Agilent 8960 Series
EDGE Handset Test – E1968A

Web Site:
http://www.agilent.com/find/8960

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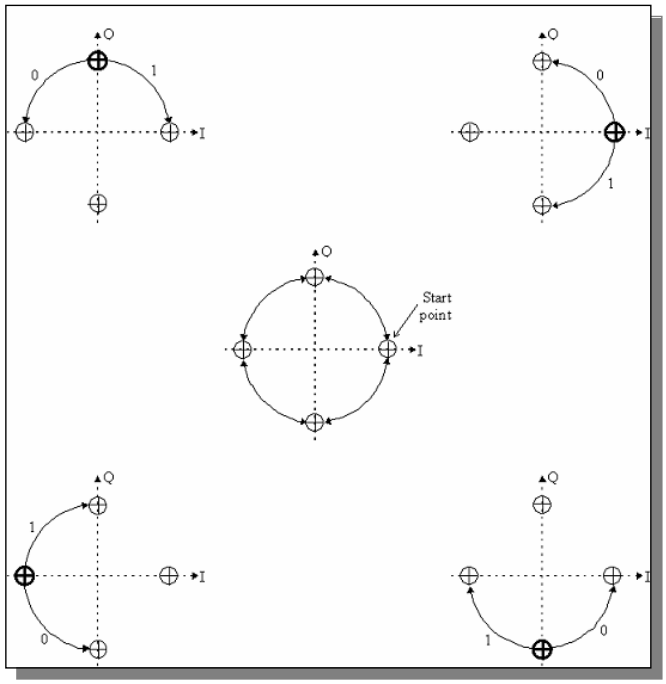
GMSK Modulation Constellations

1. EDGE coding schemes MCS1-4 (this is not the same as GPRS CS1-4)
2. Uses GMSK modulation
3. 1 bit per symbol
4. Constant power trace



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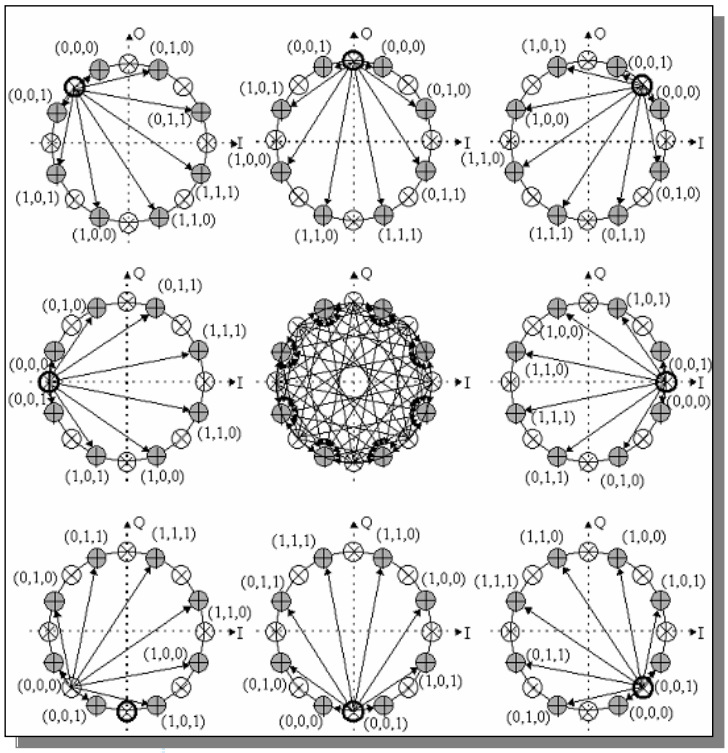
3π/8 8PSK Modulation Constellations

1. EDGE coding schemes MCS5-9
2. Uses 3π/8 8PSK
3. 3 bits per symbol
4. Utilises a 3π/8 rotation every symbol to avoid zero transitions
5. Power trace now varies with symbol transitions



EGPRS Design Considerations

- All of the considerations which previously applied to GPRS also apply to EGPRS.
  - Multi-slot down-link and up-link, faster LO and PLL settling than GSM
  - MIPS – Even faster data rates, Power consumption and Thermal issues
- There are also new or more complex considerations for 8PSK and EGPRS
  - Modulation Quality – EVM/Phase error/Frequency error
  - Amplifier linearity, efficiency
  - Filter changes between GMSK and 8PSK, but (almost same) ORFS emission mask
  - DSP decode algorithm and prediction – has to be more robust, more MIPS (approx. factor of 4), more memory, more data retention (Incremental Redundancy)
  - New user capabilities - graphics acceleration and display – more MIPS
  - Receiver must now demodulate both GMSK and 8PSK, perhaps in contiguous bursts – 8PSK S/N - BER/BLER demodulation challenges

