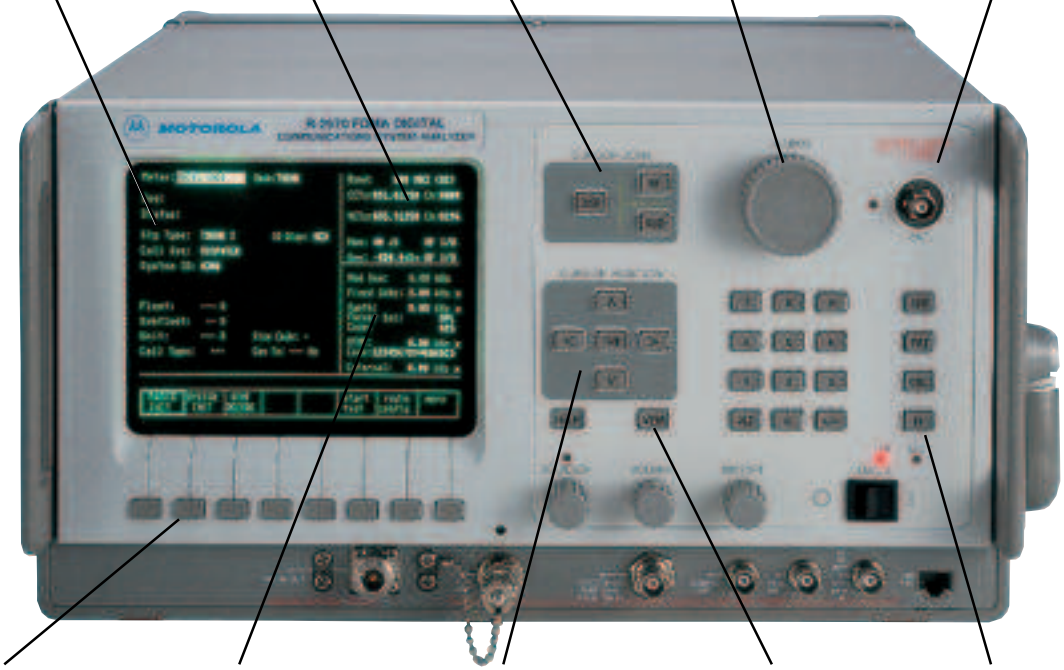
The Motorola R-2670: A Basic Description.



The R-2670: The Expandable Platform to Support Motorola Trunking, Project 25 Standard, ASTRO® and Secure Testing.

Motorola Communication Test Equipment is proud to present the R-2670 FMDA Digital Communications System Analyzer.

In addition to including all of the features of the Motorola R-2600, the R-2670 is a special digital hardware platform that allows customized configuration to include many different test features in one convenient and easy-to use unit. The R-2670 also includes, as standard equipment, the following features:

- Tracking Generator
- Cable Fault Testing
- High Stability
- High Performance Spectrum Analyzer with Markers
- Programmable Test Set-up Memory

Optional Test Capabilities:

- Motorola Analog Trunking
- APCO Project 25 Standard, conventional with IMBE Vocoder (for ASTRO CAI, or other radios)
- ASTRO VSELP Conventional and Encrypted
- Motorola ASTRO VSELP Trunking
- SECURENET™ Secure Voice

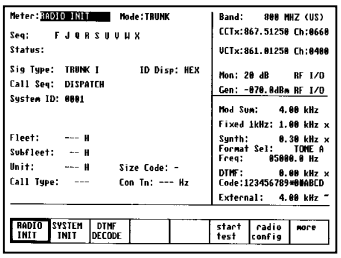
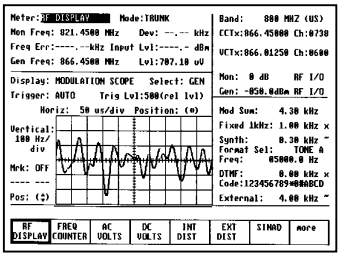
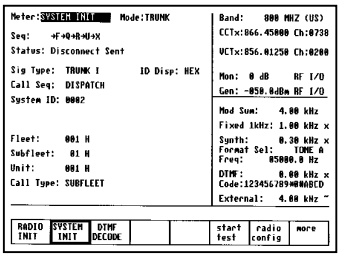
The R-2670 features specialized, dedicated, easy-to-access test screens that are conveniently grouped together to expedite test set-up. The R-2670 accepts either customer or test key codes for encryption testing. And it now tests Project 25 compliant radios, like the Motorola ASTRO. In addition, it includes:

- Dedicated screen displays for convenient observation or printout of test results.
- Innovative use of soft keys and windowing.
- Fast reacting autoranging scales with both analog and digital readouts.
- Signaling encode and decode functions.

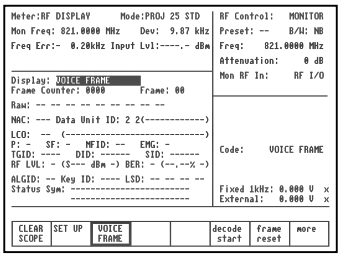
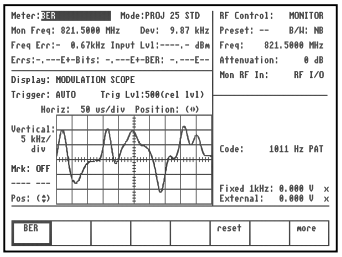
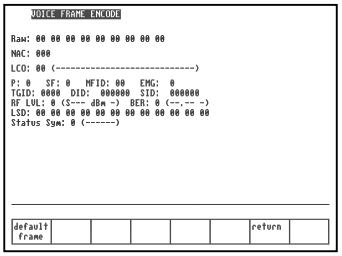
All of these convenient features are built into a versatile, rugged, and compact test unit that allows you to perform many complex operations with a single unit. Because the R-2670 is rugged enough to withstand heavy activity, and can be powered by a variety of power sources, it is ideal for use in the field.

