Application Note

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Evaluating and Operating the IFR 3901 - a guide for existing users of the IFR 2968 TETRA Radio Test Set

The new IFR 3901 Digital Radio Test Set is the successor to the industry standard IFR 2968 for testing TETRA mobiles and base stations. This application note explains the differences in operation for those already familiar with using the IFR 2968 and provides a summary comparison of the two test sets.

Introduction

The IFR 2968 TETRA Radio Test Set has established itself as the industry standard for testing TETRA mobiles and base stations. The IFR 3901 Digital Radio Test Set is a new design that offers numerous incremental improvements over the 2968 in terms of performance and capability. Ease of use has been improved through a completely new graphical user interface; consequently there are significant differences in the operation of the two test sets. This application note is intended to inform existing 2968 users of the benefits of the 3901 over their current 2968s, and to provide a guide to the differences in operation. Further details can be found in the following Aeroflex publications:

· 46891-171 IFR 3900 Series data sheet

· 46891-931 Application Note 'Testing TETRA mobiles with the IFR 3901'

· 46891-932 Application Note 'IFR 3901 Frequently Asked Questions'

Quick Summary

· Smaller, lighter, more rugged platform

· Color display with simplified Graphical User Interface

· Better RF performance including 0dBm output and -90dBm input

· Faster, more accurate measurements including 70dB power profile

· Enhanced call processing capabilities including Protocol History

· Enhanced T1 test mode capabilities for mobiles and base stations

· Hard Disk internal storage plus Ethernet and USB connections

Annex A of this application note provides a detailed comparison table for the 3901 and the 2968.

The IFR 3901 platform

The IFR 3901 is Aeroflex's new Digital Radio Test Set platform for TETRA and other Professional Mobile Radio (PMR) systems that may be supported in the future. The IFR 3901 is smaller, lighter and more portable than the IFR 2968. Instead of protruding feet, sturdy rubber bumpers front and rear protect the unit in transit and allow it to be stood on its rear end for base station testing. The new bail arm is larger than on the 2968, allowing a greater tilt angle on a bench and the hand grip is more comfortable for carrying. The 3901 is supplied with a protective cover for the front panel.

RF connections

The 2968 has a high power N-type port and a low power TNC port, either of which can be used in a simplex or duplex configuration. The IFR 3901 has three RF ports on the front panel - one N-type and two TNC. The high power N-type "T/R" (Transmit / Receive) port is similar to the 2968's N-type port, operating in duplex or simplex, and will be the main port used for most testing. The TNC ports provide separate simplex "GEN" (Generator) and "ANT" (Antenna) connections. The GEN port provides a higher maximum output level of 0 dBm for a TETRA signal, compared to maximum -20 dBm from the 2968 TNC port in simplex configuration. The ANT port provides a more sensitive input for receiving off-air signals, typically providing reliable demodulation of TETRA signals down to -90 dBm compared to -75 dBm on the 2968. There is no hard key for RF port selection, which is controlled by the [RF In] and [RF Out] softkeys in the 'RF Settings' and 'Control' tiles.

I/O connections

GPIB (IEEE-488), VGA external monitor / projector, parallel printer, serial (RS232) and EXT REF I/O (frequency standard external reference) connections are provided on both the 2968 and 3901 (RS232 is currently unused on the 3901). Additionally the 3901 provides USB sockets for connection of an optional external keyboard (also PS/2), mouse, printer, CD-ROM and memory stick (a.k.a. a "jump drive"). An Ethernet connection allows remote operation over a network. The 3901 has three connections in place of the 2968's rear panel 25-way D-type accessory socket. A dedicated BNC SYNC I/O socket provides synchronization input or output to external devices, providing the synchronization pulse input for TETRA base station testing. Front panel connections include a 15-way D-type TEST PORT for future interfacing to devices under test and an 8-way DIN MIC / ACC (microphone / accessory) socket.

New graphical user interface

The 2968 has a monochrome CRT display and a front panel containing 46 hardkeys and 22 softkeys. The 3901 has a color LCD display and a simplified front panel containing 29 hardkeys and 6 softkeys. The 3901 does not have the 2968's dedicated front panel rotary knob for INTENSITY - display brightness is adjusted by the main variable knob after pressing the adjacent ASSIGN key. The 2968's 'COPY' key (screen hold / print) is renamed 'HOLD' on the 3901.

The look-and-feel of the 3901 user interface is generally similar to Windows, so the principles of operation are easily understood. Instead of pressing a series of keys to enter a parameter, e.g. [RF] [GEN] [LEVEL], cursor keys are used to navigate to the parameter displayed on the screen. Alternatively, a USB mouse can be used to point-and-click directly.

In place of the 2968's 8 'MODE' hardkeys and 13 'FUNCTION' hardkeys the 3901 has 3 main keys to drive the operation: TEST, CONFIG and UTILS.

TEST provides access to all testing functions and it acts as a return from the CONFIG or UTILS functions. When pressed within TEST it provides a 'floating menu' of other test functions (Manual - Tiled, Data Demod, Spectrum Analyzer).

CONFIG provides access to all configuration settings specific to the currently selected system. When pressed within CONFIG it provides a 'floating menu' of other configuration screens. It is also the means by which to switch systems.

UTILS provides access to all utility functions common to the test set platform. The Store / Recall function within UTILS replaces the 2968's STORE and RECALL hardkeys.

TEST, CONFIG and UTILS can also be selected by right-clicking with a mouse.

The 'TEST: Manual - Tiled' display is divided into a series of 'tiles' that contain logical groupings of settings and / or measurements. Tiles can easily be configured to show the information of interest. Each tile can be maximized to show larger graphical displays and additional detail. The TAB key (or a mouse) is used to select the 'focus' on a particular tile, shown by a Windows-like blue title bar. Cursor navigation is within the current tile and the softkeys that are displayed are relevant to the current tile. All operations can be performed either from the front panel or with a mouse.

As with the 2968, the 3901 display can be output to an external monitor or projector via the VGA port. However, on the 3901 the VGA output is not permanently enabled - the monitor or projector must be connected before powering on the 3901 to enable the VGA output. The 3901 graphical user interface can also be reproduced on a PC for remote operation using a 'VNC Viewer' application on the PC. The PC screen reproduces the 3901 display, and the 3901 is controlled by the PC's mouse and / or keyboard. The 3901 and the PC need to be connected to a network via the 3901's Ethernet port; alternatively a direct connection can be made between the PC and the 3901 using a cross-over Ethernet cable.

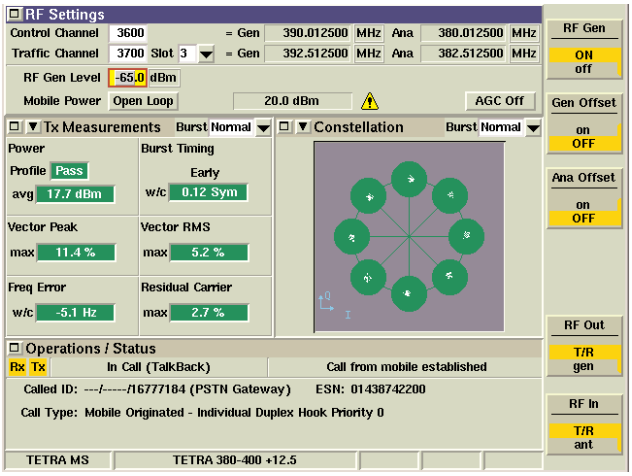

Figure 1 - 3901 TETRA MS system Manual Tiled display

RF Settings simplified

The 2968 user interface is split between protocol operations (Systems mode) and detailed measurement displays (Digital Duplex mode), using channel numbers in the Systems mode and frequencies in the Digital Duplex mode. The 3901 eliminates this split - the 'TEST: Manual - Tiled' display allows RF settings, numerical measurements, detailed graphical displays and protocol operations to be performed simultaneously on the same screen. The 3901 always shows the actual Rx and Tx frequencies when working with channel numbers and the equivalent channel number when working with frequencies.

