PRELIMINARY USER'S GUIDE

DOC33-0037

Agile Synthesizer Drawer

THOMCAST
COMMUNICATIONS Inc.
COMWAVE DIVISION

Figure 1: Agile sythesizer drawer.

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THOMCAST COMMUNICATIONS, COMWAVE DIVISION TWO YEAR LIMITED WARRANTY

Thomcast warrants each product of its manufacture to be free from any defect in material and workmanship for a period of two years after delivery to, and return by the original purchaser. No returns, however, will be accepted unless accompanied by a written factory return authorization.

The limit of liability under this warranty shall be to repair or replace any product, or part thereof, which proves to be defective after inspection by Thomcast with the exception of tubes, semiconductor devices, lamps, fuses or equipment (i.e. modulators) manufactured by others, which are subject to only such loss adjustment as Thomcast may obtain for the suppliers thereof.

This warranty shall not apply to any Thomcast product which has been modified, physically or electrically damaged, or to modules which seals have been broken, or any product which has been subjected to conditions exceeding the applicable specifications or ratings or improper service techniques.

Thomcast will not be liable for any direct or consequential injury, loss or damage incurred through the use, or the inability to use, any Thomcast product.

Thomcast reserves the right to make design changes to any Thomcast product without incurring any obligation to make the same changes to previously purchased units.

This warranty is the full extent of the obligation and liability assumed by Thomcast with respect to any and all Thomcast products. Thomcast neither makes, nor authorizes any person to make, any other guarantee or warranty concerning Thomcast products.

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[1] DOC20-0001 provides detailed contact information. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.

TOP LEVEL DESCRIPTION

The agile synthesizer drawer is used in conjunction with an agile transmitter. It provides the main local oscillator to the system. The synthesizer within is capable of being programmed to operate at the frequency necessary to achieve the on-channel S-band carrier. The LO is heterodyned with an IF signal within the transmitter. This mixing action determines what frequency the agile synthesizer drawer will be set at. Referring to the block diagram, which is subsequent to this document, may provide a better understanding of how this drawer operates.

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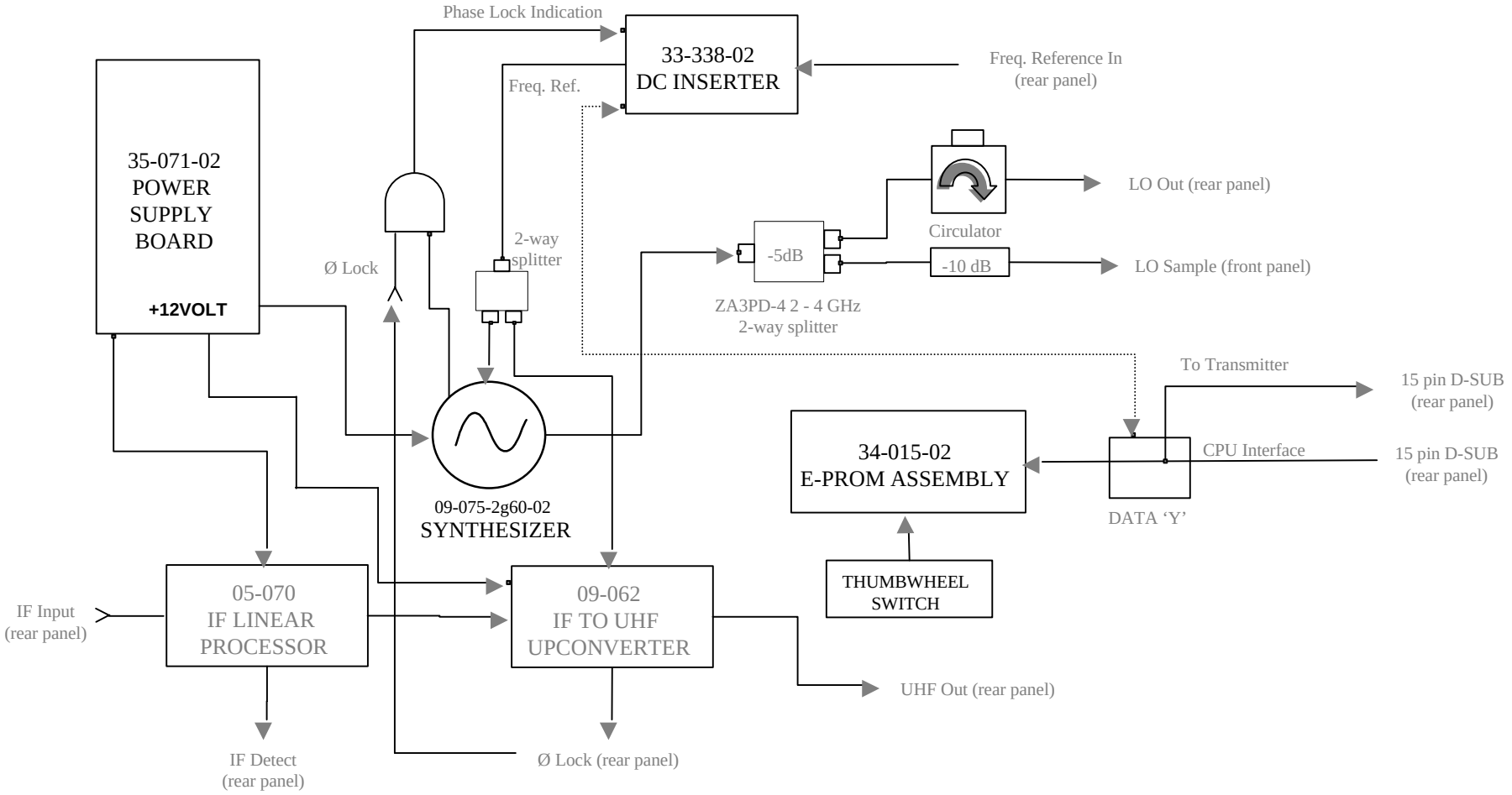

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TITLE:
Block Diagram, Agile Synthesizer Drawer

REV	Description	ECO# NAME/DATE

DRAWN: KAS / 2-28-00
CHECKED: DMW / 2-28-00
RELEASED: Name / date

DWG. NUMBER: **DOC15-0068**

Scale: none | Sheet 1of 1 | **REV: P1**

AGILE SYNTHESIZER DRAWER SPECIFICATIONS

PARAMETER	*SPECIFICATIONS*
MICROWAVE LO	
RF Output Level	+5 ±2 dB
RF Output Frequency Range Low Band High Band	 2.0 – 2.4 GHz 2.35 – 2.75 GHz
Reference Input Frequency	10 MHz (standard) accuracy 1 x 10^{-7} min
Reference Sensitivity	1 input at +1- dBm, +5 dB/-10 dB
Step Size	250 KHz
SSB Phase Noise (1 KHz res BW) (direct measurement of LO)	-80 dBc/Hz min @ 10 KHz offset -100 dBc/Hz min @ 10 KHz offset
Spurious 0 to ±10 KHz ±10 KHz to ±50 KHz ±50 KHz to beyond	 Below 1/f noise floor -60 dBc or greater -65 dBc or greater
Harmonics	=-35 dBc
Output Power	+5 ±2 dB
IF INPUT	
Center Frequency	44 MHz
Bandwidth	5.5 MHz
Ultimate Out-of-Band Rejection[1]	=45 dB
Input Signal	16 QAM, 64 QAM, 256 QAM, 8 VSB, 16 VSB or analog standard M
Input Level	-15 dBm average power typical
Input Return Loss	15 dB minimum
Frequency Response Correction	0 dB to ±1 dB typical
Frequency Response Temperature Stability	±0.25 dB typical
Group Delay Correction	0 ns to 25 ns minimum
Group Delay Temperature Stability	±2.5 ns typical
UHF OUTPUT	
LO Range	300-400 MHz
Step Size	50 KHz
Spurious 0 to ±10 KHz ±10 KHz to ±100 KHz ±100 KHz to beyond	 Below 1/f noise floor =-60 dBc =-65 dBc
SSB Phase Noise (direct measurement of LO)	-100 dBc @ 10 KHz offset
UHF Out	-18 dBm ±3 dB
Output Frequency Range[2]	222 to 408 MHz
Harmonics	=-60 dBc
Frequency Response Flatness Bandwidth Out-of-band	±.125 dB 10 – 12 MHz -45 dB @ f_c ±-35 MHz
LO Rejection	=-60 dBc
Image Rejection (relative to input)	=-60 dBc

[1] Applies to the 05-070 and 05-074 modules only.
[2] Other frequency options available.

