

PIONEER®



SERVICE MANUAL



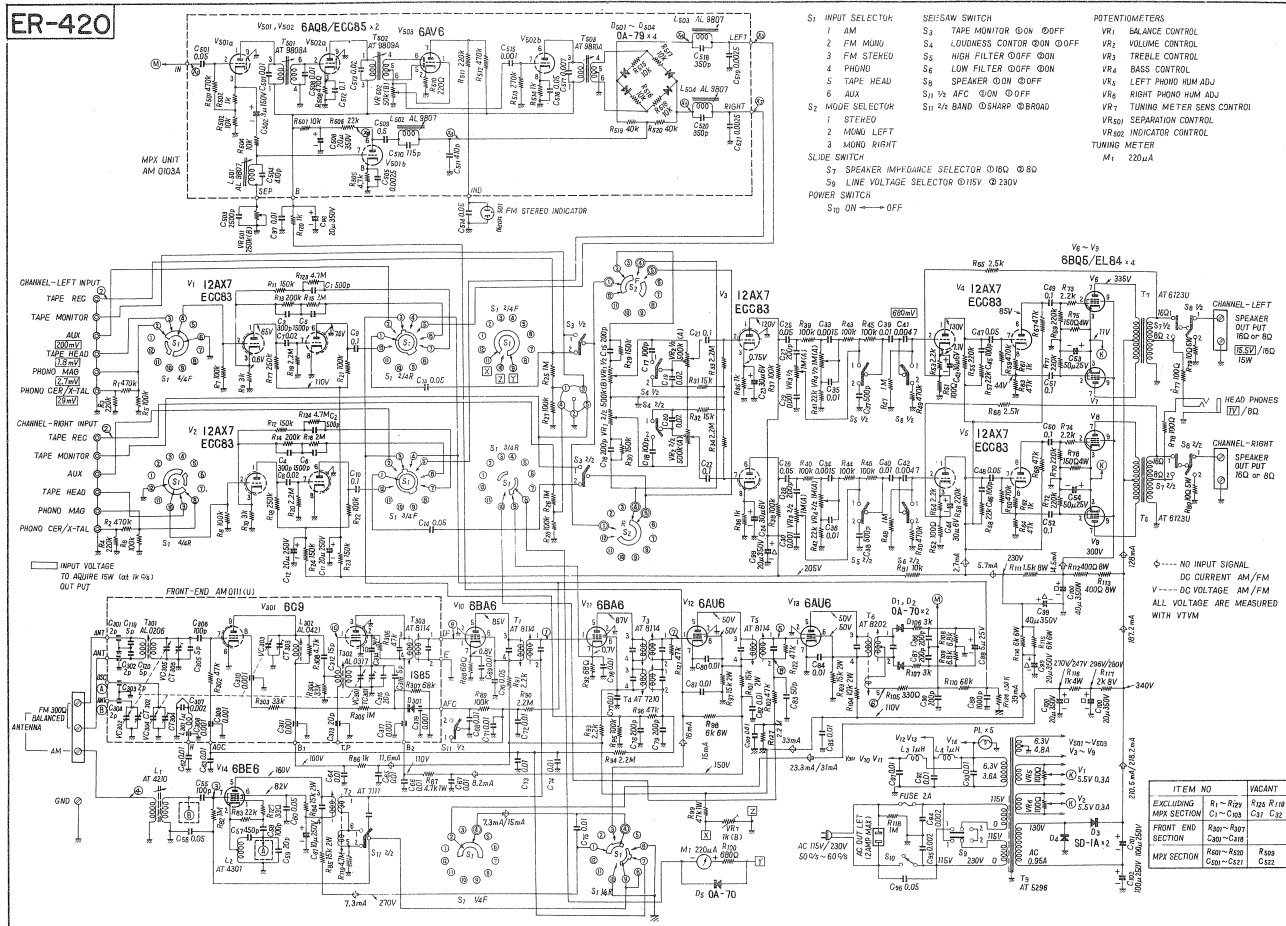
AM/FM MULTIPLEX RECEIVER

ER-420

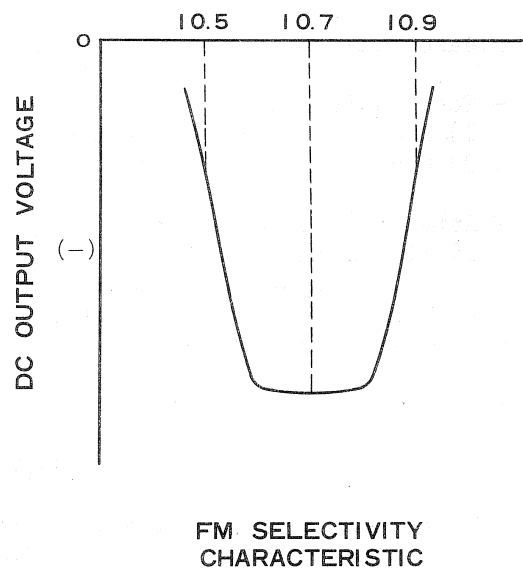
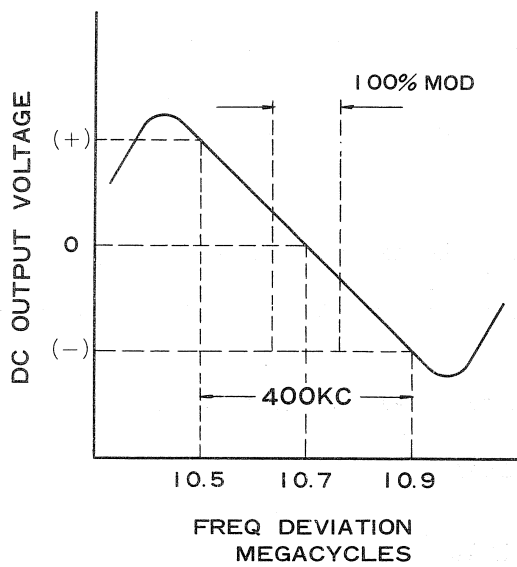
PIONEER ELECTRONIC CORPORATION

TOKYO JAPAN

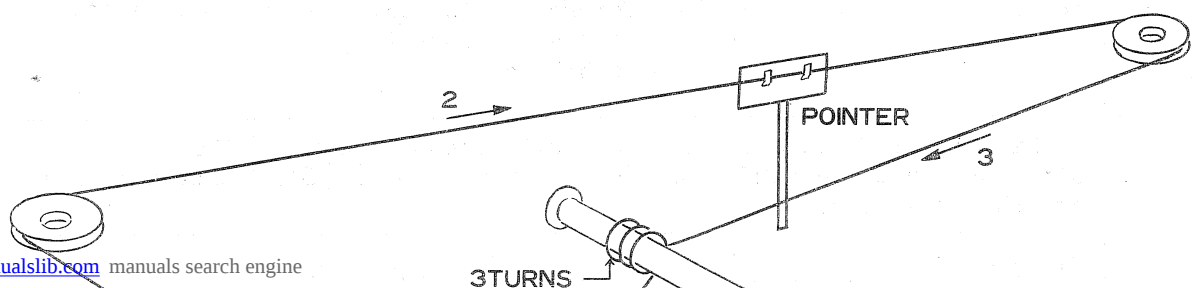
ER-420



ITEM NO	VACANT
EXCLUDING	R1 ~ R29 R118 R119 R120 R121
MPX SECTION	C1 ~ C28 C31 C32
FRONT END SECTION	R30 ~ R37 R38 R39 R40 R41
SECTION	R42 ~ R48 R49 R50 R51 R52
MPX SECTION	R53 ~ R59 R60 R61 R62 R63



ER-420 DIAL CORD STRINGING



ALIGNMENT INSTRUCTION

Please read these Instructions with extreme care before attempting alignment.

+ Test Equipment

- 1) Standard Signal Generator
- 2) VTVM. DC, AC
- 2) Oscilloscope

+ Attention on Alignment

- 1) Signal Generator Input: in every case, use the minimum generator input that will obtain a satisfactory output indication.
- 2) When connecting the test equipment to the input, use the shielded wire as short as possible.

+ VTVM and Oscilloscope should be connected in parallel at the output.

+ Alignment of AM Section

+ Note: Position of Switch; SELECTOR - AM
MODE - STEREO NORMAL
Position of Volume Control; MINIMUM

STEPS	Signal Generator Input			Dial setting	Connect VTVM	Alignment	
	Coupling	Freq.	Modu.			Adjust	Remarks
1	Pin 1 of V ₁₁ (6BA6) ①	455 kc	1 kc 30%	Point of no inter- ference as near as 535 kc	Connect AC.VTVM to Audio output ②	T ₄ top and bottom	Adjust to get Maximum deflection
2	On Step 3, at first set the band width selector switch (S11) to SHARP, after that set the (S11) to BROAD. From step 4, (S11) should be set at SHARP position.						
3	Pin 7 of V ₁₄ (6BE6) ③	455 kc	1 kc 30%	"	"	T ₂ top and bottom	"
4	Antenna terminal through dummy (0.1 uF) ④	600 kc	"	600 kc	"	L ₁ , L ₂	"
5	"	1400 kc	"	1400 kc	"	CT ₃₀₂ , CT ₃₀₄	
6	Repeat STEPS 4 & 5 until no further improvement is possible.						

