

USER'S GUIDE

EO Modulator Driver and Source

Models 3363-A, 3363-B, and 3363-C



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Please read the manual for safety information.

Warranty

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Operation

Introduction

The Model 3363 is a user-friendly EO modulator driver which mates a frequency source and a power amplifier with several handy user features in a compact package. The unit runs from standard line voltage (US or international). It is ideal for use with the New Focus line of resonant modulators. (It can also be used with our broadband EOMs as well, with lower resultant modulation depth.)

The Model 3363-A contains a voltage-controlled oscillator (VCO) as the frequency source, which is available from 25 to 1000 MHz. The VCO source can be tuned over a limited range via a convenient front panel knob. In addition, the VCO frequency can be set to track the resonance peak of the EOM; this locking mode is selectable via a front panel toggle switch.

The Models 3363-B and 3363-C contain a high-stability synthesized frequency source, available from 50 kHz to 2 GHz. The synthesized source is stabilized to a crystal oscillator for excellent long- and short-term stability. The output frequency is selected to match your EOM at time of shipment, however, the user may also adjust the frequency over a limited range through the use of an external computer port.

A front-panel toggle switch allows the user to select whether to use the internal frequency source or to use an external source.

A matched output RF amplifier provides about 30 dBm of power, enough to drive any of our resonant EO modulators to provide approximately 3 radians of phase modulation. The output modulation depth is controlled through a convenient front-panel knob, providing adjustment from no modulation to full output power.

A reflected RF power monitor provides a DC signal proportional to the voltage reflected back from the EO modulator. For the VCO-based option, this feature allows you to manually tune the frequency of the drive box to the resonance of the modulator for maximum modulation efficiency or monitor the frequency-locking circuit. For our fixed-frequency synthesizer option, it can also be used to fine-tune the resonance of our high-frequency EO modulators using the integral tuning slug.

Other usability features include an RF output enable switch to eliminate damage to the amplifier and/or EOM while connecting and disconnecting the output, an analog AM modulation input, and a TTL output disable input.

Overview of the Unit

Shown in Figures 1 and 2 are the front and rear panel of the unit. Figure 1 details the layout of “A” option of the Model 3363 and Figure 2 details the layout of the “B” and “C” options.

1. *Power switch.* Turns AC power to entire unit on and off.
2. *AC indicator.* Lights when unit is powered.
3. *RF amplifier enable.* When depressed (and LED is lit) the RF power amplifier is turned on. This switch allows you to disable the RF amplifier when connecting or disconnecting the EO modulator to the RF output (9) without damaging the EOM or

power amplifier. Note that when this button is off, there may still be some signal leaking through; the attenuation ranges from 16-30 dB depending upon option and frequency chosen.

4. *Internal Source/External Oscillator switch.* When in the up position (Int Source), the internal VCO or synthesizer is used to produce the output. When in the down position, an external frequency source can be used.
5. *External oscillator input (SMA female).* When the switch (4) is in the down (Ext Osc) position, this input provides the oscillation source for the EOM amplifier.
6. *Frequency adjust knob, Option A only.* Adjusts the frequency of the VCO. Factory adjustment is typically $\pm 5\%$ around the user-specified center frequency. This is a one-turn potentiometer.
7. *Lock/Free switch, option A only.* When down, in the “free” position, the frequency adjust knob (6) acts normally to adjust the output frequency of the unit. When up, in the “lock” position, the unit tracks the resonance of the EOM.
8. *Output Level knob.* Adjusts the output power delivered by the driver from approximately 3 dBm on the low end to approximately 30 dBm on the high end.
9. *RF output.* The high-level RF signal provided to the modulator. This must be connected to the EOM or a 50-ohm load when the RF enable (3) switch is on, or damage may occur to the amplifier.
10. *Reflected RF monitor.* This provides a DC voltage proportional to the RMS RF voltage reflected back from the modulator. When the EOM resonance and the frequency of the driver are equal, the signal is a minimum. The exact value of the minimum varies depending on drive level and each individual modulator.

