RF VII, Inc.

RF-10-X / 20-X / 30-X / CB

RF GENERATOR USER MANUAL

Document # 9006-6001-D

104 Church Street
Newfield, NJ 08344

WARNING

To avoid possible shock or fire hazards, connection of this product should be performed in compliance with the ANSI electrical code. Operation, Installation, and Maintenance should be performed by a qualified Technician or Engineer. These RF products are intended for indoor use only.

WARRANTY STATEMENT

All our products are warranted to the original purchaser against defective materials or workmanship for a period of one year from date of delivery. RF VII Inc. will at its own option repair or replace all defective material returned (freight prepaid) during the warranty period. Provided the unit is properly repackaged and returned without damage done by abuse or mishandling. (See Section 5 for shipping information)

PROPRIETARY NOTICE

These documents are considered Proprietary and confidential. All reproductions must be approved by RF VII, Inc.

RF-10/20/30-X Instruction Manual

SECTION 1

RF-10/20/30-X Instruction Manual

Section 1 Technical Specifications

RF GENERATOR

Electrical

Power Requirements / Fluctuation %	200-240Vac 50/60Hz / +/- 20%
Power Consumption	1650/ 3365 / 4365 Watts
Power Connector RF-10/20	Nema-L6-20 Flanged Inlet
RF-30	Nema-L6-20 3Ph Flanged Inlet

Output

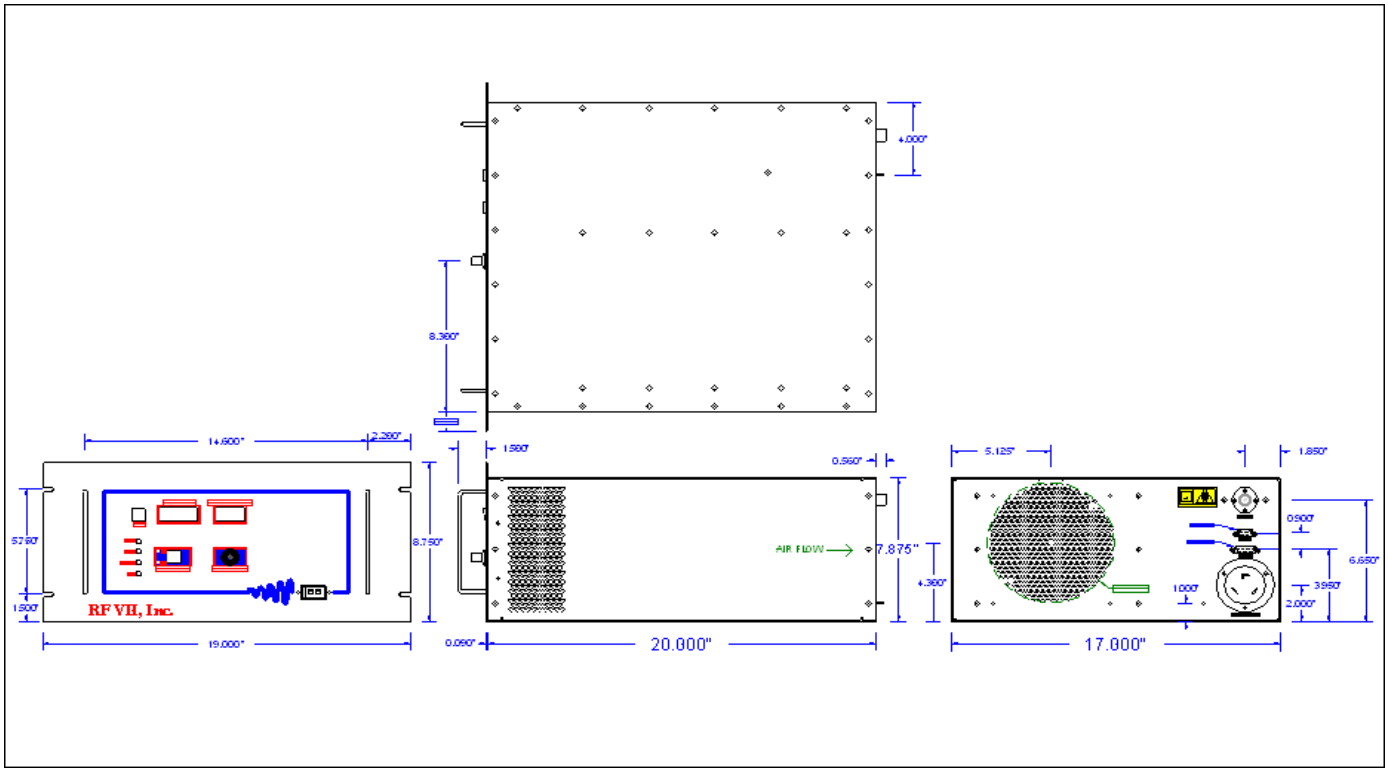
Frequency Range	2-40 MHz
Power Rating	1000/ 2000/ 3000 Watts
Impedance Rating	50 Ohms
Reflectant Limit	70 / 150 / 250 Watts

