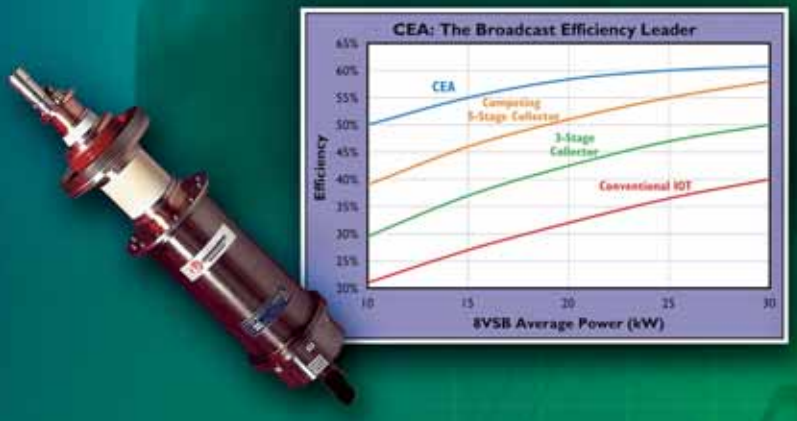
Electron Devices

CONSTANT EFFICIENCY AMPLIFIER

CEA

- Award Winning Performance
- Cost-Savings
- Reliability & Service

PUMP UP YOUR PROFITS...



L-3 Electron Devices now has the most efficient IOT technology available!

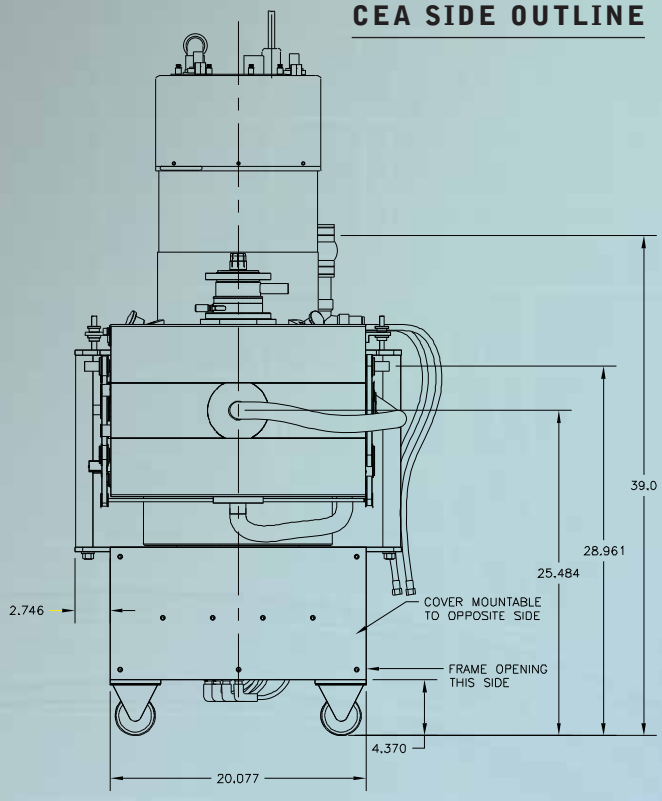
Powering Microwave Systems into the Future

L3

Constant Efficiency Amplifier

CEA

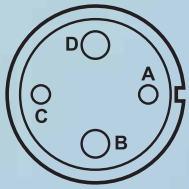
CEA SIDE OUTLINE



FOCUS COIL CONNECTOR CONNECTIONS

Amphenol connector P/N MS3102A-22-4P mounted to magnet cart. Amphenol P/N MS3106F-22-4S socket is supplied.

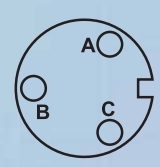
Pin	Element
A	Lid Switch
B	Focus Coil Positive
C	Lid Switch
D	Focus Coil Negative



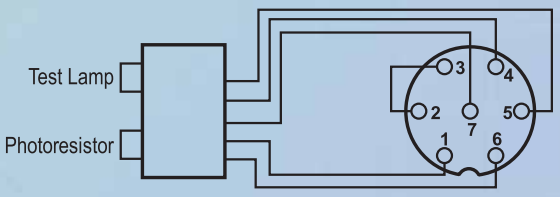
Note: Pins A and C are connected within the circuit assembly for use as an interlock circuit.