Alignment of FM Section

- Note: 1) Position of Switch: SELECTOR - FM
 " AFC - OFF
 2) Position of Volume Control: MINIMUM
 3) Connect VTVM and Oscilloscope in parallel at STEPS 10, 11.

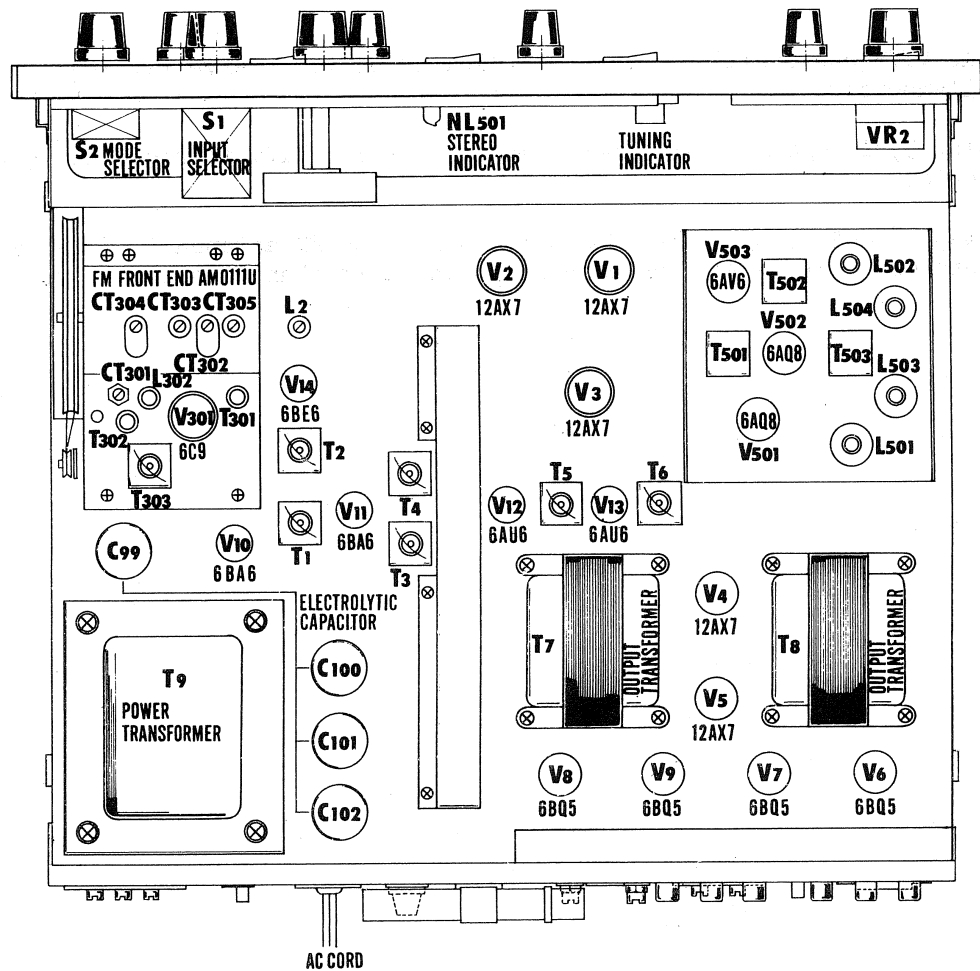
STEPS	Signal Generator Input			Dial Setting	Connect VTVM	Alignment	
	Coupling	Freq.	Modu.			Adjust	Remarks
1	Pin 1 of V ₁₃ (6AV6) 5	10.7 mc 100 db	None	Point of no interference as near as 88 mc	DC VTVM to Pin 5 of T ₆ 6	Top of T ₆	Adjust to get zero volts (between pos. and neg. reading)
2	"	10.4 mc 100 db	"	"	"	Bottom of T ₆	Adjust to get Maximum deflection
3	"	11 mc 100 db	"	"	"	"	Adjust to get Maximum deflection (Neg. reading)
4	Repeat STEPS 1, 2 and 3 several times to get a similar curve as fig. 1.						
5	Pin 1 of V ₁₂ (6AV6) 7	10.7 mc 100 db	"	"	DC VTVM to Pin 2 of T ₅ 8	Top and bottom of T ₅	"
6	Pin 1 of V ₁₁ (6BA6) 1	10.7 mc 70 db	"	"	"	Top and bottom of T ₃	"

