PANORAMIC / SINGER

Instruction Manual

Range Extending Converter

REC-2

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and maintenance instructions for the PANORAMIC* Range Extending Converter, Model REC-2 (hereafter referred to as the Converter), manufactured by The Singer Company, Metrics Division. Included in the manual are a general description of the Converter, installation and operating instructions, theory of operation, maintenance information and data, a schematic diagram and a repair parts list. The Converter is illustrated in figure 1-1.

1-3. The information contained in this manual refers to the standard version of the Converter and is current only to the date of publication. Differences in equipment components, specifications, and performance resulting from The Singer Company's continuous production improvement program or individual customer design and application requirements are described in addendum sheets.

1-4. PURPOSE AND USE OF EQUIPMENT.

1-5. The Converter is a plug-in unit primarily designed to convert the frequency spectrum between 10 Hz and 2 MHz to 2. 5 MHz when used with the Model RF-8 Tuning Head and Model CA-5 Panalyzor in the PANORAMIC Model SSB-50 Single Sideband Analyzer System. The Converter, RF-8, and CA-5 configuration provides spectrum analysis in the 10-Hz to 2-MHz frequency range. Typical applications include:

a. Audio frequency spectrum analysis.

b. Ultrasonic spectrum analysis.

c. Analysis of signals in the base band of telephone and telegraph carrier systems.

d. Single sideband receiver distortion and sensitivity measurements (with the addition of a Model TTG-5 Two-tone R-f Generator to the configuration).

1-6. Inquiries are invited regarding special applications of the Converter to particular requirements. Such inquiries should be directed to the attention of the Applications Engineering Department.

1-7. GENERAL DESCRIPTION.

1-8. The Converter is a completely solid-state plug-in unit which operates in conjunction with a variable frequency oscillator (VFO) such as the PANORAMIC Model RF-8 Tuning Head to convert the frequency spectrum between 10 Hz and 2 MHz to 2. 5 MHz. The 2. 5-MHz converted output is then heterodyned in the input mixer of the CA-5 Panalyzor with a 3-MHz oscillator output from the Converter to produce the required 500-kHz center frequency input signal to the CA-5 Panalyzor. The Converter occupies a quarter-rack width in such units as the Model MF-50 Main Frame of the Model SSB-50 Single Sideband Analyzer System. Components are mounted on the rear of the front panel and on five printed circuit boards. Operating power for the Converter is provided by the main frame in which it is installed, thereby eliminating the need for an integral power supply.

1-9. SPECIFICATIONS.

1-10. Table 1-1 lists the electrical and physical characteristics of the Converter.

1-11. TRANSISTOR, DIODE, AND CRYSTAL COMPLEMENT.

1-12. The transistor, diode, and crystal complement of the Converter is given in table 1-2.

TABLE 1-1. SPECIFICATIONS

Input frequency range:	10 Hz to 2 MHz, ±1 dB (Low frequency response limited by resolution capabilities of the associated spectrum analyzer).
Converted output frequency:	2. 5 MHz

(Cont'd)

*A Trademark of THE SINGER COMPANY

TABLE 1-1. SPECIFICATIONS (Cont'd)

Gain:	Approximately unity.
Converted Sensitivity:	3-mv input produces a 3-mv (approximately), 2.5 MHz converted output.
Distortion:	All harmonics, intermodulation, hum and spurious responses are at least 60 dB below signal level of 3 mv, with no input attenuation.
Input Attenuator:	Up to 55 dB in 5 dB steps. Accuracy ±10 percent.
Center frequency:	Yellow portion of 2.0 to 4.5 MHz dial on RF-8 Tuning Head is calibrated from 0 to 2 MHz for use with Converter.
VFO requirements:	0.3-volt (nominal), 2.5 to 4.5-MHz input, at 50 ohms.
Signal input impedance:	50 ohms or 600 ohms unbalanced, switch selectable.
Power requirements:	-15 vdc reg. at 40 ma. +15 vdc reg at 40 ma.
Physical characteristics: Weight: Width: Height: Depth (behind panel):	 3 lbs. 3 3/4 inches 4 inches 10 inches

TABLE 1-2. TRANSISTOR, DIODE, AND CRYSTAL COMPLEMENT

Reference Designation Symbol	Type	Function
	Transistors	
A1A3Q1	2N3638A	3-MHz Osc.
A3Q1, Q2	2N3565	2.5-MHz I-f Amplifier
A3Q3	2N3565	Emitter Follower
	Diodes	
A1A1CR1, CR2 A1A2CR1 thru CR3	FDH666	Diode Switches
A2CR1 thru CR4	1N906	Balanced Mixer Diodes
A1A3Y1	-	Generates 3-MHz output

