

TMC MODEL SRM-5  
SOLID STATE  
SYNTHESIZED RADIO RECEIVER



TMC (CANADA) LIMITED  
Ottawa, Ontario

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SYNTHESIZED RADIO RECEIVER



The SRM-5 current production model incorporates an improved Input Filter Selector switch in place of the PRESELECTOR shown in the centre of the front panel in the above photograph. Other features appear as shown above.

TMC (CANADA) LTD.

Ottawa, Canada

# CONTENTS

<u>Section</u>		<u>Page</u>
I	GENERAL DESCRIPTION	
	1.1 Introduction . . . . .	1.1
	1.2 Description . . . . .	1.1
	a. Mechanical . . . . .	1.1
	b. Electrical . . . . .	1.2
	1.3 Electrical Characteristics . . . . .	1.3
II	OPERATING INSTRUCTIONS	
	2.1 Controls . . . . .	2.1
III	INSTALLATION	
	3.1 Cabinet/Rack Installation . . . . .	3.1
	3.2 Power Connections . . . . .	3.1
	3.3 Other Rear Panel Connections . . . . .	3.1
	3.4 Fuses . . . . .	3.2
IV	CIRCUIT DESCRIPTION	
	4.1 General . . . . .	4.1
	4.2 Signal Path . . . . .	4.1
	a. Input Filter . . . . .	4.1
	b. RF Section . . . . .	4.2
	c. 2nd Mixer . . . . .	4.2
	d. IF Amplifier . . . . .	4.3
	e. Information Filters . . . . .	4.3
	f. Detectors . . . . .	4.4
	g. Audio Amplifier . . . . .	4.4
	h. AGC Amplifier . . . . .	4.5
	4.3 Frequency Synthesizer . . . . .	4.5
	4.4 Power Supply . . . . .	4.6
	4.5 ISB Adapter . . . . .	4.6

## LIST OF ILLUSTRATIONS

Figure No.	Title	
4.1	Model SRM-5 Receiver Signal Path Simplified Block Diagram . . . . .	4.7
4.2	Model SRM-5 Receiver Frequency Synthesizer Simplified Block Diagram . . . . .	4.8
4.3	Model SRM-5 Receiver Power Supply Simplified Block Diagram . . . . .	4.9

IDI0753 Model SRM-5 Independent Sideband Adapter.

SECTION 1  
GENERAL DESCRIPTION

1.1 INTRODUCTION

The TMC Model SRM-5 Radio Receiver is a solid state, dual conversion superheterodyne receiver providing continuous frequency coverage from 15 KHz to 29.9999 MHz.

Frequency selection is accomplished by a digitally controlled synthesizer. The frequency synthesizer provides 299,850 crystal-stable channels tuneable in 100 Hz increments over the receiver's operating range, with a fine tune capability providing crystal-stability between 100 Hz steps.

Multi-mode operation is provided, enabling reception of amplitude modulated (AM), continuous wave (CW), upper sideband (USB) and lower sideband (LSB) signals utilizing switch-selectable IF bandwidths ranging from 400 Hz to 8KHz. For CW operation a variable frequency crystal oscillator is provided as the product detector injection for operator pitch control.

1.2 DESCRIPTION

a. Mechanical

The SRM-5 Receiver is basically packaged as a rack mounted unit 5-1/4 inches high x 19 inches wide x 17 inches deep. A ventilated dust cover is normally provided when mounted in a rack/console primarily to cover the otherwise exposed power supply in the rear of the drawer. The receiver is also available packaged in a wrap-around desk-top console.

The receiver consists of a main chassis, front panel, rear panel, synthesizer housing assembly and signal path housing assembly.

The main chassis contains the power transformer, power supply filter capacitors, PC connectors for both the synthesizer and signal path, and interconnecting wiring.

The front panel assembly contains all the front panel controls as well as the variable frequency crystal BFO and the Input Filter.

The rear panel assembly contains the power supply rectifier bridges, series-pass transistors and associated heat sinks for heat dissipation. The power supply regulator PC board is also attached to the rear panel assembly.

The signal path and synthesizer housing assemblies contain the PC cards for the respective functions (signal path and synthesizer). The PC cards are plug-in units which are fitted in slides for ease of maintenance and test.

