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Australia

FMA300 Manual

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Safety note

This equipment uses high voltages internally. Any servicing should be performed by competent individuals.

Prolonged exposure to high level RF radiation has been shown to pose a health risk. Whilst the equipment is intrinsically safe, its use in conjunction with an antenna system may generate large RF fields. Appropriate precautions should be taken by individuals that habitually work close to the transmitting antenna.

The RF power devices of this equipment employ Beryllium Oxide. This substance is extremely toxic if pulverised. On no account should any RF power devices be smashed. Please refer to attached Material Safety Data Sheet for further information.

WARNING

THIS EQUIPMENT IS SUPPLIED WITH A MAINS LEAD INCORPORATING AN EARTH WIRE. IT IS IMPERATIVE THAT THIS EQUIPMENT IS CONNECTED TO A MAINS OUTLET THAT HAS AN EARTH. IN COUNTRIES WHERE EARTHED OUTLETS ARE NOT MANDATORY, IT IS THE CUSTOMER'S RESPONSIBILITY TO ENSURE THAT THIS EQUIPMENT IS APPROPRIATELY EARTHED.

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1 GENERAL DESCRIPTION

The FMA300 is a high quality 300W amplifier intended for audio broadcast service in the FM band.

Its features include:

- Frequency agile.
- Extensive self test and auto diagnostics.
- Rugged design.
- Conservatively rated.

Applications include low power broadcast, narrowcast, community broadcast, rebroadcast for tunnels, student radio stations and as a driver for high power transmitters.

The FMA300 is designed and built in Australia.

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2 UNPACKING

This section details the way in which the FMA300 should be unpacked upon receipt by the customer.

Upon receipt the amplifier should be visually inspected to ensure that no damage has occurred in transit.

Along with the amplifier, the following items should also be present:

- This manual
- Mains lead

The customer should ensure that all items are present and then store them in a safe place.

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3 INSTALLATION

3.1 General

This section describes the installation and infrastructure requirements for the FMA300. Departure from the instructions contained herein may void any warranty provided by SRK.

3.2 Environmental

The transmitter is intended for indoor use. The transmitter should be protected from rainfall and direct sunlight, extremes of temperature and humidity and from conditions of high dust levels. Ambient temperature should be in the range +10°C and +30°C. The transmitter shall not be operated at altitudes in excess of 3500m above sea level. The transmitter must be installed on a flat, stable surface. The transmitter must be installed in the upright position. The transmitter must be installed in a location free from vermin and the ingress of other animals. The transmitter shall not be installed in locations prone to flooding. All ventilation orifices must be clear to allow adequate air flow.

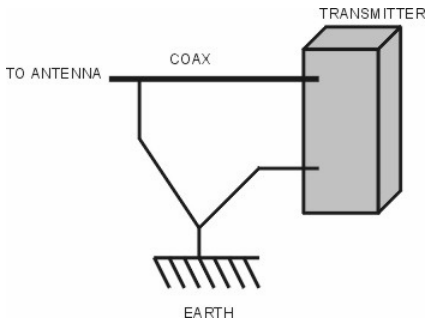
3.3 Electrical supply

The electrical supply to the transmitter must be of the voltage, form and frequency described in the specifications. All electrical wiring must be carried out in accordance with local laws, standards and regulations. If power supply voltages regularly fall outside specifications then a voltage regulator must be installed between the supply inlet and the transmitter.

3.4 Earthing

Adequate earthing of the transmitter is vital to ensure long term reliability and user safety. The electrical supply must be earthed, via the earthing pin of the IEC connector. In countries where power outlet earthing is merely optional, an earthed outlet **must** be used. See safety notice at the front of this manual. A separate, independent, earth is required for the transmitter/antenna system and must be connected to the earthing point indicated on the rear of the transmitter. The cable used to connect the earth should be as thick as possible, with 8 AWG being the smallest size acceptable. Where possible, broad earthing band should be used.

In addition to the earth connection to the transmitter, the outer conductor of the coax feed to the antenna should be connected to the earth, as indicated below.



The earth itself must be of high quality buried copper, at least 1.5m deep and preferably in ground that is habitually humid (eg, the base of a gutter down pipe).

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3.5 Antenna

The antenna load connected to the transmitter must be tuned to minimise reflections. Whilst the transmitter is designed to withstand high levels of reflection for short periods, continually high levels of reflected power will degrade the long term reliability of the transmitter. Operating SWR should be kept to below 1.9:1.

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4 OPERATION

4.1 Front View

Please refer to figure 4.1. The numbers of the following paragraphs refer to the controls shown in figure 4.1.

1 Auxiliary power indicators

These three LEDs indicate that the +5V,+15V and –15V auxiliary supplies generated within the amplifier are present.

2 Amplifier meter

Displays various internal parameters of the amplifier, as determined by the meter parameter panel (5).

3 Alarm indicators

When lit, these indicators show that an alarm or failure condition exists. The cause of any alarm should be investigated.

4 Air inlets

These inlets allow air to enter the amplifier for cooling and must not be obstructed..

5 Meter parameter panel

This indicates which parameter is currently being displayed on the meter.

6 Meter parameter button

Pressing this button causes the meter to display the next parameter, shown on the meter parameter panel.

4.2 Rear View.

Please refer to figure 4.2. The numbers of the following paragraphs refer to the controls shown in figure 4.2

7 RF out

This is the RF output connector and mates with a male N type.

8 Amplifier forced air exhaust

This is the exit port for the forced air cooling. Do not obstruct.

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9 Mains input.

Mains input. 240VAC single phase.

10 Mains circuit breaker

This is the mains circuit breaker for the amplifier. 5A.

11 Mains on-off switch.

Switches the amplifier on and off.

12 Earth stud.

This is the main earth stud. To this must be made the earth connection.

13 Remote control.

Allows remote monitoring of amplifier status. This mates with and 9 way D type plug.

14 RF in

This is the RF input connector and mates with a male N type.

15 Mains neon.

Lights when the unit is switched on and mains is present.

4.3 Switching on and off

The FMA300 is switched on by depressing the power switch (11) to the up position.

If mains voltage is present then the adjacent neon should illuminate.

The fans will start, the auxiliary power indicators will light and the panel meter will indicate forward output power

Output power is set by the exciter drive power.

Note that there is an interlock function so that if RF is present on the input of the amplifier at power on, the “HIGH I/P POWER” alarm will light and the amplifier shut down. Ensure that the RF drive is applied after the amplifier is switched on.

The FMA300 may be switched off at any time by depressing the power switch to the down position.