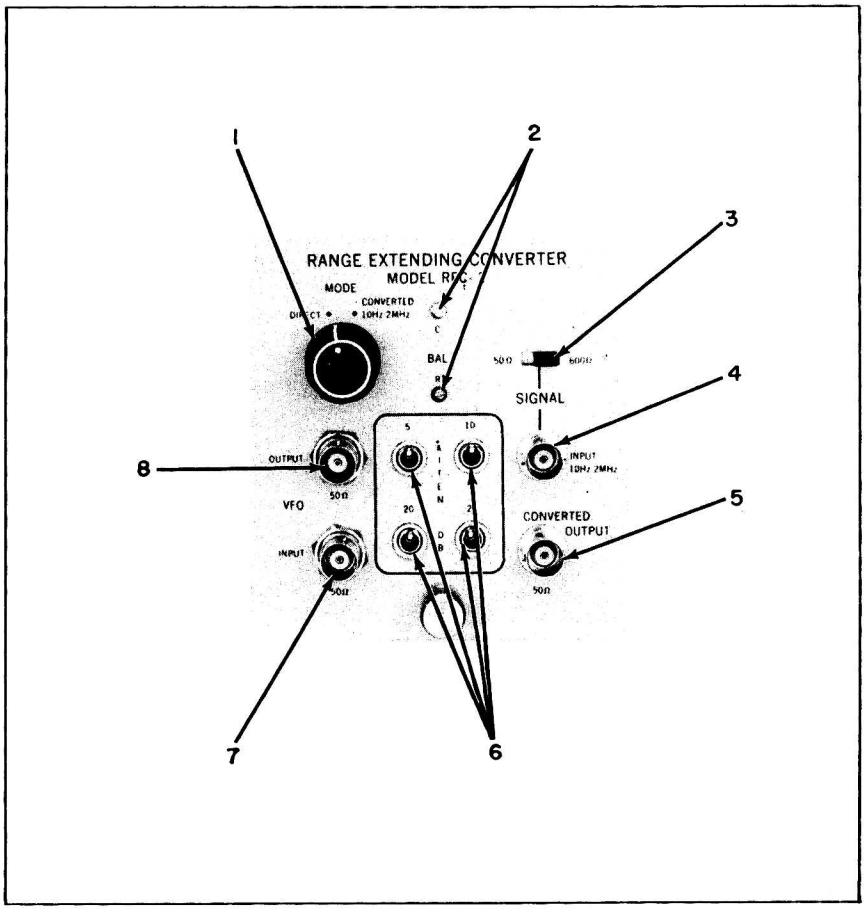


Figure 2-2. Converter, Operating Controls and Connectors

TABLE 2-1. OPERATING CONTROLS AND CONNECTORS

Index No. (Figure 2-2)	Reference Designation	Name	Function
1	S6	MODE selector switch	Selects either 3-MHz oscillator output or direct VFO output. Switches on d-c power to the converter in converted 10 Hz-2 MHz position.
2	C1 R18	C and R BAL screwdriver controls	Suppress external VFO leakage through the balanced mixer at zero input frequency, when the MODE selector switch is set to CONVERTED 10 Hz-2 MHz.
3	S1	50 Ω -600 Ω switch	Sets input impedance of the Converter to 50 or 600 ohms.
4	J1	SIGNAL INPUT 10 Hz-2 MHz jack	Connects the signal intput to the Converter.
5	J4	CONVERTED OUTPUT jack	Provides the 2. 5-MHz converted output to the associated spectrum analyzer.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS AND CONNECTORS (Cont'd)

Index No. (Figure 2-2)	Reference Designation	Name	Function
6	S3 through S5	ATTEN DB switches	Provide input attenuation of 20 dB, 20 dB, 10 dB, and 5 dB. When the switches are in the up position, the indicated attenuation is inserted.
7	J3	VFO INPUT jack	Connects external VFO to the Converter.
8	J2	VFO OUTPUT jack	Connects either external VFO (MODE selector switch in DIRECT position) or 3-MHz oscillator output (MODE selector switch in CONVERTED 10 Hz-2 MHz position) to the associated spectrum analyzer VFO input.

SECTION III
THEORY OF OPERATION

3-1. GENERAL.

3-2. This section contains the theory of operation for the Converter. The Converter is a completely solid-state plug-in device that operates in conjunction with a VFO to convert the frequency spectrum between 10 Hz and 2 MHz to 2.5 MHz. The 2.5-MHz converted output is then heterodyned in the companion analyzer, with a 3-MHz oscillator output from the Converter to produce the required 500-kHz center frequency input at its associated spectrum analyzer. Operating power for the Converter is provided by its associated main frame.

