CLX12K, 300KHz, 208V, Autotuning
RF POWER SUPPLY
Operator's Manual

Date	Revision	Detail	Author
6/11/12	1	Initial release	PR

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Before installing equipment, carefully read and familiarize yourself with the entire operations manual. Observe and obey all WARNING and CAUTION notes provided.

1 Safety Information

Warning Label and Safety Marking Explanations:

The following symbols and terms may be found on an instrument or used in this manual.

The CE mark indicates compliance with all currently applicable directives and standards.

This label indicates a general warning or caution condition.

This symbol indicates the presence of high voltages in or around the unit.

This symbol indicates that the component or circuit is short circuit protected.

This symbol indicates the presence of RF energy in or around the unit.

This symbol indicates a protective earth ground connecting point.

This label indicates a presence of high voltage in or around the equipment, which may cause sever injury or death. All appropriate precautions should be observed when installing, operating or servicing this equipment.

This label indicates the presence of Radio Frequency energy in and around the equipment, which may cause burns or other injuries. All appropriate precautions should be followed when installing, operating or servicing this equipment.

The **WARNING** heading used in this manual explains dangers that might result in personal injury or death. **Always read the associated information** very carefully before performing the indicated procedure.

The **CAUTION** heading used in this manual explains hazards that could damage the unit. Such damage may invalidate the warranty.

MUST – This word is understood to indicate a mandatory condition.

HIGH VOLTAGE – Voltages greater than 50 volts DC or 25volts AC and known to cause death or serious injury if contacted.

SERVICE – Any operation of maintenance, repair, calibration or similar activity other than normal operation of unit.

QUALIFIED SERVICE TECHNICIAN, QUALIFIED ELECTRICIAN, QUALIFIED PERSONELL These terms indicate persons specifically trained to install, service or other wise handle electronic equipment of the character and hazard potential of this unit.

End User Labeling

The system installer should obtain and apply all appropriate safety and warning labels required by the end user's local fire department jurisdiction and Occupational Health and Safety Administration over and above those supplied by the generator manufacturer.

Read And Understand This Section Fully Before Installing or Operating This Equipment.

WARNING: This equipment must be installed, operated and serviced only by trained, qualified persons.

General Safety Requirements

- **WARNING:** Hazardous Voltages and RF voltages are present inside this unit, which may cause injury or death. To prevent electrical shock and or RF burns, never operate this equipment with the covers removed. Never operate without an appropriate cable connected between the RF output connector on the rear panel and the load.

- **CAUTION: There are no user or operator serviceable parts inside this equipment. Refer all service to a qualified service technician.**

- This equipment must be bonded to Protective Earth (safety ground) prior to operating the unit. Safety ground connection must be made at the unit's rear panel designated 1/4"- 20 threaded ground stud. The ground wire should be a #14 awg or equivalent (minimum) green/yellow lead.

- This equipment must be powered only from a service capable of supplying 3 phase, 208VAC (3 wire plus ground), 50/60 Hz power. No neutral wire is used on this system. For more detail check II.A.5. The power source must be able to sustain a 45A RMS per phase draw. The source must be protected by an appropriately sized circuit protection device having a 10,000 symetrical Amp Interrupt Current (AIC) rating.

- Replace fuses only with identical type and rating parts. Installation and connection of this equipment must only be performed by a qualified electrician.

- **HEAVY OBJECT CAUTION:** A heavy object caution exists for equipment weighing more that 51 lbs or 23 kg. Use lifting aids to install unit, such as chain lifts or hooks and straps, attached to the four handles at the sides and front of unit. Guide unit into final location using care to keep hands and body parts clear of unit.

- When installed as intended and secured by the eight front panel mounting screws, the unit can withstand shocks and accelerations. Unit must be installed such that it is supported fully along both bottom side edges of the chassis, at least 2 inches in, by a suitable angle bracket on shelf.

CE Mark Specific Safety Requirements

* This equipment meets all applicable safety directives (as specified in prEN50178) required to qualify for the application of the CE marking.

* This equipment must be installed in accordance with the applicable requirements, or prEN50178 and EN60204-1 / IEC-204-1.

* This equipment is qualified to operate at Pollution Degree II and Insulation Category II.

* This equipment is intended to be powered only from a 208 VAC, 3 Phase (3 wire plus ground) service with no neutral connection used. For use at other voltages, a safety isolation transformer must be used to power this equipment in accordance with the requirements of EN60742 / IEC-742.

* The installation of this equipment must assure that the AC power input connector (UL/CSA) is not accessible to the user/operator. Access may be gained only by a qualified service technician. AC Mains connector installation must be in accordance with local requirements.

* This unit provides appropriate separation between all interface, mains and output circuits in accordance with 5.2.18 of prEN50178.

Interlock System

* The low voltage (24 V) safety interlock circuit is designed to disable the unit in the event of an interlock fault condition. At a minimum, interlock protection is located at the removable top cover, bottom cover and RF output connector safety cover.

* End user's system should provide indication to the operator of the interlock fault condition.

* Low voltage power for the interlock circuit is supplied by a step down transformer located inside the unit. This transformer is designed to provide safe low voltage operation and provide isolation from the main AC line.

Lockout/Tagout

Prior to performing system maintenance, repair or other service operations the generator must be locked out and tagged out to prevent accidentally energizing the system.