4.4 Setting output power

See FMX25 manual. Transmitter power is simply set by exciter power. Use the meter on the amplifier to monitor forward and reflected RF power.

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4.5 Setting Channel Frequency

See FMX25 manual. Note that it is advisable to reduce RF power to zero before changing frequency, then ramping power back up at the new frequency.

4.6 Setting audio gain

See FMX25 manual.

4.7 Selecting pre-emphasis and input impedance.

See FMX25 manual.

4.8 Enabling/disabling stereo.

See FMX25 manual.

4.9 SCA option.

See FMX25 manual.

4.10 Protection

The FMA300 incorporates a number of protective features that make it extremely rugged.

If the reflected power from the antenna exceeds 30W then the output RF power will be automatically reduced to bring the reflected power back to 30W. Under this condition the FMA300 will continue to function, albeit at a reduced output power, indefinitely until the reflected power reduces. The amplifier alarm LED “HIGH SWR” will light.

If the temperature of the RF amplifier becomes excessive (>85ºC), then the RF output power will be reduced to zero until the amplifier temperature falls to an acceptable level. During this time the amplifier alarm LED “HIGH TEMPERATURE” will light.

If the RF output power exceeds 330W then the amplifier will limit power to about 330W. The amplifier alarm LED “HIGH O/P POWER” will light.

If the RF input power exceeds about 10W then the amplifier will shut down until the RF power drops to less than 4W. During this time the amplifier alarm LED “HIGH I/P POWER” will light.

See also the relevant sections of the FMX25 manual.

All error conditions are recoverable automatically once the cause of the error has been removed. No user intervention is required.

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4.11 Remote operation.

The FMA300 may be monitored remotely via the “TELEMTRY” connector on the rear of the unit. This is an RS232 standard connection with the following characteristics:

Baud rate: 9600
Data bits: 8
Parity: NONE
Stop bits: 1
Flow control: NONE

The pinout for the DB9 connector is as follows: pin 2, transmit data, pin 3, receive data, pin 5, common (0V). All other pins are not connected.

The FMA300 responds to the following commands. <CR> indicates the ASCII character 0D hex. All letters are upper case, spaces (20 hex) are indicated by “_”. All commands must be terminated by <CR>. Note that a line feed (0A hex) must not be sent before or after <CR>. After a response is sent, a carriage return, line feed and “>” are sent.

FP?<CR>
Returns forward power in the form XXXW<LF><CR>>. For example:

FP?<CR> (command)
300W<LF><CR> (response from amplifier)
>

Note that for forward powers of 99W and below, the leading zero is replaced with a space

RP?<CR>
Returns reflected power in the form XXXW<LF><CR>>. For example:

RP?<CR> (command)
_00W<LF><CR> (response from amplifier)
>

Note that for reflected powers of 99W and below, the leading zero is replaced with a space.

IP?<CR>
Returns the input power in the form XX.XW<LF><CR>>. For example:

IP?<CR> (command)
_7.5W<LF><CR> (response from amplifier)
>

Note that for input powers of 9.9W and below, the leading zero is replaced with a space.

AT?<CR>
Returns the amplifier heatsink temperature in the form XXXC<LF><CR>>. For example:

AAT?<CR> (command)
_32C<LF><CR> (response from amplifier)
>

Note that for temperatures of 99C and below, the leading zero is replaced with a space.

AI?<CR>

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Returns amplifier DC current in the form XX.XA<LF><CR>>. For example:

AAI?<CR> (command)
_7.5A<LF><CR> (response from amplifier)
>

Note that for currents of 9.9A and below, the leading zero is replaced with a space.

PT?<CR>
Returns the PSU temperature in the form XXXC<LF><CR>>. For example:

PT?<CR> (command)
_32C<LF><CR> (response from amplifier)
>

Note that for temperatures of 99C and below, the leading zero is replaced with a space.

AV?<CR>
Returns the amplifier DC supply voltage in the form XX.XV<LF><CR>>. For example:

AV?<CR> (command)
50.1V<LF><CR> (response from amplifier)
>

Note that for voltages of 9.9V and below, the leading zero is replaced with a space.

BS?<CR>
Returns the current self test status in the form XXX<LF><CR>>, where X can be either 0 or 1. A 1 indicates a failure, a 0 indicates a pass. The first byte indicates high temperature, the second indicates a high input RF condition, the third indicates a high SWR condition and the fourth indicates a high RF output power condition. For further information consult the section on protection. For example:

BS?<CR> (command)
0010<LF><CR> (response from amplifier indicating a high SWR condition)
>
or
0000<LF><CR> (response from amplifier indicating no failures)
>

HP?<CR>
Returns a summery of the above commands.

Any data received by the amplifier, other than the commands listed above will generate the following error string:

Invalid_command.__Send_HP?(CR)_for_command_syntax.<LF><CR>
>

Should it be necessary to make connection to the remote port using cables running external to the building housing the FMA300, it is recommended that external filtering and transient protection be installed on these lines.

4.12 Audio limiter

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See FMX25 manual.

4.13 Amplifier metering.

The FMA300 has extensive metering to allow a number of parameters to be monitored. The parameter to be measured is selected by depressing the meter selection switch until the desired parameter is indicated by the array of lamps next to the switch. Each press of the button selects the next parameter. The following parameters may be measured:

Forward output power.

The forward output power of the amplifier is displayed in watts, 300W maximum.

Reverse output power.

The reverse output power of the amplifier is displayed in watts, 30W maximum.

Forward input power.

The RF input power is displayed in watts, 10.0W maximum .

Amplifier temperature.

The heatsink temperature of the RF amplifier is displayed in degrees centigrade.

PSU temperature.

The heatsink temperature of the PSU is displayed in degrees centigrade.

Amplifier voltage.

The supply voltage of the amplifier is displayed in volts.

Amplifier current

The supply current of the amplifier is displayed in amps, 10.0A maximum.

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5 MAINTENANCE

5.1 Recommended maintenance schedule

The FMA300 will give many years of trouble free service with little attention. However, it is recommended to clean the fan filters once per year. This can be done by switching off the transmitter and unclipping the plastic fan guards on the front of the unit. The filters may be washed gently on clean, warm water and then dried before re-fitting.

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6 CIRCUIT DESCRIPTION

6.1 Equipment Overview

The FMA300 consists of the following sub-assemblies:

- 50V Switch mode PSU
- 300W RF amplifier
- Control board
- Output directional coupler
- Auxiliary PSU

These assemblies are interconnected as per “FMA300 wiring diagram”.

