MOTOROLA ELECTRONIC MOBILE EXCHANGE (*EMX*®)*

RADIO EQUIPMENT INTERFACE

ALIGNMENT INSTRUCTIONS

1. GENERAL

1.01 This appendix supplements Section 405-100-900PT. It covers tests for aligning the transmission path used in the Motorola Electronic Mobile Exchange (***EMX***®) System.

1.02 (Reserved for future use.)

1.03 Tests covering individual module line-up, sectional line-ups and overall system continuity check are included here. Sectional tests cover EMX to Base Station Controller (BSC), and BSC to Transmitter Analog Interface/Receiver Interface (TXIA/RXI). Prior to turning up for service, Tests A through H (Chart A) should be conducted in the order presented.

Note: Prior to Modular and Sectional Tests, all carriers and metallic facilities should be aligned. All external channels should be installed and tested per Circuit Layout Record (CLR) specifications.

1.04 The last test, I, (Chart C) is to be used as an overall check of system transmission continuity if trouble is suspected. As trouble is isolated with a sectional test the module tests will be useful.

1.05 Due to characteristics of the Voice-Operated Gain Adjusting Device (VOGAD) and Signal Operated Noise Adjusting Device (SONAD) units associated with the BSC, circuit ***line-ups*** shall be made on both sides but not through the BSC. (VOGAD and SONAD alignment are covered in Motorola EMX Vol V, Maintenance.) In effect, one circuit will be lined up between the EMX and the BSC and another between the BSC and the TXIA/RXI. Exhibits 1 and 2 show typical configurations of these circuits.

Note: It should be understood that actual circuit layouts may differ and for maintenance purposes local records must be consulted for specified Transmission Level Points (TLPs).

1.06 Information on subjects other than transmission, such as installation and maintenance of EMX is contained in Motorola EMX instruction manuals furnished with the equipment. Section 405-100-900PT, a cover sheet for these manuals, contains a complete index.

1.07 A list of recommended test equipment is given in Table A.

1.08 Telco-Bantam-type test cords are required for connection to Motorola EMX equipment.

1.09 Throughout these tests some measurements are specified as terminated and others on a bridged, high impedance basis. Care must be exercised to make this distinction and adhere to each measurement mode.

1.10 Measurement jacks on the Motorola equipment are labeled as follows:

T — terminate Ohms impedance (600)
B — bridge (high impedance)
INT LEV ADJ — internal level adjust (high impedance)

(a) The terminate jack (T) is used to break the line associated with it and allow access to board circuitry. The impedance at this point is always 600 Ohms.

(b) The bridging jack (B) is used to monitor or test input or output of a particular function without breaking the line. A high impedance (100K Ohms) meter is used here.

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Note: If it is desired to isolate and test the line side of a circuit connected to a circuit card equipped with B and T-jacks, a dummy or "open" plug must be used. Insert the dummy plug into the T-jack to disconnect the equipment and connect test equipment to the B-jack. In this case, a terminated meter (600 Ohms impedance) should be used at the B-jack.

(c) The internal level monitoring jack, designated INT LEV ADJ, is used to measure the single-ended internal board level. The ring side of this jack is connected to the circuit board ground and the tip side of the jack goes to a high impedance (4.7K Ohms) internal point on the board. Therefore, a high impedance AC voltmeter (∿100K Ohms) must be used for measurements made at this point.

1.11 In the following module tests, there are requirements for strapping attenuators. The method for strapping is described in Motorola EMX Volume V under "System Optimization".

TABLE A

TRANSMISSION TEST EQUIPMENT
Transmission Measuring Set (TMS) — Hewlett Packard-HP3551, HP3552 or equivalent
Audio Frequency Counter — Hewlett Packard-HP5381 or equivalent (if not incorporated in Transmission Measuring Set)
Test cords equipped with Bantam plugs

CHART A

TRANSMISSION ALIGNMENT TESTS

STEP	PROCEDURE
	REFER TO EXHIBIT 1 (TESTS A THROUGH H)
	TEST A. ALIGNMENT OF RADIO CHANNEL INTERFACE (RCI) MODULE
	Note: The TX Input Pad (23.0dB) should be left strapped in. The TX Output Pad (23dB) should be left strapped in for carrier, strapped out for metallic facility.
1	At the TX INPUT T-jack (J1-T), send 1004Hz at a level of +7.0dBm.
2	Measure (high impedance) at the INT LEV ADJ (J2) jack and adjust TX INT LEV (R10) for a TMS reading of −16.0dBm.
3	Measure (terminated) at the TX OUTPUT jack (J3-T) and adjust TX OUT LEV ADJ (R14) for: (a) A level of −16.0dBm if facility is carrier, or (b) A level of 0.0dBm if facility is metallic. *Note:* Strap the RX Input Pad for 23.5dB loss if the receive facility is carrier or 17.0dB loss if the receive facility is metallic.