3-3. SIMPLIFIED BLOCK DIAGRAM ANALYSIS.

3-4. The Converter (figure 3-1) consists mainly of a balanced bridge mixer which combines the signals appearing at the SIGNAL INPUT 10Hz-2MHz and VFO INPUT jacks when the MODE switch is set to the CONVERTED 10Hz-2MHz position. The difference output of the mixer is amplified by a 2.5-MHz i-f amplifier and routed to the front panel CONVERTED OUTPUT jack. When in the CONVERTED 10Hz-2MHz mode, the 3-MHz oscillator provides an input to the associated spectrum analyzer (via the VFO OUTPUT jack) to effect a final heterodyning of the converted 2.5-MHz output signal to 500kHz. The MODE selector switch provides electronic switching (via diode switches A1A1 and A1A2) of either the 3-MHz oscillator output or direct VFO output. An input attenuator provides up to 55 dB of attenuation to prevent overloading of its succeeding circuits.

3-5. DETAILED THEORY OF OPERATION. (See Figures 3-1 and 5-1)

3-6. The Converter consists of five major sections: the input attenuator; balanced mixer; 2.5-MHz I-f amplifier; 3-MHz oscillator; and diode switches. Each of these is discussed below.

3-7. INPUT ATTENUATOR. The input attenuator consists of four pi-type resistive attenuator pads (R2 through R4, R5 through R7, R8 through R10, and R11 through R13) which are selected by ATTEN DB toggle switches S2 through S5. Up to 55 dB of attenuation (in 5 dB steps) can be inserted in the signal input path by operation of these switches. Toggle switch S1 selects either a 50-ohm or 600-ohm unbalanced input to the attenuator.

3-8. BALANCED MIXER. The balanced mixer employs four type 1N906 germanium diodes (A2CR1 through A2CR4) in a balanced bridge configuration. When the MODE selector switch is in the CONVERTED 10Hz-2MHz position, the mixer receives the 10 Hz to 2 MHz input signal from the input attenuator and the injection signal (2.5 to 4.5 MHz, 0.3 volt nominal) from the external VFO. The 2.5-MHz difference output signal is applied to the 2.5-MHz i-f amplifier. The VFO injection signal is balanced to a minimum in the output of the balanced mixer by means of BAL R control R18 and BAL C control C1. These components vary the resistive and reactive balance of the VFO injection signal so as to compensate for differences in diode characteristics and transformer T1 unbalance.

3-9. 2.5-MHz I-F AMPLIFIER. The 2.5-MHz i-f amplifier consists of grounded-base amplifier A3Q1, common emitter amplifier A3Q2, and emitter follower A3Q3. It amplifies the low level difference frequency output from the balanced mixer to the level required for a full-scale deflection on the associated spectrum analyzer CRT. Stage A3Q1, a low noise amplifier, matches the 75-ohm output impedance of balanced transformer T2. Overcoupled transformer A3T1 couples the output of A3Q1 to stage A3Q2, a high-gain amplifier. The overall gain of the 2.5-MHz i-f amplifier is controlled by A3R11, an adjustable resistor in the emitter circuit of A3Q2. The output of A3Q2 is applied through overcoupled transformer A3T2 to the base of emitter follower A3Q3. A low-pass filter circuit in the output of A3Q3 (A3L1 through L7 and A3C14 through C16) prevents spurious signals above 2.55 MHz from reaching the associated spectrum analyzer. The overall response of the i-f amplifier is within ±0.5 dB from 2.45 to 2.55 MHz. This 100kHz bandwidth is required to complement the 100-kHz bandwidth of the associated spectrum analyzer.

3-10. 3-MHz OSCILLATOR. The 3-MHz oscillator comprises stage A1A3Q1, a Pierce-type oscillator circuit. When the MODE selector switch is placed in the CONVERTED 10Hz-2MHz position, the 3-MHz oscillator is energized. The oscillator output is then applied through transformer A1A3T1, forward-biased diode A1A2CR3, capacitor A1A2C2, and VFO OUTPUT jack J2 to the associated spectrum analyzer.