The 3901 rotary knob can be scaled for faster variable control, e.g. to change frequencies in steps of 10 kHz rather than 1 Hz, or to change levels in steps of 10 dB rather than 0.1 dB. The cursor keys can be used as increment / decrement controls in place of the 2968's dedicated frequency and level increment keys.

The 2968 and 3901 both provide offsets for RF input and output levels; the 3901 has an easy-to-find Offsets configuration menu, and once the values have been set up, RF Generator and Analyzer level offsets can be enabled and disabled by softkeys in the TEST screen.

Simplified Channel Plans

The 2968 uses slightly cryptic names for channel plans, limited by the space on a softkey, e.g. "TETRA 380 MS" (including 12.5 kHz offset) or "TETRA 380+0MS" (0Hz offset). The 3901 uses longer more meaningful names for pre-defined channel plans, e.g. "TETRA 380-400 +12.5" or "TETRA 380-400 ZERO". For systems not covered by the pre-defined plans, a single user-defined channel plan can be created on the 2968; multiple user-defined channel plans can be created and stored on the 3901 by copying and editing existing plans. RF and system information parameters are displayed for all plans, pre-defined and user-defined, and the channel plans are available to all TETRA systems. The RF parameters are defined in terms of the downlink (BS Tx) frequencies, in line with the ETSI specification, which makes definition simpler than with the 2968's use of the uplink (MS Tx) frequencies.

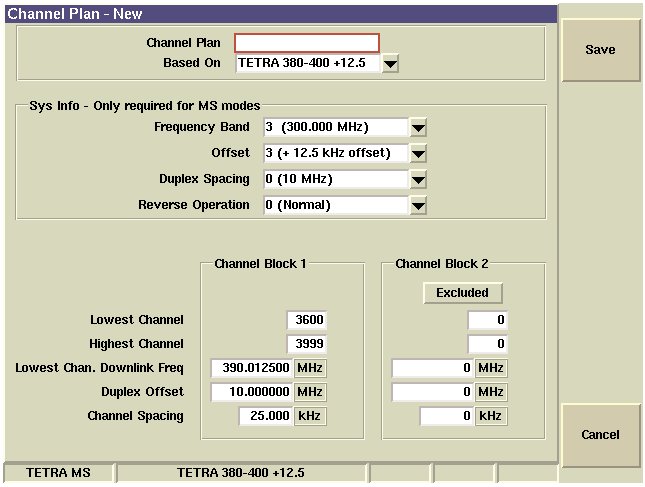

Figure 2 - Creating a new user-defined channel plan

Enhanced Transmitter Measurements

The 3901 offers a nine-fold improvement in measurement speed over the 2968, which is particularly useful when making conformance type measurements of the average or worst case condition over a number of bursts. For ETSI specification tests, 200 bursts can be measured in less than 30s, compared to nearly four minutes on the 2968. A progress bar is displayed under each measurement during accumulation of the bursts.

The number of bursts for each measurement type is set up in the 3901 maximized Tx Measurements tile rather than the 2968 HELP / SET-UP menu. The maximized tile shows maximum, minimum, worst case and average measurements simultaneously without increasing the measurement time. Barcharts with limit indications are also displayed on this tile.

The 3901's color display provides optional limit checking for measurements in manual test mode - green if within limits or red

if limits are exceeded. Additionally, power measurements are color-coded red if too high, blue if too low and yellow is used when accumulating a number of bursts for measurement averaging. Clear bright yellow icons are used to warn when level offsets are applied and when limits are exceeded.

As with the 2968, six different graphical display types are provided for modulation accuracy measurements but the 3901 displays are enhanced by the use of color and by being available in the main TEST screen. All of the graphical displays provide a color-coded 'accumulate' option, with previous traces in a background color and the 'live' trace in a foreground color. The user-definable limit for modulation accuracy (peak vector error) is reflected in the graphical displays - limit circles in the constellation and rotated vector displays; limit lines in the vector error, phase error and magnitude error displays.

The 2968 provides a 're-start measure' function, which can be used to re-start accumulation of a number of burst measurements after allowing time for adjustments by the device under test; measurement continues when accumulation is complete as there is no 'single shot' facility. The 3901 provides the option of starting or re-starting continuous or single shot transmitter measurements, for example to measure 200 bursts and stop for a conformance type test. An icon in the title bar of the measurement tile warns that the measurements are not updating.

With the 2968 it is possible to mix numerical Tx measurements from different burst types, e.g. Normal Uplink Burst / Control Burst for mobiles or Normal Downlink Burst / Sync Burst for base stations. This mixed measurement can disrupt the accumulation of multiple bursts of a single type. The 3901 separates measurements from different burst types so that when the burst type is set to Normal it will not measure Control bursts or Sync bursts. However, with the 3901 it is possible to measure two different burst types simultaneously by selecting both measurement tiles to be 'Tx Measurements' but with different burst types. Alternatively, for base station testing, selecting burst type 'PRBS' will measure any signal.

Configuration simplified

Some configuration parameters on the 2968 are located in nested menus four or five levels deep under either the Systems SET-UP menu or the main HELP / SET-UP menu. The 3901 places configuration under a dedicated CONFIG key with a logical structure. A single key press switches between configuration (CONFIG key) and testing (TEST key) and the 3901 remembers the last-used configuration screen and parameter. Navigation by cursor keys or mouse simplifies parameter entry. A second press of the CONFIG key brings up a 'floating menu' to select different configuration menus.

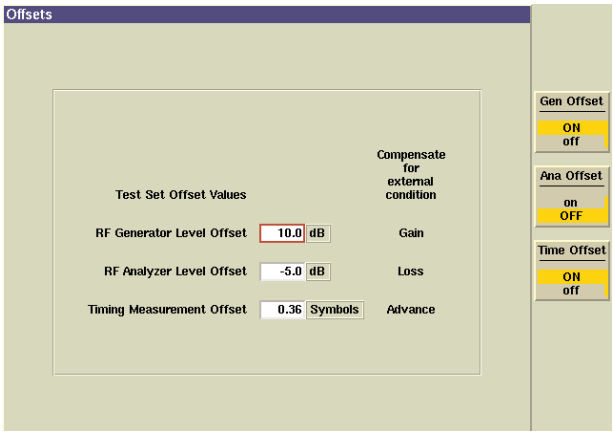

Figure 3 - CONFIG: Offsets tile

TETRA MS testing: Call Processing Enhancements

The 2968 has to be in Systems mode to handle protocol operations, such as setting up or clearing down calls; these are not supported when in Digital Duplex mode for displaying graphical measurements such as power profile or constellation display. The 3901 always supports protocol operations regardless of what it is displaying, so you can for example set up and clear down calls or press and release the PTT while viewing a maximized power profile display. Thus the 3901 call processing is more robust as it does not ignore mobile signaling when displaying graphical measurements.

The 3901 can perform 'handoff' to a different traffic channel during a duplex call without needing to clear down the call, for mobiles that support this operation, allowing the mobile's performance to be tested at different frequencies.

The 3901 implements the Fast Associated Control Channel (FACCH) for proper simulation of message trunking and quasi-transmission trunking during the quiet periods of simplex calls. The test set transmission (mobile Rx) periods in simplex calls can be controlled manually as well as under automatic timer control.

For mobile originated calls (from the mobile to the test set), the 2968 always answers the call automatically with no delay. The 3901 provides a user-defined wait time before answering the call, for better simulation of real conditions, so that the 'called party alerting' tone can be checked in the mobile. Alternatively, the test set can accept or reject or not answer the call under manual control. Immediate automatic answer is still possible by setting a zero wait time.