The following controls are located on the front panel:

- FREQUENCY SELECTION
- MODE SELECTION
- IF BANDWIDTH SELECTION
- SPEAKER ON/OFF SWITCH
- AGC FAST/SLOW SWITCH
- RF/AF METER SWITCH
- AUDIO VOLUME CONTROL AND POWER ON/OFF SWITCH
- INPUT FILTER SELECTOR SWITCH
- ANTENNA ATTENUATOR SWITCH
- FREQUENCY FINE TUNE CONTROL
- CW PITCH FIXED/VARIABLE SELECT SWITCH
- VARIABLE CW PITCH CONTROL

The antenna input connector, 8 MHz IF monitor output, 3  $\Omega$  and 600  $\Omega$  audio output terminals, fuses and AC power cord are located on the rear panel assembly.

b. Electrical

The Model SRM-5 Receiver basically consists of the signal path, frequency synthesizer and power supply.

The signal path consists of the following: Input Filter, RF Section, 2nd Mixer, IF Amplifier, Information Filters, Detectors, AGC Amplifiers and Audio Amplifier.



The frequency synthesizer provides the necessary local frequency injections for operation of the signal path; namely, the first mixer local oscillator injection of 92 - 122 MHz in 100 Hz steps (also with fine tune between 100 Hz steps), the second mixer local oscillator injection of 84 MHz and the product detector injection of 8 MHz (when "CW Pitch" switch is in the "Fixed" position).

The power supply provides +28 VDC and +5.6 VDC for operation of synthesizer and +24 VDC for the signal path.

All are described in the Circuit Description section of this book.

### 1.3 ELECTRICAL CHARACTERISTICS

Frequency Range	15 KHz to 29.9999 MHz. Full sensitivity specifications from 100 KHz to 29.9999 MHz. Sensitivity is reduced uniformly between 100 KHz and 15 KHz by approximately 10 dB at 15 KHz.
Modes of Operation	Upper sideband (USB), lower sideband (LSB), amplitude modulation (AM), continuous wave (CW), radio teletype (RTTY) and facsimile (FAX).
Frequency Selection	Digital, 299,850 channels in 100 Hz steps. Fine tune between 100 Hz steps.
Frequency Stability	Frequency drift does not exceed 1 Hz per MHz of tuned frequency over a temperature range of 0° to 50°C., and 1 Hz per MHz of tuned frequency per year after calibration of internal frequency standard.
Sensitivity	Receiver noise figure typically 10 dB (wideband position).
	Max. Applied Input for
IF Band Width	10 dB $\frac{S+N}{N}$ SSB/CW
8 KHz	0.8 microvolt
2 KHz	0.4 microvolt
1 KHz	0.3 microvolt
0.4 KHz	0.3 microvolt
SSB	0.4 microvolt
Image Rejection	70 dB
IF Rejection	70 dB
Sideband Suppression	Greater than 60 dB at 500 Hz into the unwanted sideband.
Cross Modulation	With a wanted signal of 1 milli volt, an unwanted signal of 10 millivolts 30%, 400 Hz modulation, separated 10 KHz or more, produces an output at least 30 dB below output level due to the wanted signal.

Blocking	The receiver output due to a wanted signal of 500 microvolts changes less than 3 dB when an unwanted signal of 50 millivolts at least 10 KHz removed is applied.	
IF Bandwidth (8 MHz)		
Switch Position	<u>6 dB down</u>	<u>60 dB down</u>
8 KHz	8 KHz min.	20 KHz max.
2 KHz	2 KHz min.	12 KHz max.
1 KHz	1 KHz min.	6 KHz max.
0.4 KHz	0.4 KHz min.	4 KHz max.
USB	+350 Kz to +2700 Hz	$\leq -500$ Hz and $\geq +3800$ Hz
LSB	-350 Hz to -2700 Hz	$\geq +500$ Hz and $\leq -3800$ Hz
Automatic Gain Control	Output rise 2 dB max. for input from 3 microvolts to 100,000 microvolts. Output rises 11 dB max. for input from 1 microvolt to 100,000 microvolt.	
AGC	Slow	Fast
Attack Time	$\leq 10$ milliseconds	$\leq 10$ milliseconds
Release Time	2 seconds (nominal)	150 milliseconds (nominal)
Input Impedance	.015-29.9999 MHz	75 Ohms (nominal)
Audio Output	3.2 	1 Watt at 5% max. distortion (internal or external speaker).
	600 	+10 dBm max.
Primary Power	115/230 +15% single phase 50/60 Hz	
Power Requirements	80 Watts at full audio output level.	
Temperature	0 to 50°C (meets GPO specs. requiring operation at -15°C).	
Humidity	to 95%	
Size	5-1/4" H x 19" W x 17" D.	
Weight	30 pounds.	