EGPRS RF TEST Considerations

There are also new test considerations for EDGE

- New 8PSK modulation format requires validation
- Modulation Quality – EVM/Phase error/Frequency error
- 8PSK Power measurement changes
- Power Vs Time – New mask definition
- ORFS – More challenging to meet the same specification
- Testing under multiple TX timeslots

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EGPRS RF TEST Considerations

There are also new test considerations for EDGE

- Receiver must now demodulate 8PSK - BER/BLER
- New Test Connection type – SRB
- Possible asymmetric coding schemes
- Some devices will be 8PSK Downlink ,and GMSK uplink
  – how does loop-back BER/BLER operate?
- MIPS, application, memory, network latency, delays, IR protocol complexity
- Testing under multiple timeslots

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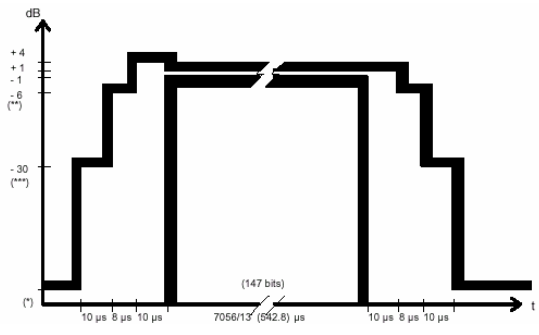
Measurement Comparison

	GSM	EDGE
Output Power over useful part of burst	Not data dependent	Use Random Data
Spectrum due to Modulation	Yes	Different Mask*
Spectrum due to Switching	Yes	Same as MSK
Spurious	Yes	Same as MSK
Power Vs. Time	Yes	Different Mask
Modulation Accuracy	Phase Error: Peak and RMS	EVM: Peak, RMS, 95th% Origin Offset

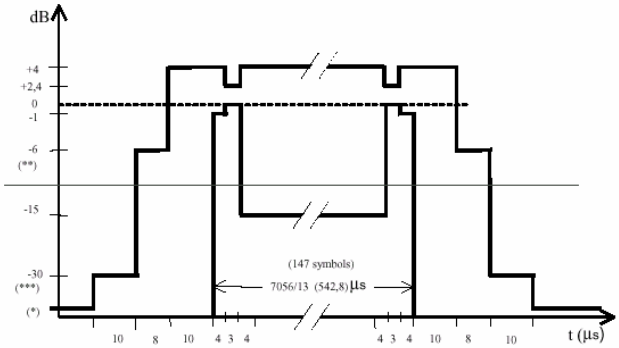
*There is a 4dB change to the 400KHz offset for the ORFS modulation