Alignment of MPX Section

- +Note: 1) Position of Switch: SELECTOR - FM MPX
 2) " " AFC - OFF
 3) Position of Volume Control: MINIMUM
 (main volume control)

STEPS	Circuit to be adjusted	Signal Generator Input			Connect VTVM	Alignment	
		Coupling	Input Signal	Mod.		Adjust	Remarks
1	38 kc Separation Coil	Audio Oscillator to (X ₁)	38 kc 200 mv (rms)	None	to junction C ₅₀₉ & L ₅₀₂ (X ₂)	Bottom of L ₅₀₁	Adjust to get Maximum deflection Position of VR ₅₀₁ : Minimum
2	67 kc Trap Coil	" (X ₁)	67 kc 300 mv (rms)	"	C ₅₁₁ (X ₃)	Bottom of L ₅₀₂	Adjust to get Minimum deflection Position of VR ₅₀₁ : Maximum
3	38 kc Trap Coil	" (X ₄)	38 kc 10 v	"	C ₅₁₉ (X ₅)	Bottom of L ₅₀₃	Adjust to get Minimum deflection
4	"	" (X ₆)	"	"	C ₅₂₁ (X ₇)	Bottom of L ₅₀₄	"
5	Sub Carrier Circuit	Multiplex Generator to FM Antenna terminal	60 db of 19 kc Pilot signal	10%	Pin 4 of T ₅₀₃ (X ₈)	T ₅₀₁ T ₅₀₂ T ₅₀₃	Adjust to get Max. deflection from T ₅₀₃ to 502 and 501 reversely, repeating several times
6	Pilot phase	"	60 db Com- posite signal each channel	19 kc 10% & Sub & Main 1 kc	C ₅₂₁ (X ₅) or (X ₇)	T ₅₀₁	Adjust to get Max. output and Min. distortion, Confirm each channel
7	Separation Control	"	"	30% "	"	VR ₅₀₁	Adjust to get Min. output of reverse channel, Confirm each channel
8	Repeat STEPS 6 and 7 several times						
9	Stereo indicator light	"	30 db 19 kc Pilot signal	19 kc 10%	-	VR ₅₀₂	Adjust to glow NL ₅₀₁ when 19 kc Pilot signal is applied

ER-420 LAYOUT



Note:

- 1) Couple VTVM and Oscilloscope in parallel so as to observe ripples simultaneously.
- 2) At Step 5, 1 megohm is indispensable in coupling VTVM to pin 4 of T₅₀₃ in series.
- 3) At Steps 6 and 7, apply the Composite signal to FM antenna terminal and measurement must be made on each right and left channel separately.

CAPACITORS

In μF 20% tolerance for all fixed capacitors unless otherwise noted. P = $\mu\mu\text{F}$

Symbol	Description	Part No.		
C1	Mica	500p	10%	400v
C2	Mica	500p	10%	400v
C3	Mica	300p	10%	400v
C4	Mica	300p	10%	400v
C5	Mica	1500p	10%	400v
C6	Mica	1500p	10%	400v
C7	Oil paper	0.02	10%	400v
C8	Oil paper	0.02	10%	400v
C9	Mylar	0.1	10%	400v
C10	Mylar	0.1	10%	400v
C11	Electrolytic	20		250v
C12	Electrolytic	20		250v
C13	Oil paper	0.05	10%	400v
C14	Oil paper	0.05	10%	400v
C15	Mica	200p	10%	400v
C16	Mica	200p	10%	400v
C17	Mica	100p	10%	400v
C18	Mica	100p	10%	400v
C19	Oil paper	0.02	10%	400v
C20	Oil paper	0.02	10%	400v
C21	Mylar	0.1	10%	400v
C22	Mylar	0.1	10%	400v
C23	Electrolytic	30		6v
C24	Electrolytic	30		6v
C25	Oil paper	0.05	10%	400v
C26	Oil paper	0.05	10%	400v
C27	Mica	200p	10%	400v
C28	Mica	200p	10%	400v
C29	Ceramic disk type	0.001	10%	500v
C30	Ceramic disk type	0.001	10%	500v
C31	Vacuum tube			
C32	Vacuum tube			