PARAMETER	*SPECIFICATIONS*
ALARMS & INDICATORS	
µW Phase Lock Alarm	3.30 V_{DC} typical (across 10K O) .290 V_{DC} typical (across 10K O)
IF Detector Output Logic Level	0 V_{DC} @ signal below threshold or +5V_{DC} for above
IF Detector Signal Level Threshold	Adjustable from –20 dBm to –10 dBm
µW Phase Lock Alarm	3.30 V_{DC} typical (across 10K O) .290 V_{DC} typical (across 10K O)
GENERAL	
Power Requirement	117/230 V_{AC}, ±10%, 50/ 60 Hz (=0.1VA)
Supply Voltages	+12 V
Connectors / Impedance Input J1 - Frequency Reference In J2 – IF In Output J3 - UHF Out J4 – LO Out	 BNC / 50Ω BNC / 75O BNC / 50Ω BNC / 75Ω
ENVIRONMENTAL	
Operating Temperature	-30°C to 50°C
Specified Temperature Range	-13°C to 33°C
Relative Humidity	95% non-condensing
Dimensions	3.5” H x 19.0” W x 21.0” D 8.89 cm H x 48.26 cm W x 53.34 cm D
Approximate Shipping Weight	18.5 lb (8.38 kg)

PROCEDURE

DOC17-0030

Chassis Installation Procedure

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INSTALLATION INSTRUCTIONS

KEY: = informational note

- Thomcast equipment operates in temperatures between –30° to 50° C (-22° to 122° F); the optimal operating temperature range is 13° to 33° C (55.4° to 91.4° F). Moderate temperatures generally extend equipment life.
- The equipment will operate with a relative humidity of up to 95% but it MUST be protected from conditions that cause condensation.

STEP ONE: PACKAGE INSPECTION

Perform a thorough check of ALL parcels.

WHY	HOW	PROBLEMS
Ensure arrival of all packages without damage.	1. Check the master packing slip to verify receipt of all packages. 2. As shipment is received, inspect each package for obvious damage.	If packages are missing or damaged, inform the freight carrier immediately to file a freight claim; then notify a Thomcast representative.[1]

STEP TWO: UNPACK EQUIPMENT

WHY	HOW	PROBLEMS
For placement in existing system.	1. Using a utility knife, open and unpack each box separately. 2. Compare the contents with the packing slip and inspect for in-transit damage. Make note of any discrepancies or damages.	If there is a discrepancy between the packing slip and contents, inform a Thomcast representative[1] immediately.

Please recycle; however, do not discard all original packing material, save it at the equipment site to use when returning items to Thomcast.

[1] Detailed contact information is provided in this manual. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.

STEP THREE: INSTALLING SLIDE RAILS

Typically slide rails are installed before shipping, if so, proceed to the next step.

WHY	HOW	PROBLEMS
Slide rails enable easy access to internal adjustable controls and other maintenance/adjustments.	Slide rails are packed and shipped with racks. **MOUNTING RAILS:** 1. Using a #10 flat screwdriver, attach the slides to the mounting rail[1] within the rack with the provided hardware. See Figure 1 for the location of the mounting rail. See Figure 2 for directions on mounting the rails. 2. Adjust rails if they don't slide easily into the rack. **ADJUSTING RAIL-MOUNTING BRACKETS:** Loosen them and manipulate the drawer to seat rails to match the rails on the drawer, once free sliding motion is achieved retighten the brackets.	Contact a Thomcast representative.[2]

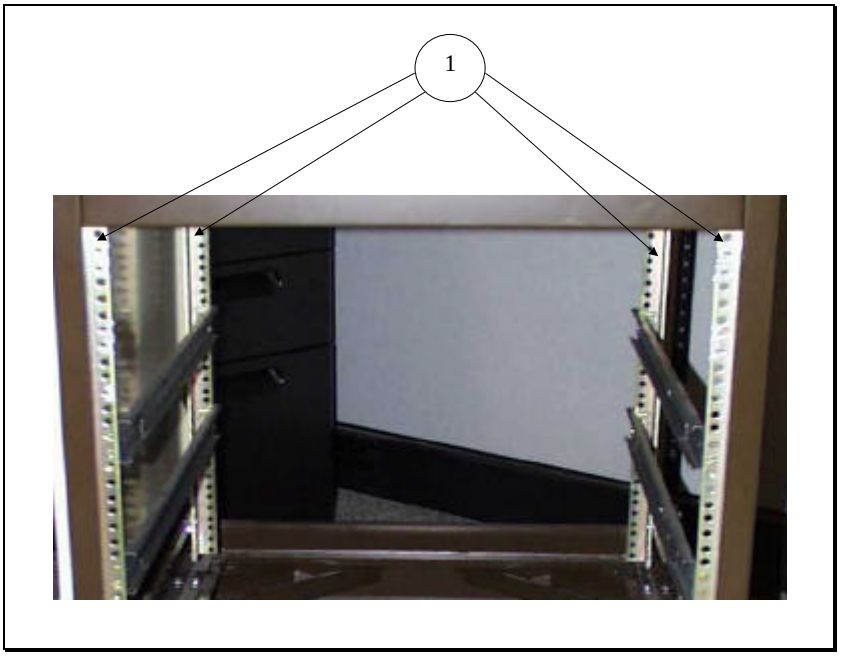


Figure 1: Rack, mounting rail.

[2] Detailed contact information is provided in this manual. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.

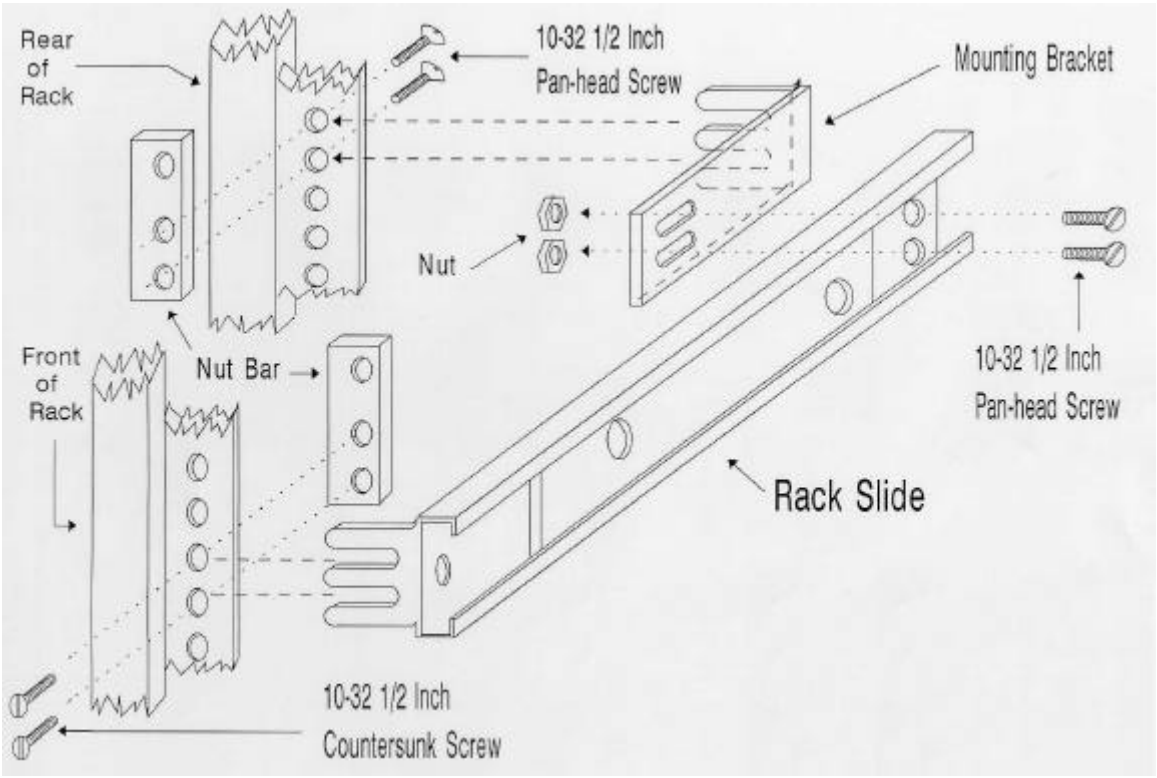


Figure 2: Mounting slide rails.

