DCS Mobile)

Synchronizing to the BCH

The following steps show you how to synchronize to the broadcast channel. Set up the base station to send the BCH now. The BCH is only required to contain the synchronization logical channel (SCH).

1. Follow the instructions under “Configuring GSM Mode on the Agilent Technologies E4406A VSA Series Transmitter Tester” and “Configuring GSM Mode on the ESG-D Series Signal Generator” in this chapter, to prepare the test equipment for synchronization.

2. To select Option 300 on the ESG:

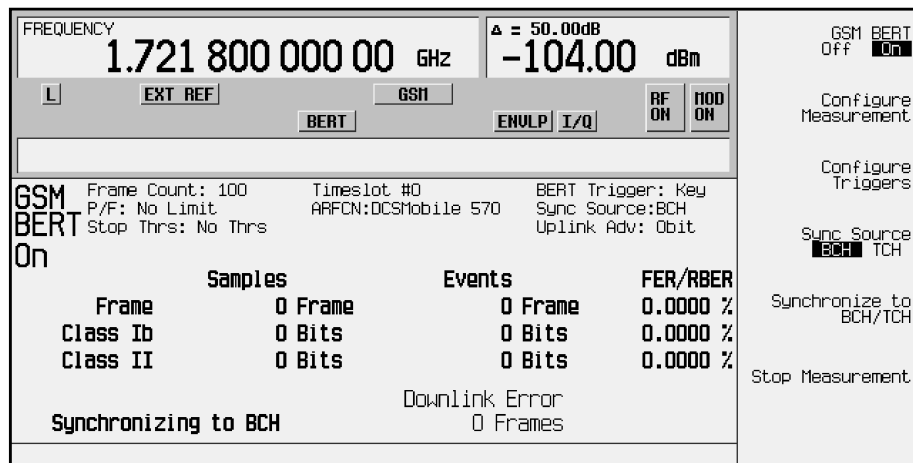
Press **Mode** > **BERT** > **BTS BERT** to select Option 300.

3. To select BCH synchronization:

Toggle the **Sync Source BCH TCH** softkey until **BCH** is highlighted.

4. To begin synchronization to the BCH:

Press the **GSM BERT Off On** softkey until **On** is highlighted and then press **Synchronize to BCH/TCH**. You will briefly see **Synchronizing to BCH** flashing on the display.



Once synchronization is achieved, the ESG will expect to receive a TCH to decode and, accordingly, will display the **Waiting for TCH** message.

5. Turn off the BCH signal and set up the base station to loop the TCH. The TCH is only required to contain a valid midamble.
6. Change the VSA to the frequency of the TCH:

Press **FREQUENCY Channel** > **Center Freq.**

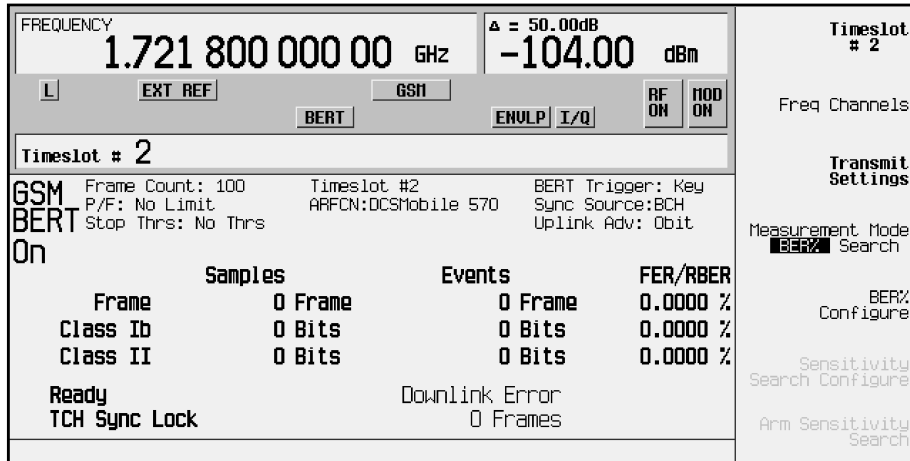
Enter **1.8168**, and then press **GHz**.

7. Set the ESG to expect the TCH in timeslot 2:

Press **Configure Measurement > Timeslot # > 2 > Enter**.

Once synchronization to the TCH is achieved, the ESG will display the **TCH Sync Lock** message.

8. Now that TCH sync lock is achieved, the ESG will try to synchronize to the PN. Once this is achieved, the ESG will display the **Ready** message.



Synchronizing to the TCH

The following steps show you how to synchronize to the traffic channel. The TCH is only required to contain a valid midamble. If appropriate for your base station, this synchronization can be performed without prior BCH synchronization.

NOTE If the base station is transmitting a BCH signal, turn it off at this time.

- Follow the instructions under [“Configuring GSM Mode on the Agilent Technologies E4406A VSA Series Transmitter Tester”](#) and [“Configuring GSM Mode on the ESG-D Series Signal Generator”](#) in this chapter, to prepare the test equipment for synchronization.
- Change the VSA to the frequency of the TCH:
Press **FREQUENCY Channel > Center Freq**.
Enter **1.8168**, and then press **GHz**.
- On the ESG, to select Option 300:
Press **Mode > BERT > BTS BERT**.
- To select TCH synchronization:
Toggle the **Sync Source BCH TCH** softkey until **TCH** is highlighted.

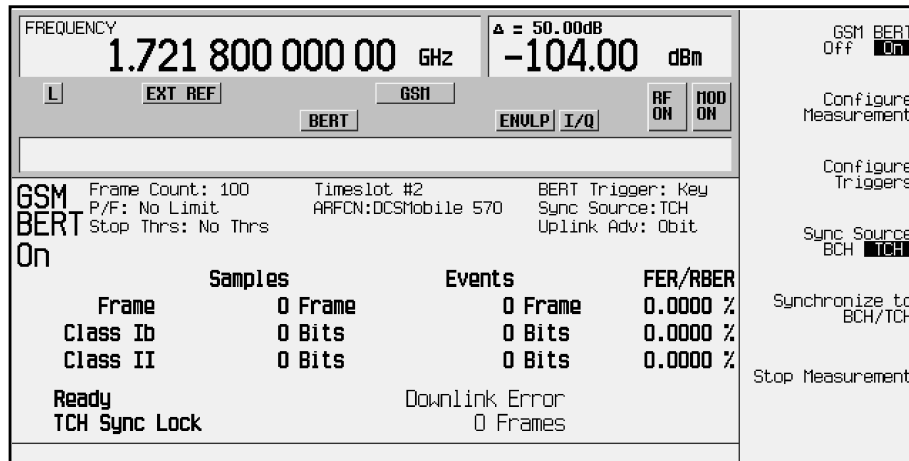
5. Set the ESG to expect the TCH in timeslot 2:

Press **Configure Measurement** > **Timeslot #** > **2** > **Enter**.

6. To begin synchronization to the TCH:

Press **Return** and toggle the **GSM BERT Off On** softkey until **On** is highlighted. Then press **Synchronize to BCH/TCH**. You will see **Synchronizing to TCH** flashing on the display followed by the **Synchronizing to PN** message.

Once synchronization is achieved, the **Ready TCH Sync Lock** message is displayed.



Making Loopback BER Measurements

The following procedure shows you how to configure the frame count, set pass/fail limits and set early stop criteria for loopback BER measurements.

1. Press **Configure Measurement** and toggle the **Measurement Mode** softkey until **BER%** is highlighted. Notice that the **BER% Configure** softkey is enabled.

2. Press **BER% Configure** to access the softkey menu for configuring BER%.

3. To set the frame count to 500 frames:

Press **Frame Count**, enter **500**, and then press **Enter**.

Notice that the **Frame Count** softkey is highlighted, **500** is displayed beneath the softkey, and **Frame Count: 500** appears in the status area of the display.

4. To set the pass/fail limits to 2% Class II RBER:

Press **Pass/Fail Limits** > **Class II RBER** > **2** > **%**.

Notice that the **Class II RBER** softkey is highlighted, **2.000% RBER** is displayed beneath the softkey, and **P/F: 2.0000% CII** appears in the status area of the display.

5. To set the stop criteria threshold for 100 events:

Press Return > Threshold # of Events to Stop > Class II Bit Error > 100 > Enter.

