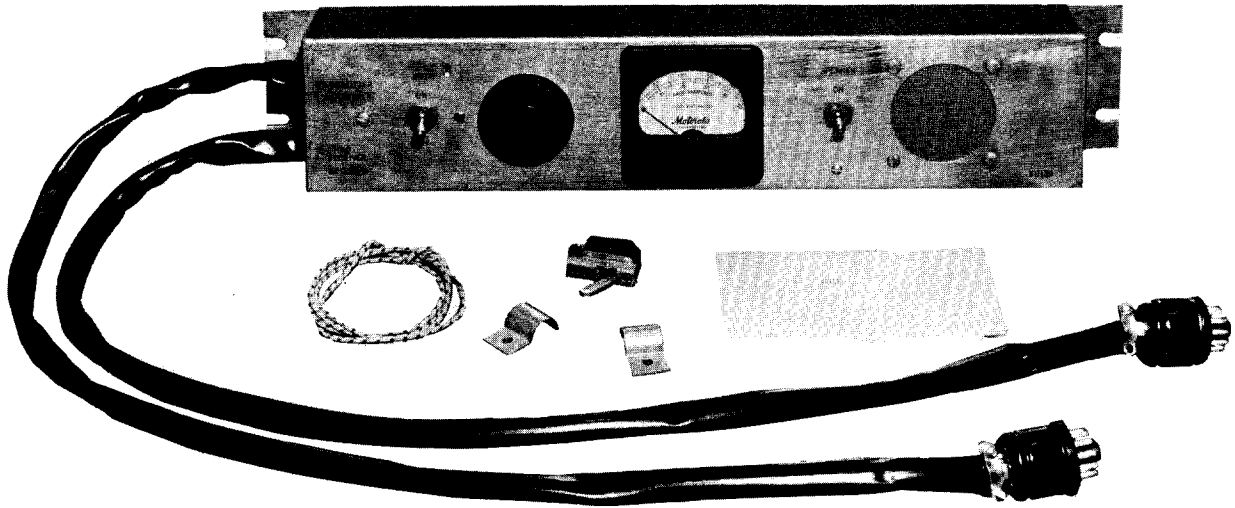


MOTOROLA

UNIVERSAL METERING KIT

Model TU-139A



1. DESCRIPTION

Motorola Model TU139A Universal Metering Chassis Kit is designed for application in Motorola base station models which do not incorporate standard "in-place" metering facilities. It is particularly suited for weatherproof, outdoor type cabinet installations. The unit incorporates complete metering and control facilities essential to tuning and checking the receiver and transmitter at the immediate location. Metering is accomplished by means of a 0-50 microammeter in series with a resistor. This combination is used for checking grid voltage, plate voltage and plate current. The specific circuits to be measured are accessible through metering receptacles on Motorola transmitter and receiver chassis. The metering chassis incorporates a rotary selector switch and attached cables and plugs which connect into the metering receptacles on the radio equipment chassis. The meter face has two graduated scales, 0-50 microamperes and 0-250 milliamperes. The microampere scale is used for all receiver

meter readings and all transmitter meter readings except power amplifier plate current which is read on the 0-250 milliampere scale. A chassis mounted speaker and a transmitter "on-off" switch are also incorporated to facilitate receiver monitoring and transmitter actuation for local test purposes.

The basic components and circuitry of the TU139A are built onto a strip type chassis which may be mounted on any standard 19" base station rack. In normal installations, the chassis is mounted directly above the transmitter or receiver. The metering cables need only be connected to the METER receptacles of the receiver and transmitter (exciter in 65 & 100 watt models) when the unit is initially installed. Specific design permits the transmitter (exciter) and receiver circuits to be metered alternately without repositioning the meter cables. (NOTE: For two receiver stations, the receiver metering cable must be alternately connected from one receiver to the other depending upon which receiver is being



MOTOROLA INC.

Communications Division

ENGINEERING PUBLICATIONS

4501 WEST AUGUSTA BOULEVARD

CHICAGO, ILLINOIS 60651

Copyright 1967 by Motorola, Inc.
Printed in U. S. A.

5/8/67-UP

-1-

68P849662
Issue - H

tested. In 65 & 100 watt stations the transmitter metering cable must alternately be connected between the exciter and final amplifier depending upon which one is being tested. The metering cables are of sufficient length to accommodate these connections.)