SECTION II  
OPERATING INSTRUCTIONS

2.1 CONTROLS

All controls required for the operation of the SRM-5 Receiver are mounted on the front panel. The function of each control is described below:

<u>CONTROL</u>	<u>FUNCTION</u>
FREQUENCY SELECTION	Selects receiver tuned frequency in MHz. Consists of six lever-controlled decades, each decade having the digits 0 thru 9, except the most significant decade, which contains only the digits 0, 1 and 2.
RF INPUT/AUDIO OUTPUT METER DISPLAY SWITCH	Toggle switch which selects either audio or RF signal strength indication on the front panel meter. The audio display is derived from the rectified audio output, while the RF level indicator is derived from the AGC DC control voltage.
AUDIO GAIN/POWER ON-OFF	Potentiometer which controls audio volume and switches AC power on/off.
SPEAKER ON/OFF SWITCH	Toggle switch which is used to silence speaker..
RF GAIN CONTROL/AGC ON SWITCH	Potentiometer which manually adjusts the 92 MHz amplifier gain and the 8 MHz IF amplifiers gain. Also switches the AGC on when the knob is fully counterclockwise (switched).
INPUT FILTER SELECTOR SWITCH	A broadcast band "Stop" filter is fitted as standard, with a high pass (above 1.6 MHz) and a low pass filter (below 1.6 MHz) as options.
ANTENNA ATTENUATOR IN/OUT	Toggle switch connects an approximately 20 dB pad in receiver front end.
FINE TUNE	Potentiometer varies tuning approximately $\pm 100$ Hz about dialed frequency.




MODE Four interlocking pushbutton switches select AM, CW, USB or LSB. In AM position, the AM detector circuitry is enabled, while the product detector circuitry and the product detector injection are disabled. In the CW, USB or LSB positions the reverse is the case.

IF BANDWIDTH Four interlocking pushbutton switches select IF bandwidth of 8 KHz, 2 KHz, 1 KHz, 0.4 KHz. These switches are automatically disabled when USB or LSB is selected.

AGC FAST/SLOW Toggle switch selects fast or slow AGC release time. Normally fast AGC is utilized for CW signals and slow AGC for SSB signals.

CW PITCH Toggle switch selects either fixed or variable frequency product detector injection. For CW operation the variable frequency crystal oscillator is utilized for operator pitch control by the associated "variable" knob. The tuning range is approximately 1 KHz. In the fixed position the product detector injection is provided by the frequency standard and produces zero beat when the incoming CW signal is precisely at the frequency of the frequency select switch.

PHONES The PHONES jack connects to the 3  audio output.

## SECTION III INSTALLATION

### 3.1 CABINET/RACK INSTALLATION

The SRM-5 Receiver will mount in a standard 19 inch rack, occupying 5-1/4 inches of panel height and 17 inches of depth. "Pem" nuts are provided in the panels for installation of the dust cover and slides. If slides are not used, do not attempt to support the receiver drawer only by the front panel. Provide braces in the cabinet or rack to support the rear of the drawer.

### 3.2 POWER CONNECTIONS

The input AC power to the SRM-5 Receiver is 115/230V, 50-60 Hz and is connected on the rear panel.

#### CAUTION

Verify that the power transformer is strapped for the correct AC input voltage.

For 115 volt operation - transformer primary windings must be connected in parallel (terminals 1 and 3 must be connected together and terminals 2 and 4 must be connected together).

For 230 volt operation - Transformer primary windings must be connected in series (only terminals 2 and 3 must be connected together).

Transformer strapping is located on the underside of the receiver chassis and access is gained by removal of the underside rear cover plate.

### 3.3 OTHER REAR PANEL CONNECTIONS

A terminal block, TB1, is provided on the receiver rear panel for other connections (see Table 3.1).




The 600  $\Omega$  audio output terminals (terminal 1 and ground) and the 3  $\Omega$  speaker output terminals are provided on the terminal block TB1, on the rear panel.

For connection to the 3  $\Omega$  speaker terminal disconnect the jumper on the terminal block and connect the external 3  $\Omega$  speaker between terminal 3 and ground (terminal 2).

NOTE. Removing the jumper disconnects the front panel speaker.

Two spare terminals (5 and 6) are provided on the terminal block.

TABLE 3.1

Terminal Block No.	Available Connection
1	600  Audio Output
2	Chassis Ground
3*	3  External Speaker
4*	3  line to front panel speaker
5	Spare
6	Spare
* Terminals 3 and 4 are normally jumpered.	

### 3.4 FUSES

Three fuses (F1, F2 and F3) are utilized in the SRM-5 Receiver. Fuses F2 and F3 are located on the rear panel, while F1 is located on the Regulator PC Card, attached to the inside of the rear panel. Table 3.2 lists the fuses, the ratings and functions.

TABLE 3.2

Designation	Rating (Amp.)	Function
F1	1.5	DC fuse following the rectifier bridge and filter for the +28 VDC and +24 VDC circuitry.
F2	1/10*	DC short circuit protection for the +28 VDC and +24 VDC circuitry.
F3	**	Primary AC fuse.