CHART A (Contd)

STEP	PROCEDURE
4	At the RX INPUT T-jack (J5-T), send 1004Hz at a level of: (a) +8.0dBm if facility is carrier, or (b) +1.0dBm if facility is metallic.
5	Measure (high impedance) at RX INT LEV ADJ jack (J4) and adjust RX INT LEV (R93) for −16.0dBm.
6	Measure (terminated) at the RX OUTPUT jack (J6-T) and adjust RX OUT LEV (R116) for −15dBm.
7	Remove all test cords.
	TEST B. ALIGNMENT OF TRANSMITTER AUDIO CONDITIONING (TAC) MODULE
1	Place the VOGAD in the bypass mode by entering command H-F7 at the TTY terminal keyboard.
2	At the INPUT T-jack (J1-T), send 1004Hz at a level of 0.0dBm.
3	Strap the TX INPUT pad for 16.0dB loss. Measure (high impedance) at INT LEV ADJ jack (J2) and set INT LEV ADJ control (R160) for −16.0dBm.
	Caution: Observe antistatic measures in the following tests when handling cards.
4	Arrange Amplifier U1 for 23.0dB of gain (strap U1, pin 3 to 8) and while measuring (terminated) at OUTPUT T-jack (J3-T), set OUTPUT LEV ADJ (R172) for a level of +9.0dBm.
5	Remove all test cords and return the VOGAD to normal by entering H-FF at the TTY terminal keyboard.
	TEST C. ALIGNMENT OF RECEIVER AUDIO CONDITIONING (RAC) MODULE WITH OR WITHOUT VOTER CONNECTION
1	Place the SONAD in the bypass mode by entering the command H-FB on the TTY terminal keyboard.
2	At the INPUT T-jack (J1-T), send 1004Hz at a level of −1.0dBm.
3	Strap the RX INPUT pad for 15.0dB loss. Measure (high impedance) at INT LEV ADJ jack (J2) and adjust the INT LEV ADJ control (R9) for a level of −16dBm.
	Note: If the RAC is optioned for connection to a receiver voter proceed with Step 4, otherwise, go to Step 7.

CHART A (Contd)

STEP	PROCEDURE
4	Strap the VOTER OUTPUT pad for 0.0dB loss. Measure (terminated) at OUT-TO-VOTER jack (J3) and adjust OUT-TO-VOTER LEV ADJ control (R47) for: (a) −1.0dBm if receiver voter is located within the same building (or complex), or (b) +9.0dBm if receiver voter is located at a distant location.
5	Strap the VOTER INPUT pad for 15.0dB loss. Arrange for 1004Hz at a level of −1.0dBm to be applied at VOTER IN. (The jack on RAC module is not available.)
6	Measure (high impedance) at IN-FROM-VOTER jack (J4) and adjust INT LEV ADJ control (R67) for −16.0dBm.
7	Strap the RX OUTPUT pad for 0.0dB loss. Measure (terminated) at OUPUT T-jack (J5-T) and adjust OUT LEV ADJ for +1.0dBm.
8	At the STAT IN T-jack (J6-T), send 1004Hz at a level of −1.0dBm.
9	Strap the TXI STATUS INPUT pad for 15.0dB loss. Measure (high impedance) at the STAT IN INT LEV ADJ jack (J7) and adjust STAT IN INT LEV ADJ control (R116) for a level of −16.0dBm.
10	Remove all test cords and return the SONAD to normal by entering the command I-FB on the TTY terminal keyboard.
	TEST D. ALIGNMENT OF TRANSMITTER ANALOG INTERFACE CONTROL (TXIA) MODULE
1	At the INPUT T-jack (J1-T), send 1004Hz at a level of −1.0dBm.
2	Strap the TX INPUT pad for a loss of 15.0dB. Measure (high impedance) at INT LEV ADJ jack (J2) and set the INT LEV ADJ control (R9) for −16dBm.
3	Strap the LINE LEVEL jumpers for a LINE DRIVER gain of 25.0dB (R44 to U20 pin 2, and U20 pin 3 to C18).
4	Measure (terminated) at the OUTPUT T-jack (J3-T) and adjust OUTPUT LEVEL ADJ control (R44) for a level of +9.0dBm.
5	Remove all test cords.
	TEST E. ALIGNMENT OF TXIA LINE DRIVER MODULE
1	Measure (terminated) the level of 2950Hz signal. Adjust (Status) OUTPUT LEV ADJ control (R158) for −11.0dBm.