Symbol	Description	Part No.		
C52	Mylar	0.1	10%	400v
C53	Electrolytic	50		25v
C54	Electrolytic	50		25v
C55	Ceramic disk type	100p	10%	400v
C56	Oil paper	0.05	10%	400v
C57	Ceramic tublar type	450p	3%	
C58	Ceramic disk type	100p	10%	400v
C59	Ceramic disk type	20p	10%	400v
C60	Oil paper	0.05	10%	400v
C61	Electrolytic	10		250v
C62	Ceramic disk type	0.01	10%	400v
C63	Ceramic disk type	0.01	10%	400v
C64	Ceramic disk type	0.01	10%	400v
C65	Ceramic disk type	0.01	10%	400v
C66	Ceramic disk type	0.01	10%	400v
C67	Ceramic disk type	0.01	10%	400v
C68	Ceramic disk type	0.01	10%	400v
C69	Ceramic disk type	0.01	10%	400v
C70	Oil paper	0.05	10%	400v
C71	Ceramic disk type	0.01	10%	400v
C72	Ceramic disk type	0.01	10%	400v
C73	Ceramic disk type	0.01	10%	400v
C74	Ceramic disk type	0.01	10%	400v
C75	Ceramic disk type	0.01	10%	400v
C76	Ceramic disk type	0.01	10%	400v
C77	Ceramic disk type	0.01	10%	400v
C78	Mica	200p	10%	400v
C79	Mica	200p	10%	400v
C80	Ceramic disk type	0.01	10%	400v
C81	Ceramic disk type	0.01	10%	400v
C82	Ceramic disk type	0.01	10%	400v
C83	Ceramic disk type	50p	10%	400v
C84	Ceramic disk type	0.01	10%	400v
C85	Ceramic disk type	0.01	10%	400v
C86	Ceramic disk type	200p	10%	400v
C87	Ceramic disk type	200p	10%	400v
C88	Electrolytic	5		25v
C89	Mica	1000p	10%	400v
C90	Ceramic disk type	200p	10%	400v
C91	Ceramic disk type	0.01	10%	400v
C92	Ceramic disk type	0.01	10%	400v
C93	Ceramic disk type	0.01	10%	400v
C94	Ceramic disk type	0.002	+100% - 0	1400v
C95	Ceramic disk type	0.002	+100% - 0	1400v
C96	Oil paper	0.05	10%	400v
C97	Ceramic disk type	0.01	10%	400v
C98	Electrolytic	20		350v
C99	Electrolytic	40+20+20		350v
C100	Electrolytic	40+20+20		350v
C101	Electrolytic	100		250v
C102	Electrolytic	100		250v
C103	Ceramic disk type	0.01	10%	400v

Symbol	Description	Part No.		
C503	Polyethylene	2500p	10%	100v
C506	Electrolytic	20		250v
C514	Mylar	0.05	20%	300v

RESISTORS

10% tolerance 1/2 watt, unless otherwise marked or noted. k = kilohm, m = megohm.

R1	Composition	470k	
R2	Composition	470k	
R3	Composition	220k	
R4	Composition	220k	
R5	Composition	100k	
R6	Composition	100k	
R7	Composition	100k	20%
R8	Composition	100k	20%
R9	Carbon Lownoise	3k	
R10	Carbon Lownoise	3k	
R11	Carbon Lownoise	150k	
R12	Carbon Lownoise	150k	
R13	Carbon Lownoise	200k	
R14	Carbon Lownoise	200k	
R15	Carbon	2m	
R16	Carbon	2m	
R17	Carbon Lownoise	250k	
R18	Carbon Lownoise	250k	
R19	Composition	2.2m	20%
R20	Composition	2.2m	20%
R21	Carbon Lownoise	100k	
R22	Carbon Lownoise	100k	
R23	Composition	150k	20%
R24	Composition	150k	20%
R25	Composition	1m	
R26	Composition	1m	