The 50V SMPSU generates 50V at up to 10A for the RF amplifier. It incorporates inrush current limiting and active power factor correction for excellent power factor. This is an OEM unit. No attempt should be made to open, modify or repair this unit.

The 300W amplifier assembly is the heart of the amplifier and is centered around a double MOSFET driven in push-pull class AB.

The RF input to this module is passed through the input directional coupler, thus allowing monitoring of input power.

The RF output from the amplifier assembly is passed through a filter to remove all harmonics, and then onto the output directional coupler which allows monitoring of both forward and reverse output power.

The whole amplifier is controlled and metered by the control board assembly.

The auxiliary PSU generates +5V for the control board.

6.2 Amplifier

Please refer to the appropriate diagram.

RF enters on BNC J2 and is passed to a directional coupler formed by T5. This takes a small sample of the input power and passes it to R6/9. This voltage is rectified by D1 and then passed to the control board to allow the input power to be measured.

The RF is then converted to a balanced signal by the action of T12.

The balanced output is passed through 9:1 transmission line transformer formed by T3 and 4.

The RF is then applied differentially to the dual MOSFET, Q1. Bias is also applied at this point.

The drain loads of Q1 are made up the 4:1 transmission line transformer formed by T1 and 2.

The drains are supplied with DC via this transformer and the decoupling network formed by C20, FB1, R11, C54 and C31.

The RF output is turned from push-pull to single sided by balun T9 and passed to the output filter.

Drain current sampling is performed by R13 and fed to the control board for metering.

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Heatsink temperature is measured by the LM35, which produces a DC output voltage of 10mV/ºC. This voltage is also passed to the control board for metering and protection.

The output filter is a 9^{th} order chebishev that provides at least 40dB of stopband attenuation at 175MHz and at least 60dB of stopband attenuation at 262.5MHz.

The RF output is passed to the output directional coupler via J3.

6.3 Control board

The control board is responsible for all measurement and protection functions. Refer to the appropriate schematic.

The heart of the controller board is U1, a micro-controller unit. This performs the following functions:

The analogue voltages representing the forward and reverse powers are digitised on pins 40 and 39. These values are then squared internally to allow the forward and reflected power to be read on the front panel and via telemetry.

Other analogue parameters are connected to pins 33 to 38 as indicated on the schematic.

The push button used to select which parameter is displayed on the front panel is read on pin 17.

The two error conditions HIGH O/P and HIGH SWR are monitored on pins 20 and 21. These signals are derived from the comparators U10 and U11. These devices monitor the forward and reflected power control loops formed by U9B and U9C. If the output of U9B drops to less than about 5V, this indicates that an over O/P power condition exists. Likewise U9C and a high SWR condition.

U9B and U9C constantly compare the actual forward and reflected power with thresholds set by VR3 and VR6 respectively. VR3 is set to the equivalent of about 330W of forward power. VR6 is set to the equivalent of about 30W of reflected power. Either U9B or U9C can reduce the bias voltage to the amplifier, thus reducing the output power. In this way, elegant and seamless power and SWR protection are provided.

The forward and reflected RF voltages from the directional coupler are accurately converted to DC levels by U7 and U8. U9A and U9D are used to scale these voltages so that 1000W passing through the directional coupler provides 5.0V to the MCU.

A small value resistor in the supply line of the MOSFET on the amplifier palette generates a voltages proportional to the drain current. This voltage is amplified and level shifted by U12, Q2. VR11 is adjusted so that 20.48A of drain current produce 5.0V into the MCU.

Gate bias for the MOSFET is set by VR14.

Telemetry is provided by the on chip USART in the MCU, with U2 providing level shifting to RS232 levels.

+10V for this board is provided by the small DC-DC converter, U14. U15 generates a nominal -7V for the analogue circuitry.

The Front panel display is driven in a multiplex format by U1. Q1, 3, 5, 6 and 7 are all switched on in turn, one at a time. Coincidentally, the appropriate segments are connected to ground by U1. This happens several hundred times a second, giving the appearance of constant brightness.

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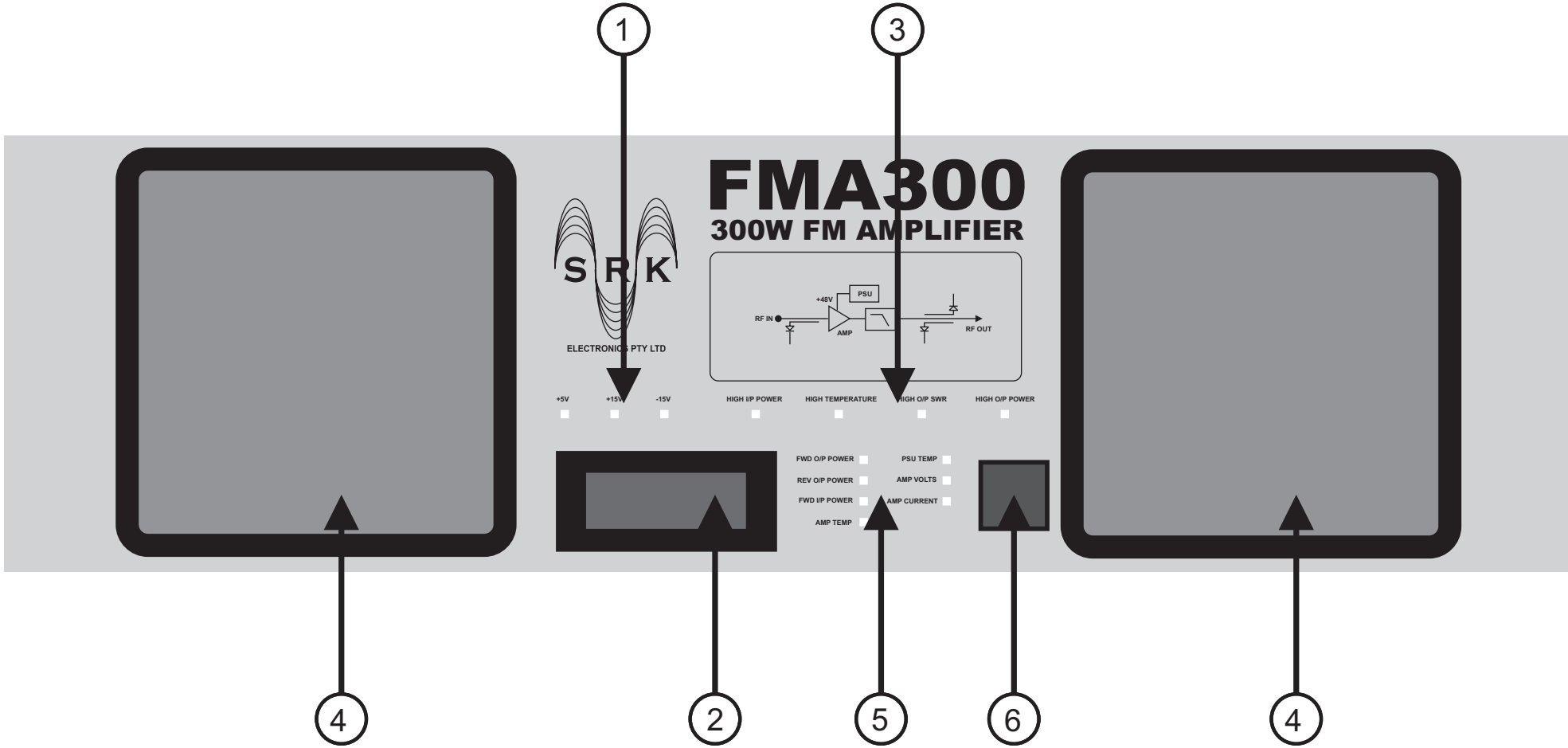