3-11. DIODE SWITCHES. Diodes A1A1CR1 and CR2, and A1A2CR1 through CR3 are electronic switches that connect either the external VFO input and 3-MHz oscillator output to the balanced mixer and associated spectrum analyzer, respectively,

or the external VFO input to the spectrum analyzer. When the MODE selector switch is set to the CONVERTED 10Hz-2MHz position, diodes A1A1CR1, A1A2CR1, and A1A2CR3 are forward-biased and diodes A1A1CR2 and A1A2CR2 are back-biased. This causes the following to occur:

a. The external VFO input, present at VFO INPUT jack J3, is applied through A1A1CR1 and A1A1C1 to balanced mixer transformer T1.

b. The 3-MHz oscillator is energized and its output is applied through A1A2CR3, A1A2C2, and VFO OUTPUT jack J2 to the associated spectrum analyzer.

c. The external VFO input is disconnected from the VFO OUTPUT line. When the MODE selector switch is set to DIRECT (associated spectrum analyzer is being used only with the external VFO), diodes A1A1CR2 and A1A2CR2 are forward-biased, and diodes A1A1CR1, A1A2CR1, and A1A2CR3 are back-biased. This causes the following to occur:

a. The external VFO input, present at VFO INPUT jack J3, is applied through A1A1CR2, A1A1C2, A1A2C1, A1A2CR2, A1A2C2, and the VFO OUTPUT jack to the associated spectrum analyzer.

b. The external VFO input is disconnected from the balanced mixer.

c. The 3-MHz oscillator is de-energized and its output transformer A1A3T1 is disconnected from the VFO OUTPUT line.