A spdt front door interlock switch is supplied with the metering chassis to insure that the transmitter will not be inadvertently keyed by the metering chassis XMTR "ON-OFF" switch when the cabinet door is closed. When the TU139A Universal Metering Chassis Kit is incorporated in a base station cabinet, this interlock should be installed in place of the standard spst interlock switch which is normally used in the cabinet. The new interlock switch "breaks" the local XMTR ON-OFF circuit when the front door is closed and the transmitter remote control circuit when the door is open.

The TU139A Universal Metering Chassis lends itself readily for installation in 25-50 mc, 70-88 mc, 144-174 mc, 406-470 mc and 890-960 mc base station equipment with only slight modifications to accommodate specific applications.

CAUTION

Only a metering chassis having a suffix of -1 or higher (such as TU139A-1, etc.) may be used with 890-960 mc equipment. The earlier Model TU139A (without a suffix number) does not have the circuitry for metering the 890-960 mc equipment. The model number and suffix are stamped on the metering chassis.

The metering kit includes all the necessary hardware and cables for standard installation.

2. APPLICATION

The TU139A Metering Chassis Kit is designed specifically for use in Motorola weatherproof-type (outdoor) base stations to provide built-in test and alignment facilities. It can be used with both single- and two-receiver station models. The chassis is standard size (19" long x 3-1/2" wide x 3-1/2" deep overall) and can be mounted on any standard 19" rack. The metering functions of this unit provide readings equivalent to those obtained with Motorola S1056A-9A and TU546 Series Portable Test Sets.

This unit can be adapted for use in all Motorola base stations which employ receivers

and transmitters incorporating 11-contact metering receptacles.

The TU139A is readily adaptable to fixed installation on the maintenance shop test bench as an "in place" test facility.

3. OPERATIONAL FEATURES

Model TU139A metering facilities provide the following basic functions:

- a. **SPEAKER:** Provides local monitoring of receiver output.
- b. **SPEAKER ON-OFF:** ON position - connects speaker across receiver output. OFF - position connects 3 ohm load across receiver output.
- c. **XMTR ON-OFF:** Provides transmitter keying control from immediate location, except in 406-420 mc 65/100 w broadband base stations.
- d. **FRONT DOOR INTERLOCK:** Door open - prevents transmitter actuation by remote control. Door closed - disables local XMTR ON-OFF switch.
- e. **METER SELECTOR SWITCH AND METER:** Provides measurement of transmitter and receiver circuits. Specific circuits measured for various selector switch positions are outlined in tables which appear later in these instructions.

4. UNPACKING AND INSPECTION

Use care when unpacking and handling this equipment. Open the shipping carton and carefully remove the individually packaged components. Check contents to be sure all items have been included.

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately.

The TU139A Universal Metering Chassis Kit consists of the following items:

- a. One metering chassis complete with receiver and transmitter connecting cables.

b. One coin envelope containing:

(1) 3 ft length of YEL-GRN wire terminated on each end with solder lugs, Part Number 1V831464.

(2) Six mounting screws, Part No. 3S119944.

(3) Two cable clamps, Part No. 42A50105.

(4) One spdt front door interlock switch, Part No. 40A831462.

(5) Two neoprene sleeves, Part Number 37K61348.

5. INSTALLATION

WARNING

Be sure primary power is disconnected from the cabinet before proceeding with installation.

a. Terminal Board Connections

IMPORTANT

Two jumpers are connected into the metering circuits when the chassis is shipped from the factory. Jumpers MUST be changed as required for any specific installation.

The exact terminal board connections for each specific type of application are detailed in the APPLICATION TABLE which appears on Schematic Diagram 63D849664.

Make the necessary circuit modifications as required before installing the TU139A Metering Chassis.

(1) Jumper Identification

Refer to Schematic Diagram 63D849664

Terminal Board TB1 has five screw-type terminals. This board is mounted on the inside of the chassis. Terminal number identification is not stamped on this board. Terminal numbers are assigned arbitrarily for convenience in identifying these terminals. The terminal board, as viewed from the rear, is numbered from left to right. The jumpers are described as follows:

(a) JU1 is a bare wire which is secured between terminals 2 and 3 when the TU139A Metering Chassis is shipped from the factory.

(b) JU2 (To make this connection, connect the bare wire between terminals 3 and 4).

(c) JU3 is a short bare wire which is connected from terminal 4 to a ground lug (as shipped from the factory).

(d) JU4 (To make this connection, connect the bare wire jumper between terminals 1 and 2).