Notice that the **Class II Bit Error** softkey is highlighted, **100 events** is displayed beneath the softkey, and **Stop Thrs: CII(100)** appears in the status area of the display.

FREQUENCY		1.721 800 000 00 GHz		Δ = 50.00dB		-104.00 dBm	
L	EXT REF	GSM	BERT	ENULP	I/Q	RF ON	MOD ON
Class II Bit Error: 100							
GSM		Frame Count: 500		Timeslot #2		BERT Trigger: Key	
BERT		P/F: 2.0000% CII		ARFCN:DCSMobile 570		Sync Source:TCH	
On		Stop Thrs:CII(100)		Uplink Adv: Obit			
Frame	0 Frame	Class Ib	0 Bits	Class II	0 Bits	FER/RBER	0.0000 %
Class Ib	0 Bits	Class II	0 Bits	FER/RBER	0.0000 %		
Class II	0 Bits	FER/RBER	0.0000 %				
Ready	Downlink Error						
TCH Sync Lock	0 Frames						
Exceeds Any Threshold							
No Thresholds							

6. To start the measurement:

Press Trigger.

You will see **Pass** or **Fail** displayed on the lower left corner of the screen, when either of the following occurs:

- The measurement completes normally; in this case, after 500 frames.
- The measurement terminates early, due to the designated number of events to stop being reached.

FREQUENCY		1.721 800 000 00 GHz		Δ = 50.00dB		-104.00 dBm	
L	EXT REF	GSM	BERT	ENULP	I/Q	RF ON	MOD ON
Class II Bit Error: 100							
GSM		Frame Count: 500		Timeslot #2		BERT Trigger: Key	
BERT		P/F: 2.0000% CII		ARFCN:DCSMobile 570		Sync Source:TCH	
On		Stop Thrs:CII(100)		Uplink Adv: Obit			
Frame	500 Frame	Class Ib	66000 Bits	Class II	39000 Bits	FER/RBER	0.0282 %
Class Ib	66000 Bits	Class II	39000 Bits	FER/RBER	0.0282 %		
Class II	39000 Bits	FER/RBER	0.0282 %				
Ready	Downlink Error						
TCH Sync Lock	PASS						
		0 Frames					
Exceeds Any Threshold							
No Thresholds							

NOTE To select an alternate trigger mode (for example, Immediate):
Press **Return** three times, then press **Configure Triggers > BERT Trigger Source > Immediate**.

Using Amplitude Sensitivity Search

This procedure shows you how to set a pass amplitude with high and low amplitude boundaries, and how to set both the target error percentage, and the frame count for an amplitude sensitivity search.

- To select Option 300:
Press **Mode > BERT > BTS BERT**.
- Press **Configure Measurement**, then toggle the **Measurement Mode** softkey until **Search** is highlighted. Notice that the **Sensitivity Search Configure** and **Arm Sensitivity Search** softkeys are enabled.
- Press **Sensitivity Search Configure** to access the softkey menu for configuring the sensitivity search.

FREQUENCY		1.721 800 000 00 GHz		Δ = 50.00dB		-104.00 dBm	
L	EXT REF	GSM		RF ON		MOD ON	
		BERT		ENULP		I/Q	
GSM		Frame Count: 100	Timeslot #2	BERT Trigger: Key		Frame Count 100	
BERT		Target %: 2.0000%	ARFCN:DCSMobile 570	Search Class: CII		Target % 2.0000%	
On		Pass Ampl:-104.00dBm	High Ampl:-90.00dBm	Low Ampl:-110.00dBm		Pass Amplitude -104.00 dBm	
		Samples	Events	RBER		High Amplitude -90.00 dBm	
Frame	0 Frame					Low Amplitude -110.00 dBm	
Class Ib	0 Bits	0 Bits	0.0000 %				
Class II	0 Bits	0 Bits	0.0000 %				
Ready	Downlink Error		Last Result				
TCH Sync Lock	0 Frames						

- To set the frame count for the final measurements in the search to 100:
Press **Frame Count**, enter **100**, and then press **Enter**.
Notice that the **Frame Count** softkey is highlighted and **100** is displayed beneath the key.
- To set the target percentage to 2%:
Press **Target %**, enter **2**, and then press **%**.
Notice that the **Target %** softkey is highlighted and **2.0000%** is displayed beneath the key.

6. To set the pass amplitude level to -104 dBm:

Press **Pass Amplitude**, enter **-104**, and then press **dBm**.

Notice that the **Pass Amplitude** softkey is highlighted and **-104.00 dBm** is displayed beneath the key.

7. To set the high amplitude level to -95 dBm:

Press **High Amplitude**, enter **-95** and then press **dBm**.

Notice that the **High Amplitude** softkey is highlighted and **-95.00 dBm** is displayed beneath the key.

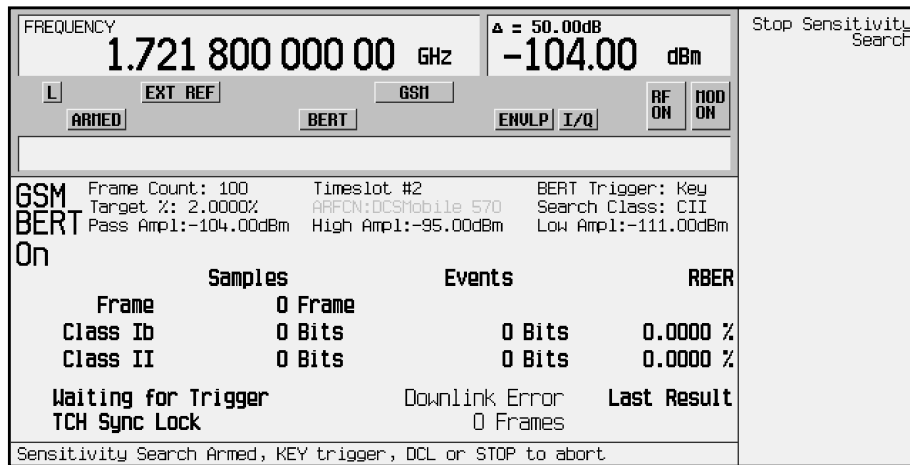
8. To set the low amplitude level to -111 dBm:

Press: **Low Amplitude** > **-111** > **dBm**.

Notice that the **Low Amplitude** softkey is highlighted and **-111.00 dBm** is displayed beneath the key.

9. To arm the signal generator:

- Press **Return** > **Arm Sensitivity Search**.

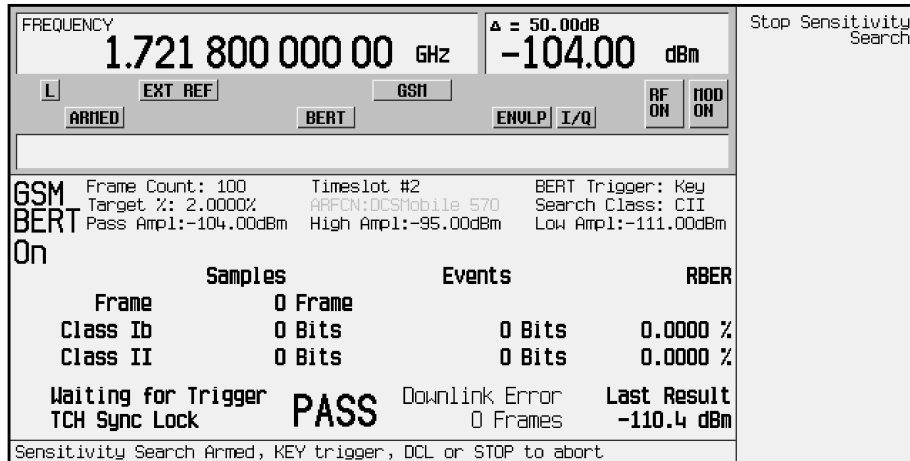


10.To start the measurement:

Press **Trigger**.

After the search is complete, you will see **Pass** or **Fail** displayed on the lower left corner of the screen, when either of the following occurs:

- The result equals or is less than the target percent within the high to low amplitude range.
- The high or low amplitude level is passed at the target% BER/RBER.



11.To terminate a measurement:

Press **Stop Sensitivity Search**.

