McMartin industries, inc.

KVTI

PRELIMINARY
INSTRUCTION MANUAL

BFM-2001

FM/SCA GENERATOR

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1.0 SPECIFICATIONS

CARRIER FREQUENCY RANGE	25 to 114 kHz
CARRIER FREQUENCY STABILITY	± 0.25%
MODULATION METHOD	Direct FM
AUDIO PROCESSING	2-1 compression ratio
DISTORTION	Less than 0.5% @ 400 Hz ± 6 kHz deviation, 67 kHz
AUDIO FREQUENCY RESPONSE	± 0.5 dB, 30 to 5,000 Hz
SIGNAL / NOISE RATIO	Better than 65 dB
MODULATION CAPABILITY	± 12% of Carrier Frequency
PRE-EMPHASIS	75 or 150 μ seconds (specify)
INPUT IMPEDANCE	600 Ω balanced (± 1 dB) 30-5,000 Hz
INPUT LEVEL	+ 10 dBm
DC INPUT	– 1 to + 1 Volt DC, ± 6 kHz deviation
MUTE LEVEL	Adjustable from 0 to – 30 dB below 100% modulation
MUTE DELAY	Adjustable from 200 milliseconds to 2 seconds
OUTPUT IMPEDANCE	Less than 1 k Ω
OUTPUT LEVEL	Adjustable up to 6 volts P-P
POWER REQUIREMENT	120/240 ± 10 VAC, 50/60 Hz, 10 W
TEMPERATURE RANGE	– 20 to 50° C
FUSE	0.25 amp — 120 V 0.125 — 240 V
DIMENSIONS	height 1¾" (4.4 cm) width 19" (48.3 cm) depth 12" (30.5 cm)
WEIGHT	shipping 8 lbs. (3.6 kg) actual 10 lbs. (4.5 kg)
FINISH	McMartin beige

2.0 INSTALLATION AND SETUP

2.1 Location

Installation should be made in a standard rack which is electrically connected to the main station ground and does not contain strong RF fields or heat producing equipment. A check should be made to insure that the ambient temperature inside the rack does not exceed 50° C (125° F). The unit may be mounted in the main transmitter cabinet if space allows and cautions regarding RF fields and ambient operating conditions are followed.

2.2 Connections

Plug the AC line cord into the proper voltage 50/60 Hz power source. **Caution: Insure that the unit is strapped for the correct AC voltage. Check schematic for correct strapping.** Connect the audio input to the barrier strip on the rear of the chassis. The input is 600 ohms balanced.

Connect the subchannel output from the BNC jack on the rear of the chassis to the exciter using as short a piece of coax as possible.

2.3 Generator Setup

Switch the front panel muting switch to the defeat position.

Adjust the front panel output control for correct injection into the main channel as verified by an FCC approved SCA monitor.

Note: The BFM-2001 has been factory adjusted to provide a deviation of ± 6 kHz with a + 10 dBm input at 400 Hz. Due to the pre-emphasis used, the audio input level must be reduced for a 100% modulation reading at the maximum modulation frequency of 5 kHz.

If audio compression is desired, the internal switch (SW1) must be switched to the compressed position. Thus the modulation increases only 5 dB with a 10 dB increase in audio level. The internal switch automatically compensates for this and the same audio input level is required for 100% modulation.

When the program material is applied to the input, additional attenuation of the audio input will be required. The VU meter is an average reading device whereas the peak flasher is a peak reading device. The ratio of peak to average readings on program material may run as much as 12 dB difference. The program material must be attenuated so that program peaks do not exceed 100%.

The front panel mute delay control can be adjusted to prevent annoying clicks when muting and also to avoid muting between pauses in program material. The attack time is extremely fast to assure that all program material is realized.

The front panel muting switch should normally be in the mute position (down) causing the subcarrier to be automatically activated by program material. The mute may be defeated with the front panel switch or remotely by interconnecting the two rear terminals marked "mute" and "ground". This is desirable when measuring main-to-SCA crosstalk, as the unmodulated SCA carrier can be remotely activated.

Note: The muting switch should be in the normal mute position.