CHART A (Contd)

STEP	PROCEDURE
2	Remove test cord.
	TEST F. ALIGNMENT OF RECEIVER INTERFACE (RXI)
1	At the INPUT T-jack (J1-T), send 1004Hz at a level of: (a) +9.0dBm if base receiver or receiver voter is connected to the RXI input and located within the same building (or complex), or (b) −1.0dBm if receiver voter is connected to the RXI input and located at a distant location.
2	Measure (high impedance) at INT LEV ADJ jack (J2) and adjust INT LEV ADJ control (R5) for a level of −16.0dBm.
3	Strap RX OUTPUT pad for 0.0dB loss. Measure (terminated) OUTPUT T-jack (J3-T) and adjust OUTPUT LEV ADJ control (R13) for +9.0dBm.
4	Remove test cords.

CHART B

SECTIONAL LEVEL TESTS

STEP	PROCEDURE
	REFER TO EXHIBIT 2 (TEST G AND H).
	TEST G. SECTIONAL LEVEL TEST — EMX TO BSC AND BSC TO EMX
1	Place the VOGAD in the bypass mode by entering the command H-F7 on the TTY terminal keyboard.
2	At the EMX Test Port, send 1004Hz at 0.0dBm.
3	Measure (terminated) at the BSC/TAC OUTPUT T-jack (J3-T). The received level should be +9.0dBm ±0.5. If not, sectionalize level problem to the TAC, RCI or facilities by using test jacks illustrated in Exhibit 2 and take corrective action. Repeat appropriate line-up tests and confirm level of +9dBm ±.5.
4	Restore the VOGAD to normal by entering H-FF at the TTY terminal keyboard.

CHART B (Contd)

STEP	PROCEDURE
5	At the BSC/RAC place an "open" plug in OUTPUT T-jack (J5-T). Send 1004Hz at 0.0dBm level into OUTPUT B-jack (J5-B).
6	Measure (terminated) at the EMX Test Port RCV jack. The received level should be 0.0dBm ±0.5. If received level is not within limit, sectionalize level problem to the RCI or facilities by using test jacks illustrated in Exhibit 2 and taking corrective action. Repeat appropriate line-up tests and confirm level of 0.0dBm.
7	Remove all test cords.
8	Restore VOGAD by entering H-FF at the TTY terminal keyboard.
	TEST H. SECTIONAL LEVEL TEST — BSC TO TXIA AND RXI TO BSC
1	At the BSC/TAC, place an "open" plug in OUTPUT T-jack (J3-T).
2	Send 1004Hz at −4.0dBm into OUTPUT B-jack (J3-B).
3	Measure (terminated) at the TXIA OUTPUT T-jack (J3-T). The received level should be −4.0dBm ±0.5. If not, sectionalize level problem to the TXI or facility by using test jacks illustrated in Exhibit 2 and taking corrective action. Repeat appropriate line-up tests and confirm level of −4.0dBm ±.5.
4	Bypass the SONAD by entering H-FB on the TTY terminal keyboard.
5	At the RXI INPUT T-jack (J1-T), send 1004Hz at a level of: (a) −4.0dBm if base receiver or receiver voter is connected to the RXI input and located within the same building (or complex), or (b) −14.0dBm if receiver voter is connected to the RXI input and located at a distant location.
6	Measure (terminated) at the BSC/RAC OUTPUT T-jack (J5-T). The received level should be −12.0±0.5. If received level is not within limit, sectionalize level problem to the RXI, RAC or facilities by using test jacks illustrated in Exhibit 2 and taking corrective action. Repeat appropriate line-up tests and confirm a level of −12.0dBm ±0.5.
7	Remove all test cords.
8	Restore the SONAD to normal by entering I-FB on the TTY terminal keyboard.