Power vs. Time Masks for GSM and EDGE

GMSK Mask

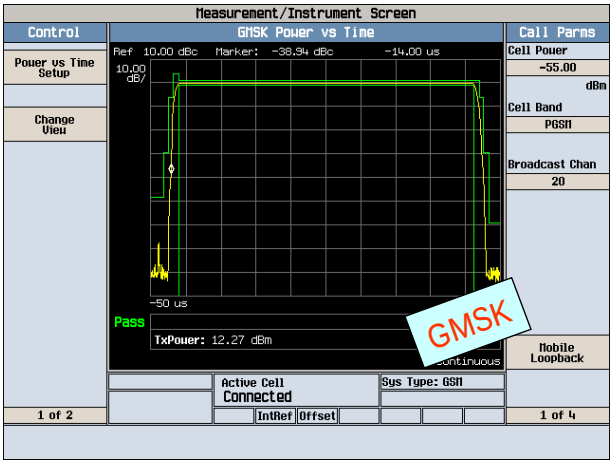


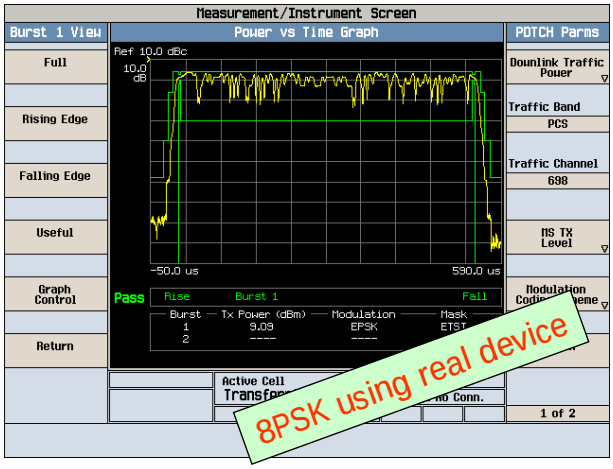
EDGE 8PSK Mask



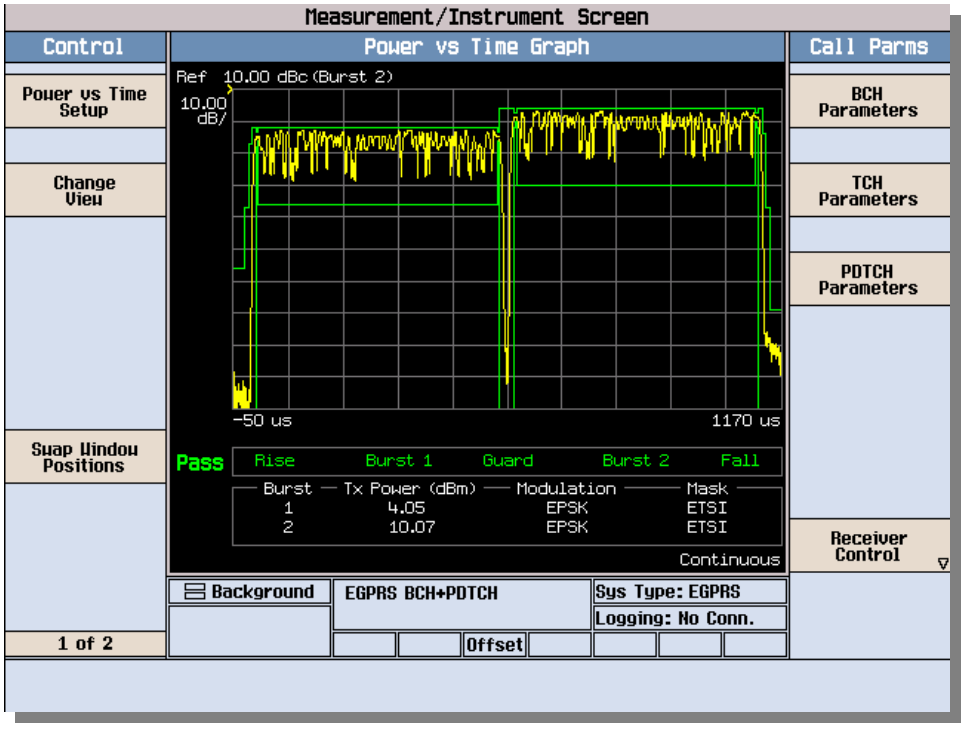
The amplitude modulation in EDGE requires that a different power versus time mask be used.

