7.2. Board CIM3452 Schematic Diagram: SEE ANNEX A

8. GAV4445 - Module 4275 – Power Supply

8.1. Module 4275 – General Functional Description

Module 4275 is a switching high power DC supply, type full-bridge powered by 208 Vac, showing overall efficiency above 80%. As part of the power supply design, there is a power factor corrector, PFC, circuit. Besides correct the power factor to close to 1, this circuit also contributes to reduce the harmonic content returning from the unit into the AC mains.

The sub-module 4275 deliveries two +32V voltage outputs, VA and VB. These two voltages feeds the 75W UHF amplifiers, sub-module 4451. This sub-module also delivery the +15V for the control unit SCU, CIM 3452, located on the power drawer.

The module 4275 is composed by the following PCB's:

POWER SUPPLY - 4275		
CIRCUIT	CIM	CIP
POWER FACTOR CORRECTION (PFC)	3238	8184
FULL BRIDGE		
FULL BRIDGE CONTROL	3429	8339
PFC CONTROL	3427	8337

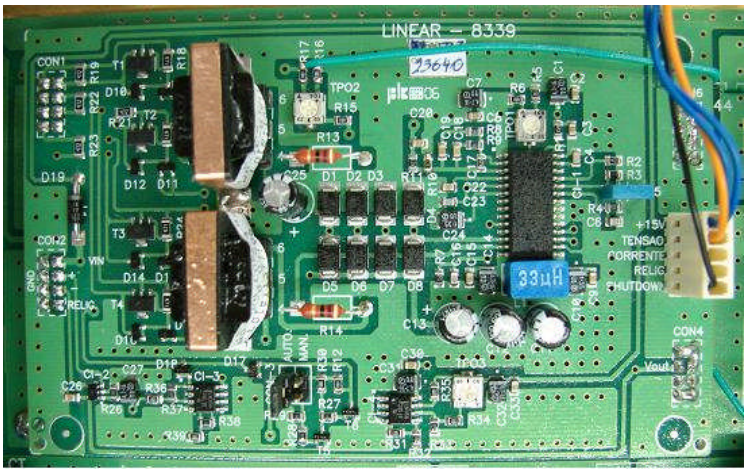
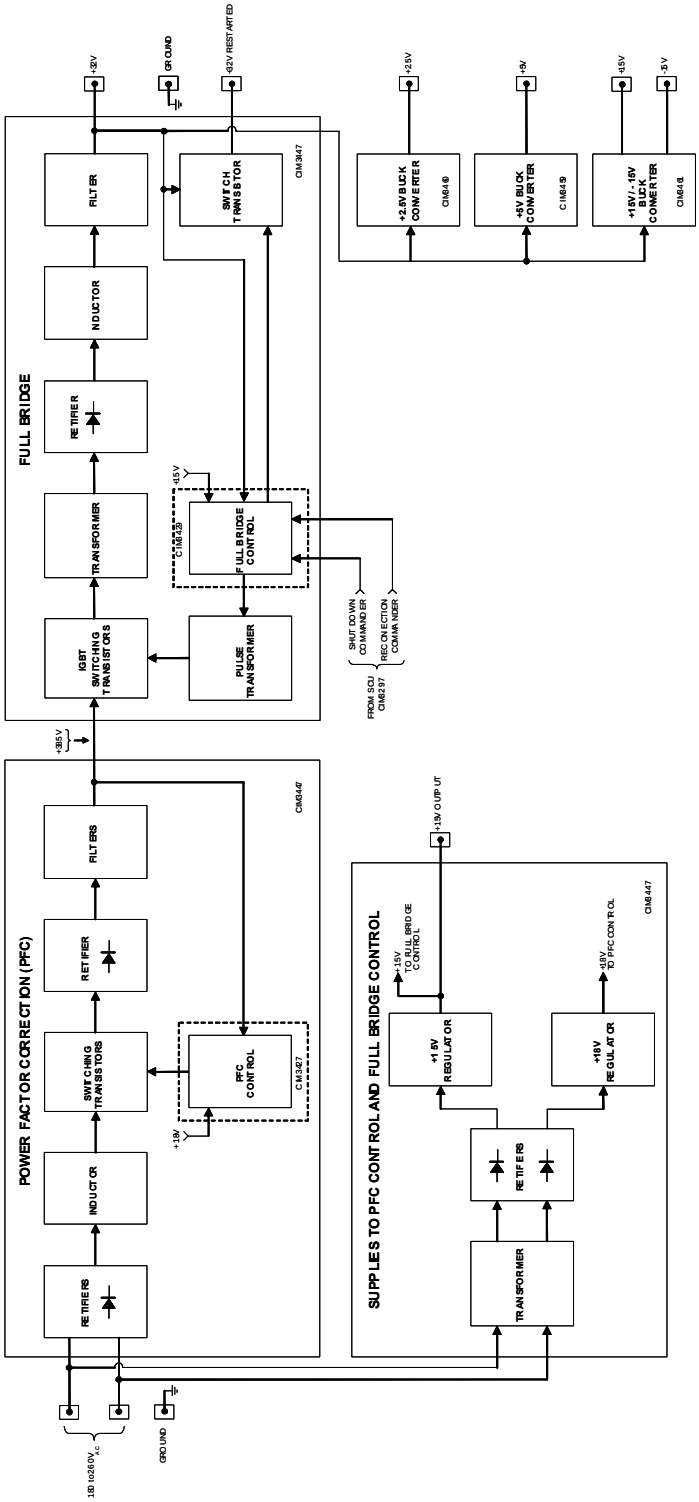


