

DATE 10-12-60

SH. 1 OF 15

COMPILED BY

L.B.

TMC SPECIFICATION NO. S 513

A

TITLE: GPT-40K TEST PROCEDURE

JOB

APPROVED

SUPERSEDED

REPLACED BY S540 WARNING

Extreme caution should be taken when operating or repairing this transmitter for there are extremely high potentials throughout the transmitter.

1. GENERAL

The GPT-40K consists of a modified GPT-10K (hereafter designated PA) that drives a 40 Kw (PEP) Class AB, grounded-grid amplifier (hereafter designated final. The final is a Machlett 6697, capable of 35 Kw plate dissipation. The filament of this tube is rated at 13 volts 205 amperes; so there is a heat hazard when this tube has filament voltage applied any length of time without adequate air cooling. The power supply is a three phase delta-wye rated at 12 Kv at 4-1/2 amps; so again, extreme caution should be practiced to avoid overheating. The shorting stick supplied with the transmitter should be used as necessary throughout the testing procedure to avoid contact with high potentials.

2. GPT-10K MODIFICATION

Since the GPT-10K will only be used as a 50-ohm unbalanced transmitter, there is no longer need for the antenna tuner. In its place a three position switch and three 900-watt 140-ohm resistors are used. The three position switch has three modes of operation:

Tune - For preliminary tuning of PA before applying power to the final.

Operate - For connecting the RF output of the PA to the input of the final.

Emergency - In case of failure of final, the output of the PA can be switched into a balanced or unbalanced antenna.

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3. INTERLOCK SYSTEM

The PA and the final are designed to work as a single integrated transmitter except in case of a PA emergency. This means that a failure in one will cause power to be removed from both simultaneously. Mounted on the mode-switch shaft is a wafer switch that tracks the main switches three modes of operation:

Tune - (1) Opens the PA's Interlock System to prevent high voltage being applied to the PA during the process of tuning the IPA and (2) applies voltage to the TUNE light on the PA's main front panel.

Operate - (1) Closes IPA's interlock circuit through PA cabling, (2) Applies power to the OPERATE light, and (3) permits final high voltage to go on.

Emergency - (1) Completes the IPA's interlock system and (2) opens the PA's interlock system.

4. IPA TEST PROCEDURE

The final with the modifications described above can be checked as an independent transmitter when use is made of the dummy load. Connect the external plug to the PA external tester and proceed as follows:

A. Mechanical and Electrical Inspection (No power on transmitter):

1. All three 230-volt input phases should be checked for possible shorts to ground; this includes the circuitry up to main transformer. T800.
2. Check 230-volt single-phase circuits in auxiliary frame for possible shorts.
3. Check high-voltage feed to plate and screen of power amplifier socket for possible shorts. (Note: High-voltage shorting switch (S801) must be open for this check.) Check the following requirements:

SCREEN: approximately 35,000 ohms
PLATE: approximately 100,000 ohms

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4. Make a mechanical inspection of the entire transmitter before turning on the unit. Particular attention must be paid to the following:

- Lead and cable dress
- Dead man assembly
- All high voltage and R.F. connections must be secure.
- Cover must be on all units.

B. Auxiliary Frame Check Out:

1. Place auxiliary circuit breaker in ON; turn power on all equipment in auxiliary frame; allow a ten minute warm up.
2. Observe the following:
 - a) Auxiliary frame fan should be operating
 - b) Removing fuse F-3000 at rear of auxiliary frame should make fan inoperative.
 - c) Check cycling of SBE, XFK, and VOX (outer) ovens.
 - d) SBE and XFK ovens cycle after approximately 10 minutes.