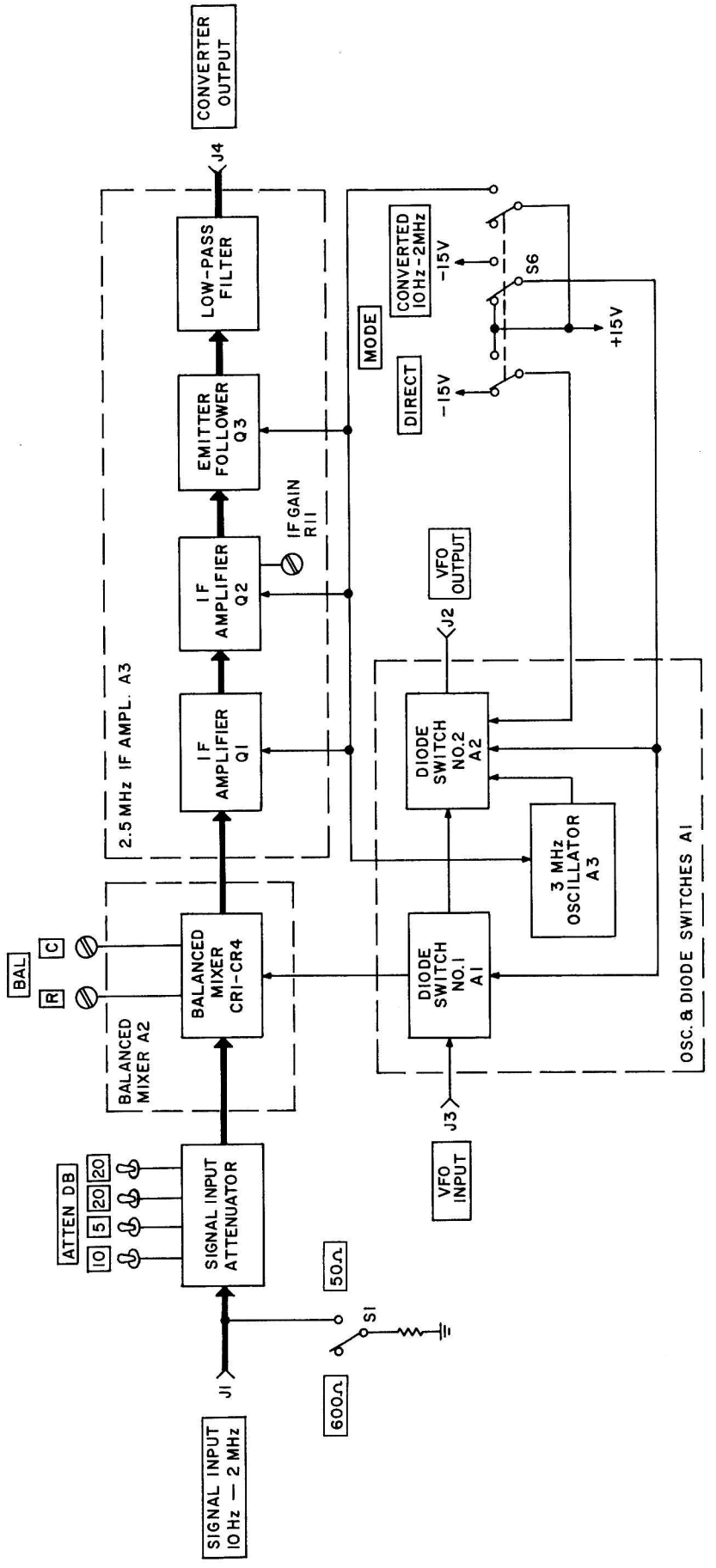
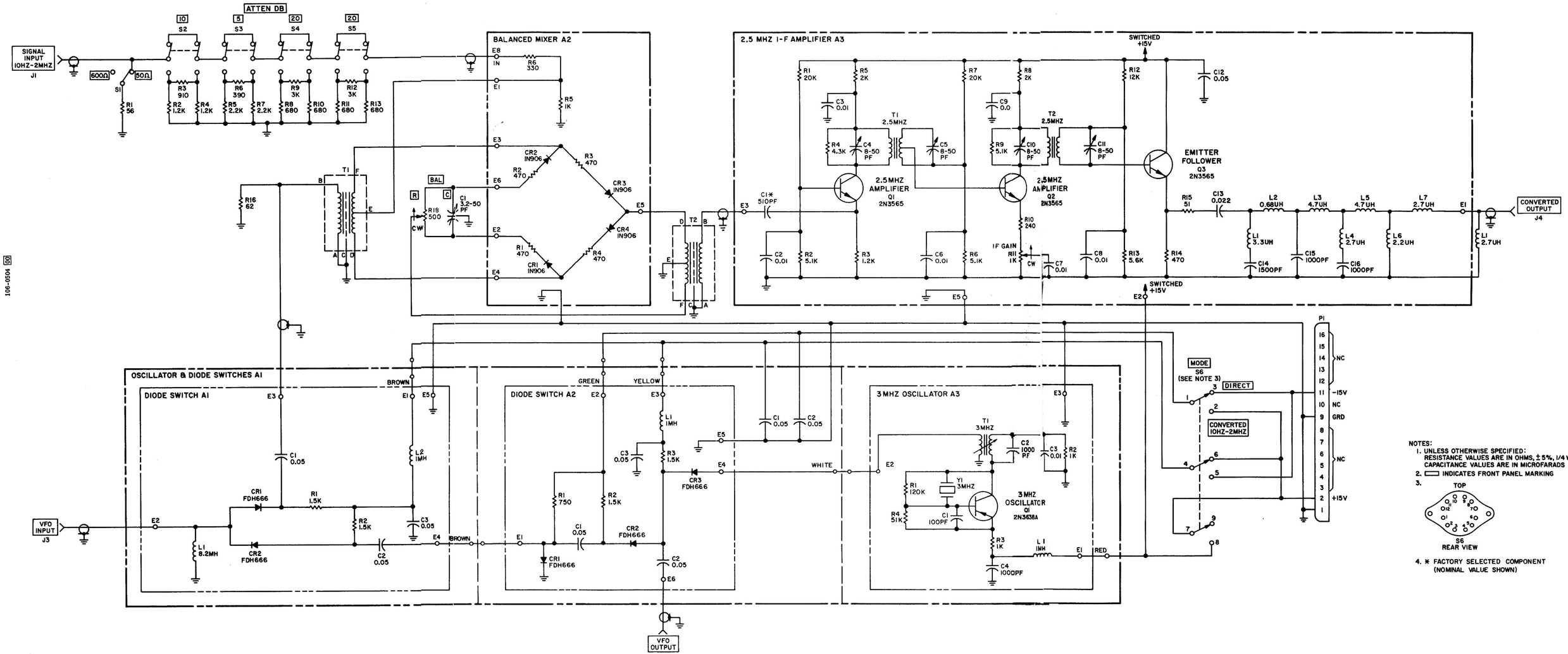