STEP FOUR: RACK EQUIPMENT

This step is for racked equipment only. If equipment is used without a rack, position it and move on.

WHY	HOW	PROBLEMS
Proper positioning of the chassis in the rack prevents damage.	1. Pull the rails out of the rack until they lock into place. 2. Align the drawer until the rails mate. 3. Unlock the rails by depressing the lock button on each rail while pushing the drawer in. ➧ The drawer should slide easily into the rack; if binding occurs, the rail-mounting brackets need to be adjusted, see step six "Adjusting Rail Mounting Brackets".	Contact a Thomcast representative.[3]

- Equipment MUST be placed in the rack prior to cabling.
- For spatial requirements refer to the specification sheet in section one of your manual.

[3] Detailed contact information is provided in this manual. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.

- In most cases, Thomcast provides a system equipment rack layout diagram that will assist in the proper installation and orientation of equipment.
- If a rear door is used to secure the rack cabinet, forced ventilation through the cabinet is required (600 cfm minimum per transmitter is recommended). An air or temperature interlock should be incorporated for protection against interruption of ventilation. The area should be kept dry and clean.

STEP FIVE: ENSURE PROPER ALIGNMENT

WHY	HOW	PROBLEMS
Misalignment allows the front panels to rub together, causing damage.	1. After racking drawers stand back and examine the front panels. 2. If they do not rub against each other they are properly aligned, proceed to the next step. 3. If they do rub against each other they are not properly aligned, make the necessary readjustment before moving on. Refer to step six, "Adjusting Rail Mounting Brackets", for instruction. 4. Repeat until aligned.	Contact a Thomcast representative. [4]

STEP FIVE: CABLE EQUIPMENT

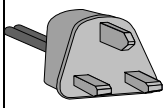
WHY	HOW	PROBLEMS
System is not operational until accurate external interconnections are completed.	See the cabling information in this manual.	Contact a Thomcast representative.[4]

STEP SIX: SYSTEM TURN-ON

WHY	HOW	PROBLEMS
System operation.	See the turn-on guide in this manual.	Contact a Thomcast representative.[4]

[4] Detailed contact information is provided in this manual. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.

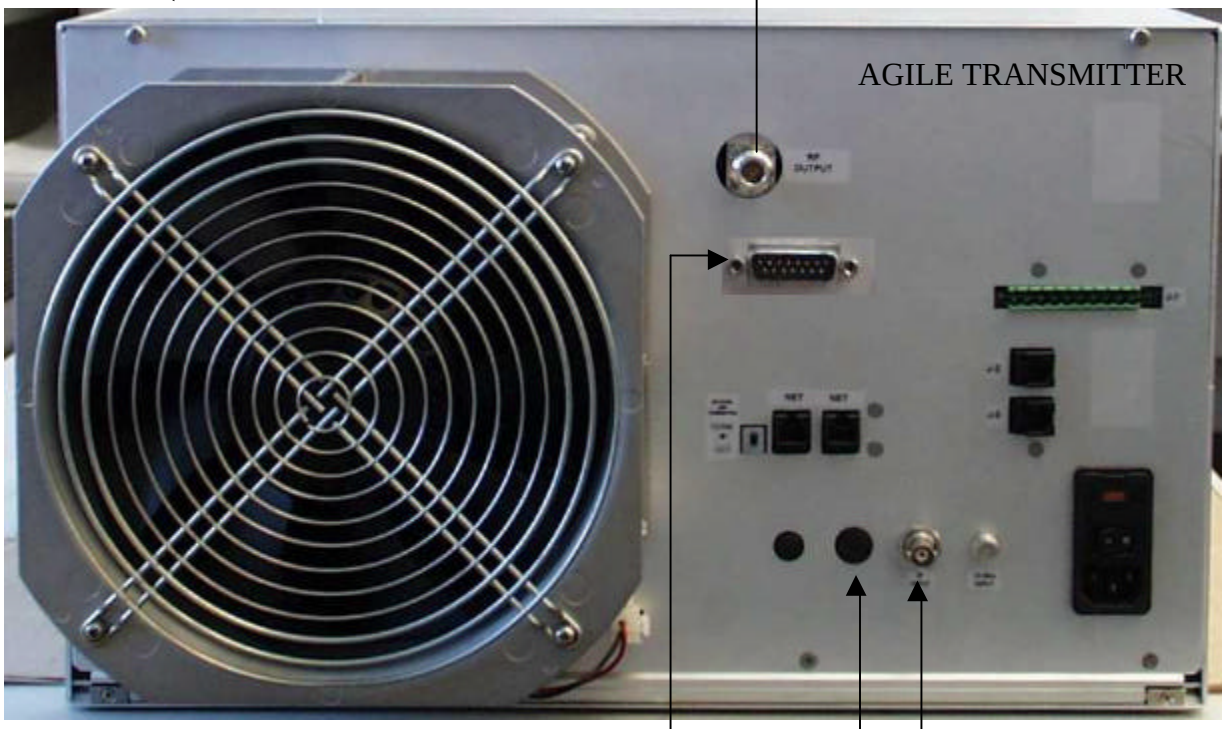
STEP SEVEN: SAFETY

WHY	HOW	PROBLEMS
Protection for you and your system. This is a very brief discussion of safety issues, refer to DOC26-0031 for more detail.	 1. This equipment utilizes a grounding plug on all power cords. For personal safety, do not defeat this safety feature. 2. As with similar types of equipment, high voltage can be accessed when the chassis cover is removed. Special care should be given in areas of fuses, line switches, and power supplies. 3. Modern high power solid state equipment contain low output voltage power supplies with very high current capability. To prevent severe burns, avoid contact of rings, watch bands, etc., with these circuits. 4. When servicing the transmission line and antenna, care must be taken to avoid exposure to high energy microwave.	Contact a Thomcast representative.[5]

[5] Detailed contact information is provided in this manual. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.

AGILE SYNTHESIZER DRAWER EXTERNAL INTERCONNECTIONS

Transmit Antenna



Freq Ref In

AGILE SYNTHESIZER DRAWER

IF In

OPTIONAL AGILE CONTROLLER see the Agile Controller technical manual for more information regarding cabling

TURN-ON PROCEDURE

This section explains the initial turn-on for your chassis and explains normal operation. Prior to equipment turn-on, verify that all appropriate cabling has been accomplished.

Turn on

1. Ensure the rear mounted main power ON/OFF switch is in the OFF position.
2. Insert the power plug into a power outlet.
3. Position the main power switch to ON.
4. The front panel LED will continuously illuminate green verifying successful turn on and normal operation:

Operation

Selecting the proper operating channel, as discussed below, and having proper interconnections established between this drawer and all accompanying chassis' enables operation.

Channel Selection / Programming:

Channel selection is accomplished in two ways, manually or automatically. Both methods are described below.

Manual Channel Selection

Manual channel selection is done through the use of the front panel thumbwheel switch. The thumbwheel interfaces with and EPROM board sending a binary coded decimal (BCD) address to the firmware located on the board. The EPROM logic then forwards programming information to the synthesizer in the same manner. Typical programming results in selection of the lowest channel when the thumbwheel switch is rotated to the [**01**] position. Progression allows channel selection to move upward in 6 MHz[1] steps.

Agile Controller Interface

Upon connection of the Agile Controller, the manual channel setting is overridden. A data 'Y' is provided on the DC insertion board. This allows a loop though of logic information in the drawer to the RF precorrector module located in the upconverter plug-in module. The CPU interface sends a BCD address to the EPROM board containing the channel selection of the transmitter to be backed up. The EPROM board then forwards this programming to the synthesizer module.

[1] Channel mapping of A1, B1, A2, B2 ….. G4 is typical, international standards are available.

TROUBLESHOOTING

The following lists explain various failure mode displays and possible solutions.

A 9-pin computer type diagnostic interface connector is located on the rear of the chassis to assist in troubleshooting. IF detect, microwave phase lock, and UHF phase lock test points can be accessed/monitored at this location.

Repair of internal modules is not recommended or advised. Contact[1] COMWAVE customer support should a failure occur.