Mechanical

Height	7.875 ″ / 20 cm
Width	17.00 ″ / 43.2 cm / 19” rack
Depth	20.00 ″ / 50.8cm

Miscellaneous

Cooling / RH Factor	Air / 301 CFM / 30-50% Rh
Altitude / Pollution Degree	5000 Ft / Degree II
Operating Temperature	15-40 Degrees C
Interface Connector	15 pin **D** type (female) **EMI/RFI Filtered**
RF Output Connector	**N or HN** type
CEX Input/Output	BNC type (Optional)
Weight	40 / 45 lbs.



SECTION 2

RF-10/20/30-X Instruction Manual

Section 2 — Description

General

The RF-10/20/30 X RF Generator is designed for power delivery of 2-40 MHz at 1, 2 or 3 K Watts of output. It requires the use of RF transmission cable (50 ohm / RG-393) to couple power into an Auto tuner (ATN models) or 50-ohm resistor load. Power is read on the front panel or remote connector provided on the rear of the generator. There are three types of operational controls, front panel, remote, and optional RS-232. These functions are more explained in the operation section of this manual.

Mechanical

The unit is a 19" rack mount chassis with a black front panel. It is also enclosed in yellow iridate aluminum for RF conductive ground purposes. The DC power supply chassis is L molded for ease of assembly and repair purposes. All metal is 0.090" or thicker for extra support during handling and shipping.

Environment

Unit is designed for various environments but with some limitations, such as altitudes higher than 5000 feet (Air cooling). Also, humidity that is higher than 70% and heat above 100 degrees F consistently will cause equipment not to operate properly or hinder protection.

Physical Use Statements

This is to state the RF Generator is to be used solely for delivering its RF signal to a 50-ohm load or tuner with load matching capabilities. Also, the unit must be positioned in such a way not to block air flow of generator. If any blockage of air passages is not clear over temp may occur and unit warranty could be voided. And all connections to our product should have ease of access (Space) and not have over stressed cable connections. Unit is designed to lay flat with side vents open, and rear panel clear exhaust air flow out.

Protection

If unit is not used for its intended design purpose, protection devises may not perform properly. Any violation, change, or repurpose, voids all warranties and safety guidelines for this unit.

Safety Statement

The intended use of our equipment is for the purpose of coupling the RF Power through a 50 Ohm rated tuner to your target source. The unit must be coupled by proper RF cabling, rated electrical cord, and grounding. If not properly set up this can cause safety issue as well as damage to the unit. This could impair the safety of its intended use if instructions are not properly followed.

Handling

When required; Removing or installing, an unit is to be lifted by the **bottom**, either from sides, or front to back when lifting or being carried.

SECTION 3

RF-10/20/30-X Instruction Manual

Section 3 — Controls and Indicators (For units with Front panel option)

Indicators

There are several indicators located on the front panel of the RF generator. The two red led indicators are for ***RF forward and reflectant*** power readings. The four indicators (LED's) are operational mode detection parameters.

Intlk = Illuminates when external interlocks are **not** satisfied.
Temp = Illuminates when heat sink temperature exceeds safe levels.
Remote = Illuminates when remote operation is activated on back Panel or when the optional RS-232 mode is enabled.
Cex = Illuminates when the CEX pin is pulled down low (J1). This allows for an external source input to be applied to J2 BNC input for dual plasma operation using 2 RF sources.

RF Enable Off = Illuminates when RF generator is idle, and RF is not enabled.
RF Enable On = Illuminates when RF switch is activated upon depressing (Enabled) red RF on button.
DC Bias Control = By pulling Pin 13 to ground this activates DC Bias control. DC Bias voltage from the Auto-Tuner Is fed to Pin 12, and the set-point control will now Control the Bias Voltage created in the chamber. This gives better control over the systems plasma Developed at the source, rather than back at the RF Generator.

Controls

There are three types of operational controls, ***Remote operation, RS-232,*** and ***Front Panel operation.***

1. Using Front Panel operation a preset set-point can be achieved by pressing and holding the blue switch and rotating the power set knob. Depressing the red switch will toggle RF ON and RF OFF.
2. The remote 15 pin D connector allows the customer's system the option of parameter control of the RF Generator. See connector pin out in the installation portion of this manual.
3. RS-232 is a 9 pin D connector for serial communication to systems Computer, Gui, PLC, or Microprocessor controls.