The following steps should be performed only by a qualified service technician:

* Disconnect AC input power to the generator.

* Mount a suitable "Clamshell" type lockout device to the AC input plug such as a Hubbell # HLD2 or equivalent. Follow all manufacturers' directions for the lockout device.

* Secure the lockout device with an appropriate padlock or safety lock.

* Apply a lockout warning tag to the lock out device.

The Lockout / Tagout device should not be removed until system service is completed and it has been determined appropriate to reconnect and operate the generator.

2 Description / Specification

The CLX12000 (Phase Locked Loop) RF amplifier operates at a center frequency of 300 kHz. The power source produces maximum transfer of power into a 50 ohm resistive load and is designed to withstand large deviations in load impedance without failure.

A. Electrical Specifications

Description	Specifications
Output Frequency:	
Center Frequency:	300 KHz.
Frequency Range:	+/- 40 KHz (autotuning)
Frequency Tuning Mechanism:	Auto Mode – Software drive tuning algorithm. Manual Mode - optical encoder knob on front panel.
Output Power:	
Rated Output Power:	12000 Watts into 50 ohm load over frequency range
Minimum Output Power:	100 Watts into 50 ohm load over frequency range, 0 Watts for setpoints less than 50 Watts.
Output Impedance:	50 ohms
RF Power Margin:	16,000 Watts min., open loop
Mismatch Power:	2:1 Mismatch: 12KW min forward power @ any phase angle 3:1 Mismatch: 6KW min forward power @ any phase angle
Reflected Power:	1500 watts Maximum Reflected Power.
Spurious Output:	All spurious output to be more than 40 dB below fundamental.
Noise, Hum and Ripple:	Less than 1% at any power level.
Harmonic Output:	Less than 40 dB below fundamental, 1KW-12KW. Less than 25 dB below fundamental, 100W-1KW.
AC to RF Efficiency:	Better than 70%
Control:	
Control Range:	0-10 V range for 0-12000 RF output
Power Leveling:	Control on forward power (by default) to be measured by direct four-quadrant multiplication of RF output voltage and current.
Command to Actual Output Power Repeatability for Same Generator:	< 0.5%
Generator-to-Generator Command Setpoint to Actual Output Variation:	+/- 2%, 1KW - 12KW. +/- 5%, 100W - 1KW.
RF Output Turn-on Time:	Less than 1 second ramp time from RF Enable signal to rated output power.
Power Response to Set Point Change Time:	Approximately 10ms.
Maximum Power Overshoot into Any Linear Impedance:	Less than 3%
Warm-up Delay Time:	Less than 3 seconds
Power Amplifier:	• Output device protection by means of active device voltage limitation, output power limitation, active reflected power limitation, over-temperature limitation, and passive device snubber circuits. These features enable the generator to encounter any load condition without failure. • 12000 Watts output power is attained through the summed output currents of eight 1250 Watt RF power amplifiers. Each power amplifier is comprised of eight FETs capable of 340 Watts dissipation each, arranged in a push pull

	configuration with four FETs per side in parallel. Each device runs at about 50 watts dissipation under normal operating conditions. Each device can withstand 300 volts from drain to source with the active voltage limit circuitry set for 175 volts MAX. • Each 1250 Watt power amplifier is built on a solid copper heatsink block that is naturally corrosion resistant. Four 5" fans reduce any possibility of condensation developing internally in the unit. • Two different manufacturer's FET devices to be qualified in specified unit.
Input Power Requirements:	
Electrical Input Requirements:	208 VAC, 3 phase; 50/60 Hz; 35 A typical @ 208 VAC, max 45A @ specified low line voltage.
Nominal Input:	208VAC, 3 phase, 50/60 Hz, 4 wire (3 wire with protective earth ground).
Voltage AC Input Range:	195-225 VAC
Input Fusing:	80 Amp circuit breaker.
Power Consumption:	Approx. 13.3KVA. Current balance between phases <10%
Power Consumption by RF Generator at Rated Output:	Less than 3.0KW to be dissipated via water cooling. Less than 500 watts to be dissipated by internal fan air cooling.
Grounding:	AC grounded via AC Line Connector. PE/Safety 1/4" ground stud provided at back panel.

B. Protection Features

Description	Specifications
Mismatch Protection:	Continuous operation into any impedance mismatch condition without damage or malfunction; forward power foldback shall occur within 500ms if reflected power exceeds 1500 Watts.
Device Over-Voltage Protection:	Output devices are protected from prolonged exposure beyond 175V peak.
AC Line Protection:	A manually resettable circuit breaker on the front panel of DC supply opens upon over current conditions.
RF Output Power Connection Interlock:	A Hard-wired interlock that disables the input AC power contactor upon removal of the RF output cable.
Safety Interlock:	Disables the input AC power contactor via either of the control I/O connection signals; open between Pins 1 & 14, the RF output connector interlock switch or when any cover of the unit is removed.
Over Temp Fault:	Output disabled on high internal temperature.
Control Signal Protection:	Unit not to be damaged if a short circuit or up to 30 volts AC or DC is placed between any input signal, return signal, and ground.