Pin	Function Checked
1	Ground
2	IF Detect
3	Microwave Phase Lock
4	UHF Phase Lock

1. Ground: for reference
2. IF Detect: high TLL = good; low TLL = bad.

   Causes: Missing IF input.

   Check for: Presence of IF input.

   Remedy: Apply IF input.
3. µW Ø Lock: high TLL = good; low TLL = bad.
4. UHF Ø Lock: high TLL = good; low TLL = bad.

   If one phase lock has a low TLL indicating that it's bad, contact Comwave for a replacement module. If both phase locks are bad check the 10 MHz reference signal.

EQUIPMENT FUSING AND PROTECTION

One replaceable fuse[2] is found in this chassis, see the table below

.

Table 1: Transmitter fuse locations.

LOCATION	*REFERENCE*	*VALUE*
Rear Panel AC	Input	1 amperes @ 230 V_{AC}

[1] DOC20-0001 provides detailed contact information. International phone 001-570-474-6751, USA & Canada phone 1-800-266-9283.
[2] Replace only with the same type and rating.

INSPECTIONS AND CLEANING

Thomcast products have been carefully designed to be maintenance free. Only periodic inspection[1] and cleaning is necessary.

INSPECTIONS

1) Inspect heat sinks and/or fans, if applicable, monthly for heavy accumulations of dirt and/or insects. Heavy accumulation of foreign debris impedes cooling effectiveness and could lead to premature failure.

2) If debris is found:
   a) Shut down the transmitter/receiver
   b) Unplug the AC line cord
   c) Remove the top cover
   d) Remove debris

3) After debris removal:
   a) Replace the top cover
   b) Plug the AC line cord in
   c) Turn on the transmitter/receiver
   d) Check the tightness of all cable connections

CLEANING

Clean the faceplate and outside cover using a damp non-abrasive cloth with a mixture of a mild detergent and water.

[1] If this is a component of a larger system, more in depth maintenance information may be included in the system manual, always verify that ALL steps are followed.

CALIBRATIONS

SETTING THE MODULE FAULT INDICATOR THRESHOLD:

1) Ensure the proper input signal is applied.

2) Insert 4dB of attenuation in line with the incoming signal.

3) Adjust the corresponding IF detector potentiometer, via the front panel of the module until the DC voltage is on the border line of being a logic high and a logic low; it is necessary to toggle the logic level between high and low in order to reach the desired threshold.

4) Remove the 4dB of attenuation and ensure that the logic level remains high.

AGILE SYNTHESIZER DRAWER THEORY OF OPERATION

The drawer acts as the local oscillator in agile systems. It consists of a synthesizer, power supply, EPROM board, precorrector board, DC inserter/power distribution board, circulator, and splitter.

It receives a 10 MHz frequency reference signal via the rear panel, which is used as the time base for phase locking the internal synthesizer. The reference signal is routed through the DC inserter board and the signal is split and amplified by hybrid amplifiers. A conditioned reference signal that contains a DC component containing information about the phase lock status of the synthesizer is returned to the rear panel.

The reference signal is then superimposed onto a DC logic level; a logic high represents a phase locked condition, while a logic low indicates an "out of lock state"[1]. A loop through allows the transmitter to utilize the reference signal for other PLL circuits. Refer to the appropriate sections of the accompanying transmitter manual for detailed information.[2].

FRONT AND REAR PANEL DESCRIPTIONS

Front panel:

1. POWER INDICATOR LED: Signifies proper operation of the main DC power supply.
2. THUMBWHEEL SWITCH: Allows manual channel selection.
3. LO SAMPLE: BNC connector provides a test point for measuring the LO at a reduced power level.
   - Terminate when not in use.

Rear panel:

1. J4 - LO OUT: BNC connector - output to transmitter; nominal -15 dBm level; use ¼" superflex cable for interconnection.
2. J3 - UHF OUT: BNC connector - output to transmitter; nominal -15 dBm level; use RG58 50ohm type cable for interconnection.
3. J2 – IF IN: BNC connector – input from modulator; nominal -15 dBm level; use RG59 75ohm type cable for interconnection.
4. J1 – FREQ REF IN: BNC connector – input from reference drawer; 5 dBm ±5dB typical; use RG59 75ohm type cable for interconnection.
5. P2 – CPU INTERFACE: 15 pin D-sub connector – output to transmitter.
6. P1 – CPU INTERFACE: 15 pin D-sub connector – input from Agile Controller.
7. FUSE HOLDER: Holds fuse for protection, see fusing section for fuse size.
8. AC ENTRY: AC interface, provides line filtering.
9. ON/OFF SWITCH: Interrupts AC power for service.
10. 9 PIN DIANOSTICS CONNECTOR.

[1] Phase lock status is processed and displayed within the transmitter.
[2] Manual sections describing DC block, UHF upconverter are recommended.

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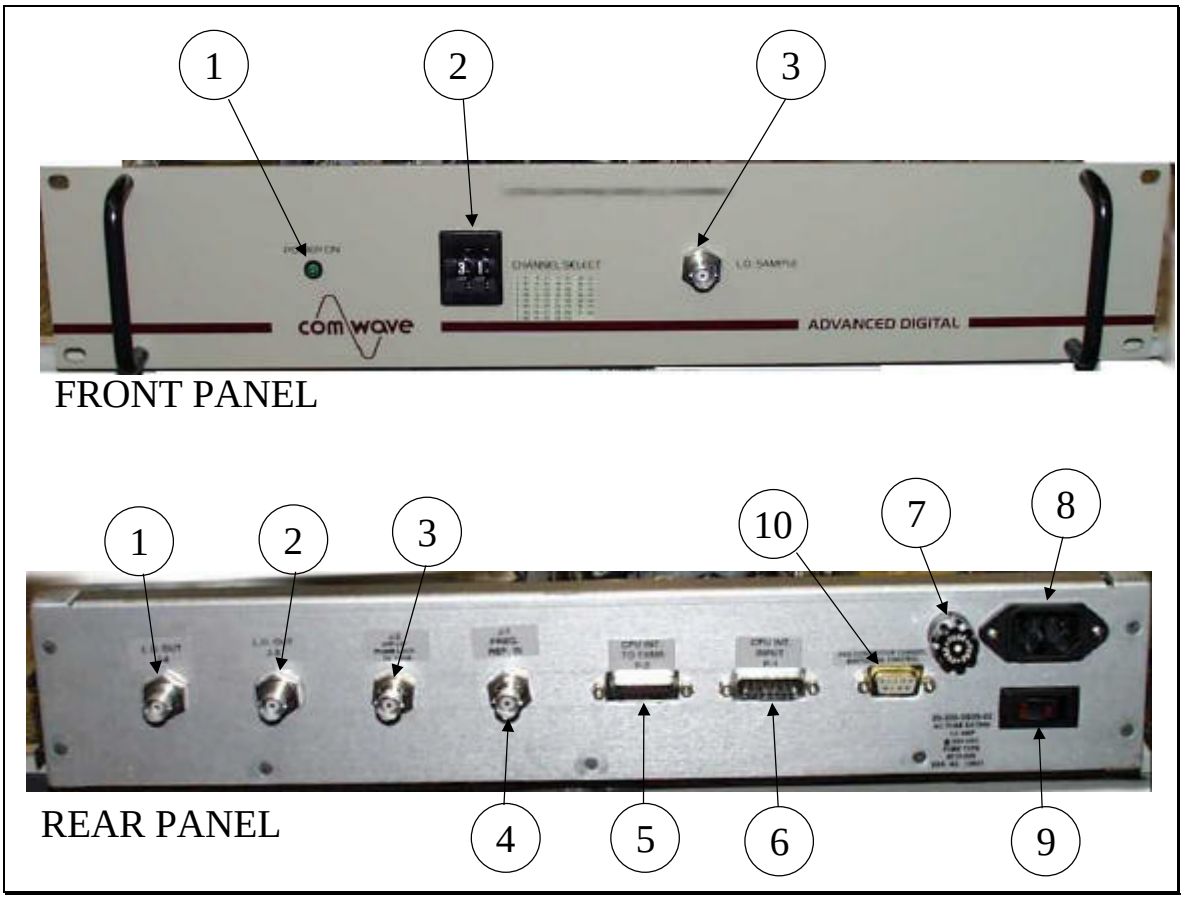

Figure 1: Front and rear panel.