For mobile terminated calls (from the test set to the mobile), the 3901 simplifies the configuration by allowing entry and display of parameters such as Calling Party SSI in decimal or hex, or by selecting from a list of pre-defined values. The 3901 does not require you to remember, for example, the SSI address for 'PSTN Gateway'. You can configure the 3901 to wait for a user-defined period and automatically abort the call setup if the call is not answered on the mobile. This simulates the calling party hanging up and checks the 'missed call' indication on the mobile; you can also abort the call setup manually. Note: to initiate protocol operations from the test set (call mobile, clear down, send message, etc.), focus on the 'Operations / Status' tile to make available the relevant soft keys.

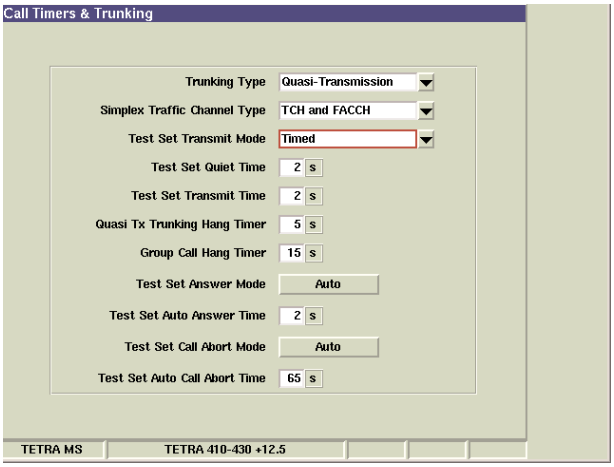

Figure 4 - CONFIG: Call Timers & Trunking tile

As with the 2968, it may be inadvisable to use some system parameter values in normal testing. On the 3901, warning triangles are shown if parameters such as Base Color Code or Base Services flags are set to non-standard values that may cause terminals to not function with the test set.

Some mobiles send 'MM-Status' messages to indicate e.g. group scanning on / off or entering Direct Mode; these are ignored by the 2968 and displayed by the 3901.

Registration, call setup, call maintenance and messaging operations typically produce many indications of call state and parameters in quick succession that overwrite previous indications. The 3901 provides a 'Protocol History' facility that records and timestamps all of the indications and parameters relating to operations performed by the mobile and the test set. Not only does this avoid the loss of information, it also allows for checking of the mobile configuration with respect to call setup parameters, operation of timers and message parameters. Up to 1000 lines can be recorded and saved to the internal hard disk. The history can be exported to a PC as a text file via USB memory or floppy disk.

TETRA MS testing: Enhanced messaging capability

The 2968 provides extensive support for status and SDS messages. The 3901 builds on this with a number of minor enhancements as well as providing support for user defined SDS-TL applications via the 'SDS-TL Other Messages' facility. Each message type has its own separate parameters for full flexibility. Status values and Calling Party SSI values can be entered in hex, in decimal, or selected from a list of pre-defined values. All message types have the option of including a Calling Party ESN value.

SDS-TL text messages on the 3901 provide the option of using standard reports as well as short reports. Three pre-defined messages of different lengths are provided and you can also enter your own messages using either the front panel numeric keypad or an optional external keyboard. If you enter your own text message, you can revert to one of the pre-defined messages at the press of a softkey. For mobile originated status or SDS messages, green or yellow envelope icons appear on the title bar of the Operations / Status tile. Selecting these icons produces a pop-up display of the full message content complete with all associated parameters and this information is, of course, recorded in full in the Protocol History tile.

The 'SDS-TL Other Messages' facility provides for sending and receiving SDS-TL messages with any Protocol Identifier, not just text messages. You provide the application message content as hex data and the associated protocol identifier; the 3901 takes care of the SDS-TL (Transport Layer) headers, message numbers, delivery reports and associated protocol. Standardized protocol identifiers can be selected from a drop down list or any value can be entered in hex or decimal. Typical applications could include GPS location reporting or Radio User Assignment (RUA) officer log-on procedures.

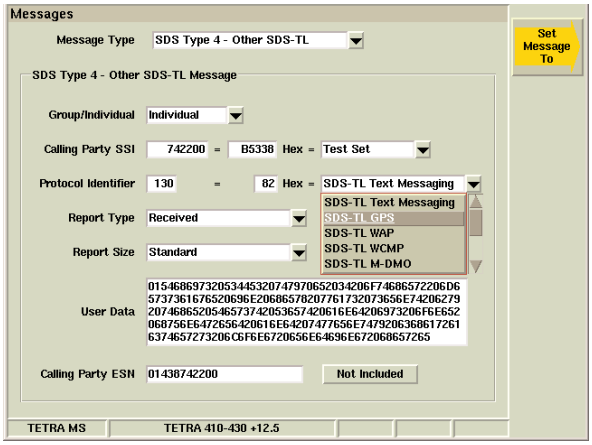

Figure 5 - CONFIG: Messages: SDS Type 4 - Other SDS-TL tile

When used with remote control, the 3901 is effectively an 'RF modem' for testing the development of user applications using SDS. The user application sends and receives data over the PEI to and from the terminal, which sends and receives SDS-TL messages over the air interface to and from the 3901, which sends and receives data over the remote control interface to and from the other end of the user application.

TETRA MS testing: Data Demod capability

The 2968 DATA display can capture a single transmitted burst at random, showing the raw demodulated burst content and the channel decoded form. The 3901's TEST - Data Demod screen can capture and display up to 5000 bursts. The data capture can be set to operate in the background, capturing every transmission by the mobile while you perform protocol and call processing operations. The extensive capture capacity means that signaling and traffic channel data can be captured during calls for up to five minutes without loss of data. Every burst is identified with the timeslot, frame and multiframe number in which it occurred, as well as a timestamp.

TETRA MS testing: Enhanced Power Profile Display

The 2968 provides a power profile display for a single burst; the level ranges are fixed as either +10 dBc to -40 dBc or +9 dBc to -6 dBc. The mask limits are fixed at the ETSI values. The 3901 Power Profile display is a significant improvement on the 2968. The full dynamic range of the burst power profile is displayed, enabling measurement of non-active power better than -70 dBc.

Both the top-of-screen reference level and the vertical scale can be configured over a wide range, enabling close inspection of the active or non-active power behavior. The displayed profile can be averaged over up to 250 bursts, enabling conformance type measurements to be performed. The levels for the profile mask can be configured, in terms of absolute level (dBm) as well as relative level (dBc) and these mask limit levels are shown on the graphical display.

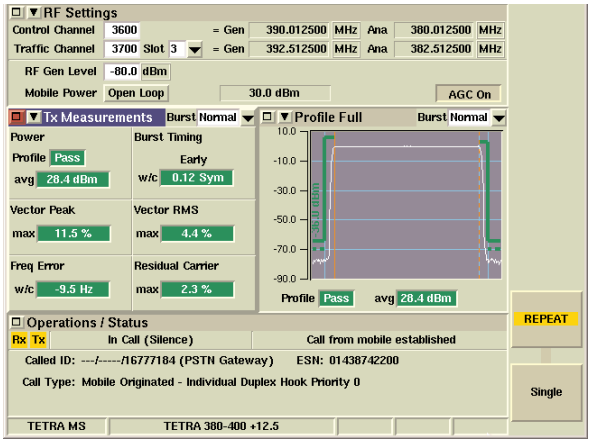

Figure 6 - Manual Tiled display including 70 dB Power Profile tile (minimized)

TETRA MS testing: Enhanced TT Loopback receiver measurements

As with the 2968, the 3901 supports TT test mode registration and TT loopback for performing receiver BER / MER / RBER measurements on the speech traffic channel during a duplex call. The 3901 maximized Rx Measurements tile additionally provides a running total of the number of bits or messages in error and the total number of bits or messages. This tile also provides the setting for the number of bits or messages over which to average the measurement, and the time required (these are under the 2968 HELP / SET-UP menu). The 3901 also provides the option of continuous or single shot receiver measurements.