Fig.5.9: CIM3429 – Full Bridge Control PCB.

8.2. GAV4445 – Module 4275 – Block Diagram



8.3. CIM3238 – Power Phase Control Unit – PFC

The PFC circuit is located at PCB CIM 3238, at sub-module 4275. The PFC circuit is a power supply built according with the "boost regulator in continuous mode (CCM)" topology. Under the CCM topology, is possible guarantee a power factor, cosφ above than 0.9. The PFC circuit is composed by a full diode bridge that performs a full-wave rectification on the AC signal, which than is routed to the boost inductor. The voltage is so boosted up to +385V. The power factor correction is obtained by the switching a MOSFET transistor, which controls the electrical current into the capacitors that are components of the output rectification filter. The switching operation is performed at the frequency of 100MHz

8.3.8. CIM3427 – PFC Control Unit

The PCB CIM 3427 generates the control pulses for the PFC circuit. The PFC switching operation is controlled by a bit stream. This control's bit stream is generated by an integrated circuit with 2 loops that are self-protected against short circuits. The function of this control is to keep stable the +385V voltage at the PFC's output.

8.4. CIM3238 – Full Bridge

The full bridge circuitry is also located at the PCB CIM 3238 as part of the sub-module 4275. This circuit is designed to step down the +385V to +32V keeping the same power rate, meaning it enable the voltage to delivery more electrical current. The full bridge topology is favorable to high power management operations. The circuit has 4 transistors technology IGBT, (Insulated Bipolar Gate Transistor). Via a step down high current transformer, the high voltage, 100 kHz, pulses are reduced down to +32V, in sequence than rectified and filtered, becoming the two +32 FIXED voltages, (VA and VB).

8.5. CIM3238 – Self-powered Power Supply, and +15V DC Output

The PCB CIM 3238 also delivery voltages for the PFC control circuits and full bridge. From this circuit is also generate the +15V to the SCU, PCB CIM 3452. The +15V Direct is a linear power supply circuit. A power transformer is directly connected to the 208 VAC mains. From this power supply is extracted (A) +15VDc voltage that feeds the SCU (CIM 3297) exclusively, (B) +18VDc feeds the control of the PFC circuit. The voltage +15VDc feed the full bridge control, and the SCU, PCB CIM 3452.

8.6. CIM3429 – Full Bridge Control and Voltage Readings

The module 4275 also holds the PCB CIM 3429. This circuit is in charge to generate the pulses that will control the full bridge circuitry. On this PCB is located the trim pot TPO-1 that adjust the +32V. On this PCB is also located the trim pot TPO-2 that adjust the over current protection. A third function is the voltage sensor reading circuit, which can be adjusted by the trim pot TPO-3. The output of this sensor is routed to the SCU, PCB CIM 3452. This module also includes the PCB CIM3470. This module is responsible on readings for current flux on each of the 4 voltage outputs. Each current value is read undependably, thought the trimpot TPO1, TPO2, TPO3, and TPO4.

8.7. Shut Down Operation

The shut down command is generated by the SCU, PCB CIM 3452. When an abnormal failure situation occurs, the SCU generate a SHUT DOWN command that is a +5V direct connected to the pin # 1 at the connector CON-5 located at the PCB CIM 3429. Since this voltage is present, the switching pulses will be inhibit and as consequence, all the DC output will be disabled and be no longer available, exception for the +15Vdc DIRECT, that feeds the SCU.

On maintenance situation the sub-module 4275 the automatic operation, (independently of the SCU status), AUT, can be turned on a manual MAN, operation by changing the position of the jump CON-3. The AUT position must be re-state as soon as the maintenance is over. The shut down operation is fundamental to protect the power supply and the UHF amplifiers as well, sub-modules 4451.