- 11. TTL Enable* Internal Source.** This allows an external TTL signal to perform the function of the Int/Ext Source switch (4). When no external source is connected to (5), a low level (nominal 0 V) on this input allows the internal generator signal to pass through; a high level (nominal 5 V) disconnects the internal frequency source.
- 12. AM modulation input.** This allows an external analog voltage (0 to 5 V) to modulate the output RF level. The output level knob (8) should be fully counterclockwise (minimum output) when using this input.
- 13. Option port, Option A.** For the option A, VCO-based models, this provides an auxiliary frequency monitor with a fixed output of approximately 10 dBm.
- 14. EAC power input connector.** AC power to the unit can range from 90 to 250 VAC. The door above the power connector contains the fuse. The fuse installed in the unit will be appropriate for your location's voltage.
- 15. Frequency Lock indicator, Option B or C only.** This LED should remain lit when the unit is operating properly; it indicates that the internal phase-locked loop circuit is locked to the internal crystal source.
- 16. Option port, Option B or C only.** For Option B, this is a RS-232 DB-9 female connector. For Option C, this is a parallel port DB-9 male connection. This port allows the synthesizer frequency to be adjusted from a computer.

Figure 1: Front and rear panel of the 3363-A

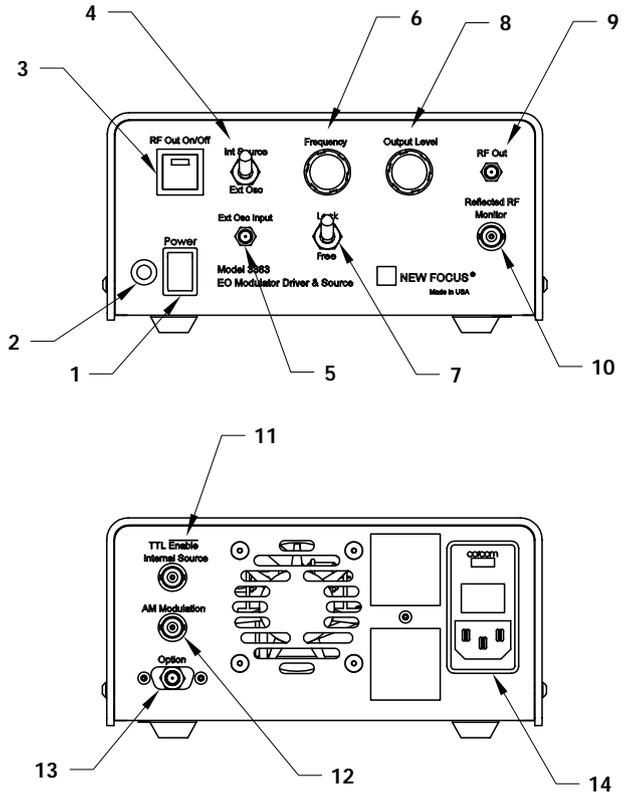
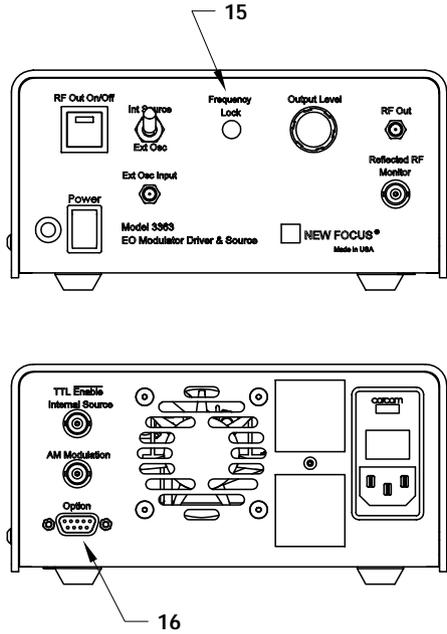


Figure 2: Front and rear panel of the 3363-B and 3363-C



Quick Start Instructions

The unit is ready-to-use straight out of the box. Check that the power switch (1) is off and that the RF out on/off switch (3) is “out”. Plug the line power cord into the back of the unit (14) and into a wall socket. Connect your EOM to the RF out port (9) using the supplied 48” long SMA-to-SMA cable and secure both ends properly (standard SMA torque is 9 in-lbs).