SECTION 3

Remote Interface Operation

1- **External Interlock** is a safety circuit which uses an internal pull-up resistor. This will disable the RF power on the generator if the analog interface connector or dummy plug is not connected. The RF will not enable if the interlock is not satisfied.
2- **RF On** is an input function with an internal pull-up resistor which can only be activated when all protective circuits are satisfied. If the generator is turned off or a protective circuit shuts off the RF at any time, all protective circuits must be re-satisfied, and the control line must transition from high to low for the RF to be reactivated.
3- **Set-point Input** is a differential input which works together with the set-point return. The set-point input must be a positive voltage from 0 to 5 volts greater than the set-point return. The maximum voltage that can be used is 5.5 volts.
4- **Set-point Return** is also a differential input and works together with the set-point input. The set-point return must be from 0 to 5 volts less then the set-point input. When the set-point input and set-point return have the same voltage, the power level is at 0 watts.
5- **RF ON & OK** is an output function with an internal pull-up resistor. It tells the RF status of the generator. If the voltage level is low, then the unit is operating correctly with RF on and low reflectant. If the voltage is high, then the unit is not running properly, and RF can either be on with high reflectant or the RF is off.
6- **CEX Enable** is an optional circuit that allows the generator to be used with multiple generators using the same crystal signal. When low voltage is put to the pin, CEX is enabled and the generator is ready to be used as a slave unit.
7- **Reflectant Monitor** is an output function. It gives a voltage from 0 to 5 volts which shows how much reflected RF power the unit is receiving. Sealing is 5 volts which equals the rated power.
8- **Forward Monitor** is an output function. The line gives a voltage from 0 to 5 volts which shows how much forward RF power the generator is outputting. An output of 5 volts means rated forward power.
9- **Ground** is from pin **9 to 13**. For proper operation of the generator, the system controlling the generator must be connected to at least one of these pins to ensure a common ground between the system and the generator.
14- **RF Enabled** tells the status of the RF as either on or off. When RF is off there is a short to ground (closed connection), and when RF is on the connection is open to ground (open connection). This output is used in conjunction with the matching network preset operation.
15- **Local/Remote Select** is an input function. It allows the user to switch between local control (optional front panel) and remote control which is also called analog interface. This line has an internal pull-up resistor. An input of 5 volts is local control, and 0 volts is remote control.

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Section 3 Rear Panels

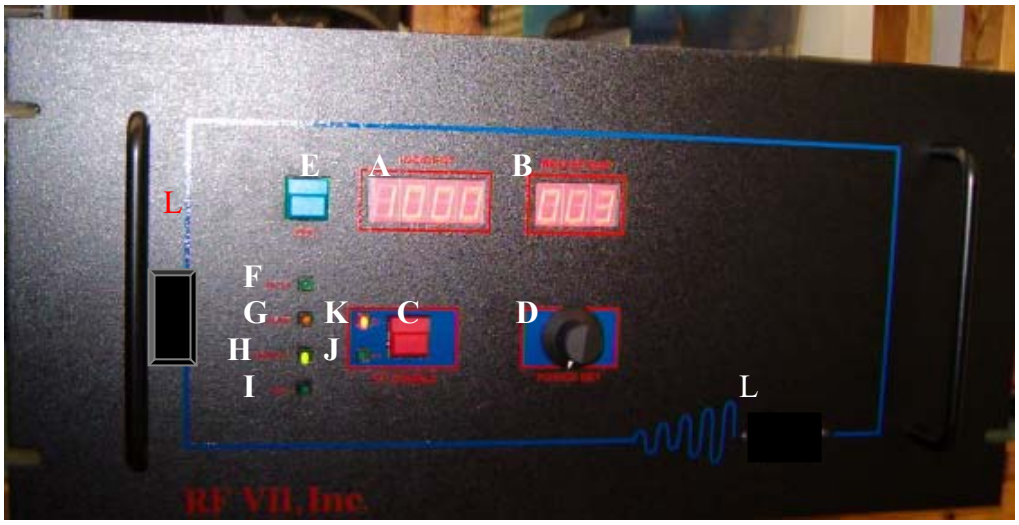
Single Phase 20A (RF-10/20)

Three Phase 20A (RF-30)

Rear Panel Layout	
A	RF Connector type N female **J2**
B	Line cord Plug (male) Nema L6-20 Flange Inlet type connector
C	Interface Connector type 15 pin D female **J1**
D	RS-232 Connector type 9 pin D female (optional)
E	CEX (In) Connector type BNC female (optional)
F	CEX (Out) Connector type BNC female (optional)
G	Pulse Connector type BNC female (optional)
H	Ground Standoff (use to ground generator to system)
I	Fan (Exhaust)