CHART C

TRANSMISSION CONTINUITY VERIFICATION

STEP	PROCEDURE
	REFER TO EXHIBIT 2.
	TEST I. OVERALL SYSTEM TRANSMISSION CONTINUITY TEST
	Note: This test is reserved for use ***only*** in verifying overall transmission continuity and is ***not*** to be used for adjusting any levels. Bridge readings only are taken at the internal level points. System design was arranged so that when the correct level is applied at the EMX Test Port or the RXI input, -29.0dBm (a bridged measurement) should be read at the internal level jacks (J2/J4) throughout the system. When transmission level problems are suspected, a quick system check may be made as follows:
1	Bypass the VOGAD by entering H-F7 at the TTY keyboard.
2	At the EMX Test Port XMT jack, send 1004Hz at a level of −13.0dBm.
3	Arrange for RCI, BSC/TAC and TXIA locations to verify the 1004Hz test tone level with a bridge reading at their internal level jacks, J2. The received level should be −29.0dBm ±1.0dB.
4	If a level discrepancy appears, use Tests G and H, and Chart A to localize the problem. If levels are within limits, restore the VOGAD by entering H-FF at the TTY terminal keyboard.
5	Bypass the SONAD by entering H-FB at the TTY terminal keyboard.
6	At the output of the base receiver, send 1004Hz at a level of −4.0dBm. ***Alternate procedure:*** Use ***ONLY*** when the RXI input is connected to a base receiver. At the RXI INPUT T-jack (J1-T), send 1004Hz at a level of: (a) −4.0dBm if base receiver is located within the same building (or complex), or (b) −14.0dBm if base receiver is located at a distant location.
7	Arrange for RXI, BSC/RAC, RCI and EMX Test Port locations to verify the 1004Hz test tone level with a bridged reading at their internal level jacks. RXI — Jack J2 RAC — Jack J2 (if connected to a RXI) Jack J4 (if connected to a receiver voter) RCI — Jack J4

CHART C (Contd)

STEP	PROCEDURE
	The received level (bridged measurement) should be -29.0dBm, ±1.0dB. EMX Test Port — RCV jack The received level (terminated measurement) should be −12.0dBm, ±1.0dB.
8	Again, if a level discrepancy appears, use Tests G and H, and Chart A to localize the problem. If levels are within limits, restore the SONAD by entering I-FB at the TTY terminal keyboard.

2. TEST COMPLETION

2.01 Upon successfully completing the EMX to base station transmission tests the base station should be properly adjusted. This should include:

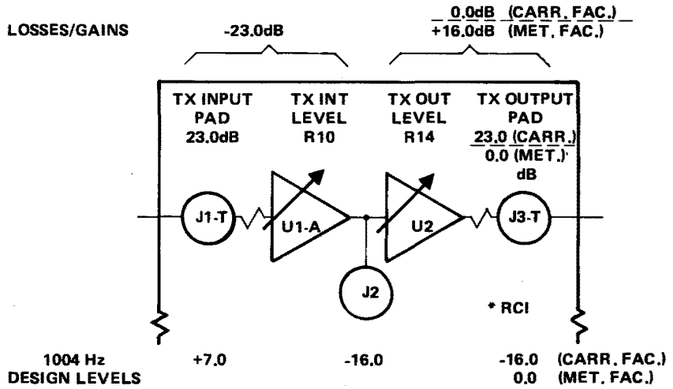
(a) Preliminary base transmitter modulation limiting adjustments and base receiver/voting selector adjustments.

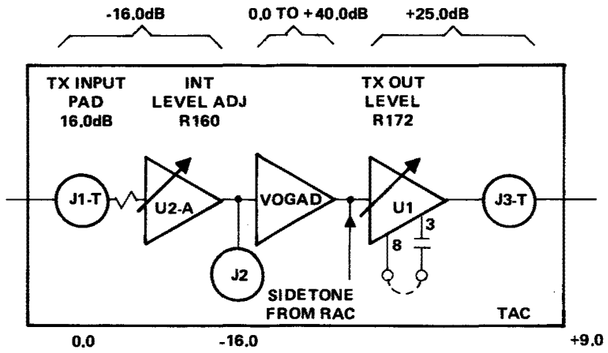
(b) Preliminary Facility Tests for frequency characteristic, noise and crosstalk requirements for radio.