Fig 4.1 FMA300 Front View

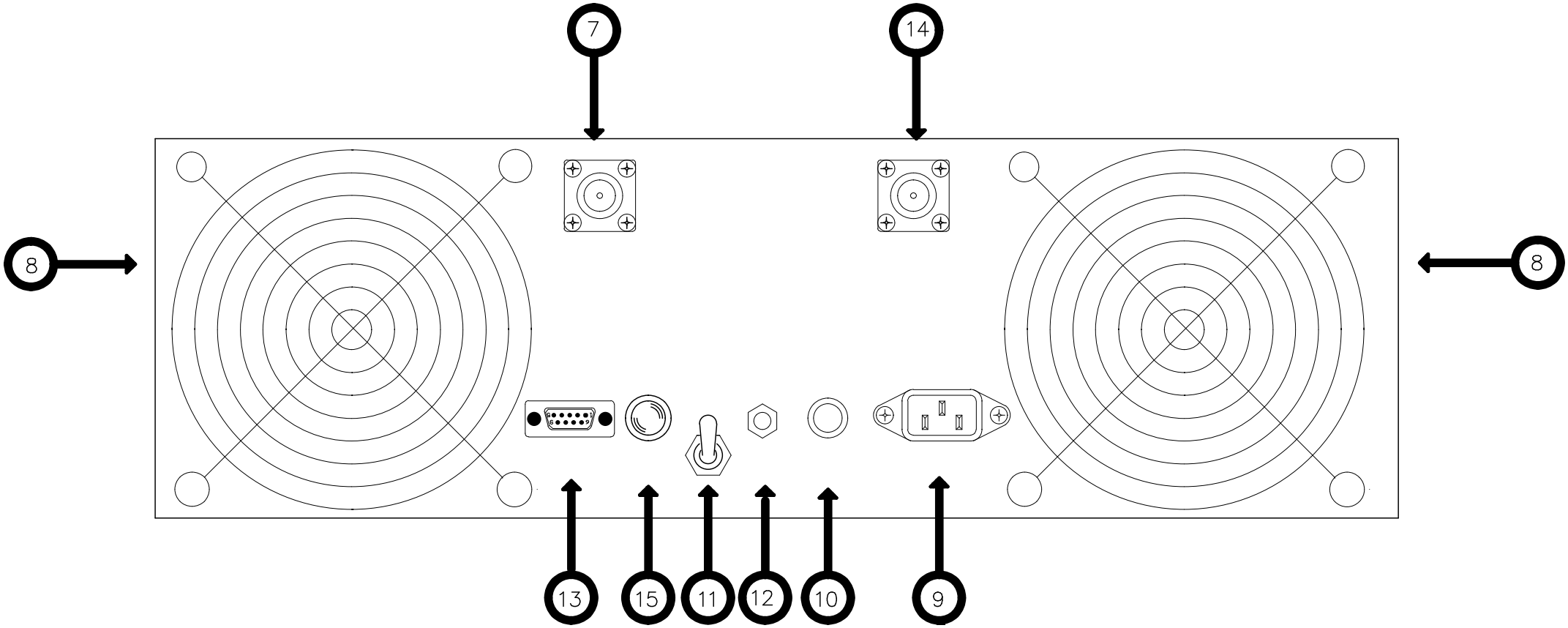
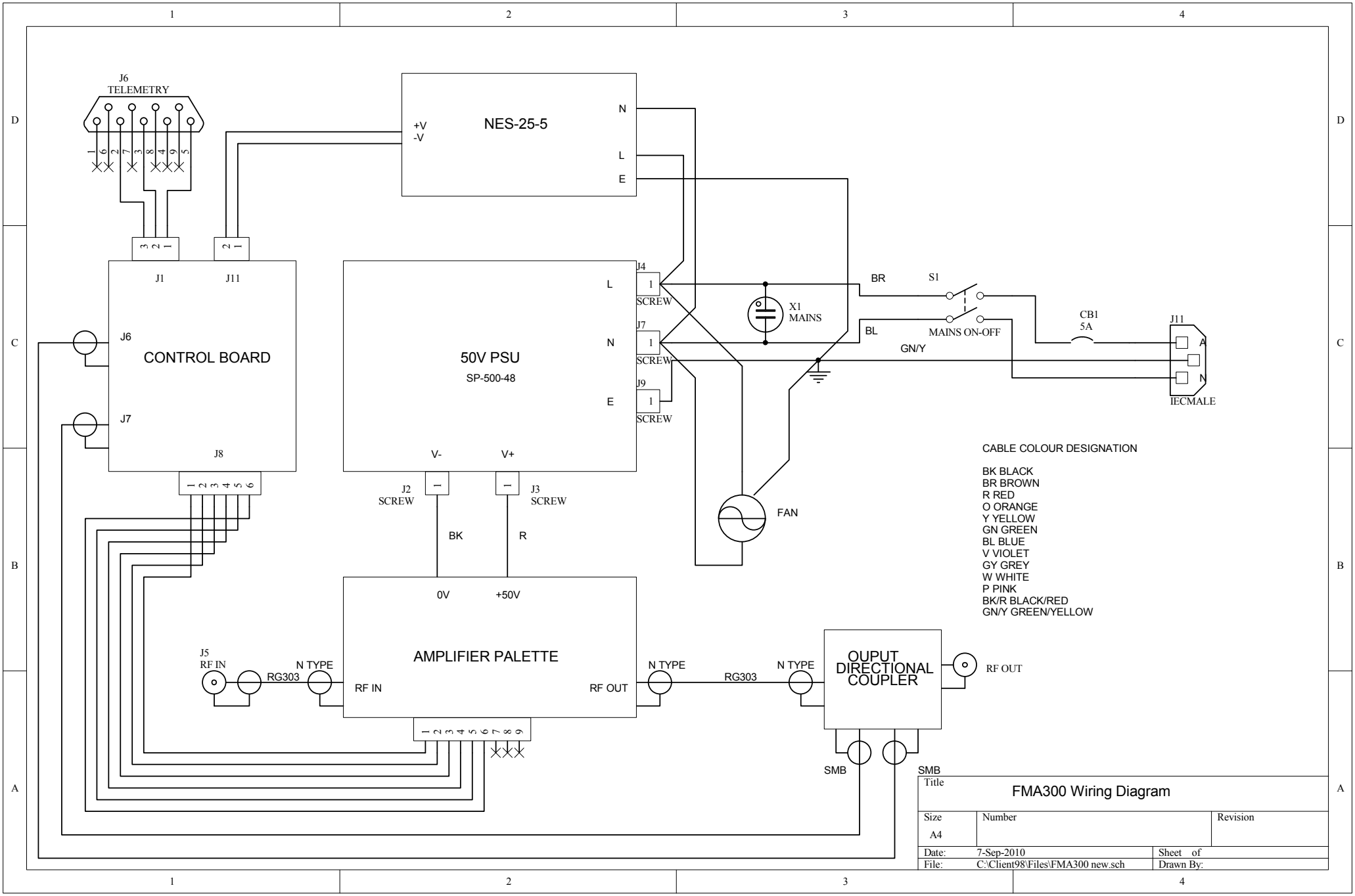