Symbol	Description	Part No.		
R47	Composition	1m		
R48	Composition	1m		
R49	Composition	470k		
R50	Composition	470k		
R51	Carbon	100		
R52	Carbon	100		
R53	Composition	2.2k		
R54	Composition	2.2k		
R55	Composition	220k		
R56	Composition	220k		
R57	Composition	22k		
R58	Composition	22k		
R59	Composition	470k		
R60	Composition	470k		
R61	Composition	1k		
R62	Composition	1k		
R63	Composition	47k		
R64	Composition	47k		
R65	Carbon	2.5k		
R66	Carbon	2.5k		
R67	Composition	47k		
R68	Composition	47k		
R69	Composition	220k		
R70	Composition	220k		
R71	Composition	220k		
R72	Composition	220k		
R73	Composition	2.2k	20%	
R74	Composition	2.2k	20%	
R75	Wire wound	150		4w
R76	Wire wound	150		4w
R77	Composition	100	20%	
R78	Composition	100	20%	
R79	Wire wound	10		5w
R80	Wire wound	10		5w
R81	Composition	10k	20%	
R82	Composition	1m	20%	
R83	Composition	22k	20%	
R84	Composition	15k		2w
R85	Composition	15k	20%	2w
R86	Composition	1k		
R87	Composition	4.7k		1w
R88	Composition	68	20%	
R89	Composition	100k	20%	
R90	Composition	2.2m	20%	
R91	Composition	2.2k	20%	
R92	Composition	68	20%	
R93	Composition	2.2k	20%	
R94	Composition	2.2m	20%	
R95	Composition	100k		
R96	Composition	47k		
R97	Composition	15k		2w
R98	Wire wound	6k		6w
R99	Composition	47k	20%	1w
R100	Composition	680		
R101	Composition	15k		2w
R102	Composition	47k		

Symbol	Description			Part No.
R103	Composition	15k		2w
R104	Composition	10k		2w
R105	Composition	330		
R106	Carbon	3k		
R107	Carbon	3k		
R108	Composition	6.8k		
R109	Composition	6.8k		
R110	Composition	68k		
R111	Wire wound	1.5k		8w
R112	Wire wound	400		8w
R113	Wire wound	400		8w
R114	Wire wound	6k		6w
R115	Wire wound	6k		6w
R116	Wire wound	1k		4w
R117	Wire wound	2k		8w
R118	Composition	1m	20%	
R119	Vacant			
R120	Composition	1k	20%	
R121	Composition	47k		
R122	Composition	47k		
R123	Composition	4.7m		
R124	Composition	4.7m		
R125	Vacant			
R126	Composition	33	20%	
R127	Composition	2.2m	20%	
R128	Composition	150k		
R129	Composition	100	20%	
R130	Composition	1m	20%	

POTENTIOMETER

VR1	Balance	500k dual	AR8541
VR2	Volume	500k dual	AR8542
VR3	Treble	1m dual	AR8546
VR4	Bass	1m dual	AR8546

Symbol	Description	Part No.
T8	Transformer Output	AT6123U
T9	Transformer Power	AT5296

TUBES AND DIODES

V1,2,3	12AX7(T)	(Audio amp)	
V4,5	12AX7(T)	(Phase inv)	
V6,7,8,9	6BQ5	(Power amp)	
V10,11	6BA6	(1F amp)	
V12,13	6AU6	(1F amp)	
V14	6BE6	(AM conv)	
D1,2	OA-70	(FM DET)	
D3,4	SD-1A	(Silicon Rect)	AG3105
D5	OA-70	(Tuning Meter)	

SWITCHES

S1	Input Selector Switch	AS1626
S2	Mode Selector Switch	AS1625
S3,4,5	See'saw Switch	AS0210
6,8,11		
S7,9	Slide Switch	AS6216
S10	Power Switch	AS0213

MISCELLANEOUS

	FM Front-end	AM0111(U)
	MPX Unit	AM0103A
PL1,2,3	Pilot Lamp	AV7206
4,5		
NL501	Neon Lamp	AV7402
	Fuse 2A	
	Fuse Holder	AK9603
	AC Concent	AK8207
	Dress Panel	AM21022
	Foot	AM6103
	Dial Scale	AA3286A
	Dial Pointer	AA3166
	Dial Pully	AM4209
	Dial Spring	AE4103
ML	Tuning Meter	AA9105
	Connector 5P for Tape REC/P.B	AK5803
	Head Phone Jack	AK7204
	Knob, Tone, Balance,	AA1182
	Power Switch	
	Knob, Tuning	AA1185
	Knob, Volume	AA1188
	Knob, Selector, Mode	AA1190
	Terminal, Speaker Output 4P	AP3113
	Terminal, Input 6P	AP2113
	Terminal, Antenna 3P	AP3111

PARTS LIST OF MULTIPLEX SECTION

CAPACITORS

Symbol	Description				Part No.
C501	Mylar	0.05	20%	50v	
C502	Electrolytic	3		100v	
C503	Polyethylene	2500p	10%	100v	
C504	Polyethylene	410p	5%	100v	
C505	Polyethylene	2500p	10%	100v	
C506	Electrolytic	20		250v	
C507	Mica	0.01			AC3501A
C508	Mica	0.01			AC3501A
C509	Mylar	0.5	20%	300v	
C510	Polyethylene	115p	5%	100v	
C511	Polyethylene	410p	5%	100v	
C512	Mylar	0.7	20%	50v	
C513	Stirol	0.02	5%	100v	
C514	Mylar	0.05	20%	300v	
C515	Polyethylene	1000p	10%	100v	
C516	Mylar	0.05	20%	50v	
C517	Stirol	0.007	5%	100v	
C518	Polyethylene	350p	10%	100v	
C519	Polyethylene	2500p	10%	100v	
C520	Polyethylene	350p	10%	100v	
C521	Polyethylene	2500p	10%	100v	

RESISTORS

10% tolerance 1/2 watt, unless otherwise marked or noted.
k = kilohm, m = megohm.