Turn power on to the unit by pressing the toggle (1). It will take 2-3 seconds for the power supply and thus front-panel indicator (2) to come on. Set the output level knob (8) to the most counterclockwise position for minimum output. Press the RF out on/off button (3) to turn on the power amplifier. Turn up the level knob (8) until you see modulation.

For the Model 3363-A model, you will likely need to adjust the frequency knob to adjust the output

frequency to be in resonance with the driver. By attaching a common voltmeter to the reflected RF monitor port (10), you can determine if you are at resonance by adjusting the frequency until the signal on the voltmeter is minimized. When you are near the minimum, you can flip the lock/free switch (7) to the “lock” position to have the VCO frequency track the EOM resonance.

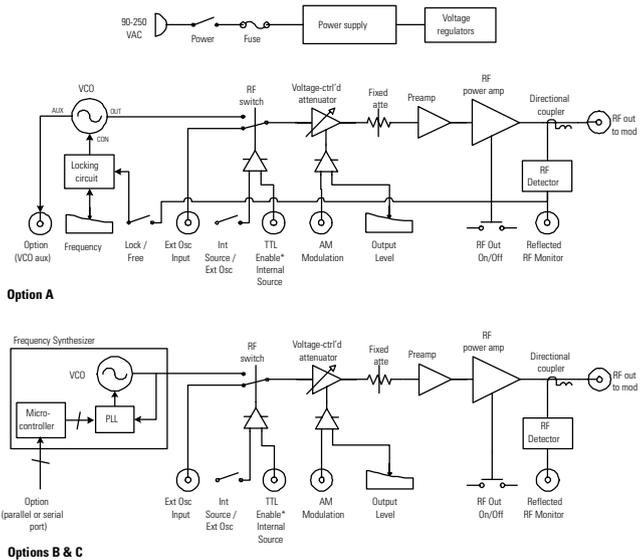
For the 3363-B and 3363-C models, the frequency is fixed at the factory to the frequency specified at time of order. By attaching a common voltmeter to the reflected RF monitor port (10), you can monitor the power reflected back by the EOM. Some of our high-frequency EOM models have a user-accessible slug that allows you to tune the resonance of the EOM to match and thus minimize the signal from the monitor port.

For an FM modulator, the easiest way to check for modulation and measure modulation depth is to use an optical spectrum analyzer. For an AM modulator, one of our detectors is ideal for measuring modulation. Using one of our DC-coupled receiver models to observe the output signal from the EO modulator is an ideal way to carefully measure modulation depth.

Operation Details

Below in Figure 3 we show a simplified block diagram. The top schematic shows the power supply configuration common to all options, the middle shows the Model 3363-A configuration, and the bottom reflects the Models 3363-B and -C configurations.

Figure 3:
Simplified
block diagram
of Model 3363



In the Option A configuration, a voltage-controlled oscillator (VCO) provides the sinusoidal frequency source. A front-panel knob controls the frequency by changing the applied voltage to the VCO. The main VCO output is the input to an RF switch, and an auxiliary output is sent to the option port for monitoring.

The RF switch provides the ability to use the internal frequency source or an external user-provided source. If the external oscillator is not connected, this switch can be used to provide approximately 45 dB of attenuation. The RF switch can also be actuated by an external TTL input. When using this external input, the switch is expected to be set to “Int Source” for proper operation. The bandwidth of the TTL enable* input is in excess of 1 MHz.

The RF output level and thus modulation depth is provided by a voltage variable attenuator. The front panel knob is normally used to adjust this level, however an analog voltage from 0 to 5V on the AM modulation input can duplicate this functionality.

When using the external AM modulation, the output level knob is expected to be fully counterclockwise (minimum output). The bandwidth of this input is in excess of 1 MHz.