Section 3

RF Generator Front Panel Features



Front Panel Layout	
A	RF Output Display -displays RF power output in watts
B	RF Reflected Display - displays reflected RF power in watts
C	RF Enable Switch - turns RF on and off (toggle)
D	RF Power Set Knob - adjusts the RF power output
E	RF Power Pre-set -Hold in and turn the RF power set knob to pre-set RF output in watts
F	INTLK - LED is on when external interlock is **not** satisfied
G	TEMP – LED is on when heat sink temperatures exceed safe levels
H	REMOTE -LED is on when remote operation is activated. Also indicates when RS-232 option is in use.
I	CEX - LED is on when the CEX is enabled allowing for slave mode operation
J	RF OFF - LED is on when generator is idle
K	RF ON - LED is on when RF is active. **Caution! Do NOT touch RF connector when this LED is on!**
L	Circuit Breaker acts as power on/off switch

SECTION 4

RF-10/20/30-X Instruction Manual

Section 4 Installation

Unpacking

Inspect RF Generator package for any shipping damage before opening container. Now remove the RF Generator from container and remove antistatic wrap from unit. Check for any damage and condition of product should be new.

Mechanic Connections

Install RF Generator into desired enclosure (19" Rack) with some bottom support. For proper operation, install RF Generator ensuring good grounding to the system.

Electrical Connections

Connect AC input and remote connections as directed in this manual. Connect RF Cable N connector to generator and then to a dummy load or Matching Network. This RF Cable should be in lengths of 12' feet (Standard) or 4' increments for shorter requirements. Improper lengths could void warranty of RF generator. Install 15 pin dummy connector with interlock pulled low for stand alone front panel operation. Or use section 4 and hook-up remote analog function control lines if front panel is not available.

Set-up & Operation

After all connections satisfied, (15 pin remote, AC Plug, and RF Cable) turn on Breaker and/or AC power on switch. Unit's fans should turn on with front panel or remote giving idol state status signals.
FRONT PANEL: Check front panel indicators for status and operation readiness. If the interlock (Pin 1 low) is satisfied (interlock indicator LED should be off) you should be able to turn *RF ON* with the Front panel button (RF enable). After getting the RF On Indicator illuminated, dial the power knob up (Dummy Load) to maximum rated watts, to ensure unit is fully functional. Or, if using an auto-tuner dial up power up until tuner eliminates reflectant power, while reaching your desired Incident power.
REMOTE PANEL: If the interlock (Pin 1 low) is satisfied, then toggle Pin 2 to ground on the remote connector to enable RF ON. Check status line on Pin 5 (should be low) indicating RF power is on. Now by applying a differential DC set-point (0-5Vdc) across Pin 3 (Set-point return is Pin 4) you should see power readings on pin 8 close to the input set-point voltage. Test unit to maximum rated power, which should be 5 Vdc set-point input with a close 5 Vdc monitor output.

If you have any problems contact a service engineer at RF VII, Inc.

Warranty

All units have a one-year depot warranty effective from the date stamped on the serial tag.

Section 4 Installation

Remote Control Connections (15 pin D Female)

J1

(1)	External Interlock (Low to Satisfy Interlock)
(2)	RF ON Enable (Low to activate)
(3)	Set-Point input (0-5Vdc)
(4)	Set-Point return
(5)	*RF ON & ok* (indicator/output) (Low = ok)
(6)	CEX Enable (Low to activate)
(7)	Reflectant monitor (5vdc = 600 watts)
(8)	Incident/Forward monitor (5vdc = 600 watts)
(9)	Ground
(10)	Ground
(11)	Ground
(12)	DC Probe Input
(13)	DC Probe control (pull low for activation)
(14)	RF Enabled for PT-II-CE Presets (low = RF off)
(15)	Local / Remote Select (low / Remote)

Remote Interface Operation

SECTION 4

Remote Connector Pin out

Pin	Description	In/Out*	Activate
1	External Interlock (IPR)**	In	High = Not Satisfied Low = Satisfied
2	RF ON (IPR)**	In	High = RF Off Low = RF On
3	Set-point Input	In	Differential Input of Zero to 5 Volts 5V = Rated Power
4	Set-point Return	In	
5	RF ON & OK (IPR)**	Out	High = Not Ok Low = Ok
6	CEX Enable or ATN Arc Suppression (Optional)	In	High = CEX Disable Low = CEX Enable
7	Reflectant Monitor	Out	Zero to 5 Volts 5V = Rated Power
8	Forward Monitor	Out	Zero to 5 Volts 5V = Rated Power
9	Ground	None	None
10	Ground	None	None
11	Ground	None	None
12	Bias Voltage Input	In	Zero- 1 Volt Approx..
13	Bias Voltage Input	In	Ground / Optional VTL
14	RF Enabled (Status) (Used for PT-II-CE Presets	Out	Open = RF On Closed = RF Off
15	Local/Remote Select (IPR)**	In	High = Local Low = Remote

*In/Out is used to describe the functionality of the pin as either an input or an output.