C. Settings of Equipment Units on Auxiliary Frame & FSA Inherent Distortion.

1. Spectrum Analyzer
 - a. I.F. Antenna switch - 20 db
 - b. Sweep Selector - 10 Kc
 - c. Amp. Scope switch - log
 - d. Gain - Maximum
 - e. Cal. Osc. - off
 - f. A.F.C. - off
2. MCP
 - a. Analyzer monitor switch to test.
 - b. VOX switch to FSA
3. TTG
 - a. R.F. tone selector - two tone
4. VOX
 - a. BAND MCS switch - 2-4 Mc
 - b. TUNING knob - 2.5 Mc
 - c. Counter - 2.5 Mc
 - d. Meter switch - HFO pos.
 - e. HFO plate switch - on
 - f. Zero beat switch - off
 - g. Output no higher than .3 volts

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5. FSA Indications. After the above settings have been made, a two tone trace should appear of the FSA scope. (Note: The VOX may have to be tuned slightly to either side of set frequency to bring in the trace).
 - a. Attenuate the input signal to the FSA with the input attenuator switches, as needed to fill the FSA graph.
 - b. Flip I.F. attenuator switch to 0 db.
 - c. FSA inherent distortion should be better than 55 db.

D. Settings of Equipment Units on Auxiliary Frame and SBE Inherent Distortion.

1. SBE

- a. Set MF XTAL SW to select a xtal of frequency 4.25 mc.
- b. Set BAND MCS selector to position 2 - 4.25 mc
- c. U.S.B. selector - off
- d. Carrier INSERT - counter clockwise.
- e. Set EXCITER switch to on - set STANDBY switch to on
- f. OUTPUT TUNING 4 - 8 mc
- g. L.S.B. selector to channel 1
- h. Meter switch to L.S.B.

2. MCP

- a. VOX RF OUTPUT to FSA
- b. ANALYZER MONITOR to SBE
- c. CHANNEL 1 to tone input
- d. CHANNEL 2 to line input
- e. MODE to SSB

3. VOX

- a. BAND MCS - 4-8 mc
- b. TUNING - 2.250
- c. Counter set to 2.250
- d. Output - .3 volts

4. TTG

- a. AUDIO TONE SELECTOR - two tone
- b. AUDIO OUTPUT - half turn clockwise
- c. R.F. TONE SELECTOR - off

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5. Distortion Test

- a. Adjust U.S.B. GAIN for minus 3 db
- b. Meter switch to M.F.
- c. Turn M.F. TUNING dial to 4.25 for peak indication meter
- d. Meter switch to R.F.
- e. OUTPUT control to maximum
- f. Set main TUNING dial at 4 mc for peak indication on meter
- g. Adjust OUTPUT for approximately minus 10 db
- h. FSA setting same as C.1 above
- i. A two-trace 2 Kc apart (approximately) should appear on scope.
- j. Attenuate tones to fill FSA graph
- K. I.F. attenuation 0 db
- l. 3rd order distortion, must be 45 db or better.

Note; Above test should be made also in L.S.B. position.

E. SIM Calibration

1. Adjust SBE audio level to minus 3 db
2. Calibrate USB on SIM for minus 3 db
3. Repeat above procedure for LSB

F. PA Frame Check-Out

1. Output mode switch S903 must be in the TUNE position
2. Turn on MAIN POWER breaker and observe the following
3. AC POWER light and auxiliary meter panel lights should be on
4. Rear fan and main blower should be operating
5. Check IPA blower for proper rotation (clockwise).
6. Removing fuse F-703 (rear fan fuse) should make fan inoperative
7. Removing fuses F-700, F-701, F-702 should make IPA blower inoperative
8. Set FIL ADJ switch to 230 volts on FILAMENT PRIMARY meter
9. After approximately one minute PA BIAS (K700) and IPA BIAS (K-708) relays will energize; also their respective indicator lights will go out.
10. PA BIAS meter should read between 200-280 volts depending on setting of PA BIAS ADJ potentiometer
11. IPA BIAS on meter M202 should indicate minus 70 to 90 volts depending on setting of IPA BIAS ADJ potentiometer R2009.
12. Check bias voltage at 4CX5000 tube socket (minus 200 to 280 volts).