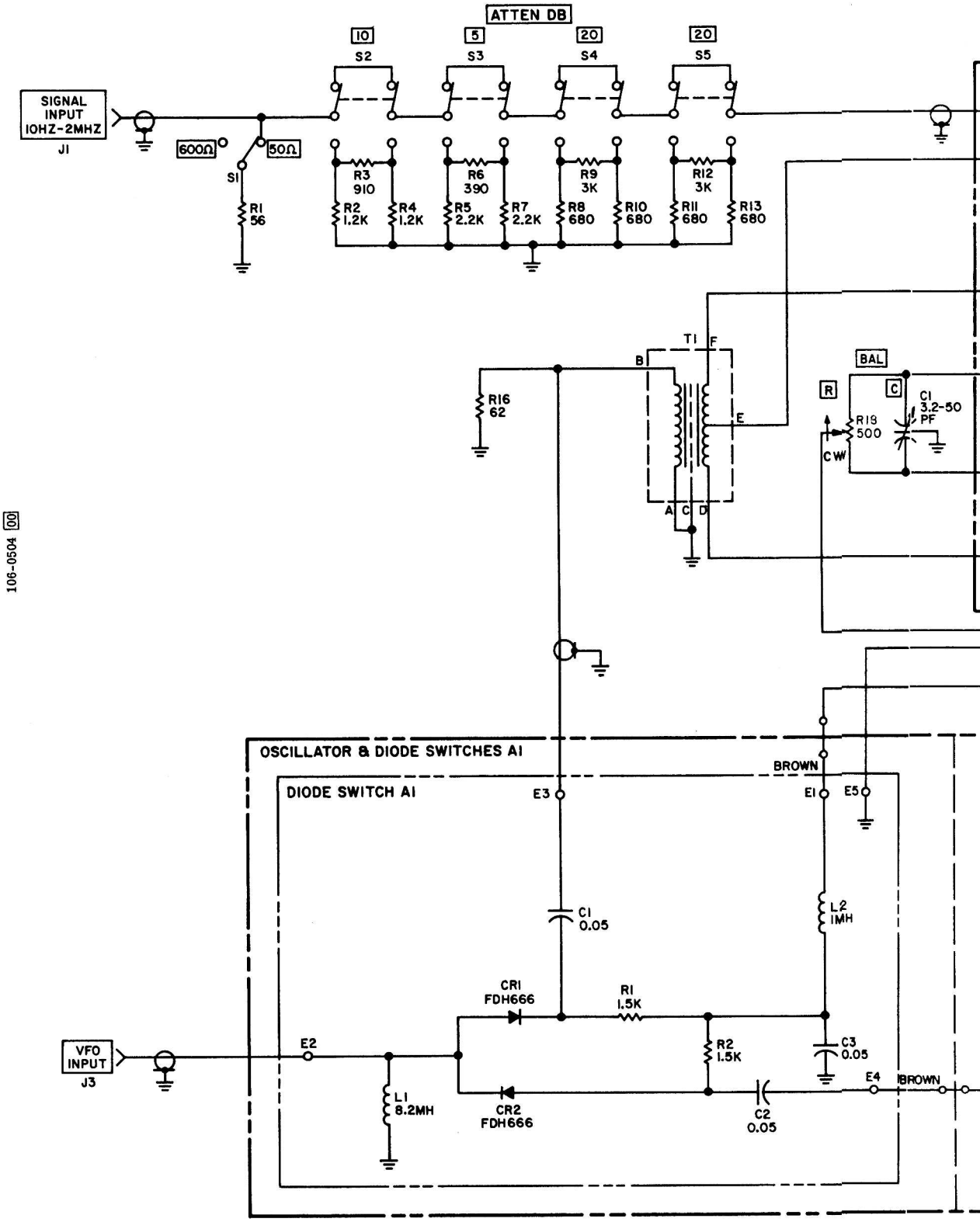