C. Remote Analog Interface

Signal Pin	Name	Type	Description
25	Forward Out	AO	Linear 0-10 differential analog out representing 0-12KW RF output forward power. 1K output impedance, +/- 2%
12	Forward Out Return	AO RET	
24	Reflected Out	AO	Linear 0-10 differential analog out representing 0-12KW RF output reflected power. 1K output impedance, +/- 2%
11	Reflected Out Return	AO RET	
23	Delivered Power Out	AO	Linear 0-10 VDC differential analog out representing 0-12KW RF output delivered power. 1K output impedance, +/- 2%
10	Delivered Power Out Return	AO RET	
22	Setpoint In	AI	0 - 10 VDC volt differential analog input giving linear response to 0-12KW delivered output power, +/- 2%. 1M input impedance.
9	Setpoint In Return	AI RET	
20	Overtemp (collector)	DO	Opto isolated digital output representing a setpoint to output fault condition. RF must be disabled via RF ENABLE IN (Pins 18 & 5) to reset overtemp latch.
7	Overtemp (emitter)	DO RET	
19	RF Enabled Out (collector)	DO	Opto isolated digital output representing RF has been enabled via RF Enable In.
6	RF Enabled Out (emitter)	DO RET	
18	RF Enable In (cathode)	DI RET	Opto isolated digital input that enables RF output. Activate input to enable. 2K input impedance.
5	RF Enable In (anode)	DI	
16	Forward/Delivered Select (anode)	DI	Opto isolated digital input to select power control loop from delivered to forward. Activate for forward control. 2K input impedance.
3	Forward/Delivered Select (cathode)	DI RET	
15	+15VDC	POWER	Aux 15VDC output, current limited by series 1K resistor. 15 mA available MAX.
2	+15VDC Return	RET	
14	Interlock Loop	INTLK	For External control of generator AC contactor. Pull-in current at 24VAC is 350mA continuous (2A peak).
1	Interlock Loop Return	INTLK	
13	Frequency Output	AO	Analog output relative to RF output frequency. Source impedance of 100 ohms. Scaled to 1V/100KHz, +/- 1%

NOTE: Unlisted pins are not connected.

D. Mechanical Specifications

Description	Specifications
Size:	**RF UNIT:** nominal, standard 19" rack mount units, 16.75"W x 5.25"H x 24"D **DC UNIT:** nominal, standard 19" rack mount units, 19" W x 5.25"H x 24" **Overall Size:** 16.75"W x 10.5"H x 24"D
Weight:	**RF unit:** 66 lbs. (29 kg) **DC unit:** 95 lbs (42 kg) **Combined Weight:** 161 lbs. (71 kg)
Connectors:	
AC Input Connector:	80A Harting, w/mating connector and 10' linecord
RF Output Connector:	LC female
Remote Interface Connector:	25 pin D-sub male on generator.
Warning Labels:	• Safety Labels for hazardous voltages, Heavy Object, and Caution for lifting by water fittings are to be provided on operator visible areas of the generator. IEC standard symbols in user visible areas for start, stop, enable and cautionary conditions, PE ground, high temperatures and RF energy present. • Special marking available at customer's specifications

E. Environmental Specifications

Operating Temperature & Humidity	
Operating ambient temperature/humidity/air pressure:	10 to 40° C, 5 - 85% humidity (non-condensing, no formation of ice), 86-106 kPa. Class 3k3 per prEN50178.
Inlet Water Cooling Requirements:	4 GPM (15.1 l/m) @ 690 kPa (100 psi) max, 35° C Max. Heat load: 3KW = 171 BTU/MIN = 10260 BTU/HR
Coolant Type:	Water
DC Unit Coolant Fittings:	Swagelok, 3/8" tube fitting. Tighten per Swagelok specifications using Swagelok Inspection gauge part# MS-IG-600.
RF Unit Coolant Fittings:	½" NPT with optional 3/8" tube fitting adaptors.
Inlet Air Requirements:	5-35° C max (40-95° F). Heat Load: 500W = 29 BTU/MIN = 1750 BTU/HR
Storage and Transportation	
Storage temperature/humidity/air pressure:	-25 to +70° C (class 1k4 per prEN50178), 5 - 95% humidity (non-condensing, no formation of ice, class 1k3), 70-106 kPa (class 1k4).
Transport temperature/humidity/air pressure:	-25 to +70° C, 5 - 95% humidity, 70-106 kPa (class 2k3).

This equipment has been designed to be compliant with FCC Part 18 emission standards for EMI/RFI radiation. Radiated emissions shall also not exceed maximum levels permitted by ANSI C95.1-1982 standards on safety levels with respect to human exposure to RF and electromagnetic fields from 300KHz to 100GHz.

F. Testing Specifications

Production Acceptance Test: Each unit will be required to "pass" production acceptance testing and a "Final Test Report" will be generated to document results.

Production Acceptance Testing process shall include as a minimum: Complete Parametric/Functional Tests covering: line regulation, calibration, linearity, burn-in, over-temp test, open circuit test, MAX power test, harmonic distortion, AC ripple, and remote interface tests. Data sheet for each generator to be shipped with unit.

G. Packaging & Shipping Specifications

1. Accessories Supplied
    - Final test results
    - Operating manual
    - DC Buss connection bars.
    - DC connection cover.
    - DC interconnect cable.
    - Water hose and fittings to connect DC unit to RF unit.