Whether used in your shop, at your customers' site or in a remote location, the R-2670 is designed to save you time because it helps you work more efficiently –- all of which improve your profitability.

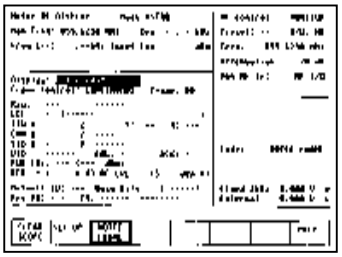
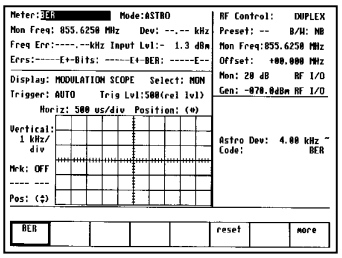
Motorola Trunking Option

Feature	Description	Benefits
Dynamic Call Testing of Subscriber Radios 	This feature tests Motorola compatible Type I, Type II, SMART ZONE and ASTRO VSELP trunked mobile and portable radio units under actual signaling conditions. This is achieved by simulating the function of the trunked fixed-end equipment. The radio access control channel is provided to perform initial registration. A thermometer-style graphic indicator shows call progression as it directs the radio to a traffic channel for parametric measurements and voice testing. Radio-initiated or system-initiated tests can be performed in either the phone interconnect or dispatch call modes. Dynamic Call Testing allows you to test auto affiliation for SMART ZONE systems. An additional RF synthesizer provides simultaneous control and traffic channels, operator selectable over the entire band of allowable channels. Allows you to exit from the main testing screen while a call is still in process to access the other diagnostic screens.	You can verify both radio system compatibility and basic functionality without using valuable air time for testing. This feature also allows you to test in areas that are beyond the range of an actual system. By obtaining precise measurements of radio performance data, you can be sure that your system is operating with the proper margin. This feature ensures compatibility with SMART ZONE system operation. The simultaneous control channel allows you to redirect a radio to the traffic channel upon temporary loss of signal. Testing all channels within a band also helps you ensure adequate performance margin. This feature affords you greater diagnostic capability to ensure proper radio operation.
Closed Cover Measurements 	Transmitter power, frequency and deviation are measured within the dynamic calling mode and displayed on the signaling screen all with a single RF connection to the radio. Additional measurements can be made on other screens while the simulated “live” call is maintained. Radio ID information is decoded in either hex or decimal format.	You can verify radio specification performance and programming quickly and easily without opening or removing the radio to activate a special test mode.
Dedicated Trunking Screens 	Conveniently accessed, dedicated test screens can be set up as a start-up default condition or a programmable test set-up. Dedicated Trunking test screens are windowed with RF and Modulation control screens to simultaneously display test results along with their test conditions. A single system configuration screen for Type I systems provides non-volatile storage of up to ten fleet maps.	This feature makes testing easier and more efficient.

Project 25 Standard Test Option

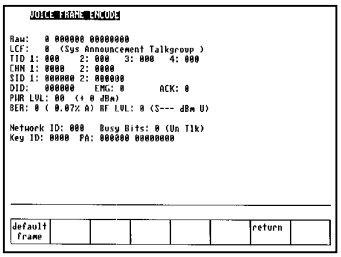
Feature	Description	Benefits
Voice Mode System Testing 	Project 25 compatible FDMA Digital C4FM modulation and either C4FM or CQPSK demodulation with vocoding and embedded data testing. Generate and monitor modes support actual functional voice testing. Within the voice mode, embedded data can be encoded and decoded for either subscriber or fixed site radio equipment.	This feature allows you to verify operation and system compatibility under actual operating conditions for increased confidence of proper system performance.
Bit Error Rate (BER) Testing 	BER testing can be performed on radios that support BER test capability. The R-2670 in Project 25-mode can generate RF transmissions modulated with either a 1011Hz tone test pattern or a calibration test pattern (generates 5% BER) for UUT BER measurement. The R-2670 in Project 25 mode can compute a BER when a 1011 Hz tone test pattern is received.	This testing provides you with an accurate quantitative measurement of modulation quality and overall system performance.
Dedicated Test Screens 	Conveniently accessed, dedicated test screens allow you to specify Link Control and Low Speed Data information contained within Voice Frames and to specify status symbol value. You can also set up from default values or operator specified input.	This feature makes testing easier, more efficient and robust by allowing operator specified values to be tested.

Motorola ASTRO VSELP Test Option

Voice Mode System Testing 	Motorola ASTRO VSELP compatible FDMA Digital C4FM modulation and either C4FM or CQPSK demodulation with vocoding and embedded data testing. Generate and monitor modes support actual functional voice testing. Within the voice mode, embedded data can be encoded and decoded for either subscriber or fixed site radio equipment.	This feature allows you to verify operation and system compatibility under actual operating conditions for increased confidence of proper system performance.
Bit Error Rate (BER) Testing 	BER testing can be performed on radios that support BER test capability. The R-2670 in ASTRO VSELP-mode can generate or monitor RF transmissions modulated with a V.52 BER test pattern.	This testing provides you with an accurate quantitative measurement of modulation quality and overall system performance. The Duplex mode supports loop-back testing.

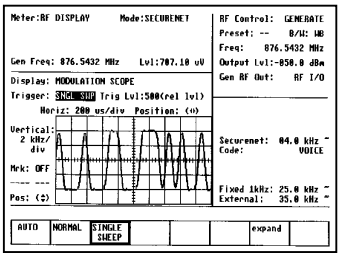
Motorola ASTRO VSELP Test Option

Feature	Description	Benefits
Dedicated Test Screens	Conveniently accessed, dedicated test screens can be set up as a start-up default condition or a programmable test set-up. Dedicated ASTRO test screens are windowed with RF and Modulation control screens to simultaneously display test results along with their test conditions. While in ASTRO mode, standard diagnostic test screens can be easily accessed.	This feature makes testing easier and more efficient. It also provides quantitative RF measurements to ensure proper system performance margin.