New separate TETRA MS T1 system for T1 test mode

When testing a mobile in T1 test mode, the 2968 and 3901 generate T1 test signals but do not perform any protocol operations. A subset of the System Information parameters is used in the T1 test signals and these may need to be different values from those used for normal trunked mode testing. In the 2968, T1 test mode is accessed as a setting within the TETRA MS system. In the 3901, T1 test mode is provided as a separate system with its own parameters, only including those parameters that are relevant to T1 test mode.

The test screen layout is optimized for T1 test mode, providing an enlarged tile for RF Settings and MS Control instead of the Operations / Status tile for protocol actions. In T1 test mode, the mobile power level can be controlled directly by the 'Tx Power Max Cell' parameter and the 3901 allows this parameter to be changed on the 'Control' tile.

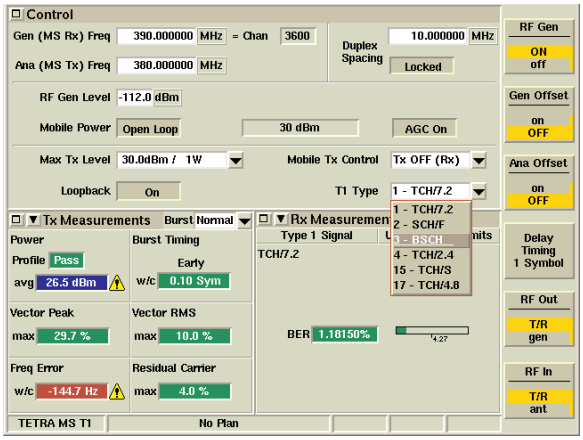

Figure 7 - TETRA MS T1 system screen layout

The 2968 generates three types of T1 test signals - Type 1 (TCH/7.2), Type 2 (SCH/F) and Type 4 (TCH/2.4). In addition to these, the 3901 also generates Type 3 (BSCH + SCH/HD), Type 15 (TCH/S) and Type 17 (TCH/4.8). The 2968 measures Bit Error Rate (BER) on the loopback T1 Type 1 (TCH/7.2) signal only. The 3901 performs BER measurement on all six loopback T1 signals. Additionally, both Message Erasure Rate (MER) and Probability of Undetected Erroneous Message (PUEM) are measured for logical channels SCH/F, BSCH, SCH/HD, TCH/S and AACH, enabling conformance type receiver measurements.

The 3901 maximized Rx Measurements tile shows numbers of bit and message errors and allows the sample sizes to be set (these are under the 2968 HELP / SET-UP menu). Measurements can be performed on a single shot or continuous rolling average basis over the specified numbers of samples (bits or messages).

MS timing measurements

The 3901 simplifies the measurement of worst case timing error (ETSI frame alignment test) when performed with an external fading simulator that has a significant end-to-end delay. A user-defined timing offset allows any external timing delay to be compensated for prior to the worst case accumulation so that the measurement is made correctly within the test set. This offset can also allow for any intentional timing advance by the mobile.

Enhanced Base Station test capability

There is no split between 'Systems mode' and 'Digital Duplex mode' - the single 'TEST: Manual - Tiled' screen combines RF Settings, Base Station identity information, transmitter measurements and graphical displays. The RF Analyzer frequency can be set to the Base Station transmitter frequency using either channel numbers or explicit frequencies (if channel plan 'No Plan' is selected). When using a channel number the 3901 shows the actual frequency; when using explicit frequencies the 3901 shows the nearest equivalent channel number.

The 2968 allows base station measurements to be selective according to burst type: 'Normal Burst TS1 & TS2', 'Normal Burst TS1 only' or 'Sync Burst'; no measurements are made on signals if they do not contain bursts with a valid TETRA Training Sequence. The 3901 additionally provides selection of 'Normal Burst TS2 only' and 'PRBS', which allows any signal to be measured even if

no training sequence is found. Transmitter measurements can be subject to simultaneous average, max, min and worst case accumulation over multiple bursts, repetitive or single shot, with user-definable limits and color-coded measurements.

The 2968 DATA screen provides a random capture of a single burst, which is demodulated and channel decoded. The 3901 'TEST: Data Demod' screen expands this capability to 5000 bursts, sufficient to capture over 70s of the Base Station transmission on all four timeslots continuously, covering more than an entire hyperframe. Every burst is captured, demodulated and channel decoded, including the important Access Assignment Channel (AACH). Any erroneous data is shown in red, such as incorrect training sequences or failed channel decoding. Each burst is tagged with the slot, frame and multiframe in which it occurred, as well as an elapsed time stamp. The superior off-air sensitivity of the 3901 Antenna port is a further benefit for capturing data from a live system.

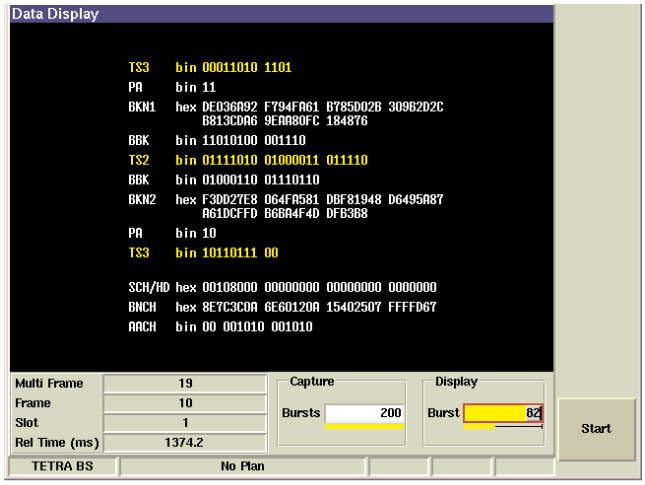

Figure 8 - TETRA BS system Data Demod display

New TETRA BS T1 System for T1 test mode

The 2968 provides T1 test mode capability as a subset of the 'TETRA base station' test system. In the 3901, 'TETRA BS T1' is provided as a separate system in its own right, with its own parameters and a user interface optimized for testing in this mode. Typically this is used during manufacturing, commissioning or conformance type testing, before the base station is operational, with the base station configured in a test mode (e.g. the ETSI T1 test mode). The base station Tx and Rx frequencies can be specified in terms of either a channel number or explicit frequencies, with the equivalent frequencies or channel number also shown. When working in explicit frequencies, the duplex spacing can be locked so that both Rx and Tx frequencies are set correctly when either one is entered.

The 3901 has the same synchronization options as the 2968 (pulse or automatic), but has a much greater range of auto-sync timing offset (±9999.99 symbols rather than ±45 bits), allowing alignment anywhere within the multiframe as for the pulse sync. The pulse sync input on the 2968 requires a special cable to the 2968's 25-way D-type accessory connector; the 3901 provides a dedicated standard BNC socket for this purpose (rear panel SYNC I/O).

The 2968 generates one type of uplink signal for base station receiver testing - the T1 Type 7 (TCH/7.2) signal. The 3901 generates four uplink T1 signals - Type 7 (TCH/7.2), Type 8 (SCH/F), Type 9 (STCH+STCH) and Type 10 (TCH/2.4). If the base station conforms to the ETSI T1 test mode specification, the 3901 can generate the required uplink T1 signal type automatically according to the type requested in the base station downlink T1 signal information.