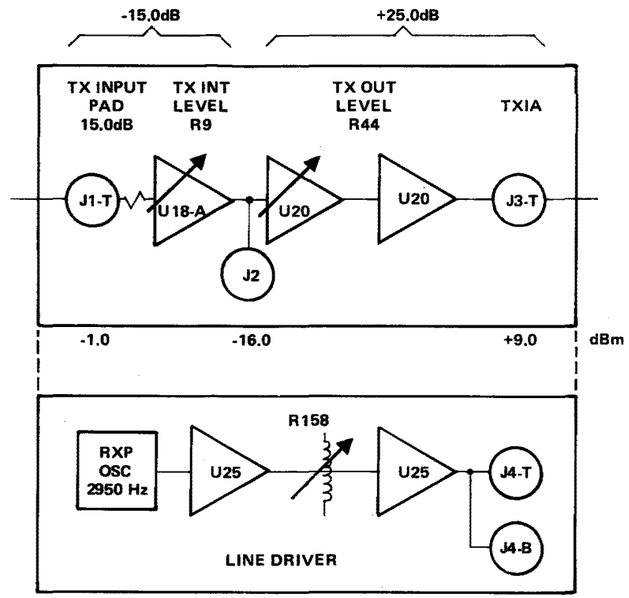
(c) Overall transmitter modulation adjustment with line-up tone and subsequent check of deviation at signaling frequencies.

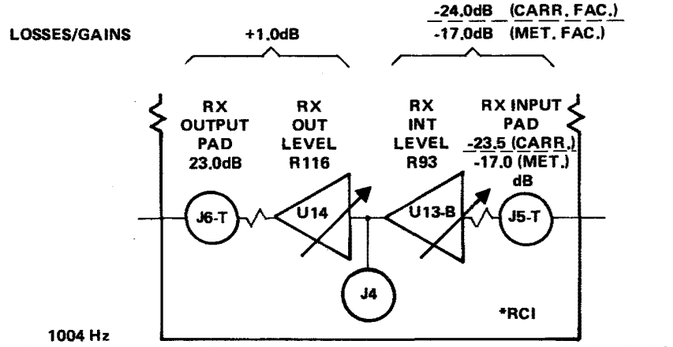
(d) Overall base receiver/voting selector system check and adjustment using modulated RF signal at input to receiver.

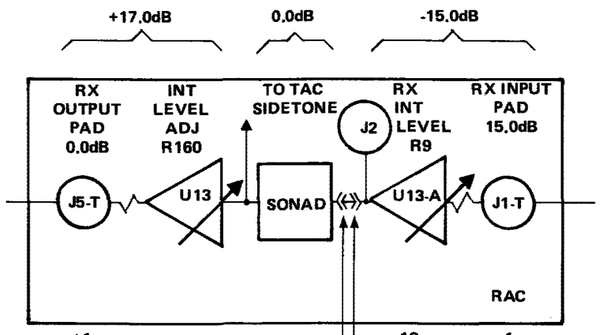
2.02 Base station equipment involved could be any of several manufacturers and vintages. For these tests refer to Sections 404-000-000PT, 404-100-XXX, and 405-200-XXX.