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G. Interlock System

1. Engage the following interlocks - S901, S-1006, S-1007, S-1008, S-1009, S-1010 and S-1011.
2. TIME DELAY relay set to 5 minutes.
3. Turn on MAIN POWER breaker; after 5 minutes HV shorting relay should be activated.
4. Set INTERLOCK switch to NORMAL position; interlock indicator should be on.
5. Set interlock switch to TIMER.
6. Remove TIME delay fuse; interlock indicator light should go out and HV shorting relay should de-activate.
7. Check out the performance of the interlock systems by opening the following interlock switches successively:
 - Relay deck
 - HV deck
 - Right side
 - PA air switch
 - Rear door
 - External
 - IPA air switch
 - IPA bands switch
 - PA band switch

Note: The IPA's TUNE-OPERATE switch must be in the TUNE position for all of the above tests.

8. Place the PA's switch S-903 to OPERATE. The PA's interlock system must be inoperative.
9. Place the IPA's output mode switch S-903 in EMERGENCY position; the IPA's interlock system should become operative.

H. High Voltage Test

1. Allow PA to warm up for 30 minutes
2. Set output mode switch S903 to TUNE
3. Remove PA final tube (4CX5000)
4. Turn on high voltage via HIGH VOLTAGE breaker
5. PA SCREEN ON-OFF switch to on
6. Set TUNE-OPERATE switch to OPERATE
7. PA's PA SCREEN voltmeter should indicate 1100-1250 volts
8. PA's PA PLATE voltmeter should indicate 6.5 to 7.5 Kv.
9. IPA's MULTIMETER should indicate 400 volts on IPA Eg.
10. IPA's MULTIMETER should indicate 3 Kv on IPA Eg.
11. Set TUNE-OPERATE switch to TUNE
12. PA's PA SCREEN voltmeter should read 600 volts.
13. Turn OFF IPA's MAIN POWER and HIGH VOLTAGE circuit breakers
14. Insert PA's final tube (4CX5000) into socket
15. Close tube compartment

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I. Parasitic Check

1. Set IPA's BAND SW to 4-6 mc
2. Set SBE drive to minimum
3. Set PA's MAIN POWER breaker to ON and allow a five minute warm-up
4. Set PA's HIGH VOLTAGE breaker to ON.
5. Rotate PA's PA TUNE capacitor from minimum to maximum and check for any sudden rise in PA PLATE RF current which would indicate a parasitic oscillation.
6. The test procedure as explained above should be repeated on the following BAND SW positions:

6-8 mc, 8-11, 11-15 mc
15-19 mc, 19-24 mc, 24-28 mc

7. Turn off PA's HIGH VOLTAGE breaker

J. RF Output Tuning

1. Place PA's output mode switch S903 to TUNE; this terminates the PA's output with 50 ohms, 3000 watts.
2. Set the following controls for 4 mc per PA's standard unbalanced tuning chart:
 - IPA TUNING: see chart
 - IPA LOADING: see chart
 - PA TUNE: see chart
 - PA LOAD: see chart
 - PA BAND SW: see chart
 - VOX: 2250
 - IPA BAND: 4-6
 - DRIVER BAND: 4-8
3. FSA's ANALYZER MONITOR to IPA
4. VOX RF OUTPUT switch to FSA
5. IPA's MULTIMETER switch to IPA, Eg. (RF)
6. Advance SBE's OUTPUT control conservatively and for 4 mc peak on SBE's multimeter.
7. Turn output SBE to zero, momentarily.
8. Set PA SCREEN ON-OFF to ON and TUNE-OPERATE to OPERATE
9. Turn on HIGH VOLTAGE breaker
10. Adjust PA PLATE current for .5 ampere with PA BIAS ADJ potentiometer if necessary.
11. Set TUNE-OPERATE control to TUNE
12. Advance SBE's OUTPUT control until IPA PLATE rises to approximately 300 ma; then dip and load the SBE conservatively.
13. Return SBE's output to zero; set TUNE-OPERATE control to operate.
14. Advance SBE's OUTPUT control until PA PLATE current rises to approximately 1 ampere; then dip and load until output meter indicates 5 amperes.