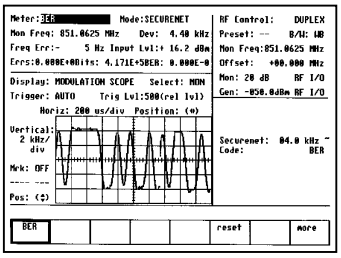


Motorola SECURENET Test Option

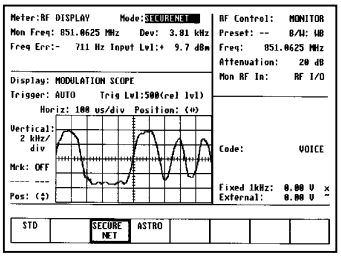
Feature	Description	Benefits
Voice Mode System Testing	Voice mode system testing provides Motorola SECURENET-compatible modulation and demodulation with vocoding. Generate and monitor modes support actual functional voice testing in the encrypted mode using either test keys, which are permanently stored in the R-2670, or actual customer-selected keys from a separate DX key loader. The R-2670 also emulates an AX, BX, or CX key loader which can be used to download test keys to a compatible radio.	This feature allows you to verify operation and system compatibility under actual encrypted voice conditions to ensure proper system performance.



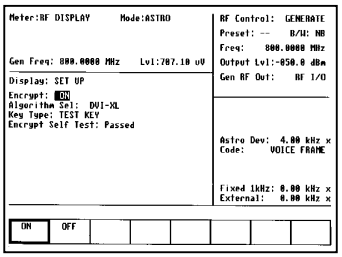
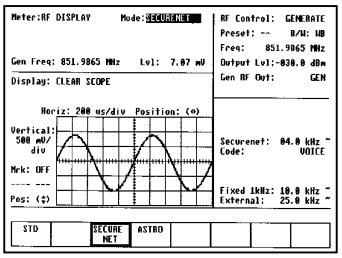
Bit Error Rate (BER) Testing	BER can be measured using the built-in V.52 test pattern generator. This standard, non-encrypted pattern can be used to either modulate the Generator or inject into a radio or system under test via the baseband output. This BER pattern can then be recovered from the radio system either through the R-2670's Monitor receiver or its baseband input to perform a closed loop BER test. The BER test is also available within the unit's Duplex mode.	This testing provides you with an accurate quantitative measurement of modulation quality and overall system performance. The Duplex mode supports loop-back testing.



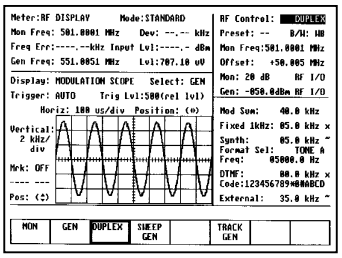
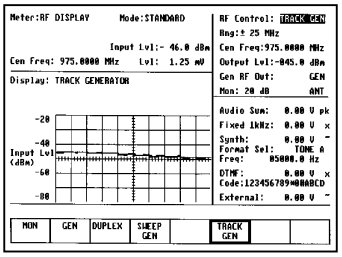
Dedicated Test Screens	Conveniently accessed, dedicated test screens can be set up as a start-up default condition or a programmable test set-up. Dedicated SECURENET test screens are windowed with RF and Modulation control screens to simultaneously display test results along with their test conditions. While in SECURENET mode, standard diagnostic test screens can be easily accessed.	This feature makes testing easier and more efficient. It also provides quantitative RF measurements to ensure proper system performance margin.



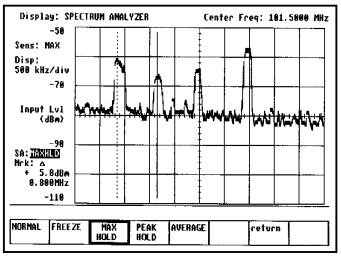
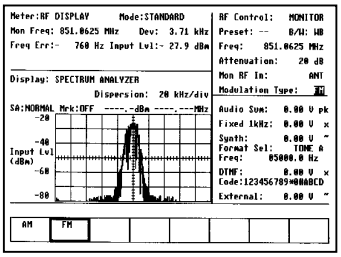
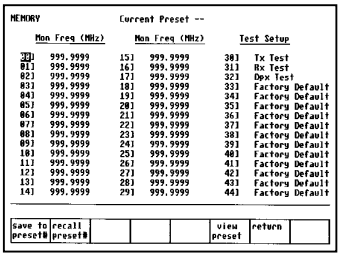
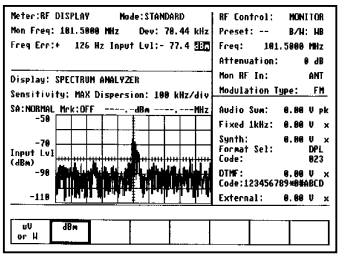
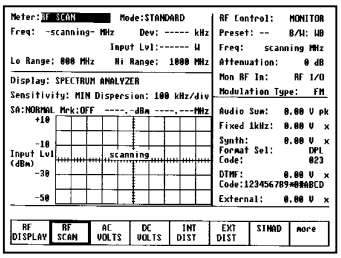
Project 25, ASTRO VSELP & SECURENET Features

Feature	Description	Benefits
Encryption Test Option 	Voice and embedded data encode and decode testing can also be done in the encrypted mode using either test keys, which are permanently stored in the R-2670, or actual customer-selected keys which can be loaded into the unit using a Motorola DX key loader.	This feature allows you to verify proper operation and system compatibility under actual encrypted conditions to ensure proper system performance.
Baseband Audio Scope Display 	This display provides a clear graphic image of the audio baseband signal-selectable at either the vocoder input in generate mode or the vocoder output in monitor mode.	This feature provides you with greater assurance of proper system operation through its graphic display of voice or tone modulation.