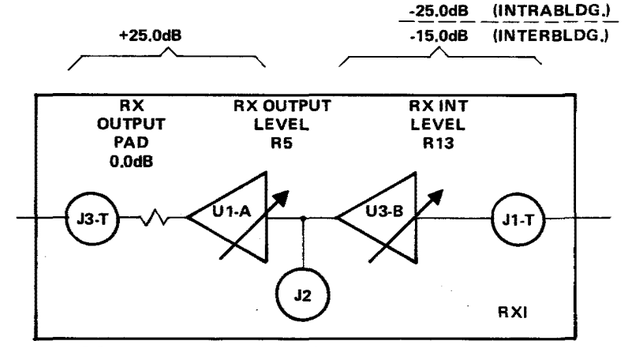


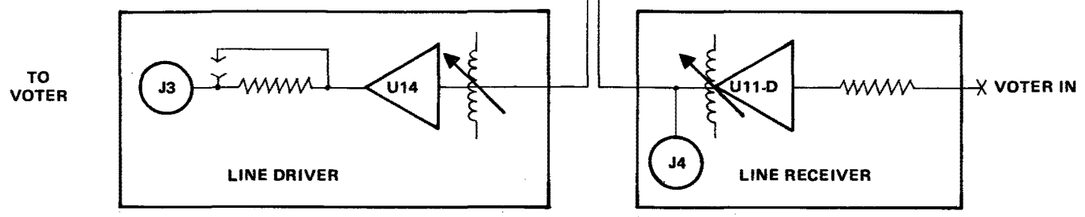






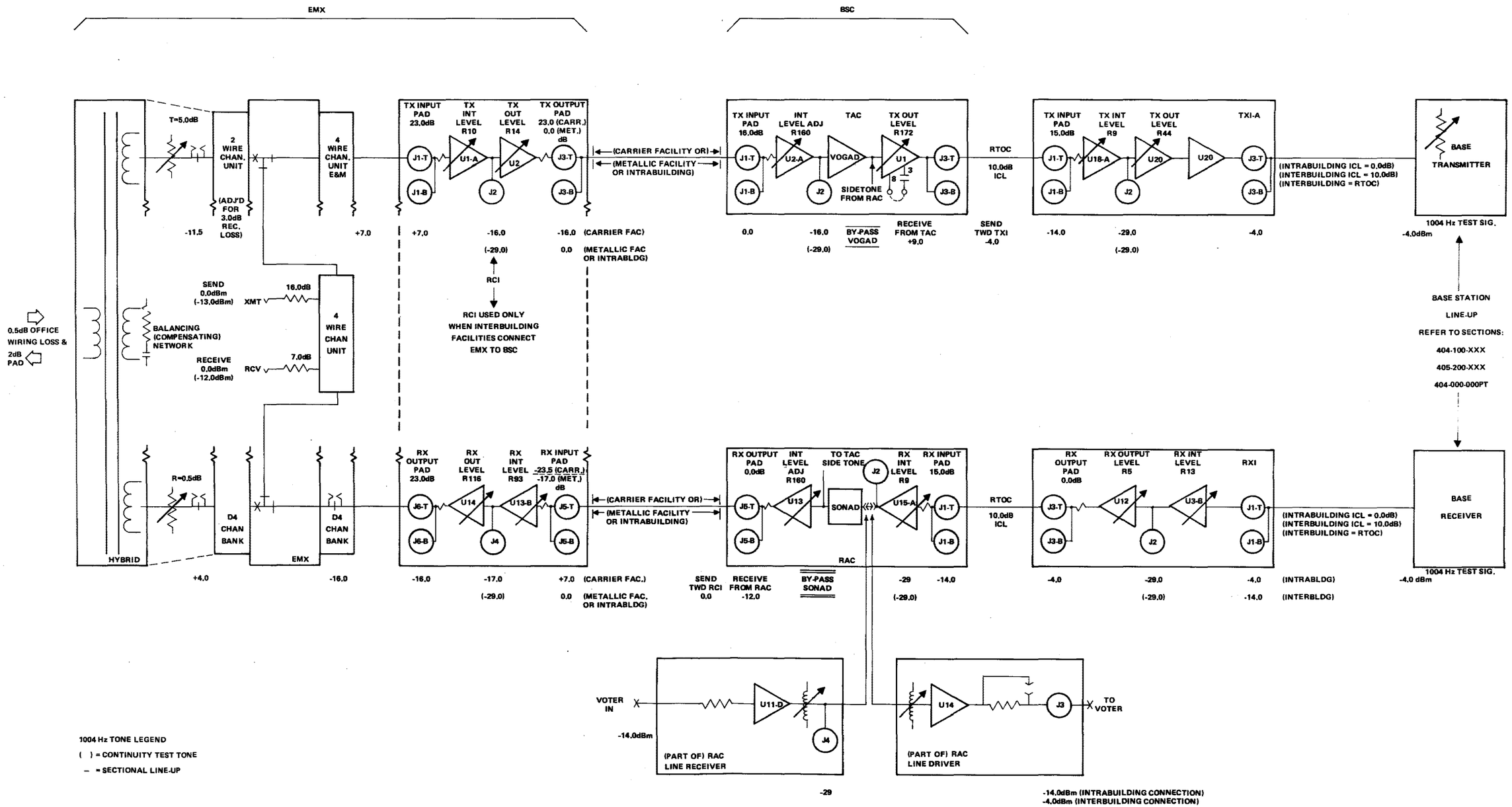






* USED ONLY WHEN INTERBUILDING FACILITIES CONNECT EMX WITH BSC.

Individual EMX Modules and Line-up Levels
Exhibit 1



Typical IMTS Layout with Overall 1004Hz Line-up Levels
Exhibit 2 .