3.0 CIRCUIT DESCRIPTION

The audio input is fed through the input attenuator pad consisting of R101, R102 and R103 and transformer T1, providing a balanced 600 ohm input impedance at all frequencies from 30 to 5,000 Hz.

The audio output signal from transformer T1 is fed through C1 to one leg of switch S1 and also through R2 to the compression circuitry of U1. The circuitry of U1 utilizes a variable gain cell. The output of the gain cell is a current which is fed to an operational amplifier providing linear gain control. Distortion (THD) trimpot R11 provides a means for trimming out the offset voltages in the gain cell providing distortion levels of less than 0.1%

Resistor R6 provides gain adjustment of the internal OP amplifier and is adjusted so the output will increase 5 dB with a 10 dB input level change. Resistor R8 is a fine trimmer to adjust the tracking down to at least 60 dB, thus reducing the audio input 60 dB will only reduce the output 30 dB. The output of compressor U1 is fed through C3 to trimpot R5 which adjusts the output level equal to the signal directly from the input transformer T1. A +8 dBm input, directly or through the compressor, will provide the same level at the output of switch S1.

The audio signal is fed to the pre-emphasis network consisting of R15, R16, C12 and C35, 150 microsecond pre-emphasis is standard. The DC input port is fed through isolation resistor R17 into the input of the DC amplifier U2. The quiescent voltage at the output pin #5 of U2 is precisely ½ the supply voltage which is precisely controlled by the voltage regulator U5. This provides a very stable DC voltage which is fed through the 5 kHz low pass filter terminated in a 1k load resistor R30. For DC operation, plug-in capacitor C22 is replaced with a wire jumper.

The audio signal is fed through R31 to the input of an extremely stable VCO (+20 ppm/°C). The VCO frequency is adjusted by the front panel control R104 (frequency). The FM distortion is typically 0.1% for ±10 kHz deviation. The triangular wave output from pin #8 of U3 is fed through a low pass filter removing all harmonics providing a carrier signal with THD of 0.3% or less. This signal is amplified by an operational amplifier U4 where the signal is amplified to an output level of 6 V (RMS). The output is fed through the front panel control R105 (injection) which adjusts the injection to the desired level.

The audio signal from U2 is fed to the amplifier/limiter Q1 where the audio signal is highly amplified and limited. Normally the output is limited when the audio input signal is 20 dB below the normal operating level. The limited signal feeds a voltage doubler consisting of C18, CR1, CR2 and C19 providing a DC control voltage for activiating the mute circuit. Transistor switch Q3 is normally turned on providing a very low impedance source and short circuiting the SCA carrier to ground through R38 (10k ohm impedance), providing at least 60 dB attenuation of the SCA carrier during mute periods.

When modulation is applied, the audio signal is amplified/limited, and voltage doubled to a DC control voltage. The DC voltage is fed through diode CR3 to transistor switch Q2, which is turned on, dropping its collector voltage to near zero. This turns off transistor switch Q3, allowing the SCA carrier to be fed to the system.

Feeding the DC voltage through diode CR3 also charges holding capacitor C20, providing a fast carrier "on" condition with modulation. Holding capacitor C31 must discharge through R28 and Q2, and the rate of decay is a function of the MUTE DELAY control R106 and capacitor C20.

The DC control voltage also activates transistor Q5 which turns on the SCA carrier (LED) indicator. A PNP transistor is used for defeating the mute circuitry. If the base is connected to ground, either by the front panel mute switch or the rear terminal mute contact, a positive DC voltage is applied to diode CR3, turning on Q2, which defeats the mute circuit.

The SCA generator DC Supply Voltage (See Dwg. #000901) is doubly regulated. The regulated 24 volt output from the power supply board P/N 553050 is fed to the second regulator U6 which provides a very stable 13 volts DC for U3 modulator providing excellent frequency stability.

4.0 MAINTENANCE

This section contains maintenance and calibration procedures for the BFM-2001 SCA generator. Before performing calibration, it must be definitely determined that the SCA generator is at fault. This can be determined by a high quality scope and a good FCC approved SCA monitor. The mute must be disabled for the following test.

4.1 Carrier Frequency Adjustment (R140)

1. Connect a frequency counter to the BNC output connector on the rear chassis or the front panel pin jack. (Frequency test).
2. Set the front panel frequency control to the correct SCA frequency.