POWER SUPPLY BOARD

The linear power supply assembly (power supply) provides operating power for the synthesizer, IF linear processor, and IF to UHF upconverter module and related diagnostic and communications functions in the chassis. The power supply receives AC line voltage from the chassis rear panel receptacle. The AC line feed is fuse-protected.

Jumpers are used to select the nominal AC line voltage, 117 or 230 V_{AC}. ***Note: The AC line voltage is set at the factory for a specific voltage and should not be changed by the end user.*** An MOV device is used to protect the power supply from AC over voltage conditions.

Incoming AC is stepped down with a transformer; bridge rectified, and fed to a filter and regulator circuit to provide an output voltage of 12 volts. The output voltage is available on power supply connector J1.

Table 1: DOC19-0142, REV P1.

Power Supply Specifications	
Input Voltage	117 or 220 VAC
Positive Output Voltage	+12 V_{DC} ± 10%
Positive Output Current	1.5 Amp
Operating Temperature	0° C to 50° C

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

IF LINEAR PROCESSOR

The IF linear processor performs multiple functions among them are IF detection, frequency response compensation, & group delay precorrection. It also provides for an optional saw filter stage, which can be added or bypassed through use of jumpers. This module is used to correct linear distortion within the transmission system.

Once inside the incoming signal is split and directed in two separate paths, one side of the splitter is sent to a variable attenuator that adjusts the signal level through the module the other is sent to the detector stage. The input attenuator provides approximately 15dB of adjustment range. Through use of an external microprocessor and automatic level control can be achieved by varying the input attenuator, this mode of operation can be selected via the front panel of the module if the system is so equipped. Each group delay cell provides approximately ±10ns of delay. These individual stages can be added as needed to compensate any distortion up to 25ns within the system. Adding a stage is accomplished by moving a pair of jumpers on the processors main board. Refer to the attached diagram for jumper configuration information. Along with delay, the frequency response of the system can be adjusted through the frequency response network.

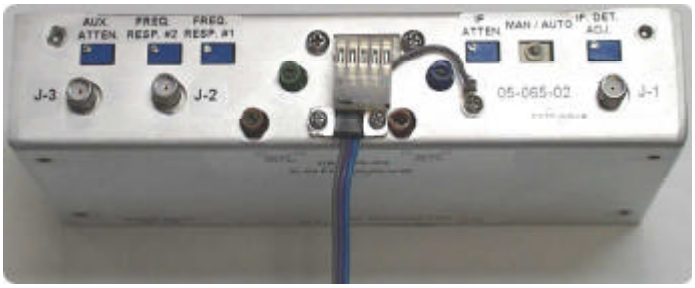

Figure 1: IF linear processor, 05-065-02 shown.

This network can provide ±.5 dB of frequency response compensation. This stage can be set to make up for a frequency tilt in the system or can be set to counteract the roll-off encountered by the channel filter. Setting the overall bandwidth of the stage is accomplished by adjusting the two variable inductors, which make up the tank circuit in each frequency response cell. The gain of each frequency response cell is adjustable via the potentiometer on the front panel of the module. The user is able to select the detection mode of the module. It is able to detect either the incoming signal or the outgoing signal. The user must set the appropriate jumper on the main board. Regardless of the detection mode the unused port must be terminated. The detector's threshold must be calibrated via the front panel adjustment, typically the signal level detector should indicate a module failure if signal is detected at –4dB lower than nominal input. A TTL logic level is used to indicate module status, a logic high shows signal presence, while a logic low shows low signal level. Another feature of the module is the auxiliary input, which allows a second carrier to be introduced, in analog systems a secondary audio carrier maybe required. This auxiliary input is also adjustable to ensure proper carrier ratio.

A final option is available normally used in digital systems; the saw filter is used to clean up out of band interference. Typically used in agile transmission equipment this additional filtering stage reduces the side-lobe regeneration of the incoming signal. In receiver applications it is used to eliminate undesired signals as a result of mixing. Refer to the module's block diagram for more detail.

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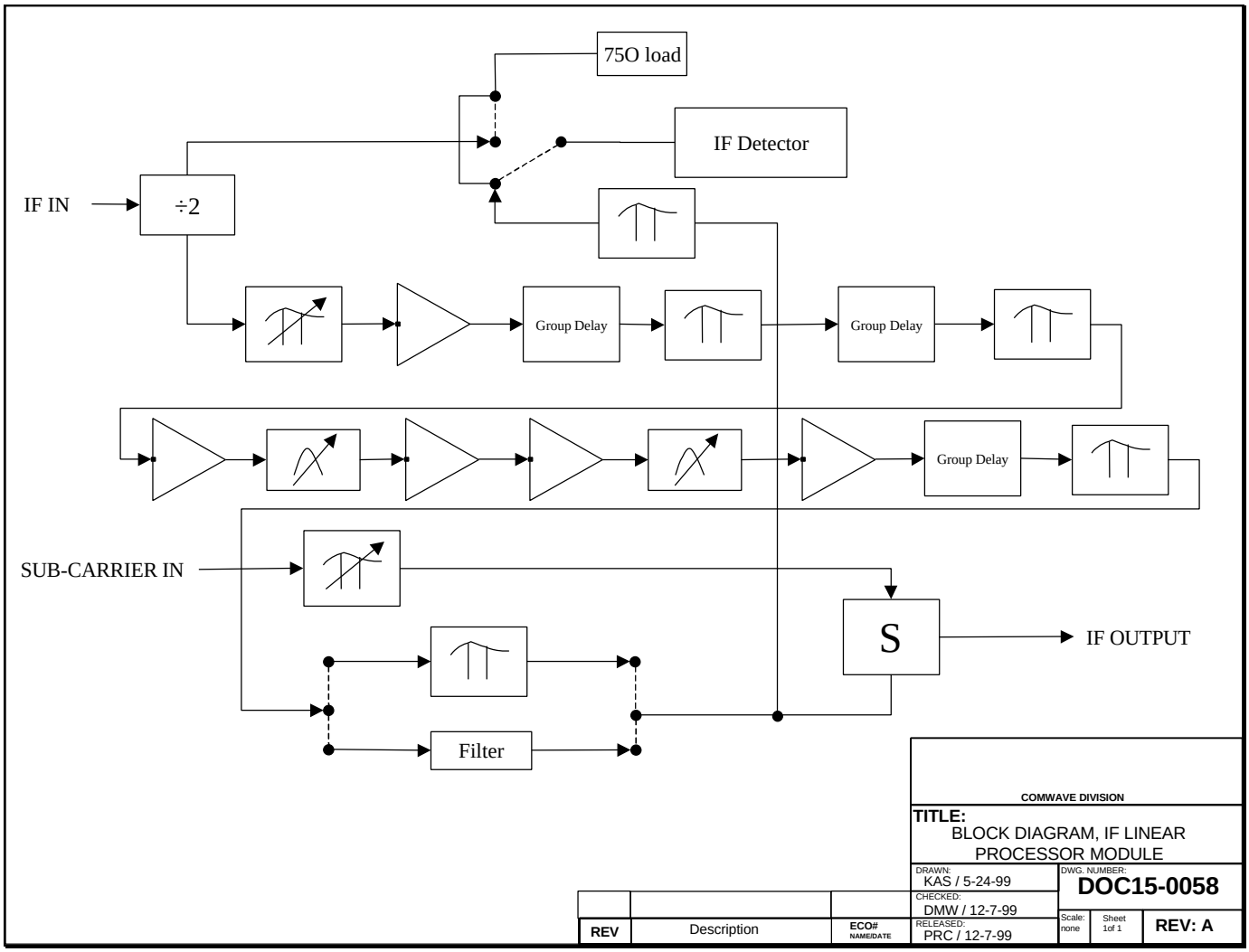

Figure 2: IF linear processor block diagram.