NOTE To select an alternate trigger mode (for example, Immediate):
 Press **Return > Configure Triggers > BERT Trigger Source > Immediate**.

NOTE For efficiency, the search routine uses shorter measurements initially with the final measurements being over the frame length selected.

3 Softkey Reference

This chapter describes the **Mode** hardkey, and explains the associated softkeys that are used to activate functions specific to the Agilent Technologies ESG-D Option 300, Base Station BERT Extension for Option UN7.

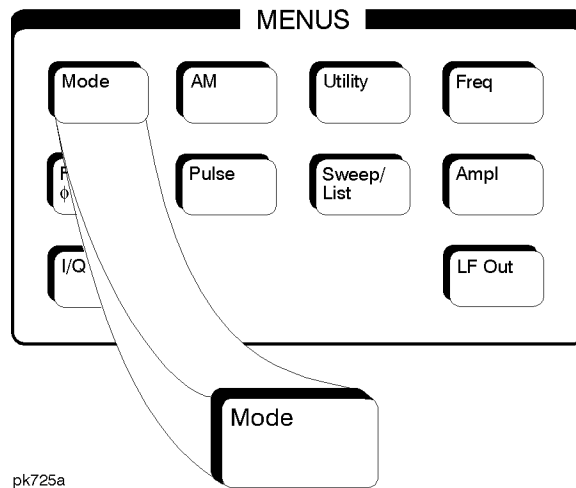
GSM Base Station Test Softkeys

Access the following Option 300 softkeys to perform GSM BTS loopback tests.

Mode

Pressing the **Mode** key accesses a menu of softkeys. These softkeys let you access further menus for configuring digital modulation formats such as **Real Time I/Q Baseband** or for performing bit error rate tests with **BERT**. If you have multiple options and the **BERT** softkey is visible, press it and then press **BTS BERT** to set the parameters for performing specific bit error rate tests (BERT) for GSM base transceiver stations (BTS). This chapter assumes that the **BERT** softkey is in the first menu.

NOTE The softkeys in this section are described in alphabetical order. The description for each softkey lists the key presses required to access the key. If you don't see a softkey in the indicated menu, it may be on the next page of the menu. Press the **More** softkey to access the next menu page.



Arm Sensitivity Search

Press this softkey to arm the sensitivity search function. Once sensitivity search is armed, the sensitivity search operation will run upon receiving the selected trigger. (If **Trigger Key** is selected, press the **Trigger** hardkey to start the search.) Press **Stop Sensitivity Search** to end the search prematurely. During search, no other softkey operation is available except **Stop Sensitivity Search**.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Arm Sensitivity Search**

BER% Configure

This softkey accesses the BER% configuration functions such as setting the frame count, the pass/fail limits, and the stop-on-event thresholds.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure**

BERT

This is the top level softkey for accessing the menu of softkeys used for setting or specifying all of the parameters required to make bit error rate tests (BERT). Baseband BERT or BTS BERT are available options.

Softkey Location: **Mode > BERT**

BERT Trigger Source

Press this softkey to access a menu of choices for selecting the BERT trigger source. You can choose triggering that occurs immediately (**Immediate**), triggering by the **Trigger** hardkey (**Trigger Key**), triggering that is supplied remotely via GPIB (**Bus**), or triggering on an external signal supplied to the TRIGGER IN connector (**Ext**).

Default Value: **Trigger Key**

Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers > BERT Trigger Source**

BTS BERT

This is a top level softkey that accesses the menu of softkeys used for setting or specifying all of the parameters required to make GSM base transceiver station bit error rate tests (BTS BERT).

Softkey Location: **Mode > BERT > BTS BERT**

Bus

Press this softkey to allow a measurement to run when the appropriate GPIB command is received, provided synchronization has already been achieved. If not already synchronized, the trigger is ignored.

Default Value: Trigger Key

Softkey Location: Mode > BERT > BTS BERT > Configure Triggers > BERT Trigger Source > Bus

Channel Band

Press this softkey to access a menu of choices for assigning channel bands based on the GSM standard. The output frequency depends on both the channel band and channel number selections.

Default Value: P-GSM Base

Softkey Location: Mode > BERT > BTS BERT > Configure Measurement > Freq Channels > Channel Band

Or: Mode > Real Time I/Q BaseBand > TDMA > GSM > Freq Channels > Channel Band

Channel Number

Pressing this softkey allows you to change the channel numbers (the frame carrier frequency) based on frequency channels defined in the GSM standard. To change the channel number, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad. The output frequency depends on both the channel band and channel number selections.

Default Value: 0

Softkey Location: Mode > BERT > BTS BERT > Configure Measurement > Freq Channels > Channel Number

Or: Mode > Real Time I/Q BaseBand > TDMA > GSM > Freq Channels > Channel Number

Class Ib Bit Error

Press this softkey to end the measurement when the detected number of Class Ib errors exceeds the set threshold. The valid range for the threshold can be set between 0 and 1,000,000 events.

Default Value: 300 events

Softkey Location: Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Threshold # of Events to Stop > Class Ib Bit Error

Class Ib RBER

Press this softkey to set the pass/fail Class Ib RBER limit. Class Ib RBER is the ratio of the number of errored Class Ib bits (after de-convolution in the non-erased speech frames) to the total number of Class Ib bits in the non-erased frames. The measurement fails if the Class Ib RBER exceeds a threshold which can be set between 0% and 100% (0 to 1).

Default Value: 0.4000% RBER

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Pass/Fail Limits > Class Ib RBER**

Class II Bit Error

Press this softkey to end the measurement when the detected number of Class II errors exceeds the set threshold. The valid range for the threshold can be set between 0 and 1,000,000 events.

Default Value: 300 events

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Threshold # of Events to Stop > Class II Bit Error**

Class II RBER

Press this softkey to set the Pass/Fail Class II RBER limit. Class II RBER is the ratio of the number of errored Class II bits (after de-convolution in the non-erased speech frames) to the total number of Class II bits in the non-erased frames. The measurement fails if the Class II RBER exceeds a threshold which can be set between 0% and 100% (0 to 1).

Default Value: 2.0000% RBER

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Pass/Fail Limits > Class II RBER**

Configure Measurement

This is a top level softkey that accesses the menu of softkeys used for configuring test parameters for BTS BER measurements.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement**

Configure Triggers

This is a top level softkey that accesses the menu of softkeys used for configuring the BERT trigger source, uplink timing advance, and inverting the spectrum.

Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers**

Exceeds Any Limits

Pressing this softkey causes a FAIL status to be displayed whenever any of the designated pass/fail limits (FER, Class Ib RBER, or Class II RBER) has been exceeded. The pass/fail indication is provided at the end of each measurement.

Default Value: No Limits

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Pass/Fail Limits > Exceeds Any Limits**

Exceeds Any Threshold

Press this softkey to end the measurement whenever the number of error events exceeds the threshold designated in the Threshold # of Events to Stop menu. This may occur before the number of frames to measure is reached.

Default Value: No Thresholds

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Threshold # of Events to Stop > Exceeds Any Threshold**

Ext

Press this softkey to allow a measurement to run when the external trigger line goes high, provided synchronization has already been achieved. If not already synchronized, the trigger is ignored.

Default Value: Trigger Key

Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers > BERT Trigger Source > Ext**

Frame Count

This softkey appears in two different situations, enabling you to designate the number of frames to measure in either a sensitivity search or in a BER% configuration.

Frame Count - BER% Configure

Press this softkey to set the number of frames to measure between 1 and 6,000,000. Unless a stop-on-event threshold has been set, the measurement ends normally when the selected number of speech frames have elapsed.

Default Value: 100

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Frame Count**

Frame Count - Sensitivity Search Configure

Press this softkey to designate the total number of frames to measure for the final measurements during a sensitivity search. This number implies the number of Class Ib and Class II bits to be measured. The acceptable range of values is from 1 to 6,000,000 frames.

Default Value: 100

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Sensitivity Search Configure > Frame Count**

Frame Erasure

Press this softkey to end the measurement when the number of erased speech frames detected exceeds a threshold which can be set between 0 and 1,000,000 frames.