LID SWITCH INTERLOCK CONNECTIONS

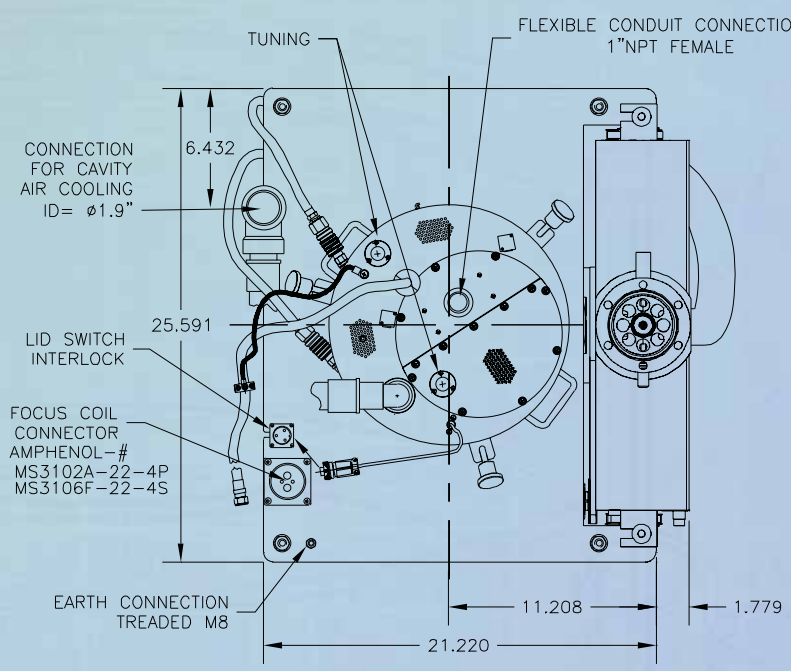
Pin	Connection
A	Lid Switch
B	Not Connected
C	Lid Switch



ARC DETECTOR CONNECTIONS



CEA TOP OUTLINE



INTELLECTUAL PROPERTY RIGHTS

This product is subject to one or more of the following U.S. patents and corresponding patents in other countries: 5,650,751, 6,133,786, 6,380,803, 6,429,589, 6,191,651, 6,262,536, 6,462,474, 6,617,791, and 5,990,622

CONSTANT EFFICIENCY AMPLIFIER

CEA

THE L-3 CONSTANT EFFICIENCY AMPLIFIER IS THE HIGHEST EFFICIENCY TUBE IN ITS CLASS.

SETTING A NEW STANDARD IN IOT PERFORMANCE

L-3 Electron Devices, the performance leader in microwave devices for over 75 years continues to set new benchmarks in the industry with the Constant Efficiency Amplifier (CEA). Winner of the 2009 Academy of Television Arts and Sciences prestigious Technical Emmy Award, the L-3 CEA 130 is the performance leader in all modern digital television transmitters.

By combining an MSDC (multi-stage depressed-collector) with an inductive output amplifier, DC input power is nearly proportional to the RF output over a wide range of power levels. Superior linearity allows full correction across the entire UHF band for all types of digital service. Power output of 130 kilowatts peak in 8VSB can be achieved with efficiencies up to 60%. Synthetic oil cools and electronically insulates the MSDC collector, saving thousands of dollars in maintenance and repair costs over the life of the transmitter.

The L-3 CEA 130 is now operating in over 200 stations in North America and the United Kingdom. Over 6 million hours of operation have been accumulated under a wide range of conditions. Average life exceeds 5 years and maintenance costs have been minimal.

At the 2010 61st Annual Technology and Engineering Awards, L-3 Electron Devices was awarded an Emmy® for their pioneering work in the development of the MSDC IOT amplifier tube, the CEA.

Cutaway View CEA Placement

SPECIAL FEATURES

- Frequency range . . . . 470 to 810 MHz
- Output power . . . . . 130 KW peak for DTV
- Efficiency 60%
- Reliable cooling . . . . Synthetic oil
- Easy input tuning . . . One input cavity provides a broad, very low VSWR over entire frequency range
- Warranty . . . . . 2-year full replacement

RECOMMENDED COOLANTS

We recommend cooling the collector and anode of the CEA with Alpha-2 fluid, manufactured by Dielectric Systems Incorporated. This high-grade synthetic oil (poly-alpha-olefin – PAO) is an insulating oil designed for transformer and switching applications and is well-suited for high-voltage applications and hot environments. It is made with 100% synthetic hydrocarbon oils, is completely biodegradable, and is compounded with advanced antioxidants and metal passivators to prevent oxidation.