IF LINEAR PROCESSOR SPECIFICATIONS

Table 1: DOC19-0055, REV A

Parameter	*Specification*
Center Frequency	44 MHz
Bandwidth	5.5 MHz
Ultimate Out-of-Band Rejection[1]	≥ 45 dB
Input Signal	16QAM, 64QAM, 256QAM, 8VSB, or 16VSB or analog standard M
Input Level	-15 dBm average power typical
Input Return Loss	15 dB minimum
Impedance / Connector Input Output	 75 O / Female SMA 75 O / Female SMA
Output Level	-15 dBm average power typical
Output Return Loss	15 dB minimum
Gain	0 dB typical, adjustable from +4 dB to –10 dB
Frequency Response Correction	0 dB to ±1 dB typical
Frequency Response Temperature Stability	±0.25 dB typical
Group Delay Correction	0 ns to 25 ns minimum
Group Delay Temperature Stability	±2.5 ns typical
Detector Output Logic Level	0 V_{DC} @ signal below threshold or +5 V_{DC} for above
Detector Signal Level Threshold	Adjustable from –20 dBm to –10 dBm
Power Supply Voltage	+12 V_{DC} ± 0.5 V_{DC}
Current	400 mA typical; 500 mA max
Operating Temperature	0° to 50° C

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

[1] Applies to the 05-070 & 05-074 modules.

UHF UPCONVERTER

This module performs an upconversion from a TV IF to a 2nd IF at around 350 MHz. This second IF frequency, when mixed with the LO, produces the desired microwave frequency. The second IF is necessary to make filtering of the microwave LO and other undesired signals manageable in broadband agile systems. The visual and aural TV IF's are treated separately through the module, each chain providing the necessary filtering to get rid of the image frequency and the UHF local oscillator. In the case of digital, the mixing / filtering stages of the aural chain are left out. Features of the module include adjustable bandpass filters, LO notches, phase lock indication, LO sample, and an adjustable aural carrier level.

UHF SYNTHESIZER

The UHF synthesizer board establishes the final output frequency operation of the module. The synthesizer operates as the local oscillator within the unit. It contains a voltage controlled oscillator (VCO) phase locked to a high stability reference source (10 MHz) achieving a precise output frequency. This signal is heterodyned (mixed) with an intermediate frequency (IF), typically 44 MHz center, to produce the modules output carriers. When the IF is mixed with the LO a sum and difference product will result.

The functionality of the synthesizer can be explained starting with the reference input. To achieve 400 KHz, a programmed PAL divides the 10 MHz source by 25. The 400 KHz signal forms the reference to the synthesizer IC. Internal to the IC is a programmable divider, which further divides the reference signal, making the reference frequency 50 KHz. The synthesizer is a control loop that is continuously monitoring the frequency status of the VCO.

Figure 1: 09-080-02 UHF upconverter module.

Beginning at the VCO, upon turn on, an unknown frequency is coupled to a dual modulous prescaler that divides the incoming frequency by either 64 or 65 depending on the logic level of the modulous control line at that instant in time. Internal to the synthesizer IC there are two divider stages, called "N" & "A". These dividers are programmed to achieve the desired output frequency of the synthesizer.

In an ideal locked condition, both phase detector inputs will equal 50 KHz. If the frequency arriving from the dual modulous prescaler happens to be higher or lower than the reference port of the phase detector, an error voltage is generated by the integrator to pull the VCO back to the desired frequency. The integrator works by comparing energy levels caused by a change in duty cycle on its inputs. Following the integrator stage is a passive low pass filter; added to further reduce the reference spurs. Eliminating reference noise before it reaches the VCO is vital. The sharp pulses generated by the synthesizer IC can cause unwanted spurious products.

THREE POLE UPCONVERTER STAGE

This stage is responsible for translating the TV IF frequency to a 2nd IF at around 350 MHz as stated above. The IF enters the module, it then passes through a lowpass filter stage, then to the mixer. Once the IF and LO are heterodyned, the undesired signals must be filtered. This is accomplished with a three pole filter designed to reject the LO and image frequency. A notch is incorporated to further reject the LO

TWO POLE UPCONVERTER STAGE ***(ANALOG ONLY)***

This stage is similar to the three pole section. Differences in the two include a much narrower bandpass filter intended only for passing the aural carrier. Additionally, the aural carrier may be adjusted in level to set the carrier ratio in analog applications.

MICROWAVE SYNTHESIZER

The microwave synthesizer module determines the microwave upconverter mixer input and transmitter output operating frequency. The operating frequency is determined by programming of the phase locked loop frequency synthesizer. Agile transmitter programming information is sent via an eprom board, there are no DIP switches. Miniature DIP switches SW1 and SW2 set N counter and A counter PLL programming inputs. A 10 MHz input reference signal applied to J1 determines the frequency stability of the PLL.

The synthesizer module uses a microwave prescaler, dual modulus prescaler, and internal dividers to reduce the 10 MHz reference and microwave voltage controlled oscillator (VCO) frequencies to 25 kHz for the 09-049 series and 09-093 version; 125 KHz for the 09-073 series, 09-097 & 09-098 versions; or 200 KHz for the 09-092 version. These signals are applied to separate inputs of a phase detector. Input signals of equal phase generate no change in output. Should the VCO deviate in frequency, a phase shift is detected causing an integrator/low pass filter to generate a DC control voltage proportional to the offset frequency. This control voltage is applied to the microwave VCO to return it to the selected frequency.

The microwave local oscillator frequency is derived by adding (or subtracting in certain cases) the desired transmitter channel frequency to the incoming IF frequency:

EXAMPLE:

Visual Output Frequency	+	Visual IF	=	Microwave LO Frequency
2501.25 MHz	+	45.75 MHz	=	2547 MHz
Aural Output Frequency	+	Aural IF	=	Microwave LO Frequency
2505.75 MHz	+	41.25 MHz	=	2547 MHz

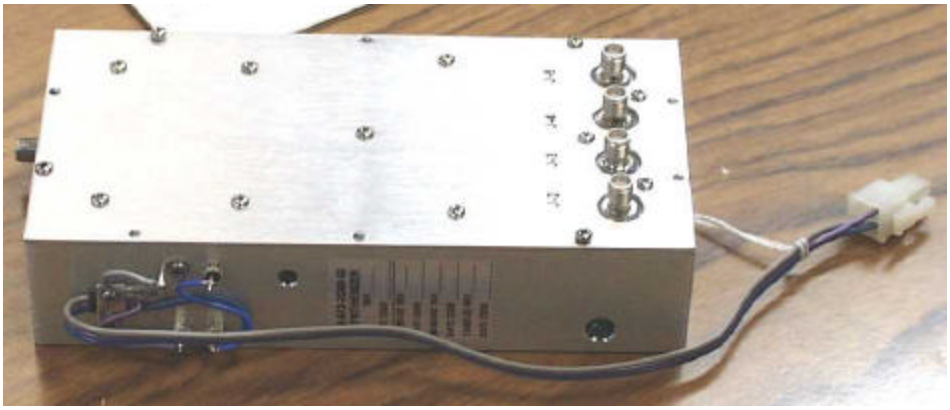

Figure 1: Fixed channel synthesizer, 09-073 version.

Table 1: DOC19-0034, REV C.

Parameter	*Specification*
VCO P/Ns 09-092, 09-093, 09-097, & 09-098 versions only	V803SE01, V604SC01 CFO-S-Axx (xx = number which varies with frequency)
Reference Input Frequency	10 MHz (Standard) accuracy 1 x 10^{-7} min
RF Output Frequency Range 09-092, 09-093, 09-097, & 09-098	Low Band: 2.0 - 2.4 GHz, High Band: 2.35 - 2.75 GHz 2.0 – 2.9 GHz
Reference Sensitivity	1 input at +10 dBm, +5 dB/-10dB
RF Output Level	4 outputs at +9 dBm, ±2 dB
Step Size 09-049 series & 09-093 09-073 series, 09-097, & 09-098 09-092	 50 KHz 250 KHz 2 MHz
Output Impedance	4 outputs at 50 Ω NOTE: All unused ports must be terminated
Isolation Between Ports	J2-J3: ≥ 25 dB J2-J4: ≥ 35 dB J2-J5: ≥ 35 dB J3-J5: ≥ 35 dB J3-J4: ≥ 35 dB J4-J5: ≥ 25 dB
SSB Phase Noise (1 KHz Res BW) 09-092, 09-093, 09-097, & 09-098 only (direct measurement of microwave LO)	-80 dBc/Hz min @ 10 KHz offset -100 dBc/Hz min @ 10 KHz offset
Spurious	0 to ±10 KHz below 1/f noise floor ±10 KHz to ±50 KHz -60 dBc or greater ±50 KHz to beyond -65 dBc or greater
Harmonics	=-35 dBc
Phase Lock Indication Locked state Unlocked state	 3.30 V_{DC} typical (across 10K Ω) .290 V_{DC} typical (across 10K Ω)
Power Supply Requirements	+12 V_{DC} ± .5v +12 V_{DC} 450 mA typical +12.5 V_{DC} 750 mA typical
Operating Temperature	-30 to +50° C

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

PRECORRECTOR CALIBRATION CONTROL BOARD

This board provides control of a frequency synthesizer and an RF precorrector. It is typically used in frequency agile equipment. This board may be used to replace various types of Thomcast EPROM boards.