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15. 3rd order distortion should be 40 db or more (less distortion). 5th order distortion should be less than 3rd order distortion. Otherwise re-tune and re-load to obtain these objectives. Minor control adjustments should only be necessary.
16. IPA's tuning and loading should be accomplished well within the following LIMITING values; when exceeded the IPA's protective relay system should be adjusted to sheet down the transmitter without delay.
 - IPA screen 30 ma
 - IPA plate 600 ma
 - PA screen 60 ma
 - PA plate 2 amps

UPON COMPLETION OF THE ABOVE TEST, THIS PA UNIT CAN BE MATED TO THE FINAL UNIT.

5. FINAL TEST PROCEDURE

A. Electrical and Mechanical Inspection

1. Check all three 230-volt input phases for ground 5.
2. Check with volt ohm meter, from plate of 6697 to B-minus (HV shorting relay activate without power), for approximately 5000 ohms.

WARNING

There is at 600-volt potential from B-minus to ground when power is ON so care must be taken to be certain that power is OFF.

3. Check that all connections in the power supply frame are tight because normal heavy currents can cause arcing if there are loose connections.
4. Check that all hardware in the PA deck are free of burrs in order to avoid arcing.
5. Check that all R.F. connections are tight to avoid arcing.
6. Check that all wiring is free from imperfections
7. Check that there are no loose knobs, indicators, fuse holders, switches or handles.
8. Check that, with the final tune and final load capacitors completely open, their respective counters read 000.
9. Check that the final band switch counter corresponds to the final band switch position.
10. Check that the counter for the balance capacitor reads 000 when the capacitor is at minimum capacitance.
11. Check that the antenna tuner band switch counter corresponds to the right position on the band switch.

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B. Check of Control Circuits

1. Set final FIL. to ON.
2. Set BLOWER to ON.
3. Set GPT-10K's MAIN POWER to ON.
4. Set OUTPUT LOADING switch to OPERATE.
5. GPT-10K's power light should go on.
6. GPT-10K's meter lights in PA and PS frame should go on.
7. Set GPT-10K's FIL ADJ to 230 volts.
8. Set the RESERVOIR FILAMENT switch in position FILAMENT; the CROWBAR FIL meter should read 6.3 volts.
8. Set the RESERVOIR FILAMENT switch to position RESERVOIR and adjust reservoir voltage to the right voltage.
Note: Stamped on the bottom thyratron is the reservoir voltage setting.
10. Set GPT-10K's OUTPUT LOADING switch to TUNE position; the TUNE light on the PA frame should go on and OPERATE light should go out.
11. Set OUTPUT LOADING switch to OPERATE.
12. Check that band switch release and detent on band switch operates when BANDSWITCH RELEASE is pressed down, check that BAND SW will turn only when BANDSWITCH RELEASE button is pressed down.
13. Operate high voltage breaker reset; note that motorized breaker switch operates when RESET button is pressed down.
14. Operate overload reset by tripping an overload relay by hand and noting or return to normal when OVLD RESET button is pressed down.
15. Operate final light switch and observe that the PA compartment lights up as required.
16. Check direction of blower; if incorrect, reverse two phases in blower contactor box; proper direction of blower rotation is CCW (facing belt).
17. Remove BLOWER CONTACTOR fuse on relay panel; GPT-10K blower must cease to run.
18. Check top exhaust fan for direction of rotation (CW); remove top fan fuse F8101 on relay panel; the fan must stop.
19. Adjust BIAS ADJ potentiometer supply so the GRID VOLTS meter read 600 volts.
20. With HIGH VOLTAGE off measure bias voltage and filament voltage of final tube with a volt ohmmeter bias plus 600 VDC; filament 13 volts AC.
21. Successively open the following interlocks and observe that the HV shorting relay (Deadman) operators (be-energized);

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Timer - remove TIME DELAY fuse
Open Rear door (PS frame)
Pull out antenna tuner-Antenna Tuner
Crowbar
H.V. Rectifier
Band switch
Air switch
Rear door P.A. deck
External

Note: External can be checked by placing the GPT-10K output switch to tune or emergency this should make the GPT-40K interlock system inoperative.