2. Shipping

NOTE: If there is a conflict between this document and customer Purchase Order then the latter supersedes.

NOTE FOR REPAIRS: Unless repairs have accessories included with them and have them listed on the Return Material Authorization (RMA) Tag, returned materials will not have to fulfill procedural requirements for accessories.

3 Unpacking and Inspection

1. Carefully unpack the unit and inspect for any obvious signs of physical damage that might have occurred during shipment.
2. Check the outside of the unit for missing or loose mounting screws or broken parts.
3. If there is shipping damage or the unit fails to operate properly upon receipt, report damage to the carrier immediately and notify Comdel factory within 30 days of receipt of unit. Failing to report any damage within this time period is the same as acknowledging that the unit was received undamaged.
4. If returning the product for repair you must:
    - Return the unit in the original, or equivalent, shipping container
    - Receive a Return Materials Authorization (RMA) number from the factory prior to the return of the product to Comdel for repair
    - Place RMA numbers clearly on the shipping container or on the packing slip

CAUTION: Breaking the seal or removing the warranty decal from this unit will void the warranty. If internal damage is suspected, contact factory for assistance.

4 Maintenance

The CLX12000 is designed to run unattended for long periods of time. Should service be required, the system is designed for quick repair. After a time, scale may build up on the inside of the cooling tubes. This could greatly reduce the cooling capacity of the system. It is recommended that the system be flushed with a descaling agent. A cleaning agent that does not damage copper, stainless-steel, nickel or nylon tubing should be chosen.

RF Output Calibration Check

The CLX12000 comes pre-calibrated from the factory and does not require any further adjustment. If you must check the calibration of the CLX12000, use the following procedure:

⚠ **WARNING:** Qualified personnel only should perform Calibration. Improper procedures could damage the unit or cause serious injury. There are no user adjustments inside the generator. Never operate this unit with the covers removed. Any calibration discrepancies should be reported immediately to Comdel customer service. **Trained Comdel technicians may only make corrective adjustments to this unit.**

Equipment required:

- Wattmeter
- 50 ohm dummy load capable of handling 12000 Watts.
- Two 50 ohm coaxial cables capable of handling 12000 Watts, one less than 10 feet long, and the other any length.

Setup:

1. Disconnect AC Power to generator.
2. Connect Wattmeter to output of Unit Under Test (UUT) with a 50 ohm coaxial cable no longer than 10 feet long.
3. Connect dummy load to Wattmeter with a 50 ohm coaxial cable of any length.
4. Disconnect any connector attached to the 25 pin 'D' Remote I/O connector at the rear of the unit and jump AC interlock pins 1-14.
5. Connect AC power and cooling water.

Procedure:

1. Turn AC power on and enable RF with the front panel RF softkey.
2. Put unit into 'CALIBRATE' mode by pushing the select ('>') softkey. Front panel display should indicate 'CAL' next to frequency readout. Frequency readout should indicate about 460KHz.
3. Turn power setpoint knob to 12000 Watts as indicated by the front panel meter with the meter switch in the 'SETPOINT' position.
4. Verify actual output power as indicated on external Wattmeter to be 12000 +/- 2%.
5. Disable RF output and AC power.

5 Preparation for Use

A. Line Requirements

The CLX12000 is designed to operate from a 208 VAC, three phase line. The system will still function within specifications when the line voltage fluctuates between 195 volts and 225 volts. Voltages over the recommended 208 VAC, however, reduce the safe performance margins designed into the system and should be avoided. The system draws a maximum of 45 Amps per phase when used to drive a load of 50 ohms. Under conditions of mismatch, the amplifier could draw slightly more current.

B. Cooling Requirements

The ambient air temperature should not exceed 40º C. There should be enough room over the top of the amplifier and along the sides to permit an unobstructed airflow through the unit. Water temperature should not exceed 35 º C, and should not fall below a temperature where excess condensation could develop within the unit. Water volume should be at least 15.1 l/m (4 GPM) and pressure kept below 690 kPa (100 PSI). Water should flow into the Water In port of the RF unit, then out of the Water Out port and into either of the water ports of the DC unit. The water return will then flow out of the other DC unit water port.

C. Installation Requirements

The RF unit and the 48 Volt DC Power Supply are separate physical units. The RF unit sits on top of the DC supply and is coupled with a DC bus arrangement as shown in Figure 1.

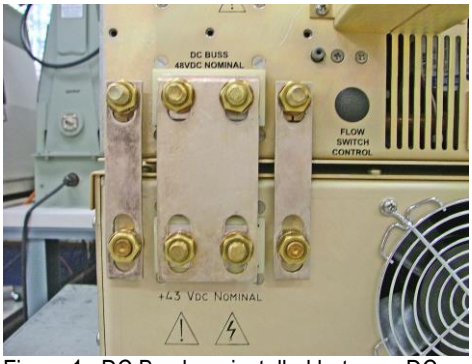


Figure 1. DC Bus bars installed between DC and RF units.

The after connecting the two units with the DC bus bars, the 48 volt DC bus is covered with a safety shield and a DC control cable is connected as show in Figure 2.