\* Slo-Blo.

\*\* 2 amp. fuse for 115 VAC operation; 1 amp. fuse for 230 VAC operation.

SECTION IV  
CIRCUIT DESCRIPTION

4.1 GENERAL

Referring to Figure 4.1, Model SRM-5 Receiver Block Diagram, the receiver basically consists of the signal path, frequency synthesizer and power supply. The signal path is shown in detail and consists of the following major blocks: Input Filter, RF Section, 2nd Mixer, IF Amplifier Information Filters, Detectors, AGC Amplifiers and Audio Amplifier. The frequency synthesizer provides the necessary local frequency injection of 92 - 122 MHz in 100 Hz steps (with fine tune between 100 Hz steps), the second mixer local oscillator injection of 84 MHz and the product detector injection of 8 MHz, (when "CW Pitch" switch is in the "Fixed" position). The power supply provides +28 VDC and +5.6 VDC for operation of synthesizer and +24 VDC for the signal path.

4.2 SIGNAL PATH

a. Input Filter

The Input Filter provides the following functions:

Protection from high voltage appearing on the antenna.  
Input attenuation - an (approximate) 20 dB pad can be switched in ahead of the first active element in the signal path.

Selection of broadcast band "Stop" filter (standard)  
or optionally High pass filter (above 1.6 MHz)  
or Low pass filter (below 1.6 MHz).

High voltage protection is accomplished with back-biased diodes which limit the antenna voltage to 5 volts peak and protects the receiver for applied voltages of 30 volts EMF (behind 50  $\mu$ ).

The input attenuator is a resistive pad which is switched in or out by means of a reed relay. When signal levels are high the pad is switched in to prevent front-end overload.

The input filters are selected as follows:

- OUT. No filter
- 1. Broadcast band "Stop" filter
- 2. High pass filter
- 3. Low pass filter

b. RF Section

The RF Section includes:

- Wideband preamplifier
- First mixer
- 92 MHz crystal filter
- 92 MHz amplifier

The wideband preamplifier is a low-noise junction FET providing nominally 10 dB gain.

The first mixer is a double-balanced diode quad mixer which mixes the input from the preamplifier with the local injection from the synthesizer (92 - 122 MHz) to produce the first IF frequency of 92 MHz.

Selectivity at 92 MHz is provided by a 4- pole crystal filter with a 3 dB bandwidth of 8 KHz, min. and a 50 dB bandwidth of 80 KHz, max.

The 92 MHz IF amplifier utilizes a dual gate MOS FET with 20 dB nominal gain. The gain of this stage is reduced by delayed AGC to -10 dB.

c. 2nd Mixer

The 2nd Mixer assembly includes:

- 92 MHz crystal filter
- Second mixer
- 8 MHz roofing filter

The 92 MHz crystal filter is a 2- pole filter with a 3 dB bandwidth of 10 KHz, min. and a 30 dB bandwidth of 200 KHz, max. It is used to further minimize the synthesizer's leakage into the 2nd mixer.

The 2nd mixer is also a double balanced diode quad mixer. The 92 MHz IF input signal is mixed with the 84 MHz local injection signal from the synthesizer to produce the second IF signal of 8 MHz.

The output of the mixer is fed directly to an 8 MHz crystal filter having a 6 dB bandwidth of approximately 8 KHz min., a 60 dB bandwidth of 24 KHz max. and a 90 dB bandwidth of 60 KHz max. This filter serves as a roofing filter for the 8 MHz IF, providing an ultimate attenuation of 90 dB.

d. IF Amplifier

The IF amplifier consists of:

Input amplifier  
Output amplifier  
Emitter follower

The input and output 8 MHz IF amplifier stages consist of two high gain integrated circuits providing a total gain of approximately 65 dB. The emitter follower stage is used to provide an IF monitor available on the rear panel. The AGC range is approximately 70 dB with envelope distortion of 4% or less, including the effects of the detector and audio amplifier.

e. Information Filters

The information filters consist of the following 8 MHz crystal filters:

<u>6 dB Bandwidth</u>	<u>60 dB Bandwidth</u>
2 KHz, min.	12 KHz, max.
1 KHz, min.	6 KHz, max.
400 Hz, max.	4 KHz, max.

and the following sideband filters:

Upper Sideband (USB)\*

6 dB pts relative to 8 MHz: +350 Hz, max. and +2700 Hz, min.  
60 dB pts relative to 8 MHz: +500 Hz, max. and -3800 Hz, max.