Default Value: 120

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Threshold # of Events to Stop > Frame Erasure**

Frame Erasure Ratio

FER is the ratio of the number of speech frames erased by the BTS to the total number of speech frames in the measurement period. The measurement fails if the FER exceeds a threshold which can be set between 0% and 100% (0 to 1).

Default Value: 0.1000% FER

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Pass/Fail Limits > Frame Erasure Ratio**

Freq Channels

Pressing this softkey accesses a menu of choices for assigning frequency channels and frequency bands based on the GSM standard.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Freq Channels**

Or: **Mode > Real Time I/Q BaseBand > TDMA > GSM > Freq Channels**

GSM BERT Off On

Press this softkey to enable and disable the GSM BERT function. Turning GSM BERT on will initiate synchronization to the base transceiver station (BTS) under test. Turning GSM BERT off will turn off any current BER measurements.

Default Value: Off

Softkey Location: **Mode > BERT > BTS BERT > GSM BERT Off On**

High Amplitude

Press this softkey to set the maximum amplitude of the range to be searched. Valid entries between +20 dBm to -136 dBm can be set. Synchronization of the PN sequence will be done at a level 10 dB higher than this level, if within the range of the signal generator.

Default Value: -90 dBm

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Sensitivity Search Configure > High Amplitude**

Immediate

With **Immediate** selected, BER measurements are initiated and repeated until you set the **GSM BERT Off On** softkey to **Off**, or until you set the **BERT Trigger Source** to **Trigger Key**, **Bus**, or **Ext**. The measurement starts as soon as the ESG achieves synchronization.

Default Value: Trigger Key

Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers > BERT Trigger Source > Immediate**

Low Amplitude

Press this softkey to set the minimum amplitude of the range to be searched. Valid entries between +20 dBm to -136 dBm can be set.

NOTE	Optimum speed will be obtained if the search range is minimized to around 5 – 10 dB.
------	--

Default Value: –136 dBm

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Sensitivity Search Configure > Low Amplitude**

Measurement Mode BER% Search

Press this softkey to determine the measurement mode by enabling either the **BER% Configure** menu or the **Sensitivity Search Configure** menu.

When **BER%** is enabled, the **Sensitivity Search Configure** softkey is unavailable. When **Search** is enabled, the **BER% Configure** softkey is unavailable.

Default Value: BER%

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Measurement Mode BER% Search**

Multiframe PN Sequence

This is a top level softkey that accesses the menu of softkeys used to configure the data field (E) with a multiframe pseudorandom bit pattern.

Default Value: PN9

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Transmit Settings > Data Format Pattern Framed > Configure Timeslots > Configure Normal > E > Multiframe PN Sequence**

Or: **Mode > Real Time I/Q Baseband > TDMA > GSM > Data Format Pattern Framed > Configure Timeslots > Configure Normal > E > Multiframe PN Sequence**

MPN15

Press this softkey to turn on a 26-TCH multiframe pattern and embed the PN15 sequence in the selected timeslot. Any or all of the 8 timeslots can be enabled.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Transmit Settings > Data Format Pattern Framed > Configure Timeslots > Configure Normal > E > Multiframe PN Sequence > MPN15**

Or: **Mode > Real Time I/Q Baseband > TDMA > GSM > Data Format Pattern Framed > Configure Timeslots > Configure Normal > E > Multiframe PN Sequence > MPN15**

MPN9

Press this softkey to turn on a 26-TCH multiframe pattern and embed the PN9 sequence in the selected timeslot. Any or all of the 8 timeslots can be enabled.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Transmit Settings > Data Format Pattern Framed > Configure Timeslots > Configure Normal > E > Multiframe PN Sequence > MPN9**

Or: **Mode > Real Time I/Q Baseband > TDMA > GSM > Data Format Pattern Framed > Configure Timeslots > Configure Normal > E > Multiframe PN Sequence > MPN9**

No Limits

Press this softkey to set no limits for pass/fail reporting and thus provide no pass/fail results.

Default Value: No Limits

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Pass/Fail Limits > No Limits**

No Thresholds

Press this softkey to apply none of the stop-on-event criteria and allow the measurement to run for the selected number of speech frames

Default Value: No Thresholds

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Threshold # of Events to Stop > No Thresholds**

Pass Amplitude

Press this softkey to set the acceptable pass amplitude of the range to be searched. Valid entries range from +20 dBm to -136 dBm can be set.

Default Value: -104 dBm

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Sensitivity Search Configure > Pass Amplitude**

Pass/Fail Limits

This is a top level softkey that accesses the pass/fail limit menu. A pass/fail indication is provided at the end of each measurement and can be configured based on the measurement exceeding none, one, or all of the following limit criteria: FER limit, Class Ib RBER limit, Class II RBER limit. The pass/fail limits apply to static level BER measurements (BER %).

Default Value: No Limits

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Pass/Fail Limits**

Sensitivity Search Configure

This is a top level menu softkey that accesses BER sensitivity search measurement functions. Measurements are repeated at different power levels to determine the input power level at which the Class II residual bit error rate (RBER) is less than or equal to a target percent.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Sensitivity Search Configure**

Spectrum Invert Off On

To invert the spectrum of the received RF signal, toggle this softkey to **On**. To turn off spectral inversion, toggle this softkey to **Off**.

Default Value: On (for operation with the VSA)

Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers > Spectrum Invert Off On**

Stop Measurement

Press this softkey to halt the current measurement.

Softkey Location: **Mode > BERT > BTS BERT > Stop Measurement**

Stop Sensitivity Search

Pressing this softkey stops the sensitivity search function if it has been enabled, and moves the softkey menu back one level to **Arm Sensitivity Search**.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Arm Sensitivity Search > Stop Sensitivity Search**

Sync Source BCH TCH

Toggle this softkey to select the synchronization source as either BCH (broadcast channel) or TCH (traffic channel).

The test equipment can use a BCH signal from the BTS to determine its required transmit timeslot, frame and multiframe timing. The BCH signal is always transmitted in timeslot 0 and contains multiframe information.

TCH synchronization relies on the BTS to supply a TCH training sequence to which the receiver can synchronize. However, the receiver must be told which timeslot is being received, since it has no absolute reference (unlike a BCH, which is always transmitted in timeslot 0).

Softkey Location: **Mode > BERT > BTS BERT > Sync Source BCH TCH**

Synchronize to BCH/TCH

Press this softkey to release the current synchronization with the BTS and immediately attempt to re-synchronize to either the BCH or TCH signal selected with the **Sync Source BCH TCH** softkey. This softkey also stops the measurement.

Default Value: BCH

Softkey Location: **Mode > BERT > BTS BERT > Synchronize to BCH/TCH**

Target%

Press this softkey to set the target BER/RBER in percent (the percent of allowable errors) for BER search. Valid range is 0 to 100%

Default Value: 2%

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Sensitivity Search Configure > Target%**

Threshold # of Events to Stop

This is a top level key softkey that accesses the Threshold # of Events to Stop menu. To save time, individual measurements can be stopped prematurely based on the following criteria set in this menu:

- Frame Erasure
- Class Ib Bit Error
- Class II Bit Error

If no stop criteria are specified, the measurement continues until the number of frames to measure is met.

The threshold # of events to stop applies only to the BER % measurement.

The acceptable range of values is from 1 to 1,000,000.

Default Value: No Thresholds

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > BER% Configure > Threshold # of Events to Stop**

Timeslot

Press this softkey to select a timeslot to be measured. Enter the timeslot number using the front panel knob, the up and down arrow keys, or enter the number using the numeric keypad and press the Enter terminator softkey.

Default Value: 0

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Timeslot #**

Transmit Settings

This is the top level softkey for accessing the GSM menu of softkeys used for selecting framed data, configuring timeslots, and selecting frequency channels. You can access the GSM menu through the **Mode** hardkey or from within the **BTS BERT** menu.

Softkey Location: **Mode > BERT > BTS BERT > Configure Measurement > Transmit Settings**

Or: **Mode > Real Time I/Q BaseBand > TDMA > GSM**

Trigger Key

Pressing this softkey allows a measurement to run when the **Trigger** hardkey is pressed, provided synchronization has already been achieved. If not already synchronized, the trigger is ignored.

To start a BER search, choose **Trigger Key**, press **Arm Sensitivity Search**, then press the **Trigger** hardkey, to start the BER search operation. No other softkey operations will be available until the search is completed, or until the **Stop Sensitivity Search** softkey is pressed.