EDGE Power Vs. Time





8960 EDGE Measurements- Power v.s. Time

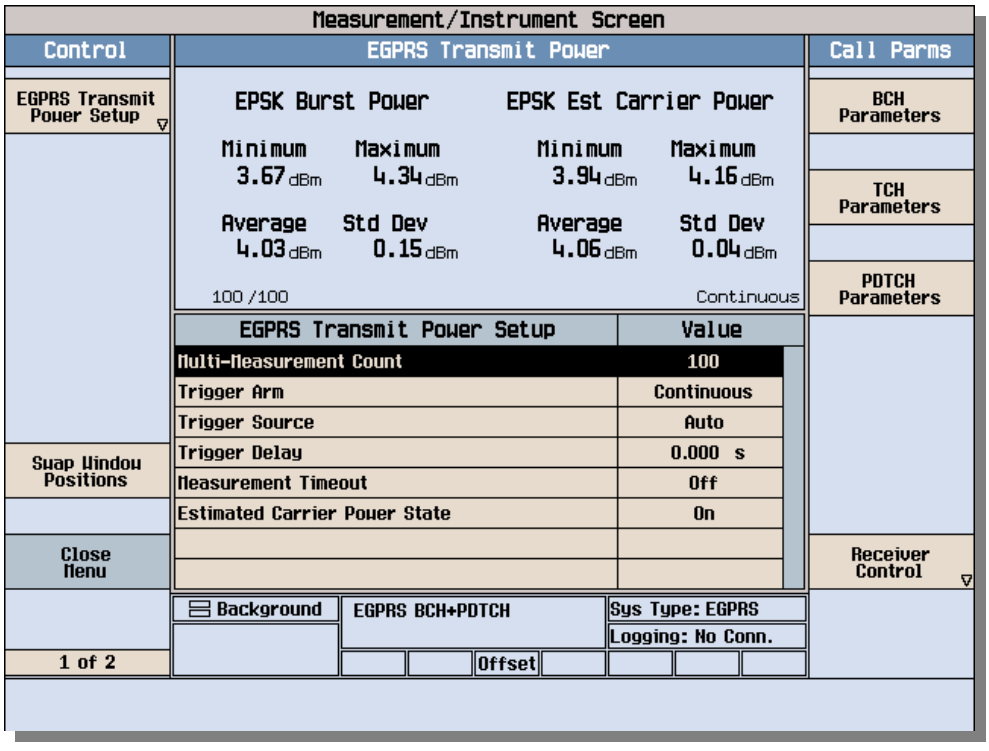


8-PSK Power Measurement

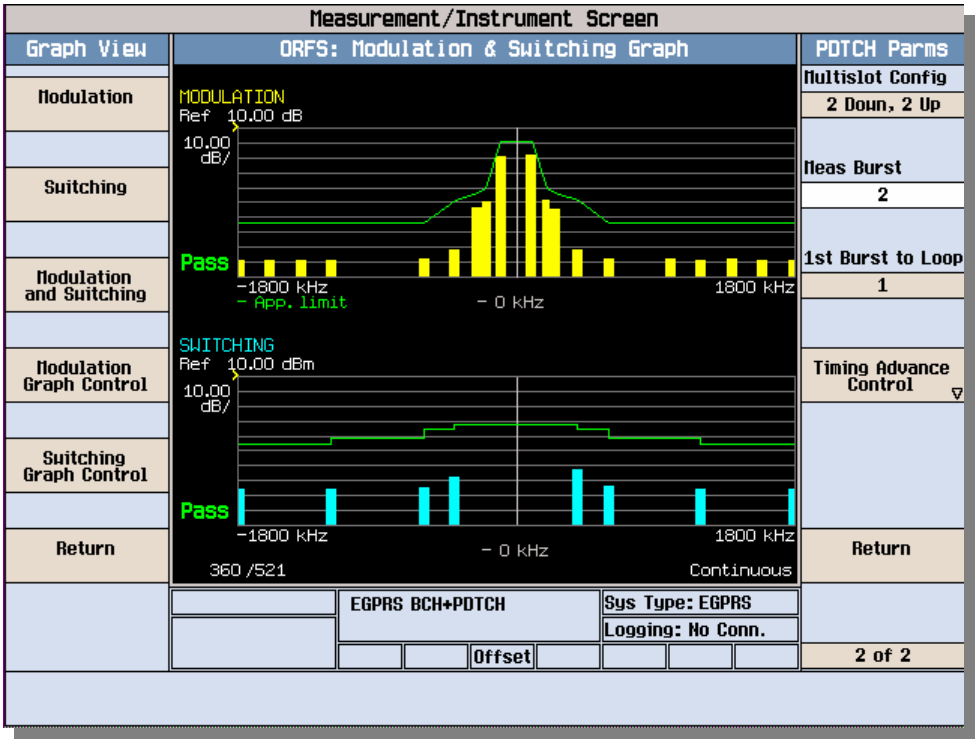
KEY STRENGTH

- 8 PSK instantaneous power depends on the data that is being used to modulate the carrier.
- There is power fluctuations due to the modulation
- Accurate average power measurement requires measuring and averaging at least 16 bursts (standards say 200)
  - ➢ By using the data used to modulate the carrier we can estimate the average power from just a single burst
- Big advantage in production due to vastly reduced test times (patent applied for)