4.2 Modulation Level

1. Connect an FCC type approved monitor or spectrum analyzer to the BNC connector on the rear of chassis. **Note:** The spectrum analyzer must be capable of reducing its bandwidth to approximately 1 kHz.
2. If a calibrated monitor is used, feed a 400 Hz audio signal into the input at a level of +10 dBm. **CAUTION: PRE-EMPHASIS SWITCH MUST BE IN THE "OUT" POSITION.**
3. Function switch in the "direct" position.
   (a) Adjust modulation control trimpot R1 for a reading of 100% on the monitor.
   (b) If a spectrum analyzer is used, feed a 2495 Hz audio signal into the audio input at a level for the first carrier null (±6 kHz deviation).
4. Function switch in the COMPRESS position.
   (a) Adjust modulation control trimpot R1 for reading of 100% on the monitor.
   (b) If a spectrum analyzer is used, feed a 2495 Hz audio signal into the audio input at a level for the first carrier null (±6 kHz deviation).

4.3 Compressor Adjustment

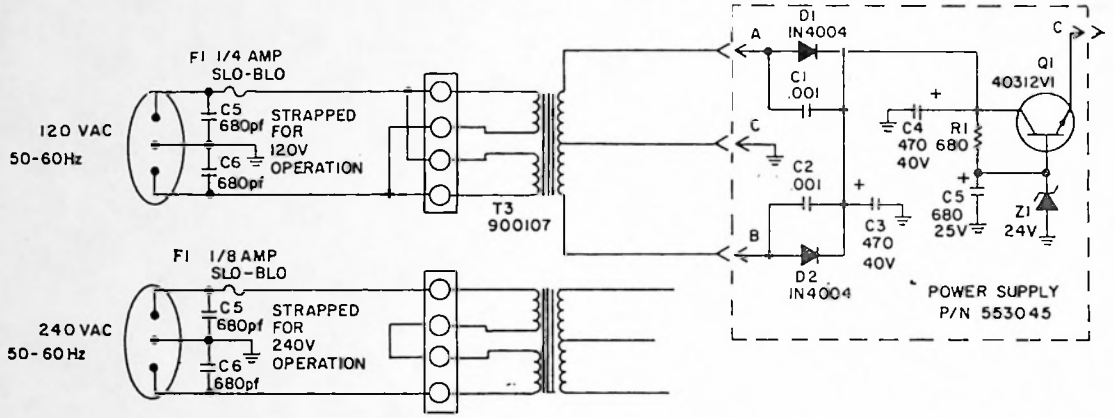
1. Feed a 400 Hz audio signal into the 600 Ω BAL input.
2. Connect an audio analyzer and scope to the junction of R51 and switch S1, and set reference level.
3. Reduce audio input level exactly 10 dB.
4. Adjust trimpot R6 for a reduction of only 5 dB below reference level on analyzer.
5. Reduce audio input 60 dB and adjust R8 to fine trim the output to 30 dB.
6. Repeat steps 4 and 5 until compressor tracks within 1 dB over a 60 dB input range. **NOTE:** For Every 2 dB drop in input level, the output will drop only 1 dB.
7. With a 10 dBm input level, adjust distortion null trimpot R11 for the lowest distortion, this should be less than 0.1% at 1,000 Hz.

4.4 Mute Level Control Adjustment (R22)

This control is normally adjusted for maximum muting which will cause an audio level of approximately −30 dB to activate the SCA carrier. If less sensitivity is required, simply turn internal control R22 clockwise for the desired turn-on point.

4.5 Mute Delay Control (R106)

This is a front panel control and can be adjusted to the desired delay. The attack time is fixed. Under normal conditions the mute switch should be in the "down" position.



Correct Strapping for 120 V or 240 V Operation

5.0 PARTS LIST

The majority of components used in the BFM-2001 SCA generator are of standard value and tolerance and are readily available from local electronic distributors.