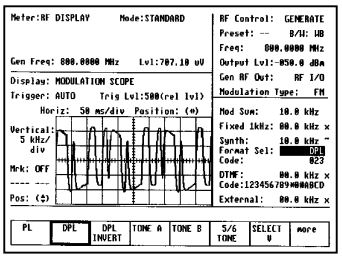
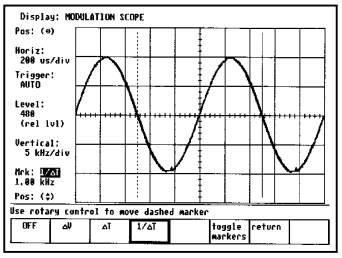
Standard System Features

Duplex 	Full output level control from -130 dBm to 0 dBm over the entire range of the instrument is available from the RF I/O port (-130 dBm up to -50 dBm) and the generation port (-80 dBm to 0 dBm). Variable offsets from 0 to ±55 MHz in 5 kHz steps are keypad-selectable.	The duplex generator provides enhanced capability to service equipment such as repeaters and full duplex radios, including cellular telephones. Full RF level control as well as full internal and external modulation capability allows receiver desensitization and transmitter tests to be performed simultaneously through one port, if desired. Storage of test setups is available in memory for instant recall.
50 MHz Tracking Generator 	The combining of the capabilities of the sweep generator and the spectrum analyzer into a Tracking Generator function allows the user to view the performance characteristics of many RF filter devices. Display range is operator selectable from a 200 kHz window up to a 50 MHz window anywhere in the 400 kHz to 1GHz spectrum.	Diagnosis and adjustment of critical receiver front ends, IFs, helical filters, cavities, combiners and duplexers can be made in a few minutes, quickly and easily with the flexibility of the R-2670 tracking generator at your fingertips.

Standard System Features

Feature	Description	Benefits
Spectrum Analyzer (See & Hear)™ 	The built-in R-2670 Spectrum Analyzer will display a window of RF spectrum anywhere within the 400 kHz to 1 GHz operating range of the unit. The EXPAND softkey enlarges the display to fill the CRT and retains dispersion and center frequency control. The R-2670 also includes Markers and a 100 MHz Window. These Markers provide the following features: • Freeze • Max Level Hold • Peak Level Hold • Absolute Level & Frequency • Delta Level & Frequency	The ability to observe the spectrum display and then store it for detailed analysis through the use of multiple Markers provides a significant advantage. The Tuning Knob retains control of the center frequency even in the EXPAND mode to perform fast sweeps or fine tuning. This allows you to quickly locate and identify signal carriers.
Terminated RF Wattmeter 	RF power anywhere in the operating range of 400 kHz to 1GHz is automatically measured by the Communications System Analyzer tuned to that frequency. The built-in RF load dissipates up to 125 watts for one minute. If a high power transmitter should be keyed into the unit for any longer, the CRT display changes to read "WARNING RF OVERLOAD", thus warning the technician to un-key.	This feature provides calibrated RF power measurements eliminating the need for a separate wattmeter. The CRT display also includes frequency error and modulation level simultaneously.
Programmable Test Memory 	**Channel Presets** – The unit has 30 memory locations which can be used to store preset channel information. Channels can be easily selected individually or automatically scanned over a user-defined range. **Programmable Test Setups** – You can easily program and store up to 15 of the most commonly used test setups, including all test conditions, measurement display formats, and levels. These memory positions operate fully independently from the channel presets.	**Channel Presets** – This feature allows you to quickly access frequently used channel location information to speed testing. Scanning allows automatic monitoring and measurement of activity on channels of interest. **Programmable Test Setups** – You can significantly reduce the number of key presses required to set up the more commonly used test setups, greatly increasing your efficiency while promoting uniform test procedures. You can also assign a custom name to the test for easy recall.
Relative Signal Strength Meter 	In addition to reading frequency error and modulation, a digital readout relative signal strength meter has been included. Sensitivity is specified to -100 dBm at the antenna port for FM signals and extends up to 125 watts at the RF I/O port. The CRT display will automatically convert to a terminating "watts" display as the level increases.	This feature, in conjunction with an external antenna, allows remote monitoring of distant transmitters to check for antenna, transmission line or P.A. problems. Many technicians also find this feature convenient in performing propagation studies to identify weak coverage areas.
RF Scan/RF Counter Function 	RF Scan operates in the monitor mode and provides a function similar to a 1 GHz counter. This feature automatically scans a user-defined frequency range to lock to the signal applied. Any RF carrier above 20 MHz can be located within 5 seconds or less and the reception is displayed with digital readouts.	It is possible to locate and identify the operating frequencies of multi-channel radios. This feature allows the technician to conveniently and immediately verify the programming of a multi-channel radio. By automatically tuning the R-2670 receiver to the detected carrier, immediate measurement data can be taken without having to enter new frequency data via the keyboard. The 1 GHz counter on your bench is now obsolete.