Default Value: Trigger Key

Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers > BERT Trigger Source > Trigger Key**

Uplink Timing Advance

Press this softkey to set the uplink timing advance to between –500 and 10,000 bits with 1 bit resolution. Setting the uplink timing advance allows you to compensate for the insertion of equipment such as fading simulators into the uplink RF path.

Default Value: 0 bits

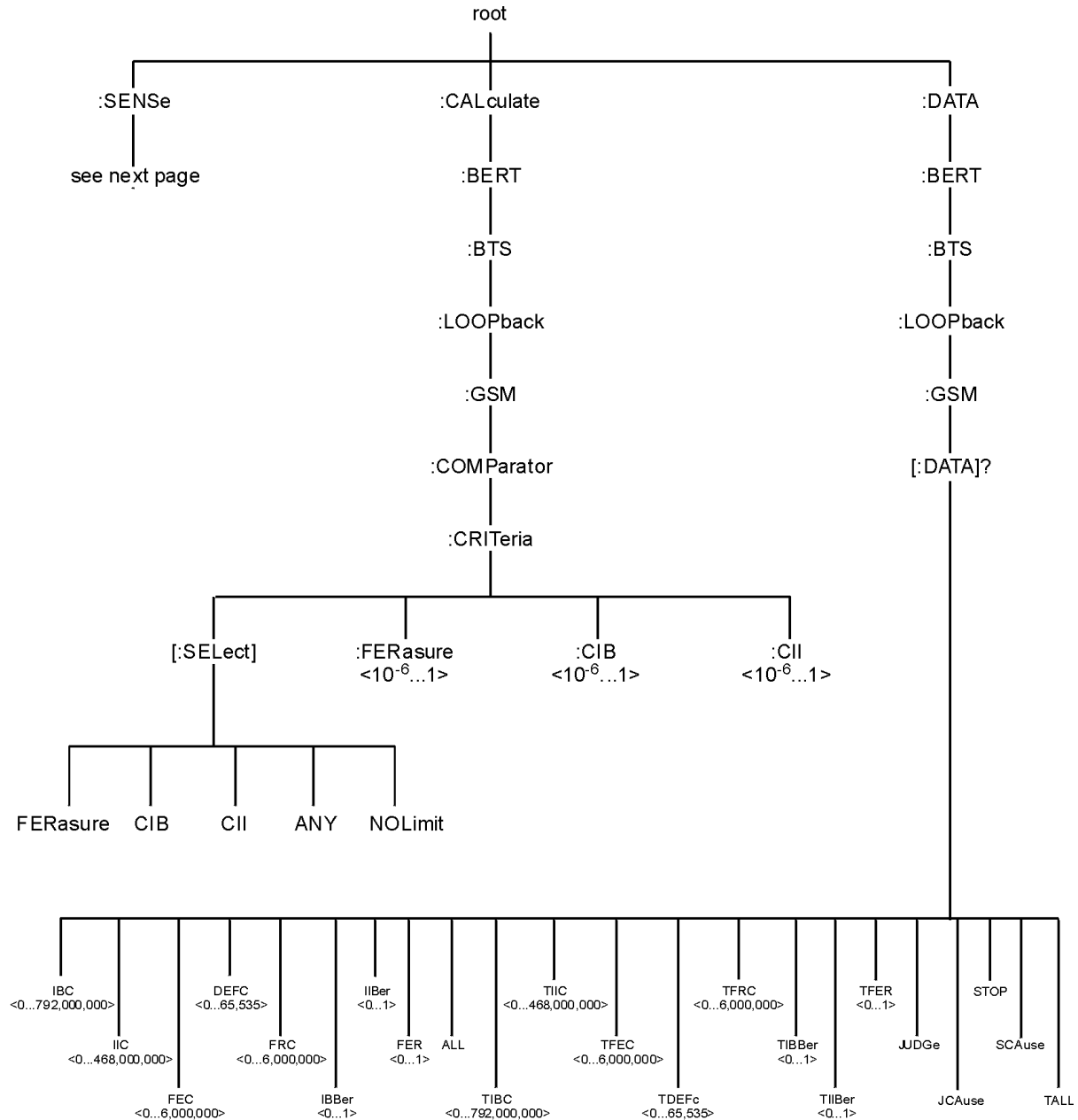
Softkey Location: **Mode > BERT > BTS BERT > Configure Triggers > Uplink Timing Advance**

4 Remote Programming

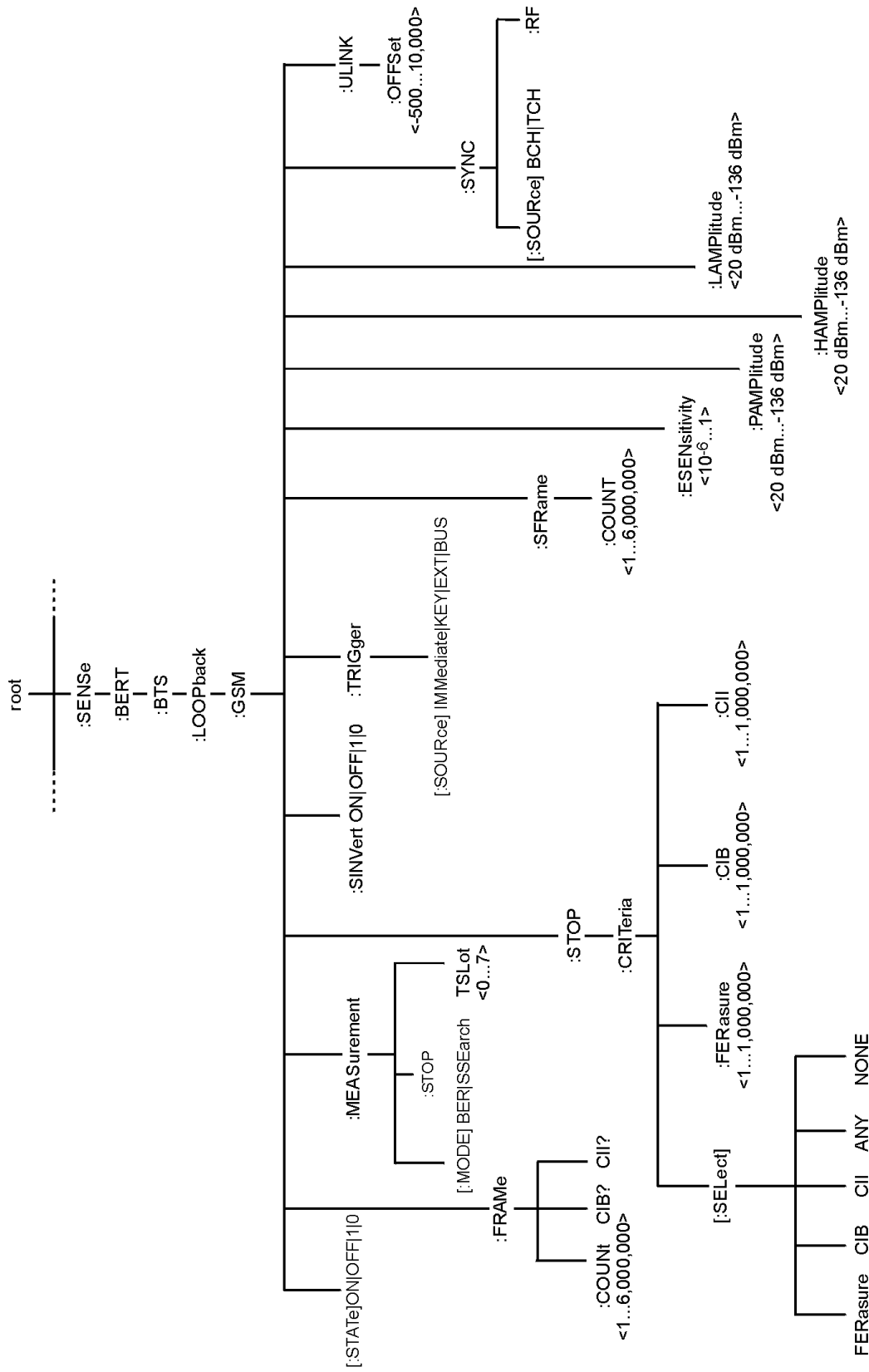
This chapter contains a command tree of the Option 300 Standard Commands for Programmable Instruments (SCPI) commands. A description of each command is provided as well as syntax requirements, ranges, restrictions, query responses, and status at *RST. For information regarding SCPI common terms, queries, implied commands, command strings, and command syntax, refer to the main programming guide.