Fig 4.2 FMA300 Rear View



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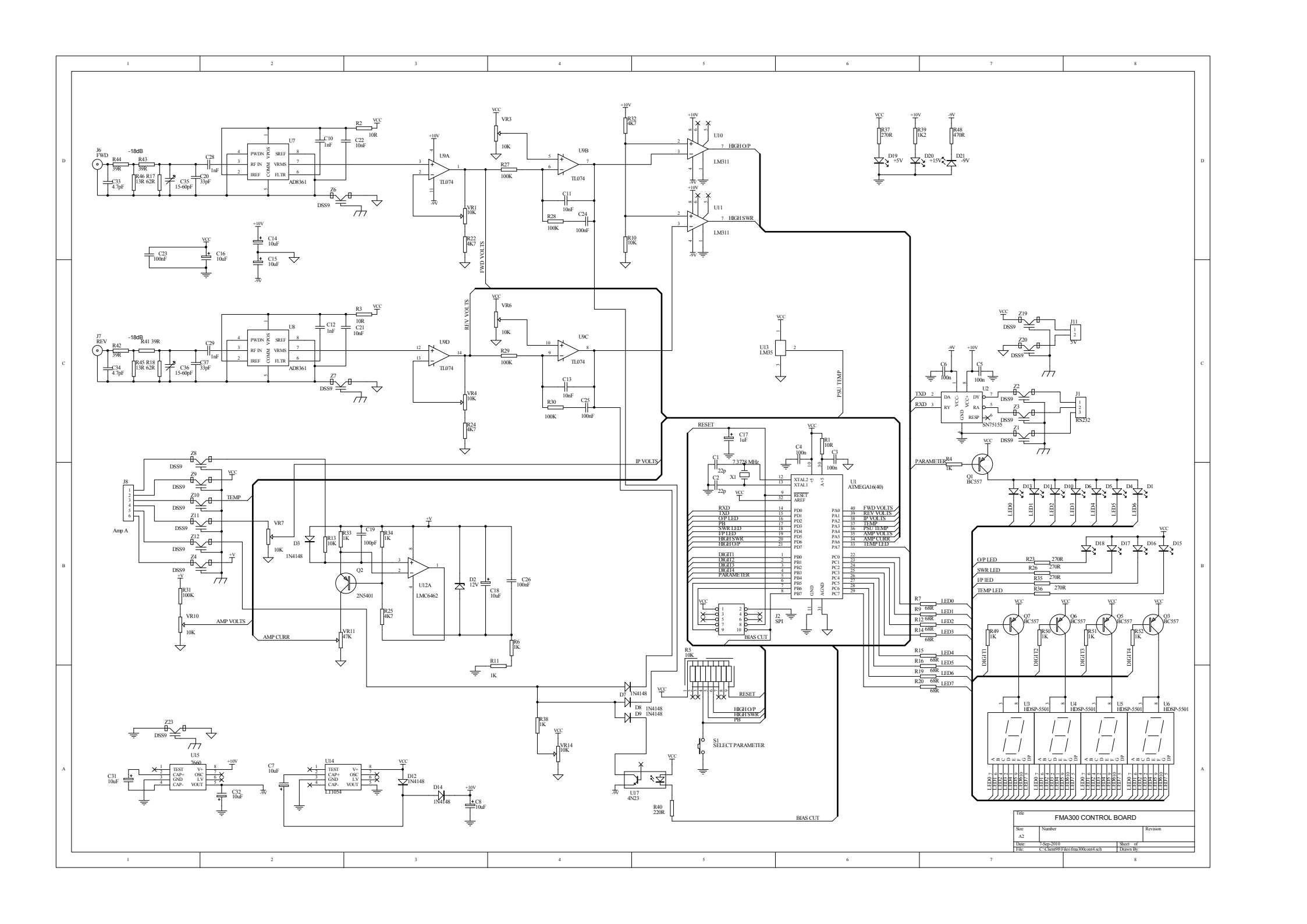
File: C:\Client98\Files\FMA300 new.sch		Drawn By:


FMA300 CONTROL BOARD
Size: A2
Number
Revision
Date: 7-Sep-2010
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Drawn By:
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7.3728 MHz
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FWD VOLTS
REV VOLTS
IP VOLTS
PSU TEMP
AMP VOLTS
AMP CURR
TEMP
HIGH O/P
HIGH SWR
SELECT PARAMETER
BIAS CUT
LM311
TL074
AD8361
LMC6462
2N5401
1N4148
LM35
HDSP-5501
BC557
SN75155
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LED1
LED2
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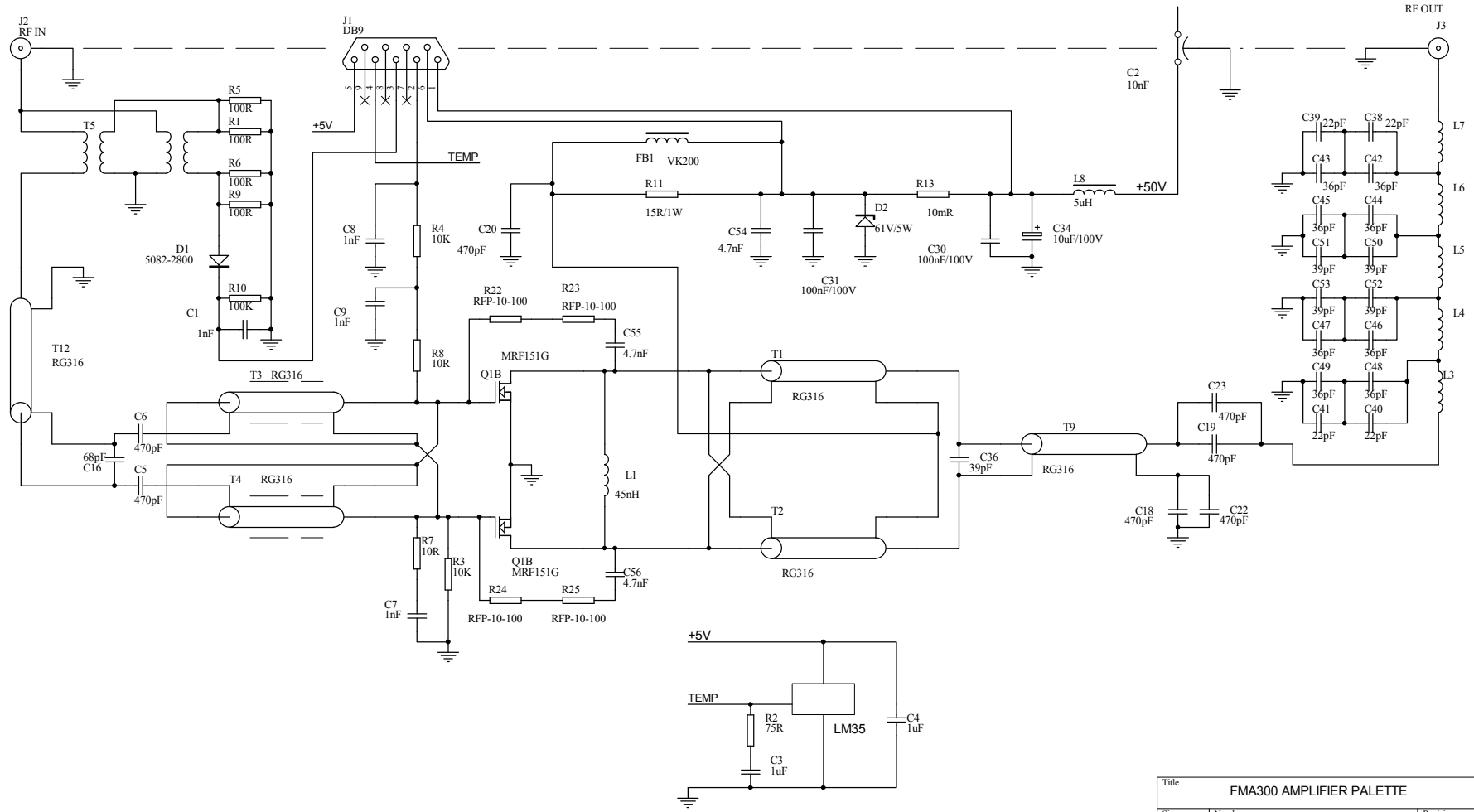

Title	FMA300 AMPLIFIER PALETTE	
Size: A3	Number	Revision
Date: 7-Sep-2010		Sheet of
File: C:\Client98\..\FMA300 amp palette.sch		Drawn By:

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Trade Name: Beryllia Ceramic
Synonym: Beryllium Oxide, Beryllia, Thermalox, Super Beryllia
Chemical Family: Beryllium Compound

II HAZARDOUS INGREDIENTS

Constituents	OSHA(1995)*	ACGIH(1994-95)*	CAS #	NIOSH/ RTECS #
Beryllium	PEL: 0.002	TLV: 0.002	7440-41-7 (Be)	DS1750000
	Ceiling: 0.005	TLV-STEL: NA	1304-56-8 (BeO)	DS4025000
	Peak: 0.025			

*All concentrations are in mg/m^3 (at the concentrations noted above, this constituent may not be visible to the human eye).

ESPI recommends the following good industrial hygiene practice which includes reducing airborne exposures to the lowest feasible level for all constituents in this product. A leading scientific body recommending occupational standards is the American Conference of Governmental Industrial Hygienists (ACGIH). The ACGIH recommends standards for all listed substances. The ACGIH defines a threshold limit value (standards) as follows: "Threshold Limit Values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects."

Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness. "Individuals may also be hyper-susceptible or otherwise unusually responsive to some industrial chemicals because of genetic factors, age, personal habits (smoking, alcohol, or other drugs), medication, or previous exposures. Such workers may not be adequately protected from adverse health effects from certain chemicals at concentrations at or below the threshold limits."

III PHYSICAL DATA

Boiling Point:	N/A	**Sublimes At**:	N/A
Evaporation Rate:	N/A	**Vapor Density (Air=1)**:	N/A
Freezing Point:	N/A	**Vapor Pressure (mm Hg)**:	N/A
Odor:	None	**% Volatile By Volume**:	None
pH:	N/A	**Color**:	White
Physical State:	Solid	**Melting Point (°F)**:	2547 (BeO)
Radioactivity:	N/A	**Molecular Weight**:	25.01 (BeO)
Solubility:	None	**Density (g/cc)**:	2.86 (BeO)

IV FIRE AND EXPLOSION HAZARDS DATA

Flash Point: N/A
Explosive Limits: N/A
Extinguishing Media: N/A

Unusual Fire and Explosion Hazards: N/A
Special Fire Fighting Procedures: If this material becomes airborne as a respirable particulate during a fire situation, pressure-demand self-contained breathing apparatus must be worn by firefighters or any other persons potentially exposed.

V HEALTH HAZARD INFORMATION

Emergency Overview: If this material is involved in a fire, pressure-demand self-contained breathing apparatus and protective clothing must be worn by persons potentially exposed to the metal fumes or airborne particulate.