5.1 Chassis Sub Assembly

Symbol	Part Number	Description
C101	660030	Capacitor, Feed Thru, 1,000 pF, 500 V
C102	660030	Capacitor, Feed Thru, 1,000 pF, 500 V
C103	660030	Capacitor, Feed Thru, 1,000 pF, 500 V
C104	660030	Capacitor, Feed Thru, 1,000 pF, 500 V
C105	660030	Capacitor, Feed Thru, 1,000 pF, 500 V
C106	640012	Capacitor, Ceramic Disc, 680 pF, 1 kV
C107	640012	Capacitor, Ceramic Disc, 680 pF, 1 kV
CR101	220044	Diode, Light Emitting, Yellow
CR102	220034	Diode, Light Emitting, Red
F1	280015	Fuse, ¼ Amp, Slo-Blo, 125 V
L101	930097	Choke, Coil, 22 μH
L102	930097	Choke, Coil, 22 μH
L103	930097	Choke, Coil, 22 μH
L104	930097	Choke, Coil, 22 μH
L105	930097	Choke, Coil, 22 μH
R101	500001	Resistor,100 Ω, ±5%, ¼ W
R102	500001	Resistor,100 Ω, ±5%, ¼ W
R103	500005	Resistor,680 ohm, ±5%, ¼ W
R104	401030	Potentiometer, 1 kΩ, ¾ W
R105	401030	Potentiometer, 1 kΩ, ¾ W
R106	401014	Potentiometer, 5 MΩ
R107	500008	Resistor, 1.5 kΩ, ¼ W, 5%
S101	480025	Switch Toggle, SPDT, Black
T101	900107	Transformer Power, 2-P-205

5.2 P.C.B., SCA Generator Assembly

C1	670025	Capacitor, Tantalum, 22 μF, 16 V, 20%
C2	670023	Capacitor, Tantalum, 10 μF, 16 V, 20%
C3	670025	Capacitor, Tantalum, 22 μF, 16 V, 20%
C4	670022	Capacitor, Tantalum, 4.7 μF, 20 V, 20%
C5	670023	Capacitor, Tantalum, 10 μF, 16 V, 20%
C6	670026	Capacitor, Tantalum, 1 μF, 35 V,
C7	670021	Capacitor, Tantalum, 2.2 μF, 20 V, 20%
C8	670013	Capacitor, Tantalum, 100 μF, 20 V, 20%
C9	116142	Capacitor, Metallized Polyester, .1 μF, 250 V, 10%
C10	600038	Capacitor, Electrolytic, 680 μF, 25 V
C11	670026	Capacitor, Tantalum, 1 μF, 35 V, 20%
C12	116082	Capacitor, Polystyrene, 2,700 pF, 33 V, 1%
C13	670025	Capacitor, Tantalum, 22 μF, 16 V, 20%
C14	670013	Capacitor, Tantalum, 100 μF, 20 V, 20%
C15	670021	Capacitor, Tantalum, 2.2 μF, 20 V, 20%
C16	670021	Capacitor, Tantalum, 2.2 μF, 20 V, 20%
C17	670023	Capacitor, Tantalum, 10 μF, 16 V, 20%
C18	670025	Capacitor, Tantalum, 22 μF, 16 V, 20%
C19	670013	Capacitor, Tantalum, 100 μF, 20 V, 20%
C20	670005	Capacitor, Tantalum, 220 μF, 10 V, 10%