For more information, contact:
Dielectric Systems, Inc. — sales@dsifluids.com

Specifications

RATINGS

	Min	Max
Heater voltage (Note 1)	5	7V
Heater current (operating)	20	30 A
Heater current (surge)	60 A	
Heater warm-up time	300 sec	
Load VSWR		1.5:1
Bias voltage (ref. to cathode)		-250V
Grid current		±150 mA
Ion pump current (beam on)		20 µA
Ion pump voltage (ref. to cathode)		4 kV
	Digital Max	
Beam voltage	38 kW	
Beam current (mean)	2.5 A	
Quiescent (idle) current	0.6 A	
Collector 1 current	0.9 A	
Collector 2 current	0.8 A	
Collector 3 current	0.6 A	
Collector 4 current	0.5 A	
Collector 5 current	0.8 A	

OPERATING VOLTAGES VS. AVERAGE OUTPUT POWER – DIGITAL

Avg Power Digital	18 kW	22 kW	26 kW	30 kW
Collector 1	32.0	34.0	36.0	38.0
Collector 2	24.0	26.0	27.5	29.0
Collector 3	18.0	19.0	20.0	21.5
Collector 4	15.0	16.0	17.0	18.0
Collector 5	8.50	9.0	9.50	10.0

All operating voltages are in kV and are referenced to the cathode.

MAXIMUM OUTPUT POWER

Type of Service	Peak Power	Average Power
Digital 8VSB	130 KW	30 kW

MAXIMUM INPUT POWER

Digital 8VSB	1500 W	250 W

MECHANICAL SPECIFICATIONS – IOT

Mounting position	Collector end down
Weight (approx.)	70 lbs

MECHANICAL SPECIFICATIONS – TROLLEY ASSEMBLY

Main electromagnet voltage (Note 7)	4.5–6.3V
Main electromagnet current (Note 7)	20–28 A
RF input	Type N
RF output	$3\frac{1}{8}$", EIA, 50 Ω
Net weight of tuning cavities (approx.)	110 lbs
Net weight of magnet assembly (approx.)	300 lbs
Collector cooling:	
Maximum inlet oil pressure	70 psi
Maximum inlet oil temperature	65°C
Maximum outlet oil temperature	75°C
Minimum collector oil flow (at operating temp.)	15 gpm
Anode cooling:	
Maximum inlet temperature (water or glycol)	65°C
Minimum anode flow (water or glycol)	0.9 gpm
Minimum anode flow oil (DSI Alpha-2 fluid)	1.5 gpm
Pressure drop across anode cooling lines in place @ .9 gpm	10 psi
Cavity cooling (Note 5)	
Airflow into input and output cavities (sea level)	90 cfm
Minimum intake air pressure	5"
Maximum intake air temperature	60°C

TYPICAL OPERATION – 8VSB DIGITAL AMPLIFICATION

Output Power (avg.)	21 kW	30 kW
Beam voltage	34	36 kV
Grid bias (Note 9)	-102	-106V
Drive power (avg.)	100	145 W
Collector 1 current	0.3	0.5 A
Collector 2 current	0.41	0.53 A
Collector 3 current	0.37	0.41 A
Collector 4 current	0.26	0.33 A
Collector 5 current	0.41	0.38 A
Shoulder level	49	48 dB
Gain	23	23 dB
Efficiency	58.9	60%
Heater voltage	6.3	6.3V
Heater current	23	23 A
Solenoid voltage	7	7V
Solenoid current	25	25 A
Collector:		
Inlet oil temperature	58°C	
Outlet oil temperature	67°C	

All operating voltages are in kV and are referenced to the cathode. All collector voltages are nominal and may vary ±1 kV in actual operation. Data taken at ch. 14 for typical operation.

Notes

1. HEATER VOLTAGE – The actual heater voltage used on a particular tube is recorded at the factory on the label and on the test data sheet supplied with each tube. It is measured at the terminals of the high-voltage junction box inside the input cavity. The heater voltage should be stabilized to within ±0.15V of the recommended value.