The 2968 does not perform base station receiver measurements by itself - the base station is expected to perform its own internal or external Bit Error Rate (BER) measurement on the received signal. If the base station implements T1 loopback, the 3901 can perform BER measurements on all four T1 signal types. For the SCH/F and STCH types, the 3901 also measures Message Erasure Rate (MER) and Probability of Undetected Erroneous Measurement (PUEM) for conformance type tests. Sample sizes and limits are easily configured for single-shot or continuous average measurements with color-coded pass / fail indication; the maximized Rx Measurements tile also provides visibility of numbers of errors and measurement accumulation times.

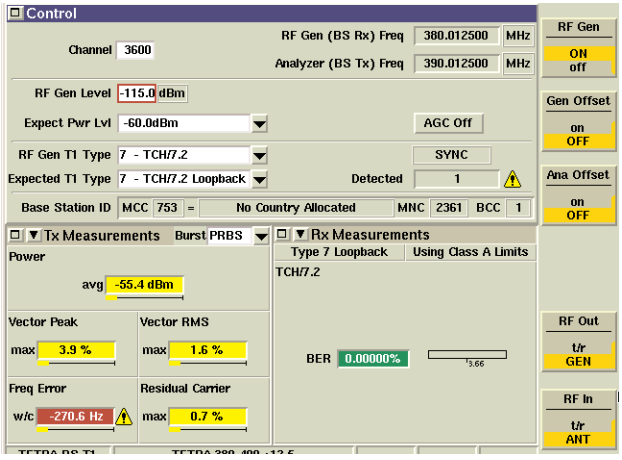

Figure 9 - TETRA BS T1 system display including loopback BER measurement

The 3901 can also generate general purpose non-T1 signals for receiver testing. The '18 Frame PRBS' signal provides four independent channels (one per timeslot) of PRBS data that is similar to TCH/7.2 except that it extends to all 18 frames, not just frames 1 to 17, in other words there is no multiframe structure only a frame structure. The 'Framed PRBS' signal provides one channel of scrambled PRBS data that extends to each timeslot, in other words there is no frame structure only a timeslot structure. The 'Unframed PRBS' signal provides one channel of unscrambled PRBS data that has no slot, frame or multiframe structure - in terms of data content it is the same as the ETSI T2 signal.

Spectrum Analyzer

The 3901 spectrum analyzer is accessed by pressing the TEST key a second time to bring up the TEST floating menu (Manual - Tiled / Data Demod / Spectrum Analyzer). As with the 2968, the spec-

trum analyzer takes over the test set RF Analyzer frequency and level setting while leaving the TETRA signal generator running to hold a TETRA mobile in a call so that it can continue transmitting. As with the 2968, the 3901 is unable to receive any signaling messages sent by the mobile while the spectrum analyzer is in use.

The 2968 spectrum analyzer provides tuning to any center frequency and a selection of frequency spans in a fixed 1 / 2 / 5 sequence. The 3901 spectrum analyzer allows arbitrary setting of the frequency span as well as a fixed sequence. The 3901 also provides start-stop mode as an alternative to center-span mode, in which the start and stop frequencies are specified explicitly, which is useful for locating base stations in a specific band, e.g. 390 MHz to 400 MHz. The 3901 spectrum analyzer also has zero-span mode for observing power vs. time at a fixed frequency through the spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) filters with user selection of sweep time.

Channel Analyzer

As well as the full spectrum analyzer under the TEST floating menu, the 3901 also offers a 'Channel Analyzer' within the TETRA Manual - Tiled screen. The Channel Analyzer provides a spectrum analysis facility in parallel with the test set RF Analyzer, so that TETRA measurements and protocol operations can continue when the Channel Analyzer is in use. The Channel Analyzer is selected from the tile selection menus of either of the measurement tiles and it can be used minimized or maximized. The Channel Analyzer has a maximum span of 5 MHz (2.5 MHz either side of the test set RF Analyzer frequency) and the RF input frequency and level remain under control of the TETRA RF Settings / Control tile.

Oscilloscope

The 3901 oscilloscope can be selected from the tile selection menus of either of the measurement tiles and it can be used maximized or minimized. The 3901 additionally offers dual-traces, trace accumulate, trace capture and manual or auto trigger level. As well as the two AUDIO IN sockets, it can also take input from two dedicated scope inputs (SCOPE CH1 and CH2) for higher performance. Triggering can be from either of the traces or from the rear panel EXT TRIG input. The 3901 does not have the 2968's dedicated front panel rotary knob for scope position - Trace A and Trace B positions can be adjusted independently with the main variable knob when the scope is maximized, and can be shifted up / down with softkeys.

Audio Test

Audio generation and audio measurement facilities will be available Q2 2005 at no extra charge. AF TEST will be selectable from the tile selection menus of either of the measurement tiles and it will be usable maximized or minimized. Facilities will be broadly similar to the 2968 AF TEST mode, excluding the Audio Analyzer and Multimeter functions. The 2968 inputs 'AF INPUT' and 'EXT MOD INPUT' are renamed 'AUDIO IN 1' and 'AUDIO IN 2' on the 3901, with the flexibility to use 'AUDIO IN 2' either for analog external modulation or as a second AF input. The 2968's hard keys for AC / DC coupling are replaced by coupling selection on-screen. The two audio inputs can be combined to provide a single 600 Ω balanced input. The 2968 output 'AF GEN OUTPUT' is renamed 'FCTN GEN' (Function Generator) on the 3901.

TETRA Direct Mode testing

The TETRA DM system will be available Q2 2005 as a cost option. It will be selectable from the CONFIG System selection menu. Functionality will be significantly enhanced compared to the 2968, including Mobile Terminated calls from the test set to the direct mode mobile.

Analog systems

Analog AM / FM capability will be available Q2 2005 as a set of additional systems at no extra charge. It will be selectable from the CONFIG System selection menu. Facilities will be broadly similar to the 2968 DUPLEX TEST, RF TEST and AF TEST modes, excluding the Audio Analyzer, Multimeter and TONES signaling functions. The 3901 will provide selectable FM pre-emphasis and de-emphasis instead of Phase Modulation. The 3901 does not have the 2968's dedicated rear panel DEMOD OUT socket - this signal is available on the multi-way front panel 'MIC / ACC' socket (8-pin DIN ring-lock). Additionally, the front panel BNC 'FCTN GEN' socket can be configured as DEMOD OUT. The 3901 does not have the 2968's dedicated front panel rotary knobs for VOLUME and SQUELCH - these functions are adjusted with the main variable knob after pressing the adjacent 'ASSIGN' key.

Auto-Test system

The 2968 provides two built-in automatic test programs, 'Call Processing Only' and 'Comprehensive Testing'. Parameters for each test can be configured in the 'Autorun Params' menu and tests can be enabled and disabled but the test sequences are fixed. Successful automatic testing depends on some manual testing parameters being suitably configured.

The 3901 provides automatic testing as a system in its own right, selectable from the CONFIG System selection menu. Instead of fixed sequences, auto-test is driven by test scripts, which can be created with a simple text editor. Various test scripts will be provided on the Aeroflex web site and these can be edited to suit particular requirements.

Parameters for each test can be specified as part of the test script, providing complete control and repeatability of the tests, with no dependence on the configuration for manual testing. Alternatively, an auto-test script can pick up parameters that have been configured for manual testing, which can simplify the initial process of creating a script to automate a testing procedure that has been proven in manual testing.

Remote Control

As with the 2968, the 3901 remote control commands have been designed to follow the structure of the local operation of the test set. The structure of systems, modes, menus and operation of the two test sets is different, so the remote control command sets are also different. However, as with the 2968, CVI drivers for the 3901 will be available on the Aeroflex web site.