A low-level preamplifier and an RF power amplifier boost the signal to approximately 30 dB at maximum output. The DC power to the RF power amplifier is controlled by the RF out on/off switch (3), allowing the RF amplifier to be disabled to change loads (EOMs). This button effectively attenuates this output by 16-30 dB, depending upon the specific RF amplifier model used.

A directional coupler, operated in reverse, samples any power reflected back from the EOM. The reflected RF signal from the coupler is sent to a power detector which turns this RF into a DC voltage proportional to the reflected RMS signal. An amplified version of this signal is provided to the user.

When the lock/free switch is in the “lock” setting, this signal is also used to adjust the VCO voltage to force the frequency to track the resonance of the EOM. The locking circuit adds a small dither (approximately 40 kHz) to the output frequency, which is used to track the minimum of the EOM resonance. Note that some models/frequencies of EOM (typically the 4001/4003 series) can have spurious resonances that are not at the actual main resonance; these can be avoided by first tuning the synthesizer to be very near the main resonance before toggling the switch from free to lock.

The 3363-B and -C models, shown at the bottom of Figure 3, replace the VCO-based source with a PLL-based synthesizer, and dispenses with the locking circuit. The Option B synthesizer has a RS-232 serial port interface and the Option C synthesizer has a parallel port interface. The synthesizer frequency is factory-set to the user’s desired frequency and use of the computer port is optional only.

Safety Notice

The output RF must be disabled using the RF out on/off switch (3) whenever the output (9) is connected or disconnected or damage to the RF amplifier may result!

There are no user-serviceable parts inside. Opening the unit is not recommended and will violate the New Focus warranty.

Characteristics

Specifications

The specifications for all three models in a comparison format are shown in the table below. The primary performance difference between the three units is determined by the use of a VCO-based versus a synthesizer-based frequency source.

All models are meant for indoor use, to be operated at altitudes upto 2000 meters and within 0-40°C temperature range. Maximum allowed non condensed humidity is 95% with mains supply voltage fluctuation upto $\pm 10\%$ of the nominal value. Rated degree of pollutions for all models is 2.

Model #	3363-A	3363-B	3363-C
Output RF power, max.	30 dBm typ.	30 dBm typ.	30 dBm typ.
Output power range	0-30 dBm	0-30 dBm	0-30 dBm
Max. mod with res. EOM	3 rad typ.	3 rad typ.	3 rad typ.
Ideal for EOM models	4001, 4003, 4103, 4421, 4423	4001, 4003, 4103	4001, 4003, 4103, 4421, 4423
Compatible with EOM models	4002, 4004, 4104	4002, 4004, 4104	4002, 4004, 4104
Frequency range	25-1000 MHz	0.05-40 MHz, in 0.001 Hz steps	45-2000 MHz, in 25-100 kHz steps
Frequency stability	Tracks EOM resonance when locked	± 1.5 ppm	± 1 ppm
Frequency adjust range	$\pm 5\%$ of center (typical)	Fixed at fac- tory*	Fixed at fac- tory*
Frequency lock indicator	No	Yes	Yes
Output VSWR, max.	2:1	2:1	2:1

Model #	3363-A	3363-B	3363-C
Output RF connection	SMA	SMA	SMA
Reflected RF monitor	16 V/V _{rms} (typical)	16 V/V _{rms} (typical)	16 V/V _{rms} (typical)
Reflected RF connector	BNC	BNC	BNC
Ext. osc. input level	-10 dBm max.	-10 dBm max.	-10 dBm max.
Ext. osc. input conn.	SMA	SMA	SMA
Disable input	Std. TTL logic, high to disable	Std. TTL logic, high to disable	Std. TTL logic, high to disable
Disable RF attenuation	45 dB typ.	45 dB typ.	45 dB typ.
Disable connector	BNC	BNC	BNC
AM modulation input	0-5 V (5V pro- duces max RF output)	0-5 V (5V pro- duces max RF output)	0-5 V (5V pro- duces max RF output)
AM modulation range	0-30 dBm	0-30 dBm	0-30 dBm
AM modulation conn.	BNC	BNC	BNC
Option connector	buffered VCO mon., SMA	RS-232, DB-9 fem.	Parallel port, DB-9 male
Power requirements	100-240VAC, 50/60Hz, 1.0-0.5 A	100-240VAC, 50/60Hz, 1.0-0.5 A	100-240VAC, 50/60Hz, 1.0-0.5 A