Standard System Features – *Continued*

Feature	Description	Benefits
Signaling Simulator: Encoder and Decoder 	The System Analyzer includes the capability of encoding and decoding PRIVATE LINE (PL), DIGITAL PRIVATE LINE (DPL), and single tone sequences as well as multi-tone sequences including DTMF signals, 5/6 tone paging, Select V and up to 20 sequential tones. Decoding displays include tone frequencies and time durations of the individual tones. The unit can also encode tone remote signaling.	The signaling capability of the R-2670 reaches a broader range of service applications with its decode capability. This gives the service technician a more flexible test instrument which aids in servicing paging equipment and specialized signaling encoders as well as mobile, portable and other radio products. The signaling simulator can perform a full system check-out faster, with more accuracy than ever before.
General Purpose & Modulation Oscilloscope 	The oscilloscope has a 50 kHz bandwidth for audio waveform analysis. The display can be triggered over the full screen range to a fixed reference level. Triggering in both automatic and normal modes is provided for synchronizing the horizontal timebase to the vertical input signal. Internal or external inputs allow observation of both generated and monitored modulation signals. Softkeys provide for an enlarged full screen display. **MARKERS** Functional markers include the following features: • Delta Voltage • Delta Frequency • Delta Period	Recovered audio or internally produced audio can be displayed visually for deviation measurements. Additionally, detection of an asymmetric modulation or audio distortion can be achieved with wavefom analysis. With internal and external triggering and a freeze display single sweep, this unit duplicates many features of more expensive scopes. The markers allow detailed analysis to measure waveforms displayed on the CRT. The EXPAND function provides an uncrowded, easy to interpret view of the signal for quick analysis.
AM, FM Signal Generator	When the GENERATE mode is selected, the RF modulation method, carrier frequency, bandwidth, composite audio modulation, and RF signal level output are displayed on the CRT.	In addition to reducing receiver test time, this flexible, self-calibrating signal generator is complemented by the simultaneous display of all necessary control information.
Off-the-Air Sensitive Receiver	The 2 microvolt sensitivity of the R-2670 is available through the antenna port. This allows off-the-air monitoring of remote transmitters operating up to 1 GHz. Variable squelch aids in picking up weak signals but can be set tighter to ensure the proper S/N ratio for measurement accuracy.	This feature reduces service costs by enabling frequent preventive maintenance parameter checks for system degradation or interference identification without leaving the shop.
Graphic Screen Print and Self-Calibration	These commands are provided as immediate action functions. Dedicated keys on the front panel provide easy access.	Graphic screen print provides a hard copy of test data, thereby improving the quality of your documentation. Self-calibration ensures measurement accuracy of RF input, output and modulation at the touch of a button.
RS-232/Serial Printer Interface (Standard)	A full bi-directional RS-232 port is standard and includes the capability to respond to serial input command vocabulary and return measurement results as a serial output stream. Included are user-selectable baud rates (up to 9600 bps) and start, stop and parity bit selection. In addition, this dual function port can drive an optional serial printer to print out data and graphic displays.	This feature allows remote monitoring of cell sites and off-the-air measurements of radio equipment located out of range without ever leaving the shop. If you have large volume repetitive testing requirements, this feature allows you to write your own programs to reduce test time costs. Printed results can be used as part of the service shop's internal quality control system and can be used to demonstrate performance to the radio equipment user.
Cable Fault	Cable fault and length are new RF measurement features which help the technician isolate cable defects. Supported by on-screen prompts and user-selectable Help messages, you can quickly set up and accurately determine the distance to a fault on a coaxial cable. The distance to fault (or cable length) is computed and displayed in feet or metric units.	Cable fault locating techniques are mandatory for site servicing, where visual inspection is not practical, safe, or effective in detecting hidden or cold-flow damage. The semi-automatic operation of the cable fault finder precludes the use of mathematical formulas and manual calculations, maximizing your on-site productivity.

Specifications

Operating/Display Modes

AM/FM Monitor	Cable Fault Locator
AM/FM Generate	Frequency Counter
Audio Synthesizer	Digital Voltmeter
Spectrum Analyzer	Wattmeter
Duplex Generator	Oscilloscope
Sweep Generator	Signal Strength Meter
Tracking Generator	SINAD/Distortion Meter

RF Signal Generator

FREQUENCY	
Range:	400 kHz to 1 GHz
Resolution:	100 Hz
Accuracy:	Refer to Accuracy of Master Oscillator
Stabilization Time:	.1 Second
OUTPUT	
Range FM:	-130 dBm to 0 dBm
Range AM:	-130 dBm to -3 dBm
Accuracy:	±2 dB from -80 dBm to -130 dBM (RF I/O PORT) ±4 dBm for all other output levels and ports. 3 MHz to 1GHz
SWEEP GENERATOR	
Range:	400 kHz to 1 GHz
Resolution:	100 Hz
Output:	-130 dBm to 0 dBm
Sweep Width:	Selectable up to ±5 MHz of center freq.
Scope Coupling:	Synchronized scope trace to the sweep signal
Accuracy:	Same as Signal Generator
DUPLEX GENERATOR	
Range:	400 kHz to 1 GHz
Resolution:	100 Hz
Output:	-130 dBm to 0 dBm
Frequency Offset:	0 MHz to ±55 MHz in 5 kHz steps
Accuracy:	Same as Signal Generator
SPECTRAL PURITY	
Spurious:	-35 dBc within +/-20 MHz of selected carrier frequency. Additional fixed spurs at an absolute level of <90 dBm at harmonic frequencies of 5 MHz. These can affect level and modulation measurements when operated at low levels at or very near these specific frequencies.)
Harmonics:	-20 dBc
FM MODULATION	
Deviation:	99.5 kHz
Accuracy:	5% of setting ±25 Hz @ 1 kHz (NB) 5% of setting ±250 Hz @ 1 kHz (WB)
Residual FM:	20 Hz max @ 300 Hz to 3 kHz audio bandwidth
External/Internal Frequency Range:	5 Hz to 20 kHz, ±2 dB
AM MODULATION	
Range:	0 to 90%
Resolution:	10% of modulation
Residual AM:	1.0% max @ 300 to 3 kHz audio bandwidth
External/Internal Frequency Range:	100 Hz to 10 kHz, ±1dB
PHASE MODULATION (Optional)	
Range:	0.5 to 10 radians
Accuracy:	±8% at 1 kHz
Resolution:	.1 radians (.01 below 2.00 radians)
External/Internal Frequency Range:	300 to 3000 Hz

Audio Modulation Synthesizer

Modulation Types:	1 kHz tone, PRIVATE LINE, DIGITAL PRIVATE LINE, Single Tone DTMF, Two-Tone Paging, 5/6 Tone Paging, International Select V, 20 Tone General Sequence, Tone Remote Control, External inputs from both a supplied microphone and BNC input.

Audio Modulation Synthesizer (Cont.)