SCPI Command Tree

This command tree illustrates every valid SCPI command for Option 300. Each command is described in detail in the following section.



ck76b



ck75b

Option 300 SCPI Command Reference

The following SCPI commands are used to set the controls and the parameters associated with Option 300 functionality.

BERT Trigger Source Selection

```
:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce] IMMEDIATE|KEY|EXT|BUS  
:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce]?
```

This command determines the trigger source for the GSM loopback bit error rate measurement.

- Select `IMMEDIATE` to begin the measurement directly after synchronization has been achieved.
- Select `KEY` to begin the measurement when the front panel `Trigger` key is pressed, provided that synchronization has been achieved. If synchronization has not occurred, the trigger is ignored.
- Select `EXT` to begin the measurement as soon as a trigger signal is applied to the `TRIGGER IN` rear panel connector provided that synchronization has been achieved. If synchronization has not occurred, the trigger is ignored.
- Select `BUS` to begin the measurement once a HP-IB trigger command is received by the signal generator provided that synchronization has been achieved. If synchronization has not occurred, the trigger is ignored.

An inherent variable delay will always exist when starting a measurement because the measurement must await the start of the next speech frame after the trigger. The delay can vary between 0 and 23 ms (5 frames) depending on where the trigger falls within the TDMA multiframe.

A trigger is ignored unless the GSM loopback operating state is turned on.

*RST Value: `KEY`.

Class Ib Bits, Number to be Measured

```
:SENSe:BERT:BTS:LOOPback:GSM:FRAME:CIB?
```

This query returns the total number of Class Ib bits to be measured which are calculated from the total number of frames specified to be measured.

Range: 132 to 792,000,000.

*RST Value: 13200.

Class II Bits, Number to be Measured

:SENSE:BERT:BTS:LOOPback:GSM:FRAME:CII?

This query returns the total number of Class II bits to be measured which are calculated from the total number of frames specified to be measured.

Range: 78 to 468,000,000.

*RST Value: 7800.

Data

:DATA:BERT:BTS:LOOPback:GSM[:DATA]?

IBC|IIC|FEC|DEFC|FRC|IBBer|IIBer|FER|ALL|TIBC|TIIC|TFEC|TDEFc|TFRC|TIBBer|TIIBer|TFER|JUDGE|JCAuse|STOP|SCAuse|TALL

This data query returns the measurement result value for each variable.

IBC|IIC|FEC|DEFC|FRC|IBBer|IIBer|FER are intermediate values, so during the measurement, these variables are updated as well as the display information. ALL returns intermediate values at the same time.

At the end of the measurement, all of them are stored to:

TIBC|TIIC|TFEC|TDEFc|TFRC|TIBBer|TIIBer|TFER variables. These variables and JUDGE|JCAuse|STOP|SCAuse are not updated until the next BER measurement is completed. TALL returns all of the total values at the same time.

IBC: Intermediate Class Ib Error Count <Integer> 0 to 792,000,000

IIC: Intermediate Class II Error Count <Integer> 0 to 468,000,000

FEC: Intermediate Frame Erasure Count <Integer> 0 to 6,000,000

DEFC: Intermediate Downlink Error Frame Count <Integer> 0 to 65,535

FRC: Intermediate Frame Count <Integer> 0 to 6,000,000

IBBer: Intermediate Class Ib Error Ratio <Real> 0 to 1 (0 to 100%)

IIBer: Intermediate Class II Error Ratio <Real> 0 to 1 (0 to 100%)

FER: Intermediate Frame Erasure Ratio <Real> 0 to 1 (0 to 100%)

ALL: IBC IIC FEC DEFC FRC IBBer IIBer FER

TIBC: Total Class Ib Bit Error Count <Integer> 0 to 792,000,000

TIIC: Total Class II Bit Error Count <Integer> 0 to 468,000,000

TFEC: Total Frame Erasure Count <Integer> 0 to 6,000,000

TDEFc: Total Downlink Error Frame Count <Integer> 0 to 65,535

TFRC: Total Frame Count <Integer> 0 to 6,000,000

TIBBer: Total Class Ib Error Ratio <Real> 0 to 1 (0 to 100%)

TIIBer: Total Class II Error Ratio <Real> 0 to 1 (0 to 100%)

TFER: Total Frame Erasure Ratio <Real> 0 to 1 (0 to 100%)

TALL: TIBC TIIC TFEC TDEFc TFRC TIBBer TIIBer TFER JUDGE JCAuse STOP SCAuse
If accidental TCH synchronization loss caused the measurement to stop, TSLoss is returned.

JUDGE: Comparator Result (TEST OUT) <Enumerated set> FAIL PASS NONE
If Pass/Fail criteria is NOLimit, NONE is returned.

JCAuse: Which limit was met to cause the comparator result.
<Enumerated set> NOLimit FER CIB CII

STOP: If stop threshold is met? <Enumerated set> TRUE FALSE
When threshold to stop criteria is NONE, FALSE is returned.

SCAuse: Stop Cause <Enumerated set> NONE FE CIB CII TSLoss
If accidental TCH synchronization loss caused the measurement to stop, TSLoss is returned.

Frame Count (BER %)

```
:SENSe:BERT:BTS:LOOPback:GSM:FRAMe:COUNT <numeric_value>  
:SENSe:BERT:BTS:LOOPback:GSM:FRAMe:COUNT?
```

This command determines the length of the measurement specified by the total number of frames included in one measurement. (See also “[Sensitivity Search, Frame Count](#)” on page 4-8.)

Range: 1 to 6,000,000. If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 100.

GSM Loopback Operating State

```
:SENSe:BERT:BTS:LOOPback:GSM[:STATe] ON|OFF|1|0  
:SENSe:BERT:BTS:LOOPback:GSM[:STATe]?
```

This command turns on and off the operating state of the GSM loopback bit error rate function. Although you can configure the measurement parameters while the operating state is off, any command triggers sent will be ignored until the operating state is turned on.

*RST Value: OFF.

Measurement Mode, Switching

```
:SENSe:BERT:BTS:LOOPback:GSM:MEASurement[:MODE] BER|SSEarch
:SENSe:BERT:BTS:LOOPback:GSM:MEASurement[:MODE]?
```

This command changes the measurement mode between BER% and Sensitivity Search. This also changes the GSM BERT display and enables the Configuration menu for either the BER% Configure menu or the Sensitivity Search menu. If the BER% measurement is already running, this command will abort the BER% measurement. If Sensitivity Search is initiated from remote control, the BUS trigger is disallowed. If Sensitivity Search is initiated from the front panel, the BUS trigger is allowed.

*RST Value: BER%.

Measurement, Stopping

```
:SENSe:BERT:BTS:LOOPback:GSM:MEASurement:STOP
```

This command immediately stops any current measurement and releases the PN synchronization. After the synchronization is released, a new PN synchronization is attempted.

Multiframe PN Sequence

```
[:SOURCE]:RADio:GSM:SLOT0|[1]|2|3|4|5|6|7:NORMal:ENCRyption MPN9|MPN15
[:SOURCE]:RADio:GSM:SLOT0|[1]|2|3|4|5|6|7:NORMal:ENCRyption?
```

This command turns on a 26-TCH multiframe pattern and embeds the PN sequence in the selected timeslot. Any or all of the 8 timeslots can be enabled.

*RST Value: PN9.

Pass/Fail Limit, Selection

```
:CALCulate:BERT:BTS:LOOPback:GSM:COMPARator:CRITeria[:SElect]
FERasure|CIB|CII|ANY|NOLimit
:CALCulate:BERT:BTS:LOOPback:GSM:COMPARator:CRITeria[SElect]?
```

This command determines which of the following pass/fail limit (comparator) criteria is applied to the measurement.