Figure 2. The DC bus safety cover and the DC control cable installed.
(NOTE: Picture of bottom DC section shows alternate 8.75" tall linear DC supply. Actual FP6810Rx switching DC supply is 5.25" tall)

Prior to energizing the RF output perform the following safety checks:

1. Confirm that an appropriate RF output cable is connected from the RF output connector of the generator to the system head or load. The RF output connector interlock cover must be securely mounted and flush to the rear panel to allow operation of the unit.
2. Check all cooling system piping and fittings for possible leaks. The preferred method is to pressurize the entire cooling system with air and observe any loss of pressure prior to exposing the system to liquid flow. The minimum air pressure used for testing should be at least equal to the maximum rated pressure of the system.
3. Confirm that the remote control cable attached to REMOTE INTERFACE 'D' connector on the rear of the unit is securely in place. This cable completes the interlock circuit as well as supplies RF enable commands to the generator.
4. Confirm that the DC control cable is securely in place between the RF & DC units.
5. Assure that the AC power connection is securely in place.
6. Test the interlock circuit to confirm that it is functioning properly. Confirm that the RF enable signal is disabled at the remote interface to the generator when an interlock fault condition occurs. Confirm that AC power in the generator is dropped when the interlock fault occurs. Confirm that the RF enable signal is held disabled by the host system after the interlock fault is cleared until it is intentionally reset by the operator.
7. Confirm that all applicable safety labeling is in place as required by the end user's local fire department jurisdiction and Occupational Health and Safety Administration (OSHA).

CAUTION: There are no user serviceable parts inside this equipment. Refer all service to a qualified service technician.

6 Operating Instructions

The CLX12000 may be operated either locally at the front panel, or remotely through the 25 pin sub-miniature D connector (J1) on the rear panel.

A. Local Operation

NOTE: AC interlock Pins 1-14 must be jumped for the unit to be operated.

1. Check to see that there is clearance around the unit for proper air flow and that a proper RF load is connected to the RF output connector at rear of unit.
2. Connect unit to 208VAC nominal, three phase and turn on main power breaker at rear of unit.
3. Verify that LED at red pushbutton (AC OFF) marked 'O' LED is on. If LED is off, then check AC line power. If LED is flashing then check RF output connector interlock switch, top cover interlock switch, or interlock loop, Pins 1 and 14 of rear panel connector.
4. If unit does not automatically turn on upon connection of AC power and completion of AC interlock circuit, push AC ON green pushbutton marked 'I'. The AC ON LED should be illuminated after the mains contactor closes.
5. The front panel display should show the model/frequency of the unit and the software version number for the first two seconds. The front panel display should show 'LOC' for local control or 'REM' for remote control depending upon the double arrow pushbutton state.
6. In 'LOC' local control, enable RF by pushing the blue RF button on the left side of the front panel. The RF button should illuminate, the display should show readings of frequency, forward and reflected power. If the display shows 'CHECK RF INTERLOCK', this means that the RF enable Pins 18 and 5 of the remote interface rear panel connector are not activated.

7. RF is disabled by pushing the RF button again, by removing RF interlock by deactivating Pin 18 and 5 of rear panel connector, or by interrupting the AC mains via the AC interlock loop, or the circuit breaker located on the front panel.
8. The CLX12000 regulates forward or delivered power based upon the activation status of the FWD/DEL inputs (Pins 16 & 3) of the remote interface connector. The setpoint is selected by the large data encoder knob on the front panel.
9. Pushing the single arrow button (>) on the right puts the CLX12000 into CALibrate mode. This locks the output frequency to 460KHz for calibration purposes with a Bird Wattmeter. The display should indicate 'CAL' to confirm this. Pushing the > button again releases the CLX12000 from CAL mode back into AUTO mode.
10. An overtemp condition due to improper clearance around the unit or high ambient temperature will automatically disable RF the CLX12000. The front panel display will show 'OVERTEMP' for about 2 seconds if the RF ENABLE softkey is pushed. RF will not be able to be turned on until proper coolant flow/temperature is established.

B. Remote Control Operation

Refer to "Electrical Specifications" section for the electrical interface specifications.

1. Follow the first five steps outlined above in "Local Operation."
2. Energize Pins 18 & 5 of rear panel remote interface connector to enable RF output. The front panel blue RF ENABLE LED should illuminate, and readings of delivered ('D') or forward ('F') and reflected ('R') power and frequency should be appropriate.
3. The CLX12000 regulates forward or delivered power based upon the activation status of the FWD/DEL inputs (Pins 16 & 3) of the remote interface connector. The power setpoint voltage on Pin 22(+) and 9(-) of the rear panel connector will determine the output power level. A voltage of 0 to 10 volts DC across Pins 22 and 9 will linearly correspond to a RF output of 0 to 10000 watts.
4. Reflected, delivered, and forward power can be monitored remotely through Pins 24(+) & 11(-), 23(+) & 10(-), and 25(+), 12(-) respectively. All analog outputs are 0 to 10 VDC linearly corresponding to 0 to 10000 watts of RF power.
5. An overtemp or fault condition as stated in #9 above in LOCAL will also result in the 'closure' of the OVERTEMP DIGITAL OUTPUT, Pins 20(collector) and 7(emitter) of the rear panel connector.
6. When RF is present at the RF output connector, the POWER DELIVERED DIGITAL OUTPUT, Pins 19(collector) and 6(emitter), will also be turned on.