Frequency Range:	10 Hz to 20 kHz ± 1dB
Mod Output Level:	Programmable to 7.95 v peak
Mod Output Impedance:	100 ohms nominal 1 kHz Tone
Distortion:	Not to exceed 1%
External Modulation Inputs:	Front panel microphone and a BNC jack are summed.
BNC Input Impedance:	600 ohms nominal
Microphone Supplied:	HMN-1056D
Microphone Input Conditioning:	Internal audio limiting providing IDC and pre-emphasis.

RF Receiver

FREQUENCY	
Range:	400 kHz to 1 GHz
Resolution:	100 Hz
Accuracy:	Refer to Accuracy of Master Oscillator
Spurious Response:	40 dB typical
SENSITIVITY (Above 10 MHz)	
Narrowband FM:	2.0 uV for 10 dB EIA SINAD
Wideband FM:	10 uV for 10 dB EIA SINAD
FREQUENCY ERROR METER	
Type of Display:	Autoranging
Resolution:	1 Hz
FM DEVIATION MEASUREMENT	
Demod Range:	Up to ±5 kHz in Narrowband Up to ±75 kHz in Wideband
Accuracy:	±5% plus peak residual FM
Frequency Response:	Selectable per the following: Low Pass Filters 300 Hz, 3 kHz, 20 kHz High Pass Filters 5 Hz, 300 Hz, 3 kHz
Demodulated Output Level:	.8 v peak per 1 kHz peak Deviation in Narrowband and per 10 kHz Deviation in Wideband
Demodulation Output Impedance:	100 ohms nominal
Deviation Alarm:	Audible, set via keypad in 100 Hz increments
AM MODULATION MEASUREMENTS	
Demodulation Range:	0 to 100%
Accuracy:	±5% for levels below 80%
Frequency Response:	Selectable per the following: Low Pass Filters 300 Hz, 3 kHz, 20 kHz High Pass Filters 5 Hz, 300 Hz, 3 kHz
Demodulated Output Level:	.8 v peak per 10% AM modulation
PHASE DEMODULATION MEASUREMENTS (Optional)	
Demod Range:	Narrowband = 1 radian Wideband = 10 radians
Accuracy/ Frequency Response:	±5% at 1 kHz, ±7.5% 300 Hz to 3.5 kHz with de-emphasis filter cornered at 100 Hz

Specifications – *Continued*

TRUNKING (OPTIONAL FEATURE)

Signaling Types:	SMARTNET, SMARTZONE (Type I, Type I EP II, Type II), ASTRO VSELP (optional). ASTRO testing in the Trunked mode is limited to functional verification of operation on a traffic channel. More detailed testing of Data, BER and Encryption must be done in conventional mode through use of the ASTRO option.
Call Sequence Tests:	Dispatch Phone Interconnect Call Alert Failsoft
Trunking Test Parameter Entries:	(Dependent on Test Selection) Signaling Type Call Sequence System ID Size Code Connect Tone Frequency Band Control and Traffic Channel (by frequency and channel number)
Test Measurement Display:	Call Sequence Status Indicator Radio ID (Hex or Decimal) Call Type RF Performance Data (via exit to standard screens)
Radio ID Decoding:	Type I: Fleet, Sub-fleet & Unit ID Type II: Talk Group, Unit ID
Smart Zone ™ Test Support:	Auto affiliation test
Frequency Bands:	851-870 MHz, 866-870 MHz Split Channel 935-941 MHz, 850-860 MHz JSMR 403-522 MHz UHF, 132-175 MHz VHF
Generate Deviation Selection:	1 kHz, 2.4 kHz, 3.0 kHz
Type I System Configuration Storage:	Non-volatile storage of up to 10 fleet maps with alpha numeric entries
Channel Plan Entry for VHF/UHF:	Separate transmitter and receiver start-and-end frequency for three blocks. Independent channel spacing for each block.

NON-TRUNKED DIAGNOSTIC OPTIONS

Project 25 Standard (Optional Feature)

Voice Testing:	Project 25-compatible IMBE vocoder for both generator and receiver provides functional voice testing capability via internal speaker and microphone accessory. Scope display of voice waveform can also be selected.
EMBEDDED SIGNALING Encode Capability:	Link Control Field (LCF) Low Speed Data (LSD) Key ID Network ID Status Symbol
Encode Operator Entry:	A default configuration can be selected or a detailed special screen can be accessed for customized programming.
Decoding Operation:	A dedicated screen may be selected to display and decode the same data as described in the encode section. The unit can also buffer 30 frames of data on a first-in/first-out basis with the capability to selectively recall any of the stored frames to the screen.

Project 25 Standard (Cont.)

BER Capability:	Compute BER from received non-encrypted 1011 Hz tone test pattern. Generate non-encrypted 1011 Hz tone test pattern or a calibration test pattern (generates 4.977% BER)for UUT BER calculation with Project 25 test mode.
Encryption Capability:	DES-OFB, DVP-XL, DES-XL, DVI-XL. For each of these algorithms, the unit can accept a test key from the R-2670 and can accept customer keys from the following Motorola external key loaders: T 3011DX, T 3012DX, T 3013DX and T 3014DX. Project 25-compatible single key software encryption. A single side connector is provided for key loading.
Generate Capability:	Project 25 Standard Voice Frames containing both IMBE vocoded voice and embedded signaling, a standard 1011 Hz tone test pattern, a calibration test pattern and a standard silence test pattern.
Monitor Capability:	Either Project 25 Standard Voice Frames containing IMBE vocoded voice and embedded signalling or a standard 1011 Hz tone test pattern.