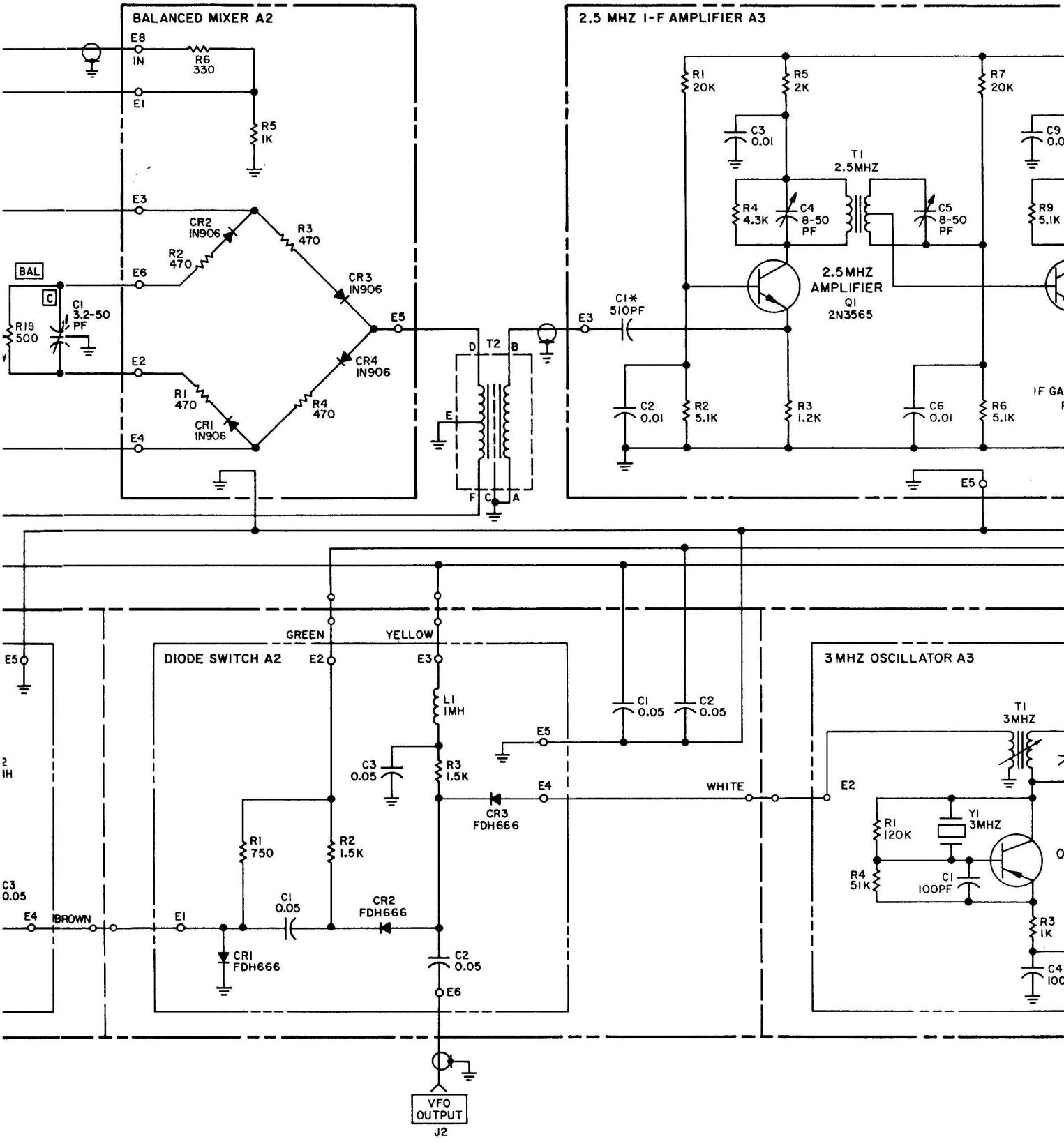
Figure 3-1. Converter, Block Diagram

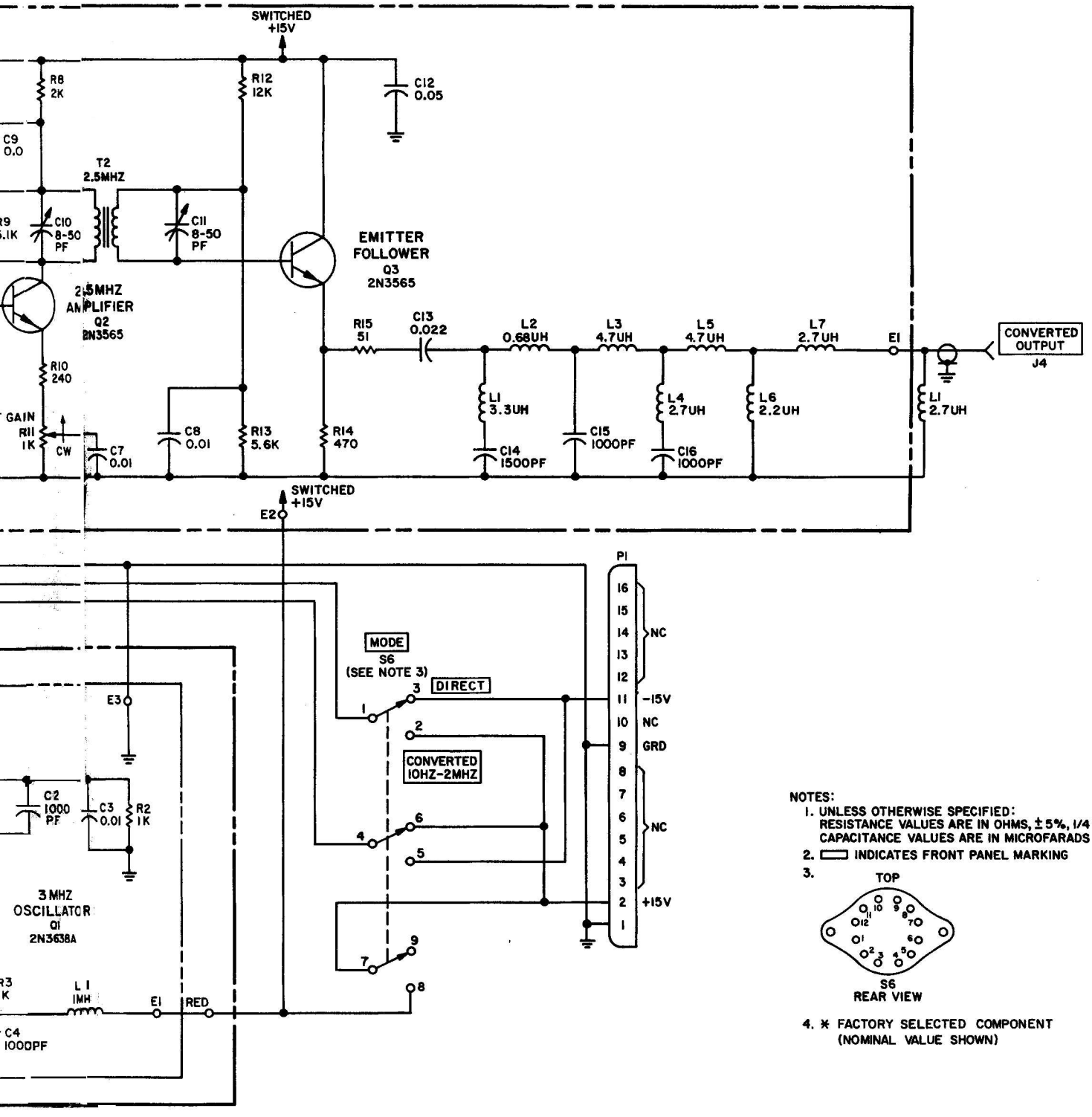


NOTES:
1. UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4 WATT CAPACITANCE VALUES ARE IN MICROFARADS
2. ▭ INDICATES FRONT PANEL MARKING
3. TOP
S6 REAR VIEW
4. * FACTORY SELECTED COMPONENT (NOMINAL VALUE SHOWN)

Figure 5-1. Converter, Schematic Diagram


ATTEN DB
10
5
20
20
S2
S3
S4
S5
SIGNAL INPUT 10HZ-2MHZ
J1
600Ω
50Ω
S1
R1 56
R3 910
R2 1.2K
R4 1.2K
R6 390
R5 2.2K
R7 2.2K
R9 3K
R8 680
R10 680
R12 3K
R11 680
R13 680
T1
B
F
E
A
C
D
R16 62
BAL
R
C
C1 3.2-50 PF
R18 500
CW
106-0504 00
OSCILLATOR & DIODE SWITCHES A1
DIODE SWITCH A1
BROWN
E3
E1
E5
C1 0.05
L2 1MH
CR1 FDH666
R1 1.5K
R2 1.5K
C3 0.05
E4
BROWN
VFO INPUT
J3
E2
L1 8.2MH
CR2 FDH666
C2 0.05


BALANCED MIXER A2
E8
IN
R6
330
E1
R5