8.8. Module 4275 – Technical Specifications

FEATURE	SPECIFICATION
GENERAL	
INPUT AC VOLTAGE	180 TO 260VAC
SWITCHING FREQUENCY	PFC = 100kHz FULL BRIDGE = 100kHz
LINE REGULATION	BETTER THAN 2% FOR ALL OUTPUTS
OUTPUT NOMINAL VOLTAGES AND CURRENTS	+32V / 30A +32V / 30A
RIPPLE	BETTER THAN 250mV
LOAD REGULATION	BETTER THAN 2% FOR ALL OUTPUS
EFFICIENCY	BETTER THAN 80%
OUTPUT OVERCURRENT LIMIT	30% UPPER NOMINAL VALUE
SHUTDOWN VOLTAGE	HIGH LEVEL: > 0.7 TO 5Vdc LOW LEVEL: < 0.7Vdc

8.9. Module 4275 –Schematic Diagrams: SEE ANNEX A

Section 6 – Output Directional Coupler, UHF Low Pass Filter & Band Pass Mask Filter

6.1. Module 4429 – Output Directional Coupler - General Description

The UHF output related power readings direct and reverse, are shown on the LCD screen at the MCU (module 4459) located on the frontal part of the ADVANCED TV line of transmitters. All the readings are RMS values of the 8VSB modulated carrier. The readings are analog DC signals sampled detected by the output directional coupler (module 4429), out from the direct and reverse output RF power.

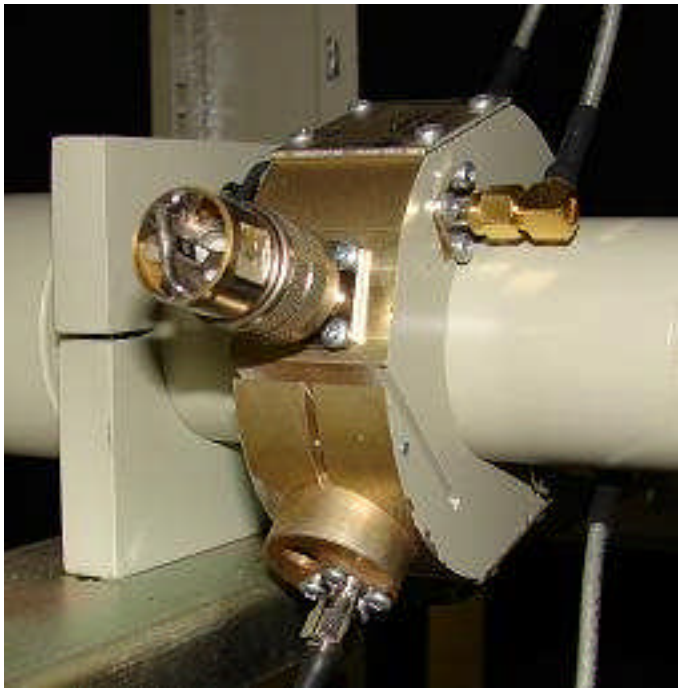


Fig.6.1: Module 4429 - Output Directional Coupler

The module 4429 is a piece of a 50Ω rigid transmission line in series with the UHF RF line up. Two samplers are than coupled to this transmission line out from where direct and reverse signals are detected and sent to the MCU unit for processing and displaying.

6.2. Module 4429 – Technical Specifications

FEATURE	SPECIFICATION
DIRECTIVITY	UHF > 20dB VHF BI > 23dB VHF BIII > 23dB

DIRECTIVITY: Is calculated in the following way:

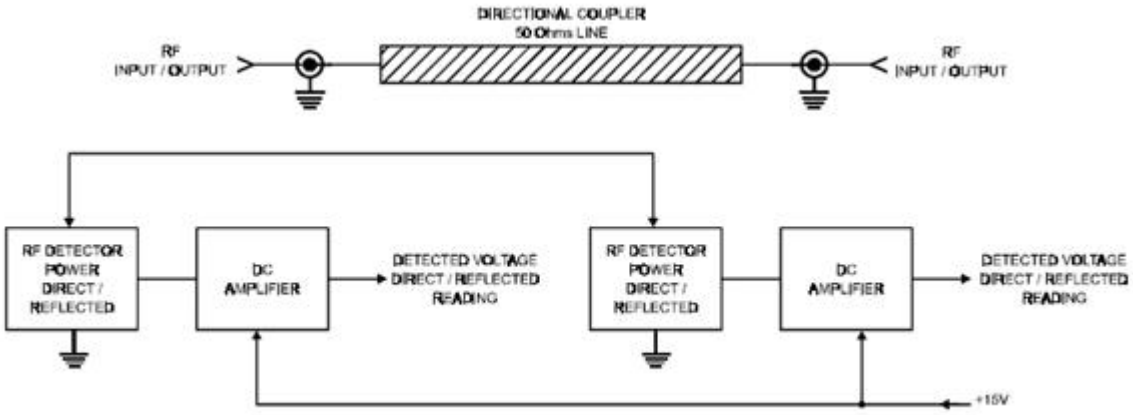
$$D = 20 \log \frac{E_{DIR}}{E_{REF}} \text{ (dB)}$$