Lower Sideband (LSB)\*

6 dB pts relative to 8 MHz: -350 Hz, max. and -2700 Hz, min.  
60 dB pts relative to 8 MHz: -500 Hz, max. and +3800 Hz, max.

The 2 KHz, 1 KHz, 400 Hz bandwidth filters and the USB and LSB filters are switch selectable on the front-panel. Filter switching is accomplished using solid state switching diodes mounted on the Information Filter PC board.

f. Detectors

The Detectors consist of:

- Product detector preamplifier
- Product detector
- AM detector preamplifier
- AM detector

The product detector preamplifier and AM detector preamplifier are integrated circuit amplifiers providing a nominal 40 dB gain, thereby presenting both the product detector and AM detector with approximately 1 VRMS signal level. The preamplifiers are switched on and off by the MODE switches.

The product detector utilizes an integrated circuit with the 8 MHz IF signal applied to the current sink and the 8 MHz injection (from either the synthesizer or the variable frequency crystal oscillator) applied to one of the transistors of the differential pair.

The AM detector is configured as a diode doubler followed by a RC filter.

\*With special LINCOMPEX filters 6 db points are:-

- USB +250 Hz max. and +3050 Hz min.
- LSB -250 Hz max. and -3050 Hz min.

g. Audio Amplifier

The Audio Amplifier consists of:

- Audio preamplifier
- Audio power amplifier
- Audio meter rectifier bridge

The detected signal is amplified by the preamplifier and drives the integrated circuit audio power stage configured to provide 2 watts output. Audio outputs of 3  $\Omega$  600  $\Omega$  are provided.

#### h. AGC Amplifier

The AGC Amplifier includes:

- 8 MHz AGC amplifier
- Diode detector
- DC amplifier
- Level shifter
- Delayed AGC DC amplifier
- RF meter output

The 8 MHz IF output is also fed to the 8 MHz AGC amplifier which provides 40 dB of gain. The AGC signal is then detected by a diode doubler and filtered. The DC voltage corresponding to the input signal is amplified and is used to control the gain of 8 MHz IF amplifiers. This IF AGC voltage is level shifted and further amplified to produce the delayed AGC voltage which is used to control the gain of the 92 MHz IF amplifier. The delayed AGC is set to become effective at receiver input signals of 500  $\mu$ v. The attack and release times are set by resistors located on the front panel and are designated fast and slow AGC.

### 4.3 FREQUENCY SYNTHESIZER

Figure 4.2 shows a simplified general block diagram of the frequency synthesizer. Generally the frequency synthesizer consists of a major and minor loop, the low frequency reference and the VHF reference.

The low frequency reference contains the 8 MHz standard oscillator and the divider logic to produce the 50 KHz and 1.6 KHz phase detector reference signals for the major loop and minor loop respectively.

The VHF reference contains the 64 MHz crystal oscillator used as an injection signal for the minor loop and the 84 MHz crystal oscillator used as the injection signal for the second mixer of the signal path. The 64 MHz crystal oscillator is capable of being voltage-controlled for fine-tuning between the 100 Hz steps.

The minor loop controls the 92 - 122 MHz synthesizer output frequency in 100 Hz, 1 KHz and 10 KHz steps for a total range of 100 KHz.

The major loop controls the 92 - 122 MHz synthesizer output frequency in 10 MHz, 1 MHz and 100 KHz steps over this range.



#### 4.4 POWER SUPPLY

The power supply operates from 115 or 230 VAC to supply +5.6, +24 and +28 VDC.

The 5.6 VDC is provided by a separate winding on the power transformer. The 5.6 VDC is regulated by an integrated circuit regulator augmented by a discrete series-pass power transistor. The 5.6 VDC is designed to provide 2 amperes load current.

Both the 24 VDC and 28 VDC are supplied from a common rectifier bridge and preregulator circuit. The preregulator is utilized to maintain an approximately 38 VDC input to both the 24 VDC and the 28 VDC IC regulators for a  $\pm 15\%$  variation in AC input voltage. The 24 VDC and 28 VDC regulators are augmented by discrete series pass transistors to provide 750 ma load current. Short-circuit protection is provided on both the 24 VDC and 28 VDC lines. These lines can sustain a short-circuit condition for approximately 10 seconds; if this period is exceeded a 100 ma slo-blo fuse is blown, protecting the power supply from permanent damage.

#### 4.5 ISB ADAPTER (OPTIONAL)

The ISB (Independent Sideband) Adapter is mounted in a separate panel occupying 3 1/2 inches of height and 17 inches of depth in a standard 19 inch rack. It also contains the 1 part in  $10^8$  frequency standard required for LINCOMPEX operation. Its schematic is shown in Drawing ID10753.