8960 EDGE Measurements- Transmit Power

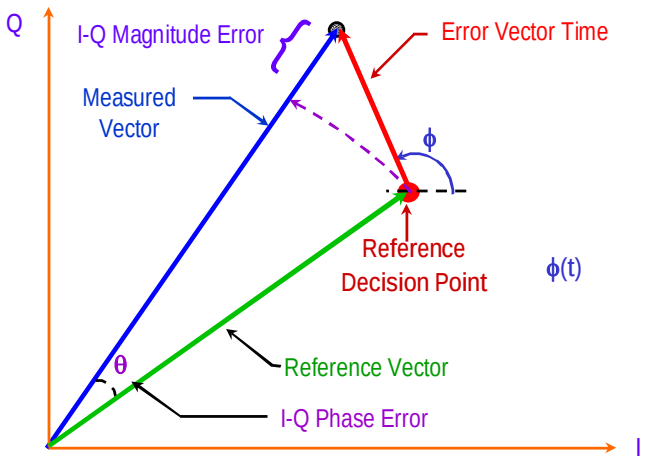


8960 EDGE Measurements- Output RF Spectrum

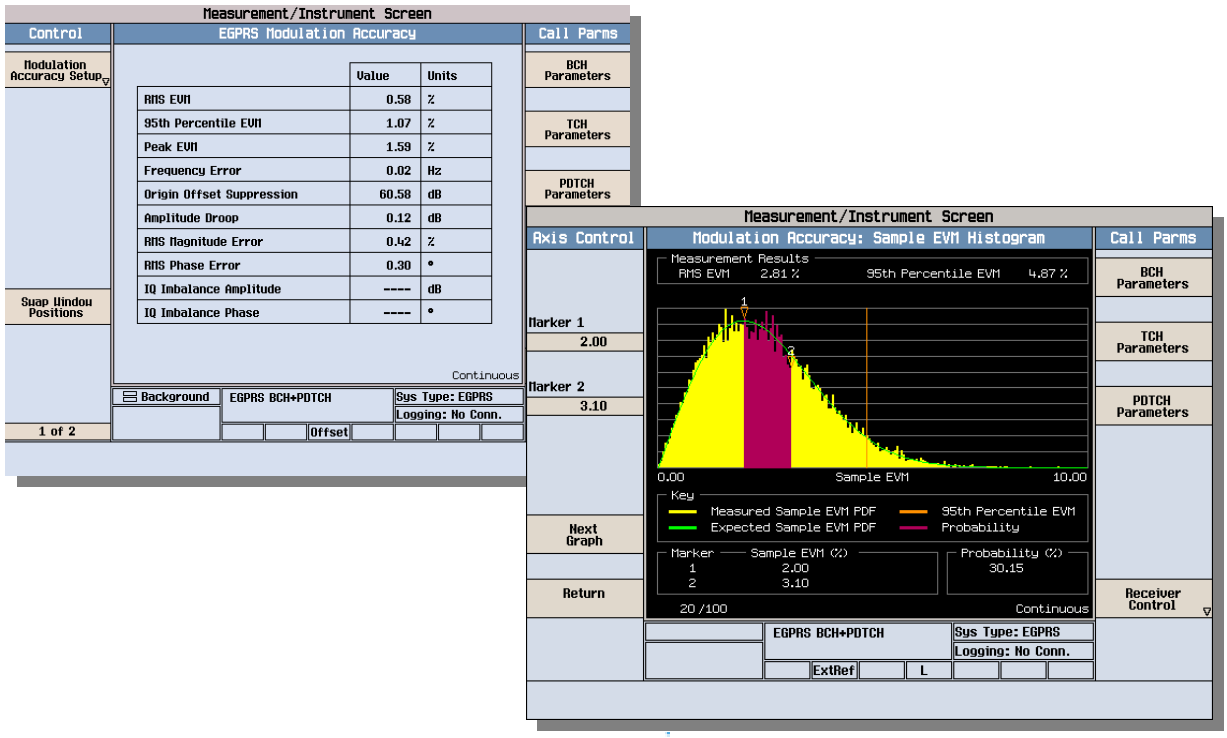


EDGE - Error Vector Magnitude

- RMS EVM≤ 9%
- Peak EVM ≤ 30%
- Origin offset suppression >30 dB
- 95:th-percentile EVM ≤ 15%
- Per burst is measured under the duration of at least 200 bursts.



8960 EDGE Measurements- Modulation Accuracy



What does not include in EVM measurement for modulation accuracy?

- Frequency Error : 0.1ppm<11.10>
- IQ Imbalance:
  - Phase Imbalance
  - Amplitude Imbalance
- Amplitude Droop

Measurements – BER / BLER

Bit Error Rate (BER)

- Instrument sends data to device, device loops back data, sent / received data is compared in instrument and BER calculated

BLER - 2 methods

- BLER Measurement Reports - device is polled and reported ACK / NACK's displayed
- BLER Measurement - BLER is derived from the BER results

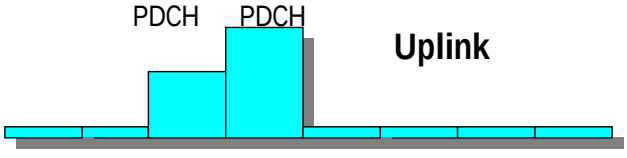
Remember that 8PSK reception Signal / Noise must be 9dB higher than for GMSK
It is necessary to check receiver sensitivity for both formats

Data Connection Type – ETSI Test Mode A

- After mobile has camped to the EGPRS test set, the EGPRS attach process is established. 8960 sends protocol control message forcing mobile to transmit.