ASTRO VSELP (Optional Feature)

Voice Testing:	ASTRO VSELP-compatible vocoder for both generator and receiver provides functional voice testing capability via internal speaker and microphone accessory. Scope display of voice waveform can also be selected.
EMBEDDED SIGNALING Encode Capability:	Link Control Field (LCF) Presentation Address (PA) Key ID Network ID Busy Bits
Encode Operator Entry:	A default configuration can be selected or a detailed special screen can be accessed for customized programming.
Decoding Operation:	A dedicated screen may be selected to display and decode the same data as described in the encode section. The unit can also buffer 30 frames of data on a first-in/first-out basis with the capability to selectively recall any of the stored frames to the screen.
BER Capability:	Free running, unframed V.52 pseudo random non-encrypted sequence compatible with ASTRO VSELP test mode. Measurement range from 0 to 20% bit errors.
Encryption Capability:	DVP-XL, DES-XL, DVI-XL. For each of these algorithms, the unit can accept a test key from the R-2670 and can accept customer keys from the following external key loaders: T 3011DX, T 3012DX, T 3013DX and T 3014DX. ASTRO VSELP-compatible single key software encryption. A single side connector is provided for key loading.
Generate Capability:	ASTRO Voice Frames containing both VSELP vocoded voice and embedded signaling or an unframed V.52 pseudo random non-encrypted sequence.
Monitor Capability:	ASTRO Voice Frames containing both VSELP vocoded voice and embedded signaling or an unframed V.52 pseudo random non-encrypted sequence.
Duplex Capability:	An unframed V.52 pseudo random non-encrypted sequence.

SECURENET (Optional Feature)

Voice Testing:	SECURENET compatible vocoder for both generator and receiver provides functional voice testing capability via internal speaker and microphone accessory. Scope display of voice waveform can also be selected.
Encryption Capability:	DVP, DVP-XL, DES, DES-XL, DVI-XL For each of these algorithms, the unit can emulate an AX, BX or CX-type key loader to load test keys to a compatible radio. It can accept actual keys from the following external key loaders: T 3010DX, T 3011DX, T 3012DX, T 3013DX and T 3014DX. A single side connector is provided for key loading.
End of Message Test:	The signaling tone that terminates a SECURENET transmission can be detected and displayed to the operator.
BER Capability:	Free running, unframed V.52 pseudo random non-encrypted sequence. Measurement range from 0 to 20% bit errors.

Interface Ports

Printer/Remote Control:	RS-232 DB25 (female)
Color Monitor:	Standard CGA, RGB DB9 (female)

Metering & Measurement

SPECTRUM ANALYZER SEE AND HEAR™	
Frequency Range:	400 kHz to 1 GHz
Dispersion:	Selectable from keypad per following: 200 kHz window - (20 kHz per division) 500 kHz window - (50 kHz per division) 1 MHz window - (100 kHz per division) 2 MHz window - (200 kHz per division) 5 MHz window - (500 kHz per division) 10 MHz window - (1 MHz per division) 20 MHz window - (2 MHz per division) 50 MHz window - (5 MHz per division) 100 MHz window - (10 MHz per division)
Dynamic Range:	60 dB
Bandwidth:	Automatically selected: 6 kHz - (100 kHz per division & below) 30 kHz - (200 kHz per division & above)
Display Range:	+50 to -95 dBm
Markers:	Freeze, Max Hold, Peak Hold Delta or Absolute Level and Frequency
SIGNAL STRENGTH INDICATOR	
Range:	3 MHz to 1 GHz
Accuracy:	±4 dB
Sensitivity:	-100 dBm (antenna port rating)
WATTMETER (RF I/O PORT)	
Frequency Range:	3 MHz to 1 GHz
Measurement Range:	.1 watt to 125 watts
Input Impedance:	50 ohms with maximum VSWR of 1.5:1
Accuracy:	±10%
Protection:	Over temperature alarms
TRACKING GENERATOR	
Frequency Range:	400 kHz to 1 GHz
Tracking Display Sweep Range:	200 kHz window - (20 kHz per division) 500 kHz window - (50 kHz per division) 1 MHz window - (100 kHz per division) 2 MHz window - (200 kHz per division) 5 MHz window - (500 kHz per division) 10 MHz window - (1 MHz per division) 20 MHz window - (2 MHz per division) 50 MHz window - (5 MHz per division)

Metering & Measurement (Cont.)

Display Range:	0 to -80 dBm
CABLE FAULT	
Method:	Standing Wave Analysis
Measure:	Fault distance, cable length
Reading:	Feet and meters
Accuracy:	10%
OSCILLOSCOPE	
CRT Size:	9 cm x 11 cm (approx. 7 inch diagonal)
Frequency Response:	0 to 50 kHz
Vertical Input Ranges:	Selectable per the following: 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1v, 2v, 5v, 10v per division
Accuracy:	5% of full scale all ranges
Sweep Ranges:	Selectable per the following: 20 usec, 50 usec, 100 usec, 200 usec, 500 usec, 1 msec, 2 msec, 5 msec, 10 msec, 20 msec, 50 msec, 100 msec, 200 msec, 500 msec, 1 sec per division
Trigger:	Automatic, normal, and single sweep
Markers:	Delta Voltage, Delta Frequency, Delta Period
DIGITAL VOLTMETER	
Meter Type:	RMS
Frequency Range:	DC plus AC of 50 Hz to 20 kHz
DC Voltage Ranges:	1.0 V, 10.0 V, 100.0 V full scale
Accuracy:	1% full scale ±1 least significant digit
AC Voltage Ranges:	1.0 V, 10.0 V, 70.0 V full scale
Accuracy:	5% full scale ±1 least significant digit
Freq. Response:	3 dB end points @ 50 Hz and 20 kHz
FREQUENCY COUNTER	
Frequency Range:	5 Hz to 500 kHz plus Auto Tune
Period Counter Range:	5 Hz to 20 kHz
Input Level:	0.1 v RMS minimum input level
Resolution:	0.1 Hz, 1 Hz, 10 Hz, 100 Hz, and 1kHz varying by frequency range
Auto Tune:	Monitor mode, 20 MHz to 1 GHz, unit will scan and find signals greater than -30 dBm
Accuracy:	See **TIME BASE**
SINAD/DISTORTION METER	
Input Level:	0.1 V to 10 V RMS
SINAD Accuracy:	±1 dB at 12 dB SINAD
Distortion Range:	1% to 20%
Distortion Accuracy:	±0.5% of distortion or ±10% of reading whichever is greater
Optional:	C-Message Filter; CCITT Filter w/ 600 ohm switchable load
TONE SEQUENCE DECODE	
Modulation types:	PRIVATE LINE, DIGITAL PRIVATE LINE, Single Tone, DTMF, Two-Tone Paging, 5/6 Tone Paging, International Select V, 20 Tone General Sequence.
Frequency Accuracy:	±3% from 300 Hz to 3 kHz
Duration Accuracy:	±12 msec for tones greater than 30 msec and 300 Hz