It contains an MC68HC711E9 MCU running a firmware program. The program directs the MCU to set the frequency synthesizer control data on output connector P4 and to output the precorrector analog control voltages on P7 and/or P8. In general, the synthesizer control data and precorrector analog control voltages will be unique for each broadcast channel available to the agile equipment. Therefore, the MCU needs to be aware of the channel that has been selected for the agile equipment. Channel selection is provided as BCD words on P1/P2 and/or P3. The MCU reads the BCD words and provides the channel-specific outputs accordingly.

Connectors P1 and P2 are board logic inputs that are typically harnessed to the thumbwheel channel selection switches on the front panel or top cover of the agile equipment. When the user sets the agile equipment to operate on a given channel, say channel 18, a combination of logic ones and zeroes is provided on connectors P1 and P2 such that the MCU reads BCD '18' (binary 0001 1000).

In cases where a Thomcast Frequency Agile Transmitter Control/Monitor system (Agile Controller) is be connected to the agile equipment to determine the agile channel in the case of a system fault, the frequency selection data is input to the board on connector P5. When the Agile Controller interface is connected to P5, P5-5 and P5-6 are grounded, causing switch ICs U4 and U5 to take the frequency selection data from P5 and to apply it to the MCU inputs, while disconnecting the thumbwheel switches. The MCU then selects the appropriate synthesizer control data from its internal memory and sends the data to the synthesizer.

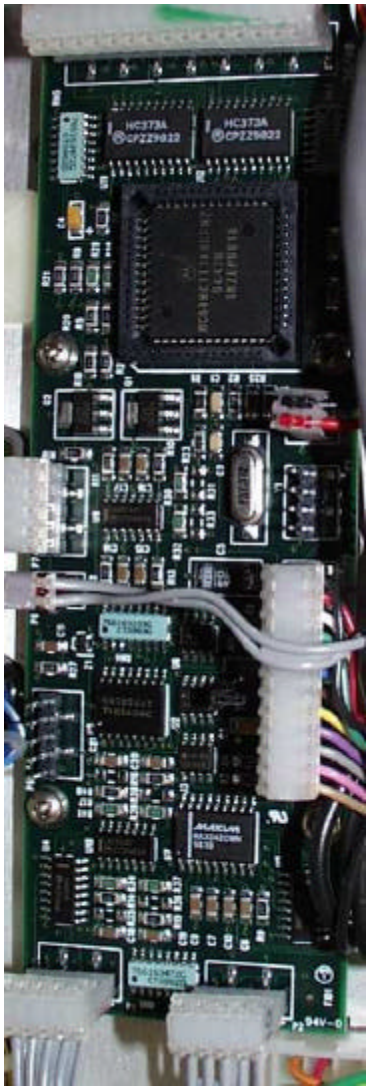

Figure 1: 34-015-02 board.

Precorrector control voltages are typically unique for a channel and are selected for output in the manner described above for the synthesizer control. For a given channel, the MCU recalls stored control data for each precorrector control circuit. The control data for each circuit is written to IC U8, a serial-input 8-channel 8-bit DAC. The MCU writes the unique control data to each DAC channel, causing analog voltages to be driven out of U8. The analog voltages are buffered and/or scaled using individual sections of op-amp ICs U9 and U10. Where greater drive capability is required, transistors Q1 and Q2 are used.

Connector P9 and IC U7 provide an RS-232 interface for the board. During factory configuration and testing of the agile equipment, a computer is interfaced to the board. The channel-specific synthesizer control data and precorrector control data is entered by a technician and stored in the MCU's internal EEPROM. This data is non-volatile and is not lost when power is removed. Any of the synthesizer or precorrector data may be changed as desired by connecting the PC and running the setup program.

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Document #: DOC13-0130 REV: FEB.23.00

DC BLOCK MODULE

The DC block module receives at its input a low frequency RF signal that is superimposed on a DC logic level. The RF signal is utilized as a frequency reference that provides a means of phase locking PLO's (phase locked oscillator) within the transmitter. The DC logic reports the phase lock status of the main LO, which is located external to the transmitter.

The input signal applied to J1 passes through a coupling capacitor that serves as a block to the DC component and secondly as a high pass filter to the RF signal. The conditioned reference signal arrives at J2. The input signal also passes through a filter where the reference signal is stripped via a low pass circuit. The resulting DC voltage is available via a feedthru for monitoring purposes, see figure 1.

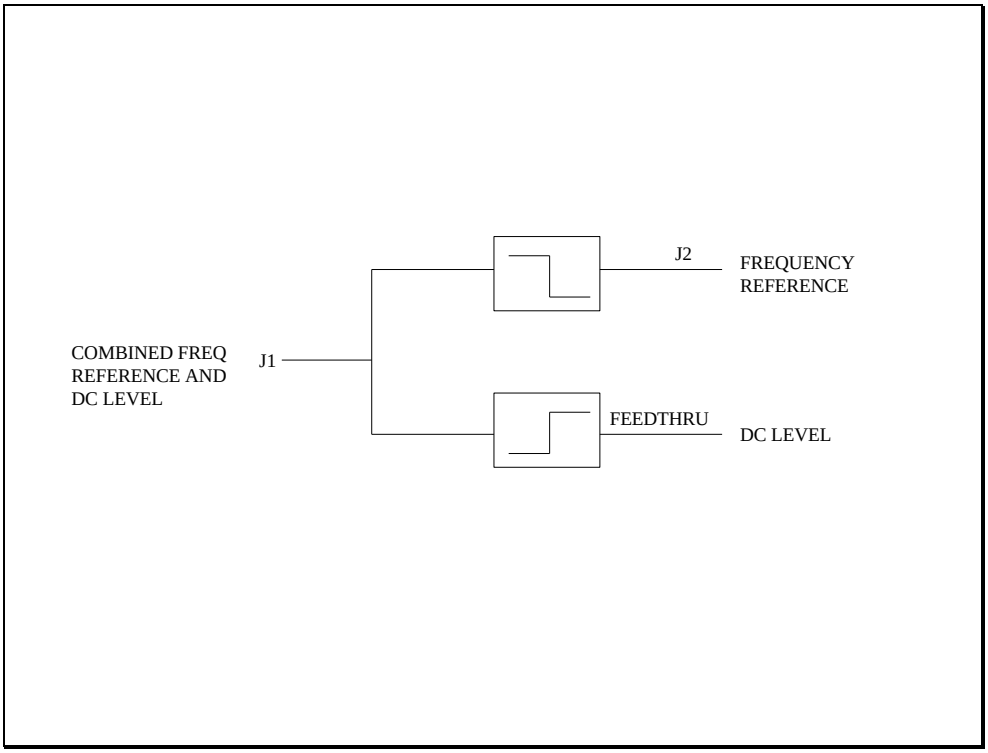

Figure 1: DC Block module block diagram.

CREATED: SS 4/28/97	CHECKED: JS 4/28/97	RELEASED: DMW 4/28/97

Document #: DOC13-0190 *REV: FEB.23.00*

AMPLIFIER WITH ALC

The ALC modules for the local oscillator are broadband output level controlled modules with a dynamic range of P1dB=+21dBm based on MMIC technology devices. These blocks have a gain range from 5 to 14dB and are fed by a +12V power supply at .4A maximum current. Access for the RF signal is made by means of J1 and J2 respectively input and output. Distinct controls are available for both manual and automatic modes, which can be set by means of an external switch.