Performance Details

In Figure 4 below, we show a typical plot of the output voltage provided to the EOM versus the angle of the output level knob (item 8 of Figure 1). The substantially flat portions at either end of the knob travel act to indicate the unit is providing either minimum or maximum available output. This curve shows performance of a typical unit; the exact voltage and angle will vary slightly from unit to unit depending upon option and frequency chosen.

Figure 4:
Output of RF
Out in Vpp
versus Output
Level knob
angle

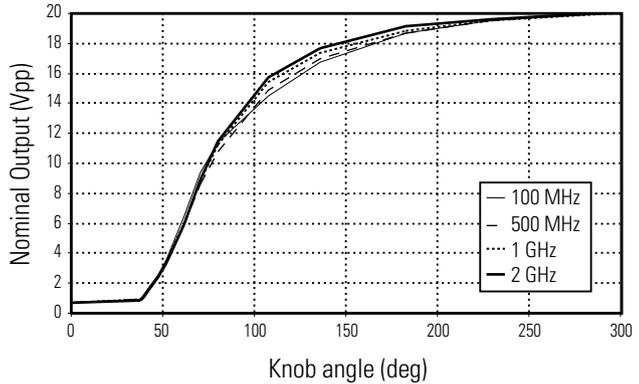


Figure 5 illustrates the typical response of the reflected RF monitor port (item 10, Figure 1) for several frequencies. The typical slope is 16 V of reflected port signal for every RMS volt reflected back from the EOM. Note that this port monitors power reflected back from the load (typically an EOM), and not the forward power transmitted to the load.

For reference, the coupler that captures the backreflected power has 20 dB typical coupling to the coupled port. The return loss, or S11, of our EOMs varies by model and by frequency, but a typical value of S11 is less than -25 dB on resonance. This value rises to nearly 0 dB (highly reflective) far off resonance. Note that it is very unlikely for the EOM and driver to be this far off resonance, as the VCO tuning range of the option A units is explicitly limited to $\pm 5\%$ of the center frequency, and the option B and C units are factory tuned to be at the EOM center frequency.

Figure 5:
Typical
response of the
Reflected RF
Monitor port

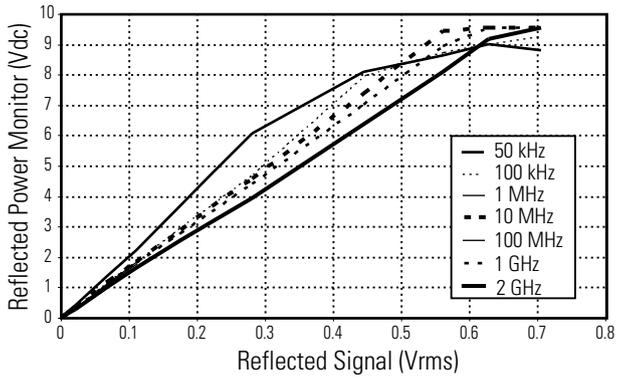


Figure 6 shows the typical transfer function of the AM modulation input (item 12, Figure 1). This input mimics the front panel output level knob with a 0 to 5 volt input range. This analog input is designed to operate with the output level knob set to minimum (fully CCW).