Where, E_{DIR} is the voltage on the detector D1

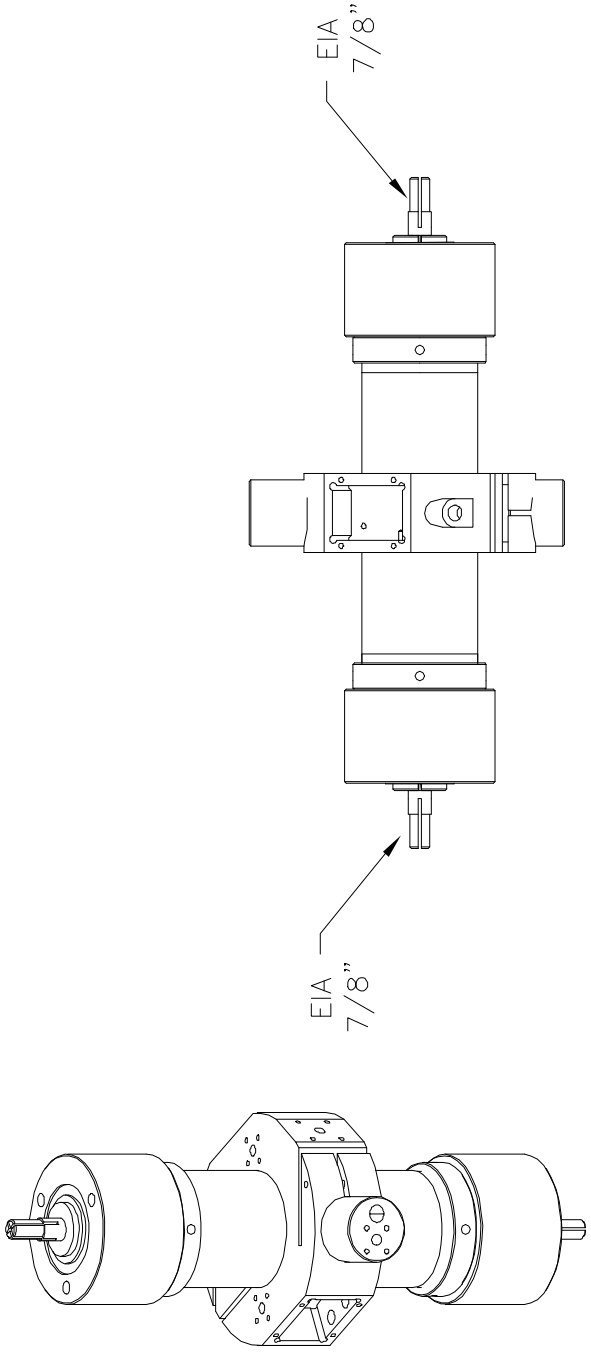
E_{REF} is the voltage on the detector D2

REFLECTOMETER - 4166		
CIRCUIT	**CIM**	**CIP**
REFLECTOMETER	3128B	8100C

6.3. Module 4429 – Block Diagram



6.4. Module 4429 - Drawings



6.5. Module 4429 – Calibration

6.5.1. Introduction

The calibration procedure is quite simple however very important for the overall transmitter operation. Usually this procedure should not take place on the field. The criterions of calibration follow the recommendation as ATSC A53/E.

In case of re-calibration, it is mandatory the utilization of ***absorption type wattmeter***. LINEAR utilizes the Agilent model E4418B EPM series single power meter in conjunction with the 8481A power sensor. The wattmeter should be calibrated before the measurements following the manufacturer's instructions manual. See the recommended set up as follows:

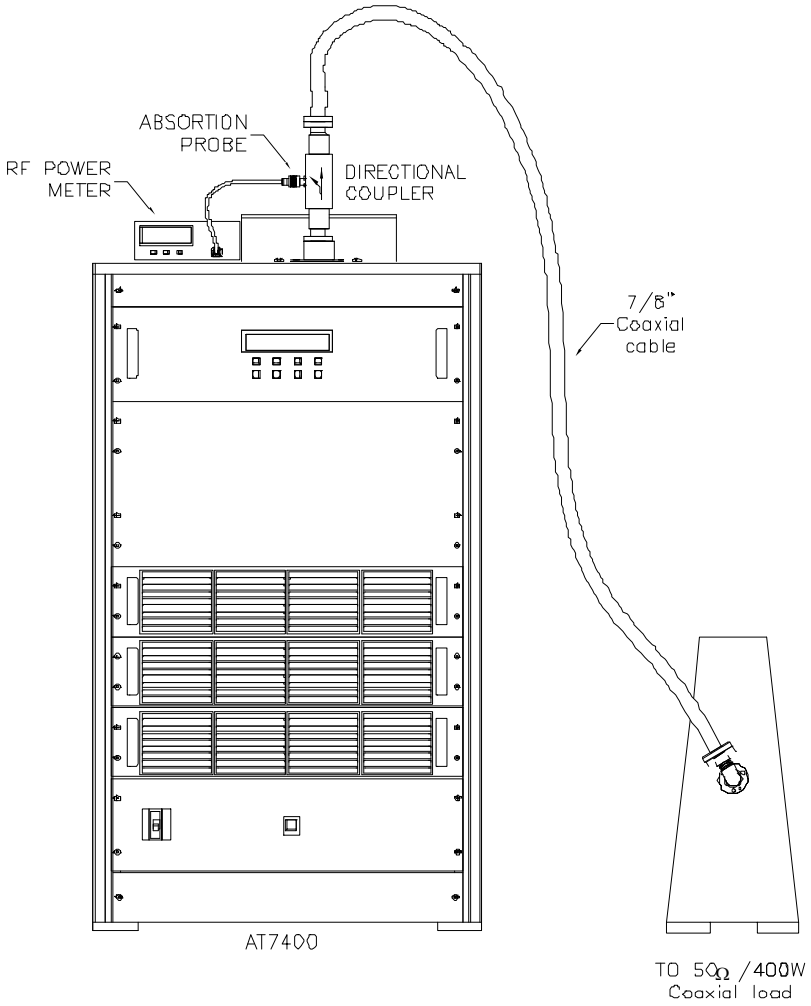


Fig. 6.3: RF power measurement calibration set up

6.5.2. Module 4429 – Calibration Step-by-Step

To reach the MAIN MENU screen, Fig.6.4, hit the CANCEL yellow key (not shown below) up to 4 times in sequence, any time.

Fig. 6.4: Main menu LCD screen at MCU unit

6.5.2.1 Direct Power Calibration

1.
Using the keyboard (soft-keys) and LCD on the MCU, manage to disconnect the ALC operation. Follow the self-explanatory screen instructions. Start with the main menu screen, striking in sequence the gray keys as going to SETUP →TRANSMIT→ALC→OFF→ENTER.

Fig.6.8: Hit the SETUP soft-key to start the ALC-OFF operation

2.
Adjust the RF power via menu (ALC is OFF at this point) to the desired nominal level read at the calibrated external wattmeter.

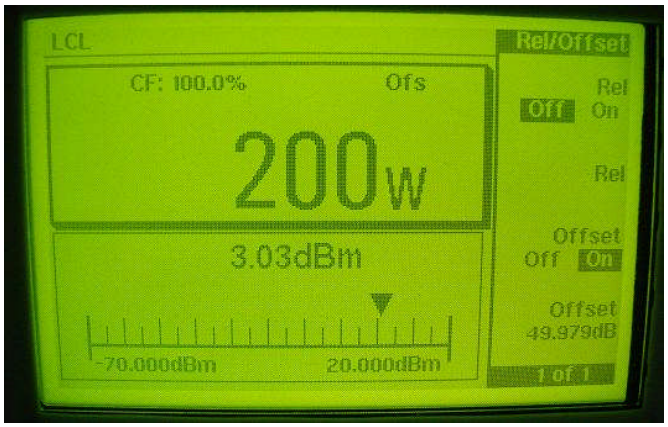


Fig.6.5: Reference output power reading on the power meter absorption

Check if the readings on the LCD screen of the transmitter are also displaying the same value. To get to this screen start out from the main menu and go to SETUP→POWER, reaching the POWER TRANSMITTER SETUP screen as shown on Fig.6.6 below:

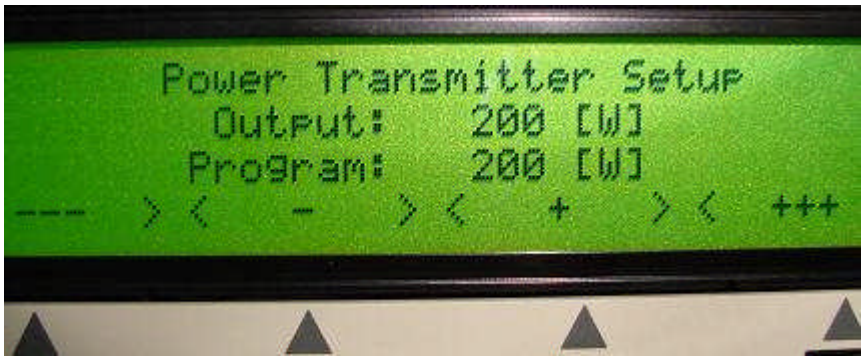


Fig.6.6: Power Setup Screen at the end, it must coincide with the external wattmeter reading

The [Output:] row may not be showing the desired output power. Next step one must make sure the [Program:] row show the desired output power. The setting of the desired output power operation is performed via the soft-keys that:

- increase; fast [+++], slowly [+], or
- decrease; fast [- - -], slowly [-]

3.
To make the power reading coincidence among the 3 readings, (a) the wattmeter, (b) the [program], and (c) [output] where (b) and (c) are present on the LCD screen, will be necessary adjust the DC level that represents the coupling coefficient between the sampler and the 50Ω transmission line at the output directional coupler hardware.

Look for the indication of FORWARD POWER opening the case of the output directional coupler, (Module 4429). On the PCB 3128A slowly twist the trim-pot TPO-1 up to the point where the (b) and (c) readings are showing equal numbers.

4.
Manage to re-state the ALC operation via soft-key and LCD screen at the MCU.

REMARK:
The calibration of the REVERSE POWER is too complex to be performed in the field without factory technical assistance. In this case please contact LINEAR at www.linear-tv.com

6.6. Output Filtering System

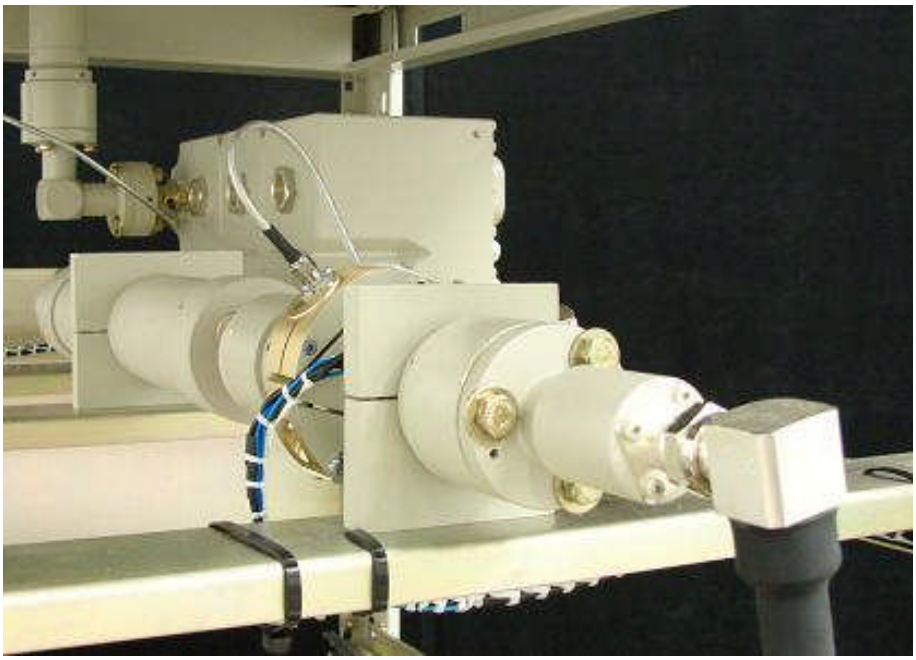


Fig. 6.8: Mechanical Assemble for; (a) output directional coupler, (b) low pass filter, (c) band pass filter

6.6.1. Module 4428 – UHF Low Pass Filter

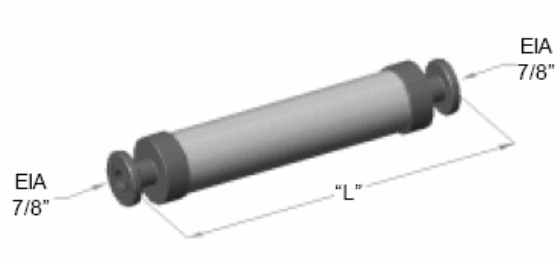


Fig.6.9: UHF low pass filter

The module 4428 is a 7/8" rigid transmission line, no tuning points. Depending of the UHF assigned band the filter is specified as:

- P/N 21802 for Channels 14 up to 39: ……....416.5 mm.
- P/N 23045 for Channels 40 up to 69: ……373.3 mm.