**IPR (Internal Pull-up Resistor) must have a transition in voltage to activate.

SECTION 4

RS-232 Operation

RS-232 is an optional way to control the generator through serial communications to a systems computer or microprocessor.

RS-232 Setup

Baud Rate: **9600**
Parity: None
Data Bits: 8
Stop Bits: 1

RS-232 Pin out DB9 Female Connector

Pin	Initials	Description
1	DCD	Data Carrier Detect
2	**TxD**	**Transmit Data***
3	**RxD**	**Receive Data***
4	DTR	Data Terminal Ready
5	**SG**	**Signal Ground**
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

*For use with a straight serial cable.

RS-232 Commands

Command	Description
HI[CR][LF]	Enter RS-232 Mode
BYE[CR][LF]	Exit RS-232 Mode
P ####[CR][LF]	Set Power
RFON[CR][LF]	Turns RF On
RFOFF[CR][LF]	Turns RF Off
G+[CR][Lf]	Pulse Mode On
G-[CR][LF]	Pulse Mode Off
F ##[CR][LF]	Pulse Frequency 1Hz to 999Hz, 1Hz resolution
D ##[CR][LF]	Duty Cycle 10% to 90%, 5% resolution
?[CR][LF]	Status Report

Note: Commands are **NOT** case sensitive.

SECTION 4

RS-232 Operation

Status Report Example

The response from the generator is as follows:

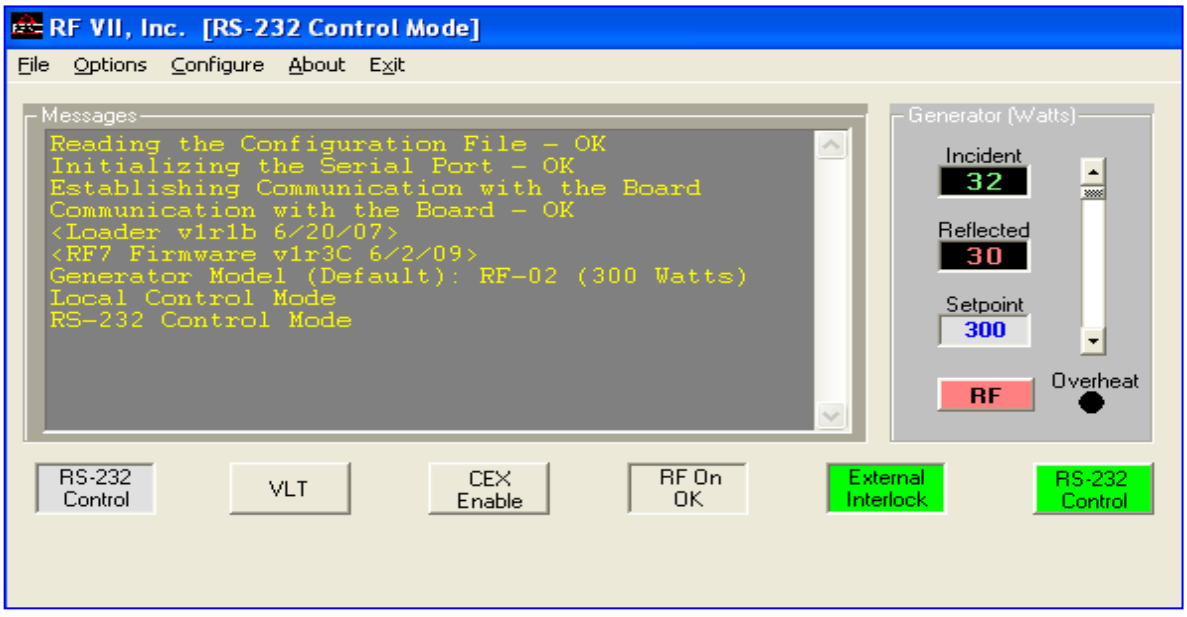
?X SET FWD REF[LF][CR]

SET is the set point power in watts, 1-4 digits
FWD is the forward power in watts, 1-4 digits
REF is the reflected power in watts, 1-4 digits
X is an ASCII character, 0 though 7

X is actually a three-bit binary number padded out to eight bits so that it will display as a numeric character. The number's bit configuration indicates the following:

Bit	True	False
DB0	RF OK	RF NOT OK
DB1	External Interlock OK	External Interlock NOT OK
DB2	RF ON	RF OFF

* Gui Software available for RS-232 communication



SECTION 5

Section 5 Schematics / Service

We have not included schematics, but they are available by request of your qualified service personnel. These drawings are proprietary and should not be reproduced for any company other than the original OEM customer.