Figure 6:
Nominal RF Out
in Vpp versus
AM modulation
input voltage.
Output level
knob is turned
fully counter
clockwise

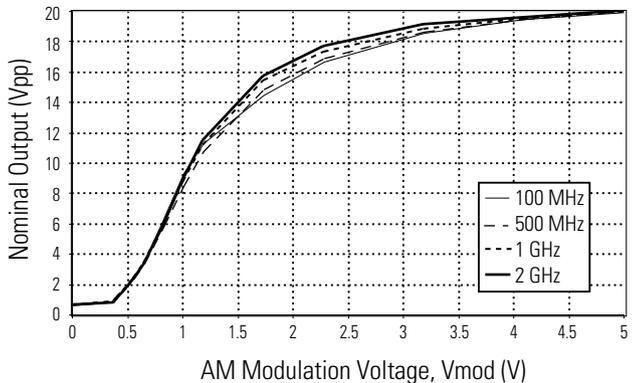


Figure 7 shows the input return loss of the external oscillator input (item 5, Figure 1) for the source selector switch (item 4, Figure 1) in both positions. The reflection is less than -9 dB when the external oscillator input is enabled, but one should note that it is slightly reflective when disabled.

Figure 7: Input return loss of external oscillator input port for both internal and external oscillator switch settings

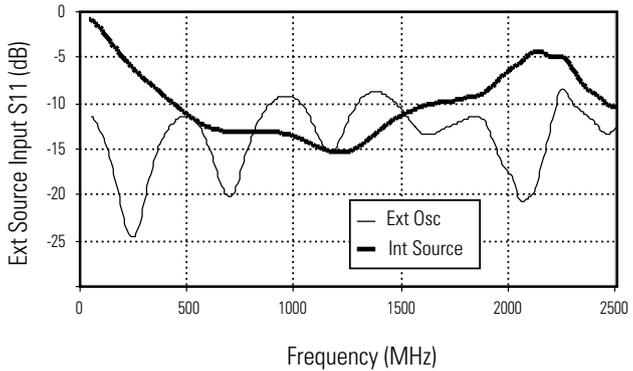
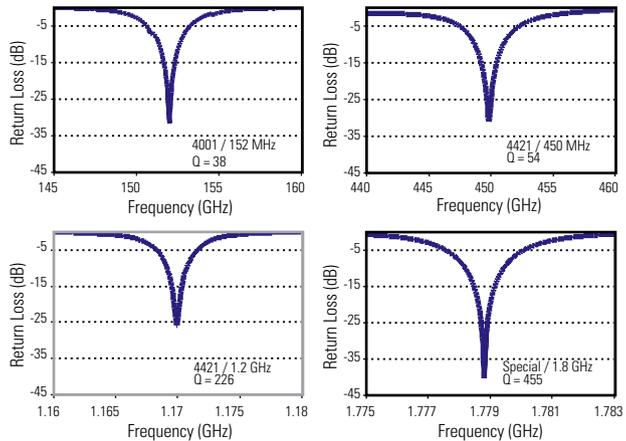


Figure 8 shows the output of the VCO aux output for the 3363-A (“Option,” item 13 in Figure 1) on a spectrum analyzer, with the system running free in the top spectrum and locked in the bottom spectrum (“Lock/Free” switch is item 7 in Figure 1). In both figures, the horizontal scale is 50 kHz/division and the vertical scale is 10 dB/division. The effect of the locking circuit on the output spectrum is to broaden it by approximately 40 kHz (the locking dither frequency is approximately 900 Hz). Since the resonance of most models of EOM is greater than 1MHz, the dither of the locking circuit should have no direct effect on the modulation depth.

modulator model and exact frequency. These data were taken under small-signal conditions and at room temperature. These plots are intended to help you understand the change in backreflected power and observed modulation depth as you tune either the frequency of the 3363, or the resonant frequency of the modulator itself.

As you observe the depth of modulation in your system, you may observe the modulation depth change over time, temperature, or drive level. Use of the locking function on the 3363-A, or use of the tuning slugs in the EOM itself, can be used to minimize these variations. Practically speaking, due to heating of the modulator crystal by the RF power incident upon it, you may note that it takes a minute or two for the modulation depth to stabilize as the temperature of the crystal settles at that particular drive level.