(2) Application of Unit as Shipped

The TU139A Metering Kit is shipped from the factory with jumpers installed for application with 450-470 mc (18-20 and 250 watt), 406-420 mc (65/100 watt broadband) and 890-960 mc stations. Refer to the application table on Schematic Diagram 63D849664 for jumpering information for other applications.

(3) Optional 890-960 MC Applications

Two optional hook-ups for use in 890-960 mc applications are provided as follows:

(a) Single Channel Push-to-talk Service

The transmitter ON-OFF switch is wired in parallel with the microphone push-to-talk circuit and is, therefore, in series with the rear door interlock switch on the cabinet. The transmitter may be operated when the front door of the cabinet is open, but the rear door must be closed. Furthermore, in push-to-talk systems, if the switch is left in the ON position and the front door is closed, the transmitter will be automatically turned off permitting the transmitter to be operated only from the external remote control console connected to the station's termination and fuse panel. This automatic turn-off feature prevents the transmitter from being inadvertently left in the ON position.

(b) Continuous Carrier or Multiple Channel Service

For continuous carrier service the transmitter ON-OFF switch operates completely independent of the cabinet door interlock switches. Thus, the transmitter r-f carrier is not interrupted by opening the cabinet doors.

In reference to Intercabling Diagram 63C849663 the YEL-GRN lead from the transmitter ON-OFF switch is connected to terminal #16 of the associated power supply terminal board. For further information refer to NOTE 5 on the attached Schematic Diagram 63D849664.

CAUTION

As the door interlock switches do not turn "off" the transmitter, HIGH VOLTAGES ARE PRESENT AT ALL TIMES. Extreme caution must be observed to avoid hazardous electrical shocks.

b. Installation of the Metering Chassis

(1) Mount the metering chassis in the cabinet immediately above the transmitter in all stations except 12, 65 and 100 watt models where the metering chassis is mounted above the receiver. Secure the chassis to the frame using the hardware provided.

(2) Plug the receiver metering cable into the METER receptacle on the receiver chassis.

(3) Plug the transmitter metering cable into the METER receptacle on the transmitter chassis.

c. Installation of the New Interlock Switch

The interlock switch assembly is not used in 890-960 mc applications, 406-420 mc broadband base stations, or in "Compa-Stations".

(1) Remove the spst front door interlock switch from the base station cabinet. Retain the mounting screws.

(2) Mount the new spdt switch onto the cabinet using the mounting screws previously removed.

NOTE

Refer to switch detail on schematic diagram for switch terminal identification.

(3) On 450-470 mc (18-20 watt only) stations, connect the BLK-BLU lead to terminal 2 of the interlock switch. On 406-420 mc and 450-470 mc 12, 65 and 100 watt stations connect the YEL-GRN lead from the remote control or multiple "PL" chassis to terminal 2 of the interlock switch. On all other stations, connect the GRAY lead to terminal 2 of the switch.

(4) On 450-470 mc (18-20 watt) stations connect the two YEL-GRN leads to terminal 3 of the interlock switch. On 406-420 and 450-470 mc 12, 65 and 100 watt stations, connect the BLK-BLU lead from the rear door interlock to terminal number 3 of the interlock switch. On all other stations, connect the RED-ORG lead to terminal 3 of the switch.

(5) Connect the YEL-GRN wire which is supplied with the metering chassis, from the right hand terminal post of the five contact terminal board (TB1) on the metering chassis to terminal 1 of the newly installed interlock switch.

d. Cable Dress

Dress all cables and wires neatly into place and secure the metering cables along the side of the rack frame with the cable clamps and hardware provided.

The installation is now complete and the unit is ready for test purposes.

e. Bench Applications

The TU139A may be installed on a bench as a universal test instrument for metering various Motorola transmitters and receivers. For such installations, it is recommended that jumpers JU1, JU2 and JU3 be replaced with spst toggle switches. In this manner, jumpers may be removed from the circuit by opening switches. The XMTR "ON-OFF" switch may be connected to the "push-to-talk" circuit on the power supply to turn the transmitter "on" and "off".

6. PRE-OPERATIONAL TEST

a. Local Speaker

(1) Place XMTR ON-OFF switch in OFF position.

(2) Apply primary power to cabinet.

(3) Place SPKR ON-OFF switch in ON position.

(4) Unsquench the receiver using the SQUELCH control on the Remote Control Chassis.

(5) Check for receiver noise. If speaker and receiver are operating properly, receiver noise will be heard.

(6) Place SPKR ON-OFF in OFF position. If the switch is functioning properly, the speaker should be disconnected from the circuit.