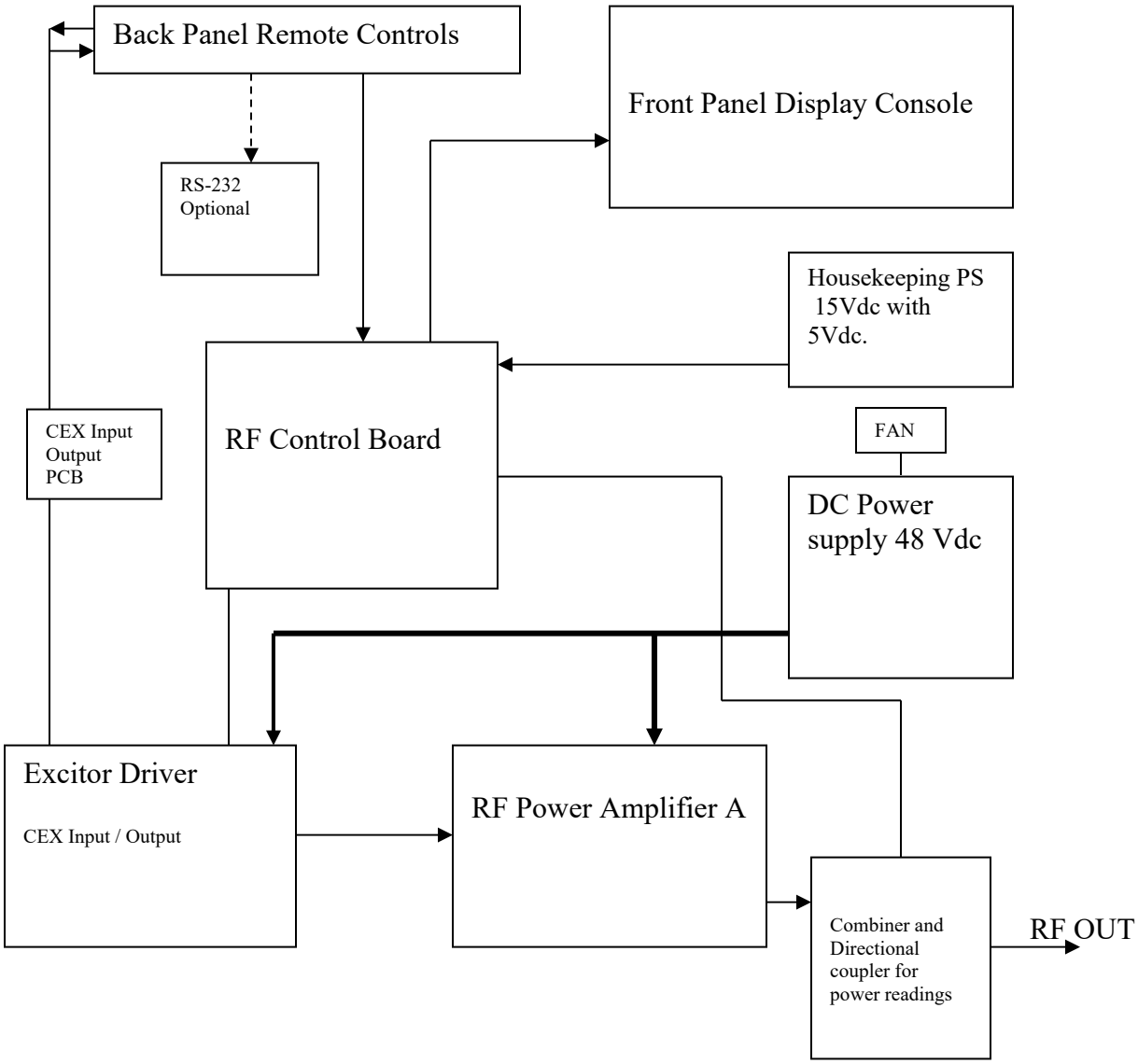
For any parts or service please contact RF VII Inc. by the following listed methods. When returning equipment, please ensure that you properly package the units. If you are unsure, please contact RF VII Inc. for proper procedure. You can also request product packaging to be shipped to your location for a nominal fee.