Figure 9:
Return loss
plots near
resonance of
several EOM
models.



Customer Service

Technical Support

Information and advice about the operation of any New Focus product is available from our technical support engineers.

Engineers are on duty from 8:00-5:00 PST, Monday through Friday (excluding holidays). For quickest response, ask for “Technical Support” and have the model number, option, frequency, and serial number of your unit, which can be found on the back panel of the unit.

Phone: (408) 919-1500

Fax: (408) 980-8883

Support is also available by email:
techsupport@newfocus.com

We typically respond to email within one business day.

Service

In the event that your unit malfunctions or becomes damaged, please contact New Focus for a return authorization number and instructions on shipping the unit back for evaluation and repair. When calling to request an RMA number, be sure you have the option letter (A, B, C), frequency, and serial number handy.

Fuse Replacement

Time Lag Fuse (Slo-Blo®) Fuse 239P Series,
250VAC, 1A

Appendix I

Changing the Frequency of the Model 3363-B

The option port on the back of the Model 3363-B is a standard RS-232 serial port. The frequency can be changed using a couple of simple commands. This appendix will describe how the user can change the frequency if necessary. Note that changing the frequency by a drastic amount from the factory setting (more than 20% up or down) may change the output power range that you see and is not recommended.

Connect the “Option” port of the unit to a standard serial port cable, plugged into the serial port of your computer. The cable is typically a DB-9 male to DB-9 female. Note that only GND, RX, and TX signal lines of the RS-232 cable are used.

If you are running Windows 2000, launch “Hyperterminal” on the computer. This is a standard program on Windows 2000 and is accessible via “Start > Programs > Accessories > Communications > HyperTerminal.” You will need to create a new connection with the following settings: 19 200 bit/s, 8 data bits, parity none, 1 stop bit, flow control none. If you are running on another operating system, any terminal server program that allows you to send and receive characters over the serial port, set to the above communications setting will work.

If you are running another operating system, any serial port communications program with its parameters set

to 19200 bit/s, 8 data bits, no parity, 1 stop bit, and no flow control will work fine.

Check that the connection is working and on the status of the synthesizer by typing “QUE” into the terminal screen. The unit should respond with a hexadecimal string of characters, for example “0000 12309CE54000 2710 14050060 0A3A 02 20.” The actual string will likely differ from this one based on the settings for your unit.

You can change the frequency by typing “F0 ” (note the space) followed by the frequency in megahertz. For example, to set the output frequency to 27.34 MHz, type “F0 27.34” followed by a return (the enter key). The unit should reply “OK” on the terminal program.

Now type “S” followed by a return into the terminal window. This step records the settings into the EEPROM of the synthesizer. If you skip this step, the frequency adjustment you made will be lost the next time the unit is powered off. The unit should again respond “OK” on the terminal program.

If desired, you may disconnect the serial cable and exit HyperTerminal (or whatever terminal program you are running) on the computer.

Appendix II

Changing the Frequency of the Model 3363-C

The option port on the back of the Model 3363-C is a standard parallel printer port. The frequency can be changed using a small control panel computer program available from New Focus. This appendix will describe how the user can change the frequency if necessary. Note that changing the frequency by a drastic amount from the factory setting (more than 20% up or down) may change the output power range that you see and is not recommended.

Connect the “Option” port of the unit to your computer using a cable with a DB-9 female connector to DB-25 parallel port connector. This cable is available as a separate item from New Focus, contact customer service to order this item.

Launch the control panel software on the computer. If the software is not yet installed on the computer you are using, please follow the instruction provided with the cable or with the software when you download it as instructed by customer service. The display should come up without any error dialogues. If there are error dialogues, the unit is not connected correctly, powered up, or you may have to configure your parallel port correctly as per the software installation instructions.

Type the desired user frequency in MHZ into the “Frequency” box. Click “Store.” Note that making changes to any other configuration parameters may cause unstable or improper operation of the unit.

Once the computer indicates the new frequency was successfully stored, you may disconnect the parallel cable and exit the control panel on the computer.