(7) Place SPKR ON-OFF switch in ON position and re-squelch receiver as desired.

b. Interlock (Not used in 890-960 mc, 406-420 mc 65/100 w broadband or "Compa-Station" applications.)

(1) Place XMTR ON-OFF switch in ON position.

(2) Check that transmitter is actuated with front door open.

(3) Open rear door.

(4) Check that transmitter becomes deactuated.

(5) Close rear door. Transmitter should become re-energized.

(6) Close front door.

(7) Check that transmitter becomes de-actuated again.

(8) Return XMTR ON-OFF switch to OFF position and close both front and rear doors.

(9) Have remote operator test keying functions for normal remote control operation. (NOTE: With cabinet doors closed, the XMTR ON-OFF switch should not affect remote control operation in any way.)

c. Metering Circuit

(1) Ascertain the XMTR ON-OFF switch is in OFF position.

(2) Check receiver metering circuits by observing meter indications for positions R1 through R8 of the meter selector switch. Refer to the instructions for the receiver for specific readings.

(3) Place the XMTR ON-OFF switch in ON position.

(4) Check the transmitter metering circuits by observing metering indications for position T2 through PO of the meter selector switch. Refer to the instructions for the transmitter for specific readings. (NOTE: positions T2 and PO used only with 18-20 watt, 450-470 mc transmitters.)

TABLE OF CIRCUIT SELECTOR SWITCH FUNCTIONS

(NOTE - Readings are for voltage unless otherwise noted)

METER SWITCH POSITION	UNIT UNDER TEST	FREQUENCY RANGE OF EQUIPMENT (MC)									CIRCUIT MEASURED
		25-54		70-88	72-76	144-174	406-470	406-470	406-420	890-960	
							(18-20 W)	(12, 65 & 100 W)	(65/100 W BROAD-BAND)		
R1	RCVR	X	X	X	X	X					2nd IF -4 grid
	RCVR						X		X	X	2nd IF -3 grid
	RCVR							X			2nd IF -2 grid
R2	RCVR	X	X	X	X	X	X	X	X	X	1st limiter grid
R3	RCVR	X	X	X	X	X					2nd limiter grid
	RCVR						X		X	X	oscillator grid
	RCVR							X			multiplier grid
R4+	RCVR	X	X	X	X	X	X	X	X	X	Discriminator balance (positive)
R4-	RCVR	X	X	X	X	X	X	X	X	X	Discriminator balance (negative)
R5	RCVR	X	X	X	X	X	X	X	X	X	Discriminator input
R6	RCVR	X	X	X	X	X		X		X	1st oscillator grid
	RCVR						X		X		Oscillator Multiplier -1 grid
R7	RCVR	X	X	X	X	X		X			B+
	RCVR						X		X	X	Oscillator Multiplier -2 grid
R8	"G" RCVR	X	X	X	X	X					(No connection)
	"A" RCVR	X			X	X					"X" Filament (6 V)
	RCVR						X	X	X	X	(No connection)
T2	XMTR	X	X	X	X	X					(No connection)
	XMTR								X	X	2nd tripler grid
	XMTR						X				Oscillator grid
	XMTR							X			2nd doubler grid
T3	XMTR			X					X	X	1st doubler grid
	XMTR	X					X				2nd doubler grid
	XMTR							X			3rd doubler grid
	XMTR		X		X						1st tripler grid
	XMTR					X					Tripler grid

TABLE OF CIRCUIT SELECTOR SWITCH FUNCTIONS (CONT'D)

(NOTE - Readings are for voltage unless otherwise noted)

METER SWITCH POSITION	UNIT UNDER TEST	FREQUENCY RANGE OF EQUIPMENT (MC)								CIRCUIT MEASURED
		25-54	70-88	72-76	144-174	406-470 (18-20 W)	406-470 (12, 65 & 100 W)	406-420 (65/100 W BROAD-BAND)	890-960	
T4	XMTR							X		2nd doubler grid
	XMTR	X				X				3rd doubler grid
	XMTR						X			Tripler
	XMTR		X	X						2nd tripler grid
T5	XMTR			X	X				X	2nd doubler grid
	XMTR	X	X	X	X					Doubler-driver grid
	XMTR					X		X	X	Tripler-driver grid
	XMTR						X			Intermediate power amplifier
T6	XMTR	X		X	X	X	X	X	X	Power amplifier grid
PA	XMTR	X	X	X	X	X	X	X	X	Power amplifier plate (plate current)
PO	XMTR						X			Oscillator grid
	XMTR	X		X	X			X		(No connection)
	XMTR					X			X	Antenna circuit (Relative RF output)
B+	XMTR						X			B+
	XMTR	X	X	X	X	X		X	X	Transmitter PA