- Select `FERasure` to report the pass or fail status compared to the specified threshold for frame erasure ratio.
- Select `CIB` to report the pass or fail status compared to the specified threshold for the number of Class Ib errors detected in the measurement.
- Select `CII` to report the pass or fail status compared to the specified threshold for the number of Class II errors detected in the measurement.

- Select **ANY** to report the pass or fail status compared to all of the specified comparator criteria.
- Select **NOLimit** to disable the pass/fail indication.

*RST Value: NOLimit.

Pass/Fail Limit, Frame Erasure Ratio

```
:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:FERasure  
<numeric_value>  
:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:FERasure?
```

This command sets the pass/fail threshold value for frame erasure rate.

Range: 0 to 1 (0% to 100%). If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 0.001 (0.1000%).

Pass/Fail Limit, Class Ib RBER

```
:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:CIB <numeric_value>  
:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:CIB?
```

This command sets the pass/fail threshold value for Class II residual bit error rate.

Range: 0 to 1 (0% to 100%), however, the meaningful range is 1/(Class II bit length) to 50%. If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 0.004 (0.4000%).

Pass/Fail Limit, Class II RBER

```
:CALCulate:BERT:COMParator[:CRITeria]:CII <numeric_value>  
:CALCulate:BERT:COMParator[:CRITeria]:CII?
```

This command sets the pass/fail threshold value for Class Ib residual bit error rate.

Range: 0 to 1 (0% to 100%), however, the meaningful range is 1/(Class Ib bit length) to 50%. If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 0.020 (2.0000%).

Sensitivity Search, Frame Count

```
:SENSe:BERT:BTS:LOOPback:GSM:SFRame:COUNT <numeric_value>
```

This command specifies the total number of frames to be measured for the final measurements during the sensitivity search.

Range: 1 to 6,000,000 frames

*RST Value: 100.

Sensitivity Search, Target Error Level

```
:SENSe:BERT:BTS:LOOPback:GSM:ESENSitivity <numeric_value>
```

This command specifies the target error rate when performing a sensitivity search.

Range: 10^{-6} to 1 (100%)

*RST Value: 0.02.

Sensitivity Search, Pass Amplitude

```
:SENSe:BERT:BTS:LOOPback:GSM:PAMPLitude <numeric_value>
```

This command specifies the threshold amplitude for Pass/Fail comparator results when performing a sensitivity search.

Range: 20.0 dBm to -136.0 dBm

*RST Value: -104.0 dBm.

Sensitivity Search, High Amplitude

```
:SENSe:BERT:BTS:LOOPback:GSM:HAMPLitude <numeric_value>
```

This command specifies the maximum amplitude level for performing a sensitivity search.

Range: 20.0 dBm to -136.0 dBm

*RST Value: -90.0 dBm.

Sensitivity Search, Low Amplitude

```
:SENSe:BERT:BTS:LOOPback:GSM:LAMPLitude <numeric_value>
```

This command specifies the minimum amplitude level for performing a sensitivity search.

Range: 20.0 dBm to -136.0 dBm

*RST Value: -110.0 dBm.

Spectrum Invert

```
:SENSe:BERT:BTS:LOOPback:GSM:SINVert ON|OFF|1|0
```

Turning Spectrum Invert to ON, specifies that the GSM demodulator invert the spectrum of the received RF signal.

*RST Value: ON.

Stop Measurement Threshold Criteria, Number of Events

```
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria[:SElect]  
FERasure|CIB|CII|ANY|NONE  
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria[:SElect]?
```

This command determines which of the following threshold criteria is used to prematurely stop the measurement prior to the normal measurement end. In each case, the measurement will terminate no later than 200 ms after the threshold is exceeded.

- Select `FERasure` to end the measurement when the number of erased frames exceeds the specified threshold.
- Select `CIB` to end the measurement when the number of Class Ib errors detected exceeds the specified threshold.
- Select `CII` to end the measurement when the number of Class II errors detected exceeds the specified threshold.
- Select `ANY` to end the measurement when any of the above stop measurement threshold criteria is exceeded.
- Select `NONE` to disable the stop measurement threshold criteria function, so that the measurement runs for the specified number of speech frames.

*RST Value: NONE.

Stop Measurement Threshold Criteria, Frame Erasure

```
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:FERasure <numeric_value>  
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:FERasure?
```

This command specifies the threshold number of erased frames to stop the measurement.

Range: 0 to 1,000,000. If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 120.

Stop Measurement Threshold Criteria, Class Ib Bit Error

```
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CIB <numeric_value>  
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CIB?
```

This command specifies the threshold number of Class Ib errors to stop the measurement.

Range: 0 to 1,000,000. If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 300.

Stop Measurement Threshold Criteria, Class II Bit Error

```
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CII <numeric_value>  
:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CII?
```

This command specifies threshold number of Class II errors to stop the measurement.

Range: 0 to 1,000,000. If an out-of-range value is set, the value will be rounded to either the minimum or maximum limit value.

*RST Value: 300.

Sync Source BCH or TCH

```
:SENSe:BERT:BTS:LOOPback:GSM:SYNC[:SOURce] BCH|TCH  
:SENSe:BERT:BTS:LOOPback:GSM:SYNC[:SOURce]?
```

This command specifies the synchronization source from the BTS under test. The choices are BCH or TCH.

*RST Value: BCH.

Synchronizing to BCH or TCH

```
:SENSe:BERT:BTS:LOOPback:GSM:SYNC:RF
```

This command releases the current synchronization with the BTS and immediately starts to try to synchronize to either a BCH or TCH signal as selected with the `SYNC[:SOURce]` command. This command will also stop the current measurement.

The test equipment can use a BCH signal from the BTS to determine its required transmit timeslot, frame and multiframe timing. The BCH signal is always transmitted in timeslot 0 and contains multiframe information. Use BCH when a BCH subset is present which contains SCH bursts with a properly coded T2 parameter.

Use TCH when providing a TCH/FS training sequence from the BTS. However, only one timeslot from the BTS can be active at a time and you must specify to the receiver which timeslot is being received since it has no absolute reference (unlike a BCH signal, which is always transmitted in timeslot 0).

*RST Value: BCH.

Timeslot Selection

```
:SENSe:BERT:BTS:LOOPback:GSM:MEASurement:TSLot <numeric_value>  
:SENSe:BERT:BTS:LOOPback:GSM:MEASurement:TSLot?
```

This command specifies the timeslot number in which the measurement is to be performed. This command couples the selected timeslot number with the GSM configuration.

The following GSM timeslot configuration conditions will generate error message “-221 Settings conflict”:

- If the specified Timeslot E field fails to designate either MPN9 or MPN15.
- If the specified timeslot is not set to “Normal.”

Changing the timeslot configuration from the GSM menu won't generate error messages under the following conditions:

- No conflict.
- If GSM BERT is Off.
- If the timeslot is Off.
- If the timeslot type is changed, even while the timeslot is On.

Range: 0 to 7.

*RST Value: 0.

Uplink Timing Advance

```
:SENSe:BERT:BTS:LOOPback:GSM:ULINK:OFFSet <numeric_value>  
:SENSe:BERT:BTS:LOOPback:GSM:ULINK:OFFSet?
```

This command specifies the amount of compensation for the insertion of equipment such as fading simulators into the uplink RF path.

Range: -500 to 10,000 bits.

*RST Value: 0.

5 Softkey/Command Cross-Reference

This chapter cross-references the Option 300 softkeys with their corresponding SCPI commands. A similar cross reference exists for other options and the main programming guide includes a cross-reference for the standard signal generator features.