Primary Routes of Exposure:
Inhalation: An exposure to airborne beryllium in excess of the occupational standard can occur when sintering, machining, grinding, sanding, abrasive cutting, polishing, laser scribing and trimming, chemical etching, crushing, or otherwise abrading the surface of this material in a manner which generates finely divided particles.

Volatile beryllium hydroxide can be formed when firing solid BeO parts at temperature greater than 900 ^{o}C in a moist atmosphere such as in a hydrogen atmosphere sintering furnace.

Machining operations conducted under a flood of liquid coolant usually require complete hooded containment and local exhaust ventilation. Openings into the hood must be baffled to prevent release of fast moving particles. The cycling through a machine of liquid lubricant/coolant containing finely divided beryllium in suspension can result in the concentration building to a point where the particulate may become airborne during use. The coolant reservoir should be enclosed and ventilated. A coolant filtering system is recommended.

The Potential for Exposure Also May Occur During Repair or Maintenance Activities on Contaminated Equipment Such as: furnace rebuilding, maintenance or repair of air cleaning equipment, structural renovation, etc.

Ingestion: There are no known cases of illness resulting from ingestion of this material. Ingestion can occur from hand, clothing, food, and drink contact with metal dust, fume or powder during hand to mouth activities such as eating, drinking, smoking, nail biting, etc. This product is not intended for internal consumption. As a standard hygiene practice, hands should be washed before eating or smoking.

Skin: Skin abrasion may cause irritation. Imbedded material may lead to localized granuloma. The beryllium in this material is in an insoluble form and does not pose a potential for an allergic dermal response.

Eyes: Injury can result form particulate irritation or mechanical injury to the eyes by dust or particulate. Exposure may result from direct contact with airborne particulate (chips, dust, or powder) or contact to the eye if contaminated hands or clothing.

Effects of Overexposure:

Acute: (immediate or near-term health effects): The beryllium fraction of this product is insoluble and does not cause acute beryllium disease. The beryllium in this product does not pose a potential for allergic dermal response.

Chronic: (long-term health effects): Inhaling dust fumes containing beryllium may cause serious, chronic lung disease called Chronic Beryllium Disease (CBD) in some individuals. Over time lung disease can be fatal. Symptoms may include cough, chest pain, shortness of breath, weight loss, weakness, and fatigue. Long-term effects may include loss of lung function, fibrosis, or subsequent secondary effects on the heart with eventual permanent impairment. Chronic beryllium disease is a hypersensitivity of allergic condition in which tissues of the lungs become inflamed with a cellular nodular reaction. This inflammation, sometimes with accompanying fibrosis, may restrict the exchange of oxygen between the lungs and the bloodstream. This allergic response to beryllium is limited to susceptible studies and animal experimentation, the International Agency for Research on Cancer and the National Toxicology Program lists beryllium as a carcinogen.

Medical Conditions Generally Aggravated by Exposure: Persons with impaired pulmonary function, airway diseases, or conditions such as asthma, emphysema, chronic bronchitis, etc. may incur further impairment if dust of fume are inhaled. If prior damage or disease to the neurological (nervous), circulatory, hematologic (blood), or urinary (kidney) systems has occurred, proper screening or examinations should be conducted on individuals who may be exposed to further risk where handling and use of this material may cause exposure.

EMERGENCY AND FIRST AID PRODCEDURES:

INHALATION: Breathing difficulty cause by inhalation of dust or fume requires immediate removal to fresh air. There are no known cases in which a person stopped breathing as a result of exposure. If breathing has stopped, perform artificial respiration and obtain medical help.

INGESTION: Swallowing beryllium oxide dust can be treated by having the affected person drink large quantities of water and attempting to induce vomiting, if conscious. Obtain medical help.
SKIN: Skin cuts and abrasions should be treated by standard first aid. Skin contamination can be removed by washing with soap and water. Obtain medical help if irritation persists. Accidental implementation of this material beneath the skin requires it be removed to prevent infection or development of a corn-like lesion.
EYES: Dust should be flushed from the eyes with a lot of clean water. Obtain medical help if irritation persists. Contact lenses should not be worn when working with metal dusts and powders because the contact lens must be removed to provide adequate treatment.

Treatment of Chronic Beryllium Disease: There is not known treatment which will cure chronic beryllium disease. Prednisone or the corticosteroids are the most specific treatment available. They are directed at suppressing the immunological reaction and have been effective in diminishing many signs and symptoms of chronic beryllium disease. In cases where steroid therapy has had only a partial or minimal effectiveness, other immuno-suppressive agents, such as cyclophospharnide, cyclosporine, or methotrexate, have been used. These latter agents remain investigational. Further, in view of the potential side effects of all the immuno-suppressive medications, including steroids such as prednisone, they should be used only under the direct care of a physician. In general, these medications should be reserved for cases with significant symptoms and/or significant loss of lung function. Other symptomatic treatment, such as oxygen, inhaled steroids or bronchodilatores, may be used by some physicians and are effective in selected cases.

The decision about when and with what medication to treat is judgement situation for individual physicians. For the most part, treatment is reserved for those persons with symptoms and measurable loss of lung function. The value of starting oral steroid treatment, before signs or symptoms are evident, remains a medically unresolved issue currently under study. Some physicians are concerned that their patients may develop a resistance to medication if it is started too soon.

The effects of continued low exposure to beryllium are unknown for individuals who are sensitized to beryllium or who have diagnosis of chronic beryllium disease. This uncertainty leads some physicians to advise a reduction or elimination of further exposure to beryllium. However, some individuals have developed CBD or have gradually become worse after removal from further exposure. Others have continued to work in the beryllium industry without any additional, or accelerated, loss of lung function.

VI REACTIVITY DATA

General Reactivity: This material is stable
Incompatibility (Materials to avoid): NA

Hazardous Decomposition Products: None under normal conditions of use
Hazardous Polymerization: Will not occur
Ecological Information: This material is insoluble in water. This material can be recycled.

VII SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled: In solid form this material poses no health or environmental risk. If this material is in powder or dust form, establish a restricted entry zone based on the severity of the spill. Persons entering the restricted zone must wear adequate respiratory protection and protective clothing appropriate for the severity of the spill. Cleanup should be conducted with a vacuum system utilizing a high efficiency particulate air filtration system followed by wet cleaning methods. Special care must be taken when changing filters on HEPA vacuum cleaners when used to clean up potentially toxic materials. Caution should be taken to minimize airborne generation of powder or dust and avoid contamination of air and water. Depending upon the quantity of material released, fine powder or dust spills to the environment may require reporting the National Response Center at (800) 424-8802 as well as the State Emergency Response Commission and Local Emergency Planning Committee.