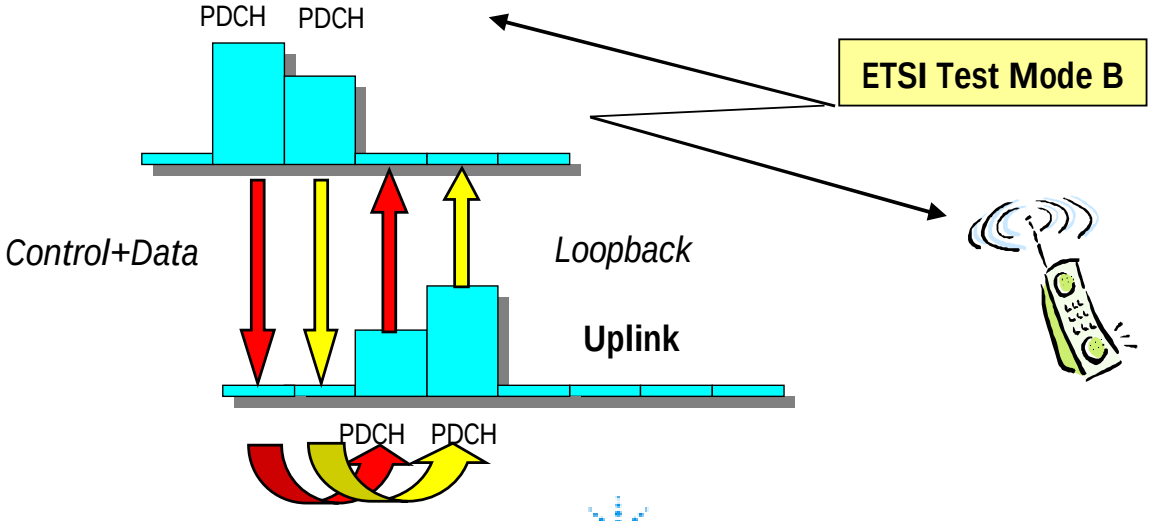
ETSI Test Mode A

- Mobile transmits on the required number of timeslots, modulation and at the required power level.



Data Connection Type – ETSI Test Mode B

Note: The multislot configuration shown here is symmetrical. There can be unequal numbers of downlinks and uplinks.



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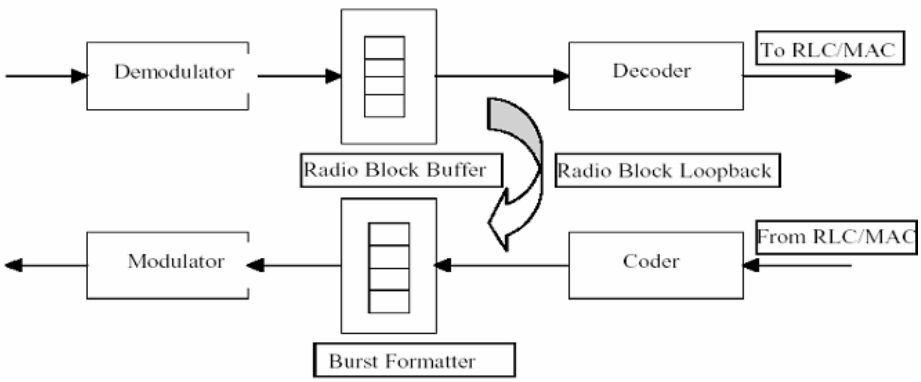
EDGE Receiver Measurements

- The EGPRS Switched Radio Block Loopback mode must be supported by an EGPRS MS.
- It is a Physical RF layer loopback performed before channel decoding designed to support BER testing.

3GPP TS 04.14 V8.4.0 (2002-07), Release 1999, Section 5.5



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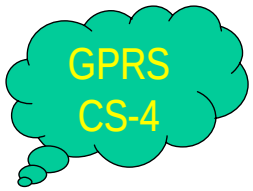
Data Connection Type - SRB