Software updates and data storage

Software updates can normally be performed by the user, with software downloaded from the Aeroflex web site. The 3901 can download software directly via its Ethernet connection, or indirectly via USB using a CD-ROM or a memory stick. Internal storage of settings and results is provided by a hard disk with at least 10 GB available to the user, so storage space should not be a problem. All user settings are retained at power-down, as long as the front panel soft shut-down button is used before removing mains power - orderly shut down only takes around 10s. The 2968 requires the use of a PCMCIA memory card to store systems settings, since internal storage is limited. The 3901 does not support PCMCIA memory cards. Settings can be stored with meaningful filenames on the internal hard disk, and can be transferred between test sets via USB memory or floppy disk.

2968 HELP / SET-UP menu functions

The 2968 HELP / SET-UP hardkey provides access to the SET-UP menus TEST OPTIONS, INPUT / OUTPUT and MISC CONFIG. In the 3901 these functions are accessed either via the UTILS hardkey (for platform utility functions) or via the CONFIG hardkey (configurations specific to individual systems).

The 2968 TEST OPTIONS menu covers settings and measurements for analog modes and digital systems (GSM and TETRA). In the 3901 these functions are configured via the CONFIG for the individual Analog systems (when available) and TETRA systems. Note that the RF port offsets are configured separately for each system in the 3901.

The 2968 INPUT / OUTPUT menu covers remote control, GIPB setup, serial port setup and printing. In the 3901 these utility functions are accessed via the UTILS hardkey and the Hardware Settings menus. The 3901 provides a much more extensive selection of printer drivers than the 2968, although the RS232 serial port is not currently supported for any function.

The 2968 MISC CONFIG menu covers the following miscellaneous functions: Screen Saver, Time & Date, Option Enable, User Names, Default Values, Language, and Int / Ext Ref. The 3901 equivalents of these functions are as follows:

Screen Saver: not required as the 3901 display is a LCD not a CRT

Time & Date: UTILS, Hardware Settings, Time & Date

Option Enable: UTILS, Software Settings, License

User Names: Auto-Test system, CONFIG

Default Values: not required as the 3901 remembers the last used values; use UTILS, Store / Recall to store specific configurations

Language: English only

Int / Ext Ref: UTILS, Hardware Settings, Frequency Reference

Annex A: summary comparison table of the 3901 and 2968

TEST SET PLATFORM	Aeroflex IFR 3901	Aeroflex IFR 2968
Physical aspects		
Dimensions H x W x D	197 mm x 356 mm x 521mm	203mm x 420 mm x 600 mm
Weight	15.9 kg	19.5 kg
Maximum tilt height / angle	310 mm / 40°	120 mm / 15°
Protective rubber bumpers	Yes, front and rear	No
AC Power supply	100-240V, 50 / 60 Hz	88-132 V, 188-265 V, 45-65 Hz
Voltage selection	Auto	Auto
Power consumption	120 W nominal, 200 W max	135 W nominal, 260 W max
DC Power supply	No	No
User interface		
Display type	Color LCD, VGA 640 x 480	Mono CRT, VGA 640 x 480
Front panel controls (keys)	29 hardkeys, 6 softkeys	46 hardkeys, 22 softkeys
Control method	Graphical navigation	Key entry
Front panel variable control	Yes	Yes
Scalable variable (x10 etc.)	Yes	No
Volume, squelch, brightness	Use variable + ASSIGN key	Dedicated controls
External keyboard operation	Optional, USB or PS/2	No
External mouse operation	Optional, USB	No
Remote user interface on PC	Optional, VNC via Ethernet	No
Remote control via GPIB	Yes	Yes
Lab Windows CVI Drivers	Yes	Yes
RF connections		
RF ports	3, 1x N-type, 2x TNC	2, 1x N-type, 1x TNC
High power duplex port	"T/R", N-type, 125 W max	N-type, 150 W max
Low power duplex port	No	TNC, 1 W max
Low power simplex port	"ANT", TNC, +10 dBm max	TNC can be simplex input
High output simplex port	"GEN", TNC	TNC can be simplex output
High output 2-port duplex	"GEN" Out, "T/R" In	TNC Out, N-type In
Low power 2-port duplex	"T/R" Out, "ANT" In	N-type Out, TNC In
High output, low power 2-port	"GEN" Out, "ANT" In	No
High output, low power 1-port	No	TNC port duplex
Max. output level (TETRA)	0 dBm (GEN port)	-20 dBm (TNC port simplex)
Minimum input level (TETRA)	approx. -90 dBm (ANT port)	approx. -75 dBm (TNC port)
I/O connections		
GPIB (IEEE 488)	Yes	Yes
VGA monitor / video projector	Yes	Yes
Parallel printer	Yes	Yes
Serial (RS232)	Not currently used	Yes
Universal Serial Bus (USB)	2x USB 1.1 ports	No
Device Under Test interface	15-way D-type, for future use	25-way D-type (Accessory)
Microphone / Accessory	8-way DIN, for future use	25-way D-type (Accessory)
Synchronization (TETRA BS)	BNC, "SYNC I/O"	25-way D-type (Accessory)
External Reference	BNC, 10 MHz	BNC, 1 / 2 / 5 / 10MHz
Multimeter Inputs	No	3x 4 mm, 375V max
Scope Inputs	2x BNC, 100 V max	No
Scope Trigger Input	BNC, "EXT TRIG"	No
Audio Input	BNC, Hi-Z, "AUDIO IN 1"	BNC, Hi-Z, "AF INPUT"
2nd Audio Input	BNC, Hi-Z, AF In 2 / Ext. Mod	BNC, Hi-Z, Ext. Mod only
600Ω Balanced Audio Input	Yes, uses AF In 1 & 2	No
Audio Generator Output	BNC, "FCTN GEN"	BNC, "AF GEN"
Data storage and transfer		
Internal Hard Disk Drive	Yes, >10 GB for user storage	No
PCMCIA Memory Card	No	Opt., SRAM R/W, Flash RO
Internal Floppy Disk Drive	Yes, for user data transfer	No
USB Memory / Jump Drive	Opt., for user data transfer	No
USB CD ROM Drive	Opt., for software update	No
Screen Dump to Memory	to Hard Disk	to PCMCIA Memory Card
Screen Dump to PC	via USB or Floppy Disk	via RS232
Screen Dump to Printer	via Parallel port or USB	via Parallel port or RS232