2. PASSIVE STANDBY – Passive standby is defined as any time period exceeding 30 minutes when reduced heater voltage is applied to the tube without beam voltage. The ion pump must have voltage applied and all cooling loops (air and water) operated normally. When an L-3 CEA 130 is being operated in the passive standby mode, the following operating guidelines are strongly recommended:

- For passive standby or black heat operation the applied heater voltage is reduced 0.75 volts below the value printed on the tube's label. Under no circumstances should the black-heat voltage level be less than 5.0 V.
- If the tube is operated in passive standby mode, heater voltage must be applied for at least 30 minutes prior to the application of beam voltage and the return to normal operating conditions.
- When the tube is returned to normal operation, the heater voltage should be raised to the value printed on the label and other auxiliary supplies energized. Upon verification of the presence of grid voltage, beam voltage and RF drive may be applied to the tube simultaneously.
- Optimum performance from the amplifier will not occur until thermal equilibrium is achieved; typically 5 to 10 minutes. Avoid overdriving the tube by disabling the transmitter's AGC circuits while the tube is stabilizing.
- Tubes placed in passive standby should be operated at rated power for a minimum of 24 continuous hours at 30-day intervals. Operating parameters should be recorded and analyzed for trends. Increasing negative grid current is an indication of grid emission and corrective action should be taken. Consult with the L-3 factory for detailed procedures to correct negative grid current conditions.
- It is recommended that a soft-start procedure be used when applying RF drive to a tube that has been operated in black heat or energized from a cold start. The RF drive may be applied simultaneously with the beam voltage and the RF ramped from zero to 100% in a minimum of 4 seconds.

3. ACTIVE STANDBY – Active standby is defined as a condition whereby the tube is operated with all normal-operating voltages and no RF drive. During this type of standby operation, the quiescent collector current is reduced to 100 mA in order to maintain a good vacuum and to reduce the overall power consumption. To return the tube to normal operation, the quiescent current is adjusted to its nominal value and RF drive is reapplied following the guidelines presented in the section describing soft-start.

4. ABSOLUTE VALUES – No single parameter of the tube's specification (except the vac-ion current) should be exceeded for more than 100 milliseconds. The vac-ion current cannot be exceeded for more than 1 second. The transmitter must incorporate a fast-disconnect circuit, which removes high voltage from the tube in the event of a condition that exceeds any one of the tubes' specification limits. High voltage should not be reapplied for at least 3 seconds following a fault. Exceeding any absolute rating repeatedly or for periods longer than 100 milliseconds may shorten tube life or cause permanent damage to the tube.

5. AIRFLOW – Recommended airflow is measured at sea level where air density is defined as 1.22 kg/m^3 (0.076 lb/ft^3). At higher altitudes the density of air decreases and a corresponding increase in air volume is necessary to maintain adequate cooling.

6. TUBE PROTECTION – The transmitter must be capable of protecting the CEA in the event of an arc within the CEA. Removal of high voltage is necessary to limit the energy dissipated within the tube during the arcing event. To verify that the transmitter's protection circuits are operating properly, L-3 recommends performing a standard wire test, where a 12" length of AWG 37 (0.00445" diameter) wire can survive a simulated high-voltage arc and not be destroyed.

7. SOLENOID CONTROL – Current-regulated solenoid power supplies should have voltage under/over trip points to fully protect the CEA in the event of a power supply or magnet failure.

8. INPUT PROTECTION – Transmitter protection circuits must remove RF drive power to the CEA in the event that beam voltage is not present. Severe tube damage can result under these circumstances.

9. BIAS SUPPLY – Grid bias should be provided by a regulated power supply capable of delivering -50 to -250 Vdc with respect to the cathode. The power supply must also be capable of sinking or sourcing at least 150 mA.

10. ARC PROTECTION – A photoresistor-type arc detector is fitted to each of the primary and secondary output cavities. The beam voltage must be removed within 100 ms of an arc being detected.

11. RECOMMENDED COOLANTS – L-3 recommends the use of PAO dielectric fluid for collector and anode cooling. Alpha-2 fluid can be obtained from Dielectric Systems Inc., e-mail: sales@dsifluids.com.