Table 5-1 Softkeys and Their Corresponding SCPI Commands

Key	SCPI Command
BERT Trigger Source	:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce] IMMEDIATE KEY EXT BUS :SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce]?
Bus	:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce] BUS
Class Ib Bit Error	:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CIB <numeric_event> :SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CIB?
Class Ib RBER	:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:CIB <numeric_value> :CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:CIB?
Class II Bit Error	:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CII <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:CII?
Class II RBER	:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:CII <numeric_value> :CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:CII?
Exceeds Any Limits	:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria ANY
Exceeds Any Threshold	:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria ANY
Ext	:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce] EXT
Frame Count	:SENSe:BERT:BTS:LOOPback:GSM:FRAME:COUNT <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:FRAME:COUNT? :SENSe:BERT:BTS:LOOPback:GSM:SFRAME:COUNT <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:SFRAME:COUNT?
Frame Erasure	:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:FERasure <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria:FERasure?
Frame Erasure Ratio	:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:FERasure <numeric_value> :CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria:FERasure?
GSM BERT Off On	:SENSe:BERT:BTS:LOOPback:GSM[:STATE] ON OFF 1 0 :SENSe:BERT:BTS:LOOPback:GSM[:STATE]?
High Amplitude	:SENSe:BERT:BTS:LOOPback:GSM:HAMPLitude <numeric_value> <unit> :SENSe:BERT:BTS:LOOPback:GSM:HAMPLitude?
Immediate	:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce] IMMEDIATE

Key	SCPI Command
Low Amplitude	:SENSe:BERT:BTS:LOOPback:GSM:LAMplitude <numeric_value> <unit> :SENSe:BERT:BTS:LOOPback:GSM:LAMplitude?
Measurement Mode BER% Search	:SENSe:BERT:BTS:LOOPback:GSM:MEASurement[:MODE] BER SSEarch :SENSe:BERT:BTS:LOOPback:GSM:MEASurement[:MODE]?
MPN15	[:SOURce]:SENSe:RADio:GSM:SLOT0 [1] 2 3 4 5 6 7:NORMAL:ENCryption MPN15 [:SOURce]:SENSe:RADio:GSM:SLOT0 [1] 2 3 4 5 6 7:NORMAL:ENCryption?
MPN9	[:SOURce]:SENSe:RADio:GSM:SLOT0 [1] 2 3 4 5 6 7:NORMAL:ENCryption MPN9 [:SOURce]:SENSe:RADio:GSM:SLOT0 [1] 2 3 4 5 6 7:NORMAL:ENCryption?
No Limits	:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria NOLimit
No Thresholds	:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria NONE
Pass Amplitude	:SENSe:BERT:BTS:LOOPback:GSM:PAMplitude <numeric_value> <unit> :SENSe:BERT:BTS:LOOPback:GSM:PAMplitude?
Pass/Fail Limits	:CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria[:SElect] FERasure CIB CII ANY NOLimit :CALCulate:BERT:BTS:LOOPback:GSM:COMParator:CRITeria[:SElect]?
Spectrum Invert Off On	:SENSe:BERT:BTS:LOOPback:GSM:SINvert ON OFF 1 0 :SENSe:BERT:BTS:LOOPback:GSM:SINvert?
Stop Measurement	:SENSe:BERT:BTS:LOOPback:GSM:MEASurement:STOP
Sync Source BCH TCH	:SENSe:BERT:BTS:LOOPback:GSM:SYNC[:SOURce] BCH TCH :SENSe:BERT:BTS:LOOPback:GSM:SYNC[:SOURce]?
Synchronize to BCH/TCH	:SENSe:BERT:BTS:LOOPback:GSM:SYNC:RF
Target %	:SENSe:BERT:BTS:LOOPback:GSM:ESENSitivity <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:ESENSitivity?
Threshold # of Events to Stop	:SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria[:SElect] FERasure CLIB CLII ANY NONE :SENSe:BERT:BTS:LOOPback:GSM:STOP:CRITeria?

Key	SCPI Command
Timeslot #	:SENSe:BERT:BTS:LOOPback:GSM:MEASurement [:TSLot] <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:MEASurement[:TSLot]?
Trigger Key	:SENSe:BERT:BTS:LOOPback:GSM:TRIGger[:SOURce] KEY
Uplink Timing Advance	:SENSe:BERT:BTS:LOOPback:GSM:ULINK:OFFSet <numeric_value> :SENSe:BERT:BTS:LOOPback:GSM:ULINK:OFFSet?

6 Theory of Operation

Look in this chapter for in-depth explanations of loopback base station receiver test functionality.

Synchronization

Synchronizing the test equipment to the base transceiver station (BTS) is a prerequisite to the BTS looping back the selected traffic channel (TCH). This can be achieved in two ways: BCH Sync or TCH Sync.

BCH Sync The BTS is set to transmit to the test equipment a BCH on timeslot 0 of a selected absolute radio frequency channel number (ARFCN). The test equipment uses the BCH signal to determine its required TCH transmit timing.

On completion, the BTS may be switched into loopback mode on any selected ARFCN and timeslot number.

TCH Sync This is a very quick mode of synchronization, but take care initially to set the receiver to the correct timeslot number being transmitted by the BTS.

In this mode the base station must transmit a signal on the selected timeslot prior to data being looped back. In some base stations this will happen as soon as a timeslot is set to loopback, regardless of whether the signal to the BTS has the correct timing. In other base stations, the BTS may need to be set to transmit a signal in the selected timeslot prior to achieving synchronization.

The test equipment can lock to this signal if it contains the correct midamble. Once synchronized, the test equipment uses this information to determine the required TCH transmit timing. If the BTS is set accordingly, any timeslot can be transmitted with the correct timing to enable it to be looped back by the BTS to the receiver (VSA/ESG).

NOTE The TCH sync mode relies on the user to set the correct timeslot number into both ESG transmitter and receiver during synchronization. Thereafter, the ESG can correctly test any timeslot since its relative timing is defined.

NOTE This capability can be used to speed up test of consecutive timeslots in manufacture. TCH sync mode can be used to test all timeslots consecutively without changing a single setting on the ESG/VSA. All that is required is to consecutively loopback each timeslot using the BTS MMI and resynchronize and trigger the ESG.

PN synchronization is also a prerequisite to BER measurements. This is automatic but is dependent on prior BCH or TCH synchronization.

The pattern to be recognized (PN9 or PN15) is determined by the corresponding transmit timeslot pattern selection.

Uplink Timing Advance

Uplink timing advance is set in bits to compensate for any additional delay which might be caused by insertion of equipment (such as a fading simulator) in the uplink path between the test equipment and the BTS.

Erased Frame Detection

When an incorrect CRC in an uplink speech frame is detected by a BTS conforming to the GSM standards, the BTS substitutes an all-zero speech frame.

In the loopback mode, the BTS transmitter then recodes this substituted zero speech frame before transmission back to the test equipment receiver (VSA/ESG).

The ESG receiver detects any coded all-zeros speech frames in the returned downlink signal and increments the (erased) frame event count.

Downlink Errors

The loopback method of measuring BTS receiver BER quality requires a high quality downlink return path which introduces no errors.

To cater for the situation where the downlink path is faulty, the VSA/ESG provides a measure of downlink quality based on TCH payload errors detected by convolutional decoding of the return path. This records errors introduced into the TCH between the downlink coding (BTS transmitter) and decoding (VSA/ESG) processes and should normally be zero. For any payload errors detected during a measurement, the measurement is extended by a speech frame for every downlink error detected.

If a downlink problem results in errors introduced into the downlink midamble, the measurement aborts, providing further security against downlink problems.

GSM Frame Structure

26-frame TCH multiframe structure.

Frames: Frame 12 (SACCH) and frame 25 (idle) empty.

Identical repetitive frames. Content as per ESG GSM capability.

GSM Received Data

The [Table 6-1](#) shows the minimum requirements for the GSM received data frame structure during synchronization to the BTS and during measurements.

Table 6-1 GSM Received Data

During BCH Synchronization	
TS0	51-frame BCH Multiframe Structure
	SCH in frames 1, 11, 21, 31, 41
TS1-7	No SCH, but otherwise, don't care
During TCH Synchronization	
TSX	26-frame TCH Multiframe Structure
	Frame 25 idle
	Frame 12 don't care
	Other frames TCH
During Measurements	
Timeslot under test	26-frame full-rate voice TCH Multiframe Structure
TCH Frames 0-11, 13-24	Content determined by transmitted signal (looped by BTS except for errored speech frames, i.e. speech frames with bad CRC)
Frames 12, 25	Don't care

GSM Transmit Data

The minimum GSM transmit data requirements for the loopback test are a fully GSM-coded 26-channel multiframe with either PN9 or PN15 in the payload. This is selected on the ESG by setting the timeslot under test to normal and selecting the MPN9 or MPN15 multiframe PN pattern.

To meet the GSM standards requirements for full conformance, the adjacent timeslots should be loaded with fully GSM-coded data. The ESG offers full flexibility of loading all timeslots.

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