These filters have NO adjustment to be done. Pay attention for mechanical damages that may occur on the main line, or also on the IN/OUT connectors.

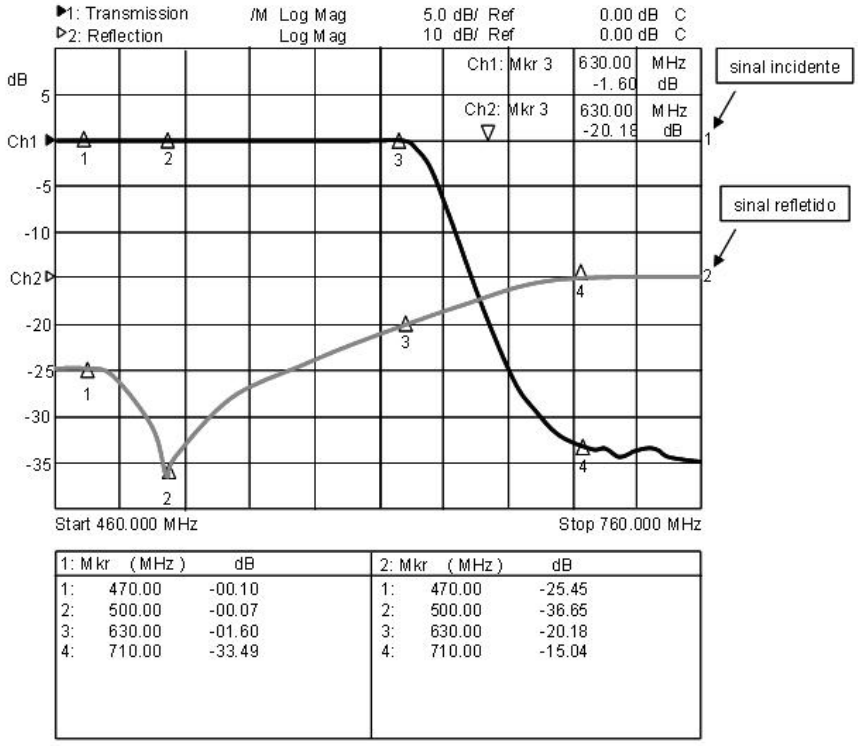


Fig.6.10: Module 4428 frequency response

6.6.2. Module FC6E80C – UHF Band Pass Filter – ATSC Mask Filter Featured

Product Data Sheet — **UHF Digital TV Filters**

UHF DVB BANDPASS FILTER

400 W, 6 Poles (Cross Coupling)

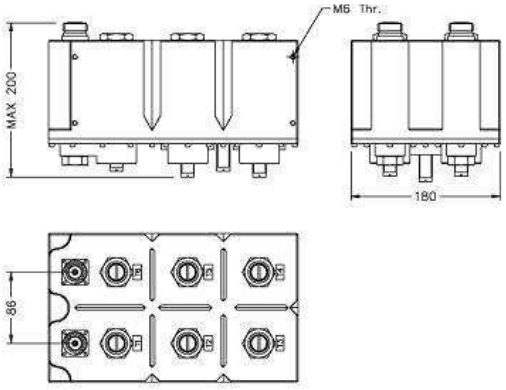
FC6E80C

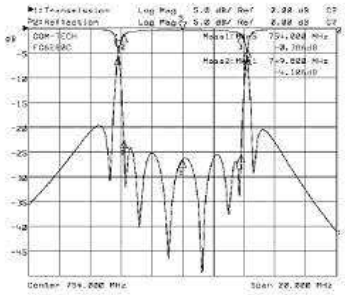
DVB Digital Video Broadcasting

FEATURES

- UHF 400 W DVB TV output filter
- Suitable for Non-Critical mask requirements
- 6 poles elliptical response
- Cross Coupling technique (two transmission zeros)
- Foreshorten folded combline structure
- Iris couplings with fine bandwidth regulation
- 3D Electromagnetic CAD
- High selectivity and low loss
  (Typ. 0.42 dB @ 858 MHz)
- Temperature stabilized design (< 4 kHz / K)
- Very compact and lightweight

OUTPUT FILTERS





SPECIFICATIONS *(Values referred to 8 MHz DVB-T Standard)*

Frequency Range	470 – 862 MHz	Bandwidth	6 to 8 MHz
Max Input Power	400 W DVB	Selectivity	> 4 dB @ C.F. +/- 4.2 MHz
Insertion Loss	< 0.48 dB @ 858 MHz		> 20 dB @ C.F. +/- 6 MHz
	< 0.40 dB @ 474 MHz		> 35 dB @ V.C. +/- 12 MHz
	< 1.40 @ C.F. +/- 3.8 MHz	Temperature Stability	< 4 kHz / K
Return Loss	> 24 dB	Connectors	7/16 Female
Group Delay Variation	< 200 nS	Weight (Approx)	9 kg
		Operating Temperature	-10 to +50 °C