C21	670025	Capacitor, Tantalum, 22 μF, 16 V, 20%
C22		*Value selected in final test
C23		*Value selected in final test
C24	670013	Capacitor, Tantalum, 100 μF, 20 V, 20%
C25	116142	Capacitor, Metallized Polyester, .1 μF, 250 V, 10%
C26	670022	Capacitor, Tantalum, 4.7 μF, 20 V, 20%
C27	116142	Capacitor, Metallized Polyester, .1 μF, 250 V, 10%
C28	670021	Capacitor, Tantalum, 2.2 μF, 20 V, 20%
C29	116142	Capacitor, Metallized Polyester, .1 μF, 250 V, 10%
C30	670021	Capacitor, Tantalum, 2.2 μF, 20 V, 20%
C31	670013	Capacitor, Tantalum, 100 μF, 20 V, 20%
C32	116142	Capacitor, Metallized Polyester, .1 μF, 250 V, 10%
C33	116142	Capacitor, Metallized Polyester, .1 μF, 250 V, 10%
C34	600027	Capacitor, Electrolytic, 22 μF, 25 V
CR1	220005	Diode, 1N3604
CR2	220005	Diode, 1N3604
CR3	220005	Diode, 1N3604
CR4	220005	Diode, 1N3604
	935075	Filter, Low Pass, 5 kHz
Q1	201074	Transistor, 2N2060
Q2	201049	Transistor, PE4002
Q3	201056	Transistor, PN3569
Q4	201055	Transistor, PN4355
Q5	201056	Transistor, PN3569
R1	401021	Control, 5 kΩ, 30%
R2	500015	Resistor, 22 kΩ, ¼ W, 5%
R3	500017	Resistor, 33 kΩ, ¼ W, 5%
R4	500017	Resistor, 33 kΩ, ¼ W, 5%
R5	401021	Control, 5 kΩ, 30%
R6	400042	Control, 50 kΩ, 30%
R7		Not used
R8		Not used
R9	502172	Resistor, 3.3 MΩ, ½ W, 5%
R10	500027	Resistor, 220 kΩ, ¼ W, 5%
R11	400043	Control, 100 kΩ, 30%
R12	500013	Resistor, 6.8 kΩ, ¼ W, 5%
R13	500001	Resistor, 100 Ω, ¼ W, 5%
R14	502056	Resistor, 47 Ω, ½ W, 5%
R15	500020	Resistor, 68 kΩ, ¼ W, 5%
R16	500005	Resistor, 3.3 kΩ, ¼ W, 5%
R17	500021	Resistor, 100 kΩ, ¼ W, 5%
R18	500012	Resistor, 4.7 kΩ, ¼ W, 5%
R19	500005	Resistor, 680 Ω, ¼ W, 5%
R20	500002	Resistor, 330 Ω, ¼ W, 5%
R21	500006	Resistor, 1 kΩ, ¼ W, 5%
R22	400042	Control, 50 kΩ, 30%
R23	500019	Resistor, 47 kΩ, ¼ W, 5%
R24	500015	Resistor, 22 kΩ, ¼ W, 5%
R25	500002	Resistor, 330 Ω, ¼ W, 5%
R26	500006	Resistor, 1 kΩ, ¼ W, 5%
R27	500015	Resistor, 22 kΩ, ¼ W, 5%
R28	500017	Resistor, 33 kΩ, ¼ W, 5%
R29	500014	Resistor, 10 kΩ, ¼ W, 5%
R30	500006	Resistor, 1 kΩ, ¼ W, 5%
R31		*Value selected in final test
R32		*Value selected in final test
R33		Not used
R34	500013	Resistor, 6.8 kΩ, ¼ W, 5%
R35	500012	Resistor, 4.7 kΩ, ¼ W, 5%

R36	500031	Resistor, 220 Ω, ¼ W, 5%
R37	500019	Resistor, 47 kΩ, ¼ W, 5%
R38	500014	Resistor, 10 kΩ, ¼ W, 5%
R39	500014	Resistor, 10 kΩ, ¼ W, 5%
R40	500019	Resistor, 47 kΩ, ¼ W, 5%
R41	500019	Resistor, 47 kΩ, ¼ W, 5%
R42	500024	Resistor, 15 kΩ, ¼ W, 5%
R43	500005	Resistor, 680 Ω, ¼ W, 5%
R44	500024	Resistor, 15 kΩ, ¼ W, 5%
R45	500024	Resistor, 15 kΩ, ¼ W, 5%
R46	500009	Resistor, 2.2 kΩ, ¼ W, 5%
R47	500014	Resistor, 10 kΩ, ¼ W, 5%
R48	500054	Resistor, 82 kΩ, ¼ W, 5%
R49	500014	Resistor, 10 kΩ, ¼ W, 5%
R50	500031	Resistor, 220 Ω, ¼ W, 5%
R51	500033	Resistor, 2.7 Ω, ¼ W, 5%
S1	480037	Switch, Slide, Miniature
S2	480037	Switch, Slide, Miniature
T1	910074	Transformer, 2-A-139
U1	230093	Integrated Circuit, NE570N
U2	230060	Integrated Circuit, LM386
U3	230130	Integrated Circuit, XR2209M
U4	230090	Integrated Circuit, NE5534
U5	230052	Voltage Regulator, LM904H
U6	230084	Voltage Regulator, LM340T15