R501	Composition	470k
R502	Composition	10k
R503	Composition	1k
R504	Composition	10k

POTENTIOMETERS

Symbol	Description	Part No.
VR501	Separation control 250k	AR0011
VR502	FM STEREO Indicator light adj. 30k	AR0020

COILS

L501,502 503,504	50mH Coil (38,67kc Filter coil)	AL9807C
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TRANSFORMERS

T501	19kc double tuned	AT9808B
T502	19kc single tuned	AT9809B
T503	38kc multiplier	AT9810B

TUBES

V501,502	6AQ8
V503	6AV6

DIODES

D501,502, 503,504	0A79	Switching Bridge
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PARTS LIST OF FM FRONT-END

CAPACITORS

Symbol	Description	Part No.
C301	Feed Through 2p	AC9703
C302	Feed Through 2p	AC9703
C303	Feed Through 2p	AC9703
C304	Feed Through 2p	AC9703
C305	Ceramic disk type 5p 100v	
C306	Ceramic disk type 100p 100v	
C307	Ceramic disk type 0.002 400v	
C308	Feed Through 1000p	AC9702
C309	Feed Through 1000p	AC9702
C310	Feed Through 1000p	AC9702
C311	Feed Through 1000p	AC9702
C312	Ceramic disk type 15p 100v	
C313	Feed Through 20p	AC9701
C314	Ceramic disk type 30p 100v	
C315	Ceramic disk type 15p 100v	
C316	Vacant	
C317	Feed Through 1000p	AC9702
C318	Feed Through 1000p	AC9702
C319	Ceramic disk type 20p 100v	

Symbol	Description	Part No.
VC	Variable Condensor AM/FM	AC6427
CT301	OSC Trimmer	AC0302

RESISTORS

R301	Vacant			
R302	Composition	47k	10%	1/4
R303	Composition	33k	10%	1/4
R304	Composition	33k	10%	1/4
R305	Composition	1m	10%	1/4
R306	Composition	47k	10%	1/4
R307	Composition	68k	10%	1/4

COILS AND TRANSFORMERS

L301	Filament Choke Coil 1 μ H	AL0502
L302	RF Coil	AL0420
T301	ANT Coil	AL0207
T302	OSC Coil	AL0318
T303	Transformer, IF	AT8114

TUBE AND DIODE

V301	6C9
D301	1S89

TROUBLE SHOOTING

POWER CIRCUIT

SYMPTOMS	POSSIBLE CAUSE	TO BE CHECKED
Does not light up of function at all.	1) No power supplied.	
	a. Severed power cable.	Check where cable enters plug.
	b. Defective power switch.	Check contact point.
	c. Fuse blown or no fuse inserted.	Replace or insert new fuse.
	2) Fuse blows	
	a. Power transformer heat up.	Short between transformer windings layer.
	b. Defective insulation in OPT between primary and secondary.	Replace OPT.
	c. Short between electrodes in tubes or diodes.	Mainly in rectifier or in power tube.
	d. Defective electrolytic capacitor.	Mainly in ripple filter circuit.
	3) Emits smoke.	
Light up, but does not function	a. Short in filament wiring	Check wiring by removing tubes.
	b. Defective tube socket	Mainly poor insulation of wafer-type socket.
	1) Insufficient plate voltage	
	a. Rectifier tube diode burned out.	Replace tube or diode.
	b. Resistor in ripple filter circuit burned out.	Replace resistor.
	c. No rectifier	
	2) No voltage at plate circuit.	
	a. Primary windings of OPT burned out.	