1K
E3
CR2
IN906
R3
470
R2
470
BAL
E6
C
C1
3.2-50
PF
R19
500
CR3
IN906
E5
E2
CR4
IN906
R1
470
R4
470
CR1
IN906
E4
D
T2
B
E
F
C
A
2.5 MHZ I-F AMPLIFIER A3
R1
20K
R5
2K
R7
20K
C3
0.01
T1
2.5MHZ
R4
4.3K
C4
8-50
PF
C5
8-50
PF
C9
0.0
R9
5.1K
2.5MHZ
AMPLIFIER
Q1
2N3565
C1*
510PF
E3
C2
0.01
R2
5.1K
R3
1.2K
C6
0.01
R6
5.1K
IF GA
E5
GREEN
YELLOW
DIODE SWITCH A2
E2
E3
L1
1MH
C1
0.05
C2
0.05
E5
C3
0.05
R3
1.5K
E4
WHITE
CR3
FDH666
R1
750
R2
1.5K
C1
0.05
CR2
FDH666
E4
BROWN
E1
CR1
FDH666
C2
0.05
E6
3MHZ OSCILLATOR A3
T1
3MHZ
E2
R1
120K
Y1
3MHZ
R4
51K
C1
100PF
R3
1K
VFO
OUTPUT
J2



NOTES:
1. UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4 WATT CAPACITANCE VALUES ARE IN MICROFARADS
2. ▭ INDICATES FRONT PANEL MARKING
3.

4. * FACTORY SELECTED COMPONENT (NOMINAL VALUE SHOWN)

Figure 5-1. Converter, Schematic Diagram