AVAILABLE OPTIONS

A	SMA Output Monitor Probe	B	SMB Output Monitor Probe
H	EIA 7/8" Flange Connections	Z	Painted Black

Information contained in this datasheet is proprietary
Data subject to change without notice
Dimensions are in mm

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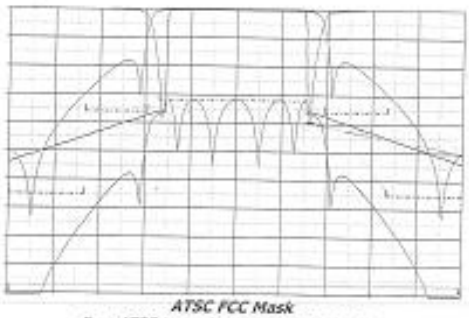
Appendix

3. ATSC TRANSMISSIONS

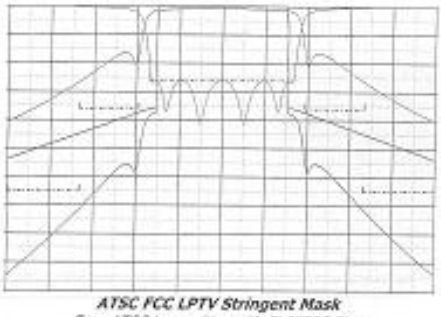
ATSC broadcast emission requirements have been defined by "FCC DTV Emission Mask", contained in the "ATSC Standard, Doc. A/64 Rev. A" document.
For low power ATSC transmitters and repeaters (LPTV = < 3 W VHF, < 30 W UHF) less restrictive masks have recently been approved called "Simple" Mask and "Stringent" Mask to improve the overall performance of these devices (FCC 04-220, September 30, 2004), ref. G. Sgrignoli, IEEE Trans. On Broadcasting, Vol. 49, No. 1, March 2003.
The choice of masks has been left to the operators, and although the minimum requirement is represented by the Simple Mask, the Stringent Mask is able to provide a better protection between the adjacent channels.
Therefore, COM-TECH has adopted the LPTV "Stringent" Mask as a conservative choice.

	Att.@C.F.±3 MHz	Att.@C.F.±3.5 MHz	Att.@C.F.±6 MHz	Att.@C.F.±9 MHz
Typical TX spectrum	36 dB	36 dB	45 dB	54 dB
ATSC FCC Mask	36 dB	36 dB	65 dB	99 dB
ATSC FCC LPTV Stringent Mask	36 dB	36 dB	65 dB	65 dB

The following diagrams show the typical output spectrum of a solid state ATSC DTV transmitter before and after the filter. The traced limits correspond to the masks.
In tracing the transmitter spectrum, reference was made to a state-of-the-art transmitter (latest generation of amplifiers in class AB with linearity pre-correction).
The reference spectrum includes shoulders of -36 dB @+/-3.5 MHz linearly decreasing until -54 dB @+/-9 MHz.



ATSC FCC Mask
E.g.: ATSC transmitter with TCEE140C filter



ATSC FCC LPTV Stringent Mask
E.g.: ATSC transmitter with CL6K50C filter

NOTES:
- The output spectrum may vary based on manufacturer, which is responsible for evaluating the case
- COM-TECH can provide 5 parameters for its filters upon request.

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FEATURES

- UHF 500W Digital TV band pass filter
- ATSC FCC Mask applications
- 6 poles elliptical response (cross coupling)
- Dual Cross technique (four transmission zeros)
- Combline topology
- High selectivity and low loss (Typ. 0.42dB@858 MHz)
- Temperature stabilized
- Very compact and lightweight

SPECIFICATIONS

Frequency Range	470 to 862 MHz
Max Input Power	500 W DTV (ATSC)
Band width	6MHz
Input / Output Impedance	50Ω
Input / Output Connectors	EIA 7/8" Female
Temperature Stability	< 4 kHz / K
Operating Temperature	-5 to +45 ºC

ATSC FCC MASK TUNNING DATA

Inserction Loss	< 0.72 dB@C.F. (803 MHz) < 1.22 dB@C.F. ±2.7 MHz
Selectivity	> 6 dB@C.F. ±3.5 MHz > 26 dB@C.F. ±6 MHz > 45 dB@C.F. ±9 MHz
Return Loss	>26 dB
Group Delay Variation	150 ns

RESPONSE