TABLE OF CIRCUIT SELECTOR SWITCH FUNCTIONS FOR USE WITH 406-470 MC, 65 AND 100 WATT FINAL AMPLIFIERS

(NOTE - Readings are for voltage unless otherwise noted)

METER SWITCH POSITION	UNIT UNDER TEST	CIRCUIT MEASURED
T6	FINAL AMPLIFIER	Power amplifier grid
PA	FINAL AMPLIFIER	Power amplifier plate
PO	FINAL AMPLIFIER	(No connection)
B+	FINAL AMPLIFIER	B+

NOTE

For nominal meter readings which should be obtained under normal operating conditions, refer to the RECEIVER and TRANSMITTER sections of the instruction manual for the equipment being metered. Model TU139A meter positions and readings will correspond to respective meter positions and readings for the S1056A-9A or TU546 Series Test Sets. Meter readings as stipulated in the manual for the Test Set will be applicable for the TU139A as well.

If these measurements are made while a Receiver Shield and Filter Kit is used in conjunction with the receiver, some of the readings may be slightly lower than normal. If in question, temporarily plug the meter cable assembly directly into the meter receptacle on the receiver chassis.

6. DATA INCLUDED

Base Station Control Circuits
Using TU139A Universal
Metering Panel Partial
Intercabling Diagram