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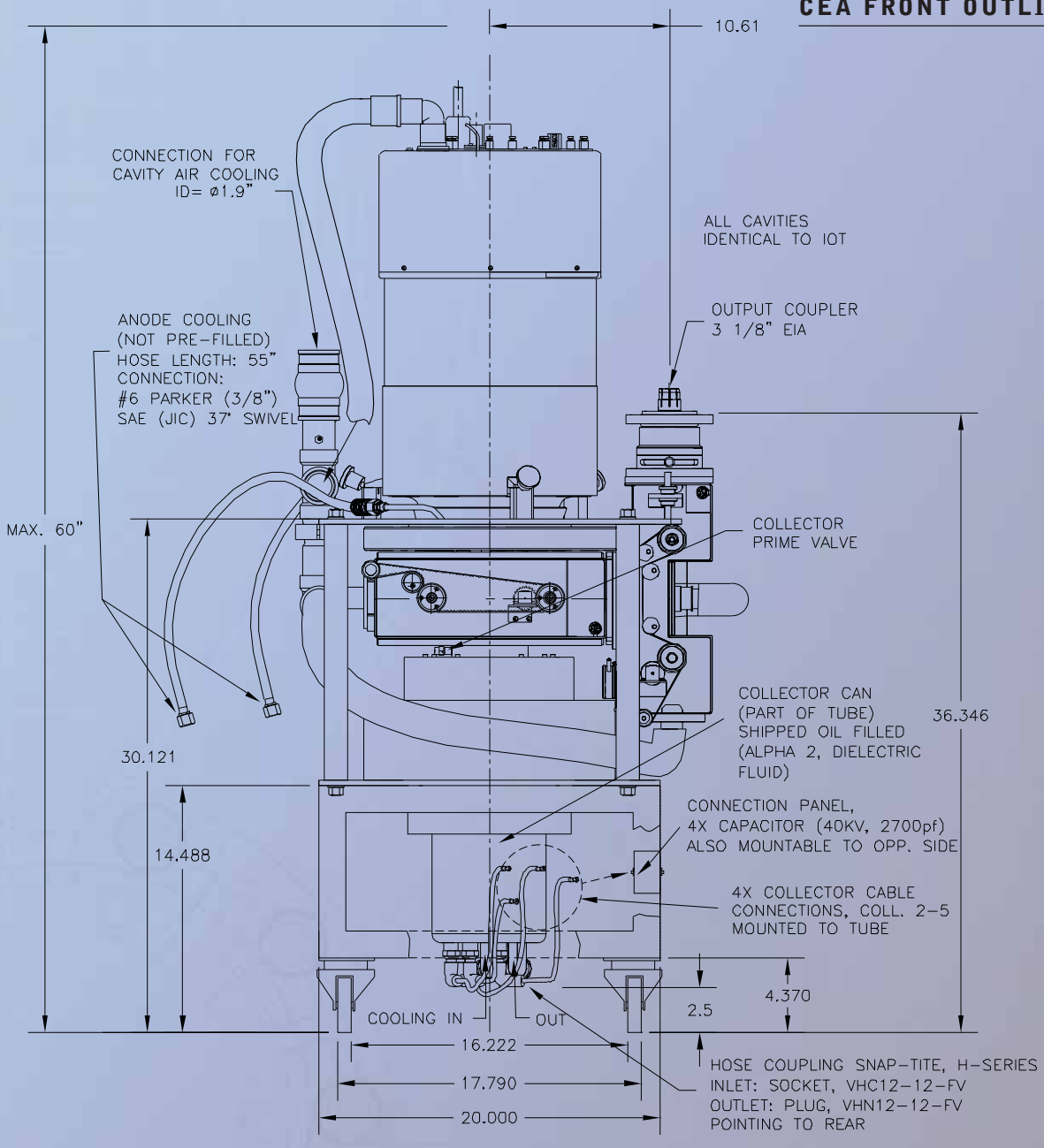
CONSTANT EFFICIENCY AMPLIFIER

CEA

CEA FRONT OUTLINE



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MADE IN U.S.A.

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L-3. Headquartered in New York City, L-3 Communications employs over 64,000 people worldwide and is a prime contractor in aircraft modernization and maintenance, C³ISR (Command, Control, Communications, Intelligence, Surveillance and Reconnaissance) systems and government services. L-3 is also a leading provider of high technology products, subsystems and systems.