22. Turn off BLOWER switch. Observe that this removes FILAMENT PRIMARY voltage and the FINAL FILAMENT pilot light should go on.
23. Removing of LIGHTS fuse in control panel in power supply panel should make all lights in the power amplifier and power supply panel go out.
24. Removing of INTERLOCK fuse should make interlock system inoperative.
25. Remove BREAKER MOTOR fuse, this should make the motor breaker inoperative.
26. Check to see that all rectifiers are illuminated (receiving filament voltage).
27. Make interlock circuit operative by closing all interlock switches and checking that the TIME DELAY fuse has been replaced. (see item 21).
28. REMOVE INPUT PHASES TO HIGH VOLTAGE TRANSFORMERS.
Turn on HIGH VOLTAGE switch, HV shorting relay should operate (be energized); also, as a result, the HV Contractors. Now open every interlock one at a time; this should de-energize the high voltage contractors.
29. Reset all interlocks. Leave input phases to HV transformer disconnected.
30. Successively trip the following Overload Relay:
Plate Overload
Grid Overload
Retune Relay
SWR Relay
Bias Relay
Driver Interlock
Final Filament
Crowbar

This should operate (de-energize) the high voltage contactors.

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31. After all relays are reset, turn HIGH VOLTAGE switch off.
32. With a volt-ohmmeter measure bias voltage from filament to ground; this must be plus 600 VDC; if not adjust BIAS ADJ potentiometer so GRID VOLTS meter reads 600 VDC.
33. Measure filament voltage; this should be 13 VAC \pm 1.5 VAC; FIL ADJ tap switch must correspond to input line voltage.
34. Secure all connections on final tube and button up the compartment.
35. Check operation of power supply as follows:
 - a. Remove high voltage lead from power supply to PA section. This lead is the 12 KV lead from B+ to L7306.
 - b. Re-connect input phases to high voltage transformers.
 - c. Connect resistive load capable of draining 1.5 amperes from the B+ to the B- output terminals of power supply. At 12KV, this load must dissipate 18000 watts; its resistance must be 8000 ohms.
 - d. After twenty minutes warming - up for rectifiers, turn on HIGH VOLTAGE breaker and leave on for ten minutes.
36. Turn off HIGH VOLTAGE and breaker and re-connect high voltage lead from power supply to PA section.
37. Turn on HIGH VOLTAGE breaker.
38. Adjust BIAS ADJ for 1.5 amperes of quiescent plate current.
39. Plate voltmeter should indicate 11 kilovolts plus or minus 1.5 kilovolts.
40. Raise quiescent current to 3 amperes and adjust TUBE PROJECT relay to trip high voltage off.
Note: Caution. Do not leave transmitter in the above condition for more than 10 seconds.
41. Adjust BIAS ADJ for 1.5 amperes DC residual plate current.
42. Turn high voltage off.

6. GPT-40K TUNING PROCEDURE

1. Place GPT-10K Transmitter to tune position (OUTPUT LOADING selector switch in TUNE position).
2. Tune transmitter to one of the test frequencies.
Note: Test frequencies are - For details, see Part II Volume I Section 3 of GPT-40K instruction book.

Final
Amplifier
Bands

	1	2	3	4	5	6	7	8
FMC	4	5	6	8	11	15	19	24
FMC	5	6	8	11	15	19	24	28

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3. Load transmitter to 5 amperes. For details, see Part II Volume I Section 3 of GPT-40K instruction book.
4. Set SBE's drive to zero.
5. Place transmitter to operate position (OUTPUT LOADING selector switch in OPERATE position). Note: In the process of tuning the GPT-40Kw transmitter care must be taken not to over dissipate the final tube with excessive plate current and no R.F. output. For details, see Part IV Section 3 of GPT-40K instruction book.
6. Place final amplifier to correspond to the tuning chart provided with the test procedure.
7. Turn on HIGH VOLTAGE.
8. Raise plate current to 2.3 amperes.
9. Tune to resonance and load to required output. For details, see Part IV Section 3 of GPT-40K instruction book.
10. Check 3rd order distortion to TMC Specifications.
11. Check all test frequencies on balanced and unbalanced outputs.