5.3 P.C.B, Power Supply Assembly

C1	640004	Capacitor, Disc Ceramic, .001 μF, 500 V
C2	640004	Capacitor, Disc Ceramic, .001 μF, 500 V
C3	600020	Capacitor, Electrolytic, 470 μF, 40 V
C4	600020	Capacitor, Electrolytic, 470 μF, 40 V
C5	600038	Capacitor, Electrolytic, 680 μF, 25 V
D1	210008	Diode, 1N4004
D2	210008	Diode, 1N4004
Q1	201059	Transistor, RCA 40312VI
R1	502084	Resistor, 680 Ω, ½ W, 5%
Z1	220011	Zener Diode, 1N4749

5.4 P.C.B., 95 kHz Filter Assembly

C1	116141	Capacitor, Metal Polyester, .0022 μF, 1,000 V
C2	650018	Capacitor, Dipped Mica, 270 pF, 500 V
C3	116150	Capacitor, Metal Polyester, .0033 μF, 1,000 V
C4	650024	Capacitor, Dipped Mica, 750 pF, 500 V
C5	116151	Capacitor, Metal Polyester, .0015 μF, 630 V
L1	932068	Pot Core Assy., 1.75 mH
L2	932067	Pot Core Assy., 2.3 mH
R1	500006	Resistor, 1 kΩ, ¼ W, 5%
R2	500006	Resistor, 1 kΩ, ¼ W, 5%

6.0 SCHEMATIC DIAGRAMS

	PART NUMBER
MASTER SCHEMATIC P.C.B. TOP	000901 550308/3

WARRANTY

McMartin products are warranted to be free from defects in materials and workmanship for a period of one year after shipping date, when subjected to normal usage and service. All warranties are void if (a) equipment has been altered or repaired by others without McMartin's specific prior authorization; or (b) equipment is operated under environmental conditions or circumstances other than those specifically described in McMartin literature or instruction manuals.

Upon notification within the applicable warranty period, McMartin agrees without charge, to repair, replace, or supply replacement parts for any properly maintained equipment or parts that are defective as to design, materials or workmanship and that are returned in accordance with McMartin's instructions to the Buyer. At McMartin's sole discretion, the Buyer may be requested to return the defective part or equipment to McMartin, FOB Omaha, Nebraska. Parts or equipment may be returned only with McMartin's prior authorization and must be identified by a return authorization number previously issued by McMartin's Customer Service Department. All merchandise so returned must be sent transportation prepaid, at Buyer's risk. Full details of the failure or malfunction should be included so as to expedite repair or replacement. Repair parts or repaired or replaced equipment will be returned to the Buyer, FOB factory.

The above warranty does not extend to other equipment, such as tubes, transistors, I.C.'s lamps or fuses manufactured by others, which are subject to only such adjustment as McMartin may obtain from the suppliers thereof. McMartin shall not be liable for consequent damages resulting from the use of, or the inability to use, the equipment; nor for any loss, damage or expense incurred thereby; nor from any other cause.

Except as set forth herein, and except as to title, there are no warranties, or any affirmations of fact or promises by McMartin, with reference to the equipment, or to merchantability, fitness, for particular application, signal coverage, infringement, or otherwise, which extend beyond the description of the equipment on the face hereof.

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CORRECTION on Schematic #000901

U3	is	Integrated Circuit, XR2209M
C4	is	Capacitor, Tant., 4.7 uF, 20 V, 20%
C12	is	Capacitor, Polystyrene, 2700 pF, 33 V, 1%
C26	is	Capacitor, Tant., 4.7 uF, 20 V, 20%
R16	is	Resistor, Carbon Film, 3.3k ohm, 5%
R31	is	Resistor, Metal Film, 22.1k ohm, 1%

NOTE: These corrections have already been made in the Parts List.