C. Serial Operation (Optional)

The following is a description of the RS-232 ASCII instruction set to operate the CLX series of RF generators. The baud rate is selectable via a DIP switch on the uP control PCB behind the front panel and is factory set to 9600 baud, N, 8, 1, with echo.

1. All incoming instructions need to be terminated with a carriage return (HEX 'D') except for the ATTENTION (!) and EXIT (#) commands.
2. The CLX interface does not normally require handshaking for it's input because it is interrupt driven with a 1K buffer. Handshake control of its output is optional.
3. The (PROMPT) response is defined as: <CR><LF> > or HEX D, A, & 3E

Instruction	Function	Response
! (NO <CR>)	ATTENTION	(PROMPT)
SPxxxx	SET RF POWER	(PROMPT)
ER	ENABLE RF	(PROMPT)
DR	DISABLE RF	(PROMPT)
P+xx.x	SET POWER UPRAMP TIME	(PROMPT)

P-xx.x	SET POWER DOWNRAMP TIME	(PROMPT)
RF	READ FORWARD POWER	xxxx (PROMPT)
RR	READ REFLECTED POWER	xxxx (PROMPT)
EE	ENABLE ECHO	(PROMPT)
DE	DISABLE ECHO	(PROMPT)
# (NO <CR>)	EXIT	CR><LF>BYE

4. Function descriptions:

! - ATTENTION

The '!' command redirects control of the RF generator from either local (front panel) or analog remote (25 pin 'D' connector) to the serial port (9 pin 'D' connector). There will be no response from the CLX from any other ASCII codes sent while in local or analog remote modes. Upon receipt of the ASCII '!', the CLX will disable RF, set power setpoint to 0 watts, disable echoing of ASCII characters, and issue a PROMPT. The CLX is now ready to receive ASCII commands via the serial port and will not respond to local or analog remote commands. This command does not require a carriage return <CR>.

SPxxxx - SET RF POWER

This command provides for forward power setpoint (in watts). The syntax allows up to four digits (xxxx) with leading zeroes OK.

This command only adjusts the setpoint for the CLX and does not enable or disable the RF power.

ER - ENABLE RF

This command enables RF power at the preprogrammed setpoint SPxxxx (SET RF POWER). The power out will start at 0 watts and increase linearly to the setpoint over the period of time as set by P+xx (UPRAMP TIME).

If the external RF interlock connection is interrupted (25 pin rear panel analog remote interface connector), the RF output will not be enabled, and the CLX12000 will respond with the message: "CHECK RF INTERLOCK". If RF output is already turned on when the RF interlock is interrupted, the CLX12000 will respond with the same message and disable RF output.

If at any time the CLX12000 overheats, the unit will disable RF and respond with the message: "OVERTEMP".

DR - DISABLE RF

This command disables RF power without affecting the setpoint. The power out will decrease from setpoint to 0 watts linearly over the period of time as set by P-xx.x (DOWNRAMP TIME).

P+xx.x - UPRAMP TIME

This command allows up to three digits with an optional decimal point (xx.x) to set the RF power upramp time as described above in the ER (ENABLE RF) command.

The units of time is in seconds and is adjustable from .1 to 10 seconds. The default time is .1 second unless previously set from either the serial port or local control (front panel).

P-xx.x - DOWNRAMP TIME

This command allow up to three digits with an optional decimal point (xx.x) to set the RF power downramp time as described above in the DR (DISABLE RF) command.

The units of time is in seconds and is adjustable from .1 to 10 seconds. The default time is .1 second unless previously set from either the serial port or local control (front panel).

RF - READ FORWARD POWER

This command returns the forward power of the CLX.

The returned value can be from one to four digits and the units will be watts. The PROMPT as described above will follow the value returned.

RD - READ DELIVERED POWER

This command returns the delivered power of the CLX. The returned value can be from one to four digits and the units will be watts. The PROMPT as described above will follow the value returned.

RR - READ REFLECTED POWER

This command returns the reflected power of the CLX.

The returned value can be from one to four digits and the units will be watts. The PROMPT as described above will follow the value returned.

EE - ENABLE ECHO

This command enables the serial port to echo all ASCII characters sent. The start default for the echo function is programmable by the serial port configuration switch on the micro controller PCB mounted on the back of the front panel, switch #1.

DE - DISABLE ECHO

This command disables echoing of characters.

- EXIT

Upon receipt of this ASCII character the CLX will disable RF power, set the power setpoint to zero, issue a "<CR><LF>BYE" response, then redirect control of the CLX to the mode the unit was previously in when the attention command (!) was given.

7 Certification

This product has been successfully tested and listed in accordance with the following US, Canadian, and international safety standards:

1. This unit carries the ETL safety compliance mark to UL standard UL-1012.
2. This unit is SEMI F47 voltage sag immunity tested.
3. This unit is designed and labeled in compliance with CE mark certification requirements. The manufacturer will supply a Declaration of Conformity as required.

8 Customer Service

Comdel field services, technical support, and repair services are available to all customers and for both warranty and non-warranty products. When sending equipment to the factory for service or calibration, you need a Return Material Authorization (RMA) number to ensure that we can properly track your equipment.

Technical Support

Technical support is available by phone during regular business hours at any one of our worldwide field offices or authorized agents.