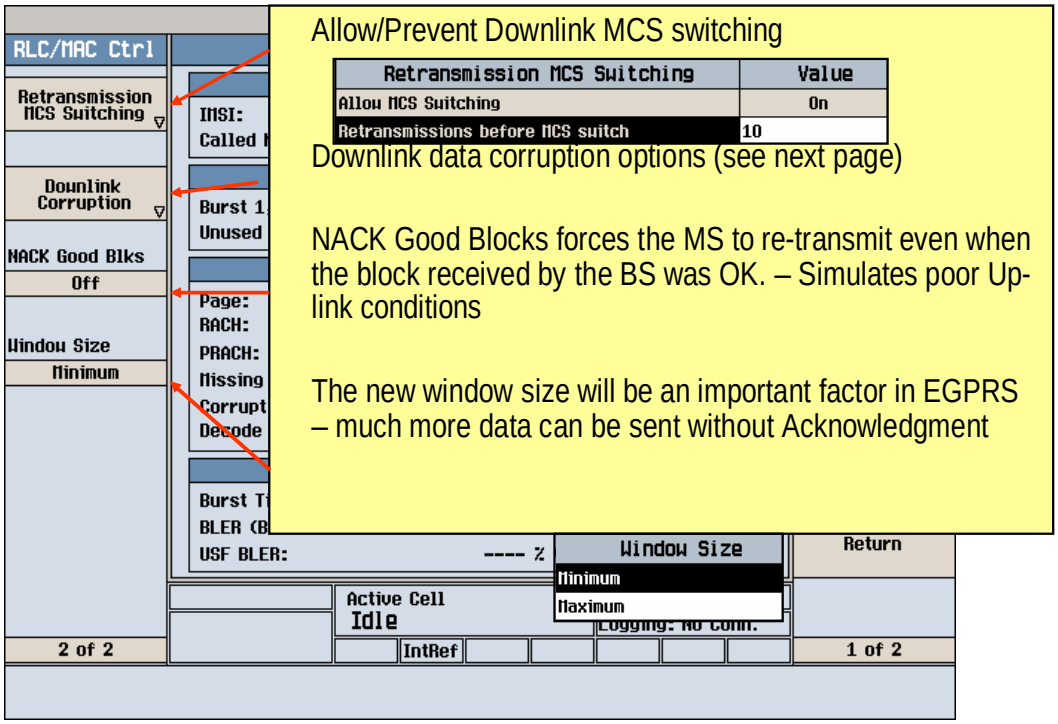


- EGPRS has no “clear-coded” coding Schemes – Even MSC4, 9 have error correction
- Switched Radio Block Loop-back mode (SRB) - Loops back data before decoding – downlink data is sent back on the uplink
- Unlike ETSI test Mode B – no MS interpretation or correction of the raw data
- The preferred EGPRS RF test data connection type
- SRB must be supported by the MS

Agilent’s BLER Mode

- BLER connection type was very helpful for GPRS mobiles which did not support ETSI A or B test modes. It can still be used for EGPRS, BUT the ACK/NACK’s are always transmitted in GMSK.
- BLER can therefore be used for 8PSK demod, BLER tests and GMSK transmitter measurements, but NOT 8PSK Tx Measurements.

The E6704A / E6701C EGPRS LA Solution



Allow/Prevent Downlink MCS switching

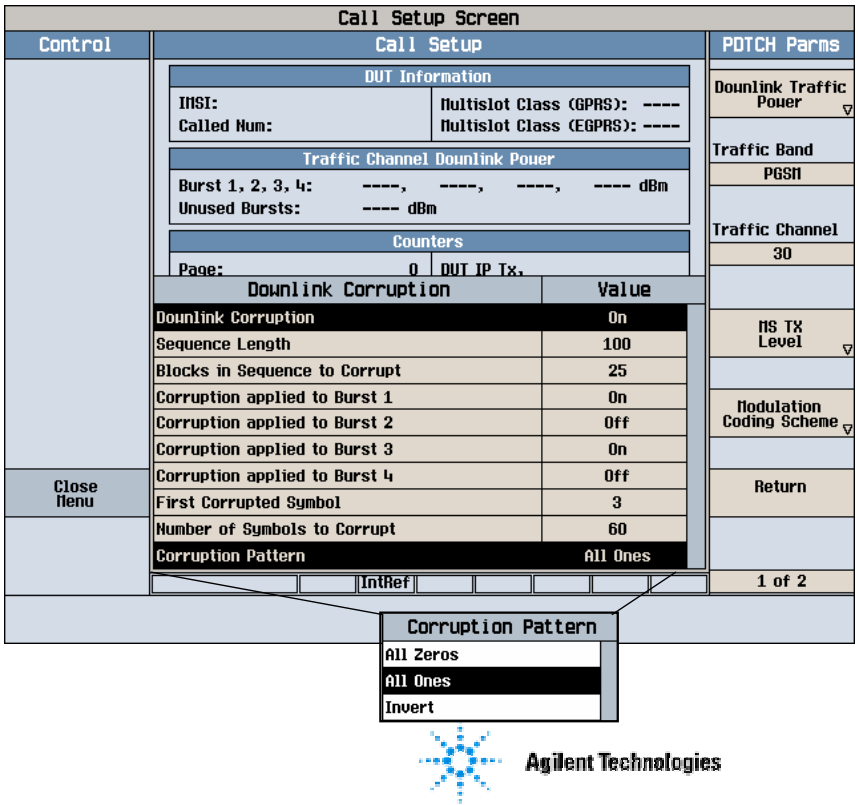
Retransmission MCS Switching	Value
Allow MCS Switching	On
Retransmissions before MCS switch	10