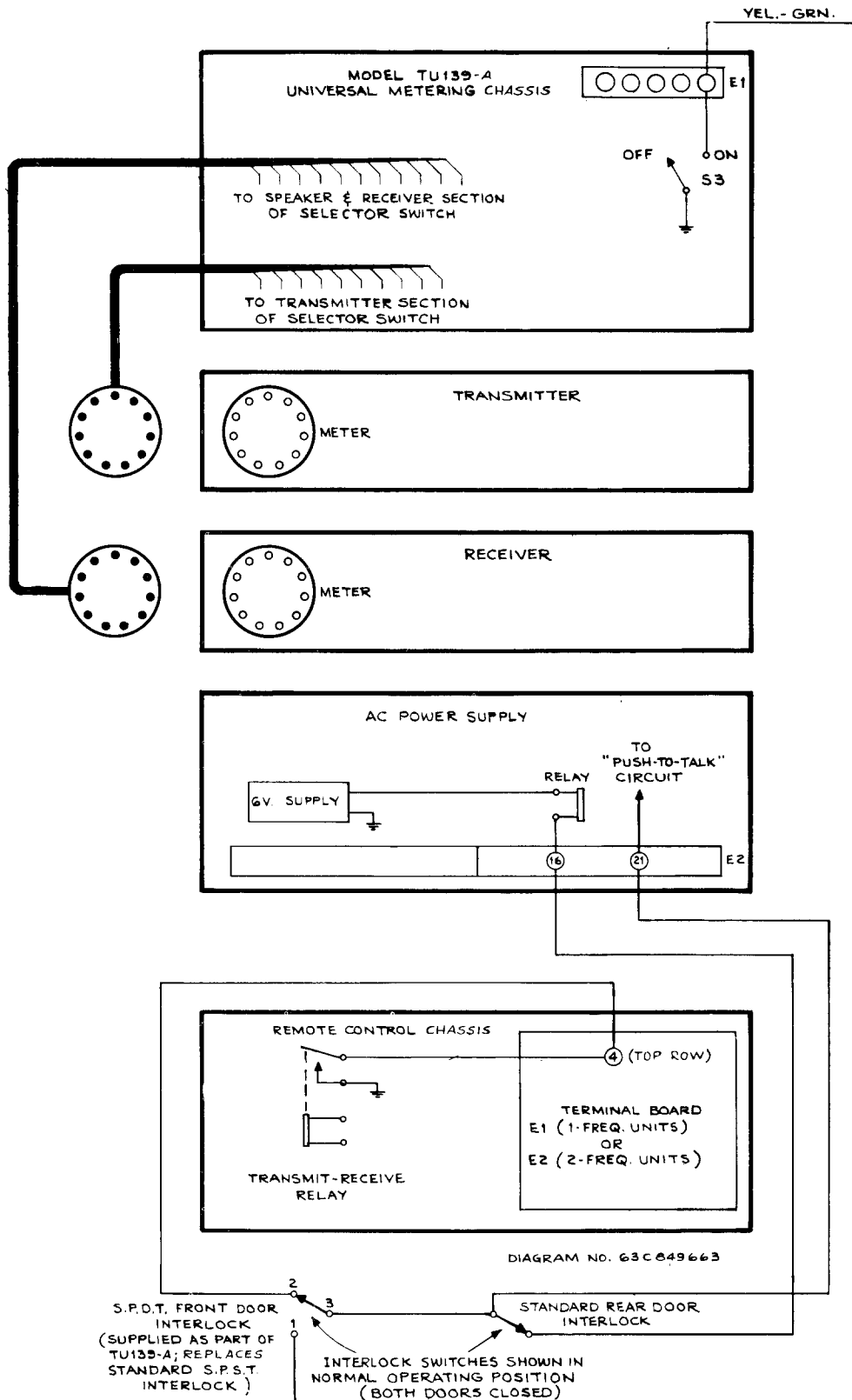
63C849663

450-470 Community Repeater Control
Circuit using TU139A Universal
Metering Panel Partial
Intercabling Diagram
Universal Metering Chassis Kit
Schematic Diagram