Comdel Support on www.comdel.com

The Comdel website offers a complete list of sales and service offices, product troubleshooting tips through the Frequently Asked Questions (FAQ) page, an online request form for RMA numbers, and access to RF & DC product manuals.

Factory Service & RMA Information

Comdel field services, technical support, and repair services are available to all customers and for both warranty and non-warranty products. When sending equipment to the factory for service or calibration, you need a Return Material Authorization (RMA) number to ensure that we can properly track your equipment.

Obtaining an RMA Number

- To complete an online request for an RMA number log on to www.comdel.com and click on Factory Service under the Sales & Service Menu or for direct access go to http://www.comdel.com/pages/sales/rma.php4
- Call 978-282-0620 or 800-468-3144. If this is a machine-down situation, call the factory immediately.

Note: We will respond to all e-mail requests by the next business day.

Customer Support and Worldwide Office Contacts

For customers located within the United States, you can reach us by phone, fax, or e-mail.

Corporate Headquarters ♦ (Authorized Repair Depot)
11 Kondelin Road
Gloucester, MA 01930
Phone 800-468-3144 or 978-282-0620 (M-F 8:00 a.m. - 5:00 p.m. EST)
Fax: 978-282-4980
E-mail: info@comdel.com

Comdel US Regional Office
Comdel California, USA ♦ (Authorized Repair Depot)
Phone: 408-727-5254
Fax: 408-727-4433

For customers located outside the United States, please contact your local Comdel office or Distributor. (Consult attached directory.)

International Support

We currently provide authorized product repairs and technical support through the following USA and International Comdel locations marketed with ♦ Authorized Repair Depot (ARD). These offices have experienced technicians that can assist in arranging for product returns or on-site assistance.

The Comdel authorized repair depots stock parts and test equipment that support most Comdel products. Customers are encouraged to discuss specific service support needs with their local Comdel office to ensure prior product support preparation is arranged.

Other Comdel sales and service distributors are available to support facilitating return of Comdel products to the most appropriate service repair depot.

Comdel authorized depots offer application support, RF training, and product design assistance. All are fully supported by the product marketing and engineering team at Comdel's headquarters.

International Offices

EUROPE
Comdel United Kingdom ♦ *(ARD)*
Phone: +44-1256-766914 or +44-1256-766917
Fax: +44-1256-766915
Email: steve_ottaway@comdel.com

MIDDLE EAST
Israel
Odem Scientific Applications Ltd.
Phone: +972-8-9366101
Fax: +972-8-9366102
Email: ori@odemltd.com

ASIA
Comdel Seoul, Korea ♦ *(ARD)*
Phone: +82-2-565-4780
Fax: +82-2-564-5398
Email: eric_joo@comdel.com

Singapore/Malaysia
DAL Engineering (S) PTE, Ltd. ♦ *(ARD)*
Phone: +65-6-743-5538
Fax: +65-6-743-5539
Email: david_wong@comdel.com

Taiwan, ROC
FairTech Corp. ♦ *(ARD)*
Phone: +886-3-5723257
Fax: +886-3-5727302
Email: farcorp@ms25.hinet.net

China
Beijing Leyfond Vacuum Tech. Co., Ltd.
Phone: +86-10-82843366
Fax: +86-10-82842835
Email: fangliwu@leyfond.com

JAPAN
Comdel Branch Office Japan ♦ *(ARD)*
Phone: + 81-47-369-9393
Fax: +47-369-3317
Email: big-sakamoto@pra.co.jp

PRA Ltd. ♦ *(ARD)*
Phone: +47-369-3389
Fax: +47-369-3317
Email: m.ozawa@pra.jp

Comdel Warranty

Seller fully warrants that equipment, service, software, repair or parts supplied shall conform to the description in the quotation and agrees to repair or replace F.O.B. shipping point, any parts (excepting expendable items such as semiconductors and vacuum devices), services, or repairs that fail due to defects in material or workmanship within (1) one year of start-up of equipment or (24) twenty four months after shipment, whichever occurs first, or in the case of service or repair, within (1) one year of rendering service or repair. At Buyers request, failure analysis will be provided for all in-warranty failures returned by Buyer to Comdel Gloucester. Liability of Seller under this warranty shall exist provided that: Buyer exposes the product to normal use and service; in case of shipping damage, Buyer notifies Seller within 30 days of receipt of goods; the Buyer receives a Return Materials Authorization (RMA) number from Seller prior to the return of product for repair; if upon examination of such product by Seller it is disclosed that a defect in materials and/or workmanship does exist, and the defect in the product was not caused by improper conditions, misuse, abuse or negligence; and that Sellers warranty decals have not been removed or tampered with and the equipment has not been repaired or modified by anyone other than Seller's authorized personnel. Other than those expressly stated herein, **there are no other warranties of any kind, expressed or implied, and specifically excluded, but not by way of limitation, are the implied warranties of fitness for particular purpose and merchantability.**

It is understood and agreed that Seller's liability, whether in contract, in tort, under any warranty, in negligence or otherwise shall not exceed and Buyer's remedy is limited to either (i) repair or replacement of the defective parts F.O.B. shipping points, correction of the defective service or repair, or at Seller's option (ii) return of the product and refund of the purchase or service price. Under no circumstances shall Seller be liable for special, indirect, incidental, or consequential damages. The price stated for the equipment, service, repair or parts is a consideration in limiting Seller's liability. No action, regardless of form, arising out of the transactions of this agreement may be brought by Purchaser more than one year after the cause of action has accrued. The warranty for the equipment, service, repair or parts proposed in this quotation is as stated in the above paragraphs. It is not re-stated nor does it appear in any other form.