7. Protective Circuit Adjustments

1. Plate overload relay
Adjust relay to trip at 5.0 amps.
2. Grid overload relay
Adjust relay to trip at 200 ma.
3. Retune overload relay
This relay works in conjunction with the tube protect relay. Adjust the retune overload relay so that, when the transmitter is properly tuned and there's sufficient plate RF volts, the relay is un-energized. By removing the plate RF volts the transmitter should become in-operative.
4. SWR overload relay
Set SWR adjustment to midposition.
This overload is safety factor that can only be checked by continuity.

8. Interlock Control Circuits.

1. Leave transmitter high voltage on.
2. Turn off final amplifier high voltage.
3. GPT-10K high voltage should go off.
4. Place driver interlock switch to off position.
5. Due to the final plate high heat dissipation, the final blower is automatically left on after main power is removed. The time left on is determined by the blower delay which can be set from 0 - 5 minutes. This should be set for 5 minutes to cool final tube after main power is removed. If the above conditions are met check off test sheet and sign.

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TEST SHEET

A. Mechanical Inspection:

Accept

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- 1. Exciter Frame
- 2. GPT-10K PA Frame
- 3. Final Amp Frame
- 4. Final Power Sypply Frame
- 5. Proper Hardware
- 6. Connections
- 7. Knobs
- 8. Lamps
- 9. Fuse Holders
- 10. Switches
- 11. Relays

B. Electrical Inspection:

- 1. Correct Fusing
- 2. Correct Lamps
- 3. Resistance Check
- 4. Frayed Wires
- 5. Correct Insulation

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TEST SHEET

C. Protective Circuits:

Accept

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1. Plate Overload

2. Grid Overload

3. Retune Overload

4. SWR Overload

5. Bias

6. Crowbar

7. Final Filaments

8. Tube Protect

9. Blower Delay

D. Unit Operation:

1. Frequency Limits

2. Distortion

Approval:

Date _____

Tester _____

Insp. _____

Incoming Plate time _____

Outgoing Plate time _____

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TABLE A - TYPICAL GPT-40K TUNING AND LOADING PARAMETERS

FMO	Ant. Band	Final Band	Tune	Load	BALANCE OUTPUT				UNBALANCED OUTPUT		
					40KW				Tune	Load	Load Cur Amps
					I1	I2	% unbal.	Balance output			
4	4-14	4-5	541	774	*5.7	*5.7	0	138	335	712	20x
5	4-14	4-5	298	422	*5.7	*5.7	0	122	236	812	20x
5	4-14	5-6	577	645	*	*	0	122	068	145	20x
6	4-15	5-6	311	497	*	*	0	117	001	052	20x
6	4-15	6-8	534	678	*	*	0	117	222	581	20x
8	4-15	6-8	167	363	*	*	0	165	332	672	20x
8	4-15	8-11	271	809	*	*	0	165	586	809	20x
11	4-15	8-11	030	385	*	*	0	117	137	268	20x
11	4-15	11-15	313	720	*	*	0	117	367	641	20x
15	15-20	11-15	137	322	*	*	0	170	166	294	20x
15	15-20	15-19	295	442	*	*	0	170	318	417	20x
19	15-20	15-19	171	242	*	*	0	132	185	242	20x
19	15-20	19-24	328	313	*	*	0	132	340	300	20x
24	20-28	19-24	239	195	*	*	0	135	214	184	20x
24	20-28	24-28	225	231	*	*	0	135	272	200	20x
28	20-28	24-28	196	162	*	*	0	124	194	151	20x

* For 40Kw P.E.P. 5.7 amps of current thru 600 ohm load
 x For 40Kw P.E.P. 20 amps of current thru 50 ohm load

DC Residual Plate
 Current 2 amps