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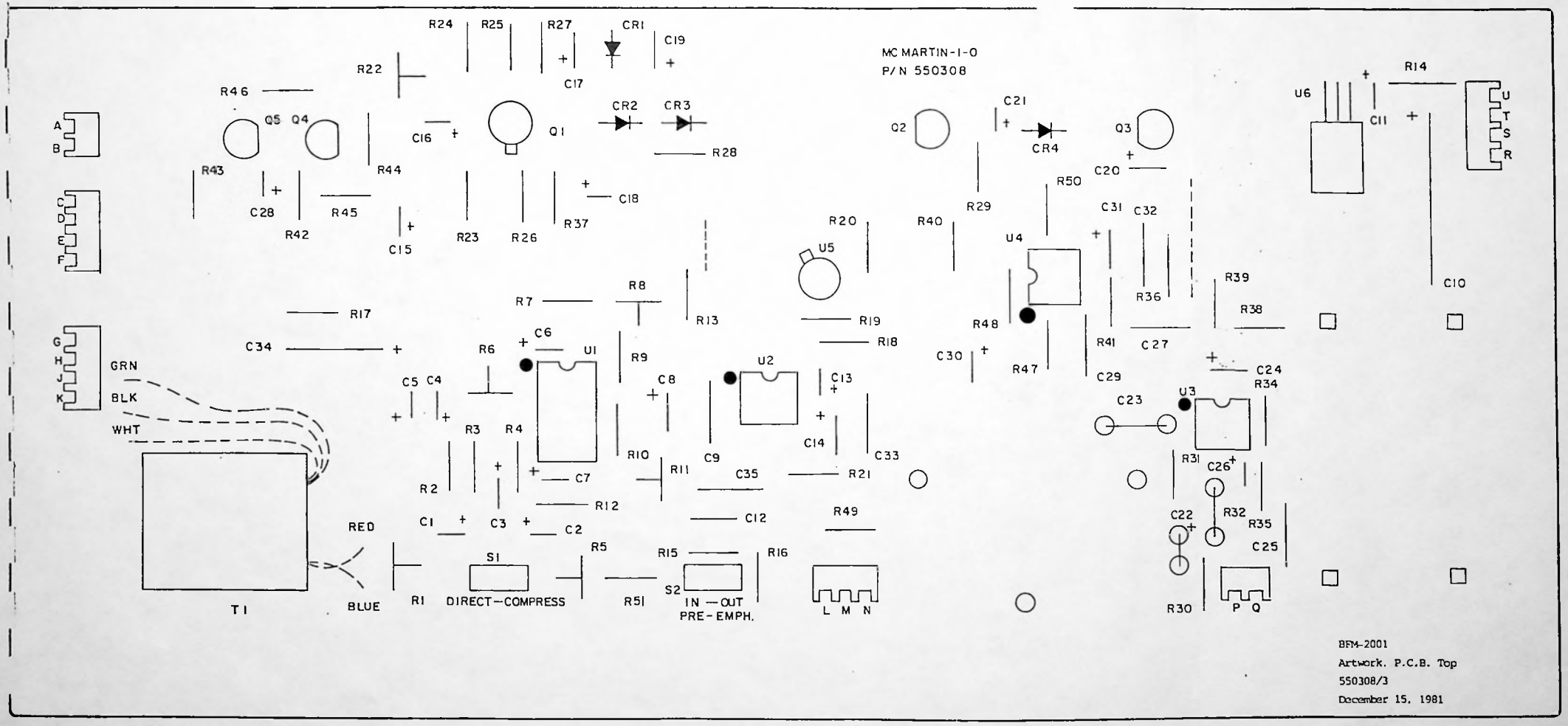
MC MARTIN-1-0
P/N 550308
R24
R25
R27
CR1
C19
R22
C17
R46
Q5
Q4
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CR2
CR3
R28
R43
C28
R44
R45
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C15
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C1
C3
C2
C12
R49
RED
BLUE
T1
R1
S1
DIRECT—COMPRESS
R5
R51
R15
R16
S2
IN —OUT
PRE-EMPH.
L M N
G
H
J
K
GRN
BLK
WHT
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U5
R19
R18
Q2
C21
CR4
Q3
C20
R29
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C31
C32
R36
R39
R38
R48
R41
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BFM-2001
Artwork. P.C.B. Top
550308/3
December 15, 1981