AUTHORIZATION TO MARK

This authorizes the manufacturer to apply the ETL mark to certified products; also to the multiple listee model numbers as listed on the correlation page of the Listing Report where applicable; when made in accordance with the accompanying descriptions and drawings under the conditions set forth in the Certification Agreement herein:

Applicant:	Comdel, Inc. 11 Kondelin Road Gloucester, MA 01930
Contact:	Bob Dettorre
Manufacturer:	Same as Applicant
Reference Report No.:	3027022
Product Covered:	CLX-10K
Description:	RF Generator
Standard(s):	UL 1012, Sixth Edition, 1997

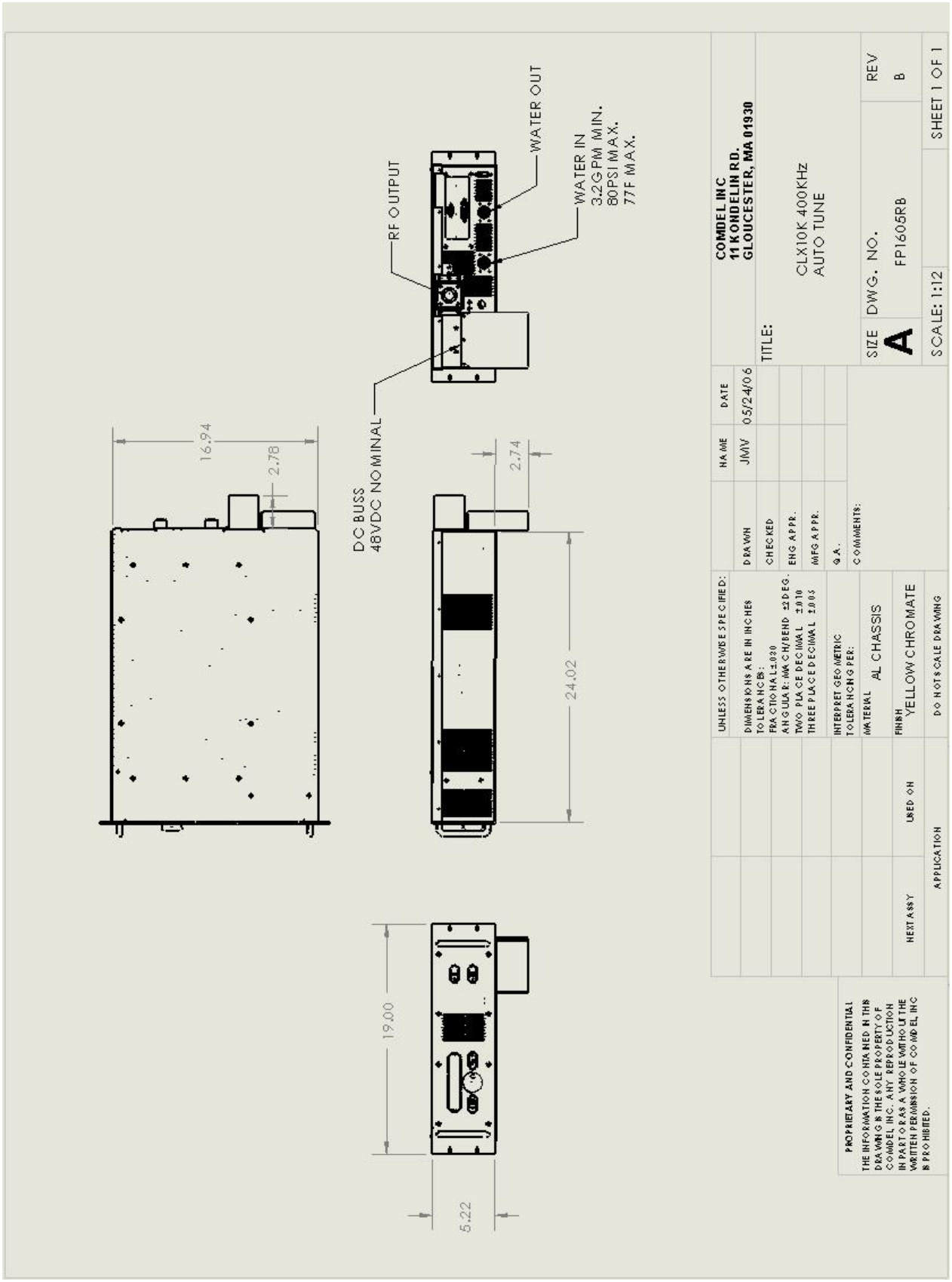
This procedure, with all revisions, etc., is the property of Intertek Testing Services and is intended solely for the guidance of the listee and the representative of Intertek Testing Services, and is not transferable.

Issued by: Intertek Testing Services, 24 Groton Avenue, Cortland, NY 13045-2014 USA

Authorized by: William T Starr 2nd **Date:** July 11, 2002

William T. Starr
Certification Manager

Control Number: 2001447



FP6810Rx 20KW Switching DC supply