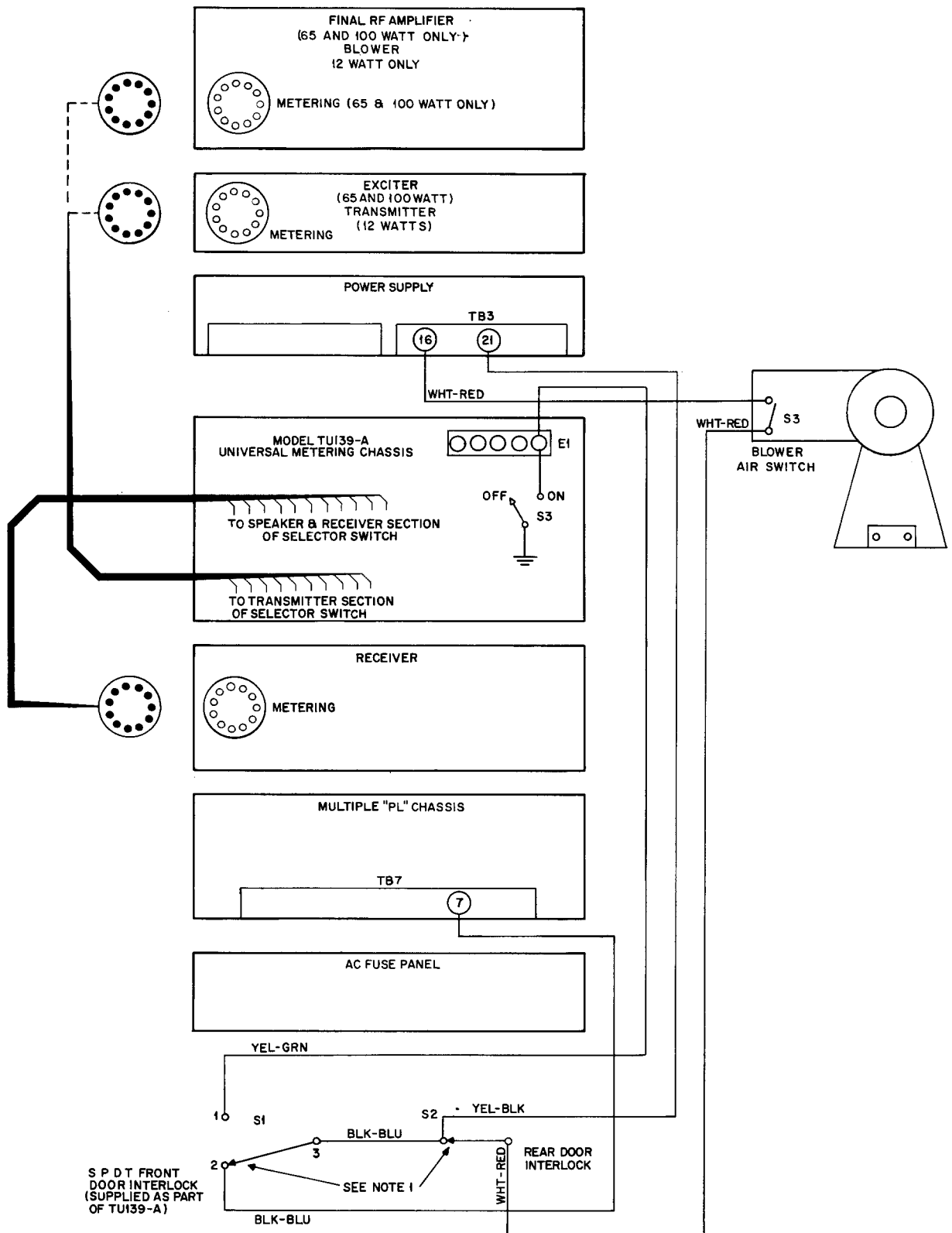
63D81016A36

63D849664

REAR VIEW OF CABINET



REAR VIEW OF CABINET



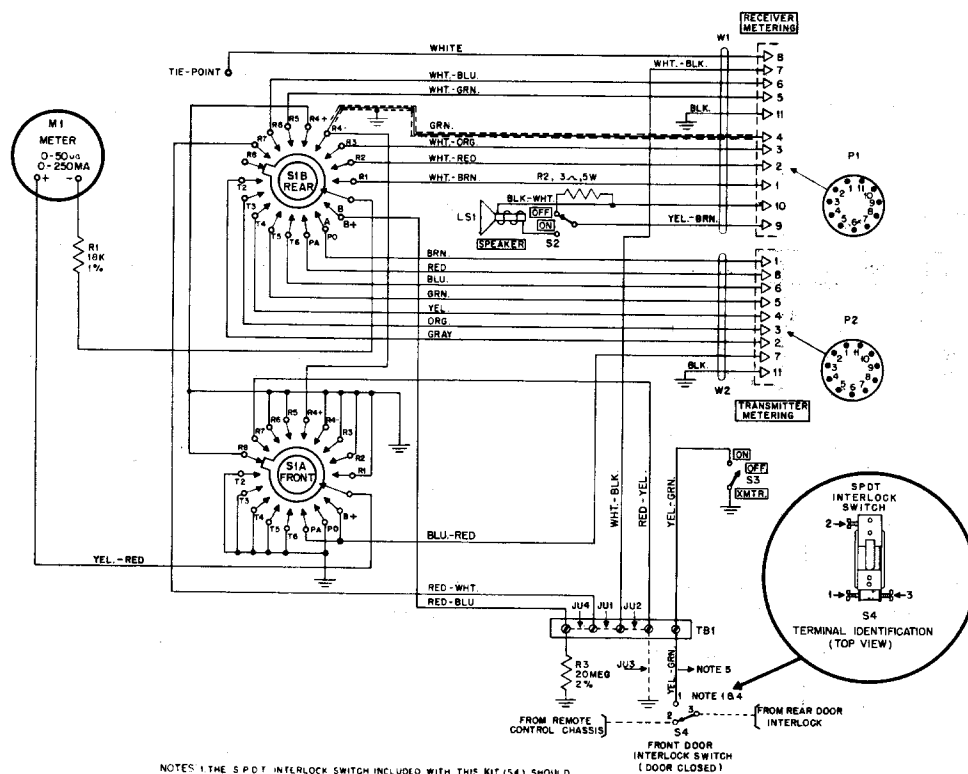
NOTE:

1. INTERLOCK SWITCHES SHOWN IN NORMAL OPERATING POSITION (BOTH DOORS CLOSED).

DIAGRAM NO. 63D81016A36-A

450-470 MC Community Repeater Control Circuit
Using TUI39A Universal Metering Panel
Partial Intercabling Diagram
Motorola No. 63D81016A36-A
5/8/67-UP

(Page 10 is blank)



NOTES: 1. THE SPDT INTERLOCK SWITCH INCLUDED WITH THIS KIT (S4) SHOULD BE INSTALLED IN PLACE OF THE STANDARD SPST FRONT DOOR INTERLOCK SWITCH NORMALLY USED ON BASE STATION MODELS. DASHED LEADS ARE PART OF STANDARD BASE STATION CABLING.

2. JUMPERS MUST BE ARRANGED FOR SPECIFIC APPLICATION BEFORE INSTALLING; OTHERWISE, DAMAGE TO THE METER WILL RESULT.

3. REFER TO THE JUMPER TABLE BELOW FOR PARTICULAR JUMPERS EMPLOYED FOR VARIOUS APPLICATIONS.

4. INTERLOCK SWITCH NOT USED WITH 70-88 MC, 890-960 MC BASE STATION, COMPA-STATION AND 65/100 W BROADBAND BASE STATION.

5. YEL-GRN LEAD NORMALLY CONNECTED TO TERM. 21 OF ASSOCIATED POWER SUPPLY EXCEPT WHEN UNINTERRUPTED CARRIER SERVICE IS REQUIRED. CONNECT TO ALTERNATE TERM. 16 INSTEAD OF TERM. 21 AS SHOWN WHEN CONTINUOUS CARRIER SERVICE IS REQUIRED.