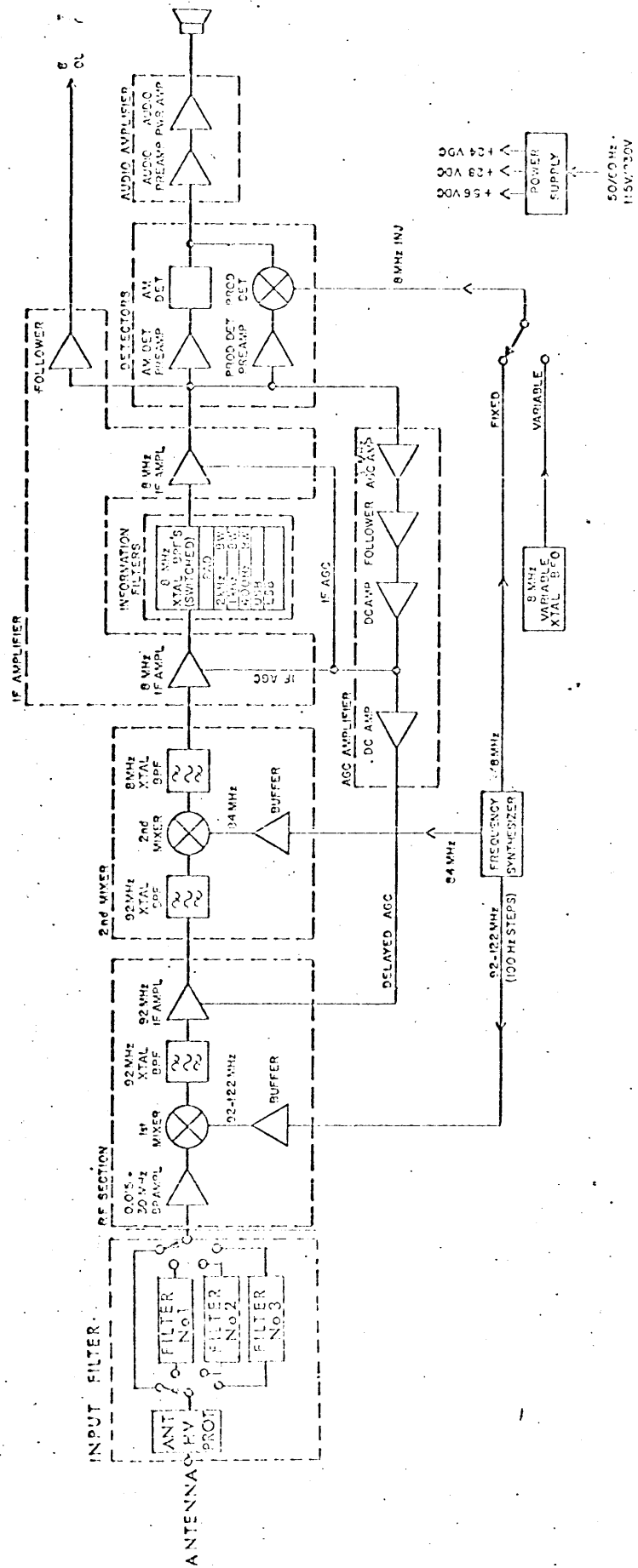


Figure 4.1 Model SRM-5 Receiver Frequency Synthesizer Simplified Block Diagram

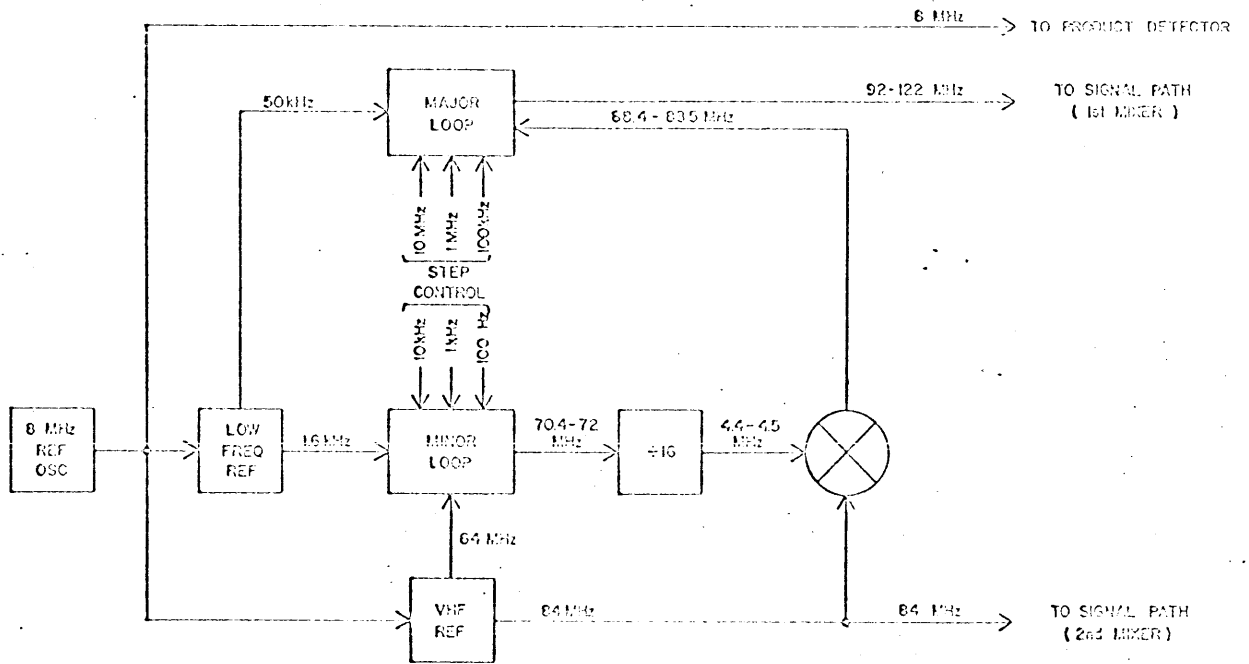


Figure 4. 2. Type SRM-5 Receiver Frequency Synthesizer Simplified Block Diagram.