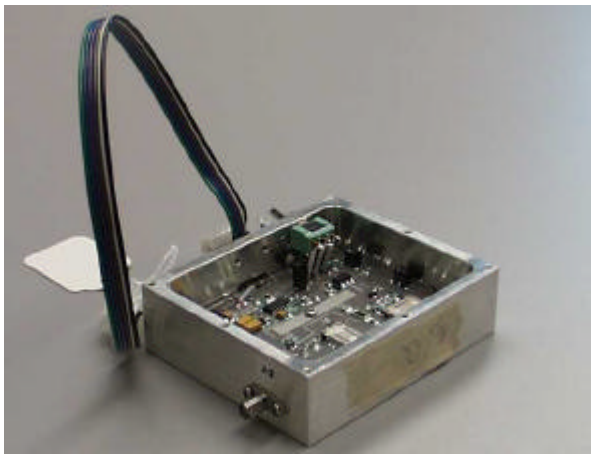

Figure 1: 04-314-02 ALC module.

Table 1: DOC19-0028, REV B.

PARAMETER	SPECIFICATION	NOTES/TEST CONDITIONS
RF (04-308/04-314)		
Input Return Loss	-15 dB typical, -12 maximum	2.0 GHz to 2.7 GHz
Gain	5 to 14 dB typical	2.0 GHz to 2.7 GHz
Total Flatness	0.5 dB typical, 1 maximum	2.0 GHz to 2.7 GHz
DC (04-305/04-314)		
Power Supply	12 V	
Current	400 mA maximum	
GENERAL		
Impedance / Connector Input Output	 50 O / Female SMA 50 O / Female SMA	
Operating Temperature	0° C to 50° C	

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

CUSTOMER SERVICE

CONTACT INFORMATION
DURING BUSINESS HOURS
Inquiries may be directed to Thomcast Communications, Comwave Division during business hours, 8 am to 5 pm Monday through Friday. When the automated attendant answers you will be given the option of dialing your party direct or speaking with the operator.

AFTER BUSINESS HOURS
If you need emergency assistance due to equipment shutdown or malfunction, customer support personnel are available 24 hours a day. Call Comwave at one of the numbers listed below; when the automated attendant answers press 6, leave your name, company name, phone number, equipment model number(s), and a brief description of the problem you're encountering. When you hang up the system will automatically page the on-call technician who will then return your call in a timely manner. You can listen to the message prompt for other options as well, however, for emergency assistance you MUST use option 6.

Thomcast Communications, Comwave Division **Crestwood Industrial Park, 395 Oakhill Road** **Mountaintop, PA 18707**	
1-800-266-9283	USA & Canada
1-570-474-6751	International[1] & USA
(Please note, as of 12/98, our area code changed from 717 to 570)	
1-570-474-5469	FAX
(Please note, as of 12/98, our area code changed from 717 to 570)	

COMMENTS/SUGGESTIONS
Please forward comments regarding documentation content and/or layout, or suggestions to improve Comwave publications to ksimeone@thomcastcom.com.

EQUIPMENT RETURNS
If the equipment requires return for factory service, please follow the guidelines listed. Thomcast cannot be held responsible for damaged equipment received due to improper packing; contact Thomcast with any questions or concerns.

1. ***Contact Comwave:*** Call Comwave to report the problem and to **obtain a "Return Authorization" number[2] (RA).** This enables accurate tracking and identity of returned equipment for prompt and efficient service.

2. ***Obtain packaging materials:*** Use original boxes and packing materials when returning any equipment. This will safeguard against most in-transit damages. If original boxes and packing materials are not available, contact Thomcast to obtain replacement materials prior to shipping, they are provided at a nominal cost.

3. ***Pack equipment:*** Use original packing materials and directions provided. Most equipment is packed in a box within another box; this varies with each product. Double boxing provides maximum protection.

Caution: Do not pack equipment using "PEANUTS" as filler it does NOT provide sufficient protection during shipping. Rough handling by the carrier may cause permanent damage to the equipment. Thomcast cannot be held responsible for damaged equipment received due to improper packing.

[1] International calls must dial the country code before the phone number, i.e. 001-570-474-6751.
[2] If you do not obtain an RA number **prior** to returning equipment Thomcast cannot be held responsible for delays in repair and return time.

CREATED: KAS 5/6/99	ECO #: 99-035, 3/25/99	CHECKED: DMW 1/18/99	RELEASED: PRC 1/18/99

RETURN PACKAGING

Below is a pictorial view of the following steps.

1) Begin with an empty Thomcast box, if you don't have one please inform customer service when you contact them for a return authorization (RA) number, which you MUST do prior to returning ANY equipment. ***NOTE: A box consists of 4 parts, one cardboard box, one cardboard tube, and two polyethylene endcaps.***
   a) To assemble a flattened box put three[1] layers of 2" clear box tape over the bottom seam, then position four pieces of fiberglass strapping tape over the edges.
2) Put the cardboard tube in the box.
3) Place the polyethylene endcaps against the sides of the equipment. ***NOTE the front panel fits snuggly into a slotted opening in the endcap.***
4) Put the chassis in the box.
5) Close the box and seal the top seam with three layers of 2" clear box tape, then position four pieces of fiberglass strapping tape over the edges.
6) Affix a shipping label to the box see DOC20-0001, preceding this document, for shipping address.
7) **Mark the RA number on the outside of the box before shipping.** If the RA number is not clearly visible Thomcast cannot be held responsible for delays in repair and return time.

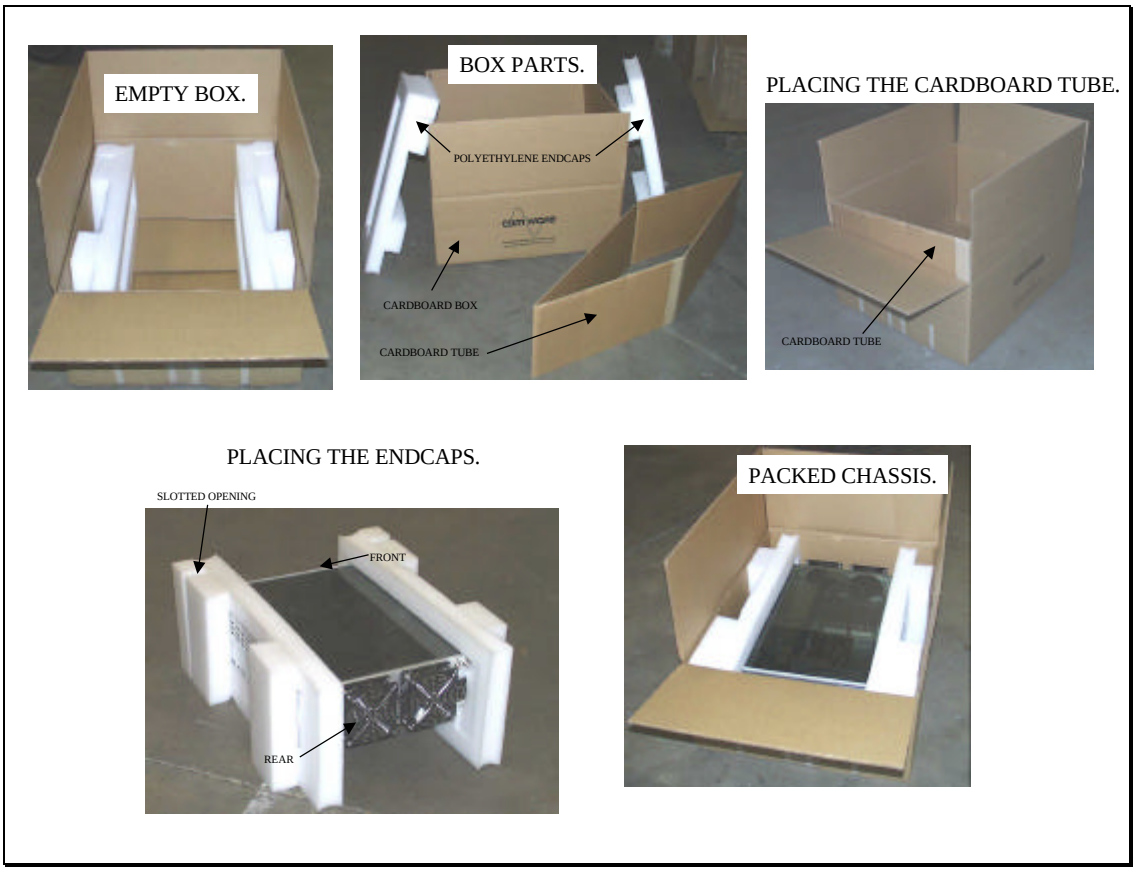

Figure 1: Equipment packing.

[1] Using several layers of tape assures the strength of the box.