Downlink data corruption options (see next page)

NACK Good Blocks forces the MS to re-transmit even when the block received by the BS was OK. – Simulates poor Up-link conditions

The new window size will be an important factor in EGPRS – much more data can be sent without Acknowledgment

The EGPRS LA Solution – DL Corruption



Downlink Corruption	Value
Downlink Corruption	On
Sequence Length	100
Blocks in Sequence to Corrupt	25
Corruption applied to Burst 1	On
Corruption applied to Burst 2	Off
Corruption applied to Burst 3	On
Corruption applied to Burst 4	Off
First Corrupted Symbol	3
Number of Symbols to Corrupt	60
Corruption Pattern	All Ones

Link Adaptation Test in EGPRS LA

- Networks will switch Modulation Coding Schemes automatically, based on the number of requests for retransmissions and quality reports from the mobile such as the *bit error probability*, is known as *link adaptation*.
- When Incremental Redundancy is switched on - EGPRS LA will provide automatic changes to the Modulation Coding Scheme after a fixed user settable number of re-transmissions (and automatic puncturing scheme cycling)
  - ➢ EGPRS LA will not switch MSC based on BEP or re-transmissions

Retransmission MCS Switching	Value
Allow MCS Switching	On
Retransmissions before MCS switch	10

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EDGE Manufacturing Considerations
-GSM / GPRS / EGPRS Test Strategy

- **Testing GSM only, do not test GPRS / EGPRS**
  - ✓ There are many changes in physical layers in GPRS.
    (e.g. PLL / LO timing, 2 uplink PvT testing, Block Error Rate.....)
- **Testing GSM & GPRS & EGPRS in 2 separate testers**
  - ✓ Waste of handling time, power on / off & camping time,.....
  - ✓ GSM & EGPRS testings are very similar.
- **Combination GSM & EGPRS testing together, *NO GPRS testing required***
  - ✓ Saving the overall testing time
  - ✓ Testing the switching between GSM (Voice) & EGPRS (data)
  - ✓ **EGPRS will cover GPRS testing.**

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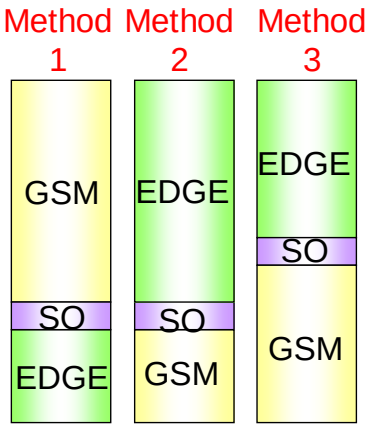
EDGE Manufacturing Considerations
-GSM / EGPRS Test Strategy

- **Combination GSM & EGPRS testing together**
  - ✓ Target Test time = 1.5X (comparing with existing GSM test plan)
- **Different Testing Strategies**
  - ✓ GSM (Major test) + EGPRS (Minor)
  - ✓ EGPRS (Major test) + GSM (minor)
  - ✓ GSM (50%) + EGPRS (50%)
- **Different Testing conditions**

  New EGPRS testing items
  - ✓ Slot Configurations: 1x1, 2x1,3x1, 4x1, 2x2, 3x2
  - ✓ Modulation Coding Scheme: MCS1-4 (GMSK)
  - ✓ MCS5-9 (8PSK)
  - ✓ Uplink & Downlink MCS BLER testing.



SO= Switching Over

EDGE Manufacturing Considerations
-GSM / GPRS Test Strategy

- **Typical GSM Test plan**

  Under dual-band or tri-band mode
  - ✓ Lower Channel : TX + RX tests
  - ✓ Middle Channel: Major TX tests
  - ✓ Upper Channel: TX + RX tests
- **When designing a Combined GSM / EDGE testing:**
  - ✓ EGPRS can cover most of TX tests in GSM
  - ✓ GSM is under 1x1.
  - ✓ New MCS testing requirement
  - ✓ New Modulation Accuracy testing requirement