AUDIO CIRCUIT

SYMPTOMS	POSSIBLE CAUSE
Does not function	1) Power amplifier section a. Severed output transformer(s) windings (primary and secondary) b. Power output tubes damaged or heaters burned out c. Plate load resistors between each stages burned out. d. Bias resistor in cathode circuit burned out. 2) Preamplifier section a. Plate load resistors between each stages burned out. b. Poor contact(s) in input selector switch or mode switch. c. Defective cathode resistor. d. Defective de-coupling resistors between each stages. e. Defective tubes.
Noises	1) Tubes a. Defective tubes. 2) Resistors a. Defective plate resistors, negative feed back resistors, or cathode resistors. 3) Capacitors a. Defective capacitor, coupling phase compensation circuit. 4) Potentiometers a. Noise emanating from defective volume control or other variable resistors.
Hum	1) Tubes a. Defective tubes, particularly short between electrodes.

2) Resistors

a. Defective load resistor in phase inverter circuit on

AM TUNER CIRCUIT

SYMPTOMS	POSSIBLE CAUSE	NOTE
Does not function	a. Defective tubes b. Poor contact or defective insulation in input selector or mode switch. c. Burnt out resistor in power supply. d. Severed winding(s) in IF transformer. e. Severed oscillator coil winding. f. Short of variable capacitor (tuning) inside mechanism. g. Germanium diode in detector circuit is defective.	
Poor sensitivity	a. Severed winding in RF coil. b. Out of alignment in IF transformer. c. Out of tracking alignment d. Defective tubes e. Poor insulation of trimming capacitors.	
Distortion	a. Defective germanium diode. b. Defective tubes. c. Defective tuning indicator tube. d. Defect in AVC circuit.	
Noise	a. Noise emanating from defective tube. b. Occasional short between fixed plate and rotor plate of variable capacitor. c. Poor soldering or short between parts.	

FM TUNER CIRCUIT

SYMPTOMS	POSSIBLE CAUSE	NOTE
Does not function	a. Defective tubes. b. Severed winding(s) in IF Transformers. c. Poor contact or defective insulation in rotary switch. d. Burnt out resistor(s) in power supply. e. Loose oscillation coil connection, or poor soldering. f. Poor contact between sockets and tube pins. g. Defective germanium diode(s).	
Poor sensitivity	a. IF transformers out of alignment. b. Tracking out of alignment. c. Defective tubes.	
Distortion	a. Discriminator IF transformer out of alignment. b. Defective tubes. c. Defective germanium diode(s)	
Noises including Microphonic	a. In most cases, due to defective tubes in RF amplifier or local oscillator tube(s).	

MULTIPLEX TROUBLE SHOOTING AND REPAIRS

SYMPTOMS	PROBABLE CAUSE	REPAIRS NECESSARY
Poor separation	1. Pilot amplifying circuit (drift in 19 kc transformer, or other faulty components). 2. Composite circuit (drift in separation control; drift in 38 kc coil; or other faulty components).	1. Readjustment (AT9808-AT9810); replacement of components. 2. Readjustment of separation control; readjustment of components.
Excessive distortion in stereo reception	1. Pilot amplifier circuit. 2. Composite circuit (6AQ8, etc.) 3. Drop in line power voltage.	1. Readjustment or replacement of components. 2. Vicinity of 6AQ8. 3. Provide supply of proper voltage.
Distortion prevalent at points of high	1. Inadequate pilot level. 2. Drop in line power voltage.	1. Readjustment; replacement of faulty components. 2. Check power supply section.
Extreme drop in volume in stereo reception	1. Composite amplifying circuit (Faulty 6AQ8 or components in its vicinity)	1. Replace 6AQ8 or other faulty components in vicinity of 6AQ8.
Separation control completely ineffective (No. change even when separation control adjusted.)	1. Faulty separation control variable resistor (burnt out) 2. Severed 38 kc coil. 3. 6AQ8. 2500pf cathode capacitor faulty.	1. Replace component. 2. Replace component. 3. Replace components.
Poor separation on one channel only	1. Faulty 38 kc filter (one channel only). 2. One of secondary windings of 38 kc transformer severed.	1. Replace component. 2. Replace component.
Stereo indicator fails to function	1. Faulty neon tube. 2. Improper working point.	1. Replace component. 2. Readjust indicator sensitivity control.

* Other malfunctions should be dealt with in the same way as for other amplifiers.

PIONEER ELECTRONIC CORPORATION

15-5, 4-CHOME, OHMORI-NISHI, OHTA-KU, TOKYO, JAPAN
PIONEER ELECTRONIC CORPORATION U.S. REPRESENTATIVE OFFICE
350 FIFTH AVE., NEW YORK, N.Y. 10001, U.S.A.
PIONEER INTERNATIONAL INCORPORATED.,
EUROPEAN REPRESENTATIVE OFFICE
48, RUE DE LA CONCORDE, BRUSSELS 5, BELGIUM