	Aeroflex IFR 3901	Aeroflex IFR 2968
Printer Drivers	over 50 makes supported	HP LaserJet, Epson FX80
Software Update method	User, from Aeroflex web-site	Aeroflex service center
Instruments		
Spectrum Analyzer	Specification t.b.a.	Yes
Channel Analyzer	Specification t.b.a.	No
Oscilloscope	Specification t.b.a.	Yes (AF TEST mode)
Audio FFT Analyzer	No	Yes (AF TEST mode)
Multimeter	No	Yes (AF TEST mode)
Audio Generation	Available Q2 2005	Yes (AF TEST mode)
Audio Measurements	Available Q2 2005	Yes (AF TEST mode)
SYSTEMS Available		
TETRA MS / TETRA MS T1	Option	Option
TETRA BS / TETRA BS T1	Option	Option
TETRA Direct Mode	Option, available Q2 2005	Option
Auto Test for TETRA MS	Yes, uses test scripts	Yes, programs / parameters
Analog AM / FM	Available Q2 2005	Yes
Analog Signaling Tones	No	SEQU, CTCSS, DTMF, DCS
Pager Signaling	No	POCSAG
TACS, AMPS, NMT Cellular	No	Options
GSM Digital Cellular	No	Option (900 MHz only)
MPT 1327 Analog Trunking	No	Option
Other Analog PMR / Trunking	Future options t.b.a.	No
Other Digital PMR / Trunking	Future options t.b.a.	No
TETRA SYSTEMS		
RF Generator (TETRA modulation)		
Frequency range	1 MHz to 1.05 GHz	10 MHz to 1.08 GHz
Level range, duplex N-type	-130 dBm to -40 dBm	-135 dBm to -50 dBm
Level range, simplex N-type	-130 dBm to -40 dBm	-135 dBm to -40 dBm
Level range, duplex TNC	N/A	-135 dBm to -30 dBm
Level range, simplex TNC	-120 dBm to 0 dBm	-135 dBm to -20 dBm
Level accuracy	±0.6 dB	±1.0 dB (15 °C to 35 °C)
Vector error, RMS	< 3%	< 3%
Vector error, Peak	< 6%	< 6%
Residual carrier power	< -35 dBc	< -35 dBc
RF Analyzer (TETRA modulation)		
Frequency range	1 MHz to 1.05 GHz	10 MHz to 1.05 GHz
Power meter accuracy	±0.6 dB (after user cal)	±0.6 dB (15 °C to 35 °C)
Modulation meter range	20% RMS, 40% PK, 20% RC	20% RMS, 40% PK, 20% RC
Modulation meter accuracy	±0.5% at 10% error	±0.5% at 10% error
Frequency meter range	±500 Hz	±500 Hz
Frequency meter accuracy	±15 Hz	±15 Hz
Timing meter range	±510 symbols	±510 symbols
Timing meter accuracy	±0.05 symbols	±0.05 symbols
Channel plans and frequencies		
Pre-defined channel plans	11 plans pre-defined	11 plans pre-defined
User-defined channel plans	Multiple plans can be defined	Single plan can be defined
Copy & edit existing plans	Yes	No
Frequencies set by channel	Yes, also shown in Hz	Yes[1]
Frequencies set in Hz	Yes, also shown as channel	Yes
Transmitter measurements		
Burst Power in dBm or W	Yes	Yes
Power Profile pass / fail (MS)	Yes	Yes
Burst Timing (MS)	Yes	Yes
EVM: RMS, peak, residual	Yes	Yes
Number of bursts measured	1 to 250	1 to 250
Time to measure 200 bursts	< 30s	3m 54s
Avg., max, min, worst case	All measured simultaneously	Single type selectable
Manual test limit checking	Yes, color coded pass / fail	No
User-defined limits	Yes	N/A
ETSI-defined limits	Yes	N/A
Measurement barcharts	Yes, with limit indications	Yes[2]

	Aeroflex IFR 3901	Aeroflex IFR 2968
Progress indication	Progress bars	No
Re-start measurements	Yes	Yes
Continuous measurements	Yes	Yes
Single-shot measurements	Yes	No
Level offset correction	±40 dB, with enable / disable	±40 dB
Timing offset correction (MS)	±999.99 symbols	No
Modulation analysis displays (IQ)		
Constellation diagram	Yes	Yes[2]
Phase Trajectory diagram	Yes	Yes[2]
Rotated Vector diagram	Yes	Yes[2]
Display limit circles	User-defined or ETSI-defined	ETSI-defined only
Display Averaging	No, single burst display	No, single burst display
Trace Accumulation	Yes	Yes
Marker Measurements	No	No
Modulation analysis displays (vs. time)		
Vector Error vs. Time	Yes	Yes[2]
Phase Error vs. Time	Yes	Yes[2]
Magnitude Error vs. Time	Yes	Yes[2]
Display limit lines	User-defined or ETSI-defined	ETSI-defined only
Display Averaging	No, single burst display	No, single burst display
Trace Accumulation	Yes	No
Marker Measurements	Yes	Yes
Power profile displays (MS)		
Full Burst profile	Yes	Yes[2]
Ramp Up / Down profile	Yes	Yes[2]
Minimum Level	< -70 dBc	-40 dBc
Reference Level	Variable +20 dBc to -70 dBc	Fixed +10 dBc or +9 dBc
Vertical Scale	Variable 20 dB to 0.1 dB /div	10 dB /div or 3 dB /div
Profile Mask	ETSI-defined or user-defined	ETSI-defined only
Profile Averaging	Yes, up to 250 bursts	No, single burst only
Trace Accumulation	Yes	No
Marker Measurements	Yes	Yes
Receiver measurements		
Bit Error Rate (BER)	Yes	Yes
Message Erasure (MER)	Yes	MS TCH/S TT loopback only
Prob. of Undetected (PUEM)	Yes	No
Error Count and Total Count	Yes	No
Sample sizes, BER	1000 to 10000000 bits	1000 to 10000000 bits
Sample sizes, MER	10 to 1000000 messages	10 to 1000000 messages
Manual test limit checking	Yes, color coded pass / fail	No
User-defined limits	Yes	N/A
ETSI-defined limits	Yes	N/A
Measurement barcharts	Yes, with limit indications	Yes[2]
Progress indication	Progress bars	'Settled' % age1
Re-start measurements	Yes	Yes
Continuous measurements	Yes	Yes
Single-shot measurements	Yes	No
Level offset correction	±40 dB, with enable / disable	±40 dB
Demodulated data display		
Demodulated burst data	Yes	Yes
Channel decoded burst data	Yes	Yes
Burst capture	5000 bursts, 70s continuous	1 burst
Slot, frame, multiframe info	Yes	No
Timestamp relative to start	Yes	N/A
TETRA MS SYSTEM		
TETRA MS channel types		
Main Control Channel MCCH	Yes	Yes
Traffic Channel TCH	Yes	Yes
Traffic Channel Content	Talkback, Silence, Test Tone	Talkback, Silence, Test Tone
MCCH ⇔ TCH allocation	Yes	Yes[1]

	Aeroflex IFR 3901	Aeroflex IFR 2968
MCCH-TCH frequency switch	Yes, TCH on any channel	Yes[1], TCH on any channel
TCH-TCH frequency switch	Yes[3], handoff during call	No
Fast Assoc. Channel FACCH	Yes	No
TETRA MS registration functions		
Base Station Identity config.	MCC, MNC, BCC, LA	MCC, MNC, BCC, LA
Power-on Registration	Yes	Yes[1]
Power-off De-Registration	Yes	Yes[1]
Commanded Re-Registration	Yes	Yes[1]
Migrating Registration	Yes	Yes[1]
Group Attach, Detach, Modify	Yes	Yes[1]
TT Test Mode Confirmation	Yes[3]	Yes[1,3]
MM-Status Message display	Yes	No
Mobile Classmark display	Yes	Yes[1]
Attached Groups display	Yes, up to 40 groups	Yes, up to 40 groups[1]
Neighbor Cell Broadcast	Yes, 1 neighbor cell	Yes, 1 neighbor cell
Cell Re-Select parameters	Yes	Yes
Cell Re-Selection	Yes[4]	Yes[1,4]
Call Restoration	Yes[4]	Yes[1,4]
TETRA MS call setup		
Mobile Originated (MO)	Yes	Yes[1]
Mobile Terminated (MT)	Yes	Yes[1]
Group calls	Yes	Yes[1]
Private calls	Yes	Yes[1]
Phone calls	Yes	Yes[1]
Emergency calls	Yes	Yes[1]
User-Defined calls	Yes	Yes[1]
Simplex & Duplex calls	Yes	Yes[1]
Hook & Direct calls	Yes	Yes[1]
Calling / Called Party SSI	Yes	Yes[1]
Calling / Called Party ESN	Yes	Yes[1]
Call Modification, MO calls	No, accepts MS set-up	No, accepts MS set-up[1]
Call Modification, MT calls	Yes, details displayed	Yes[1]
TETRA MS call answer / abort / cleardown		
MO call Testset Auto-Answer	Yes	Yes[1]
MO call Auto-Answer delay	0 - 30s, user setting	No, immediate auto-answer[1]
MO call Manual Answer	Yes, Accept / Reject	No, immediate auto-answer[1]
MT call User Answer	Yes, Accept / Reject	Yes[1], Accept / Reject
MT call Testset Auto-Abort	Yes	Yes[1]
MT call Auto-Abort timer	1 - 300s, user setting	fixed 65s[1]
MT call Manual Abort	Yes	Yes[1], within auto-abort time
Call Cleardown from MS	Yes, by user or MS timer	Yes[1], by user or MS timer
Call Cleardown from Testset	Yes, by user or hang timer	Yes[1], by user or hang timer
TETRA MS simplex call trunking		
Transmission Trunking	Yes	Yes[1]
Message Trunking	Yes	Continuous TCH, no FACCH
Quasi-Transmission Trunking	Yes	N/A, no FACCH
Downlink and Uplink TCH	Yes	Yes
Downlink TCH, UL FACCH	Yes	No
Uplink TCH, DL FACCH	Yes	No
Testset Auto-Transmit period	Continuous, Timed, None	Continuous, Timed[1], None
Testset Manual Transmit	Yes, Transmit / Cease	No
TETRA MS duplex call operations		
Handoff TCH to TCH	Yes[3]	No
TT Loopback BER / RBER	Yes[3]	Yes[1,3]
DTMF Signaling	Yes	Yes[1]
TETRA MS power control		
Open Loop Power Control	Yes	Yes