RS232 PORT (Requires Special Cable)
Bi-directional port provided with capability to respond to serial input command vocabulary to activate standard functions and return measured results. Baud rates to 9600 bps with selectable start, stop and parity bits.

TIME BASE	
Standard OCXO:	Aging .5 ppm/yr, Temperature .05 ppm

Power and Environment

AC:	100 to 130 VRMS or 200 to 260 VRMS @ 50 Hz to 440 Hz
DC:	+11 to +16 VDC
Battery Option:	13.6 V, 50 minutes typical
Dimensions:	8.5" high x 16" wide x 17" deep (21.6 cm x 40.7 cm wide x 43.2 cm) excluding accessories, battery pack and cover
Weight:	36 pounds (Basic model excluding accessory cover)
Temperature:	0° C to +50° C (operating) -40° C to +85° C (storage)

Accessories

ACCESSORIES SUPPLIED

The following accessories are included with the R-2670A but can also be ordered separately.

Microphone	HMN-1056D
Power Cord	30-80397A62
Whip Antenna	TEKA-24A
Signal Generator Termination (50 Ohm)	58-80386B73
Oscilloscope Probe	RTL-4011A
BNC to N Adapter	58-84300A98
DC Power Connector Kit	RPX-4097A
Spare RF Fuses	GG-6530277C002
R-2670 Operator's Manual	68-80309F17
RF Detector Probe (req'd for Cable Fault testing)	RTL-4075A
BNC RF "T" (req'd for Cable Fault testing)	09-82578B01

OPTIONAL ACCESSORIES

Key loading cables/adapter for encrypted operation–	
KVL to R-2670 & R-2670 to MX Radio	RTK-4012A
R-2670 to MICOR	RTK-4011A
R-2670 to SYNTOR X	RTK-4051A
R-2670 to EXPO	RTK-4070A
R-2670 to SABER/ASTRO	01-80358A60
Adapter for R-2670 to SPECTRA (also requires RTK-4070A)	TRN-7414A
R-2670 to MTS2000	30-P30984C007
R-2670 to MCS2000	30-P30984C008
Isolation Transformer for Meter Input	01-80302E83
Isolation Transformer for Baseband Output	01-80302E82
Battery Pack	RPN-4000A
Canvas Case	15-80357B77
Transit Case	A-001
Telescoping Antenna	RTA-4000A
RF Detector (50 ohm Termination)	58-80345B96
Serial/Parallel Dot Matrix Printer	RLN-4375A
Serial Printer Cable	30-80387B58
CGA Monitor Cable (DB9M-DB9M)	30-80387B60
RS232 Cable (DB25M-DB9F)	30-80387B59
RS232 Adapter (DB9M-DB25F)	HLN-9390A
Programming Reference Manual (RS232 & IEEE)	68-80309E55
Service Manual	RLN-4120C

Project 25 is the creation of the Association of Public Safety Communications Officials (APCO). Project 25 brings together representatives of federal, state and local government agencies. These agencies and other user organizations evaluate basic technologies in advanced land mobile radio to find solutions that best serve the needs of the public safety marketplace. The committee has encouraged participation by many international public safety organizations. The National Association of State Telecommunications Directors (NASTD), National Communications Systems (NCS), National Telecommunications & Information Agency (NTIA) and the Department of Defense (DOD) are all actively involved in the development of these user-driven standards.

Model Nomenclature

Communications System Analyzer with FDMA Digital Capability includes High Stability, Tracking Generator, Cable Fault, High Performance Spectrum Analyzer with Markers and Programmable Test SetupsMemory as Standard Features.
R-2670A

Selection Guide to R-2670 Options and Retrofits

Trunking Options

Description	Part #
Motorola Analog Trunking (SMARTNET, SMARTZONE)	RLN-4498
Motorola Analog Trunking with ASTRO Trunking	RLN-4497A

Non-Trunked Diagnostic Options

Optional diagnostic capabilities consist of a common hardware module, selectable transmission format options and, and if desired, additional encryption options.

Hardware Module (Required with any of the following)

Description	Part #	Retrofit Model*
Conventional (non-encrypted)	CM-701	CR-701

Transmission Formats (Select Any Combination)

Description	Part #	Retrofit Model*
SECURENET (Requires encryption option selection)	CM-711	CR-711
ASTRO VSELP	CM-712	CR-712
Project 25 Compliant	CM-713	CR-713

Encryption Options (Select Only One)

Description	Part #	Retrofit Model*
Project 25 Compliant: DES-OFB**	CM-702	CR-702
Project 25 Compliant: DES-OFB retrofit***		CR-703
U.S.: DES-OFB, DES, DES-XL, DVP, DVP-XL	CM-704	CR-704
International: DVI-XL, DVP, DVP-XL	CM-705	CR-705

Additional Options

Description	Part #
C Message Filter with 600 ohm selectable meter load	RLN-4034A
CCITT Filter with 600 ohm selectable meter load	RLN-4361A
Phase Modulation/ Demodulation	RLN-4484A

**All Retrofits require the installation, test and callibration kit (part # REX-4309).*
***Not applicable to ASTRO VSELP or SECURENET.*
****Can only be added to R-2670 models which have Options RLN-4495 or RLN-4492 already installed. Also requires the CR-713.*