Handling and Storage: Wear gloves when handling to prevent cuts and skin abrasions. Store in a dry area.

Ventilation and Engineering Controls: Whenever possible, the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume. Where utilized, pickups on flexible ventilation lines should be positioned as close to the source of airborne contamination as possible. Disruption of the airflow in the area of a local exhaust inlet, such as by a man cooling fan, should be avoided. Ventilation equipment should be checked regularly to ensure it is functioning properly. Ventilation training is recommended for all users. Ventilation systems designed and installed by qualified professionals.

Respiratory Protection: When potential exposures are above the occupational limits shown in this MSDS, approved respirators must be used as specified by an Industrial Hygienist of other qualified professional. Respirator users must be medically evaluated to determine if they are physically capable of wearing a respirator. Quantitative an/or qualitative fit testing and respirator training must be satisfactorily completed by all personnel prior to respirator use. Users of any style respirator training must be clean shaven on those areas of the face where the respirator seal contacts the face. Exposure to unknown concentrations of fumes or dusts requires the wearing of a pressure-demand airline respirator or pressure-demand self-contained breathing apparatus. Pressure-demand airline respirators are recommended when performing jobs with high potential exposures such as changing filters in a bag house air cleaning device.

Housekeeping: Vacuum and wet cleaning methods are recommended for dust removal. Be certain to de-energize electrical systems, as necessary, before beginning wet cleaning. Vacuum cleaners with high efficiency particulate air (HEPA) filters are the recommended type. The use of compressed air or brooms to remove dusts should be avoided as such an activity can result in unnecessary short-term elevated exposures to airborne dusts.

Maintenance: During repair or maintenance activities the potential exists for exposures in excess of the occupational standard. Under these circumstances, protecting workers can require the use of specific work practices or procedures involving the combined use of ventilation, wet methods, respiratory protection, decontamination, special protection clothing, and when necessary, restricted work zones.

Other Protective Equipment: No special protective equipment or clothing is requires when handling solid forms. Protective over garments or work clothing must be worn by persons who may become contaminated with dusts, fumes, or powders during activities such as machining, furnace rebuilding, air cleaning equipment filter changes, maintenance, etc. Contaminated work clothing and over garments must be managed in such a manner so as to prevent secondary exposure to persons such as laundry operators and to prevent contamination to personal clothing. Never use compressed air to clean work clothing.

Protective Gloves: Wear gloves to prevent cuts and skin abrasions during handling.
Eye Protection: Wear safety glasses, goggles, or face shield when risk of eye injury is present, particularly during machining, grinding, etc.

Recommended Monitoring Procedures:

Environmental Surveillance: Exposure to airborne materials should be determined by having air samples taken in the employee breathing zone, work area, and department. The frequency and type of air sampling should be as specified by an Industrial Hygienist or other qualified professional. Air sample results should be make available to employees.

Medical Surveillance: Persons exposed to airborne concentrations of this material should be included in a periodic medical surveillance program. The program should include examination of the skin and respiratory systems. Non-specific findings of skin rash, skin granulomata, or respiratory signs or symptoms may indicate a reaction to this material. A minimum medical surveillance program should include (1) skin examination, (2) respiratory history, (3) auscultation of the lungs, (4) spirometry (FVC and FEV), and (5) periodic chest x-ray. In addition, a specialized, specific, immunological blood test, the beryllium blood lymphocyte proliferation test (BLPT), is available (on a limited basis to assist in the diagnosis) to screen beryllium-exposed persons for beryllium reactions. Note: It should be recognized that BLPT has limited sensitivity for chronic beryllium disease. Individuals who have an abnormal BLPT are normally referred to a lung specialist for additional specific tests to determine if chronic beryllium disease is present.

VIII SPECIAL PROTECTION INFORMATION

Transport Information: There are nor U.S. Department of Transportation hazardous material regulations which apply to the packaging and labeling of this product as shipped by ESPI. Hazard Communication regulations of the U.S. Occupational Safety and Health Administration require that this material be labeled.

Regulatory Information: OSHA Hazard Communications Standard, 29 CFR 1910.1200: Beryllium is considered a hazardous ingredient.

Ambient Air Emissions: Beryllium-containing materials are subject to the National Emission Standard for Beryllium as promulgated by EPA (40 CFR 61, Subpart (C). The National Emission Standard for beryllium is 0.01 micrograms per cubic meter (30 day average) in ambient air for those production facilities which have been qualified to be regulated through ambient air monitoring. Other facilities must meet a 10 gram per 24-hour total site emission limit. Most process air emission sources will require an air permit from a local and/or state air pollution control agency. The use of air cleaning equipment may be necessary to achieve a permissible emission. Tempered makeup air should be provided to prevent excessive negative pressure in a building. Direct recycling of cleaned process exhaust air is not recommended. Plant exhausts should be located so as not to re-enter the plant through makeup air or other inlets. Regular maintenance and inspection of air cleaning equipment and monitoring of operating parameters is recommended to ensure adequate efficiency is maintained.

Wastewater: Wastewater regulations can vary considerably. Contact your local and state governments to determine their requirements.

Toxic Substances Control Act: Beryllium is listed on the TSCA Chemical Substance Inventory of Existing Chemical Substances.

Sara Title III Reporting Requirements: On February 16, 1988 the U.S. Environmental Protection Agency (EPA) issued a final rule that implements the requirements of the Superfund Amendments and Re-authorization Act (SARA) Title III, Section 313 (53) Federal Register 4525. Title III is the portion of SARA concerning reporting on specific chemicals which are manufactured, processed or used at certain U.S. Industrial facilities.

Beryllium is reportable under Section 313. The Chemical Abstracts Services number is provided in this MSDS. SARA Title Hotline 1-800-535-0202 or 202-555-1411

This MSDS has been revised following the guidelines outlined in the American National Standard for Hazardous Chemicals Z400.1-1993 “Material Safety Data Sheets-Preparation.”

IX SPECIAL PRECAUTIONS

Disposal Considerations:

Byproduct Recycling: When recycled (used in a process to recover metals), this material is not classified as hazardous waste under federal law. Dusty or dust-like materials should be sealed inside two plastic bags, placed in a DOT approved container, and appropriately labeled.

Solid Waste Management: When spent products are declared solid wastes (no longer recyclable), they must be labeled, managed and disposed of, in accordance with federal, state and local requirements. This material is not classified a hazardous waste under federal law.

Prepared by: S. Dierks
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