	Aeroflex IFR 3901	Aeroflex IFR 2968
Closed Loop Power Control	Yes[3]	Yes[1,3]
TETRA MS messaging functions		
Mobile Originated (MO)	Yes	Yes[1]
Mobile Terminated (MT)	Yes	Yes[1]
Status Messages	Yes	Yes[1]
SDS Type 1 / 2 / 3 Messages	Yes	Yes[1]
SDS Type 4 (Hex Data)	Yes	Yes[1]
SDS-TL Text Messages	Yes, 7-bit and 8-bit	Yes[1], 7-bit and 8-bit
SDS-TL Other Messages	Yes, any Protocol Identifier	No
SDS-TL Short Reports	Yes	Yes[1]
SDS-TL Standard Reports	Yes	No
User entry of messages	Yes	Yes[1]
Pre-defined messages	3	1, lost on user entry
Calling / Called Party SSI	Yes	Yes1
Calling / Called Party ESN	Yes	Called Party ESN only[1]
TETRA MS protocol history (event log)		
Size of event log	1000 lines	most recent event only[1]
Timestamp	Yes, Real Time / Elapsed	No
Registration details	Yes	most recent event only[1]
MO call / message details	Yes	only during call[1]
MT call / message details	Yes	partial, only during call[1]
Save and export as text file	Yes	No
TETRA MS transmitter measurements		
Normal Uplink Bursts	Yes	Yes
Control Uplink Bursts	Yes	Yes
Combined Normal / Control	via 2x Tx Measurements tiles	Yes, burst type indicated
TETRA MS TT loopback receiver measurements		
TCH/S BER Class 0, 1, 2	Yes[3]	Yes[3]
TCH/S RBER Class 0, 1	Yes[3]	Yes[3]
TCH/S MER	Yes[3]	Yes[3]
TETRA MS T1 SYSTEM		
TETRA MS T1 test mode control		
Implementation	Separate MS T1 system	Mode in TETRA MS system
Configuration and settings	Specific to T1 test mode	Common with TETRA MS
Open Loop power control	Yes	Yes
Max Tx Level power control	Yes[3], available in TEST tile	Yes[1,3], only in SET-UP menu
MS transmit control	Yes[3], normal, control, off	Yes[1,3], normal, control, off
MS loopback control	Yes[3]	Yes[1,3]
Delay timing by one symbol	Yes	Yes[1]
TETRA MS T1 test signals generated		
T1 Type 1 - TCH/7.2	Yes	Yes
T1 Type 2 - SCH/F	Yes	Yes
T1 Type 3 - BSCH, SCH/HD	Yes	No
T1 Type 4 - TCH/2.4	Yes	Yes
T1 Type 15 - TCH/S	Yes	No
T1 Type 17 - TCH/4.8	Yes	No
TETRA MS T1 transmitter measurements		
Normal Uplink Bursts	Yes	Yes
Control Uplink Bursts	Yes	Yes
TETRA MS T1 loopback receiver measurements		
TCH/7.2 BER	Yes[3]	Yes[3]
TCH/4.8 BER	Yes[3]	No
TCH/2.4 BER	Yes[3]	No
TCH/S BER Class 0, 1, 2	Yes[3]	No
TCH/S MER, PUEM	Yes[3]	No
SCH/F BER, MER, PUEM	Yes[3]	No
BSCH BER, MER, PUEM	Yes[3]	No
SCH/HD BER, MER, PUEM	Yes[3]	No

	Aeroflex IFR 3901	Aeroflex IFR 2968
AACH BER, MER, PUEM	Yes[3]	No
TETRA BS SYSTEM		
TETRA BS control and indications		
Manual scrambling control	MCC, MNC, BCC	MCC, MNC, BCC
Automatic scrambling control	From Base Station Identity	From Base Station Identity
Base Station Identity display	MCC, MNC, BCC, LA	MCC[1], MNC[1], BCC[1], LA[1]
TETRA BS transmitter measurements		
Normal Downlink Bursts TS1	Yes	Yes
Normal Downlink Bursts TS2	Yes	No
Combined TS1 / TS2 Bursts	Yes	Yes
Sync Bursts	Yes	Yes
Combined Normal / Sync	via 2x Tx Measurements tiles	Yes
PRBS (no training sequence)	Yes	No
TETRA BS T1 SYSTEM		
TETRA BS T1 test mode control		
Implementation	Separate BS T1 system	Mode in TETRA BS system
Configuration and settings	Specific to T1 test mode	Common with TETRA BS
Manual scrambling control	MCC, MNC, BCC	MCC, MNC, BCC
Automatic scrambling control	From Base Station Identity	From Base Station Identity
Base Station Identity display	MCC, MNC, BCC	MCC[1], MNC[1], BCC[1]
Synchronization to BS	Auto, Pulse (rising, falling)	Auto, Pulse (rising, falling)
Auto-Sync Path Offset	±9999.99 symbols	±22.50 symbols
Sync Pulse Offset	0 to 1.02s x1µs	0 to 1.02s x1µs
BS uplink T1 type detected	Yes[5]	No
Auto-generate detected type	Yes[5]	No
TETRA BS T1 test signals generated		
T1 Type 7 - TCH/7.2	Yes	Yes
T1 Type 8 - SCH/F	Yes	No
T1 Type 9 - STCH	Yes	No
T1 Type 10 - TCH/2.4	Yes	No
18 Frame PRBS (scrambled)	Yes	No
Framed PRBS (scrambled)	Yes	No
Unframed PRBS	Yes	No
TETRA BS T1 transmitter measurements		
Normal Downlink Bursts TS1	Yes	Yes
Normal Downlink Bursts TS2	Yes	No
Combined TS1 / TS2 Bursts	Yes	Yes
Sync Bursts	Yes	Yes
Combined Normal / Sync	via 2x Tx Measurements tiles	Yes
PRBS (no training sequence)	Yes	No
TETRA BS T1 loopback receiver measurements		
TCH/7.2 BER	Yes[5]	No
TCH/2.4 BER	Yes[5]	No
SCH/F BER, MER, PUEM	Yes[5]	No
STCH BER, MER, PUEM	Yes[5]	No
TETRA BS T1 transmitter BER or loopback receiver BER measurements		
TCH/7.2 PRBS BER	Yes	No
18 Frame PRBS BER	Yes[5]	No
Framed PRBS BER	Yes[5]	No
Unframed PRBS BER	Yes[5]	No

Notes

[1] Only in SYSTEMS mode

[2] Only in Digital Duplex mode

[3] For mobiles supporting this function

[4] Requires two test sets and a power splitter

[5] For base stations supporting this function

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A passion for performance.

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