MODEL	SUFFIX	DESCRIPTION
TU139A	1	UNIVERSAL METERING CHASSIS KIT

DIAGRAM NO. 63D849664-C5

STATION FREQ. (SEE NOTE 2)	CIRCUIT ARRANGEMENT			
	JU-1	JU-2	JU-3	JU-4
25-54 MC	OMIT	USE	OMIT	USE
72-76 MC	OMIT	USE	OMIT	USE
144-174 MC	OMIT	USE	OMIT	USE
450-470 MC *	USE	OMIT	USE	OMIT
70-88 MC	OMIT	USE	OMIT	USE
890-960 MC	USE	OMIT	USE	OMIT
406-470 MC **	OMIT	USE	OMIT	USE
406-420 MC ***	USE	OMIT	USE	OMIT

* 18-20 & 250 WATT STATIONS.

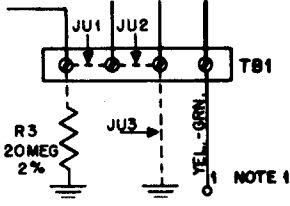
** 12, 65 & 100 WATT STATION.

*** 65/100 WATT BROADBAND BASE STATIONS

PREVIOUS REVISIONS SHOWN
ON BACK OF THIS DIAGRAM

Model TU139A Universal
Metering Chassis Kit
Schematic Diagram
Motorola No. 63D849664-C5
5/8/67-UP

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
C	TU139A-1	S1	WAS 40B822398	XMTR METERING
			RED-BLU LEAD ADDED	S1B-B TO TB1-GRN
			BLU-RED LEAD ADDED	S1A-PO TO S1A-PA
			NOTES 4 & 5 ADDED	NOTES
		TB1	WAS 31A831388 (4 TERM.)	
		JU4	ADDED JUMPER ARRANGEMENT WAS AS SHOWN BELOW	
				
C1	TU139A-1		25-54 MC STATION FREQ WAS 25-50 MC 144-174 MC STATION FREQ WAS 152-174 MC	APPLICATION TABLE
C2	TU139A-1		*18-20 & 250 W STATIONS	APPLICATION TABLE
C3			** 65 & 100 W STATIONS ADDED	
C4	TU139A-1		*** 65/100 W BROADBAND BASE STATIONS ADDED	APPLICATION TABLE AND NOTE 4
C5	TU139A-1		**WAS 65 & 100 W STATIONS	APPLICATION TABLE

PARTS LIST for Schematic Diagram 63D849664-C5

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
LS1	50K801757	<u>SPEAKER</u> , magnetic: impedance 3,2 ohm; 2-1/2"
M1	52B892096	<u>METER</u> , ammeter: range, 0 to 50 micro-ampere and 0 to 250 milli-ampere; 3" x 3-1/8" case
P1	28B813576	<u>CONNECTOR</u> , plug: male 11 contact; polarized round molded black phenolic base; does not incl 15A483149 SHELL, connector; which must be ordered separately; To Receiver Metering Connector; p/o W1
P2		same as P1 except To Transmitter Metering Connector; p/o W2
R1	6A892470	<u>RESISTOR, fixed</u> : carbon film; 18K $\pm 1\%$; 1/2 w; ins
R2	17K82839	wire wound; 3 ohm $\pm 10\%$; 5 w; ins
R3	6K892455	carbon film; 20 megohm $\pm 2\%$; 2 w
S1	40B867723	<u>SWITCH</u> , rotary: 2 pole; 18 position; consisting of:
S1A		1 pole, 18 position; Front Sect.
S1B		1 pole, 18 position; Rear Sect.
S2	40K811753	toggle: S. P. D. T.; Speaker
S3	40A482097	toggle: S. P. S. T.; XMTR
S4	40A831462	interlock: S. P. D. T.; Front Door
TB1	31A835165	<u>BOARD</u> , terminal: 5 screw terminals
W1	1V832873	<u>CABLE ASSEMBLY</u> , special purpose: Receiver Metering; incl miscellaneous wire leads and ref part P1
W2	1V852371	special purpose: Transmitter Metering; incl miscellaneous wire leads and ref part P2