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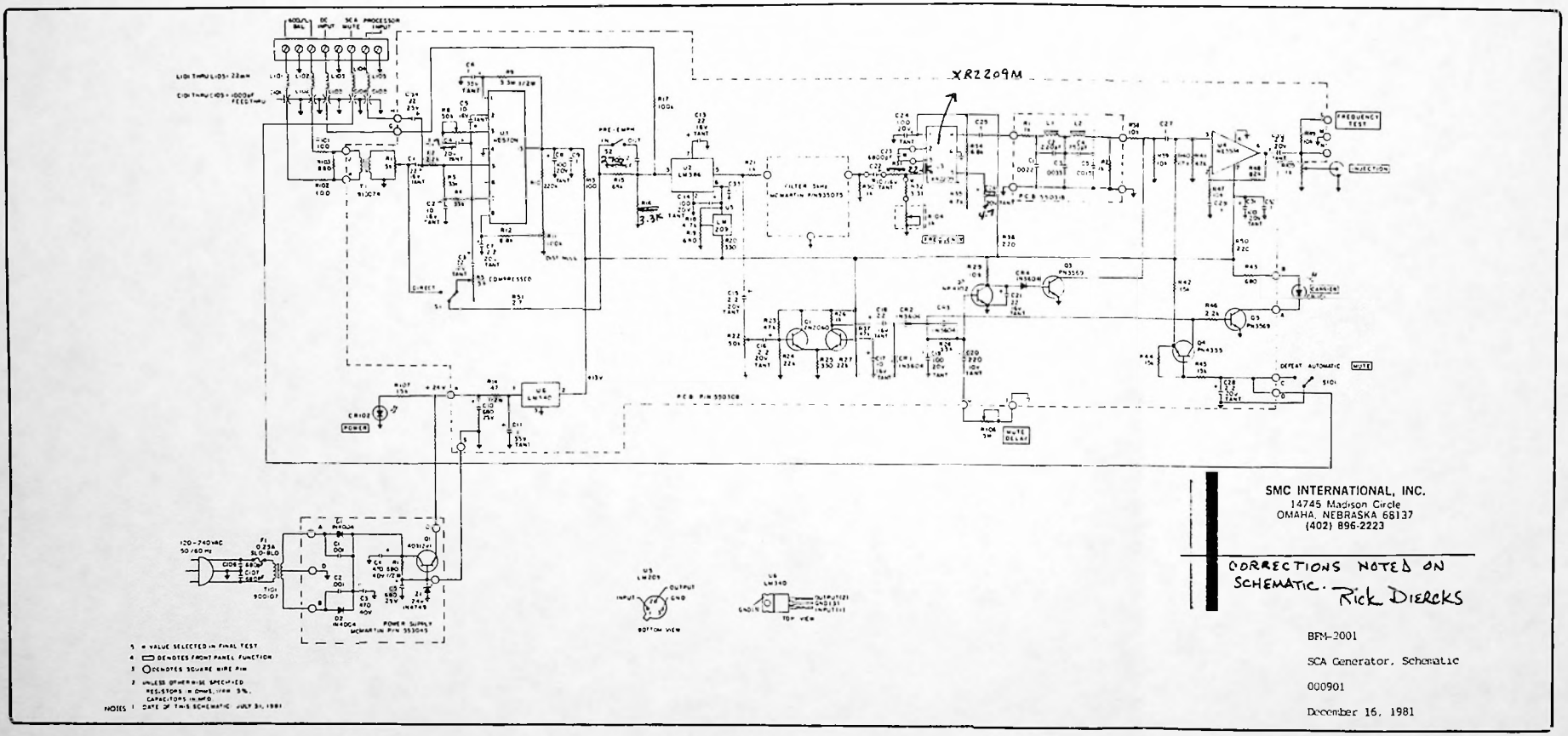
XR2209M
SMC INTERNATIONAL, INC.
14745 Madison Circle
OMAHA, NEBRASKA 68137
(402) 896-2223
CORRECTIONS NOTED ON SCHEMATIC. Rick DIERCKS
BFM-2001
SCA Generator, Schematic
000901
December 16, 1981