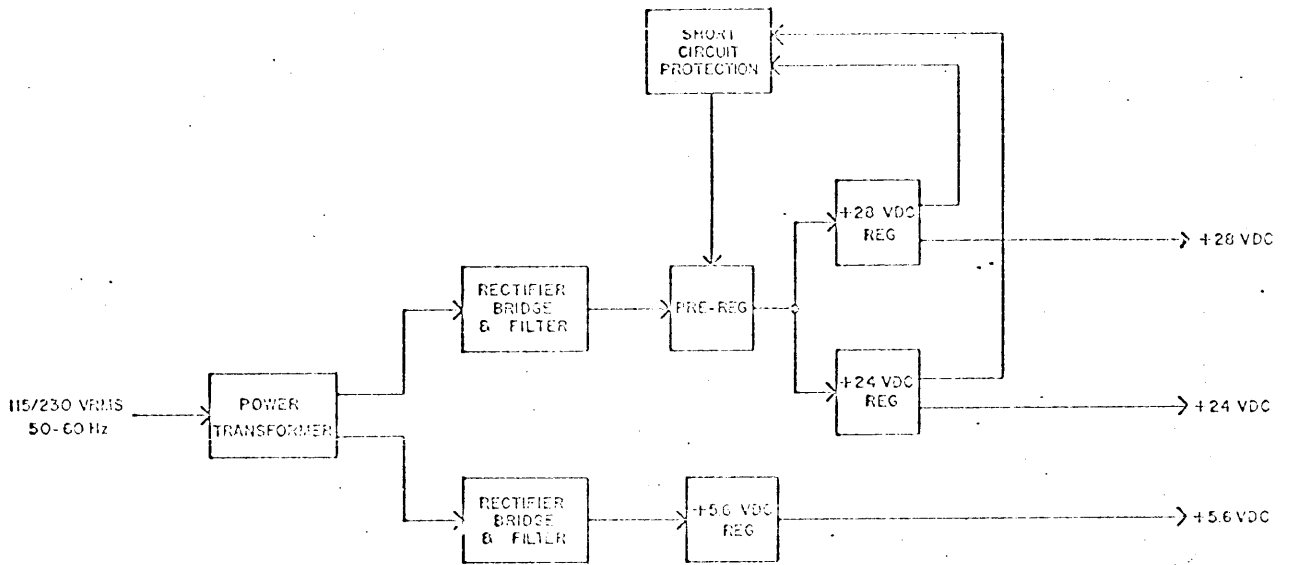
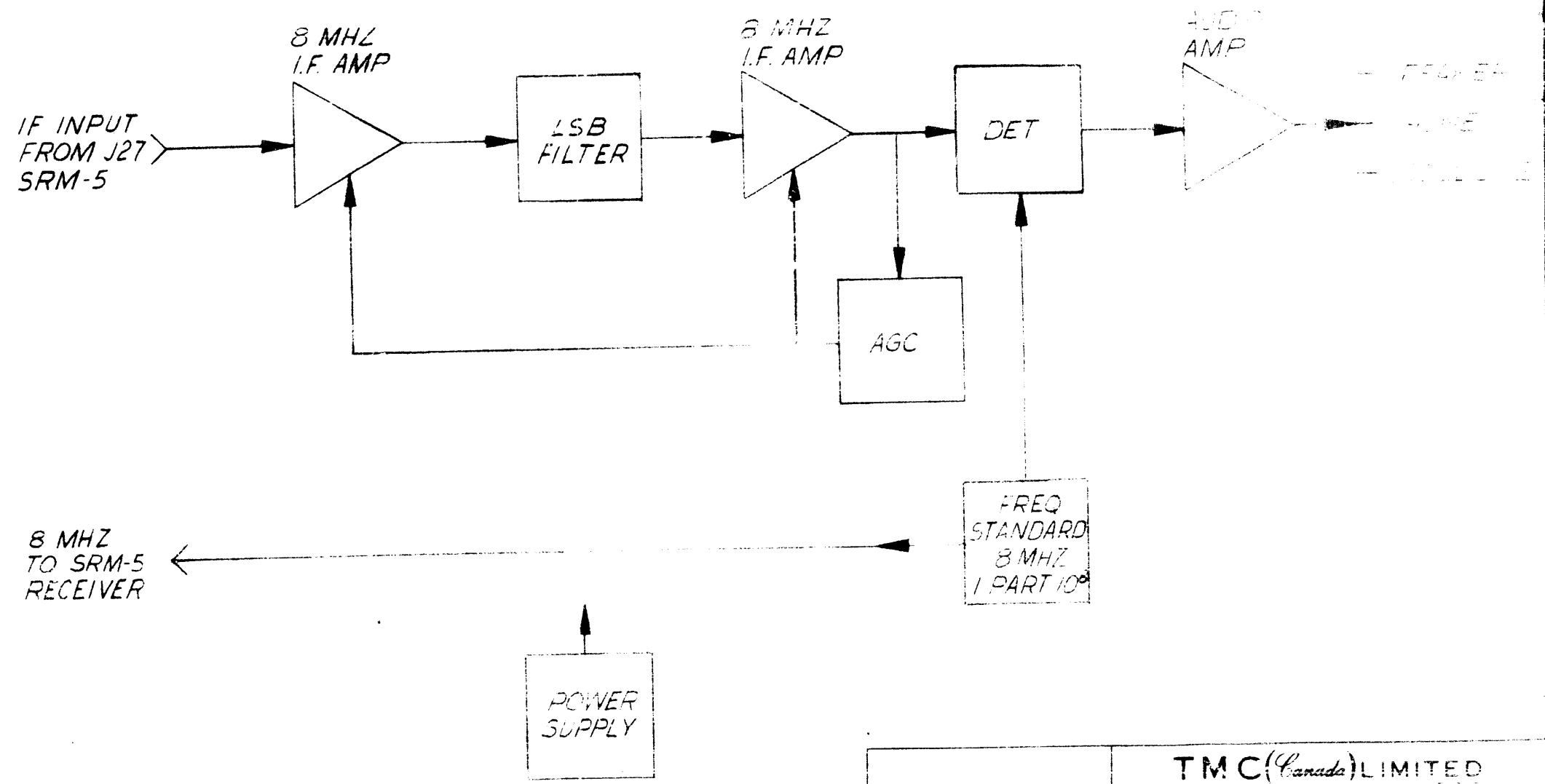


Figure 4. 3. Type SRM-5 Receiver Power Supply Simplified Block Diagram.

IF IT IS FOUND DESIRABLE TO CHANGE ANY TOLERANCE OR OTHER DETAIL SPECIFIED ON THIS DRAWING NOTIFY THE PURCHASER PROMPTLY		DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED					
MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND DEVIATIONS WILL BE CAUSE FOR REJECTION REMOVE ALL BURRS AND SHARP EDGES							
ISSUE	ITEM	CHANGED FROM	DATE	CN NO	DRAFTS	CHECKER	CNS APP

ID 10753

REQ	ITEM	PART NO	DESCRIPTION	SYMBOL
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STOCK SIZE		TMC (Canada) LIMITED OTTAWA ONTARIO	
MATERIAL		ISB ADAPTER	
WEIGHT PER PC		L. BROWN	
TYPE & TEMPER		DRAWN	
HEAT TREAT SPEC		CHECKED	
FINISH & SPEC NO		10753	

TOLERANCES UNLESS OTHERWISE SPECIFIED		SCALE N.T.S.		SRM-5		9 NOV 71	
ALL OTHERS	DEC DIM 1/64	XX = .01	XXX = .005	MODEL	PROJECT NO	ASSY NO	DATE
DRILL, PUNCH, COMMERCIAL STOCK BITS AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED				USED ON			