RF VII Inc.
104 Church Street
Newfield, NJ 08344

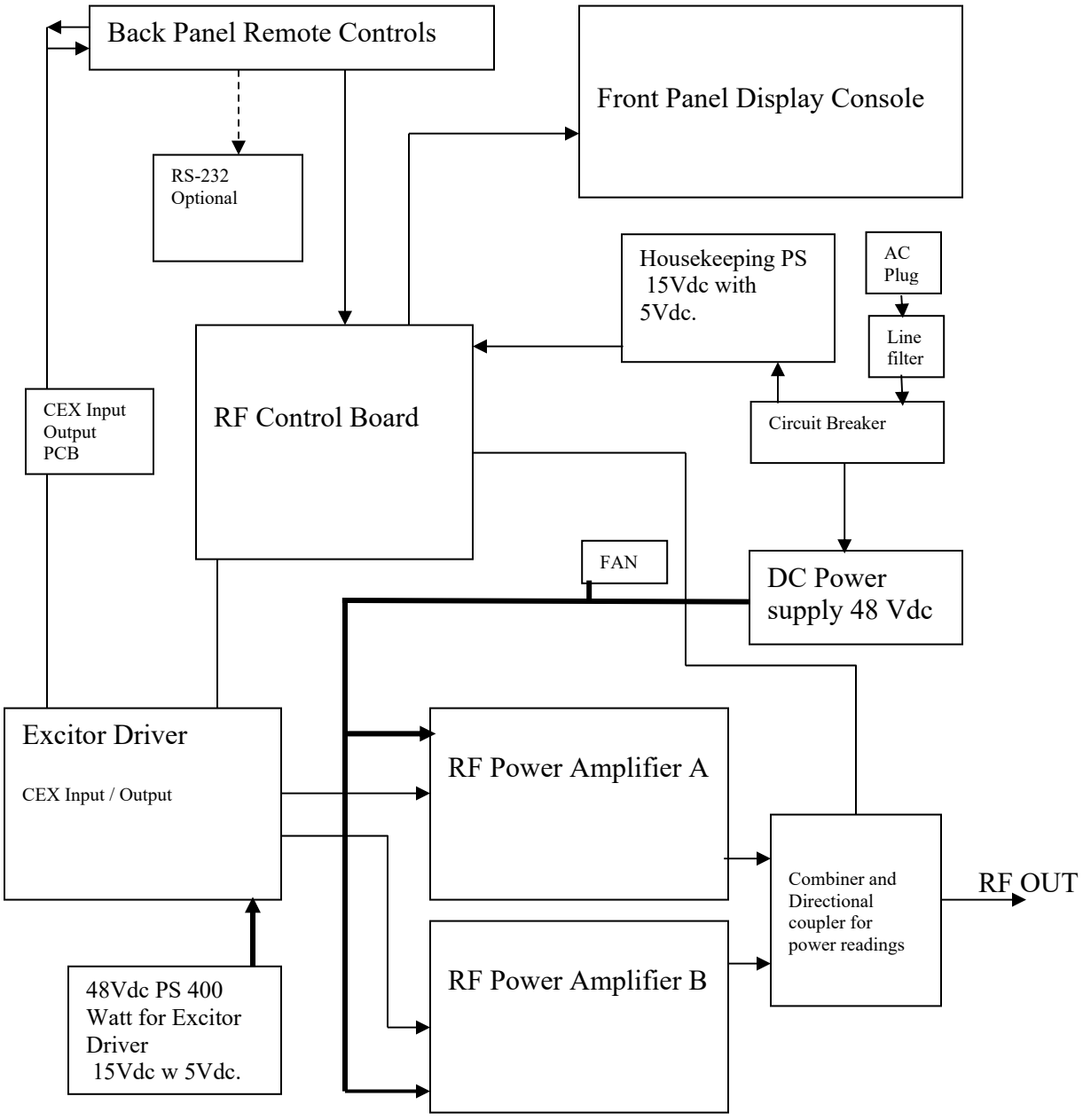
Ph: 856-875-2121
Fx: 856-839-2473

Url: www.rfvii.com
Em: rfvii@yahoo.com

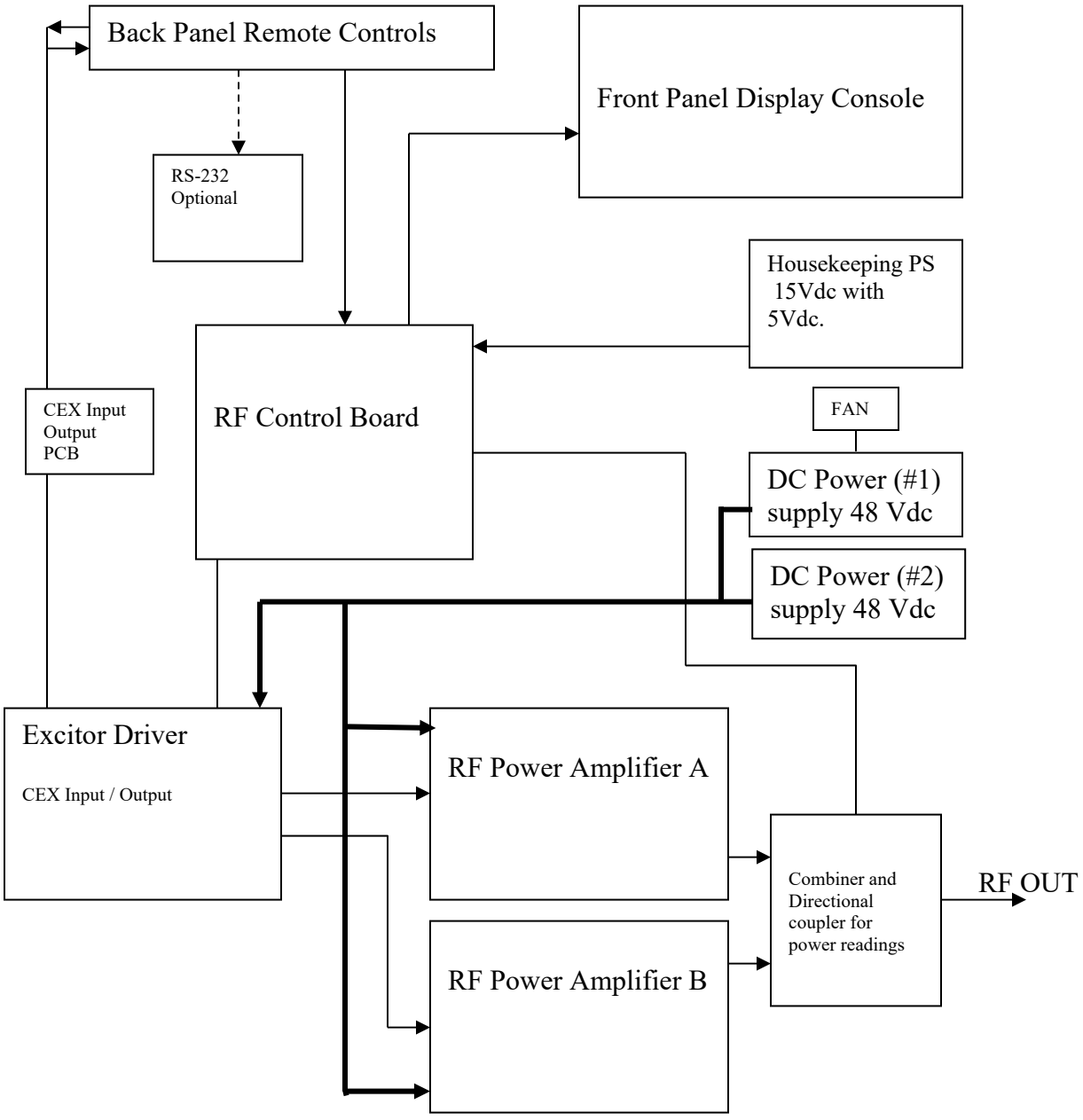
RF-10-X Chassis Block Diagram



RF-20-X Chassis Block Diagram



RF-30-X Chassis Block Diagram



SYMBOL GLOSSARY

CE

Symbol means a product has met the European Unions Consumer Health and Environmental Safety Requirements.

IEC IECEE CB SCHEME

Symbol for the Certified Body for the International Electro-Technical Commission. Which is the worldwide System For conformity testing and certification of Electro-technical Equipment and Components (IECEE)

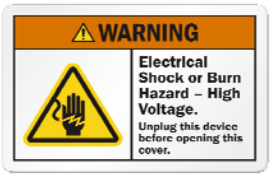
Standard Electrical Shock Hazard Symbol

General Warning Symbol

Non-Ionizing Radiation Symbol

French Electrical Hazard Symbol

Japanese / Chinese Hazard Symbol



Germany / European Shock Hazard Symbol

Glossary

AC – Alternating Current
ANSI electrical code – (American National Standard Institute)
CEX - An abbreviation for Common Exciter.
DC – Direct Current
GUI – **G**raphical **U**ser **I**nterface – Type of user interface that allows humans to interact with electronic devises such as computers.
HARMONICS – A component Frequency of the Signal that is an integer multiple of the fundamental frequency.
HERTZ- is equal to a CYCLE, which is the method of frequency/time of a given signal. Depending on your age is which term you use.
KHz – Kilo Hertz, 1000 Hertz / Cycles per second

IMPEDENCE – is the measurement of capacitance or inductance in a reactive circuit. Unit of measurement is in ohms of reactance (Not to be confused with electrical resistance) and classified Inductive or Capacitive.
MHz – Mega-Hertz, 1,000,000 Hertz / Cycles per second
RESONANCE- is when capacitance and inductance, in a reactive circuit, cancel each other.

Roman Numeral Frequency Conversion Table.

I	= 1.2 MHz
II	= 2.0 MHz
RF- VII	= RF- Seven “Company Pronunciation”
XIII	= 13.56 MHz
XXVII	= 27.12 MHz
XL	= 40.68 MHz